REPORT ON THE PHD THESIS OF OLGA M. C. C. AMEIXA,

"TRENDS IN INSECT BIODIVERSITY IN A CHANGING WORLD"

REPORT WRITTEN BY J-L. HEMPTINNE

1. THE STRUCTURE OF THE THESIS

Throughout her thesis Olga Ameixa shows an interest in understanding how insect populations and communities are coping with habitats affected by several changes, such as climatic modifications or disturbances and transformation provoked by human activities. The thesis is made up of two parts: the first is a short text of 14 pages in which the candidate presents a short introduction, the scope of the thesis, a summary and discussion and finally some general conclusions. The second part, presented as appendices, is a collection of 7 papers. Three of these present original results and are published in scientific journals, one is a manuscript of an oral presentation at a conference and 3 are book chapters, which are more like reviews or syntheses.

The studies presented by O. Ameixa in the second part of her thesis are on to two topics: 1) the relationship between trends in biodiversity in agricultural landscapes and ecological services; 2) consequences of the colonization of Central Europe by *Harmonia axyridis* on the distribution and abundance of indigenous species of ladybird beetles.

To conclude this survey of the structure of this thesis, I should mention 2 papers that have little connection with the main topics cited above. The first of these deals with the way in which aphids are likely to adapt to climatic and habitats modifications, and the second the responses of a species of parasitoid to plant odours and aphid alarm pheromones.

2. ANALYSIS OF THE THESIS

2.1. The first part

The first section is worrying because it is brief and very economical with information. This feeling probably stems from the fact that the thesis covers a wide field, as indicated briefly in the first part of my report. The reader is, for example, immediately looking for a link between a first paper about carabid communities in an agricultural landscape and a laboratory study on how parasitoids choose between blends of odours. Therefore, it is important for the reader to discover Ariane's thread connecting all the chapters or the motivations or the strategy of the author in carrying out this study? O. Ameixa decided to dig several shallow pits rather than a single large and deep hole. This leads to my first question:

- What was the candidate's research strategy? In particular, what were the reasons for exploring briefly several topics instead of investing her time and talent in a single topic?

More specifically on this first part and to illustrate the absence of a backbone, the few pages on "the scope of the thesis" and the "summary of results and discussion" mainly repeat the messages of the 7 papers. There is a lack of a discussion of the relevance of the candidate's results to the topic of the thesis. As a consequence, when reading the general conclusions, it is difficult to identify what the candidate has contributed to science. This difficulty is reinforced by the absence of references to literature in the general conclusions. Thus, my second question is:

- Would the candidate liked to have specified her original contribution to science at the end of her thesis and if so what was her contribution?

2.2. The second part

I will not analyse each paper in detail for two reasons: firstly, they are already published or in the hands of referees and it is, therefore, not necessary to add my own comments to those already provided during the process of publication. Secondly, it will take too much time. Instead I will try to raise some issues that are common to several papers.

PAPERS 1 & 5

The control of aphid abundance is a theme common to these two papers. The first chapter of the first paper presents one view, illustrated by the two last sentences of the introduction on page 467, which state that: "efficient biological control by natural enemies, if at all possible, [...]" and "[...] The role of natural enemies in preventing cereal aphid outbreaks is questionable and discussed in many studies [...]". In contrast, your view is much more definite in paper 5 as particularly clearly stated on page 10 of this paper. In fact, in the section entitled "Effect of invasive predators on the abundance of herbivore pests", you explain that the control of a pest by natural enemies depends on the ratio of the lengths of the generations of both the predator and the herbivore. Therefore, my question is straightforward:

- What is the reason for the change of emphasis in these two papers?
- Would it be possible to apply the reasoning of paper 5 to the first: are carabids likely to control aphids, yes or no? What is the level of understanding on this point?

PAPERS 1 & 6

Paper 1 also echoes some of the ideas presented in paper 6 although the scales of observation are not the same in these two studies. In an analysis of long term trends in ladybird abundance in the Czech Republic, which is the subject of Paper 6, it appears that the diversity of ladybirds was higher in 2002-2010 than in 1976-1983. However, the number of individuals per species was lower. This change is tentatively attributed to causes such as changes in land use, in particular the decline in the acreage planted with cereals between the first and second period. To conclude, landscape modification explains the reported trend. The picture presented in paper 1 for carabids is less clear. This paper ends with the following sentence: "This study reveals no clear evidence that agricultural intensification (nitrogen fertilization and disturbance of the surrounding landscape) leads to a decrease in carabid abundance [...]". As science is about finding robust patterns, the difference between the two conclusions is puzzling.

- In your opinion, why do communities of carabids and ladybirds react differently to changes in landscape structure?

PAPERS 4 & 6

I would like now to discuss some of the methods used in these two papers to compare the diversity of various communities. Using the Shannon-Wiener diversity index and the Shannon's evenness is traditional and that is what I would have done. However, a third method is used: an ordinary least square regression is fitted to the rank-abundance data and the absolute value of the slope used to compare communities.

- I am puzzled because the x and y axis values are not independent. This method is new to me and I would like the candidate to explain the method in more detail and what its advantages are over more traditional methods.

PAPER 7

This, the last part of the thesis is a study on the effect of synthetic and plant-extracted aphid pheromones on the behaviour of a parasitoid. This chapter is published in the Journal of Applied Entomology. Having been reviewed by referees it raises few issues. However, I would like to have the candidate's opinion on the following.

- The theme of this chapter is completely different from those of the preceding chapters. Therefore, I would like to know why and how you became interested in this field instead of doing more work to complement your field work on carabids and landscape or on the long term trends in ladybird beetle communities.
- You tested three mixtures of pheromones and a control solvent in a closed arena. There is no information on the volatility of these compounds and on how fast they mix in the arena. Do parasitoids detect a pheromone in a way similar to that used by moths? Do you think that another experimental design would have been more appropriate?
- I assume that Figure 8 presents ordinary least square regressions of the time spent in adjacent cells on time spent in the treatments? If this is the case and bearing in mind the errors made when recording these periods of time, do you think that you used the most appropriate method?

3. CONCLUSIONS

Included in Olga Ameixa's thesis are two published research papers of which she is the first author, a short paper derived from an oral presentation at a conference and two book chapters. These papers indicate that the candidate can:

1. Identify scientific issues worthy of interest, formulate hypotheses about these issues and independently test these hypotheses.
2. Design and carry out field and laboratory experiments in order to test hypotheses and is familiar with data analysis and statistical methods.
3. Able to write down and communicate the results of scientific work. In addition, as the first or second author of three published chapters in books she is clearly able to review and analyze scientific literature.

The fact that the candidate is also the second author of another book chapter and one of the authors of another research paper indicates she can work as part of a team.

For all the above reasons, I declare that the thesis as presented is worthy of presentation for consideration by the jury for the award of a Ph.D degree.

UNIVERSIDADE DOS AÇORES
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Review of the PhD Thesis by Olga Ameixa: "Trends in insect biodiversity in a changing world"

Thesis Supervisor: Pavel Kindlmann (Charles University, Prague)

In České Budějovice, Czech Republic, October 7, 2011

Structure and volume of the thesis. The submitted thesis comprises two main parts: i) a more general section including an introduction (four pages), scope of the thesis (two pages), followed by the three pages of summary of the results, general conclusions (two pages) and the references (three pages); and ii) the appendices representing five papers and two manuscripts submitted. This important and timely study is of interest and represents an endeavour to applied ecologists working in biological control. The text is written in a mostly correct and clear language. The objectives of the study were clear and the experiments were, in general, well designed. For those reasons and considering the fact that mostly of the papers were already published, the candidate is commended for. In the following section I present some comments which might contribute to a pleasant scientific discussion.

Review of the individual papers of the thesis. Authors aimed to study the effects of agricultural intensification on the density of ground-living carabids and their potential for biological control of aphids (**paper I**). The study does not provide a full insight on the composition, structure and functioning of the entire ground-living beetle community (e.g. predators and preys, other than carabids and aphids) and thus presents an incomplete view on the role of the synergetic and/or antagonistic interactions between the members of the guild and their impact for biocontrol. This might be one of the reasons for some result to appear counterintuitive. Although interesting and important, results have brought to evidence that agricultural intensification (measured as nitrogen inputs) might not beget a reduction in carabids and potential biocontrol against aphids on winter wheat fields.

Authors stated that current agricultural production models seem to fail in the maintenance of biodiversity and some species are more sensitive to disturbance (**paper II**, final remarks). However, this statement is not fully supported by the results on tables 2 and 3 in which no clear association between agricultural intensification and landscape structure on biodiversity was shown.

Over a short period of time, *H. axyridis* has moved to a front position in the coccinellid-rank abundance (**paper IV**). What can be foreseen in the coming decades to Central Europe considering what has happened in the USA and Canada and also the invasiveness of the species (page 12: combination of higher number of generations and survival rate and great ability to exert IGP and competition)? On **paper VI** (page 14 and 15) authors argue that habitat loss or fragmentation might be more important causes of species declines. However the relative importance of invasiveness/invasibility/interactions on the apparent success of *H. axyridis* remains unclear.

Paper VI presents the results of a long-term sampling program on deciduous trees, wild herbaceous and cereal crop habitats and discusses the potential influences of recent climate and agriculture changes on the composition and abundance of aphidophagous coccinellid communities. Long-term sampling programs are rare in studies of population dynamics and thus very welcomed. From the correlations between the abundance of coccinellids recorded on the first and second periods three outlier species have emerged (*Coccinella quinquepunctata*,

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Hippodamia variegata, *Calvia quatuordecimguttata*). *Coccinella undecimpunctata* and *Ceratomegilla undecimnotata* were recorded only in the first and second periods, respectively. It is unclear i) how extensive were climate changes on Czech Republic (increased summer temperature with milder winters) and the ecological and biological advantage for the thermophilic *H. variegata* in relation to the other species within the community and ii) the changes in fertilizers uses to the changes in the despairing of *C. undecimpunctata*.

Diversity of coccinellid communities was higher in the second period, although the number of individuals was lower (**paper VI**). This was evident for deciduous trees and wild herbaceous where *H. axyridis* became more abundant. In fact, not only Shannon-Wiener diversity index was higher but also the evenness index (table 2). Results seem to indicate that, for some reason, coccinellid communities were rearranged in this way: arrival of two new species in the communities, decrease of overall abundance and a more even distribution of the individuals by species. This seems to agree with the trends found in the relationship between the number of individuals recorded in the first and the second period on trees and herbs (maybe checking how statistically different are the slopes of linear equations and also their statistical deviance from 1. Lower values of slopes may indicate that less abundant species have become more abundant and/or abundant species have become less abundant). The rearrange of the communities, maybe is related with the arrival of *H. axyridis*, and do not fully agree with the suggestion that "arrival of the exotic *H. axyridis* (in 2006) has not yet result in any significant changes in communities of native coccinellids in Central Europe".

According to the authors, there is a lack of persuasive evidences that invaders negatively affect abundance of native coccinellid species and also the invasion by long-lived alien predators on systems consisting of long-lived native predators and short-lived prey do not substantially affect the abundance of the prey (**paper V**). This is a very good and attractive suggestion. However, it was not discussed any mechanism explaining how aphidophagous coccinellid communities in Central Europe are able to integrate new species without changing the abundance of the prey?

The main question addressed in **paper III** was how global warming is going to affect aphids? Hypothetical evolutionary history of aphids matched with i) global historical events of climate changes and ii) meta-analysis of published reports of empirical studies on the effects of climate changes on aphids, tend to show that aphids are able to adapt to climate changes and likely to move to different geographical locations in order to track more suitable conditions, but limited by habitat fragmentation and habitat loss.

In the **paper VII** authors propose to test the effect of a mixture, instead single use, of synthetic and plant-extracted aphid semiochemicals on the behaviour of *Aphidius colemani*. The approach used on that study seems to be innovative. Why authors did not use the experimental set-up to investigate the subsequent parasitoid responses to cues?

The present PhD thesis by Olga Ameixa is an excellent contribution for science and thus highly recommended for defence.

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