

**POST- NAUPLIAR STAGES OF "*ACARTIA (ACARTIELLA)*
FAOENSIS" , KHALAF (COPEPODA : CALANOIDA) , FROM KHOR
AL-ZUBAIR SOUTH OF IRAQ**

TALIB A. KHALAF

*Maine Biology Department, Marine Science Centre
University of Basrah, Basrah, Iraq*

ABSTRACT

Acartia (Acartiella) faoensis has been established by the author, (Khalaf, 1991) from Khor Al-Zubair and Khor Abdulla NW Arabian Gulf. It passes through six copepodite stages identical with most other copepods; the last stage is the adult. Description, illustration and measurements for every stage are presented.

INTRODUCTION

Acartia (Acartiella) faoensis is a calanoid copepod from the family Acartiidae. It was described as a new species, (Khalaf, 1991) from the surface water of Khor Al-Zubair and Khor Abdulla, NW Arabian Gulf. The author has reported also 23 species of calanoid, cyclopoid and harpacticoid copepods new to the Iraqi marine and brackish water environment, (Khalaf, 1988 ; 1992 ; 1994).

Khor Al-Zubair is considered as a marine arm extends for about 40 km. The surface area is almost 60 km². It is 1 to 2 km wide during high tide with a depth of about 10 to 20 m. (AL-Ramadhan, 1986). It joins Khor Abdulla and then the Arabian Gulf from the South, Shatt Al-Basrah canal and then the Shatt Al-Arab river from the North (Fig.1). Water temperature of Khor Al-Zubair is fluctuated between 11-29.5°C and it is oligohaline to mesohaline brackish water, because it is affected by fresh water coming from Shatt Al-Basrah canal. The salinity values ranged between 25.4-33.5‰ (Ajeel, 1990). The abundance of *A. (A.) faoensis* in Khor Al-Zubair waters was ranging between 2 and 854 ind/m³ during February and April 1990, respectively, and these figures decreased toward Khor Abdulla (Ajeel & Khalaf, 1995).

The present study is aiming to describe the copepodite stages of *A. (A.) faoensis* for the first time as it is one of mostly dominant species in Iraqi brackish water of Khor Al-Zubair canal, so it must be playing a great nutritional role in the food chain of the region and hence it is important for aquaculture processes and aqua-culturist to know the life history of this species.

MATERIALS AND METHODS

Plankton samples were collected from the surface layer of Khor Al-Zubair waters (Fig.1) at the peak production period of *A. (A.) faoesnsi*, which is defined previously from mid February to the end of March (Ajeel & Khalaf, 1995), by using of 0.09 mesh sized plankton net of mouth aperture of 40 cm. in diameter. Sampling was carried out through March 2006 at very short intervals of time (3-5 days), starting from 1st. to 15th. of March 2006, to insure that all copepodite stages are contained in the sample. Samples were fixed with 4-6% formaldehyde solution depending on its density. Specimens of all copepodite stages were isolated in different vials, one for each stage. Specimens were dissected in a drop of lacto-phenyl alcohol solution by using dissecting microscope type "Olympus", and mounted on slides with cover slips.

All drawings were made by using compound microscope, type "Zeiss" with the aid of camera Lucida. Total lengths were measured, all mouth parts, thoracic

appendages, prosome segments, urosome segments and furcal rami as well as furcal setae developments were illustrated and described.

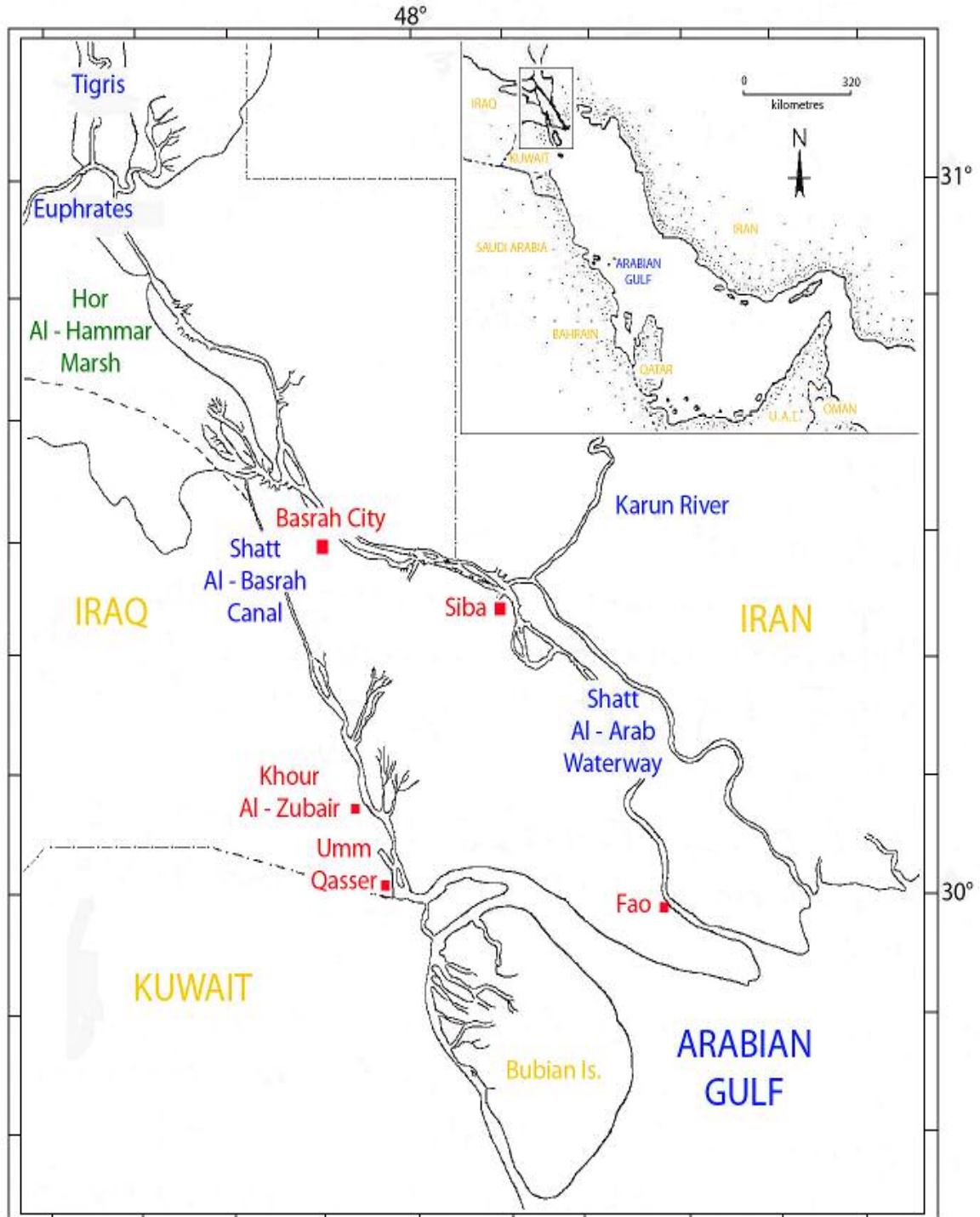


Fig. 1 . Map of sampling station

DESCRIPTION

Sexual differences first appear in copepodite stage IV in the form of a 5th pair of legs which is symmetrical in female and asymmetrical in male. Duration of time from hatching to adult stage was about 20 days for females and 19.5 for males (Ajeel & Khalaf, 1995).

COPEPODITE STAGE I

Body (Fig. 2) 0.38 mm (0.34 – 0.42) in average length. Anterior end of head rounded in shape. Thorax composed of 3 segments, first 2 each provided with a pair of swimming legs. Abdomen 1-segmented, caudal rami asymmetrical each ramus bearing 3 long and a very short setae .

Antennule (Fig. 8) . 10-segmented . Antenna (Fig 13). Coxa with a seta; basipodite with 3 setae, 2 of them on the proximal part and one on the distal part, endopod 1-segmented bearing 4 terminal and one medial seta, exopod one-segmented with 7 terminal setae.

Mandible(Fig.14).Coxa with one distal seta and mandibular blade (gnathobase) with 2 distinct and 1 small indistinct teeth; basipod with 2 small setae, endopod 1-segmented with 2 inner sub-terminal and 3 terminal setae; exopod indistinctly 2-segmented, first segment larger with one distal seta, and the second smaller with 4 terminal setae.

Maxillule (Fig. 15). First inner lobe or gnathobase with 5 spines; second inner lobe with 2 setae; outer lobe or epipodite with 4 long setae; exopodite with 2 long and one smaller setae; endopodite rudimentary with one seta. A small marginal seta arising between epipodite and exopodite.

Maxilla(Fig.16).Uniramous. Basipodite with 2 small proximal setae and indistinctly 3 endites, 1st. and 2nd. each with 2 setae, 3rd with one seta; endopodite indistinctly segmented with a total of 3 setae.

Maxillipede . Very small.

Swimming legs. 1st. leg (Fig.35). Both coxa and basipodite with no setae; endopodite of a single segment with 4 setae;exopodite 2-segmented, 2nd. segment with 2 outer spines, larger terminal and smaller sub-terminal in addition to 4 terminal and 1 sub-terminal setae.

2nd. leg (Fig. 36) Both coxa and basipodite with no setae; endopodite 1-segmented with 4 setae ; exopodite of 2 segments, 1st without spines and setae, 2nd. with one outer small spine and 4 terminal setae.

COPEPODITE STAGE II

Body (Fig.3)0.54mm (0.51- 0.57mm) in average length. Thorax composed of 4 segments, first three each possessing a swimming legs. Abdomen of 2 segments. Caudal rami as in stage I, but a short seta arising on the outer side little longer.

Antennule (Fig. 9). 14-segmented.

Antenna (Fig. 17). Same as in stage I, but endopodite with an additional seta in terminal group.

Mandible (Fig. 18). Same as in stage I, but mandibular blade with 3 distinct teeth

Maxillule (Fig. 19). Same as in stage one I, but the small third seta on exopodite becoming of the same size as the other two setae, in addition to the spines of gnathobase and setae groups of all lobes becoming larger in sizes .

Maxilla (Fig. 20). Same as in stage I, but small proximal setae of basipodite becoming larger and 1st endite with 3 setae.

Maxillipede endistinguished .

1st leg (Fig. 37). Same as in stage I, but 2nd. exopodite segment with 3 terminal, 2 sub-terminal setae; and outer spines becoming larger.

2nd leg (Fig. 38). Same as in stage I, but 1st. exopodite segment with 1 small outer spine and 2nd. exopodite segment with additional lateral inner seta.

3rd leg (Fig.39). Both coxa and basipodite without setae, endopodite 1-

segmented with 4 setae; exopodite 2-segmented, 1st segment with one small outer spine, 2nd with one outer spine and 4 setae.

COPEPODITE STAGE III

Body (Fig. 4) 0.65 mm (0.62 – 0.68 mm) in average length. Prosome length 0.46 mm (0.43 – 0.49 mm). Thorax composed of 4 segments, each provided with a swimming leg. Abdomen of 2 segments. Caudal rami as in stage II, but with an additional small outer caudal seta for each ramus.

Antennule (Fig.10). 19 – segmented.

Antenna. (Fig.21). Same as in stage II.

Mandible.(Fig.22). Same as in stage II, but outer larger spine of gnathobase sharply more projected.

Maxillule. (Fig.23). Same as in stage II, but outer lobe or epipodite with 5 long setae.

Maxilla (Fig. 24). Same as in stage II.

Maxilliped. very small.

1st swimming leg. (Fig. 40). Same as in stage II, but endopodite of 2 segments, 1st segment with 1 seta and 2nd with 5 setae; outer spines of 2nd exopodite segment becoming larger than in stage II.

2nd swimming leg (Fig.41). Same as in stage II, but endopodite of 2 segments, 1st with 1 seta, 2nd with 4 seta.

3rd swimming leg (Fig. 42). Same as in stage II, but endopodite of 2 segments, 1st segment with 1 seta and 2nd segment with 5 setae; 3rd exopodite segment with 6 setae.

4th swimming leg (Fig. 43). Both coxa and basipodite without setae; endopodite of 2 segments, 1st with 1 seta, 2nd with 5 setae; exopodite of 2 segments, 1st with no spine or setae, 2nd with 1 small outer spine and 5 setae.

COPEPODITE STAGE IV

Body (Fig. 5) 0.75 mm (0.72 – 0.78 mm) in average length in female, 0.70 mm (0.68 – 0.72 mm) in male. Thorax composed of 4 segments, thoracic segments 4 and 5 are fused, segments 1-3

each with a pair of swimming legs, while 4th segment with 2 pairs of swimming legs. Abdomen with 3 segments. Caudal rami with 4 long setae and a short lateral one.

Antennule (Fig. 11). 21-segmented.

Antenna(Fig.25). Same as in stage III.

Mandible (Fig. 26). Same as in stage III, but mandibular blade with 3 small distinct teeth and one strong spine.

Maxillule (Fig. 27). Same as in stage III, but epipodite with 6 long setae and smaller one, 1st inner lobe or gnathobase with 6 serrated spines.

Maxilla (Fig. 28). Same as in stage III, but 2nd endite with an additional smaller seta

Maxillipede (Fig.29). Biramous, coxa without spines and setae, basipodite with one long proximal seta, endopodite 2-segmented, 1st with one small seta and stiff hairs along distal inner margin, 2nd segment with 2 small lateral and one strong curved terminal spines. Exopodite of 1 segment with 1 small lateral and other longer terminal setae.

1st swimming leg (Fig. 44). Same as in stage III, but 1st endopodite segment with 2 setae, and 2nd segment with 6 setae.

2nd swimming leg (Fig. 45). Same as in stage III.

3rd swimming leg (Fig. 46). Same as in stage III.

4th swimming leg (Fig. 47). Same as in stage III.

5th swimming leg (Fig. 48). Legs of female symmetrical; coxa without seta, basis with one small outer seta; both legs without endopodite; exopodite of one segment of 2 unequal terminal spines.

COPEPODITE STAGE V

Body (Fig. 6) 0.84 mm (0.82 – 0.86 mm) in average length in female, 0.8 mm (0.78–0.82 mm) in male. Sexes easily recognizable by 5th. pair of swimming legs and urosome. Thorax of male and female composed of 4 separated segments, 4th and 5th thoracic segments are fused to carry 2 pairs of swimming legs, while

thoracic segments 1-3 carrying 1 pair of swimming legs each. Abdomen of 5 segments in male and 3 segments in female. Caudal rami asymmetrical in both sexes with 5 long and 1 short setae.

Antennule (Fig. 12) of 22 separate segments = 24 segments, segments 2-4 are fused. In adults antennule, segments 2-5 are fused (Khalaf, 1991).

Antenna (Fig.30). Same as in stage IV .

Mandible (Fig. 31). Same as in stage V, but mandibular blade with three distinct teeth and stronger outer curved spine.

Maxillule (Fig. 32). Same as in stage IV, but 1st inner lobe or gnathobase with 7 serrated spines.

Maxilla (Fig. 33). Same as in stage IV, but basipodite with 2 additional small setae.

Maxillipede (Fig.34). Same as in stage IV, but endopodite 2nd segment with an additional spine and terminal curved spine being stronger and larger .

1st swimming leg (Fig.49). Coxa and basipodite as in stage IV, exopodite of 3 segments, 1st segment without seta and spine, 2nd segment with 1 inner seta, 3rd as long as second segment with 2 outer spines and 5 setae; endopodite same as in stage IV

2nd swimming leg. (Fig. 50). Coxa and basis same as in stage IV; exopodite of 3 segments, 1st segment with an outer spine, 2nd segment with 1 inner seta, 3rd with one outer small spine and 5 setae; endopodite same as in stage IV, but 2nd segment with 5 setae.

3rd swimming leg (Fig. 51). Coxa and basis same as in stage IV; exopodite of

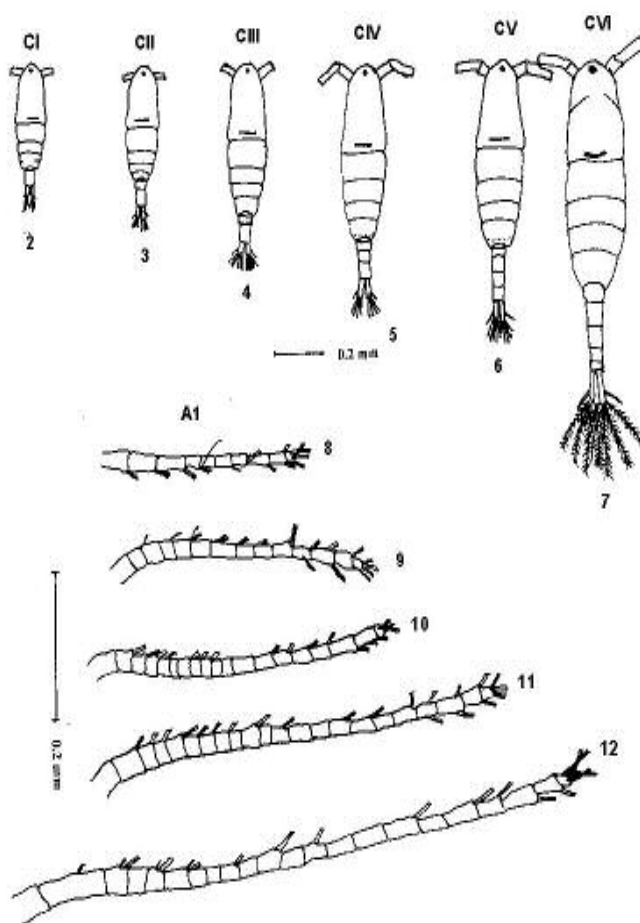
3 segments, 1st with 1 inner seta and outer small spine, 2nd with 1 inner seta, 3rd with one outer small spine and 5 setae; endopodite same as in stage IV.

4th swimming leg (Fig. 52). Coxa and basis same as in stage IV ; exopodite of 3 segments, 1st with an outer spine and inner seta, 2nd with 1 seta, 3rd with one outer small spine and 5 setae; endopodite of 2 segments, 1st with 1 seta , 2nd with 6 setae .

5th swimming leg (Fig.53 for female; Fig. 54 for male). Legs of female symmetrical, coxa same as in stage IV, but basis with longer seta; exopodite of longer apical spine; endopodite of 1 small segment carrying an apical small spine. Legs of male asymmetrical. Right leg larger than the left, coxa without spine and seta, basis with one long distal seta; exopodite of 2 segments, 1st with 1 outer small spine, 2nd segment of same size as 1st carrying 2 unequal apical spines. Left leg, basis as half as that of right leg with small outer seta; exopodite of 2 segments, 1st without spine or seta, 2nd with an apical small spine .

DESCUSSION

Naupliar and copepodite stages of *Acartia (Acartiella) faoensis* are easily recognizable from all other naupliar and copepodite stages of another species in plankton samples by the presence of a pattern of pigmentation in thoracic segment of Mx2 in a form of violet transverse thick line similar to that of adults of *A.(A.) faoensis*. Antennule, segments 2-4 and 2-5 are fused in copepodite stages IV and V respectively as in adult (Khalaf, 1991).

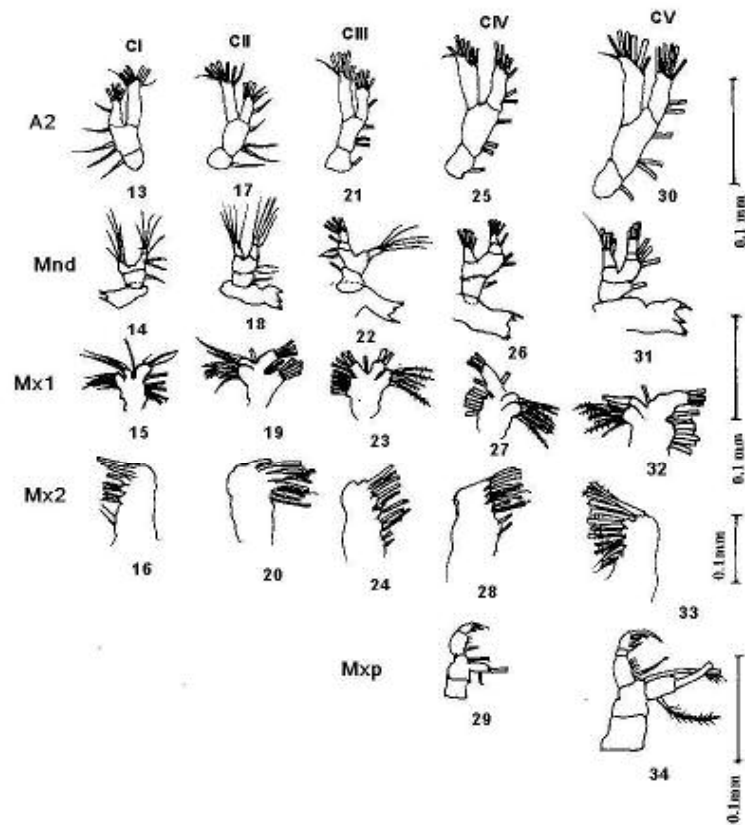


Figs. 2-12 . *Acartia (Acartiella) faoensis* Khalaf 1991 . figs. 2-6 (CI- CV) dorsal view ; fig. 7, CVI = adult male, dorsal view; figs. 8-12, A1 of CI-CV.

Abbreviations:

CI-CVI = 1st - 6th. Copepodite stages

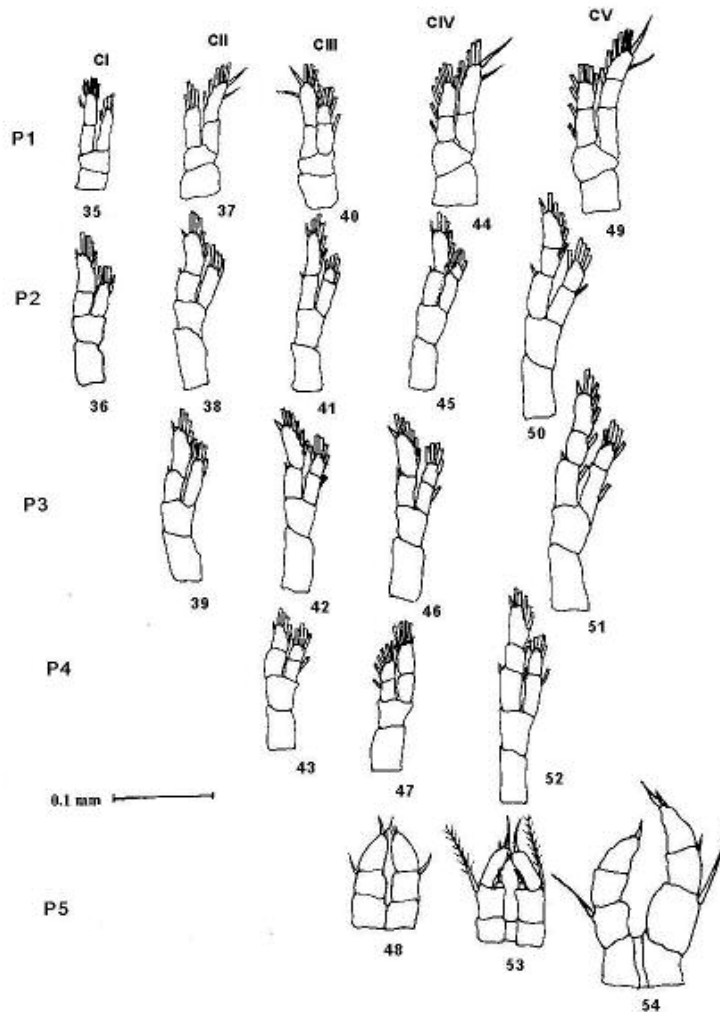
A1 = Antennule



Figs. 13-34, *Acartia (Acartiella) faoensis* Khalaf 1991 ; Figs. 13,17,21,25,30 A2 Of CI-CV ; Figs.14,18,22,26,31, Mnd of CI-CV; Figs.15,19, 23, 27, 32, Mx1 Of CI-CV; Figs. 16, 20, 24, 28, 33, Mx2 of CI-CV; Figs. 29, 34, Mxp CIV, CV

Abbreviations :

- A2 = Antennae
- Mnd = Mandible
- Mx1 = Maxillule
- Mx2 = Maxilla
- Mxp = Maxilliped



Figs. 35-54. *Acartia (Acartiella) faoensis* Khalaf 1991; figs. 35,37,40, 44, 49 , P1 of CI-CV; figs. 36, 38, 41, 45, 50, P2 of CI-CV; figs. 39, 42, 46, 51, P3 of CII-CV; figs. 43, 47, 52, P4 of CIII-CV; figs. 48, 53 , P5 of CIV and CV female, respectively; fig. 54, P5 of male .

Abbreviations : P1-P5 = 1st. - 5th. pairs of swimming legs

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وصف الأطوار اليرقية بعد النابولية للنوع *Acartia* (*Acartiella*) *faoensis* خلف (Calanoida : Copepoda) من منطقة خور الزبير جنوب العراق

طالب عباس خلف

قسم الأحياء البحرية ، مركز علوم لبحار، جامعة البصرة

الخلاصة

تم وصف الأطوار اليرقية الكوبيبودايتية بشكل تفصيلي ولأول مرة للنوع *Acartia* (*Acartiella*) *faoensis* الذي سجل من قبل المؤلف نفسه عام 1991 من مياه خور الزبير وخور عبدالله . جمعت عينات الهائمات الحيوانية الحاوية على الأطوار اليرقية للنوع أعلاه في فترة الذروة لتكاثر هذا النوع ابتداءً من 1 آذار إلى 15 من نفس الشهر 2006 بفترات متقاربة (2-5 أيام) للتأكد من الحصول على جميع الأطوار اليرقية ضمن العينات المجموعة ، وقد تم فصل الأطوار اليرقية الكوبيبودايتية (1-5) في قوارير صغيرة . المرحلة السادسة عبارة عن طور البلوغ كما هو الحال لجميع أفراد مجدافية الأقدام ، من ثم أخذ قياساتها وتشريحها تحت المجهر التشريحي نوع (Olympus) ثم رسم جميع تفاصيلها تحت المجهر المركب نوع (Zeiss) بمساعدة كاميرا لوسيدا . ومما ساعد في تحديد الأطوار اليرقية لهذا النوع عن الأطوار اليرقية لغيره من الأنواع هو وجود الصبغة البنفسجية على المنطقة الظهرية مقابل زوج الفكوك المساعد الثاني (Mx2) . أهمية هذا العمل تكمن في التوصل الى تحديد الأطوار اليرقية بسهولة مستقبلاً نظراً لأهمية هذا النوع في المياه العراقية حيث انه من الأنواع السائدة ضمن الهائمات الحيوانية عموماً ومجموعة مجدافية الأقدام خصوصاً .