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La parole aux utilisateurs

Frédéric Médail

imbe
institut méditerranéen de biodiversité et d'écologie
marine et continentale

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La base de données SILENE Quelles utilisations dans les recherches en écologie et biogéographie ?

Frédéric MEDAIL

Laurence AFFRE, Alex BAUMEL, Patrick GRILLAS, Agathe LERICHE

Virgile NOBLE, Arne SAATKAMP, Thierry TATONI

10 ANS

imbe institut méditerranéen de biodiversité et d'écologie marine et continentale

Aix*Marseille université

Tour du Valat

Conservatoire Botanique National Méditerranéen PORQUEROLLES

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Champ des questionnements scientifiques utilisant SILENE

Structure biogéographique

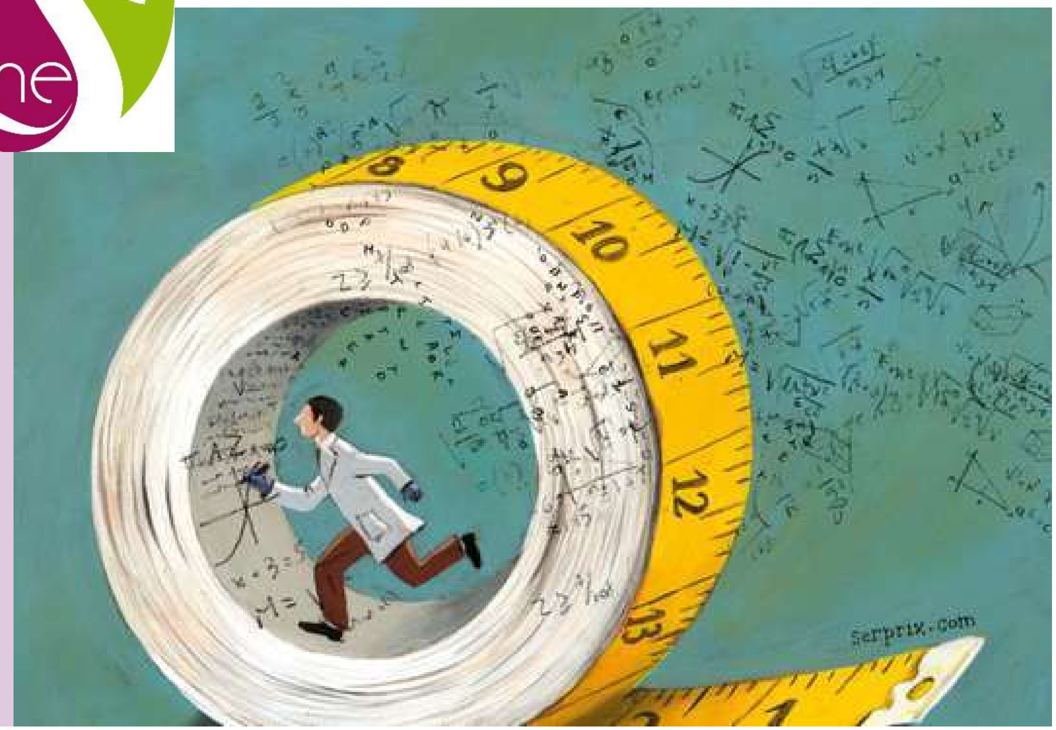
Niche écologique

Congruence entre niveaux de biodiversité

Modélisation / changements globaux

Rareté – Vulnérabilité – Sensibilité

Priorités de conservation (territoires)



Principaux organismes de recherche utilisant SILENE

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Tour du Valat

GBH

Centre d'Ecologie Fonctionnelle & Evolutive

LECA
Laboratoire d'Ecologie Alpine

AMAP

LPED
Laboratoire Population Environnement Développement
UMR 151 AMU-IRD

INRA
SCIENCE & IMPACT

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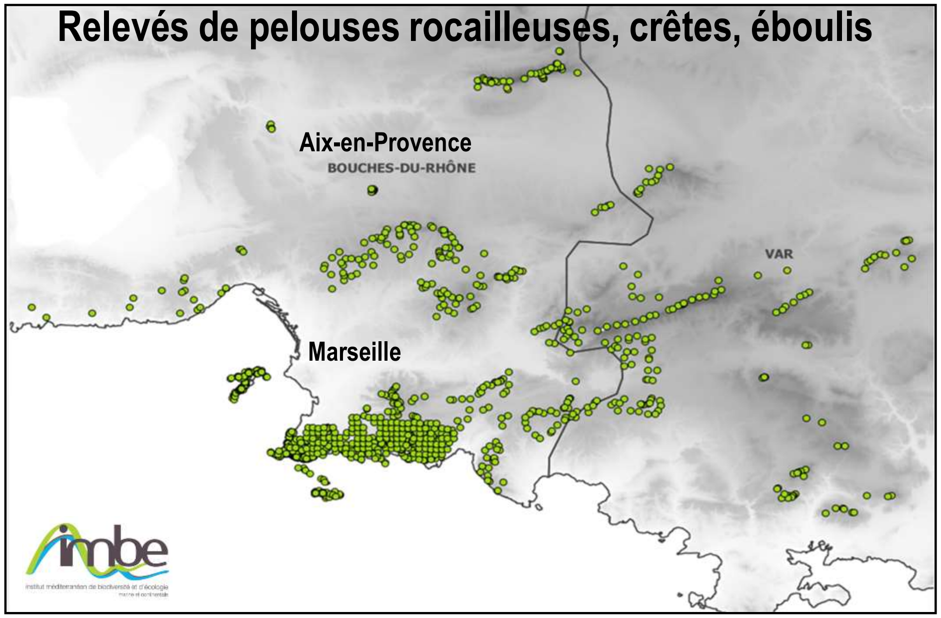
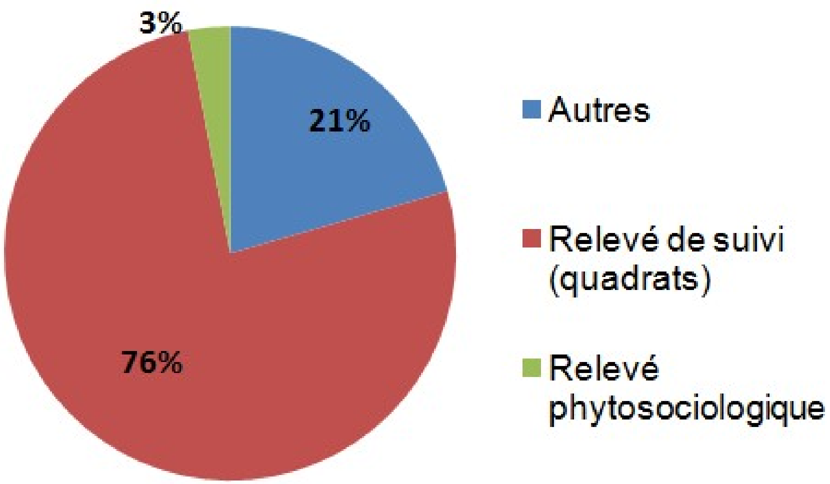
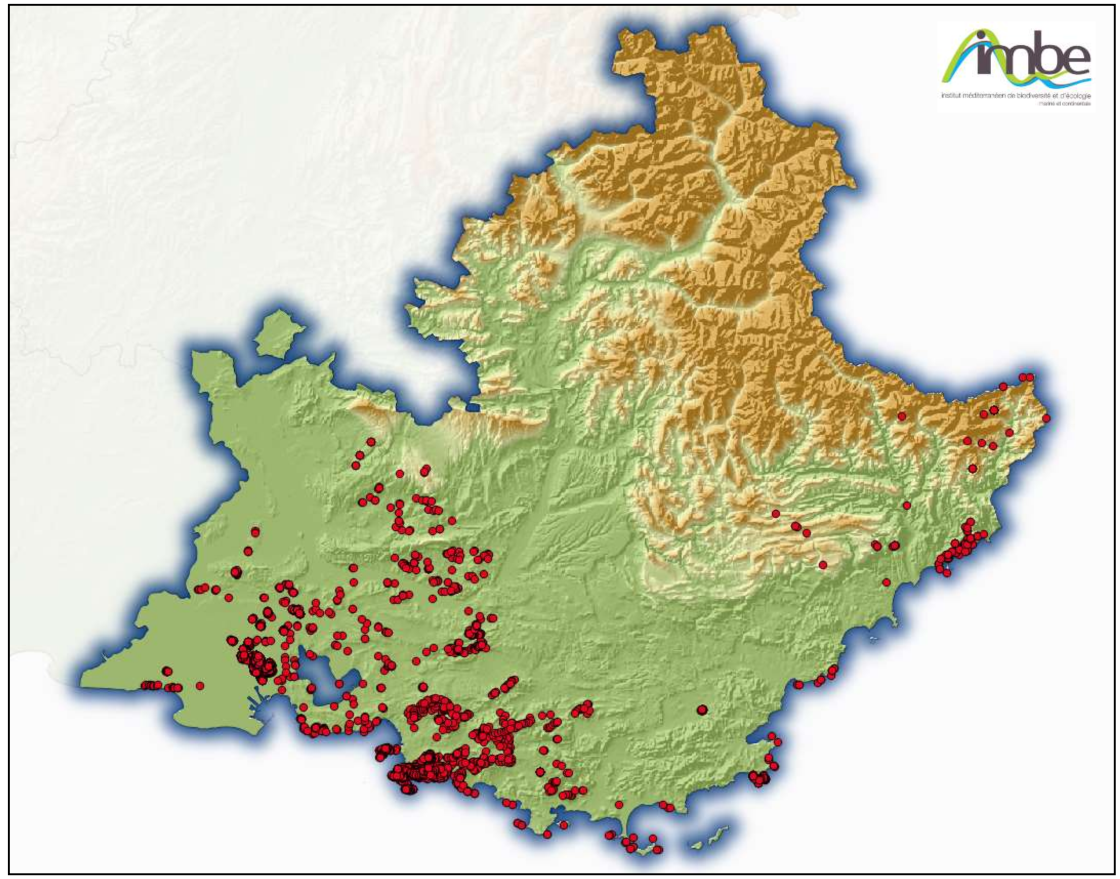
Implication de l'IMBE dans la BD SILENE





5122 relevés floristiques (108 069 observations)



Relevés de suivi : 0,7 % des relevés en PACA
Relevés phytosociologiques : 4 % des relevés en PACA

➔ **Spécificité des données de la recherche : protocoles**

Comprendre l’organisation et l’origine de la biodiversité

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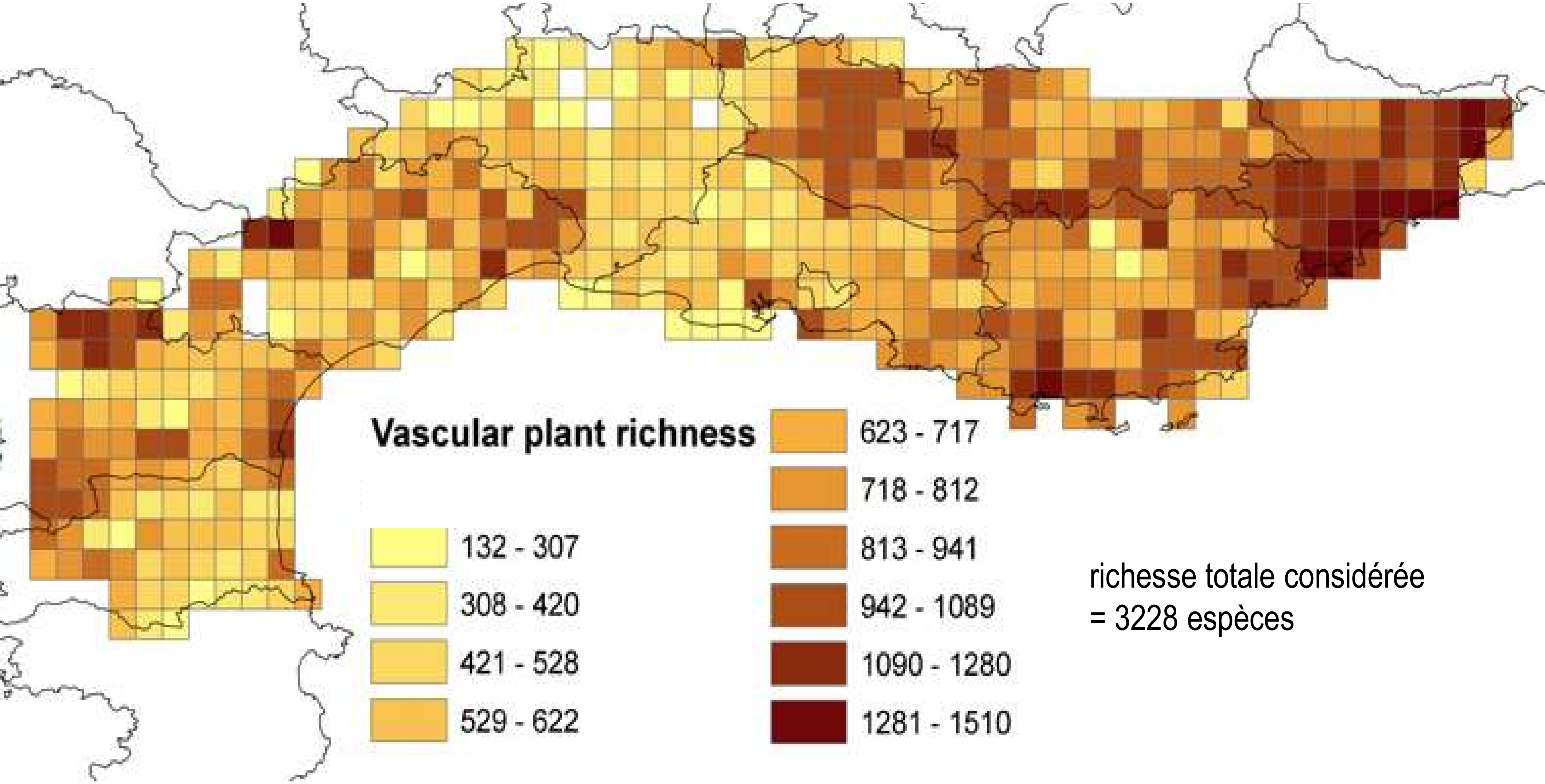
Distribution de la richesse floristique en France méridionale

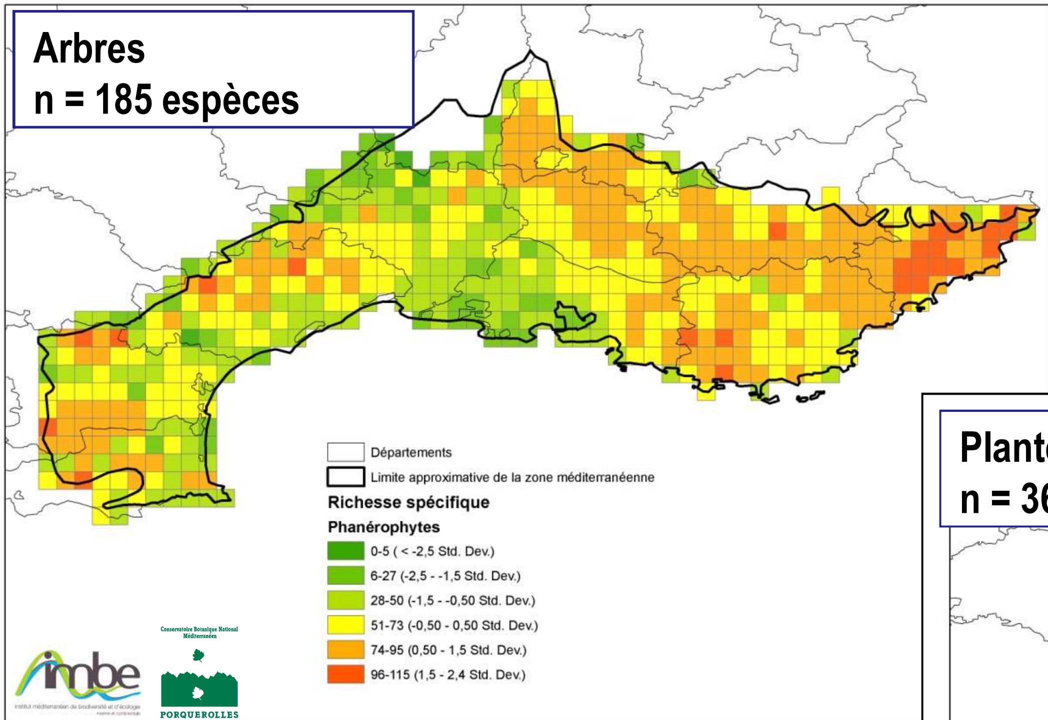
Nombre total de végétaux indigènes présents selon un maillage de 0,1 degré^2 ($\approx$ 100 km^2)



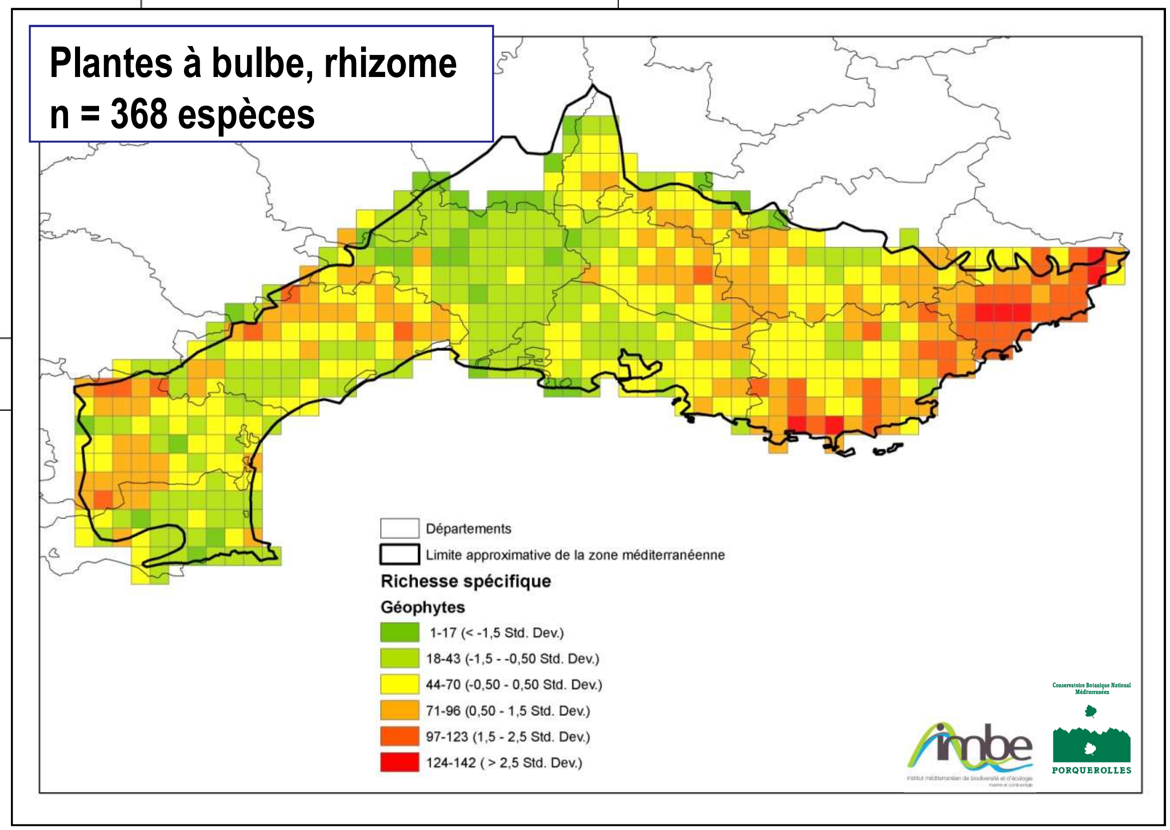
richesse totale considérée
= 3228 espèces

V. Noble, A. Leriche & F. Médail (CBNMed / IMBE), in prep.

Distribution de la richesse floristique en France méridionale



Cas de deux types biologiques
très différents sur le plan fonctionnel

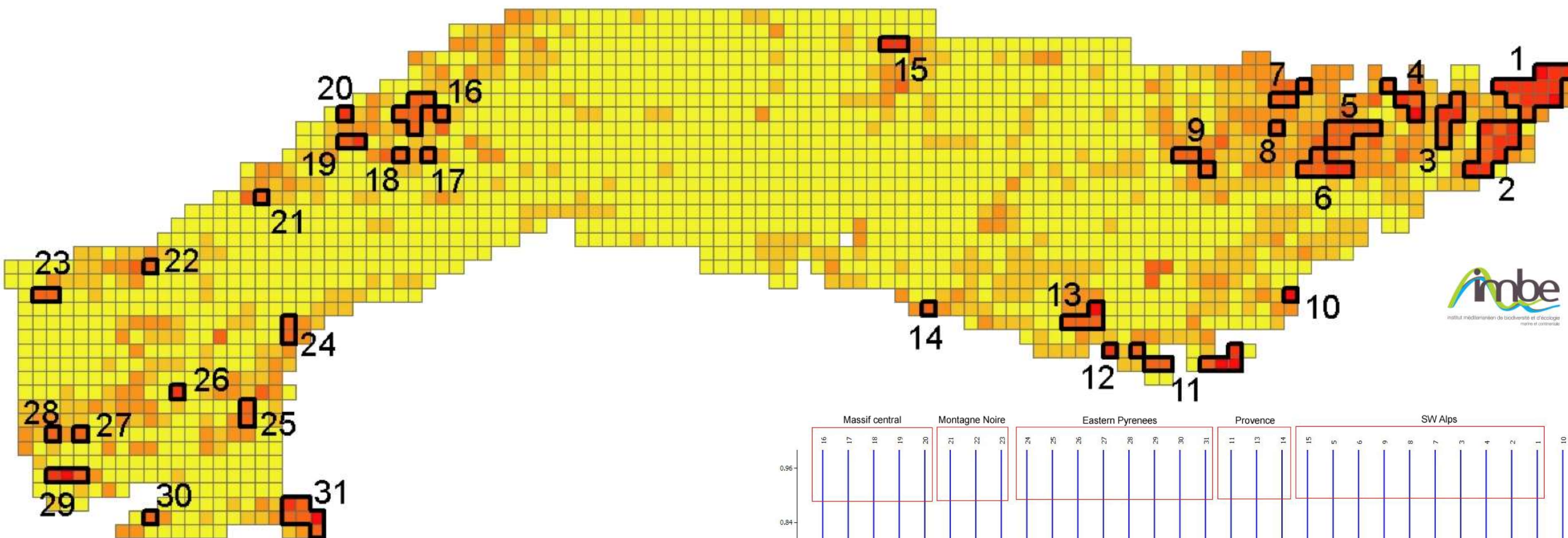


V. Noble, A. Leriche & F. Médail (CBNMed / IMBE), ined.

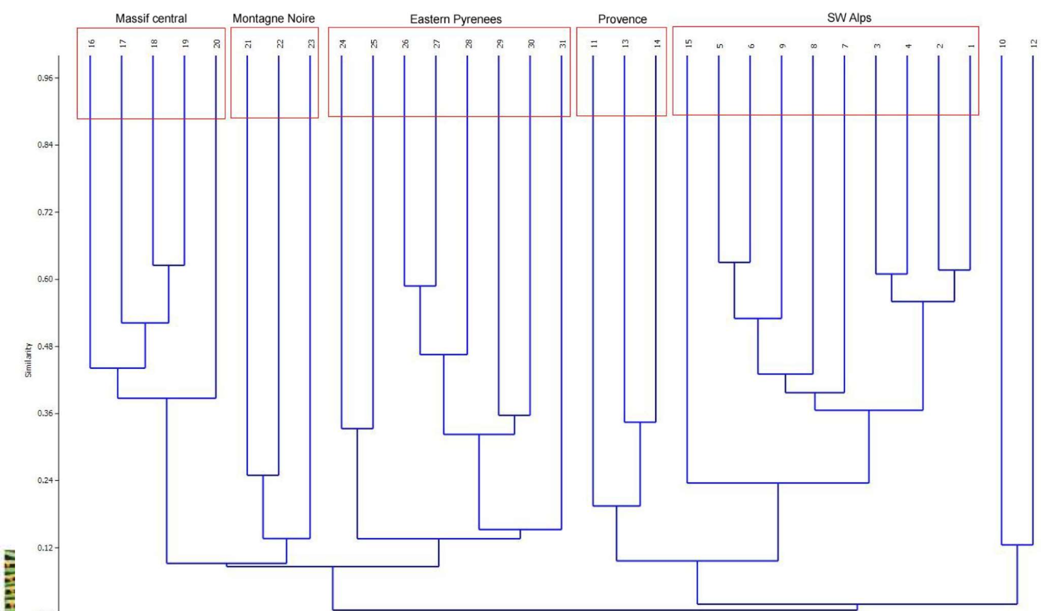
Centres d'endémisme végétal en France méridionale

31 centres d'endémisme

5% des valeurs de mailles les plus élevées en richesse pondérée d'endémiques (maillage ≈ 25 km^2)

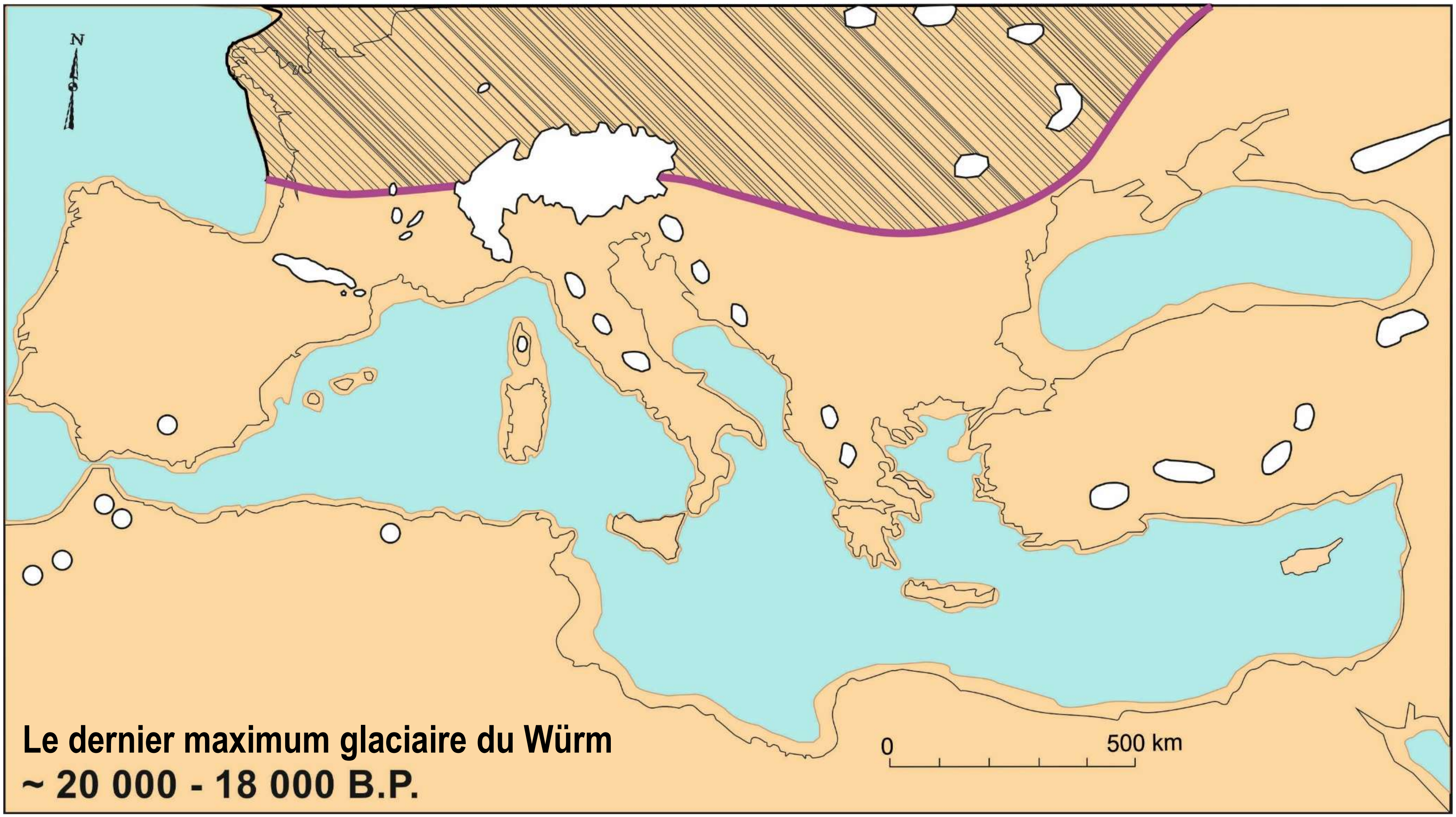


V. Noble, A. Leriche & F. Médail, (CBNMed / IMBE), in prep.



Dendrogramme des affinités floristiques entre centres d'endémisme
(indice de similarité de Jaccard, méthode UPGMA)

Rôle clé des épisodes glaciaires / interglaciaires



Analyses phylogéographiques d'espèces endémiques

Progetto ALCOTRA n. 192

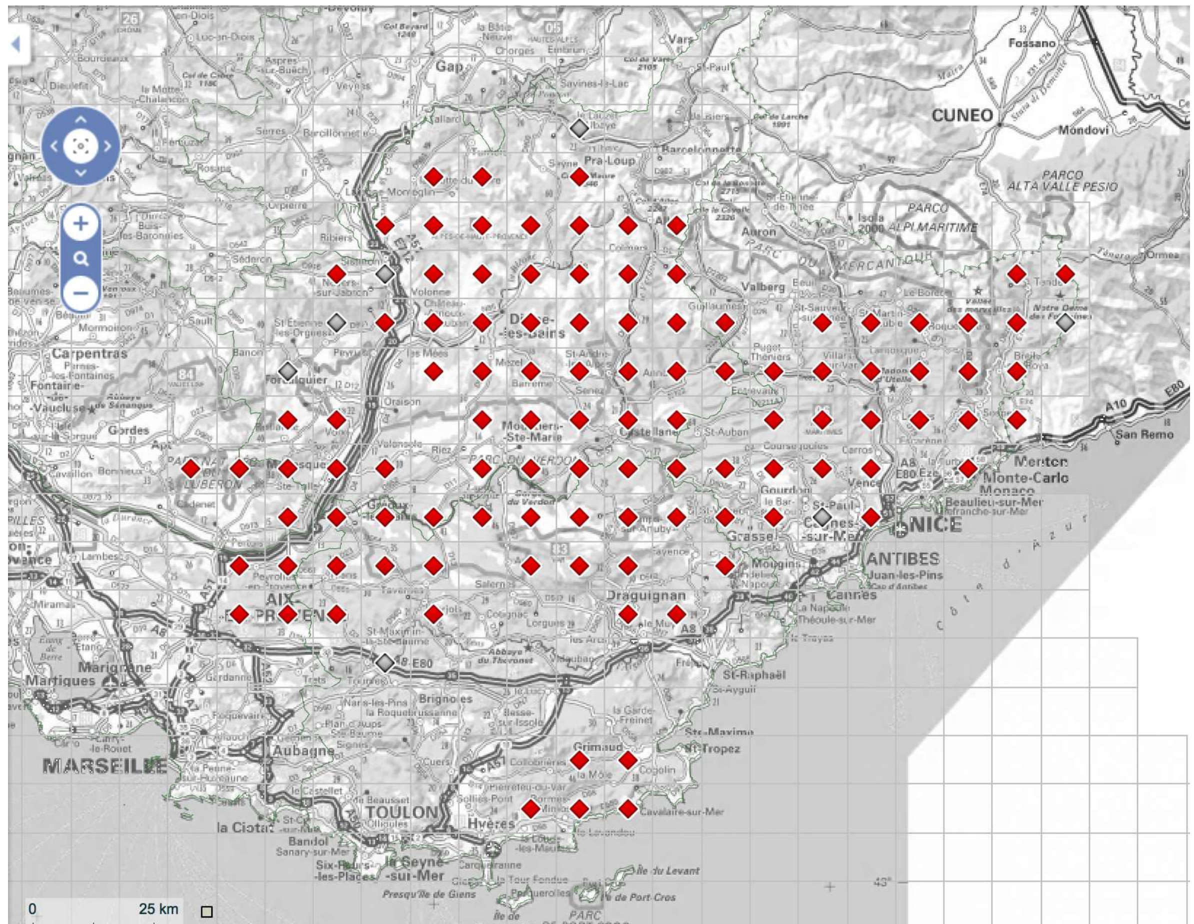
"BIODIVAM - Biodiversità nelle Alpi del Mare"

Conservatoire Botanique National Méditerranéen

PORQUEROLLES

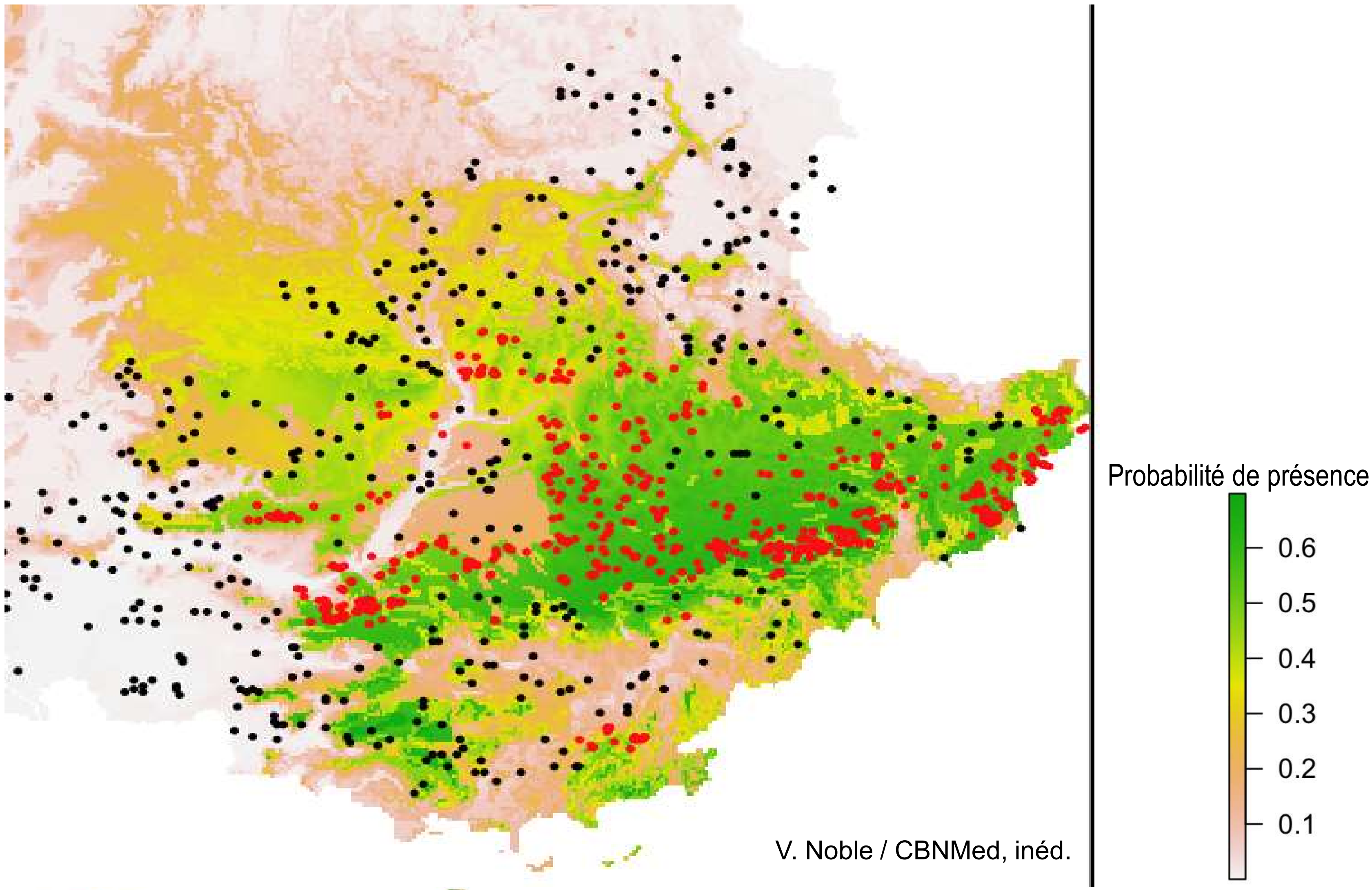
institut méditerranéen de biodiversité et d'écologie marine et continentale

Cas de la Fritillaire (*Fritillaria involucrata*)



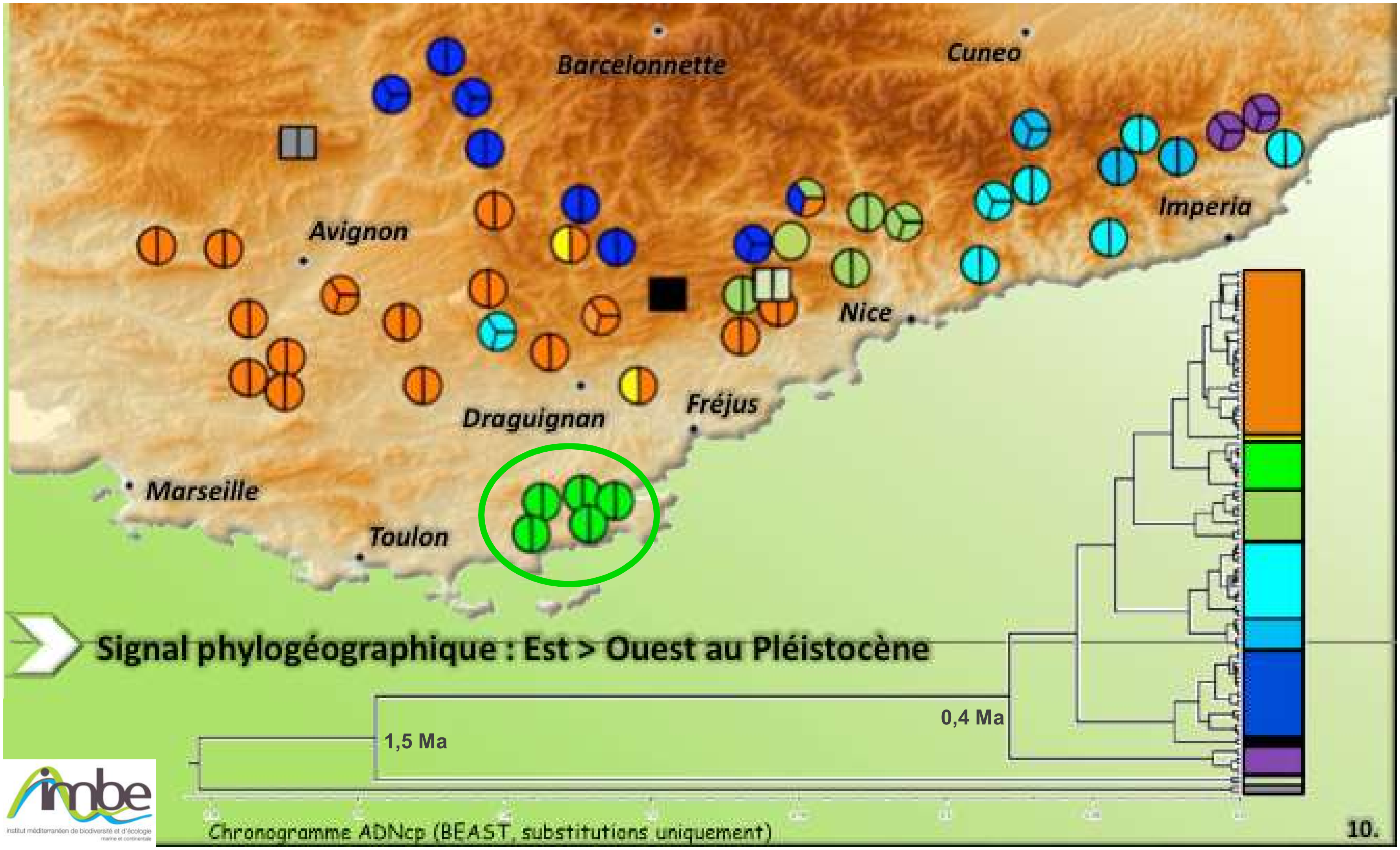
Modèle de distribution potentielle d’une espèce

Exemple de *Fritillaria involucrata*
points rouge = occurrences ; point noirs = pseudo-absences



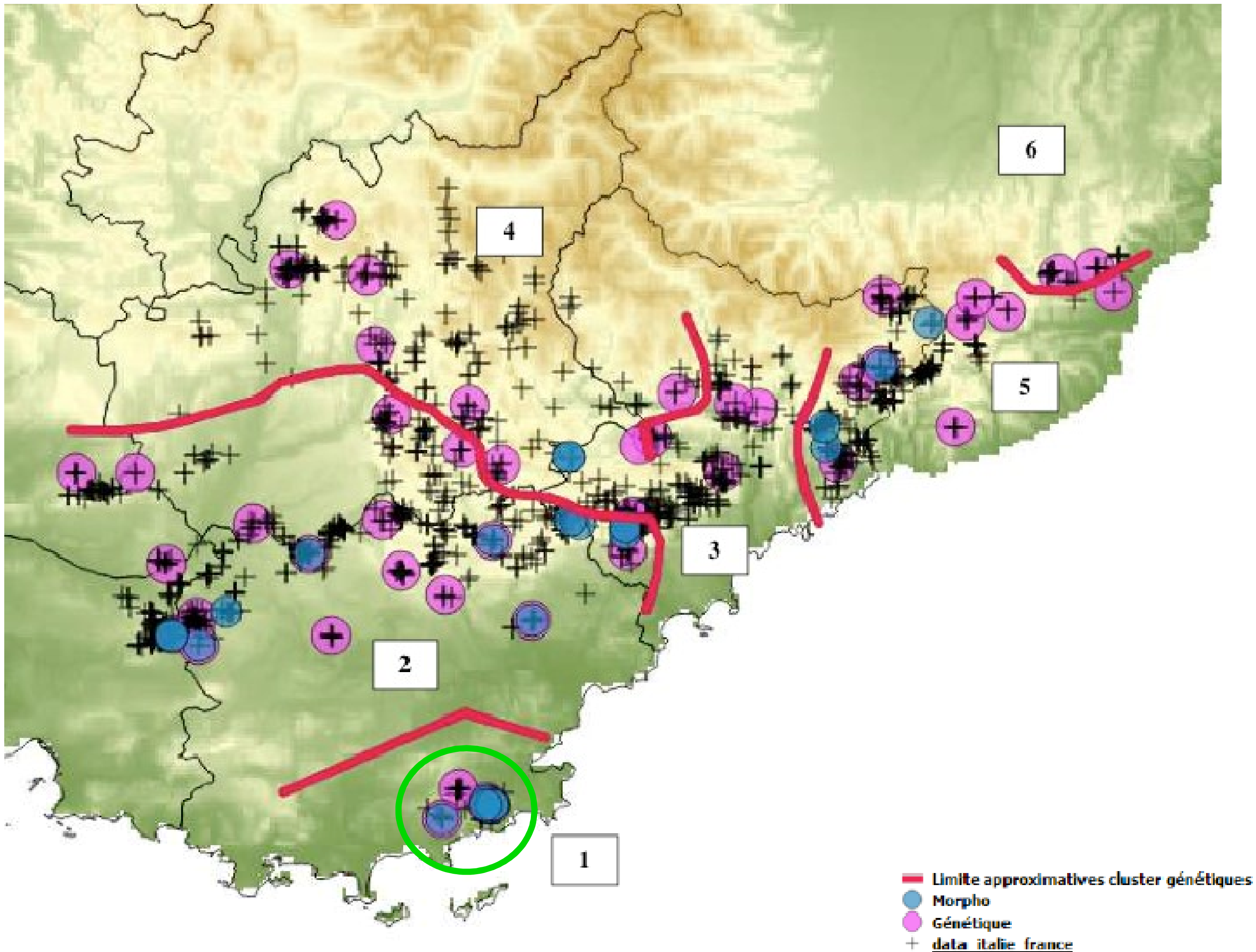
Retracer la complexité de l'histoire évolutive d'une espèce

Forte diversité génétique : 38 haplotypes différents dans 47 populations analysées

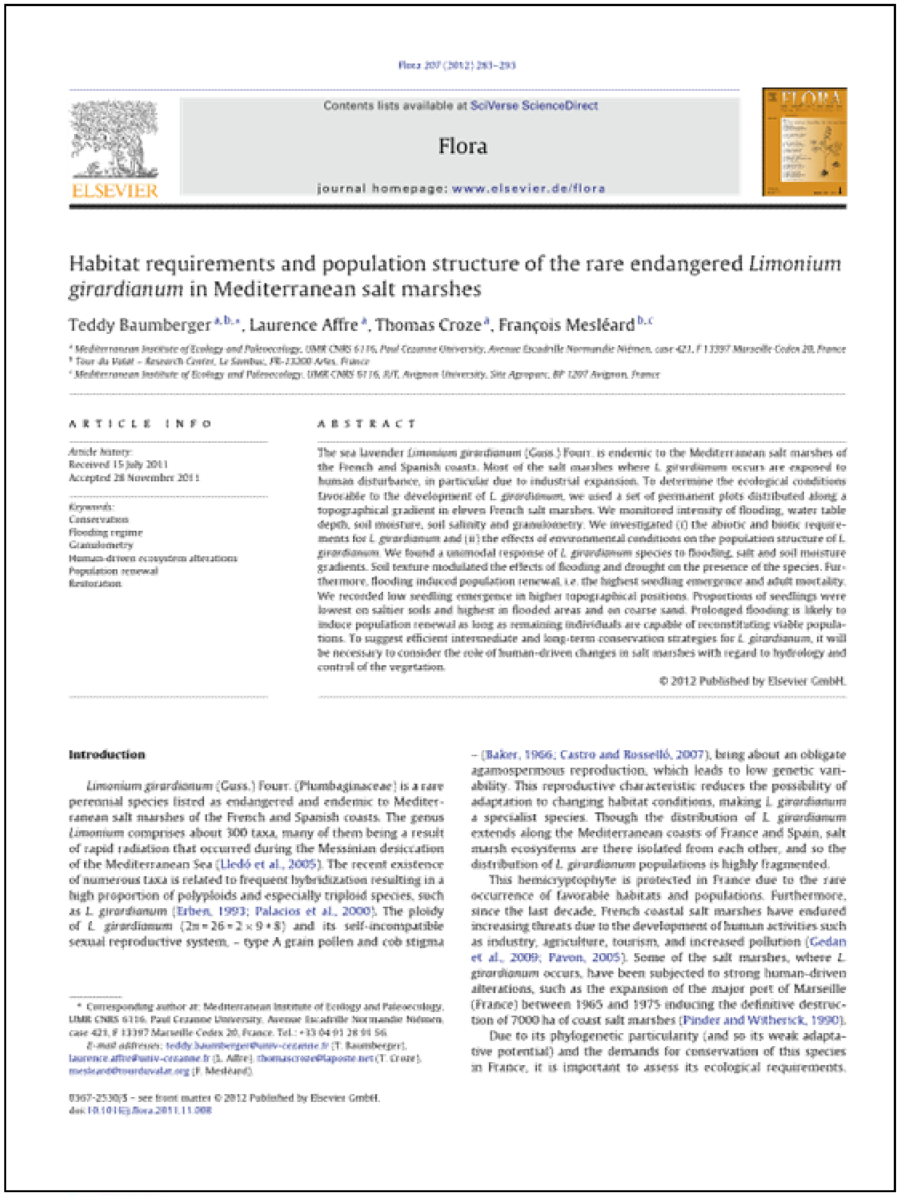


Travail de laboratoire et analyses : Jérémy Migliore & Marianick Juin / IMBE

Analyses de taxonomie : phylogéographie + morphologie



Niche écologique et facteurs de rareté d’une espèce



Flora 207 (2012) 283–293

Contents lists available at SciVerse ScienceDirect

Flora

journal homepage: www.elsevier.de/flora

Habitat requirements and population structure of the rare endangered *Limonium girardianum* in Mediterranean salt marshes

Teddy Baumberger[a,b,*], Laurence Affre[a], Thomas Croze[a], François Mesléard[b,c]

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ARTICLE INFO

Article history:
Received 15 July 2011
Accepted 28 November 2011

Keywords:
Conservation
Flooding regime
Granulometry
Human-driven ecosystem alterations
Population renewal
Restoration

ABSTRACT

The sea lavender *Limonium girardianum* (Guss.) Fourr. is endemic to the Mediterranean salt marshes of the French and Spanish coasts. Most of the salt marshes where *L. girardianum* occurs are exposed to human disturbance, in particular due to industrial expansion. To determine the ecological conditions favorable to the development of *L. girardianum*, we used a set of permanent plots distributed along a topographical gradient in eleven French salt marshes. We monitored intensity of flooding, water table depth, soil moisture, soil salinity and granulometry. We investigated (i) the abiotic and biotic requirements for *L. girardianum* and (ii) the effects of environmental conditions on the population structure of *L. girardianum*. We found a unimodal response of *L. girardianum* species to flooding, salt and soil moisture gradients. Soil texture modulated the effects of flooding and drought on the presence of the species. Furthermore, flooding induced population renewal, i.e. the highest seedling emergence and adult mortality. We recorded low seedling emergence in higher topographical positions. Proportions of seedlings were lowest on saltier soils and highest in flooded areas and on coarse sand. Prolonged flooding is likely to induce population renewal as long as remaining individuals are capable of reconstituting viable populations. To suggest efficient intermediate and long-term conservation strategies for *L. girardianum*, it will be necessary to consider the role of human-driven changes in salt marshes with regard to hydrology and control of the vegetation.

Introduction

Limonium girardianum (Guss.) Fourr. (*Plumbaginaceae*) is a rare perennial species listed as endangered and endemic to Mediterranean salt marshes of the French and Spanish coasts. The genus *Limonium* comprises about 300 taxa, many of them being a result of rapid radiation that occurred during the Messinian desiccation of the Mediterranean Sea (Lledó et al., 2005). The recent existence of numerous taxa is related to frequent hybridization resulting in a high proportion of polyploids and especially triploid species, such as *L. girardianum* (Erben, 1993; Palacios et al., 2000). The ploidy of *L. girardianum* ($2n = 26 = 2 \times 9 + 8$) and its self-incompatible sexual reproductive system, – type A grain pollen and cob stigma – (Baker, 1966; Castro and Rosselló, 2007), bring about an obligate agamospermous reproduction, which leads to low genetic variability. This reproductive characteristic reduces the possibility of adaptation to changing habitat conditions, making *L. girardianum* a specialist species. Though the distribution of *L. girardianum* extends along the Mediterranean coasts of France and Spain, salt marsh ecosystems are there isolated from each other, and so the distribution of *L. girardianum* populations is highly fragmented.

This hemicryptophyte is protected in France due to the rare occurrence of favorable habitats and populations. Furthermore, since the last decade, French coastal salt marshes have endured increasing threats due to the development of human activities such as industry, agriculture, tourism, and increased pollution (Gedan et al., 2009; Pavon, 2005). Some of the salt marshes, where *L. girardianum* occurs, have been subjected to strong human-driven alterations, such as the expansion of the major port of Marseille (France) between 1965 and 1975 inducing the definitive destruction of 7000 ha of coast salt marshes (Pinder and Witherick, 1990).

Due to its phylogenetic particularity (and so its weak adaptative potential) and the demands for conservation of this species in France, it is important to assess its ecological requirements.

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E-mail addresses: teddy.baumberger@univ-cezanne.fr (T. Baumberger), laurence.affre@univ-cezanne.fr (L. Affre), thomascroze@laposte.net (T. Croze), mesleard@tourduvalat.org (F. Mesléard).

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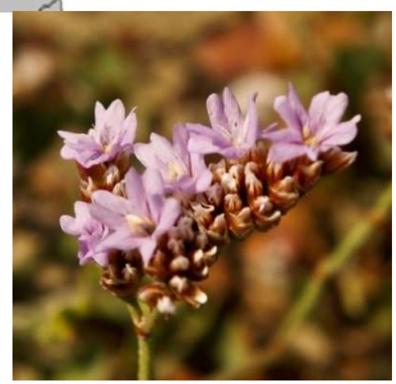
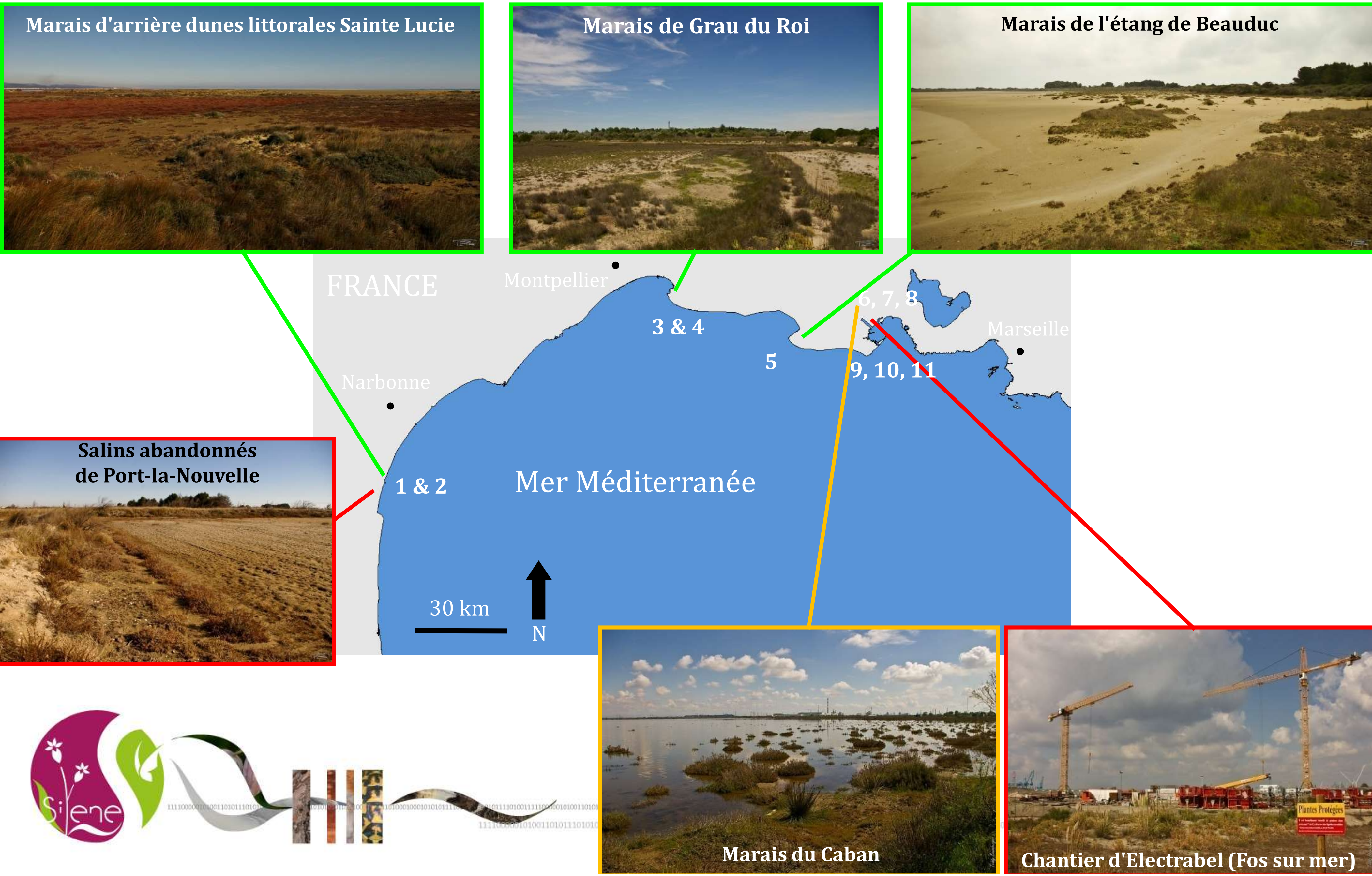
doi:10.1016/j.flora.2011.11.008

Cas de la Saladelle de Girard (*Limonium girardianum*)



Niche écologique et facteurs de rareté d'une espèce



Niche écologique et facteurs de rareté d'une espèce

Conservation biogéographique

10

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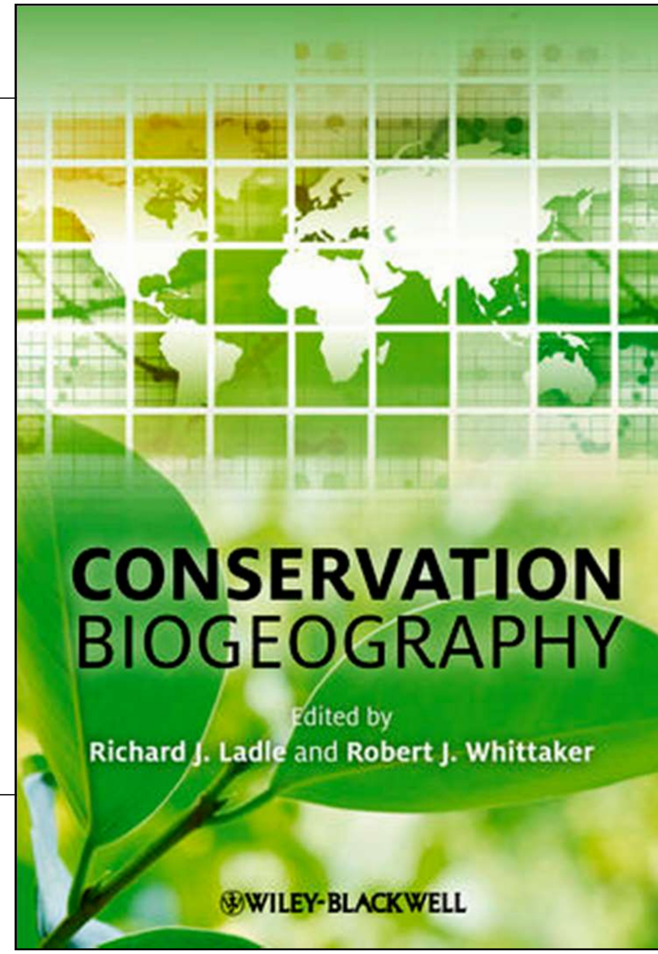
Connaître, partager, conserver

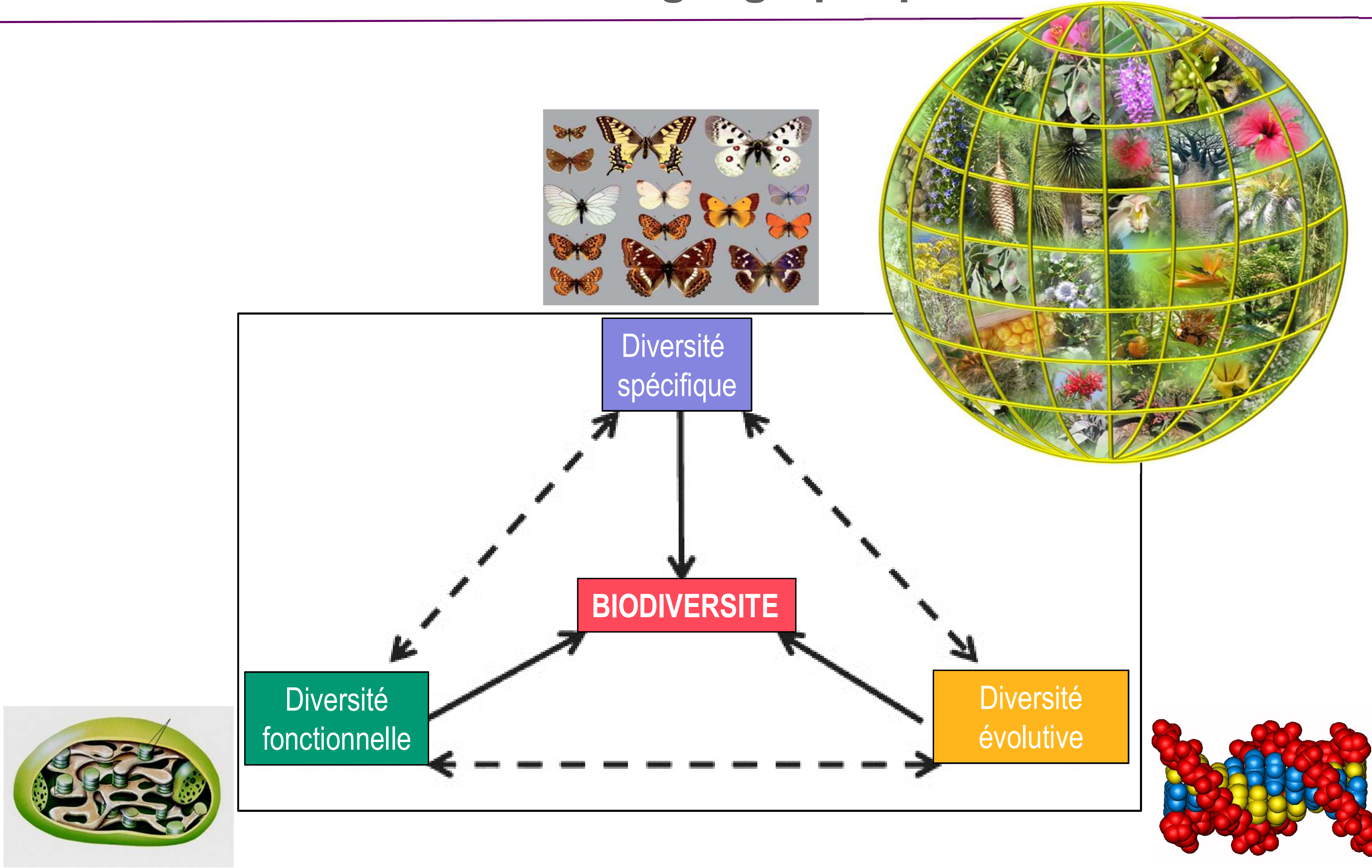
Conservation biogéographique

Application des principes, théories et analyses de la biogéographie (notamment ceux concernant la distribution dynamique des espèces prises individuellement ou collectivement) aux problématiques de conservation de la biodiversité.

→ **Conserver les multi facettes de la biodiversité !**



Pour une conservation biogéographique de la biodiversité



Quelle conservation de l’héritage évolutif ?

Ecological Indicators 60 (2016) 736–745

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Spatial mismatches between plant biodiversity facets and evolutionary legacy in the vicinity of a major Mediterranean city

M. Pouget[a,*], S. Youssef[b], P.-J. Dumas[a], T. Baumberger[c], A. San Roman[a], F. Torre[a], L. Affre[a], F. Médail[a], A. Baumel[a]

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ARTICLE INFO

Article history:
Received 12 June 2014
Received in revised form 17 July 2015
Accepted 20 July 2015

Keywords:
Phylogenetic diversity
Evolutionary legacy
Rocky habitats
Surrogate
Conservation
Arenaria provincialis
National Park of Calanques

ABSTRACT

The analyses of congruencies among biodiversity components address the issue of conservation priorities, but previously they have been done at coarse scales with limited relevance for conservation actions. Moreover, these former studies consider only the species level components of biodiversity and not the intra-specific evolutionary legacy that influences future biodiversity. This study represents the first assessment of congruencies between various components of plant biodiversity and the evolutionary legacy of a narrow endemic taxon (*Arenaria provincialis*, Caryophyllaceae). Assessment is conducted in the vicinity of a Mediterranean big city (Marseille, S.E. France) where habitats and flora are threatened by mass tourism and urban sprawl. Our analyses reveal that the different plant biodiversity facets assessed are spatially mismatched and unequally protected. Moreover, by using only species-level components of biodiversity as conservation targets we ignore crucial areas for the evolutionary legacy of this narrow endemic plant. Our results highlight the crucial role of phylogeography as a criterion to target the genetic precursors of future biodiversity in conservation planning.

1. Introduction

Conservation biology aims to conserve all components of biodiversity as well as the ecological and evolutionary processes that sustain them (Moritz, 2002; Lankau et al., 2011). To date, conservation strategies have largely focused on taxonomic diversity to protect species or areas at various scales. Evolutionary assessments of biodiversity may reveal serious weaknesses in the network of protected areas, especially where areas with high species richness are not cradles of diversification (Becerra and Venable, 2008) or hotspots of genetic diversity or uniqueness (Taberlet et al., 2012). For example, Davis et al. (2008), who investigated mammal diversity, and Kraft et al. (2010), who focused on plant diversity, demonstrate some spatial discrepancies between simple counts of endemic species richness and ongoing diversification within the California biodiversity hotspot. Other recent studies report robust links between the genetic and specific components of biodiversity (*e.g.*, He et al., 2008; Papadopoulou et al., 2011; Lamy et al., 2013) and support the existence of surrogates of genetic diversity under certain conditions and scales. These results emphasise that, for system-based conservation planning (Whittaker et al., 2005; Rodrigues and Brooks, 2007), and to better understand the future of biodiversity under global change (Lee and Jetz, 2008), we need to improve our knowledge of the relevance and consistency of putative links between the different components of biodiversity. These links question the existence and value of biological and ecological surrogates.

The inclusion of the evolutionary history of populations in conservation planning is an important issue for long-term management of biodiversity (Moritz, 2002; Sechrest et al., 2002; Tucker et al., 2012; Moritz and Potter, 2013). Historically isolated sets of populations are likely to have distinct evolutionary potential (Moritz, 1994): their existence is the consequence of past evolutionary processes that occurred within populations, shaping

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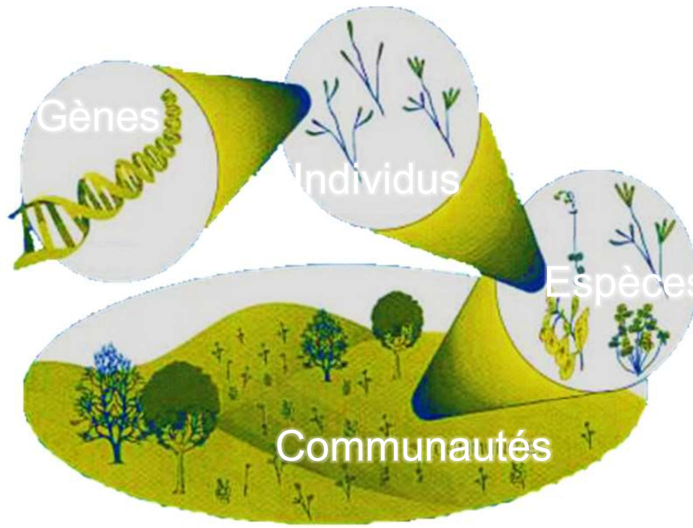
http://dx.doi.org/10.1016/j.ecolind.2015.07.017



Évaluer la capacité d’une composante de la biodiversité à être utilisée comme substitut de l’héritage évolutif

- Orienter la conservation vers les processus évolutifs
- Rechercher les corrélations entre niveaux de biodiversité
- Révéler la présence de substituts

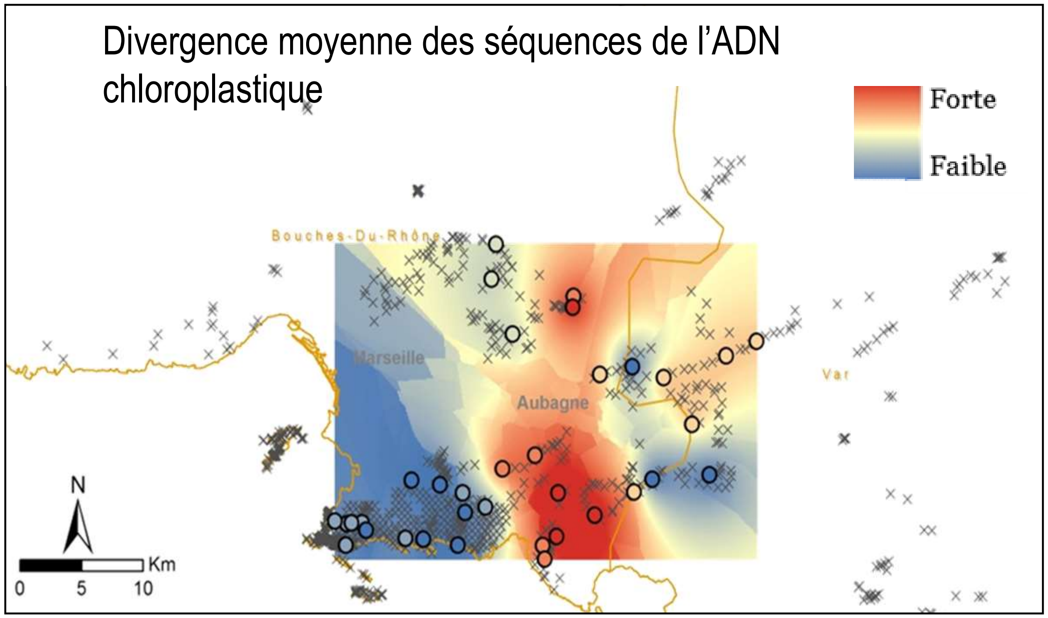
Région Provence-Alpes-Côte d'Azur

Office National des Forêts

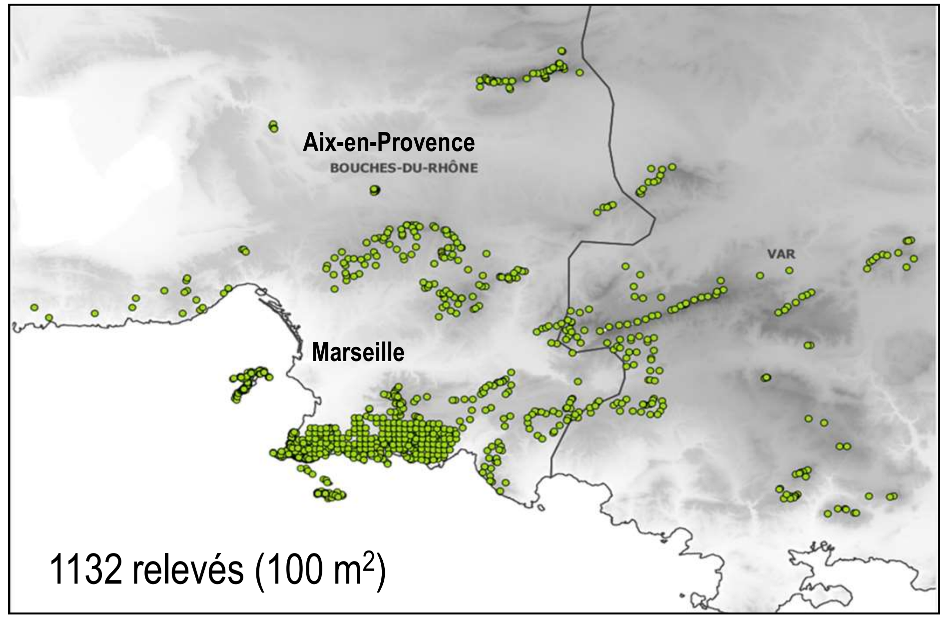
Connaître, partager, conserver

Quelle conservation de l'héritage évolutif ?

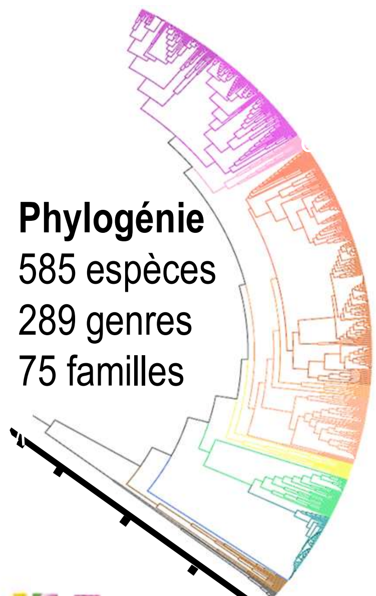
Héritage évolutif de la sabline de Provence



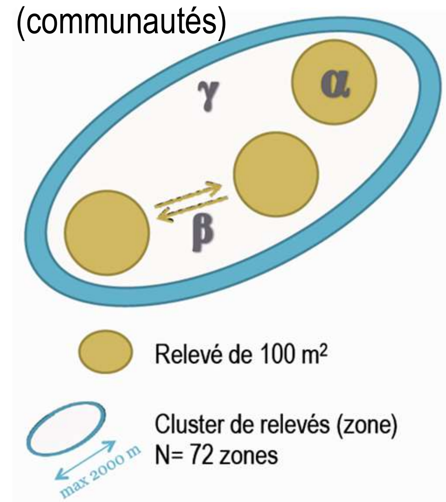
Relevés floristiques et mésologiques



Phylogénie
585 espèces
289 genres
75 familles



Indices de diversité
(communautés)

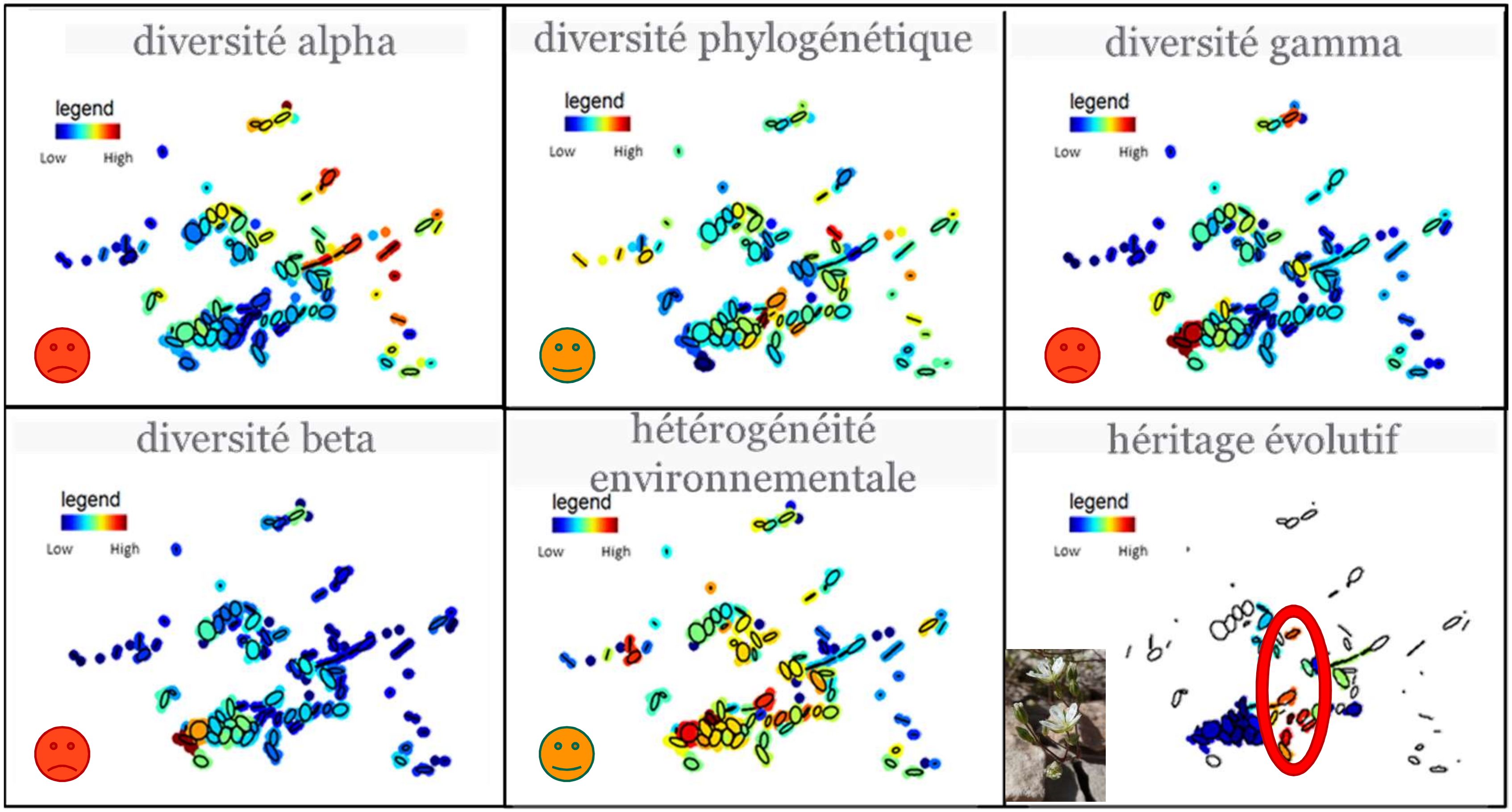


Quelle conservation de l'héritage évolutif ?

CORRÉLATIONS ENTRE COMPOSANTES DE DIVERSITÉ

➔ Faible corrélation spatiale

➔ Impossible de considérer une seule zone qui englobe les fortes valeurs de toutes les composantes de diversité



Vulnérabilité face à l'urbanisation : unités de conservation

Biodivers Conserv (2017) 26:293–307
DOI 10.1007/s10531-016-1242-3

ORIGINAL PAPER

Conservation unit allows assessing vulnerability and setting conservation priorities for a Mediterranean endemic plant within the context of extreme urbanization

Marine Pouget[1,2] · Alex Baumel[1] · Katia Diadema[3] · Frédéric Médail[1]

Received: 24 April 2016 / Revised: 10 October 2016 / Accepted: 21 October 2016 / Published online: 4 November 2016

Abstract Current biodiversity patterns are a temporary state in a continuum of ecological and evolutionary changes. Conservation policies must incorporate this dynamic to ensure the long-term conservation of biodiversity which is particularly challenging in a context of extreme urbanization. An original approach, rarely used for plant conservation, is to define conservation units to set conservation priorities within species by combining ecological and evolutionary divergences. In the Maritime Alps (southern France), the ecological and evolutionary divergences between the populations of *Acis nicaeensis* has allowed us the determination of conservation units of this endemic plant threatened by severe urbanization and land-use changes. Phylogeographical data (cpDNA haplotype) were considered as a proxy for evolutionary legacy, and ecological data (multivariate analysis of habitat) were used as a proxy for ecological distinctiveness. Our goal was to explore the potential of this approach to assess vulnerability and set conservation priorities for narrow endemic species in the context of conflict between biodiversity and human activities. The results highlight five different conservation units within *A. nicaeensis* distribution. Genetic and ecological divergences are present at fine-scale. This pattern is highly endangered by urbanisation. This study highlights the vulnerability of conservation units near the coast whose

Communicated by Daniel Sanchez Mata.

This article belongs to the Topical Collection: Urban biodiversity.

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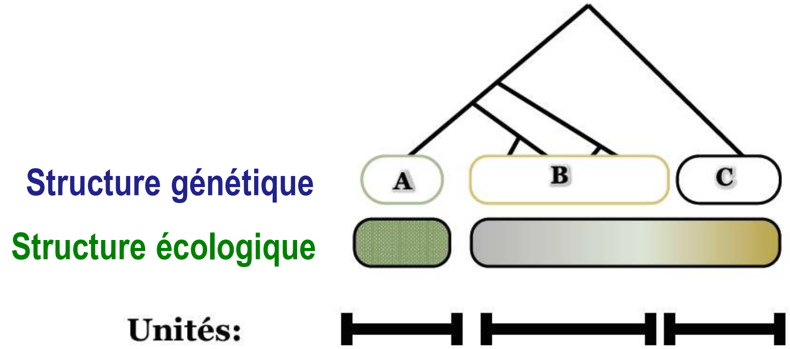
2 Centre for Middle Eastern Plants, Royal Botanic Garden Edinburgh, 20a Inverleith Row, Edinburgh EH3 5LR, United Kingdom

3 Conservatoire botanique national méditerranéen de Porquerolles (CBNMed), 34 avenue Gambetta, 83400 Hyères, France

Définition d'unités de conservation



Nivéole de Nice
(*Acis nicaeensis*)

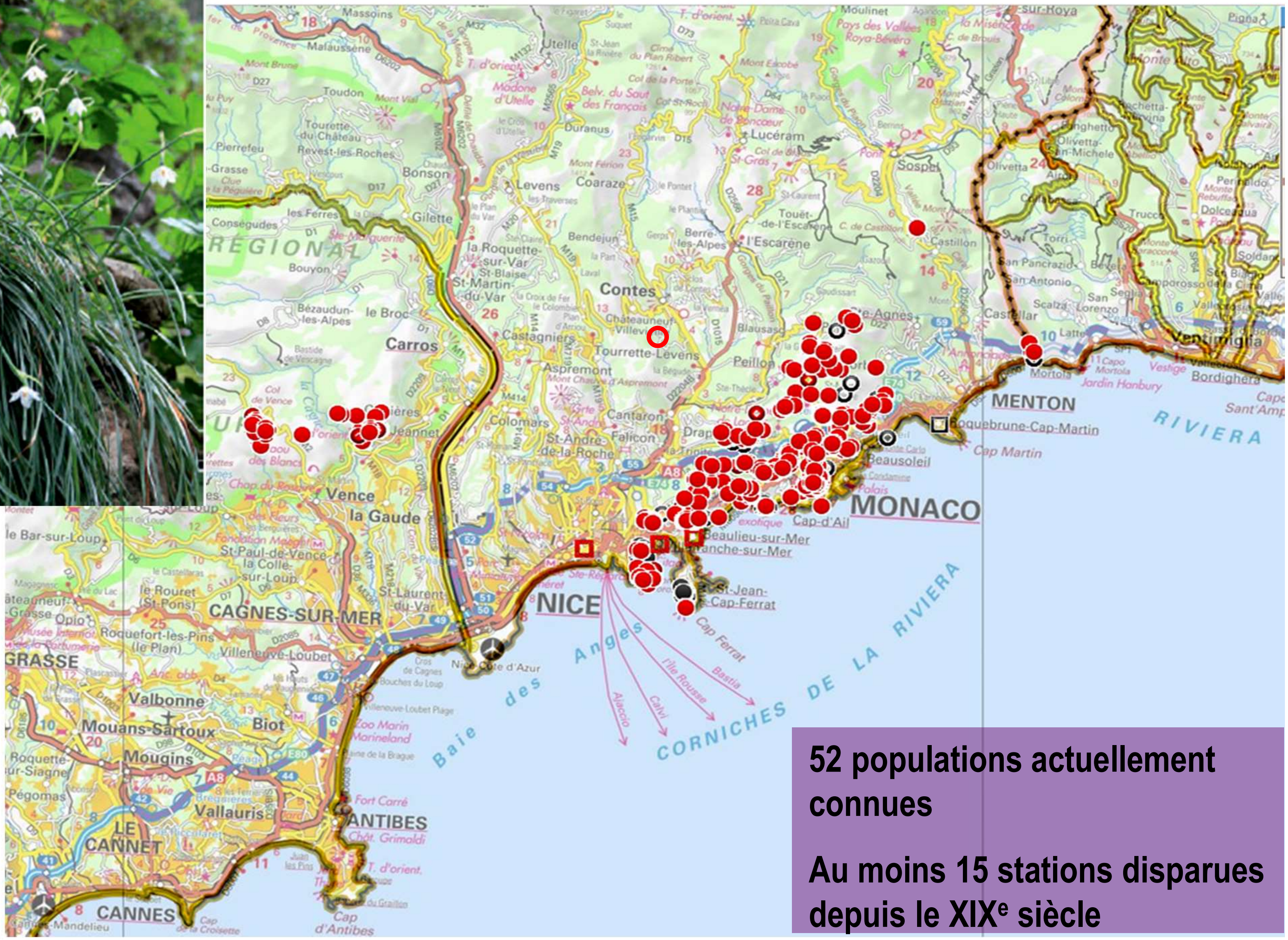
Région
Provence-Alpes-Côte d'Azur

Gouvernement Princier
PRINCIPAUTÉ DE MONACO

Connaître, partager, conserver

Cas de la Nivéole de Nice, endémique restreinte

Acis nicaeensis

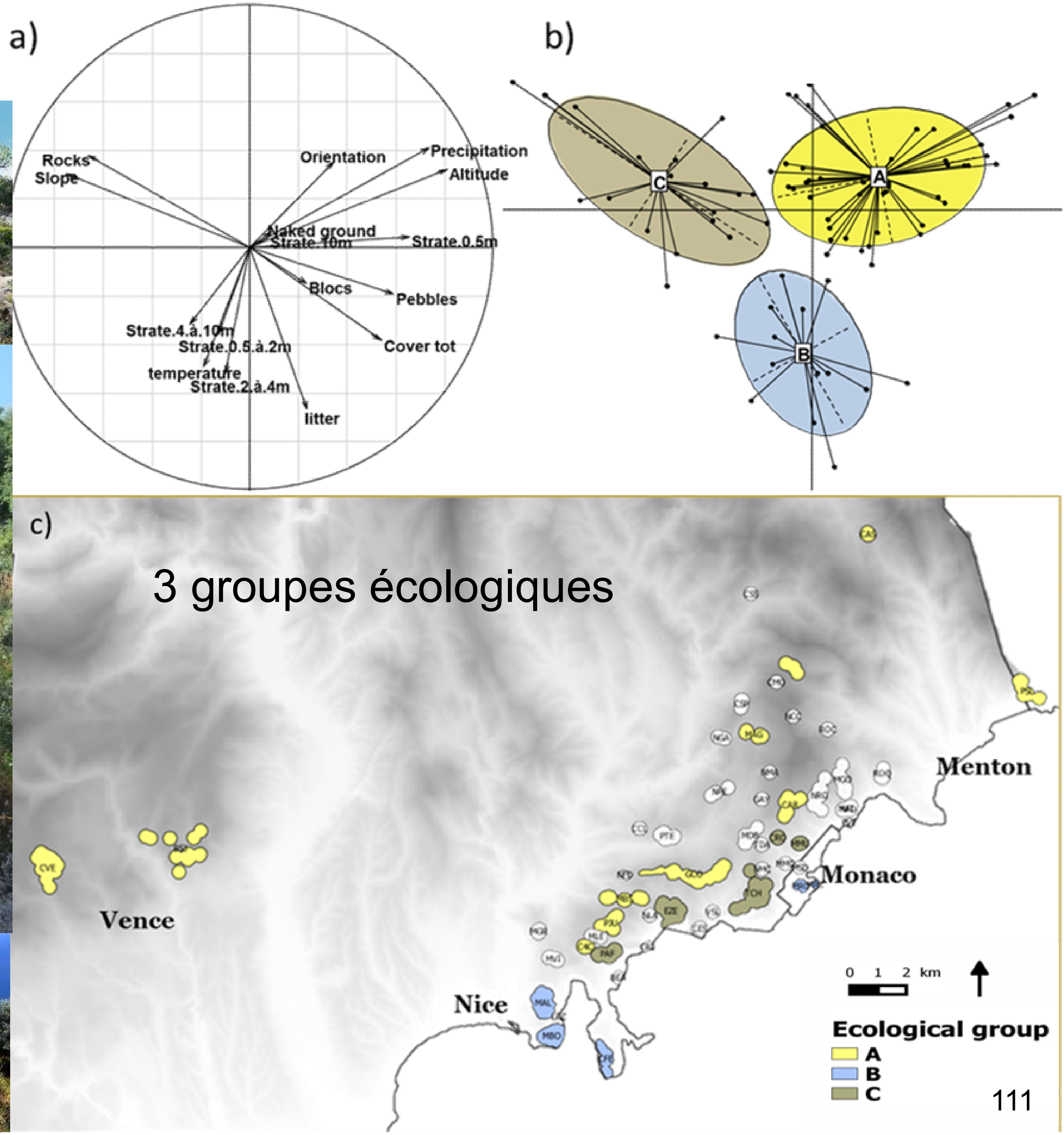


52 populations actuellement connues

Au moins 15 stations disparues depuis le XIXe siècle

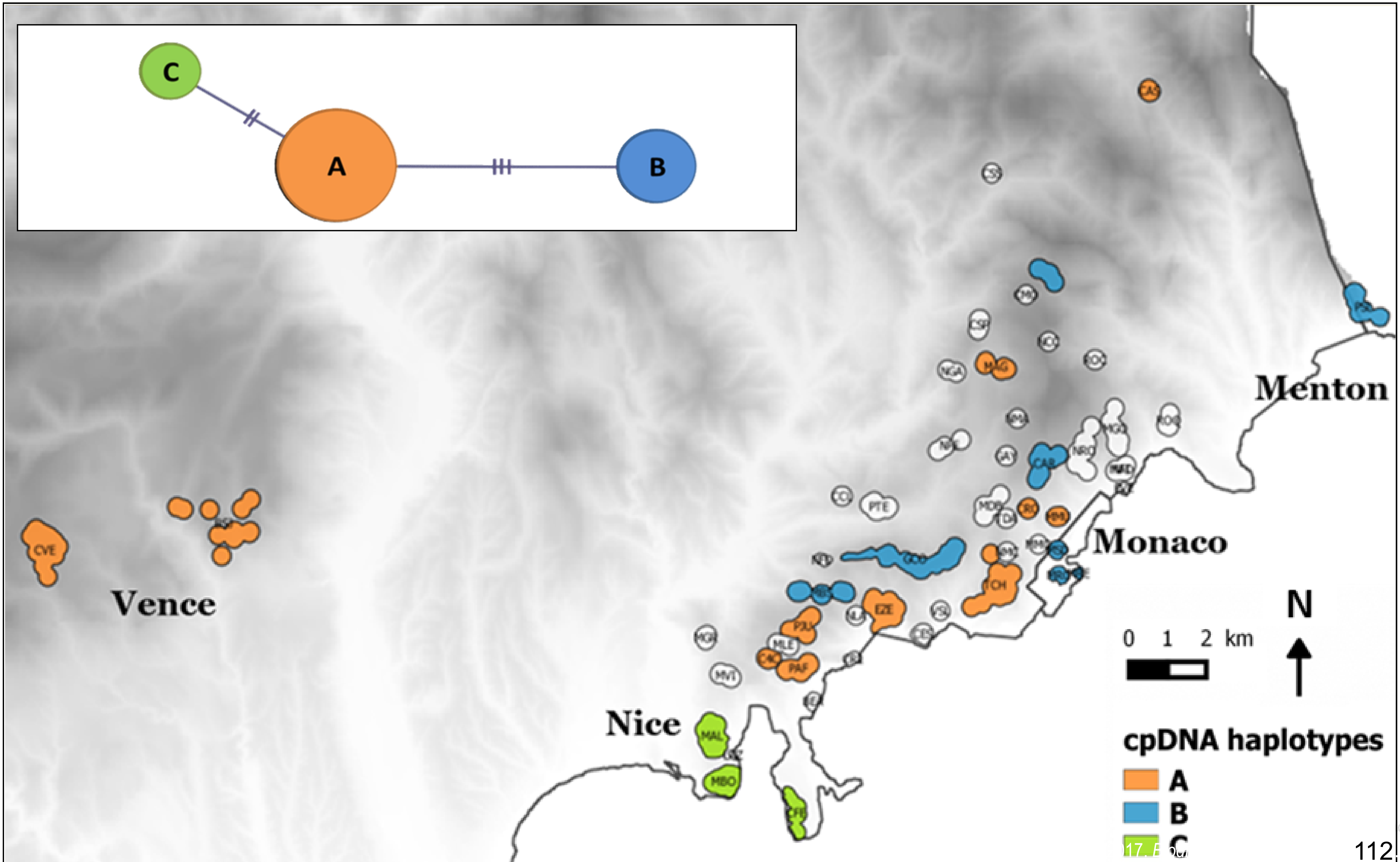
10 ANS

Structure écologique des populations de Nivéole de Nice



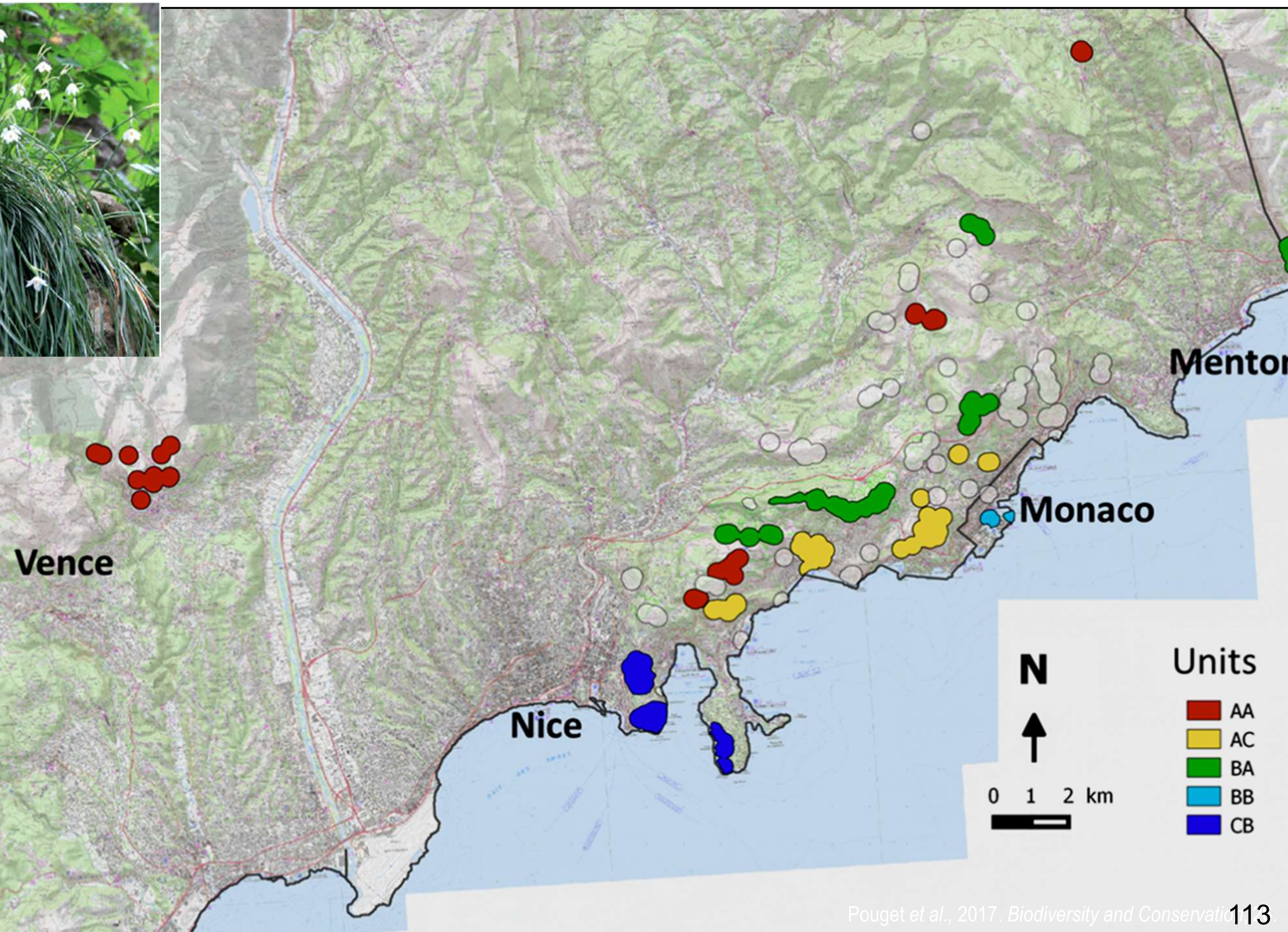
Structure génétique de la Nivéole de Nice

Réseau et distribution des 3 haplotypes identifiés (ADN chloroplastique)



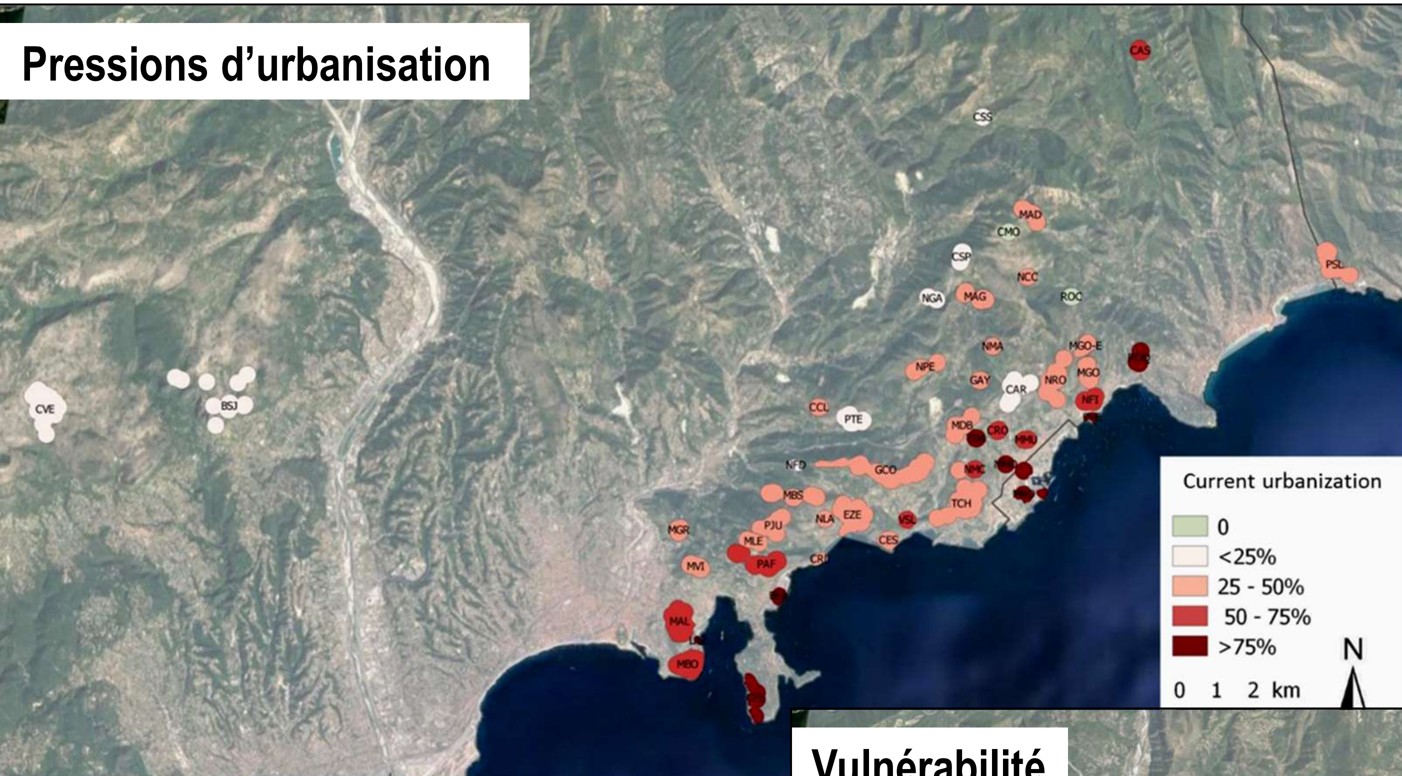
Distinction de 5 unités de conservation

Unité de conservation = informations génétiques + écologiques

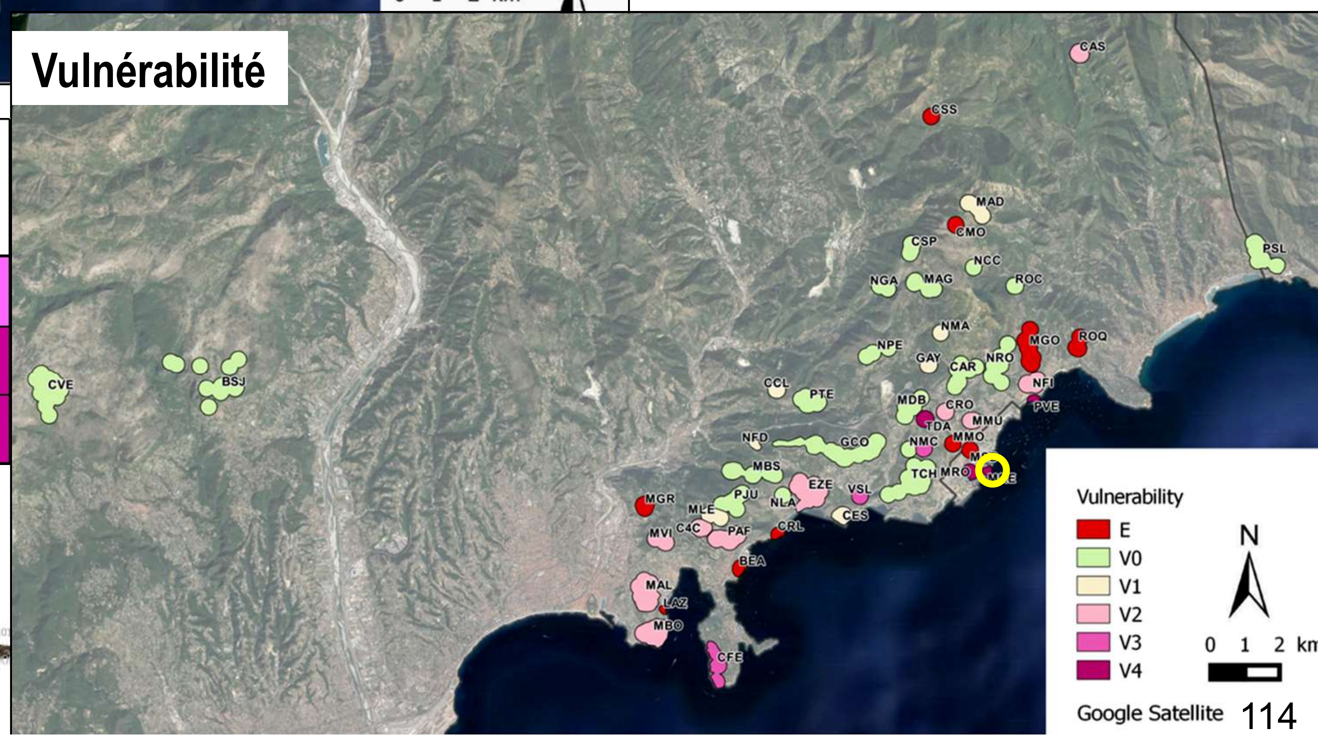


Pouget *et al.*, 2017. *Biodiversity and Conservatio*

Vulnérabilité des populations de Nivéole face à l'urbanisation



Superficie \ Urbanization (Low → High)		I	II	III	IV
Large	III	V0	V0	V2	V3
	II	V0	V1	V2	V4
Small	I	V0	V1	V3	V4



Vulnérabilités écologiques et priorités de conservation (territoires)

10

ANS

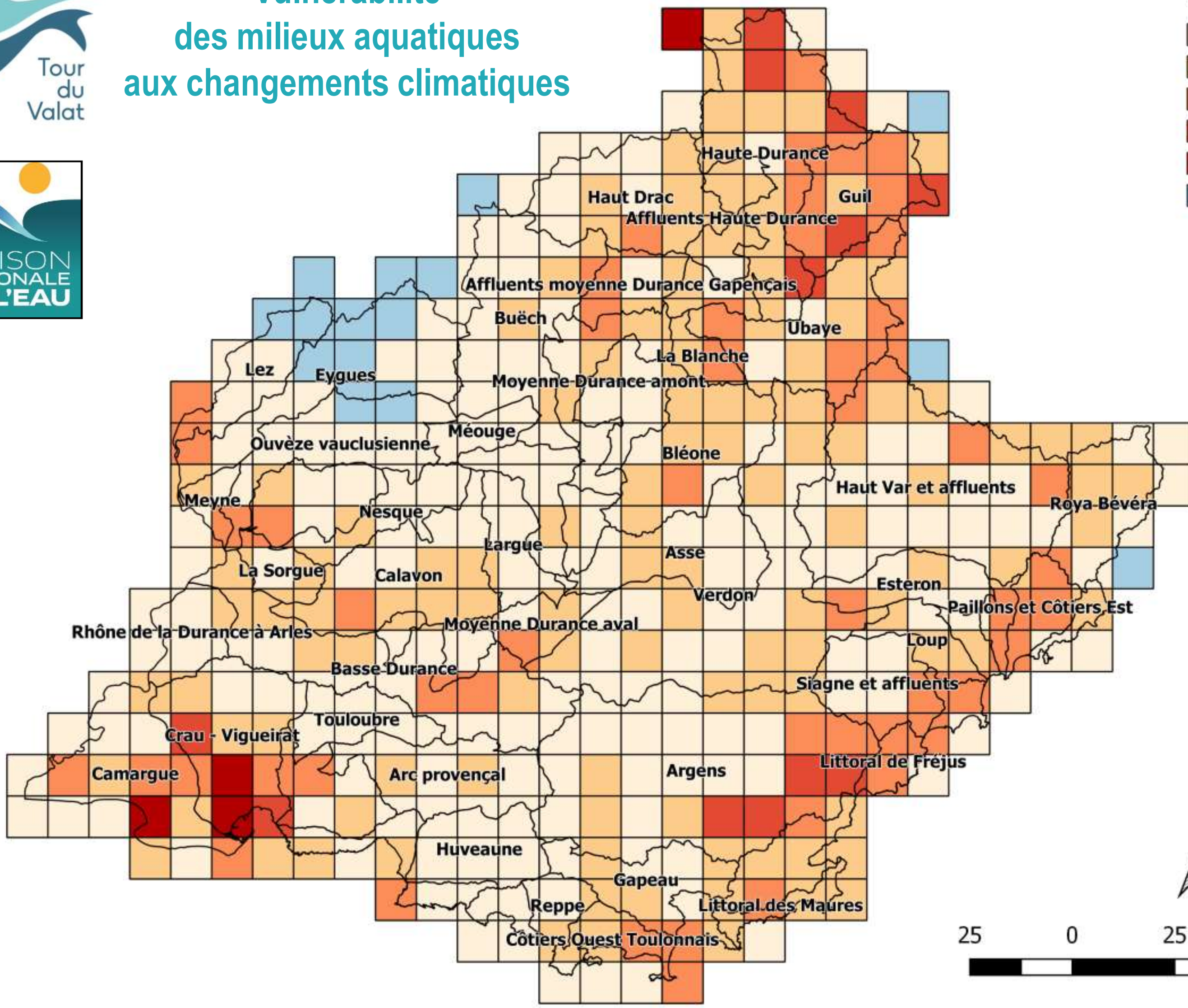
Connaître, partager, conserver

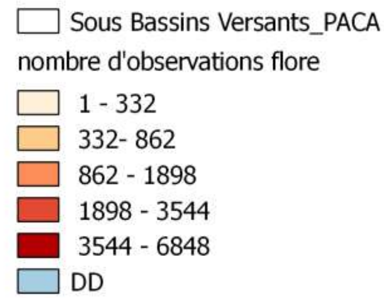
Sensibilité au changement climatique de la flore des zones humides

Tour du Valat

MAISON RÉGIONALE DE L'EAU

Vulnérabilité des milieux aquatiques aux changements climatiques

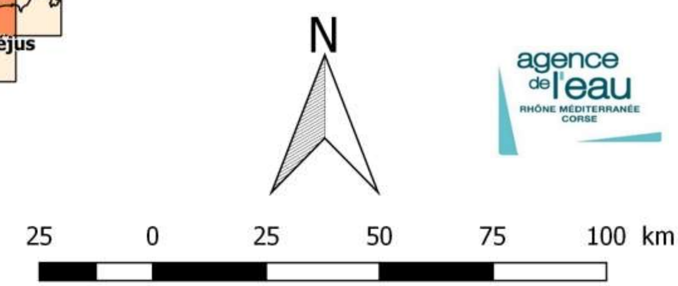




Forte densité d'observations :
Camargue, Crau-Vigueirat, Nord du sous-bassin de la Haute Durance.

Densité moyenne d'observations :
Est du sous-bassin de l'Argens, Guil.

Déficit d'observations :
Centre de la région PACA.



agence de l'eau RHÔNE MÉDITERRANÉE CORSE

Région Provence-Alpes-Côte d'Azur

Silene

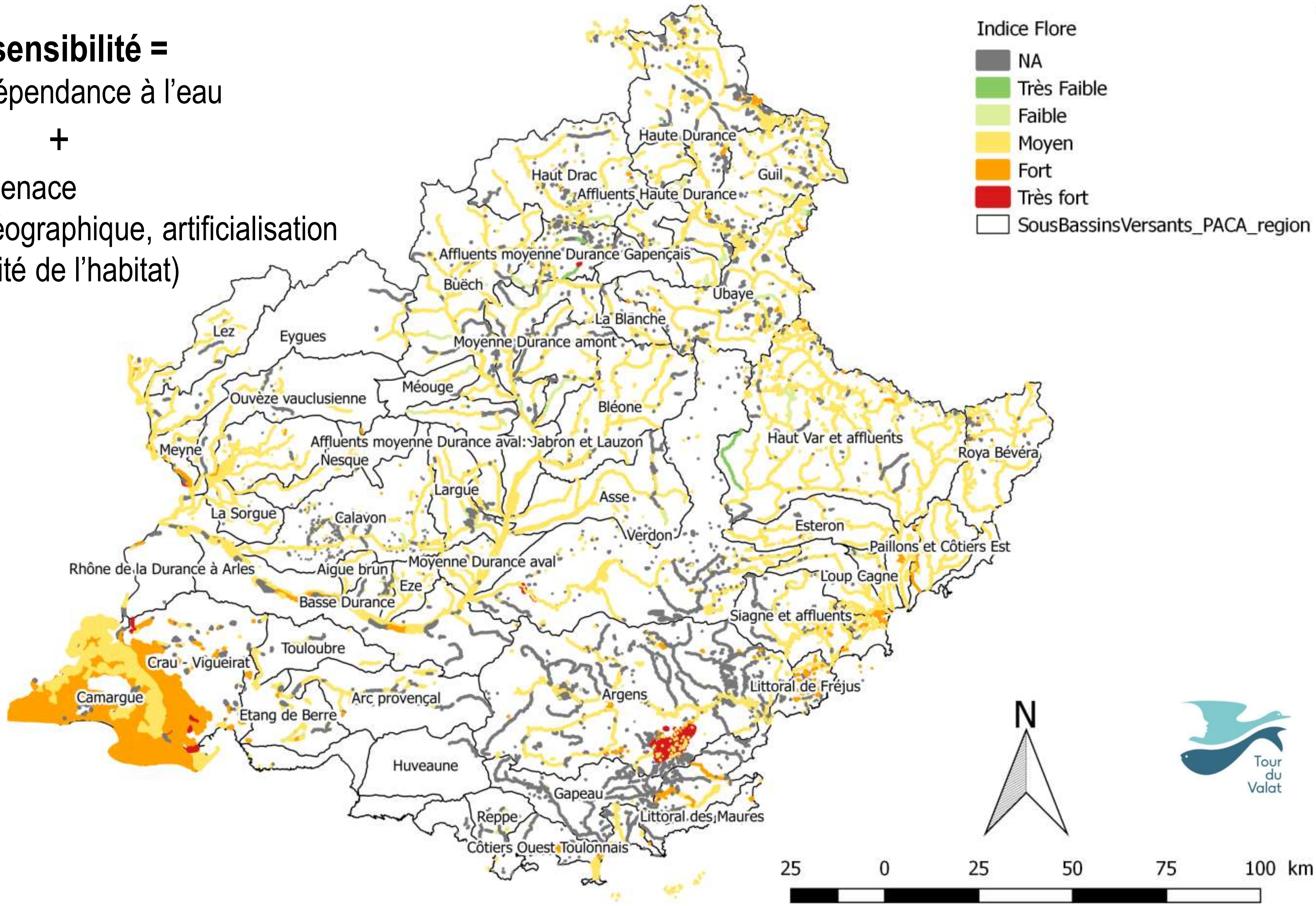
Connaître, partager, conserver

Sensibilité au changement climatique de la flore des zones humides

Indice de sensibilité =
Critère de dépendance à l'eau

+

Critère de menace
(rareté biogéographique, artificialisation
et vulnérabilité de l'habitat)



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Zones de conservation prioritaires pour la flore littorale menacée

Journal of Environmental Management 201 (2017) 425–434

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Research article

Prioritizing conservation areas for coastal plant diversity under increasing urbanization

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ARTICLE INFO

Article history:
Received 7 March 2017
Received in revised form 8 June 2017
Accepted 9 June 2017
Available online 10 July 2017

Keywords:
Complementarity
Land-use scenarios
Mediterranean ecosystems
Protected area network
Rarity
Species distribution models

ABSTRACT

Coastal urban expansion will continue to drive further biodiversity losses, if conservation targets for coastal ecosystems are not defined and met. Prioritizing areas for future protected area networks is thus an urgent task in such urbanization-threatened ecosystems. Our aim is to quantify past and future losses of coastal vegetation priority areas due to urbanization and assess the effectiveness of the existing protected area network for conservation.

We conduct a prioritization analysis, based on 82 coastal plants, including common and IUCN red list species, in a highly-urbanized but biotically diverse region, in South-Eastern France. We evaluate the role of protected areas, by taking into account both strict and multi-use areas. We assess the impact of past and future urbanization on high priority areas, by combining prioritization analyses and urbanization models.

We show that half of the highly diverse areas have already been lost due to urbanization. Remaining top priority areas are also among the most exposed to future urban expansion. The effectiveness of the existing protected area (PA) network is only partial. While strict PAs coincide well with top priority areas, they only represent less than one third of priority areas. The effectiveness of multi-use PAs, such as the Natura 2000 network, also remains limited.

Our approach highlights the impact of urbanization on plant conservation targets. By modelling urbanization, we manage to identify those areas where protection could be more efficient to limit further losses. We suggest to use our approach in the future to expand the PA network in order to achieve the 2020 Aichi biodiversity targets.

1. Introduction

Urbanization is one of the main factors of long-lasting land transformation and a major threat to biodiversity worldwide (Grimm et al., 2008; McKinney, 2002; Seto et al., 2011). Coastal areas are particularly affected by both increasing urban population and mass tourism that lead to the rapid development of urbanized areas and consequently to losses of natural habitats (Airoldi and Beck, 2007; Bulleri and Chapman, 2010). Connecting land and sea, coastal habitats often stand out by a unique plant diversity and high specialisation within strong ecological gradients at small spatial scales (Médail and Quézel, 1997). Many coastal plants are adapted to stressful levels of salinity, drought and temperature (Baastrup-Spohr et al., 2015; Malcolm and Zedler, 1995) and are thus highly vulnerable to habitat decrease (Stefanaki et al., 2015). The conflict between human pressures and conservation of irreplaceable, vulnerable biodiversity makes prioritizing conservation actions within coastal zones particularly urgent.

The Mediterranean basin is a typical example, even though it covers only 2% of the Earth's land surface, it holds over 20% of the known vascular plant species. It harbours particularly high proportions (>50%) of endemic species (Greuter, 1994; Médail and Quézel, 1997). Therefore, Mediterranean coasts are recognized for their important diversity of habitats and species (Cox and

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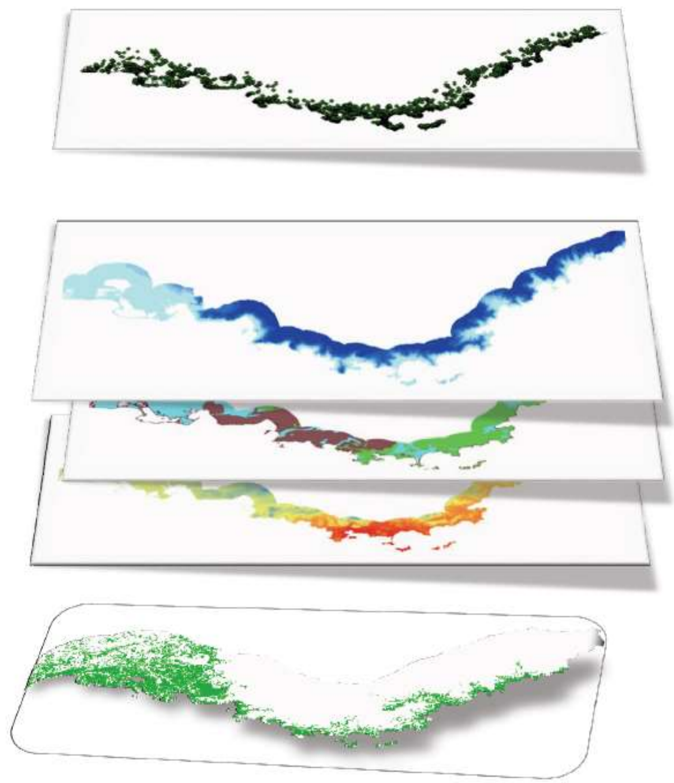
E-mail address: aggeliki.doxa@imbe.fr (A. Doxa).

http://dx.doi.org/10.1016/j.jenvman.2017.06.021

Passer d'observations ponctuelles à des cartes de distribution à l'échelle régionale : modélisation de distributions



Observations dans SILENE

+

Données environnementales : climat, géologie, relief

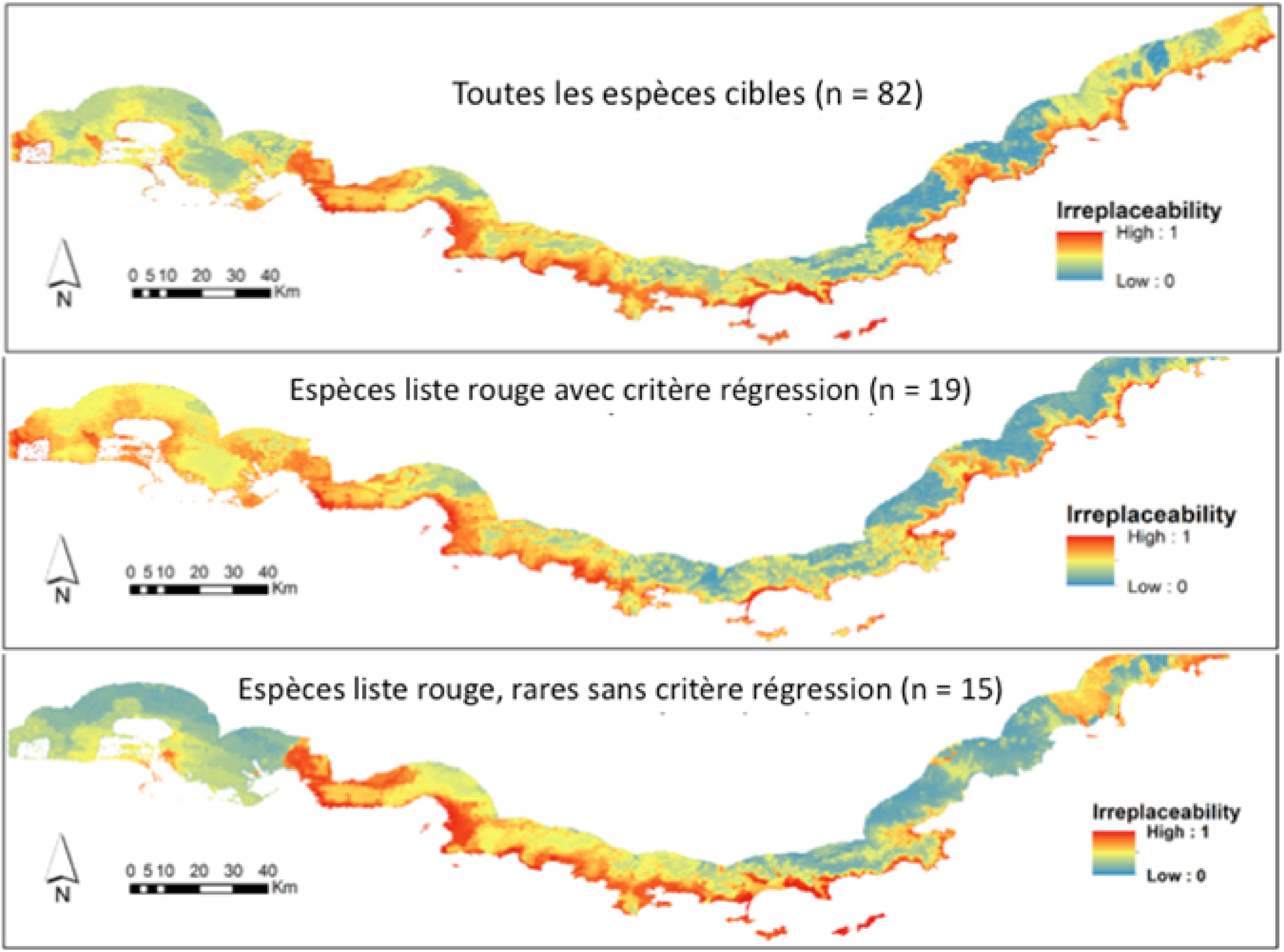
+

Modèles de distribution validés

ENPI CBCMED
GREATmed
Project funded by the EUROPEAN UNION

Silene — Connaître, partager, conserver

Zones de conservation prioritaires pour la flore littorale menacée

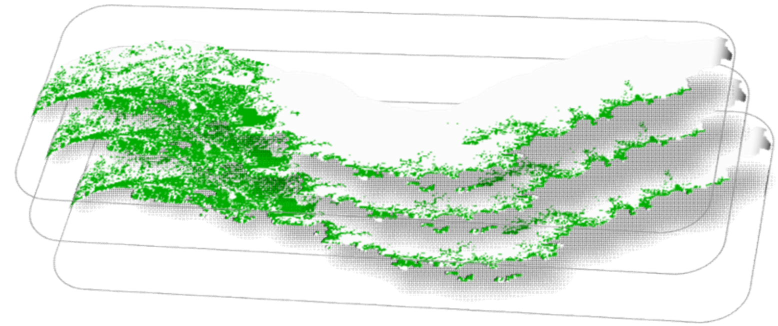


Zones de conservation prioritaires pour la flore littorale menacée

Réseau existant de sites protégés

(protection stricte : PN, RNN)

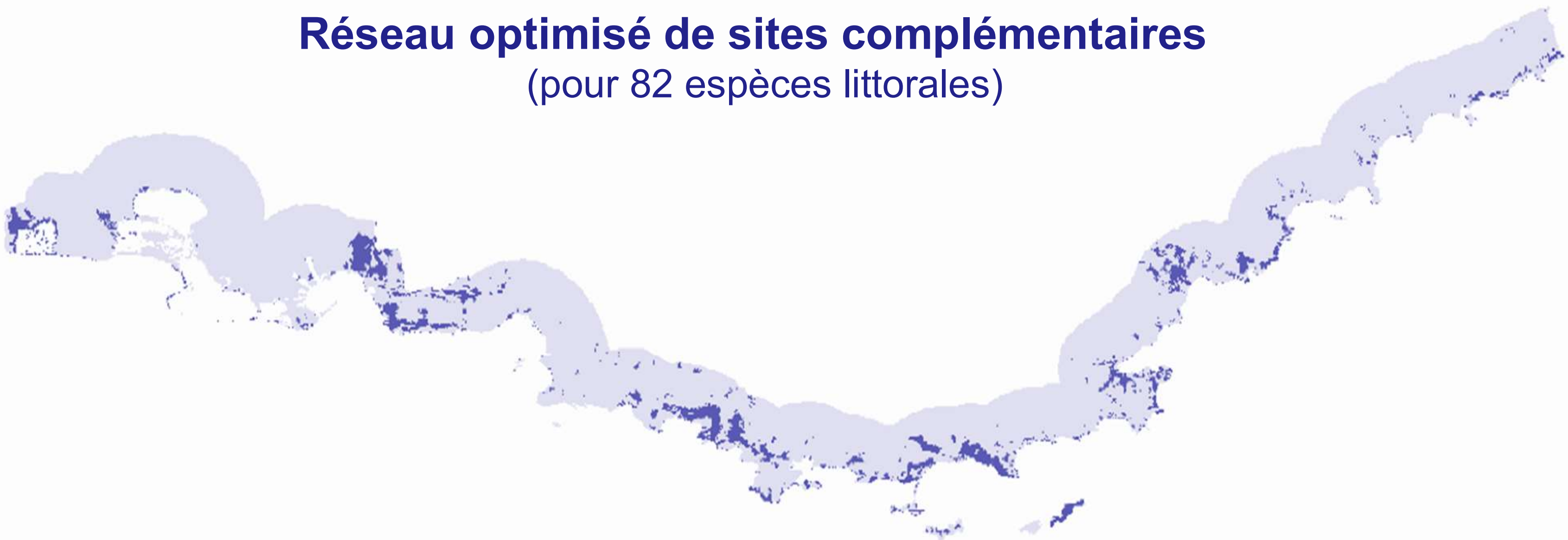
+



Modèles de distribution validés

Réseau optimisé de sites complémentaires

(pour 82 espèces littorales)



Les challenges à résoudre!

10

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Connaître, partager, conserver

Evaluation de la qualité de l'échantillonnage

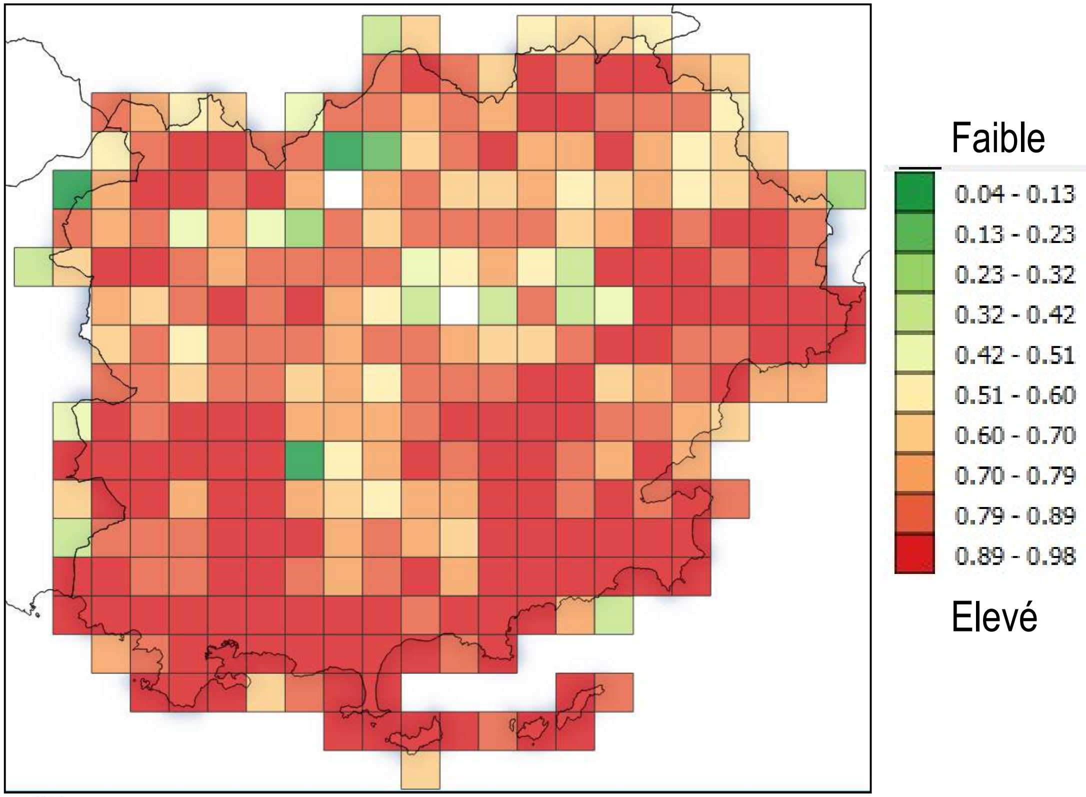
Quelle est le niveau d'exhaustivité de l'inventaire SILENE ?

Prise en compte du biais d'échantillonnage dans l'utilisation des données

➔ Développement d'analyses statistiques (IMBE-CBNMed)
script R, techniques d'estimation non paramétrique basée sur l'analyse de courbes d'accumulation

Pourcentage d'exhaustivité des inventaires
Exemple de la flore vasculaire du Var pour une résolution de 5 x 5 km.

10 ANS



A. Doxa, E. Queller & V. Noble
IMBE & CBNMed, inéd.

Les enjeux de l'outil SILENE pour la recherche

Couverture géographique / écologique non systématique :

➔ Pb des données d'absence (modèles de niche)

Difficulté de distinguer les données d'occurrence brute par rapport à celles des relevés :

➔ Généraliser la prise de relevés, quelle exhaustivité du relevé ?

➔ Protocole de prise de données plus « traçable »

Aspects faune : groupes sous échantillonnés

➔ Inter-opérabilité des diverses bases de données

➔ Congruence faune / flore (analyse des lacunes de conservation)

Aspects fonctionnels à développer

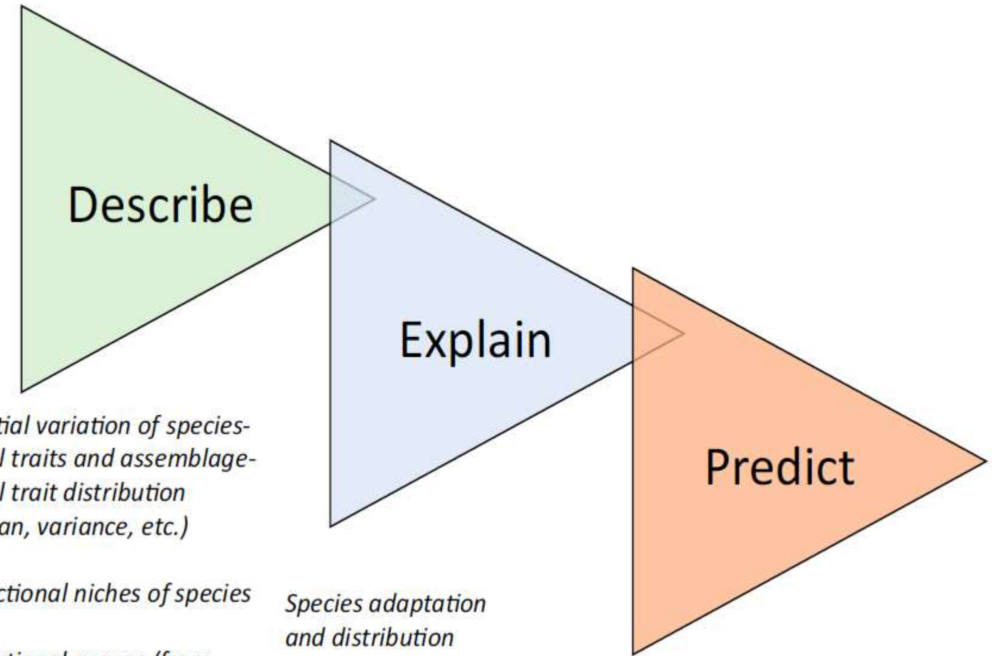
Un partenariat fructueux noué depuis 10 ans et un outil de base important pour les sciences écologiques et de la conservation !

The emergence and promise of functional biogeography

Cyrille Violle[a,b,1], Peter B. Reich[c,d], Stephen W. Pacala[e], Brian J. Enquist[f,g,h], and Jens Kattge[i,j]

13690–13696 | PNAS | September 23, 2014 | vol. 111

1. Décrire la distribution des types et fonctions selon les gradients environnementaux et les échelles spatiales.
2. Utiliser cette information pour expliquer la distribution géographique de la biodiversité (notamment les espèces et la diversité évolutive) et les processus écosystémiques.
3. Prédire les réponses de la biodiversité face aux changements globaux en utilisant des modèles prédictifs basés sur les traits d'histoire de vie des espèces.



Describe:
- *Spatial variation of species-level traits and assemblage-level trait distribution (mean, variance, etc.)*
- *Functional niches of species*
- *Functional spaces (from populations to biomes)*
- *Functional diversity-area relationships*
- *Diversity within Plant Functional Types (PFT)*
- *Trait-based (multi-trophic) network of species co-occurrences*
- *Mapping of traits and functional diversity*
- *Trait-environment relationships*

Explain:
- *Species adaptation and distribution*
- *Conservation status of species*
- *Taxonomic and phylogenetic patterns (alpha, beta, gamma scales)*
- *Community assembly and structure*
- *Scaling of species interactions*
- *Drivers of ecosystem properties and services*

Predict:
- *Response of organisms and communities to environmental changes*
- *Ecosystem functioning*
- *Biogeochemical cycling and carbon stocks*
- *Ecosystem services*
- *Delineation of conservation areas*

www.silene.eu

Merci
de votre attention

frederic.medail@imbe.fr

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