

Narrow-headed Garter Snake (*Thamnophis rufipunctatus*)

The narrow-headed garter snake is a harmless, nonvenomous snake that is distinguished by its elongated, triangular-shaped head and the red or dark spots on its olive to tan body. Today, the narrow-headed garter snake is a species of special concern in the United States because of its decline over much of its historic range. Arizona's Oak Creek has historically contained the largest population of narrow-headed garter snakes in the United States. The U.S. Geological Survey (USGS) and the Arizona Game and Fish Department jointly funded research by USGS scientists in Oak Creek to shed light on the factors causing declining population numbers. The research resulted in better understanding of the snake's habitat needs, winter and summer range, and dietary habits. Based on the research findings, the U.S. Forest Service has developed recommendations that visitors and local residents can adopt to help slow the decline of the narrow-headed garter snake in Oak Creek.

Research Findings

Narrow-headed garter snakes spend most of their lives in or immediately adjacent to the perennial streams of the Mogollon Rim and the White Mountains of Arizona and New Mexico in the United States and in the Sierra Madre Occidental mountain range in Mexico. The snakes were once common throughout Oak Creek, which originates north of Sedona and ends near Cottonwood, Arizona, at the confluence with the Verde River. Today, the narrow-headed garter is seldom found downstream of Oak Creek Canyon. USGS data indicate that current population numbers appear to be stable in the upper and middle reaches of Oak Creek Canyon; however, there is evidence of declines in lower canyon reaches.

By tracking snakes that were surgically implanted with radio transmitters, USGS biologists were able to determine that narrow-headed garter snakes in Oak Creek hibernate from November to April in rocky areas well above the floodplain. This behavior probably developed as a strategy for avoiding winter or spring floods. The research effort also confirmed that the snakes have small home ranges. In fact, during the summer the snakes usually do not travel more than 0.8 km (0.5 mi) from their hibernation sites. Adult narrow-headed garter snakes appear to favor sections of Oak Creek Canyon with overhanging vegetation that provides hiding places from predators. Hawks, wading birds, ravens and crows, raccoons, crayfish, predatory fish, and other snake species will eat garter snakes.

Fish are a major source of food for narrow-headed garter snakes, which also hunt frogs and tadpoles. In Oak Creek, narrow-headed garter snakes appear to feed primarily on smooth-bodied fish with soft fins, especially nonnative brown



Figure 1. Narrow-headed garter snake (*Thamnophis rufipunctatus*) is a species of special concern in the United States. The U.S. Geological Survey (USGS) and the Arizona Game and Fish Department jointly funded research by USGS scientists in Oak Creek to explore the factors causing population declines.

(*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) and native suckers and speckled dace (*Rhinichthys osculus*). Native and nonnative fish species with this fusiform, or smooth, body type are more abundant in upper Oak Creek Canyon. USGS research findings indicate that the overall distribution pattern of narrow-headed garter snakes parallels the availability and relative abundance of smooth-bodied fish in Oak Creek. The lower sections of the creek are dominated by nonnative fish species with stiff, spiny fins, which may make them unsuitable prey for the snakes because they represent a choking hazard. More research is needed to understand the interaction of narrow-headed garter snakes with nonnative fish species.

Causes of Decline

Research suggests that multiple factors are likely contributing to population declines for the narrow-headed garter snake in Oak Creek. The most significant factor appears to be the negative effects of nonnative crayfish on snakes and their prey base. Crayfish are opportunistic feeders, eating both plants and animals, including young snakes, and can quickly outgrow predation by most fish. USGS research in the Southwest confirms that nonnative crayfish prey on native fish species and compete with them for food and cover. Declines in snake populations may also be caused by the replacement of native



Figure 2. Narrow-headed garter snake with nonnative brown trout. (photograph courtesy of Susi MacVean, Arizona Game and Fish Department)



Figure 3. This adult narrow-headed garter snake was surgically implanted with a radio transmitter. The transmitter allowed USGS scientists to track the snake's movements, providing insights into travel patterns and habitat needs.

fish that the snakes feed on with nonnative species and increases in other nonnative fish that may prey on the snakes. Another contributing factor is thought to be the heavy recreational use of Oak Creek, which can result in the localized trampling of habitat used by young snakes and fish for spawning sites. Floods, the intentional killing or relocation of snakes by people, and the accidental killing of snakes by vehicles using low-water crossings can also result in snake mortality.

Research Implications

USGS research has identified a number of the factors contributing to the decline of the narrow-headed garter snake in Oak Creek. As with all USGS research, this effort was designed to develop relevant information that could inform and support management decisions. The U.S. Forest Service has used the findings to develop recommendations that visitors and local residents can adopt. Forest managers worked cooperatively with Friends of the Forest and the National Forest Foundation to post signs in developed areas of Oak Creek listing the recommendations. The signs include the following suggestions:

- Please do not kill or relocate the garter snakes.
- Please do not handle or collect the snakes because they overheat with handling and do not adapt well to captivity.
- Watch for young garter snakes when driving over low-water crossings.
- Keep pets leashed.
- Stay near developed recreation sites and step on rocks when enjoying the creek.
- Do not release live bait, especially crayfish, into the creek.

More Information

Nowak, E., 2005, Monitoring surveys and radio-telemetry of narrow-headed garter snakes (*Thamnophis rufipunctatus*) in Oak Creek, Arizona: Draft annual progress report submitted to Arizona Game and Fish Department, U.S. Geological Survey, Colorado Plateau Research Station, 20 p.

Nowak, E.M., and Santana-Bendix, M.A., 2002, Status, distribution, and management recommendations for the narrow-headed garter snakes (*Thamnophis rufipunctatus*) in Oak Creek, Arizona: Final report submitted to Arizona Game and Fish Department (Heritage Grant I99007), U.S. Geological Survey, Colorado Plateau Research Station.

Erika M. Nowak, U.S. Geological Survey
 Southwest Biological Science Center
 Colorado Plateau Research Station
 2255 N. Gemini Drive
 Flagstaff, Arizona, 86001
 Tel: 928-556-7466 (ext. 239); E-mail: enowak@usgs.gov

Narrow-headed garter snake research is conducted by the Southwest Biological Science Center (SBSC) [<http://sbsc.wr.usgs.gov>], which is one of the 17 science centers that are a part of the U.S. Geological Survey's Biological Resources Discipline. To address the research needs of the large and biologically varied Southwestern United States, SBSC research is conducted by scientists working at four research stations, including Canyonlands Research Station (Moab, Utah), Colorado Plateau Research Station (Flagstaff, Arizona), Grand Canyon Monitoring and Research Center (Flagstaff, Arizona), and Sonoran Desert Research Station (Tucson, Arizona). The mission of the USGS Biological Resources Discipline is to work with others to provide the scientific understanding and technologies needed to support the sound management and conservation of the Nation's biological resources.