Studies on Olividae. XVI. Fasciolar region measurements as taxonomic characters in the genus *Oliva*.

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MOTS-CLEFS. Mollusca, Gastropoda, *Oliva*, morphométrie, région fasciolaire, taxonomie.

ABSTRACT. Novel shell measurements of the fasciolar region of *Oliva* shells are defined. The reproducibility of these measurements has been tested and their potential for *Oliva* taxonomy evidenced.

RESUME. De nouvelles mesures de la région fasciolaire des coquilles d'*Oliva* sont définies. La reproductibilité de ces mesures ainsi que leur potentiel pour la taxonomie du genre *Oliva* ont été démontrés.

1. INTRODUCTION

Shell morphometry has been demonstrated to be a convenient, objective tool for the clarification of the complex taxonomy of the genus *Oliva* (TURSCH & GERMAIN, 1985, TURSCH, GERMAIN and GREIFENEDER, 1986a and 1986b; TURSCH and HUART, 1988; TURSCH and GREIFENEDER, 1989; TURSCH and GREIFENEDER, 1989; TURSCH and HUART, 1990, TURSCH, MISSA & BOUILLON, 1992).

The power of the biometrical approach increases with the number of available, operational, independent characters. The search for additional *Oliva* shell characters is thus a continuing endeavour in this laboratory (TURSCH & GERMAIN, 1985 and 1986; TURSCH & VAN OSSELAER, 1987; VAN OSSELAER & TURSCH, 1988; VAN OSSELAER & TURSCH, 1992).

We wish to report here on the possibilities offered by measurements of the fasciolar zone that is a conspicuous feature of all *Oliva* shells (see Fig. 1). Quantitative measurements in the fasciolar region are still unexplored in the genus *Oliva*, but have already been utilized as taxonomic characters for *Ancilla* by KILBURN (1981), who measured the width of the ancillid band and expressed it as a ratio against the width of the fasciolar band taken at the labium.

The fasciolar region has been described and discussed in detail by OLSSON (1956) for the genus *Olivella* and by KILBURN (1981) for the genus *Ancilla*. There is no detailed discussion of these features in the two latest review works on the genus *Oliva* (ZEIGLER & PORRECA, 1969 and PETUCH & SARGENT, 1986) and a short description of the fasciolar region of *Oliva* will thus be given hereunder.

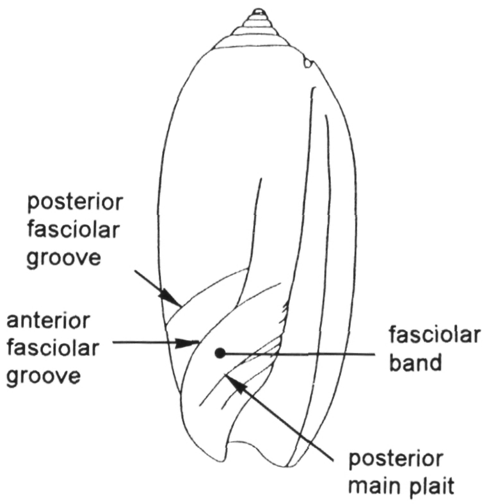

Fig. 1. General ventral view of an *Oliva* shell with characteristical features of the fasciolar region

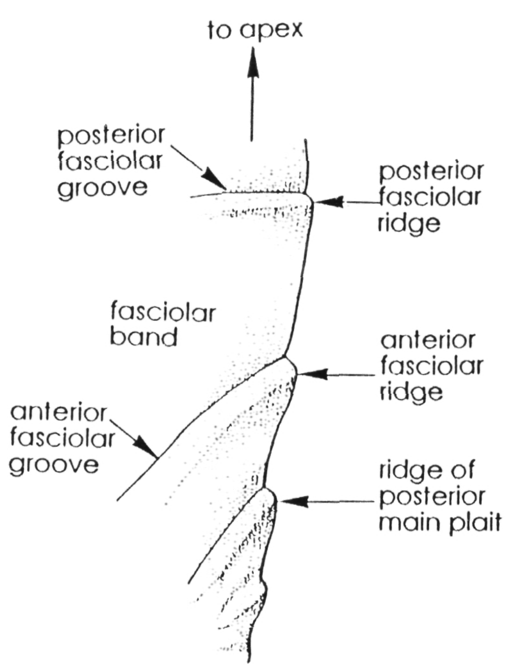

Fig. 2. Characteristical features of the fasciolar region of an *Oliva* shell. Greatly enlarged side view of the fasciolar region.

Fig. 1 provides a general ventral view and Fig. 2 a greatly enlarged side view of the fasciolar region of *Oliva* shells. In all *Oliva* shells, the anterior, ventral portion is sharply marked off by an incised line, the **posterior fasciolar groove**, closely followed by an abapical small raised edge, the **posterior fasciolar ridge**.

The anterior part of the fasciolar region is again marked off by another incised line, the **anterior fasciolar groove**, also closely followed by an abapical raised edge, the **anterior fasciolar ridge**.

Between the posterior and the anterior fasciolar grooves is a region called the **fasciolar band**. It often presents quite characteristical colour patterns. These have been utilized for instance for the description of *O. australis pallescens* and *O. kurzi* by PETUCH & SARGENT (1986) and for the distinction between *O. mantichora* and *0. amethystina* by TURSCH, GERMAIN & GREIFENEDER (1986b).

The anterior region delimited by the anterior fasciolar groove is the **fasciole**, covered by a thick callous growth. This is a very obvious feature: its texture contrasts conspicuously with that of the remainder of the shell and its colour is also different. The fasciole is crossed by one or several prominent spiral ridges, which are the continuation of columellar plaits. The most adapical of these prominent ridges is called here the **posterior main plait**.

Only a very few *Oliva* possess additional sculpture. As described by OLSSON (1956): "In most species of *Oliva*, the fasciolar band is similar to that of *Olivella* but in some special groups such as *Strephonella*, *Omogymna* and *Lamprodomina*, an extra callous band of variable size is added above, and which is sometimes so wide that it extends across the parietal wall nearly to the suture."

The terms "posterior fasciolar groove", "anterior fasciolar groove" and "fasciolar band" are utilized here *sensu* KILBURN (1981). The terms "posterior fasciolar ridge", "anterior fasciolar ridge" and "posterior main plait" are new definitions.

The present paper aims solely at defining novel shell measurements in the fasciolar region and at testing their taxonomic potential for the genus *Oliva*.

2. METHODS

2.1. Positioning the shell

It is very difficult to obtain reproducible direct measurements of the fasciolar features, especially on a small shell. This difficulty can be solved by making measurements on an enlarged, accurate drawing of a ventral view of the shell. In order to have reproducible drawings, it is of course crucial to observe the shell in a position that is itself reproducible.

Dorsal views of a given *Oliva* shell are highly reproducible. Indeed, when an *Oliva* shell is deposited aperture down on a flat surface it generally rests in a stable, reproducible position. In contrast, an *Oliva* shell deposited aperture up will roll quite freely on its rounded body whorl. The ventral views needed for fasciolar measurements are thus highly erratic unless special precautions are taken to ensure that one will always have the same ventral view of a given shell.

Several solutions to this practical problem have been tested. The simplest, and by far the most reliable consists in depositing the *Oliva* specimen aperture down on a glass plate of appropriate size. The shell is then firmly pressed in its "equilibrium position" against the glass plate by means of plasticine (for a small specimen) or rubber bands (for a large specimen). The glass plate is now turned upside down (with the shell now hanging below the plate), deposited on a suitable horizontal support (such as the rim of an open rigid plastic box) and brought under the binocular lens for examination. The shell is now viewed as in Fig. 3a.

2.2. Drawing the shell

The shell being properly positioned, a careful drawing can now be made with the help of the *camera lucida* attachement of the binocular lens. In practice, one does not have to draw the entire shell: only the indispensable features (designated by arrows in Fig.3b) are necessary. In order to give an internal reference for scaling the measurements is also necessary to draw a segment of known length, using a precalibrated ocular reticulum. The length of the drawing of a 1 mm segment will be called **REF**.

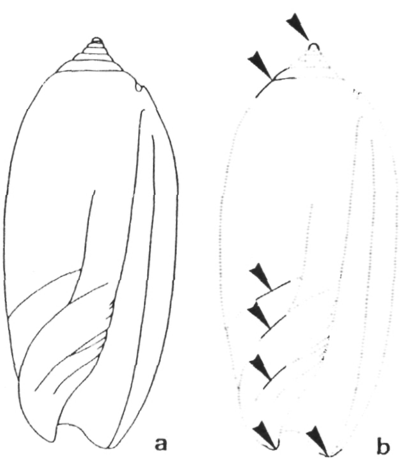

Fig. 3. Drawing the shell, after proper positioning. Fig 3a shows the shell as it is seen. Only the features indicated by arrows in Fig.3b have to be drawn.

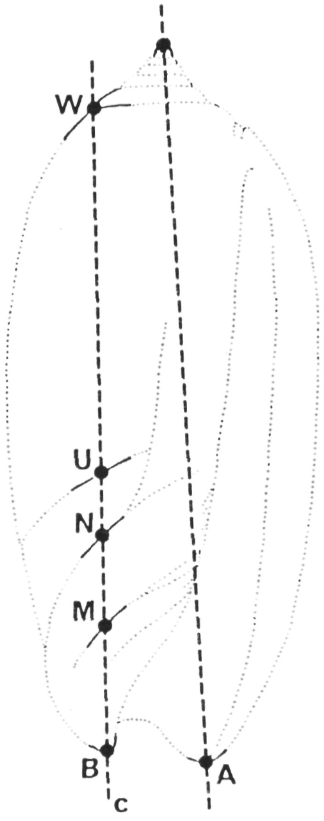

Fig. 4. Definition of measurements.

As depicted in Fig. 4, let us call **A** the most abapical (anterior) point of the outer lip and **B** the most abapical (anterior) point of the columellar lip. The tip of the apex is designated as **P**. The point where the outer edge of the penultimate whorl is seen to meet the body whorl (opposite the lip) is called **W**.

Let us call **c** the line joining B to W, **M** the intersection of line c with the ridge of the posterior main plait, **N** the intersection of line c with the anterior fasciolar ridge (just below the anterior fasciolar groove) and **U** the intersection of line c with the posterior fasciolar groove (see Fig. 2).

2.3. Measurements

Let us now define the measurements **PLI** as the real length of the segment BM (this is BM/REF), **LF** as the real length of the segment BN (this is BN/ REF), **UF** as the real length of the segment BU (this is BU/REF) and **BW** as the real length of the segment BW (this is BW/REF).

2.4. Practical tips.

It is important to check that the shell does not move. The drawing is facilitated if one directs a nearly horizontal light beam on the anterior part of the shell and rotates the object until maximum contrast is obtained on the posterior main plait and the anterior fasciolar ridge.

As for all linear measurements, the error is roughly proportional to the actual lengths measured on the drawing. One should thus try to make drawings as large as practicable. The size of the drawing can be controlled by adjusting the magnification of the binocular lens. Precision is increased if the shell is carefully centered in the lens field.

3. REPRODUCIBILITY and PRECISION

Errors on the drawing and on the geometrical construction have been shown to be practically negligible. Reproducibility and precision have been estimated by comparing the measurements performed by two independent observers on ten different series of measurements on the same shell. This was effected for a large shell (*Oliva miniacea*, H: 78.21 mm and a small shell (*Oliva hilli*, H: 12.00 mm). The results are given in Table 1, where the coefficient of variability CV (MAYR, 1969) can be utilized to estimate the dispersion of the measurements. It can be seen that the measurements of the two observers differ by no more than 0.67 mm for the 78.21 mm shell (0.86 % of the heigth of the shell) and by no more than 0.06 mm for the 12.00 mm shell (0.50 % of the heigth of the shell).

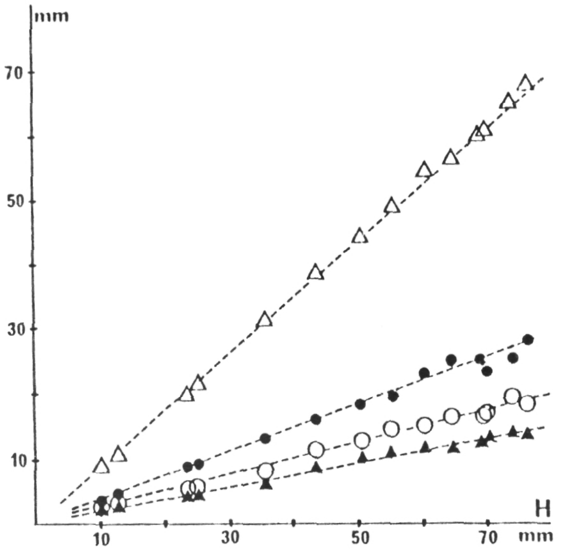

Fig. 5. Measurements on a growth series of *Oliva sayana* Ravenel, 1834. Variation of the measurements BW (open triangles), UF (black circles), LF (open circles) and PLI (black triangles) with the heigth of the shell H. All measurements in millimiters.

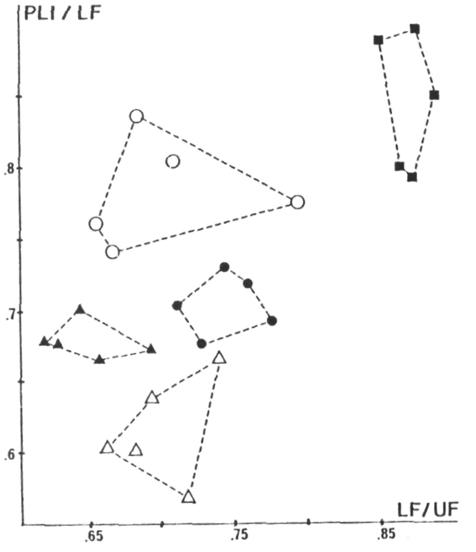

Fig. 6. Scatter diagram of LF/UF *versus* PLI/LF. Minimum convex polygons. Open triangles: *Oliva amathystina* Röding, 1798. Black squares: *O. dubia* Schepman, 1911. Black triangles: *O. hirasei* Kuroda & Habe, 1952. Open circles: *O. polpasta* Duclos, 1835. Black circles: *O. reticulata* Röding, 1798.

4. VARIATION WITH SIZE

Before attempting any taxonomic application one should first establish how the measurements defined hereabove are dependent upon the size of the shell. Measurements effectd on a growth series of *Oliva sayana* show that BW, UF, LF and PLI are practically proportional to the heigth of the shell H (see Fig. 5) and that the regression lines have a zero intercept with the axes. The measurements BW, UF, LF and PLI could also be expressed as a function of the number of postnuclear whorls pnw (TURSCH & GERMAIN, 1985).

Since the measurements BW, UF, LF and PLI are size-dependent, we can compare shells of different sizes only by utilizing ratios of these data to other linear measurements (such as H). Ratios of fasciolar measurements are of course valid.

5. TAXONOMIC APPLICATION

Numerical data constitute taxonomic characters only if their utilisation leads to effective discrimination of taxa. The fasciolar region has been measured on a number of *Oliva* species (to be published) and have been shown to be operational (alone or in combination with other measurements) in numerous species separations. Fig. 6 gives an example (amongst many others) of total separation of five species, using solely the fasciolar region measurements described above.

6. DISCUSSION

6.1. At first sight it could appear that the length of the segment AP would provide a more convenient internal length reference because AP is by definition the heigth of the shell **H** (TURSCH & GERMAIN, 1985), that is directly measured on the shell with a precision digital display calliper. Microscope measurements are true only if the measured segment lies exactly in the plane of observation (perpendicular to the optical axis).

In this case, the orientation of the line AP is not necessarily parallel to the observation plane. The observed segment AP is really the orthogonal projection of AP on that plane. Numerous trials have shown that AP is generally shorter than H (as expected) and differs by an average 2.5 %.

This remark applies to all the measurements defined here: all are projections of the true lengths on the observation plane. In particular, it applies to the distance AB, the true length of which has been previously defined as the measurement DN (VAN OSSELAER & TURSCH, 1992). AB is also the projection of DN on the observation plane (and differs from DN by an average 4.20 % in numerous trials). AB could however be of some use as an additional measurement because it could give information of the angle between DN and the observation plane in the "equilibrium position" of the shell (see 2.1).

6.2. The measurements described hereabove are quite easy and fast (less than 5 minutes per shell). Their precision and reproducibility have been proven satisfactory. The fasciolar region has been shown to yield stable and operational taxonomic characters.

One advantage of these characters is that the fasciolarian region is generally intact, even in severely damaged shells. These measurements do not require perfect specimens and can be performed on fossil material. Fasciolar measurements are not necessarily restricted to the genus *Oliva* and could presumably be extended to other groups in the Volutacea superfamily.

	Observer B			**Observer O**		
measurement	mean	S	CV	mean	S	CV
Oliva miniacea, H: 78.21 mm						
BU	71.79	0.11	0.15	71.44	0.23	0.33
UF	27.04	0.28	1.03	25.35	0.27	1.09
LF	18.53	0.28	1.49	17.86	0.33	1.87
PLI	12.70	0.40	3.17	12.17	0.21	1.75
Oliva hilli, H: 12.00 mm						
BW	10.27	0.04	0.41	10.21	0.06	0.62
UF	4.26	0.05	1.25	4.20	0.04	1.05
LF	3.09	0.03	1.10	3.05	0.06	2.23
PLI	2.19	0.02	0.93	2.15	0.05	2.64

Table 1. Series of ten independent measurements effected by two independent observers on the same shell (*Oliva miniacea* and *O. hilli*). Data in bold characters are actual lengths in mm on shell.

7. MATERIAL EXAMINED

"BT-" Specimen numbers refer to shells in the author's collection.

Oliva amethystina Röding, 1798. PHILIPPINES: BT-4494 (Mindanao); BT-4563, BT-4564, BT-4567 and BT-4570 (no loc.).

O. dubia Schepman, 1911. PAPUA-NEW GUINEA: BT-4928, BT-4929, BT-4930, BT-4931 and BT-4932 (Hansa Bay, 50 m).

O. hilli Petuch & Sargent, 1986. TONGA: BT-6026, Vava'u I.

O. hirasei Kuroda & Habe, 1952. PHILIPPINES: BT-5021, BT-5022 and BT-6202 (Sulu); BT-6194 and BT-6196 (Panglao).

O. miniacea Röding, 1798. PHILIPPINES: BT-6670 (no loc.).

O. polpasta Duclos, 1835. W. MEXICO: BT-0314, BT-0315 and BT-0316 (Baja California); BT-4613 (off Salina Cruz, Oaxaca). PANAMA: BT-3779 (Cebaco I.).

O. reticulata Röding, 1798. PHILIPPINES: BT-4594, BT-4596, BT-4597, BT-4598 and BT-6029 (no loc.).

O. sayana Ravenel, 1834. U.S.A., Florida: BT-6671 (no loc.); BT-5316, BT-5315, BT-5318, BT-4072 and BT-4074 (off Cape Canaveral); BT-4094 and BT-4098 (Sanibel I.); BT-4097 (Tampa Bay); BT-0944 (Marco Beach); BT-6672, BT-6673, BT-6674 and BT-6675 (Port St. Joe Bay).

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