



## ENDURE

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## Summary

The main tasks that we had set to ourselves for the present deliverable was to report on the presentations and discussions that concluded the IOBC meeting in order to draw an overview of questions that are currently asked by scientists working in the field of landscape management for functional biodiversity and of perspectives they identify for future research.

Questions asked were about (1) the definition of functional biodiversity and the diversity of functions that biodiversity may fulfill could be taken into account, (2) the relevance and organization of multi-disciplinarity and (3) landscape description.

In general it was concluded (see details below) that, in many situations, a more systemic view of the landscape management should be considered, looking at food webs instead of single species, at the landscape context instead of field borders and at the multiple functions of agriculture over a landscape. For this reason multidisciplinary should be encouraged. However, this is a difficult task that needs changing perspectives and scales and it could not be easily achieved on short term projects.

## 1 INTRODUCTION

The aims of IOBC WPRS (International Organisation for Biological Control, West Palaearctic Region Section) and the program of that workshop can be found in Appendix 1 and more details are available from the IOBC web site: [www.iobc-wprs.org/](http://www.iobc-wprs.org/).

The main tasks that we had set to ourselves for the present deliverable was to report on the presentations and discussions that concluded the IOBC meeting in order to draw an overview of questions that are currently asked by scientists working in the field of landscape management for functional biodiversity and of perspectives they identify for future research.

The debate was introduced by Guillaume Pain, a landscape ecologist working in agro-ecosystems. Three main items were open for discussion:

1- functional biodiversity: definitions and how to take into account the diversity of functions that biodiversity may fulfill ?

2- interdisciplinarity: is it necessary, with whom and how?

3- landscape description: spatial and temporal scales, elements to be mapped.

These items were discussed in three working and results were reported in a plenary session to allow for a general discussion.

## 2 SUBGROUP 1: FUNCTIONAL BIODIVERSITY

### 2.1 What is functional biodiversity for the IOBC working group?

The many possible functions of biodiversity were listed by participants, including pollination, resources for farmland birds, water protection, aesthetics... However, there was a consensus that only biocontrol would be considered within the group.

### 2.2 Topics addressed or not in terms of biocontrol?

The following observations were made:

- Most talks focused on insect control by insects/spiders whereas insects could also be controlled by vertebrates, fungi, diseases or viruses.
- There were no talks on conservation biological control of fungi and only one talk on the impact of landscape on epidemics (Phytophthora). It was not known from the participants if this was due to a lack of research or to the fact that people working on that topic did not attend the meeting.
- Biocontrol of weeds was not considered. Interactions might be sought with the weed research society on that topic. There is some work going on on weed control by insects and seed predation by birds.

It was concluded that joint meetings with other IOBC working groups should be encouraged.

### 2.3 Taking into account the multiple consequences of landscape management

It was generally recognized by participants that, although this is the most common approach, managing the landscape for a single pest enemy is not a solution since it can have positive or negative consequences for numerous other organisms. A more holistic approach is thus needed using, for example, pest profiles. The single crop/single organism approach is in

particular not relevant for annual crops because different crops are found on the same plot over the years. Participants presented examples of side effects of grass strips such as increased weed or pest problems for the farmer. This aspect was for example taken into account in one study from the Netherlands, where the composition of flowering strips was based on flowering crops to avoid potential weeds and agricultural problems such as pollination with wild carrots.

In general, it was agreed that research should focus more on food webs than on single species, and in particular that direct effects on the pest should not be overlooked. It was also agreed that whole food webs were too complex and should be simplified and that more focus should be made on crop damage.

## 2.4 Biocontrol and multi-functionality of agriculture?

This topic raised the question of how landscape management for biocontrol could be thought in the frame of the multi-functionality of agriculture (in the example from the Netherlands mentioned above, flowering strips may increase biocontrol but not conservation of wild species). It was generally concluded that landscape management for biocontrol should be thought in that context through interactions with other scientists (which in fact is often done in the labs).

However, some participants thought that this frame would create problems and not help to find solutions for biocontrol because questions would not be focused enough. It was in particular noted from earlier presentations that farmers will only agree to have landscape devoted to non productive landscape features such as strips or hedges if there is a direct positive impact for their production. This would be even more the case as the price of agricultural products increases. This statement created a debate among participants as some other studies showed that different farmers agreed to set up non productive landscape features for different reasons, depending, in particular, on their educational level. In that view, promoting the different functions of non productive features may raise interest of more farmers. It was also noted that in some cases there would be conflicts between different functions (e.g. conservation of butterflies but control of pest Lepidoptera).

## 2.5 Conclusions from subgroup 1:

- Studies on the biocontrol effects of non productive landscape features should include evaluation of consequences for not only the targeted pest enemy but also for direct or indirect effects on the pest itself and on other pests/ pest enemies including diseases, viruses...

- There is a need for dialogue with other disciplines to take into account the diverse possible functions of these non productive features.

## 3 SUBGROUP 2: NEED FOR INTERDISCIPLINARITY

### 3.1 Why interdisciplinarity?

It was reiterated that the general aim of the IOBC working group is to improve cropping system. However, very little was heard during the meeting about the cropping system in which the field studies were conducted. There seems to be a lack of data, at least within the

group about what is really done in the farms, resulting in different definitions of, for example, intensive or extensive management.

In that context, there is a need for the study of farming practices, and in particular for quantitative data.

The aim would be:

- to assess their diversity and to understand why there is variation among farmers;
- to evaluate the potential impact of current practices on pests, pest enemies and other species;
- to identify possible changes in farming practices.

Interdisciplinarity is needed for that purpose, as for understanding any human activity. Other disciplines identified are geography, landscape ecology, sociology...

### **3.2 How to organize interdisciplinarity?**

Agronomy and ecology were recognized as core disciplines for landscape management for biocontrol. For short-term projects it was found easier for partners to work with agronomists that have some experience in other disciplines (e.g. sociology) because mutual understanding of research questions between too different disciplines takes too much time. On the long-term, however, collaborations with social scientists might prove more fruitful as this would bring in new ideas.

Interdisciplinarity should also not be a goal in itself. A pragmatic approach would be to collaborate on a case by case basis with scientists most likely to answer questions about variation unexplained by agronomists or ecologists. A possible problem with that approach is that it would probably not be very satisfactory to other disciplines.

### **3.3 Conclusions from subgroup 2**

At next workshop, all speakers should spend some times explaining the current cropping system over their landscape

Interdisciplinarity is essential, with ecology and agronomy as core disciplines

Real interdisciplinarity is difficult to achieve, in particular on short term projects.

## **4 SUBGROUP 3: SCALES AND MAPPING OF LANDSCAPES**

### **4.1 Study areas: field margins versus landscapes**

The discussion here probably arose from the fact that a number of talks during the meeting dealt with the impact of a single field margin/ flower strip besides a single field.

Although participants did not aim at a clear-cut answer about the area over which studies should take place some general principles were discussed:

- Scale in terms of metrics depends on the size of the fields and the mobility of the pests, however, it would be more relevant to define a study area in terms of numbers of fields (e.g. ten fields)
- Some processes that might prove important for landscape management occur at much finer scales and fine scale studies help understand mechanisms

- However, to understand the effect of land management for biocontrol, it is not a local effect that should be investigated (e.g. one flower strip and one field) but the multiplied effect of many local features (e.g. flower strips) distributed throughout a landscape. In fact the impact of a single landscape feature will largely depend on the surrounding landscape. Adding a flower strip will probably have no significant effect if there are already many flowers over the landscape, and, a contrario, adding a flower strip in a landscape deprived of flowers will not enhance pest enemy populations simply because there are no pest enemies able to colonise rapidly the new flower strip. This might be a reason for which the biocontrol impact of single landscape features is rarely demonstrated. Thus although it is the local population that is important for biocontrol, measures taken for its enhancement should consider the landscape context, i.e. the scale of analysis may differ from the scale of the management.

## 4.2 Elements to be mapped over landscapes

Following the discussion on field margins participants raised the point of other landscape features that should be considered. In particular, the crop mosaic over the landscape and the associated pesticide treatments appeared to some participants more important than the spatial pattern of field margins. The crop mosaic is important both through its composition, providing more or less plants that host the pest or resources for pest enemies, and its configuration (sizes, shapes and spatial distribution of fields) that determine the length of contact zones between fields and non crop areas. Pesticides have local effects on pests and pest enemies and may also create invisible barriers to migration of both pests and pest enemies that prevent colonization of newly established margins.

## 4.3 Time scale

It is recognized that landscapes effects may vary with time. Within a growing season, the population dynamics of the pest (e.g. arrival, exponential growth...) will drive the dynamics of specialist pest enemies. Different landscape elements may also provide resources at different times of the year for the pest enemies. The expected impact of landscape elements may thus vary during a single growing season.

Further, the few data available on pluri-annual surveys show a variability of results among years. In some cases this is probably because populations need time to colonise non cropped areas and establish populations. Long-term surveys are thus necessary.

## 4.4 Consequences of working at the landscape level

Taking into account the landscape scale has consequences both in terms of research methodologies and on communication strategies with farmers and advisers.

- Very detailed observations are difficult to gather at a landscape scale and numerous individuals are to be followed over different places in a short time. We thus need to consider new methods (DNA, immunology...) for monitoring pest and pest enemies. These methods should allow simple estimations of population densities and their interactions.
- Research focus should move from local experimental set-ups to large empirical studies. This implies the reinforcement of research in medium to long-term



“observatoires”. Questions would focus on understanding sources of variation rather than the effect of controlled factors.

- More links are necessary between populations/community ecology and 3D analysis and topography.
- There is a need for spatially explicit modeling
- Communication should shift from documenting positive effects of landscape management for a single farmer to communicating about research of a ‘general good’ for all stakeholders over a larger area.

## 4.5 Conclusions from subgroup 3

Relevant scales are generally the field mosaics and depend on the range the organisms under focus

Considering how landscape context impacts local populations requires a change of perspective which could prove challenging.

There is a need to set better replicated studies on the impact of local landscape features

There is a need for fine scale studies to determine species habitats and adapt typology for landscape description

## 5 General conclusions from the IOBC convenors

### 5.1 At present:

The pattern is fragmented and there is a need for:

- detailed studies of functions of ecological structures
- multidisciplinary approaches to incorporate the different players at the landscape scale

Further, the history of the landscape management may have a very large effect on what we observe.

### 5.2 For the future:

Before setting up studies, we should ask whether the landscape scale is pertinent given what we know about the ecology of the species.

One solution for having replicates may be to have different people working on similar systems in different countries.

It is necessary to take into account the effect of landscape management on the many potential functions of biodiversity.

## 6 Some lessons for landscape considerations in ENDURE

### 6.1 Study objects

Managing the landscape for a single pest enemy is not a solution, research should focus more on food webs and multi-pest profiles

### 6.2 Study scale

A challenge is changing perspective and considering how landscape context impacts local populations/ communities.

There is a need for:

- Detailed studies of functions of ecological structures + habitat analyses to adapt typology in landscape description (coll. RA4.3: Exploitation of natural biological processes).
- Multidisciplinary approaches to incorporate the different players at the landscape scale (system studies).

### 6.3 Multidisciplinarity

Need for better characterization of cropping systems

Need to take into account the diverse possible functions of landscape management