



XVIIth EHW BRETAGNE 2022

**“From coastal to continental heaths:
challenges in ecological restoration”
August 21th - 27th - Bretagne 2022**

**Programme
Abstract Book
Excursion guide**



CONTENTS

SPONSORS & AFFILIATES	3
WELCOME FROM THE ORGANISERS	7
WELCOME FROM THE CHAIR OF THE NETWORK	8
INFORMATION	9
Emergency telephone numbers.....	9
First-aiders.....	9
Hotel.....	9
Taxis.....	9
The best of Brest.....	9
WORKSHOP PROGRAMME	10
PARTICIPANTS	11
SCIENTIFIC PROGRAMME	12
ORAL SESSIONS	14
POSTERS PROGRAMME	21
EXCURSION GUIDE	26



SPONSORS & AFFILIATES

We are grateful to the following for their time, input and direct sponsorship.



**French Society
of Phytosociology**
(Société Française
de Phytosociologie)
www.phytosocio.org

Created in 2002, the French Society of Phytosociology is a NGO which objectives are the promotion and the development of Phytosociology, both from theoretical and applied point of view, in France, Europe and over francophone countries. Its actions are related with the other national associations in Europe:

- > development of scientific knowledge and exchanges in the field of Phytosociology;
- > preservation and valorisation of the bibliographic information;
- > elaboration of regional and national Prodromus of vegetation;
- > applications in assessment and management of natural and anthropised environments;
- > redaction and edition of scientific and pedagogic manuals and books;
- > promotion of scientific publications;
- > organization of international symposiums and seminars...

International meetings

- 2002: Les landes et la Directive Habitats, Limoges. (Proceedings: n° 155, vol. 1, *Acta Botanica Gallica*, 2008).
- 2008: La Phytosociologie face aux défis de la connaissance et de la gestion durable des espaces naturels. Hommage au Professeur Jean-Claude Rameau, Nancy. (Proceedings: vol. 3-4, *Revue Forestière Française*, 2010).
- 2010: Centenaire de la Phytosociologie sigmatiste. Honneur au Professeur Jean-Marie Géhu, novembre 2010, Brest (Proceedings: vol. 1, *Documents Phytosociologiques*, série 3, 2014).
- 2012: Les Prodromes des végétations d'Europe (Proceedings: vol. 6, *Documents Phytosociologiques*, série 3, 2017).

2012: La cartographie des végétations en Europe (Proceedings: vol. 6, *Documents Phytosociologiques*, série 3, 2017).

2014: 1973-2014 : La phytosociologie paysagère, des concepts aux applications (Proceedings: vol. 9, *Documents Phytosociologiques*, série 3, 2020).

2016: Vegetation and Nature Conservation, Saint-Brieuc.

2017: Valeurs et usages des zones humides, Bailleul (Proceedings: vol. 12, *Documents Phytosociologiques*, série 3, 2019).

Management and Conservation of Biodiversity international seminars

2014: VIII. Red lists of habitats and vegetation series, Oeyreluy (landes).

2017: XI. Vegetation of insular environments of Atlantic and Mediterranean regions, Ouessant (Finistère).

Field sessions are regularly organized: Pays Basque, Forêt de Rambouillet, Bryosociologie, Végétations des falaises et des landes de l'île d'Ouessant, Les milieux associés à la forêt (manteaux, ourlets, végétation des coupes et chablis), Alsace, Hoëdic, Cap Sizun et Île de Sein...

Edition

Since 2014, the SFP is editing the **Documents Phytosociologiques** : 14 volumes have been published between 1994 to 2020. The journal is being now transformed to a online journal.

Since 2017, the SFP is editing the **Cahiers de Braun-Blanquetia** : 7 issues have been published.

Prodromus of France Vegetation

It aims to update and fulfill the first publication up to the plant association level. (Bardat J., Bioret F., Botineau M., Boulet V., Delpech R., Géhu J.-M., Haury J., Lacoste A., Rameau J.-C., Royer J.-M., Roux G. & Touffet J., **2004** - *Prodrome des végétations de France*. Collection Patrimoines Naturels 61, Muséum National d'Histoire Naturelle, Paris, 171 p.)

About 50 phytosociological Classes have been published since 2009; available on : www.phytosocio.org

Bioret F., Gaudillat V., Royer J.-M., 2013 - The Prodrome of French vegetation: a national synsystem for phytosociological knowledge and management issues. *Plant Sociology* 50(1) : 17-21.



Since the decentralization laws, the French regions have the authority to create Regional Nature Reserves (RNR), alongside National Nature Reserves (NNN).

The Regional Council of Brittany has thus created 9 RNRs. 4 other sites have been designated during this current mandate.



Parc naturel régional d'Armorique

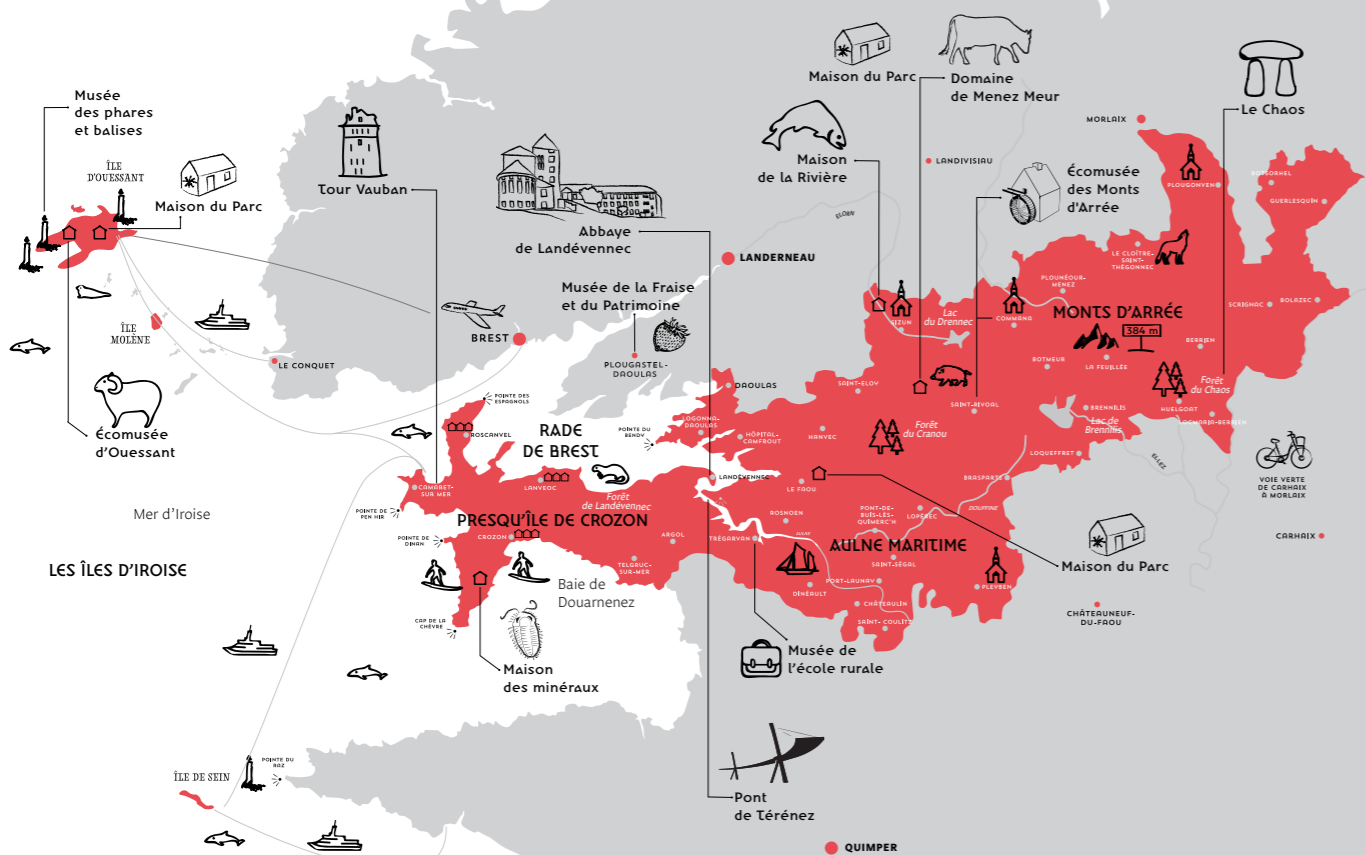
Created in 1969, the Regional Natural Park of Armorique (PNRA) brings together 44 municipalities. It works on environmental, economic and land use issues. The Monts d'Arrée registered site very quickly marked the singularity of this territory. The Park is currently working on the renewal of its charter for the next 15 years.

Designated as the Natura 2000 operator of the Natura 2000 sites FR 5300013-39 Monts d'Arrée and Menez Meur (2007) and FR 5300014 Menez Hom (2008), the PNRA is also the operator of the Natura 2000 site of the Rade de Brest, the terrestrial parts of the Iroise Sea islands and the Huelgoat forest.

Today, 6 RNRs out of 13 are designated for the protection of heathland and Sphagnum peat bogs, including the Cragou - Vergam RNR (excursion n°3). The Region appoints an institutional or associative operator to ensure the management of RNR sites and habitats. 2 Regional Natural Parks (PNR) and another one as project are the second center of nature and landscape protection under the aegis of the Regional Council of Brittany.

In this capacity, the Park carries out restoration and/or conservation work on habitats of community interest, including moors and peat bogs. Thus, the Park participated in the Interreg HEATH in the 2000s, it co-sponsored with Bretagne Vivante the national call for projects for biodiversity «Restoration of desensitized moors in the Monts d'Arrée» and currently supports the LIFE moorland of Armorique, which started in January 2021.

Administrative boundary of the Armorique Regional Nature Park, PNRA



Laboratoire Géoarchitecture. Territoires, Urbanisation, Biodiversité, Environnement (Université de Bretagne occidentale)

Since 1986, this pluridisciplinary research unit gathers 25 researchers in Brest (UBO) and Lorient (UBS) universities, representing a wide range of research fields : ecology, economy, urbanism and land planification, architecture, sociology, genetics...



Bretagne Vivante is a regional association of reference for the protection, management and conservation of spaces and species in historic Brittany. It also carries out nature education and training activities.

Missions

> Knowledge: Bretagne Vivante participates in naturalist and scientific studies and expertise to improve our knowledge of Brittany's natural heritage. This data is essential for understanding the management and conservation of species and areas.

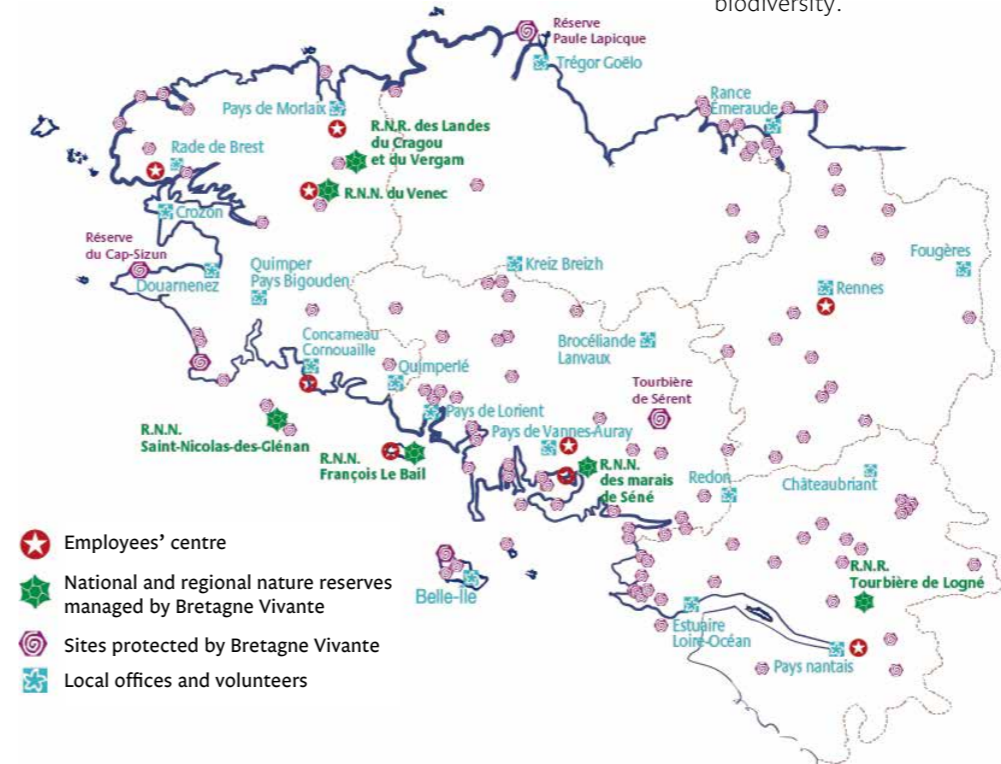
Two main research transversal axis are concerning *Territories dynamics and Heritages construction and management*.

- Among a wide diversity of research programmes, recent programmes are related to heathlands:
 - > National programme dealing with the assessment of conservation status of heathland habitats (2018-2021);
 - > PhD thesis (2021-2024): Historical Ecology of Armorican maritime cliffs: origin and dynamic of coastal heathlands (Erwan Glemarec).

- > Raising awareness and training: Based on its educational project, Bretagne Vivante develops popular education on nature for all audiences. The aim of our training and animation programmes is to re-establish a link between humans and nature, in direct contact with living things.
- > Protecting: Bretagne Vivante runs a unique regional network of over 135 natural sites, including 4 national nature reserves and 2 regional nature reserves. Our monitoring, management and promotion activities are carried out in partnership with the State, local authorities and public and private owners.
- > Activism: Bretagne Vivante and its local branches carry out militant and legal actions to ensure that nature is taken into account on a daily basis. The association is in constant discussion with the public authorities by participating in various local, departmental and regional bodies and commissions.

Key figures

- > Present in 5 departments
 - > 4,000 members
 - > 20 local branches
 - > 70 employees and 400 active volunteers
- More than 60 years of action in the service of nature and biodiversity.



- ★ Employees' centre
- 🌿 National and regional nature reserves managed by Bretagne Vivante
- 🌀 Sites protected by Bretagne Vivante
- 🏠 Local offices and volunteers





**Centre d'étude
du milieu d'Ouessant**

The CEMO is an association (1901 law) created in 1984 and based on the island of Ouessant. Its main missions are the study of the island environment, education on the environment and sustainable development, as well as the management of accommodation at the ornithological center.

Study of the island environment

Since 1984, the CEMO has been carrying out a permanent inventory of the fauna and flora of the island of Ouessant, monitoring the migrations and nesting of birds.

The CEMO also participates in several scientific programs and surveys coordinated on a regional or national scale, and regularly carries out environmental diagnoses or naturalist expertise for various organizations, particularly in the fields of restoration ecology, land use planning and territory, management and conservation of biodiversity and habitats. Versatile in nature, his team is interested in many fauna and flora groups, from the terrestrial domain to the foreshore.

If the association is based on Ouessant and its actions mainly centered on the North Iroise, the CEMO nevertheless regularly carries out missions on the archipelago of Molène and the island of Sein.

Environmental education and sustainable development

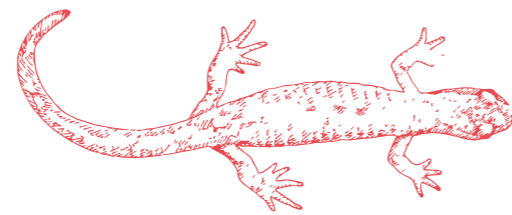
The wonder aroused by the observation of a biodiversity as rich and original as that of the island of Ouessant contributes to the awareness of the fragility of ecosystems and their preservation. This is why since its creation, the CEMO has invested in public awareness and environmental education. Thus, a good number of "nature" outings are organized each year for various audiences (schoolchildren, naturalists, associations, hikers, etc.), on different themes (seaweed and seaside animals, avifauna, changing landscapes, etc.)



In addition, the association organizes an annual exhibition on themes related to the island environment, visible in the premises of the center in summer and publishes its own collection of popular works, the Cahiers du CEMO (9 issues published nowadays).

The popularization actions are aimed at both the public passing through the island and the island public. Many actions are carried out with young audiences, especially schoolchildren on the island of Ouessant. Conferences are also organized to reach the adult public, which can - on certain occasions - be associated with various mediation projects (role play, documentation of photographic collections, participatory science, etc.).

The CEMO also manages the ornithological center, equipment of the Parc Naturel Régional d'Armorique, with a capacity of 39 beds. Equipped with a multipurpose room, a meeting room and a laboratory, it is the ideal equipment to receive various types of public. The center thus welcomes a diverse public of scientists and academics (naturalists, ecologists, sociologists, ethnologists, archaeologists, etc.), amateur ornithologists coming to follow migrations, schoolchildren, hikers, etc.



**The Communauté de communes
Presqu'île de Crozon-Aulne
maritime**

includes ten communes: Argol, Camaret-sur-mer, Crozon, Landévennec, Lanvéoc, Le Faou, Pont-de-Buis lès-Quimerç'h, Rosnoën, Roscanvel and Telgruc-sur-mer for a total of 24,132 inhabitants.

This community is responsible for the management of natural areas. With a team of 9 people, it can act to manage and preserve fragile environments within the framework of Natura 2000, the Regional Nature Reserve of Geological Sites and for the management of the properties of the Conservatoire du littoral and the Department of Finistère.

WELCOME FROM THE ORGANISERS

Bernard Clément

Who are we ?

Where do we come from ?

In 1972, 3 colleagues from the University of Rennes 1 decided to set up a project to study the Armorican heaths. They founded the Armorican Heaths Study Group. In 1979, the British Ecological Society and the French Society of Ecology organized an international symposium in Paimpont (Bretagne). In 1982, Professor Charles Gimingham invited certain researchers to Aberdeen (Scotland). We are founding the European Heathland Network with the aim of meeting every 3 years in a different country.

I organized the 4th European Heathland Workshop in Fréhel (Côtes d'Armor) and in the Monts d'Arrée (Finistère) in 1992. Today, we welcome you to the 17th EHW in Brest.

In the meantime, in 2007, another international colloquium within the framework of the INTERREG HEATH program took place in Chateaulin (Finistère - Bretagne) in which some of you were present.

The 17th EHW has as its general theme, the restoration of sites and heaths; some sites are subject to overcrowding while others are no longer managed or transformed into afforestation of exotic species, such as *Picea sitchensis* or *Cupressus lawsoniana*. For many years, regional and local authorities, such as the Parc Naturel Régional d'Armorique or Communauté de communes Presqu'île de Crozon-Aulne maritime, or nature protection associations such as Bretagne Vivante, have been working to carry out operations to restore heathland habitats. Scientific research is carried out in connection with restoration operations, in particular at the University of Bretagne Occidentale (UBO). A Life program is now conducted under the aegis of PNR Armorique

The purpose of the excursion program is to make you discover the remarkable landscapes and the results of the management and restoration operations of the heaths near Brest. Participants in the post-session will have the privilege of discovering other remarkable sites in Brittany.

To conclude, I would like to warmly thank the institutions, associations, people in charge of them for their involvement during this 17th EHW 2022.

WELCOME
BIENVENUE
DEGEMER MAT
BONN ARRIV



A WORD OF WELCOME FROM THE CHAIR OF THE NETWORK

Geert De Blust

Dear friends and colleagues,

Welcome to the 17th European Heathland Workshop, undoubtedly a very special one (as were all previous workshops). More than 40 years ago, in July 1979, the organizer of this workshop, Bernard Clément, was one of the initiators of a meeting, here in Brittany, where ecologists from France and the UK discussed heathland ecology and the management measures needed to keep the heath in a favourable conservation status and preserve it for the future. The direct exchange of knowledge and experience was highly appreciated and thus it was agreed upon to meet again at regular times. Since then, every two to three years an international workshop is organized in a rather informal way in one of the heathland regions of Europe, as in 1992 here in Brittany, when Bernard Clément invited us for the 4th European Heathland Workshop. And now, 30 years later he, his wife Mireille and colleagues welcome us again. Thank you so much for that. I wonder how the French heathlands, scientific knowledge as well as management expertise evolved since then.

This reflection on the past however will not concern that many workshop participants today. Maybe much more important is the fact that with the current workshop we can finally return to our work and passion after that uncertain, unpleasant and sometimes scary corona-time. I hope you didn't suffer too much from Covid-19 and your activities in the heathland were not hampered excessively either. Undoubtedly, you've noticed that because of limited freedom of movement and other restrictions enforced by the different levels of lockdown, people went for a walk in their own neighbourhood and started to explore the regions nearby. And then, many of them (re)discovered heathlands as the perfect place to relax, to wander around, to wonder and admire. Consider this a sign that the results of our efforts to understand the functioning of heathland and preserve and manage it properly, are well appreciated by the public and society. This may encourage us to continue our work as before.

And there is still a lot of work to be done. Increased societal interest in heathlands and changing environmental and spatial conditions present new challenges. How to balance heathland as a priority place for outdoor recreation and relaxation, and heathland as a hotspot for biodiversity? How can heathland contribute to climate mitigation and adaptation measures and how is it impacted by climate change itself? What are favourable conditions for carbon

sequestration in a heathland and how effective is this C-sequestration compared with carbon accumulation in other ecosystems? Wouldn't increasing incidence of devastating wildfires finally cause the loss of heathland in various regions of Europe? Is heathland restoration and even day-to-day management still worthwhile given the lasting very bad environmental conditions, the continuous pressures, the increasing isolation, the remaining impoverished communities? Shouldn't rewilding of heathland provide better opportunities to biodiversity compared to strictly managed heathlands? These and many other questions and remarks are often heard. More research is needed, smart and systematic experiments carried out, and especially dissemination of results and insights should be high on the agenda, formulated in such a way that they can support decision making, inspire visions for the future or can serve evidence-based policy and management. With all these issues in mind, it is clear that we as managers and researchers should actively involve in the public debate.

It is right that the heathland landscape is a common European cultural heritage. However, being aware of this is not sufficient to secure its future. A re-examination of the role and function of this century-old landscape for society today and tomorrow is necessary. This calls for an integrated approach: heathlands as a functional part of the complex world we are living in. This perception is obvious to us; in the past we regularly argued to re-establish the link between for instance agricultural land and adjacent heathland, to assess the potential role of heathlands in a multifunctional landscape. However, segregation and isolation still prevail. Models that propose an alternative land use design are rarely used or put into practice. Of course, this is not merely the fault of those who reflect on these new arrangements. It is a sign of unbalanced economic and political power, of the weak integration of knowledge and of policy domains, of limited understanding and mutual trust of different points of view and interests, of a lack of real collaboration towards common objectives. We as the European Heathlands Network and our European Heathland Workshop will not change this situation fundamentally. But, we should not abandon hope either; on the contrary, we must look to the future and strengthen the efforts to establish proper integrated research and action. That means broadening our network and involving specialists and stakeholders with other backgrounds than the usual suspects: for instance agronomists and economists, sociologists and spatial planners, policy makers and transition thinkers.

This may be an ideal; I'm aware of the limitations of our informal network. But managers and researchers should not restrain themselves, let's begin to explore opportunities and necessities to broaden our scope of action; let's work more interdisciplinary; let us invite agronomists, archaeologists, soils scientists (as was done in the past); let us start from a socio-ecological system perspective when analyzing research and management questions.

The program of this 17th European Heathland Workshop looks promising. The contributions and field visits will give ample opportunity to gain insight into new scientific and practical developments regarding the functioning and management of heathland ecosystems in our complex world. Results of in-depth research, broad and explorative analyses as well as discussions with different stakeholders will feed our knowledge network and community of practice, both needed more than ever to promote collaboration and mutual learning. With this workshop we will once again have the opportunity to make progress and collect the necessary information needed to underpin scientifically sound and socially accepted heathland conservation and management.

Enjoy the workshop

Geert De Blust

Former Research Institute for Nature and Forest - INBO

INFORMATION

EMERGENCY TELEPHONE NUMBERS

Emergency phone number: 112

FIRST-AIDERS

› Bernard Clément: + 33 (0) 6 77 90 90 96

› Mireille Clément: + 33 (0) 6 56 85 35 82

HOTEL

› phone number: + 33 (0) 2 98 80 78 07

› info@hotelcenter.com

TAXIS

Please ask desk Hotel Center

THE BEST OF BREST

<https://fr.calameo.com/read/004656587c234be13a8d3?page=1>



WORKSHOP PROGRAMME

Sunday 21th August

Arrival

16.00 – 20.00	Arrival & check in at the Hotel Center, Brest
20.00	Dinner

Monday 22th August

07.00 – 08.30	Breakfast
09.00 – 09.30	Welcome by the organisers Opening by the chair of the EHN, Geert de Blust
09.30 – 10.30	Oral session 1 chaired by Isabel Alonso
10.30 – 11.00	Coffee break
11.00 – 12.00	Oral session 1
12.30 – 13.30	Lunch
14.00 – 15.30	Posters session chaired by Joost Vogels
15.30 – 16.00	Coffee break
16.00 – 18.00	Oral session 2 chaired by Heidi Iren Saure
20.00	Dinner

Tuesday 23th August

07.00 – 08.30	Breakfast
09.00 – 10.30	Oral session 3 chaired by Henk Siepel
10.30 – 11.00	Coffee break
11.00 – 12.30	Oral session 3
12.30 – 13.30	Lunch
14.00 – 15.30	Posters session
15.30 – 16.00	Coffee break
16.00 – 17.00	Presentation / discussion by Jaime Fagundez European heathland carbon storage
17.00 – 18.00	Presentation by Guest speakers - chaired by Geert De Blust Glemarec Erwan, Chevrollier Coentint, Bioret Frédéric Presentation of LIFE Armorican heaths, by Le Guen Yves-Marie
20.00	Dinner

Wednesday 24th August

07.00 – 08.30	Breakfast
08.45	Board bus to visit “ Presqu’île of Crozon - Cap de la Chèvre”
12.30 – 13.30	Lunch stop
17.00 – 18.00	Bus travel to Hotel by Menez Hom
20.00	Dinner

Thursday 25th August

06.30 – 07.15	Breakfast
07.45 – 08.45	Board bus to Le Conquet
09.00 – 10.15	Travel time by boat: Penn Ar Bed Compagny
10.30 – 12.30	Trip in Ouessant Island (walking)
12.30 – 13.30	Lunch stop
13.30 – 16.45	Trip in Ouessant Island (bus)
17.00 – 18.15	Travel time by boat: Penn Ar Bed Compagny
18.15 – 19.15	Bus travel to Hotel
20.00	Conference dinner

Friday 26th August

07.00 – 08.30	Breakfast
08.45	Board bus to Monts d’Arrée
09.30	Trip in Menez Meur (PNR Armorique)
12.30 – 13.30	Lunch stop
13.30 – 16.45	Trip in Cragou (RNR Bretagne Vivante)
17.00	Bus travel to Hotel
20.00	Dinner

Saturday 27th August

Departure

07.30 – 08.30	Breakfast
09.00	Optional extension: tour of coastal Heathlands and continental of north east Côtes d’Armor (Erquy, Fréhel, La Poterie...)

PARTICIPANTS

Family name First name - Affiliation - Pays

Alonso Isabel - Natural England - UK	Mistarz Margaux - PatriNat - OFB/CNRS/MNHN - France
Andreasson Hans - Väst kuststiftelsen - Suède	Naedts Frederik - Natuurpunt Beheer - Belgique
Bifolchi Aline - RNR Glomel - France	Olsen Henrik - The Danish Nature Agency - Danemark
Bioret Frédéric - Géoarchitecture - UBO - France	Panter Chris - Footprint Ecology - UK
Boillot Sarah - RNR Glomel - France	Pedersen Halvard - Norwegian Nature Inspectorate - Norvège
Bolton Adam - Surrey Wildlife Trust - UK	Post Peter - County Administrative Board of Västra Götaland - Suède
Bourdoulous Jérémie - PNRA - France	Quénot François - CEMO - France
Boutaud Estève - Institute for Ecology, Leuphana University of Lüneburg - Allemagne	Reyes Figueira Otilia - University of Santiago de Compostela - Espagne
Chevrollier Coentint - Géoarchitecture - UBO - France	Saure Heidi Iren - NLA University College - Norvège
Clément Bernard - Retired from University Rennes 1 - France	Schmidt Inger Kappel - University of Copenhagen - Danemark
Clémence Mireille - Retired from Education Nationale - France	Schouten Jos - Natuurmonumenten - Pays-Bas
Cools Corina - Agency for Nature and Forest - Belgique	Scott Nick - Irlande
Coroller Harmonie - PNRA - France	Sewerniak Piotr - Nicolaus Copernicus University in Toruń - Pologne
Damgaard Christian - Aarhus University - Danemark	Sheeby Skeffington Micheline - NUI Galway - Irlande
De Blust Geert - Research Institute for Nature and Forest - INBO - Belgique	Sibbett Nick - The Landscape Partnership - UK
De Winter Jef - Agency for Nature and Forest - Belgique	Siepel Henk - Radboud Institute for Biological and Environmental Sciences (RIBES) - Pays-Bas
Dictus Chris - Natuurpunt - Belgique	Smits Jap - Jap Smits ecological advise - Pays-Bas
Diemont Herbert - Volt - Pays-Bas	Smits Ludo - Research centre B-WARE - Pays-Bas
Eklo Michael - Norwegian Nature Inspectorate - Norvège	Strandberg Morten - Aarhus University, Department of Ecoscience - Danemark
Fagundez Jaime - University of A Coruña - Espagne	Sawtschuk Jérôme - Geoarchitecture - UBO- France
Fry Stephen - freelance - UK	Taylor Toby - RSPB - UK
Glémarec Erwan - Géoarchitecture - UBO - France	Thoonen Marijke - Research Institute for Nature and Forest - Belgique
Gorissen Ingmar	Thorvaldsen Pal - NIBIO - Norvège
Guéguen Ségolène - Communauté de communes Presqu’île de Crozon-Aulne maritime - France	Valbuena Maria Luz - University of León - Espagne
Hansen Rikke - Aarhus University - Danemark	Vanlerberghe Wouter - Agency for Nature and Forest - Belgique
Hederstedt Ellinor - Nature conservationist - Suède	Van Assche Luc - Agency for Nature and Forest - Belgique
Hendrix Jef - Natuurpunt Beheer vzw - Belgique	Van der Bijl Lilian - Danemark
Hilkjaer Thomas - Zealand, Academy of Technologies and Business - Danemark	Van Hove Werner - Agency for Nature and Forest - Belgique
Hjorth Ceylan Emilie - Zealand - Danemark	Vansteenbrugge Hans - Agency for Nature and Forest - Belgique
Holc Jerzy - Pologne	Velle Liv Guri - Moreforskning - Norvège
Holder Emmanuel - Bretagne Vivante - France	Verbaarschot Evi - Research Centre B-WARE - Pays-Bas
Holloway Simon - Forestry England - UK	Vogels Joost - Bargerveen foundation Nijmegen / RIBES Dept. of Animal ecology and -ecophysiology, Nijmegen - Pays-Bas
Jacobs Karen - Agency for Nature and Forest - Belgique	Walmsley David - Leuphana University Lüneburg - Allemagne
Kaland Peter Emil - Department of Biological Sciences, University of Bergen - Norvège	Wiersinga Annet - Pays-Bas
Kunz Mięczysław - Nicolaus Copernicus University in Toruń -Pologne	
Kvamme Mons - The Heathland Centre - Norvège	
Larzillière Agathe - PNRA - France	
Leguen Yves-Marie - PNRA - France	
Lerest Maïwenn - CPIE Cotentin - France	
Lindholm Mattias - Väst kuststiftelsen - Suède	
Massard Olivier - CŒUR Emeraude - France	
Meulebrouck Klaar - Agency for Nature and Forest - Belgique	
Meunier Nicole - Association les Landes Monténeuf - France	

SCIENTIFIC PROGRAMME

Session 1 - HEATHLAND DYNAMICS / HEATHLAND PATTERNS MONDAY 22TH

09.30 > 09.50 - **Session 1.1**

Micheline Sheehy Skeffington and Darach Lupton
The story of the heathland Kerry Lily *Simethis mattiazii* in Ireland: its unusual origins and links with France?

09.50 > 10.10 - **Session 1.2**

Jaime Fagúndez and Xabier Pontevedra-Pombal
Plants and soil interlinks in the Galician *Erica mackayana* wet heathlands

10.10 > 10.30 - **Session 1.3**

Piotr Sewerniak, Mieczysław Kunz, Łukasz Mendyk
Rate and spatial pattern of forest succession on dune heathlands in Poland

11.00 > 11.20 - **Session 1.4**

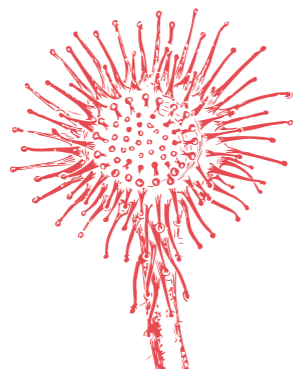
Saure, H.I., Vetaas, O.R., Hassel, K. & Vandvik, V
Restoration of heathlands after afforestation on two islands in Western Norway

11.20 > 11.40 - **Session 1.5**

Mattias Lindholm, Thomas Appelqvist, Bengt Gunnarsson
Effect of late seasonal burning and soil removal on heathland vegetation

11.40 > 12.00 - **Session 1.6**

Rikke Reisner Hansen; Morten Tune Strandberg; Christian Damgaard
Resource-based habitat monitoring



POSTERS SESSION

14.00 > 15.30

Poster 1

Martín-Caramés F., Riveiro S.F., Cruz O., Reyes O.
Effects of fire on the germination of *Corema album* (L.) D. Don ex Steud

Poster 2

Thorvaldsen, P., Velle, L.G., Haugum, S.V., Geange, S. R. and Vandvik, V.
Calluna die-back after winter drought and the role of land use and environmental variation

Poster 3

Crespo N., Fernández-García V., Calvo L., Valbuena L.
The regeneration of *Erica. Australis* L. after a forest fire

Poster 4

Estève Boutaud, David Walmsley, Jelena Daniels, Werner Härdtle, and Vicky Temperton
Effect of traditional lowland heathland management methods - mowing, burning, and choppering - on ground beetles assemblages

Poster 5

Isabel Alonso
Nature based Solutions to the Climate and Biodiversity Crisis from Heathlands

Poster 6

Jaime Fagúndez, Laura Lagos, César Blanco-Arias, Alfonso Laborda, Emilio Díaz-Varela and Ramón Díaz-Varela
Habitat management for conservation in wet heathlands and bogs of NW Spain. Main outcomes from the project Life in Common Land

Poster 7

Inger Kappel Schmidt, An De Schrijver, Kris Verheyen, Sebastian Kepfer-Rojos
Land-use legacies strongly affect heathland soil and vegetation composition for more than a century



Session 2 - HEATHLAND MANAGEMENT RESEARCH MONDAY 22TH

16.00 > 16.20 - **Session 2.1**

Christian Damgaard and Rikke Reisner Hansen
Effect of management on dry heathland vegetation

16.20 > 16.40 - **Session 2.2**

Liv Guri Velle, Siri Vatsø Haugum, Richard Telford, Pål Thorvaldsen, Vigdis Vandvik
Prescribed burning to promote recovery after an extreme drought event in Atlantic Heathlands

16.40 > 17.00 - **Session 2.3**

David Bille Byriel, Hjalte Ro-Poulsen, Sebastian Kepfer-Rojas, Aslak Kappel Hansen, Rikke Reisner Hansen, Mathias Just Justesen, Emil Kristensen, Cecilie Bülow Møller & Inger Kappel Schmidt
Contrasting responses of multiple insect taxa to common heathland management regimes and old-growth successional stages

17.00 > 17.20 - **Session 2.4**

Estève Boutaud, David Walmsley, Jelena Daniels, Werner Härdtle, and Vicky Temperton
Effect of scarification, a novel heathland management method, on ground beetles assemblages

17.20 > 17.40 - **Session 2.5**

E. Verbaarschot, M. Weijters, L. Smits, R. Bobbink, J. Vogels, H. Siepel, P. Verbeek, M. Scherpenisse
Six years of rock powder research I: can rock powder addition be a suitable restoration measure for the recovery of acidified heathland soils?

17.40 > 18.00 - **Session 2.6**

J. Vogels, M. Weijters, E. Verbaarschot, R. Bobbink, H. Siepel, P. Verbeek & M. Scherpenisse
Six years of rock powder research II: is rock powder a better alternative to liming for heathland fauna?

18.00 > 18.20 - **Session 2.7**

Jef Hendrix, Joost Vogels, Stephanie Schelfhout & Joost Deswyspelaere
LIFE Nardus & Limosa: Abiotic restoration by P-mining in relation to breeding meadow birds

Session 3 - HEATHLAND MANAGEMENT APPROACHES & STRATEGIES TUESDAY 23TH

09.00 > 09.20 - **Session 3.1**

Marijke Thoonen
Resilience for and adaptation of Flemish heathland reserves to climate change

09.20 > 09.40 - **Session 3.2**

Jef De Winter
Groot Schietveld, management challenges after big wildfire on military domain

09.40 > 10.00 - **Session 3.3**

Meulebrouck Klaar and Vansteenbrugge Hans
Heathland restoration in Drongenoged (Flanders): The importance of good communication

10.00 > 10.20 - **Session 3.4**

Frederik Naedts
13 years

11.00 > 11.20 - **Session 3.5**

Herbert Diemont, Gerard Jagers and Raymond Schrijver
Ecological restoration of heathlands

11.20 > 11.40 - **Session 3.6**

David Walmsley, Estève Boutaud, Jelena Daniels, Maïke Brune, Benjamin Delory, Isabel Alonso, Vicky Temperton and Werner Härdtle
Ensuring the long-term provision of heathland ecosystem services - the importance of a functional perspective in management decision frameworks

POSTERS SESSION - NEXT

14.00 > 15.30

16.00 > 18.00

Glemarec Erwan, Chevrollier Corentin, Bioret Frédéric
Historical and ecological approach to the Armorican coastal heathlands

Le Guen Yves-Marie

Presentation of LIFE Armorican heaths (issues, objectives, progress of the programme, prospects)

Session 1.1 – Monday 22th

The story of the heathland Kerry Lily *Simethis mattiazzii* in Ireland: its unusual origins and links with France?

Micheline Sheehy Skeffington¹ and Darach Lupton²

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Abstract

Simethis mattiazzii (Vand.) Sacc. is one of our Hiberno-Lusitanian species, as it does not occur as a native in Britain and its nearest substantial populations are centred around north-west Iberia and south-west France. In Ireland, it is confined to Counties Kerry and Cork, in heathland either side of one bay in the south-west; Kenmare Bay. A preliminary genetic analysis of chloroplast and nuclear gene regions in samples from all the Irish populations revealed no genetic diversity, suggesting that the species in Ireland comprises one large, single metapopulation. This would also indicate that the species has arrived in Ireland relatively recently because a species would be expected to develop genetic diversity with a regional signature over time. Though it cannot be determined exactly when the species might have arrived in Ireland, local historical records provide some clues. The potential mode of dispersal is discussed in relation to trade with continental Europe, notably by one Kerry family in connection with the Bordeaux region, which includes the Landes heathland, where *Simethis* is widespread.

Session 1.2 – Monday 22th

Plants and soil interlinks in the Galician *Erica mackayana* wet heathlands

Jaime Fagúndez¹ and Xabier Pontevedra-Pombal²

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Abstract

The wet heathlands of *Erica mackayana* are a special mountain heathland type that occurs in a very narrow oceanic belt on the Cantabrian coastal mountain ranges of North West Spain. It is a highly unique community because of the presence and dominance of the endemic heather *Erica mackayana* and the high values species richness and diversity, including endangered and endemic species.

The floristic composition of this heath type includes several shrubs and graminoids (grasses and sedges) which are structural elements of the community, and several herbs. Shrubs and graminoids are either widespread species found across the Atlantic European region such as *Calluna vulgaris*, *Molinia caerulea* or *Deschampsia flexuosa*, or species with a narrow distribution, some Iberian endemics such as *Pseudoarrhenatherum longifolium* or *Erica umbellata*. The final composition at the fine scale is probably dependent on specific conditions of climate, topography, management and interactions among species.

Here we present findings on the soil condition in relation to floristic composition of shrubs and graminoids throughout the distribution area of the community in Galicia, NW Spain. We used two floristic datasets, from plots and transects, in 18 study sites with different management regimes: abandonment, or grazed by sheep (one site) or different densities of cattle and wild ponies. In each site, we measured a range of parameters in five soil samples, at two different depths.

We identified one main soil gradient explained by high values of soil organic matter (SOM), which correlates to the effective cation exchange complex (eCEC) and assimilable phosphorus (P), and negative Aluminium-Calcium ratios (Al:Ca). Cattle density had a positive correlation with the main gradient in the surface layer. Climate (mean annual temperature and summer temperature and precipitation) and other management levels (grazed vs ungrazed, ponies densities) were unrelated to soil conditions.

Plants response to soil conditions was mostly observed for *Erica cinerea*, *Ulex gallii* and *Molinia caerulea*. The three species showed differences both at the landscaped and plot scales. Frequency of *Molinia caerulea*, was higher in soils with high SOM values and relatively high eCEC, base cations and low Al:Ca ratio. *Erica cinerea* showed the opposite reaction at the site and plot scales. *Ulex gallii* abundance showed a similar but weaker response at the landscape scale, with a negative correlation with C:N ratio at the plot scale and deeper layer. *Deschampsia flexuosa* occurred in highly acid soils, other graminoids such as *Danthonia decumbens* or *Carex binervis* occurred in less acid soils.

A set of species give valuable information regards soil condition, which can be useful to address specific management measures. The impact of cattle in soils should also be addressed with more research, but wild ponies seem to have a softer effect in vegetation and soils in this particular heathland type.



Session 1.3 – Monday 22th

Effect of scarification, a novel heathland management method, on ground beetles assemblages

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Abstract

Pine dominated forests constitute the main climax vegetation on dry and nutrient-poor inland dunes of Central and Eastern Europe. Consequently, heathlands occurring on the deforested dunes have been gradually overgrown with trees encroaching due to natural, secondary forest succession. This process has been observed for decades; however, until now, its rate with reference to spatial differences in topography has not been detailed investigated, which was the aim of this study.

The research was conducted in the Toruń artillery range, which constitutes the most extensive heathland area located on inland dunes in Poland. The area has been deforested for military needs (mainly for observation purposes) several decades ago, and since then it has been subjected to forest re-encroaching by natural regeneration. In 2011 we established the 14.87 ha “Glinki” research area for long-term investigations (Sewerniak and Mendyk 2015), in which all occurring trees at least 1 m high were surveyed regarding GPS location, height, and diameter at 5 cm above the ground level. This survey was repeated 10 years later (in 2021). The results were examined with regard to 3 topographical positions: north- and south-facing dune slopes, as well as intra-dune depressions. The results showed that the density of trees increased almost 4 times within the investigated time span. Additionally, we found the clear effect of topography on spatial distribution of encroaching trees. Specifically, for both studied years, the highest density was revealed for north-facing slopes, which could be explained by higher soil moisture when compared to S-slopes, and much lower competitive pressure of grasses with comparison

Session 1.4 – Monday 22th

Restoration of heathlands after afforestation on two islands in Western Norway

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Abstract

Loss of coastal heathlands is an ongoing process which is serious with respect to biodiversity and cultural heritage legacies. Restoration projects are often labour- and cost-demanding, and the outcome can be uncertain. We investigated whether it is possible to restore coastal heathlands through natural succession (i.e., “passive restoration”) after removal of Sitka spruce plantations on two neighbour islands in a Nature reserve in Western Norway. Furthermore, we evaluated the effect of leaving the clear-felled woody material as chips on site, this

being a cost-efficient strategy on islands. Succession was monitored 1st, 2nd, 4th/5th and 8th year after clear-felling, and revegetation of vascular plants and bryophytes was compared to target heathland vegetation. Surprisingly, we found different successional trajectories on the two islands; Species composition on one island (NIL) was approaching target vegetation, but not so on the other (SIL). Management action beyond introducing sheep grazing is necessary to counter regeneration of the woody species *Picea sitchensis* on NIL. Woody chips reduced species richness and slowed the restoration process, but effects were only short term. Differences in land-use change and soil conditions may explain the successional trajectories on the two islands.

Session 1.5 – Monday 22th

Effect of late seasonal burning and soil removal on heathland vegetation

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Abstract

In many areas in Europe, lowland heathland dominated by *Calluna vulgaris* are being degraded and replaced by grass-dominated vegetation (Fig. 1). Expansion of grasses on *Calluna* heathland may occur as a result of deposition of atmospheric nitrogen (N) compounds. This is one of the greatest threats to global terrestrial diversity and the effects in N-limited biomes, such as heathlands, are quite severe. Atmospheric N contributes to an increased productivity and accelerates nutrient cycle. Moreover, *Calluna* and many other typical heathland species are being replaced by grasses as a result of elevated N levels. In the past, a variety of management techniques has been used to restore the heathlands and remove N and the dominant grasses. The restorations often involve removing of plant biomass and creation of bare ground to allow heathland species to grow. Removal of top-soil has so far been proven to be the most effective tool in removal of nutrients. The negative part is that these projects tend to be big with very high costs due to labour.

The use of fire is an effective management tool that can be used to control large areas with a minimum of manpower i.e. for a low cost. But, burning contributes to only a small amount of nutrient loss, and it is not sufficient to counterbalance the N input. However, these burnings are carried out in late winter and early spring, when the litter on the ground is still wet and cold, and only the above ground parts of *Calluna* are burned up in the fires. Most of the N in the heathlands is stored in the top-layer of the soil, and this is not affected by the fires, especially when there is a thick layer of litter that insulates the ground.

In this study, we tested various restoration techniques in a *Calluna* heathland that is transferring into grass heaths. Our hypothesis was that a late seasonal burning would create a high-intensity fire that removed the litter and the organic layer of the soil (the top-soil), and this would be comparable with the effect of mechanical removal of top-soil and it would create better conditions for *Calluna* seeds to grow. The treatment with late seasonal burning would create more *Calluna* seedlings and less grass cover than burnings early in the season. We also compared the burning treatments with top-soil removal in respect of *Calluna* seedlings, grass cover and recovery of heathland flora.

To test our hypothesis, we performed an experimental study and compared plots that were burned early in the season (early spring), with plots that were burned later in the season (late spring) and plots where we had removed the top-soil. We analysed the following variables: (i) number of *Calluna* seedlings, (ii) grass cover, (iii) change of species frequency of all vascular plants and (iv) species richness of vascular plants (number of species per plot and Shannon diversity).

Results: High-intensity prescribed burnings did not result in significantly more seedlings of *Calluna vulgaris* than traditionally low-intensity prescribed burnings. Both burning treatments caused low numbers of *Calluna vulgaris* seedlings and a high increase of grass cover. High intensity burning did not have a clear negative effect on the heathland vegetation, and species richness (number of species per plot and Shannon diversity) increased after treatment. Top-soil removal had a positive effect on seed germination of *Calluna vulgaris* and the treatment did not increase the grass cover. The heathland vegetation was almost recolonized two years after the top-soil removal treatment.

References

Lindholm, M. 2019. Heathlands – A Lost World? [Doctoral Theses, University of Gothenburg]. <http://hdl.handle.net/2077/59796>

a



b



Hulegården, Sweden, in 1984 (a) and 2011 (b). *Calluna vulgaris* has been replaced with grass. Photo: Tore Hagman. Photos published at: <http://www.mulensmarker.se>

Session 1.6 – Monday 22th

Resource-based habitat monitoring

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Abstract

Insect abundances and diversity are in rapid decline and for many species, heathlands represent their last strongholds. In Denmark, we have more than 18000 insect species, all representing a variety of different adaptations to the environment they inhabit. For instance, some insects require a certain combination of resources at different stages of their lifecycle. These resources may be promoted or limited by different management actions and particularly heathland management plays a vital role in shaping these habitats. As such, different adaptations require different approaches if the decline is to be stopped. Here, we present an approach that centres around the necessary resources an organism needs to complete its lifecycle. This approach is based on a solid knowledge of insect ecology which allows the spectator to gaze through the eyes of the organism. We discuss the following aspects: Which resources and how much of them? How should they be distributed? What is the relevant scale? We propose an attempt that aims to operationalize the resource-based habitat concept at a scale and a level relevant to entire species communities.

Session 2.1 – Monday 22th

Effect of management on dry heathland vegetation

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Abstract

Recently, there has been an increasing interest in model-based approaches for the statistical modelling of the joint distribution of multi-species abundances. The Dirichlet-multinomial distribution has been proposed as a suitable candidate distribution for the joint species distribution of pin-point plant cover data and is here applied in a model-based ordination framework. Unlike most model-based ordination methods, both fixed and random effects are in our proposed model structured as p -dimensional vectors and added to the latent variables before multiplying with the species-specific coefficients. This parameterization allows statistical inference of the effect of fixed and random factors in vector space, and makes it easier for practitioners to perform inferences on species composition in a multivariate setting. The method was applied on plant pin-point cover data from dry heathlands that had received different management treatments (burned, grazed, harvested, unmanaged), and it was found that treatment have a significant effect on heathland vegetation both when considering plant functional groups or when the taxonomic resolution was at the species level.



Session 2.2 – Monday 22th

Prescribed burning to promote recovery after an extreme drought event in Atlantic heathlands

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Abstract

Extreme climatic events are expected to have system-wide impacts on species and ecosystems. During the winter of 2014, an intense drought combined with sub-zero temperatures resulted in a massive dieback of *Calluna* in northern heathlands. We conducted a study in seven *Calluna* heath sites spanning a ~600 km latitudinal gradient along the coast of Norway (60.22–65.69°N). We assessed if heathland resistance to drought is governed by regional and microsite climate, if the recovery in unburnt heather stands is affected by the extent of damage and, if prescribed burning can be used as a tool to reset damaged stands. The study had a factorial repeated measurements design with floristic data sampled from permanent plots within burnt and unburnt stands across sites. Plots were recorded over four years (n = 280). The data were analysed using multivariate ordination techniques and mixed effects models. The drought event in 2014 was characterized by a prolonged period of low air humidity, which increased in severity northwards. After two years, we observed a high but variable damage and mortality of *Calluna*, with the highest proportion of dead *Calluna* in the north. Vegetation recovery in the unburnt heather stands spanned from high to very low. In sites with high recovery, damaged *Calluna* recovered over three years. In sites with low recovery, *Calluna* stayed unchanged over our study period. Both damage and recovery were only weakly related to site or climatic factors. Vegetation recovery after burning largely followed the rate and direction of post-fire vegetation dynamics within heathlands. We found a distinct impact of the extreme winter drought, resulting in substantial and often persistent drought damage in *Calluna* along the latitudinal gradient. After drought events, prescribed burning can be an effective tool to promote recovery and ensure ecosystem resilience and functioning.

Session 2.3 – Monday 22th

Contrasting responses of multiple insect taxa to common heathland management regimes and old-growth successional stages

David Bille Byriel, Hjalte Ro-Poulsen, Sebastian Kepfer-Rojas, Aslak Kappel Hansen, Rikke Reisner Hansen, Mathias Just Justesen, Emil Kristensen, Cecilie Bülow Møller & Inger Kappel Schmidt

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Abstract

Maintaining heathlands in early successional stages to sustain heather (*Calluna vulgaris*) is a common, large-scale management practice in Europe. However, allowing patches of long-term natural vegetation development may increase habitat heterogeneity benefitting insects, but empirical evidence is sparse. We investigated how old-growth heath areas (>30 yrs. abandonment) affect species richness and composition of bees (*Anthophila*), crane flies (*Tipuloidea*), ground beetles (*Carabidae*), hoverflies

(*Syrphidae*) and rove beetles (*Staphylinidae*). Adult insects were collected along with vegetation and edaphic explanatory variables in old-growth areas and compared to a variety of managed areas and wet areas in four lowland heathlands in Denmark. We found 302 species including 54 heathland specialists and 25 nationally red-listed. Species composition differed between managed, old-growth and wet areas for most taxa, with similar numbers of indicator species in each type. Rove beetle and crane fly richness were significantly higher in old-growth areas, while bee and heathland specialist richness were significantly higher in managed areas. Vegetation structure and composition, especially bare soil and vegetation height density, were key drivers explaining the contrasting responses in richness and composition. Our results demonstrate that heathland management focusing on early successional vegetation stages may homogenize insect communities. We suggest that management practices should be focused on improving structural vegetation heterogeneity. This could be achieved through small-scale mosaic management regimes resetting the succession and exposing bare soil for specialized heathland insects, but also allowing patches of old-growth vegetation stages to develop and conserving existing ones.

Insects and their distribution among taxa. Red-listed species in brackets were based on expert assessments.

Taxon	Plots	Species	Specimens	Heathland specialists	Red-listed	% species of taxon in DK
Bees	97	69	1873	17	6	24%
Crane flies	120	30	791	9	(2)	11%
Ground beetles	108	62	2896	14	6	19%
Hoverflies	97/120	81	6323	9	7	27%
Rove beetles	108	60	4245	5	(4)	6%



Pitfall traps for collection of bees and hover flies



Sweep netting for hover flies and crane flies

Session 2.4 – Monday 22th

Effect of scarification, a novel heathland management method, on ground beetles assemblages

Estève Boutaud, David Walmsley, Jelena Daniels, Werner Härdtle, and Vicky Temperton

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Abstract

Increasing atmospheric nitrogen deposition threatens heathlands and mosses have been shown to play a key role in the nitrogen cycle of such ecosystems. Scarification, a novel heathland management method aiming in particular at removing the moss layer, is currently being tested as an alternative to higher intensity and costlier methods such as choppers or sod-cutting. However, there is a lack of knowledge regarding the possible effects of this novel method on the invertebrate diversity dependent on heathland habitats. We studied the short-term effect of scarification and the resulting change in vegetation structure on carabid beetles by comparing species assemblages in managed heathland patches by either mowing or scarification, and unmanaged ones. Assemblages from scarified sites differed clearly from those of mowed and unmanaged sites. Species richness of heathland species and threatened species was highest in scarified areas and lowest in unmanaged ones. The activity-density of both species groups was highest in managed areas and lowest in unmanaged ones. Differences in the vegetation structure explained shifts in species richness and activity-density. Heather cover was the main driver of the difference in heathland and threatened species richness while moss cover or its thickness negatively influenced the activity density of heathlands species but positively influenced the activity density of threatened ones. The long-term conservation of the specialized heathland carabid beetle species depends on the availability of recently managed habitat patches with the appropriate vegetation structures. Scarification could create such habitat patches making this novel method highly suitable for heathland management. We recommend using scarification alongside already existing methods such as mowing to create a mosaic of different vegetation structures needed to support the largest number of heathland carabid species.

Session 2.5 – Monday 22th

Six years of rock powder research I: can rock powder addition be a suitable restoration measure for the recovery of acidified heathland soils?

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Abstract

Soil acidification due to N (and formerly S) deposition is a major problem in Dutch heathland ecosystems. Soil acidification results in loss of available base cations, reduction of acid neutralising capacity of the soil and increased NH₄ and Al availability in soil. Soil acidification and N-addition also lead to nutrient imbalances in the vegetation, which can result in reductions in invertebrate species abundance or richness.

In heathlands an often used restoration tool to counteract soil acidification is the application of dolomite lime after sod-cutting. This has been proven effective in restoring soil buffering status and vascular plant species richness, but is found to not always lead to the desired system recovery. The main source of base cations in heathland systems is the weathering of minerals and cycling of nutrients through the adsorption complex. The lost fraction of soil minerals (including potassium, phosphorus and trace elements) is not supplemented with the application of dolomite lime. Adding quickly dissolving Ca (and Mg) to the soil could lead to increased mineralisation, shock-effects for the soil community and undesired changes in elemental stoichiometry, all of which are linked to invertebrate species loss.

In order to find a tool that can be used on intact heathland vegetations that minimizes these risks, we tested an alternative restoration method using slow release buffering agents. These slow release agents consist of finely ground igneous rocks (rock powder) and release a broader spectrum of cations and micro-nutrients to the soil via mineral weathering. In a number of field trials in Dutch heathlands, we investigated the effects on soil- and plant chemistry of addition of several slow-release agents with both the original control situation as well as traditional liming as method. In this oral presentation we will discuss the results on soil and plant chemistry after six years of monitoring.

Session 2.6 – Monday 22th

Six years of rock powder research II: is rock powder a better alternative to liming for heathland fauna?

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Abstract

Soil acidification due to air pollution is a major problem in Dutch heathland ecosystems. Soil acidification results in decreased bryophyte, lichen and vascular plant species richness, and is often accompanied by reductions in invertebrate species richness and/or abundance. This works either indirectly through reduced plant species richness, or directly through reduced plant nutritional quality or hampered soil organic matter decomposition rates.

An often used restoration tool to counteract soil acidification is the application of dolomite lime, which has been proven effective in restoring soil buffering status and vascular plant species richness. Invertebrate response to liming is however mixed or even negative. Negative side-effects are thought to arise from shock effects of adding large quantities of quickly dissolving Ca and Mg to the soil, resulting in newly introduced nutrient imbalances at the micro-nutrient level and/or temporarily increased P-limited conditions as a result of lime application.

In order to minimize negative effects of mitigating measures on fauna communities, we tested an alternative restoration method using slow release buffering agents. These slow release agents consist of finely ground igneous rocks (rock powder) and release a broader spectrum of cations and micro-nutrients to the soil via mineral weathering. In a number of field trials in Dutch heathlands, we investigated and contrasted the faunal response to addition of several slow-release agents with both the original control situation as well as traditional liming as method. In this oral presentation we will discuss the results after six years of monitoring.

Session 2.7 – Monday 22th

LIFE Nardus & Limosa: Abiotic restoration by P-mining in relation to breeding meadow birds

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Abstract

LIFE Nardus & Limosa is a project aimed at restoring Nardus grasslands (6230*) on a large scale in the Campine region in Belgium and the Netherlands. Nardus grasslands in the region have largely disappeared due to agricultural intensification, resulting in eutrophication of the former grasslands. Excess availability of phosphate is currently hampering restoration success. In order to remove this bottleneck, the technique of P-mining is applied to increase removal of excess phosphate.

Many grasslands however currently function as breeding grounds for endangered meadow birds. P-mining could be detrimental to these populations, as it involves increased mowing frequency as well as the application of N and K fertilizer, which may negatively impact prey availability. Often, a choice has to be made in nature management of similar areas: «grassland restoration or conservation of the meadow bird population?». In this project we try to reconcile both objectives by developing a fauna-friendly form of P-mining, taking measures that result in the expansion of suitable breeding habitat and by implementing a management scheme that results in a mosaic of grassland patches with optimal conditions for meadow bird habitat, and patches with optimal conditions for Nardus grasslands.

The process is closely monitored by Ghent University and the Bargerveen Foundation for scientific guidance and research. Ghent University provides guidelines for optimal P-mining strategy and Bargerveen Foundation investigates the relation between abiotic conditions, soil and aboveground invertebrates and other conditions for meadow birds, in relation to the implemented P-mining management.

In this presentation, we will introduce you to the P-mining project and present current research results.

Session 3.1 – Tuesday 23th

Resilience for and adaptation of Flemish heathland reserves to climate change

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Abstract

The goal of our project was supporting the implementation of adaptive management of Flemish heathlands in cooperation with site-managers. Climate change adaptation in nature management reduces climate risks for biodiversity and ecosystem services. We analysed how climate change affects the key structures and functions of heathlands. Then we identified which ecosystem and landscape qualities determine the resilience of sites. These elements were used to design a basic scoring-tool to help managers evaluate climate resilience at site-level or plot-level. The analysis points out the vulnerabilities at site level and provides starting points for management action. Our review revealed that there are significant knowledge gaps regarding the results and impacts of adaptive solutions for climate change in heathlands. However, this information is crucial to underpin policy and management decisions. We expect that climate change adaptation will become a key leitmotif in nature management decisions and policies in the future.

Session 3.2 – Tuesday 23th

Groot Schietveld, management challenges after big wildfire on military domain

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Abstract

The Groot Schietveld is a 1570 ha large military heathland and Natura2000 reserve in the north of Belgium, near Antwerp. The nature management is carried out by the Flemish Government's «Agency for Nature and Forest». This area is designated for various European protected heathland habitats and is important for various protected species such as Adder and Alcon blue.

The area is heavily grassed with Molinia due to historical drainage, structural dehydration (because of the increased droughts the past years), nitrogen deposition, previous accidental fires and too limited management due to the presence of unexploded ammunition and military activities. As a result of military activity, a fire broke out on 23 April 2021. It spread rapidly over a large area, partly due to the large presence of Molinia, ultimately burning 565 hectares in just one day.

After the fire incident, goal is both to restore the habitats as improve the prevention and fire safety. This presentation will focus on the measures taken such as sheep grazing, mowing, choppers, soil cutting and restoring the hydrology. The big challenge was to work this out in a short time and get it operational, in an uneven terrain, with unexploded ammunition and military activities still going on.

Session 3.3 – Tuesday 23th

Heathland restoration in Drongengoed (Flanders): The importance of good communication

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Abstract

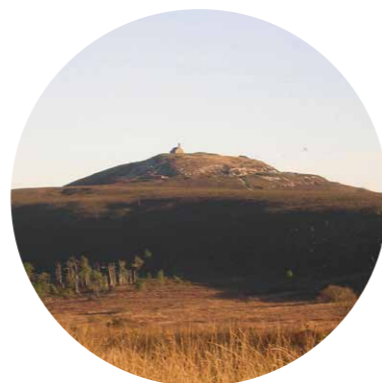
The northwestern part of Belgium has long been characterized by the presence of lowland heathland areas. The original ‘Maldegem velt’ itself consisted of a mosaic of heathland, woods and ponds of about 2000 hectares. The area was part of a large heath complex called ‘Bulskampveld’. Since the 18th century onwards however, this mosaic has been subjected to an important landscape inversion. Large parts of the heathlands were planted for wood production or became farmland.

Today Drongengoed is a unique nature reserve of about 800 ha. It is part of the of the Natura 2000 network for which an important task of restoring heathland vegetation has been provided. In addition to quality improvement, expansion has also been planned in order to link the existing heathland fragments with each other in terms of landscape and ecology. This task has been included in the management plan of Drongengoed.

In 2018, Agentschap Natuur en Bos started large-scale heathland restoration works in Drongengoed. Spread over four years, major nature restoration works were planned on an area of about 34 ha in which large areas of forest had to be cleared for heathland to develop. Given the large scale of the works, the clear impact on the area and the limited presence of large forests in this part of Flanders, resistance was expected. Therefore, from the very start, intense communication with the local government and the general public was initiated. Proactive communication was used as well as local communication through different channels tailored to the progress of the works. Using visual elements, we showed local residents and visitors what the final and aimed view of the changes is and which species we aim for. In addition, two information walks per year are organised during which the participants are informed about the progress and are invited to ask questions.

During the works Agentschap Natuur en Bos was also assisted by experts to adjust the works where needed based on monitoring data and their input. During the execution of the works several adjustments were made. The adjustments were also openly communicated to the general public.

Currently, the last phase of nature restoration is being carried out at Drongengoed. The communication process was at times intensive, but has ensured that a large part of the formerly critical public is now cautiously positive about the project. We can therefore conclude that good communication is one of the main factors for the success of a major restoration project.



Session 3.4 – Tuesday 23th

13 years

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Abstract

In 2009 Natuurpunt purchased an estate of 365 ha in the cross-border park Kalmthoutse heide (Belgium, Netherlands) that was formerly owned by a rich industrial family. The site was not managed for nature and at that time it existed of pine plantations with Invasive Alien Species (IAS), open waters, degraded heathlands and heavily degraded bogs. Thanks to LIFE Helvex 55 ha inland dunes (2310, 2330) and 15 ha heathland (4010, 4030, 7150) were restored between 2015 and 2021 and on 130 ha the IAS were managed. Today its a good moment to make up a balance of the project in relation to climate change and excessive nitrogen deposition. Parallel to the above-ground actions plans are made to increase the groundwater influence. With the support of Interreg CANAPE a 1300 meter foil screen will be placed to stop the external drainage for farmland. Next to that 4000 meter internal ditches will be dampened in autumn 2022 to create suitable conditions for 60 ha boggy heathlands (4010, 7140, 7150).

Session 3.5 – Tuesday 23th

Ecological restoration of heathlands

**Herbert Diemont and Gerard Jagers
and Raymond Schrijver**

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Abstract

Ecological restoration of heathlands requires re-introducing traditional agricultural practices such as grazing, prescribed burning and turf cutting in order to warrant a protection of natural resources such as required by the Natura 2000 network. Strange enough this way of nature protection is frustrating the spontaneous i.e. the natural succession in nature. Fortunately this strange situation is just the result of a mind set of scientists, by denying (may be for good reasons?) that man is still part of nature, even after we have left the garden of Eden. Thus taking again the human species serious as the top predator in the biodiversity pyramid provides the solution, where we can just decide what to protect or not to protect. In this account we discuss this question what land resources to protect and for what reasons at a time that most semi-natural habitats such as heathland have already become again wasteland in the Natura 2000 network and also 50 percent of the agricultural land in the EU is becoming wasteland, subject to wild fires and drought.

Session 3.6 – Tuesday 23th

Ensuring the long-term provision of heathland ecosystem services – the importance of a functional perspective in management decision frameworks

**David Walmsley, Estève Boutaud, Jelena Daniels,
Maike Brune, Benjamin Delory, Isabel Alonso,
Vicky Temperton and Werner Härdtle**

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Abstract

Most heathlands require management in order to protect them from natural succession and thus to preserve these ancient, diverse and legally protected habitats. The question at large is how best to manage these systems. The incorporation of ecosystem services has been put forward as a way of balancing economic, ecological and societal drivers in (adaptive) management decision-making processes. This requires the assessment and subsequent valuation of all components under consideration. The objective of this study was to analyse trade-offs related to the effects of five common heathland management measures (grazing, burning, mowing, choppers and sod-cutting) on important ecosystem functions (elemental balances of nitrogen, phosphorus and major cations) and services (groundwater recharge, groundwater quality, carbon sequestration potential and appreciation by the general public). In addition, we include the net cost of their implementation

as a trade-off component. Importantly, our analysis is based on quantitative data obtained from empirical studies with the nature conservation area “Lüneburger Heide” (Northern Germany). Our results show that maintaining a low N system whilst concurrently increasing groundwater recharge (large benefit) generally comes at the cost of all other components considered here. In the light of current N deposition rates this trade-off is, however, inevitable, at least if the aim is to preserve heathlands and their associated ecosystem service in the long-term, as only the high-intensity measures are capable preventing the transition into non-heather dominated habitat types. Consequently, we argue that if a legal obligation exists to protect a certain habitat type, management decision frameworks must prioritise ecosystem functioning over ecosystem services. If this functional prioritisation approach is not considered, decisions based solely on the quantification of total trade-offs will ultimately result in the loss of the protected habitat and the service potential they provide. This does not mean that the inclusion of ecosystem services into management decision frameworks is not without benefits – on the contrary. We go on to show how they help in the identification of interactions between the trade-off components and possible underlying drivers and thus aid in the identification of key areas of action regarding the development of novel or adapted management practises such as the newly developed management method of scarification presented in the talk of Estève Boutaud. Finally, we include this method in our trade-off analysis and discuss the findings.



POSTERS PROGRAMME

Monday 22th

Poster 1

Effects of fire on the germination of *Corema album* (L.) D. Don ex Steud.

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Abstract

Corema album (L.) D. Don ex Steud is a species of the Ericaceae family with a very restricted current distribution and is endemic to the Iberian Peninsula. It is present on the Atlantic coasts of the Iberian Peninsula (Spain and Portugal) forming part of dune vegetation and is the dominant species in those ecosystems of which it is part. In Galicia it is known as camariña and traditionally this species was used for human food and as a medicinal plant. It is currently threatened due to tourist pressure, land use change, habitat fragmentation, colonization of invasive alien species, forest fires, etc.

Forest fires are becoming more frequent and severe and even reach coastal areas, for example one of the largest populations of this species is in the PN of Doñana (Spain) and suffered a fire in 2017. For this reason we have considered analyzing the role of fire on the germination of this species. For this purpose, seeds of *C. album* belonging to two populations present on the coast of Galicia, one in the cove of Trece (Camariñas) and another in the beach of Rodas (Cíes Islands, PNMT of the Atlantic Islands of Galicia) were selected.

In July and September 2021, the fruits of this species were collected in the two populations mentioned above, the seeds were extracted and kept in refrigerator for a month. To simulate the action of fire, heat, smoke, ash and charcoal treatments were applied to the seeds of camariña. We have detected similar fire behaviour in both populations, although with different germination values. Germination control of *C. album* is very low and dispersed over time. The first germinations occurred 3 months after incubation and the seeds continued to germinate until 9 months. The control germination in the population of Trece was 5% and in the population of Cíes 2%. The fire treatment of 80°C for 5 min was the one that most stimulated germination in the seeds of the population of Cíes and 80°C-10min in the population of Trece. With these treatments, the control percentages were multiplied by 9 and 3 times, respectively. Severe heat treatments (150°C and 200°C) and most ash treatments completely annulled germination. The seeds treated with smoke or charcoal did not show significant differences with the control.

This study opens the door to the investigation of techniques to favor the germination of this species based on moderate thermal treatments.

Poster 2

Calluna die-back after winter drought and the role of land use and environmental variation

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Abstract

Extreme climatic events (droughts, floods, heat waves, cold snaps) are likely to increase in frequency and intensity in the future (IPCC 2012). This is particularly relevant for nature management and conservation, as extreme events are expected to have system-wide impacts on species and ecosystems and could drive ecosystems past ecological thresholds. During the winter of 2014, a two-month drought combined with unusually low temperatures resulted in a massive die-back of *Calluna vulgaris* in the coastal heathlands of Norway. In this project, we have quantified the extent of *Calluna* die-back and related the variation to land use, local climate, environments and vegetation types using a GIS-study. We obtained data from geo-rectified colour aerial photos from the Norwegian Program for Rotational Aerial Photography, recorded in July 2014 at a resolution of 0.5 x 0.5 meter at ground level from three different sites. To quantify die-back, the photos were compared to aerial photos obtained before the die-back-event (2012). The rasters were classified using the Maximum Likelihood Classification algorithm separating the raster into seven distinct vegetation classes. The output of the classification was verified in randomly selected transects in each site. Data on slope, aspect and vegetation height was acquired from a digital terrain model generated from the Lidar dataset at 0.5 x 0.5 meter resolution. Preliminary results show that the *Calluna* die-back was affected by land-use and slope, but less-so from aspect. With increasing slope there was decreasing *Calluna* die-back. This is possibly related to decreasing soil depth at increasing slope, and the presence of ground frost in deeper soils at the onset of growth in early spring. Moreover, heathlands in early regenerative phases were more resilient to drought than old mature stands. This might be related to younger individuals having shorter root systems and smaller plants compared to older ones.

Key words: *Calluna vulgaris*, coastal heathland, drought, regeneration, resilience.

Poster 3

The regeneration of *Erica. Australis* L. after a forest fire

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Abstract

Fires have shift the ecosystems distribution and functioning of the Iberian Peninsula, affecting among others variables the biodiversity. In these ecosystems, plant species behavior after fire is affected by the type of post-fire regeneration response and the fire regime (recurrence and severity). Heathlands dominated by *Erica australis* L. are an example of fire prone ecosystems. The dominant species, *Erica australis*, uses as a main mechanism to recover after fire the the resprouting from lignotuber. However, it is also capable of produce important soil seed banks. Our work try to analyze the effect of recurrence and fire severity on the regeneration strategies that this species utilizes. We selected a large wildfire occurred in Leon Province in 2017 (NW of Spain), taking into account the fire recurrence in the last 35 years and the fire severity of the fire occurred in 2017. In 25 sampling units we studied the the size and survival of *Erica's* lignotuber, the number and height of sprouts, as well as the number of *Erica's* seedlings. The main results indicated that in the regeneration of *Erica australis* there were not significant effects of recurrence and fire severity.

Poster 4

Effect of traditional lowland heathland management methods – mowing, burning, and choppering – on ground beetles assemblages

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Abstract

Lowland oceanic heathlands are among the most threatened semi-natural ecosystems in Central Europe. They host characteristic and highly specialized fauna often comprising numerous threatened species making them valuable for biodiversity conservation. Two of the main threats to heathlands are increased atmospheric nitrogen deposition and succession which are currently addressed by the use of more or less intensive management methods – mowing, burning, choppering – which effectively reverse succession while removing nutrients. However, empirical studies on the effects of such management practices on the rich invertebrate fauna of such habitats remain scarce. The few available studies have investigated a limited number of practices and only studied their short-term effects. Our study aimed to analyze the long-term effects of heathland management measures on carabid beetles. For this, we compared carabid beetle assemblages across two gradients from young to old successional stages and from low- to high-intensity management measures. Our results revealed that the composition of carabid beetle assemblages differed across the successional stages gradient but not across the management intensity gradient. Overall, all management measures fostered mainly heathland specialists and threatened carabid beetle species at least

in the short term. In contrast, carabid beetle assemblages of the late-successional stages consisted mainly of non-threatened heathland generalists and forest species. In conclusion, the long-term conservation of a large extent of the specialised carabid beetle fauna of lowland heathlands depends on the permanent availability of early successional stages. Such early successional stages could be created by any of the management methods studied. An increase in the frequency at which management interventions are conducted appears necessary to ensure the permanent presence of early successional stages, in particular, in areas where only small remnants of lowland heathland persist.

Poster 5

Nature based Solutions to the Climate and Biodiversity Crisis from Heathlands

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Abstract

Confronted with a climate crisis, many policy makers are looking at tree planting as one of the main nature based solutions. However, it must be remembered that we are also in the middle of a biodiversity crisis and there is evidence that addressing both simultaneously is likely to be more productive than one or the other separately.

Most heathlands in Western Europe require regular management to keep them in favourable conservation status, i.e.: maintain their structure, function and characteristic assemblage of species. This is seen as contrary to some climate mitigation initiatives, such as planting trees or allowing natural succession. However, heathlands are characteristically open landscapes, with species adapted to this openness (short vegetation and areas of bare ground). On the other hand, heathlands store high levels of carbon, mainly in the soil, which may have laid undisturbed for centuries. Any active climate mitigation initiatives need to consider the resulting changes in biodiversity, including losses of heathland specialists and other open ground species.

Bare ground is important for many heathland dwellers, such as solitary bees or sand lizards. But on the other hand, soil disturbance as a result of management could increase carbon emissions from the soil stock. There is a trade-off to consider between soil conservation to reduce carbon emissions from the ecosystem and minimal disturbance for the species benefit.

Somehow counter-intuitively, heathlands undergoing shrub or tree encroachment may release carbon into the atmosphere from the soil, which will not be offset by the growing shrubs or trees for decades. Also, removing conifers from afforested heathland may result in some carbon emissions, but will benefit the soil carbon stores and heathland biodiversity in the long term.

Restoring degraded heathland (e.g. overgrazed and transformed into grassland) is likely to result in increased carbon sequestration in soils and vegetation and benefit biodiversity. In the British uplands a reduction in grazing levels on heathlands and more careful targeting of habitats suitable for burning would result in increased carbon sequestration.

Poster 6

Habitat management for conservation in wet heathlands and bogs of NW Spain. Main outcomes from the project Life in Common Land

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Abstract

The main goal of the project Life in Common Land is to ensure the long-term conservation of three important habitats that represent a large proportion of the Serra do Xistral Natura 2000 Special Area of Conservation in Galicia, NW Spain. The three target habitats are the Atlantic wet heathlands (EU Habitats directive code 4020*), Raised bogs (7110*) and Blanket bogs (7130*), all of them rely on the high humidity levels in this mountain range throughout the year. During the lifetime of the project, different actions have been taken to promote sustainable management for conservation and improvement of habitat condition. In the framework of the project, we developed a comprehensive table of indicators of habitat quality, and used them for classifying and mapping habitat conservation state at patch level. From this initial cartography, we targeted areas in poor condition to develop restoration actions including cutting, fencing and management of livestock and wild ponies, and removal of non-native tree species.

Overall, we estimate a total of over 400 ha of the three priority habitats that have improved its habitat quality during the course of the project, including 226 ha of wet heathlands, 14 ha of raised bogs and 166 ha of blanket bogs. 156 ha of heaths and bogs with high cover values of gorse (*Ulex* spp.) were recovered by cutting at ten different patches (mean surface = 12 ha). Another 145 ha of heathlands and bogs covered by pine and eucalyptus tree stands were restored, including tree felling and various techniques of hauling like animal logging combined with log sled or cable skidding. 3,600 metres of temporary fencing helped to restore vegetation at five sites by promoting selective grazing by wild ponies and avoid overgrazing by cattle in bogs.

All actions are being monitored through remote image sensing using satellite images and Remotely Piloted Aircraft Systems (RPAs), coupled with field assessment and monitoring plots. From these pilot actions, we were able to define effective protocols of habitat restoration that can be applied to improve the actual conservation status of these habitats in the region.

Poster 7

Land-use legacies strongly affect heathland soil and vegetation composition for more than a century

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Abstract

Land-use legacies are recognized determinants of vegetation dynamics and plant community assembly. Here, we studied the duration of these legacies and how they influence the structure of vegetation communities developing naturally in nutrient-poor heathland ecosystem. We compared previous agricultural practices on multiple vegetation properties in a heathland where agriculture and domestic grazing ceased near 1870 and 1895, respectively. We compared diversity, compositional and functional properties of the vegetation to land-use legacies in the soil between areas with different agricultural histories (previously cultivated vs. uncultivated). Diversity measures were found to be higher in the previously cultivated soils. β -diversity was mainly driven by changes in species relative cover and increased with increasing nutrient availability in the cultivated area. The changes in vegetation composition were directly linked to soil properties only in the previously cultivated part of the heathland. Our study shows that land-use legacies of moderate intensity can alter the diversity patterns in unmanaged vegetation that can be maintained after more than a century since cessation of agricultural practice. Identifying land-use legacies and understanding how they structure heathland communities can thus lead to management decisions adapted to the specific assembly mechanisms and result in a more effective management.

a



b



Nørholm Heath in Denmark has areas, which has been cultivated until 1870 (a) and areas without signs of cultivation but known records of grazing until 1895 (b). Since then, the heath has been left unmanaged.

Historical and ecological approach to the Armorican coastal heathlands

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The subject of the presentation is an approach to the historical ecology of the Armorican maritime cliffs, focusing particularly on the coastal heathlands.

Maritime cliffs heathlands have a biological diversity resulting from strong ecological constraints (wind, salt, drought, oligotrophy). These constraints sometimes give them stability, with some heathlands being considered primary or (sub/plagio) climax. Different dynamic trajectories exist, some of them being blocked at the stage of non-tree vegetation.

Remains of anthropogenic uses are omnipresent on the Armorican coasts: low walls, paths, mounds, ditches, barred spurs, Neolithic remains, seaweed ovens... These heathlands have been grazed, harvested, sometimes sown. They were integrated into peasant activity until the end of the XIXth century and were maintained in certain sectors thanks to a peasant activity of poly-livestock which lasted until the middle of the XXth century.

If the knowledge of the ecological determinism of the coastal heathlands brings part of the elements of comprehension of the coastal landscapes, historical and social dimensions seem essential.

The objective is therefore to understand the origin, history and dynamics of coastal heathlands considered as a natural and cultural heritage, with a view to their conservation management.

>What is the part of restrictive ecological conditions and anthropogenic uses in the determinism and diversity of coastal heathlands?

>Are there primitive vegetation, did coastal forests pre-exist and what are the plant markers?

>What are the foreseeable evolution of current vegetation?

>What are the uses and know-how on the coastal heathlands?

>How to take into account historical elements in the conservation management of coastal heathland habitats?

After a presentation of the diversity of coastal heathlands by the phytosociological and ecological approach, we propose a multidisciplinary approach in historical ecology structured by four 4 main axes: 1) Archaeo-botany on maritime cliffs, 2) Rural history and study of land registers by inventorying indices of past uses, 3) Ethnographic survey of agro-pastoral uses, 4) Landscape phytosociology.

Phytosociological approach

From a phytosociological point of view, coastal heathlands are related to class of *Calluno vulgaris-Ulicetetea minoris*, order of *Ulicetalia minoris* and alliance of *Dactylido-Ulicion maritimi*. This alliance unit gathers heathlands under marine influences, and which physiognomy is marked by halo-anemogenic forms. A bibliographic synthesis, completed by a campaign of phytosociological and synphytosociological relevés, allow to produce an updated synthesis on the Armorican coastal heathlands. The different phytosociological associations of coastal heathlands will be synthetically presented: biogeography, ecology, floristic composition and distribution.

Archaeo-botany on Cap de la Chèvre in Crozon and on island of Ouessant

Recent searches for charcoals in the soil have been carried out on coastal sites, in heathlands, old gorse culture, fern communities, halo-anemogenic grasslands and pre-forest edges. The studied sites are characterized by the absence of spontaneous and natural trees. We are trying to answer the pre-existence of a coastal forest by analyzing charcoal: dating and determination. The first results are presented, especially through a comparison between the sites of Crozon and Ouessant.

Rural history and study of old land registers by inventorying indices of past uses on Ouessant

For the management of natural sites in Ouessant, a typology of coastal heathlands is proposed, based on floristico-ecological and dynamic criteria. A diachronic analysis compares four vegetation maps: 1844 obtained by analyzing the ancient land register data, 1952 land occupation map, 1986 and 2017 vegetation maps. The results allow to differentiate different heathland types considered as management units: subprimary heathland, characterized by a continuity and stability since 1844; ancient secondary heathlands and recent secondary heathlands. The vegetation transition matrix between 1985 and nowadays, also makes it possible to differentiate three types of extinct heathlands. Management recommendations, as well as long term monitoring protocols, are proposed for the different heathland categories.

Ethnographic survey of agro-pastoral uses

We want to collect information from people who have practiced, known, observed or heard (oral transmissions) an agricultural use on coastal cliffs (heathlands, grasslands, large expanses of ferns, thickets, scrublands, etc.). The three research questions posed are: 1- Were the practices carried out on the cliffs different from those carried out inside? What techniques, particular uses? 2- When, how and why did these practices on the coast stop? 3- What are the changes in the landscape and how are they perceived?

First and provisional results will be presented.

Synphytosociological approach

The synphytosociological or landscape phytosociology approach is useful for establishing the typology of the vegetation series in which the different types of Armorican coastal heathlands take place, taking into ecological conditions, account past and present human uses, which may influence the composition and structure of these vegetations. The analysis of these synrelevés allow to determinate three different types of series:

(1) permaseries, are single-stage series corresponding to prostrate heathlands in equilibrium with mesologic conditions and showing no dynamics;

(2) minoriseris, which are series with at least two stages whose final stage is not a forest; heathlands corresponding either to the mature stage or to a dynamic stage of the minoriseris ending by scrublands;

(3) holoseris corresponding to vegetation series whose last stage is a forest vegetation; heathlands corresponding to one of the dynamic stage of these series.

The methodologies and the first results of historical ecology approach will be presented on two sites which correspond to the excursions of the workshop (Cap de la Chèvre and Ouessant). It will give the opportunity to discuss with the participants about the dynamics and singularity of coastal heathlands and the recommended conservation managements.

Yves-Marie Le Guen

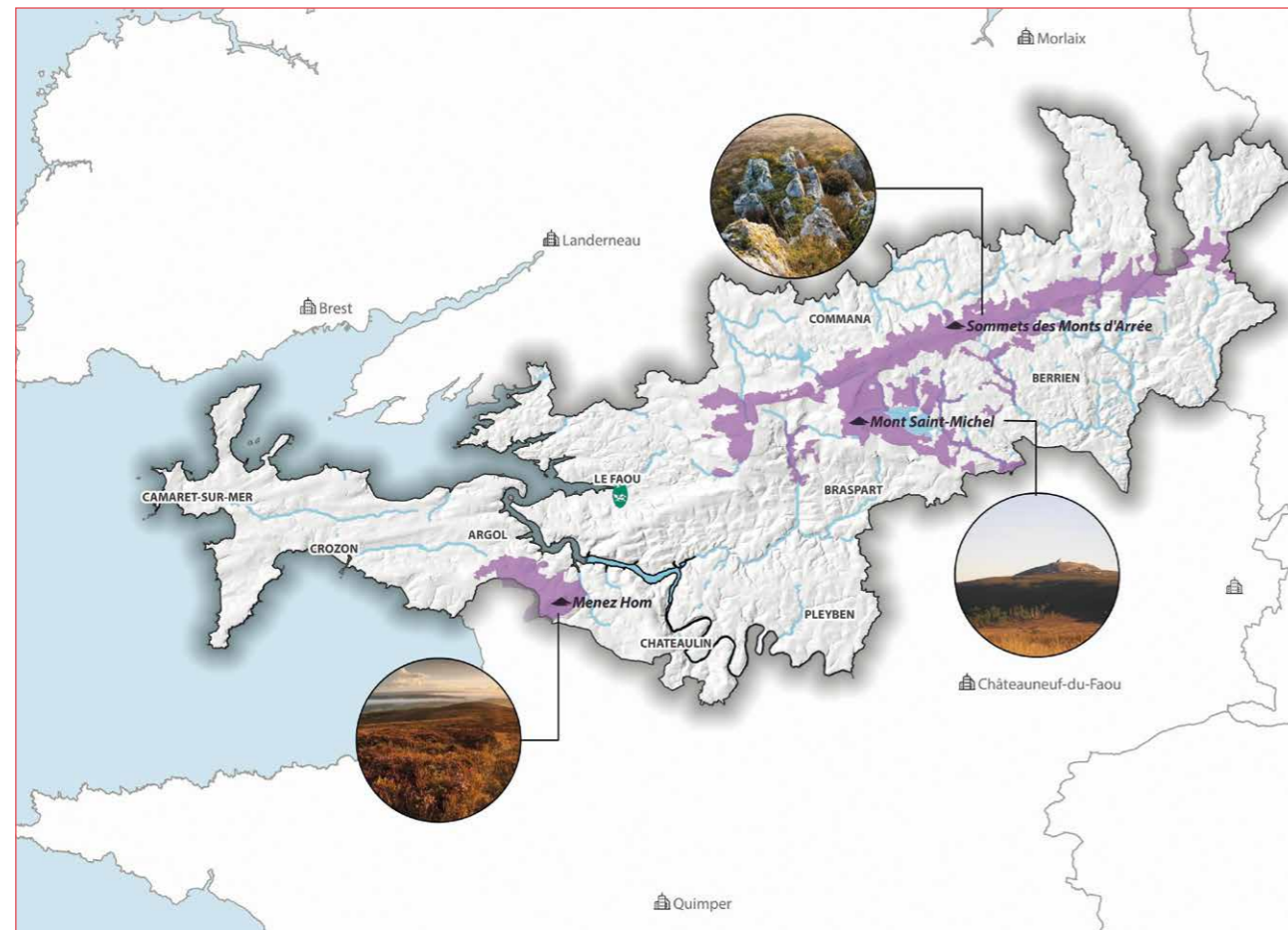
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LIFE Armorican Heaths is supported by the Park, as coordinator, the Department of Finistère and Bretagne Vivante as associated beneficiaries. It is financially supported by the Brittany region and the Ministry of Ecological Transition.

The programme aims to restore 200 hectares of moorland and peat bogs on three emblematic sites of the PNRA: Menez Hom, Menez Meur and the Monts d'Arrée. These sites alone represent the largest group of Atlantic moors in France and the largest complex of peat bogs in Brittany.

Natura 2000 sites concerned by the LIFE Armorican heaths



The moors and peat bogs of Armorique and the biodiversity they shelter are currently threatened:

- > Forestry developments (particularly coniferous plantations), generally preceded by drainage works, which have led to the irreversible destruction of several thousand hectares;
- > By the abandonment of ancestral management practices with the abandonment of agriculture: the wet moors were formerly exploited in a traditional and reasoned manner (litter, grazing);
- > Over-frequented certain natural sites due to the lack of suitable facilities and the failure to respect good practice;
- > The effects of climate change.

The LIFE Landes d'Armorique allows the implementation of an ambitious action programme (budget of 1.6 M€) over 5 years (2021 - 2025) and focuses on the major issues of these open natural spaces: the desilting of moors (restoration of 60 hectares with variable densities), the restoration of management (90 hectares), the plugging of drains (restoration of 50 hectares) and the redevelopment of paths.

- > LIFE Landes d'Armorique will have an indirect impact on the species that frequent these environments by restoring habitats adapted to their life cycle:
- > The Whimbrel: the Monts d'Arrée are home to the last bastion of breeding whimbrels in Brittany;
- > The Sphagnum of the Pylaie: the Monts d'Arrée and the Menez Hom host 95% of the national population.



EXCURSION GUIDE

TRANSPORT

Transport to each location during the main part of the workshop will be by coach. Virtually all excursions will involve walking with distances varying on each day.

The Thursday boat trip will be aboard a large boat with covered seating and toilet facilities, as well as an outside deck.

PRACTICALITIES

Terrain will be rough in places and while the excursions will largely stick to paths, good hiking boots will be necessary if you wish explore the locations visited. We cannot guarantee good weather and waterproofs may be necessary. During the Friday excursion in Monts d'Arrée, some areas could be very wet and some others muddy!

If the weather is warm, please ensure you take adequate precautions for the heat and the sunshine.

Ticks are a risk at all sites visited and can carry Lyme disease. We recommend that you check for ticks at the end of each day.

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OVERVIEW OF EXCURSIONS

EXCURSION 1: PRESQU'ÎLE DE CROZON (24 TH AUGUST).....	27
1a - Penn Hir (Jérôme Swatschuk).....	27
1b - Pointe de Dinan (Bernard Clément).....	27
1c - Cap de la Chèvre (Ségolène Guéguen).....	27
1d - Menez Hom (Bernard Clément).....	30

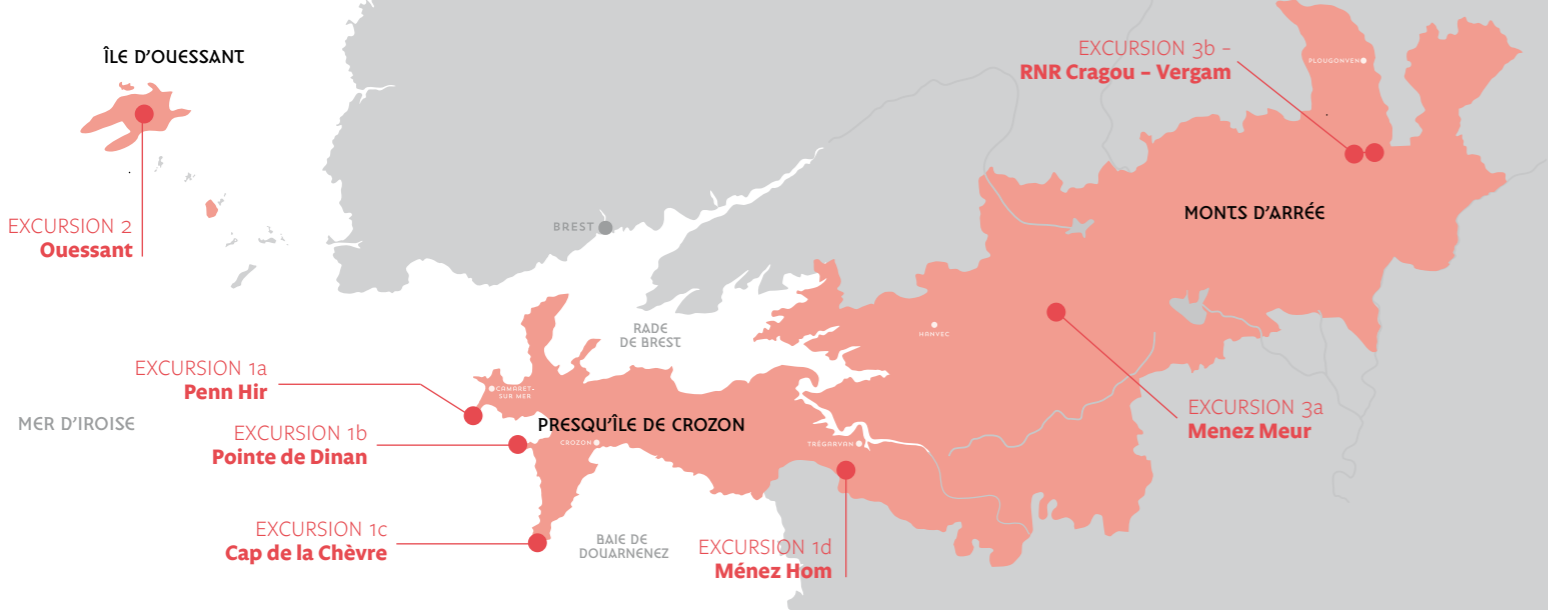
EXCURSION 2: OUESSANT (25 TH AUGUST).....	30
(Frédéric Bioret, Erwan Glémarec, Corentin Chevrollier, Fanch Quénot, Agathe Larzillière)	

EXCURSION 3: MONTS D'ARRÉE (26 TH AUGUST).....	40
3a - Menez Meur (Harmonie Coroller, Yves-Marie Le Guen, Jérémie Bourdoulous).....	40
3b - RNR Cragou - Vergam (Emmanuel Holder).....	45

Guides list

- Ségolène Guéguen
- Frédéric Bioret
- Erwan Glémarec
- Corentin Chevrollier
- Fanch Quénot
- Bernard Clément
- Agathe Larzillière
- Jérémie Bourdoulous
- Harmonie Coroller
- Emmanuel Holder
- Jérôme Swatschuk
- Yves-Marie Le Guen





EXCURSION 1: PRESQU'ÎLE DE CROZON

The Crozon peninsula is a site of major geological interest. Thus, a Regional Nature Reserve was created in 2013. This reserve includes 27 sites located on the coast which combine elements of geological, biological and landscape heritage. The rocks are of Paleozoic age. They were set up between - 475 Ma (Ordovician) and - 300 Ma (Upper Devonian). Human colonization began between 600,000 years and 300,000 years before our era (presence of choppers).

1a - Penn Hir - Camaret

In Brittany (France), impacts of human activities, especially those caused by tourism, have progressively resulted in the alteration of coastal cliff-top heathland and grassland vegetation in most popular tourist sites. In this framework, in many sites, access to degraded areas has been restricted to stop degradation, while restoration operations have been carried out, mostly based on the natural resilience of the vegetation. In addition, various ecological engineering techniques aimed at enhancing the re-vegetation of the worst degraded areas have also been implemented. This study assesses experimentally various combinations of the most classical restoration techniques in use in cliff-top restoration operations as geotextile, soil decompaction, turfing, harvested biomass or litter transfer, at different environmental exposures in two sites of Brittany (Crozon peninsula at the far west end and Belle-Île in the south). These investigations highlighted significant differences between methods. Litter treatment appeared to be one of the most efficient techniques, with geotextile and harvested biomass. Turfing, although effective, does not justify its use in comparison with the previous less destructive techniques. Association between techniques especially with geotextile highlighted beneficial complementarities. Experiments set up in different stress exposures show a global negative effect of stress exposure on the efficacy of restoration techniques.

1b - Pointe de Dinan - Crozon

The tip of Dinan is a remarkable site because it allows a superb view point. It is made of Armorican sandstone. It is occupied by dry heathland with *Erica cinerea*, *Calluna vulgaris* and *Ulex gallii*. Exposed to the spray, the heathland is modeled in pads. It is remarkable to note the resilience of the heathland near the current car park. This prohibiting took place a few decades ago, in two successive stages. Observing the restored heathland highlights its remarkable resilience.

1c - Cap de la Chèvre - Crozon

Location

At the far western end of Brittany, in the town of Crozon, Cap de la Chèvre (Goat's Cape) is at the very south of Crozon Peninsula.

It faces Cape Sizun and forms part of the mouth of Douarnenez Bay.

The southernmost part of Cap de la Chèvre draws the most tourists, with its views of the bay and the open ocean.



Nature of the site

Cap de la Chèvre is a geographic zone made up of moors, cliffs and dunes. The part concerned by the tour mainly comprises lowland moors with tall Armorican sandstone cliffs.

Dry moors are the primary habitat at the far end of Cap de la Chèvre, mostly featuring Dorset heath (*Erica ciliaris*), bell heather (*Erica cinerea*), western gorse, prostrate form (*Ulex gallii* var. *humilis*), common gorse (*Ulex europaeus* var. *maritimus*), purple moor grass (*Molinia caerulea*) and common heather (*Calluna vulgaris*). Depending on their exposure, these moors tend to grow in mats, with plant cover that can be even and stable.

On Cap de la Chèvre, you can also see thickets of blackthorn (*Prunus spinosa*), which have really thrived in recent years.

The site also has cliffs with vegetation along the Atlantic coast, particularly halophytic grassland where red fescue (*Festuca rubra*), sea thrift (*Armeria maritima*), sea carrot (*Daucus carota* subsp. *gummifer*) and sea campion (*Silene maritima*) flourish.

At the tour site, you will note the presence of military remains that are now used by greater horseshoe bats (*Rhinolophus ferrumequinum*) as dens for resting and hibernating. Palmate newts (*Lissotriton helveticus*) can also be found in a pond by the entrance to one of the bunkers.

As concerns birds, Cap de la Chèvre is frequented by the red-billed chough (*Pyrrhocorax pyrrhocorax*), the Dartford warbler (*Sylvia undata*), the common raven (*Corvus corax*), the European shag (*Phalacrocorax aristotelis*) and the barn swallow (*Hirundo rustica*), amongst others.

History of the site

The site of Cap de la Chèvre also boasts an important military history, as witnessed by its signal tower and its many remnants of fortifications.

The first signal tower dated from the early 19th century, and the artillery batteries were built on the cape in the early 20th century. There are casemates for cannons surrounded by buried bunkers used for munitions storage and a command post. The goal was to defend the mouth of Douarnenez Bay.

The cape was a military site up until the year 2000, although it was already open to the public by then. The first work to channel foot traffic was done in 1999, by the Ministry of Defence in collaboration with Crozon's town council.

In 1988, one of the casemates was converted into a war memorial to casualties of the French Naval Aviation's 2nd maritime region.

Protection

Cap de la Chèvre benefited from the long ago awareness of a handful of locals who managed to attract the attention of the public authorities and elected officials regarding the site's quality and heritage value. Now, thanks to that early awareness, the site enjoys very strong regulatory protection, that largely guarantees the conservation and quality of its landscapes, spared the ravages of "unbridled" urbanisation.

> Cap de la Chèvre is a listed site under the French Law of 2 May 1930, the aim of which is to protect natural monuments and artistic, historical, scientific, legendary and picturesque sites. For Cap de la Chèvre, that designation was made in a decree dated 4 July 1983.

> The Conservatoire du Littoral, whose purpose is to protect coastal sites through land acquisitions, is the biggest landowner on Cap de la Chèvre. It possesses nearly all of the site covered by the tour.

> Cap de la Chèvre is also part of the Natura 2000 site, Presqu'île de Crozon, and is included in the Armorique Regional Nature Park.

> Lastly, Cap de la Chèvre is number 219 on the ZNIEFF inventory list of natural zones of interest in terms of ecology, wildlife or plantlife (type 1, for ecologically homogeneous zones).

Management

The far end of Cap de la Chèvre is widely renowned, making it a very popular place to visit, a fact that drove action very early on to address the impact of foot traffic on the site's natural environments. In 1999, the Ministry of Defence had a barrier cable installed to contain walkers. After the site's sale to the Conservatoire du Littoral in 2000, the department responsible for natural areas at Crozon's town hall improved the arrangements. In 2017, the Conservatoire du Littoral installed more barrier cables to increase the protection of the cape's natural environments.

Some moorland, after being placed under protection in the 2000s, is now almost completely wild and might even benefit from being mown.

To the west of the site, you can still spot the low walls that were once built to protect livestock and crops from the wind. They now provide shelter for the ageing moors.

The hottentot fig (*Carpobrotus edulis*), which was planted in the signal tower's garden in the 1980s, has expanded onto the cliffs. A Natura 2000 contract made it possible to pull up most of it (1,700 kg in 2012 and 44 kg in 2014). Unfortunately, the plant has begun growing on the cliffs again since then, so further action will be required.



Websites

<http://presquile-de-crozon.n2000.fr>
<https://www.reservepresquiledcrozon.bzh/informations-generales>
<https://www.comcom-crozon.com>

1d - Ménez Hom

The Ménez Hom is a hill located at the base of the Crozon peninsula. It is part of a geological formation of Armorican sandstone (white quartzite) dating back approximately 480 million years. Its altitude is 330 meters. The Natura 2000 site is the "Ménez Hom - Argol complex", 14 habitats of European community interest are listed. Heathlands and sloping bogs are the most notable habitats. Pine woods are present on the slopes of the hill.

The main risks are fires like the one in June 2022. Disturbances to the natural environment are associated with tourist numbers and sports activities (300,000 visitors per year).

The emblematic species of the site is the *Pylae Sphagnum* (*Sphagnum pylaisii*); it is common in peat moors and sloping bogs. *Spiranthes aestivalis*, *Trichomonas speciosum*, or *Elona quimperiana* (an endemic snail) are some of the other species at stake on the site. The good state of conservation of remarkable habitats and species is ensured by the oligotrophic nature of the substrate.

EXCURSION 2: OUESSANT

Typology and conservation management of coastal eathlands of the Isle of Ouessant

Field excursion of 25th August 2022

Frédéric Bioret¹, Coentin Chevrollier¹, Erwan Glemarec¹, Agathe Larzillière², François Quénot³

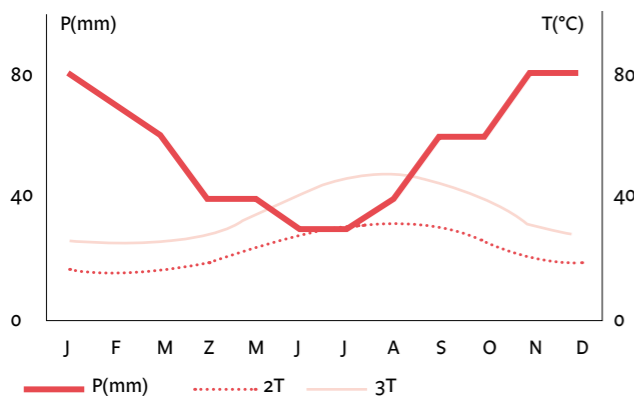
¹ Laboratoire Géoarchitecture, Université de Bretagne occidentale, Brest

² Parc naturel régional d'Armorique

³ Centre d'Étude du Milieu d'Ouessant

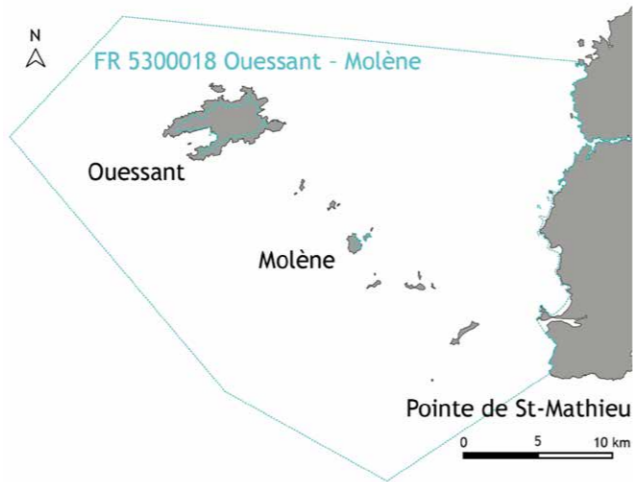
Introduction

Located at about twenty kilometers off the western coast of Finistère, the island of Ouessant extends over more than 1500 hectares; it is made up of a rocky plateau whose altitude culminates at 55m above sea level in the northeast and then gradually decreases towards the southwest up to about 10m. The climate is hyperatlantic and characterized by mild winters and cool summers. June and August can be considered as sub-dry months and July as a dry month if we consider the ombrothermic diagram produced from the temperature and precipitation data corresponding to the period 1981-2010 (Dubreuil et al., 2012, in Demartini, 2016).



Ombrothermic diagram of the Isle of Ouessant: When $P \leq 2T$, then month is considered as dry; when $P \leq 3T$, then month is considered as sub-dry (Demartini 2016; 1981-2010 period).

The phanerogamic vegetation of the maritime cliffs has a high specific richness, depending on the proximity of the sea, wind and spray exposure, nature and depth of the substrate and past or current human uses. The conservation management of the terrestrial part of the « site classé » and the Natura 2000 site of the island of Ouessant is coordinated by the Regional Natural Park of Armorique (PNRA).



Chronology of typology and mapping of the eathlands of Ouessant

The first publication concerning the coastal eathlands of the island of Ouessant is "Essai pour un système de classification phytosociologique des eath atlantiques françaises" (Géhu, 1975) which covers all the French coastal eathlands. This author already worked on *Cytisus scoparius* subsp. *maritimus* heathland in Ouessant from the 1960s (Géhu, 1963).

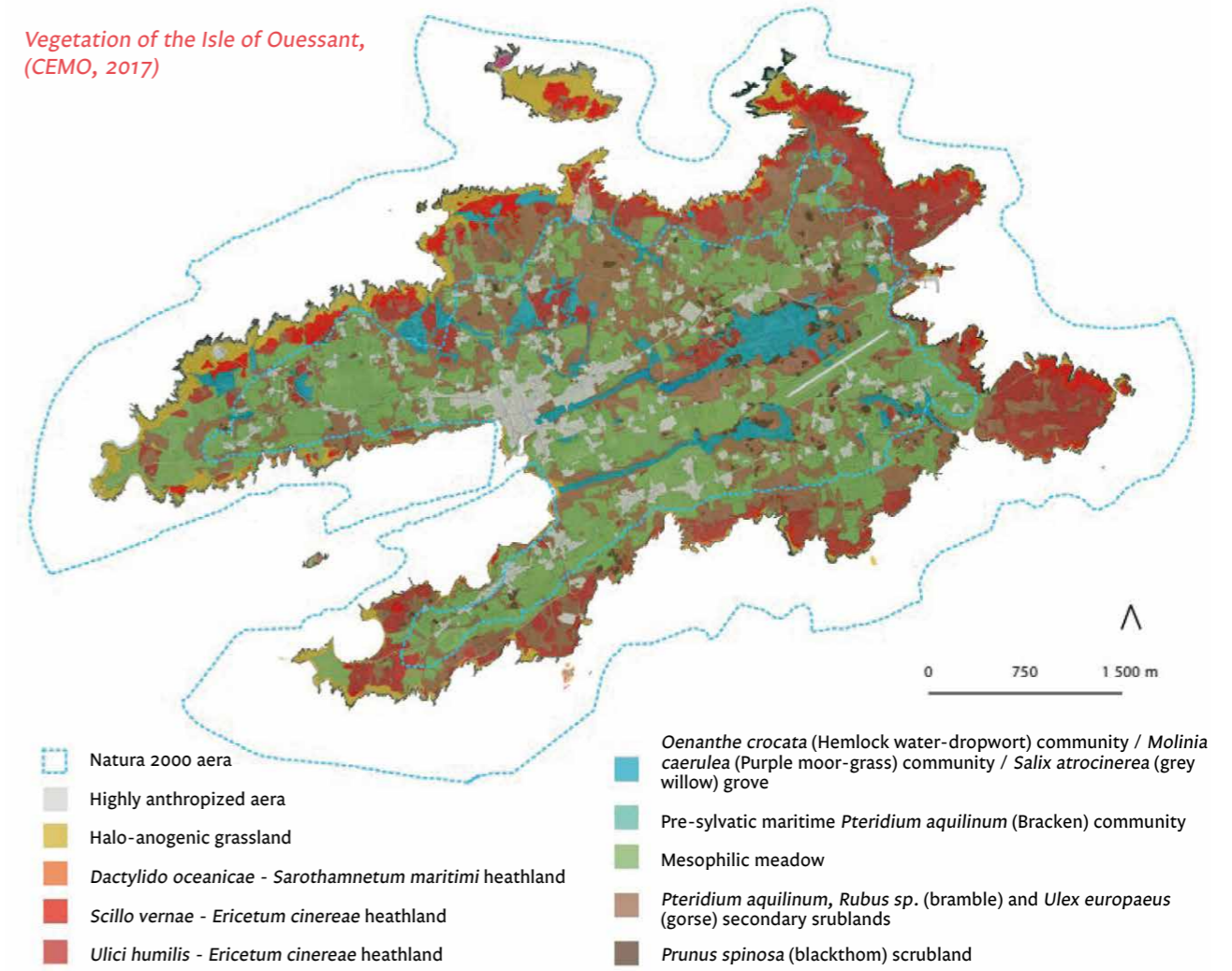
The studies of Bioret (1985, 1989, 1994) and Hardegen & Bioret (2000) made it possible to specify the phytosociological typology and the spatial distribution of the coastal eathlands of Ouessant. The maps realized in 2010 (Loncle & Bioret, 2010; Glemarec & Lebellour, 2010) established the correspondances to Natura 2000 habitats. This typology recently supplemented by Glemarec & Bioret (2022) makes it possible to determinate stable and dynamic eathlands and scrublands.

A historical approach, using data from the Napoleonic cadastre (1844), particularly with regard to ancient uses, made it possible to differentiate primary stable eathlands from secondary eathlands (Chevrollier et al., 2021).

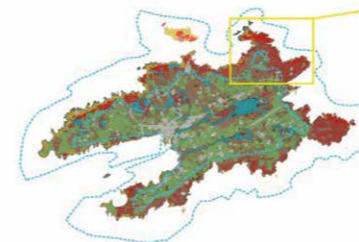
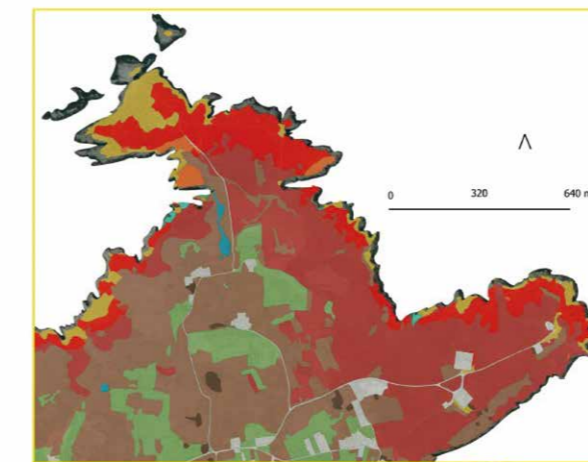
The landscape phytosociological approach of the eathlands of Ouessant was first conceptualized by Bioret et al. (1991), supplemented by Demartini (2016).

Bioret & Glemarec (2022) specify the dynamic trajectories of the different types of coastal eathlands, considering stable community as permaseries, or as terminal stage of minoriseries, and unstable communities as dynamic stages to mature scrublands minoriseries.

Vegetation of the Isle of Ouessant, (CEMO, 2017)



First stop: Coastal vegetation from Stiff to Kadoran (north coast)



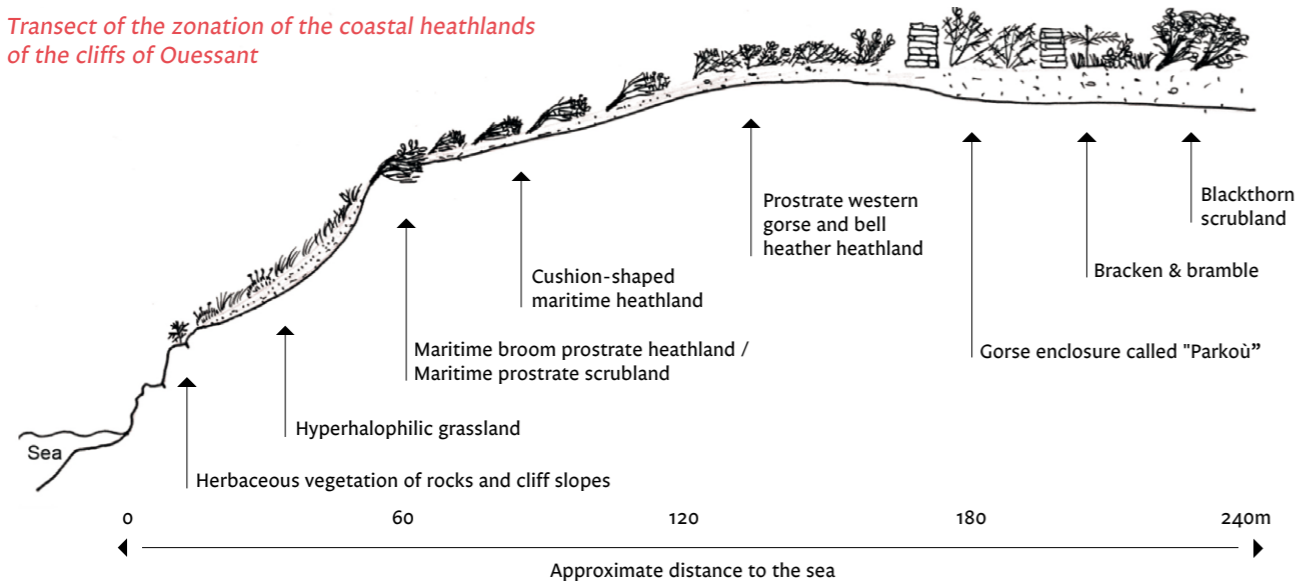
Herbaceous vegetation of rocks and cliff slopes

In the lighted maritime rock-crevices, very subject to sea spray, *Spergularia rupicola* (Rock sea-spurrey) and *Crithmum maritimum* (Rock samphire) constitute an adapted plant community (*Spergulario rupicolae-Crithmetum eathlan* (Roux & Lahondère 1960) Géhu 1962). In subhumid crevices, *Asplenium marinum* (Sea spleenwort) is associated with *Armeria eathlan* (Thrift) and *Umbilicus rupestris* (Navelwort) (*Armerio maritimae-Asplenietum marini* Géhu & Géhu-Franck 1984). The base of the shaded and fresh cliffs is colonized by *Cochlearia officinalis* (Common scurvygrass) and *Armeria eathlan* (*Armerio maritimae-Cochlearietum officinalis* Géhu & Géhu-Franck 1984).

In the contact zone between the chasmophytic vegetations and the halo-anemogenic grasslands, a short and sparse grassland develops, with *Armeria eathlan* and *Plantago coronopus* (Buck's-horn plantain) and *Cochlearia danica* (Danish scurvygrass) (*Armerio maritimae-Plantagnetum coronopodis* (Vanden Berghen 1965) Bioret & Géhu 2008).

A paucispecific perennial, sub-open, hyperhalophilic grassland develops on the very exposed low cliffs of the north and north-west coast of the island. Characterized by *Agrostis stolonifera* var. *eathlan* (syn. var. *arenaria*) (Creeping bent) and *Festuca rubra* subsp. *pruinosa* (syn. subsp. *juncea*) (Red fescue), it corresponds to *Armerio maritimae-Agrostietum maritimae* (Bioret & Géhu 2008). The most common halo-anemogenic perennial grassland, grows on fairly deep, mesophilic ranker, in cool exposure. Dominated by *Festuca rubra* subsp. *pruinosa*, *Armeria eathlan* and *Lotus corniculatus* var. *crassifolius* (Common bird's-foot trefoil), this grassland corresponds to the *Armerio maritimae-Festucetum pruinosa* Géhu 2008.

Transect of the zonation of the coastal heathlands of the cliffs of Ouessant



Chamephytic vegetations

Coastal eathlands are subject to strong ecological constraints. Oligotrophy of the soil, wind and salt spray exposure determine the presence and the shape of the chamephytes. Ecotypes and accommodations of gorses and brooms structure eathlands vegetations communities. Maritime broom (= scotch/prostrate broom), *Cytisus scoparius* subsp. *maritimus* (Rouy) Heywood [1959, *Bot. Soc. Brit. Isles Proc.* 3: 176] is present on the coast of Ouessant. This maritime subspecies is characterized by short and prostrate plants, shaped by the wind, with silky-hairy densely pubescent young branches becoming glabrous when mature. Prostrate western gorse, *Ulex gallii* Planchon f. *humilis* (Planch.) Cubas [1979, *Lazaroa*, 1: 114] is characterized by a cushion port, strongly shaped by maritime conditions.

These two taxa are associated with *Erica cinerea* (bell heather) and *Calluna vulgaris* (Common heather) to constitute maritime eathlands communities. They also characterize low coastal scrublands without *Ericaceae*. Three main coastal eathlands associations are present in Ouessant. They are presented in synthetic sheets.

› **Maritime broom prostrate heathland** (*Dactylido oceanicae-Sarothamnetum eathlan* Géhu 1963) is located along the south and north-east coast. It is situated at the upper contact of the halo-anemogenic vegetation of chamephytic rocks with *Crithmum maritimum* (*Crithmo-Limonietea*) and grasslands with *Festuca rubra* subsp. *pruinosa* on rankosols (*Armerio maritimae-Festucetum pruinosa*). This heathland presents a linear development at the level of the slope break of the cliff-top, on superficial and eroded soils (Géhu, 1963; Hardegen & Bioret, 2000). At the upper contact, it is replaced by other types of eathlands, on deeper soils.

› **Cushion-shaped maritime heathland** with bell heather and common heather (*Scillo vernae-Ericetum cinereae* Bioret 1994) is located mainly in the north and east of the island and on the peninsula of Penn Arlan in the south-east. Typical of exposed slopes, this cushion-shaped eathlands is physiognomically recognizable by its significant necroses and “waved” structure (Bioret, 1994; Hardegen & Bioret, 2000). Bare soil patches are present, due to aerohaline stress. *Tractema verna* (Spring squill) develops in these interstices. It is located on cliff tops in upper contact with the halo-anemogenic grasslands.



Scillo vernae-Ericetum cinereae (Ouessant F-29)

› **Western gorse and bell heather coastal heathland** (*Ulici humilis-Ericetum cinereae* (Vanden Berghen 1958) Géhu & Géhu-Franck 1975) is the most widespread heathland on the island. It grows on cliff headlands, in upper contact with other eathlands (if present). Co-dominated by gorse and heather, it may be stable or present a dynamic towards scrublands in sheltered conditions or according to past uses. At the upper contact, this heathland can be relayed by vegetation dominated by *Pteridium aquilinum* (Bracken), *Rubus* sp. (Bramble) or coastal scrublands with *Ulex europaeus* (European gorse) (cultivated as firewood or cattle feed and escaped from cultivated enclosures) and on deep soils by *Prunus spinosa* (Blackthorn).



Ulici humilis-Ericetum cinereae (Ouessant F-29)

› **Maritime broom thicket** (*Sileno eathlan-Cytisetum eathlan* Glemarec & Bioret 2022) corresponds to a low halo-anemorphic thicket, dominated by *Cytisus scoparius* subsp. *maritimus*, dense to semi-open, the interstices between maritime brooms allowing the development of *Dactylis glomerata* s.l. (including subsp. *eathla*) (Cock’s foot) and *Silene eathlan* (Sea campion).

Species of the *Armerio maritimae-Festucetum pruinosa* can take place in the characteristic combination. *Ericaceae* are absent. The optimum of this vegetation corresponds to steep slopes, less often on slope breaks, on coastal cliffs exposed to wind, on silty, sandy, veneered, shallow and eroded soils, also on the edges of outcropping rocks. The substrate corresponds to shallow (<20 cm) eroded lithosols or rankosols.

This vegetation presents a pioneering character and a primary dynamic, on naturally eroded substrates (cliff erosion) or linked to the presence of vertebrate populations (rabbit warrens, seabird rookeries) and former human activities (quarries...) (Glemarec & Bioret, 2022).



Sileno maritimae-Cytisetum eathlan (Ouessant F-29)

› **Western gorse scrublands** (*Silene eathlan-Ulex humilis* community) are low pioneer thickets that develop around rocky outcrops, on very superficial soils, often at the upper contact of haloanemogenic grasslands, at the lower contact of coastal eathlands. The thicket is dominated by the western gorse *Ulex gallii* f. *humilis*, with associated grass species such as *Dactylis glomerata*, *Silene eathlan*, *Rumex acetosa* (Common sorrel) and pre-sylvatic scrubs species such as *Teucrium scorodonia* (Wood sage), *Lonicera periclymenum* (Honeysuckle), *Rubus* sp., *Polypodium interjectum* (Intermediate polypody).

› **Secondary Blackthorn scrublands** associated with bracken, grow on deeper soils, on former cultivated fields and at the top of maritime cliffs, at the topographic contact of *Ulici humilis-Ericetum cinereae* heathland.

Ulex europaeus (European gorse) was grown on the island of Ouessant, mainly for the production of firewood (house and bread oven). It was also used to feed the cows and horses, the young shoots were crushed with a chipper. The first mention of gorse cultivation is 1790. These plantations took place in fields enclosed by walls, named in Breton language *park*, *parkou* (plural) (Gestin et al., 1982). The number of



Park with *Ulex europaeus*, old enclosure (Ouessant F-29)

parkou increased during the XIXth century, regressed during the XXth century. They tend to disappear today but are still visible. European gorse remains confined in and around the old enclosures, but can occasionally appear in former cultivated areas or in places that have recently been subject to soil modification.

The coastal landscape of Ouessant is characterized by the absence of trees. Landscape is dominated by open spaces characterized by grasslands, eathlands and scrublands. In Ouessant, as in the rest of Europe, and until the XXth century, eathlands were integrated into agricultural life. They provided food resource for animals or organic material to fertilize cultivated fields. The study of the Napoleonic cadastre (1844) and the comparison with current vegetation maps make it possible to qualify stable eathlands, eathlands having evolved into scrublands and recent eathlands on areas in agricultural decline (Chevrollier et al., 2021). Each heathland type according to these past uses presents a specific dynamic. However, the most exposed eathlands of *Dactylido oceanicae-Sarothamnetum eathlan* and *Scillo vernae-Ericetum cinereae*, located between Penn Arlan, le Stiff and Kadoran, can be considered as the oldest eathlands of the island, stable and showing no signs of dynamics. The possible pre-existence of a possible coastal forest is under study (Glemarec & Bioret, 2021), but these eathlands can be today considered as sub-primary eathlands.

The disappearance of eathlands in favor of scrublands in the less exposed parts of the coast is also noted. The occasional appearance of eathlands is then linked to localized clearings. The cessation of firewood collection, the gradual disappearance of grazing activity, causes the following. Coastal scrublands on the cliff tops are probably more important than before, but their dynamic is slow due to the constraints of soil, wind and salt spray.

Conservatory management actions are carried out to reopen the fallow areas in the interior of the island. Non-intervention seems to be the most appropriate way of management for the stable maritime eathlands (Chevrollier et al., 2021).

Bracken community

On the cool exposed slopes of the maritime cliffs, (sub) primary bracken communities constitute edge vegetation with species of undergrowth or forest edges: *Primula vulgaris* (Primrose), *Hyacinthoides non-scripta* (Bluebell), *Lonicera periclymenum*... These primary bracken communities present a significant phytocoenotic originality and should not be considered as paucispecific agropastoral abandonment vegetations.

However, the majority of the bracken communities present on Ouessant are secondary and correspond to post-cultural vegetation that developed following the abandonment of agriculture and grazing of meadows. The most widespread scrub is dominated by *Rubus* sp., *Pteridium aquilinum*, sometimes accompanied by *Prunus spinosa*.

Hygrophilous vegetation

The only wooded formations currently present on Ouessant correspond to groves dominated by *Salix atrocinerea* (Grey willow = *Salix cinereae* subsp. *Oleifolia*). The herbaceous layer is dominated by *Oenanthe crocata* (Hemlock water-dropwort), *Iris pseudacorus* (Yellow iris), *Ranunculus flammula* (Lesser spearwort), *Apium nodiflorum* (Fool’s water-cress)... Oligotrophic soils are home to communities of *Molinia caerulea* (Purple moor-grass) or *Deschampsia cespitosa* (Tufted hair-fat). Hygrophilous vegetations, particularly willow groves, are a result of pastoral abandonment and mowing of wet meadows.

Sheets

1 - Maritime broom prostate heathland

Dactylido oceanicae - Sarothamnetum eathlan
Géhu 1963

Physiography

This heathland presents a linear development at the level of the slope break of the upper part of semi-exposed coastal cliffs. It is most frequent near the crest of the cliffs and only appears in the most-advanced rocky coastal headlands.

Ecology

It develops on a shallow substrate, on eroded silty veneers or to granitic arenas enriched in fine elements (lithosols or thin rankosols), poor in organic matter, very stony and dry in summer. Exposure to wind and salt spray is important.

Floristic composition

The characteristic combination usually associates *Cytisus scoparius* subsp. *Maritimus* and *Dactylis glomerata* s.l (included subsp. *eathla*). *Erica cinerea* is present. Prostrate western gorse is absent.

Physiognomy

This prostrate heathland is characterized by horizontal port, with short stature, procumbent, shaped by the wind, horizontal and flattened to the ground. The eathlands optimum extends from late spring to early summer (May-June). At the time of the vernal *Cytisus* flowering, this heathland revealed in the coastal cliffs landscape, a yellow narrow fringe; it never occupies large areas. This plant community has a dense phanerogamic covering (80-100%).

Uses

Historically, the maritime broom was harvested for firewood. Its collect was intense in Ouessant as mentioned by Géhu (1963) who observed many old broom stumps cut at ground level, even in the cliffs. Written evidence from the 1800s (*in Gestin et al., 1982*) confirms that Ouessant did not produce firewood, only gorse and broom, which were cultivated or collected with a high financial value. Today there are no more uses of this heathland.

Chorology

The geographic distribution of this heathland is limited to the Armorican Massif and the south west part of the British Isles. It is recorded on the Breton coast in Finistère and Morbihan, in Normandy, on the exposed points of the Cotentin (Nez de Jobourg), in the Channel Islands (Jersey, Sark) and to the west coast of Cornwall and Wales.

Dynamic

No dynamic was observed. Considered as climax, this heathland corresponds to a permanent vegetation.

Contacts

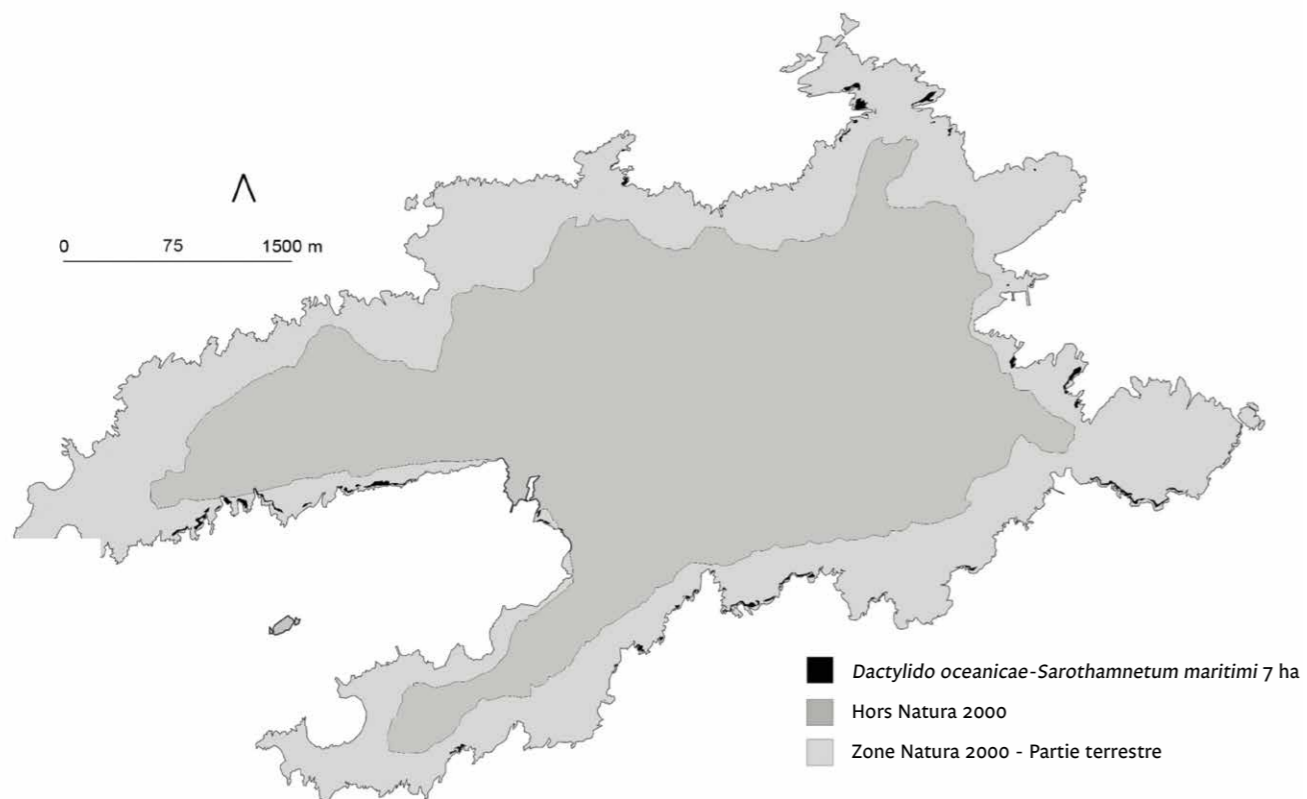
This heathland develops at the upper contact of chasmo-halophytic vegetations on rocky soils (*Crithmo eathlan-Limonietea pseudominuti*) or halo-anemogenic grassland on rankosols (*Armerio maritimae-Festucetea pruinosa*) and at the lower contact of cushion shaped eathlands as *Scillo vernaie-Ericetum cinerea* or *Ulici humilis-Ericetum cinerea*.

Heritage value

Maritime broom prostate heathland characterize habitat of community interest 4030-European dry eathlands and to the elementary habitat (French Natura 2000 typology): maritime Atlantic heathland 4030-2. It does not include any protected plant species. Nevertheless, it is characterized by the presence of coastal ecotypes including *Cytisus scoparius* subsp. *Maritimus* and *Dactylis glomerata* subsp. *eathla*.

The absence of natural dynamics and nowadays anthropogenic uses, allow a very good state of conservation of this heathland on the island. Finally, given its restricted geographic distribution, it represents here a major conservation issue at the national level, but it does not require any interventionist management measure.

Location of *Dactylido oceanicae-Sarothamnetum maritimi* heathland



2. Cushion-shaped maritime heathland with Bell heather and Common heather

Scillo vernaie-Ericetum cinerea Bioret 1994

Physiography

The cushion-shaped heathland develops on the upper part of the slope of the exposed coastal cliffs, mainly on the northeast, near Kadoran and the Stiff, and southeast coast of the island, in Pen Arlan peninsula.

Ecology

This heathland grows through drained and shallow (<15cm) coastal rankers, in maritime exposed conditions.

Floristic composition

The floristic combination associates *Tractema (Scilla) verna*, *Erica cinerea* and *Calluna vulgaris*. Prostrate western gorse is absent. A grass, the Huon's Fescue *Festuca huonii* is punctually present. Bare soils patches are due to the aerohaline stress. Other grassland pioneer species develop in these interstices: *Thymus drucei*, *Luzula campestris*, *Pedicularis sylvatica*, *Sedum anglicum*...

Physiognomy

This heathland is physiognomically marked by its "waved" structure. The height never exceeds 15 cm, with an asymmetrical growth: parts of the heather facing the sea show significant necrosis which protect the more sheltered parts that suffer less drought and salt sparying.

Uses

This heathland may have been extensively grazed in previous centuries, but this is no longer the case today. It is locally subject to stripping practices, especially on motorized vehicles accessible points. This heathland is not subject to any interventionist conservation management measures.

Chorology

The distribution of this community is limited to a few sites of the islands and rocky points of western Brittany (Ouessant, Cap de la Chèvre). This heathland is also present in British Cornwall (Scilly's, Land's End) (Bioret, 1994). Ouessant represents the most important eathl spot for this heathland.

Dynamic

Due to the environmental constraints, the dynamic of this heathland is very reduced, even blocked. It can be considered as a permanent vegetation. The very low phytomass produced just compensates the destruction at the level of necrosis due to salt. It is possible to observe a slight "cyclical" or "oscillating" dynamic during which the heather takes over from the grasslands and vice versa, depending on the strength of the climatic conditions.

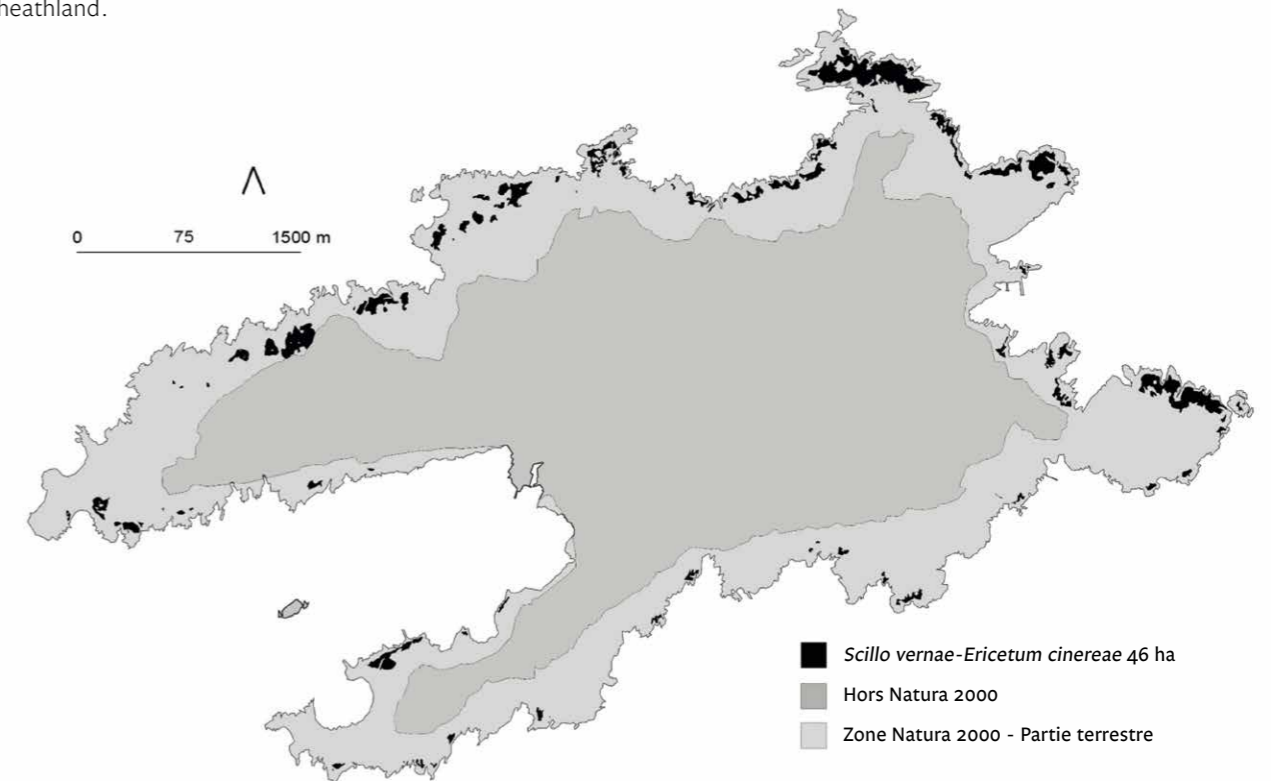
Contacts

This heathland develops at the upper contact of chasmo-halophytic vegetations on rocky soils (*Crithmo eathlan-Limonietea pseudominuti*) or halo-anemogenic grassland on rankosols (*Armerio maritimae-Festucetea pruinosa*). Sometimes, it is present at the upper contact of *Dactylido oceanicae-Sarothamnetum 83eathlan*. At the top of the slopes, the transition towards *Ulici humilis-Ericetum cinerea* heathland is marked by the appearance of the prostrate western gorse.

Heritage value

Cushion-shaped maritime heathland with Bell Heather and Common heather characterizes the habitat of community interest 4030-European dry eathlands and the elementary habitat (French typology): maritime Atlantic heathland 4030-3. The very limited geographical distribution of these eathlands tends to represent a major conservation issue at the national scale. *Solidago virgaurea* subsp. *Rupicola*, rare dwarf ecotype of Goldenrod is regularly present.

Location of *Scillo vernaie-Ericetum cinerea* heathland



3. Prostrate Western gorse and Bell heather heathland

Ulici humilis-Ericetum cinereae
(Vanden Berghen 1958) Géhu 1975

Physiography

This coastal heathland develops on the summit headland of semi-exposed to sheltered coastal cliffs; it is absent from the parts most exposed to maritime conditions.

Ecology

It is found on drained substrate, in deeper rankersols (20 to 40cm), sometimes with a start of podzolization.

Floristic composition

The characteristic combination usually associates *Ulex gallii* var. *humilis* and *Erica cinerea*. Several herbaceous species are regularly present: *Viola riviniana*, *Potentilla erecta*, *Danthonia decumbens*...

Physiognomy

The general eathlands of this heathland is due to the cushion shape of gorse and heather. Western prostrate gorses present the main physiognomic and structural importance of the heathland. Its height can reach 40 to 50 cm in the most indented sectors of the edge of the cliffs.

Uses

In sectors close to the sea and where the heathland is the lowest level, stripping is still practiced in places. Historically, western prostate gorse was collected as firewood, but it was gradually abandoned from the XVIIIth century. Another gorse, European gorse, was planted and harvested in enclosed fields, the Parkoù. The production of wood was more important. Heathland could also be taken as bedding for cowsheds. Today, as part of the management of the Natura 2000 site, for the conservation of the eathlands, scrublands cuts are made to restore or maintain this heathland.

Chorology

This heathland is characteristic of cliffs in a hyperoceanic climate. It is present in Normandy (Cotentin) and in the Channel Islands. In Brittany, it is present on the most important coastal cliffs.

Dynamic

In the most wind and salt spray exposed areas, this heathland seems to be stable as no dynamics have been observed. It can be considered as a (para)climatic heathland. In the sheltered sectors of the coastal cliffs, a progressive dynamic can be observed. The appearance and development of pre-forest species contribute to the evolution towards scrublands. The characteristic species of this dynamic phase are *Teucrium scorodonia*, *Hedera helix*, *Lonicera periclymenum*, *Rubus* sp. *Pteridium aquilinum*, and even sometimes *Prunus spinosa*, reflecting the dynamic potential towards the blackthorn scrublands.

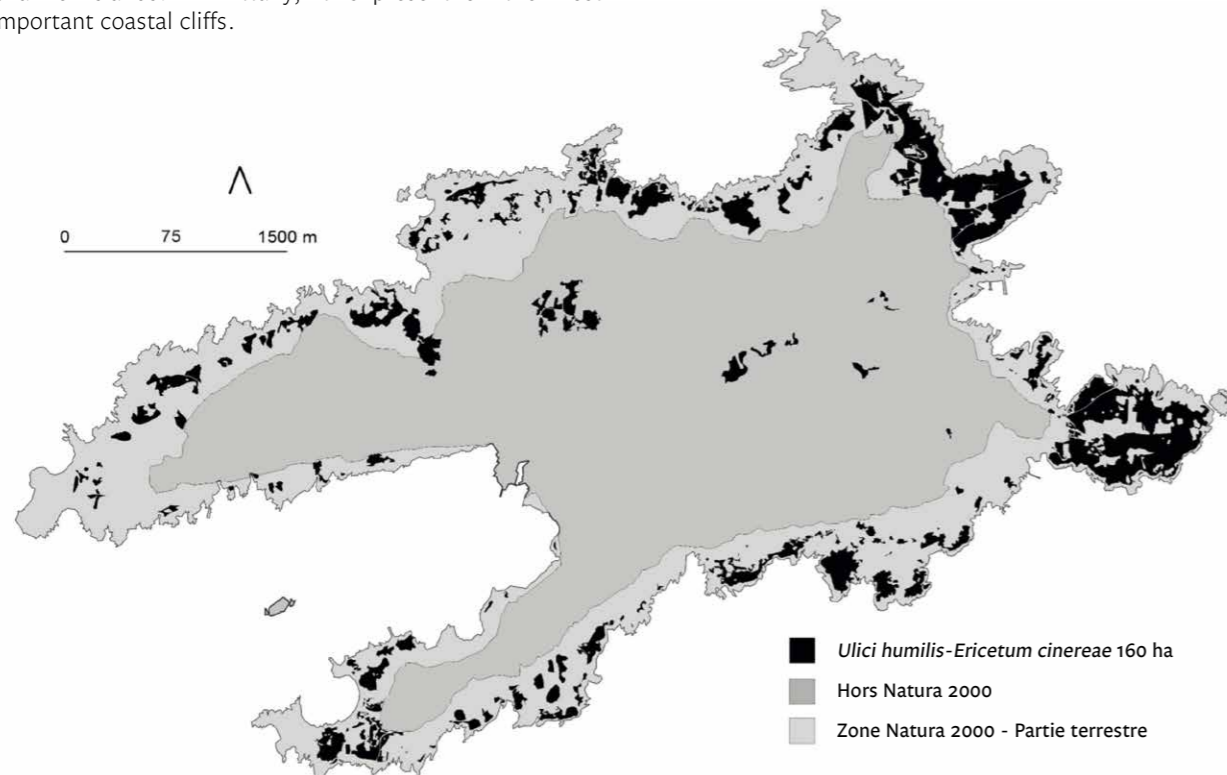
Vegetation in contact

It develops at the upper contact of halo-anemogenic grassland with *Armeria eathlan* and *Festuca rubra* subsp. *Pruinosa* (*Armerio maritimae-Festucetum pruinosa*) or Cushion-shaped maritime heathland with Bell Heather and Common Heather (*Scillo verna-Ericetum cinereae*). At the upper contact, on deeper soils, in more sheltered conditions or in modified soils, bracken communities or scrublands with *Ulex europaeus* or *Prunus spinosa* may be present.

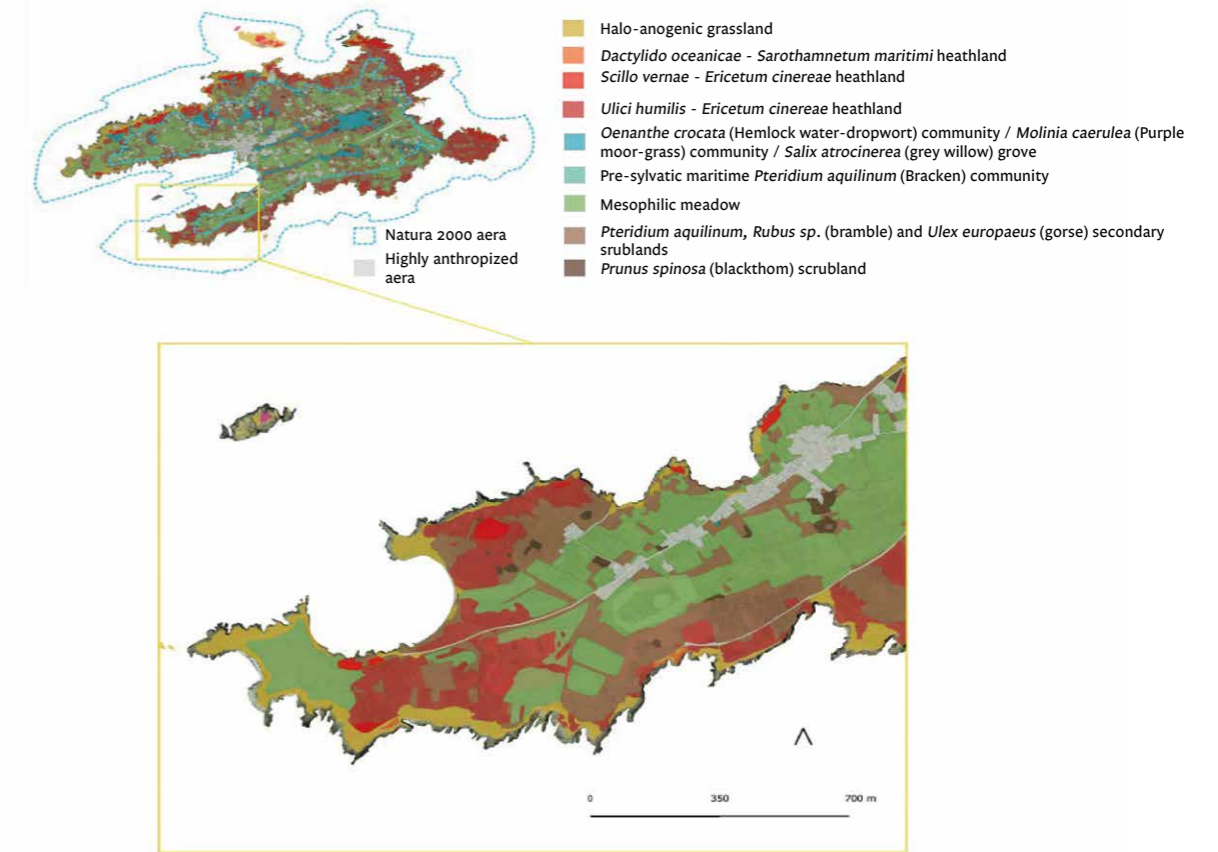
Heritage value

Prostrate western gorse and Bell heather heathland characterize habitat of community interest 4030-European dry eathlands and to the elementary habitat (French typology): maritime Atlantic heathland 4030-3. The cushion ecotype of *Ulex gallii* represented by the *humilis* form is restricted to this heathland type that must be considered as a major ecological heritage value.

Location of *Ulici humilis-Ericetum cinereae* heathland



Second stop: Porz Coret and Porz Doun (south coast)



The coastal part of Ouessant is included within a special conservation area (ZSC) and a special protection area (ZPS) relating to the European Directives “Habitats, flora, fauna” and “Birds” and integrated into the Natura 2000 “FR 5310072 Ouessant - Molène” which extends over more than 77 000 ha, 99% of which is marine environment (MNHN 2003). The PNRA, operator of the terrestrial part of the inhabited islands of the Natura 2000 site, is in charge of drafting and managing the “Objectives Document” (DOCOB) (PNRA, 2010).

Four natural and semi-natural land habitats of Community interest listed in Annex I of the Directive have been identified. The two most represented habitats are the habitats “1230- Cliffs with vegetation of the Atlantic and Baltic coasts” and “4030- European dry eathlands”. More occasionally, two other coastal habitats are present: 1210 “Annual vegetation of seashores” and 1220 “Perennial vegetation of pebble shores”.

The DOCOB provides for the actions planned for the management of natural habitats and species of Community interest which justified the designation of the Natura 2000 site. One of these actions consists in mowing the shrubs by rotary slashing.

The issue of stripping (“étrépage”)

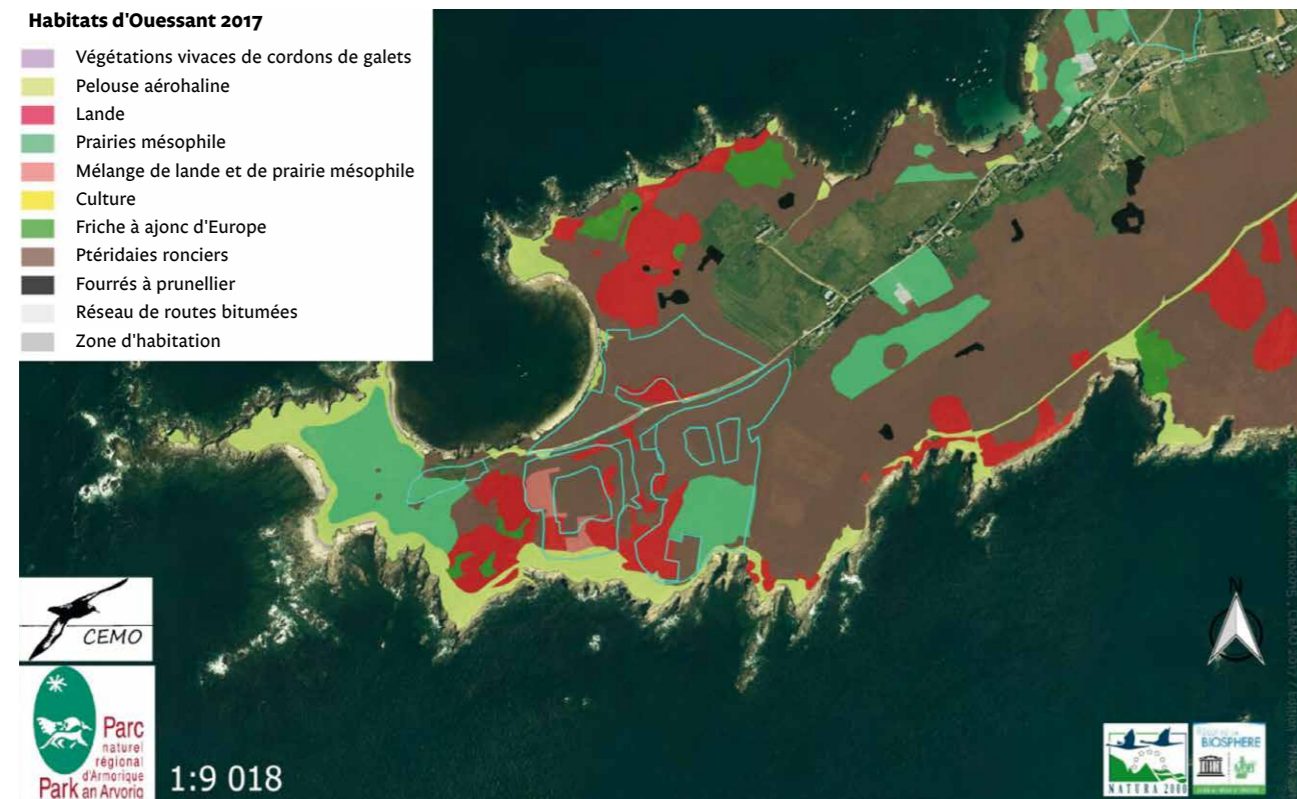
This ancestral practice consists of taking clods of coastal lawn or heathland as fuel for the preparation of slow-cooked dishes such as lamb or fish stews. Previously, each family took clods from their own plots and mostly from the interior of the island, with a very specific technique ensuring the maintenance of this resource over time.

Today this practice continues mainly to supply restaurants who prepare lamb stew “cooked under the motte” to meet tourist demand, but it has been relocated to coastal areas, which are not very favorable in terms of type of vegetation and soil nature. In addition, the practice is not always respecting the ancestral “rules”. Locally, vegetation grows back more or less slowly, which can cause or accelerate erosion phenomena. The question now arises of its sustainability, regarding to of the vast areas of bare soil that it generates. A reflection is ongoing to try to propose a more sustainable stripping practice, in concertation with local stakeholders.

Conservation management of coastal eathlands

Since the 2000s, the PNRA has maintained the natural areas of Ouessant by rotary slashing and brushing, in particular the points, in order to limit the falling of them. In addition to the landscape interest of this maintenance, the maintained spaces serve as a fallback site for the feeding and resting of Red-billed chough (*Pyrrhocorax pyrrhocorax*), an emblematic protected species of Ouessant. Over the years, on certain sectors thus maintained, the vegetation gradually evolves into heathland (Larzillièrre et al., 2019), without exporting the litter. Beyond its undeniable landscape interest, this “new” vegetation also has the advantage of being relatively stable and therefore of spacing out the maintenance phases more over time, which makes it possible to transfer the slashing efforts to other sectors with similar potential. The diachronic study carried out by the CEMO in 2018 (Chevrollier et al., 2021) identified a few sectors in which a return to the heathland is possible, and which today serve as test sectors for the management of the eathlands. Scientific monitoring will be carried out to follow the evolution of these environments following the mowing operations.

Cartographie des habitats de l'île d'Ouessant
Carte simplifiée des végétations en 2017 : secteur de Pors Dou



Near Fort du Kernic (north coast), on one of the plots of fallow land with potential for heathland development identified by the CEMO study, a mowing operation was carried out in 2021. A monitoring protocol is now in progress, in order to follow the evolution of the vegetation over time. These mowing operations are intended to

be carried out in other sectors of the island, in different conditions of exposure, type of soil, and different contexts (history, type of heathland...), and the monitoring protocol developed will also be applied to these sectors, so that to get enough replicates.



Heathland colonized by *Rubus* sp. and *Pteridium aquilinum*



Heathland colonized by *Pteridium aquilinum*



Regeneration of coastal heathland after *Pteridium* and *Rubus* vegetation slashing

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EXCURSION 3: MONTS D'ARRÉE

3a - Menez Meur

Presentation of the Menez Meur site and the restored sites

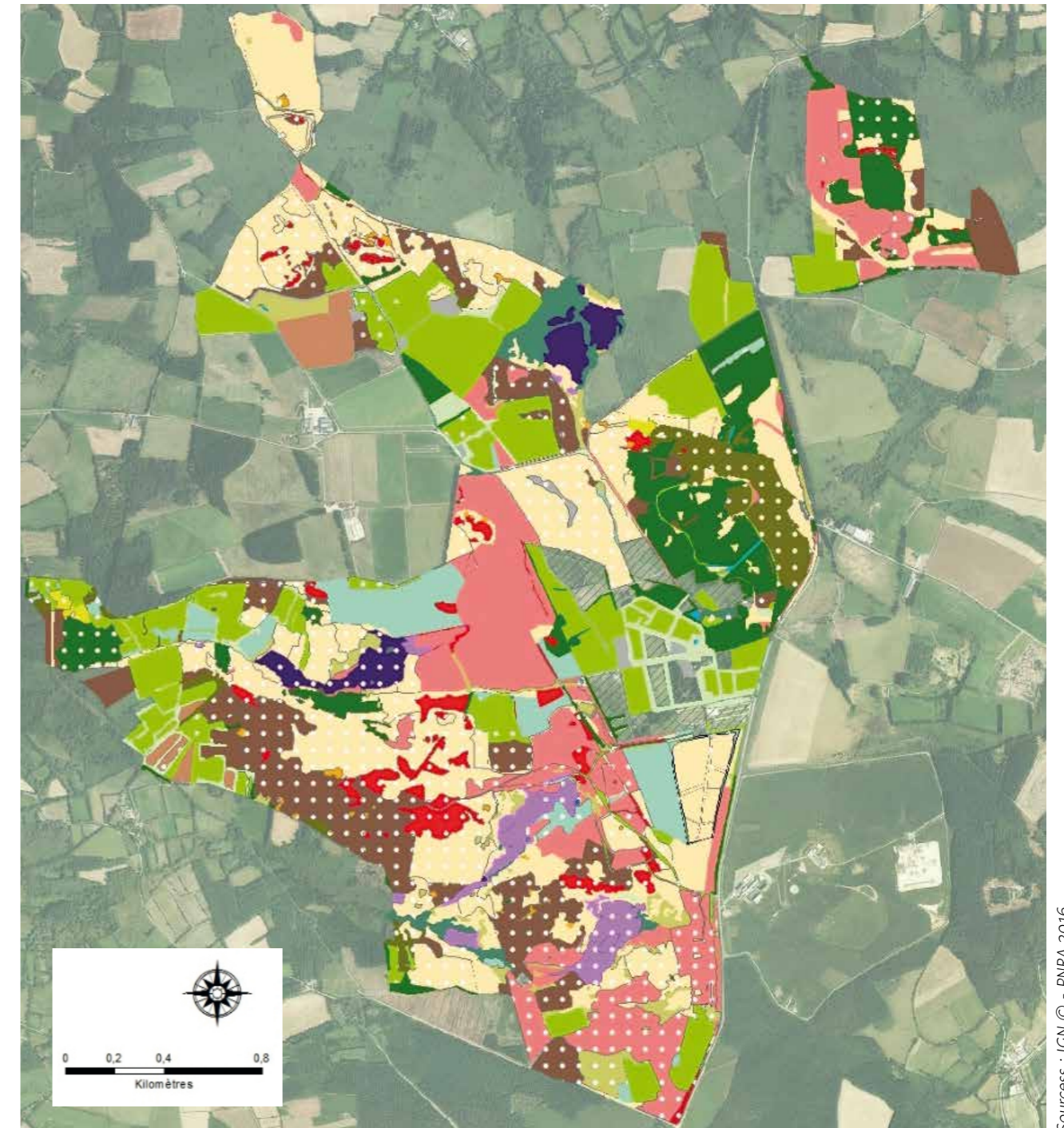
The Park has been managing the Menez Meur sensitive natural area (ENS) for over 50 years. This ENS, owned by the Finistère department, is the largest in the region, covering around 650 hectares. The site is known for its moors dotted with rocky outcrops.

The management of the site is organised by a management plan. Several moors on the estate have been the subject of restoration work following the removal of boulders. In parallel with this work, monitoring has been set up to measure the impact of the work and to study the resilience of the vegetation after such work.



Landscapes of moorland and rock of Menez Meur
H Coroller, PNRA

Mapping of the main vegetation types on the Menez Meur estate - CBNB, PNRA.

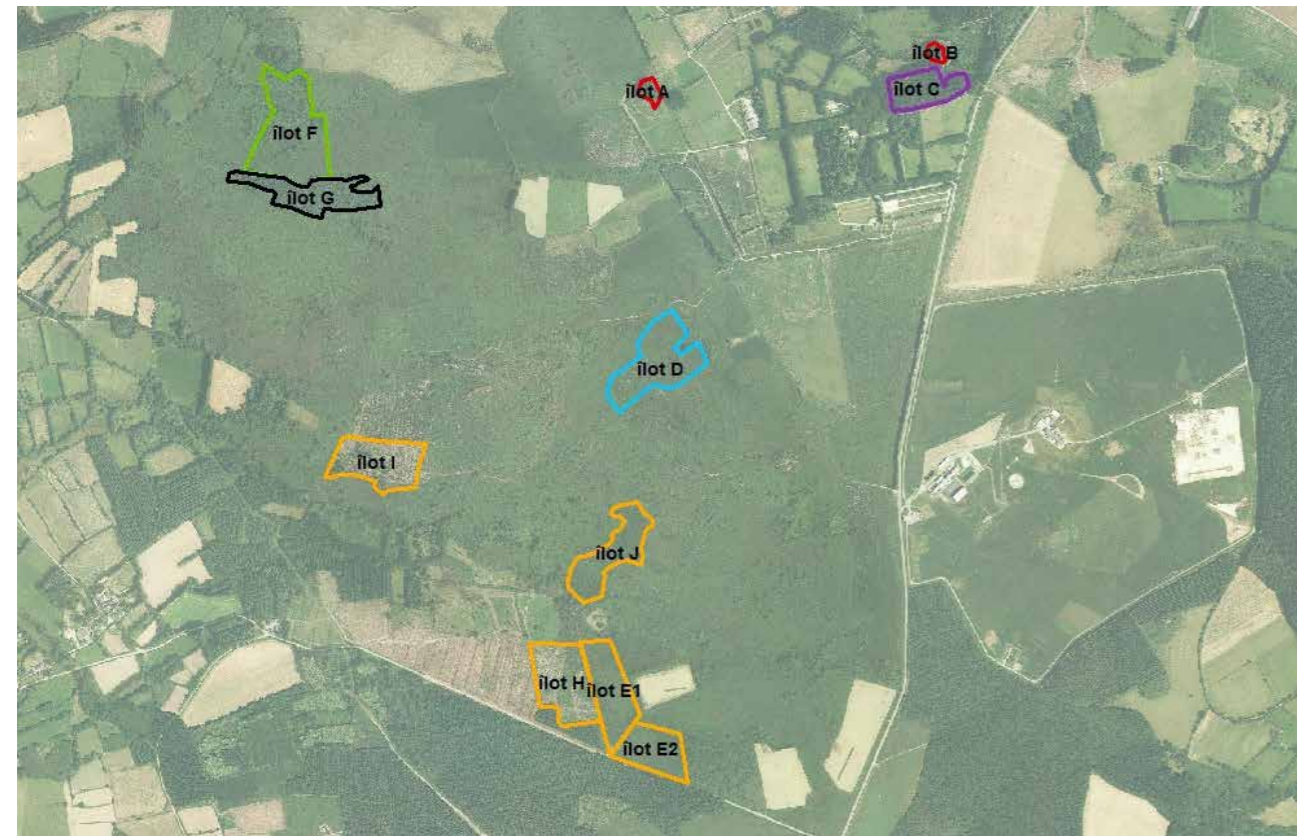


Forêts	Landes et tourbières	Végétations herbacées	Végétations aquatiques
Forêts sèches	Landes sèches	Ourllets	Mares avec ou sans végétation
Forêts mésophiles	Landes mésophiles	Prairies et pelouses sèches	Autres
Forêts hygrophiles	Landes hygrophiles	Prairies et pelouses mésophiles	Végétations anthropiques
Fourrés arbustifs	Tourbières	Prairies et pelouses hygrophiles	Milieus non végétalisés
Fourrés secs		Prairies et amphibies	
Fourrés mésophiles			
Fourrés hygrophiles			







The first experiments in restoring heathland, as a consequence of conifers afforestation/invasion, were carried out on Menez Meur and on the outskirts of the Vénec National Natural Reserve. This was part of an Interreg IIIB cooperation programme entitled "Heath" led by Natural England and whose French leader was the PNRA (2004 - 2007).


Various moorland rehabilitation operations were tested, including 24 hectares of deforestation on several sites and in various situations. This was followed by the restoration of de-silting moors in the Monts d'Arrée from 2013 to 2016. At Menez Meur, work was carried out on several sites, including two rocks and a peat bog site.

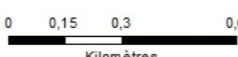
Types of work carried out on Menez Meur as part of the project to restore de-silting moorland in the Monts d'Arrée, PNRA.



Actions

	Traitement des rémanents, nettoyage roc'h		Débardage, arrachage, roulage de fougère
	Désenresinement, rognage, épandage litière de lande		Désenresinement non réalisé
	Fascinage, gyrobroyage d'ouverture, pâturage		Gyrobroyage, exportation produits gyrobroyage, épierrage





1 - Roc'h Glujau

Roc'h Glujau was covered by a mature Sitka spruce forest on its entire southern side. The northern face of the rock was obstructed by naturally regenerated young spruce trees which prevented any light penetration on the rock face. The top of the rock retained well-preserved grassland habitats, which may have accelerated the recovery of interesting vegetation. It should be noted that this rock is equipped for educational purposes with facilities for channelling traffic and with interpretation signs (redevelopment undertaken in 2015 in parallel with the restoration work).

Felling operations were therefore undertaken in November 2013 by a forestry operator. The operator took charge of the evacuation of the slash to transform it into wood for energy. The young spruce trees on the northern flank of the Roc'h Glujau were felled on a regular basis and were followed by stump removal operations in autumn 2015. Since then, the resumption of coniferous trees has been grubbed up every two years.

Finally, a monitoring of the vegetation of the rocks was undertaken from 2014 by an ecologist. In 2019, the conclusions indicate that there is a long adaptation time for the installation of bryophytes, as well as a greater diversification of vascular plants, which are quite specific to lit or shaded rocks (Durfort, 2019).



Roc'h Glujau after slash removal in 2014, H Coroller, PNRA

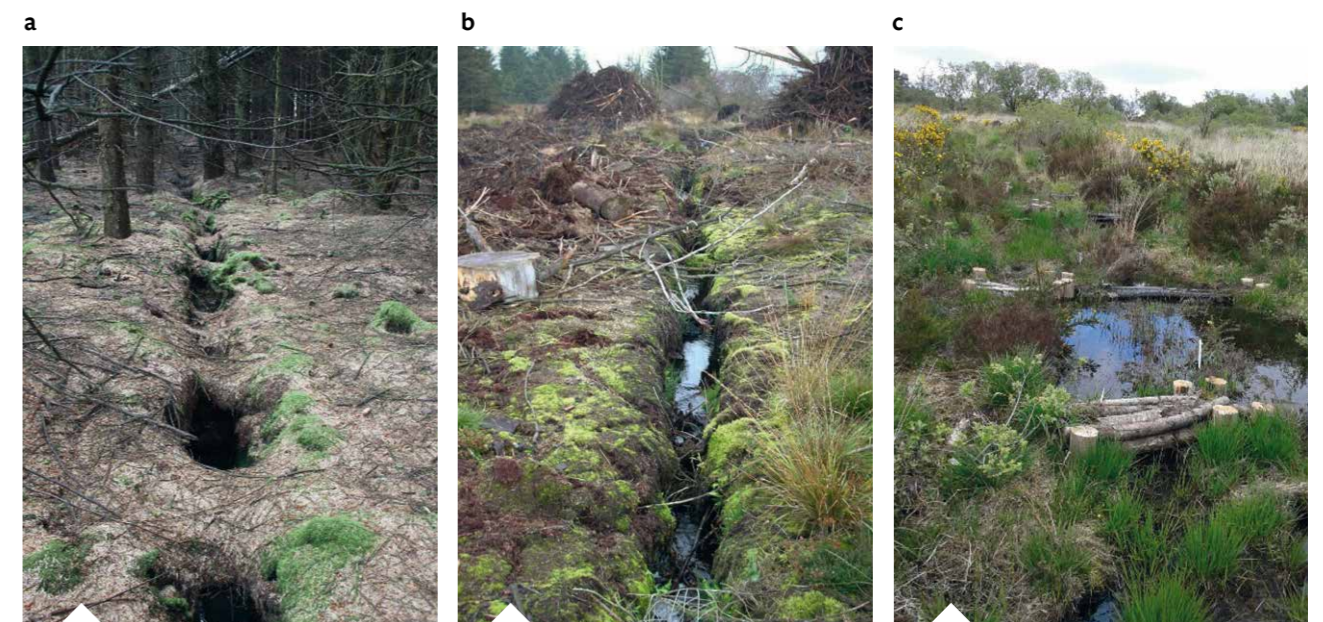


Roc'h Glujau, uprooting of resinous trees in 2021, H Coroller, PNRA



Roc'h Glujau after trimming the stumps in 2016, H Coroller, PNRA

The roc'h Plat site is located at the headwaters of the Camfrout stream, upstream from a sloping peat bog formed in the talweg. This island has benefited from the clearing of coniferous trees present in varying densities since 2007 as part of the Interreg IIIB Heath programme. A series of actions was then undertaken by the Park to restore the functionality of a wet heathland evolving into a sloping peat bog: treatment of the stumps with a Becker tooth by a forester during the winter of 2008; collection of the slash. Between 2010 and 2013, spontaneous vegetation, dominated by European gorse, developed strongly on the least humid parts of the plots. In the central part, downstream of the fire pond, unstabilised vegetation has developed, of the wet low marsh to wet heath type, with some pockets of sphagnum moss in the wet depressions.



Aerial drainage ditch in (a) the still forested plot (June 2006, M-C. Regnier), (b) after desilting (2009 M-C. Regnier) and (c) after fascination works (2015, H. Coroller)

An overhead drainage system built at the time of planting was still present in the plot, causing heavy runoff and drying out the rest of the block. Hydraulic work to slow down the torrential flows was undertaken in order to raise the water table and allow water to better diffuse into the plot: installation of fascines in the ditches and creation of breaches in the slopes to encourage lateral flows, and removal of coniferous regrowth.

2 - Roc'h Glaz (option during the site visit)

The twin site of Roc'h Glujau, Roc'h Glaz, has been subject to the same interventions and now regular removal of coniferous regrowth. Monitoring of vegetation recovery is also carried out on this site, both on the vegetation adjacent to the rock and on the rock slabs.

2014



2016



2019

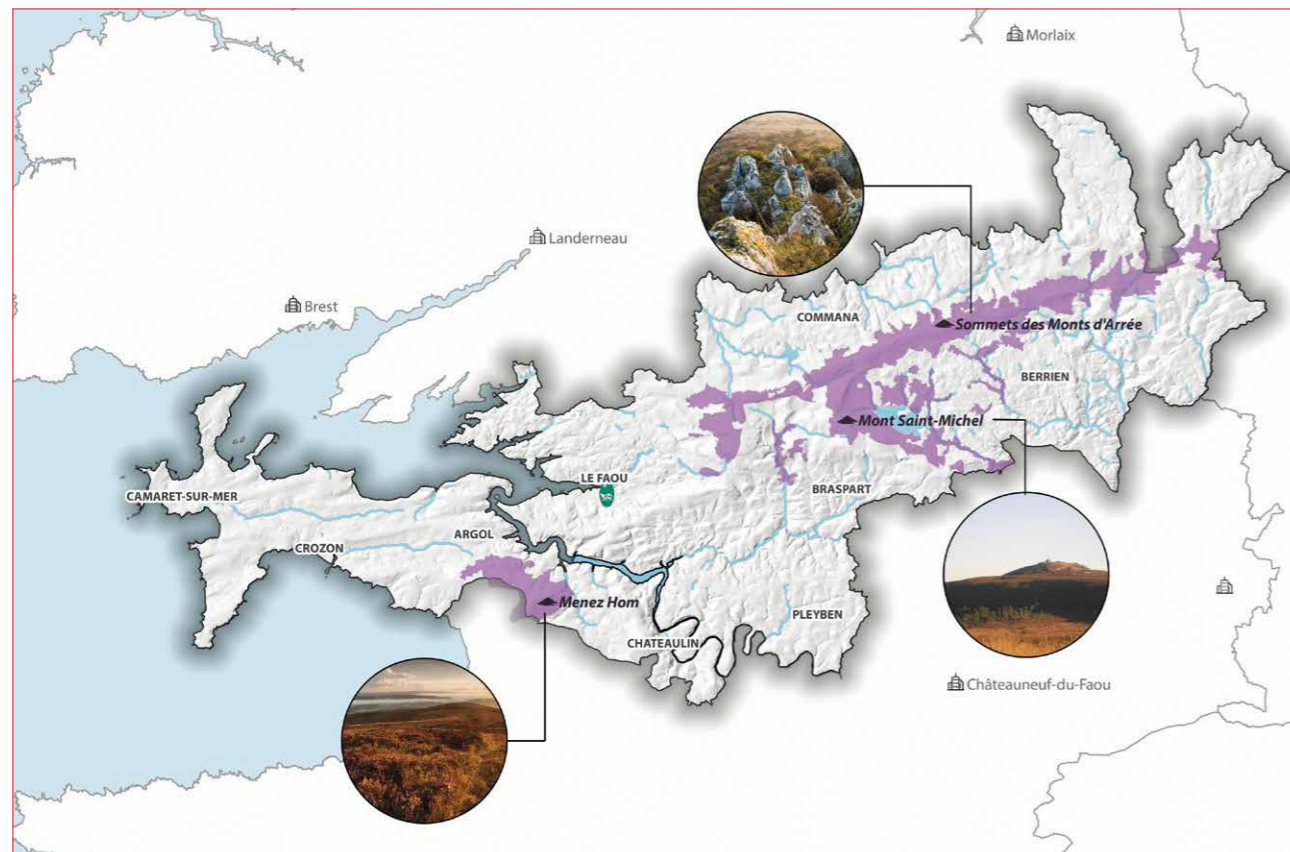


Photograph of the surveys on the rocky slab - extract from the study by José Durfort. Monitoring 5 years after restoration of the Roc'h Glaz & Glujeau Domaine de Ménez-Meur in Hanvec Second monitoring after 5 years (2019)

LIFE Armorican Heaths

LIFE Armorican Heaths is supported by the Park, as coordinator, the Department of Finistère and Bretagne Vivante as associated beneficiaries. It is financially supported by the Brittany region and the Ministry of Ecological Transition. The programme aims to restore 200 hectares of moorland and peat bogs on three emblematic sites of the PNRA: Menez Hom, Menez Meur and the Monts d'Arrée. These sites alone represent the largest group of Atlantic moors in France and the largest complex of peat bogs in Brittany.

Natura 2000 sites concerned by the LIFE Landes d'Armorique



The moors and peat bogs of Armorique and the biodiversity they shelter are currently threatened:

- > Forestry developments (particularly coniferous plantations), generally preceded by drainage works, which have led to the irreversible destruction of several thousand hectares;
- > By the abandonment of ancestral management practices with the abandonment of agriculture: the wet moors were formerly exploited in a traditional and reasoned manner (litter, grazing);
- > Over-frequented of certain natural sites due to the lack of suitable facilities and the failure to respect good practice;
- > the effects of climate change.

The LIFE Landes d'Armorique allows the implementation of an ambitious action programme (budget of 1.6 M €) over 5 years (2021 - 2025) and focuses on the major issues of these open natural spaces: the desilting of moors (restoration of 60 hectares with variable densities), the restoration of management (90 hectares), the plugging of drains (restoration of 50 hectares) and the redevelopment of paths.

> LIFE Landes d'Armorique will have an indirect impact on the species that frequent these environments by restoring habitats adapted to their life cycle:

- > The Whimbrel: the Monts d'Arrée are home to the last bastion of breeding whimbrels in Brittany;
- > The Sphagnum of the Pylaie: the Monts d'Arrée and the Menez Hom host 95% of the national population.



Websites

<https://www.pnr-armorique.fr/le-parc-en-action/life-landes-darmorique/>



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3b - The Regional nature reserve of the Cragou and Vergam moors

Introduction

The biological reserves of Cragou and Vergam heathlands were created in 1986 and 1994 respectively. The Cragou and Vergam heathlands and peatlands Nature Reserve, created in 2008, brings together these two sites a few kilometers apart.

The Cragou site covers an area of 720 hectares (ha) spread over three municipalities corresponding to the land intervention perimeter set up by the Departmental Council (Scrignac, Le Cloître Saint-Thégonnec, Plougonven) and / or preemption (Le Cloître Saint-Thégonnec, Plougonven).

The Vergam site has an estimated area of 690 ha, including 160 ha of peat bogs, spread over three municipalities: Scrignac, Lannéanou, Plougonven.

Bretagne vivante, l'association gestionnaire Bretagne vivante, the managing association

In 1953, at a time when ecology was not widespread, naturalists passionate about the natural resources of their region came together to take action. In 1958, they founded the Society for the Study and Protection of Nature in Brittany (SEPNB) and played a pioneering role by creating ornithological reserves on the coast. In 1998, the SEPNB changed its name and became Bretagne vivante - SEPNB. Its field of action has extended to all questions of environmental protection, even if it acts primarily in the field of biodiversity.

The association has developed and operates a unique regional network made up of 120 natural sites, including four National Nature Reserves and two Regional Nature Reserves, in partnership with their owners, public or private. Its contributions to better scientific knowledge, its contributions to concerted operations with other associations, communities or the State, and its educational work, make it a permanent player in the protection and enhancement of Breton natural heritage.

Historical player on the Cragou and Vergam moors, Bretagne vivante - SEPNB was ideally suited to be appointed as the manager of the Nature Reserve. In 1986, the association set up management based on grazing and collaboration with local farmers.

With regard to Vergam, it was in 1992 that Bretagne Vivante intervened for the first time on the site following threats from conifer plantations and the burial of waste. Thanks to a LIFE "Peatlands" program, the association becomes the main owner of the site and directs the management of the site to the mowing of heathlands by local farmers.

Since the creation of these associative reserves, Bretagne Vivante has on the one hand participated in numerous programs to finance the management of the sites and on the other hand, has been able to forge effective partnerships that support the work of the manager.

Location of the Cragou and Vergam Regional Nature Reserve



Presentation

A few kilometers apart, the Cragou and Vergam sites are like twin brothers, similar at all levels but unique when you look at them more closely.

These two sites mainly made up of moors and peat bogs, shelter a diversity among which we find rare and protected plants and animals such as Hen harrier (*Circus cyaneus*), Montagu's harrier (*Circus pygargus*), Nightjar (*Caprimulgus europaeus*), Marsh clubmoss (*Lycopodiella inundata*), Sphagnum pylaisii or the two species of sundew (*Drosera* sp.).



Drosera rotundifolia ou rossolis Sundew



Nightjar

Like the national nature reserve of Venec, these two sites are managed by Bretagne Vivante. Many partnerships have been set up in terms of management. Thus, the Vergam heathlands are mainly mown by farmers, while the northern slope of the Cragou is grazed more by the cattle of the management association. The southern slope of the Cragou has been left to its own devices for over 60 years.

The classification of the regional nature reserve of the interior heathlands and the peat bogs of Cragou and Vergam intervenes on December 20, 2008 by deliberation of the regional council of Brittany.

On the Vergam moors, Bretagne Vivante owns around one hundred hectares out of the 350 ha that make up the heart of the site. In Cragou, the Departmental Council of Finistère owns 343 ha out of the 720 ha of the work area. The entire Regional Nature Reserve (RNR) is 468 ha. Morlaix Community is also a partner of the two sites by supporting their management.

The Cragou and Vergam heathlands RNR is part of a network of 9 RNRs and 7 National Nature Reserves in Brittany.

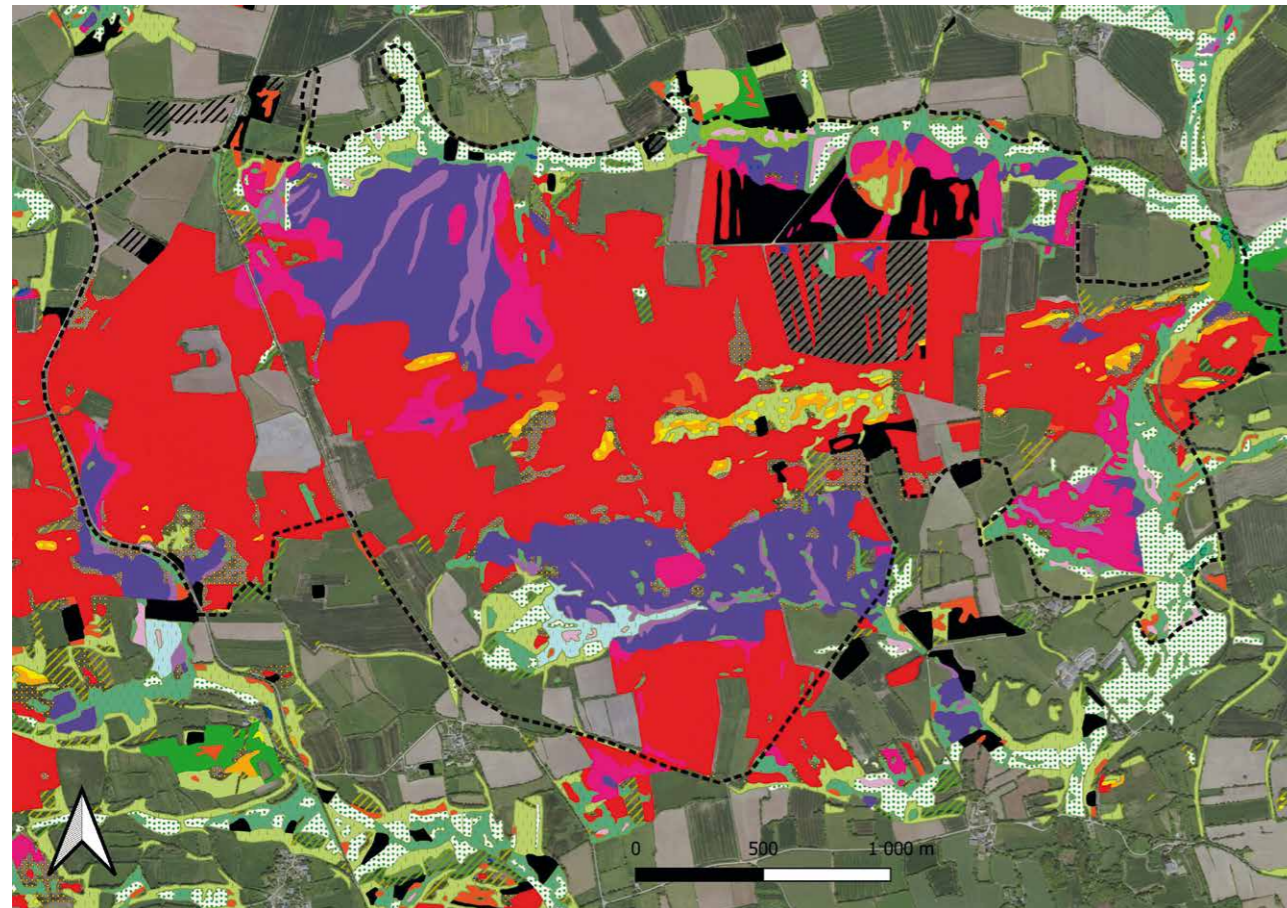
Réserves naturelles de Bretagne (2021)



Heritage interests

The moors of Cragou and Vergam present rich and varied biotopes which allow many rare or threatened plants to flourish but also a certain number of animal species which are equally heritage.

Cragou habitat map and legend



--- Périmètre

Habitats

Rochers et pelouses sèches - IC 8220 et IC* 6230*	Rocks and dry grasslands
Landes sèches - IC 4030	Dry heaths
Landes mésophiles - IC 4030	Mesophile heaths
Landes humides - IC* 4020*	Wet heaths
Tourbières de pentes et de vallées - IC* 7110*	Slope peat bogs
Prairies humides à molinie - IC 6410	Wet meadows with molinia
Prairies humides à joncs	Wet rush meadows
Cariçaies et végétations du bord des eaux	Sedge meadows and riverside vegetation
Plans d'eau	Ponds
Cours d'eau	Rivers
Bois humides	Wet wood
Bois feuillus	Deciduous woods
Ptéridaies	Pteridia
Fourrés, broussailles, friches	Thickets, scrub, wasteland
Prairies mésophiles	Mesophile grasslands
Boisements artificiels résineux	Artificial afforestation of softwoods
Plantations feuillus	Deciduous plantation
Coupes à blanc de boisements artificiels	Clear-cutting of artificial woodland
Moliniaies tourbeuses - IC 7120	Degraded vegetation of active raised bogs
Saulaies-boulaies tourbeuses - IC* 91D0*	Peaty willow-birch wood
Saulaies tourbeuses	Peat willow wood
Hêtraies-chênaies acidophiles à ilex et/ou taxus - IC 9120	Beech-oak acidiphilous wood with ilex and/or taxus
Hêtraies-chênaies acidophiles à ilex et/ou taxus, peu caractérisées - IC 9120pot	Uncharacteristic beech-oak acidiphilous wood
Landes à fougère aigle et molinie - IC 4030pot	Heaths with fern and molinia

Among the numerous remarkable plants present on these sites, some can be considered as patrimonial in the sense that the nature reserve has a responsibility in their conservation. We can mention *Pseudoplectania sphagnophila*, a very rare fungus of the peat bogs (3 mentions in Brittany), *Splachnum ampullaceum*, a moss which grows only on the dung of cows grazing the peat bogs (Cragou and Vergam are the only known stations in Brittany with the peat bog of Mougau in Commana), *Hammarbya paludosa* which is part of the priority species and of which a conservation plan has just been published by the National Botanical Conservatory of Brest, Sphagnum mosses such as *Sphagnum teres* and *Sphagnum majus* but also *Sphagnum Pylaisii*, endemic to Lower Brittany, northwest Spain and the eastern United States, the liverworts *Adelanthus decipiens* (unique in Finistère for France) and *Barbilophozia*

barbata (very rare in Brittany) and, finally, the lichens *Bryoria fuscescens* (the main Breton stations are located on the crests of Cragou) and *Teloschistes flavicans* (the only known Breton station inland is located on the crests of Cragou). Other remarkable plants grow on the slopes of the natural reserve: *Lycopodiella inundata* spotted on the paddocks where grazing and/or hugging operations take place, the *Spiranthes aestivalis*, discovered at the places where the ponies graze, the Magellanic sphagnum (*Sphagnum magellanicum*), a remarkable species of regional interest, or *Gentiana pneumonanthe* and the two species of sundew (*Drosera* sp.). Finally, many lichens including eight remarkable species (in addition to *Bryoria fuscescens* and *Teloschistes flavicans*) are present on the Cragou. The presence of lichens extremely sensitive to pollution underlines the quality of the air bathing the moors of Cragou.

Plant species of the RNR with high heritage value

Nom scientifique	Nom vernaculaire	English name	Statut de protection ⁽¹⁾	Liste rouge nationale 2012 ⁽²⁾	Liste rouge Bretagne 2015 ⁽³⁾
1 - Enjeu européen ou national / European or national stake					
<i>Hammarbya paludosa</i> (L.) Kuntze	Malaxis des marais	Bog Orchid	PN	EN	EN
<i>Lycopodiella inundata</i> (L.) Holub	Lycopode inondé	Marsh Clubmoss	PN	NT	NT
<i>Spiranthes aestivalis</i> (Poir.) Rich.	Spiranthe d'été	Summer Lady's-tresses	PN	VU	NT
<i>Trichomanes speciosum</i> Willd.	Trichomanès élégant	Killarney Fern	PN		LC
2 - Enjeu régional fort / Strong regional stake					
<i>Huperzia selago</i> (L.) Bernh. ex Schrank & Mart.	Lycopode sélagine	Fir Clubmoss	PR		CR
<i>Rhynchospora fusca</i> (L.) W.T.Aiton	Rhynchospora brun	Brown Beak-sedge			VU
3 - Enjeu régional / Regional stake					
<i>Dactylorhiza incarnata</i> (L.) Soó subsp. incarnata	Orchis incarnat	Early Marsh-orchid			NT
<i>Gentiana pneumonanthe</i> L.	Gentiane pneumonanthe	Marsh Gentian			NT
<i>Pedicularis palustris</i> L.	Pédiculaire des marais	Marsh Lousewort			NT
4 - Enjeu réglementaire / Regulatory issue					
<i>Drosera intermedia</i> Hayne	Rosolis intermédiaire	Oblong-leaved Sundew	PN		LC
<i>Drosera rotundifolia</i> L.	Rosolis à feuilles rondes	Round-leaved Sundew	PN		LC
<i>Dryopteris aemula</i> (Aiton) Kuntze	Dryoptéris à odeur de foin	Hay-scented Buckler-fern	PN		LC
<i>Hymenophyllum tunbrigense</i> (L.) Sm.	Hymenophylle de Tunbridge	Tunbridge Filmy Fern	PN		LC
<i>Pilularia globulifera</i> L.	Pilulaire	Pillwort			LC
5 - Autres espèces intéressantes / Other interesting species					
<i>Carex rostrata</i> Stoke	Laïche à bec	Bottle Sedge			LC
<i>Epilobium palustre</i> L.	Epilobe des marais	Marsh Willowherb			LC
<i>Juncus squarrosus</i> L.	Jonc raide	Heath Rush			LC
<i>Menyanthes trifoliata</i> L.	Trèfle d'eau	Bogbean			LC
<i>Myrica gale</i> L.	Piment royal	Bog-myrtle			LC
<i>Narthecium ossifragum</i> (L.) Huds.	Narthécie ossifrage	Bog Asphodel			LC
<i>Oreopteris limbosperma</i> (Bellardi ex All.) Holub	Fougère des montagnes	Lemon-scented Fern			LC
<i>Pinguicula lusitanica</i> L.	Grassette du Portugal	Pale Butterwort			LC
<i>Pseudarrhenatherum longifolium</i> (Thore) Rouy	Avoine de Thore				LC
<i>Rhynchospora alba</i> (L.) Vahl	Rhynchospora blanc	White Beak-sedge			LC
<i>Scirpus cespitosus</i> L. subsp. germanicus (Palla) Brodd.	Scirpe cespiteux	Deergrass			LC

⁽¹⁾ PN : protection nationale / national protection

⁽²⁾ Liste rouge nationale / National Red List : LC : préoccupation mineure / minor concern ; NT : quasi menacé / almost threatened ; VU : vulnérable / vulnerable ; EN : en danger / in danger ; CR : en danger critique / critically endangered

⁽³⁾ Liste rouge régionale / Regional Red List



Cross-leaved Heath



Bell Heather



Oblong-leaved Sundew



Marsh Clubmoss



Bog Asphodel



Common Cottongrass



Sphagnum Pylaisii



Sphagnum rubellum



Splachnum ampullaceum

From a faunistic point of view, the interest of the Cragou and Vergam is no longer to be demonstrated since many remarkable species live within the perimeter of the nature reserve. However, even if arthropods, reptiles, amphibians and mammals are present in great numbers on the reserve, it is the birds, and in particular the curlews (*Numenius arquata*) and the harriers (*Circus sp.*), which made the fame of these sites and which motivated in part their protection. Other birds such as the Dartford warbler (*Sylvia undata*), mainly located near the ridges, the common snipe

(*Gallinago gallinago*), the whinchat (*Saxicola torquata*) or the European nightjar (*Caprimulgus europaeus*) contribute to make the Cragou and the Vergam sites of great naturalistic interest. This exceptional diversity is underlined by the integration of the two sites in numerous inventories and environmental protection schemes. However, it is necessary to distinguish the species for which the natural reserve has a responsibility in terms of conservation and we will retain the two grey harriers (*Circus pygargus* and *Circus cyaneus*) whose numbers of breeding pairs are decreasing.

Birds species of the RNR with high heritage value

Nom scientifique	Nom vernaculaire	English name	Directive Oiseaux ⁽¹⁾ * European directive	Statut de protection ⁽²⁾ Protection status	Liste rouge Nationale ⁽³⁾ National Red List	Liste rouge Bretagne 2015 ⁽⁴⁾ Regional Red List	Cragou ⁽⁵⁾ Vergam ⁽⁵⁾	
							Biological status	Biological status
<i>Anthus pratensis</i>	Pipit farlouse	Meadow pipit		PN	VU	VU	N	E
<i>Asio flammeus</i>	Hibou des marais	Short-eared Owl			VU	/	N (1998)	H
<i>Caprimulgus europaeus</i>	Engoulevent d'Europe	European Nightjar	anx I	PN	LC	LC	N	N
<i>Circaetus gallicus</i>	Circaète Jean-le-Blanc	Short-toed Snake Eagle	anx I	PN	LC	/	E	P
<i>Circus aeruginosus</i>	Busard des roseaux	Western Marsh Harrier	anx I	PN	NT	EN	N (2020)	N (2008)
<i>Circus cyaneus</i>	Busard Saint-Martin	Hen Harrier	anx I	PN	LC	EN	N	N
<i>Circus pygargus</i>	Busard cendré	Montagu's Harrier	anx I	PN	NT	CR	N	N
<i>Corvus corax</i>	Grand Corbeau	Northern Raven		PN	LC	EN	N (2011)	H
<i>Dryocopus martius</i>	Pic noir	Black Woodpecker		PN	LC	LC	E	N (2008)
<i>Emberia citrinella</i>	Bruant jaune	Yellowhammer		PN	VU	NT	N	N
<i>Emberiza schoeniclus</i>	Bruant des roseaux	Common Reed Bunting		PN	EN	VU	N	N Probable
<i>Falco columbarius</i>	Faucon émerillon	Merlin	anx I		/	DD	H	H
<i>Falco peregrinus</i>	Faucon pèlerin	Peregrine Falcon			LC	EN	/	P (2010)
<i>Falco subbuteo</i>	Faucon hobereau	Eurasian Hobby		PN	LC	NT	N	N
<i>Lanius collurio</i>	Pie-grièche écorcheur	Red-backed Shrike	anx I	PN	NT	EN	E	P
<i>Numenius arquata</i>	Courlis cendré	Eurasian Curlew			VU	EN	N	N
<i>Parus ater</i>	Mésange noire	Coal Tit		PN	LC	NT	N	/
<i>Parus palustris</i>	Mésange nonnette	Marsh Tit		PN	LC	NT	N	N
<i>Pernis apivorus</i>	Bondrée apivore	European Honey Buzzard	anx I	PN	LC	LC	E. N ?	P
<i>Phoenicurus phoenicurus</i>	Rougequeue à front blanc	Common Redstart		PN	LC	VU	N (2009)	/
<i>Phylloscopus sibilatrix</i>	Pouillot siffleur	Wood Warbler		PN	NT	NT	E	/
<i>Phylloscopus trochilus</i>	Pouillot fitis	Willow Warbler		PN	NT	EN	N	N
<i>Pluvialis apricaria</i>	Pluvier doré	European Golden Plover	anx I		/	LC	P (2009)	/
<i>Pyrrhula pyrrhula</i>	Bouvreuil pivoine	Eurasian Bullfinch		PN	VU	VU	N	N
<i>Saxicola rubetra</i>	Tarier des prés	Whinchat		PN	VU	CR	N (1999)	N (1996)
<i>Sylvia undata</i>	Fauvette pitchou	Dartford Warbler	anx I	PN	EN	LC	N	N

Les espèces pour lesquelles l'enjeu de conservation est fort sur la RNR sont surlignées en jaune / The species for which the conservation stake is high on the RNR are highlighted in yellow

⁽¹⁾ Directive européenne dite Directive Oiseaux (Directive 79/409/CEE) : Annexe I / European Directive known as the Birds Directive (Directive 79/409 / EEC): Annex I

⁽²⁾ Liste des oiseaux protégés sur l'ensemble du territoire / List of birds protected throughout the territory

⁽³⁾ Liste rouge des oiseaux nicheurs de France métropolitaine (2016) : / Red List of Breeding Birds in Metropolitan France (2016) :

LC : préoccupation mineure / minor concern ; NT : quasi menacé / almost threatened ; VU : vulnérable / vulnerable ; EN : en danger / in danger ; CR : en danger critique / critically endangered

⁽⁴⁾ CSRPN & GIP Bretagne environnement (coord., 2015)

⁽⁵⁾ Statut biologique Oiseaux / Biological status : E : estivant non nicheur / non-breeding summer visitor ; H : hivernant / overwintering ; N : nicheur / breeder ; P : passage / passage



Dartford warbler



Sky Lark



Eurasian Woodcock



Common Snipe



Yellowhammer



European Stonechat



Meadow pipit



Eurasian curlew

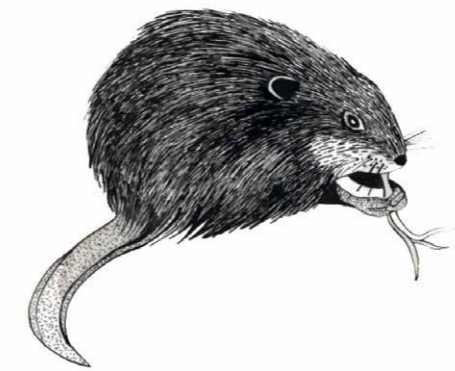
Among the mammals with protection or rarity status (Table 3), four species are considered to have a high heritage value: the amphibian vole, the bicolored shrew, the dormouse and the water shrew. In spite of its status, the European otter presents a medium stake for the RNR because the Cragou site is only a hunting area for this species (not regularly present). On the other hand, the bicolored shrew and the water shrew have been added to the list of species at stake because they are species for which knowledge needs to be improved on a regional scale. The Nature Reserve could thus constitute a «test site» to set up new protocols for monitoring populations, in partnership with mammalogues.



Badger



Roe deer



Amphibian vole



Dormouse

List of mammals with high heritage value observed in the RNR, protection status and level of concern

Nom scientifique	Nom vernaculaire	English name	DHFF ^{(1)*}	Statut de protection ⁽²⁾ Protection status	Liste rouge Nationale ⁽³⁾ National Red List	Liste rouge Bretagne 2015 ⁽⁴⁾ Regional Red List	Cragou	Vergam
<i>Arvicola sapidus</i>	Campagnol amphibie	Southern water vole		PN	NT	NT	X	X
<i>Barbastella barbastellus</i>	Barbastelle d'Europe	Western Barbastelle	anx II et IV	PN	LC	NT	X	
<i>Crocidura leucodon</i>	Crocidure leucode	Bicolored shrew			LC	VU	X	
<i>Eptesicus serotinus</i>	Sérotine commune	Serotine Bat	anx IV	PN	LC	LC	X	
<i>Lutra lutra</i>	Loutre d'Europe	European Otter	anx II et IV	PN	LC	LC	X	
<i>Muscardinus avellanarius</i>	Muscardin	Hazel Dormouse	anx IV	PN	LC	NT	X	
<i>Myotis nattereri</i>	Murin de Natterer	Natterer's Bat	anx IV	PN	LC	NT	X	
<i>Neomys fodiens</i>	Crossope aquatique	Eurasian Water Shrew		PN	LC	DD	X	
<i>Oryctolagus cuniculus</i>	Lapin de garenne	European Rabbit			NT	NT	X	
<i>Pipistrellus pipistrellus</i>	Pipistrelle commune	Common Pipistrelle	anx IV	PN	LC	LC	X	

Les espèces pour lesquelles l'enjeu de conservation est fort sur la RNR sont surlignées en jaune / The species for which the conservation stake is high on the RNR are highlighted in yellow

⁽¹⁾ Directive européenne dite Directive Habitats-Faune-Flore Directive : Annexe II ou Annexe IV / European Directive known as the Habitats-Fauna-Flora Directive Annex II or Annex IV

⁽²⁾ Liste des mammifères terrestres protégés sur l'ensemble du territoire français / List of terrestrial mammals protected throughout France

⁽³⁾ Liste rouge des mammifères continentaux de France métropolitaine (2009) / Red list of continental mammals of metropolitan France

⁽⁴⁾ CSRPN & GIP Bretagne environnement (coord., 2015)

LC : préoccupation mineure / minor concern ; NT : quasi menacé / almost threatened ; VU : vulnérable / vulnerable ; EN : en danger / in danger ; CR : en danger critique / critically endangered

List of **amphibians** and **reptiles** with high heritage value observed in the RNR, protection status and level of concern

Nom scientifique	Nom vernaculaire	English name	DHFF ^{(1)*}	Statut de protection ⁽²⁾	Liste rouge Nationale ⁽³⁾	Liste rouge Bretagne 2015 ⁽⁴⁾	Cragou	Vergam
				Protection status	National Red List	Regional Red List		
Amphibiens								
<i>Alytes obstetricans</i>	Alyte accoucheur	Common Midwife Toad	anx IV	PN (art.2)	LC	NT	X	X
<i>Rana temporaria</i>	Grenouille rousse	Grass Frog		PN (art.5 & 6)	LC	NT	X	X
<i>Rana dalmatina</i>	Grenouille agile	Agile Frog	anx IV	PN (art.2)	LC	LC	X	X
<i>Triturus marmoratus</i>	Triton marbré	Marbled Newt	anx IV	PN (art.2)	NT	LC	X	X
Reptiles								
<i>Coronella austriaca</i>	Coronelle lisse	Smooth Snake	anx IV	PN (art.2)	LC	DD	X	
<i>Zootaca vivipara</i>	Lézard vivipare	Viviparous Lizard		PN (art.3)	LC	NT	X	X
<i>Vipera berus</i>	Vipère péliade	Adder		PN (art.4)	VU	EN	X	X

(1) Directive européenne dite Directive Habitats-Faune-Flore Directive (Directive 92/43/CEE) : Annexe II ou Annexe IV

* pour simplifier la lecture du tableau, ne sont indiqués que les statuts indiquant des enjeux (Annexes II et IV)

(2) Listes des amphibiens et des reptiles protégés sur l'ensemble du territoire français et les modalités de leur protection : Articles 2 à 6

(3) Liste rouge des amphibiens de France métropolitaine (2015) - Liste rouge des reptiles de France métropolitaine (2015) : EN : en danger ;

VU : vulnérable ; NT : quasi men LC : préoccupation mineure



Vipera berus



Coronella austriaca



Zootaca vivipera

The diversity of arthropods is very important and fairly well known in the Nature Reserve and on the Cragou moors in particular. Arthropods are first-rate indicators and the study of their populations makes it possible to evaluate the management operations carried out in the Nature Reserve. Thus, a comparison of the studies carried out in 1996 and 1999 shows, on the one hand, an increase in the populations of common species and, on the other, an increase in the specific richness (Fouillet, 1994; Fouillet, 1999). Of course, caution should be exercised when interpreting this type of evolution, as the world of insects is vast and allows for frequent naturalist discoveries for those who linger on the subject.

Among the remarkable invertebrates of the RNR, the presence of:

> Three species of rhopalocerans typical of moors: *Euphydryas aurinia*, *Hipparchia semele*, *Heteropterus morpheus*;

> A species of odonate characteristic of the peat bogs of the monts d'Arrée: *Sympetrum danae*;

> An endemic species of gastropod, the Quimper snail: *Elona quimperiana*.

List of **arthropods** with a high heritage value present in the RNR and for which the conservation challenge is high

Nom scientifique	Liste rouge Nationale ⁽¹⁾	Indice de priorité ⁽²⁾	Protection ⁽³⁾	DDHF ⁽⁴⁾	Cragou	Vergam
	National Red List		Protection status			
Odonates						
<i>Orthetrum coerulescens</i>	LC				X	
<i>Sympetrum danae</i>	VU				X	X
Orthoptères						
<i>Chorthippus montanus</i>		1			X	
<i>Conocephalus dorsalis</i>		2			X	
<i>Metrioptera brachyptera</i>		2			X	X
<i>Myrmeleotettix maculatus</i>		3			X	
<i>Omocestus petraeus</i>		1			X	
<i>Omocestus viridulus</i>		3			X	X
<i>Stenobothrus lineatus</i>		4			X	
<i>Stenobothrus stigmaticus</i>		2			X	
<i>Stethophyma grossum</i>		3			X	
Lépidoptères						
<i>Boloria selene</i>	NT				X	X
<i>Hipparchia semele</i>	LC				X	
<i>Euphydryas aurinia</i>	LC		PN	anx II	X	
<i>Plebejus argus</i>	LC				X	
<i>Heteropterus morpheus</i>	LC				X	X
<i>Pavonia pavonia</i>					X	
Diptères syrphidés						
<i>Trichopsomyia flavitarsis</i>					X	
<i>Sphaerophoria batava</i>					X	
Hémiptères						
<i>Jassargus sursumflexus</i>					X	
Hyménoptères						
<i>Formica picea</i>					X	X
<i>Mutilla europaea</i>					X	X
Coléoptères						
<i>Holpia farinosa</i>					X	
<i>Prionus coriarius</i>					X	
<i>Carabus auronitens costellatus</i>			PN		X	X
Araignées						
<i>Atypus affinis</i>					X	
<i>Dolomedes fimbriatus</i>					X	à rechercher

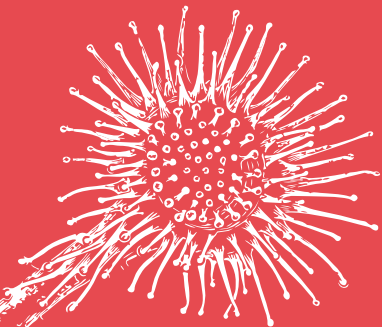
(1) Listes rouges des espèces menacées en France : Libellules de France métropolitaine (UICN France, MNHN &

(2) Domaine néormal (Sardet & Defaut, 2004)

(3) PN : protection nationale - Liste des insectes protégés sur l'ensemble du territoire et les modalités de leur pro

(4) Directive européenne Habitats-Faune-Flore annexe II





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