

## Rare behavioural observations of the Milos Viper, *Macrovipera schweizeri* (Werner, 1935), on Sifnos Island, Greece

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*Macrovipera schweizeri* (Werner, 1935), commonly known as the Milos Viper or Cyclades Blunt-nosed Viper, is a venomous snake of the family Viperidae. The Milos Viper is endemic to four Greek islands of the Milos Archipelago in the western Aegean Sea (Fig. 1): Milos, Kimolos, Polyaiagos, and Sifnos (Adamopoulou et al., 1997). The Milos Viper is categorized as an endangered species by the IUCN (Böhme et al., 2009) and has an estimated total population size of only around 3000 individuals on Milos (Nilson et al., 1999). Approximately 2500 of the estimated 3000 total individuals on Milos occur on the westernmost part of the island (Nilson et al., 1999), and just a few hundred individuals occur on each of the other three islands. Historically, the Milos Viper has been threatened by persecution by humans, mining activities on Milos (Nilson et al., 1999), which is volcanic in origin and contains over 200 mines that extract baryte, bentonite, kaolin, manganese, and perlite ([www.miningreece.com](http://www.miningreece.com)). Increased road traffic from tourism and mining development has negatively impacted this species, causing a high number of roadkills, and conservation efforts have focused on providing under-road tunnels to allow snakes to move safely across these road barriers. While the total number of Milos Vipers seems to have stabilized in recent years, this species is somewhat rare, particularly on the other three islands, where far fewer individuals appear to occur.

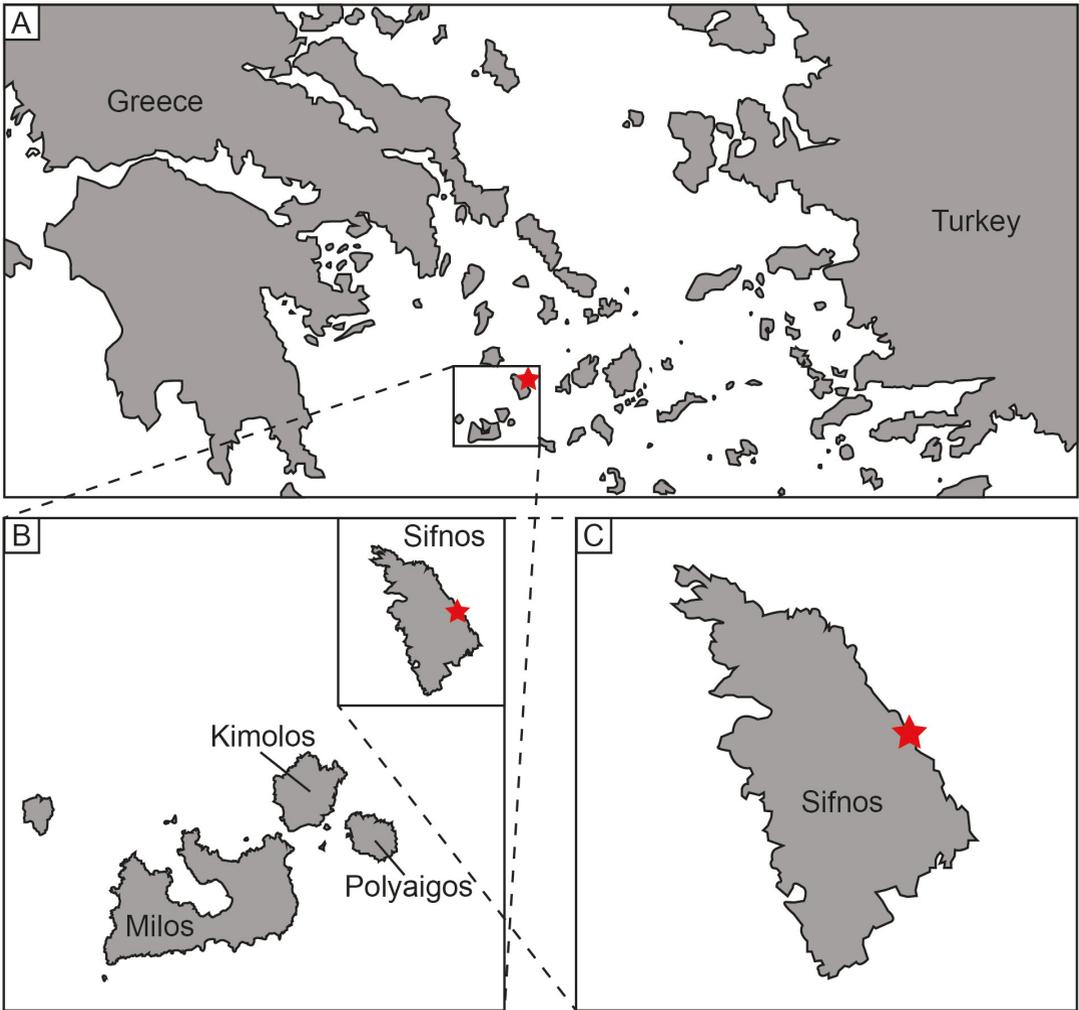
Due to a combination of its elusive nature and endangered status, relatively little is known about the ecology and behaviour of the Milos Viper (Adamopoulou et al., 1997; Nilson et al., 1999). A geographic break between the Milos Island cluster and the central Cyclades from Pliocene sea-level rise (Dermitzakis, 1990) means that the Milos Viper has been biogeographically isolated from other related viper species for millions of years (Nilson et al., 1990). This species is oviparous (Arnold and Burton, 1978), generally breeds once per year in late spring, and lays comparatively small (ten or fewer eggs per clutch) clutches (Schweizer, 1932; Triet, 1981; Cattaneo, 1989; Nilson et al., 1999). Adult *M. schweizeri* range from 35–80 cm in total length (Nilson et al., 1999), which is much smaller than its sister species *M. lebetinus* in Cyprus or Turkey, which easily grow to > 100 cm. Their preferred habitat seems to be densely vegetated areas with bushy maquis vegetation to “bush bask” or remain hidden while thermoregulating (Nilson et al., 1999). Indeed, a study found that the viper was completely absent from areas without either dense grassy vegetation or large bushes (*Pistacia lentiscus*, *Genista acanthoclada*, *Juniperus phoenicea*, *Nerium oleander*, *Myrtus communis*, and *Olea europaea*) (Nilson et al., 1999). During the breeding season in mid-May, vipers tend to congregate in vegetated areas near freshwater or in valleys (Nilson et al., 1999). The diet of younger vipers consists primarily of lizards (*Podarcis milensis*, *Ablepharus kitaibelii*, *Mediodactylus kotschyi*, *Hemidactylus turcicus*, and *Lacerta trilineata hansschweizeri* eggs). Adult diets primarily consist of birds (Nilson et al., 1999), but a few lizards and small subadult rats (*Rattus rattus*) have been found in the digestive tracts of museum specimens (Adamopoulou et al., 1997). Previous studies suggest that this species is mostly nocturnal, with some crepuscular activity in the summer months (Adamopoulou et al., 1997; Nilson et al., 1999). Foraging activity usually takes place at night, when vipers will ascend trees and wait for bird prey to strike (Nilson et al., 1999). However, in the early start of the breeding season and cooler months in late autumn, individuals have been observed basking and hunting

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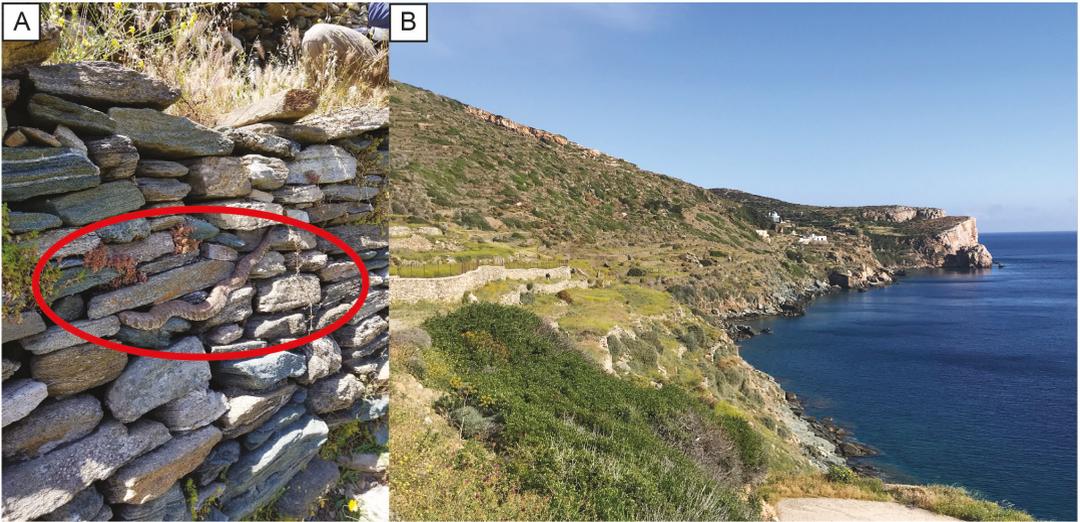
**Figure 1.** Map of Greece (A), the Milos Island cluster (B), and the site on Sifnos where we made our observation (C). The snake we observed was located on an eastward facing dry stone wall along a coastal hiking trail.

migratory birds in tree branches (Stephanos Roussos, pers. comm.).

On 16 May 2019 at approximately 15:52 h, while on a herpetological expedition to Sifnos concerning the Aegean wall lizard, *Podarcis erhardii* (Bedriaga, 1882), we observed an adult Milos Viper actively foraging on a drystone wall (Fig. 2A). The day was warm, partially overcast, and windy (approximately 4 on the Beaufort wind scale) at the time of the sighting. Our team was slowly working its way along a coastal hiking trail starting near Sifnos Castle and ending our daily expedition at Panagia Poulati Church northwest of the castle (Fig. 2B). This trail ran parallel and adjacent to the coastline with no observable freshwater sources in the vicinity. A dry,

stone wall runs the entire length of this trail segment and the trail itself sits on the elevated terrace created by the placement of this stone wall in the steep slope of the hill, which runs down towards and terminates at the sea's edge.

The first author first observed the snake when it was rearing its head back to enter a crack in the dry, stone wall (36.9799°N, 24.7380°E, elevation 10 m). The snake was spotted moving along the rock wall with its back facing the sea (Fig. 2A). It initially travelled at a relatively relaxed pace and was probing its head into and out of the many crevices provided by the loose-fitting stones of the wall. The snake appeared to be hunting, as it surveyed several crevices along the wall, which is known to host a high-density population of Aegean wall



**Figure 2.** (A) An adult Milos Viper (*Macrovipera schweizeri*) foraging for wall lizards (*Podarcis erhardii*) along a coastal hiking path on Sifnos Island, Greece. (B) East-facing hiking path, where we observed the viper actively foraging at mid-day. Photos by Robert Degen.

lizards (nine lizards per 100 m of transect length). The first author was able to observe the entire snake as it moved along the wall and estimated its total length to be around 80 cm. The individual appeared healthy, with no observable injuries or maladies. The entire team kept an appreciable distance from the snake and never attempted to catch it. The snake noticed us after a few minutes of observation and quickly fled the stone wall by flinging its head and forebody away from the wall, dropping itself into the dense vegetation. It moved quickly away from the stone wall and concealed itself in the tall grass and dense shrubs growing on the terrace.

Our encounter with this Milos Viper was unusual in several ways. Firstly, a detailed radio telemetry study (Nilson et al., 1999) found that this species was practically nocturnal during the time of year when we made our observation. This particular individual was observed moving quickly in search of prey in the midday summer sun. Secondly, this species tends to favour inland habitat with more mature vegetation and water than the coastal areas during this time of year (Nilson et al., 1999). We observed this individual along a relatively dry and exposed hiking trail with substantial human activity and exposure to sun and high winds. Finally, we believe this individual was hunting for wall lizards, which according to prior diet studies, do occur in the stomachs of dissected specimens but do not usually make up a significant portion of the adult Milos Viper diet

(Adamopoulou et al., 1997; Nilson et al., 1999). Rodents, such as mice (*Mus musculus* and *M. domesticus*) and rats (*Rattus rattus*), may also be present in dry stone walls where the viper we observed was hunting. However, we did not observe any rodents in the walls we surveyed.

On Sifnos, there are relatively few vipers compared to Milos, possibly due to less overall area with mature vegetation and water sources that the viper seems to prefer (Nilson et al., 1999). Additionally, few researchers have explored Sifnos for vipers, so small population estimates could also be due to sampling bias. Future studies should investigate ecological differences of Milos Viper populations on the different islands it inhabits. These four islands where Milos Vipers occur differ substantially in vegetation structure, human activity, and snake population densities (Nilson et al., 1999). Thus, the ecology and behaviour of Milos Vipers may vary from island to island, which could be important to its conservation. Most published literature concerning the Milos Viper (of which there is little) focuses on the larger Milos population. However, we advocate for a greater understanding of the similarities and differences among island populations of this snake to better help conserve this endangered species across its range.

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