Mahasagar–Bulletin of the National Institute of Oceanography, **18**(3), 1985, 407–412.

ENDOPHRAGMAL SKELETON OF PRAWNS — A TAXONOMICAL TOOL

P. SITA RAMI REDDY AND K. RAMACHANDRAN
Department of Zoology, Madras Christian College, Tambaram, Madras - 600 059.

ABSTRACT

Descriptions of the endophragmal skeletons of *Macrobrachium javanicum, M. idae* and *Penaeus monodon* have been given. 'Endosternal plate', 'epistomal apodeme', 'epimeral ridges', 'oblique endosternal rods', 'epimeral plate' and 'mandibular apodeme' revealed distinct differences and these structures have been tentatively named for the first time. The utility of endophragmal skeleton as a taxonomical tool in the prawns has been indicated.

Key-words : Endophragmal skeleton, *Macrobrachium javanicum, M. idae, Penaeus monodon,* taxonomy.

INTRODUCTION

The role of endoskeleton in the systematics of vertebrates at interspecific, intergeneric, interfamilial and interordinal levels has been well documented. Since the apodemal framework present in the cephalothoracic region of prawns is also a supporting structure, it has been attempted here to show whether or not the endophragmal skeleton plays a role in the taxonomy of prawns. This approach has not been made so far in the prawns and therefore three species of prawns, viz., *M. javanicum, M. idae* and *P. monodon* have been chosen to reveal the validity of the endophragmal skeleton in prawns as a taxonomical tool.

MATERIAL AND METHODS

Three species of prawns, viz., *M. javanicum, M. idae* and *P. monodon* ranging from 15 to 25 cm were procured from the local fish markets. The cephalothoracic region was cut and separated from the abdomen. Then the carapace and appendages were carefully dissected out. Afterwards, the muscles of the cephalothoracic region were carefully teased out without damaging the apodemal ingrowths. Finally, the endophragmal skeleton was thoroughly washed and dried till the moisture evaporated. The terminology used in the description of endophragmal skeleton is largely of Patwardhan (1937).

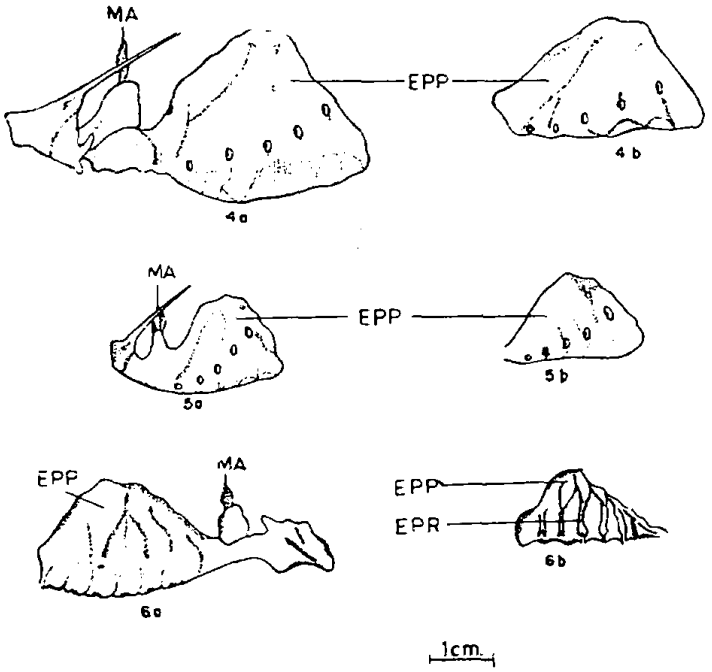
RESULTS AND DISCUSSION

The endophragmal skeletons of *M. javanicum, M. idae* and *P. monodon* are presented in Figs. 1–6. The skeleton has been divided into two regions, viz., anterior cephalic region and posterior thoracic region. The cephalic region is that part of the endophragmal skeleton which can be demarcated by the presence of cephalic appendages, viz., antennule, antenna, mandible,

maxillula and maxilla. The endophragmal skeleton of crustacea is not homologous with that of vertebrates as it is formed by a number of ingrowths of the exoskeleton called the apodemes, which provides a foothold for the insertion of the muscles. In prawns, these apodemes are present only in the cephalothoracic region and these are connected together to form a regular framework known as the endophragmal skeleton.

M. javanicum, (Figs. 1 & 4).

In *M. javanicum* when the dorsal plate and the rostrum are removed, a narrow, transversely placed rod like plate situated at the extreme anterior end of the body and extending between two eye stalks is seen; this is the opthalmic sternum. This covers the brain anteriorly and dorsally. Immediately below and behind this, on the anterior surface lies the antennal sternum which gives off a bilobed protruberance. From the antennal sternum arises a median rod which separates the antennular sockets. The antennal sternum is called epistome which is a flat, triangular plate. The epistome is bound



Figs. 1–3. Dorsal (a) and ventral views (b) of endophragmal skeleton of *M. javanicum* (Fig. 1), *M. idae* (Fig. 2), & *P. monodon* (Fig 3), ANS-Antennular socket; AS-Antennal socket; CA-Cephalic apodeme; EM-Epimeron; ENS-Endosternal plate; EP-Epistome; EPA-Epistomal apodeme; ER-Epimeral rods; LA-Labrum; MA-Mandibular apodeme; MESO-Mesophragm; OER-Oblique endosternal rod; OS-Ophthalmic sternum; POA-Preoral apodeme; PP-Paraphragm; S-Sternum.

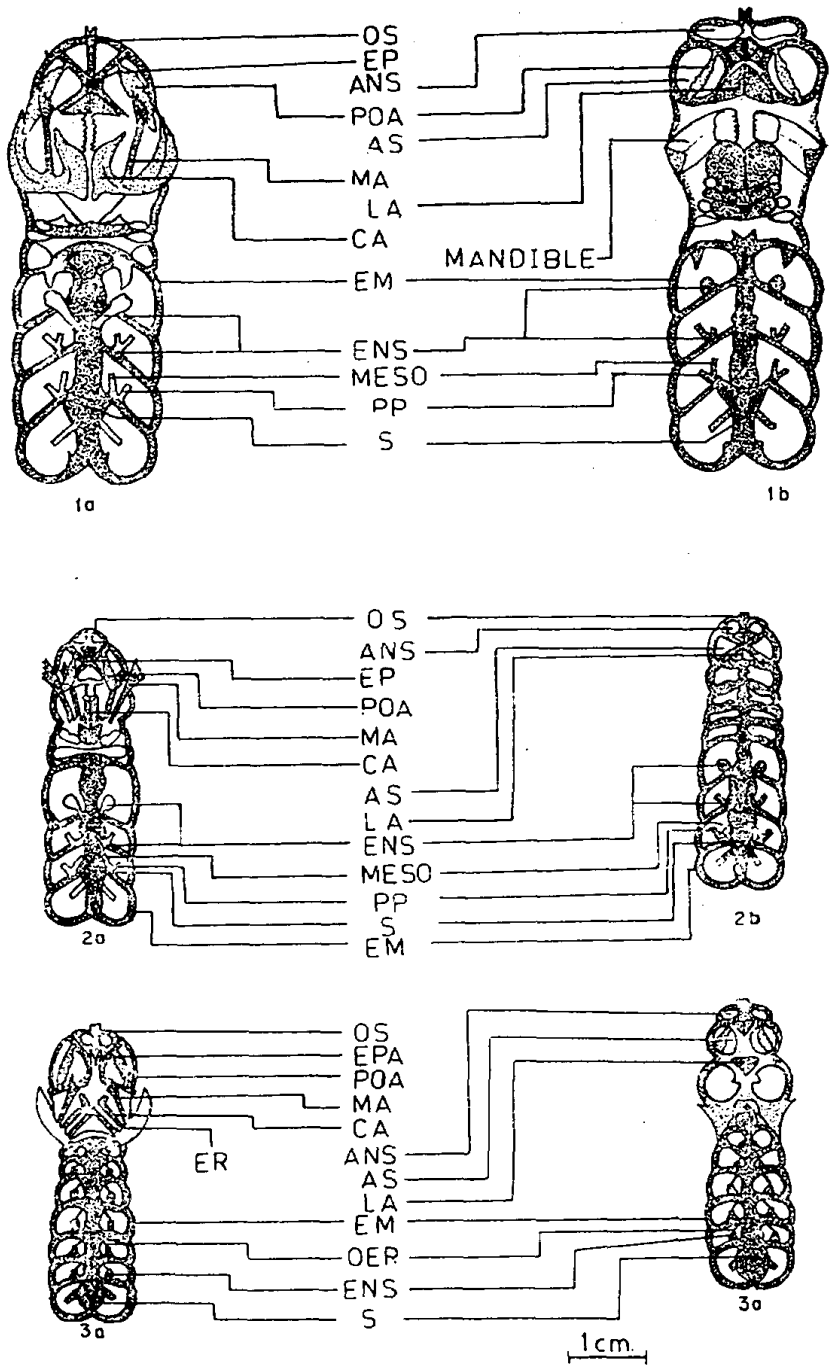
on its two sides by the bases of the antennules and the antennals and behind by the prominent shield shaped plate called the labrum. From the epistome arise two rod like structures which give off two small projections. From the transverse rod separating the antennular and antennal sockets arise two elongated, posteriorly directed leaf-like processes which project inwards towards the mandible and these structures have been presently named as 'preoral apodeme' (Fig. 1).

From the mandibular sternum arise two vertical, rod like projections which are laminated at their free ends. These have been presently named as 'mandibular apodeme'.

Between the mandibular and maxillular segments, the apodeme of each side is well developed and its mesophragmal process is thick and large. Each process projects obliquely upwards and is connected with its fellow of the other side by a transverse fibrous strand, thus forming a 'H' shaped structure called 'cephalic apodeme' which serves for the insertion of the adductor muscles of the mandibles, the muscles of branchiosteges and small gastric muscles. On each side, the cephalic apodeme is produced into a prominent process which expands at its extremity into a flattend plate with a backward extension; it bears along its anterior margin an articular facet which serves as a pivot upon which the mandible rotates during its masticatory movements.

In the thoracic region, an apodeme consists of (a) an 'endopleurite posterior', a projection from the antero-lateral end of the epimeron belonging to one segment meeting a similar projection, the 'endosternite posterior' from the sternal elements of the same segment and (b) an endopleurite anterior from the postero-lateral end of the epimeron belonging to the preceeding segment meeting a similar projection, the 'endosternite anterior' from the sternal element of this very segment. These two pairs of ingrowths together constitute a rigid vertical double wall lying between the bases of two consecutive appendages and serving for the attachment of appendicular muscles. From the inner ends of adjacent endosternites of an apodeme, a vertical plate projects upwards and these structures are presently named as 'endosternal plates' (Fig. 1). This forks at its free end to form a 'Y' shaped structure; the inner arm of the 'Y' is called 'mesophragm' and the outer oneparaphragm'. These processes also belong to the apodeme and serve for the attachment of the flexor muscles of the abdomen. Such a typical apodeme with a complete number of endopleurites and endosternites and the mesophragm and paraphragm occurs only between the eleventh and twelfth and the twelfth and thirteenth segments. In other segments, the typical number is reduced. Between the tenth and the eleventh sternum, the 'endosternal plate is expanded.

The 'epimeron' from the sixth segment to the thirteenth segment is extended vertically upwards to form a plate like structure and this is presently named as 'epimeral plate' (Fig. 4).



Figs. 4 – 6 Lateral view of endophragmal Skeleton (4a, 5a & 6a) and inner view of epimeral plate (4b, 5b, & 6b) of *M. javanicum* (Fig 4), *M. idae* (Fig 5), *P. monodon* (Fig 6). EPP-Epimeral plate; EPR-Epimeral ridges; MA-Mandibular apodeme.

M. idae (Figs. 2 & 5)

In *M. idae*, 'mandibular apodeme' is paired, of which the anterior one is short and broad while the posterior one is long and thin. The other descriptions of endophragmal skeleton are as in *M. javanicum*.

P. monodon (Figs. 3 & 6).

In *P. monodon*, 'epistome' arises vertically as a rod like projection which is formed at its free end. This has been presently named as 'epistomal apodeme' (Fig. 3a). The preoral apodeme has a serrated margin.

From the 'epimeral plate' of the sixth segment, projecting anteriorly are two rod like structures which join with the cephalic apodeme. These have been presently named as 'epimeral rods' (Fig. 3a).

The 'epimeral plate' bears 'Y' shaped projections on the inner side from the eighth segment onwards which are directed downwards and these have been presently named as 'epimeral ridges' (Fig. 6b).

The 'endosternal plate' is truncated. Across the sternum and endosternal plate there is a rodlike structure running obliquely. These have been presently named as 'oblique endosternal rods' (Fig. 3).

Other descriptions of endophragmal skeleton are as in *M. javanicum*.

Young (1959) had described the skeletal elements of White shrimp, *Penaeus setiferus* from the Gulf of Mexico. Although Huxley (1906), Calman (1909) and other students of Crustacea often referred to the system of pleurosternal invaginations or apodemes in decapods as the 'endophragmal system', Young (1959) while describing the skeletal elements of gnathothorax of *P. setiferus* stated that "In the gnathothorax of prawn, the laterotergal and sternal apodemes are light and do not fuse; consequently no endophragmal system is found, unless we consider the transverse mandibular apodeme, an endophragm of some sort". Further, while describing the skeletal elements of mandibles he stated that "In forms having a well developed endoskeletal system in the thorax, the mandibular element is considered to be part of that system". From these statements, it is clear that the opinion of Young (1959) on endophragmal skeleton is very ambiguous and he described the cuticular components of all the appendages as skeletal elements in *P. setiferus*. He perhaps did not come across the work of Patwardhan (1937). His descriptions of protocephalon and gnathothorax of *P. setiferus* did not include names of several typical structures as described by Patwardhan (1937) in *Palaemon*.

The present observations on the endophragmal skeleton of *M. javanicum*, *M. idae* and *P. monodon* revealed that there are some similarities between the three species. Besides these similarities, presence and absence of some structures were observed. It is also interesting to note that some of these structures exhibited morphological variations between the species.

In *M. javanicum*, the 'endosternal plate' is rod-like and is forked to form a mesophragm and a paraphragm and is 'Y' shaped in the twelfth and thirteenth segments, whereas in *P. monodon*, 'endosternal plate' is truncated.

In *M. javanicum*, the 'epistomal apodeme' is absent, whereas in *P. monodon*, from the epistome arises a vertical rod like projection which is forked at its free end.

In *M. javanicum*, the 'epimeral ridges' are absent, whereas in *P. monodon* from the eighth segment onwards the epimeral plate bears 'Y' shaped projections which are directed downwards.

In *P. monodon*, 'oblique endosternal rods' are present, whereas in *M. javanicum* they are absent.

In *M. javanicum* 'epimeral rods' are absent but in *Pmonodon*, 'epimeral rods' are present and project anteriorly from the 'epimeral plate' of the sixth segment and join with the cephalic apodeme.

In both *M. javanicum* **and** *P. monodon*, a pair of 'mandibular apodemes' is present.

These similarities in the structure of endophragmal skeleton as discussed above may be due to their closer relationships at supraspecific levels, i.e., at the generic level.

The important species-specific characters are 'mandibular apodemes' which is one pair in *M. javanicum* and two pairs in *M. idae*. The dissimilarity may be attributed to their differences at the specific level.

In the light of the present observations it is suggested that a thorough investigation on the endophragmal skeleton of all the commercially important penaeid and non-penaeid prawns needs immediate attention. This may throw more light on the taxonomy of commercially important penaeid and non-penaeid prawns in general and in closely related species in particular.

ACKNOWLEDGEMENTS

Authors are thankful to Prof. P.J. Sanjeeva Raj, Head of the Department of Zoology and to the Management of the Madras Christian College for their interest and co-operation.

REFERENCES

Calman, W.T., 1909. Part VII Appendiculata, Third Fascile, Crustacea, In: *A Treatise on Zoology*, edited by Sir Ray Lankaster. Charles Black, London, 346 pp.

Huxley, T.H., 1906. *The Cray Fish*. 7th edition, Kegan Paul, Trench, Trubner and Co. Ltd., London, 371 pp.

Patwardhan, S.S., 1937. *Palaemon. Indian Zoological Memoirs*, **6**: 100 pp.

Young, J.H., 1959. Morphology of the White Shrimp, *Penaeus setiferus* (Linnaeus, 1958), *Fishery Bulletin*, **59** (145): 168 pp.