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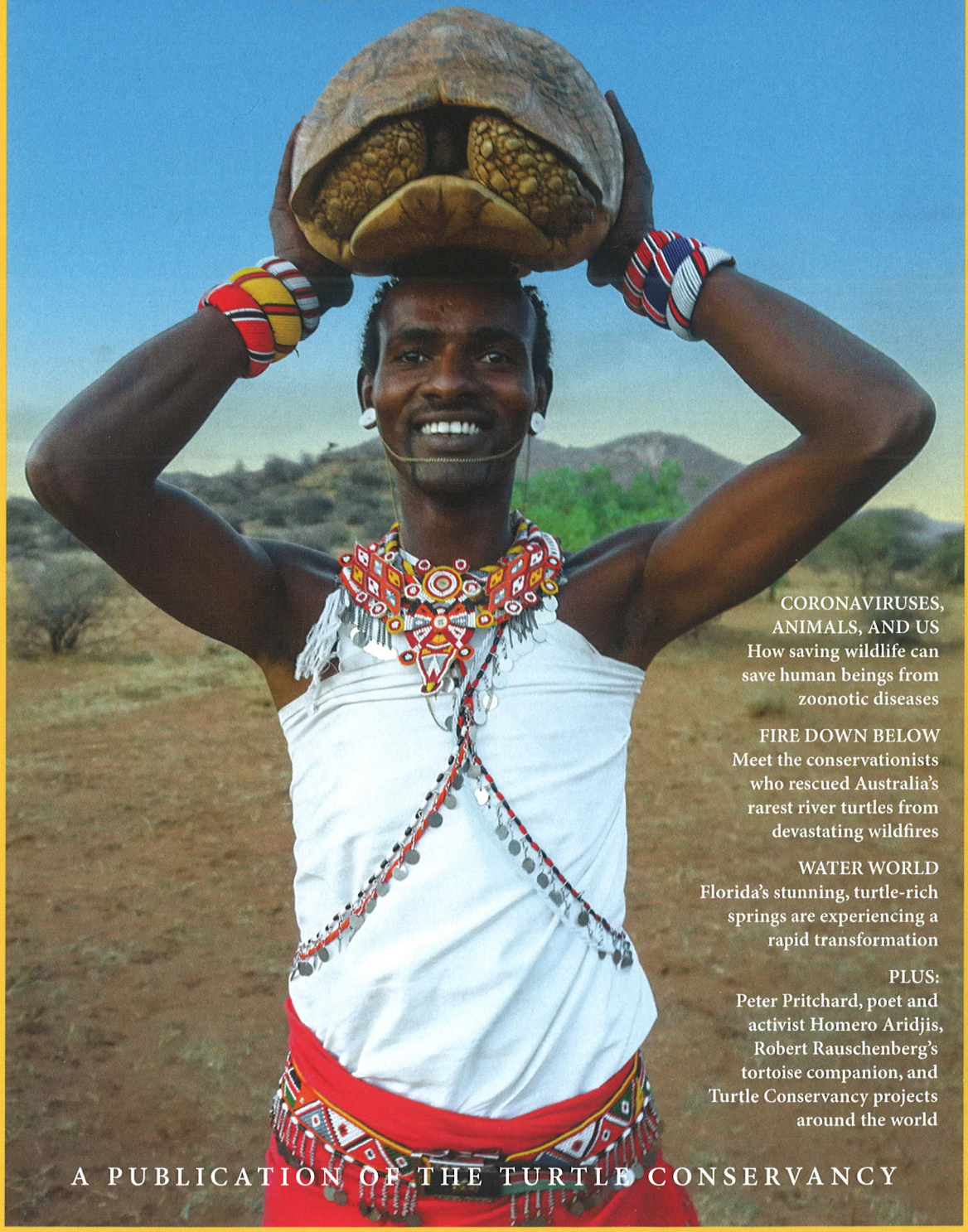

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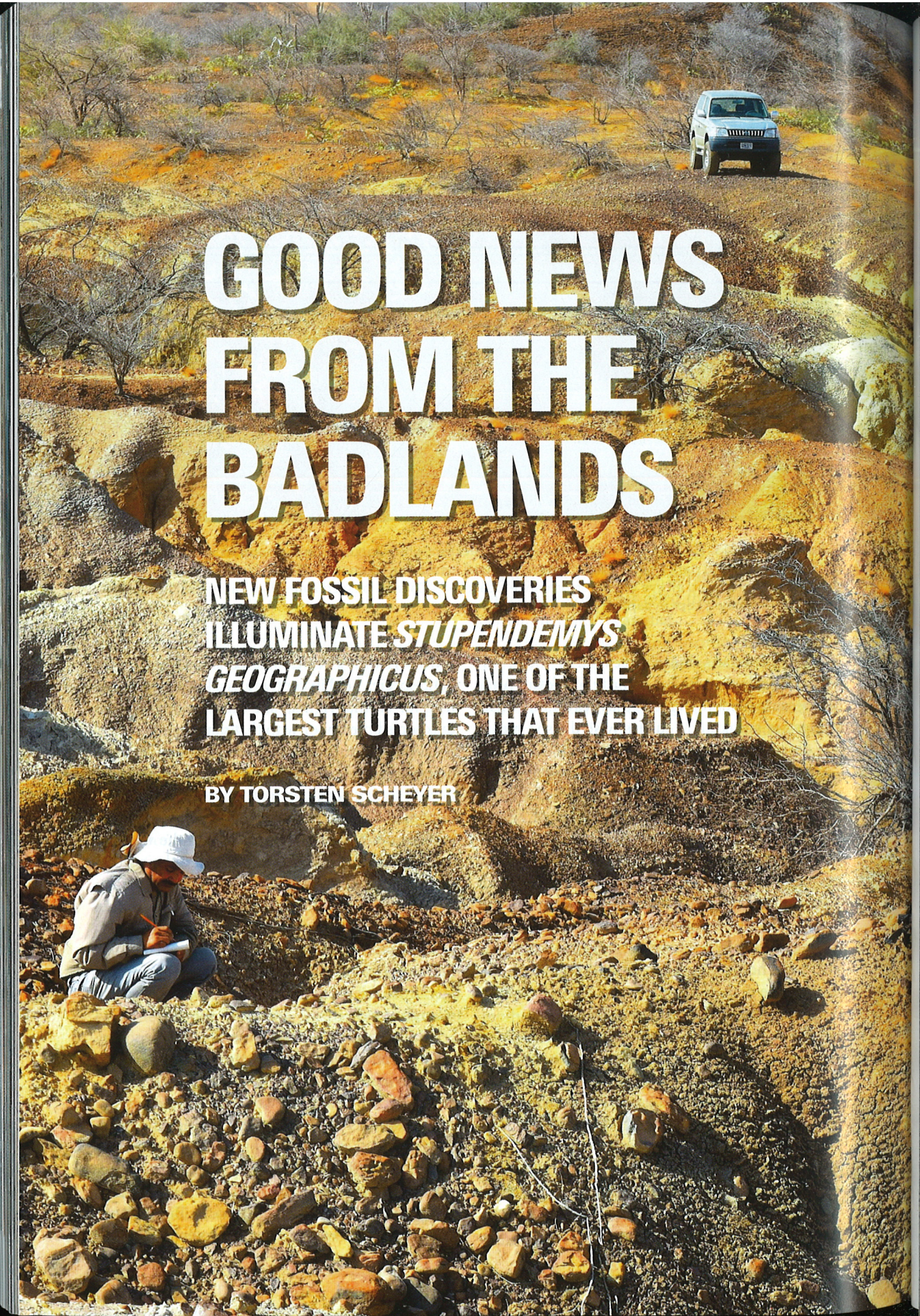


GOOD NEWS FROM THE BADLANDS

NEW FOSSIL DISCOVERIES ILLUMINATE *STUPENDEMYS GEOGRAPHICUS*, ONE OF THE LARGEST TURTLES THAT EVER LIVED

BY TORSTEN SCHEYER

Trekking through the dry, sparsely vegetated Urumaco badlands of northern Venezuela, it is difficult to believe that, millions of years ago, the region was a lushly forested system of lakes, rivers, and swamps. It was a land of giants, home to enormous ground sloths, glyptodonts (animals closely related to modern armadillos), colossal catfish, and bus-sized caimans more than 30 feet long.

But when I traveled there with a team of fellow paleontologists in 2015, we were not looking for the fossil remains of those animals. We were searching for one very special, poorly understood species of prehistoric turtle: *Stupendemys geographicus*.

Stupendemys was one of the largest turtles to have ever lived, measuring 13 feet long and weighing about 1.25 tons, and it swam the rivers of the northern Neotropics 12 to 5 million years ago, during a period known as the middle to late Miocene. This winter, we had the rare pleasure of announcing our discoveries from that field season—several outstanding new *Stupendemys* specimens that shed light on the appearance and behavior of this sedan-sized reptile.

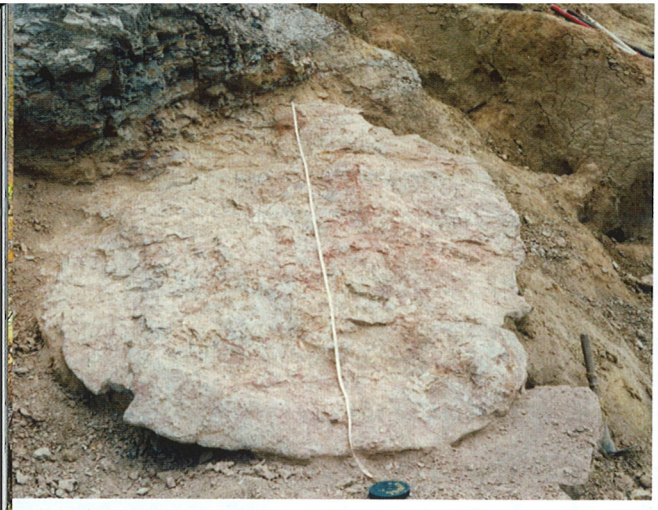
Now you might be wondering why you're reading about fossilized turtles in a magazine that is primarily concerned with their living relatives. How could extinct animals that vanished millions of years ago help us understand living creatures? In fact, fossils often deepen our knowledge of the (often precarious) situations turtles now face. By studying evolutionary patterns and processes in the distant geological past, paleontologists like myself learn about the distribution patterns of modern animals and plants—their relationships to one another, and how ecological and physiological requirements have changed over long periods of time.

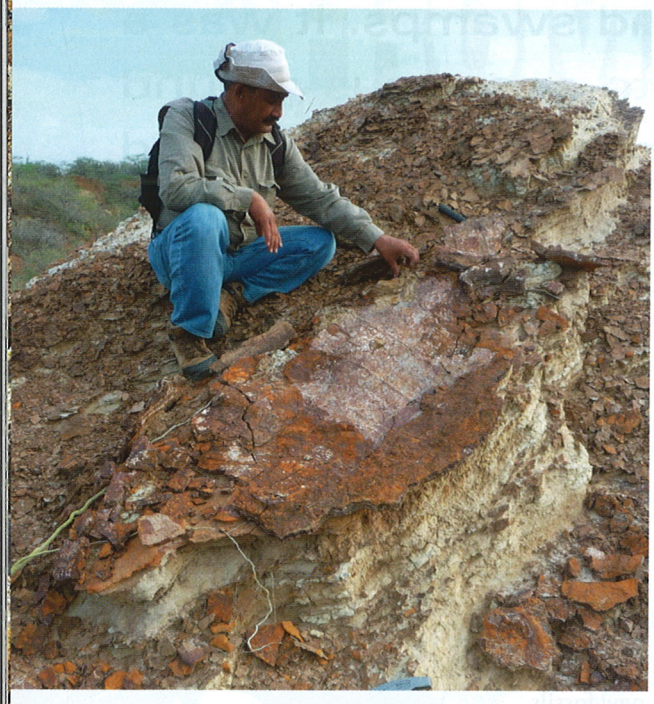
Our team consisted of my colleague at the University of Zurich, Marcelo Sánchez; Rodolfo Sánchez and Jorge Carrillo-Briceño from Venezuela; and Edwin Cadena from Colombia. Together, we traveled to cities, small towns, and the wilderness of Venezuela to study previously collected *Stupendemys* material and to look for new fossils.

Our first stop was Caracas—not the safest of places, as part of the team found out the hard way when they were held at gunpoint in the hotel lobby one morning—to study the partially preserved shell of the holotype specimen, which is stored in the collections of the Museo de Ciencias Naturales. From there, our team traveled onward to the much more agreeable port city of Santa Ana de Coro, the capital of Falcón State and the oldest colonial town in the country. There, we studied a giant *Stupendemys* shell (nearly 10 by 6.5 feet) for the first time since its recovery from the field in 1994 at the Centro de Investigaciones Antropológicas, Arqueológicas y Paleontológicas (CIAAP), which is located in a beautiful manor in the old quarter of the town. We marveled at the shell's colossal dimensions and, naturally, all posed for photos with it (for scale, of course).

TORSTEN SCHEYER

The badlands of northern Venezuela are rich in fossils from the middle to late Miocene, when giant turtles, caimans, catfish, and sloths inhabited a lush ecosystem of lakes, rivers, and marshes.





From top: The largest shell of *Stupendemys* recovered from the field to date, in 1994. Rodolfo Sánchez with a badly weathered *Stupendemys* specimen in 2015. The recently recovered sharp-tipped lower jaw suggests that *Stupendemys* fed on mollusks and fish in addition to plants.

Afterward, we traveled on toward the small town of Urumaco, enjoying the tranquility of the badlands after Venezuela's bustling cities. Finally, we set out into the field to hunt for new specimens. During these days of prospecting for fossils, we began as early as possible to avoid the punishing afternoon heat. Reaching the fossil-rich locations around Urumaco with a four-wheel drive Jeep was often an adventure in itself, but Rodolfo Sánchez was an excellent guide, one who knew the intricate paths through the hilly landscape of the badlands—sometimes little more than a goat trail—by heart. We often had to trek over bumpy dirt roads and through forests of opuntia cacti because strong seasonal rainfalls had washed away the access tracks to the fossil localities. These cacti left especially long-lasting impressions on me—or rather, puncture holes in me—when I stumbled into them, distracted by beautifully colored whiptail lizards (belonging to the genus *Cnemidophorus*), which critically eyed all of our movements.

Unfortunately, we did not encounter any living turtles or tortoises while looking for their fossilized relatives—we had to visit Rodolfo's backyard for that. But the badlands yielded incredible finds: several new large *Stupendemys* shells, which were excavated and prepared the following years, and the first lower jaw of *Stupendemys* from Urumaco. Together with other recently unearthed fossils from the Tatacoa Desert in Colombia that also included shell and lower jaw remains, we had finally reached a critical mass of individuals to warrant a reinvestigation of the species.

Comparing the new shells to the enormous older specimen in Santa Ana de Coro, we noticed that only some had horn-like protrusions framing the neck region. This difference may support the early hypothesis of Roger Wood—who described *Stupendemys* in 1976—that the sexes could potentially be identified based on variation in the shells' neck region. We suspect that the horns are present in the shells of male turtles, serving to protect the head region and potentially as weapons in male-on-male combat.

Because of its enormous size, scientists had previously thought that *Stupendemys* was exclusively carnivorous. However, the sharp-tipped jaws on the new specimens closely resemble those of the extant Big-headed Sideneck Turtle (*Peltocephalus dumerilianus*), which feeds on a broad range of food items, including plants, fruit and seeds, fishes, and invertebrates such as mollusks. It is likely that

TOP LEFT: ORANGEL AGUILERA | TORSTEN SCHEYER (×2)

The question remains: why was *Stupendemys* so much larger and more than 100 times heavier than its closest living relatives?

Stupendemys had a similarly diverse diet that potentially included large palm fruits—an idea that was suggested by the ecologist (and previous *Tortoise* contributor) Dennis Hansen from the University of Zurich. A close relationship to the Big-headed Sideneck Turtle and the Madagascan Big-headed Turtle (*Erymnochelys madagascariensis*) was generally supported by our phylogenetic analyses, in which we used morphological characters of both the shell and other bones of the body to determine the placement of *Stupendemys* in the turtle family tree.

The question remains: why was *Stupendemys* so much larger and more than 100 times heavier than its closest living relatives? One explanation may be that this colossal turtle shared its habitat with giant caimans—deep gouges on some fossilized shell bones indicate that, despite their size, turtles were hardly off the menu. Indeed, turtles and crocodylians have shared a path through evolutionary history for more than an unfathomable 220 million years, often sharing habitats. To view the astounding size of *Stupendemys* as merely the result of an arms race against giant crocodylian predators during the Miocene might be too simplistic, however. It is more likely that several factors—such as the climate, habitat size, productivity of the environment, and food availability, as well as predation by and competition with other animals—influenced the growth of *Stupendemys*. Today's Big-headed Sideneck Turtle is still preyed upon by caimans, although the largest threat to the species—and the reason why it is listed as Vulnerable—is increased commercial usage and hunting.

Five years after my last excursion to Venezuela, I often find myself thinking back fondly to the incredible experience of doing fieldwork in the badlands (although not necessarily to the cactus spines), the astonishing fossils that were unearthed after millions of years in the ground, and the warmth of our friends and colleagues in Venezuela. The generous support from officials and collection representatives over the years is also on my mind—without them, we could not even attempt to reconstruct the evolutionary history of the amazing turtles that lived around what is now Urumaco and the long-gone ecosystems, of which they were an immensely important component.

Top: A male Rainbow Whiptail Lizard gave us a reproachful look as we searched for fossils.

Bottom: We were always glad to meet modern Chelonians on our journey, such as this Red-footed Tortoise (*Chelonoidis carbonarius*)–a species supported by the Turtle Conservancy–in Urumaco.

TORSTEN SCHEYER (×2)

STUPENDEMYS: A HISTORY OF DISCOVERY

Stupdendemys remains were first discovered in the summer of 1972 by a Harvard University team scouring the Urumaco badlands in Falcón State. They found the fossilized shells and a few additional bones of several individuals, which the paleontologist Roger Wood described and officially assigned to the new species *Stupendemys geographicus* in a 1976 article in *Breviora*, a journal published by the Museum of Comparative Zoology at Harvard.

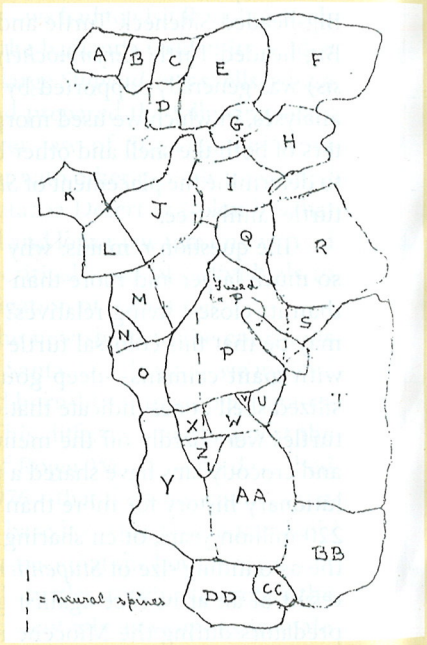
Early on, the shape of *Stupendemys* shells and bones led paleontologists to identify it as an oversized aquatic turtle belonging to the side-necked Pelomedusidae family, which is currently represented by the African helmeted turtles (*Pelomedusa* spp.) from Africa, the southern Arabian Peninsula, and Madagascar, but was much more inclusive in the past. Later, the pelomedusid subfamily Podocneminae was elevated to become the Podocnemididae family, whose members are today found only in South America and Madagascar, but which has a fossil record that was more widespread–as indicated, for example, by Late Cretaceous fossils from India. *Stupendemys* was then assigned to Podocnemididae. A mostly complete shell of *Stupendemys* with a midline carapace length of nearly 86 inches discovered at the site known as the Capa de Tortugas, still on view at the Museum of Comparative Zoology, was especially instrumental in cementing its status as the largest turtle with a full shell lacking fontanelles that ever lived.

Stupendemys was estimated to have been more than twice the length of the Arrau Turtle (*Podocnemis expansa*), the largest turtle living in South America today. It is only rivaled in size by the Late Cretaceous marine turtle *Archelon ischyros* that inhabited the Western Interior Seaway, an ocean that divided the western and eastern parts of the North American continent at that time. *Archelon*, like modern sea turtles, retained huge fontanelles in between the shell bones, so its carapace and plastron resemble a lightweight scaffold compared to the massive shell of *Stupendemys*.

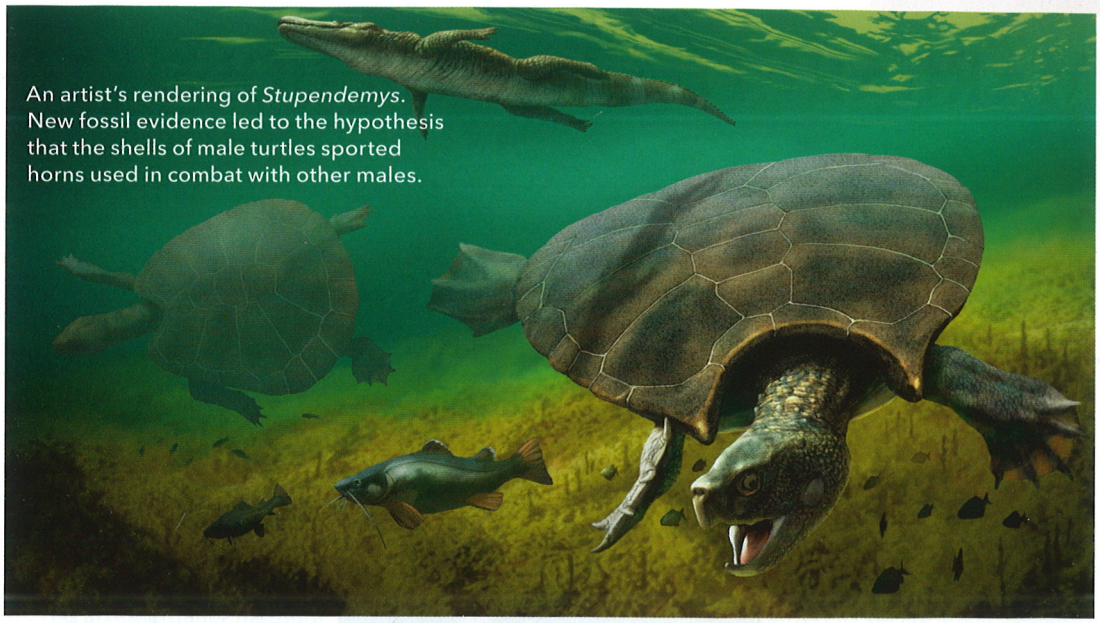
Unfortunately, that first expedition did not yield any skulls or lower jawbones that would have allowed for a more accurate comparison of *Stupendemys* to modern turtles. There was, however, skull and lower jaw material from another, then-undescribed, large turtle that had been found by the mining geologist Llewellyn Ivor Price during the early 1960s in southwestern Amazonia, in the Acre state of Brazil. The subsequent interpretations of this material diverged between two research groups, one in France, one in the United States, and it remained unclear whether the fossils–which were finally described as *Caninemys tridentata* in 2009–might actually represent the skull and jaw of *Stupendemys*.

The new millennium finally brought to light fresh *Stupendemys* shell and limb material, which was studied by Venezuelan researchers, primarily Orangel Aguilera, then a professor at Universidad Nacional Experimental Francisco de Miranda at Coro; Rodolfo Sánchez, resident geologist at Urumaco; and Marcelo Sánchez, an undergraduate student at the Universidad Simón Bolívar in Caracas. Between the mid-1990s and 2004, their research teams discovered and partially excavated some large individuals from the Urumaco badlands, among them a very large shell nearly 10 feet in length and 6.5 feet wide. Little attention was paid to these shells for some years to come, however, and the biology and ecology of the largest of freshwater turtles thus remained poorly understood.

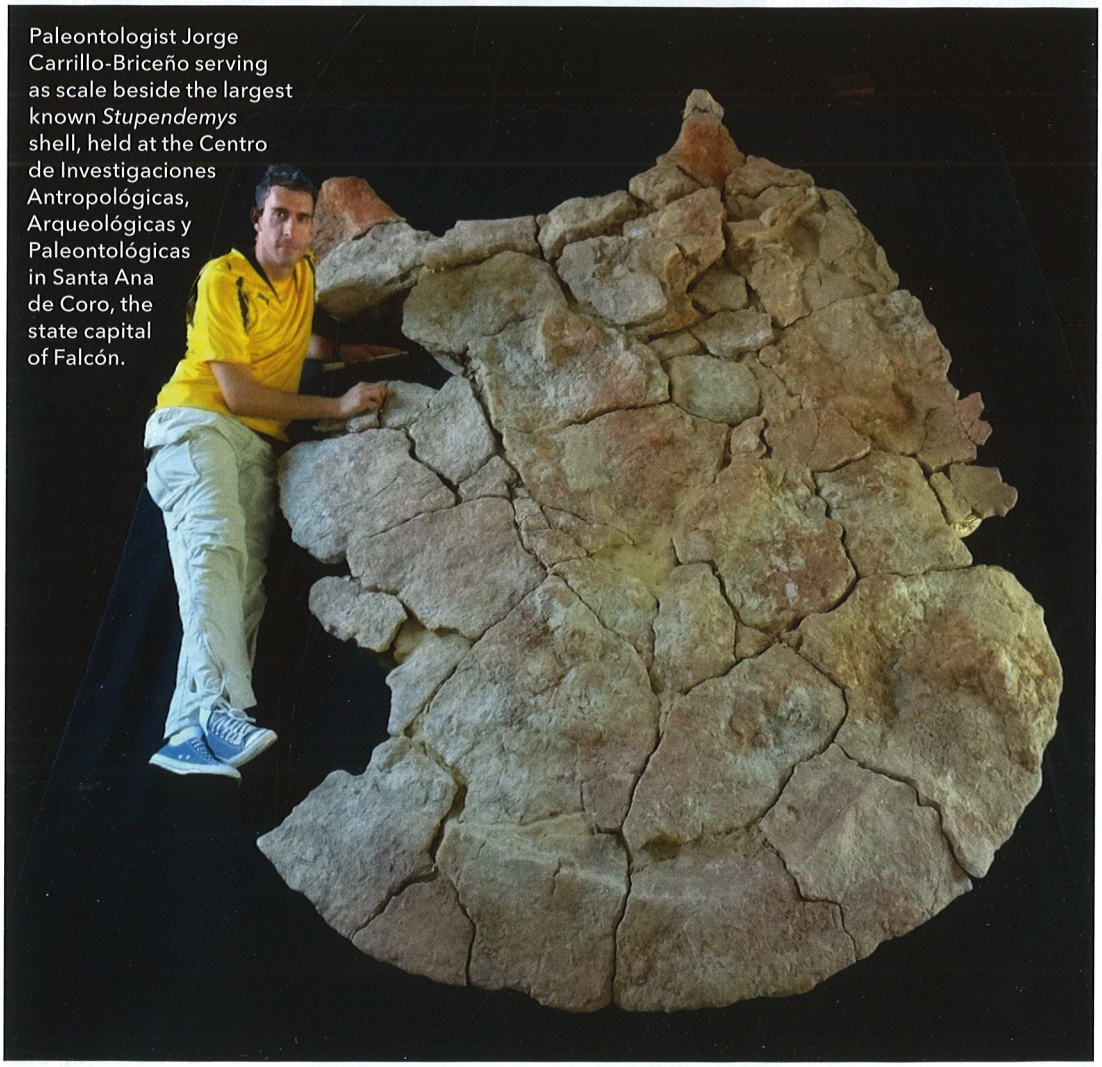
During the last 10 years, further excavations and student field excursions co-organized by Marcelo Sánchez, who had become a professor at the University of Zurich, Switzerland, and local colleagues in Venezuela finally provided the incentive for our field season in 2015.



A digital copy of an original drawing of the holotype from the 1972 Harvard expedition. Many thanks to Jurahimar Gamboa at the collections of the Museo de Ciencias Naturales Caracas, who kindly provided access to these field notes.



An artist's rendering of *Stupendemys*. New fossil evidence led to the hypothesis that the shells of male turtles sported horns used in combat with other males.



Paleontologist Jorge Carrillo-Briceño serving as scale beside the largest known *Stupendemys* shell, held at the Centro de Investigaciones Antropológicas, Arqueológicas y Paleontológicas in Santa Ana de Coro, the state capital of Falcón.

TOP: JAIME CHIRINOS | BOTTOM: JORGE CARRILLO-BRICEÑO