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ORIGINAL ARTICLE

Ecological aspects of the horned viper, *Cerastes cerastes gasperettii* in the central region of Saudi Arabia

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Abstract Feeding ecology of any species can help us to understand its natural history, ecological requirements and approaches involved in searching for food. Feeding ecology and sexual dimorphism in the horned viper, *Cerastes cerastes gasperetti* collected from the Al-Thumama area, central region of Saudi Arabia was described. The gut content of *Cerastes c. gasperetti* mainly consisted of rodents (70%) in addition to arthropods (15%) and lizards (10%). Least sexual size dimorphism was noticed in the species in terms of total length. Significant difference was noticed between males and females in terms of two correlation points vent tail length (VT) and total length (TL) with the males attaining a larger size ($P < 0.05$). The mean number of the dorsal body scales, ventrals and subcaudals for the females was 102, 156 and 33 scales respectively which were significantly different from respective ones in males 95, 160 and 38 scales. There are many aspects of the feeding of this snake that remain unknown and further studies are clearly needed.

1. Introduction

Snakes are considered to be exceptional model organisms (Shine and Bonnet, 2000), in part because of their unique adaptations for feeding and foraging (Greene, 1997). Limited ecological studies have been done on snakes and lizards of different geographical regions of Saudi Arabia viz., Southern Hijaz (Parker, 1938), Eastern Arabia and Northeastern Arabia (Mandaville, 1967), Central Arabia (Al-Wailly and Al-Uthman, 1971), and Riyadh (Al-Sadoon and Al-Otaibi, 2014). Studies of diet can provide valuable insights into the biology of snakes, including their evolutionary divergence (Colston et al., 2010), movements and habitat use (Heard et al., 2004; Lillywhite et al., 2008; Baxley and Qualls, 2009), interspecific competition and community structure (Nowak et al., 2008), and conservation (Holycross et al., 2002b). Although some snakes are specialists with narrow diets, many exhibit a substantial variation in diet at both individual and population levels (Greene, 1997). Understanding geographic variation in diet can benefit our knowledge of venom composition (Barlow et al., 2009); the relationships between

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environment, body size, and sexual size dimorphism (Amarello et al., 2010); and, potentially, trophic morphology (Vincent et al., 2009).

External morphology of an organism is the outcome of the interaction between the organism itself and the habitat in which it lives (Greene, 1997). Most snake species exhibit sexual dimorphism in body size, with females larger than males (Fitch, 1981). Sexual head size dimorphism has also been documented in rattlesnakes (Glaudas et al., 2008), and may be associated with sexual differences in diet (Vincent et al., 2004).

Body size and various other external characteristics have an impact on the life of an organism, acting on its capacity to adopt itself to face the situations in order to survive, grow up and reproduce (Fornasiero et al., 2007). Sexual size dimorphism in different viper, elapid, and colubrid species has been reported for snout–vent length, relative head size, head shape, relative tail size, and mass (Krause et al., 2003). Another sexual difference among snake species is that males have longer tails than females (Rossman et al., 1996). Due to their relatively simple structure and organization, snakes check variations in morphological and morphometrical features caused by different ecological pressures. Besides, variations in body size and relative body mass have been specifically correlated to the abundance and availability of prey (Schwaner and Sarre, 1988).

The horned viper *Cerastes cerastes gasperetti* (Gasperetti's sand viper) belongs to the family Viperidae which is the most common snake in Saudi Arabia (Al-Sadoon et al., 2013). However, this snake has received little interest, even though it is distributed throughout many deserts, mostly in Egypt, Jordan and Saudi Arabia (Al-Sadoon, 1989). Horned viper is a nocturnal true desert snake and prefers sandy soil with some vegetation as shelters. Horned vipers, which comprise one of the most-studied groups of snakes, are generally recognized as opportunistic predators with varied diets; yet no study has specifically addressed the diet of the species, *Cerastes c. gasperettii*. Therefore, the study of an organism's feeding habits and its external morphology may be a valuable approach to understand the ecological aspects of this species.

2. Materials and methods

A total of 238 specimens (males, $n = 115$; females, $n = 123$) of the horned viper, *Cerastes c. gasperettii* were collected from Al-Thumama area, in the central region of Saudi Arabia for a period of one year from May, 1998–April, 1999. Ecological field studies including morphological characters and the mode of nutrition were carried out. The captured snakes were transported to the Reptilian Laboratory in the Zoology Department, College of Science, King Saud University where all experimental procedures were performed. Animals were kept at ambient temperature and with natural photoperiod.

Standard morphological measures of all specimens were taken and the parameters studied were: snout–vent length (SV), vent tail length (VT) and total length (TL), number of dorsal scales (DS) according to Gasperetti (1988), number of ventral scales (VS) and number of subcaudal scales (SCS).

The animals ($n = 80$) were killed by freezing at −2 °C for 24 h. A mid-ventral incision was made to determine presence/absence of food items in stomach contents and fecal matter. Prey items and stomach, gut, and fecal contents were stored individually in sealed glass vials containing 70% ethanol. Prey items were classified as arthropods, lizards, rodents, or unknown.

The experiments were conducted in agreement with the standards mentioned in the guidelines for the care and use of experimental animals by the King Saud University, Riyadh, Kingdom of Saudi Arabia.

3. Results

Through the study of 238 samples of this species, results showed that *Cerastes c. gasperettii* are similar to *Cerastes cerastes*, but the head is slightly wider and flat and the scales of the upper lip are small and there are no swollen warts on the occipital region. There is a pair of scale like horns above the eyes. But these horns are oblique to the dorsal side and not dorsally vertical as in *Cerastes cerastes*. The head color of *Cerastes c. gasperettii* is different than *Cerastes cerastes*, where the dark diagonal line behind the eyes is thin and relatively longer. The shaded areas on the dorsal site have a parallel weak and faint line, and contain a series of dotted rhombic shapes. *Cerastes c. gasperettii* showed a camouflage character e.g. they become red on sandy soils and gray in desert plains.

In terms of snout–vent length (SV) no significant difference was observed between males and females with the males attaining a slightly longer size than females ($P > 0.05$). Significant difference was noticed between males and females in terms of two correlation points VT and TL ($r = 0.9998$) with the males attaining a larger size ($P < 0.05$). Vent-tail length showed significant differences ($P < 0.05$) as adult males (VT = 62 mm) were longer than females (VT = 49 mm). In case of males VT (62 mm) comprised a significantly larger part of TL (552 mm). However, VT comprised (49 mm) of the TL (538 mm) in females (Fig. 1).

For females the mean number of the dorsal body scales, ventral body scales and subcaudal scales was 102, 156 and 33 scales, respectively, which was significantly different from respective ones in males 95, 160 and 38 scales (Fig. 2). The three correlation points of the dorsal scales anterior (34), mid body (35) and posterior (33) were significantly higher in females than the males ($r = 0.9984$). Table 1 displays the comparison between the results obtained from this study and the results of Werner et al. (1991).

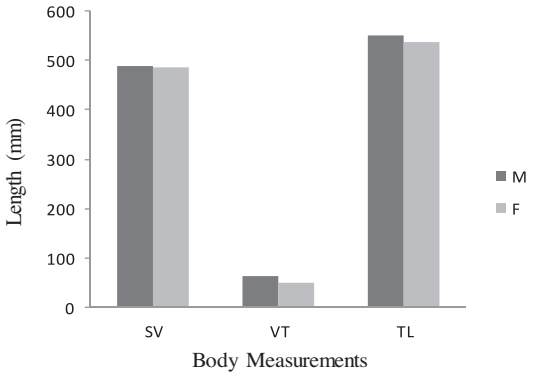

Figure 1 Length measurements for *Cerates c. gasperettii*.