The complete larval development of *Armases benedicti* (Rathbun) (Decapoda, Sesarmidae), from the Amazon region, reared in the laboratory

Jô de F. Lima & Fernando Abrunhosa

Núcleo de Estudos Costeiros, Universidade Federal do Pará. Campus de Bragança, Alameda Leandro Ribeiro, Aldeia, 68600-000 Bragança, Pará, Brasil. E-mail: jodeflima@yahoo.com.br; faraujo@ufpa.br

ABSTRACT. The four zoeal and one megalopal stages of the wharf crab *Armases benedicti* (Rathbun, 1897) larvae reared in the laboratory are described and illustrated in detail. The mean duration for each larval stage was 3, 2, 4, 4 and 13 days, respectively. The duration of the larval period from hatching to the first juvenile was 26 days. Morphologically, *A. benedicti* is very similar to the reported species of genus. However, a small lateral spine is clearly observed in the carapace of zoeal stages of this species. This feature appears to be unique among the family Sesarmidae. Another distinctive character for this species is the zoeal setation of the maxilla endopod (2+2) in which most of the sesarmids have setation (2+3) except for *Sesarma tetragonum* (Fabricius, 1798). Other comparisons with previous larval studies of the genus *Armases* Abele, 1992 are briefly discussed.
KEY WORDS. Caeté estuary; larval morphology; sesarmid.

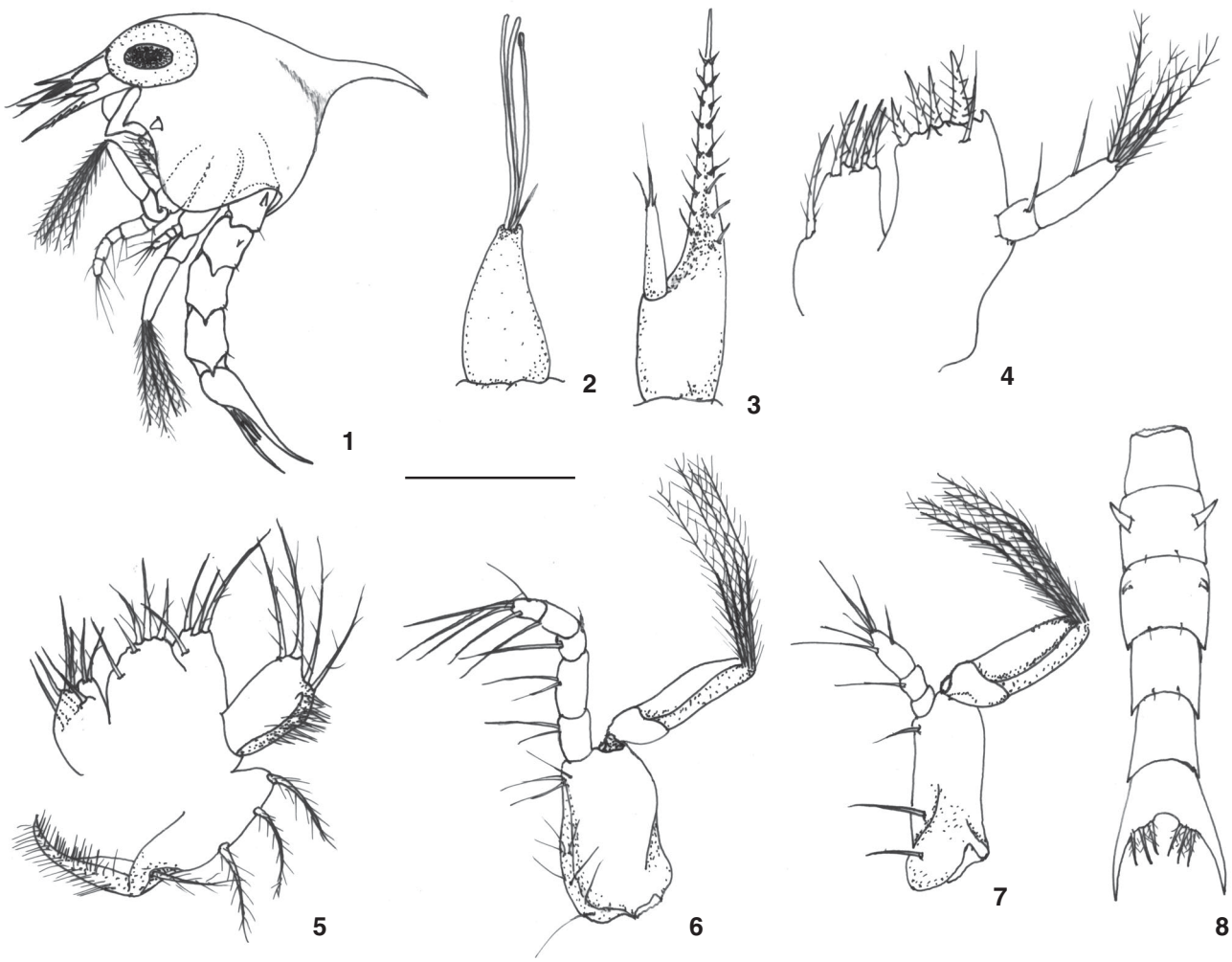
RESUMO. **O desenvolvimento larval completo de *Armases benedicti* (Rathbun) (Decapoda, Sesarmidae), da região Amazônica, obtido em laboratório.** São descritos e ilustrados em detalhes, os quatro estágios de zoea e um de megalopa do caranguejo *Armases benedicti* (Rathbun, 1897), a partir de larvas obtidas em laboratório. A média de duração de cada estágio larval foi 3, 2, 4, 4 e 13 dias, respectivamente. O período compreendido desde a eclosão até o surgimento do primeiro juvenil foi de 26 dias. Morfologicamente *A. benedicti* é muito similar às outras espécies do gênero, contudo, um pequeno espinho lateral é claramente observado na carapaça das zoeas desta espécie. Esta característica aparenta ser única dentre os Sesarmidae. Outra característica distinta desta espécie é a distribuição das cerdas do endópodo da maxila (2+2), o qual difere dos demais sesarmídeos que apresentam a distribuição (2+3), exceto para *Sesarma tetragonum* (Fabricius, 1798) o qual apresenta (2+2). Outras comparações morfológicas com trabalhos anteriores relacionados a larvas do gênero *Armases* Abele, 1992 são brevemente discutidas.
PALAVRAS-CHAVE. Estuário do Caeté; morfologia larval; sesarmídeo.

The morphological descriptions of larvae are considered valuable in the elaboration key in the classification of the planktonic species and for phylogenetic studies, making explanation possible about evolutionary strategies for decapods. The culture of larvae in laboratory has, undoubtedly, contributed significantly to obtaining such knowledge (Rice 1980, Marques & Pohle 1996a, b, Pereyra Lago 1987, 1989, 1993). However, despite of the many studies available on reared larvae, many species still remain unknown (Anger 1995).

The family Sesarmidae, proposed by Martin & Davis (2001), has 37 recorded species in which the larval development is studied (Islam *et al*. 2002). However, some species continue with their larval stage unknown. According to Islam *et al*. (2002), the literature has reported an extensive and useful list on larval development, in which five species are present belonging to the genus *Armases*: *A. cinereum* (Bosc, 1802) by Costlow & Bookhout (1960); *A. ricordi* (H. Milne Edwards, 1853) and *A. rubripes* (Rathbun, 1897) both by Diaz & Ewald (1968), *A. angustipes* (Dana, 1852) by Cuesta & Anger (2001) and *A. miersii* (Rathbun, 1897) by Cuesta *et al*. (1999), where their complete larval development is described from larvae reared in the laboratory.

Four species of *Armases* Abele, 1992 are recorded as being inhabited in Brazil: *A. rubripes*, *A. ricordi*, *A. angustipes* and *A. benedicti* (Rodriguez 1980, Melo 1996). The later is a common crab occurring in oligohaline water, living on deed woods and stone in the margin of oligohaline streams on the northeastern coast of the state of Pará and Amapá and it is the only species in which the larval development is still not reported.

The present study provides a detailed description and illustration of zoeal and megalopal stages of *A. benedicti*. A brief comparative study with other species of the genus *Armases* is also provided.



Figures 1-8. *Armases benedicti*: (1) zoea I, lateral view; (2) antennule; (3) antenna; (4) maxillule; (5) maxilla; (6) first maxilliped; (7) second maxilliped; (8) abdomen and telson. Scale bar: 1 = 0.3 mm, 2-5 = 0.075 mm, 6-7 = 0.15 mm, 8 = 0.24 mm.

MATERIAL AND METHODS

Three ovigerous females of *Armases benedicti* were manually collected along the margin of the River Caeté estuary, Bragança City, Pará, and carried to the laboratory. They were carefully washed and conditioned in aquariums (capacity 5 l). Immediately after the hatching, around 600 larvae (200/female) were transferred into three recipients (500 ml) filled with 400 ml of filtered water with constant aeration. The water was monitored daily and salinity of 15 ppt, pH 8.2 and temperature of 27ºC (± 1.5) were maintained constant. The larvae were fed with newly hatched nauplii of *Artemia* Leach, 1819. Microalgae *Thalassiosira* Cleve, 1873 was added to the culture recipients to maintain of the water quality. The numbers of larval stages, survival rate and the intermolting period were monitored carefully during cultivation.

Samples of each larval stage and exuviae were preserved in alcohol 70%+ glycerol (1:1) solution. The samples were dissected using fine needles under an ocular microscope Zeiss Axioskop 40 equipped with an ocular micrometer disc. The carapace length was measured from ocular region to posterior margin of the carapace. At least, 10 larvae and postlarvae were used for illustration and measurements.

The terminology used in the morphological descriptions follows Díaz & Ewald (1968), Bousquette (1980), Pereyra Lago (1987,1989, 1993), Marques & Pohle (1996a, b), Magalhães & Medeiros (1998), Cuesta & Anger (2001), Islam *et al*. (2002, 2004), Guerao *et al*. (2004) and Abrunhosa *et al*. (2005).

RESULTS

The larval development of *A. benedicti* consists of four zoeae and one megalopa. Intense feeding activity and cannibalistic behavior were observed during the zoeal and megalopal

stages. The mean duration for each larval stage was 3, 2, 4, 4 for zoeae and 13 days for megalopa, respectively. The duration of larval period from hatching to first juvenile was 26 days (Tab. I). Appendages and setation evolution of *Armases benedicti* during the zoeal development are shown in the table II. Morphological comparisons among previously described for genus *Armases* (zoea I and megalopa stages) and present study are shown in the tables III, IV, and V, respectively.

Zoea I

Carapace length: 0.26 mm (0.25-0.28 mm).

Carapace (Fig. 1): globose and smooth bearing with one dorsal, one rostral and two lateral spines. Dorsal spine curved downward. Rostral spine straight. Lateral spine small, approximately perpendicular to the carapace measuring about 1/4 of the dorsal spine. Posterior and ventral margins lacking setae. Eyes sessile.

Antennule (Fig. 2): uniramous unsegmented, conical. Exopod with three long aesthetascs and one simple terminal seta.

Antenna (Fig. 3): well-developed, approximately twice the rostral spine length. Protopod a little longer than rostral spine,

Table I. Survival rate, intermolting period and accumulative days for *Armases benedicti* reared in the laboratory.

Larval stage	Intermolting period	Accumulative days	Survival rate (%)
Zoea I	3	3	100
Zoea II	2	5	98
Zoea III	4	9	34
Zoea IV	4	13	12
Megalopa	13	26	2
Juvenile	*	*	1

*) Not recorded.

Table II. Appendages and setation evolution of *Armases benedicti* during the zoeal development. (S) Setation, (A) aesthetascs, (Seg) segment, (Ep) epipod, (Prot.) protopod, (Ex) exopod, (BE) basal endite, (CE) coxal endite, (End) endopod, (Scap) scaphognathite.

Appendages	Zoea I	Zoea II	Zoea III	Zoea IV
Antennule				
A + S	3 + 1	4 + 1	4 + 1	5 + 1
Antenna				
End	absent	small bud	small bud	2- segmented
Maxillule				
Prot - S	absent	1	2	1
End - Seg	2	2	2	2
End - S	1and 4 + 1	1 and 4 + 1	1 and 4 + 1	1 and 4 + 1
CE - S	4 + 1	5 + 1	5 + 1	5 + 1
BE - S	4 + 1	4 + 3	5 + 3	8 + 3
Maxilla				
End - Seg	1	1	1	1
End - S	2+2	2+2	2+2	2+2
CE - S	3 + 4	4 + 4	5 + 3	6 + 3
BE - S	4 + 5	4 + 5	4 + 5	5 + 6
Scap - S	4	5 + 3	13	22
Maxilliped I				
Exop - Seg	2	2	2	2
Ex - S	4	6	8	10
Seg - End	5	5	5	5
End - S	2, 2, 2, 1 e 5	2, 2, 2, 1 e 5	2, 2, 2, 1 e 5	2, 2, 2, 2 e 5
Maxilliped II				
Seg - Exop	2	2	2	2
Exop - S	4	6	8	10
Seg - End	3	3	3	3
End - S	0, 1, 6	0, 1, 6	0, 1, 5	0, 1, 6
Maxilliped III	minute bud	small bud	endopod e exopod differentiated	End. e Ex. completely differentiated
Pereiopods	minute bud	minute bud	Segmented	cheliped chelated
Pleopods	absent	absent	minute bud	endopod bud present
Abdomen	5 somites	5 somites	6 somites	6 somites

Table III. Morphological comparisons among previously described for *Armases* zoea I and present study. Data were obtained from previous descriptions, illustrations, and present study. (S) Setation, (A) aesthetascs, (Ba) basipod, (Seg) segment, (Ex) exopod, (BE) basal endite, (CE) coxal endite, (End) endopod, (Scap) scaphognathite, (Sp) spines, (nd) no data.

Appendages	*A. rubripes* (1)	*A. ricordi* (2)	*A. miersii* (3)	*A. cinereum* (4)	*A. angustipes* (1)	*A. benedicti* (5)
Carapace	present	present	absent	absent	absent	present
Lateral - Sp	as a small protuberance	as a small protuberance				as a small spine
Antennule - S	3A, 1S	3A, 2S	3A, 2S	3A, 2S	3A, 2S	3A, 1S
Antenna						
Prot - Sp	1 rows	2 rows	2 rows	1 rows	2 rows	2 rows
EX - S, Sp	2, 1	2, 2	2, 0	2, 0	2, 2	2, 1
Maxillule						
End - S	1, 4+1	1, 4+1	1, 4+1	1, 4+1	1, 4+1	1, 4+1
CE - S	5	5	6	5	6	4+1
BE - S	5	5	5	5	5	4+1
Maxilla						
End - S	2+3	2+3	2+3	2+3	2+3	2+2
CE - S	8	8	8	7	8	7
BE - S	9	9	9	9	9	9
Scap - S	4	4	4	4	4	4
Maxilliped I						
Ba	2,2,3,3	2,2,3,3	2,2,3,3	nd	2,2,3,3	2,2,3,3
Ex - S	4	4	4	4	4	4
End - S	2,2,1,2,5	2,2,1,2,5	2,2,1,2,5	1,1,1,2,4	2,2,1,2,5	2,2,2,1,5
Maxilliped II						
Exop - S	4	4	4	4	4	4
End - S	0,1,6	0,1,6	0,1,6	0,1,6	0,1,6	0,1,6

1) Cuesta & Anger (2001), 2) Díaz &Ewald (1968), 3) Cuesta *et al.* (1999), 4) Costlow & Bookhout (1960), 5) Present work.

Table IV. Summarize of the main morphological characters of megalopa of Sesarmidae, which occur in the Brazilian mangroves.

Species	Font	Antenna segmentation	Maxillule endopod setae	Scaphognathite marginal setae	First maxilliped exopod setae	Pleopods exopod setae
Sesarma rectum	Fransozo & Hebling (1986)	9	1,5 (2-segmented)	33-36	2,6	13,13,13,11,6
S. curacaoense	Anger *et al.* (1995)	9	1,5 (2-segmented)	22	3,5	12,12,12,9,6
Aratus pisonii	Warner (1968)	9	1,5 (2-segmented)	30	no data	13,13,13,10,7
Armases rubripes	Díaz & Ewald (1968)	9	1,5 (2-segmented)	±40	3,4	13,13,13,11,6
A. angustipes	Cuesta & Anger (2001)	9	2,4 (2-segmented)	39	3,4	13,16,17,15,7
A. ricordi	Díaz & Ewald (1968)	9	2,4 (2-segmented)	50	3,4	13,13,13,11,8
A. benedicti	Present study	9	6 (unsegmented)	30-31	3,3	14,13,13,11,6

bearing two rows of small spines. Endopod absent. Exopod with two terminal setae and one small spine.

Maxillule (Fig. 4): endopod 2-segmented, proximal segment with one simple seta and distal segment with one simple setae and four long terminal setae. Basal endite with four plumodenticulate and one simple setae. Coxal endite with 4 + 1 plumodenticulate setae. Protopod absent.

Maxilla (Fig. 5): scaphognathite with four plumose setae and one elongate distal process with microtrichia as illustrated. Endopod unsegmented with 2+2 long plumose setae showing marginal microtrichia. Basal endite with proximal and distal lobes almost fused with 5+4 setae. Coxal endite with proximal and distal lobes fused with 4+3 setae.

First Maxilliped (Fig. 6): basipod with internal margin bearing 2,2,3,3 simple setae. Endopod 5-segmented with 2,2,2,1,4+1 setae, respectively. Exopod 2-segmented, proximal

Table V. Morphological comparison between previously described for *Armases* megalopa and the present study. Data were obtained from previous descriptions, illustrations, and the present study. (S) Setation, (A) aesthetascs, (Ba) basipod, (Seg) segment, (Ex) exopod, (BE) basal endite, (CE) coxal endite, (End) endopod, (Scap) scaphognathite, (Sp) spines, (nd) no data.

Appendages	*A. rubripes* (1)	*A. ricordi* (2)	*A. miersii* (3)	*A. cinereum* (4)	*A. angustipes* (1)	*A. benedicti* (5)
Antennule						
Peduncle - S	3,1,3	3,1,1	5,1,1	3,1,1	4,1,1	0,1,1
Flagelum - A	0,7,5	0,9,5	0,7,6	0,6,5	0,8,5	0,5,4
Antenna						
Peduncle - S	2,1,1	1,1,1	2,1,1	0,0,1	0,1,1	0,1,1
Flagelum - S	0,2,1,4,1,3	0,2,1,5,1,3	0,2,2,5,1,3	0,2,1,2,1,2	0,2,1,5,1,3	0,2,0,3,0,3
Maxillule						
End - S	2,4	2,4	2,4	2,4	3,4	6
CE - S	11	11	12	9	11	11
BE - S	17	18	20	12	15	14-16
Maxilla						
End - S	0	0	1	2,3	1,3	0
CE - S	14	14	15	13	16	14
BE - S	12	12	16	14	15	13
Scap - S	35+5	45+5	33+3	30+0	39+3	35+2
Maxilliped I						
End - S	2	2	2	8	4	2
Ex - S	3,4	3,4	2,3	3,5	3,4	3,3
Maxilliped II						
End - S	0,1,3,6	0,1,3,6	0,1,4,7	0,1,6,6	0,1,4,8	0,1,3,6
Ex - S	1,5	1,5	1,5	0,5	1,6	1,5
Maxilliped III						
End - S	8,9,3,4,7	8,9,4,3,6	10,9,4,4,7	7,6,3,2,5	10,8,3,4,6	7,8,4,4,3
Ex - S	1,5	1,4	1,5	0,5	1,4	0,5

1) Cuesta & Anger (2001), 2) Díaz &Ewald (1968), 3) Cuesta *et al.* (1999), 4) Costlow & Bookhout (1960), 5) Present work.

segment short, distal segment with four plumo-natatory setae.

Second Maxilliped (Fig. 7): basipod with three simple setae. Endopod 3-segmented with 0,1,(5+1) setae, respectively. Exopod 2-segmented, proximal segment short, distal segment with four plumo-natatory setae.

Abdomen (Fig. 8): Five abdominal somites; somites 2 and 3 with a pair of acute dorsolateral spines projecting anteriorly in somite 2. Pleopods absent.

Telson (Fig. 8): articulate with five abdominal somites and bifurcated posteriorly. Posterior margin with six (3+3) setae. Two rows of teeth in inner part of each furcal branch.

Zoea II

Carapace length: 0.33 mm (0.32-0.34 mm).

Carapace (Fig. 9): similar to previous stage. Eyes stalked.

Antennule (Fig. 10): exopod with four long aesthetascs and 1 simple terminal seta.

Antenna (Fig. 11): protopod reaching rostral spine.

Maxillule (Fig. 12): basal endite with 4+3 plumodenticulate setae. Protopod present.

Maxilla (Fig. 13): scaphognathite with 5+3 setae. Coxal endite with proximal and distal lobes partially fused with 4+4 setae.

First Maxilliped (Fig. 14): exopod with distal segment bearing six plumo-natatory setae. Endopod with 2,2,1,2,4+1 simple setae.

Second Maxilliped (Fig. 15): exopod with distal segment bearing six plumo-natatory setae.

Abdomen (Figs 9-16): similar to previous stage.

Telson (Fig. 16): similar to previous stage.

Zoea III

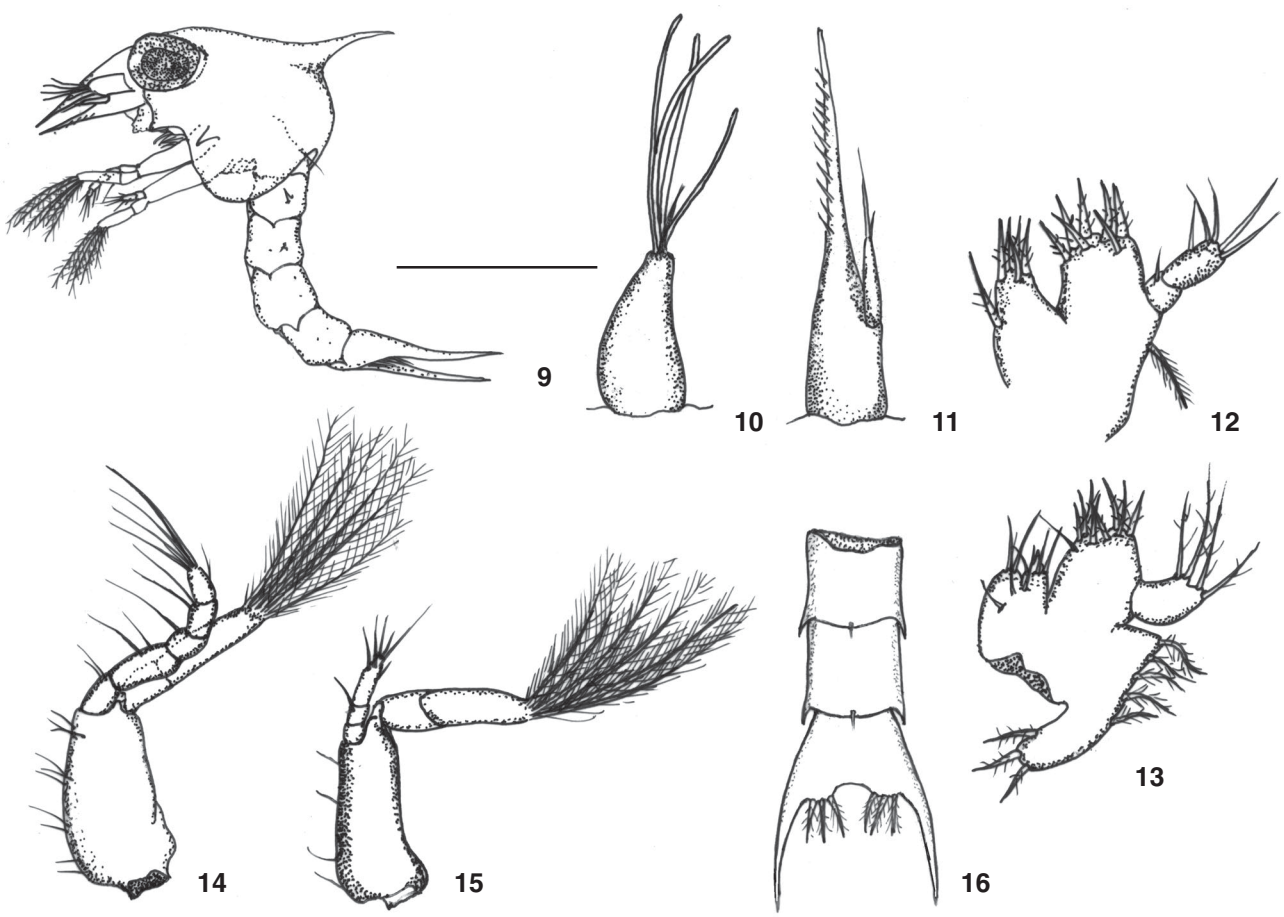
Carapace length: 0.52 mm (0.51-0.53 mm).

Carapace (Fig. 17): similar to previous stage. Eyes stalked.

Antennule (Fig. 18): similar to previous stage.

Antenna (Fig. 19): protopod as illustrated. Endopod bud a little longer than exopod. Exopod similar to previous stage.

Maxillule (Fig. 20): basal endite with six plumodenticulate



Figures 9-16. *Armases benedicti*: (9) zoea II, lateral right view; (10) antennule; (11) antenna; (12) maxillule; (13) maxilla; (14) first maxilliped; (15) second maxilliped; (16) abdomen and telson. Scale bar: 9 = 0.52 mm, 10 = 0.14 mm, 11 = 0.15 mm, 12-13 = 0.16 mm, 14-15 = 0.26 mm, 16 = 0.33 mm.

and (1+1) simple setae. Coxal endite with (5 + 1) and 1 simple seta. Protopod present with two long plumose setae.

Maxilla (Fig. 21): scaphognathite with 13 marginal setae. Basal endite with proximal and distal lobes with four plumodenticulate and five simple setae, respectively. Coxal endite with eight setae and one short spine, as illustrated.

First maxilliped (Fig. 22): exopod with eight plumo-natatory setae.

Second maxilliped (Fig. 23): exopod with eight plumo-natatory setae.

Abdomen (Figs 17-24): showing six abdominal somites.

Pleopods (Fig. 17): buds, present on the second to sixth abdominal somites.

Pereiopods (Fig. 17): present, rudimentary.

Telson (Fig. 24): similar to previous stage.

Zoea IV

Carapace length: 0.62 mm (0.60-0.65 mm).

Carapace (Fig. 25): similar to previous stage. Eyes stalked.

Antennule (Fig. 26): exopod with five long terminal aesthetascs and one simple seta.

Antenna (Fig. 27): protopod almost twice endopod length. Endopod 2-segmented surpassing the tip of distal seta of the exopod.

Maxillule (Fig. 28): basal endite with 9-10 terminal plumodenticulate and one simple basal seta. Protopod with one plumose setae.

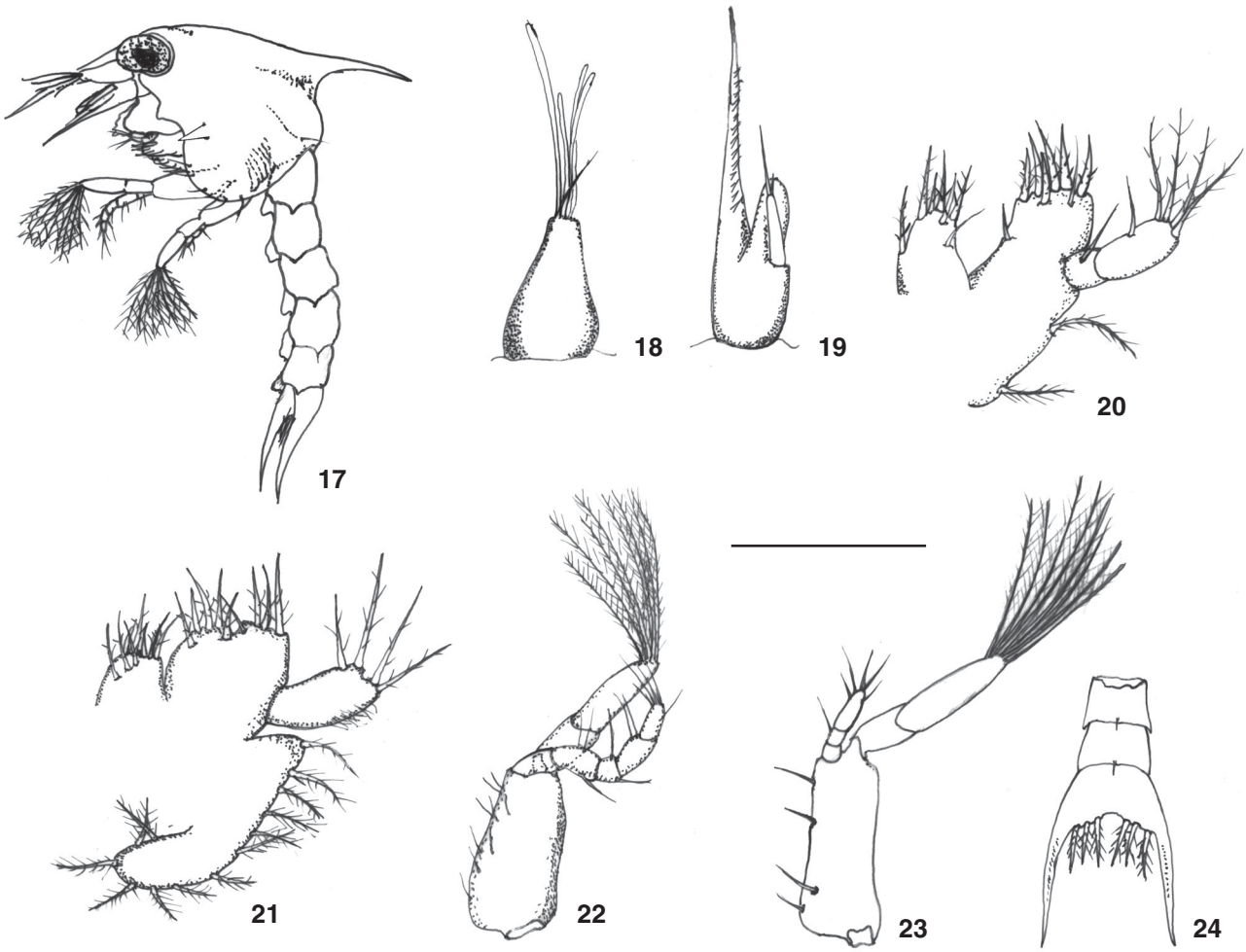
Maxilla (Fig. 29): scaphognathite with 20-22 plumose setae. Basal endite with 5 + 6 setae. Coxal endite with nine setae and one short spine in the distal lobe.

First maxilliped (Fig. 30): exopod with 10 plumo-natatory setae.

Second maxilliped (Fig. 31): exopod with 10 plumo-natatory setae.

Third maxilliped (Fig. 32): bud. Endopod and exopod visible.

Pereiopods (Fig. 25): segmented bud as illustrated.



Figures 17-24. *Armases benedicti*: (17) zoea III, lateral right view; (18) antennule; (19) antenna; (20) maxillule; (21) maxilla; (22) first maxilliped; (23) second maxilliped; (24) abdomen and telson. Scale bar: 17 = 0.65 mm, 18 = 0.18 mm, 19 = 0.18 mm, 20 = 0.20 mm, 21 = 0.21 mm; 22-23 = 0.36 mm; 24 = 0.41 mm.

Pleopods (Fig. 25): more developed compared to previous stage, lacking setae.

Megalopa

Carapace length: 0.73 mm (0.72-0.75 mm).

Carapace (Fig. 34): semi-rectangular with dorsal surface smooth and irregular. Posterior margin with numerous small simple setae. rostrum triangular projecting ventrally. Eyes mobiles and stalked.

Antennule (Fig. 35): peduncle 3-segmented with 0,1,1 setae, respectively. Endopod absent. Exopod 3-segmented with 0,5,4 aesthetascs, respectively, and 0,0,1 small setae.

Antenna (Fig. 36): peduncle 3-segmented having 0,1,1 setae, respectively. Flagellum 6-segmented, surpassing rostrum having 0,2,0,3,0,3 simple setae, respectively.

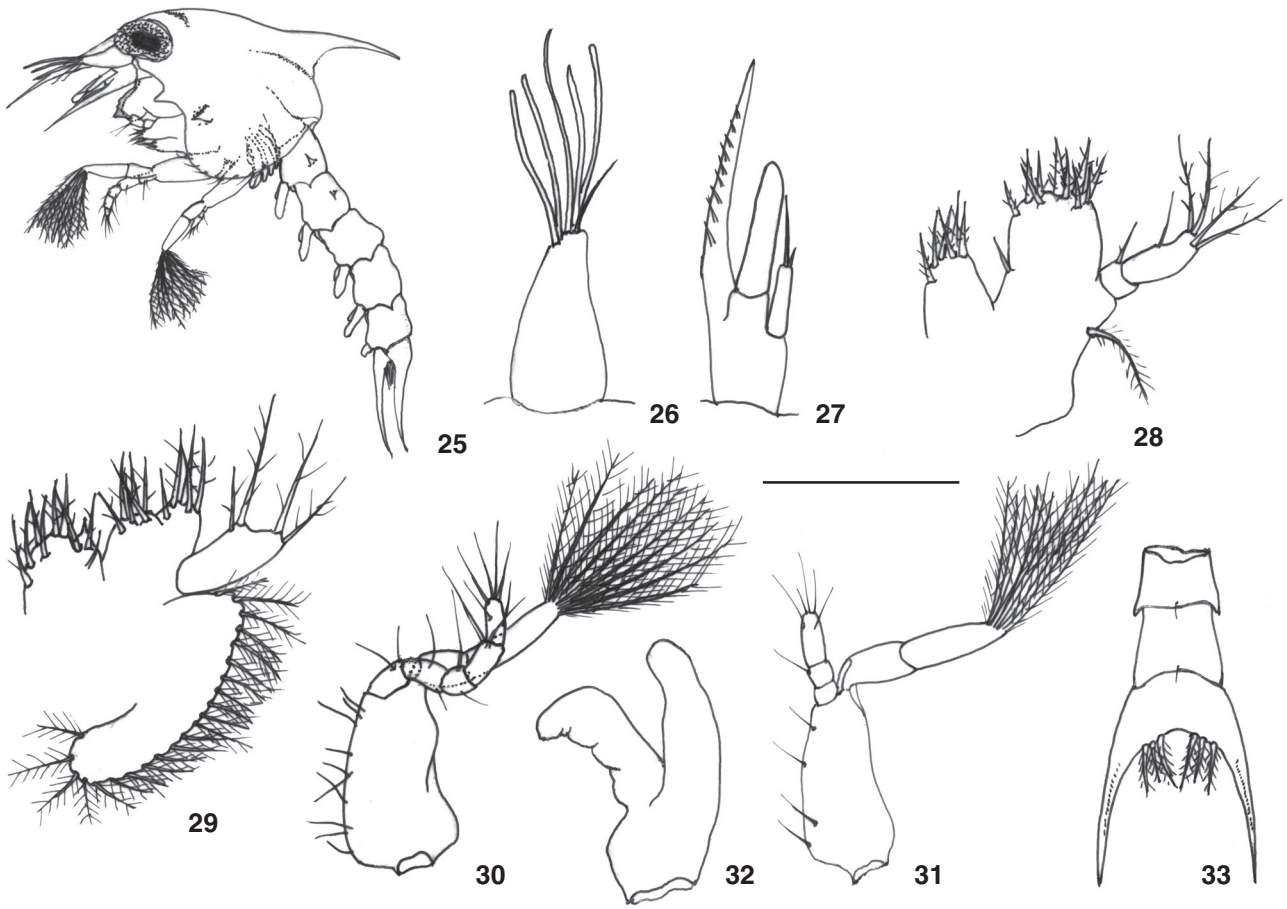
Maxillule (Fig. 37): endopod with three pairs of setae, as illustrated. Basal endite showing 14-16 terminal setae plumodenticulate and two simple basal setae. Coxal endite with 11 plumodenticulate. Protopod present with three long plumose setae.

Maxilla (Fig. 38): scaphognathite with 33-35 plumose setae along anterior margin and two marginal setae. Endopod unsegmented lacking setae and spines. Basal endite with proximal and distal lobes almost fused, proximal lobe with five plumose and one simple seta, distal lobe with seven plumose setae. Coxal endite with proximal and distal lobes fused having 14 setae.

First maxilliped (Fig. 39): basipod not illustrated. Endopod 2-segmented with two simple setae. Exopod 2-segmented, proximal segment with three simple setae in the terminal portion.

Distal segment with three long and plumose setae.

Second maxilliped (Fig. 40): endopod 4-segmented with



Figures 25-33. *Armases benedicti*: (25) zoea IV, lateral view; (26) antennule; (27) antenna; (28) maxillule; (29) maxilla; (30) first maxilliped; (31) second maxilliped; (32) third maxilliped; (33) abdomen and telson. Scale bar: 25 = 0.75 mm, 26 = 0.23 mm, 27 = 0.23 mm, 28 = 0.26 mm, 29 = 0.27 mm, 30-31 = 0.44 mm, 32 = 0.083 mm, 33 = 48 mm.

0, 1, 3, 6 setae, respectively. Exopod 2-segmented, proximal segment with one small median seta, distal segment with five long plumose setae.

Third maxilliped (Fig. 41): endopod 5-segmented, with 8, 8, 4, 3, 4 setae respectively. Exopod 2-segmented, with 4-5 terminal plumose setae.

Abdomen (Figs 52-53): short than carapace showing six abdominal somites. Somite 5 with spine-like posterolateral projections. Somites 2-5 with numerous minute setae.

Pereiopods (Figs 42-46): well developed bearing numerous spaced setae. Dactyl of the fifth pereiopod with three long terminal setae and 1 small terminal spine. Other pereiopods as illustrated.

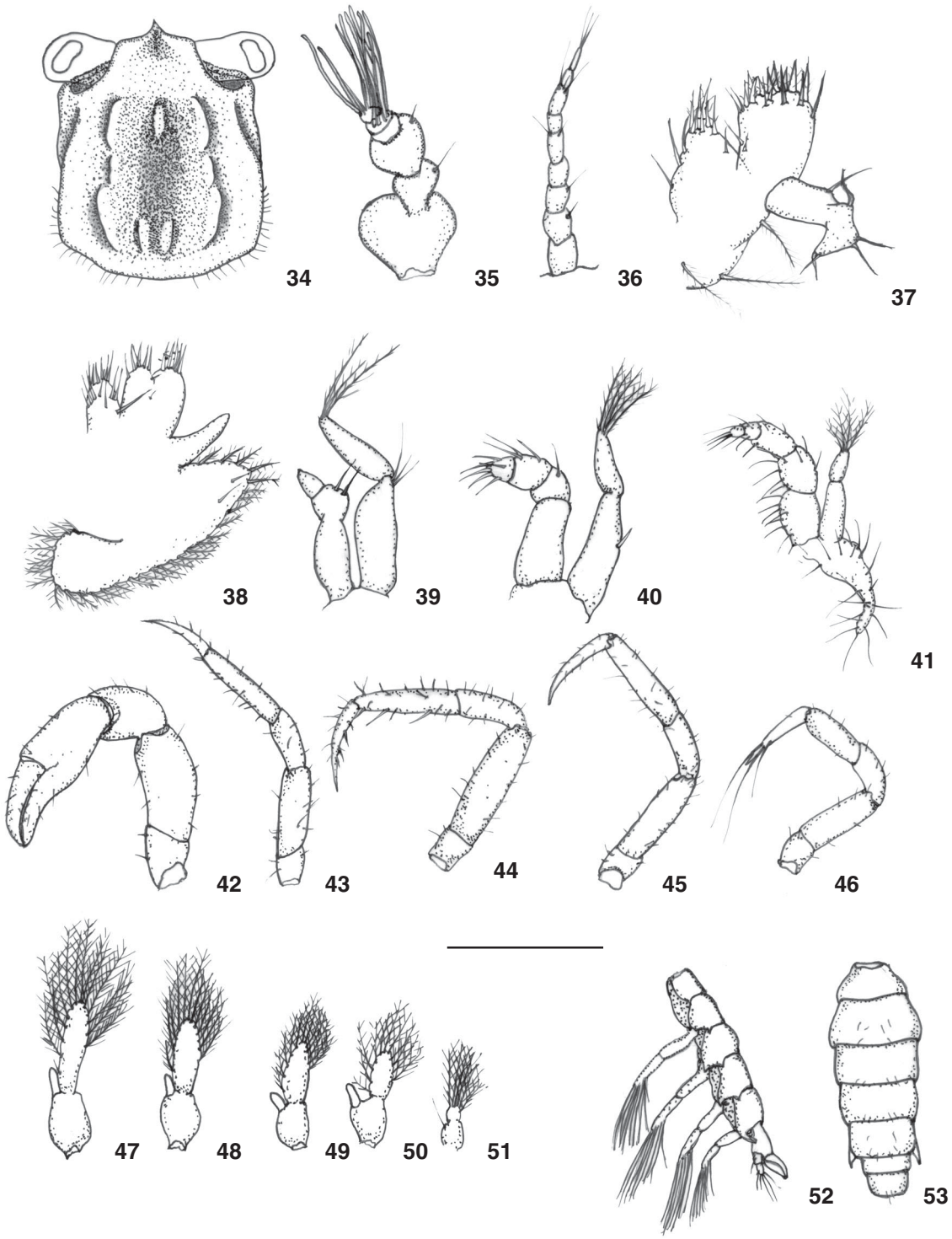
Pleopods (Figs 47-51): endopod of pleopod first to fifth setose, with 13-14, 12-14, 12-13, 11, 6-7 setae, respectively.

Telson (Fig. 53): Posterior margin convex, wider than long, completely articulated with abdomen having two pairs of small setae.

DISCUSSION

Various numbers of larval stages and different developmental durations are observed within the Sesarmidae family, ranging from two to five stages and one megalopa (Islam *et al*. 2002). However, for *Armases* species, including *A. benedicti* of the present study, the larval development is comprised of four zoeal stages before metamorphosis to the megalopal stage: *A. angustipes* (Cuesta & Anger 2001); *A. cinereum* (Costlow & Bookhout 1960); *A. ricordi* and A. *rubripes* (Díaz & Ewald 1968). An exception described by Cuesta *et al*. (1999) occurs in *A. miersii* which shows an abbreviated shortened development, composed only of three larval stages. This zoeal reduction may be considered a phylogenetic advanced type of development (Anger *et al*. 1995).

A morphological difference is observed in the larval stages of Sesarmidae species and *A. benedicti*. This species clearly shows a pair of small lateral spines (about 1/4 of the dorsal spine size). Comparing the first zoeal stages of *A. rubripes, A. ricordi* and *A.*



Figures 34-53. Megalopa of *Armases benedicti*: (34) carapace, dorsal view; (35) antennule; (36) antenna; (37) maxillule; (38) maxilla; (39) first maxilliped; (40) second maxilliped; (41) third maxilliped; (42-46) pereiopods; (47-50) pleopods; (51) uropod; (52) abdomen in straight lateral view; (53) abdomen in dorsal view. Escale bars: 34 = 0.50 mm, 35 = 0.26 mm, 36 = 0.24 mm, 37 = 0.125 mm, 38 = 0.125 mm, 39 = 0.22 mm, 40 = 0.24 mm, 41 = 0.42 mm, 42-45 = 0.46 mm, 47-51 = 0.40 mm, 52-53 = 0.43 mm.

benedicti, a slight similarity can be found mainly in the zoea I, where the lateral spines are not well developed and they are shown in bud form in both species. According to Islam *et al*. (2002) this structure is lacking in larvae of 37 species of Sesarmidae. The absence of lateral spine was also reported for zoeae of the *Parasesarma fasciatum* (Guerao *et al*. 2004) and *Neosarmatium trispinosum* (Islam *et al*. 2004). However, despite the absence of lateral spines, Diaz & Ewald (1968) observed a small protuberance in larvae of *A. rubripes* and *A. ricordi*. Such protuberance may be a remaining characteristic that is preserved in these species.

The summary of the morphological comparisions among previously described species for genus zoea I of genus *Armases* and present study are recorded in the table III. The zoeal setation 2+2 (shown in the table II) of the endopod of the maxilla of *A. benedicti* is not observed in the other species described by Diaz & Ewald (1968) and Cuesta & Anger (2001), in which this structure shows a pattern of 2+3 setae. But, similar features are observed in the *Sesarma* species (Fransozo & Hebling 1986, Anger *et al*. 1995). The number of aesthetascs and setae of the *A. benedicti* antennule are similar to *A. rubripes*, which have three aesthetascs and one simple seta, while *A. angustipes* shows three aesthetascs and two simple setae.

The subfamilies Varuninae-Sesarminae have been divided into two distinct groups according to the presence of the two lateral spines and the setation number of maxilla endopod (Rice 1980). Thus, the genera *Sesarma*, *Aratus*, *Chiromantes* e *Armases* are included in the group, which lacks lateral spines and has (2+3) setae in the endopod of the maxilla. The second group is represented for the genera *Hemigrapsus*, *Chasmagnathus*, *Cyclograpsus*, *Eriocheir* e *Helice* that show lateral spines in the carapace and bear 2+2 setae in the endopod of the maxilla. Following Rice (1980) proposition, *A. benedicti* should be included in the second group because the larvae have clearly showed (despite reduced size), lateral spines and setation 2+2 setae in the maxilla. However, Pereyra Lago (1993) suggests that more characteristics are necessary for a correct division of these sub families. In relation to our species, further filogenetic and/or molecular studies have to be done in order to determine their correct taxonomic position, because the two distinct character may be a homoplasy or *A. benedict* may be placed in an erroneous family.

The megalopa of *A. rubripes, A. angustipes* and *A. benedicti* have shown distinguishable morphological differences. The telson of the *A. rubripes* megalopa described by Díaz & Ewald (1968) is rounded having only one distal seta but in *A. benedicti* this structure is semi-rectangular and has three small setae. However, for *A. angustipes* (Cuesta & Anger 2001), three morphological differences are found in the telson: first, lacking lateral spines and with two long terminal setae and short setae; second, supporting a pair of lateral spines and three similar pairs of setae; third, lateral spines and well developed setae. These morphological variations observed in the telson of *A. angustipes* were not found in any other species of the genus *Armases*.

The endopod of the maxillule in the megalopal stages of genus *Armases* shows 2-segmented, differing from *A. benedicti* that have only a single segment. This characteristic is similar in other species belonging to the genus *Sesarma*: *S. curacaoense* described by Anger *et al*. (1995) and *S. rectum* by Fransozo & Hebling (1986) as showed in table IV. Other important differences can be found in the station of scaphognathite of maxilla in the megalopas of *A. angustipes, A. ricordi*, *A. rubripes* and *A. benedicti* as showed in table V.

ACKNOWLEDGMENTS

To the Institute Millennium and to the project MADAN for the financial resource destined to this research; to the Universidade Federal do Pará and Maria I. Sampaio, Laboratory of Molecular Biology of University campus of Bragança, Pará.

REFERENCES

Abrunhosa, F.; M.A.B. Pires; J.F. Lima, & P.A. Coelho-Filho. 2005. Larval development of *Lepidophthalmus siriboia* Felder & Rodrigues, 1993 (Decapoda: Thalassinidea) from the Amazon region, reared in the laboratory. **Acta Amazonica**, Manaus, **35** (1): 77-84.

Anger, K; D. Schreiber & M. Montú. 1995. Abbreviated larval development of *Sesarma curacaoense* (Rathbun, 1897) (Decapoda: Grapsidae) reared in the laboratory. **Nauplius**, Botucatú, **3**: 127-154.

Bousquette, G.D. 1980. The larval development of *Pinnixa longipes* (Lockington, 1877) (Brachyura: Pinnotheridae), reared in the Laboratory. **Biological Bulletin**, Miami, **159**: 592-605.

Costlow, J.D. & C.G. Bookhout. 1960. The complete larval development of *Sesarma cinereum* (Bosc) reared in the laboratory. **Crustaceana**, Leyden, **4**: 281-294.

Cuesta, J.A. & K. Anger. 2001. Larval morphology of the sesarmid crab *Armases angustipes* Dana, 1852 (Decapoda, Brachyura, Grapsoidea). **Journal of Crustacean Biology**, Kansas, **21** (3): 821-838.

Cuesta, J.A.; M. Schuh; R. Diesel & C.D. Shubart. 1999. Abbreviated development of *Armases miersii*(Grapsidae: Sesarminae), a crab that beeds in supralittoral rock pools. **Journal of Crustacean Biology**, Kansas, **19**: 26-41.

Díaz, H. & J.J. Ewald. 1968. A comparison of the larval development of *Metasearma rubripes* (Rathbun) and *Sesarma ricordi* H. Milne Edwalds (Brachyura, Grapsidae) Reared under similar laboratory conditions. **Crustaceana**, Leyden, (Suppl. 2): 225-248.

Fransozo, A. & N.J. Hebling. 1986. Desenvolvimento larval de *Sesarma* (*Holometopus*) *rectum* Randall, 1840 (Decapoda, Grapsidae), em laboratório. **Revista Brasileira de Biologia**, Rio de Janeiro, **46**: 353-364.

Guerao, G.O.; K. Anger; U.W.E. Nettelmann & C.D. Schubart. 2004. Complete larval and early juvenile development of

the mangrove crab *Perisesarma fasciatum* (Crustacea: Brachyura: Sesarmidae) from Singapore, with a larval comparison of *Parasesarma* and *Perisesarma*. **Journal of Plankton Research**, Oxford, **26** (12): 1389-1408.

Islam, M.S.; M. Aminur Rahman & S. Shigemitsu. 2004. Larval development of the mangrove sesarmid crab *Neosarmatium trispinosum* (Brachyura: Grapsoidea) described from laboratory-reared material. **Journal of Crustacean Biology**, Kansas, **24** (2): 356-371.

Islam, M.S.; S. Shokita & N. Shikatani. 2002. Larval development of the mangrove sesarmid crab *Neosarmatium indicum* (Brachyura: Grapsoidea) described from laboratory-reared material. **Journal of Crustacean Biology**, Kansas, **22**: 916-937.

Magalhães, C. & N. Medeiros. 1998. The larval Development of Palaemonid shrimps from the Amazon Region reared in the Laboratory. VII. Abbreviated development of *Pseudopalaemon amazonensis* Ramos-Porto, 1979 (Crustacea: Decapoda: Caridea). **Acta Amazônica**, Manaus **28** (4): 433-448.

Marques, F. & G. Pohle. 1996a. Laboratory-reared larval stages of *Dissodactylus mellitae* (Decapoda: Brachyura: Pinnotheridae) and developmental patterns within the *Dissodactylus* species complex. **Canadian Journal of Zoology**, Ottawa, **74**: 47-62.

Marques, F. & G. Pohle. 1996b. Complete Larval Development of *Clypeasterophilus stebbing* (Decapoda: Brachyura: Pinnotheridae) and a comparison with other species within the *Dissodactylus* complex. **Bulletin of Marine Science**, Miami, **58** (1): 165-185.

Martin, J.W. & G.E. Davis. 2001. An updated classification of the Recent Crustacea. **Natural History Museum of Los Angeles County Science Series**, Los Angeles, **39**: 1-124.

Melo, G.A.S. 1996. **Manual de identificação dos Brachyura (caranguejos e siris) do litoral brasileiro.** São Paulo, Editora Plêiade, FAPESP, 603p.

Pereyra Lago, R. 1987. Larval development of *Sesarma catenata* Ortmann (Brachyura: Grapsidae: Sesarminae) reared in the laboratory. **South African Journal of Zoology**, Transkei, **22**(3): 200-212.

Pereyra Lago, R. 1989. The larval development of the red mangrove *Sesarma meinerti* Ortmann (Brachyura: Grapsidae) reared in the laboratory. **South African Journal of Zoology**, Transkei, **24** (3): 199-211.

Pereyra Lago, R. 1993. Larval development of *Sesarma guttatum* A. Milne Edwards (Decapoda: Brachyura: Grapsidae) reared in the laboratory, with comments on larval generic and familial characters. **Journal of Crustacean Biology**, Kansas, **24** (3): 199-211.

Rice, A.L. 1980. Crab zoeal morphology and its bearing on the Classification of Brachyura. **Transactions of The Zoological Society of London 35**: 271-424.

Rodriguez, G. 1980. **Los Crustaceos Decapodos de Venezuela.** Caracas, Instituto Nacional de Invertigaciones Científicas, 494p.

Received in 14.VII.2005; accepted in 05.V.2006.