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GOPHERUS AGASSIZII (Desert Tortoise). BURROW COLLAPSE.

In the deserts of the southwestern U.S., burrows are utilized by the Desert Tortoise to escape environmental extremes (reviewed by Ernst and Lovich 2009. *Turtles of the United States and Canada*. 2nd ed. Johns Hopkins Univ. Press, Baltimore, Maryland. 827 pp.). However, the potential for mortality through burrow collapse and entrapment is poorly documented. Nicholson and Humphreys (1981. *Proceedings of the Desert Tortoise Council*, pp. 163–194) suggested that collapse due to livestock trampling may cause mortality. In addition, Lovich et al. (2011. *Cons. Biol.* 10[1]:124–129) documented a Desert Tortoise that used a steel culvert as a burrow surrogate. The culvert filled completely with sediment following a significant rain event, entombing the animal and ultimately resulting in its death. We note that this mortality was associated with an anthropogenic structure; because tortoises are prodigious diggers, one might hypothesize that they have the ability to dig out of collapsed natural burrows in most situations. Circumstances described here presented us with an opportunity to test this hypothesis.

On 5 January 2011, we observed four occurrences of adult telemetered Desert Tortoises (one male and three females) hibernating in separate burrows that collapsed at our study site on a utility-scale renewable energy wind farm (33.95168°N, 116.667295°W; WGS84) in southern Riverside Co., California, USA. In mid December 2010, winter rainstorms in southern California caused the partial collapse of several burrows distributed throughout the study site (Fig. 1). Wet soil above the mouth of the burrows slumped into the openings blocking the entrance. The lengths of the collapsed segments were not measured relative to total burrow length but each completely occluded the burrow opening. The collapsed burrows were not located near any anthropogenic structures.

One Desert Tortoise, a female (CL = 25 cm, mass = 2950 g), was found (5 January) covered with dirt outside of a collapsed burrow from which she presumably extricated herself. By 5 May 2011, this individual had been relocated five times, producing two clutches of eggs, suggesting normal behavior unaffected by the temporary entombment. The second female (CL = 25 cm, mass = 3100 g) also successfully dug out of her collapsed burrow at some point in early February, and by 6 May 2011, had been relocated three times exhibiting normal behavior. The third female tortoise (CL = 23.3 cm, mass = 2750 g) began excavating her burrow, as observed by one of the authors while peering into a small opening in the dirt, but did not complete the process until early April 2011. By 5 May 2011 she has been relocated three times. By mid-April the last tortoise (male, CL = 32.8, mass = 6275 g) was still inside his collapsed burrow, on the right side of center of the original opening (from observer's perspective), apparently unable to extricate himself. A different female tortoise (separate from those above) began excavating into the left side of this male's burrow (from the outside) but did not complete the process. During the course of the spring the soil surrounding the male dried to an adobe-like consistency. On 14 April 2011, one



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FIG. 1. A burrow of *Gopherus agassizii*, approximately 30 cm wide, caved in following winter rains in December 2010. The burrow depicted was the domicile of the third female to excavate herself (April 2011).

of the authors used a shovel to remove soil from the top and left side of the male. Even with the body partially exposed, the tortoise was so firmly embedded in the soil that he could not be lifted out without digging away more soil on the right side of the body. The tortoise was completely encased in hard loamy soil with no space for moving the head, limbs, or body, exactly as the tortoise reported by Lovich et al. (*op. cit.*). It is our opinion that this animal would have remained entombed and would have died if not excavated.

Because of the conditions under which the natural burrows collapsed, the survival of the three female tortoises contrasts with the impending mortality of the male observed in this study. This is likely due to the fact that the females were not entombed in burrows oriented so as to allow the sun to bake the collapsed soil. When entombed under these conditions it appears that some tortoises may be unable to free themselves. Given the digging prowess of Desert Tortoises we hypothesize that this is not a frequent cause of mortality. However, temporary entrapment may result in physiological stress or late egress that translates into a delayed or complete loss of opportunity for early spring feeding and reproduction.

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GRAPTEMYS FLAVIMACULATA (Yellow-blotched Map Turtle). UNIQUE AERIAL BASKING BEHAVIORS. The genus *Graptemys* (Emydidae) is the most diverse genus of North American turtles, with most species occurring within river systems that drain into the Gulf of Mexico (Lindeman, *in press*. *The Map Turtle and Sawback Atlas: Ecology, Evolution, Distribution, and Conservation of the Genus Graptemys*). One of these species, *G. flavimaculata*, is