Funded PhD project: History of an evolutionary convergence: evolution of chemical defenses within mimetic butterflies communities.

The Labex BcDIV funds a PhD for 3 years on the evolution of chemical defenses in neo-tropical butterflies. This PhD project will be located in the Muséum National d’Histoire Naturelle in Paris (France) and jointly supervised by Violaine Llaurens (CNRS researcher, isyeb.mnhn.fr/annuaire-et-pages-personnelles/pages-personnelles/LLAURENS-Violaine) and Bastien Nay (CNRS research director, naygroup.wordpress.com), in collaboration with Marianne Elias (CNRS researcher, isyeb.mnhn.fr/annuaire-et-pages-personnelles/pages-personnelles/ELIAS-Marianne,279). We are seeking a highly motivated student with a chemical ecology profile to work on this interdisciplinary project combining natural product chemistry and evolutionary biology.

Scientific context:
Many toxic butterflies display vivid wing colour pattern, used as a warning signal by predators. Evolutionary convergences in these wing colour patterns are frequently observed among distantly related species, creating ‘mimicry rings’ of butterfly species displaying similar colour patterns. The more individuals and/or species share the same warning signal, the more efficiently the signal is recognized by predators, which suffer from the effect of the chemical defenses carried by butterflies. The evolution of chemical defenses within Lepidoptera lineages therefore plays an important role in the evolutionary convergence of mimetic colour pattern. Chemical defenses can be sequestered from food or been neo-synthetized by butterflies, and may exhibit large variations within and among species. In turn, those variations have important consequences on predators’ behaviour and on the dynamics of mimetic signal. This PhD project focuses on two highly divergent neo-tropical clades of mimetic butterflies (split circa. 90 million years ago), namely the sub-tribes Heliconiini and Ithomiini. In these two clades, chemical defenses are acquired through different routes, but some species display strikingly similar wing colour patterns. In Heliconiini, toxicity stems from cyanogenic glucosides stored at larval stage from Passiflora host plants, or can be neosynthesized by butterflies themselves. However, in Ithomiini, toxicity relies on pyrrolizidic alkaloids, sequestered at adult stage from Asteraceae, Boraginaceae, and Apocynaceae flowers. The difference in plants from which toxins might be stored, together with the variations in the neosynthesis capabilities, and stage of acquisition suggests contrasted evolution of chemical defenses in the two clades. Furthermore, species within these two clades also differ in their behavior and ecology, e.g. can have gregarious or solitary larval stages, and various abundances of their mimicry rings and level of conspicuousness of the associated signal. These traits can also be influenced by other selective forces, therefore may intervene in the evolution of chemical defenses. This PhD project aims at qualitatively and quantitatively analysing variations in chemical compounds in different species of the two clades and characterizing their metabolic origin to understand the evolution of chemical defenses in those two mimetic clades.

Profile:
We are looking for a student with a Master degree in chemical ecology or natural product chemistry. A specific interest in macro-evolutionary questions would be appreciated. The student should be able to perform chemical analyses on biological material using various innovative analytical techniques. Together with those lab skills, the student should display a high motivation for fieldwork in tropical areas.

Schedule:
The PhD thesis will start in October 2016. Application files should contain: a CV, a cover letter, Master score sheets, and two recommendation letters. Complete application files must be sent to llaurens@mnhn.fr and bnay@mnhn.fr before March 30th. Selected candidates will then be interviewed by a selection committee in May. The PhD will start on October 1st, 2016.