Biodiversity in crisis: new perspectives about species identification by near infrared spectroscopy

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Introduction

Taxonomy is the science based on morphology and/or genetic sequences to give a name to each living organism. Insects are one of the most megadiverse groups; flies for example, have hundreds of thousands of different species. New strategies to identify this biodiversity are welcome because taxonomy is in crisis because of the multitude of unknown species, loss of natural habitats and loss of taxonomists. We use a group of species of flies to propose, test and organise simultaneous hypotheses about delimitation of species and their evaluative patterns based in their spectral fingerprint obtained by NIR spectroscopy.

Materials and Methods

One hundred and twenty two specimens of nineteen neotropical species of flies with distinct grades of morphological and evolutionary similarity were analysed in a FT-NIR spectrophotometer (BOMEM MB-160; ABB, Canada) with a tungsten-halogen light source and an InGaAs detector reading in the 800 - 2500 nm region. Insects were placed on the diffuse reflectance accessory. Each animal had spectra generated from four different positions. Noisy regions were detected visually and eliminated prior to statistical analysis. Preprocessing involved a Savitzky-Golay 1st derivative (21 point window and second order polynomial) and smoothing (seven point window). PCA and Linear Discriminant Analysis (LDA) were then applied to the spectra. In LDA, a group of individuals was used to training and some individuals for testing.

Results and Discussion

PCA was successful to propose identity of species as confirmed by their morphology but only for groups of three or four species. With more species, PCA was not effective but other patterns emerged: the evolutionary relations between the groups of species. LDA was successful to confirm hypothesis of all the species. LDA, like PCA, not only confirmed the identification for all the species but also displayed patterns related to their evolution.

Conclusion

NIR spectroscopy is a promising tool for studying biodiversity of megadiverse groups of biological species and their evolution.

Reference paper as:
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