

Studies on the Abdominal Musculature of the Subterranean Mysid, *Lepidomysis longipes* (Pillai and Mariamma)

by

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INTRODUCTION

Subterranean life induces striking modifications in the animals occupying that realm. A study undertaken on a subterranean mysid recently discovered has revealed the great extent to which the musculature has been modified as a result of subterranean life. The mysid, *Lepidomysis longipes*, lives in underground channels and freshwater wells, into which these channels lead. The narrow and circuitous channels place strong restrictions on movements of the occupants. The muscles concerned in the movement of the body show remarkable modifications and differ from those of the epigeal relatives as is shown in the following description.

MATERIALS AND METHODS

Animals preserved in a mixture of 70% alcohol and 4% formol were dissected for the study of the muscles. This method is recommended by Daniel (1931). In addition, formaline preserved specimens were cleared in lactic acid and dissected for the study as they gave a clear picture of the position and attachments of the different muscles. A few drops of orange-G or Eosin added to the lactic acid simplified the dissection and the location of the different muscles.

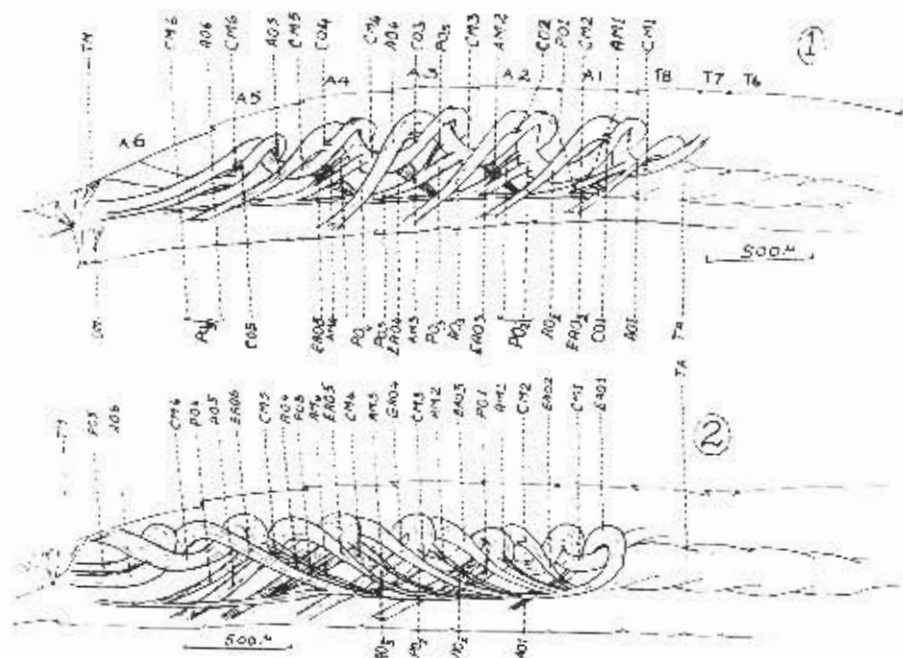
Musculature

The major part of the muscular system of the animal is located in the abdomen and forms the abdominal musculature. This may be conveniently grouped into four types.

- 1) The main ventral muscles,
- 2) The superficial ventral muscles,
- 3) The dorsal muscles, and
- 4) The lateral muscles.

The main ventral muscles deal with the flexure of the abdomen while the dorsal muscles aid in the extension of the abdomen. The lateral and the superficial ventral

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Figs. 1. – 2. Arrangement of the main ventral muscles as seen from outside and inside respectively.

muscles are weak structures connecting the successive terga and sterna respectively. Because of their poor development, they cannot be expected to provide much assistance in the movement of the abdomen.

1) *The main ventral muscles.* These consist of the thoraco-abdominal muscles and the ventral abdominal muscles.

a) *Thoraco-abdominal muscles* (Fig. 1 & 2: TA)

The thoraco-abdominal muscles show a very simple arrangement. They originate from the middle of the first abdominal segment beneath the first central muscle and extend to the middle of the cephalothorax. These muscles have lateral disposition and each is formed of two muscle bundles on each side. These muscles originate from the region of insertion of the external arm of the anterior oblique muscle 2. In the beginning they are slightly intermingled with the latter.

b) *Ventral abdominal muscles* (Figs. 1 & 2)

The bulk of the ventral muscles consists of the ventral abdominal muscles. This is formed by a series of muscles arranged longitudinally and linked together among members of the same series and to members of other series. This compact system of

muscles has segmentally arranged components with slight modifications. These muscles are formed of four series as described below.

I) *Anterior oblique muscles 1-6* (Figs. 1 & 2: AO₁-AO₆)

They form the most conspicuous muscles of the system. Each anterior oblique muscle has a main portion lying medial to the central muscle of the segment and presents a broad surface which is pressed against its fellow of the opposite side. It starts from above the central muscle and runs in a posteroventral direction to get inserted on to the posterior margin of the segment. The external arm of the anterior oblique muscle runs laterally and anteriorly to get inserted to the sternum of the segment in front. To this region is attached a posterior oblique muscle and also the auxiliary muscle of some of the anterior segments.

II) *Auxiliary muscles of the anterior oblique muscles* (Figs. 1 & 2: AM₁-AM₂)

Each external arm of the anterior oblique muscles is accompanied by an auxiliary muscle sharing the same origin. These are absent for the first and second anterior oblique muscles. These muscles have a lateral disposition and take a posterodorsal course before becoming attached to the corresponding central muscle.

III) *Posterior oblique muscles 1-5* (Figs. 1 & 2: PO₁-PO₅)

There is one posterior oblique muscle for each abdominal segment except the last. They arise from the ventral side near, though not exactly at the region from where the corresponding anterior oblique muscles start. These terminate in the next segment, being connected to the central muscles in front.

IV) *Central muscles 1-6* (Figs. 1 & 2: CM₁-CM₆)

These are intersegmental in position as in other Malacostraca, with their ends in the adjoining segments. They act as 'supporting saddles' to the anterior oblique muscles. However, they do not form a continuous 'rope' as in *Homarus* (Daniel, 1931) and *Galathea* (1947). Each has independent attachments to the dorsolateral walls in each segment. Continuity of fibres is almost absent.

Transverse muscles are completely absent. They do not occur even as contributions from the central muscles as is often the case in some decapods.

The dorsolateral muscles and the posterior auxiliary muscles described by Daniel (1931) for a typical malacostracan segment are also absent in *Lepidomysis*.

2) *Superficial ventral muscles*

They are seen only as thin sheets connecting sternal plates. Most of them are transparent, thin and narrow and cannot be expected to play any major role in the movement of the body.

3) *Dorsal muscles*

These are divisible into the main dorsal muscles and the lateral dorsal muscles.

a) *The main dorsal muscles* (Fig. 3: DM)

They consist of two long strips of muscles, one on each side, which twine around one another to make nearly four turns, starting from the first abdominal segment.

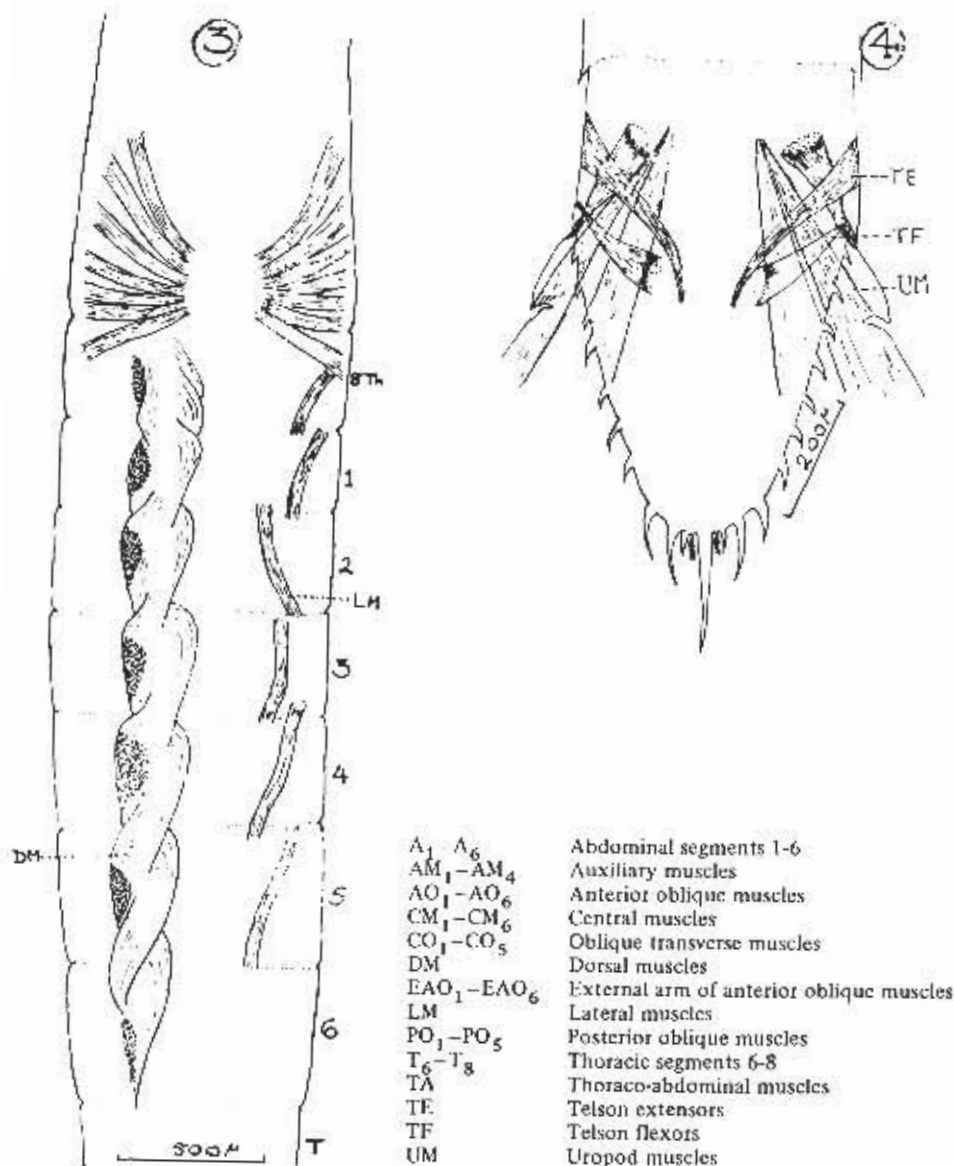


Fig. 3. Arrangement of the dorsal muscles and the lateral muscles.

Fig. 4. Arrangement of the muscles working the telson and the uropods.

Anterior to this they extend forward as two strips into the cephalothorax, being inserted near the anterior insertions of the thoraco-abdominal muscles. Posteriorly, the two strips of the main dorsal muscles are attached to the abdominal terga. One of the strips gets itself inserted on to the posterior half of the fifth abdominal tergum, while the other extends posteriorly being attached to the dorsal wall of the sixth abdominal segment near the point of insertion of central muscle 6.

During their course posteriorwards, each of the strips gives off muscle fibres permitting attachments to the terga of the segments they traverse.

These dorsal muscles are fairly stout and form important structures for the movement of the animal.

b) The lateral dorsal muscles

They are small strips of muscles confined to each segment and lying lateral to the main dorsal muscles. They are demarcated into two parts:

I) *Anterior lateral dorsal muscles*, which are paired thin strips one on either side extending from the anterior border of the first abdominal segment to the middle of the third abdominal segment, and

II) *Posterior lateral dorsal muscles*, which extend from the middle of the third abdominal tergum and run posteriorly as thin strips one on either side up to the posterior border of the fifth tergum.

Neither of these two sets show twisting as seen in the main dorsal muscles.

4) Lateral muscles (Fig. 3: LM)

In each of the segments 2, 3, 4 & 5, the lateral muscles originate at the middle of the tergum and end at the hind end.

Muscles working the telson and the uropods

There are two pairs of muscles in the last abdominal segment concerned with the movement of the telson. Of these one originates from near the base of the telson, fans out and attaches to the dorsolateral wall of the abdominal segment 6, near the attachment of the central muscles of the segment. This aids in extending the telson and may be called the telson extensor (Fig. 4: TE). Arising from the same spot as the telson extensor, but running in the opposite direction to get attached to the dorsal wall of the telson are another pair of muscles. These help in flexing the telson and can be called the telson flexors (Fig. 4: TF).

Muscles working the uropods are similarly attached to the base of the uropods (Fig. 4: UM).

DISCUSSION

Daniel (1931, 1932) examined the representatives of three different orders of Crustacea and made a comparative study of the musculature of these forms. He noted that there is repetition of the definite muscle pattern in segments 2 and 3 of the animals he studied. These segments were designated by him as "typical segments". In *Lepidomysis longipes* also these same segments are "typical".

Since *Praunus* alone among the animals studied by Daniel belongs to the sub order Mysida, the musculature of *Lepidomysis* is here compared with that of *Praunus* (See table attached).

The thoraco-abdominal muscles of *Praunus* are segmentally arranged, whereas in *L. longipes* they are simpler and more like those of *Homarus* (Daniel, 1952). The thoracic central muscle of *Praunus* is not represented in *Lepidomysis*.

The anterior oblique muscles of *Praunus* do not show much similarity to those of *Lepidomysis*. The median part of the muscle is not directly connected to their external arms in *Praunus*, differing from *Lepidomysis*. This condition in *L. longipes* is strikingly similar to that in other decapods. The posterior loop of the anterior oblique muscle is lacking in *Lepidomysis*, while it is present in *Praunus*.

Lepidomysis appears unique among crustaceans in the fact that the median part of the anterior oblique muscles is not attached to the sternum at the same level as the posterior oblique muscles as is the usual case. The result is that the linkage of the muscles noticed in *Praunus* and other forms does not exist in the *Lepidomysis*.

The central muscles of *Lepidomysis* differ widely from those of *Praunus*. All the central muscles except the first in *Praunus* have double construction, while in *Lepidomysis*, they are not only all single but have independent insertions on the dorsolateral walls of the segments. This independence of attachment is probably the result of the disappearance of the transverse muscles, which in turn may be the result of subterranean life of the animal which has restricted mobility. Transverse muscles are well developed only in those forms which possess well developed swimming habits. *Lepidomysis* has been noticed to be a poor swimmer.

The central muscles receive oblique transverse muscles in *Lepidomysis*, while in *Praunus*, these muscles seem to be practically independent of the anterior oblique muscles.

The auxiliary muscles are well developed in *Lepidomysis*, though they are suppressed in the first two segments of the abdomen. In *Praunus*, these segments also have auxiliary muscles. The posterior auxiliary muscles are completely absent in *Lepidomysis*, whereas in *Praunus* these are present. According to Daniel (1932), the posterior auxiliary muscles disappear with the development of dorsolateral muscles. In *Lepidomysis*, where even the latter are absent, it would appear that this absence is a secondary development. This, however, does not lead to a reappearance of the posterior auxiliary muscles since "a muscle when once destroyed can never be supplied" (Daniel, 1932).

The complete absence of the transverse muscles in *Lepidomysis* has already been referred to. This muscle acts as support to the more powerful anterior oblique muscles in actively swimming animals. Hence, the absence of this important muscle is not surprising, since the animal is a poor swimmer.

Table 1. Summary of the muscles present in muscular system of *Lepidomysis longipes* and *Praunus flexuosus*

Muscles	<i>Lepidomysis</i>	<i>Praunus</i>
Anterior oblique muscles showing the occurrence and the manner in which they are linked together in series.	1-4- isolated median portion of 2, 3, 4, 5 & 6 attached in isolation	1-4-7-2 isolated
Anterior oblique muscles consisting of a median portion joined directly to an external arm.	23436	Only connected through oblique transverse muscles
Posterior loop of the anterior oblique muscles	Absent	12343 -
Auxiliary muscles	-3456-	12345 (6)-
Oblique transverse muscles	-23456-	(1) (2) (3) 456 practically independent of anterior oblique muscles
Central muscles	123456 no posterior transverse process, independent attachment	1 single 2345 composed of double muscle
Transverse muscles	Absent	12? 3? 4? 5 6
Dorsolateral muscles	Absent	Absent
Posterior auxiliary muscles	Absent	-3 4 5 - -

CONCLUSION

The musculature of the subterranean mysid, *L. longipes* shows important differences from that of its epigeal relatives. These involve the absence of some important muscles performing swimming movements. *L. longipes*, being an inhabitant of narrow subterranean channels, apparently is not required to perform as much swimming as its epigeal relatives. Consequently, the muscles controlling such movements appear to have undergone atrophy.

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SUMMARY

The musculature of the hypogean mysid, *Lepidomysis longipes* (Pillai and Mariamma) is remarkably modified. It shows the absence of many muscles and poor development of others in the abdominal region. This is correlated with the subterranean nature of the animal.

RESUME

La musculature de ce Myside hypogé *Lepidomysis longipes* (Pillai and Mariamma) est remarquablement modifié. Elle montre l'absence de plusieurs muscles et un faible développement des autres dans la région abdominale. Ceci est en relation avec la vie hypogée de cet animal.

LITERATURE

- DANIEL, R. J. 1931 - Comparative study of abdominal musculature of Malacostraca. *Proc. Liverpool Biol. Soc.*, 45:57-71.
-----1932 - Comparative study of the abdominal musculature of Malacostraca. *Proc. Liverpool Biol. Soc.*, 46:46-104.
PIKE, R. B. 1947 - *Galathea*: Liverpool Marine Biological Committee Memoirs., University Press, Liverpool.