Université de Liège

McGill

Biological characteristics of a rodent species in expansion

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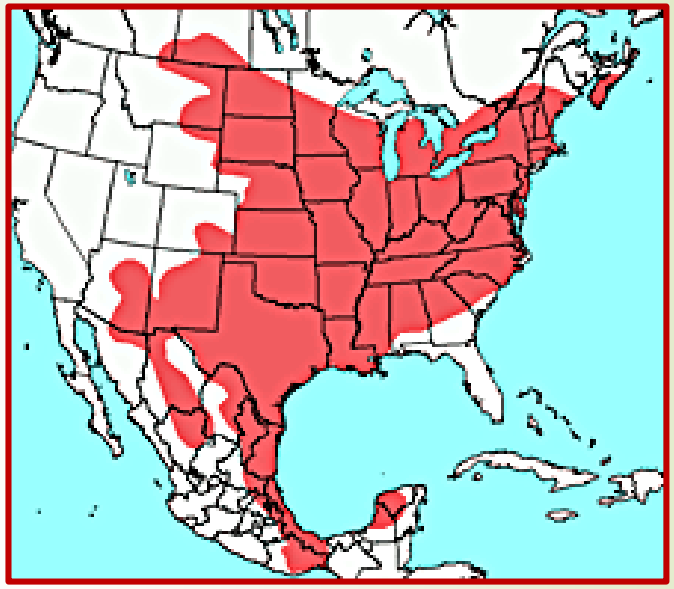
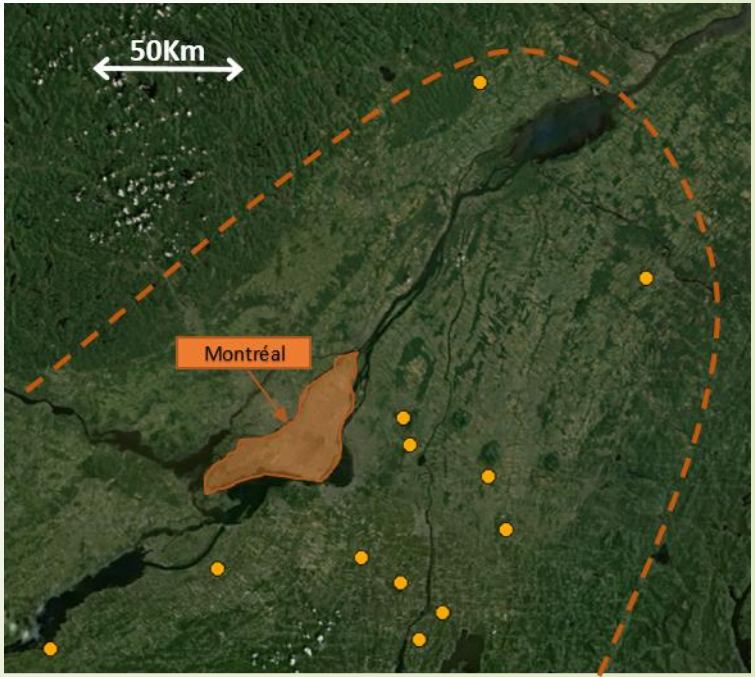
Virginie Millien (Mcgill University)
Johan Michaux (Université de Liège)

Peromyscus leucopus

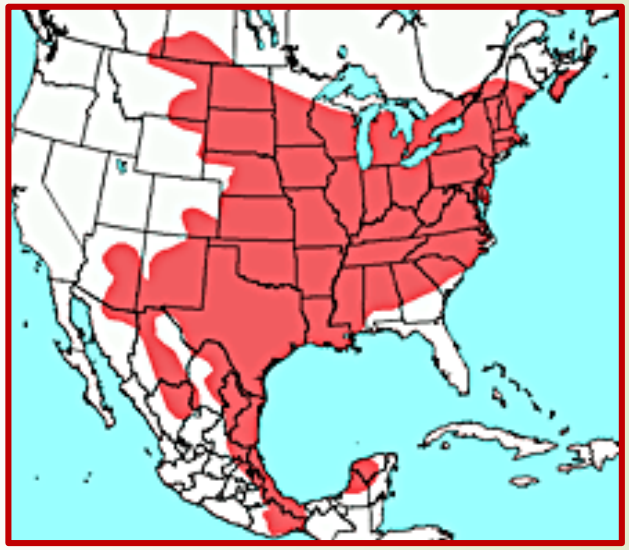
- Rodent from the *Cricetidae* family
- Widely distributed across North America
- Principal reservoir for Lyme disease in North America (Borreliosis associated with ticks as vector.)
- Currently increasing its Northern range toward southern Quebec.(Roy-Dufresne et al 2013)
- Recent Lyme disease cases reported in the region



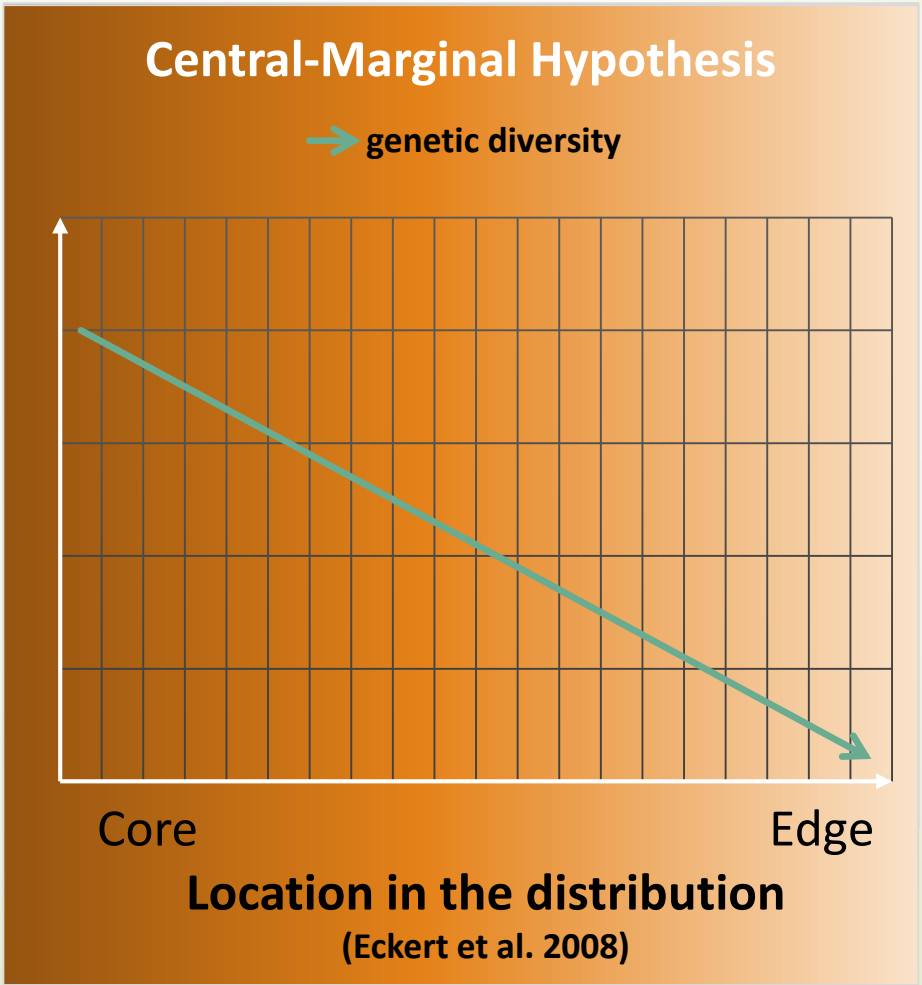


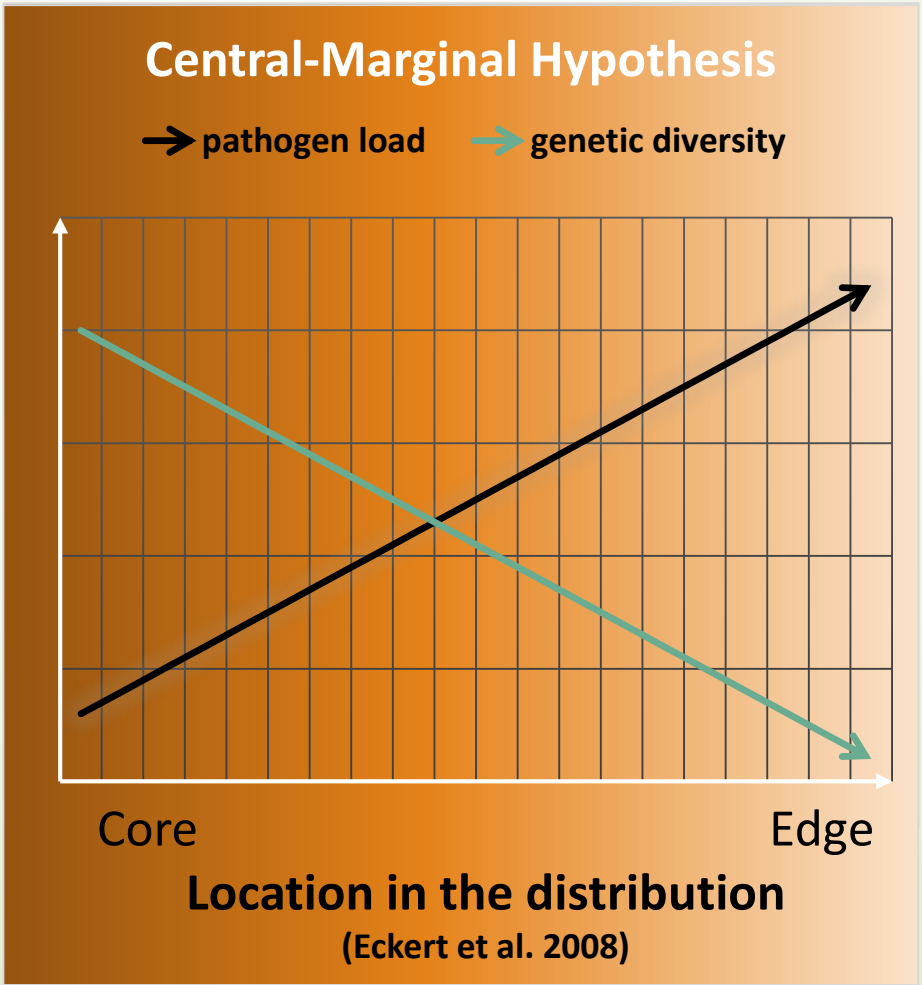
Species distributions

- Abiotic factors :
  - Climate
  - Soil composition
  - …
- Biotic factors :
  - resource availability
  - Pathogens & predators
  - Inter-specific competition
  - …



Dynamic!!!


Central-Marginal Hypothesis
genetic diversity
Core
Edge
Location in the distribution
(Eckert et al. 2008)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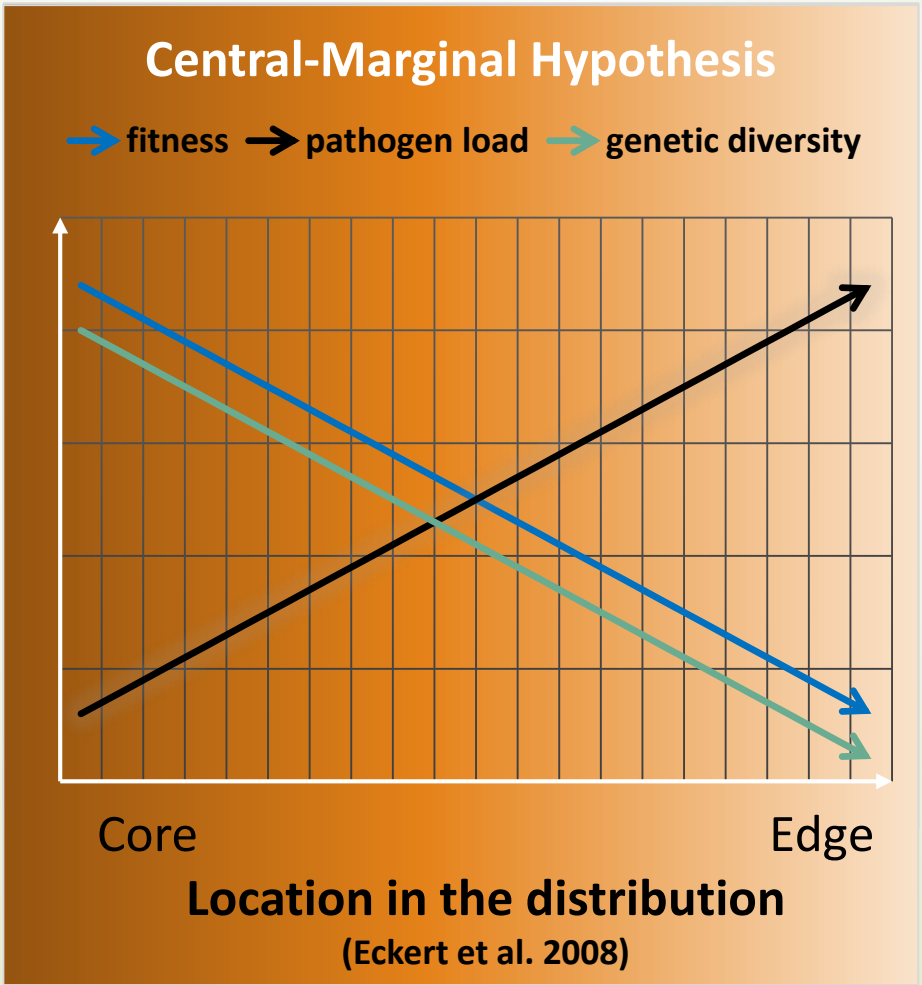
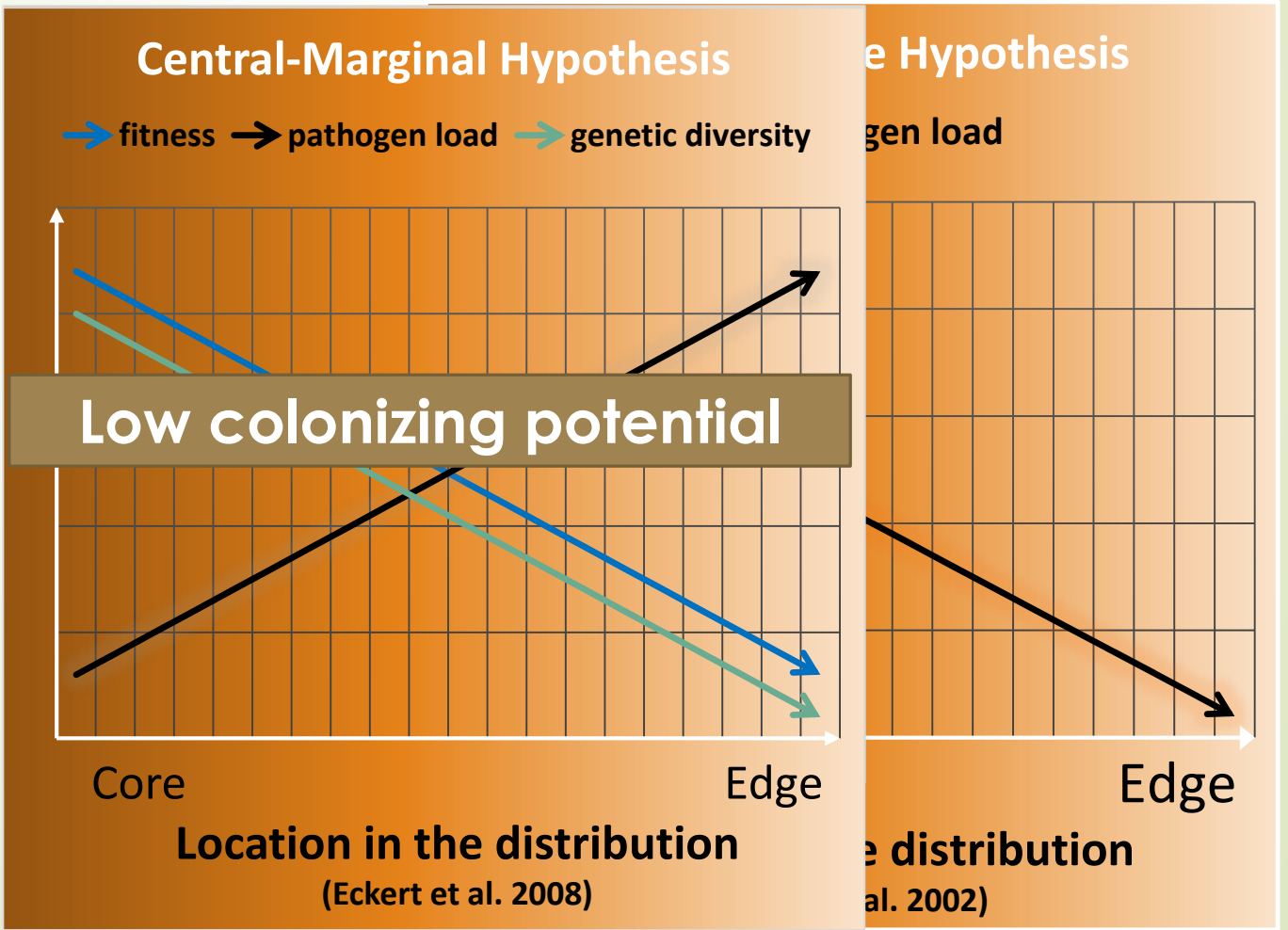
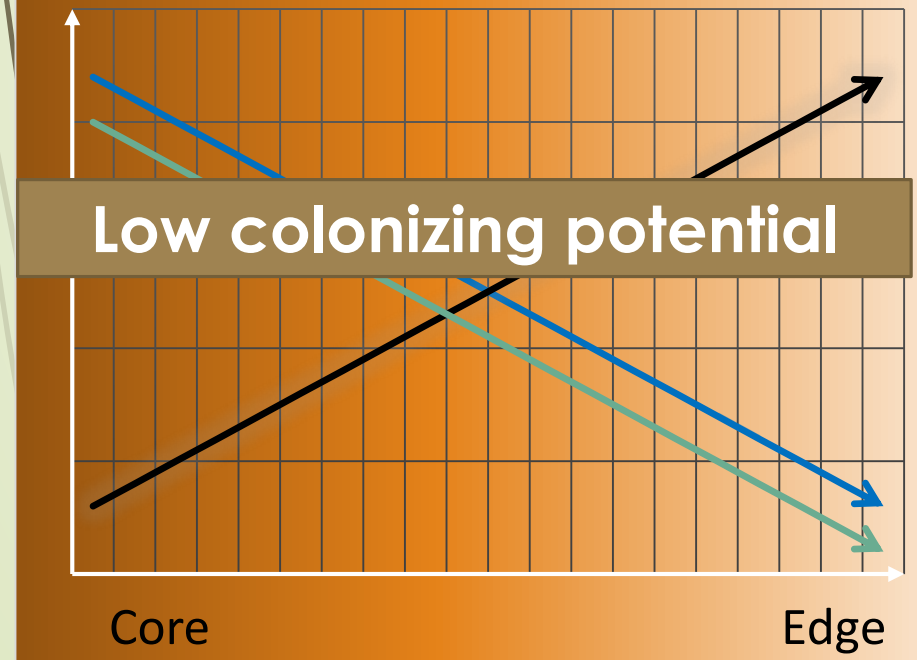



Central-Marginal Hypothesis
fitness
pathogen load
genetic diversity
Low colonizing potential
Core
Edge
Location in the distribution
(Eckert et al. 2008)
e Hypothesis
gen load
Edge
e distribution
al. 2002)

Central-Marginal Hypothesis

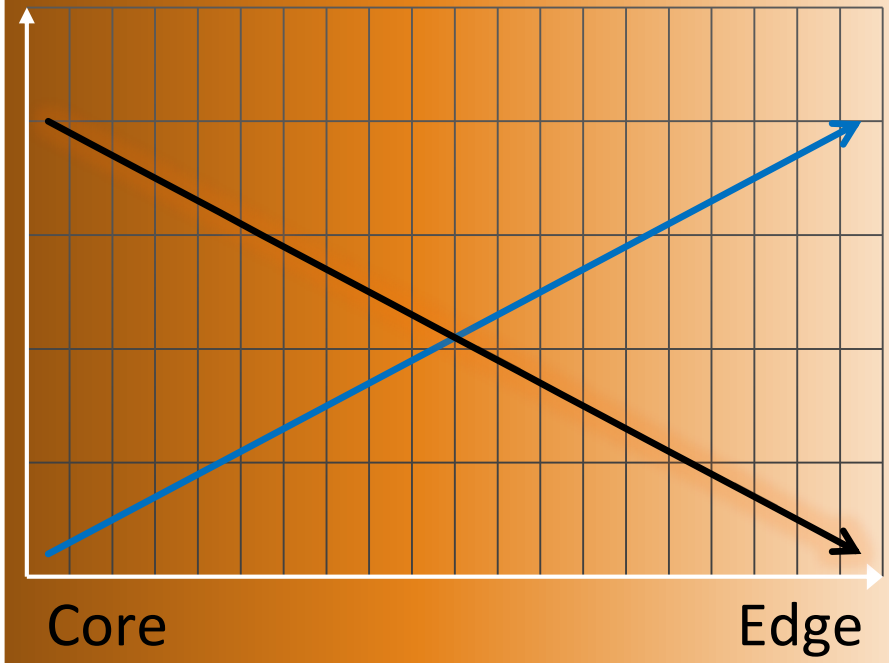
fitness → pathogen load → genetic diversity



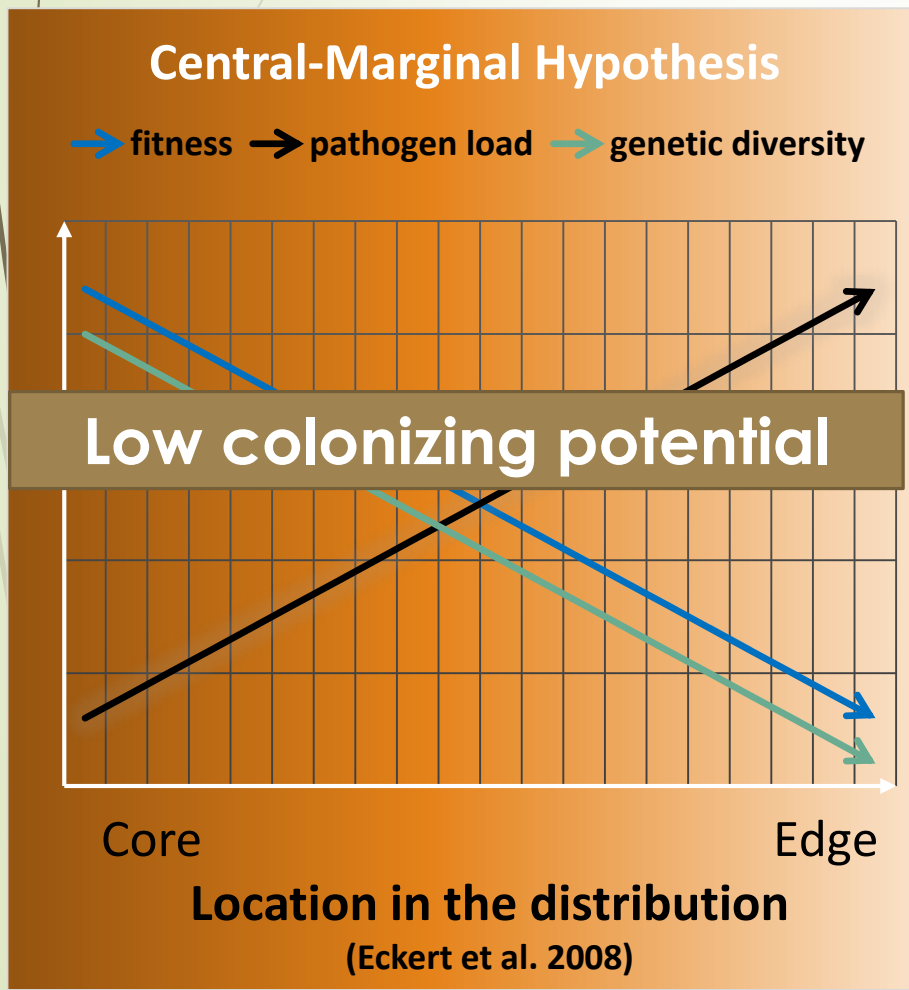
(Eckert et al. 2008)

Enemy Release Hypothesis

fitness → pathogen load



(Keane et al, 2002)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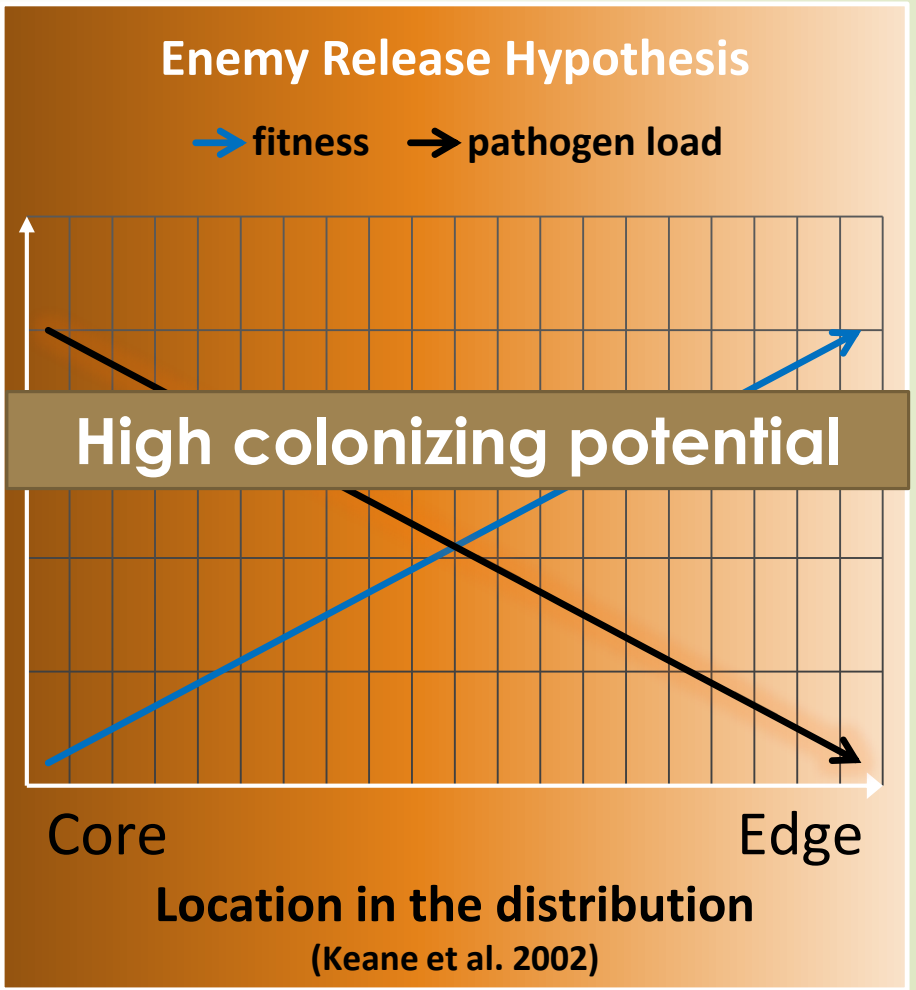
Enemy Release Hypothesis
fitness
pathogen load
High colonizing potential
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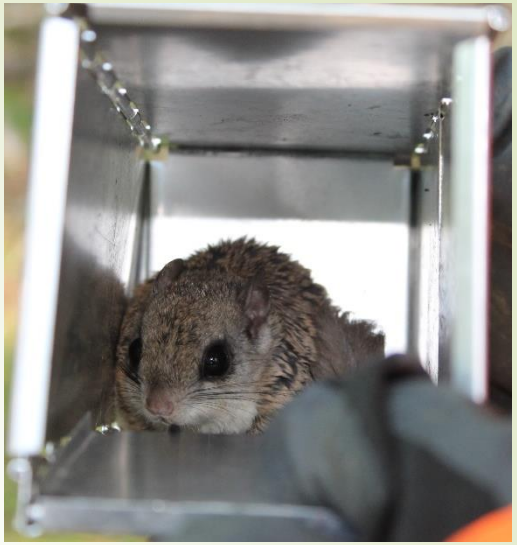
Location in the distribution
(Keane et al. 2002)

Objectives:

- Compare different populations according to their position within the species range
  - Genetic diversity related to the immune sytem
  - Stress level
  - Global health level
  - Endo- and exo-parasite diversity
  - Bacterial diversity

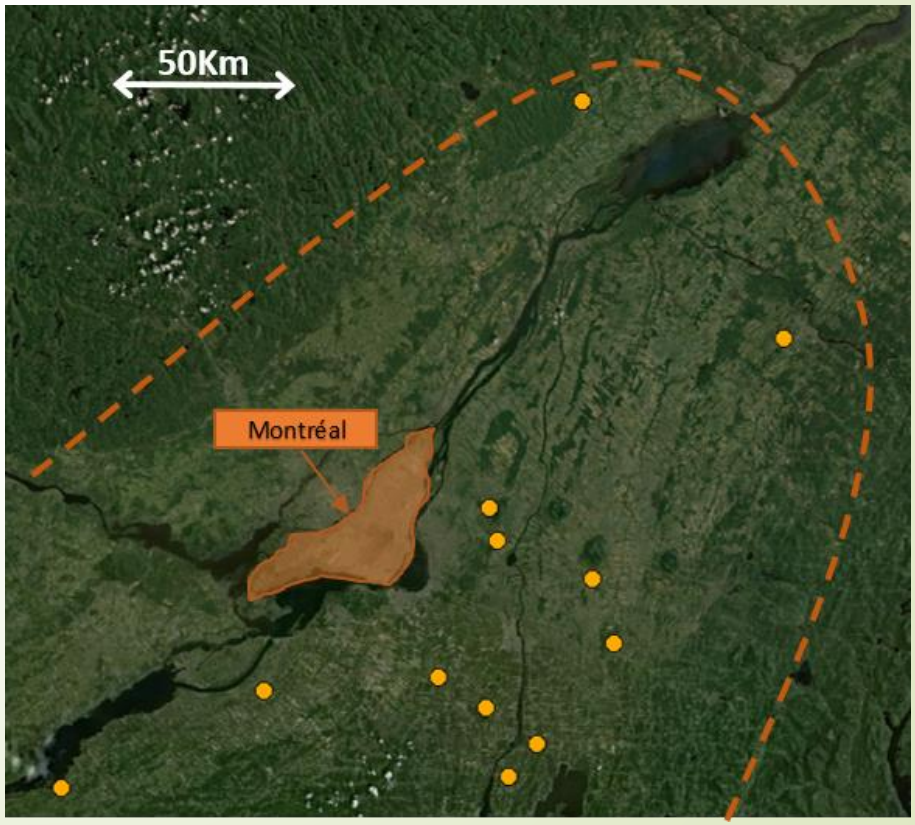
2013 Sampling



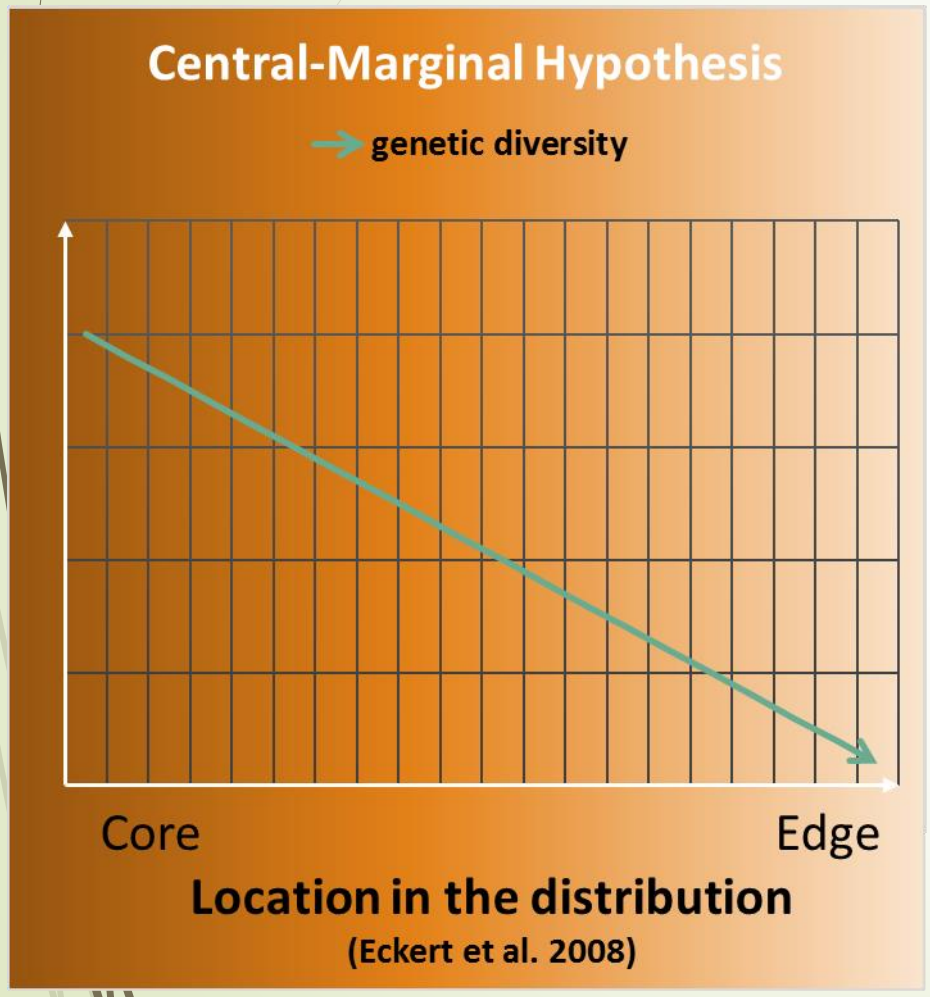
- 15 sampling sites
- 140 Shermann traps/site
- 3 or 4 nights/site

- 140 *Peromyscus leucopus*

- *+ 200 leucopus tissues from 2011 & 2012 sampling*



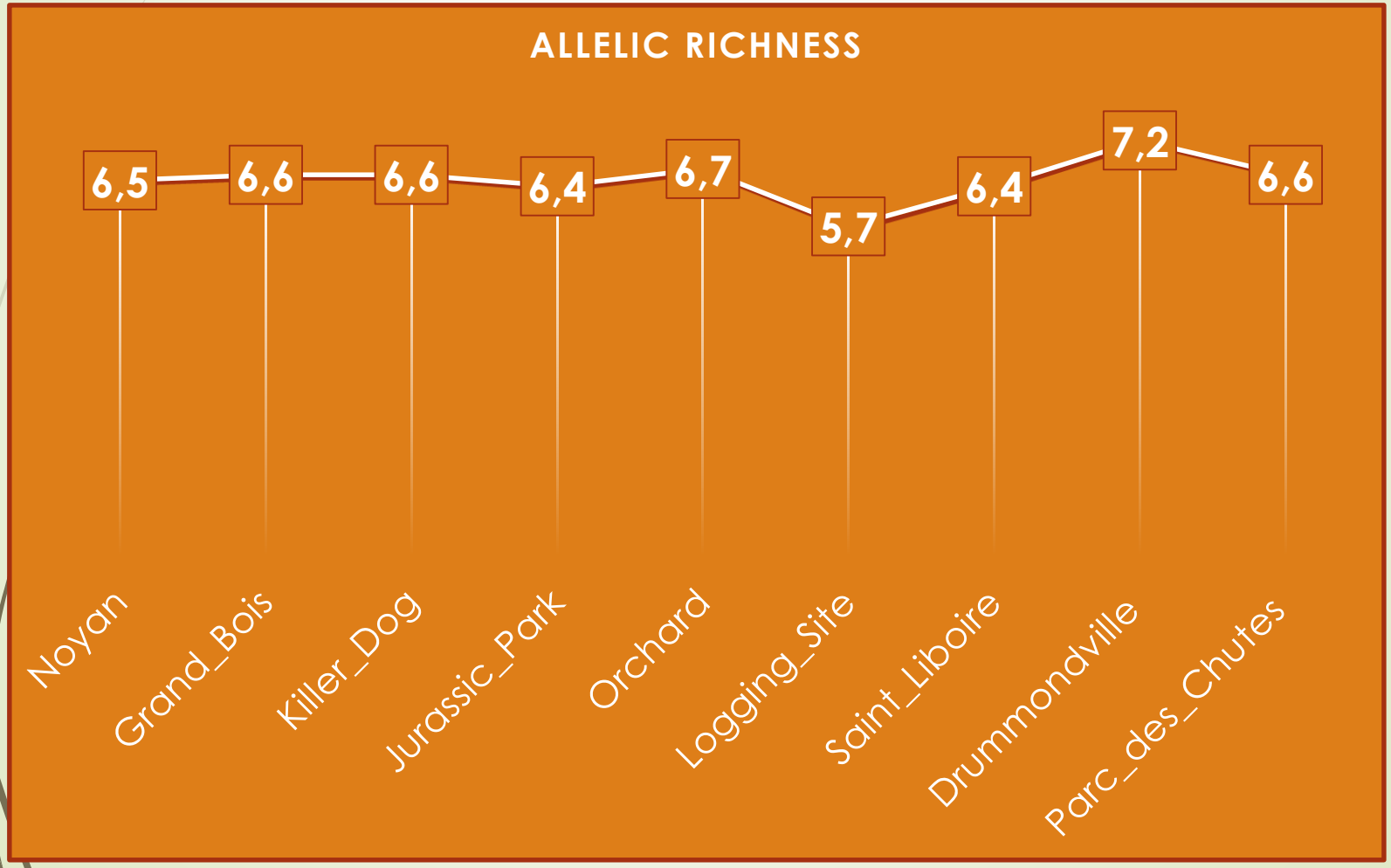
MHC II genetic

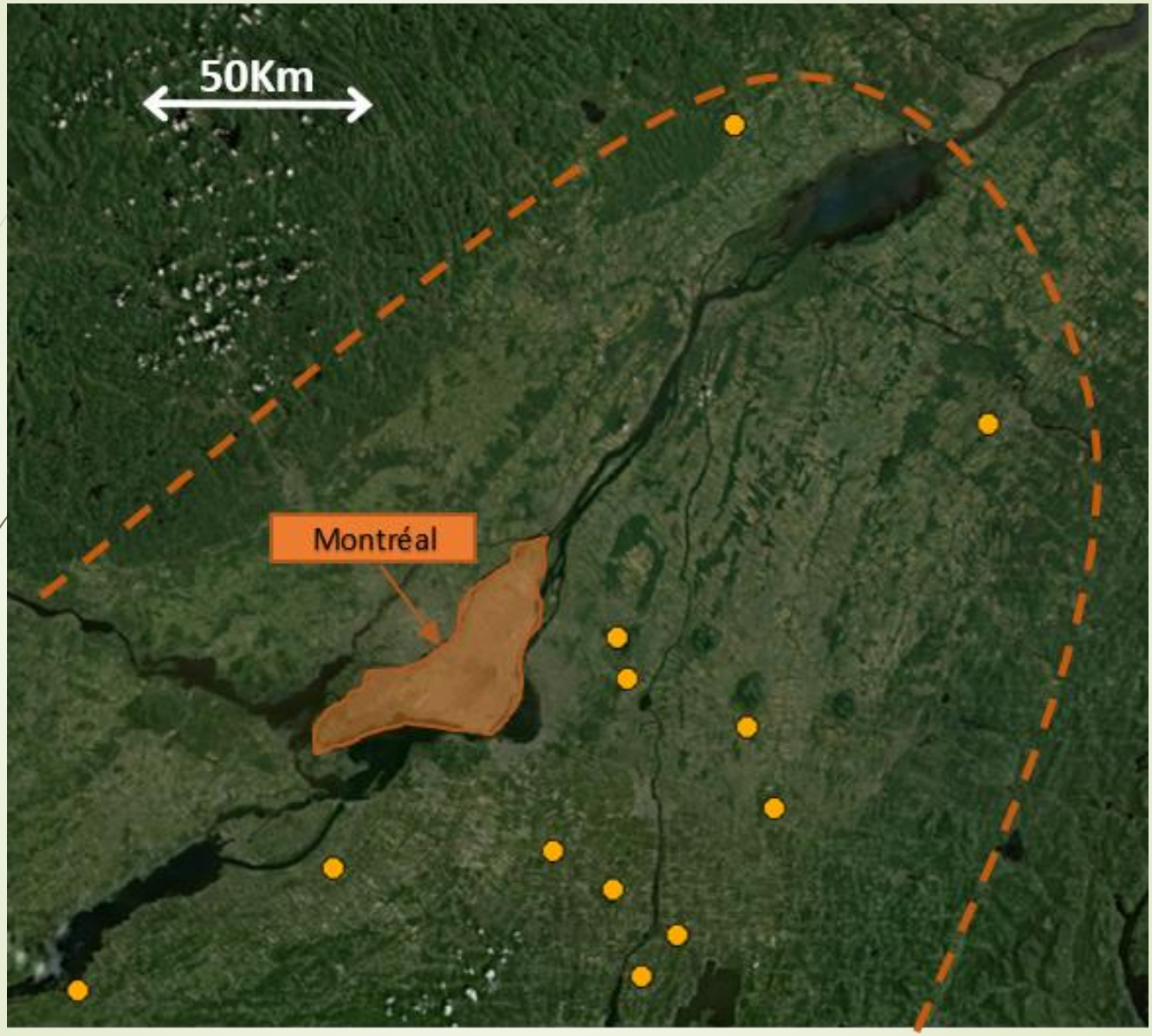


- Major histocompatibility complex II
- Key role in the immune system for pathogen recognition.
- 38 different alleles out of 230 mice from 16 different populations (2011 & 2012)

Allelic richness

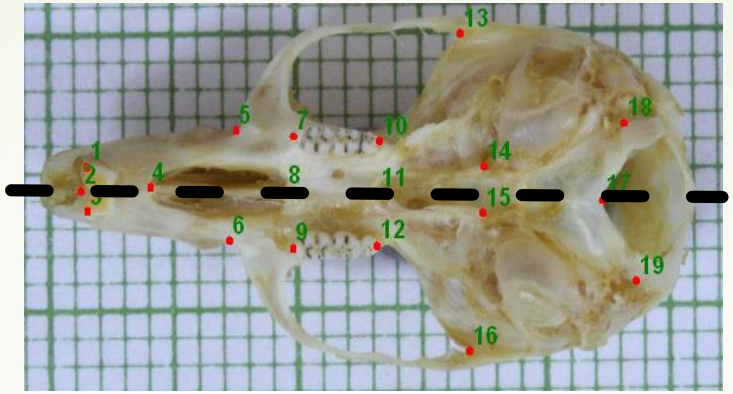
9 populations with minimum 11 individuals
Rarefaction method (k=10)

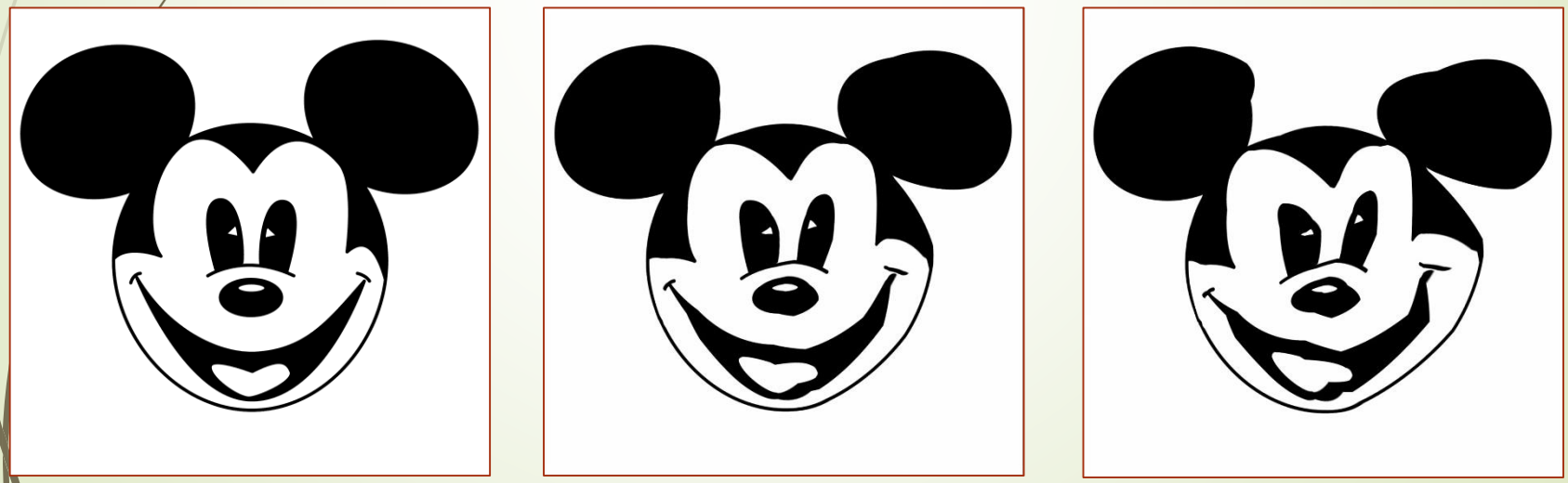



50Km
Montréal

Stress level evaluation

1)Fluctuating Asymmetry





Core

Edge

Location in the distribution

Stress level evaluation

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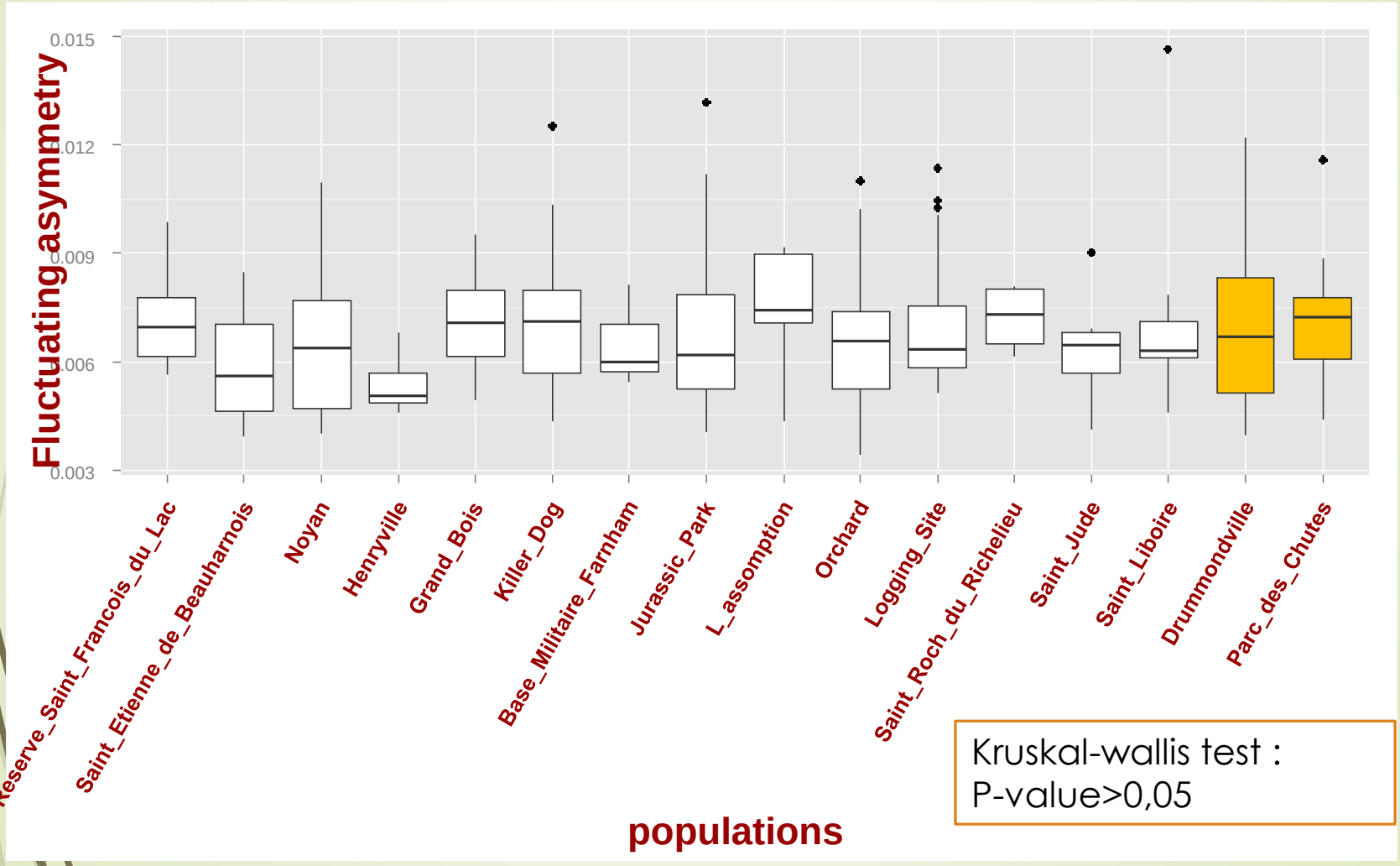
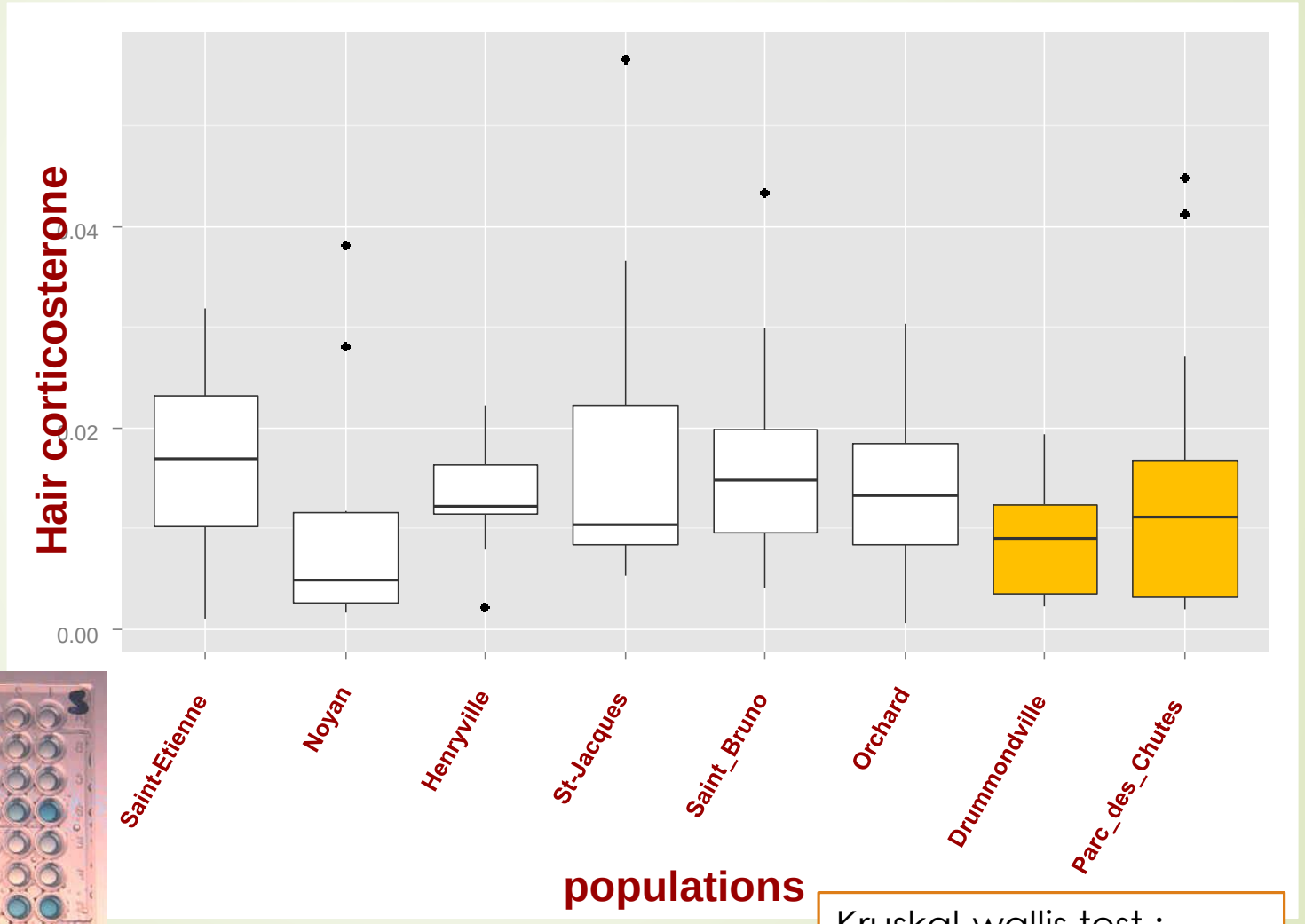
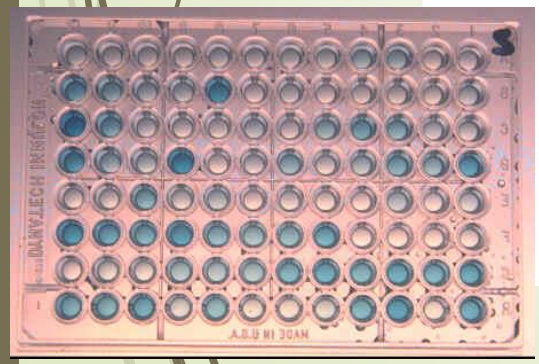


Kruskal-wallis test :
P-value>0,05

Stress level evaluation

2) Hair corticosterone

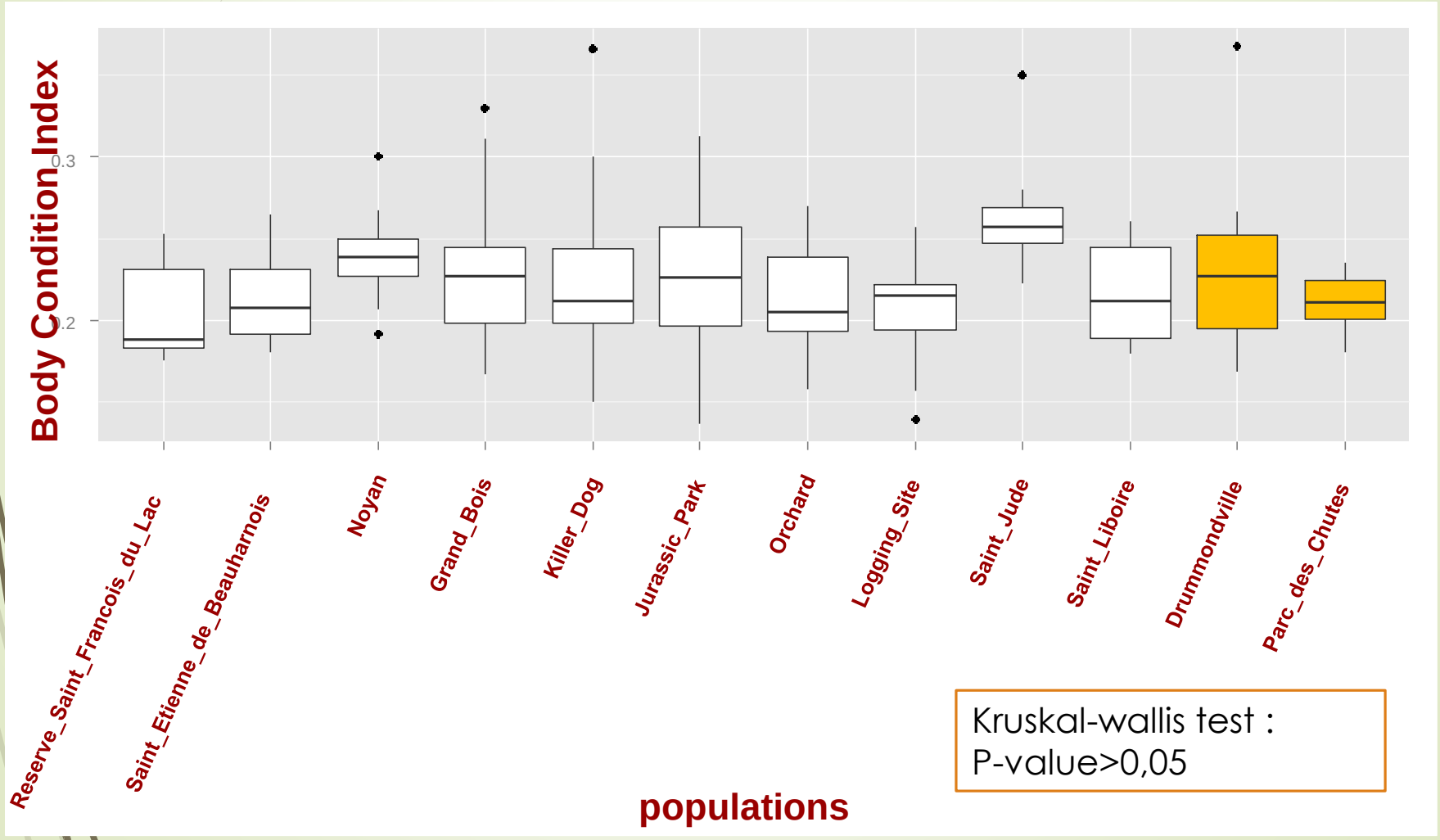




Kruskal-wallis test :
P-value>0,05

Body condition index

(residuals of the regression from the body mass on the body size)



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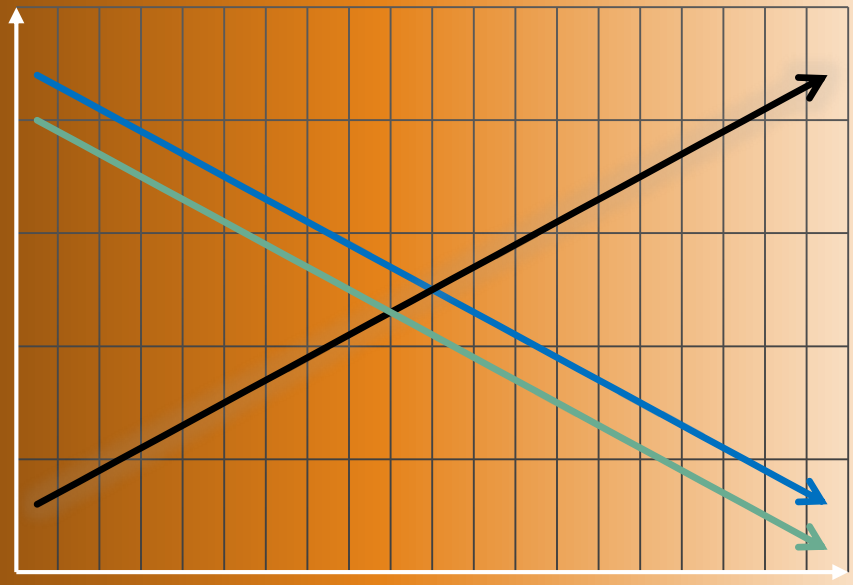
P-value>0,05

Central-Marginal Hypothesis

fitness pathogen load genetic diversity

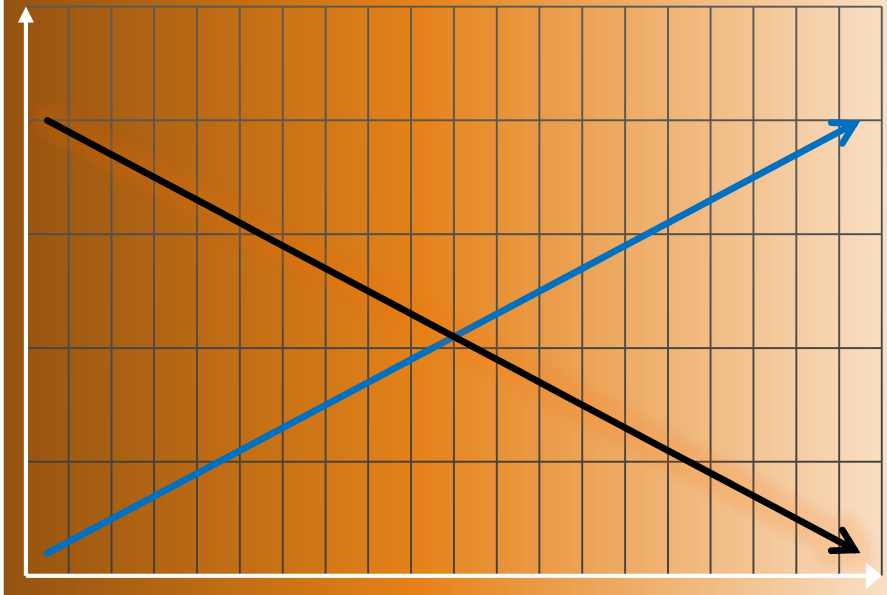


Location in the distribution

(Eckert et al. 2008)

Enemy Release Hypothesis

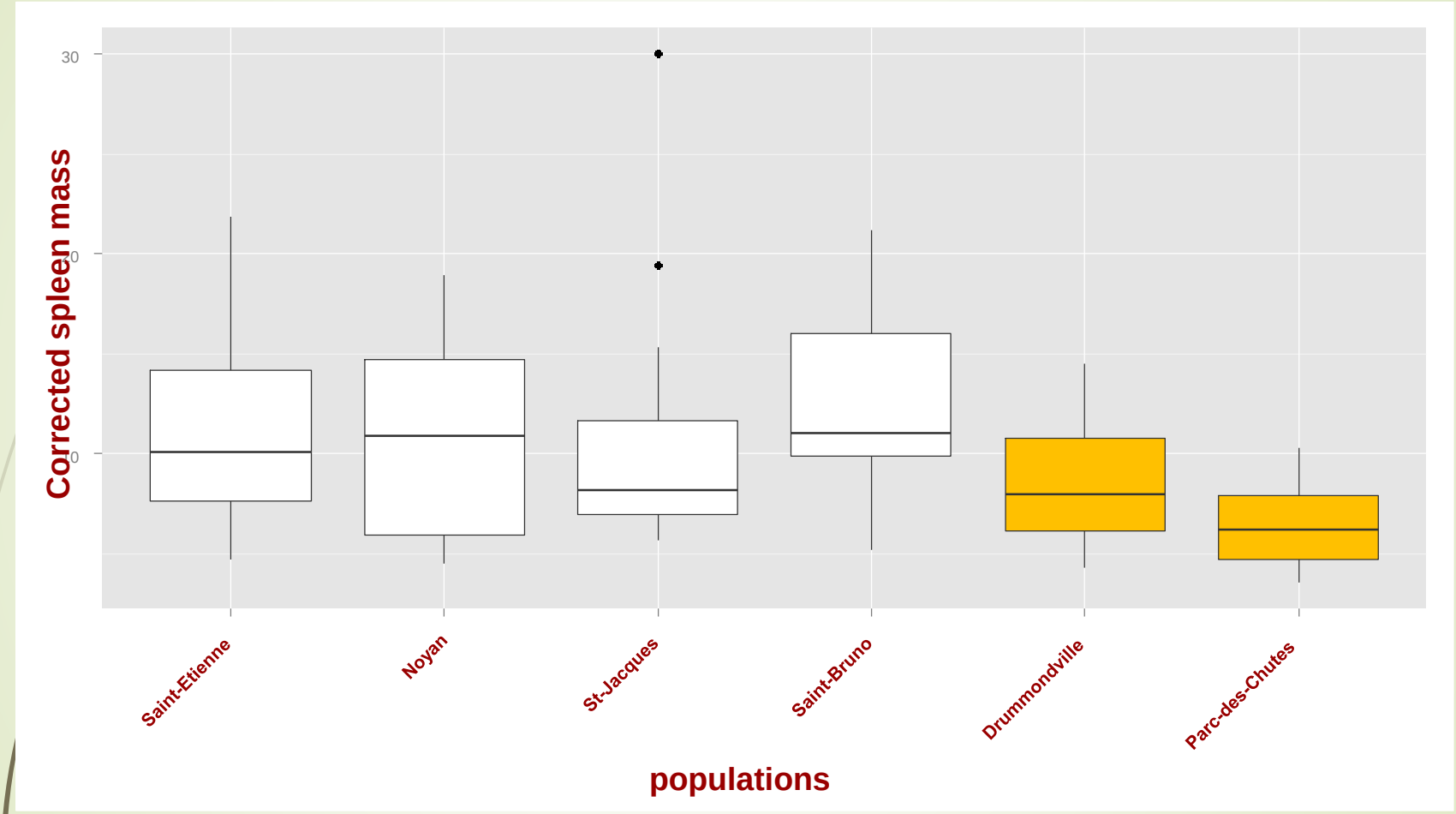
fitness pathogen load



Location in the distribution

(Keane et al, 2002)

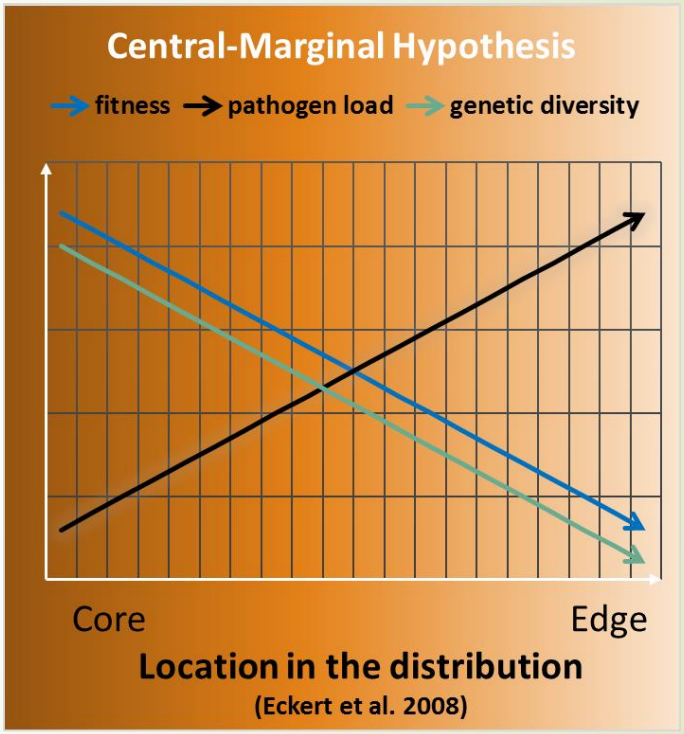
Spleen mass



Kruskal test p-value = 0,0018
(P-values from wilcoxon rank sum tests between « parc des chutes » and other populations < O.O5)

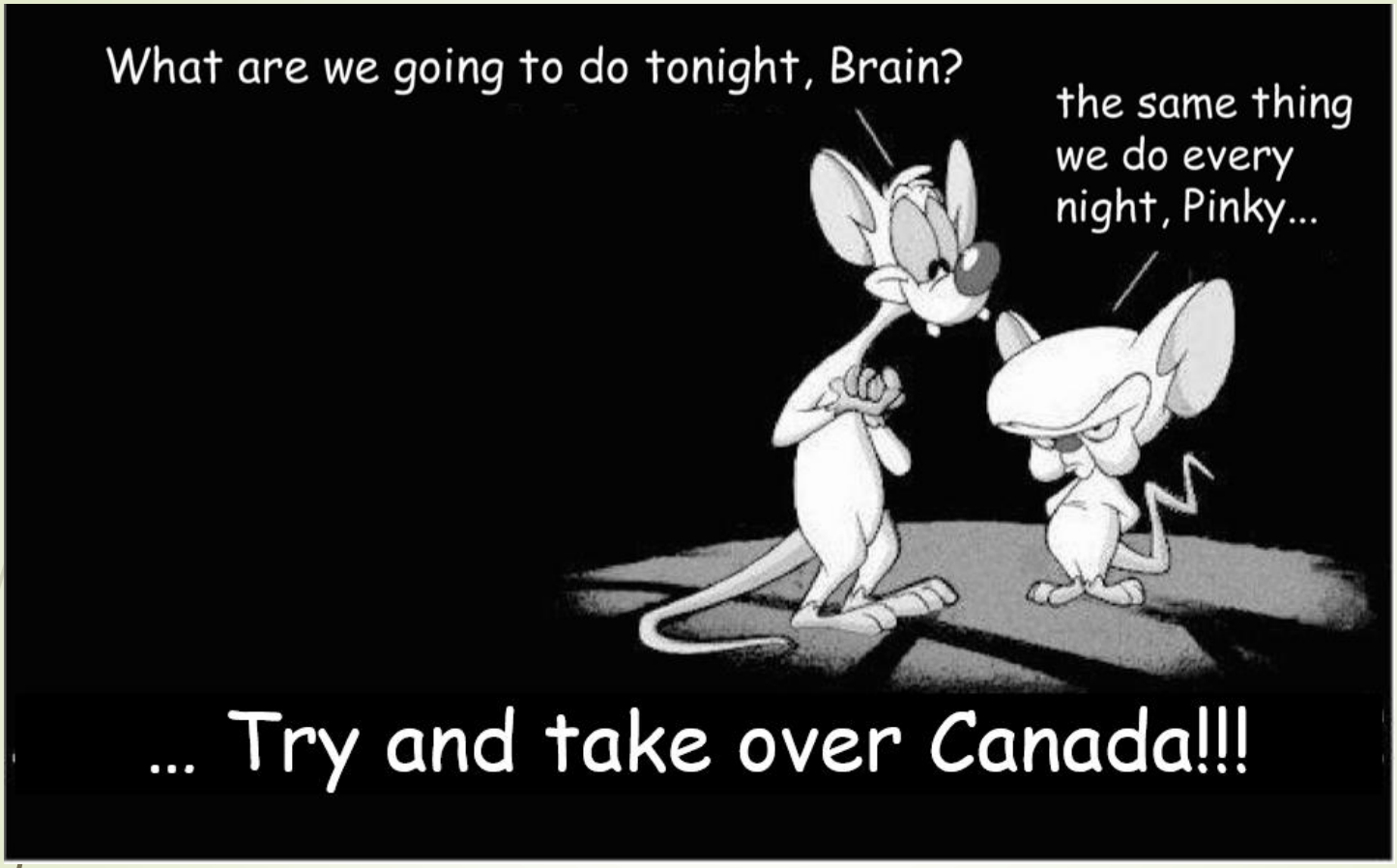
TAKE HOME MESSAGE

- Central V.S. External populations :
  - No differences in :
    - Genetic richness
    - Stress levels
    - Body condition index
  - Smaller spleens in northern populations



- No biological reason yet for the mice to stop their northward expansion!

TAKE HOME MESSAGE



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Acknowledgement

Funding :
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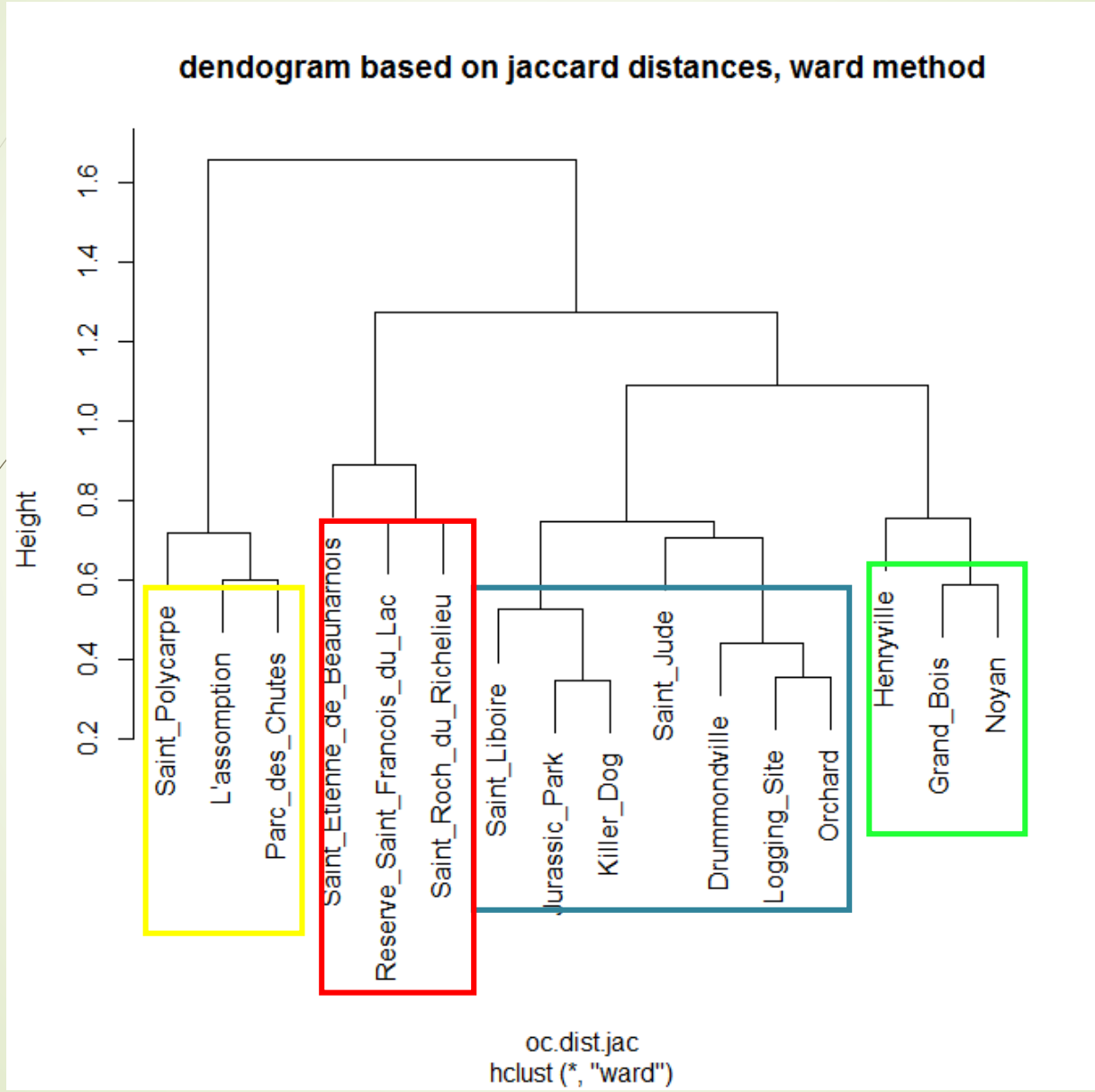
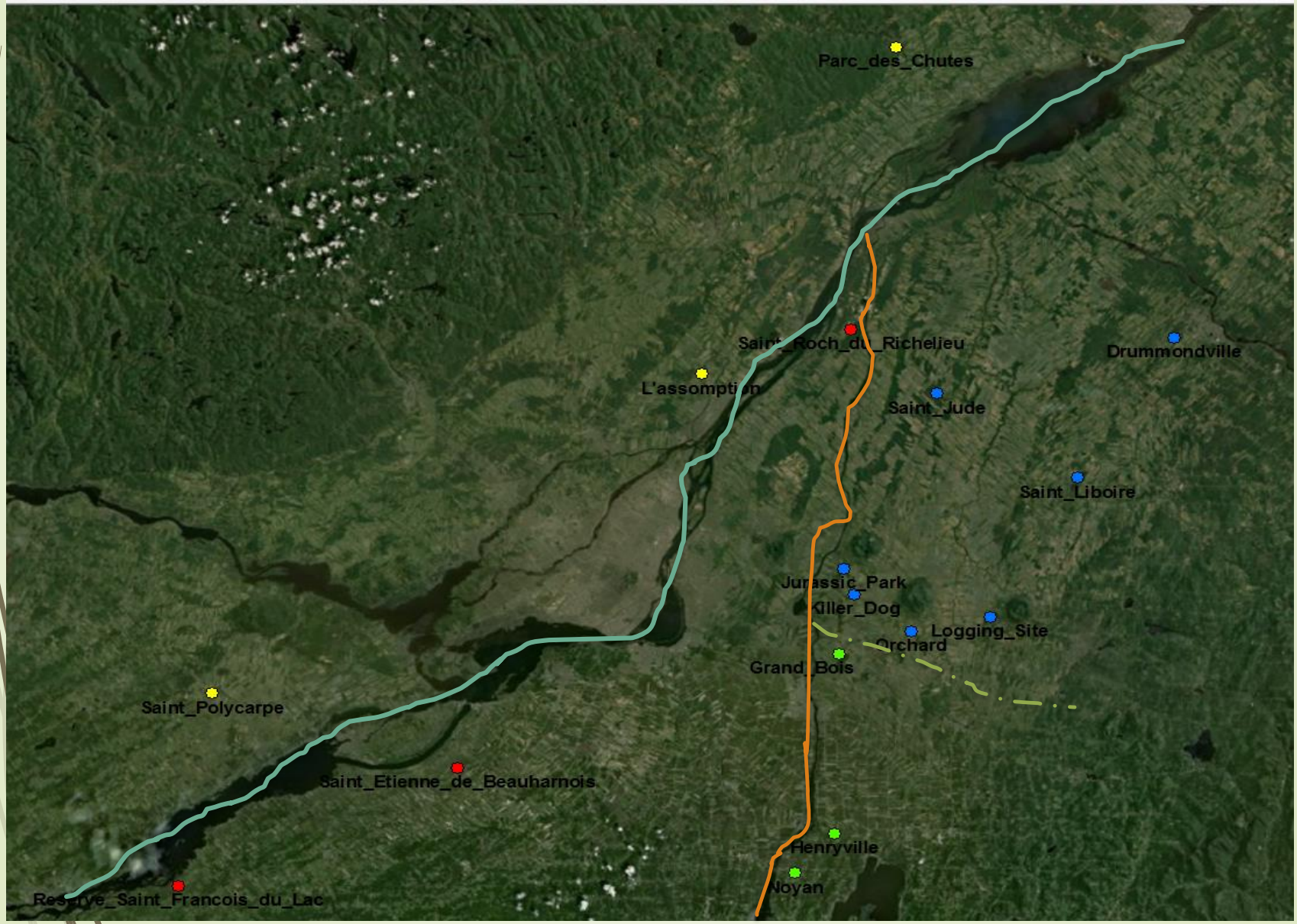
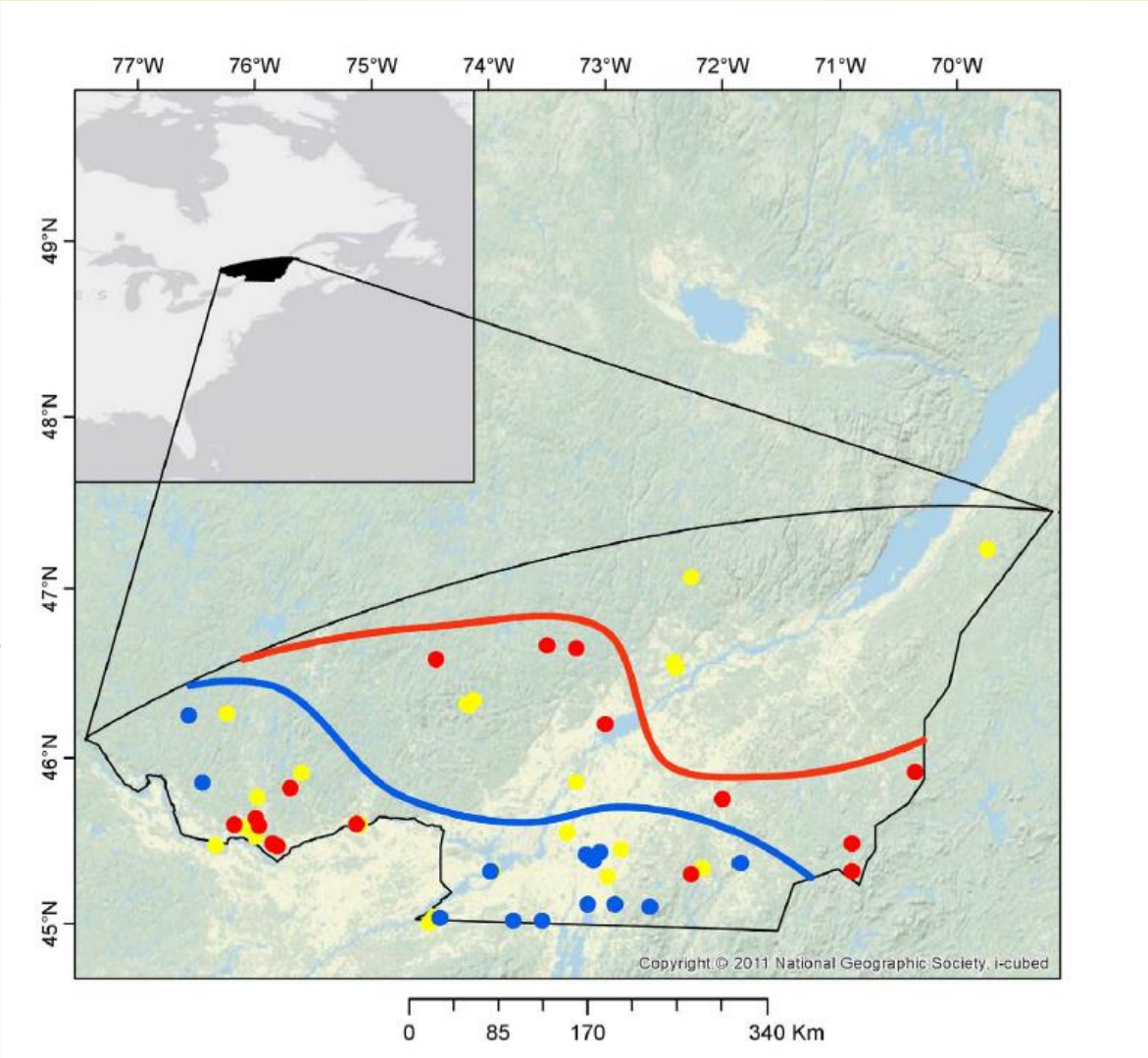
Special thanks to
-Alice Mouton
-Maxime Galan
-all the field and lab collaborators
-all my friends and family

Additional results


dendogram based on jaccard distances, ward method
Height
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Saint_Polycarpe
L'assomption
Parc_des_Chutes
Saint_Etienne_de_Beauharnois
Reserve_Saint_Francois_du_Lac
Saint_Roch_du_Richelieu
Saint_Liboire
Jurassic_Park
Killer_Dog
Saint_Jude
Drummondville
Logging_Site
Orchard
Henryville
Grand_Bois
Noyan
oc.dist.jac
hclust (*, "ward")

Groups based on occurrence of the 38 alleles in the 16 populations





Leucopus presence : (Roy-Dufresne et al 2013)

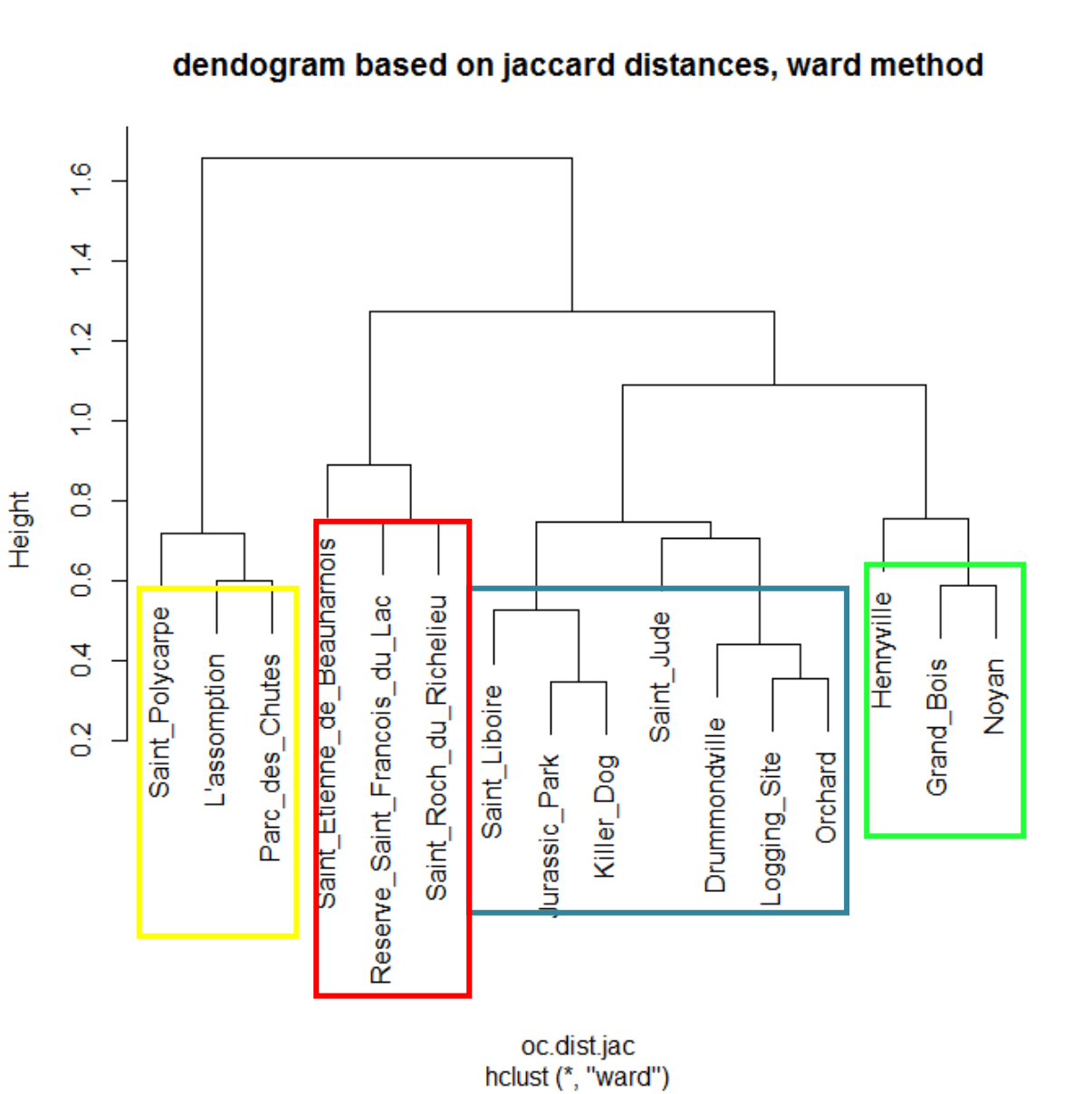
- Blue dots: 1975-1984
- Red dots :1985-1994
- Yellow dots :1994-2004

parasite screening

- Exoparasites :
  - Ticks, fleas, botflies
    - No effect on stress level or body condition index.
    - Botfly presence directly related to spleen mass
- Endoparasites :
  - 25 screened samples out of 125
  - 6 parasited mice
  - 5 with *Syphacia*
  - 1 with trematode.

MHC Phylogeny

Dendogram based on occurrence of the 38 alleles in 16 popula



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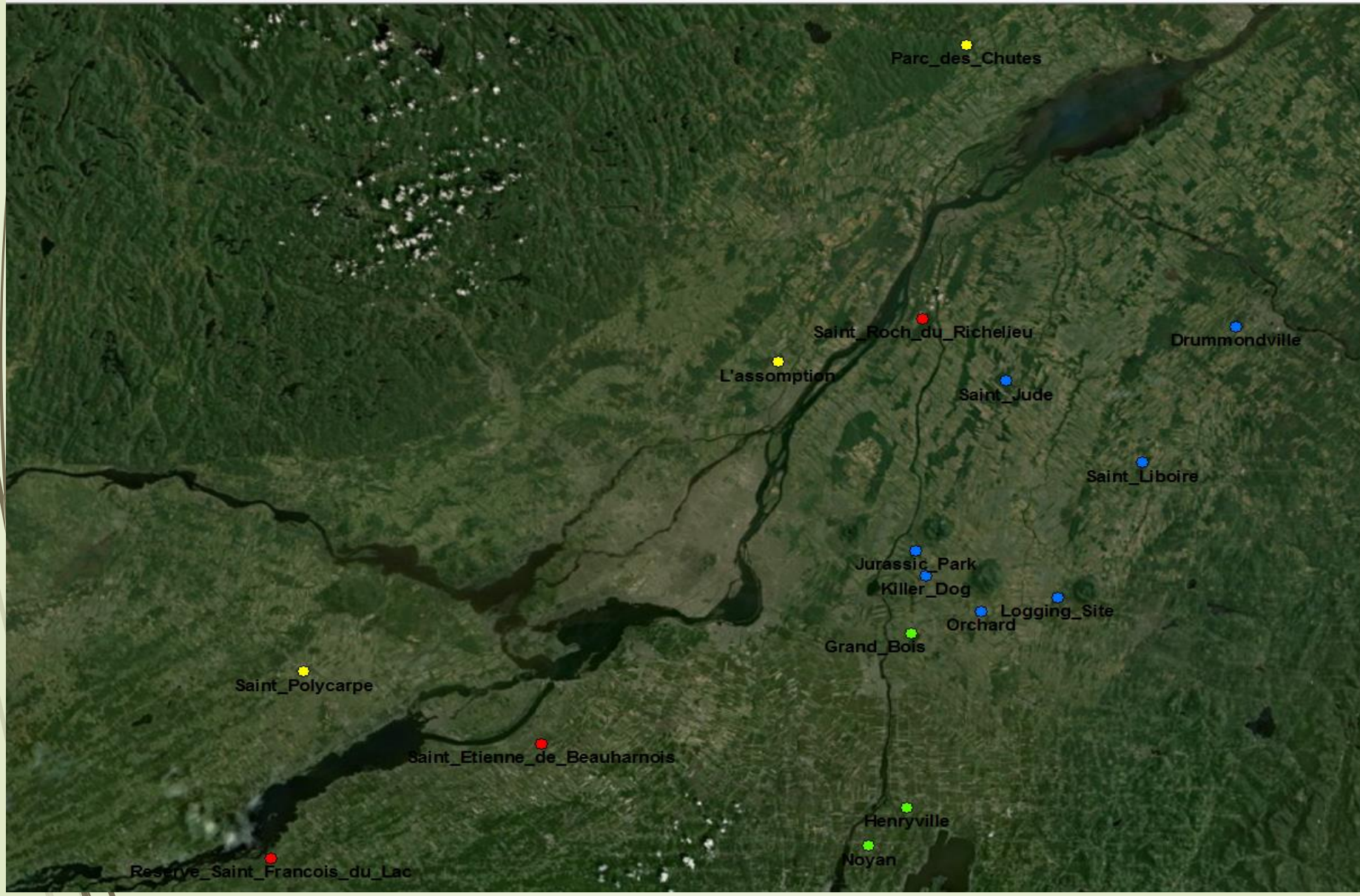

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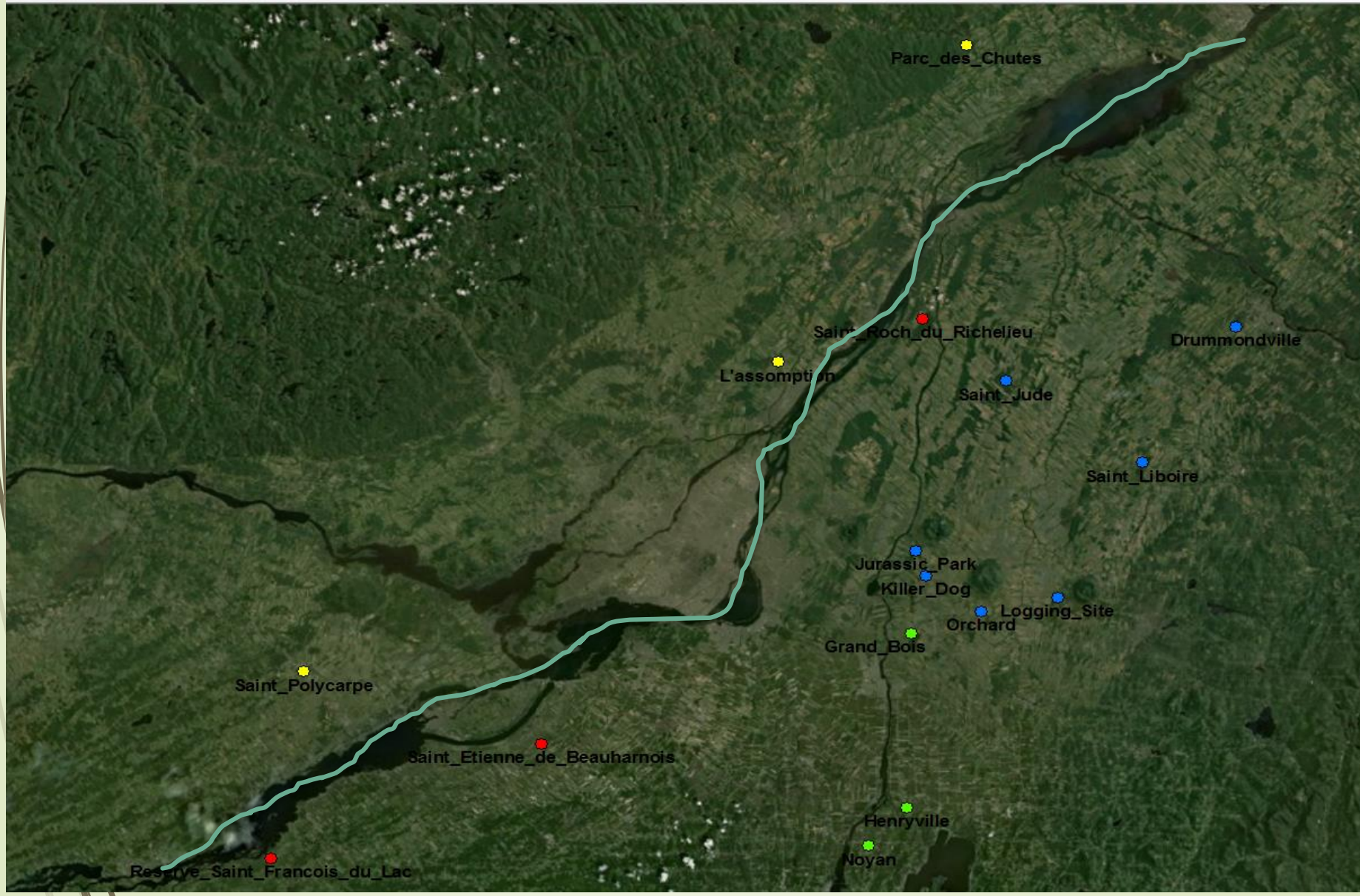

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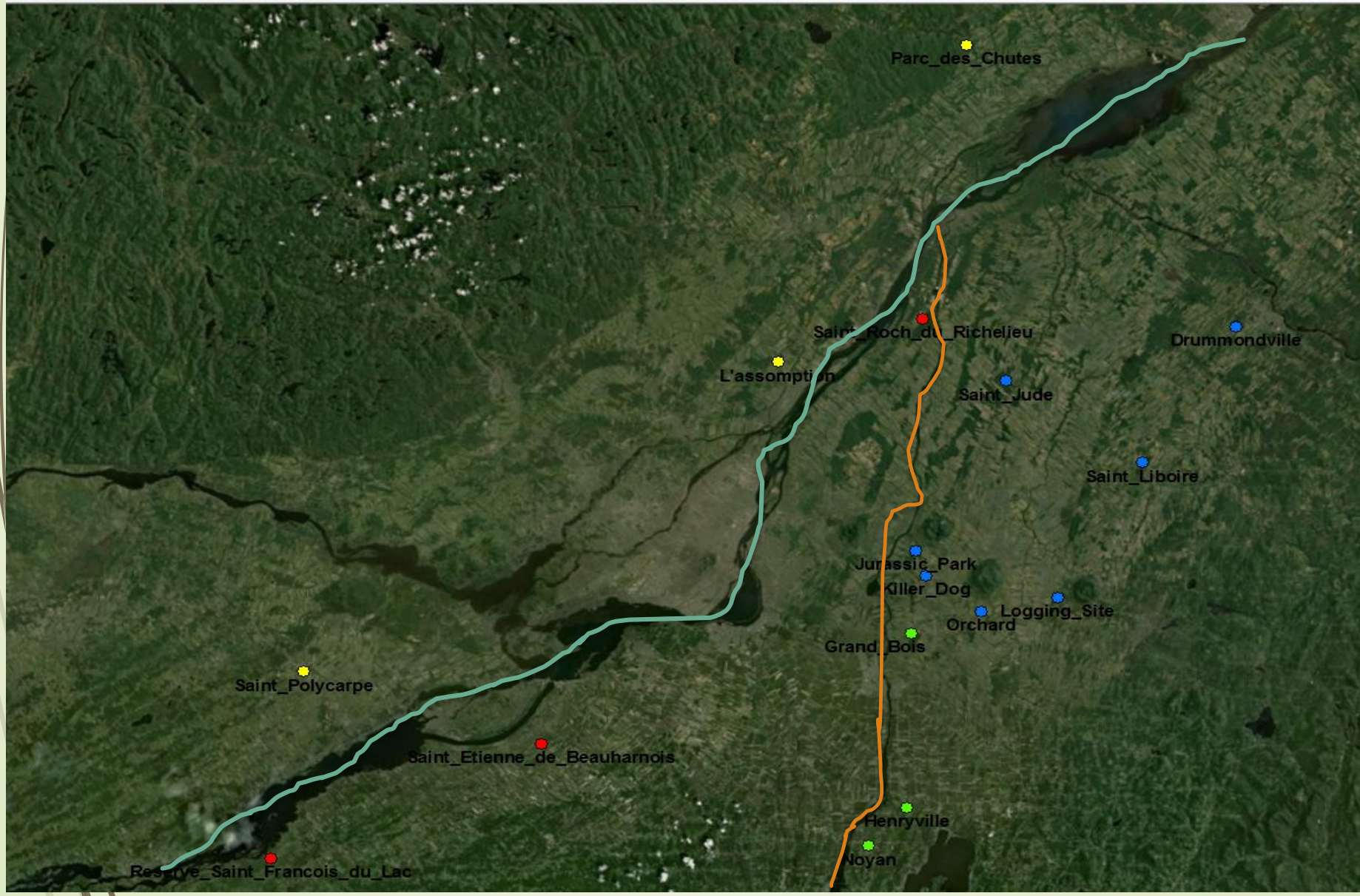

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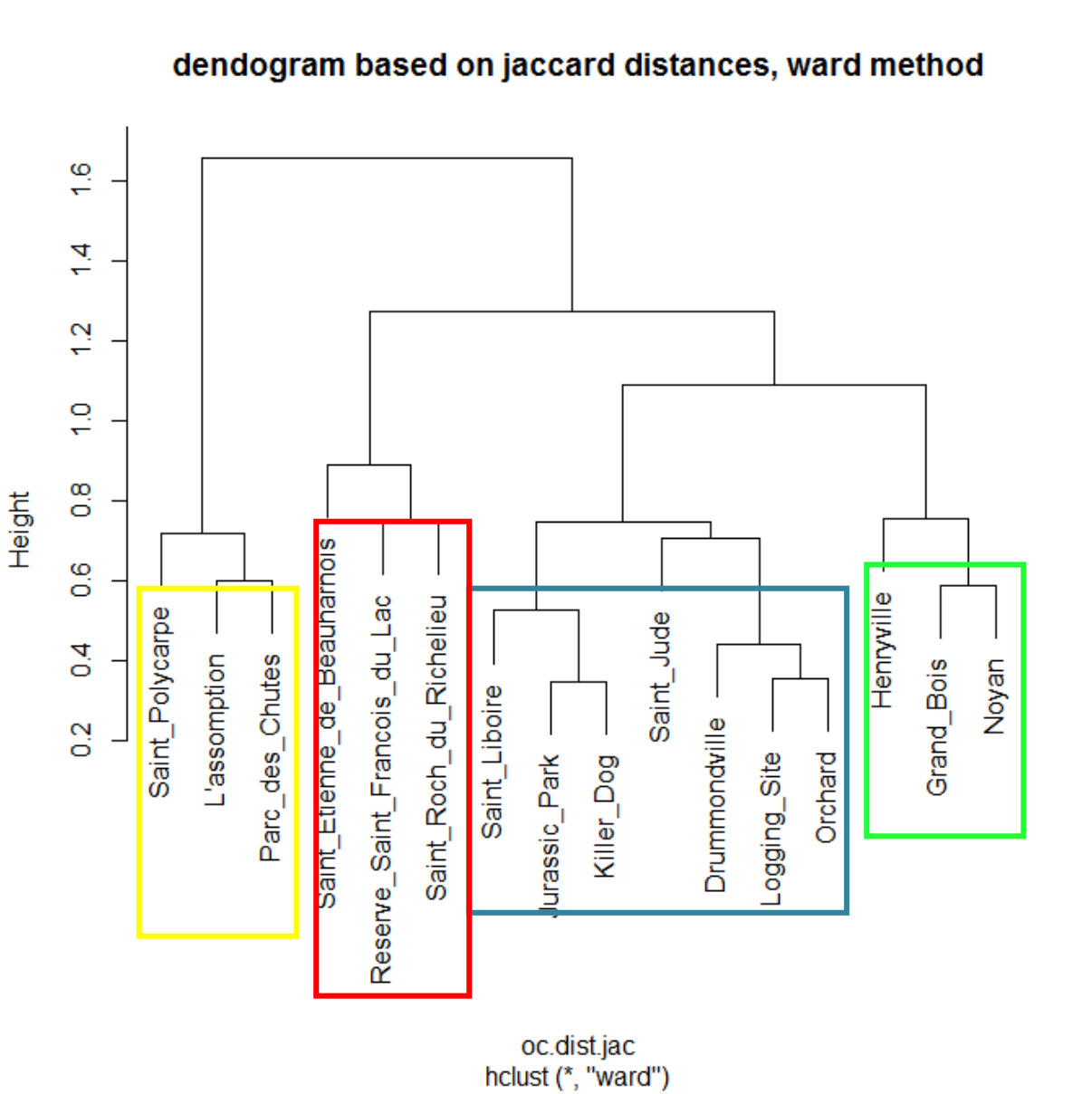
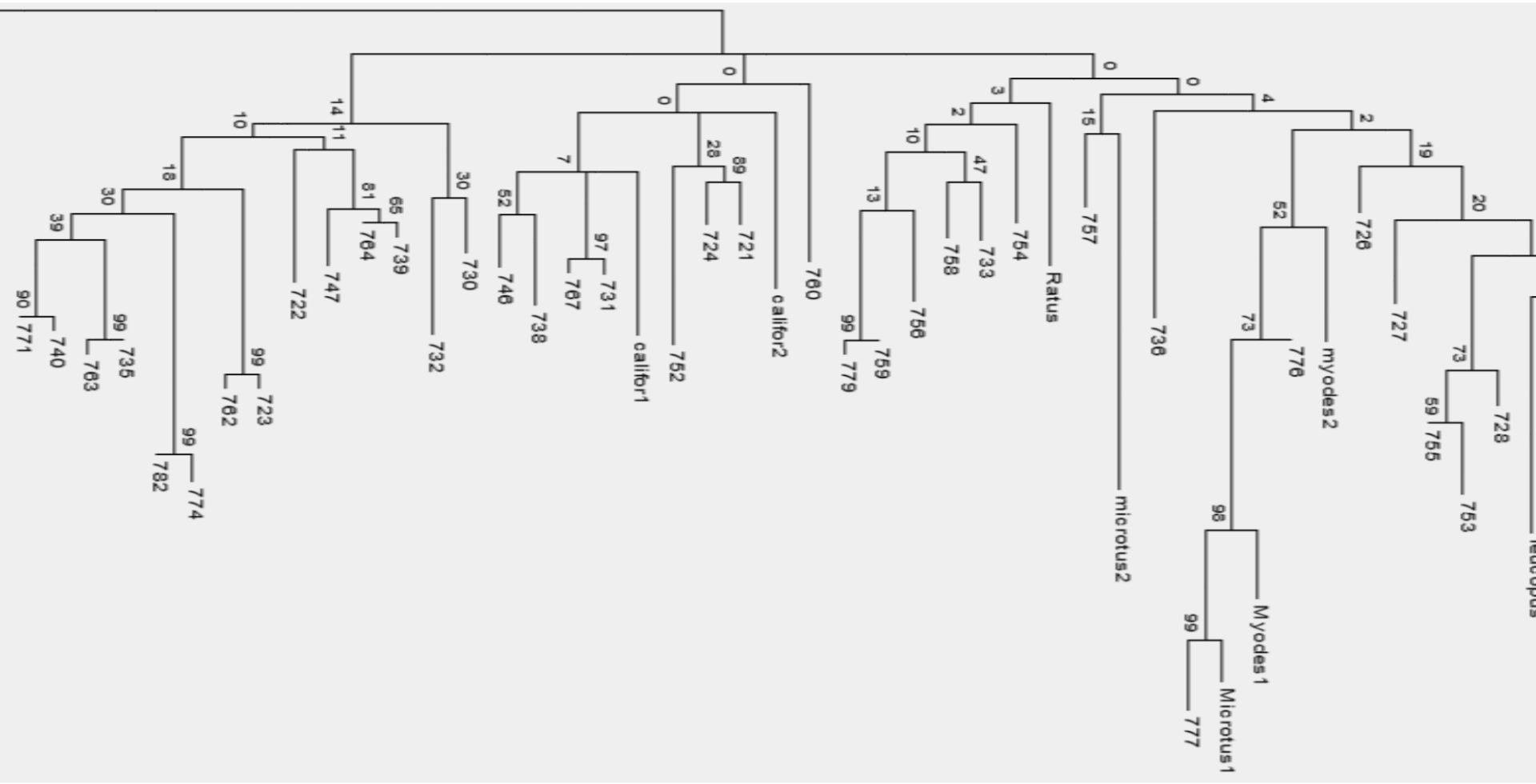
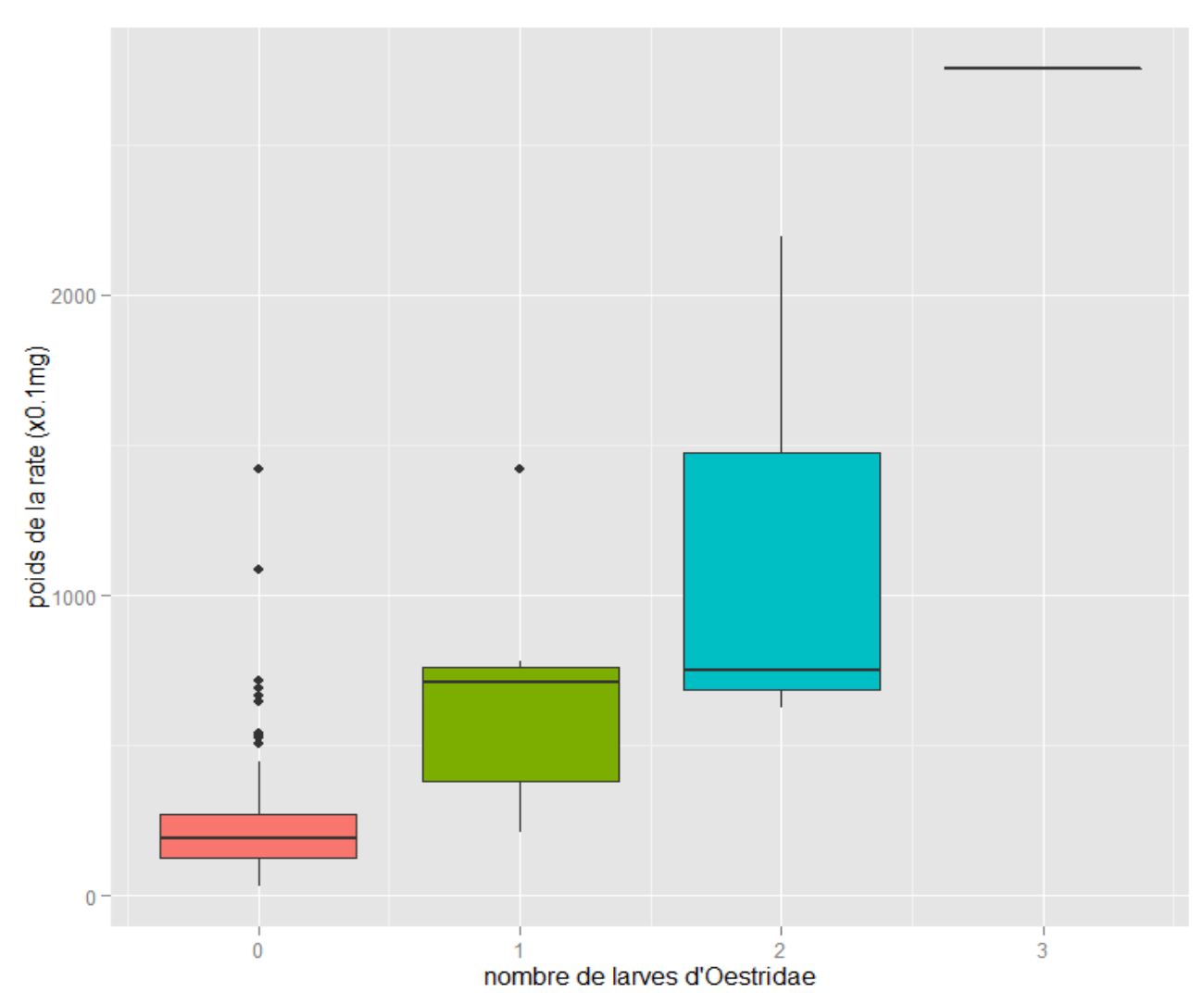


Phylogeny (Maximum likelihood tree): Evidence for **trans-species** polymorphism (work in progress)

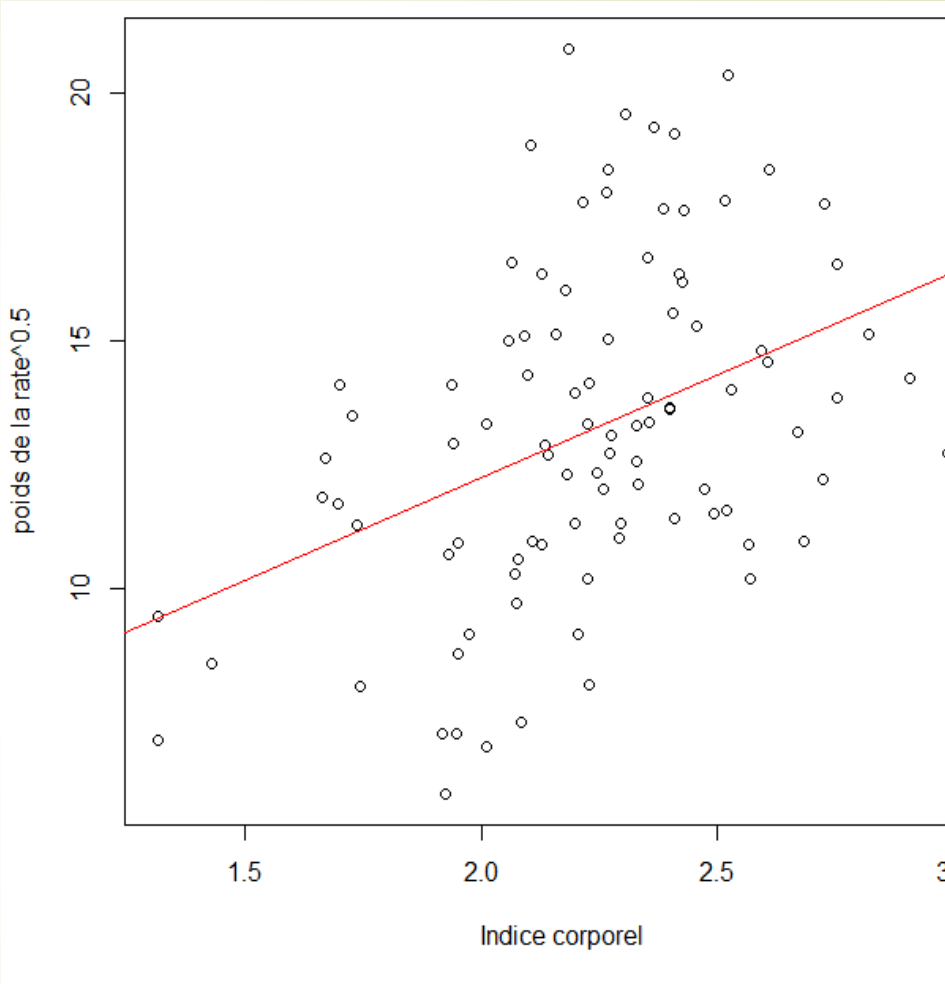


Spleen mass:


poids de la rate (x0.1mg)
2000
1000
0
0
1
2
3
nombre de larves d'Oestridae

Spleen mass:

Body condition index:
esidues from the
egression of the body
mass on the body size.
= general health index



Adjusted R-squared: 0.1694
p-value: 1.837e-05

Spleen mass:

Individuals with big spleens are whether :

- Bot-flies parasited mice
  ➔need to invest energy in the immune system to fight parasites or their negative impact.

- Generally healthy mice
  ➔investment of the extra energy in the immune system potential futur infections.