FAST MOVING FRONTS - 2010

February 2010

PDF

Corrie S. Moreau talks with *ScienceWatch.com* and answers a few questions about this month's Emerging Research Fronts paper in the field of Social Sciences, general. The author has also sent along images of her work.

[+]enlarge

Article: Phylogeny of the ants: Diversification in the age of angiosperms
Author: **Moreau, CS**;Bell, CD;Vila, R;Archibald, SB;Pierce, NE
Journal: SCIENCE, 312 (5770): 101-104 APR 7 2006
Addresses: Harvard Univ, Museum Comparat Zool, 26 Oxford St, Cambridge, MA 02138 USA.
Harvard Univ, Museum Comparat Zool, Cambridge, MA 02138 USA.
Florida State Univ, Sch Computat Sci, Dirac Sci Lib 150R, Tallahassee, FL 32306 USA.

Dr. Corrie Moreau on Magnetic Island, Queensland, Australia. Photo by J. Moreau

---

SW: Why do you think your paper is highly cited?

Ants occupy almost every terrestrial niche on the planet, so understanding how they came to this ecological dominance and the time frames involved is an intriguing question. The results of our 2006 research published in the journal "*Science*" suggest that ants are considerably older than had been appreciated based on the fossil record alone, having originated 140-168 million years ago, but also that the rise of the angiosperms or flowering plants likely had a marked effect on the diversification of the ants.

I believe our paper is highly cited due in part to our finding of a correlation of the diversification of the ants and rise of the flowering plants and the large amount of DNA data and molecular clock techniques we utilized in our research.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

My colleagues and I produced the first large-scale molecular phylogeny of the ants based on DNA from 6 genes for each of 139 of the 288 described genera. This well-resolved phylogeny reinforced some previous hypotheses about the morphological evolution of the ants, but we also were able to demonstrate that the modification or reduction of the stinger happened twice independently within the ants.

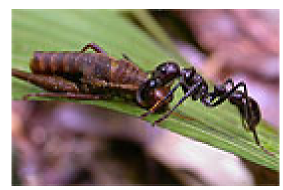
In addition, we used a "molecular clock," calibrated with 43 fossils distributed throughout the ant family tree, to date key events in the evolution of ants, providing a well-supported estimate for the age of modern lineages. Although ants are older than hypothesized, their diversification appears to closely track the rise of the angiosperms. Our data suggest that these insects, now dominant in terrestrial ecosystems worldwide, flourished with the rise of flowering plants.

SW: Would you summarize the significance of your paper in layman's terms?

Our research sheds light on three main points in the evolution of the ants: 1) We reconstructed the first large-scale phylogeny or family tree for ants based on DNA; 2) Using the extensive ant fossil record, which goes back 100–125 million years, we were able to provide an age of 140–168 million years ago for the modern ants and a timeline for their evolution; and 3) Using the resulting family tree and timeline for ant evolution, we were able to explain patterns of their diversification and suggest that ants were able to capitalize on the ecological opportunities provided by flowering plants and the herbivorous insects that co-evolved with them.

These plants provided ants with new habitats, both in the forest canopy and in the more complex leaf litter on the forest floor, and the herbivorous insects that evolved alongside flowering plants provided food for ants, allowing them to diversify into the over 14,000 species known today.

Figure 1 [+] details

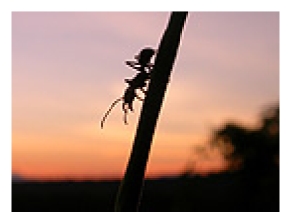


The bullet ant...

SW: How did you become involved in this research and were any particular problems encountered along the way?

My Ph.D. thesis was on the evolution of the ants and the natural progression for my interests was to take on this large project to really delve into this topic. By coupling my passion for ant biology, molecular phylogenetics, and evolutionary biology, I was able to address these questions in a significantly more rigorous way than I would have been able to using a single tool alone.

Figure 2 [+] details



An ant of the genus Ectatomma...

SW: Where do you see your research leading in the future?

Although I have many interests in evolutionary biology, several projects I have been involved with recently have me really excited.

First, we are just beginning to understand the wealth of bacteria associated with ants and how these mutualisms may have helped ants diversify and take advantage of novel food resources and ecological niches.

Figure 3 [+] details

Green tree ants...

Some recently published research by my colleagues and I (*PNAS* 106: 21236-41) suggest that multiple independent associations between *Rhizobiales* bacteria and herbivorous ants provide strong evidence that symbiotic bacteria have facilitated the evolution of nectar and exudate-feeding life histories in ants and their radiation into otherwise inhospitable rainforest canopy habitats, providing a novel instance of innovation through symbiosis.

Second, I have been conducting research on ants in the lowland rainforests of Queensland, Australia to determine how past (and potentially future) climate changes have affected the ants and other organisms. My preliminary findings suggest that past drying events did indeed significantly impact the lower elevation species and that some of the known genetic barriers to populations of vertebrates appear to be even older than previously thought and that these barriers have affected invertebrate species, including ants.

In addition, some ant species were more impacted than others, due to their ability to climatically buffer during these fluctuations. It appears that species that live in the soil and rotten logs may have been able to buffer themselves from the long period of drying events by digging further into the soil where moisture likely remained higher.

Species that are always associated with the leaves of the plants in the rainforest (such as those species that build their nests between leaves and live in the canopy) were very hard hit and likely suffered severe extinction events. This has implications not only for understanding the past history of these species, but also how they will likely respond to future changes in their ecosystems due to habitat destruction and global climate change.

Lastly, the wave of genomic tools that are becoming available, even for non-model organisms, makes this an exciting time to be involved in evolutionary biology. Genomics provides us with the power to unlock many interesting mysteries in biology and I am personally looking forward to seeing what we learn.

SW: Do you foresee any social or political implications for your research?

Although all research in biodiversity, ecology, and evolution furthers our understanding of the natural world, it is really the potential for direct conservation implications that makes much of our research likely to have social or political implications.

Through understanding the factors that affect the distributions, densities, or genetic diversity of species and how they change through time, we can study how past, current, and potentially future events impact species.

In my own research in Australia's rainforests, it appears that past climatic drying events had profound impacts on ant species diversity, which has implications for current and future deforestation and climate change worldwide.

Through careful scientific investigation and advocacy for governmental policy, we can potentially help protect the planet's biodiversity by identifying factors that may lead to the loss of biological and genetic diversity, which could eventually lead to species extinction.

Corrie S. Moreau, Ph.D.

Assistant Curator

Field Museum of Natural History

Department of Zoology

Chicago, IL, USA

Web | Web

KEYWORDS: RDNA SEQUENCES; FORMICIDAE; HYMENOPTERA; ORIGIN; BEETLES.

FAST MOVING FRONTS - 2010

February 2010

PDF

Corrie S. Moreau talks with *ScienceWatch.com* and answers a few questions about this month's Emerging Research Fronts paper in the field of Social Sciences, general. The author has also sent along images of her work.

Article: Phylogeny of the ants: Diversification in the age of angiosperms
Author: **Moreau, CS**;Bell, CD;Vila, R;Archibald, SB;Pierce, NE

Return to interview.

Figures and Descriptions

FIGURE 1:

FIGURE 1 DESCRIPTION:

The bullet ant, Paraponera clavata, drags her prey item back to the nest in Ecuador. Photo by C.S. Moreau.

View larger image (close new browser window to return to this page).

FIGURE 2:

FIGURE 2 DESCRIPTION:

An ant of the genus Ectatomma foraging at sunset in the Peruvian rainforest. Photo by C.S. Moreau.

View larger image (close new browser window to return to this page).

FIGURE 3:

FIGURE 3 DESCRIPTION:

Green tree ants, Oecophylla smaragdina, defending their nest in Cape Tribulation, Australia. These ants use their larvae to sew together leaves to construct their nest enclosures. Photo by C.S. Moreau.

View larger image (close new browser window to return to this page).

FIGURE 4:

FIGURE 4 DESCRIPTION:

Dr. Corrie Moreau on Magnetic Island, Queensland, Australia. Photo by J. Moreau.

View larger image (close new browser window to return to this page).

Return to interview.

PDF

back to top