AMERICAN MUSEUM ŏ NATURAL HISTORY

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SCORPIONS HAVE SIMILAR TASTES IN BURROW ARCHITECTURE

NEW RESEARCH USES METAL CASTING AND 3D SCANNING TO UNVEIL COMMON SCORPION BURROW STRUCTURE, IMPLYING EVOLUTIONARY IMPORTANCE

New research on the burrows of scorpions in diverse environments finds that these predatory arachnids build strikingly similar architectural features in their homes. The study, published recently in the journal *The Science of Nature*, was conducted using molten aluminum casts and 3D scanning, and suggests that common features of scorpion burrows are part of their "extended physiology" and are vital to the arachnids' survival in some of the world's most inhospitable places.

"This work is about how burrow architecture can extend an animal's physiology by performing functions its body would otherwise have to do on its own, like maintaining a comfortable temperature or improving ventilation," said Berry Pinshow of the Jacob Blaustein Institutes for Desert Research at Israel's Ben-Gurion University of the Negev, who led the new study.

Many animals, ranging in size from ants to aardvarks, inhabit burrows, including hundreds of scorpion species of at least 10 different families.

"It's amazing how ubiquitous scorpion burrows are in some parts of the world, yet very little has been done to study them until now," said Lorenzo Prendini, a curator in the American Museum of Natural History's Division of Invertebrate Zoology and co-author of the new study.

Scorpion burrows can differ drastically, running the gamut in size and design from short runs to complex spiral tunnels up to 9 feet long to multi-entrance communal structures. Some burrows are used for less than 24 hours while others serve as a semi-permanent home in which a scorpion can spend most of its life and more than 90 percent of

its time.

"As ectothermic, or so-called 'cold-blooded,' animals, scorpions rely on energy from the environment to regulate their internal temperature," said Amanda Adams, lead author of the publication in *The Science of Nature* and a former postdoctoral researcher at the Jacob Blaustein Institutes for Desert Research who is currently at Texas A&M University. "Various features of the burrow assist the scorpion in meeting the biological challenges of its environment."

To explore how scorpions use their burrows to their advantage, the researchers examined the burrow architecture of three scorpion species from the same family, Scorpionidae: *Scorpio palmatus*, found in the Negev desert in Israel; *Opistophthalmus setifrons*, from the central highlands of Namibia; and *Opistophthalmus wahlbergii*, from the Kalahari desert in Namibia.

After removing the scorpions from their burrows and taking temperature and humidity measurements at various points along each burrow, the researchers poured molten aluminum—heated in the field with a gas-powered kiln to more than 660 degrees Celsius (1,220 degrees Fahrenheit)—down each burrow to create a cast of its intricate structure. Once exhumed, the casts were scanned to create 3D digital models of the burrow that were analyzed with a computer program.

The scientists found three common burrow features: A horizontal platform near the ground surface that might provide a safe place for the scorpion to "doorkeep"—monitor the presence of potential prey, predators, and mates—and warm up before foraging; at least two spiral or switch-back bends that might deter predators from digging them up, or prevent air flow from the surface, thereby maintaining relatively high humidity and low temperature; and an enlarged terminal chamber at a depth at which temperatures are almost constant, providing a refuge during the heat of the day as well as a place to feed, mate, molt, and give birth.

The research team also found that burrow architecture may change in response to soil composition, hardness, and moisture. For example, the burrows the scientists examined from sandy soil were deeper than those from hard soil.

The researchers point out that although many questions remain unanswered concerning the burrow environment and natural history of burrowing scorpions in general,

the shared features of these three species have been shaped through natural selection for millions of years and may be equally important to other burrowing scorpion species around the world.

Other authors on this paper include Eugene Marais from the National Museum of Namibia and J. Scott Turner from the State University of New York.

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The Science of Nature **paper**: http://link.springer.com/article/10.1007/s00114-016-1374-z

AMERICAN MUSEUM OF NATURAL HISTORY (AMNH.ORG)

The American Museum of Natural History, founded in 1869, is one of the world's preeminent scientific, educational, and cultural institutions. The Museum encompasses 45 permanent exhibition halls, including the Rose Center for Earth and Space and the Hayden Planetarium, as well as galleries for temporary exhibitions. It is home to the Theodore Roosevelt Memorial, New York State's official memorial to its 33rd governor and the nation's 26th president, and a tribute to Roosevelt's enduring legacy of conservation. The Museum's five active research divisions and three cross-disciplinary centers support approximately 200 scientists, whose work draws on a world-class permanent collection of more than 33 million specimens and artifacts, as well as specialized collections for frozen tissue and genomic and astrophysical data, and one of the largest natural history libraries in the world. Through its Richard Gilder Graduate School, it is the only American museum authorized to grant the Ph.D. degree and the Master of Arts in Teaching degree. Annual attendance has grown to approximately 5 million, and the Museum's exhibitions and Space Shows can be seen in venues on five continents. The Museum's website and collection of apps for mobile devices extend its collections, exhibitions, and educational programs to millions more beyond its walls. Visit amnh.org for more information.

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