NATURAL HISTORY MUSEUM
LOS ANGELES COUNTY

NEWS

MEDIA CONTACTS: Kristin Friedrich (213) 763-3532 kfriedri@nhm.org

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WHERE DID INSECTS COME FROM?
NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY SCIENTISTS ARE MAJOR CONTRIBUTORS TO A NEW STUDY ESTABLISHING RELATIONSHIPS AMONG ALL ARTHROPODS

Study Supports Hypothesis That Insects Evolved From Crustacean Ancestors; Finds That Spiders Are More Distantly Related To Insects Than Previously Thought

LOS ANGELES - Since the dawn of the biological sciences, mankind has struggled to comprehend the relationships among the major groups of "jointed-legged" animals — the arthropods. Now, a team of researchers, including Dr. Joel Martin and Dr. Regina Wetzer from the Natural History Museum of Los Angeles County (NHM), has finished a completely new analysis of the evolutionary relationships among the arthropods, answering many questions that defied previous attempts to unravel how these creatures were connected. Their study is scheduled for online publication in the journal *Nature* on Feb. 10.

Now, for the first time, science has a solid grasp of what those relationships are, and a framework upon which to build. The new study makes a major contribution to our understanding of the nature and origins of the planet's biodiversity. The paper's other researchers are Jerome C. Regier, Andreas Zwick and April Hussey from the University of Maryland Biotechnology Institute; Jeffrey W. Shultz of the University of Maryland's Department of Entomology; and Bernard Ball and Clifford W. Cunningham from Duke University's Department of Biology.

This animal, *Speleonectes tulumensis*, is from a group of rare, blind, cave-dwelling crustaceans called "remipedes." The new analysis in *Nature* shows that the remipedes are the crustaceans most closely related to the insects. Remipedes and insects together are now shown to be a sister group to all the other crustacea including the crabs, shrimps, and lobsters. Photo credit: Simon Richards

There are millions of distinct species of arthropods, including all the insects, crustaceans, millipedes, centipedes, spiders, and a host of other animals, all united by having a hard external shell and jointed legs. They are by far the most numerous, and most diverse, of all creatures on Earth — in terms of the sheer number of species, no other group comes close. They make up perhaps 1.6 million of the estimated 1.8 to 1.9 million described species, dominating the planet in number, biomass, and diversity.

The economic aspects of arthropods are also overwhelming. From seafood industries worth billions of dollars annually to the world's economy, to the importance of insects as pollinators of ornamental and agriculturally important crops, to the medical role played by arthropods (e.g. as disease vectors and parasites), to biological control of introduced species, to their role in every known food web, to toxicology and biopharmaceuticals, arthropods are by far the planet's most important group of animals.

"We've never really known how arthropods, the most successful animals on Earth, evolved into the diversity we see today," said research scientist and co-author Dr. Regina Wetzer. "For me, what makes this study really exciting is getting such a solid understanding of how these animals are related, so that now we can better

understand how they evolved."

Because of their amazing diversity, deciphering the evolutionary history and relationships among the major subgroups of arthropods has proven difficult. Scientists have tried using various combinations of features, in recent years including DNA sequences, to try to understand which groups are related through common ancestors. To date, those attempts have been stymied by the sheer number of species and wild shape variations between the various groups.

One of the most important results of this new study is support for the hypothesis that the insects evolved from a group of crustaceans. So flies, honeybees, ants, and crickets all branched off the arthropod family tree from within the lineage that gave rise to today's crabs, shrimp, and lobsters. Another important finding is that the "Chelicerata" (a group that includes the spiders, scorpions, ticks, and mites) branched off very early, earlier than the millipedes, centipedes, crustaceans, and insects. That means that the spiders, for example, are more distantly related to the insects than many researchers previously thought.

This team approached the problem of illuminating the arthropod family tree by using genetic data (DNA sequences) obtained from 75 species carefully selected to sample the range of arthropod diversity. Many previous analyses were based on the sequences of a handful of genes. The researchers in this study, knowing the daunting diversity they faced, used DNA sequence information from as many genes as they could. In the end, they were able to apply data from 62 protein-coding genes to the problem, leading to an extremely well-supported analysis.

"The Museum's collection of arthropods, and in particular its collection of crustaceans, are what made a study like this possible in the first place," says Dr. Joel W. Martin, NHM Curator of Crustacea and one of the authors who designed the study nearly eight years ago. "The wealth of stored biodiversity information contained in it, both in terms of specimens and in terms of the data, theories, and research related to those specimens, are why natural history museums exist, and why they play such a critical role in explaining the world's diversity. Studies like this confirm the incredible value, not only of existing natural history museum collections, but of continuing to add to these collections every year."

A key problem that the research team had to solve was obtaining specimens of some of rare and obscure organisms whose DNA was needed for the analysis. Because of their extensive experience in field biology, this was a major contribution to the project from NHM scientists. Dr. Wetzer recalls lying on the beach with a microscope at Woods Hole, Massachusetts. She was hunting for specimens of a tiny, little-known crustacean that lives between grains of sand. "I got the mystacocarids we needed, but I think I also provided pretty good entertainment to the families at the beach that day," Dr. Wetzer said.

About the Natural History Museum

The Natural History Museum of Los Angeles County is located at 900 Exposition Blvd., Los Angeles. It is open weekdays, 9:30 am to 5 pm; and weekends and holidays from 10 am to 5 pm. The Museum was the first dedicated museum building in Los Angeles, opening its doors in 1913. It has amassed one of the world's most extensive and valuable collections of natural and cultural history — with more than 35 million objects, some as old as 4.5 billion years. The Natural History Family of Museums includes the NHM, the Page Museum at the La Brea Tar Pits (Hancock Park/Mid-Wilshire), and the William S. Hart Park and Museum (Newhall, California). The Family of Museums serves more than one million families and visitors annually, and is a national leader in research, exhibitions and education.

NHM Next

Last year's completed renovation of the Beaux-Arts 1913 Building, the original component of the NHM, has set the stage for the rollout of a series of new exhibits leading up to the Museum's centennial in 2013: *Age of Mammals* and the Haaga Family Rotunda galleries open in Summer 2010; *Dinosaur Mysteries*, and teaching and learning gardens in Summer 2011, and *Under the Sun*, an exhibition focusing on the Southern California environmental history, in Spring 2012.