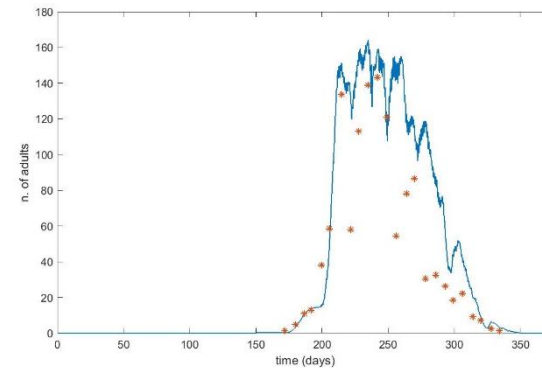
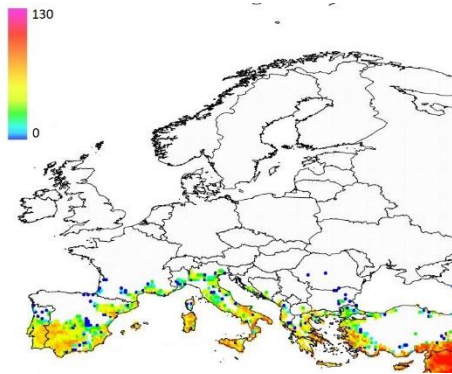


Development of mathematical models supporting sustainable agriculture in Europe



Giorgio Sperandio

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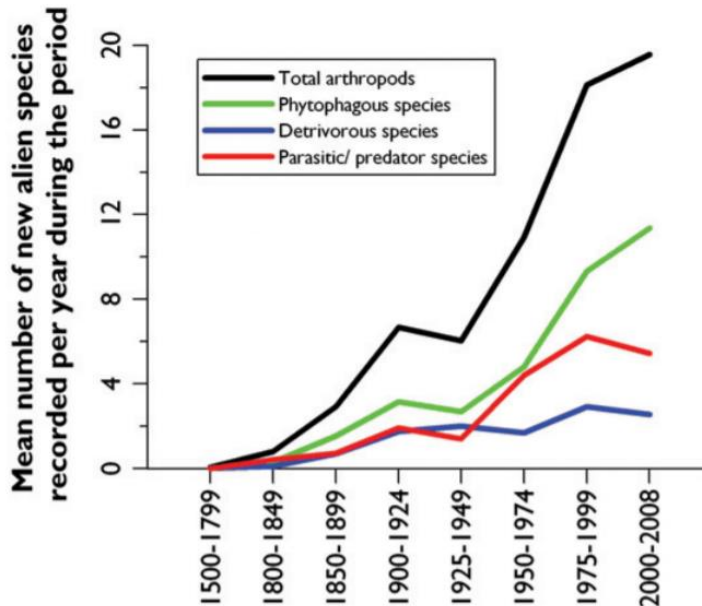
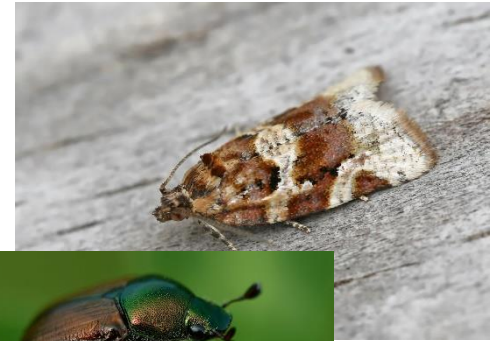
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Insect pests and invasive species: a global threat

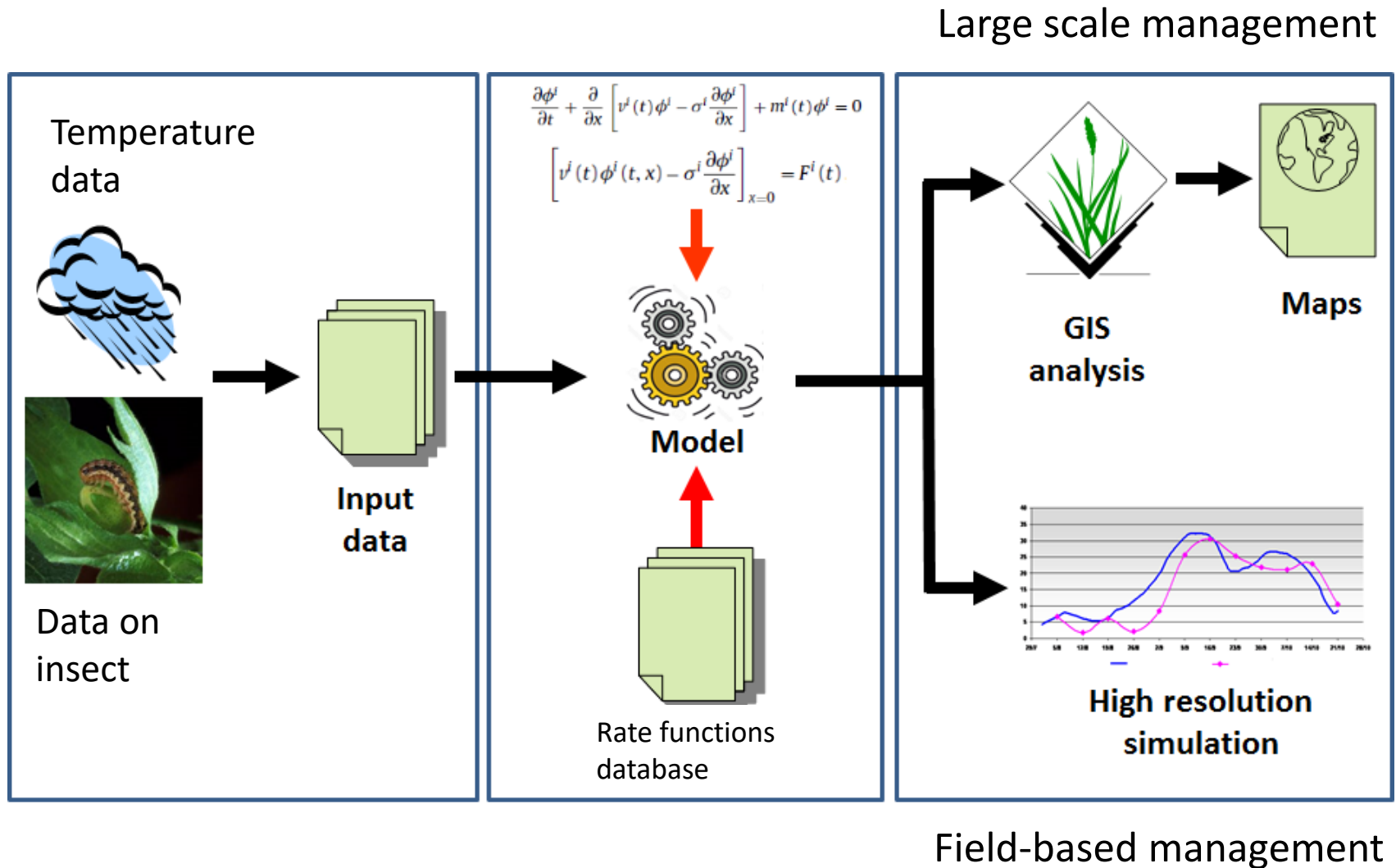
- **Economic impact:** costs to agriculture ~ 300 billions \$/year worldwide
- **Environmental impact:** threat to the structure of ecological communities and ecosystem services (agricultural and forestry production, resources availability)
- **Social and health impact:** more than 100 species may cause impacts to human health



The number of new records of arthropod alien species is increasing over time

Source: Roques, 2010. Biorisk

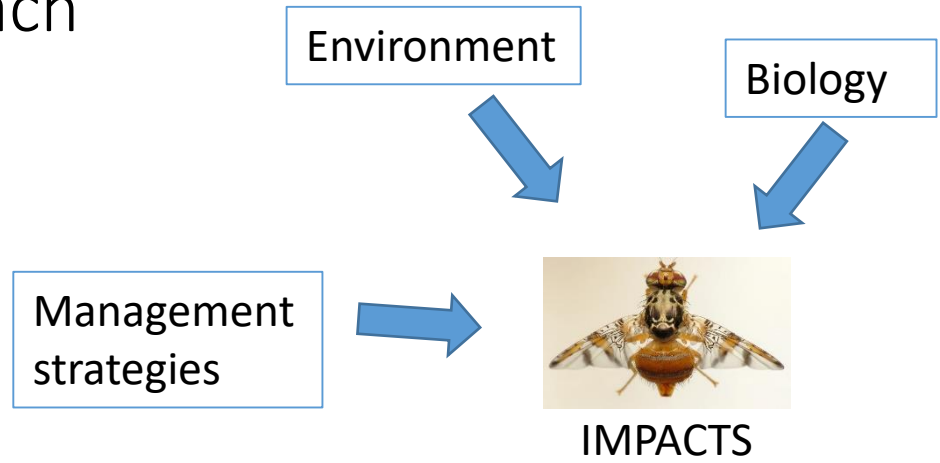
Tools supporting the sustainable management of insects



The overall modelling approach

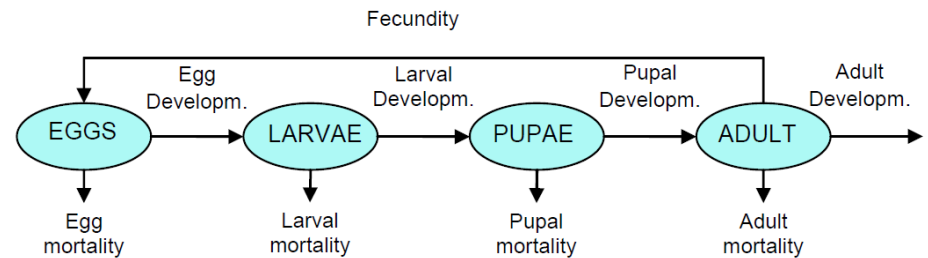
- **Multi-dimensional approach**

Deal with the main drivers and processes involved



- **Conceptualize the system**

Represent the biology, life-cycle, life-history strategy



- **Capture insects' physiological responses**

Realistically represent the influence of external drivers (e.g. temperature) on insects physiology and population dynamics

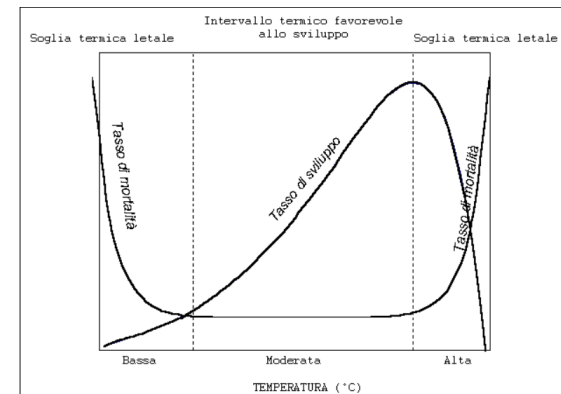
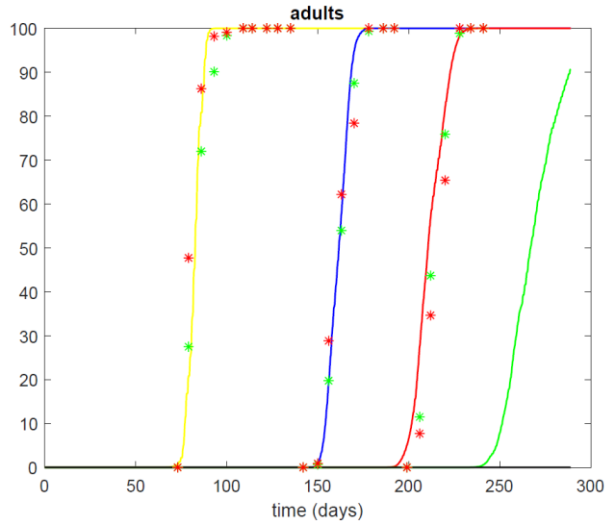


Figura 2.1 - Schema teorico dell'effetto delle temperature costanti sul tasso di sviluppo e di mortalità

Models supporting IPM

Argyrotaenia ljungiana



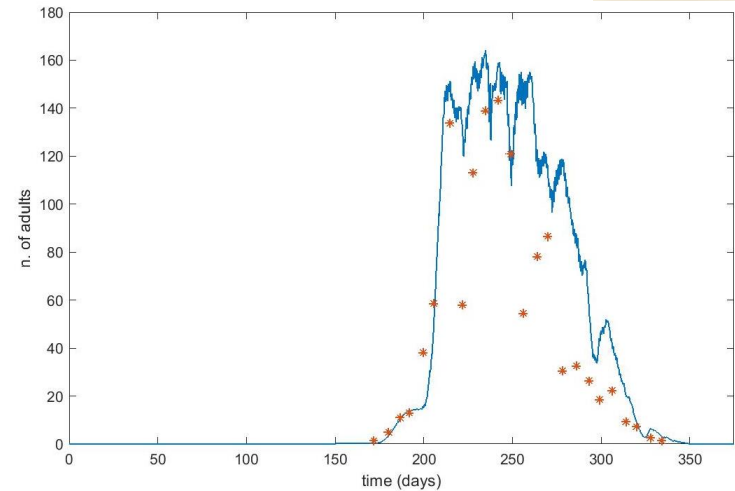
Phenological models

Predicting the emergence of threatening pest stages

Supporting

- The implementation of monitoring activities
- The application of pest control actions
- The assessment of pest's potential impacts (at local level)

Ceratitis capitata



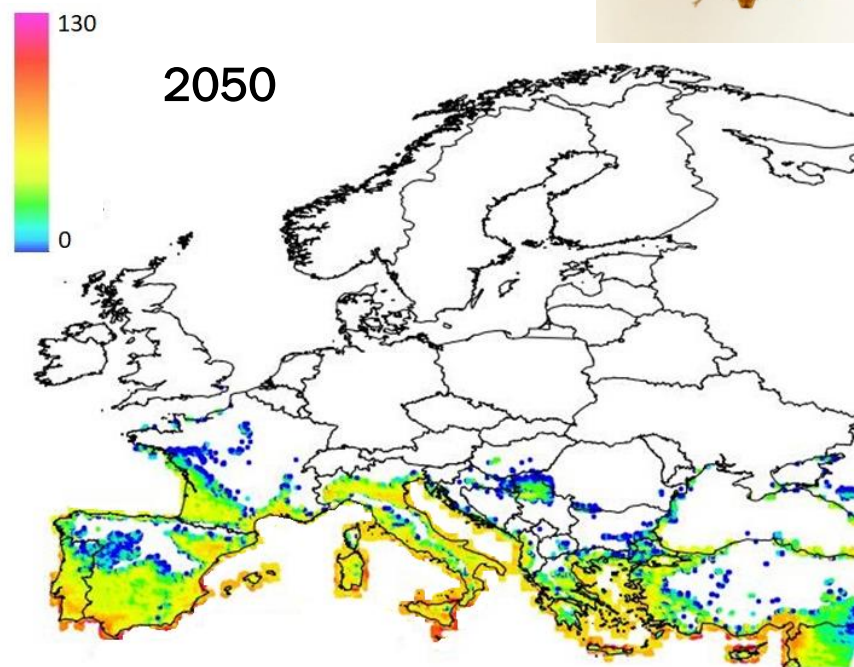
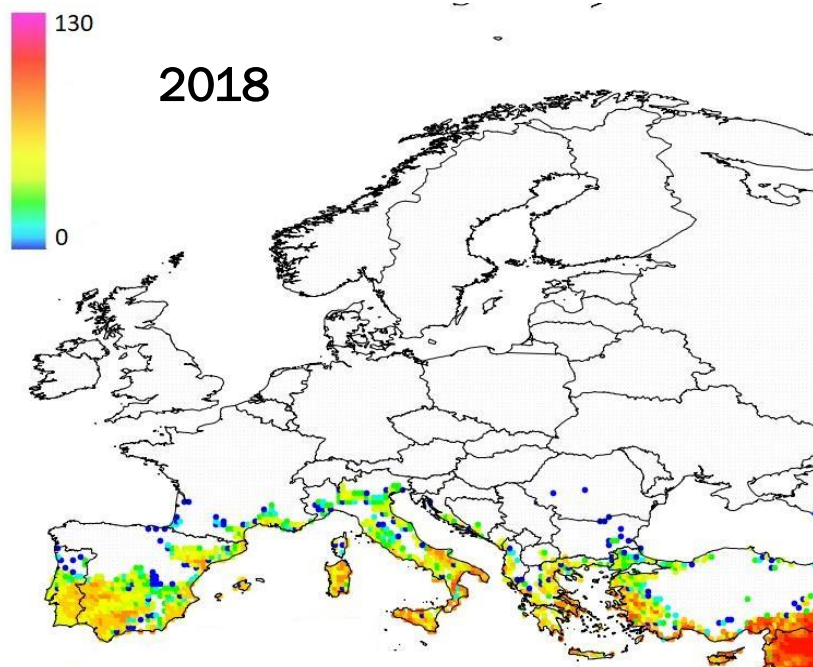
Population dynamics models

Predicting the population dynamics of a pest, the abundance and the potential impact



Models supporting pest risk assessment

Spatial explicit models



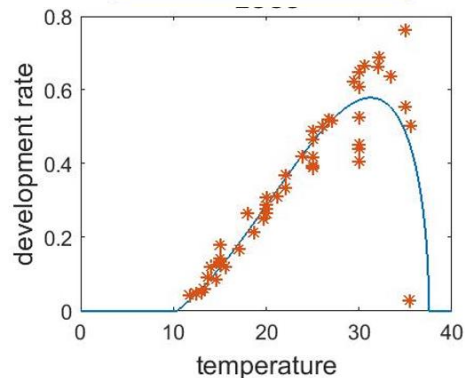
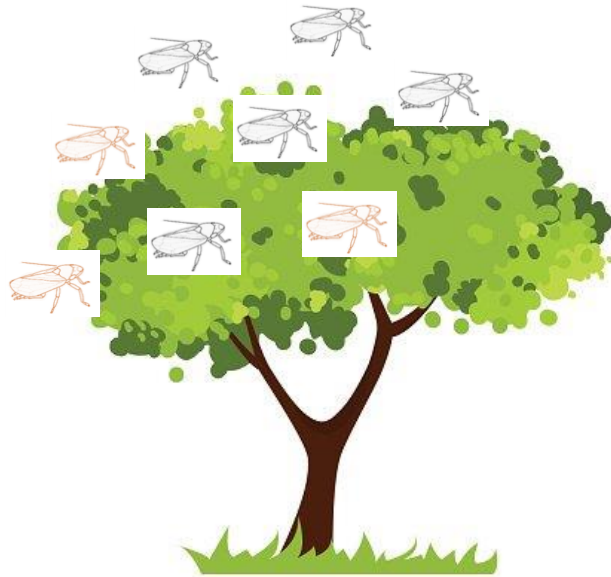
Simulating the current and the projected potential distribution and abundance of pests

Supporting:

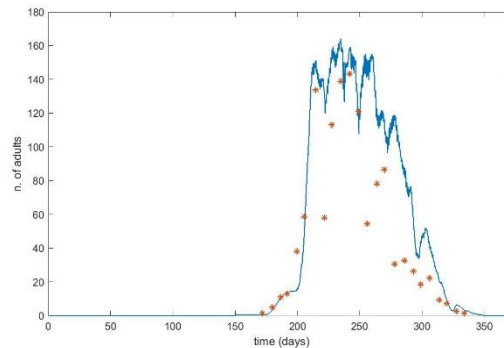
- The assessment of pest's potential distribution and impacts (large scale)
- Identification of areas at higher risks
- The comparative assessment of scenarios linked to climate, management, land characteristics etc.

Future directions - Composite modelling approach:

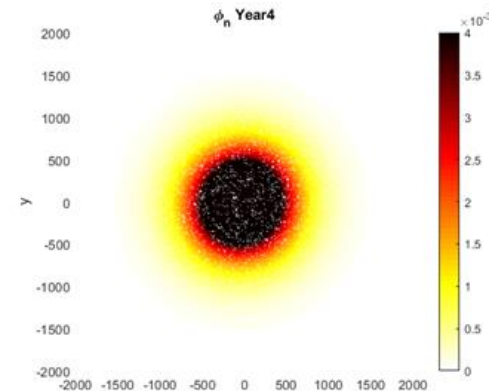
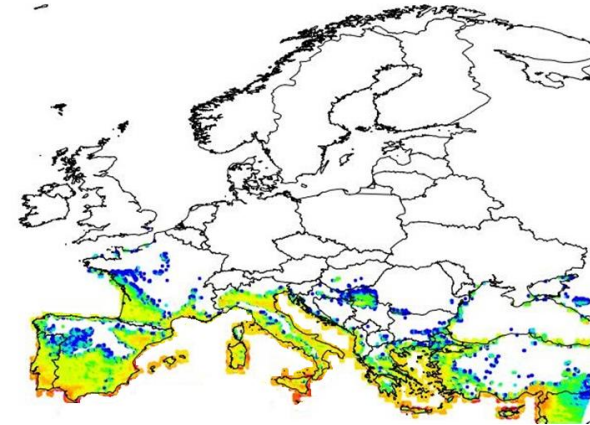
Step 1:
Individual-based models



Step 2:
Population dynamics models



Step 3:
Models for spatial dynamics



Scientific outputs

Publications in scientific Journals: 5

- Rossi, V., **Sperandio, G.**, Caffi, T., Simonetto, A., & Gilioli, G. (2019). Critical Success Factors for the Adoption of Decision Tools in IPM. *Agronomy*, 9(11), 710.
- Pasquali, S., Mariani, L., Calvitti, M., Moretti, R., Ponti, L., Chiari, M., **Sperandio, G.**, Gilioli, G. (2019). Development and calibration of a model for the potential establishment and impact of *Aedes albopictus* in Europe. *Acta tropica*, 105228.
- **Sperandio, G.**, Simonetto, A., Carnesecchi, E., Costa, C., Hatjina, F., Tosi, S., & Gilioli, G. (2019). Beekeeping and honey bee colony health: A review and conceptualization of beekeeping management practices implemented in Europe. *Science of the Total Environment*, 133795.
- Gilioli, G., **Sperandio, G.**, Hatjina, F., Simonetto, A. (2019). Towards the development of an index for the holistic assessment of the health status of a honey bee colony. *Ecological Indicators*, 101, 341-347.
- Gilioli, G., Simonetto, A., Hatjina, F., **Sperandio, G.** (2018). Multi-dimensional modelling tools supporting decision-making for the beekeeping sector. *IFAC-PapersOnLine*, 51(5), 144-149.

Scientific outputs

Projects' involvement: **4**

- GESPO - Nuovi metodi di lotta nella gestione integrata di *Popillia japonica*
- Modelli a supporto della gestione sostenibile delle strategie fitosanitarie contro parassiti delle colture
- Assessment of impacts of plant pests under climate change
- Messa a punto di un protocollo di campionamento per popolazioni di *Anopheles* spp. e verifica del loro potenziale ruolo come vettori di patogeni emergenti

Participation to symposia: **2**

IX Annual Meeting, European PhD Network "Insect Science", 14-16 November, 2018

Oral presentation

- **G. Sperandio**, S. Pasquali, G. Schrader, A. Wilstermann, G. Gilioli (2018). Physiologically-Based Demographic Models for assessing the impact of invasive alien species in the light of climate change: a case study on *Ceratitis capitata*

Poster presentation

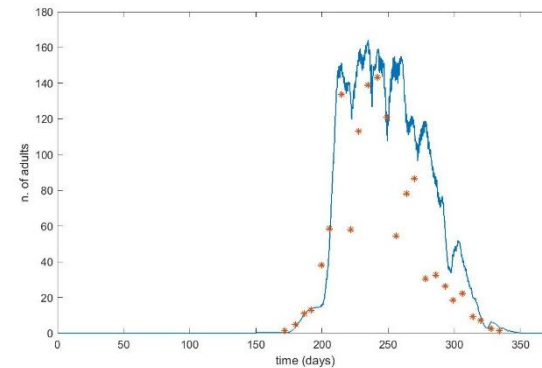
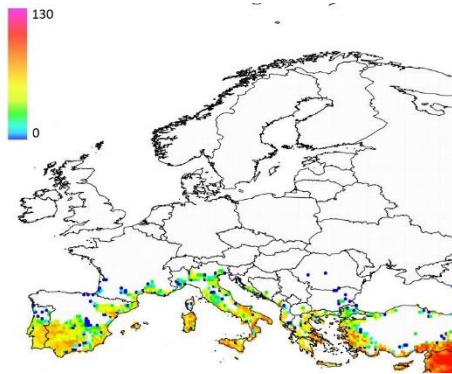
- **G. Sperandio**, A. Simonetto, E. Carnesecchi, C. Costa, F. Hatjina, S. Tosi, G. Gilioli (2018). Beekeeping and honey bees: a conceptual framework for the classification of beekeeping management practices implemented in Europe

XI European Congress of Entomology, 2-6 July, 2018

Poster presentation

- **G. Gilioli**, **A. Simonetto**, **F. Hatjina**, **G. Sperandio** (2018). multi-dimensional modelling tools for the assessment of honey bee colony health, Productivity and Pollination services

Thanks for your attention!



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