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FRESHWATER OSTRACODS (CRUSTACEA: OSTRACODA) OF TELANGANA, INDIA

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ABSTRACT

The present investigation explored the freshwater ostracods from Telangana, India, between the years January 2013 to March 2015. The study was collected and documented eleven species of ostracods belongs to three families. All the species were studied under a light microscope and the detailed taxonomic features were drawn through camera lucida. Interestingly, *Fabaeformiscandona subacuta* and *Stenocypris simulans* were recorded for the first time from India. *Cyprinotus cingalensis* and *Chrissia formosa* were new to this region. *Stenocypris hislopi* originally described from India was synonymzed as *Chrissia hislopi*. But, the present study clearly reconfirms that *S. hislopi* has septa around the carapace margin and widely distributed from this region.

Key words: Taxonomy, Ostraocods, Telangana

INTRODUCTION

Ostracods are commonly known as "seed shrimps". They are one of the most diverse groups of Crustaceans. It exists in all aquatic ecosystems, *viz.* marine, brackish and freshwater including subterranean waters. Globally, freshwater ostracods were documented and classified under the order Podocopida, which contains 15 families, 209 genera and 2103 species (Martens *et al.,* 2008; Martens and Savatenalinton, 2011; Karanovic, 2012). All the freshwater ostracods belong to Podocopida are very common in most inland waters (Meisch, 2000). They are playing a vital role in food chain and energy flow in the aquatic ecosystem (Altmsach *et al.,* 2014). Ostracods are indicators of environmental changes in fresh, brackish and marine waters due to their specific ecological preference and tolerance (Kulkoyluoglu, 2003).

The taxonomic studies on Indian Ostracods were initiated by Baird (1859). Victor and Fernando (1979) listed about 56 freshwater Ostracoda species from the Indian subcontinent. Venkataraman and Krishnamoorthy (1998) reported 120 species of Ostracoda from freshwater and marine habitats, which include four families and 24 genera. Subsequently, A checklist of India ostracods were made based on earlier noteworthy studies by Karuthapandi *et al.,* (2014). It reveals that there are several new species described in the past few decades from the Indian subcontinent by various workers Baird (1859); Battish (1978, 1998); Deb (1972, 1973, 1983), Victor and Michael (1975). But the description of most of the species seems to be insufficient to give the status of new species. Though most of the Indian taxonomists emphasized carapace morphology for identification, the recent studies emphasise on their internal characters which seem to be homologous in described species. It was also observed that most

of the discovered species lack voucher information and the type locality (Karanovic (2012). It creates confusion to the current Ostracoda nomenclature and validity of the species. The type locality information of global and Indian ostracods is available in the works of Karanovic (2012).

Further, freshwater faunal studies on Indian Ostracoda are limited and scattered, when compared to the global studies. In fact, the Indian studies are confined to few states like Tamil Nadu, Kerala, Maharashtra, Madhya Pradesh, Chhattisgarh, Rajasthan, and few parts of Delhi. The present study aims is to explore the Ostracods faunal diversity and their distribution from the wetlands of Telangana State.

MATERIALS AND METHODS

Study Area

The study area was chosen from the state of Telangana, India, situated between coordinates 16°-20°N and 77-82°E. It includes ten districts such as Adilabad, Nizambad, Hyderabad, Warangal, Khammam, Karimnagar, Nalgonda, Ranga Reddy, Medak and Mahabubnagar. The state has more than 17 major reservoirs, several tanks and ponds (Fig. 1 and 2). This study was chosen twenty-three different freshwater habitats for exploring freshwater ostracods between January 2013 to March 2015. The collection locations, habitat type and the coordinates of the sampling areas were shown in Table 1.

Table 1. Details of sampling localities

Sl. No.	Locality	Habitat	District	Date	Latitude	Longitude
1	Ameenpur tank	Tank	Medak	27.08.13	17°31′19″N	78°19′58″E
2	Bandam Kommu Cheruvu	Pond	Medak	17.05.13	17°28′47″N	78°47′36″E
3	Dindi reservoir	Reservoir	Mahabubnagar	26.02.14	16°53′85″N	78°64′27″E
4	Himayatsagar	Reservoir	Ranga Reedy	05.08.14	17°33′12″N	78°36′42″E
5	Jurala dam	Reservoir	Mahabubnagar	24.02.14	16°34′19″N	77°68′22″E
6	Kaddam reservoir	Reservoir	Adilabad	24.08.14	19°13′21″N	78°74′19″E
7	Kinnerasarani dam	Reservoir	Khammam	27.08.14	17°71′15″N	80°63′82″E
8	Koilsagar	Reservoir	Mahabubnagar	23.02.14	16°70′93″N	77°77′89″E
9	Lower Manair dam	Reservoir	Karimnagar	26.08.14	18°40′95″N	79°09′83″E
10	Manjeera dam	Reservoir	Medak	28.03.14	17°65′52″N	78°07′60″E
11	Nagarjunasagar	Reservoir	Nalgonda	29.08.14	17°11′96″N	79°54′13″E
12	Nizamsagar	Reservoir	Nizamabad	29.03.14	18°18′08″N	77°93′49″E
13	Osmania University Pond	Pond	Hyderabad	28.09.13	17°25′02″N	78°31′44″E
14	Osmansagar	Reservoir	Ranga Reedy	05.08.14	17°37′62″N	78°29′88″E
15	Pakhal dam	Reservoir	Warangal	27.08.14	17°95′25″N	80°00′59″E
16	Palair dam	Reservoir	Khammam	28.08.14	17°20′73″N	79°90′24″E
17	Pocharam dam	Reservoir	Medak	23.08.14	18°11′92″N	78°17′91″E
18	Safilguda tank	Tank	Hyderabad	09.06.13	17°27′50″N	78°32′10″E
19	Sathnala dam	Reservoir	Adilabad	25.08.14	19°64′14″N	78°68′24″E
20	Singur dam	Reservoir	Medak	28.03.14	17°79′99″N	77°89′38″E
21	Sriramsagar	Reservoir	Nizamabad	24.08.14	19°00′80″N	78°20′61″E
22	Uppar manair dam	Reservoir	Nizamabad	29.03.14	18°27′39″N	78°54′13″E
23	Wyra dam	Reservoir	Khammam	27.07.14	17°21′62″N	80°37′97″E

Collection and Identification of Ostracods

The Ostracod samples were collected from the littoral regions of the water bodies by using zooplankton net (64µm mesh size). The collections were stored in a 100ml plastic container, preserved with 4% formalin solution. The specimens were sorted for detailed taxonomical identification. A single individual of each species was kept on a clean slide contain water and glycerin (1:1 ratio) for dissection under the stereo zoom binocular microscope (Olympus SZ10). The carapace of the Ostracod was separated out and preserved in a vial and the soft internal organs were mounted on the slide. The slides were studied under a compound light microscope and the taxonomical characteristic features were drawn through camera lucida. The identification of the species was made according to Victor and Fernando (1979), Karanovic (2012).

The abbreviations of the taxonomic features as follows

A1- Antennule

A2- Antenna

G, Gm, GM- name of the antenna claw

Gp- Claw posterior

Ga- Claw anterior

LU- Left uropod

RU- Right uropod

Sa- Setae anterior

Sp- Setae posterior

a, b, d, dp, e, f, g, h, s, t, z, α, β- name of the setae

RESULTS

During the study, we have collected 130 containers of wet ostracods and sorted 2300 ostracods specimens from 23 freshwater habitats of Telangana. Of which, 15 species of ostracods were identified belongs to three families. There were 11 species identified upto the species level *viz. Stenocypris hislopi, S. derputa, S. major, S. simulans, Chrissia formosa, C. spinosa, Cypris subglobosa, Cyprinotus cingalensis, Fabaeformiscanoda subacuta, Hemicypris dissona* and *Heterocypris favosa.* Four species were identified only upto the generic level, *Plesiocypridopsis sp., Sclerocypris sp., Strandesia sp.* and *Ilyocypris sp.* All the collections were deposited in the National Zoological Collections, Freshwater Biology Regional Centre, Hyderabad. Interestingly, *Fabaeformiscanoda subacuta, Stenocypris simulans* were recorded for the first time from Indian fresh waters. *Cyprinotus cingalensis* and *Chrissa formosa* reported earlier only from Pune, now we have documented their distribution from the state of Telangana.

Systematic List of Ostracods identified from Telangana

Class OSTRACODA Latreille 1802

Subclass PRODOCOPA G.W. Müller, 1894

Order PODOCOPIDA Sars 1866

Suborder CYPRIDOCOPINA Jones 1901

Super family CYPRIDOIDEA Baird 1845

Family CYPRIDIDAE Baird 1845

Subfamily CYPRINOTINAE Bronstein, 1947

1. *Cyprinotus cingalensis* Brady, 1886
2. *Hemicypris dissona* Victor and Fernando, 1976
3. *Heterocypris favosa* Victor and Fernando, 1980

Subfamily CYPRIDINAE Baird 1845

4. *Cypris subglobosa* Sowerby, 1840

Subfamily HERPETOCYPRELLINAE Bronstein 1947

5. *Chrissia formosa* (Klie, 1938)
6. *Chrissia spinosa* (Tressler, 1937)
7. *Stenocypris derputa* (Vavra, 1906)
8. *Stenocypris hislopi* Ferguson, 1969
9. *Stenocypris simulans* Rome, 1952
10. *Stenocypris major* Baird, 1859

Family CANDONIDAE Kaufmann 1900

Subfamily CANDONINAE Kaufmann, 1900

11. *Fabaeformiscandona subacuta* (Yang, 1982)

SYSTEMATIC ACCOUNT

Family CYPRIDIDAE

Cyprinotus cingalensis Brady, 1886
(Fig. 3, 4, 5)

1886. *Cyprinotus cingalensis* Brady, *J. Linn. Soc. Zool.,* **19**: 302.

1979. *Cyprinotus cingalensis*: Victor and Fernando, *Rec. Zool. Surv. India,* **74(2)**: 147-242.

2008. *Cyprinotus cingalensis*: Karanovic, *Rec. West. Aus. Mus*., **24**: 267-287.

Material examined: 9exs., Dindi reservoir, 26.02.2014, Reg. No: 1019; 01ex., Upper Manair dam, 29.03.2014, Reg. No: 1020.

Morphological features: Carapace subtriangular, anterior and posterior margins round, ventral margin straight and dorsal margin arched with well developed flange (Fig. 3A, D) and tubercles on the right valve (Fig. 3C, E), flange and tubercules absent in left valve (Fig. 3B). The surface of the carapace is smooth, ornamented with small pits and at the center has adductor muscle scar (Fig. 3F). The length of the carapace is 1.27mm and width 0.96mm. Antennule seven segmented (Fig. 3G). Antenna five segmented, swimming setae are exceeding tip of the terminal claws. G1, long G2, G3, GM and Gm claws are present (Fig. 4A). Mandibular coxal plate well developed, palp three segmented; α and β setae are present (Fig. 4B,C). Maxillula palp is two segmented; the first segment has five long setae on the penultimate segment (Fig. 4D). Terminal segment elongated with strong teethes. First enditie teeth were strong and serrated. First thoracopod with 'a', 'b' and 'd' seta, exopod has many rays of claw like setae (Fig. 4E); second thoracopod five segmented (Fig. 5A), basal segment with a seta, second, third and fourth segments has one seta each 'e', 'f' and 'g', the fifth segment has a long claw 'h2', anterior 'h1' and posterior 'h3' seta; third thoracopod basal with setae 'd1', 'd2' and 'dp', second and third segment carries 'e' and 'f' seta each and terminal segment with a long seta and a short claw like seta (Fig. 5B). Uropodal ramus long and thin with anterior and posterior claws (Fig. 5C). Its anterior setae 1/3 of the anterior claw. The attachments of the uropodal ramus branched (Fig. 5D).

Distribution: India (Andhra Pradesh, Haryana, Jammu and Kashmir, Maharashtra, Punjab and Telangana), Australia, Pilbara region and Queens land.

Hemicypris dissona Victor and Fernando, 1976
(Fig. 6, 7)

1976. *Hemicypris dissona* Victor and Fernando, *Can. J. Zool.,* **54**: 1806-1810.

1979. *Hemicypris dissona*: Victor and Fernando, *Rec. Zool. Surv. India,* **74(2)**: 147-242.

Material examined: 14exs., Osmansagar, Reg. No: 1166; 07exs., Osmania University pond, Reg. No: 1167; 13exs., Nizamsagar, Reg. No: 1168; 100exs., Wyra, Reg. No: 1169; 12exs., Dindi reservoir, Reg. No: 1175; 04exs., Nagarsunasagar, Reg. No: 1170; 74exs., Kedam, Reg. No: 1171; 40exs., Safilguda tank, Reg. No: 1178; 28exs., Himayatsagar, Reg. No: 1172, 40exs., Sathnaladam, Reg. No: 1173; 80exs., Ramagundam, Reg. No: 1174; 60exs., Pakhal dam, Reg. No: 1176; 26exs., Karimnagar dam, Reg. No: 1177.

Morphological features: Carapace ovate, anterior and posterior margins round, ventral margin straight and dorsal margin smoothly arched. The maximum height at the middle of the carapace and tubercles present in the left valve (Fig. 6A,B). The length of the carapace 1.3 mm and width 0.98mm. Antennule seven segmented (Fig. 6C). Antenna is five segmented (Fig. 6D), swimming setae on the third segment are exceeding tip of the terminal claws. The fourth segment with t1-t4 postero-medially; mid-apical region has three 'Z' setae. Distally, claws short G1, long G2 and G3. Terminal segment has two claws long GM and short Gm. Mandibular coxal plate well developed (Fig. 7A); Palp has α seta and β seta (Fig. 6E). Maxillula palp has two segments (Fig. 7B, C), first segment with five long setae and terminal segment elongated. First thoracopod palp has a long seta and two short setae. Protopod with 'b' and 'd' setae, exopod has many rays of claw like setae. Second thoracopod five segmented (Fig.

7D), basal segment has two setae 'd1' and 'd2', second, third and fourth segments has one seta each 'e', 'f' and 'g' respectively, the fifth segment has a long claw 'h2', anterior 'h1' and posterior 'h3' seta. Third thoracopod four segmented (Fig. 7E), basal segment with setae 'd1', 'd2' and 'dp'; second and third segment carries 'e' and 'f' seta each and terminal segment with a long seta and a short claw like seta. Uropodal ramus long and thin with anterior and posterior claws, the anterior setae 1/3 of the anterior claw (Fig. 7F, G).

Distribution: India (Andhra Pradesh, Maharastra, Tamilnadu and Telangana)

Heterocypris favosa Victor and Fernando, 1980
(Fig. 8, 9)

1980. *Heterocypris favosa* Victor and Fernando, *Can. J. Zool.,* **58**: 1288-1297.

Material examined: 100 exs., Safilguda tank, Reg. No: 1179; 02 exs., Bandam Kommu pond, Reg. No: 1180.

Morphological features: Carapace subovate, anterior and posterior margins round, ventral margin straight and dorsal margin arched (Fig. 8A); tubercles on right valve and absent in left valve. The surface of the carapace is smooth, ornamented, reticulated mark with small pits and five adductor muscle scare seen in the center. The length of the carapace 1.27mm and width 0.96mm. Antennule seven segmented (Fig. 8B); Antenna five segmented (Fig. 8C), swimming setae on the third segment are exceeding tip of the terminal claws. G1, G2 and G3, GM and Gm claws are present. Mandibular coxal plate well developed, palp three segmented α and β setae are present (Fig. 8D, E). Maxillula palp has two segments (Fig. 9A). Second thoracopod five segmented (Fig. 9B), basal segment with a seta, second, third and fourth segments has one seta each 'e', 'f' and 'g' respectively, and the fifth segment has a long claw 'h2', anterior 'h1' and posterior h3. Third thoracopod four segmented (Fig. 9C), basal segment with 'd1', 'd2' and a 'dp' setae, second and third segment carries 'e' and 'f' setae each and terminal segment has a long seta and a short claw like seta. Uropodal ramus long and thin with anterior and posterior claws (Fig. 9D), the anterior setae 1/3 of the anterior claw, posterior claw half of the length of the anterior claw and posterior seta half the length of the posterior claw. The attachments of the uropodal ramus branched (Fig. 9E).

Distribution: India (Telangana), Philippines.

Cypris subglobosa Sowerby, 1840
(Fig. 10, 11)

1859. *Cypris subglobosa* Sowerby, *Trans. Geo. Soc. London*., **2**(5): pages not numbered.

1979. *Cypris subglobosa:* Victor and Fernando*, Rec. Zool. Surv. India*, **74**: 147-242.

2009. *Eurcypris subglobosa:* Yu *et al., Zootaxa*, **2067**: 29-50.

2011. *Cypris subglobosa*: Harshey and Thilak, Fauna of Madhya Pradesh, *State Fauna Series, Zool. Surv. India,* **15**(3): 31-44.

Material examined: 15exs., Koilsagar, Reg. No: 995 and 1034; 30exs., Dindi reservoir, Reg. No: 996; 03exs., Upper Manair dam, Reg. No: 1032; 01exs., Manjeera dam, Reg. No: 1033; 20exs., Pakhal dam, Reg. No: 1105; 05exs., Pocharam dam, Reg. No: 1106; 04exs., Sriramsagar, Reg. No: 1107; 06ex, Wyra dam, Reg. No: 1108; 48 exs., Bandam Kommu pond, Reg. No: 1144; 02exs., Ameenpur tank, Reg. No: 1145; 03exs., Temporary pond, Reg. No: 1149; 07ex, Osmania University pond, Reg. No: 1148.

Morphological features: Carapace is tumid, subglobular, round, anterior and posterior margin with hairs. The dorsal region is convex, ventral margin almost straight. The surface of the carapace with thimble-shaped depressions and hairy setae (Fig. 10A,B). Antennule seven segmented (Fig. 10C). Antenna five segmented (Fig. 10D), swimming setae exceeding upto tip of the distal claws. Fourth segment has three 'Z' setae, claws G1, G2 and G3. Terminal segment with a long GM claw, short Gm claw and additional setae in the margin. Mandibular coxal plate well developed (Fig. 10E & 11A). Palp three segmented (Fig. 11B), a short α and long β setae are present. Maxillula palp (endopoda) two segmented (Fig. 11C). First thracopoda three segmented, exopoda with many claw like setae at the terminal, Pulp has a long and two small sub-equal setae

(Fig. 11D). Second thoracopod five segmented (Fig. 11E), first segment has one 'd1' and 'd2' setae. Second, third and fourth segments carry one seta each 'e', 'f' and 'g' distally. Terminal segment is short and it carries one long claw 'h2' two seta at the anterior 'h1' and posterior 'h3'. Third thoracopod first basal with 'd1', 'd2' and 'dp' setae. Second and third segment carries each one seta anteriorly 'e' and 'f'. Fourth segment with pincer, long 'h3' seta and short, broad, curved 'h2' setae (Fig. 11F). Uropodal rami (Fig. 11G) are narrow, long, rod shaped, symmetrical, anterior claw long, posterior claw short and 1/2 the length of the anterior claw, anterior and posterior setae are short more are less equal in length.

Distribution: India (Andhra Pradesh, Kerala, Madhya Pradesh, Maharashtra, Odissa, Punjab Rajasthan, Tamilnadu, and Telangana), Afghanistan, America, Australia, China, Europe, Iran, Japan, Malaysia and Sri Lanka.

Chrissia formosa (Klie, 1938)
(Fig. 12, 13)

1938. *Stenocypris formosa* Klie, *Bull. Biogeo. Soc. Japan*, **8**: 21-33.

1982. *Chrissia formosa*: Victor and Fernando, *J. Biogeo*., **9**: 281-288.

2011. *Chrissia formosa*: Smith *et al.,* Zootaxa, **2874**: 1-37.

2011. *Chrissia formosa*: Harshey and Thilak, Fauna of Madhya Pradesh, *State Fauna Series, Zool. Surv. India,* **15(3)**: 31-44.

Material examined: 70exs., Dindi reservoir, Reg. No: 1124; 10exs., Upper manair dam, Reg. No: 1125; 13exs., Himayatsagar, Reg. No: 1126; 05exs., Kedam dam, Reg. No: 1127; 40exs., Koilsagar, Reg. No: 1128; 02exs., Singur dam, Reg. No: 1129; 05exs., Bandam Kommu pond, 17.05.2013, Reg. No: 1130.

Morphological features: Carapace elongated with a maximum height at posterior mid dorsal and ventral region, smoothly arched and inclined towards anteriorly and tapering towards posterior (Fig. 12A). Both anterior and posterior margins are equally narrow and round; ventral margin flat. There is no septum around the margins. Antennule seven segmented (Fig. 12B) a rome organ present in ventral side of the second segment. Antenna five segmented (Fig. 12C), fourth segment has 'Z' setae, G1, G2 and G3 claws. Terminal segment has GM and Gm claws with additional setae. Mandibular coxal plate is well developed and palp has α and β setae (Fig. 12D). Maxillula palp (endopod) is two segmented. First segment carries five setae antero-distally and second segment elongated (Fig. 12E). First thoracopod three segmented with seta 'a', 'b' and 'd' seta and pulp has three setae on distal end (Fig. 13A). Second thoracopod five segmented (Fig. 13B), first segment has 'd1'and 'd2' setae. Second, third and fourth segments each carries a seta 'e', 'f' and 'g' at the distally. Terminal segment is short and it carries one long claw 'h_2' and two short setae 'h1' and 'h3'. Seta 'h3' is longer than 'h1'. Third thoracopod with 'd1' and 'd2' 'dp', 'e' and 'f' setae; Fourth segment has pincer, long 'h3' seta, broad and curved claw like 'h2' seta (Fig. 13C). Uropodal right ramui slightly curved, each rami with two serrated claws. Anterior claw is longer than posterior and a short anterior seta is present. Right rami ventral margin with strong spines, gradually decrease in length upto the mid-ventral region. UR attachment branched and base region triangular (Fig. 13D, E).

Distribution: India (Madhya Pradesh, Maharastra and Telangana), Formosa, Japan, Philippines.

Chrissia spinosa (Tressler, 1937)
(Fig. 14, 15)

1937. *Stenocypris spinosa* Tressler, *Inter. Rev. Gesamten Hydrobiol. Hydrogrph*., **34**: 188-207.

1972. *Stenocypris spinosa*: Deb, *Rec. Zool. Surv. India,* **67**: 233-259.

Material examined: 10exs., Himayatsagar, Reg. No: 1031; 03exs., Osmania University pond, Reg. No: 1046; 16exs., Sriramsagar, Reg. No: 1104.

Morphological features: Carapace elongated, anterior margin wider than posterior margin, dorsal margin straight, Postero-ventral margin with a sharp spine towards posterior on both the valves, mid-ventral slightly concaved (Fig. 14A). Surface of the carapace smooth, punctuated, length 1.3mm and width 0.48mm. Antennule seven

segmented (Fig. 14B). Antenna five segmented (Fig. 14C); swimming setae are reaching up to the tip of the claws. Fourth segment has four setae t1-t4, three long 'Z' setae and three claws G1, G2 and G3. Terminal segment has GM and Gm claws with additional setae. Mandibular coxal plate is well developed (Fig. 14D), α and β seta are present (Fig. 14E). Maxillula palp (endopod) is two segmented. First segment carries five setae antero-distally. Second segment elongated with five claw like setae. First thoracopod 'a' 'b' and 'd' seta (Fig. 15A). Second thoracopod five segmented (Fig. 15B), first segment has one 'd1' and 'd2' setae. Second, third and fourth segments each carries a seta 'e', 'f' and a short 'g' distally. Terminal segment carries one long claw 'h2' and two setae one short at posterior 'h1' and a long and reaching half the length of 'h2' claw at anterior 'h3'. Third thoracopod basal segment with 'd1'', d2', 'dp', 'e' and 'f' setae; pincer, 'h3' and curved claw like 'h2' seta (Fig. 15C). Uropodal right rami slightly curved each rami with two claws with serrations. Anterior claw is longer than posterior and a short anterior seta and half the length of the anterior claw. Right rami ventral margin with only 6 to 7 strong spines and remaining are smaller, gradually decrease in length upto the mid-ventral region. UR attachment branched (Fig. 15D).

Distribution: India (Rajasthan and Telangana), Camaguin Island, Philippines.

Stenocypris hislopi Ferguson, 1969
(Fig. 16, 17)

1969. *Stenocypris hislopi* Ferguson, Oliver and Boyd Ltd. Edinburgh, pp. 67-75.

1979. *Stenocypris hislopi*: Victor and Fernando, *Rec. Zool. Surv. India,* **74(2)**: 196-197.

2011. *Stenocypris hislopi*: Smith *et al., Zootaxa*, **2874**: 1-37.

2011. *Stenocypris hislopi*: Harshey and Thilak, Fauna of Madhya Pradesh, *State Fauna Series, Zool. Surv. India,* **15(3)**: 31-44.

Material examined: 41exs., Osmansagar, Reg. No: 883; 20exs., Singur dam, Reg. No: 1035; 01exs., Manjeera dam, Reg. No: 1036; 48exs., Upper Manair dam, Reg. No: 1037; 33exs., Koilsagar, Reg. No: 1038; 35exs., Pocharam dam, Reg. No: 1039; 19exs., Dindi reservoir, Reg. No: 1040; 45exs., Nizamsagar, Reg. No: 1041; 31exs., Osmania University pond, Reg. No: 1042; 01ex, Bandam Kommu pond, Reg. No: 1043; 54 exs., Raigir tank, Reg. No: 1044; 50exs., Himayatsagar, Reg. No: 1029; 42exs., Wyra, Reg. No: 1097; 02exs., Sathnala dam, Reg. No: 1098; 35exs., Sriramsagar, Reg. No: 1099; 80exs., Kedam dam, Reg. No: 1010; 25exs., Pakhal dam, Reg. No: 1101; 20exs., Karimnagar dam, Reg. No: 1102.

Morphological features: Carapace elongated (Fig. 16A), anterior and posterior margins are rounded, dorsal smoothly arched, ventral flat, septa present in the anterior, posterior and ventral margins. Distinctly broad septa present in the anterior dorsal and anterior ventral region. Surface of the carapace smooth, adductor muscle scar located at the centre of the carapace. Antennule seven segmented (Fig. 16B), rome organ present in the second segment. Antenna five segmented (Fig. 16C), Third segment (first endopoda) carries an aesthetasc 'Y' and a group of long swimming setae are exceeding the tip of the distal claws. Fourth segment has 't' and 'Z' setae and G1, G2, G3 claw. Terminal segment has two claw GM and Gm with additional seta on margin. Mandibular coxal plate well developed, palp has α, β and gamma setae (Fig. 16D,17A). Maxillula palp (endopod) has two segmented (Fig. 16E). First thoracopod has endopoda, exopoda and prodopoda (Fig. 17B). Second thoracopod five segmented (Fig. 17C), first segment has two setae 'd1' and 'd2' at the antero-distally. Second, third and forth segments carry each one seta distally. Terminal segment carries one long claw 'h2' and two setae at anterior 'h1' and posterior 'h3' region. Third thoracopod first basal segment has two setae anterioly 'd1' and 'd2' and one posterioly 'dp'. Second segment (first endopod) carries one seta anterioly 'e' third segment has one seta 'f'. Forth segment with pincer, long 'h3' seta and broad 'h2' seta (Fig. 17D). Uropodal right ramus curved, each with two claws, anterior claw long and short posterior claw. Anterior margin has a long seta and reaches upto the end of the anterior claw. The right rami margin is deeply serrated upto the middle of the rami (Fig. 17E).

Distribution: India (Andhra Pradesh, Kerala Madhya Pradesh, Maharastra, Odissa, Rajasthan, Tamilnadu, Telangana and Uttarakand), Japan, Korea, Malaysia and Sri Lanka.

Stenocypris derputa Vavra, 1906
(Fig. 18, 19, 20)

1906. *Stenocypris derputa* Vavra, *Zool. Jb. Syst*., **23**: 426.

1972. *Stenocypris derputa*: Deb, *Rec. Zool. Surv. India,* **67**: 233-259.

1979. *Stenocypris derputa*: Victor and Fernando, *Rec. Zool. Surv. India,* **74(2)**: 195-196.

2011. *Stenocypris derputa*: Harshey and Thilak, Fauna of Madhya Pradesh, *State Fauna Series, Zool. Surv. India,* **15(3)**: 31-44.

Material examined: 06exs., Singur dam, Reg. No: 1026; 140exs., Upper Manair dam, Reg.No: 1023; 01ex, Koilsagar, Reg. No: 1022; 05exs., Pocharam dam, Reg. No: 1024; 12exs., Dindi reservoir, Reg. No: 1025 and 1021; 14exs., Kedam dam, Reg. No: 1095; 02exs., Wyra dam, Reg. No: 1096.

Morphological features: Carapace elongated, anterior broad, posterior distinctly narrow margin, dorsum smoothly arched (Fig. 18A, B, C), ventral margin flat and straight. Septa around anterior, posterior margin are broad than ventral. Especially, the mid-ventral region septa are small. Surface of the carapace is smooth with punctuations and distributed with hairy cilia. Antennule seven segmented (Fig. 18D); rome organ is situated in the ventral side of the second segment. Antenna five segmented (Fig. 19A, B), all the setae and claws are present. Mandibular coxal plate well developed and palp has α, β and gama seta are present (Fig. 19C, D). Maxillula palp (endopod) has two segmented. Second segment elongated claw like setae (Fig. 20A). First thoracopod bears a seta 'a', 'b' and 'd' (Fig. 20C). Second thoracopod with 'd1' 'd2' 'e', 'f' and 'g' setae and it carries one long claw 'h2'; 'h1' and 'h3'setae (Fig. 20B). Third thoracopod has 'd1', 'd2', 'dp', 'e' and 'f' setae. Forth segment with pincer, long 'h3' seta and a short curved 'h2' seta (Fig. 20D,E). Uropodal rami have anterior and posterior claws with serrations and anterior seta about ¾ length of anterior claw. The right rami has serrated spine present in the posterior margin. Spines behind the posterior claw are stronger than the others (Fig. 20F). UR attachment is branched.

Distribution: India (Andhra Pradesh, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Rajasthan, Tamilnadu, Telangana and Uttarakand), Philippines, Sri Lanka, Sumatra and Western Java.

Stenocypris major Baird, 1859
(Fig. 21, 22)

1859. *Cypris cylindrical major* Baird, *Proc. Zool. Soc. London,* **398**: 231-233.

1979. *Stenocypris major*: Victor and Fernando, *Rec. Zool. Surv. India,* **74(2)**: 193-194.

1999. *Stenocypris major*: Venkataraman, *Rec. Zool. Surv. India,* **97(3)**: 91-96.

2011. *Stenocypris major*: Harshey and Thilak, Fauna of Madhya Pradesh, *State Fauna Series, Zool. Surv. India,* **15(3)**: 31-44.

Material examined: 02exs., Sriramsagar, Reg. No: 1109.

Morphological features: Carapace elongated posterior margins broader than the anterior margin, dorsum smooth and almost flat. Ventral margin is straight with a concave depression in the mid-ventral region. Septa around posterior margin are equally broad. Speta broader in mid-anteroventral margin than other septa. The mid-ventral region septa are small with a concave depression in this region. Surface of the carapace is smooth with punctuations and distributed with hairy cilia (Fig. 21A). Antennule seven segmented, rome organ is present (Fig. 21B). Antenna five segmented with aesthetasc 'Y', swimming setae, 't' setae, Z setae, G1, G2, G3 GM, and Gm claws (Fig. 21C). Mandibular coxal plate well developed with toothed setae on the outer edges, palp has a short α and long β and setae (Fig. 21D and E). Maxillula palp (endopod) two segmented. First segment carries five setae antero-distally. Second segment elongated with five claw like setae, of which two are long medial setae (Fig. 22A). First thoracopod bears 'a', 'b' and 'd'setae on the protopod (Fig. 22B). Second thoracopod five segmented with 'd1', 'd2' 'e', 'f' and 'g' setae. Terminal segment carries one long claw

'h2' toothed at centre, two setae longer 'h1' and short 'h3' (Fig. 22C). Third thoracopod first basal segment has two setae, anteriorly 'd1' and 'd2' and one seta at posterior 'dp'. Second and third segment carries each one seta anteriorly 'e' and 'f'. Forth segment with pincer, long 'h3' seta and a short curved 'h2' seta (Fig. 22D). Uropodal rami have an anterior and posterior claw with half of the margin serrated and anterior seta length equal to anterior claw. The right has serrated spine present in the posterior margin. Spines behind the posterior claw are stronger than the others (Fig. 22E). UR attachment is branched and triangular base.

Distribution: India (Andhra Pradesh, Bihar, Gujarat, Jammu and Kashmir, Kerala, Madhya Pradesh, Maharastra, Rajasthan, Tamilnadu, Telangana, Uttarakand and West Bengal), Europe, Indonesia, Japan, Malaysia, Philippines, Sri Lanka and Sumatra.

Stenocypris simulans Rome, 1965
(Fig. 23, 24)

1965. *Stenocypris simulans* Rome, *Parc. Natl Upemba. Mission GF Witte,* **69**: 3-71.

Material examined: 08exs., Himayatsagar, Reg. No: 1030; 01ex, Osmania University Pond, Reg. No: 1045; 125exs., Sriramsagar, Reg. No :1103.

Morphological features: Carapace elongated (Fig. 23A), right valve of the carapace has a distinct curved spine in the mid posteroventral region. Septa around anterior, posterior margin are broader than ventral. Especially, the mid-ventral region septa are small. Surface of the carapace is smooth with punctuations and distributed with hairy cilia. Antennule seven segmented (Fig. 23B). Antenna five segmented (Fig. 23C), with an aesthetasc 'Y', swimming setae, 't' seta, Z setae, G1, G2, G3, GM, Gm claws and additional setae in the margins. Mandibular coxal plate well developed, palp has α, β and gama setae (Fig. 23D). Maxillula palp (endopod) has two segmented. First segment carries five setae antero-distally. Second segment elongated with five claw like setae of which two are long medial setae (Fig. 23E). First thoracopod bears a seta 'a', 'b' and 'd' (Fig. 24A). Second thoracopod with 'd1', 'd2', 'e', 'f', 'g' setae; and it carries one long claw 'h2' toothed at centre, two short setae, long anterior 'h1' and short posterior 'h3' (Fig. 24B). Third thoracopod first basal segment has two setae anteriorly 'd1' and 'd2' and one seta posteriorly 'dp'. Second and third segment carries each one seta anteriorly 'e' and 'f'. Forth segment with pincer like long 'h3' seta and a short curved 'h2' seta (Fig. 24C). Uropodal rami have anterior and posterior claw with entire margin serrated and anterior seta as long as anterior claw. The right ramus slightly curved and serrated spine present in the posterior margin. (Fig. 24D, E). UR attachment is branched with triangular base.

Ditrubution: India (Rajasthan and Telangana), China.

Fabaeformiscandona subacuta (Yang, 1982)
(Fig. 25, 26)

1982. *Candona subacuta* Yang (In Hou *et al.,*), Geological Publishing House, Pekin, China.

2007. *Fabaeformiscandona subacuta*: Smith and Kamiya, *Hydrobiologia*, **585**: 225-248.

2011. *Fabaeformiscandona subacuta*: Escriva *et al., J. Crust. Biol.,* **32(6)**: 949-961.

2014. *Fabaeformiscandona subacuta*: Smith *et al., J. Nat. Hist.,* 1-39.

Material examined: 05exs., Osmansagar, Reg. No:953; 1ex, Manjeera dam, Reg. No: 1027; 01ex, Himayatsagar, Reg. No: 1028; 01ex, Kedam dam, Reg. No: 1122.

Morphological features: Carapace in female elongated, length 0.9mm and width 0.45mm (Fig. 25A), dorsal margin straight sloping towards anterior, ventral concave medially; posterior and anterior margins are round. The maximum height is in posterior medially. Posterior ventral margin inner crescent layer is slightly concave. In male, anterior and posterior margins are round, posterior broader than anterior, maximum height postero-medial region, ventral medially concave (Fig. 26A). Both, male and female carapace surface are smooth and punctuated. Antennule seven segmented (Fig. 25B and 26B). Antenna with aesthetasc 'Y' seta, Z1 seta transformed into claw, G2, G3 claws equally long and natatory setae

are absent. Terminal segment has one long GM and short Gm (Fig. 25C). Male, aesthetasc 'Y' is slender and long. t2, t3 setae are thick with round end on the fourth segment, t2 longer then t3 (Fig. 26C). Mandibular coxal plate elongated, median is broad (Fig. 25E). Maxillula palp two segmented. First thoracopod with setae 'a', 'b' and 'd'. Second thoracopod terminal segment with long distal claw 'h2' and two setae, 'h1' longer than 'h3' (Fig. 25F). Third throracopoda basal segment with short 'd1', 'd2' and long 'dp' setae; terminal segment with short seta 'h1' and two long 'h2' and 'h3'. Uropodal ramus slightly curved, symmetrical, posterior and anterior setae are present. Posterior claw shorter than anterior. Anterior seta half the length of posterior seta (Fig. 26F). Hemipenis large, elongated and wide, a lobe has a shallow ridge, m processor elongated terminated with h lobe (Fig. 26D and E). Female reproductive organ anteriorly round.

Distribution: India (First time reported from the state Telangana), Australia, Colombia, Japan, New Zealand, Russia, South Korea, Spain and Thailand.

DISCUSSION

During this study, we have collected and documented 11 species of freshwater ostracods from Telangana, of which two species *Fabaeformiscandona subacuta* and *Stenocypris simulans* are new to India and two species *Cyprinotus cingalensis* and *Chrissia formosa* are new to this region. There are 15 species of freshwater ostracoda reported previously from Andhra Pradesh (Victor and Fernando, 1979 and Battish, 2000) and there are 152 valid species of freshwater ostracods were documented from India (Karuthapandi *et al.,* 2014). This study added three more species *Fabaeformiscandona subacuta, Stenocypris hislopi* and *Stenocypris simulans* to the Indian Ostracods.

The taxonomy and global distribution of the species *Fabaeformiscandona subacuta* was reviewed by Escriva *et al.,* (2012). Globally, 55 species of ostracods belonging to the genus *Fabaeformiscandona* were documented (Martens and Savatenalinaton, 2011). It reveals that there was no record of this species from Indian Peninsula, though globally it has been recorded from 78 locations. Interestingly, while studying the ostracods of Telangana, the authors have recorded for the first time *F. subacuta* from Deccan plateau of the Indian subcontinent. Besides, it is the first record of its distribution from South Asia, might be a 79th locality on the globe.

In India, there are five species belongs to genus *Stenocypris*, of which three species *Stenocypris distinct, S. jabalpurensis* and *S. sohni* are originally described from India. Hence, four species *S. hislopi* Ferguson, 1969; *S. khopoliensis* Deb, 1983; *S. krishnakantai* Deb, 1983 and *S. biswasi* Deb, 1972 described as genus *Stenocypris* has been synonymized into genus *Chrissia* due to the absence of septa around the carapace margin. *S. hislopi* originally described from India was synonymzed as *Chrissia hislopi* by Karanovic (2012). But, the present study clearly confirms that *S. hislopi* has septa around the carapace margin and widely distributed in Telangana. Similarly, *Chrissia formosa, Cyprinotus cingalensis* are previously recorded only from Maharashtra, now it has been documented from the state of Telangana. *Stenocypirs hislopi*, *S. derputa* and *Cypris subglobosa, Hemicypris sp.* are the most commonly distributed species of this region. *Stenocypris punjabensis* is in very close resemblance with *Stenocypris simulans*. Genus *Strandesia* sp., *Plesiocypridopsis* sp., *Ilyocypris* sp. are yet to be identity upto species level.

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PLATE-1

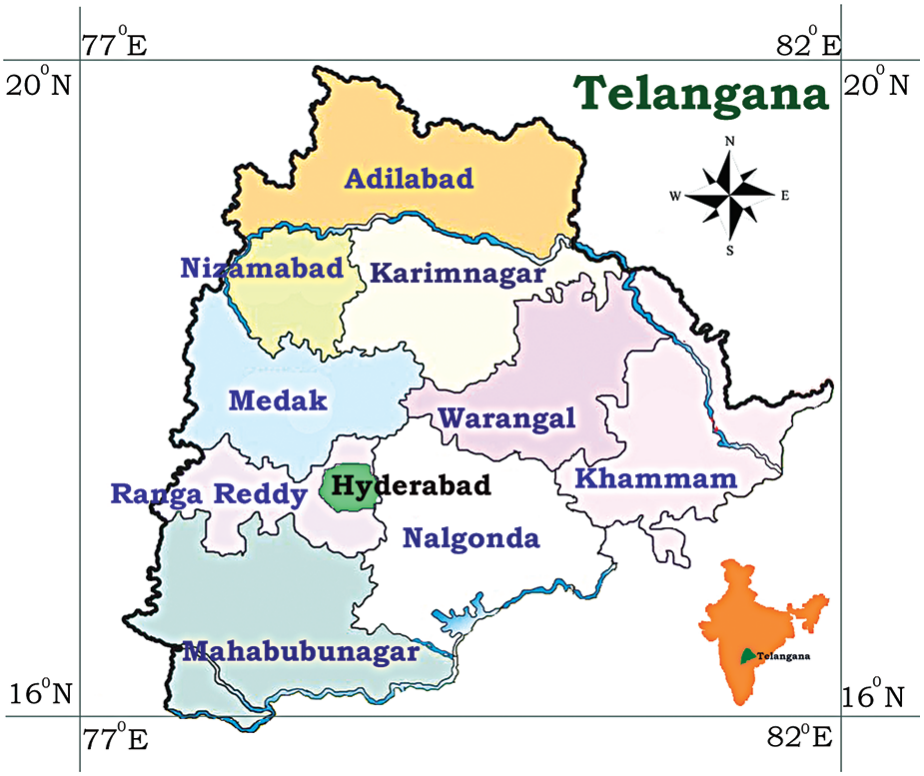

Fig. 1. Map of Telangana

Fig. 2. Collection locations and Major reservoirs of Telangana

PLATE-2

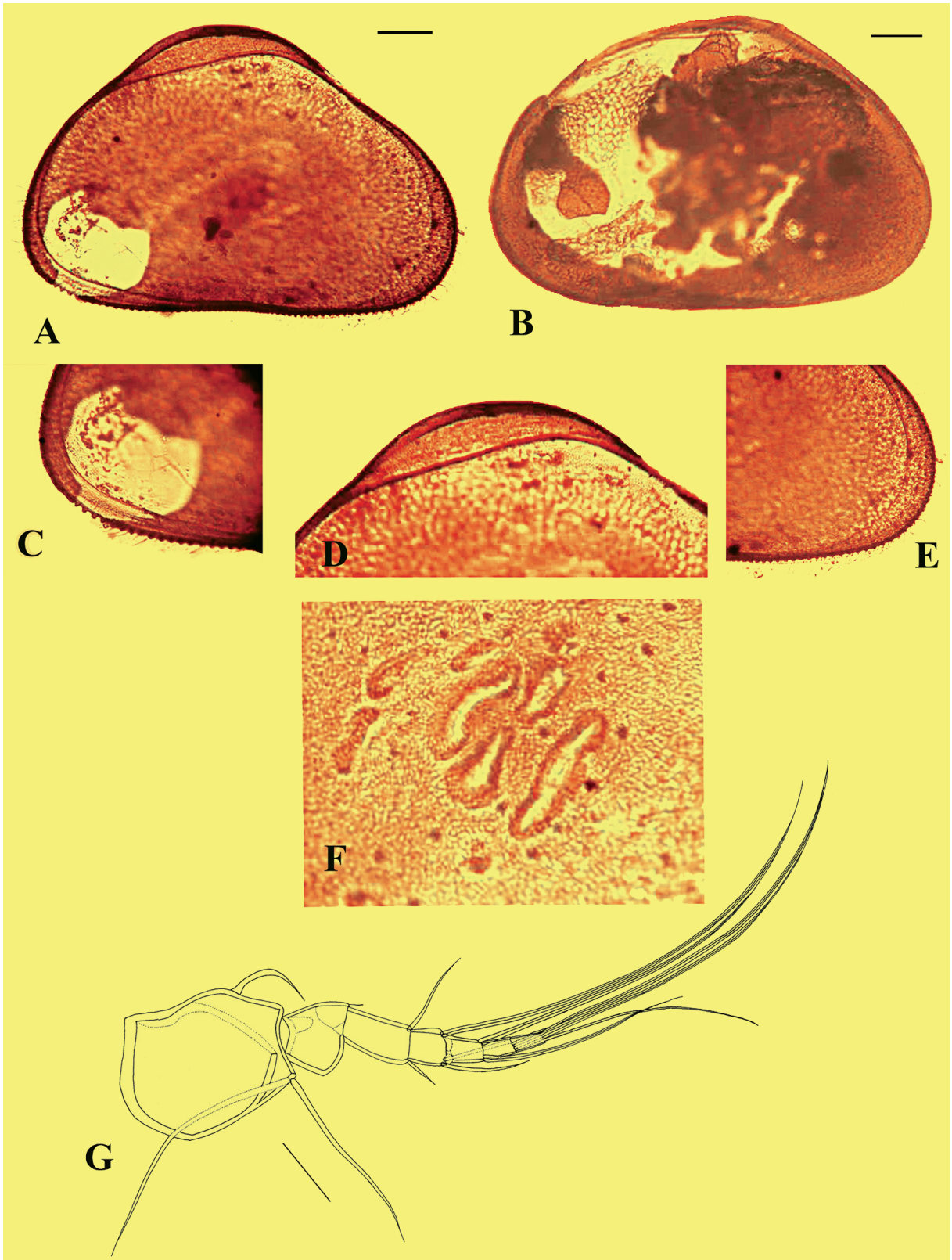

Fig. 3. *Cyprinotus cingalensis* Brady, 1889; A- Right valve of the carapace; B- Left valve; C- Right valve posterior margin; D- Right valve dorsal flange; E- Right valve anterior margin; F- Adductor muscle scar; G- Antennule (A1). Scale = 0.1mm.

PLATE-3

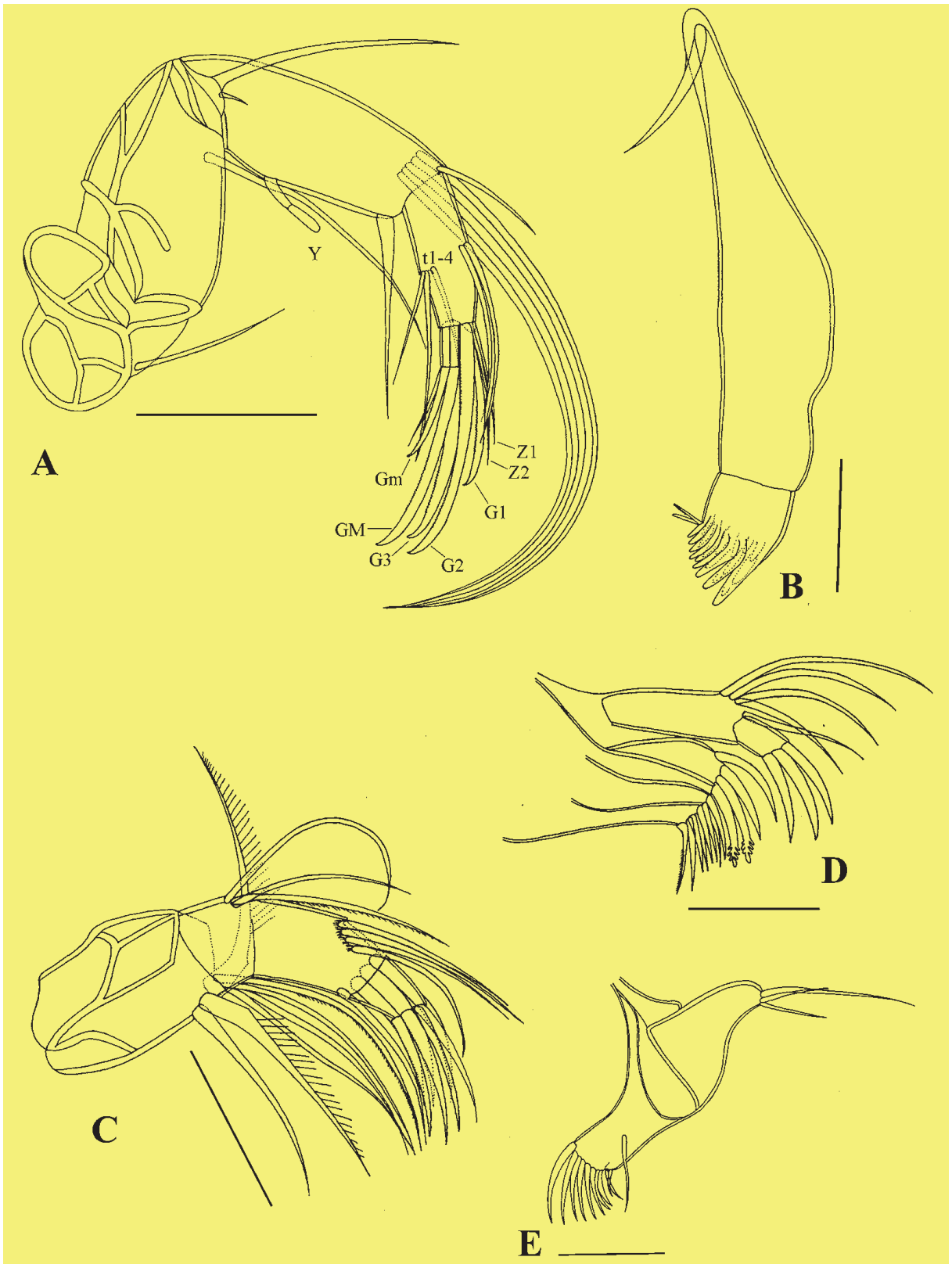

Fig. 4. *Cyprinotus cingalensis* Brady, 1889; A- Antenna; B- mandibular coxal plate; C- Mandibular palp; D- Maxillula; E- First thoracopod. Scale = 0.1mm

PLATE-4

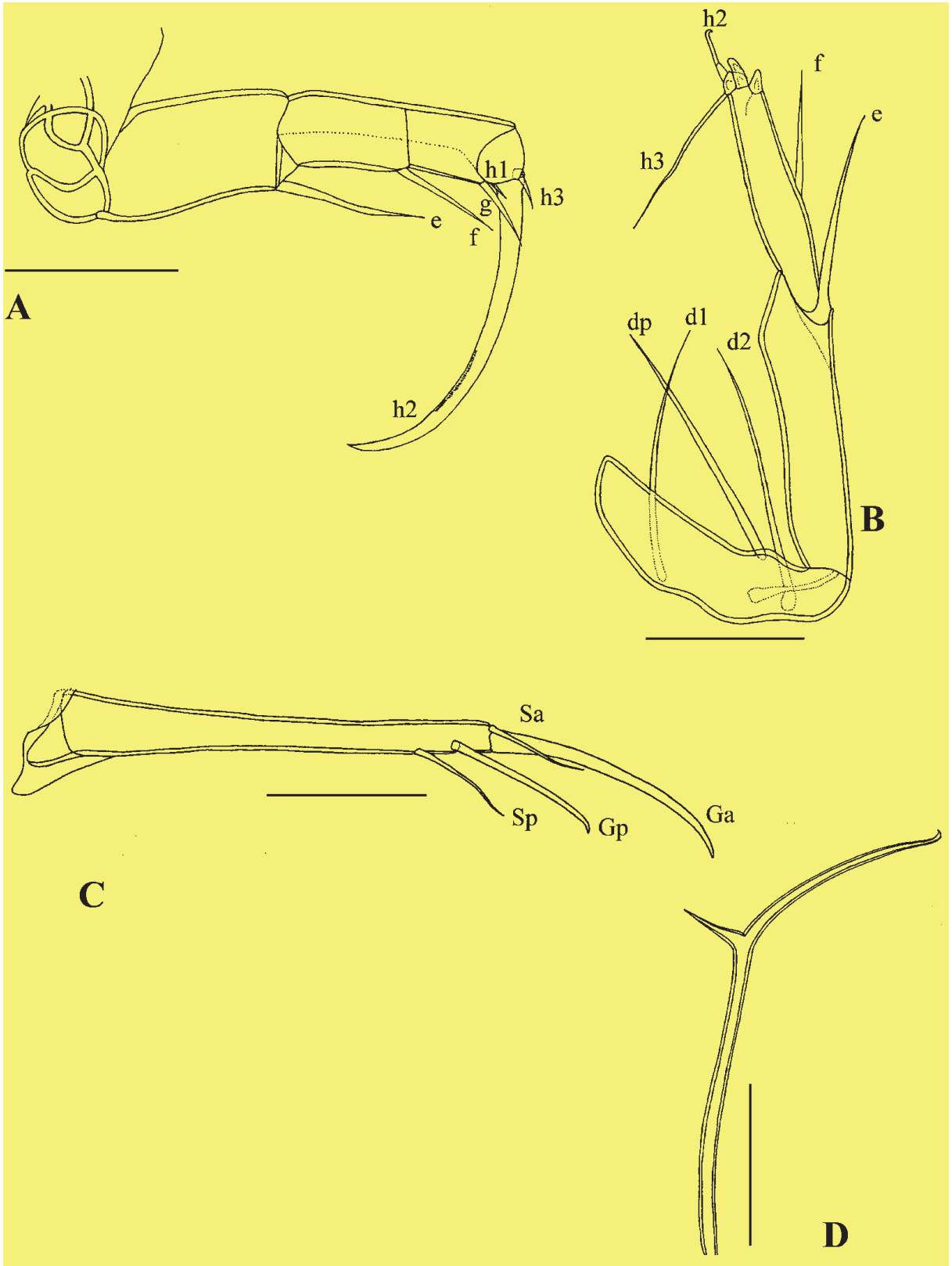

Fig. 5. *Cyprinotus cingalensis* Brady, 1889; A- Second thoracopod; B- Third thodacopod; C- Uropodal ramus; D- Uropodal attachment. Scale = 0.1mm

PLATES-5

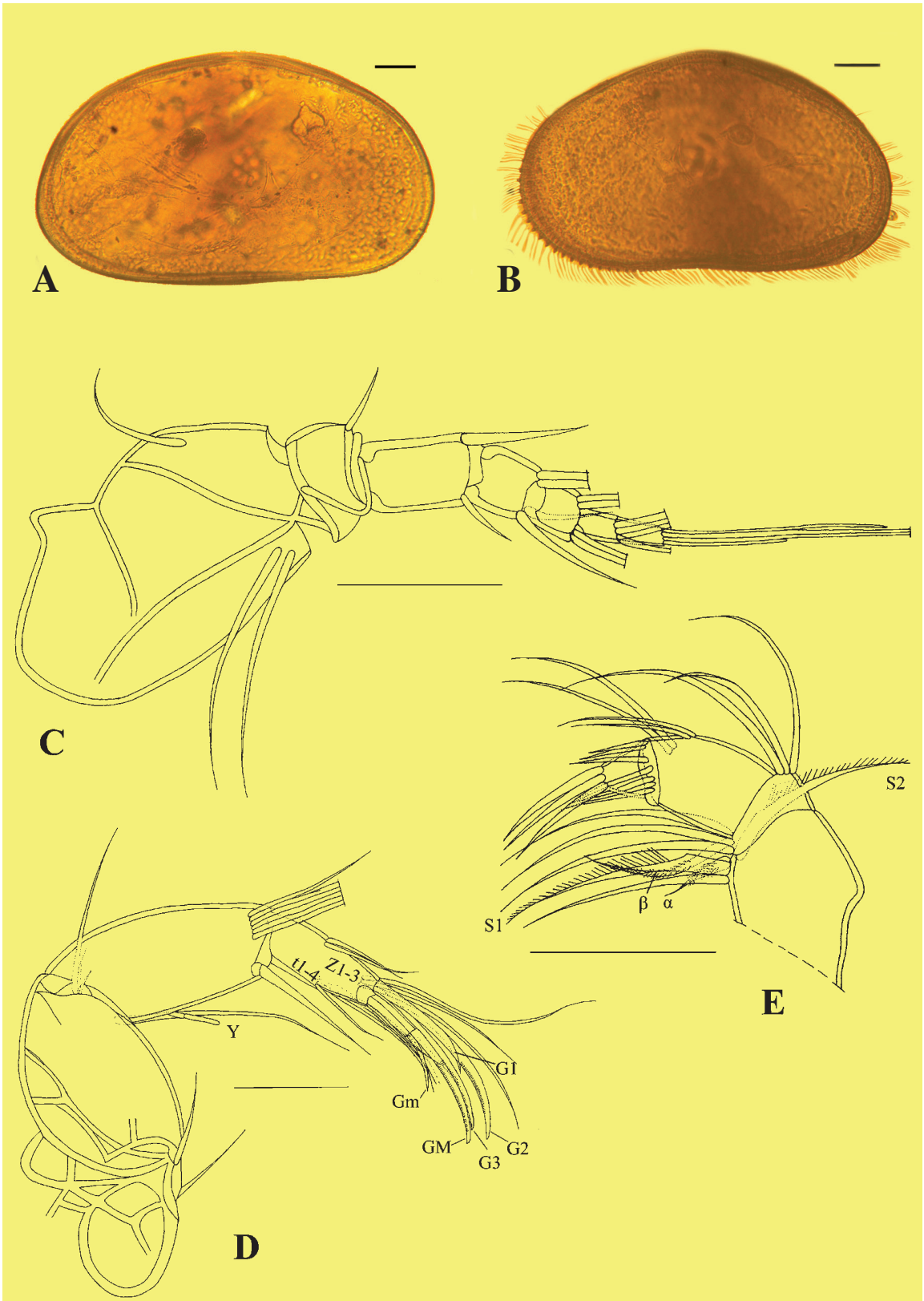

Fig. 6. *Hemicypris dissona* Victor and Fernando, 1976. A- Right valve; B- Left valve with tubercules; C- Antennule; D-Antenna; E- Mandibula. Scale = 0.1mm.

PLATES-6

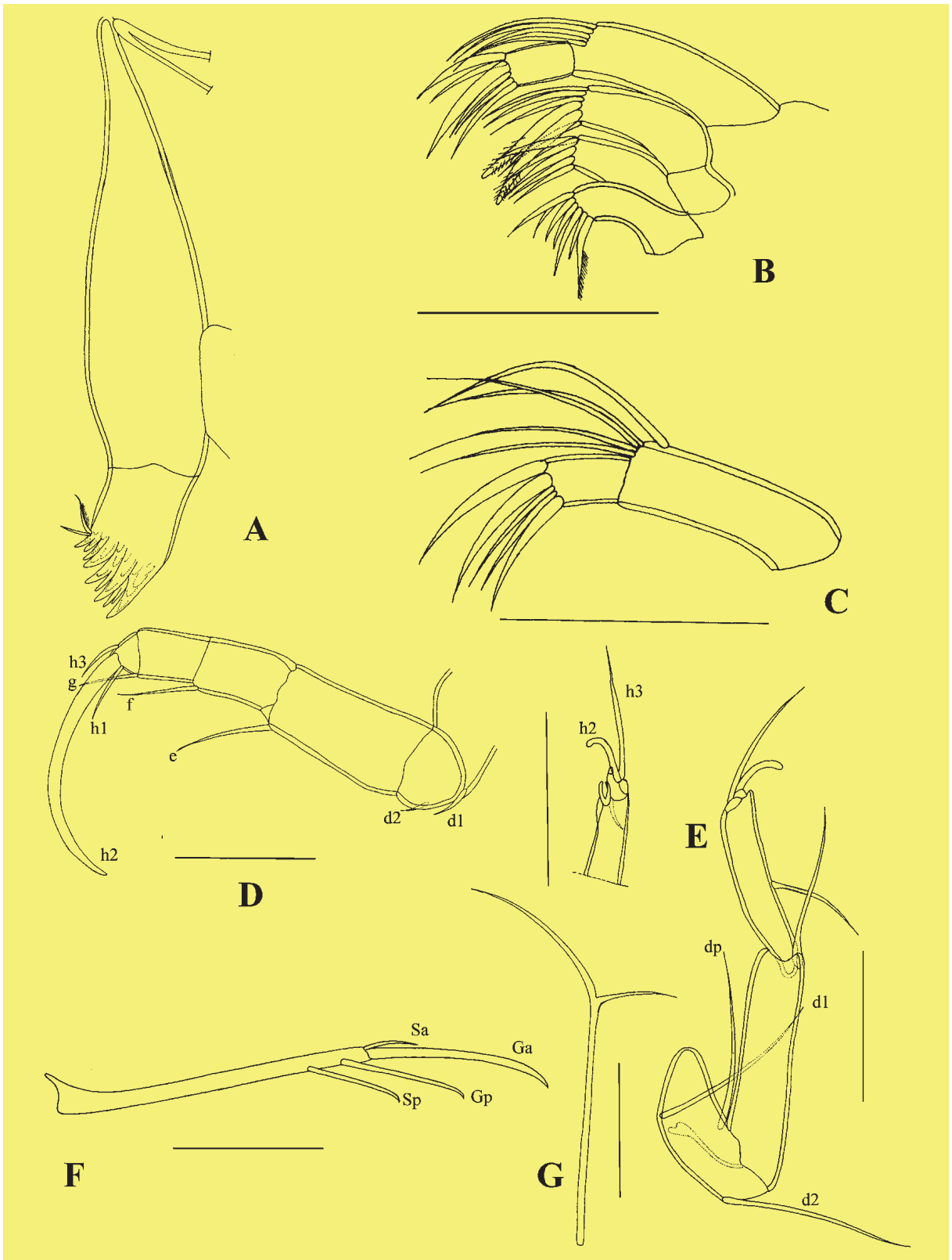

Fig. 7. *Hemicypris dissona* Victor and Fernando, 1976. A- Coxal palte of mandibula; B- Maxillula; C- maxillula palp; D- Second thoracopod; E- Third thoracopod; F- Uropodal ramus; G- Uropodal attachment. Scale = 0.1mm

PLATES-7

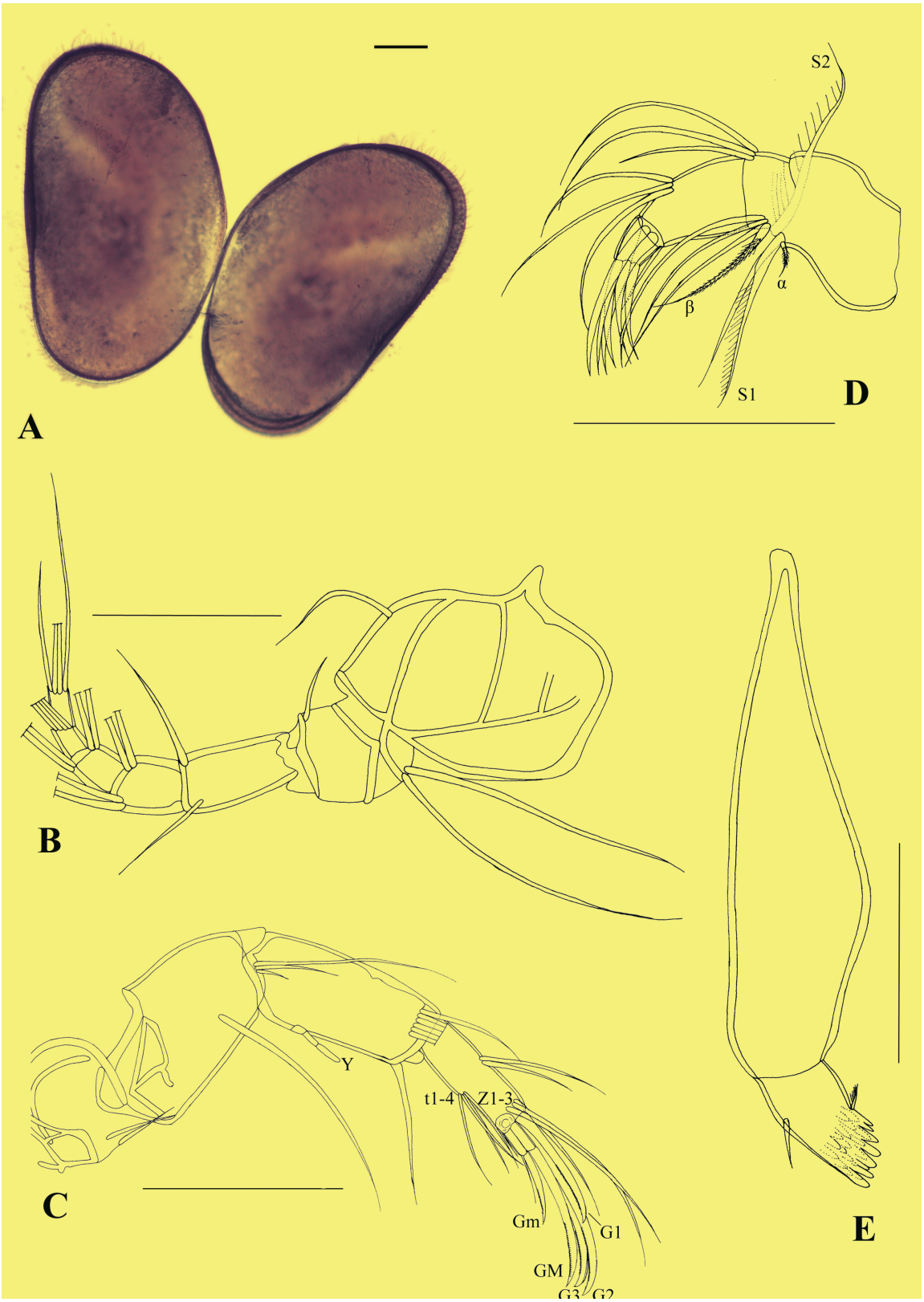

Fig. 8. *Heterocypris favosa* Victor and Fernando, 1980. A- Carapace; B- Antennule; C- Antenna; D- Mandibula; E- Mandibula coxal plate. Scale = 0.1mm

PLATES-8

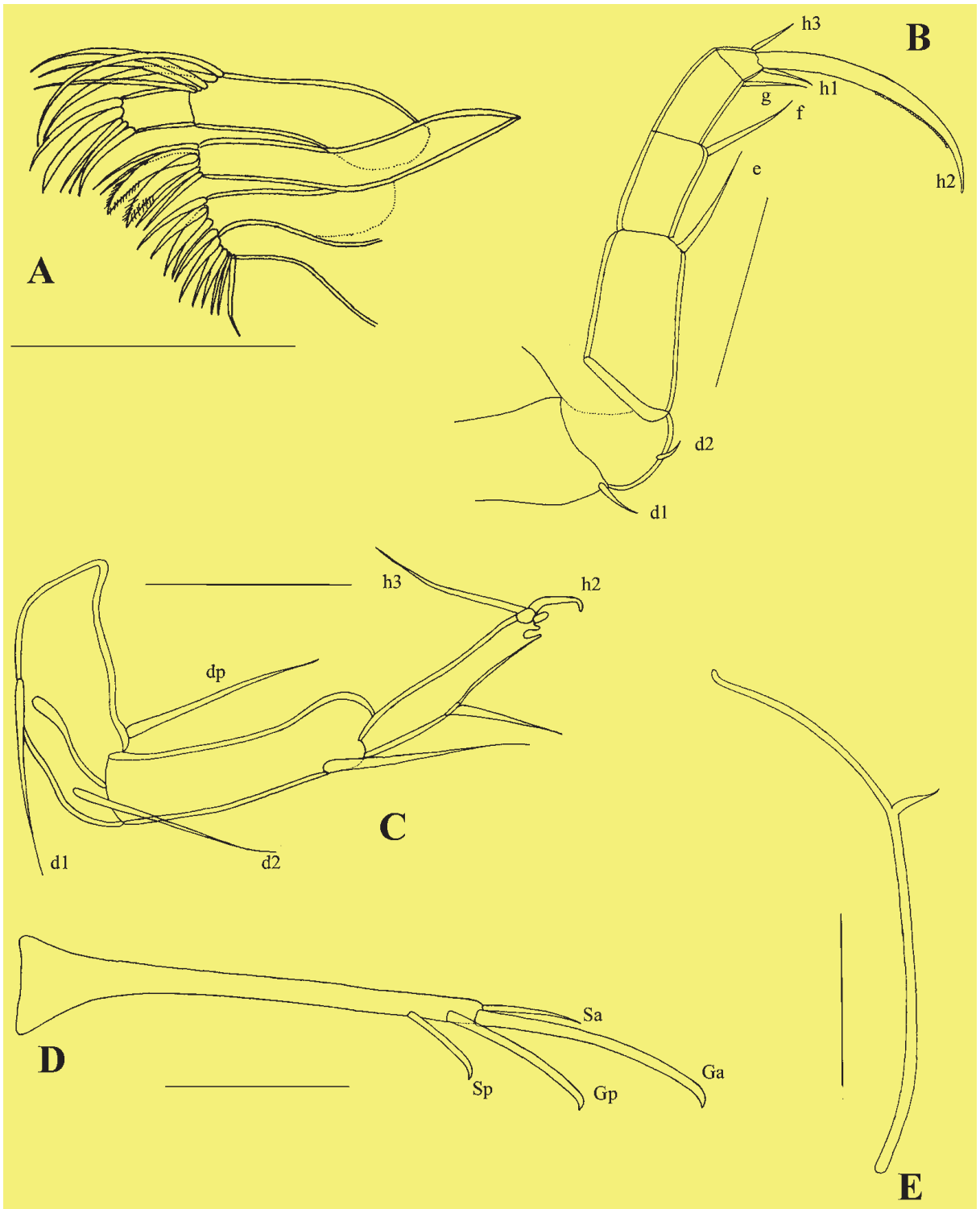

Fig. 9. *Heterocypris favosa* Victor and Fernando, 1980. A- maxillula; B- Second thoracopod; C- Third thoracopod; D- Uropodal ramus; E- Uropodal attachment. Scale = 0.1mm

PLATES-9

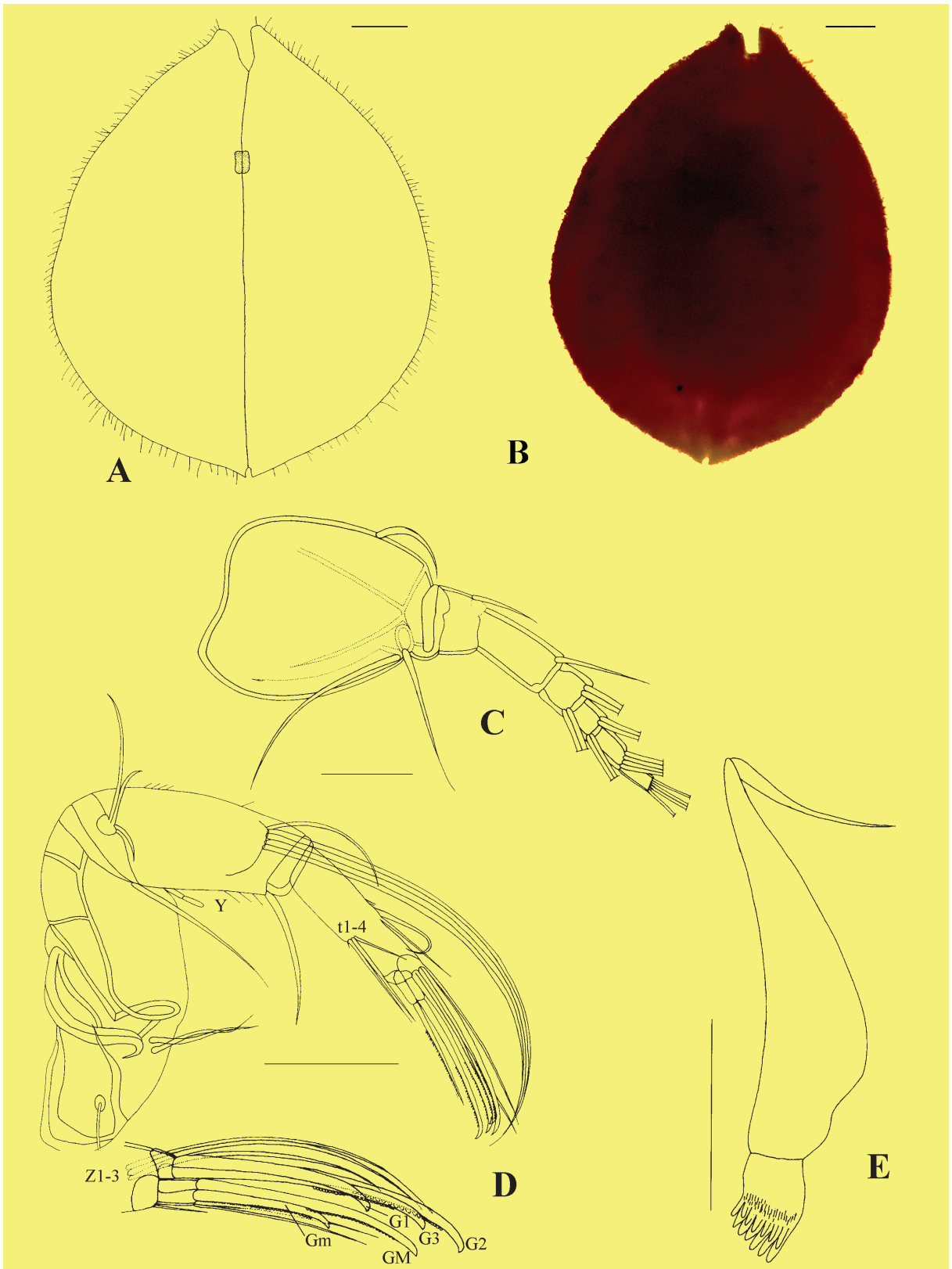

Fig. 10. *Cypris subglobosa* Sowerby, 1840 ♀; A and B- Carapace; C- Antennule; D- Anntena; E- Mandibular coxal plate.

PLATES-10

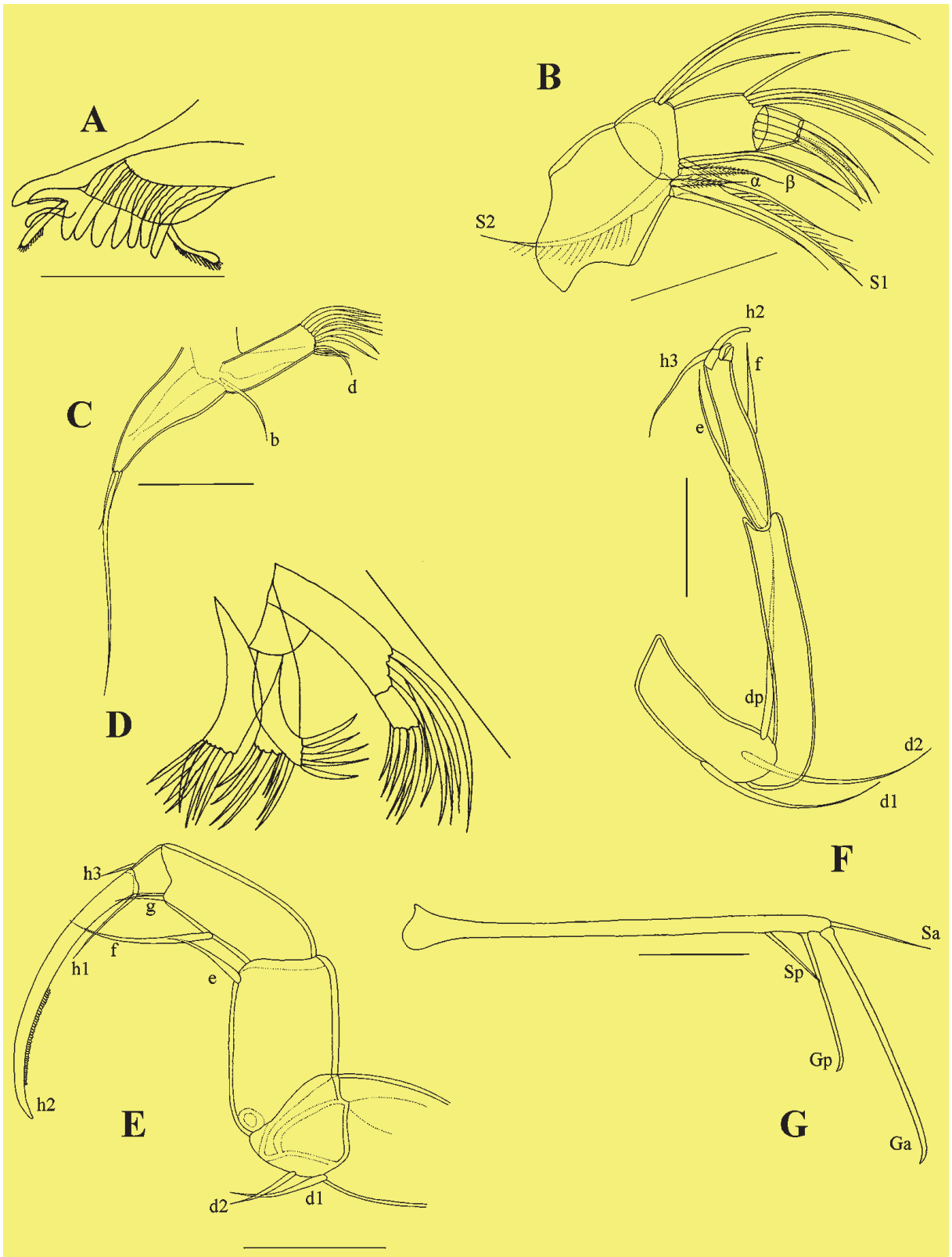

Fig. 11. *Cypris subglobosa* Sowerby, 1840 ♀; A- Tooth of the Coxal plate; B- Mandibular palp; C- First thoracopod; D- Maxillula; E- Second thoracopod; F- Third thoracopod; G- Uropodal ramus

PLATES-11

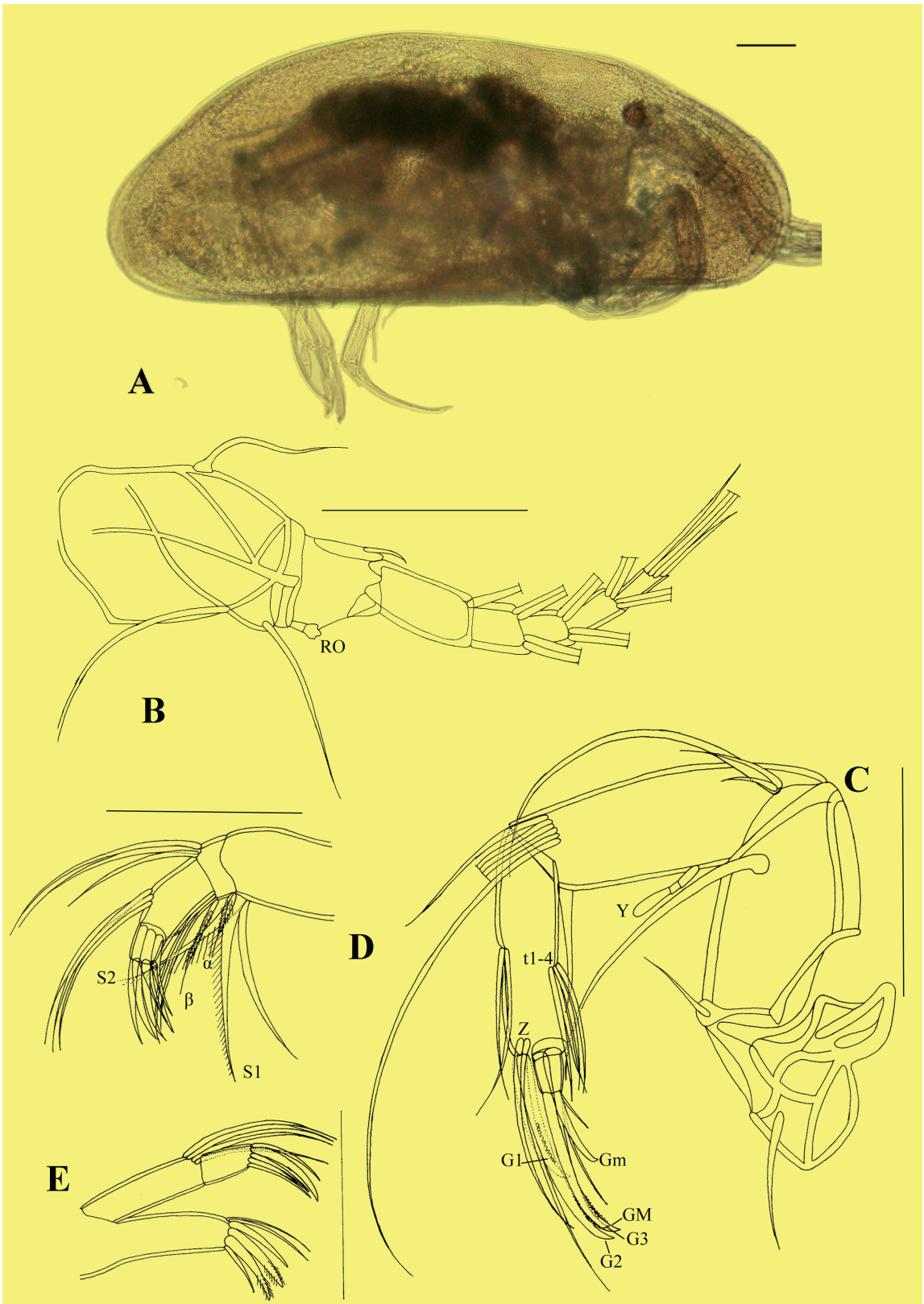

Fig. 12. *Chrissia formosa* (Klie, 1938) A- Carapace of the animal; B- Antennule; C- Antenna; D- Mandibula; E- Maxillula palp and first endities. Scale = 0.1mm.

PLATES-12

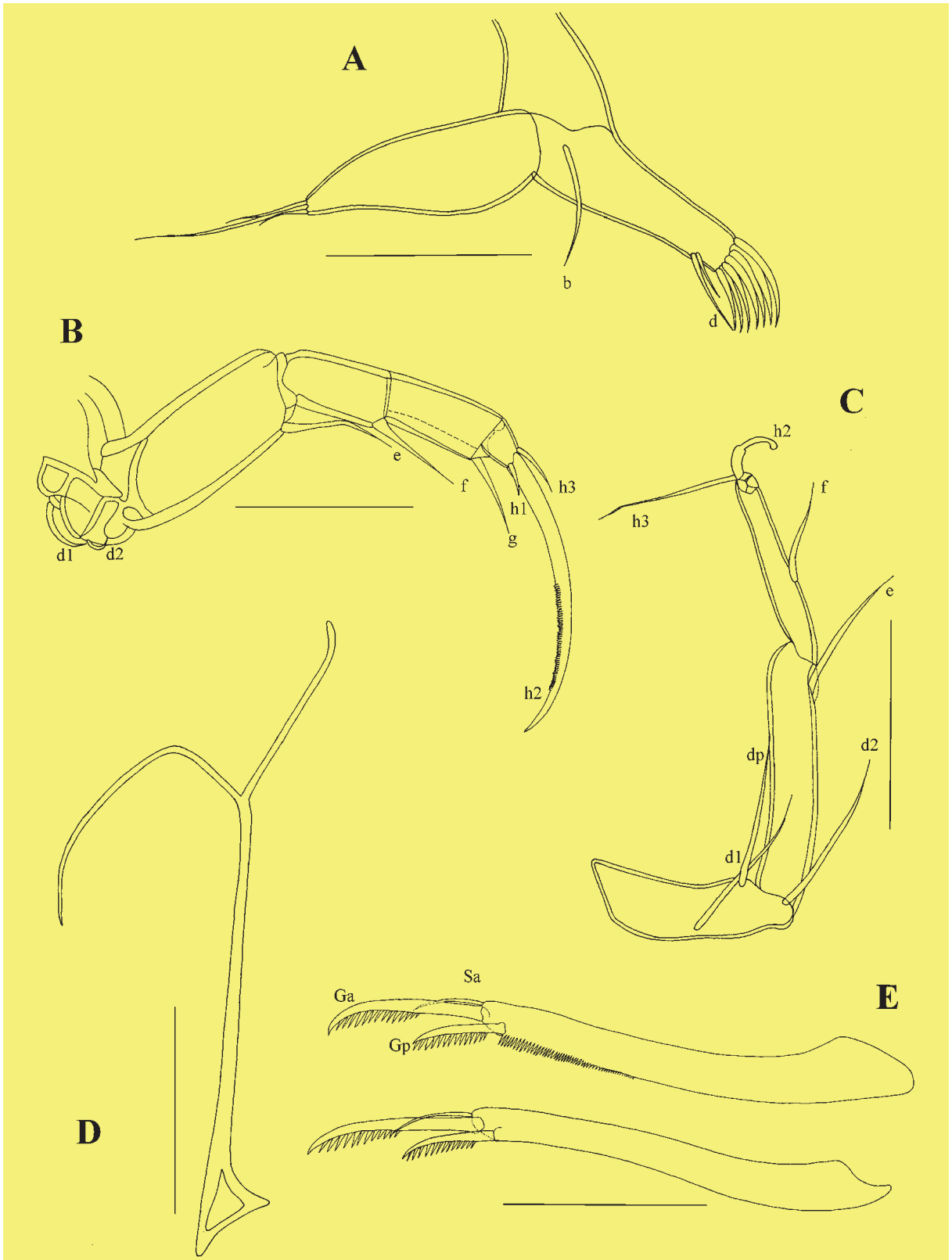

Fig. 13. *Chrissia formosa* (Klie, 1938) A- First thoracopod; B- Second thoracopod; C- Third thoracopod; D- Uropodal attachment; E- Uropodal ramus. Scale = 0.1mm

PLATES-13

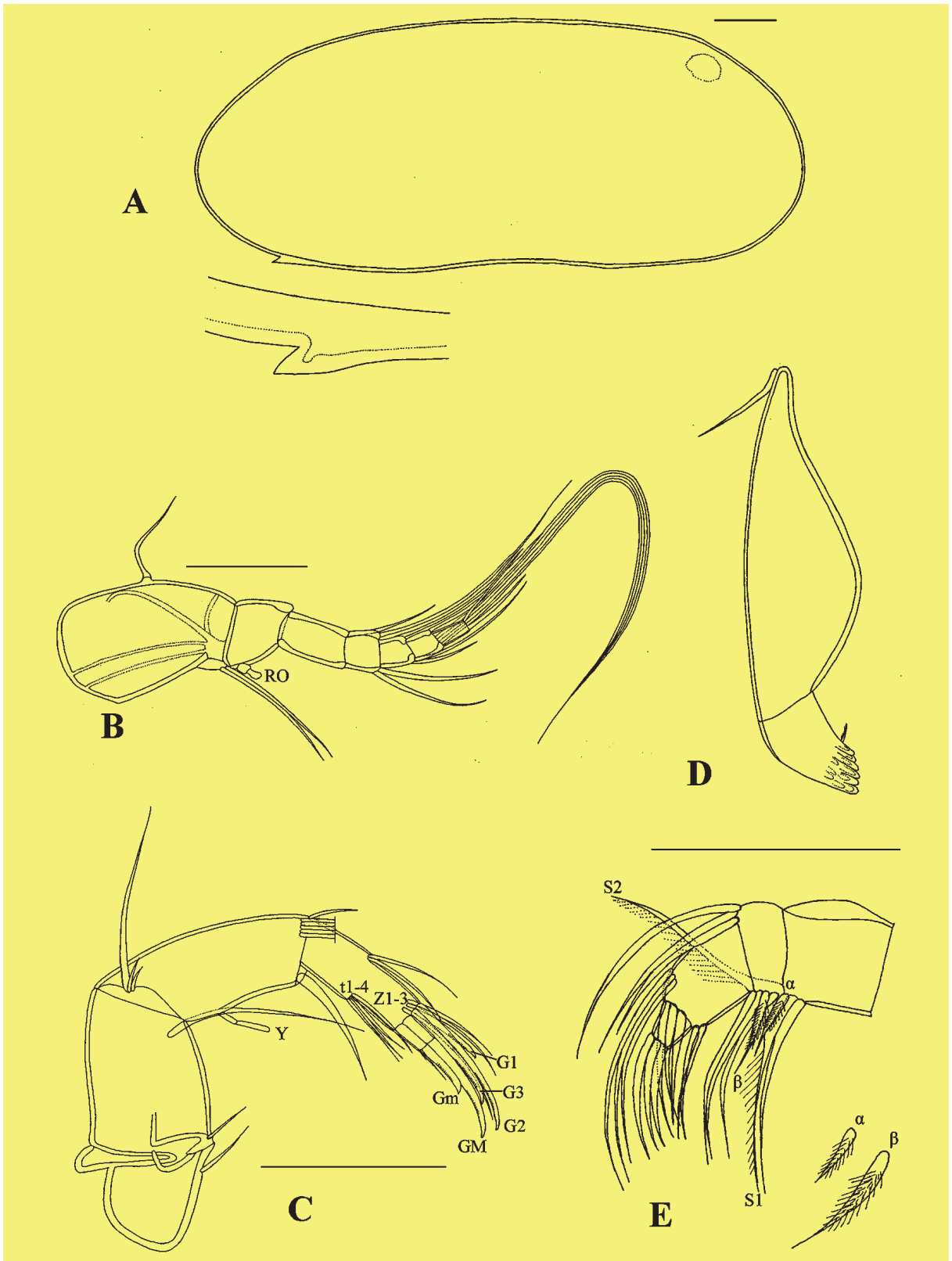

Fig. 14. *Chrissia spinosa* (Tressler, 1937); A- Carapace; B- Antennule; C-Antenna; D- Mandibular coxal plate; E- mandibular palp. Scale = 0.1mm

PLATES-14

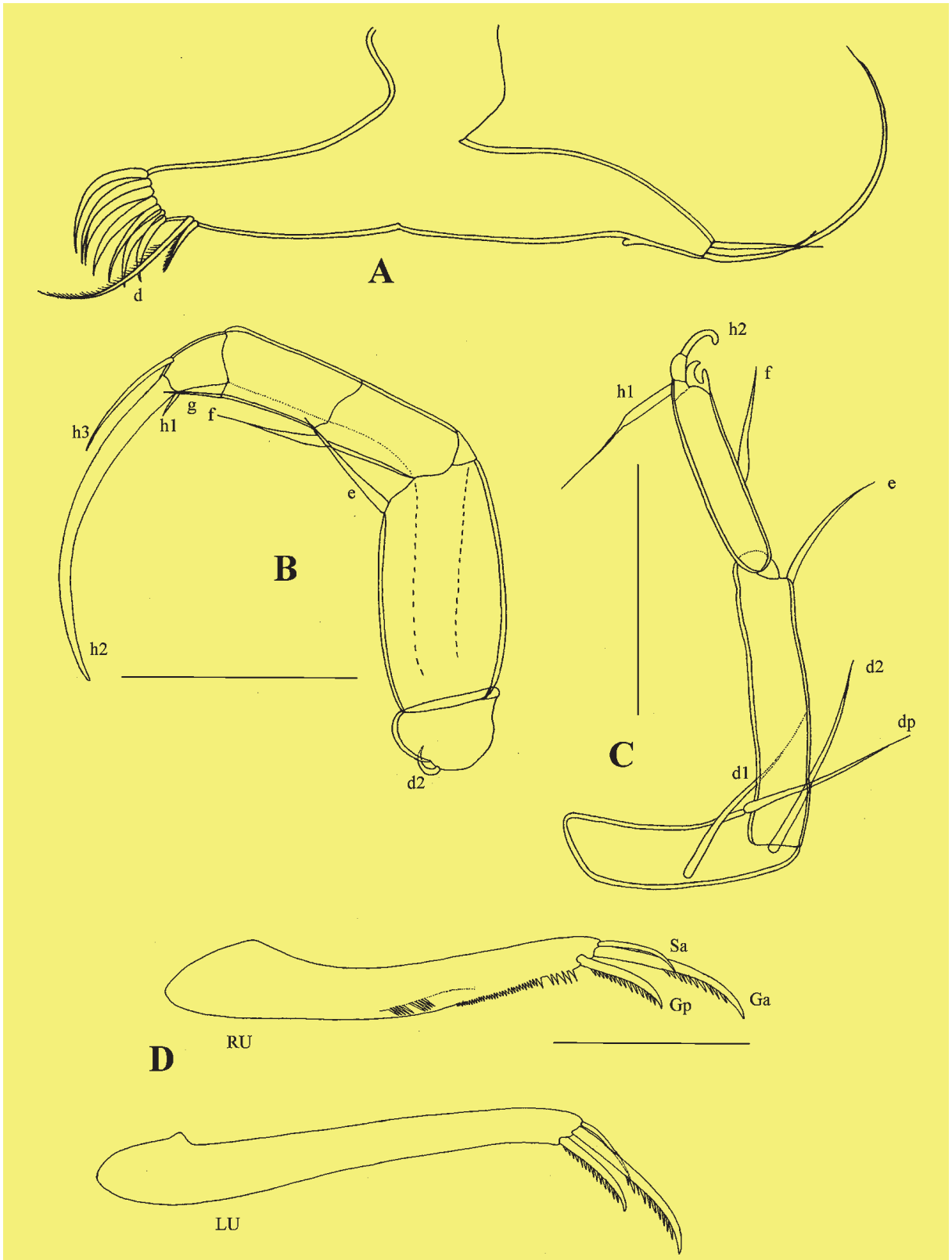

Fig. 15. *Chrissia spinosa* (Tressler, 1937); A- First thoracopod; B- Second thoracopod; C- Third thoracopod; D- Uropodal ramus . Scale = 0.1mm

PLATES-15

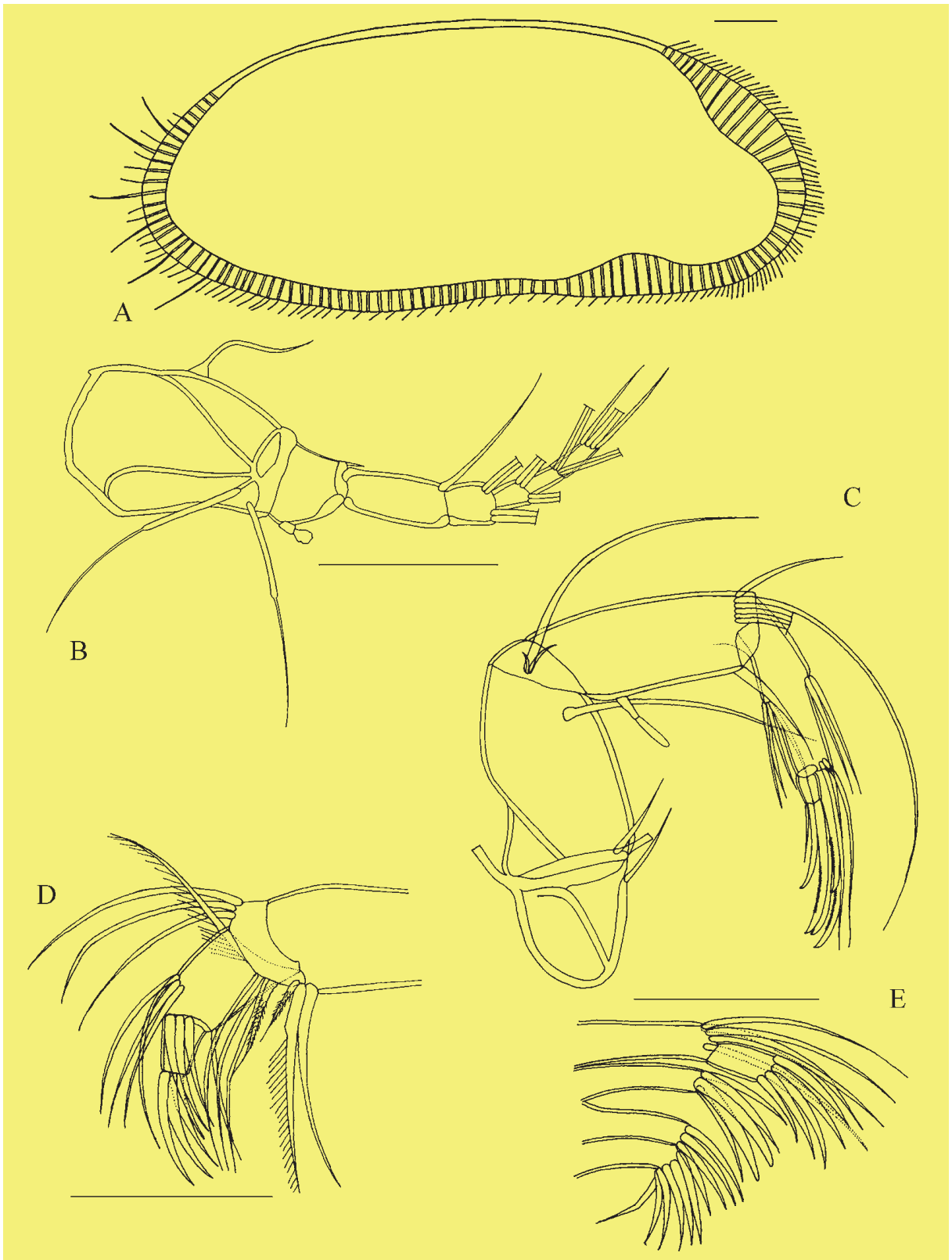

Fig. 16. *Stenocypris hislopi* Ferguson, 1969; A- Carapace; B- Antennule; C- Antenna; D- Mandibular palp; E- Maxillula.

PLATES-16

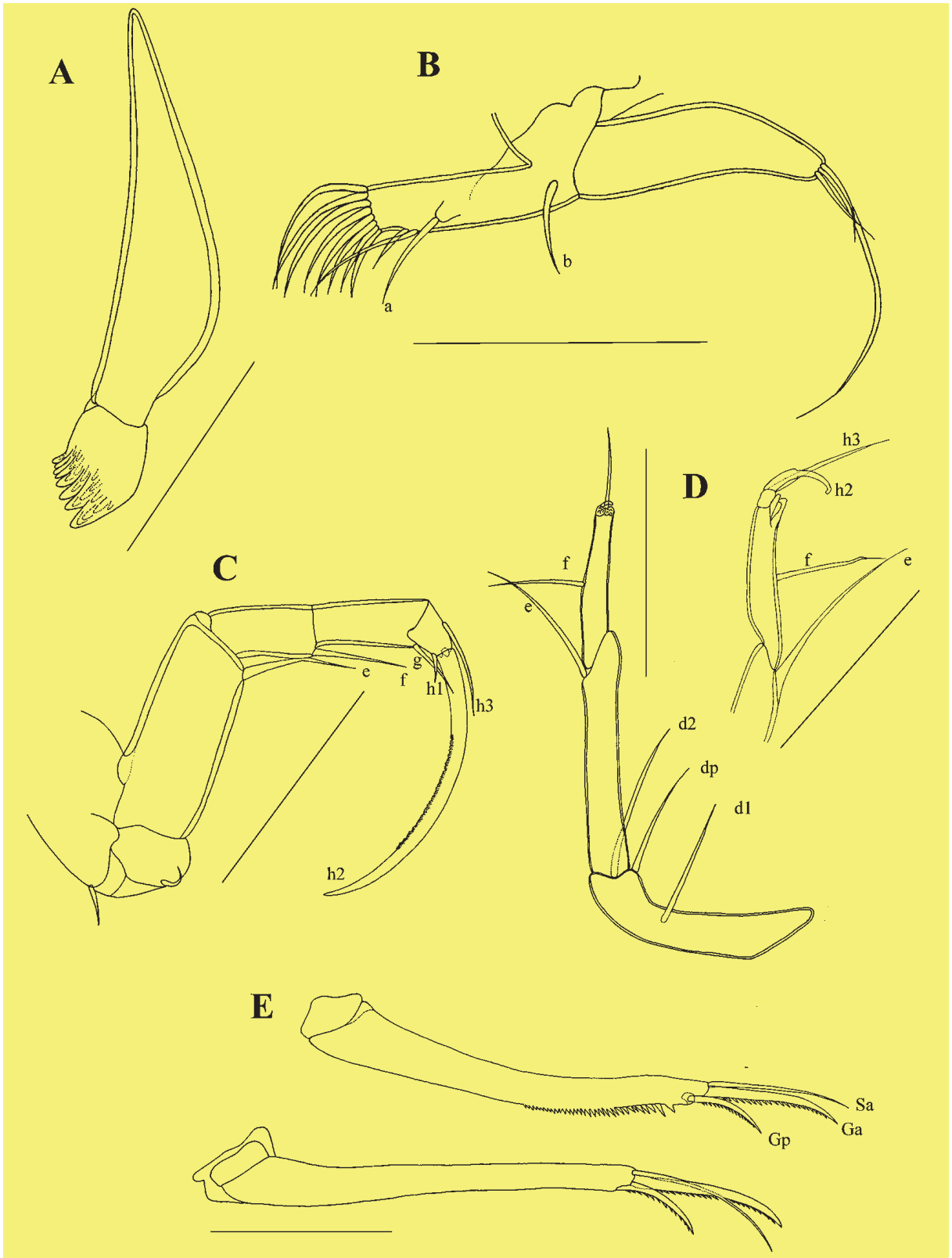

Fig. 17. *Stencypris hislopi* Ferguson, 1969; A- Mandibular coxal palte; B- First thoracopod; C- Second thoracopod; D- Third thoracopod; E- Right and Left Uropodal ramus.

PLATES-17

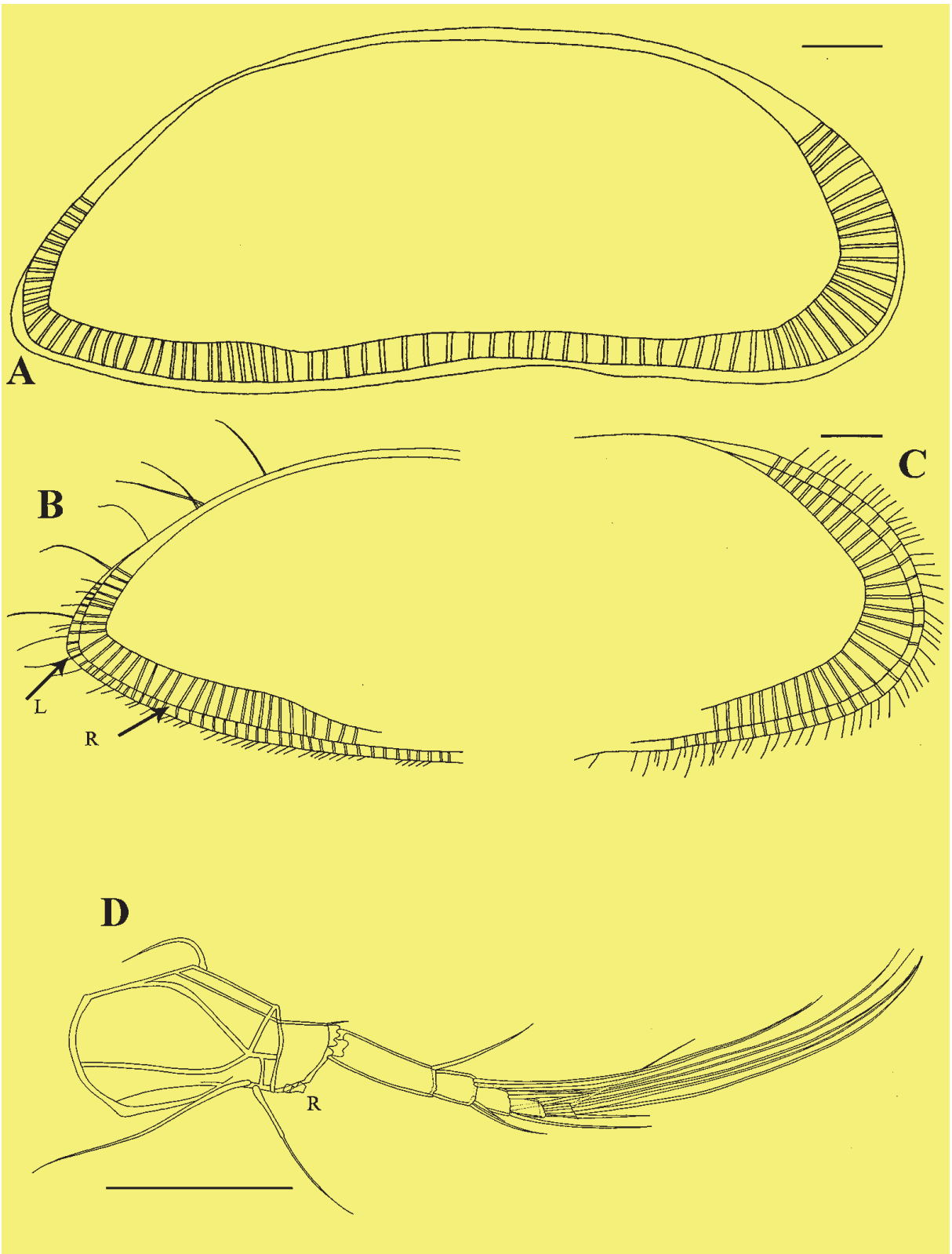

Fig. 18. *Stenocypris derputa* Vavra, 1906; A- Carapace; B- Posterior margin, C- Anterior margin; D- Antennule

PLATES-18

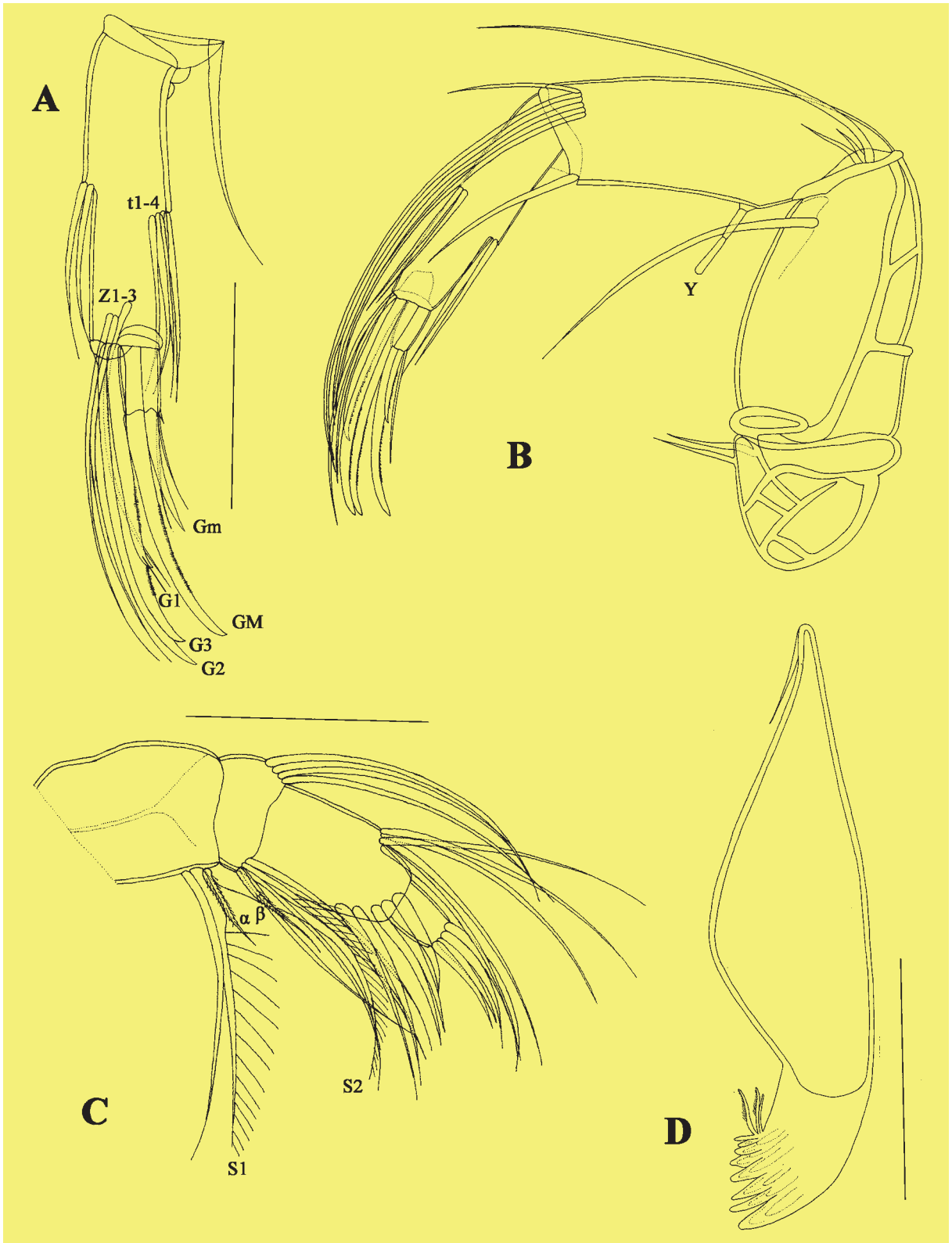

Fig. 19. *Stenocypris derputa* Vavra, 1906; A&B- Anntena; C- Mandibula palp; D- Madibular coxal palte

PLATES-19

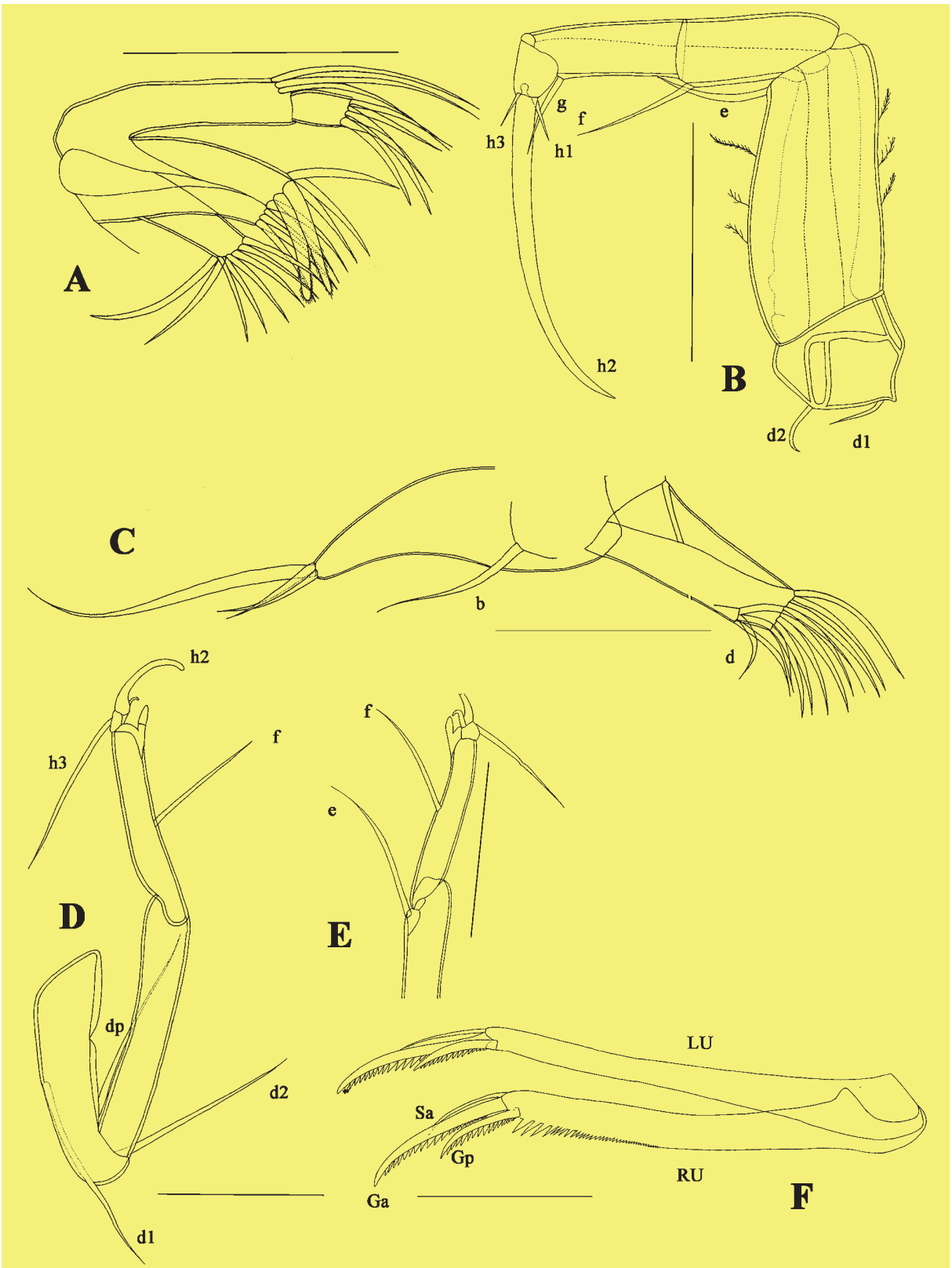

Fig. 20. *Stenocypris derputa* Vavra, 1906; A- Maxillula, B- First thoracopod; C- Second thoracopod; D&E- Third thoracopod; F- Uropodal ramus.

PLATES-20

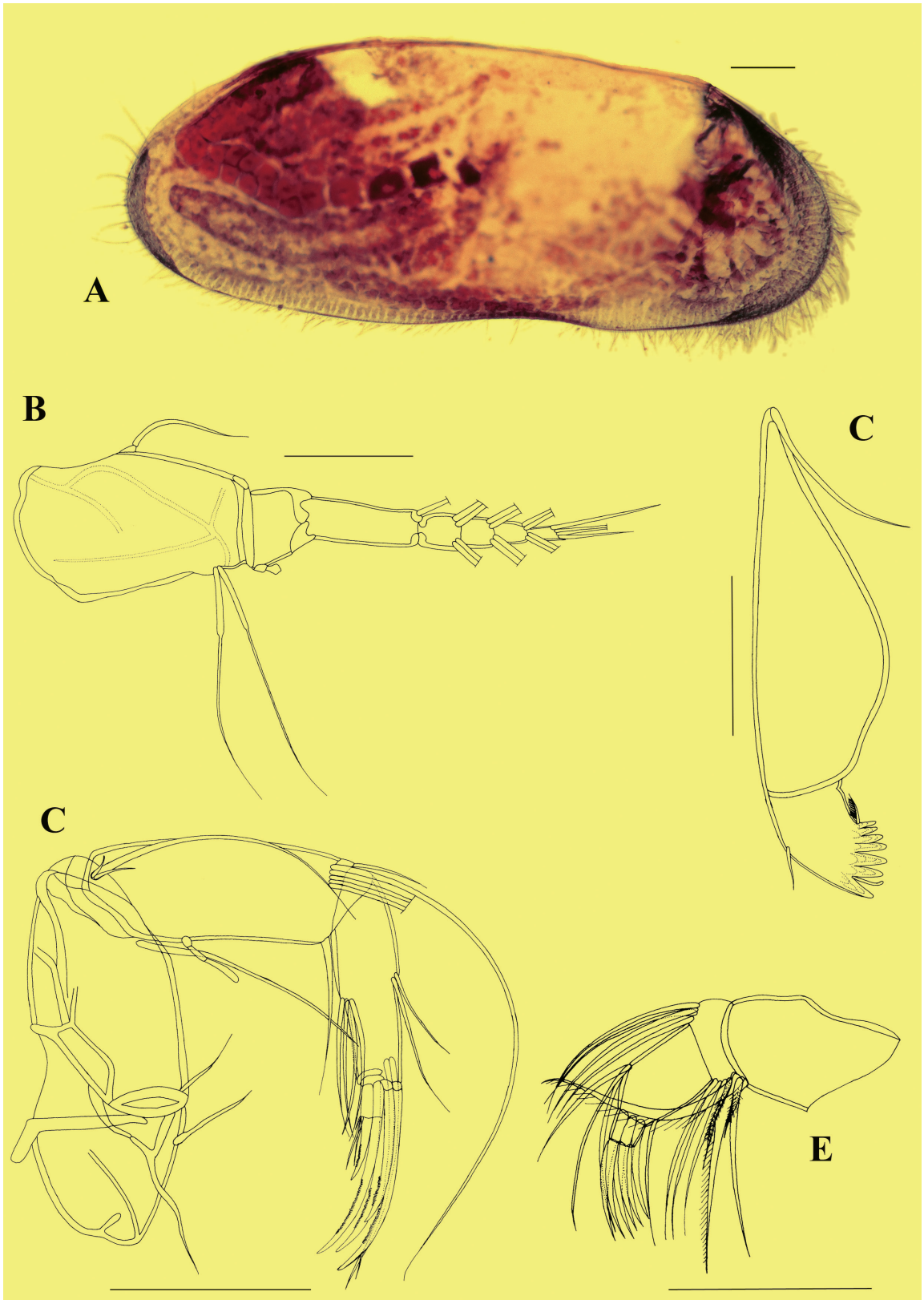

Fig. 21. *Stenocypris major* Baird, 1859 A- Carapace Left valve; B- Antennule; C- Antenna; D- mandibular coxal plate; E- Mandibular palp. Scale= 0.1mm.

PLATES-21

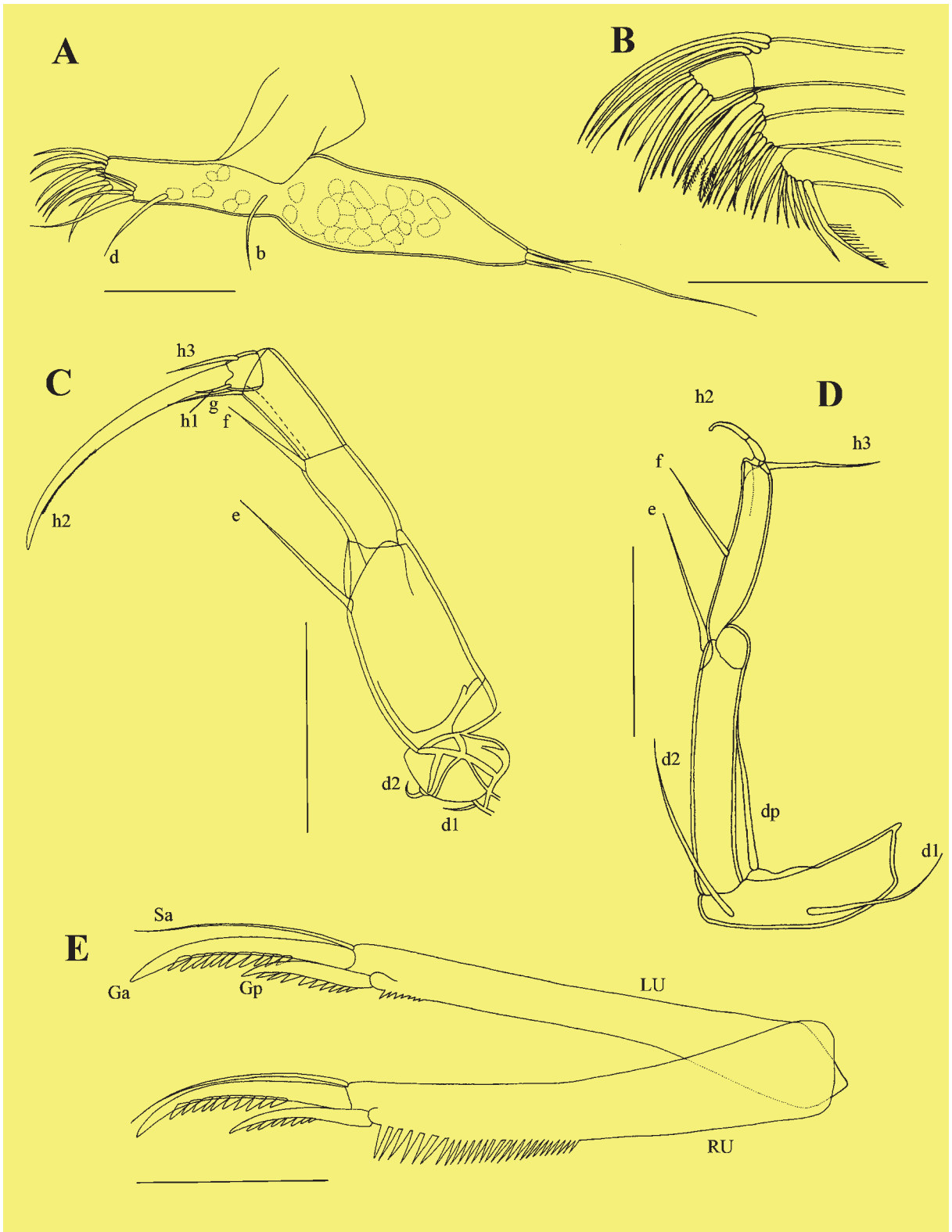

Fig. 22. *Stenocypris major* Baird, 1859 A- Maxillula; B- First thoracopod; C- Second thoracopod; D- Third thoracopod; E- Uropodal ramus. Scale = 0.1mm.

PLATES-22

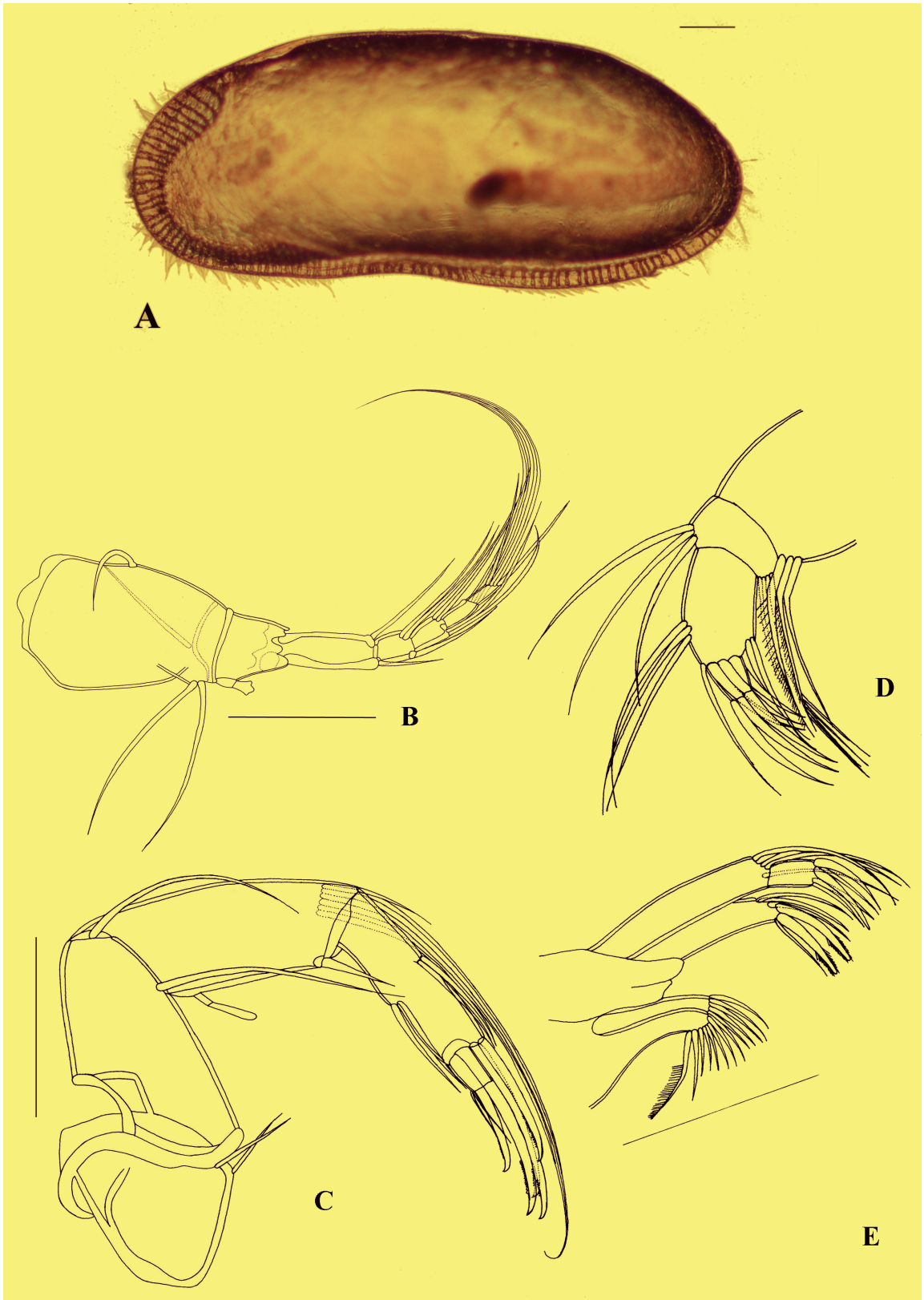

Fig. 23. *Stenocypris simulans* Rome 1965; A- Carapace; B- Antennule; C- Anntena; D- Mandibular palp; E- Maxillula with first endities. Scale = 0.1mm.

PLATES-23

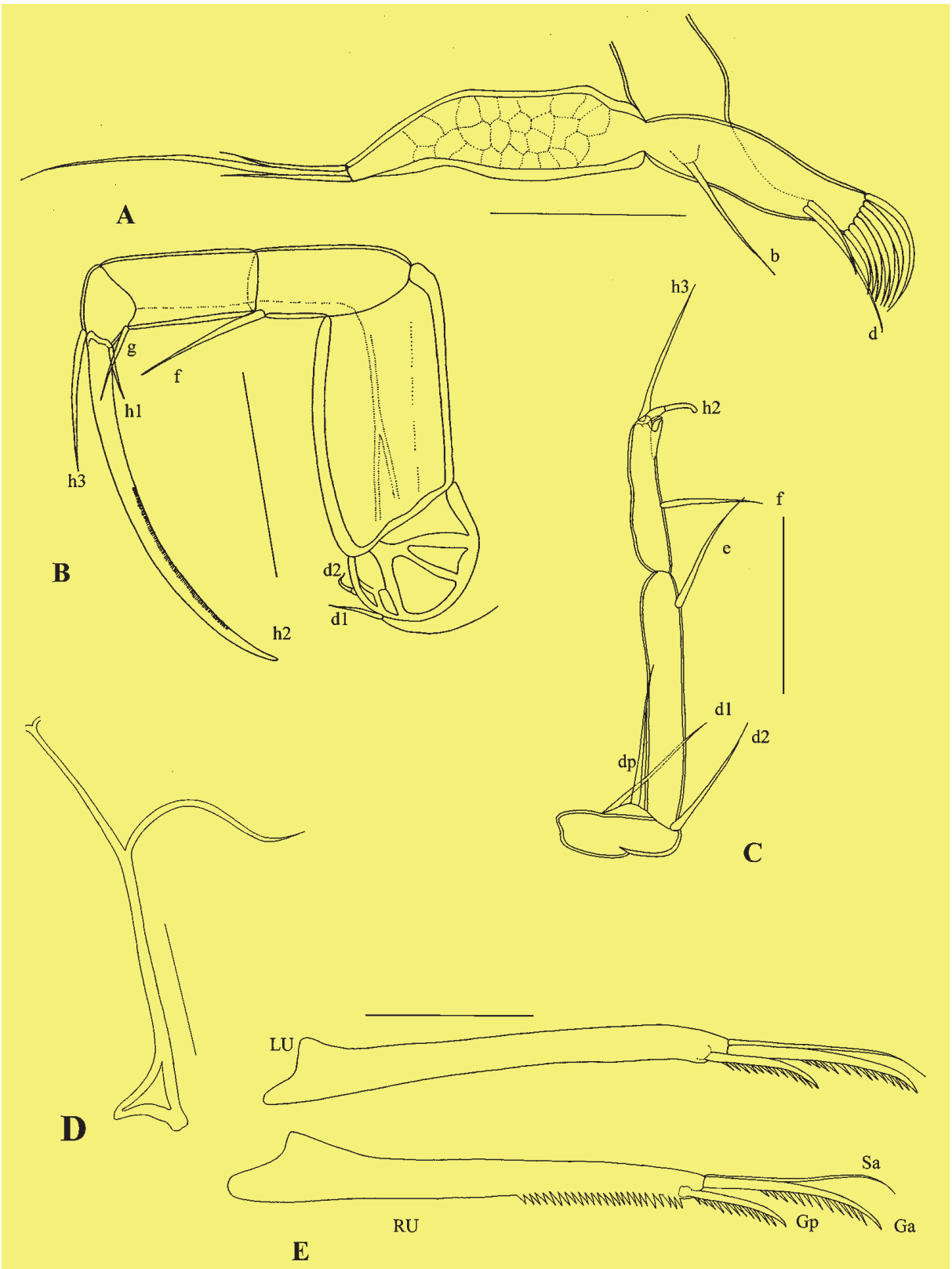

Fig. 24. *Stenocypris simulans* Rome 1965; A- First thracopoda; B- Second thoracopod; C- Third thodracopod; D-Uropodal attachment; E- Uropodal ramus.

PLATES-24

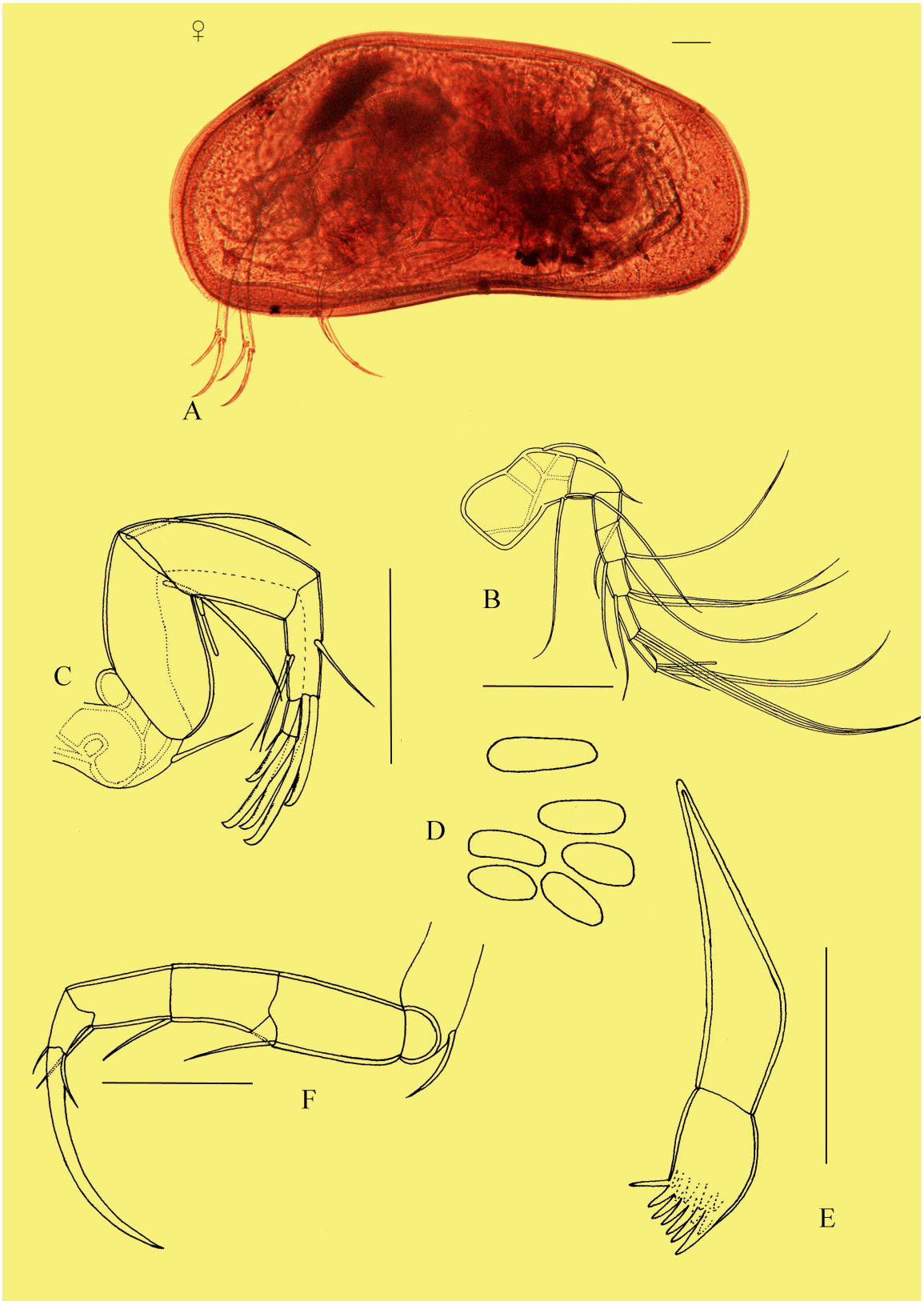

Fig. 25. *Fabaeformiscandona subacuta* (Yang, 1982) ♀; A- Carapce of the female animal; B- Antennule; C- Anntena; D- Adductor muscle scar; E- Mandibular coxal plate; F- Second thoracopod. Scale = 0.1mm

PLATES-25

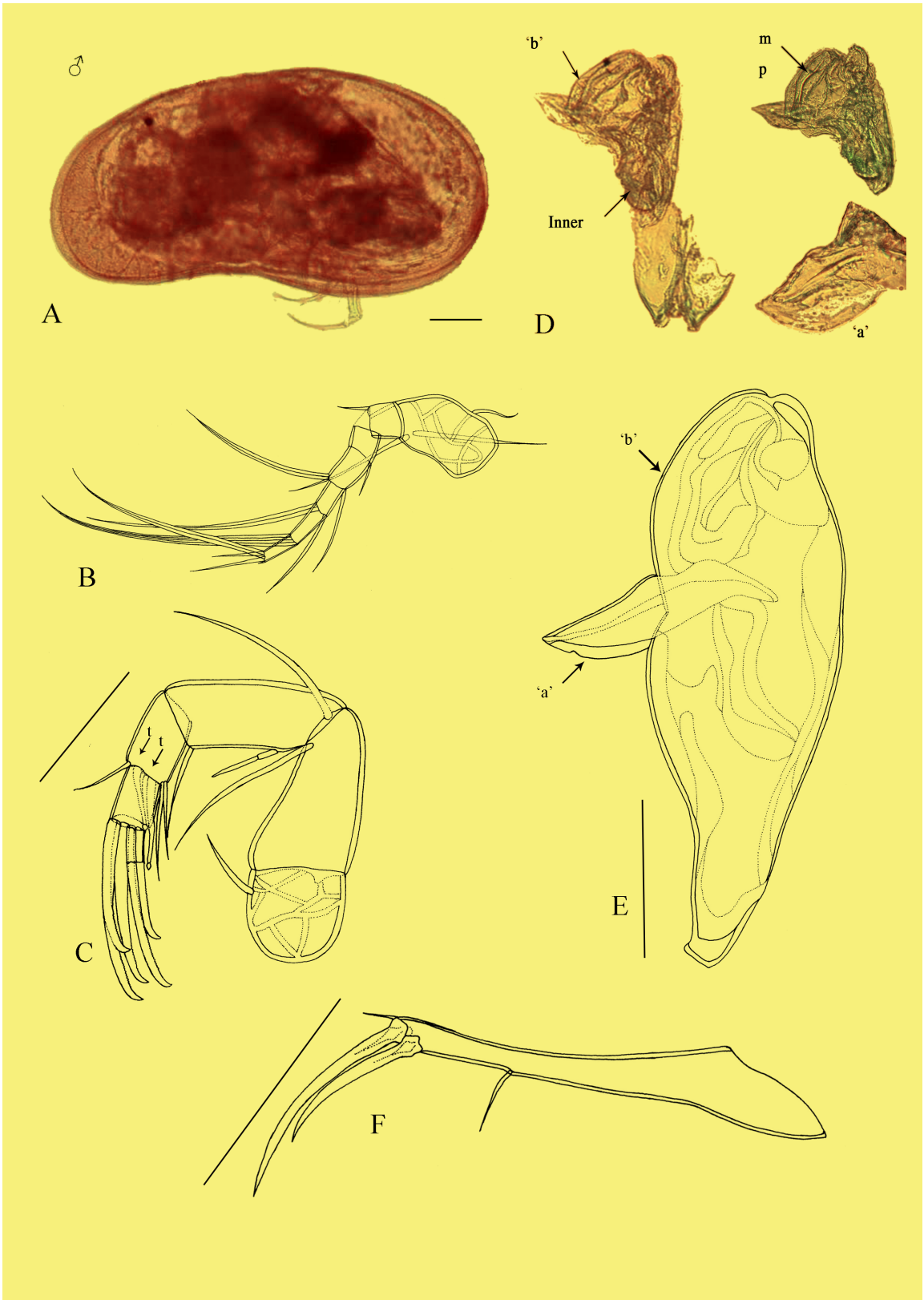

Fig. 26. *Fabaeformiscandona subacuta* (Yang, 1982) ♂; A- Carapace of the male animal; B- Antennule; C- Antenna; D&E- Hemipenis; F- Uropodal ramus. Scale = 0.1mm.