Lichens of the Creux-du-Van nature reserve (Neuchâtel, Switzerland)

LICHENS OF THE CREUX-DU-VAN NATURE RESERVE (NEUCHÂTEL, SWITZERLAND)

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Abstract

The Creux-du-Van nature reserve was created in 1960 to protect a large rocky cirque ca. 1.5 km wide in the Jura mountains in Switzerland. This impressive rock formation comprises a large variety of habitats over small distances that favor a wide diversity of lichen species. We conducted a lichen inventory of the reserve and compiled data from the literature and herbarium collections. We found a total of 167 species, out of which 44 were cited for the first time in the state (canton) of Neuchâtel and two in the Jura region of Switzerland. In addition, 34 species were under threat in the Jura region or in the country as a whole. The beech forests surrounding the cliff harbored the widest diversity of species, while specialized lichen species adapted to specific microhabitats were growing at the bottom of the cliff and on the south-exposed ridge.

Key words: lichenized fungi, floristics, conservation, corticolous, saxicolous, lignicolous, terricolous.

Lichens de la réserve naturelle du Creux-du-Van (Neuchâtel, Suisse)

Résumé

Le cirque du Creux-du-Van est constitué d'une impressionnante formation rocheuse d'environ 1,5 km de large dans les montagnes du Jura suisse. Le site est protégé sous forme de réserve naturelle régionale depuis 1960 et abrite une grande variété d'habitats sur de courtes distances, ce qui favorise une grande diversité de lichens. Un inventaire des lichens de la réserve a été réalisé en parallèle à la compilation des données provenant de la littérature et des collections d'herbiers. Au total, 167 espèces de lichens ont été recensées dans la réserve, dont 44 sont citées pour la première fois dans le canton de Neuchâtel et deux dans la région du Jura suisse, ainsi que 34 espèces possédant un indice de menace dans le Jura ou en Suisse. Les forêts de hêtres aux alentours de la falaise abritent la plus grande diversité d'espèces, tandis qu'un cortège d'espèces spécialisées se rencontre dans les microclimats du pied de la falaise et sur la crête exposée sud.

Mots clés: champignons lichénisés, floristique, conservation, corticole, saxicole, lignicole, terricole.

INTRODUCTION

The Creux-du-Van is a large rocky cirque ca. 1.5 km wide and 150 m high that culminates at 1 476 m in the Jura mountains in Switzerland, in the states (cantons) of Neuchâtel (NE) and Vaud (VD). This impressive rock formation was formed by glacial erosion from a ramification of the Rhone glacier during the Quaternary. Protected by private land since 1876, a regional nature reserve was created in 1960 to preserve the diversity of vegetation types and habitats over small distances. Climax forests dominated by *Fagus sylvatica* and *Abies alba* surround the cliff, while *Pinus sylvestris subsp. mugo* grows on the south-exposed ridge. At the bottom of the cliff, sparse stands of *Acer pseudoplatanus* grow along scree slopes, while dwarf individuals of *Picea abies* extend onto the subalpine acidic moorland.

The wide floristic diversity at the Creux-du-Van has attracted botanists since the 18th century; for example, A. von Haller, who first wrote about the plant flora of Switzerland (Haller 1742). Many studies have been conducted on the diversity of the plants and vegetation of this area (i.e. Moor & Schwarz 1957; Richard 1961, 1972), but little is known about the diversity of the lichens of Creux-du-Van or in the canton of NE (Truong 2013). A checklist of Jurassic lichens by Cornaz (1846–1847) mentions a few species from Creux-du-Van. This checklist represents a synthesis of various publications, especially Schaerer, whose publication of *Lichenes helvetici exsiccati* (1823–1852) was the first work on the lichen flora of Switzerland. Charles Meylan, a school teacher from the small village of St-Croix (VD), studied the lichens of the region and cites a few species from Creux-du-Van in his notes (Meylan 1922, 1925, 1930, 1936). Eduard Frey, another teacher from Bern (BE) and considered to be one of the foremost experts on Swiss lichens (i.e. Frey 1959), also collected a few lichen species from Creux-du-Van.

Knowledge about the lichens of Switzerland remains scattered and unevenly distributed across the country (Clerc 1998), but the last 30 years have been particularly prolific (i.e. Camenzind & Wildi 1991; Dietrich 1991; Burgisser *et al.* 2004; Aptroot & Honegger 2006; Dietrich *et al.* 2008; Vust *et al.* 2009, Truong 2013). The first national inventory of lichens was started in the 1990s and resulted in the Red List of epiphytic and terricolous lichens of Switzerland (Scheidegger & Clerc 2002). Within this framework, randomized survey plots stratified according to biogeographic regions and vegetation belts were created throughout the country (Scheidegger 2002; Vust 2002). These data are compiled in a national database called SwissLichens (Stofer *et al.* 2011), but unfortunately no surveys have yet been conducted in Creux-du-Van. The publication of the lichen checklist of Switzerland (Clerc 2004), now available online (Clerc & Truong 2012), is a compilation of lichen citations in the literature according to biogeographical region, vegetation belt and canton. It constitutes the main reference of the current state of knowledge about the lichens of Switzerland since Stizenberger's (1882–1883) checklist. In this checklist, 350 species are cited for the canton of NE.

The goals of this study were 1) to perform an inventory of the lichens of Creux-du-Van; 2) to estimate the floristic richness for each vegetation type and substrate in order to identify habitats with a wide diversity of lichens for conservation purposes; and 3) to acquire better knowledge about the diversity of lichens in the canton of NE.

MATERIALS AND METHODS

Study site

The Creux-du-Van has a suboceanic climate with abundant precipitation culminating in June. The wide elevation gradient and variety of habitats both favor a wide diversity of plant species and vegetation types (fig. 1). The plant

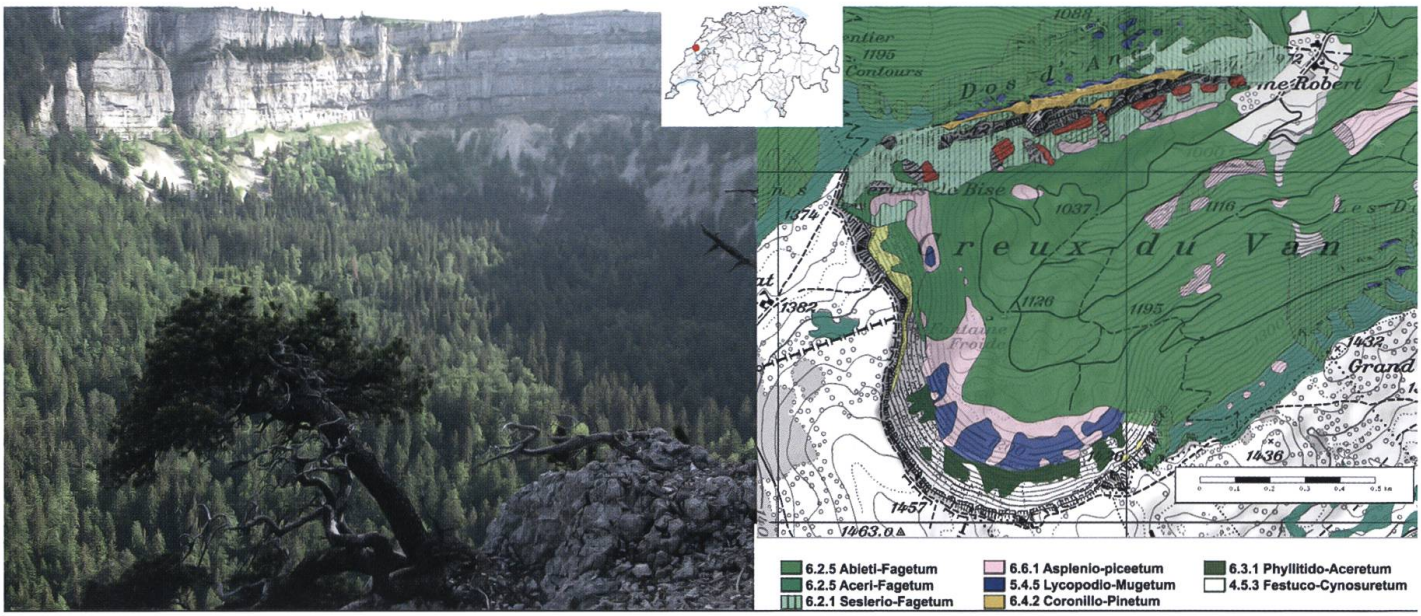

Figure 1. (*left*) View of Creux-du-Van from the northern side of the cliff (Dos d'Ane); (*right*) vegetation map adapted from SITN (2009) with the vegetation types annotated according to DELARZE and GONSETH (2008).

flora is typically Centro-European with plant associations representative of climax montane forests dominated by *Fagus sylvatica* mixed with *Abies alba* at lower elevations and *Acer* spp. above 1 200 m (Association 6.2.5 in DELARZE & GONSETH 2008). The xeric conditions on the south-exposed ridge favor the xero-thermophilous *Fagus* forest (6.2.1) and the stands of *Pinus sylvestris* subsp. *mugo* (6.4.2). At the bottom of the cliff, there is a cold current that generates microclimatic conditions with a permafrost soil that is frozen most of the year. The organic soil horizon is composed of a thick layer of acidic humus, even though the rock material is calcareous. A *Picea abies* forest grows among large rocks (6.6.1), while the open areas closer to the cliff are covered with subalpine acidic moorland colonized by individual dwarf *Picea* (5.4.5). The scree slopes at the very bottom of the cliff are sparsely colonized by individual *Acer pseudoplatanus* (6.3.1). At the cliff summit, low and mid-elevation pastures (4.5.3) have long replaced the native vegetation. The widely diverse vegetation of Creux-du-Van offers numerous microhabitats and substrates for lichen species with specific ecological preferences.

Specimens studied

For two consecutive years (2008-2009), corticolous, lignicolous, terricolous and saxicolous lichens were collected from bark, wood, soil and rocks in the different vegetation types described above. For each collection, the geographical coordinates, elevation, vegetation type, substrate and microhabitat (exposure to the sun and running water) were recorded. Voucher specimens were deposited in the herbarium at the Conservatoire et Jardin botaniques de la Ville de Genève (G), while common species that could be readily identified in the field were recorded as field observations.

Parallel to the collection of fresh material, a historical survey of the literature was conducted, including records from the SwissLichens database (STOFER *et al.* 2011). Specimens

from Creux-du-Van from the herbarium collections at Geneva (G) and the University of Neuchâtel (NEU) were also studied.

Species identification

The morphologies of the specimens were studied using a Leica MS5 stereomicroscope. Preparations of apothecia and spores were observed and measured at 400–1000 × using a Leica DM2000 microscope. When necessary (especially for sterile crustose lichens), thin layer chromatography (TLC) analyses were carried out according to Culberson & Ammann (1979) with solvent B modified following Culberson & Johnson (1982). The species identifications were conducted according to the reference literature from neighboring countries (Poelt & Vezda 1977, 1981; Smith *et al.* 2009; Wirth 1995; Nimis & Martellos 2004). The nomenclature follows Clerc & Truong's (2012) checklist with nomenclatural updates from Clerc that will be published in a new version of the checklist.

RESULTS AND DISCUSSION

Lichen diversity

We inventoried a total of 167 lichen species (tab. 1) representing almost 10% of the lichen diversity in the country. Illustrations of notable lichens of the Creux-du-Van are also presented. Forty-four species are new for the canton of NE, taking the number of lichen species recorded in the canton from 350 to 394. When comparing the diversity of lichen species per km^2 in each canton, the additional data here yield an average diversity of lichen species for NE compared to the rest of the country (fig. 2). The wide diversity of habitats in Creux-du-Van, therefore, contributes significantly to the diversity of lichen species in the canton of NE.

Few lichen species are mentioned in the literature for the canton of NE in the works of Cornaz (1846–1847), Meylan (1922, 1925, 1930, 1936) and Richard (1961). We found 18 records of lichen species from Creux-du-Van in the literature, out of which seven species were also found in the herbarium or/and during the inventory (tab. 1). The remaining 11 species were recorded solely in the literature, with no available specimens to confirm their identification (tab. 2). The nomenclatural and taxonomic concept of these species has changed considerably since their publication, making the identity of the species hiding behind these names difficult to assess with no available specimens to study. Therefore, we considered these species to be potential records without including them in the final list of species. Further work is needed to confirm these species' presence in Creux-du-Van.

We found 27 of the species that were collected in Creux-du-Van by E. Frey and deposited in the lichen collections of G, out of which five were not encountered again during our inventory (tab. 1): *Acolium karelicum, Calicium viride*, *Cladonia fimbriata*, *C. subulata* and *Mycoblastus sanguinarius*, the latter two being endangered in the Jura according to Scheidegger & Clerc (2002). Our inventory is far from exhaustive and these rare species are not necessarily extinct in the area, as the localities indicated on the labels of the voucher specimens from Creux-du-Van were imprecise.

With a large variety of suitable habitats for lichens and the absence of large human agglomerations, the diversity of lichens in the canton of NE is potentially much wider than is currently known. An inventory of the lichens in the city of Neuchâtel listed 80 species, out of which 23 were new for the canton of NE (Truong 2013). Both studies illustrate the scarcity of lichen studies in the canton of NE and the need for further investigation in the region.

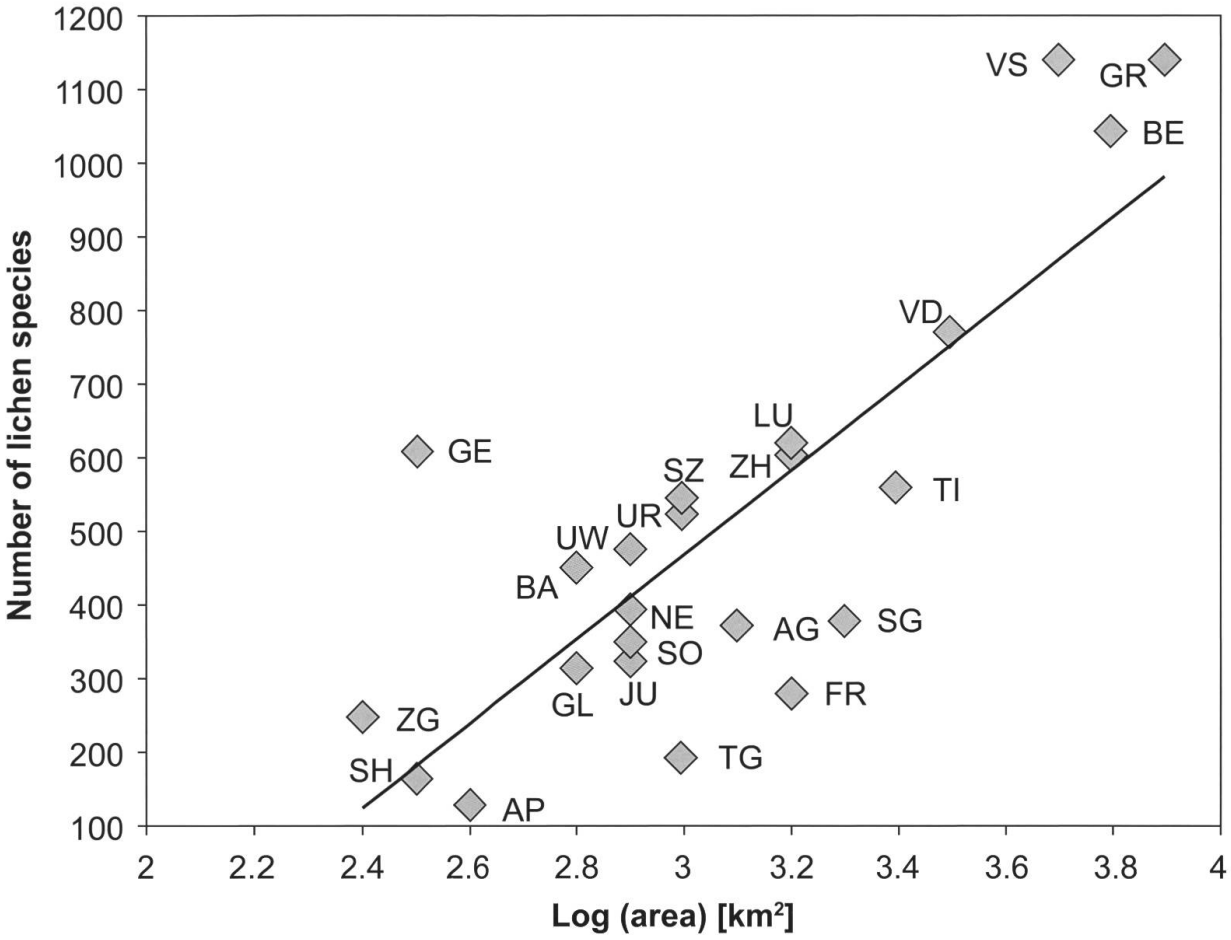

Figure 2. Number of lichen species per area (km²) for each Swiss canton: AP=Appenzell, AG=Aargau, BA=Basel, BE=Bern, FR=Fribourg, GE=Geneva, GL=Glarus, GR=Graubünden, JU=Jura, LU=Luzern, NE=Neuchâtel, SH=Schaffhausen, SG=St. Gallen, SO=Solothurn, SZ=Schwyz, TG=Thurgau, TI=Ticino, UR=Uri, UW= Unterwald, VD=Vaud, VS=Valais, ZG=Zug, ZH=Zürich (graphic adapted from CLERC & TRUONG 2012).

Habitat and ecology

More than 50% of the species were only found in one vegetation type (fig. 3), thus illustrating the adaptation of many lichen species to specific microhabitats. Corticolous species that occurred several times in various forest types included *Buellia disciformis*, *B. griseovirens*, *Cladonia furcata*, *Hypogymnia farinacea, H. tubulosa*, *Lecanora argentata*, *L. chlarotera*, *L. circumborealis, L. intumescens, Lecidella elaeochroma*, *Lepraria eburnea*, *Pertusaria coronata*, *Phlyctis argena*, *Placynthiella icmalea* and *Ropalospora viridis*. Saxicolous species growing on the calcareous substrate throughout the nature reserve included *Bagliettoa steineri*, *Farnoldia jurana*, *Lathagrium fuscovirens*, *Leproplaca cirrochroa*, *Polyblastia cupularis*, *Protoblastenia calva*, *P. incrustans*, *Sagiolechia protuberans* and *Scytinium lichenoides* (*sensu stricto*, OTALORA *et al.* 2008). The common species *Cladonia pyxidata*, *Hypogymnia physodes*, *Mycoblastus fucatus*, *Parmelia sulcata* and *Pseudevernia furfuracea* were found frequently in almost every type of vegetation that we visited.

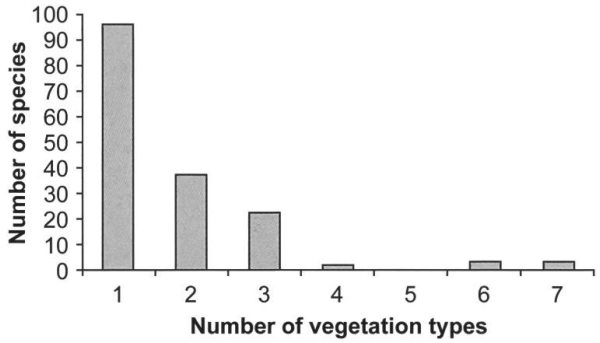

Figure 3. Number of vegetation types where each species was found.

We found lichen species growing on four different types of substrate, i.e. bark, wood, soil and rock (fig. 4A). A small majority of the species were corticolous (39%) and grew on the bark of a wide variety of tree species in the nature reserve (fig. 5A). The widest diversity of species was found in the climax montane forest (6.2.5 *Aceri-* and *Abieti-Fagetum*, fig. 4C), which provided a habitat for many corticolous species and for a large percentage of the lignicolous species and saxicolous taxa growing on calcareous substrates (fig. 5A). These results reflect the good health of the forest in the nature reserve, with a wide range of tree age classes and dead wood left in place on the forest floor. These characteristics are essential for the development and maintenance of a rich diversity of lichens (SCHEIDEGGER & CLERC 2002). For example, the presence of old growth forest stands, as well as a forest management that preserves a wide diversity of microhabitats (stumps and fallen trunks left on the forest floor), favored

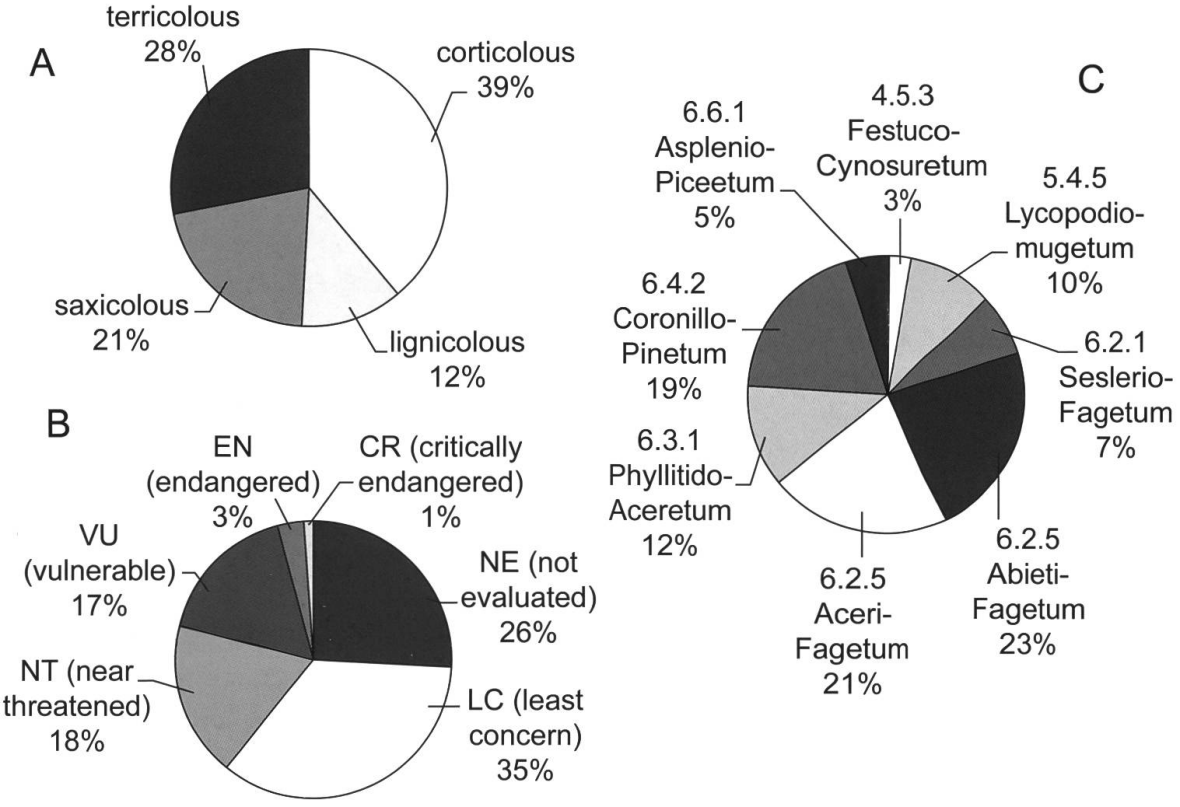

Figure 4. Percentage of species found (A) on each substrate; (B) per the Red List criteria in the Jura according to SCHEIDEGGER & CLERC (2002) and (C) in each vegetation type according to DELARZE and GONSETH (2008).

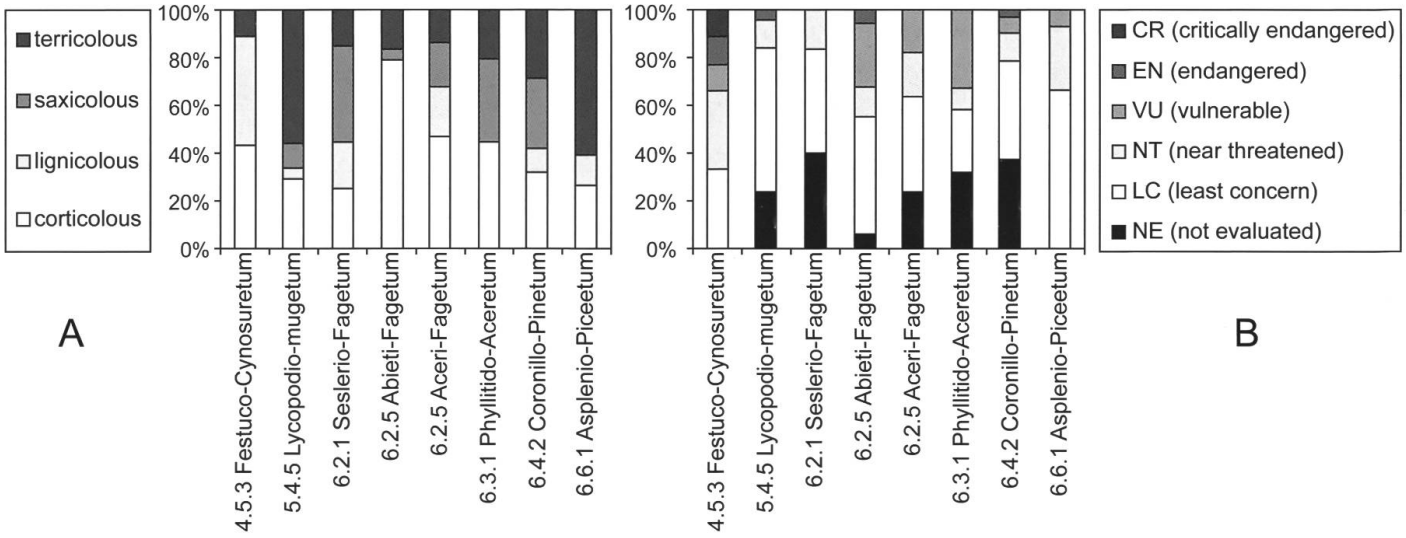

Figure 5. Percentage of species found (A) on each substrate and (B) per the Red List criteria in the Jura according to SCHEIDEGGER & CLERC (2002).

a relatively wide diversity of lignicolous species (12%, fig. 4A) in the nature reserve.

A large percentage of the species were saxicolous (21%, fig. 4A) and represented 21 out of the 44 new species records for the canton of NE. These results reflect our lack of knowledge about the saxicolous lichen flora, as saxicolous species were not assessed in the Red List of lichens of Switzerland (SCHEIDEGGER & CLERC 2002). In Creux-du-Van, saxicolous species were growing in almost every type of vegetation (fig. 5A) and were particularly abundant in the south-exposed xero-thermophilous sites along the ridge (6.2.1 and 6.4.2) and on the scree slopes at the bottom of the cliff (6.3.1). The xeric conditions and open vegetation along the ridge favored the development of unique saxicolous species such as *Enchylium polycarpon*, *Squamarina gypsacea* and *Verrucaria nigrescens*, as well as terricolous species growing in rock anfractuosities (i.e. *Thalloidima sedifolium* and *Toniniopsis aromatica*). On the scree slopes, saxicolous species such as *Dermatocarpon miniatum*, *Polyblastia albida* and *Thelidium papulare* had colonized the mobile rocks, while corticolous species were growing on the bark of *Acer pseudoplatanus*, including various threatened species: a very large population of *Lobaria pulmonaria*, as well as *Blastenia herbidella*, *Collema nigrescens*, *Leptogium saturninum*, *Nephroma resupinatum*, *Peltigera collina* and *Thelotrema lepadinum*. All these species were assessed as being vulnerable in the Jura region in the Red List of lichens of Switzerland (SCHEIDEGGER & CLERC 2002, fig. 5B).

Terricolous species represented 28% of the total number of species (fig. 4A) and were particularly abundant in the *Picea* forest (6.6.1) and in the subalpine acidic moorland (5.4.5) at the bottom of the cliff (fig. 5A). In these habitats, the high levels of humidity and the dense moss cover on the forest floor favored the development of terricolous species such as *Cladonia* spp. and *Peltigera neopolydactyla*. On the open acidic moorland, we found several species typical of alpine regions, i.e. *Cetraria islandica*, *Cladonia arbuscula*, *C. rangiferina* and *Protopannaria pezizoides*. As terricolous species were assessed

in the Red List of lichens of Switzerland for the entire country and not according to biogeographical region (SCHEIDEGGER & CLERC 2002), it would be interesting to investigate further whether these terricolous species are under threat in the Jura region.

In the pastures at the top of the cliff, plant competition and cattle grazing are not favorable for lichen growth. Few species were found in protected microhabitats, i.e. on mosses or on the barks of small trees and bushes. Several threatened species were found in this habitat such as *Thelenella muscorum* (critically endangered in Switzerland) or *Varicellaria hemisphaerica* (endangered in the Jura).

New and interesting species

Two species are cited here for the first time in the Jura mountains in Switzerland:

Protoblastenia siebenhaariana (photo 26) has a superficial (not immersed) and distinctly areolated thallus. Apothecia (0.5–1.5 mm) are moderately convex with an orange-brown tinge reacting K+ red-purple. Preparations of apothecia revealed an orange-brown hypothecium with spores 8–10 × 4–6 µm in size. This rare arctic-alpine species was previously known in Switzerland in the northern and central Alps. In Italy, it is a rare species in subalpine and montane regions (NIMIS & MARTELLOS 2008). In Creux-du-Van, we found it at 1 400 m on a vertical calcareous cliff inside the forest. This species resembles *Protoblastenia rupestris*, which is more common and was also found on the site. The latter differs in its smaller (0.3–0.9 mm) and more pronouncedly convex apothecia, its colorless to yellowish hypothecium and larger spores (8–17 × 5–8 µm). Detailed descriptions and illustrations can be found in SMITH *et al.* (2009) and WIRTH *et al.* (2013).

Cladonia norvegica (photo 6) has a grayish-green thallus without a yellow tone (usnic acid is absent from the cortex) and almost entirely sorediose podetia with brownish apothecia. This species can be readily identified by the presence of barbatic acid detected by TLC in the medulla. Detailed descriptions and illustrations can be found in TØNSBERG & HOLIEN (2008) and AHTI *et al.* (2013). This rare but probably overlooked species was previously only known in central Switzerland. It is a temperate to boreal species that grows on dead wood and in acidic soil in humid and shaded habitats. In Creux-du-Van, we found it on acidic humus in the subalpine moorland and at the base of a stump inside the *Picea* forest.

We also found a species from the *Scytinium plicatile* group that had colonized a rock on the scree slopes at the bottom of the cliff. This alpine morph of *S. plicatile* has elongated and almost cylindrical lobes that are erect in the central part of the thallus and adnate towards the edges. The lobes are covered with globose isidia. The thin and eroded upper cortex, thick algal layer and anatomical characters are otherwise similar to *S. plicatile* s.str. Detailed studies of the morphological variation of the *S. plicatile* complex are necessary (JØRGENSEN 1994, JØRGENSEN pers. comm.) to establish whether this specimen represents a new, currently undescribed species.

CONCLUSIONS

We found a wide diversity of lichen species with a total of 167 species recorded in the Creux-du-Van nature reserve. The widest diversity of species was found in the climax montane forests surrounding the cliff, with a majority of corticolous species and a good proportion of lignicolous species. Saxicolous and terricolous lichen species adapted to specific microhabitats were most abundant at the bottom of the cliff and on the south-exposed ridge. In total, 21% of the species are under threat in the Jura or nationwide according to the Red List of lichens of Switzerland (SCHEIDEGGER & CLERC 2002). Considering that saxicolous species (26%) were not evaluated in the Red List, these results indicate that many threatened lichen species are growing within the

nature reserve. With a wide diversity of micro-habitats, the presence of old-growth forest and sustainable forest management, Creux-du-Van offers habitat and protection for a wide diversity of lichens.

ACKNOWLEDGMENTS

The Office de la conservation de la nature du canton de Neuchâtel provided collection permits for the nature reserve. Mathias Vust and Jean-Claude Mermillod participated in the field collections, helped with identifying the lichens and provided photographs of some of the species. Per M. Jørgensen confirmed the identifications of the specimens from the Scytinium plicatile group. The Conservatoire et Jardin botaniques de la Ville de Genève provided the necessary infrastructure for the specimen identification (microscopy and TLC).

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Table 1. List of the 167 lichen species recorded in the Creux-du-Van nature reserve. The Red List indices are indicated for the Jura region (in italics for Switzerland) according to SCHEIDEGGER & CLERC (2002): LC (least concerned), NT (near threatened), VU (vulnerable), EN (endangered), CR (critically endangered) and NE (not evaluated); * = new record for the canton of NE, ** = new record for the Jura chain in Switzerland according to CLERC & TRUONG 2012; S = data from the SwissLichens database (STOFER *et al.* 2011); H = herbarium specimen (in G) found again during the inventory (in italics = not found again during the inventory); L = data from the literature for which a specimen was available to confirm the species identification. N.B. Species records that come solely from the literature (no specimens available) are listed in Table 2.

NE	*	*Acarospora glaucocarpa* (Ach.) Körb.	*NT*	*L*	*Cladonia cenotea* (Ach.) Schaer.
EN	*H*	*Acolium karelicum* (Vain.) M.Prieto & Wedin	*LC*		*Cladonia chlorophaea* (Sommerf.) Spreng.
VU		*Alyxoria varia* (Pers.) Ertz & Tehler	*LC*	*H*	*Cladonia coccifera* (L.) Willd.
VU		*Anaptychia ciliaris* (L.) A.Massal.	*LC*	*	*Cladonia coniocraea* (Flörke) Spreng.
LC		*Arthonia radiata* (Pers.) Ach.	*LC*	*H*	*Cladonia crispata* (Ach.) Flot.
LC		*Baeomyces rufus* (Huds.) Rebe.	*LC*	*HL*	*Cladonia deformis* (L.) Hoffm.
NE	*	*Bagliettoa steineri* (Kusan) Vezda	*NT*		*Cladonia digitata* (L.) Hoffm.
VU		*Biatora globulosa* (Flörke) Fr.	*NT*	*H*	*Cladonia fimbriata* (L.) Fr.
VU		*Biatoridium monasteriense* G.Lahm ex Körb.	*LC*	*HL*	*Cladonia furcata* (Huds.) Schrad.
NT		*Bilimbia sabuletorum* (Schreb.) Arnold	*LC*		*Cladonia macilenta* Hoffm.
VU		*Blastenia herbidella* (Hue) Servit	*LC*	*H*	*Cladonia macroceras* (Delise) Hav.
LC		*Blennothallia crispa* (Huds.) Otalora et al.	*NE*	**	*Cladonia norvegica* Tønsberg & Holien
LC		*Bryobilimbia hypnorum* (Lib.) Fryday et al.	*LC*		*Cladonia pocillum* (Ach.) Grognot
VU		*Bryoria capillaris* (Ach.) Brodo & D. Hawksw.	*LC*	*HL*	*Cladonia pyxidata* (L.) Hoffm.
NT		*Bryoria* cf. *fuscescens* (Gyeln.) Brodo & D.Hawksw.	*LC*	*HL*	*Cladonia rangiferina* (L.) F.H.Wigg.
VU	*	*Buellia disciformis* (Fr.) Mune	*NT*	*HL*	*Cladonia squamosa* Hoffm.
LC		*Buellia griseovirens* (Sm.) Almb.	*LC*	*H*	*Cladonia subulata* (L.) F.H.Wigg.
NT	*	*Calicium abietinum* Pers.	*LC*		*Cladonia sulphurina* (Michx.) Fr.
NT	*	*Calicium glaucellum* Ach.	*LC*	*H*	*Cladonia symphycarpa* (Flörke) Fr.
NT	*H*	*Calicium viride* Pers.	*NE*	*	*Clauzadea monticola* (Schaer.) Hafellner & Bellem.
VU		*Candelaria concolor* (Dicks) Stein	*NT*		*Collema flaccidum* (Ach.) Ach.
LC		*Candelariella reflexa* (Nyl.) Lettau	*VU*		*Collema nigrescens* (Huds.) DC.
LC	*H*	*Cetraria islandica* (L.) Ach.	*NE*		*Dermatocarpon miniatum* (L.) W.Mann
EN	*	*Cetraria pinastri* (Scop.) Gray	*NE*		*Enchylium polycarpon* (Hoffm.) Otalora et al.
VU		*Chaenotheca brunneola* (Ach.) Müll.Arg.	*LC*		*Evernia prunastri* (L.) Ach.
LC		*Chaenotheca chrysocephala* (Ach.) Th.Fr.	*NE*		*Farnoldia hypocrita* (A.Massal.) Fröberg
NT		*Chaenotheca furfuracea* (L.) Tibell	*NE*		*Farnoldia jurana* (Schaer.) Hertel
VU		*Chrysothrix candelaris* (L.) J.R.Laundon	*NE*		*Flavoplaca citrina* (Hoffm.) Arup et al.
LC	*HL*	*Cladonia arbuscula* (Wallr.) Flot.	*LC*		*Graphis scripta* (L.) Ach.

NE	*	*Gyalecta jenensis* (Batsch.) Zahlbr.	*NT*	*	*Normandina pulchella* (Borrer) Nyl.
VU	*	*Haematomma ochroleucum* (Neck.) J.R.Laundon	*NT*		*Ochrolechia androgyna* (Hoffm.) Arnold
NE	*	*Hymenelia epulotica* (Ach.) Lutzoni	*NE*	*	*Opegrapha dolomitica* (Arnold) Körb.
NE		*Hymenelia melanocarpa* (Kremp.) Arnold	*NE*	*	*Parabagliettoa dufourii* (DC.) Gueidan & Cl. Roux
LC		*Hypogymnia farinacea* Zopf	*NT*		*Parmelia saxatilis* (L.) Ach.
LC		*Hypogymnia physodes* (L.) Nyl.	*VU*		*Parmelia submontana* Hale
LC		*Hypogymnia tubulosa* (Schar.) Hav.	*LC*		*Parmelia sulcata* Taylor
NE	*H*	*Icmadophila ericetorum* (L.) Zahlbr.	*VU*	*H*	*Parmeliella triptophylla* (Ach.) Müll.Arg.
NT		*Imshaugia aleurites* (Ach.) S.L.F.Meyer	*VU*		*Parmelina pastillifera* (Harm.) Hale
LC	*H*	*Lathagrium auriforme* (With.) Otalora et al.	*LC*		*Parmeliopsis ambigua* (Wulfen) Nyl.
NE		*Lathagrium fuscovirens* (With.) Otalora et al.	*VU*	*H*	*Peltigera collina* (Ach.) Schrad.
LC		*Lecanora argentata* (Ach.) Malme	*NT*		*Peltigera horizontalis* (Huds.) Baumg.
VU	*	*Lecanora barkmaniana* Aptroot & van Herk	*LC*	* *H*	*Peltigera leucophlebia* (Nyl.) Gyeln.
LC		*Lecanora carpinea* (L.) Vain.	*LC*	*	*Peltigera neopolydactyla* (Gyeln.) Gyeln.
LC		*Lecanora chlarotera* Nyl.	*LC*		*Peltigera polydactylon* (Neck.) Hoffm.
NT		*Lecanora circumborealis* Brodo & Vitik.	*LC*	*H*	*Peltigera praetextata* (Sommerf.) Zopf
VU	*	*Lecanora expallens* Ach.	*LC*		*Peltigera rufescens* (Weiss) Humb.
VU	*	*Lecanora horiza* (Ach.) Linds.	*LC*	*S*	*Peltigera venosa* (L.) Hoffm.
VU	*H*	*Lecanora intumescens* (Rebe.) Rabenh.	*VU*		*Pertusaria coronata* (Ach.) Th.Fr.
NE	*	*Lecanora rouxii* S.Ekman & Tønsberg	*VU*		*Pertusaria leioplaca* DC.
LC		*Lecidella elaeochroma* (Ach.) M.Choisy	*NT*		*Pertusaria pupillaris* (Nyl.) Th.Fr.
LC		*Lepra amara* (Ach.) Hafellner	*NE*		*Petractis clausa* (Hoffm.) Kremp.
NT		*Lepraria eburnea* J.R.Laundon	*LC*		*Phaeophyscia endophoenicea* (Harm.) Moberg
NT		*Lepraria jackii* Tønsberg	*LC*		*Phlyctis argena* (Spreng.) Flot.
LC		*Lepraria finkii* (B. de Lesd.) R.C Harris	*LC*		*Physcia adscendens* (Fr.) H.Olivier
NE		*Lepraria nivalis* J.R.Laundon	*LC*		*Physconia distorta* (With.) J.R.Laundon
LC		*Lepraria rigidula* (B. de Lesd.) Tønsberg	*NE*		*Placidium squamulosum* (Ach.) Breuss
NE	*	*Leproplaca chrysodeta* (Vain. ex Räsänen) J.R. Laundon	*NT*		*Placynthiella icmalea* (Ach.) Coppins & P.James
NE		*Leproplaca cirrochroa* (Ach.) Arup et al.	*NE*	*	*Placynthium nigrum* (Huds.) Gray
LC		*Lepraria vouauxii* (Hue) R.C.Harris	*NT*		*Platismatia glauca* (L.) W.L.Culb. & C.F.Culb.
VU	*	*Leptogium saturninum* (Dicks.) Nyl.	*NE*		*Pleurosticta acetabulum* (Neck.) Elix & Lumbsch
VU	*H*	*Lobaria pulmonaria* (L.) Hoffm.	*NE*	*	*Polyblastia albida* Arnold
VU		*Loxospora elatina* (Ach.) A.Massal	*NE*	*	*Polyblastia cupularis* A.Massal.
LC		*Melanelixia fuliginosa* (Duby) O.Blanco et al.	*NT*		*Polycauliona candelaria* (L.) Frödén et al.
NE	*	*Micarea lignaria* (Ach.) Hedl.	*NE*		*Protoblastenia calva* (Dicks.) Zahlbr.
NE	*	*Myriolecis dispersa* s.l. (Pers.) Sliwa et al.	*NE*	*	*Protoblastenia incrustans* (DC.) J.Steiner
EN	*H	*Mycoblastus sanguinarius* (L.) Norman	*NE*		*Protoblastenia rupestris* (Scop.) J.Steiner
VU		*Nephroma resupinatum* (L.) Ach.	*NE*	**	*Protoblastenia siebenhaariana* (Körb.) J.Steiner

LC	* *H*	*Protopannaria pezizoides* (Weber) M.Jørg. & S.Ekman	*LC*		*Thalloidima sedifolium* (Scop.) Kistenich et al.
LC		*Pseudevernia furfuracea* (L.) Zopf	*CR*	*	*Thelenella muscorum* (Fr.) Vain.
NE	*	*Pseudoleptogium diffractum* (Körb.) Müll. Arg.	*NE*		*Thelidium papulare* (Fr.) Arnold
NT	*	*Pycnora sorophora* (Vain.) Hafellner	*NE*	*	*Thelidium pyrenophorum* (Ach.) Mudd.
LC		*Ramalina farinacea* (L.) Ach.	*VU*		*Thelotrema lepadinum* (Ach.) Ach.
VU		*Ramalina fraxinea* (L.) Ach.	*NE*	*	*Toniniopsis aromatica* (Sm.) Kistenich et al.
NT		*Romjularia lurida* (Ach.) Timdal	*NT*	*H*	*Trapeliopsis flexuosa* (Fr.) Coppins & P.James
VU		*Ropalospora viridis* (Tønsberg) Tønsberg	*LC*	*	*Trapeliopsis gelatinosa* (Flörke) Coppins & P.James
NE	*	*Sagiolechia protuberans* (Ach.) A.Massal.	*LC*	* *H*	*Trapeliopsis pseudogranulosa* Coppins & P.James
LC		*Scytinium gelatinosum* (With.) Otalora et al.	*EN*		*Usnea intermedia* (A.Massal.) Jatta
LC		*Scytinium lichenoides* (L.) Otalora et al.	*EN*	*	*Varicellaria hemisphaerica* (Flörke) I. Schmitt & Lumbsch
NE		*Scytinium plicatile* (Ach.) Otalora et al.	*NE*	*	*Variospora flavescens* (Huds.) Arup et al.
NE		*Scytinium* sp. (plicatile group)	*NE*		*Verrucaria nigrescens* Pers.
LC		*Solorina saccata* (L.) Ach.	*NE*		*Violella fucata* (Stirt.) T.Sprib.
NE		*Squamarina gypsacea* (Sm.) Poelt	*LC*		*Xanthoria parietina* (L.) Th.Fr.
NT		*Tephromela atra* (Huds.) Hafellner	*NE*	*	*Xylographa parallela* (Ach.: Fr.) Behlen & Desberger
NE	*	*Thalloidima diffractum* (A.Massal.) A.Massal.			

Table 2. Lichen species recorded in the Creux-du-Van nature reserve solely from the literature and for which no specimens were available to confirm their identification.

SPECIES	SOURCE			
	CORNAZ (1846–1847)	MEYLAN (1922)	MEYLAN (1925)	MEYLAN (1936)
Bilimbia tetramera De Not.		*x*		
Bryoria bicolor (Hoffm.) Brodo & D. Hawksw.				*x*
Cladonia gracilis subsp. *turbinata* (Ach.) Ahti	*x*			
Cladonia mitis Sandst.				*x*
Cladonia stellaris (Opiz) Pouzar & Vezda			*x*	
Lecanora reuteri Schaer.			*x*	
Parmotrema perlatum (Huds.) M. Choisy			*x*	
Peltigera aphthosa (L.) Willd.	*x*			
Psora testacea Hoffm.	*x*			
Ramalina fastigiata (Pers.) Ach.	*x*			
Staurothele clopima (Wahlenb.) Th. Fr.			*x*	

Photo 1. *Acarospora glaucocarpa*.
© Jean-Claude Mermilliod.

Photo 2. *Anaptychia ciliaris*.
© Camille Truong.

Photo 3. *Chaenotheca chrysocephala*.
© Jean-Claude Mermilliod.

Photo 4. *Chaenotheca furfuracea*.
© Jean-Claude Mermilliod.

Photo 5. *Cladonia macroceras*.
© Camille Truong.

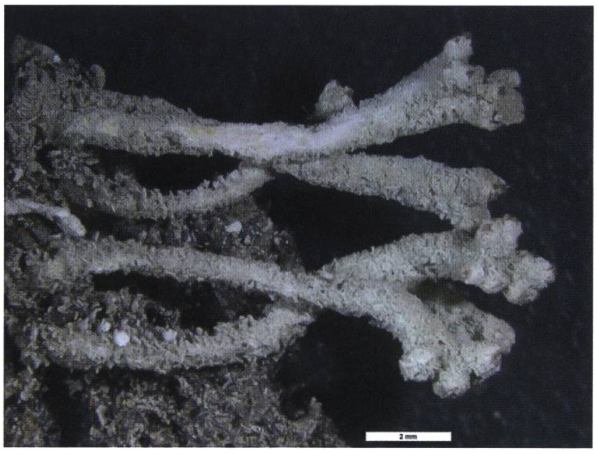

Photo 6. *Cladonia norvegica*.
© Philippe Clerc.

Photo 7. *Cladonia rangiferina*.
© Camille Truong.

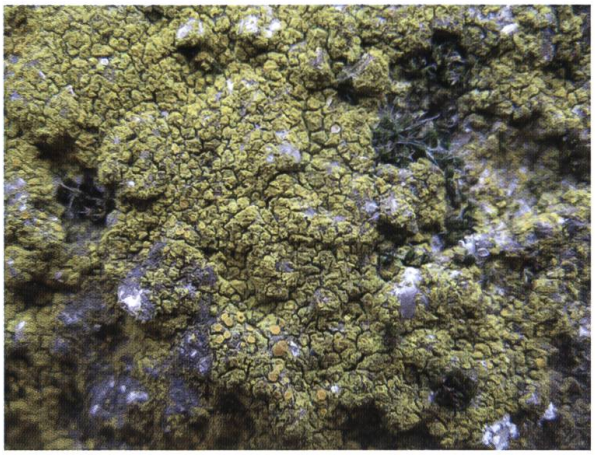

Photo 8. *Flavoplaca citrina*.
© Camille Truong.

Photo 9. *Graphis scripta*.
© Jean-Claude Mermilliod.

Photo 10. *Gyalecta jenensis*.
© Camille Truong.

Photo 11. *Hymenelia epulotica*.
© Jean-Claude Mermilliod.

Photo 12. *Icmadophila ericetorum*.
© Jean-Claude Mermilliod.

Photo 13. *Imshaugia aleurites*.
© Jean-Claude Mermilliod.

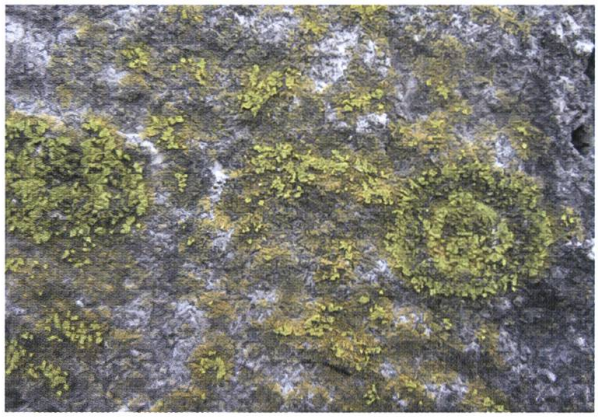

Photo 14. *Leproplaca cirrochoa*.
© Camille Truong.

Photo 15. *Leptogium saturninum*.
© Camille Truong.

Photo 16. *Lobaria pulmonaria*.
© Camille Truong.

Photo 17. *Nephroma resupinum*.
© Camille Truong.

Photo 18. *Protopannaria pezizoides*.
© Camille Truong.

Photo 19. *Parmeliella triptophylla*.
© Camille Truong.

Photo 20. *Peltigera horizontalis*.
© Camille Truong.

Photo 21. *Peltigera leucophlebia*.
© Camille Truong.

Photo 22. *Peltigera praetextata*.
© Camille Truong.

Photo 23. *Physconia distorta*.
© Jean-Claude Mermilliod.

Photo 24. *Placythium nigrum*.
© Camille Truong.

Photo 25. *Protoblastenia calva*.
© Jean-Claude Mermilliod.

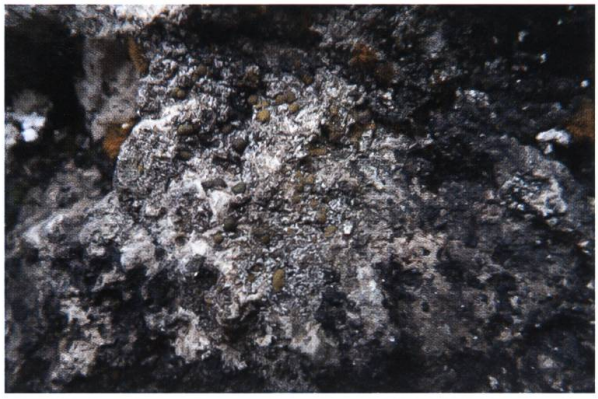

Photo 26. *Protoblastenia siebenhaariana*.
© Mathias Vust.

Photo 27. *Sagiolechia protuberans*.
© Jean-Claude Mermilliod.

Photo 28. *Scytinium lichenoides*.
© Camille Truong.

Photo 29. *Scytinium* (sp., plicatile group).
© Camille Truong.

Photo 30. *Scytinium* (sp., plicatile group).
© Jean-Claude Mermilliod.

Photo 31. *Solorina sacata*.
© Camille Truong.

Photo 32. *Squamarina gypsacea*.
© Jean-Claude Mermilliod.

Photo 33. *Thalloidima diffractum*.
© Jean-Claude Mermilliod.

Photo 34. *Thelidium pyrenophorum*.
© Jean-Claude Mermilliod.

Photo 35. *Toniniopsis aromatica*.
© Jean-Claude Mermilliod.

Photo 36. *Variospora flavescens*.
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