An isolated Adder (*Vipera berus)* population in Hungary

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Abstract

A four-year study of an isolated Adder (*Vipera berus*) population in the vicinity of the Dávodi fish pond system (Boronka Landscape Protection Area) at Nagybajom-Ciframalom, Somogy County, southwestern Hungary, was carried out. By using a capture-recapture method, 56 specimens (34 males and 22 females) could be caught and measured in the field. The approximate population size estimated by the Petersen-Lincoln index was found to consist of 278 specimens. Based on body length and weight comparisons, three age classes could be distinguished. Males and females did not differ significantly in dimensions, while melanistic specimens of either gender were heavier and longer than normally coloured ones. Males finished hibernating two to three weeks earlier than females, and the activity of both sexes largely ceased between late June and mid-August. Young were born in August, and retreated to their overwintering sites in the second half of October at latest, at the same time as adults. In colour pattern, mid-body and subocular scale counts, the population appeared to consist mostly of specimens intermediate between *V. b. berus* and *V. b. bosniensis.* The ratio of melanistic individuals was unexpectedly high (39.27%). Colouration was found to alter considerably during ontogeny.

Introduction

The subspecific identity of the Adder (*Vipera berus*) populations inhabiting southwestern Hungary remains unclear to date, and no detailed study has ever been conducted on their living conditions and population biology. Fejérváry (1923) assigned them to *Vipera berus pseudaspis* Schreiber, 1912, while others referred them to *Vipera berus bosniensis* Boettger, 1889 (Dely, 1972; Dely and Marián, 1960; Fritzsche and Obst, 1966; Marián, 1956, 1957). However, preliminary studies conducted in the area (Lazányi, 1997) revealed a mixed occurrence of morphological characters thought to define subspecies in the Adder.

Material and Methods

In the course of a three-year field work undertaken from 1997 to 1999 in the vicinity of the Dávodi fish pond system (Boronka Landscape Protection Area) at Nagybajom-Ciframalom, Somogy County, southwestern Hungary, the capture-recapture method was used to estimate population size. The specimens thus caught were photographed,

measured (weight and total length) and released unharmed. Their subsequent identifying was made on the basis of these photographs. Number of the mid-body scale and subocular rows, and the back pattern were subjected to morphological analysis. In the course of our study not all morphological data were consequently noted, hence the number of specimens included in an analysis of a given morphological character might differ.

Results and discussion

Population size

In total 56 Adders (34 males and 22 females) were collected in the study area (table 1). Seven individuals were recaptured (only observations separated by an overwintering

	Males	***Females***	***Recapture***
(1991)	1	0	0
1996	2	1	1
1997	14	10	1
1998	17	11	5
Σ	**34**	**22**	**7**

Table 1. Adders captured and recaptured in the Nagybajom-Ciframalom study area in the course of a three-year study period

period were taken into account). An approximate population size estimated by the Petersen-Lincoln index (Sutherland, 1998) was found to consist of 278 specimens.

Age and sex distribution

On the basis of the body mass-body length ratio, three age classes could be distinguished (fig. 1.). Group I contains newborns and juveniles that have hibernated only once (up to 35 g and 300 mm). The members assigned to Group II have reached a larger body mass during their first summer, hence this class contains specimens that have survived their first and second feeding period and their second or third hibernation (two- and three-year old individuals). Group III contains all specimens over 100 g and 550 mm, and we no longer succeeded in establishing the age of Adders exclusively on the basis of size characteristics.

No significant difference was found between the body masses and lengths of males and females (Student's t-test, body mass: $t = 0.69$, $DF = 38$; body length: $t = 0.99$; $DF = 71$) (table 2), whereas body lengths and weights of melanistic and normal colour morphs differed significantly.

Fig. 1.

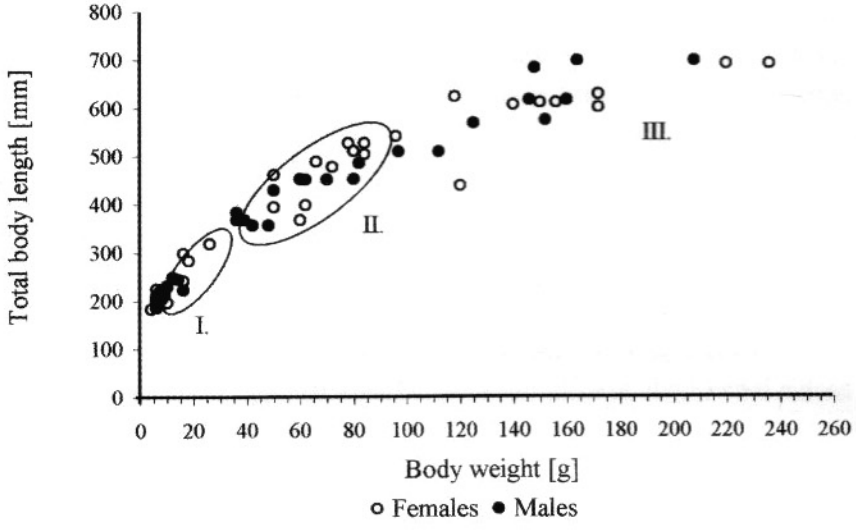

Fig. 1. Body mass-body length ratio of the Nagybajom-Ciframalom population.

	Body mass [g]	Body length [mm]
Females	99.65 ± 43.47 (n = 17)	486.29 ± 78.33 (n = 14)
Males	99.48 ± 47.09 (n = 25)	501.85 ± 103.85 (n = 26)

Table 2. Mean body mass and body length of the adders in the Nagybajom-Ciframalom-population.

	Normal colour N = 47	Melanistic N = 47
Body length [mm] (Student's t-test, t= 21.50, P< 0.1%, DF= 46)	253.43 ± 68.35	522.66 ± 92.29
Body weight [g] (Student's t-test, t= 8.22, P< 0.1%, DF= 46)	19.39±18.30	103.21±46.50

Table 3. Summarizing the difference between the body lengths and weights of melanistic and normal colour morphs.

Melanistic specimens were heavier and longer than normally coloured ones (table 3), similarly to results published elsewhere (Andrén & Nilson, 1981, 1983; Capula and Luiselli, 1994; Luiselli, 1992, 1993; Madsen and Stille, 1988; Monney *et al*,. 1996). The reason for the latter is that newborn individuals were found to be always normally coloured, and thus including their data into our analysis resulted in a smaller average body length of normally coloured specimens. Colouration was found to alter considerably during ontogeny: the distinct dorsal zig-zag band of juveniles was obscured by the darkening background with time, (Luiselli, 1992, 1993; Monney *et al*,. 1996) (fig. 2.). Melanistic individuals were dominating (almost 40%) in the population, an explanation for which might be that a black colouration is probably advantageous for the animals. The thermoregulation of melanistic specimens is better and, as a result, their metabolism is more effective: they are able to feed on more or bigger prey, so they ultimately reach a larger body size. Males utilize their advantage resulting from a larger body size/mass in combat bouts, while females thus have a higher reproductive rate (Andrén and Nilson, 1981; Luiselli, 1992, 1993). Monney *et al.* (1995, 1996) and Capula & Luiselli (1994) have shown that black females reproduce more frequently and have a higher level of fecundity. Another explanation for the high number of black specimens may be that they can adapt better to lower temperature and higher humidity levels characterizing close forested areas (Monney *et al*., 1996).

Fig.2.

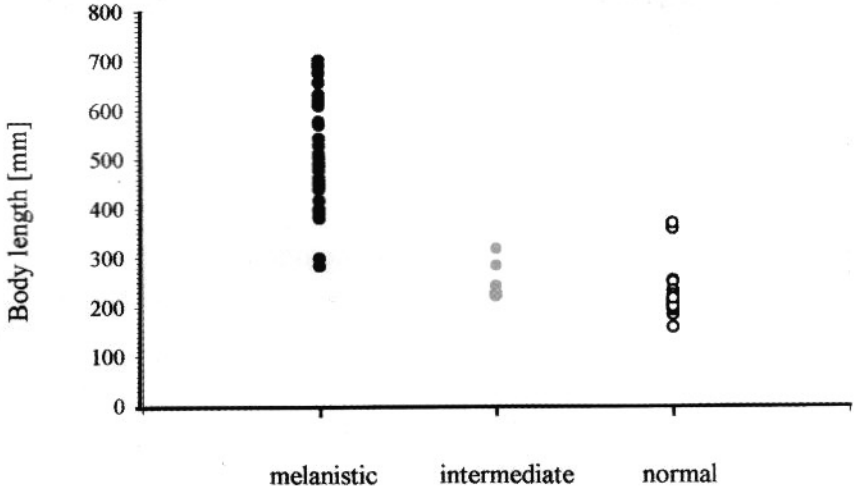

Fig. 2. Altering colouration during ontogeny in the Nagybajom-Ciframalom population.

Annual activity cycle

Capture and observation data are summarized in fig. 3. They reveal that males end their hibernation earlier (they can be observed basking already on the warmer days of

January). Early spring almost exclusively males can be seen, which, immediately after their first shedding start searching for females. Females end their hibernation two to three weeks later, in mid-March. Simultaneously, also juveniles born in the previous year emerge from hibernation. Most (probably) adult females were encountered between May and mid-June. In the subsequent period (in July), probably due to excessive heat, Adders were only rarely observed. The number of (re-)captured individuals again increased from mid-August on, and also the first newborns were appearing in this period. The last specimens could be seen in the second half of October. In contrast to earlier allegations, our data revealed that juveniles began their hibernation at the same time as adults. Individuals were active for 8-9 months, and hibernated for only 3-4 months. As shown by numerous authors (e. g. Forsman and ús, 1987; Gibson & Falls, 1979), melanistic specimens can better adapt to a colder and more humid environment, and thus can extend their annual activity period (also confirmed by our results).

Fig. 3.

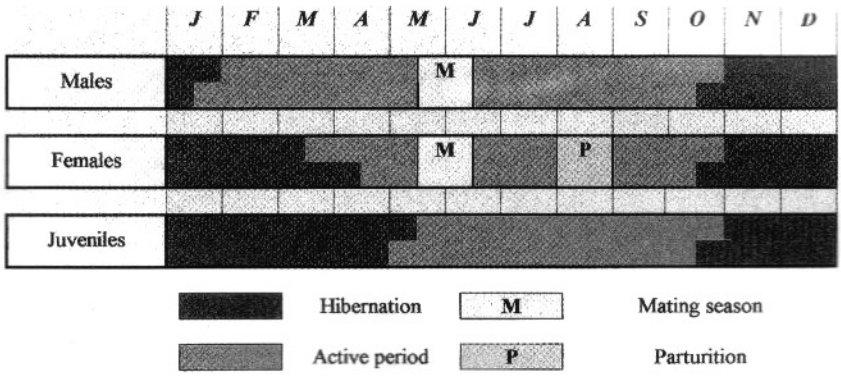

Fig. 3. Annual activity cycle of the Nagybajom-Ciframalom population.

Morphological comparisons

We wished to establish the subspecific identity of the members of the population by morphological comparisons of the three traditionally recognized characteristics of the nominate form (*Vipera berus berus*) and the Bosnian subspecies (*V. b. bosniensis*) of the Adder, such as mid-body and subocular scale counts, as well as dorsal colouration and pattern. *V. b. bosniensis* possesses a broken, ladder-like dorsal band, and, according to Dely (1978), specimens are often completely melanistic. There are two scalerows between the lower edge of the eye and the supralabials, and the mid-body scales amount 23 (Marián, 1956; referring to Méhely [1895] – erroneously cited as from 1897 –, whose work, however, does not contain any such information). It should be noted that according to Schiemenz (1987) 21 rows of mid-body scales occur in 98%

and 23 only in 2% of all specimens. Schreiber (1912), on the other hand, did not make a distinction on the basis of this characteristic among the different „varieties" of the Adder considered valid by him, while Boulenger (1896) stated that rarely 19 or 23 rows of mid-body scales occurred in *V. berus* (at that time including *Vipera seoanei* Lataste, 1879). In the typical race, there usually are 21 rows of scales around the mid-body, the dorsal pattern consists of an unbroken zig-zag band, and the subocular scales are aligned in a single row (Marián, 1956; Schiemenz, 1987; Schreiber, 1912). In the population studied, specimens resembling the typical race in colouration and pattern, as well as entirely black, and also individuals with a broken dorsal band were represented. In addition, also some melanistic specimens were found in which the earlier pattern remained visible („intermediate pattern"). Males born silvery gray, and brownish females often became entirely black by their second year (fig. 2). Table 4 reveals that most members in the population are melanistic or possess a broken, bosniensis-like dorsal band. By including all three characteristics in the analysis (table 5), we found that only 5.6% of the specimens exhibited all three features of the nominate form, and 2.8% all three characteristics of the subspecies *bosniensis*. Most numerous (22.2%) were melanistic specimens having 21 rows of mid-body scales, and 1 row of subocularis. 16.7% were melanistic, but had 23 rows of mid-body scales, and one row of subocularis.

Pattern	Males	Females	Mean
Unbroken zig-zag band	6.25%	21.74%	13.99%
Entirely black	43.75%	34.78%	39.27%
Intermediate	9.375%	8.69%	9.03%
Broken, bosniensis-like Dorsal band	40.625%	34.78%	37.70%
N =	32	23	55

Table 4. Division of the dorsal pattern within the population studied.

Because melanistic individuals are very common in alpine *Vipera berus berus* populations (Fejérváry, 1923; Monney *et al.*, 1996), a black colouration cannot be regarded an exclusive characteristic of *V. b. bosniensis*. Hence we studied the „taxonomic composition" of the population taking only morphological characters into account (tables 6, 7, 8). In mid-body scale counts, both males and females usually exhibited the 21 rows characterizing the typical race, while those resembling the Bosnian subspecies in possessing 23 rows of scales totalled 1/3 of all specimens studied (table 6).

The occurrence of this character in more than 30% of the individuals is definitely sur-

Sc. Dorsale - Pattern	21 – 1	21– 2	22 – 1	22 – 2	23 – 1	23 – 2	Σ
Unbroken zig-zag band	5.6	0	0	0	0	0	5.6
Entirely black	22.2	8.4	9.3	0	16.7	2.8	59.4
Intermediate	2.8	6.7	0	0	5.6	0	15.1
Broken, bosniensis-like dorsal band	2.8	5.8	0	0	8.5	2.8	19.9
Σ = 25	33.3	19.4	8.3	0	30.6	5.6	100

Table 5. Analysis of the three taxonomically interested characters (data given in percentage).

prising, when compared to Schiemenz's (1987) 2%. As to subocular scales, in males two rows occurred in 1/3, and one row in 2/3 of the specimens studied. In females, no such an obvious difference could be observed (45 and 55%, respectively) (table 7). Regarding the three descriptive morphological characters together, we found that specimens exhibiting scale counts characterizing the nominate form were clearly dominant

Mid-body scale rows	Males	Females	Mean
21	58.33	53.3	55.82
22	4.16	13.3	8.76
23	33.3	33.3	33.3
N =	23	15	38

Table 6. Analysis focused only on the midbody scale rows (data given in percentage).

(almost 40%) over individuals with bosniensis-like morphology (15%) (table 8).
On the basis of morphological characters, we failed to assign the population studied to either subspecies. We suspect the presence of an intergradation zone in the given area. It is also possible that the characterization (traditionally) used in the literature and by

Subocular scales	Males	Females	Mean
1	72.41	45.83	59.12
2	27.59	54.2	40.89
N =	29	15	44

Table 7. Analysis focused only on the number of the subocular scale rows (data given in percentage).

Sc. Dorsale / Sc. Suboculare	Males		Females		Mean	
	1	2	1	2	1	2
21	30,43	26,09	46,67	6,67	**38,55**	16,38
22	4,35	0	6,67	6,67	5,51	3,34
23	34,78	4,35	6,67	26,66	20,73	**15,51**
N=	23		15		64,79	35,23

Table 8. Analysis of the morphological characters together (data given in percentage).

us is insufficient for defining subspecies in the Adder, and we thus stress the need of further investigations on a wider biological scale.

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