
MorphBank: image databasing for biologists

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MorphBank is an open web repository for images documenting comparative anatomy, morphological phylogenetics and biodiversity research. The current version of the system, which has been accessible on the web since 2002, offers web uploading of images and simple searching of the text information associated with each image. Version 2 of the MorphBank system, which will first be released in March of 2006, will have dramatically enhanced functionality, including more advanced search options, taxonomic browsing of images, image annotation tools, correction of previous species determinations, linking of specimens to genetic data, and protected access to prepublication images. I will demonstrate some of these functions and discuss future plans for the development of the MorphBank system, focusing in particular on how it can be useful for hymenopterists.

The Swedish Taxonomy Initiative: an update

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The Swedish Taxonomy Initiative will completely inventory all multi-cellular species occurring in the country within a 20-year period. All species will be documented in the scientific literature and presented in a popular National Biodiversity Encyclopedia in Swedish. The richly illustrated Encyclopedia will contain identification keys and descriptions including data on the distribution, biology, and conservation status of each species. The project received start-up funds 2002-2004 and is now fully funded. About 130 Encyclopedia volumes will be produced, two of which appeared in 2005 (butterflies and millipedes). A number of taxonomic research projects on poorly known groups of organisms has been funded in addition to large-scale inventory efforts. Of particular interest to hymenopterists is the Swedish Malaise Trap project, which has assembled three years' worth of Malaise trap catches from about 60 sites covering a range of interesting habitats throughout the country. There is also an effort to educate a new generation of taxonomic experts on poorly known organism groups, such as the parasitic Hymenoptera. We discuss various ways in which the international community of hymenopterists can benefit from and contribute to the Swedish Taxonomy Initiative and similar projects that we expect will be launched in the near future in neighboring countries.

Dating the early radiation of the Hymenoptera

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The fossil record can be used to date the early radiation of extant hymenopterans but the information is difficult to evaluate because of uncertainty in the phylogenetic position of each fossil specimen. Here, we develop a total-evidence Bayesian approach to fossil dating, in which we combine morphological and molecular evidence from extant and fossil taxa. This allows us to integrate over the uncertainty in fossil





placements, using morphological data scored for extinct and extant taxa, while using molecular data from extant taxa to calibrate a molecular clock. In the Hymenoptera, we find that the phylogenetic placement of many old fossils is uncertain and that it is essential to accommodate this uncertainty when dating the radiation of extant lineages.

Do hymenopterous venom components act independently, additively, or synergistically?

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Animal venoms contain a dazzling variety of enzymes, peptides, and biologically active constituents. Some of these are exceedingly specific in their activity; others are considered general in activity and affect many different cellular systems. Most toxinologists support the concept that the compositions of venoms are so complex because many components are necessary for proper venom function; that is, the various components play synergistic roles. I asked the question: do hymenopterous venoms used primarily for defense against vertebrates act in similar manners across taxa, or is each venom uniquely evolved with its own set of different toxic activities? If each venom acts independently from those of unrelated species, then mixing venoms together should reduce the toxicity of the mixture relative to the individual venoms. If the venoms affect the same targets within predators, then mixing venoms should yield an additive effect. If venom components act synergistically within each species, but not between species, the results would be the same as for independent activities. I investigated this question by mixing equal lethality ratios of the venoms of *Pogonomyrmex maricopa*, *Apis mellifera*, *Synoecca septentrionalis*, and *Myrmecia gulosa* and determining the lethality of the venom mixture versus the individual venoms to mice. A second set of venoms from *Xylocopa californica*, *Pachycondyla (Paltothyreus) tarsatus*, *Bombus impatiens*, and *Dinoponera gigantea* were likewise tested. The results indicated that the activities of different venoms are additive, and not independent or synergistic, a finding not entirely expected based on phylogenetic considerations of the venomous species and prevailing toxinological wisdom.

Phylogenetic implications of male genitalia anatomy in Hymenoptera

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The morphology, functional morphology, and terminology of the male reproductive organs of Hymenoptera is presented. Their utility for phylogenetic inference is discussed.

Phylogeny of basal Hymenoptera, emphasizing new results on Tenthredinoidea phylogeny

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Over the last ten years, Vilhelmsen and Schulmeister assembled a large dataset for basal Hymenopteran lineages, comprising morphological characters as well as DNA sequences from several ribosomal genes and Cytochrome Oxidase 1. The phylogenetic relationships among the symphytan superfamilies in the resulting



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