New records of lichens from Mahabaleshwar and Koyna areas of Satara District, Maharashtra, India

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ABSTRACT

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An enumeration of 65 species of lichens, belonging to 29 genera and 20 families, from Mahabaleshwar and Koyna areas of Satara District, Maharashtra is provided. Forty five species have been recorded from the Koyna area and 36 species from the Mahabaleshwar area. Sixteen species are common to both the areas. The crustose growth forms exhibit their dominance with 42 species followed by foliose, squamulose, leprose and fruticose with 13, 4, 4 and 2 species respectively. The corticolous lichens dominate in both the localities with 27 species followed by saxicolous, ramicolous and terricolous with 13, 3 and 2 species respectively. The members of family Graphidaceae exhibit their dominance with 3 genera and 11 species. Ramalinaceae is represented by 2 genera and 7 species whereas Lecanoraceae and Collemataceae comprise of a single genus and 7 species each. *Anisomeridium albisedum* (Nyl.) R. C. Harris and *Pertusaria corallina* (L.) Arnold are described as new record for Indian lichen flora.

Key-words: Lichens, new records, Mahabaleshwar and Koyna, Maharashtra, India.

INTRODUCTION

Lichens are one of the important constituents of Indian flora. The vast topographical and climatic diversity has endowed it with rich lichen flora, both in luxuriance and diversity. Despite intense efforts in exploration and survey during the last four decades, our knowledge about lichens from different floristic regions of India is poor as many areas are still unexplored for their lichen wealth. The lichens are most valuable biomonitors for atmospheric pollution. They can be used as sensitive indicators to estimate the biological effects of pollutants by measuring changes at community or population level of an area. Lichen monitoring can be very effective as an early warning system to detect environmental changes (Loppi and Bonini 2000). For monitoring purposes, it is necessary to conduct periodical observations and documentation of floristic data which are useful for future study (Garty 2001).

Few floristic accounts of lichens from the state of Maharashtra in general and Mahabaleshwar in particular are available (Chitale et al. 2008, Makhija et al. 2004, Nayaka and Upreti 2004), however, so far the floristic accounts of Satara district are not available. Awasthi (1988, 1991) recorded the occurrence of 39 microlichens and 10 macrolichens from the Maharashtra state. The Satara district is located in the western part of Maharashtra and has a variety of landscapes influenced by relief, climate and vegetation. The variation in relief ranges from the pinnacles and high plateaus of main Sahyadri range having height over 1400 m to the subdued basin of the Koyna and Krishna rivers with the average height of about 510 m. The climate ranges from the rainiest in the Mahabaleshwar region, with an average annual rainfall of over 6000 mm to the driest in Koyna area with about 780 mm. The vegetation cover too varies from the typical monsoon forest in the northern part to scrub and poor grass in western and southern parts. The diverse vegetation together with varied climate and topography provided few unique habitats for lichens to colonize in Mahabaleshwar and Koyna areas of Satara district (Plate 1, figures 1-3).

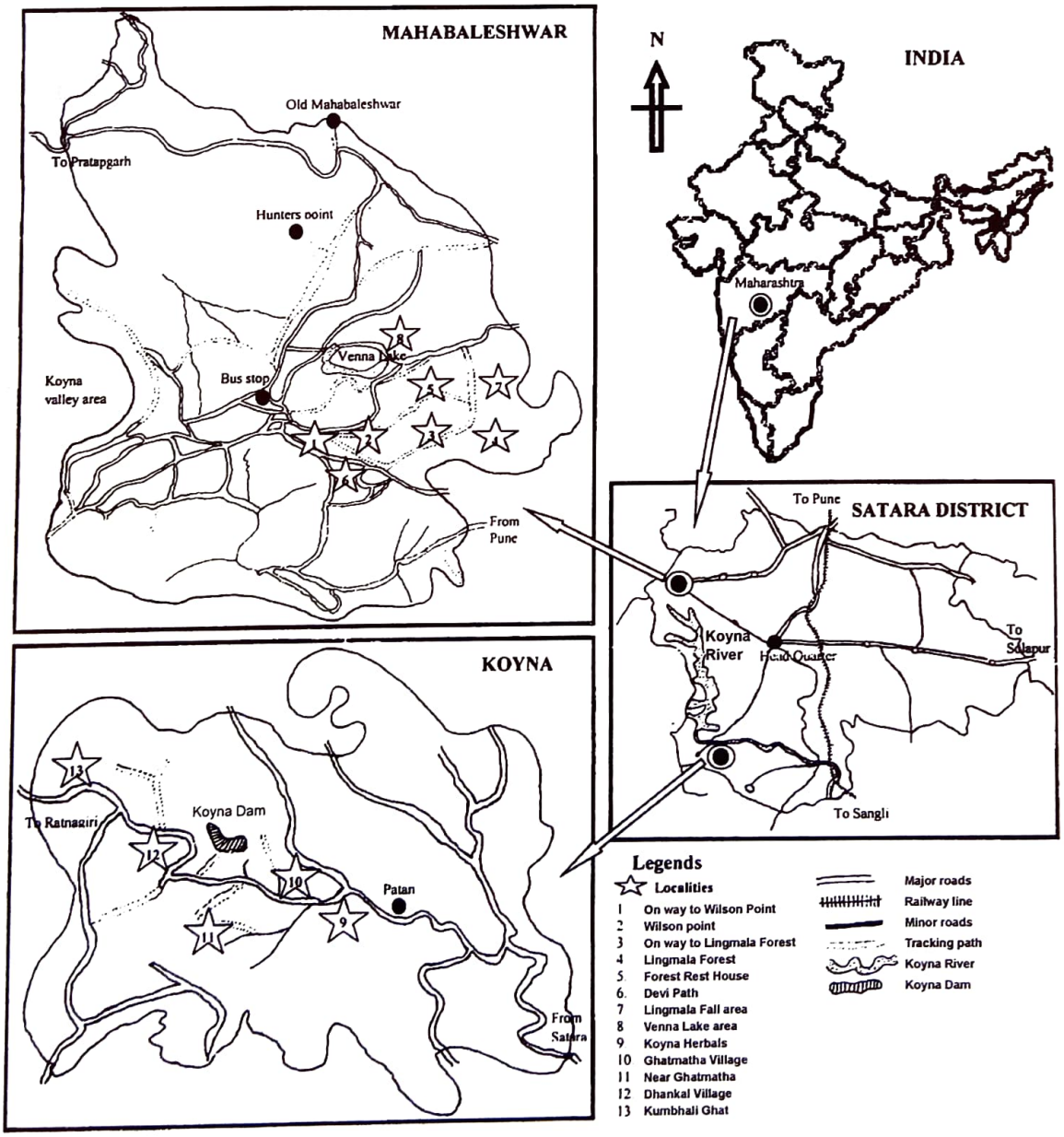
MATERIAL AND METHOD

The study is based on the collection of lichens from eight localities in Mahabaleshwar area and five in Koyna area (Table-1, Text-figure 1). More than 350 lichen specimens were collected from rock, twigs and barks of *Woodfordia*, *Memecylone edule, M. umballatum*, *Taxus* sp., *Mangifera indica*, *Saraca indica* and *Erythrina* trees during March 2010.

The collected specimens were investigated morphologically, anatomically and chemically. The specimens were identified up to species level following the publications of Coppins and James (1984), Awasthi (1991, 2000, 2007) and Harris (1995). The colour tests were performed with the usual reagents, i.e. K (5% potassium hydroxide), C (Aqueous solution of calcium hypochloride) and P (Paraphenylene diamine). Lichen substances were identified with thin layer chromatography (TLC) in solvent system A (toluene: dioxane: acetic acid; 180: 60: 8 ml.) using the technique of Walker and James (1980). The identified specimens are preserved in the herbarium of National Botanical Research Institute, Lucknow (LWG).

RESULTS AND DISCUSSION

Both the study areas have diverse climate, topography and vegetation which provide a suitable



Text-figure 1. Maps of the studied areas.

habitat for different group of lichens to colonize on various substrates. A total of 65 species, belonging to 29 genera and 20 families, are reported from both the areas (Table-2). Of these, 29 species are found only in Koyna area 20 species only in Mahabaleshwar area. Only 16 species are common to both the areas. The corticolous lichens dominate in both the localities with 27 species followed by 13 saxicolous, 3 ramicolous and 2 terricolous lichen species. The shrubs and trees of the area with open canopy favour the growth of lichens at both the study areas. The crustose taxa exhibit luxuriant growth in both the areas represented by 42 species followed by 13 foliose, 4 squamulose, 4 leprose and 3 fruticose species respectively. The exposed rocky, dried climatic condition, together with scrub forest, supports growth of light loving micro and macrolichens.

The lichen species exhibit their maximum diversity in localities having exposed rocks in high altitudes with moist habitats. The localities of Dhankal and Ghatmatha Village, on way to Lingmala Forest and near Koyna Herbals areas having moist and semi exposed area show maximum diversity of lichens. The crustose lichen genera *Lecanora*, *Graphis*, *Pertusaria*, *Bacidia* and *Caloplaca* show their dominance in this area.

The localities around Koyna, between 500-700 m, show occurrence of 30 species of lichens with dominance of crustose forms. The Mahabaleshwar area, between 1100-1500 m, has 22 species with dominance of foliose and fruticose lichens. It is interesting to note that an endemic fruticose lichen species *Usnea ghattensis* G. Awasthi (Plate 1, figure 6) and *Cladonia scabriuscula* (Delise) Nyl., exhibit their luxuriant growth in and around Wilson Point (1470 m altitude) of Mahabaleshwar area. *U. ghattensis*, an epiphytic lichen, is found growing on variety of trees while *C. scabriuscula* grows luxuriantly on soil. The species of lichen genus *Leptogium* grow luxuriantly in most of the localities of the study area (Plate 1, figure 5). The Lingmala Forest area, owing to its moist damp climatic condition, provides excellent habitat for many lichen taxa to colonize on different substrates available including the iron electric poles (Plate 1, figure 4).

The exposed rocky areas in higher altitude of Wilson point exhibits luxuriant growth of *Caloplaca amarkantakana* Y. Joshi & Upreti, *Lepraria lobificans* Nyl., *Diploschistes rampoddensis* (Nyl.) Zahlbr., *Trapelia placodioides* Coppins & P. James and *Porina* sp. on rocks. The hard dry twigs of most of the shrubs and trees show occurrence of some unique lichen taxa such as *Remototrachyna awasthii* (Hale & Patw.) Divakar & Crespo, *Phlyctis karnatakana* Joshi S. & Upreti, *Arthothelium nigrodiscum* Patw. & Makh., *Graphina subserpentina* (Nyl.) Müll. Arg., *Phyllopsora corallina* (Eschw.) Müll. Arg., and *Strigula stigmatella* (Ach.) R. C. Harris.

The occurrence of 65 species within a small phytogeographical area clearly indicates the lichen richness of this region. Intensive survey for lichens in the adjoining areas will definitely help in tracing more lichen taxa from this region. The study also recorded the occurrence of two lichen taxa as new records for the Indian lichen flora and are described below:

Table 1. Site descriptions

Areas	Localities	Altitude (m)	Remarks
Mahabaleshwar area	On way to Wilson Point	1350	Road side area with close canopy of trees
	Wilson Point	1470	Fully exposed rocky area with shrubby vegetation
	On way to Lingmala Forest	1375	Dense shrubby forest, away from road side
	Lingmala Forest	1200	Dense forest with close canopy of trees and moist area
	Forest Rest House	1339	Near road side, semi-exposed
	Devi Path	1394	Highway area with open canopy of trees
	Lingmala Fall	1120	Semi-exposed rocky with moist habitats
	Venna Lake	1294	Road side area
Koyna valley area	Koyna Herbals	585	Open canopy of trees with dominance of shrubs
	Ghatmatha Village	631	Exposed rocky area with shrubs
	Around Ghatmatha Village	695	Road side with shrubs
	Dhankal Village	620	Agricultural field area, semi-exposed with moist rocks and shrubs
	Kumbhali Ghat	631	Semi-exposed rocky area, shaded with trees

Table 2. Lichens of Mahabaleshwar and Koyna areas of Satara District, Maharashtra, India. 1-8. Mahabaleshwar area. 1. On way to Wilson Point. 2. Wilson Point. 3. On way to Lingmala Forest. 4. Lingmala Forest. 5. Forest Rest House. 6. Devi Path. 7. Lingmala Fall 8. Venna Lake. 9-13. Koyna area. 9. Koyna Herbals. 10. Ghatmatha Village. 11. Around Ghatmatha Village. 12. Dhankal Village. 13. Kumbhali Ghat.

Families	Genera	Species	Name of lichen	Growth forms	Mahabaleshwar area								Koyna area					
					1	2	3	4	5	6	7	8	9	10	11	12	13	
Arthoniaceae	1	2	*Arthothelium albescens* Patw. & Makh.	Crustose	+										+			Bark
			A. nigrodiscum Patw. & Makh.	Crustose													+	Bark
Cladoniaceae	1	1	*Cladonia scabriuscula* (Delise) Nyl.	Fruticose		+												Rock, Rock with mosses
Collemataceae	1	7	*Leptogium burnetiae* C. W. Dodge	Foliose					+									Soil
			L. chloromelum (SW.) Nyl.	Foliose	+	+												Mosses, Bark
			L. denticulatum Nyl.	Foliose										+	+			Bark
			L. gelatinosum (With.) J. R. Laundon	Foliose							+						+	Twig, Bark
			L. indicum D. D. Awasthi & Akhtar	Foliose							+				+			On dried Orchid, Bark
			L. phyllocarpum (Pers.) Mont.	Foliose										+				Twig
			L. ulvaceum (Pers.) Vain.	Foliose				+										Soil
Graphidaceae	3	11	*Diorygma junghuhnii* (Mont. & Bosch) Kalb et al.	Crustose					+	+			+	+	+	+		Bark
			D. hieroglyphicum (Pers.) Stainger & Kalb. in Kalb	Crustose											+	+		Bark
			Graphis capillacea Stirton	Crustose												+	+	Bark
			G. lineola Ach.	Crustose													+	Bark, Twig
			G. longiramea Müll. Arg.	Crustose									+					Bark
			G. nigroglauca Leight	Crustose				+										Twig
			G. proserpens Vain.	Crustose		+	+	+	+		+			+	+	+		Bark, Twig
			G. duplicata Ach.	Crustose			+	+					+	+		+	+	Bark, Twig
			G. tsunodae Zahlbr.	Crustose			+									+		Bark
			G. subserpentina (Nyl.) Müll. Arg.	Crustose				+										Bark
			Hemithecium pyrrhochroa (Mont. & Bosch) V. Tewari & Upreti	Crustose			+											Bark
Lecanoraceae	1	7	*Lecanora achroa* Nyl.	Crustose										+				Bark
			L. alba Lumbsch	Crustose	+				+	+								Twig, Bark
			L. argentata (Ach.) Degel.	Squamulose											+			Twig
			L. chlarotera Nyl.	Crustose											+	+		Bark
			L. fimbriatula Stirton	Crustose										+	+	+	+	Twig, Bark
			L. interjecta Müll. Arg.	Crustose	+			+										Twig
			L. perplexa Brodo	Crustose									+		+	+		Twig, Bark
Lecideaceae	1	1	*Lecidea granifera* (Ach.) Vaino.	Crustose											+	+		Bark
Megasporaceae	1	1	*Aspicilia calcarea* (L.) Sommerf.	Crustose		+	+											Rock
Monoblastiaceae	1	1	**Anisomeridium albisedum* (Nyl.) R. C. Harris	Crustose										+				Twig
Parmeliaceae	3	3	*Parmotrema latissimum* (Fée) Hale	Foliose												+		Bark

			Remototrachyna awasthii (Hale & Patw.) Divakar & A. Crespo	Foliose		+	+	+	+	+		+							Twig, Bark
			Usnea ghattensis G. Awasthi	Foliose		+		+	+	+	+								Twig
Pertusariaceae	1	3	**Pertusaria corallina* (L.) Arnold	Crustose			+												Rock
			P. leucostoma (Bernh.) Massal.	Crustose									+					+	Bark
			P. quassiae (Fée) Nyl.	Crustose												+	+	+	Bark
Phlyctidaceae	1	1	*Phlyctis karnatakana* S. Joshi & Upreti	Crustose				+		+	+					+	+		Bark
Physciaceae	1	5	*Heterodermia diademata* (Taylor) D. D. Awasthi	Foliose			+	+		+	+			+	+				Twig, Bark, Rock
			H. hypocaesia (Yasuda) D. D. Awasthi	Foliose			+		+		+								Bark, Twig
			H. incana (Stirton) D. D. Awasthi	Foliose	+		+	+	+	+			+			+	+		Bark, Twig
			H. japonica (Sato.) Swinsc. Krog	Foliose				+											Rock, Twig
			H. speciosa (Wulf.) Trevis.	Foliose	+		+	+	+	+	+	+							Rock, Twig, Bark
Pilocarpaceae	1	1	*Micarea prasina* Fr.	Crustose												+	+		Bark
Porinaceae	1	1	*Porina* sp.	Crustose			+						+	+	+				Rock
Ramalinaceae	3	7	*Bacidia alutacea* (Krempelh.)Zahlbr.	Crustose								+							Bark
			B. fusconigrescens (Nyl.) Zahlbr.	Crustose									+						Bark
			B. personata Malme	Crustose													+		Bark
			B. phaeolomoides (Müll. Arg.) Zahlbr.	Crustose													+		Twig
			B. rubella (Hoffm.) Massal	Crustose									+	+					Bark
			Bacidiospora psorina (Nyl. ex Hue) Kalb	Crustose														+	Twig
			Phyllopsora corallina (Eschw.) Müll. Arg.	Squamulose				+											Bark
Stereocaulaceae	1	2	*Lepraria coriensis* (Hue) Shipman	Leprose				+										+	Bark
			L. lobificans Nyl.	Leprose		+													Rock
Teloschistaceae	1	4	*Caloplaca abuensis* Y. Joshi & Upreti	Crustose		+													Rock
			C. amarkantakana Y. Joshi & Upreti	Crustose		+	+	+	+		+								Rock
			C. cupulifera (Vainio) Zahlbr.	Crustose		+	+		+									+	Rock
			C. flavorubescens (Huds.) J. R. Laundon	Crustose										+		+			Bark
Thelotremataceae	2	2	*Diploschistes rampoddensis* (Nyl.) Zahlbr.	Crustose		+													Rock
			Thelotrema monosporum Nyl.	Crustose									+						Bark
Trapelariaceae	1	1	*Trapelia placodioides* Coppins & P. James	Crustose			+	+					+	+		+	+		Rock
Verrucariaceae	3	4	*Endocarpon subrosettum* A. Singh & Upreti	Squamulose									+			+			Rock
			Staurothele clopima (Wahlenb.) Th. Fr.	Crustose									+	+	+	+			Rock
			S. fissa (Taylor) Zwack	Crustose		+	+						+	+	+				Rock
			Verrucaria acrotella Ach.	Crustose									+						Rock

Mahabaleshwar area: 1. On way to Wilson Point, 2. Wilson Point, 3. On way to Lingmala Forest, 4. Lingmala Forest, 5. Forest Rest House, 6. Devi Path, 7. Lingmala Fall, 8. Venna Lake.

Koyna area: 9. Koyna Herbals, 10. Ghatmatha Village, 11. Around Ghatmatha Village, 12. Dhankal Village, 13. Kumbhali Ghat.

* New Records for India

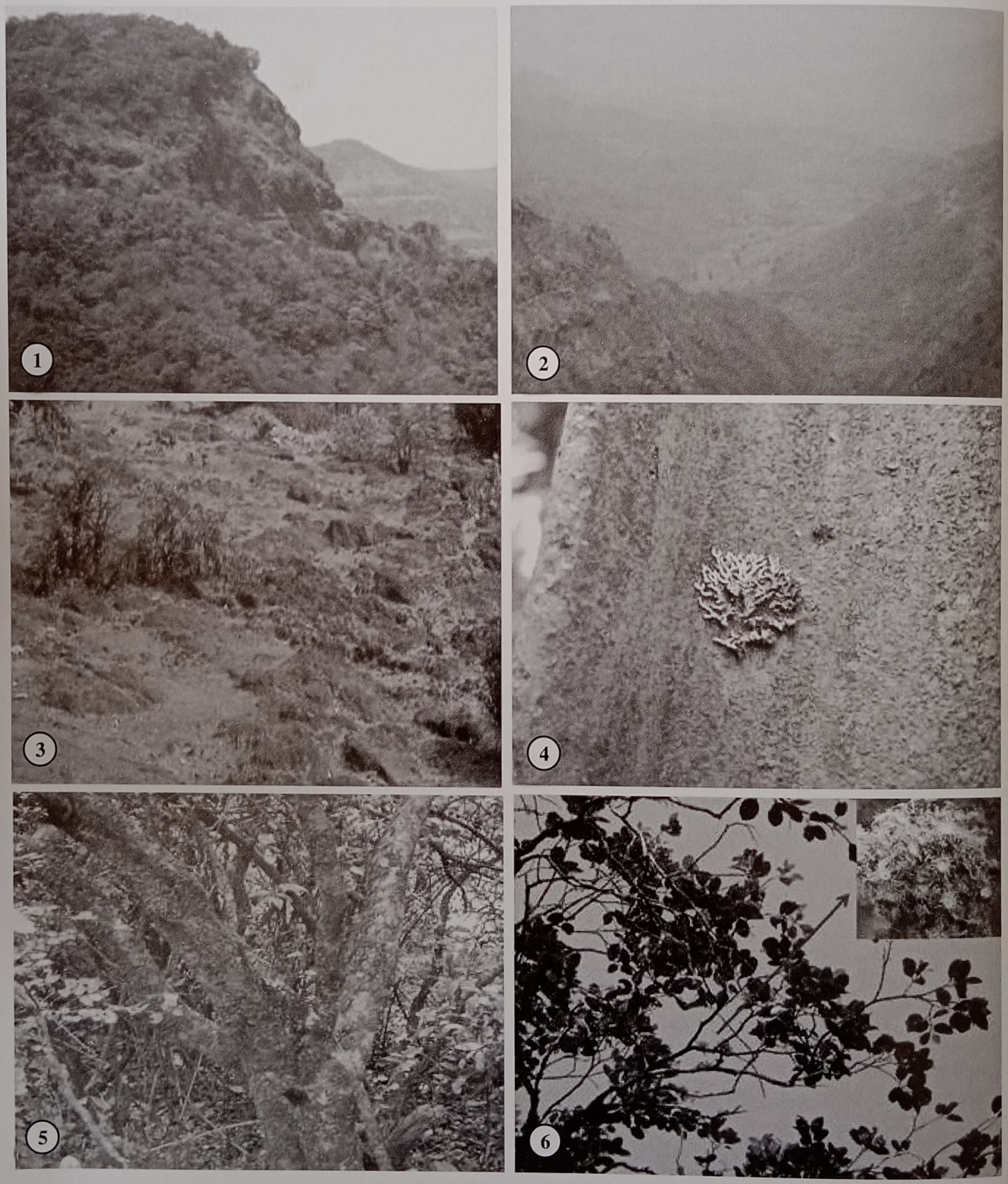


Plate 1

Vegetation at Koyna area. 1. Shady slope. 2. Sun facing. 3. Open exposed rocky area of Wilson point. 4. *Heterodermia diademata* (Taylor) D.D. Awasthi, on iron electric pole. 5. *Leptogium chloromelum* (Sw.) Nyl. 6. *Usnea ghattensis* G. Awasthi.

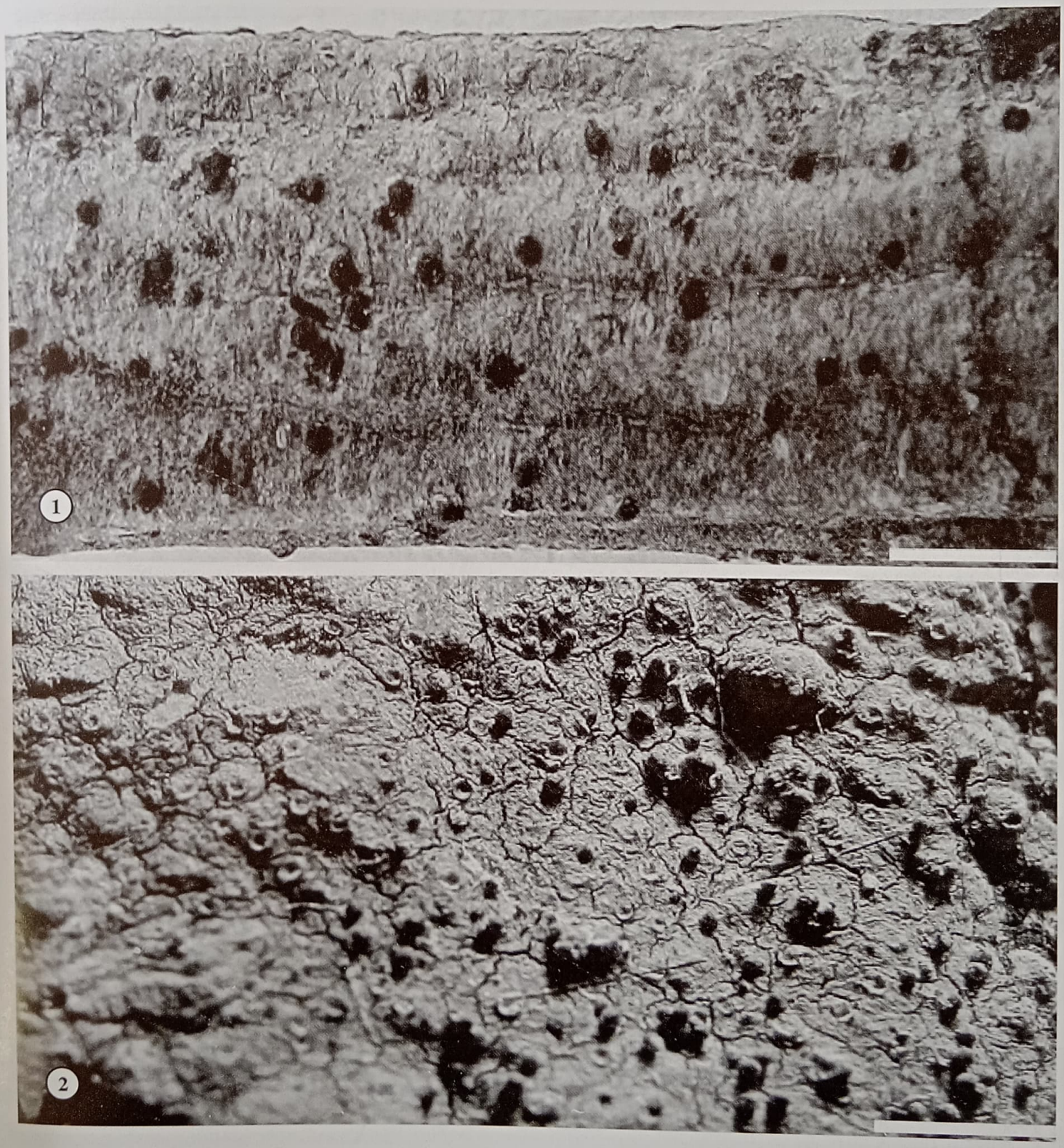


Plate 2

New records of lichens from Satara District. 1. *Anisomeridium albisedum* (Nyl.) R. C. Harris. 2. *Pertusaria corallina* (L.) Arnold. (Scale bar = 4 mm).

Anisomeridium albisedum (Nyl.) R. C. Harris

Plate 2, figure 1

Bryologist 90: 163 (1987); *Verrucaria viridiseda* f. *albiseda* Nyl., Lich. Lapon. 108, (1890).

Description: Thallus corticolous, crustose, whitish grey, smooth to evanescent; perithecia 0.15-0.30 mm diam., immersed at the base, sometimes completely naked and shining or covered up to top with corticiform layer, globose hemispherical or convex and slightly spreading laterally, ostiole apical, 20-35 µm diam., indistinct, or area around ostiole slightly thickened; peridium carbonized, brown-black, 40-60 µm broad at top, 80-100 µm at base and laterally; centrum 60-80 µm high, lacking oil globules. Asci 8 spored, cylindrical, 40-50 x 8-10 µm; spores uniseriately arranged, colourless to smoky brown, 1- septate, 8-10 x 3-4 µm, both cells ± equal in size. Thallus K-, C-, KC-, P-, UV- and no chemical in TLC.

Specimens examined: India: Maharashtra, Satara District, near Ghatmatha Village, altitude 631 m, 23.03.2010, on twigs of *Woodfordia*, Bajpai R., 10-013308 (LWG).

Remarks: *Anisomeridium albisedum,* one of the smallest spore species of *Anisomeridium*, was earlier known from Florida (Harris 1995).

Pertusaria corallina (L.) Arnold

Plate 2, figure 2

Description: Thallus saxicolous, crustose, pale to whitish or yellowish green, continuous, cracked areolate, prothallus indistinct, white isidiate, isidia abundant 0.2-0.4 mm long, simple, cylindrical, erect, isidia leave non-sorediate pit on thallus when shed, sometimes shiny, corallid, and without brown apices. Fertile warts and apothecia absent. Thallus K-, C-, KC-, P+ yellow, UV+ yellow, stictic, constrictic acid present in TLC.

Specimens examined: India: Maharashtra, Satara district, Mahabaleshwar, on way to Lingmala Forest, altitude 1375 m, 26.03.2010, on rock, Bajpai R., 10-013999 (LWG).

Remarks: *Pertusaria corallina* was earlier known from Great Britain and Sweden (Purvis et al. 1992).

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REFERENCES

Awasthi D. D. 1988. Key to the macrolichen of India and Nepal. J. Hattori Bot. Lab. 65: 207-302.

Awasthi D. D. 1991. A key to the microlichens of India, Nepal and Sri Lanka. Bibliothica Lichenolgica 40: 1-337.

Awasthi D. D. 2000. Lichenology in Indian Subcontinent. Bishen Singh Mahendera Pal Singh, Dehradun, India.

Awasthi D. D. 2007. A compendium of the macrolichens from India, Nepal and Sri Lanka. Bishen Singh Mahendera Pal Singh, Dehradun, India.

Chitale G., Dube A. & Makhija U. 2008. The lichen genus *Physcia* and allied genera from Maharashtra, India. Geothytology 37: 13-21.

Coppins B. J. & James P. W. 1984. New or interesting British lichens V. Lichenologist 16(3): 241-264.

Garty J. 2001. Biomonitoring atmospheric heavy metals with lichens: theory and application. Critical Rev. Plant Sci. 20(4): 309-371.

Harris R. C. 1995. More Florida lichens including the 10c tour of the pyrenolichens. The New York Botanical Garden Press, Bronx, NY, U.S.A. pp. 125.

Loppi S. & Bonini I. 2000. Lichens and mosses as biomonitors of trace elements in areas with thermal springs and fumarole activity (Mt. Amianta, Central Italy). Chemosphere 41: 1333-1136.

Makhija U., Chitale G. & Dube A. 2004. The lichen genus *Heterodermia* (family Physciaceae) from Maharashtra. Geophytology 34(1-2): 43-55.

Nayaka S. & Upreti D. K. 2004. Scope for cryptogamic studies in sacred groves: A case study of lichens from Maharashtra. J. Econo. Taxon. Bot. 28(1): 209-212.

Purvis O.P., Coppins B.J., Hawksworth D.L., James P. W. & Moore D. M. 1992. The lichen flora of Great Britain and Ireland. Natural History Museum Publications in association with The British Lichen Society: 447-459.

Walker F. J. & James P. W. 1980. A revised guide and microchemical techniques for the identification of lichen substances. Bull. Brit. Lichenol. Soc. 46: 13-29.