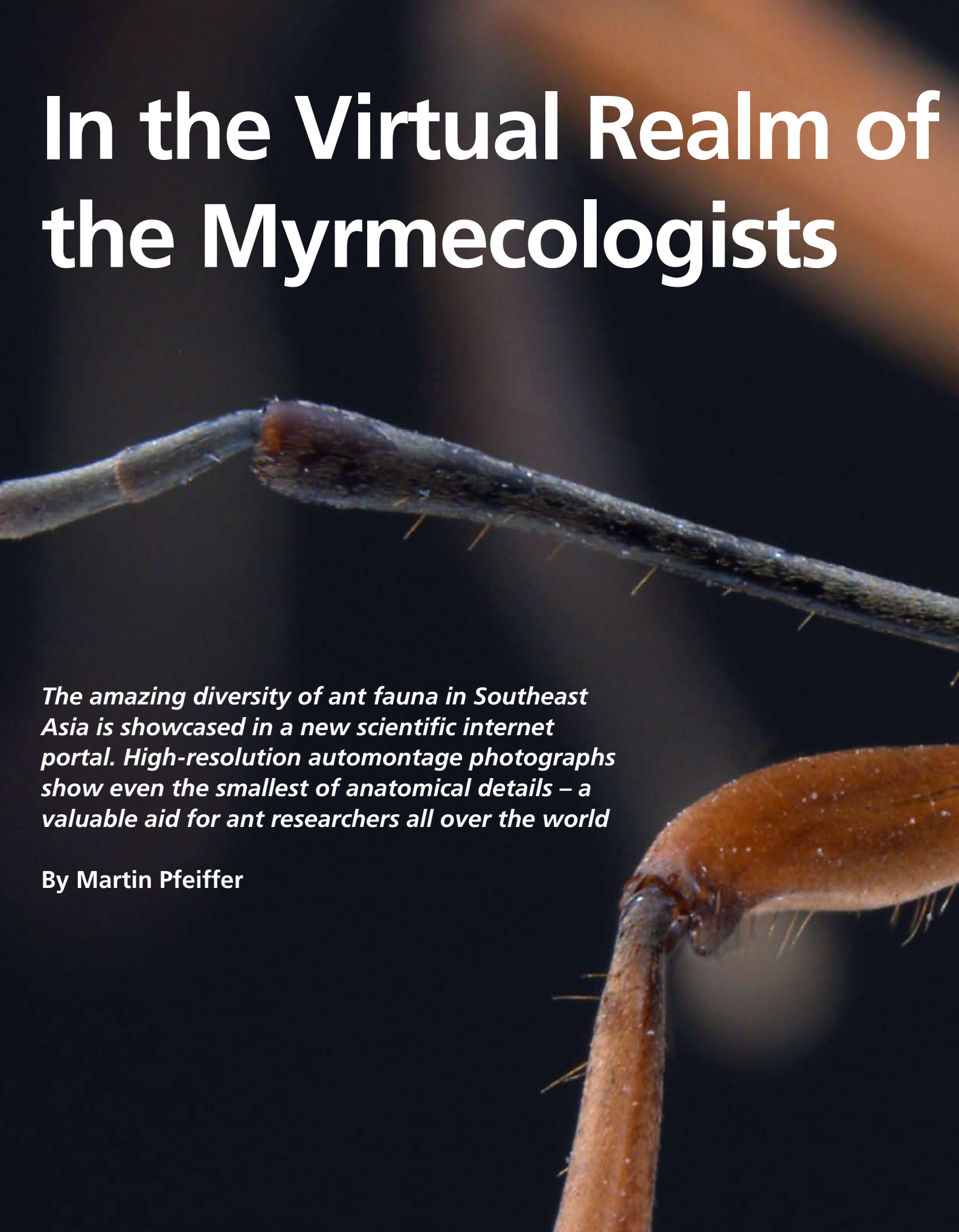


In the Virtual Realm of the Myrmecologists

A close-up photograph of an ant's legs, showing the intricate details of the joints and the fine hairs on the segments. The legs are a mix of brown and dark grey colors, set against a dark, blurred background.

The amazing diversity of ant fauna in Southeast Asia is showcased in a new scientific internet portal. High-resolution automontage photographs show even the smallest of anatomical details – a valuable aid for ant researchers all over the world

By Martin Pfeiffer



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At the start of the 21st century, the width and diversity of the fauna and flora are endangered in many regions of the planet. This is especially true for tropical ecosystems where more than seven million hectares of rain forest are lost each year due to deforestation. The disappearance of tropical forests is accompanied by large-scale extinction of the native species. Furthermore, many of these species are still unnamed and have not yet been scientifically characterised.

Insects make up the majority of the unknown species, whose number is estimated to be as many as five million. Their exact identification and description – biologists call this “taxonomic classification” – is both difficult and time-consuming. Identification and documentation of the huge number of tropical species is hampered by the limited availability of taxonomic reference materials, which are generally stored in science museums around the world where they are archived and managed by specialists. Owing to the fact only a few examples are collected each time of the rarer insect species, which make up the majority of the tropical collections, the small number of reference specimens has greatly limited the circle of experts.

Until recently, this also applied to tropical ants, which are found in all rain forest habitats. They perform key functions in the ever-changing tropical ecosystems, have been well-studied by taxonomists, are easy to collect and are relatively easy to classify down to the genus. This means that they are predestined for comparative studies on biodiversity.

Up to now, ant fauna was identified by sending the prepared insects to taxonomic specialists or by borrowing specimens from science museums as reference materials. Nowadays, an increasing number of insect researchers – or entomologists – are able to compare their ant specimens with high-quality images downloaded from the internet.

Taxonomic image databases, such as the DFG-sponsored portal www.antbase.net provide high-res-



Illustrations: Deufel (left), Mezger (right)



Mammoth undertaking: weaver ants building a nest held together with sticky threads of larval secretions. Fascinating diversity (bottom, from left to right): an as-yet unclassified *Myrmoteras* species, a hungry *Camponotus gigas* worker, the impressive head of *Myrmoteras bakeri* and a long-legged *Pheidole aglae*.

olution photographs of characteristic species. The pinned animals are shown in sharp, crystal-clear images with high magnification. These "automontage" photographs are calculated by a computer from up to 80 individual images and have an "infinite" depth of focus. All details of the object are in sharp focus and none of the contours are blurred. Such results have only been possible to date with an electron microscope after the objects have been subjected to an elaborate gold-coating process. With automontage photography, which uses optical microscopy, the pinned insects retain their original state and even the colours of the specimens remain authentic.

Technological advances in the digitisation of image data greatly facilitate taxonomic classification of the collected material," sums up Dirk Mezger, doctoral researcher at the Institute of Experimental Ecology at the University of Ulm. He is currently studying the food web on the floor of Malaysian rain forests and is comparing the ant fauna in the different types of forests in Borneo. Although the entomologist will still have to use taxonomic keys for time-consuming identification of specimens, he can avoid using reference specimens in most cases.

In addition to a stereomicroscope for identifying his specimens, he also works with photographs of ants on his computer screen. "Classifying insects with automontage images has major advantages over a direct comparison with reference objects," explains Dirk Mezger, "this avoids having to swap between specimens and refocusing the stereomicroscope on morphological details. Because I can see all the key features on the computer



Illustration: Pfeiffer

Illustrations (both): Katzmann

screen at the same time, I can simply compare the specimen and its identification characteristics."

This is particularly important for tropical insects, for which the number of unidentified species largely exceeds those already classified. Automontage photographs help to avoid incorrect classifications. In earlier times, only taxonomic specialists had direct access to reference materials so that they could carry out identification quickly and accurately. Nowadays, a much wider group of experts, including the doctoral researcher in Ulm, are able to classify many of the specimens with sufficient accuracy using the online images.

The internet database providing the photographs is also compiled by the institute in Ulm. Hans Peter Katzmann, the project manager of the portal, is responsible for the ant photographs and for compiling the web pages, which have been produced since 2003 at the University of Ulm by the group of Professor Elisabeth Kalko.

This project has been sponsored by the DFG since 2006. More than 500 ant species from 94 genera have already been digitalised, two-thirds of which were processed with the new technology.

The foundation of the picturebase is the zoological collection of the University of Würzburg, one of the largest ant collections in Europe. For more than 15 years, tropical ecologists working in the group of Professor K. Eduard Linsenmair have been carrying out intensive research on the diversity of tropical

organisms and have been searching for ants, particularly in the Bornean rain forests. This collection will now be continued and substantially expanded by the researchers in Ulm. The lively contacts and busy loan service between leading taxonomists all over the world means that the materials are continuously examined and classified. Newly classified species are often made available online within a short time. The resonance from the experts is huge: on a monthly average, more than 38,000 pages are viewed and about 1,800 MB data are downloaded.

However, the objective of the internet database goes even further. "Our scientific portal aims not only to provide reference materials, classification literature and identification keys for ants, but we are also working on a comprehensive network of myrmecologists (ant specialists) in Asia," emphasises Katzmann. He has recently added home pages of 30 scientists to the portal. "Particularly in Asia, many of the smaller institutes still do not have an English version of their website. These scientists can upload their data to our portal thus making it available to a wider audience. This also provides them with an opportunity to come into contact with other experts." The internet portal also provides a range of such services to support "ANeT", an international network for ant research in Asia. A

comprehensive research database is gradually being expanded to promote the exchange of information between scientists.

In addition to networking scientists and supporting their research, documentation of the diversity of tropical species is one of the core objectives of the internet portal. Interested non-specialists surfing through the picturebase will be fascinated by the morphological diversity of the presented genera and species. And many are surprised by the huge number of species that have evolved and which are now populating their screens at www.antbase.net: *Polyrhachis* ants, for example, that are equipped with huge barbs to protect them against birds, blind army ants of the genus *Aenictus*, long-legged

Anoplolepis gracilipes, wasp-like *Tetraponera*, densely haired *Meranoplus* species or *Myrmoteras* workers with enormous eyes and sabre-shaped mandibles.

"Most people know only a few kinds of ants and can't even begin to imagine the wide range of species in a rain forest," says Hans Peter Katzmann, "a visit to our virtual museum opens up a whole new world to them." The belief that humankind protects only what it knows is one of the many factors motivating the database specialists. As a consequence, this information platform also provides texts on ant ecology, a virtual exhibition of scientific posters as well as a collection of ant videos. And, to maximise the number of people getting to know about ants, the pages with the explanatory texts are available in three languages – English, German and Malaysian.

A large number of the species presented on the web originate

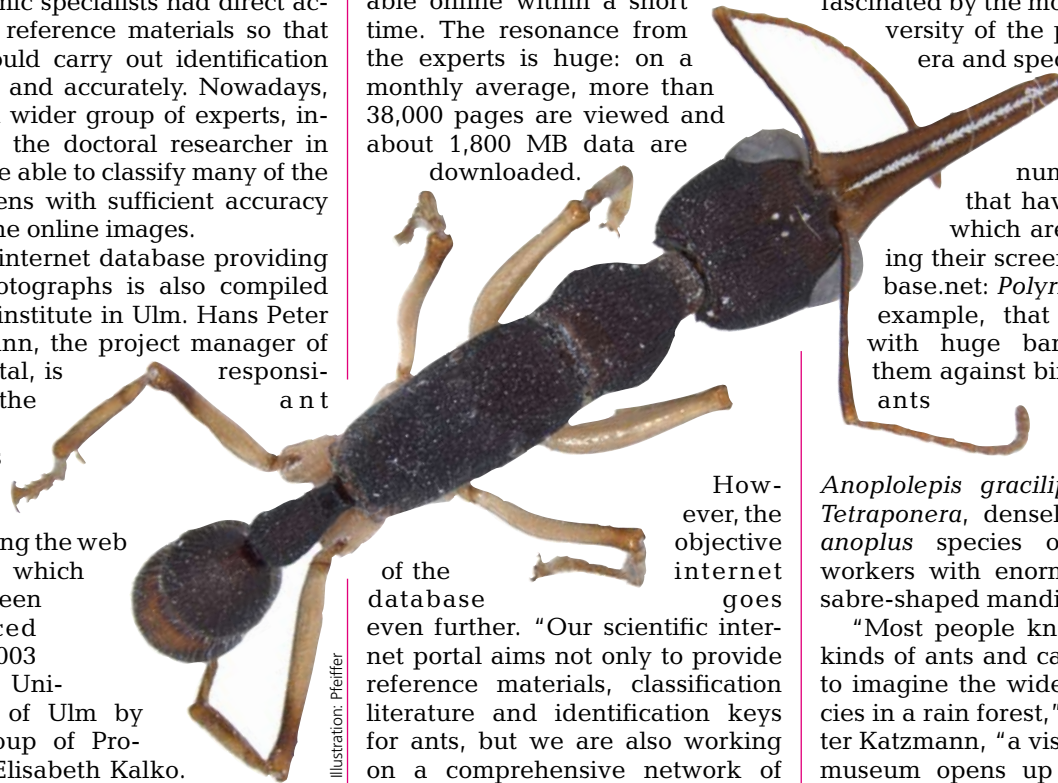


Illustration: Pfeiffer

Distinctive contours and pincer-like jaws: *Harpegnathos venator*. These ants are specialised hunters – their mandibles and large eyes enable them to hunt ground fauna.

The internet portal ANeT networks scientists and research and extensively documents the diversity of tropical species

Right: In the Malaysian rain forest – Dirk Mezger with locals who are helping to search for ants. Middle: Each ant has to be described down to the last detail. Bottom: The final result – the immense diversity of species documented at the portal.

from Malaysia, a tropical country with a particularly diverse fauna. An ant diversity hotspot was discovered in a small area at the foot of Mount Kinabalu, the highest mountain in Southeast Asia: 640 ant species were found within a few square kilometres, whereas only 114 species are found in the whole of Germany. Many of the species from this hotspot have already been documented in the internet database.

Because the creation of each automontage photograph is a lengthy process (more than three hours in some cases), it will still take some time until all the species found in the Kinabalu National Park have been photographed with the new technology. Unfortunately, the algorithm used by the program is still not working absolutely correctly so that the combined images have to be reworked in many places. The perfect final product requires a lot of experienced manual work and photographic skills. Nevertheless, the database team plans to show the majority of the more than 1000 ant species of Borneo by the end of the project.

Thanks to the cooperation between researchers from other Asian countries, species from Thailand, India, Iran and the Philippines will also be presented. Most of the ant fauna of Mongolia is already included in the database. Even "German ants" will be added to the database – in the interests of research and the documentation of the worldwide diversity of species.

PD Dr. Martin Pfeiffer researches and lectures at the University of Ulm and is the head of the www.antbase.net project.

Contact: Institut für Experimentelle Ökologie, Universität Ulm, Albert-Einstein-Allee 11, 89069 Ulm, Germany.

► www.antbase.net



Illustration: Pfeiffer

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Screenshot: antbase.net