



## MONTEZUMA WELL

## Sonoran Mud Turtle (*Kinostemon sonoriense*)

The Sonoran mud turtle (*Kinostemon sonoriense*) is the only native turtle species living in Montezuma Well. The normal geographic range of Sonoran mud turtles is throughout the Southwest, into southern California, and into northwestern Mexico. Montezuma Well is the most permanent water source in the Sonoran mud turtle range (Stanila 2009), with a near constant water temperature of about 70 degrees F (Blinn 2008). The Well is also unique in its high carbon dioxide concentrations, number of endemic species (found nowhere else in the world), and lack of fish and amphibians.

Sonoran mud turtles are medium-sized (up to 6 ½ inches long, with the females larger than the males), with high-domed smooth shells. The shells are light-brown to yellowish brown, and often covered in algae, and the skin is dark olive with yellow and cream colored markings on the head and neck (Ollig 2008). As a water-dwelling species, Sonoran mud turtles also have webbed feet.

The Sonoran mud turtle is primarily carnivorous, but an opportunistic forager (Lovich et al. 2010). At Montezuma Well, the mud turtles feed primarily on invertebrates (amphipods and aquatic insects) and vegetation (Blinn 2008). They are also known to eat Arizona alligator lizards (*Elgaria kingie nobilis*) and ground snakes (*Sonora semiannulata*) at Montezuma Well – while snakes have been reported previously as part of the Sonoran mud turtle diet, lizards have not (Lovich et al. 2010).



Hatchling Sonoran mud turtle found at the top of the steps on the trail leading down to Beaver Creek at the Well in 2007.

## FACT SHEET



Montezuma Well.

Sonoran mud turtles may live more than 40 years in the wild. The females reach maturity between five and nine years old, and may lay two clutches of eggs per year (usually 6-7 eggs per clutch). At Montezuma Well, the females move away from the water to nest, laying eggs between May and October (Drost et al. 2012; Rosen 1986).

### Predation

At Montezuma Well, skunks, raccoons, and possibly fox feed on the mud turtles (Drost et al. 2012; Rosen 1986). Although not observed as of yet, predation on eggs may also be a problem at Montezuma Well, where the cliffs provide ample den space for carnivores including gray fox (*Urocyon cinereoargenteus*), hog-nosed skunk (*Conepatus leuconotus*), spotted skunk (*Spilogale gracilis*), raccoons (*Procyon lotor*), ringtails (*Bassariscus astutus*), and striped skunks (*Mephitis mephitis*) (Drost et al. 2012).

### Threats

The Sonoran mud turtle population in Montezuma Well has declined since the first inventory of the species in 1983 (Drost et al. 2012). Although predation may have played a role in this decline, it seems more likely that competition with introduced turtles species is at least partially to blame.

Red-eared slider turtles (*Trachemys scripta*) were introduced into Montezuma Well sometime in the late 1960s or 1970s. A single Pacific pond turtle (*Actinemys marmorata*) and a

yellow-bellied slider (*Trachemys scripta scripta*) were also introduced sometime later. Pacific pond turtles are native to the Pacific coastal region of North America and have not been recorded in Arizona before. This turtle was therefore likely captured in the wild and kept as a pet for some time before being released into Montezuma Well (Drost et al. 2012). The original red-eared sliders and the yellow-bellied slider were also likely pets, but ones purchased in pet stores before being released into the Well.

Through a series of capture projects beginning in 2007, the National Park Service has successfully removed all non-native turtle species from Montezuma Well, with the last red-eared slider captured in 2013. The Park Service continues to monitor the Well for new introductions and to track the status of the native mud turtles.

## Special Status

Although unproven, it has long been suspected that the Montezuma Well mud turtles are in fact a separate species or subspecies endemic to the Well (NPS 1992). If formally recognized, the mud turtles of Montezuma Well will be the third subspecies of *K. sonoriense* known in the greater Southwest, or perhaps a new species of *Kinosternon* altogether.

## Source Literature

Blinn, Dean W.

2008 The Extreme Environment, Trophic Structure, and Ecosystem Dynamics of a Large, Fishless Desert Spring: Montezuma Well, Arizona, in *Arid Land Springs in North America*, edited by L.E. Stevens and V.J. Meretsky, pp. 98-126. Arizona-Sonora Desert Museum Studies in Natural History. University of Arizona Press, Tucson.

Drost, Charles A., Jeffrey E. Lovich, Sheila V. Madrak, and A.J. Monatesti

2012 *Removal of Nonnative Slider Turtles (Trachemys scripta) and Effects on Native Sonora Mud Turtles (Kinosternon sonoriense) at Montezuma Well, Yavapai County, Arizona*. U.S. Geological Survey Open-File Report 2010-1177, <http://pubs.usgs.gov/of/2010/1177/>.

Lovich, Jeff, Charles Drost, A.J. Monatesti, Dennis Casper, Dustin A. Wood, and Michele Girard

2010 Reptilian Prey of the Sonora Mud Turtle (*Kinosternon sonoriense*) with Comments on Saurophagy and Ophiophagy in North American Turtles. *The Southwestern Naturalist* 55(1):135-138.

Lovich, Jeffrey E., Sheila V. Madrak, Charles A. Drost, Anthony J. Monatesti, Dennis Casper, and Mohammed Znari

2012 Optimal Egg Size in a Supoptimal Environment: Reproduction Ecology of Female Sonora Mud Turtles (*Kinosternon sonoriense*) in Central Arizona, USA. *Amphibia-Reptilia* 33:161-170.



USGS / DROST ET AL. (2012; FIGURE 4)

Introduced species removed from Montezuma Well in 2008: Red-eared slider (*Trachemys scripta*) in the front and yellow-bellied slider (*Trachemys scripta scripta*) in the back.

National Park Service (NPS)

1992 *Water Resource Management Plan. Montezuma Castle and Tuzigoot National Monuments*. United States Department of the Interior, National Park Service.

Ollig, Paul

2008 Turtles in Trouble! *Echoes* 2(1):10-11.

Rosen, Philip C.

1986 Population Decline of Sonoran Mud Turtles at Quitabquito Springs: Final Report. Zoology Department, Arizona State University, Tempe.

Stanila, Brian Douglas

2009 Morphology and Demography of Sonoran Mud Turtles (*Kinosternon sonoriense*) Along an Aquatic Habitat Permanence Gradient. Master's thesis, Department of Biology, University of Central Oklahoma, Edmond.



NPS

Sonoran mud turtles at Montezuma Well.