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Biometrical studies on *Balanus amphitrite amphitrite* Darwin (Cirripedia : Crustacea) in NW Arabian Gulf

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Abstract:

Biometrical characters have been measured on the scutum and tergum of the cosmopolitan Cirripedia: *Balanus amphitrite amphitrite* Darwin, collections from two positions; Garmat-Ali River and Al-Fao site. These values attempt to define the shape of these valves. The measurements show that there is more or less a gradual change in the operculum shape; and this change may be related to the change in salinity of the two different environments.

Key words:NW Arabian Gulf, *Balanus amphitrite amphitrite*, biometrical characters.

Introduction:

Barnacles are one of the universal species on the rocky shores in temperate waters (Stephenson and Stephenson, 1949). They have evolved features which have rendered them highly successful in occupying intertidal and subtidal zones. These modifications not only seal them from desiccation but also protect them from predators. The Cirripedia shell formes an advancing mantle edge, by the increased or decreased rate of shell deposition at various points around the circumference of the mantle. The shell in the sessile barnacle consists of a ring of overlapping calcareous plates in the form of a truncated cone (Bourget, 1977). The wall plates vary in number in different species and their arrangement is of great importance in classification, the shell has evolved through a basic pattern of two paired opercular plates, the scutum and the tergum. The opercular plates must clearly be mobile to allow the cirri to emerge and so are suspended by a tough flexible membrane attached to an overhang which project downwards from the upper end of the pairs. Bourget (1987) points out that there are two major components in the barnacle shell: calcium carbonate and organic matter, the latter constitutes about 1% of the weight of the shell in *Balanus*, and there are only two forms of calcium carbonates; calcite and aragonite. *Balanus amphitrite amphitrite* Darwin is a marine cosmopolitan species and is largely a low littoral, extending into the sublittoral and restricted in both quite waters and exposed coasts; it can withstand low salinity, common in estuaries and has eight wall plates. It is also a hermaphrodite species, continuously reproducting allover the year and has two peaks of larval settlements, a short life cycle, opportunists in feeding and very successful in aquatic environment (Abdul-Sahib,1997; Abdul-Sahib, *et al*.,2003). The first study on this species in our area was on the larval settlement in Arabian Gulf (Mohammed, 1975). Then Rasshed (1977) worked on the reproduction and settlement of larvae of the species in different water depths. In the same year Araf (1977) studied the effects of some physical factors on the density of larvae. Abdul-Sahib(1997) studied the energy flow of *B. a. amphitrite* in details and at different temperatures. Lately Abdul-Sahib (1999) worked on the change of the chemical composition of this cirriped in the four seasons. Plenty of papers had been published on the biometrical changes of sessile barnacles included the operculum and the wall plates of *B. balanus, B. crenatus, B. improvisus, B. glandula, B. amphitrite stutsburi; B. eburneus*; *B. improvisus* (Barnes and Healy, 1969; 1971 ; Furman and Crisp, 1989). The present study is undertaken to elucidate the dimensions of the scutum and tergum of the sessile barnacle *B. a. amphitrite* , which are very important characters for the classification of barnacle, and to examine the relationships between operculum and the

environmental conditions which represent the difference in relative growth of the barnacle in two different aquatic environments.

Materials and measurements:

The animals were collected from two stations, Garmat-Ali River and Al-Fao station (Fig. 1). Selection was made of almost a specific size group of the animals from the two sites. The animals selected for measurements were boiled gently in 5% sodium hydroxide, then washed with water and dried. The shell components were separated after measuring the aperture length in (mm) by using varnier caliper to the nearest 0.02 mm, which indicated the animal size. The valves were picked out, separated to scutum and tergum (Plate 1), washed and dried, as far as possible. Six dimensions were measured (Fig. 2) as previously: in view, however of differences in configuration of the valves complete identity of the dimensions. In orded to investigate the differences in the slop of the linear equations an analysis of varience were undertaken. The measurements were made with a binocular microscope using scaled eye-piece.The range of salinity in both stations was determined by conductivity measurements using salinometer model 6-202.

Fig. 1: A map of the sampling area in Garmat-Ali River and Al-Fao site.

Plate (1) : *Balanus amphitrite amphitrite*:
(A): The four parts of the operculum. (B): Pair of scutum.
(C): Pair of tergum.

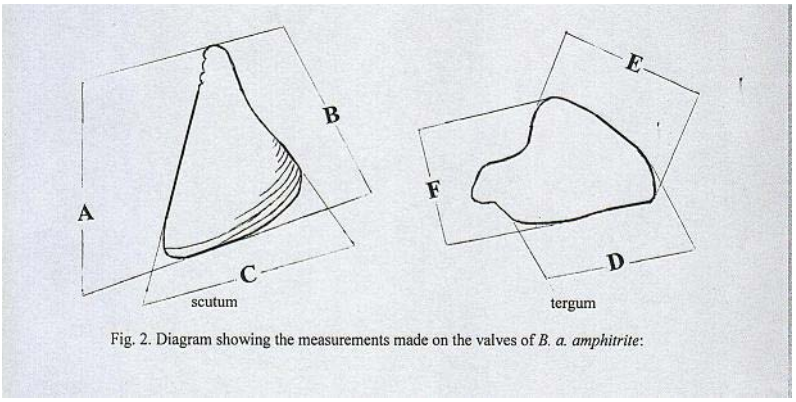


Fig. 2. Diagram showing the measurements made on the valves of *B. a. amphitrite*:

scutum **tergum**

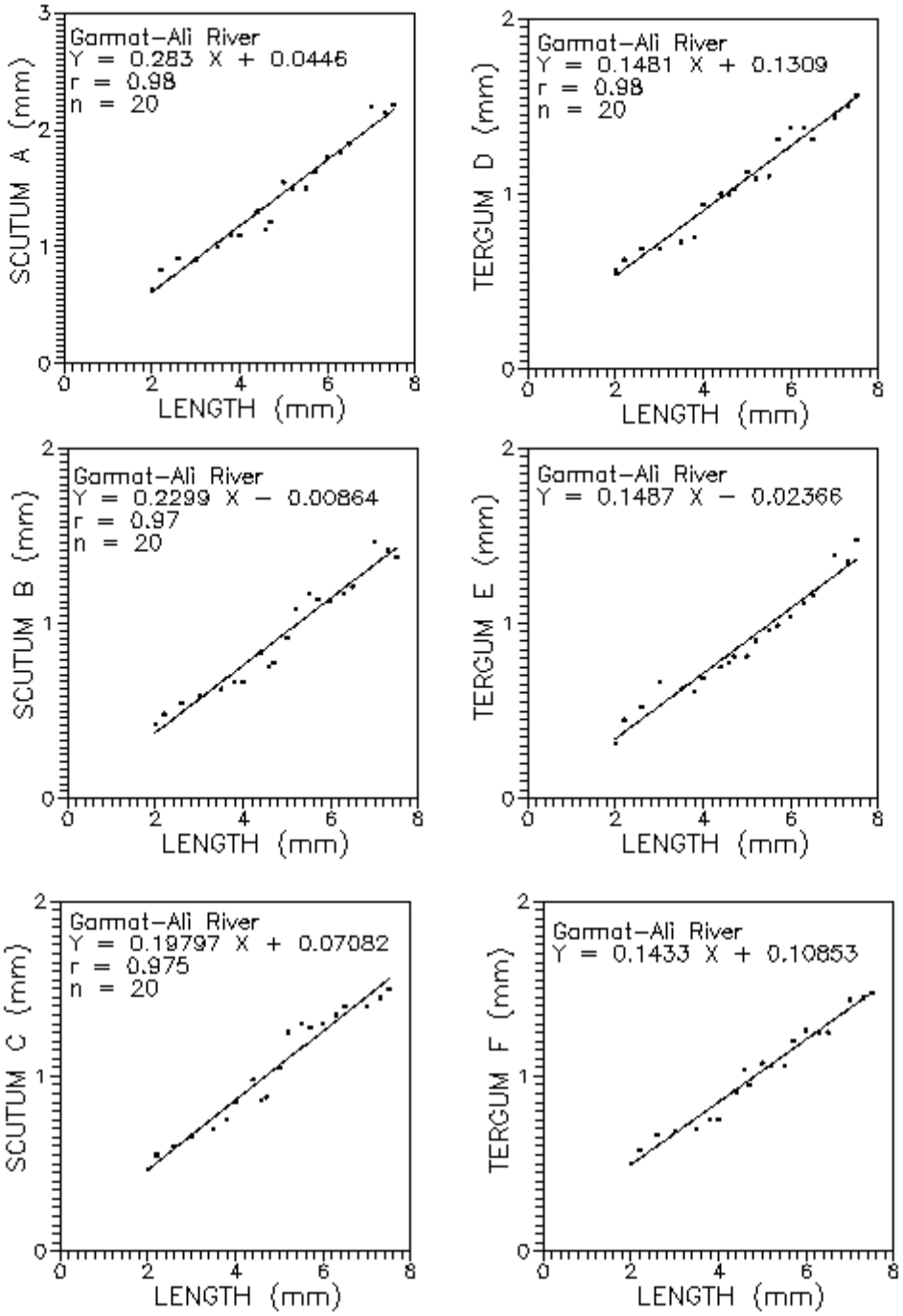
Fig. 2. Diagram showing the measurements made on the valves of *B. a. amphitrite*.

Results and Discussion:

The relationships:

The scutum of *B. a. amphitrite* in Garmat-Ali River was plotted as a function of shell length (mm) and shown in Fig. 3 (left). The correlation coefficients of the fitted lines were ranging between 0.89 and 0.93 and the slops were ranging between 0.198 and 0.283.

Fig. 3, Relationships between the shell length (mm) and the scutum length (mm)



(left), and the tergum length (mm) (right) of the barnacle *B. a. amphitrite* in Garmat-Ali River.

The same figure shows the linear relationships between the shell length (mm), and the measurements of the tergum (right). The correlation coefficient of the fitted lines were ranging between 0.85-0.90 and the slops were ranging between 0.143-0.149. These relationships show that there were increase in the scutum and the tergum measurements with the increase of the shell length of this barnacle in Garmat-Ali River.

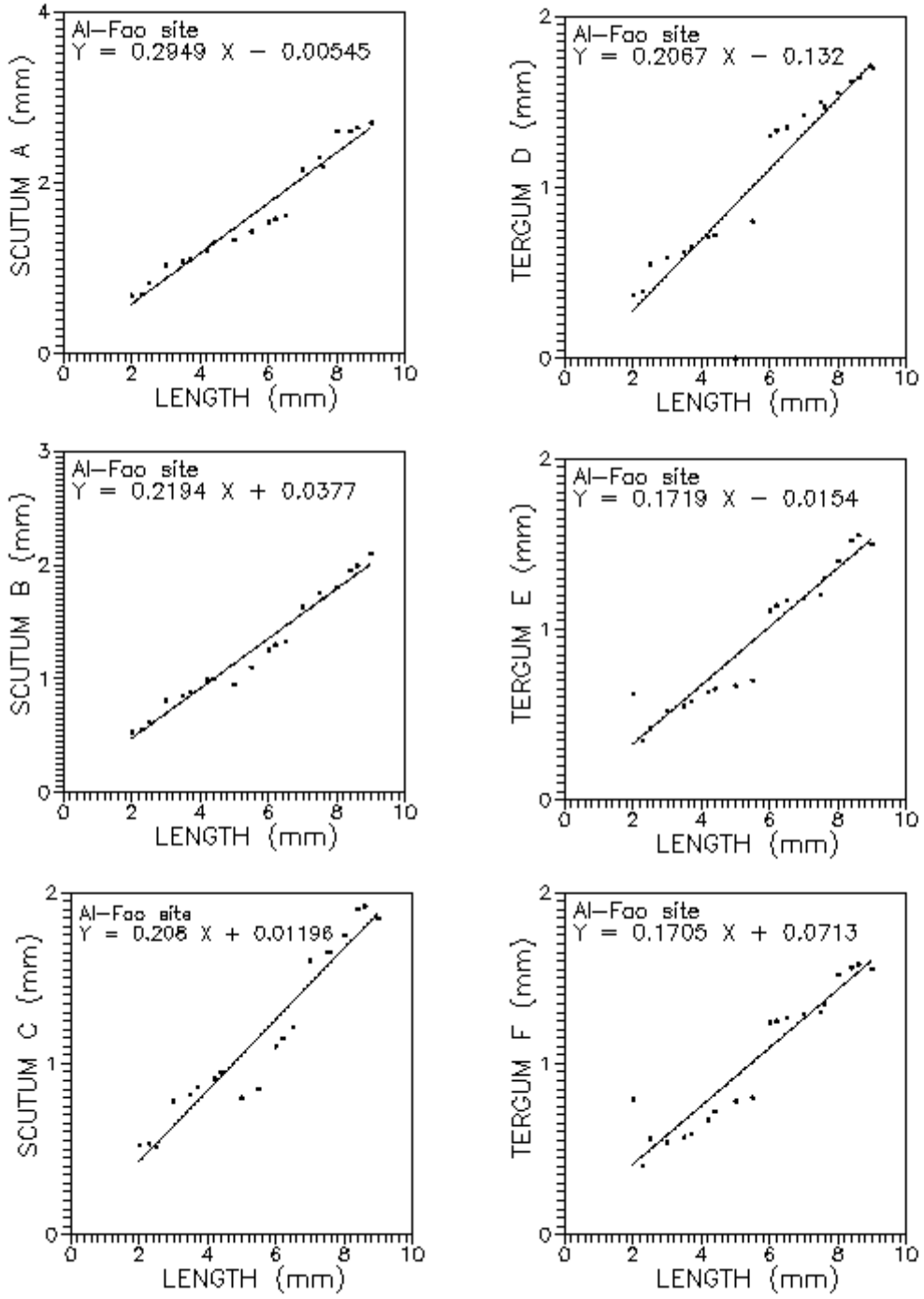


Fig. 4, Relationships between the shell length (mm) and the scutum length (left), and the tergum length (right), of *B. a. amphitrite* in Al-Fao site.

Fig. 4, shows the linear relations of *B. a. amphitrite* in Al-Fao site, , the correlation coefficient of the fitted lines were ranged between 0.88 -0.93 and the slop were ranged between 0.208-

0.295 The same figure shows the linear relationships between the shell length (mm) and the measurements of the tergum , the correlation coefficient of fitted lines were raged between 0.81-0.92 and the slop were ranged between 0.171-0.207 .It is apparent that the three measurements were significant positive correlation with the shell length .

The dimensions of scutum and tergum:

The scutum and tergum have almost triangular shape, but, it can not take the area of the triangular because it has no straight lines and irregular angles, therefore we take three dimensions for each one. Fig. 5, shows the three dimensions A, B and C of the scutum in both stations Garmat-Ali river and Al-Fao site, it is obviously that the three dimensions of the scutum and the tergum of the specimens of Al-Fao are more longer than that of the other station, the scutum A in Al-Fao reach 2.70 mm, it's reach 2.21 mm in Garmat-Ali, the other two dimensions are to be near each other for both stations. But the three dimensions of the tergum for the two stations were all to be near and in some places are interference with each other, the tergum A, reach 1.70 mm in Al-Fao, and 1.25 mm in Garmat-Ali.

Biometrical work on barnacles has been concerned with the opercular valves, the shape of an important taxonomic character (Henry and McLaughlin, 1975). The morphology of a barnacle has great plasticity, so that its form may be much modified. Generally there were three main factors causing modification in the shape: the forces produced by the growth or surrounding individuals; the shape of the surface on which the barnacle growing and salinity (Crisp and Bourget, 1985).The results here shows that the salinity had an effect on the dimension of the operculum valves. The salinity in Al-Fao site ranged from 2 ‰ in February to 13.7 ‰ in August (Al-Mahdi, and Abdullah, 1996), while it ranged from 1.088 ‰ to1.8 ‰ in Garmat-Ali River (Abdul-Sahib, 1997). The dimensions of the scutum and tergum in the Al-Fao site were larger than that of the Garmat-Ali site, these may due to the fact that Al-Fao site consider as a marine environment which is the original environment of the barnacle. While, the shape of the valves were not effected by salinity, but more hardness to the valves comparing with those in the Garmat-Ali. It is well known that when sessile barnacles grow in close proximity, their shells become elongated and the base narrow. Therefore, the opercular plates are often a better guide to size and age than the shell as all (Abdul-Sahib, 1997), while the euryhaline barnacle *B. improvisus* shows no comparable change in shape (Barnes and Barnes, 1961) nor, the cosmopolitan species *B. a. amphitrite* (Crisp and Bourget, 1985), while the lower salinity caused *B. balanoides* to adopt a lower profile and reduced shell (Barnes and Barnes, 1962).It is necessary to established that many biometrics formulas of external parts morphology of the aquatic crustacea could not give the real classification due to environmental effect on the species, now or in future, because the aquatic animals generally change their characters or features when the environment change or when the species immigrates to other aquatic areas or isolated in special environment which caused morphological changes suited the new one.

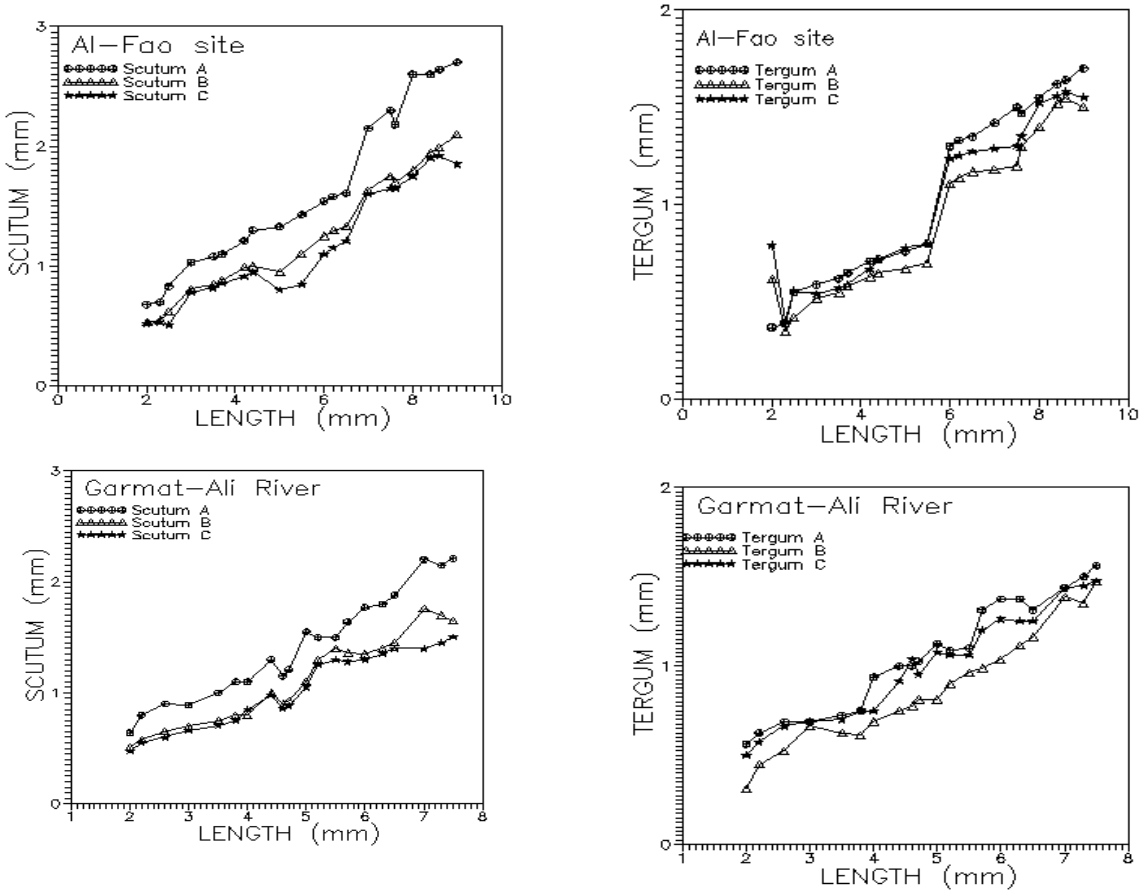


Fig. 5. Illustrated the three dimensions of the scutum and tergum of the barnacle *B. a. amphitrite*, In Garmat-Ali River and Al-Fao site.

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العلاقات المظهرية في البرنقيل *Balanus amphitrite amphitrite* Darwin (Cirripedia: Crustacea) في شمال غرب الخليج العربي

د. ابتسام مهدي عبد الصاحب

لنقر عجلطاحئذ – جئلعبطا شب لكا شب جعف

شدبلاخ

تم في هذه الدراسة تحديد الخصائص المظهرية باستخدام القياسات المترية للظهر Tergum والدرع Scutum لذؤابي الأقدام العالمي التوزيع *Balanus amphitrite amphitrite* Darwin والذي تم جمعه من محطتي نهر كرمة علي والفاو. وقد بينت النتائج وجود علاقات مظهرية قوية بين الطول الكلي للحيوان وقياسات غطاء الصدفة المتكون من الدرع والظهر وأعطت النتائج تعريف لشكل المصراعين كما أظهرت القياسات وجود تدرج في شكل الغطاء يعود الى اختلاف تركيز الملوحة في مياه المحطتين .