Review of the manuscript entitled "Plant eco-evolution weakens mutualistic interaction with declining pollinator populations" by Weinbach, Loeuille & Rohr

Using an eco-evolutionary dynamics model, this work investigates how the evolution of attractiveness can impact plant and pollinator populations persistence. Different evolutionary scenarios are possible according to (i) the shape of the trade-off between attractiveness and plant intrinsic growth rate and (ii) the degree of pollinator decline. In general, I think this paper is clearly written and that it is easy to understand the frame and purpose of the study. While there is a wealth of literature about the demographic effects of pollinators decline on plant populations persistence, the potential effect of plants trait evolution remains understudied to date. This is especially true for floral traits that are linked to pollinator attraction. I however think there is a lack of clarity regarding the definitions of the plant intrinsic growth rate and the allocation trade-off. Because these terms are key concepts of the paper, I think the authors should explain more precisely the biological hypothesis behind those. This would allow empiricists, such as myself, to better understand the significance of the results presented in the manuscript.

MAJOR COMMENTS

<u>*Comment 1*</u> – My first concern is about the plant intrinsic growth rate. As said in L60 "we assume r_P to be strictly positive because of other reproduction means, *e.g.* vegetative reproduction or autogamy". I think this is a reasonable assumption except if individuals suffer from inbreeding depression. In this case, one can imagine that plant intrinsic growth rates could decrease to negative values because of mortality before reproduction or infertility.

The exact definition of "plant intrinsic growth rate" should be clarified throughout the manuscript. For instance, the abstract suggests that it impacts plant biomass (L6), but this term is never used again in the rest of the paper and it seems that the authors modeled the plant intrinsic growth rate as the capacity of plants to reproduce only. I also found it confusing that in the section entitled "Plant-pollinator model and ecological dynamics", r_P seems to be a population-level parameter, while in the section about "Evolution of plant attractiveness", the same parameter is used in the allocation trade off as an individual-level parameter (the authors explain that "The plant has a given quantity of energy, divided into different functions; some energy is allocated to intrinsic growth and to self-reproduction, and some to attractiveness").

<u>*Comment 2*</u> – My second concern is about the resource allocation trade-off between attractiveness and plant intrinsic growth rate. L72, the authors list various traits that are classically involved in attractiveness when defining parameter α. That list includes flower number, which has indeed been shown to play a crucial role in pollinator

attraction in many systems. However, this trait should increase both functions: on one hand plants with a lot of flowers should attract more pollinators, but on the other hand plants with large displays will also produce more gametes and so should present a higher intrinsic growth rate. The exact definition of the two terms of the trade-off needs to be clarified. It would also be good to cite empirical work studying such tradeoffs and to acknowledge that, while tradeoffs are expected to be frequent, they might not be ubiquitous. Trade-offs can indeed be masked by a high inter-individual variance in the ability to acquire resources, or by inbreeding depression which could establish positive correlations among traits, independently of any resources allocation strategy.

<u>*Comment 3*</u> – My third concern is about the hypothesis advanced by the authors concerning the evolutionary response of plant to pollinator decline. They only cite two possible scenarios: evolution towards more attractiveness or evolution towards selfing (and so less attractiveness). What about species which cannot evolve towards selfing, like dioecious species or self-incompatible species where self-incompatibility has not been bypassed? Is evolution towards increased wind pollination also a possible outcome?

MINOR COMMENTS

L1-2 – I think that the wording "recent pollinator declines […] greatly impact plant-pollinator coevolution" may be too strong. To the best of my knowledge, there are not that many empirical studies showing a micro-evolutionary plant response to pollinator decline itself.

L28 – Maybe the authors should not mention climate change in the introduction section, since their model focuses on absolute pollinator decline rather than on phenological shifts.

L32 – "showed" instead of "shown"

L36 – "Flora size" should be replaced by "flower size"

L45 – The authors should consider citing Thomann *et al.* (2013) to emphasize the two different evolutionary plant responses under pollinator decline (*i.e.*, evolution towards autonomous selfing or reinforced interaction to pollinators).

Equation (1) – I think there is a mistake in equation (1): N should be replaced by A

L72 – The amount and quality (sugar concentration for example) of nectar should also be cited because it is an important reward for pollinators.

Figure 1 – It is the only time in the article that the intrinsic plant growth rate r_P is written as $r_P(\alpha)$.

L158 – Parameters values are indeed the same except for s ($s = 3$ *versus* $s = 2.5$)

L158 – Figure descriptions should only appear in the legend.

Figure 4 – "More concave trade-offs allow a larger coexistence domain"; this should not appear in the legend but rather in the results or discussion section.

L253 – I think that this should read "an increase in autonomous selfing".

Citation 42 – The name of the first author is Bodbyl Roels.

Electronic Supplementary Material

The allocation trade-off – I am not sure I understand the meaning of [1] and [2] in the first sentence.

REFERENCES

Thomann M., Imbert E., Devaux C. & Cheptou P-O. (2013). "Flowering plant under global pollinator decline". Trends in Plant Science **18**(7): 353-359