

**DESCRIPTION OF THE FIRST TO FOURTH ZOEAL STAGES OF
MACROBRACHIUM EQUIDENS (DANA, 1852) (CRUSTACEA:
DECAPODA: PALAEMONIDAE)**

Farhana S. Ghory, Quddusi B. Kazmi and M. Afzal Kazmi
Marine Reference Collection and Resource Centre and Department of Zoology
University of Karachi, Karachi – 75270, Pakistan
email: farhanaghory@yahoo.com

ABSTRACT: An ovigerous female of *Macrobrachium equidens* (Dana, 1852) collected from near shore of Sandspit back waters (Karachi, Pakistan) (Long. 66° 54' 24"E Lat. 24° 50' 24"N) on 19, October, 2009, and kept under the laboratory conditions. Larvae were hatched out after 13 days. Zoea I to zoea III stages passed within 6 days at room temperature 31°C, water temperature 29°C, in filtered seawater of a salinity of 37 ‰ and pH 7.9. The Zoea IV of the same species was collected from planktonic sample of Manora Channel, Karachi (Long. 66° 59' E Lat. 24° 48' N) on 1995.

The larvae of this species are described and illustrated along with comparisons to those described previously.

KEYWORDS: Decapoda, Palaemonidae, *Macrobrachium equidens*, developmental stages, Pakistan.

INTRODUCTION

Family Palaemonidae consists of two sub-families Pontoninae and Palaemoninae. The subfamily Palaemoninae includes 21 genera and 2 subgenera (Jayachandran, 2001), in Pakistani waters we have found seven genera *Macrobrachium*, *Exopalaemon*, *Nematopalaemon*, *Palaemon*, *Leandrites* and *Leptocarpus*. The genus *Macrobrachium* comprises approximately 210 species worldwide (Short, 2004). In Pakistani waters we have reported eighteen species (Kazmi and Kazmi, 2012).

Macrobrachium equidens is found worldwide tropical and subtropical aquatic environments (Holthuis 1952, Coelho and Ramos-Porto 1985, Bond-Buckup and Buckup 1989, Melo 2003, Maciel *et al.*, 2011). The species is amphidromous, euryhaline and occurs in the middle and lower reaches of estuaries, mangrove, rarely found in fresh water.

Previously Ngoc-Ho (1976); Shy and Yu (1990), Pillai (1990a) and Akane *et al.*, (2003) have described the larval stages of *M. equidens* from Thailand, Taiwan, India and Japan. In the present study we described four zoeal stages of *M. equidens*.

MATERIAL AND METHODS

Ovigerous female of *Macrobrachium equidens* (Dana, 1852) was obtained from Sandspit back waters (Karachi, Pakistan) (Long. 66° 54' 24"E Lat. 24° 50' 24"N) on 19, October, 2009. The ovigerous female was maintained in filtered seawater at room temperature (31°C-29°C) with a salinity of 35-37‰ and a pH range of 7.5-7.9. The larvae

were hatched after 13 days. We placed five newly hatched larvae per beaker (500ml) containing filtered seawater of salinity 35-37‰ and temperature 31°C-29°C. The nauplii of *Artemia* were offered as food. Exuviae and dead larvae were examined daily in each beaker. To make temporary slides, we used glycerin and 5% formalin (3:1).

Planktonic sample was brought in Manora Channel (Long. 66° 59' E Lat. 24° 48' N) on 1995. We sampled two stations, A and B, 5 kilometers apart. The samples were collected using Bango nets with 300 micron mesh size equipped with a flow meter for four 10 minute tows: AI (surface sample), AII (subsurface sample), BI (surface sample), BII (subsurface sample) at shallow depth 15'- 20'. The samples were preserved in 5% formalin. Using a binocular microscope Ogawa Seiki (4 x 10 magnification), we separated crustacean larvae and transferred them to 70% alcohol.

As part of the dissections, tungsten needles were used under a binocular microscope (Nikon) at 10x/21 magnifications. We used an Olympus BX51 microscope (magnifications WHN10X/22 x10, 20 and 40) with Nomarski interference contrast and a camera lucida for making illustrations. Measurements (millimeter = mm) of illustrated specimens were through via using stage micrometer. The total length (TL) was measured from the tip of the rostrum to the mid posterior border of the telson. The spent female and the remaining larvae were preserved in alcohol and housed in the Marine Reference Collection and Resource Centre, University of Karachi.

RESULTS AND DISCUSSION

Description of the larvae

Zoea I: (Fig. 1A – K)

Size: TL = 1.68mm – 1.75mm

Duration: 1 day.

Diagnostic Features:

Carapace (Fig. 1A): Downy with a medio-dorsal hump; rostrum long; eyes sessile.

Antennule (Fig. 1B): Peduncle unsegmented; inner ramus (endopod) stand for by a long plumose seta; outer ramus with 3 aesthetascs and 2 setae.

Antenna (Fig. 1C): Biramous, peduncle with a distal spine on inner margin; endopod with 1 plumose seta and 1 spine; scaphocerite (exopod) 5-segmented with 1,1,1,1, and 4 setae, respectively.

Mandible (Fig. 1D): Incisor process well developed.

Maxillule (Fig. 1E): Coxalendite with 2 spines; basialendite with 2 cuspidate and 1 plumodenticulate seta; endopod with 1 plumodenticulate seta.

Maxilla (Fig. 1F): Coxalendite with 3 plumodenticulate setae; basialendite with 3 plumodenticulate setae; endopod with 1 seta; scaphognathite with 5 setae.

Maxilliped I (Fig. 1G): Coxa broken; basis with 3 spines; unsegmented endopod with 3 setae; exopod with 4 setae.

Maxilliped II (Fig. 1H): Coxa broken; basis naked; endopod 3-segmented with 0, 0, and 2 +1 (2 setae and 1 spine) setae, respectively; exopod with 2 terminal and 2 subterminal plumose natatory setae.

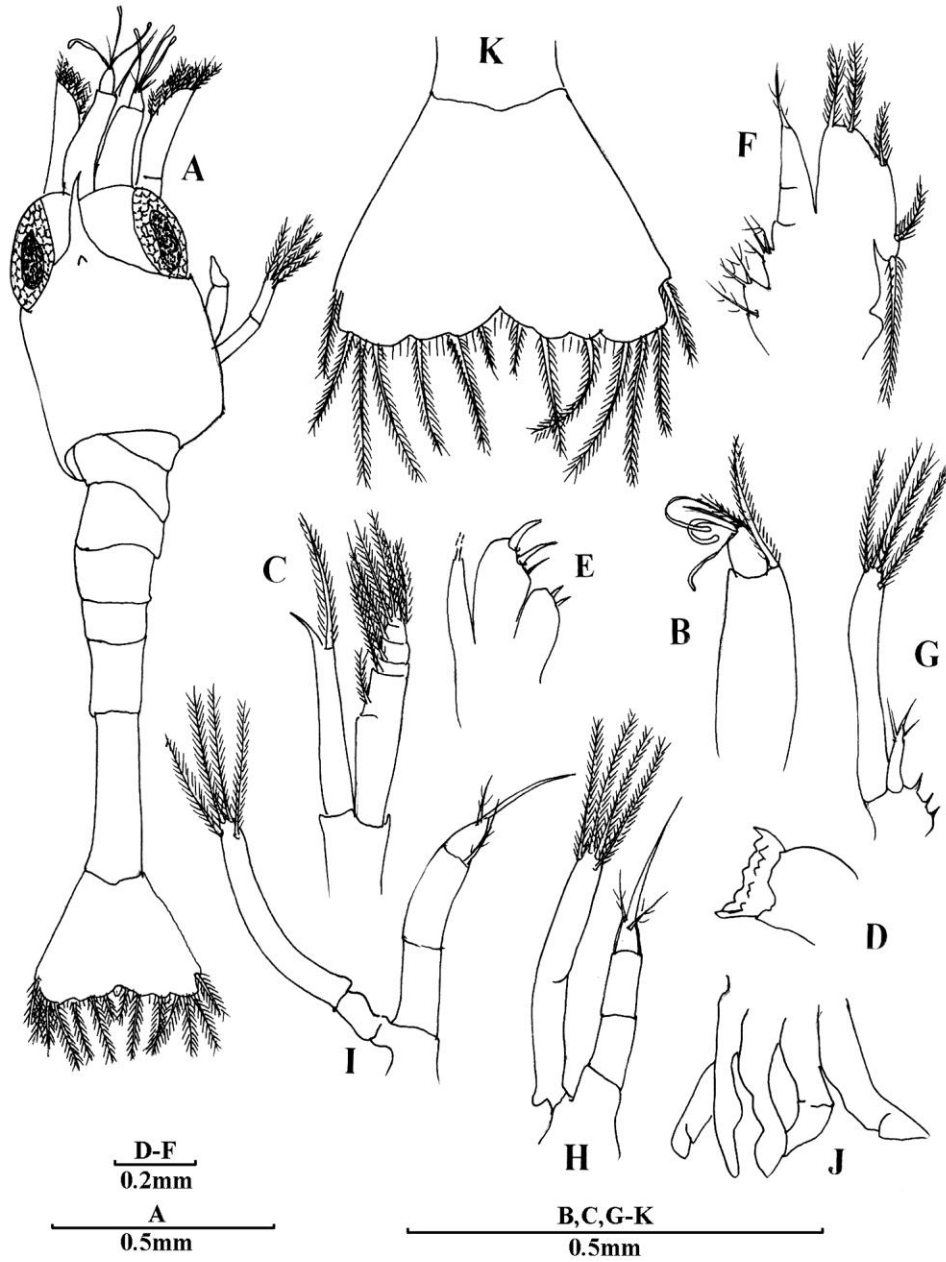


Fig. 1. *Macrobrachium equidens* (Dana, 1852). Zoea I: A, entire, dorsal view; B, antennule; C, antenna; D, mandible; E, maxillule; F, maxilla; G-I, maxillipeds I-III; J, pereiopods I-V; K, telson.

Maxilliped III (Fig. 1I): Coxa broken; basis naked; endopod 3-segmented with 0, 1, and 1 + 1 (1 seta and 1 spine) setae, respectively ; exopod with 2 terminal and 2 subterminal setae.

Pereiopods I - V (Fig. 1J): Undeveloped, partially segmented.

Abdomen (Fig. 1A): Six somites.

Telson (Fig. 1K): Triangular, posterior margin with 7 pairs of setae.

Zoea II: (Fig. 2A - O)

Size: TL = 1.75mm – 1.76mm

Duration: 3 days.

Diagnostic Features:

Carapace (Fig. 2A): Downy; rostrum broad; eyes stalked.

Antennule (Fig. 2B): Peduncle 2-segmented, proximal segment with 3 simple setae, distal Segment biramous; inner ramus (endopod) characterize by a long seta; outer ramus (exopod) with 5 aesthetascs.

Antenna (Fig. 2C): Biramous, peduncle with a distal spine on inner margin; endopod by 1 plumose seta and 1 spine; scaphocerite (exopod) 5-segmented by 1,1,1,1, and 7 setae, respectively.

Mandible (Fig. 2D): Well developed.

Maxillule (Fig. 2E): Coxal endite with 5 setae; basialendite with 6 + 1 setae; endopod with 1 seta.

Maxilla (Fig. 2F): Coxal and basial endites with 2 and 1 setae respectively; endopod with 1 seta;

scaphognathite 5 setae.

Maxilliped I (Fig. 2G): Coxa broken; basis with 3 spines; endopod unsegmented with 1 seta; exopod with 4 setae.

Maxilliped II (Fig. 2H): Coxa broken; basis naked; endopod 3-segmented with 0, 2, and 3 + 1 (3 setae and 1 spine) setae, respectively; exopod with 2 terminal and 2 subterminal setae.

Maxilliped III (Fig. 2I): Coxa broken; basis naked; endopod 5-segmented with 1, 1, 1, 2 and 1 + 1 (1 seta and 1 spine) setae, respectively; exopod with 2 terminal and 2 subterminal setae.

Pereiopods I - V (Figs. 2J - N): Pereiopod I (Fig. 59J) coxa broken; basis with 2 simple setae; endopod 4-segmented with 1,1,2 plumodenticulate setae and 1 spine; exopod with 2 terminal and 2 subterminal plumose natatory setae; pereiopods II (Fig. 2K) coxa broken; basis naked; endopod 4-segmented with 1,0,2 and 1 + 1 (1 seta + 1 spine) plumodenticulate setae ; exopod with 2 terminal and 2 subterminal plumose natatory setae and 2 simple setae; pereiopods III - V (Figs. 59L-N) rudimentary, partially segmented.

Abdomen (Fig. 2A): Six somites.

Telson (Fig. 2O): Triangular, posterior margin with 8 pairs of plumose natatory setae; rudiments of uropods visible through cuticle.

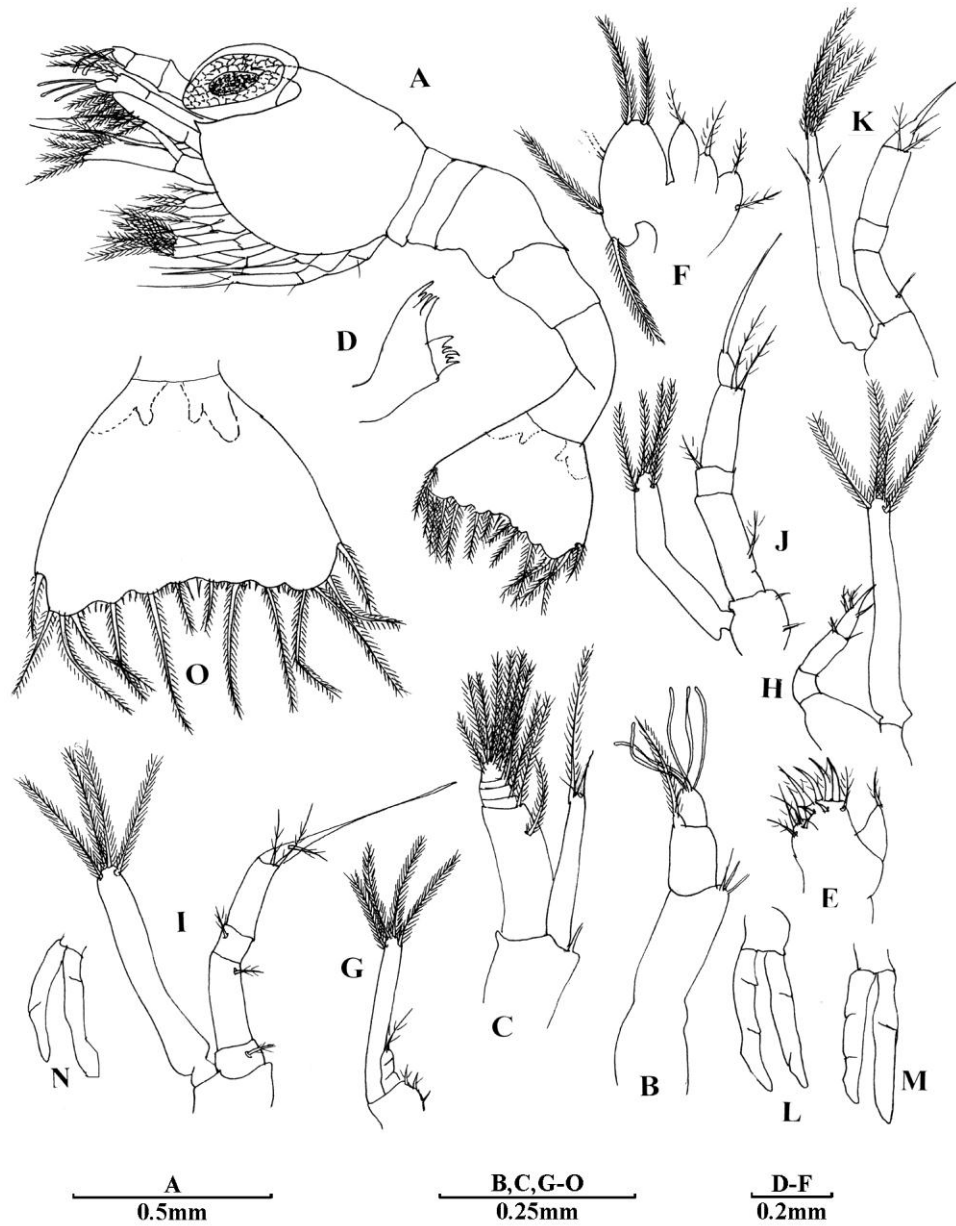


Fig. 2. *Macrobrachium equidens* (Dana, 1852). Zoea II: A, entire, lateral view; B, antennule; C, antenna; D, mandible; E, maxillule; F, maxilla; G-I, maxillipeds I-III; J - N, pereiopods I-V; O, telson.

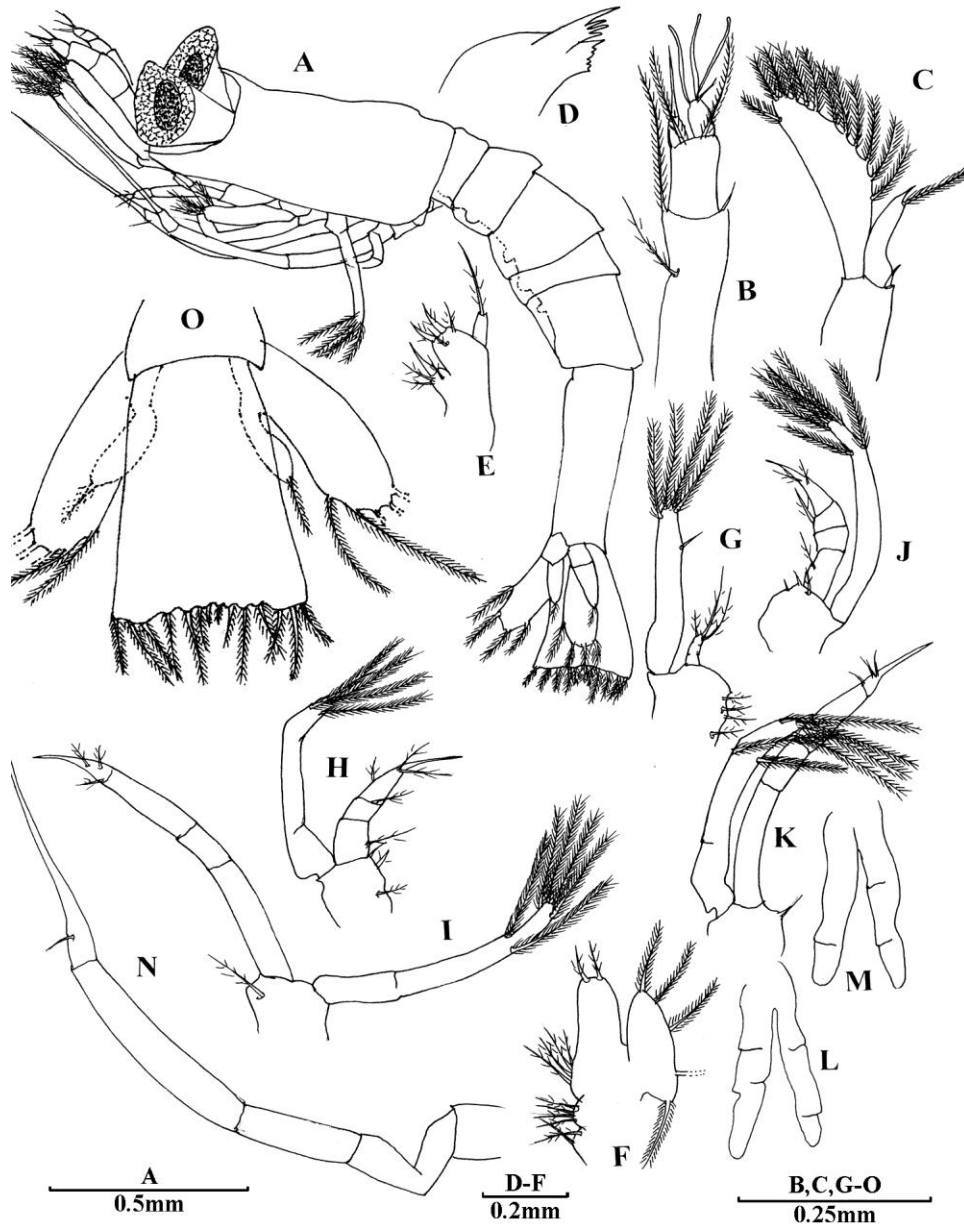


Fig. 3. *Macrbrachium equidens* (Dana, 1852). Zoea III: A, entire lateral view; B, antennule; C, antenna; D, mandible; E, maxillule; F, maxilla, G-I, maxillipeds I-III; J-N, periopods I-V; O, telson with uropods.

Zoea III: (Fig. 3A -O)**Size:** TL = 1.98mm – 2.13mm**Duration:** 2 days. (Died).**Diagnostic Features:**

Carapace (Fig. 3A): Smooth; rostrum broad; eyes stalked.

Antennule (Fig. 3B): Peduncle 2-segmented, proximal segment with 3 (1 plumodenticulate + 1 plumose + 1 simple) setae, distal segment biramous with 2 plumose setae; inner ramus (endopod) with 1 long plumose seta; outer ramus (exopod) with 3 aesthetascs and 1 seta.

Antenna (Fig. 3C): Biramous, peduncle with a distal spine on inner margin; endopod with 1 plumose seta and 1 spine; scaphocerite (exopod) with 12 setae.

Mandible (Fig. 3D): Well developed.

Maxillule (Fig. 3E): Coxal endite with 4 setae; basal endite with 2 + 2 setae; endopod with 1 seta.

Maxilla (Fig. 3F): Coxal endite with 2 setae; basal endite with 4 setae; endopod with 4 + 2 setae; scaphognathite with 5 setae.

Maxilliped I (Fig. 3G): Coxa broken; basis with 4 plumodenticulate setae; endopod with 3 plumodenticulate setae; exopod with 2 + 2 + 1 setae.

Maxilliped II (Fig. 3H): Coxa broken; basis with 3 setae; 3-segmented endopod, with 1, 1, and 3 + 1 (3 setae and 1 spine) setae, respectively; exopod with 2 terminal and 2 subterminal setae.

Maxilliped III (Fig. 3I): Coxa broken; basis with 1 seta; endopod 4-segmented with 0, 0, 1 and 2 + 1 (2 setae and 1 spine) setae, respectively ; exopod with 2 terminal and 4 subterminal plumose natatory setae.

Pereiopods I - V (Figs. 3J - N): Pereiopods I (Fig. 3J) coxa broken; basis with 3 simple setae; endopod 4-segmented with 1, 0, 1 and 2 + 1 (2 setae + 1 spine) plumodenticulate setae and 1 spine; exopod with 2 + 4 setae; pereiopods II (Fig. 3K) coxa broken; basis with 1 seta; endopod 4-segmented with 0, 0, 1 and 2 + 1 (2 setae + 1 spine) setae; exopod with 2 + 4 setae; pereiopods III and IV (Figs. 3L-M) rudimentary; pereiopod V (Fig. 3N) 5-segmented, terminal segment ending in long strong spine.

Pleopods (Fig. 3A): Rudimentary.

Abdomen (Fig. 3A): Six somites.

Telson (Fig. 3O): Triangular, posterior margin with 7 pairs of plumose setae; uropod biramous; endopod with 1 plumose seta; exopod with 5 long plumose setae

Zoea IV: (Fig. 4A - O)**Size:** TL = 2.35mm – 2.65mm**Diagnostic Features:**

Carapace (Fig. 4A): Rostral spine large; supra-orbital spine present; 2 epigastric spines present; eyes stalked.

Antennule (Fig. 4B): Peduncle 2-segmented, proximal segment with 7 plumodenticulate setae, distal segment with 4 plumodenticulate setae; inner ramus (endopod) with 1 long plumose seta and 1 plumodenticulate seta; outer ramus (exopod) with 2 aesthetascs and 3 setae.

Antenna (Fig. 4C): Biramous, peduncle with a distal spine on inner margin; endopod with 1 plumose seta and 1 spine; scaphocerite (exopod) with several setae.

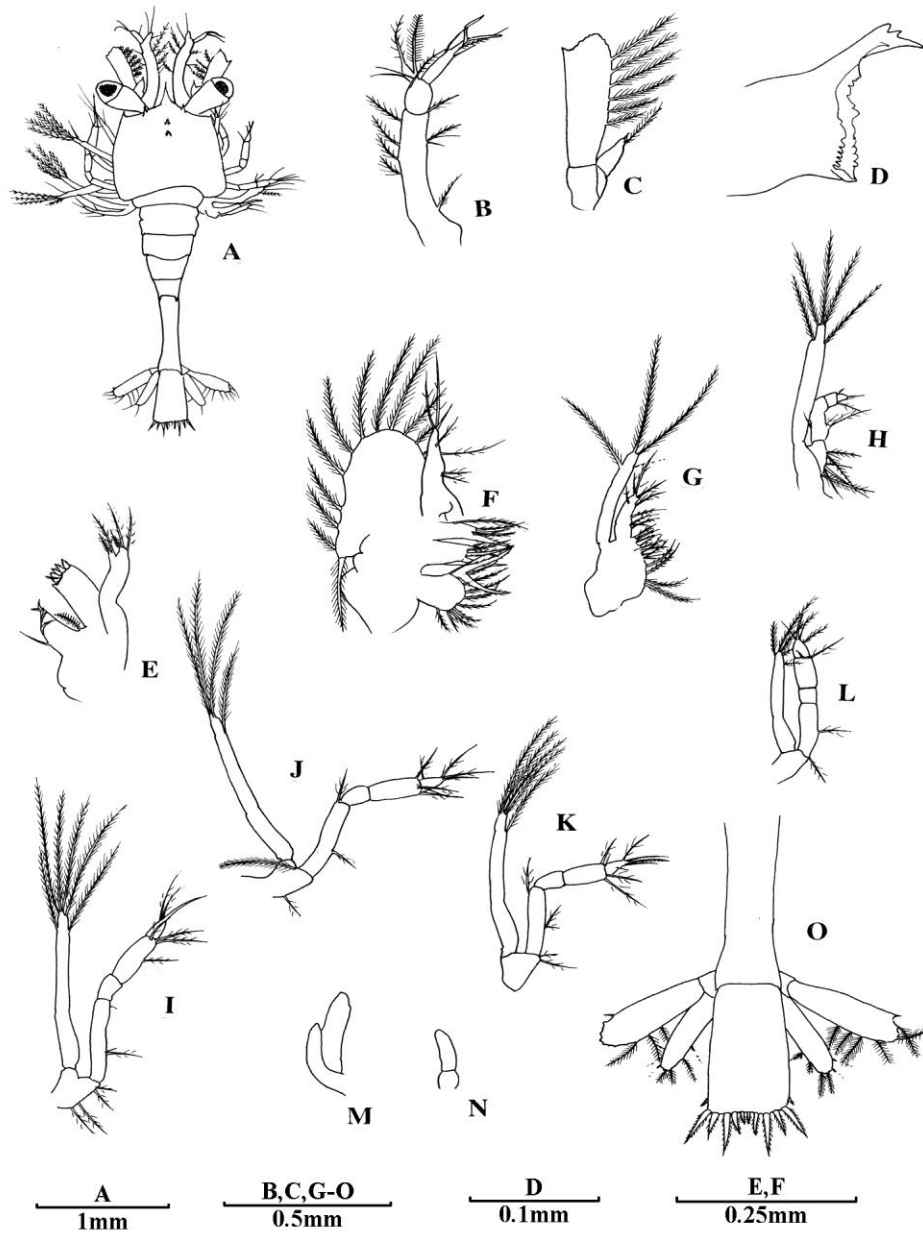


Fig. 4. *Macrbrachium equidens* (Dana, 1852). Zoea IV: A, entire, dorsal view; B, antennule; C, antenna; D, mandible; E, maxillule; F, maxilla, G-I, maxillipeds I-III; J-N, pereopods I-V; O, telson and uropods.

Mandible (Fig. 4D): Well developed.

Maxillule (Fig. 4E): Coxal endite with 6 setae; basal endite with 4 cuspidate and 1 plumodenticulate setae; endopod with 2 + 3 setae.

Maxilla (Fig. 4F): Coxal endite with 10+2 plumodenticulate setae; basal endite with 5+5 plumodenticulate setae; endopod with 2, 2+3 plumodenticulate setae; scaphognathite with 12 setae.

Maxilliped I (Fig. 4G): Coxa naked; basis with 15 plumodenticulate setae; endopod unsegmented with 4, 5 plumodenticulate setae; exopod with 2 + 2 setae.

Maxilliped II (Fig. 4H): Coxa with 1 seta; basis with 5 plumodenticulate setae; endopod 3-segmented with 3+1, 1 and 2 plumodenticulate setae; exopod with 3 terminal and 2 subterminal natatory plumose setae.

Maxilliped III (Fig. 4I): Coxa and basis each with 2 plumodenticulate setae, respectively; endopod 4-segmented with 2, 0, 1+3 and 2+1 (2 setae and 1 spine) setae, respectively; exopod with 4 terminal and 2 subterminal plumose natatory setae.

Pereiopods I - V (Figs. 4J - N): Pereiopod I (Fig. 4J) coxa and basis each with 1 seta; endopod 4-segmented with 2, 0, 4 and 1 + 3 plumodenticulate setae, respectively; exopod with 3 + 1 setae; pereiopod II (Fig. 4K) coxa broken; basis with 2 setae; endopod 4-segmented with 2+1, 0, 3 and 4 + 1 plumodenticulate setae, respectively; exopod with 4 + 1 setae; pereiopod III (Fig. 4L) coxa broken; basis with 1 seta; endopod 4-segmented with 1, 0, 2 and 1 + 3 plumodenticulate setae ; exopod with 3 + 2 setae; pereiopods IV-V (Figs. 4M, N) rudimentary.

Pleopods: Rudimentary.

Abdomen (Fig. 4A): Six somites.

Telson (Fig. 4O): Broader than long, posterior margin with 6 pairs of plumose setae; uropod biramous; endopod with 6 setae; exopod with 6 - 9 setae.

REMARKS: According to some theories, *Macrobrachium* is an ancient marine genus whose members have established freshwater colonies to varying degrees. In this regard, it is found that these prawns occupy a variety of aquatic environments, including marine, estuarine and river waters as well as impounded waters. Therefore, they have evolved different types of developmental patterns. This genus was recognized as having three basic developmental patterns viz., prolonged or normal type (with 8 to 20 stages), partially abbreviated type (with 2 or 3 stages) and completely abbreviated type (with only 1 stage). Nevertheless, several species display a transitional developmental pattern (Sankolli *et al.*, 1993). Murphy and Austin (2005) did not include the present *M. equidens* in abbreviated types, therefore the present *Macrobrachium* is grouped in normal type. The previous (Kazmi *et al.* 1991, abstract only) and present laboratory rearing of *M. equidens* victoriously metamorphosed in sea water of typical salinity, stopped after zoea III and died. Next stage i.e. zoea IV was obtained from near shore plankton sample therefore its larval pattern could not be decided in Pakistani waters. However, Ngoc-Ho, (1976) have described 10 larval stages from Thailand waters. The number of larvae per spawn associated considerably with body size (total length), accomplishment a maximum of 4,027 larvae (Maciel *et al.*, 2011).

M. equidens and *M. rude* are the only marine species of the genus from the Pakistani coast. Both species are very similar, the differences between the two species are easily

discernible in adults, but the differences between juveniles and females are harder to describe and figure out when there are specimens in hand.

Larval development of *M. equidens* is described therefore the comparison with other congeneric sympatric species, was not possible. Indian worker Pillai (1990a) gave some observations on the larvae but no detailed morphology and earlier work by Jagadisha, 1977, being not available could not be included in comparison. There are several differences found in the setal counts and various features in Pakistani, Thai, Taiwanese and Japanese material but the Pakistanese material differ noticeably in endopod of maxillipede 1 of zoea 1 and pereopod 1 and 11 from Thai, Taiwanese and Japanese material (Table 1).

Table 1: An assessment of laboratory reared zoea I - III and planktonic larval zoea IV of *Macrobrachium equidens* (present study) and previously studied larvae of its congener species.

Zoea I:

Characters	<i>M. equidens</i> present study (Lab. rearing)	<i>M. equidens</i> Ngoc-Ho (1976) (Lab. rearing)	<i>M. equidens</i> Shy & Yu (1990) (Lab. rearing)	<i>M. equidens</i> Akane <i>et al.</i> (2003) (Lab. rearing)
Antenna: scaphocerite	8 setae	10 setae	9 setae	10 setae
Maxillule: Coxal endite	2 spines	4 spines	no mention	1+3 setae
endopod	1 seta	2 spines	no mention	2 spines
Maxilla: Coxal endite	3 setae	4 setae	no mention	2 + 2 setae
Basial endite	3 setae	2 + 2 setae	no mention	2-3 + 2-3 setae
Maxilliped I: basipod	3 spines	1 seta	no mention	5-6 setae
endopod	3-segmented with 1,1,1 setae	unsegmented with 3 setae	unsegmented with 2 setae	Unsegmented 3+5 setae
Pereiopods I & II	uniramous	biramous	biramous	bramous
Abdomen	6-segmented	5-segmented	unsegmented	5-segmented
Telson posterior margin	7 pairs of setae	7 pairs of setae	7 pairs of setae	7 pairs of setae

Zoea II:

Characters	<i>M. equidens</i> present study (Lab. rearing)	<i>M. equidens</i> Ngoc-Ho (1976) (Lab. rearing)	<i>M. equidens</i> Shy & Yu (1990) (Lab. rearing)
Carapace: supra-orbital spine	absent	present	present
Antennule: peduncle	2-segmented, proximal segment with 3 setae, distal segment with 1 seta	2-segmented, proximal segment with 1 seta, distal segment with 2 setae	2-segmented, distal segment with 1 seta
aesthetascs	5	4	3
setae	setae absent	1 seta	1 seta
Antenna: endopod	1 seta + 1 spine	2 setae	1 seta
scaphocerite	11 setae	10 setae	10 setae
Maxillule: Coxal endite	5 setae	3 spines+ 1 seta	no mention
endopod	1 seta	2 setae	no mention
Maxilla: Coxal endite	2 setae	4 setae	no mention
Basial endite	1 seta	2 + 2 setae	no mention
endopod	1 seta	2 +1 setae	no mention
scaphognathite	5 setae	7 setae	no mention
Maxilliped I: Basipod	3 setae	4 setae	4 setae
endopod	3-segmented with 1 seta	unsegmented with 1 seta	unsegmented with 2 setae
Maxilliped II: basipod	without setae	1 seta	without setae
Maxilliped III: endopod	5-segmented with 1,1,1,2 setae + 1 spine	4-segmented with 2,0,3,2 setae + 1 spine	4-segmented with 1,1,1,1 setae + 1 spine
Pereiopod I: endopod	4-segmented with 1,1,2 setae + 1 spine	4-segmented with 2,1,2 ,14- segmented with 2,1,2 ,1	4-segmented with 1,1,1,1 setae + 1 spine
Pereiopod II: basipod	without setae	2 setae	1 seta
endopod	4-segmented with 1,0,2,1 setae + 1 spine	4-segmented with 1,1,2, setae +1 spine	4-segmented with 1,1,1,1 spine
Telson posterior margin	8 pairs of setae	8 pairs of setae	8 pairs of setae

Zoea III:

Characters	<i>M. equidens</i> present study (Lab. rearing)	<i>M. equidens</i> Ngoc-Ho (1976) (Lab. rearing)	<i>M. equidens</i> Shy & Yu (1990) (Lab. rearing)
Carapace: epigastric spine	absent	present	present
supra-orbital spine	absent	present	present
Antennule: peduncle	2-segmented, with 3, 2 setae	2-segmented, with 2, 5 setae	3-segmented, with 1+3,1,1 setae
Antenna: endopod	unsegmented with 1 seta + 1 spine	2-segmented with 4 setae	2-segmented with 2 setae
Maxillule: Coxal endite	4 setae	5 setae	no mention
Basial endite	4 setae	7 setae	no mention
endopod	1 seta	setae absent	no mention
Maxilla: Coxal endite	2 setae	4 setae	no mention
Basial endite	4 seta	6 setae	no mention
endopod	4+2 setae	2 +1 setae	no mention
scaphognathite	5 setae	5 setae	no mention
Maxilliped I: basipod	4 setae	5 setae	5 setae
endopod	3-segmented with 3 setae	unsegmented with 4 setae	unsegmented with 3 setae
exopod	5 setae	4 setae	
Maxilliped II: basipod	3 setae	2 setae	4 setae
endopod	3-segmented with 1,1,1,2 setae + 1 spine	4-segmented with 2,1,3,1 setae + 1 spine	3-segmented with 1,2,1 setae
exopod	4 setae	5 setae	6 setae
Maxilliped III: basipod	1 seta	2 setae	without setae
endopod	4-segmented with 0,0,3 setae + 1 spine	4-segmented with 1,1,3,1 setae + 1 spine	4-segmented with 0,0,2, 1 setae + 1 spine
Telson: posterior margin	7 pairs of setae	8 pairs of setae	no mention

Zoea IV:

Characters	<i>M. equidens</i> (planktonic)	<i>M. equidens</i> Ngoc-Ho (1976) (Lab. rearing)	<i>M. equidens</i> Shy & Yu (1990) (Lab. rearing)
Antennule: peduncle	2-segmented, proximal segment with 7 setae, distal segment with 4 setae	2-segmented, proximal segment with 7 setae, distal segment with 3 setae + 1 tubercle	3-segmented, proximal segment with 7 +4 setae, distal segment with 4 setae
Antenna: endopod	unsegmented with 1 seta + 1 spine	2-segmented, terminal segment with 4 setae	2-segmented, terminal segment with 2 setae
Maxillule: Coxal endite	6 setae	no mention	no mention
Basial endite	4+1 setae	no mention	no mention
endopod	2+3 setae	no mention	no mention
Maxilla: coxalendite	10+ 2 setae	4 setae	no mention
Basial endite	5+5 setae	3 + 3 setae	no mention
endopod	2,2+3 setae	2 +1 setae	no mention
scaphognathite	12 setae	7 setae	no mention
Pereiopod I: endopod	4-segmented with 2,0,4,1+3 setae + 1 spine	4-segmented with 2,1,3 ,1+1 setae + 1 spine	4-segmented with 0,1,3 ,1 setae
exopod	4 setae	6 setae	6 setae
Pereiopod II: endopod	4-segmented with 2+1, 0, 3, 4 + 1 setae	4-segmented with 2,1,3 ,1+1 spine	4-segmented with 1,1,3 ,1 setae
exopod	5 setae	6 setae	6 setae
Pereiopod III: endopod	4-segmented with 1, 0, 2, 1 + 3 setae	4-segmented with 0,0,0, 1+1 spine	4-segmented with 1,1,4,1 setae
exopod	5 setae	6 setae	6 setae
Pereiopod V:	rudimentary	developed	developed
Telson posterior margin	6 pairs of setae	6 pairs of setae	no mention

M. equidens is said to be represented by two morphological forms. There has been controversy regarding the taxonomy of this species due to these morphological differences (Pillai, 1990a, b). According to Pillai (1990a) a detailed description of the larval development of both forms of the two species was published to address this problem, and a comparison was made with the earlier literature on the species (Pillai1990b).

An endemic species of *M. equidens*, with longitudinal stripes along its whole body, is found in Kerala waters, India's Karwar region (Jagadisha, 1977). Unfortunately we did not notice the colour pattern of the mother specimen in any of our experiments (only a black and white picture is available (Kazmi and Kazmi, 2012, pl.3). In order to establish the species status of *M. equidens*, morphometric, meristic and genetic studies (as was done by Jose *et al.*, 2016) may be attempted on new fresh collection to 1) verify Jagadisha's statement about its endemism in India and 2) verify larval characters, which show that *M. equidens* in Pakistan is to be compared that found in south east Asia.

Overall the present larvae of *M. equidens* resemble in stage I, depicted *Macrobrachium* larvae do not have their third to fifth legs, their carapaces lack epigastric spines, and their fifth abdominal somite is lacking lateral spines. The larvae of *M. equidens*, lack teeth until they reach the post-larval stage. Ngoc-Ho (1976) also mentioned that in general, larvae of *M. Equidens* were similar to larvae of other genera in the family in this regard, for example the *Palaemonetes*. The larvae of *M. Equidens* were morphologically indistinguishable from previous stages of development after the 6th moult; some larvae were observed to repeat the larval form through 2 or more inter-moult before metamorphosis.

In Indian *M. equidens* in zoea II 2 endopodal setae are present on maxillula, these setae are of the same length until they metamorphose to zoea VI (Pillai, 1990b) but in Pakistanese specimen have 1 endopodal seta. This is another reason to verify the mother shrimp identification.

REFERENCES

- Akane, Ito, F. Yoshihisa and S. Shigemitsu, 2003. Redescription of the first zoeas of six *Macrobrachium* species (Decapoda: Caridea: Palaemonidae) occurring in Japan. *Crustac. Res.* 32: 55-72.
- Bond, G. and L. Buckup, 1982. O ciclo reprodutor de *Macrobrachium borellii* (Nobili, 1896) e *Macrobrachium potiuna* (Muller, 1880) (Crustacea: Decapoda: Palaemonidae) e suas relações com a temperatura. *Rev. Bras. de Biol.* Rio de Janeiro. 42(3): 473-483.
- Coelho, P.A. and M. Ramos-Porto, 1985. Os camarões da água doce do Brasil: distribuição geográfica. *Rev. Bras. Zool.* 2(6): 405-410.
- Holthuis, L.B., 1952. A general revision of the Palaemonidae (Crustacea: Decapoda: Natantia) of the Americas. II. The subfamily Palaemoninae. Allan Hancock Foundation Publications Occasional Papers 12: 1-396.
- Jagadisha, K., 1977. Studies on caridean prawns of Karwar. Ph.D. Thesis, Kamatak University of Marine Station. 69 & 72.
- Jayachandran, K.V., 2001. Palaemonid prawns. Biodiversity, taxonomy, biology and management. New Hampshire: Science Publishers Inc. 1-624.
- Jose, D., B. Nidhin, K.P. Anil Kumar, P.J. Pradeep and M. Harikrishnan, 2016. A molecular approach towards the taxonomy of fresh water prawns *Macrobrachium striatum* and *M. equidens* (Decapoda, Palaemonidae) using mitochondrial markers. *Taylor and Francis.* 27(4): 2585-2593. (<https://doi.org/10.3109/19401736.2015.1041114>)

- Kazmi, Q.B. and M.A. Kazmi, 2012. Biodiversity and Biogeography of Carideans shrimps of Pakistan. MRC & HEC Publication, pp. 533.
- Kazmi, Q.B., F.A. Siddidui and M.A. Kazmi, 1991. Report on *Macrobrachium equidens* (Palaemoninae: Crustacea) and its early developmental stages. 11th Pak. Cong. Zool. Khanuspur. Abstract: 68.
- Maciel, C., 2011. The invasive status of *Macrobrachium rosenbergii* (De Man, 1879) in Northern Brazil, with an estimation of areas at risk globally. *Aquat. Invas.* 6(3): 419-428.
- Melo Gas., 2003. Manual de identificação dos Crustacea, Decapoda de água doce do Brasil. São Paulo. Edições Loyola, 429 p.
- Murphy, N.P. and C.M. Austin, 2005. Phylogenetic relationships of the globally distributed freshwater prawn genus *Macrobrachium* (Crustacea: Decapoda: Palaemonidae): biogeography, taxonomy and the convergent evolution of abbreviated larval development. *Zool. Scrip.* 34: 187-197.
- Ngoc-Ho, N., 1976. The larval development of the prawns *Macrobrachium equidens* and *Macrobrachium* sp. Decapoda, Palaemonidae reared in the laboratory. *J. Zool.* (London) 178(1): 15-55.
- Pillai, N.N., 1990a. Observations on the breeding, larval development and taxonomic status of *Macrobrachium equidens* (Dana, 1852). *Ind. J. Fish.* 37(2): 151-153.
- Pillai, N.N., 1990b. *Macrobrachium striatus*: A new species from the southwest coast of India. *J. mar. biol. Ass. India.* 32(1 & 2): 248-253.
- Sankolli, K.N., D.R. Jalihal and S. Shakuntala, 1993. Evolution of Larval Developmental Patterns and the Process of Freshwaterization in the Prawn Genus *Macrobrachium* Bate, 1868 (Decapoda: Palaemonidae). *Crustac.* 65(3): 365-376. (doi: <https://doi.org/10.1163/156854093X00793>)
- Short, J.W., 2004. A revision of Australian river prawns, *Macrobrachium* (Crustacea: Decapoda: Palaemonidae). *Hydrobiol.* 525: 1-100.
- Shy, J.Y., Y.H.P., 1990. Morphological observation on the larval development of *Macrobrachium equidens* Crustacea, Decapoda, Palaemonidae. *Journal of the Fisheries Society of Taiwan* 17(3): 185-198.