

Importation and Preservation of Germplasm for U.S. Honey Bee Breeding and Stock Improvement

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Project Cooperators

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Objectives

- Continue collection of germplasm from endemic populations of European honey bees
- Implement cryopreservation of all collected honey bee germplasm for both immediate and long term breeding use.
- Continue a selective breeding program to evaluate and improve introduced stocks and hybrids under US conditions, screening especially for resistance to pests and diseases
- Cooperate with ongoing honey bee stock improvement efforts (11-POLL4-Cobey) and the tech transfer program to improve honey bee stocks (11-POLL5-Spivak/Donohue)

Background

Recent declines in honey bee populations and the difficulties in reliably maintaining colony health are of concern to both beekeepers and growers of crops needing pollination services. Amid widespread research on honey bee health issues, including Colony Collapse Disorder (CCD), there remains a notable lack of research directed toward the genetic improvement of honey bees.

There is a strong queen production industry in the US, but these producers continue to be limited by the lack of genetic diversity available. Most importations of honey bees to the US took place between 1860 and 1922. In 1922, the Honey Bee Act restricted further importations of bees. As a result, queen producers rely primarily on populations of bees that were established during the period of importation between 1860 and 1922. While there were few additional importations of honey bee germplasm after 1922, feral European honey bee populations in some southern states served as supplementary sources of genetic variation for breeding operations. However, the establishment of Varroa mites in 1987 led to a major decline in US feral honey bee populations



The most practical means of allowing germplasm entry to US is through collection of honey bee semen under permit and using instrumental insemination for subsequent propagation and screening of the genetic material.



Collecting site for *A. m. caucasica* in 2010 and 2011 in Mestia, Georgia

In 2010 (WSS) and 2011 (WSS,BH,SC) we traveled to the Republic of Georgia and made significant collections of *A. m. caucasica* semen from two disparate areas of the Caucasus Mountains. The primary areas sampled were Mestia, in the western Caucasus and Pasanauri in the central Caucasus. In 2011, SC and BH traveled to Slovenia and collected semen from *A. m. carnica* (see Susan Cobey poster). In all cases semen was collected and returned to the US under a USDA-APHIS hand carry permit. California queen producer collaborators had pre-shipped virgin queens from US domestic stocks to WSU and these were then inseminated with the imported honey bee semen. Susan Cobey conducted the instrumental inseminations and also served as primary industry liaison to acquire virgin queens. Aliquots of semen were concurrently supplied to Dr. Judy Chen of the USDA-ARS Bee Research Laboratory in Beltsville MD for virus determination. The collection and introduction of genetic material derived from endemic populations of these three honey bee subspecies will provide increased genetic resources for US bee breeding. Maintaining adequate genetic diversity in breeding stocks of bees is of high importance, as queen breeders strive to select for disease and parasite resistance in bee stocks and to reduce reliance on chemotherapeutic agents.



Collection of *A. m. caucasica* honey bee semen in Kutaisi, Georgia

Importation of honey bee germplasm. Why?

1. Enhance genetic diversity of US honey bee populations

2. Provide new “raw material” for bee breeding efforts

3. Reintroduce a previously available strain - the Caucasian honey bee



A frame of queen cells ready to place in mating nuclei



Mating nuclei at Smoot Hill – WSU mating apiary

This report chronicles progress towards the improvement of US honey bee populations, based on the importation of novel honey bee genetic diversity that will be accessed by the bee breeding industry. Funding by the Almond Board allowed a second year of collection in the Caucasus region and additional importations of semen from Slovenian *A. m. carnica* in July 2011. In addition, our laboratory made major progress in honey bee semen cryopreservation technology in 2010 with the production of sequential queens from cryopreserved semen (Hopkins et al., *In Press*). The ability to cryopreserve semen, coupled with the establishment of a USDA-APHIS/WSU permit protocol to import honey bee germplasm, lays groundwork to develop a honey bee genetic repository in the United States. Such a repository would allow practical permanent storage of honey bee genetic material for subsequent use, much as has become routine in other animals of agricultural significance (dairy and meat cattle, sheep, swine, horses, etc.). The Almond Board funding received by WSU for honey bee germplasm collection efforts is a significant contribution to the establishment of a permanent honey bee germplasm repository.



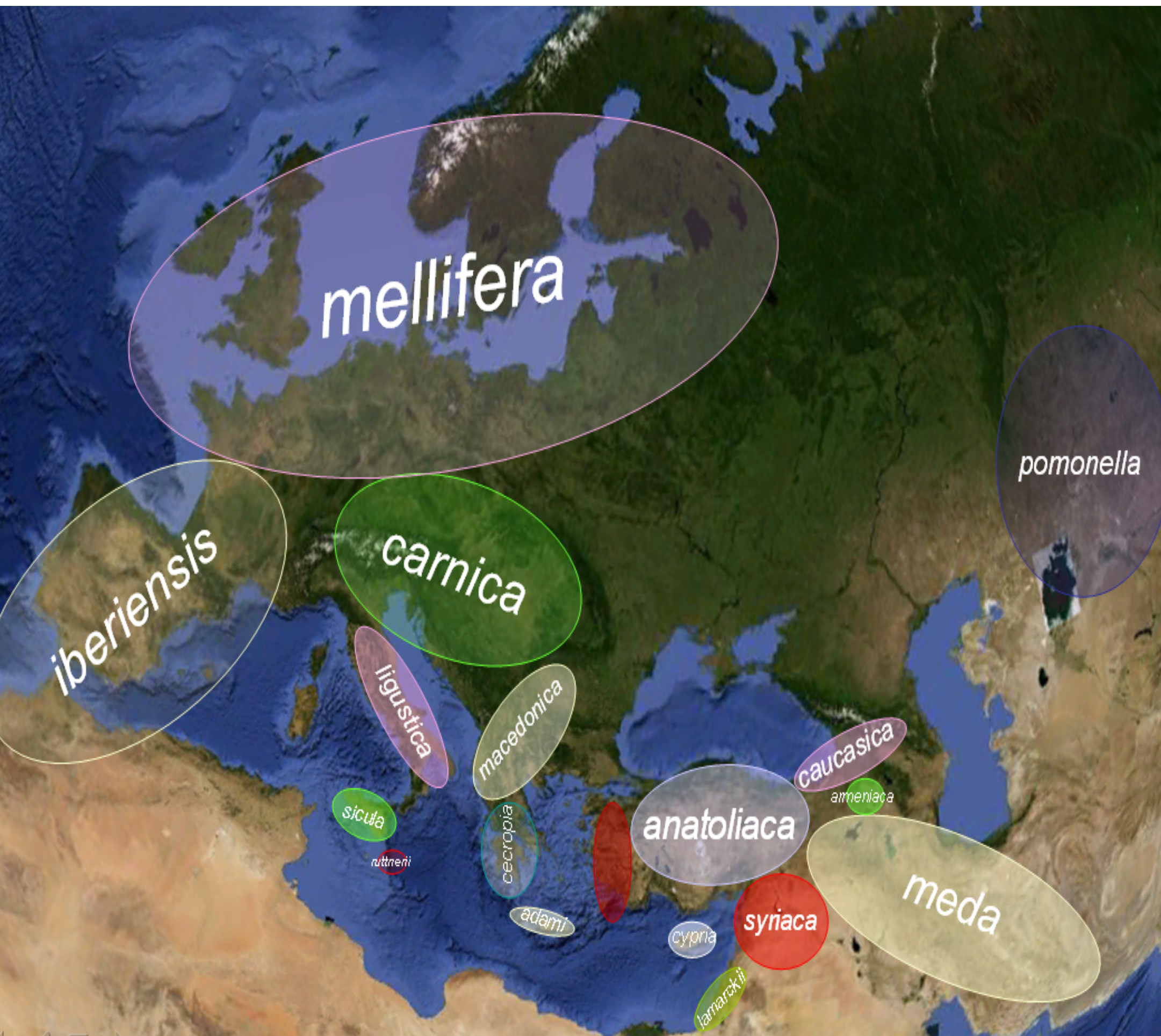
WSU isolated mating apiary



A. m. caucasica F1



Computer controlled freezing unit for cryopreservation



The Western honey bee is native to the Old World and three subspecies, *Apis mellifera ligustica*, *A. m. carnica* and *A. m. caucasica* are being sampled for germplasm as part of this project. (from L. Garney)

Recent success of our laboratory in developing cryopreservation methods for bee semen, the establishment of a USDA-APHIS approved quarantine apiary at Washington State University for germplasm introductions and collaboration with California cooperators (UC Davis honey bee program and the Tech-Transfer Team) provides new opportunities for bee breeding. The means now exist to for progress on collecting, importing and utilizing desirable honey bee germplasm in a timely manner. With cryopreservation, the semen can be preserved, stored and used in a matter of weeks, months or years via instrumental insemination of queens.



< *A. m. caucasica* drones

Mestia apiary >



Georgia – homeland of *A. m. caucasica*

Research Effort Recent Publications:

No specific publications based on the 2011-2012 Almond Board funding are published. However, a related paper in the area of cryopreservation is currently in press (Hopkins et al. *In Press*). Our 2011 collecting trip included the dual collection of fresh semen for immediate use and cryopreserved material for both future use and to contribute to a honey bee germplasm repository. A manuscript highlighting the collecting trips and the genetic material resource is being prepared for the American Bee Journal/Bee Culture magazines. In keeping with Almond Board policy, manuscript drafts will be submitted to the Almond Board prior to journal submission.

References Cited:

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