Mountain wolf snake (*Lycodon r. ruhstrati*) predation on an exotic lizard, *Anolis sagrei*, in Chiayi County, Taiwan

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ABSTRACT – The Mountain wolf snake (*Lycodon ruhstrati ruhstrati*) is a common snake species at low elevations all over Taiwan. Still, it appears to be poorly studied in Taiwan and adjacent areas since little has been reported about this species. On 26th August 2002 ten *L. r. ruhstrati* eggs were obtained from an adult female, one of two that were caught a day before, and eight of the eggs hatched successfully on 14th October 2002. While in captivity all the adults preyed upon *Anolis sagrei*, which were given to them as prey, while two neonates accepted *A. sagrei* hatchlings offered to them as food. On February 18th, 2006, a DOR Mountain wolf snake, with an *A. sagrei* in its stomach, was found on a tarred road in Santzepu, Sheishan District, Chiayi County. This appears to be the first report from Taiwan of the Mountain wolf snake (*L. r. ruhstrati*) preying on the exotic introduced lizard *A. sagrei*.

THE common name 'wolf snake' refers to members of the genera *Cryptolycus* – 1 species, from Mozambique; *Lycodon* – 26 species, distributed over Asia; and *Lycophidion* – 15 species, inhabiting tropical and southern Africa (Coborn, 1991; Mattison, 1999). Their common name derives from their enlarged curved teeth, which are used for capturing lizards such as skinks (Greene, 1997).

The Mountain wolf snake (*Lycodon ruhstrati*), formerly classified as *Dinodon septentrionale* and *Ophites ruhstrati* (Ota, 1988), can be found in Indo-China, central to southwestern China, as well as Hong Kong and Ryukyu Island, and *Lycodon ruhstrati ruhstrati* is the only member of these peculiar snakes that naturally occur in Taiwan, where they tend to inhabit mountainous areas below 2000 m, as well as gardens, rice paddies and other agricultural areas, and secondary forests all over Taiwan (Kuntz, 1963; Lazell, 1999; Lue *et al*., 2002). Although this is a fairly common species (Kuntz, 1963; Maki, 1931), apart from its distribution and possible prey, it seems that very little has been reported about this snake and its natural history is thus most likely poorly understood.

Introduced populations of the Brown anole (*Anolis sagrei*), also known as *Norops sagrei* (Köhler, 2000; Lee, 2000), have been recorded in Jamaica (Roughgarden, 1995, Landwer *et al*., 1995) (Note: It is not definite that *A. sagrei* was introduced into Jamaica by anthropogenic activities as opposed to getting there by natural dispersal (J.B. Losos, *personal communication*)), Grand Cayman (Roughgarden, 1995), Arkansas (McAllister *et al*., 2003), Texas (Conant & Collins, 1991), Louisiana (Steven & Lance 1994), Georgia, northeastern Florida and all Florida counties southeast of the Suwannee River (Campbell, 1996; Campbell, 2003), México to Belize (Calderon *et al*., 2003; Rodriguez Schettino 1999; Schwartz & Henderson, 1991), Granada, West Indies (Greene *et al*., 2002), Hawaii (Goldberg & Bursey, 2000) and Taiwan (Norval *et al*., 2002). Here we report what appears to be the first reported case of a Mountain wolf snake (*L. r. ruhstrati*) predation on the exotic introduced lizard *A. sagrei* in the wild.

MATERIALS AND METHODS

On 25th August 2002, two adult *L. r. ruhstrati* females were captured in the shower of the administration building of the Taiwan Flower

Biotechnology (TFB) nursery in Santzepu, Sheishan District, Chiayi County (23º25'51"N, 120º28'30"E). The snakes were given to Norval for examination. Due to time constraints, he decided to leave the snakes in their containers until the following morning. When the snakes were removed for examination the following morning, it was found that the largest of the two females (female-A) had laid 10 eggs. Since the eggs had not whitened completely and were still soft it is believed that oviposition most likely took place earlier that morning. On 14th October 2002 eight eggs hatched, but only six of the neonates survived.

As part of an investigation whether *L. r. ruhstrati* would prey on the introduced brown anole (*Anolis sagrei*, also known as *Norops sagrei*) (Norval *et al*., 2002), which also occur in the area surrounding the nursery, live *A. sagrei* were collected from the wild and offered as prey items to the adult and neonate snakes. The sex, SVL, TL (measured to the nearest mm with a ruler) and mass (measured to the nearest 0.1g with an electronic scale) of the lizards were recorded before placing them in the containers containing the snakes. If predation did not take place within 48h, the lizard was removed and the trial was scored as failed to predate. The date on which predation took place was noted if it took place. Upon completion of the study, the snakes were released (the adult females on 9th October 2002 and the neonates on 18th November 2002) back into the wild in the vicinity where the adult females were collected.

On February 18th, 2006, at 10:38 h, a DOR (dead on road) Mountain wolf snake was found on a tarred road in Santzepu, Sheishan District, Chiayi County (23º25'41"N, 120º29'20"E; datum: WGS84). The road is bordered on the eastern side by a betelnut palm plantation (*Areca catechu*), and on the western side by a temple and some residences. Vegetation such as *Ampelopsis brevipedunculata* var. *hancei*, *Bidens pilosa*, *Cardiospernum halicacabum*, *Ipomoea cairica*, *Ipomoea obscura*, *Melastoma candidum*, *Mikania micrantha*, and *Panicum maximum* make up the under-story vegetation of the betelnut palm plantation. Brown anoles (*A. sagrei*), *Eumeces elegans*, *Hemidactylus frenatus*, *Japalura swinhonis*, *Mabuya longicaudata*, *Sphenomorphus indicus*, and *Takydromus formosanus* were the only lizard species observed in this area, and the only other snake species observed were *Amphiesma stolatum*, *Bungarus multicinctus multicinctus*, *Dinodon rufozonatum rufozonatum*, *Elaphe carinata carinata*, *E. taeniura friesei*, *Naja atra*, *Oligodon formosanus*, *Ptyas korros*, and *Xenochrophis piscator*.

The snout-vent length (SVL) and tail-length (TL) of the two adult females were measured to the nearest millimeter and they were weighed to the nearest 0.1g with an electronic scale. To avoid injury to the neonates, they were not sexed and were measured by being placed next to a small ruler for scaling under a white sheet, which was on an EPSON PROFESSIONAL 1650 scanner set to scan at 400 dpi, and scanned at 100% (Mao *et al*., in preparation). All the neonate measurements were then recorded from these scanned images. The neonates were also weighed to the nearest 0.1g with an electronic scale.

The SVL and TL of the DOR snake was measured to the nearest millimeter, using a transparent plastic ruler, and the body mass was weighed to the nearest 0.1g with a PROSCALE BEB-250 digital scale. It was then dissected by making a mid-ventral incision with a surgical scissor. The stomach appeared to be containing a prey item, and an incision was therefore made in the stomach wall to remove the stomach contents. The snake and stomach content were fixed and preserved in 75% alcohol.

Using a transparent plastic ruler, the stomach contents – the remains of a lizard – was measured to the nearest millimeter, after which it was identified to the lowest possible taxonomic category based on the scales of the tail, limbs, and digits.

RESULTS

The mean SVL, TL and body mass of the adult *L. r. ruhstrati* were 585 mm (SD = ±42.43), 75.5 mm (SD = ±21.92), and 20.35g (SD = ±6.29), respectively. On 14th October 2002 the six live neonates had a mean SVL, TL and body mass of 156.8 mm (SD = ±22.53), 56.9 mm (SD = ±5.98), and 2.2g (SD = ±0.46), respectively. Exactly a

Snake species (as predator)	*Anolis sagrei* (as prey)				Trial	
	Sex	SVL (mm)	TL (mm)	Mass (g)	Date	Result
Lycodon r. ruhstrati (female A)	F	31	62	1	09-09-2002	P 09-09-2002
	F	31	61	1	17-09-2002	P 17-09-2002
	F	30	54	2.3	26-09-2002	P 26-09-2002
Lycodon r. ruhstrati (female B)	M	30	66	1.4	09-09-2002	P 09-09-2002
	M	55	55	5	17-09-2002	P 17-09-2002
	F	45	92	0.5	26-09-2002	P 26-09-2002
Lycodon r. ruhstrati (neonate A)	M	19	32	0.2	15-11-2002	F
Lycodon r. ruhstrati (neonate B)	F	19	30	0.1	15-11-2002	P 16-11-2002
Lycodon r. ruhstrati (neonate C)	F	20	15	0.2	15-11-2002	F
Lycodon r. ruhstrati (neonate D)	F	23	41	0.3	15-11-2002	F
Lycodon r. ruhstrati (neonate E)	M	17	30	0.1	15-11-2002	P 16-11-2002
Lycodon r. ruhstrati (neonate F)	M	19	32	0.2	15-11-2002	F
Dinodon r. rufozonatum (Male; SVL-630, TL-150, 43.5g) obtained 08-08-2003	F	45	59	2.6	15-08-2003	P 15-08-2003
	M	51	101	4.3	27-08-2003	P 27-08-2003
	M	55	120	4.9	05-09-2003	P 05-09-2003
	F	41	77	2.0	05-09-2003	P 05-09-2003
	M	50	104	3.9	17-09-2003	P 17-09-2003
Elaphe c. carinata (Female; SVL-378, TL-108, 20.6g) obtained 11-09-2003	M	47	85	3.4	17-09-2003	P 17-09-2003

Table 1. *Lycodon r. ruhstrati* individuals used in *A. sagrei* predation trials, as well as the outcome of each trial (P - Predation took place, F - Predation failed to take place). For snake species other than *L. r. ruhstrati*, dimensions are provided - measured on the day the animal was obtained.

month later, the six neonates had an average SVL, TL and body mass of 172.4 mm (SD = ±22.22), 61.7 mm (SD= ±6.57), and 1.9 g (SD = ±0.45), respectively.

Both the adult *L. r. ruhstrati* accepted the *A. sagrei* that were offered to them as prey, while only two neonates preyed on the *A. sagrei* hatchlings offered to them (Table 1).

The DOR *L. r. ruhstrati* had a SVL, TL, and pre-dissection mass of 626 mm, 153 mm, and 46.3g, respectively. A partly digested male *A. sagrei* (TL – 120 mm) was retrieved from the stomach. From the scalation of the tail, it was determined that this individual had never experienced tail-loss.

DISCUSSION

Even though the Mountain wolf snake is a common snake species in Taiwan, its small size and nocturnal nature may make it an unsuitable study subject, which may explain why so little has been reported about this species. This may also be the case for many other *Lycodon* species. Mattison (1999), for example, stated that the taxonomy of this

genus is not clear and that the number of species may be exaggerated. In India, where six *Lycodon* species occur, nothing is known of the diet and reproductive behaviour of *L. flavomaculatus* and *L. travancoricus* (Das, 2002). For that reason chance observations, like the ones described in this paper, should be reported not only to develop a better understanding of the natural history of the species in question, but also to highlight the aspects that require more research.

The feeding behaviour and dietary preference of the Mountain wolf snake is very poorly reported. Pope (1929) stated that this species is saurophagus, although, according to Lue *et al.* (2002) they might also be insectivorous. Ota and Azuma (2006) reported feeding *L. r. multifasciatus*, a related subspecies from Okinawa (Goris & Maeda, 2004), in captivity tropical house geckos (*Hemidactylus frenatus*). Under captive conditions, in the predation trials we also noted that the adults, as well as the two largest neonates of *L. r. ruhstrati* preyed on *A. sagrei* that were offered to them as prey. Although one should be cautious when interpreting predation under captive conditions, the predation trials, as well as the stomach content of the DOR *L. r. ruhstrati*, confirms that these snakes are indeed saurophagus, and even more importantly, they are natural predators of the exotic lizards. The fact that the adults so readily accepted the exotic Brown anole as food items may indicate towards a possible important ecological role for *L. r. ruhstrati* in the biological control of the brown anole in this region. The question remains, however, why didn't the other neonates prey on the *A. sagrei* offered to them? Were they simply too big to handle, or do very small *L. r. ruhstrati* neonates prey on another type of prey, and if so, what prey? This also raises the question about how these snakes capture their prey. While conducting fieldwork, between the 1st of September 2005 and 1st of November 2006, on three occasions, *L. r. ruhstrati* were encountered in the study area on vegetation. In addition to that, another four *L. r. ruhstrati* were captured in traps set in the study area to collect terrestrial reptiles, and from this, it can be deduced that these snakes are semi-arboreal. But it is still not clear how these snakes locate and capture their prey. Like all the other biological aspects of this snake species, the feeding behaviour requires more in depth study.

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