



# Etudier et prendre soin des bousiers 12 ans de travaux pour leur conservation

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JR PROF. CAMILA LEANDRO

UNIVERSITÉ DE MONTPELLIER – CENTRE D'ÉCOLOGIE FONCTIONNELLE ET EVOLUTIVE

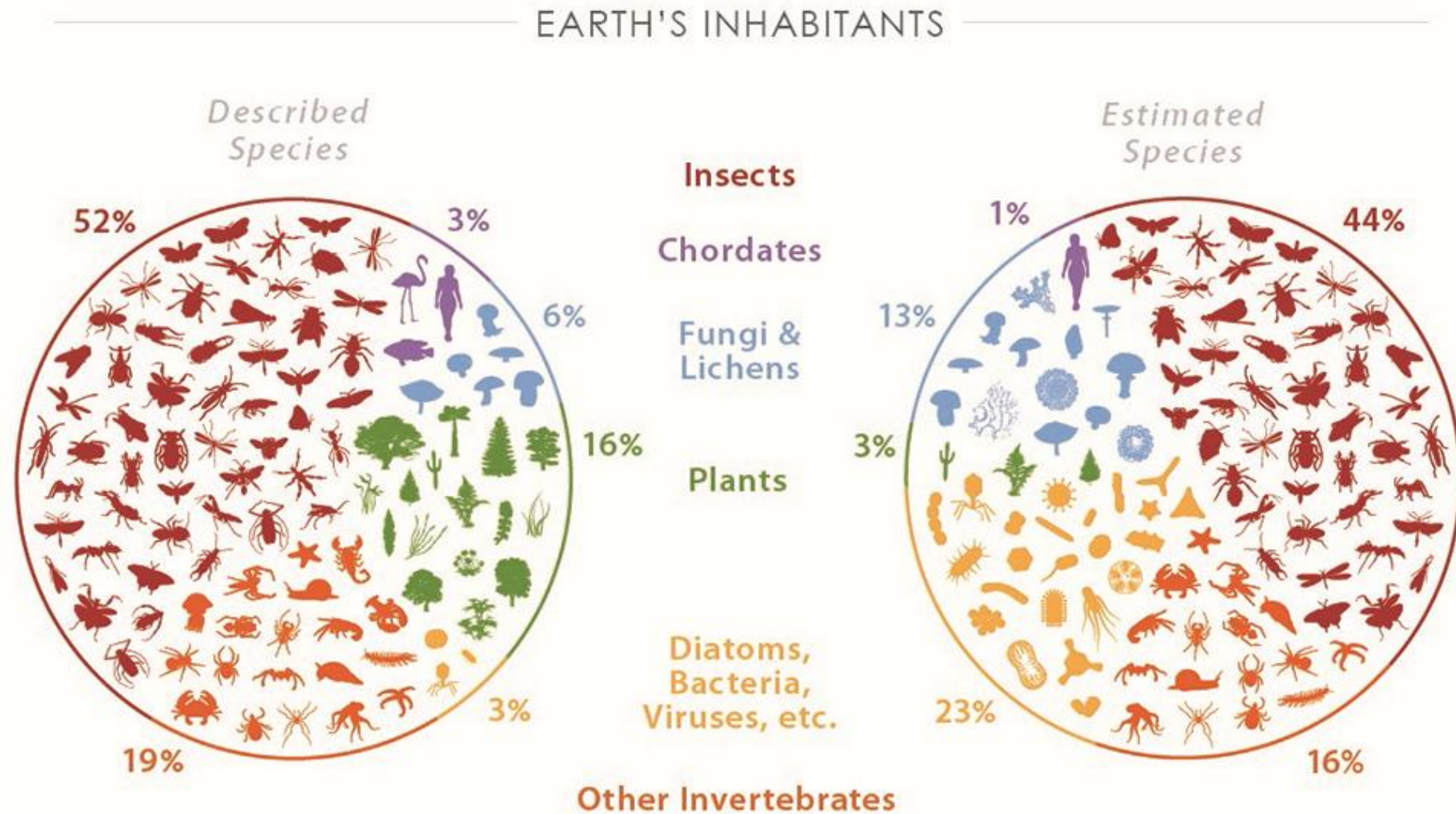
CO-CHAIR OF THE DUNG BEETLE SPECIALIST GROUP (SSC-IUCN)



UMR 5175  
CENTRE D'ÉCOLOGIE  
FONCTIONNELLE  
& EVOLUTIVE

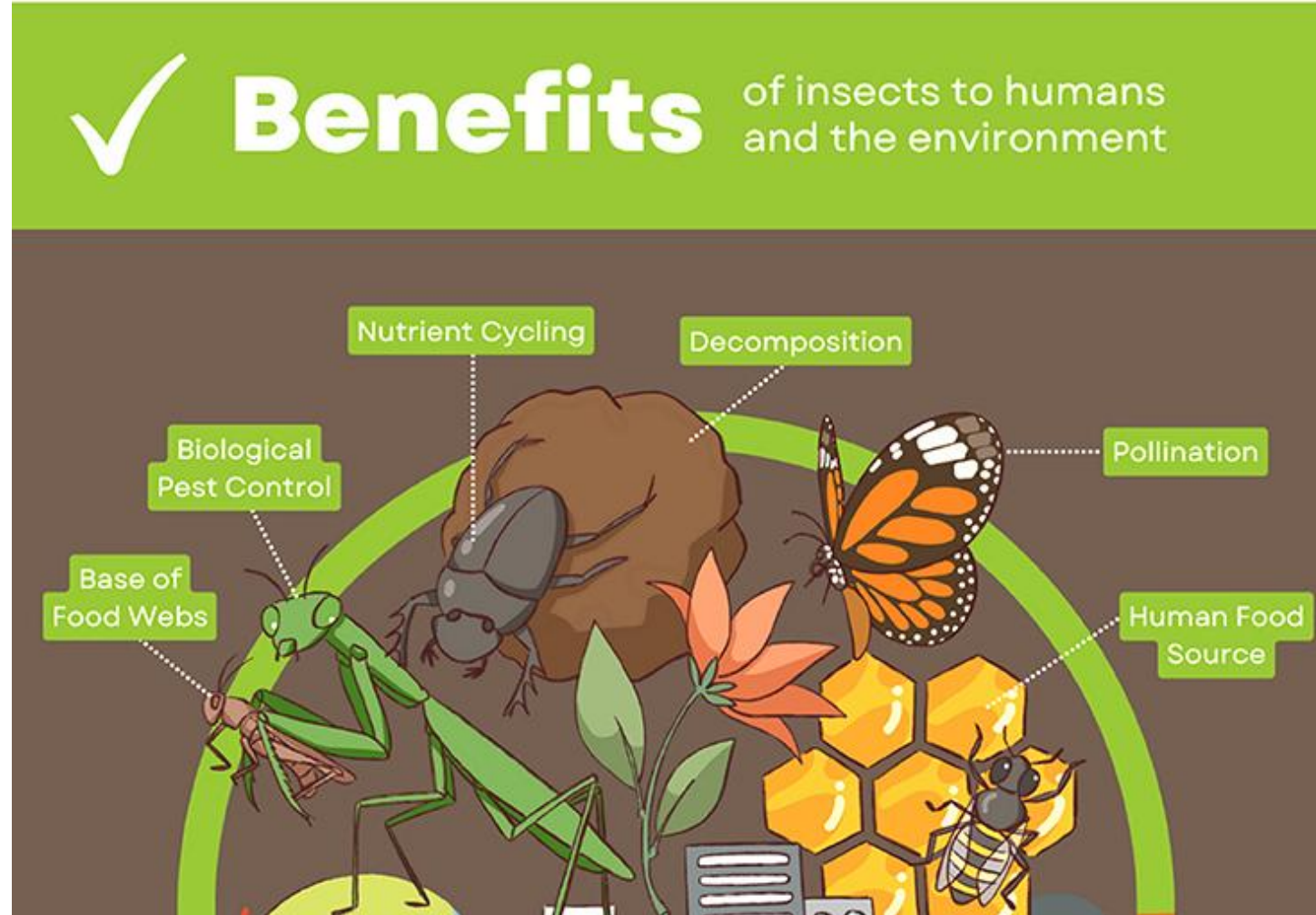
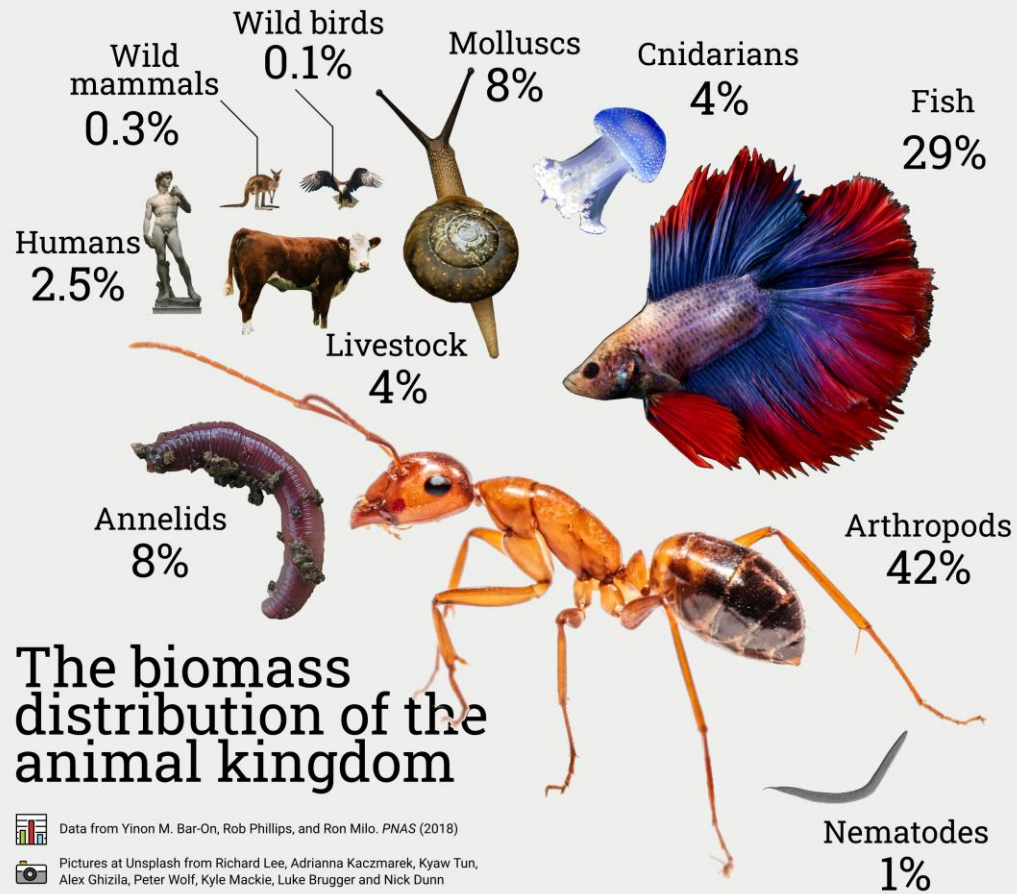
**DUNG  
BEETLE**  
IUCN SSC SPECIALIST GROUP

# I. Des insectes, partout !



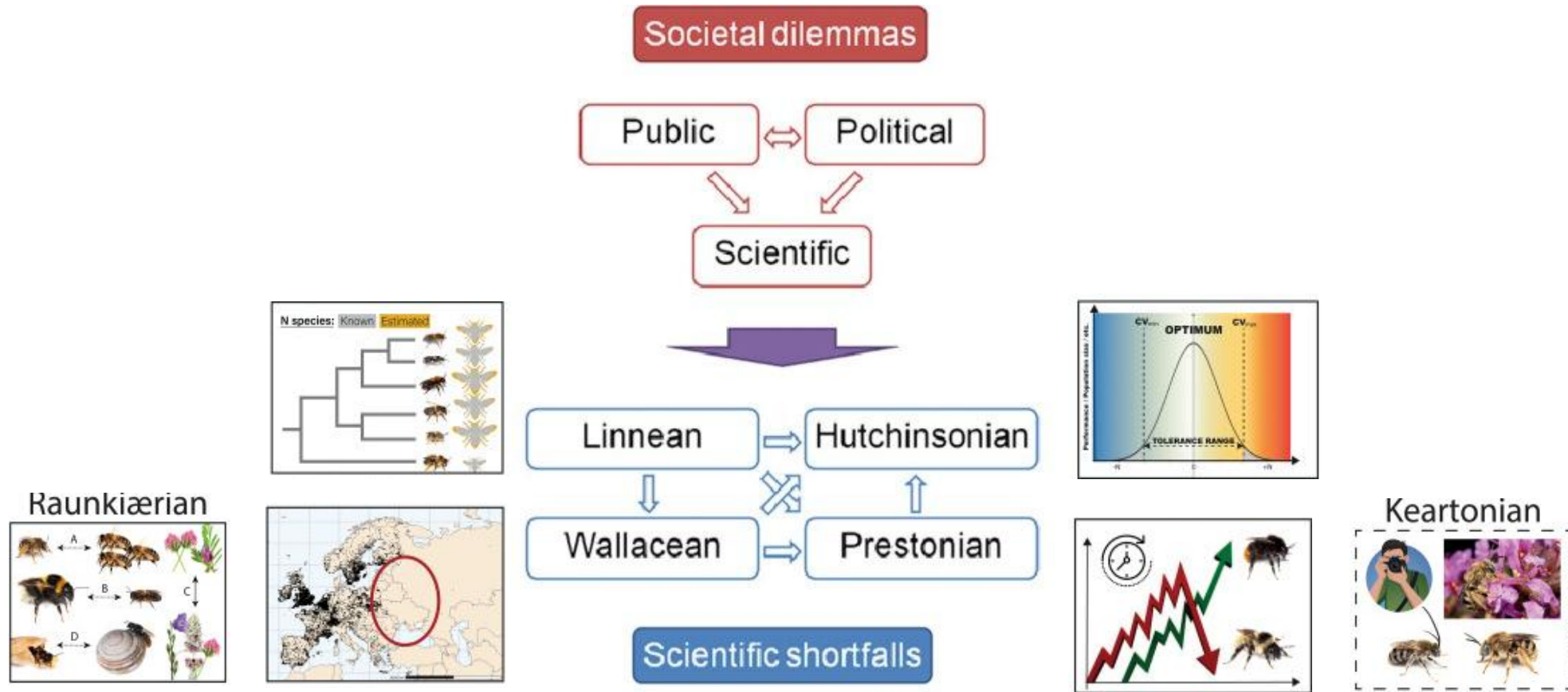
Data: Chapman 2009  
Art: Cara Gibson 2015

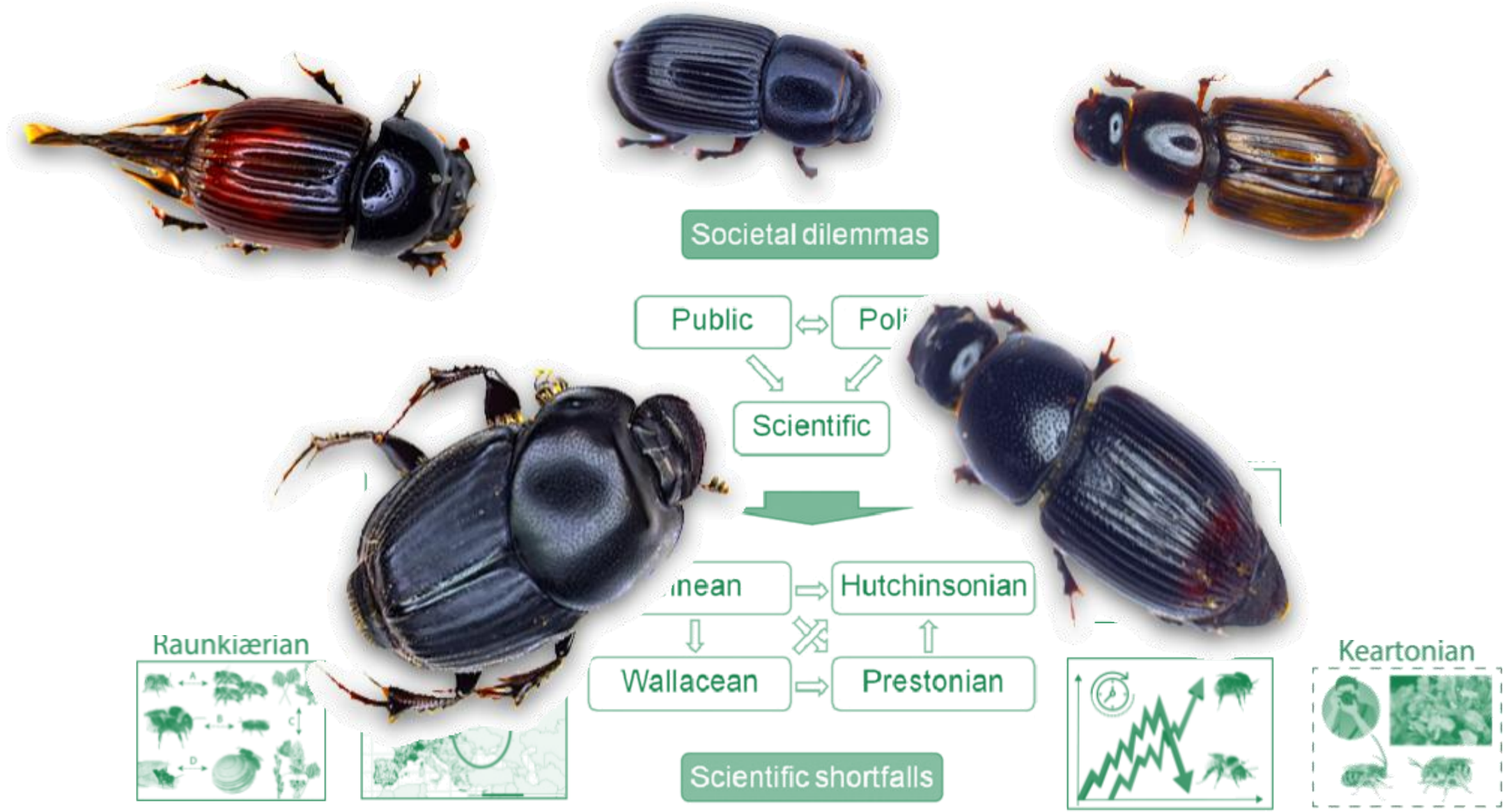
# I. Des insectes, partout !



# I. Des insectes, partout ! Mais...

Les sept obstacles à la conservation des invertébrés  
et leurs liens respectifs (Cardoso et al. 2011)





Une équipe qui travaille dessus à Montpellier !



JAY-ROBERT Pierre



PERRIN William



LEANDRO Camila



JOLY Cloé



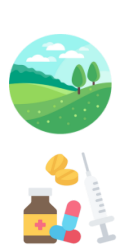
BERTRAND Mélanie



BRAND Matthias



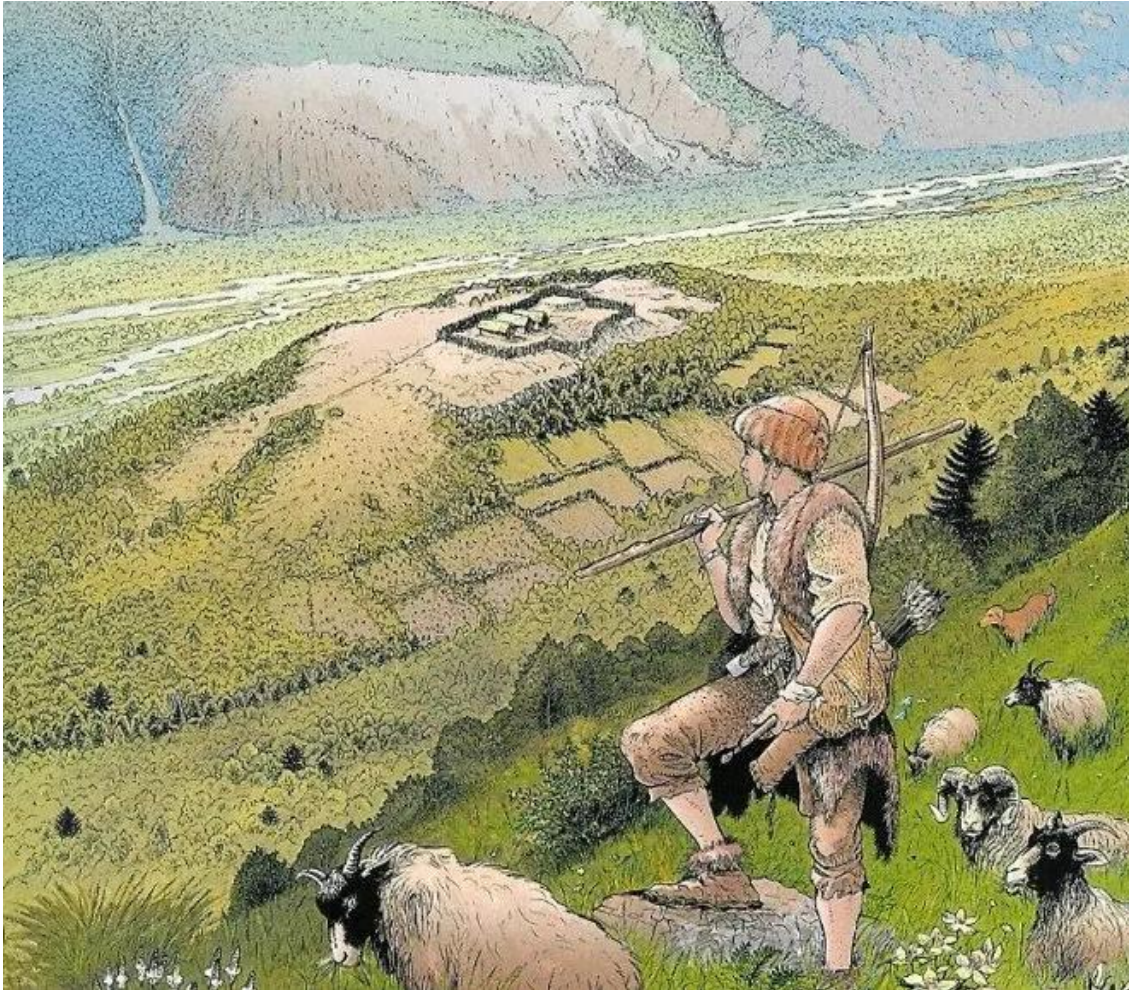
LARQUIER Corentin



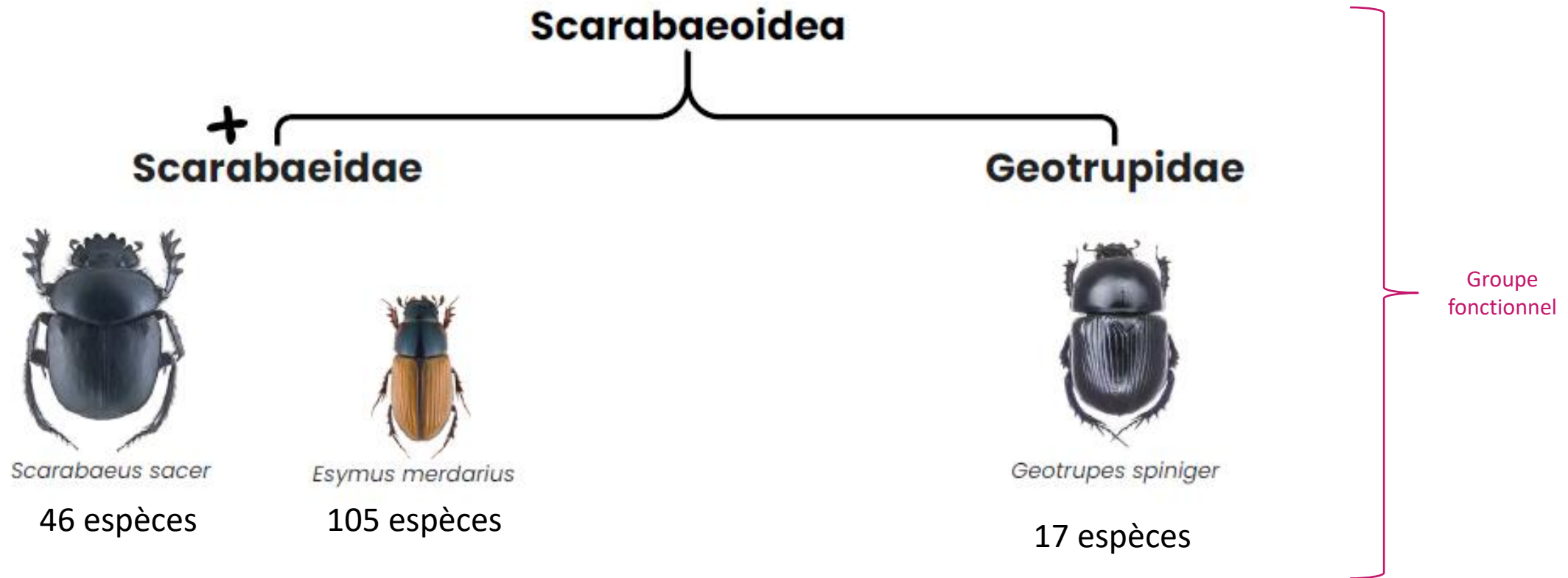
*Et bien d'autres stagiaires, collaborateurs et partenaires, d'hier et d'aujourd'hui !*



# 1. Les bousiers de France



# 1. Les bousiers de France



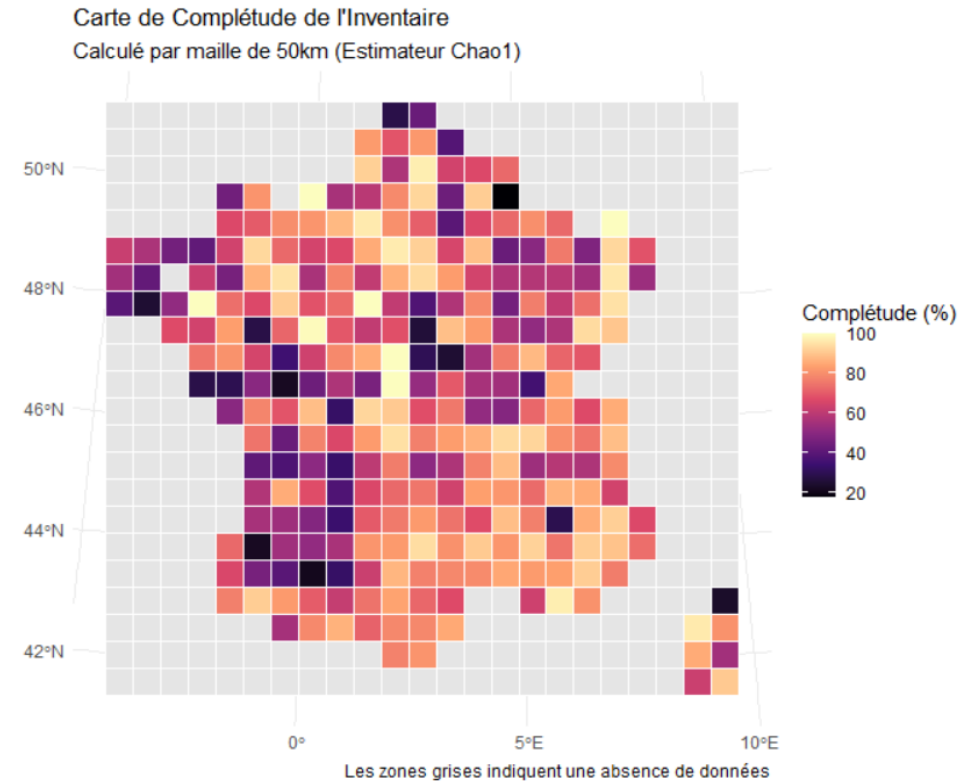
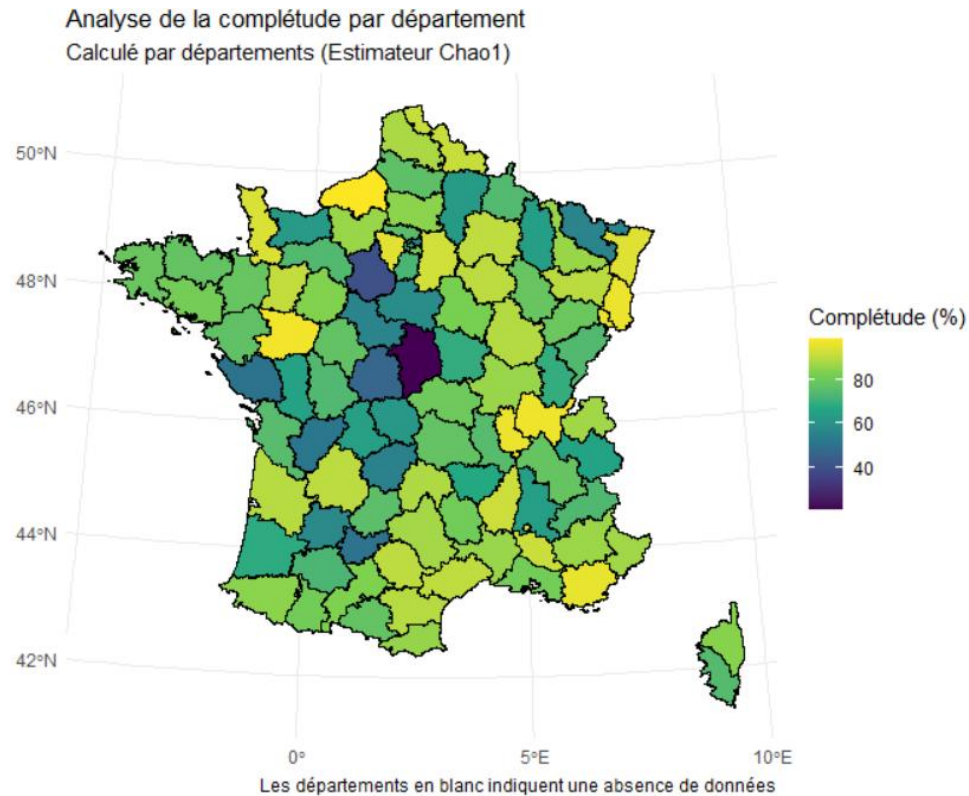
Des Aurochs aux ongulés domestiques <https://www.inrap.fr/les-premieres-productions-laitieres-neolithiques-en-europe-atlantique-15030>

# 1. Les bousiers de France



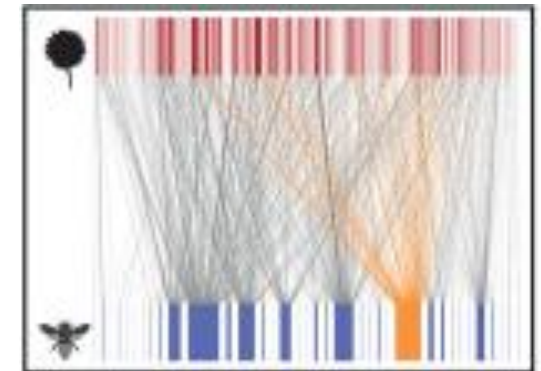
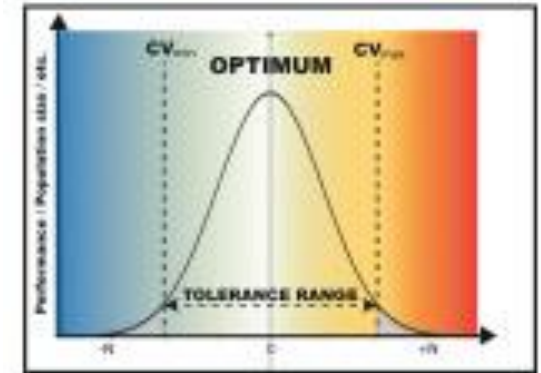
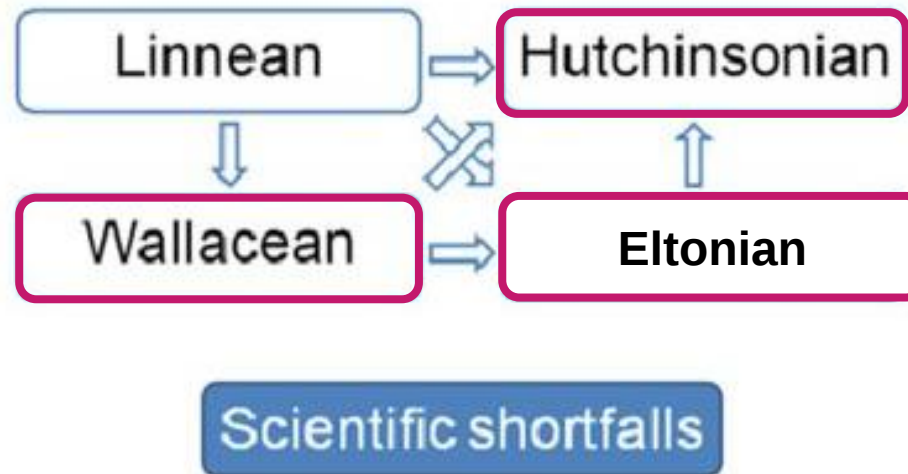
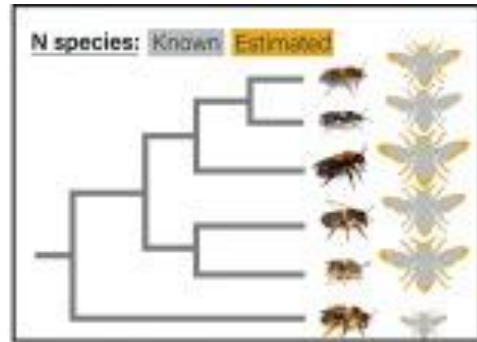
48 h après – recyclage à 95 % (Roussières, 34)

# 1. Les bousiers de France

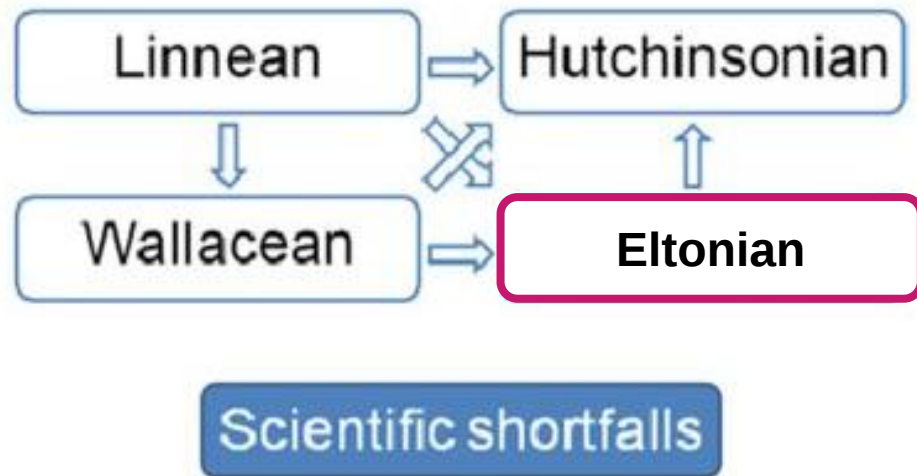


Travail en cours – stage A. Bourgery

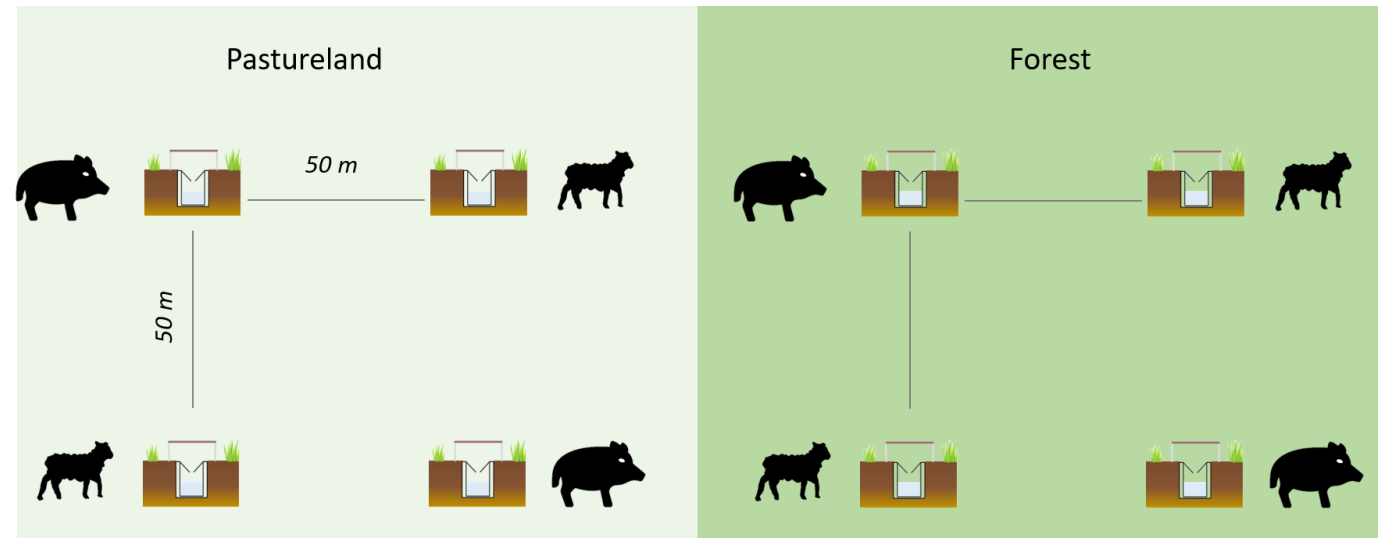
## 2. S'attaquer à (certaines) des lacunes



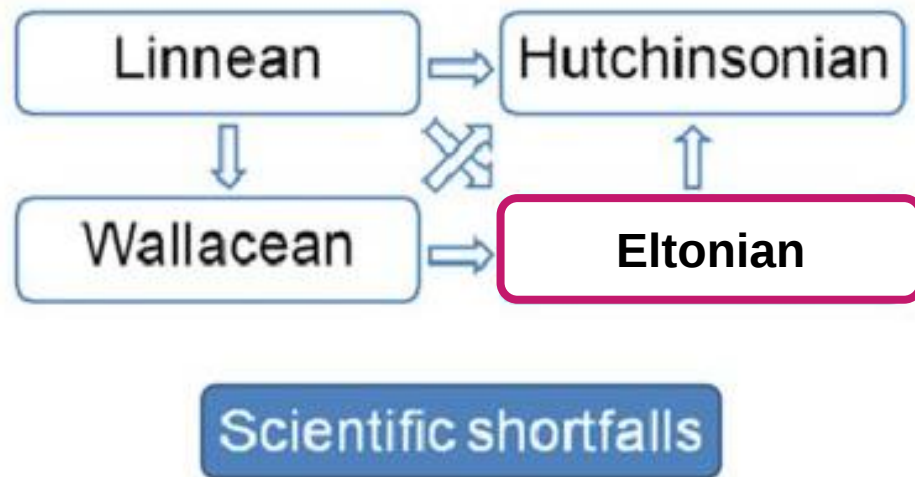
## 2. S'attaquer à (certaines) des lacunes



M. Bertrand



## 2. S'attaquer à (certaines) des lacunes



Kilian PREVOST

### UN BOUSIER SOUS MON CHAPEAU ?

Votre trouvaille mycologique fini par la rageante observation d'un scarabée mangeant grassement votre champignon ? Rien n'est perdu ! Votre observation est précieuse pour un groupe de chercheurs travaillant sur l'interaction entre bousiers géotrupes et champignons !

Envoyez à [scarab.obs@gmail.com](mailto:scarab.obs@gmail.com) votre photo de Scarabée avec la localisation de l'observation et le nom et photo du champignon consommé.



Voici quelques guides pour prendre votre photo :

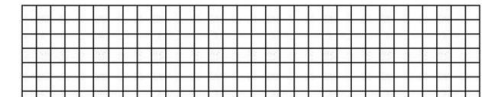
- Active les modes HDR ou macro si vous les avez ;
- Orientez le smartphone à la verticale au-dessus de l'insecte. Celui-ci peut être tenu par les pattes arrière ;
- Approchez lentement jusqu'à ce que l'image soit nette ;
- Touchez l'écran pour faire la mise au point sur l'insecte.
- Assurez-vous que : 1) l'insecte est entièrement visible, 2) le quadrillage est bien perpendiculaire et 3) l'image est lumineuse et nette ;
- Prenez plusieurs photos, au cas où certaines seraient floues ;
- Recommencez pour avoir le côté dorsal ou ventral !
- Si l'insecte est vivant, relâchez-le délicatement.

Identifier des géotrupes, c'est possible aussi ->

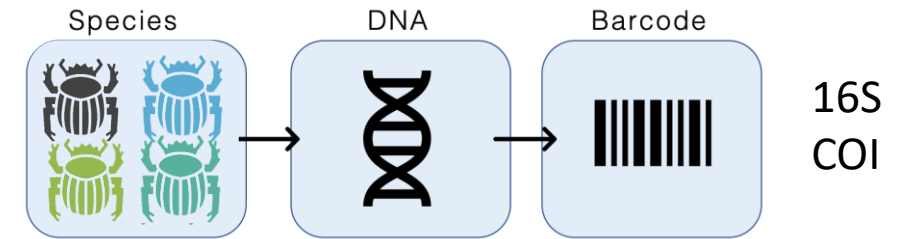
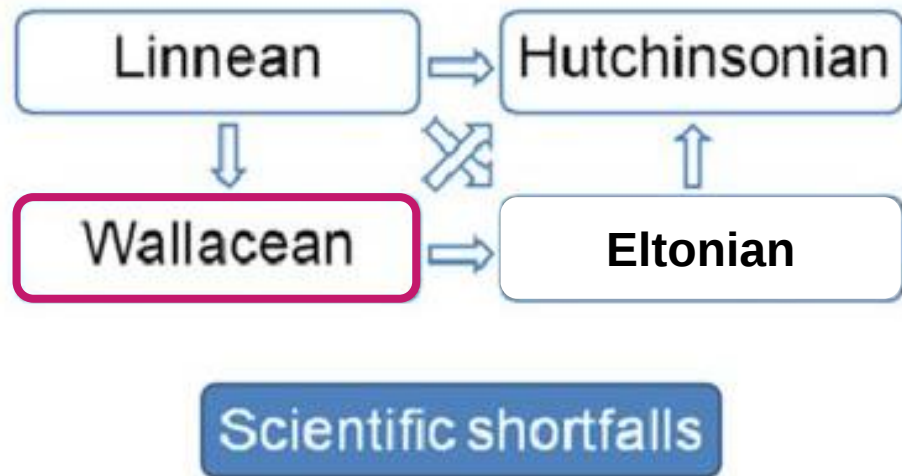


Scarab-obs.fr

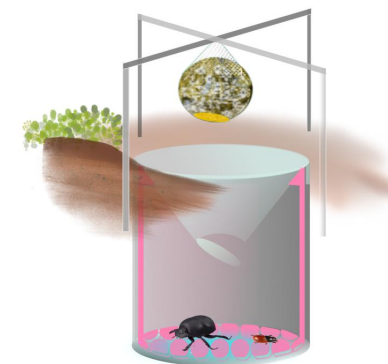
GRILLE UTILISABLE POUR VOS PHOTOS



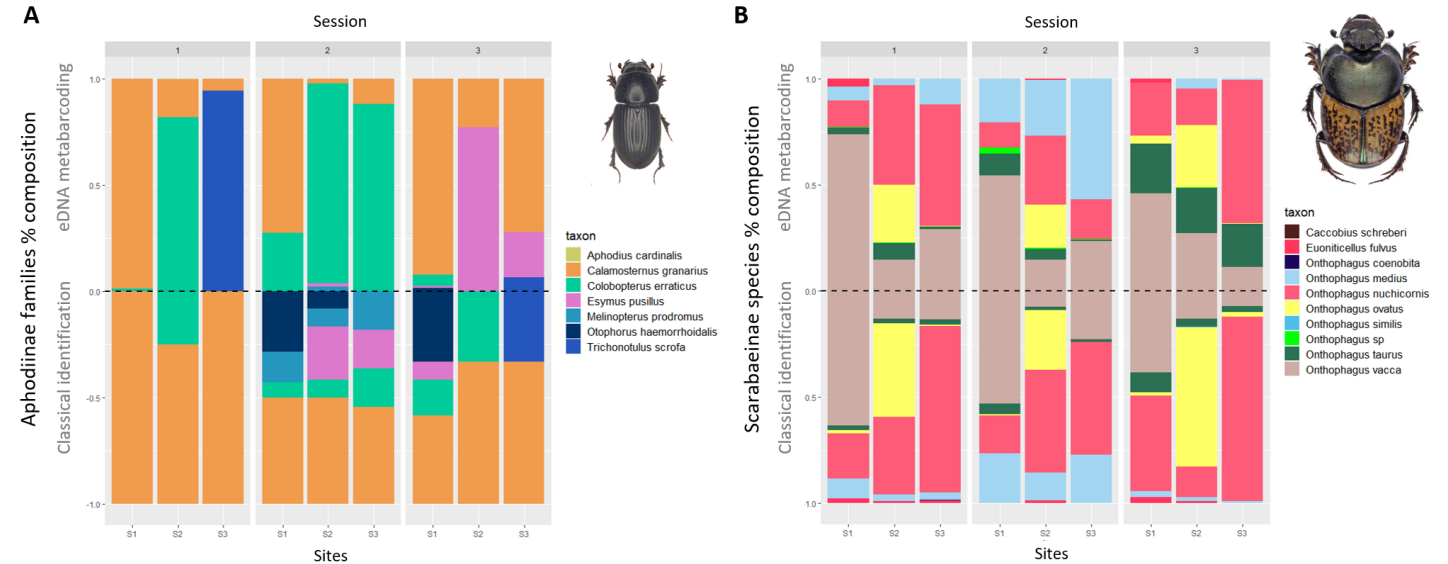
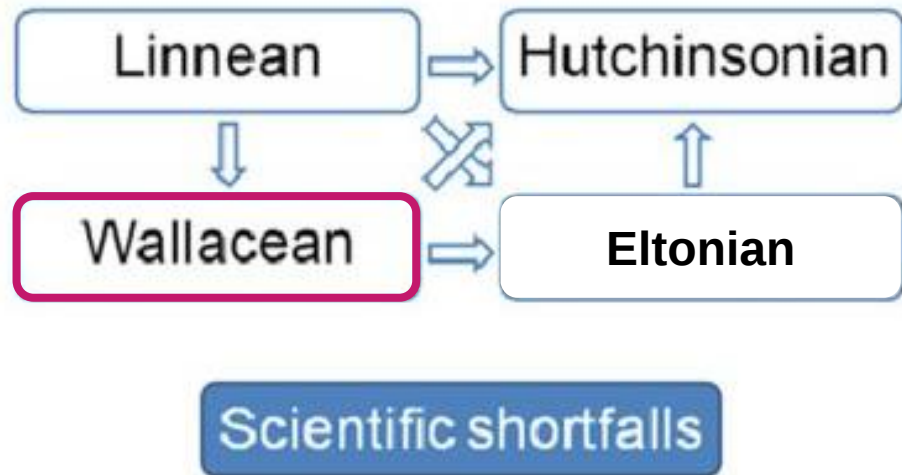
## 2. S'attaquer à (certaines) des lacunes



eDNA Monitoring result  
vs visual result (CSR)



## 2. S'attaquer à (certaines) des lacunes



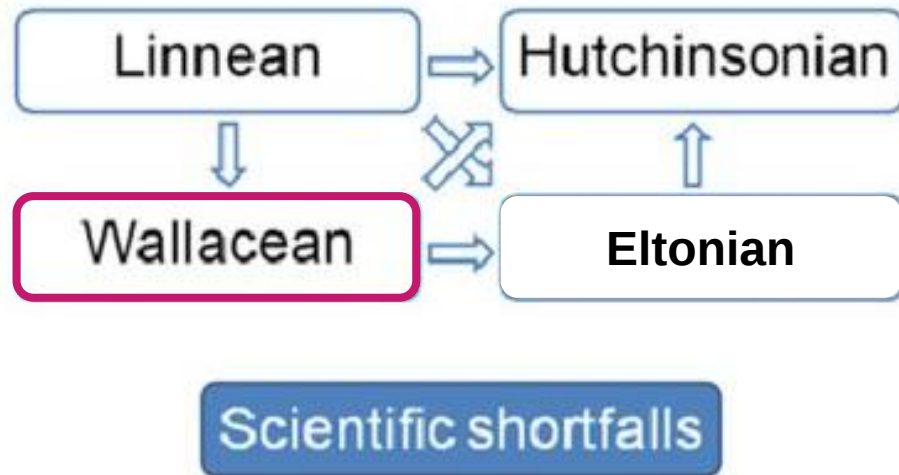
Bon taux d'identification

Corrélation entre l'abondance de l'ADN environnemental et le rang d'abondance des individus

*Leandro et al., 2021 (Journal of Insect Conservation)*

*Leandro et al., 2025 (Entomologia Experimentalis et Applicata)*

## 2. S'attaquer à (certaines) des lacunes



I. PRÉSENTATION DU MATÉRIEL

8:43

TUTORIEL ADN  
ENVIRONNEMENTALE 1/2 :...

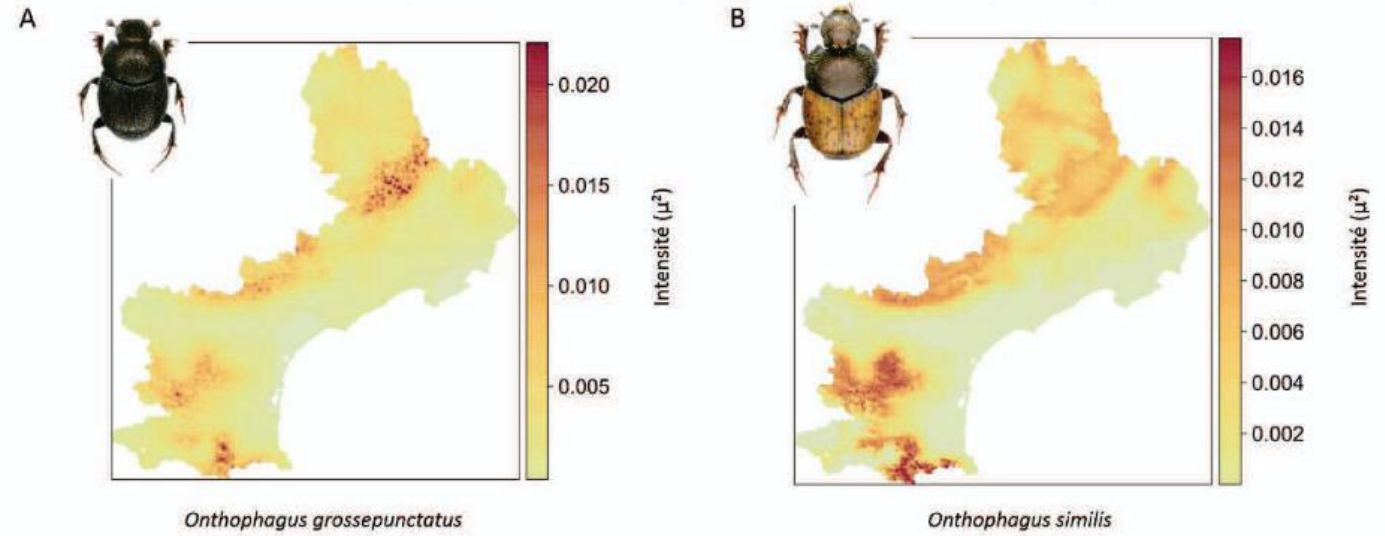
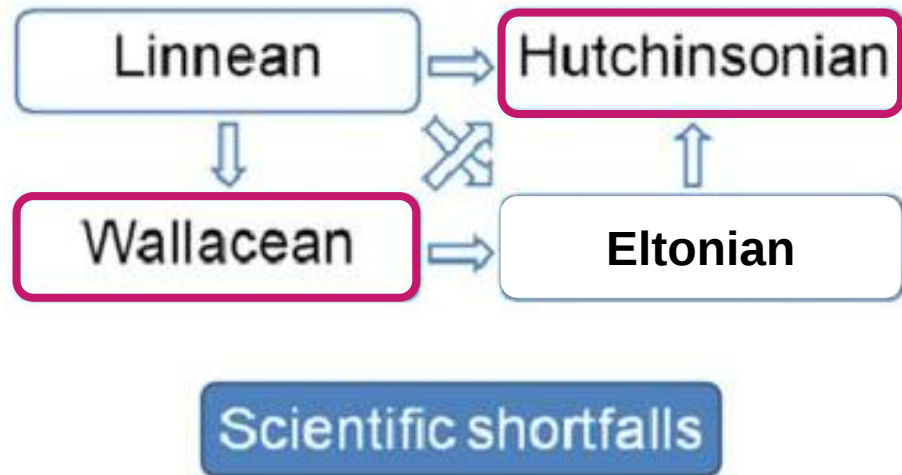
II. DÉMONSTRATION DE L'UTILISATION  
DU PIÈGE NDC SUR LE TERRAIN

10:05

TUTORIEL ADN  
ENVIRONNEMENTALE 2/2 :...



## 2. S'attaquer à (certaines) des lacunes



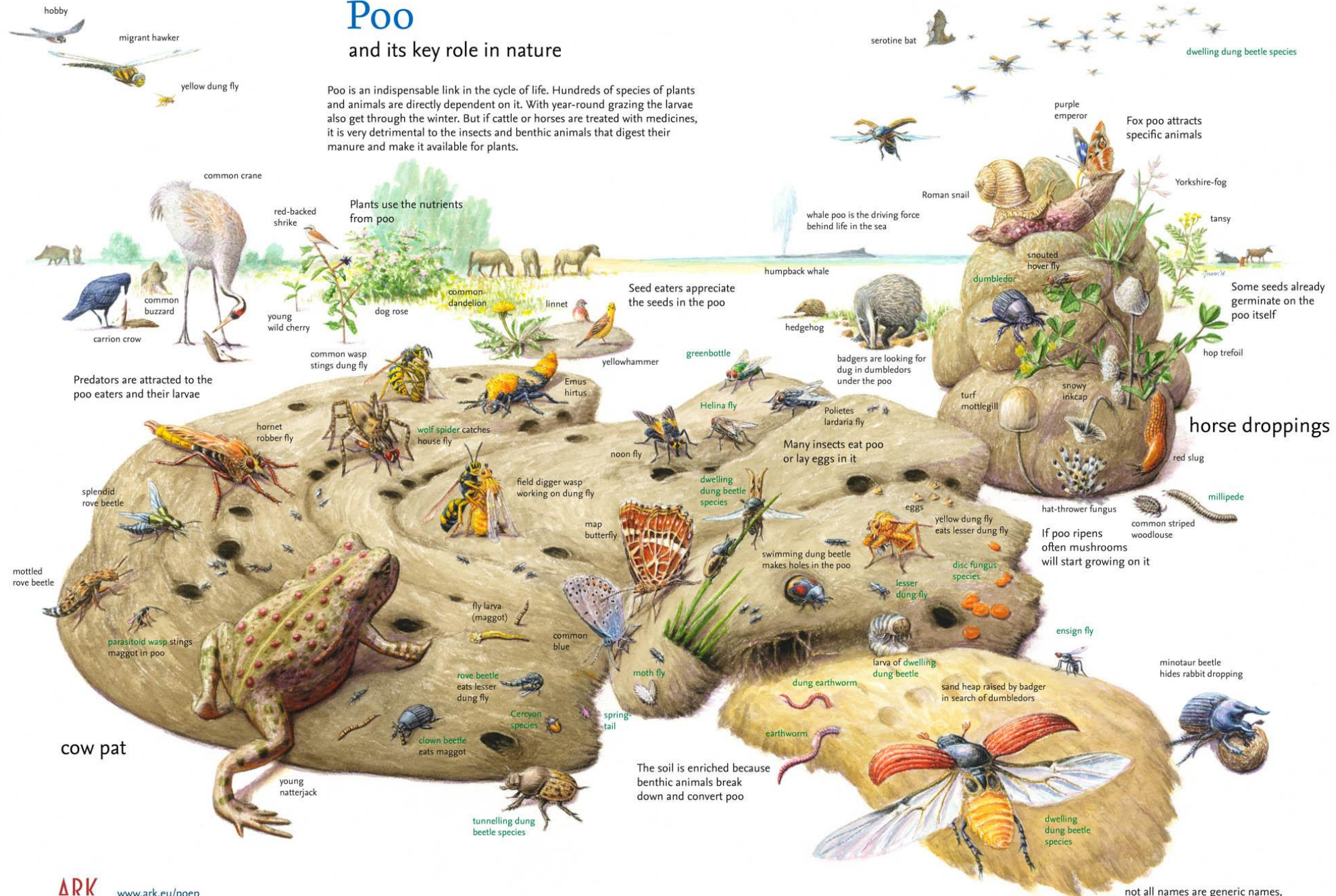
Répartition potentielle de deux espèces d'*Onthophagus* dans une région française (Languedoc-Roussillon) – PPM

*Leandro 2018 (phD Manuscript)*

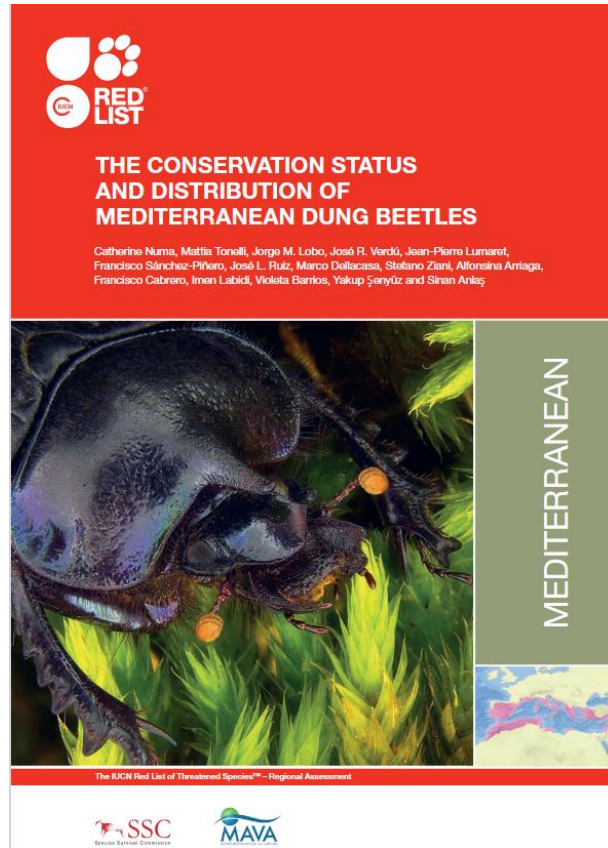
# Poo

## and its key role in nature

Poo is an indispensable link in the cycle of life. Hundreds of species of plants and animals are directly dependent on it. With year-round grazing the larvae also get through the winter. But if cattle or horses are treated with medicines, it is very detrimental to the insects and benthic animals that digest their manure and make it available for plants.



# 1. Menaces sur les bousiers de France



|              |              |                                    |                       |    |
|--------------|--------------|------------------------------------|-----------------------|----|
| Geotrupidae  | Geotrupinae  | <i>Jekelius chersinus</i>          | (Delabie, 1954)       | EN |
| Geotrupidae  | Geotrupinae  | <i>Jekelius hernandezi</i>         | (López-Colón, 1988)   | EN |
| Geotrupidae  | Geotrupinae  | <i>Jekelius hispanus</i>           | (Reitter, 1892)       | EN |
| Geotrupidae  | Geotrupinae  | <i>Jekelius punctatolineatus</i>   | (François, 1904)      | EN |
| Geotrupidae  | Geotrupinae  | <i>Jekelius sardous</i>            | (Erichson, 1847)      | EN |
| Geotrupidae  | Geotrupinae  | <i>Renaudtrupes distinctus</i>     | (Marseul, 1878)       | EN |
| Geotrupidae  | Geotrupinae  | <i>Silphotrupes punctatissimus</i> | (Chevrolat, 1840)     | EN |
| Geotrupidae  | Geotrupinae  | <i>Thorectes baraudi</i>           | López-Colón, 1981     | EN |
| Geotrupidae  | Geotrupinae  | <i>Thorectes coiffaiti</i>         | Baraud, 1969          | EN |
| Geotrupidae  | Geotrupinae  | <i>Thorectes puncticollis</i>      | Lucas, 1846           | EN |
| Geotrupidae  | Geotrupinae  | <i>Thorectes variolipennis</i>     | Marseul, 1876         | EN |
| Scarabaeidae | Aphodiinae   | <i>Ahermodontus ambrosi</i>        | (Pardo Alcaide, 1936) | EN |
| Scarabaeidae | Aphodiinae   | <i>Heptaulacus gadetinus</i>       | Baraud, 1973          | EN |
| Scarabaeidae | Aphodiinae   | <i>Nimbus anyerae</i>              | (Ruiz, 1998)          | EN |
| Geotrupidae  | Geotrupinae  | <i>Thorectes valencianus</i>       | (Baraud, 1966)        | VU |
| Scarabaeidae | Scarabaeinae | <i>Ateuchetus semipunctatus</i>    | (Fabricius, 1792)     | VU |
| Scarabaeidae | Scarabaeinae | <i>Onthophagus albarracinus</i>    | Baraud, 1979          | VU |

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| Geotrupidae  | Geotrupinae  | <i>Renaudtrupes distinctus</i>     | (Marseul, 1878)       | EN |
| Geotrupidae  | Geotrupinae  | <i>Silphotrupes punctatissimus</i> | (Chevrolat, 1840)     | EN |
| Geotrupidae  | Geotrupinae  | <i>Thorectes baraudi</i>           | López-Colón, 1981     | EN |
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CR

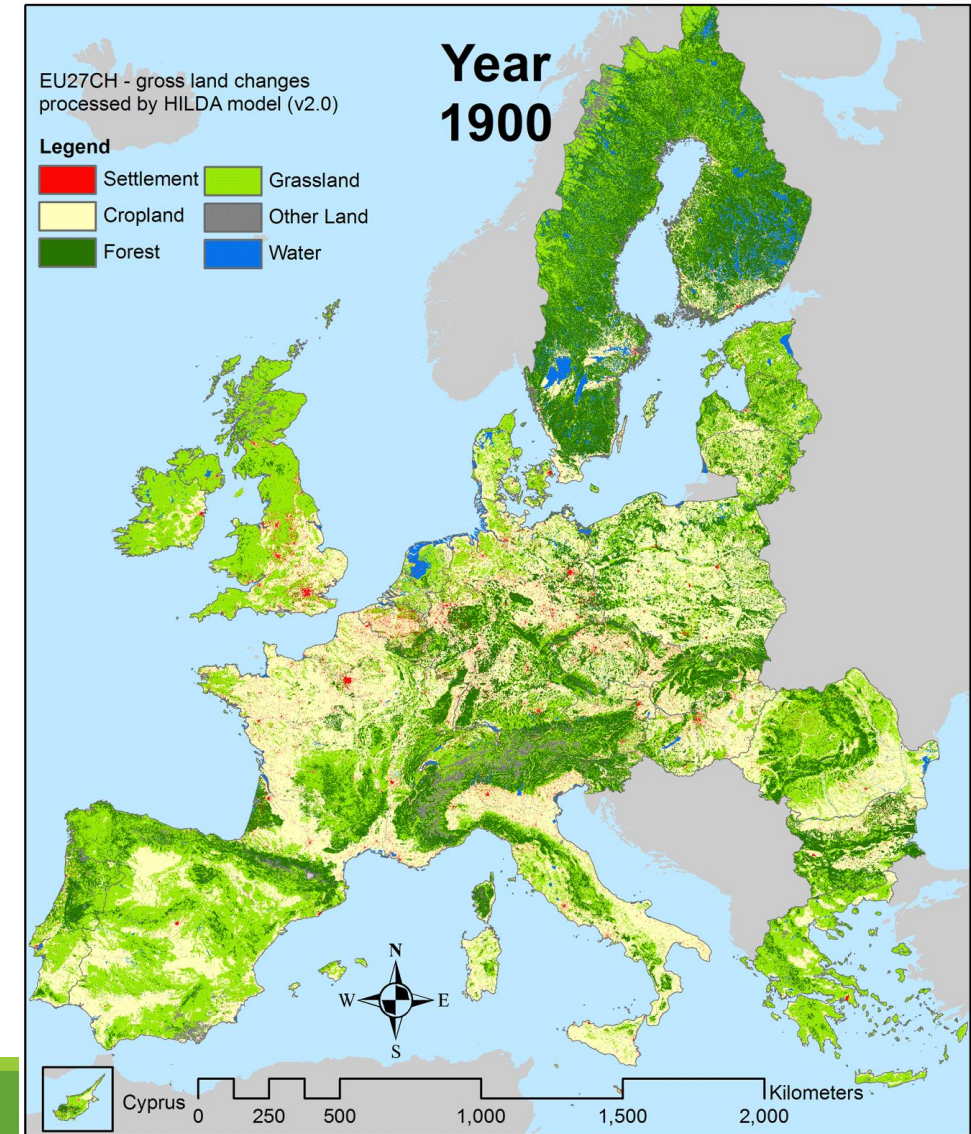
CR

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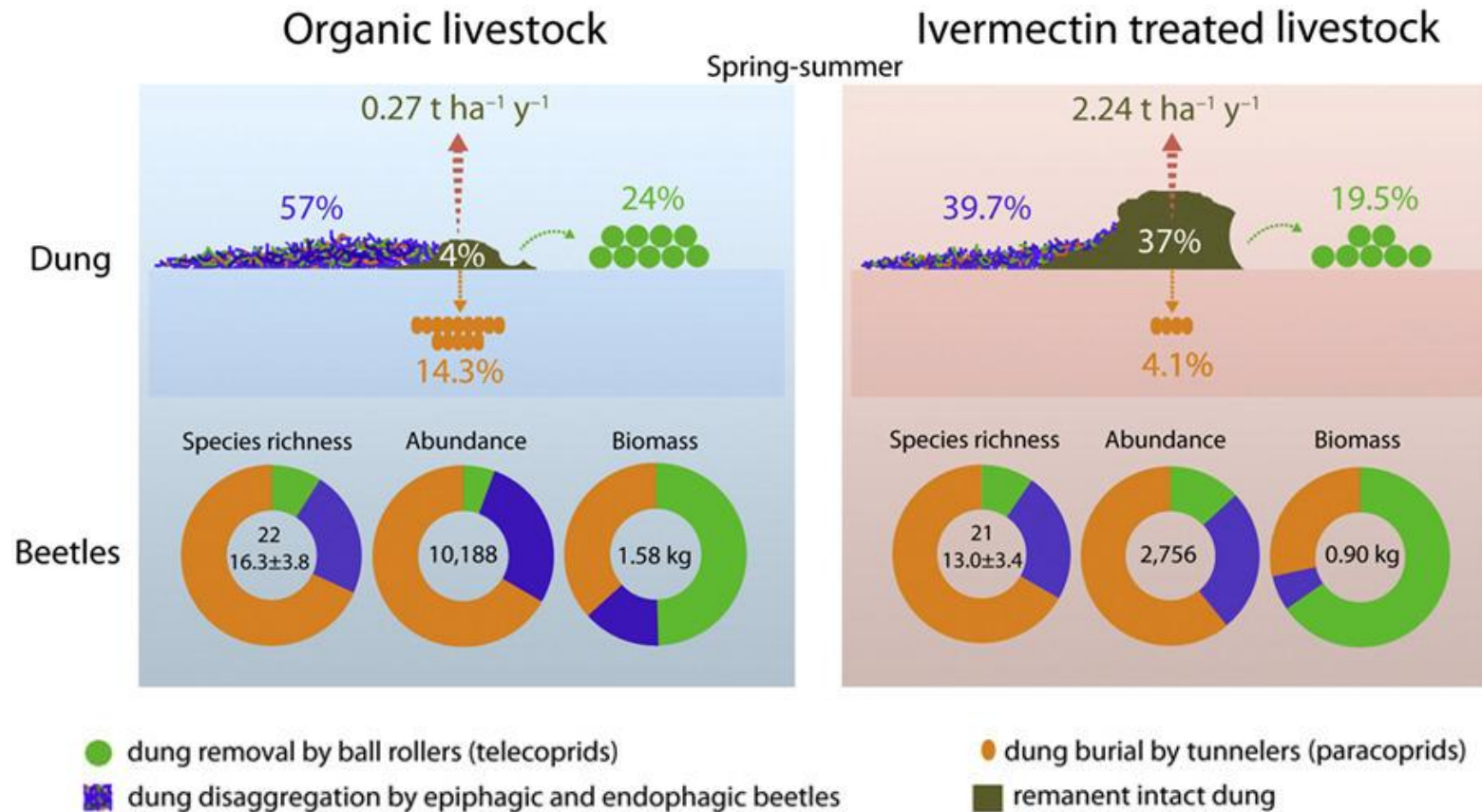
Xxeme siècle : Abandon, fermeture, intensification



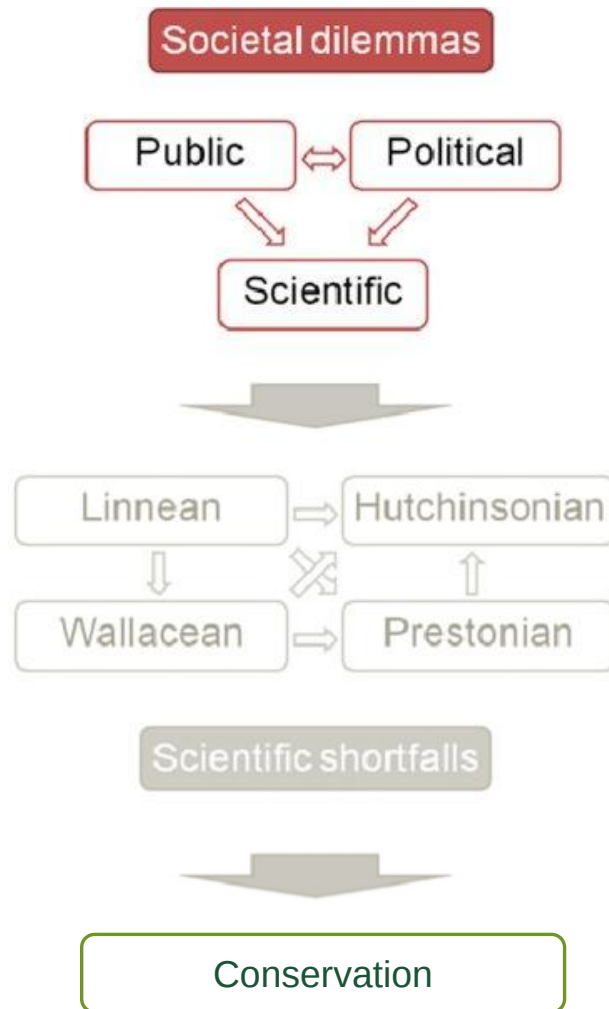
Pastoralisme vers Auzet massif des Monges ©AD04-Raoul Getraud

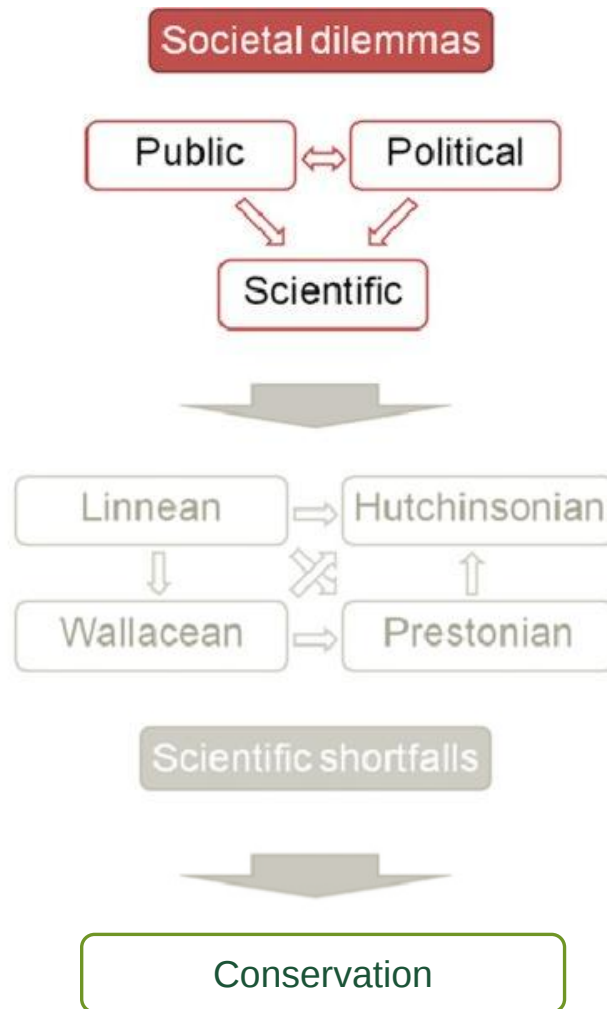


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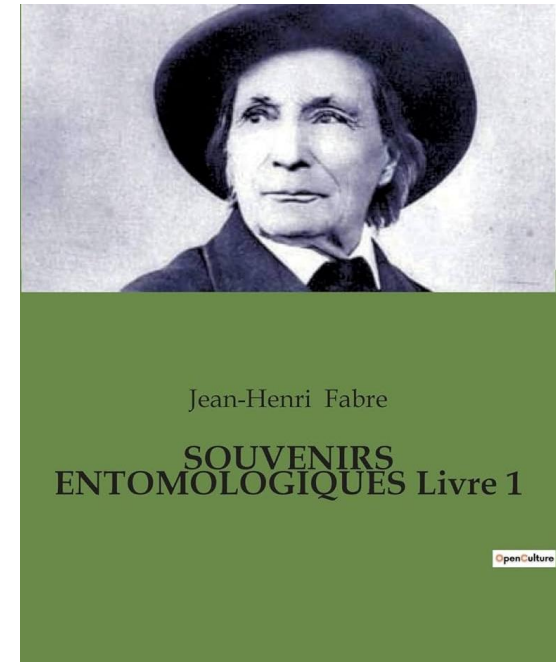
Verdu et al., 2018 (Science of The Total Environment)

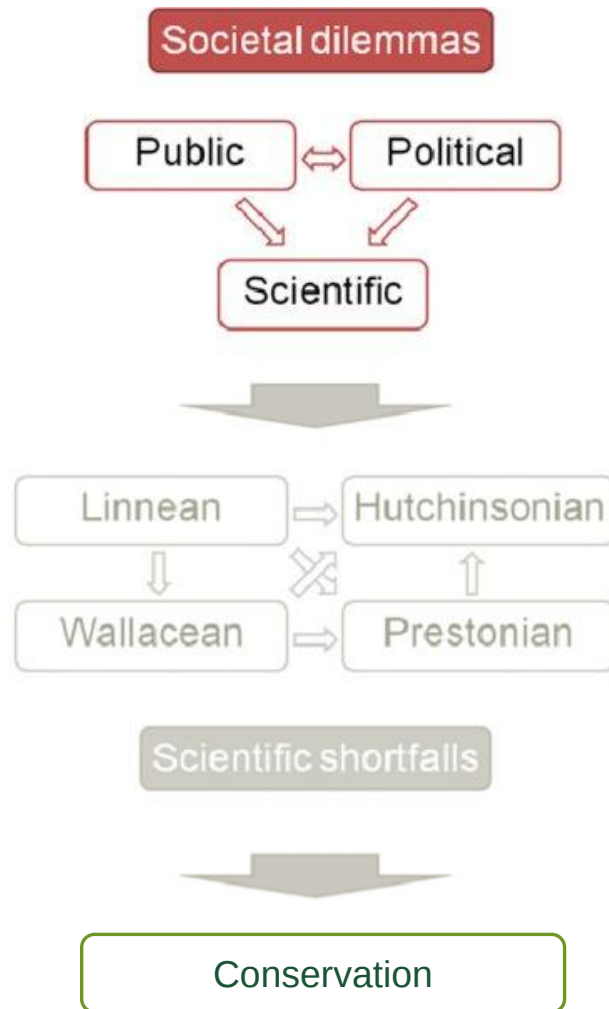




Manque de connaissances en entomologie (Fabre n'est pas une figure connue !)

Manque de connaissances et de compréhension de la diversité des insectes chez le grand public ;





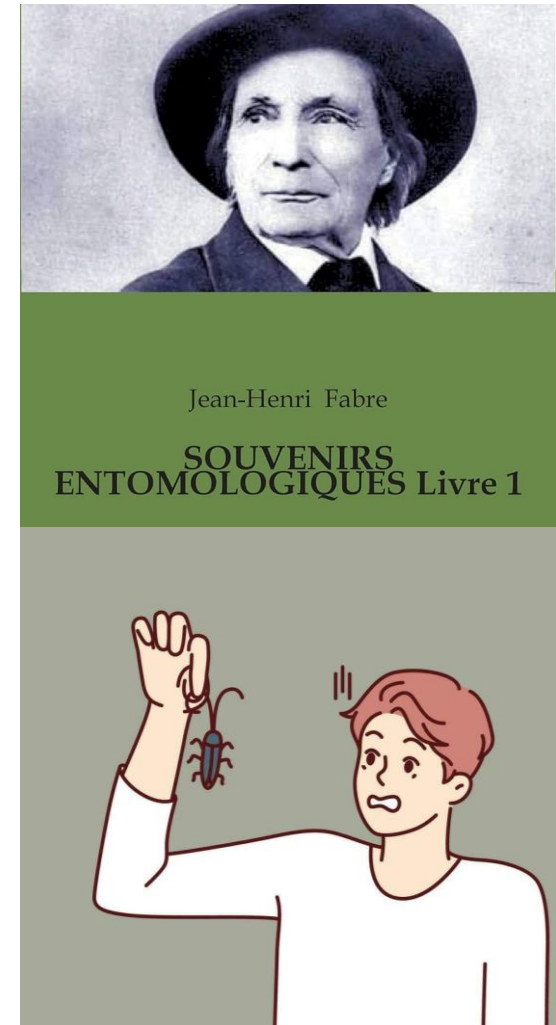
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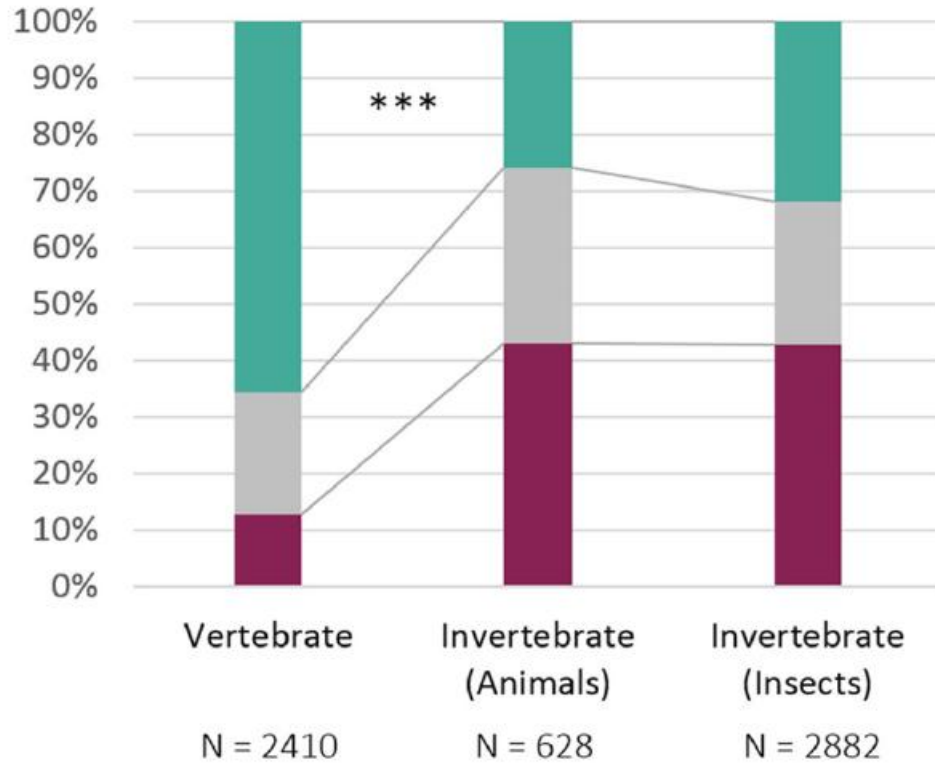
Manque de connaissances et de compréhension de la diversité des insectes chez le grand public ;

La peur et le dégoût que suscitent la plupart des insectes ou de la faune du sol ;

Peu de gens savent ce qu'est un bousier et connaissent les services écosystémiques

Leandro & Jay-Robert 2019 (Biol. Cons)  
Le Blan & Leandro, under review

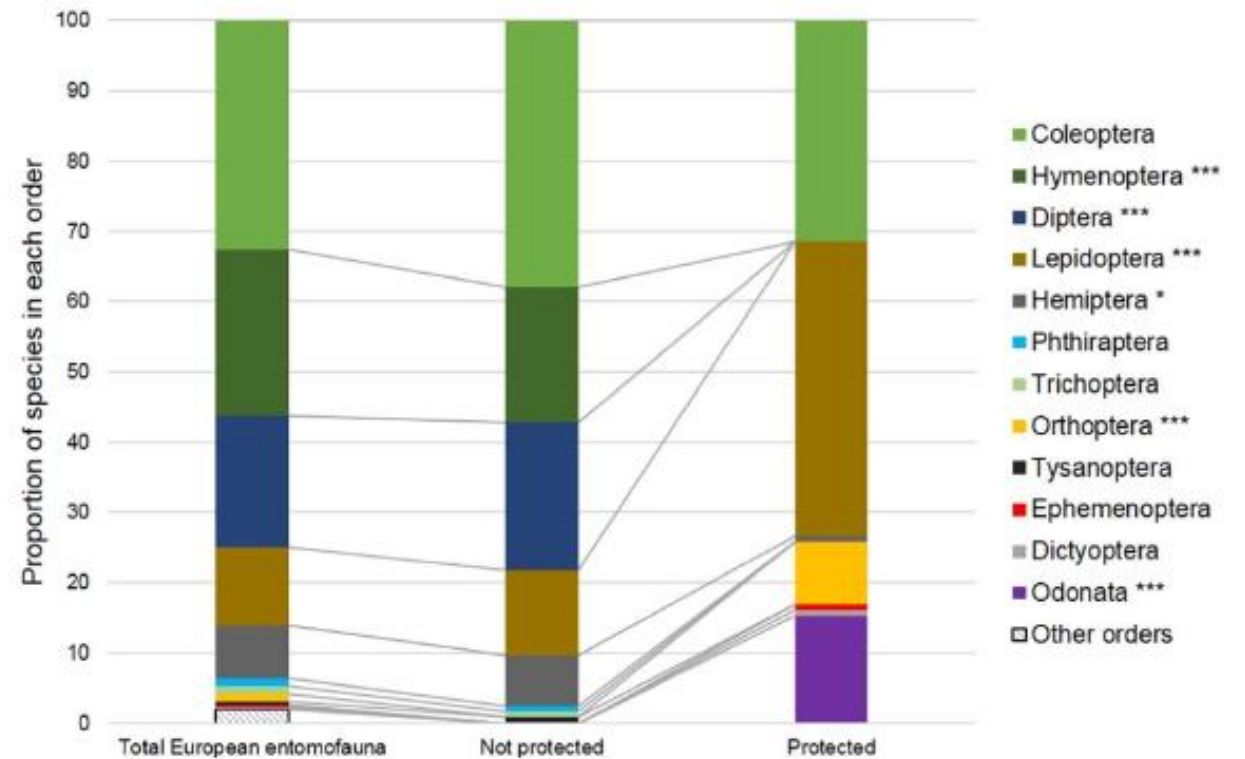




Leandro & Jay-Robert 2019 (Biol. Cons)

N = 1100 000

N = 100



Leandro et al., 2017 (Biol. Cons)

## 2. Révéler la diversité

Collaboration avec des artistes et des professionnels des organismes culturels pour mettre en valeur le sol et ses habitants :

Projet La Vie cachée des Sols (Zoo du Lunaret à Montpellier !)

<https://vimeo.com/953040496?fl=pl&fe=vl>



### 3. Appeler différents public à regarder

Target specific stakeholders ; participatory process embeded in education cycles

### 3. Appeler différents public à regarder



W. Perrin



#### ColCopEA – un programme de sciences participatives

30 Lycées agricoles participent !

Questionner les pratiques agricoles

Sensibiliser et créer également des connaissances (services écosystémiques)



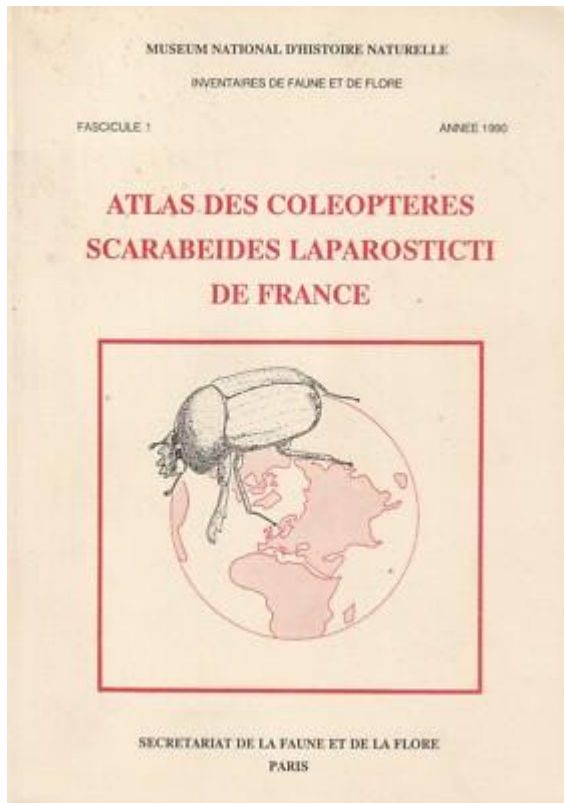
Cibler des parties prenantes spécifiques ; un processus participatif intégré aux cycles éducatifs

### 3. Appeler différents public à regarder



Cibler des parties prenantes spécifiques ; un processus participatif intégré aux cycles éducatifs

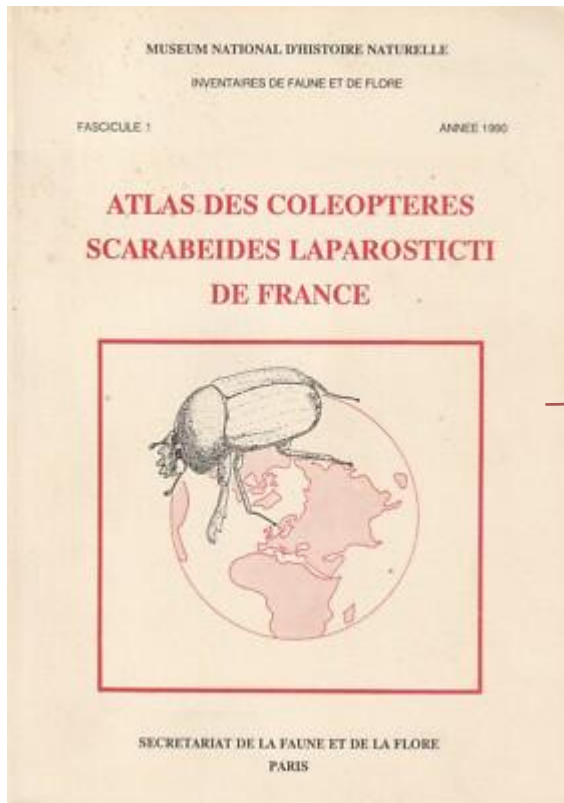
### 3. Appeler différents public à regarder



<https://scarab-obs.fr/>

Atlas participatif ; Renforcement des capacités

### 3. Appeler différents public à regarder



### ScaraB'Obs – L'enquête Sisyphé

+100 observations; entomologistes  
& grand public

**Mission Sisyphé**  
Etude et conservation des Scarabaeoidea laparosticti de France

Accueil / Bases de données / Observatoire des communautés animales / Scarabées / Contribuer / Mission Sisyphé

Pour localiser votre observation, vous pouvez vous géolocaliser (bouton *Ma position*), cliquer sur la carte ou saisir des coordonnées dans le formulaire.

Saisissez les informations de votre nouvelle observation

★ Le compte Scarab'Obs vous permet de devenir Contributeur-rice Scarab'Obs. Vous pourrez alors saisir des observations, consulter et éditer vos observations. Je me crée un compte Scarab'Obs

**Localisation**

☒ WGS84 (longitude / latitude) ☐ Lambert93

Longitude:  Latitude:

Ville:

**Taxon (Taxref)**

**Date**

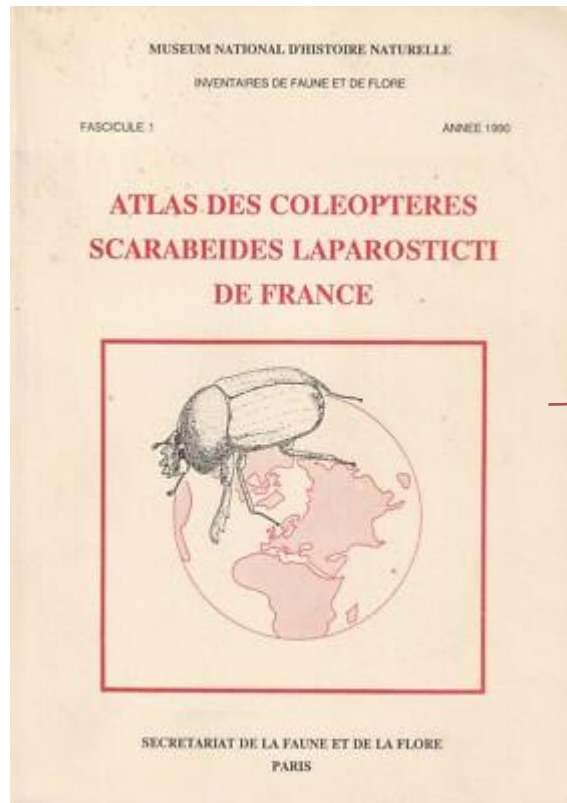
☒ Date unique ☐ Date début/fin

Date:



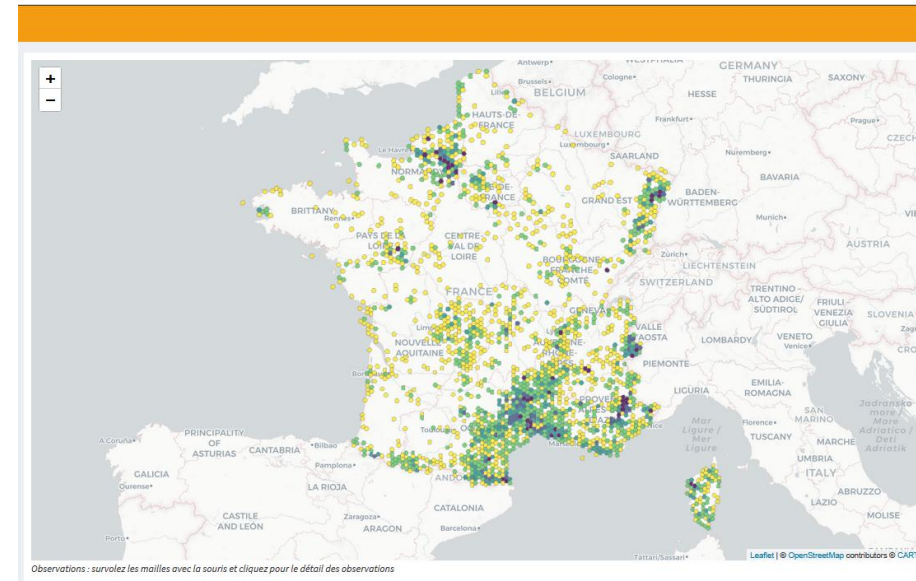
Atlas participatif ; Renforcement des capacités

### 3. Appeler différents public à regarder



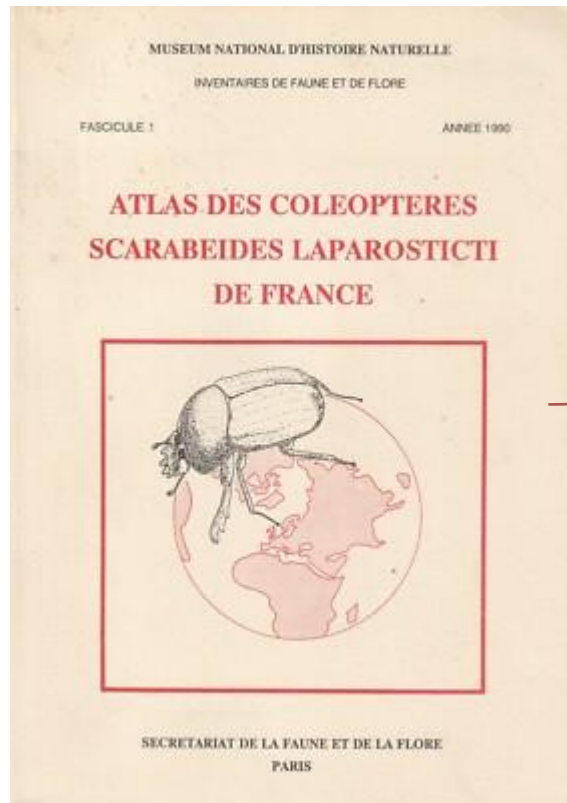
#### ScaraB'Obs – Atlas participatif

45 000 observations; entomologistes



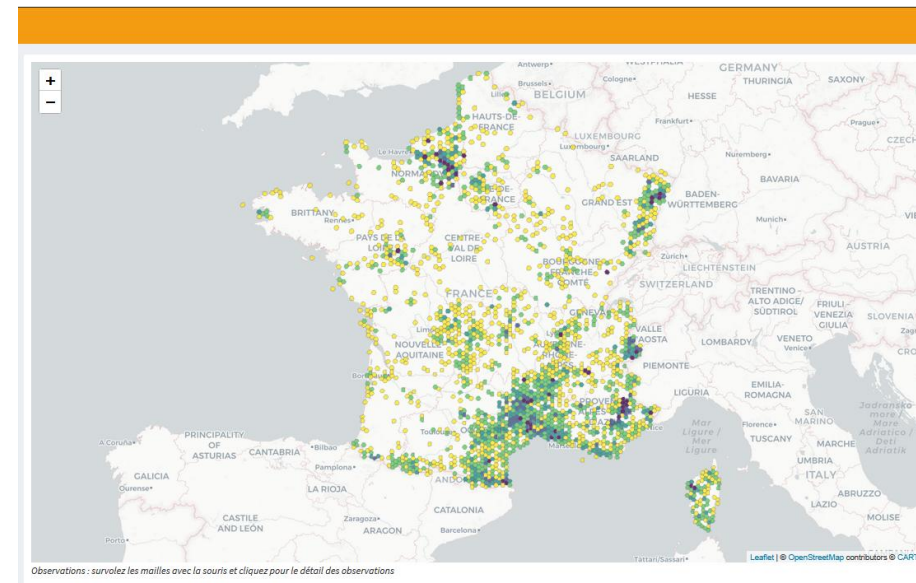
Atlas participatif ; Renforcement des capacités

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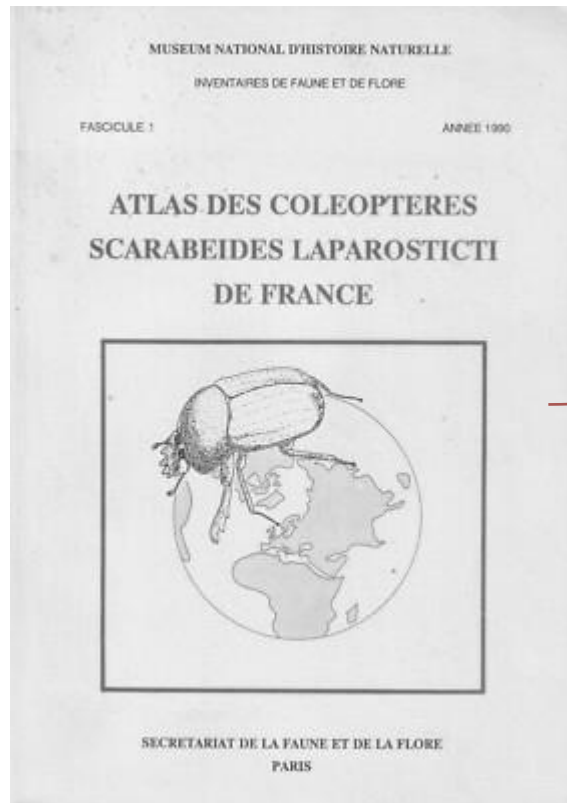
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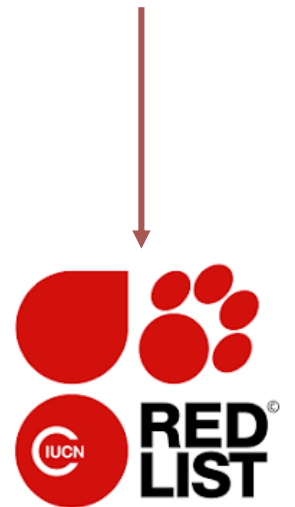


Atlas participatif ; Renforcement des capacités

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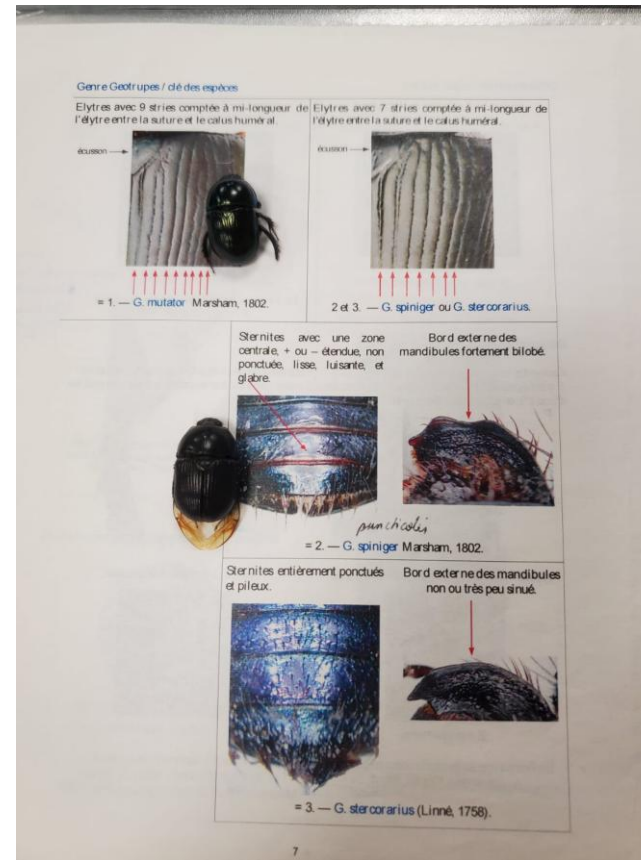


ScaraB'Obs – Atlas participatif



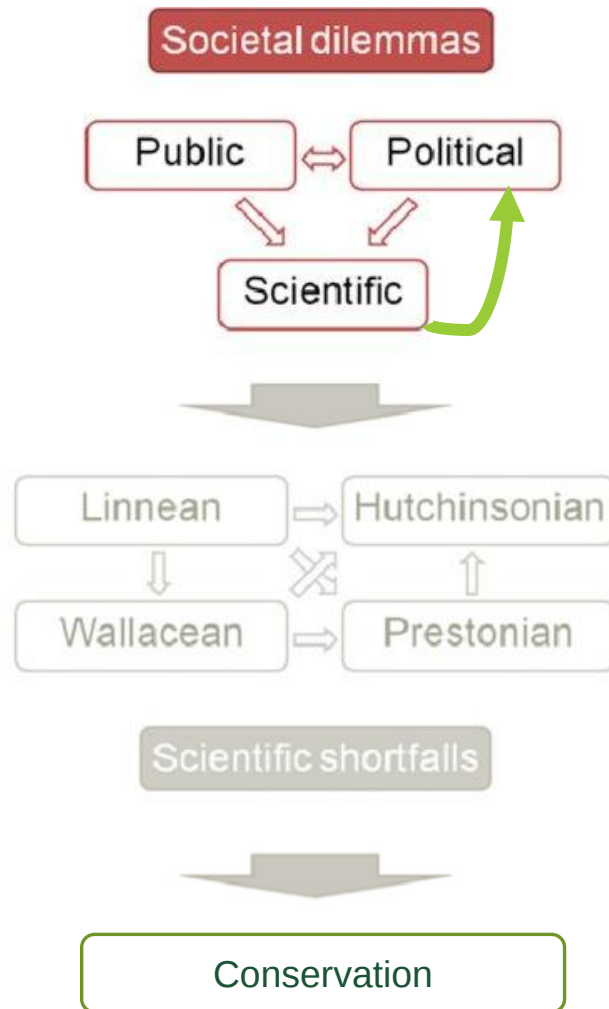
Donner des statuts de conservation aux espèces

## 4. Former



Renforcement des capacités – formations annuelles (à venir dans le catalogue de l'Opie)





### Governmental Stakeholders

- National and Subnational Governments -  
Ministries, embassies, governmental departments,  
public agencies...



### Intergovernmental and Supranational Stakeholders

Multilateral international organisations and related  
institutions in global governance



### Private Sector

Multinationals  
SMEs with international  
projection



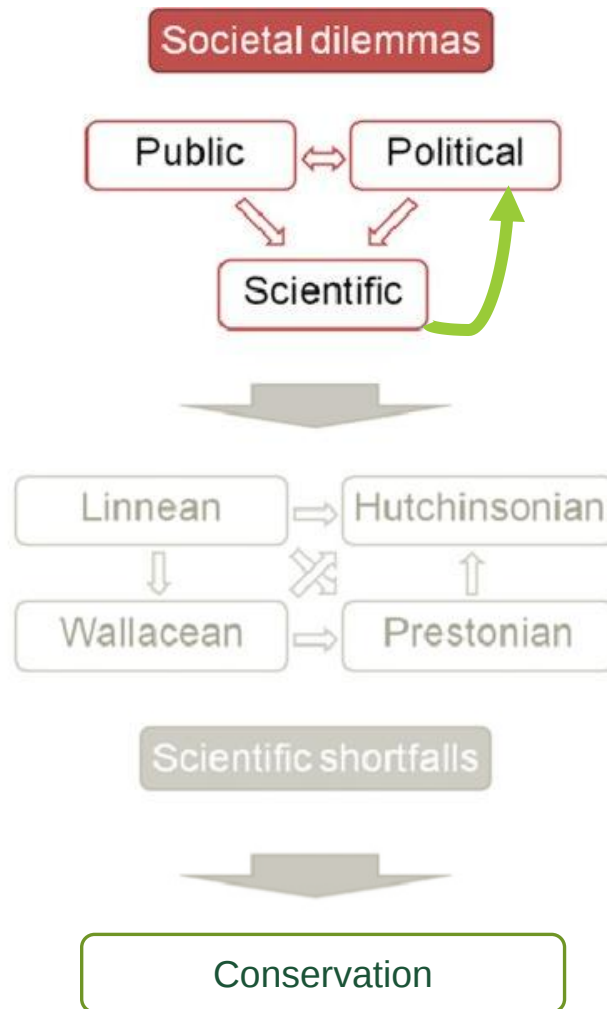
### Research and Academic Sector

Research Councils  
Universities  
Research Centres  
Large Research Infrastructures  
National academies  
Learned societies  
Funding agencies  
Individual committed scientists



### Organised Civil Society

National and transnational NGOs  
Civil associations  
Private charities  
Patrons  
Activists



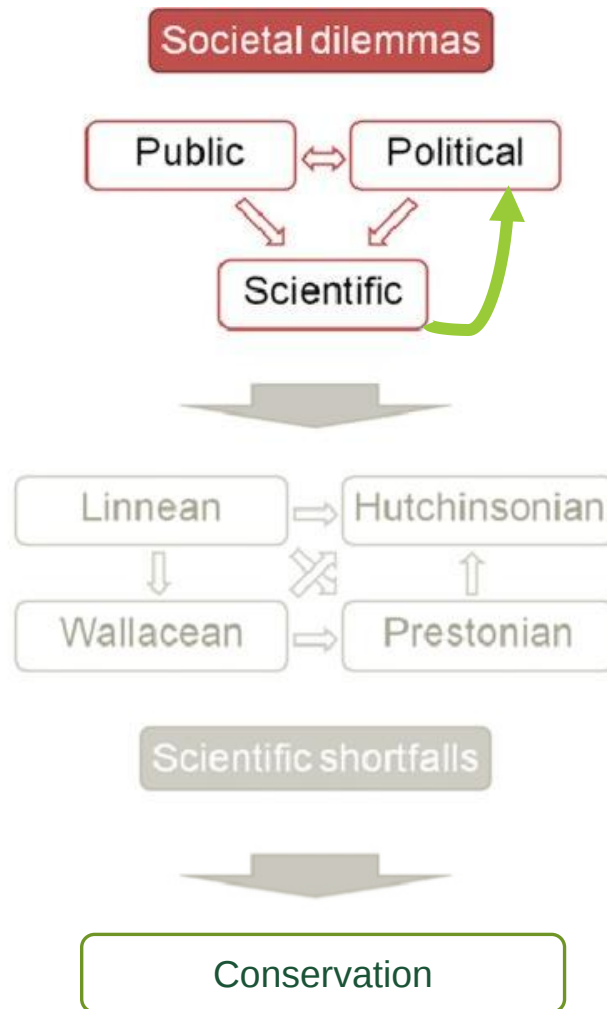
P. Jay-Robert



W. Perrin



Collaboration avec les écoles nationales de formation vétérinaire ; discussions avec les chambres d'agriculture



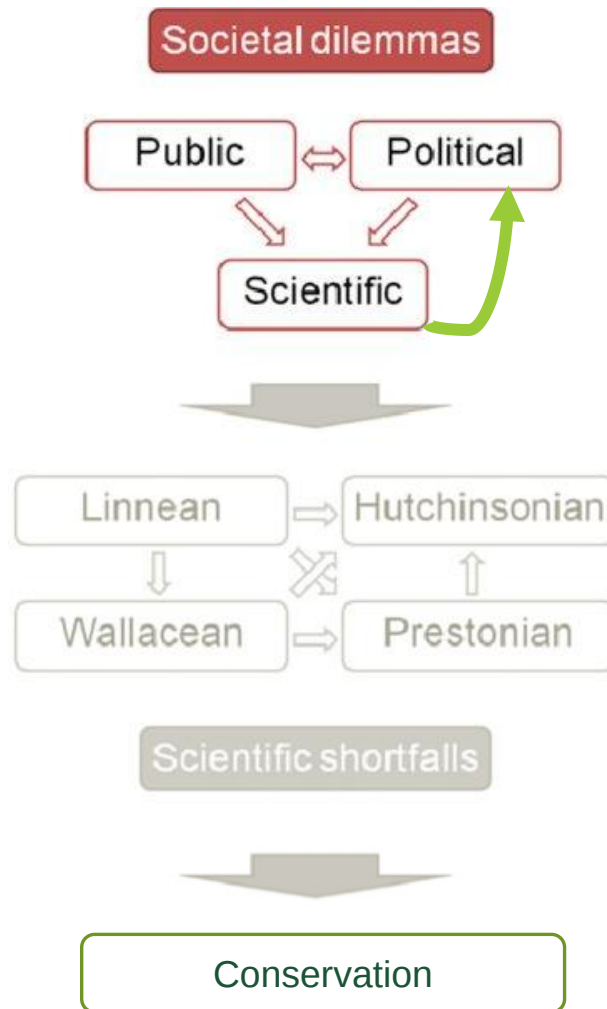
P. Jay-Robert



C. Leandro



Comités scientifique pour les zones protégées et instances décisionnelles en matière de protection des espèces

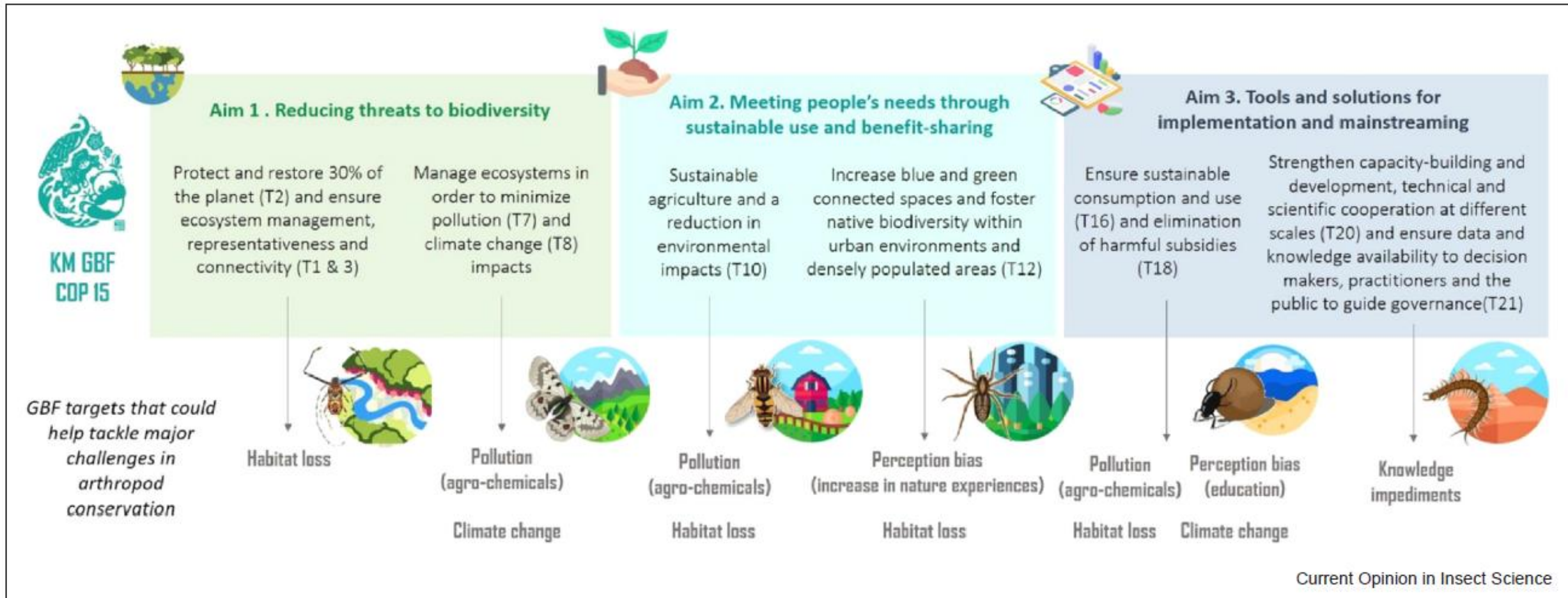


F. Vaz-de-Mello



C. Leandro





TOP PANEL: Biodiverse Garden - High Insect Diversity



MIDDLE PANEL: Moderately Simplified - Reduced Diversity



BOTTOM PANEL: Manicured Monoculture - Low Diversity



Ecological Impact of Replacing Nature-Friendly Yards with Monoculture Lawns:

**INSECT DIVERSITY DECLINE**



Toutefois, prendre soin s'est s'attaquer à la façon même dont on est en relation avec notre monde



**Merci  
beaucoup !**

# *Phelotrupes oshimanus* from Amami (Japan)

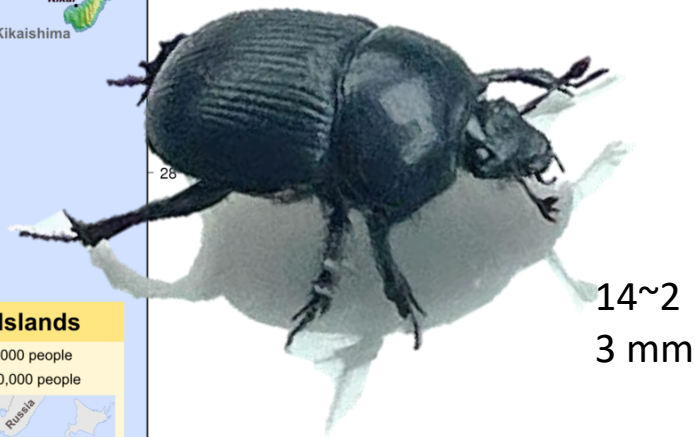
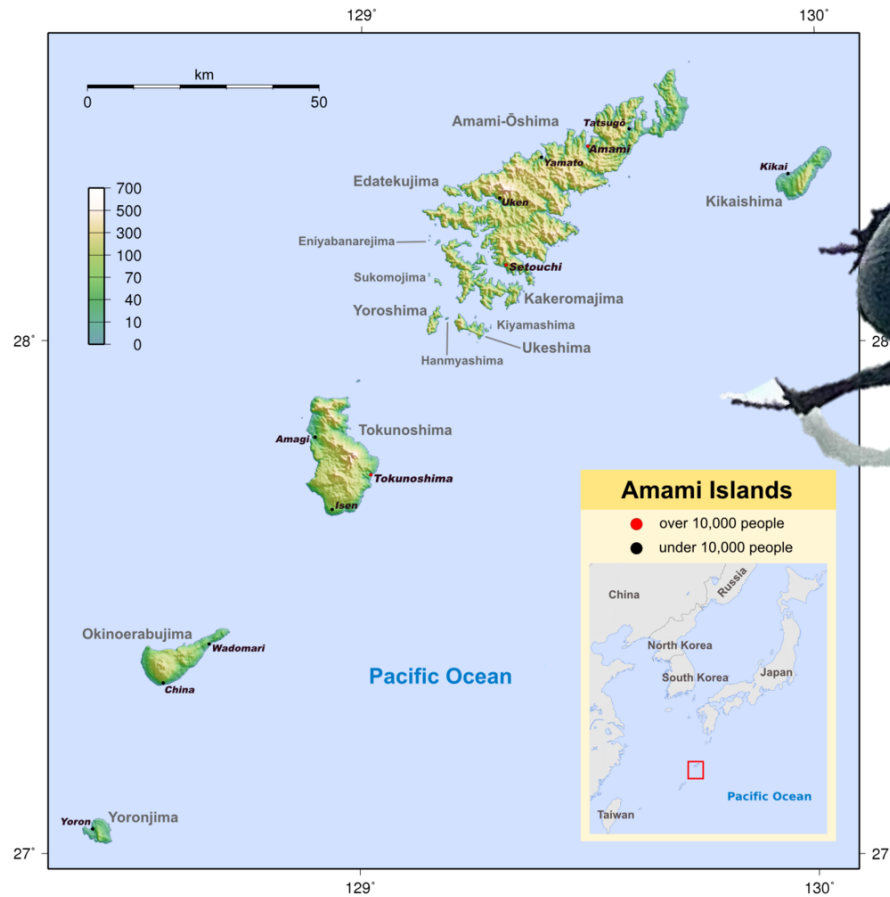
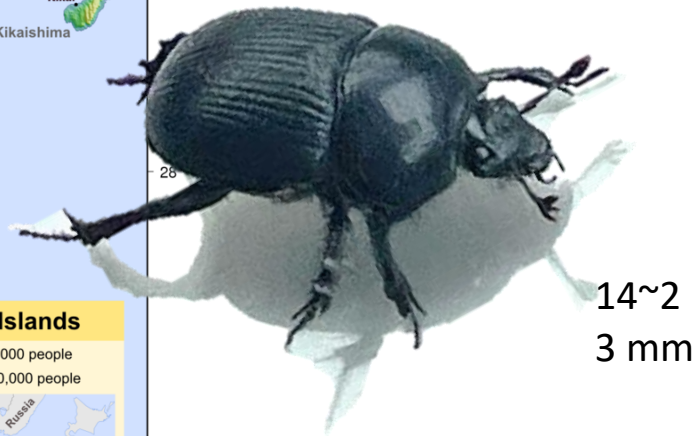
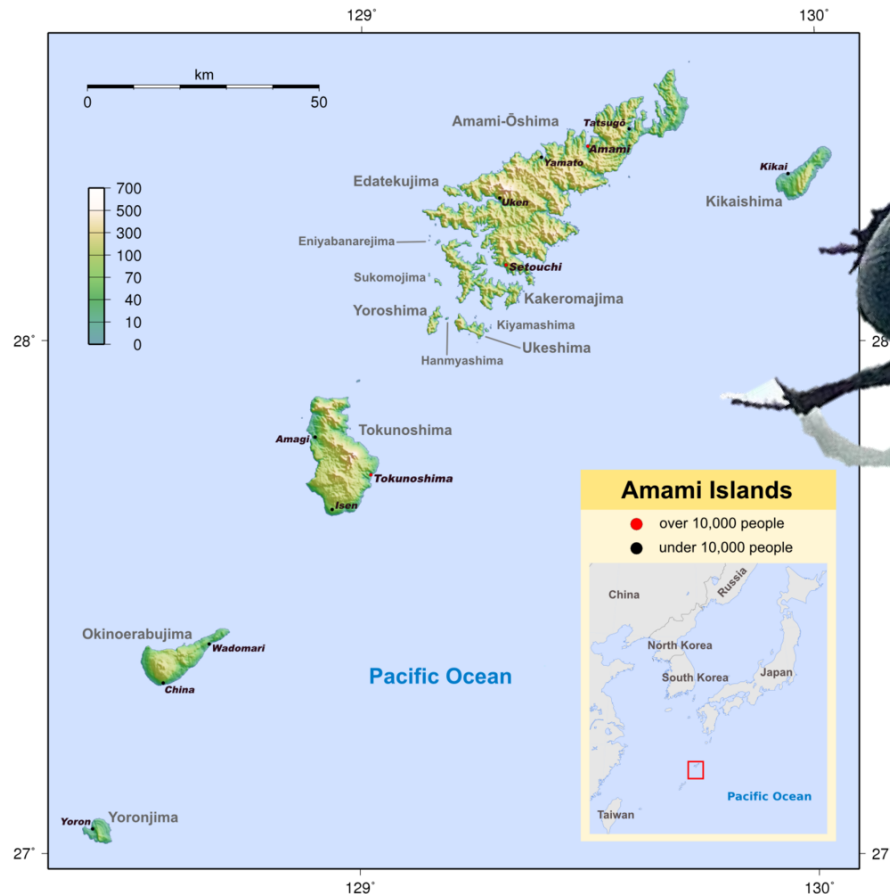


Photo by Wich'yanan (Jay) Limparungpatthanakij from Inaturalist – may 2024



# *Phelotrupes oshimanus* from Amami (Japan)



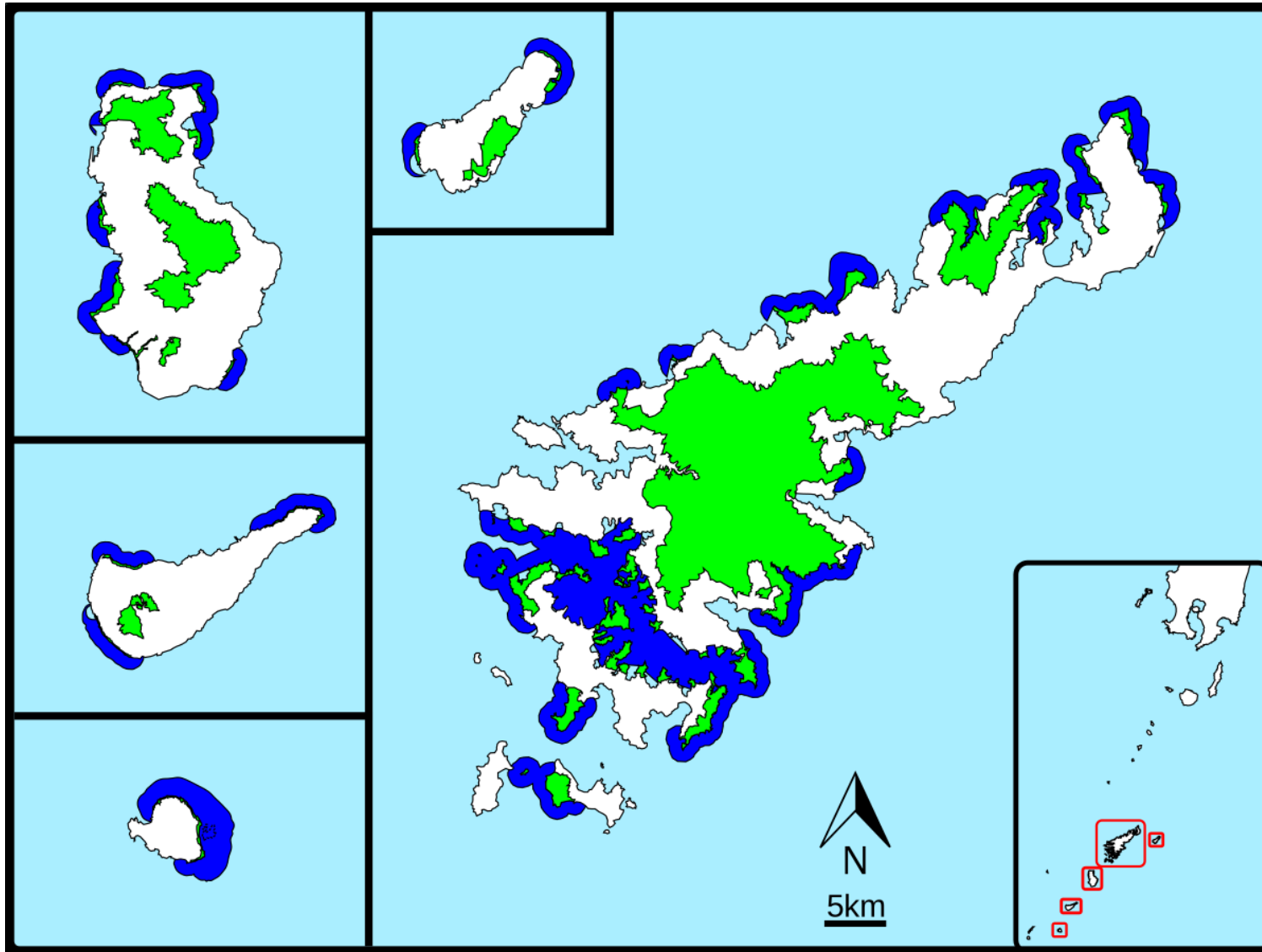
14~2  
3 mm



صندوق محمد بن زايد  
للمحافظة على  
الكائنات الحية

The Mohamed bin Zayed  
SPECIES CONSERVATION FUND

Invitation by M. Kwak  
Hokkaido University



**English:** Area map of the Amami Gunto National Park

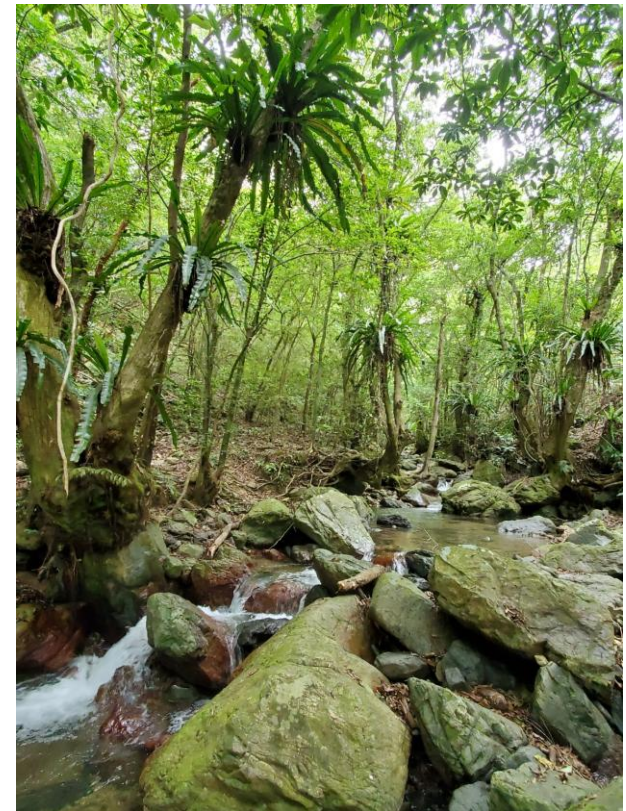
Land area

Ocean area

**日本語:** 奄美群島国立公園の区域図。

陸域

海域





A) Ranches and cane plantations are common in north Amami

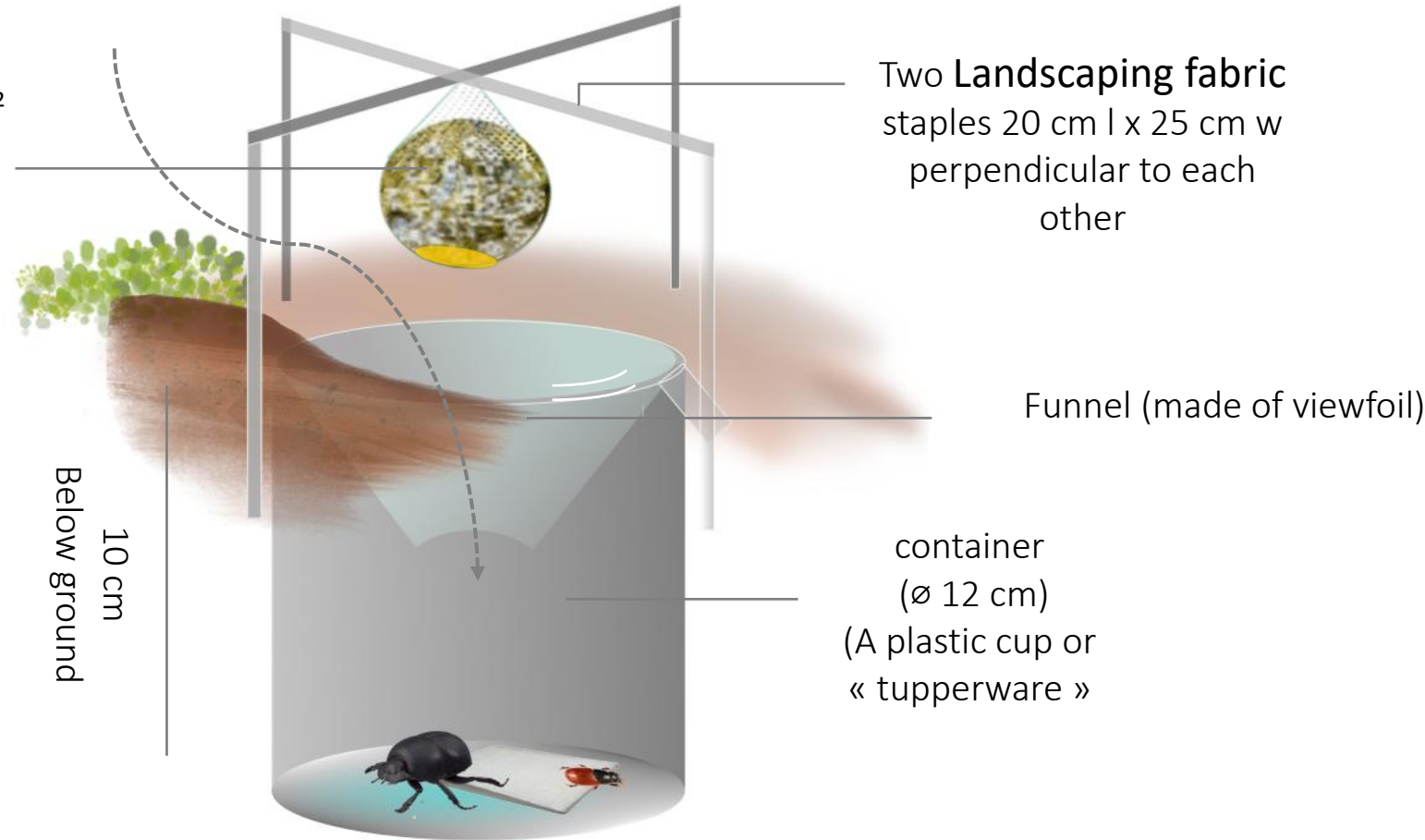
B) Tankan farms are mostly around the forest heart of the island



Non destructive baited pitfall traps  
Durantion on the field = 48 h



Bait in a 20cm<sup>2</sup>  
mosquito net  
container



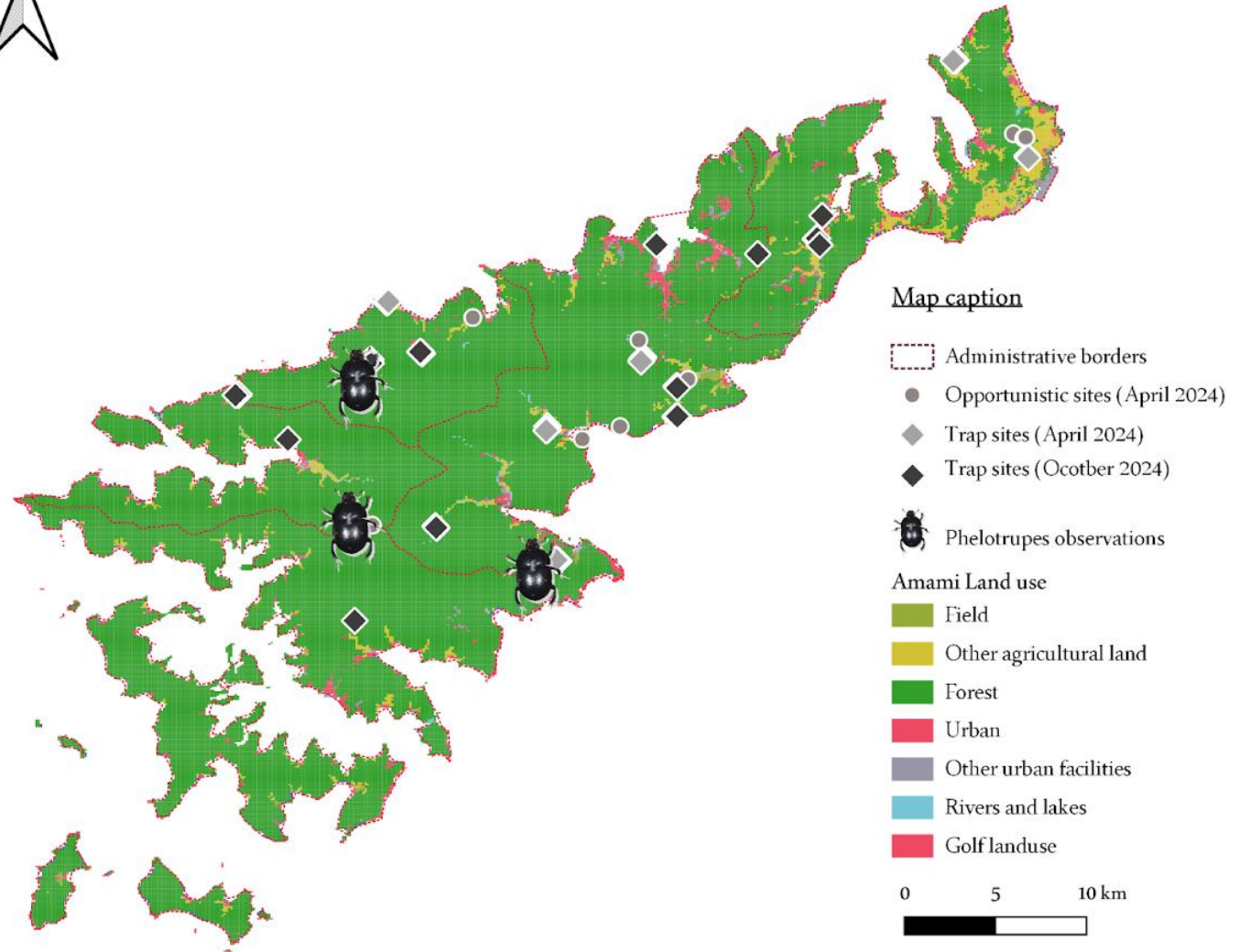


Seeing the species with Echigo Hazuki (Ms)





Seeing the species with Echigo Hazuki (Ms)



*Phelotrupes oshimanus*' observations  
in Amami island (2024 fieldtrips)

# *Phelotrupes oshimanus* from Amami (Japan)

Phenology problem for sampling ?

-> lack of information

How specialized the species can be (habitat, bait)?

-> lack of information

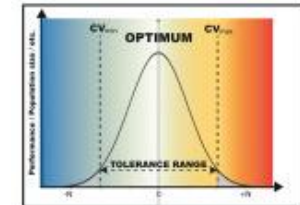
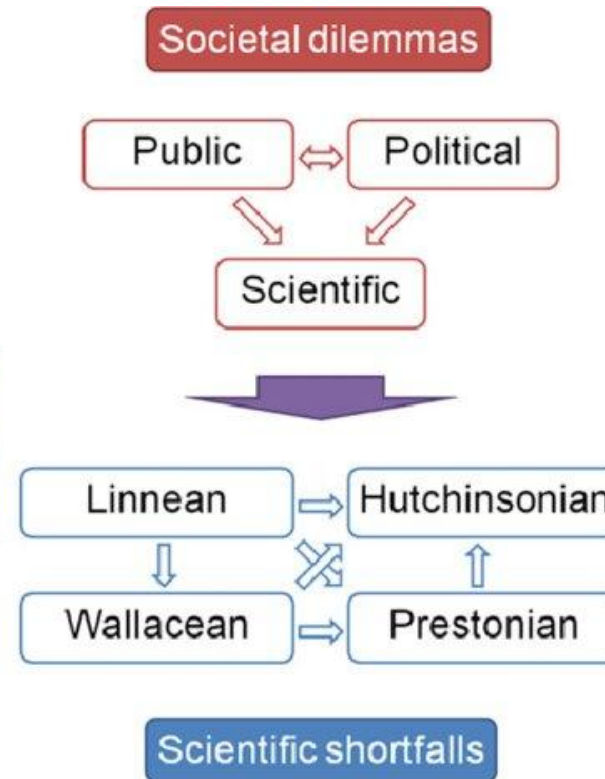
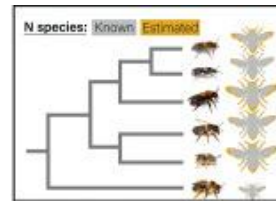
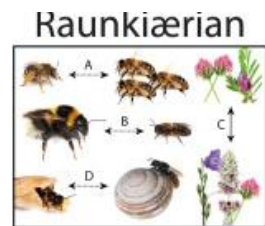
Few data (and with coordinates)

-> lack of interest, training, confusion?

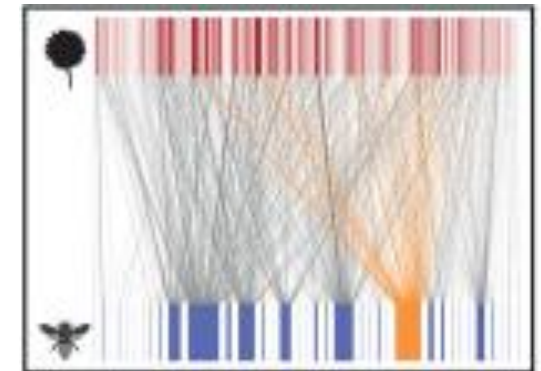
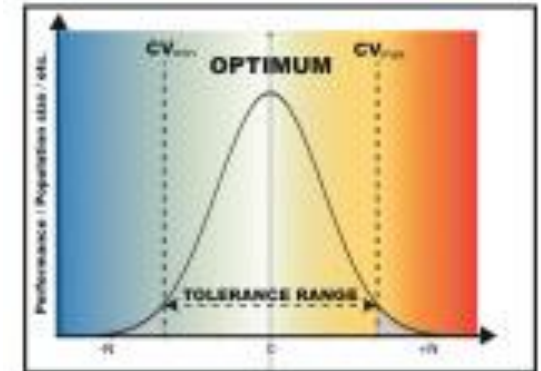
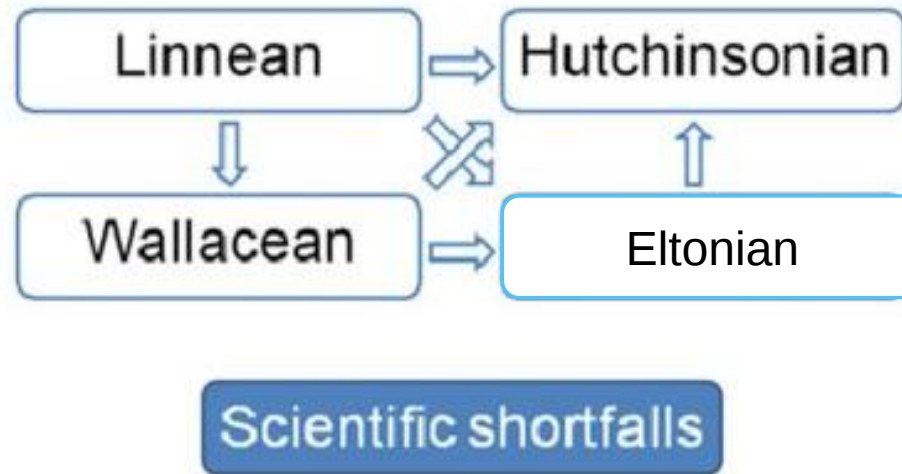
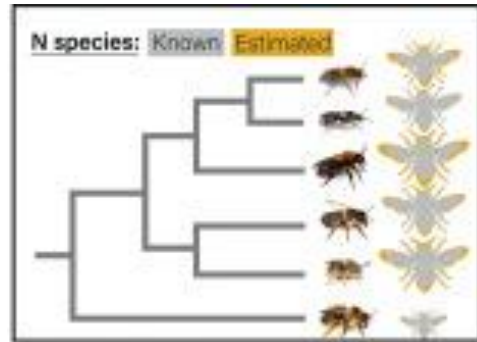


# *Phelotrupes oshimanus* and all invertebrates!

The seven impediments in invertebrate conservation and respective relations (Cardoso et al. 2011)

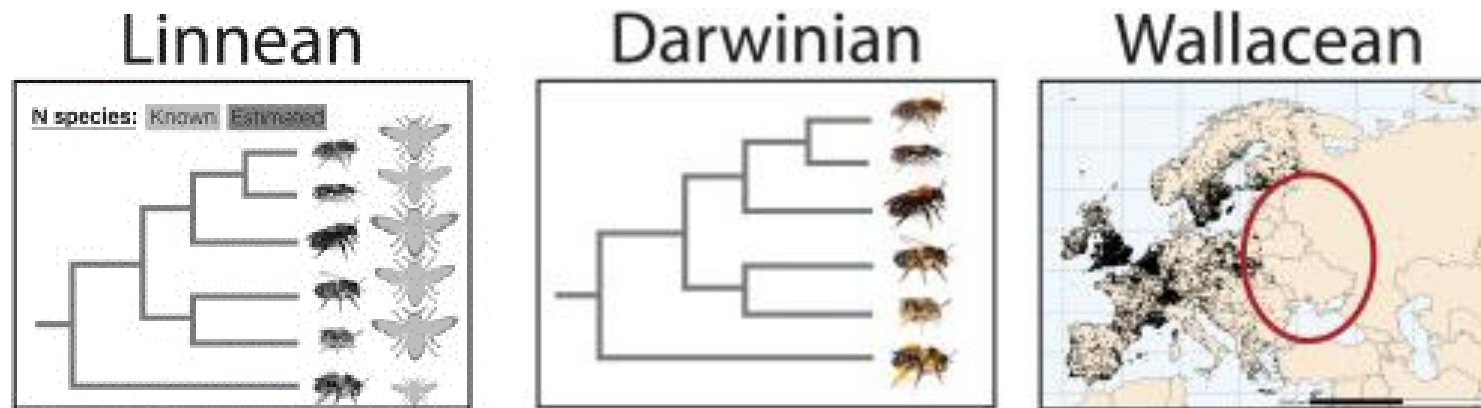


## 2. Addressing shortfalls



## 2a. Addressing the Wallacean shortfall: eDNA

Despite interest, little entomological literacy in France and very few dung beetle experts.

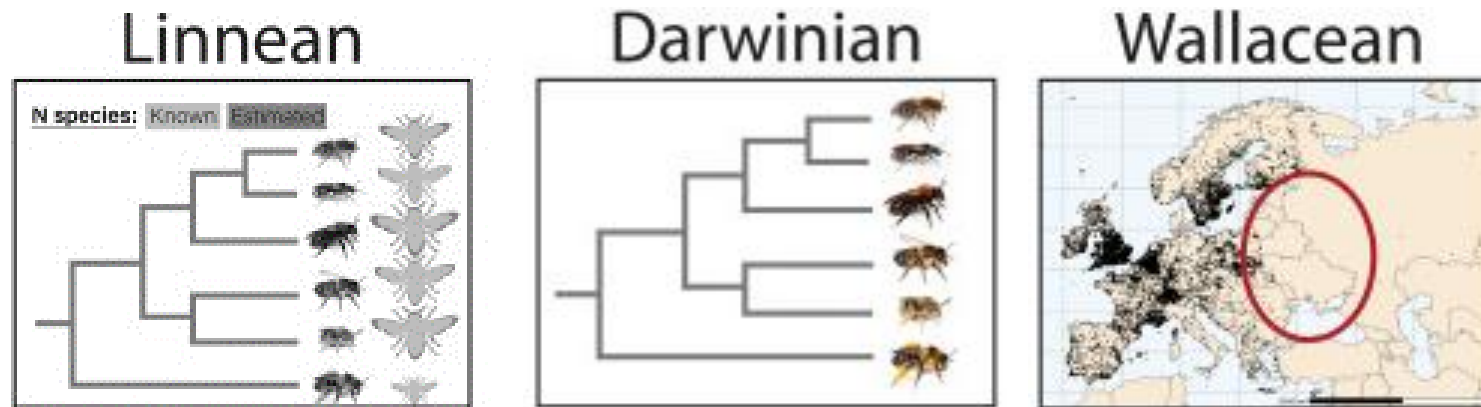


Marshall et al., 2024 (Biol. Cons)

## 2a. Addressing the Wallacean shortfall: eDNA

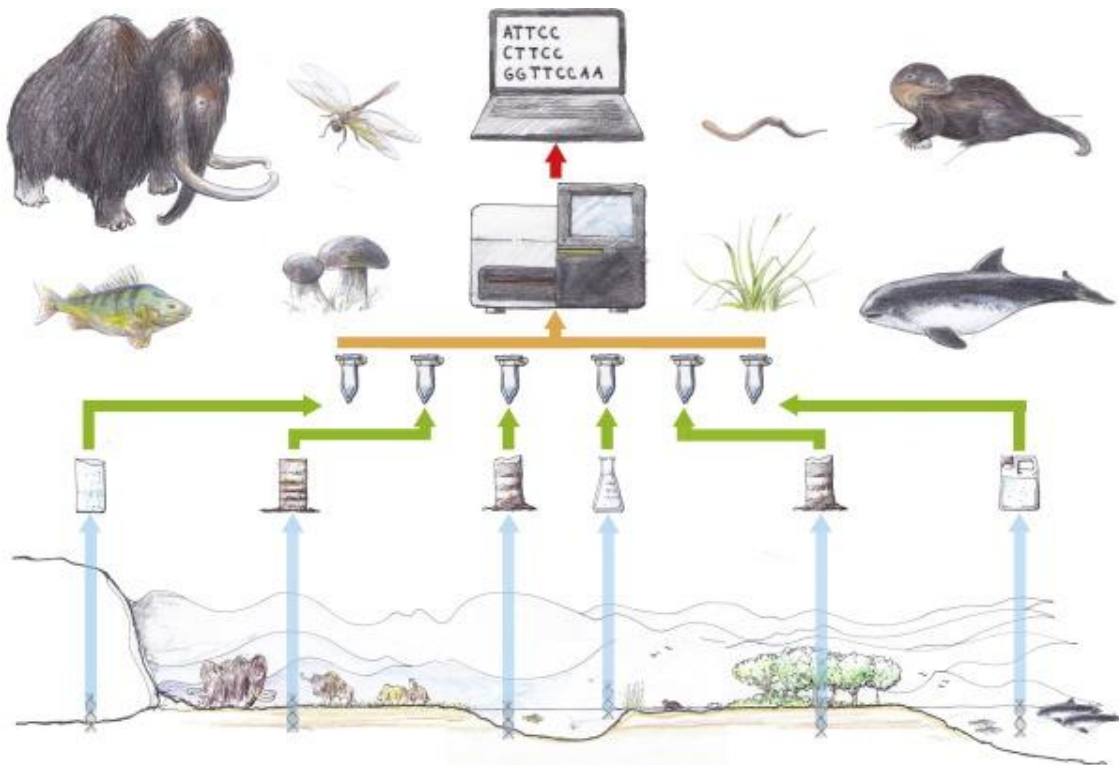
Despite interest, little entomological literacy in France and very few dung beetle experts.

**eDNA** as a tool f helping non experts monitor dung beetles, and also contribute to address Darwinian shortfall (complete phylogenies through barcoding)



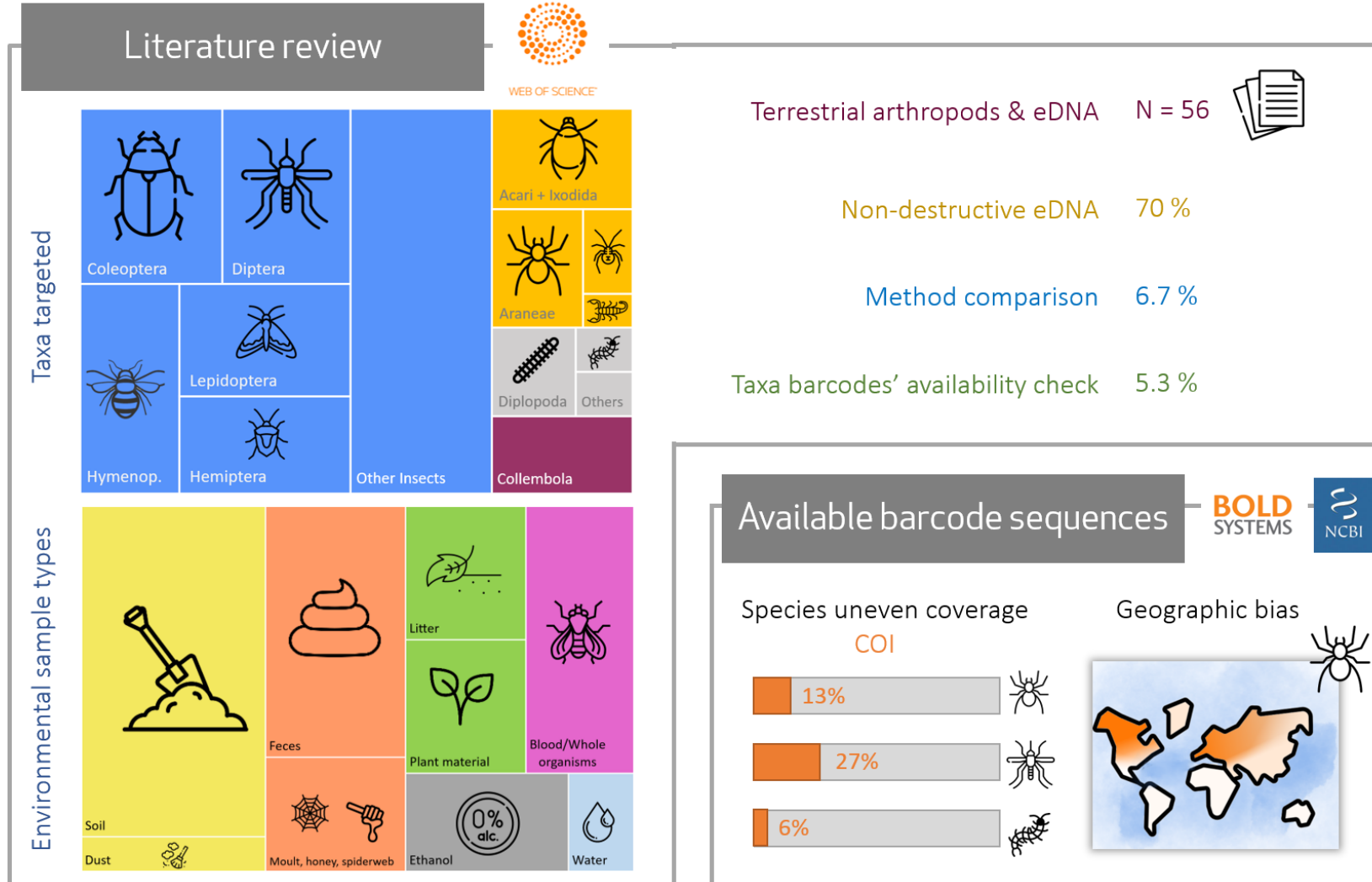
Marshall et al., 2024 (Biol. Cons)

## 2a. Addressing the Wallacean shortfall: eDNA



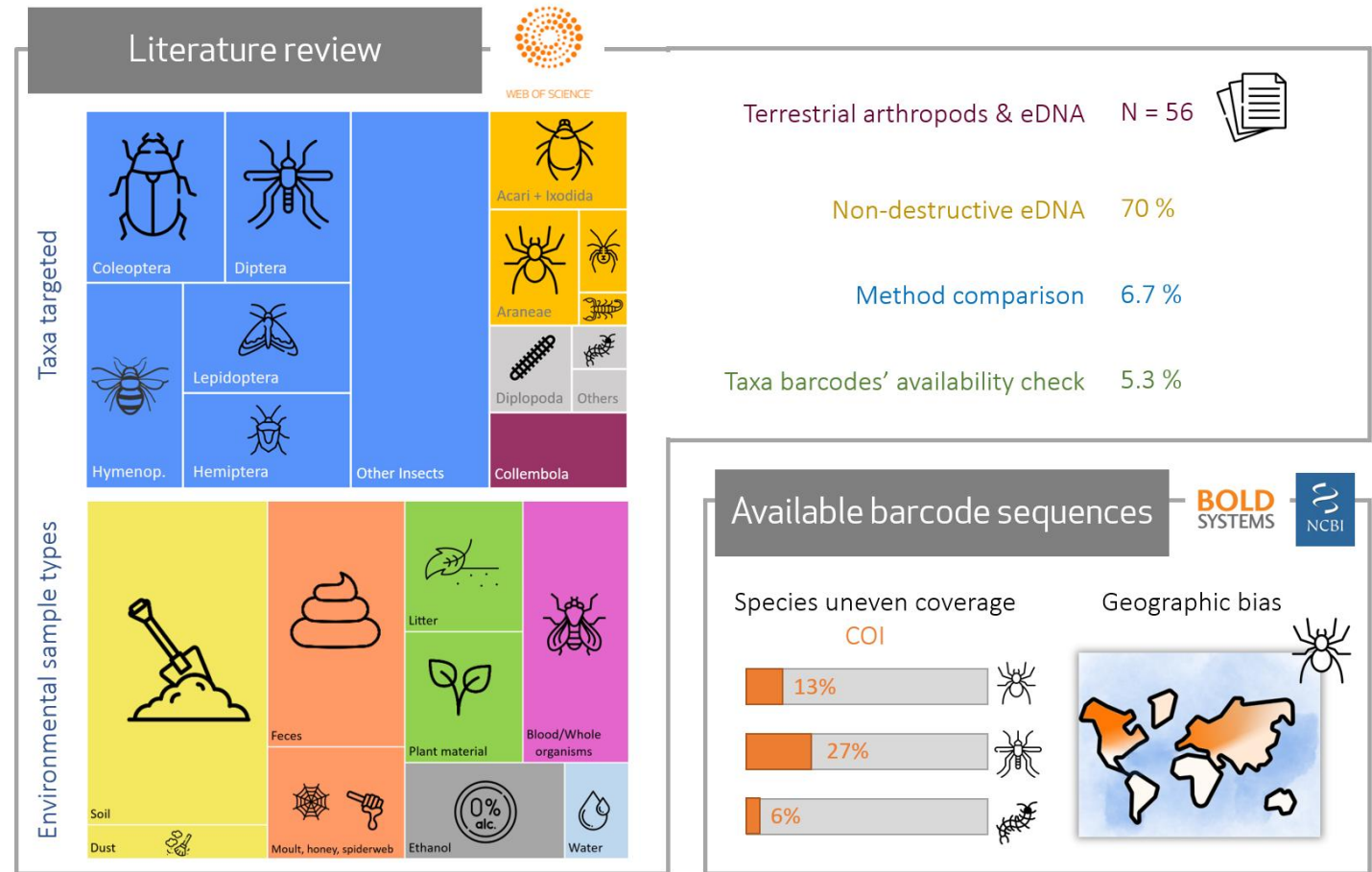
Thomsen & Willerslev 2015 (Biol. Cons)

## 2a. Addressing the Wallacean shortfall: eDNA



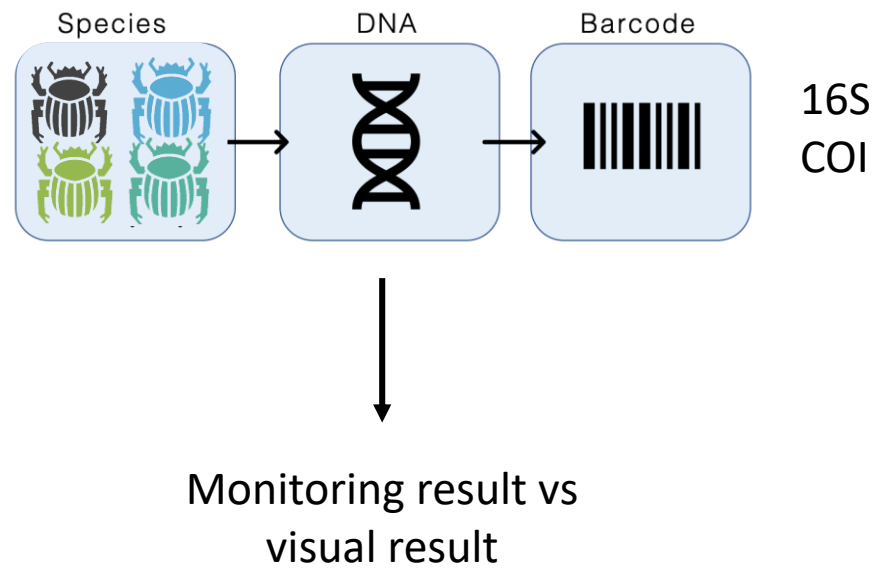
## 2a. Addressing the Wallacean shortfall: eDNA

Not a fit for all situation,  
as it is crucial to have  
correctly barcoded all  
species that we aim to see  
(many individuals from  
different populations...)  
and test the efficiency of  
the method

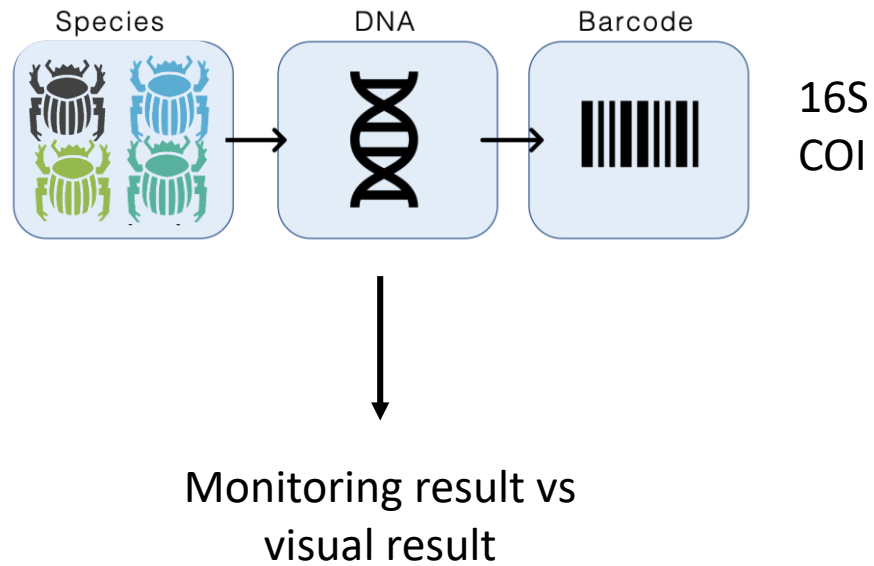


*Leandro et al., 2024 (Insect Diversity and Conservation)*

## 2a. Addressing the Wallacean shortfall: eDNA



## 2a. Addressing the Wallacean shortfall: eDNA



### Barcode Development Since 2018

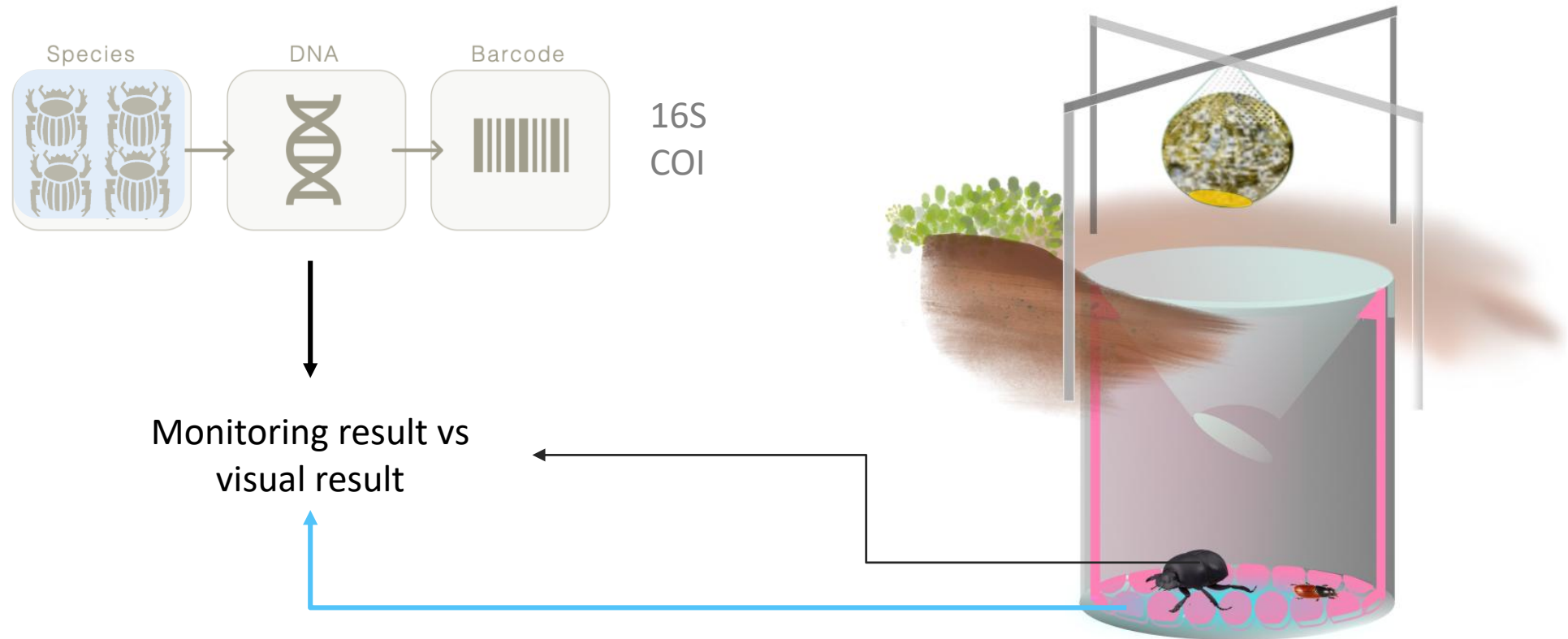
LPL (3 postdoctoral projects contributed)

3 individuals from different populations

80 % of France's fauna currently covered

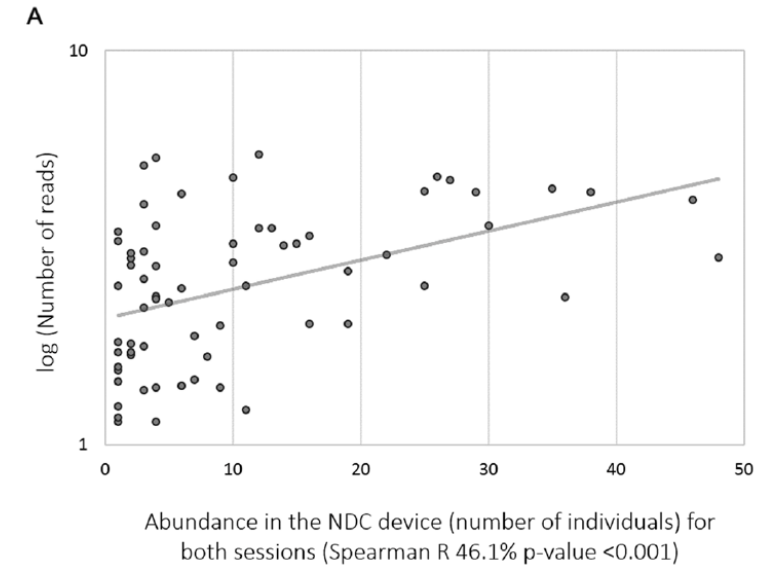
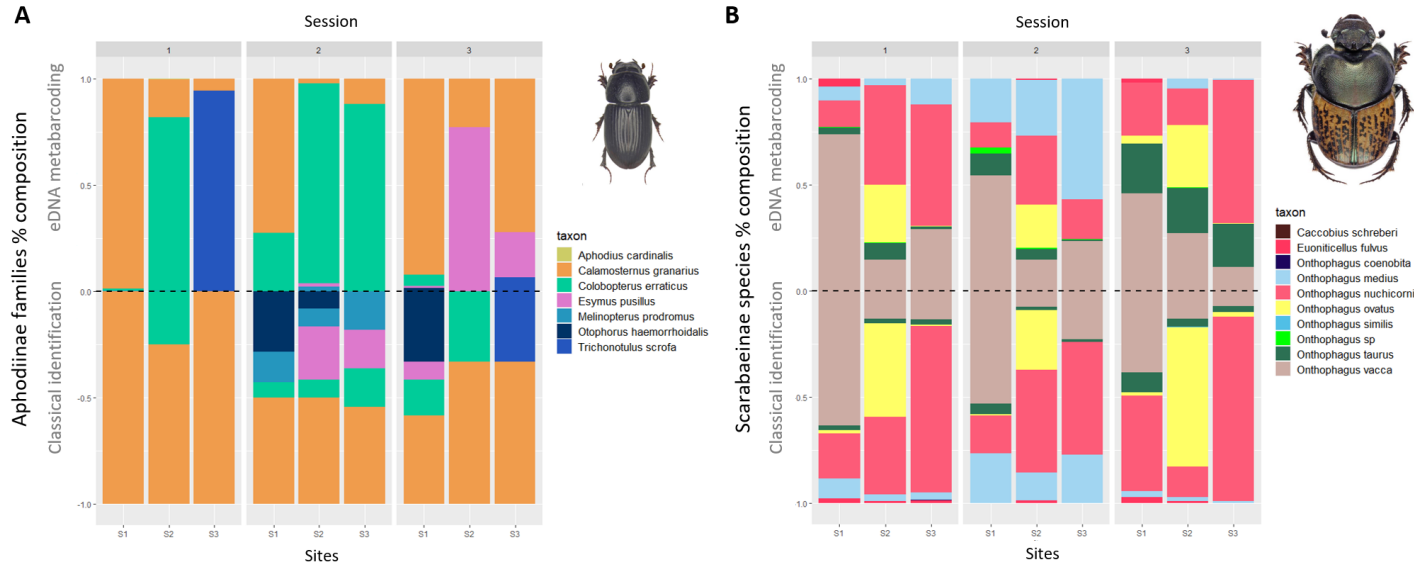
Barcodes will soon be available on NCBI

## 2a. Addressing the Wallacean shortfall: eDNA



A system developed in 2016 and subsequently improved between 2020 and 2021  
(during my thesis and postdoctoral research)

## 2a. Addressing the Wallacean shortfall: eDNA



Good identification rate

Correlation between eDNA abundance and individual abundance rank

*Leandro et al., 2021 (Journal of Insect Conservation)*

*Leandro et al., 2025 (Entomologia Experimentalis et Applicata)*

## 2a. Addressing the Wallacean shortfall: eDNA

Protocol highlighted by the French Biodiversity Agency : <https://professionnels.ofb.fr/fr/node/1447>

All patterns, documents and methods to do it available ; used in national parks ;

Youtube protocols illustrated

**Méthode d'inventaire moléculaire de l'entomofaune du sol en milieu pastoral d'altitude**  
 Projet conduit de 2019 à 2021 en partenariat avec les Parcs nationaux (PN des Cévennes, PN des Écrins, PN du Mercantour, PN des Pyrénées et PN de la Vanoise) et soutenu par l'OFB, l'UPVM3 et l'OSU-OREME

Camila Leandro et Pierre Jay-Robert  
 Université Paul-Valéry Montpellier 3  
 Centre d'Ecologie Fonctionnelle et Evolutive  
 RENDU FINAL : Octobre 2021

**I. PRÉSENTATION DU MATÉRIEL** (8:43)

**II. DÉMONSTRATION DE L'UTILISATION DU PIÈGE NDC SUR LE TERRAIN** (10:05)

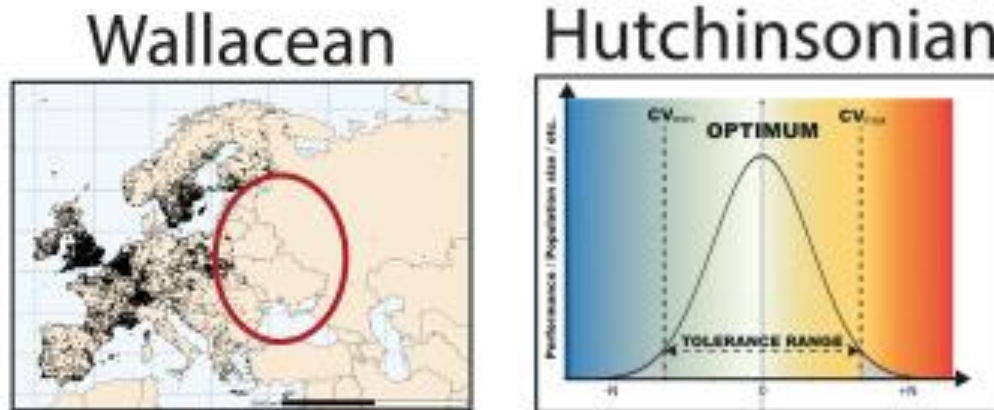
**TUTORIEL ADN ENVIRONNEMENTALE 1/2 :...**

**TUTORIEL ADN ENVIRONNEMENTALE 2/2 :...**

## 2b. Addressing spatial shortfall: SDMs

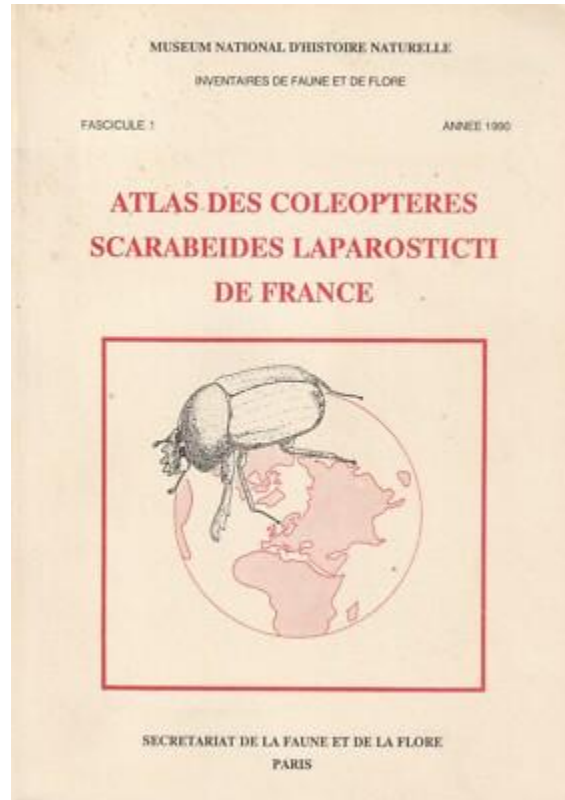
**But having data points it's not enough: with scarce occurrences, producing distribution maps through species distribution modelling is a very good option!**

Moreover, by investigating species relationships to environmental gradients, we can also address the Hutchinsonian shortfall.

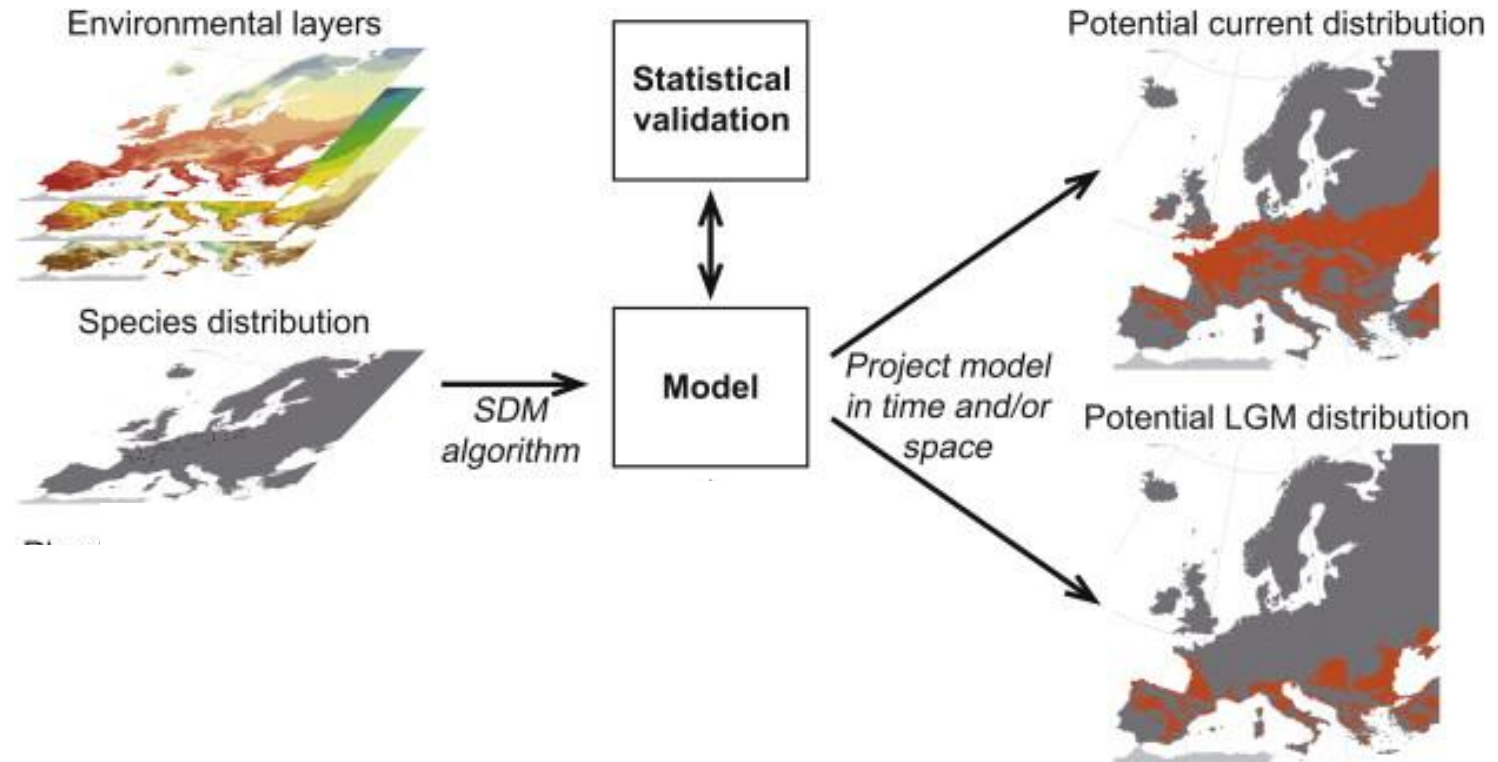


Marshall et al., 2024 (Biol. Cons)

## 2b. Addressing spatial shortfall: SDMs

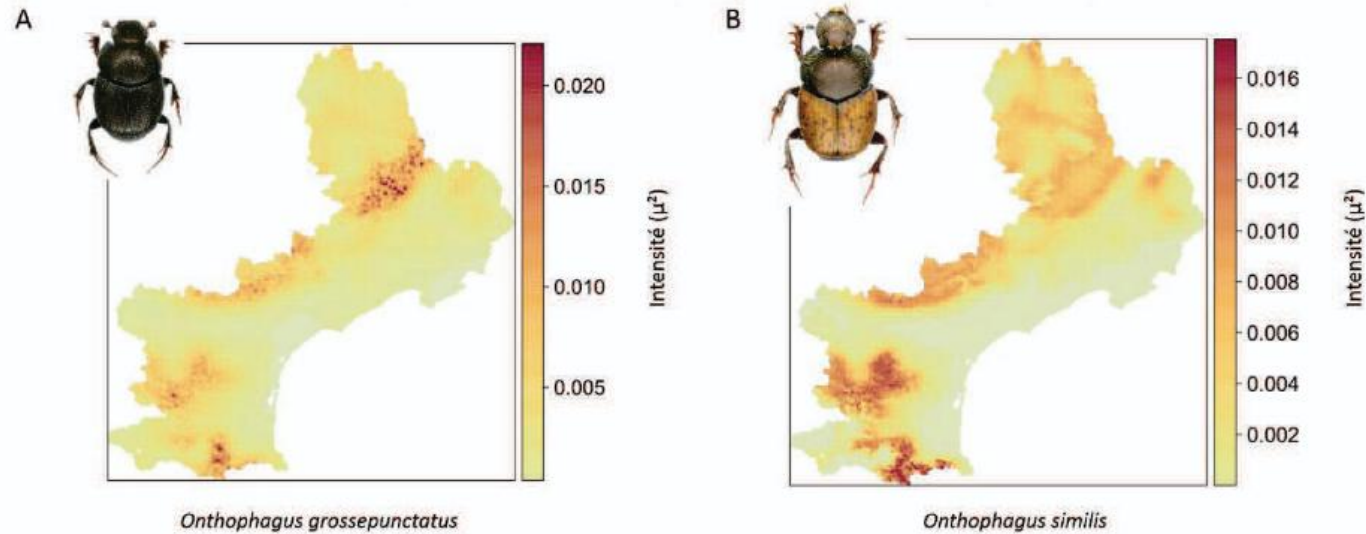


Opportunistic data



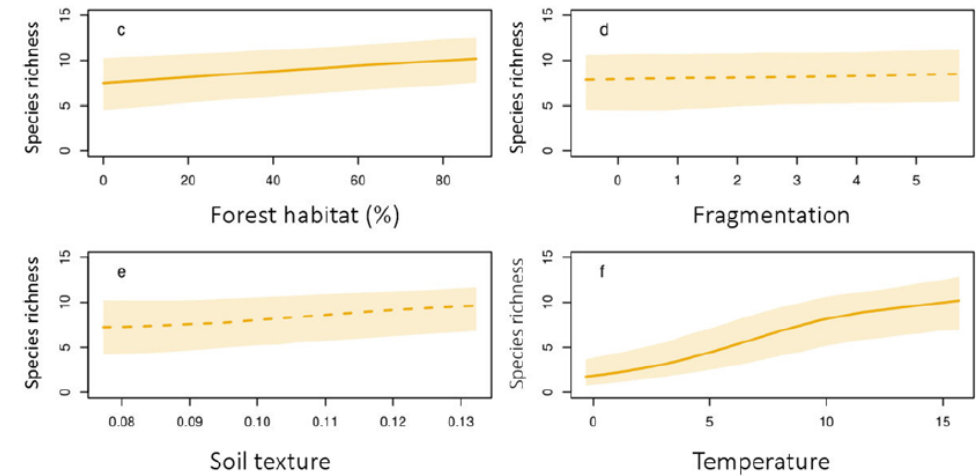
Modified from Svenning *et al.* 2011 (Quaternary Science Reviews)

## 2b. Addressing spatial shortfall: SDMs



Potential distribution of two *Onthophagus* species across a french region (Languedoc-Roussillon) - PPM

*Leandro 2018 (phD Manuscript)*



Niche evaluation for all dung beetles in Southern France - HMSC

*Leandro et al., 2023 (Landscape Ecology)*

## 2b. Addressing spatial shortfall: SDMs

Interesting patterns related to forests and will to better include agropastoral information at large scale...

Yet, not enough data in France or even at the european level to get more accurate information on species distributions.

*One promising lead : partnership with the entomological cell of ONF and the fairly new work on red list.*

