ABSTRACT OF HABILITATION THESIS

INTEGRATIVE TAXONOMY: AT THE CROSSROAD OF MORPHOLOGY, MOLECULAR PHYLOGENETICS, ECOLOGY AND BIOGEOGRAPHY TO DELIMIT SPECIES OF CHALCIDOID WASPS AND NOT ONLY

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The habilitation thesis is based on the results obtained by the author in the field of integrative taxonomy of parasitoid wasps (superfamily Chalcidoidea) and is divided into 2 sections. Part I presents the current trends in this research area focusing on the author's contributions after the defence of his doctoral thesis. Part II is a presentation of the author's career followed by the main objectives of the academic career development. The thesis ends with a references list that also includes the author's articles.

The first three chapters of Part I are based on three articles published as sole author or as corresponding author. A taxonomic revision* of the Palaearctic species of the subgenus *Hirticauda* Bouček, genus *Reikosiella* Yoshimoto is presented in chapter one. The revision includes an illustrated identification key needed to identify females of the ten species recognized in the article and all known males. Prior to this work, *R.* (*H.*) *hungarica* (Erdős) was the only recognized Palaearctic species. Two species were transferred to the genus and subgenus while seven species were described new: one from the Canary Islands, two from Greece, one from the United Arab Emirates and three from South Korea. Published data on the hosts of these species were critically discussed considering their new generic classification.

Chapter two is a revision of the European species of the subgenus *Macroneura* Walker of the genus *Eupelmus* Dalman using an integrative approach. This work is presented at length due to its complexity and time required to complete it. The subgenus includes the common, cosmopolitan and highly polyphagous species *Eupelmus vesicularis* Retzius. To demonstrate that it actually includes several cryptic species, various sources of information were used: DNA sequences of the D2 expansion region of 28S rRNA (28S-D2), sequences of subunit I of cytochrome c oxidase (COI), cytogenetic evidence, morphological and arealographic evidence. *Eupelmus messene* Walker was removed from erroneous synonymy with *E. vesicularis* and treated as a valid cosmopolitan species. The biological attributes that led to the successful colonization of new territories by this species were discussed. In addition, four new species were described: two from the Balkan Peninsula, one from throughout Europe except the north, and one from the Balkan Peninsula and the Middle East. Three of the new species and *E. messene* were previously included in *E. vesicularis*, which has led to uncertainty in the extensive literature published under this name. A key was provided for females of 12 species and males of 8 species, 5 of which were previously unknown. The purpose of the review was to facilitate identifications by ecologists and researchers working in biological pest control.

The third chapter is the revision of the World species of *Megaphragma* Timberlake. This genus of parasitoid wasps includes some of the smallest known insects, some being smaller than the unicellular *Paramecium* Müller. They are parasitoids of thrips eggs (Thysanoptera) and as such are potential pest control agents (many thrips species are among pests of crops or ornamental plants). The molecular analyses facilitated the taxonomic revision because many species would have never been described as new without additional evidence (the characters used to separate them are so subtle that they would pass unnoticed or could be attributed to intraspecific variability without evidence from phylogenetic analyses). The result was the first revision of the genus that included numerous synonymies, the formal descriptions and naming of 22 species and a key to all 32 valid species.

* A taxonomic revision is different from a review in the sense that for a revision, in addition to the analysis of the publications, specimens from the respective group (including the type specimens) accumulated in natural history museums and other collections all other the world, are critically reanalysed. Consequently, due to logistical issues and the reassessment of species concepts, a revision frequently takes several years.

Chapter four briefly describes the other scientific achievements, including the disentanglement by a multinational team of a complex of 21 species of economically important parasitoids in the genus *Eupelmus* by using molecular phylogenetics and morphology and revealing 11 new species. The same team conducted a study on the ecological differentiation in the *Eupelmus urozonus* group based on a multi-locus phylogeny and first reliable host records, showing the presence of specialized cryptic species with implications for the biological control of the olive fruit fly. In a study complementary to the previous two, we inventoried 104 species of *Eupelmus* from the Palaearctic region (starting from Portugal and ending in Japan), of which 76 species were revised, including 25 species new to science. Many of these species are nearly cryptic and were described with the aid of DNA barcodes. The revision of the genera *Coryptilus* Gibson and *Calymmochilus* Masi presented next, were undertaken together with co-authors from Japan, Korea, and UK. In collaboration with a team from Muséum national d'Histoire naturelle in Paris a revision of J. Risbec's African Eupelmidae slide collection was published, advancing the taxonomy of the group. I coauthored the descriptions of the second species of the very rare genus *Eopelma* from Borneo (including the first molecular phylogenetic analysis that included the genus), of the first European species of *Tineobius* Ashmead, and of a species of the rare genus *Balcha* Walker. In the family Scelionidae which are egg parasitoids of various insects, including true bugs, I collaborated on a project of karyotyping *Trissolcus basalis* (Wollaston) and on a paper that used molecular phylogenetics to test the intergeneric limits in a group of parasitoids used worldwide in the biological control of invasive bugs. Besides my primary interest in parasitoid wasps, I worked and published with colleagues on species delimitations in beetles and crickets where we showed that DNA barcoding must be used with caution, and correlated sexes, respectively. In the family Encyrtidae I contributed to solving the taxonomy of potential biocontrol agents in the genus *Ooencyrtus* and advancing the American biocontrol program against the Bagrada bug. With Greek colleagues I analysed a species of *Ooencurtus* Ashmead that is a parasitoid of the invasive bug *Halyomorpha halys* Stål: it turned out to be the first European record of *O. mirus* Triapitsyn & Power. With colleagues from UK, American Samoa and USA, I contributed to the description of the first parasitoid of the Samoan swallowtail butterfly, gain from the genus *Ooencyrtus*. Also related to the biological control of agriculture pests I contributed towards the integrative taxonomy of *Torymus sinensis* Kamijo a parasitoid of the chestnut gall wasp (*Dryocosmus kuriphilus* Yasumatsu), hence an important biocontrol agent for the chestnut industry worldwide. We demonstrated that the European biocontrol program against the Oriental chestnut gall wasp was unwillingly and unknowingly based on introgressed specimens because they present molecular and morphological signs of historical hybridization. We provided the first illustrated key for all European species of *Torymus* Dalman associated with the pest that will serve as a reference and as an identification tool for non-taxonomists working in forestry and agriculture. My more recent interest is in upscaling the use of molecular data for phylogenetic analysis and for species delimitations by using massively parallel sequencing technology (NGS and third-generation sequencing). This already resulted in the delimitation of a new subfamily of chalcidoid wasps (Eusandalinae) and several coauthored publications.

The last chapter of Part I is a summary of the new taxa that I described as single author or as a co-author. These are mostly species in the family Eupelmidae but not only and include: the subfamily Eusandalinae, seven species of *Merostenus* Walker, 32 species of *Eupelmus*, two of *Coryptilus*, one species in each of the genera *Eopelma*, *Tineobius*, *Calymmochilus* and *Balcha*. Besides Eupelmidae I described wasps in other families: a fossil species in the family Leptoomidae from the Baltic amber (some 40 millions years old), a new genus of Aphelinidae (*Wallaceaphytis* Polaszek & Fusu), two species of Encyrtidae in the genera *Dicarnosis* Mercet and *Ooencyrtus*, 20 species of *Megaphragma* (Trichogrammatidae). Additionally, I co-authored one subspecies of long-horned beetles.

The second part is a synopsis of the professional and academic achievements including research grants, a description of my lab and research group, the activity in learned societies and on the editorial bord of journals, conferences, and the development of new university courses. It also describes my career development plan and my main objectives of career development.