

***Costigulella primennilus* spec. nov., a new minute western African terrestrial snail, with remarks on the genus *Costigulella* (Gastropoda Pulmonata: Streptaxidae)**

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Key words: Mollusca, Gastropoda, *Gulella*, *Costigulella* new status, new species, distribution, Africa, Cameroon, shell development, apertural barriers.

*Costigulella primennilus* spec. nov. is the first representative of *Costigulella* reported from Cameroon. It is probably the smallest species of the family Streptaxidae known world-wide. Arguments are provided to consider *Costigulella* an independent radiation and genus, rather than a subgenus of *Gulella*. The mode of development of apertural barriers in juvenile shells in *Costigulella* and in other Streptaxidae is discussed.

### Introduction

The taxon *Costigulella* Pilsbry, 1919 was erected as a section of *Gulella* L. Pfeiffer, 1856 for a group of small Streptaxidae with strong, regular ribs on almost the entire shell, except the first quarter to half whorl. Apart from two species from the Belgian Congo, Pilsbry (1919) included a number of taxa from eastern Africa in *Costigulella*. Pilsbry & Cockerell (1933) added another species from the Congo. Adam (1984) reviewed the position of the group, excluded most of the species apart from the two for which the taxon was originally erected, the type species *G. (C.) langi* Pilsbry, 1919, and *G. (C.) toticostata* Pilsbry, 1919. He described (from south-eastern Congo) *G. (C.) kazibae* Adam, 1984, which he apparently thought to be the third species of *Costigulella*, thereby overlooking two species earlier described as members of *Costigulella*: *G. (C.) hedwigae* Degner, 1934, from Liberia and *G. (C.) pooensis* Ortiz de Zarate Lopez & Ortiz de Zarate Rocandio, 1956, from the isle of Fernando Poo (presently Bioko, Equatorial Guinea). Degner (1934) contributed the only available data on the anatomy of the group. In the present paper a sixth species is described, which has probably the smallest known adult shell in the entire family Streptaxidae world-wide. In addition, the systematic position of *Costigulella* as a subgenus within *Gulella* is considered, and remarks are made as to the formation of the apertural barriers during the development of the juvenile shell.

### Methods

Specimens were collected from litter samples as described in De Winter & Gittenberger (1998). Shell measurements were made by a calibrated ocular micrometer in a Leica M16A1 dissecting microscope. Each specimen was mounted and measured on

two different occasions, and slightly different outcomes were averaged. Whorls were counted as described in Kerney & Cameron (1979: 13).

### Abbreviations

H, shell height; D, maximum shell diameter; W, number of whorls; RMNH, collection of the Nationaal Natuurhistorisch Museum, formerly Rijksmuseum van Natuurlijke Historie, Leiden.

### Systematic part

Genus *Costigulella* Pilsbry, 1919 stat. nov.

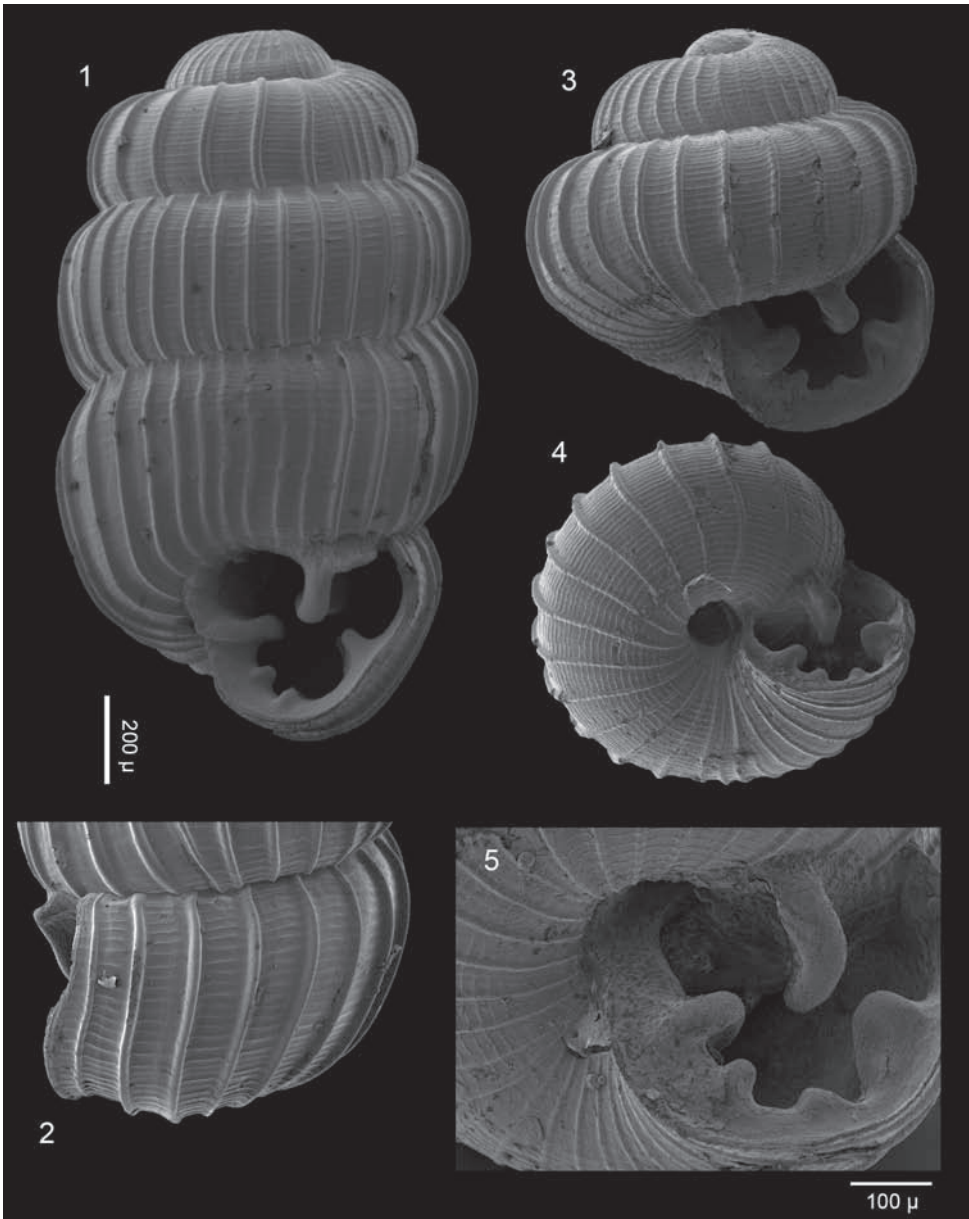
*Costigulella primennilus* spec. nov.

(figs 1-9)

Material (all dry shells).— Holotype (RMNH 109.069): Cameroon, Sud Province, Minwo area, 15 km S of Lolodorf, 3°06'N 10°44'E, approx. alt. 470 m, large rock boulders in old secondary forest, 31.viii.1995; A.J de Winter leg. Paratypes: together with holotype (RMNH 109.070/ 1 ad., 2 juv. shells); within same square km of type locality (see also De Winter & Gittenberger, 1998) on different dates in 1995 and 1996 (RMNH 109.068/ 5 ad., 5 juv., RMNH 109.071/1 juv.; RMNH 109.073/ 1 juv.). Cameroon, Sud Province, Meka'a II W of Nyangong, undisturbed forest with large rock boulders, 2°58'N 10°44'E, alt. 790 m (RMNH 109.067/ 2 ad.). Cameroon, Sud Province, SW of Nyangong, 2°57'N 10°44'E, alt. 670 m undisturbed forest with large rock boulders (RMNH109.072/ 3 ad., 1 juv.). Cameroon, Centre Province, Mbal-mayo Forest Reserve, old secondary forest, approx. 3°31'N 11°27'E, alt. 680 m (RMNH 109.074/1 ad., second specimen destroyed during ultrasonic cleaning).

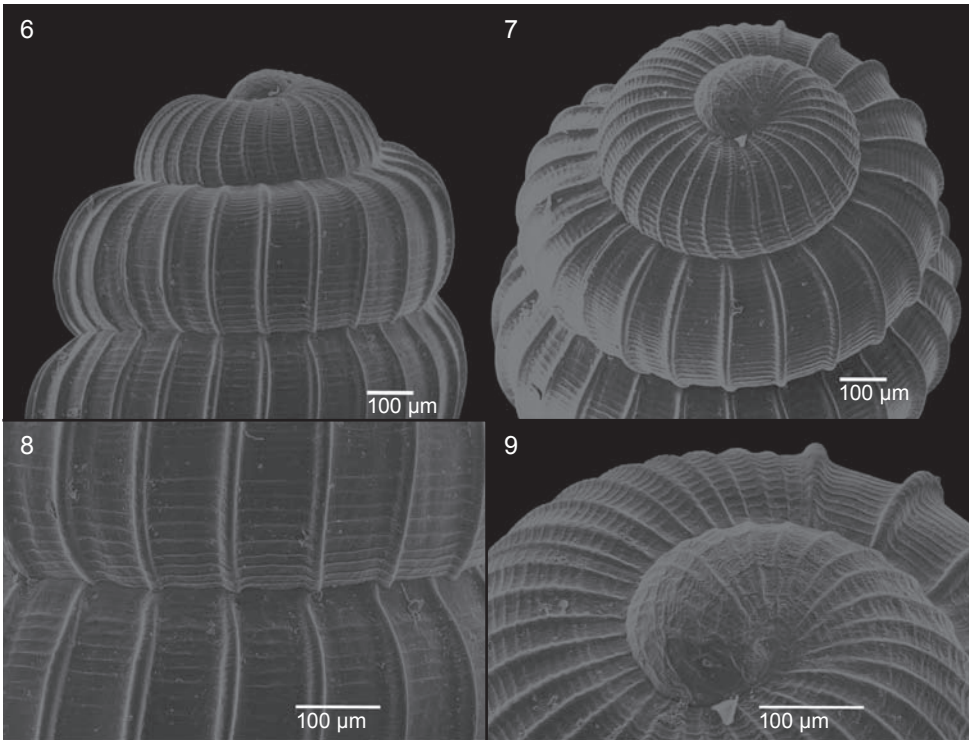
Diagnosis.— A species of *Costigulella* with adult shell  $H \times D = 1.5\text{-}1.6 \text{ mm} \times 0.9\text{-}1.0 \text{ mm}$ ,  $W =$  approx. 4.5, appreciably and consistently smaller in H and D (including diameter of embryonic shell) than smallest congeneric species, *C. kazibae* ( $H = 1.9\text{-}2.0 \text{ mm}$ , Adam, 1984). Ribbing of embryonic whorls dense (approx. 40 ribs), transition into neanic whorls well marked.

Description.— Adult shell extremely small,  $H = 1.52\text{-}1.64 \text{ mm}$ , mean  $1.58 \pm 0.05$ ,  $D = 0.93\text{-}0.99 \text{ mm}$ , mean  $0.96 \pm 0.02$ ,  $N = 12$  (holotype  $H \times D = 1.62 \times 0.97 \text{ mm}$ ), range  $H/D = 1.60\text{-}1.71$ , elongate-ovoid to subcylindrical, greatest width at last whorl.  $W = 4\frac{1}{3}$  to  $4\frac{1}{2}$ , rather convex. Shell colourless, fresh shells translucent. Umbilicus closed. Embryonic shell  $W = 1\frac{1}{3}\text{-}1\frac{1}{2}$ , diameter 0.63 mm, with approx. 40 close-set ribs, well demarcated from neanic whorls by an abrupt transition from close-set to stronger and much more widely spaced axial ribs (figs 6-8). Ribs rather distant on first half neanic whorl, from there rib density gradually increasing towards last whorl (approx. 13 per mm on penultimate whorl, approx. 15 per mm on last whorl above aperture). Interstices with much finer, but regularly spaced spiral threads (approx. 15  $\mu\text{m}$  apart, 25-30 on penultimate whorl). Especially on apical whorls and close to lower suture, spiral threads can be seen to actually overlay the axial ribs. Both axial and spiral sculpture cover entire whorl between upper and lower suture (on last whorl from depression of closed umbilicus to upper suture), remaining almost equally high over entire whorl surface. Aperture more or less triangular, peristome simple, not strongly dilated, with five major barriers: a large upper columellar lamella that reaches edge of peristome; a



Figs 1-5. *Costigulella primennilus* spec. nov. 1, holotype (RMNH 109.069); 2, lateral view of last whorl of a paratype from Nyangong (RMNH 109.072); 3-5, juvenile paratypes from type locality (RMNH 109.068), 3 and 5 are different views of the same specimen.

much smaller lower columellar tooth; a small basal denticle; a large, obliquely placed, wedge-shaped palatal tooth; and a large, not deeply inrunning, somewhat twisted angular tooth. Angular tooth with more or less developed lateral outgrowth towards palatal margin of peristome, in most individuals like an individualized nodule that



Figs 6-9. *Costigulella primennilus* spec. nov., juvenile paratype from type locality (RMNH 109.068). 6-7, different views of apical part of spire; 8, detail of sculpture on 3rd whorl; 9, sculpture of embryonic shell.

projects well out of the plane of the peristome. A few individuals with an almost obsolete additional supracolumellar denticle. Outer lip simple, externally not radially constricted, nor with any depression corresponding to strong inner palatal tooth.

Juvenile shells of all sizes (the situation in the embryonic shell is unknown) already exhibit the five major apertural teeth present in adult shells. Only the projecting lateral denticle of the angular tooth is absent. Adults shells differ from juvenile ones further by a slight widening of the peristome, and the receding upper palatal edge of the outer lip bordering the sinus (fig. 2), which is barely discernable in frontal view. The umbilicus in juvenile shells is open up to a shell height of approx. 0.9 mm (figs. 3-5), thereafter closed.

Ecology.— The species was only collected in old secondary and undisturbed rainforest above 400 m altitude from samples of the thin layer of soil and leaf litter on large rock boulders, as described by De Winter & Gittenberger (1998).

Etymology.— The epithet *primennilus* is a combination and anagram of *primus* (first) and *Linne*, to commemorate that Linnaeus (Carl von Linné) founded the present-day systematic nomenclature 250 years ago. The name also reminds of *Ennea* - the generic entity to which most species of Streptaxidae in the 19<sup>th</sup> century were assigned - and phonetically resembles a Latin diminutive, underlining the small size of this species, one of the tiniest Afrotropical land snails known to date. Linnaeus himself described only one Afrotropical land snail, *Bulla achatina*, now *Achatina achatina* (Lin-

naeus, 1758) (though he indicated its provenance erroneously as American, see Bequaert, 1950), which species, by contrast, competes for the nomination of the largest extant land snail world-wide. The name *primennilus* is to be treated as a noun in apposition.

Remarks.— Shells of *C. primennilus* resemble those of *C. kazibae* in shape and apertural dentition, and at first I hesitated to consider the Cameroonian specimens as a distinct species. The latter was described from Upemba National Park in the southeastern Congo (Katanga Province), more than 2200 km (as the crow flies) from the nearest Cameroonian locality of the new species. Shells of *C. primennilus* are about 20% smaller-sized at approximately the same number of whorls. Variation in shells dimensions of *C. primennilus* within and among the Cameroonian localities, which are up to 100 km distant, is rather small. The ribbing on the embryonic whorls is slightly more pronounced and denser, and the embryonic shell width is smaller than in *C. kazibae* (Adam, 1984; 3 paratypes in RMNH). These taxa eventually may turn out to be extremes of a cline, or subspecies of the same species, though African streptaxid species with surmised (natural) ranges in the order of 2000 km appear to be quite uncommon, especially in forest-dwelling species, and the conspecific status of most need confirmation, identifications being based on conchological similarity only.

*Costigulella primennilus* is probably the tiniest member of the entire family Streptaxidae reported to date. Van Bruggen (1991) mentioned as smallest streptaxids (“under 2 mm”) *Gulella columnella* and *G. pentheri*. Connolly (1939) mentioned *G. pentheri* var. *kowinsensis* Burnup, 1926 (1.8 × 0.65 mm (“perhaps the smallest of yet known South African *Gulellae*”) and *G. columnella* var. *vitreola* (Melville & Ponsonby, 1908) (H × D 1.76-1.87 × 0.92-0.94 mm). Shell height of *Gulella* (*Juventigulella*) *habibui* Tattersfield, 1998, is between 1.4 and 1.7 mm, but in that species the shell is wider than high, 1.9-2.1 mm (Tattersfield, 1998). Searches of the literature failed to find any smaller Streptaxidae.

### Systematic position of *Costigulella*

*Costigulella* is here considered an independent radiation, rather than subgenus of *Gulella* (type species *G. menkeana* (L. Pfeiffer, 1853), from which it strongly differs conchologically (see e.g. Connolly, 1939) and anatomically (*G. menkeana*: Herbert et al, in prep., *Costigulella*: Degner, 1934 (*C. hedwigae*). The six attributed species all live west of the Ruwenzori range, the classical watershed between the Western and Eastern African forest biotas. All are small (shell height 1.5-3.25 mm), and share strong regular ribs on all but the first half whorl, a similar arrangement of apertural barriers, and a simple outer lip, without any pit or furrow corresponding with the inner palatal tooth.

A unique feature of *Costigulella* may be the presence of the five major denticles of the adult shell peristome throughout the development of the juvenile shell after the egg stage. Most other species attributed to *Gulella* s.l. have edentate juvenile shells. In a few groups juveniles have only a single tooth on the parietal wall, other denticles developing upon adulthood. In a few East African taxa like *G. jacquelineae* Adam, 1965, and *G. spatium* (Preston, 1913), the juvenile stages are also known to already possess most of the complex adult apertural dentition (Adam, 1965; Verdcourt, 1970). However, the process of formation and resorption of teeth appears to be quite different. In *Costigulella* species of which the juveniles are known, all juvenile shells, from rather



small ones to nearly adults, have teeth on the peristome. In *G. jacquelinae* the teeth may be absent on the juvenile peristome, but these can then be observed deeper in the aperture (Adam, 1965, 1984). This suggests that in *G. jacquelinae* tooth formation (and resorption, if such occurs at all; Verdcourt's (1970) observations on a specimen of *G. cf. spatium*, actually the holotype of *Acanthennea franzi* Blume, 1965, suggests that the juvenile teeth in that species are retained within the adult shell) is a periodical rather than a continuous process, whilst the latter appears to be the case in *Costigulella* species. In the few damaged adult shells of *Costigulella* species seen, no remains of juvenile teeth could be observed. Discontinuous tooth formation also occurs in some other streptaxids. One example is *Ptychotrema (Ennea) aillyi* Adam, 1981 (De Winter, unpublished observation). Since material of the latter was partly collected at the same localities as *C. primemilus*, the different tooth formation process is unlikely to be due to different regimes of periodical drought and precipitation.

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