University of
Northampton

11th November 2024

Report on the PhD thesis of Guillermo Uceda Gómez, entitled 'Organization of Afrotropical plant-bird pollination communities: the effects of altitude and seasonality' (Charles University)

The thesis comprises an Introduction to the subject being studied and then three sections with chapters based on published papers plus one manuscript in review, as follows:

Part I: Drivers of sunbird-plant pollination interactions

Chapter I: **Uceda-Gómez**, *et al.* (2024) Drivers of sunbird-plant interactions on Mount Cameroon: Between neutrality and niche-based processes. *Biotropica*

Part II: Bird pollination syndrome

Chapter II: Janeček, Chmel, **Uceda Gómez**, *et al.* (2020) Ecological fitting is a sufficient driver of tight interactions between sunbirds and ornithophilous plants. *Ecology and Evolution*

Chapter III: Mundi, Awa, Chmel, Ewome, **Uceda-Gómez**, *et al.* (2022). The ornithophily of *Impatiens sakeriana* does not guarantee a preference by sunbirds. *Biological Journal of the Linnean Society*

Chapter IV: Chmel, Ewome, **Uceda-Gómez**, *et al.* (2021). Bird pollination syndrome works as the plant's adaptation to ornithophily, while nectarivorous birds do not seem to care. *Oikos*

Part III: Spatiotemporal variability in sunbird-plant interactions

Chapter V: Janeček, **Uceda-Gómez**, *et al.* (2024) Food resource partitioning between males and females of Volcano Sunbird *Cinnyris preussi* on Mount Cameroon. *Journal of Ornithology*

Chapter VI: Janeček, Chmel, Mlíkovský, **Uceda-Gómez**, *et al.* (2022) Spatiotemporal pattern of specialization of sunbird-plant networks on Mt. Cameroon. *Oecologia*

Chapter VII: **Uceda-Gómez**, *et al.* (in review) Coping with altitude: Altitude-driven visitor shifts to *Hypericum revolutum* (Hypericaceae) on Mount Cameroon grasslands. *Journal of Plant Ecology*

University of Northampton
University Drive
Northampton
NN1 5PH

Switchboard **01604 735500**
Study Enquiries **0300 303 2772**
Study Email **study@northampton.ac.uk**
Web **northampton.ac.uk**

Regardless of author position in the papers, the candidate was closely involved in the research in each chapter. This included conceptualisation of the work (3/7 chapters), data collection in the field (6/7 chapters) or laboratory (1/1 chapters), working on processing and/or analysis of the data (4/7 chapters), and editing and reviewing the final manuscripts (7/7 chapters). This is clearly a thesis of PhD standard to which the candidate has significantly contributed, both in terms of time and intellectual effort.

This body of studies tackles some important questions in ecology and evolutionary biology: how are the interactions between plants and their pollinators structured in high-diversity, tropical mountain regions, and what are the implications of such patterns for the evolution of flowers. These types of questions have been well researched in the mountainous regions of Central and of South America, but much less so in Afrotropical mountains.

The studies include both natural history observations, laboratory analyses and ecological experiments, and are an excellent example of collaborative research between European and African scientists. The amount of data supporting this thesis could not have been collected by one individual, it had to involve a diversity of individuals bringing their own complementary skills and efforts to the field, laboratory and analytical work.

There's not enough room in this short report to provide a detailed account of all of the strengths and weaknesses of the thesis, so instead I will focus on some of the key findings and particular limitations of the work. With this in mind, it is worth emphasising that no PhD thesis is perfect, and indeed no body of research provides all of the answers to a particular set of questions. All research does is to provide the next piece in a larger jigsaw puzzle, and some of the pieces fit better than others.

The Introduction to the thesis provides a very useful summary of flowering plant evolution and the relationships between pollinators and the flowers whose evolution they affect. However the Introduction seems to have been written rather swiftly and would have benefitted from more time spent considering the implications of some very broad generalisations. For example, the opening statement that flowering plants "play a pivotal role in nearly all terrestrial and aquatic ecosystems" should have been more nuanced. If "pivotal role" refers to primary productivity, then this statement is not true in boreal forests or many alpine ecosystems, where conifers dominate. Nor is it true in marine aquatic ecosystems and large fresh water bodies, where algae are the main photosynthesisers.

Likewise, the statement that "One of the key features of angiosperms is their unique relationship with animal pollinators" is incorrect as probably one third of living (and many extinct) gymnosperms are (were) insect pollinated (which the candidate acknowledges later).

Finally, the comment about "rejecting or accepting the legitimacy of the pollination syndrome concept" really misses the point: no one has rejected their legitimacy, the questions that are being

asked are mainly about their frequency and applicability across the flowering plants. In this regard I would have liked to have seen Paul Aigner's Least Effective Pollinator Principle (LEPP) referred to as an alternative hypothesis to Stebbins' Most Effective Pollinator Principle (MEPP). The LEPP tends to get ignored during discussions of floral evolution, but it's an important idea and I will be suggesting some literature that the candidate should read in the future.

These minor weaknesses aside, the real strengths of the thesis lie in the fascinating and important findings in the main chapters, some of which I will outline below.

In Chapter I, the discovery of a seasonal shift in what drives bird visitation is especially interesting. In the dry season, bird visits are mainly influenced by neutral processes, where random factors dominate. However, in the wet season, niche-based processes become more influential.

Chapter II found significant ecological compatibility among species from distinct evolutionary lineages and continents, illustrating that bird-pollination interactions are not limited by geographic or evolutionary differences. This supports the idea that the bird-pollination syndrome can effectively function across diverse regions and species, highlighting its wide ecological applicability.

Chapter III, however, complicates the story by finding that sunbirds visited a variety of plant species, showing little preference based on pollination syndrome. Notably, the species they visited most often was *Tabernaemontana ventricosa*, which appears to be adapted for moth pollination rather than bird pollination. This preference was unexpected and highlights the flexibility in sunbird foraging behaviour, indicating that they may favour certain plants based on factors other than traditional pollinator associations.

Chapter IV found that a spectrum of plant-visitor interactions, where both birds and insects visited plants associated with various pollination syndromes. From the perspective of the plants, however, the bird-pollination syndrome held true: ornithophilous, or bird-adapted, plants were primarily visited by sunbirds. Interestingly, nectar production emerged as the most reliable factor in predicting sunbird visits. Sunbirds frequently visited certain plants not specifically adapted for bird pollination—such as *Anthonotha fragans* and *Nuxia congesta*—that provided ample nectar, particularly in the dry season. This suggests that high nectar output can attract sunbirds even to plants without typical bird-pollination traits.

These studies demonstrate the complexity of pollination syndromes and are helping to move us away from simple, qualitative descriptions of flower traits and their supposed pollinators, to a more nuanced view of how flower evolution occurs and how ecological interactions are structured.

A key finding from Chapter V was the sharp decline in nectar production across habitats during the wet season, which corresponded with a marked drop in female bird presence. In contrast, female activity showed a significant increase at the lowest and highest points of the elevational range during this period. This pattern suggests that females may adjust their foraging behaviour more than males in order to seek out areas with more abundant resources when nectar availability diminishes.

Chapter VI found that sunbird communities at high elevations, as well as the entire network of interactions, were highly generalized, with sunbirds visiting a broad range of plant species. In contrast, sunbirds at lower elevations formed more specialized relationships with specific plants. Additionally, sunbird-plant interactions showed greater specialization during the wet season.

These two studies add to an increasing body of evidence that sunbird-flower assemblages are not so different in their structural complexity and specialisation compared to hummingbird-flower assemblages, but also may have some unique features.

Chapter VII is perhaps the weakest of the substantive chapters because there was no attempt to assess the relative importance of the different groups of flower visitors as pollinators, which is important when considering how floral traits may differ under selection by diverse visitor assemblages. The finding of a hump-shaped trend in bird visits to flowers relative to elevation, with visitation rates peaking around 2,700 meters above sea level, was interesting however. This pattern became especially pronounced during the seasonal shift from wet to dry conditions, indicating that elevation and seasonal transitions together play a significant role in influencing bird-flower interactions.

The fact that many of the studies in this thesis span different seasons and an elevational gradient is a huge bonus as much work in this area of research is restricted spatially and temporally. As the candidate and his colleagues have clearly shown, time and space matter!

Finally, a strength of the thesis is that it sets up further questions that can be addressed in future studies, either by the supervisor's research group or other scientists. That is how good science works and the candidate and his collaborators are to be congratulated on producing such a fascinating body of work.

Sincerely yours,

J. Ollerton

Prof. Jeff Ollerton

Visiting Professor of Biodiversity

University of Northampton
University Drive
Northampton
NN1 5PH

Switchboard **01604 735500**
Study Enquiries **0300 303 2772**
Study Email **study@northampton.ac.uk**
Web **northampton.ac.uk**