Additional information about desert tortoise

Q: Why was this study done?

A: For more than 20 years, biologists and land managers in the desert southwest have recognized differences in shell shape and mitochondrial DNA (DNA generally inherited through the mother's line) between the desert tortoises on each side of the Colorado River, as well as between the northern part of their geographic range in the U.S. and the southern part of the range in Sinaloa, Mexico. Desert tortoises are an important component of balanced desert ecosystems, and to improve the management of these reptiles, land managers need to know how many species actually exist and what their respective geographic boundaries are.

Q: Who is the new desert tortoise species named after?

A: The study authors named *Gopherus morafkai* after Dr. David J. Morafka, the late biologist and professor at California State University Dominguez Hills. Professor Morafka was a renowned desert ecologist who was recognized for his many contributions to the biology and conservation of both bolson and desert tortoises, and his efforts at facilitating collaborative research, even among researchers with very different perspectives.

Q: Why are desert tortoises important to the desert ecosystem?

A: Tortoises are often called sensitive species, flagship species or umbrella species for many reasons.

First, tortoises are burrowing animals (hence the genus name *Gopherus*, referring to its gopher-like habits) and spend a substantial amount of their lives in digging new burrows or improving an existing burrow. Tortoises that live in rock shelters or caves also dig and move soil too. They are soil engineers, moving substantial amounts of dirt and nutrients. Tortoises show great fidelity to their winter and summer burrows and shelters and are often found year after year at the same sites. Throughout their long lives, they share these homesites with many other animals: insects, spiders, rodents, lizards, snakes, kit foxes, and burrowing owls. Agassiz's desert tortoise, for example, shares its burrow with the state-listed threatened Mohave ground squirrel, a species endemic to the western Mojave Desert. Tortoise burrows protect other desert animals from extreme winter and summer temperatures.

Second, tortoises are an important part of the food web. They are prey for many predators and provide food during all life stages. Their eggs are excavated and eaten by Gila monsters, kit fox, badgers, and coyotes. The juveniles have been called "walking ravioli" by Dr. Morafka, and indeed, the juveniles with their soft shells are eaten by ants, ground squirrels, foxes, coyotes, skunks, ravens, road runners, and snakes. Even adults serve as food for golden eagles, ravens, coyotes, foxes, badgers, and mountain lions.

Third, desert tortoises are long-lived and serve as sentinels for the condition of the environment. They are herbivores with preferences for specific groups of native wildflowers, and as such, do not thrive in highly disturbed landscapes. In many areas in the desert southwest, invasive, non-native grasses and forbs introduced through human activities have replaced a substantial portion of the vegetation and have

contributed to an increase in frequency of large wildfires. The fires can be deadly to desert tortoises and smaller, less mobile organisms.

Fourth, tortoises, because of their longevity, can concentrate contaminants, such as arsenic and mercury, which in turn weaken their health. The sources of such contaminants can be dust from old or recent mining activity, recreation, road construction, and other developments — and linger as a signal of past landscape disturbances in a tortoises body.

USGS studies on the roles of tortoises in the natural desert landscape will help inform the landscape and species management efforts of government agencies

Q: If wildlife managers long suspected that desert tortoises are comprised of multiple species, why did it take so long to recognize them?

A: Many issues needed to be resolved — ranging from when and where the original specimen was collected to the genetics of different populations. In part, the analysis of chemically preserved tissue from the original tortoise specimen, collected 150 years ago, was not possible until recently. The laboratory techniques needed to be developed. The authors needed to confirm the genetic identification to distinguish these desert tortoise species.

The desert tortoise (*Gopherus agassizii*) was first collected and described by a medical doctor and scientist, James Cooper, in 1861 on the basis of three young tortoises. But due to museum fires in the early 1900s, only one specimen appeared to remain in museum collections. Further, confusion existed about where the specimens were collected — whether from the mountains of California or Ft. Mohave, Arizona. The source of the original collection was critical, because populations differ from one side of the Colorado River to the other. The situation was further complicated in 1989, when a new species of desert tortoise was described from Baja California. The genetic relationship of this new species to desert tortoises in the U.S. and Mexico also needed to be clarified.

Authors of this study painstakingly retrieved historical records spanning 1861 to modern day to figure out where specimens were collected and where they now existed. In the end, they learned that only one of the original *Gopherus agassizii* specimens remained and it was at the Smithsonian. The authors were able to use genetic material — mitochondrial DNA and microsatellites (a repeating sequence in DNA) — from the 1861 specimen and the Baja California specimen to compare with genetic samples of tortoises throughout the geographic range today.

The DNA analysis confirmed what scientists had observed in the past about differences in life histories and behaviors of the tortoises. The authors found that the original specimen, collected in 1861, had the genetic makeup of a California tortoise, so the authors then were able to assign the original name, *Gopherus agassizii*, to tortoises occurring north and west of the Colorado River. Tortoises living south and east of the Colorado River in Arizona, and in the states of Sonora and Sinaloa, Mexico, were given a new name, *Gopherus morafkai*.

As for the Baja California tortoise, DNA analysis showed that it was from the Mojave Desert of California, probably transplanted by humans.

Q: Are there potentially more species of desert tortoises?

A: The existing genetic and morphological (the outward form and structure of the animal) evidence points to one or more additional species in the southern part of the range, in the southern parts of the state of Sonora and in Sinaloa, Mexico. Genetic samples have been collected from hundreds of desert tortoises throughout the Mojave and Sonoran deserts from California south to the tropical deciduous forests in Mexico. Field studies on habitat preferences and additional genetic analyses will confirm the boundaries of additional species in Mexico, one of which may be a forest-dwelling tortoise!

Q: Does this study change the way we manage for desert tortoises?

A: The naming of a second species of desert tortoise provides scientific support for managing the two species separately, although management actions are ultimately the decision of resource managers at federal, military, state, county and city agencies. Please contact the respective agencies for their answer to this question.

Recognizing that tortoises in two distinct geographic ranges are two different species would imply that tortoises in one range cannot serve as a genetic reservoir or population source for the other — such as for translocation and other species management options. This could underscore the importance of habitat availability in each species' respective geographic range.

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