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A STUDY OF THE MALE REPRODUCTIVE ORGANS OF NINE SPECIES OF PENAEID PRAWNS (CRUSTACEA: PENAEINAE)

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ABSTRACT: This paper deals with the male reproductive organs of nine species of penaeid prawns; *Penaeus penicillatus* Alcock, *P. merguiensis* De Man, *P. semisulcatus* De Haan, *Metapenaeus affinis* (H.Milne Edwards), *M. monoceros* (Fabricius), *M. stebbingi* Nobili, *Parapenaeopsis hardwickii* (Miers), *P. sculptilis* (Heller) and *P. stylifera* (H. Milne Edwards). The male reproductive organs exhibited structural variations, which were more pronounced at generic level. These variations are mainly due to the type of spermatophore they possess. One species of each genus, that is, *P. merguiensis*, *M. affinis* and *P. sculptilis* were also studied histologically to examine the internal structure of the male reproductive organs. Spermatophores of the six species belonging to the genera *Penaeus* and *Parapenaeopsis* are also described and illustrated.

KEY WORDS: Male reproductive organs - spermatophore - penaeid prawns.

INTRODUCTION

The male reproductive organs of penaeid prawns have received less attention as compared to those of female. This is mainly due to the uncertainty of the ripeness in males and also due to the absence of seasonal and cyclic changes. The workers who have undertaken studies on the male reproductive organs of penaeid prawns include Heldt (1938), King (1948), Eldred (1958), Shaikhmahmud and Tembe (1958), Subrhamanyam (1965), Tuma (1967), Tirmizi and Khan (1970), Malek and Bawab (1974a,b), Huq (1981), Motoh (1981), Chen (1986), Champion (1987) and Ro *et al.* (1990). The species which were investigated by these authors are *Penaeus duorarum, P. indicus, P. japonicus, P. kerathurus, P. merguiensis, P. monodon, P. orientalis, P. penicillatus, P. semisulcatus, P. setiferus* and *Parapenaeopsis stylifera.*

In this paper we describe the male reproductive organs of the nine species of penaeid prawns; *Penaeus penicillatus* Alcock, *P. merguiensis* De Man, *P. semisulcatus* De Haan, *Metapenaeus affinis* (H. Milne Edwards), *M. monoceros* (Fabricius), *M. stebbingi* Nobili, *Parapenaeopsis hardwickii* (Miers), *P. sculptilis* (Heller) and *P. stylifera* (H. Milne Edwards). Of these the male reproductive organs of the three species of *Metapenaeus* and the two species of *Parapenaeopsis* have not been studied previously.

Male reproductive organs of *P. merguiensis, M. affinis* and *P. sculptilis* were also studied histologically to examine the internal structures. Spermatophores of six species, namely *Penaeus penicillatus, P. merguiensis, P. semisulcatus, Parapenaeopsis sculptilis, P. hardwickii* and *P. stylifera* were also studied and these are described and illustrated here. A review on spermatophores and sperm transfer in marine crustaceans has recently been published by Subramoniam (1993). General features of the spermatophore of *P. stylifera* were presented by Shaikhmahmud and Tembe (1958) and Tirmizi (1968), while Tuma (1967) and Huq (1981) recorded a few observations on the spermatophore of *P. merguiensis*. An account of *P. penicillatus* spermatophore was given by Tirmizi and Khan (1970). The spermatophores of the

remaining three species; *P. semisulcatus, P. sculptilis* and *P. hardwickii*, have not been described so far.

MATERIALS AND METHODS

The specimens were collected from commercial landings at Karachi fish harbour and Korangi fish harbour, during July 1983 to April 1985. The specimens were brought to the laboratory in a vacuum flask containing ice. In the laboratory measurements were taken to the nearest millimeter. The total length were taken from tip of the rostrum to the posterior end of telson. Dissections were performed in chilled seawater. For histology, tissues were fixed in Davidson's fluid (alcohol, formaldehyde, glycerol, acetic acid and seawater in the ratio of 3:2:1:1:3) overnight, washed thoroughly with running tap-water, dehydrated with graded alcohol series and embedded in paraffin. Six to eight micron thick sections were cut by a rotary microtome. Sections were stained with Harris's haematoxylin and eosin.

The spermatophores were removed by pressing the terminal ampulla with the finger or by placing the whole terminal ampoule in tap-water for few hours. The latter method was found much safer although time consuming. The illustrations were drawn with the aid of a camera lucida or a squared eye piece. Photographs were taken by Olympus photomicroscope.

RESULTS

A total of 155 male prawns belonging to nine species were dissected and their reproductive organs were examined. Table I shows the number of specimens, size range and the variation in number of testicular lobes in each species. The reproductive organs consists of paired testes, vasa deferentia and terminal ampulla. No significant differences in shape and structure of the reproductive organs were observed in species of the same genus. However, structural differences were found at generic level.

Penaeus penicillatus

Each testis consists of five testicular lobes in most cases (Fig.1A) however the number may vary from two to five (Table I). The testicular lobes are elongated, distinctly separated finger-like projections of almost equal size as shown in figure 1B. Each lobe has a small and narrow tubule which joins a collecting tubule. The collecting tubule leads to proximal vas deferens, which is a short tube and opens into the medial vas deferens through a sub terminal opening, leaving a small but broad area behind, that is blind pouch (Fig.1B). The medial vas deferens is an inverted U- shaped tube. The limb adjacent to proximal vas deferens that is, ascending arm is situated medially and directed upward (in-situ), while the adjoining lateral limb, descending arm is directed downward. The posterior part of the descending arm gradually tapers and continued into the distal vas deferens, which opens into a sac-like terminal ampoule. When the vas deferens was cut open, it was observed that the lumen of the entire vas deferens is divided longitudinally into two unequal divisions by means of a septum, which is fairly thick in the region of the medial vas deferens and divides it completely into two separate ducts, spermatic and wing ducts. The spermatic duct is

Table I. Number of testicular lobes in different species of penaeid prawns.

Species	N	Prawn size TL (mm)	No. of lobes in each testis
P. penicillatus	40	99-147	2 to 5
P. merguiensis	27	115-148	2 to 5
P. semisulcatus	14	105-174	3 to 8
M. affinis	21	102-137	4 to 5
M. monoceros	4	121-130	5 to 7
M. stebbingi	4	61-88	5
P. hardwickii	14	54-68	2 to 5
P. sculptilis	15	62-105	2 to 5
P. stylifera	16	61-90	2

membranous, transparent and narrow, containing loose spermatic material. The wing duct is filled with an elastic, opaque to yellowish solid material. The shape of the wing duct and the quantity of the material present in the lumen were found highly variable. In several specimens it was found as a simple structure which became folded and irregular, occupying major part of the breadth of medial vas deferens (Fig. 1C), while in other specimens it was observed that most material of the wing duct accumulates at the junction of ascending and descending arms (Fig.1D). In some specimens this material was confined into the medial vas deferens while in some other specimens it extended into the terminal ampoule.

In distal vas deferens the septum inside the lumen is thin, hanging freely from one side and continues upto the terminal ampoule. The terminal ampoule is also divided into two almost equal chambers, spermatic and wing chambers, communicating with each other. The spermatic chamber contains a sperm sac while the wing chamber contains the wing-like membrane of the spermatophore. The median septum bears three to five oblique folds in the spermatic chamber (Fig.1E), the impression of these folds were visible on the sperm sac. A fairly wide opening lies at the base of the spermatic chamber for extrusion of spermatophores.

Penaeus merguiensis

All parts of testis, vas deferens and terminal ampoule were found almost identical to that of *P. penicillatus*, described above. Number of testicular lobes in each testis was also found similar to *P. penicillatus*, which is two to five (Table I). Figure 1F shows the various parts of the male reproductive organs of this species.

Penaeus semisulcatus

The structure of reproductive organs (Fig.1G) was found similar to those of *P. penicillatus* and *P. merguiensis* described above. However, few minor differences were observed: maximum number of testicular lobes was eight instead of five (Table I). The terminal ampoule is conical (Fig.1H and I) and the spermatic chamber is smaller than the wing chamber. The median septum of terminal ampoule is devoid of any fold.

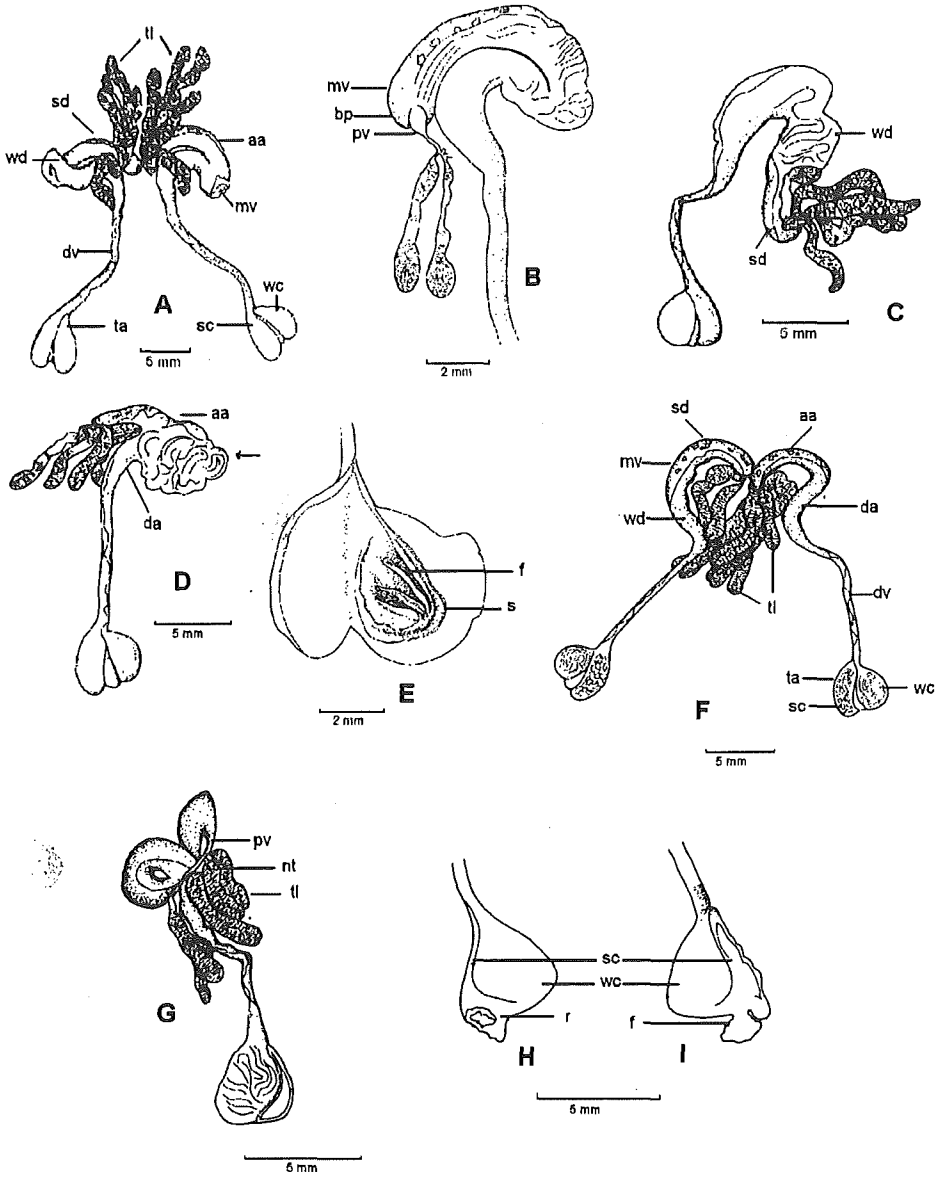

Fig.1. (A) Male reproductive organs of *Penaeus penicillatus*, (B) vasa deferentia of *P. penicillatus* showing blind pouch, (C) reproductive organs of a male *P. penicillatus* with broad wing duct in the region of medial vasa deferntia, (D) reproductive organs of another male *P. penicillatus:* arrow indicates accumulated wing material at junction of ascending and descending arms of medial vasa deferentia, (E) terminal ampoule of *P. penicillatus* showing oblique folds on the median septum, (F) male reprodutive organs of *Penaeus merguiensis*, (G) male reproductive organs, right half of *Penaeus semisulcatus*, showing opening of testicular lobes into narrow tubes, (H) and (I) two views of terminal ampoule of *P. semisulcatus*.

aa: ascending arms, bp: blind pouch, da: descending arms, dv: distal vasa deferentia, f: fold, fl: flap, mv: medial vasa deferntia, nt: narrow tube, o: opening, pv: proximal vasa deferentia, r: rim, s:septum, sc: spermatic chamber, sd: spermatic duct, ta: terminal ampoule, tl: testicular lobe, wc: wing chamber, wd: wing duct.

Metapenaeus affinis

Figure 2A shows the male reproductive organs of *M. affinis*. Each testis has four to six testicular lobes, in most cases five lobes on each side (Table I). The testicular lobes are elongated and distinctly separated finger-like projections of unequal length (Fig.2B). Each testicular lobe directly opens into a narrow tube, which joins the proximal vas deferens laterally. The proximal vas deferens is a narrow tube coiled irregularly. The medial vas deferens forms a single whorl around its axis in its middle length (Fig.2A). The terminal ampoule is large and oval in shape. The division of the lumen of the medial and distal vasa deferentia exists in the same way as in the species of *Penaeus*, described above; the difference however lies only in the structure of terminal ampoule, which instead of a septum bears a strongly thick fold in the upper half of the terminal ampoule (Fig.2C) which forms a pocket with the opposing wall of it. The pocket is not a separate chamber as it communicates with the lumen of terminal ampoule. This pocket lodges an opaque pad-like structure of non spermatic material.

Metapenaeus monoceros

The number of testicular lobes vary from five to seven in each testis (Table I). The shape and the structure of different parts of the vas deferens and terminal ampoule (Fig.2D) are almost identical to those of *M. affinis*.

Metapenaeus stebbingi

Figure 2E shows the reproductive organs of this species. Each testis has five testicular lobes on each side. All other parts of the vas deferens and terminal ampoule are similar to those of *M. affinis* and *M. monoceros* described above except the length of the proximal vas deferens, which is comparatively short and less coiled.

Parapenaeopsis sculptilis

The number of testicular lobes varies from two to five (Table I). The testicular lobes are short, broad, somewhat flattened and spread over the proximal vas deferens (Fig.3A). The lobes are well separated anteriorly, whereas these are more or less united at their bases. The proximal vas deferens is extremely long and convoluted tube, narrower than the medial vas deferens (Fig.3B). The medial vas deferens is loosely coiled in a spring-like manner. The diameter of the medial and distal vasa deferentia are the same, unlike all the species of *Penaeus* and *Metapenaeus* described above. The terminal ampoule is represented by a small and weakly dilated sac (Fig.3A). Its basal part is enlarged and forms a tubular structure, which opens to the exterior through a terminal opening (Fig.3C). This terminal enlargement lies at the extreme margin of the genital opening.

Parapenaeopsis hardwickii

In most of the specimens, each testis had two lobes (Fig.3D); however, one specimen had five lobes in the right testis, and two in the left testis (Table I). All other parts of the reproductive system are similar to that of *P. sculptilis*, described above, except the outer surface of the terminal ampoule, which bears few swellings or protuberances on its inner margin (Fig.3E).

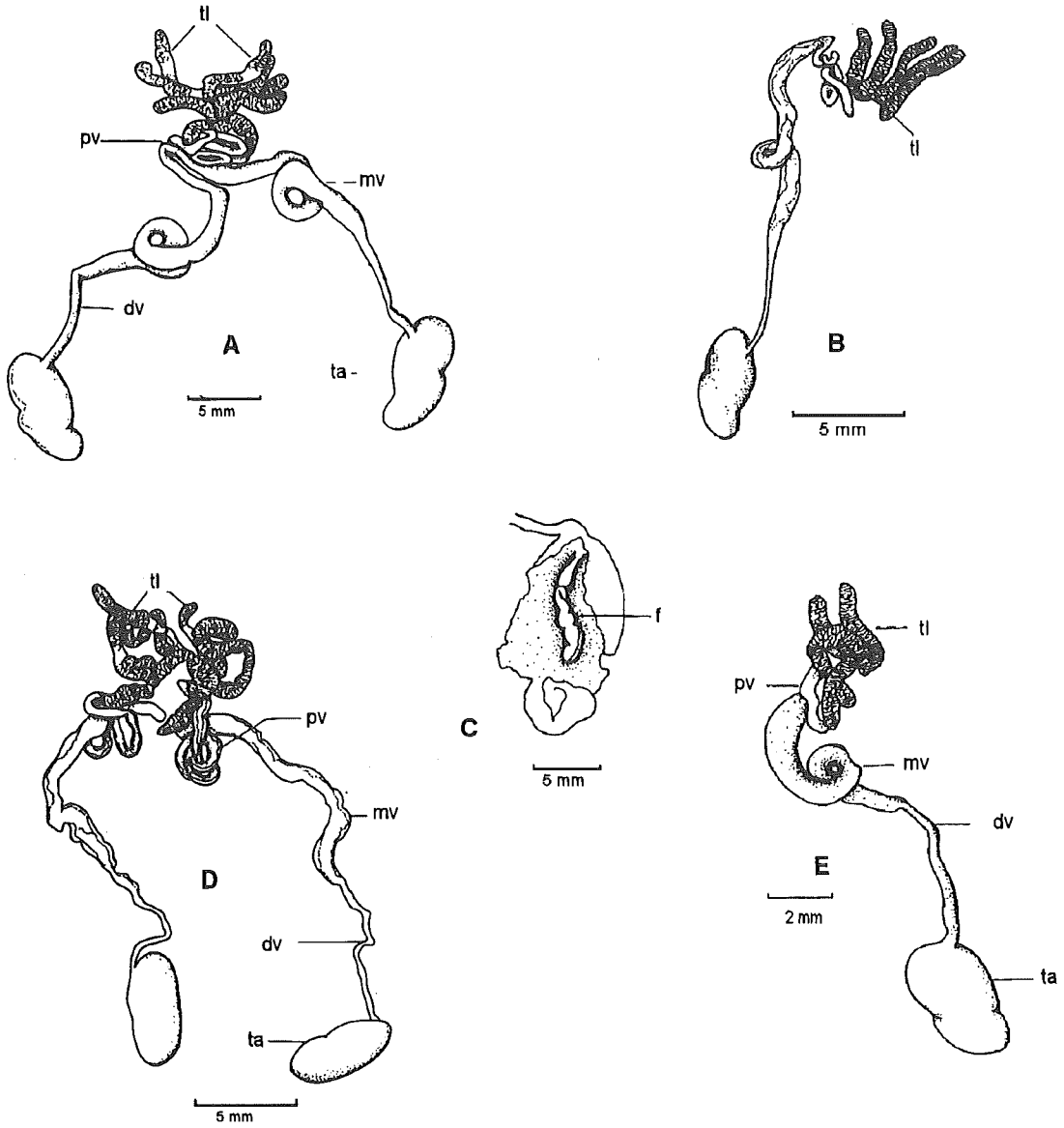

Fig.2. (A) Male reproductive organs of *Metapenaeus affinis*, (B) left half of the reproductive organs of *M. affinis* showing arrangement of testicular lobes, (C) terminal ampoule of *M. affinis*, cut open to show internal fold, (D) male reproductive organs of *Metapenaeus monoceros*, (E) right half of the male reproductive organs of *Metapenaeus stebbingi*.
dv: distal vasa deferentia, f: fold, mv: medial vasa deferentia, pv: proximal vasa deferntia, ta: terminal ampoule, tl: testicular lobe.

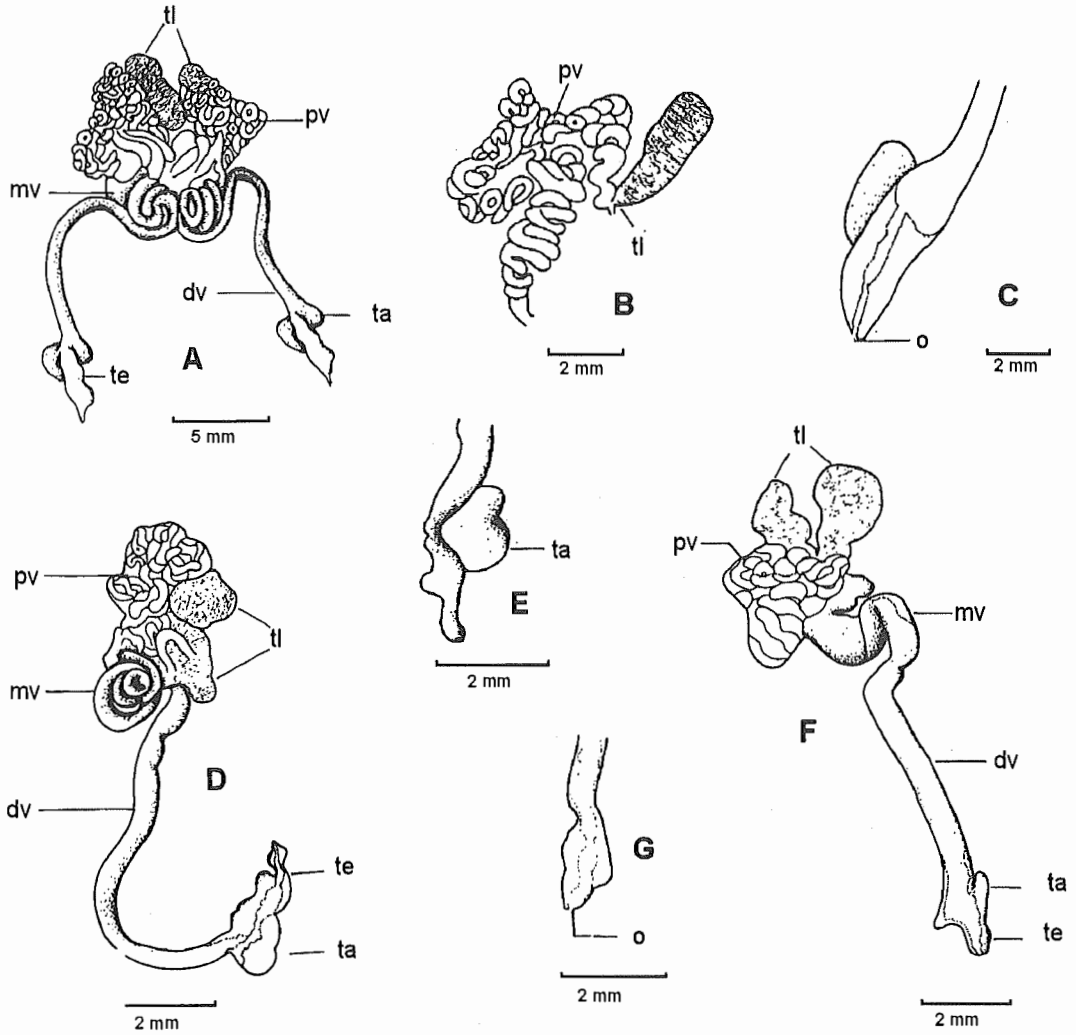

Fig.3. (A) Male reproduction organs of *Parapenaeopsis sculptilis*, (B) testicular lobe and proximal vasa deferentia of *P. sculptilis* enlarged, (C) terminal ampoule of *P. sculptilis*, (D) male reproductive organs, right half, of *Parapenaeopsis hardwickii*, (E) terminal ampoule of *P. hardwickii* showing protuberances, (F) male reproductive organs, left half, of *Parapenaeopsis stylifera*, (G) terminal ampoule of *P. stylifera*.

dv: distal vasa deferentia, mv: medial vasa diferentia, o: opening, pv: proximal vasa deferentia, ta: terminal ampoule, te: tubular enlargement, tl: testicular lobe.

Parapenaeopsis stylifera

It was observed that each testis has two testicular lobes in all the specimens studied (Table I). The testicular lobes and proximal vas deferens are same as in *P. sculptilis*. The medial vas deferens is broad, straight and folded over itself (Fig.3F). The terminal ampoule is found in its simplest form in this species. It is represented by a small dilation at the end of vas deferens (Fig.3G), basal portion of which is elongated and opens through a terminal opening.

SPERMATOPHORES

Fully formed spermatophores of *P. penicillatus, P. merguiensis, P. semisulcatus, P. sculptilis, P. hardwickii* and *P. stylifera* were studied and are shown in figures 4 and 5. Table II shows the average size of sperm sac in the six species. The largest size was observed in *P. merguiensis* (5.28 mm ± 0.552 S.D.) whereas smallest size was found in *P. stylifera* (0.145 mm ± 0.011 S.D.).

In *Penaeus* species spermatophore consists of a sperm sac and an accessory membranous structure, whereas in *Parapenaeopsis* species spermatophore is simple and consists of a sperm sac alone without any accessory structure. The spermatophore of each species is described below.

Table II. Size of the sperm-sac in different species of penaeid prawns (N=number of sperm-sac measured).

Species	N	Average size± S.D. (mm)	Observed range (mm)
P. penicilltus	14	5.060±0.976	3.500-7.000
P. merguiensis	8	5.528±0.552	4.500-6.500
P. semisulcatus	4	4.660±1.040	3.500-5.500
P. hardwickii	19	0.021±0.001	0.014-0.002
P. sculptulis	22	0.027±0.008	0.011-0.042
P. stylifera	7	0.145±0.011	0.115-0.166

Penaeus penicillatus: Each terminal ampoule had only one spermatophore. A fully formed spermatophore (Figs.4A and B) has an oval and transparent sperm sac, measuring 3.5 to 7.0 mm in length. The anterior end of the sac was bluntly pointed while the posterior end was rounded. The sperm sac is filled with spermatic material, embedded in viscous fluid. The wing is anteriorly connected with the sperm sac and covered a part of it. The proximal part of the wing (or stalk) is thick and elongated. The upper margin of the stalk is irregular while the lower margin is straight. The two margins are turned inwards to form a trough-like structure. The distal part of the wing is thin and greatly distended as semicircular membrane.

The two least developed spermatophores were found from a male measuring 99 mm in total length. Each spermatophore (Fig.4C) had a small sperm sac, measuring 2.5 mm in length, and was found almost empty except a small amount of spermatic material concentrated towards the posterior end. The wing was elongated; the margins

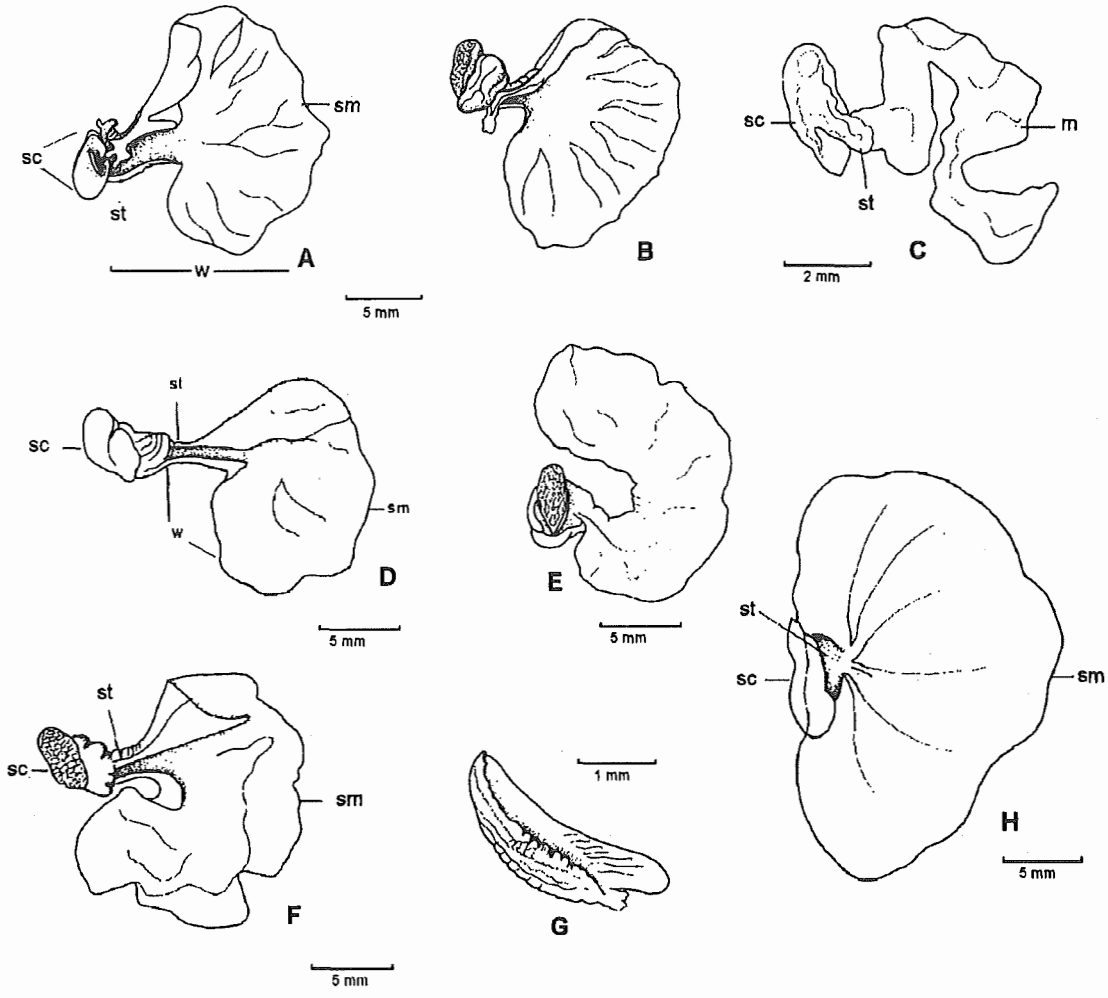

Fig.4. Spermatophores of: (A) and (B) *Penaeus penicillatus* in two different views, (C) *P. penicillatus*, not fully formed, (D) *P. penicillatus*, with long stalk, (E) *P. penicillatus*, (F) *Penaeus merguiensis*, (G) flat irregular somite found in a terminal ampoule of *P. merguiensis*, (H) *Penaeus semisulcatus*.
m: membrane, sc: sperm sac, sm: semicircular membrane, st: stalk, w: wing.

of the stalk were straight and not folded as observed in fully formed spermatophores. The membrane was narrow and elongated, instead of being semicircular.

The spermatophore shown in figure 4D was found in a male of 111mm total length, had exceptionally long stalk with slightly turned margins. In another spermatophore (Fig.4E) extruded out from a male of 113 mm total length, the membrane was elongated, not semicircular, though the sperm sac was filled with spermatic material, visible through the transparent walls.

Penaeus merguiensis: The spermatophore of *P. merguiensis* was found similar to *P. penicillatus*, except the upper margin of the stalk which is straight, instead of irregular (Fig.4F). One male whose total length was 129 mm had a small, flat, stiff and irregular structure (Fig.4G) in the left terminal ampoule while the right ampoule was empty.

Penaeus semisulcatus: The sperm sac is slender and with the anterior end sharply pointed (Fig.4H). The stalk is short, straight and attached to the middle of sperm sac. The semicircular membrane is enormous and encircled the sperm sac as soon as it extrudes.

Parapenaeopsis sculptilis: Unlike the *Penaeus* spp., a large number of spermatophores was obtained from a single specimen by pressing the each terminal ampoule. The spermatophores are minute, microscopic and oval or elongated structures (Fig.5A). Their size varies from 0.011 mm to 0.042 mm in length. The larger spermatophores were filled with spermatic material, whereas smaller ones were partially filled.

Parapenaeopsis hardwickii: Several spermatophores were obtained from each terminal ampoule of the male. The spermatophores are minute, microscopic structure, measuring from 0.014 mm to 0.022 mm in length. The spermatophores are barrel shaped and they have several irregularly arranged longitudinal striations as shown in Fig.5B.

Parapenaeopsis stylifera: The spermatophores of this species were obtained from the terminal ampullae of the males as well as from the thelycum of the impregnated females. The impregnated females were easily recognised by the pear-shaped whitish structures visible through the posterior plate of the thelycum. The spermatophores are minute, spindle-shaped, measuring 0.15 mm to 0.166 mm in length. There were six to eight transverse rows of fine striations, arranged regularly on each spermatophore (Fig.5C). The spermatophores from the impregnated females had disintegrated outer walls, otherwise they were similar in size and shape.

HISTOLOGY OF MALE REPRODUCTIVE ORGANS

Histological study of male reproductive organs was undertaken in three species of penaeid prawns, *Penaeus merguiensis, Metapenaeus affinis* and *Parapenaeopsis stylifera*. The internal structure of the testicular lobes was found almost identical in all the three species. However, the variations were found in the internal structure of the vas deferens and the terminal ampoule in different species, mainly due to the presence or absence of the median septum and typhlosole.

The main bulk of each testicular lobe is composed of a mass of convoluted seminiferous tubules, enveloped by a thin cortex. Each seminiferous tubule consists of a thick outer membrane and an inner germinal epithelium. The seminiferous tubule contains the germ cells in different stages of development. The cortex has two layers, an outer layer of epithelial cells and an inner layer of connective tissues.

The wall of vas deferens is composed of two layers, an outer layer of fibrous coat and an inner thick layer of connective tissues with circular muscle fibers. The thickness of the wall varies in different regions of vas deferens but it consist of the same layer of the cells. The terminal ampoule is a highly glandular structure and muscle fibers are the major component of its wall.

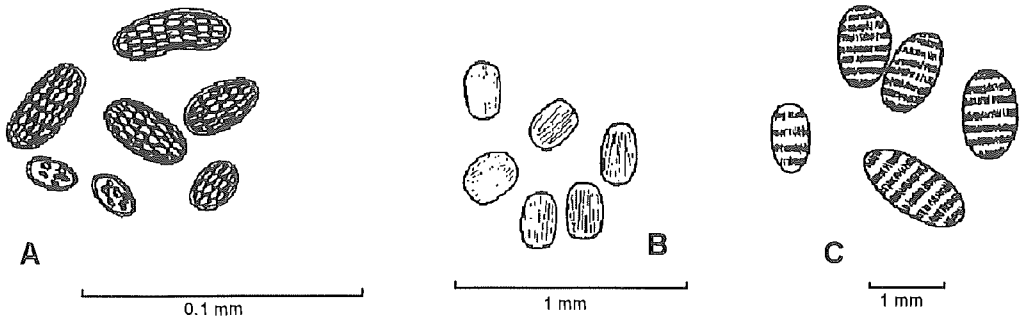

Fig. 5. Spermatophores of: (A) *Parapenaeopsis sculptilis*, (B) *Parapenaeopsis hardwickii* and (C) *Parapenaeopsis stylifera.*

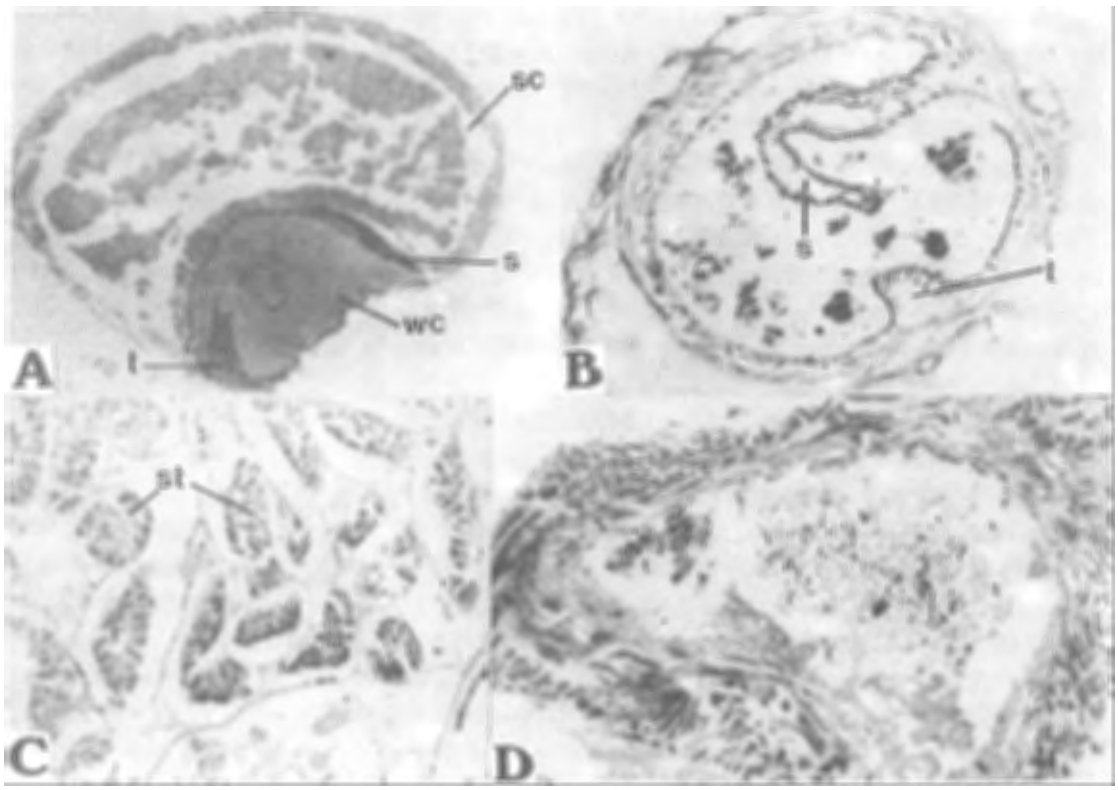

Fig.6. Histology of the male reproductive system; *P. merguiensis*, (A) medial vas deferens, descending arm, (B) distal vas deferens; *P. stylifera*, (C) testicular lobes and (D) terminal ampoule.
s: septum; sc: spermatic chamber; st: seminiferous tubules; t: typhlosole; wc. wing duct.

Penaeus merguiensis: The transverse section of testicular lobe has the usual structure described above, the male germ cells were found in different developmental stages in the seminiferous tubules. The section of vas deferens revealed the presence of median septum in the medial and distal part of the vas deferens, whereas the proximal vas deferens was a simple tube without any septum. The septum composed of a thick layer of connective tissue with muscle fibers and a few large cells, which may be glandular. The septum originates at the point where the proximal vas deferens opens into the medial vas deferens. The septum is thick and complete in the medial vas deferens, thereby dividing the lumen into two ducts (Fig.6A), but in distal vas deferens, the septum is thin and incomplete, hanging in the lumen, connected with one side only (Fig.6B). The wall of the spermatic duct projected inwards to form a typhlosole. A similar typhlosole was also observed in the wing duct at a lower level, i.e. in the descending arm. The section of the terminal ampoule shows that the median septum is fairly thick and wide, although it is incomplete and hanging freely. The sperm sac and the wing of the spermatophore are partially separated by the median septum.

Metapenaeus affinis: The transverse section of the testicular lobe showed the seminiferous tubules with developing germ cells. A septum was observed in the regions of medial and distal vas deferens. The medial vas deferens completely divided into two unequal chambers due to the septum. In the distal part of the vas deferens, the septum was seen hanging freely in the lumen and therefore the tube is divided only partially, as seen in *P. merguiensis*. The terminal ampoule had no septum but a small fold projecting inward was observed.

Parapenaeopsis stylifera: The section of the testis showed the usual structure, the seminiferous tubules and the germ cells in various developmental stages (Fig.6C). The study of transverse sections revealed the absence of the septum and the typhlosole in the vas deferens. Incompletely formed spermatophores were observed in the sections of the proximal vas deferens. The terminal ampoule had no septum or fold. It is a sac-like structure with thick muscular wall (Fig.6D).

DISCUSSION

Like all other decapod Crustacea, the male reproductive organs of the shrimp basically consist of paired testes, vasa deferentia and terminal ampulla. It was observed that the number of testicular lobes varies not only from species to species but also from specimen to specimen and even in the two halves of the same specimen. The variation in the number of testicular lobes may be due to the rapid deterioration of the testicular lobes after death of the animal or due to the empty lobes which are transparent and membranous and hence difficult to locate.

Species of all the three genera lack an accessory gland, which has been reported in stomatopod, *Squilla oratoria* (Komai, 1920; Wolfe, 1971) and branchipod, *Artemia* (Deecaraman and Subramoniam, 1980). Shaikhmahmud and Tembe (1958), however, reported the presence of an accessory gland in *Parapenaeopsis stylifera*. During present study no such gland was found either in this species or in any other species. It has been reported that the role of accessory gland in shrimp and lobster has been taken over by vas deferens (Shyamasundri and Rao, 1986; Malek and Bawab, 1974b),

Table III. Comparison of the male reproductive organs of the three penaeid genera, (PVD=proximal vas deferens; MVD=medial vas deferens; DVD=distal vas deferens).

Penaeus	*Metapenaeus*	*Parapenaeopsis*
TESTICULAR LOBE: Elongated, finger-like, usually equal in length.	elongated, finger-like, usually unequal in length.	short, broad and flattened.
Distinctly separated, opens through narrow tubes into the PVD.	distinctly separated, opens through a narrow tube into the PVD.	conjoined posteriorly into PVD
PROXIMAL VAS DEFERENS: Short, straight, opens subterminally into MVD.	moderately long, irregularly coiled, continued into MVD	extremely long, much convoluted continued into MVD
With blind pouch.	no blind pouch.	no blind pouch.
MEDIAL VAS DEFERENS: Inverted U-shaped, diameter much broader than DVD.	forms a single whorl, diameter broader than DVD.	coiled, spring-like, diameter equal to DVD.
Longitudinal division by a septum.	longitudinal division by a septum.	no longitudinal division.
DISTAL VAS DEFERENS: With a hanging septum	with a hanging septum	without any septum.
TERMINAL AMPULLAE: Large, pear-shaped	large, strongly dilated, oval-shaped.	small, weakly dilated.
With a median hanging septum.	with strong thick fold	without any septum
Basal part not tubular.	basal part not tubular.	basal part enlarged to form a tubular structure.
SPERMATOPHORES: Single spermatophore in each terminal ampoule, sperm-sac attached to an accessory wing-like membrane.	single spermatophore in each terminal ampoule, sperm sac with a separate pad-like structure.	numerous spermatophores in each terminal ampoule, no accessory structure is found.

which is highly glandular, greatly modified and differentiated into four distinct regions, according to its functional significance in different genera. The four regions of vas deferens have been recognized on the basis of their varying diameter and shape.

Table III presents a comparison of various parts in male reproductive organs in the three genera. The shape of testicular lobes varies from a short, broad and posteriorly conjoined form (*Parapenaeopsis* spp.) to distinctly separated and elongated finger-like projections of equal (*Penaeus* spp.) or unequal length (*Metapenaeus* spp.). The opening of testicular lobes into vas deferens is either direct, as in *Parapenaeopsis*, or through a narrow tube as in *Metapenaeus* and *Penaeus*, which is referred by some authors (Shaikhmahmud and Tembe, 1958) as vas efferens. The structure and functional significance of vas deferens has been described in details by Malek and Bawab (1974) and Ro *et al.* (1990) in *Penaeus kerathurus* and *P. setiferus*, respectively. During the present investigation, shape and structure of vas deferens in *Penaeus* spp. is found to be almost similar as previously described for these species except a rotation of 90° in the medial vas deferens. This rotation of 90° in the medial vas deferens is known in *P. kerathurus* (Malek and Bawab, 1974). The simplest type of vas deferens is found in *Parapenaeopsis* spp., where it is a long and coiled tube without any internal partitioning. The spermatophore in this genus is consists of a single sperm sac with no accessory structure hence no partition exists for its formation. In contrast to this, spermatophore in *Penaeus* and *Metapenaeus* consists of a sperm sac and an accessory structure (a wing-like membrane in *Penaeus* and a pad-like structure in *Metapenaeus*). .The division of vas deferens is, therefore, meant for the separate processing of the two materials (the spermatic and non- spermatic).

The greatest variations occur in the region of proximal and medial vas deferens, which are reported as the site for initial formation of spermatophore, whereas the final phase is completed in the terminal ampoule, which is also greatly enlarged and highly modified in *Penaeus* spp. In *Parapenaeopsis* spp., the terminal ampoule is small, weakly dilated and somewhat elongated structure, which possibly may protrude out during transfer of spermatophore. The role of vas deferens in the formation of spermatophore in *Metapenaeus* spp. and *Parapenaeopsis* spp. is not known. However, on the basis of available informations and the shape of spermatophores and vasa deferentia observed during present investigation it could be inferred that the structural changes in the different parts of vasa differentia are associated with the type of spermatophores.

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