Conus cacao Ferrario, 1983, taxonomical and systematic context (Mollusca : Prosobranchia : Conidae).

José M. LAUER

Rue du Hohlandsbourg, 16, F-68920 Wintzenheim, France.

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ABSTRACT : As part of a revision concerning the taxonomy and the systematics of the Conidae from North-Western Africa, the research reveals that the types of *Conus franciscanus* Hwass in Bruguière, 1792 and *Conus lamarckii* Kiener, 1845 are within the natural range of variability of *C. guinaicus* Hwass in Bruguière, 1792, and thus are conspecific with this species.
Another separate species, usually admitted by authors as being *C. lamarckii* ("auctorum", non Kiener, 1845), and more often considered as a "variety" of *C. mercator* Linnaeus, 1758, remained without a valid name.

RESUME : Dans le cadre d'une révision concernant la taxonomie et la systématique des Conidae du Nord-Ouest Africain, les recherches ont démontré que les types de *Conus franciscanus* Hwass in Bruguière, 1792 et de *Conus lamarckii* Kiener, 1845, font partie de la variabilité naturelle de *Conus guinaicus* Hwass in Bruguière, 1792, et par conséquent sont conspécifiques avec cette espèce.
Une autre espèce distincte, généralement identifiée par les auteurs comme *Conus lamarckii* ("auctorum", non Kiener, 1845), et le plus souvent considérée comme une "variété" de *Conus mercator* Linné, 1758, était restée sans nom valide.

Conus cacao Ferrario, 1983 : p.146 + fig.

Original Description

"Often confused with *C. lamarckii* Kiener, a species which is related with *C. mercator*, this *Conus* on the contrary seems more allied with the mediterranean *C. ventricosus*, as indicates the two white bands inside the purple-brown aperture. Heigh of more than 3 cm (2,4 and 3,5 in the figured specimens) it has a colouration that varies between pale olive-green and chocolate-brown, with very fine axial lines, and 2-3 close reticulated bands. The shoulder is rounded ; the spire, strongly eroded, brown with white dashes, presents 5 fine grooves immediately below the suture between the whorls. The periostracum is velvet. Not very common, it lives in sand between the rocks of the littoral in some tens of meters depth, and is endemic from Senegal."

The same description and picture were reproduced in 1988, in a further publication : "Il Grande Libro delle Conchiglie" by the same editor, p. 113. The figured shells must be considered as syntypes.

Type

The largest specimen figured by Ferrario is here selected as lectotype of *Conus cacao*.

Due to the courtesy of Mr Ferrario, it is today deposited at the Museum National d'Histoire Naturelle in Paris. Its measurements are : 36.6 x 20.9 mm. (Fig. 1).

The second figured specimen (paralectotype, 24 mm) is preserved in the collection of Mr Ferrario.

Type Locality

Senegal. According with the original label of the lectotype, this one was collected between rocks at tide line in the bay of the estuary of La Somone river, Senegal.

Distribution

The species is endemic from Senegal and Gambia, between Yenne (South of Dakar) and Banjul (Gambia). Some specimens were collected more southern, near Cap Skirring and Kafoutine.

Material Examined

62 specimens were examined, 33 of which were measured, including the lectotype.

Additional Description

To the original description should be added some more characters : the spire is seemingly always eroded, so that the protoconch cannot be scrutinized. No larval shells were available. Consequently, counting the number of spire whorls was not easy. In a majority of shells (even when live or juvenile taken) only the 2 or 3 last spire whorls are intact. Thus, a precise valuation of the rate of the whorl expansion (WE) can be obtained only by mathematical ways (see morphometric measures and ratios).

Variability

The variability of the species concerns essentially the colour pattern, the colouration of the inside of the aperture, and the height of the spire (see tables). The background of the shell is olive-green, and totally covered with a network of very fine and close more or less straight undulating brown axial lines. Between this network, there are generally three bands, articulated with small lanceolate white dots. These bands are localized directly around the shoulder, on the first third of the body whorl, and a little lower than the median. Their width is variable, sometimes the bands are joined, sometimes the totality of the body whorl is covered with a net of lanceolate dots. In specimens with reduced patterns, subsists only a slight median band. (Fig. 3 c).

The colour of the aperture is the result of the violet colouration of the intermediate strate of the ostracum (mesostracum), this colour being visible by translucence of the inner strate (hypostracum). The mesostracum is pure white in *C. mercator*. The violet colour in *C. cacao*, well seen towards the edge of the lip, becomes paler towards the inside, because of the progressive thickening of the whitish hypostracum. This violet colour varies between dark violet and reddish-brown. Other characters are described in the morphological comparison table.

Taxonomic And Systematic Context

Before an examination of the validity of *C. cacao* Ferrario, it appears necessary to compare it with its congeneric species. There are two principal species and two colour forms (or ecotypes) which live in the same restricted area : *C. guinaicus* Hwass in Bruguière, 1792, *C. mercator* Linnaeus, 1758, *C. franciscanus* Hwass in Bruguière, 1792, and *C. lamarckii* Kiener, 1845.

Conus guinaicus Hwass in Bruguière, 1792 : p.697-698.

Hwass (in Bruguière) gave three latin diagnosis of three "varieties" which he distinguished in *C. guinaicus*. Their proposed translations are :

- Var. A : "Cone, shell conical rust-coloured, obsolete fasciae varying between whitish and brownish ; obtuse and maculated spire".
- Var. B : "Shell rust-coloured, distinct and broader fasciae."
- Var. C : "Shell with obsolete fasciae, ornamented with little pale bluish blotches."

Only two of these three "varieties" were illustrated in the "Tableau Encyclopédique", pl. 337, fig. 4 as Var. A, and fig. 6 as Var. C (KOHN, 1968 : 460). (Fig. 2 and 6).

The analysis of Bruguière's subdescription allows to identify as Var. A the most common phenotype from Senegal, which presents two more or less distinct bands, punctate with paler to whatever, sometimes cardiform and slightly bluish dashes on a reddish-brown to chestnut background. The periphery of the shoulder is often punctate with identical, but smaller dashes. Its figure in "Tableau", Pl. 337, Fig. 4 (our Fig. 4) is interesting to compare with some specimens of *C. cacao* (Fig.3 b) and could explain some ancient confusions. However, the intermediate flame-shaped dashes on the body whorl clearly indicate that the specimen figured in "Tableau" belongs to the species *C. guinaicus*, such flames being never seen in *C. cacao*.

The Var. B is distinct, according to BRUGUIERE (1792 : 698), only by lengthening of these dashes ("more considerable breadth of the fascies") and the formation of axial undulating flamules between this pattern.

The Var. C shows large distorded bluish-white dashes on a tawny to deep-brown background, with the presence, slightly below the midbody, of a paler band, distinctly visible by translucence of the lip. This whitish band also is seen in other "varieties", but is somewhat obliterated by the complexity of the external colour pattern. Only the shell of the Var. C today is available in the Hwass Collection at M.H.N.G. in Geneva (n° 1106/87 - 55,5 x 25,5 mm) and was designated by KOHN (1968) as lectotype of *C. guinaicus* Hwass in B. (Fig. 5).

Distribution

BRUGUIERE adds that these "varieties" occur on the "African coasts, and principally on the coasts of Guinea, which explains their name". LAMARCK (1822 : 493) confirms the same origin. The name of "Guinea" was used during the 18th century until to the second half of the 19th to designate the African coasts stretching from the Cap Vert peninsula (Senegal) to the actual Angola. The species today is known from Southern Mauretania to Sierra Leone and from the Canary Islands, where it seems rather rare. The affinities of *C. guinaicus* with *C. aemulus* Reeve, 1844 remain to be cleared up.

Variability

All the authors who treated about *C. guinaicus* noticed the extreme variability of the species (Fig. 7). This variability, even within one and a same population, is considerable and does not restrict to the three "varieties" described by Hwass and Bruguière. One can add several others, with as much intermediate variants, all these seeming only to be the result of the genetic variability of the species, unless today it is possible to impute them some determinant ecological causes. In this way, the forms shown on Fig. 7 come from the same ecological area which extends between Popenguine and M'Bour (Petite Côte, Sénégal).

Note

Although it was correctly identified by MARSH (1964) and by KAICHER (1977), *C. guinaicus* was confused with *C. ermineus* by WALLS (1979 : p. 285 above right).

Conus franscicanus Hwass in Gruguière, 1792 : p. 698-699.

Type

The specimen of the Hwass collection was selected by KOHN (1968) as lectotype of *C. franciscanus* Hwass in Bruguière. This specimen is kept at the M.H.N.G., Geneva, with the n° 1106/74/1 - 55 x 30,5 mm (Fig. 10).

Type Locality

"Africa" without other precisions.

Discussion

The lectotype of *C. franciscanus* is a faded, certainly beach taken and formerly polished shell, so that its original colour pattern, which appears as axially close lineated and reduced, became blurred and hardly recognizable. All its other characters oblige to recognize it as one of the multiple colour "varieties" of *C. guinaicus* : number of the spire whorls, characteristic median depression of the top of the two last spire whorls, texture of the body whorl, etc... RÖCKEL (1989 : 21-22) reached to the same conclusion. A single difference of colour patterns, in the context of the high natural variability of *C. guinaicus*, cannot be retained on a specific level, and *C. franciscanus* is concluded to be a colour variant.

Remarks

Kohn based *C. ventricosus* Gmelin, 1791 on one of the two figures published by KÄMMERER (1786, Pl. 6 fig. 3) and selected this figure as lectotype of *C. ventricosus* (KOHN, 1966 : Pl. 3, fig. 28).

The second figure of KÄMMERER (1786, Pl. 6, fig. 4) was also cited by Gmelin for his *C. ventricosus*, as well as by Hwass for his *C. franciscanus*. For this reason, I presume, Kohn synonymized the two names.

The controversy about the identity of *C. ventricosus* is for a long time. Some authors (BANDEL & WILS, 1977) pointed out the absence of a type-locality, of an available type-shell and an inadequate original description. The poor figure in Kämmerer may be interpreted as representing 4 or 5 diverse taxa : *C. caracteristicus* Fischer, *C. zeylanicus* Hwass, *C. guinaicus* Hwass, etc... These authors prefer using the name *C. mediterraneus* Hwass in Bruguière, 1792, proposed as a synonym by DAUTZENBERG (1920) and by KOHN (1968), but which presents the advantage to have a good and recognizable type figure, a well known type-locality and an original description that does not leave any doubt about the species concerned.

The generally admitted idea is that in the Mediterranean lives one and a sole species, if we except the rare ones which immigrate from the Red Sea via the Suez Channel (such as *C. fumigatus*) and eventually *C. desidiosus* Adams, whose identity remains to be cleared up. It seems more and more necessary to take an inventory of all the different Mediterranean populations to establish serious morphological, morphometric, ethological and anatomical comparisons and to set up proteinic electrophoresis, as well as genetic and phylogenic researches. It could not be excluded that we would find two different species : a first one which reaches rarely up to 30 mm in height (*C. mediterraneus*), and a second one which may reach 65 to 70 mm (*C. ventricosus*). For the moment, I personally prefer using the name *C. mediterraneus* for Mediterranean populations, and *C. ventricosus* for Lusitanian and North-West African populations.

Note

Some collectors, as well as some authors, consider several colour variants of separate species as being the "true" *C. franciscanus*. Between these, one can find some phenotypes of *C. mediterraneus*, *C. adansonii* Lamarck (= *C. hybridus* Kiener) or even of *C. aemulus* Reeve.

All these species belong to the same subgenus : *Lautoconus* Monterosato, 1923. As we indicated above, *C. franciscanus* is considered as a peculiar colour variant of *C. guinaicus* with a reduced pattern. This phenotypical particularity, which concerns only the colour pattern, also arises in other allied species. The colours vary from tawny to dark or blackish brown, but each specimen of these "colour forms" retains its other specific characters and may be identified by these characters, and not by more or less variable colour peculiarities.

Conus lamarckii Kiener, 1845 : p. 240.

Genesis

BRUGUIERE (1792 : 706, n° 98) described *C. luzonicus* for which Hwass had given two latin diagnosis whose proposed translations are :

1) - "Cone, whitish shell, dark-brown fasciae interrupted by lines which are punctated with milky coloured, like arrowheads formed spots ; spire convex and mucronate."

2) - "Cone, withish shell, stained with series of bands by "arrowheadish" and nebulous tawny spots ; spire obtuse, aperture bluish."

Only the first "variety" has been figured in the Tableau Encyclopédique (Pl. 338, fig. 6) the figure of which was designated by KOHN (1968) as representative of the holotype of *C. luzonicus*. This taxon has been diversely interpreted by successive authors :

KIENER (1845, Pl. 83 fig. 3) seems to have only reproduced the figure of the Tableau, with some "ameliorations" and had considered it as a synonym of *C. portoricanus* Hwass in Bruguière (1792 : 714, n° 1107 ; Tableau Pl. 338, fig. 4).

Successively REEVE (1844), CROSSE (1858) and WEINKAUFF (1873) considered *C. luzonicus* as a nomen dubium.

KOHN (1968 : 465) synonymised it with *C. testudinarius* Hwass in Bruguière (= *C. ermineus*) as well as *C. portoricanus* (1968 : 756), followed by VINK (1989, II : 7) who considered it as a juvenile and still granulose specimen of *C. ermineus*.

Hwass's second "variety" has been reconsidered by LAMARCK (1822 : 497, n° 118 [b] as his own "variety[b]" of *C. luzonicus* a specimen of which he possessed in his own collection. KIENER (1845 : 240, Pl. 83, fig. 4) seems to be the first one to distinguish this *Conus*, which he called "Cône de Lamarck" or *C. lamarckii* as a species separated from *C. luzonicus*. MERMOD (1947) states that the shell figured by Kiener, and which is kept in the M.H.N.G. in Geneva (N° 1105/87), holotype of *C. lamarckii*, is also the type of Lamarck's *C. luzonicus* "var. [b] (Fig. 8). Thus the synonymy between both taxa is objective.

Kiener's diagnosis (translated from latin) is: "Cone, turbinate shell, thick, swollen towards the upper part, tawny with two fasciae, whitish reticulated dots, spire rounded, obtuse and mucronate with a decurrent excavation, white dashed."

Some precisions are brought in the description : "the spire counts six whorls which are marked below the suture with a superficial decurrent groove, and the spire, of a deeper colouration, is marked with brown and white blotches". Kiener adds : "nice species which was confused by Lamarck with the *Conus luzonicus*, and constituting his variety b. But it is enough to glance over the figures which represent both species to ascertain the differences of their forms or of their colouration."

A superficial examination is sufficient to be convinced that the holotype of *C. lamarckii* also belongs to the variability of *C. guinaicus*, and has very little to do with the *Conus* usually called *lamarckii* (auctorum = *C. cacao* Ferrario) in the literature or even in Museums.

A second and more careful examination and a comparison with series of *C. guinaicus* constrain to identify it as a variant of this species which could be placed at halfway between the phenotype "var.b" of Hwass and the phenotype *C. franciscanus*. Also here the morphological differences are only restricted to the colour pattern of the shell, and its morphometric parameters (see tables) fall in the range of those of *C. guinaicus*. A similar shell was figured by WALLS (1979 : 648, above left) with the erroneous label "*C. taslei*", which is another species. A shell with a similar pattern is shown in our Figs. 7 a and 9.

From these conclusions ensues that C. lamarckii auctorum (non Kiener) remained during a long time without a valid name before Ferrario described it as Conus cacao.

COMPARISONS:

The morphological and morphometric differences between *C. cacao* and *C. guinaicus* are easy to establish. For a long time, it was also considered as a "variety" of *C. mercator* (KAICHER, 1977, III, Card 1250 ; CLOVER, 1978 : 18 ; WALLS, 1979 : 453 below right (?) ; KORN, 1988 : 25, etc...). Some other authors held it as a separate species but with the name "*C. lamarckii*". PIN (1989) established the differences between all these Senegalese *Conus* on basis of their "anal channel", which is strongly tinged with violet in *C. cacao* and pure white in *C. mercator*. (See fig. B).

The Comparison Tables and Graphs will convince better than long sentences.

GEOGRAPHICAL DISTRIBUTION

(See Fig. A). : *C. guinaicus* is commonly distributed along the West-African coasts, from Mauritania to Sierra Leone. It also lives in the Canary Islands.

The normal distribution range of *C. cacao* is restricted along the "Petite Côte", the part of the Senegalese coast between Yenne (northern) and Banjul (southern, Gambia). Some specimens were collected more southern, in Casamance, near Djembering and Kabrousse, which appears the extreme limit of the distribution range of *C. cacao*.

The range of *C. mercator* runs around the Cap Vert peninsula, from Yoff (northern) to Bel Air (southern), including Gorée Island.

C. mercator and *C. cacao* live allopatric. The first one habits in sandy bottom under rock falls, whereas the second is always associated with algae substrates.

CONCLUSIONS:

There are 17 morphological characters which distinct *C. cacao* from *C. guinaicus*, and 13 other ones which distinct it from *C. mercator*. Their morphometric parameters also confirm these differences, as shown in our table. Consequently, *C. cacao* is to be considered as a valid species.

C. franciscanus Hwass, as well as *C. lamarckii* Kiener should be considered only as colour variants of the species *C. guinaicus* Hwass.

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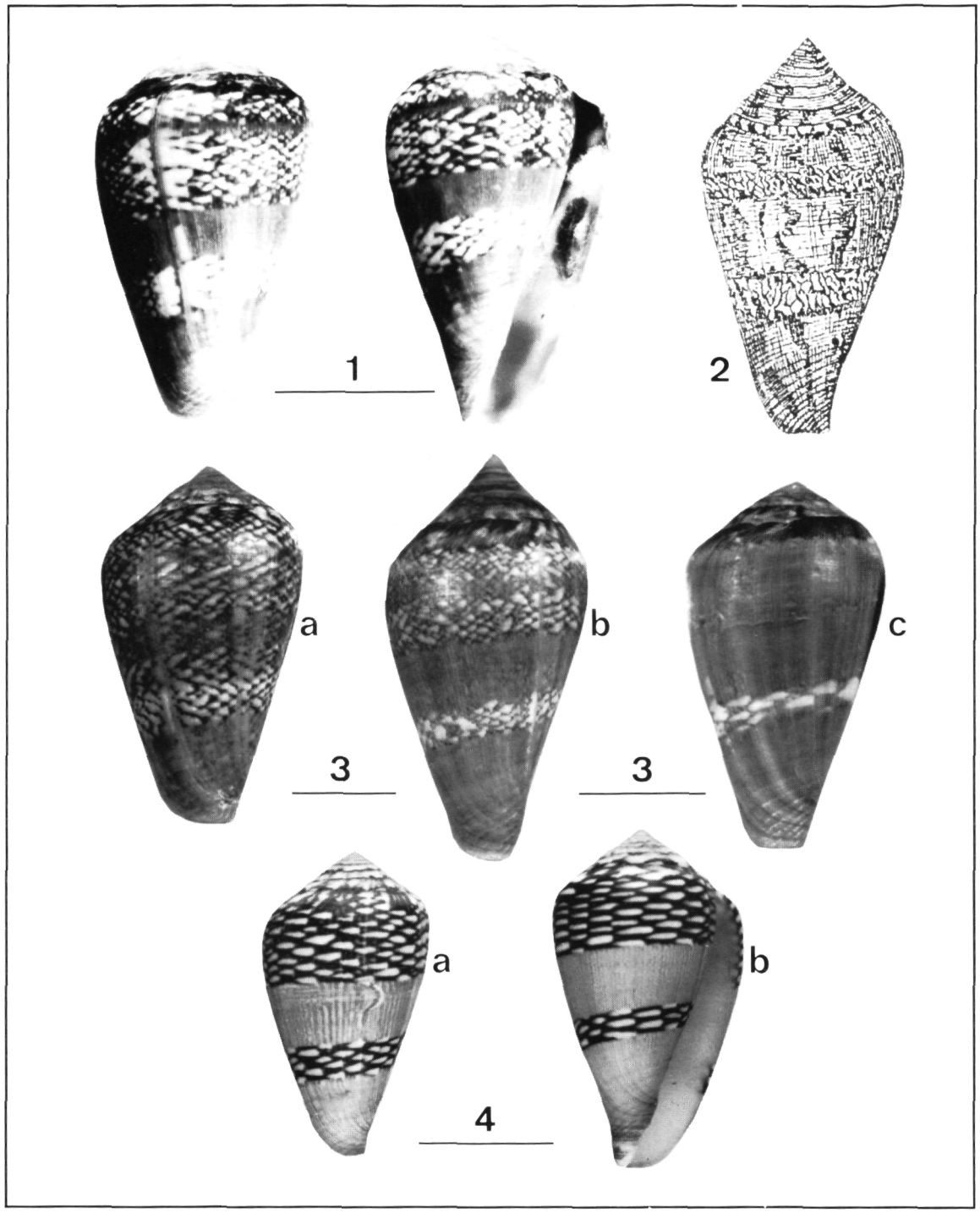


Fig.1 - *Conus cacao* - lectotype, M.N.H.N. Paris - 36.5 x 20.9 mm. dorsal and apertural views (Phot.Lauer)
Fig.2 - *Conus guinaicus* var.A.,in"Tableau",Pl.337,Fig.4. (to compare with Fig.3b)
Fig.3 - *Conus cacao* - Variability - Petite côte, Senegal - a)32 mm - b)36.3 mm - c)33 mm.(Phot.& coll. Lauer)
Fig.4 - *Conus mercator* - N'Gor, Sénégal - a)41.8 mm - b)46 mm.(Phot.& coll. Lauer)

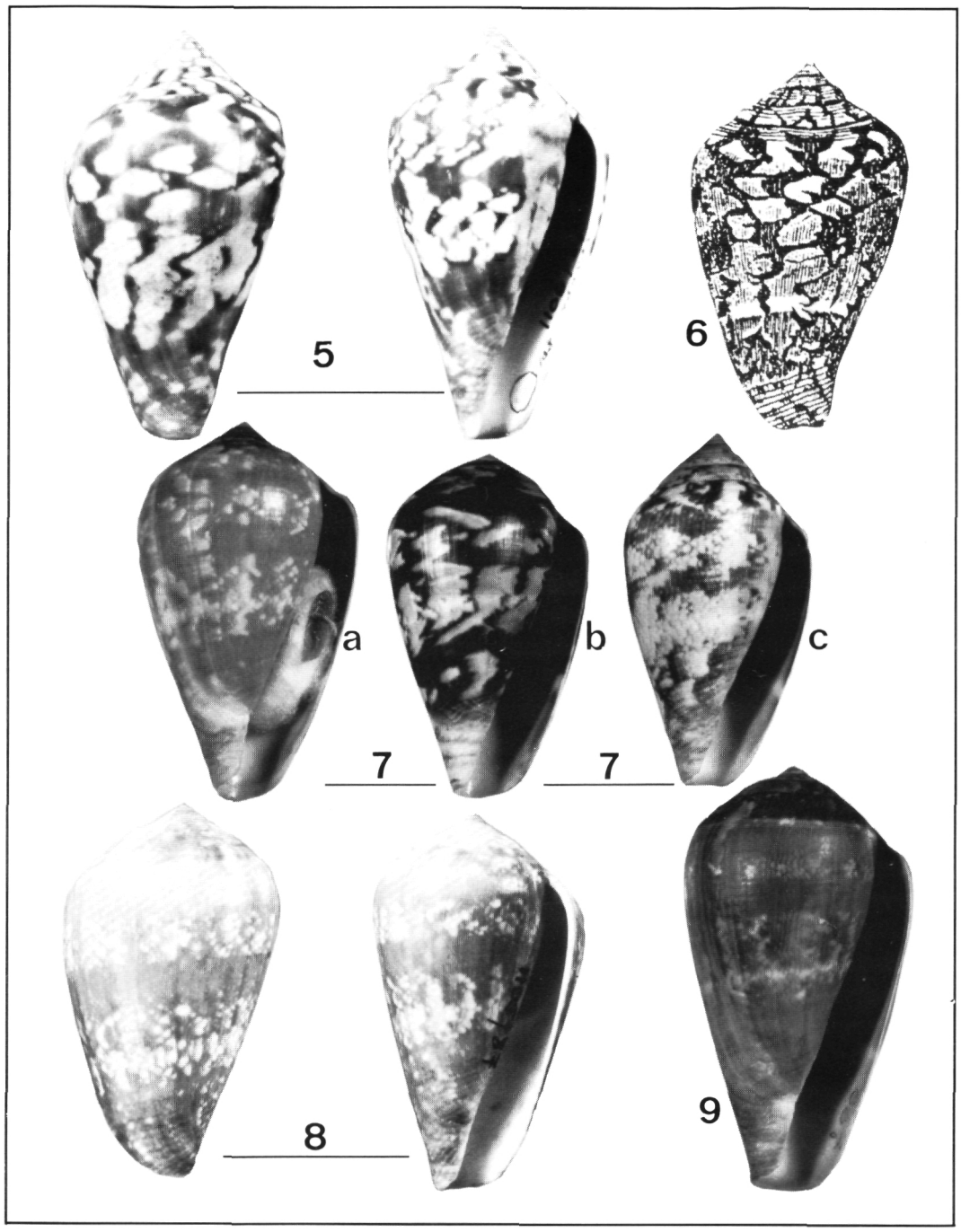


Fig.5 - *Conus guinaicus* - lectotype M.H.N.Genova. - 55.5 x 25.5 mm. (Phot.Dajoz, M.H.N.G.)
Fig.6 - *Conus guinaicus* var.C,in "Tableau",Pl. 337, Fig.6
Fig.7 - *Conus guinaicus* - Variability - Popenguine, Senegal - a)47 mm b)44.1 mm - c)M'Bour, Sénégal:43.4 mm. (Phot.& coll. Lauer)
Fig.8 - *Conus lamarckii* - holotype M.H.N.Genova. - 39.5 x 19.7 mm (Phot.Dajoz, M.H.N.G.)
Fig.9 - *Conus guinaicus* f.*lamarckii* - "homeotype"(*) Petite Côte, Senegal, 44.7 mm.(Phot.& coll.Lauer)

* The term "homeotype is here used to indicate a specimen which closely matches with de type of the species.

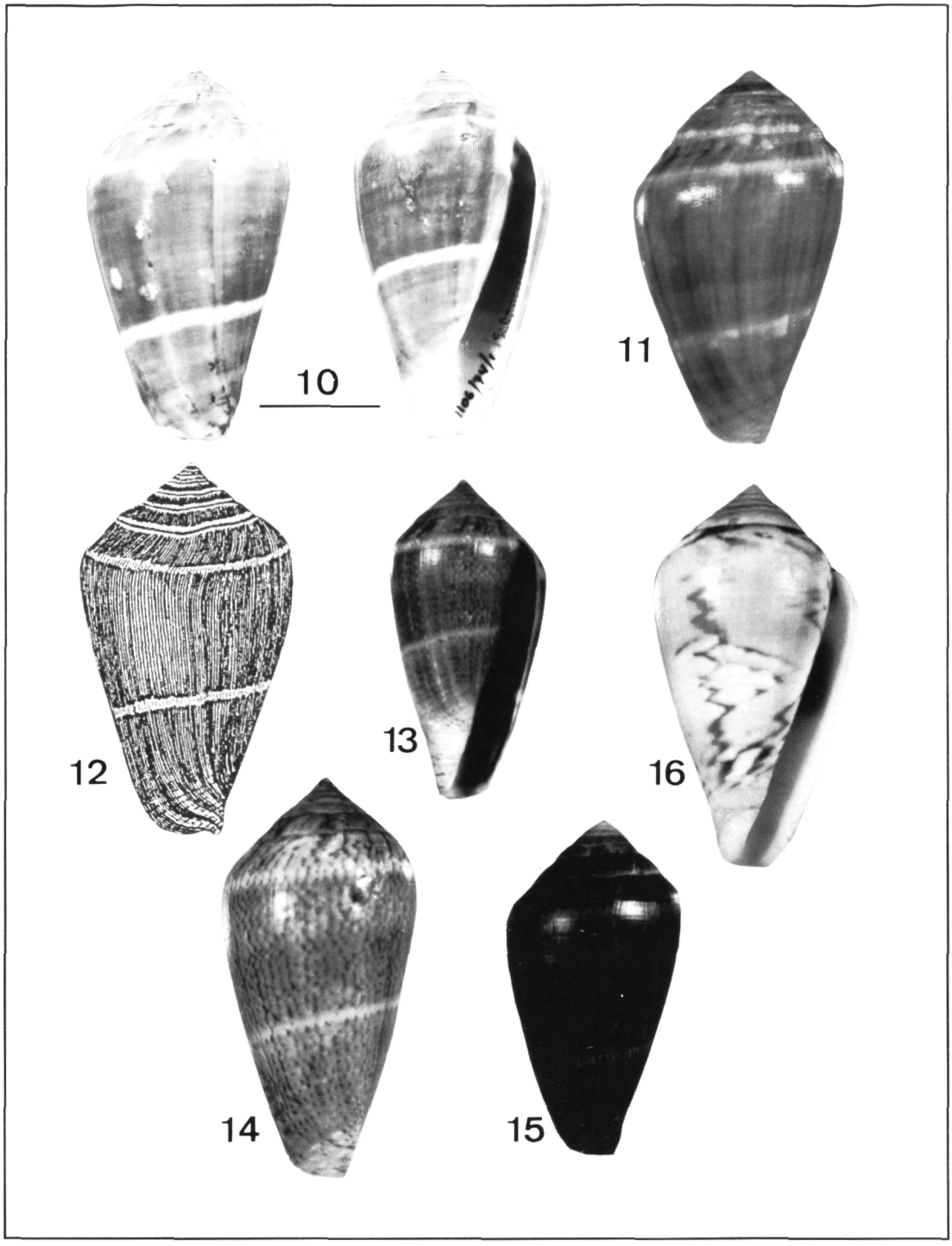
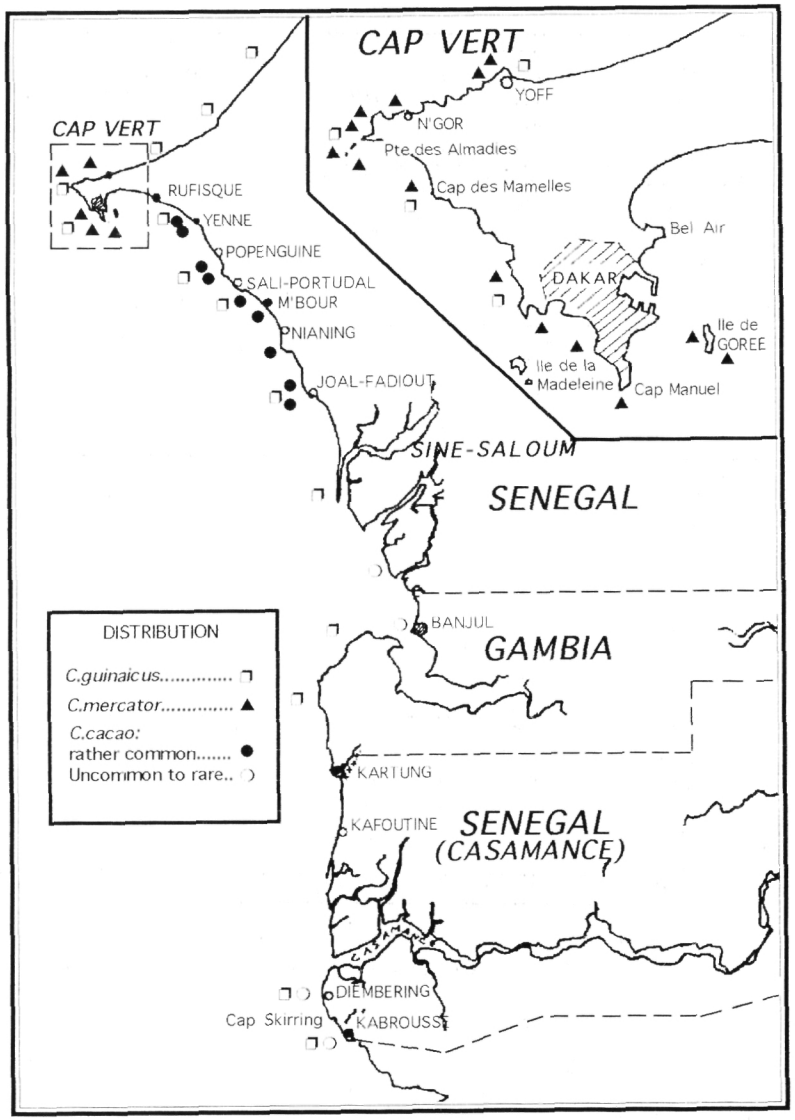


Fig.10 - *Conus franciscanus* - lectotype - M.H.N.Genova, 55 x 30.5 mm. (Phot.Dajoz)
Fig.11 - *Conus guinaicus* f.*franciscanus* - homeotype(*) - Petite Côte, Senegal - 40.9 mm. (Phot.& coll.Lauer)
Fig.12 - *Conus franciscanus* in "Tableau",Pl.337,F.5.
Fig.13 - *Conus adansonii* "f.*franciscanus*" - N'Gor, Senegal 40.5 mm.(Phot.& coll.Lauer)
Fig.14 - *Conus adansonii* "f.*franciscanus*" - N'Gor, Senegal 46 mm.(Phot.& coll.Lauer)
Fig.15 - *Conus aemulus* "f.*franciscanus*" - Angola 33.5 mm.(Phot.& coll.Lauer)
Fig.16 - *Conus species* aff.*mercator* - N'Gor, Senegal 32.3 mm.(Phot.& coll.Lauer)

* The term "homeotype" is here used to indicate a specimen which closely matches with de type of the species.



Distribution map of *C.guinaicus, C.mercator and C.cacao*

TABLE 1 - MORPHOLOGICAL COMPARISONS

CHARACTERS	*Conus guinaicus*	*Conus cacao*	*Conus mercator*
PROTOCONCH	white, always more or less strongly eroded. Number of whorls hard to establish.	white, always strongly eroded. Number of whorls hard to establish.	of paucispiral type, mostly eroded, 1.5 to 1.7 larval whorls.
SPIRE	from 7 to 8.7 (Mean 7.8)spire whorls . Sides straight to slightly convexe. Whorls nearly flat to convexe, the last one being depressed in its middle.	from 7 to 8.3 (Mean 7.8) spire whorls . Sides usually concave in mature specimens, sometimes straight or even convexe in juvenile ones. Whorls flat, the upper part of the last whorl being convexe and rounded.	from 7 to 9.7 (Mean 8.6) postnuclear whorls . From straight to slightly convexe or slightly concave sides. Usually convexe in juveniles. Whorls convexe.
SPIRE SCULPTURES	very fine radial striae; from 4 to 7 fine spiral grooves, sometimes obsolete.	fine radial striae; 4 to 5 spiral grooves, only visible on the two last whorls, the other being to strongly eroded.	fine radial striae, 3 spiral grooves, principally visible on the last whorl.
SPIRE SUTURE	somewhat irregular, the upper edge of the whorls overlaping slightly the base of the preceding ones.	rather regular and linear.	linear.
SHOULDER	rounded with a very weak subangulation.	rounded without subangulation.	rounded without subangulation.
BODY WHORL	Swollen, smooth and moderately glossy. Fine axial and very faint spiral striae. Base: 10 to 12 weak undulating and near flat ridges.	sides from moderately swollen to nearly straight. Smooth and satiny fine axial and very faint spiral striae. Base: 8 to 10 more or less varicose flat costulations.	moderately swollen, sometimes nearly straight sides. Very fine axial striae. Base: 7 to 9 more or less varicose and weak costulations.
COLUMELLAR FOLD	fine, flat to somewhat twisted, of white to yellowish colour.	moderately strong, nearly straight, grayish with a browm marking near the base.	strong, pure white, hearly straight.
APERTURE	rather wide, enlarging towards the base.	moderately wide, lip nearly parallele to the columella.	moderately wide, slightly enlarging towards the base.
LIP	fine and sharp. Origin: prolonging the apical angle and showing a median concavity which is characteristic in *C.guinaicus*.	fine and sharp. Origin: generally prolonging the apical angle, often more elevate than the side of this angle. Rounded, without a median depression.	fine and sharp. Origin: prolonging the apical angle sides, rounded without a depression.
COLOUR PATTERNS Spire	Earlier whorls white to tawnish with an upper chestnut border. Multiform chestnut to chocolate brown dashes on a white background.	Earlier whorls eroded and whitish with an upper brown to blackish border. Small elongate white spots on a dark-brown background.	Earlier whorls mostly eroded. Further ones springled with reddish-brown dashes on a white background. Following whorls with somewhat lanceolate white dashes with brown outlines.
Body whorl	Whitish background, often suffused with pale bluish to geenish tones. Pattern of close axial lines, whose colour varies between yellowish ochre and dark or even blackish-brown. Presence of a median fascia of whitish dashes, generally lanceolate and spirally elongate. Two other occasional fascies of smaller dashes are localized below the shoulder and towards the base. Great variability of the patterns, the one of the lectotype being rather uncommon.	Olive-greenish background. Pattern of very fine and close chestnut to reddish-brown axial lines. Usual pattern: three fasciae of lanceolate white and close spots of variable width. The variability concerns essentially the general colouration (from deep to light), and the width of the fascies. Reduced patterns show only a small whitish band on their median.	Pure white background. Axial orange-ochre to light chest-nut close axial lines. Usual pattern: a wide fascia of spirally elongate lanceolate white dashes outlined with deep chocolate-brown, and whish covers from 1/3 to 1/2 of the anterior part of the body whorl. A second, smaller fascie with the same ornamentation is placed slightly below the midbody. The variability concerns the width of the fascies, the more or less strong elongation of their white dashes and their dimensions.

Aperture	Tinget of tawnish brown, with two small whitish bands directly below the shoulder and slightly below the midbody. The white colour of the hypostracum may be shaded of bluish gray.	Tinget of dark violet to chestnut-brown. The edge of the lip is inside sometimes bordered with orange-tawn . Two whitish small bands below the shoulder and slightly below the midbody.	Pure white. Some "varieties" showing dark blotches inside the aperture need further investigations concerning their specific belonging. These "forms" may show very large and distorded dashes on a white to grayish or greenish background.

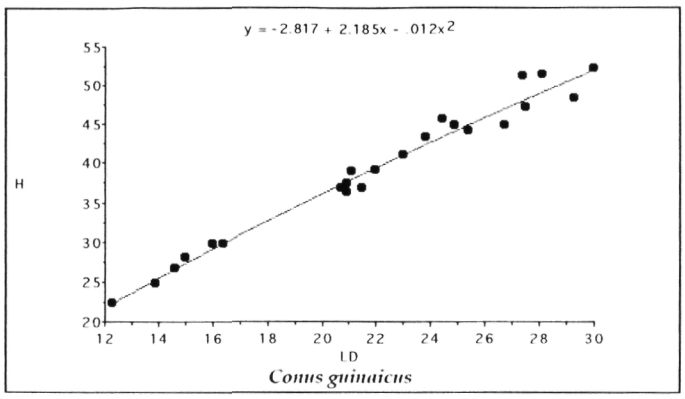
TABLE 2 - MORPHOMETRIC COMPARISONS

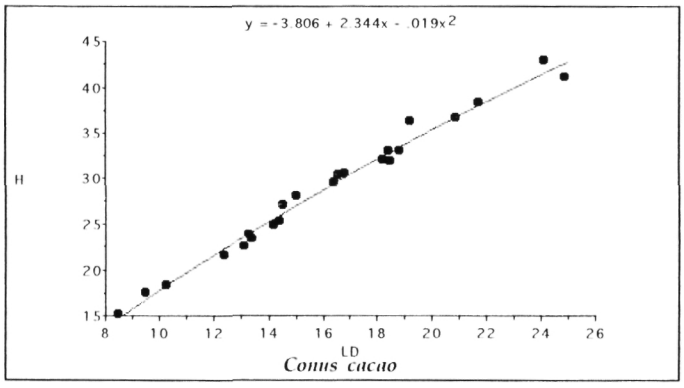
The samplings include specimens from subadult to adult stages (growth series)

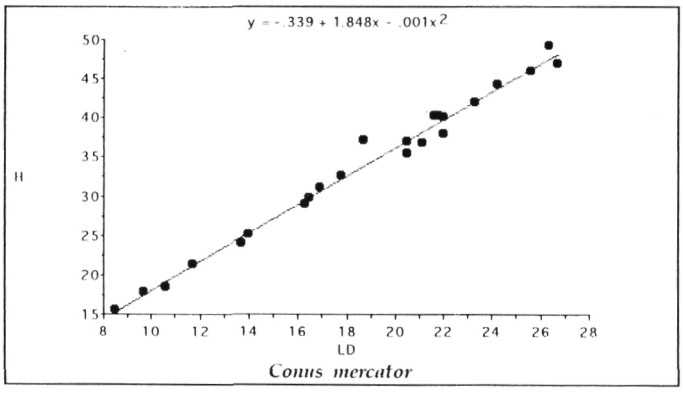
		C.guinaicus	*C.cacao*	*C.mercator*
H	Minimum	22.3	15.2	15.6
HEIGHT of the SHELL	Maximum	52.2	42.9	49.3
	MEAN	39.14	28.83	33.81
	Stand.deviation	8.89	7.45	9.79
	Variation Coef.	22.71 %	25.83 %	28.95 %
	Confid.Interval 95 %	22.4 > < 56.9	13.9 > < 43.7	14.2 > < 53.4
LD	Minimum	12.3	8.5	8.5
LARGEST DIAMETER	Maximum	30	24.9	26.7
	MEAN	22	16.22	18.7
	Stand.deviation	5.23	4.33	5.34
	Variation Coef.	23.78 %	26.67 %	28.72 %
B	Minimum	17.4	12.1	12.1
HEIGHT of the BODY	Maximum	41.3	36.3	40.8
WHORL	MEAN	31.9	24.36	28.41
	Stand.deviation	7.48	6.58	8.29
	Variation Coef.	24.44 %	27.02 %	29.18 %
S	Minimum	4.3	2.2	2.9
HEIGHT of the SPIRE	Maximum	11.5	7.3	10.1
	MEAN	7.24	4.48	5.4
	Stand.deviation	1.91	1.28	1.91
	Variation Coef.	26.39 %	28.57 %	35.29 %
AA°	Minimum	87	88	86
APICAL ANGLE	Maximum	112	123	118
(in degrees)	MEAN	99	105.8	104.7
	Stand.deviation	7.19	9.17	9.57
	Variation Coef.	7.26 %	8.67 %	9.14 %
	Confid.Interval 95 %	84.6 > < 113.4	87.5 > < 126.1	85.5 > < 123.8
W	Minimum	1.3	0.65	0.52
WEIGHT	Maximum	17.78	10.6	12.89
(in gramms)	MEAN	7.92	3.71	5.86
	Stand.deviation	4.79	2.69	3.96
	Variation Coef.	60.44 %	71.93 %	67.58 %

		C.guinaicus	*C.cacao*	*C.mercator*
H/LD	Minimum	1.65	1.65	1.73
	Maximum	1.87	1.89	1.99
	MEAN	1.79	1.78	1.89
	Stand.deviation	0.06	0.06	0.06
	Variation Coef.	3.42 %	3.12 %	3.20 %
RSH	Minimum	0.14	0.1	0.11
RELATIVE SPIRE	Maximum	0.25	0.2	0.22
HEIGHT	MEAN	0.19	0.16	0.16
(S/H)	Stand.deviation	0.03	0.03	0.03
	Variation Coef.	15.61 %	20.04 %	19.93 %
RD	Minimum	0.65	0.63	0.63
RELATIVE DIAMETER	Maximum	0.75	0.72	0.7
of the BODY WHORL	MEAN	0.69	0.67	0.66
(LD/B)	Stand.deviation	0.02	0.023	0.016
	Variation Coef.	3.48 %	3.47 %	2.46 %
W/H	Minimum	0.06	0.04	0.03
RELATIVE WEIGHT	Maximum	0.34	0.23	0.28
	MEAN	0.18	0.12	0.15
	Stand.deviation	0.08	0.06	0.07
	Variation Coef.	44.18 %	48.09 %	49.95 %
RWE	Minimum	1.11	1.15	1.16
RELATIVE WHORL	Maximum	1.21	1.26	1.21
EXPANSION	MEAN	1.17	1.19	1.18
(LD/SD)	Stand.deviation	0.02	0.03	0.01
	Variation Coef.	1.83 %	2.26 %	1.30 %
AE	Minimum	0.06	0.09	0.09
APERTURE EXPANSION	Maximum	0.12	0.15	0.12
(AW/B)	MEAN	0.1	0.12	0.1
	Stand.deviation	0.01	0.01	0.01
	Variation Coef.	10.98 %	13.50 %	8.71 %
RBA°	Minimum	24.2	20.4	22.4
RELAT.BASAL ANGLE	Maximum	38.1	33.6	32.3
	MEAN	29.9	27.6	27.7
	Stand.deviation	3.46	3.53	2.71
	Variation Coef.	11.58 %	12.80 %	9.80 %
RSA°	Minimum	109.6	106.2	107.5
RELAT.SPIRAL ANGLE	Maximum	123.7	122.3	122.4
	MEAN	115.6	113.3	113.8
	Stand.deviation	3.59	4.37	4.38
	Variation Coef.	3.10 %	3.86 %	3.85 %

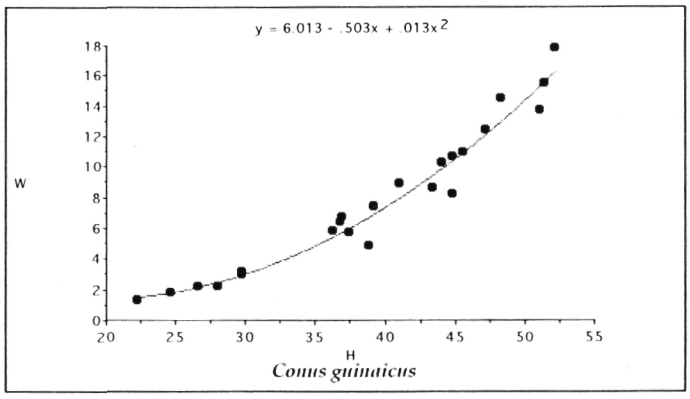
GRAPHS I - POLINOMIAL REGRESSION of H vs LD

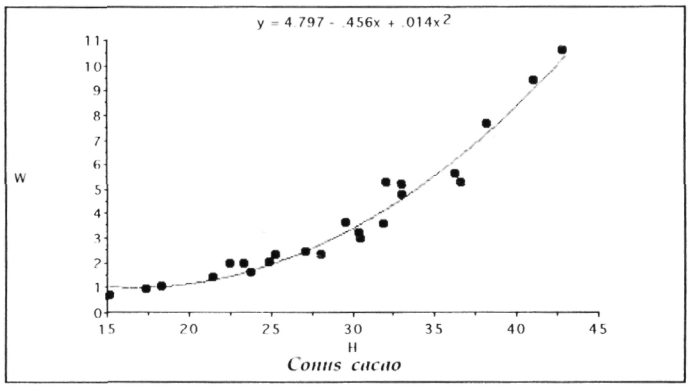


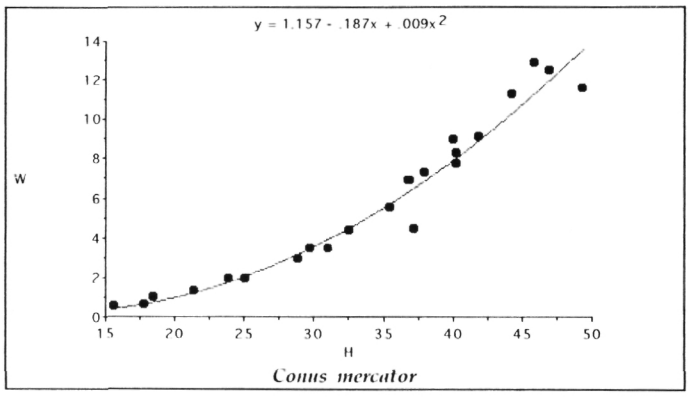


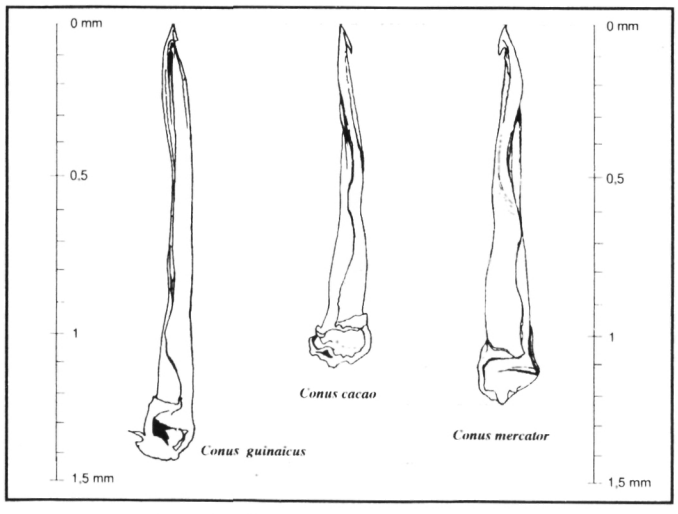


GRAPHS II: POLINOMIAL REGRESSION of W vs H

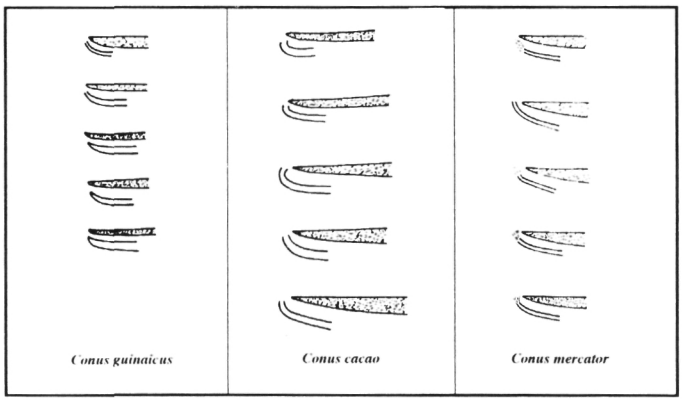








RADULAR TEETH of *C.guinaicus*, *C.cacao* and *C.mercator*



COMPARISON TABLE OF THE " ANAL CHANNELS " in *C.guinaicus*, *C.cacao* and *C.mercator*
(after PIN (1989). Scale: x 2)