REPTILES & AMPHIBIANS

Texas River Cooter, *Pseudemys texana* (Testudines: Emydidae) Carcass Displaying Evidence of Boat-Strike Damage

Lawrence G. Bassett[1] and Michael R.J. Forstner[2]

[1]Clean Rivers Program, Texas Commission on Environmental Quality, Austin, Texas 78753, USA (lawrencebassett@gmail.com)
[2]Department of Biology, Texas State University, San Marcos, Texas 78666, USA

Injuries resulting from collision with the hull or propeller of a boat (i.e., boat strikes) may represent a source of additive mortality for aquatic turtle populations. Such incidents can cause death due to blunt force trauma, or decreased fitness and survivorship due to lingering injuries such as severe scarring and loss of limbs. Turtle populations are sensitive to increased adult mortality due to low annual recruitment and the delayed sexual maturity of individuals (Brooks et al. 1991; Congdon et al. 1993, 1994). Potential sources of additive mortality affecting turtle populations, such as boat strike injuries, are seldom clearly documented despite their potential to influence recruitment. Boat strike injuries have been documented from the marine turtle families Cheloniidae (Phu and Palaniappan 2019; Ataman et al. 2021), and Dermochelyidae (Deem et al. 2006) as well as freshwater and estuarine species from the families Chelydridae (Smith et al. 2018), Emydidae (Bulté et al. 2010; Heinrich et al. 2012; Lester et al. 2013; Smith et al. 2018), Kinosternidae (Bennett and Litzgus 2014), and Trionychidae (Galois and Ouellet 2007). However, to the best of our knowledge, no such report exists documenting boat strike injury for the Texas River Cooter (*Pseudemys texana*).

Pseudemys texana is a large freshwater emydid (SCL_{max} = 343 mm; Munscher and Franklin 2019) endemic to central and south Texas, USA, with populations in the Brazos, Colorado, Guadalupe, Nueces, and San Antonio watersheds (Dixon 2013; Rhodin et al. 2017; Bassett et al. 2020; Ernst and Lovich 2009). Texas River Cooters occupy a variety of water bodies including ponds, lakes, rivers, creeks, irrigation ditches, and cattle tanks. Occupied habitats generally offer plentiful aquatic vegetation and basking sites (Ernst and Lovich 2009). Known anthropogenic threats facing *P. texana* include vehicular traffic and intentional killing by fishermen (Ernst and Lovich 2009). To contribute towards a more complete characterization of the anthropogenic threats facing *P. texana*, we herein provide evidence of apparent boat strike damage from a salvaged *P. texana* carcass.

At 0004 h on 25 June 2022, while sampling for turtles on the Guadalupe River in Comal County, Texas, USA, we collected a *P. texana* carcass that was submerged in shallow water along the river's bank (29.9077 N, 98.3312 W). Extending from the fourth marginal scute (counting counterclockwise from the nuchal scute) to the posterior of the second costal scute (Fig. 1) was a large scar most likely attributable to a boat strike. We are unaware of any predators occurring in the area that would be capable of inflicting an injury of this

Figure 1. Dorsal view of a Texas River Cooter (*Pseudemys texana*) carcass collected from the Guadalupe River in Comal County, Texas, USA. Extending from the fourth marginal scute (counting counterclockwise from the nuchal scute) to the posterior of the second costal scute is a large scar most likely attributable to a boat strike. Calipers are accurate to 1 mm. Photograph by Lawrence G. Bassett.

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size, nor does the nature of the injury match the crushed appearance expected from an automobile strike. It is possible the turtle fell from the limestone cliff on the east side of the river; however, the steep and rugged nature of the cliffs would seem to prevent the prerequisite uphill movement. It is also possible that this turtle, while on land to lay a clutch, was injured when agricultural fields were being disked (Bowers et al. 2021). Other than this single injury, the carcass was well intact and measured 297 mm midline carapace length (Iverson and Lewis 2018), 231 mm maximum carapace width (van Dam and Diez 1998), 255 mm midline plastron length (Iverson and Lewis 2018), 181 mm maximum plastron width (measured as straight-line distance from the lateral margin of each abdominal scute), and 122 mm maximum body depth (van Dam and Diez 1998). The small amount of remaining flesh was manually removed using a Dremel tool equipped with a tile cutting bit. The shell was then preserved with a single coat of polyurethane and submitted to the Amphibian and Reptile Diversity Research Center at the University of Texas at Arlington (accession UTA-R-66126).

The injury exhibited by this specimen appeared to be healed, as evidenced by the remodeled nature of the underlying bone (i.e., carapacial bone had healed in a shape identical to the injury). The scar also possessed structural integrity, not collapsing or cracking when compressed. Therefore, we think that the death of this individual was not a direct result from the injury. From our observations, this site seems to be subjected to a higher frequency of motorized boat traffic in comparison to our other study sites on the river. The Guadalupe River is impounded 22 river km downstream at the Canyon Lake Dam resulting in a deeper, wider river channel that is more suitable for the operation of jet skis and motorboats. Natural obstacles to motorized boat traffic such as riffles and sandbars are lacking with the nearest boat ramp located only 1.2 river km downstream. Substrate at the site is variable including both deep silt and limestone cobble. The riverbank varies from low sloping agricultural fields (westward) to steep limestone cliffs (eastward). While submerged aquatic vegetation is plentiful, emergent vegetation is sparse. Basking structures, primarily in the form of downed woody debris, are abundant.

At this site, we have captured 41 turtles across 25 nocturnal survey hours belonging to three different species: Cagle's Map Turtle (*Graptemys caglei*) (n = 15), *P. texana* (n = 16), and Pond Slider (*Trachemys scripta*) (n = 10). Of these individuals, 21 were juveniles (midline SCL < 62 mm). This specimen is the only turtle we have observed at this site with an apparent boat strike injury, resulting in a moderate frequency of such injuries (frequency of adults [all species] injured = 5%). However, our sample size (n = 20) is small, and a larger sample may produce a dramatically different estimate. Heinrich et al. (2012) reported frequencies of 4–10% for the Suwannee Cooter (*Pseudemys concinna suwanniensis*) whereas frequencies ranging from 0–30% have been reported for *T. scripta* (Smith et al. 2006). Acquiring an accurate estimate of the frequency of such injuries may, however, be unlikely if turtles mortally injured by boat strikes sink to the bottom of the river where they cannot be detected due to the turbid nature of the water and obvious sampling constraints (temporal and financial). Water is especially turbid at this site making such detections in deeper portions of the river impossible.

Boat strike injuries may lead to the loss of reproductively mature turtles from populations and therefore result in lowered recruitment (Brooks et al. 1991; Congdon et al. 1993, 1994). Therefore, boat strike injuries represent a threat requiring documentation and further inquiry. Future work should systematically investigate, with a larger sample size, the frequency of boat strike injuries for *P. texana* and other chelonian species occupying the Guadalupe River at, or near, Canyon Lake Dam where boat traffic is frequent. This is especially worth investigating for the state threatened *G. caglei* given its imperiled status and the evidence of boat strike injuries from the congeneric *G. geographica* in other river systems (Smith et al. 2006; Bulté et al. 2010; Bennett and Litzgus 2014).

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