Size matters in lizard research

March 8 2011, By Pete Zrioka

An adult Gila monster in the Dale DeNardo lab. The largest land lizard in the United States, the Gila monster can grow to about a foot-and-a-half in length. Credit: Pete Zrioka

(PhysOrg.com) -- For a species whose name suggests otherwise, Gila monsters are actually quite shy. Their size and bite are the only monstrous things about these animals, which are the second-largest and one of only two venomous lizards native to North America.

But it's their monstrous mass that makes Gila monsters ideal candidates for research. Christian Wright and Karla Moeller, biology doctorate students in the Dale DeNardo Lab at Arizona State University, are taking advantage of that quality to further our understanding of how these animals adapt and survive in an austere, changing environment.

Moeller studies physiological differences between adults and juvenile Gila monsters, and how those differences can affect their behavior. She says that studies of juvenile animals overall are scarce, but if there are significant differences between young animals and adults, conservation biologists need to take this into account.

The size of Gila monsters makes them convenient for Moeller's research.

"They're the largest-bodied lizards in the United States, and the juveniles are bigger than a lot of adult lizards," she says. "This size makes some aspects of the research more feasible."

The juveniles, in turn, are dwarfed by their elders, which reach around a foot-and-a-half in length. Because of this impressive size, the researchers are able to implant radio transmitters for tracking purposes in the wild as well as temperature-sensing data loggers inside both adult and juvenile Gilas.

The data loggers are devices called iButtons, commonly used to monitor the temperature of food to ensure it doesn't spoil. These loggers have been modified to fit inside the Gila monsters' body cavities.

"The devices we use are small and fit very nicely in the body cavity without hurting the animal," Moeller says. "We've had animals in our study for over eight years that have had iButtons and transmitters in them and they're perfectly healthy."

The iButtons record hourly body temperature in the animals. By comparing body temperature with the air temperature at the site, the researchers can tell if the lizards are above or below ground, since Gila monsters are ectotherms and do not produce their own heat. This gives them a way to look at the animals' behavior patterns, called temperature-based activity estimates, which focus on the timing and duration of

activity.

The radio transmitters also are vital, allowing the researchers to track their established population of approximately 15 adult Gila monsters, located in an area about 30 miles north of Tucson.

Wright examines how adult Gila monsters cope with variation in food availability, predicting how they will respond to the changing climate of the Sonoran Desert. Climate scientists predict that the region will have higher temperatures and increasingly variable, lower annual rainfall in the next 100 years.

“Precipitation is directly linked to food availability, so I’m looking at how they respond to food availability in the wild and using that to predict how future climate changes could impact their survivorship,” Wright says.

To determine this, Wright conducted a feeding study on the wild population, giving half of the adult lizards a 60-gram meal and the other half nothing as a control. Since Gila monsters use their bladders to store water and keep fat reserves in their tails, they can go extended periods of time without eating or drinking. Given their already remarkable resource preservation ability, Wright wanted to know how dramatically a large meal would affect their behavior and physiology in the wild.

“Behaviorally, they spend a lot of their time inactive, but getting more food means they have more energy, allowing them to search for more food, or potential mates,” Wright says. “Or that might mean they’ll reduce their activity because, ‘Oh, I’ve got a full belly, I don’t need to search for food and I can stay underground and conserve energy.’”

Wright still is analyzing the study data, but so far the information on the mass, fat stores and hydration of both groups of wild animals has

revealed no difference. This suggests food availability has little bearing on how Gila monsters conserve water. Because there are no differences in mass or fat stores, animals with more energy may be spending it, rather than conserving it relative to unfed animals.

Wright's fieldwork also is informed by lab studies, particularly how meals affect the hydration levels of the animals.

"They go long periods without water – up to three months. A lot of work has shown they can tolerate extended droughts. But that's just looking at water," Wright says. "I wanted to look at how food plays a role in hydration."

Focusing on the water Gila monsters get from a meal, Wright fed one group in the study but not the other, watering neither. By analyzing blood samples, Wright established the point at which the animals from each group needed water and found that the fed animals were getting very little water from their meals.

"Although they are a desert-dwelling species, they are dependent on the winter and monsoonal rainfall pulses to survive," Wright says. "This means that if precipitation patterns change enough, Gila monsters may not be able to get the water they need, putting their survival in jeopardy."

Moeller also looks at how Gila monsters manage their water, but she compares juveniles and adults.

"We know adults can hold enough water in their bladder and pull from that throughout the summer to survive," she says. "But the juveniles are smaller and have a higher surface-area-to-volume ratio, which means they're going to lose more water relative to the adults. My question starting out was 'how do they get through this drought, especially if they're losing relatively more water than the adults, who are already

pretty much pushed to their limits?'"

To answer this question, Moeller must first figure out how much water the animals lose at different temperatures.

She uses an environmental chamber to control Gila monsters' body temperatures. She then runs air across the animals and compares the humidity of the air going in and of the air going out. This lets her measure how much water the animals are losing at various temperatures.

The data gathered from the environmental chamber complements the data the researchers collect from their population of animals in the field. More importantly, it allows Moeller to draw physiological comparisons of adults and juveniles.

"The little miniature data loggers that we put in our free-ranging animals allows us to interpret their behavior, and hopefully identify behavioral differences between the adults and juveniles," Moeller says. "Juvenile Gila monsters appear to be essentially miniature adults. If I can show that these juveniles are actually different physiologically or behaviorally, then this makes a good case for the need to better understand juvenile ecology, physiology and behavior in other groups of animals as well."

This is why Moeller believes her research is so important – juvenile animal studies are severely lacking and not just with reptiles.

"The lack of information on juveniles is surprising," Moeller says. "Natural selection acts on animals of all life stages, so there's no reason, as conservationists, we shouldn't be looking at juveniles as well."

The aim of Wright's research also comes back to conservation.

"There's a lot of work that's currently being done about how climate

change is going to impact animals, not only if they can survive but how they're going to cope," Wright says. "My research gives us a better understanding of how climate change affects organisms in terms of their survivorship. People tend to focus on the cute and cuddly animals, but climate change is going to impact more than just them – and those impacts could be dramatic."

Provided by Arizona State University