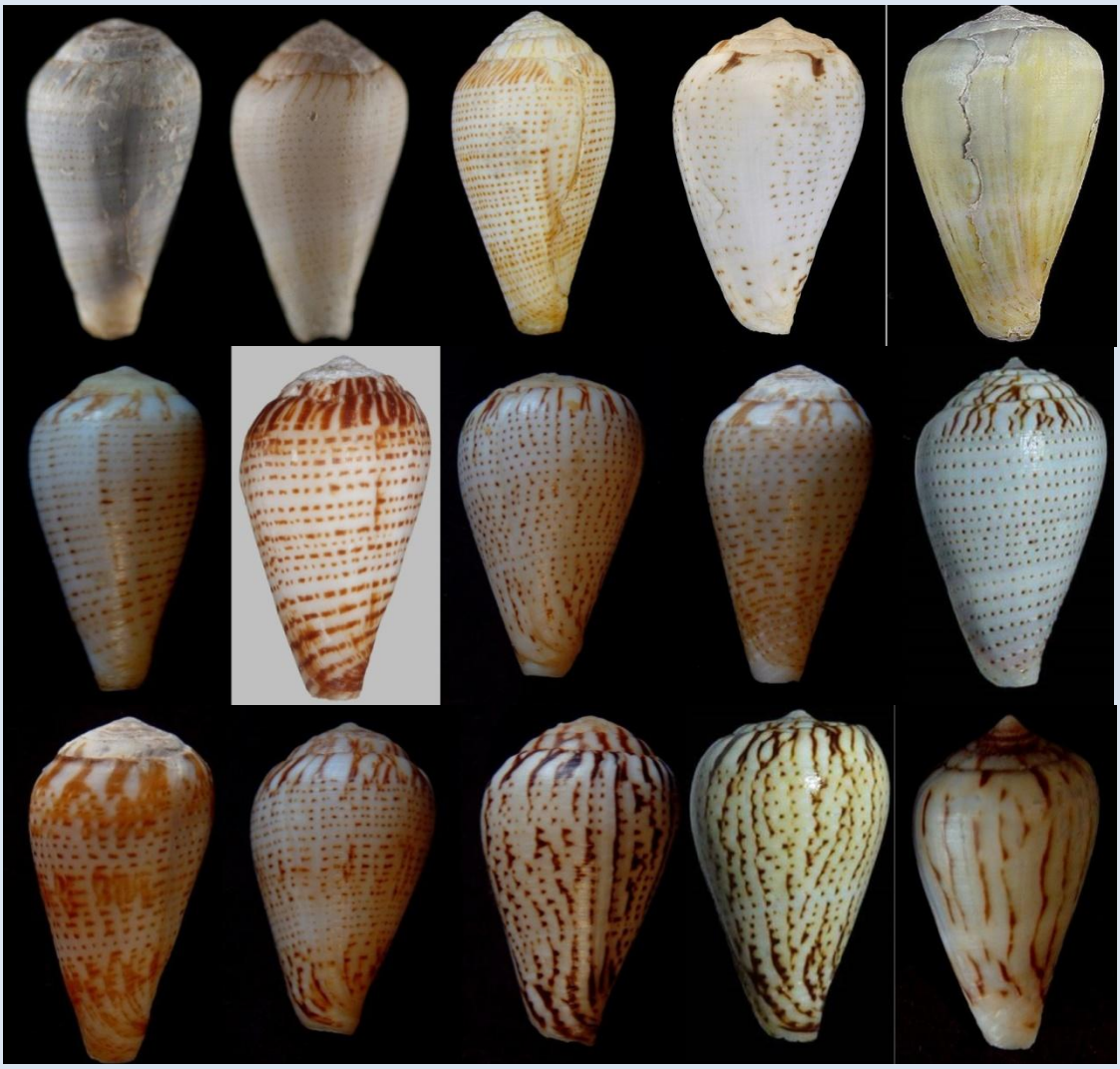
Identifying Angolan Cones

Identifying Angolan cones from the shell morphology?



How many species in the above picture?

At least 3 currently accepted species. The type specimens of *C. micropunctatus, C. lineopunctatus* and *C trovaoi* are in the top row on the right.(specimens 3-5)

Top row: specimen 1 on the left is labelled in the DNA set as *C. trovaoi* . The only shell features that would justify this label are the white spiral lines at the shoulder and middle and a purple aperture. Perhaps the radula is similar to the distinctive small radula of *C. trovaoi*?.

Top row: specimen 2 is labelled *C. micropunctatus* in the DNA set. It has a dotted pattern and thin axial lines on shoulder as found on *C. micropunctatus* but shape nearer to *C.lineopunctatus*.

Middle row: the central specimen 8 has the dotted pattern of *C. micropunctatus* but the shape of *C. lineopunctatus.* On its left, specimen 7 has a strong pattern of dashes suggesting *C. lineopunctatus*; on its right, specimen 9 is a bluish specimen with the pattern of *C. lineopunctatus* but the narrower shape of *C. micropunctatus*.

The specimens with tones of blue or green in the ground colour, all have a purple aperture.

Row three: specimens include a banded population of orange shells from Santa Maria; specimens from Limagens in which the pattern begins to include arrow heads and the formation of wavy axial lines.

There is invaluable information to be found if you have a sequence of specimens.

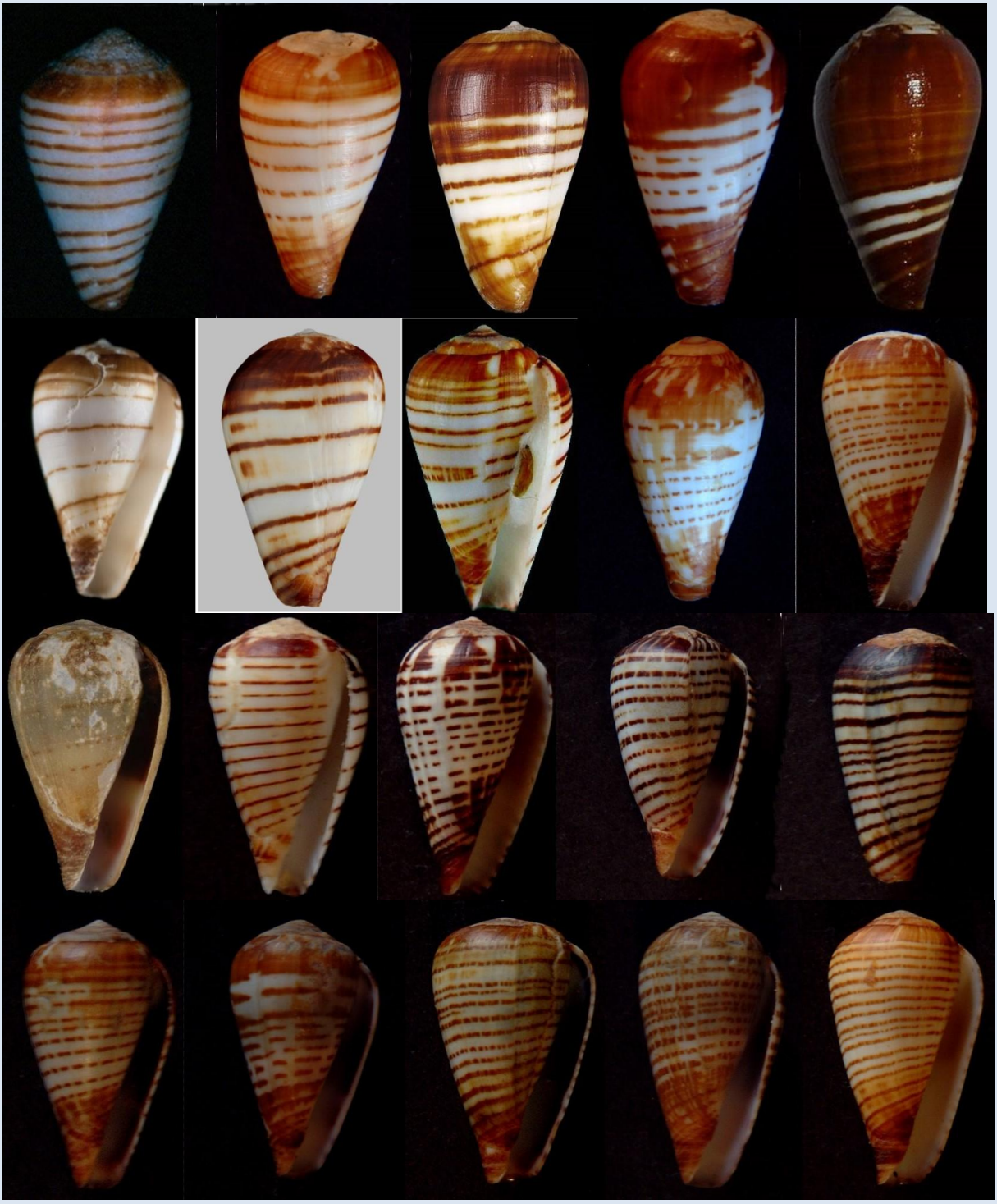
Santa Maria C. species. Note the sequence shows differing spiral areas of orange bands.

Limagens growth sequence of *C. aff trovaoi.*

To illustrate some of the identifications further one can consider *C. chytreus*.

Its key pattern features are a solid brown pattern on its spire, bands of spiral uninterrupted lines and a white aperture.

The first row of specimens below match the description of the type specimen on the left and the specimens gradually change colour form with more and more brown in the pattern.



In the second row, the left specimen is recorded as *C. chytreus* in the DNA set. On the other specimens, the lines become interrupted and the brown shoulder pattern shows matching spots. One would question whether the specimens on the right of row 2 are C. chytreus.

In the third row, the left specimen is very similar to the DNA *chytreus* specimen immediately above it, except for the purple aperture normally found when blue is in ground colour. It was interpreted questionably and published as *C. variegatus* . The specimen on the right from Campiona with solid colour on its spire and uninterrupted spiral lines looks like *C. chytreus* except for its blue ground colour and purple aperture. However the specimen on its left also from Campiona has a very similar pattern with broken spiral lines and a narrow white band at the middle with small spots; many such specimens are interpreted as *C. variegatus.*

In the fourth row, it would be a challenge to separate specimens between *C. variegatus* and *C. chytreus* without using other factors such as DNA or the radula.

In Rolán & Röckel, 2000, *C. bulbus* and *C. musivus* were maintained as separate species. However, the shape and patterns are quite similar in many specimens and there is no significant difference in their radulae.

Specimens of *C. bulbus.* Lectotype left specimen.


C. alexandrinus holotype


C.musivus holotype

While most specimens of *C. bulbus* lack arrowheads in their patterns, the specimen 5 on the right above shows chevrons creating the axial streaks. In the patterns of the types of *C. alexandrinus* and of *C. musivus*, the chevrons create a distinctive reticulate pattern.

The set of specimens below from Limagens shows the variability.

Specimens *C. aff. musivus* from its type locality Limagens.

Perhaps two or three specimens from the original set of 70 specimens collected by Chris Schönherr at Limagens, could be considered as possible *C. bulbus*.

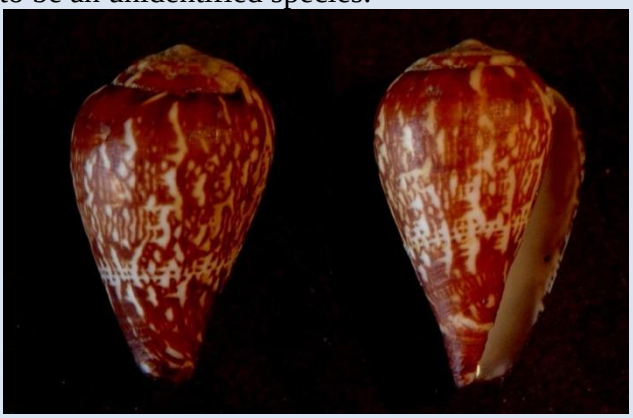
However the pattern elements of *C. musivus* are not found outside a small area around Limagens whereas specimens with the *C. bulbus* pattern have a wide range from Azul to Santa Maria.

If they were the same species, it would be highly unusual to find that no morphs with the pattern of *C. musivus* were to be found in the northern part of the distribution range; only *C. bulbus* patterns are found in the north.

Rolán & Röckel concluded:
"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"

A valid, but most unusual criterion to use in separating species!

As an illustration of a challenge in identification, a specimen recently found at Meva appears to be an unidentified species.



Meva 22mm

The shell at length 22mm has a wide rounded shoulder and wide aperture. Its ground colour is white with a brown pattern; solid brown on the shoulder, a narrow white band at the middle with row of dots; large areas of brown at base and shoulder; and an axial pattern of white streaks and thin wavy axial brown lines.

Found at Meva to the south of Limagens, the Rolán & Röckel distribution chart lists the following similar species in the area: *bulbus, naranjus, musivus, zebroides, tenuilineatus.*

Type specimens of bulbus, musivus/alexandrinus, tevesi(syn musivus) naranjus,tenuilineatus.

A comparison with the Meva specimen would suggest elements of *C. musivus* and *C. tenuilineatus.*

Other specimens collected at same time show significant variation in pattern and shape showing features of *C. tenuilineatus, C. musivus and C. bulbus*.

Meva 20mm

Meva 25mm

Meva 26mm

Meva 24mm

Meva 18mm

Meva 26mm

Meva 15mm

Juveniles would seem to indicate that the shell form replicates across generations. In a batch of 30 similar specimens from Meva, no dominant form could be identified.

Have we one species or three? The next trip to Meva will prioritise getting some preserved specimens so that the radula can be tested for several forms which will help in defining how many species are involved.

One day when a database of comparative data is accumulated for Angolan cones, DNA may resolve the

issue so the depositing of specimens with institutions for future testing remains essential to progress.

Guidance for the shell collector.

Check the specimen thoroughly; most specimens have growth marks and other flaws.

Check that the periostracum has been removed. Most of the species have a very thin transparent yellow/brown periostracum which is very difficult to remove.

Avoid specimens with locality “Angola”. The locality can contribute to the identification process.

Try to find specimens from the type locality which have a colour and shape similar to the type or from a locality where the radula of the local population has been tested.

You will find 30-40% of specimens would seem to have features of at least two species. Be prepared to use labels such as “aff. species” or even “species”.

Guidance for describing “new species” of Angolan cones

Make sure that you have 20 specimens from one locality which are all of a similar dominant form and pattern, plus another 10-20 specimens to suggest the variation.

Make sure that you have 4-6 preserved specimens so that the radula, animal and periostracum can be documented for the dominant form and some of the varietal forms. Offering specimens for future DNA testing would be a good idea.

Be prepared to use the skills of other cone experts to test the radula.

Try to find some specimens of different maturities from juvenile to adult to check if there is a continuation of form across generations.

Avoid assuming that similar shells from a different locality are the same species and limit description accordingly.

At the current time do not expect DNA to determine a conclusive differentiation of species.

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