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Distribution and size of Gulella viae Bnp. and G. contraria Conn., two South African streptaxids (Gastropoda Pulmonata)

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The Drakensberg range, forming an interrupted eastern escarpment in South Africa and further north, is covered with various types of forest on its eastern (= wet) slopes. These forests harbour a rich assemblage of land molluscs displaying different patterns of distribution. Normally one would expect the escarpment species to be distributed from the interrupted eastern Cape Province mountains to the almost continuous Natal range with further north again scattered occurrence in Swaziland (a poorly collected country) and the eastern Transvaal, with occasional distribution northward in the eastern escarpment on the borders of Zimbabwe (formerly Rhodesia) and Mozambique. Where the range is discontinuous such as in the eastern Cape Province and Transvaal, more or less well-marked endemism may occur and where the interval is of major historical/ecological significance, such as the ancient and arid Limpopo River valley, it may act as a biogeographical barrier.

The detailed distribution of the majority of southern African land gastropods is unknown; although many patterns have emerged, these should be considered with suspicion and a number of these have already been emended by newly collected material. Some patterns may reflect collecting activity rather than natural distributions. This may particularly apply to the Natal mountainous areas, which have been well investigated by Henry Clifden Burnup (1852-1928) and his associates; most of this material has been deposited in the Natal Museum at Pietermaritzburg, where Burnup was honorary curator of molluscs in the years 1904-1928. Collecting activities by the present author in the Transvaal in the period 1962-1966 have revealed that a number of the Natal Drakensberg species also occur in the Transvaal escarpment forests and are in fact only limited in their distribution by the low-lying and arid Limpopo River valley.

In terms of numbers of species the pulmonate family Streptaxidae with slightly more than 20% of the total number of species of land gastropods, occupies a dominant position in southern Africa. The majority of these streptaxids are classified with the genus *Gulella* L. Pfeiffer, 1856. The numerous species exhibit various types of distribution (see e.g., Connolly, 1939; Van Bruggen, 1969, 1973, 1980). A number of the species occurs on the eastern escarpment, two of which, hitherto known only from Natal, have now been recorded from the Transvaal. *Gulella viae* was thought to be exclusive to the higher reaches of the Natal Drakensberg, and *G. contraria*, interesting because of its isolated position among its congeners, was only known from Vryheid, Natal. Therefore no apology is needed for a somewhat detailed treatment of these taxa.

Material has been studied belonging to the following collections: British Museum (Natural History), London (abbreviated BM); Durban Museum and Art Gallery, Durban, South Africa (DM); Natal Museum, Pietermaritzburg (NM); Rijksmuseum

van Natuurlijke Historie, Leiden (RMNH); South African Museum, Cape Town (SAM).

Other abbreviations used are alc. for alcohol, and l/d for the ratio length/major diameter of shells, which gives an impression of the shape of the shell (l/d have been calculated from micrometer readings).

Acknowledgements are due to the curators in charge for allowing study of their material; particular mention should be made of Dr. E. Gittenberger (RMNH), whose gallant trials to obtain a radula from *G. viae* unfortunately came to naught, and Dr. P.B. Mordan (BM). H. Heijn (Leiden university) deserves great credit for his professional art work.

Van Bruggen (1980) has been followed for style of description, etc.

Gulella viae Burnup, 1925 (figs. 1, 3-5)

Gulella viae Burnup, 1925, Ann. Natal Mus. 5: 143, pl. 9 figs. 47-51; Connolly, 1939, Ann. S. Afr. Mus 33: 78; Van Bruggen, 1973, Malacologia 14: 422.

Diagnostic characters. — A small, costulate species with a comparatively small and constricted aperture with six-fold dentition consisting of angular lamella, two labral processes, a basal denticle, and a duplex columellar lamella, of which angular lamella and labral complex are comparatively very large.

Description of shell. — Shell (figs. 1, 3, 4) small, subcylindriform to elongate-ovate or suboval, rimate or with closed umbilicus. Spire produced, sides straight to slightly convex, subparallel, apex flattened to obtusely conical. Whorls 6 ½-7 ¾, slightly convex, sculptured with close, regular, fairly straight, oblique and prominent costulae, interstices about as wide as costulae, smooth, under high magnification very finely granulate; sutures (fairly) deeply impressed, (sub)crenellate. First two whorls finely granulate and smooth. Aperture obliquely ovate, actual opening rather narrow and somewhat constricted, peristome thick, expanded, somewhat reflected, white and glossy, aperture much obstructed by six-fold dentition: large and prominent angular lamella, which protrudes beyond the labral complex and is also quite prominent in profile, connected with the apex of the labrum in such a way that in side view an almost circular opening can be seen; labral complex consisting of small upper process, partly hidden by the angular lamella, and a larger lower process (sometimes more like an inrunning lamella) on a common base, the complex corresponding to a deep and extensive outside depression; a deeply set mid-basal tubercle; outer columellar process in the form of a ridge with a cusp at its bottom, inner columellar lamella large and deeply situated.

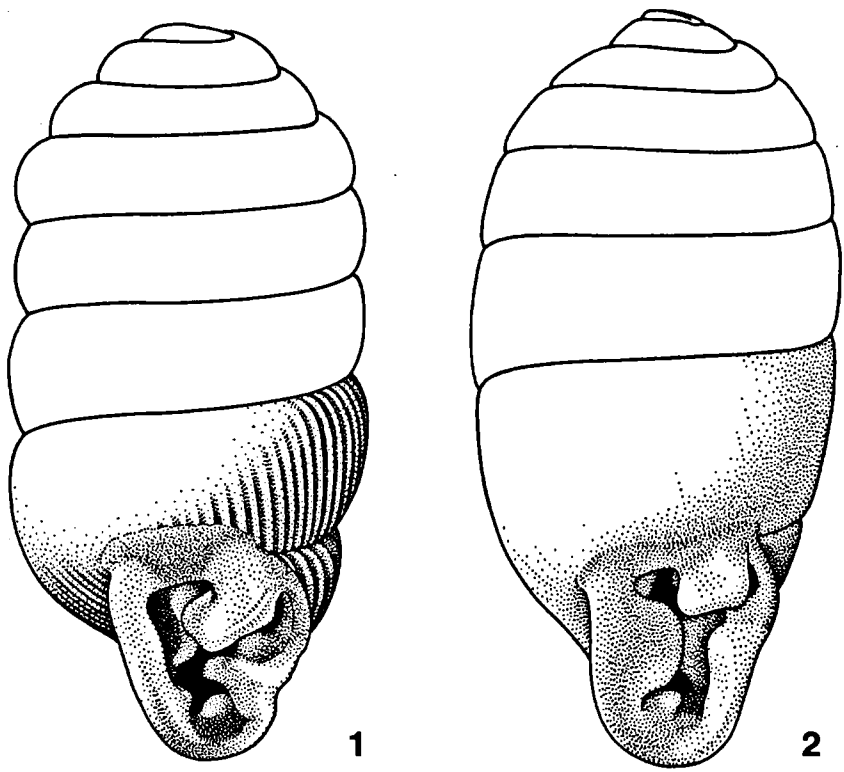
Measurements of shell: 2.8-3.4 x 1.5-1.7 mm, l/d 1.73-2.25. The type measures 3.1 x 1.6 mm, l/d 1.94. Smallest specimen (Mariepskop Forest Reserve, NM) 2.8 x 1.6 mm, l/d 1.80, largest shell (Hanglip Forest, NM) 3.4 x 1.7 mm, l/d 1.96. An average specimen (Van Reenen's Pass, RMNH, fig. 1) measures 3.2 x 1.6 mm, l/d 2.04, aperture 0.9 x 0.9 mm, last whorl 1.6 mm.

Distribution (fig. 5). — *G. viae* occurs on the Drakensberg range above about 800 m in both Natal and the Transvaal.

NATAL: Mt. aux Sources, W. Falcon (NM); Van Reenen's Pass, H.C. Burnup (BM 1925.4.21.9, holotype; BM 1937.12.30.1286-89, 4 paratypes; NM 3548, type 587, 7 paratypes; NM type 587, 1 and 3 paratypes respectively; NM, 3 paratypes;

NM, RMNH); do., W.G. Rump (NM); do. (DM, Puzey colln. 12); Paulpietersburg (Connolly, 1939: 78). TRANSVAAL: Barberton, R.F. Lawrence (NM alc.); do., H.J. Puzey (DM, Puzey colln. 12; SAM A30001); Pilgrim's Rest District, Mariepskop Forest Reserve, NE. area (Nature Reserve), montane forest at about 1500 m, A.C. & W.H. van Bruggen (NM, NM alc., RMNH, RMNH alc.); Hanglip Forest near Louis Trichardt, c. 1400 m, A.C. & W.H. van Bruggen (NM); Tate Vondo Forest near Sibasa, c. 1200 m, A.C. & W.H. van Bruggen (NM).

Type locality: Van Reenen's Pass (c. 1700 m), where first collected by Burnup in March, 1918.



Figs. 1-2. Shells of South African *Gulella*. 1, *G. viae* Bnp., Van Reenen's Pass, Natal (length 3.2 mm, RMNH); 2, *G. contraria* Conn., Vryheid, Natal (length 4.5 mm, paratype, NM).

Specimens from "Maritzburg" (= Pietermaritzburg) (BM 1956.5.12.15-17, Price-Jones colln.) have been considered wrongly localized.

Although *G. viae* occupies a large area, but obviously with an assemblage of scattered and isolated populations, few differences have been found in the biometrical data, as demonstrated by the following table:

Natal Drakensberg	2.9-3.4 x 1.5-1.7 mm, l/d 1.84-2.25, n = > 100
Barberton	3.0-3.2 x 1.5-1.6 mm, l/d 1.92-2.12, n = 4
Eastern Transvaal	2.8-3.3 x 1.6-1.7 mm, l/d 1.73-2.04, n = 12
Northern Transvaal	3.0-3.4 x 1.5-1.7 mm, l/d 1.85-1.96, n = 6

These data are based on inadequate samples, so that any conclusions drawn should be treated with suspicion. Sufficient material is available for the Natal localities, which are not all that far apart. It is shown that almost the full range of variation already occurs in this, the southern part of the area occupied by the species. However, attention might be drawn to the l/d, where there is a seemingly noticeable difference between the Natal populations (1.84-2.25, mean 2.04) and the Transvaal populations (1.73-2.12, mean 1.92), which implies that the shells in Natal are somewhat more slender than those in the Transvaal.

The cusp at the bottom of the outer columellar lamella is sometimes really a denticle; the ridge itself can be very weak indeed. One shell (Van Reenen's Pass, NM) is abnormal, having a repaired aperture with much reduced dentition; a reduced labral complex and inner columellar lamella are all that is left. If this specimen had not been found in a sample of *G. viae*, it would have been very difficult to identify.

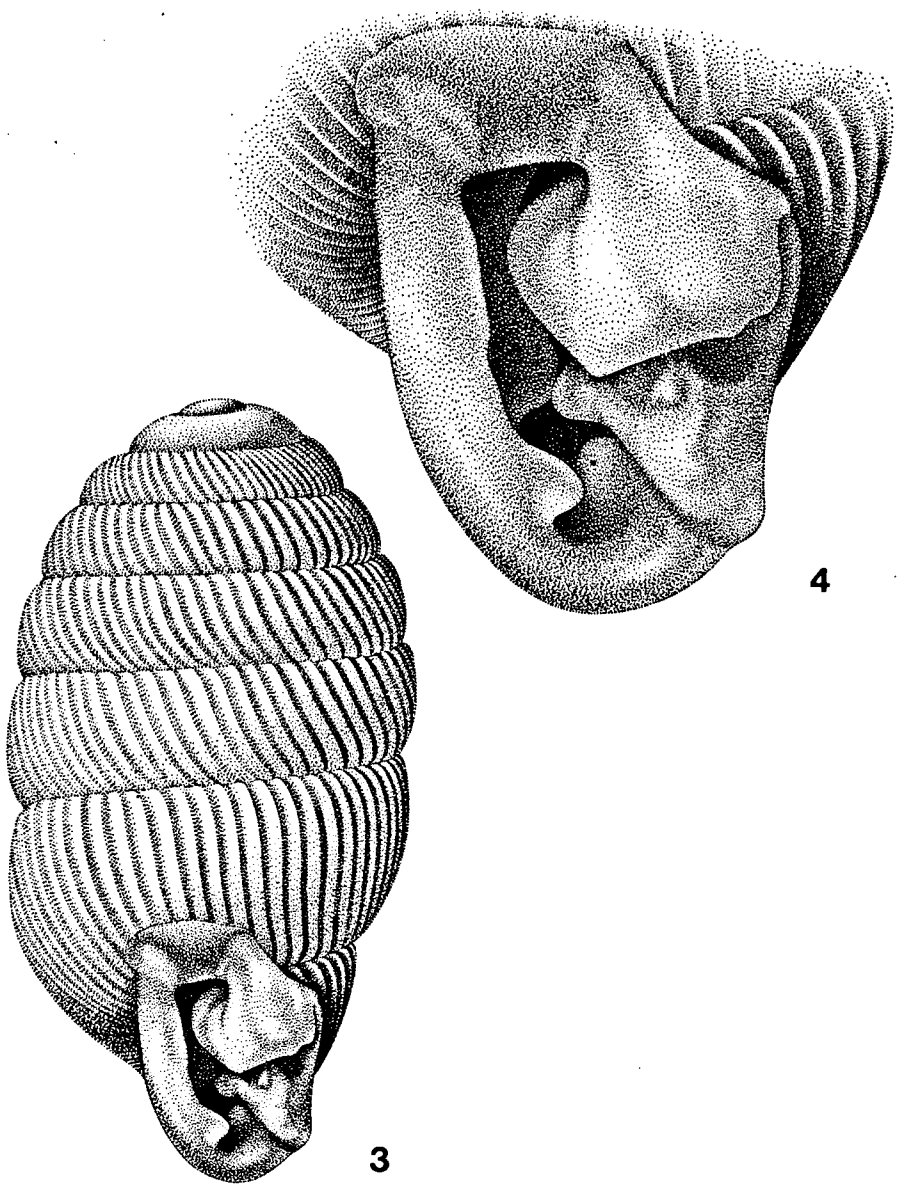
At times there is sufficient minor variation in apertural dentition for doubt to arise as regards identity of specimens or populations. Initially the Mariepskop material was considered to represent a separate taxon on a specific or subspecific level. However, there is sufficient overlap in almost all characters for it to be considered part of *G. viae*, particularly in view of its range of variation as now known. Figs. 3-4 depict the Mariepskop material as compared to a specimen from Natal (fig. 1). Numerous minor differences may be observed, such as shape and costulation, size and shape of the columellar lamella, and size and shape of the labral complex. Also, the aperture in the Mariepskop material is more constricted. In Natal material the aperture is usually about as long as wide (e.g., 0.9 x 0.9 mm in the specimen of fig. 1), in the Mariepskop specimens it is always longer than wide (e.g., 1.0 x 0.7 mm in the specimen of fig. 3).

My colleague, Dr. E. Gittenberger of the Leiden museum, has vainly tried to obtain a radula for inspection and comparison with the data in Aiken's 1981 paper.

G. viae ranges vertically from approximately 750 m to about 2500 m in various types of forest termed Afromontane by White (1978). Its distribution is restricted by the upper limits of forest on the east slopes of the Drakensberg escarpment, which limits occur at about 2500 m. The total area discontinuously inhabited by the species probably lies between the Limpopo River valley in the north and about 30°S in western Natal. It is confidently expected to occur in the many forests in the Transvaal that so far have been poorly sampled. Indeed, in a voluminous correspondence with Dr. H.E. van Hoepen (Germiston, South Africa), neurologist/psychiatrist and amateur malacologist of note, there are indications of *G. viae* elsewhere in the Transvaal. Dr. van Hoepen's camera lucida drawings of *Gulella* shells are very good indeed and on the strength of his unpublished figures two localities have been provisionally incorporated on the map (fig. 5), viz., Magoebaskloof near Tzaneen and Ofcolaco approximately 50 km south of Tzaneen.

Gulella contraria Connolly, 1932 (figs. 2, 5)

Gulella contraria Connolly, 1932, Ann. Natal Mus. 7: 88, pl. 4 fig. 17; Connolly, 1939, Ann. S. Afr. Mus 33: 97 (author erroneously between brackets); Zilch, 1961, Arch. Molluskenk. 90: 93.



Figs. 3-4. Shell of *Gulella viae* Bnp., Mariepskop Forest Reserve, Transvaal (length 3.0 mm, RMNH); the aperture is highly enlarged in order to show the dentition in detail.

Diagnostic characters. — A small, smooth species with the aperture much obstructed by six-fold dentition consisting of angular lamella, double labral lamella, a basal denticle, a large superficial columellar process, and an insignificant inner columellar lamella.

Description of shell. — Shell (fig. 2) small, cylindrical to elongate-ovate, (sub)rimate. Spire produced, sides subparallel, slightly convex, apex obtusely conical. Whorls 6 ½-7¼, flattish, smooth or with faint traces of growth striae; sutures fairly shallow, simple. Aperture elongate-ovate, slightly constricted and well obstructed by six-fold dentition: well-developed angular lamella, flattened in front view, connected with the apex of the labrum; duplex labral lamella shaped like an inverted V, apex usually with acute denticle, outer arm superficial, inner arm of inverted V more deeply situated, correspondng to a longish and shallow outside depression; deeply situated basal denticle to the left of the base, corresponding to insignificant outside depression; squarish and superficial outer columellar process protruding as far as the middle of the aperture; insignificant inner columellar fold.

Measurements of shell: 3.7-4.7 x 1.8-2.2 mm, l/d 1.97-2.19. The type measures 4.7 x 2.2 mm, l/d 2.14. Smallest specimen (Mbabane, NM) 3.7 x 1.9 mm, l/d 1.97, largest shell (type), second largest shell (Vryheid, NM) 4.5 x 2.2 mm, l/d 2.06. An average specimen (Vryheid, SAM) measures 4.3 x 2.2 mm, l/d 1.97, aperture 1.4 x 1.1 mm, last whorl 2.2 mm.

Distribution (fig. 5). — *G. contraria* is only known from altitudes of over 750 m in northern Natal, Swaziland and adjoining parts of the Transvaal.

NATAL: Vryheid, H.J. Puzey (BM1937.12.30.1289, holotype; BM 1931.6.3.54-59, 6 paratypes; DM, Puzey colln. 22; NM type 543, 2 paratypes; SAM A7653, SAM A7659). SWAZILAND: Mbabane, R.F. Lawrence (NM). TRANSVAAL: Barberton, H.J. Puzey (DM, Puzey colln. 22; NM).

Type locality: Vryheid, where first collected by Puzey some time before 1931

Two specimens from "Zululand", ex H.C. Fulton (RMNH) have not been included in the above distribution records. Although the uplands of north-western Zululand might well harbour the present species (fig. 5), this record has been ignored for the present, because the experience learns, that the general label "Zululand" in most causes indicates lowland rather than the higher areas.

Little material (a total of 28 specimens from 4 localities) is available; nevertheless it seems worth while to compare the measurements:

Vryheid	4.0-4.7 x 1.9-2.2 mm, l/d 1.97-2.14, n = 13
Mbabane	3.7-3.8 x 1.8-1.9 mm, l/d 1.97-2.10, n = 6
Barberton	4.1-4.5 x 2.0-2.1 mm, l/d 2.03-2.19, n = 7

The material from Vryheid and Barberton agrees well in size and shape. Incidentally, the "Zululand" shells have measurements entirely within the range of variation of the Vryheid/Barberton specimens. In this context it is interesting to mention that Barberton is about 300 m lower than Vryheid and also approximately 2° latitude further north; Barberton indeed enjoys a much warmer climate than Vryheid. The Swaziland specimens are considerably smaller than the others; Mbabane is only a little lower in elevation than Vryheid and is situated some 60 km south of Barberton. There is little difference in climate between Mbabane and Barberton. This once again shows that a knowledge of the local topography does not always solve problems such as these.

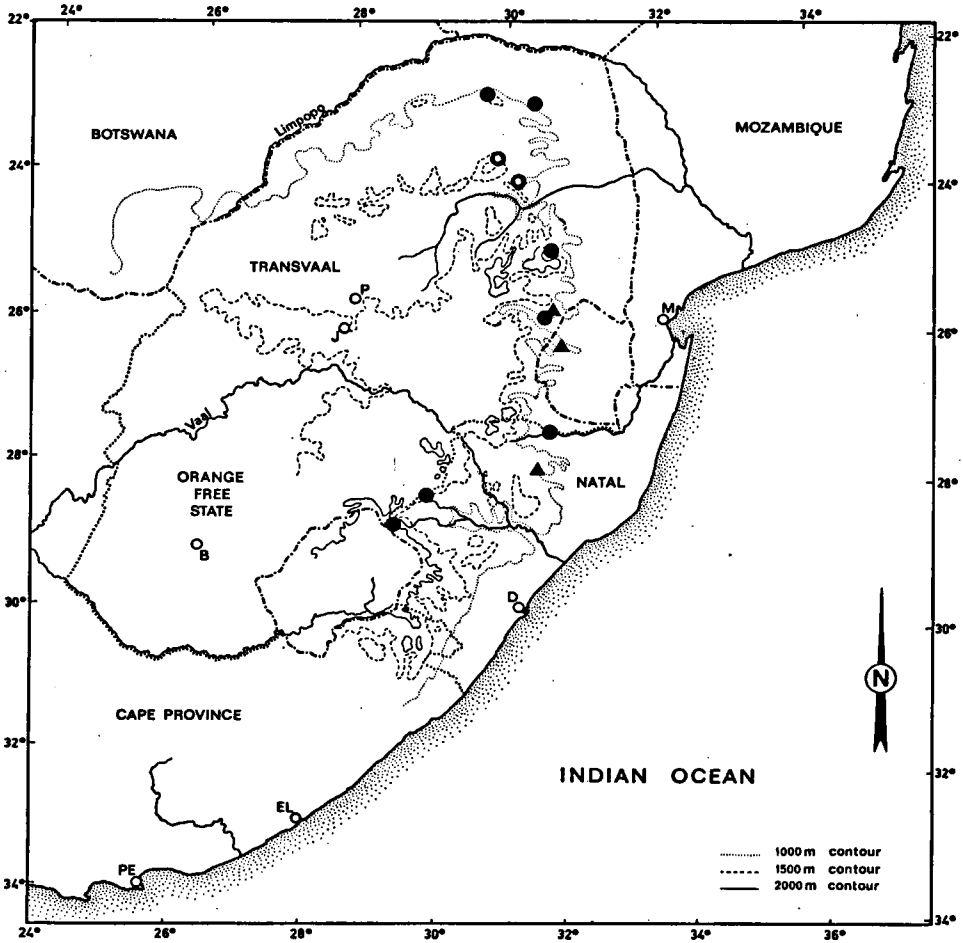


Fig. 5. Distribution of *Gulella viae* Bnp. (dots; unconfirmed localities shown as circles) and of *G. contraria* Conn. (triangles). The following abbreviations have been used for major towns: B = Bloemfontein, D = Durban, EL = East London, J = Johannesburg, M = Maputo, P = Pretoria, PE = Port Elizabeth.

Obviously *G. contraria* does not exhibit a size cline nor can be divided into subspecies. Scattered populations have become isolated from each other with concurrent lesser gene flow, which in many cases would be absent altogether. The activities of man, mainly in the form of (selective) cutting of the forest greatly fosters this process; the isolation of populations of land snails, or for that matter, any cryptozoic organism inhabiting leaf litter on the forest floor, will become more pronounced in the near future. This means that gene flow will become even more restricted.

The apertural dentition of *G. contraria*, described by Connolly (1932, 1939) as fivefold because of the absence of an inner columellar lamella, may just as well be con-

sidered six-fold since a close scrutingy reveals the presence of an insignificant process on the columella deep down in the aperture.

A duplication of the columellar process is not uncommon in the genus *Gulella*; about a third of the southern African species does show this character. A duplex labral complex appears to be rare. In southern Africa it has also been observed in *G. incurvidens* Van Bruggen, 1972, from the Mariepskop Forest Reserve, but the shell of this species is unusual to such a degree that this character would almost be overlooked. However, it appears that in *G. incurvidens* the duplex labral process is also shaped like an inverted V. There are a few other species with a double labral lamella north of the Zambezi River. Connolly (1932: 88) refers to *G. porcina* Connolly, 1930, from Uganda, in many respects also vastly different from *G. contraria*, not only by its apertural dentition, but also by its giant size.

The genus *Gulella* displays an enormous diversity in the Afrotropical Region. While some distribution patterns are seemingly straightforward and explained without too much trouble, much remains a mystery in this context. Van Bruggen (1980: 58) writes "Analysis of clinal variation and subspecies has failed to reveal a common pattern of correlation between shell characters and biotic/abiotic factors". Variation in shell biometrical data of the above treated two cases shows, that at least in these it may be a sequel to interruption of once continuous ranges. Increasing aridity of Africa has resulted in the fragmentation of formerly continuous forest complexes and their faunas, which must account for the sometimes noticeable differences in shell size and shape.

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