Danish Bilharziasis Laboratory

A field guide to
African freshwater snails

1. West African species

D.S. Brown and T.K. Kristensen
1993

PREFACE

This volume is a revised version of the 2nd Edition of this guide published in 1978. The area covered extends from Senegambia eastward to include Lake Chad and Nigeria, and islands in the Gulf of Guinea.

The identification keys use as far as possible readily observable external characters. Acquaintance with conchological terms is essential, and the ability to carry out a dissection and to make a radula preparation is necessary to complete some identifications. These aspects and other methods of study are described in the introductory volume of this series (Danish Bilharziasis Laboratory, 1973, 1982) and in Brown (1980).

It should be borne in mind that there may be a wide difference between the scale of illustrations for different genera. The reader should note that measurements given for the shell are usually not of the largest specimens known but the size that is not commonly exceeded. Measurements for spired shells are length (height) x width, and for discoid shells height x maximum diameter. Maximum size achieved by a species may vary considerably among different populations, and the size of snails in a particular sample will partly depend on the time of sampling in relation to the life-cycle.

Despite the extensive investigations of recent years, there are still problems with the definition and identification of species within some groups of snails found in West Africa. Unfortunately, this is so for the medically important genera *Bulinus* and *Biomphalaria*. The authors wish the reader to appreciate that this volume is truly a guide and not a definitive classification. Research in progress and yet to begin will no doubt produce many taxonomic changes.

Accordingly every collector of snails has a chance to make a valuable scientific contribution. A user of this guide who experiences difficulty in deciding on an identification or who wishes to have one confirmed is welcome to send specimens to either address below.

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IDENTIFICATION KEY TO FRESHWATER SNAILS OF WEST AFRICA

KEY TO THE TWO MAIN GROUPS

African freshwater snails belong to two main groups (subclasses), viz. **Prosobranchia** (Prosobranchs) and **Pulmonata** (Pulmonates), which can be distinguished as described below:

A The snail has an operculum, which closes the opening of the shell when the body is withdrawn. The shell is commonly thick-walled and large (20 mm or more in height/length or width). Discoid shell forms are not found
. . . . . **Prosobranchia**, proceed below

B The snail does not have an operculum. The shell usually is thin-walled and small (less than 20mm in height/length or width); the shell may be discoid
. . . . . **Pulmonata**, proceed to page 29

PROSOBRANCHS

The freshwater prosobranchs are easily recognized by the presence of an operculum. The shell may be thick-walled and large, though some are fragile and in some genera all species are small. In West Africa, shell shape is commonly globose or higher, though in the Neritidae the expanded body whorl may hide the earlier whorls. The prosobranch radula is distinctive in being taenioglossate (having only 7 teeth per transverse row), except in the Neritidae, in which it is rhipidoglossate (many teeth in a row of which only few are conspicuous).

KEY TO PROSOBRANCH FAMILIES

1 A Shell globose or depressed, consisting of few whorls, which increase rapidly so that the apex may be hidden. Aperture D-shaped; its straight (columellar) side may bear small teeth. Operculum strongly calcified, with one or two internal processes. Radula rhipidoglossate. From near the coast, usually in brackish water . . . . . NERITIDAE, p.4

B Shell globose, apex visible, aperture somewhat D-shaped, but without columellar teeth. Operculum calcified, without any internal process. Radula taenioglossate. Rather neritid like snails living in rapidly flowing rivers . . . . . BITHYNIIDAE, part (*Sierraia*),p.17

C Shell globose or higher, aperture rounded or oval. Operculum with or without calcification. Radula taenioglossate 2

2 A Fully grown shell more than 10 mm high. Radula without basal denticles 3

B Fully grown shell less than 10 mm high. Basal denticles present in most species 5

3 A Operculum concentric. Shell shape in the range from depressed to ovate or conical 4

B Operculum paucispiral or concentric with a spiral nucleus. Shell spire commonly is turreted . . . . . THIARIDAE, p.21

C Operculum multispiral. Shell spire turreted, strongly sculptured, aperture with a notch at the base. Found at the coast in brackish water . . . . . POTAMIDIDAE, p.29

4 A Shell conical. Female viviparous. Right tentacle of male enlarged, forming a copulatory organ . . . . . VIVIPARIDAE, p.8

B Shell depressed, globose or little higher. Female oviparous. Male with a copulatory organ near the mantle border . . . . . AMPULLARIIDAE, p.8

5 A Operculum corneous and paucispiral. Basal denticles present. From near the coast . . . . . HYDROBIIDAE, p.13

B Operculum calcareous, concentric around a spiral inner part. Basal denticles present . . . . . BITHYNIIDAE, part (*Gabbiella*), p.16

C Operculum almost uncalcified, small and structureless. Basal denticles absent. Guinea . . . . . BITHYNIIDAE part (*Soapitia*), p.17

D Operculum corneous and paucispiral. Radula with accessory plate between the lateral and the first marginal tooth . . . . . ASSIMINEIDAE, p.20

FAMILY NERITIDAE

Shell strong, imperforate, with a thickened columellar margin and a small spire. Usually the shell surface has a pattern of variable markings. Operculum calcareous, paucispiral with one or two processes (apophyses) projecting from the inner surface near the base. This is the only gastropod family in African fresh waters with a rhipidoglossate radula.

Many neritids are marine but some live in brackish or fresh water, though in tropical Africa no species penetrates far inland from the coast. Two genera are found in West Africa.

KEY TO THE GENERA

A Fully grown shell more than 7 mm high. Operculum with 2 well developed apophyses . . . . . *Neritina*

B Fully grown shell less than 5 mm high. Operculum with a single apophysis . . . . . *Neritilia*

Genus *Neritina* Lamarck, 1816

Shell hemispherical with a D-shaped aperture having its straight side formed by the thick columellar margin. Operculum with 2 strong, connected apophyses, the rib and the peg. The oval egg capsules, 1 to 2 mm long, are often seen on the shell. The 8 species known in West Africa are associated with estuaries, coastal lagoons and mangrove swamps.

KEY TO THE SPECIES

1 A Columellar margin smooth 2

B Columellar margin toothed 4

2 A Fully grown shell less than 15 mm in diameter, highly variable in colour and pattern 3

B Fully grown shell more than 15 mm in diameter. Brownish with a dark pattern 7

3 A Shell diameter up to 9 mm, spire low, last whorl evenly rounded, surface smooth and shining . . . . . *N. glabrata*

B Shell diameter up to 12 mm, spire higher, last whorl somewhat angular, surface less shining . . . . . *N. adansoniana*

4 A Spire low 5

B Spire more prominent 6

5 A Columellar plate with its outer zone orange-tinged, shell surface usually dark with fine dense pattern . . . . . *N. afra*

B Columellar plate white or pale yellow, shell surface usually less densely patterned, paler . . . . . *N. oweniana*
(Juveniles: adult columella smooth, see 7)

6 A Spire prominent, aperture comparatively small, columellar margin finely toothed . . . . . *N. rubricata*

B Spire lower, aperture larger, columellar margin more coarsely toothed. Some shells have a sub-sutural ridge . . . . . *N. cristata*

7 A Mature peristome usually with an expanded lobe above and below. Operculum with the peg comparatively large . . . . . *N. oweniana*

B Peristome not lobed. Peg of operculum smaller . . . . . *N. tiassalensis*

Neritina glabrata Sowerby, 1849

Up to 7.5 x 8.5 mm. Shell extremely variable in pattern and colours (including black, brown, red and yellow). Surface smooth and shining. On the coast from Gambia to Angola, often abundant in estuaries.

Neritina adansoniana (Recluz, 1841)

Up to 12 x 11 mm. Less varied in colour and pattern than the preceding species, contour of whorl more angular and surface less shining. Senegal to Angola.

Neritina afra Sowerby, 1841

Up to 15 x 15 mm. Fully grown shell appears almost black due to the dense fine pattern, though some young shells have yellowish patches. Columellar plate more or less orange towards its outer edge. Cameroun and probably in Nigeria; islands of Fernando Po, Ile du Prince and São Tomé.

Neritina rubricata Morelet, 1858

Up to 15 x 15 mm. This and the following species are similar in colour and pattern, in which spiral bands predominate. In *rubricata* the spire is more prominent and the aperture comparatively small. Gambia to Cameroun.

Neritina cristata Morelet, 1864

Up to 16 x 18 mm. Spire distinct though low, aperture comparatively large. A subsutural ridge, to which this species owes its name, is not always present. Sierra Leone to Gabon.

Neritina oweniana (Wood, 1828)

Up to 28 mm (greatest dimensions, including lobes). Mature shells have the columellar edge smooth and those with a lobed lip are unmistakable. Specimens that do not develop lobes resemble *N. tiassalensis* (which may be distinguished by the operculum). Small shells always lack lobes and their columellar margin is toothed. Liberia to Angola, penetrating up estuaries well into fresh water, reaching Bator on the lower Volta river.

Neritina tiassalensis Binder, 1955

Up to 25 x 26 mm. Shell resembles a large *N. oweniana* without a lobed lip. The peg of the operculum is smaller than in *oweniana*. Known only from Ivory Coast. Found on rocks in strong current in the Bandama river about 80 km inland.

Genus *Neritilia* Martens, 1879

Small species, with the shell uniformly pale in colour, the operculum with only one apophysis, the radula lacking the median row of teeth. In fresh waters near coastal areas in West Africa, the Caribbean and Indo-Pacific regions. One species found in West Africa.

Neritilia manoeli (Dohrn, 1866)

Up to 3.5 x 4.0 mm. This small, pale-shelled species (when clean), is readily distinguishable from other neritids found in fresh water in West Africa. Cameroon and Principe Island, probably more widespread, found in streams on stones and on aquatic plants.

FAMILY VIVIPARIDAE

Shell dextral with a conical spire. Operculum thin, corneous and concentric. The female is viviparous and carries developing young in the lower part of the oviduct. Male with the right tentacle enlarged to serve as a copulatory organ. The genus found in West Africa is associated with lakes and slowly flowing rivers and streams.

Genus *Bellamya* Jousseaume, 1886

Widespread in tropical Africa with many described species, though apparently just one occurs in West Africa.

Bellamya unicolor (Olivier, 1804)

Up to 25 x 18 mm. The conical spire is about as high as the aperture. The last whorl is more or less flattened at the periphery, forming 2 blunt angulations which correspond to quite sharp carinations on earlier whorls. Small bristles of periostracum may be seen. Commonly, the peristome is a rounded oval, though the columellar margin sometimes is straighter forming an angle with the basal margin (especially so in juvenile shells). Present in Egypt and East Africa, and widespread in West Africa, where it is found in scattered localities, mostly in rivers.

FAMILY AMPULLARIIDAE (PILIDAE)

The fully grown shell can be large (more than 100 mm high). Operculum concentric, animal with a tentacle-like process (pseudopodium) on each side of the snout in addition to the tentacles. Mantle cavity divided into two compartments, one with a gill and the other serving as a lung. Female oviparous, male with a copulatory organ on the right side, formed by a modified part of the mantle border, which enclose the penis. Worldwide in distribution in tropical freshwaters. Four genera occur in West Africa. They are associated with swamps

and slowly flowing rivers and streams, some species occur in seasonal waters that dry out for many months.

KEY TO THE GENERA

1 A Shell sinistral . . . . . *Lanistes*
B Shell dextral 2

2 A Operculum corneous 3
B Operculum calcareous . . . . . *Pila*

3 A Reaching 45 mm high, thin- shelled with irregular pattern of transverse bands and spots, light and dark . . . . . *Saulea*
B At most 25 mm high, thick-shelled with dark surface and indistinct spiral bands . . . . . *Afropomus*

Genus *Lanistes* Montfort, 1810

The shell, but not the animal, is sinistral (hyperstrophy). Gelatinous clusters of eggs are deposited on vegetation within water. Restricted to Madagascar and Africa, where it occurs from the lower Nile southward almost throughout the tropical area. Three species are found in West Africa.

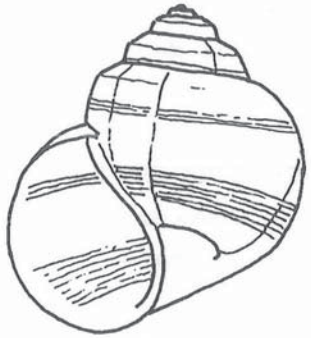
KEY TO THE SPECIES

1 A Shell with a distinct shoulder angle and dark spiral bands . . . . . *L. libycus*
B Shell without a shoulder angle, usually not banded but uniformly dark 2

2 A Shell shape subglobose or little higher, umbilicus large . . . . . *L. varicus*
B Spire about as high as the aperture, umbilicus smaller . . . . . *L. ovum*

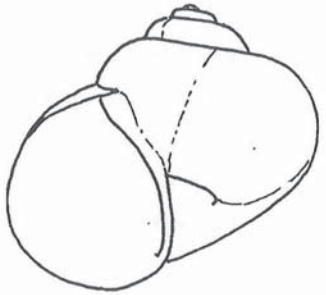
Lanistes libycus (Morelet, 1848)

Up to 52 x 47 mm and 42 x 33 mm (high-spired form). Besides the strong, even carinate shoulder angle, there is an angulation around the large umbilicus. Spiral sculpture is usually strong and bristles of periostracum may be present. West Africa from Ivory Coast eastward, and then southward into Gabon.



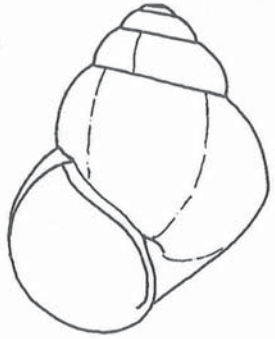
Lanistes varicus (Müller, 1774)

Up to 60 x 65 mm and 37 x 32 mm (high-spired form). Typically subglobose with evenly curved whorls, large aperture and wide umbilicus, and coloured uniform brown. A form with higher spire is known from Senegambia. Restricted to West Africa: widespread in Ghana and found in scattered localities in Ivory Coast, Niger, Upper Volta, Mali and Senegambia.



Lanistes ovum Peters, 1845

Up to 52 x 44 mm (in West Africa, larger elsewhere). A widely variable species represented in West Africa by a rather high-spired form, which extends from Sudan through Chad into Nigeria. Widespread in tropical Africa.



Genus *Pila* Röding, 1798

The large dextral shell and calcareous operculum are distinctive. Clusters of eggs with white calcareous shells are deposited about the water level, often in crevices in earth banks. Present in Asia and Africa, where it occurs from the lower Nile southward to Namibia, Botswana and northern Mozambique. Three species are found in West Africa.

KEY TO SPECIES

1 A Aperture and operculum slender, height almost twice the width. Shell growing very large (up to 130 mm high) . . . . . *P. wernei*

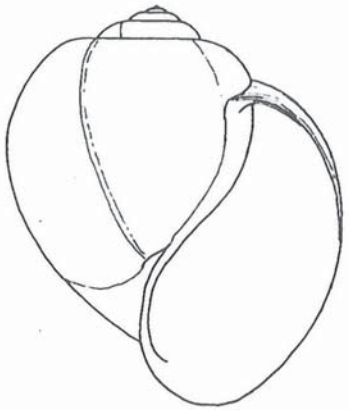
B Aperture and operculum broader, height only 1.5 to 1.7 times width. Fully grown shell less than 60 mm high 2

2 A Shell with only weak spiral sculpture if any . . . . . *P. ovata*

B Shell with fine but distinct spiral sculpture of ridges and grooves visible at x 12 magnification . . . . . *P. africana*

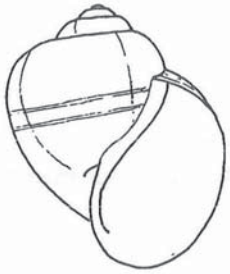
Pila wernei (Philippi, 1851)

Up to 127 x 125 mm. The large size, globose shape, comparatively narrow aperture and operculum are distinctive. This species, the largest African freshwater snail, is widely distributed in the tropical region, but in West Africa is found only in Chad and the river Niger.



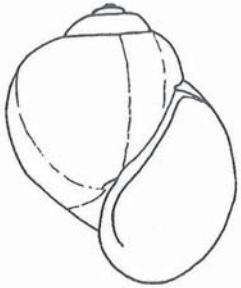
Pila ovata (Olivier, 1804)

Up to 50 x 45 mm (in West Africa, larger elsewhere). A shell of similar shape to the following species but the surface is smoother and shinier. Common in eastern Africa, but in West Africa found, rarely, only in Chad and Nigeria.



Pila africana (Martens, 1886)

Up to 50 x 45 mm. A comparatively small species for this genus and with distinctive strong spiral sculpture. The most common *Pila* in West Africa, found from Liberia to Ghana.



Genus *Saulea* Gray, 1867

The varied light and dark pattering of the shell is unique among African freshwater snails. One species is known, found only in West Africa.

Saulea vitrea (Born, 1780)

Up to 45 x 36 mm. A rather large though fragile shell due to the weak calcification. Upper whorls carinate, lower whorls nearly evenly curved. The distinctive brown and cream pattern might be confused with that of the landsnail *Achatina* spp. Found in Liberia and Sierra Leone, living in small streams, pools and swamps.

Genus *Afropomus* Pilsbry & Bequaert, 1927

A small snail for the family Ampullaridae, with a thick-walled imperforate shell. One species is known, found only in West Africa.

Afropomus balanoidea (Gould, 1850)

Up to 23 x 20 mm. The generally dark blackish-brown shell surface contrasts with the whitish thickened columella. Spiral bands may be visible within the aperture. Found in Liberia, Ivory Coast and Sierra Leone. Habitats are varied, including small rivers and ditches.

FAMILY HYDROBIIDAE

Definitions of this family and of groups within it are currently being revised, according to anatomical characters. It is not yet clear what will be the eventual position of the species from tropical Africa that have until now been classified in the Hydrobiidae. These are small dextral snails with denticles on the basal plate of the central radular tooth (so far as known) and a corneous paucispiral operculum. Two of the genera found in the coastal region of West Africa and classified by authors as Hydrobiidae, are treated below (another one, *Soapitia*, is included under the Bithyniidae).

KEY TO THE GENERA

1 A Shell with a row of spines along the shoulder . . . . . *Potamopyrgus*

B Shell without spines . . . . . *Hydrobia*

Genus *Potamopyrgus* Stimpson, 1865

The row of spines, made of periostracum, are characteristic. Several species live in New Zealand and Australia, one of them thought to have been introduced into Europe where it is widespread. The single species found in Africa shows several distinctive characters.

Potamopyrgus ciliatus (Gould, 1850)

Up to 5.8 x 3.2 mm. The spines and sharply conical spire are easily recognized. In coastal localities, such as mangrove swamps, from Liberia to Cameroun, and extending southward to the lower Zaire river.

Genus *Hydrobia* Hartmann, 1821

Three small species, less than 5 mm, are reported from West Africa

KEY TO SPECIES

1 A Shell with spiral ridges (seen at x 25 magnification) . . . . . *H. lineata*

B Shell without spiral ridges 2

2 A Shell consists of only 4 to 5 convex whorls, spire only slightly higher than the aperture . . . . . *H. guyenoti*

B Shell can complete 6 to 7 rather flat whorls, spire about twice as high as the aperture . . . . . *H. accrensis*

Hydrobia lineata Binder, 1957

Up to 3 x 2 mm. Shell with fine spiral ridges. Ivory Coast and Togo.

Hydrobia guyenoti Binder, 1955

Up to 2.7 x 1.8 mm. Whorls smooth, convex, spire shorter than in the following species. Ivory Coast.

Hydrobia accrensis Connolly, 1929

Up to 4.5 x 2.0 mm. Whorls smooth, rather weakly curved, spire higher than in the two preceding species. Ghana and Togo.

FAMILY BITHYNIIDAE

Small to moderately large dextral snails usually with calcareous operculum. Male with a penis having a lateral lobe. Three genera known to occur in West Africa.

KEY TO THE GENERA

1 A Shell conical, spire as high as or higher than the aperture.
Operculum with a definite paucispiral nucleus.
Central radular tooth with basal denticles . . . . . *Gabbiella*

B Shell globose, spire shorter than aperture.
Operculum may appear entirely concentric and always
lacks a definitely spiral nucleus.
Central tooth without basal denticles 2

2 A Shell colour is a uniform pale brown.
Outer lip thin and simple. Operculum very small,
almost uncalcified . . . . . *Soapitia*

B Shell banded or spotted or uniformly dark, outer lip either
thick or thin and reflected. Operculum of normal size and
strongly calcified . . . . . *Sierraia*

Genus *Gabbiella* Mandahl-Barth, 1968

Fully grown shell up to 9 mm high, conical in West African species. Operculum with paucispiral nucleus and, when fully grown, an outer concentric zone. Central tooth of radula with 2 to 5 basal denticles on either side. Known only from Africa where some 20 species are recognized, mostly occurring in eastern and central tropical areas. Three species in West Africa.

KEY TO THE SPECIES

1 A Fully grown shell up to 5 mm high . . . . . *G. tchadiensis*

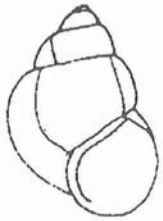
B Fully grown shell more than 6 mm high 2

2 A Spire scarcely higher than the aperture, central tooth
with 5 basal denticles on each side . . . . . *G. africana*

B Spire about 1.5 times as high as the aperture.
Central tooth with up to 4 basal denticles on each side . . . . . *G. senaariensis*

Gabbiella tchadiensis Mandahl-Barth, 1968

Up to 5 x 3.5 mm. The whorls are evenly convex, the umbilicus closed in young shells but open in large ones, which may have fine spiral ridges. Lake Chad and the Chari river, also in Lake Léré and the Yobi river in Nigeria.



Gabbiella africana (Frauenfeld, 1862)

Up to 9 x 6.6 mm. A large species for this genus, with a thick operculum. Originally described from simply "West Africa" and known with certainty only from Ivory Coast. A species known as *G. tilhoi* (Germain, 1912), from Bengou in Niger and not yet refound, possibly is distinct but could be the young of this or of the following species.

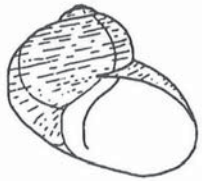
Gabbiella senaariensis (Küster, 1852)

Up to 8.5 x 5.5 mm. A comparatively large, slender and high spired shell. Common in the river Nile and extending westward into Chad and northeast Nigeria (Yobi river).

Genus *Soapitia* Binder, 1961

An unusual bithyniid with the operculum much reduced in size and calcification. It shows resemblance to the following genus *Sierraia*. One species is known, found only in West Africa and in a single locality.

Soapitia dageti Binder, 1961



Up to 5.8 x 5.4 mm. The globose shell consists of 3.5 rapidly increasing whorls with fine spiral ridges. Aperture large but operculum small, lacking spiral structure and very weakly calcified. Central tooth of radula without any basal denticles. Found only in the Konkouré River in Guinea, above the Kalela rapids near Soapiti. Its morphology suggests that the habitat is on stones in fast current.

Genus *Sierraia* Connolly, 1929

The variable colouring and patterning of the shell is unique among the Bithyniidae. Some species have a D-shaped aperture, rather like that in the Neritidae, with an expanded columellar plate. The mature operculum appears wholly concentric, as the sub-spiral membraneous nucleus is usually lost as growth proceeds. The 4 species known are found only in Sierra Leone and they live in rivers, remarkably existing in large numbers in stony rapids and in water with hardly any calcium. Mature females can be twice as large as a mature male.

KEY TO THE SPECIES

1 A Mature peristome continuously thick, without a columellar plate. Aperture ovate . . . . . *S. leonensis*

B Peristome interrupted at the parietal margin, with an expanded columellar plate. Aperture D-shaped 2

2 A Outer lip thin, expanded and reflected when mature. Shell surface rough with nodules in spiral rows . . . . . *S. expansilabrum*

B Outer lip thick, not expanded. Shell surface smoother 3

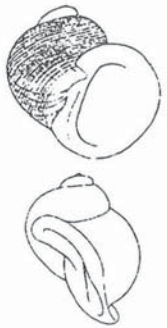
3 A Shell small, less than 6 mm high, surface nearly smooth. Penis with accessory lobe . . . . . *S. outambensis*

B Shell larger, nearly 9 mm high, surface with fine reticulate sculpture. Penis without accessory lobe . . . . . *S. whitei*

Sierraia leonensis Connolly, 1929

Up to 10 x 9 mm. Peristome ovate with margin continuously thickened, without the columellar plate present in the 3 other species. Shell surface nearly smooth, colour varying from greenish grey to reddish brown, usually with dark marks in the periostracum, forming patterns of great variety. Operculum broadly ovate, lodging at the peristome. Found only in Sierra Leone, in perennially flowing rivers (Mabole, Rokel, Jong (Taia), Little Scarcies and Tabe); found on tree roots as well as on stones in rapids.

Sierraia expansilabrum Brown, 1988

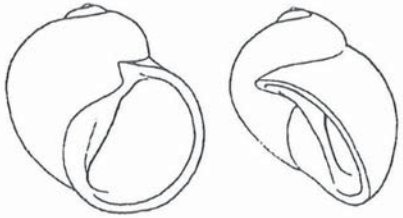


Up to 12 x 12 mm. Peristome thin, outer lip expanded and reflected when mature, columellar margin forming a broad plate. Shell surface rough with numerous spiral ridges of nodules. Colour usually dark grey and sometimes with yellowish-brown or orange spiral bands. Operculum narrowly ovate, smaller than the aperture. Found only in Sierra Leone, beneath stones in rapids of rapidly flowing rivers (Little Scarcies and Moa).

Sierraia outambensis Brown, 1988

Up to 5.5 x 5.5 mm. A small species scarcely reaching the lower range of size of the other species when mature. Mature peristome with a thick outer lip, but a thin parietal region and an expanded columellar plate. Shell surface with weak spiral ridges, various patterns of spiral grey bands on a pale yellow to orange-brown ground colour. Operculum narrowly ovate, smaller than the aperture. Found only in Sierra Leone, beneath stones in rapids of the Little Scarcies river.

Sierraia whitei Brown, 1988



Up to 8.5 x 8.5 mm. Larger than *S. outambensis* but the shell similarly has a thick outer lip and a columellar plate. The reticulate sculpture is stronger than in *outambensis* (though finer than in *expansilabrum*). Colour may be uniformly grey or black, or with yellowish-orange spiral bands. Operculum narrowly ovate, smaller than the aperture. The male lacks an accessory lobe on the penis

(a unique character for the species and apparently also for the entire Bithyniidae). Found only in Sierra Leone, beneath stones in rapids of rivers (Jong (Taia), Rokel and Moa).

FAMILY ASSIMINEIDAE

The aquatic members of this family (which belong in the subfamily Assimineinae) are small and live generally near coasts in fresh and brackish waters. African species are small with dextral shells, mostly with a conical spire. The radula is distinctive in having an accessory plate between the lateral tooth and the first marginal tooth. Central tooth with or without basal denticles. Operculum corneous and paucispiral. The male has a penis lacking an accessory lobe. One species has been reported for West Africa.

Genus *Assiminea* Fleming, 1828

Species from the eastern, southern and the western coasts of Africa have been classified in this genus. However, their true systematic position is uncertain, as internal organs have been studied little. Detailed comparisons are needed with species living in Europe, Asia and the Indo-Pacific region. One species has been reported for West Africa.

Assiminea hessei O. Boettger 1887

Up to 3.7 x 2.5 mm. The small, conical, imperforate shell has fine spiral lines (visible at x 50). Operculum and penis as for the family. Central tooth without basal denticles. Lower Zaire river and found in Nigeria at Port Harcourt in a mangrove swamp.

FAMILY THIARIDAE

Shell varies from conical-ovate to very high-spired (turreted) and is strongly sculptured in many of the genera. Operculum corneous. The male lacks a copulatory organ. A large family of mainly freshwater snails, and a few that are estuarine. Five genera are found in West Africa.

KEY TO THE GENERA

1 A Operculum entirely spiral 2
B Operculum concentric with spiral nucleus 4

2 A Operculum with nucleus near center
Radula strong and very long . . . . . *Potadoma*
B Operculum with nucleus near the basal margin.
Radula small 3

3 A Basal margin of aperture evenly rounded.
Freshwater species . . . . . *Melanoides*
B Basal margin produced spoutlike.
Estuarine . . . . . *Pachymelania*

4 A Operculum with small spiral part,
less than half the diameter . . . . . *Cleopatra*
B Operculum with large spiral part, about
2/3 of the diameter . . . . . *Pseudocleopatra*

Genus *Potadoma* Swainson, 1840

Shell medium-sized to large, strong, conical to turreted, though usually the spire is decollate. Shell colour is generally dark grey or brown, sometimes with poorly defined spiral bands. Operculum nucleus situated near the centre. The radula is very long and

the central tooth has a strong quadrangular base. About 20 species are currently recognized, distributed in two areas, one extending from eastern Zaire into the Central African Republic, and the other reaching from western Zaire northwards and westward into Liberia. These snails often are abundant in streams within forests. Six species are found in West Africa, and certain ones possibly act as first intermediate host for the lung-flukes, *Paragonimus* spp.

KEY TO THE SPECIES

1 A Shell reaching only about 16 x 10 mm, with
2 strong ridges (keels), spire not much
higher than aperture . . . . . *P. bicarinata*
B Shell reaching 20-50 mm high, without any strong
spiral ridges or with 4 or more. Complete spire
at least twice as high as the aperture
(NB, allow for erosion) 2

2 A Shell with spiral ridges around the base, more than
35 mm high when fully grown 3
B Without basal spiral ridges, less than 35 mm high . . . . . *P. liberiensis*

3 A Spire with slightly convex sides, surface with fine,
regular wavy lines . . . . . *P. freethi*

B Spire with straight sides, no fine spiral lines
(though coarser sculpture may be present) 4

4 A No spiral ridges on the spire . . . . . *P. togoensis*
B Spiral ridges present 5

5 A Shell slender, spiral ridges are few and strong
(about 6 visible on the penultimate whorl . . . . . *P. vogeli*

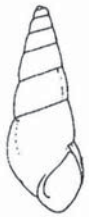
B Shell broader, the spiral ridges are many and finer
(about 20 visible on penultimate whorl) . . . . . *P. moerchi*

Potadoma bicarinata Mandahl-Barth, 1967

Up to 16 x 10 mm. The small size and 2 sharp keels are distinctive. Eastern Ghana.

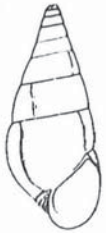
Potadoma liberiensis (Schepman, 1888)

Up to 34 x 12 mm with 9-10 whorls, but usually eroded down to 3-6. Basal ridges are lacking, unlike the other species of *Potadoma* found in West Africa. Liberia, Ivory Coast and Guinea.



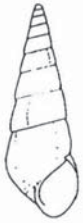
Potadoma freethi (Gray, 1831)

Up to 53 x 20 mm with about 12 whorls, but usually eroded down to 4-5. Spire with slightly curved sides. The fine wavy sculpture may be intersected by transverse sculpture producing a granular effect. Variation in shell shape and sculpture led to the recognition of 4 subspecies in West Africa (Mandahl-Barth, 1967). Commonly found species, distributed from Ivory Coast to lower Zaire.



Potadoma togoensis Thiele, 1928

Up to 40 x 14 mm with 14-15 whorls, but spire usually much eroded. Slender shell with basal ridges but elsewhere only a few fine spiral lines. Eastern Ghana.



Potadoma vogeli Binder, 1955

Up to 40 x 11 mm. Slender shell with strong spiral ridges on at least the lower whorls (about 6 visible on the penultimate whorl). Ivory Coast.

Potadoma buttikoferi (Schepman, 1888) has a somewhat broader shell, also with strong spiral ridges, though these are fewer (4 visible on the penultimate whorl). This species is known only from empty shells and its systematic position is uncertain. Possibly it is a species of *Cleopatra*. Known only from the type locality in Liberia. (St. Paul's river near Bavia).

Potadoma moerchi (Reeve, 1859)

Up to 55 x 18 mm with 14-15 whorls, but usually eroded down to 3-8. Close-set spiral ridges (about 3 per mm) are more or less interrupted by transverse sculpture producing a granular effect. This sculpture is coarser than in any form of *P. freethi*. Eastern Ghana (Volta river basin) eastward into western Nigeria.

Genus *Melanoides* Olivier, 1804

Slender shells with a high spire (turreted) though often decollate. Conspicuous transverse and spiral sculpture is usually present, and many species have patches of reddish-brown colour following the pattern of sculpture. Operculum paucispiral with a basal nucleus. The female is viviparous, with a brood pouch for the young; males are rarely found in at least the best known species, *M. tuberculata*. The large range of distribution includes the Indo-Pacific region, southern Asia, Caribbean islands and much of Africa. About 30 species known in Africa, of which 3 are found in West Africa.

KEY TO THE SPECIES

1 A Shell nearly smooth, sculptured with only fine spiral lines . . . . . *M. manguensis*

B Shell strongly sculptured with spiral ridges, ribs or nodules 2

2 A Spire with distinctly tapered sides. Close-set spiral ridges on all whorls and ribs on upper whorls . . . . . *M. tuberculata*

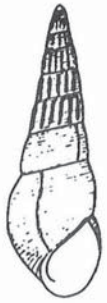
B Lower part of spire nearly cylindrical, spiral ridges more separated, bearing nodules . . . . . *M. voltae*

Melanoides manguensis (Thiele, 1928)

Up to 21 x 6 mm. A slender weakly sculptured shell without nodules. Ghana (northeast) and Ivory Coast (Comoe river).

Melanoides tuberculata (Müller, 1774)

Up to 35 x 12 mm (in West Africa, larger elsewhere). Spire is, if intact, clearly more pointed than in the next species. The sculpture is comparatively fine. Widely distributed in Africa, and abundant in Lake Chad but uncommon further west. Found in a few localities in Nigeria, Ghana, Gambia, Senegal and Mauretania.



Melanoides voltae (Thiele, 1928)

Up to 18 x 6 mm (4 whorls remaining). Lower part of spire almost cylindrical. Last whorl with 3 or 5 rows of coarse nodules. Eastern Ghana in tributaries of the Volta river.

Genus *Pachymelania* Smith, 1893

Large snails reaching 60 mm high, with a tall spire (though commonly decollate) and strong sculpture. Base of aperture is spout-like. Operculum and radula similar to *Melanoides*. Living on the coast of western Africa in brackish water. All the 3 known species are found in West Africa.

KEY TO THE SPECIES

1 A One or two sharp spiral keels present or the shell surface is granular (many nodules, sometimes in transverse rows): both types of sculpture on some shells . . . . . *P. fusca*

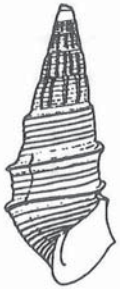
B Shell with large nodules in one or more spiral rows 2

2 A Single row of large nodules at the periphery . . . . . *P. aurita*

B Three rows of nodules on the last whorl (2 are seen above) . . . . . *P. byronensis*

Pachymelania fusca (Gmelin, 1791)

Up to 45 x 16 mm. Sculpture highly varied, the form with strong keels being easily recognized, but the form with entirely granular surface can be confused with *Melanoides tuberculata*. Some individual shells have the spire granular above but keeled below. Senegal to Angola.



Pachymelania aurita (Müller, 1774)

Up to 55 x 20 mm. With a distinctive single row of large tubercles on the lower whorls, and sometimes a conspicuous dark spiral band. Senegal to Angola.

Pachymelania byronensis (Wood, 1828)

Up to 60 x 27 mm. A comparatively large shell with 2 or 3 rows of strong tubercles. Ivory Coast to Nigeria.

Genus *Cleopatra* Troschel, 1856

Shell medium-sized, ovate, with a conical spire that usually is higher than the aperture (though commonly decollate in large specimens). Dark brown spiral bands may be present. Spiral angulations and ridges may be present, and weaker transverse sculpture, but some species may appear smooth. Operculum concentric with a spiral nucleus near to the columellar margin. Distributed from lower Egypt southward and widespread in tropical Africa. About 20 African species are known, but only one is found in West Africa.

Cleopatra bulimoides (Olivier, 1804)

Up to 16 x 9 mm (though often smaller, especially near the western limit of distribution). The shell varies widely in shape and sculpture. A form with 2 or 3 carinations occurs in Lake Chad and differs considerably from the comparatively slender and smooth-whorled form found in Senegal (*C. senegalensis* of Morelet, 1860). Lake Chad and in scattered localities westward to Senegal, found usually in stagnant or slowly flowing waters on sand or mud.

Genus *Pseudocleopatra* Thiele, 1928

Shell varies from ovate to slender, differing from *Cleopatra* is usually lacking spiral brown bands and having a more sinuous outer lip. The operculum of *Pseudocleopatra* has a larger spiral part, occupying about two-thirds of the fully grown width (only about one-fifth in *Cleopatra*).

Four species are known, 2 in the lower Zaire river and 2 in West Africa.

KEY TO THE SPECIES

1 A Shell ovate, with slightly angular whorls, last whorl otherwise is smooth . . . . . *P. togoensis*

B Shell slender with up to 6 strong spiral ridges, though sometimes the whorls are almost smooth . . . . . *P. voltana*

Pseudocleopatra togoensis Thiele, 1928

Up to 13 x 9 mm. A comparatively broad shell with the whorls somewhat flattened at the periphery. Upper whorls with low spiral ridges but the last whorl is almost smooth. Shell coloured a uniform greenish-gray. Ghana; Oti and White Volta rivers.

Pseudocleopatra voltana Mandahl-Barth, 1973

Up to 12 x 6 mm. Comparatively slender shell, the spire higher than the aperture. Whorls nearly smooth or with up to 6 strong spiral ridges. Up to 3 brown spiral bands may be visible. Ghana; in the Volta river and a few other localities in the northeast region.

FAMILY POTAMIDIDAE

Medium-sized to large snails with a high spire and commonly strongly sculptured. Aperture with a deep notch at the base of the columella. Operculum corneous and multispiral. Widely distributed in brackish water on tropical coasts. The one species known in West Africa lives commonly in mangrove swamps with *Pachymelania*.

Tympanotonus fuscatus (Linnaeus, 1758)
Up to 80 x 25 mm. Shell strongly sculptured with spiral ridges, tuberculate ribs and large nodules, which may project as short spines. Commonly found with *Pachymelania fusca*, from which it may be quickly distinguished by the notch at the base of the aperture. Senegal and southwards to Angola.

PULMONATES

The African freshwater pulmonates can be distinguished from the prosobranchs by the absence of an operculum and by the radula, which has numerous small and rather uniform teeth. The shell generally is thin-walled and fragile, lacking strong sculpture. The range of shell shape includes shield-shaped, discoid, lentiform, globose and slender high-spired forms.

KEY TO THE PULMONATE FAMILIES

1 A Living in brackish waters, especially mangrove swamps. Dextral shell with a narrow aperture having internal teeth . . . . . **ELLOBIIDAE, p.31**

B Living in fresh water. Dextral or sinistral shells of various shapes 2

2 A Shell shield-shaped . . . . . **ANCYLIDAE, p.32**

B Shell spirally coiled 3

3 A Shell discoid or lentiform . . . . . **PLANORBIDAE** . . . . . subfamily **PLANORBINAE, p.34** . . . . . (and *Indoplanorbis*), **p.42**

B Shell with exserted spire 4

4 A Shell dextral . . . . . **LYMNAEIDAE, p.31**

B Shell sinistral 5

5 A Spire not sharply pointed, surface dull. Pseudobranch present. Mantle border smooth. Radula teeth in nearly straight rows. Blood red . . . . . **PLANORBIDAE** . . . . . subfamily **BULININAE, p. 41** . . . . . (and *Amerianna*),**p.35**

B Spire sharply pointed, surface glossy. Pseudobranch lacking. Mantle border with finger-like processes. Radula teeth in v-shaped rows. Blood colourless . . . . . **PHYSIDAE, p. 48**

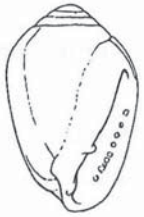
FAMILY ELLOBIIDAE

Small to large snails with the aperture more or less obstructed by folds or teeth just within the margin. Amphibious, living in marine and brackish habitats, especially mangrove swamps in the Indo-Pacific region. Only one species appears to be widespread on the coast of West Africa.

Genus *Melampus* Montfort, 1810

Shell up to about 15 mm high, with a low conical spire composed of many whorls. Aperture narrow, its columellar and parietal margins each with one or two folds, the outer lip with internal small teeth.

Melampus liberianus H. & A. Adams, 1854



Up to 14 x 8.3 mm. Spiral grooves present on the upper and lower parts of the last whorl. There are about 10 low teeth within the outer lip. Shell colour is sepia-brown with weak lighter bands. Found in mangrove swamps from Senegal to the Zaire River estuary.

FAMILY LYMNAEIDAE

Dextral fragile shells with a pointed spire. The flat and triangular tentacles are distinctive. Pseudobranch lacking. Worldwide in distribution, though with comparatively few species in tropical Africa, all of which can be classified in the genus *Lymnaea*.

Genus *Lymnaea* Lamarck, 1799

The one species found in West Africa is important as the intermediate host for the liver-fluke *Fasciola*.

Lymnaea natalensis Krauss, 1848

Up to 25 x 16 mm. The spire is variable though always less high than the aperture. Shell surface often with spiral rows of small grooves but never with spiral ridges (which are characteristic of *L. columella*, an American species introduced into some other regions of Africa). *L. natalensis* occurs throughout tropical Africa, though it does not live in such seasonal waterbodies as temporary rainpools, where some planorbid snails are found. Widespread in West Africa and common in some areas, with associated fascioliasis in cattle (Schillhorn Van Veen, 1980).

FAMILY ANCYLIDAE

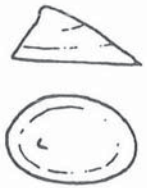
Small, usually less than 10 mm long, cap-like or shield-shaped shells. Although often abundant, ancylids are not easily obtained by standard collecting methods, as they adhere closely to vegetation and stones. Worldwide in distribution, with 3 genera in Africa, of which one occurs in West Africa.

Genus *Ferrissia* Walker, 1903

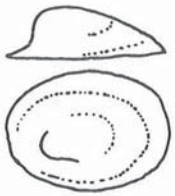
Usually less than 5 mm long, with an obtuse apex bearing numerous, very fine radial ridges (rather than pits, which are characteristic of the genus *Burnupia*, which lives in streams in other regions of Africa). *Ferrissia* sometimes forms a shell septum, apparently in preparation for drying up of the water, after which a new shell grows beneath the old one, such septate shells have been classified in a separate genus *Gundlachia*. *Ferrissia* has a nearly cosmopolitan distribution and probably occurs throughout Africa; it lives in a wide range of habitats including stagnant seasonal pools as well as perennial streams.

Three species have been described from West Africa, but they are poorly differentiated by subtle differences in shell shape and quite likely are one and the same species.

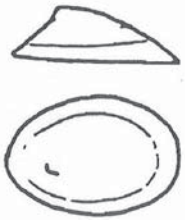
Ferrissia chudeaui Germain, 1917
Up to 2.5 x 1.5 x 1.3 mm. Type of locality: Senegambia, Bakoy River at Tukoto (in southwest Mali).



Ferrissia leonensis Connolly, 1928
Up to 3.6 x 2.5 x 1.6 mm. Type of locality: Sierra Leone, Regent.



Ferrissia eburnensis Binder, 1957
Up to 3.4 x 2.4 x 0.9 mm. Type of locality: Ivory Coast, Bingerville. Recently reported from São Tomé Island (Brown, 1990).



FAMILY PLANORBIDAE

Animal with long slender tentacles and reddish blood. Shell and anatomy highly diverse. Two subfamilies are present in Africa.

Subfamily PLANORBINAE

The shell is most commonly discoid; it is often described and illustrated as dextral, as in this guide, though the animal is anatomically sinistral, having its genital openings, and pneumostome on the left side. Rarely the shell has an exserted spire (*Amerianna*) and is clearly sinistral, resembling *Bulinus*. Copulatory organ not of the "ultrapenis" type characteristic of the Bulininae. The Planorbinae has 5 genera native to West Africa (*Afrogyrus, Biomphalaria, Ceratophallus, Gyraulus* and *Segmentorbis*) and one (*Amerianna*) has been introduced. The following key includes also *Helisoma*, which has been introduced into many localities in Africa and may be expected in West Africa. *Indoplanorbis*, though a member of the subfamily Bulininae, is also included in this key, because its large discoid shell is rather similar to *Biomphalaria* and *Helisoma*.

KEY TO THE GENERA

1 A Shell with exserted spire, sinistral; whorls sharply shouldered . . . . . *Amerianna*,
B Shell discoid or lentiform 2
2 A Shell discoid 3
B Shell lentiform . . . . . *Segmentorbis*,
3 A Shell large, at least 2 mm high 4
B Shell small, less than 2 mm high 6
4 A Shell less than 6 mm high, whorls more or less convex above and below. Prostatic lobes arranged in a row. Copulatory organ lacks a preputial gland. Commonly found . . . . . *Biomphalaria*

B Shell up to 14 mm high (more than 6 mm when only half-grown). Rare, introduced species 5

5 A Whorls strongly convex above, angular on the underside and flat within the umbilicus. Prostatic lobes in a bunch. Copulatory organ with an external preputial gland . . . . . *Helisoma*

B Whorls not flattened within the umbilicus. Prostatic lobes concentrated in a compact organ. Penis of the "ultrapenis" type (see Bulininae) . . . . . *Indoplanorbis*

6 A Fully grown shell less than 1 mm high, with 4 to 5 slowly increasing whorls. Penis with a cap-like stylet . . . . . *Afrogyrus*

B Fully grown shell higher, whorls increasing more rapidly; armature of penis different 7

7 A Whorls more rapidly increasing, 3 to 4 are completed, with regular ribs and sometimes sharply angular at the periphery. Penis with a dagger-like stylet . . . . . *Gyraulus*

B Whorls more slowly increasing; up to 5 are completed, which lack strong ribs and are never sharply angular. Penis with a sclerotised tip but not a distinct stylet . . . . . *Ceratophallus*

Genus *Amerianna* Strand, 1928

A small group of species occurring naturally within the Australasian region, of which one has been found in Nigeria, where it presumably was introduced by human agency. The shell is sinistral with a conical spire and strongly shouldered whorls. The copulatory organ is of a simple planorbid type, lacking flagella and other accessory structures, with the penis projecting freely into the sheath and its tip without a stylet. These snails are not known to be intermediate hosts for any schistosome parasite of man or livestock.

Amerianna carinata (H. Adams, 1861)

Up to 7.3 x 5.2 mm (Nigerian example; elsewhere known to reach 12 mm high). This shell superficially resembles *Bulinus truncatus*, but is easily distinguishable, when well cleaned, by the sharp shoulder and the presence of numerous fine spiral ridges, which may bear filaments of periostracum. Reported from lakes in Ibadan (Brown, 1983; Jelnes, 1983).

Genus *Segmentorbis* Mandahl-Barth, 1954

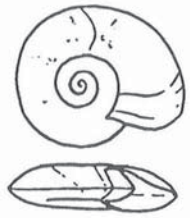
Shell with convex upper surface and flat underside; whorls deeply embracing, umbilicus narrow and deep; set of internal septa are present. Penis sheath with or without a single flagellum according to species. An African genus, present in lower Egypt and southward to Angola and Zululand. Six species known, of which 2 occur in West Africa.

KEY TO THE SPECIES

1 A Shell sharply carinate at the periphery, with distinct spiral lines . . . . . *S. kanisaensis*

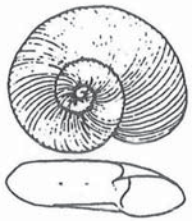
B Shell higher, bluntly angular at the periphery, without spiral lines . . . . . *S. angustus*

Segmentorbis kanisaensis (Preston, 1914)



Up to 1.2 x 4.6 mm. This depressed and carinate shell is easily recognized. Penis sheath lacking a flagellum. Found in marshes and seasonal pools in much of tropical Africa. Widely distributed in West Africa from Chad to Gambia. *S. formosa* from Sierra Leone is a synonym of this species.

Segmentorbis angustus (Jickeli, 1874)



Up to 2 x 2.5 mm. Shell proportionally higher than *S. kanisaensis*, with an even smaller umbilicus. The surface is shiny and even glossy. Penis sheath with a flagellum. Widespread in eastern tropical Africa, but not yet found further west than Lake Chad.

Genus *Biomphalaria* Preston, 1910

Large discoid snails present in Central and South America, and Arabia as well as Africa. The shells of *Helisoma* and *Indoplanorbis* may appear similar but *Biomphalaria* is clearly distinguishable by its prostatic lobes arranged in a row and the absence of a preputial gland. A genus of great medical importance as perhaps all species can act as intermediate hosts for *Schistosoma mansoni*.

Distributed practically throughout tropical Africa and penetrating the semi-arid Sahelian region where suitable habitats occur. Widespread in West Africa, though apparently commonest in the southern part of this region.

KEY TO THE SPECIES

1 A Fully grown shell with a thickened, somewhat expanded peristome; found in or near Lake Chad . . . . . *B. tchadiensis*

B Fully grown shell with peristome thin and unexpanded 2

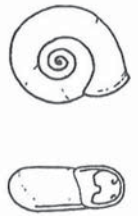
2 A Fully grown shell consists of 4.5-5.0 whorls, rather rapidly increasing. Diameter of umbilicus smaller than height of shell . . . . . *B. pfeifferi*

B Fully grown shell consists of 5.5-6.5 whorls, more slowly increasing. Diameter of umbilicus as large as or larger than height of shell 3

3 A Shell flatter, about 4 times as wide as high. Umbilicus much wider than height of shell . . . . . *B. sudanica*

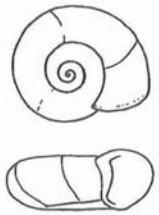
B Shell higher, about 3 times as wide as high. Umbilicus not much wider than shell height. . . . . *B. camerunensis*

Biomphalaria tchadiensis (Germain, 1904)



Up to 3.5 x 10 mm. The shape of the peristome differs from typical *B. pfeifferi*, of which this may be a lake-dwelling form. There may be a few lamellae ("teeth") within the aperture. Found only in or near Lake Chad.

Biomphalaria pfeifferi (Krauss, 1848)

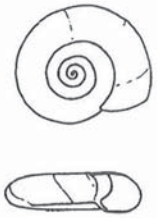


Up to 5.5. x 16.0 mm, but usually smaller. Variable in the size relationship between shell height and diameter of umbilicus, though the latter is always proportionally smaller than in the two following species. Lamellae are sometimes present within the aperture. Living in a wide range of flowing and still waters, but usually not in small seasonal pools. Widespread species in Africa and the commonest member of this genus in West Africa, where it is most frequently found

south of latitude 14 degrees (Sellin et al., 1980). Recently there was a great increase in *B. pfeifferi* and in transmission of *S. mansoni* as a result of construction of an anti-salinity barrage in the Senegal River delta (Diaw et al., 1990).

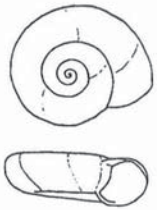
Biomphalaria sudanica (Martens, 1870)

Up to 4 x 16 mm. An East African species reported from Lake Chad but not found further west.



Biomphalaria camerunensis (Boettger, 1941)

Up to 7 x 20 mm, but usually smaller. The whorls are rather flat on the upper surface and bluntly angular beneath. Found from lower Zaire to Ghana, mainly near the coast. Much less common than *B. pfeifferi*.

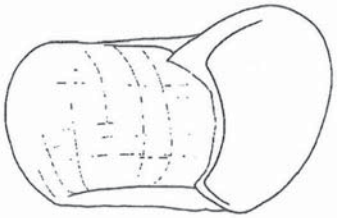


Genus *Helisoma* Swainson, 1840

Often growing larger than *Biomphalaria* and differing in the relatively high whorls, strongly convex or angular, and the flat umbilical surface. An American group introduced into many parts of the world and found in widely separated localities in Africa.

Helisoma duryi (Wetherby, 1879)

Up to 14 x 25 mm. The flat umbilical area should be distinctive, and a conclusive identification can be reached by observing the bunched prostatic lobes and the accessory preputial glad. Not yet reported from West Africa, but likely to occur, especially in or near cities.



Genus *Afrogyrus* Brown & Mandahl-Barth, 1973

Small flat shell, rarely exceeding 4 mm in diameter in Africa. Penis with a sub-terminal opening and a small cap-like terminal stylet (less than 10 μ m long). Found in North Africa and much of the tropical region, also Madagascar and other islands. One species known from West Africa.

Afrogyrus coretus (de Blainville, 1826)

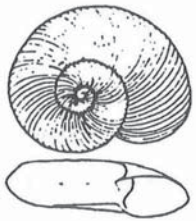
Up to 0.7 x 4.0 mm. Between 4 and 5 whorls are completed, which is about half a whorl more than a young *Ceratophallus* of the same diameter. Identification should be confirmed by examination of the penis. Widespread in tropical Africa and common in some areas of West Africa; most numerous in small waterbodies such as pools and springs.

Genus *Gyraulus* Charpentier, 1837

The whorls are fewer and increase more rapidly than in *Afrogyrus* or *Ceratophallus natalensis*. Penis with a sub-terminal opening and a dagger-like stylet. Worldwide in distribution except for the Neotropical region. Three species are known from Africa, one living in Egypt, one restricted to southern Africa and one found throughout most of tropical Africa.

Gyraulus costulatus (Krauss, 1848)

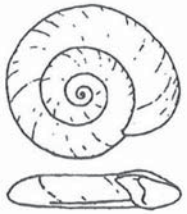
Up to 1.5 x 6.6 mm (depressed form). The typical form is depressed and sharply carinate; it is easily recognized. Some shells are higher and only bluntly angular at the periphery; these can be identified from their regular ribs and rapidly increasing whorls compared with *Afrogyrus* and *Ceratophallus*. Living in rivers, streams and lakes, but not in waters that regularly dry out. Widespread in tropical Africa and found in most countries in West Africa, though apparently not common.



Genus *Ceratophallus* Brown & Mandahl-Barth, 1973

The whorls increase more rapidly than in *Afrogyrus* but more slowly than in *Gyraulus*. Penis with a sclerotised tip and a terminal opening. Found mainly in eastern Africa, where a number of species are endemic to lakes. Only one species occurs as far westward as Lake Chad.

Ceratophallus natalensis (Krauss, 1848)



Up to 1.8 x 6.7 mm. Up to 5 convex whorls are completed, which may be somewhat flattened beneath. Even young snails can be distinguished from *Afrogyrus* by the different appearance of the penis. Living in marshes and slowly flowing streams as well as seasonal pools. Common in eastern Africa, but not found west of Lake Chad.

Subfamily BULININAE

Small to medium-sized, sinistral snails, with the shell globose, ovate or higher (*Bulinus*) or discoid. (*Indoplanorbis*). The major anatomical difference from the Planorbinae is the structure of the penis, which is attached at both the upper and the lower ends of the penis sheath (the "ultrapenis"). The prostatic lobes are concentrated into a compact organ. Two genera are known: *Bulinus* of Africa and southwest Asia, and *Indoplanorbis* of southern Asia. *Indoplanorbis* has recently been found in West Africa, where it is thought to have been introduced by human agency.

KEY TO THE GENERA

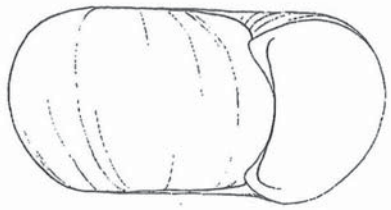
A Shell discoid . . . . . *Indoplanorbis*

B Shell globose, ovate or higher (turreted) . . . . . *Bulinus*

Genus *Indoplanorbis* Annandale & Prashad, 1920

There appears to be a single species, occurring naturally in southern Asia and differing from *Bulinus* in its discoid shell and in minor anatomical characters. Its presence in West Africa seems to be the result of introduction by man.

Indoplanorbis exustus (Deshayes, 1834)



Up to 13 x 25 mm. Whorls rapidly increasing, nearly as high as wide, strongly convex above. Umbilical area not so flat as in *Helisoma*. Close-set ribs may be present. The greater height of the shell in proportion to the breadth distinguishes this species from a *Biomphalaria*. The copulatory organ differs from those of *Biomphalaria* and *Helisoma*. *Indoplanorbis* is widespread in southern Asia and occurs in southeast Arabia and on the island of Socotra. Known from 2 localities in Africa, a rice-growing area in Nigeria near Lagos (Kristensen & Ogunnowo, 1987) and artificial lakes in Yamoussoukro, Ivory Coast (Mouchet et al., 1987a). In Asia, *Indoplanorbis* is a host for schistosome parasites of domestic ungulates, but attempts to infect it with African schistosomes have been unsuccessful.

Genus *Bulinus* Müller, 1781

Identifiable by the sinistral shell and the presence of a pseudobranch (lacking in the Physidae, the only common snails in Africa having a similar shell). About 30 species are known from Africa and islands in the Indian Ocean, the genus also occurs in Iberian peninsula, Mediterranean islands and southwest Asia. *Bulinus* is of great medical importance since it provides all of the known snail host species for *Schistosoma haematobium*. Unfortunately few of the species are well enough defined and it may be doubtful whether morphological features by themselves will ever be sufficient to provide a classification adequate for the parasitologist. Characters more directly linked to genetic differences, such as chromosome number and enzyme variation are of increasing importance in the taxonomy of this group. Yet it is still convenient to divide the genus according to shell forms into 4 species groups, of which 3 are represented in West Africa.

KEY TO THE SPECIES

1 A Shell slender and turreted, total height 1.5 or more times of the height of the aperture . . . . . (*forskalii*-group) 2

B Shell globose or ovate, total height less than 1.5 times the height of the aperture 4

2 A Whorls evenly curved, lacking shouldering and carination. Surface mostly smooth; if transverse ribs are present they are confined to the earliest few whorls . . . . . *B. senegalensis*

B Whorls mostly shouldered and ribbed 3

3 A Shell with high spire (total shell height usually more than twice height of aperture). Widely distributed . . . . . *B. forskalii*

B Shell less turreted (total height rarely reaching 1.8 times the aperture height) Known only from lakes in West Cameroon . . . . . *B. camerunensis*

4 A Microsculpture (best seen on apex) of nodules, short ridges and grooves, or wavy corrugations. Columella "truncate", with a ridge (though weak in some species or hidden within the aperture). A ridge is usually present on the kidney. Euphallic (copulatory organ is normally present . . . . . (*africanus*-group) 5

B Apical microsculpture is of regular transverse ribs, which may bear lamellae of periostracum. The columella lacks a ridge (though it may be twisted). No kidney ridge. Commonly aphallic (lacking copulatory organ). . . . . *B. truncatus* (*truncatus/tropicus* group)

5 A Shell with large umbilicus, columellar margin broadly reflected. Columellar ridge is sometimes lacking. Found in the northern savanna zone. . . . . *B. umbilicatus*

B Shell imperforate or not more than moderately umbilicate. Columellar margin narrower; columellar ridge visible though varying in strength 6

6 A Large shell growing 14 to 22 mm high usually with a strong columellar ridge. Widely distributed . . . . . *B. globosus*

B Smaller, less than 12 mm high with a weak columellar ridge. Found in the northern savanna region . . . . . *B. jousseaumei*

FORSKALII-GROUP

Six African species are recognized, of which 3 occur in West Africa.

Bulinus senegalensis Müller, 1781

Up to 12 x 5 mm. The evenly curved, mostly smooth, whorls should distinguish the shell from that of *B. forskalii*, which is shouldered and usually more slender. Abundant in seasonal rainpools; also found, sometimes with *B. forskalii*, in more permanent habitats such as rice fields (Goll, 1981). Known from the northern region extending from Senegambia through Niger (Mouchet et al., 1987) to northeast Nigeria (Betterton et al., 1983). Intermediate host for *S. haematobium* in some areas.

Bulinus forskalii (Ehrenberg, 1831)

Up to 17 x 5.4 mm (smaller in many localities). The presence of a shoulder angle is the most reliable difference from *B. senegalensis*. Further, *B. forskalii* usually is more slender and more strongly ribbed. Habitats are varied, including lakes, irrigation channels and seasonal pools; sometimes together with *B. senegalensis*. *B. forskalii* occurs in most of tropical Africa; widespread in West Africa and found also in the Cape Verde Islands and São Tomé island, where it transmits *S. intercalatum* (Brown et al., 1989; Brown, 1990). *B. forskalii* is not otherwise known to transmit a schistosome parasite of man under natural conditions.

Bulinus camerunensis Mandahl-Barth, 1957

Up to 9 x 4.5 mm. Similar to a small form of *B. forskalii*, but the aperture is longer (more than half the total shell length) and the entire shell is somewhat broader. Known only from crater lakes in western Cameroon; proved to transmit *S. haematobium* in Lake Barombi Kotto.

TRUNCATUS/TROPICUS GROUP

The shell microsculpture differs clearly from that in the *africanus*-group. It is neither nodular nor corrugated, but regular transverse ribs usually are present and they may bear raised lamellae of periostracum. The ribs may however become weak on the last whorl. Twisting of the columella sometimes produces a shape like that seen in the *africanus*-group, but close inspection will show the lack of an actual columellar ridge. The kidney lacks a renal ridge. Aphallic animals (lacking the copulatory organ) are found in some species. Care is needed to distinguish truly aphallic individuals from those in which the copulatory organ has not developed beyond a small size, due to parasitic infection. The number of species is uncertain. Further comprehensive studies are needed of variation in chromosome number and biochemical attributes, in conjunction with careful analysis of traditional morphological features. Apparently only a single species is present in West Africa, but perhaps genetically different local forms exist, as recently found in Cameroon

(Mimpfoundi & Greer, 1990). The West African snail populations are so far as known all tetraploid, with the chromosome number 2n = 72. In eastern and southern Africa the common species of this group are diploid (2n = 36).

Bulinus truncatus (Audouin, 1827)

Up to 14.4. x 9.7 mm; usually attaining only two-thirds this size. Spire prominent though widely variable in height. Whorls somewhat shouldered. Shell colour pale (even almost white) in comparison with *B. globosus*. Aphallic specimens are common (over 90% in some West African localities). Snails of this kind from West Africa have often been classified as either *B. guernei* (Dautzenberg) or *B. rohlfsi* (Clessin), but these appear to be the same species as *B. truncatus* according to shell morphology (Brown et al., 1986) and enzymes (Jelnes, 1986). The various habitats include small streams and seasonal pools, irrigation systems, dams and lakes. In Lake Volta in Ghana the plant *Ceratophyllum* provides favourable conditions (Scott et al., 1982). *B. truncatus* occurs in Arabia, North Africa and has been further identified (according to its tetraploid chromosome number of 2n = 72) from as far south as Zaire and Malawi. Widespread in West Africa and particularly common in the northern " sahélo-soudanais" region (Sellin et al., 1980). Important host for *S. haematobium* in places where a suitable parasite strain occurs.

B. natalensis (Küster) is recently identified from the highlands of western Cameroon (Mimpfoundi & Greer, 1990), being distinguished from *B. truncatus* by its depressed spire, chromosome number (2n = 36) and electrophoretic patterns for certain enzymes. *B. natalensis* was previously thought to be restricted to eastern and southern Africa. Malacologists should be alert to the possibility of its presence even further west than Cameroon.

AFRICANUS GROUP

Distinctive microsculpture of nodules, short ridges and grooves or wavy corrugations. Columella "truncate" with a fold or ridge. A ridge is usually present on the kidney. Species in this group are usually susceptible to *S. haematobium*.

Bulinus umbilicatus Mandahl-Barth, 1973

Up to 16 x 11 mm. The umbilicus is large and deep, though partly hidden by the broad columellar margin. Whorls strongly convex. Columellar ridge, if present, inconspicuous and lying within the aperture. A renal ridge is present in some specimens but not others. The typical form, found in the northern savanna belt, is highly distinctive, but further south in West Africa there appears to be some intergradation in shell form with *B. globosus*. Efforts to resolve this taxonomic complex have been made using enzyme electrophoresis (Jelnes, 1986) and shell morphometrics (Kristensen & Christensen, 1989). Habitats are usually seasonal marshes and rainpools, in the northern area extending from Sudan to Mauretania and Senegal. Not known to transmit schistosome parasites of man; intermediate host for *S. curassoni* Brumpt (Southgate et al., 1985; Diaw & Vassiliades, 1987).

Bulinus globosus (Morelet, 1866)

Up to 22 x 14 mm. The shell has a well developed columellar ridge and is either imperforate or not more than moderately umbilicate. Habitats are various and include streams within forest, earth dams (Pugh et al., 1980) and seasonal pools in savanna (Betterton et al., 1988 a,b). Present in much of Africa south of the Sahara. Found in West African countries from Nigeria to Senegal, mostly south of latitude 12 degrees (Sellin et al., 1980), yet present in the Niger basin above 16 degrees in Mali (Madsen et al., 1987). A major intermediate host for *S. haematobium*; the existence of local parasite strains adapted to *B. globosus* was originally reported for Ghana and was recently confirmed for northern Nigeria (Betterton et al., 1988b).

Bulinus jousseaumei (Dautzenberg, 1890)

Up to 11 x 8 mm. Separated from *B. globosus* mainly by its smaller size, weaker columellar ridge and poorly developed microsculpture. *B. jousseaumei* appeared to be a conspecific form of *B. globosus* according to studies of enzymes (Jelnes, 1986), but it

emerged as a distinct taxon in a morphometric analysis of the shell (Kristensen & Christensen, 1989).

A scattered distribution from Lake Chad to Senegal, mainly in the north. Apparently playing no more than a minor part in transmission of *S. haematobium*.

FAMILY PHYSIDAE

Sinistral shells with a sharply - pointed spire and smooth surface. Physid snails can be confused with species belonging to the genus *Bulinus*, but their distinguishing characters include colourless blood, lack of a pseudobranch, radular teeth in V-shaped rows and freely ending penis (in contrast to the "ultrapenis" of *Bulinus*). Moreover, African physids may be recognized by the enlarged margin of the mantle, which may project externally over the shell. Most species occur in the Americas, with some in Eurasia and Africa, where they are thought to have been introduced by man. Two genera are represented in West Africa,each with one species.

KEY TO GENERA AND SPECIES

1 A Shell with very shallow sutures.
Preputium without accessory gland . . . . . *Aplexa waterloti*

B Shell with deep sutures.
Preputium with an accessory gland . . . . . *Physa acuta*

Aplexa waterloti (Germain, 1911)

Up to 13 x 6.8 mm. Shell resembles some species of *Bulinus*, but has a more pointed spire and is smoother (so glossy that it slips through the fingers!). The copulatory organ lacks an accessory gland on the preputium, which is present on *P. acuta*. *A. waterloti* is found usually in or near towns, in waters that may be quite severely polluted. Originally described from Dahomey and found also in Ghana, Togo and Nigeria. Not known to be host for any schistosome.

Physa acuta Draparnaud, 1805

Up to 15 x 9 mm. In comparison with *A. waterloti* the shell is broad, with deeper sutures and less shiny. An accessory gland is present on the preputium. *P. acuta* is more similar to a *Bulinus* like *B. truncatus*, from which it differs in its more acutely pointed apex and smoother surface on the shell. No pseudobranch is present. *P. acuta* is reported from many African countries, but in West Africa only from one locality at Lagos in Nigeria (Kristensen & Ogunnowo, 1992). The species is probably spreading through human activities and thrives in mildly polluted waters in urban areas.

CHECK LIST OF SPECIES

Square brackets enclose the names of 2 species not yet found west of Cameroon (*Bulinus camerunensis* and *B. natalensis*) and one species that may be expected to be introduced in West Africa (*Helisoma duryi*).

PROSOBRANCHIA

FAMILY NERITIDAE

Neritina glabrata Sowerby
N. adansoniana (Recluz)
N. afra Sowerby
N. rubricata Morelet
N. cristata Morelet
N. oweniana (Wood)
N. tiassalensis Binder
Neritilia manoeli (Dohrn)

FAMILY VIVIPARIDAE

Bellamya unicolor (Olivier)

FAMILY BITHYNIIDAE

Gabbiella tchadiensis Mandahl-Barth
G. africana (Frauenfeld)
G. senaariensis (Küster)
Soapitia dageti Binder
Sierraia leonensis Connolly
S. expansilabrum Brown
S. outambensis Brown
S. whitei Brown

FAMILY AMPULLARIIDAE

Lanistes libycus (Morelet)
L. varicus (Müller)
L. ovum (Peters)

Pila wernei (Philippi)
P. ovata (Olivier)
P. africana (Martens)
Saulea vitrea (Born)

Afropomus balanoidea (Gould)

FAMILY HYDROBIIDAE

Potamopyrgus ciliatus (Gould)

Hydrobia lineata Binder
H. guyenoti Binder
H. accrensis Connolly

FAMILY ASSIMINEIDAE

Assiminea hessei O. Boettger

FAMILY THIARIDAE

Potadoma bicarinata Mandahl-Barth
P. liberiensis (Schepman)
P. freethi (Gray)
P. togoensis Thiele
P. vogeli Binder
P. buttikoferi (Schepman)
P. moerchi (Reeve)

Melanoides manguensis (Thiele)
M. tuberculata (Müller)
M. voltae (Thiele)

Pachymelania fusca (Gmelin)
P. aurita (Müller)
P. byronensis (Wood)

Cleopatra bulimoides (Olivier)

Pseudocleopatra togoensis Thiele
P. voltana Mandahl-Barth

FAMILY POTAMIDIDAE

Tympanotonus fuscatus (Linnaeus)

PULMONATA

FAMILY ELLOBIIDAE

Melampus liberianus H. & A. Adams

FAMILY LYMNAEIDAE

Lymnaea natalensis Krauss

FAMILY ANCYLIDAE

Ferrissia chudeaui Germain
F. leonensis Connolly
F. eburnensis Binder

FAMILY PLANORBIDAE

Amerianna carinata (H. Adams)
Segmentorbis kanisaensis (Preston)
S. angustus (Jickeli)
Biomphalaria tchadiensis (Germain)
B. pfeifferi (Krauss)
B. sudanica (Martens)
B. camerunensis (Boettger)
[*Helisoma duryi* (Wetherby)]
Afrogyrus coretus (de Blainville)
Gyraulus costulatus (Krauss)
Ceratophallus natalensis (Krauss)

Bulinus senegalensis Müller
B. forskalii (Ehrenberg)
[*B. camerunensis* Mandahl-Barth]
B. truncatus (Audouin)
[*B. natalensis* (Küster)]
B. umbilicatus Mandahl-Barth
B. globosus (Morelet)
B. jousseaumei (Dautzenberg)

FAMILY PHYSIDAE

Physa waterloti (Germain)
P. acuta Draparnaud

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