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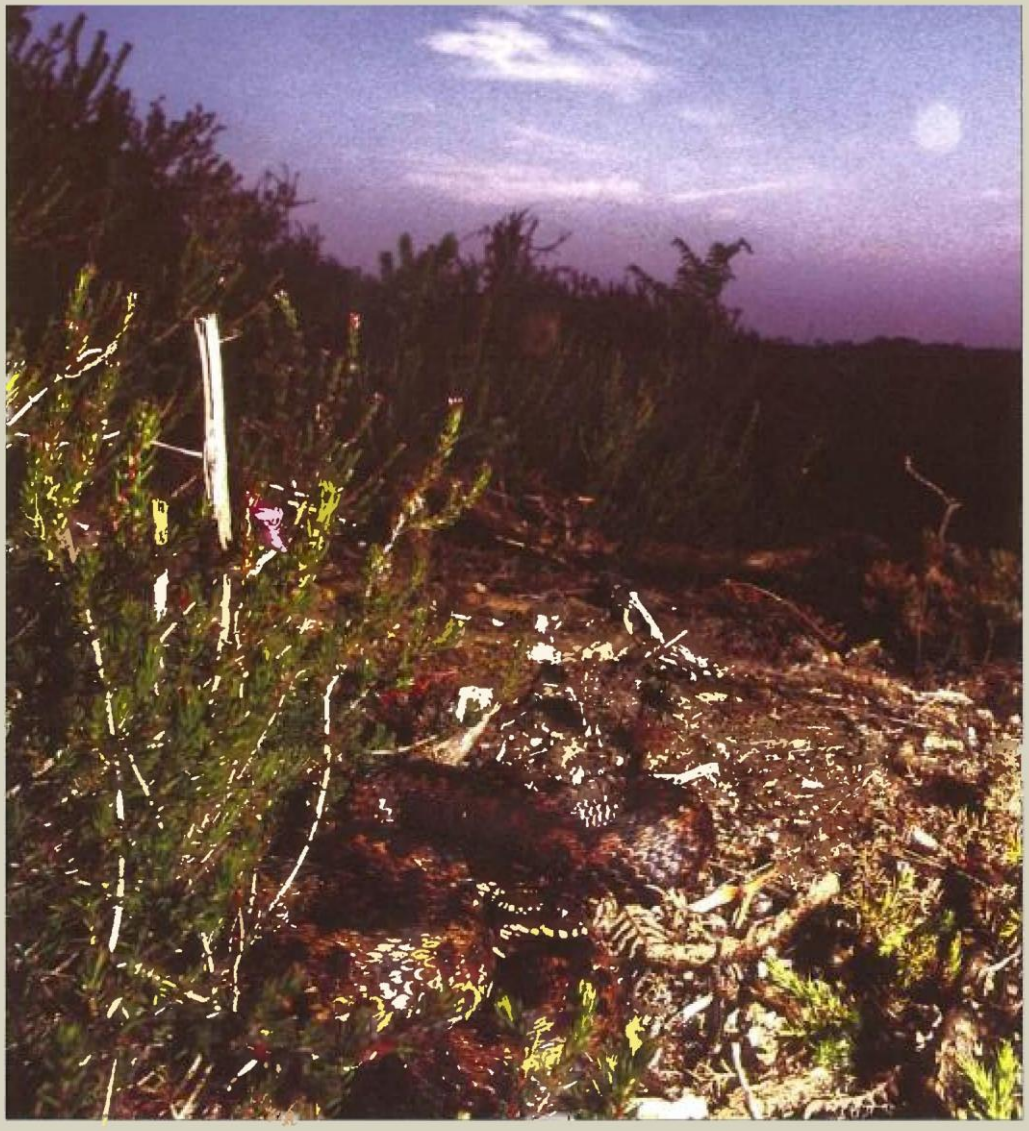

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THE HERPETOLOGICAL BULLETIN

The **Herpetological Bulletin** is produced quarterly and publishes, in English, a range of articles concerned with herpetology. These include full-length papers of mostly a semi-technical nature, book reviews, letters from readers, society news, and other items of general herpetological interest. Emphasis is placed on natural history, conservation, captive breeding and husbandry, veterinary and behavioural aspects. Articles reporting the results of experimental research, descriptions of new taxa, or taxonomic revisions should be submitted to The Herpetological Journal (see inside back cover for Editor's address).

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Contents

Seasonal variation in dietary preferences of a Hispaniolan anole, *Anolis longitibialis*
Brian E. Fontenot, Matthew E. Gifford, and Robert Powell 2

Aspects of the ecology and conservation of the Meadow Viper, *Vipera ursinii*, in the Duchessa Mountains Natural Park (Latium, central Italy)
Ernesto Filippi and Luca Luiselli 5

Ecological parameters of the Northern Brown Snake, *Storeria dekayi*
Carl. H. Ernst 10

The herpetofauna of Annobon island, Gulf of Guinea, West Africa
José Jesus, António Brehm, and D. James Harris 20

Learning of a trial and error escape routine in an Arizona Mountain Kingsnake (*Lampropeltis p. pyromelana*)
Robert Bustard 23

NATURAL HISTORY NOTES

Bitis gabonica (Gaboon Adder): Unusual mortality
Tony Phelps 24

Vipera berus (European Adder): Hot weather behaviour in Purbeck, Dorset
Tony Phelps 26

Natrix natrix (Grass Snake): Albino hatchling
John Baker 27

Natrix natrix (Grass Snake): Unusual markings
Tony Phelps 28

BOOK REVIEWS

Amphibians and Reptiles of Nepal, Eds. H. Hermann Schleich and Werner Kästle
Mark O'Shea 30

The really useful handbook of reptile husbandry, by Caroline Gosden
David Blatchford 31

Information for contributing authors is available at: http://www.thebhs.org

Front cover illustration. Female Adder (*Vipera berus*) lying out at dusk. Studland, Dorset. Photograph © Tony Phelps. See article on page 26.

EDITORIAL

British Herpetological Society on-line

Website – Following a period of redevelopment this is now accessible again at *http://www.thebhs.org/*. Certain pages remain incomplete and further modifications are envisaged in the near future.

Discussion site – A new e-mail discussion site for British Herpetological Society members has been set up at *B_H_S_members@yahoogroups.co.uk*. This is a forum where members can discuss the affairs of the Society, access library lists and bibliographies, find out about conservation tasks and meetings, place advertisements for their captive-bred animals, spare equipment etc, and ask questions on any aspect of herpetology.

Meet the Council....

Richard Griffiths. Managing Editor, *The Herpetological Journal*.

As a schoolboy in North London, Richard Griffiths served a fairly typical herpetological apprenticeship. Visits to local ponds resulted in a steady stream of herpetofauna being accommodated in bedroom vivaria, much to the chagrin of his parents. After gaining a degree in zoology, he studied the behaviour of newts and salamanders for a PhD under the supervision of John Cloudsley-Thompson in the Zoology Department at Birkbeck College. Around this time he joined the BHS. He soon became a member of the Conservation Committee, and spent many happy Sundays clearing invasive pine in the cause of reptile conservation on heathlands in Surrey and Hampshire. Many lasting friendships were forged on these conservation tasks, and there was often more 'jaw jaw' than 'saw saw'! Near the end of his PhD, Richard met Paul Gittins – who was then conducting research on Common Toads – at a BHS meeting in the Linnean Society meeting rooms in Piccadilly. Their discussion in the pub afterwards led to him joining Paul's productive research group at Llysdinam Field Centre in mid-Wales. After three idyllic years in the Wye valley pursuing newts, frogs and the occasional reptile, Richard spent a short time co-ordinating the National Amphibian Survey at Leicester Polytechnic with Rob Oldham, and then obtained a lectureship in Biological Sciences at North East Surrey College of Technology. This return to southern England led to a highly successful collaboration with Trevor Beebee at Sussex University, investigating growth inhibition in Natterjack tadpoles and its implications for Natterjack conservation. Towards the end of the 1980s Richard became a member of the National Executive charged with organising the First World Congress of Herpetology at Canterbury. This led to him joining the fledgling Durrell Institute of Conservation and Ecology (DICE) at the University of Kent, on an advanced research fellowship.

Having been elected to BHS Council in 1988, Richard took over the reigns of the editor of the *Herpetological Journal* in 1991. The next few years saw the number of submissions to the journal – together with their international breadth – steadily increase to the extent that the growing workload had to be split between two editors in 1999. Richard's own research activities also expanded in line with DICE's international focus, and in recent years have embraced work on chameleons in Madagascar, Midwife Toads in Mallorca, Axolotls in Mexico and frogs and lizards in Chile. Closer to home, work on native herpetofauna has continued with conservation projects on all six native amphibians (seven, if the Pool Frog is included) as well as research on Grass Snakes and Slow-worms. Much of this work has

been in collaboration with a flourishing group of graduate students, research assistants and visiting researchers, which has generated 12 PhD theses, over 50 MSc dissertations and 30 research papers and two books over the past ten years. After some 12 years as an editor of the *Herpetological Journal*, Richard hopes to stand down from Council shortly, but herpetological work will continue to feature highly in his current position as a Reader in Biological Conservation at DICE.

ORIGINAL ARTICLES

Seasonal variation in dietary preferences of a Hispaniolan anole, *Anolis longitibialis*

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SEASONAL differences in activity patterns among animals living in temperate areas are readily observed, and many animals living in tropical areas also exhibit seasonal variation in various life history parameters. However, most studies of the natural history of the Caribbean herpetofauna have been conducted on abbreviated trips during only one season.

Hispaniolan *Anolis* are separated by a wide range of morphological, geographical, and ecological differences. *Anolis longitibialis* is a member of the *A. cybotes* species complex and is endemic to Isla Beata and the lower Barahona Peninsula (Powell et al., 1999; Schwartz & Henderson, 1991). This species inhabits rock crevices and the lower portions of trees in xeric scrub forests, and presumably feeds primarily on arthropod prey (Gifford et al., 2003).

Members of the genus *Anolis* typically are characterised as opportunistic sit-and-wait foragers and generally exploit a wide range of dietary items (Pough et al., 1998). However, in June 1999, *A. longitibialis* preyed upon an unusually narrow range of items, with lepidopteran larvae comprising the primary food source (Gifford et al., 2003). The authors hypothesised that the narrow dietary range was due primarily to the abundance of lepidopteran larvae in the summer months, and that *A. longitibialis* might have been taking advantage of an abundant food source in order to prepare for reproduction prior to the upcoming rainy season. We returned to the Barahona Peninsula in January 2002 and collected a sample of *A. longitibialis* to further evaluate that hypothesis.

All specimens were captured approximately 3 km south of Los Tres Charcos, Pedernales Province, Dominican Republic. Hoppe (1989) described the vegetation of this area as xeric, subtropical thorn forest and listed a mean annual temperature of 27°C and annual precipitation of 500–700 mm. The site is characterised by little or no herbaceous cover, dense thickets of *Acacia* scrub, and a substrate of dry, sandy soil interspersed with reef limestone outcrops. Erosion of the limestone resulted in deep crevices that provide excellent habitat for *A. longitibialis*.

We captured lizards by noosing or by hand and immediately placed them on ice. We euthanised specimens by lethal injection and placed stomach contents in 95% ethanol for analysis. Specimens were euthanised because samples of this species taken at this time of year are sparse in museum collections. In addition to the dietary data

presented herein, these specimens will also serve in a comprehensive study of reproductive activity investigating seasonal patterns in the *Anolis cybotes* complex on the island of Hispaniola.

When possible, we identified arthropodan prey to order or family. We used methods of Milstead (1957) for volumetric analysis and calculated relative importance values for each prey type according to methods of Powell et al. (1990). We used relative importance values to determine dietary niche breadths (Levins, 1968) and dietary niche overlap (MacArthur & Levins, 1967) between males and females, standardising the latter on a scale of 0–1 (Pianka, 1973), and used a two-sample Kolmogorov-Smirnov test to evaluate differences between seasons. Specimens were deposited in the Bobby Witcher Memorial Collection, Avila University, Kansas City, Missouri, 64145, USA (BWMC 06868–06870, 06872–06876).

Stomach Contents	All $n = 8$	Males $n = 4$	Females $n = 4$
Arachnida (Araneae)	8/0.325/7	5/0.270/4	3/0.055/3
	0.301	0.396	0.186
Coleoptera (larvae)	1/0.060/1	1/0.060/1	0/0/0
	0.047	0.109	0.0
Diptera	2/0.020/2	2/0.020/2	0/0/0
	0.053	0.107	0.0
Formicidae	5/0.120/4	1/0.030/1	4/0.090/3
	0.149	0.068	0.239
Isoptera	1/0.005/1	0/0/0	1/0.005/1
	0.024	0.0	0.048
Blattaria	1/0.050/1	1/0.050/1	0/0/0
	0.043	0.082	0.0
Orthoptera (Gryllidae)	2/0.100/2	0/0/0	2/.0100/2
	0.086	0.0	0.189
Isopoda	1/0.010/1	1/0.010/1	0/0/0
	0.027	0.054	0.0
Misc. Arthropod Parts	5/0.080/2	3/0.030/1	2/0.050/1
	0.107	0.109	0.112
Gastropoda	1/0.005/1	0/0/0	1/0.005/1
	0.024	0.0	0.048
Plant/other	3/0.005/3	2/0.005/2	1/trace/1
	0.069	0.096	0.043
Fruits/Seeds	5/0.020/1	0/0/0	5/0.020/1
	0.069	0.0	0.134

Table 1. Results of stomach content analysis of *Anolis longitibialis* from Hispaniola. The first line in each entry contains the total number of each prey item, total volume of each prey type (cm^3), and the frequency of occurrence of each prey type among the individuals sampled. The second line in each entry contains the relative importance value of each prey item in the diet with larger numbers indicating greater dietary importance. All volumes and relative importance values are rounded to the nearest 0.001.

Snout-vent lengths (SVL) did not differ significantly between males ($n = 4$, $= 44 \pm 6.4$ mm) and females ($n = 4$, $= 49.2 \pm 4.1$ mm; $\chi^2 = 12.5$, df = 10, $P = 0.75$). All females contained either one shelled egg and one yolked ovarian follicle ($n = 3$) or two shelled eggs ($n = 1$). Gifford et al. (2003) found that all of the females they sampled contained shelled eggs or yolked ovarian follicles, and they hypothesised that the disproportionate amount of lepidopteran larvae in their diets could be the result of the females 'stockpiling' an abundant and energy-rich food resource to prepare for reproduction during the upcoming rainy season. That all of our females were gravid suggests that *A. longitibialis* has an extended reproductive season not tied strictly to the rainy season.

Excised stomach contents contained 35 prey items distributed among ten orders of invertebrates (Table 1). Spiders and flies showed the highest relative importance values among males, whereas ants and crickets were highest among females. Male anoles actively defend territories and could potentially encounter different types of prey than females in the same environment (Carpenter, 1967). For all individuals, spiders had the highest relative importance value, followed by ants and crickets. Gifford et al. (2003) had found lepidopteran larvae to be the most important dietary component in *A. longitibialis*. We found no lepidopteran larvae.

Our standardised dietary niche breadth for all individuals of 0.51 suggests a fairly diverse diet and a relatively low dietary niche overlap between males and females probably can be explained by our small sample size and the apparent diversity of available prey. Gifford et al. (2003) found *A. longitibialis* to have an uncharacteristically narrow niche breadth (0.16) and a very high dietary niche overlap between males and females (0.94), both of which they attributed to exploitation of seasonally abundant prey.

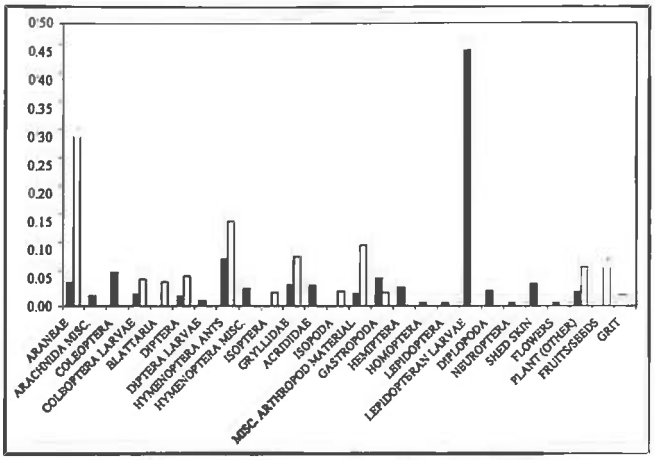

Figure 1. Relative importance values for prey items consumed by *Anolis longitibialis* from the Barahona Peninsula, Dominican Republic, summer 1999 (Gifford et al., 2003; black bars) and winter 2002 (present study; white bars).

Several seasonal differences in the types of prey eaten were obvious. Spiders, ants, and crickets showed higher relative importance values in January than in June (Fig. 1). Lepidopteran larvae and beetles, two of the most important prey types in June, were not found in January. Several other food items were observed in one season or the other but not in both. The January sample contained considerably more plant material, which may reflect seasonal availability or merely a greater dependence on plants when no single arthropodan resource is extremely abundant. The relative importance values of prey items for individuals sampled during January were significantly different from those of individuals sampled during the summer season (Kolmogorov-Smirnov, $Z = 1.39$, $P = 0.04$, $n = 26$). The relatively small sample size could potentially have influenced the results, but we feel that the absence of lepidopterans at the study site support the hypothesis that *Anolis longitibialis* is an opportunisitic feeder that utilises seasonally abundant food resources.

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Aspects of the ecology and conservation of the Meadow Viper, *Vipera ursinii*, in the Duchessa Mountains Natural Park (Latium, central Italy)

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ABSTRACT — The population of Meadow Vipers (*Vipera ursinii*) living in the Duchessa Mountains Natural Park (Latium, central Italy) was studied from June to September 2000 and 2002. In this area the vipers were not homogenously distributed over the whole territory, but occurred just at a few places. Most of the specimens were observed inside or around (within 5 m) *Juniperus* bushes, and some specimens also in open grass. There was a clear preference for bushes of large size (i.e. those > 6 m diameter). Meadow Vipers are apparently rare in the territory surveyed, where they coexist with *Vipera aspis* and *Coronella austriaca*. Females were significantly larger than males, and the sex-ratio was close to equality. The main conservation issues affecting *V. ursinii* in this area are the intentional killing of snakes by people, over-grazing, and also the likely over-population of Wild Boar (*Sus scrofa*).

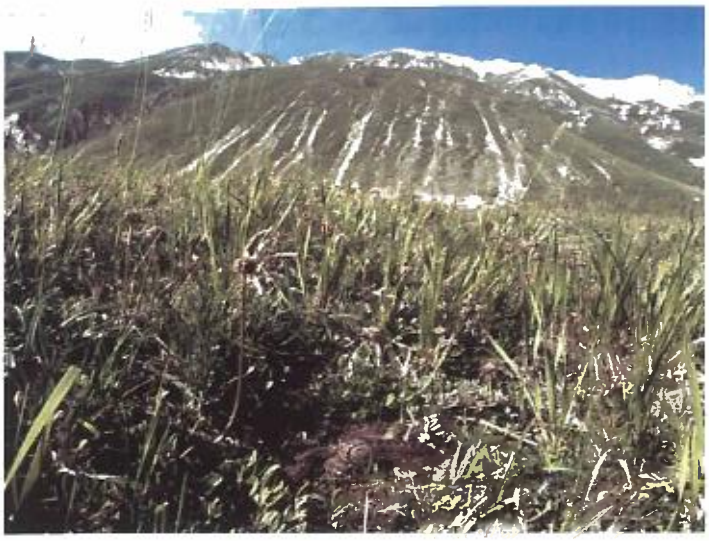
THE Meadow Viper (*Vipera ursinii*) is one of the most threatened snake species in Italy (Filippi & Luiselli, 2000a). It has a scattered distribution in some Apennine massifs (Bruno & Maugeri, 1979; Capula & Luiselli, 1992), and in Latium it occurs in just two mountain ranges (Capula & Luiselli, 2000). Although some aspects of the ecology of this viper have been studied in Italy (Agrimi & Luiselli, 1992; Filippi, 2001), very little is known on the population inhabiting the Duchessa Mountains, where they appear more isolated than in other massifs like Gran Sasso, Sibillini, and Majella (Filippi, 2001). In this area, the Meadow Viper was discovered in relatively recent years (Mangili, 1946), and has always been reported to be very rare (Calò, 1983; Capula, 1989, 1995; Capula & Luiselli, 2000). During a research study funded by the Authorities of the Duchessa Mountains Natural Park, we collected some field data on this viper population. In this report we address the data collected during the execution of this project.

MATERIALS AND METHODS

All data were gathered inside the territory of Duchessa Mountains Natural Park, province of Rieti (Latium). Detailed data on the status and distribution of *V. ursinii* in this territory are presented elsewhere (Filippi & Luiselli, 2000b). Field research was conducted at sites between 1700 m and 2000 m. a.s.l., i.e. 'Monte Morrone' (NW, W, and SW facing slopes), 'Caparnie', surroundings of 'Lago della Duchessa', 'Solagne del Lago', and 'Malopasso', in two distinct phases: (i) between June and September 2000, and (ii) between June and September 2002.

On average, the area receives 1090–1173 mm of annual rainfall and mean annual temperatures range from 11.3 to 12.7°C (based on data for 1886 and 1986 provided by Ministero dei Lavori Pubblici).

We searched for snakes along standardised routes in the various micro-habitats frequented by snakes. We captured snakes by hand, and always recorded the site of capture and the habitat at each capture site. Each snake was measured for snout-



Immature female *Vipera ursinii* in habitat at 1900 m, Campo Imperatore, Gran Sasso Massif, Central Italy. Photograph ©Tony Phelps.

vent length (SVL, to the nearest ± 0.1 cm) and tail length, sexed by examining the morphology of the cloacal region, weighed with an electronic balance, and individually marked by ventral scale clipping for future identification.

Statistical tests were two-tailed, and alpha was set at 5%. We used STATISTICA (Windows version 5.0) for all tests.

Vipera ursinii from the Duchessa Mountains. Photograph ©L. Luiselli.

RESULTS AND DISCUSSION

In both phases of the research, specimens of *V. ursinii* were seldom observed, and only on the SW facing slopes of 'Monte Morrone' (area of 'Pratone della Cesa' to crest of the massif and up the 'Lago della Duchessa', and at 'Malopasso' (coordinates: 42° 12' N, 0° 54' 30" E of 'Monte Mario'). Approximately 85% (n = 19) of all specimens were observed inside, or around (within 5 m), prostrate Dwarf Juniper (*Juniperus nana*) bushes, and 15% in open grass. In the year 2000, the preferred microhabitat consisted of *Juniperus* bushes of large size (i.e. > 6 m diameter; total n = 31), whereas bushes of smaller size (i.e. those of diameter < 2.99 m, and those of diameter < 5.99 m) were used less (χ^2 = 23.5, df = 2, P < 0.01). These data mirrored data collected in 2002 (not shown here for brevity). The species is apparently rare in the territory surveyed, where it coexists with two potential competitors: *Vipera aspis* (abundant on the slopes of 'Monte Morrone'), and *Coronella austriaca* (apparently very rare in this territory). It is noteworthy that *Vipera aspis* appears very common also around bushes of prostrate Dwarf Juniper, which are usual habitats of *V. ursinii*. On four different days we have observed basking activity by one *V. ursinii* and one *V. aspis* in the same spot, always at the border of a *Juniperus* bush. Thus, we may conclude that the territory of Duchessa Mountains is one of the few known places in the Apennines where these two *Vipera* species are spatially syntopic. Studies on niche divergence between these species are in progress, under the financial support of the same Park which has sponsored this research.

Between June and September 2000, 19 specimens were captured: 10 males and 9 females. Twelve additional specimens escaped capture, but were positively identified to species level.

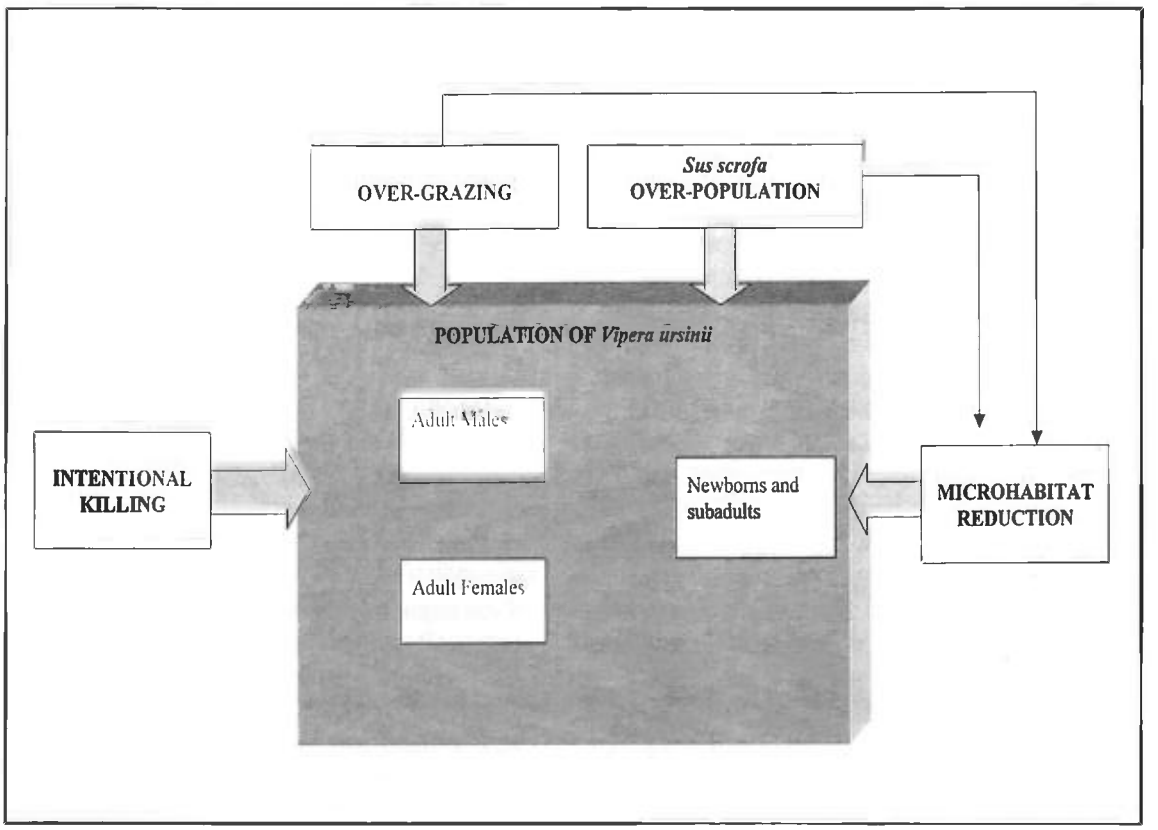


Figure 1. Principal direct and indirect threats to *Vipera ursinii* in the Duchessa Mountains Natural Park.

Between June and September 2002, we captured 13 specimens (8 males and 5 females), and four additional specimens escaped capture.

In both the years the adult sex-ratio did not differ significantly from equality (for each year, Yates' χ^2, df = 1, $P > 0.05$). In 2000, the mean length of adult males was 29.9 ± 0.04 cm ($n = 7$; maximum size = 31.8 cm), and the mean length of adult females was 35.1 ± 3.5 cm ($n = 8$; maximum size = 41.2 cm). In 2002, the mean length of adult males was 27.8 ± 2.03 cm ($n = 8$; maximum size = 31.9 cm), and the mean length of adult females was 33.7 ± 2.6 cm ($n = 5$; maximum size = 42.5 cm). The females attained on average larger sizes than males in both study periods (for year 2000: Student *t*-test with df = 13, $P < 0.001$; for year 2002: Student *t*-test df = 11, $P = 0.0008$), as expected on studies of conspecifics from elsewhere (Agrimi & Luiselli, 1992; Baron et al., 1996; Baron, 1997; Filippi, 2001; Filippi & Luiselli, 2002a). The mean length of the females was not significantly different between 2000 and 2002 (Student *t*-test with df = 11, $P = 0.295$), whereas the mean length of the males was significantly different between years (Student *t*-test with df = 13 , $P = 0.017$).

In 2000, although the absolute values of mean tail length (tL) were not significantly different intersexually (males: 4.1± 0.6 cm, $n = 7$; females: 3.5 ± 0.4 cm, $n = 8$; inter-sample difference: $t = 1.8$, df = 13, $P > 0.09$), ANCOVA on slopes of the respective regressions SVL against tL revealed that, at the same body length, males had significantly longer tails than females ($F_{1,17} = 12.064$, $P = 0.00001$). These morphometric measurements mirrored data collected in 2002 (not shown here for brevity) as well as data collected on other *V. ursinii ursinii* populations from elsewhere, both in Italy (Filippi, 2001; Filippi & Luiselli, 2002a) and in France (Baron et al., 1993; Baron, 1997).

The main direct and indirect threats to the continued existence of Meadow Vipers in the Duchessa Mountains are summarised in Figure 1. Parts of the area inhabited by *V. ursinii* were regularly visited by Wild Boar (*Sus scrofa*). Although we did not study the effects of these large ungulates on the vipers, at lower elevations in the same mountain massif we demonstrated (Filippi & Luiselli, 2002b) that over-population of Wild Boars affected negatively the local snake populations, via both direct effects of micro-habitat disturbance and predation, and indirectly via predation and disturbance on potential prey species. Thus, it is very likely that over-population of these animals may also negatively affect populations of *V. ursinii* in the Duchessa Mountains. Accordingly, we would urge the competent authorities to always consider the potential effects of Wild Boar in the few areas inhabited by *V. ursinii*, and to instigate additional studies on this. We suggest:

(i) to monitor the effects of the Wild Boar on the viper populations year-by-year, by following the same protocol of Filippi & Luiselli (2002b);

(ii) to build electric fences around the areas inhabited by the Meadow Vipers, particularly around their communal hibernacula (see Filippi & Luiselli, 2000b, 2002a) and their spring mating areas, where these snakes are exposed to particularly high mortality risks (Filippi & Luiselli, 2000a). Indeed, electric fences have proved to be useful tools in preventing Wild Boar entering into areas where their presence would have otherwise resulted in damage to cultivations or wildlife (Fermanelli & Rossetti, 1999; Toso & Pedrotti, 2001).

Another major threat facing *V. ursinii* in the Duchessa Mountains is over-grazing, which is especially acute in the vicinity of Duchessa Lake, and in the same microhabitats inhabited by the vipers (Filippi & Luiselli, 2000b). On the other hand, the effects of trekking by tourism seems to be less harmful for the vipers, at least in the area studied. Nonetheless, this must be monitored, because we found two dead vipers apparently killed by excursionists or shepherds, along two mountain paths in 2000.

ACKNOWLEDGEMENTS

We are indebted to Dr Grazia Pulzoni and Dr Cosimo Marco Calò (respectively former and current director of the Duchessa Mountains Natural Park) for having financed the present study project, and the rangers of the park for having escorted us in the field on many occasions. The snake specimens were captured under authorisation (protocol no. 79/2000) of the 'Regione Lazio Dipartimento Ambiente e Protezione Civile'.

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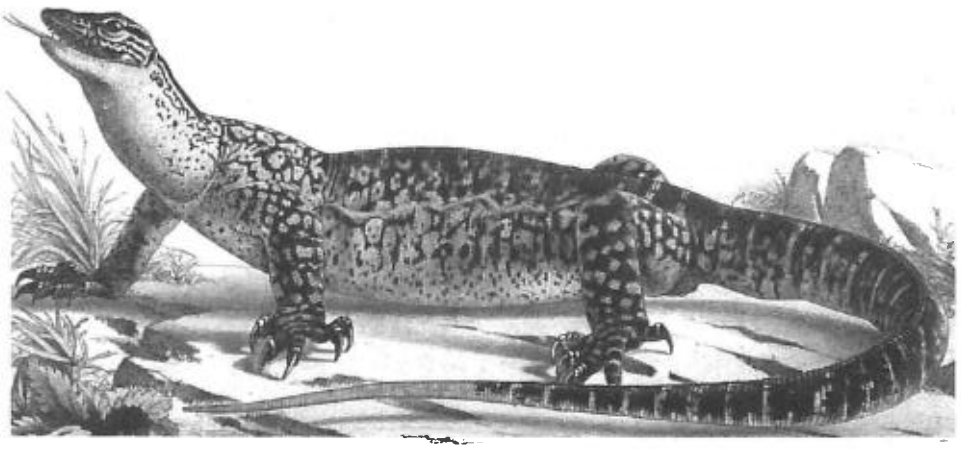

Gould's Monitor (*Varanus gouldii*). From an original plate in *Natural History of Victoria*. 1887. Reproduction courtesy of The Natural History Museum.

Ecological parameters of the Northern Brown Snake, *Storeria dekayi*

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ABSTRACT — Data were gathered on 702 Northern Brown Snakes, *Storeria dekayi*, captured 1,041 times at two similar sites in Lancaster County, Pennsylvania, USA, during the years 1960–1967. Eight-nine percent of the captures were of active snakes. The overall population size was estimated to be 1,095 (S.E. 201) individuals, and the density varied between 66 snakes/ha and 300 snakes/ha at the two sites. Total biomass at the two sites was over 2.5 kg (860 g/ha). The combined population was composed of 188 juveniles (including neonates) and 512 adults, a juvenile to adult ratio of 0.37:1.00 and an adult male to female sex ratio of 0.81:1.00. Both ratios were statistically significant ($P = 0.05$). The snakes were active for an average of 200 days each year between April and October. The annual cycle was bimodal with most activity in the spring and early summer and a lesser peak of activity in the early fall. Daily activity was also bimodal in summer, with most activity in the morning and a second spike in activity in late afternoon and early evening. Active snakes had body temperatures of 10.0–29.5°C. Additional data and comparisons between the two sites are reported on population dynamics, activity periods and hibernation, thermal ecology, habitat, movements, reproduction, feeding behaviour, and injuries, predation and ectoparasites.

THE Northern Brown Snake, *Storeria dekayi*, ranges in North America from southern Maine, Quebec and Ontario west to Wisconsin, Minnesota, and the eastern Dakotas, and south through Florida in the East, to the Gulf of Mexico in the Midwest (Christman, 1982; Ernst & Ernst, 2003). Although widespread and not uncommon, its behaviour and ecology have not been adequately studied. Freedman & Catling (1978, 1979) and Catling & Freedman (1980) reported on the movements and population dynamics of an Ontario, Canada population, and Clausen (1936), Kofron (1979) and Trapido (1940) reported on reproductive aspects of the species, but most available data are of an anecdotal nature (see Ernst & Ernst, 2003 for a summary).

The Northern Brown Snake, *Soreria dekayi dekayi*, was studied in Lancaster County, Pennsylvania, USA from March 1960 through July 1967. It was hoped that specific data from this study would fill in many of the gaps our knowledge of this snake, and to present comparative material with studies on it conducted elsewhere. Data from the study of *S. dekayi* are presented below.

METHODS

Study Areas

Data were gathered on two disjunct populations of *S. dekayi dekayi* located about 4 km apart in Lancaster County, Pennsylvania, USA. Site 1 (Edward Hand) contained the largest population, and was located on a 2 ha abandoned 'shanty town' behind the playing fields of Edward Hand Junior High School near the southeastern corner of the city of Lancaster. The site was in an open mesic woodland dominated by oak (*Quercus* sp.), maple (*Acer* sp.), and locust (*Robina* sp.) trees bounded on the south by a gravel road, the Conestoga Creek to the north, a row of houses and an open field to the west, and an Army Reserve facility on the east. Much debris remained from the destruction of the shanties in 1959 in the form of sheets of tin, tar paper, wooden boards, and other discarded human trash, as well as some logs, which provided excellent ground cover for snakes. The tree canopy was relatively open, but all sections of the site were shaded at sometime during the day. A drainage gully, fed by a natural spring, ran northward through the western third of the site.

The second study site (Slackwater) was along an approximately 100 m loosely constructed, north-south, stone fence on a wooded hill at Slackwater, approximately 1 km south of Millersville, Pennsylvania. It overlooked and sloped into the Conestoga Creek to the south through an open mesic woodland dominated by oak (*Quercus* sp.), maple (*Acer* sp.), and tulip poplar (*Liriodendron* sp.) trees, and was bounded by a pasture to the north. The total area of the site was about 1.5 ha.

The bedrock at both sites was composed predominately of limestone, and the overall characteristics of the two Pennsylvania sites agreed closely with those of other study sites of *S. dekayi* in Kansas (Fitch, 1999), in North Carolina (Palmer & Braswell, 1995), and in Ontario (Catling & Freedman, 1980).

Procedures

Snakes were hand collected. Each snake was marked by scale clipping (Blanchard & Finster, 1933; Fitch, 1949). At each capture, the total body length (TBL), snout-vent length (SVL), and tail length (TL) were recorded with a metal metric tape measure accurate to 1.0 mm, and the snake was weighed with a spring scale accurate to 0.1 g. Each snake was sexed (Conant & Collins, 1998; Palmer & Braswell, 1995). The following data were also recorded: date, time, type of activity (snakes were considered active if responsive to disturbance; dormant, if not responsive), air temperature (AT), surface temperature (ST), cloacal temperature (BT), presence or absence of a food bolus, and any signs of injury or parasites. BT was taken with a quick reading Schultheis cloacal thermometer, and AT and ST were recorded with the unshaded bulb of a standard laboratory mercury thermometer. Snakes swollen with a food bolus were gently palpated to force regurgitation of the ingested prey. These prey and others from natural observations of feeding were recorded.

The statistical methods used to analyse data were taken from Sokal & Rohlf (1973). The acceptable confidence level for all statistics was set at 0.05.

RESULTS

A total of 702 *S. dekayi* were marked (Edward Hand, 603; Slackwater, 99), and captured 1,041 times (Edward Hand, 855; Slackwater, 186). Of the 1,041 captures, 935 (89.8%) were of active snakes (Edward Hand, 785, 91.8%; Slackwater, 150, 80.7%), and 106 (10.2%) were considered dormant (Edward Hand, 70, 8.2%; Slackwater, 36, 19.3%). All captures were at ground level of exposed or under cover snakes; no *S. dekayi* was found above ground level, similar to what was reported elsewhere (Neill, 1948).

Annual Activity Period

Responsive *S. dekayi* were found, either under shelters or surface active, from 28th March to 1st November, an average annual activity period of about 200 days, and a maximum one of 219 days (Edward Hand 28th March – 1st November, 219 days; Slackwater 16th April – 13th October, 181 days). The snakes had slightly varying annual active periods during 1961–1966; with the greatest number of active days at both sites occurring in 1962, and the fewest numbers of active days at both sites in the drought year 1966 (Edward Hand, 189 days; Slackwater 175 days). Both the maximum and minimum active days for the six complete years of study, 1961–1966, at the two sites were significantly different (Chi square test, 12.029, 5 df, $P = 0.05$).

The annual activity period was bimodal (Tables 1 and 2), with a spring peak period from 20th April – 25th June when 555 (59%) of the total 935 captures were made, and a lesser activity period in the fall from 3rd September – 20th October when 244 (26%) captures occurred. Early spring Pennsylvania records (28th March – 30th April) represented for the most part individuals that had emerged from hibernation, but had not dispersed from their communal hibernaculum. The late September and October records were mostly of individuals aggregated at hibernacula.

Daily Activity Period

The timing of daily activity varied with the season at both sites (Table 2). Although most captures were of individuals under cover, some *S. dekayi*

Month	Adult Males	Adult Females	**Juveniles**	**Totals**
M	3	0	0	3
A	49	41	43	133
M	130	78	49	257
J	58	88	30	176
J	24	32	9	65
A	21	30	1	52
S	38	35	16	89
O	65	51	39	155
N	2	3	0	5
Totals	**390**	**358**	187	935

Table 1. Frequency of captures by age category and sex of active *Storeria dekayi* by months (1960–1967).

were found basking or moving over the surface of the ground. From April to early June and in September and October, some snakes were found moving or basking in late morning or early afternoon (10:00–15:30 hrs). Daytime surface activity slowed or ceased from mid-June through August, when the snakes became either vespertime (two records at 19:45 and 20:13 hrs) or nocturnal (based on the absence of *S. dekayi* under selected shelters in the evening, but their presence there at 07:00–08:30 hrs the next morning). Three individuals were found moving in the early night (21:17, 22:48, 22:55 hrs), and another was discovered eating an earthworm at 20:48 hrs. Possibly, most summer activity occurs between 20:00 and 24:00 hrs).

Thermal ecology

Body and environmental temperatures were recorded during 815 captures of adult *S. dekayi* (juveniles and neonates were too small to measure); 725 (77.5%) captures of active snakes, 90 (84.9%) of inactive individuals. Mean BT of active adult snakes was 25.3°C (10.0-29.5°C). Seventy percent (n = 508) of the active snakes had BTs in the 20-27°C range; the most frequent BTs of active snakes were 23° (n = 152), 24° (n = 103), and 22°C (n = 90). At Edward Hand, the range of BTs of active *S. dekayi* was 10-27.5°C (mean 24.9°); at Slackwater, active snakes had BTs of 11.2–27.0°C (mean 25.8°). No statistical difference occurred between the BTs of the snakes at the two sites (Chi square, 89.245, 50 df, n.s.) Overall, active snakes had a mean body temperature differential of 1.8°C compared to AT, and a mean 0.8°C differential to the ST (Table 3 gives the cloacal and environmental temperatures by activity).

Inactive snakes were all considered to be hibernating or to be entering hibernation. The lowest BT (3°C) of inactive *S. dekayi* were of five adults hibernating in a ball in the stone wall at Slackwater on 20th January 1967; the lowest BT 3.5°C of an inactive snake at Edward Hand was of a hibernating adult within a log on 10th January 1963. The highest BT (7°C) for inactive snakes was recorded from five adults balled together in a shallow depression under tarpaper at Edward Hand on 31st March 1963, and from an adult in the stone wall at Slackwater on 12th December 1966. Inactive snakes at Edward Hand (n = 15) had BTs of 3–7°C (mean 4.3°C); at Slackwater inactive adults (n = 30) had the same range in BTs, but averaged only 4°C. Overall, inactive snakes had a –1.2°C BT differential with the AT, and a 0.2°C differential with the ST.

Population dynamics

A combined total of 702 individual *S. dekayi* were captured and marked at the two sites during 1960–1967 (see above). Only 42 (4%) captures were of exposed *S. dekayi*; 999 (96%) captures were of snakes hiding under some shelter. Exclusive of hibernating aggregations, as many as six active individuals were found sharing the same shelter at Edward Hand, but never more than one active *S. dekayi* was found under a shelter at Slackwater. Daily study duration was equal at the two sites; about 4 hours per day. The number of captured individuals per day averaged 10.8 (0–30) at Edward Hand, but only 2.8 (0–11) per day at Slackwater. The overall proportion of recaptures of marked snakes (as well as those of each of the

Time (hrs)	M	A	M	J	J	A	S	O	N	Totals
07:00	0	0	3	4	1	2	2	0	0	12
08:00	0	0	19	15	1	1	2	0	0	38
09:00	0	18	23	18	3	0	1	1	1	65
10:00	0	12	31	28	2	0	2	11	4	90
11:00	1	14	29	22	2	0	16	25	0	109
12:00	1	18	28	19	3	0	14	23	0	106
13:00	1	21	38	18	0	0	15	31	0	124
14:00	0	18	31	20	0	0	14	15	0	98
15:00	0	11	29	12	5	1	10	14	0	82
16:00	0	14	17	9	8	10	8	10	0	76
17:00	0	3	6	4	11	12	4	16	0	56
18:00	0	4	3	2	10	10	1	9	0	39
19:00	0	0	0	2	7	5	0	0	0	14
20:00	0	0	0	3	11	3	0	0	0	17
21:00	0	0	0	0	1	2	0	0	0	3
22:00	0	0	0	0	0	6	0	0	0	6
Totals	3	133	257	176	65	52	89	155	5	935

Table 2. Frequency of capture of active *Storeria dekayi* by months and hours (1960–1967).

two sites) did not increase as more individuals were marked (Spearman's coefficient of rank correlation, $r_s = 0.439$, $P > 0.05$). Only 104 (14.8%) of the marked snakes were recaptured more than once; one male was recaptured six times, and four females were recaptured five times each.

The interval between recaptures gives a rough estimate of survivorship. Six *S. dekayi* first marked as juveniles averaged 4.2 years (1–7 years) between first and last capture. The male mentioned above was captured six times in 5 years, and the four females captured five times each averaged 3.7 years (2–7 years) between their first and last capture.

The population size for both sites combined and those of the two individual sites were calculated with the weighted least squares method of Schumacher & Eschmeyer (1943), recommended by Turner (1977). This method has the advantage of eliminating bias caused by unequal recapture rates, as it is based on a series of collecting periods rather than only on two, as in the Peterson Estimate (Begon, 1979). Data from a series composed of the last 300 collections of *S. dekayi* between 1964 and 1967 were used to calculate the population sizes, and the population size limits were determined by adding and subtracting two standard errors (S.E.; 95% confidence level) from the population sizes (Schumacher & Eschmeyer, 1943). The overall population size was estimated to be 1,095 (S.E. 201) *S. dekayi* with a possible range of 693–1,497 individuals. The Edward Hand population was estimated to contain 704 (S.E. 108) individuals (range of 488–920); the Slackwater population was only estimated to be composed of 152 individuals (S.E. 48; range 56-248). Population density was estimated to be 66/ha at Slackwater, and 300/ha at Edward Hand. Most Slackwater captures were made at the stone wall, but the *S. dekayi* at Edward Hand were more scattered among the surface debris.

Snakes were weighed during 904 of the 1,041 total captures at the two study sites. Adult males (304 captures) had a mean mass of 3.00 (1.85–3.55) g, adult females (388 captures) had a

Activity	Body Temperature	Air Temperature	Surface Temperature
Hibernate ($n = 90$)	4.2 (3.0-7.0)	4.0 (-1.0-7.0)	6.2 (2.0-10.0)
Under shelter (active) ($n = 683$)	23.0 (10.0-26.0)	24.0 (8.0-36.0)	21.0 (10.0-26.0)
Basking ($n = 6$)	28.5 (26.0-29.5)	29.1 (25.0-32.0)	26.8 (24.3-30.5)
Moving ($n = 21$)	25.5 (24.0-28.2)	27.5 (25.3-30.0)	25.09 (22.5-27.5)
Feeding ($n = 5$)	24.2 (22.0-26.5)	26.2 (25.0-28.0)	24.8 (22.0-28.0)
Mating ($n = 10$)	21.6 (20.0-23.0)	24.6 (22.0-26.0)	22.2 (20.0-24.0)

Table 3. Mean body and environmental temperatures and ranges (°C) of *Storeria dekayi* by activities.

mean mass of 3.85 (1.88–4.43) g, and juveniles (212 captures, including neonates) averaged 0.82 (0.20–2.21) g. Total biomass at the two sites was 2579.64 g, a biomass density of 859.88 g/ha. At Edward Hand, weights were taken during 728 of the 855 captures, and yielded a total biomass of 1974.16 g, and a biomass density of 987 g/ha. At Slackwater weights taken during 176 of 186 captures yielded a total biomass of 605.48 g and a biomass density of 403.6 g/ha.

Male *S. dekayi* were considered mature at 19.0 cm SVL or larger, and females at 22.0 cm SVL or larger (Ernst & Ernst, 2003). The combined population was composed of 188 juveniles and 512 adults, a ratio of 0.37:1.00. The overall adult male to adult female ratio was 0.82:1.00. Both of these ratios are significantly different from 1:1 (Chi square test, 4.100, 1 df, $P = 0.05$). At Edward Hand, the adult sex ratio was 0.90:1.00, and the juvenile to adult ratio was 0.44:1.00; at Slackwater these ratios were 0.52:1.00 and 0.03:1.00, respectively. The juvenile to adult ratios at both sites and the adult sex ratio at Slackwater were significantly different from 1:1 (Chi square test, 5.09, 1 df, $P = 0.05$).

Movements

Because relatively few recaptures were made of individual *S. dekayi*, home ranges were calculated using the circular method (Fitch, 1999). The average home range diameter of snakes that had moved and were captured more than twice at both sites was 47 m (28–64 m, $n = 41$) for males, and 39 m (22–54 m, $n = 63$) m for females. Most recaptures were made less than 40 m from the previous capture site (73% of males, 90% of females). Ten gravid females were recaptured at their original capture site. Home ranges at Slackwater were smaller, probably due to less available suitable habitat; 46 m (25–54 m) for males, 38 m (22–45 m) for females. At Edward Hand, males had average home ranges of 51 m (28–64 m), and females 41 m (25–54 m). The greatest distances moved between captures occurred at Edward Hand: 670 m and 555 m by two males with 30.5 cm, and 31.8 cm SVLs, respectively, and 604 m by a 38.1 cm SVL female. All three of these snakes were only recaptured once.

Reproduction

Observations on reproduction of wild *S. dekayi* were limited. However, 16 adult males (SVL 19.0–22.2 cm) and 16 adult females (SVL 22.0–40.2 cm) were brought into the laboratory and housed in mixed sex pairs, and some data were obtained from them. Captive copulatory behaviour occurred from 20th April to 15th May.

Males apparently find females by following female pheromone trails (Ernst & Barbour, 1989). Courtship behaviour by the Pennsylvania males consisted of rubbing the chin along the female's back and neck and performing a series of caudocephalic waves while laying in contact

Age (years)		SVL (cm)	N	Mass (g)	N
Neonate		7.8 (7.2-8.5)	194	0.25 (0.20-0.50)	194
1		12.8 (10.7-13.8)	21	0.80 (0.24-1.00)	21
2		14.6 (13.3-15.7)	17	1.85 (1.20-2.20)	17
3	Male	18.2 (17.0-19.5)	3	2.31 (1.85-2.85)	3
	Female	19.5 (18.3-22.1)	7	2.81 (1.90-3.40)	7
4	Male	25.3	1	3.30	1
	Female	31.4 (28.9-33.9)	2	3.70 (3.30-4.10)	2
5	Female	3.50	1	4.25	1
6	Female	3.75	1	4.33	1

Table 4. Length and mass relationships of known age *Storeria dekayi* in Lancaster County, Pennsylvania (1960–1967).

beside the female. Captive matings occurred mostly in the morning (08:10–11:15 hrs), but two occurred in the afternoon (04:00 hrs, 04:31 hrs), and two in the early evening (07:19 hrs, 07:50 hrs); no night observations were made. Copulations lasted 19–30 min. Nine of the pairs were found copulating on more than one occasion. Two copulating pairs of *S. dekayi* were found at Edward Hand at 09:31 hrs on 30th April 1961 and 08:39 hrs on 5th May 1960.

Parturition by the captive females occurred between 20th August and 15th September after gestation periods of 81–94 days after the first observed copulation. The females fed only sparingly from July until the birth of their young. Wild neonates were found in September at both study sites. The captive females produced a total of 194 neonates (190 alive, 4 stillborn; Table 4). Litter size was 6–19 (mean 12) young. The largest (presumably oldest) females produced the greatest numbers of offspring per litter; females 35 cm or longer had litters of 12–19 young, females shorter than 35 cm produced litters with 6–13 young. Although not significantly different, neonates from the larger litters were slightly shorter and weighed slightly less than those from litters containing smaller numbers of offspring. Neonate SVL and mass were not significantly correlated with female size or weight.

Growth

SVL and mass were recorded for all captured *S. dekayi*. Moreover, similar data were taken from 194 neonates born in captivity. Data from known age snakes are presented in Table 4. These data are similar to those from Kansas *S. d. texana* (Fitch, 1999), although the Pennsylvania snakes were slightly longer and more massive. Combined adult SVL and mass data compiled at both Lancaster County sites (n = 975) were as follows: males, mean SVL 24.2 cm (17.0–27.0 cm), mean mass 4.41 g (1.85–5.50 g); females, mean SVL 28.9 cm (18.2–49.0 cm), mean mass 8.09 g (1.80–16.45 g).

Neonates grew rapidly in the first months after birth, but growth was slower in juveniles, and the growth rate slowed even more in adults. One hundred ninety neonates (four were stillborn) were released within a day of their birth in August. Ten recaptured in September had a mean SVL of 8.9 (8.0–9.4) cm, a mean increase of 14.1%; and a mean mass of 0.33 (0.25–0.40) g, an increase of 32%. Two recaptured in early October had grown to 8.3 cm (0.44 g) and 9.0 cm (0.62 g), respectively. Eleven recaptured year old juveniles had an average increase in SVL of 10.9%, and an increase of 24.5% in mass; and 10 second year recaptured young had grown an average of 8.2% in SVL, and 22.2% in mass.

Feeding observations

Observations of foraging behaviour were made at both study sites. All feeding observations took place in the evening or night between 19:35 hrs and 21:02 hrs. The earliest was on 29th April, the latest on 15th September, a possible annual feeding duration of 140 days in Lancaster County.

Earthworms, the primary prey of *S. dekayi* (Ernst & Ernst, 2003), were abundant at both study sites. Ten of the snakes were seen tracking earthworms, and six others were found ingesting them. The worms were apparently located by their scent. Once the worm's odor trail was found, the snake quickly followed it with much tongue-flicking until the worm was located. The snake at once examined the worm with several tongue flicks, and then bit it along its body. The snake worked along it by alternatingly releasing its jaws and then biting the worm farther along its body toward the closest end. Once the snake reached the end of the worm, it aligned its mouth and body with that of the worm and began to swallow it. No preference was noted as to which end, head or tail, of the earthworm was swallowed. Swallowing usually began at the closest end of the worm from the initial bite position, only one snake worked to the fartherest end before swallowing the worm. Most worms were ingested within three minutes (mean 160 sec). Two other *S. dekayi* were found ingesting small slugs; the swallowing behaviour did not differ from that used to ingest earthworms. On two occasions, captive female *S. dekayi* ate their newborn young before they could be counted or measured. Ernst & Ernst (2003) present a list of reported prey of *S. dekayi*.

Injuries, predation and parasites

The only nonpredatory injuries noted were of four (0.5%) individuals with bobtails, probably caused by frost bite, and another (0.1%) with a jagged abrasion on its side. Only three snakes were found to have been predated: one had been pecked by a bird, another was found with its head chewed off (apparently by a small mammal), and an 10.6 cm SVL individual was regurgitated by a 63 cm SVL Common Garter Snake, *Thamnophis sirtalis*. Several birds, including American Robins (*Turdus migratorius*), which were common at both sites, are known to prey on *S. dekayi* (Ernst & Ernst, 2003). Forty-one *S. dekayi* had mite infestations beneath their scales when first captured in the early spring, but all recaptured later lacked scale mites and had apparently cast them off with the first ecdysis of the year. The rates of predation and mite infestation in the Pennsylvania populations were not high.

DISCUSSION

The differences in the lengths of the annual activity period of the two sites may have occurred because the stone wall at Slackwater, the main center of activity there, was almost constantly in shade during the day. At Edward Hand, the trees were more scattered and the canopy cover more open allowing more sunlight to reach the ground and warm it faster than at Slackwater. The annual activity period at the two sites is slightly shorter than the monthly activities of Kansas and North Carolina *S. dekayi* reported by Fitch (1999) and Palmer & Braswell (1995). Fitch (1999) reported an annual activity period of mid-March to mid-November, or about 245 days in Kansas, and Palmer & Braswell (1995) found the snake active in every month in North Carolina, but more so in the spring. Possibly the ground and air temperatures average higher in Kansas and North Carolina than at the two Pennsylvania study sites. As in southeastern Pennsylvania, the annual activity period is bimodal in North Carolina,

where 53% of captures occur between March and June (Palmer & Braswell, 1995).

Snakes at Edward Hand overwintered under debris piles, in rotten logs, or within rodent burrows (one record). At Slackwater, the snakes used cavities in the stone wall and old logs. The hibernacula in the stone wall were entered at ground level, and either extended laterally into the wall 20–25 cm or at a slight downward slope to 20–30 cm. Lachner (1942) reported a hibernaculum in a Pennsylvania gravel bank, and Bailey (1948) another in an Iowa roadside embankment. Winter mortality by freezing may be high (Bailey, 1948).

Northern Brown Snake (*Storeria dekayi*). Photograph © Carl Ernst.

Recaptures of the same individuals at a particular hibernaculum over several years indicated a high philopatry (site-fidelity) rate; with mean return rates of 67% (40-83%) at Slackwater, and 63% (55-75%) at Edward Hand. At Slackwater only 12 *S. dekayi* changed hibernacula over the years; at Edward Hand 14 individuals changed hibernation sites from one year to the next. Spring aggregations at hibernacula ranged from 2–13 snakes (mean 5 individuals), and fall aggregations 5–10 snakes (mean 6.7 individuals). At Slackwater, eight *S. dekayi* were found on 20th January 1967 in a hole in the rock wall approximately 25 cm long and 4 cm deep. At Edward Hand, six individuals were found on 2 February 1961 within a single rotting log. On both occasions the snakes were coiled together in a ball.

The daily activity cycle of *S. dekayi* at the two southeastern Pennsylvania sites followed the pattern typical of North American colubrid snakes (Ernst & Ernst, 2003).

The BTs recorded from Pennsylvania snakes closely match other reported BTs, although the highest BT in Pennsylvania is slightly greater. Clarke (1958) recorded BTs of 2–27°C for S. *dekayi* in Kansas, and Brattstrom (1965) and Fitch (1999) reported BTs of 20.4–27.0°C at ATs of 12.8–28.0°C.

Soil temperatures vary less than air temperatures, and the BTs of both active (n = 725) and hibernating (n = 90) Pennsylvania *S. dekayi* most closely matched the ST than AT (Table 3).

Based on a calculation of mean population size using four different methods, an Ontario population of *S. dekayi* consisted of 545 snakes (96–1,160 individuals) (Freedman & Catling, 1978). Fitch (1999) reported an estimated density of 42 snakes/ha in an open Kansas woodland, and Freedman & Catling (1978) reported one of 70 snakes/ha in the habitat most occupied at an Ontario site. Apparently, sites with more cover objects can support larger populations of *S. dekayi*, as was seen at the Edward Hand site. The adult sex ratio at the Ontario site studied by Freedman & Catling (1978) was 0.36:1.00, slightly lower than those at the two Pennsylvania sites. The mean population sizes, densities, adult sex ratios, and juvenile to adult ratios of the two Pennsylvania sites showed them to be viable populations during the period they were studied. Unfortunately, both sites have been developed into home sites since the 1960s, and both populations were consequently extirpated.

Freedman & Catling (1979) reported the average home range of *S. dekayi* in an Ontario, Canada population was shorter than 60 m, so those calculated for *S. dekayi* at the two Pennsylvania sites are not out of line. Snake home range dimensions essentially become larger with an increase in SVL of the species (Ernst & Ernst,

2003), and a short snake such as *S. dekayi* would be expected to have a relatively small home range, as indicated in this study. Nevertheless, some *S. dekayi* made relatively long movements over time (> 600 m) for their size. Even greater movements have been reported. Noble & Clausen (1936) recorded movements up to 1.2 km by marked *S. dekayi*, and migrations from summer feeding ranges to upland hibernacula are made by some populations of *S. dekayi* (Towey & Tucker, 2001).

Courtship and mating in wild *S. d. dekayi* occurs as early as February and March and continues through May (Clausen, 1936). Copulations by captive and wild Pennsylvania individuals also occurred within this period. Noble (1937) published a detailed description of courtship behaviour in *S. dekayi*, and courtship observations on captives in Pennsylvania showed they followed a similar pattern. Ovulation usually occurs in late March or April, but may take place as late as July in Louisiana (Kofron, 1979). Four dissected Edward Hand females had ovulated in May, later than in Louisiana females. This is best explained by the difference in latitude, and, probably, a longer annual activity period in Louisiana.

Noticeably pregnant females were found at both Lancaster County sites in June and July, and, based on captive birth dates, parturition probably occurred in late August or early September. Known captive gestation periods ranged from 81–94 days, well within the 14–113 day periods reported by Clausen (1936), King (1997), Kofron (1979), and Velhagen & Savitsky (1998).

Literature records of litter size in *S. dekayi* are 3–41 young (Morris, 1974; Wright & Wright, 1957), and the 6–19 neonates/litter produced by the captive Pennsylvania females fall within this range. Although, data on the relationship of neonate size and mass to female size showed that female size possibly influences both neonate size, litter size was dependent on female size. This supports the optimal egg size model, which states that variation in reproductive output will be in clutch (= litter) size, not in egg (= offspring) size (Smith & Fretwell, 1974). The relative clutch mass (RCM) calculated using the female's postpartum body mass averaged 0.40 (0.32–0.43); this agrees favourably with the 0.36–0.48 RCMs reported for the species (Meshaka, 1994; Seigel & Fitch, 1984).

Male *S. dekayi* mature at a SVL of 15–16 cm (Fitch, 1999; King, 1997; Mitchell, 1994), and females mature between 17.0–17.5 cm SVL (Kofron, 1979; Mitchell, 1994); both sexes mature in 2–3 years. Once the snake's sex could be determined at three years from its tail length, Pennsylvania females were always longer and heavier than males (Table 4). Data from recaptured juveniles showed that they grew at an annual SVL rate of 8–11% The annual SVL growth rate of recaptured adult males was 4.2%, and that of adult females, 6.0%. The growth rate decreases with age, as in other North American snakes (Ernst & Ernst, 2003). The oldest known recaptured *S. dekayi*, a female at Edward Hand, was in her sixth year (Table 4). The record longevity for the species is 7 years, 13 days in captivity (Snider & Bowler, 1992).

Observed feedings by wild and captive Pennsylvania *S. dekayi* indicated that the feeding periods coincided with the snakes' daily activity times. The annual feeding period of 140 days was probably determined by the environmental temperatures, and possibly by summer drought conditions which forced many of the snakes underground in 1966. The snakes were not found to feed until the surface temperature had reached 22°C (Table 3). A diet of earthworms and slugs is well known for this species (Ernst & Ernst, 2003), but the ingestion of neonates by females has not been previously reported. Perhaps unknown stresses of captivity triggered this behaviour.

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The herpetofauna of Annobon island, Gulf of Guinea, West Africa

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COMPARED to the reptiles of other Atlantic volcanic islands such as the Cape Verde and Canary islands, there is surprisingly little known about the herpetofauna of Annobon. There are no reliable recent species lists for the island. Some species were described in the 19th century, often by Portuguese herpetologists, but have not been studied since. The following report is an account of the reptile fauna recorded during a three day expedition in August 2002 by the three authors specifically to examine the reptiles of this island. Voucher specimens of each species were taken, and are stored in the collection of the University of Madeira.

Discovered by Diego Ramirez Diaz, a Spanish sailor, in 1470 and named as Isla de San António, Annobon, or as it is named locally Pagalu, is about 160 km southwest of São Tomé and 350 km westsouthwest of Cabo Lopez (Fig. 1), at 01° 26' S and 05° 37' E. It is a small island governed by Equatorial Guinea of about 8 km from north to south and 3 km wide with a total land area of approximately 17 km^2. It is formed by three major peaks, Pico del Fuego (454 m) in the north, Pico del Centro, and in the south the Pico Surcado. The shallow Lake Apot, about 1 km in diameter, is situated in the crater of Pico del Centro at 270 m. With an estimated age of 4.8 million years (Lee et al. 1994) the island of Annobon is the last island of the Cameroon volcanic chain that consists also of Mount Cameroon, Bioko, São Tomé and Príncipe.

There is a single small village, San António, on the northern tip of the island. Local inhabitants are primarily fisherman, but there is also a garrison of soldiers from Equatorial Guinea. The climate is wet tropical, although with 1000 mm of rain annually, Annobon is considerably drier than the other Gulf of Guinea islands. Mean monthly temperatures vary from 17–32°C. Lowland and submontane forests originally covered the whole island, but are now replaced in northern lowland regions by savanna grasslands and banana plantations. The woodlands are relatively dry, but with cloud forest over 500m. Introduced rats are extremely common throughout the island. There are many endemic plants, and a single endemic land bird, *Zosterops griseovirescens* Bocage 1893. There are no reports of amphibians from the island, and we did not find any evidence of them either.

In total we found seven species of reptiles. The most common and widespread reptile on this island is a medium-sized skink, *Mabuya ozorii* Bocage, 1893. It is difficult to find records of this skink in the literature, and it is not mentioned on the EMBL reptile database (www.embl-heidelberg.de/~uetz/livingreptiles) (Table 1). *Mabuya ozorii* was described by Barboza du Bocage in the 19th century, and since then very few references to this taxon have been made. Although widespread across the island, this species was not usually found in wet and shaded places such as the dense forest that covers the upper slopes of the island.

We also found another skink, *Panapis africana annobonensis* Fuhn, 1972. Compared with *Mabuya ozorii*, this small-sized endemic subspecies (total length less then 50 mm) has a more restricted distribution. This species was usually found among leaf-litter in the forest at relatively high densities. In drier places, especially near the coast, it was very difficult to find this species.

The family Gekkonidae is represented on the island by one widespread species, *Hemidactylus mabouia* Moreau de Jonnés, 1818 one endemic species, *Hemidactylus newtonii* Ferreira 1897 and one endemic subspecies, *Lygodactylus thomensis delicatus* Pasteur 1962. Near houses and in the village, the most common gecko seems to be *H. mabouia*. Based on molecular evidence we found that *H. mabouia* from distinct islands, like Madeira (Jesus et al., 2002), Cape Verde (Jesus et al., 2001), São Tomé and Príncipe and Annobon (unpublished data) are very similar, almost certainly indicating very recent introduction by humans. The situation in Annobon is surprising as there is no large airport or harbour to facilitate such introductions. The proportion of observed individuals of *Hemidactylus mabouia* to *H. newtonii* was about 3:1. All were found only around the village of San Antonio.

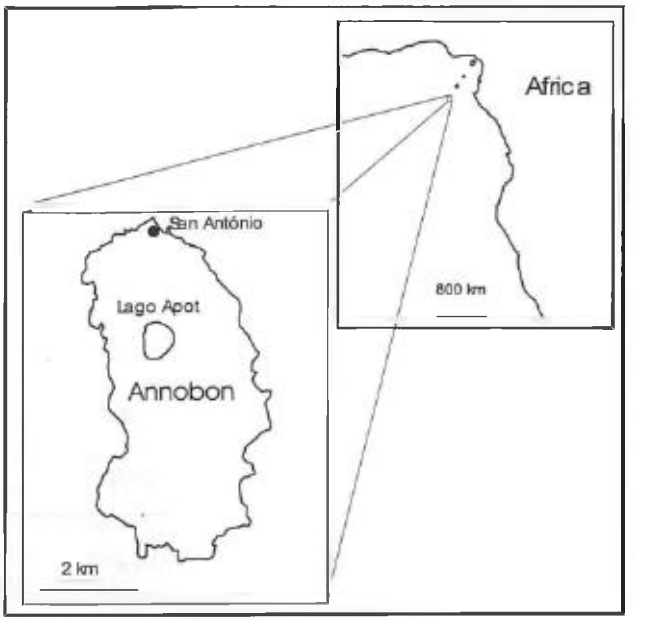
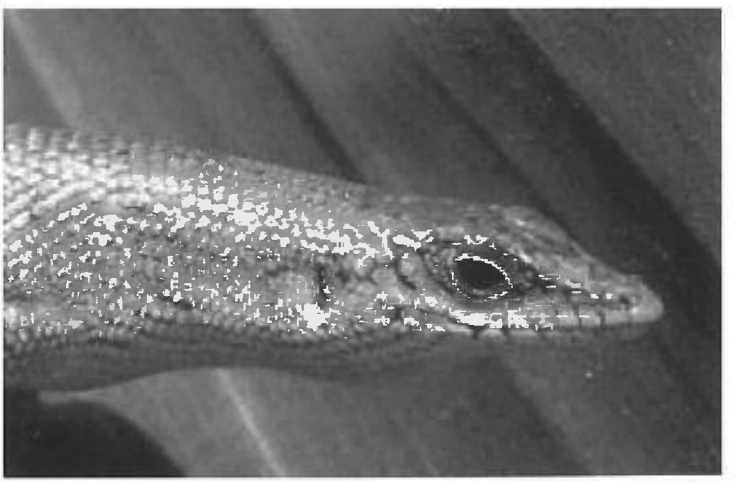


Figure 1. Map of Annobon Island

Lygodactylus thomensis (Peters 1881) is peculiar in being diurnally activity. It is endemic to Sao Tomé, Príncipe and Annobon. Unlike *Hemidactylus*, we found it only in the forest, climbing on small trees, during the day. It seemed to have a patchy distribution, being locally abundant but absent from other areas. We also found two species of snakes. The endemic species, *Philothamnus girardi* Bocage 1893, is a colubrid that is widespread on the island, mainly in large open spaces with shrubs and grasses, outside of the village. The blue specks on a light green background were quite different from the plain green coloration of the species of São Tomé, *Philothamnus thomensis* Bocage 1882. We also discovered three specimens of the Flower Pot Snake, *Ramphotyphlops braminus* (Daudin, 1803), under rocks on the outskirts of San Antonio. This tiny slender snake is originally from Asia but has been widely introduced; recent new reports include Egypt (Baha El Din, 1996), Mexico (Vázquez-Díaz & Quintero-Díaz, 2001) and the Cayman Islands (Echternacht & Burton, 2003) Its parthenogenetic reproductive strategy almost certainly has played a role in its extensive colonisation of islands.

The number of species of reptiles on this very small island is high when compared with the other two islands of the gulf of Guinea, São Tomé and Príncipe, yet Annobon is the youngest, smallest, and most geographically isolated. Of these seven



Mabuya ozorii. Photograph ©James Harris.

Species	Family	Our expedition	EMBL reptile database
Mabuya ozorii	Scincidae	+	
Panaspis africana	Scincidae	+	+
Lygodactylus thomensis	Gekkonidae	+	+
Hemidactylus mabouia *	Gekkonidae	+	
Hemidactylus newtonii	Gekkonidae	+	+
Philothamnus girardi	Colubridae	+	+
Ramphotyphlops braminus *	Typhlopidae	+	

Table 1. List of reptiles found in Annobon Island.
* Indicates first record of these species on the island.

species, two are introduced. All non-introduced taxa are endemic species or sub-species. High species density may be due to their different ecological requirements. The geckos have different periods of activity (one is active during the day, the other at night) and different distributions (one lives mainly in rocky habitats, the other on trees in the forest). The two skinks also have distinct habitat requirements. The introduction of *Hemidactylus mabouia* to the island could pose a serious threat to *H. newtonii* - in the Mascarene islands, *Nactus* geckos have probably been eliminated from some islands by introduced *H. frenatus* (Arnold, 2000). It is also unknown if these two species could hybridise. It is therefore important to determine the exact distribution and possible spread of *H. mabouia* on the island and its affect on or interaction with this endemic species.

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Learning of a trial and error escape routine in an Arizona Mountain Kingsnake (*Lampropeltis p. pyromelana*)

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A group of five adult Arizona Mountain Kingsnakes comprising one large male, one young adult male, and three females were maintained in a large vivarium at my Manx home. On a visit of several weeks duration to Scotland they were brought and housed in a 3-foot (90cm) glass tank with a standard vivarium lid, the central portion of which was a horizontal glass panel. The vivarium was accessed by sliding out the glass panel.

About a week after housing them in Scotland I noticed one morning that the vivarium lid was partially open and that the snakes had all escaped. I thought perhaps I had not closed the lid properly after feeding them the previous day. I rounded up the snakes, returned them to the vivarium and slid the lid home carefully. The next morning the lid was again open and all the snakes were again absent. They were again collected and returned to the vivarium.

The following evening I entered the room before dusk (when the snakes become active) and sat quietly where I could observe the vivarium largely unseen. The large male emerged from cover as dusk fell, climbed up onto the glass ledge near the top of the tank immediately below the vivarium lid, and by a combination of pressing its body against the glass and making sideways movements of its body all in one direction, slid the glass lid back. It then moved out of the vivarium followed shortly thereafter by the other four kingsnakes.

The snakes were again returned to the vivarium and the lid closed. I watched again the following evening when the large male again slid the lid back and all five snakes climbed out.

Prior to being brought to Scotland these snakes had no previous experience of a sliding vivarium lid. The fact that one of them (assumed to be the large male on all four occasions) managed to escape by sliding the glass of the vivarium lid is unremarkable. What is noteworthy is that having *once* managed to slide the lid back and escape it was able to repeat the performance at will (first on the following evening, and then on each of the next two evenings while under observation).

On evenings three and four whilst under observation the snake opened the lid quickly. It was obvious from watching it that the snake was carrying out a precise set of movements which resulted in a rapid escape, not effecting escape by trial and error as must have happened on the night of the first escape.

Hence the components of what began as a trial and error escape routine were learned as a result of the single 'trial' on the first escape night, and used successfully to effect escape on each of the three following nights.

This behaviour has interesting parallels with rapid learning – single instance learning – in a number of naive, juvenile, wild *Crocodylus porosus* (Bustard, 1968). There are also parallels with apparent learning of a complicated task – again a routine to escape from confinement – by a *Testudo hermanni* (Bustard, 2001).

The tortoise escape routine is seen as a far more difficult task for a tortoise on morphological grounds than the method employed by the kingsnake to make its escape. The interesting parallel, however, is that both successful routines appear to have been learned from the one successful escape and then been used to effect further successful escapes thereafter. These third and fourth subsequent escapes in the case of the kingsnake were observed and were speedy.

It would have been interesting to remove the large male and see how long it was before further

escapes ocurred by trial and error and to test whether these were also rapidly learned.

It is not suggested that another member of the group would have been able to observe what the larger male did and copy it, but that they would have had to learn the escape routine by trial and error.

Clearly the data reported here offer great scope for follow-up experiments.

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NATURAL HISTORY NOTES

Natural History Notes features shorter articles documenting original observations of amphibians and reptiles mostly in the field. Articles should be concise and may consist of as little as two or three paragraphs, although ideally will be between 500 and 700 words. Preferred contributions should represent an observation made of a free-living animal with little human intrusion, and describe a specific aspect of natural history. Information based on a captive observation should be declared as such in the text and the precise geographical origin of the specimen stated. With few exceptions, an individual 'Note' should concern only one species, and authors are requested to choose a keyword or short phrase which best describes the nature of their observation (e.g. Diet, Reproduction). The use of photographs is encouraged, but should replace words rather than embellish them. Contributions are accepted on the premise that they represent a previously unreported observation, and may be edited prior to acceptance. Standard format for this section is as follows:

SCIENTIFIC NAME (Common Name): KEYWORD. Text (there are no constraints on how information is presented but the date, time, and locality – with full map coordinates if possible – must be included, as should precise details on the nature of the observation with some discussion of its significance, and references to pertinent literature). If the information relates to a preserved specimen, its catalogue number and place of deposition should also be given. REFERENCES. Then leave a line space and close with name and address details in full.

***BITIS GABONICA* (Gaboon Adder): UNUSUAL MORTALITY.** The Gaboon Adder is most often associated with rainforest habitat but it is now known that it is well represented in wetlands, grassland, and cultivated areas throughout various parts of it's range (e.g. see Phelps, 1989; Luiselli & Akani, 2003; and Mallow et al., 2003).

Apart from Central and West Africa the Gaboon Adder has a fragmented range in eastern and southern Africa and north-eastern KwaZulu-Natal represents it's most southerly distribution.

Since 1983 I have made an occasional study of the Gaboon Adder in this part of it's range, which includes the St Lucia Wetland complex and the Dukuduku Forest. The Zulu translation of Dukuduku means 'place of hiding' which was rather apt because although the Gaboon Adder is not uncommon in the area it was difficult to find. This was partly overcome by the use of refugia in the form of plywood boards measuring a metre square. This method, including opportunistic sightings and night road searches, resulted in recording 112 individuals over a two year period. It is of interest to note that at least on two sites within the area, a large open forest clearing and a cultivated area, the Gaboon Adder was sympatric with the other large member of the genus, the Puff Adder, *Bitis arietans*.

One site was a large expanse of sand forest which extended northward from the St Lucia Estuary. Although much of the forest was virtually impenetrable there were numerous large clearings

which yielded good results. Gaboon Adders were also found in the dune system just above the shoreline and here they were easier to find due to the sparse vegetation, although they were never more than a short distance away from thick cover.

In September 1984 I received a message from a colleague stating that a number of Gaboon Adders had been found dead along the shoreline. The area was a section of coastline where the dunes banked down steeply at an acute angle away from the forest. During a walk along the bottom of the dunes I found the remains of four Gaboon Adders over a distance of about a kilometre. All were adults and in various states of decomposition, two were just remains of skeletons, and the remaining two were just a matter of weeks old. Talking to local people later that day it was confirmed that this appeared to be a regular occurrence

Adult female Gaboon Adder, *Bitis gabonica*, on frontal dunes. KwaZulu-Natal, South Africa. Photograph by author.

The Gaboon Adder is the largest viper in the world and can weigh as much as eight kilograms. Although snakes are amongst the most agile creatures it seemed that the very bulk of an adult Gaboon Adder meant that it could not negotiate the loose steep sand to gain the safety of cover, and therefore would be exposed to the full force of the African sun and certain death. It is not certain but the snakes must have slid down the dunes by accident as it is difficult to imagine that they would visit such an exposed situation voluntarily.

During May 1984 I actually found a live adult at the bottom of a dune, an adult female measuring 120 cm. Luckily it was late afternoon and the snake had not been there that long as its 'slide' marks could still be seen clearly on the face of the dune. Large members of this genus are well known for their caterpillar mode of locomotion, and just out of curiosity I placed the snake at the bottom of the dune facing upwards. Sure enough the Gaboon Adder started to 'caterpillar it's way up the dune, reaching just about halfway, about two metres, and then slid ungracefully to the bottom.

This represents a rather unusual natural hazard, and although the Gaboon Adder is a protected species in South Africa, there appears little can be done to alleviate the problem.

I last visited the area during October 2003 and found two more corpses at the bottom of the dunes, but the good news is that I also observed a good number of live ones in the dunes and the forest beyond.

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***VIPERA BERUS* (European Adder): HOT WEATHER BEHAVIOUR IN PURBECK, DORSET.** The summer of 2003 was notable for the hot dry weather, and for those of us working in the field a lack of consistent reptile sightings. Extreme weather and the apparent dearth of reptiles, particularly snakes, called for some initiative.

One obvious approach was to search during early morning, a method which in past hot years, (e.g. 1976, 1998), has not been very successful. Sure enough, apart from a few Common Lizards, *Zootoca vivipara*, no reptiles were sighted. Nocturnal behaviour in the Adder is not unknown (Wareham, 1998), although in the past searches at dusk and beyond by myself and others (see Prestt, 1971), have revealed little. The first evening and night searches began in June and on 9th June a non-breeding female was found lying out at Studland at 20:30 hrs, and was still there when I returned at 22:00 (see front cover). On 22nd June a sub-adult male was found crossing the road at Hartland Moor at 21:30, and on 26th June an adult male was found under refugia (tin) at Furzebrook at 22:15. Daytime temperatures were around 26°C, and there had been no rain, with an almost zero dewpoint.

Temperature began to peak during July and August and fieldwork continued during early morning and night. During 1997, refugia (tins) had been placed in areas known to be summer grounds for the Adder. These are usually checked from May onwards and in 2003 that month proved very successful for recaptures of adult males and immature individuals. Such recaptures followed a trend for previous years which normally provided good data for the entire summer period.

From about the middle of July sightings in the summer grounds dropped off to almost nil as daytime temperatures soared to in excess of 30°C, and this also included early morning and evening searches. It was also routine to check hibernation areas during the summer months as it is known that breeding females remain in these areas (Phelps, 1977).

Around mid August there was an evening of substantial rain. The following day was cloudy with occasional sunny spells and an air temperature of around 20°C. The first site visited was a hibernation bank at Furzebrook near Wareham. Two adult males were found coiled together, with another adult male coiled just two metres away. These snakes were coated in a thin layer of clay which strongly suggested that they had recently emerged from an underground retreat (Fig. 1). All the males were identified and each one had been previously recorded in the summer ground during late May. The summer ground was about five hundred metres away and it seems that these males at least had deliberately returned to the hibernation bank to undertake a period of aestivation. Two gravid females were also found on the hibernation bank, and these too had clay adhering to the body (Fig. 2).

On 8th September two of the males recorded on the hibernation bank were found back on the summer grounds. Both had recently fed, and indeed, these and other adders subsequently examined seemed to be in good condition. Birthing dates were also normal and neonates were much in evidence during early September.

These observations pose a number of questions. Firstly, in a temperate climate is aestivation obligatory during such extreme weather?, and why return to the hibernation area? Summer grounds are usually damp places and would apparently

Figure 1. Males on hibernation bank during August with clay adhering to bodies, Furzebrook. All photographs by author.

Figure 2. Gravid female on hibernation bank with clay adhering to body, Furzebrook.

offer plenty of scope for thermoregulation during hot weather. Or could this highlight the attachment to the hibernation area?, which after all is the focus of all Adder populations (Phelps, in press). When considering conservation and management we probably underestimate the aspect of site fidelity with regard to the Adder and other snake species and even though unwittingly, could be a cause of the decline of populations if such management is deemed inappropriate.

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***NATRIX NATRIX* (Grass Snake): ALBINO HATCHLING.** Albino Grass Snakes are a rarity in Britain. Boulenger (1913) wrote that they are found 'occasionally', noting a specimen from Horsted Keynes, Sussex. Procter (1926) gave a detailed description of an albino Grass Snake that was donated to London Zoo, and Bowles (2001) described a young albino, found at Moor Park Golf Course in Hertfordshire (Fig. 1).

In October 2002 a member of the public captured an albino hatchling Grass Snake in a garden in the Dunwich Forest area of the Suffolk Sandlings (O.S. reference TM47) (Fig. 2). The snake was passed on to a member of staff from an English Nature local team, and has been reported in the newsletter of the Suffolk Naturalists' Society (Baker, 2003). This albino differed in some details of coloration from the previously described snakes (Boulenger, 1913; Procter, 1926; Bowles, 2001). The main difference lies in the background coloration, which is pale pink in the current specimen, but was

Figure 1. Albino Grass Snake from Moor Park Golf Course. Watercolour ©Frank Bowles.

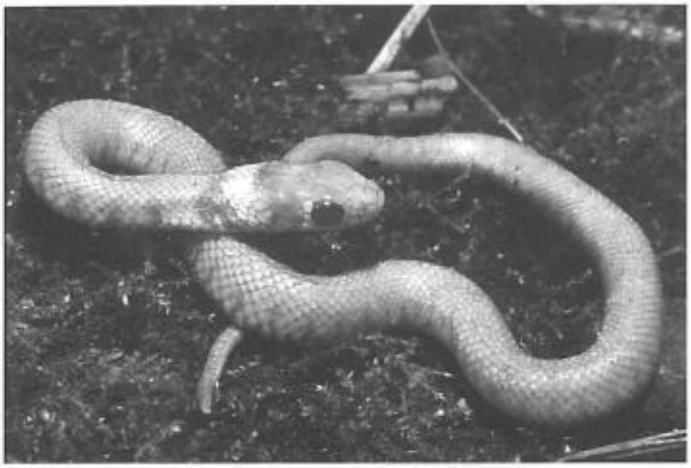

Figure 1. Hatchling albino Grass Snake from Dunwich Forest, Suffolk. Photograph by author.

described as yellowish flesh colour, ivory-white or pale cream in the previous accounts. This difference may be age-related; the earlier descriptions make no reference to hatchlings and the specimen reported by Bowles was about 60 cm long.

There are some similarities between the Dunwich snake and previous descriptions, but there are also several differences, as there are between the previously described albinos themselves. In the Dunwich snake the collar was cream – as in the snake described by Procter. However, Boulenger noted that the collar could also be yellow. In the hatchling the bars and other, normally, black markings were pale mauve-pink. Procter explained this as being due to the muscle tissue showing through the transparent skin. In Procter's specimen internal organs could be seen through the transparent (normally black) areas. These were not apparent in the currently reported hatchling. Boulenger described these normally dark makings as reddish, and in Bowles' specimen they were light grey. Similarly, the white tongue of the Dunwich snake corresponds with Procter's description, but Boulenger noted that the tongue was red. Boulenger and Bowles reported red eyes, but Procter described the eyes of the London Zoo specimen as being dark red with a pale orange iris; those of the Dunwich Forest specimen were pink, but also with an orange iris.

In most cases of albinism, the chances of survival in the wild are likely to be lower than for normally coloured animals, as the individuals concerned will be more conspicuous to predators. This particular hatchling certainly drew the attention of the householder who captured it. It was also not a vigorous animal. Due to the low chance of survival in the wild and the curiosity value of the animal, it was kept in a vivarium by a local herpetologist, Mark Jones. However, its lack of vigour persisted. It was lethargic, lying motionless in the open – rather than under the shelter provided – and was unresponsive to moving objects. Three weeks after capture the snake died and was donated to the Ipswich Museum.

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***NATRIX NATRIX* (Grass Snake): UNUSUAL MARKINGS.** On September 11th 2003 a juvenile Grass Snake was captured at a site on the Hampshire/Surrey border. This was part of a capture and release programme in an area earmarked for development where reptiles, (*Anguis fragilis*, *Zootoca vivipara* and *Natrix natrix*), were released in suitable adjacent habitat via an exclusion fence.

The snake was found beneath refugia, (roofing felt), and was observed to have recently moulted, the discarded skin being under the same refugia.

The snake was measured and weighed; total length 210 mm, (172 + 38 mm), weight 7.6 g. The snake was deemed to be a juvenile female in it's second season born during the summer of 2002.

A vivid pale yellow collar and black inverted 'V' marking immediately behind the head was typical, although the black patch had a thin pale border. The actual body markings were less typical and very unusual. Grass snakes vary considerably with regard to markings and the typical Western European subspecies, *N. n. helvetica* is usually the most heavily marked, and for this reason is sometimes called the Barred Grass Snake. Typical markings are vertical lateral bars interspaced with smaller bars or spots on the dorsolateral surface which may extend across the vertebral line.

The dark markings on this snake were dominant to the extent that the apart from some white stippling, the last 50 mm of the body and tail was black. The vertical lateral bars were fused with higher lateral markings giving the snake a distinctive viperine appearance. Indeed, when viewed from above, and if the head was not visible, the snake could easily have been mistaken for a young Adder, *Vipera berus*. However, the zig-zag pattern was formed by the grey ground colour and not the actual markings and consisted of thirty five 'windings' running for almost the entire length of the dorsal surface. Interestingly, the ventral surface was entirely black and bore no trace of the more usual 'chequer board' markings.

The snake was photographed and released the next day.

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Left: *Natrix n. helvetica*. Typical heavily marked adult from Surrey.

Below: *Natrix natrix*. Unusually marked juvenile female from Hampshire/Surrey border. Photographs ©Tony Phelps.

Amphibians and Reptiles of Nepal

H. Hermann Schleich and Werner Kästle, Eds.
2002
1201 pp. A.R.G. Gantner Verlag K.G.
Hardback with dj.
ISBN 3-904144-79-0
(distributed by Koeltz Scientific Books,
Königstein, Germany)
€149 / £105

This is a big book, and since everything seems to weigh so much more when trekking in the thin air of the Himalaya, why would a field herpetologist visiting Nepal pack a copy of this heavy tome in his/her rucksack, a challenge almost akin to trekking across the Australian Outback with a copy of Cogger's 6th edition (2002) as extra ballast. In truth Schleich & Kästle weighs in at a little less that Cogger (2.10 kg versus 2.45 kg) and I am sure that even by the 6th edition it will not have expanded at the same rate as the Australian herpetological bible, but it is a consideration, with excess baggage on aircraft to bear in mind too. Here I aim to justify the expense of the book and the back injuries caused by humping it around the terai forests and Himalayan foothills (I am inclined to think Everest Base Camp is a trek too far).

I have been to Nepal twice to conduct herpetological and ichthyological survey work, on both occasions to the far west, to the Royal Bardia National Park and the Karnali and Bheri River systems. Back then, in the early 1990s, I spent many weeks, if not months, beforehand, compiling lists of which species I considered probabilities, and which possibilities, for the region I was to visit. I obtained museum separates, the most useful being Swan & Leviton (1962), Kramer (1977), Nanhoe & Ouboter (1987), and obscure papers from less well known publications (Cox, 1986)!! I also drew heavily on the excellent, though somewhat outdated, books on the neighbouring countries such as Malcolm Smith's three volumes on reptiles of British India (1931, 1934 & 1943). I even prepared my own dichotomous key to the snakes I might encounter.

Today none of this is necessary, all you need is Schleich & Kästle which really only weighs 20 gms more than the Smith trilogy. But is it any good, after all it is certainly isn't cheap? I do think this a worthy purchase, not least because it combines the collaborative efforts of twelve herpetologists and experts on Nepalese natural history.

The first 127 pages provide a broad overview of Nepal, its climate and vegetation and the place of amphibians and reptiles in the culture and economy of this mountain kingdom. The risk, first aid and treatment of snakebite are documented and the threats to, and conservation of, species are examined. There are numerous checklists and the zoogeography of the Nepalese herpetofauna is discussed by four of the authors with consideration of where the various taxa originated outside the national borders. All this is very helpful background information if one is to understand why certain species occur in Nepal and others do not.

Of course, the most important part of the book, from the point of view of the fieldworker, are 900 pages devoted to 175 species accounts. The layout is reminiscent of the editor's earlier (1996) book on North Africa that I must confess I initially found a little difficult to follow.

How comprehensive is Schleich and Kästle? Probably very, but the results of my 1991/1992 field trips to Nepal were published in 1998, in the delayed symposium proceedings for a South Asian herpetological conference, which was also attended by three of the authors of the current publication, so I was surprised to see it had been overlooked here. My paper listed three important additions to the herpetofauna of the region. An earlier abstract of my paper, from 1996, is cited in the general Literature references but appears in only one of the species reference sections, that of *Python molurus bivittatus* (pp. 795-802) by

Kabisch. However, the author insists that the subspecies in Bardia District, Nepal is *P. molurus molurus*, which has supralabials in contact with the eye and lacks subocular scales. I captured three *P. molurus* in Bardia and all possessed subocular scales on either sides and were assuredly *P. m .bivittatus*, a fact overlooked in this account. My records of the wolfsnake *Lycodon jara* are completely omitted by Gruber (pp. 886-887) and of the blindsnake *Typhlops diardii* by Kabisch (pp. 1000-1002). Yet my abstract is referenced under these species in the Supplements (pp. 1043-1069). Since my full paper was published in the symposium proceedings four years prior to publication of this book I think its omission an oversight. Disappointed? Yes! Damning? No! I put this down to the problem of coordinating a book with multiple authors in different countries.

As with the North Africa book, all the photographs are grouped together near the centre of the book, and of a very high quality. The back of the book includes a very useful gazetteer section listing all collection localities, a glossary and an extensive literature section.

Is this heavy book worth the considerable expense and a bad back? I believe it is, but maybe it should remain in expedition base camp and have specimens brought back to it.

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MARK O'SHEA

The Really Useful Handbook of Reptile Husbandry

Caroline Gosden

Butterworth Heinemann
(Elsevier Science Limited)
ISBN 0-7506-5443-0. October 2003.
Paperback · 186 Pages · 15 Illustrations
£19.99

The thinking behind this book is both compelling and laudable; that it should be possible to compile a set of questions a veterinary surgeon, inexperienced in the field of reptile medicine, can pose to an equally ill informed reptile owner, that will allow some deduction of the underlying problems. It is based entirely on the precept that the 'most common reason for illness amongst reptiles is inappropriate husbandry'. The publication also adopts the novel approach of providing a renewal supply of question and answer forms care of a CD.ROM attached to the back cover.

Anyone who has ever attempted to construct a standard form will rapidly appreciate there are problems inherent in the process. Not the least being the aphorism that the exception is the rule. To offset this objection, the author has analysed the requirements of some of the species most commonly kept by newcomers to the field of reptile, and despite the book's title, amphibian husbandry. She has then supplied a series of questions that will allow the vet to determine if it is a shortfall in husbandry technique that has brought the animal into their surgery. This is a commendable aim but does require that someone whose income depends on throughput is going to bother with completing a form or that an anxious owner is equipped with the information necessary to complete their end of the bargain. Nevertheless the questions posed are pertinent to untangling the likely cause of ill-health.

The first section is given over to a series of forms that cover; 1 snakes and lizards, 2 tortoises, 3 terrapins and finally 4 amphibians. Each form is accompanied by an explanation for each of the questions.

There then follows a set of completed forms for the usual suspects, which admittedly are those species most likely to be purchased by newcomers to reptile keeping. Finally a section of self-test histories allows the reader to compare their assessments with that of the author.

There is a series of appendices; some photographs of injures arising from inappropriate husbandry, a weekly diet sheet, a flow chart to identify possible causes of anorexia in snakes together with some tactics to induce feeding. Finally there is a table of data pertaining to the species covered within the text.

One could perhaps take issue with some of the recommendations. The author advocates 'environmental stimulation' despite the evolutionary conclusion that potted plants and mossy grottoes, compost and peat are a sure fired route to a chaotic mess and the possibility of novel injury.

However, this is a book intended to be used by a third party advising a keeper who looks upon their charges as pets, so some latitude with regard to cage décor must be afforded.

There are two assurances – one in the preface and another on the following page – that the 'book is quick and easy to use'. I beg to differ. The layout of the book is confusing and difficult to navigate; this is not the fault of the author but of the publisher who has elected to use a font and binding that make regular use of this handbook anything other than easy. Space should have been created between sections to aid the reader in navigation perhaps at the expense of the large scale line drawings that add little to the text, for example half a page dedicated to a sketch of an old-fashioned analogue humidity gauge. These are faults in the editorial process manifest in the extraordinary pronouncement on the Elsevier website; *(http://intl.elsevierhealth.com/catalogue/title.cfm?ISBN=0750654430)* that 'Reptile owners are becoming more and more inexperienced as the popularity of these animals becomes more widespread'. There are other shortfalls in the editorial process that should have detected statements such as 'most snakes are carnivorous'.

Perhaps the rather depressing conclusion from this particular work is that despite the extraordinary range of books, booklets and internet information that is readily available, it must be presumed the newcomer is as reluctant as ever to acquire the elementary knowledge that would have rendered much of this text unnecessary.

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