KURZFASSUNGEN DER POSTER

Artenrückgang bei Wildbienen der Gattung *Anthophora*

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Der Begriff ‚Insektensterben' ist heutzutage in aller Munde. Naturschutzgruppen bieten Kurse im Insektenhotel-Basteln, Supermärkte verschenken Saatgut für Bienenweiden und in den Zeitungen wird regelmäßig Biene Mayas Tod prophezeit. Der Film ‚More Than Honey' hat viele Menschen tief erschüttert, indem er auf sehr plakative Weise zeigt, wie Landarbeiter in China ganze Obstplantagen mit kleinen Pinseln in mühevoller Handarbeit bestäuben oder in Kalifornien unzählige Honigbienenvölker in den Mandelplantagen regelrecht „verheizt", von Imkern als „Kahlfliegen" bezeichnet, werden. In diesem Zusammenhang wird Albert Einstein häufig in den Mund gelegt sinngemäß gesagt zu haben: Wenn die Bienen sterben, hat der Mensch noch vier Jahre zu leben.

Die Honigbiene ist ohne jeden Zweifel ein Sympathieträger, deren drohender Verlust die Menschen auf emotionaler Ebene berührt. Ein Effekt, der den deutschen Imkervereinen offensichtlich zu Gute kommt: seit einigen Jahren verzeichnen die deutschen Imkervereine deutlich steigende Mitgliedszahlen.

In der vorliegenden Arbeit soll anhand von zwei Arten untersucht werden, ob im Landkreis Schwäbisch Hall ein Rückgang von Wildbienen nachweisbar ist. Dazu wurden 20 Standorte einer Region ausgewählt, auf denen innerhalb der letzten 25 Jahre Nachweise für eine der beiden Arten vorliegen. Für jede Art wurden 10 Flächen ausgewählt, die jeweils drei Mal begangen wurden um alle dort vorgefundenen Individuen von *Anthophora aestivalis* Panzer und *Anthophora plumipes* Pallas zu erfassen. Ebenfalls erfasst wurden Nachweise von *Melecta albifrons* Forster, einer Kuckucksbiene, deren Hauptwirt *A. plumipes* ist. Erwartet wurde, dass auf den meisten der ausgewählten Flächen Wiederfunde erfolgen, da sich die Habitatqualität dort nicht wesentlich verändert hat.

Cuticular hydrocarbons of cuckoo wasps are species-specific

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Species identification via DNA barcoding is well established and can help distinguishing closely related, and cryptic species. However, its large-scale application is time and cost intensive. When dealing with insects, species identification by analyzing the cuticular hydrocarbons (CHCs) of the samples in question could be an alternative for rapid species identification, with comparatively low running costs. Here we present results from testing whether or not the CHCs of cuckoo wasps (Chrysididae) can be used to identify the species in this group. We compared CHC profiles of males and females of almost 60 species of Chrysididae to assess whether 1) CHCs are species-specific and 2) closely related species are chemically similar to each other than distantly related ones. In addition, we use a group of closely related species to assess whether CHC profiles vary geographically. Our analyses revealed that the CHCs of cuckoo wasps are species-specific and do not vary much geographically. The CHC profiles of males tend to be less diagnostic across species than those of females, probably reflecting differences in selective pressures on the two sexes. In conclusion, our results indicate that the analysis of CHC represents a promising tool for identification of otherwise difficult to distinguish insect species.

The musculoskeletal ovipositor system of an ichneumonid wasp: structural and functional aspects

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The vast majority of hymenopterans are parasitoids of other insects. Their ovipositor serves several tasks in the parasitoid lifestyle, i.e. navigating or penetrating the substrate (if the host is concealed) or the targeted puparium, assessing and piercing the host, injecting venom, oviciding the competitors' eggs, finding a suitable place for egg laying and ovipositing. Undoubtedly, modifications of the ovipositor have played a prominent role in defining the host range of parasitoid hymenopterans. Despite many comparative studies on the structure of the hymenopteran terebra (e.g. Snodgrass 1933; Quicke et al. 1994), the underlying working mechanisms of the musculoskeletal ovipositor system of the extremely diverse and species-rich Ichneumonoidea has remained largely unexplored so far and only

little is known about the actuation of the various ovipositor movements. Therefore, we examined all inherent cuticular elements and muscles of the ovipositor of *Venturia canescens* (Gravenhorst, 1829) (Hymenoptera: Ichneumonidae: Campopleginae), a solitary, koinobiont larval endoparasitoid of several moth species (Lepidoptera) (for oviposition behaviour cf. Rogers 1972). Furthermore, we investigated the mechanics of the ovipositor system and determined its mode of function.

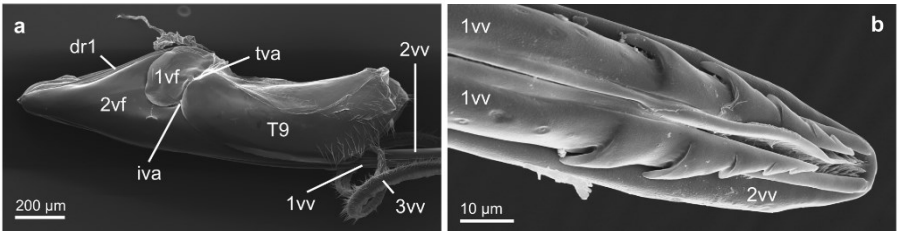

Fig. 1: SEM images. **a** Ovipositor of *Venturia canescens* excised from the genital chamber (left is anterior, lateral view). **b** Apex of the terebra (ventral view). Abbreviations: 1vf, 1st valvifer; 1vv, 1st valvula; 2vf, 2nd valvifer; 2vv, 2nd valula; 3vv, 3rd valvula; dr1 dorsal ramus of the 1st valvula; iva, intervalvifer articulation; T9, female T9; tva, tergo-valvifer articulation

The ichneumonid ovipositor consists of the female T9 (9th abdominal tergum), two pairs of valvifers and three pairs of valvulae (Fig. 1a). The paired 1st and the 2nd valvulae are tightly interlocked by the olistheter and form the terebra (Fig. 1b). The ovipositor movements are actuated by a set of six muscles. The antagonistically acting posterior and anterior 2nd valvifer-2nd valvula muscles flex and extend the terebra from its resting towards an active probing position and back. The dorsal T9-2nd valvifer muscle is modified in *V. canescens*; it forms two distinct bundles that, together with the antagonistically acting ventral T9-2nd valvifer muscle, change the relative position of the 2nd valvifer to the female T9. This indirectly causes a tilting movement of the 1st valvifer, because it is linked with both of them via intervalvifer and tergo-valvifer articulation, respectively. The 1st valvifer acts as a lever arm, which transfers movements to the 1st valvula via the dorsal ramus. Thus, the shape of the 1st valvifer and the relative positions of the tergo-valvifer and the intervalvifer articulations influence the movements of the 1st valvula. The posterior T9-2nd valvifer muscle and the small 1st-valvifer-genital membrane muscle mainly stabilize the system during oviposition.

From the examination of the elements of the musculoskeletal ovipositor system, we discussed leverage and muscle forces and finally developed a structural and functional model of the underlying working mechanisms. This way, a better understanding of a key feature in the evolution of parasitoid hymenopterans could be attained, a feature that has impacted the evolutionary success of ichneumonid wasps (with more than 24,000 described species (Yu et al. 2004)) and parasitoid hymenopterans in general.

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Institut für Bienenschutz: Untersuchungen zur Sensitivität verschiedener Wildbienenarten (Hymeoptera: Aculeata: Apiformes) gegenüber Pflanzenschutzmitteln im Vergleich zur Westlichen Honigbiene (*Apis mellifera*)

Institute for Bee Protection: Comparative studies concerning the sensitivity of different bee species (Hymenoptera: Aculeata: Apiformes) to plant protection products

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Das Julius Kühn-Institut (JKI) vereint unter seinem Dach 17 Fachinstitute und gehört als Bundesoberbehörde zum Bundesministerium für Ernährung und Landwirtschaft (BMEL). Die Bearbeitung aktueller Forschungsvorhaben und die wissenschaftliche Vorbereitung der Politikberatung erfolgt an 10 Standorten, u. a. in den Bereichen Pflanzenbau, Züchtung, Pflanzen-, Bienen-, Vorratsschutz und Pflanzengesundheit.

Im jüngsten Fachinstitut des JKI werden an den Standorten Braunschweig und Berlin-Dahlem aktuelle Fragen rund um den Bienenschutz bearbeitet. Nach § 57 Abs. 2 Nr. 11 PflSchG hat das Institut die Aufgabe, Bienen auf Schäden durch Pflanzenschutzmittel (PSM) zu untersuchen. Im Rahmen der Zulassung von PSM sowie der EU-Wirkstoffprüfung sind die Risiken für Honigbienen und andere kommerziell relevante Bestäuber (Hummeln und weitere Wildbienen) durch das Institut zu bewerten. Die Forschungsschwerpunkte liegen im Bereich der Ökotoxikologie von Honig- und Wildbienen. Über die Weiterentwicklung von Methoden der Risikobewertung hinaus werden mögliche Risiken für Bienen erforscht.

Die unterschiedlichen biologischen Eigenschaften der verschiedenen Wildbienenarten finden in der derzeitigen Risikobewertung für PSM möglicherweise eine unzureichende Berücksichtigung, da aufgrund einer mangelnden Datengrundlage oft von der Westlichen Honigbiene (*Apis mellifera*) als Stellvertreterorganismus auf die Gesamtheit der Wildbienenarten geschlossen wird. Im Beitrag werden aktuelle Untersuchungsergebnisse zur Sensitivität verschiedener Wildbienenarten (u.a. *Bombus terrestris*, *Osmia bicornis*, *Megachile rotundata*, *Andrena vaga*) gegenüber PSM im Vergleich zur Westlichen Honigbiene (*Apis mellifera*) vorgestellt. Die Ergebnisse tragen dazu bei, die Risikobewertung für PSM der Realität weiter anzunähern.

The Hymenoptera Collection of the Museum für Naturkunde Berlin
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Status Quo and Future Perspectives

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The Hymenoptera Collection of the Museum für Naturkunde Berlin houses approximately 2.277.880 specimens, which represent about 235.000 species. The majority of the specimens are pinned. It contains about 11.400 type specimens. Additionally holdings consist of 238 nests, 1.100 leafs with galls, 10.000 larvae, 2.200 cocoons, 28.000 microslides and 125.000 specimens in alcohol.

The Hymenoptera in Berlin, formerly known under a variety of names, like Zoologisches Museum Berlin, contains significant historical holdings by Klug, Foerster, Pfannkuch, Stitz, Friese, Conde, Bischoff and Muche. The bee collection by Friese, which includes species and types from all continents, is of particular interest. In addition, the collection contains considerable material from the former German colonies, particularly from Africa and the Australasian region. Since 1992, extensive material was collected during numerous research trips to the Afrotropical region, especially to southern Africa and Southeast Asia.

The Hymenoptera collection is currently in the process of being digitized in order to replace paper-based card indexes and ledgers, which is still the major source of information for the collection holdings. This includes mass-digitization of insect drawers, multifocus imaging of type specimens, and 3D photography of selected specimens. Specimen metadata are databased. A group of technicians, students and volunteers are working simultaneously on all levels of the digitization project.

The complete digitization of this important collection has high priority in order to improve digital and physical access to its holdings. The largest part of the collection is still in historical drawers, which need to be replaced within a short time for curatorial reasons. All specimens are being transferred into unit-trays and type specimens isolated from non-type specimens.

There are still many problems to solve particularly with respect to historical types, which are only partly labeled accordingly. Not all types bear type-labels, and not all specimens with type-labels actually are types. Whereas some collections like the Friese bee collection have always attracted interest by taxonomists, some other taxonomic groups have largely been neglected for decades. Reconstructing the type status particularly of historical specimen with poor documentation and unreliable labels is a major task, which should best be done by specialists. We therefore invite hymenopterists to Berlin to work on this important historical collection.

Ein Vergleich von Methoden zur Erfassung von Wildbienen (Hymenoptera: Aculeata: Apiformes) in Weinbausteillagen

A comparison of methods for sampling wild bees (Hymenoptera: Aculeata: Apiformes) on steep slopes under viticulture

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Während der Sichtfang von vielen Autoren als Methode zur Erfassung von Wildbienenzönosen präferiert wird, ist die Erfassung von Wildbienen mittels Handfängen in Weinbausteillagen mit Schwierigkeiten verbunden. Probleme werden durch die abschüssige Hangneigung bereitet, insbesondere in Verbindung mit rutschigem Substrat sowie zum Teil dichtem Aufwuchs von krautiger und verholzter Vegetation. Eine Vielzahl anvisierter Wildbienen entzieht sich dem Sichtfang, da der Beobachter die Fluchtdistanz nicht schnell genug überwinden kann. Die durch Sichtfänge an Steilhängen erbeutete Anzahl erfasster Wildbienenindividuen ist daher vermutlich deutlich niedriger als in leichter begehbaren Habitaten mit vergleichbarer Individuendichte.

In Vorbereitung eines mehrjährigen Monitorings der Wildbienen in Weinbausteillagen wurden von 2012 bis 2014 die Erfassungsmethoden Sichtfang, Farbschalen, Malaise-Fallen und Nisthilfen in Bezug auf die erfassten Wildbienenzönosen an zwei Standorten im Mittleren Moseltal untersucht. Darüber hinaus wurde der Einfluss der Fangerfahrung des Beobachters und der verschiedenen Fangschalenfarben auf das Erfassungsergebnis ausgewertet. Um mögliche Einsparungen des Erfassungsaufwandes zu evaluieren, wurden die Ergebnisse verschieden intensiver Monitoringstrategien miteinander verglichen.

Die vorgestellten Ergebnisse sind Teil einer abgeschlossenen Dissertation (Krahner, A. 2017: Die Stechimmendiversität der Weinbausteillagen im Mittleren Moseltal (Hymenoptera Aculeata) unter besonderer Berücksichtigung der Wildbienen (Apiformes) – Dissertation, 2017 – Universität Trier, Trier.). Die zugrundeliegenden Untersuchungen wurden durch die Bundesanstalt für Landwirtschaft und Ernährung gefördert (Förderkennzeichen: 2811HS003).

Wild bees (Anthophila) of Porto Santo (Madeira Archipelago): Taxonomy, diversity, distribution patterns and bee-plant interaction networks

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Porto Santo is the oldest island in the Madeira Archipelago (11.1-14.3 Ma). The altitudes are low and therefore the main part of the island is characterised by xeric vegetation and a semiarid climate. Subhumid conditions with trade-wind clouds are only present in a small area of the summits and under special site conditions. We were able to study the wild-bee fauna with pan traps and hand-netting or observation and the bee-plant network mainly during three stays in March 2005, 2012 and 2017. Until now, 9 wild-bee species have been detected. Two species are endemic to Porto Santo, and two species along with one subspecies are endemic to the Madeira Archipelago. The two endemic species have been described recently by Kratochwil & Scheuchl (2013) and Kratochwil et al. (2014) and further information is published in Kratochwil et al. (2008) and Kratochwil (2015, 2018).

An actualised and annotated check list of the wild-bee species will be presented, including a comparison with Madeira Island and Desertas. The colonisation history of the endemic species *Andrena dourada* Kratochwil & Scheuchl, 2013, and *A. portosanctana* Cockerell, 1922, will be discussed. The distribution patterns of the bee species of Porto Santo, which we got from 628 new data and 69 data from other authors show a wide distribution of the endemic and native bee species in the xeric zone. Nevertheless, population sizes are small in the case of the endemic species; therefore, *A. dourada* and *A. portosanctana* are endangered. *A. portosanctana* was already included in the IUCN list of threatened species. Only *Bombus terrestris lusitanicus* Krüger, 1956 (formerly *B. maderensis*, Erlandson, 1979) is restricted to the subhumid area.

All in all, we detected about 300 bee-plant interactions. In contrast to mainland networks, e.g. in the warm-temperate zone, which are as a rule characterised by many more bee than plant species, the bee-plant network of Porto Santo shows many more plant than bee species and is highly asymmetric. Six wild-bee species used 27 different plant species. Bee and plant species were highly interconnected, showing that under difficult environmental conditions and resource limitations, alternative nectar and pollen resources were available. In particular, the woody *Echium* species *E. nervosum* (endemic to the Madeira-Archipelago) and *E. portosanctensis* (endemic to Porto-Santo) are on one hand key species as resources for wild bees and on the other side self-incompatible outbreeders and depend on pollination. Even in very dry periods (e.g. from November 2011 to March 2012 there was no precipitation), *Echium* showed rich flower production and was intensively visited by wild-bee species. In the wet spring of 2017 (October 2016-March 2017: 301 mm), there was a difference in the number of bees compared to the dry spring (15 % reduction per day, but more detections without flower visits and fewer detections on flowers).

Brassicaceae species are important for the endemic species *A. portosanctana*; the key species is *Cakile maritima*, also flowering intensively after the dry winter of 2012.

A comprehensive publication on the bee fauna of Porto Santo, the distribution pattern of the species and the bee-plant network is in preparation (Kratochwil & Schwabe in prep.).

Acknowledgements

We thank cordially for cooperation: Antonio M.F. Aguiar (Laboratório Agrícola, Camacha, Madeira, Portugal), Jan Smit (Nationaal Natuurhistorisch Museum, Leiden, The Netherlands), Pater Andreas Werner Ebmer (Puchenau, Austria), Holger Dathe (German Entomological Institute, Müncheberg, Germany), Patricia Gentili-Poole and Brian Harris (Department of Entomology Smithsonian Institution, Washington DC, USA), Ysabel Gonçalves (Museu de História Natural do Funchal, Madeira, Portugal), Fritz Gusenleitner (Biology Centre Museum Linz, Austria), James Hogan (Hope Entomological Collections, Oxford University, United Kingdom), Michael Kuhlmann (Kiel University, Zoological Museum, Germany), Vincent F. Lee (Department of Entomology, California Academy of Sciences, San Francisco, CA, USA), Volker Lohrmann and Herbert Hohmann (Übersee-Museum Bremen, Germany), David Notton (Natural History Museum, London, United Kingdom), Hans-Richard Schwenninger (Stuttgart, Germany), Erwin Scheuchl (Ergolding, Germany).

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“Biodiversity areas” – a measure in the Agri-environmental programme of Austria: Do wild bees benefit?

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Agricultural intensification and the related loss of habitats are known to be the main drivers for species decline in Central Europe. The Austrian Agri-environmental programme ÖPUL aims to counteract this negative development by supporting a sustainable management of agricultural areas. Simultaneously ÖPUL complies with the greening requirements of the EU.

One of twenty-three measures, which are offered in the programme, includes “biodiversity areas on arable land”. Thereby, a seed mixture with at least four entomophilous plant species has to be sown, ploughing is not allowed before the second year and the area has to be mown every year.

As a part of the project BINATS II (BIodiversity–NATure–Safety), we focus on the question, if these areas promote wild bee diversity in farmland. Therefore, we have investigated 30 “biodiversity areas on arable land” distributed in the Austrian farmland in 2017 and 2018. The bee survey was performed using a semi-quantitative transect method along a 80x2 m transect four times a year. Each transect is situated in a test area of 625x625 m and compared with ten randomly selected transects in the same square. In these test areas habitat structures are mapped area-wide, vegetation types are recorded along the transect.

We present first results on effects of “biodiversity areas” on wild bee diversity and abundance considering the surrounding habitat configuration and the provided forage supply.

The project is financed by the Austrian Federal Ministry for Sustainability and Tourism and the Federal Ministry for Labour, Social Affairs, Health and Consumer Protection.

Built to pursue: wasps hunting for highly mobile prey have more elongated wings

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Aereodynamic models of animal flight suggest that wings with high aspect ratio (long and narrow wings) minimize induced drag and provide high lift to drag ratios, and thus enhance flight ability. Flying predators coursing flying prey, for example, could benefit of having such wings. Hymenoptera are an adequate model to test such a hypothesis, because the resource targeted for larval food encompasses immobile or almost immobile items (e.g. lepidopteran larvae, pollen within flowers (NM)), weakly or moderately mobile items (e.g. orthopterans, coleopterans (WM)) and highly mobile, fast-flying items (bees and flies (HM)). I predicted highest wing aspect ratio in species foraging on HM-species. Across 63 species spanning 15 families, wing aspect ratio increased with resource mobility, after controlling for wing length. Effects of phylogeny on such relationship seemed to be weak. For example, bees and parasitoids wasps attacking immobile larvae had similar aspect ratio, and HM-hunting predatory wasp species from two different superfamilies had also similar aspect ratio. These results are in accordance with the hypothesis that pursing a highly mobile prey requires more elongated wings. Since HM-hunting wasps were previously reported to possess also high flight muscle ratio and low wing loading, which increase load-lifting capacity and flight manoeuvrability, overall these predators seem to be finely adapted to both fit their foraging behaviour (carry loads to the nests) and the behaviour of their prey (mobility).

Spatiotemporal size relationships between the eusocial bee *Lasioglossum malachurum* and its hymenopteran natural enemies

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In Hymenoptera, the greater the amount of food eaten by larvae, the greater the size of the adults. It thus predictable that both cleptoparasites (which feed on the provisions collected by adult hosts) and parasitoids (which feed on immature stages of the host) are larger in periods and locations were their host is also larger, although evidences lack for systems involving aculeate natural enemies and hosts. Here we tested this hypothesis on a model system including the eusocial bee *Lasioglossum malachurum* (Halictidae) as host and the cleptoparasitic bee *Sphecodes monilicornis* (Halictidae) and the ectoparasitoid *Myrmilla capitata* (Mutillidae) as natural enemies. According to predictions, females of *S. monilicornis*

were larger at sites where workers of *L. malachurum* were larger; however, they were not larger in months where host workers were larger, being largest in May possibly because it emerged from queen cells at the beginning of the season. On the other side, *M. capitata* size did not differ significantly across sites and months. Patterns of body wear suggest that *S. monilicornis* has at least two generations a year. On the contrary, the body wear of M. capitata was lowest at the beginning of the host nesting season and highest at its end, suggesting that a single generation attacks all the host broods across the year. We suggest the number of generations of the natural enemies may explain at least partially why their size and that of host do not always match.

Überraschende Vielfalt an unbeschriebenen Erzwespen in einer mitteleuropäischen Großstadt (Stuttgart)

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Hymenopteren sind eine der artenreichsten Ordnungen der Insekten und Parasitoide sind innerhalb der Hymenopteren besonders artenreich. Insbesondere in den Tropen werden regelmäßig zahlreiche unbekannte Arten gefunden, aber auch in Mitteleuropa werden immer wieder unbeschriebene Arten identifiziert. So konnte in einer vorangegangenen Studien gezeigt werden, dass es sich bei der Lagererzwespe *Lariophagus distinguendus* (Förster, 1941) (Hymenoptera: Pteromalidae) um mindestens zwei getrennte Arten handelt, die reproduktiv und genetisch voneinander isoliert sind. Eine der Arten lebt in Getreidelagern, wo sie v.a. Larven des Kornkäfers *Sitophilus granarius* (Linnaeus, 1758) (Coleoptera: Dryophtoridae) parasitiert, die andere in Vorratskammern an Larven des Brotkäfers *Stegobium paniceum* (Linnaeus, 1758) (Coleoptera: Ptinidae).

In der vorliegenden Studie untersuchen wir die Diversität innerhalb der Brotkäfer-Art im Großraum Stuttgart. Zwischen 2017 und 2018 wurden Köderdosen mit Larven von Brotkäfern als Wirten ausgebracht um freifliegende Lagererzwespen zu fangen. Die Köderdosen wurden anschließend ins Labor gebracht und aus den schlüpfenden Wespen Zuchtlinien etabliert.

Molekularbiologische Untersuchungen der Barcoderegion (COI) ergaben, dass es innerhalb der „Brotkäferart" von *Lariophagus* mehrere Linien gibt, die sich um bis zu 6,8% unterscheiden. Diese erheblichen Unterschiede deuten darauf hin, dass es sich bei diesen verschiedenen Linien um eigene Arten handelt. *L. distinguendus* ist also nicht nur eine Art, sondern ein Artenkomplex aus mehreren Arten. Damit zeigen unsere Ergebnisse, dass es innerhalb der Hymenopteren nicht nur in den Tropen, sondern auch mitten in Europa und sogar in unmittelbarer Umgebung zum Menschen eine erhebliche Diversität an noch unbeschriebenen Arten gibt.

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