

Pyric-carnivory: predation of a Texas Tortoise, *Gopherus berlandieri* (Agassiz, 1857), by a Crested Caracara, *Caracara plancus* (Miller, 1777), following a prescribed fire in southern Texas

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Some species have adapted to use disturbances such as fires as an opportunity for predation (Doherty et al., 2022). Fire often attracts raptors and avian scavengers during and post-disturbance because of the increased accessibility of prey items that have been killed, injured, or driven from cover (Komarek, 1969; Hovick et al., 2017; Doherty et al., 2022; Newsome and Spencer, 2022). This behaviour, termed pyric-carnivory (Hovick et al., 2017), is exhibited by the Crested Caracara, *Caracara plancus* (Miller, 1777). In the United States, this raptor's range extends into southern Texas (Rodríguez-Estrella and Rodríguez, 1997; Dunne et al., 2012), overlapping with the Texas Tortoise, *Gopherus berlandieri* (Agassiz, 1857).

Texas Tortoises range from southern Texas to the northeastern corner of San Luis, Potosi, Mexico, and are associated with subtropical brushland and thornscrub vegetation communities within its distribution (Auffenberg and Franz, 1978; Kazmaier et al., 2001). In southern Texas, the documented history of fire pre-European settlement suggests a regular fire regime, with fire return interval estimates ranging from 1-5 years that

ultimately decreased after the introduction of cattle ranching practices (Hanselka, 1980; Frost, 1998; Grace et al., 2005; Guyette et al., 2012; Stambaugh et al., 2014). This suggests that native species have previously persisted with fire as a disturbance, though the effects of fire on the Texas Tortoise have not yet been studied. Here, we present an observation that demonstrates a relationship between prescribed fire and the predation of a Texas Tortoise by a Crested Caracara.

Information regarding the diet of Crested Caracaras is mostly limited to anecdotal evidence (Rodríguez-Estrella and Rodríguez, 1997; Travaini et al., 2001; Morrison and Pias, 2006). Historically considered an opportunistic scavenger with occasional forays into live prey (Rodríguez-Estrella and Rodríguez, 1997; Travaini et al., 2001; Morrison and Pias, 2006; Dunne et al., 2012), the Crested Caracara's diet includes a diversity of invertebrates, reptiles, and small mammals, as well as carcasses and carrion of domestic animals such as cattle (Rodríguez-Estrella and Rodríguez, 1997; Morrison and Pias, 2006; Dunne et al., 2012; Farquhar and Boal, 2022). More quantitative analyses have posited that Crested Caracara diets may include more live prey than previously thought. Over 80% of prey items consumed at nesting sites in Baja California, Mexico were live, similar to habits observed in the eastern extent of their range in Florida where only 20–40% of their diet consisted of carrion (Rodríguez-Estrella and Rodríguez, 1997; Morrison and Pias, 2006). Crested Caracaras are also known for taking advantage of crop harvesting and fires that disrupt the environment of their prey, following behind or patrolling ahead of agricultural machinery or fire fronts to capture fleeing prey (Lyon et al., 2000; Farquhar and Boal, 2022).

Overlap in the distributions and associated vegetation communities of the Crested Caracara and the Texas Tortoise suggests some measure of interaction between

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them in those regions, including southern Texas. Crested Caracaras may act as one common predator of Texas Tortoises. For instance, Hellgren et al. (2000) recorded five instances of predation of Texas Tortoises attributed to Crested Caracaras. Some sources assert the Crested Caracara's reptile prey of choice to be mostly snakes and iguanas (Rodríguez-Estrella and Rodríguez, 1997) or turtle eggs (Dunne et al., 2012; Farquhar and Boal, 2022). However, Honig et al. (2024) documented the majority of vertebrate prey remains beneath a Crested Caracara nest in Waller County, Texas to be that of juvenile turtles of various species, including: Red-eared Sliders, *Trachemys scripta elegans* (Wied-Neuwied, 1838); Eastern Mud Turtles, *Kinosternon subrubrum* (Lacepède, 1788); and a Common Snapping Turtle, *Chelydra serpentina* (Linnaeus, 1758). Though this observation occurred at only one nest, it may suggest that Crested Caracaras prey on turtles and tortoises more than previously believed.

To better understand effects of prescribed fire on Texas Tortoise populations in southern Texas, a project was initiated in 2022 at the East Foundation's El Sauz Ranch in Willacy and Kenedy counties, Texas. The East Foundation conducts a large-scale experimental prescribed fire project that began in 2016, in which pastures (mean area 273 ha) are burned in the summer or the winter. During a survey on the morning following a prescribed fire, at 11:49 h on 20 February 2023, we flushed a Crested Caracara that was standing over a live, adult male Texas Tortoise (straight midline carapace length ~173 mm) flipped on its carapace with a fresh wound on its right hind leg (26.5930°N, 97.4690°W; Fig. 1). The pasture in which we made this observation was burned on 19 February 2023. The skin of the tortoise's leg was pulled back, exposing bone and other tissues, and the area was actively bleeding. Given the circumstances, these injuries appear to have been produced as a result of the predation attempt by the Crested Caracara that had flushed upon our arrival. We returned the tortoise, which was visibly breathing and responsive, to an upright position before leaving the area. On 26 February 2023, we returned to the observation location and found the tortoise was again flipped on its carapace, had since died, and was further predated. Its identification was confirmed by visual comparison of carapace attributes.

This observation is consistent with previously established Crested Caracara behaviour in terms of scavenging during and after environmental disturbances such as fire and tilling. Hovick et al. (2017) observed raptors consuming exposed, injured, or dead reptiles

and small mammals in the wake of fire, and Guinn and Luger (2011) observed Black Vultures, *Coragyps atratus* (Bechstein, 1793), and Crested Caracaras consuming the remains of turtles and other wildlife mortalities post-fire. The more recent acceptance of the Crested Caracara's ability to hunt for live food demonstrates that the Crested Caracara is likely not limited to merely scavenging mortalities directly caused by fire but may also take advantage of the disturbance to hunt newly vulnerable live prey (Rodríguez-Estrella and Rodríguez, 1997; Morrison and Pias, 2006; Lyon et al., 2000; Farquhar and Boal, 2022). After a fire, turtles and tortoises are subject to environmental disturbance pressures such as reduced shelter and food availability and increased exposure to predators (Rose and Judd, 2014). Defensive behaviours by tortoises that facilitate escape from predators typically include using vegetation cover (Nafus et al., 2015; Segura et al., 2020) and avoiding areas such as open, non-woody grasslands and riparian zones where they are susceptible to predators such as Crested Caracaras and raccoons (Genus *Procyon*; Storr, 1780), respectively (Kazmaier et al., 2001). Fire may initially reduce opportunities to engage in these protective behaviours by temporarily removing



Figure 1. Injuries sustained by a live *Gopherus berlandieri* from a predation attempt by *Caracara plancus*, observed the morning following a prescribed fire conducted on the East Foundation's El Sauz Ranch in southern Texas, USA, February 2023. The photograph depicts the *Gopherus berlandieri* as it was found immediately following flushing the *Caracara plancus*. Photo by Camryn M. Kiel.

available cover until vegetation regrowth occurs. This may be especially true for species like the Texas Tortoise that do not engage in the burrowing behaviours of other species in the *Gopherus* genus, and instead use shallow pallets under vegetation (Rose and Judd, 2014). To our knowledge, pyric-carnivory of a Texas Tortoise by a Crested Caracara following prescribed fire has not yet been documented. This observation suggests that the Texas Tortoise may experience indirect effects of prescribed fire on their survival via loss of protective cover in the post-fire landscape that exposes them to predators (Rose and Judd, 2014).

Prescribed fires are often a method used to replicate the historic fire regime, helping to maintain grassland diversity and composition, improve forage and habitat quality, and prevent encroachment of woody growth (Grace et al., 2005; Ruthven et al., 2008). Though prescribed fire can result in direct individual mortality, research suggests that prescribed fire does not have a large, population-level effect on most reptile populations (Lyon et al., 2000; Keyser et al., 2004; Wilgers and Horne, 2006; Ruthven et al., 2008). Moreover, prescribed fire may have beneficial long-term indirect effects on reptile populations by maintaining habitat conditions, increasing herbaceous vegetation diversity, and improving nutritional quality of plants (Russell et al., 1999; Lyon et al., 2000; Haynes et al., 2023).

The effects of fire on tortoises within the *Gopherus* genus varies by species. For the Gopher Tortoise, *Gopherus polyphemus* (Daudin, 1801), fire suppression has been suggested as a factor in population declines because fire maintains open canopy conditions for the species (Russell et al., 1999; Nussear and Tuberville, 2014). In contrast, fire has adverse effects on the habitat of the Desert Tortoise, *Gopherus agassizii* (Cooper, 1863), which inhabits a region that has not evolved with frequent fires (Nussear and Tuberville, 2014). At this time, the effects of fire on the Texas Tortoise have not yet been assessed; however, this note provides important information regarding the relationship between fire and predator-prey dynamics. We suggest further research into the short-term effects that fires may have on avian predators and herpetofaunal prey so that management strategies might better plan for the long-term ecological implications of these influenced predator-prey dynamics.

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