Guide to Bryological hot spots in Europe 6. Ticino in Switzerland

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Abstract: The location of Ticino in the southern Alps with an altitudinal range from 200 to more than 3000 m generates a high biodiversity of bryophytes, however, in addition, a mixture of mediterranean elements (caused by mild temperatures), atlantic elements (caused by high precipitation) and especially insubrian elements (confined to the Southern Alps) has attracted many famous bryologists over the past 150 years and make this region to a real bryological hot spot. Six of the 7 insubrian species are mainly distributed in North America. Their presence in the Southern Alps is correlated with a certain geological formation and their origin is not clear.

Zusammenfassung: Die Lage des Tessins in den südlichen Alpen mit Höhenlagen von 200 bis über 3000 m führt allein schon zu einer hohen Biodiversität. In niederen Lagen gibt es eine Mischung aus mediterranen Elementen (hervorgerufen durch milde Temperaturen), atlantische Elemente (hervorgerufen durch hohe Niederschläge) und insubrische Elemente (die auf die Südalpen beschränkt sind), die seit 150 Jahren viele berühmte Bryologen angezogen hat und diese Gegend zu einer wahren bryologischen Sehenswürdigkeit machen. Von den sieben insubrischen Arten kommen sechs hauptsächlich in Nordamerika vor. Ihre Vorkommen in den Südalpen ist mit einer bestimmten geologischen Formation verbunden, ihre Herkunft völlig ungeklärt.

The Ticino (Tessin) is situated along the southern slopes of the Alps in Switzerland. The lowest part is at the level of the lakes Lugano and Maggiore in 200-250 m altitude, the highest parts are in more than 3000 m. This altitudinal range results in an enormous biodiversity and has attracted many famous bryologists, not only Swiss (Jäggli, Marti, Culmann), Italian (Bottini, Daldini, Venturi, De Notaris, Cesati) but also others such as Röll, Kindberg, Schimper, Holler, Pfeffer, Loeske, Le Roy Andrews, Gams, Barkman etc. Interestingly, the bryological exploration was started in the midth of the 19. century by Italians, since the region was easier accessible from the south. First the opening of the railway tunnel through the Gotthard in 1882 allowed more bryologists from the north to visit Ticino.

The region is favoured by the mild climate caused by the lakes, which results in a sub-mediterranean flora. The annual temperature is in average 11°-12° (fig. 4) and thus so mild, that certain species of banana are cultivated and palms (Washingtonia spp.) are not only grown in gardens but are widely naturalized, however, it is not free of frost during the winter months. At the same time, the precipitation at lake level is about 1800 mm, an unusual combination of high

Fig.1: View from Morcote, S of Lugano in November. In the background quite dry extended oak – chestnut forest with deep, less explored and not easily accessible ravines.

temperature and high precipitation, which explains the occurrence of Atlantic as well as Mediterranean species.
And at least the lower parts of the Southern Alps harbour a special (insubrian) bryoflora with species confined in Europe to this region.
A great advantage of the Ticino is the presence of a bryoflora (Jäggli 1950), which provides an easy overlook of species, localities and collectors.
According to Rikli (1943-1948), 85% of the flora of Ticino is boreo-alpine, which seems also to be the case for bryophyte species. The rare and interesting bryophyte species, belong to the Mediterranean, atlantic and insubrian element.

Mediterranean species
Fissidens rivularis
Octodiceras julianum
Fabronia ciliaris
Fabronia pusilla
Habrodon perpusillus
Leptodon smithii
Epipterygium tozeri
Scorpiurium circinatum

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Fig. 2: The monastry Madonna del Sasso above Locarno. The bottom of the rocks below the church (in the dark) are known for Harpalejeunea ovata and Plagiochila exigua.

Timmiella barbuloides
Campylopus pilifer
Corsinia coriandrina
Riccia bischofii
Riccia croszalsii
Riccia nigrella
Targionia hypophylla
Plagiochasma rupestre
Mannia androgyna
Marchantia paleacea

In general, all these species are rarely found and do not contribute to the aspect of the bryoflora. It is conpicuous that some typical and elsewhere also frequent mediterranean species such as Scleropodium illecebrum are not found in Ticino, which seems to support chance as factor for dispersal and an argument for a colonization from the Mediterranean during the Holocene. Scorpiurium circinatum was only three times found since 1995 and Plagiochasma rupestre has only recently been found in 2008, which may be a result of climate change, although the climatic data seem not to have changed much in the past. Jäggli (1950) indicates for the time before 1950 1875 mm precipitation and 11,6° C median annual temperature. In 2012, the precipitation was 1742 mm and the median annual temperature 11,7°C (source internet).
The origin of the Mediterranean flora in Ticino was discussed by Rikli (1943-1948), who favoured the hypothesis that it is a remnant from the time when the plain of river Po was part of the

mediterranean Sea and the Mediterranean flora reached around the present plain. However, the Po plain was filled up during the Pleistocene (Ghielmi et al. 2013), that this hypothesis is easily refuted.

Atlantic species

Ptychomitrium polyphyllum
Sematophyllum demissum
Hookeria lucens
Cryphaea heteromalla
Fossombronia caespitiformis
Campylopus atrovirens
Nardia compressa
Anthoceros punctatus (husnotii)
Fossombronia angulosa

In one place (Madonna del Sasso, Orselina above Locarno, fig. 2), Harpalejeunea ovata and Plagiochila exigua have been found (Bisang et al. 1986). Both species are next found in the Apuanian Alps. The locality Madonna del Sasso has been visited already by many early bryologists in the midth of the 19. century and it is therefore hardly understandable that these both species should have been overlooked in the past and should have arrived recently.
Atlantic species are favoured by the extraordinary high precipitation. Therefore they are lacking in Alto Adige, which shares many species with Ticino. Special habitats for atlantic species are humid ravines, of which only a small part seem to be investigated. In general large lower parts of the Ticino seem to be unexplored, but they mainly consist of deciduous (oak-chestnut) forests, which are rather dry bryologically less interesting (fig. 1).

Insubrian species

The term “insubrian” is dubious as it is used for political, geographical, genealogical, geological and phytogeographical purposes, in different senses, sometimes for only the lake region of Ticino (because of its higher humidity), sometimes for the complete lake region in the southern Alps with its chestnut belt in the southern Alps (cf. Rikli 1943-48) together with some indicator species, however, these are not specific for this region. Geologically it is a region of acidic metamorphic rocks, which is not identical with the lake region but extends by far to the East (fig.5). Remarkably, Istria belongs to this geological region, where several species known from Ticino as well as Alto Adige such as Haplocladium angustifolium are found again. Specific are species which are more or less confined in Europe to the Insubrian Lakes region in the southern Alps.
It is highly conspicuous that all these species show up again in the surroundings of Meran in Alto Adige (Italy, Tab. 1), and usually not in between. Alto Adige has a comparable temperature but much less precipitation (<800 mm as compared to 1800 mm in Ticino). Both regions share the presence of plutonitic rocks. Both regions are also situated in a comparable altitude.

Braunia alopecura

> The world wide range of this species has recently been critically revised (Frahm 2013). Only China, the southern Alps and the Cape Verde Islands remained, which makes phytogeographically no sense at the moment. The species occurs in a small band through the southern Alps from Lombardy to Alto Adige.

Haplocladium angustifolium

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Has been found at first „circa Locarno“ by Daldini in 1863, also near Merano in Italy by Milde in the same year (!), and at about the same time in Istria, Croatia, by Tomasini. In Ticino, one more historical collection was made around Bellinzona by Mari in 1895, however, a third collection was made by Gottfried Schwab in 1985 in Muzzano S of Lugano, a famous locality, where the 19th century bryologists already collected. The species also occurs, like many of the other species, in Alto Adige, in addition in Lombardy and Istria and was collected by me in 1973 at Lake Garda (unpubl.)

Haplocladium virginianum (as H. microphyllum)

About a dozen historical records, but only two recent ones. Also found in Graubünden, thus not confined to Ticino.

Campylopus oerstedianus

This species is not confined to Insubria but occurs else in Europe in the Pyrenees, Chalkidike (Greece) and locally in Central and Eastern France. It has, however, a typical insubrian distribution in the Southern Alps together with the other species mentioned here.

Ptychomitrium incurvum

Again a predominantly North American species which is rarely found in the Pyrenees, the southern Alps and the Caucasus. It was found only in the 19. century, but now twice above Sementina in a chestnut forest and along a small road between vineyards and forest, both an Gneiss rocks. It remains a secret why all these North American species are found in the southern Alps. In Italy, it was collected in Piemont (this is next to Ticino) and Lombardy before 1950 (Aleffi et al. 2008).

Haplohymenium triste (Anomodon t.)

A species known from Asia (Nepal, Tibet, China, Japan) and from Eastern North America. In Europe only in a few localities in the southern Alps in Ticino and around Merano.

Frullania riparia (cesatiana)

Recorded from localities in the southern Alps of Switzerland, Austria, Italy and Croatia, east to Bulgaria, Pyrenees, Tenerife, North America, China and Japan.

Frullania inflata

A species which was not known in Ticino before Jäggli (1950). In Europe only in Albania, Hungary, Austria, Czechia, and the southern Alps (only the surroundings of Meran and Lugano), else in North America, Mexico, Colombia and China.

Bruchia flexuosa

was found first closeby in Italy„in Piemonte presso Trobaso in Valle Intrasca, La Maggiore, De Notaris 1865-67“ (Cortini Pedrotti 2001) and described as Bruchia trobasiana. It is the only record in Italy, not found in Switzerland but included here as insubriuan element.. Later is was also found “bei Rothwein in der Steiermark“ (Mönkemeyer 1927). Grims (1999) wrote: “Das Moos wurde von Breidler ab 1874 mehrfach in der südlichen Steiermark nachgewiesen. Letztmals wurde es von Glowacki 1913 gefunden. – Auf Erdböße n in nassen Wiesen und Äckern, auf feuchten Waldwegen.“ Important to know is the elevation up to 310 m, which resembles the situation in Italy. Rushing (1986) synonymized it with Bruchia flexuosa from North America. It has never been found again in Europe. In contrast to the European B. vogesiaca, which has a life span from June to September, B. flexuosa “produces spores in spring (from March to June)” (Crum & Anderson 1981). In Europe it shall be in May and June (Limpricht 1890).

Tab. 1: Bryophyte species which are mainly found in Europe in the Southern Alps and mostly in the surroundings of Lugano (Ticino and nearby Italy) and Merano.

Species	**Ticino**	**Alto Adige**	**elsewhere in the S-Alps**	**else in Europe**
Braunia alopecura	x	x	x	-
Haplohymenium triste	x	x	x (Piemont)	
Haplocladium virginianum	x	x	x (Istria)	
Haplocladium angustifolium	x	x	x (Lombardy, Veneto, Istria)	
Frullania inflata	x	x	?	Albania, Czechia, Hungary, Carinthia
Frullania riparia	x	x	x (Istria)	Pyrenees, Styria, Bulgaria
Bruchia flexuosa (trobasiana)	†	-		† Styria
Ptychomitrium incurvum	x		x (Lombardy, Piemont)	Pyrenees
Braunia alopecura	x	x	x (Lombardy, Graubünden)	China, Cape Verde Isl.

What happened in the midth of the 19. century, that North American species showed up in the southern Alps? And other American species such as Heterophyllium affine or Haplocladium microphyllum at the same time in Central Europe, only for a couple of years?

The usual question is, are these species from the southern slope of the Alps relics (that means in Europe from interglacials or even from the Tertiary) or did they arrive after in the Holocene by long distance dispersal? The question can not be answered without molecular studies but only discussed. Arguments pro dispersal are:
- the present habitats were ice covered in the Pleistocene (fig. 3)
- the species are fertile and able for long distance dispersal
- the species grow also in secondary habitats

Arguments contra dispersal are
- the species are “migration relics” that means they survived in nearby ice free areas but migrated short distances to their present localities to newly offered habitats.
- the species are sterile and have no means of dispersal.
- they are only found in primary habitats.
- they are found in the only place in the world (Radula visianica).

As already outlined by Bisang et al. (1986), female plants of Plagiochila exigua are not known in Europe, and also Harpalejeunea molleri does not produce sporophytes, however, this argument cannot be used as argument for a relic. The species is widely distributed (although very scattered) also outside its core range in Scotland, Wales and Ireland in France, Italy and Spain – and remarkably also in SW Norway. Norway, could however, be only reached by dispersal, since it was fully glaciated during the Pleistocene, had no relictual habitats and has never been connected

by a land bridge with Scotland and Ireland. These scattered occurrences in Spain, Italy and Switzerland can hardly be remnants of a formerly closed range. *In conclusion, sterility does not inhibit dispersal over long distances* as shown by species extending their range such as Tortula pagorum, which dispersed in the past over long distance by brood leaves. Also Plagiochila exigua disperses by asexual propagation by means of caducous leaves and flagellae.

Fig. 3: A big erratic bloc at the Alpe Vicania above Morcote (S of Lugano) in 650 m alt. clearly demonstrates that the area was ice covered during Pleistocene and did not provide habitats for relic species.

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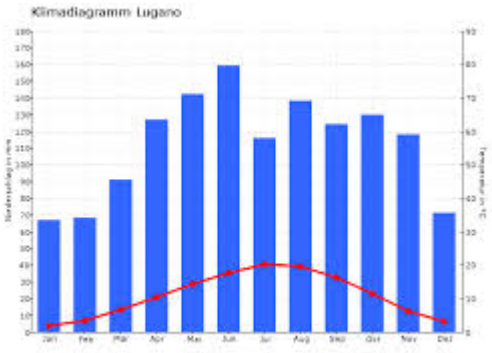

Fig. 4: Clima diagram for Lugano (source internet)

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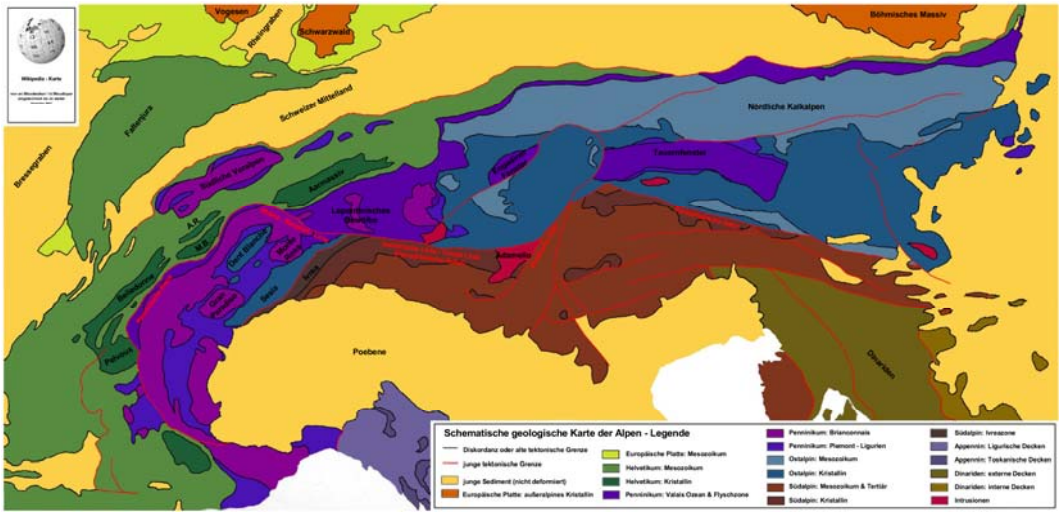

Fig. 5: Geological map of the Alps (source Wikipedia). The brown signature resembles the insubrian region in geological sense and concerns also the distribution of remarkable bryophyte species.