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

Miguel VILAS BOAS[1], Maria Alice PINTO[1], Cátia NEVES[1],, Lionel GARNERY[2], Hélène LEGOUT[2], Sylvie HOUTE[3], Jean-François ODOUX[4], Andone ESTONBA[5], Irati MIGUEL[5], Iratxe MONTES[5], Noel MALLET[6], Claude GRENIER[6], Jean-Charles LABAT[6], Luc CHAMPIN[6], Jonathan COLOMBET[7], Samuel GUYOT[7], Télesphore SIME-NGANDO[7], Frédéric DELBAC[7], Iris EOUZAN[7], David G. BIRON[7]

[1]Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5301-855 Bragança, Portugal; [2]EGCE, UMR CNRS 9191, Paris, France; [3]Centre d'Etudes Biologiques de Chizé–approved ILTER - UPR CNRS 1934, France; [4]Centre INRA Poitou-Charentes, France; [5]Universidad del País Vasco, Spain; [6]Lycée Professionnel Agricole / Centre Régional de formation d'Apprentis, St-Gervais, France; [7]LMGE, UMR CNRS 6023, Aubière, France.

Like most species, the «natural» genetic structure of the honeybee is the result of complex alternating evolutionary processes such as population history and demography, putative isolation of groups of populations during glacial events, genetic drift, natural migration and recolonization processes, but also adaptation to local environments under Darwinian selection. As a result of these interacting processes, studies have showed that honeybee biodiversity can be subdivided into at least 26 subspecies which are geographically structured into four evolutionary lineages, covering Africa, Europe and Western Asia. The western European lineage (M lineage), which ranges from southern Iberia to Scandinavia and from the Atlantic coast to the Ural mountains, is the oldest lineage which colonized northern Europe about 1 million years ago. The M-lineage is composed of two honeybee subspecies: (i) the Iberian honeybee, *Apis mellifera iberiensis* , and (ii) the black honeybee, *A. m. mellifera*.

For about 20 years, the European honeybee has been subjected to a constant decline for which pesticides and pathogens seem to be the main contributors. However, recent surveys suggest that current honeybee declines in European apiaries can be also caused by commercial and European trade of honeybees by **(i) the introduction of unadapted and artificially maintained colonies, and (ii) the spread of allochtone and invasive pathogens carried by allochtone honeybees**. Large molecular surveys have already been performed in France (Fig. 1A), in Spain and Portugal (Fig. 1B) to characterize the French, Spanish and Portuguese livestock of honeybees, and to assess the impact of importations of foreign queens. In France, high levels of introgression were measured in north-east and southwest. In these areas, the situation is worrying for the M lineage, especially for the native subspecies (the black honeybee), which genetic integrity is seriously threatened by C-lineage introgression (Fig. 1A).

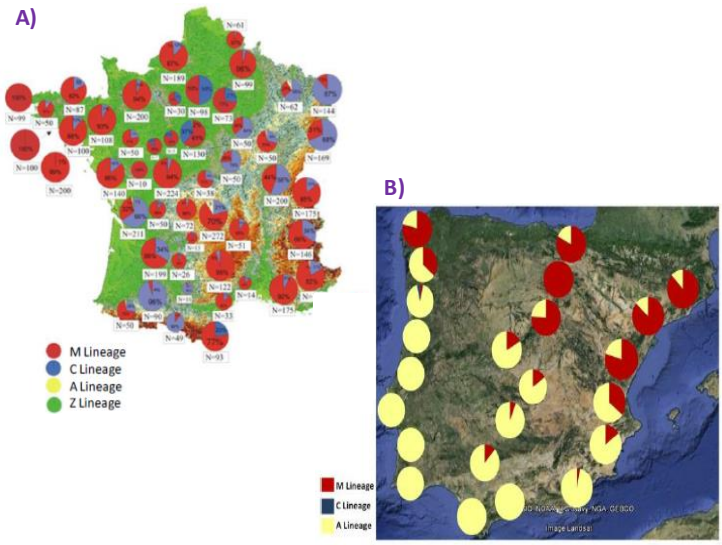

Figure 1: Impact study based on mitochondrial DNA (mtDNA) diversity of (A) French honeybee colonies (n=5257) in 2008, and of (B) Spanish and Portuguese colonies (n=711) in 2010.

Which solution ?
Sustainable or intensive beekeeping practices ?

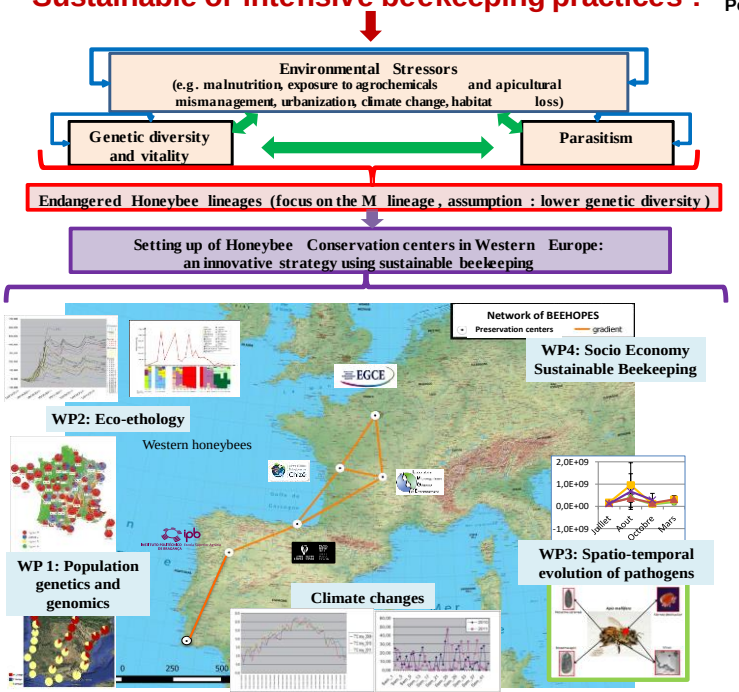

Figure 2: Schematic overview of "BEEHOPE" for the set-up of a network of conservatories to preserve the genetic diversity of the M-lineage, and to promote and stimulate "sustainable beekeeping" in European beekeeping apiaries.

The main goal of **BEEHOPE**, our BioDIVERSA ERANET funded project, is to set up, according to a North/South gradient, genetic conservatories of native honeybee populations. BEEHOPE is divided into four work packages (WP): (i) impact study on the genetic background (heritage) of our colonies; (ii) choice of our sites and establishment of preservation centers; (iii) monitoring of eco-ethological and physiological parameters of a honeybee colony, and spatio-temporal monitoring of pathogens and predators (e.g.: small hive beetle); (iv) dynamic interactions with stakeholders involved in the beekeeping sector for the development of a sustainable beekeeping (Fig. 2).

This European network of honeybee preservation centers (~530,93 km^2 per preservation center) will have as missions: (i) to characterize the genetic and eco-ethologic diversity of honeybees from the Western European lineage (M-lineage); (ii) to protect the genetic diversity of those populations; (iii) to constitute a reserve of diversity usable by the honeybee industry and beekeepers; (iv) to study the impact of the domesticated honeybee in the maintenance of local floristic diversity; and (v) to be able to use the honeybee as a bio-collector and as a biological indicator of environmental quality.