THE ENDEMIC CONUS OF ANGOLA

E. Rolan
Canovas del Castillo 22
E -36202 Vigo,
Spain
E-mail: 0208378g01@abonados.cplus.es

Dieter Rockel
Neckaranlage,6
D -69412 Eberbach/Neckar,
Germany
E-mail: D.Roeckel@t-online.de

KEYWORDS: Conus, Angola, endemism, new species

ABSTRACT
22 species of the genus Conus endemic from Angola and considered valid, are presented and described: taxa previously known and 6 more which are described as new. The populations corresponding with the type material of the 16 known taxa are ascertained and a number of type localities have been designated. The radular tooth of each species is figured and compared with that of similar species. A list of the Angolan Conus species and a Table showing their range are presented.

INTRODUCTION

Between 1758 and 1840, a total of 660 species-group names were introduced by Linne, Born, Gmelin, Hwass, Roding, Lamarck, Sowerby I and numerous other authors in the gastropod genus Conus, about 30 % of them are considered to represent valid species (KOHN, 1992). Not a single one of these 660 taxa referred to an endemic Conus of Angola. In this time, none of the famous shell collections, private as well as governmental, owned any endemic Conus shells from Angola. Obviously the Angola coast was, for long time, out-of-the-way and not visited by people interested in shells.

In the forties of the 19th century a few specimens were brought to Paris and London and were described by REEVE (1843, 184) and by KIENER (1845-49). It seems, they were brought by sailors, who had acquired these shells from other persons, because none of the new taxa gave any information or correct information on the locality. As these shells are small and without conspicuous character, they often were considered to be juveniles of known species.

After Reeve and Kiener only Melvill in TRYON (1883) described a further Angolan species within that century. Nothing changed in the first half of the last century: One single description by SOWERBY III (1905) -with an undoubtedly wrong type locality -was published. PAES DA FRANCA(1957), a Portuguese scientist, described two taxa, but they proved to be synonyms of species, already described more than 100years ago by Kiener. Still MARSH & RlPPINGALE (1964) ("Cone Shells of the World") neither mentioned nor depicted any Angolan Conus.

Finally- in 1975- Herculano Trovao terminated this long period of unawareness of the Angolan Conus fauna. He started to publish a serie of descriptions, based on a large quantity of material with

exact localities (TROVAO, 1975a, 1975b, 1978). His descriptions consisted not only of shell morphology, but also took into account the radulae.

Nevertheless -with regard to the similar shell shapes of these endemics (small, rounded shoulder, without strong shell sculpture) and the lack of material available -collectors and scientists didn't generally recognize the validity of these descriptions. So WALLS (1979) in his Monography of the living Conidae considered as valid only three species. In the same period, apart from Trovao's new names, a number of irritating "collectors names" were used in price
lists, names not based on a correct description and therefore not available, caused partially by KAICHER (1977-1978), who depicted in her "Card catalogue of worldwide shells" Angolan specimens with a number of misidentified, unpublished names like "negroides", "lobitensis" and others, attributed wrongly to da Franca and Trovao as authors.

At last, ROCKEL & FERNANDES (1981, 1982a,1982b, 1982c) decided to review all the known Angolan cones and compiled a list with all, so far validly described, endemic species. In addition, they depicted a number of shells, not matching the known taxa; they abstained from describing. them as new, because, based on the shell morphology, they couldn't unequivocally decide if they were varieties or intergradations of known species. Anyway, this work brought a first review of the hitherto known valid species.

MATERIAL AND METHODS

During the last 25 years, Francisco Fernandes, a Portuguese malacologist living in Luanda, Angola, collected systematically a large number of cone shells from many places along the coast of Angola. Most of this material was collected snorkeling in 1-4 metres depth, near the coast. Some samples were collected by the first author in intertidal and subtidal area near Luanda. On the basis of all this material and Fernandes information, a revision of these endemic cones was initiated. The work was interrupted by the sudden death of Franciso. Later on, Gabriella Raybaudi Massilia, another member of the initial team, withdrew and was replaced by the second author. The actual two authors reviewed basically the work, but have not finished it yet. Additional parts will follow, step by step, when further parts of Fernandes' material have been examined.

This first part of our work deals with the endemic Conus of Angola in chronological order of their original description; it excludes species with wider distribution connected to their planktotrophic development like Conus ermineus, C. pulcher or C. genuanus. The endemic species have the following characteristics:

-a high variability in colour-pattern within the populations and geographically separated populations;
-living in small bays with interim bays in which they are not present; most of them with an interrupted range, appearing in two bays and not in the bay between;
-all or almost all populations are very close in their characters: size, shape, sculpture of shell, vermivorous radula; so far as we know egg capsules and larval shells are also very similar. So a phylogenetic relationship can be assumed.

The radulae were examined according the methods exposed in ROLAN (1992). The terminology on the characters of the radula tooth is based on that in RoLAN (1992, 1993) as well as ROLAN & RAYBAUDI MASSILIA (1994a). Most of the endemic cones of Angola do probably share a quite recent common ancestry. Thus, their radular teeth show a high evolutionary proximity. This made it difficult to find significant differences among the numerous populations existing, but allowed us to

find at least important differences between several groups. Our experience led to the following conclusions:
-as suggested in ROLAN & RAYBAUDI MASSILIA (1994a, 1994b), type and shape of radular tooth in Conus indicate feeding affinity, while most of the tooth characters may represent a specific difference; -important differences in the radular tooth in two morphologically distinct populations imply that radula characters, added to other criteria, make a decision of specific separation highly probable; -on the contrary, when in doubt about the relationship between two allopatric but resembling morphs, the identical radula tooth reinforces the assumption of conspecificy.
All the radular studies, drawings and preparations are being kept by the first author.

Egg capsules. We tried to incorporate the egg capsules of the Angolan species in our examination. But at present only are known those of C. musivus (TROVAO,1975b), C. aemulus (Figs. 110-113), C. bocagei (TROVAO, 1978) and C. xicoi (Figs. 117-118), being all them very similar: cream-white, almost rectangular, border rounded, with a short base. Escape window wide and translucent. Spawn consisting of several capsules, fixed one on the other forming a small mass(Fig. 113). (cf "type II" of KOHN & PERRON, 1994).

Each shell description contains a list of the most important quantitative data. The terms used are adopted from the Glossary of the "Manual of the Living Conidae" (ROCKEL, KORN & KOHN, 1995) and defined in the following list, usually based on at least 10, often more than 20 specimens. The terms and abbreviations of the radula-characters are based on Rolan (1992) and ROLAN & RAYBAUDI MASSILIA (1994a).

D Number of denticles in serration
DR/PA Total length of radula tooth/apical portion
F Blade of radula tooth
L Shell length
LC/DR Length of shell/length of radula tooth
ND Number of teeth in the radula
%PA Extension of apical portion covered by the blade of radula tooth (F) (100*F/PA) Position of maximum diameter of last whorl = height of maximum diameter/aperture height.
RD Relative diameter of last whorl = maximum diameter/aperture height
RSH Relative height of spire = (shell length - aperture height)/shell length. Relative weight of the shell = absolute weight/L
S Serration juvenile shell, shells
Sp. specimen collected alive

Abbreviations:

AMNH American Museum of Natural History, New York.
BMNH The Natural History Museum, Londres.
CPAS Centro portugues de Actividades Subaquaticas, Lisbon.
MNCN Museo Nacional de Ciencias Naturales, Madrid.
MNHN Museum Natjonal d'Histoire Naturelle, Paris.
MZFC Museo Zoologia Facultad Ciencias Universidad, Lisbon.
NMWZ National Museum ofWales, Cardiff
SMF Senckenberg Museum, Frankfurt.
SMNS Staatliches Museum fur Naturkunde,Stuttgart.
USNM The National History Museum, Washington.

CDR collection Dieter Rockel, Eberbach, Neckar.
CER collection Emilio Rolan, Vigo.
CFF collection Francisco Fernandes, Cacelas, Portugal.
CGRM collection Gabriela Raybaudi Massilia, Roma.
CMF collection Michael Filmer, Chobham, Surrey.
CPT collection Peter Ryall, Takoradi, Ghana.

The material without other indication is in CER

Map of Angola
Species maps by Region

.
SPECIES ACCOUNT

Conus bulbus Reeve, 1843 (Figs. 2-6)

Plate1

Conus bulbus Reeve, 1843. Conch. Icon., 1, Conus, 1843: pi. 30, sp. 169. (1844, Proc. Zool. Soc. London, 11: 171).

Other material examined: 2 sp, Benguela Bay; 2 sp, Benguela (SMNS); 33 sp, Caota Bay; 4 sp, Caota (CFF); 8 sp, Caota Bay (SMNS); 3 sp, Baia Azul; 4 sp, Baia Azul (CFF); 36 sp, Baia Binga; 7 sp, Santa Maria; 2 s, Santa Maria (SMNS); 3 s, without locality (SMNS); 10 sp, without locality, Angola.

Type locality: "Cabinda, West coast of Africa (found at the depth of five fathoms in soft mud, washed down by the waters of the Congo)". This locality is probably erroneous, there are no recent reports from this and neighbouring localities. We consider shells from Baia Binga as most similar to the type and thus Baia Binga is herewith designated the type locality.

Shell description: Small, moderately light. Last whorl broadly and ventricosely conical, sometimes pyriform. Outline convex at ad apical third, almost straight below. Left side slightly concave near base. Aperture wider at base than near shoulder. Shoulder rounded. Spire of low to moderate height, outline straight to sigmoid. Teleoconch sutural ramps flat to convex, with fine spiral striae. Last whorl almost smooth, with about 10 spiral ribs at base.

Ground colour white to bluish-white. Last whorl and spire with dark brown axial flames and streaks, occasionally converging at base and shoulder. Density as well as width of the axial streaks variable. Aperture light, sometimes translucent and with a collabral brown band.

Periostracum orange and translucent.

Shell morphometry:
L 16-25 mm
RD 0.63-0.71
RSH 0.07-0.19
PMD 0.66-0.71
RW about 0.05 g/mm

Description of animal: Animal dark cream with black spots (ROCKEL & FERNANDES, 1982a). Penis small and narrow (Figs. 97-98). Operculum small (Fig. 99).

Radula: In radula sac 58-63 teeth. Tooth (Fig. 120) of typical vermivorous type, middle sized. Apical portion shorter than halfDR. Denticles coarser in upper part of saw, usually starting within a single row, then arranged into 2, following smaller and in a single row.Basal angle of saw about 45°. Blade barely prominent, covering near 80% of apical portion.

Type material: Lectotype (Figs. 2-3) designated and depicted by COOMANS, MOOLENBEEK & WILS (1982, fig. 292), in BMNH (24 x 14 mm).

Radula morphometry:
(n = 10)

D 15-29
ABS about 45°
LC/DR 40-59
DR/PA 1.91-2.20

Distribution: populations in the southern area approach other species in shell pattern, suggesting adaptive convergence. C. bulbus is sympatrically living with the non endemic species and with C. neoguttatus, C. variegatus, C. zebroides, C. carnalis, C. fuscolineatus, C. musivus, C. naranjus, and C. albuquerquei. The reference to Fernando Poo (WALLS, 1979) is erroneous.

Habitat: Low tide to 2 m down on rocks in small crevices. Living in colonies with more than 12 specimens (ROCKEL & FERNANDES, 1982a).

Discussion: Conus bulbus is the oldest described taxon for Angolan Conus and can easily be distinguished from hitherto described species. There are some populations with similar patterns which possibly are conspecific with C. bulbus; further studies on their taxonomical status are necessary.

Conus bulbus is similar to C. africanus, C. variegatus, C. zebroides and C. musivus. For comparison, see the Discussions of those species.

Conus aemulus Reeve, 1844

(Figs. 7 -11)
Plate1
Conus aemulus Reeve, 1844. Conch. Icon., 1, Conus, pl. 46, sp. 256.

Type material: Lectotype, designated by BANDEL & WILS, 1977, depicted by COOMANS, MOOLENBEEK & WILS (1979), in BMNH (34 x 19 mm).

Other material studied: 9 sp, Cacuaco; 1 sp, Cacuaco (SMNS); 2 j, Mussulo (CPP); 27 sp, 8 j, Mussulo Bay; 26 sp, Mussulo (SMNS); 4 sp, Samba, Luanda (CPP); 38 sp, 65 j, Corimba, Luanda; 8 sp, Parol das Lagostas, Luanda; 4 sp, Parol das Lagostas (SMNS); 12 sp, 3 s, without locality, Angola.

Type locality: Mussulo Bay, Angola; designated by COOMANS ET AL. (1982).

Shell description: Small to medium sized, moderately light. Last whorl broadly and ventricosely conical; outline convex at ad apical half and usually straight below. Shoulder subangulate. Spire of moderate height. Larval shell ofl.75 whorls, maximum diameter 0.6-0.7 mm; nucleus 0.35 mm. Postnuclear whorls not tuberculate. Teleoconch sutural ramps flat to slightly concave, with fine axial growth lines. Last whorl smooth but dull, with a few spiral grooves basally.

Ground colour bluish white, with brown bands of different width at shoulder, above centre and at base and with numerous spiral rows of brown dots, often alternating with white dashes or dots. More or less uniformly brown specimens co-occur with typically patterned shells. Aperture white to light violet, translucent at collabral edge.

Larval shells white with dark base (Figs.14-116)

Shell morphometry

L 20-58 mm
RD 0.63-0.73
RSH 0.13-0.22
PMD 0.75-0.80
RW(L 34-40) 0.135g/mu

Description of animal: Variable. Pinkish grey to pinkish with black dots (ROCKEL & FERNANDES, 1982a).

Radula: Radula sac with 45-60 teeth. Tooth {Fig. 121) of vermivorous type, relatively small. PA about half or little more than half tooth length. Only a single row of D in S, being small. F slightly prominent and far from waist, covering 70-80% of PA.

Radula morphometry:

D 18-25
ABS 40-45°
LC/DR 51-67

DR/PA 1.83-2.00

Egg capsules: White, almost rectangular, with short base (Figs. 110-112). Escape window wide and translucent. Spawn with several capsules fixed one on the other and forming a group (Fig. 113).

Distribution: From Cacuaco up to Mussulo Bay, all in Luanda area, north of Angola (Fig. 145). Sympatrically living with C. ermineus, C. genuanus, C. ambiguus, C. pulcher; and with C. xicoi as another endemic species.

Habitat: At low tide buried in sand in seaweed areas. Found only in calm and sometimes near rocks or on rocks (ROCKEL & FERNANDES, 1982a).

Discussion: Conus aemulus is an endemic species of Angola. Its closer relationship with the Conus ventricosus-group rather than to the other endemics is evident, in particular with Conus guinaicus Hwass from Senegal. COOMANS ET AL. (1979} explained the differences of the shell characters: "Conus aemulus has a smooth spire, the outlines of the last whorl are almost straight, the design shows a number of white spiral lines regularly covered with dark brown dots". Juvenile specimens of C. aemulus may resemble C. variegatus and are sometimes similar to C. xicoi in its colour pattern. For comparison with C. variegatus and C. xicoi, see the Discussion of the latter species.

Uniformly dark brown shells of c. aemulus with a light central band have been sometimes assigned to c. franciscanus Hwass, 1792. This taxon has been commented on by Rockel (1989), who considered it dubious though more similar in his opinion to C. guinaicus. Other authors like Kohn (1992) considered C. franciscanus a junior synonym of c. ventricosus Gmelin,1791.
Small shells (L 12-14 mm) showing similar characters as C. aemulus are found in Parol das Lagostas, Luanda area and in Sombreiro Bay, Benguela. Further studies may reveal their taxonomical status.

Conus africanus Kiener,1845

(Figs.12-17)
Plate1
Conus africanus Kiener, 1845. Coq. Vivant., 2: 260, pl. 104, fig. 2. 1849: 260.
Conus neoafricanus da Motta, 1991: unjustified replacement for C. africanus Kiener (C. africanus Meuschen is a rejected taxon).

Type material: Representation of holotype (Figs. 12- 13) in KIENER (1845, pI. 104, fig. 2) (30 x 17 mm). Its present whereabouts unknown.

Other material studied: 2 sp, Sao Nicolau; 28 sp, Bentiaba (5. Nicolau); 7 sp, without locality, Angola.

Type locality: "L'ocean Atlantique, la cote de Guinee". We herewith designate Namibe, Province of Angola, between Chapeu Armada and Sao Nicolau, the type locality.

Shell description: Small, moderately light to moderately solid. Last whorl broadly and ventricosely conical to broadly ovate, outline convex at adapical third, slightly concave; near base. Aperture moderate. Shoulder rounded. Spire of low to moderate height, outline straight to slightly convex. Teleoconch sutural ramps flat to convex, with fine spiral striae. Last whorl almost smooth and dull, with about 10 weak spiral grooves near base.

Ground colour white. Last whorl and spire with dark brown blotches and streaks turning into bars and dashes. Aperture white, occasionally with a brown fleck deep inside.
Shell morphometry:

L 17-25 mm (holotype: 30 mm)
RD 0.65-0.72
RSH 0.0.11-0.18
PMD 0.70-0.75

Description of animal: No information about the population we consider C. africanus. The information on soft parts -pinkish with black spots (ROCKEL & FERNANDES, 1982a) -for the population of Ponta das Vacas may be not applicable, as it cannot be affiliated to C. Africanus.

Radula: High number (72-96) of teeth. Tooth (Fig.122) middle-sized with PA shorter than half DR. A narrow S with about 15-20 small D in a single row. F slightly prominent, covering about 82% of PA ABS about 45°

Radula morphometry:
(n = 5)

D 13-20
ABS 45°
LC/DR 46-58
DR/PA 2.1-2.4

Distribution: Several populations of Angolan Conus have been assigned to the taxon C. africanus. Shells from Baia Farta, Baia Azul and Chapeu Armado are similar in pattern, but lighter in colour,

while shells from S. Nicolau and S. Maria are dark brown but their pattern is less similar the holotype as depicted by Kiener. We provisionally consider the dark brown populations from Bentiaba (S. Nicolau) (Fig. 145) conspecific with this species and have doubts with respect of the populations from Baia Farta and Chapeu Armado. The radula studies are made with specimens from S. Nicolau. In this place C. Africanus is sympatrically living with C. fuscolineatus, C. zebroides, and C. cepasi.

Habitat: Buried in sand between rocks.

Discussion: Several populations of Angolan Conus have been assigned to the taxon C. africanus. Shells from Baia Farta, Baia Azul and Chapeu Armado are similar in pattern, but lighter in colour, while shells from S. Nicolau and S. Maria are dark brown but their pattern is less similar to the holotype as depicted by Kiener. We provisionally consider the dark brown populations from Bentiaba (S. Nicolau) conspecific with this species and have doubts with respect to the populations from Baia Farta and Chapeu Armado.

The radula studies are made with specimens from S.Nicolau.

C. africanus resembles C. bulbus in size, shape, and shell sculpture. C. bulbus can be distinguished by its pattern: its axial streaks and the absence of spiral lines and dashes; in C. africanus axial lines are usually limited to a central belt. In Santa Maria and Lucira Bay both species may be sympatric.

The radular tooth of C. africanus differs obviously from that of c. bulbus, chiefly being relatively smaller and having different proportions of the apical part, also in the number and arrangement of denticles in the serration. In C. africanus ,S is wide near serration, F is not appreciable. D are not in the upper part of S and arranged in one row, while in C. bulbus D are in two rows in the upper part, being larger here.

C. africanus is also similar to C. variegatus and C. nobrei. For comparison, see the Discussion of the latter species.

Conus neoguttatus da Motta, 1991

(Figs.18-21)
Plate1
Conus guttatus Kiener, 1845. Coq. Vivant., 2: pl. 105, fig. 4. 1949: 259.
Conus neoguttatus da Motta, 1991. La Conchiglia, 22 (258): 73, nomen novum for C. guttatus Kiener, 1845, non Cucullus guttatus, Roding, 1798.

Type material: Representation of the holotype in KIENER (1845: pl. 105, fig. 4) (35 x 21 mm).

Other material studied: 7 sp, Limagens (SMNS); 3 sp, Limagens; 3 sp, Meva {SMNS); 2 sp, Meva; 3 sp, Canoco; 13 sp, 3 j, Santa Maria; 6 sp, Santa Maria {SMNS); 4 sp, without locality, Angola.

Type locality: Not mentioned; we herewith designate Santa Maria, Angola, as the type locality

Shell description: Moderately small to medium-sized, moderately solid. Last whorl ventricosely conical; outline convex at adapical half and straight or slightly concave below. Shoulder rounded. Spire of moderate height, outline slightly sigmoid. Larval shell of about 1.5-2 whorls, maximum diameter 0.5 mm. Teleoconch sutural ramps convex, smooth or with fine striae. Last whorl smooth and dull, with some spaced spiral ribs at base.

Ground colour white. Last whorl with irregular brown flecks, bars or streaks, sometimes with incomplete dotted spiral lines and axial hair-lines. Aperture white.

Shell morphometry

L 23-38 mm
RD 0.65-0.76
RSH 0.11-0.18
PMD 0.72-0.78
RW 0.15-0.24 g/mm

Description of animal: Reddish with black dots (ROCKEL & FERNANDES, 1981).

Radula: In radula sac 80-90 teeth. Tooth (Fig. 137) very primitive, with a large base, covered oil external surface with dense tubercles. Tooth extremely small, possibly the smallest ever found in typical vermivorous species. Waist not evident, PA small, very simple. Saw bare of denticles, but, exceptionally, bigger specimens can have a small number of them. Apparently no blade.

Radula morphometry:
(n = 4)

D no one
ABS 20-25
LC/DR 90-155
DR/PA 2.7-3.0

Distribution: Only found in Santa Maria, Meva, Canoco and Limagens (Fig. 146), sympatrically living with C. bulbus, C. vanegatus, C. zebroides, C. carnalis, C. chytreus, C. nobrei, C. musivus, and C. Naranjus

Habitat: Buried in sand at 2-3 m, under rocks.

Discussion: RODING (1798) introduced a new generic name, Cucullus, in place of Conus. WINCKWORTH (1945) noted that Cucullus Roding, 1798 is a junior synonym of Conus Linne, 1758. KOHN (1992) confirmed this and indicated Conus by Cucullus. So the name Conus guttatus Kiener, 1845 was invalid and was correctly replaced by da Motta with Conus neoguttatus.

C. neoguttatus differs clearly in colour pattern from all other endemic Conus species of Angola. In shape and size it is similar C. trovaoi n. sp. For comparison, see the Discussion of that species.

Conus variegatus Kiener, 1845

(Figs. 22-26)
Plate2 Conus variegatus Kiener, 1845. Coq. Vivant., 2: pi. 106, figs. 1, la. 1949: 261. ,
Conus obtusus Kiener, 1845. Coq. Vivant., 2: pi. 109 fig.3. 1849: 317

Type material: Lectotype, designated by ROCKEL & FERNANDES (1981) represented by KIENER (1845: pl.106, fig. la) (19 x 11 mm). Its present whereabouts are unknown. C. obtusus: We herewith designate Kiener, fig.3 pl. 109, representation of the lectotype (25 x 15 mm) of C. obtusus.

Other material studied: 7 sp, Limagens (SMNS); 29 sp, Limagens; 10 sp, Limagens (CFF); 6 sp, Baia Binga (CFF) 6 sp, Canoco (SMNS); 6 sp, Canoco (CFF); 23 sp, Santa Maria; 7 sp, Santa Maria (SMNS); 2 sp, Bonfim (CFF); 10 sp, Bissonga (CFF); 20 sp, Baia do Cesar, Lucira; 26 sp, Capato; 214 sp, Lucira; 11 sp, Lucira (CFF) ; 6 sp, without locality, Angola.

Type locality: We herewith designate Santa Maria Bay, Angola, as the type locality

Shell description: Small to moderately small, moderately light. Last whorl broadly and ventricosely conical to broadly ovate, outline convex at adapical half almost straight to pyriform below. Aperture moderate. Shoulder rounded. Spire of low to moderate height, outline straight or sigmoid. Teleoconch sutural ramps straight to convex, with fine spiral striae, usually inconspicuous. Last whorl smooth and dull, with about 10 spiral grooves at base.

Ground colour white to bluish white, with variably spaced spiral rows of alternating white and brown dots or dashes from base to shoulder. Shoulder with irregular axial brown blotches, occasionally coalescing to a broad brown band. Aperture dark brown with a ground-colour band at centre and below shoulder.

Periostracum dark brown to orange, transparent

Shell morphometry:
L 18-26 mm
RD 0.60-0.72
RSH 0.08-0.17
RW 0.10 g/mm
PMD 0.70-0.76

Description of animal (Figs. 100-101): Dark siphon and rostrum, base of foot grey (observed in alcohol) .Operculum small (Fig. 102).

Radula (form obtusus): In radula sac 53-80 teeth. Tooth (Fig. 123) typical vermivorous, medium sized. PA sligthly variable. D in S very small, arranged in a single row adapically, in two rows below. F hardly visible, covering about 70-80%.

Radula morphometry:(n = 13)

D 21-30
ABS 40-50°
LC/DR 47-62

DR/PA 2.0-2.2

Distribution: Limagens to Lucira, Angola (Fig. 147). Sympatrically living with C. bulbus, C. neoguttatus, C. zebroides, C. carnalis, C. chytreus, C. nobrei, C. naranjus, and C. albuquerquei.

Habitat: Under rocks buried in sand at 2-3 mdepth (ROCKEL & FERNANDES, 1981 for C. variegatus); near rocks half buried in sand in very quiet zones, 0.5 -1m (ROCKEL & FERNANDES, 1981 for C. obtusus).

Discussion: C. variegatus and C. obtusus are synonyms. According to Article 24(a) ICZN we determine precedence of the name c. variegatus. This name characterizes the high degree of variability of this species. Specimens of c. variegatus differ usually within the same population in length, shape, and pattern.
C. variegatus is similar to C. bulbus, C. aemulus, C. africanus, and C. fuscolineatus. C. bulbus has a similar shape, but differs in its colour-pattern (axial flames and streaks) and in the structure of its radula teeth. C. aemulus may have a similar colour pattern, but it is larger in size and has a less rounded, subangulate shoulder. In addition, the sides of last whorl are not concave basally as C. variegatus (Kiener: "forme plus attenuee vers sa base"). C. africanus can be distinguished by its last whorl, colour pattern and its white aperture. The radular tooth of C. bulbus has bigger denticles, in the apical part of the serration (C. variegatus only very small). C. aemulus has always one row of D in S, and DR/pA is less than 2 (while in C.variegatus is >2). C. africanus has less than 20 D in S (more than 20 in C. variegatus), and also has always 2 rows of D in S (C. variegatus has one when the shells are small and only 2 in the biggest ones). For comparison with C. fuscolineatus, see the Discussion of the latter species.

Conus zebroides, Kiener, 1845

(Figs. 27 -33)
Plate 2
Conus zebroides Kiener, 1845. Coq. Vivant., 2: pl. 104, fig. 2. 1949: 260.
Conus angolensis Paes da Franca, 1957. Trab. Miss.Bioi. Marit., 13: 80, pl. 1, figs. 7, 8, pl. 2.

Type material: Representation of the holotype of C. zebroides, figure in KIENER (1845) (25 x 46 mm).

Holotype of c. angolensis in Museu Zoologico da Facultade de Ciencias, U niversity of Lisbon (18 x 28mm).

Other material studied: Typical form: 2 sp, Caota Bay; 3 sp, Caota (CFF); 3 sp, Baia Azul (SMNS); 2 sp, Campeona; 5 sp, Limagens (SMNS); 4 sp, Baia Binga; 4 sp, Meva; 2 sp, Canoco (SMNS); 5 sp, 3 j, Canoco; 2 sp, Santa Maria (SMNS); 10 sp, 2 j, Santa Maria; 1 sp,3 j, Santa Maria (CFF) 6 sp, 1 j, Bissonga; 28 sp, Lucira Bay; 3 sp, Doca,Lucira; 4 sp, Capato; 6 sp, sao Nicolau; 1 sp, Chapeu Armadq; 5 sp, without locality, Angola. Dark form: 15 sp, 7 j, S. Nicolau; 3 sp, S. Nicolau (CPR); 1 sp, 4 j, Chapeu Armado; 2 sp, 2 s, without locality, Angola.

Type locality: C. zebroides: Unknown; C. Angolensis: Lucira Bay. As C. angolensis is a junior synoym of C. zebroides, Lucira Bay, Angola, is considered the type locality of C. zebroides.

Shell description: Moderately small to medium sized, moderately solid to solid. Last whorl yentricosely conical; outline convex at ad apical half and more or less straight below. Shoulder rounded, Spire of low to moderate height, outline convex, straight, or sigmoid. Larval shell of about 1.5 whorls. Teleoconch sutural ramps convex, smooth or with very fine spiral striae.
Last whorl smooth and dull, with some spaced spiral ribs at base.

Ground colour white. Spire and last whorl with brown, evenly spaced axial streaks. The axial lines are generally hair-like and irregularly branching (Santa Lucira, Santa Maria, Bissonga), more spaces (Caota) and broader(often coalescing to a more spaced form) streaks sometimes only in the middle of last whorl in Sao Nicolau; here shells with previously mentioned pattern co-occuring with all intergradations. Aperture with a bluish-brown shade or white in larger specimens. Shells from S. Nicolau with a purple blotch in adapical aperture.

Shell Morphometry

L 28-51 mm
RD 0.64-0.70
RSH 0.07-0.17
PMD 0.74-0.80
RW 0.15-0.45g/mm

Description of animal (Fig. 103): Foot creamy-grey, with black dots and spots more dense on the rostrum, which is almost blackish (ROCKEL & FERNANDES, 1982a). Penis short, white and curved. Rostrum small.Venom bulb small (5x3x1 mm) in a specimen of "L 41.7 mm from s. Nicolau. Operculum small.

Radula with surprisingly variable number of teeth (55-118). Tooth (Figs. 119,124) of vermivorous type, figured in ROLAN (1993). Tooth elongated, relatively small, with very small denticles in saw, with 1-2 rows ad apically and always 2 in the rest, disappearing in
the lower part. No F appreciable. and attenuated, cephalic tentacles short and thin.

Radula morphometry: {n = 16)

D 10-27
ABS 40-60
LC/DR 51-97
DR/PA 2.0-3.6

Distribution: From Lobito to Sao Nicolau and Chapeu Armado (Fig. 148) .Sympatrically living with C. bulbus, C. neoguttatus, C. variegatus, C. carnalis, C. chytreus, c. nobrei, C. musivus, c. naranjus, C. albuquerquei, and C. bocagei.

Habitat: Buried in fine sand under rocks, in 1-2 m.(ROCKEL & FERNANDES, 1982a).

Discussion: Shells from S. Nicolau provisionally considered con specific in spite of its distinct pattern (see above): dark brown, with more spaced and coalescing streaks, sometimes completely brown, leaving a central band with white axial streaks. All intergradations are seen. The radula teeth (Fig. 119) only differ slightly in the relation DR/PA and LC/DR, notably by the influence of spire erosion.

C. zebroides resembles sometimes C. bulbus in pattern, particularly specimens from Baia Binga, which can hardly be differentiated except in its size: C. bulbus is a small shell (up to L 25 mm), C. zebroides is middle-sized (L 28-48 mm). But the radula teeth are different enough to justify species separation: C. bulbus has a bigger tooth, less in number in radula, the denticles in the apical part of the row are bigger and has an evident blade (not so in C. zebroides).

Similar in shell shape and occasionally in pattern may be C. trovaoi. For comparison, see the Discussion of this species.

Conus carnalis Sowerby, 1879 ("1878")

(Figs. 34-36)
Plate2
Conus carnalis Sowerby, 1879("1878"). Proc. Zoot. Soc.London, 1878: 796, pi. 48 6.2;. 2.

Conus amethystinus Trovao, 1975, Boletitn..C.PA.S., 4(2): 9-10, pl. 1, fig. 1, pl. 2, figs. 1-2.

Type material: Ho1otype of c. carnalis in NMWZ (48.1 x 25.1 mm). Ho1otype of c. amethystinus in the Laboratory of Ma1aco1ogy ofCPAS (34.2 x 19.1 mm).

Other material studied: 4 sp, Limagens; 1 sp, Limagens (CFF); I sp, Canoco (SMNS); 1 sp, Canoco Bay; 1 sp, St. Maria(SMNS); 5 sp, 5 j, Santa Maria (CFF) 1 sp, Santa Maria Bay; 1 sp, LuciraBay; 2 sp, without locality (SMNS); 5 s, without locality, Angola.

Type locality: Santa Maria Bay, Angola; designated by COOMANS, MOOLENBEEK & WILS (1983).

Shell description: Moderately small to medium sized, moderately solid. Last whorl ventricosely conical; outline convex at adapical third, and straight below. Left side slightly concave basally. Aperture narrow to moderate. Shoulder rounded. Spire of moderate height, outline convex. Teleoconch sutural ramps concave and smooth, sometimes with 2 weak spiral grooves. Periostracum dark brown, thick and opaque

Ground colour white or light purple, last whorl and spire violet, orange or yellow, leaving a light central band. Aperture light and or translucent.

Shell morphometry:

L 35-63 mm
RD 0.62-0.65
RSH 0.10-0.16
PMD 0.74-0.80
RW 0.20 g/mm

Description of animal: Colour salmon red (ROCKEL & FERNANDES, 1982b).

Radula: Tooth (Fig. 125) of an intermediate form between vermivorous and molluscivorous, and very different from most of the other endemic Conus of Angola. Apical portion larger than halfDR. Denticles in 1 row in upper part and in 2 in lower part, being elongated, separated from next ones and curved. ABS smaller than 40°. Blade prominent covering only a short part of the apical portion.

Radula morphometry:
(n = 3)

D 30-55
ABS 30-40°
LC/DR 37-53
DR/PA 1.48-1.58

Distribution: From Limagens to Lucira Bay (Fig. 147). Sympatric with C. bulbus, C. neoguttatus, C. variegatus, C. zebroides, C. chytreus, C. nobrei, C. musivus, C. naranjus and C. albuquerquei.

Habitat: From 2 to 15 m, under rocks, often attached to the rocks (ROCKEL & FERNANDES, 1982b).

Discussion: C. carnalis is similar to C. ambiguus Reeve, 1843, and C. tabidus Reeve, 1843. C. ambiguus. (C. bellocqae van Rossum, 1996 is probably a synonym), a deep-water species from Senegal, has a glossy, broadly conical last whorl (RD 0.65-0.70) and a sharply angled shoulder. C. tabidus (synonym: Conus gernanti Petuch, 1975), sympatrically living with C. carnalis, is smaller (L up to 38 mm), more conical in shape (PMD >80) has a dull surface, an angulate to subangulate shoulder and 2-3 spiral grooves on the teleoconch sutural ramps; its colour is white with brown streaks or flecks or -often in juveniles -totally light brown or yellowish brown.

Conus chytreus Melvill, 1884 ("1983"):

(Figs.37-41) 30-55
Plate2
Conus figulinus var. chyereus Melvill in Tryon, 1884 ("1883"). Man. Conch. (1),6: 17, pi. 27, fig. 1.
Conus chyereus Melvill, Hopwood, 1920 (redescription). J. Conchol., 16: 103.
Conus lucirensis Paes da Franca, 1957. Trab. Miss. Biol.
Marie. 13: 79, pi. 1, figs. 5-6, pi. 2.
Conus variegatus "Kiener", Walls, 1979. Cone shells:693, fig. above and below, left.

Type material: Holotype of c. chytreus in NMWZ (16.6 x 10 mm), depicted by COOMANS ET AL. (1983, 414 a, b). Holotype of C.lucirensis in MZFC.

Other material studied: 2 sp, Campeona; 3 sp, Equimina (SMNS); 9 sp, Limagens (SMNS); 8 sp, Limagens (CFF) 2 sp, Bissonga (SMNS); 42 sp, Bissonga; 1 j, Baia do Cesar, Lucira; 25 sp, 5 j, Lucira; 2 sp, Lucira (SMNS); 5 j, Doca, Lucira; 8 sp, Salinas, Lucira; 5 sp, Salinas (SMNS); 5 sp, 4 s, without locality,Angola.

Type locality: Lucira Bay, Angola, designated by COOMANS ET AL., (1983: 118).

Shell description: Small to moderately small, moderately solid. Last whorl ovate to broadly ovate, slightly pyriform. Outline convex at ad apical half and slightly concave below. Shoulder rounded. Spire of low to moderate height, outline straight or sigmoid. Teleoconch sutural ramps convex, usually with numerous spiral striae. Last whorl smooth and dull, with about 10 spiral ribs at base.

Ground colour white, shoulder with a wide brown band down to sub shoulder area, last whorl with continuous brown spiral lines. Lines may be fine or broad, spaced or closely arranged. Base usually brown. Aperture white inside.

Periostracum thin, smooth, translucent.

Shell morphometry:

L 19-32 mm
RD 0.62-0.71
RSH 0.08-0.16
PMD 0.69-0.72
RW 0.14 g/mm

Description of animal: Animal pinkish cream with black dots (ROCKEL & FERNANDES, 1982b).

Radula: In radula sac 52-71 teeth. Tooth (Fig. 126) medium sized; PA equal or slightly longer than half tooth; two or three rows ofD in S in adapical part and two or one below, here very poorly evident. D only in the upper part of S and in two rows. F hardly observable, covering only 55-68% of PA.

Radula morphometry:
(n = 10)

D 17-26
ABS 40-45°
LC/DR 39-60
DR/PA 1.8-2,0

Distribution: From Lucira to Santa Maria (Fig. 149). In this area sympatric with C. bulbus, C. neoguttatus, C. variegatus, C. zebroides, C. carnalis, C. nobrei, C. musivus, C. naranjus and C. albuquerquei.

Habitat: Zone of calm shallow water, to 1 m depth, buried in fine sand with shell grits. Gregarious behaviour around Holoturia sp. (Echinoderms) was also observed.

Discussion: MELVILL (1883) described C. chytreus erroneously as variant of the Indopacific C. figulinus because of the presence of spiral lines on last whorl. Coomans et al. (1983) stated a similarity to C. variegatus, but the colour of the aperture is different and C. variegatus has a pattern with spiral rows of brown dots or dashes, alternating with white. The radular teeth have evident differences: DP/PA is usually smaller than 2 in C. chytreus and 2 or more in C. variegatus. Also the D in S are more prominent and numerous in the upper part of C. chytreus and the opposite in C. variegatus. Most similar in shell morphology is C. fuscolineatus. For comparison, see the Discussion of the latter species.

Conus fuscolineatus Sowerby, 1905

(Figs. 42-46)
Plate3
Conus fuscolineatus Sowerby, 1905. Proc. Mat. Soc. London, 6: 282, fig. 6.

Type material: Holotype (Figs. 42-43) in BMNH (21.8 x 13 mm).

Other material studied: 2 sp, 4 j, S. Nicolau; 26 sp, 1j, Chapeu Armado; 2 sp, Chapeu Armado (CFF); 8 sp, Baia do Baba; 21 sp, Mucuio; 2 sp, Baia das Pipas (SMNS); 36 sp, 20 j, Baia das Pipas; 26 sp, 7 j, Saco Mar; 5 sp, Saco Mar (SMNS); 18 sp, Ponta de Noronha; 2 sp, Noronha (SMNS); 5 sp, Tres Irmaos; 2 sp, PraiaAmelia(SMNS); 7 sp, PraiaAmelia; 17 sp, without locality, Angola

Type locality: "Sierra Leone". This is most probably erroneous. The type belongs to a population living off Ponta de Noronha, near Mocamedes Bay, Angola, which we herewith designate the type locality

Shell description: Small to moderately small, moderately solid. Last whorl ventricosely conical to ovate, outline convex at adapical third, straight or slightly convex below. Left side slightly concave near base. Aperture wider at base than near shoulder. Shoulder rounded. Spire of low to moderate height, outline straight to slightly sigmoid. Teleoconch sutural ramps flat to convex, with fine spiral striae. Last whorl smooth and dull, with few spiral grooves at base.

Ground colour greenish white. Last whorl with about 20 brown spiral lines, here and there interrupted and in the central area changing to dotted or dashed rows. Irregular brown flecks and streaks may be present. Aperture dark or light brown with two white spiral bands at shoulder and base.
Periostracum thin, smooth, translucent.

Shell morphometry:
L 19-27 mm
RD 0.63-0.69
RSH 0.06-0.16
PMD 0.70-0.73
RW 0.12 g/mm

Description of animal: Colour pinkish with dark dots and spots (ROCKEL & FERNANDES, 1982c).

Radula: Restricted to the typical material from Ponta de Noronha: Radula sac with about 45 teeth. Tooth (Fig. 127) of vermivorous type, rather small (LC/DR = 70). The apical part approximate half the total length (DR/PA = 2.0). A blade is not visible. There are about 20 very small denticles in the serration, arranged into a single row. ABS about 45°.

Radula morphometry: (including the other populations)
(n = 6)

D 20-45
ABS 45°

LC/DR 58-70
DR/PA 2.0-2.1

Distribution: Specimens matching the holotype are found in Punta de Noronha, Mocamedes (Fig 146). The species lives sympatrically with C. africanus, C.zebroides, C. cepasi, and C. filmeri n. sp.

Habitat: Buried in sand at 1-2 m deep near rocks or in rock crevices (ROCKEL & FERNANDES, 1981).

Discussion: Only the population of Ponta de Noronha corresponds exactly with the holotype. There are other populations along the Angolan coast with similar morphological characters. Whether they are local forms of this species or distinct species can not definitively answered at present. Therefore, we provisionally consider only the Ponta de Noronha population representing C. fuscolineatus. Future studies will shed more light upon this. C. variegatus may be similar in shape and pattern, but lacks the greenish ground colour and the unfinished brown spiral lines. The radula teeth arenot very different, except the blade (F).

C. chytreus has a similar shape and pattern, but its spiral lines are continuous and not interrupted, its ground colour is white and the shell is also white inside the aperture. More important differences can be observed in the radular, tooth: LC/DR is 39-60 in C. chytreus and 58-70 in C. fuscolineatus. Blade is visible in C. chytreus, but not in C. fuscolineatus.

Conus cepasi Trovao, 1975

(Figs.47-49)
Plate3

Conus cepasi Trovao 1975. Boletim C.PA. S., 4 (1), 1975: 3-4, pl. 1 figs. 1 a-f

Type material: Holotype in CPAS, Lisbon (46.6 x 26.4 mm).

Other material studied: 3 sp, Sao Nicolau (CPR); 27 sp, 2 j, Chapeu Armado; 4 sp, Chapeu Armado (SMNS); 1 sp, Chapeu Armado (CPR); 1 sp, Chapeu Armado (CFF); 3 sp, without locality (SMNS); 3 sp, without locality, Angola.

Type locality: "14° 27' S -12° 20' E". This is near Sao Nicolau, Angola.

Shell description: Moderately small to medium sized, moderately solid to solid. Last whorl ventricosely conical to ovate; outline convex at adapical half to third, straight below. Left side concave near base. Aperture wider at base than near shoulder. Shoulder rounded. Spire of moderate height, outline convex to sigmoid. Teleoconch sutural ramps flat to convex, with fine spiral striae. Last whorl smooth and dull, with a few weak spiral grooves near base.

Ground colour white or cream or light orange, with numerous orange-brown axial hairlines, occasionally with light brown spiral bands near shoulder and both sides of centre. Aperture white.

Periostracum thin, smooth, translucent, yellowish.

Shell morphometry:

L 26-50 mm
RD 0.64-0.70
RSH 0.11-0.17
PMD 0.68-0.77
RW 0.28-0.31 g/mm

Description of animal (Fig. 104}: Light pink with some irregular dark reticulation (Trovao, 1975a}; cream to greyish with small dark dots. The border of the mantle is darker due to the concentration of dark gray dots. The same colour on the siphon and proboscis (ROCKEL & FERNANDES, 1981}. The penis is narrow and elongated. Operculum small (Fig. 105}.

Radula: In radula-sac about 74-84 teeth. Tooth (Fig. 128) of vermivorous type, very small. Apical portion smaller than half of DR. Denticles in one single row, being more sharp at lower part Basal angle of saw smaller than usual. Blade not observable. Base of the tooth (Fig. 129) wider in some positions.

Radula morphometry:
(n = 4)

D 14-23
ABS 30-35

LC/DR 54-96
DR/PA 2.1-2.3

Distribution: Mostly found in the area of Chapeu Armado, also in S. Nicolao, South Angola, living sympatrically with C. africanus, some populations provisionally assigned to C. fuscolineatus, and C. zebroides (Fig. 147).

Habitat: under rocks buried in sand at very low tide,sometimes in depths of about 1 m (ROCKEL &FERNANDES, 1981).

Discussion: C. cepasi is similar in size and shape to C. zebroides and to C. trovaoi n. sp., but can be distinguished by its strikingly different pattern as well as by differences in the radular teeth. The radula teeth of C. zebroides are similar in some characters, however the D in C. cepasi are in a single row and are more acute, in C. zebroides they are smaller and in some rows. C. naranjus has similarities in colour pattern. For comparison, see the Discussion of the latter species.

Conus nobrei Trovao, 1975

(Figs.50-51)
Plate 3

Conus nobrei Trovao, 1975. Boletim C.PA. S., 4 (1), 1975: 5, pI. 1, figs. la-b. .

Type material: Holotype in CPAS (17.1 x 10.6 mm),depicted by TROVAO (1975a, 1994).

Other material studied: 9 sp, Canoco; 4 sp, Santa Maria; S sp, 16 j, Santa Maria (CFF); 34 sp, 1 s, 13 j, Lucira; 1 sp, Baia do Cesar, Lucira; 2 sp, Lucira (SMNS); 1 sp, 1 j, Doca, Lucira; 2 s, Doca (CFF); 6 sp, Canoco(SMNS); 1 sp, without locality (SMNS); 3 s, without locality, Angola.

Type locality: "The cross between 12° 48' and 13° 51 ,S" is of land. The 12° 48'E cross the coast line near Baia dos Elefantes from which there is not any knowledge of collecting specimens of C. nobrei; the 13° 51 , S is near Lucira, from where the species was collected, and Lucira is therefore designated the type locality.

Shell description: Very small to small, light to moderately light. Last whorl ovate to ventricosely conical, outline convex at adapical third, almost straight or slightly sigmoid below. Left side concave at base. Shoulder rounded, spire low to moderate, outline straight, convex or sigmoid. Teleoconch sutural ramps flat to convex, with fine spiral striae. Last whorl smooth with about 10 spiral grooves at base.

Ground colour bluish white to white, with irregular axial dark brown or greenish brown streaks or lines, sometimes coalescing to dark brown flecks, and changing to dotted or dashed spiral rows or in a dark network with small white flecks. Patterns intergrade in most populations. Aperture dark violet with light zones at shoulder and centre.

Shell morphometry:

L 12-20 mm
RD 0.69-0.73
RSH 0.10-0.16
PMD 0.71-0.77
RW 0.04-0.07 g/mm

Description of animal: Red-orangish (TROVAO, 1975a); of pink colour with small dots. Border of the mantle like the body, proboscis and siphonal canal a little darker (ROCKEL & FERNANDES, 1981).

Radula: Tooth (Fig. 130) relatively large; 18 denticles in the serration, arranged in a single row, except in the middle part, where they are doubled. Blade slightly prominent, covering 73% of PA.

Radula morphometry:
(n = 1}

D 18
ABS 45

LC/DR 38 (34 in the original description)
DR/PA 2.14

Distribution: From Lucira Bay to Santa Maria (Fig. 150). Sympatric with C. bulbus, C. neoguttatus, C. variegatus, C. zebroides, C. carnalis, C. chytreus, C. musivus, and C. naranjus

Habitat: Buried in sand in rock crevices, sometimes under small rocks, in big holes of stones with sand, 1-3 m deep (ROCKEL & FERNANDES, 1981).

Discussion: C. nobrei is very similar to C. albuquerquei. For comparison, see the Discussion of that species.

Conus musivus Trovao, 1975

(Figs.52-53)
Plate3

Conus musivus Trovao, 1975: Boletim C.P.A.S., 4(2), 1975: 11, pl. 1, fig. 2, pl. 2, figs. 3,4,6.
Conus tevesi Trovao, 1978. nom. nov. for C. Musivus Trovao, non C. musivum Broderip, 1833. Boletim C.P.A.S., 4(4): 18.

Type material: Holotye in CPAS (33.3 x 18.6 mm),depicted by TROVAO (1975, 1994).

Other material studied: 5 sp, Limagens (SMNS); 12 sp, 3 j Limagens; 8 sp, Limagens (CFF); 50 sp, 2 j, Santa Maria; 2 sp, Santa Maria (SMNS); 3 sp, 3 s, without locality, Angola.

Type locality: "12° 32' E, 13° 26' S". This is near the cape of Santa Maria Bay. So Santa Maria Bay is designated the type locality.

Shell description: Small to moderately small, solid. Last whorl ventricosely conical, outline convex at adapical third, almost straight below. Left side slightly concave near base. Aperture wider at base than near shoulder. Shoulder rounded. Spire of low to moderate height, outline straight to slightly sigmoid. Teleoconch sutural ramps flat to convex, with fine spiral striae. Last whorl smooth and dull, with about 8-10 spiral ribs at base.

Ground colour white to bluish white. Last whorl with brown axial streaks, branching and coalescing to an irregularly tented pattern. Base may be dark brown. Aperture white or purplish-brown, leaving two light bands at shoulder and centre.

Shell morphometry:

L 20-33 mm
RD 0.60-0.78
RSH 0.06-0.15
PMD 0.74-0.80
RW 0.09-0.11 g/mm

Description of animal: Animal pink with some dark dots (TROVAO, 1975b).

Radula: In radula sac 43-60 teeth. Within the shells with a somewhat tented pattern we found some variability in the radular tooth {Fig. 131). Only some of them correspond with the radular tooth depicted by TROVAO {1975b). Radulae of the typical morph of C. musivus are unusually inconsistent; for instance, the ratio DR/PA ranges in some specimens from 2.2-2.3 to 1.8-1.9 in other ones. This incongruence was neither correlated with a distinct locality nor with the size {ontogenetic changes). It was not possible to discover any sexual dimorphism because of the poor state of conservation of soft parts of the study material. Unknown factors may cause this inconsistence, as perhaps different habitat or food, or a certain degree of genetical flow.

Radula morphometry:
(n = 8)

D 18-27
ABS 40-45°
LC/DR 38-43
DR/PA 1.8-2.3

Egg Capsules: Capsules flat, smooth and with the window escape at the upper part.

Distribution: From Limagens to Santa Maria (Fig. 146) .Sympatrically living with C. bulbus, C. neoguttatus, C. variegatus, C. zebroides, C. chytreus, C. Carnalis, C. nobrei, C. naranjus, and c. Albuquerquei

Habitat: Rocky bottom, almost bare of sand.

Discussion: The name C. musivus was replaced by TROVAO (1978), because he assumed pre-occupation by C. musivum Broderip, 1833. Since the spelling is different, the original name maintains validity (Art. 57, 58 ICZN). Some specimens may have an intergrading pattern to C. bulbus, hence some authors (WALLS, 1979, ROCKEL & FERNANDES, 1982a) supposed synonymity. The radular differences are not significant.
Nevertheless we provisionally accept the validity of C.musivus, as near the type locality of C. musivus typical patterned specimens of C. bulbus have been collected. If C. bulbus and C. musivus are the same species, the distribution of the morphs would be irregular: In the Santa Maria-Limagens area C. musivus predominates, while it does not appear on the coast from Benguela to Limagens

Conus naranjus Trovao, 1975

(Figs. 54- 56)
Plate 3

Conus naranjus Trovao, 1975. Boletim C.P.A.S., 4(2), 1975: 12, pi. 1 fig. 3, pi. 2 figs. 5; 8.

Type material: Holotype in CPAS (18.1 x 10.7 mm), depicted by TROVAO (1975, 1994).

Other material studied: 1 sp, Caota, Benguela; 2 sp, Caota (SMNS); 23 sp, Caota (CFF); 2 sp, Baia Azul (SMNS); 1 sp, Baia Binga (CFF); 4 sp, Santa Maria (SMNS); 25 sp, Santa Maria; 4 sp, Santa Maria (CFF); 21 sp, Lucira; 4 sp, Lucira (CFF); 5 s, without locality, Angola.

Type locality: "Angola, 12° 40' E, 12° 22' S". The lines cross far off the coast; the first line corresponds with Limagens, north of Santa Maria. As this locality is close to the material referred to by us, we herewith designate it the type locality.

Shell description: Small, moderately light. Last whorl ovate to ventricosely conical, outline convex at adapical third, almost straight below. Left side concave near base. Aperture wider at base than near shoulder. Shoulder rounded. Spire of low to moderate height, outline concave to sigmoid. Teleoconch sutural ramps flat to convex, with fine spiral striae. Last whorl smooth and dull, with 6-10 spiral ribs at base.

Ground colour light orange or white. The holotype represents a form with dark orange, very fine to solid, somewhat wavy axial lines, sometimes leaving a few dotted spiral bands at centre. Another

form consists of spiral rows of minute brown dots and brown axial lines at shoulder. Specimens from the Caota population may be almost brown with light axial streaks at centre. Aperture white or pale orange with a translucent collabral band.

Periostracum yellow, thin and translucent.

Shell morphometry:
L 18-23 mm
RD 0.62-0.69
RSH 0.11-0.15
PMD 0.68-0.76
RW 0.07-0.10 g/mm

Description of animal: Pinkish red with black dots (ROCKEL & FERNANDES, 1982b).

Radula sac with about 60 teeth. Tooth {Figs. 132-133) vermivorous with unusally large base, covered on external surface by dense tuber. Tooth small. PA smaller than half of DR. Ontogenetic changes are observed in adult specimens: Teeth in similarly sized specimens are immature or already mature. Serration S can be fine and bare of denticles {immature) or carrying up to 10 denticles as tubercles. It may have a short blade in adapical part, but not easily observable. In the latter aspect we disagree with TROVAO {1975b).

Radula morphometry:
(n = 2)

D 0-10
ABS 30°-45°
LC/DR 68-80
DR/PA 2.1-2.4

Distribution: From Lucira to Santa Maria (Fig. 150). An isolated population occurs in Baia Caota, Benguela. C. naranjus lives sympatrically with C. bulbus, C. neoguttatus, C. variegatus, C. zebroides, C. carnalis, C. chytreus, C. nobrei, c. musivus, and C.albuquerquei.

Habitat: In calm waters under rocks buried in fine sand with shell residues at very low tide to 1 m depth. Generally they are found alone, occasionally in groups of 9-18 specimens around Holoturia sp. (ROCKEL & FERNANDES, 1982b

Discussion: The holotype-form of c. naranjus resembles c. cepasi in colour-pattern. The shell of c. naranjus can be distinguished only by its lighter and smaller size (18-23 mm vs. 26-50 mm), its usually orange instead of white ground-colour and the existence of dotted spiral lines in some populations. C. naranjus and C. cepasi live sympatrically without intergradations. The radula, of shells of similar size, of c. cepasi and C. naranjus show differences: c. naranjus has barely or very small D in S, while C. cepasi has them evident. Also c. naranjus has LC/DR between 68-78, C. cepasi usualJy up to 82 (including all the material studied by TROVAO, 1975).

Conus albuquerquei Trovao, 1978

(Figs.57-59)
Plate 3

Conus albuquerquei, Trovao, 1978. Boletim C.P.A.S., 4(4),1978: 11-12,pl.1, fig. 1,pl.2, figs. 2, 2a, pl. 3, fig. 5.

Type material: Holotype in CPAS (12.7 x 7.5 mm), depicted by Trovoa (1978, 1994).

Other material studied: 39 sp, 5 j, Santa Maria; 4 sp, Santa Maria (SMNS); 2 sp, without locality, Angola.
Type locality: "Angola, 120 32' E, 130 26' S". Both lines cross near Santa Maria, where the holotype was collected. Santa Maria is herewith considered type locality.

Shell description: Very small to small, light to moderately light. Last whorl ovate to ventricosely conical, outline convex at ad apical third, almost straight or slightly sigmoid below. Left side concave at base. Shoulder rounded, spire low to moderate, outline straight, convex or sigmoid. Teleoconch sutural ramps flat to convex, with fine spiral striae. Last whorl smooth with about 10 weak spiral grooves at base.

Colour dark to blackish brown, with axial white bars and streaks, sometimes with short spiral dashes, usually forming a broad spiral band at centre. Bars and streaks may change into more numerous axial white streaks. Irregular white spots at shoulder and base.

Periostracum smooth and translucent

Shell morphometry:

L 12-17 mm
RD 0.68.0.74
RSH 0.10.-0.16
PMD 0.71-0.77
RW 0.04-0.06 g/mm

Description of animal: Reddish with black dots (ROCKEL & FERNANDES, 1982a).

Radula: In radula sac about 48 teeth. Tooth (Fig. 134) relatively large, compatible with the data in original description; it is wide, with a short PA; F hardly visible, covering 73-77% of PA; ABS about 45-60°. About 14-20 D in S in two rows.

Radula morphometry:
(N = 4)

D 14-20
ABS 45-60°
LC/DR 34-40
DR/PA 2.15-2.28

Distribution: Only found in Santa Maria (Fig. 150). Sympatric with C. bulbus, C. neoguttatus, C. variegatus, C. zebroides, C. carnalis, C. nobrei C. musivus, and C. naranjus.

Habitat: On stones, between 4-10 m, on sandy bottom (TROVAO, 1978); buried in sand intertidal to as deep as 3 m, under large rocks (ROCKEL & FERNANDES,1982a).

Discussion: We have some doubts about the assigment of the populations from south of Chapeu Armado to C. albuquerquei; with regard to radula differences. If they are conspecific, they live also sympatrically with C. fuscolineatus. Coomans et al. (1979) placed C. albuquerquei; in the C. africanus -complex. There may be certain similarities in shell pattern, however the shell of c. africanus is larger and the radular teeth are different: C. africanus has usually more teeth in the radula sac, its tooth is relatively smaller and F is not. visible; Additionally, the tooth of C. albuquerquei is wider. C. albuquerquei is similar to C. nobrei: The shell morphometry is identical, and also the radula teeth are not significantly different. Most different is the shell-pattern, but the population of Canoco seems to be an intergradation of both patterns. Therefore we can only provisionally accept separation of these species.

Conus bocagei Trovao, 1978

(Figs.60-61)
Plate3

Conus bocagei Trovao, 1978. Boletim C.P A.S., 4 (4) : 17 -18, pl. 1 fig. 2, pl. 2, figs. 3-4, pl. 3, fig. 1.

Type material: Holotype in CPAS (27.2 x 16.8 mm), depicted by TROVAO (1978, 1994).

Other material studied: 8 sp, Lobito; 9 sp, Lobito (SMNS); 2 sp, without locality (SMNS); 3 sp, without locality, Angola.

Type locality: "13° 35' S -12° 19' E". This is off Santa Maria. But the holotype. was collected, according to the original description, at Lobito. So we designate Lobito; Angola, the type locality.

Shell description: Small to moderately small, moderately light to moderately solid. Last whorl ovate to broadly ovate. Outline convex at adapical third, almost straight below. Left side slightly concave near base. Aperture wider at base than near shoulder. Shoulder subangulate to angulate. Spire of moderate height, outline straight to sligthly sigmoid.Teleoconch sutural ramps flat to slightly concave,with fine spiral striae. Last whorl smooth and dull, with about 10 basal spiral cords.

Ground colour bluish white. Last whorl with spiral rows of alternating brown and white dots and dashes, at shoulder and at base coalescing to brown flecks, leaving short light streaks. Aperture light to dark brown with a light collabral zone and a light central band

Shell morphometry:

L 20-32 mm
RD 0.67-0.78
RSH 0.12-0.20
PMD 0.69-0.77
RW 0.09-0.10 g/mm

Description of animal (Fig. 106): Uniform cream in colour (TROVAO, 1978). Penis small.

Radula: About 50-60 teeth in radula sac (Fig. 107). A vermivorous tooth (Fig. 135), medium sized, narrow, with an apical portion half total length of tooth. S narrow with small D in 1-2 rows, disappearing in lower part. ABS 30-45°, blade almost unobservable, covering near 80%.

Radula morphometry'
(n = 3)

D 22-30
ABS 30-45
LC/DR 48-63
DR/PA 2.0-2.1

Habitat: Buried in sand at 1-2 m deep, near rocks or in rock crevices (ROCKEL & FERNANDES, 1981).

Distribution: Only found in Lobito. Sympatric with C. zebroides and parapatric with C. naranjus. Specimens from other localities, mentioned in the original description, may be similar to C. bocagei, but are not considered conspecific.

Discussion: The shells from Namibe (Mocamedes), mentioned by Trovao, do probably not belong to this species, they differ by their rounded shoulder, more convex spire, and narrower last whorl. C. bocagei can easily be distinguished from most of the other endemic Conus species of Angola by its angulate to subangulate -instead of rounded -shoulder.

Conus xicoi Rockel, 1987

(Figs. 62-66)
Plate 4

Conus hieroglyphicus "Duclos" (printer's error for hieroglyphus) in Kiener, 1845. Coq. Vi"vant., 2: pi. 73 fig. 1a.
Conus "lugubris" RockeI & Fernandes, 1982 non Reeve. La Conchiglia, 14(156-157): 5.
Conus xicoi Rockel, 1987. Publ. Ocas. Soc. Port. Malac.,9: 45, pl. 1 A, B, C. D, pl. 2 A, C.
Conus xicoi Rockel, 1988. Club Conchylia, 20: pl 2, fig.

Type material: Holotype in SMF, depicted by ROCKEL (1987) (25.5 x 14.7 mm); paratypes in SMNS (Figs. 64-66); other paratypes, see ROCKEL (1988).

Other material studied: 11 sp, Santiago Bay {SMNS); 12 sp, Praia Santiago, N. Luanda; 2 sp, Praia Santiago {CFF).

Type locality: Praia Santiago (30 km north of Luanda), Angola.

Shell description: Small to moderately small, moderately solid, Last whorl broadly and ventricosely conical; outline convex at adapical third, straight or slightly concave below. Aperture moderate, wider at base than near shoulder. Shoulder angulate and smooth. Spire of low to moderate height with straight, sometimes slightly convex outline. Teleoconch sutural ramps flat with numerous striae, crossed by axial threads. First 4- 5 postnuclear whorls with 2 stronger spiral grooves, perceptible in juvenile specimens only.

Surface smooth and slightly glossy with about 10 narrow spiral grooves at base. Periostracum yellowish, thick and only partially translucent, with slightly tufted spiral lines.

Ground colour bluish white with two small lighter spiral bands at centre and shoulder. Dark brown reticular pattern leaving spiral rows ofbluish-white axial streaks as well as fine irregular ziczac-lines and flammules. Occasionally specimens may be completely brown with scattered light spiral bands at centre and shoulder. Aperture dark brown with a light margin; deeper inside light violet

Shell morphometry:
L 22-32 mm
RD 0.70-0.81
RSH 0.10 -0.18
PMD 0.76-0.84
RW 0.10-0.16 g/mm

Description of animal: Colour cream pinkish, mantle border dark pinkish and covered with dark dots. Siphon and proboscis blackish colour. (ROCKEL & FERNANDES, 1982b).

Radula: In radula sac 50-56 teeth. Tooth (Fig. 136) of vermivorous type, middle sized. F covers 72% of PA. ABS smaller than usual. D in S are small and in two rows in the middle.

Radula morphometry:
(n = 4)

D 13-27
ABS 20-30°
LC/DR 44-56
DR/PA 1.9-2.1

Egg capsules: White, almost rectangular, with short base (Figs. 117-118). Escape window wide and translucent. One prominence at each side of posterior surface.

Distribution: From Santiago Beach (30 km north of Luanda) up to the mouth of the Dande river, Angola (Fig. 146). Juveniles were collected in Luanda.

Habitat: Intertidal from very low water down to the surge zone, in rock crevices or between rocks, partly buried in sand.

Discussion: The dark brown form of Conus xicoi was depicted by KlENER (1845, pI. 73 fig. la) as "Conus hieroglyphicus Duclos", a printer's error for Conus hieroglyphus Duclos, which is a Caribbean species. This misidentification by Kiener cannot be used for that taxon (ICZN, Article 49). Later, C. xicoi was misidentified by ROCKEL & FERNANDES {1982b) as C. lugubris Reeve, a species from Cape Verde Islands. C. xicoi is easily distinguished from other endemic Angolan cones by its angulated instead of rounded shoulder; C. aemulus -living sympatrically -has certain similarities, but is larger (Lup to 58 mm), narrower in shape (0.70-0.81 vs. 0..63-0.73), and has a more dull surface. Dotted or dashed spiral lines, usually present in the C. aemulus-pattern, are lacking in C. xicoi, as well as the spiral grooves on first teleoconch sutural ramps.

Conus gabrielae n. Sp

(Figs.67-71)
Plate 4

Conus sp. 26 in ROCKEL & FERNANDES, 1982. La Conchiglia, 14(164-165): 18, fig. 26.
"Conus negroides Paes da Franca" in Kaicher, 1977.

Type material: Holotype (Figs. 67-68) in MNCN (no15.05/39748) (24.7 x 14.5 mill). Paratypes in AMNH(I), BMNH (I), MNHN (I), SMNS (2), USNM (I), CPR (I), CER (40), CMF (I), cpR (1), CGRM (I), all from the type locality.

Other material examined: 3 sp, Chapeu Armado (SMNS}; 26 sp, Chapeu Armado; 2 sp, 5 j, Chapeu Armado (CFF}; 1 sp, sao Nicolau.

Type locality: Chapeu Armado, South Angola.

Etymology: Named after Gabriella Raybaudi Massilia, who cooperated in the beginning of this Work.

Shell description: Small, moderately solid. Last whorl ventricosely conical to broadly ventricosely conical. Outline convex at ad apical third, almost straight below. Left side slightly concave near base. Aperture wider at base than near shoulder. Shoulder rounded. Spire of low to moderate height, outline slightly concave. Teleoconch sutural ramps are concave, with numerous spiral striae. Last whorl smooth or with spiral striae, and about 10 spiral ribs at base.

Periostracum yellow and transparent.

Colour dark brown, leaving a relatively narrow, white or cream sub-centr:al band, interrupted by axial brown lines. This pattern is rarely variable. Aperture light bluish-white inside with a collabral brown band.

Shell morphometry:

L 20-27 mm
RD 0.68-0.72
RSH 0.09-0.14
PMD 0.75-0.78
RW 0.08-0.12 g/mm

Description, of animal: No information except dark colouration

Radula: In radula sac 50-74 teeth. Tooth vermivorous (Fig. 138), medium sized. PA small, F slightly prominent, D more evident adapically, into two rows centrally or into two rows along the entire S in large specimens. S curved and not very narrow, almost bare of D in its lower part.

Radula morphometry:
(n = 8)

D 16-28

ABS 40-45°
LC/DR 50-65
DR/PA 2.1-2.4

Distribution: Known from Chapeu Armado and Sao Nicolau, South Angola (Fig. 147), sympatrically living with C. africanus, C. neoguttatus, C. vanriegatus, C. zebroides, C. chytreus, C. fuscolineatus, C. nobrei, C. naranjus, and C. franciscoi n. sp.

Habitat: Buried in sand between stones, at 1-3 m depth; juveniles in the high tidal level.

Discussion: The allopatric c. bulbus is usually smaller in size, has a slightly narrower and lighter shell, its pattern is formed by axial streaks without a central band. The radular teeth are rather similar, but C. bulbus has bigger D in the upper part of the saw. C. africanus, sympatric with C. gabrielae, has a more ovate shell (PMD 0.70-75 vs. 0.75-0.80} and a different pattern with blotches and streaks on last whorl. Its radula is significantly different: LC/DR is relatively and consistently smaller (LC/DR 46- 58 vs. 55-65} and with more teeth in radula sac (72-96 vs. 50-74}; further more, in the upper part of the saw, C. africanus has no denticles. C. zebroides -sympatric in sao Nicolau- usually has a larger shell, its pattern consists of axial lines or streaks, and its radula can clearly be distinguished: Smaller DR and PA; less D in S and juvenile aspect in similarly sized specimens. C. xicoi clearly differs by its angulate instead of rounded shoulder, its different pattern in some radula characters: smaller ABS (30° vs. 40-45°) and larger PA(DR/PA 1.9-2.1 vs. 2.1-2.4). For comparison with C. franciscoi n. sp. see the Discussion of this species.

Conus micropunctatus n. Sp.

(Figs. 72-76)
Plate 4

Conus "lineopunctatus" Rockel & Fernandes, 1982. La Conchiglia, 14(164-165): 17, fig. 23.
Conus "variegatus" Walls, 1979. Cone shells: 692, figure below, right.

Type material: Holotype (Figs. 72-73) in MNCN (15.05/39749) (32.5 x l7 mm), paratypes in AMNH (I), BMNH (I), MNHN (1),.SMNS (I), USNM (I), CDR (1), CER (25), CG~ (1), CMR (1), CPR (1), all from type locality.

Other material studied: 13 sp, Equimina; 2 sp, Equimina (CPR); 11 sp, 1 s, 2 j. Campeona; 12 sp, Limagens; 4 sp, Limagens (CPR); 11 sp, Canoco; 4 sp, Canoco (CPR); 51 sp, Lucira; 19 sp, Bissonga; 24 sp, Baia do Cesar, Lucira

Type locality: Lucira, Angola.

Shell description: Moderately small, moderately solid. Last whorl ventricosely conical, slightly pyriform. Outline convex at adapical half; straight to slightly concave (left side) below. Aperture wider at base than near shoulder. Shoulder rounded. Spire of low to moderate height, outline straight to convex. Teleoconch sutural ramps convex, with fine spiral striae. Last whorl smooth and dull, with 8-10 ribs at base.

Periostracum yellow, thin, and smooth.

Ground colour white or bluish white. Last whorl with 30-50 spiral rows of minute brown dots; spire whorls and sometimes base with axial hairlines. Aperture white, occasionally with brown flecks.

Shell morphometry:

L25-35 mm
RD 0.63-0.68
RSH 0.08-0.17
PMD 0.75-0.79
RW 0.10-0.15 /mm

Description of animal (Fig. 108): Colour pinkish with dark dots and spots (ROCKEL & FERNANDES,1982c). Penis small and curved. Operculum small(Fig. 109)

Radula: In radula sac 51-73 teeth. Tooth (Fig. 139) of vermivorous typ,e, a little bit variable even within populations. Tooth relatively small (mean 52), PA smaller thari half of DR; D in S, in one row in the upper part and in two below. F covers about 65-75%.

Radula morphometry:
(n = 8)

D15-28
ABS 45°

LC/DR 32-68
DR/PA 2.0-2.3

Distribution: From Equimina to Lucira Angola

Habitat: Under rocks buried in sand, 1-2 m, sympatrica11y living with C. bulbus, c. neoguttatus, C. variegatus, C. zebroides, C. carnalis, C. nobrei, C. musivus, C. naranjus, and C. Trovaoi

Etymology: The name is referred to the pattern of the shell.

Discussion: There are some Angolan Conus populations, which might be affiliated to C. micropunctatus with respect to their similar shell pattern. One of them, having a smaller size (L < 26 mm) and orange shade, could be an ecotype of C. naranjus or another valid species. Its punctated spiral lines are very dense and often fuse in continuous lines. We provisionally separate them from C. micropunctatus. C. micropunctatus may be similar to C. neoguttatus and C. fuscolineatus. The relative diameter of similar patterned specimens of C. neoguttatus is usually larger (>0.70), the number of dotted spiral lines is fewer (<30) and the distance of dots is larger. C. fuscolineatus differs by it brown, sometimes interrupted spiral lines instead of punctated lines and its greenish white ground colour. The radular tooth of C. neoguttatus is very different: without D in S and without F. More similar is that of C. fuscolineatus but F is usually not noticeable.

Conus filmeri n. Sp.

(Figs.77-80)
Plate 4

"Conus dealbatus A. Adams" in Rockel & Fernandes, 1982. La Conchiglia, 14(156-157): 4, fig. C. Dealbatus.
Type material: Holotype in SMNS (ZI 30493) (33.1 x 19.5 mm). Paratypes in AMNH (1), BMNH (1), MNHN Q), USNM (1), CDR (1), CER (14), CGRM (1), CMR (1), CPR (1), all from type locality.

Other material examined: 10 sp, Praia das Conchas, Namibe (Mocamedes); 1 sp, Praia Amelia (CFF); 1 sp, Saco Mar (CFF).

Type locality: Saco Mar, southern Angola

Shell description: Small to moderately small, moderately solid. Last whorl ventricosely conical to broadly and ventricosely conical, large specimens pyriform. Outline convex at ad apical third, almost straight or slightly concave near base. Aperture wider at base than near shoulder. Shoulder subangulated. Spire of low to moderate height, outline concave to straight in smaller specimens, concave in larger specimens. Teleoconch sutural ramps flat to convex, with numerous spiral striae. Last whorl smooth and dull, with light spiral grooves at base.

Colour pure white bigger shells but juvenile specimens can have a brown line in the suture and some very slight cream colour in some parts of the last whorl.

Periostracum greyish brown, thick and opaque

Shell morphometry:

L 23-33 mm
RD 0.68-0.72
RSH 0.09-0.14
PMD 0.74-0.80
RW 0.18g/mm (larger shells)

Description of animal: Colour reddish cream with small black dots (ROCKEL & FERNANDES, 1982b).

Radula: High number of teeth (55-108) In radula sac. Tooth (Fig. 140) relatively small; apical portion about half the tooth length. F covering between 71-82% of PA.

Radula morphometry:
(n = 6)
D 22-22
ABS 40-45°
LC/DR 56-69
DR/PA 2.1-2.3

Distribution: Known only from Saco Mar (Fig. 148). A similar, light brown coloured population occurs in Praia das Conchas, Namibe (Mocamedes). Sympatric with C. fuscolineatus.

Habitat: In calm water at two meters depth under rocks, buried in fine sand (ROCKEL & FERNANDES, 1982b).

Etymology: The new species is named after the shell collector and Conus expert R. M. Filmer, Chobham, Surrey, England.

Discussion: The most similar shell is the holotype of Conus dealbatus A. Adams, 1853 (Fig. 81), preserved in the BMNH. It is like Conus filmeri pure white and has a pyriform shape. But it can be distinguished by its narrower last whorl (RD 0.61 vs. 0.68-0.72) and its deep spiral grooves at base. In addition, specimens of Conus filmeri of similar small size (L about 24.5 mm) are less pyriform and more ventricosely conical. The holotype of Conus dealbatus seems to be a fossil or subfossil shell (so also COOMANS, MOOLENBEEK & WILS, 1985, Filmer and pers. comm.). Other endemic Conus species from Angola differ obviously in their pattern and shape (rounded shoulder, less pyriform).

Conus franciscoi n. Sp

(Figs. 82-86)
Plate 5

Conus sp. Rockel, 1988. Club Conchylia, 20: pI. 2, figs.3 & 8
Conus variegatus "Kiener", Walls, 1979: Cone shells:693, fig. below, right.

Type material: Holotype (Figs. 82-83) in MNCN (15.05/39751) of28.4 x 15.6 mm. Paratypes in AMNH (1), BMNH (I), MNHN (1), SMNS (I), USNM (1), CDR (1), CER (14), CGRM (I), CMF (I), CPR (I), all from type locality.

Other material examined: 1 sp, Sao Nicolau; 2 sp, sao Nicolau (CPR); 3 sp, without locality, Angola; 3 sp, sao Nicolau (CPR); 3 sp, Chapeu Armado (SMNS); 26 sp, Chapeu Armado; 2 sp, Chapeu Armado (CFF).

Type locality: Chapeu Armado, Angola.

Shell description: Moderately small to medium sized, moderately solid. Last whorl ventricosely conical, outline convex at adapical third, almost straight below. Aperture wider at base than near shoulder. Shoulder rounded. Spire of low to moderate height, outline slightly convex to sigmoid. Teleoconch sutural ramps convex, with fine spiral striae. Last whorl smooth, with some weak spiral grooves at base.

Shell dark brown, leaving a broad central spiral band consisting of broad white axial streaks and bars.

Periostracum translucent and of orange colour.

Shell morphometry:

L 30-38 mm
RD 0.65-0.70
RSH 0.10-0.16
PMD 0.75-0.81
RW 0.20-0.25 g/mm

Description of animal: Colour of animal unknown.

Radula: In radula sac 40-61 teeth. Tooth (Fig. 141), relatively small, with an unusually elongate PA for Angolan species; D in S, usually arranged into two rows adapically and into a single row below; ABS about 45°.

Radula morphometry:
(n = 5)
D 30-43
ABS 45°
LC/DR 43-57
DR/PA 1.7-1.8

Distribution: Only known from Sao Nicolau and Chapeu Armado (Fig. 147) .There it is sympatric with C. chytreus, C.fuscolineatus, C. nobrei, C. albuquerquei, C. neoguttatus, C. naranjus, C. africanus, and C. variegatus.

Habitat: Buried in sand between stones; juveniles in the high tidal level.

Etymology: Named in honour of the late Francisco Fernandes, who began the present work and collected most of the material.

Discussion: C. franciscoi n. sp. was named (but never published) by dealers and collectors as "C. Armatus" (e.g. CLOVER, 1978: 14) or "C. armadensis". Similar species are the sympatrically living C. zebroides and C. gabrielae. C. zebroides from So Nicolau has an almost identical shell morphometry, but differs in its axial lines, usually covering the shell from shoulder to the base. Specimens of c. zebroides from the S. Nicolau population may have a reduced pattern, and can be distinguished only by their narrower white axial streaks. Much more significantly different are the radula teeth: LC/DR is 70-85 (5. Nicolau-population of C. zebroides) vs. 43-57 (C. franciscoi); the PA is larger in C,franciscoi (DR/PA = 1.66 vs. 2.1-2.4); also the number of D is very different: 16-25 in C. zebroides vs. 30-43 in C, franciscoi, there are in two rows in the base of C. franciscoi and one only in C. zebroides. C. gabrielae has a very similar morphometry and pattern, but it has a smaller (20-25 mm vs. 30-38 mm) and slightly broader shell and its axial streaks are narrower. More different are the radula teeth: C. gabrielae has less D in 5 (16-20 vs, 30-43 in C.franciscoi), and PA is smaller in C. gabrielae (2.1-2.4 vs. 1,7-1,8 in C. Franciscoi}.

Conus trovaoi n. Sp

(Figs.87-91))
Plate 5

"Conus olivaceus" Rockel & Fernandes, 1982. La Conchiglia, 14(164-165): 17, fig. 19.

Type material: Holotype (Figs. 87-88) in MNCN (15.05/39752) (38.5 x 20.8 mm). Paratypes inAMNH (I), BMNH (I), MNHN (I), SMNS (3), USNM (I), CDR (I), CER (16), CGRM (1), CMF (I), CPR (I), all from type locality.

Other material examined: 5 sp, Limagens (SMNS); 10 sp, Limagens; II sp, Baia do Cesar; 8 sp, Lucira; 2 s, without locality.

Type locality: Limagens, Angola

Shell description: Moderately small to medium sized, moderately solid. Last whorl ventricosely conical to broadly and ventricosely conical. Outline convex at ad apical third, almost straight below. Left side concave near base. Aperture wider at base than near shouder. Shoulder rounded. Spire of low to moderate height, outline straight to sigmoid. Teleoconch sutural ramps straight to convex, with fine spiral striae. Last whorl smooth, with some weak spiral ribs at base.

Ground colour light green to grey or pale yellow, with two light narrow spiral bands at centre and at shoulder. Specimens may have dark brown irregular flecks and streaks. Aperture dark violet with two light spiral bands at centre and shoulder and a white collabral band

Periostracum yellowish green, thin and transparent.

Shell morphometry:

L 25-44 mm
RD 0.67-0.71
RSH 0.09-0.16
PMD 0.73-0.81
RW 0.13-0.25 g/mm

Description of animal: Colour pinkish with dark spots and dots (ROCKEL & FERNANDES 1982c).

Radula: In radula sac 103-123 teeth. The tooth (Figs:142-143) is among the smallest ever found in the vermivorous type: Ratio LC/DR between 113-140; PA small. S fine without D in specimens with shell smaller than L 30 mm and with 10-16 small D in larger shells.

Radula morphometry:
(n = 5)

D 0-16
ABS 30-45°
LC/DR 113-141
DR/PA 2.4-3.1

Habitat: 1-3 m, buried in sand under large rocks or half buried near them in quiet zones without wave movement (ROCKEL & FERNANDES, 1982c).

Distribution: Found in Limagens, Baia do Cesar, and Lucira (Fig. 147).

Etymology: The new species is named after Herculano Trovao {Lisbon), who started studies of Angolan Conidae, employing the radular teeth for specific separation.

Discussion: As C. trovaoi n. sp. looks like an olive (colour and shape), collectors were inclined to call this species C. olivaceus, a name for a species described by KIENER (1845). The latter species is known only by its figure, which shows a shell of similar size and colour-pattern, but with a subangulate to angulate shoulder -different from the rounded shoulder of c. trovaoi. Therefore the new species cannot be identified with c. olivaceus. C. trovaoi is similar to C. neoguttatus in size and differs slightly in its somewhat more conical shape (PMD 073-0.81 vs. 0.72-0.78). The colour pattern is obviously different: Greenish instead of white ground colour, absence of any spiral lines and small dots, and dark violet coloured aperture. The radular teeth of both species are similar. They share the unusual character, that sometimes large specimens may have an ontogenetic change having a vermivorous tooth without D in S., smaller base, etc.

The radular tooth of C. trovaoi may easily be distinguished from all of the other previously described Angolan cones.

Conus flavusalbus n. Sp.

(Figs. 92-96)
Plate 5

Conus sp. Rockel, 1988: Club Conchylia, 20: pl. 2 fig. 22

Type material: Holotype (Figs. 92-93) in MNCN (15.05/39753) of23.7 x 14.3 mm. Paratypes in AMNH (I), BM:NH (I), MNHN (I), SMNS (I), USNM (I), CDR (I), CER (20), CGRM (I), CMF (I), CPR (1), all from type locality.

Other material studied: 10 sp, 8 j, Baia das Pipas; 6sp, Pipas Bay (SMNS).

Type locality: Baia das Pipas, Angola.

Shell description: Small to medium sized, moderately light to moderately solid. Last whorl ventricosely conical; outline convex at adapical third, slightly pyriform below. Aperture wider at base than near shoulder. Shoulder rounded. Spire of low to moderate height, outline convex. Postnuclear whorls eroded, sutural ramps slightly convex, without sculpture. Last whorl smooth, slightly glossy in smaller, duller in larger specimens, with some weak spiral grooves basally.

Ground color white; last whorl light orange-brown, leaving a white base and shoulder. The coloured part of last whorl may be reduced to irregular flecks or interrupted by white spiral bands. Aperture white

Periostracum brown, smooth, transparent

Description of animal: Unknown.

Shell morphometry:

L 18-24 mm
RD 0.66-0.72
RSH 0.04-0.15
PMD 0.73-0.80
RW 0.08-0.32 g/mm

Radula: In radula sac about 40 teeth. Tooth (Fig. 144) of vermivorous type, relatively small. PA smaller than half of DR; D in S, in one row in the upper part, sometimes two rows below. F poorly visible, in particular at its end, covering 7l-80 % of PA.

Radula morphometry:
(n = 4)

D 15-18
ABS 45°
LC/DR 45-64
DR/PA 2.1-2.3

Distribution: Found only in the type locality, living sympatricaly with c. fuscolineatus (Fig. 149) .

Habitat: under stones and rocks in 2-3 m.

Discussion: C. flavusalbus n. sp. has similarities only with some forms of c. fuscolincatus, which have narrow rows of spiral lines on last whorl and lack the white shoulder and base. They are sympatrically living in Baia das Pipas without showing intergradations

FINAL REMARKS

In this work 22 species of the genus Conus, endemic in Angola and considered valid, are presented and described. 16 taxa were previously kf!own and 6 more which are described as new. The populations corresponding with the type material of the 16 known taxa are ascertained and a number of type localities have been designated.

1- List of the endemic taxa of Angola cones supposedly valid, listed in chronological order of description with indications of the types:

Conus bulbus Reeve, 1843; Lectotype in BMNH, designated by COOMANS, MOOLENBEEK & WILS(1982)
Conus aemulus Reeve, 1844. Lectotype in BMNH, designated by BANDEL & WILS (1977)
Conus africanus Kiener, 1845. Holotype represented in Kiener (1849)
Conus guttatus Kiener, 1845, non Cucullus guttatus Roding, 1798. Holotype represented in Kiener.(New name: Conus neoguttatus da Motta, 1991)
Conus variegatus Kiener, 1845. Lectotype represented in Kiener, designated by ROcKEL & FERNANDES (1981)
Conus zebroides Kiener, 1845. Holotype represented in Kiener.
Conus carnalis Sowerby, 1879("1978"). Holotype in NMWZ.
Conus chytreus Metvill, 1884("1883"). Hototype in NMWZ.
Conus fuscolineatus Sowerby, 1905. Hototype in BMNH.
Conus cepasi Trovao, 1975. Holotype in CPAS.
Conus nobrei Trovao, 1975. Holotype in CPAS.
Conus musivus Trovao, 1975. Holotype in CPAS.
Conus naranjus Trovao, 1975. Holotype in CPAS.
Conus albuquerquei Trovao, 1978. Holotype in CPAS.
Conus bocagei Trovio, 1978. Holotype in CPAS.
Conus xicoi Rockel, 1987. Holotype in SMF.
Conus neoguttatus da Motta, 1991: non. nov. for c. guttatus Kiener, 1845.
Conus gabrielae Rolan & R&kel, 2000. Holotype in MNCN.
Conus micropunctatus Rolan & Rockel, 2000. Holotype in MNCN.
Conus filmeri Rolan & Rockel, 2000. Holotype in SMNS.
Conus franciscoi Rolan & R&kel, 2000. Holotype in MNCN.
Conus trovaoi Rolan & Rockel, 2000. Holotype in MNCN.
Conus flavusalbus Rolan & R&kel, 2000. Holotype in MNCN.

2- List of other taxa -invalid or not available -used for Angolan cones and (in bold) the not endemic valid species):

Conus alexandrinus "Paes da Franca" in Kaicher, 1978: nomen nudum.
Conus ambiguus Reeve, 1844: not endemic.
Conus amethystinus Trovao, 1975: Synonym of C. Carnalis.
Conus angolensis Paes da Franca, 1957: Synonym of C. zebroides.
Conus armatus auct. (e.g. CLOVER, 1978): nomen nudum.
Conus cesarensis auct.: nomen nudum.
Conus ermineus Born, 1778: not endemic.
Conus ficus auct.: nomen nudum.
Conus franciscanus Hwass, 1792: not a Conus from Angola.
Conus genuanus Linne, 1758: not endemic.
Conus gernanti Trov3o, 1978: Synonym of C. ambiguus.
Conus grayi Reeve, 1878: Synonym of C. ermineus.
Conus guttatus Kiener, 1845: Homonym of C. Guttatus Roding, 1798.
Conus hieroglyphicus var. Duclos in Kiener, 1845: is a misspelling of C. hieroglyphus Duclos, 1833, a Conus from the Caribbean.
Conus inquinatus Reeve, 1849: Synonym ot:.C. ermineus.
Conus lineopunctatus "Trovao" in KAICHER (1978):nomen nudum.
Conus lobitensis "Paes da Franca" in KAICHER (1978):nomen nudum.
Conus lucirensis Paes da Franca, 1957: Synonym of C.chytreus.
Conus lugubris Reeve, 1949: is a Conus from Cabo Verde Is.
Conus neoafricanus Da Motta, 1991: unjustified replacement.
Conus negroides "da Franca" in Kaicher, 1978: nomen nudum.
Conus obtusus Kiener, 1845: Synonym of C. variegatus.
Conus olivaceus "Kiener" 1845 auct.: not. C. Olivaceus Kiener.
Conus pipaensis auct.: nomen nudum
Conus pulcher Lightfoot, 1786: not endemic.
Conus tabidus Reeve, 1844: not endemic.
Conus taslei Kiener, 1845: is not from Angola.
Conus tevesi Trovio, 1975: a synonym of C. musivus; unjustified replacement for C. musivus.
Conus unifasciatus Kiener, 1845: is not from Angola.
Conus variegatus llKiener" in Walls, 1979: is C. chytreus.

3- Range of distribution (Table 1)

All species treated in this study have a limited range of distribution, corresponding with their direct development. There is in Angola a similar situation to that which we find in other isolated oceanic islands, in which a closely related group of species diversified -like,' for instance, the endemic cones in the Cape Verde Islands.

Nevertheless the geographical presence of most species is not constant, as the appropriate habitat for them to live in is not always available along the Angolan coast. Even in the protected bays, the distribution is not continuous. So it is rather curious that in the Cuanza-Sul-province no Conus have been found, perhaps because it is a sand-coast, not offering optimal habitats for cones. It seems that the area of Luanda separates two species complexes, one of them living in the southern part of Angola, the other one north of Luanda
.
There is a second line of isolation, not geographic, and perhaps the result of sea temperature differences: due to the cold current of Benguela which affects the southern Angolan coast. The freshwater current of the San-Nicolau-river (= Bentiaba-river) establishes another physical barrier

for the larval dispersal. Indeed, when we examined the distribution area of the species under study, only very few of them have been found on both sides of this river.

Species in the Luanda area:
C.aemulus
C. xicoi

Species living from Lobito to Lucira, north of Sao Nicolau:
C. albuquerquei
C. bocagei
C. bulbus
C. carnalis
C. cepasi
C. chytreus
C. micropunctatus
C. musivus
C. naranjus
C. neoguttatus .
C. nobrei ,
C. trovaoi
C. variegatus

Species living south of Sio Nicolau:
C. filmeri
C. flavusalbus
C. franciscoi
C. fuscolineatus
C. gabrielae

This is a provisional survey because numerous populations not mentioned in this work are still being studied.

Species of the North with similar patterned populations occurring in the south:
C. albuquerquei

Species from the North possibly having conspecific populations in the South:
C. zebroides

Species described from the South with similar patterned populations to those from the North and still to be studied about their conspecificity:
C.africanus

4- Phylogenetic relations among the species studied.

It is difficult to determine exactly the relationships between the species. All are vermivorous and most of them have similar shapes and sculptures. Nevertheless it is obvious. that some species have a close affinity, -for instance C. neoguttatus and C. trovaoi, C. chytreus and C. variegatus, and C. bulbus and C. musivus.

The radular teeth of most species have minor differences, but in some species the teeth appear to be closely related, as is in C. naranjus, C. neoguttatus and C. trovaoi; C. carnalis seems to have close relationship with C. tabidus and C. ambiguus, while C. franciscoi has a tooth differing from most of the other species.

Table I. Distribution of the known species of Conus.

1- Luanda area (Praia Santiago, Cacuaco, Corimba, Farol das Lagostas, Mussulo, Quanza).
2- Lobito
3- Benguela, Sobreiro, Caotinha, Caota, Baia Azul, Baia Farta)
4- Cuio, Equimina, Campcona, Elefantes Bay)
5- Limagens Bay
6- Baia Binga
7- Meva, Canoco Bay, Santa Maria Bay
8- Bonfim, Bissonga Bay, Lucira, Cesar Bay, Doca, Capato, Calonga.
9- São Nicolau, Bentiaba,
10- Salinas Bay
11- Chapeu Armado
12- Baia do Baba
13- Mocuio Bay
14- Baia das Pipas
15- Saco Mar (do Saco), Moçamedes Bay, Ponta de Noronha, Praia Amelia,
16- Tres Irmãos

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
C. bulbus			●			●	●									
C. aemulus	●															
C. africanus									●							
C. neoguttatus					●		●									
C. variegatus					●	●	●	●								
C. zebroides			●	●	●	●	●	●	●		●					
C. carnalis					●		●	●								
C. chytreus				●	●			●		●						
C. fuscolineatus									●		●	●	●	●	●	●
C. cepasi									●		●					
C. nobrei							●	●								
C. musivus					●		●									
C. naranjus			●			●	●	●								
C. albuquerquei							●									
C. bocagei		●														
C. xicoi	●															
C. gabrielae									●		●					
C. micropunctatus				●	●		●	●								
C. filmeri															●	
C. franciscoi									●		●					
C. trovaoi					●			●								
C. flavusalbus														●		