

## Ecological behaviour of *Letharia vulpina* (L.) Hue in the Northwest of the Iberian Peninsula

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**Abstract** – The location of *Letharia vulpina* in The Teleno (León, NW of Iberian Peninsula) living as saxicolous, raised our interest in improving the knowledge of the ecological requirements of this species, as well as that of the plant community in which it lives. We have carried out a critical differential analysis about how this species behaves when it lives as saxicolous, and when it lives as epiphytic, not only in this area but also in other ones from central and northern continental Europe. We made this analysis by means of several phytosociological relevés, and notes regarding the ecological parameters having any effect on *Letharia vulpina*. We propose a new saxicolous association as *Rhizoplaco chrysoleucae-Letharietum vulpinae*.

### Ecological behaviour / phytosociology / NW of Iberian Peninsula / *Letharia vulpina*

**Resumen** – La localización de *Letharia vulpina* en el macizo de El Teleno (León, NW de la Península Ibérica), viviendo como saxícola, desencadenó nuestro interés por conocer las exigencias de carácter ecológico que identificaban a esta especie, así como las del cortejo florístico que la acompaña, realizando para ello un análisis crítico diferencial entre cómo esta especie se comporta cuando se desarrolla como saxícola, a cómo lo hace cuando vive epífita, tanto en nuestro territorio como en otros del centro o norte del continente europeo. Fundamentamos este análisis en la realización de una serie de inventarios de carácter fitosociológico, así como en otros parámetros ecológicos que afectan de alguna manera a la especie de nuestro interés.

### Comportamiento / Ecología / Fitosociología / NW Península Ibérica / *Letharia vulpina*

## INTRODUCTION

*Letharia vulpina* is a lichen characterised by having a typically fruticose, pendulous or terete habitus, up to 15 cm on length, with prismatic-flat branches, irregular, rigid, generally very branched, sometimes with a reticulate look or with

\* Correspondence and reprints.

very strong ribs between large depressions, and, in consequence, angulous in section very light yellow-greenish sulphurine colour; furthermore, it has a lot of isidia of the same colour than the thallus, with a brown-black apex. Finally, they become more or less widespread, and with granular look, soralia. It is a typical species of high altitude in the central and northern continental Europe and Atlas range, where it behaves as epiphytic, its presence on stones being very scarce. Its mainly distribution area is on the Alps (Wirth, 1995), and eastern Norway, and the central part of Sweden, becoming rarer in the south of Sweden and Finland (Dahl & Krog, 1973), and it appears also very occasionally in other European and northafrican territories (John, 1996; Kondratyuk & al. 1996; Egea 1996). In the Iberian Peninsula its punctual presence has been recorded in different territories, mainly from the septentrional half and we have also located it from other localities of the peninsular Northwest, in the Canary Islands (Tenerife) on *Pinus canariensis*, and also on the *Cedrus atlantica* forest of Ifrane Valley in the Atlas Mountains (Morocco). Most of the times, it has been reported as lignicolous, and some times as corticolous (on *Larix* in the Alps).

We have made our research preferentially in three territories from the Northwest of Iberian Peninsula (Fig. 1): 1.- in the Teleno Mountains, and pine forest of Tabuyo del Monte, 2.- in the Hormas Valley-Riaño Mountains, both in León Province, and 3.- in Puerto del Portillo-Las Batuecas, close to Peña de Francia Mountains in Salamanca province. In these three territories, *Letharia vulpina* appears living as epiphytic or as saxicolous, and sometimes in both habitats.

## MATERIALS AND METHODS

This research about the ecological behaviour of *Letharia vulpina* is mainly based in the analysis of two lichenic communities in which it lives, one with epiphytic character, deeply studied since a long time ago, which is named *Letharietum vulpinae* Frey, and a second one typically saxicolous, that we want to typify in the present. So, we have carried out several relevés of phytosociological character, in order to make a comparative analysis with other previous research also refereed to the *Letharia vulpina* ecological behaviour. During the preparation of the phytosociological relevés, we have put attention on all ecological parameters which allow us to carry out a critical analysis between the communities which we differentiate according to the substrata where the lichens characterising them are living. We have made a comparative analysis (% of lichenic biotypes) between the epiphytic and saxicolous communities.

## RESULTS AND DISCUSSION

The phytosociological relevés are grouped in two different tables (Table I and II), according to the substratum colonised by *Letharia vulpina*, and following its characteristic floristic spectrum.

On the Table I, we grouped the relevés in which *Letharia vulpina* appears as epiphytic, having put information about this species as corticolous and as ligni-



Fig. 1. (1) Teleno mountains (Localities: 1 to 5 on Table 1, and localities 1 to 7, 9 and 11 to 13 on Table 2). (2) Hormas-Riaño Valley (Localities 6 to 11 on Table 1). (3) Portillo Mountain (Localities: 8 and 10 on Table 2).

colous. In our studied territory, when lignicolous, *Letharia vulpina* lives preferentially on the lower third of the stem, and also on the branches of aged plants of *Erica australis* subsp. *aragonensis* (Ea), sometimes on the outer part of its roots, when they were partially exposed. Also, *Letharia vulpina* lives on the log of old, and frequently on dead trunks of *Quercus petraea* (Qp). As a corticolous, *Letharia vulpina* lives, preferentially in the area of study, on big specimens of *Quercus petraea* which, even show a healthy condition, but it also appears on the bark of well developed plants of *Pinus pinaster* (Pp). It is noteworthy that aged plants of *Fagus sylvatica*, in a healthy development condition, never found to be colonised by *Letharia vulpina*, neither corticolous or lignicolous, despite *Fagus sylvatica* and *Quercus petraea* are very similar electrolyte average and/or phosphate concentration on the bark, similar bark hardness, similar water retention capacity, and the form of the bark in both plants is also very similar, and, in consequence, they have, the same lichenic flora when young (Barkman, 1958), but not when older.

In the Alps, *Letharia vulpina* has a restricted presence to *Larix* sp., *Pinus cembra*, *Pinus mugo* and *Picea excelsa*. So on *Pinus cembra*, it appears only on the wood, while on *Larix europaea* it appears only on the bark. In Scandinavia, it is also represented on *Pinus sylvestris*. Barkman (1958) showed that in the Tyrol, the typical association characterised by *Letharia vulpina* (*Letharietum vulpinae* Frey) appears as well in north as in south position, although he believes that this association is best developed when it colonises the northern side. In consequence, he considers *Letharia vulpina* to be anheliophilous. In our research, it is not certain because this specie shows any preferent orientation. In consequence, we must consider that in the NW of the Iberian Peninsula, the range extent in relation to the sun irradiation would be wider than it seems to be in the central Europe. In consequence, it seems best to qualify *Letharia vulpina*, in our territory, as moderately photophilous to very strongly sciaphilous.

Table I. *Letharietum vulpinae* Frey 1937

Running relevé no.	1	2	3	4	5	6	7	8	9	10	11
Altitude (1/10 m)	155	151	126	128	122	140	141	145	141	142	130
High over the ground (m)	0.2	0.1	0.3	0.2	0.2	1.0	0.5	1.5	2.0	5.0	3.0
Exposition	.	.	.	.	N	E	S	W	W	.	ENE
Inclination (°)	.	.	.	.	100	85	85	90	90	100	70
Area (dm <sup>2</sup> )	1.5	1.0	2.0	1.0	6.0	3.0	20	8.0	6.0	6.0	12
Coverage	30	20	60	40	70	60	95	80	80	95	90
Number of taxa	11	11	5	4	14	11	11	9	10	9	13
Phorophyte	Ea	Ea	Ea	Ea	Pp	Qp	Qp	Qp	Qp	Qp	Qp
Fruticulous (%)	45.5	45.5	40	25	42.8	45.5	54.5	44.4	40	44.4	53.8
Foliaceous (%)	36.4	27.3	40	25	50	45.5	18.2	33.3	20	33.3	30.7
Crustaceous (%)	18.2	18.2	20	50	7.14	.	18.2	11.1	30	22.2	.
Leprarioid (%)	.	9.1	.	.	.	9.1	9.1	11.1	10	.	15.4
<b>Faithful, characteristic and differential taxa of association and upper taxa</b>											
<i>Letharia vulpina</i>	1	1	4	2	+	3	5	2	3	4	3
<i>Bryoria fuscescens</i>	+	+	.	.	+	+	+	.	+	1	1
<i>Pseudevernia furfuracea</i>	2	3	+	.	+	.	.	+	.	+	2
<i>Platismatia glauca</i>	+	+	.	.	+	+	.	.	+	+	2
<i>Hypogymnia physodes</i>	1	1	+	1	2	+	.	.	.	.	1
<i>Parmelia sulcata</i>	.	.	.	.	1	1	+	.	+	.	.
<i>Lepraria incana</i>	.	.	.	.	.	1	+	+	+	.	1
<i>Cetraria chlorophylla</i>	+	.	.	.	+	.	+	1	.	.	1
<i>Parmeliopsis ambigua</i>	.	.	.	.	+	1	.	3	.	1	1
<i>Usnea glabrescens</i>	.	.	.	.	.	+	+	.	+	+	+
<i>Hypocenomyce scalaris</i>	+	.	+	.	.	.	.	+	.	+	.
<b>Companions</b>											
<i>Lecanora varia</i>	1	1	.	1	1	.	.	.	.	.	.
<i>Evernia prunastri</i>	+	.	.	.	.	2	+	.	.	.	1
<i>Cladonia sp.</i>	.	.	.	.	+	+	+	.	+	.	.
<i>Cetraria sepincola</i>	+	+	.	.	+	.	.	.	.	.	.
<i>Cetraria aculeata</i>	+	+	.	.	.	.	.	.	.	.	.
<i>Usnea sp.</i>	.	.	.	.	+	.	.	+	.	.	.
<i>Parmelia saxatilis</i>	.	.	.	.	.	.	.	.	.	1	1

Additional taxa: *Ramalina fraxinea*, *Lepraria aeruginosa* and *Lecidella pulveracea* + on 2, *Strangospora moriformis* + on 4, *Hypogymnia tubulosa*, *Cetraria crespoae* 2 on 5, *Usnea florida* 2 on 11, *Parmelia exasperata* + on 6, *Lecanora carpinea*, *Ramalina farinacea*, *Candelariella vitellina* + on 7, *Cladonia macilentia*, *Physconia distorta* + on 8, *Calicium quercinum* 2 on 9, *Calicium viride*, *Pertusaria amara* + on 9, *Ochrolechia turneri* + on 10 y *Lepraria latebrarum* 1 on 11.

Localities: 1. - Arroyo de Xaudella-Telero (29TQG2087). 2. - Arroyo de Río Molinos-Pozos (29TQG2086). 3. - Pinares de Tabuyo del Monte (29TQG2586). 4. - Pinares de Tabuyo del Monte (29TQG2586). 5. - Pinares de Tabuyo del Monte (29TQG2586). 6. - Valle de Hormas-Riaño (30TUN4062). 7. - Valle de Hormas-Riaño (30TUN3964). 8. - Valle de Hormas-Riaño (30TUN4064). 9. - Valle de Hormas-Riaño (30TUN4063). 10. - Valle de Hormas-Riaño (30TUN4063). 11. - Valle de Hormas-Riaño (30TUN4062).

Table II: Rhizoplaco chrysoleucae-Letharietum vulpinae ass. nova

Running relevé no.	1	2*	3	4	5	6	7	8	9	10	11	12	13
Altitude (1/10 m)	156	155	126	162	154	155	123	138	151	139	155	151	128
High over the ground (m)	2.0	1.5	3.0	5.0	2.0	1.5	2.0	3.0	3.5	2.5	0.2	3.0	3.5
Exposition	N	NNE	NNE	NNE	NE	NW	W	S	S	SSE	SSE	E	E
Inclination (°)	95	90	90	100	90	85	90	95	90	90	90	90	95
Area (dm <sup>2</sup> )	24	20	14	14	5	6	8	4	12	6	10	4	16
Coverage (%)	98	90	90	70	70	80	60	80	90	90	90	95	80
Substrata	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc
Number of taxa	19	14	14	13	10	12	14	5	11	12	8	16	14
Fruticulous (%)	31.6	28.6	28.6	30.8	40	41.7	14.3	40	45.5	16.6	37.5	25	35.7
Foliaceous (%)	10.5	7.1	50	15.4	20	16.6	57	.	27.3	25	12.5	31.3	14.3
Crustaceous (%)	47.4	57.1	14.3	53.8	40	41.7	21.4	60	27.3	58.3	50	43.8	42.9
Leprarioids (%)	10.5	7.1	7.1	.	.	.	7.1	.	.	.	.	.	7.1
<b>Faithful, characteristic and differential taxa of association and upper taxa</b>													
<i>Letharia vulpina</i>	2	2	2	2	2	1	1	1	2	1	2	2	2
<i>Pseudevernia furfuracea</i>	.	+	+	+	+	1	.	.	.	.	+	.	+
<i>Hypogymnia farinacea</i>	.	.	+	+	1	.	+	.	.	2	.	.	+
<i>Bryoria fuscescens</i>	1	+	+	.	2	1	.	.	.	.	.	.	+
<i>Rhizoplaca chrysoleuca</i>	2	3	.	+	.	+	.	2	.	2	3	+	2
<i>Protoparmelia badia</i>	+	1	.	+	.	1	.	.	+	1	+	+	2
<i>Ramalina polymorpha</i>	1	1	.	.	+	.	.	+	1	+	+	.	.
<i>Lecanora polytropa</i>	.	+	.	+	2	+	.	.	.	.	+	+	.
<i>Rhizocarpon geographicum</i>	.	.	+	.	1	.	+	.	+	.	.	+	.
<i>Ramalina capitata</i>	.	.	.	+	.	+	.	.	1	.	.	1	1
<i>Lecanora frustulosa</i>	2	3	.	.	1	.	.	.	.	3	.	.	.
<i>Parmelia sulcata</i>	.	+	1	.	+	.	+	.	.	.	.	.	.
<i>Cornicularia normoerica</i>	+	.	.	.	.	1	.	.	+	.	.	1	.
<i>Pseudephebe pubescens</i>	+	.	.	1	.	.	+	.	.	.	.	1	.
<i>Umbilicaria crustulosa</i>	.	.	2	.	.	+	1	.	1	.	.	.	.
<i>Rhizocarpon riparium</i>	+	.	.	2	.	+	.	.	.	.	.	.	.
<i>Parmelia omphalodes</i>	.	.	1	+	.	.	2	.	.	.	.	.	.
<i>Parmelia pulla</i>	.	.	.	.	.	.	.	.	+	+	.	.	.
<i>Rinodina confragosa</i>	+	.	.	.	.	.	.	.	.	1	.	.	.
<i>Lecanora cenisia</i>	1	.	.	.	.	.	.	.	.	.	.	1	.
<i>Parmelia stygia</i>	.	.	.	.	.	.	+	.	.	.	.	+	.
<i>Dimelaena oreina</i>	.	.	.	.	.	.	.	.	1	.	.	.	+
<b>Companions</b>													
<i>Umbilicaria grisea</i>	.	.	1	.	.	.	.	.	2	1	1	.	+
<i>Lecanora subcarnea</i>	1	1	.	+	.	.	.	.	.	+	.	.	.
<i>Rhizocarpon drepanodes</i>	.	1	.	.	.	.	.	.	.	+	.	.	+
<i>Arthrorhaphis citrinella</i>	2	1	.	.	.	.	.	.	.	.	.	.	+

Running relevé no.	1	2*	3	4	5	6	7	8	9	10	11	12	13
<i>Umbilicaria polyphylla</i>	+	.	.	.	.	.	1	.	.	.	.	1	.
<i>Pertusaria rupestris</i>	.	.	.	+	.	.	+	.	.	.	.	.	+
<i>Hypocenomyce scalaris</i>	.	.	+	.	.	.	.	1	.	.	.	.	.
<i>Ramalina strepsilis</i>	+	.	.	.	.	.	.	.	1	.	.	.	.
<i>Platismatia glauca</i>	.	.	1	.	.	.	+	.	.	.	.	.	.
<i>Tephromela atra</i>	.	.	.	.	.	+	+	.	.	.	.	.	.

Additional taxa: *Umbilicaria torrefacta*, *Candelariella vitellina*, *Chrysothrix candelaris* and *Lecidella stigmatea* - on 1; *Lecanora sulphurea*, *Lecanora rupicola*, + on 2, *Lepruloma membranaceum*, *Parmelia taractica* and *Coelocaulon aculeatum* + on 3, *Lecidea luteoatra* + on 4, *Lecanora muralis* + on 5, *Brodoa intestiniformis* 1 on 6, *Umbilicaria polyrrhiza*, *Lepraria incana* + on 7, *Lecanora soralifera* 4 on 8, *Pertusaria corallina* + on 10, *Aspicilia* sp. + on 11, *Umbilicaria freyi* and *Aspicilia cinerea* 2 on 12, *Caloplaca arenaria*, *Umbilicaria nylan-deriana* and *Lasallia hispanica* + on 12, *Rhizocarpon dinohetes* and *Ramalina fastigiata* + on 13.

Localities: 1.- Arroyo de Xaudella-Telero (LE) (29TQG2087). 2.- Peña de la Campana-Telero (LE) (29TQG2187) *Holotypus* ass.. 3.- Pinares de Tabuyo del Monte (LE) (29TQG2596). 4.- Sanguiñal-Telero (LE) (29TQG2486). 5.- Peña de la Campana-Telero (LE) (29TQG2287). 6.- Peña de la Campana-Telero (LE) (29TQG2287). 7.- Pinares de Tabuyo del Monte (LE) (29TQG2586). 8.- Puerto del Portillo (SA) (30TQE48). 9.- Arroyo de Río Molinos-Pozos (LE) (29TQG2086). 10.- Puerto del Portillo (SA) (30TQE48). 11.- Peña de la Campana-Telero (LE) (29TQG2287). 12.- Arroyo de Río Molinos-Pozos (LE) (29TQG2086). 13.- Pinares de Tabuyo del Monte (LE) (29TQG2586).

Syntaxonomical scheme of the association *Letharietum vulpinae* Frey, 1937

Order *Parmelietales physodo-tubulosae* Barkman, 1958

Alliance *Parmelion saxatilis* Barkman, 1958

Suball. *Parmelienion furfuraceae* Barkman, 1958

Syntaxonomical scheme of the association proposed as new

Class *Rhizocarpetea geographici* Mattick, 1951 em. Wirth, 1980

Order *Rinodino confragosae-Xanthorietalia elegantis* Creveld, 1981

Alliance *Dimelaenion oreinae* Creveld, 1981

Association: *Rhizoplaco chrysoleucae-Letharietum vulpinae* ass. nova

The same author (Barkman, 1954) considers that *Letharia vulpina* is always located in a position where the snow never protect it, so that it appears in the upper part (upper half) of the stem. Thus, it must be considered as chionophobic, and it is exposed to all climatic severity. So, *Letharia vulpina* shows in our area surveyed the same behaviour as in middle and northern Europe, as even when it lives closer to the ground (on the roots of *Erica australis* subsp. *aragonensis*) it is never covered by the snow.

Regarding the altitude range in which the epiphytic community develops, Barkman (1954) states that in the Alps it would be placed between 1700 and 2100 m with an optimum development between 1950 and 2050 meters, while in Scandinavia the altitudinal range in which this community shows a good developmental condition is, logically, very different because it is placed between 600 and 800 m. In the studied territory, *Letharietum vulpinae* shows a good development between 1300 and 1600 meters.

The total coverage in the relevés, included in the *Letharietum vulpinae* association (Table I), varies between (20-30) 40-95%, and are significantly lower in the relevés carried out on *Erica australis* subsp. *aragonensis* (Ea) (20-60%) than

Table III. Total coverage % (biotypes) on the relevés where *Letharia vulpina* appears

	Saxicolous		Epiphytic		Total
		<i>Erica australis</i>	<i>Pinus pinaster</i>	<i>Quercus petraea</i>	
Crustaceous	42.91	25.69	7.14	13.58	15.47
Foliaceous	22.06	32.15	50	30.11	37.42
Fruticulous	31.97	38.96	42.85	47.11	43.73
Leprarioids	3.03	2.27	—	6.54	2.94

in those carried out on *Quercus petraea* (Qp) or on *Pinus pinaster* (Pp) (60) 70-95%. This last range is similar to that reported in the same community, in the Alps. This puts in evidence that the % of fruticose lichens of *Letharietum vulpinae* in the Alps are 60% in every altitude, raising to the 84% in the optimum altitude. In the NW of Iberian Peninsula, the coverage of the fruticose species varies between 38.96% in the relevés carried out on Ea (*Erica australis* subsp. *aragonensis*), 42.85% in those carried out on Pp (*Pinus pinaster*) and to 47.11% in those carried out on Qp (*Quercus petraea*) (Table III). In any case, they are appreciably lower than the coverage recorded in the central Europe. The coverage of the foliose species appears in inverse relation, which in the studied territory show values of 32.15%, 50% and 30.11% (Table III) respectively for the phorophytes previously mentioned, exceeding the same values of this biotype in the Alps, where it varies between (0) 2-3 and 20-25 (50) %.

From the successional point of view, we want to highlight that in the studied territory, as in the central and northern Europe, the *Letharietum vulpinae* can be considered as the stage which follows the *Pseudevernetium furfuraceae* (although in the Alps, some times, *Letharietum vulpinae* can grow directly on the trees), and *Letharia vulpina* will be later replaced by a community which floristic composition, we thought, is typical of *Parmeliopsidetum ambiguae*, as a consequence of the increase of duration of the snow cover, previously not present.

About the floristic richness of each relevé (species number/relevé), we want to show that, with exception of the relevés 3 and 4 (both very poor, with 5 and 4 species respectively), all of them have higher values (9-10)11-14, generally higher than those reported in the *Letharietum vulpinae* of central Europe.

In the Table II we assembled all the relevés carried out on rocky substratum, which always was, in the studied area, recrystallized very hard quartzite (Cc). The localities where we have found *Letharia vulpina* as saxicolous are placed in two very separated territories, one in the Teleno Mountains and closed to this area in the León province, and in the Puerto of Portillo-Las Batuecas, in the Salamanca province (Fig. 1).

The ecological parameters characterising *Letharia vulpina* and the species living with it in saxicolous substratum are, sometimes, similar to those identifying the *Letharietum vulpinae*, although with some differences that we are going to list. Beginning with the altitude range occupied by the saxicolous community, we want to point out that this range varies between 1200 and 1700 meters, wider than that occupied by the *Letharietum vulpinae* in our studied territory.

As saxicolous, *Letharia vulpina* shows some preference by more humid habitats than when it appears as epiphytic, so, although it appears in almost all exposures (excepting the SW), it shows a great preference for the northern or

north component exposures, mainly for the NE exposure, and it is always placed on big walls of 3 to 10 meter high, from subvertical (85°) to slightly overplumbed (100°), and always distant from the soil (0.2)1.5-3.5 meters; showing again a heatly chionophobous behaviour.

Although *Letharia vulpina*, when epiphytic, behaves as neutrophilous to moderately acidophilous, when saxicolous it always shows a neat acidophilous character.

The floristic richness is greater in the relevés belonging to the saxicolous association, than in those belonging to the *Letharietum vulpinae*, as in the saxicolous association, the number of species of each relevé varies between (5)-10-16-(-19).

When we analyse the biotipes of the lichens taking part in the saxicolous association, it can be seen that the average values are (Table III): 42.91% for crustose, 22.06% for foliose, 31.97% for fruticose and 3.03% for leprose. If we make a comparison of these values and those characterising the epiphytic community (*Letharietum vulpinae*) two things appear: 1., the similar coverage of the leprose thalli in both cases, as well as the intermediate position occupied by the foliose thalli coverage in both associations, and 2., we want to point out the fact that the fruticose and crustose lichens show an inverse relation in these communities so, while the fruticose are mainly present in the *Letharietum vulpinae*, the crustose are mainly in the saxicolous association. We propose a new association, *Rhizoplaco chrysoleucae-Letharietum vulpinae* ass. nova (Typus: relevé 2, Table II) to this saxicolous association

In order to get a global synthesis of this research, we carried out a comparative analysis between the ecological parameters defining the behaviour of *Letharia vulpina* in middle and northern Europe, and the differential aspects of this species in the NW of the Iberian Peninsula, and we list the main differences in both cases:

a. – In central and northern Europe, *Letharia vulpina* appears almost exclusively as epiphytic while, in the NW of the Iberian Peninsula it grows as well as epiphytic than as saxicolous.

b. – In central and northern Europe, *Letharia vulpina* behaves as extremely fotophilous. Conversely, in the studied territory its illumination preferences are wider, varying from moderately fotophilous to very sciaphilous.

c. – In middle and northern Europe, *Letharia vulpina* behaves as aeroxefitic, while in our territory, it varies from aeroxerophilous to hygrophilous.

d. – In both territories, it behaves as chionophobous and cold resistant.

e. – In middle and northern Europe, *Letharia vulpina* has a strong acidophilous preference; however, in the NW of the Iberian Peninsula this range is wider, even behaving as moderately neutrophilous.

f. – In the Alps, it is known as corticolous on *Larix* sp. and lignicolous on *Pinus cembra*, in Scandinavian it appears as lignicolous on *Pinus sylvestris*. In our research area, it is lignicolous on *Erica australis* subsp. *aragonensis* and *Quercus petraea*, and corticolous on *Pinus pinaster* and *Quercus petraea*, but it grows also as saxicolous on recrystalized quartzites.

g. – In the Alps, *Letharia vulpina* lives from 1700 to 2300 m, in Scandinavian from 600 to 800 m, and in the NW of the Iberian Peninsula from 1200 to 1700 m when saxicolous, and from 1300 to 1600 m when epiphytic.

h. – In middle Europe *Letharia vulpina* shows a subalpine-subartic-continental distribution, while in the studied territory it shows a typical altimontane behaviour.



i. – In the NW of the Iberian Peninsula, when saxicolous, it invades some subverticals and overhanging walls (85-100°); when corticolous, it lives on trees or shrubs, in many instances burned, weakened or dead; when lignicolous, it lives on the lower third of the trunk and on some branches of *Erica australis* subsp. *aragonensis*, or on old specimens of *Quercus petraea*, specially talled down.

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