Short Note

Galemys, 26 : 114-118, 2014
ISSN 1137-8700
e-ISSN 2254-8408
DOI: 10.7325/Galemys.2014.N6

Record of predation on the bat *Rhinopoma microphyllum* (Chiroptera: Rhinopomatidae) by the *Spalerosophis microlepis* (Reptilia: Colubridae), in western Iran

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Bats have few natural enemies because are able to benefit from space more efficiently than most predators. Flight and echolocation not only give bats the ability to benefit from dark sky and cave but also evolved them life history traits that enable them to "long live-die late" with the help of high longevity, delayed maturity, low litter size, multiple reproductive events and long postnatal growth (Altrinham 1966). However, there are predators that can seize bats in caves or in sky. The most prominent bat predators mentioned in the scientific literature are owls (Whitaker & Hamilton 1998), hawks, snakes and mammalian carnivores (Hill & Smith 1984). Predation by reptiles or even large arthropods is occasionally documented in the literature (e.g. Molinari *et al.* 2005, Nyffeler & Knörnschild 2013). Some colonies of bats may have over many thousands or millions of bats. These colonies of bats make available a potential concentration of food for many different predators including medium or large sized snakes.

Bats that are reportedly prey upon by snakes comprise several families including Molossidae, Natalidae, Noctilionidae, Phyllostomidae and Vespertillionidae. There are detailed reports of snake predation on various species of these families (Davis 1951, Sánchez-Hernández & Ramírez-Bautista 1992, Hammer & Arlettaz 1998, Esberard & Vrcibradic 2007, Carver & Lereculeur 2013 and Garrido-García et al. 2013). In the present study we report an instance of snake predation on a bat in a summer roost (Bishedraz) in south west Iran.

The Bishedraz Cave (46° 58′ E, 32° 48′ N) locates in Ilam Province in south western Iran. The area includes portions of the southern edges of the Zagros Range in vicinity of the northern Mesopotamian plain at the border of Iran and Iraq. This cave is a part of several large cavities created as a result of collapse in a karst formation. This collapse has exposed a large karst aquifer and two adjacent deep caves. The caves are about 100 meters away from a small village with the same name. The area around the caves is extensively altered for agriculture purposes and almost nothing is left from the natural vegetation cover except in the depth of high valleys. The weather condition in this area is characterized by a hot and dry summer and a winter with no freezing period. Although average annual precipitation in this area is around 300 mm most of this comes as winter or early spring rains. As a result, very few permanent streams and rivers are present in this area. In lowlands of the Mesopotamian plain summer is hot and average maximum temperature in July may approach to 50ºC. However, in some areas where the Mesopotamian plain meets the Zagros range too abruptly a rapid environmental gradient appears as a result of interaction of the cold and wet climatic system from the highlands of the Iranian plateau and the hot and dry climate regime from the northern Mesopotamian plain.

Rhinopoma microphyllum

The greater mouse-tailed bat (*Rhinopoma microphyllum)* is a medium-sized bat with a free tail, inhabiting arid and semi arid regions of the Old World. Records of *R. microphyllum* in Iran are restricted to the northern shores of the Oman Sea and the Persian Gulf and adjacent arid lands in the northern Mesopotamian plain where the climate is characteristically hot and prolonged in summer with no freezing period in winter (DeBlase 1980). Although some reports indicate that *R. microphyllum* enters the Iranian plateau and stays in marginal areas of the Zagros range to the Mesopotamian plain for a short period in summer (Hemmati 2001, Akmali *et al.* 2011), this bat occurs mainly in dry lands of southern parts of Iran. Species of the genus *Rhinopoma* demonstrate well developed morphological and physiological adaptations to their desert life with a valve nostril, efficient kidneys, less capillarized skin and a short gut (Schliter & Qumsiyeh 1996). Similar to other dry habitat bats, *R. microphyllum* is an opportunistic forager and aggregate in large colonies to compensate the shortage and irregularity of food in arid region.

Spalerosophis microlepis

Snakes of the genus *Spalerosophis* are widely distributed in arid and semiarid regions from North Africa in the west through Arabia, Iran, Pakistan to central India in the east. Some authors suggest that six species of this genus occur in the vast area from Northern Africa to the Indian sub-continent. The Iranian species of this genus include two species (*S. diadema* and *S. microlepis*), with *S. diadema* occurring throughout the country except to north and northwestern regions (Latifi 2000) and *S. microlepis* occurring in the Zagros mountains in western Iran (Schätti *et al.* 2009, Fathinia *et al.* 2010) with recently known extended distribution into Iraqi territory in Sulaymanyah (Afrasiab & Mohamad 2014). According to data provided by Baig & Masroor (2008) *S. atriceps* is characterized by its large size (snout-vent length may exceed 1400 mm and total length 1800 mm). *S. microsophis* is probably a fairly common colubrid species in Iran occurring in northern littorals of Persian Gulf and Oman Sea. According to Latifi (2000) maximum total length of *S. microlepis* reaches to 1430 mm.

In the present note we describe the predation on 24th of February 2010 in Bishedraz Cave. The predation was recorded during observation of a bat colony in Bishedraz Cave. In this cave approximately three thousand rhinopomid species including *R. microphyllum, R. hardwickei, R. muscatellum* and *Asellia tridens* have been reported (DeBlase 1980, Hemmati 2001). On this day between 11:45 h and 12:15 h in the main northern corridor of Bishedraz Cave we observed predation of one adult *R. microphyllum* by a *S. microlepis*. In the periphery of a satellite portion of the population of approximately 100 *R. microphyllum* (Fig. 1A) a snake estimated a total length ca. 1.50 m was found in a fissure moving toward the bats (Fig. 1B). The bats had evidently not been aware of the presence of the snake. The authors noticed the act of predation by load distress calls of bats heard at 11:50 (*R. micrphyllum* is a low frequency CF echolocating bat with a peak frequency of about 24 KHZ which can partly be heard by human). The actual capture of the bat was not witnessed by the authors, therefore, the secrecy exhibited during the foraging by the colubride snake was not known. After about five minutes we heard a bat squawking loudly for about 20 seconds before becoming silent and during this period only few bats flew around the predation site. The remaining bats stayed calmly and did not show any signs of distress or mobbing. The intensity of bat movements rapidly declined and snake began flicking toward the bat on a secure fissure on the cliff (Fig. 1C).

When the snake was seen for the first time, an adult *R. microphyllum* was seen wrapped by the snake in two or three coils. At the time, the bat was immobile, but the snake continued to constrict and its breathing was audible. Between 12:15 h and 12:20 h while the snake was tongue-flicking approached the bat (Fig. 1C), re-oriented its body in order to reach to the closest body part; the left forearm (Fig. 1D). The snake commenced forearm-first swallowing, but it had difficulty gulping down to the main body. Following an aborted attempt the snake flicked its tongue on the forearm again and began a second attempt to swallow the bat from the head. While the snake was hanging vertically and, because of the weight of its body and of the bat (Fig. 1E, F), it stopped swallowing several times and elevated more than half of its body onto a fissure on the ceiling of the cave. The snake swallowed the bat completely and its body was located into the fissure. The entire swallowing process lasted 2.45 minutes. The snake remained in a resting position for few minutes and then moved along the fissure and disappeared quickly.

Although the actual capture of the bat was not recorded we assume that great challenges of time and energy go into foraging in a large cave with a high ceiling. *R. microphyllum* is not a true hibernating bat (Schliter & Qumsiyeh 1996) and at the time of observation the bats were active. The determination of the snake to overcome the difficulty presented by the darkness and movement on the high ceiling

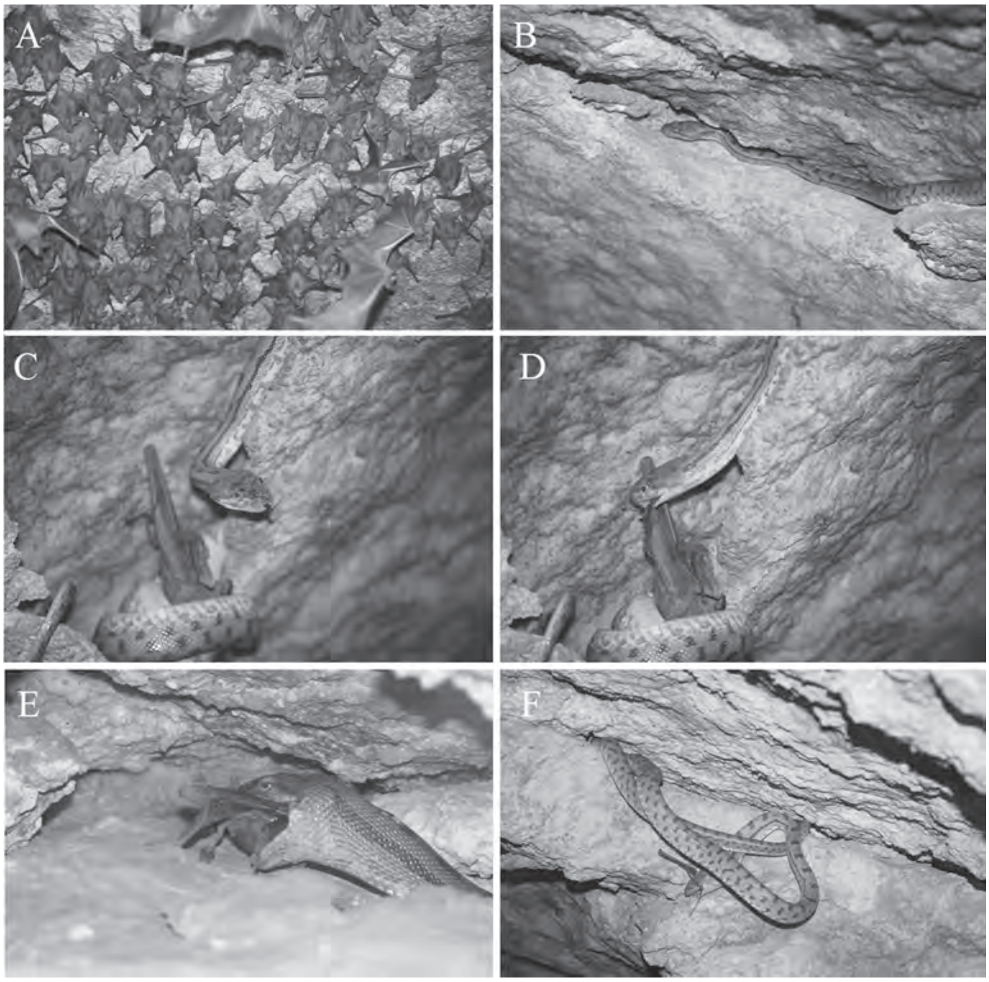

Figure 1. Photographs of the *S. microlepis* capturing large colony of Rhinopomid bats (A), a Colubrid snake approaching the colony (B), tongue-flicking toward dead bat (C), second attempt for swallowing (D) and final swallowing (E and F).

amid many vigorous bats is not surprising. This observation indicates that *S. microlepis* is an active forager and able to climb, proficient at moving along vertical or overhanging rocks. However, we presume that it is easier for this snake to capture crevice-dwelling bats such as *R. microphyllum* and other species of this genus as these species cannot hang vertically from the cave and should use its forehand fingers to hold of sloping surfaces inside a cave.

Esberard & Vrcibradic (2007) suggest two predatory strategies for snakes preying on bats in caves. One is an active search at the entrance of caves for ambushing bats at the time of emerging from the cave and the other is searching inside the cave. In the former case the snakes position themselves close to sites where there is a chance of passage for bats. This type of predation is best documented for Boiid snakes as they have prehensile tails which can help them in hanging from the entrance or ceiling of caves or branches of trees. However, preying on flying bats is not restricted to Boiids and there are several reports indicating that colubrid snakes foraging at or near cave entrances to attack bats that are lying on the ground or clinging to cave walls (Herreid 1961, Hammer & Arlettaz 1998) and sometimes on the wing (e,g. López *et al.* 2005).

Searching inside the dark environment of caves has been reported by both Colubridae and Boiidae. This strategy has been frequently reported for large size Colubrid snakes (Esberard & Vrcibradic 2007). Lewis (1995) suggests that Molossid and Vespertilionid bats which occur in high number in warm and dump roost provide a good hunting ground for snakes. Present study documents a case of predation inside in a relatively large colony of Rhinopomid bats in western Iran. Although the Rinopomatid bats with body mass of 25-30 g are not unusually large for an adult colubrid snake but considering very long wing span of over 85 mm and forearms which may exceed to over 65 mm may become a lethal food for a small Colubrid snake.

Data on predator prey relationship in Bishedraz Cave are lacking. Since this cave is not a nursery roost and is visited as a foraging cave by bats, the snakes cannot rely on the Rhinopomatid bats as a stable food source throughout the year. It is therefore possible that snakes are not permanent residents of the cave. However, the lack of noticeable anti-predator behavior by bats and also presence of large size colubrid snakes and their molted skin remaining (Fig. 2A, B) may imply that the adequate food for growth of the snakes are available during their stay in the cave. Such condition also imply that in an relatively insular environment with a seemingly easy access to high prey density colubrid snakes should also occur at higher densities and tend to gain larger body size to prey more efficiently and also escape intraspecific competition. As has been suggested by various authors (Pafilis *et al*. 2009, Gould *et al*. 2004, Lomolino 2005) we, therefore, suggest that, presence of the high population size of bats with relatively high body mass and the respective increase in food availability the selective pressure may drive the snake to attain what is known as cave gigantism (Pafilis *et al*. 2009). Gigantism as a process by which an organism tends to increase its body size beyond the range of normal size has been reported in insular population in various islands and may be also investigate in Bishedraz Cave (Pafilis *et al*. 2009).

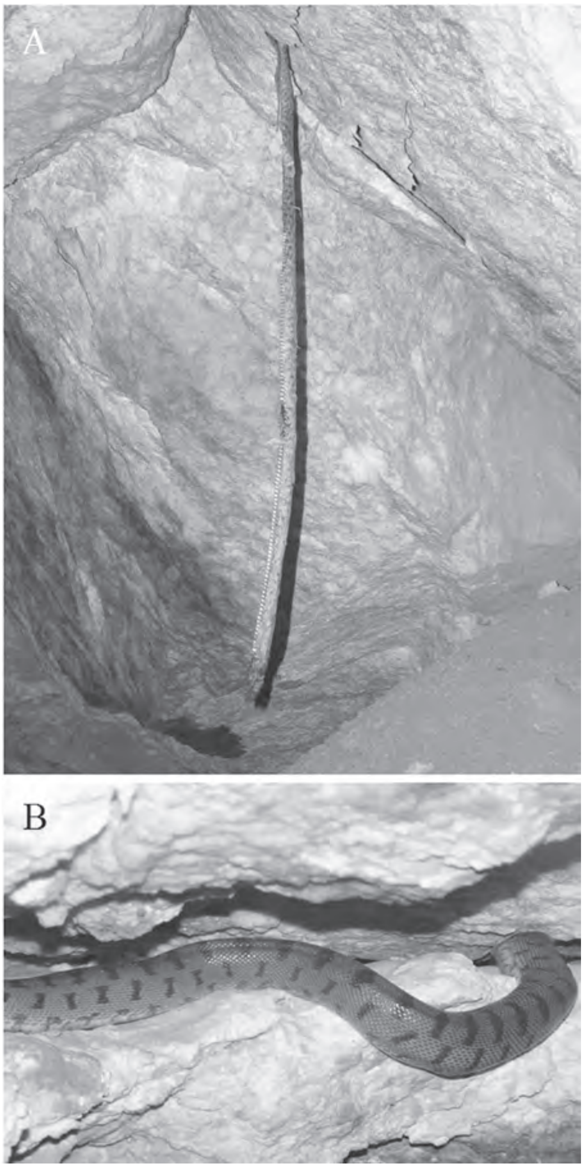

Figure 2. An exuvia of a Colobrid snake hanging from the cave ceiling in Bishedraz Cave (A). A large *S. microlepis* in Bishedraz Cave (B). This exuvia was approximately over 2 meters in length.

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Associate Editor was Óscar de Paz