Natural History of the Western Hog-nosed Snake (*Heterodon nasicus*) with Notes on Envenomation

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Figure 1. Western Hog-nosed Snake (*Heterodon nasicus*). Photo by A.T. Holycross.

One of the United States' most comical snakes is the puff adder or spreadin' adder, more formally known as the Western Hog-nosed Snake (*Heterodon nasicus*; Figure 1). The species' namesake characteristic is its upturned rostral scale, which is more prominent and keeled compared to the concave rostral of the more diminutive hook-nosed snakes (*Gyalopion* spp.). The short head with upturned rostral curving along the upper labial scales gives the appearance that the snake has a silly grin on its face; however, its defensive behavior is what is most amusing. When threatened, the Western Hog-nosed Snake may respond with an impressive bluff, spreading its neck and inflating its body (hence the local names by which the species is often known), hissing, and striking with closed mouth. If this fails, the snake may play "possum" by flipping upside down and writhing, mouth open (Figure 2). To further the charade, the snake may hang its tongue lifelessly out of its open mouth. During its "death" throes, the little actor may excrete and smear feces over its body (o.k., maybe this part of the act is less comical than smelly and gross). The ruse is compromised, however, by the fact that if flipped right side up, the deceased immediately flips itself back over to its preferred lifeless pose. On occasion, an individual may also continue tongue flicking while upside down instead of hanging its tongue motionless.

In addition to its unique rostral scale, the Western Hog-nosed Snake's head is further adorned with a chocolate mask and neck blotches. The species is a heavy-bodied snake with keeled scales, gray to tan ground color, and a series of darker blotches down its back and sides. The belly and underside of the tail are black with irregular yellow or orange blotches. The "Plains" subspecies (*H. n. nasicus*) may exceed 90 cm in total length, but the Mexican Hog-nosed Snake (*H. n. kennerlyi* reaches typical lengths of approximately 64 cm (Werler and Dixon 2000).

The Western Hog-nosed Snake ranges from southwestern Manitoba and southeastern Saskatchewan, Canada; south through the U.S. Great Plains states (as far east as Illinois); through Texas, New Mexico, and Arizona; and into Mexico as far south as Zacatecas and San Luis Potosí (Stebbins 2003; Wright and Wright 1957). The species occurs primarily within prairies, open brushland and woodland, farmlands, and river floodplains, occasionally extending into semidesert areas or mountain canyon bottoms (Stebbins 2003). Arizona

contains the Mexican subspecies within semidesert grassland and Chihuahuan desertscrub in Cochise, Graham, Pima, and Santa Cruz counties (Brennan and Holycross 2006). Rosen et al. (1996) found all individuals on the valley floor, none on the upper bajadas, during herpetofaunal surveys of the Sulphur Springs Valley, Cochise County.

Western Hog-nosed Snakes are generally active during mornings and evenings, retreating to below-ground shelter at night and during mid-day. When seeking shelter, the snake uses its specialized rostral scale as a spade to dig into loose sandy or loamy soil. Its keeled body scales also serve as cleats when pressed against a burrow wall to provide a firm grip while rooting into the soil. They also use small rodent burrows, but hog-nosed snakes rarely take cover below logs, boards, or other surface objects (Werler and Dixon 2000). The hog-nosed snake's digging adaptation and behavior also facilitate foraging for amphibians (mostly toads and frogs), reptiles, and the occasional mammal or bird. Particularly unusual prey in Nebraska includes the eggs of the Yellow Mud Turtle (*Kinosternon flavescens*), which may be responsible for the rare development of parental care in a turtle (Iverson 1990; the Desert Tortoise [*Gopherus agassizii*] is the only other chelonian reported to care for its eggs in the wild [Barrett and Humphrey 1986; Murray et al. 1996]). The Western Hog-nosed Snake uses its Jacobson's organ and tongue flicking to follow scent trails to its prey, hidden in a rodent tunnel or in the soil (Werler and Dixon 2000). This species also benefits from keen eyesight and surprisingly quick reflexes to ensnare relatively fast-moving prey on the surface (Kroll 1976), as I personally found out with a captive individual (see Envenomation by Western Hog-nosed Snakes, below). Whiptail lizards (*Aspidoscelis* spp.) have even been found in the diet (Ernst and Barbour 1989).

Hog-nosed snakes do not constrict their prey, although they may press it beneath a loop of their body to help restrain it, and so risk losing vigorously struggling victims. However, Western Hog-nosed Snakes have yet another adaptation to overcome this apparent disadvantage. The generic name *Heterodon* refers to this adaptation and comes from the Greek, heteros (different or other) and odotos (tooth), in reference to enlarged, rear maxillary fangs (Beltz 2006; curiously, Conant and Collins [1991] do not include hog-nosed snakes with other colubrid rear-fanged snakes). These ungrooved fangs normally rest nearly parallel to the snake's head, pointing to the rear. When engaged, skull articulations allow the fangs to rotate downward to a 45-degree angle and penetrate the prey (Kroll 1976; Figure 3). Contrary to popular belief, the fangs are incapable of deflating toads during normal feeding behavior; they are simply too short (Kroll 1976). Rather, the enlarged teeth provide a strong grip and allow the introduction of venom from the salivary glands into the wound (read more about hog-nosed snake envenomation below). Hog-nosed snakes do possess specific adaptations to consume toads, however. Toad skin secretions are toxic to most snakes, but remarkably enlarged adrenal glands provide the hog-nosed snake with physiological resistance to these poisons (Werler and Dixon 2000).

Mating usually occurs in the fall, although females at more northerly latitudes may breed only every other year. In June or July, females lay up to 23 eggs (average 9-10), each almost 4 cm long, below several cm of sandy or loamy soil. The young hatch approximately 50-60 days later and measure 15-20 cm in length. Males may reach sexual maturity as early as 21 months, but females typically require more than 2 years to attain breeding age (Werler and Dixon 2000).

Even though the species has a relatively limited distribution in the state, Western Hog-nosed Snakes currently are not believed to be imperiled in Arizona. The species is not included on the list of Species of Greatest Conservation Need in Arizona (Arizona Game and Fish Department [AGFD] 2006). Although Rosen et al. (1996) only found road-killed specimens during their surveys, this is likely a result of their normally secretive nature but increased visibility – and vulnerability – when basking on paved roads. Hog-nosed snakes occur within the southern Apache Highlands ecoregion identified in Arizona's Comprehensive Wildlife Conservation Strategy (AGFD 2006). Ranching is the dominant land use in this ecoregion, but human population growth, urbanization, traffic, and habitat fragmentation continue to increase. Other stressors to communities within this ecoregion, particularly within semidesert grassland and Chihuahuan desertscrub, include changes in ecological processes, such as unnatural fire regimes and habitat degradation/shrub invasion; climate change; and invasive species, especially exotic plants. AGFD (2006) paints a bleak picture for the future of much of the Western Hog-nosed Snake's habitat in the state and suggests that conservation goals should focus on protection of enough of these areas from development to restore them to ecological function.

Envenomation by Western Hog-nosed Snakes

The Western Hog-nosed Snake possesses a pair of enlarged venom glands behind the maxillae and rear fangs (Figure 3). Venom exits the glands through ducts connecting to the fang sheath. These glands are not enlarged in the Eastern Hog-nosed Snake (*Heterodon platyrhinos*; Kroll 1976). Kroll (1976) tested the effects of *H. nasicus* venom on a sample of 10 Eastern Fence Lizards (*Sceloporus undulatus*) by injecting each with 0.2 ml of venom extract. He found that all 10 lizards exhibited edema within about ½ hour, 7 were immobilized within an average of 1.7 hr, and 5 had died within an average of 3.7 hr (at least one within the first hour). Extracts from two other cranial glands

During the evening the swelling spread to the middle knuckle of my ring finger, so I removed my wedding band to prevent further constriction.

Figure 2. Death feigning by the Western Hog-nosed Snake. Photo by A.T. Holycross.

produced some swelling over longer time periods than from the venom glands, but resulted in immobilization and death in only 2 and 1 lizards, respectively. McAlister (1963) tested the effects of *H. platyrhinos* venom (up to 1.0 ml) on samples of adult male white mice and a series of small anurans and found no effects to the mice, but most of the anurans died within 24 hr. He concluded that *Heterodon* toxins would be ineffectual in producing symptoms in humans.

I witnessed the Western Hog-nosed Snake's quick reflexes, as noted above, and experienced its envenomation first-hand on 9 July 2006. The specimen of interest is a 60-cm (total length) male snake that I collected in Runnels County, Texas, on 23 May 1990 (57 cm at capture) and have since maintained in captivity. The snake readily takes mice, is habituated to feeding, and is very alert to movement near its cage. On 9 July at about 2030h, I was changing its water bowl when the snake darted half way out of the cage's front-sliding door, apparently expecting a mouse. Not having a mouse, I gently placed my hand under its body and lifted it back into the cage. As I was setting it down, the snake whipped around and struck my left fifth finger on the inside surface of the middle knuckle, nearly encircling the entire finger. Since I had not been handling anything that could have left residual scent of a prey item, I initially expected the snake to release my finger when it discovered that it was not a mouse. I placed my hand and the snake on a coffee table to see if it would voluntarily release my finger.

Contrary to my expectations, the snake forcefully began manipulating its jaws and engaged its rear fangs, which I could distinctly feel penetrating nearly to the bone (there's not much meat on my little finger!). Given the extent to which the snake's mouth encircled my finger, and not wanting to injure it during removal, I gently tried to pry its jaws away from my finger with a pencil. This only caused the snake to engage the opposite fang even more vigorously, producing increasingly sharp pain with each contraction of its jaws. Resorting to Plan B, I placed the snake and my finger under moderately flowing water from the kitchen faucet for almost a minute with no relief of the solid grip. Back to Plan A and the pencil: this time I dislodged the right rear fang with one pencil and used a second pencil to disengage the snake's lower jaw, allowing me to free my finger. This entire process lasted approximately 10 min. I then indelicately returned the snake to its cage, carrying it by the tip of its tail (think Crocodile Hunter handling an 8-foot black mamba).

The wounds from the fangs bled freely, and I washed my hand with antibacterial soap and applied an un-medicated band-aid. With relief from the fang-piercing pain, I now experienced a milder stinging sensation in immediate vicinity of bite. My finger swelled slightly from the site of the bite to the distal knuckle, which prevented bending the finger. During the evening the swelling spread to the middle knuckle of my ring finger, so I removed my wedding band to prevent further constriction. By the end of the evening, the swollen area had increased about 5-6 cm along the outside of my hand and itched. On 10 July, the swelling extended an additional 2-3 cm along my hand, had a slight purplish coloration, and I was unable to ball a fist. The stinging and itching had subsided, but was replaced with a slight soreness. On 11 July, my hand had no discoloration, and the swelling was reduced in the fifth finger. My ring finger was still too swollen to wear my wedding band, and the swelling in my hand was similar to the previous day. I experienced mild, throbbing pain all day. On 12 July, all swelling had diminished, but the knuckle at the site of the bite was sensitive to touch or light pressure. Finally, all symptoms had disappeared by 13 July, 4 days after the bite.

Several cases of hog-nosed snake envenomation of humans have been reported in the literature. My experience resembled those from *H. nasicus* bites reported by Bragg (1960), Kroll (1976), and Morris (1985), with various differences. Bragg, bitten on the thumb, experienced swelling about 1/3 the way up his arm; tenderness (not associated with the region of the wound) lasted for a period of about two weeks. Kroll experienced pain extending from a bite on his thumb up to his elbow. Morris suffered oozing blood and fluid until the day after a bite on his right fourth finger and

developed blisters that lasted almost two days. Walley (2002) reported a more serious case, in which a middle-aged male struck on the ankle experienced edema for three weeks, as well as extensive hemorrhaging that covered most of the foot and extended about 10 cm up the leg. Tissues did not return to normal for almost 3 months. Finally, Grogan (1974) reported envenomation from a bite by a *H. platyrhinos* near the wrist of a 16-year old boy. The boy experienced nausea in addition to swelling, discoloration, and tenderness. All pain had dissipated within 2 days, but pus, possibly from a secondary infection, was evident several days later.

Morris (1985) noted that toxic effects had been reported for all recorded bites by *H. nasicus*, but only 1 of 3 by *H. platyrhinos*, suggesting that *H. nasicus* may have venom more toxic to mammals. This is consistent with the toxicity experiments conducted by McAlister (1963) and Kroll (1976), as well as the more specialized amphibian diet of *H. platyrhinos* (Werler and Dixon 2000). The larger venom gland of *H. nasicus* compared to *H. platyrhinos* (Kroll 1976) may also play a role in the amount of venom delivered, thus affecting subsequent reactions.

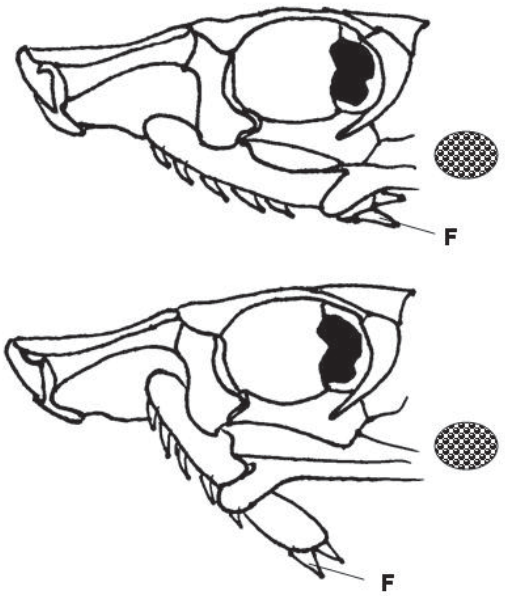

Figure 3. *Heterodon* skull diagram showing rear fangs in resting position (above) and engaged (below). F, fang. Modified from Kroll (1976). The patterned oval shows the approximate location of the venom gland.

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