Lichenized and lichenicolous fungi of Yaylacık (Bolu) and Yenice (Karabük) Research Forests in Turkey

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Abstract. One hundred fifty two taxa belonging to 64 genera are reported from Yaylacık and Yenice Research Forests (Bolu, Karabük, Turkey). Fifty five of 100 taxa are new to the province of Bolu and 107 of 108 taxa are new for the province of Karabük. *Buellia schaereri, Caloplaca cretensis, Lichenoconium pyxidatae,* and *Toninia pennina,* are all new records for Turkey. Comments on habitat and substrata are provided for some interesting taxa.

Key words: *Ascomycota,* Black Sea Region, lichens, Turkey

Introduction

Although the lichen composition of northern Turkey has a certain uniformity, the eastern Black Sea region of Turkey (cfr Yazıcı 1999; Aslan *et al*. 2002; John & Breuss 2004; Kınalıoğlu 2005) differs from the western Black Sea region (Szatala 1927; Hertel 1989; Özdemir Türk 1997; Öztürk & Güvenç 2002; Yildiz & John 2002). Only a few lichens have previously reported from the provinces of Bolu and Karabük (Aydın 1990; Öztürk & Güvenç 2002; Çobanoğlu & Akdemir 2004; Hafellner & John 2006). However the study area is one of the most valuable areas in the world in terms of biological diversity (National Geographic 2005). We aim here to contribute to the lichen checklist of Turkey by studying this region for the first time thoroughly.

Study area

The study area is part of the Euxianian section of the Euro-Siberian floristic region of Turkey. It is located between 40°59'03" and 41°00'00" N, and 32°05'55" and 32°18'15" E in the western part of the Black Sea region, and belongs to Mengen district in the province of Bolu, and Yenice district in the province of Karabük (Fig. 1). 5246 ha of the study area (5304 ha) is forest and 58 ha is open space.

The highest locality in Yaylacık Research Forest is Keçikıran Hill at 1654 m altitude and the lowest, the intersection İncedere with Doksandere in the vicinity of Otlaklıburun at the northwest border at 345 m. The villagers in Mengen District use the Elmaören, Keçikıran and Karaboğa areas of Yaylacık Forest for grazing sheeps.

Yenice Forests comprise Göktepe, Bakacak kulesi, Sorgun plateau, Şimşirdere, Camiyanı, Karakaya, Kavaklı Arboreatum area, Keltepe and İncidere divisions in Yenice (Filyos) valley, northeast of Yenice itself. The Yenice Forests to the east of Yenice River and in the south of Yenice district have the maximum species diversity of undisturbed woody species anywhere in Turkey (National Geogeaphic 2005).

These two forests are among the 100 forested areas in Turkey which must be urgently protected according to researches of the WWF (National Geographic 2005). These areas classified as "Hot Spots of European Forests", are one of the most valuable areas in terms of biological diversity in the region.

Summits constitute the southern border of the area and shapes the eastern extensions of Bolu Mountain chains. Yenice Forests is noted for its humid and rainy climate. The annual mean temperature is 8.8 °C, relative humidity 76.2% and total precipitation about 1200 mm. Ombro-termic diagrams for Bolu and Karabük are provided in Figs 2-3. The high precipitation ratio in the study area issues in a rich tree diversity and dominant *Fagus – Abies* forests. The uneven topography

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precludes the enlargement of settlements, thus leaving the area undisturbed and rich in biological diversity. Yenice and Yaylacık forests are respected for their conserve action of natural characteristics and the very large areas they cover.

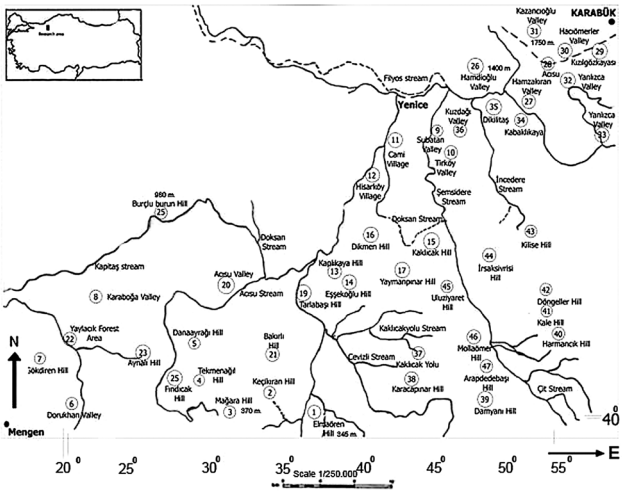

Fig. 1. Map of the study area

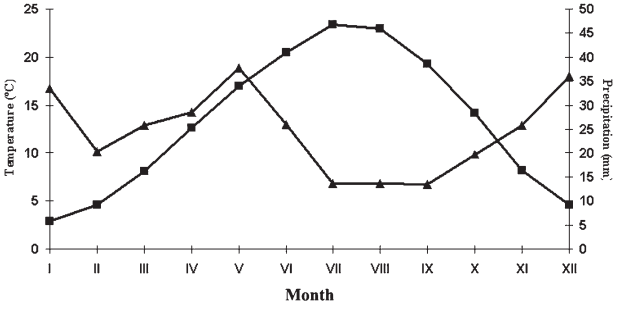

Fig. 2. Climatic diagram of Bolu district

The basic rocks in the region erupt from metagranodiorites of Precambrian age. The forests in Yenice (Filyos) Valley towards the northeast are distributed over large areas of shallow maritime carbonate sediments of Cretaceous age.

The collecting localities are given in Table 1.

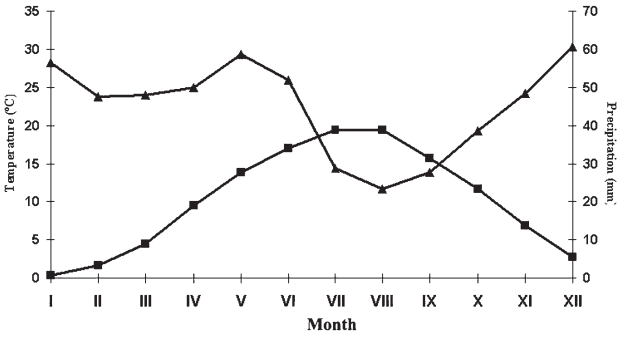

Fig. 3. Climatic diagram of Karabük district

Materials and Methods

Collections were from 47 localities between 2003 and 2005. We considered altitude, substratum and inclination in the choice of localities by ourselves. All samples are now stored in ANK. The taxa are listed in alphabetical order followed by the collection locality numbers, and substrata. The nomenclature follows Hafellner & Türk (2001) and other modern results (e.g. Blanco *et al.* 2004). Abbreviations of author names are according to Kirk & Ansell (1992). Lichen taxa new to Turkey are indicated by #, those new to Bolu province by *, and those new to Karabük province by ¤. The collecting localities (see Fig. 1) are given in Table 1.

Abbreviations of substrata used in the taxa list of taxa

Ab	Abies nordmanniana	Pr	*Prunus* sp.
Ac	*Acer* sp.	Q	*Quercus* sp.
Ca	Carpinus betulus	Sa	*Salix* sp.
Cu	*Cupressus* sp.	sil	siliceous rocks
J	*Juniperus* sp.	cal	calcareous rocks
Pi	*Pinus* sp.	ter	soil
Po	*Populus* sp.	M	bryophytes

Table 1. The collecting localities in the study area

Locality No	Date of collection	GPS co-ordinates	Locality name	Altitude (m)
1	11.07.2003	41°43’ N, 34°41’ E	Bolu, Mengen, Elmaören position	345
2	12.07.2003		Bolu, Mengen, Keçikıran Hill	425
3	12.07.2003	41°04’ N, 32°02 E	Bolu, Mengen, Mağara Hill	370
4	12.07.2003		Bolu, Mengen, Tekmenağıl Hill	472
5	12.07.2003		Bolu, Mengen, Danaayrağı Hill	810
6	12.07.2003		Bolu, Mengen, Dorukhan, Karataş Position	360

Locality No	Date of collection	GPS co-ordinates	Locality name	Altitude (m)
7	12.07.2003		Bolu, Mengen, Gökdiren Hill	540
8	13.07.2003		Bolu, Mengen, Karaboğa Plateau	880
9	20.05.2005	41°10' N, 32°24' E	Karabük, Yenice, Subatan Plateau	1120
10	20.05.2005	45°43' N, 34°41' E	Karabük, Yenice, Tirköy Position	1060
11	20.05.2005	41°10' N, 32°24' E	Karabük, Yenice, vicinity of Cami district	1100
12	20.05.2005	41°10' N, 32°23' E	Karabük, Yenice, Hisarköy Position	1003
13	25.08.2005	41°06' N, 32°18' E	Karabük, Yenice, 500 m east of Kaplıkaya Hill	925
14	25.08.2005	41°06' N, 32°18' E	Karabük, Yenice, 800 m east of Eşşekyolu Hill	910
15	25.08.2005	41°05' N, 32°19' E	Karabük, Yenice-Kaklıcak Hill	940
16	25.08.2005	41°05' N, 32°19' E	Karabük, Yenice, Dikmen Hill	950
17	25.08.2005	41°05' N, 32°19' E	Karabük, Yenice, the highest summit of Yaymanpınar Hill	930
18	25.08.2005	41°05' N, 32°19' E	Karabük, Yenice, 1 km south of Yaymanpınar Hill	850
19	25.08.2005	41°04' N, 32°15' E	Karabük, Yenice, Tarlabaşı Hill, Tarla İşçi Forest	865
20	25.08.2005	41°04' N, 32°15' E	Karabük, Yenice, Acısu Position	894
21	25.08.2005	40°59' N, 32°15' E	Karabük, Yenice, Bakırlı Hill	630
22	25.08.2005	40°59' N, 32°15' E	Karabük, Mengen, vicinity of Yaylacık Forest Operation Center	780
23	25.08.2005	40°59' N, 32°15' E	Karabük, Yenice, Aynalı Hill	615
24	25.08.2005	40°59' N, 32°15' E	Karabük, Yenice, Fındıcak Hill	480
25	25.08.2005	41°06' N, 32°16' E	Karabük, Yenice, Burçluburun Hill	980
26	26.08.2005	41°12' N, 32°25' E	Karabük, Yenice, vicinity of Kuzdere, Hamdioğlu district	1400
27	26.08.2005	41°13' N, 32°28' E	Karabük, Yenice, vicinity of Hamzakıran district	1140
28	26.08.2005	41°11' N, 32°27' E	Karabük, Yenice, Acısu Center	1375
29	26.08.2005	41°12' N, 32°29' E	Karabük, Yenice, Kızılgöz kayası	1385
30	26.08.2005	41°12' N, 32°29' E	Karabük, Yenice, Hacıömerler district	1380
31	26.08.2005	41°14' N, 32°33' E	Karabük, Yenice, Kazancıoğlu district	1750
32	26.08.2005	41°15' N, 32°34' E	Karabük, Yenice, North of Yalnızca plateau	1200
33	26.08.2005	41°15' N, 32°34' E	Karabük, Yenice, Yalnızca Plateau	1059
34	26.08.2005	41°15' N, 32°35' E	Karabük, Yenice, Kabaklı kaya	1140
35	26.08.2005	41°14' N, 32°35' E	Karabük, Yenice, Dikilitaş	1125
36	15.11.2005	44°62' N, 45°73' E	Karabük, Yenice, Kuzdağ district	1125
37	15.11.2005	44°48' N, 45°71' E	Karabük, Yenice, Near Kaklıcak stream	550
38	15.11.2005	44°51' N, 45°66' E	Karabük, Yenice, Karacapınar Hill	525
39	15.11.2005	44°82' N, 45°69' E	Karabük, Yenice, Damyanı Hill	460
40	15.11.2005	45°18' N, 45°69' E	Karabük, Yenice, Harmancık Hill	840
41	15.11.2005	45°01' N, 45°69' E	Karabük, Yenice, Kale Hill	870
42	15.11.2005	44°40' N, 45°65' E	Karabük, Yenice, Döngeller Hill	920
43	15.11.2005	44°49' N, 45°62' E	Karabük, Yenice, Kilise Hill	915
44	15.11.2005	44°52' N, 45°62' E	Karabük, Yenice, İrsaksivrisi Hill	938
45	15.11.2005	44°90' N, 45°65' E	Karabük, Yenice, Uluziyaret Hill	905
46	15.11.2005	44°81' N, 45°65' E	Karabük, Yenice, Mollaömer Hill	817
47	15.11.2005	45°01' N, 45°63' E	Karabük, Yenice, Arapdedebaşı Hill	535

List of taxa and comments on some species

***Acarospora** cervina* A. Massal. – 3 (cal)

¤*A. fuscata* (Nyl.) Th. Fr. – 28, 36 (sil)

*¤*A. heppii* (Nägeli) Körb. – 1, 33 (cal); this species was previously only recorded from Kastamonu province in Turkey (Güvenç *et al.* 2006). It is strongly associated with *Arthonia lapidicola* on the calcareous rocks of Locality 1. This situation confirms the data in Wirth (1995).

Amandinea *punctata* (Hoffm.) Coppins & Scheid. – 1 (Pi)

¤***Anaptychia** ciliaris* Körb. ex A. Massal. – 16 (Q)

*¤*A. setifera* Meresch. ex Räsänen – 4, 14 (Q)

*¤***Arthonia** *lapidicola* (Taylor) Branth & Rostr. – 1, 2, 27 (cal)

¤***Aspicilia** caesiocinerea* (Nyl. ex Malbr.) Arnold – 31 (sil)

¤*A. cinerea* (L.) Körb. – 31, 40 (sil)

¤*A. contorta* (Hoffm.) Kremp. subsp. *contorta*– 5 , 14, 19, 29 (cal)

**A. contorta* subsp. *hoffmaniana* S. Ekman & Fröberg – 3, 5 (cal)

¤*A. intermutans* (Nyl.) Arnold – 31 (sil)

*¤*A. viridescens* (A. Massal.) Hue – 5, 41, 42 (cal)

*¤***Baeomyces** *rufus* (Huds.) Rebent. – 1, 39 (cal); this circumpolar species in temperate and boreal regions is recorded from the western part of Black Sea Region for the first time.

¤***Bryoria** fuscescens* (Gyeln.) Brodo & D. Hawksw. – 3, 34 (Pi)

¤***Buellia** badia* (Fr.) A. Massal. – 28 (lichenicolous on *Xanthoparmelia pulla*), 39 (lichenicolous on *Aspicilia intermutans*); this is a widespread lichenicolous lichen in the North Hemisphere especially on *Xanthoparmelia conspersa* group (Wirth 1995).

¤*B. griseovirens* (Turner & Borrer ex Sm.) Almb. – 18 (Pi)

#*B. schaereri* De Not. – 5 (Pi)

¤***Calicium** viride* Pers. – 28, 44, 46 (Ab)

Caloplaca *agardhiana* auct. – 3 (cal)

¤*C. cerina* (Ehrh. ex Hedw.) Th. Fr. var. *cerina* – 1 (Cu), 2 (Po), 7 (Sa), 40 (Q)

**C. crenularia* (With.) J.R. Laundon – 5 (sil)

#*C. cretensis* (Zahlbr.) Wunder – 1, 5 (cal); this is the first record for Turkey and the species is easily distinguished from other *Caloplaca* species with by the rust coloured apothecia discs and K + red epipsamma. This species was reported from Greece (Wunder 1974).

C. dolomiticola (Hue) Zahlbr. – 2, 3 (cal)

**C. flavescens* (Huds.) J.R. Laundon – 3, 9 (sil)

C. lactea (A. Massal.) Zahlbr. – 1, 3 (cal)

**C. paulsenii* (Vain.) Zahlbr. – 2 (cal)

¤*C. tiroliensis* Zahlbr. – 34 (M)

C. variabilis (Pers.) Müll. Arg. – 1, 11 (cal)

¤***Candelariella** aurella* (Hoffm.) Zahlbr. – 1, 2, 3, 27, 28 (cal)

¤*C. vitellina* (Hoffm.) Müll. Arg. – 5, 41 (sil)

Carbonea *vitellinaria* (Nyl.) Hertel – 5 (lichenicolous on *Candelariella vitellina*)

*¤***Chaenotheca** *furfuraceae* (L.) Tibell – 5, 11, 33, 38, 44 (Pi)

¤***Chrysothrix** candelaris* (L.) J.R. Laundon – 1, 6, 20, 30, 41 (Ab)

¤***Cladonia** coniocraea* (Flörke) Spreng. – 9, 13 (ter)

¤*C. fimbriata* (L.) Fr. – 1, 13, 35 (M)

*¤*C. floerkeana* (Fr.) Flörke – 1, 5, 26, 27, 28 (ter)

¤*C. furcata* (Huds.) Schrad. – 28, 44 (ter)

¤*C. pyxidata* (L.) Hoffm. – 1, 6, 30 (ter)

¤***Collema** polycarpon* Hoffm. – 9 (cal)

¤*C. undulatum* Laurer ex Flot. – 12 (cal)

¤***Diploschistes** scruposus* (Schreb.) Norman – 28 (lichenicolous on *Cladonia* sp. in young stages)

Diplotomma *alboatrum* (Hoffm.) Flot. – 2 (cal)

Evernia *divaricata* (L.) Ach. – 3 (Pi), 4 (J), 6 (Pi), 7 (Ab), 8 (J), 10, 33 (Pi), 36 (J), 40 (Ab), 43, 47 (Pi)

¤*E. prunastri* (L.) Ach. – 10 (Pi), 26, 30 (Ab)

Farnoldia *micropsis* (A. Massal.) Hertel – 2 (cal); the known distribution of this arctic-alpinic species is extended to the north Turkey, it is previously only recorded from Erzurum (Aslan 2000) and Kastamonu (Yıldız *et al.* 2002).

*¤***Flavoparmelia** *caperata* (L.) Hale – 6, 12 (Q), 15, 26, 38, 41 (Pi), 45 (Q)

¤***Foraminella** ambigua* (Wulfen) S.L.F. Mey. – 1 (Ca), 4 (Ab), 16 (Pi)

¤ ***Fuscidea** cyathoides* (Ach.) V. Wirth & Vězda – 16 (sil)

*¤***Glypholecia** *scabra* (Pers.) Müll. Arg. – 3, 32 (cal)

¤***Hypogymnia** physodes* (L.) Nyl. – 4 (Pi), 5, 13 (Q), 30 (sil), 40 (Pi), 43 (Q), 47 (Pi)

¤*H. tubulosa* (Schaer.) Hav. – 2, 4 (Q), 8 (sil), 10 (Pi), 13, 27 (Q), 35 (Pi), 36 (Q)

¤*H. vittata* (Ach.) Parrique – 11 (Q), 13 (Pi)

Intralichen *christiansenii* (D. Hawksw.) D. Hawksw. & M.S. Cole – 4 (lichenicolous on the apothecia of *Lecanora carpinea*); This is a widespread lichenicolous fungus occuring on a wide range of lecanoralean hosts such as species of *Buellia, Caloplaca, Candelariella, Lecanora, Phaeophyscia, Rhizocarpon,* and *Usnea*. This coelomycetes is found in the hymenia of the host apothecia, but can occur also on the thallus (Alstrup & Hawksworth 1990). This species found in the hymenium of *Lecanora carpinea* seems to be partly pathogenic as ascospore production is suppressed in the host in infected parts of the hymenia.

*¤***Lecanora** *albella* (Pers.) Ach. – 4 (Pi), 11 (Pr)

¤*L. allophana* (Ach.) Nyl. – 9, 45 (sil)

L. carpinea (L.) Vainio – 4 (Ab), 7 (Pi), 24 (Ab), 37 (Ab), 46 (Ca)

¤*L. chlarotera* Nyl. – 1, 2, 14, 25 (Ab)

¤*L. crenulata* (Dicks.) Hook. – 1, 2, 9, 37 (cal)

¤*L. dispersa* (Pers.) Sommerf. – 5, 12, 15, 42 (cal)

L. hagenii (Ach.) Ach.– 1 (Ab)

¤*L. polytropa* (Hoffm.) Rabenh. – 14 (sil)

¤*L. rupicola* (L.) Zahlbr. subsp. *rupicola* – 18, 43 (sil)

¤*L. varia* (Hoffm.) Ach. – 2 (Ab), 45 (Ca)

*¤***Lecidea** *fuscoatra* (L.) Ach. – 2, 38 (sil)

**L. tessellata* Flörke –5 (lichenicolous on *Aspicilia contorta*)

Lecidella *carpathica* Körb. – 2, 5 (sil)

¤*L. elaeochroma* (Ach.) M. Choisy – 1 (Ab), 2 (Ca), 45 (J)
¤*L. patavina* (A. Massal.) Knoph & Leuckert – 18 (cal)
L. stigmatea (Ach.) Hertel & Leuckert – 5 (cal)
¤***Leptogium** gelatinosum* (With.) J.R. Laundon – 3, 46 (M)
¤*L. saturninum* (Dicks.) Nyl. – 18, 29 (Po)
*¤***Letharia** vulpina* (L.) Hue – 1, 4, 6, 8, 35, 41, 43, 46 (Ab)
#***Lichenoconium** pyxidatae* (Oudem.) Petr. & Syd. – 1 (lichenicolous on the squamules of *Cladonia* sp.)
Lichenodiplis lecanorae* (Vouaux) Dyko & D. Hawksw. – 2 (lichenicolous on the apothecia of *Caloplaca cerina* var. *cerina*); this species was previously recorded from Turkey by Halıcı *et al*. (2006) on the apothecia of *Caloplaca holocarpa* and by Hafellner & John (2006) on the apothecia of *Lecanora albella*. Here, it is reported from the apothecia of *Caloplaca cerina* var. *cerina.* This species is known on a wide range of mainly crustose lichen species as aggregated black spots of sunken conidiomata on the thallus and apothecia of the hosts (Alstrup & Hawksworth 1990).
Lichenostigma cosmopolites* Hafellner & Calatayud – 2 (lichenicolous on *Xanthoparmelia stenophylla*). This cosmopolite lichenicolous fungus species is known to grow on *Xanthoparmelia conspersa* group*,* forming a black reticulate net over the host thallus. It was previously recorded from Turkey on thallus of *Xanthoparmelia tinctina* and *Xanthoparmelia* sp. by Hafellner & John (2006). It is reported for the second time in Turkey on the thallus of *Xanthoparmelia stenophylla* on siliceous rocks in the study area.
L. maureri Hafellner. – 5 (lichenicolous on *Pseudevernia furfuracea*); this species was previously recorded from Bolu province on thallus of *P. furfuracea* by Hafellner & John (2006). This commensalistic lichenicolous fungus species is re-collected by us on the thallus of *Pseudevernia furfuracea* from Bolu province.
¤***Lobaria** amplissima* (Scop.) Forssell – 11 (Ac)
*¤*L. pulmonaria* (L.) Hoffm. – 4, 10, 11, 29, 30, 32, 33, 34, 37, 39, 40, 44 (Ca)
¤***Lobarina** scrobiculata* (Scop.) Cromb. – 12 (Ca)
¤***Lobothallia** alphoplaca* (Wahlenb.) Hafellner – 17, 18, 21 (sil)
*¤***Melanohalea** elegantula* (Zahlbr.) O. Blanco *et al.* – 5 (Pr), 16 (M), 18, 44 (Pr)
¤*M. exasperatula* (Nyl.) O. Blanco *et al.* – 1 (Q), 3 (Sa), 5 (Ac), 11, 24 (Q)
¤***Melanelixia** glabra* (Schaer.) O. Blanco *et al.*– 19, 45 (Ca)
¤*M. fuliginosa* (Duby) O. Blanco *et al.* subsp. *glabratula* (Lamy) J.R. Laundon – 9 (Pi), 12, 17, 26 (Q)
¤***Miriquidica** deusta* (Stenh.) Hertel & Rambold – 28, 35 (sil)
¤***Parmelia** saxatilis* (L.) Ach. – 7 (Pi), 8 (Ca), 9 (Ab)
¤*P. sulcata* Taylor – 4 (Ca), 5, 6 (Pi), 7 (Q), 8 (Q), 9, 20 (Ab), 25, 43 (Pi)
Parmelina carphorrhizans* (Taylor) Poelt & Vězda – 7 (Q)
¤*P. tiliacea* (Hoffm.) Hale – 14 (M), 16 (Q), 17, 19 (Pi)
*¤***Peltigera** didactyla* (With.) J.R. Laundon – 6, 7, 9, 20, 42 (ter)
¤*P. praetextata* (Flörke ex Sommerf.) Vain. – 1, 6, 22, 36 (M)
¤*P. rufescens* (Weiss) Humb. – 9, 20, 33 (ter)
¤***Pertusaria** amara* (Ach.) Nyl. – 1 (Ca), 2, 4, 7 (Ab), 8 (Ca), 9, 10, 17, 18, 32, 33, 35, 36 (Ab), 38 (Ca), 40, 43 (Ab)
¤*P. hemisphaerica* (Flörke) Erichsen – 30 (Ab)
¤*P. lactea* (L.) Arnold – 2, 7, 23 (sil)
*¤*P. pertusa* (Weigel) Tuck. – 4, 8, 10 (Pi)
Phaeorrhiza nimbosa* (Fr.) H. Mayrhofer & Poelt – 3 (ter); This species was collected from the western part of the Black Sea Region for the first time. It is previously recorded from Kayseri (Halıcı *et al.* 2005) and Rize (John & Breuss 2004) in Turkey.
***Physcia** aipolia* (Ehrh. ex Humb.) Fürnr. – 3 (Pr)
¤*P. dubia* (Hoffm.) Lettau – 5, 21 (sil)
¤*P. leptalea* (Ach.) DC. – 2 (M)
¤*P. magnussonii* Frey – 15 (sil)
**P. tenella* (Scop.) DC. – 2 (Q)
¤***Physconia** distorta* (With.) J.R. Laundon – 9 (Ca), 36 (Q)
**P. enteroxantha* (Nyl.) Poelt – 1 (M)
¤***Platismatia** glauca* (L.) W.L. Culb. & C.F. Culb. – 21 (Pi), 27, 33, 39 (Ab)
Plectocarpon lichenum* (Sommerf.) D. Hawksw. – 4 (Pi); this species was previously reported on thallus of *Lobaria pulmonaria* from Turkey by Hafellner & John (2006). This species has a wide distribution in Europe and also Canary Islands and it is easily distinguished from the other species of the genus by the apothecia with a constricted base (Diederich & Etayo 1994).
¤***Pleurosticta** acetabulum* (Neck.) Elix & Lumbsch – 8, 28 (Ca)
¤***Porpidia** crustulata* (Ach.) Hertel & Knoph – 21, 27 (sil)
¤***Protoparmeliopsis** muralis* (Schreb.) M. Choisy – 5, 21 (cal), 24 (sil), 27, 28 (cal)
¤***Pseudevernia** furfuracea* (L.) Zopf var. *furfuracea* – 5 (Ab), 8 (Pi), 40, 43, 47 (Ab)
¤*P. furfuracea* var. *ceratea* (Ach.) D. Hawksw. – 4, 5, 6, 8 (Ab), 10 (Pi), 30 (Ab), 36 (Pi)
*¤***Ramalina** capitata* (Ach.) Nyl. – 8, 31, 34, 39 (sil)
¤*R. farinaceea* (L.) Ach. – 5 (Ab), 34 (Q), 44, 45 (Pi)
¤*R. fastigiata* (Pers.) Ach. – 10 (Q), 13 (Ab), 16 (Ca), 20, 21, 27 (Pi)
*¤*R. fraxinea* (L.) Ach. – 7, 27 (Q), 35 (Ca)
¤*R. pollinaria* (Westr.) Ach. – 7, 8 (Pi), 10 (Pr), 27 (Q), 31 (sil)
*¤*R. polymorpha* (Lilj.) Ach. – 2 (sil), 8 (Q), 22 (sil), 31 (Ab), 34 (Pi), 39 (Ab)
¤***Rhizocarpon** geminatum* Körb. – 14, 23, 29 (sil)
¤*Rh. geograpicum* (L.) DC. – 26, 28, 29, 31, 36, 39, 42 (sil)
**Rh. macrosporum* Räsänen – 5 (sil)
¤*Rh. subgeminatum* Eitner – 28, 37 (sil)
*¤***Rinodina** immersa* (Körb.) Arnold. – 1, 3, 23 (cal)
**R. septentrionalis* Malme – 1 (Pi)
Staurothele areolata* (Ach.) Lettau – 3 (cal)
Strigula affinis* (A. Massal.) R.C. Harris – 1 (Ca)

*__Thelidium__ *papulare* (Fr.) Arnold – 3 (cal); this species was only recorded before from Trabzon province in Turkey (John & Breuss 2004) and was found in the study area on limestone in damp situations.

*__Toninia__ *cinereovirens* (Schaer.) A. Massal. – 5 (sil)

#*T. pennina* (Schaer.) Gyeln. – 1, 2, 40, 46 (sil)

**T. rosulata* (Anzi) H. Olivier – 3 (ter)

¤*T. sedifolia* (Scop.) Timdal – 3, 44, 47 (ter)

__Usnea__ *filipendula* Stirt. – 1 (Pi)

¤*U. florida* (L.) Weber ex F.H. Wigg. – 10 (Ab), 20 (Pi)

¤*U. hirta* (L.) Weber ex F.H. Wigg. – 6, 9, 11, 24, 32, 47 (Pi)

¤*U. longissima* Ach. – 11, 35 (Pi)

¤*U. rigida* (Ach.) Motyka – 11 (Pi)

¤*U. subfloridana* Stirt. – 12, 22 (Pi)

**__Verrucaria__ *compacta* (A. Massal.) Jatta – 3 (cal)

**¤V. maculiformis* Kremp. – 1, 2, 19, 38 (cal)

¤*V. muralis* Ach. – 1, 2, 22, 43 (cal)

¤__Xanthoparmelia__ *conspersa* (Ehrh ex Ach.) Hale – 15, 19, 25, 46 (sil)

¤*X. mougeotii* (Schaer. ex D. Dietr.) Hale – 38, 32, 35, 45 (sil)

¤*X. mexicana* (Gyeln.) Hale – 28, 30, 41 (sil)

¤*X. pulla* (Ach.) O. Blanco et al. – 15, 17, 23, 25, 35, 36 (sil)

¤*X. stenophylla* (Ach.) Ahti & D. Hawksw. – 23, 25, 36 (sil)

¤__Xanthoria__ *elegans* (Link) Th. Fr. – 7, 28, 34 (cal)

¤*X. parietina* (L.) Th. Fr. – 19 (Pr), 22, 27, 29 (Pi)

**X. polycarpa* (Hoffm.) Rieber – 2 (Q)

**__Zwackhiomyces__ *coepulonus* (Norman) Grube & R. Sant. – 3 (lichenicolous on *Caloplaca lactea*); This fungus seems relatively pathogenic to the host as the ascospore production in the infected parts of the host apothecia are partly suppressed.

**Z. lecanorae* (Stein) Nik. Hoffm. – 1 (lichenicolous on *Aspicilia contorta*); This species is a common lichenicolous fungus on a wide range of crustose lichens on calcareous substrates, including *Aspicilia contorta, Candelariella aurella, Lecanora albescens, L. crenulata, L. dispersa, Lecidella stigmatea,* and *Verrucaria parmigera.* It is easily distinguished from the other species of the genus by its broad and ± urceolate ostiole and simple ascospores (Etayo 1994). The Turkish specimen which is identical in all characters to the original description, was collected on the thallus of *Aspicilia contorta.* It seems to be commensalistic as no demage to the host thallus is observed. It was only recorded from Manisa province in Turkey by Halıcı *et al.* (2007) on *Lobothallia radiosa.*

The list includes 152 taxa including 145 lichenized and seven lichenicolous fungal taxa; all are new records for the study area. Of these, 55 of 100 taxa from the province of Bolu and 107 of 108 taxa from the province of Karabük are reported for the first time from these provinces. Besides, four taxa namely: *Buellia schaereri, Caloplaca cretensis, Lichenoconium pyxidatae,* and *Toninia pennina* are new records for Turkey.

Discussion

The study area possesses both a rich tree diversity and rocky areas and this results in a rich diversity of lichens and associated fungi. When we analyse the substrata on which the lichen species grow, the saxicolous species are the most common in the area accounting for 44 % of the species (21 % on calcareous rocks, 23 % on siliceous rocks). The species on bark and wood of both decidious and evergreen trees are the second most common group of 38 %. Lichenicolous and terricolous species comprise 6 %, and the least common lichens are muscicolous species amounting to 5 %.

The most common saxicolous lichens on calcareous rocks are: *Candelariella aurella* (5 localities), *Aspicilia contorta* subsp. *contorta, Lecanora crenulata, L. dispersa, Protoparmeliopsis muralis, Verrucaria maculiformis,* and *V. muralis* (4 localities), *Arthonia lapidicola, Aspicilia viridescens, Rinodina immersa,* and *Xanthoria elegans* (3 localities). All these species are common and widely distributed in Europe (Purvis *et al*. 1992; Hafellner & Türk 2001). Some lichenicolous lichens and fungi occur on saxicolous lichens on calcareous rocks; such as *Lecidea tesselata* and *Zwackhiomyces lecanorae* on *Aspicilia contorta* and *Zwackhiomyces coepulonus* on the apothecia of *Caloplaca lactea.* The arctic-alpinic species on calcareous rocks, such as *Collema polycarpon, C. undulatum, Farnoldia micropsis, Lecanora crenulata, L. dispersa, Lecidella patavina,* and *Xanthoria elegans,* we mostly collected from higher elevations of the study area.

Siliceous rocks are mostly dominated by: *Rhizocarpon geographicum* (7 localities); *Xanthoparmelia pulla* (6 localities); *Ramalina capitata, Toninia pennina, Xanthoparmelia conspersa, X. mougeotii* (4 localities); *Lobothallia alphoplaca, Pertusaria lactea, Rhizocarpon geminatum, Xanthoparmelia mexicana,* and *X. stenophylla* (3 localities). Some epiphytic species such as *Hypogymnia physodes, H. tubulosa,* and *Lecanora allophana* also occur on siliceous rocks in the study area.

The epiphytic species were collected from a rich diversity of both evergreen (*Abies nordmanniana, Cupressus* sp., *Juniperus* sp., *Pinus* sp.) and deciduous (*Acer* sp., *Carpinus betulus, Populus* sp., *Prunus* sp., *Quercus* sp., *Salix* sp.) trees. The most common species on the bark of evergreen trees are *Pertusaria amara* (13 localities), *Evernia divaricata* (11 localities), *Pseudevernia furfuracea* (10 localities), *Usnea hirta* (6 localities), *Chrysothrix candelaris,* and *Parmelia sulcata* (5 localities). All these species show optimal growth on the acidic bark of evergreen trees (Wirth 1995). Of these species, *Chrysothrix candelaris* has its optimal growth on the dry, shaded sides of rough barked trees such as *Abies* sp. in the study area. The most common epiphytic species on the bark of deciduous trees are *Lobaria pulmonaria* (12 localities), *Hypogymnia tubulosa,* and *Melanohalea exasperatula* (4 localities). Epiphytic species collected both on the bark of evergreen and decidious trees were: *Caloplaca cerina* var. *cerina, Flavoparmelia caperata, Foraminella ambigua, Hypogymnia physodes, H. tubulosa, H. vittata,*

Lecanora carpinea, L. varia, Lecidella elaochroma, Parmelia saxatilis, P. sulcata, Parmelina tiliacaea, Ramalina farinacae, R. fastigiata, R. pollinaria, R. polymorpha, and *Xanthoria parietina. Chaenotheca* species and *Leptogium saturninum* are good indicators of old forests trees, so the presence of these species in the study area shows that there are very old past forests.

Only a few muscicolous species were observed: *Caloplaca tiroliensis, Cladonia fimbriata, Leptogium gelatinosum, Melanohalea elegantula, Peltigera praetextata, Physcia leptalea,* and *Physconia enteroxantha.* Of these species, *Caloplaca tiroliensis* was collected from one of the highest localities at 1140 m. This arctic-alpinic species is known to be resistant to long snow cover (Wirth 1995). Besides, *Diploschistes scruposus* was observed to be lichenicolous on *Cladonia* spp., especially in its young stage. Several species of *Diploschistes* first attack an established lichen, killing the original fungal partner of the lichen, but then proceed to take over the algal partner and build a new structure, often with a different chemistry (Hawksworth 2004).

The common species of *Cladonia, Peltigera,* and *Toninia* in terricolous habitats but it is surprising that an arctic-alpinic terricolous species *Phaeorrhiza nimbosa* was collected in one of the lowest localities in the study area.

In the study area, representative indicator species with an oceanic distribution are *Fuscidea cyathoides, Leptogium saturninum, Lobaria amplissima, Parmelina carporrhizans, Pertusaria lactea, Physconia enteroxantha,* and *Usnea longissima.* A rather rich diversity with some sensitive species and genera like *Anapthychia ciliaris, Bryoria fuscescens, Lobaria, Ramalina,* and *Usnea* species with healthy appearance indicates low immisions of pollutants in the study area.

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