

Bonn. zool. Beitr.	Bd. 39	H. 4	S. 371—379	Bonn, November 1988
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## *Vipera lebetina transmediterranea*, a new subspecies of viper from North Africa, with remarks on the taxonomy of *Vipera lebetina* and *Vipera mauritanica* (Reptilia: Viperidae)

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**Abstract.** A new subspecies, *Vipera lebetina transmediterranea* ssp. n. from North Africa, is described. Five specimens from different museum collections originate from Algiers and Tunis. This new taxon differs from the sympatric *V. mauritanica* in number of dorsal scale rows and other scalation characteristics, as well as in colour pattern. A combination of scalation characteristics also separates it from the Asian subspecies of *V. lebetina*. From *Vipera schweizeri* it differs in the number of dorsal scale rows.

**Key words.** Reptilia, Squamata, Viperidae, *Vipera lebetina transmediterranea* ssp. n., *Vipera mauritanica*, *Vipera schweizeri*, North Africa.

*Vipera lebetina* has during the last few decades been divided into several subspecies in its rather extensive range. Some of these have proved good taxa while others have disappeared into synonymy. The main distribution of *lebetina* s. l. is found in Asia, a region to which also most of the different subspecies' names are connected. One form, *schweizeri*, is endemic to Europe (Milos and adjacent islands in the Greek Cyclades) while two subspecies, *mauritanica* and *deserti*, are restricted to northwest Africa. The rest, which include nominal taxa as *lebetina*, *obtusa*, *turanica*, *euphratica*, *peilei*, occur in western Asia. Different authors argue variously over the validity of these subspecies and e. g. Joger (1984) only accepts *lebetina* and *obtusa* of the Asian subspecies. On the other hand the north African taxa, *mauritanica* and *deserti*, are considered to be two subspecies of a separate species, *Vipera mauritanica* (Kramer & Schnurrenberger, 1959, 1963). *Vipera mauritanica* differs morphologically from the Asian populations of *lebetina*, and this partition of *lebetina* s. l. is acceptable from a phenetic point of view. Moreover, the European taxon, *schweizeri*, is with only 23 midbody scale rows, a morphological extreme in an opposite direction and merits species' status on the same grounds as *mauritanica*. Osteologically *schweizeri* is also very different from Asian subspecies of *V. lebetina* (Szyndlar, pers. inf.), and by being much smaller than other *lebetina* taxa also reproductively isolated in a similar way as *Vipera (latasti) monticola* is from other *V. latasti* taxa (Beerli et al. 1986). Thus from a phenetic point of view, *lebetina* s. l. could be divided into three species, *Vipera schweizeri*, *Viperas lebetina* s. str. and *Vipera mauritanica*, restricted to Europe, Asia and Africa respectively. Further the various Asiatic populations of *V. lebetina* show both clinal and local variation in external morphology (MS in prep) which motivates reevaluation of the systematic division of this species.

Many authors (e. g. Bons & Girot, 1962; Klemmer, 1963, 1968; Rage, 1976, 1984; Harding & Welch, 1980; Welch, 1982; Bruno, 1985) continue to treat *mauritanica* as a subspecies of *V. lebetina*. Some North-African specimens actually resemble typical *lebetina*, as was mentioned and illustrated by Wittman (1954), and the pattern of

*lebetina* s. str. restricted to Asia, has been disturbed by the appearance of African vipers very similar to the Cypriot *V. l. lebetina* in external morphology. In fact, when Anderson (1892) described his *deserti* he compared it exclusively with various *lebetina* specimens, but not with *mauritanica*. The two African specimens he used for comparison were from Algiers (Anderson, 1892, tab. p. 21). They are typical *lebetina* and very different in appearance from *m. mauritanica*. During the revisionary work of the large Oriental vipers, the “*Vipera lebetina* complex”, it has become necessary to make consecutive taxonomic descriptions of populations that do not fit in with the current taxonomic pattern. The two specimens that Anderson used belong to such a taxon similar to *lebetina* and are here included as syntypes in the description of a new subspecies.

This new taxon has been associated for some time with Algeria and Tunisia where it may be sympatric with *m. mauritanica* and/or *m. deserti* (Nilson & Andrén, 1986). The exact distribution is not clear. The five specimens available in museum collections are all labelled “Algeria” (Algeria) or “Tunis” only. Sochurek (1956) photographed both typical *V. m. mauritanica* and what seems to be an adult specimen of this new subspecies of *V. lebetina* from west Algeria. The exact locality for this last specimen was “Tal bei Misserghin” and “Djebel Murdjadjo bei Oran” which is a region from where also typical *mauritanica* are known (e. g. Domergue, 1901).

This new subspecies is morphologically similar to Asian subspecies of *lebetina* and shows clear morphological distinction from North African *mauritanica*. As no intermediate specimens between *mauritanica* and this new taxon occur whatsoever in any museum collection, we consider it to be a separate species in relation to *Vipera mauritanica*, but due to similarities with *lebetina* as a north African subspecies of the latter.

*Vipera lebetina transmediterranea* ssp. n.

Holotype: USNM 6210, male from Algiers, (don. Paris Museum).

Paratypes: BM 1946.1.18.28, male from Algiers, leg. Parzudaki; BM 61.5.21.51, female from Algiers; ZMK R. 68140, male from Algier, 21.11. 1848, leg. Kammerherr Falbe; NMW 25229, juvenile specimen from Tunis, 1913, leg. Weidholz, Fig. 1.

Diagnosis and definition: A subspecies of *Vipera lebetina* that is geographically separated from other subspecies by the Mediterranean Sea, and which can be characterized as a typical *lebetina* form having light ground colour with a pattern consisting of 34–41 transverse bars. Midbody scale rows 25 in number and the number of ventrals is between 150 and 164 in females; between 154 and 163 in males.

This new subspecies differs from other taxa of the *lebetina* complex s. l. (except for *l. lebetina* and *V. schweizeri*, Table 1), in having a low ventral number. The mean values for different scalation characteristics indicate a higher fragmentation of head scales in this new taxon compared with other subspecies of *lebetina* as well as with *V. schweizeri* and *V. mauritanica* (see Table 2). The mean value for the number of loreals, interoculars and 1st and 2nd circumoculars is higher than in any of the compared taxa. It is most similar to the nominate subspecies, *Vipera l. lebetina* from Cyprus, from which, however, it differs in having a higher ventral count (150 to 164 in female, and 154 to 163 in male *transmediterranea*; 146 to 153 in female, and 147



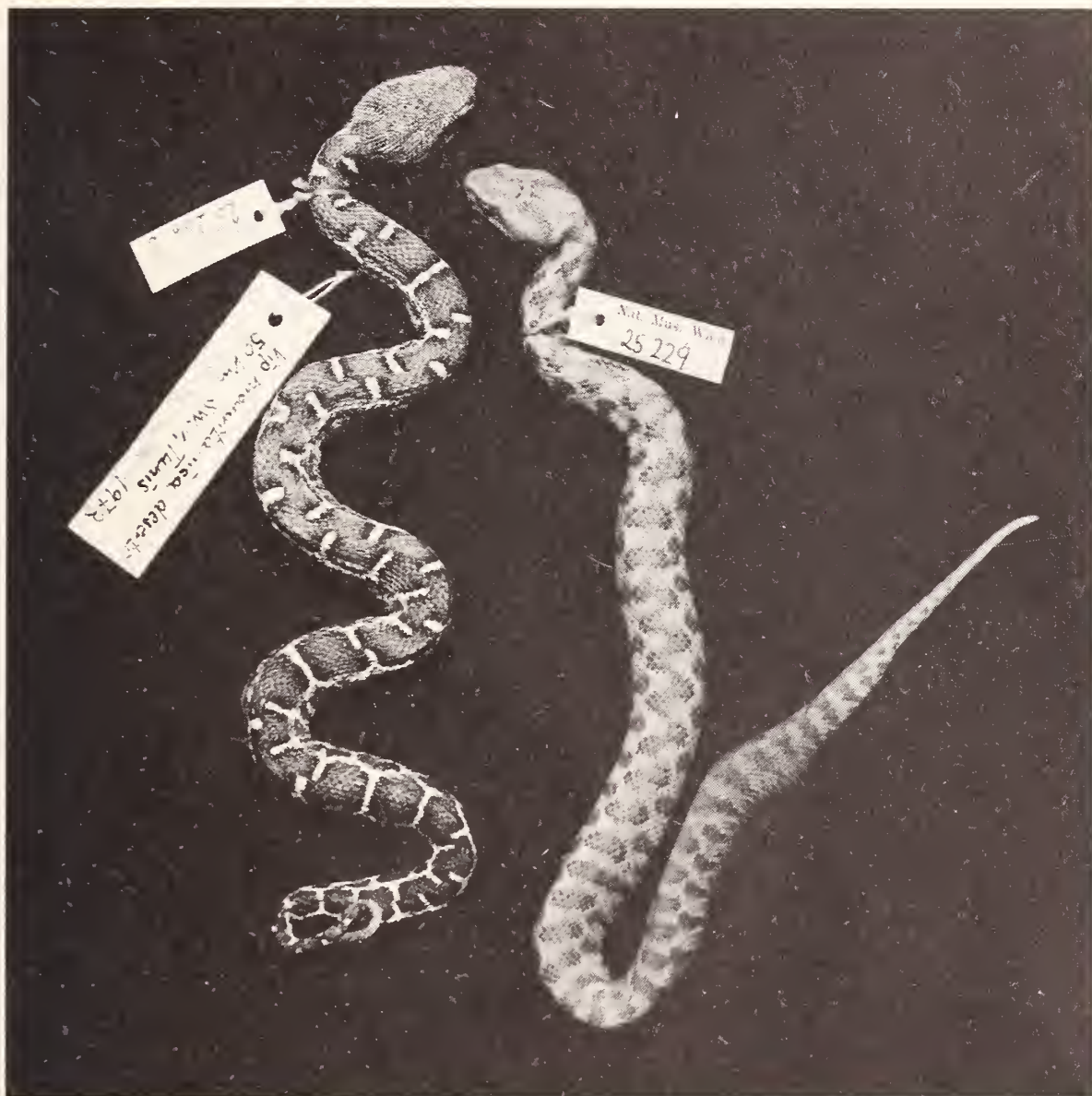


Fig. 1: Juvenile specimens of *Vipera mauritanica deserti* Anderson (NMW 25236:2) labelled "50 km SW v. Tunis", and *Vipera lebetina transmediterranea* ssp. n. (paratype, NMW 25229) labelled "Tunis".

to 154 in male *V. lebetina*), and in the number of anterior scale rows which range from 23 to 27 ( $X = 24$ ) in *transmediterranea* and from 21 to 23 ( $X = 22.2$ ) in *V. lebetina*.

From the sympatric (or parapatric) *Vipera mauritanica* the new subspecies differs in colour pattern (*V. mauritanica* has a wavy zig-zag band containing 23 to 33 windings; *V. l. transmediterranea* has 34 to 41 transverse bands), the midbody scale rows are 25 in *V. l. transmediterranea*, 27 in *V. mauritanica*; the number of scale rows on the neck is around 24 in *V. l. transmediterranea*, between 26 and 27 in *V. mauritanica*; the number of ventrals is 150 to 164 in female and 154 to 163 in male *V. l. transmediterranea*, 157 to 174 in female and 163 to 170 in male *V. mauritanica*; the number of subcaudals is between 37 and 43 in female *V. l. transmediterranea*, and between 45 and 48 in female *V. mauritanica*; corresponding figures for males are between 42 to 51 and 45 to 50 respectively.

Maximum length for both sexes is 98.5 cm. Relative tail length in the two males are 12.6 and 13.2 % of total length, while corresponding figures in the two adult females are 10.1 and 13.1 %.

Table 1: Comparisons between number of ventral plates in *Vipera lebetina transmediterranea* ssp. n. and other taxa within the *lebetina* complex.

	Females				Males			
	N	Range	Mean	s. d.	N	Range	Mean	s. d.
<i>schweizeri</i>	15	148–157	152.3	2.5	10	142–160	151.7	6.0
<i>l. turanica</i>	4	167–174	170.8	2.9	12	167–177	172.1	3.0
<i>l. obtusa</i>	14	163–175	168.3	3.5	8	166–177	168.5	4.4
<i>l. lebetina</i>	3	146–153	150.3	3.8	8	147–154	150.1	2.6
<i>l. transmed.</i>	3	150–164	155.0	7.6	2	154–163	158.5	6.4
<i>m. deserti</i>	4	164–170	162.3	2.5	3	166–169	167.0	1.7
<i>m. mauritanica</i>	6	157–174	165.8	6.4	6	163–170	166.2	2.8

Table 2: Comparisons between mean values of *Vipera lebetina transmediterranea* ssp. n. and other taxa within the *lebetina* complex.

	N	Loreals*	Inter-oculars	First circum-oculars*	Second circum-oculars*	Midbody scale rows	Sublabials*
<i>schweizeri</i>	14	14.6	8.3	29.5	30.5	23	25.8
<i>l. turanica</i>	17	19.4	8.6	27.2	35.0	25–27	26.1
<i>l. obtusa</i>	24	16.9	8.3	28.6	33.8	24–27	26.0
<i>l. lebetina</i>	13	19.6	8.6	29.6	32.1	25	25.8
<i>l. transmed.</i>	5	20.3	9.0	31.6	36.0	25	27.6
<i>m. deserti</i>	6	16.5	8.0	29.6	35.4	27	27.1
<i>m. mauritanica</i>	17	18.6	7.0	27.4	32.7	27	28.2

\* = Sum of right and left side

Table 3: Morphological variation in *Vipera lebetina transmediterranea*.

	Range	Mean	S. E.
Ventrals in males	154–163	158.5	4.6
Ventrals in females	150–164	155.3	4.5
Subcaudals in males	42–51	46.5	3.8
Subcaudals in females	37–43	40.3	1.8
Anterior scale rows	23–27	24.0	0.8
Midbody scale rows	25	25.0	0.0
Posterior scale rows	19	19.0	0.0
Apicals	2–3	2.8	0.2
Supralabials*	20–22	21.0	0.5
Sublabials*	26–30	27.6	0.8
1st circumoculars*	27–34	31.6	1.3
2nd circumoculars*	31–44	36.6	2.7
Loreals*	19–23	20.3	0.9
Suboculars*	4–6	5.2	0.4
Interoculars	8–10	9.0	0.5
Dorsal transverse bars	34–41	37.3	1.7

\* = Sum of right and left side



Description of holotype: A typical female *lebetina* with total length of 79.4 cm, tail 10.4 cm. Groundcolour greyish with 34 dark grey transverse bands along the back of body, each band two to three scales wide and separated by three scale wide interspaces. Lateral side of head black. Head length 35 mm to corner of mouth, width 29 mm at broadest place, transverse diameter of eye 4 mm, distance between mouth and eye 4 mm. Canthus rostralis pronounced.

Head covered by 54 intersupraoculars and 22 intercanthals which all are keeled, interocular row with eight scales, three canthals on right and two on left side, three apicals, three supraoculars on each side, ten supralabials and 13 sublabials on each side, first circumocular ring containing 13 on right and 14 on left side, second circumocular ring containing 16 on right and 15 on left side, nine loreals, eye separated from supralabials by three suboculars on right and two on left side, anterior chinshields bordered behind by four second chinshields, two preventrals, 150 ventrals, 43 + 1 subcaudals, 23 dorsal transverse scale rows one headlength behind head, 25 at midbody and 19 one head length anterior of anal.

Variation: Some of the total variation is shown in the diagnosis and in Table 3. The number of transversal bars varied between 34 and 41, the number of scales in the interocular row between 8 and 10, the number of supralabials varied between 10 and 11 and the number of sublabials between 13 and 15 on each side.

Discussion: The taxonomic definition of different west Asian populations of *V. lebetina* has to a certain extent been discussed elsewhere (Nilson et al. 1988). It can be said that our lower value (146) of ventral numbers from Cypriot *V. lebetina* agrees well with what is stated in the literature. Billing & Schätti (1984) believed that such a low value for *V. lebetina* was a result of intermixing with specimens from the Cyclades (i. e. *schweizeri*). The values for *V. lebetina* presented by these authors varied between 152 and 156 (N = 5). Our values range between 146 and 154 (N = 11) and together these figures probably reflect the normal range rather well. Meanwhile higher ventral numbers such as 163 (Werner, 1936) which are referred to in literature (e. g. Joger, 1984) have not been verified in other sources. It has not been possible to trace the Werner specimen from Cyprus for reexamination. In the new subspecies the number of ventrals varies between 150 and 164 and this is slightly higher than comparative figures for *V. lebetina*. This is particularly pronounced when comparing the different sexes. Females of the new subspecies vary between 150 and 164 in ventral number ( $X = 155$ ) compared to females of *V. lebetina* which have a range between 146 and 153 ( $X = 150.3$ ) ventrals. Corresponding figures for males are 154–163 ( $X = 156.5$ ) in the new subspecies and 147 to 154 ( $X = 150.1$ ) for *V. lebetina* (Table 1).

The new subspecies and *V. lebetina* also differ significantly in the number of dorsal scale rows on the anterior part of the body. The nominate subspecies ranges between 21 and 23 ( $X = 22.4 \pm 0.34$  S. E.) scale rows while the new subspecies has between 23 and 27 ( $X = 24 \pm 0.77$  S. E.) anterior scale rows ( $p < 0.05$ ). Also the number of sublabials (counted on both sides together) seems to separate the two subspecies. The new subspecies has between 26 and 30 sublabials ( $X = 27.6 \pm 0.75$ ) compared to *V. lebetina* which has between 24 and 27 ( $X = 25.4 \pm 0.3$ ) sublabials. This difference is also significant ( $p = 0.02$ ) as is the difference in number of first circumocular scales ( $31.6 \pm 1.3$  and  $29.2 \pm 0.8$  respectively,  $p = 0.01$ ). Besides a lower number of

ventrals (Table 1) it further differs from *V. l. obtusa* in the number of loreals, which varies between 18 and 23 ( $X = 19.8 \pm 8.86$  S. E.) in the new subspecies and between 10 and 21 ( $X = 16.07 \pm 0.66$  S. E.) in *l. obtusa* ( $p = 0.0125$ ).

From the two north African subspecies of *V. mauritanica* it is easily separated by the number of midbody scale rows and by a completely different colour pattern. *Vipera mauritanica* has a wavy undulating zig-zag band along the back which constitutes 23 to 33 blotches or windings while the new subspecies of *V. lebetina* has 34 to 41 transverse bars. In the subspecies *m. deserti* the pattern fades with age and adult specimens are normally rather pale with pattern weakly developed or absent. *Vipera m. mauritanica* can also occur in a pale morph which can approach *deserti* in colour-pattern by being reddish or brownish with weakly developed pattern (e. g. Saint Girons, 1956; own observations). However, both subspecies of *V. mauritanica* have, when visible, the characteristic undulating band along the back which is always well developed in juveniles (fig. 1).

From *V. m. mauritanica* it further differs significantly in a number of external morphological characters, such as having a lower number of anterior dorsal scale rows ( $24.0 \pm 1.17$  compared to  $27.0 \pm 0.17$ ,  $p \leq 0.02$ ), more first circumocular scales (Table 2,  $p \leq 0.02$ ), more (greater fragmentation of) supraocular plates ( $7.0 \pm 0.48$  compared to  $5.33 \pm 1.19$ ,  $p \leq 0.05$ ), more intercanthals ( $20.4 \pm 1.17$  compared to  $13.5 \pm 0.88$ ,  $p = 0.002$ ) and intersupraoculars ( $46.6 \pm 4.2$  compared to  $39.8 \pm 1.19$ ,  $p \leq 0.05$ ). The total fragmentation of head plates has gone so far that, apart from *V. m. deserti*, this new taxon differs from all compared subspecies. *Vipera lebetina transmediterranea* has  $190.2 \pm 3.8$  S. E. scales covering the upper head and upper jaw and this is significantly higher than in *l. obtusa*, which has  $178.8 \pm 2.3$  ( $p \leq 0.05$ ), and in *m. mauritanica*, which has  $164.0 \pm 2.0$  ( $p \leq 0.001$ ). It is also significantly higher compared to *l. lebetina* if the lower jaw is included ( $p \leq 0.05$ ). *Vipera m. deserti* cannot be separated from *V. l. transmediterranea* on head scale fragmentation, but differs significantly in other characteristics such as having more prefrontals ( $2.6 \pm 0.4$  compared to  $1.5 \pm 0.2$ ;  $p \leq 0.05$ ) and more loreals ( $19.8 \pm 0.9$  compared to  $16.5 \pm 1.3$ ;  $p = 0.015$ ), and in having less anterior body scale rows ( $24 \pm 0.8$  compared to  $26.7 \pm 0.4$ ;  $p = 0.026$ ), supralabials ( $21.0 \pm 0.4$  compared to  $22.7 \pm 0.4$ ;  $p = 0.026$ ) and second chinshields ( $4.4 \pm 0.4$  compared to  $5.8 \pm 0.4$ ;  $p \leq 0.05$ ).

It is also distinct from *V. schweizeri* by a different midbody scale count (Table 2). Thereby, it is separated from the Asian mainland forms of *lebetina* as well as from the north African *mauritanica* populations and *V. schweizeri* in Greece.

Meanwhile, figures ranging from 23 to 27 midbody scale rows in *mauritanica* are found in literature concerning snakes of North Africa (e. g. Domergue, 1901; Domergue, 1959; Bons & Girot, 1962) but these figures generally seem to hint at *Vipera lebetina* s. lat. in its entire range, i. e. including Asian and Aegean populations. It is likely, however, that Domergue (1901), like Anderson (1892) a few years before, also included specimens of *V. l. transmediterranea* when discussing *mauritanica*. The variation of certain scale characteristics given by Domergue “. . . 23 à 27 rangées de dorsales; 156—171 gastrostèges (en Berbérie); 38—51 sous-caudales, . . .” could well include both taxa.

Cope described *Vipera confluenta* from “Africa” in 1863. It was considered as a variety of *mauritanica* by Strauch (1869). The description was based on two



specimens of similar pattern to *mauritanica* and one of the specimens (from British Museum) was examined and described by Cope. This specimen had a high number of ventrals (180) while the number of dorsal rows was only 25. The overall description is clearly of a *mauritanica* and the low number of scale rows might only reflect a variation, although a rare occurrence, in this characteristic within *mauritanica*. We have not, however, seen any variation in this characteristic within *V. mauritanica*, and Balozet (1957), who examined 46 *mauritanica* specimens, did not find a single exception to this rule. A possibility, although hypothetical, is that the *confluenta* specimen represents an intergrading population. Recent preliminary investigations of immunological distances between *Vipera* taxa shows that *m. mauritanica* seems to be close to *l. lebetina*, whereas *deserti* has a high distance (Herrmann et al., 1987), and if these results are verified by additional experiments (in preparation), a different systematic pattern compared to that which is indicated by external morphology, must be considered. In any case, *deserti* with its different head shape and scalation seems to be well separated from all other taxa. Other names connected to north African taxa are *Vipera echis* Schlegel 1841, and *Vipera minuta* Eichwald 1851, which are both based on specimens from Oran, the type locality for *V. m. mauritanica*.

One fossil viper from North Africa, *Vipera maghrebiana*, has been considered as a hypothetical ancestor of *Vipera lebetina* (Rage, 1976; Nilson & Andrén, 1986). However, this taxon differs much in maxillar morphology from both Moroccan *Vipera m. mauritanica* and Cypriotic *Vipera l. lebetina* (ZIG and GNM specimens); and if *maghrebiana* is an ancestor of African *lebetina* s. l. it must have undergone a marked evolutionary change.

**Sympatry:** This taxon is known from Algeria and Tunis, but the only more exact locality might be Djebel Murdjado close to Oran, where it should be sympatric with *Vipera m. mauritanica*. Sympatry between closely related taxa occur meanwhile when different niches can be utilized. In northern Spain *Vipera a. apis* and *V. l. latasti* are sympatric in different habitats. Also *Vipera r. raddei* and *V. wagneri* in eastern Turkey are sympatric in different habitats and *Vipera latasti gaditana* and *V. (latasti) monticola* are reproductively separated by being of different sizes. In our case, *Vipera m. mauritanica* is known to reach sizes of more than 180 cm (Schweizer, 1956), while the *V. lebetina transmediterranea* specimens all are shorter than 100 cm. A shorter size, which is also reflected by a reduced number of dorsal scale rows, might indicate a niche diversification.

**Material and methods:** Besides the five specimens of the new subspecies, 109 more specimens within the *lebetina* complex have been examined thus far as part of a more comprehensive study and are here used for comparison. Of these, 56 belong to the different Asian mainland populations; 14 specimens from Milos and Siphnos (*schweizeri*); 13 specimens from Cyprus (*l. lebetina*); 9 *m. deserti* from Libya and Tunis (including the holotype in BM) and 17 specimens of *m. mauritanica* from Algeria and Morocco (including the two syntypes in MNHN). Thirty-six external morphological characteristics are taken from each complete specimen, fewer from incomplete ones. Not all measurements taken are used in this paper. Two-tailed Mann-Whitney U tests have been used for statistical tests.

#### Acknowledgements

Specimens used for comparison were provided by Wolfgang Böhme, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn; Christine Stocker, Naturhistorisches Museum

Basel; Franz Tiedemann, Naturhistorisches Museum Wien (NMW); W. Ronald Heyer, National Museum of Natural History, Smithsonian Institution (USNM); Volker Mahnert, Muséum d'Histoire naturelle, Genève; E. N. Arnold, British Museum (Natural History), London (BM); Jens B. Rasmussen, Zoologisk Museum, Kopenhagen (ZMK); M. Thireau, Muséum National d'Histoire naturelle, Paris (MNHN); as well as personal collections at the department of Zoology, University of Göteborg (ZIG) and at Göteborg Natural History Museum (GMN). To all these persons and institutions we are much indebted. Field work with "lebetinas" was carried out in Iran 1976 together with Björn Gullander, Anders Börjeson and Christer Hall; in Cyprus 1980 together with Margareta Nilson; in Turkey 1983 and 1984, and in Morocco 1985 together with Börje Flärdh.

### Zusammenfassung

Nach 5 Vipern aus Algerien und Tunesien wird eine neue Unterart *Vipera lebetina transmediterranea* ssp. n. beschrieben. Von der sympatrischen *Vipera mauritanica* unterscheidet sich das neue Taxon in der Anzahl der dorsalen Schuppenreihen sowie in anderen Pholidosemerkmalen und auch im Farbmuster. Eine Kombination von Schuppenwerten trennt es auch von der asiatischen Unterart von *V. lebetina*. Von *Vipera schweizeri* unterscheidet es sich in der Zahl der dorsalen Schuppenreihen.

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Jahr/Year: 1988

Band/Volume: [39](#)

Autor(en)/Author(s): Nilson Göran, Andrén Claes

Artikel/Article: [Vipera lebetina transmediterranea, a new subspecies of viper from North Africa, with remarks on the taxonomy of Vipera lebetina and Vipera mauritanica \(Reptilia: Viperidae\) 371-379](#)