Increasing the Multifunctionality of Agroecosystems by Harnessing fOod webs (IMAgHO)

Augmenter la multifonctionnalité des agroécosystèmes par l'exploitation des réseaux trophiques

I. Proposal's context, positioning and objective(s)

a. Objectives and scientific hypotheses

IMAgHO comprises three objectives: 1) to describe the temporal dynamics of species assemblages and interaction networks involving key species of regulatory services in oilseed rape (OSR) crops, 2) to measure the impact of environmental variables, farming management and biodiversity on food webs and their associated services over time and space, and 3) to design and test in real farming conditions potential management options that could be used to manipulate food webs in order to maximize regulatory services (Fig. 1). By combining monthly genetic data on trophic links, control feeding experiments, monthly observation of pollination networks, long-term census data on biodiversity and agricultural practices as well as statistical modelling and field experimentation, IMAgHO will infer causal relationships between farming practices, ecological networks and ecosystem services such as pest control and crop pollination. **As well as generating fundamental ecological knowledge on ecosystem functioning, this project will produce operational guidelines and applied references to limit agrochemical inputs in one of the most consuming annual crop in cereal rotations and to enhance ecological intensification in agroecosystems.**

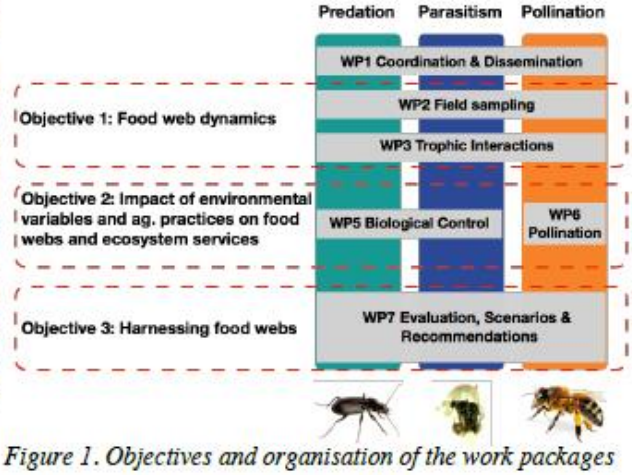

Figure 1. Objectives and organisation of the work packages

Numerous studies have demonstrated that increased biodiversity promotes ecosystem functioning and resilience [24–28]. This is partly due to species complementarity [29], functional redundancy [30,31] and the presence of key species which, by their abundance, have a major impact on ecosystem functioning [32]. These three explanatory mechanisms are evidently strongly influenced by biotic interactions. For instance, it has been demonstrated that increasing predator species richness or pollinator species richness respectively increases biological pest control and pollination levels [33,34]. Yet, very few studies have quantified the links between biodiversity, the structure and intensity of species interaction networks and ecosystem functioning through multivariate analyses and at multiple spatial or temporal scales [35–39].

To fully deploy an ecological intensification strategy and ensure optimum delivery of ecosystem services, a better understanding of the underpinning mechanisms shaping not only biodiversity but also interaction networks and their associated services is needed [40]. In agroecosystems, regulatory services such as animal pollination and biological control of pests are particularly important because they have the potential to maintain or increase crop production while reducing chemical inputs. These services are based not only on key species but also on their trophic interactions. However, the mechanisms underpinning the relationship between interaction networks and ecosystem services are still largely unknown. Moreover, if on average there is a positive relationship between diversity of service-providing communities and community functioning [41], the identity of the species delivering the function as well as the spatio-temporal turnover of these species remain unexplored. Previous studies have generally focused on a relatively limited number of taxa or interactions [36] and are not based on a precise quantification of the contribution of each species and of the service itself [42,43]. Such studies are necessary for a better understanding of the potentially complex food webs in man-made systems [4,44,45]. For example, if the biological control of aphids is improved by increasing floral resources in simplified ecosystems, this is not always the case in more complex landscapes [21]. Among the key variables that could explain this context-dependency, distance from source populations, agricultural practices and landscape context are major elements [46]. For example, the taxonomic and functional structuring of carabid communities depends on crops organization in the landscape [30]. Recently, secondary effects have been described on the diet of predators [47], but little is known on the eventual effects on food web structure and stability as well as the resulting regulatory services. **IMAgHo aims at understanding the dynamic of three types of food webs, (i.e. prey-predator, plant-pollinator and host-parasitoid food webs) covering three types of ecological interaction (i.e. predation, mutualism and parasitism) and fall within key regulatory services (pest control and pollination) in agroecosystems.**