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# First report of laboratory reared developmental stages of *Palaemon sewelli* (KEMP, 1925) (Crustacea: Caridea: Palaemonidae: Palaemonidae)

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**Abstract**
The ovigerous female of *Palaemon sewelli* (Kemp, 1925) was collected from Korangi Creek (Karachi, Pakistan) and kept in the laboratory. The larvae hatched after 7 days and survived until Zoea IV within 5 days at room temperature 29 °C-31 °C in filtered seawater with a salinity of 35-37 parts per thousand and a pH of 7.5-7.9. In order to feed the larvae, *Artemia* nauplii was used. The larval developmental stages are described, illustrated and compared with those of its congener's larvae known previously.

**Keywords:** Crustacea, Caridea, Palaemonidae, *Palaemon sewelli* larvae

## 1. Introduction

As the second most species-rich group among the Decapoda, the infraorder Caridea is the most specious shrimp group in the world. Globally, approximately 3000 species of carideans have been rescored (Grave and Fransen, 2011) [1].

The family Palaemonidae species live in freshwater, estuarine and marine environments in Pakistan. Most *Palaemon* species are tolerant of low salinities, including brackish water estuaries and bays as well as fresh water. Marine and estuarine species have relatively small and numerous eggs, and their larvae undergo a complex larval development including 13 stages before becoming juveniles (Kazmi and Kazmi 2010) [2].

Among some carideans, there may be two distinct developmental modes that are not taxonomically related, one abbreviated with the elimination of zoeal stages and the other nearly direct development in postlarval stages, which are eliminated or are morphologically advanced and more adult-like as a result of metamorphosis from the larval stage (Rabalais and Gore, 1985) [3].

In the literature, few reports have been published on caridean larvae in Pakistan (Tufail and Hashmi, 1965; Yaqoob, 1980, 1987; Barkati, 1980; Tirmizi and Kazmi, 1986; Ghory and Siddiqui, 2001; Ghory *et al.*, 2005, 2011, 2016, 2022; Ghazi *et al.*, 2006; Siddiqui and Ghory, 2006; Ghory and Kazmi, 2009, 2014, 2018, 2022; Kazmi *et al.*, 2019) [4-20]. This paper describes and illustrates the morphology of *Palaemon sewelli* from the first to the fourth zoeal stages.

**1.1 Distribution:** It is found in tropical and temperate climates.
**1.2 Habit and Habitat:** It occurs in brackish water.

**Fig 1:** *Palaemon sewelli* (Kemp, 1925), Ovigerous female

## 2. Materials and Methods

From Korangi Creek (Lat. 24° 48' 4.5216" N, Long. 67° 9' 15.7716" E), we obtained an ovigerous female of *Palaemon sewelli* (Kemp, 1925). During the study, the ovigerous female was kept in filtered seawater with a salinity of 35-37 and pH of 7.5-7.9 at room temperature (29 °C -30 °C). We separated newly hatched larvae and placed five larvae per beaker (500ml) of filtered seawater. The nauplii of *Artemia* were served as food. We examined each beaker daily for dead larvae and exuviae. Glycerin plus formalin (3:1) was used to prepare temporary slides. Under a binocular microscope (Nikon) with 10x/21 magnifications, specimens were dissected with tungsten needle. Olympus BX51 microscope (magnifications WHN10X/22 x10, 20 and 40) with Nomarski interference contrast and *camera lucida* attachment was used to make the illustrations. We measured the illustrated specimens using a stage micrometer (millimeter = mm). From the tip of the rostrum to the mid posterior border of the telson, we measured the total length (TL). The spent female and the remaining larvae were preserved in formalin and stored at the Marine Reference Collection and Resource Centre, University of Karachi.

**Table 1:** Observations on *Palaemon sewelli* (Kemp, 1925) larval stages and the time of first appearance.

| Stage | Days elapsed after hatching | Total Length TL ± SD (mm) |
|---|---|---|
| Zoea I | 2 days | 1.43 mm ± 1.54 mm |
| Zoea II | 1 day | 01.93 mm ± 02.00 mm |
| Zoea III | 1 day | 2.03 mm ± 2.06 mm |
| Zoea IV | 1 day | 3.65 mm ± 3.80 mm |

## 3. Results

### 3.1 Description of the larvae

#### 3.1.1 Zoea I (Fig. 2A – J)

**Diagnostic Features.-**

Carapace (Fig. 2A).- Smooth; rostrum long, reaching near 1st antennular peduncle; eyes sessile.

Antennule (Fig. 2B).- Peduncle 2-segmented, distal segment with a long plumose seta; outer ramus (exopod) with 3 aesthetascs and 1 seta.

Antenna (Fig. 2C).-Biramous, endopod with a long plumose seta; exopod (scaphocerite) with 10 long plumose setae.

Mandible (Fig.2D).- Well developed.
Maxillule (Fig.2E).-Coxal endite with 4 plumodenticulate setae; basial endite with 2 cuspidate and 2 plumodenticulate setae; endopod with a single plumodenticulate seta.
Maxilla (Fig.2F).- Coxal and basial endites bilobed with 1 + 2 and 3 + 4 plumodenticulate setae, respectively; endopod with 2 plumodenticulate setae; scaphognathite with 4 setae.
Maxilliped I (Fig.2G).-Coxopod naked; basipod with 7 plumodenticulate setae; endopod 3-segmented with 0,1 and 4 plumodenticulate setae, respectively; exopod partially segmented with 5 long plumose natatory setae.
Maxilliped II (Fig.2H).-Coxopod broken; basipod with 1 seta; endopod 3-segmented with 0,3 and 2 plumodenticulate setae, respectively; exopod 3-segmented with 2,2 and 2 plumose natatory setae
Maxilliped III (Fig. 2I).-Coxopod broken; basipod naked; endopod 5-segmented with 1,0,0,2 and 2 plumodenticulate setae ; exopod 3-segmented with 2,2 and 2 plumose natatory setae.
Pereiopod I-V (Fig.2J).- Rudimentary.
Abdomen (Fig.2A).- 5 somites.
Telson (Fig.2A).- Triangular; posterior margin with 6 pairs of plumose setae and 1 pair of spines.

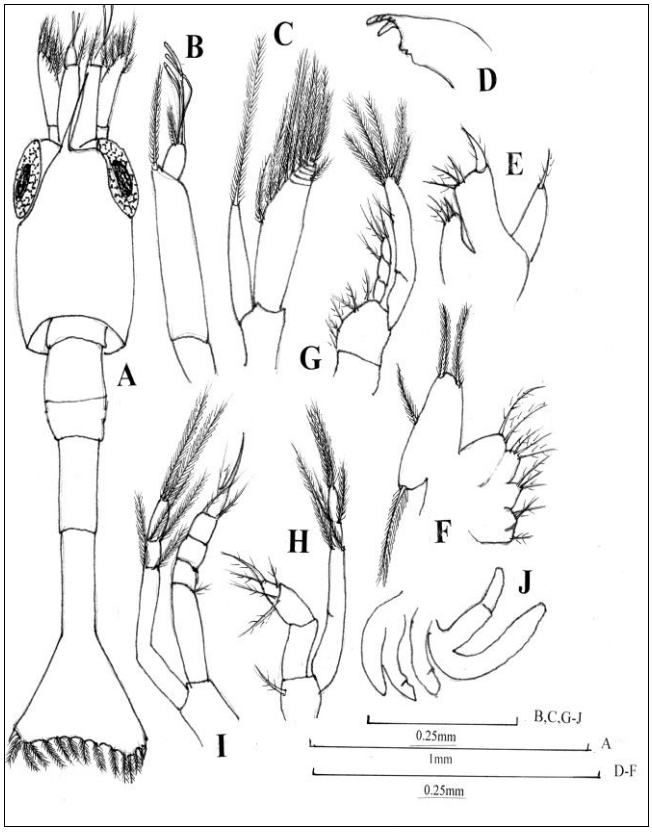


**Fig 2:** *Palaemon sewelli* (Kemp, 1925) Zoea I: A, entire, dorsal view; B, antennule; C, antenna; D, mandible; E, maxillule; F, maxilla, G - I, maxillipeds I - III; J, pereiopods I-V.

### 3.1.2 Zoea II (Fig. 3A – L)
**Diagnostic Features**
Carapace (Fig. 3A).- with 1 epigastric spine.
Antennule (Fig. 3B).- Peduncle 2-segmented with 7 (5 simple and 2 plumodenticulate setae) and 1 plumodenticulate setae; outerramus (exopod) with 4 aesthetascs and 1 plumodenticulate seta.
Antenna (Fig. 3C).-Biramous, endopod with 3 plumose setae; exopod (scaphocerite) with 9 long plumose setae.
Mandible (Fig. 3D).- Well developed.
Maxillule (Fig. 3E).-Coxal endite with 5 plumodenticulate setae; basial endite with 4 cuspidate and 1 seta; endopod with a single plumodenticulate seta.
Maxilla (Fig. 3F).- Coxal and basial endites bilobed with 3 + 3 and 4 + 1 plumodenticulate setae, respectively; endopod with 1 plumodenticulate seta; scaphognathite with 6 setae.
Maxilliped I (Fig. 3G).- Coxopod naked; basipod with 6 plumodenticulate setae; endopod 3-segmented with 0,1 and 4 plumodenticulate setae, respectively; exopod 2-segmented, terminal segment with 2 terminal and 4 subterminal plumose natatory setae.
Maxilliped II (Fig. 3H).-Coxopod and basipod broken; endopod 3-segmented with 1,0 and 7 plumodenticulate setae ; exopod 3-segmented with 0,1 and 4 (2 terminal and 2 subterminal) plumose natatory setae.
Maxilliped III (Fig. 3I).-Coxopod and basipod naked; endopod 5-segmented with 0,2,0,2 and 5 plumodenticulate setae; exopod 3-segmented with 0,4 and 4 (2 terminal and 2 subterminal) long plumose natatory setae respectively.
Pereiopods I-V (Figs. 3 J-L).- Pereiopod I and II (Figs. 3J and K), biramous, pereiopod I (Fig. 3J) with 2-segmented endopod, distal segment with 4 plumodenticulate setae; exopod 2-segmented, distal segment with 2 terminal and 4 subterminal plumose natatory setae; pereiopod II (Fig. 3K), endopod 4-segmented with 2,1,3,and 2 plumodenticulate setae, respectively; exopod with 4 terminal and 4 subterminal setae; pereiopods III-V (Fig. 3L) rudimentary.
Abdomen (Fig.3A).- 5 somites.
Telson (Fig. 3A).- Triangular; posterior margin with 6 pairs of plumose setae and 1 pair of spines.

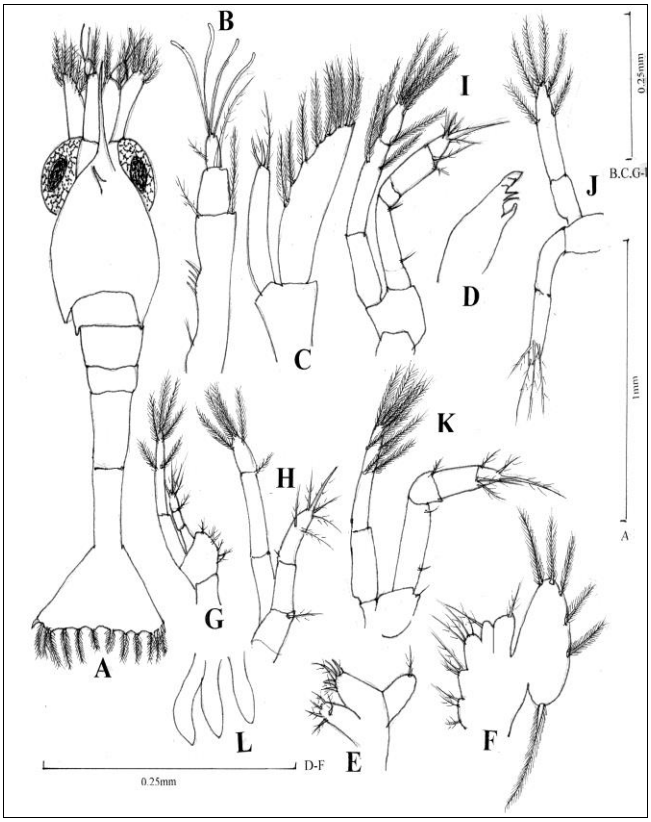


**Fig 3:** ***Palaemon sewelli*** **(Kemp, 1925) Zoea II:** A, entire, dorsal view; B, antennule; C, antenna; D, mandible; E, maxillule;F, maxilla, G - I, maxillipeds I - III; J, K, pereiopods I, II;L, pereiopods III - V.

### 3.1.3 Zoea III (Figs. 4A – 5E)
**Diagnostic Features**
Carapace (Fig.4A).- with 2 epigastric spines.

Antennule (Fig.4B).-Biramous; peduncle 3-segmented with 5 setae and 2 spines, 0 and 5 plumodenticulate setae, respectively; inner ramus (endopod) with 2 setae; outer ramus (exopod) with 4 aesthetascs.

Antenna (Fig.4C).-Biramous; endopod 6-segmented, distal segment with 2 plumose setae; scaphocerite with 1 distolateral spine and 14 marginal plumose setae.

Mandible (Fig. 4D).- Incisor and molar processes well developed.

Maxillule (Fig. 4E).-Coxal endite with 6 plumodenticulate setae; basial endite with 4 cuspidate and 3 plumodenticulate setae; endopod with a single plumodenticulate seta.

Maxilla (Fig. 4F).-Coxa and basis bilobed with 5 + 4 and 4 + 2 setae, respectively; endopod with 1 seta; scaphognathite with 9 setae.

Maxilliped I (Fig. 4G).- Coxopod naked; basipod with 6 plumodenticulate setae; endopod 3-segmented with 0,1 and 4 plumodenticulate setae, respectively ; exopod 3-segmented, distal segment with 4 (2 terminal and 2 subterminal) long plumose natatory setae.

Maxilliped II (Fig. 4H).-Coxopod broken; basipod naked; endopod 3-segmented with 1,0 and 6 plumodenticulate setae ; exopod 4-segmented with 0,2,2 and 4 setae.

Maxilliped III (Fig. 4I).-Coxopod broken; basipod naked; endopod 5-segmented with 0,2,2, 3 and 3 plumodenticulate setae; exopod with 8 (4 terminal and 4 subterminal) long plumose natatory setae respectively.

Pereiopods I-V (Figs.5A- D).- Biramous, pereiopod I (Fig.5A), endopod 4-segmented with 0,1,3 and 2 plumodenticulate setae; exopod with 2 terminal and 4 subterminal long plumose natatorysetae; pereiopod II (Fig.5B), endopod 5-segmented with 0,1,1,5 and 3 plumodenticulate setae ;exopod with 4 terminal and 4 subterminal plumose natatory setae; pereiopod III (Fig.5C), endopod 5-segmented with 0,2,1,3 and 2 plumodenticulate setae, respectively; exopod with 2 terminal and 6 subterminal long plumose natatory setae; pereiopods IV and V (Figs. 5D), rudimentary.

Telson (Fig. 5E).- Posterior margin with 4 pairs of plumose setae; uropod well developed; endopod with 3 and exopod with 11-13 long plumose setae.

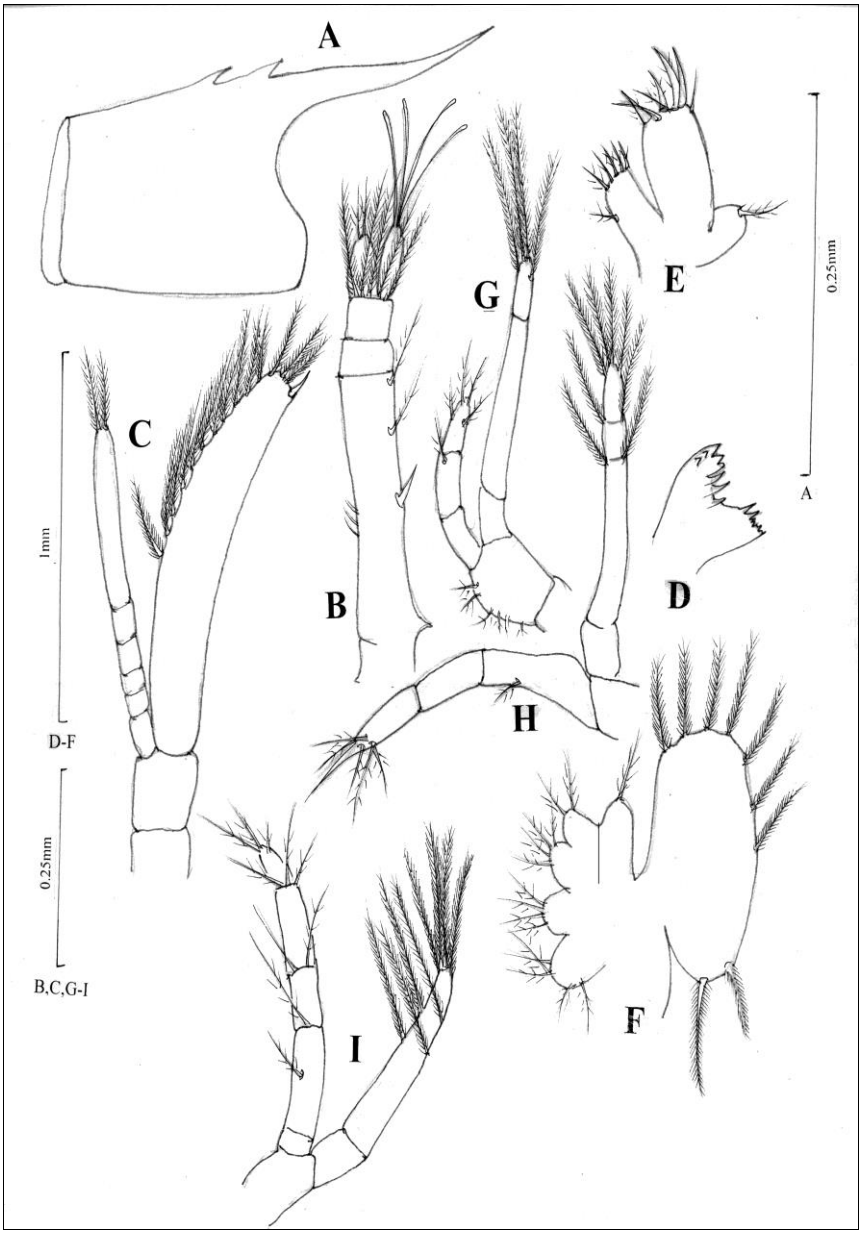


**Fig 4:** *Palaemon sewelli* (Kemp, 1925) Zoea III: A, lateral view of carapace; B, antennule; C, antenna; D, mandible; E, maxillule; F, maxilla, G - I, maxillipeds I – III.

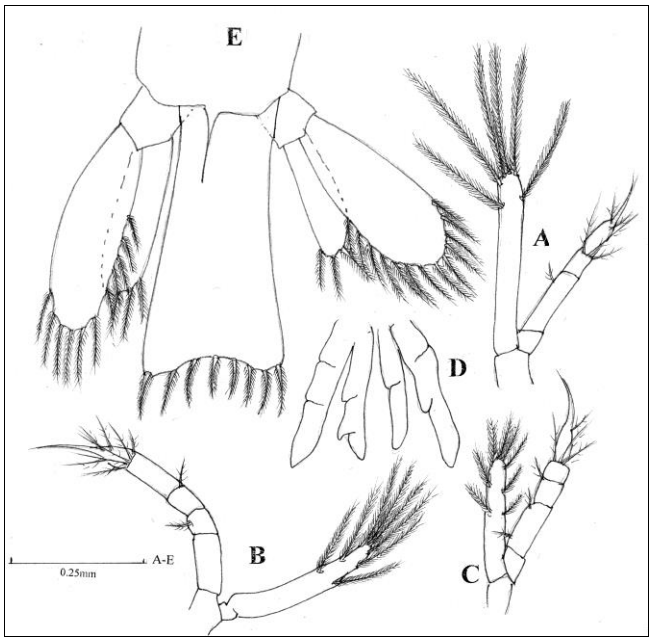


**Fig 5:** *Palaemon sewelli* (Kemp, 1925) Zoea III: A - C, pereiopods I - III; D, pereiopods IV- V; E, telson with uropods.

### 3.1.4 Zoea IV (Figs. 6A – 7F)

**Diagnostic Features**

Carapace (Fig.6A).- With 3 epigastric spines.

Antennule (Fig.6B).-Biramous; peduncle 2-segmented with 10 and 4 setae, respectively; inner ramus (endopod) with 2 setae; outer ramus (exopod) with 4 aesthetascs and 1 plumodenticulate setae.

Antenna (Fig. 6C).-Endopod 3-segmented, terminal segment with 3 setae; scaphocerite with 1 distolateral spine and 14 setae.

Mandible (Fig. 6D).- Well developed.

Maxillule (Fig. 6E).-Coxal endite with 5 plumodentidulate setae; basial endite with 4 cuspidate and 3 plumodenticulate setae; endopod with a single plumodenticulate seta.

Maxilla (Fig.6F).-Coxopod and basipod bilobed with 5 + 3 and 4 + 2 plumodenticulate setae, respectively; endopod with 1 plumodenticulate seta; scaphognathite with 9 setae.

Maxilliped I (Fig.6G).- Coxopod naked; basipod with 7 plumodenticulate setae; endopod 3-segmented with 0, 1 and 4 plumodenticulate setae ; exopod 2-segmented, distal segment with 4 long plumose natatory setae.

Maxilliped II (Fig. 6H).-Coxopod broken; basipod with 3 setae; endopod 3-segmented with 0,2 and 4 plumodenticulate setae;exopod 4-segmented with 0,2,2 and 4 plumose natatory setae.

Maxilliped III (Fig. 6I).-Coxopod broken; basipod with 2 setae; endopod 4-segmented with 1,0,3 and 2 plumodenticulate setae; exopod with 8 (4 terminal and 4 subterminal) long plumose natatory setae respectively.

Pereiopods I-V (Figs.7A-E).- Pereiopod I-IV biramous, pereiopod I (Fig.7A) basipod with 1 seta; endopod 4-segmented with 2,0,3 and 3 setae, respectively; exopod with 4 terminal and 4 subterminal plumose setae; pereiopod II (Fig.7B) basipod with 1 seta; endopod 5-segmented with 0,0,0,2 and 2 plumodenticulate setae, respectively; exopod 4 terminal and 2 subterminal plumose setae; pereiopd III (Fig.7C) endopod 5-segmented with 1,0,0,3 and 4 plumodenticulate setae, respectively; exopod with 2 terminal and 6 subterminal long plumose natatory setae; pereiopod IV (Fig.7D), basipod with 1 plumodenticulate seta; endopod 5-segmented with 1,0,0,3 and 2 plumodenticulate setae; exopod with 2 terminal and 4 subterminal plumose natatory setae; pereiopod V (Fig.7E) endopod 5-segmented with 1,1,2,2 and 2 setae; terminal segment ending in a strong spine.

Abdomen (Fig. 6A).- Fifth abdominal somite with a pair of rather large posteriolateral spine.

Telson (Fig. 7F).- ).- Posterior margin with 4 pairs of plumose setae; uropod well developed; endopod and exopod with several long plumose setae.

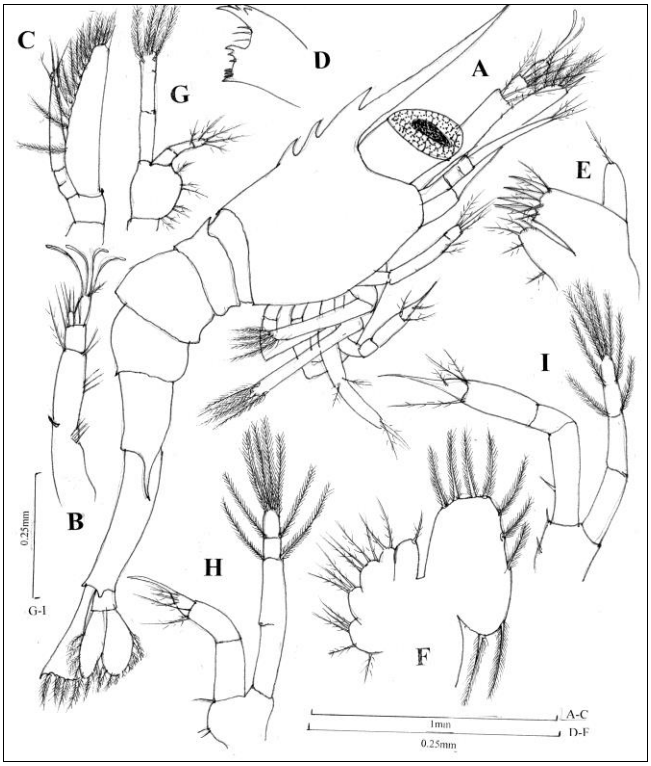


**Fig 6:** *Palaemon sewelli* (Kemp, 1925). Zoea IV: A, entire, lateral view; B, antennule; C, antenna; D, mandible; E, maxillule; F, maxilla, G - I, maxillipeds I – III.

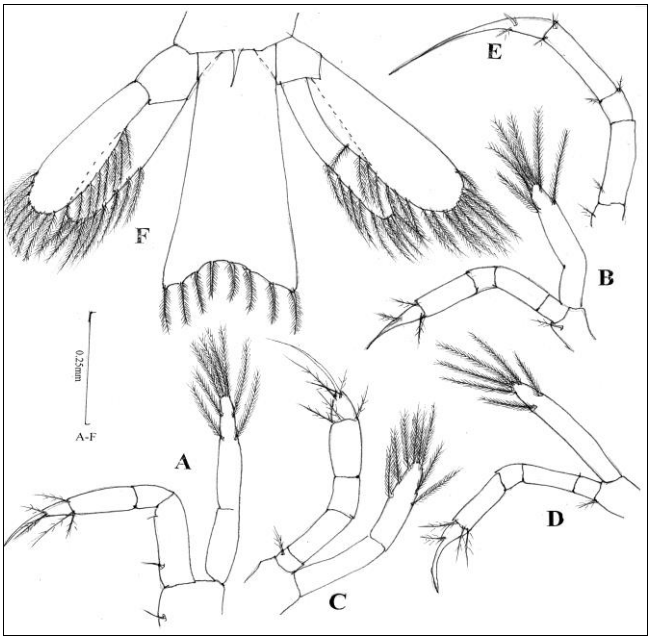


**Fig 7:** *Palaemon sewelli* (Kemp, 1925). Zoea IV: A - E, pereiopods I – V; F, telson with uropods.

## 4. Discussion

Understanding the adult life history of a species relies heavily on the lifespan and morphology of the larval stages, which are only obtained through studying reared specimens. A phylogenetic relationship can be characterized by larval

descriptors (Ng and Clark 2000; Felder and Martin 2003; Anger 2006) [21 -23], especially if the adults are difficult to distinguish (Ng and Clark 2000; Cuesta and Anger 2001) [21, 24]. As well, morphological descriptions of larval stages of decapods reared in laboratory are important tools for identifying planktonic zoea (Muzio *et al*., 2018) [25].

As the adults of *Palaemon sewelli* Kemp (1925) resemble *Palaemon eteshornelli* (now *Leandrites celebensis*), whose larvae have been described by Pillai (1974) [26], *Palaemon sewelli* is often confused with *P. serrifer*. However, as shown here (Table 2), larvae differ in several ways that enable their identification.

**Table 2:** Comparative study of zoea I - IV of *Palaemon sewelli* (present study) raised in the laboratory and its congeners *P. concinus, P. semmelinkii, P. pacificus* and *P. serrifer.*

Zoea I

| **Characters** | ***P. sewelli* present study** | ***P. semmelinkii* Jagadisha & Sankolli (1977) [27]** | ***P. pacificus* Han & Hong (1978) [28]** | ***P. concinus* Pillai (1979) [29]** | ***P. serrifer* Shy *et al.* (2005) [30]** | ***P. pacificus* Ghory & Kazmi (2014) [17]** |
|---|---|---|---|---|---|---|
| Total length | 1.43mm - 1.54mm | 2.35mm | 2.10mm- 2.28mm | 2.37mm-2.62mm | --------- | 2.08mm-2.59mm |
| Carapace: epigastric spines | absent | absent | absent | absent | one spine present | present |
| Antennule: aesthetascs | 3 aesthetascs | 4 aesthetascs | 4 aesthetascs | 3 aesthetascs | 2 aesthetascs | 3 aesthetascs |
| Antenna: endopod | 1 seta | 1 spine +1 seta | 1 spine +1 seta | 1 spine +1 seta | 2 setae | 2 setae |
| scaphocerite | 10 setae | 10 setae | 10 setae | 12 setae | 6 setae | distolateral spine + 8 setae |
| Maxilliped I: exopod | 5 setae | 6 setae | 4 setae + 2 spine | 4 setae | 4 setae | 6 setae |
| Maxilliped II: exopod | 6 setae | 8 setae | 7 setae | 4 setae | 4 setae | 8 setae |
| Maxilliped III: exopod | 6 setae | 8 setae | 8 setae | 4 setae | 8 setae | 8 setae |
| Pereiopod I: | rudimentary | rudimentary | rudimentary | rudimentary | developed | rudimentary |

Zoea II

| **Characters** | ***P. sewelli* present study** | ***P. semmelinkii* Jagadisha & Sankolli (1977) [27]** | ***P. pacificus* Han & Hong (1978) [28]** | ***P. concinus* Pillai (1979) [29]** | ***P. serrifer* Shy *et al.* (2005) [30]** | ***P. pacificus* Ghory&Kazmi (2014) [17]** |
|---|---|---|---|---|---|---|
| Carapace: epigastric spines | 1 spine present | 1 spine present | 1 spine present | absent | 2 spines present | 1 spine present |
| Antennule: aesthetascs | 4 aesthetascs | 4 aesthetascs | 4 aesthetascs | 3 aesthetascs | 4 aesthetascs | 3 aesthetascs |
| Antenna: endopod | 3 setae | 1 spine + 1 seta | 1 spine + 3 setae | 1 spine + 3 setae | 2 setae | 2 setae |
| scaphocerite | 9 setae | 14 setae | 13 setae | 11 setae | 13 setae | 16 setae |
| Maxilliped I: exopod | 6 setae | 6 setae | 4 setae | 6 setae | 3 setae | 6 setae |
| Maxilliped II: exopod | 5 setae | 8 setae | 8 setae | 5 setae | 4 setae | 8 setae |
| Maxilliped III: exopod | 8 setae | 10 setae | 8 setae | 5 setae | 6 setae | 8 setae |
| Pereiopod I: | rudimentary | developed | developed | developed | developed | developed |

Zoea III

| **Characters** | ***P. sewelli* present study** | ***P. semmelinkii* Jagadisha & Sankolli (1977) [27]** | ***P. pacificus* Han & Hong (1978) [28]** | ***P. concinus* Pillai (1979) [29]** | ***P. serrifer* Shy *et al.*(2005) [30]** | ***P. pacificus* Ghory&Kazmi (2014) [17]** |
|---|---|---|---|---|---|---|
| Carapace: epigastric spines | 2 spines | 2 spines | 2 spines | hump present | 3 spines | 2 spines present |
| Antenna: endopod | 2 setae | 4 setae | 6 setae | 4 setae | 2 setae | 4 setae |
| scaphocerite | 14 setae | 16 setae | 16 setae | 12 setae | 19 setae | 16 setae |
| Maxilliped I: exopod | 4 setae | 6 setae | 6 setae | 6 setae | 3 setae | 6 setae |
| Maxilliped II: exopod | 8 setae | 8 setae | 8 setae | 5 setae | 4 setae | 8 setae |
| Maxilliped III: exopod | 8 setae | 10 setae | 8 setae | 5 setae | 6 setae | 8 setae |
| Pereiopod I: exopod | 6 setae | 8 setae | 8 setae | 4 setae | 6 setae | 8 setae |
| Abdomen: dorsal spine of 3rd somite | absent | absent | absent | absent | present | absent |
| Telson: | 4 pairs of setae | 7 pairs of setae | 7 pairs of setae | 7 pairs of setae | 1 pair of spines and 6 pairs of setae | 7 pairs of setae |
| Uropod: endopod | 3 setae | without setae | without setae | without setae | 17 setae | without setae |
| exopod | 11-13 setae | 10 setae | 11 setae | 11 setae | 19 setae | 10-11 setae |

Zoea IV

| Characters | *P. sewelli* Present study | *P. semmelinkii* Jagadisha & Sankolli (1977) [27] | *P. pacificus* Han & Hong (1978) [28] | *P. concinus* Pillai (1979) [29] | *P. serrifer* Shy *et al.* ( 2005) [30] | *P. pacificus* Ghory & Kazmi (2014) [17] |
|---|---|---|---|---|---|---|
| Antenna: Endopod | 2 setae | 4 setae | 6 setae | 2 setae | 3 setae | 4 setae |
| scaphocerite | 14 setae | 13 setae | 19 setae | 14 setae | 19 setae | 16 setae |
| Maxilliped I: exopod | 4 setae | 6 setae | 4 setae | 6 setae | 3 setae | 4 setae |
| Maxilliped II: exopod | 8 setae | 8 setae | 8 setae | 5 setae | 6 setae | 8 setae |
| Maxilliped III: exopod | 8 setae | 8 setae | 8 setae | 5 setae | 6 setae | 8 setae |
| Pereiopod I: exopod | 8 setae | 8 setae | 8 setae | 5 setae | 6 setae | 8 setae |
| Pleopod: | absent | absent | rudimentary | absent | rudimentary | rudimentary |
| Telson: | 4 pairs of setae | 8 pairs of setae | 5 pairs of setae | 5 pairs of setae | 1 pair of spines and 6 pairs of setae | 5 pairs of setae |

The zoeae of the present species differ from those of *P. semmelinkii, P. pacificus, P. concinus* and *P. serrifer* in the following regards: The antennal, endopod of *P. sewelli* has 1 seta, whereas *P. pacificus* and *P. concinus* have 1 spine plus 1 seta, and *P. serrifer* has 2 setae in zoea I. In zoea II, *P. sewelli* has 3 antennal endopod setae and 9 setae of scaphocerite while *P. semmelinkii* has 1 spine and 1 antennal endopod seta, *P. pacificus* and *P. concinus* have 1 spine and 3 antennal endopod setae, *P. serrifer* has 2 endopodal setae of antenna and 13 scaphocerite setae. In zoea III, *P. sewelli* has 14 scaphocerite setae and 4 exopodal setae in maxilliped I whereas, *P. semmelinkii, P. pacificus, P. concinus* and *P. serrifer* have 16, 12 and 19 scaphocerite, and 6 and 3 exopodal setae respectively. In telson *P. sewelli* has 4 pairs of posterior marginal setae while *P. semmelinkii, P. pacificus, P. concinus* and *P. serrifer* have 7 pairs of setae. Uropod has 3 endopodal setae in *P. sewelli* whereas *P. serrifer* has 17 endopodal setae and *P. semmelinkii, P. pacificus, P. concinus* without endopodal setae. In zoea IV, *P. sewelli* has 4 pairs of posterior marginal setae of telson, while *P. semmelinkii, P. pacificus, P. concinus* and *P. serrifer* have 8, 5, 5, and 7 pairs of posterior marginal setae respectively.

The literature survey reveals that larvae of *Palaeomon elegans* by Fincham (1977) [31], *P. semmelinkii* by Jagadisha and Sankolli (1977) [27], *P. pacificus* by Han and Hong (1978) [28] and Shy and Yu (1988) [32], *P. longirostris* by Fincham (1979) [33], *P. concinus* Pillai (1979) [29], *P. serratus* by Fincham (1983) [34], *P. adspersus* by Fincham (1985) [35], and *P. serrifer* by Shy *et al*. (2005) [30] have been obtained but those of *P. sewelli* are unknown and consequently this study will be the first on the species. Further studies on larval development of the remaining species of *Paleomon* are needed to better understand these differnces.

## 5. References


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