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**Record of two *Anuretes* species (Copepoda: Siphonostomatoida)
from fishes of the Arab Gulf, off Iraq**

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Abstract: Two species of the genus *Anuretes*: *Anuretes anomalus* Pillai, 1967 and *A. branchialis* Rangnekar, 1953 were recorded from gills of *Diagramma pictum* (Thunberg, 1792) and *Platax teira* (Forsskål, 1775), respectively. Fishes were caught off coast of Iraq during the period from January 2011 till April 2012. Illustrated descriptions of both parasites have been given. The prevalence and mean intensity of infection were 58.3% and 7.3, for *A. anomalus* and 24.6% and 4.2, for *A. branchialis*.

Key words: Fish, *Diagramma*, *Platax*, Parasites, Caligidae, *Anuretes*.

Introduction

Longfin batfish *Platax teira* (Forsskål, 1775) is a member of the family Ehippidae, an inshore species distributed in the waters of Indo-Pacific region (Bilecenoglu and Kaya, 2006). It has minor commercial importance as a food fish (Golani *et al.*, 2011), but it is a valuable aquarium fish (Froese and Pauly, 2017). Painted sweetlip *Diagramma pictum* (Thunberg, 1792) also has a minor commercial importance as food fish. However, some individuals of this fish are marketed daily in Basrah fish markets mixed with other commercial fishes. According to Froese and Pauly (2017), it is more or less a public aquarium fish, as its size is far too large. This two hosts are common in the Arab Gulf (Carpenter *et al.*, 1997), but still have not so far examined for copepod parasites except the study of Ho and Sey (1996), who reported *Anuretes yamagutii* Prabha & Pillai, 1986 (= *A. anomalus*) from *D. pictum*.

The genus *Anuretes* was established by Heller in 1985 to accommodate species in the family Caligidae, that lack a well-defined abdomen and without lunnules on the paired frontal plates (Venmathi Maran *et al.*, 2008). According to Walter and Boxshall (2017), the genus *Anuretes* includes 19 valid species.

A significant parasitic problem has been consistently observed in marine and brackish waters fish culture throughout the world, which is the infestation with copepods belonging to the family Caligidae, because of their impact as disease cause agents (Cruz-Lacierda *et al.*, 2011). The present study is dealing with the records of two sea lice which may threat the future projects of aquaculture in the Arab Gulf.

Materials and methods

Fish samples were irregularly collected during the period from January 2011 till April 2012 from the north west of the Arab Gulf (48° 44' to 48° 46' N; 29° 46' to 29° 47' E). A total of 57 *Diagramma pictum* ranged from 9.7-32.0 cm in total length, and seven *Platax teira* were caught by a trawl net. Fishes were isolated in a plastic bag and kept on ice in thermal proof box (Plumb and Bowser, 1983; Carvajal *et al.*, 1998). Then, fish samples were examined in the laboratory as soon as possible. The gills were separated in petri dishes with a small amount of tap water and examined under Meiji dissecting microscope (7-28X). The copepods were isolated, kept in watch glasses filled with 5% aquatic solution of sodium hypochlorite, in order to be washed and cleared from attached mucus and debris (Price, 1966; Khamees, 1996). Parasite specimens were preserved in 70% ethanol. Copepods were cleared in 85% lactic acid and examined microscopically using Humes and Gooding (1964) modified glass-slide method (Adday, 2013) under different magnifications. Appropriate measurements and illustrations were made with the aid of calibrated ocular micrometer and camera lucida respectively. All measurements and scale bars are in mm.

Anuretes anomalus Pillai, 1967

Fifty-nine parasitic adult females were found attached on gills of 14 *D. pictum*. These fishes were 17.5-27.7 cm in length while the remaining specimens (9.7-32.0 cm in length) were not infested (prevalence of infestation was 24.6 % and mean intensity of infection was 4.2). The following description and measurements were based on nine females. One voucher specimen of this parasite was deposited in the Natural History Museum, London U.K. (NHMUK 2013.54-55).

Body (Fig. 1A) 1.14 (0.92-1.30) long excluding setae of the caudal rami. Cephalothorax slightly longer than wide, 0.72 (0.57-0.88) x 0.62 (0.43 -0.65), partially

covered by free posterior margin of cephalothorax. Genital complex slightly wider than long, 0.35 (0.26-0.42) x 0.47 (0.42-0.56). Abdomen (Figs. 1 A, 1B) reduced, represented by small bilobate anal somite at the end of the genital complex. Caudal ramus (Fig. 1B) slightly wider than long, 0.07 (0.06-0.08) x 0.08 (0.07-0.09) carrying three short and three long plumose setae.

Egg sac 0.5 (0.33-0.93) long, containing 7 (3-12) eggs. Antennule (Fig. 1C) two-segmented, the basal segment, stout armed with 16 sub marginal, ventral short setae. Distal segment cylindrical with 11 un-plumose setae plus aesthetic on distal margin. Antenna (Fig. 1D) three-segmented, proximal segment smallest with pointed process, second segment unarmed, third segment long, cylindrical, bearing two basal setae and another seta on the middle. The distal portion of this segment represents pointed bent claw. Postantennal process (Fig. 1E) represents pointed, slightly bent claw bearing three basal papillae each with four setules, and another nearby similar papilla. Mandible (Fig. 1F), two subequal segments, with 11 teeth on inner margin of distal blade. Maxillule (Fig. 1G), short, triangular and pointed process, with one basal papilla bearing one long and two short setae. Maxilla (Figs. 1H, 1I) two segmented, proximal segment (lacertus) large and unarmed, distal segment (brachium) carrying hyaline membrane on outer edge and two elements (calamus and canna) terminally. maxillary whip (Fig. 1J) long slightly bent located posterolaterally to maxilla. Maxilliped (Fig. 1K) three-segmented, proximal segment (corpus) large and unarmed, middle and distal segments fused to form strong, sharply pointed claw with medial seta. Sternal furca (Fig. 1L) has a broad base with two diverging rami apically rounded.

Armature on rami of legs 1-4 as follows (Roman numeral indicating spines and Arabic numeral indicating setae):

	Exopod	Endopod
Leg 1	I-0; III,1,3	vestigial
Leg 2	I-1; I,1; II,1,5	0-1; 0-2; 6
Leg 3	I-0; 9	0-0; 6
Leg 4	I-0; III	missing

Leg 1 (Fig. 1M) protopod with long outer seta and another short inner (posterior) seta, endopod vestigial. First segment of exopod long with row of setules on posterior edge. Three inner setae on last segment of exopod (Figs. 1M, 1N) tipped with accessory claw-like process. Leg 2 (Fig. 1O), coxa small with large, inner, long and plumose seta.

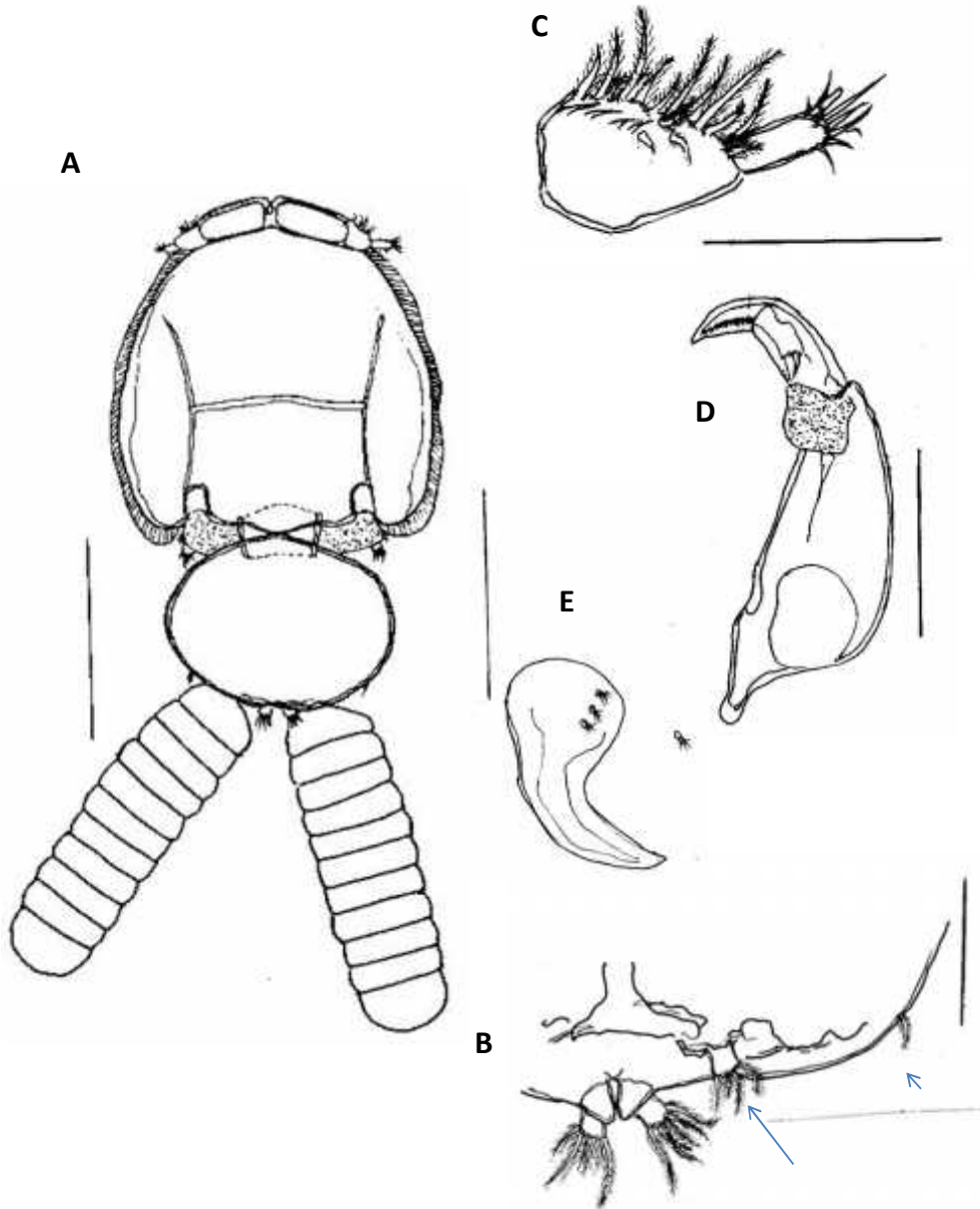


Fig. (1): *Anuretes anomalus*, Female: A: Habitus, dorsal; B: Abdomen & caudal rami, 5th leg (arrow head), 6th leg (arrow); C: Antennule; D: Antenna; E: Postantennal process (scale bars: 0.5 in A; 0.1 in B, C, D & E).

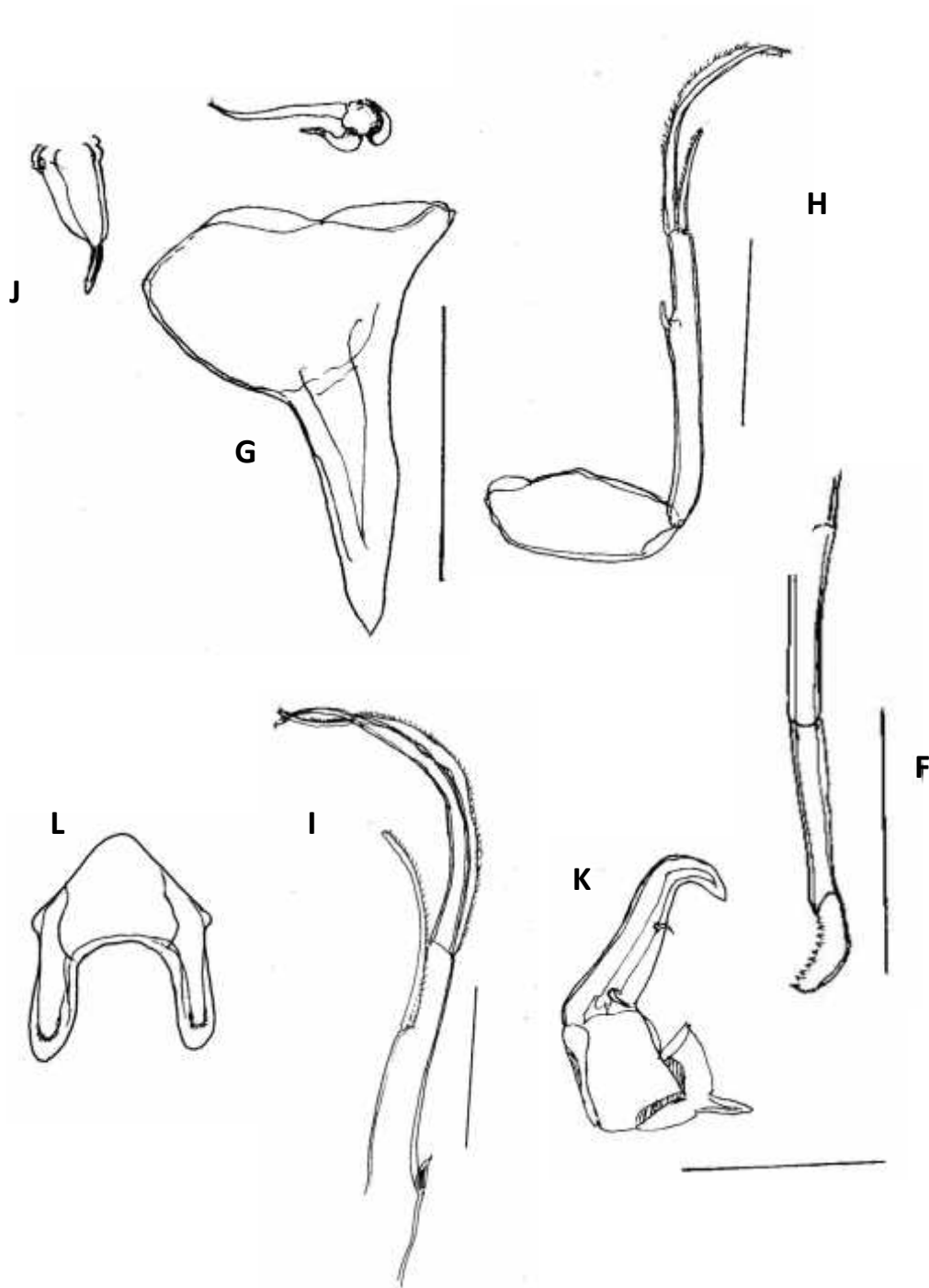


Fig. (1): *Anuretes anomalus*, Female (cont.)

F: Mandible; G: Maxillule; H: Maxilla; I: Tip of maxilla; J: Maxillary whip; K: Maxilliped; L: Sternal furca (scale bars: 0.05 in, F, G, I, J & L; 0.1 in H, K & Q).

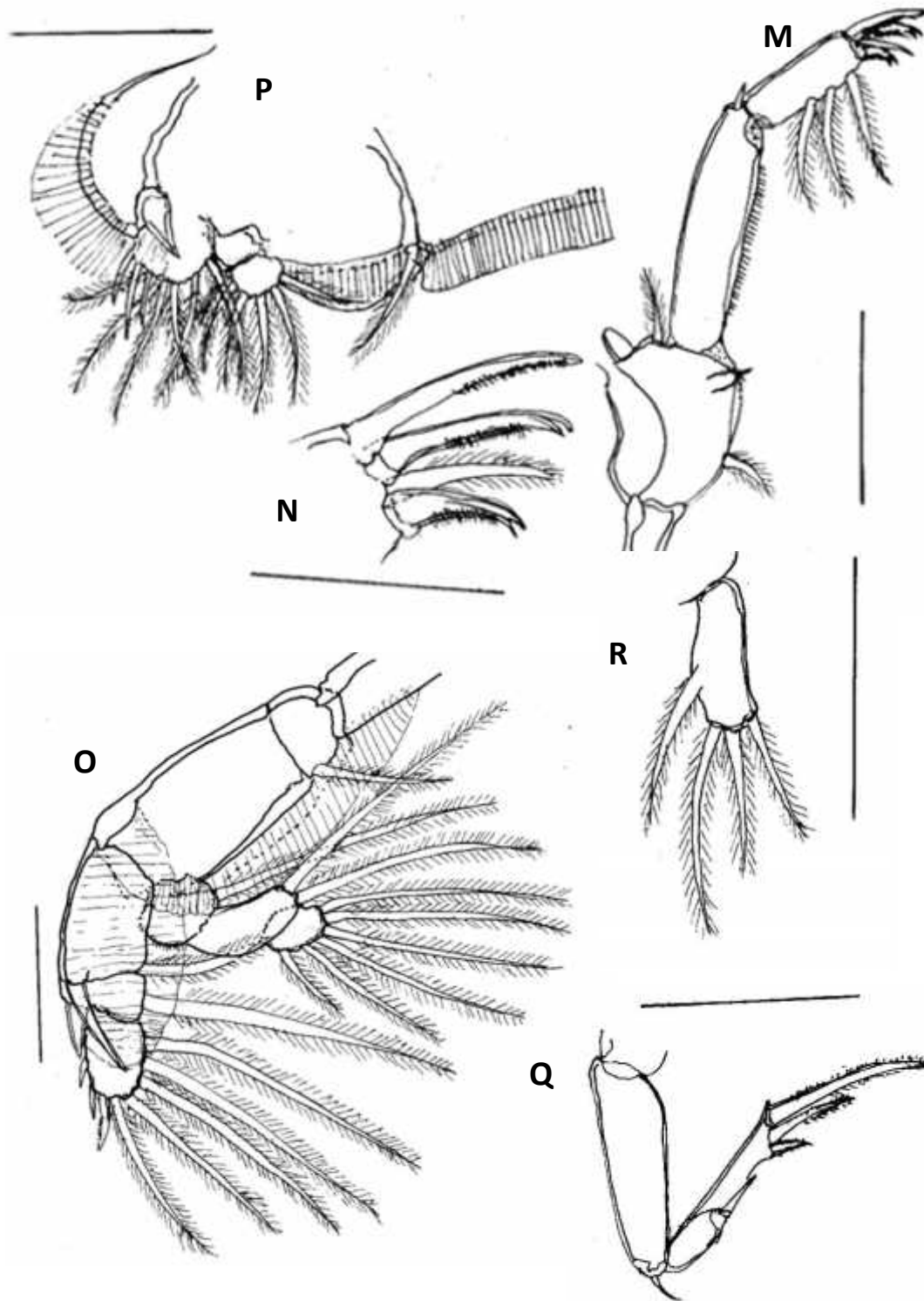


Fig. (1): *Anuretes anomalus*, Female (cont.)

M: Leg 1; N: tip of leg 1; O: leg 2; P: leg 3; Q: Leg 4; R: leg 6 (scale bars 0.1 in M, O, P & Q; 0.05 in N& R)

Both outer edge of exopod and inner edge of basis with large marginal membrane. Leg 3 (Fig. 1P) with large membrane, posterior edge with long plumose seta. Leg 4 (Fig. 1Q) with outer necked seta, pectin on bases of both outer terminal spines. Leg 5 (Fig. 1B arrow head) represents small papilla with single plumose seta. Leg 6 (Figs. 1B, 1R) represents large papilla with inner, long plumose seta and tipped with three plumose setae.

Anuretes branchialis Rangnekar, 1953

Fifteen parasitic females were found attached on gills of seven *P. teira*, These fishes were 20.5-28.0 cm in length while five fishes (13.5- 46.5 cm in length) were found free of this parasites (Prevalence% was 58.3, mean intensity of infection was 2.2). Two specimens of this parasite were kept in the Natural History Museum, London U.K. (NHMUK 2013.51). The following description and measurements based on five females. Body (Fig. 2A) 1.81 (1.78-1.84) long, excluding setae of the caudal rami. Cephalothorax 1.5 longer than wide, 1.26 (1.25-1.28) x 0.86 (0.80-0.90), excluding marginal hyaline membrane.

Fourth pediger wider than long, 0.12 (0.10-0.14) x 0.25 (0.24-0.28). Genital complex slightly wider than long, 0.46 (0.45-0.53) x 0.58 (0.52-0.64) with rounded corners. Abdomen (Figs. 2A, 2B) vestigial represented by a small triangular anal somite at the end of the genital complex. Caudal ramus (Fig. 2B) is slightly longer than wide, 0.027 (0.025-0.029) x 0.024 (0.023-0.027), carrying four short and two long plumose setae. Egg sac 0.68 (0.34-1.20) long, containing 6 (3-11) eggs. Antennule (Fig. 2C) 2-segmented, the basal segment, stout armed with 24 setae, some are short and smooth, on the anterodistal surface with one blunt process at the anterodistal corner, distal segment, long with sub-terminal seta, and 11 terminal setae plus two aesthetics. Antenna (Fig. 2D) 3-

segmented, proximal segment smallest, with bluntly pointed, posteromedial process, middle segment long, cylindrical, and terminated into sharply pointed bent claw with two setae, one in the basal region and the other on the middle. Post-antennal process (Fig. 2E) reduced with two nearby papillae each bearing two situles. Mandible (Fig. 2F) slender, 4-segmented with distal blade bearing 12 teeth on inner margin.

Maxillule (Fig. 2G) short with basal papilla carrying one long and two short setae. Maxilla (Fig. 2H) 2-segmented, proximal segment (lacertus) unarmed, distal segment (brachium) slender, longer than proximal segment, carrying a subterminal hyaline membrane and two elements (calamus and canna) terminally. Maxillary whip absent. Maxilliped (Fig. 2I) 3- segmented, proximal segment (corpus) largest and unarmed, middle segment (shaft) and distal segment (claw) fused to form subchelum with surface striations and medial seta. Sternal furca (Fig. 2J) carrying two blunt pointed tines. Armature on rami of legs 1-4 as follows (Roman numeral indicating spines and Arabic numeral indicating setae):

	Exopod	Endopod
Leg 1	I-0; III, 1, 3	vestigial
Leg 2	I-1; I-1; II, I, 5	0-1; 0-2; 6
Leg 3	I-0; 9	0-0; 6
Leg 4	I-0; III	missing

Leg 1 (Fig. 2K) protopod with long outer (anterior) and another inner (posterior) plumose setae, endopod vestigial. First segment of exopod blunt with row of setules on posterior edge. Two inner setae on last segment of exopod (Fig. 2L) tipped with accessory claw- like process.

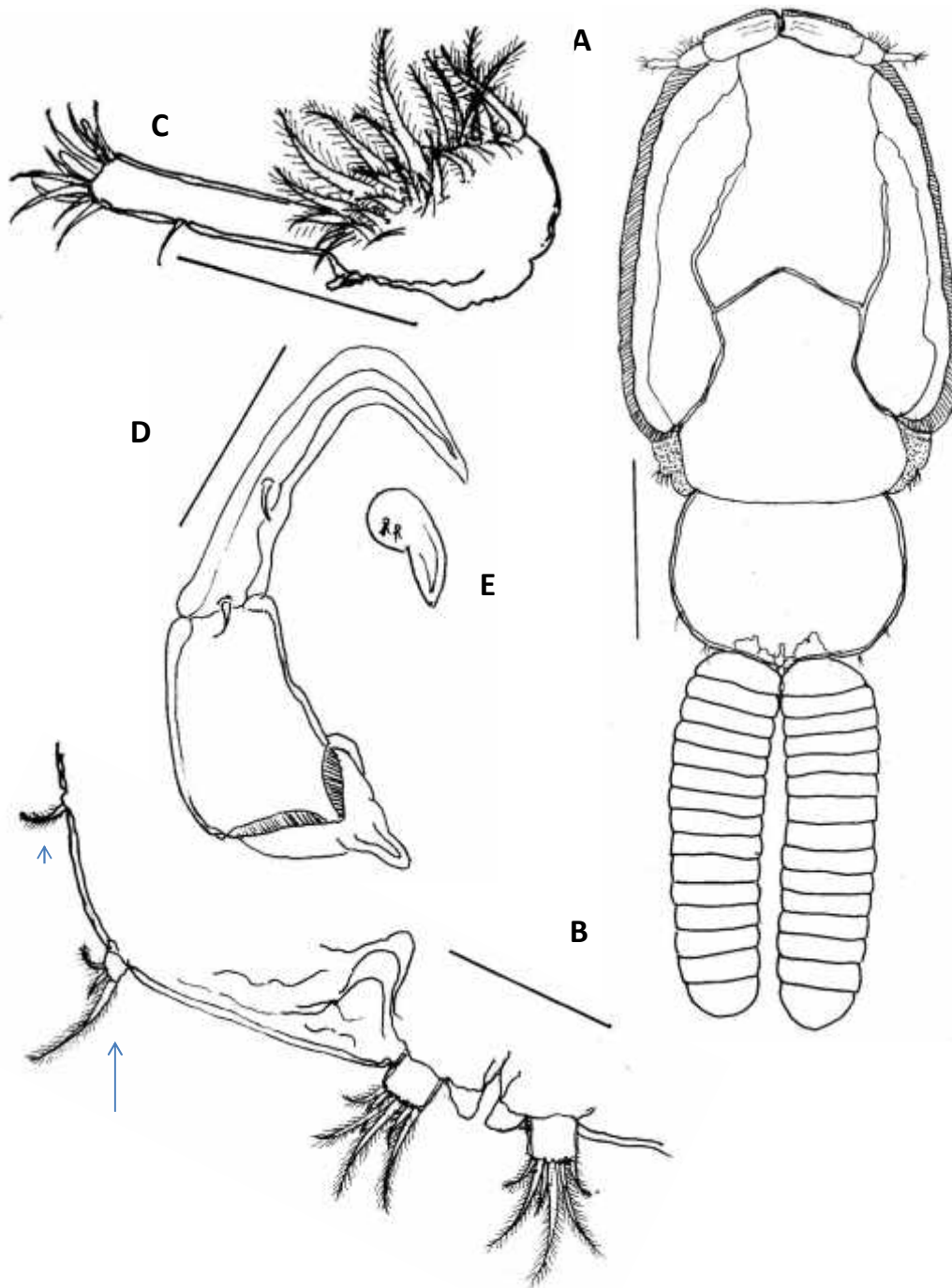


Fig. (2): *Anuretes branchialis*, Female

A: Habitus, dorsal; B: Abdomen and caudal rami, 5th leg (arrow head), 6th leg (arrow); C: Antennule; D: Antenna; E: Postantennal process (scale bars: 0.5 in A, 0.05 in B, C, D, E).

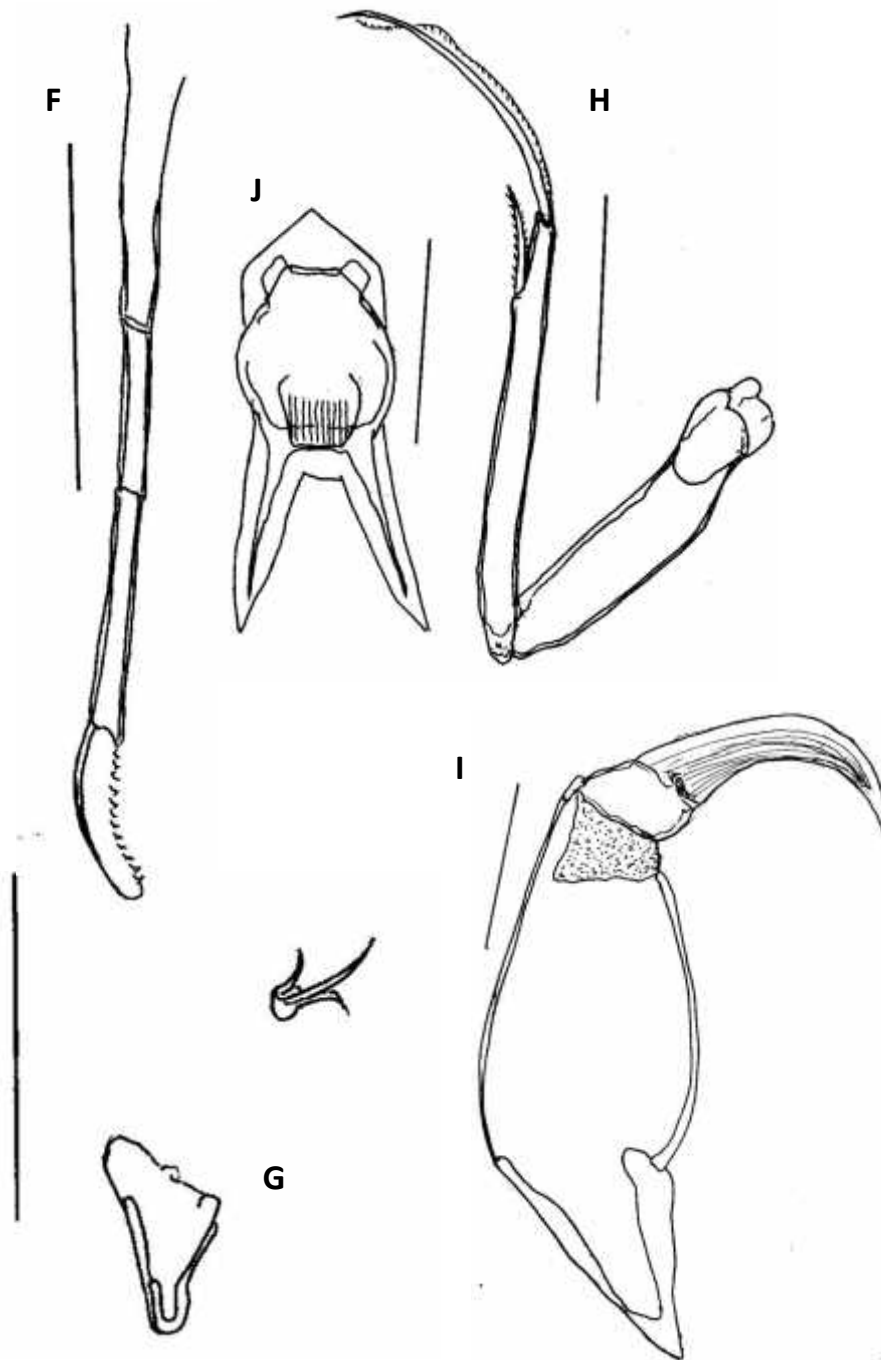


Fig. (2): *Anuretes branchialis*, Female (cont.)

F: Mandible; G: Maxillule; H: Maxilla; I: Maxilliped; J: Sternal furca (scale bar: 0.1 in F, G, H, I, J).

Leg 2 (Fig. M) coxa small with large, inner, long and plumose seta. Outer edge of exopod with long plumose seta, and long and wide membrane. The inner edge of basis with long and narrow membrane. Leg 3 (Fig. 2N) protopod (apron) with small, outer, naked seta and long, plumose inner seta in addition to an outer and posterior marginal membrane. Leg

4 (Fig. 2O) protopod with naked seta at outer distal corner, with pectum at base of each spine on exopod. Leg 5 (Figs. 2B, Q) small papilla bearing single pinnate seta located on posterolateral margin of genital complex. Leg 6 (Figs. 2 B, P) represented by slightly larger papilla tipped with three pinnate setae located on posterior margin of genital complex.

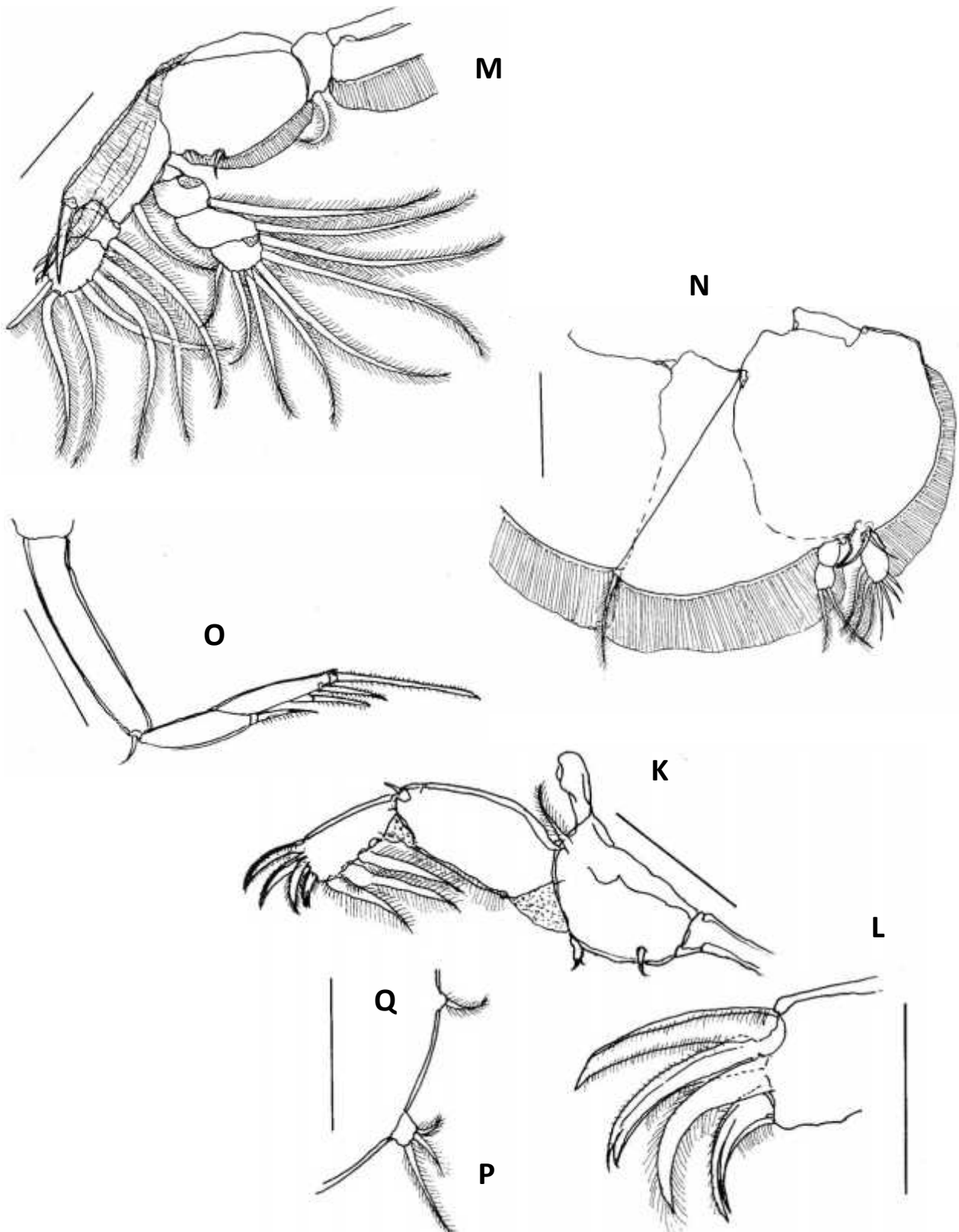


Fig. (2): *Anuretes branchialis*, Female (cont.)

K: Leg 1; L: Tip of leg 1; M: Leg 2; O: Leg 4; Q: Leg 5; P: Leg 6 (scale bar: 0.1 in K, L, M, N, O, P & Q).

Discussion

Anuretes Heller, 1865 belongs to the family Caligidae, known as sea lice. *Anuretes* members may be confused with the members of the genus *Lepeophtheirus* (Pillai, 1967), recently the two genera are valid, species of the former genus have relatively very small or vestigial abdomen (Venmathi Maran *et al.*, 2008). Sea lice have been reported as intensive threat causing disease outbreaks and high mortalities in farmed marine fishes (Cruz-Lacierda *et al.*, 2011).

Walter and Boxshall (2017) listed 19 valid species of *Anuretes*. Pillai (1967) described *A. anomalus* as a new species from *P. teira* in Indian coasts. He was unable to see the vestigial first endopod. Ho and Lin (2000) mentioned that this parasite was also recorded from *D. pictum* from Australia and Heron island.

Ho and Sey (1996) recorded *A. yamagutii* (Prabha & Pillai, 1986) from *Plectorhinchus cinctus* (Temminck *et* Schlegel, 1843) and *D. pictum* from the Arab gulf. Ho and Lin (2000) considered *A. yamagutii* as synonym of *A. anomalus*. Carpenter *et al.* (1997) considered *P. cinctus* as misidentification of *P. pictus* (Tortonese, 1935). In Iraq Al-Hasson *et al.* (2014) recorded *A. similis* Ho & Lin, 2000 from *P. sordidus*, which was considered as the first record in Iraq. *A. branchialis* was firstly described by Rangnekar (1953) from *Eleutheronema tetradactylum* (Show, 1804) from the Arab Sea. Later on this parasite was recorded from other three hosts from the Indo-pacific region (Ho and Lin, 2000). The descriptions of the two species in this study are well identical with the original descriptions of both *A. anomalus* and *A. branchialis*. The main character which can be used to group species of the genus *Anuretes* is the presence or absence of the maxillary whip on the ventral surface of the cephalothorax (Ho and Lin, 2000; Venmathi Maran *et al.*, 2008). Venmathi Maran *et al.* (2008) proposed that the maxillary whip is an enigmatic structure arising as an outgrowth rather than representing a modified paired limb. *A. anomalus* and *A. similis* retain this structure. Al-Hasson *et al.* (2014) missed this

important character. *A. anomalus* can be easily distinguished from other species of *Anuretes* by having its genital complex being smaller than half of cephalothorax and leg 6 bearing four plumose setae, while *A. similis* can be distinguished by having its length of genital complex about 1/2 that of cephalothorax and maxillary whip with a pair of short setiform processes (Ho and Lin, 2000).

A. branchialis shares the character of losing the maxillary whip with other 13 species (Venmathi Maran *et al.*, 2008). Having their fourth pedigerous somite totally covered dorsally by the free expanded posterior margin of the cephalothorax, this parasite can be grouped with *A. justini* Venmathi Maran, Ohtsuka & Boxshall, 2008, *A. occultus* Ho and Lin, 2000 and *A. plectorhynchii* Yamaguti, 1936. *A. branchialis* can be easily distinguished from the other species in this group by bearing two setae on terminal segment of leg 3 endopod (Ho and Lin, 2000).

Conclusions

Recently, Khamees *et al.* (2015) listed *A. anomalus*, *A. branchialis* and *A. similis* as representatives of *Anuretes* in the Iraqi marine waters. The former two species were recorded by Adday (2013), while *A. similis* was recorded by Al-Hasson *et al.* (2014). Hence, the genus *Anuretes* in the Iraqi marine waters and in the whole Arab gulf is represented by these three valid species.

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