

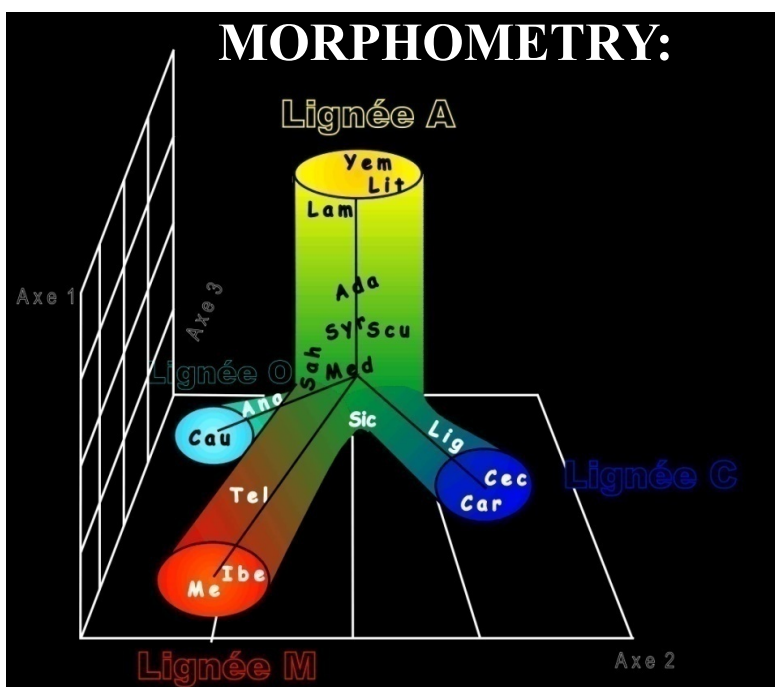


BEEHOPE

Honeybee Conservation centers in Western Europe: an innovative strategy using sustainable beekeeping to reduce honeybee decline.

Les conservatoires d'abeilles en Europe de l'Ouest: une stratégie novatrice fondée sur l'Apiculture durable pour réduire le déclin des abeilles

High level of diversity:
Morphological and éco-éthological



=) The 26 subspecies are distributed in 4 evolutionary lineages (Ruttner, 1988)

Adaptive and evolutionary heritages to save

The honeybee paradox

Ecological interest: Key species

- Pollination of wild plants

Economical Interest

- Honey, wax, royal jelly, pollen
- Pollination of cultivated plants



==> essential to conserve the intra-specific diversity

Honeybee and «domestication»:

* Until the beginning of 20th century, the beekeeper is mainly a honey-picker

* Since the invention the modern beehive:

==> Development of new apicultural practices

Seasonal migrations of honeybee colonies and importing of queens

* **Queen rearing:**

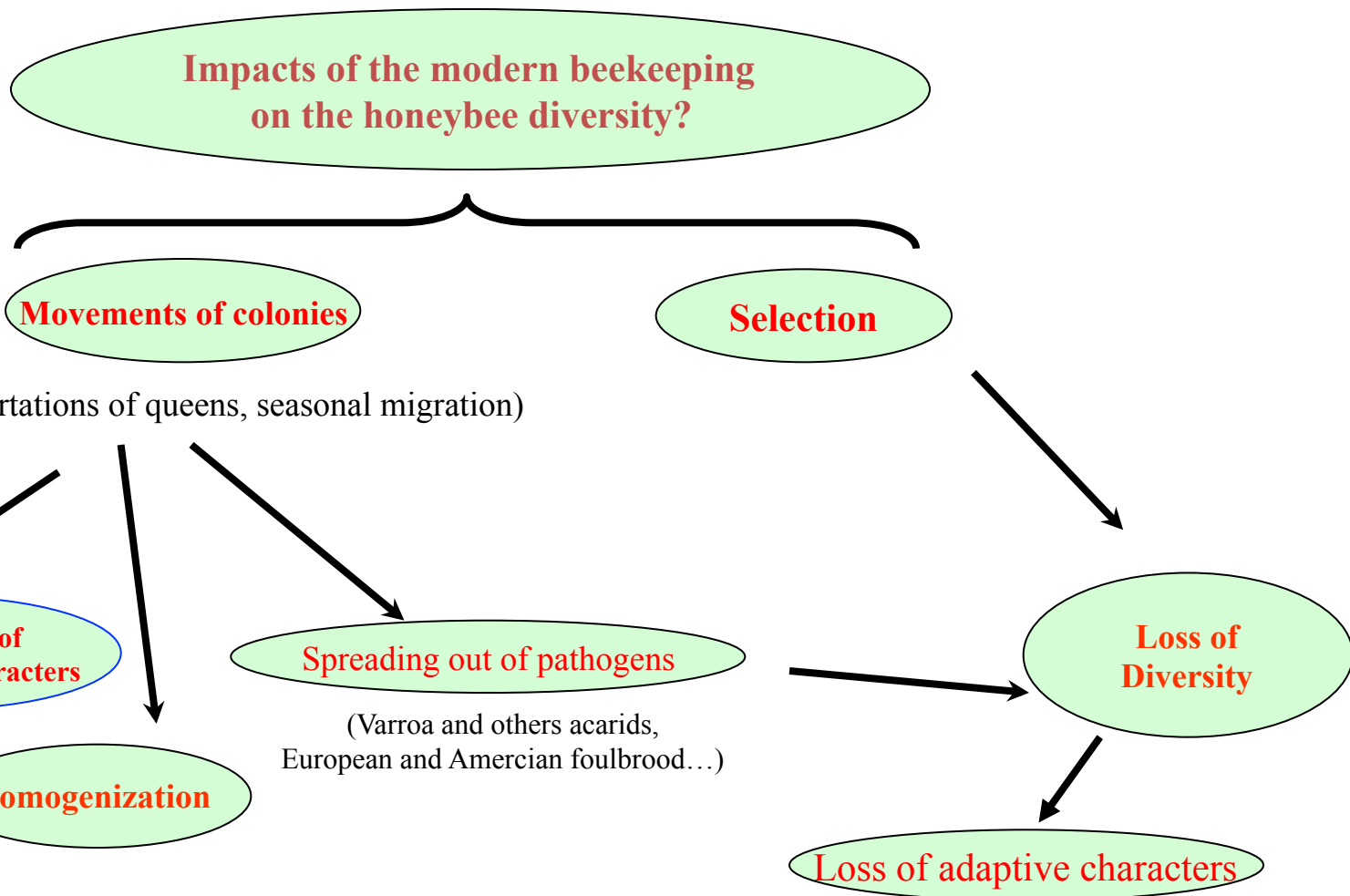
(More and more used)

* **Artificial insemination:**

(punctual)

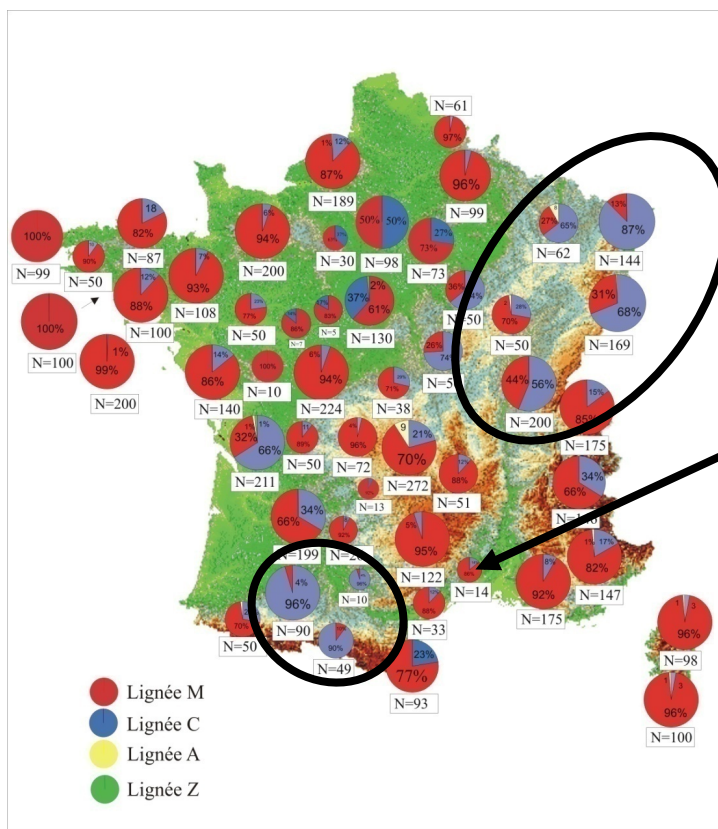
**Real domestication
(influence the reproductive
system)**

==> Potential large impact on the genetic diversity of honeybee



SITUATION IN FRANCE

73 % M
26 % C and O
1 % A



Alarming Situation

Areas with a high level of introgressions (importations)
56% < % C < 96

In Ile de France
 50% in 2008 / 80% in 2014
In Cévennes:
 5% in 2006 / 48% in 2014

Haplotype balance local versus imported
 (**haplotypes M** / **haplotypes C**)

Samples:
 5227 colonies

Findings over the last twenty years:

Increasing of **genetic pollution**

Decreasing of honey production

Decreasing of the vitality of queens (fertility, lifespan)

Increasing of colony losses (1990s)

Only one accused : the pesticides !!!

Apiarian practices: a possible additional cause or not ???

Importation of queens

- poor adaptation to the habitat ?

- fast spreading of pathogens (activated by the seasonal migration)

(the beekeepers have a lot of experience):

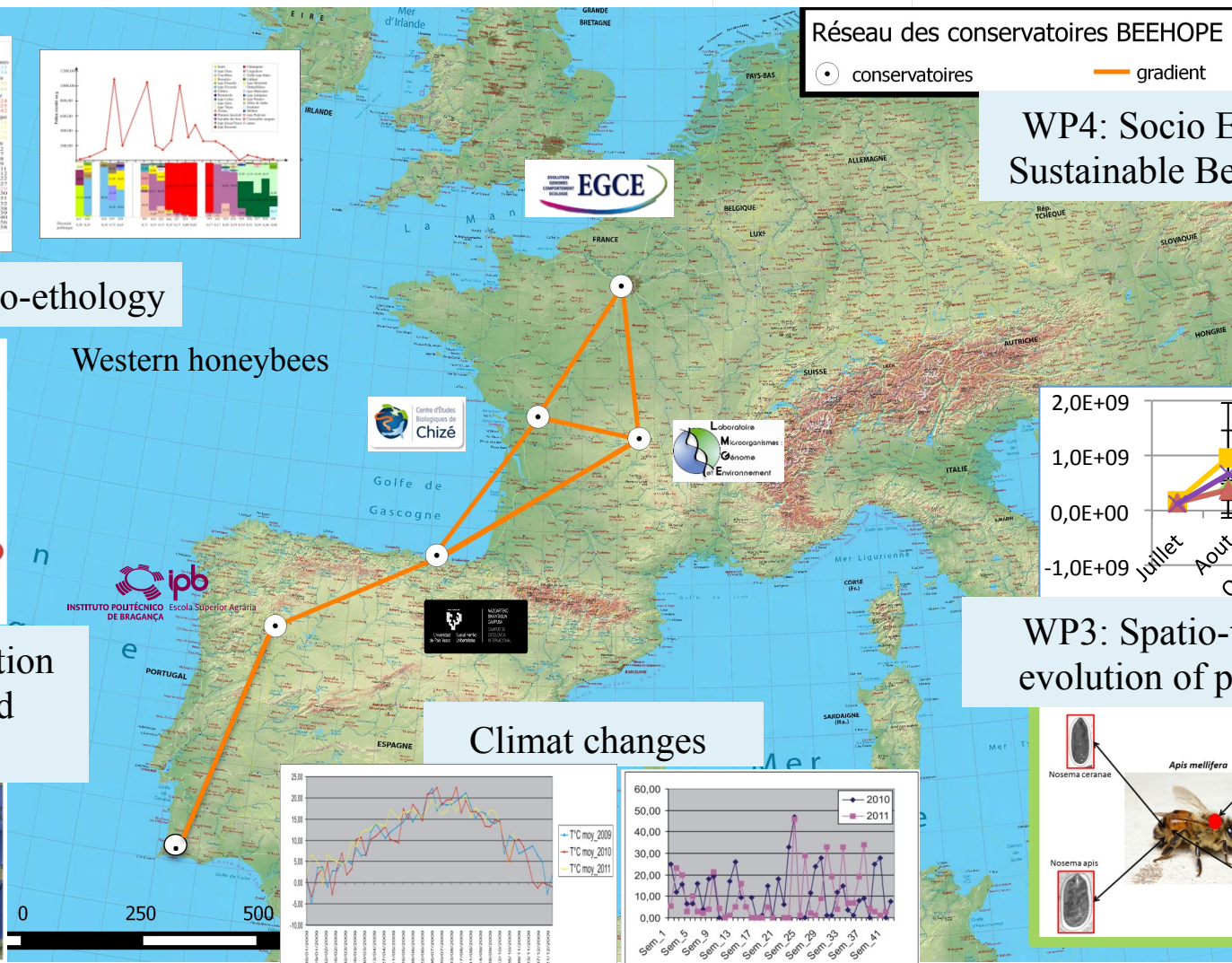
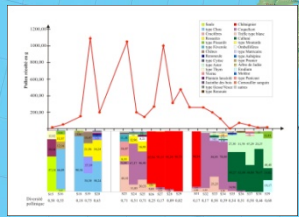
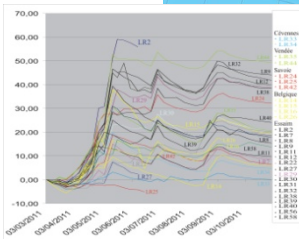
Varroa, *Nosema cerenae* et now *Aethinia thumida*

Which solution ?

Réseau des conservatoires BEEHOPE

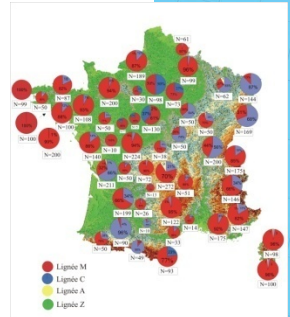
○ conservatoires — gradient

WP4: Socio Economy Sustainable Beekeeping

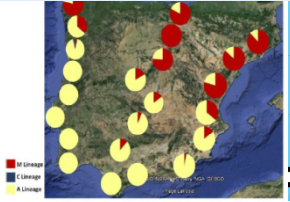


WP2: Eco-ethology

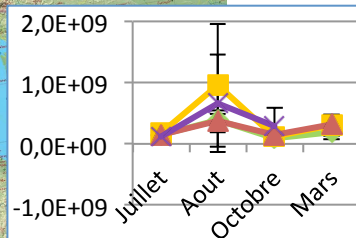
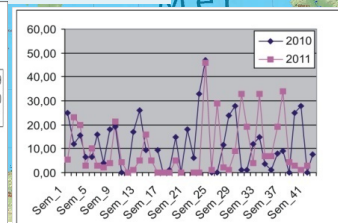
Western honeybees



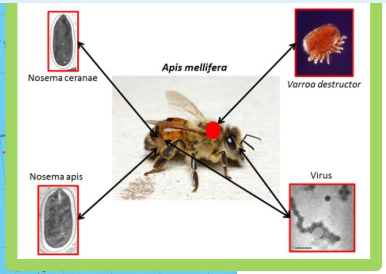
WP 1: Population genetics and genomics



Climat changes



WP3: Spatio-temporal evolution of pathogens





People involved in BEEHOPE



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Iratxe Montes

Noel Mallet

Luc Champlin

Jean-Charles Labat

Thank you for you attention



PARTENAIRES. Réunis hier, au laboratoire micro-organismes génome de l'environnement, près des ruches du campus des Cézeaux. PHOTO S. GRAND

Kick-off meeting, 4-5 March in Arverne

(Journal la Montagne du 5 mars 2015)

Workpackage 1: The impact study

Aims:

Objectifs:

Characterize the genetic structure of each conservation center

Définir la structure génétique de chaque population conservatoire

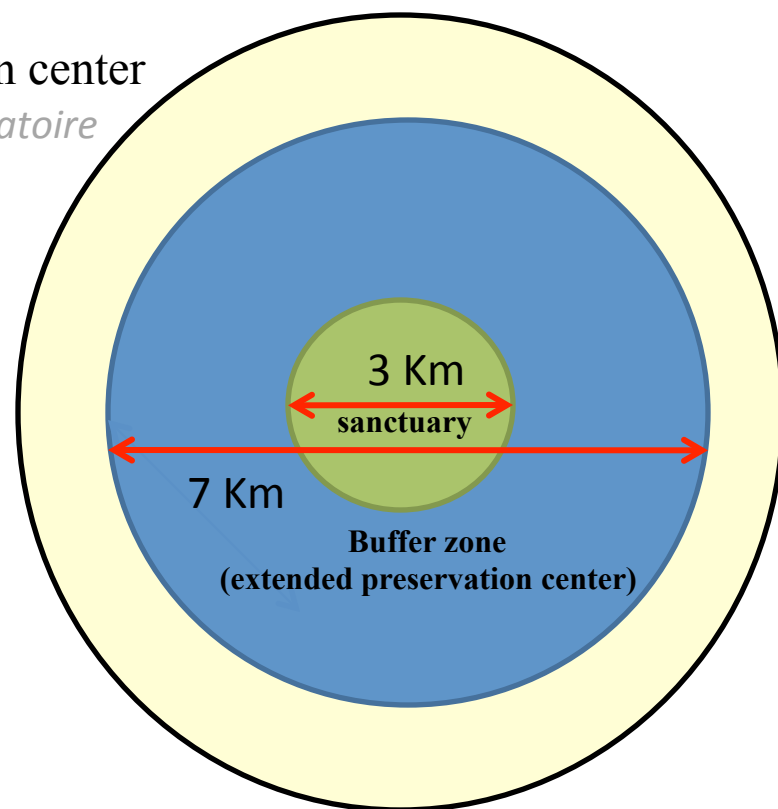
- Levels of variation / *niveaux de variation*
- Levels of introgression / *niveaux d'introgression*
- Risks of introgression / *Risques d'introgressions*

Map the genetic diversity

Cartographier la diversité génétique

Mt DNA studies (COI-COII / *Dra I* Test)

14 Microsatellites loci





The New Generation Sequencing protocol:

Aims:

Objectifs:

- Develop a new genetic system based on SNPs for introgression detection (comparison with microsatellite datas)

Développer de nouveaux marqueurs génétiques de type SNPs pour l'estimation des introgressions (comparaison avec les marqueurs μ sat)

- Define an exclusive SNP profil for the honeybee population included in each preservation center => for local origin assignment

Définir des profils SNPs exclusifs pour caractériser les populations d'abeilles locales de chaque conservatoires

- isolate a set of genomic fragment that show signature of selective Sweeps associated with local adaptation (link with WP2)

Caractériser des régions du génome montrant des signatures de sélection associés aux populations locales (lié au WP2)



Workpackage 2: Eco-ethological survey:

Aims:

- Characterize the biological cycle of the colonies of the preservation centers
Caracteriser le cycle biologique des colonies des conservatoires
- Follow up the evolution of preservation centers in a context of global change
Suivre l'évolution des conservatoires génétiques dans le contexte de changements globaux.
- Impact of climate change on adaptation of populations for 2 honeybee subspecies
Etudier l'impact du changement climatique sur l'adaptation des populations de deux sous espèce d'abeilles
- Develop protocols for the preservation of genetic and adaptative traits of local populations
Développer des protocoles de gestion de la diversité génétique et adaptative des populations locales.



Workpackage 3: Spatio-temporal dynamics of pathogens

Aims:

Monitoring the spatio temporal dynamics of key parasites involved in the arm race in each of the studied area (varroa, virus, microsporidia and bacteria).

Objectifs: Suivre la dynamique spatiale et temporelle des parasites clés impliqués dans la course aux armements de chaque sites étudié (varroa, virus, microsporidies et bactéries).

- **Spatial approach:** Assess the diversity of pathogens associated with geographical origin and history of honeybee populations

Approche spatiale: Déterminer les relations entre diversité des pathogènes et origines géographique historique de différentes populations d'abeilles

- **temporal approach:** survey the evolution of the cortège during the project

Approche temporelle: Suivre l'évolution du cortège de pathogènes durant le projet.

Tools: OMICS methods

Outils: méthodes OMIC



Workpackage 4: Sustainable beekeeping and preservation centers

-Inform beekeepers about the advantage to breed honeybee ecotype
Informer les apiculteurs sur les avantages d'élever des abeilles locales

Development of programs promoting the use of honeybee ecotype in European apiaries to counter the honeybee decline and reduce risks of introduction of alien pathogens

Développer des programmes de promotion pour l'utilisation des abeilles locales pour contrer les pertes de colonies et réduire le risque d'introduction de pathogènes.



Succinct Calendar

I-Impact study to choose sanctuary and buffer areas,
assessment of genetic background of honeybee colonies
-January 2015- December 2015

II-Eco-ethological surveys
-Springs 2015-December 2017

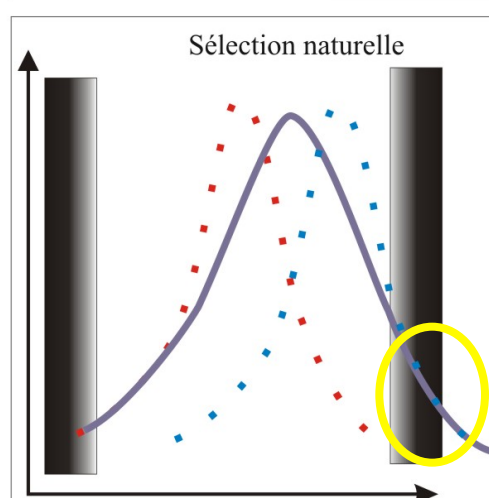
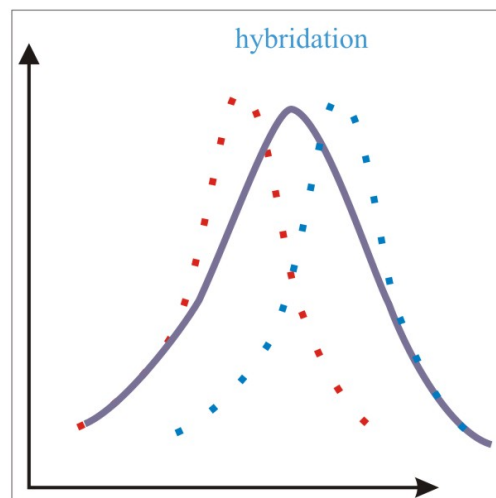
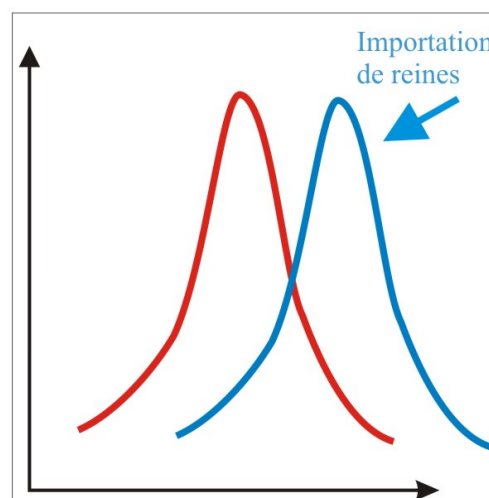
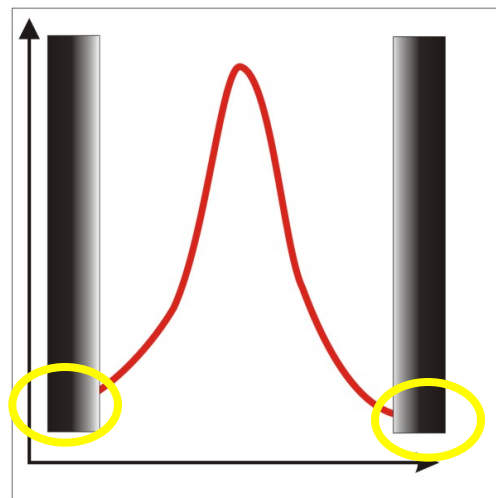
III- Health monitoring of bee colonies and spatio-temporal
dynamics of pathogens
-Spring 2015-December 2016

IV-Participative science (citizen comitte on each site, and
communication with socio-economic actors)
- Spring 2015-December 2017



Effets des importations et de l'introduction de caractères non adaptatifs ?

5 à 10%
De pertes

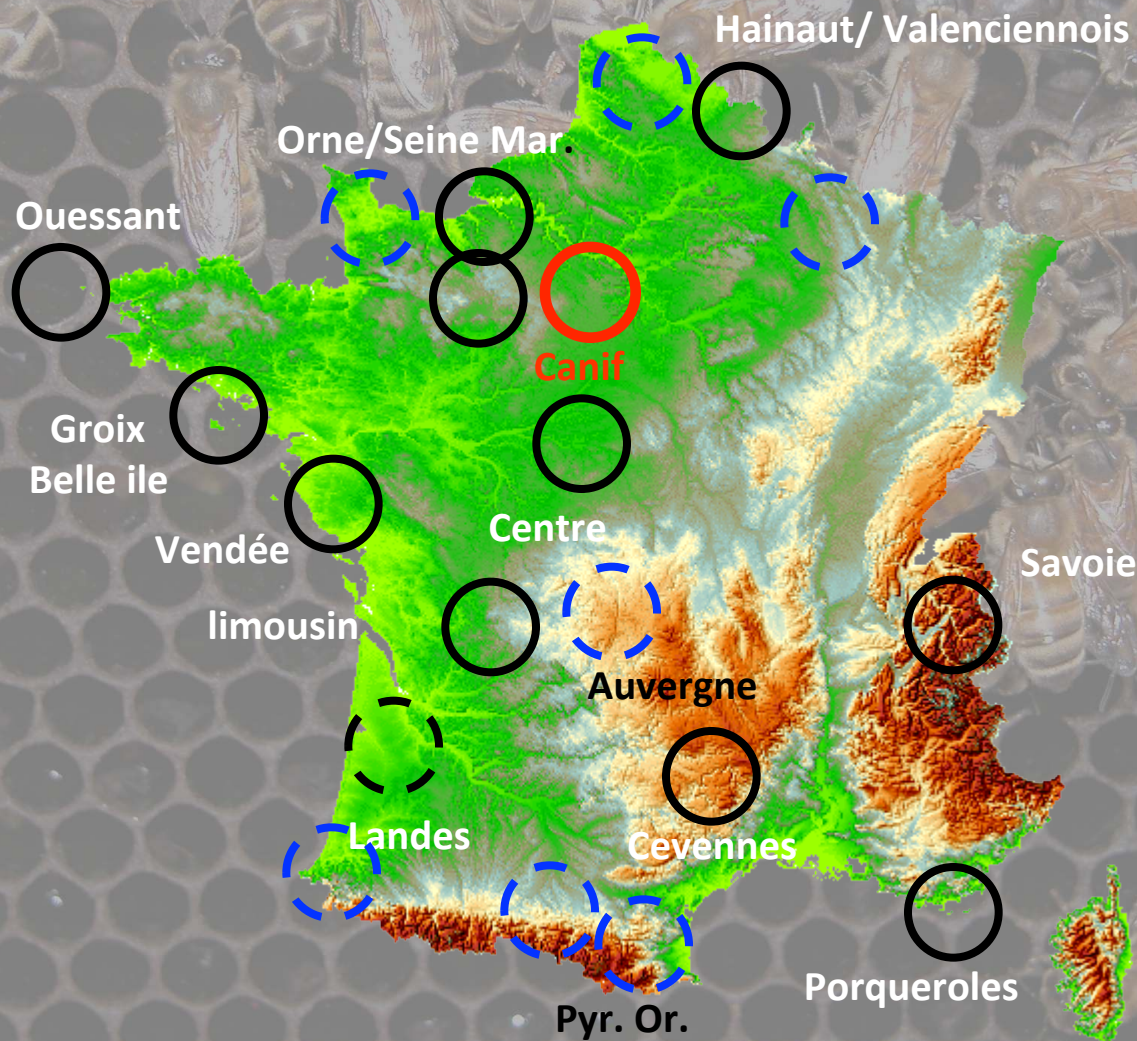


> 10%
de pertes

Bilan : Augmentation des pertes

Solution pour le maintien du cheptel d'abeilles locales:

Mise en place d'un réseau de conservatoires génétiques





Center of dispersion





