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Nest Guarding in the Gopher Tortoise (*Gopherus polyphemus*)

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ABSTRACT. – Nest guarding is rarely observed among reptiles. Specifically, turtles and tortoises are generally perceived as providing no nest protection once the eggs are laid. Here, we describe observations of nest guarding by female gopher tortoises (*Gopherus polyphemus*).

Nest guarding among reptiles is considered uncommon (Reynolds et al. 2002). Although many crocodilians are known to protect their nests and offspring from potential predators, turtles and tortoises are generally

perceived as providing no parental care once the egg laying process is complete. However, some tortoise species have been observed defending their nests from potential predators, namely the desert tortoise (*Gopherus agassizii*; Vaughan and Humphrey 1984) and Asian brown tortoise (*Manouria emys*; McKeown 1990; Eggenschwiler 2003; Bonin et al. 2006). *Manouria emys* behave similarly to crocodilians with regard to nest construction and protection and have been observed guarding their nests from intruders (McKeown 1990; Eggenschwiler 2003; Bonin et al. 2006). During the nesting season, female *M. emys* will gather nearby debris and vegetation and construct a small mound. Once completed, the female digs a small compartment in the center and deposits her eggs. The female remains near the nest and when a potential threat appears, she will move toward the threat in an attempt to bite and push the intruder away with her carapace (McKeown 1990; Eggenschwiler 2003; Bonin et al. 2006). If she is unable to deter the predator the female will then move to the top of the nest and lie flat, with limbs extended down over the sides of the nest, in an effort to make access to the nest more difficult (McKeown 1990). Documented observations have shown these behaviors to be successful in deterring intruders from investigating the nest more closely, thus protecting the eggs from depredation (Bonin et al. 2006).

Gopher tortoises (*Gopherus polyphemus*) live in underground burrows they excavate. Females are known to construct their nests in close proximity to their burrows. During burrow excavation, excess sand is shoveled to the surface and deposited outside the burrow entrance, creating a large mound of sand, or apron. As a result of tortoises digging their burrows where the canopy is relatively open, the apron is often used as a basking platform. The apron's deep sandy soils also provide a suitable nesting site. In addition, by nesting at the burrow entrance or apron, females may reduce their own vulnerability to potential predators or extreme heat during nesting because they can rapidly retreat into the shelter of the burrow. Additionally, tortoises may be providing their nests with some degree of protection by laying eggs at the entrance of their burrow where they are in close proximity of the resident female, though this has never been confirmed.

The Aiken Gopher Tortoise Heritage Preserve (AGTHP) is a 656-ha preserve managed by the South Carolina Department of Natural Resources (SCDNR) primarily for gopher tortoises and their habitat. The AGTHP is located in Aiken County, South Carolina, and marks the location of the northern-most known native population of gopher tortoises (Clark et al. 2001; SCDNR 2005). As part of an on-going population augmentation project (K.A. Buhlmann, B.M. Moule, A.M. Grosse, T.D. Tuberville, and S. Bennet, unpubl. data, 2010), native tortoises on the preserve, as well as waif tortoises (i.e., formerly captive or confiscated individuals with no locality data or rehabilitated injured tortoises) from around the southeastern United States, have been translocated and penned in 1-ha enclosures for at least one year to increase site fidelity by limiting dispersal after pen removal (Tuberville et al. 2005). One such pen was removed in July 2009, and all tortoises ($n = 14$) were equipped with Holohil (Ontario, Canada) AI-2F transmitters. Following release from their pens, tortoises were radio tracked weekly, during which time individuals were frequently seen basking on burrow aprons. In every such observation, tortoises retreated into their burrows once observers were close enough to be seen or heard. In August 2010, we searched for nests in aprons of burrows used by free-ranging females to document natural reproduction in the translocated animals. At one burrow, we observed what we consider to be nest guarding behavior by a female gopher tortoise and describe our observations below.

On 25 August 2010, we arrived at a gopher tortoise burrow that had been established almost a year prior by a free-ranging adult female tortoise (carapace length = 332 mm). This particular tortoise was observed many times before while radio tracking, and every time she would retreat into her burrow as she was approached. Upon our arrival, this tortoise was not visible at the burrow entrance and was presumed to have retreated further into her burrow. We began our nest searching by digging with hand trowels at the burrow entrance. At the onset of digging, we were unable to see the tortoise within 2 m of the burrow entrance. However, almost immediately, the female tortoise emerged from the burrow and began hissing and lunging toward the shovel. As we continued digging, she moved closer to the shovel but did not venture further than the burrow entrance and continued hissing and lunging forward. This behavior of lunging forward and hissing loudly continued intermittently for almost 20 min while we continued to carefully excavate the apron, digging backwards from the burrow entrance. At 0.5 m from the burrow entrance, sand was removed to reveal a clutch of nine eggs—seven live hatchlings and two unhatched eggs. As the hatchlings and eggs were carefully removed, the resident female tortoise continued to lunge forward and toward us while hissing loudly. One of the authors (KAB) put his hand in front of the tortoise (< 8 cm) to prevent her from trampling the hatchlings and eggs, in response to which she quickly opened her mouth and made a deliberate lunging attempt to bite his hand (Fig. 1). Once the clutch of hatchlings and eggs were successfully removed from the nest, we retreated, and the tortoise continued to loudly hiss from the safety of her burrow. On a return trip the following week to radio-track tortoises, this female was observed basking at the entrance of the same burrow. Upon our arrival, she slid back into her burrow and only retreated further when attempts were made to entice her to the burrow entrance again (e.g., digging at the apron and patting the sand at the entrance). The following year, 30 August 2011, one of the authors (KAB) returned to the same burrow to search for a

Figure 1. (Top) Excavated nest in relation to the burrow entrance, (middle) female gopher tortoise at the entrance of her burrow, and (bottom) female tortoise lunging forward and attempting to bite the intruder's hand.

new nest. Upon starting the excavation, the same female as in the previous year emerged from deep in her burrow and once again began hissing and lunging forward toward the hands of the excavator. As in the previous year, a nest was discovered with 9 eggs. These behaviors continued for the entirety of the excavation, but once the eggs were successfully removed and sand replaced, the female turned and retreated in her burrow, even though the excavator was still present.

Past observations of both *G. agassizii* and *G. polyphemus* have described similar behaviors (biting, lunging forward, hissing) when referring to sexual and defensive behaviors (Berry 1986; Ashton and Ashton 2008). Although the behavior exhibited by the female *G. polyphemus* could be a defensive behavior, we believe the observed behaviors described above were an attempt by the female to deter potential predators from her nest. Over a 2-yr period, this individual was approached frequently during radio tracking, and only twice did she display the described aggressive behaviors; during both occasions a nest was present in the apron of the burrow she occupied. Further, observations of *M. emys* describe the female as crawling on top of the nest to defend it when lunging and pushing the intruder away with her carapace was not effective (McKeown 1990; Eggenschwiler 2003; Bonin et al. 2006). We believe the *G. polyphemus* behaviors described above did not include the female covering the nest for the following reasons: (1) there were 5 biologists surrounding the burrow entrance with multiple shovels and human limbs between the tortoise and the nest; (2) remaining at the burrow entrance provided the tortoise with the ability to successfully retreat, if necessary; and (3) the way in which the nest was excavated made it very difficult for the tortoise to climb on top of the nest.

To our knowledge, this is the first written account describing what we consider to be nest guarding in the gopher tortoise. One of us (TDT) has also observed this behavior on two other occasions in a gopher tortoise population on St. Catherines Island (SCI), Georgia. On 13 September 2006, a female (carapace length = 334 mm) was observed 0.3 meters inside the burrow entrance and hissed, advanced toward the burrow entrance, and started bobbing her head once apron excavation was initiated. A clutch of 11 eggs was subsequently discovered in the apron. On 23 June 2007, this same female was observed inside a different burrow, where a clutch of 12 eggs was detected during apron excavation. The female exited the burrow as the protective nest cage was installed.

Despite the more than 200 gopher tortoise burrow aprons collectively searched for nests by the authors, we only observed this previously unreported behavior on four occasions. In each case, we confirmed that a nest had been deposited in the apron; we never observed the behavior when searching aprons of female-occupied burrows where no nest was detected. The female from the AGTHP is the only gopher tortoise that has ever attempted to bite. Further, by comparing the genotypes of the successfully hatched offspring to the female residing in the burrow, we were able to confirm that the hatchlings were in fact the resident female's offspring (SCI—Tuberville et al. 2011; AGTHP—T.D. Tuberville, K.A. Buhlmann, and B.M. Moule, unpubl. data, 2012). Based on our field observations and the genetic data, the female gopher tortoise in each occasion reported above appeared to be protecting her nest from a perceived predator. That the behavior was observed in only two females, both of which repeated the behavior in a subsequent year, suggests that such behavior may be rare within a population, comprising the behavioral repertoire of only a few individuals (Henen 1999). We suggest that other researchers who are studying tortoises be observant for other instances of nest guarding.

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