

The Taxonomy of the Lampyrinae: History and Future Directions

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ABSTRACT

This project consists of two portions: a history of the taxonomic classification of fireflies, and an analysis of the current state of taxonomy within the subfamily Lampyrinae. To accomplish these objectives, a literature review is being undertaken to determine the contributions of significant authors in the taxonomic history of the Lampyrinae and to compile information on each valid genus in Lampyrinae. Thus far, several genera have been found for which the original descriptions are not available. Additionally, the most recent comprehensive revision of classifications within both Lampyridae and Lampyrinae was done in 1966. These findings highlight the need for further study on this topic.

INTRODUCTION

Fireflies are a charismatic group of beetles comprising the family Lampyridae Rafinesque, 1815. They are most well-known for the flashy courtship displays that some species emit via light signals. However, many fireflies do not glow to communicate, and indeed some do not have lanterns at all as adults. These adults will often communicate via the use of pheromones as a sexual signal, and some taxa that use pheromones also employ light signals (de Cock et al. 2014). The distinguishing trait of Lampyridae is that they all have paired light spots on the eighth segment of their ventral sides as larvae (Branham and Wenzel 2003). According to recent classifications, this family contains roughly 2200 species and ten subfamilies (Martin et al. 2019).

Lampyrinae Rafinesque, 1815 is the largest subfamily in Lampyridae. It contains more than 50 genera (Jeng 2008), yet lacks any defining morphological characters possessed by all members (Martin et al. 2019). It contains many of the most well-known firefly taxa.

Currently, the generic-level classifications of many members of Lampyrinae are unclear, as most genera have not been tested for monophyly using either molecular or morphological data (Silveira et al. 2021). Monophyly is important because it indicates that all the taxa belong to a particular genus, along with their common ancestor. It means that a genus' members will be more closely related to each other than to members of other genera. However, within Lampyrinae, overlapping genus-level descriptions have raised questions (Silveira et al. 2019), and widely sampled studies that have been done indicate that some genera as they stand are likely paraphyletic.

This project seeks to answer two main questions. First, how has classification within and of Lampyrinae changed historically? Second, how many genera in Lampyrinae are lacking a) a comprehensive morphological description b) molecular data or c) both?

METHODS

For this paper, literature is being compiled from multiple sources, with particular focus given to the original descriptions of the 68 genera in Lampyrinae. References such as the World Lampyrid Database are being used to aid in finding original descriptions and confirming the number of valid genera in the subfamily. For each genus baseline information is being obtained such as the type species, the known distributions for all species, and a brief morphological description. From this information, a remarks section is being compiled for each genus regarding what could be improved upon in its current classification, as well as how each genus is similar or different to genera found in the same tribe.

Another area of focus in the literature is in tracing a timeline of firefly taxonomy through history, highlighting some of the major authors. These authors are being examined for their contributions including which genera they described and how (if at all) they rearranged tribes and subtribes.

Olivier, 1907 (9 subfamilies, 48 genera)	McDermott, 1966 (7 subfamilies, 85 genera)
Subfamily Lampyrinae Latreille (9) ¹	Subfamily Lampyrinae Latreille (53)
Subfamily Lamprocerinae Olivier (14)	Tribe Lampyrini Latreille (11)
Subfamily Photininae LeConte (6) ²	Tribe Pleotomini Green (5)
Subfamily Lucidotinae LeConte (7)	Tribe Lamprocerini Olivier (5)
Subfamily Dadophorinae Olivier (1)	Tribe Cratomorphini Green (5)
Subfamily Megalopthalminae Olivier (2)	Tribe Photinini LeConte (27)
Subfamily Amydetinae Olivier (1)	Subtribe Photinina LeConte (13)
Subfamily Photurinae Lacordaire (1)	Subtribe Lucidotina Lacordaire (10)
Subfamily Luciolinae Lacordaire (7)	Subtribe Dadophorina Olivier (1)
	Subtribe Phosphaeina McDermott (2)
	Subtribe Lamprigerina McDermott (1)
Crowson, 1972 (8 subfamilies)	Subfamily Amydetinae Olivier (12)
Subfamily Lampyrinae Latreille	Tribe Amydetini Olivier (2)
Subfamily Amydetinae Olivier	Tribe Vestini McDermott (5)
Subfamily Photurinae Lacordaire	Tribe Psilocladini McDermott (5)
Subfamily Luciolinae Lacordaire	Subfamily Photurinae Lacordaire (4)
Subfamily Ototretinae McDermott	Subfamily Luciolinae Lacordaire (9)
Subfamily Pterotinae LeConte	Tribe Luciolini Lacordaire (6)
Subfamily Cyphonocerinae Crowson	Tribe Curtosini McDermott (1)
Subfamily Ototretadrilinae Crowson	Tribe Ototretini McDermott (2)
	Subfamily Matheteinae LeConte (2)
	Subfamily Pterotinae LeConte (1)
	Subfamily Rhagophthalminae Olivier (4)

Figure 1: A table depicting the classifications within Lampyridae according to three major authors: Olivier, McDermott, and Crowson. Note that of the 3, only McDermott further divides Lampyrinae into tribes/subtribes. Figure from Jeng (2008).

Once the major authors are identified, a graphic will be created listing dates that major changes were made to taxonomy in Lampyrinae as well as which authors are associated with them. The combination of the study of past taxonomy in Lampyrinae and the analysis of the current state of taxonomy in this groups will hopefully provide future researchers with areas that most need to be studied.

ANTICIPATED RESULTS

The expected result for the first part of the project is as follows: a summary of historical changes in Lampyrinae taxonomy, focusing especially on changes that created or altered the composition of tribes and subtribes. This includes summaries of the contribution of major authors. This will be accompanied by a graphic representing changes in the taxonomic history of Lampyrinae, likely in the form of a timeline or something similar.

For the second part of the project, the expected result is a compilation of information regarding each of the 68 valid genera in Lampyrinae. For each genus, a remarks section will also be written. Photos will be included when available.

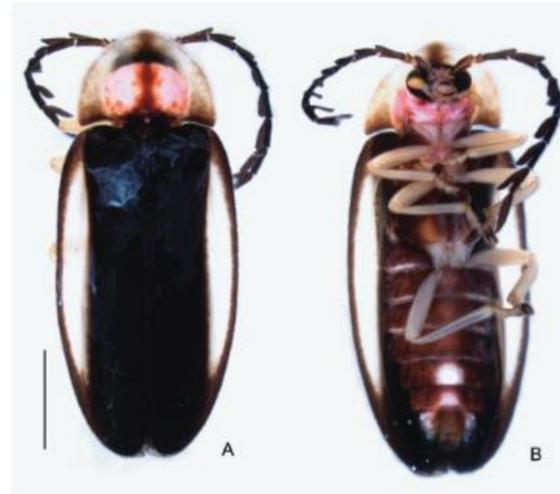


Figure 2: Dorsal and ventral view of the male of *Costalampys delicata*, the type species of *Costalampys*, one of the most recent genera added to the Lampyrinae. *Costalampys* is one of several genera classified as Lampyrinae incertae sedis. Figure from Silveira et al. (2021).

Expectations for results include not being able to find original descriptions for genera, particularly those which were described more than 100 years ago. This has already been the case for several taxa looked at.

Additionally, it is expected that many genera will be found to be *incertae sedis* due to the lack of a recent widespread taxonomic revision of the subfamily. This means that their specific placement within the subfamily is unclear. Of the genera that have been looked at already, several have been given tribal but not subtribal classifications. In the case of placement in Lucidotini, this would make these species Lucidotini *incertae sedis*.

Because most genera have never been tested for monophyly, it is expected that the descriptions of some genera will exhibit overlap.

DISCUSSION

This work is still ongoing. However, it seems clear that there is much work to be done in preserving knowledge of Lampyrinae taxonomy. Original descriptions for some genera are entirely unavailable, with the only documentation of the morphology for some genera being found in a 1964 catalog. This, incidentally, is the most recent comprehensive taxonomy of fireflies.

Having historical background of taxonomy is important, if only because understanding how the taxonomy of the Lampyrinae got to this place can also help us see how this study can be improved in the future.

The information chosen to be included in the summaries for each genus was chosen due to its usefulness to future researchers. For example, the type species, location of holotype, and distribution are basic information necessary for further study of a genus. Having a description on hand for a genus will help researchers both in identifying specimens they may have, and in seeing overlap between generic descriptions.

The remarks section for each genus is expected to provide context for how the description could be confused with those of other genera, which genera can be found in the same area as the genus, and how the description of the genus could potentially be improved. It essentially exists to point out shortfalls in the current understanding of a genus, so that knowledge can be improved.

Also included for each genus is a summary of any molecular work done and any work done on females. Working with DNA is becoming more and more popular, yet surprisingly few fireflies have been studied in this way. DNA data provides valuable additional evidence for the distinctiveness of a taxon, as well as another way to identify specimens. Although female fireflies are often distinct from males, very little work has been done on them comparatively. This leaves an entire field of study open to exploration.

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Acknowledgements

I would like to thank my advisor, Dr. Luiz Silveira, for his direction and encouragement. I would like to thank my thesis committee, Dr. Kathy Mathews and Dr. Indi Bose. I would also like to thank the WCU Graduate School for funding work on this research.