New records of *Aspicilia hispida* from Italy and Greece

Josef HAFELLNER, Pier Luigi NIMIS & Mauro TRETIACH

Abstract: HAFELLNER, J., NIMIS, P. L. & TRETIACH, M. 2004. New records of *Aspicilia hispida* from Italy and Greece. – Herzogia **17**: 95–102.

The dwarf fruticose *Aspicilia hispida*, a vagrant lichen widely distributed in North America and Eurasia, is recorded for the first time from Italy and Greece. The new localities, located in the alpine belt of the south-western Alps and in the cryomediterranean belt of Mt. Parnassus, fill the distribution gap between the winter-cold steppes of the lower Volga region and the open *Juniperus thurifera* woodlands and steppes of central Spain, where *A. hispida* is relatively common. The present knowledge on vagrant *Aspicilia* species and their recognisable morphological types, as well as the global distribution of *Aspicilia hispida* are briefly discussed. The new combination *Aspicilia taurica* is proposed.

Zusammenfassung: HAFELLNER, J., NIMIS, P. L. & TRETIACH, M. 2004. Über Nachweise von *Aspicilia hispida* in Italien und Griechenland. – Herzogia **17**: 95–102.

Die zwergstrauchige Flechte *Aspicilia hispida*, weit verbreitet in Eurasien und Nordamerika, wird von zwei alpinen Fundpunkten im Nordwesten Italiens (Westalpen) und vom Mt. Parnassus (Griechenland) nachgewiesen. Die Fundpunkte schließen eine Verbreitungslücke zwischen den winterkalten Steppen im unteren Wolgagebiet und den offenen *Juniperus thurifera*-Gehölzen in Zentralspanien. Der gegenwärtige Kenntnisstand über aspicilioide Wanderflechten, die morphologischen Ableitungslinien und die globale Verbreitung von *Aspicilia hispida* werden zusammenfassend dargestellt. Die neue Kombination *Aspicilia taurica* wird vorgeschlagen.

Key words: Lichenized fungi, vagrant lichens, flora of Italy, flora of Greece.

Introduction

Several genera are known in which, under environmental conditions best described as "winter cold" and "summer arid", vagrant species have evolved (ELENKIN 1901, MERESCHKOVSKY 1911, ROSENTRETER 1993, 1997). Areas with such a climate host a steppe or semi-desert vegetation, in which terricolous lichens form important synusiae. Beside lichens contributing to soil crusts that stabilise the soil surface, some foliose lichens with detached enrolled thalli [e.g. *Xanthoparmelia camschadalis* (Ach.) Hale], and special life forms of otherwise crustose genera occur. The prominent genus *Aspicilia*, with mainly crustose taxa, in steppe habitats is represented by several taxa developing either „spherical" or dwarf-fruticose thalli (ELENKIN 1901, MERESCHKOWSKY 1911, THOMSON 1960, KOPAČEVSKAJA et al. 1971, HAFELLNER 1991, ROSENTRETER 1993, ELDRIDGE & ROSENTRETER 1997, KULAKOV 2002). One of these, *Aspicilia hispida* Mereschk. [syn. *Agrestia hispida* (Mereschk.) Hale & W.L.Culb.] has surprisingly been found at two localities in the Italian Western Alps, and on Mt. Parnassus (Greece). Some details on these findings, and a discussion on fruticose thallus organisation in *Aspicilia*, and on the distribution of *Aspicilia hispida*, are presented below.

Material and methods

Routine methods (light microscopy) were applied for studying the specimens. Secondary chemistry was studied by standard TLC methods as described by CULBERSON & AMMANN (1979).

Abbreviations of institutional herbaria follow HOLMGREN et al. (1990). Author's abbreviations follow BRUMMITT & POWELL (1992).

Specimens, including those of accompanying species, are deposited in GZU (sites 1, 2) and TSB (sites 2, 3).

The following material has been used for comparision:

Aspicilia desertorum (Kremp.) Mereschk. – Russia: Rossia europaea austro-orientalis, regio Astrachanensis ad lapides montis Bogdo, non procul lacu Baskunczak, 1926, leg. V. P. Savicz = Savicz, Lichenotheca Rossica 76 sub *A. desertorum* f. *ferruginea* (GZU). – Ad lapides calcareas arenareasque montis Bogdo prope lacu Baskuntschak in gub. Astrachan, 1910, leg. C. Mereschkowsky = Mereschkowsky, Lichenes Rossiae exs. 16 (GZU).

Aspicilia esculenta (Pall.) Flagey – Russia: ad terram et inter lapides montis Bogdo prope lacu Baskuntschak in gub. Astrachan, 1910, leg. C. Mereschkowsky = Mereschkowsky, Lichenes Rossiae exs. 18 (GZU).

Aspicilia hispida Mereschk. – Russia: Rossia europaea austro-orientalis, regio Astrachanensis per declive (in parte superiore montis Bogdo ad terram inter gramina, fruticulos lapidesque crescit, saepe libere vagtur, 1926, leg. V. P. Savicz = Savicz, Lichenotheca Rossica 97 (GZU). – Spain: Prov. Soria, Hochfläche (Paramera) W von Calatayud, kurz W des Ortes Judes SE Arcos de Jalón, ca. 1200 m; offenes Juniperetum thuriferae, Kalk-Skelettboden, 24.V.1983, leg. J. Hafellner no. 17528 (herb. Hafellner). – U.S.A.: COLORADO, Montezuma Co., Mesa Verde National Park, Wetherill Mesa above Long House, on thin red soil over sandstone near rim of canyon, 7000 ft., 30.V.1959, leg. W. A. Weber & J. Erdman = Lichenes Exs. Univ. Colorado Mus. 144 (GZU). – Canada: Saskatchewan, near Lac Pelletier, 49°58'N, 107°55'W, 900 m, on steep slope, on eroded calcareous soil in Astragaletum caespitosi, 29.V.1959, leg. J. Looman no. 592311 = Lichenes Canadenses exs. 77 sub *Agrestia h.* (GZU). – British Columbia, Fraser River Basin (Kamloops area), NW of Tranquille, along forest trail, near east end of Dedrop Ridge, 50°47'N, 120°34'W, 1000 m, interior douglas fir zone, open east- and south-facing ridge, rather exposed, terricolous over loose barren earth, 28. V. 1988, leg. T. Goward no. 88-118 & H. Knight = Lichenes Canadenses exs. 226 sub *Agrestia h*. (GZU).

Aspicilia fruticulosa (Eversm.) Flagey – Russia: ad terram et inter lapides montis Bogdo prope lacu Baskuntschak in gub. Astrachan, 1910, leg. C. Mereschkowsky = Mereschkowsky, Lichenes Rossiae exs. 20 (GZU). – Spain: Prov. Soria, Hochfläche (Paramera) W von Calatayud, kurz W des Ortes Judes SE Arcos de Jalón, ca. 1200 m; offenes Juniperetum thuriferae, Kalk-Skelettboden, 24.V.1983, leg. J. Hafellner no. 17527 (herb. Hafellner) – Ibid., leg. J. Poelt, leg. H. Mayrhofer no. 3656 (GZU). – Turkey: Prov. Corum, flat hills near the roadside between Merzifon and Corum, 30 km S of Merzifon, 40°39'N, 35°15'E, alt. 950 m, on soil between calcareous stones, 4.VIII.1997, leg. V. John, A. Yildiz & U. Zeybek = John, Lichenes Anatolici exs. 7 (GZU) = Lumbsch & Feige, Lecanoroid Lichens 82 (GZU).

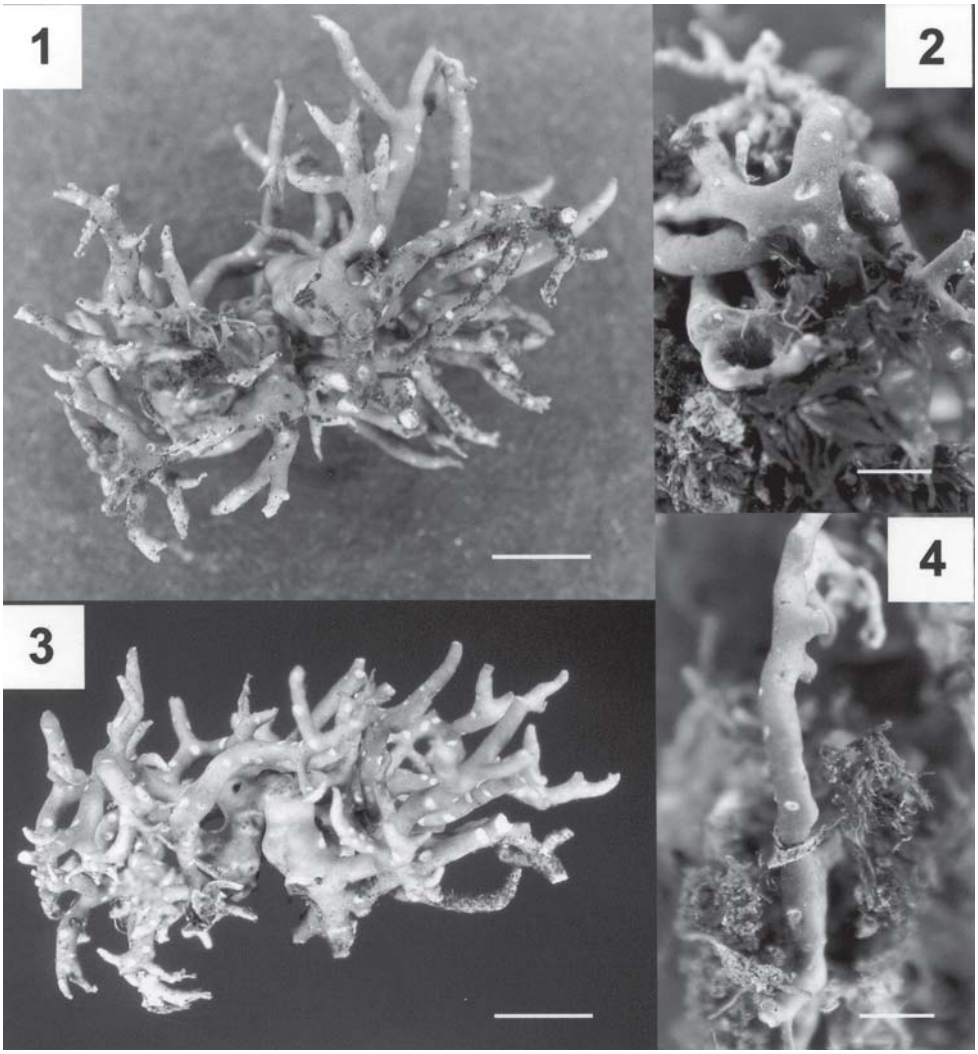
Aspicilia reptans (Looman) Wetmore – U.S.A.: Idaho, Ada County, south of Kuna, 790 m, in *Chrysothamnus-Poa sandbergii* formation, 28.III.1980, leg. R. Rosentreter no. 1664 (GZU).

Aspicilia vagans Oksner – Russia: ad terram et inter lapides montis Bogdo (120 m) prope lacu Baskuntschak in gub. Astrachan, 1910, leg. C. Mereschkowsky = Mereschkowsky, Lichenes Rossiae exs. 19 sub *A. affinis* (GZU).

Aspicilia taurica (Mereschk.) Hafellner – Spain: Prov. Soria, Hochfläche (Paramera) W von Calatayud, kurz W des Ortes Judes SE Arcos de Jalón, ca. 1200 m; offenes Juniperetum thuriferae, Kalk-Skelettboden, 24.V.1983, leg. J. Hafellner no. 17529 (herb. Hafellner).

Results

Several thalli of a dwarf fruticose lichen were recently collected at two alpine localities in the Western Alps, both of them in Italian territory, not far from the French border (figs 2, 4). They were identical to material collected by one of us (M.T.) during an OPTIMA excursion on Mt. Parnassus (Greece) in 1989 (figs 1, 3). Comparisons with specimens from other regions as well as samples of authentic material of taxa described by MERESCHKOVSKY (1911) and others, have shown that these collections fit perfectly with *Aspicilia hispida* Mereschk. The samples consist of small, grey or brownish-grey, fruticose, irregularly branched thalli, which grew basally attached to the soil, but may easily break off when dry. The branches become attenuated towards the tips, and are provided with scattered pseudocyphellae. Apothecia are not present in our collections. No lichen substances were detected by standard TLC.



Figs 1–4: *Aspicilia hispida*: thalli collected in Greece (figs 1, 3; TSB 13566) and Italy (figs 2, 4; TSB 35758). Scale = 1.2 mm (figs 1, 3), and 0.6 mm (figs 2, 4).

The collection sites are:

Site 1: Italy, Piemonte, Prov. Cuneo: Alpi Cozie, crest SW above Colle dell'Agnello, 44°40'55"N/06°58'35"E, c. 2830 m; outcrops of calcareous schists on steep slope exposed to the SE, on soil layer over banks of calcareous schist, 25.VII.2000, leg. J. Hafellner no. 59364 (GZU).

Site 2: Italy, Piemonte, Prov. Cuneo: Alpi Liguri, Cima di Pertega W above the village Úpega, just E below the summit, 44°08'50"N/07°41'00"E, c. 2400 m; outcrops of calcareous schists in alpine vegetation, on soil among low outcrops on the crest, 20.VII.2000, leg. A. Hafellner & J. Hafellner no. 59353 (GZU, dupl. in TSB 35758).

Site 3: Greece, Mt. Parnassus, Fterolaka, near the cableway, 1850 m, on calcareous soil, 13.–14.IX.1989, leg. M. Tretiach & C. Roux (TSB 13566).

The climatic diagrams of localities near the collection sites are reported in fig. 5. Chianale, dominated by Colle dell'Agnello, which lies only 4 km far from the village, is located at 1800 m: its climate is characterised by an evident summer decrease in precipitation after and before the equinoctial maxima, and mean monthly temperatures below 0 °C for at least three months (fig. 5A). This climate belongs to the IV (VI) type of WALTER & LIETH (1960), and is typical of the south-western Alps (see map 17 in WALTER & LIETH 1960). Somewhat different conditions are present in the Ligurian Alps, which are nearer to the Mediterranean sea, which results in higher precipitation, and in milder temperatures [climate type IV (X) of WALTER & LIETH (1960)]. In Úpega, a village located at c. 1300 m and dominated by Cima di Pertega, annual precipitation is c. 1100 mm (against c. 900 mm in Chianale), and mean temperature is 6.6 °C (against 5.2 °C in Chianale). However, also in Úpega and nearby areas there is a summer drought period (fig. 5B), albeit shorter than in Chianale. In Arachova, located at 950 m, in the immediate vicinity of Mt. Parnassus, precipitation is considerably lower (501 mm per year), and mean temperature higher (13.2 °C), with a severe drought period in summer, which is extended over five months, from May to September (fig. 5C).

The ecological conditions at the sites with *Aspicilia hispida* are certainly more severe than in the above mentioned villages, situated at lower altitudes. As the sites belong to the alpine (sites 1, 2) or cryomediterranean (site 3) vegetation belts, frost is certainly frequent in winter. However, the exposed microhabitats are probably snow-free at least during part of the cold season, because most of the snow is blown away by the frequent heavy winds. The high solar irradiation of the south-exposed slopes increase the intensity of summer drought, which certainly persist to some extent also at higher altitudes, in spite of the slight increase in rainfall. A relatively marked drought can be expected on Mt. Parnassus in Greece. All these features make the overall microclimate of the sites continental to a certain degree.

In all three sites the thalli of *Aspicilia hispida* grew on thin soil layers overlaying Ca-rich schists (site 1) or limestone (sites 2, 3). At site 2 the vegetation was a *Carex firma*-rich meadow, at sites 1 and 3 no continuous vegetation cover was observed, with higher plants present only in irregular groups leaving larger patches of soil ready for colonisation by cryptogams.

Accompanying species in site 1 (only soil-lichens mentioned here): *Buellia elegans*, *Cladonia pyxidata*, *Collema tenax*, *Dacampia hookeri*, *Diploschistes muscorum*, *Fulgensia bracteata* ssp. *deformis*, *Mycobilimbia lurida*, *Peltigera rufescens*, *Phaeorrhiza nimbosa*, *Psora decipiens*, *Solorina bispora*, *Thamnolia vermicularis* and *Toninia diffracta*.

Accompanying species in site 2: *Catapyrenium cinereum*, *Collema tenax*, *Fulgensia bracteata* ssp. *deformis*, *Mycobilimbia lurida*, *Bilimbia lobulata*, *Peltigera rufescens*, *Phaeorrhiza*

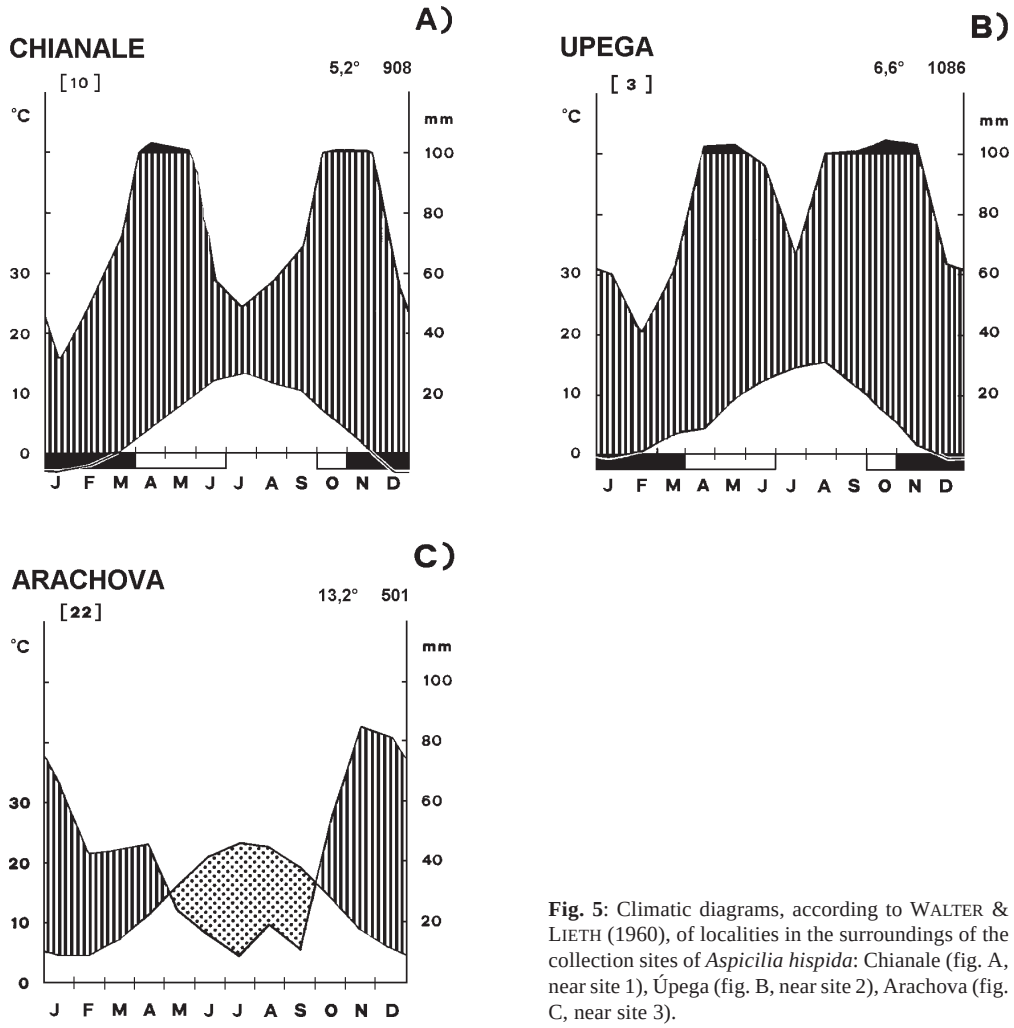


Fig. 5: Climatic diagrams, according to WALTER & LIETH (1960), of localities in the surroundings of the collection sites of *Aspicilia hispida*: Chianale (fig. A, near site 1), Úpega (fig. B, near site 2), Arachova (fig. C, near site 3).

nimbosa, *Placidium lachneum*, *Psora decipiens*, *Solorina bispora*, *Thamnolia vermicularis* and *Toninia sedifolia*.

Accompanying species in site 3: *Agonimia tristicula*, *Caloplaca stillicidiorum*, *Catapyrenium cinereum*, *Cetraria aculeata*, *Megaspora verrucosa*, *Mycobilimbia lurida*, *Bilimbia lobulata*, *Rinodina olivaceobrunnea* and *Toninia sedifolia*.

Discussion

The global distribution of *Aspicilia hispida*

Aspicilia hispida is widely distributed in the northern hemisphere, both in North America and Eurasia (sketch map in BARRENO 1991). In North America it ranges from Colorado in the

U.S.A. to British Columbia and Saskatchewan in Canada (LOOMAN 1964, ROSENTRETER 1993, GOWARD & THOR 1992). All the North American localities are situated at high altitudes and mainly host a winter cold steppe or semi-desert vegetation (ROSENTRETER 1993). In Eurasia several disjunct areas are known. The largest continuous distribution range is in the eastern European to central Asian winter cold steppes and deserts, from the lower Volga region (KOPAČZEVSKAJA et al. 1971, KULAKOV 2002) to Tajikistan (KUDRATOV 1998, KUDRATOV & MAYRHOFER 2002) and Kyrgyzstan (LITTERSKI 2002). An important disjunction is in the steppes and open *Juniperus thurifera* woodlands of central Spain, where *A. hispida* occurs together with other vagrant lichens (FOLLMANN & CRESPO 1974, CRESPO & BARRENO 1978, BARRENO 1991).

The new localities of *A. hispida* are located between these two large European disjunctions, and can be interpreted as their natural connection. The species should be searched for in other xerothermic areas of the Mediterranean region with a continental climate, for instance the eastern slopes of the Gran Sasso massif in central Italy, which at high altitudes host a characteristic steppe-like vegetation on calcareous substrata (TAMMARO 1998). Interestingly, another *Aspicilia* of the same group, *A. desertorum*, has been recently reported from this area (NIMIS & TRETIACH 1999), which was present also close to site 3 (Mt. Parnassus).

Present knowledge about vagrant *Aspicilia* species

MERESCHKOVSKY (1911) was the first to try an account of the *Aspicilia esculenta*-group and to distinguish further taxa among the vagrant Aspicilias. Beside some taxa known for a long time, namely *Aspicilia esculenta* (Pall.) Flagey, *A. fruticulosa* (Eversm.) Flagey, *A. affinis* (Eversm.) Mereschk., *A. desertorum* (Kremp.) Mereschk., and *A. jussufii* (Link) Mereschk., he described two further species (*A. hispida* Mereschk. and *A. lacunosa* Mereschk.) and some infraspecific taxa at the rank of forma or variety, one of which was later raised to species level (*A. desertorum* var. *aspera* Mereschk.). According to our observations one further of his infraspecific taxa deserves species rank: ***Aspicilia taurica*** (Mereschk.) Hafellner **comb. nov.** (Bas.: *Aspicilia fruticulosa* f. *taurica* Mereschkovsky, Trav. Soc. Naturalistes Univ. Imp. Kazan 43: 9, 1911).

The genus *Aspicilia* was monographed for the former Soviet Union by KOPAČZEVSKAJA et al. (1971). Among the vagrant taxa, eight species and several infraspecific taxa were accepted, *A. esculenta*, *A. emiliae* (Tomin) Oksner, *Aspicilia vagans* Oksner [syn. *A. affinis* (Eversm.) Mereschk. non (A.Massal.) Anzi], *A. tominii* Oksner, *A. fruticulosa*, *A. aspera*, *A. hispida* and *A. lacunosa*.

A recent treatment of the vagrant *Aspicilia* species with spherical, or foliose-detached, or dwarf-fruticose thalli of the Lower Volga region was published by KULAKOV (2002), who accepted 6 species and one variety: *A. aspera*, *A. aspera* var. *hispidioides* (Mereschk.) Tomin, *A. emiliae*, *A. esculenta*, *A. fruticulosa*, *A. hispida* and *A. vagans*. LITTERSKI (2002) treated the vagrant lichens of Kyrgyzstan, including some species of *Aspicilia*, such as *A. aspera*, *A. esculenta*, *A. fruticulosa*, *A. hispida* and *A. vagans*.

In North America the vagrant *Aspicilia* species and related taxa in the meanwhile are fairly well known. The first record of *A. hispida* dates back to the early second half of the last century (THOMSON 1960, as *Agrestia cyphellata*). LOOMAN (1962) described an additional species from the grasslands of the Great Plains in southern Canada, *Lecanora* (*Aspicilia*) *reptans* Looman. Further taxa of the *Aspicilia reptans* group in North America have been recognised and treated by ROSENTRETER (1998), namely *A. californica* Rosentr. and *A. filiformis* Rosentr.

RICO (1999) described *A. crespiana* from central Spain and Sardinia, a squamulose lichen with well developed rhizomorphs, closely related to the crustose *A. contorta* (SANDERS & RICO 1992).

Data on lichen communities containing vagrant taxa of *Aspicilia* have been published from the prairies in North America and open woodlands in central Spain. In North America such terricolous lichen communities were studied in some detail by LOOMAN (1964) as did CRESPO & BARRENO (1978) in Spain.

Morphological variation in *Aspicilia* under steppe-like environmental conditions

Within the *Aspicilia calcarea* group several independent vagrant taxa have evolved (HAFELLNER 1991). One lineage can be interpreted as crustose, but enrolling soil particles ("*A. esculenta*-type"), which results into spherical individual thalli. The generic name *Sphaerothallia* would be available for these taxa, but as there is a continuum to the pebble-inhabiting *A. desertorum*, there is hardly a justification for such a separation. Another lineage leads to the formation of true fruticose thalli ("*A. hispida*-type"), for which the genus *Agrestia* has been described (THOMSON 1960). Studying only *Aspicilia hispida*, the separation in the genus *Agrestia* seems justified. However, looking at the whole range of morphological variation of taxa present in larger steppe areas of the world (e.g. *Aspicilia vagans*, *A. fruticulosa*, *A. taurica*, *A. desertorum*, *A. aspera*, *A. aspera* var. *hispidioides*, *A. hispida* in Eurasia; *Aspicilia reptans*, *A. californica*, *A. filiformis*, *A. hispida*, *A. fruticulosa* in North America) it is clear that these species can be arranged along a morphological continuum, possibly in more than one lineage. In our opinion, these species are best kept together into *Aspicilia* (WEBER 1967, ROSENTRETER 1998).

A rare further type is the foliose-detached one (*A. emiliae*-type), showing a superficial similarity to several Parmeliaceae or *Dermatocarpon*-species occurring in steppes. *Aspicilia crespiana*, whose morphology was studied in detail by SANDERS & RICO (1992), can be considered as the connection between crustose taxa of the *A. contorta* complex, and the foliose morphotype. *Aspicilia crespiana* consists of two interconnected structures, lichenized squamules and mycobiont rhizomorphs, giving origin to a squamulose to subfruticose thallus. As all these species groups are centred around the *Aspicilia contorta*/*calcarea*-group, a separation of one of these lineages as an independent genus would leave behind a paraphyletic rest, and should be avoided. Only the entire *Aspicilia contorta*/*calcarea*-group is worth to be considered as a distinct taxon, but this, in our opinion, could well be a subgenus within *Aspicilia*.

Acknowledgements

The M.I.U.R. is thanked for financial support of the fieldwork (project „Una rete di banche-dati sulla Biodiversità delle Crittogame terrestri d'Italia", resp. P.L. Nimis). Dr M. Zhurbenko (St. Petersburg) helped with the arrangement of a loan of several relevant specimens preserved in St. Petersburg. Additional information on vagrant Aspiciliaceae was obtained from Dr V. Kulakov (Volgograd), whose help is also gratefully acknowledged. Furthermore we thank Dr B. Gallino (Parco Regionale di Valle Pesio), and Dr Stergios A. Pirintsos (University of Crete, Heraklion) for meteorological data and finally Dr R. Rosentreter (Boise) for critical reading of the manuscript.

References

BARRENO, E. 1991. Phytogeography of terricolous lichens in the Iberian Peninsula and the Canary Islands. – Bot. Chron. (Patras) **10**: 199–210.

BRUMMITT, R. K. & POWELL, C. E. 1992. Authors of plant names. – Kew: Royal Botanic Gardens.

CRESPO, A. & BARRENO, E. 1978. Sobre las comunidades terricolas de liquenes vagantes (Sphaerothallio-Xanthoparmelion vagantis all. nov.). – Acta Bot. Malacitana **4**: 55–62.

CULBERSON, C. F. & AMMANN, K. 1979. Standardmethode zur Dünnschichtchromatographie von Flechtensubstanzen. – Herzogia **5**: 1–24.

ELDRIDGE, D. & ROSENTRETER, R. 1997. Terricolous *Aspicilia* in semi-arid eastern Australia: how many species are there? – Australasian Lichenology **41**: 18–19.

ELENKIN, A. 1901. Wanderflechten der Steppen und Wüsten. – Bull. Jard. Imp. Bot. St.-Petersbourg **1**: 16–38, tab., 52–72, tab. [Transcription and translation of title according to summary.]

FOLLMANN, G. & CRESPO, A. 1974. Observaciones acerca de la distribucion de líquenes españoles. II. *Sphaerothallia fruticulosa* (Eversm.) Follm. & Crespo. – Anal. Inst. Bot. Cavanilles **31**: 325–333.

GOWARD, T. & THOR, G. 1992. Notes on the lichens and allied fungi of British Columbia. I. – Bryologist 95: 33–37.

HAFELLNER, J. 1991. Die Gattung *Aspicilia*, ihre Ableitungen nebst Bemerkungen über cryptolecanorine Ascocarporganisation bei anderen Genera der Lecanorales (Ascomycetes lichenisati). – Acta Bot. Malacitana **16**: 133–140.

HOLMGREN, P. K., HOLMGREN, N. H. & BARNETT, L. C. (eds) 1990. Index herbariorum. Part I. The herbaria of the world. 8th ed. – Bronx, New York: New York Botanical Garden for the International Association for Plant Taxonomy.

KOPAČEVSKAJA, E. G., MAKAREVIČ, M. F., OKSNER, A. N. & RASSADINA, K. A. 1971. Opredelitel' lišajnikov SSSR. 1. Pertuzarievye, Lekanorovye, Parmelievye. [Hankbook of the Lichens of the USSR. 1. Pertusariaceae, Lecanoraceae and Parmeliaceae.] – Leningrad: Izdatel'stvo „Nauka".

KUDRATOV, I. 1998. The genus *Aspicilia* in Tajikistan. In: KONDRATYUK, S. Y. & COPPINS, B. J. (eds), Lobarion Lichens as Indicators of the Primeval Forests of the Eastern Carpathians, p. 186. – Kiev: M. H. Kholodny Institute of Botany, Ukrainian Phytosociological Centre.

KUDRATOV, I. & MAYRHOFER, H. 2002. Catalogue of the lichenized and lichenicolous fungi of Tajikistan. – Herzogia **15**: 91–128.

KULAKOV, V. G. 2002. Kustistye i listovatye ližajniki nižnego Povolž'ja [Fruticose and foliose lichens of the lower Wolga]. – Volgograd.

LITTERSKI, B. 2002. Vagrant lichens of Kyrgyzstan. In: LLIMONA, X., LUMBSCH, T. H. & OTT, S. (eds). Progress and problems in lichenology at the turn of the millenium. – Biblioth. Lichenol. **82**: 77–82.

LOOMAN, J. 1962: Some lichens of Saskatchewan. – Bryologist **65**: 294–304.

LOOMAN, J. 1964: The distribution of some lichen communities in the prairie provinces and adjacent parts of the Great Plains. – Bryologist **67**: 209–224.

MERESCHKOVSKY, C. de 1911. Excursion lichenologique dans les steppes kirghises (Mont Bogdo). – Trav. Soc. Naturalistes Univ. Imp. Kazan **43**: 1–42, tab.

NIMIS, P. L., & TRETIACH, M. 1999. Itinera Adriatica – Lichens from the eastern part of the Italian Peninsula. – Studia Geobot. **18**: 51–106.

RICO, V. J. 1999. *Aspicilia crespiana*, a new lichen species from southern Europe. – Lichenologist **31**: 129–139.

ROSENTRETER, R. 1993. Vagrant lichens in North America. – Bryologist **96**: 333–338.

ROSENTRETER, R. 1997. Conservation and management of vagrant lichens in the northern Great Basin, USA. – In: KAYE, T. N., LISTON, A., LOVE, R. M., LUOMA, D. L., MEINKE, R. & WILSON, M. V. (eds.): Conservation and management of native plants and fungi, pp. 242–248. – Corvallis: Native Plant Society of Oregon.

ROSENTRETER, R. 1998. Notes on *Aspicilia reptans* complex, with descriptions of two new species. – In: GLENN, M. G., HARRIS, R. C., DIRIG, R. & COLE, M. S. (eds), Lichenographia Thomsoniana: North American Lichenology in Honour of John W. Thomson, pp. 163–170. – Ithaca, New York: Mycotaxon Ltd.

SANDERS, W. B. & RICO, V. J. 1992. Lichenizing rhizomorphs and thallus development in the squamulose lichen *Aspicilia crespiana* Rico ined. (Lecanorales, Ascomycetes). – Bot. Acta **105**: 449–456.

THOMSON, J. W. 1960. *Agrestia cyphellata*, a new genus and species of lichen in the Usneaceae. – Bryologist **63**: 246–250.

TAMMARO, F. 1998. Il paesaggio vegetale dell'Abruzzo. – Penne: Cogecstre Edizioni.

WALTER, H. & LIETH, H. 1960. Klimadiagramm-Weltatlas. – Jena: VEB Gustav Fischer Verlag.

WEBER, W. A. 1967. Environmental modification in crustose lichens. II. Fruticose growth forms in *Aspicilia*. – Aquilo, Ser. Bot., **6**: 43–51.

Manuscript accepted: 15 November 2003.

Addresses of the authors

Josef Hafellner, Institut für Pflanzenwissenschaften, Karl-Franzens-Universität, Holteigasse 6, A-8010 Graz, Austria. E-mail: josef.hafellner@uni-graz.at

Pier Luigi Nimis & Mauro Tretiach, Dipartimento di Biologia, Università degli Studi di Trieste, Via L. Giorgieri 10, I-34127 Trieste, Italy. E-mail: nimis@units.it, tretiach@units.it