NATURAL HISTORY NOTE

Opportunism and dietary extremism leading to mortality in the Gopher Snake (*Pituophis catenifer*)

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Reptiles and amphibians feed on a wide range of prey items, typically swallowed whole (Stebbins 1956, Cundall 1983, Duellman and Trueb 1986, Shrine 1991). With the exception of snakes, these predators' prey selection is limited by the size of a fixed gape. Prey selection may target certain species, but opportunism may play a role in predation events (Shrine 1991). Inappropriate prey, opportunistically availed of, may lead to dire consequences in the form of injury or death. In just one documented example (USFWS 2002), mortality from long-term exposure resulted when an American Bullfrog (*Lithobates catesbieanus*) attempted to prey upon too large a California Red-legged Frog (*Rana draytonii*). The bullfrog was unable to move after partially swallowing the prey, and died from exhaustion, exposure, or other consequence. Predation events such as this are rarely witnessed, and compromised predators must often, in turn, fall prey to other predators and scavengers, and thus go unseen.

Snakes can mitigate opportunistic capture of otherwise oversized prey due to a highly flexible midline jaw connection and a mobile jaw hinge that can swing outward; the limit to what they can swallow is dictated by the degree to which their soft tissues can stretch (Kardong 1977). It is rare, therefore, that snakes succumb to mortality due to dietary miscalculation. That said, snake mortalities due to predatory error likely occur more often than reported. We report here on the death by dietary misadventure of three individual Gopher Snakes (*Pituophis catenifer*), a wide-ranging species that preys primarily on small mammals, birds, eggs, lizards, and insects (Stebbins 1956). All three observations are from California, USA; all three snakes died due to the food items consumed; and each observation occurred separate from the others.

In the first example, in Santa Clara County, California, a Gopher Snake was observed on a sunny, early December afternoon. A large mid-body bulge indicated that it had recently consumed prey, and the fact that the snake didn't move when approached indicated it was in distress (from cold or constriction or both). Attempts to warm it failed; the snake subsequently died later that afternoon. Subsequent X-rays revealed it had consumed an adult California Meadow Vole (*Microtus californicus*) (Fig. 1). It appeared that although the snake had consumed the prey when temperatures were adequate for digestion, cold weather had set in abruptly, drastically slowing the snake's metabolic process. The snake likely died of complications related to dysmotility.

In the second case, a Gopher Snake was found recently dead in the field in Tuolumne County, California. The snake had attempted to swallow a bat (Chiroptera; species undetermined). In the process, the bat's wing had pierced the snake's esophagus, musculature, and skin. A portion of the bat's right wing protruded from a laceration in the neck of the snake (Fig. 2), restricting the snake's ability to swallow or to regurgitate the prey item. We surmised that the laceration may have directly killed the snake (conclusion based on the freshness of the snake and lack of other sign), however, if this was not the case, limited mobility might have led to death by predation or exposure, or the severity of the wound might have lead to starvation or fatal infection.

In the third example, in Contra Costa County, California, a Gopher Snake was found dead, adjacent to a juvenile Black-tailed Hare (*Lepus californicus*) around which the snake was coiled (Fig. 3). The Gopher Snake was found with mouth agape and a large laceration in its neck. We surmised that the hare had attempted to defend itself with a bite to the snake's neck, which nearly severed the head and proved to be a fatal wound.

Although there appears to be video and photographic (i.e., anecdotal) observations of miscalculated predation attempts by snakes on novel food items, there is a dearth of published observations of prey miscalculation. The role this may play in the population ecology is currently not understood. In each of these cases it appears that opportunistic predation comes at a risk to predators.

Snakes can mitigate opportunistic capture of otherwise oversized prey due to a highly flexible midline jaw connection and a mobile jaw hinge that can swing outward; the limit to what they can swallow is dictated by the degree to which their soft tissues can stretch (Kardong 1977).

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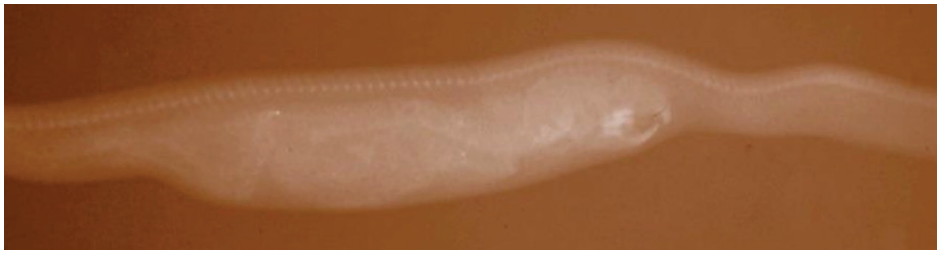

Fig. 1. X-ray of a Gopher Snake (*Pituophis catenifer*) that had recently and unsuccessfully preyed upon a California Meadow Vole (*Microtus californicus*). Photo by J.T. Wilcox.

Fig. 2. Gopher Snake (*Pituophis catenifer*) that had recently preyed upon a bat (Chiroptera) too unwieldy and possibly too large to swallow. Note portion of bat wing (digits 4 and 5 at red arrow) protruding from the snake's neck. Photo by J.C. Dittes.

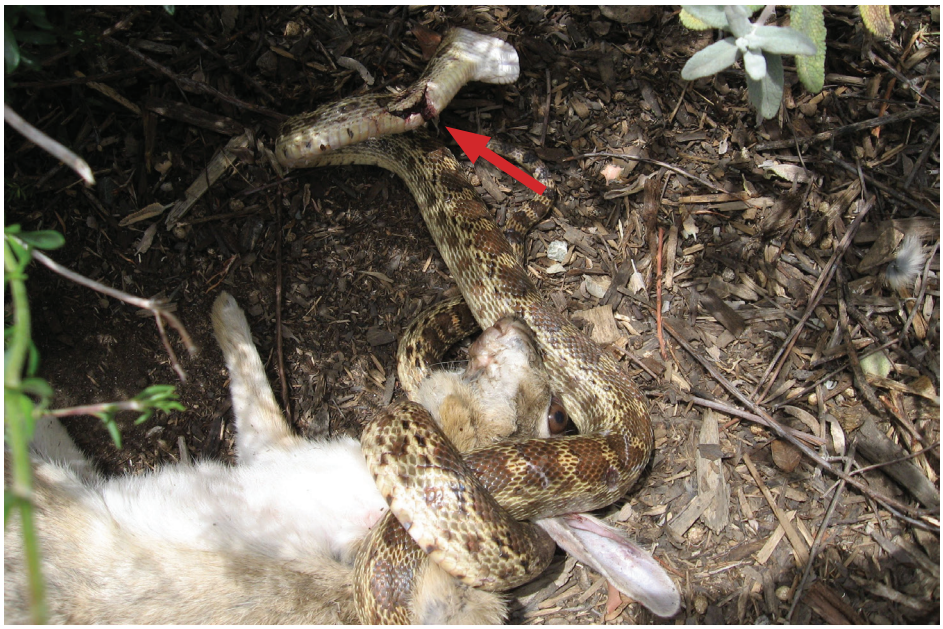

Fig. 3. A Gopher Snake (*Pituophis catenifer*) that had attempted to eat a Black-tailed Hare (*Lepus californicus*) but was mortally wounded in the process. Note severe laceration at the neck (red arrow). Photo by J.E. Howard.