ON THE BRINK OF THE ATLANTIC:
THE RECKONING OF A VULNERABLE BRYOPHYTE (*DENDROCRYPHAEA LAMYANA*) THROUGH COLLECTIONS, TIME AND EUROPE.


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XX SIMPÓSIO DE BOTÂNICA CRIPTOGÂMICA
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Introduction

The west-European bryophyte *Dendrocryphaea lamyana* (Mont.) P.Rao is a threatened moss at the European level. Currently listed as Vulnerable on the Welsh Red-list and Near-Threatened in Great Britain, it receives special protection in several countries. Locally distributed in west and south Europe (south Britain, France, Portugal, Spain and Italy), and most likely erroneously cited in Switzerland and North Africa, it has been considered either as a euatlantic, atlantic, subatlantic, oceanic-submediterranean-montane or a southern-atlantic temperate species. All these chorologic classifications highlight the species' restriction to territories bordering the Atlantic Ocean.

Through time, bryologists and collectors have described this moss as requiring very specific fluvial ecological conditions, which further restrict the distribution of the species within its range. As more data is comprehensively gathered and chronologically classified, we observe the enlargement of its bioclimatic and hydro-geologic niche definition, and consequently question its perceived threatened status.

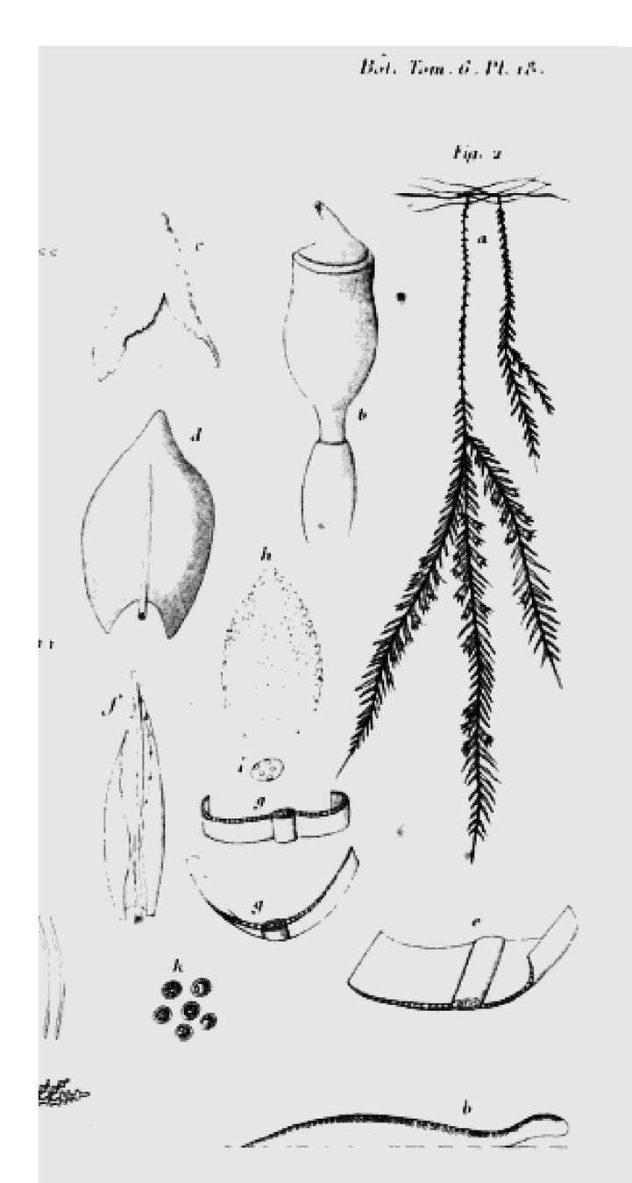
In the present work we identified and gathered all the available information on this species and explored the most important parameters that allow the detailed description of species' macro-, meso- and micro-ecology. Point occurrences from a wide range of herbarium specimens and field observations throughout the species' known range were compiled to start exploring how much of Europe is potentially suitable for this species and to establish its overall distribution.

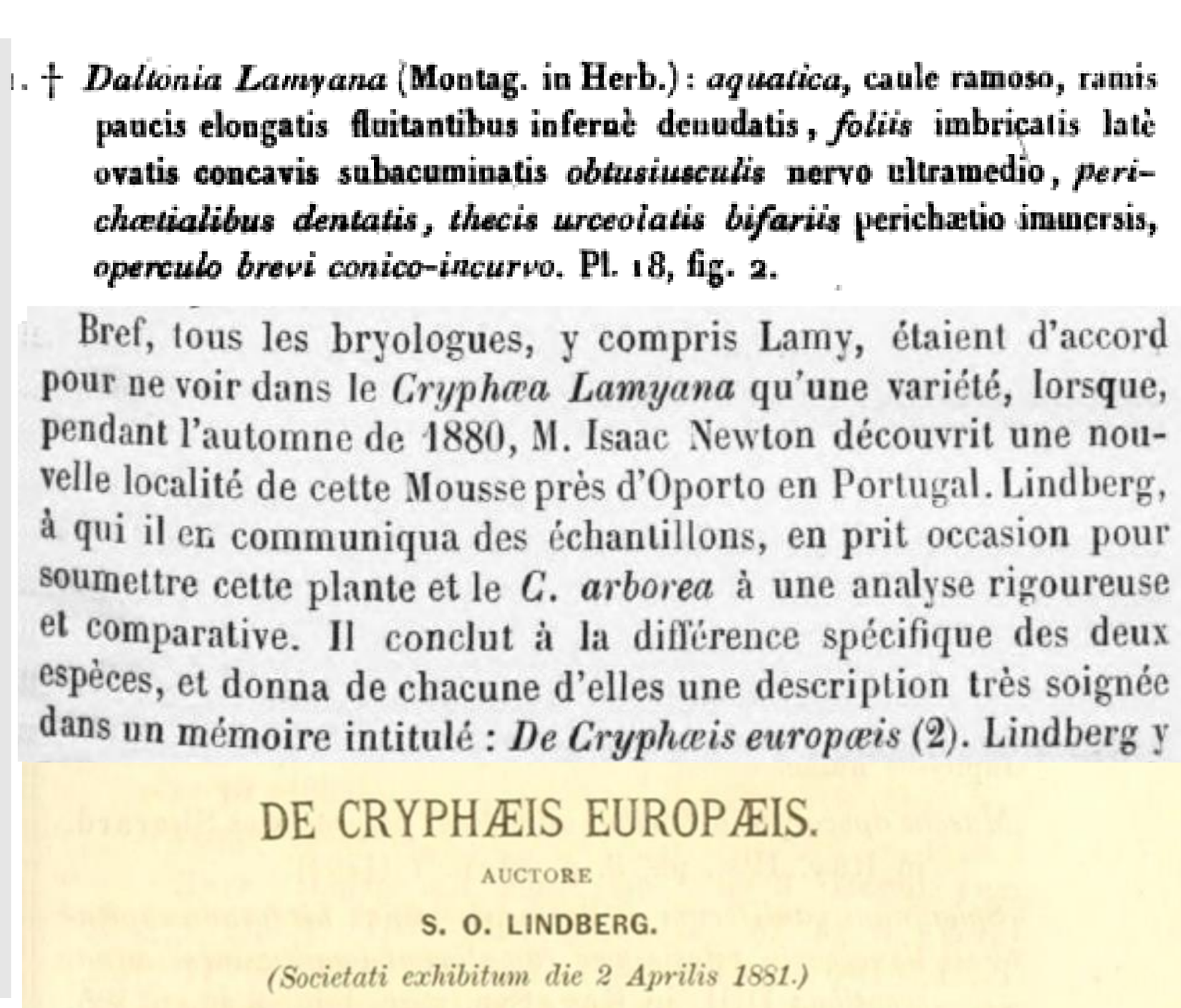
Methods and Results

Surveys: Taxonomy and Biogeography

XIX Century

Once upon a time…
1836: Described by the French botanist C. Montagne as *Daltonia lamyana* in dedication to his friend Lamy de la Chapelle who collected it in Limoges, France.
1881: Effectively distinguished from *Cryphea arborea (*syn. *Cryphea heteromalla)* by Lindberg after decades of confusion between the two taxa and after a specimen collected in Oporto by the PO Herbarium collector of English origin, M. Isaac Newton (which location remains unconfirmed due to lack of specimen in known Herbaria).
1894: Camus finds new localities in France and describes the habitat of the species





1. † *Daltonia Lamyana* (Montag. in Herb.) : *aquatica,* caule ramoso, ramis paucis elongatis fluitantibus inferne denudatis, *foliis* imbricatis late ovatis concavis subacuminatis *obtusiusculis* nervo ultramedio, *perichaetialibus dentatis, thecis urceolatis bifariis* perichaetio immersis, *operculo brevi conico-incurvo.* Pl. 18, fig. 2.

Bref, tous les bryologues, y compris Lamy, étaient d'accord pour ne voir dans le *Cryphæa Lamyana* qu'une variété, lorsque, pendant l'automne de 1880, M. Isaac Newton découvrit une nouvelle localité de cette Mousse près d'Oporto en Portugal. Lindberg, à qui il en communiqua des échantillons, en prit occasion pour soumettre cette plante et le *C. arborea* à une analyse rigoureuse et comparative. Il conclut à la différence spécifique des deux espèces, et donna de chacune d'elles une description très soignée dans un mémoire intitulé : *De Cryphæis europæis* (2). Lindberg y

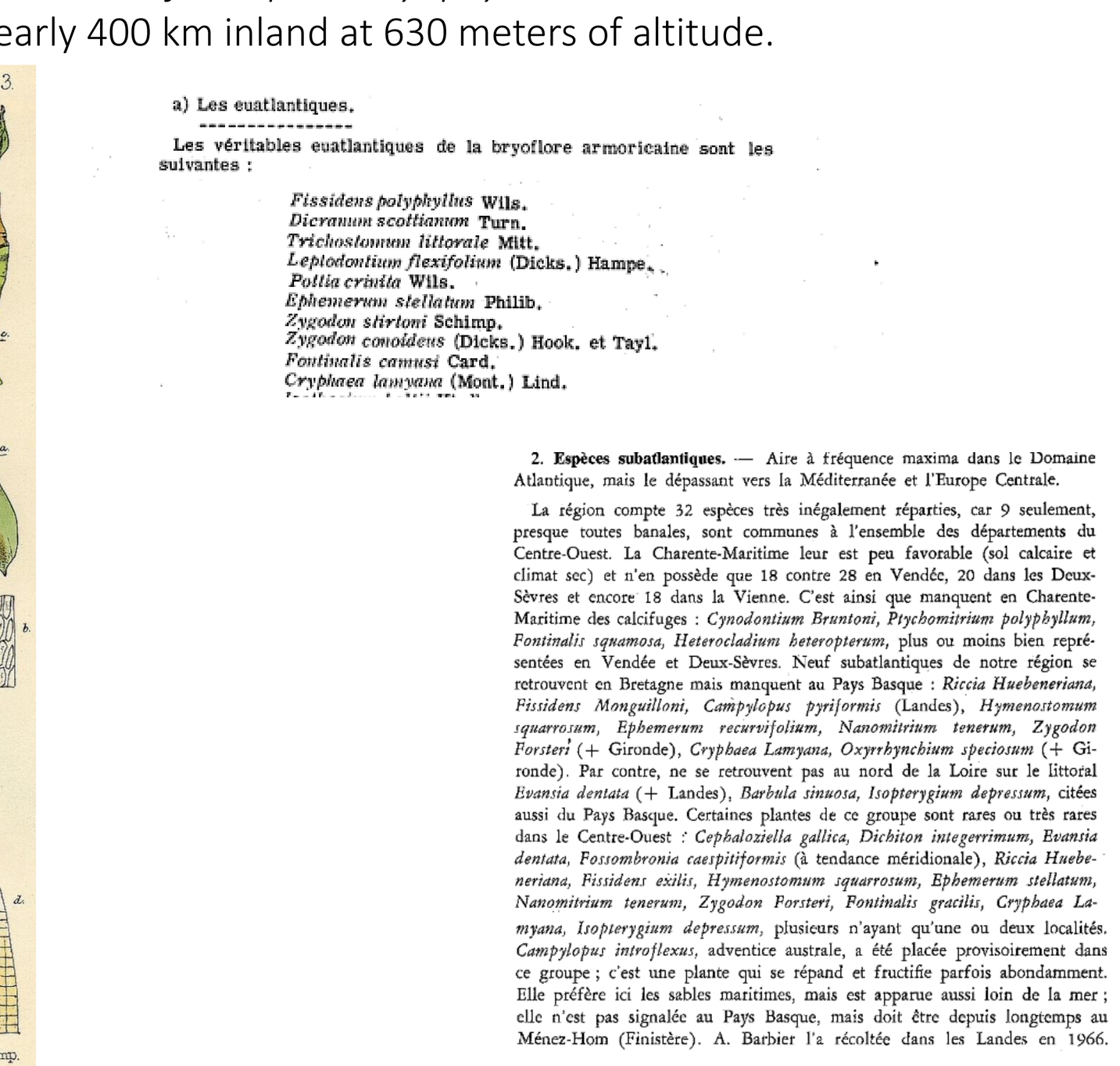
DE CRYPHÆIS EUROPÆIS.
AUCTORE
S. O. LINDBERG.
(Societati exhibitum die 2 Aprilis 1881.)

Images and texts from CAMUS, F., 1894. Note sur le Cryphaea Lamyana (Mont.). Bulletin de la Société botanique de France, 41 : CLI-CLXIII; LINDBERG, S.O., 1881. De Cryphaesis europaeis. Meddeland. Soc. Fauna Fl. Fenn., 6: 71-75; MONTAGNE, C., 1836. Notice sur les plantes cryptogames récemment découvertes en France, contenant aussi l'indication précise des localités de quelques espèces les plus rares de la Flore française. *Annales des Sciences Naturelles. Botanique*, série 2, 6: 321-339.

Chorologic classification: occidental and austro-ocidental Europe
Countries: recorded from 14 sampling points, only in France (Portuguese locality not confirmed).

XX Century

Then…
1969: Touffet describes the species as euatlantic in a inventory of the bryoflora of the Armorican Massif (NW France). Meanwhile, it is also reported from Portugal, Spain and England.
1978: Preston discovered the northernmost world population, in Wales.
1992: Casas et al. mapped the species from several Iberian localities, mostly limited to Galicia and N. Portugal, but with disjunct localities in the south of the Iberian Peninsula within 200 km of coast.
1994: In the Iberian Peninsula *C. lamyana* was included in the IUCN Vulnerable category
1995: Listed as Vulnerable in the *Red Data Book of European Bryophytes*
1999: Lara *et al.* recorded the species nearly 400 km inland at 630 meters of altitude.



a) Les euatlantiques.

Les véritables euatlantiques de la bryoflore armoricaine sont les suivantes :

Fissidens polyphyllus Wils.
Dicranum scottianum Turn.
Trichostomum littorale Mitt.
Leptodontium flexifolium (Dicks.) Hampe.
Pottia crinita Wils.
Ephemerum stellatum Philib.
Zygodon stirtoni Schimp.
Zygodon conoideus (Dicks.) Hook. et Tayl.
Fontinalis camusi Card.
Cryphaea lamyana (Mont.) Lind.

2. **Espèces subatlantiques.** — Aire à fréquence maxima dans le Domaine Atlantique, mais le dépassant vers la Méditerranée et l'Europe Centrale.

La région compte 32 espèces très inégalement réparties, car 9 seulement, presque toutes banales, sont communes à l'ensemble des départements du Centre-Ouest. La Charente-Maritime leur est peu favorable (sol calcaire et climat sec) et n'en possède que 18 contre 28 en Vendée, 20 dans les Deux-Sèvres et encore 18 dans la Vienne. C'est ainsi que manquent en Charente-Maritime des calcifuges : *Cynodontium Bruntoni, Ptychomitrium polyphyllum, Fontinalis squamosa, Heterocladium heteropterum*, plus ou moins bien représentées en Vendée et Deux-Sèvres. Neuf subatlantiques de notre région se retrouvent en Bretagne mais manquent au Pays Basque : *Riccia Huebeneriana, Fissidens Monguilloni, Campylopus pyriformis* (Landes), *Hymenostomum squarrosum, Ephemerum recurvifolium, Nanomitrium tenerum, Zygodon Forsteri* (+ Gironde), *Cryphaea Lamyana, Oxyrrhynchium speciosum* (+ Gironde). Par contre, ne se retrouvent pas au nord de la Loire sur le littoral *Evansia dentata* (+ Landes), *Barbula sinuosa, Isopterygium depressum*, citées aussi du Pays Basque. Certaines plantes de ce groupe sont rares ou très rares dans le Centre-Ouest : *Cephaloziella gallica, Dichiton integerrimum, Evansia dentata, Fossombronia caespitiformis* (à tendance méridionale), *Riccia Huebeneriana, Fissidens exilis, Hymenostomum squarrosum, Ephemerum stellatum, Nanomitrium tenerum, Zygodon Forsteri, Fontinalis gracilis, Cryphaea Lamyana, Isopterygium depressum*, plusieurs n'ayant qu'une ou deux localités. *Campylopus introflexus*, adventice australe, a été placée provisoirement dans ce groupe ; c'est une plante qui se répand et fructifie parfois abondamment. Elle préfère ici les sables maritimes, mais est apparue aussi loin de la mer ; elle n'est pas signalée au Pays Basque, mais doit être depuis longtemps au Ménez-Hom (Finistère). A. Barbier l'a récoltée dans les Landes en 1966.

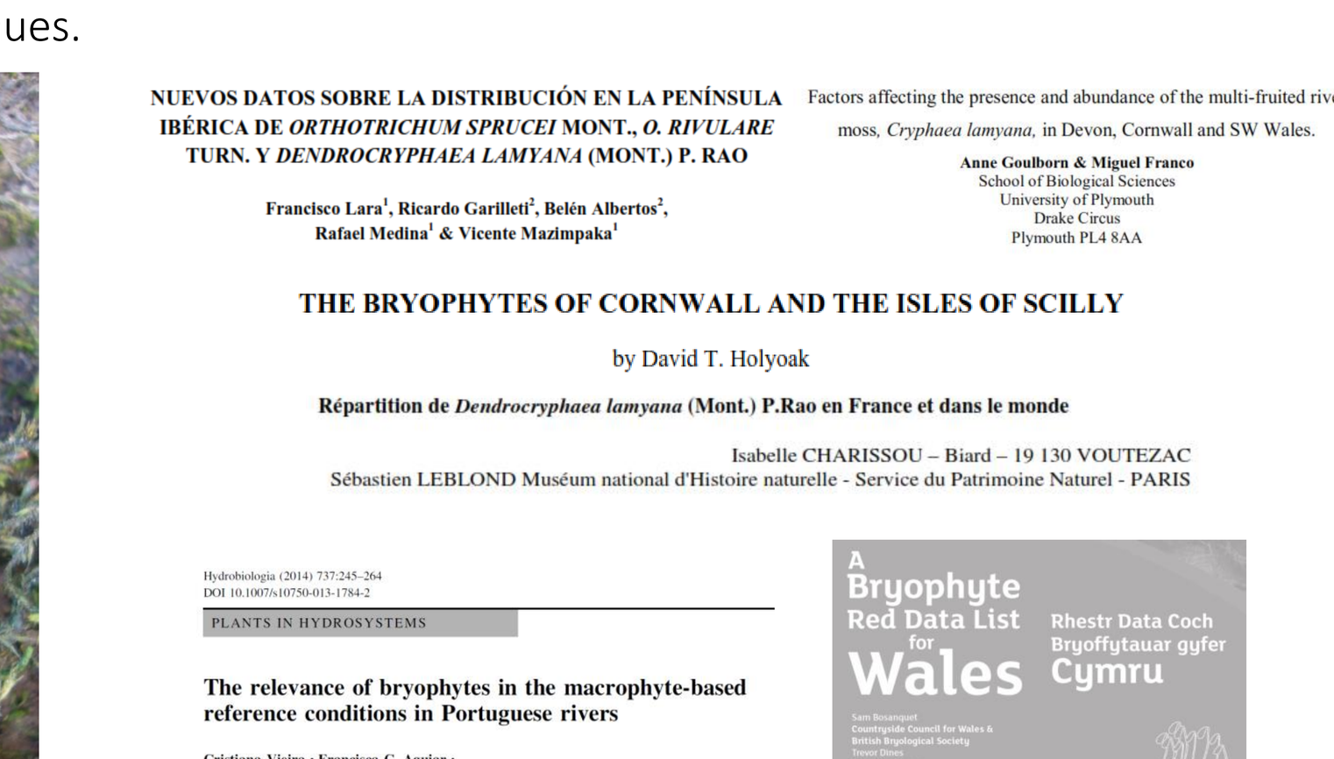
Images and texts from TOUFFET, J., 1969. Les éléments de la bryoflore armoricaine et leur intérêt phytogéographique. Botanica Rhedonica, ser. A, 7: 29-72.

Chorologic classification: The species was classified by Hill & Preston (1998) as an oceanic-southern temperate species, although its distribution in fact reveals a highly oceanic affinity;
Countries: recorded from 65 sampling points, in Portugal, Spain, France, Italy and Wales.

XXI Century

And more recently…
2000-2005: Holyoak reviews the world range of the species which consists of few and scattered localities in England, Wales, France, Portugal, Spain and Italy and revisits sites in England and Wales. Considered a priority Species within the UK's Biodiversity Action Plan.
2005-2006: Franco and Goulborn study the habitat requirements of the species in SW Wales and Cornwall
2006 : Lara *et al.* describe new occurrences for Spain.
2005-2014: Fieldwork records (PhD of C. Vieira and Water framework Directive implementation in Portugal) reveal 48 sampling points with *Dendrocryphea lamyana,* a species pointed as relevant to the macrophyte-based reference conditions in Portuguese rivers.
2010: Bosanquet uses *Cryphaea lamyana* in Wales to explain a detailed monitoring technique for rare riverine species.
2015: Holyoak searches in numerous possible habitats during 12 years of fieldwork covering much of Ireland but never found it.
2015: Charissou revisits the distribution of the species in France and contacts Vieira. Soon a collaboration network with all the authors of this poster begins. The search for population of *Dendrocryphea lamyana* continues.

Dendrocryphea lamyana growing in a tree in the river margin at Corgo river (Portugal). Photo by C. Vieira



NUEVOS DATOS SOBRE LA DISTRIBUCIÓN EN LA PENÍNSULA IBÉRICA DE *ORTHOTRICHUM SPRUCEI* MONT., *O. RIVULARE* TURN. Y *DENDROCRYPHAEA LAMYANA* (MONT.) P. RAO

Francisco Lara[1], Ricardo Garilleti[2], Belén Albertos[2], Rafael Medina[1] & Vicente Mazimpaka[1]

Factors affecting the presence and abundance of the multi-fruited river moss, *Cryphaea lamyana,* in Devon, Cornwall and SW Wales.

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THE BRYOPHYTES OF CORNWALL AND THE ISLES OF SCILLY

by David T. Holyoak

Répartition de *Dendrocryphaea lamyana* (Mont.) P.Rao en France et dans le monde

Isabelle CHARISSOU – Biard – 19 130 VOUTEZAC
Sébastien LEBLOND Muséum national d'Histoire naturelle - Service du Patrimoine Naturel - PARIS

Hydrobiologia (2014) 737:245–264

PLANTS IN HYDROSYSTEMS

The relevance of bryophytes in the macrophyte-based reference conditions in Portuguese rivers

Cristiana Vieira · Francisca C. Aguiar · Maria Teresa Ferreira

A Bryophyte Red Data List for Wales

Rhestr Data Coch Bryoffytauar gyfer Cymru

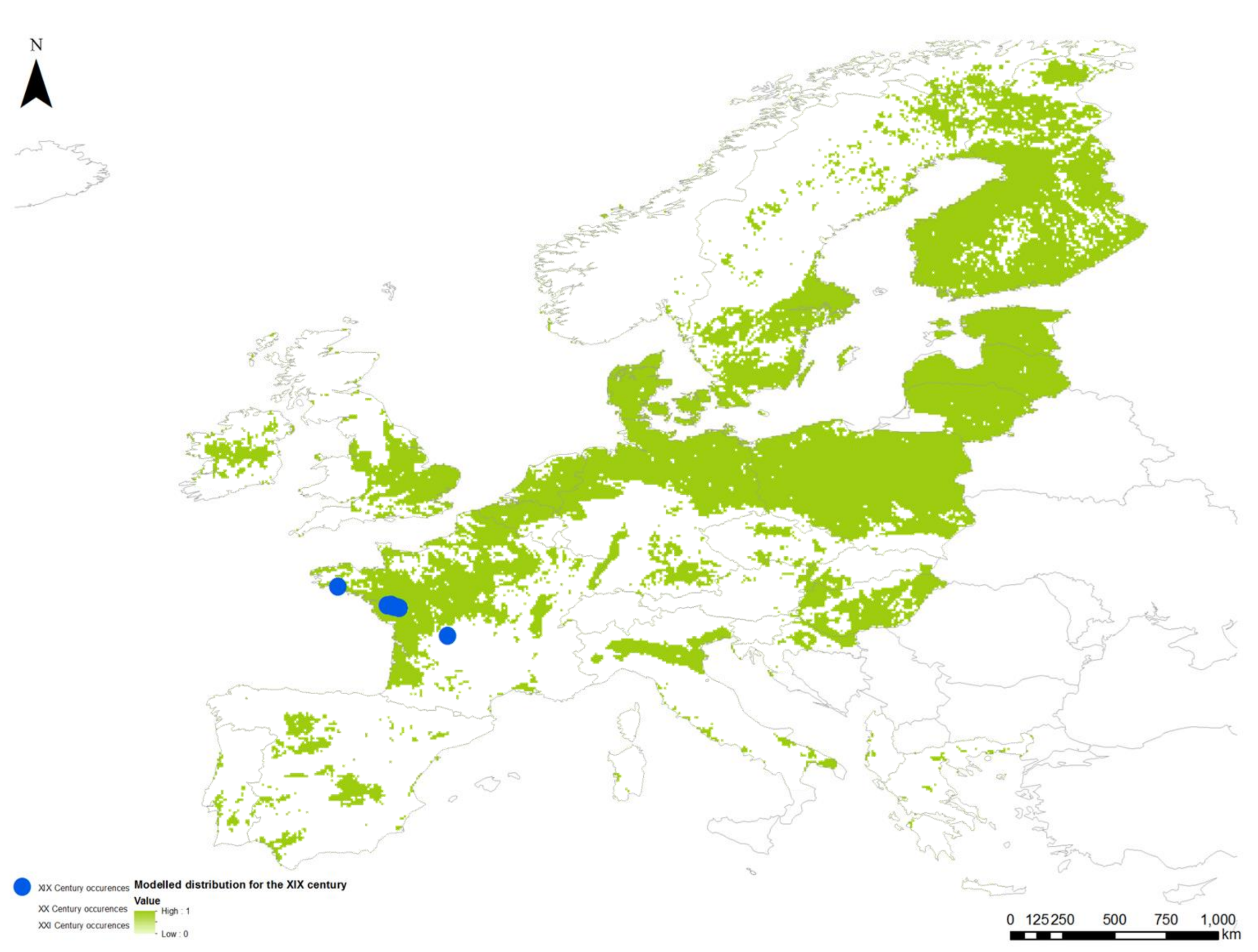
Chorologic classification: considered an Atlantic to Subatlantic element;
Countries: recorded from 298 sampling points, in Portugal, Spain, France, England & Wales.

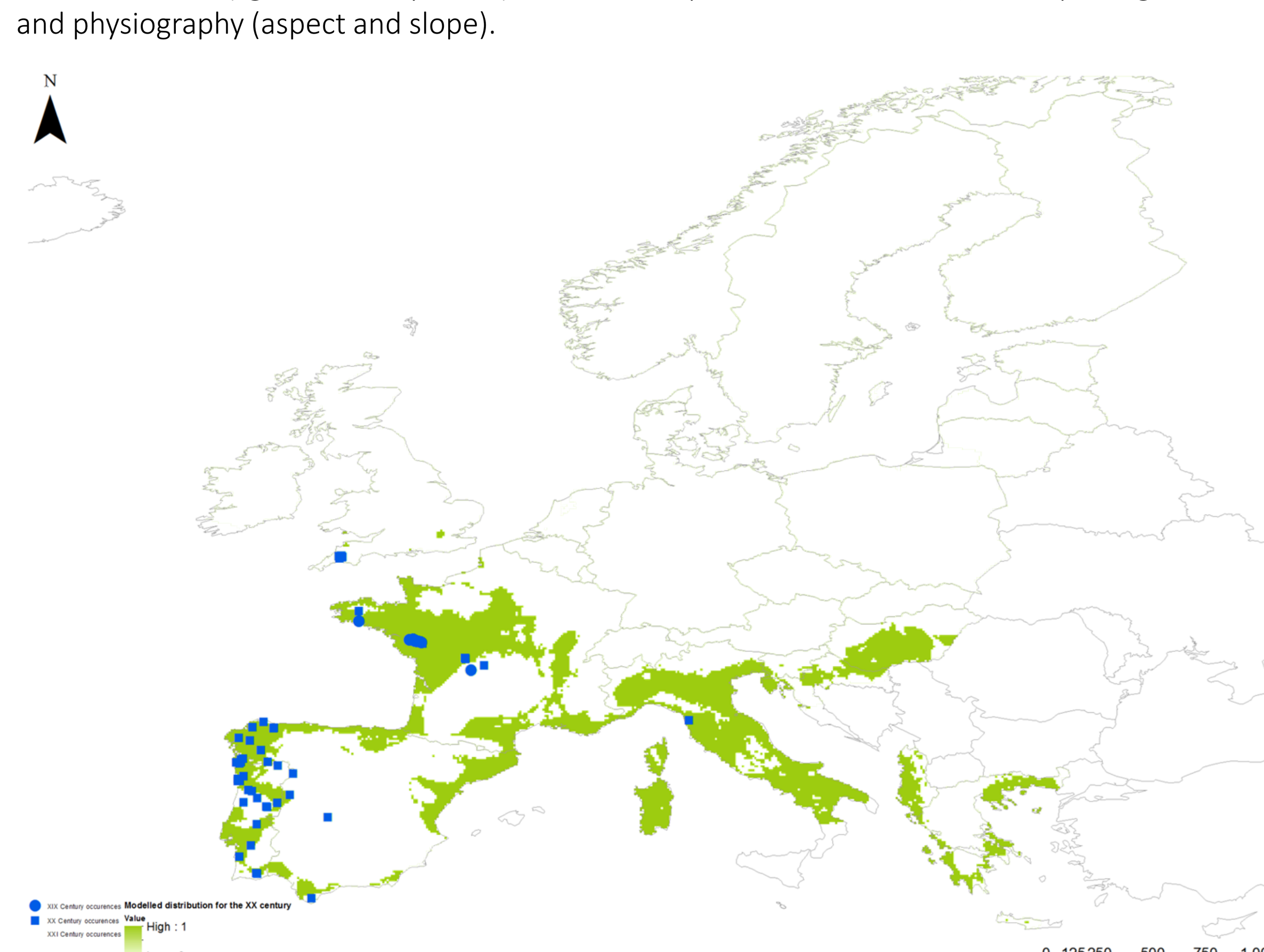
Species Distribution Modelling

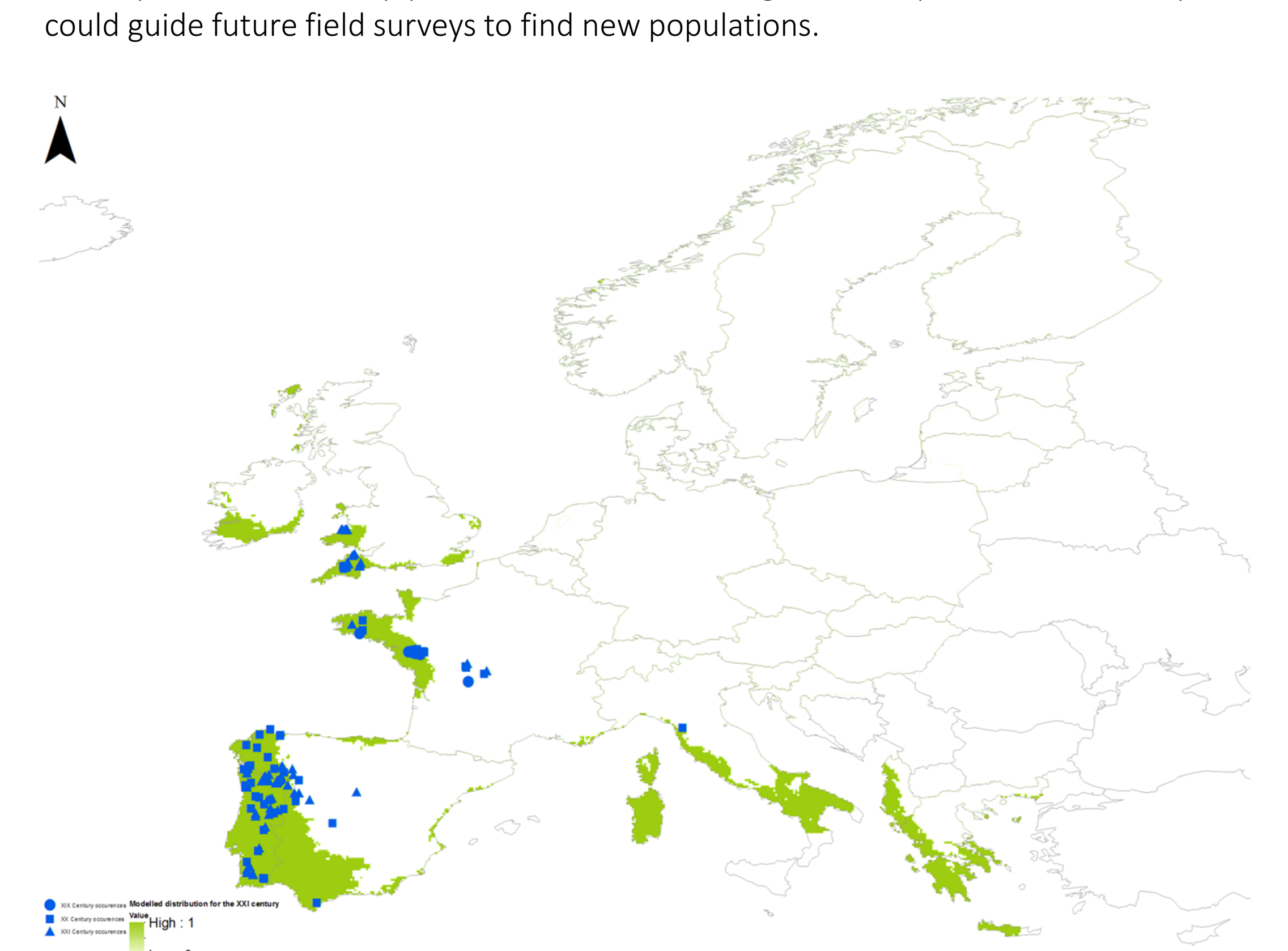
To better understand the distribution of this species we used **Species Distribution Modelling** techniques with the sampling points known for each of the time periods. We modelled the distribution of the species using biomod2 ensemble forecasting package in R environment.

The **occurrence data available** in each century (cumulative information) and a set of 10 uncorrelated environmental predictors were used to perform the models. Environmental predictors include bioclimatic variables (Annual Mean Temperature, Mean Temperature of Warmest Quarter, Mean Temperature of Coldest Quarter, Annual Precipitation, Precipitation of Wettest Quarter) geochemistry data (stream water pH and NO^{3-} content, and top soil grain index) and physiography (aspect and slope).

We utilized the following **modelling algorithms**: Random Forest, Artificial Neural Networks Multiple Adaptive Regression Splines, MAXENT and Classification Tree Analysis. Only models with an AUC evaluation score ≥0.7 were included in the ensemble forecast, which was then binarized to obtain the maps below. Results are presented in the three Europe maps for each century. This XXI century potential distribution range of the species at the European level could guide future field surveys to find new populations.







Model variables' importance

Mean variable importance across modelling algorithms and runs was calculated and environmental predictors were ranked **in the total of runs of all the models** accordingly.

Environmental predictors (XIX century)	Rank position
Stream water pH	1
Top soil grain index	1
Precipitation of Wettest Quarter	3
Annual Mean Temperature	4
Aspect	5
Mean Temperature of Warmest Quarter	5
Annual Precipitation	5

The three tables show **the rank position** of variables at the macro and meso-scale in the Species Distribution models for each century.

Environmental predictors (XX century)	**Rank position**
Stream water NO^{3-}	1
Stream water pH	2
Top soil grain index	3
Aspect	3
Annual Mean Temperature	5
Mean Temperature of Warmest Quarter	5

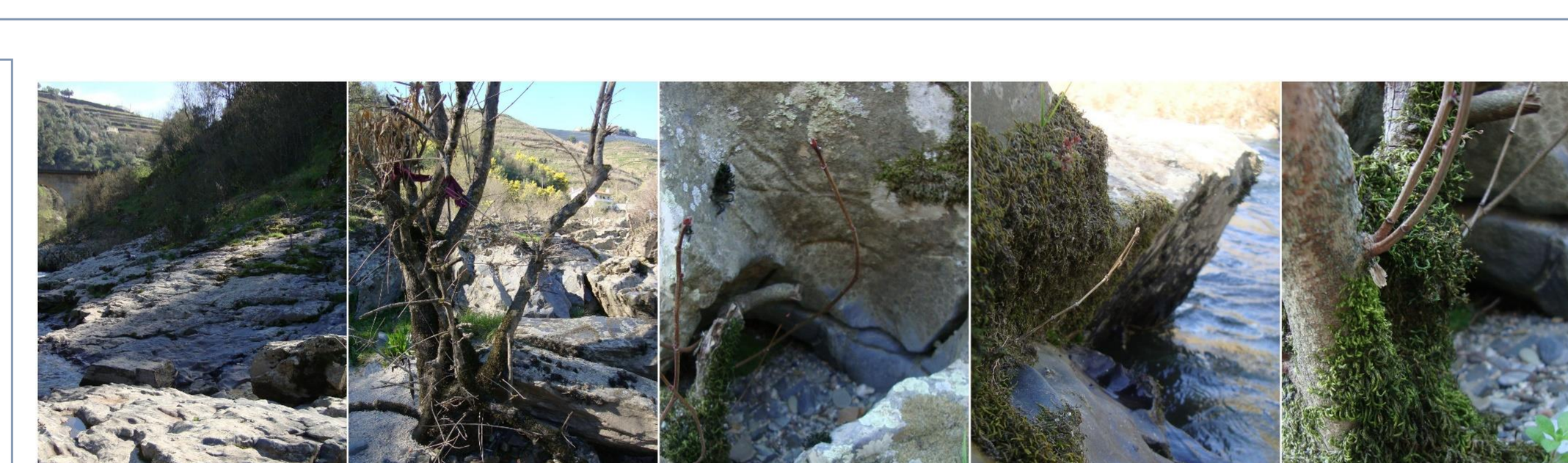
We believe that further improvement of this model and understanding of the **underlying factors** determining species occurrence at the European level will be achieved only with the inclusion of flow discharge or stream order variables. Additionally the validation of potentially erroneous occurrence data, namely in Italy, could also contribute for model refinement.

Environmental predictors (XXI century)	Rank position
Aspect	1
Top soil grain index	2
Stream water NO^{3-}	3
Slope	3
Stream water pH	5

Micro-Ecology

Currently, we observed that *Dendrocryphea lamyana* tends to prefer microhabitats:

…growing frequently slightly above annual mean water level but inundated for at least 1-2 week periods each winter;
…with riparian tree or rocks as permanently stable substrates;
…located in places less severely frosted or droughted;
…located in sunny south-facing substrates in colder climates;
…located in shaded substrates in hotter climates or more temporary rivers.



Dendrocryphea lamyana growing in tree bases and rocks by the river margin at Corgo river (Portugal). Photo by C. Vieira

Further research

Now that a network of researchers and a platform of all the known occurence data of *Dendrocryphea lamyana* is established, we aim to:

… identify probable sampling gaps of this species in Europe;
… superimpose the species occurrence with macroclimatic and hydrologic variables to better understand species ecology;
…discuss and propose an updated conservation status in Europe considering the results of this work and the current integrity of European fluvial scenarios;

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