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Scorpions Thrive Where Least Expected

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Scorpions are known as desert-dwellers with a venomous sting, but non- desert species may outnumber their relatives, and few species are actually dangerous.

The real animals are far more complex than the caricature. These fascinating creatures are found from the deserts of the American Southwest to the trees of Brazilian forests, as well as in British Columbia, North Carolina, and even the Himalayas—and they've been around for hundreds of millions of years.

What makes them tick is an adaptable lifestyle, a hardy metabolism, and of course their venom—which is more complex than might meet the eye.

Scorpion populations spread slowly, but they can start a colony from a single pregnant female. That ability has allowed them to relocate to some surprising places.

"We have species of scorpions, introduced by humans, living in strange environments," said Victor Fet, a professor of biological sciences at Marshall University. He has observed a southern European species (found naturally in Italy, Greece, and Turkey) that has colonized two desert oases in Yemen and Iraq—apparently by tagging along with ancient travelers.

"It has nothing to do with the desert," said Fet, "it lives in these areas, which were perhaps oases on ancient caravan routes. They are a long way away [from their range], across desert that the scorpions could not cross on their own. They were definitely delivered there by humans, so this is a kind of extreme example that shows how they can survive."

It's far from the only example. In the border area of Uzbekistan and Afghanistan, Fet encountered what he believes could be the most ancient of surviving scorpion family lines. In the high, desert-like mountains of the region, the animals appear only briefly in the spring of each year when they cling to the wet mud of temporary waterways. The rest of the year they retreat to cracks in the rock for hibernation.

"I think this creature is a remnant of times before deserts," Fet said. "Perhaps it was caught in the uplifting mountains which were once on the shores of the ancient sea. I think of this unique creature trapped in time and space, which still survives on an ancient ability to live and reproduce in an extremely narrow habitat, literally narrow, in a mountain canyon. Between the dry walls, on the mud under your feet, this relic species is sitting there."

Insect Eaters

How do scorpions thrive in such diverse places? Adaptability is the key, and it starts with food. Their diet, consisting largely of insects, is so diverse that they are seldom at a loss for something to eat. Scorpions are quite amenable to living in human habitats, like homes, where insects are plentiful.

In the desert, they employ exquisitely sensitive detectors to pick up vibration waves in the sand. These clues determine the direction and distance of prey—even when it's below the surface

Scorpions will eat lots of things, but they really don't need to eat much of anything. Their amazing ability to slow their metabolism to a third of the rate of another typical arthropod, like an insect, means they can get by eating as little as one insect a year. That in turn means they can survive in some of nature's harshest environments.

Philip Brownell, a professor of zoology at Oregon State University, has studied the metabolism adaptations that make scorpions stand out in the animal kingdom. "John Lighton [of the University of Nevada, Las Vegas] and I measured their basic metabolic rate," he said, "and found it's right down there with ticks, which hang on branches for a year and don't see food. Scorpions have the same rate per body mass."

Scorpions are members of the class Arachnida that includes spiders, mites, and ticks.

Their metabolic ability allows them, in extreme conditions, to "hunker down" in burrows using little oxygen and requiring few food resources. The animals can quickly switch from this mode to one of active hunting when conditions become more favorable.

"It's a bunker-mentality approach to living, pushed apparently to the extreme," Brownell said. "They can't compete on the surface so they hang out in areas where the conditions are extreme and come up at night when other predators have gone."

These metabolic abilities have led to interesting times in the lab. "We've had the experience of losing one in the lab, or forgetting one in a jar, and finding it six months later perfectly alive," Brownell recalled. "How do they do it? Ticks let themselves degenerate, atrophy; scorpions don't do that. They can immediately become predators. They have the ability to shut it on and off; that's the key."

Scorpions hibernate in times of extreme cold, which allows Asian species to live as far north as nearly 50 degrees latitude. "That's under snow a good four months a year," said Fet. "There's no way they are active there in cold weather, but they hibernate, and do this even in Asian deserts where it becomes very cold."

Brownell has frozen scorpions in his research, only to place them in the sun the next day and watch them thaw out and walk away.

The animals' northern boundaries are defined not by cold, but by substrate. When the soil surface is an area where they cannot burrow, such as frozen ground or even prairie grass, it becomes uninhabitable.

Specialized Venoms

Of the nearly 2,000 scorpion species, only perhaps 30 or 40 are toxic enough to kill a human. All species do have the poisonous gland on the end of their tail, for stinging prey, but not all use it in the same way. The reason could be an example of evolution at work.

"They really haven't changed much since they came out of the ocean hundreds of millions of years ago," Brownell said. "It may be that a new species evolves when they develop a new venom that's particularly good at killing a prey, or providing a nasty defense for anything that might try to eat it."

One clue to such evolution is the presence of mammal-specific venoms, perhaps a result of the rise of mammals with which many scorpions shared burrows. "From the scorpion viewpoint, mammals are yesterday's upstarts," said Fet. "I think that highly potent, mammal-specific venoms appeared when there was a high selective pressure for killing mammals—because most rodents can eat them."

Researchers speculate that ongoing evolution may mean that some species are in the process of losing venom that they rarely use. "If we look carefully, we do have some scorpions which are probably essentially in the process of losing venom," said Fet.

To determine which ones, look for the claw-like pincers. As a rule of thumb, scorpions with huge pincers are not toxic; those with small pincers are. Those with large pincers use them to catch and crush prey, and many have tails that are so small that stinging is difficult. "These species rarely sting," Fet said. "Why should they? They live in burrows where predators can't reach them and their pincers are large and strong enough to smash prey. They could eventually lose the whole tail and venom apparatus."

Other species, which use the venom as a defense, retain potent stinging power and are responsible for human deaths each year. Still, the risks are small, and the animal deserves respect for more than its venom.

"This animal is so scary to people," Brownell said. "But if they can get beyond that sting it's just an incredible machine for doing what it does."
