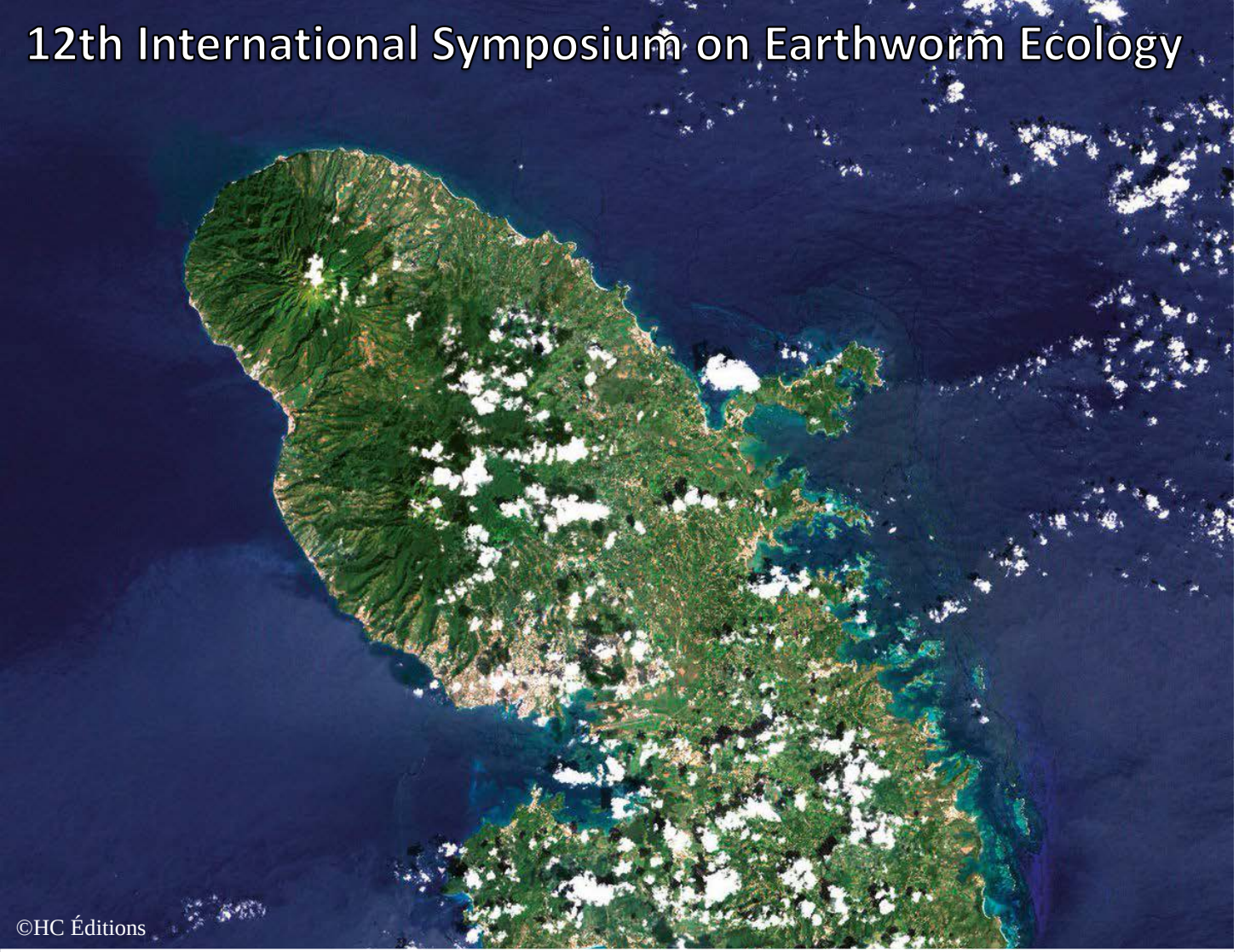
12th International Symposium on Earthworm Ecology



Is there an ecological niche overlap between native and exotic earthworm species in Martinique ?

This Work is

Realised / Presented by

Quentin Gabriac

Co-worked with

Alexis Delaplace, Lise Dupont, Carla-Marie Brunet & Mathieu Coulis

Acknowledgement

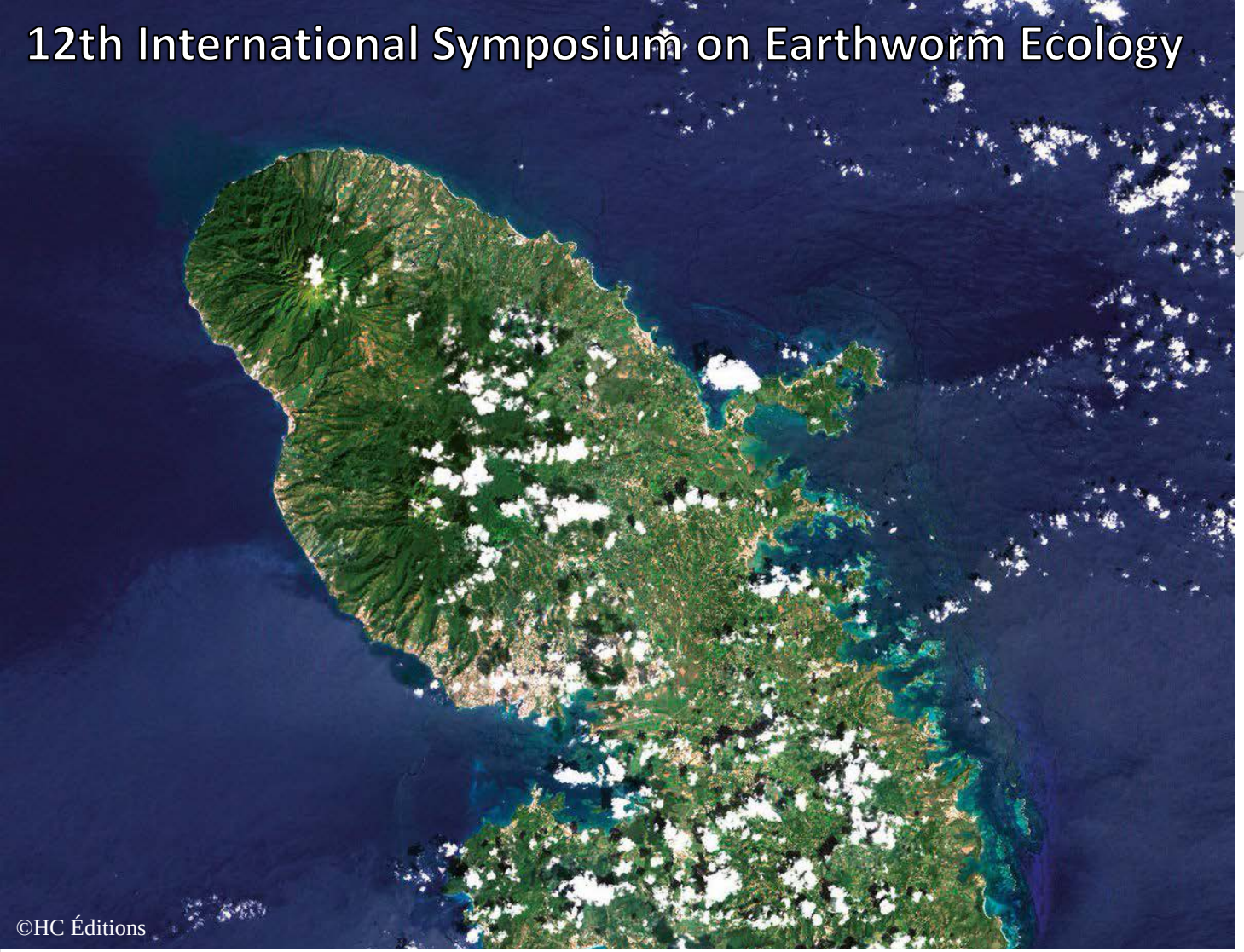
Christiane Mauriol, Lucas Wintz, Mathieu Luce, Nelly Telle, Samuel James

Supported by the **REBIOS Project….**

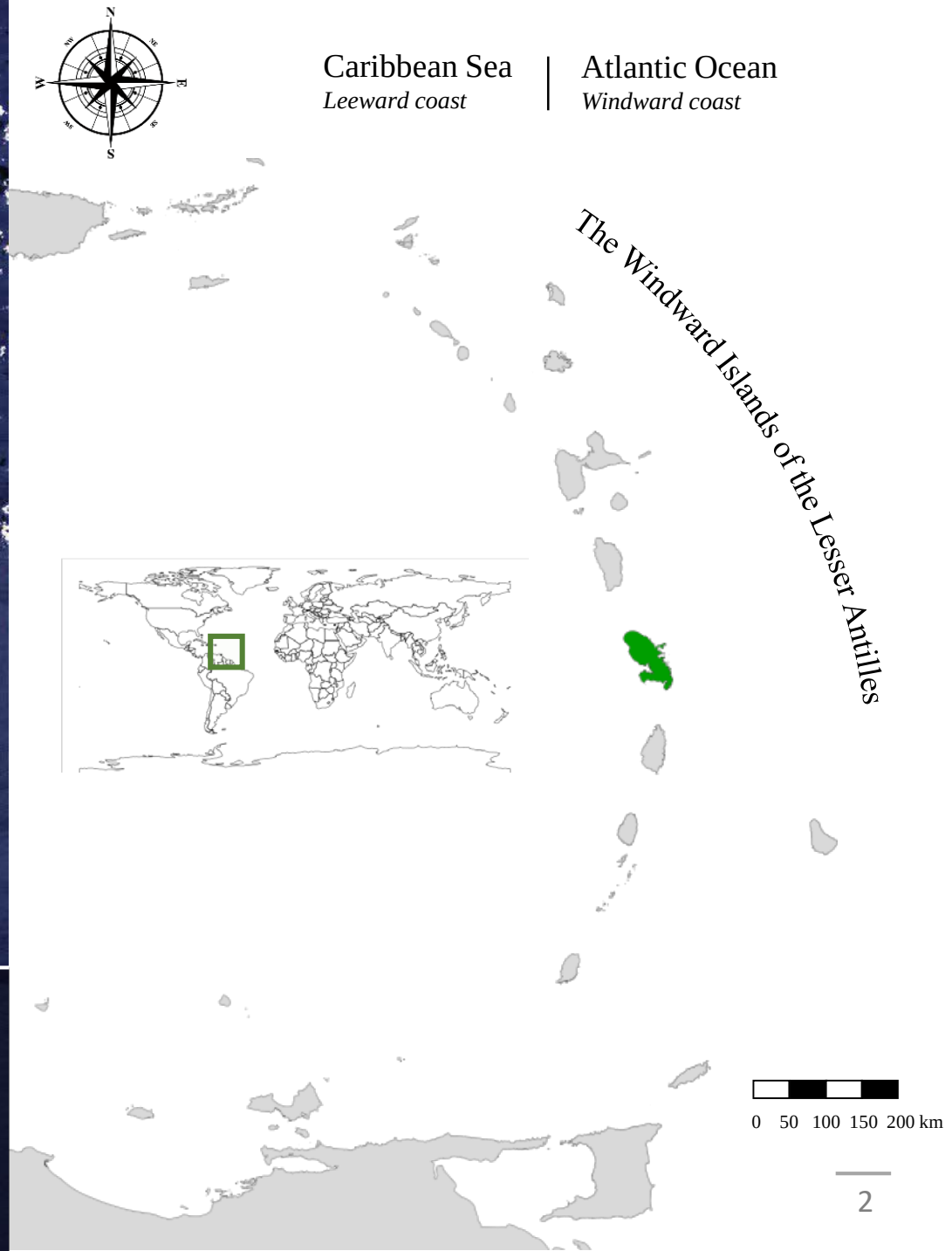
cirad UR GECO

CAEC Campus Agro Environnemental Caraïbe

iEES PARIS Institute of Ecology and Environmental Sciences of Paris



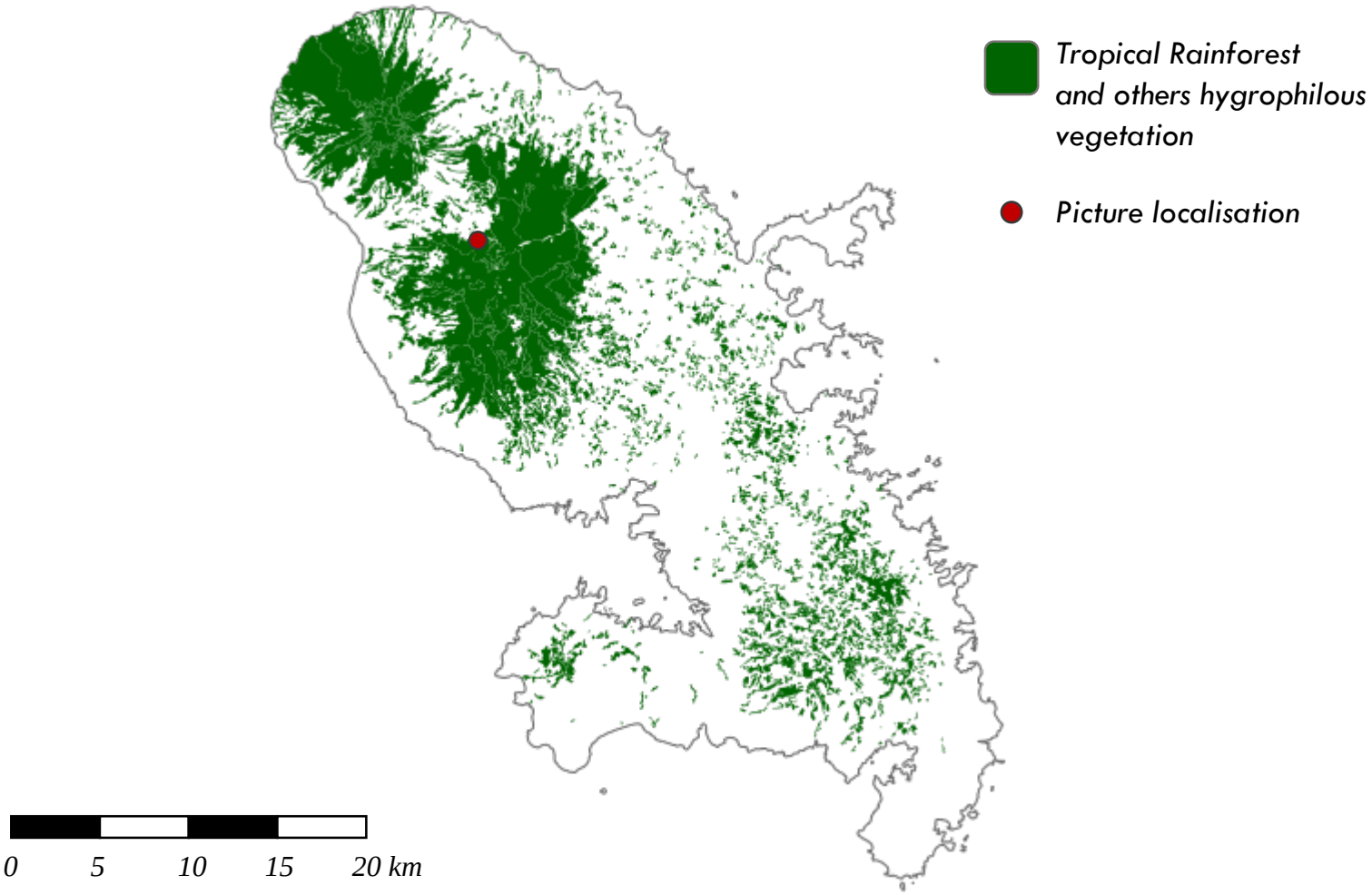
Is there an ecological niche overlap between native and exotic earthworm species in Martinique ?



Tropical Rainforest

Morne Rouge, Sainte Cécile, Departmental forest of the Pitons du Carbet, Crest of the Cournan.

A landscape mosaic shaped by the island's relief and climate and by the social and agricultural history of the island

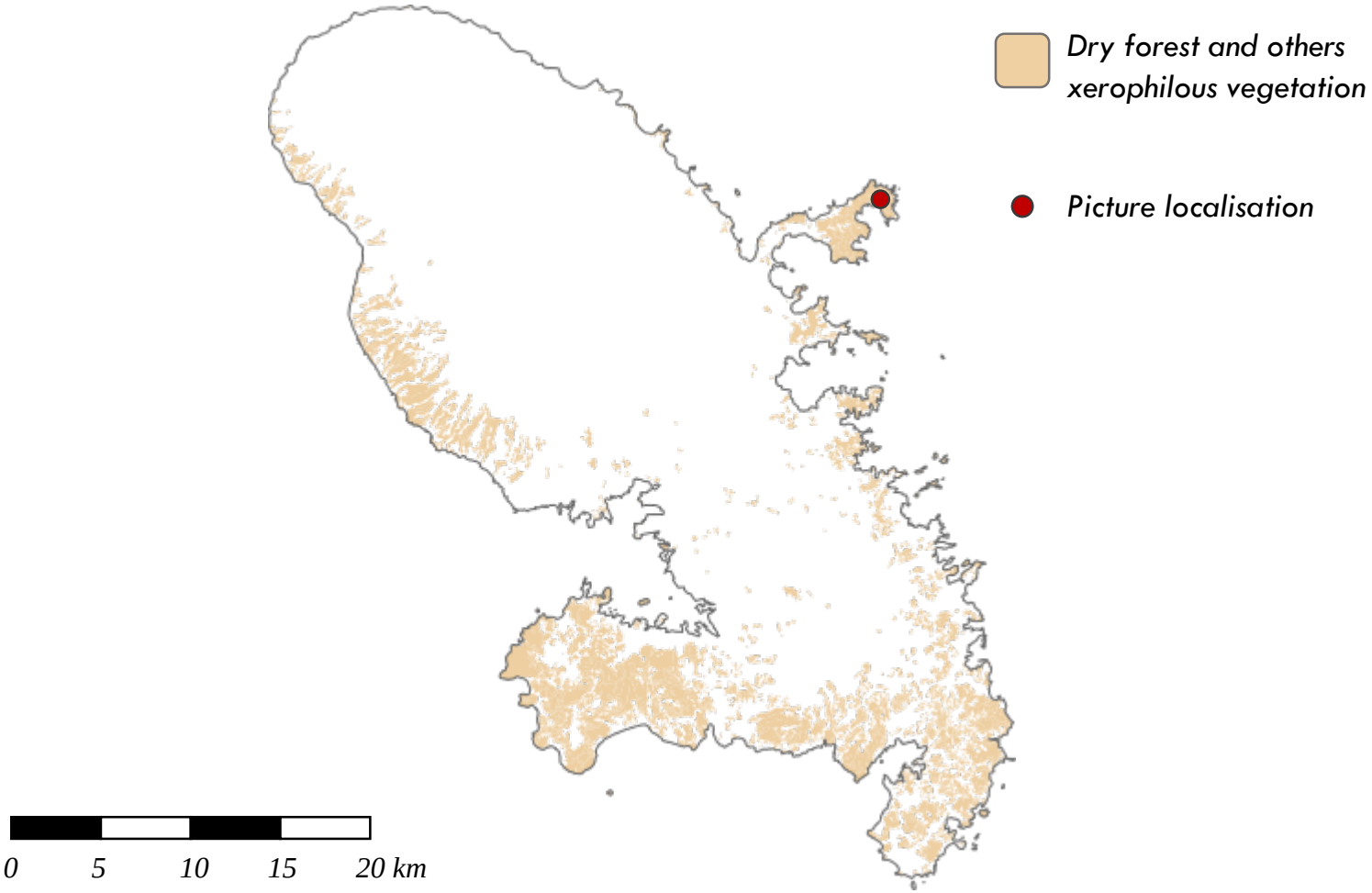


Source : IGN 2018, Diagnostique des forêt de la Martinique

Dry Forest

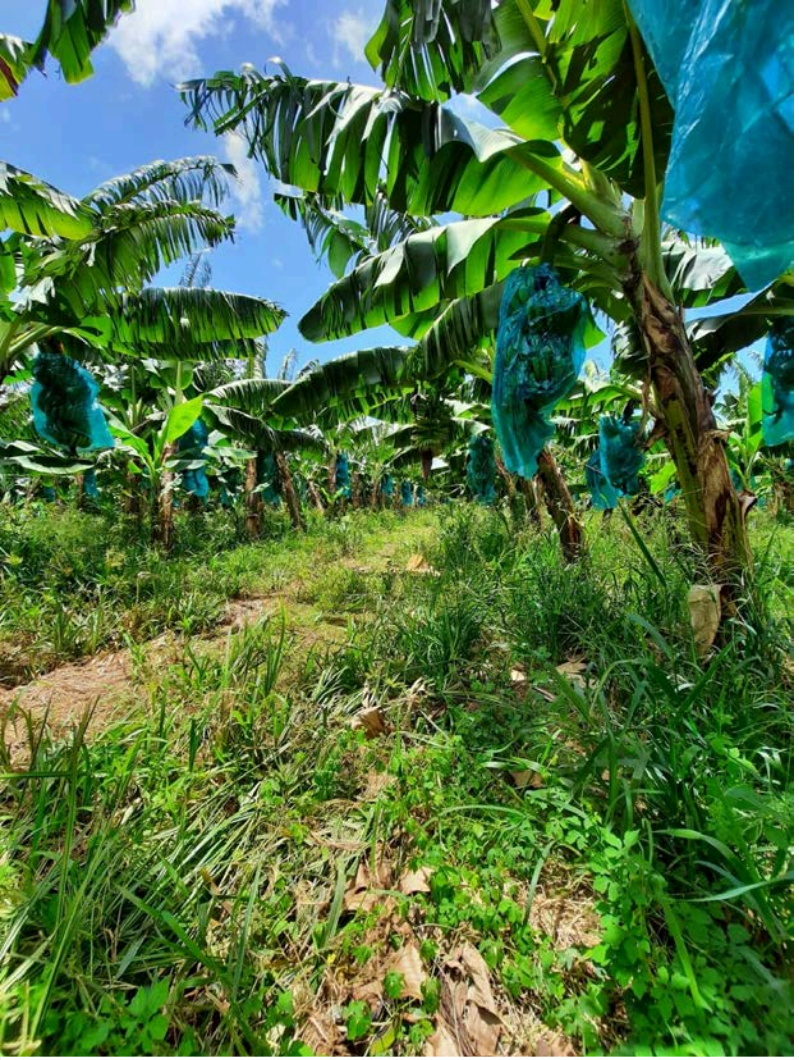
La Trinité, Presqu'île de la Caravelle, Nature Reserve of presqu'île de la Caravelle

A landscape mosaic shaped by the island's relief and climate and by the social and agricultural history of the island



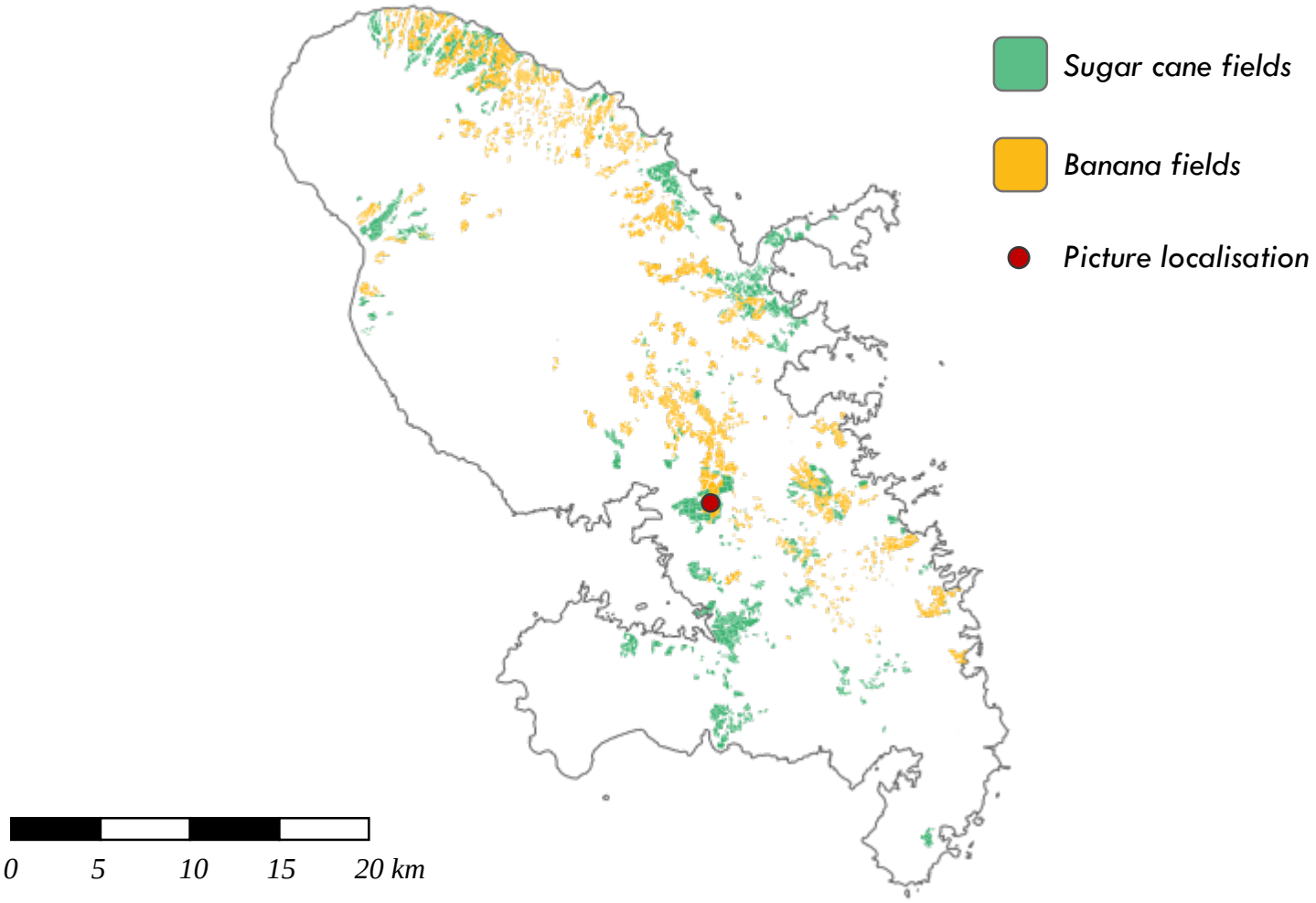
Source : IGN 2018, Diagnostique des forêt de la Martinique

A landscape mosaic shaped by the island's relief and climate and by the social and agricultural history of the island



Banana field

Le Lamentin, Morne Pitault, Habitation Petit Morne

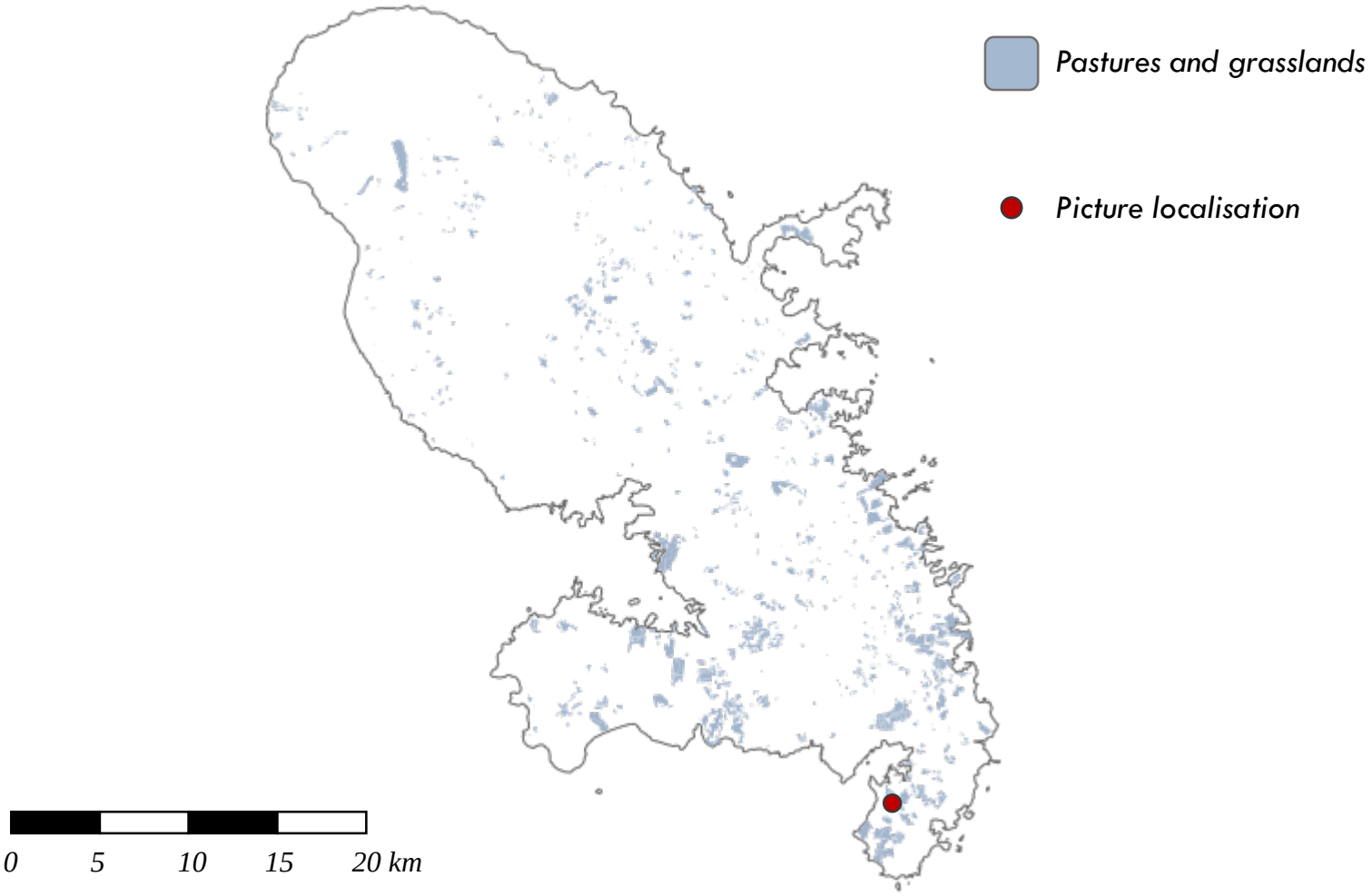


Source : Registre parcellaire graphique 2019

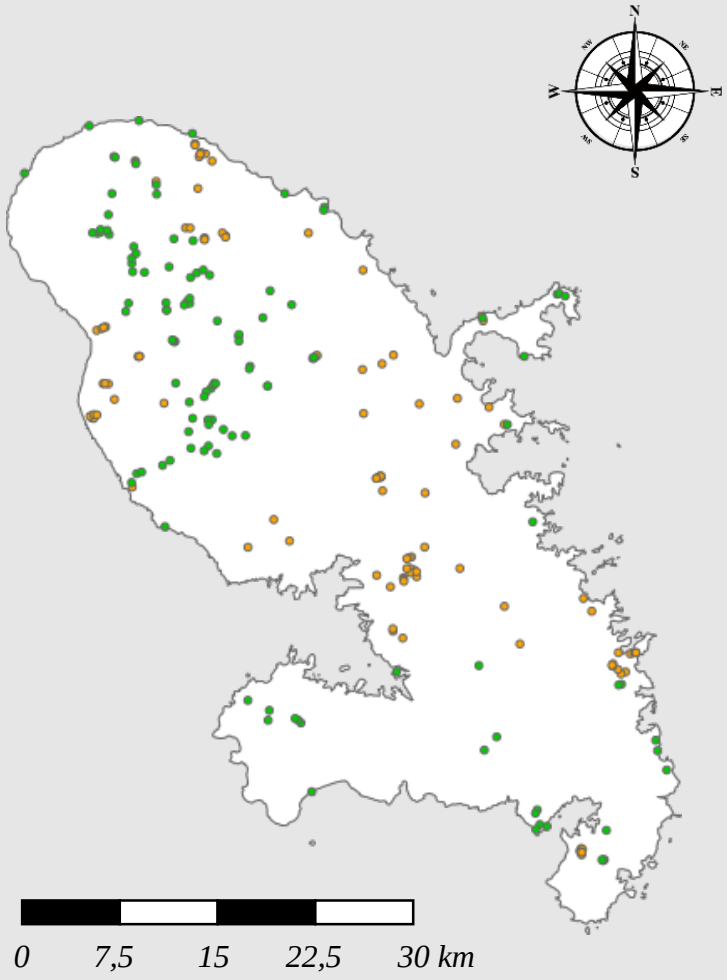
A landscape mosaic shaped by the island's relief and climate and by the social and agricultural history of the island

Pasture

Sainte-Anne, Quartier Val d'Or, Service d'Expérimentation en Agro-écologie



Source : Registre parcellaire graphique 2019



Location of the different sites prospected

Natural and semi-natural sites in green and agricultural sites in orange.

The REBIOS project has enabled a synthesis of CIRAD earthworm data from 2015 to 2022

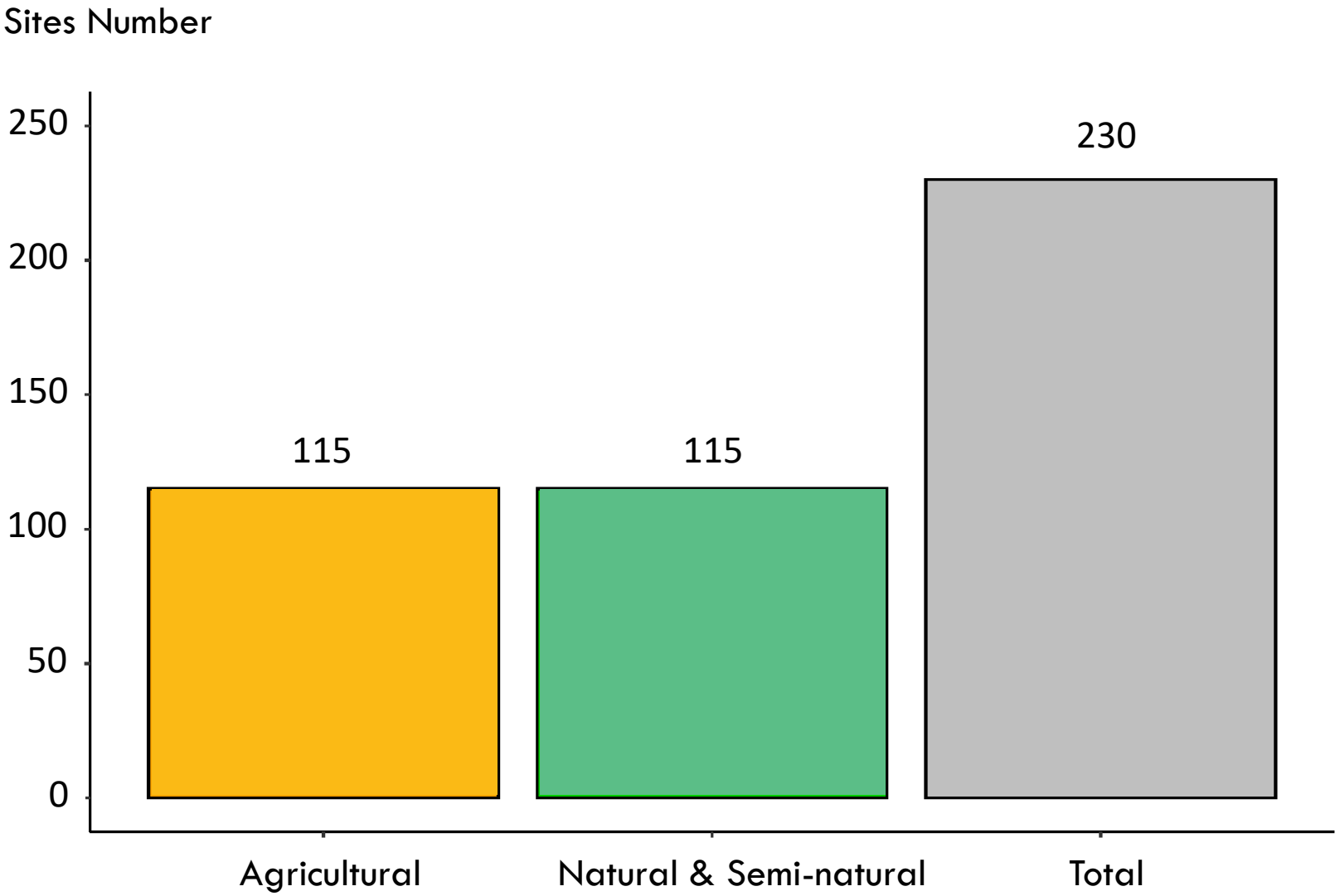
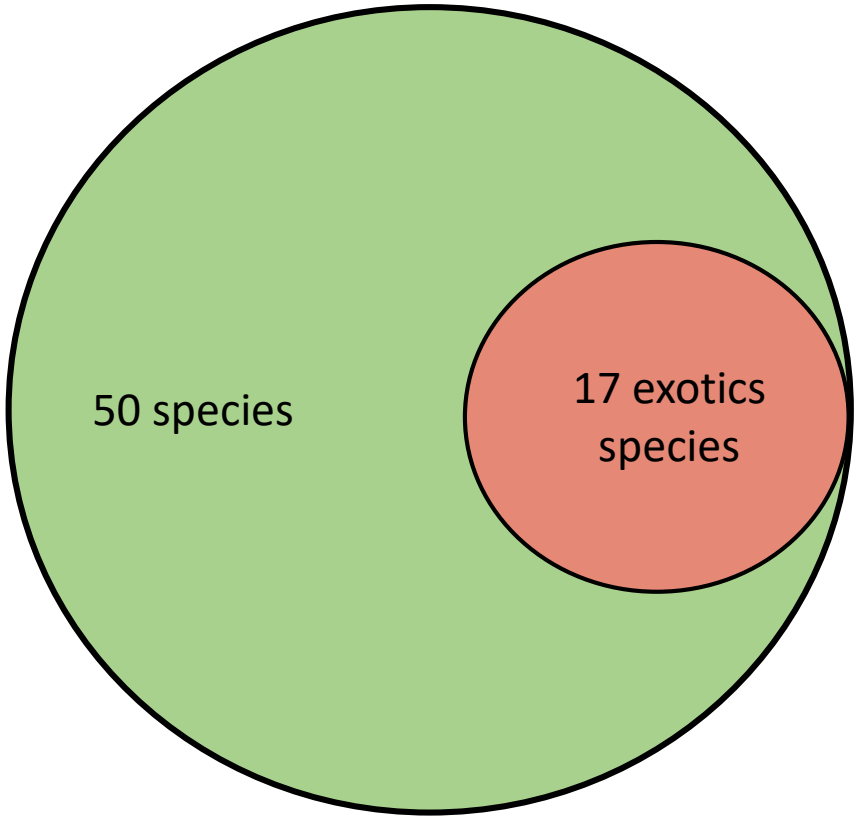


Photo of two earthworm species

1. Photo of an undescribed native specie of the genus Dichogaster. 2. Picture of Dichogaster andina.

This synthesis allowed the identification of an high diversity with a significant number of exotic species (in red on the graph)



Cf. Presentation of Ms Lise Dupont. Biodiversity inventory of earthworms of Martinique through the use of DNA barcoding unveiled both native and introduced species.

Photo of two earthworm species

1. Photo of an undescribed native specie of the genus Dichogaster. 2. Picture of Dichogaster andina.

Do these species share a common distribution area ?

Is it important ?

How can it be quantified ?

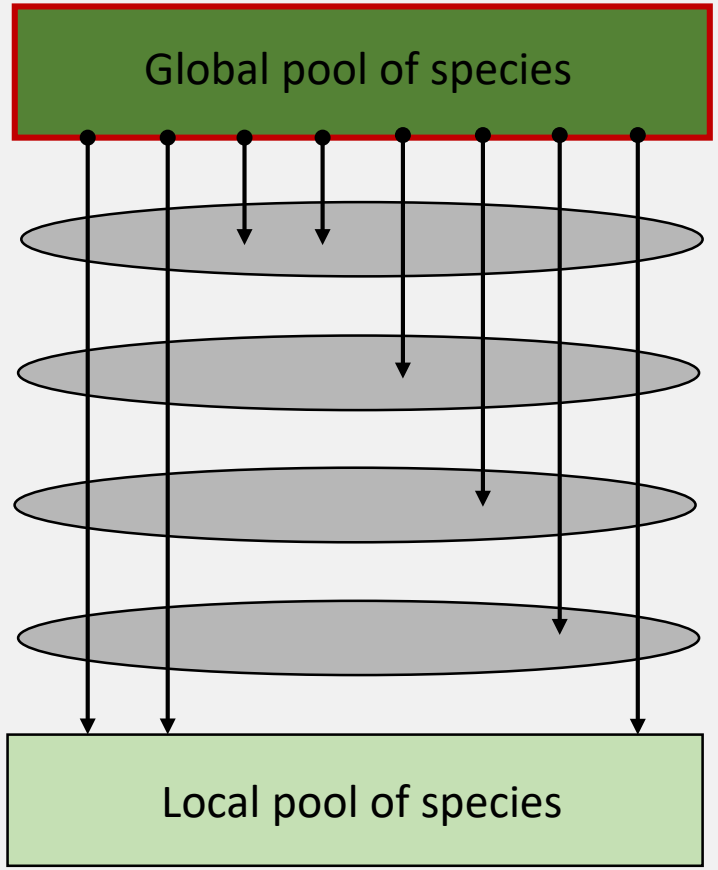


Figure 1. Environmental filters

After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

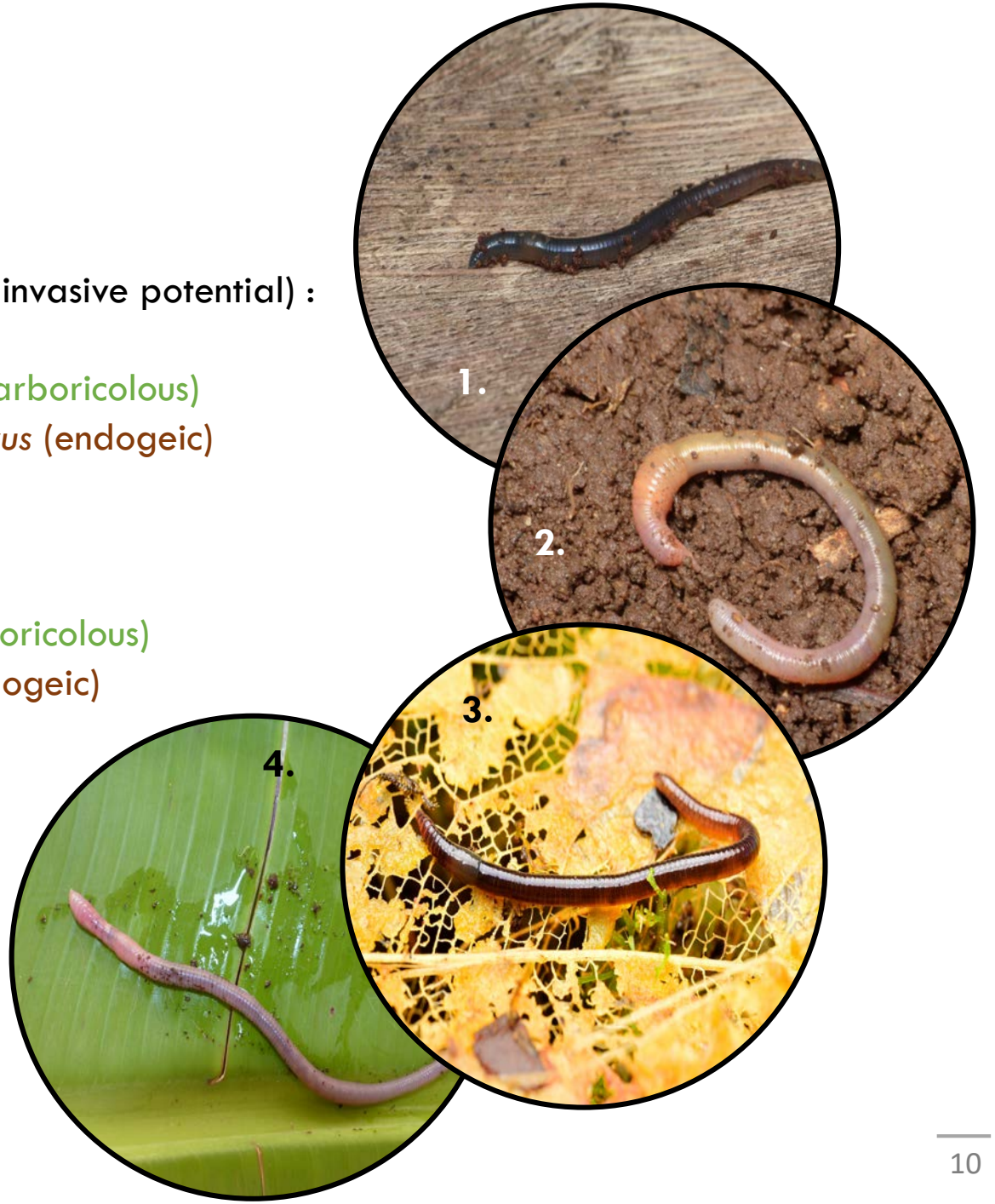
Which species ?

Exotic species (with an invasive potential) :

1. *Dichogaster andina* (arboricolous)
2. *Pontoscolex corethrurus* (endogeic)

Native species

3. *Dichogaster sp6* (arboricolous)
4. *Glossodrilus sp1* (endogeic)



How are these species distributed in Martinique ?

Photo of two earthworm species

1. Photo of an undescribed native specie of the genus Dichogaster. 2. Picture of Dichogaster andina.

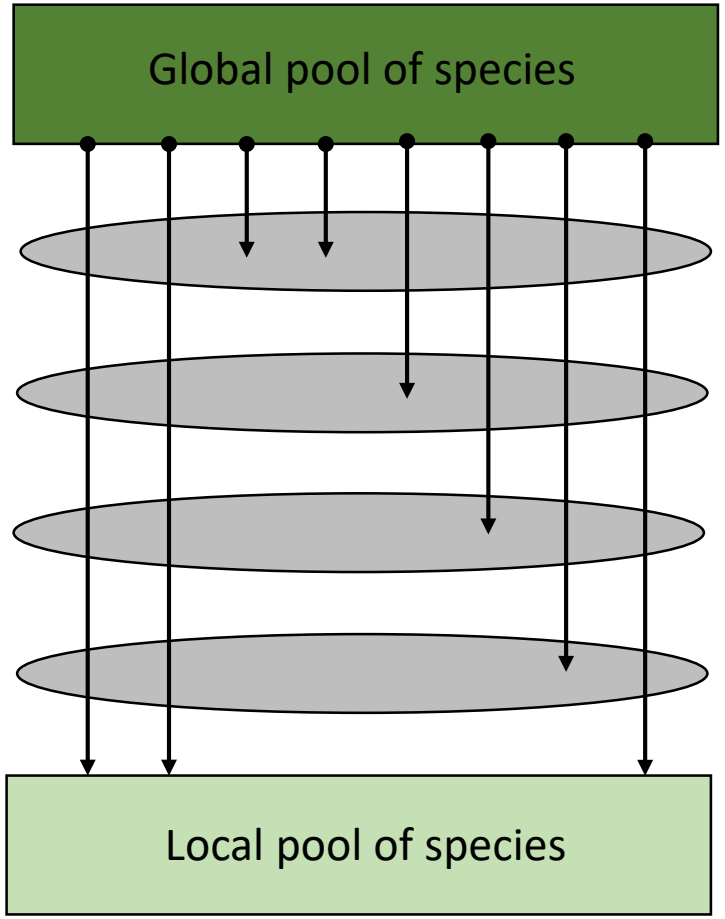


Photo of two earthworm species

1. Photo of an undescribed native specie of the genus Dichogaster. 2. Picture of Dichogaster andina.

How do different environmental filters affect their distributions ?

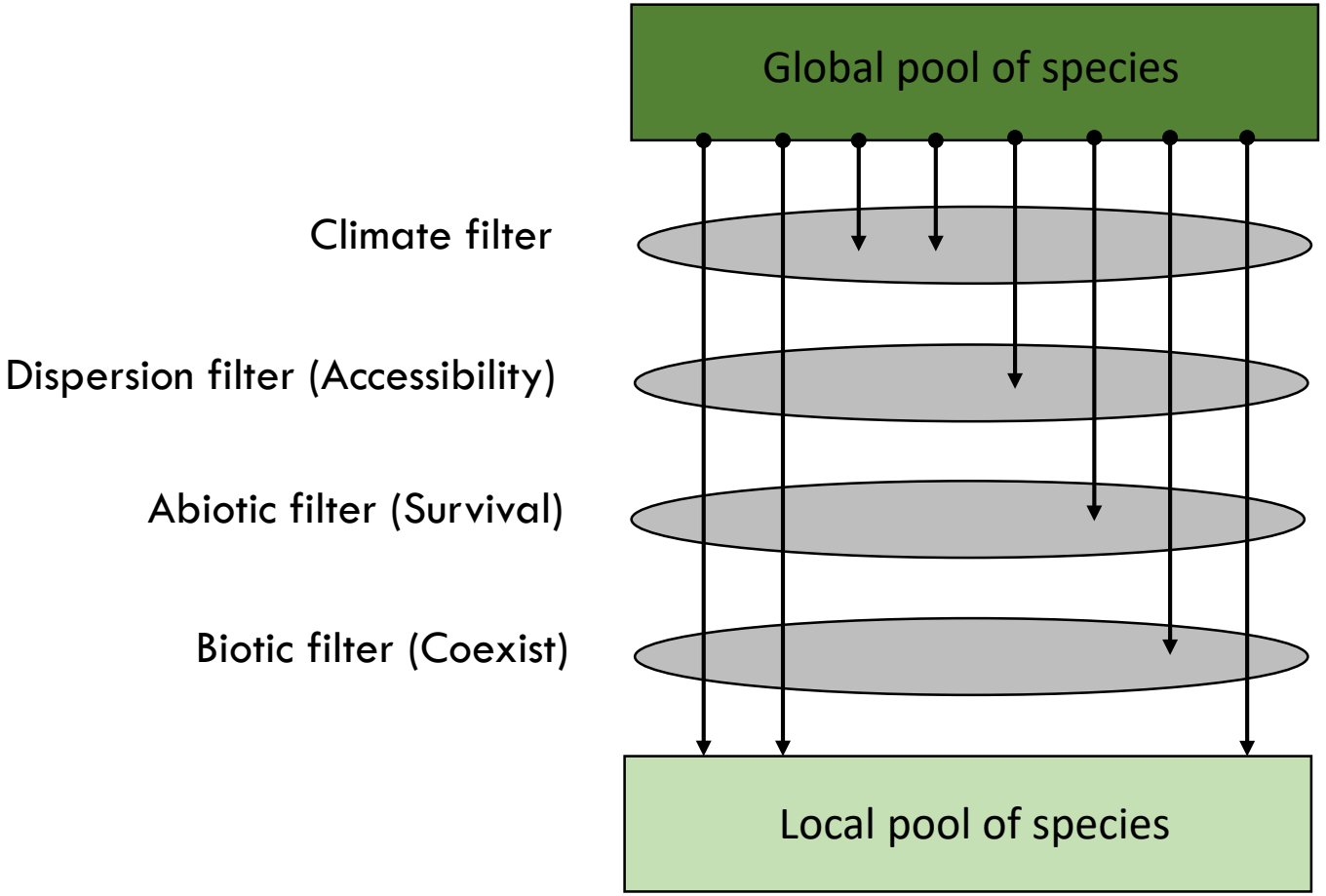


Photo of two earthworm species

1. Photo of an undescribed native specie of the genus Dichogaster. 2. Picture of Dichogaster andina.

How do different environmental filters affect their distributions ?

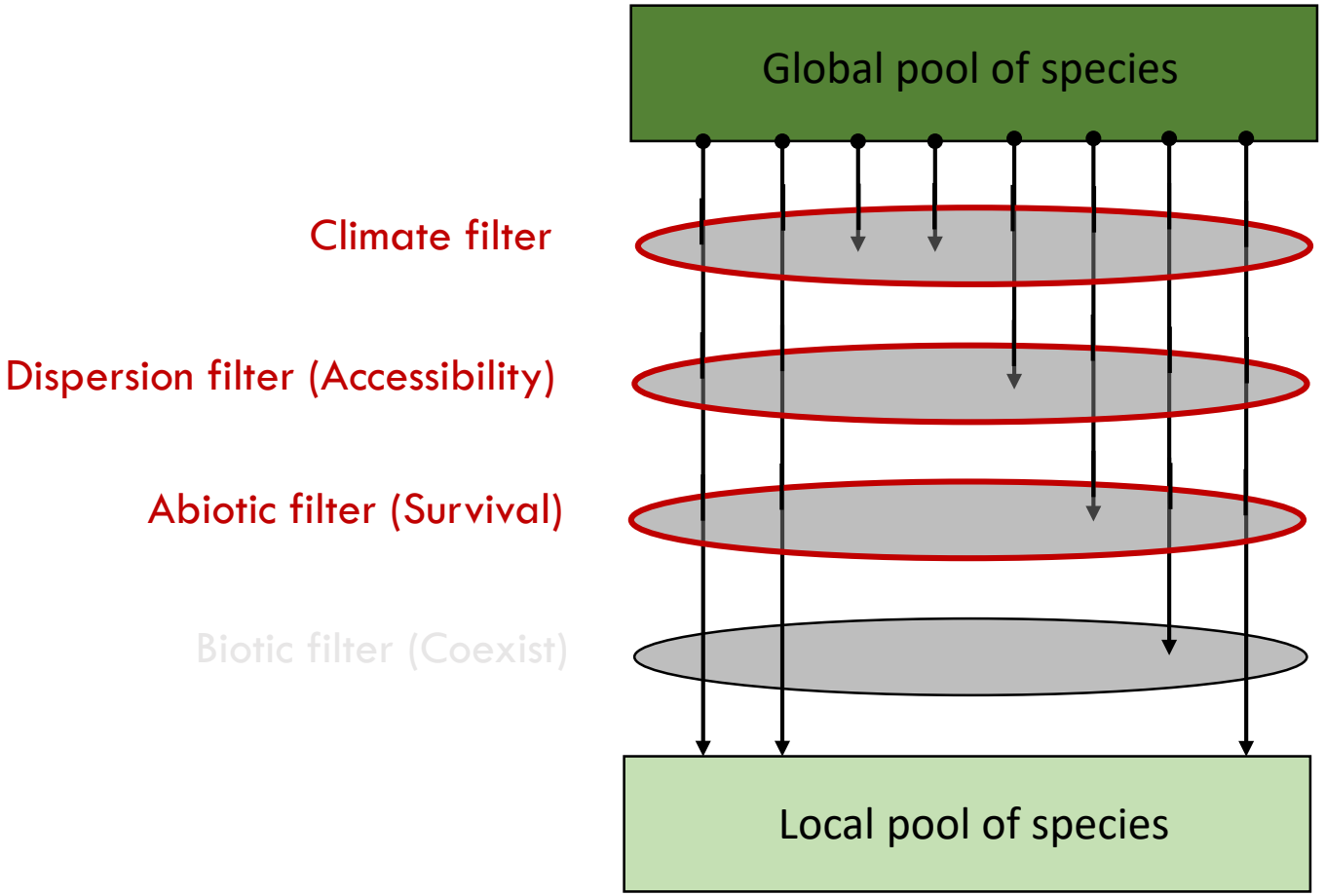
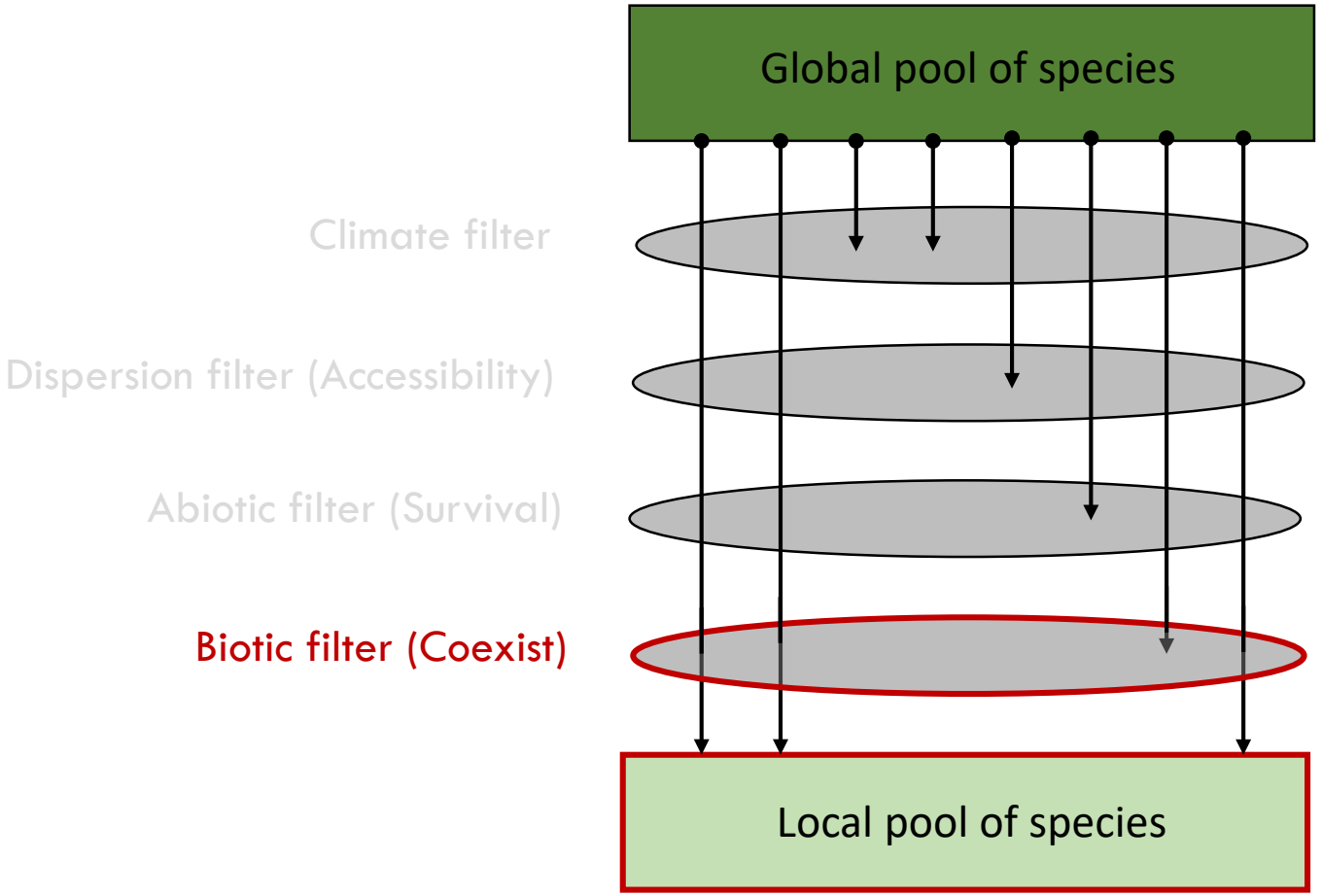


Photo of two earthworm species

1. Photo of an undescribed native specie of the genus Dichogaster. 2. Picture of Dichogaster andina.

Is there an ecological niche overlap between native and exotic earthworm species in Martinique ?



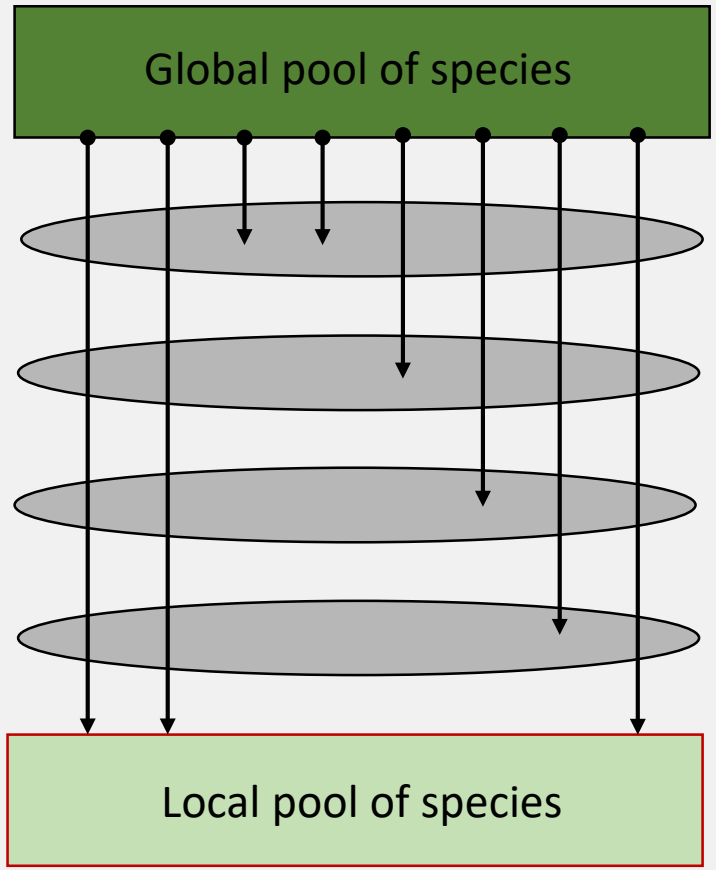


Figure 1. Environmental filters

After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

How can the geographical distribution of the species be predicted?

The MaxEnt program : Maximum entropy method (Phillips *et al.* 2006)

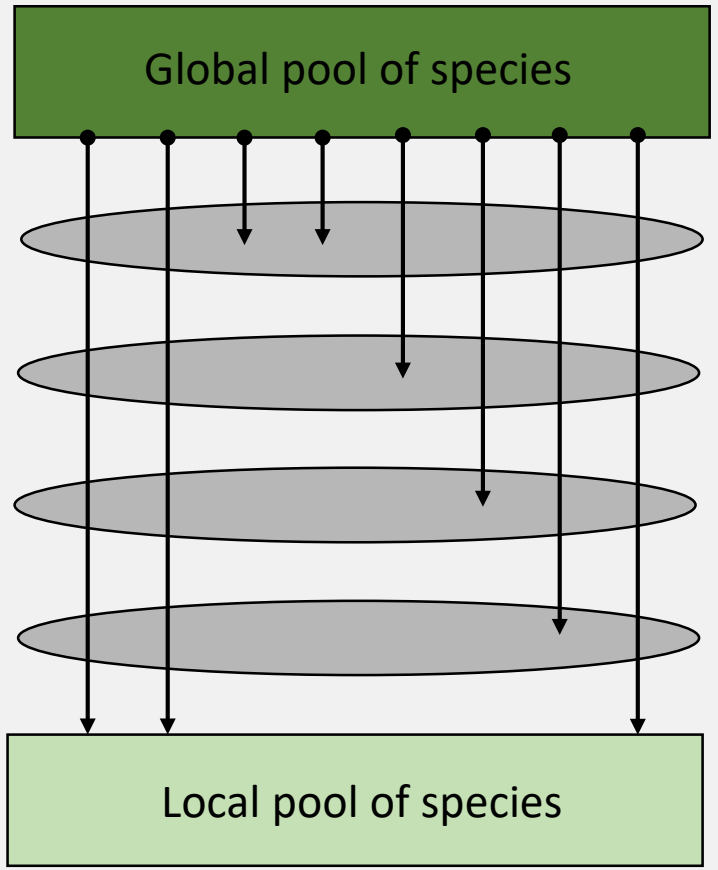


Figure 1. Environmental filters

After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

Why this method ?

The MaxEnt program : Maximum entropy method (Phillips *et al.* 2006)

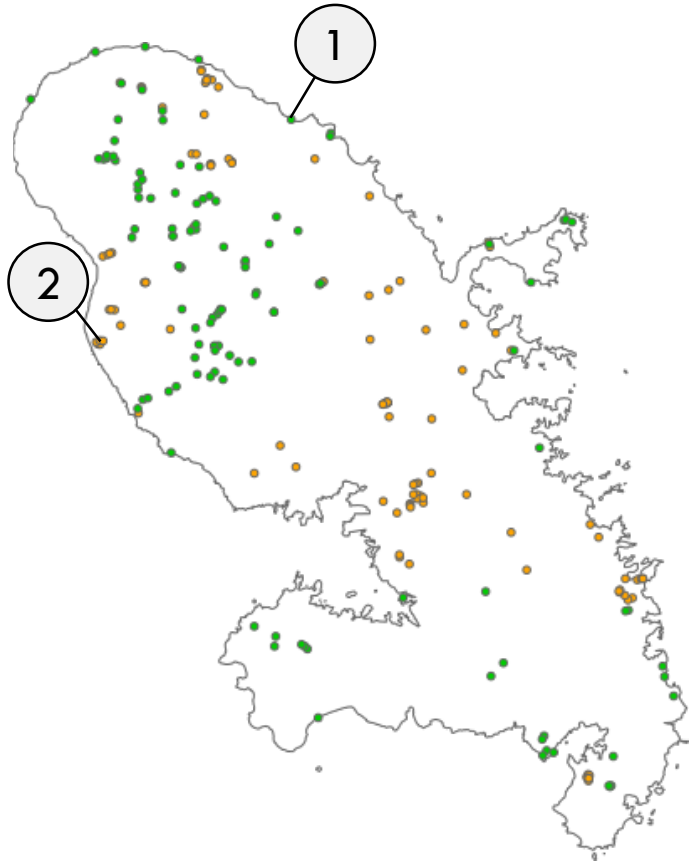
The dataset : absence data not available for each site

1

Sampling method : extraction of 5 blocs (30x30x30)
Number of earthworms found : 50

2

Sampling method : Litter digging (10 minutes)
Number of earthworms found : 2



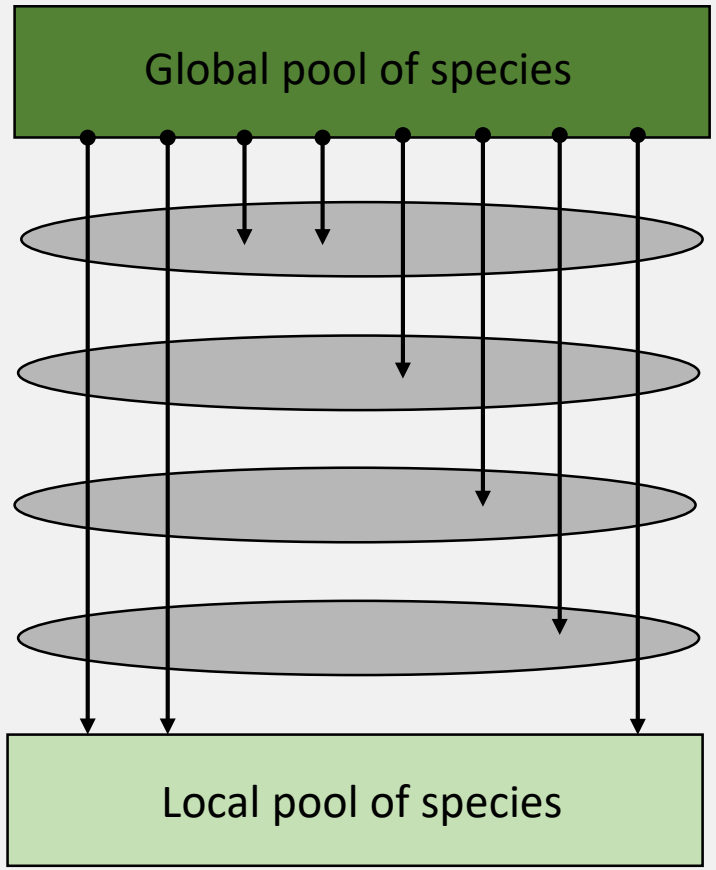


Figure 1. Environmental filters

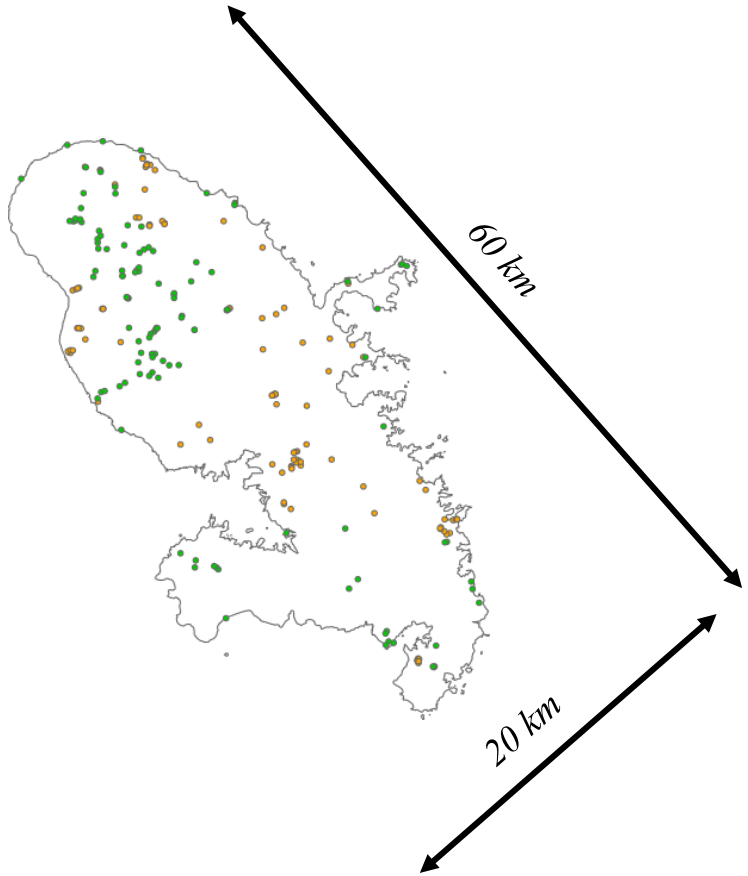
After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

Why this method ?

The MaxEnt program : Maximum entropy method (Phillips *et al.* 2006)

The dataset : Presence only program (Phillips *et al.* 2006)

The study area: Show great results at low scale (Elith *et al.* 2010)



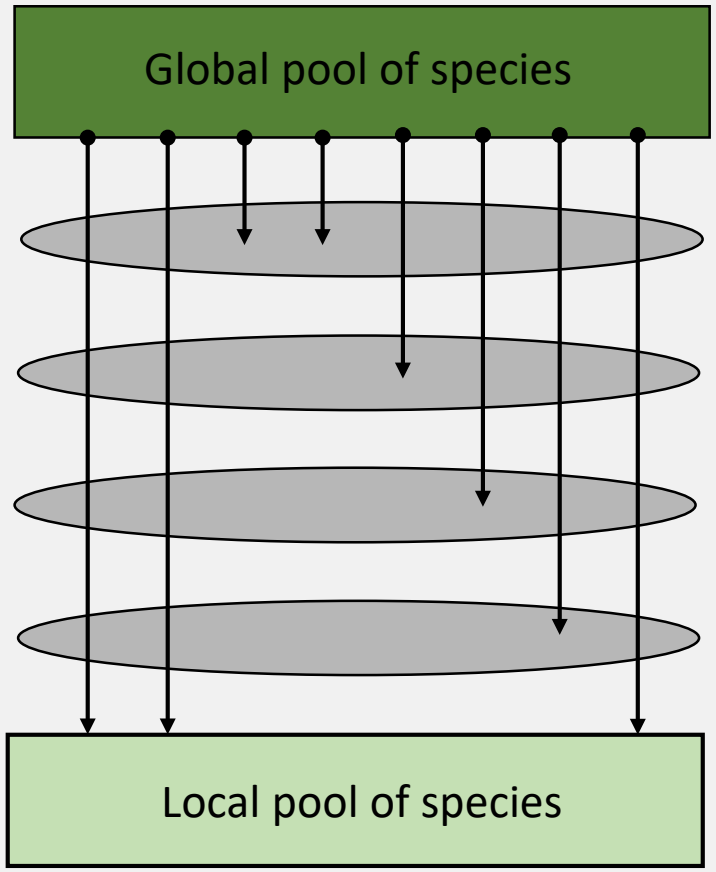


Figure 1. Environmental filters

After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

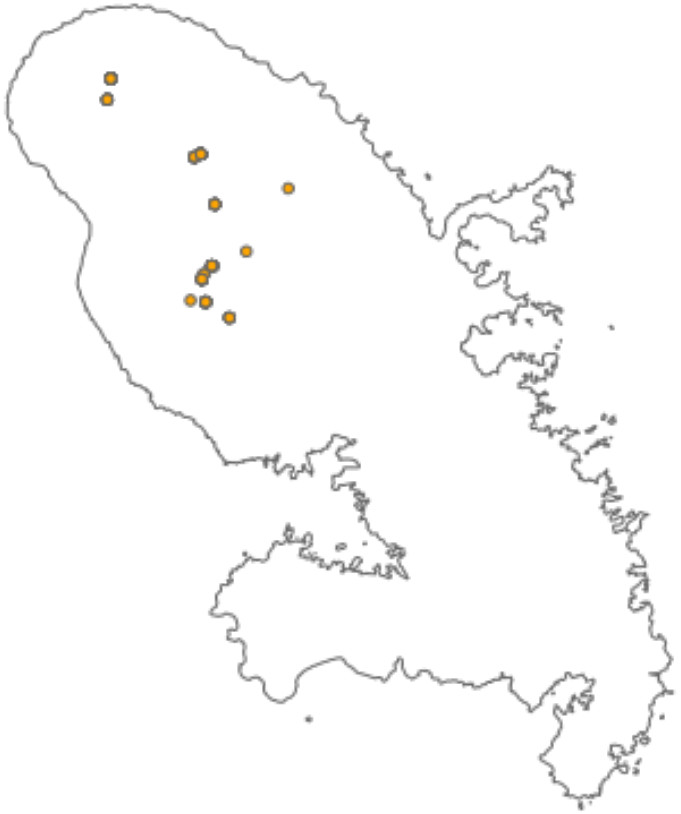
Why this method ?

The MaxEnt program : Maximum entropy method (Phillips *et al.* 2006)

The dataset : Presence only program (Phillips *et al.* 2006)

The study area : Show great results at low scale (Elith *et al.* 2010)

Occurrence number : Rare species occurrence (Phillips *et al.* 2006)



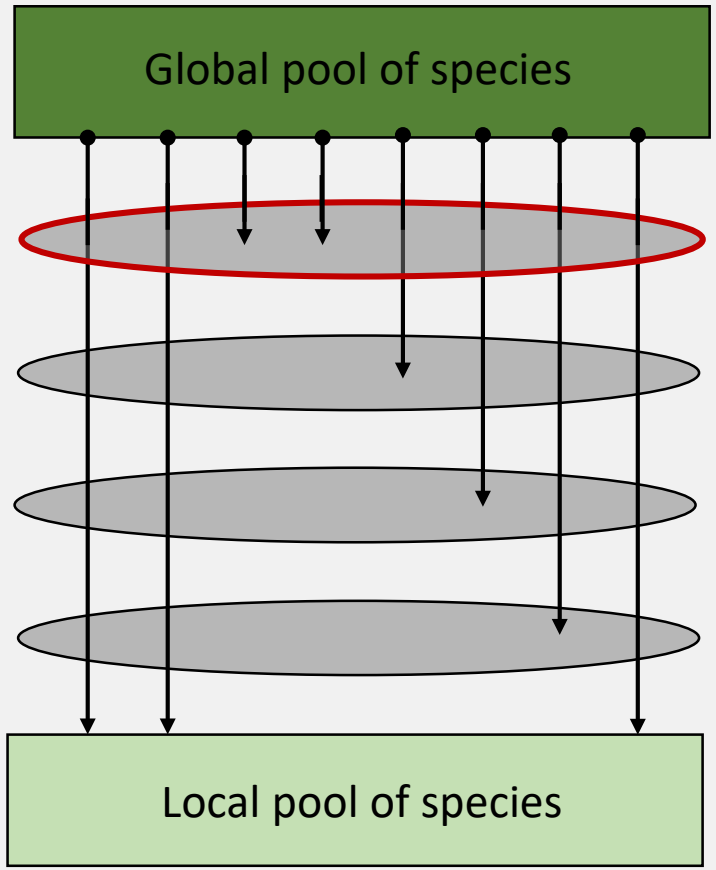
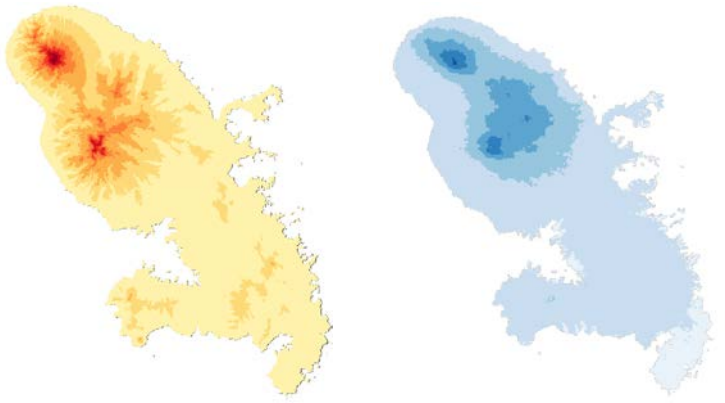


Figure 1. Environmental filters

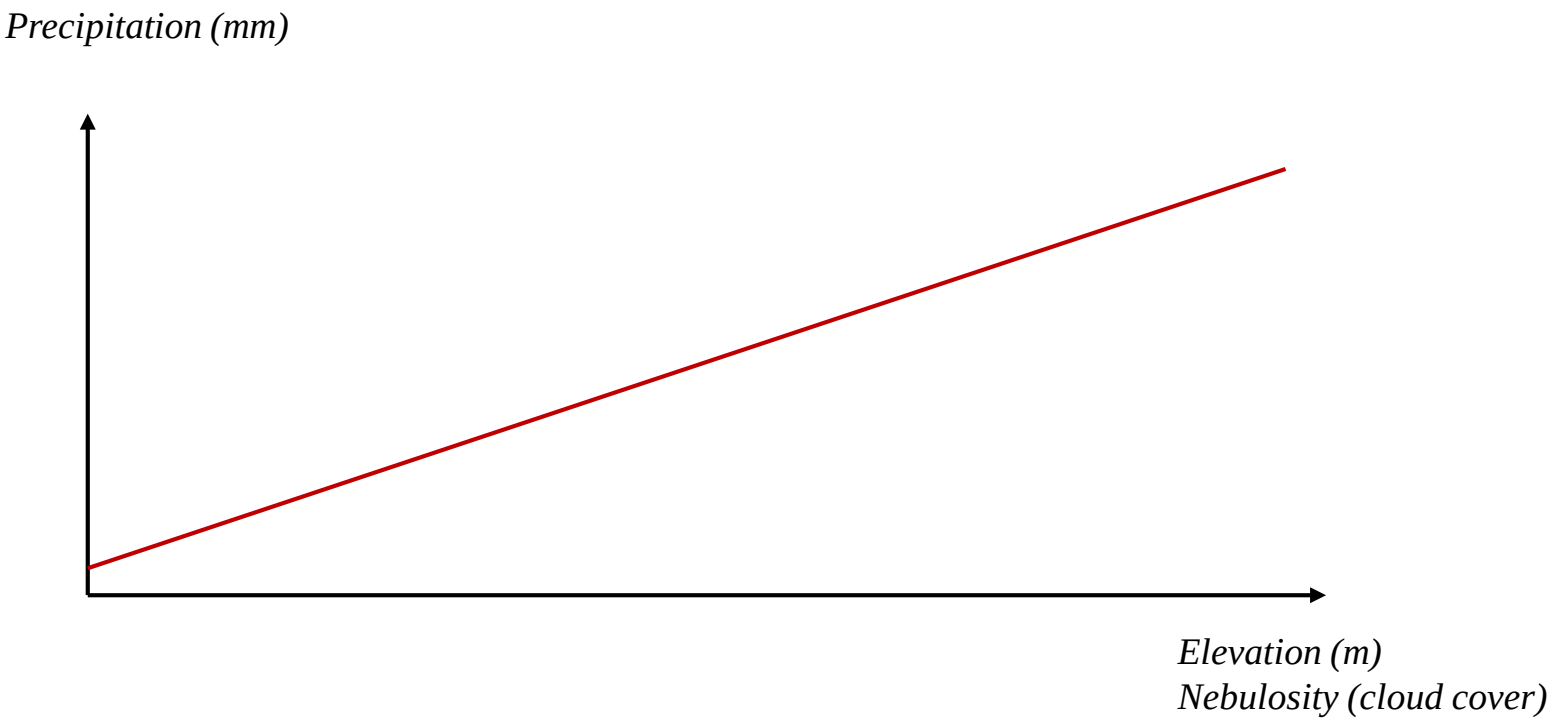
After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

Which variables to select ?

The Climatic filter



Elevation Nebulosity



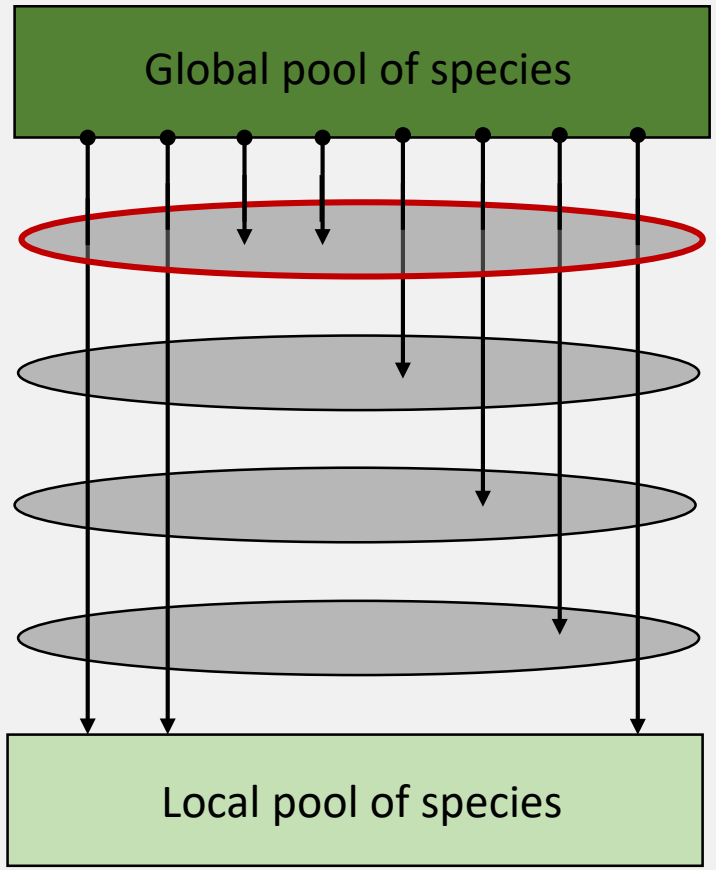
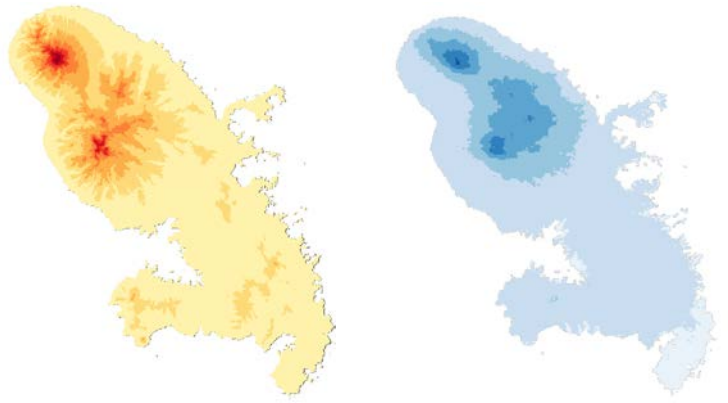


Figure 1. Environmental filters

After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

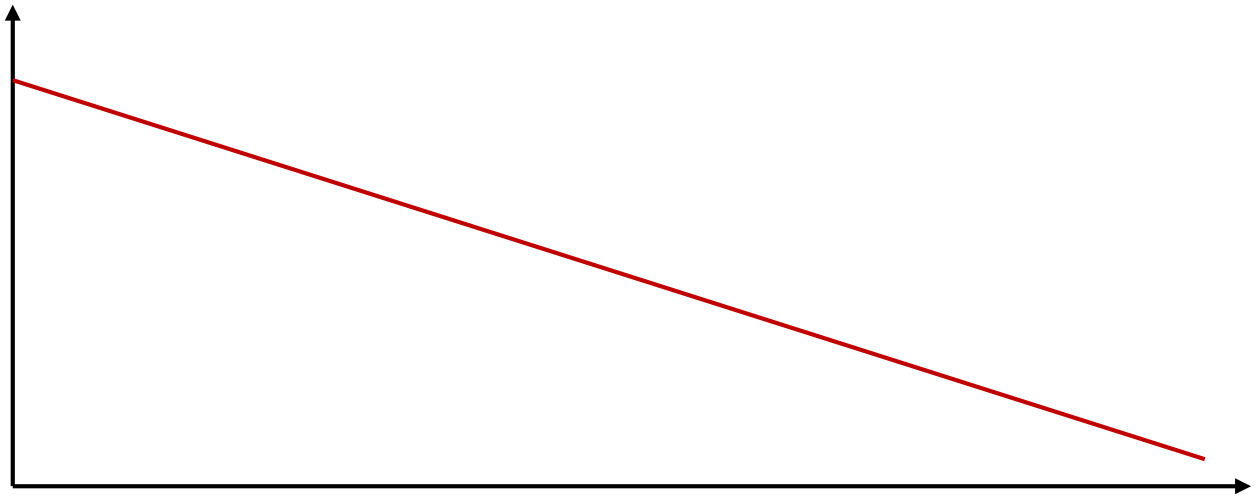
Which variables to select ?

The Climatic filter



Elevation Nebulosity

Temperature (°C)
Seasonal effect



Elevation (m)
Nebulosity (cloud cover)

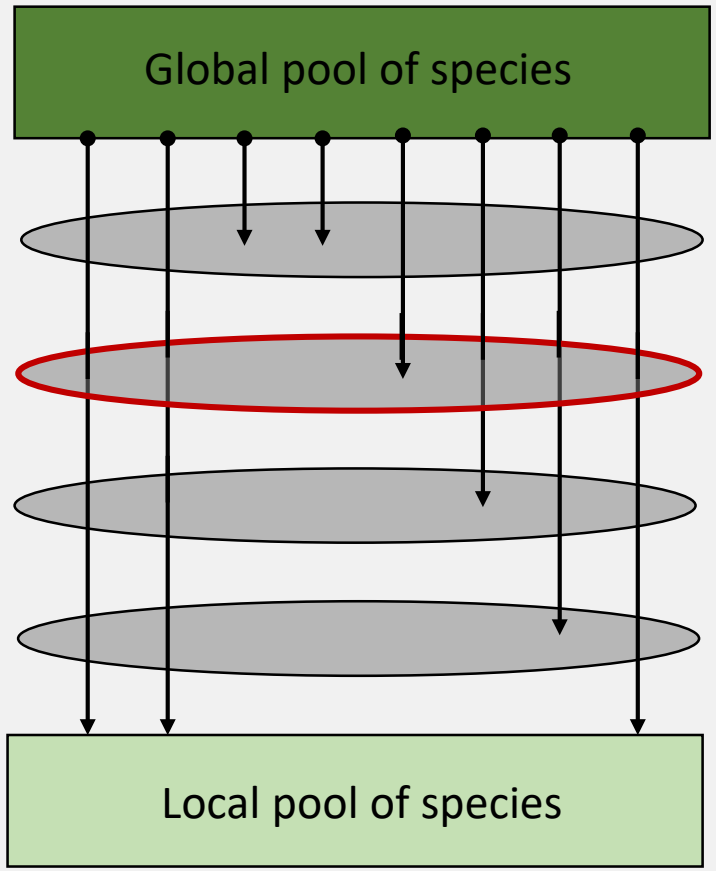
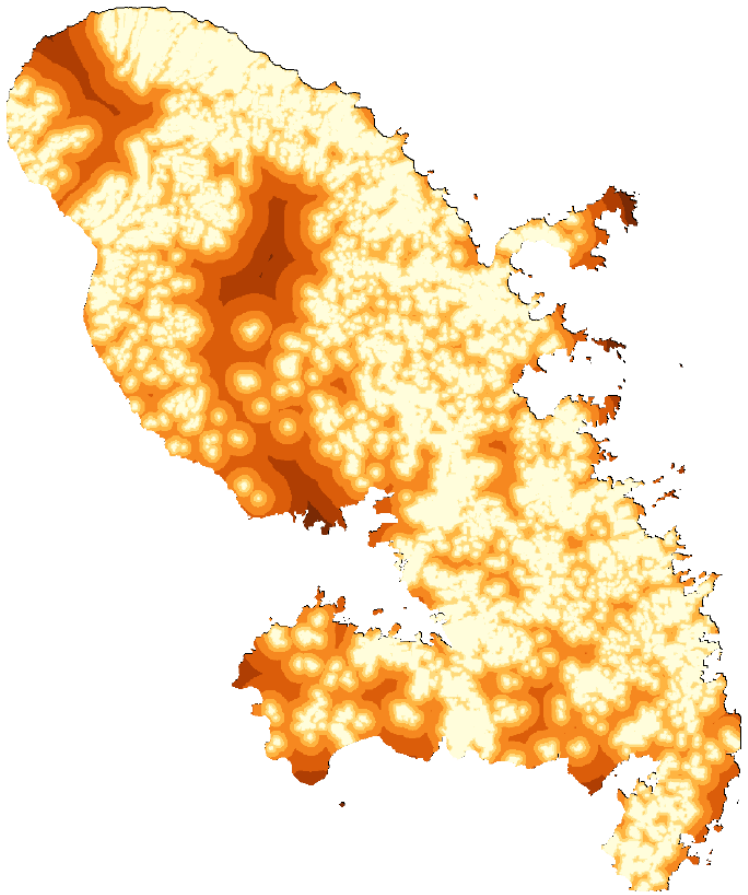


Figure 1. Environmental filters

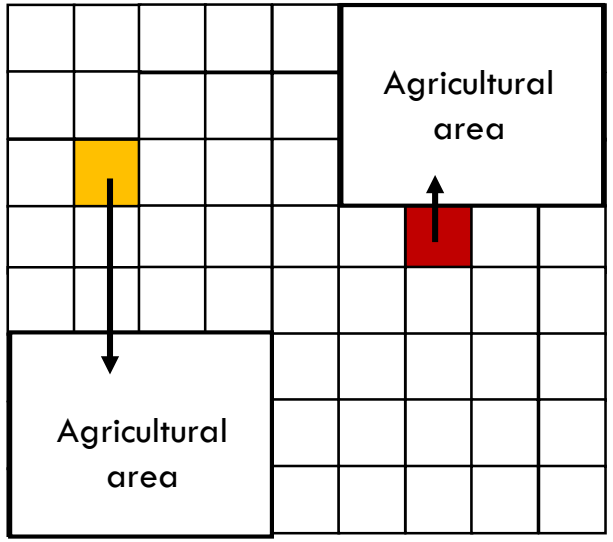
After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

Which variables to select ?

Dispersion filter (Accessibility)



Minimal distance from an agricultural area (m) after Registre parcellaire 2019



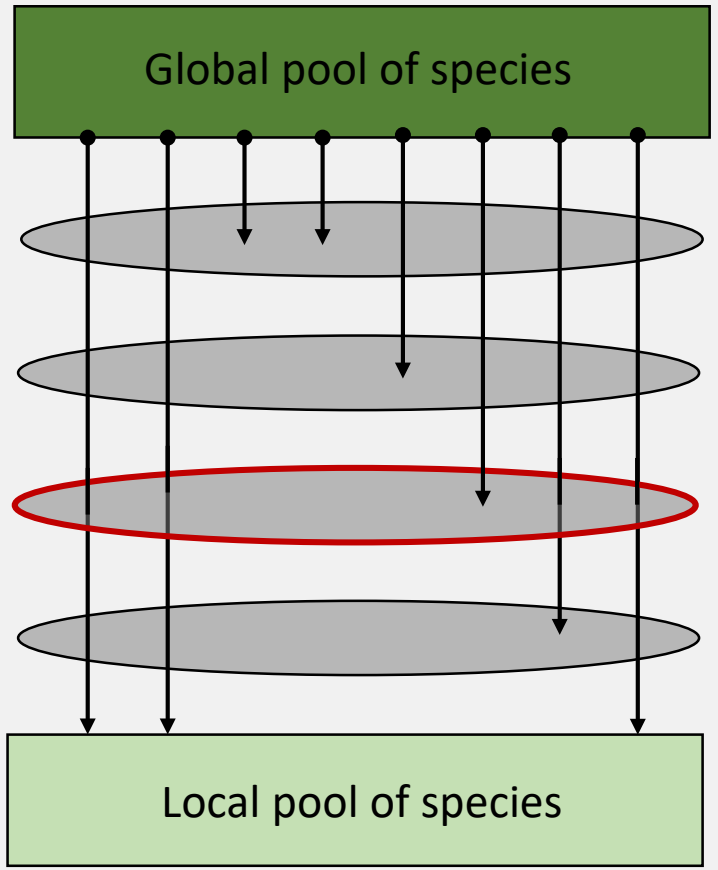
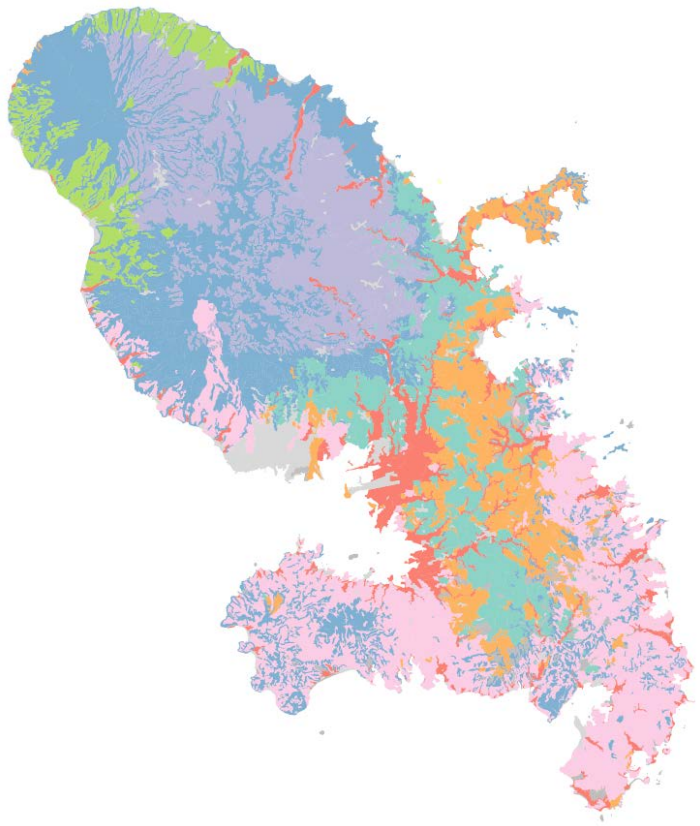


Figure 1. Environmental filters

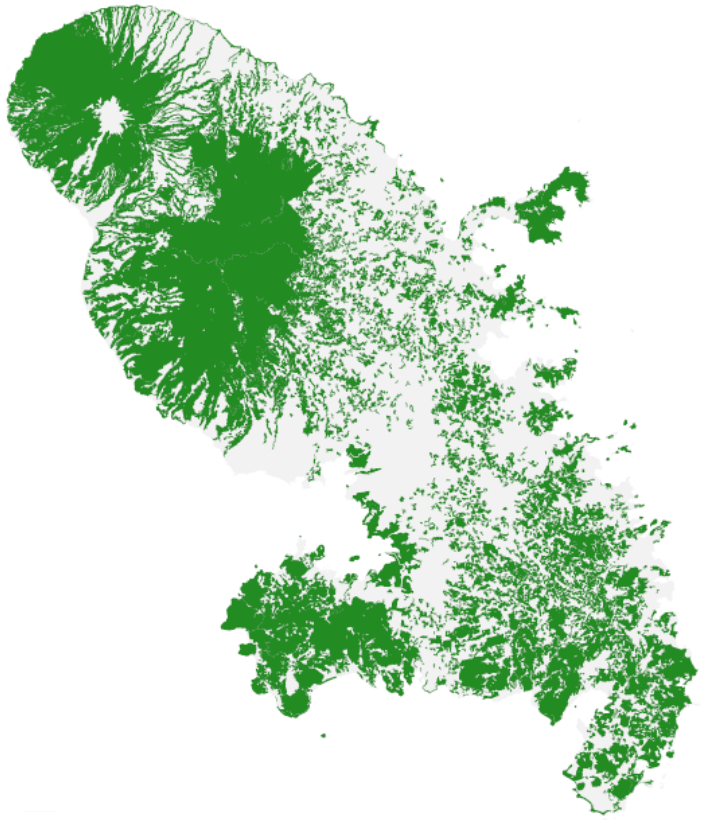
After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

Which variables to select ?

Abiotic filter (Survival)



Soil type (*Colmet-Daâge* 1969)



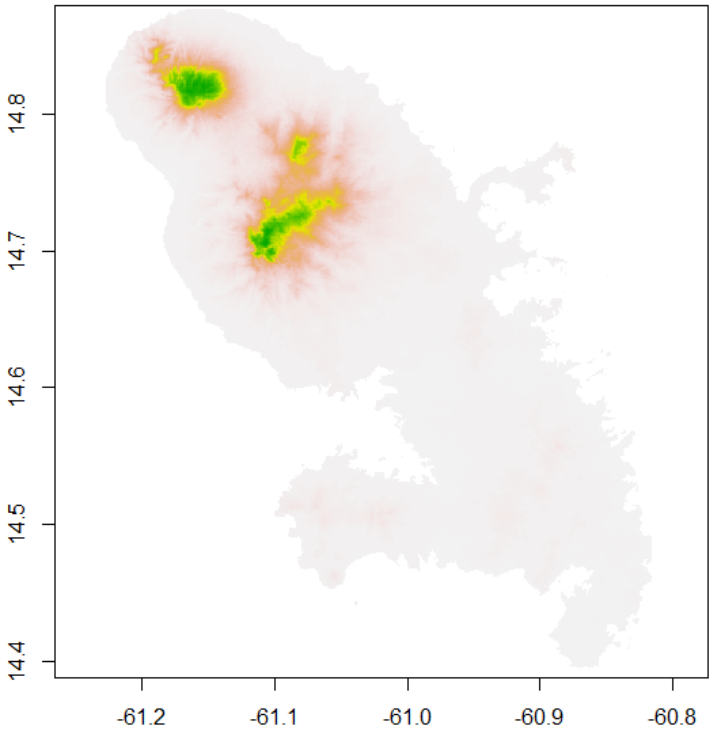
Arboreal vegetaion (*OCS-GE 2017*)

Bromeliaceae

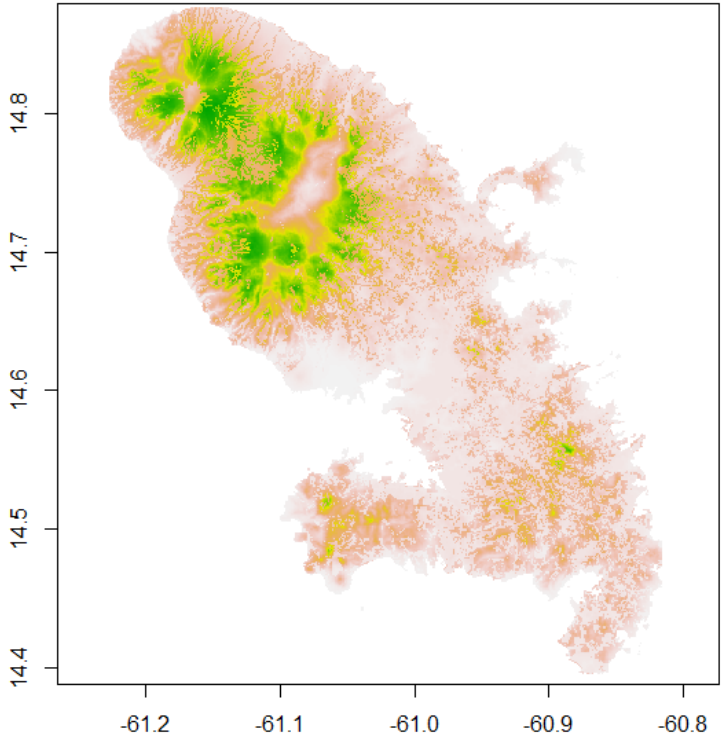
Bromeliad tank can be great habitat for arboricolous species

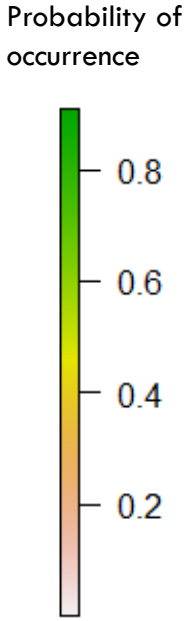
Geographical distribution of arboricolous species

Dichogaster sp6



Dichogaster andina





Models were calibrated according to the recommendations of Phillips et al. 2006 and evaluated by Crossvalidation (10 replicates) and ROC curves (all AUC scores > 0.8).

Bromeliaceae

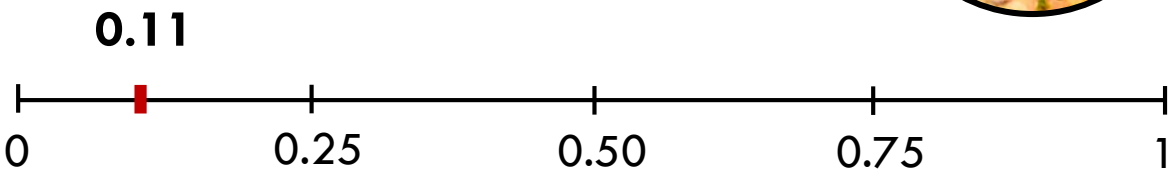
Tank bromeliad can be great habitat for arboricolous species

Niche breadth of arboricolous species

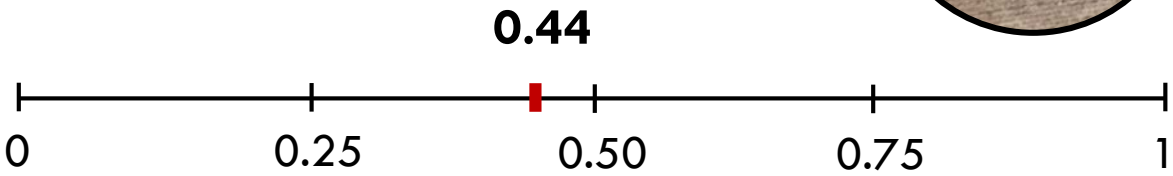
Levins (1968) Index B2

(0 : extrem specialist, 1 : extrem generalist)

Dichogaster sp6



Dichogaster andina



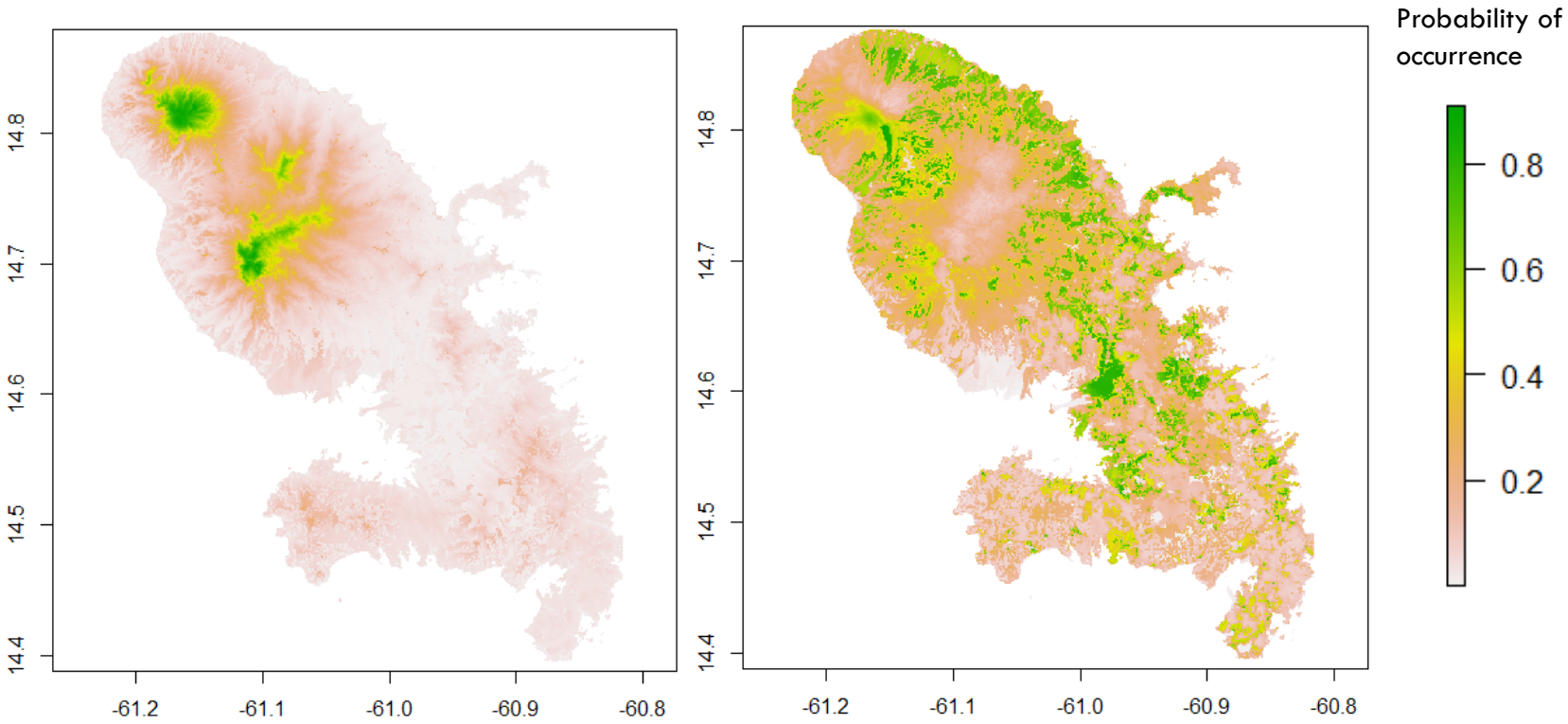
Geographical distribution of endogeic species

Soil matrix

Soil matrix excavation in a banana plantation (Le Vauclin, Petite Grenade, Belle étoile)

Glossodrilus sp1

Pontoscolex corethrurus



Models were calibrated according to the recommendations of Phillips et al. 2006 and evaluated by Crossvalidation (10 replicates) and ROC curves (all AUC scores > 0.8).

Soil matrix

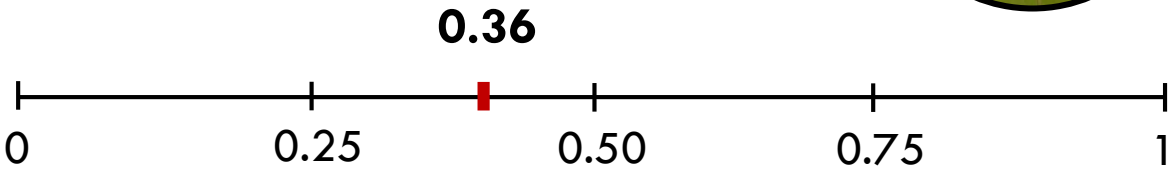
Soil matrix excavation in a banana plantation (Le Vauclin, Petite Grenade, Belle étoile)

Niche breadth of endogeic species

Levins (1968) Index B2

(0 : extrem specialist, 1 : extrem generalist)

Glossodrilus sp1



P. corethrurus

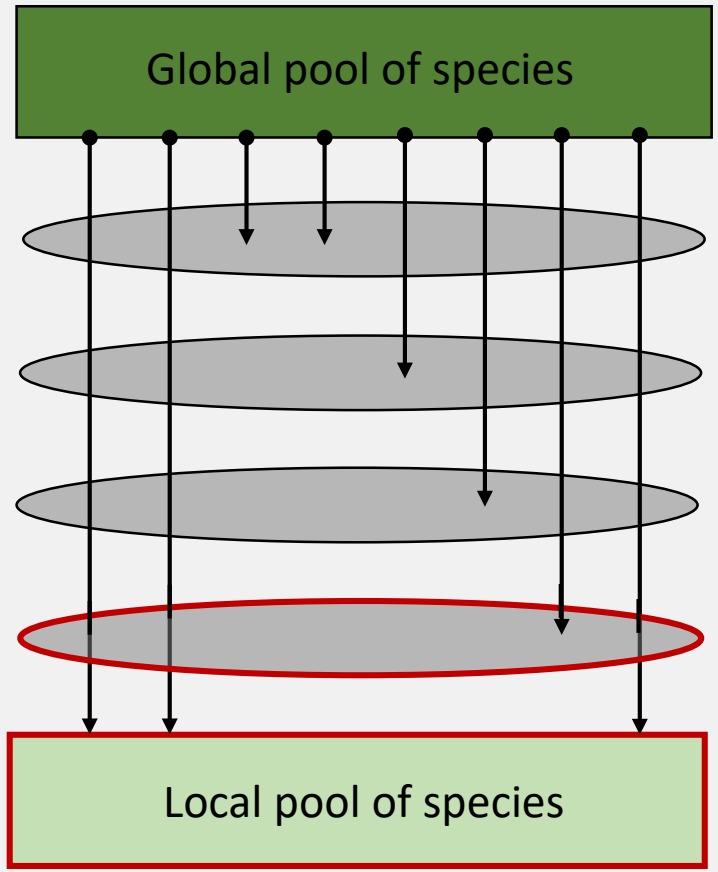


Figure 1. Environmental filters

After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

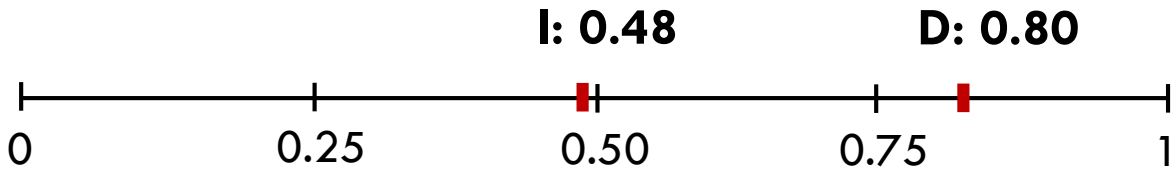
Is there an ecological niche overlap between native and exotic earthworm species ?

D: Index based on Schoener's (1968) statistic

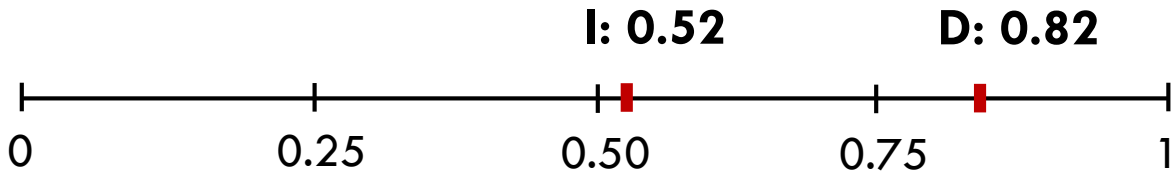
I: Index based on Hellinger distance

(0 : Completely dissimilar, 1 : Similar)

Dichogaster sp6
VS
Dichogaster andina



Glossodrilus sp1
VS
P. corethrurus



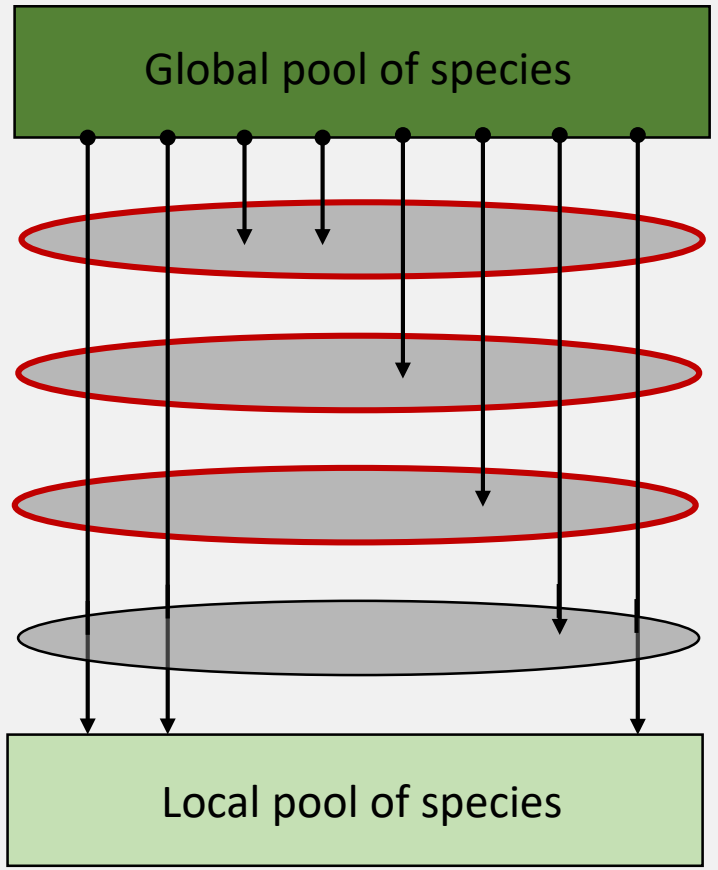
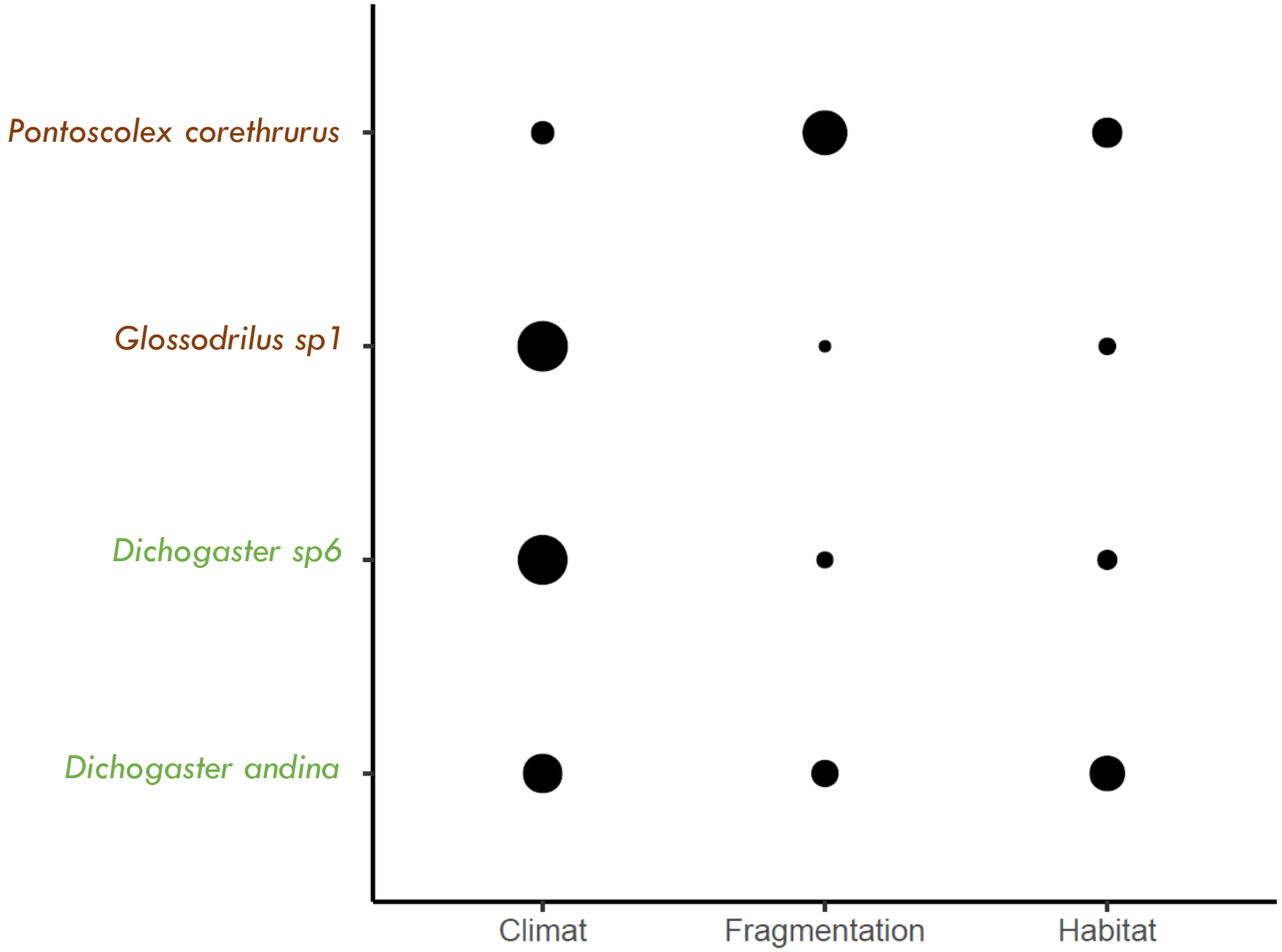


Figure 1. Environmental filters

After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

Contribution of environmental drivers



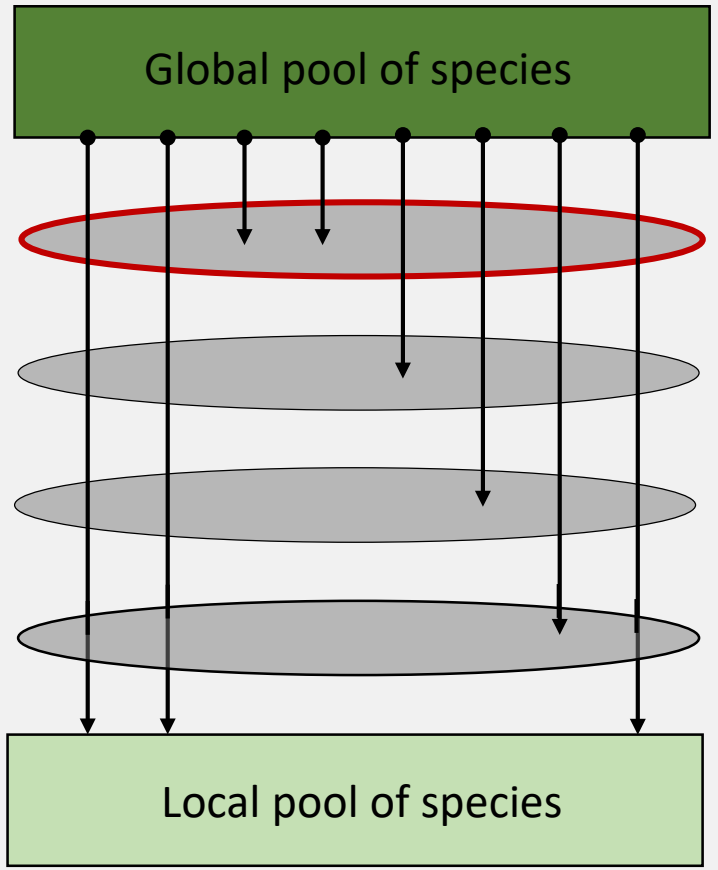
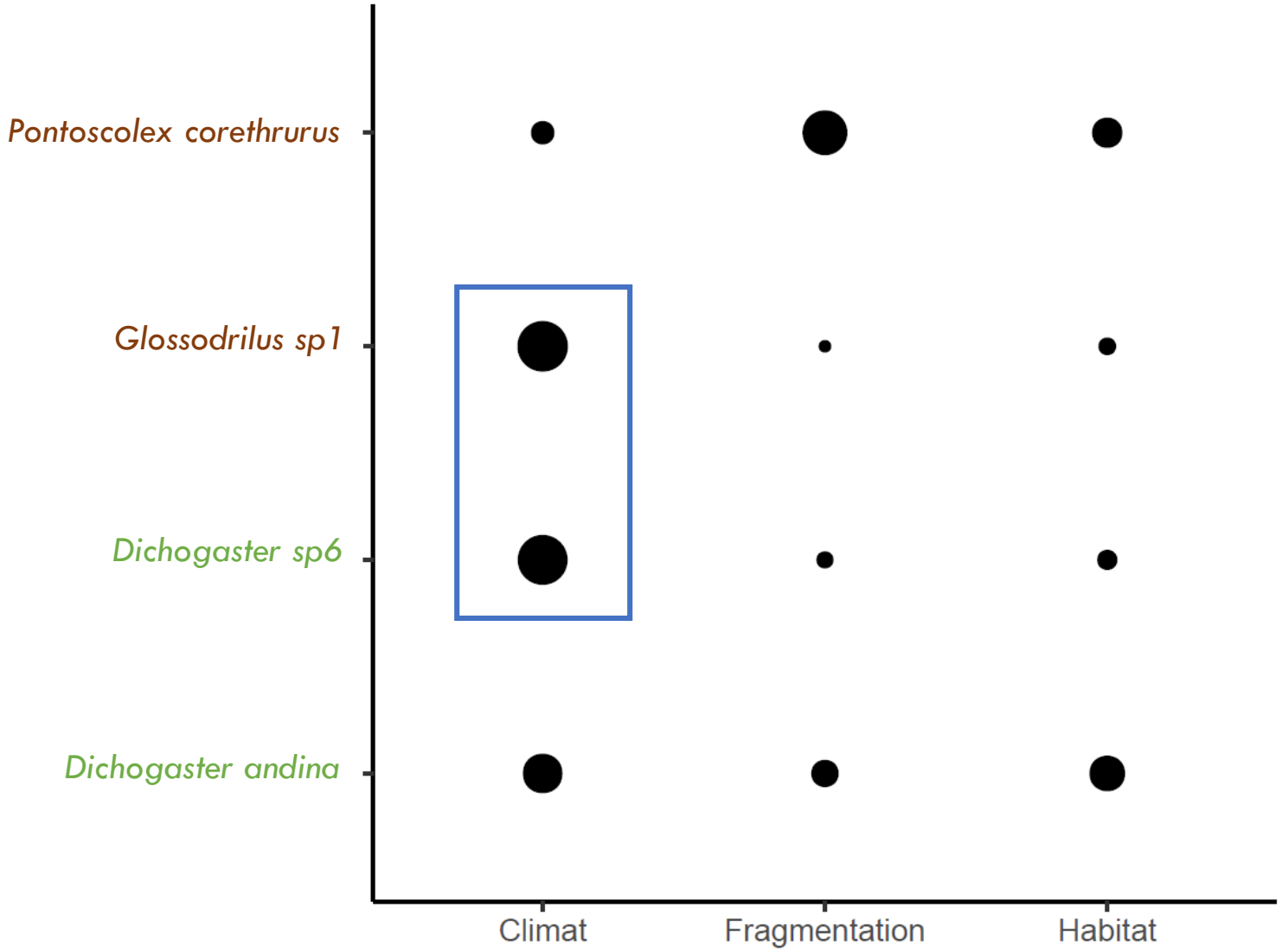


Figure 1. Environmental filters

After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

Contribution of environmental drivers



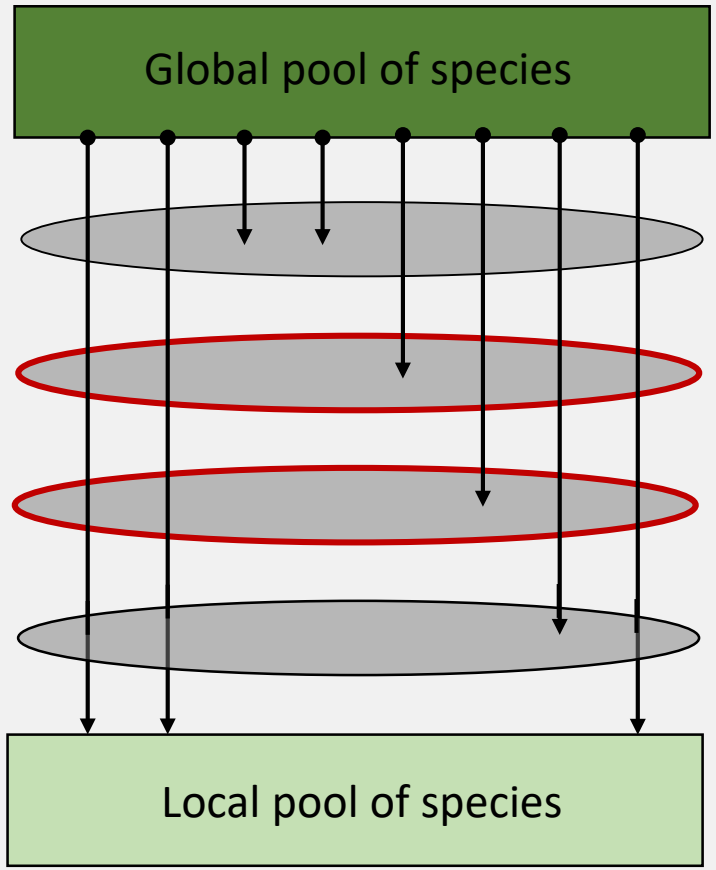
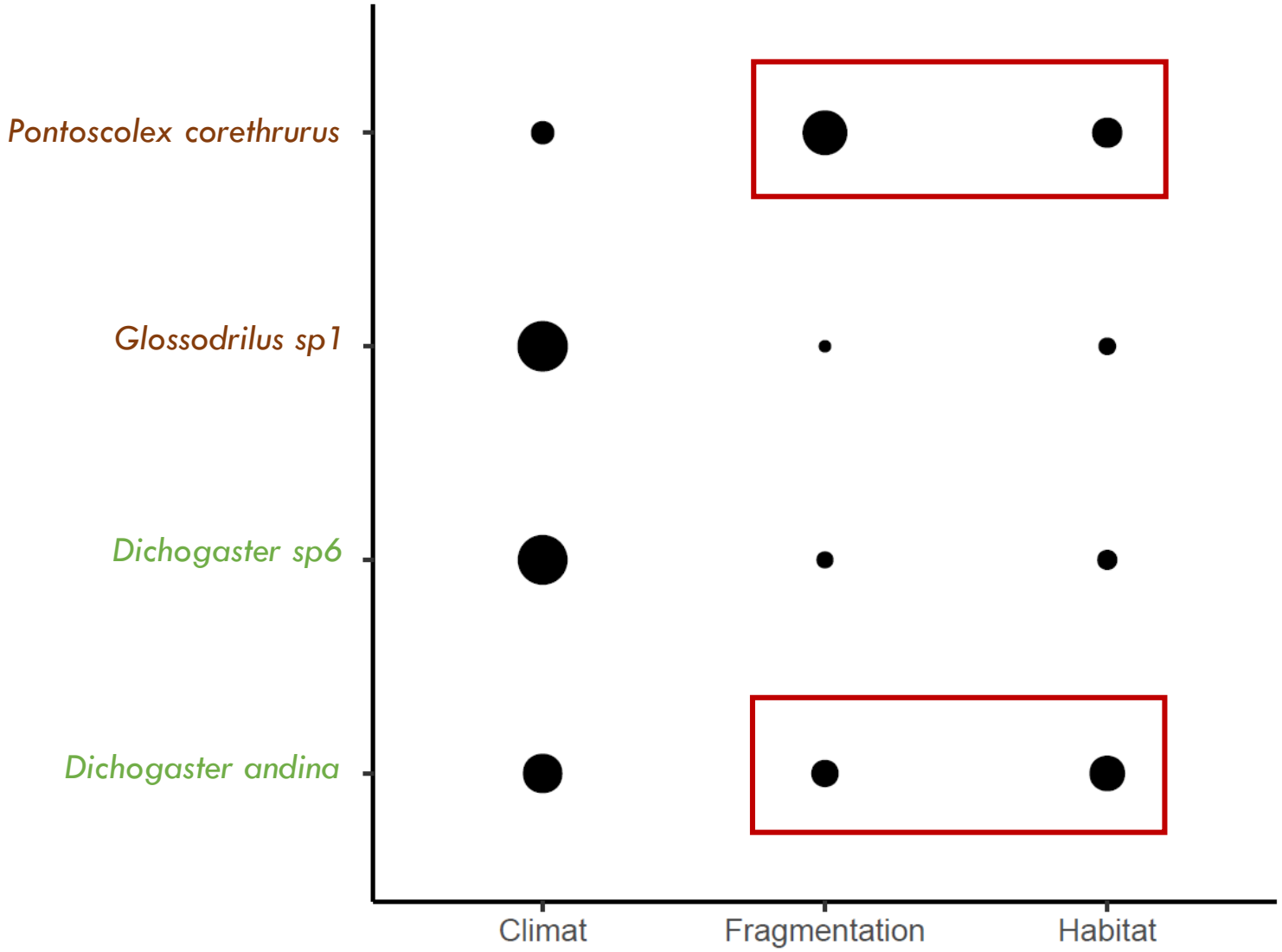


Figure 1. Environmental filters

After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

Contribution of environmental drivers



Pitons du Carbet

Summit at 1200 m of altitude.

Conclusion, discussion and outlook

Native species seem to have stronger ecological requirements than exotics, linked to climate.

Exotic species seem more constrained by the nature of their habitat and favoured by human activities.

Despite this, they seem to be found togethers in a significant part of the landscape

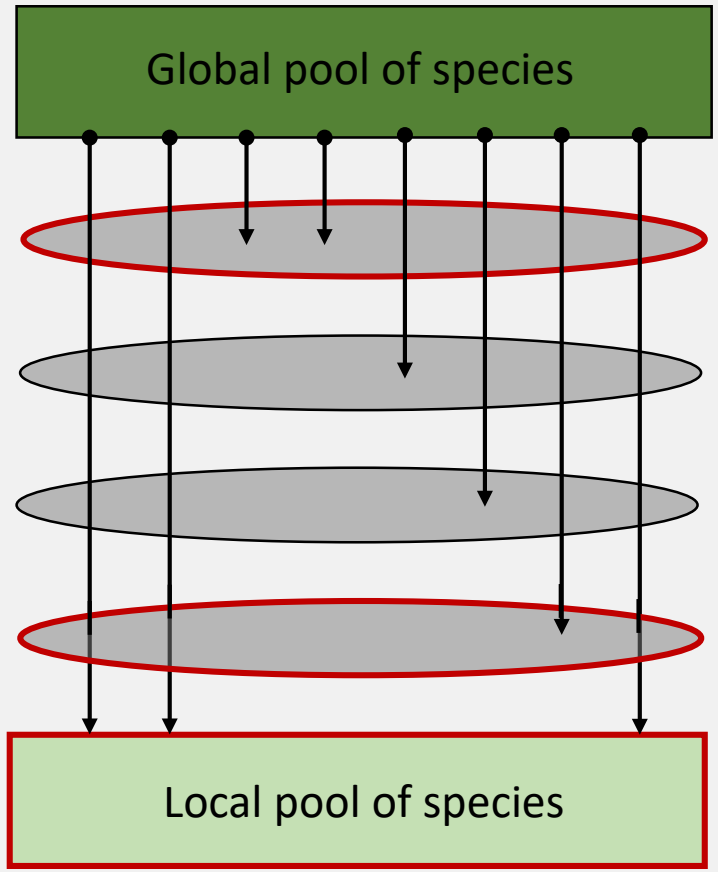


Figure 1. Environmental filters

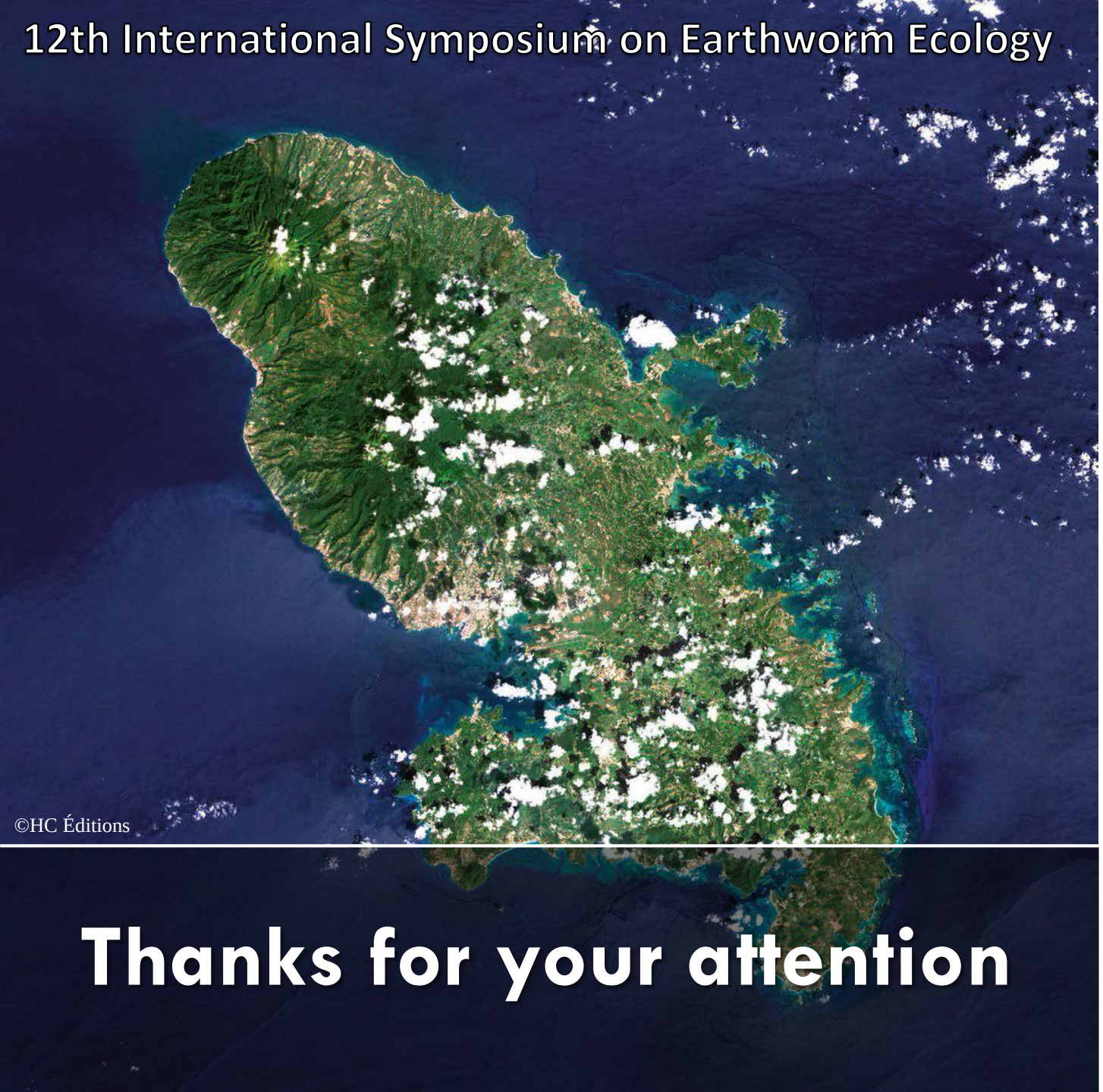
After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

Conclusion, discussion and outlook

Are they coexisting or are we watching a potential competitive exclusion by exotic (or native ?) species ?

And what about climate change… ?

Many new questions …. but you will have more information at a lower scale with the presentation of Ms. Lise Dupont



Thanks for your attention

This Work is

Realised / Presented by

Quentin Gabriac

Co-worked with

Alexis Delaplace, Lise Dupont, Carla-Marie Brunet, & Mathieu Coulis

Acknowledgement

Christian Mauriol, Lucas Wintz, Mathieu Luce, Nelly Telle

Supported by the **REBIOS Project….**

cirad UR GECO

CAEC Campus Agro Environnemental Caraïbe

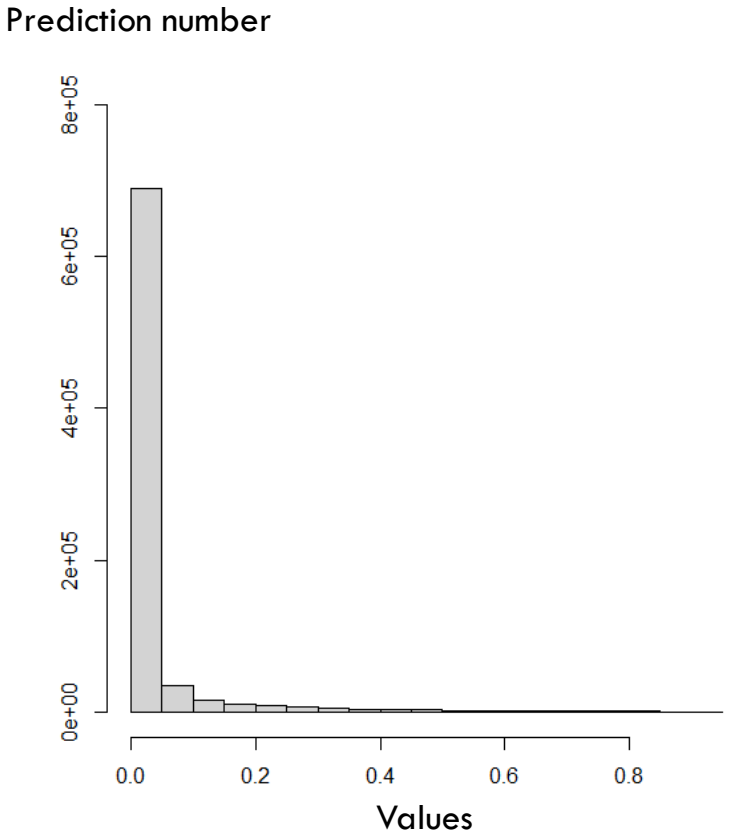
iEES PARIS Institute of Ecology and Environmental Sciences of Paris

Bromeliaceae

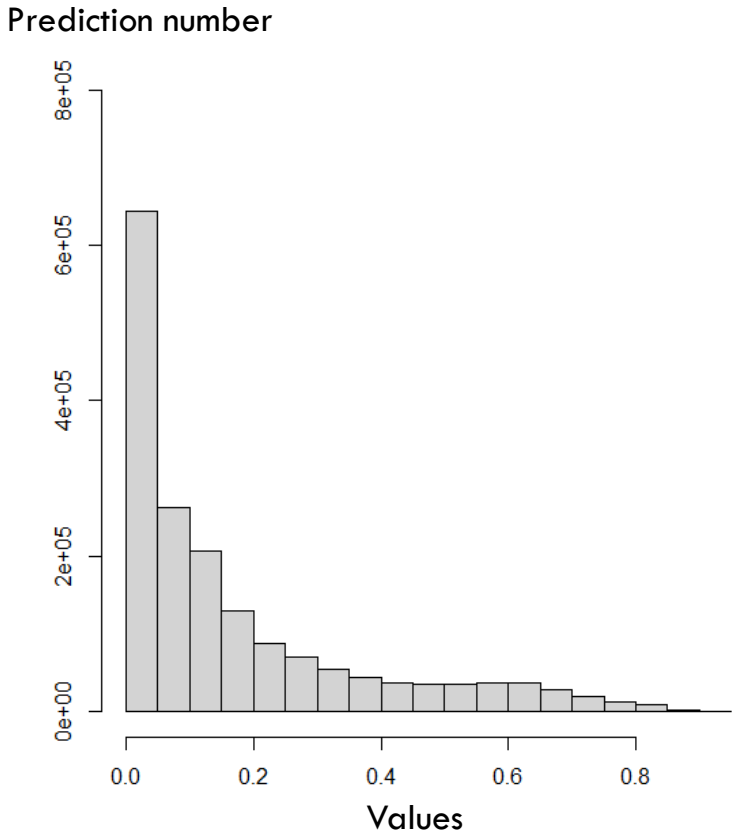
Tank bromeliad can be great habitat for arboricolous species

Niche breadth of arboricolous species

Dichogaster sp6



Dichogaster andina

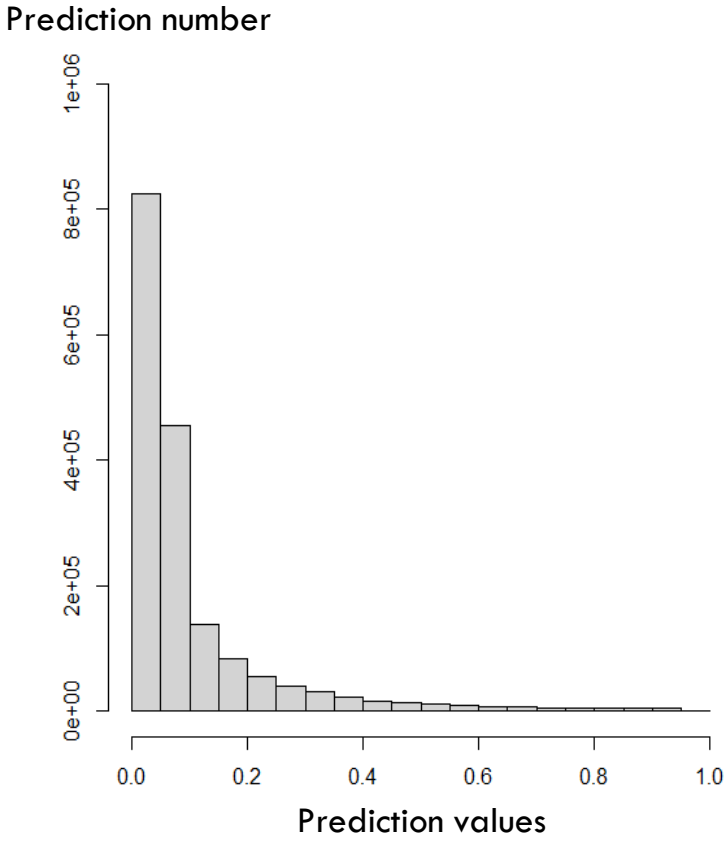


Soil matrix

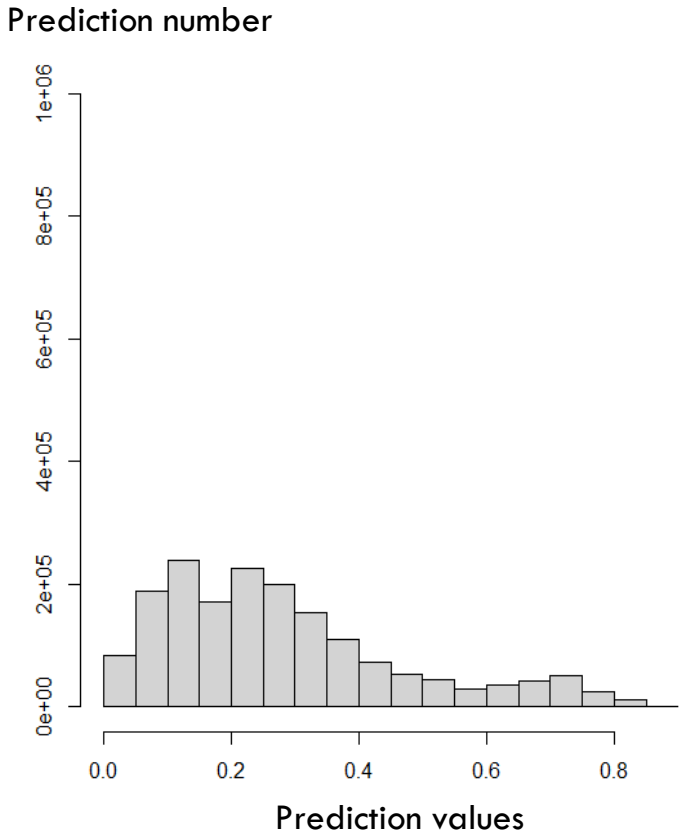
Soil matrix excavation in a banana plantation (Le Vauclin, Petite Grenade, Belle étoile)

Niche breadth of endogeic species

Glossodrilus sp1



Pontoscolex corethrurus



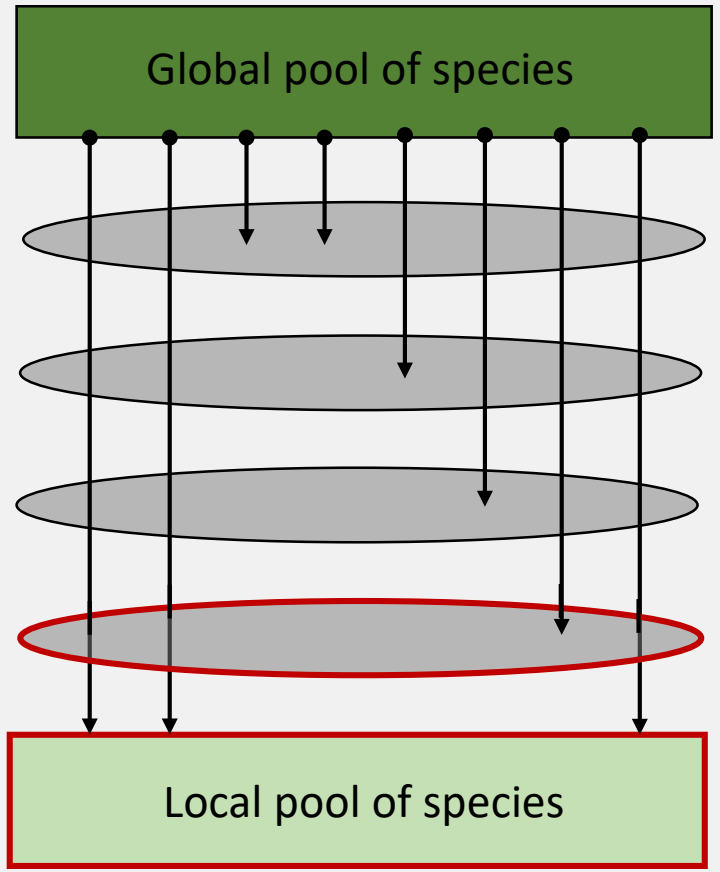


Figure 1. Environmental filters

After Lake et al. 2007 / Rahel, 2002 and Decaëns et al. 2006 / Alard & Poudevigne 2002.

Is there an ecological niche overlap between native and exotic earthworm species ?

P. corethrurus vs Glossodrilus sp1

Overlap
I : 0.5231236
D : 0.822068

Identity test (100 rep)
Pvalue <0,05

D. andina vs Dichogaster sp6

Overlap
I : 0.4797768
D : 0.7978663

Identity test (100 rep)
Pvalue <0,05