

Providing farmers with high-tech tools for functional biodiversity assessments

A practical experience of technology development and transfer between researchers and agricultural sector players in France

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We have developed a reliable, convenient and fast method accessible to non-specialists to **monitor predominant functional guilds of arthropods** (pollinators, predators, parasitoids and herbivores) in French horticultural agrosystems.

The methodological framework is partly based on **species classification by morphospecies** according to the Rapid Biodiversity Assessment (RBA) method which allows monitoring average local species richness and related ecosystem services.

Our final aim is to provide professional end-users from the agricultural sector with an **innovative Android tablet application** that facilitates data collection and calculation of indicators for biodiversity monitoring. The generated tool is currently being tested for its performance in field conditions. This innovative project brings together biologists, computer scientists, sociologists and horticultural professionals.

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“Whatever the spatial scale considered, arthropods largely contribute to species richness. They are thus more representative for organismal biodiversity than any other group of organisms.”

The morphospecies (MS) approach

Identification of arthropods at the species level, usually required to estimate relevant biodiversity trends, is often unreachable to non-specialists whose professional activities depend on the quality of local ecosystem services. To meet this demand, decision trees were constructed to classify field-collected arthropods into 30 morphospecies (MS) according to evident morphological differences. Each of these parataxonomic units belonged to a predominant functional guild including pollinators, predators, parasitoids, herbivores and polyphagous organisms. Our classification scheme for MS determination was then integrated into an Android tablet application and the resulting identification tool was tested in field conditions.

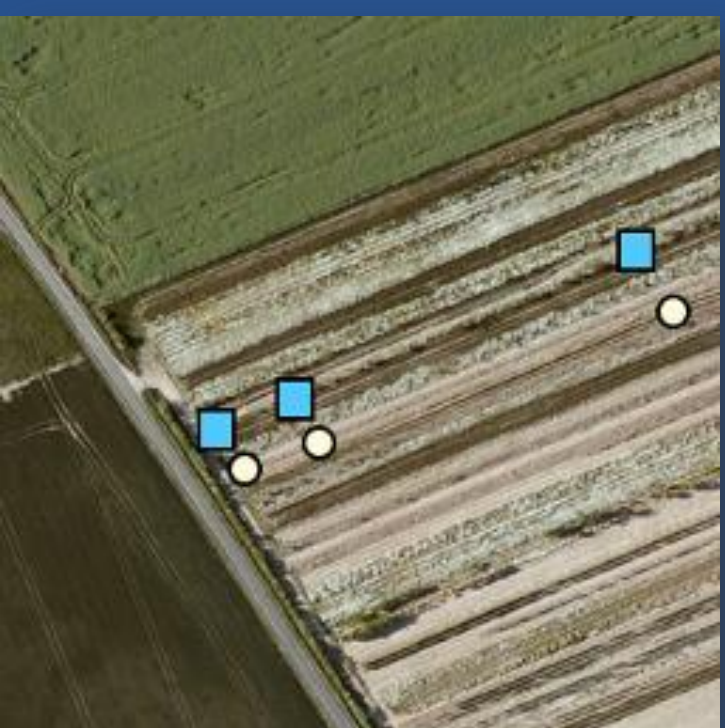
Testing the MS approach in field conditions

A standardized sampling protocol has been set up and tested in three different horticultural centers in Region Centre (France). At each experimental site, the average number of MS per location was estimated and two RBA indicators were calculated: the **Biocontrol Index** (ratio between numbers of predator or parasitoid MS and herbivore MS) and the **Pollinators Index** (percentage of pollinator MS among other collected MS). Each trap station consisted of one pitfall trap and one Malaise trap, monitored during three months. Collected specimens were classified in MS by non-entomologists and then determined at the species or genus level by expert entomologists using morphological determination or DNA barcoding, to estimate the reliability of the MS approach compared to classical identification tools.^{42,05-40,57}

A case study: effects of hedges on biodiversity in an apple nursery

Pitfall and Malaise traps were disposed at 1, 20 and 80 m away from the hedge

Cartography of sampling sites in the apple nursery



Number of individuals examined during the study

Functional guilds of arthropods	Number of specimens classified in MS
Parasitoids	2181
Predators	2081
Pollinators	127
Herbivores	792
Omnivores	3243
TOTAL	8424

Classification of a specimen into a MS generally takes **LESS THAN ONE MINUTE**, allowing the rapid treatment of large sets of samples!

Applications

Our new identification tool based on the MS approach was tested with horticulture professionals in different production conditions and to reach different objectives of applied research :

- evaluation of ecosystem services (pollination and regulation of pests) in asparagus crop production,
- assessment of the status of useful biodiversity in conventional versus organic farms,
- impact of flower strips on temporal evolution of functional guilds of arthropods in a vegetable garden,
- effect of hedges on arthropod biodiversity in an apple nursery...

Results obtained thank to this new tool for biodiversity assessment are **in line with results obtained with classic pre-existing methods** (species identification either by taxonomic determination or DNA barcoding). **The MS approach allows measuring relevant biodiversity indicators** such as average local species richness and relative abundance of major functional guilds of arthropods.

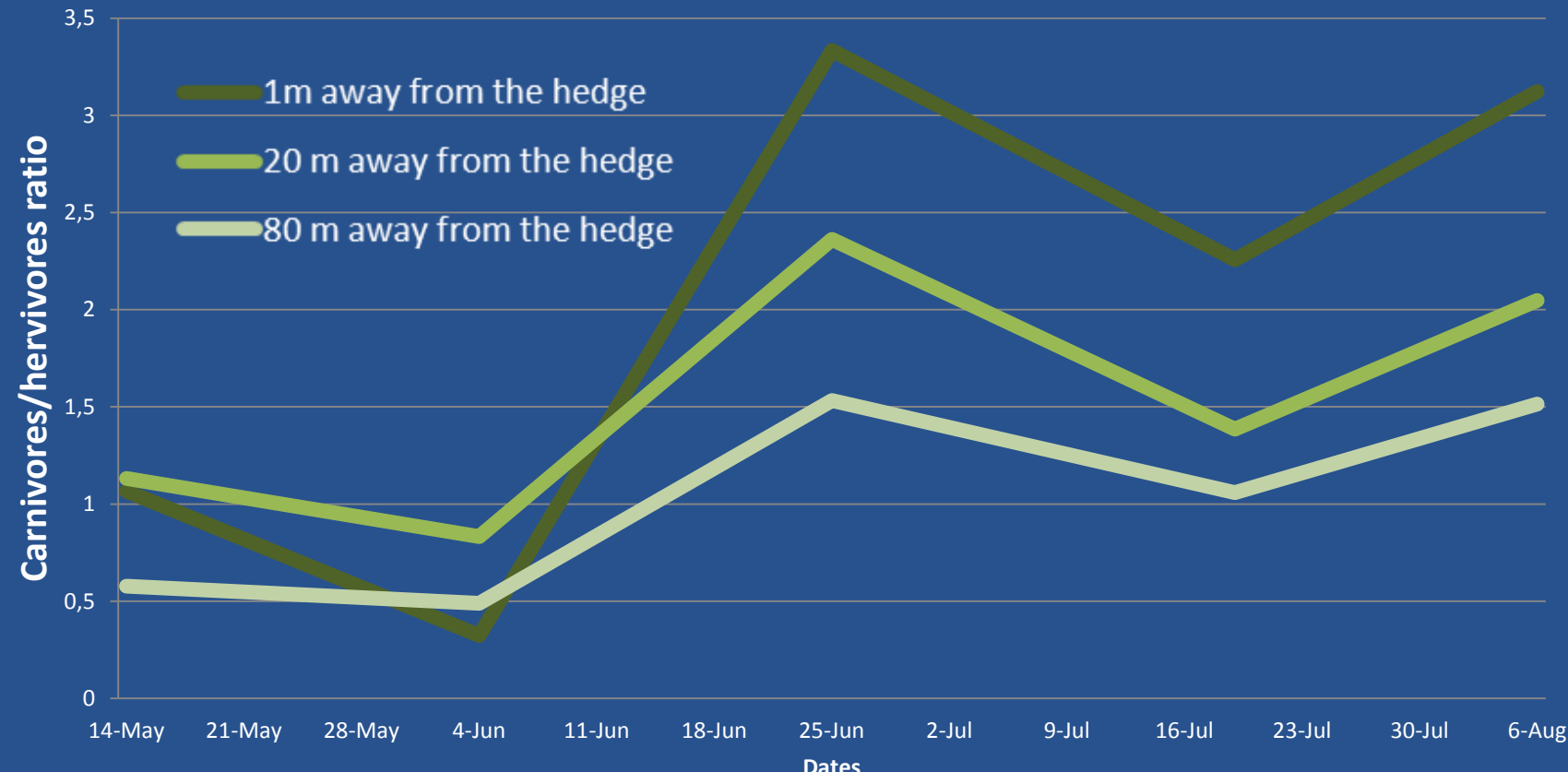
With the exception of some hemipteran and hymenopteran specimens whose correct classification into morphospecies and functional guilds may be difficult for non-specialists, **the method revealed convenient and rapid for exploitation of large sets of specimens** and for calculation of reliable indicators.

Integration of decision trees into the **Android tablet application** allowed very fast identification (about 1 min for each MS) and preliminary feedbacks by professional users are very positive and supportive.

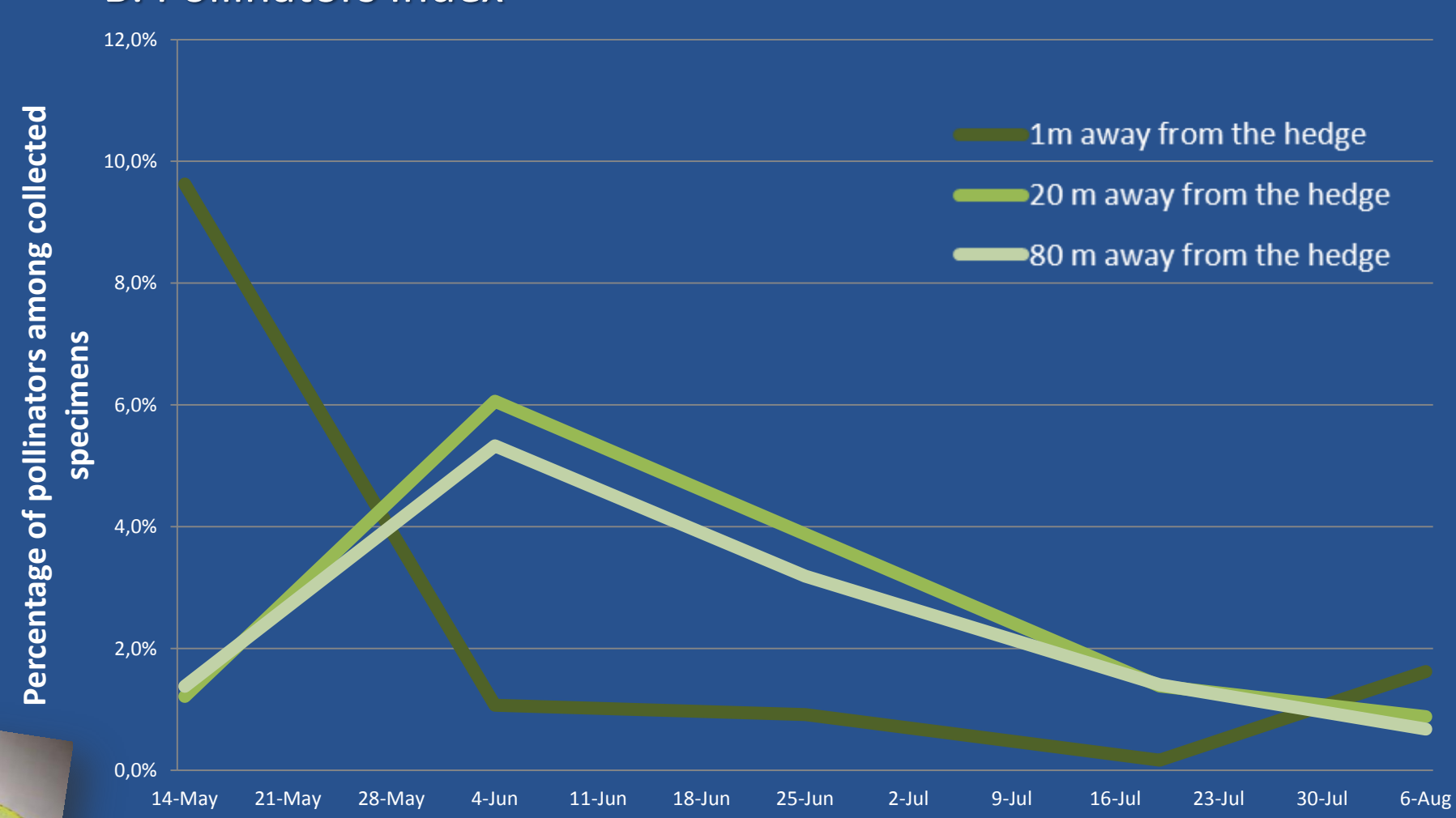
Our work opens the **possibility of an adaption of the tool to a wider typology of agrosystems**.

Hedges offer habitat to useful parasitoid and predator arthropods

A. Biocontrol Index



B. Pollinators Index



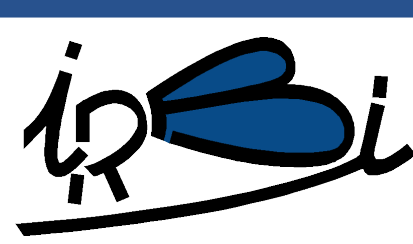
Hedges offer habitat to pollinators in spring and at the end of summer



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