

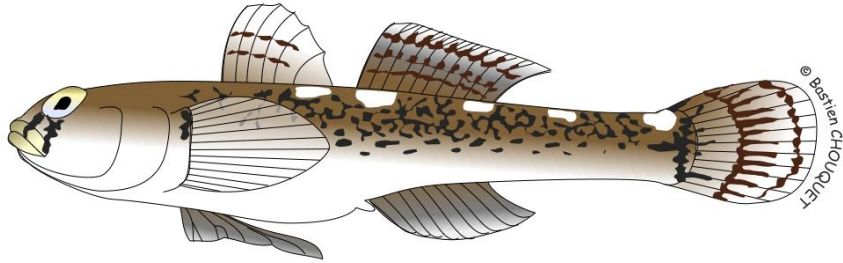
Computer aided identification apps and citizen science

Towards combining human and automatic process

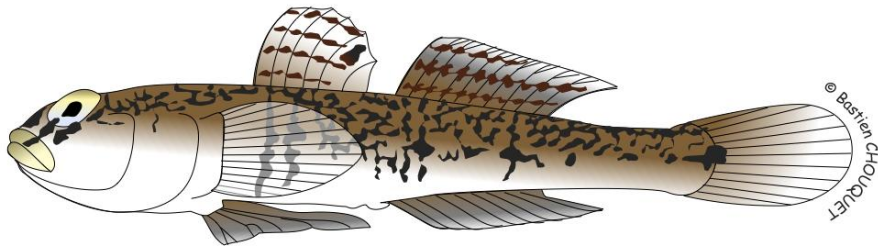
Regine Vignes Lebbe
Institut de Systematique, Evolution, Biodiversite
(Sorbonne Universite, MNHN, CNRS, EPHE, Univ. des Antilles)



Identification

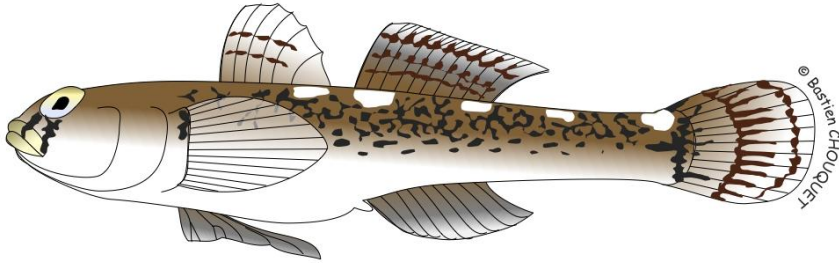


?

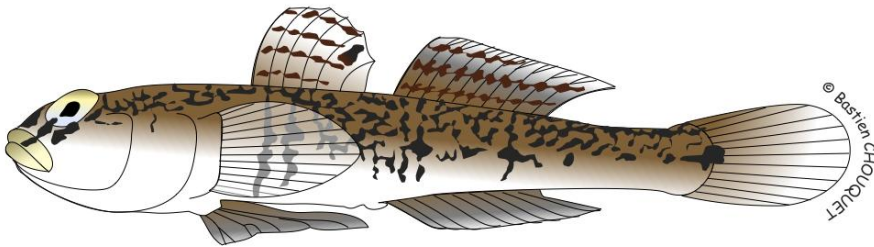


?

Identification



Pomatoschistus microps
(female)



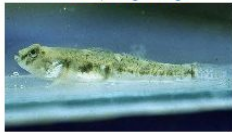
Pomatoschistus minutus
(male)

Taxonomic names are the key access



Pomatoschistus microps (Krøyer, 1838) Common goby

Upload your photos and videos
[Pictures](#) | [Google image](#)



Pomatoschistus microps
 Picture by Busse, K.

Add your observation in Fish Watcher
[Native range](#) | [All suitable habitat](#) | [Point map](#) | [Year 2100](#)



This map was computer-generated and has not yet been reviewed.
Pomatoschistus microps AquaMaps Data sources: GBIF GBIS

Classification / Names [Common names](#) | [Synonyms](#) | [Catalog of Fishes \(gen., sp.\)](#) | [ITIS](#) | [CoL](#) | [WoRMS](#) | [Cloffa](#)

Actinopterygii (ray-finned fishes) > **Perciformes** (Perch-likes) > **Gobiidae** (Gobies) > Gobiinae
 Etymology: *Pomatoschistus*: Greek, poma, -atos = cover, operculum + Greek, schistos = divided (Ref. 45335).

Environment / Climate / Range [Ecology](#)

Marine; freshwater; brackish; demersal; amphidromous (Ref. 51243); depth range 0 - 12 m (Ref. 35388).
 Temperate; 8°C - 24°C (Ref. 4944), preferred ?; 64°N - 20°N, 19°W - 31°E

Length at first maturity / Size / Weight / Age

Maturity: L_m ?, range 3 - ? cm
 Max length : 9.0 cm TL male/unsexed; (Ref. 6303); max. reported age: 3 years (Ref. 40230)

Short description [Morphology](#) | [Morphometrics](#)

Dorsal spines (total): 6 - 8; **Dorsal soft rays** (total): 8-11; **Anal spines**: 1; **Anal soft rays**: 7 - 10; **Vertebrae**: 30 - 32.
 This species is distinguished from other gobies in European freshwaters by the following characters: males with conspicuous dark proximal posterior spot on first dorsal; with cephalic lateral line canals; anterior oculoscapular

Fishbase

The screenshot shows the GBIF (Global Biodiversity Information Facility) website for the species *Pomatoschistus microps* (Krøyer, 1838). The page includes a navigation bar with links for Data, News, Community, and About. The main header displays the species name and its taxonomic status as an accepted species. It shows 6,141 occurrences and 0 infraspecifics. A 'View occurrences' button is present. The 'Overview' section provides detailed taxonomic information, including the full name, common names (e.g., bouquette na, buhode na, gobie buhorthe na), habitat (Not terrestrial, Marine, Freshwater, Marine, Freshwater, Brackish), and synonyms (e.g., Gobius laticeps Morsau, 1881; Gobius microps Krøyer, 1838; Gobius microps subsp. microps; Gobius microps subsp. puckersis Lawacz, 1965; Gobius minutus subsp. minor Hencke, 1880). A small photograph of the fish is also visible. The 'Georeferenced data' section features a map of Europe with yellow dots indicating occurrence locations, and a sidebar showing 5,276 view records and distribution information.

GBIF

Identification is critical

For scientific activities (scientific names)

For discovering biodiversity (scientific and vernacular names)

For many citizen science project.

VIGIENATURE
Un réseau de citoyens qui fait avancer la science



How to help identification ?

Morphological characters (keys)

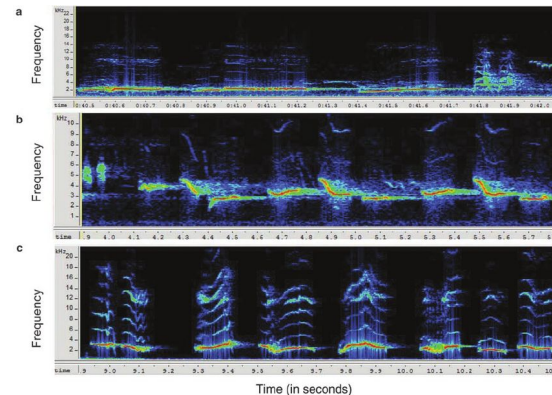
Measures and geometry (morphometry)

Molecular data (barcoding)

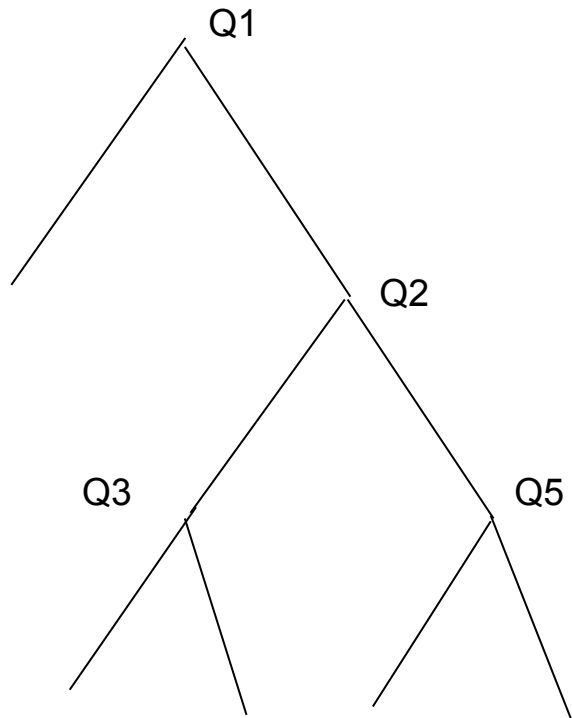
Images (data mining and neural network)

Acoustic

Behavior ...


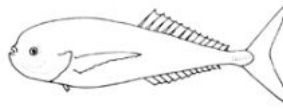
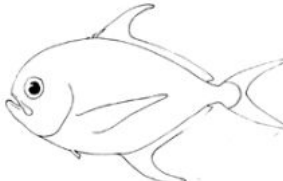

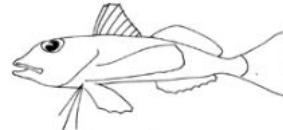
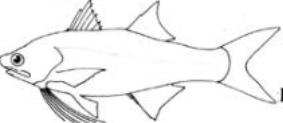



Identification key



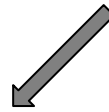
Dicho/polytomous key
= Single access key
= Mathematical tree
= Decision tree

Section G: Pelvic Fins Thoracic With Exactly One Spine and Five Soft-rays (continued)

- 9b Tail forked; lateral line wavy  **CORYPHAENIDAE**
 Dolphin-fishes
 Pages 150-151
- 10a *From 7a page 22: spines in dorsal fin*
 Dorsal and anal fins with spines only, no soft-rays  **LUVARIDAE**
 Louvar
 Page 198
- 10b Dorsal fin with both spines and soft-rays 11
- 11a Dorsal fin with 5 or more spines 13
- 11b Dorsal fin with only 3 or 4 spines 12
- 12a Snout blunt; area over eye enlarged; dorsal fin rays highest in anterior portion of fin  **BRAMIDAE**
 Pomfrets (fanfish)
 Pages 150-151
- 12b Snout elongate; dorsal rays highest in posterior portion of fin  **CENTROLOPHIDAE**
 Medusafishes
 Page 198
- 13a Lowermost rays of pectoral fin not detached from fin 15
- 13b Lowermost rays of pectoral detached and thread-like or barbel-like 14
- 14a Three lowermost pectoral rays detached  **TRIGLIDAE**
 Searobins
 Page 113
- 14b Five to 9 lowermost pectoral rays detached  **POLYNEMIDAE**
 Threadfins (bobos)
 Pages 168-169
- 15a Suborbital stay absent 20 (next page)
- 15b Suborbital stay present 16
- 16a Anal spines absent; body scaleless or only partly scaled  **COTTIDAE**
 Sculpins (cabezon)
 Page 118
- 16b (next page)

Biological keys and algorithms

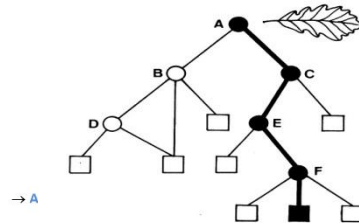
To compute
a tree



Single access polytomous key

Clé d'identification abrégée

1. Forme du corps
 - 1.1. Corps aplati
 - 1.2.2. Absence de nageoires pectorales → A
 - 1.2. Corps serpentiforme : longiligne, en forme de serpent
 - 1.2.1. Présence de nageoires pectorales → A
 - 1.2.2. Absence de nageoires pectorales → A
- 1.3. Corps fusiforme : dos convexe et une section plus ou moins cylindrique
 - 1.3.1. Un barbillon → Lote (p. 15)
 - 1.3.2. Deux barbillons → Goujons, Tanche (p. 16-19)
 - 1.3.3. Quatre barbillons → Barbeaux, Carpe commune, Esturgeons (p. 20-24)
 - 1.3.4. Six barbillons → Loche épineuse, Loche franche, Loche transalpine, Silure glane (p. 25-28)
 - 1.3.5. Huit barbillons → Poisson-chat (p. 29)
 - 1.3.6. Dix barbillons → Loche d'étang (p. 30)
 - 1.3.7. Pas de barbillon
 - 1.3.7.1. Deux nageoires dorsales



- Single access
- Answer must be « yes » / « no » at each question
- No fuzzy or vague answer

To explore
databases

Interactive or free access Key

- Free access
- Possibility of doubting,
- Additional helpful information (text, images, links to external resources)
- Guidance to choose characters

Produce and publish your keys



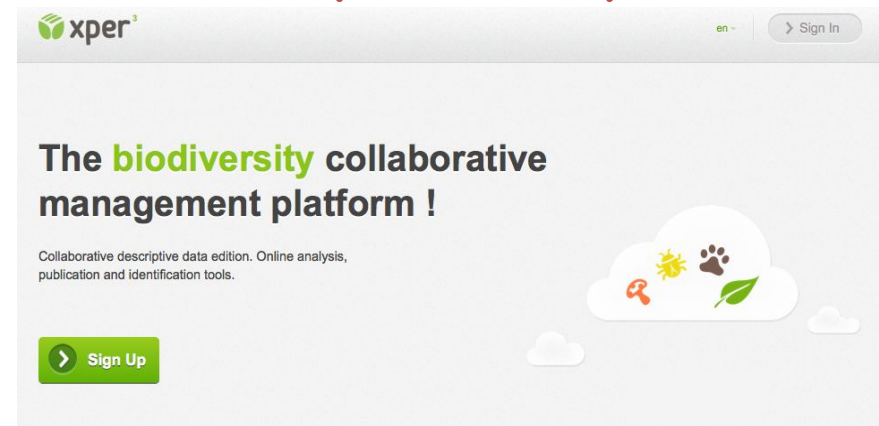
<http://www.xper3.fr/>

Online collaborative system to create your own knowledge base and keys

Open since october 2013

> 2500 accounts

> 3000 knowledge bases



Edition

Xper³ allows you to store and edit your descriptive data online. Furthermore it is possible for you to share your data with other users, thus making collaborative descriptive data management possible.

> [Get Started](#)



taxa

descriptors

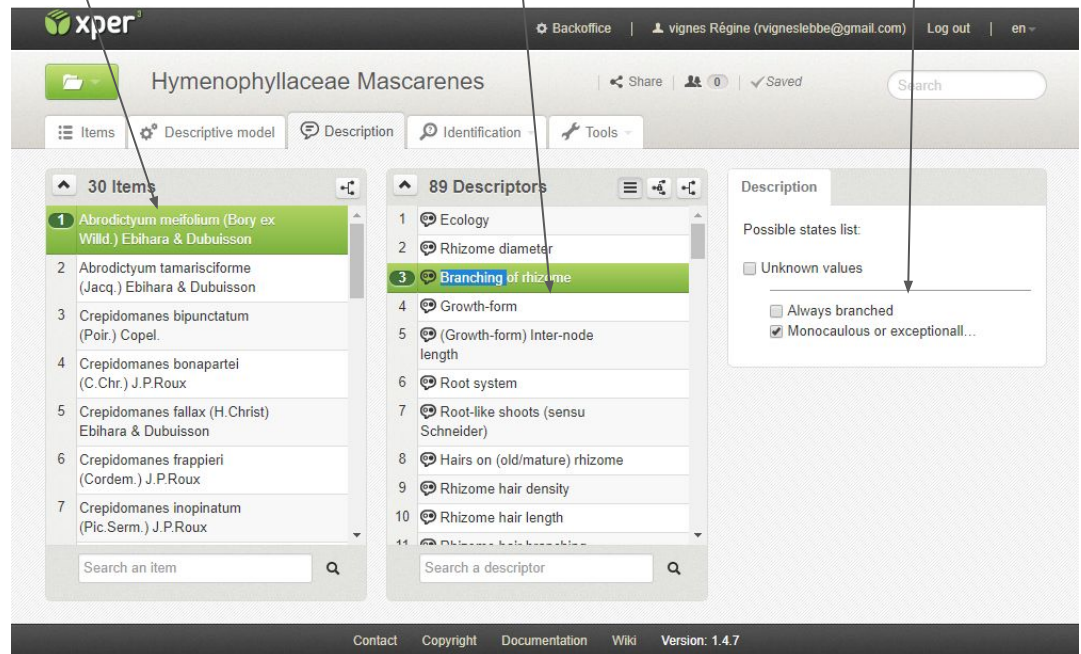
states

All taxa are described using a **common terminology**.

Taxa (items), descriptors and states are **documented** by texts and images.

The content is **accessible** for all if the author(s) publish the content and/or identification key online.

Here a knowledge base describing Hymenophyllaceae of Mascarenes.



The screenshot displays the xper³ web interface for the knowledge base 'Hymenophyllaceae Mascarenes'. The interface is organized into several sections:

- Header:** Includes the xper³ logo, user information (vignes Régine), and navigation options (Backoffice, Log out, en).
- Navigation:** Features tabs for 'Items', 'Descriptive model', 'Description', 'Identification', and 'Tools'.
- 30 Items:** A list of 30 taxa, with the first item, 'Abrodictyum mefolium (Bory ex Willd.) Ebihara & Dubuisson', highlighted in green.
- 89 Descriptors:** A list of 89 descriptors, with the third item, 'Branching of rhizome', highlighted in green.
- Description:** A panel showing the 'Possible states list' for the selected descriptor, including options like 'Unknown values', 'Always branched', and 'Monocaulous or exceptional...'. The 'Monocaulous or exceptional...' option is checked.

Arrows from the text above point to these panels: 'taxa' points to the '30 Items' list, 'descriptors' points to the '89 Descriptors' list, and 'states' points to the 'Description' panel.

taxa

descriptors

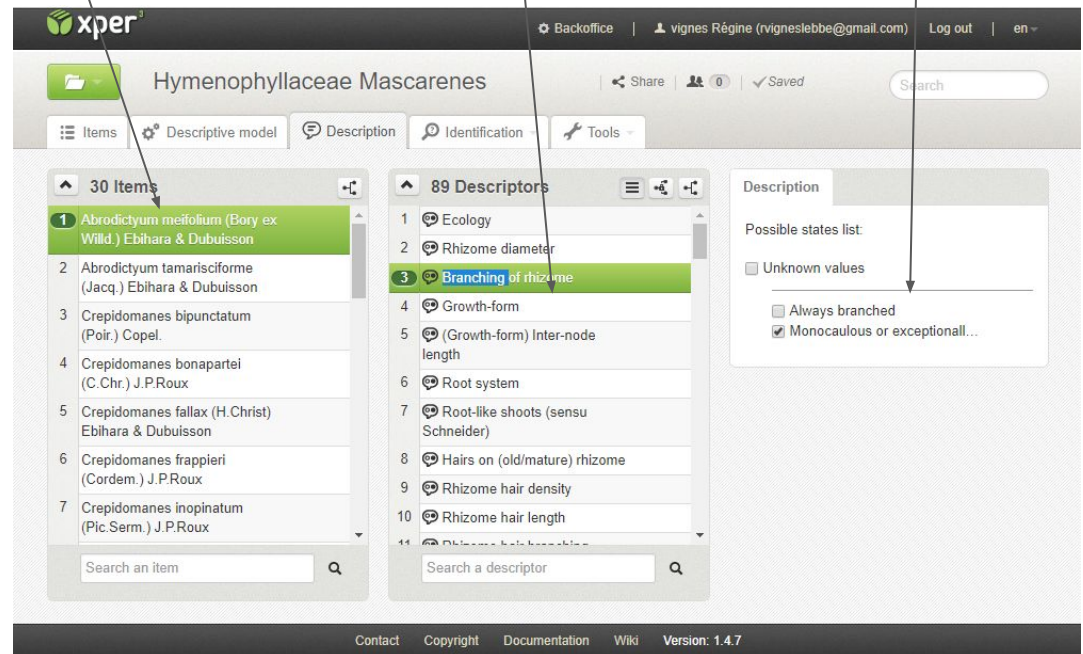
states

All taxa are described using a **common terminology**.

Taxa (items), descriptors and states are **documented** by texts and images.

The content is **accessible** for all if the author(s) publish the content and/or identification key online.

Here a knowledge base describing Hymenophyllaceae of Mascarenes.



The screenshot shows the xper³ web interface for 'Hymenophyllaceae Mascarenes'. It features a navigation bar with 'Items', 'Descriptive model', 'Description', 'Identification', and 'Tools'. The main content area is divided into three panels: '30 Items' (listing various species like *Abrodictyum mefolium*), '89 Descriptors' (listing characteristics like 'Ecology', 'Rhizome diameter', and 'Branching of rhizome'), and a 'Description' panel showing 'Possible states list' with options like 'Always branched' and 'Monocaulous or exceptionall...'. Arrows from the text labels 'taxa', 'descriptors', and 'states' point to these respective sections.

Litterature,
collections, expertise

bottleneck



Knowledge bases,
Structured data

Spipoll



Example of identification service for a citizen project about flower visitors



<http://spipoll.org>

Spipoll

Report a problem

19 Des... History...

Longueur des antennes

La longueur des antennes se mesure d'une extrémité à l'autre.

Forme des yeux

Type de coloration de l'abdomen

Type de coloration du thorax

Longueur des antennes

Antennes courtes ou Antennes de taille Antennes longues à

Antennes courtes ou à peine visibles (77)

Les antennes sont plus courtes que la longueur de la tête.

196 Remaining taxa (species, grou... Q

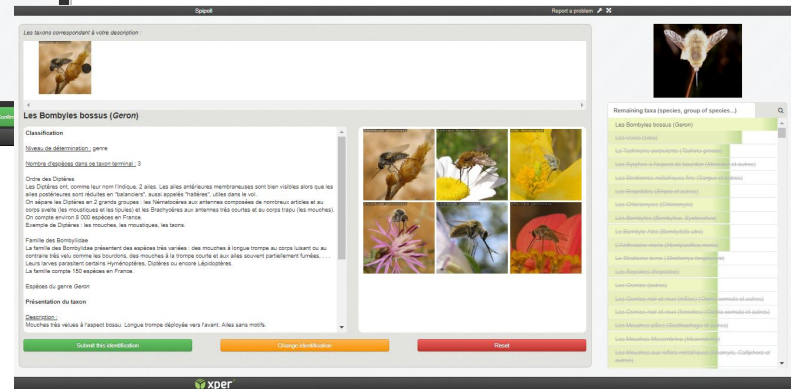
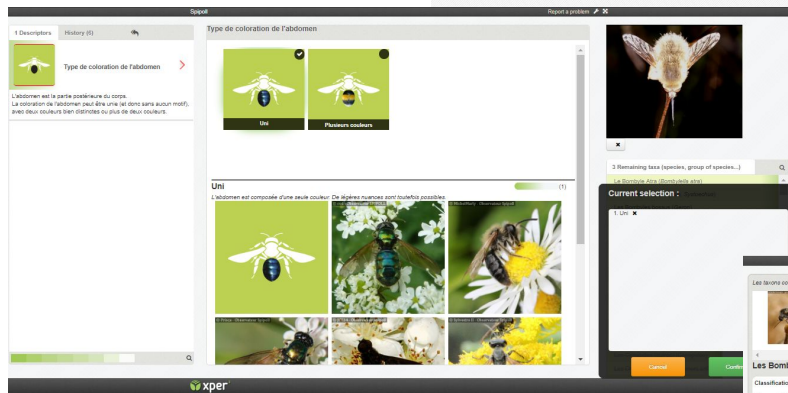
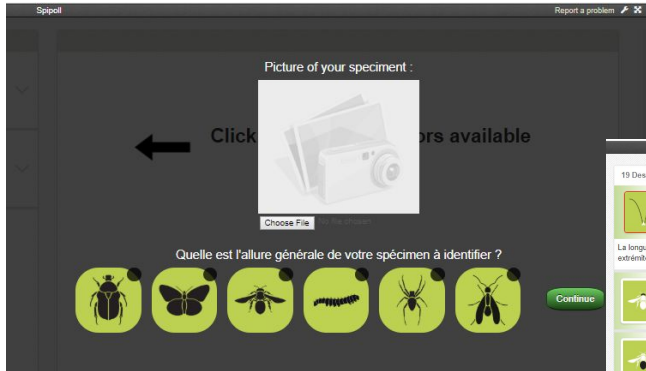
- L'Abeille Ceratina noire (*Ceratina cucurbitina*)
- L'Abeille coucou Epeloides (femelle) (*Epeoloides coecutiens*)
- L'Abeille mellifère (*Apis mellifera*)
- Les Abeilles à abdomen rouge (*Sphecodes et autres*)

Finish this identification

xper



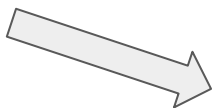
Spipoll: key demo online



Lichen GO!



ÉVALUEZ LA QUALITÉ DE L'AIR EN OBSERVANT LES LICHENS



Online free access key

5 Descriptors History (2)

Présence d'apothécies
Les apothécies sont des structures de reproduction sexuée des lichens, elles ont le plus souvent une forme de coupe, ou de disque dressée sur le thalle.

Oui (6)

Non (3)
Attention les apothécies peuvent être rares.

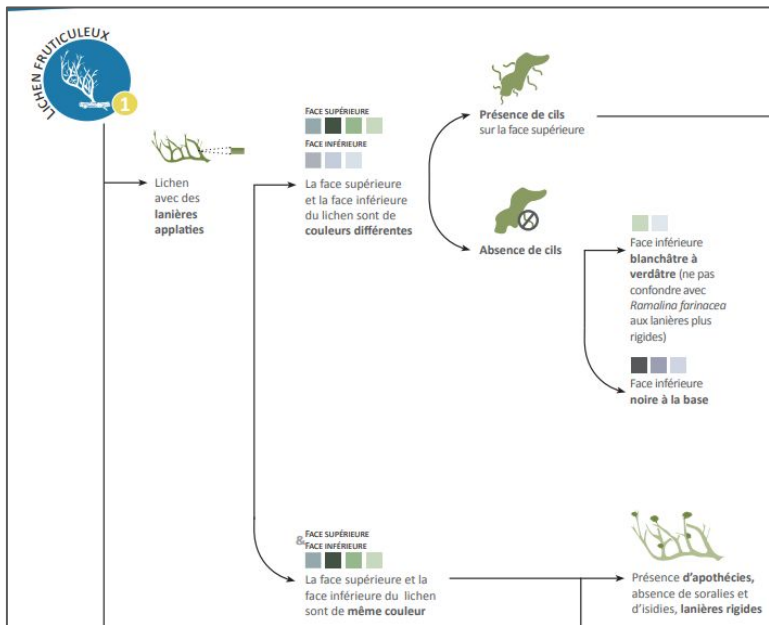
Présence d'isidies

6 Remaining taxa Among 37

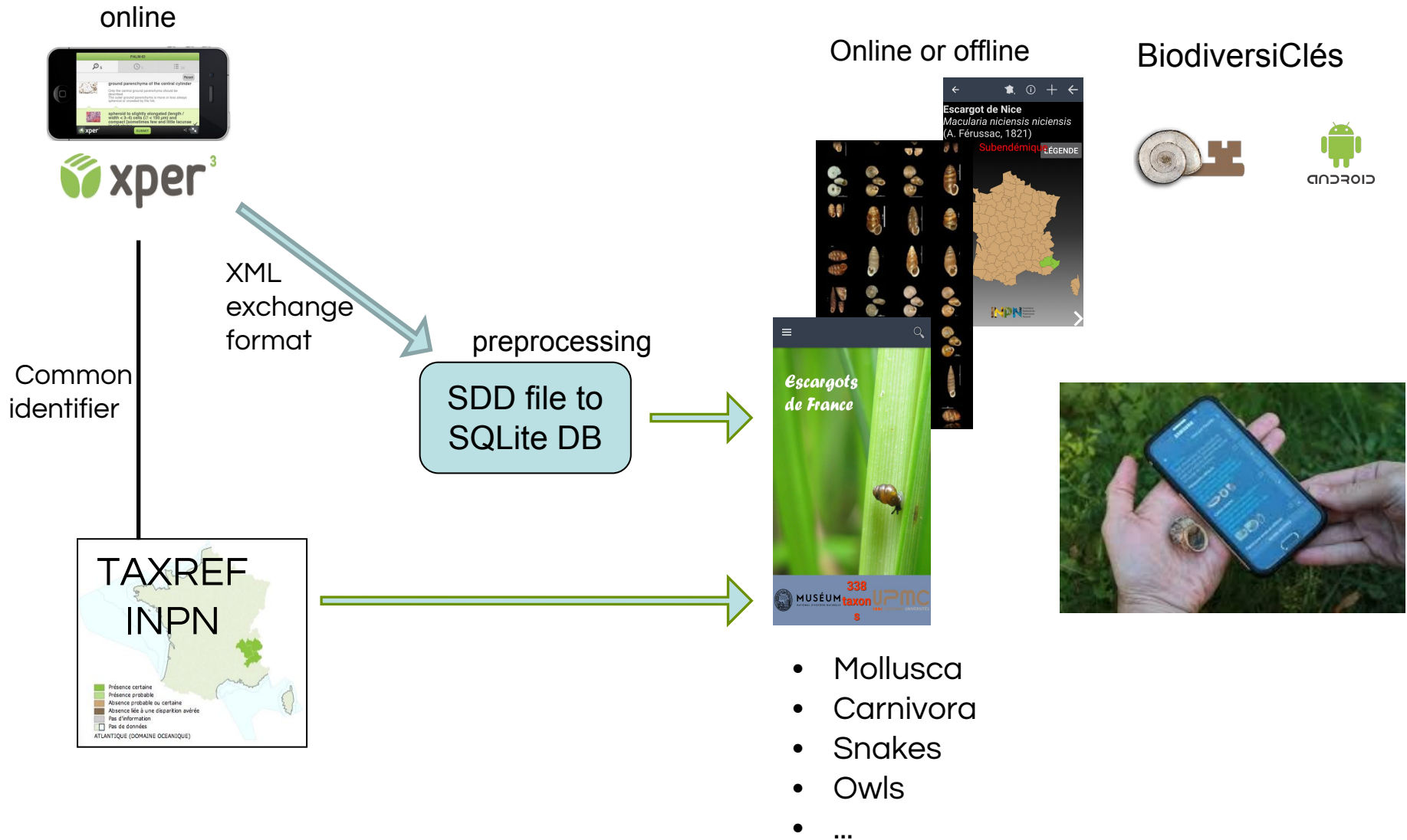
- Anaptychia ciliaris
- Evernia prunastri
- Pseudevernia furfuracea
- Ramalina fastigiata
- Ramalina fraxinea
- Ramalina farinacea
- Autre-lichen-fruticuleux-à-ramifications-cylindriques
- Usnea-sp.
- Lichen-crustacé-à-virgules
- Pertusaria-portusa
- Amandinea-punctata / Lecidella-elaeochroma
- Lecanora-sp.
- Lichen-crustacé-à-aspect-poudreux
- Diploicia-canescens

xper

Printed single access key



Mobile access in the field ...



Automatic method



Requête Contribuer Conseils

Ajouter / glisser une image ou ajouter une url

IDENTIFIER

Résultats

- Hydrangea spp.
Hydrangeaceae
- Hydrangea macrophylla (Thunb.) Ser.
Hydrangeaceae
Hortensia
- Hydrangea arborescens L.
Hydrangeaceae
- Viburnum opulus L.
Adonidaceae
Obier, Viorne aquatique

<https://hal.inria.fr/hal-01182775/document>

Interactive plant identification based on social image data

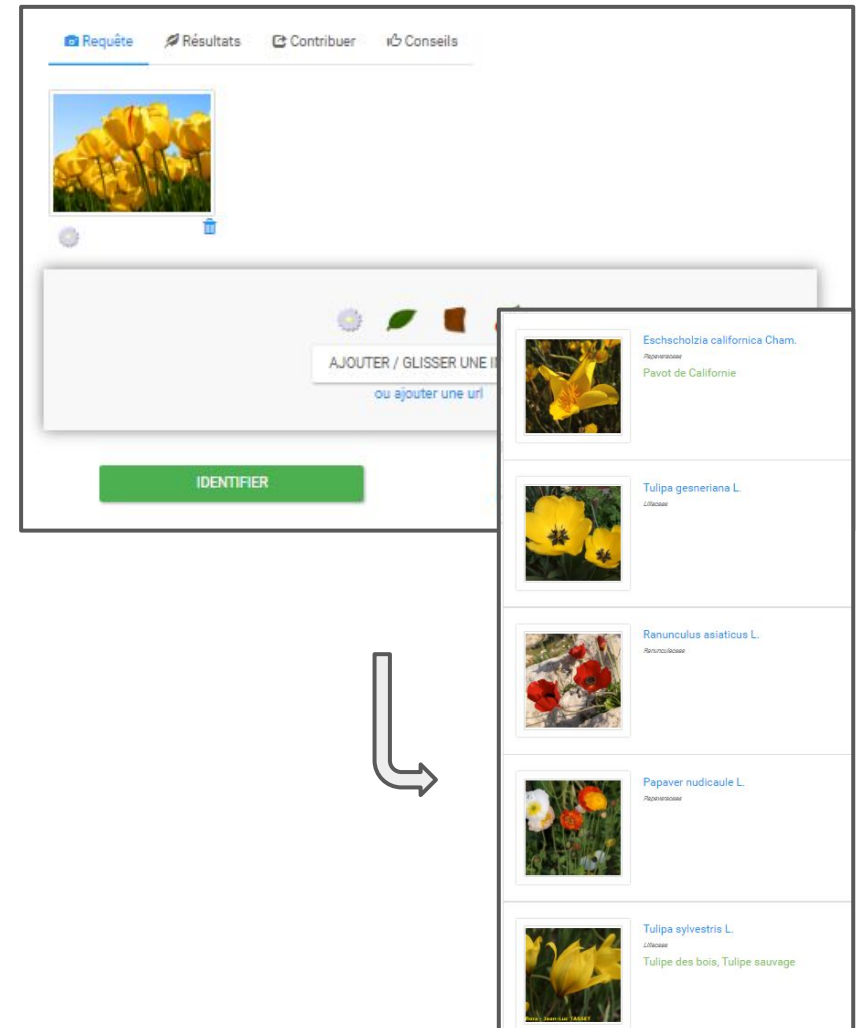
Alexis Joly ^a, Hervé Goëau ^a, Pierre Bonnet ^b, Vera Bakić ^a, Julien Barbe ^c, Souheil Selmi ^a, Itheri Yahiaoui ^d, Jennifer Carré ^e, Elise Mouysset ^e, Jean-François Molino ^f, Nozha Boujemaa ^g, Daniel Barthélémy ^h

Show more

<https://doi.org/10.1016/j.ecoinf.2013.07.006>

Get rights and content

Automatic method



Based on neural networks

Large training sets

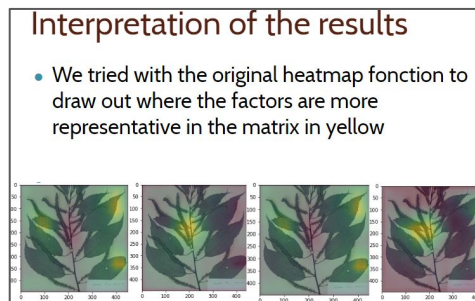
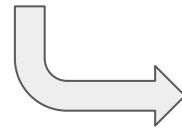
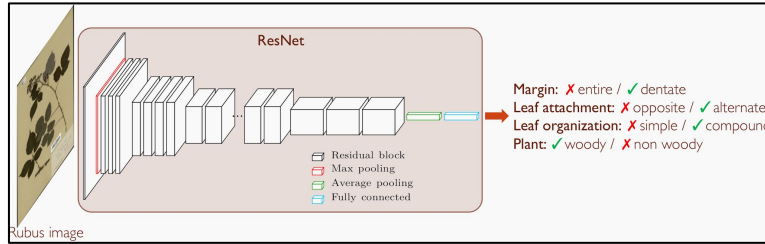
Take care to select the appropriate DB

Look at several results

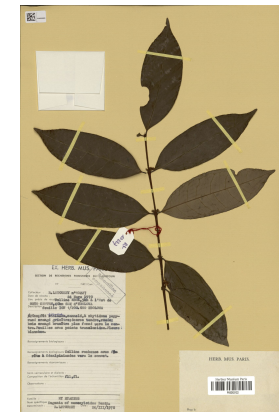
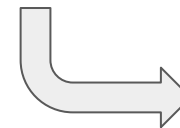
Deep learning to recognize character states

MNHN herbarium, Paris

10 millions specimens



Simple leaf
Opposite phyllotaxy
Smooth border



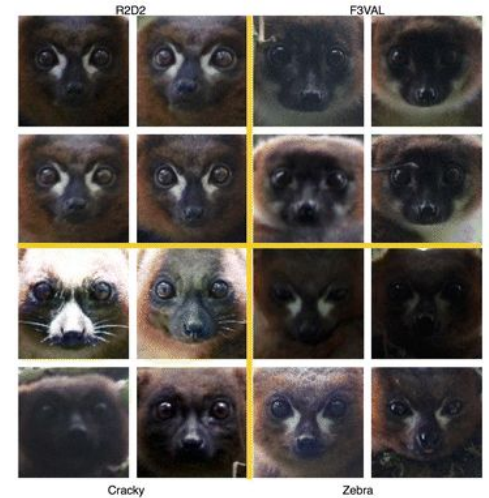
(Stage Yue Zhu,
Ecole Polytechnique, 2017)
Encadrement du LIP6, SU.
Présenté à TDWG 2017.

Deep learning & biodiversity

Many applications specially on images and sounds at species level, and individual level

Deep learning with neural network:

- necessity to have a very **large set of images for training** the network
- the identification method gives a result but **no explanation**

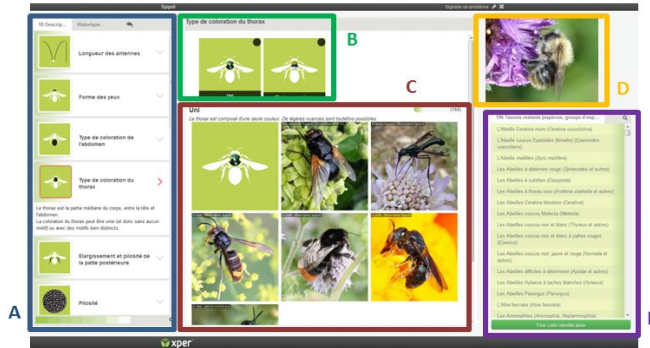


Interesting in monitoring survey, epidemiological survey, camera trap, satellite images ...

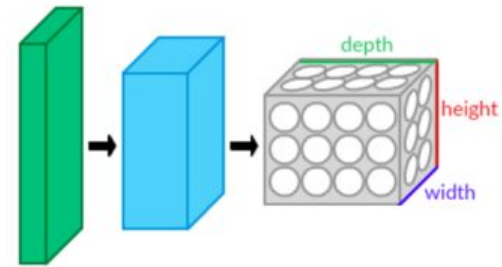
But few interest at the moment for learning observation of nature
And how to recognize.



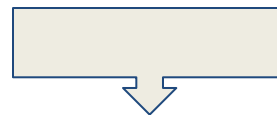
Human versus automatic process



- Learn terminology of the domain
- Analytic process
- Active observation by human
- Explanation of the identification, why it is not another species



- No verbal description
- Synthetic, global approach
- Automatic,
- Statistical method
- No explanation



How to combine?

Combining human and automatic process

For identification:

Automatic **filter** to restrict identification key to possible taxa (GPS, season, picture recognition)

Backoffice automatic process to check user answer on character states, to propose **advise**, to pop up alert if there is a high probability of misobservation of a character, or miidentification of the species

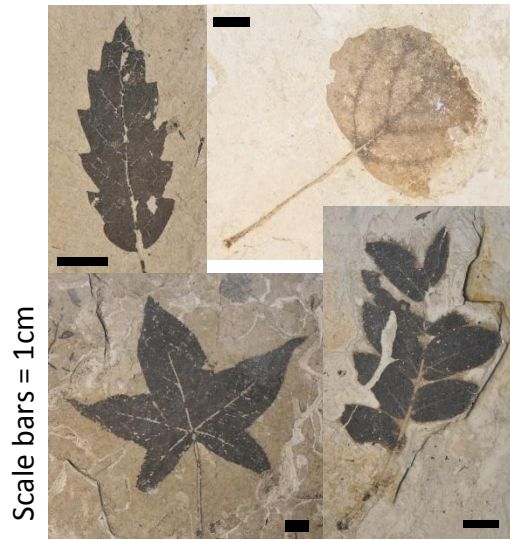
To create **Databases** for identification:

Bottleneck of the human production of structured databases

Applying **text mining** to speed up the data harvesting

Teaching applications and knowledge transfer to the public

- ◆ Teaching unit (Sorbonne University) : Biodiversity and paleobiodiversity (3ECTS)
Leaves identification & co-existence approach



Scale bars = 1cm



Quercus sp.



Populus sp.

Sorbus sp.

Acer sp.

Saint Bazile,
France, Miocene

Mean
Annual
Temperature

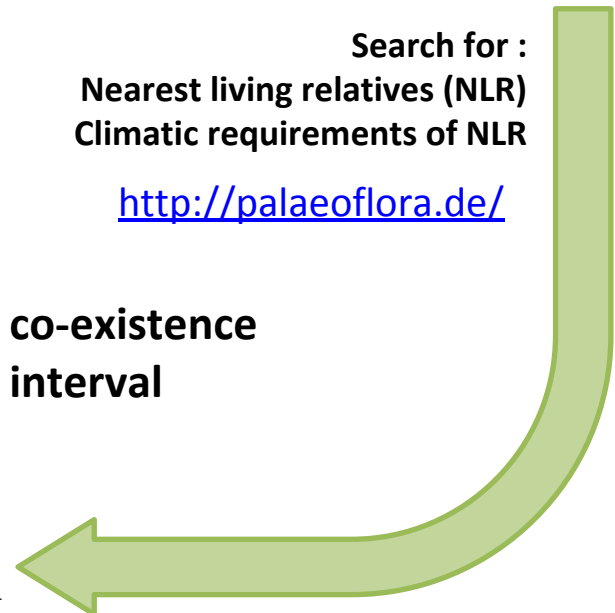
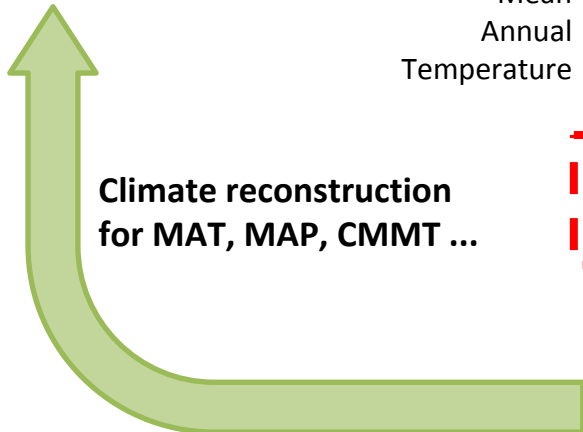
Climate reconstruction
for MAT, MAP, CMMT ...

Populus tremula
Quercus cerris
Acer sp.
Sorbus aucuparia

Search for :
Nearest living relatives (NLR)
Climatic requirements of NLR

<http://palaeoflora.de/>

co-existence
interval



Thank you for your attention

