Reading the Ashes: Arson Decimates a Tropical Wetland, But Allows New Observations of a Neotropical Mud Turtle

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All photographs by the senior author.

During a National Science Foundation-funded summer research program for undergraduates, we witnessed the loss of more than 5,000 ha of prime semi-fossorial turtle habitat near Catalina Station, Palo Verde National Park in Guanacaste, Costa Rica. According to park officials, the fire was set intentionally by poachers to allow access to wildlife from the Tempisque River, which borders the park. Natural wildland fires can be devastating, but also beneficial for a local ecosystem; however, human-induced fires are generally more destructive due to lack of perimeter controls and heavy fuel loads. Wetland fires are especially damaging because of the loss of habitat and individuals from species that are not adapted for fast overland motility. Although Cattails (*Typha* sp.) are exotic in this region, they provide habitat for a number of native species, including semi-fossorial turtles. The fire provided a unique opportunity to view a wetland community that we would otherwise have been hard pressed to observe.

As the fire still smoldered in the Área de Conservación Arenal Tempisque, we made a preliminary hike around the southern perimeter of the fire. The landscape was dominated by hundreds of Black Vultures (*Coragyps atratus*) and Crested Caracara (*Polyborus plancus*) feasting on the

An irruption of Black Vultures (*Coragyps atratus*) that arrived to pick up the pieces following the fire.

Remains of Scorpion Mud Turtles (*Kinosternon scorpioides*) consumed by fire at Palo Verde National Park. The individual in the upper right had partially buried itself during the fire.

remains of turtles and other wildlife killed by the fire. The putrid combination of smells from burned flesh, ash, and wetland sludge hung in the air and clung to our clothes. The visual scene was no more appealing; an astonishing abundance of dead turtles was clearly visible even from beyond the border of the fire zone. So dramatic was the effect that front pages of local and national papers included an image of a burned turtle (Campos and Arroyo 2008).

Background

Palo Verde National Park is located 28 km south of Bagaces, Costa Rica in the Tempisque Basin. The park consists of more than 13,000 ha of floodplain, marshes, limestone ridges, and seasonal pools in the middle of the driest region in Costa Rica. Palo Verde serves to connect to two other reserves, the Dr. Rafael Lucas Rodriguez Caballero Wildlife Refuge and the Lomas Barbudal Biological Reserve. The swamplands that connect Palo Verde to the other reserves are threatened by local entrepreneurs who have invested in permits to clear the swamp forest and plant crops, which would further increase the isolation of these reserves (Baker 2004).

The region experiences distinct wet and dry seasons. The lack of precipitation from roughly November to March causes the region to become very dry. During this period, some farmers will intentionally start fires in order to clear land for their crops. In this region, if land is cleared of forest

by natural causes, it is essentially open to farming. Additionally, poachers set fires to improve access to certain coveted wildlife species.

Palo Verde and its surrounding reserves have 15 different habitats, including several types of swamps and marshlands. These habitats provide for a wealth of species diversity ranging from White-tailed Deer (*Odocoileus virginianus*), White-nosed Coati (*Nasua narica*), and American Crocodile (*Crocodylus acutus*) to endangered species including the Great Curassow (*Crax rubra*), Yellow-naped Parrot (*Amazona auropalliata*), and King Vulture (*Sarcoramphus papa*).

Prescribed fire is a beneficial management tool that can maintain or restore desired, historic ecological conditions (e.g., Brockway and Lewis 1997, Carter and Foster 2004). Prescribed burning has become a primary tool of ecosystem restoration in the United States because of the benefits and historical association of fire in some ecosystems (Johnson and Hale 2002). With such an increase in the use of prescribed fires, understanding the effects on wildlife became increasingly important (Ford et al. 1999). Unfortunately, little information exists about the effects of prescribed fire on amphibians and reptiles (McLeod and Gates 1998, Ford et al. 1999, Greenburg et al. 1994, Pilliod et al. 2003). Although some obvious and immediate declines of amphibian and reptilian populations will occur during a wetland fire, vegetative recovery and restructuring might provide better habitat for individual populations — a subject in need of more study.

Recording the Effects

We documented turtles and other species within and around the fire zone by utilizing standardized transect sampling methods. We also attempted to determine turtle densities in different areas of the fire zone by using a stratified-random study design. The fire zone was classified into three categories: (1) Close to the ignition point, (2) close to the terminus of the fire, and (3) an intermediate area. Within each zone, we randomly selected three 1,000 x 1,000-m study plots. Within each plot, we counted turtles within five 300-m transects.

We expected to find an assemblage of turtle species in the wetland, but the Scorpion Mud Turtle (*Kinosternon scorpioides*) was considered the most likely to occur. It ranges at low elevations from southern Tamaulipas, México, southward to northern Argentina, Bolivia, and northern Perú (Ernst et al. 1992). This species is omnivorous and will eat fish, snails, amphibians, insects, algae, and other plants (Vanzolini et al. 1980). It has a high-domed carapace that can measure up to 17.5 cm in length. The carapace has three well-developed longitudinal keels and is an unmarked brown to black in color. The plastron has a single movable hinge between the pectoral and abdominal scutes. The plastron might not be large enough to completely protect the animal when closed (Ernst et al. 1992, Berry and Iverson 2001).

One subspecies of Scorpion Mud Turtle, the Red-cheeked Mud Turtle (*K. s. cruentatum*), was the only turtle observed in the fire zone or adjacent areas. Turtles occurred at a density of 6.33 turtles/transect or 316.5 turtles/ha. This was similar, but slightly greater than the 254 turtles/ha reported by Medina et al. (2007) for another subspecies of *K. scorpioides* (*K. s. albogulare*). In temperate regions, Gibbons (1983) reported 56 *K. subrubrum*/ha and Bonin et al. (2006) reported densities for several species of mud and musk turtles, including 260 turtles/ha for *K. subrubrum*, 229

Additional species killed in the fire zone included Northern Tamandua (*Tamandua mexicana*; A), White-lipped Peccary (*Tayassu pecari*; B), White-nosed Coati (*Nasua narica*; C), and Boa Constrictor (*Boa constrictor*; D).

One of the few Scorpion Mud Turtles that survived the fire, its shell slightly charred, but otherwise unscathed.

turtles/ha for *Sternotherus carinatus*, and 194 turtles/ha for *S. odoratus*. No density estimates were available for *K. s. cruentatum* in other areas.

No significant differences (one-way ANOVA, F = 0.08, P = 0.10) existed in the numbers of turtles observed among site categories, suggesting that turtles did not make large movements away from the ignition point. Mud turtles might be particularly susceptible to fires due to an adaptation to seasonal dry weather; they often burrow in the mud until the next rain (Ernst et al. 1992). This adaptation could be one explanation for why so many mud turtles were killed in the Palo Verde marshland fire. Perhaps they did not try to escape the fire, but instead simply tried to burrow into the sediments. However, Teska (1976) reported substantial movements of turtles in Guanacaste Province during the dry season.

Additional species killed in the fire zone included Northern Tamandua (*Tamandua mexicana*), White-lipped Peccary (*Tayassu pecari*), White-nosed Coati (*Nasua narica*), and Boa Constrictor (*Boa constrictor*) along with several unidentifiable snake species. Other sources (Campos and Arroyo 2008) also listed the Gray Fox (*Urocyon cinereoargenteus*). Documentation of such mobile species and accounts from park officials suggest that the fire was extremely fast-moving. However, these species might have tried to climb or burrow in unsuccessful attempts at escaping the fire. Interestingly, no crocodilians were observed in the fire zone.

While the loss of individuals due to this act of arson cannot be overstated, the insight into turtle communities provided by this research increases park managers' knowledge of the herpetofauna. According to Savage (2002), "very little is known of the life of this common species" (Red-cheeked Scorpion Mud Turtle). Also, during our final transect, we recorded the only living turtles that were observed during our entire time at Palo Verde National Park. Three Red-cheeked Mud Turtles made their way along the fire line, their shells slightly charred, but otherwise unscathed. By the end of our study, fresh green sprouts were already erupting from the ashes. Moll (1990), Gibbons et al. (1983), and Pritchard and Trebbau (1994) suggested that Scorpion Mud Turtles could rapidly move into different areas in response to drought and habitat availability. The outlook for reestablishing the turtle population in this area appears to be very positive.

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