

# The Larval Development of the Spider Crab *Menaethiops nodulosus* (Nobili, 1905) (Crustacea, Decapoda, Majidae) Reared in the Laboratory

Farhana S. GHORY, Feroz A. SIDDIQUI

Marine Reference Collection and Resource Centre, University of Karachi, Karachi-75270, PAKISTAN

Received: 16.05.2000

**Abstract:** The present paper is based on the larval development of a spider crab *Menaethiops nodulosus* (Nobili, 1905) reared in the laboratory. The genus *Menaethiops* is represented by twelve species from Indo-Pacific regions including *M. bicornis* Alcock, 1895. Later two more species *M. gadaniensis* Kazmi & Tirmizi and *M. nodulosus* (Nobili) were added to the marine fauna of Pakistan.

The ovigerous female of *M. nodulosus* was collected from Buleji on October 28, 1996, prezoaeae and first zoeae were obtained on November 13, 1996 and the first zoeae were segregated for further experiment. This species passes through two zoeal stages before moulting to megalopa. The duration from hatching to megalopa is 9 days at room temperature (27°-28°C) in stored, filtered seawater of a salinity of 35-37 parts per thousand and pH 7.9.

The larval stages of *Menaethiops nodulosus* are described along with their illustrations for the first time to our knowledge. The zoeae of *M. nodulosus* are compared with the laboratory reared zoeae of majid crabs: *M. bicornis* (unpublished), *Achaeus lacertosus* Stimpson 1858, *Schizophrys aspera* (H. Milne Edwards, 1834) and *Micippa platipes* Rüppell, 1830.

**Key Words:** Decapoda, Majidae, Larval development of *Menaethiops nodulosus*, Pakistan

## Laboratuvarda Yetiştirilen *Menaethiops nodulosus*'un (Noblili, 1905) (Crustacea, Dcapoda, Majidae) Larval Gelişimi

**Özet:** Bu makale, laboratuvarda yetiştirilen *Menaethiops nodulosus*'un (Nobili, 1905) larval gelişimiyle ilgilidir. *Menaethiops* cinsi, Indo-Pacific bölgesinden başta *M. bicornis* Alcock, 1895 olmak üzere 12 tür ile temsil edilmektedir. Daha sonra, Pakistan'ın deniz faunasına iki tür, *M. gadaniensis* Kazmi & Tirmizi ile *M. nodulosus* (Nobili), eklenmiştir.

Yumurta taşıyan dişi olan bir *M. nodulosus* örneği 28 Ekim 1996 tarihinde toplanmıştır. Prezoearlar ile ilk zoelar 13 Kasım 1996 tarihinde elde edilmiş ve ilk zoelar ilerideki deney için ayrılmıştır. Bu tür, megalopa evresine geçmeden önce iki zoea evresinden geçmektedir. Yumurtadan çıkıştan megalopa evresine geçiş süresi, oda sıcaklığında (27°-28°C) ve dopalanmış, filtre edilmiş, salinitesi 35-37‰, pH değeri 7.9 olan deniz suyunda 9 gündür.

*Menaethiops nodulosus*'un larva evrelerinin resimleriyle birlikte tanımları bildiğimiz kadarıyla bu raporda ilk kez olarak verilmektedir. *M. nodulosus* zoelarları, laboratuvarda yetişen majid yengeçlerinin zoelarlarıyla karşılaştırılmıştır. *M. bicornis* (yayımlanmamış), *Achaeus lacertosus* Stimpson 1858, *Schizophrys aspera* (H. Milne Edwards, 2845) ve *Micippa platipes* Rüppell, 1830.

**Anahtar Sözcükler:** Decapoda, Majidae, *Menaethiops nodulosus*'un larval gelişimi, Pakistan

## Introduction

Twelve species of the genus *Menaethiops* from Indo-Pacific regions are mentioned (1), including *Menaethiops bicornis* Alcock, 1895 the only representative of the genus from Pakistan at that time. Later, two more species were added: *Menaethiops gadaniensis* Kazmi & Tirmizi, 1999 and *Menaethiops nodulosus* (Nobili, 1905) (2), as a first record in Pakistan waters.

To our knowledge the larvae of the genus *Menaethiops* have not been studied before. Recently

several ovigerous females of *M. nodulosus* were obtained from Buleji, and their larvae were reared up to the megalopal stage in the laboratory. This species passes through two zoeal stages before attaining the megalopal stage. The maximum duration from hatching to the megalopal stage is nine days at room temperature in filtered seawater.

The detailed descriptions with their illustrations are presented and their morphological characters are also summarized in Table 1. The main objective of the present study is to obtain information about the larvae of the

Table 1. Morphological Characters of *Menaethiops nodulosus* (Nobili, 1905) from Prezoea to Megalopa.

Characters	Pre-Zoea	Zoea I	Zoea II	Megalopa
	CL = 0.53 - 0.83mm TL = 1.40 - 9.25mm	CL = 0.94 - 1.02mm TL = 1.83-2.01mm	CL = 0.92 - 1.02 mm TL = 1.87-1.96 mm	CL = 0.91 - 0.92mm TL = 1.73-1.74mm
Carapace:	no setules	posterolateral margin bear 5+5 setules.	posterolateral margin bear 7+7 setules.	
rostral spine	absent	very small	further developed	small knob
Eyes:	sessile	sessile	stalked	stalked and prominent
Abdomen:				
somites, dorsolateral	5+telson	5+telson	6+telson	6+telson
knobs on somite 2 posterolateral	absent	well developed	no change	absent
angles 3-5	developed	further developed	"	no change
pleopods	absent	absent	bud present	well developed used as swimmerets
Telson:				
furca:				
lateral spine, posterior processes	1-pair 3+3	no change "	no change "	absent "
Mandibles:				
palp	absent	absent	present	3-segmented, distal segment fringed with setae
Antennule:				
aesthetascs,	2	4	6	9 on 4-segmented exopod
setae, endopod	absent "	1 absent	no change present	nil 2-segmented, 3 setae
Antenna:				
protopod	a plumose seta	1/4 distal end spinulate	no change	3-segmented peduncle; 7 setae (3+1, 3) on 3-segmented flagellum
exopod,	segmented, 2 terminal setae	exopod reaching equal to spinous, process, with 1 of its 3 setae.	"	-
endopod,	present	reaching upto 1/3 of exopod.	reaching nearly 1/2 of exopod	-
Maxillule:				
setae:				
coxa endite,	5	7	8+2	7
basal endite,	1	3+4	5+5+1	8+8
endopod	3	2-segmented 1, 1+4	no change "	no change absent
Maxilla:				
Setae:				
coxa endite,	2	4+4	"	9
basal endite,	4	5+5	"	4+6
endopod,	2	5	"	reduced
scaphognathite.	5	9	17-19	21-24

Table 1. (Continued)

Characters	Pre-Zoea CL = 0.53 - 0.83mm TL = 1.40 - 9.25mm	Zoea I CL = 0.94 - 1.02mm TL = 1.83-2.01mm	Zoea II CL = 0.92 - 1.02 mm TL = 1.87-1.96 mm	Megalopa CL = 0.91 - 0.92mm TL = 1.73-1.74mm
Maxilliped I: setae:				
coxopod,	nil	no change	no change	2
basipod,	1	9 (2, 2, 2, 3)	8 (2, 2, 2, 2)	6
endopod,	7 (1, 1, 1, 1, 3)	13 (3, 2, 1, 2, 4+1)	12 (3, 2, 1, 2, 4)	3
exopod	3	4	6	4 (1,3)
Maxilliped II: setae:				
coxopod,	nil	not observed	not observed	not observed
basipod,	1	3 (1, 1, 1)	3 (1, 1, 1)	nil
endopod,	3 (0, 3)	5 (0, 1, 2+2)	no change	10 (0, 1,3, 3+3)
exopod	4	4	6	4
Maxilliped III:	absent	biramous	no change	quite developed: epipod with 3, coxopod with 7, bsipod with 2, endopod with 27 (11,3+2, 2+2,3+1,3) and exopod with 4 setae
Pereiopods I-V:	"	rudimentary	buds more developed	developed, sparsely setose

species *M. nodulosus* and the differences with the zoeae of *M. bicornis*, which is another representative of the genus *Menaethiops* reared in the laboratory from hatching to zoeae II. The larvae of *M. nodulosus* are also compared with the other laboratory reared zoeae of majid crabs of Pakistan: *Achaeus lacertosus* Stimpson 1858, *Schizophrys aspera* (H. Milne Edwards, 1834) and *Micippa platipes* Rüpell, 1830 (3-5).

## Materials and Methods

Ovigerous females of *Menaethiops nodulosus* (Nobili, 1905) were obtained from Buleji (long 66°49'E, lat 24°56'N) on October 28, 1996, November 26, 1996 and April 26, 1997. The ovigerous females were kept in the laboratory in unfiltered seawater with a salinity of 35-37 parts per thousand at room temperature (27°C-28°C). The larvae of October 28, 1996 batch, hatched on November 13, 1996, were segregated and placed, ten in each, in five glass beakers (500 ml), containing filtered

seawater of the same salinity and temperature as mentioned before. Each beaker was examined daily for exuviae, dead specimens and subsequent developmental stages. Surviving larvae were transferred daily to the clean beakers filled with freshly filtered, stored seawater, and freshly hatched *Artemia* nauplii were offered as food. Exuviae and dead larvae were preserved in 5% formalin. Temporary slides were made, using glycerin plus 5% formalin (3:1).

Measurements of each stage were made with a stage micrometer. The total length (TL) was determined by adding the carapace length (CL), measured from the tip of the rostral spine to the posterior midpoint of the carapace, and abdominal length, measured from the centre of the somite-2 to the midposterior margin of the telson. Measurements are in millimeters (mm). The spent females and the remaining larvae were preserved and stored in Marine Reference Collection and Resource Centre (MRCC) (Cat. No. BRAC.671 and BRAC. 676).

**Results**

**Pre-zoea (Figure 1A-I)**

Size.- CL = 0.53 - 0.83mm, TL = 1.40 - 9.25mm (5 specimens examined) Duration.- Died within 2 days.

Carapace (Figure 1A, A').- Carapace devoid of spines. Eyes sessile.

Abdomen (Figure 1B).- 5 somites, posterolateral angles of somite 2-5, produced; somite 2 and 3 without dorsolateral processes.

Telson (Figure 1B).- Developing fork with a single pair of lateral spines and inner posterior margin with 3 pairs of spinulose processes.

Antennule (Figure 1C).- Uniramous with 2 terminal aesthetascs.

Antenna (Figure 1D).- Protopod with a single plumose seta; exopod with 2 terminal plumose setae, endopodal bud present.

Mandible (Figure 1E).- Developing bud with molar processes.

Maxillule, Maxilla, Maxillipeds I & II (Figures 1F-I).- Developing buds with few small setae.

**Zoea I (Figure 2A-K)**

Size.- CL = 0.94 - 1.02 mm, TL = 1.83 - 2.01mm (5-specimens examined) Duration.- 4-5 days.

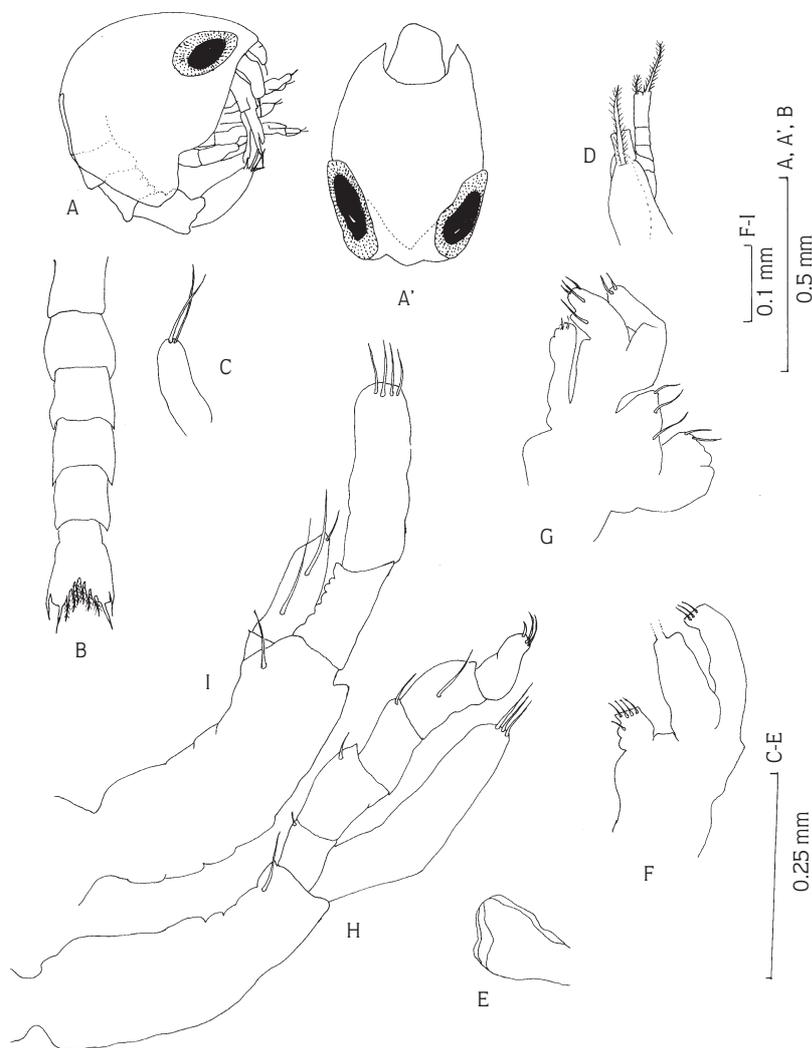


Figure 1. *Menaethiops nodulosus* (Nobili, 1905). Per-zoea: A, lateral view; A', dorsofrontal view; B, abdomen with telson, dorsal view; C, antennule; D, antenna; E, mandible; F, maxillule; G, maxilla; H, I, maxilliped I, II.

Carapace (Figure 2A, A').- Dorsal spine curved backwards; rostral spine small; posterolateral margins bear 5+5 setules. Eyes sessile.

Abdomen (Figure 2B).- 5 somites each somite with a pair of fine setae on its middorsal surface; somite 2 with a pair of forwardly directed, curved dorsolateral processes; somite 3-5 with well developed posterolateral processes.

Telson (Figure 2B).- Forked with a single pair of lateral spines; inner posterior margin with 3 pairs of spinulose processes.

Antennule (Figure 2C).- Uniramous with 4 terminal aesthetascs and 1 seta.

Antenna. (Figure 2D).- Protopod developed, distally 1/4 spinous process with spinulate; exopod with 3 terminal cuspidate setae, longest seta reaching to apex of spinous process; endopod a rudimentary bud reaching upto 1/3 of spinous process proximally.

Mandible (Figure 2E).- Incisor and molar processes well developed, palp absent.

Maxillule (Figure 2F).- Coxal endite with 7 setae, basal endite with 3 cuspidate setae and 4 plumose setae; endopod 2-segmented, with 1, 1+4 setae from proximal to distal segments.

Maxilla (Figure 2G).- Coxal and basal endites bilobed, with 4+4 and 5+5 plumose setae on each proximal and

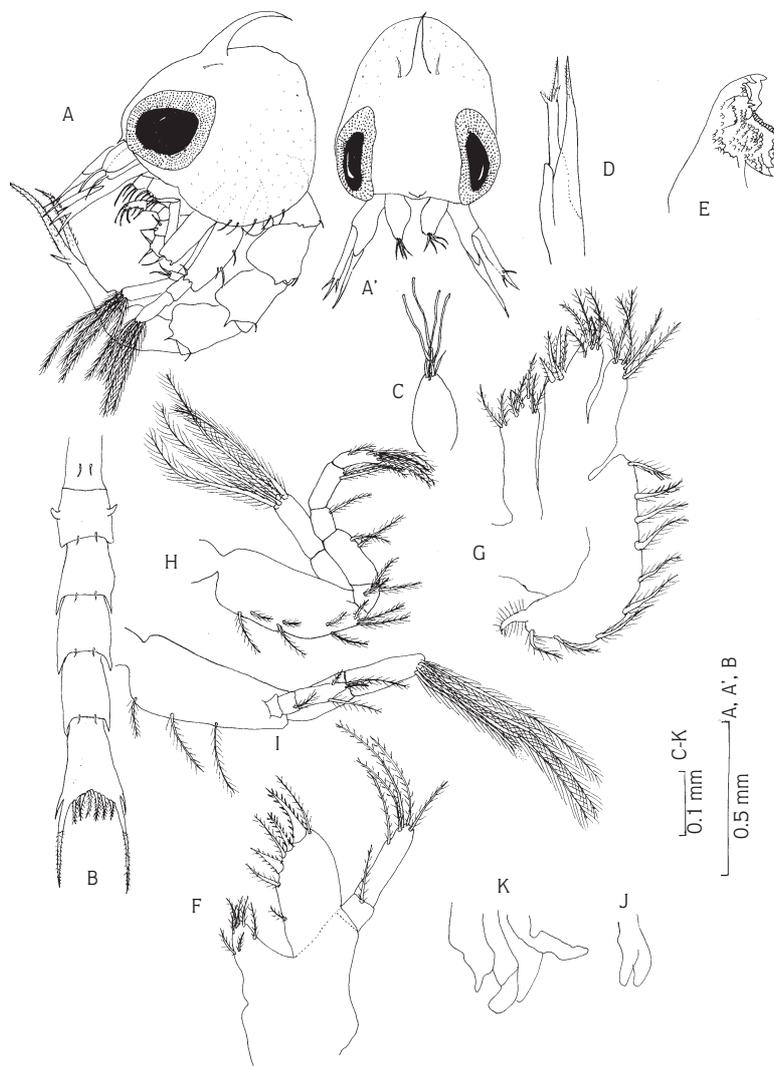


Figure 2. *Menaethiops nodulosus* (Nobili, 1905). Zoea I: A, lateral view; A', dorsofrontal view; B, abdomen with telson, dorsal view; C, antennule; D, antenna; E, mandible; F, maxillule; G, maxilla; H-J, maxilliped I-III; K, pereopods.

distal lobes respectively; endopod with 5 plumose setae; scaphognathite with 9 marginal setae, and terminates posteriorly in a process.

Maxilliped I (Figure 2H).- Basipod with 9 plumose setae on medial margin, endopod 5-segmented, with 3, 2, 1, 2, 4+1 setae from proximal to distal segments respectively; exopod with 4 terminal natatory plumose setae.

Maxilliped II (Figure 2I).- Basipod with 3 plumose setae on medial margin; endopod 3-segmented with 0,1, 2+2 setae from proximal to distal segments respectively; exopod with 4 terminal natatory plumose setae.

Maxilliped III (Figure 2J).- Biramous, rudimentary bud.

Pereiopods I-V (Figures 2K).- Rudimentary buds.

**Zoea II (Figure 3A-O).**

Size.- CL = 0.92 - 1.02mm, TL = 1.87 - 1.96 (3 specimens examined). Duration.- 3-4 days.

Carapace (Figure 3A, A').- Slight increase in size from previous stage, rostral spine more developed, posterolateral margin bear 7+7 setules. Eyes stalked.

Abdomen (Figure 3B).- 6 somites; pleopodal buds present.

Telson (Figure 3B).- Unchanged.

Antennule (Figure 3C).- Biramous and globular, outer ramous with 6 terminal aesthestascs and one small seta; inner ramous rudimentary.

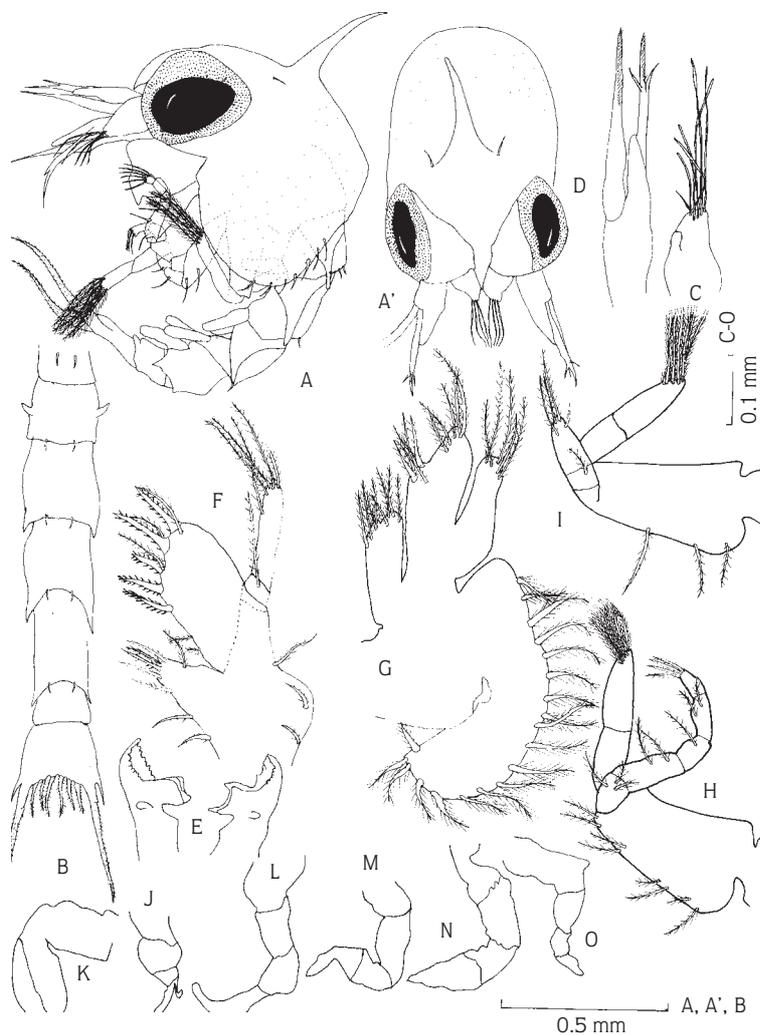


Figure 3. *Menaethiops nodulosus* (Nobili, 1905). Zoea II: A, lateral view; A', dorsofrontal view; B, abdomen with telson, dorsal view; C, antennule; D, antenna; E, mandibles; F, maxillule; G, maxilla; H-J, maxilliped I-III; K-O, pereiopods I-V.

Antenna (Figure 3D).- Similar to previous stage except endopod increase in size.

Mandibles (Figure 3E).- Mandibular palp present as a rudimentary bud.

Maxillule (Figure 3F).- Coxal endite with 8+2 setae, basal endite with 5 cuspidate setae and 5+1 plumose setae, endopod unchanged.

Maxilla (Figure 3G).- Coxal, basal endites and endopod unchanged; scaphognathite with 17-19 marginal setae and posterior process absent.

Maxilliped I (Figure 3H).- Basipod with 8 plumose setae on medial margin, endopod 5-segmented with 3, 2, 1, 2, 4 setae from proximal to distal segments respectively; exopod with 6 terminal natatory plumose setae.

Maxilliped II (Figure 3I).- Basipod and endopod unchanged; except exopod with 6 terminal natatory plumose setae.

Maxilliped III (Figure 3J).- Biramous bud further developed.

Pereiopods I-V (Figures 3K-O).- Buds further developed.

#### **Megalopa (Figure 4A-O)**

Size.- CL = 0.91 - 0.92mm, TL = 1.73 - 1.74mm (2 specimens examined) Duration.- Died within 3-4 days.

Carapace (Figure 4A).- Broader than long; dorsal surface punctate and several small setae. The rostrum bent downwards. The eyes are stalked and prominent.

Abdomen (Figure 4A).- Abdomen with 6 somites, without process. Somites 2-5 bear numerous setae on posterodorsal margins, 3-5 abdominal somites with prominent posterolateral angles.

Pleopod (Figure 4P).- Pleopods biramous developed on abdominal somite 2-5, exopod with 10-11 natatory setae; endopod with 2 coupling hooks.

Telson (Figure 4B).- Smooth, subquadrate and simple; uropod with 3 natatory setae on posterior margin of each distal segment.

Antennule (Figure 4C).- Biramous, 3-segmented peduncle; Second and third segments each with 1 simple seta; inner ramous 2-segmented with 2 terminal and 1 subterminal seta, outer ramous 4-segmented with 9 aesthetascs.

Antenna (Figure 4D).- Uniramous with 3-segmented peduncle each segment with a few setae; flagellum 3-segmented, with 0, 4, 3 setae from proximal to distal segments respectively.

Mandible (Figure 4E).- Masticatory processes adult like, palp 3-segmented, distal segment fringed with setae.

Maxillule (Figure 4F).- Coxal endite with 7 plumose setae, basal endite with 8 cuspidate spines and 8 plumose setae, endopod 2-segmented.

Maxilla (Figure 4G).- Coxal endite with 9 setae; basal endite bilobed with 4+6 setae; endopod reduced; scaphognathite with 21-24 plumose setae.

Maxilliped I (Figure 4H).- Coxopod with 2 plumose setae, basipod with 6 plumose setae; endopod with 3 setae; exopod 2-segmented, with 1, 3 setae from proximal to distal segments respectively.

Maxilliped II (Figure 4I).- Coxopod broken; basipod without setae, endopod 4-segmented with 0, 1, 3, 3+3 setae from proximal to distal segments respectively; exopod 2-segmented with 4 terminal plumose setae.

Maxilliped III (Figure 4J).- Coxopod and basipod with 7 and 2 setae respectively; endopod 5-segmented, with 11, 3+2, 2+2, 3+1, 3 plumose setae progressing distally. Exopod 2-segmented with 4 terminal plumose setae; endopod uniramous with 3 long plumose setae.

Pereiopods I-V (Figures 4K-O).- I-V pereiopods sparsely covered with simple and plumose setae. Pereiopod II with a stout spine on ischiopod.

#### **Discussion**

The larvae of *Menaethiops nodulosus* (Nobili, 1905) have been reared in laboratory conditions for the first time to our knowledge. It has two zoeal stages followed by the megalopa, some times prezoal stages have also been obtained. The larvae of *M. nodulosus* agree well with the description of larvae of the subfamily Acanthonychinae (=Epiplatinae) (6) except a difference of a spine on the basal segment of the second pereiopod (Figure 4L) in megalopa. The zoeal morphology of *M. nodulosus* is very close to the zoeae (unpublished) of the only other species: *M. bicornis* reared in the laboratory. However, the zoeal stages I and II of the two species *M. nodulosus* and *M. bicornis* can be distinguished by the differences in the number of setation on their appendages, as shown in Table 2.

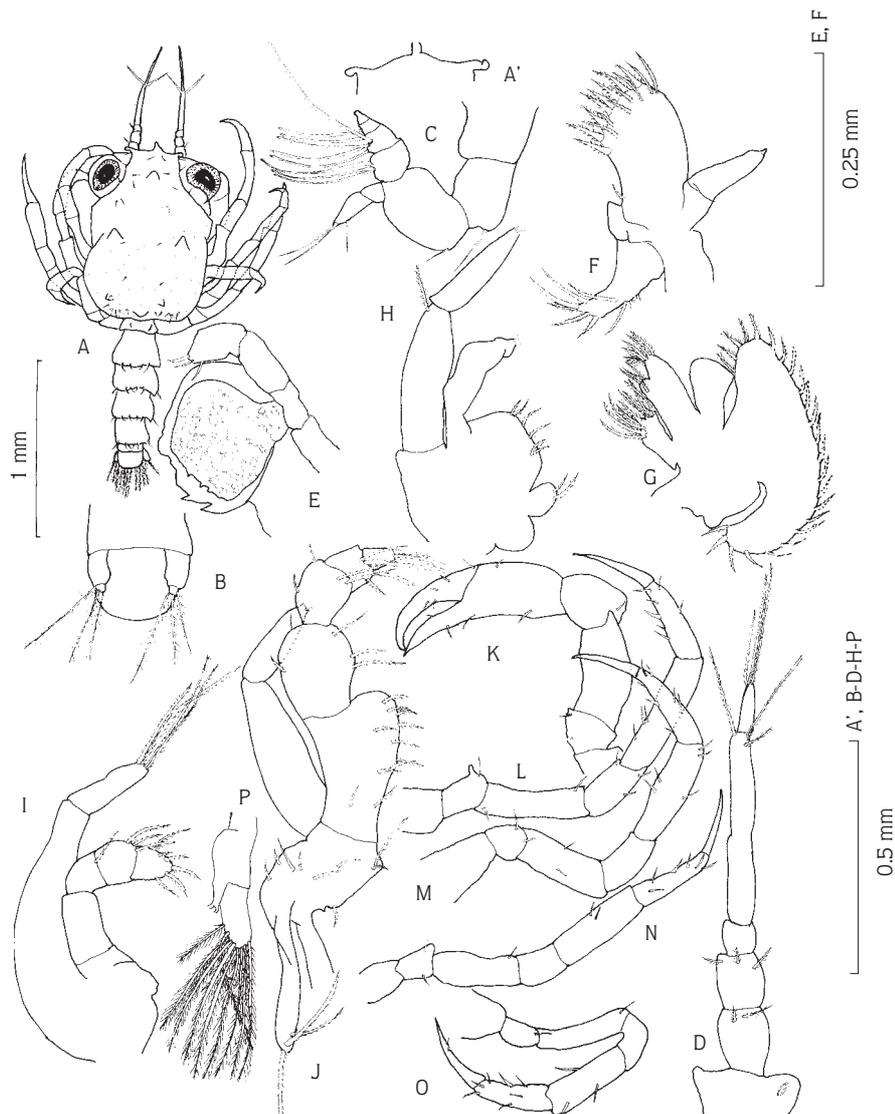


Figure 4. *Menaethiops nodulosus* (Nobili, 1905). Megalopa: A, dorsal view; A', frontal margin of carapace; B, telson with uropod; C, antennule; D, antenna; E, mandible; F, maxillule; G, maxilla; H-J, maxilliped I-III; K-O, pereopods I-V; P, pleopod IV.

The differences are also noted between the laboratory reared zoeae I and II of *M. nodulosus* and three Pakistani species of spider crabs: *Achaeus lacertosus*, *Schizophrys aspera* and *Micippa platipes* (3-5) and the differences are tabulated in Table 3. It is seen that the zoea I and II of *M. nodulosus* show a comparatively greater resemblance to those of *Achaeus lacertosus*; however, the zoeae I and II have a very significant difference between *M. nodulosus* and *A. lacertosus*: the posterolateral angles of the second abdominal somite

are simple in *M. nodulosus*, whereas they are pointed in *A. lacertosus*.

#### Acknowledgements

The authors are grateful to Professor Dr. Quddusi B. Kazmi, Director, Marine Reference Collection and Resource Centre, University of Karachi for providing research facilities and valuable suggestions after reading the manuscript.

Characters	<i>M. nodulosus</i> (Nobili, 1905) (present study)	<i>M. bicornis</i> Alcock, 1895 (unpublished)
Zoea I:		
Maxillule:		
setae:		
coxal endite	7	8
endopod	1, 1+4	1, 4
Maxilla:		
basal endite	5+5	5+4
Zoea II:		
Antennule:		
aesthetascs	6	5
seta	1	absent
Maxillule:		
coxal endite	8+2	6-7
basal endite	5+5+1	6+3+1
endopod	1, 1+4	1, 4
Maxilla:		
coxal endite	4+4	3+3

Table 2. Difference between setation of zoea I and II of *Menaethiops nodulosus* (Nobili, 1905) and *Menaethiops bicornis* Alcock, 1895.

Table 3. The differences between zoea I and II of *Menaethiops nodulosus* (Nobili, 1905) (present study) and the zoea I and II of three Pakistani species of spider crabs: *Achaeus lacertosus* Stimpson 1858, *Schizophrys aspera* (H. Milne-Edwards, 1834) and *Micippa platipes* Rüpell, 1830.

Zoea I Characters	<i>M. nodulosus</i>	<i>A. lacertosus</i>	<i>S. aspera</i>	<i>M. platipes</i>
Carapace:				
dorsal spine	well developed	well developed	well developed	absent
rostral spine	short	short	long	long
lateral spine	absent	absent	developed	developed
Abdomen:				
dorsolateral knobs on somite 3	"	"	"	"
posterolateral angles somite 2	simple	pointed	simple	pointed
Telson:				
lateral spine	1-pair	1-pair	1-pair	3-pairs
Antennule:				
aesthetascs + seta	4+1	2+2	4+nil	3+1
Antenna:				
exopod length	protopod and exopod equal in length	protopod and exopod equal in length	protopod is larger than exopod	protopod and exopod equal in length
setae	2+1	2+1	3	2+1
Maxillule:				
basal endite	3+4	3+3	3+4	7
endopod	2-segmented	3-segmented	2-segmented	2-segmented
Maxilla:				
scaphognathite	9	12-13	14	16-21
posterior process	developed	developed	absent	developed
Maxilliped I:				
basipod setae	9 (2, 2, 2, 3)	10 (2, 2, 3, 3)	8 (2, 2, 2, 2)	10 (2, 2, 3, 3)

Table 3. Continued.

Zoea II				
Carapace:				
dorsal spine	well developed	well developed	well developed	absent
rostral spine	short	short	long	long
lateral spine	absent	absent	developed	developed
Abdomen:				
dorsolateral knobs on somite 3	“	“	“	“
posterolateral angles somite 2	simple	pointed	simple	pointed
Telson:				
lateral spine	1-pair	1-pair	1-pair	3-pairs
Antennule:				
aesthetascs + seta	6+1	5+nil	5+nil	5+1
Antenna:				
exopod length	protopod and exopod equal in length	protopod and exopod equal in length	protopod is larger than exopod	protopod and exopod equal in length
setae	2+1	2+1	3	2+1
Maxillule:				
basal endite	5+5+1	4+6	3+4	9
endopod	2-segmented	3-segmented	3-segmented	2-segmented
Maxilla:				
scaphognathite	17-19	24-25	26	28-30
posterior process	absent	absent	absent	absent
Maxilliped I:				
basipod setae	8 ( 2, 2, 2, 2)	10 ( 2, 2, 3, 3)	8 ( 2, 2, 2, 2)	10 ( 2, 2, 3, 3)

## References

1. Tirmizi, N.M. and Q.B. Kazmi., Marine Fauna of Pakistan: 4. Crustacea: Brachyura (Dromiacea, Arachaeobrachyura, Oxystomata, Oxyrhyncha) Pub. I BCCI Foun. Cha. Ins. Mar. Sci. Uni. Karachi: 1-244, 1988.
2. Kazmi, Q.B. and N.M. Tirmizi., Two new species and a new record of spider crabs with a note on *Stibognathus curvicornis* (Herbst, 1803) from Pakistan waters of the Northern Arabian Sea. *Crus.* 72(4): 369-382, 1999.
3. Siddiqui, F.A., The complete larval development of *Achaeus lacertosus* Stimpson 1858 (Decapoda, Brachyura, Majidae) reared in the laboratory. *Pak. Jour. Mar. Sci.* 8(2): 159-169, 1999.
4. Tirmizi, N.M. and Q.B. Kazmi., Larval development of two spider crabs reared in the laboratory, families Hymenosomatidae and Majidae. *Crus.* 53(3): 281-291, 1987.
5. Siddiqui, F.A., Larval development of *Micippa platipes* Rüppell, 1830, reared under laboratory conditions (Crustacea, Decapoda, Majidae). *Pak. Jour. Mar. Sci.* 5(2): 155-160, 1996.
6. Ingle, R.W., The larval development of the spider crab *Rochinia carpenteri* (Thomson) [Oxyrhyncha: Majidae] with a review of majid subfamilial larval features. *Bull. Br. Mus. nat. Hist. (Zool.)* 37(1): 47-66, 1979.