



FIG. 1. Hamerkop nest where *Pelomedusa subrufa* shells were found in Omusati Region, Namibia.

Hamerkop is a common breeding bird species in the Cuvelai Drainage System of north-central Namibia (Kopij 2013. *Int. Sci. Technol. J. Namibia* 2:44–58; Kopij 2014. *Vest. Zool.* 48: 269–274; Kopij 2015. *Orn. Observ.* 6:73–81). There, it is known to feed mostly on the Giant Bullfrog (*Pyxicephalus adspersus*), Ornate Frog (*Hildebrandtia ornata*), and small catfishes (*Clarias* spp.; GK, pers. obs.).

On 30 November 2017, I found a former Hamerkop nest being used for breeding by Barn Owls (*Tyto alba*; Fig. 1). The nest was located on a Mopane Tree (*Colophospermum mopane*), ca. 4 m above the ground, in close proximity to an oshana (a natural depression filled with water during the wet season). The habitat around the nest comprised an extensive pure stand of Mopane Savanna with a network of numerous oshanas (Kopij 2014, *op. cit.*). It is located in the Ogongo area, Omusati Region, in north-central Namibia (17.7125°S, 15.3083°E). Although no Barn Owl pellets were found on the ground below the nest, as expected, there were five entire (not damaged) shells (carapace connected with plastron) of the African Helmeted Turtle (*Pelomedusa subrufa*). Each one was ca. 20 cm in length. There were no traces of any meat, bones and other body parts inside this shell. It appeared as these were totally extracted by the well-adopted hooked beak of the Hamerkop. Since no Barn Owl pellets were found, it can be assumed that Barn Owls began using the nest a few days prior to this observation. There was a prolonged drought in 2017 in northern Namibia, so most oshanas were still not filled with water at the end of November. When the site was revisited on 29 July 2018, the nest was still occupied by the Barn Owls, but all the turtle shells had disappeared, perhaps removed by scavengers.

*Pelomedusa subrufa* may reach 325 mm in length and 2.5 kg in body mass. It is the most widespread and common turtle in southern Africa (Alexander and Marais 2007. *A Guide to the Reptiles of Southern Africa*. Struik Nature, Cape Town, South Africa. 408 pp.). Due to strong defensive odor secretions, it is not considered edible by most people. In the Cuvelai Drainage System in northern Namibia it commonly inhabits the ephemeral oshanas, where it aestivates in the mud in the banks or on the bottom when the water totally evaporates in the dry season (GK, pers. obs.). Hamerkop may easily prey upon *P. subrufa* when the water levels in oshanas are low enough

to allow it to wade and capture turtles. In this critical period (October/November, May/June), *P. subrufa* may constitute an easily available prey for the Hamerkop.

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**TERRAPENE BAURI (Florida Box Turtle) and GOPHERUS POLYPHEMUS (Gopher Tortoise). BURROW ASSOCIATE and REPRODUCTION.** Gopher Tortoises are ecosystem engineers, providing microhabitat for hundreds of documented species (Kinlaw and Grasmueck 2012. *Geomorphology* 1:108–121). However, few observations of other turtle species using tortoise burrows have been documented. These observations include the use of the apron of an abandoned burrow for nesting by a Florida Softshell Turtle (*Apalone ferox*; Heinrich and Richardson 1993. *Herpetol. Rev.* 24:3) and the use of burrows as refugia by box turtles (*Terrapene* sp.; Jackson and Milstrey 1989. Diemer et al. [eds.], *Gopher Tortoise Relocation Symposium Proceedings*, pp. 86–98. State of Florida Game and Fresh Water Fish Commission Nongame Wildlife Program Technical Report No. 5; Hipps 2019. M.S. Thesis, Florida Atlantic University, Boca Raton, Florida). Moreover, limited observations of interactions between Gopher Tortoises and box turtles exist despite overlap in extensive portions of their range throughout the southeastern United States (Buhlmann et al. 2008. *Turtles of the Southeast*. University of Georgia Press, Athens, Georgia. 252 pp.). Here, we describe the use of Gopher Tortoise burrow aprons as nest sites by Florida Box Turtles (*Terrapene bauri*) at two different locations in south Florida, USA.

The first observation occurred at ca. 1145 h on 14 May 2012 in Collier County, Florida, USA. An adult female *T. bauri* (133 mm SCL) was observed by RS at the edge of an active tortoise burrow apron in open scrub habitat composed predominantly of Saw Palmetto (*Serenoa repens*), Slash Pine (*Pinus elliotii*), and oak (*Quercus* sp.). Closer inspection revealed that the individual was constructing an egg chamber and depositing eggs. Excavation of the nest by RS ca. 4 h later revealed two eggs, weighing 9 and 10 g, respectively. The depth to the top egg was ca. 2 cm. After weighing and inspection, eggs were returned to the chamber and covered with soil. Excavating the chamber ca. 90 d later revealed hatched eggshells.

The second observation occurred at ca. 1000 h on 4 June 2020 at Boyd Hill Nature Preserve in Pinellas County, Florida, USA, in similar habitat to the Collier County site. While examining Gopher Tortoise burrow aprons for signs of tortoise nests, MC found a clutch of two box turtle eggs. Eggs were confirmed to species by SD and reburied. Canopy openness of the nest site was 32% (estimated using hemispherical photography and gap light analysis; after Doody et al. 2006. *Evol. Ecol.* 20:307–330).

Our observations suggest that Gopher Tortoise burrow aprons can provide nest sites with suitable incubation conditions for developing Florida Box Turtle eggs. We do not know if the box turtles that nested at these sites sought out burrow aprons, or if they were chosen randomly with respect to those features. Despite their overlapping ranges and similar habitat preferences, there is limited data on interactions between these two species. Our observations, however, provide direct evidence of overlap in microhabitat use, further supporting Florida Box Turtles as a Gopher Tortoise burrow associate.

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**TERRAPENE CAROLINA (Eastern Box Turtle). NESTING BEHAVIOR.** The classification of box turtles is both complicated and controversial (see Martin et al. 2013. *Molec. Phylogen. Evol.* 68:119–134; Fritz and Havas 2014. *Zootaxa* 3835:295–298). *Terrapene carolina* has been traditionally divided into several distinct subspecies, including the Eastern Box Turtle (*Terrapene carolina carolina*), Three-toed Box Turtle (*Terrapene carolina triungus*), and the Gulf Coast Box Turtle (*Terrapene carolina major*); we follow that convention here. Nesting behavior has been described for each subspecies (see Buchman et al. 2010. *BIOS* 81:84–90; Jackson 1991. *Florida Field Nat.* 19:14–16) and typically involves four distinct stages: site selection, digging, egg deposition, and concealment (Congello 1978. *Proc. Pennsylvania Acad. Sci.*, 52:51–56). This note describes similarities in the nesting behavior across these subspecies, including a description of nest searching behavior and observations suggesting that nest concealment behavior operates as a fixed action pattern.

These observations were conducted on animals in a *T. carolina* colony maintained within a fenced (6.1 × 15.2 m) natural area in eastern Pennsylvania, USA (40.03361°N, 75.33389°W). The study area, which contains oak trees, short grasses, shrubs and milkweed, receives ca. 122 cm of rain/yr, and has both shaded and sunny locations. The turtle colony has been maintained since 1992 and currently consists of eleven box turtles, including six *T. c. carolina* females, three *T. c. carolina* males, one *T. c. triungus* female and one *T. c. major* female. These animals spend the entire year in the study area. During the cold winter months, they dig under leaf litter and become inactive.

Between 14 June and 7 July 2021, five separate nesting events were carefully monitored. These included two successful nests completed by the *T. c. triungus* female (14 June 2021 and 4 July 2021), successful nests completed by two different *T. c. carolina* females (both on 29 June 2021), and a single successful nest completed by the *T. c. major* female (7 July 2021). Each nesting event began between 1700–2000 h, on days when it was raining or about to rain. In each case, the nesting event began with site selection in which the female moved throughout an area of the pen (always preferring the region that receives the strongest sunlight during the day), taking a few steps, then holding her nose to the soil for a few seconds, possibly gathering information on soil temperature and humidity, then moving and repeating. At irregular intervals, the females would use their front legs to pull at the soil following the nose-down behavior. For each nesting incident, site selection continued for at least 2 h with the female moving through the same region several times. This behavior was identical for females from each subspecies.

The next phase of the nesting behavior was digging with the back legs. Nest digging involved a series of stereotyped movements with the back legs, alternating left and right, pulling small scoops of soil out of the ground, creating a hole. In every

nesting event, across all subspecies, the female dug at least one partial “false” nest, which was abandoned as a shallow hole in the ground. One young female *T. c. carolina* performed site selection behavior followed by “false” nesting for eight consecutive days before finally digging a complete nest and depositing eggs.

Nesting behavior (digging a full nest and depositing eggs) always occurred after dark. Following egg deposition, the females began a series of stereotyped movements with the back legs, alternating left and right, pulling loose soil back into the hole. At the point at which the nest was completely covered with soil, each female was lifted off the ground by a researcher. In every case the female continued the synchronized nest covering behaviors, alternating movements of the left and right back legs despite no longer being on the ground. Afterwards each female was moved to new location (not the nest) and, in each case, the nest covering behavior continued.

The continuation of nest covering behaviors, despite being removed from the nest, suggests that this behavior is a Fixed Action Pattern (FAP). FAPs are considered to be neurological programs, which create stereotyped behaviors, which run to completion even if the situation changes and the behaviors are no longer appropriate (see Moltz, 1962. *In* Wortis [ed.], *Recent Advances in Biological Psychiatry*. Springer, Boston, Massachusetts). It is likely that many aspects of reproductive behavior, across many species, function as FAPs, but we believe this is one of the few instances where this has been analyzed in the nesting behavior of turtles.

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**TERRAPENE CAROLINA MAJOR (Gulf Coast Box Turtle). BEHAVIOR.** Eastern Box Turtles (*Terrapene carolina*) are long-lived vertebrates whose life histories preclude rapid recovery from high mortality events. The survival rates of Florida Box Turtles (*Terrapene carolina bauri*) on Egmont Key, Florida, USA, were not impacted by tropical storms that washed saltwater over the island (Dodd et al. 2006. *Ecol App.* 16:1936–1944.). Dodd et al. (2006, *op. cit.*) estimated that it would take ca. 10 years for a population to recover from a major disturbance (assuming no additional disturbances) but suggested that if turtles and other long-lived vertebrates can disperse to non-disturbed refugia during periods of disturbance, disturbance events may have little effect on the long-term status of a population.

While box turtles are primarily terrestrial, soaking and estivation are common (Dodd 2001. *North American Box Turtles: A Natural History*. University of Oklahoma Press, Norman, Oklahoma. 231 pp.; Donaldson and Echternacht 2005. *J. Herpetol.* 39: 278–284). Gulf Coast Box Turtles (*Terrapene carolina major*) are often described as being more aquatic in nature than other *T. carolina* subspecies and tend to use wetland habitats in coastal areas (Carr 1952. *Handbook of Turtles: The Turtles of the United States, Canada, and Baja California*. Comstock Publishing Associates, Ithaca, New York. 542 pp.; Ernst and Lovich 2009. *Turtles of the United States and Canada*. John Hopkins University Press, Baltimore, Maryland. 827 pp.). Gulf Coast Box Turtles have been observed swimming in coastal Mississippi (Heaton 2017. *Herpetol. Rev.* 48:429–430).

In April of 2005, a mark-recapture project for box turtles began at the Grand Bay National Estuarine Research Reserve