



DISCOVERING TEN NEW SPECIES OF *PARAMYIA* WILLISTON (DIPTERA: MILICHIIDAE) IN NORTH AMERICA USING DNA BARCODING

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Making the process of species identification more efficient by focusing morphological efforts using DNA-based tools

The process of discovering and describing new species – the job of taxonomists – is time consuming. To tackle the challenge, one must become an expert on a specific group in order to notice those rarities among the masses. This is without counting the added challenges of cryptic groups where the external morphology is of limited help as individuals often appear to belong to the same species despite being genetically distinct. In many cases, the taxonomist must dissect hundreds of specimens to detect slight differences in their genitalia which are usually unique for each species. DNA barcoding can greatly assist any taxonomist by speeding up this laborious identification process, particularly with small flies like *Paramyia* Williston (Diptera: Milichiidae).

Paramyia, a kleptoparasitic genus well represented worldwide, provides a perfect example of joining DNA barcoding and traditional taxonomy. *Paramyia* is a small genus, with under 30 described species, of tiny blackish flies, usually under 2 mm long, with very similar external morphology. In the Nearctic, it was only represented by one species, *P. nitens* Loew. With that knowledge in mind, no attention was given to specimens collected in that geographic range. That is until multiple Barcode Index Number (BIN) were found on the Barcode of Life Data System (BOLD) under the same species name. This strongly indicated that multiple undescribed species may have been placed under one species - *P. nitens*. A closer look at their genitalia revealed this to be true, and so a revision of the genus was then needed.

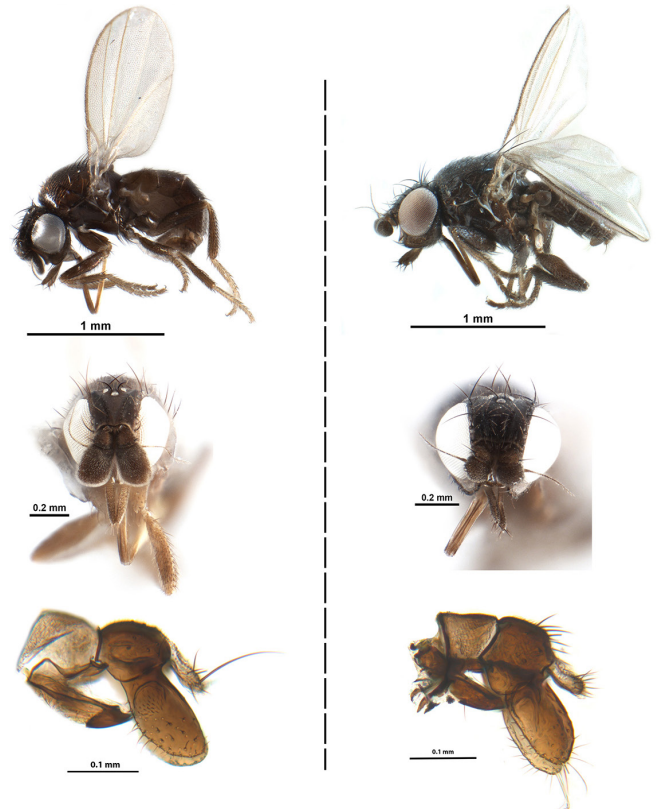


Paramyia sp. displaying *keptoparasitism*, that is, feeding on the captured prey (stink bug) of another predator (spider).
PHOTO CREDIT: Steve A. Marshall

As with any revision, I first acquired multiple loans from large museum collections to compare and study the many diverse and variable specimens from a specific geographic range, in this case, North America. Then, I studied the morphology of these specimens in-depth to detect variation between those grouped together based on their similarities (i.e., morphs) and dissected the genitalia to confirm if they were indeed new species. With a genus like *Paramyia*, most helpful characters to differentiate between the species are genitalic, which means that good dissection skills are essential. The skill needed to dissect the genitalia of such small flies is comparable to performing surgery on a baby's tooth. Important to note, there are no morphology characters to split the females of most species apart.

This is where DNA barcoding comes in handy. I sequenced specimens from my different morphs, and then dissect males grouped in the same BIN to verify the correspondence between the BIN and the species concept. When the molecular and the morphological analysis align perfectly, females can get correctly associates with their male counterpart, which would have otherwise been impossible. Hence, the species description can be more complete, and the sequences are available to be used by other researchers to correctly identify that group, e.g. in monitoring programs. I applied this process in the Nearctic revision of *Paramyia* and described 10 new species! Future revisions tackling the remaining geographic regions can build from this work.

The taxonomic impediment coupled with the current rate of species extinction is making the job of the taxonomist increasingly more difficult and yet, there's an urgent need to record species before they disappear. As this study demonstrates, by quickly sorting specimens based on morphology and sequencing representative of each group, the number of undescribed species can be assessed, and the amount of dissection needed to make such a discovery can be managed. The focus can then be on the morphology and genitalia of the different BINs, hence speeding up the process of species identification.



♂ *Paramyia pseudonitens* n. sp.

♂ *Paramyia brevikeraia* n. sp.

Comparative morphology between the new species P. pseudonitens and P. brevikeraia with a body profile, frontal head and genitalia photos (top to bottom)

PHOTO CREDIT: Valerie Levesque-Beaudin

For full details, please refer to the publication:

Levesque-Beaudin & Mlynarek (2020) Revision of Nearctic *Paramyia* Williston (Diptera: Milichiidae). *Zootaxa*. 732:1. <http://dx.doi.org/10.11646/zootaxa.4732.1.1>

Online:

<https://ibol.org/barcodebulletin/research/discovering-ten-new-species-of-paramyia-williston-diptera-milichiidae-in-north-america-using-dna-barcoding/>