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Morphological variability of planktonic ostracods of the genus *Halocypris* (Dana, 1853)

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Abstract A study has been carried out into the variability of the main morphological characters of pelagic ostracod species belonging to the genus *Halocypris* collected from the Pacific, Indian, and Atlantic Oceans. The type and range of morphological variability are compared between the species, and the possibility of using some of these characters for species identification is considered.

Keywords: pelagic ostracods, Halocyprididae, *Halocypris*, morphological variability

Introduction

Members of the genus *Halocypris* are widely distributed in the tropical and subtropical zones and often occur far beyond their normal limits both to the north (60ºN, Vavra, 1906; Poulsen, 1969) and to the south (54ºS in Deevey, 1982) as a result of advection in warm poleward-flowing currents. The species have been reported as inhabiting wide depth ranges from the surface to depths of 2000–3000 m (e.g. Poulsen, 1969; Deevey, 1982) and even to 4000 m (Chen and Lin, 1994b). However, they undoubtedly occur most abundantly in the upper 200 m (Angel, 1982).

Only three species are presently known: *H. inflata* (Dana, 1849) and *H. pelagica* Claus, 1890, and now *H. angustifrontalis* Chavtur (Chavtur & Stovbun, 2008) that has only recently been described.

All the species are highly polymorphic. This may accounts for the frequency with which new species were described during the second half of 19th century, and then subsequently found to be variants of already established species. These included *H. toynbeeana* Lubbock, 1860, *H. concha* Claus, 1874, *H. dubia* Müller, 1890, and *H. distincta* Claus, 1890. Not only are the species polymorphic, but all three are also very similar morphologically. Their traditional taxonomic characters are highly variable and tend to overlap between the species. Therefore, it is often extremely difficult to distinguish these species with any confidence, such that at the beginning of 20th century the two supreme authorities in halocyprid taxonomy, G. W. Müller (1906) and T. Skogsberg (1920) both concluded that *H. pelagica* is a synonym of *H. inflata*. This opinion was generally accepted for many decades, until Angel (1982) undertook a thorough comparison of morphological features of *H. inflata* and demonstrated that *H. pelagica* is a valid species. He listed a number of characters which, in his opinion, reliably separated the two species.

The aim of this study has been to establish the character and range of the variability of the main morphological characters of these species, not only those considered in the literature but also some additional

ones. The very extensive plankton collections available to us, have enabled us to assess this variability throughout the entire geographic ranges species in all the oceans in which they occur.

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Materials

This study is based on the extensive material collected by Russian expeditions during 1956 to 1990 from the Pacific, Indian, and Atlantic Oceans (Figs. 1, 2). The study of these collections and literature sources has allowed a more complete account of the distribution of each of the species.

Systematics

Order HALOCYPRIDA Dana, 1853
Suborder Halocypridina Dana, 1853
Superfamily Halocypridoidea Dana, 1853
Family Halocyprididae Dana, 1853
Subfamily Halocypridinae Claus, 1891
Genus *Halocypris* Dana, 1853

This genus includes only *H. inflata* (Dana, 1849), *H. pelagica* Claus, 1890, and *H. angustifrontalis* Chavtur & Stovbun, 2008).

1. *Halocypris inflata* (Dana, 1849)
(Figs. 1, 3–13)

Conchoecia brevirostris + *C. inflata* Dana, 1849: 52.
Synonymy: see Chavtur & Stovbun, 2008b: 71–72.
Halocypris inflata: Chavtur & Stovbun, 2008b: 71–73.

Material studied: see Appendix 1.

Description of morphological variability.

Shell. The carapace varies in size throughout the species's distributional range, and at each locality, but there is no correlation between this variability in size and latitude (Tables 1, 2, 8). The carapace lengths in males range from 1.30 to 1.60 mm and in females from 1.41 to 1.81 mm (Tables 1, 8), although Poulsen (1969) noted the maximum length to be 2.02 mm in females from 27 to 29ºN in the North Atlantic (see his Table for *H. brevirostris*: Table 8, p. 67).

The relative height of the carapace expressed as a percentage of its length (see Angel (1982): Table 2) averages 59% and 72% for males and females respectively from the North and Equatorial Atlantic. Skogsberg (1920: pp. 585, 596), also for Atlantic material recorded the relative height to be 69% and 80–91% for males and females respectively. The mean height of the carapace in our specimens from all the various regions is 67–78% in males and 74–82% in females (Table 2).

The relative breadth also varies extensively; Angel (1982) reported mean breadths for males and females to

be 69 and 82% respectively, and Skogsberg (1920) 60 and 80% respectively. Our specimens have mean relative breadths of 61–65% in males and 73–78% in females (Table 2).

Frontal organ. The shape and size of this organ is very variable in *H. inflata,* not only throughout the distributional range of species, but also within regions, and even within a single sample. The length of the capitulum (expressed as % of the carapace length) is 18–21% in males and 15–20% in females (Table 2). In males from the Atlantic Ocean, its relative length averages 20%, which is comparable with data in Angel (1982: Table 2). The capitulum of males from the Indian Ocean and West Pacific are somewhat shorter, averaging 19% (19.1 and 18.9% respectively). The single male in our collections from the East Pacific has a capitulum length of 20% (Table 2). Our females from the Atlantic Ocean have mean capitulum lengths of only 17%, whereas Angel (1982: Table 2) reported mean relative capitulum lengths to be 18% in material from the same area. The capitulums of females from the Indian and Pacific Ocean are longer, averaging 19% (19.2 and 19.5% respectively).

In males, the height of the capitulum is usually similar throughout its length, but a very few specimens have been illustrated in which the height in the distal part is either slightly greater (Figs. **3**, *13, 14* and **4**, *4*) or slightly less (Fig. **4**, *8*; also in Müller, 1906: Taf. 7, Fig. 27, 28). In females, the capitulum is also similar in height throughout its length (Figs. **3**, *4, 6, 12, 15, 16* and **4**, *10*; also in Skogsberg, 1920: Fig. **62**, *7, 8* and in Tseng, 1980: Fig. 8). The height of the capitulum of the frontal organ averages 23% of its length in males from the North Atlantic, whereas in specimens from the South Atlantic, Indian Ocean and West Pacific, the mean height is somewhat greater averaging 24–25%. In Müller's (1906: Taf. 7, Fig. 27, 28) males, it is approximately 26%. In females, the relative height is similar (20.4–20.9%) in specimens studied from the regions listed in Table 7; only in one specimen from the Equatorial Atlantic was it larger (22.3%). Skogsberg's (1920: Fig. **62**, *7, 8*) and Tseng's (1980: Fig. 8) figures of females show the capitulum height to be approximately 22 and 23% of its length respectively. The mean relative height of the capitulum throughout all the regions investigated was 24% for males and 21% for females.

The shape of the tip of the frontal organ is very variable in both sexes. In males from the Atlantic Ocean, it is usually rounded, rarely it is pointed or almost pointed (Fig. **3**, *3, 11*). Müller's (1906: Taf. 7, Fig. 27, 28) illustrations of male frontal organs in specimens from this area show both rounded and pointed capitulums. Males from the Indian and Pacific Oceans males have rounded (Figs. **3,** *13, 14*; **4**, *1, 2, 4*) or blunt tips (Figs. **3**, *8*; **4**, *3, 8, 12*) to the capitulum. Brady's (1880: Pl. 39, Fig. 6) and Müller's (1890: Taf. 28) illustrations show only rounded tips. In females, the tip of the frontal organ is always rounded, also as illustrated by Skogsberg (1920: Fig. 8) and Tseng (1980: Fig. **62**, *7, 8*).

The ganglionic mass inside of the capitulum is elongated and thin and is very variable in shape in both males and females.

Second antenna, endopodite: In males and females of *H. inflata,* the endopodite is exceedingly variable, not only throughout the geographical range of species, but also within the various regions, even with a single sample and between the left and right limbs of the same specimen. There are no patterns in this variability that could be related to either latitude or longitude. Below ranges in the variability some characteristics of the endopodite on the second antenna are given.

In males, the "a" bristle on the first segment of the endopodite is generally bare and is of the usual type, but very occasionally examples occur in which it is spine-like (Fig. **5**, *5, 6*), or minute (Fig. **5**, *3–5*), or quite large (Figs. **6**, *4, 6* and **7**, *8*). Usually this seta ranges in length from about 20% (Fig. **5**, *3, 4*) to about 50% (Figs. **6**, *4, 6* and **7**, *8*) of the length "b" bristle (Skogsberg's illustration (1920) p. 588 shows it as 50%). Usually the "a" bristle is delimited from the first segment by an obvious suture, but ocassionally it is fused with it (Figs. **6**, *1* and **8**, *5*). The near the base of the "a" bristle the surface of the segment can be either bare (Fig. **5**, *2, 6*) or covered with a few short hairs (Fig. **5**, *3–5, 7, 8*).

The length of the "b" bristle ranges in males from the Atlantic Ocean from 32% to 52% of the breadth of the first segment (averaging 41%) (Figs. **5, 6**, *1-4*; in Skogsberg, 1920 - about 50% in p. 588 and approximately 40% in Fig. **113**, *10*). In males from the Indian Ocean, its range is 30–51% (averaging 39%) (Figs. **6,** *5-8* and **7**, *1-4*) and those from the Pacific Ocean 33–40% (averaging 37%) (Figs. **7**, *5-8* and **8**). This bristle is usually is bare, but rarely it is armed with short hairs (Fig. **6**, *3, 4, 7, 8*). It varies in length and thickness, but usually the "b" bristle is longer, than "c" seta (also in Skogsberg, 1920: Fig. **113**, *10*), but occasionally it is equal in length (Figs. **6**, *7* and **7**, *3*) or slightly shorter (Fig. **8**, *6*). At the base of the "b" bristle, there is usually a suture, but, in a very few specimens, it is fused to the segment (Figs. **5**, *1* and **6**, *1*). The surface of the segment where this bristle is inserted is always bare. The bases of "a" and "b" bristles may be contiguous (Fig. **7**, *1, 5* and **8**, *5*) or separated (slightly in Figs. **6**, *4* and **7**, *7, 8*, but extensively in Figs. **5**, *6, 7* and **6**, *1*).

On the second endopodite segment, the "c" bristle is shorter, than the "d" bristle. The length of the "c" bristle is very variable, and often differs between the left and right limbs of the same specimen. Usually its length is 50–60% that of the "b" bristle, but very occasionall they are subequal or the "c" bristle may even exceed the length of the "b" bristle (Figs. **6**, *7, 8*; **7**, *7, 8* and **8**, *5, 6*).

The "d" bristle on the second endopodite segment is also highly variable in its length, even between on the left and right limbs of the same male (Figs. **6**, *1, 2, 7, 8* and **7**, *7, 8*). Usually, this bristle usually is a little longer or equal in length to the "b" bristle, but very occasionally it is slightly shorter (Figs. **5**, *4, 6, 8* and **8**, *4*; equal in Skogsberg, 1920: Fig. **113**, *10*). The bases of the "c" and "d" bristles always are almost always contiguous and only in one case they observed to be separate (Fig. **7**, *3*).

Some males were found with abnormal numbers of bristles on the second segment. Thus, a few individuals were found from the Indian (Fig. **7**, *7, 8*) and Pacific (Fig. **8**, *3, 4*) Oceans with an additional bristle near with the "c" and "d" bristles. The one specimen from the North-East Pacific had only a single long bristle on the second segment (Fig. **8**, *5, 6*). Finally the specimen collected from the Atlantic Ocean (near the Equatorial Africa) also had a minute "e" bristle together with the "c" and "d" bristles (Fig. **6**, *1, 2*).

The right and left claspers on the endopodite are very curved, and vary in shape and size. Terminally they are slightly swollen with some subterminal ridging; they may or may not have a tiny terminal point. On the right limb, the clasper on the right limb may either be evenly thick throughout its length (Figs. **5**, *3*; **6**, *5*; **7**, *1, 3* and **8**, *1, 3, 5*) or slightly thickened either proximally (Fig. **6**, *3*) or medially (Figs. **5**, *5* and **6**, *1, 7*) or distally (Figs. **5**, 1 and **7**, *7*), and the ventral margin may be either evenly rounded (Fig. **6**, *3, 5* et al.) or slightly undulate (Figs. 5, *1*; **6**, *7*; **7**, *7* et al.). The base of this clasper is short, and then it curves through an angle of 90°, or occasionally a little less (Figs. **7**, *1* and **8**, *1*). Just over half way along its length, it curves through another angle of about 90° (Figs. **5**, *1*; **6**, *1, 5* and **7,** *3*) or more (Figs. **5**, *3, 5, 7*; **6**, *3, 7*; **7**, *1, 5, 7* and **8**, *1, 3, 5*). The clasper on the left limb is weaker and is evenly thick throughout its length. It too is curved proximally and centrally through angles of about 90° (Figs. **7**, *6*; **8**, *2, 4* et al.) or slightly more (Figs. **6**, *4*; **7**, *8*; **8**, *6* et al.).

The distoventral surface of the second endopodite segment may be either bare (Figs. **5**, *1, 2* et al.) or covered with short hairs (Figs. **5**, *3, 4* etc).

In females: the endopodite of the first antenna is also exceedingly variable in the numbers and sizes of its bristle, and in shape of the 1st segment, throughout its entire distributional range, within different regions, within a single sample and even between the right and left limbs of the same specimen (Figs. **9–11**). The distoventral margins of the first and second segments either form a straight line or an angle of about 150° (Fig. **9**, *1*). This margin on the first segment is either smooth (Fig. **9**, *4, 5*) or wrinkled (Figs. **9**, *6* and **10**, *6*).

The "a" and "b" bristles are placed either on the angled top of the first endopodite segment (Fig. 9; see also Skogsberg, 1920: Fig. **113**, *12* and in Müller, 1906: Taf. 7, Fig. 26) or on the protuberance (Fig. **10**, *3–5*). The "a" bristle is almost always present, but was lacking in one specimen (Fig. **9**, *4*). It is short and slim in females from the Atlantic (Fig. 9) and Indian (Fig. 10) Oceans, but, in some specimens from the Pacific Ocean, it is long

and stout (Fig. **11**, *6, 7*). Its the length ranges from 20–25% to 40–60% the length of the "b" bristle in females. Skogsberg (1920: Fig. **113**, *12*) shows its length to be is about 20% of the "b" bristle, and Müller (1906: Taf. 7, Fig. 26) approximately 25%.

The "b" bristle is mostly long and quite stout, and occasionally short and slim (Fig. **9**, *6, 7*). Its length relative to the breadth of the first segment is 40–57% (averaging 49%) in females from the North Atlantic (Fig. **9**, *1–5*); 30% in those from the South Atlantic (Fig. **9**, *6, 7*); 38–53% (averaging 47%) in those from the Indian Ocean (Fig. 10) and 35–50% (averaging 41%) in those from the Pacific Ocean (Fig. 11). Müller's (1906: Taf. 7, Fig. 28) and Skogsberg's (1920: Fig. **113**, *12*) illustrations show it to be about 50–55% of the segment's breadth. The "a" and "b" bristles are either separated from the first segment by a suture (Fig. **10**, *1*) or are fused with it (Fig. **9**, *1*). Similarly, in some specimens, their bases are contiguous (Fig. **11**, *7*), or set apart (Fig. **9**, *3*).

The "c" bristle on the second endopodite segment is usually absent, but very occasionally specimens have one on either the left or right limb (Figs. **9**, *1* and **11**, *7*), or even both (Fig. **9**, *6* and **7**). The "d" bristle is either similar in length (Fig. **9,** *1*) or little shorter (Figs. **9**, *6, 7* and **11**, *7*) than the length of the distodorsal margin of the second segment (this length is the distance from the base of the "f" bristle to the joint with the first segment.

The dorsal surface of the first segment is bare, whereas the distoventral surface is either covered with short hairs (Fig. **9**, *2*) or bare (Fig. **9**, *3*).

Copulatory appendage. The copulatory appendages are similar in length in males throughout the geographical range of *H. inflata*. Its length ranged from 28–32% of the carapace length, only in one specimen from the South Atlantic was it 35% (Table 2). It varies in shape between different individuals (Figs. **12, 13**). As a rule, its dorsal margin is straight (Fig. **12**, *2*) or slightly concave (Fig. **12**, *3*) and its ventral margin is convex (Fig. 12, 1) or in one example slightly convex (Fig. **12**, *6*). It is relatively broad. Its breadth (B1 – see Fig. **12**, *1*) varies between locations and is fairly uniform. The breadth is ranges from 26% to 31% (mostly 28–29%) of its length (Table 9).

Distally it tapers towards its tip (c.f. Skogsberg, 1920: Fig. 115, *25*). The breadth of its tip (B2) is usually 52–54% of the maximum breadth (B1) (Table 9). On the tip of the appendage is comb with some subterminal spinules. There are 3–6 (usually 4) oblique muscle bands.

Distribution.

Circumtropical - subtropical interzonal species. It occurs widely in shallow and deep waters in the tropics and subtropics of the Atlantic (60ºN–42ºS, at depths ranging from the surface to 1000 m and rarely deeper), the Indian (from the Sri-Lanka to 36º S in vertical tows from 2000–3000 m to the surface), the Pacific (33ºN–42ºS, in depth range 0–2000 m, but most abundantly between the surface and 200–500 m) and South Oceans (from its north boundary at 54ºS in the Indian sector and to 49ºS in the Pacific sector, in the depth range 0–2000 m) (Chavtur and Stovbun, 2008b).

Our material previously unpublished comes from three oceans. In the Atlantic Ocean, *H. inflata* was caught in the area 22ºN–41ºS and 26º–53ºW in a horizontal tows from surface to 400 (424) m and in a vertical tows from 5000 to the surface. It was also collected at 0º27’N, 13º33’E at a depth of 0–250 m. In the Indian Ocean, it was found between 5ºN–34ºS and 53º–66ºE at depths of 0–110 (130) m and in vertical tows from 1250–3350 m to surface, between 23º–38ºN and 138º–149ºE from surface to 500 m and the layer 2000–2500 m (37ºN, 143ºE). In the Pacific Ocean it was collected between 23º–39ºN and 136º–149ºE in stratified tows from the surface to 2500 m but it was most numerous in upper 200 m, also at 13ºN–92ºW in the layer 200–500 m. In the South Ocean, it occurred between 42º–46ºS and 123º–129ºE in vertical tows from 500–2200 m to surface (Indian sector), and between 43º–52ºS and 144º–148ºE in stratified catches from 400 to 0 m (Pacific sector).

Size.

In literature, the length of males of *H. inflata* from the Atlantic Ocean are reported to range from 1.32 mm to 1.60 mm, and females from 1.48 mm to 2.02 mm. In the Indian Ocean (and Indian sector of the South Ocean), males range in length from 1.40 to 1.54 mm, and females from 1.40 to 1.70 mm. In the Pacific Ocean (and also the Pacific sector of the Southern Ocean), males range from 1.36 to 1.57 mm, and females from 1.51 to 1.80 mm (Chavtur and Stovbun, 2008b).

Our specimens of males and females of *H. inflata* from the Atlantic Ocean have length ranges of 1.35–1.55 mm and 1.52–1.85 mm respectively, from the Indian Ocean (and Indian sector of the South Ocean) 1.30–1.55 mm and 1.41–1.80 mm respectively, and from the Pacific Ocean (and Pacific sector of the South Ocean) 1.42–1.53 mm and 1.48–1.76 mm respectively.

2. *Halocypris pelagica* Claus, 1890
(Figs. 2, 14–26)

Synonymy: see Chavtur & Stovbun, 2008b: 64.
Halocypris pelagica: Chavtur & Stovbun, 2008b: 64–71, Figs. 6–10.

Material studied: see Appendix 2.

Description of morphological variability.

Shell. The caparace size of *H. pelagica* is smaller than of *H. inflata*, and their length ranges overlap. As for *H. inflata*, there is no evidence for latitudinal variability in *H. pelagica* (Tables 3, 4, 8). The ranges of the carapace length are 0.95–1.34 mm in males and 1.0–1.52 mm in females (Table 3, 8).

Angel (1982: Table 2) observed the carapace of *H. pelagica* to be somewhat higher (% of the length) than that in *H. inflata*; height averaging 69% in males and 81% in females. Mean heights of our specimens from the different regions were similar, ranging from 67 to 71% in males and from 73–82% in females (Table 4). This is generally comparable to the heights of our specimens of *H. inflata* (Table 2). Only from the Northeast Pacific have males and females somewhat smaller heights - 63 and 69% respectively.

Angel (1982: Table 2) reported this species as being somewhat slimmer than *H. inflata* with relative breadths averaging 57% in males and 68% in females. Our specimens are also slimmer then *H. inflata* but were somewhat broader, than Angel's material (Table 4); their relative breadths were 57–64% in males and 70–73% in females (means for the different regions). The breadth of our single female specimen from the North East Pacific was 59% of the carapace length.

Frontal organ: The shape and size of this organ in both sexes of *H. pelagica* are also highly variable. The length of organ relative to the total carapace length ranged from 19 to 23% in males and from 17 to 22% in females (Table 4). Its length in males (23%) and females (21%) from the North Atlantic were comparable to Angel's material (1982: Table 2 – 22 and 20% respectively), whereas, in specimens from the equatorial Atlantic near the African coast, the relative lengths were considerably less, averaging 19 and 17% in males and females respectively (Table 4). In Indian Ocean specimens, the relatively lengths were almost the same 21.6 and 21.2% respectively, but, in specimens from the Pacific Ocean, they averaged 22% in males but only 18% in females.

In both sex, the capitulum is similar in height in both the proximal and distal regions; very occasional specimens have been reported with the capitulum's height slightly less in the proximal half (see Figs. **14**, *11*, also Chen and Lin (1995): Fig. **59**, *2*; female - Fig. **15**, *14*; Angel (1982): Fig. 7c and Deevey (1968): Fig. 3c). The relative height of the capitulum in both sexes varies. However, it is always greater than that in *H. inflata* (Table 7), averaging 30% in males and 26% in females (c.f. 24 and 21% in *H. inflata*: Table 7).

Angel (1982) (Figs. 5c, 7c) illustrates the capitulum height in male and female to 25% and 26% of its length respectively. Chen et al. (1983) (Fig. 5e) also illustrate the male capitulum with a height that is 25% of its length, whereas Chen and Lin (1995)(Fig. **59**, *2*) it to be 33% in a male, and Deevey (1968)(Fig. 3c) shows it to be 25–26%.

In both sexes, the shape of the tip of the frontal organ is variable, but usually it is rounded and very occasionally it is slightly pointed (Figs. **14**, *14* and **15**, *10*).

Inside of the capitulum the ganglionic mass in males is thick (except Fig. **14**, *13*) and compact, but, very occasionally, it is elongate (Fig. **14**, *3–5*); and, in females, it is thin and can be either short or elongate.

Endopodite of second antenna: As in *H. inflata*, it is highly variable in both sexes, and this variability shows no correlation with latitude or longitude. We list some of these variations below.

Male: the "a" bristle is normally bare and of medium length (Figs. **16**; **17**, *1–6*; **18** et al.), but it can range from being minute (Fig. **19**, *6*) to large (Figs. **16**, *2* and **17**, *2*), and, very occasionally, it is spine-like (Figs. **17**, *7*, **19**, *6* and **20,** *4*). Its length ranges from 20–25% (Fig. **17**, *3*) to almost 70% (Fig, **17**, *2*) of the length "b" bristle. Illustrations in Angel (1982) (Fig. 5 E, F) and Chen et al. (1983: Fig. 5 b) show it to be approximately 30% the length of the “b” bristle, whereas Deevey (1968)(Fig. 3e) shows it as 70%. In some specimens, it is delimited from the first segment by a suture (Fig. **16**, *1, 2* et al.), but, in others, it is fused with it (Fig. **16**, *3–6* et al.). The surface of the first segment at the base of the "a" bristle may either be covered with a few short hairs (Fig. **16**, *1, 3, 4* et al.) or it is bare (Fig. **16**, *2, 5, 6* et al.).

The length of the "b" bristle relative to the breadth of the first segment is 37–42% (average 37.5%) in males from the Atlantic Ocean (Figs. **16**; **17**, *1, 2*); it is 33–47% (average 38%) in males from the Indian Ocean (Fig. **17**, *3–7*); and 30–40% (average 33%) in males from the Pacific Ocean (Figs. **18**; **19**; **20**, *1–4*), where Chen et al., (1983)(Fig. 5 b) illustrate it as 25%. This bristle may be armed with short hairs (Fig. **16,** *1, 2* et al.) or bare (Fig. **16**, *3–6* et al.), and be stout (Fig. **17**, *3* et al.) or slim (Fig. **18**, *5* et al.). In all our specimens, the “b” bristle exceeds the length of the “c” bristle (also Chen et al., 1983: Fig. 5 b). However, both Deevey (1968: Fig. 3e) and Angel (1982: Fig. 5 E, F) illustrate it as being shorter. The “b” bristle may be either delimited from the segment by suture (Fig. **16**, *1, 2, 6* et al.) or fused with it (Fig. **16**, *3–5* et al.). The surface of the first segment at the base of this bristle is bare in our material, but Angel (1982: Fig. 5 E, F) illustrates there being short hairs there. The bases of the "a" and "b" bristles usually are normally separated, but, in rare specimens, they are contiguous (Fig. **17**, *2* and **20**, *2*).

On the second endopodite segment, the “c” bristle is shorter than the "d" bristle, but its length varies even between the left and right limbs in the same specimen (Figs. **16**, *3, 4* and **18**, *3, 4*). Its length ranges from about 50% (Fig. **16**, *1*) to 80% (Fig. **17**, *1*) of the length of the "b" bristle. Quite often, the "c" bristle is missing either from the right (Figs. **17**, *3* and **19**, *5*) or from the left (Fig. **20**, *2*), or from both endopodites (Fig. **16**, *5, 6*).

The length of the “d” bristle also varies and even between the two limbs of the same specimen (Figs. **17**, *3, 4*; **18**, *1, 2* and **20**, *3, 4*). It ranges from being about one and a half times (Figs. **16**, *3–6*; **17**, *1–4*; **18**, *2–3* and **20**, *3*) to being subequal (Figs. **17**, *5, 6*; **18**, *1, 4–6*; **19**, *1–3*; **20**, *4*) or even slightly shorter (Figs. **16**, *1, 2*; **17**, *7*; **19**, *4*; **20**, *1, 2*) than the length of the “b” bristle. Both Deevey (1968) (Fig. 3e) and Chen et al. (1983: Fig. 5b) illustrate this bristle as being one and a half times the “b” bristle, whereas Angel (1982)(Fig. 5 F, E) shows it as twice as long. The bases of the "c" and "d" bristles always are contiguous. There is no minute "e" bristle.

In males, the right and left claspers of the endopodite are strongly curved and vary in shape and size. Terminally, they are slightly swollen, with or without a tiny point, and there is subterminal ridging. On the right limb, it may either evenly thick throughout its length (Figs. **16**, *5*; **17**, *1* et al.) or is slightly thickened in its the proximal part (Figs. **16**, *1* and **18**, *5*). There are no noticeable swelling (as in *H. inflata*) in its medial and distal parts (exclusion Fig. **16**, *3*). The ventral margin of the right clasper is either smoothly rounded (Fig. **16**, *1*) or slightly undulate (Fig. **17**, *1, 5*). Near its base, this clasper curves through an angle of approximately 90º or

occasionally a little more (Fig. **16**, *1*). At midlength, it again curves about at an angle of 90° (Fig. **18**, *1, 3*) or a little more (Figs. **16**, *5* and **17**, *5*). The base of the right clasper is short. The clasper on the left limb is weaker and is evenly thick throughout its length. This clasper also curves near its base through about 90º, and again at midlength though an angle which is usually a little more than 90º (Fig. **17**, *1*). The distoventral surface of the 2nd segment may be either bare (Fig. **13**, *3*) or covered with short hairs (Figs. **5**, *3, 4* et al.).

Female: the structure and armament of the endopodite are also very variable (Figs. **21–23**), especially in specimens the only sample taken in the Indian Ocean (Figs. **21**, *6, 7* and **22,** *1–4*). The distoventral margins of the first and second segments are either aligned (Fig. **22**, *1*) or form an angle of about 130º (Fig. **20,** *5*). The ventral margin of the first segment may either be straight (Fig. **20**, *5, 6*), curved (Fig. **21**, *1, 2*) or wrinkled (Fig. **22**, *7*).

Both “a” and “b” bristles (Fig. 21) or just the “b” bristle (Fig. **20**, *5, 6*) are placed on a protuberance on the dorsal margin of the first segment (see also Angel, 1982: Fig. 7 F and Chen et al., 1983: Fig. 5 F). The "a" bristle usually is present but is very occasional specimens is lacking (Figs. **22**, *2* and **23**, *7*). It is usually slim and short (Fig. **20**, *5, 6*), but in one specimen from the Indian Ocean, it was well developed and long (Fig. **22**, *3, 4*). Its length ranges from 10% (Fig. **23**, *3, 4*) to 80% (Fig. **22**, *3, 4*) of the length of the “b” bristle, but usually 15 – 30% (Angel, 1982: Fig. 7 F illustrate it as 15% and Chen et al., 1983: Fig. 5 f, as 30%).

The relative to the breadth of the first segment, the length of the "b" bristle is 33–44% (average 38%) in Atlantic Ocean specimens (Figs. **20,** *5, 6* and **21**, *1–5*); 36–51% (average 41%) in Indian Ocean specimens (Figs. **21**, *6, 7* and **22**, *1–4*) and 35–50% (average 41%) in Pacific Ocean specimens (Figs. **22**, *5–8* and **23**). Angel (1982: Fig. 7 F) and Chen et al., (1983: Fig. 5 f) show its relative length to be 42% and 35% respectively. The “b” bristle is stout and long. Both “a” and “b” bristles are usually delimited from the first segment by a suture (Fig. **20**, *5, 6*) but, in a very few specimens, they are fused (Fig. **22**, *4*). Their bases are slightly separated (with one exception - Fig. **23**, *3, 4*).

The dorsal surface of the first segment is always bare, but the distoventral surface may either be covered with short hairs (Fig. **20**, *6*) or be bare (Fig. **20**, *5*). There is no "c" bristle on the second segment.

Copulatory appendage. Its length relative to the carapace length ranges from 21% to 34%, greater than in *H. inflata*, but its realtively mean length (30–33%) is very similar (Table 4). The shape is somewhat less variable than in *H. inflata* (Figs. **24–26**). The dorsal margin is either straight (Fig. **24**, *2*) or slightly concave (Fig **24**, *5*). Its ventral margin is less convex than in *H. inflata*, but the appendage is broader. Its breadth (B1)(see Fig. **12**.*1*) usually varies from 30 to 33% of the length (Table 9). Distally, the appendage tapers slightly towards its tip. The breadth of its tip (B2) is usually 62–63% of its maximum breadth (B1)(Table 9). The tip usually has a large comb with subterminal spinules. There are 3–8 (mainly 3–4) oblique muscle bands. Angel (1982)(Fig 5G) illustrates the copulatory appendage to be very similar to those of the our males.

Distribution

Circumtropical - subtropical interzonal species. It is widely distributed in shallow and deep waters in the tropics and subtropics of the Atlantic (37ºN–32ºS, in depth range 0–1500 m), Indian (5º–28ºS, in a vertical tows from 900–?3000 m to surface) and Pacific Oceans (42ºN–42ºS, in stratified catchs from surface to 4000 m, but most abundantly between surface and 200–500 m) (Chavtur and Stovbun, 2008b).

Our material, previously unpublished, comes from three oceans: - from the Atlantic Ocean at 0º, 13ºW at depths of 0–250 m, at 40ºN, 50ºW at 0–1000 m, and at 44ºN, 30ºW at 0–100 m; from the Indian Ocean between 0º and 36ºS, and 53º and 136ºE mainly from the upper 120 (150) m, also in a vertical tows from 1100–3000 m to surface; from the East Pacific between 5º and 40ºN and 34º–36ºS; from the West Pacific between 8º–34ºN in stratified catches from surface to 4000–5000 (5500) m but most abundantly in the upper 100 (to 200) m.

Size.

In literature, the length of males range from 0.95 mm to 1.26 mm, and females from 1.0 mm to 1.4 mm in the Atlantic. Sizes of this species for the Indian Ocean are unknown. Males from the Pacific Ocean range in length from 1.05 mm to 1.42 mm and females from 1.16 to 1.40 mm (Chavtur and Stovbun, 2008b).

Our specimens of males and females from the Atlantic Ocean have respective length ranges of 1.15–1.31 mm and 1.20–1.52 mm, and from the Indian Ocean 1.0–1.34 mm and 1.05–1.44 mm, and from Pacific Ocean 1.12–1.30 mm and 1.20–1.43 mm.

3. *Halocypris angustifrontalis* Chavtur & Stovbun, 2008 (Figs. 1, 27–35)

Halocypris angustifrontalis Chavtur & Stovbun, 2008a: 56–64, Figs. 1–5.

Synonymy: see Chavtur & Stovbun, 2008a: 56

Material studied: see Appendix 3.

Description of morphological variability.

Shell: This is the largest species in the genus. However, its length range overlaps that of *H. inflata* being 1.57 to 1.96 mm in males and 1.72 to 2.12 mm in females (Tables 5, 8). In contrast to previous two species, there is correlation between latitudinal and the carapace length. Specimens from the locations near both north and south extremes of its distributional range are larger, than in the central part of its range (Table 5). The height of carapace relative to its length is similar to that of the other species, and averaging 68–69% in males and 75–80% in females (Table 6). Males are somewhat broader (mean 65–66% of the carapace length) but females are similar in breadth to both *H. inflata* and *H. pelagica.*

Frontal organ: The shape and size is again very variable. In males the length of the capitulum relative to the carapace length varies from 19 to 21%, although its mean length is the same in all the regions investigated in the Pacific Ocean, averaging 19% (19.3–19.9%). In females, its relative length varies from 15 to 19%, with mean lengths ranging from 16–18% in the individual regions and 17% for all specimens from the Pacific Ocean (Table 6).

In both sexes, the capitulum is usually uniform in height throughout its length, but, in a few individuals, it is slightly higher in the proximal half (male - Fig. **18**, *7*; female - Figs. **27**, *4, 9* and **28**, *3, 12*). In males, the relative height of the capitulum ranges from 21 to 23% in the various regions of the Pacific (Table 7). In females, the relative height generally averages 20–21%, but in some specimens from 90ºN, 119ºW, it reaches 24% or even 27% (Table 7).

The tip of the frontal organ is variable in shape in both sexes being either rounded (Fig. **27**, *1*) or blunt (Fig. **27**, *3*).

The ganglionic mass inside of capitulum in both sexes is likewise variable and is either thick (Fig. **27**, *6*) or thin (Fig. **27**, *9*), but is always elongate.

Endopodite of the second antenna: This varies in both males and females, but, as in the other two species, there is no relationship between this variation and either latitude or longitude. Some of the variations in the characteristics are described below:

Male: the “a” bristle is bare and of the usual type. Its length ranges from 50% (Fig. **29**, *2*) to 70% (Fig. **29**, *5*) of the length of the “b” bristle. It is often delimited from the first segment by obvious suture, but sometimes it is fused with it (Fig. **29**, *9, 10*). Near its base the surface of the first segment is either covered by a few short hairs

(Fig. **29**, *2*) or is bare (Fig. **29**, *4*). In the only specimen collected off the Japan, this bristle is absent (not broken off!).

The length of the “b” bristle relative to the breadth of the first segment is 37–53% (Figs. **29** and **30**), average 46%. Usually it is bare, but in one specimen it was armed with short hairs (Fig. **29**, *10*). Its length does not vary. Usually, it is longer than the “c” bristle, but occasionally, they are subequal (Fig. **30**, *1, 10*). It is either delimited from the first segment by obvious suture (Fig. **29**, *2*) or fused with it (Fig. **29**, *10*). The surface of the first segment at the base of the “b” bristle is usually bare, but there are a few short hairs in a very few specimens (Fig. **30**, *10*). The bases of the “a” and “b” bristles are usually separated, but, in a very few specimens, they are contiguous (Fig. **29**, *5, 10*). In one specimen from the Northeast Pacific, there was an additional minute bristle near "a" and "b" bristles (Fig. **30**, *6, 7*).

On the second endopodite segment, the “c” bristle is usually shorter than the “d” bristle, but very occasionally they are subequal (Fig. **30**, *1, 6*). Its length relative to that of the “b” seta ranges from about 50% (Fig. **29**, *2, 3*) to 100% (Fig. **30**, *1, 10*).

As a rule, there is only a single “d” bristle on the second segment of the endopodite, but, in the only specimen from the South Pacific, there were two (Fig. **30**, *9*). The length of this bristle varies considerably, even between the left and right limbs of the same specimen (Figs. **19**, *1–4* and **30**, *5, 6, 8, 9*). It can be either longer (Fig. **29**, *2*), or subequal (Fig. **30**, *2*), or shorter (Fig. **29**, *5*), than the “b” bristle. The bases of the “c” and “d” bristles are always contiguous. A minute "e" bristle was found in the only specimen from the South Pacific (Fig. **30**, *10*).

The right and left claspers of the endopodite are both strongly curved and vary in shape and size. Terminally they are either unswollen (Fig. **29**, *5*) or slightly swollen (Fig. **30**, *5*), either with or without a tiny point, and there is subterminal ridging. The clasper on the right limb is either of even thickness throughout its length (Figs. **29**, *3* and **30**, *10*) or is thickened either proximally (Fig. **29**, *5, 9*) or medially (Fig. **30**, *1, 3, 5, 7*). Generally, the claspers are slimmer than in *H. inflata* and *H. pelagica*. The ventral margin of this clasper is always smoothly rounded. Near its base, this clasper is bent through an angle of 90º or less commonly slightly less (Fig. **29**, *1, 3*). It bends again at midlength through another 90º (Fig. **30**, *1*) or more (Fig. **30**, *3*). The base of the right clasper is more prolonged than in either *H. inflata* or *H. pelagica*. On the left limb, the clasper is again weaker and has an even thickness throughout its length. Both proximally and distally, it is bent through angles of about 90º (Fig. **30**, *6*) or more (Fig. **29**, *3*). The distoventral surface of the second segment of the endopodite always is covered with short hairs.

Female: the structure and armament of the endopodite in this species, especially in specimens from the Peruvian region (Fig. **32**, *1–4*) and from the South Pacific (Fig. **32**, *5–6*).

The distoventral margins of the first and second segments are generally angled at 110º to 150º and rarely form a straight line (Fig. **32**, *2*). This margin of the first segment is usually curved and very occasionally either wrinkled (Fig. **22**, *7*) or straight (Fig. **32**, *1*). The “a” and “b” bristles (Fig. **31**) or only the “b” bristle (Fig. **32**, *5, 6*) are placed on a protuberance on its dorsal margin or sometimes on the angled top (Fig. **32**, *1*). An “a” bristle always is present, but its length varies. It can be short and slim (Fig. **32**, *3*), or long and stout (Fig. **31**, *3*). The length range of this bristle relative to the “b” bristle is between 10% (Fig. **32**, *3*) and almost 80% (Fig. **32**, *7*). The bases of the "a" and "b" bristles are either set apart (Fig. **31**, *2*) or contiguous (Fig. **31**, *7*). Relative to the breadth of the first segment, the length of the “b” bristle is 35–46% (averaging 42%) (Figs.**31, 32**). It is always long and stout. Both the “a” and “b” bristles are almost always delimited by a suture from the first segment; in only one case (Fig. **31**, *4*) was the “a” bristle found to be fused.

The “c” bristle is present only in females from the South Pacific (Fig. **32**, *5–8*), and its length is varied considerably.

The dorsal surface of the first endopodite segment is bare and distoventrally is either covered with short hairs,

(Fig. **31**, *1*) or bare (Fig. **31**, *8*).

Mandible. The structure of the basal and coxal segments on the mandible is main character differentiating this species from the others. The basal endite in *H. angustifrontalis* bears an additional tiny lateral tooth (Fig. 33,1), which is absent in both *H. inflata* and *H. pelagica* (Skogsberg, 1920: Fig. **114**, *2*; Chavtur and Stovbun, 2008a: Fig. **9**, *3*). The distal and proximal tooth rows on the coxal endite are very variable in structure and so are not reliable characters for differentiating the species of this genus (Fig.**33**, *3, 4* and **34**, *2, 3*). The masticatory surface of the coxale is covered with sensory filaments in *H. angustifrontalis* (Fig. **33**) and only with spine-like hairs (bristles in *H. inflata* (Skogsberg, 1920: Fig. **144**, *18*) and *H. pelagica* (Chavtur and Stovbun, 2008a): Fig. **7**, *7, 8*). The shape, sizes and numbers of filaments vary in specimens of *H. angustifrontalis* from the various regions. Thus, specimens from the Northwest Pacific have less than 20 filaments of various sizes (both long and short) with thick bases and sharply taper to very pointed tips (Fig. **33**, *5, 6*). In specimens from the Northeast Pacific, there is about 30 filaments, which are mostly long, have the usual base, distally slightly taper to a rounded or pointed tip (Fig. **33**, *2*). Specimens of *H. angustifrontalis* from the Mexican and Peruvian region have a mixture of about 25 filament, some long and thick, which sharply taper towards their tips (in its distal half) and with pointed (non spine-like) tips, and also short and thin filaments, which have spine-like sharp tips (Fig. **34**, *5, 6*). In the subtropical zone of the South Pacific there are about 25 filaments, which are mostly short and sharply tapering towards the tip (in the distal half), with thick bases and very pointed (spine-like) tips (Fig. **34**, *6*).

Thus, the four intraspecific groups are singled out for *H. angustifrontalis* based on these differences in the shape, size and numbers of these filaments. The first group inhabits the area of the Kuroshio Current and its adjacent waters (Northwest Pacific), the second group in the subtropical waters of the Northeast Pacific (about 40ºN), the third group in the tropical zone of the East Pacific, and the fourth in the subtropical waters of the South Pacific.

Copulatory appendage. This is very similar to the appendage of *H. inflata.* Its realtive length ranges from 29 to 33% of the carapace length (mean 30–32% for the different regions), similar to that of both *H. inflata* and *H. pelagica* (Table 6). As in *H. inflate,* its shape is variable. The breadth (B1 - see Fig. 12, 1) in males from different locations ranges from 26 to 30% (mainly 28%) of the limb's length of the limb; somewhat less than in *H. inflata* (Table 9). The appendage tapers distally towards its tip (as in *H. inflata*). The breadth (B2) of this tip averages 50%; slightly less than in *H. inflata* (Table 9). On the tip is a comb of variable size and some subterminal spinules. There are 4–6 (usually 5) oblique muscle bands.

Distribution.

Our specimens were caught in East Pacific between 37º–40ºN and 124º–130ºW in the depth range 0–400 m, and in the West Pacific between 32º–35ºN and 141º– 49ºW in the upper 100 m.

Poulsen (1969) noted finding of the large specimens of *H. brevirostris* in the East Pacific at latitudes ranging from 33ºN–42ºS. He recorded the depths of occurrence as 200–3000m by day, and mostly 0–200m at night (his p.77). Probably, his large specimens belong to *H. angustifrontalis*.

Size.

Males and females of this species have length ranges of 1.65–1.97 mm and 1.72–2.20 mm respectively (Chavtur and Stovbun, 2008a). Poulsen's (1969) males had a maximum length of 1.88 mm, and his females ranged in size from 1.88 to 2.15 mm.

Summary

Halocypris angustifrontalis is largest species in the genus, and *H. inflata* is larger than *H. pelagica*, nevertheless the sizes ranges of their lengths, heights and breadths overlap at the extremes of their ranges. Even so, when these species co-occur, as a rule the easiest way to differentiate between them is by their lengths. Angel (1982) pointed out that, when *H. inflata* and *H. pelagica* co-occur, they show less variation in carapace length and the overlap almost disappears, which he suggested may indicate character displacement as a result of competition. Contrary to Angel's (1982) conclusions, relative height and breadth of the carapace are not reliable criteria for differentiating these species.

Frontal organ. Both sexes of *H. pelagica* have the longest frontal organs relative to the length of the carapace (c.f. Angel, 1982: Table 2); in its females from the Pacific Ocean, its relative length is somewhat less than in *H. inflata*. In males of *H. infata* and *H. angustifrontalis,* the relative lengths of the frontal organ are similar, but, in the females, the relative length is somewhat less in the latter species.

The relative height of this capitulum is also larger in *H. pelagica* (also in Angel, 1982: p. 333) compared with the other species. In females of *H. inflata* and *H. angustifrontalis*, relative height of the capitulum is similar, but in males it is somewhat less than in the latter species.

Endopodite of second antenna. All the characteristics of the endopodite of the second antenna examined are exceedingly variable in both sexes of all three species. Consequently, only a few characters were identified which are potentially helpful in the differentiation of this species. The right clasper in male of the *H. angustifrontalis* is generally thinner, has a longer base and has evenly rounded ventral margins and terminally is either unswollen or swollen less than that in *H. inflata* and *H. pelagica*. Otherwise and only for the Pacific Ocean, the length of the "b" bristle relative to the breadth of the first segment is longest in *H. angustifrontalis* (46%), median in *H. inflata* (37%) and shortest in *H. pelagica* (33%), although the ranges overlap. In females of the *H. inflata* and *H. pelagic,* the dorsal margins of the first and second segments either form a straight line or angles between 130º and 150º, whereas, in *H. angustifrontalis,* these margins generally form an angle of between 110º–150º and are very seldom aligned. In females, *H. pelagica* the "c" bristle always is missing, whereas, in the other species, it is present sometimes. In Pacific specimens, the "a" bristle is always short, whereas, in the other species, its length varies from short to long.

Mandible. The structure of the mandible is important in the identification of the *Halocypris* species. The mandible of *H. angustifrontalis* sharply differs from the two other species in having a lateral tooth on its basale and sensory filaments on its coxale (in *H. inflata* and *H. pelagica*, there are spine-like hairs). The shape, sizes and numbers of these filaments vary in relation to latitude and longitude. On these grounds, four intraspecific groups are identified for *H. angustifrontalis*; one group in the northern subtropical zone of the West Pacific, one in the corresponding zone in the East Pacific, the third in the tropical zone of the Eastern Pacific and the fourth in the subtropical zone of the South Pacific.

Copulatory appendage. The shapes and relative sizes of this appendage in the three species of *Halocypris* are very similar. There are some minor differences as follows: - in *H. pelagica,* the appendage is broader, its ventral margin is less convex, and its tip is broader, than that in the other species. This appendages of *H. inflata* and *H. angustifrontalis* are almost indistinguishable; only the breadth of the tip in *H. angustifrontalis* is very slightly less, than that in *H. inflata*.

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Table 1. Shell length (mm) of *Halocypris inflata* in regions investigated.

	Male			Female		
Location; Vesesel	**Specimens**	**Range**	**Mean**	**Specimens**	**Range**	**Mean**
Atlantic Ocean						
22°N, 37°W; R/V Kurchatov, 1983	3	1.42–1.45	1.44	4	1.52–1.67	1.52
0°, 13°W;R/V Lena, 1956	2	1.55 and 1.55	1.55	2	1.80–1.85	1.82
36°–41°S, 26°–53°W; R/V Kurchatov, 1971	1	1.35		1	1.55	
Indian Ocean						
R/V Ob, 1956	360	1.30–1.55	1.43	290	1.41–1.80	1.64
Pacific Ocean						
Kuroshio Current; R/V Vitjaz, 1955; R/V Orlyk, 1972; R/V Seskar, 1975; R/V Pelamida, 1974,1976	2	1.42–1.48	1.45	11	1.48–1.76	1.63
13°N, 92°W; R/VBirokan, 1965	1	1.37				
Southern Ocean						
Pacific Sector; R/V Mendeleev, 1976	4	1.50–1.55	1.52	5	1.55–1.75	1.68

Table 2. Merisitc characters of shell, frontal organ and copulatory organ of *Halocypris inflata* from various locations expressed as percentages of the total length.

	Male		Female	
Atlantic Ocean				
22°N, 37°W; R/V Kurchatov, 1983				
Height	64.78–68.98	66.88 (3)	76.25–80.83	78.57 (2)
Breadth	60.0–63.38	61.69(2)	75.0–81.25	78.12(2)
Frontal organ	19.0–21.10	20.26 (3)	16.16–18.75	17.69(2)
Copulatory organ	29.92–31.69	30.88 (3)		
00°, 130°W; R/V Lena, 1956				
Height	69.03	69.03 (1)	74.35–76.31	75.33 (2)
Breadth	64.51	64.51 (1)	71.79–74.73	73.26 (2)
Frontal organ	19.35	19.35(1)	15.38–15.78	15.58(2)
Copulatory organ	32.25	32.25 (1)		
36°–41°S, 26°–53°W; R/V Kurchatov, 1971				
Height	77.77	77.77 (1)	72.25	77.77 (1)
Breadth	?	?	?	?
Frontal organ	21.11	21.11(1)	17.74	17.74(1)
Copulatory organ	35.18	35.18(1)		
Indian Ocean				
R/V OB, 1956				
Height	65.78–70.0	68.13 (7)	78.80–85.30	82.26 (5)
Breadth	62.50–66.6	64.34 (7)	70.0–77.10	73.99 (5)
Frontal organ	17.70–20.74	19.10(7)	17.64–20.0	19.18(5)
Copulatory organ	29.60–31.89	31.11(7)		
Pacific Ocean				
Kuroshio Current; R/V Vitjaz, 1955; Orlyk, 1972; Seskar, 1975; Pelamida, 1974, 1976.				
Height	65.54–69.93	67.73 (2)	72.67–76.70	74.68 (2)
Breadth	62.50–68.62	65.65 (2)	76.70–76.74	76.72 (2)
Frontal organ	18.24–19.60	18.92(2)	19.18–19.88	19.53 (2)
Copulatory organ	28.37–31.83	30.10(2)		
130°N, 92°W; R/V Birokan, 1965				
Height	71.42	71.42(1)		
Breadth	60.71	60.71 (1)		
Frontal organ	20.35	20.35 (1)		
Copulatory organ	32.14	32.14.(1)		

Table 3. Shell length (mm) of *Halocypris pelagica* from all the regions investigated.

	Male			Female		
Location; Vessel	**Number**	**Range (mm)**	**Mean (mm)**	**Number**	**Range (mm)**	**Mean (mm)**
Atlantic Ocean						
44°N, 30°W; R/V Lomonosov, 1959						
	1	1.15				
40°0N, 50°W (R/V Topseda, 1964)						
				1	1.2	
0°, 130°W (R/V Lena, 1956)						
		1.27–1.31	1	3	1.46–1.52	1.5
Indian Ocean						
R/V Ob, 1956						
	162	1.0–1.34	1.13	21	1.05–1.44	1.21
Pacific Ocean						
Kuroshio Current; R/V SRT 662, 1953; R/V Adler, 1966, 1967; Orlyk, 1967; R/V Pelamida, 1976; R/V/ Cavalerovo, 1980						
	21	1.12–1.25	1.19	1	1.20–1.43	1.29
35°N, 139°W;R/V Vitjaz, 1958						
				1	1.25	
5°N–33°N, 91°W–172°E; R/V Birokan, 1964–1965						
	8	1.15–1.25	1.19	2	1.22 and 1.22	1.22
5°N–5°S, 124°–130°E; R/V Vitjaz, 1975						
	7	1.15–1.22	1.17	14	1.22–1.35	1.29

Table 4. Meristic characters of shell, frontal organ and copulatory organ of *Halocypris pelagica* from various localities, expressed as percentages of the total shell length. Numbers in brackets indicate the number of specimens measured

		Male		Female	
Location/Vessel	**Character**	**Range**	**Mean**	**Range**	**Mean**
Atlantic Ocean					
40°–44°N, 30°–50°W; R/V Lomonosov, 1959, R/V Topseda, 1964					
	Frontal organ	23.47	23.47(1)	20.8	20.80 (1)
	Copulatory organ	36	36.0(1)		
0°, 130°W; R/V Lena, 1956					
	Height	66.9–67.69	67.16(3)	76.97–82.75	79.55 (3)
	Breadth	60–62.90	61.47 (3)	70.39–77.24	73.77 (3)
	Frontal organ	19.23–19.68	19.38 (3)	17.10–17.93	17.37 (3)
	Copulatory organ	30.76–31.49	31.0(3)		
Indian Ocean					
R/V Ob, 1956					
	Height	66.90–74.50	71.20(5)	80.30–83.30	81.84(5)
	Breadth	59.80–63.60	61.50(5)	68.20–76.40	73.0 (5)
	Frontal organ	20.80–22.70	21.64(4)	20.45–21.74	21.17(5)
	Copulatory organ	30.51–33.04	31.70(5)		
Pacific Ocean					
Kuroshio Current (R/V SRT 662, 1953; R/V Adler,1966, 1967; R/V Orlyk, 1967; R/V Pelamida 1976; R/V Cavalerovo, 1980)					
	Height	65.57–71.30	68.23 (4)	72.0–76.0	73.14(3)
	Breadth	63.97–64.73	64.33 (2)	73.60; 73.60	73.60 (2)
	Frontal organ	19.64–20.49	20.06 (2)	18.40; 18.40	18.40 (2)
	Copulatory organ	32.78–33.48	33.13(2)		
50°N–50°S, 124°–130°E(R/VVitjaz, 1975)					
	Height	68.75–72.65	70.70 (4)	76.37–81.48	78.72 (4)
	Breadth	56.52–57.37	56.94 (2)	69.23–71.42	70.47 (4)
	Frontal organ	20.83–23.50	21.74 (3)	18.35–18.66	18.50 (3)
	Copulatory organ	30.94–32.78	32.01 (3)		
5°–33°N, 91°W–172°E (R/V Birokan, 1964–1965)					
	Height	63.52–64.04	63.78 (2)	69.67	69.67 (1)
	Breadth	63.52–64.04	63.78 (2)	59.42	59.42 (1)
	Frontal organ	22.34–23.36	22.80 (3)	18.85	18.85(1)
	Copulatory organ	28.92–30.73	30.02 (3)		

Table 5. Shell lengths (mm) of *Halocypris angustifrontalis* from all the regions investigated.

Location/Vessel	Male			Female		
	Specimens	Range	Mea	Specimens	Range	Mean
NW Pacific						
Kuroshio Current (R/V Pelamida, 1974, 1976; R/V Seskar, 1975)						
	2	1.73–1.85	1.79	8	1.80–2.12	1.96
NE Pacific						
40°N, 130°W; R/V Ogon, 1975						
	3	1.75–1.82	1.78	2	2.05; 2.07	2.06
37°–38°N, 125°–128°W; R/V SRTM 8–459, 1971						
	9	1.63–1.85	1.77	4	1.80–2.0	1.9
37°N, 124°–127°W; R/V Tikhookeansky, 1979						
	4	1.65–1.80	1.73	1	2	
31°N, 135°W; R/V Keldysh, 1990						
	4	1.57–1.72	1.66	4	1.72–1.87	1.8
9°N, 119°W; R/V Lira,1966						
				10	1.75–2.10	1.94
S. Pacific						
45°S, 157°W; R/V Mys Tykhy, 1978,						
	56	1.70–1.96	1.87	82	1.85–2.12	1.95

Table 6. Merisitic characters of shell, frontal organ and copulatory organ of *Halocypris angustifrontalis* expressed as percentages of the total shell length. Numbers in brackets indicate the number of specimens measured.

		Male		Female	
Location; Vessel	**Character**	**Range**	**Mean (n)**	**Range**	**Mean (n)**
NW Pacific					
Kuroshio Current (R/V Pelamida, 1974, 1976: R/V Seskar, 1975)					
	Height	66.47–69.51	67.99 (2)	74.05–77.02	75.88 (2)
	Beadth	67.61		70.45–76.41	73.43 (2)
	Frontal organ	18.91–20.23	19.57 (2)	17.45–18.31	17.88 (2)
	Copulatory organ	31.09–33.23	32.16(2)		
NE Pacific					
37°–40°N, 125°–130°W; R/V SRTM 8-459, 1971; R/V Ogon, 1975					
	Height	66.10–71.42	68.60 (6)	79.29–78.26	75.12(3)
	Beadth	64.97–68.68	66.45 (3)	71.70–75.84	73.77 (2)
	Frontal organ	19.03–19.78	19.35 (3)	16.28–17.07	16.67 (2)
	Copulatory organ	30.21–31.07	30.52 (3)		
31°N, 135°W; R/VKeldysh, 1990					
	Height	66.86–71.33	69.41 (4)	77.40–80.21	78.70 (4)
	Beadth	63.95–66.87	64.89 (4)	72.19–76.74	74.85 (4)
	Frontal organ	19.11–20.58	19.94 (4)	18.02–18.89	18.49 (4)
	Copulatory organ	29.07–31.84	30.65 (4)		
90°N, 119°W; R/V Lira, 1966					
	Height			78.02–81.86	79.67 (4)
	Beadth			75.27–76.92	76.10(3)
	Frontal organ			15.38–17.14	16.41 (4)
S. Pacific					
45°S, 157°W; R/V Mys Tykhy, 1980					
	Height	65.10–72.08	69.65 (3)	76.58–82.92	80.32 (3)
	Beadth	63.54–67.0	65.73 (3)	62.0–76.58	70.58 (3)
	Frontal organ	19.30–20.50	19.90 (3)	17.60–18.22	17.98 (4)
	Copulatory organ	29.48–29.94	29.71 (2)		

Table 7. Height of capitulum in the three species of *Halocypris* expressed as percentages of the total lenght of the frontal organ. Numbers in brackets indicate the number of specimens measured.

H. inflata (Figs. 3, 4)			*H. pelagica* (Figs. 14, 15)			*H. angustifrontalis* (Figs. 27, 28)		
Expedition	**Male**	**Female**	**Expedition**	**Male**	**Female**	**Expedition**	**Male**	Female
Atlantic Ocean								
R/V Kurchatov, 1983	22.8 (3)	20.8 (3)	**R/V** Lomonosov, 1959	27.8(1)				
			R/VTopseda, 1964		26.1(1)			
R/V Una, 1956	22.7 (2)	22.3 (2)	R/V Lena, 1956	31.1(3)	25.3 (3)			
R/V Kurchatov, 1971	24.3 (4)	20.4 (1)						
Indian Ocean								
R/V Ob, 1956	24.5 (6)	20.4 (5)	R/V Ob, 1956	32.8 (5)	27.4 (5)			
Pacific Ocean								
R/V Pelamida, 1974, 1976, R/V Seskar, 1979	24.9 (2)	20.9 (2)	R/V Cavalerovo, 1980, R/V Orlyk, 1966	30.4 (2)	27.6 (2)	R/V Seskar, 1975	21.6(2)	21.5 (2)
			R/V Vitjaz, 1975	28.7 (3)	24.9 (3)			
R/V Birokan, 1964	25.4(1)		R/V Birokan, 1964	33.3(3)	28.1(1)	R/V Ogon, 1975	22.8 (3)	21.1(3)
						R/V SRTM 8–459, 197	20.8 (1)	21.8(1)
						R/V Keldysh, 1990	22.5 (4)	19.9 (4)
						R/V Lira, 1966		23.4 (4)
						R/V MysTikhy,	22.9 (2)	20.8 (4)
Mean	24.1(18)	21(13)	Mean	30.7 (17)	26.6 (15)	Mean	22.3 (12)	21 (18)

Table 8. Records of *Halocypris* species, which include length data (mm)

Species	Author	Region	Male	Female
H. inflata	Dana, 1849	S. W. Atlantic	1.6	1.7
	Claus, 1874a;1874b	? Atlantic		1.8
	Brady, 1980		1.55(?)	
	Claus, 1890; 1891	Atlantic		1.8
	Brady, Norman, 1896	? Atlantic		1.8
	Vavra, 1906	Atlantic		1.8
	Scott, 1912	Atlantic		1.65
	Skogsberg, 1920	Atlantic	1.4–1.6	1.6–1.8
	Skogsberg, 1931	NW Atlantic		1.8
	Poulsen, 1969	N Atlantic		1.39– 2.02*
	Deevey, 1970	NW Atlantic	1.4	1.6
	Deevey, 1974	SW Atlantic	1.44–1.50	1.50–1.60
	Angel, 1982a	Tropical Atlantic	1.32–1.60	1.48–1.82
	This paper	NW Atlantic	1.42–1.45	1.52–1.67
	This paper	Tropical Atlantic	1.55	1.80–1.85
	This paper	SW Atlantic	1.35	1.55
	Poulsen, 1969	Indian Ocean		1.39– 1.76
	This paper	Indian Ocean	1.37–1.52	1.55–1.70
	Muller, 1890	NW Pacific	1.44	1.78
	Poulsen, 1969	NW Pacific	1.44–1.56	1.56–1.75
	Deevey, 1978a	SW Pacific	1.44–1.50	1.60–1.76
	Martens, 1979	SW Pacific	1.36–1.57	1.51–1.74
	Tseng, 1980	NE Pacific	1.4	1.7
	This paper	NE Pacific	1.42–1.48	1.48–1.76
	This paper	NW Pacific	1.37	
	This paper	South Ocean (Pacific sector)	1.50–1.55	1.55–1.75
H. pelagica	Claus, 1890; 1891	NE Atlantic	1.1	1.4
	Brady and Norman, 1896	NE Atlantic	1.1	1.4
	Vavra, 1906	Atlantic	1.1	1.4
	Skogsberg, 1920	SW Atlantic	0.95	
	Deevey, 1968	NW Atlantic	0.95–1.15	1.10–1.30
	Deevey, 1974	SW Atlantic	1.15–1.25	1.15–1.25
	Angel, 1979	NW Atlantic	1.0–1.2	1.0–1.4
	Angel, 1982a	Tropical Atlantic	1.04–1.26	1.16–1.38
	Angel, 1982a	N Atlantic	1.00–1.20	1.00–1.40
	This paper	NW Atlantic	1.15	1.2
	This paper	Tropical Atlantic	1.27–1.31	1.46–1.52
	This paper	Indian Ocean	1.00–1.34	1.05–1.44
	Juday, 1906	NW Pacific	1.1	1.4
	Chavtur, 1976	Japan Sea	Juvenile	1.1
	Tseng, 1980	NE Pacific	1.1	
	Chen *et al.,* 1983	NE Pacific	1.05–1.21	1.16–1.40
	Chen and Lin, 1995	NE Pacific	1.35–1.42	
	This paper	NE Pacific	1.12–1.25	1.20–1.43
	This paper	Tropical Pacific	1.15–1.22	1.22–1.35

Table 8. (Continued). Records of *Halocypris* species, which include length data (mm)

Species	Author	Region	Male	Female
H. angustifrontalis	Poulsen, 1969*	Pacific	1.6–1.9	1.7–2.2
	This paper	NW Pacific	1.73–1.85	1.80–2.15
	This paper	NE Pacific	1.57–1.85	1.72–2.10
	This paper	S Pacific	1.70–1.96	1.85–2.12

Comment: * - probably Poulsen's large specimens of *H. brevirostris* belong to *H. angustifrontalis*: p. 65 (part) (stations 4781 and 4788, males 1.6–1.9 mm and females 1.8–2.2 mm, Fig. 25 (for "SE Pacific"), Table 8 (for females longer 1.7–1.8 mm from: "Pacific" of 140°E and 33°N, 14°N–13°S, 33°–42°S), Table 9 (for males longer 1.6 mm from: "Pacific" 33°–42°S, "E Pacific" 12°–22°S)

Table 9. Ratios of some meristic characters of the copulatory appendages of the *Halocypris* species expressed as percentages

		H. pelagica		*H. inflata*		*H. angustifrontalis*	
Region	**Ratios**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**
N. Atlantic	B1 :L1*	32.8	32.8	28.4–30.0	29		
	B1 :L2	43.8	43.8	38.9–43.6	41.1		
	B1 :B1	54.7	54.7	47.7–57.1	52.4		
Tropical Atlantic	B1 :L1*	27.8–32.6	30.2	28.1–30.7	29.1		
	B1 :L2	38.1–44.7	41.6	38.5–43.2	40.8		
	B1 :B1	60.9–67.2	63	50.9–53.3	52.1		
S. Atlantic	B1 :L1*			27.8	27.8		
	B1 :L2			38.3	38.3		
	B1 :B1			59.1	59.1		
Indian Ocean	B1 :L1*	20.6–33.8	30.5	28.9–30.0	29.5		
	B1 :L2	39.3–48.1	43.4	38.1–43.3	40.4		
	B1 :B1	55.4–72.7	63.8	48.8–58.9	54.3		
N. Pacific	B1 :L1*	27.9–32.2	30.6	26.1–30.0	28	26.1–29.7	28.1
	B1 :L2	36.1–46.4	42.8	33.1–39.1	36.1	35.8–44.0	40.9
	B1 :B1	51.8–72.7	62.6	48.9	48.9	44.7–55.0	50
Tropical Pacific	B1 :L1*	29.2–32.1	30.6	27.3	27.3		
	B1 :L2	40.1–41.5	40.8	36.7	36.7		
	B1 :B1	61.0–65.4	63.2	56.8	56.8		
S. Pacific	B1 :L1*					27.2–28.4	27.8
	B1 :L2					36.4–39.7	38
	B1 :B1					47.6–52.5	50.1
Total	B1 :L1*	20.6–33.8	30.7	26.1–30.7	28.9	26.1–29.7	28.5
	B1 :L2	36.1–48.1	42.6	33.1–43.6	39.6	35.8–44.0	40.3
	B1 :B1	51.8–72.7	61.7	47.7–59.1	53.8	44.7–55.0	50.2

LI = total length of appendage; L2 = Length from tip to arch on dorsal side; Bl = appendage's maximum breadth; B2 = Breadth of distal margin (see Fig 12.)

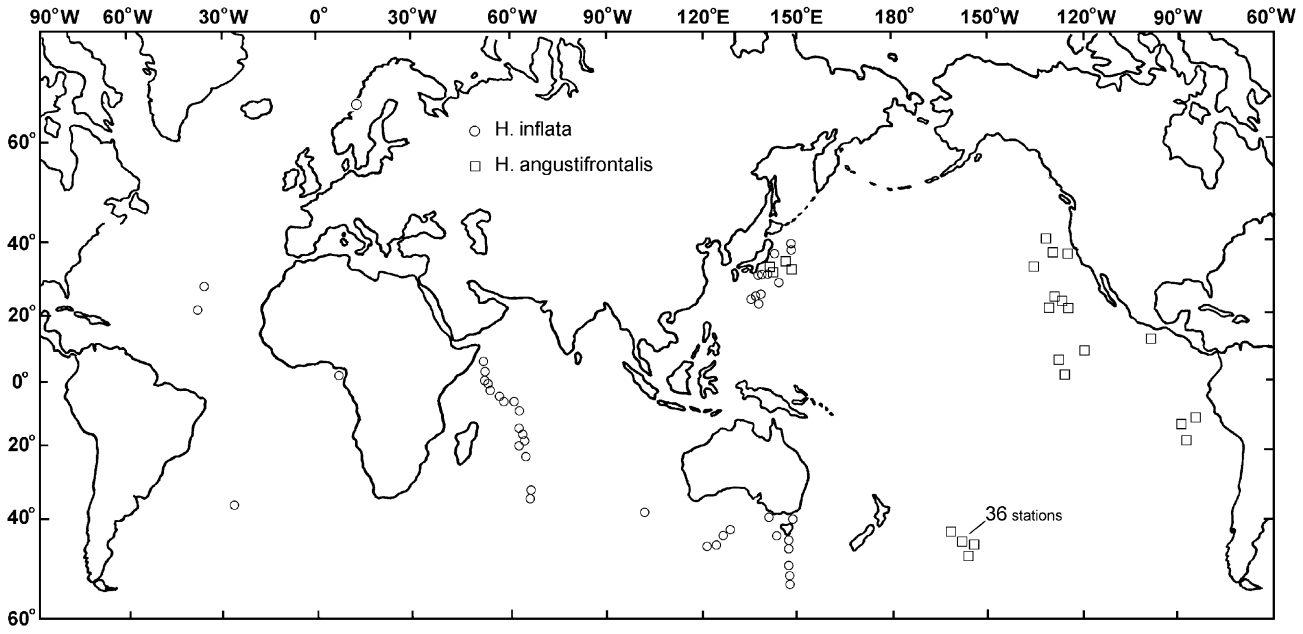

Figure 1. Station locations for *Halocypris inflata* and *H. angustifrontalis.*

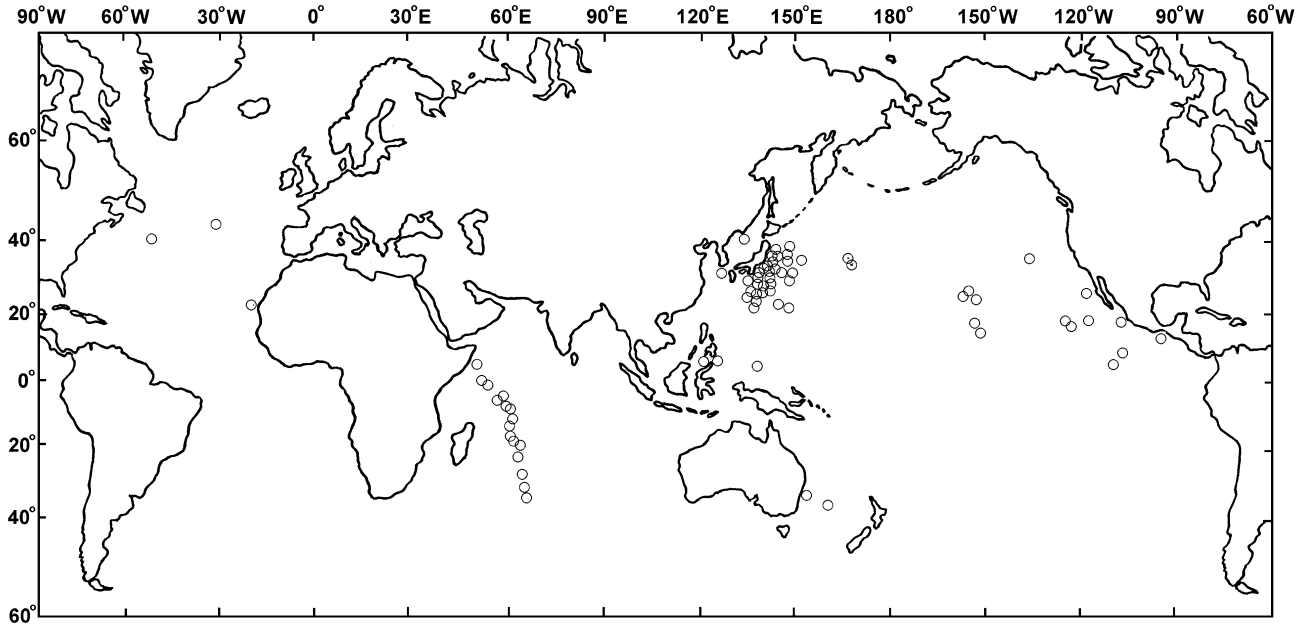

Figure 2. Station locations for *Halocypris pelagica.*

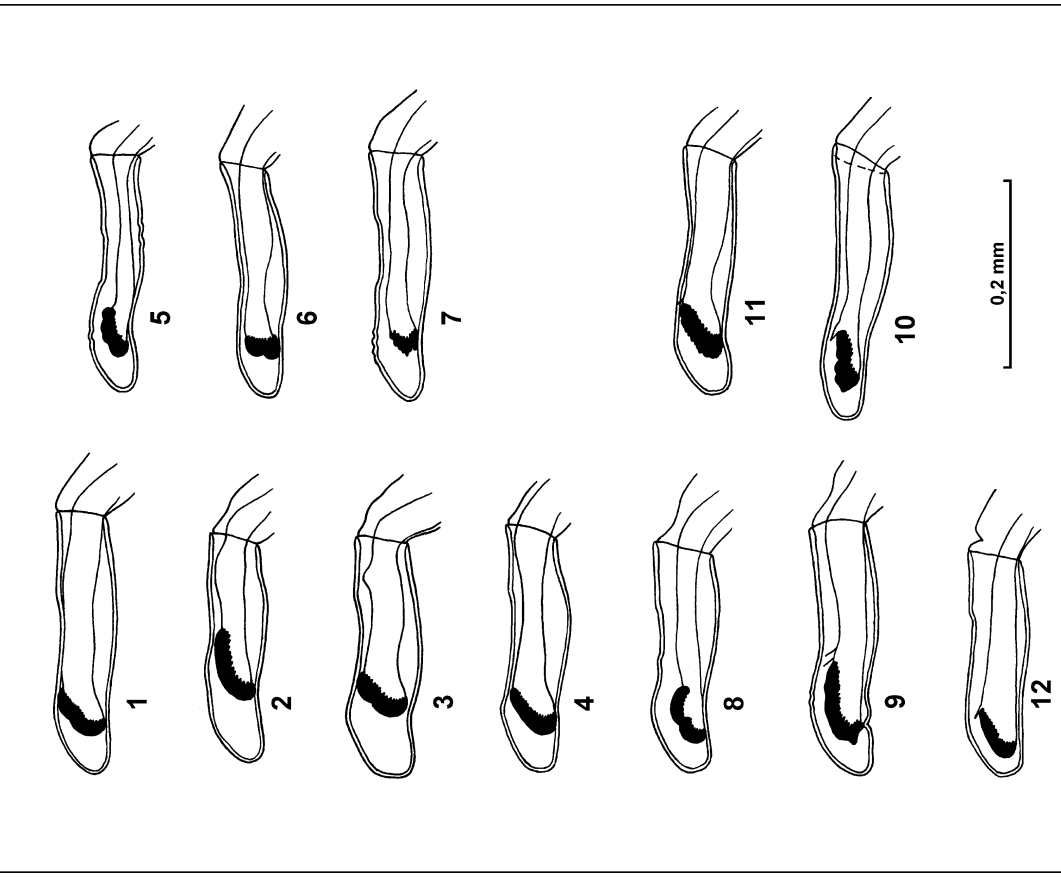

Figure 4. Frontal organ of *Halocypris inflata*. Indian Ocean: *1* (N1217), *2* (N1218), *3* (N1219), *4* (N1220), *5* (N1212), *6* (N1213), *7* (N1214); Pacific Ocean: *8* (N1224), *9* (N1223), *10* (N1224); *11* (N1225); *12* (N1222).

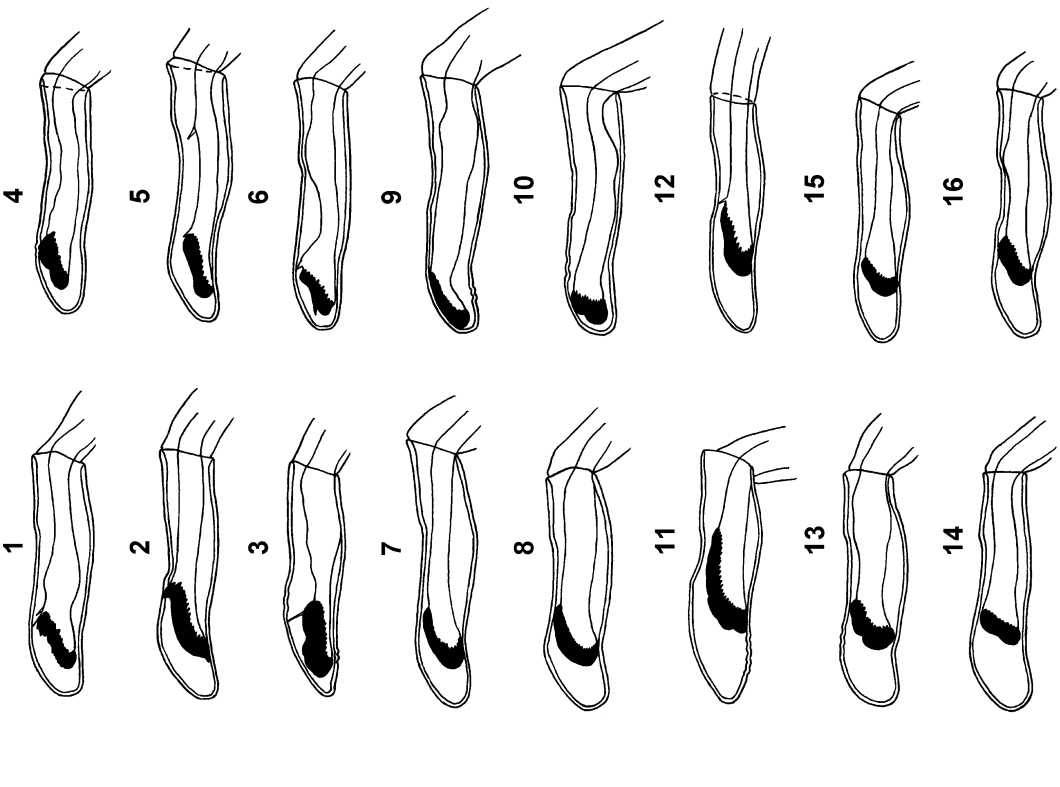

Figure 3. Frontal organ of *Halocypris inflata*. Atlantic Ocean: *1* (N1204), *2* (N1205), *3* (N1206), *4* (N1207), *5* (N1208), *6* (N1209), *7* (N1198), *8* (N1199), *9* (N1200), *10* (N1201), *11* (N1202), *12* (N1203); *13* (N1215), *14* (N1216), *15* (N1210), *16* (N1211).

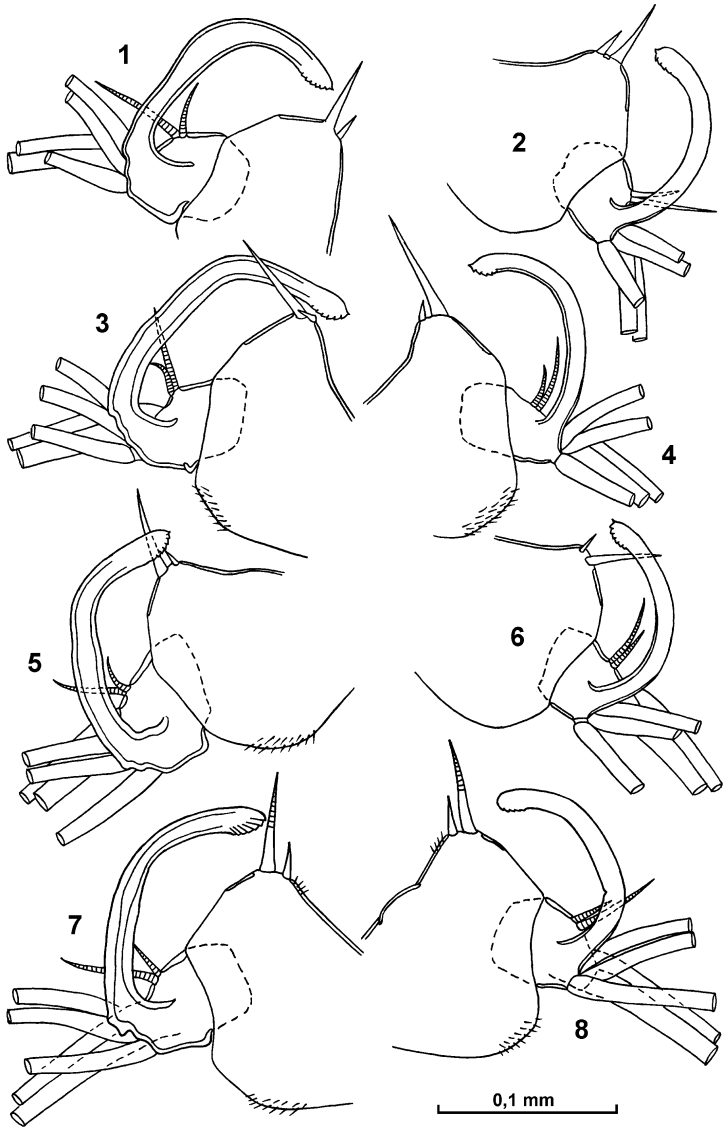

Figure 5. Endopodite on 2nd antenna of male of *Halocypris inflata* (right: *1*, *3*, *5* and *7*; left: *2*, *4*, *6* and *8*). Atlantic Ocean: *1* and *2* (N1204), *3* and *4* (N1205), *5* and *6* (N1206), *7* and *8* (N1198).

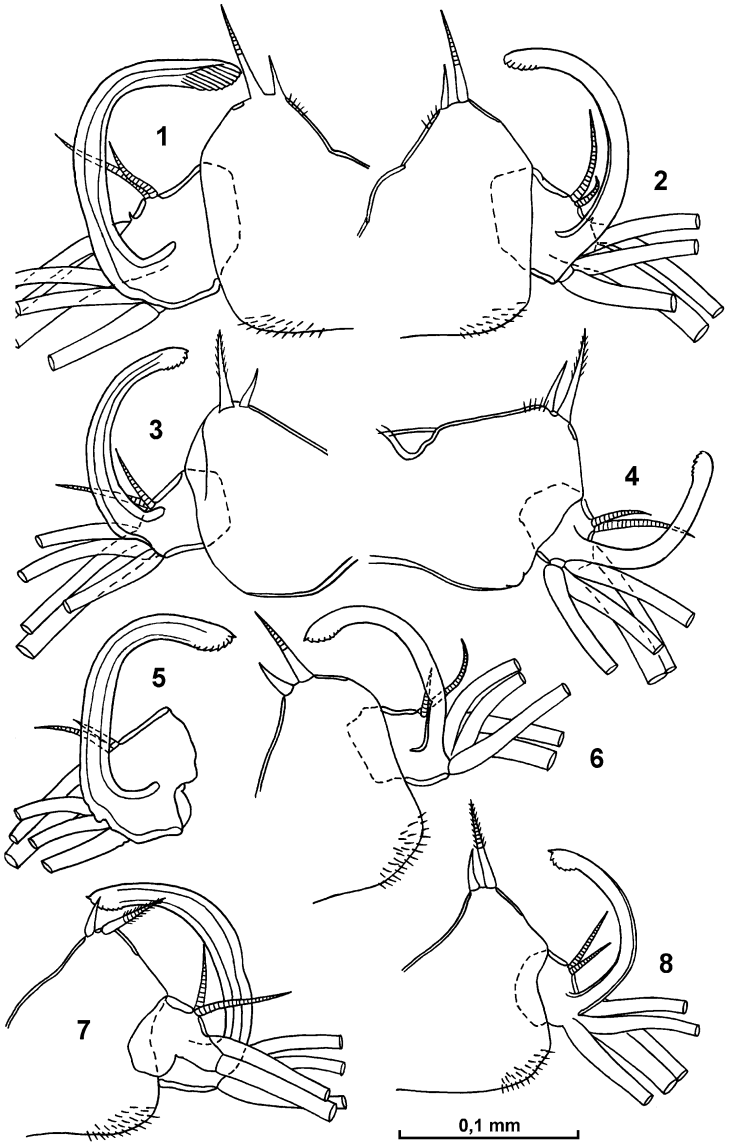

Figure 6. Endopodite on 2nd antenna of male of *Halocypris inflata* (right: *1*, *3*, *5* and *7*; left: *2*, *4*, *6* and *8*). Atlantic Ocean: *1* and *2* (N1199), *3* and *4* (N1202); Indian Ocean: *5* and *6* (N1216), *7* and *8* (N1217).

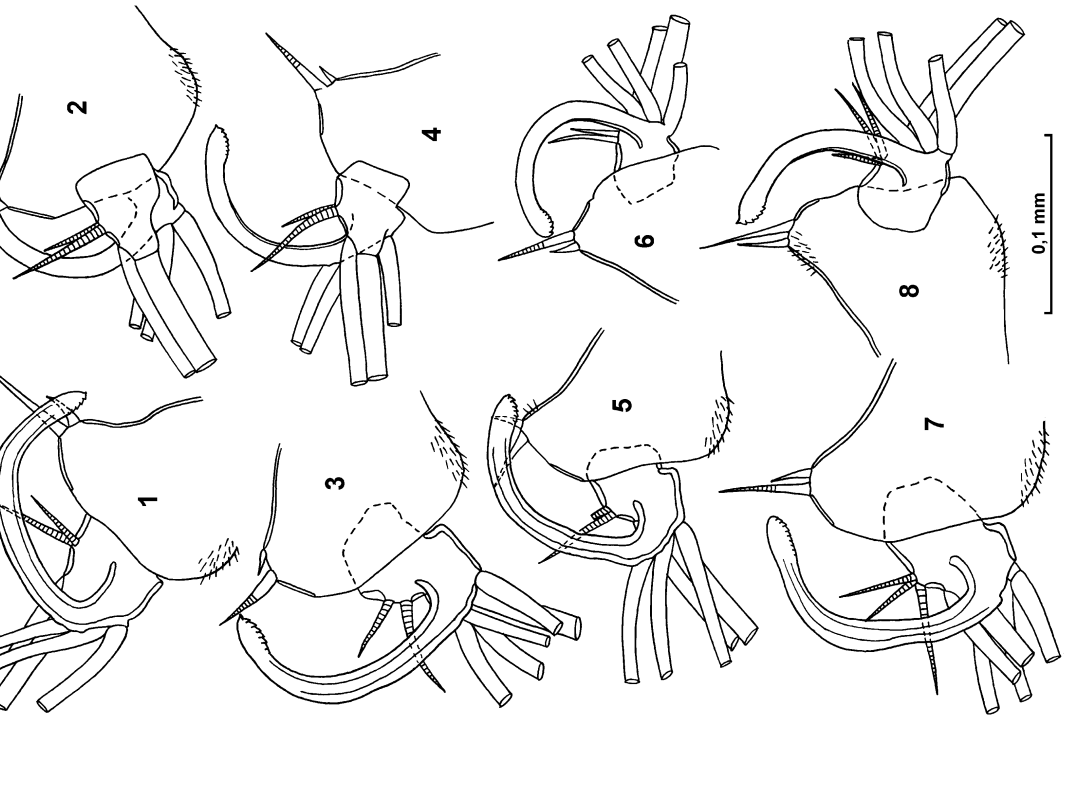

Figure 7. Endopodite on 2nd antenna of male of *Halocypris inflata* (right: *1*, *3*, *5* and *7*; left: *2*, *4*, *6*, and *8*). Indian Ocean: *1* and *2* (N1218), *3* and *4* (N1219), *5* and *6* (N1220), *7* and *8* (N1221).

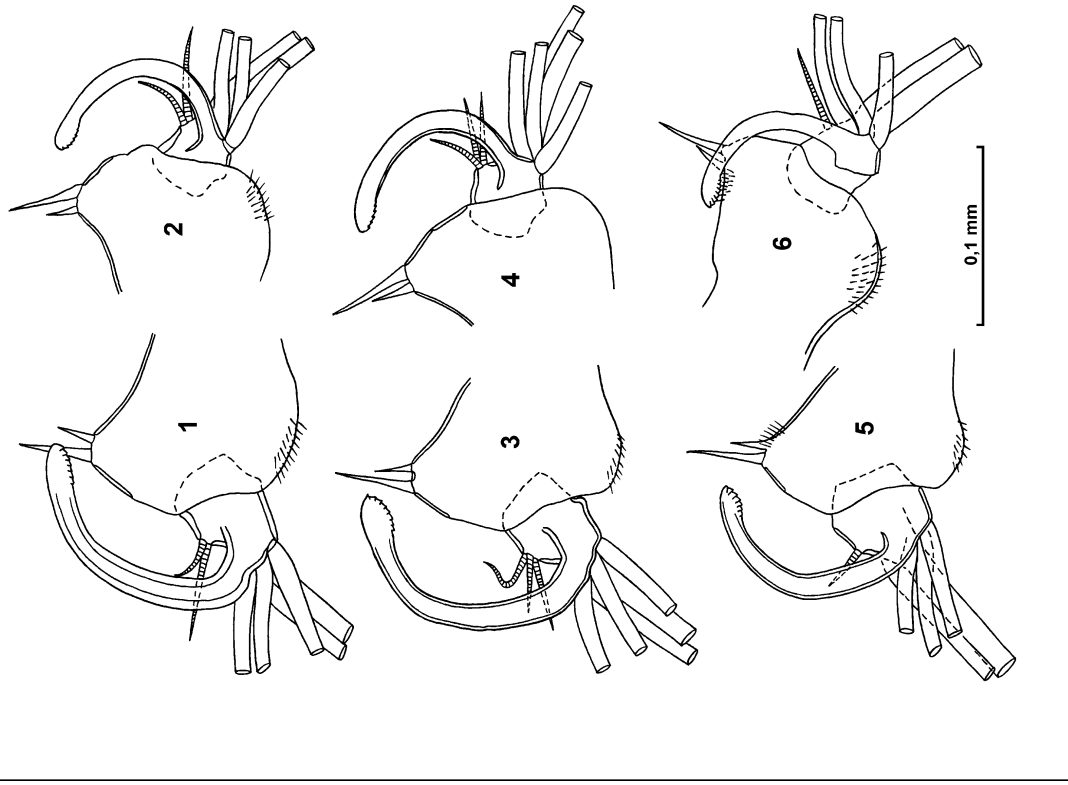

Figure 8. Endopodite on 2nd antenna of male of *Halocypris inflata* (right: *1*, *3*, and *5*; left: *2*, *4* and *6*). Pacific Ocean: *1* and *2* (N1223), *3* and *4* (N1226), *5* and *6* (N1222).

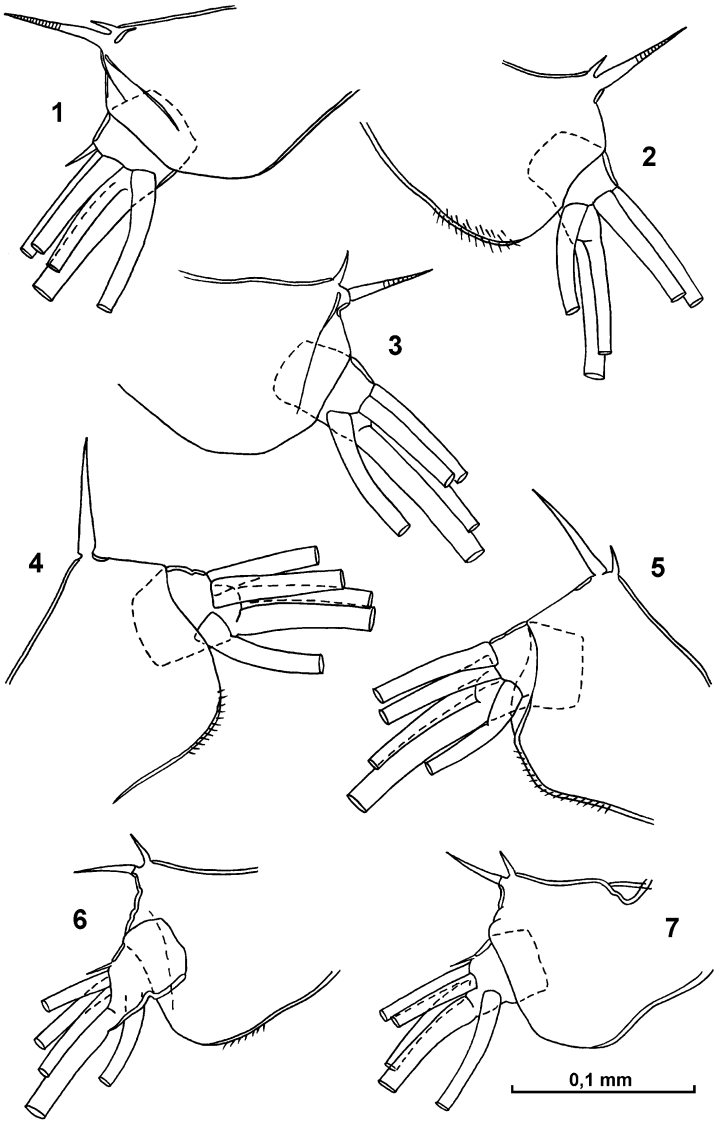

Figure 9. Endopodite on 2nd antenna of female of *Halocypris inflata*. Atlantic Ocean: *1* (N1207), *2* (N1208), *3* (N1209); *4* and *5* (N1201), *6* and *7* (N1203).

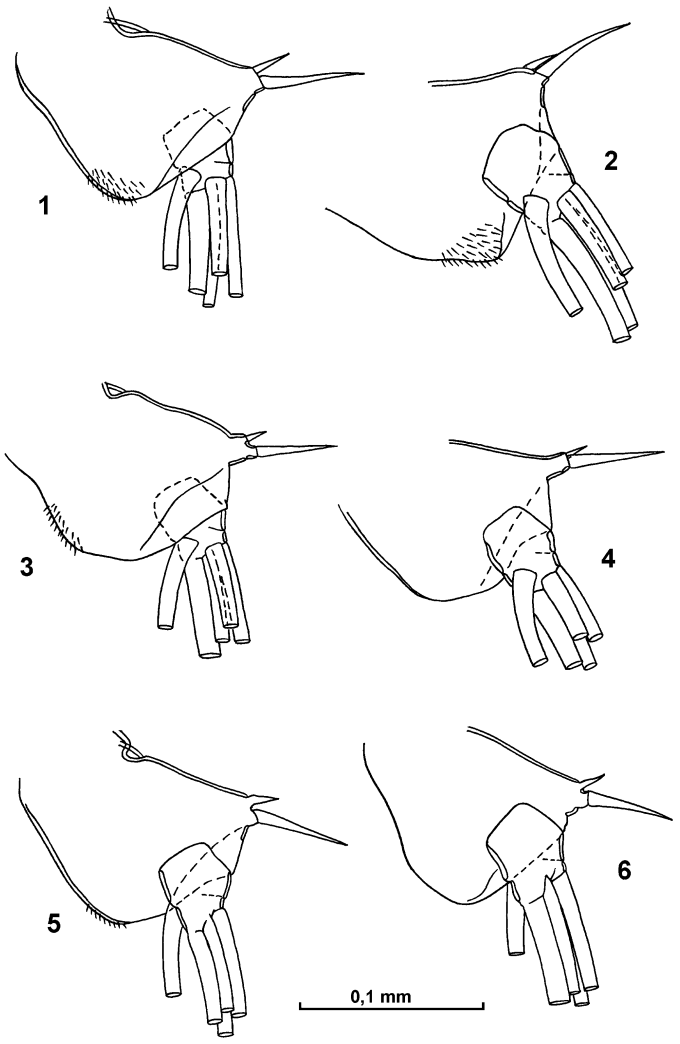

Figure 10. Endopodite on 2nd antenna of female of *Halocypris inflata*. Indian Ocean: *1* and *2* (N1210), *3* and *4* (N1212), *5* and *6* (N1213).

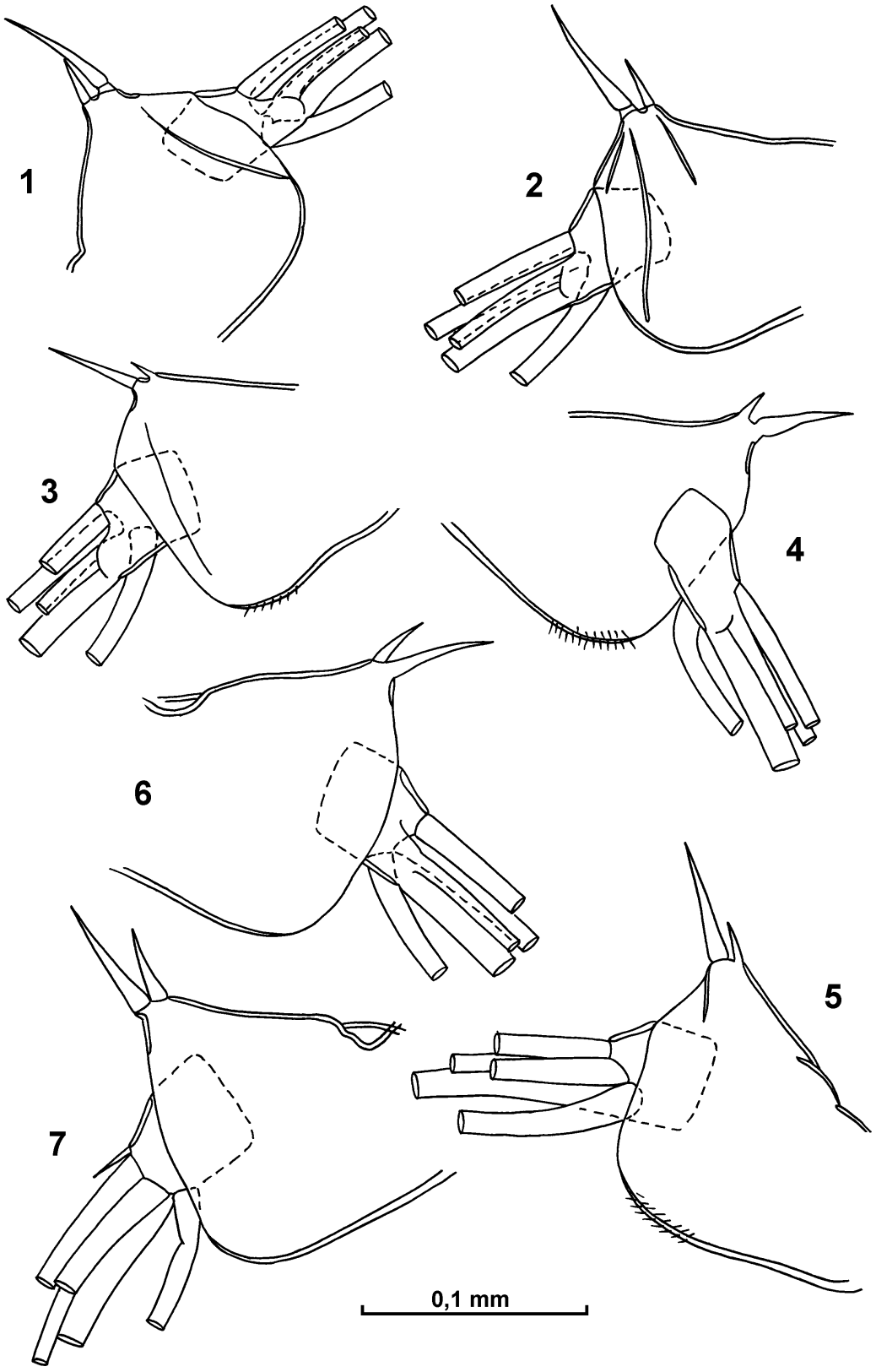

Figure 11. Endopodite on 2nd antenna of female of *Halocypris inflata.* Pacific Ocean: *1* and *2* (N1224), *3* (N1225); *4* (N1155), *5* (N1156), *6* (N1157) and *7* (N1158).

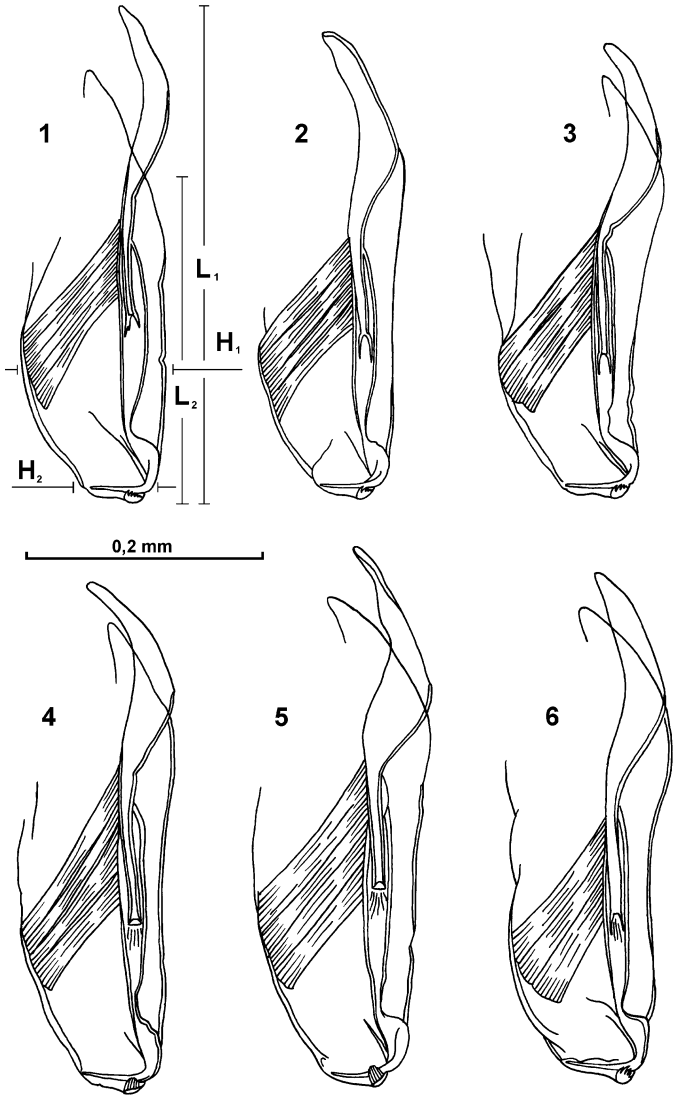

Figure 12. Copulatory appendage of *Halocypris inflata*. Atlantic Ocean: *1* (N1204), *2* (N1205), *3* (N1206), *4* (N1198), *5* (1199), *6* (N1202).

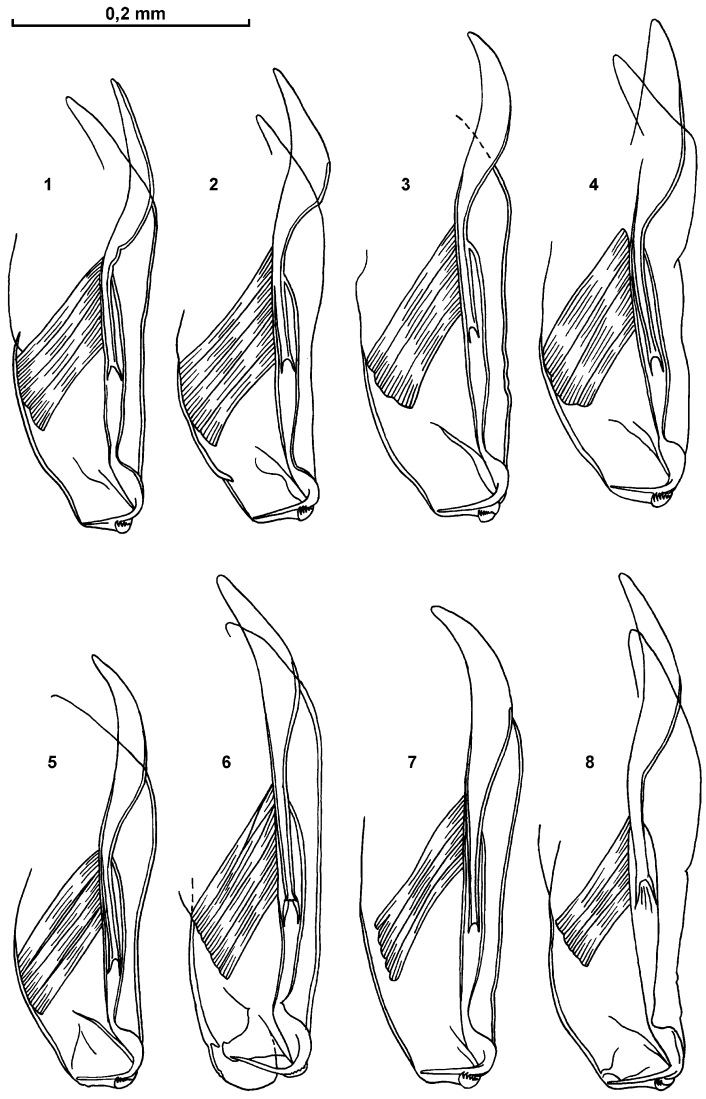

Figure 13. Copulatory appendage of *Halocypris inflata*. Indian Ocean: *1* (N1215), *2* (N1216), *3* (N1217), *4* (N1218), *5* (N1219), *6* (N1223), *7* (N1226), *8* (N1222).

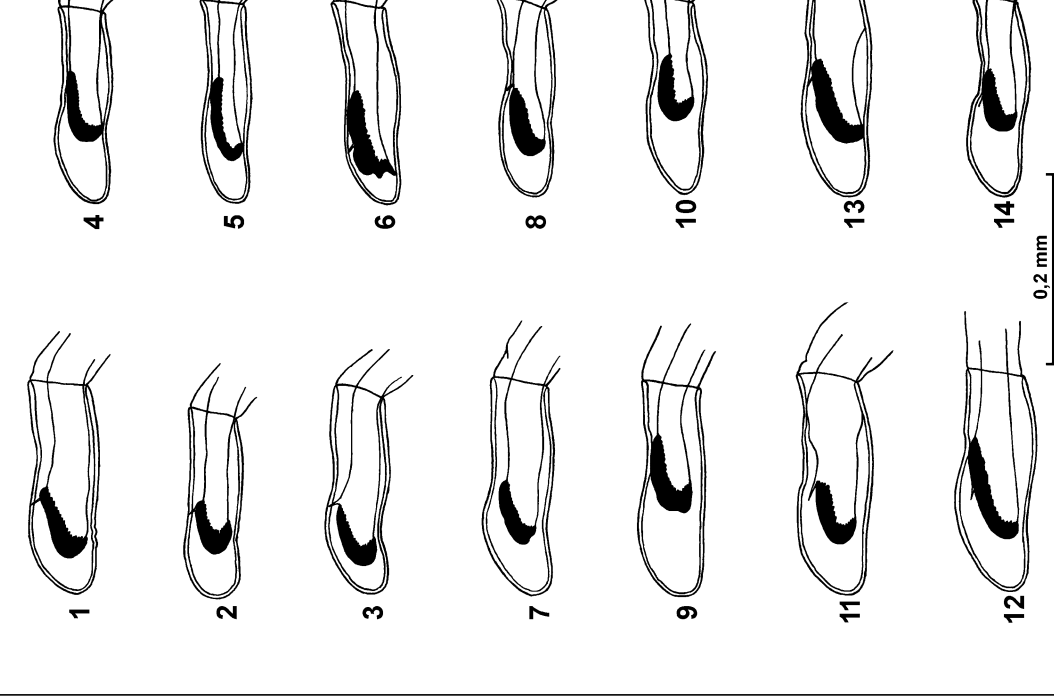

Figure 14. Frontal organ of *Halocypris pelagica*. Atlantic Ocean: *1* (N1165), *2* (N1166), *3* (N1159), *4* (N1160), *5* (N1161), *6* (N1162), *7* (N1163), *8* (N1164); Indian Ocean: *9* (N1167), *10* (N1168), *11* (N1169), *12* (N1170), *13* (N1171), *14* (N1172), *15* (1173), *16* (N1174), *17* (N1175), *18* (N1176).

Figure 15. Frontal organ of *Halocypris pelagica* (male: *1-3, 7, 8, 11-13*; female: *4-6, 9, 10, 14*). Pacific Ocean: *1* (N1188), *2* (N1189), *3* (N1192), *4* (N1191), *5* (N1194), *6* (N1195), *7* (N1197), *8* (N1196), *9* (N1187), *10* (N1186); *11* (N1177), *12* (N1179), *13* (N1180), *14* (N1178).

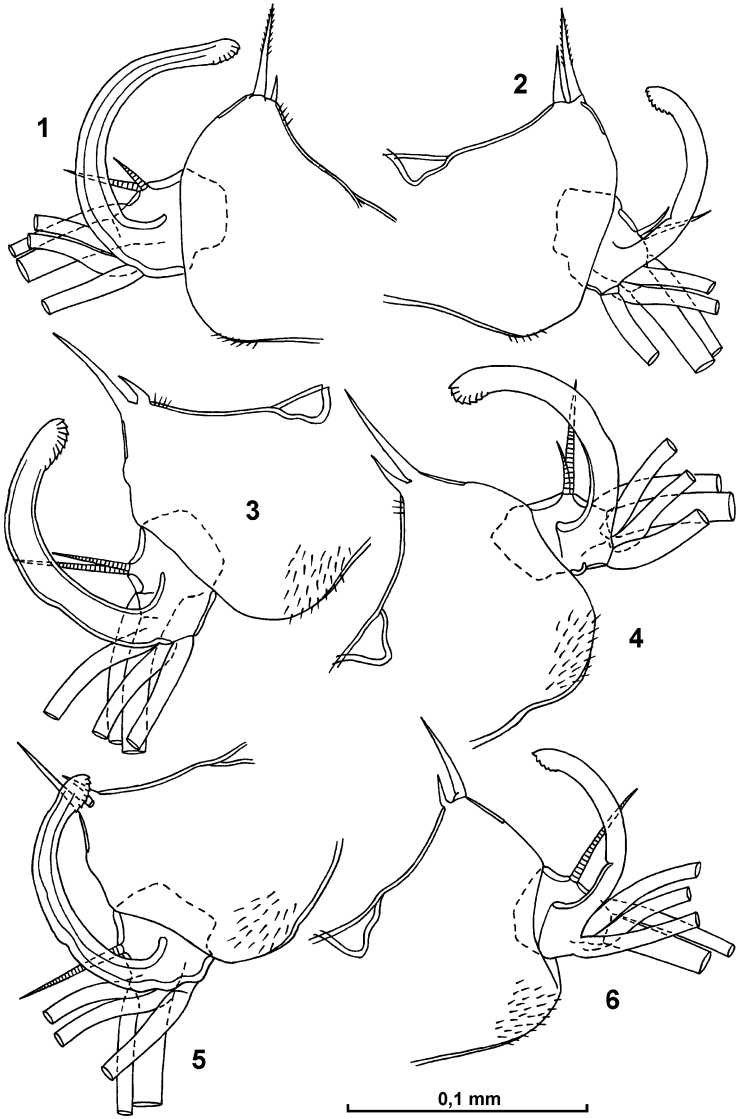

Figure 16. Endopodite on 2nd antenna of male of *Halocypris pelagica* (right: *1*, *3* and *5*; left: *2*, *4* and *6*). Atlantic Ocean: *1* and *2* (N1165); *3* and *4* (N1159), *5* and *6* (N1160).

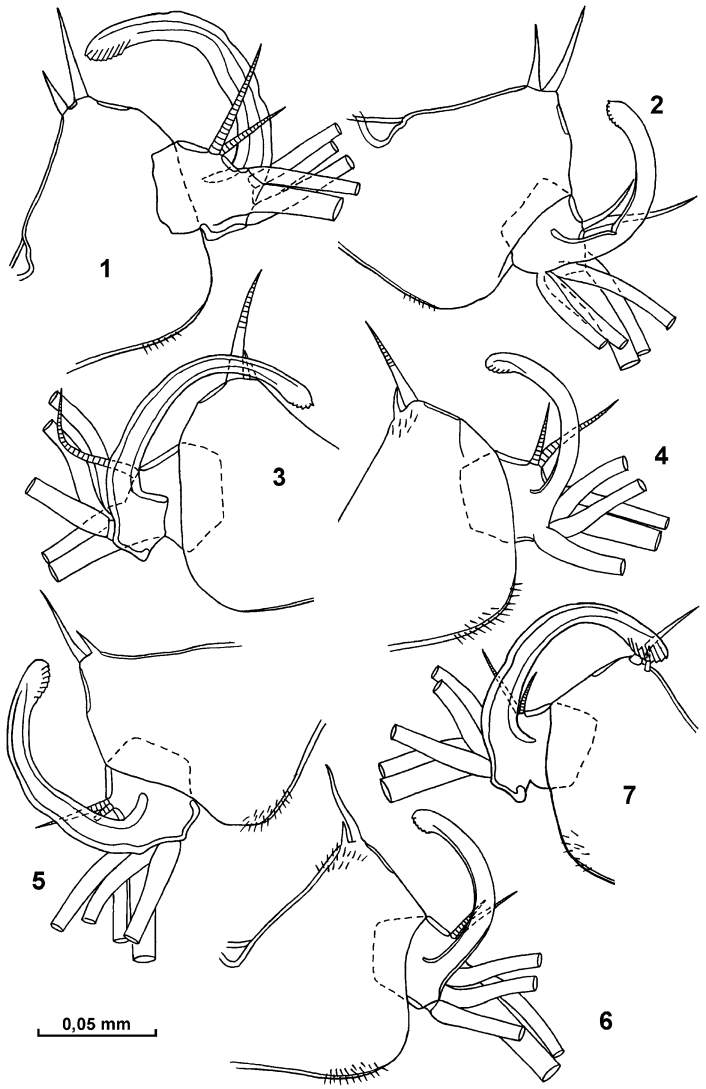

Figure 17. Endopodite on 2nd antenna of male of *Halocypris pelagica* (right: *1*, *3*, *5* and *7*; left: *2*, *4* and *6*) Atlantic Ocean: *1* and *2* (N1161); Indian Ocean: *3* and *4* (N1167), *5* and *6* (N1168), *7* (N1169).

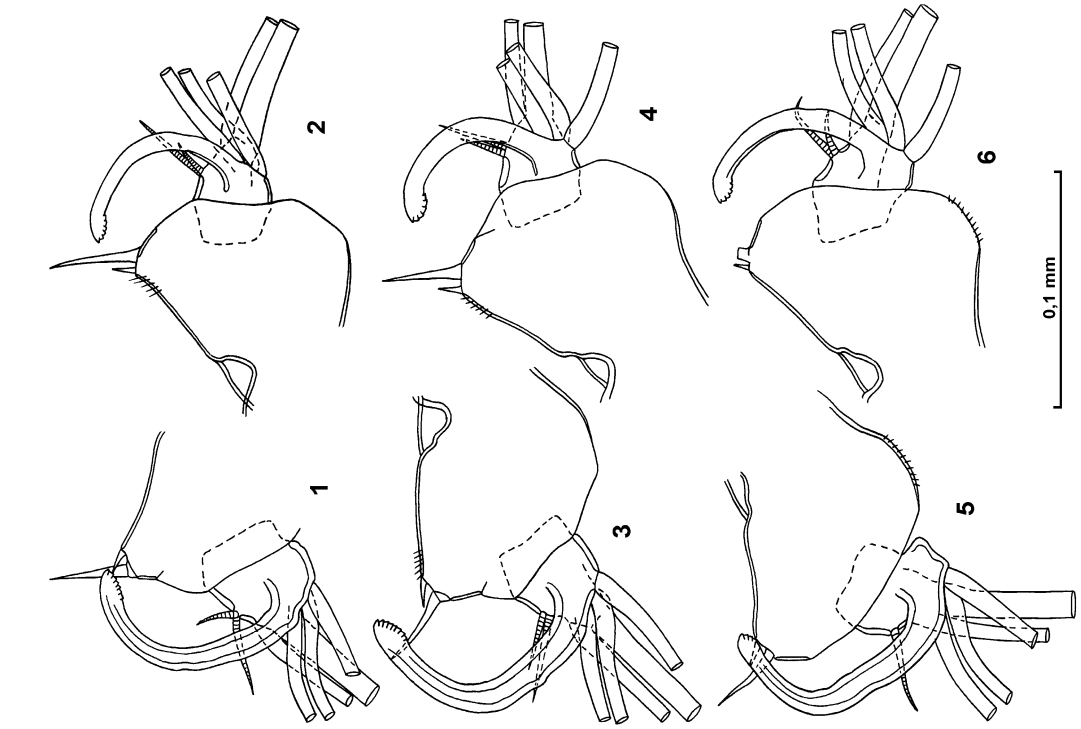

Figure 19. Endopodite on 2nd antenna of male of *Halocypris pelagica* (right - *1*, *3* and *5*; left - *2*, *4* and *6*). Pacific Ocean: *1*, and *2* (N1187), *3* and *4* (N1197); *5* and *6* (N1177).

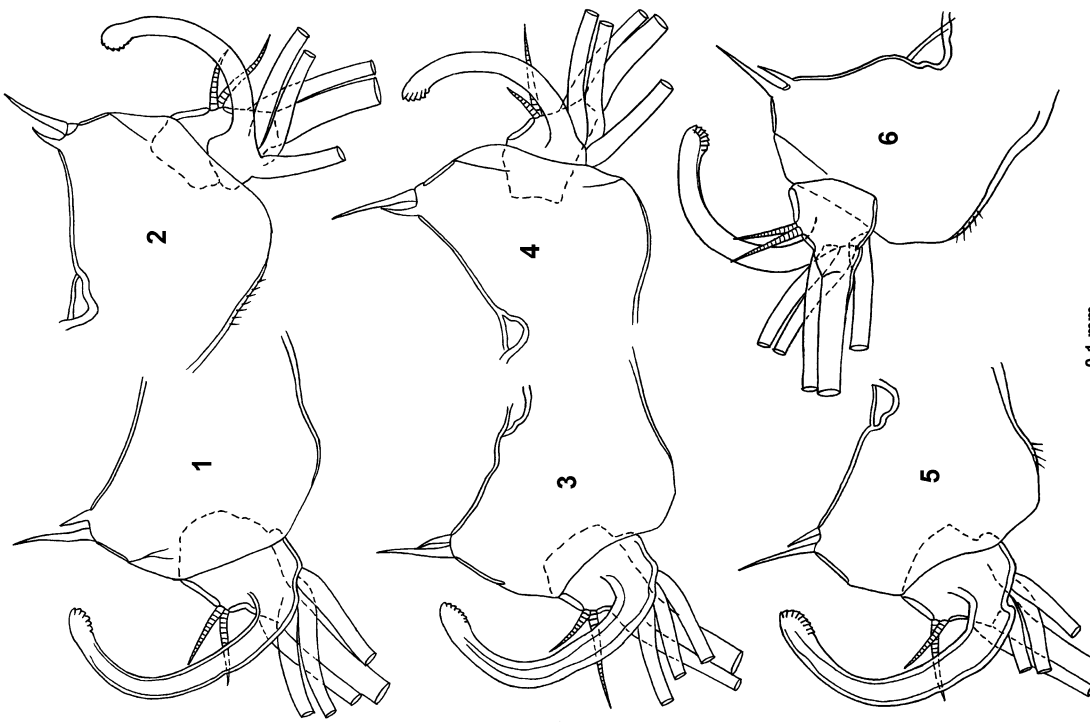

Figure 18. Endopodite on 2nd antenna of male of *Halocypris pelagica* (right: *1*, *3* and *5*; left: *2*, *4*, and *6*) Pacific Ocean: *1* and *2* (N1188), *3* and *4* (N1192), *5* and *6* (N1193).

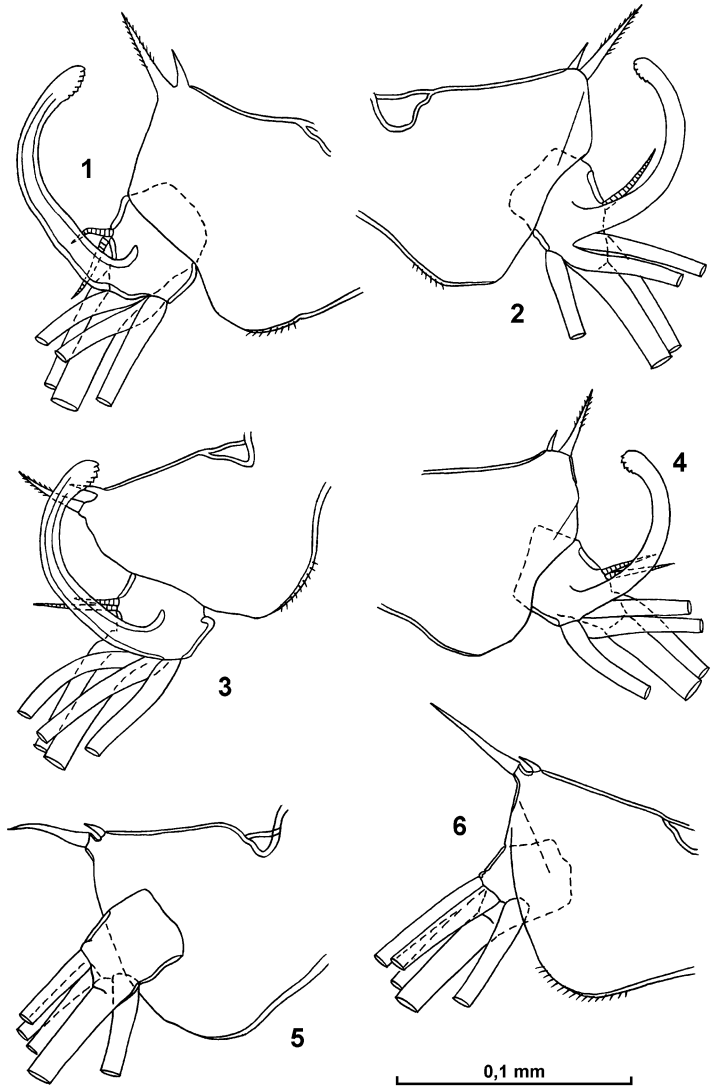

Figure 20. Endopodite on 2nd antenna of male of *Halocypris pelagica* (male: *1-4*; female: *5* and *6*; right: *1*, *3* and *5*; left: *2*, *4* and *6*). Pacific Ocean: *1* and *2* (N1180), *3* and *4* (N1179); Atlantic Ocean: *5* and *6* (N1162).

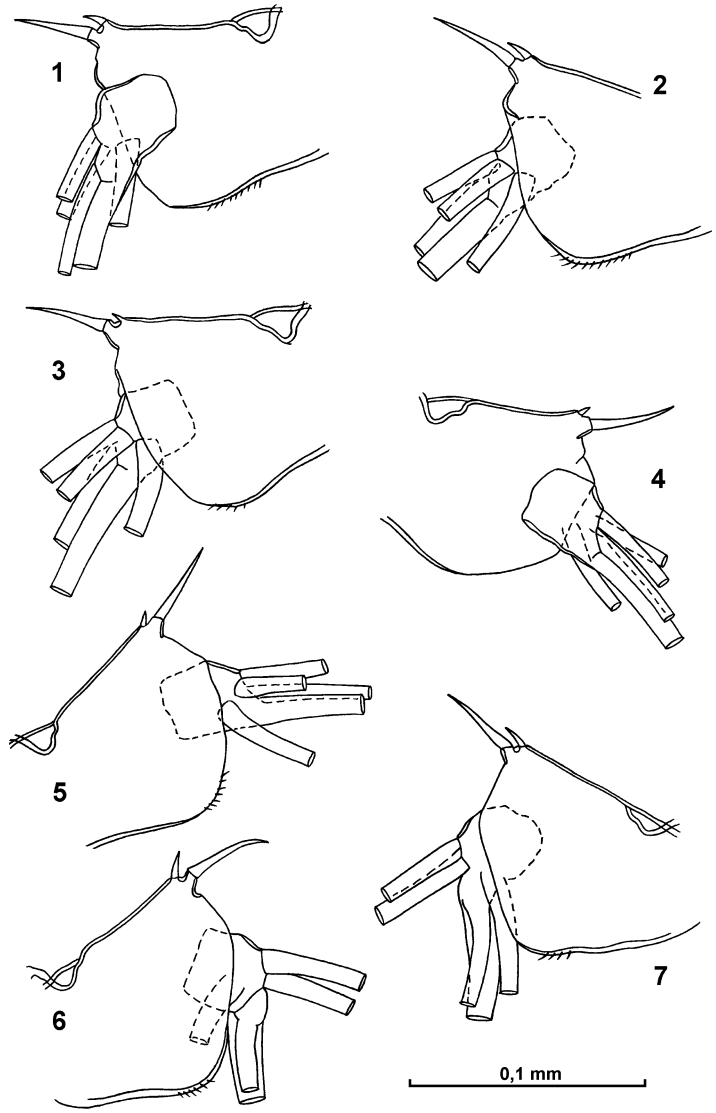

Figure 21. Endopodite on 2nd antenna of female of *Halocypris pelagica*. Atlantic Ocean: *1* and *2* (N1163), *3* (N1164), *4* and *5* (N1166); Indian Ocean: *6* and *7* (N1174).

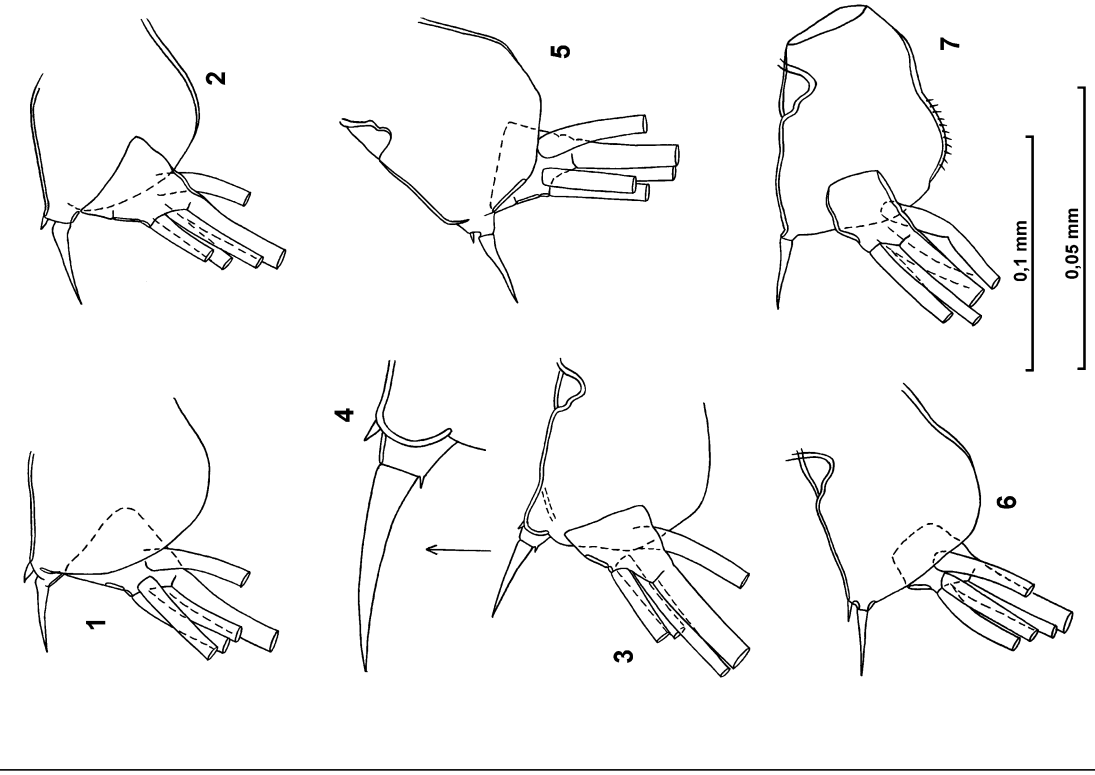

Figure 23. Endopodite on 2nd antenna of female of *Halocypris pelagica*. Pacific Ocean: *1* and *2* (N1186), *3*-*5* (N1196), *6* and *7* (N1178).

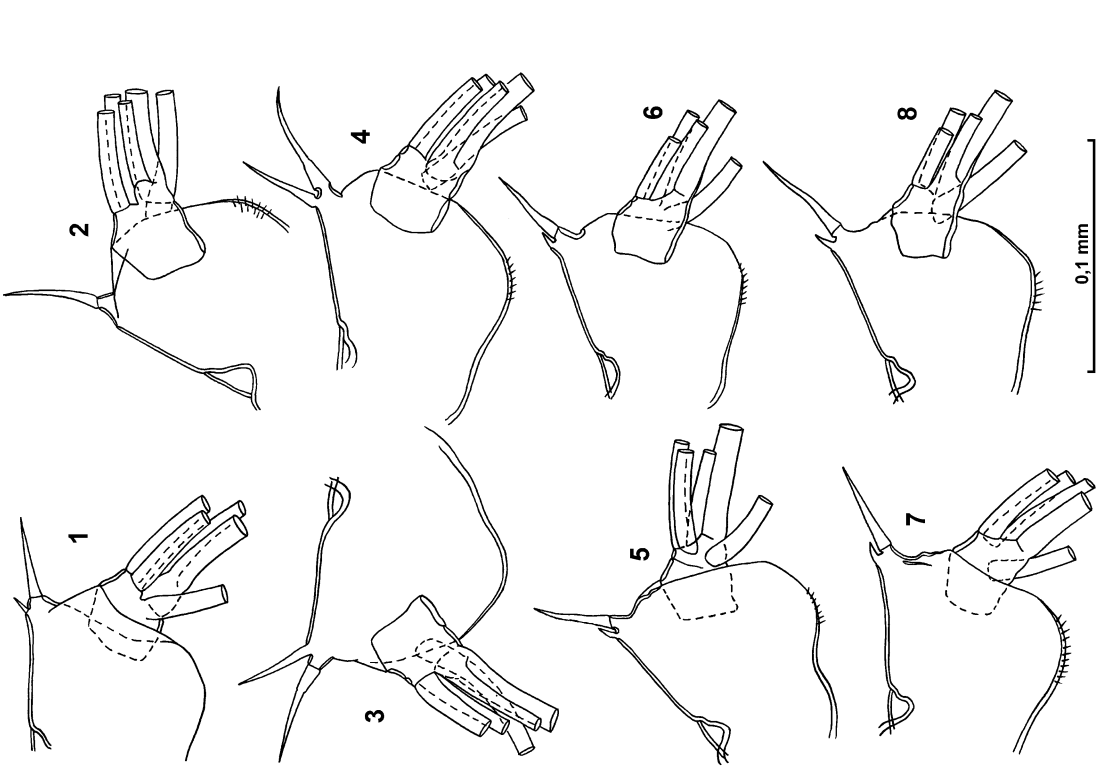

Figure 22. Endopodite on 2nd antenna of female of *Halocypris pelagica*. Indian Ocean: *1* and *2* (N1175), *3* and *4* (N1176); Pacific Ocean: *5* and *6* (N1191), *7* and *8* (N1195).

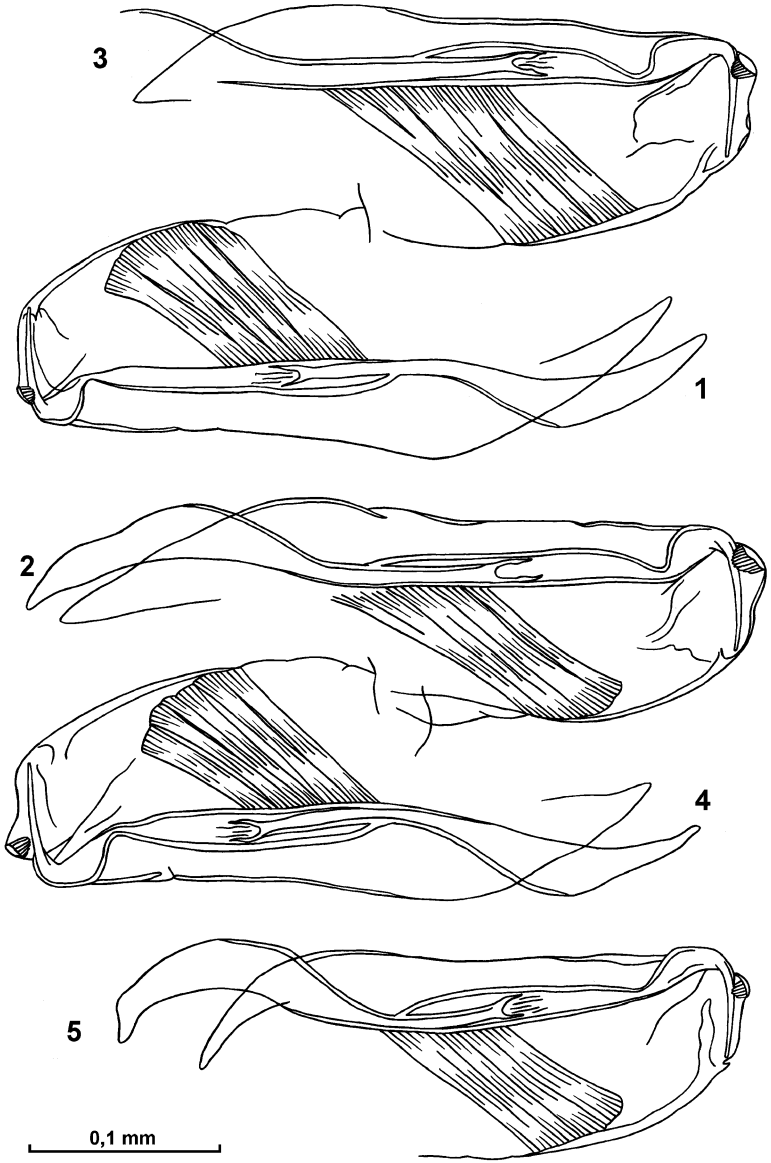

Figure 24. Copulatory appendage of *Halocypris pelagica*. Atlantic Ocean: *1* (N1165), *2* (N1159), *3* (N1160), *4* (N1161); Indian Ocean: *5* (N1168).

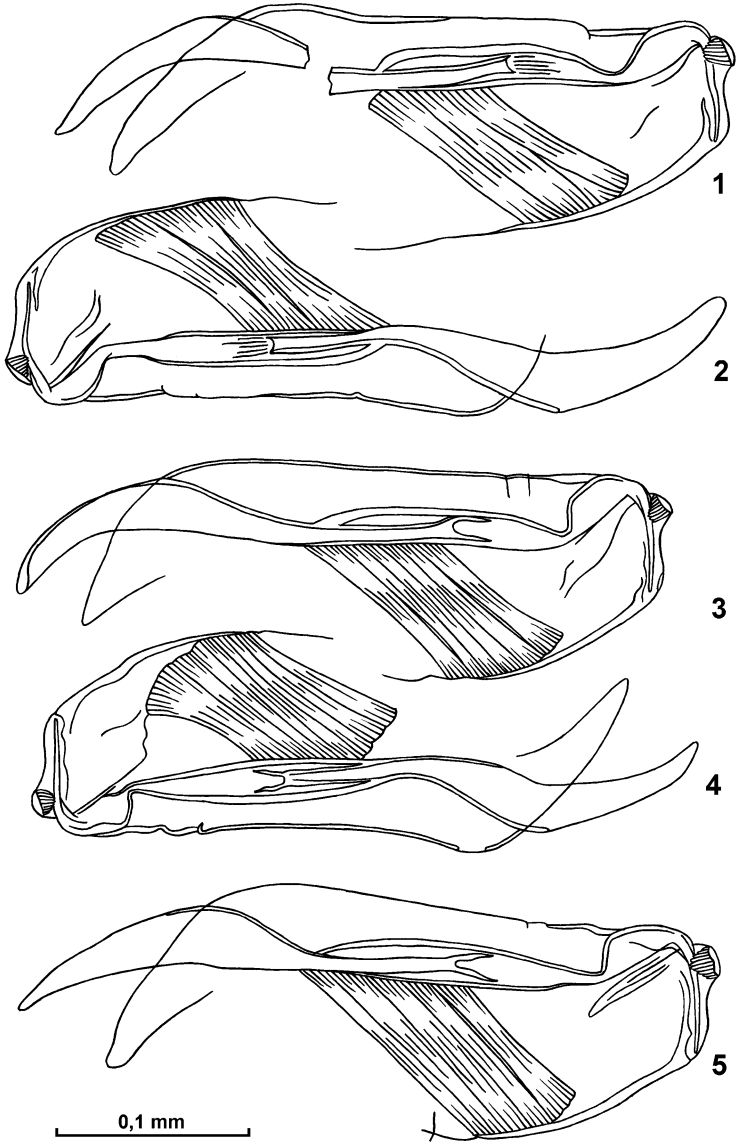

Figure 25. Copulatory appendage of *Halocypris pelagica*. Indian Ocean: *1* (N1167), *2* (N1171); Pacific Ocean: *3* (N1169), *4* (N1170), *5* (N1197).

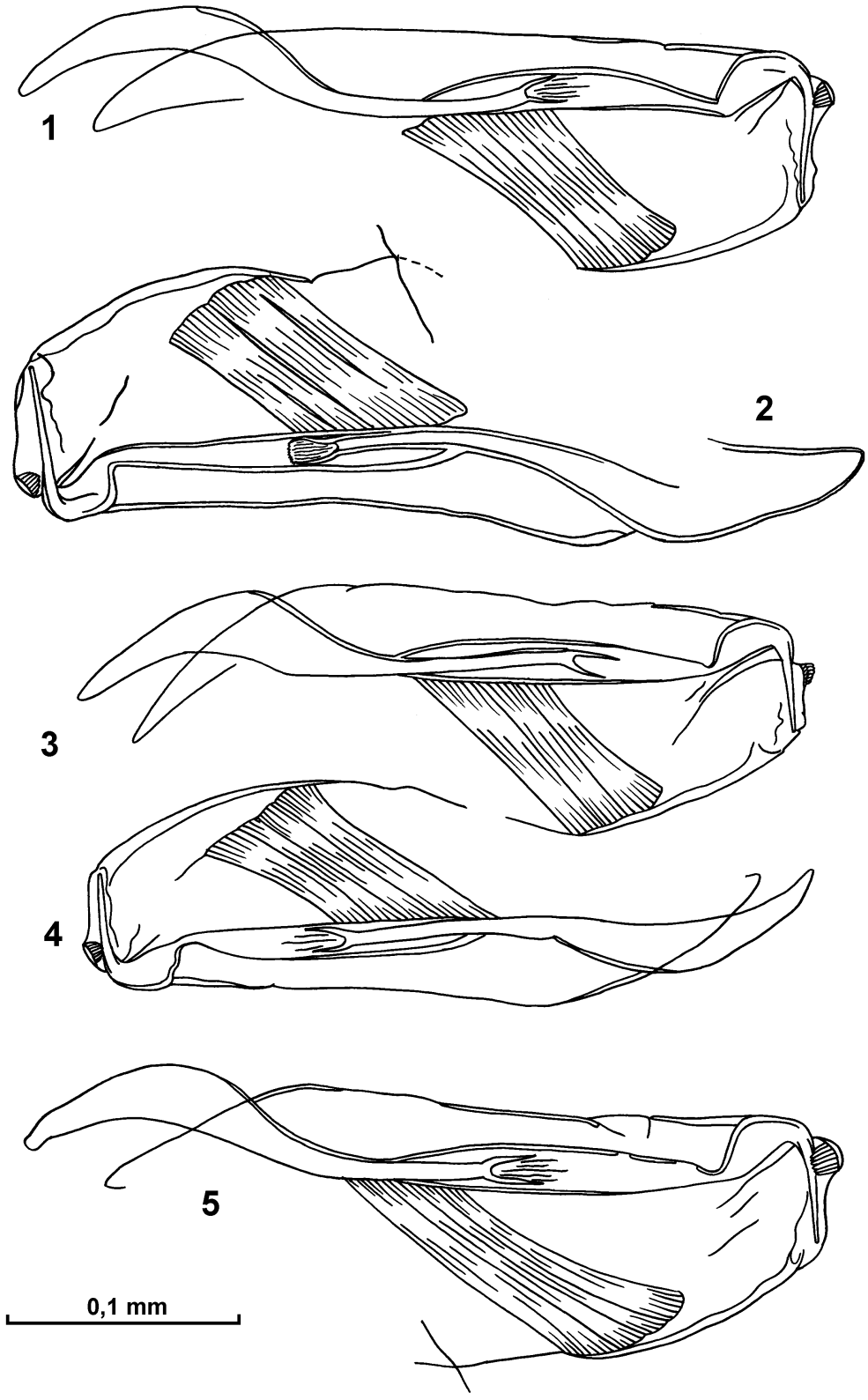

Figure 26. Copulatory appendage of *Halocypris pelagica*. Pacific Ocean: *1* (N1187), *2* (N1182), *3* (N1177), *4* (N1179), *5* (N1181).

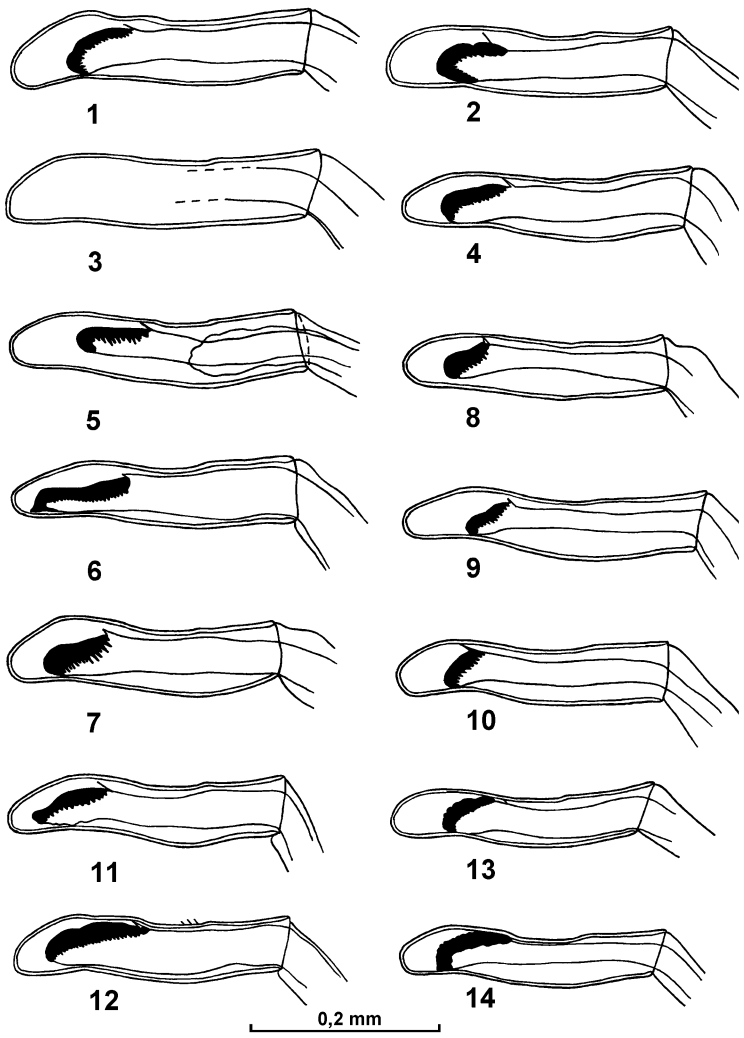

Figure 27. Frontal organ of *Halocypris angustifrontalis*. Pacific Ocean: *1* (N1135), *2* (N1136), *3* (N1143), *4* (1134), *5* (N1137), *6* (N1138), *7* (N1139), *8* (N1140), *9* (N1141), *10* (N1142), *11* (N1151), *12* (N1152), *13* (N1155), *14* (N1156).

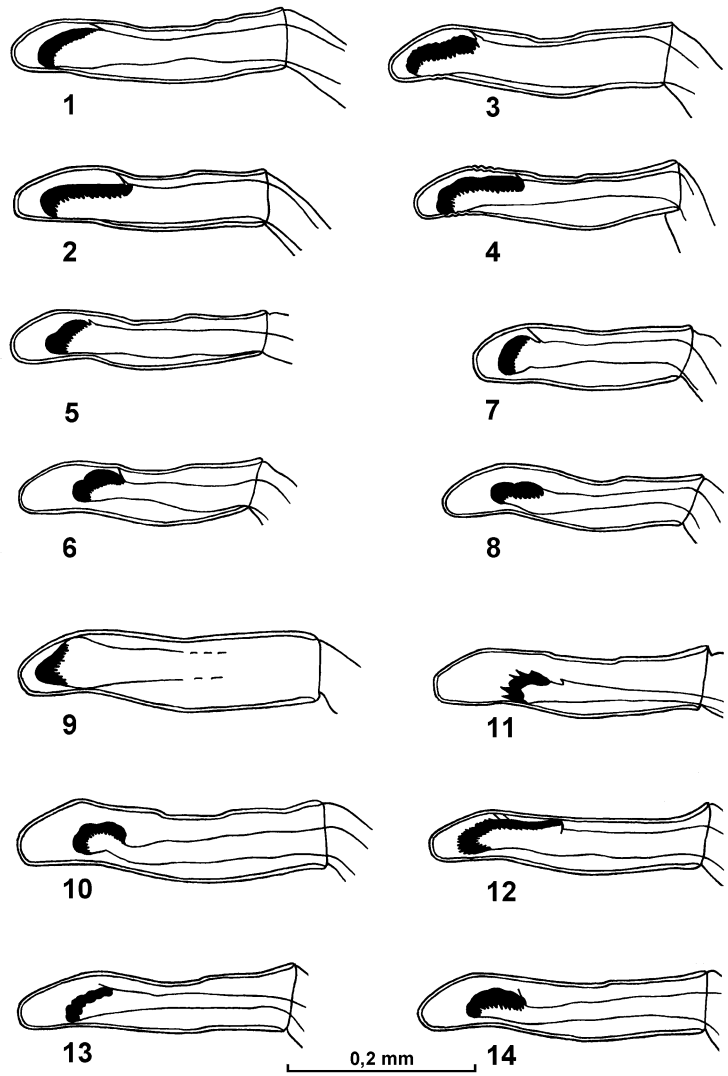

Figure 28. Frontal organ of *Halocypris angustifrontalis* (male: *1*, *2*, *9* and *10*; female: *3-8*, *11-14*) Pacific Ocean: *1* (N1153), *2* (N1154), *3* (N1157), *4* (N1158), *5* (N1131), *6* (N1130), *7* (N1132), *8* (N1133), *9* (N1144), *10* (N1145), *11* (N1147), *12* (N1148), *13* (N1149), *14* (N1150).

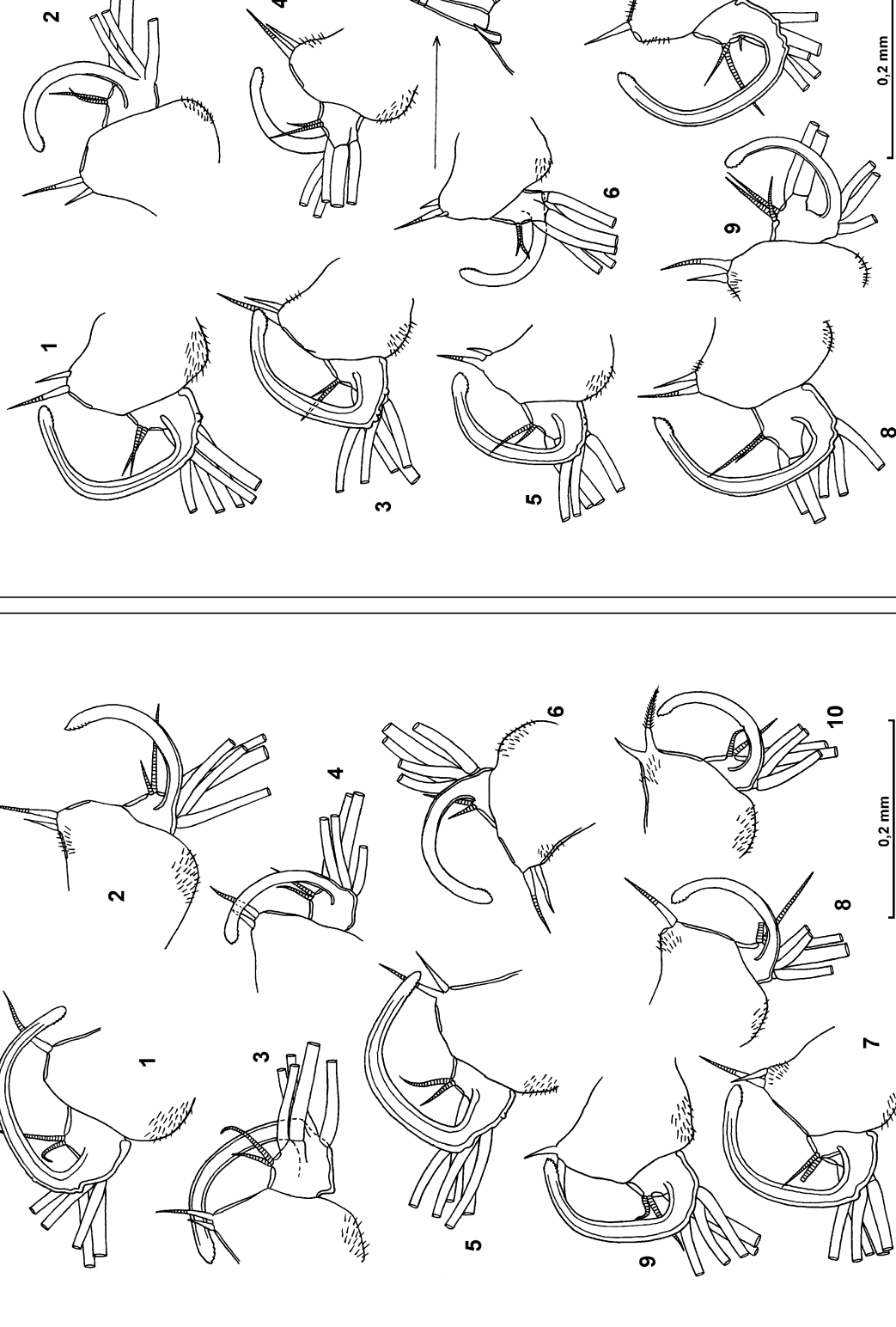

Figure 29. Endopodite on 2nd antenna of male of *Halocypris angustifrontalis* (right: *1*, *3*, *5*, *7* and *9*; left: *2*, *4*, *6*, *8* and *10*). Pacific Ocean: *1* and *2* (N1135); *3* and *4* (N1143), *5* and *6* (N1137), *7* and *8* (N1138), *9* and *10* (N1139).

Figure 30. Endopodite on 2nd antenna on male of *Halocypris angustifrontalis* (right: *1*, *3*, *5*, *8* and *10*; left: *2*, *4*, *6*, *7* and *9*). Pacific Ocean: *1* and *2* (N1151), *3* and *4* (N1152), *5-7* (N1154), *8* and *9* (N1144), *10* (N1146).

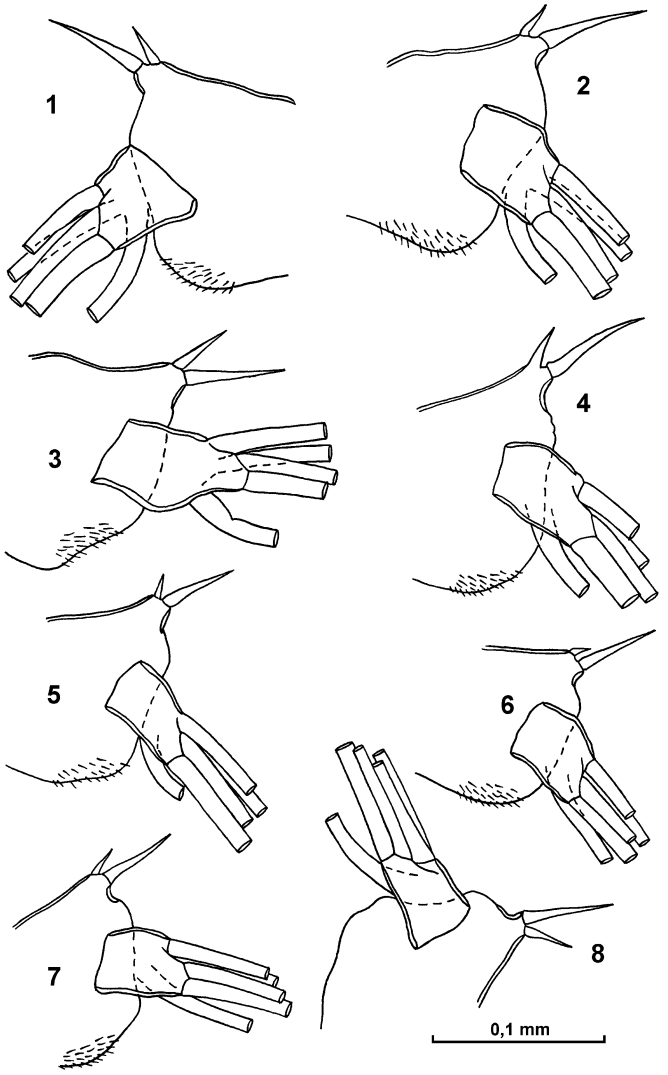

Figure 31. Endopodite on 2nd antenna of female of *Halocypris angustifrontalis*. Pacific Ocean: *1* and *2* (N1134), *3* (N1140), *4* (N1141), *5* (N1155), *6* (N1156), *7* (N1157), *8* (N1158).

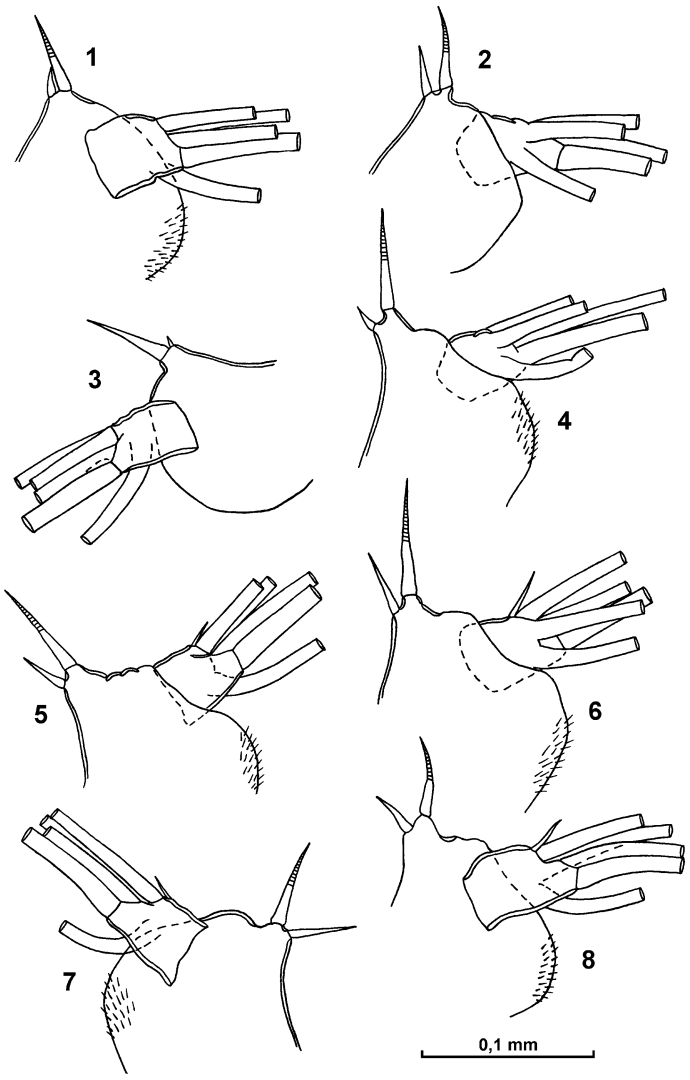

Figure 32. Endopodite on 2nd antenna of female of *Halocypris angustifrontalis*. Pacific Ocean: *1* (N1130), *2* (N1131), *3* (N1132), *4* (N1134); *5* (N1147), *6* (N1149), *7* and *8* (N1150).

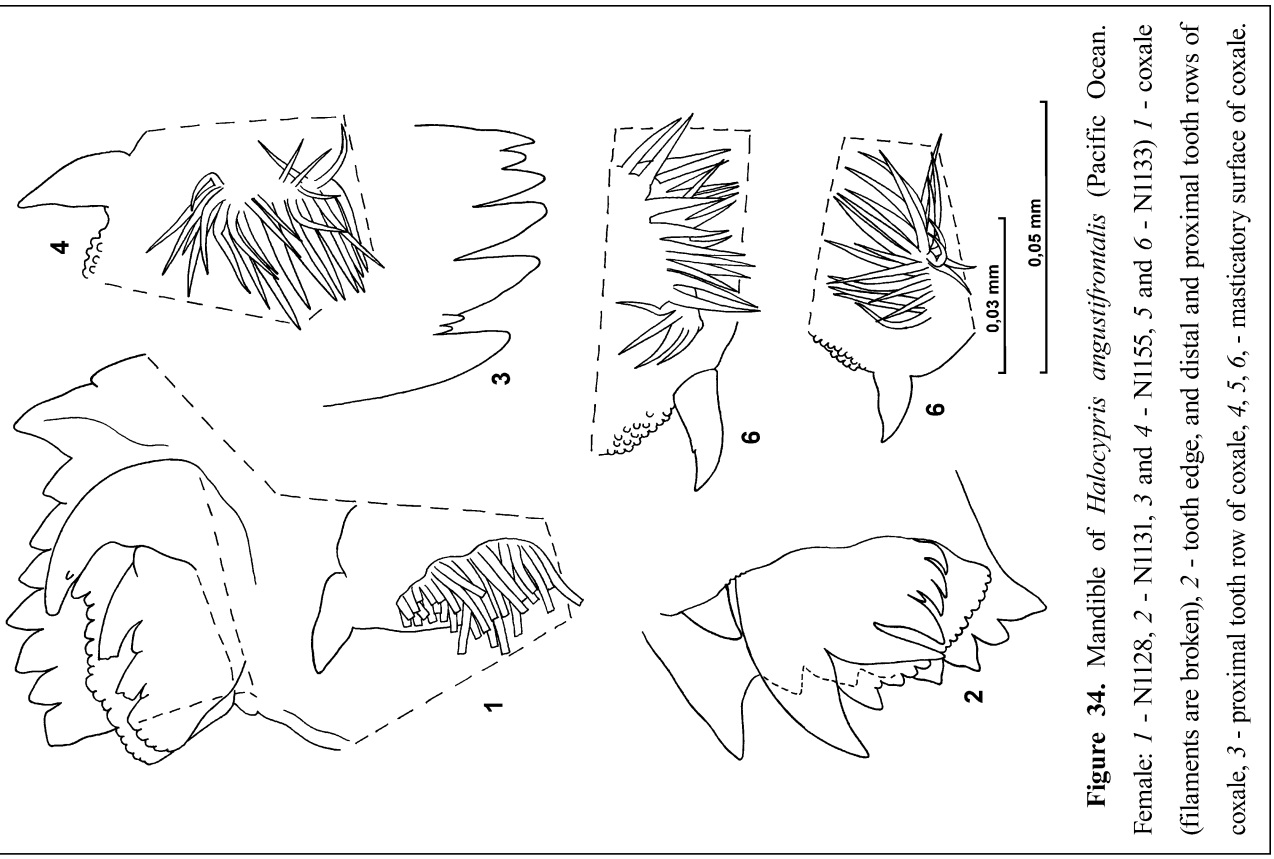

Figure 34. Mandible of *Halocypris angustifrontalis* (Pacific Ocean. Female: *1* - N1128, *2* - N1131, *3* and *4* - N1155, *5* and *6* - N1133) *1* - coxale (filaments are broken), *2* - tooth edge, and distal and proximal tooth rows of coxale, *3* - proximal tooth row of coxale, *4*, *5*, *6*, - masticatory surface of coxale.

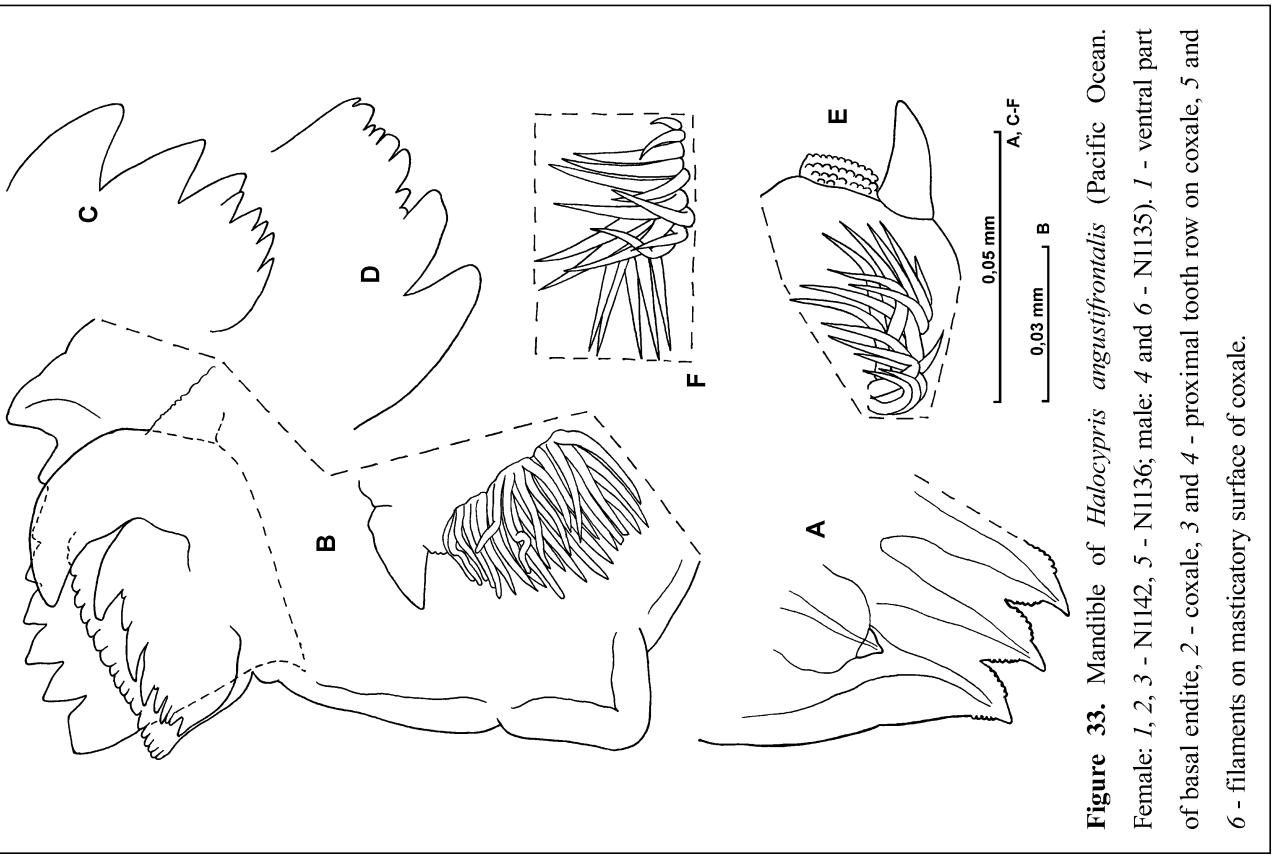

Figure 33. Mandible of *Halocypris angustifrontalis* (Pacific Ocean. Female: *1*, *2*, *3* - N1142, *5* - N1136; male: *4* and *6* - N1135). *1* - ventral part of basal endite, *2* - coxale, *3* and *4* - proximal tooth row on coxale, *5* and *6* - filaments on masticatory surface of coxale.

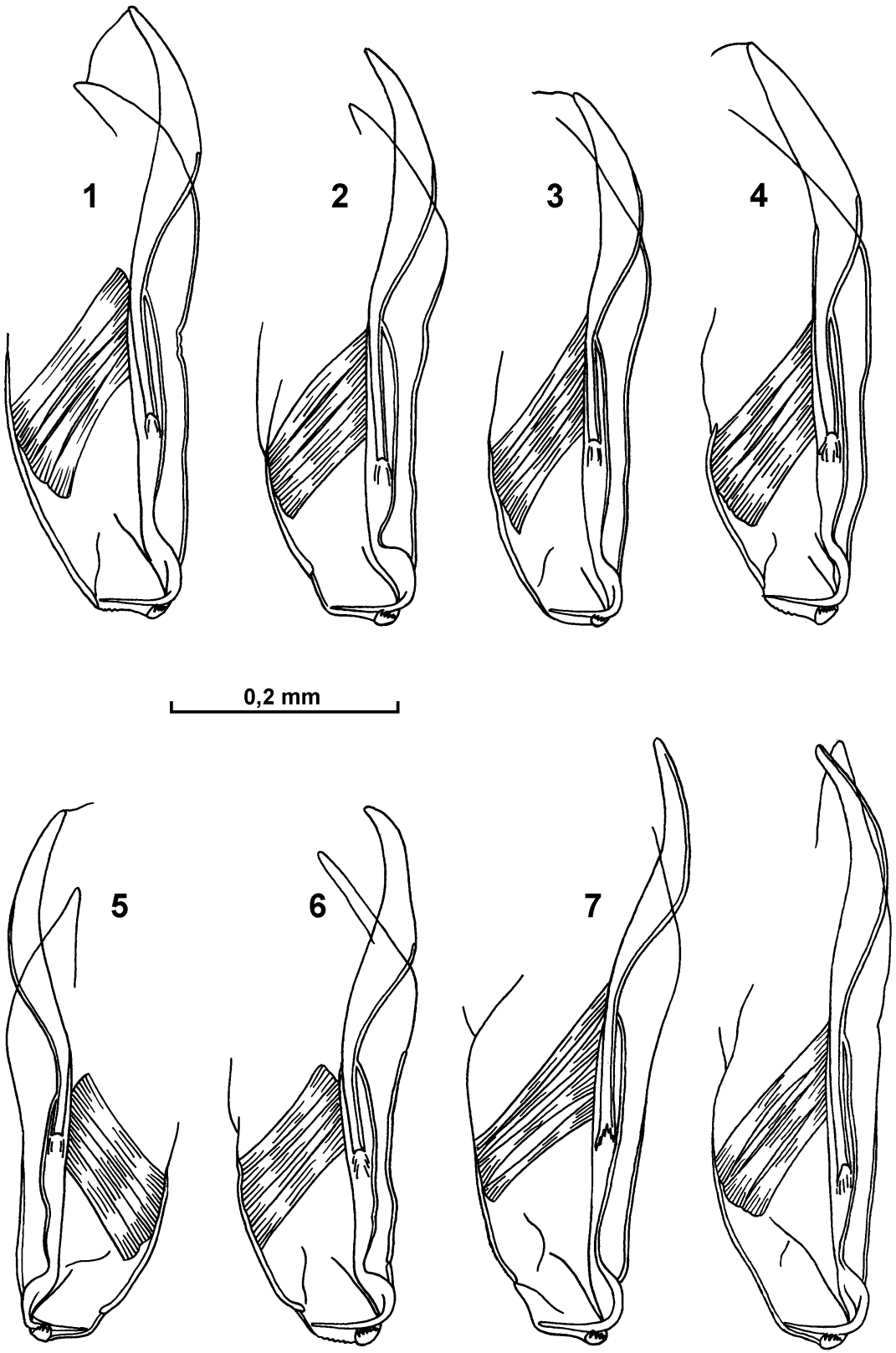

Figure 35. Copulatory appendage of *Halocypris angustifrontalis* Pacific Ocean: *1* (N1135), *2* (N1137), *3* (N1139), *4* (N1151), *5* (N1154), *6* (N1152), *7* (N1144), *8* (N1146)

Appendix 1. Material examined on *Halocypris inflata** (Russian Expedition)

Material examined* (Russian Expedition):				
RV	**Date**	**Depth, m**	**Position**	**Material**
Atlantic Ocean: "Lena"	1/1/1956	0–250	0º27′N, 13º33′W	N1198 m# 1.55 mm, N1199 m#1.55 mm, N1200 f# 1.80 mm, N1201 f# 1.85 mm
"Kurchatov"	18/11/1971	182–424	36º59′N, 26º31′W	N1202 m# 1.35 mm
"Kurchatov"	21/12/1971	0–120	41º32′S, 53º31′W	1203 f# 1.55 mm
"Kurchatov"	18/9/1983	0–5000	22º17′N, 37º07′W	N1204 m# 1.45 mm, N1205 m# 1.45 mm, N1206 m# 1.42 mm, N1207 f# 1.60 mm, N1208 f# 1.67 mm, N1209 f# 1.65 mm
Indian Ocean: "Ob"	4/5/1956	0–2200	45º26′S, 15º25′E	N1210 f#1.62 mm, N2756 f# 1.65 mm, N2757 # 1.55 mm, N2758 # 1.67 mm, N2759 # 1.70 mm,
"Ob"	25/5/1956	0–2200	31º20′S, 66º04′E	N2760 m# .37 mm, N2761 m# 1.42 mm, N2762 m# 1.50 mm, N2763 m# 1.47 mm, N2764 m# 1.35 mm, N2765 m# 1.52 mm, N2766 m# 1.47 mm
Pacific Ocean:				
"Birokan"	4/2/1965	200–500	13º56′N, 92º48′W	N2767 m# 1.37 mm
"Pelamida"	29/5/1974	50-100	38º00′N, 149º00′E	N2768 m# 1.53 mm, N2769 m# 1.76 mm
"Seskar"	28/8/1975	0–100	30º00′N, 138º00′E	N2770 m# 1.48 mm
"Pelamida"	1/9/1976	0–100	26º00′N, 138º00′E	N2771 m# 1.42 mm

* All specimens are dissected, appendages and valves in alcohol

Additional material on *Halocypris inflata*

Additional material (Russian Expedition):				
RV	**Date**	**Depth, m**	**Position**	**Material**
Atlantic Ocean: "Kurchatov"	18/9/1983		0–5000 22º17′N, 37º07′E	1m# 1.52 mm and 4 juv. 0.9–1.04 mm
Indian Ocean: "Ob"	3/5/1956	0–600	42º20′S, 129º24′E	25m# 1.44–150 mm, 5f#1.75–1.79 mm
"Ob"	4/5/1956	0–600	43º55′S, 127º47′E	3m# 1.45–1.51 mm, 2f# 1.74–1.75 mm
"Ob"	4/5/1956	0–800	45º26′S, 125º52′E	34m# 1.48–1.55 mm, 12f# 1.64–1.76 mm, 1 juv. 1.24 mm
"Ob"	4/5/1956	0–2200	45º26′S, 125º52′E	3m# 1.45–1.47 mm, 3f# 1.67–1.72 mm
"Ob"	5/5/1956	0–500	46º52′S, 123º55′E	9m# 1.42–1.50 mm, 2f# 1.67–1.70 mm

Appendix 1. (continued)

“Ob”	25/5/1956	0–100	34º18′S, 66º48E	1 juv. 1.33 mm
“Ob”	28/5/1956	0–120	22º28S, 66º40′E	2m# 1.35–1.35 mm, 2f# 1.48–1.50 mm, 2 juv. 0.96-1.0 mm
“Ob”	29/5/1956	0–120	19º47′S, 63º38′E	2m# 1.37–1.49 mm, 6f# 1.60–1.69 mm
“Ob”	29/5/1956	0–400	19º47′S, 63º38′E	14♂ 1.42–1.50 mm, 4♀ 1.62–1.66 mm
“Ob”	29/5/1956	0–400	19º47′S, 63º38′E	3m# 1.35–1.40 mm, 1f# 1.61 mm
“Ob”	29/5/1956	Surface	19º47′S, 63º38′E	18m# 1.41–1.50 mm, 22f# 1.50–1.59 mm
“Ob”	29/5/1956	0–2700	19º09′S, 63º07′E	15m# 1.41–1.45 mm, 7f# 1.50–1.65mm
“Ob”	29/5/1956	Surface	19º09′S, 63º07′E	1m# 1.30 mm
“Ob”	29/5/1956	0–130	19º09′S, 63º07′E	1m# 1.53 mm, 1f# 1.70 mm
“Ob”	29/5/1956	0–3300	19º09′S, 63º07′E	16m# 1.36–1.45 mm, 16f# 1.41–1.65 mm, 4 juv. 0.93–1.20 mm
“Ob”	30/5/1956	Surface	16º55′S 63º01′E	10m# 1.31–1.35 mm, 18f# 1.41–1.50 mm, 4 juv. 1.00–1.10 mm
“Ob”	30/5/1956	0–1300	16º55′S 63º01′E	14m# 1.30–1.41 mm, 19f# 1.43–1.56 mm, 19 juv 0.95–1.10 mm
“Ob”	30/5/1956	0–1250	14º47′S, 62º53′E	35m# 1.31–1.35 mm, 42f# 1.41–1.50 mm, 66 juv 0.80–1.10 mm
“Ob”	30/5/1956	0–120	14º47′S, 62º53′E	17m# 1.40–1.50 mm, 44f# 1.46–1.65 mm
“Ob”	31/5/1956	0–120	9º58′S, 62º46′E	117m#1.39–1.50 mm, 48f# 1.74–1.80 mm, 48 juv 1.00–1.11 mm
“Ob”	1/6/1956	0–1500	7º50′S, 60º32′E	2f# 1.66, 1.70 mm, 4 juv 0.90–1.14 mm
“Ob”	1/6/1956	0–130	7º50′S, 60º32′E	1m# 1.50 mm, 1f# 1.59 mm
“Ob′”	2/6/1956	0–120	7º50′S, 60º32′E	1m# 1.50 mm
“Ob”	2/6/1956	0–1250	5º05′S, 57º34′E	2f# 1.65, 1.65 mm
“Ob”	2/6/1956	surface	5º05′S, 57º34′E	2m# 1.40–1.45 mm,
“Ob”	4/6/1956	0–3000	1º20′S, 55º05′E	4m# 1.38–1.45 mm, 2f# 1.70–1.75 mm, 1 juv. 1.40 mm

Appendix 1. (continued)

"Ob"	4/6/1956	0–120	0º51′S, 54º 27′E	2m# 1.46–1.47 mm, 3f# 1.56–1.64 mm, 3juv.1.04–1.06 mm
"Ob"	4/6/1956	surface	0.51′S, 5427′E	2♀ 1.55–1.65 mm, 1 juv. 1.09 mm
"Ob"	5/5/1956	0–3350	3 º 09′N, 53 º 45′E	1m# 1.41 mm, 11f# 1.45–1.50 mm, 12 juv.0.77–1.0 mm
"Ob"	6/5/1956	0–2000	5º18′N, 53º00′E	2m# 1.30–1.35 mm, 1f# 1.57 mm, 4 juv.0.95–1.10 mm
Pacific Ocean:				
"Vityaz"	2/5/1955	150–1000	37º39′N, 144º30′E	1f# 1.60 mm and 2 juv. 1.10–1.15 mm
"Vityaz"	2/5/1955	200–500	37º39′N, 144º30′E	1f# 1.50 mm and 1 juv. 1.10 mm
"Orlyk"	16/5/1967	0–100	31º55′N, 138º11′E	1f# (deformed), 2 juv. 1.08–1.18 mm
"Vityaz"	29/6/1969	2000–2500	37º38′N, 143º51′E	1 juv. 1.30 mm
"Orlyk"	20/8/1972	0–25	30º00′N, 145º00′E	1f# 1.65 mm
"Seskar"	29/6/75	0–100	33º29′N, 141º28′E	3f# 1.60–1.65 mm
"Seskar"	29/6/75	0–100	33º29′N, 141º28′E	1f# 1.63 mm
"Pelamida"	6/6/1976	800–1000	23º00′N, 138º14′E	1f# 1.62 mm
"Pelamida"	1/9/1976	0–100	26º00′N, 138º00′E	1m# 1.48 mm
"Pelamida"	5/6/1976	0–100	24º00′N, 136º00′E	3f# 1.57–1.65 mm
"Mendeleev"	11/2/1976	50–100	52º05′S, 148 º 42′E	1f# 1.72 mm, 3 juv.0.75–1.15 mm
"Mendeleev"	11/2/1976	100–250	52 º 03′S, 148º49′E	1m# 1.52 mm
"Mendeleev"	13/2/1976	300–400	50º05′S, 148º42 ′E	1m# 1.50 mm
"Mendeleev"	13/2/1976	50–100	50º05′S, 148º42′ E	1m# 1.51 mm, 1f# 1.70 mm, 2 juv. 1.05–1.20 mm
"Mendeleev"	19/2/1976	50–100	46º49′S, 148º35′E	1f# 1.70 mm
"Mendeleev"	20/2/1976	100-200	44º45′S, 148º03′E	1m# 1.55 mm
"Mendeleev"	21/2/1976	0–200	43º35′S, 144º03′E	2f# 1.55–1.70 mm
"Cavalerovo"	23/8/1980	0–100	39º00′N, 149º00′N	1 juv. 0.94 mm
"Cavalerovo"	1/9/1980	0–100	33º06′N, 141º34′E	1 juv. 1.07 mm

Appendix 2. Material examined on *Halocypris pelagica** (Russian Expedition)

RV	Date	Depth, m	Position	Material
Atlantic Ocean: "Lena"	1/1/1956	0–250	0º27′N, 13º33′W	N1159 m# 1.27 mm, N1160 m# 1.30 mm, N1161 m# 1.31 mm, N1162 f# 1.52 mm, N1163 m# 1.52 mm, N1164 f# 1.46 mm
"Lomonosov"	4/5/1959	0–100	44º02′N, 30º03′W	N1165 m# 1.15 mm
"Topseda"	24/9/1964	0–1000	40º00′N, 50º12′W	N1166 f# 1.20 mm
Indian Ocean: "Ob"	25/5/1956	Surface	31º20′S, 66º04′E	N1167 m# 1.20 mm, N1168 m# 1.17 mm, N1169 m# 1.15 mm, N1170 m# 1.10 mm, N2771 m# 1.15 mm, N1172 f# 1.15 mm, N1173 f# 1.27 mm, N1174 f# 1.35 mm, N1175 f# 1.27 mm, N1176 f# 1.32 mm
Pacific Ocean: "Birokan"	25/1/1964	0–100	25º06′N, 154º56′W	N1177 m# 1.21 mm
"Birokan"	29/1/1964	0–200	27º07′N, 153º07′W	N1178 f# 1.22 mm
"Birokan"	2/2/1964	0–200	24º52′N, 151º36′W	N1179 m# 1.15 mm
"Birokan"	5/11/1964	0–100	34º47′N, 172º46′W	N1180 m# deformed
"Orlyk"	19/5/1967	0–100	26º00′N, 138º12′E	N1181 m# 1.25mm
"Orlyk"	3/6/1967	0–100	31º30′N, 149º00′E	N1182 m# 1.15 mm, N1183 m# 1.23 mm, N1184 m# 1.15 mm, N1185 f# deformed, N1186 f# 1.25 mm
"Orlyk"		0–100	31º30′N, 142º21′E	N1187 m# 1.12 mm
"Vityaz"	25/2/1975	200–300	5º00′N, 124º04′E	N1188 m# 1.15 mm, N1189 m# 1.20 mm, N1190 f# 1.30 mm, N1191 f# 1.27 mm
"Vityaz"	25/2/1975	50–100	5º00′N, 124º04′E	N1192 m# 1.17 mm
"Vityaz"	26/2/1975	2000–3000	5º57′N, 123º40′E	N1193 m# 1.22 mm, N1194 f# 1.40 mm
"Vityaz"	26/2/1975	1088–2000	5º57′N, 123º40′E	N1195 f# 1.35 mm
"Kavalerovo"	30/8/1980	0–100	35º43′N, 143º40′E	N1196 f# 1.25 mm
"Kavalerovo"	1/9/1980	0–100	34º29′N, 140º45′E	N1197 m# 1.22 mm

*All specimens are dissected, appendages and valves in alcohol

Additional material on *Halocypris pelagica*

RV	Date	Depth, m	Position	Material
Indian Ocean: "Ob"	1/5/1956	0–410	36º06′S, 136º01′E	2f# 1.23, 1.24 mm
"Ob"	25/5/1956	0–1100	34º18′S, 66º48′E	2m# 1.15, 1.21 mm
"Ob"	25/5/1956	0–110	31º20′S, 66º04′E	3m#1.07–1.20mm,12f# 1.05–1.20 mm, 1 juv. 0.85 mm
"Ob"	25/5/1956	Surface	31º20′S, 66º04′E	3m# 1.08–1.11 mm, 23f# 1.05–1.33 mm, 4 juv. 0.64–0.80 mm
"Ob"	25/5/1956	0–2200	31º20′S, 66º04′E	3m# 1.05–1.12 mm, 3f# 1.14–1.21 mm
"Ob"	25/5/1956	0–120	28º34′S, 65º21′E	2m# 1.10–1.19 mm, 3f# 1.32–1.35 mm, 8 juv. 0.65–0.76 mm

Appendix 2. (continued)

“Ob”	25/5/1956	0–700	28º34′S, 65º21′E	13m# 1.07–1.10 mm, 7f# 1.17–1.20 mm, 3 juv. 0.71–0.80 mm
“Ob”	28/5/1956	0–120	22º28′S, 64º02E	2m# 1.00–1.05 mm
“Ob”	29/5/1956	0–120	19º47S, 63º38′E	21m# 1.08–1.13 mm, 14f# 1.13–1.20 mm, 5 juv. 0.60–0.71 mm
“Ob”	29/5/1956	0–400	19º47′S, 63º38′E	53m# 1.03–1.20 mm, 30f# 1.05–1.21 mm, 7 juv. 0.72–1.00 mm
“Ob”	29/5/1956	0–2700	19º09′S 63º07′E	26m# 1.05–1.27 mm, 53f# 1.11–1.24 mm, 5 juv. 0.50–1.00 mm
“Ob”	29/5/1956	0–3300	19º09′S, 63º07′E	29m# 1.05–1.11 mm, 49f# 1.05–1.15 mm, 8 juv. 0.61–0.70 mm
“Ob”	30/5/1956	0–130	16º55′S, 6º01′E	3m# 1.25–1.34 mm, 9f# 1.40–1.44 mm, 5 juv. 0.55–0.81 mm
“Ob”	30/5/1956	Surface	16º55′S, 63º01′E	2m# 1.12–1.24 mm, 4f# 1.02–1.18 mm, 8 juv. 0.65–0.80 mm
“Ob”	30/5/1956	0–1300	16º55′S, 63º01′E	9m# 1.02–1.13 mm, 11f# 1.05–1.15 mm, 17 juv. 0.55–0.80 mm
“Ob”	30/5/1956	0–1250	14º47′S, 62º53′E	13m# 1.10–1.21 mm, 26f# 1.20–1.30 mm
“Ob”	30/5/1956	0–120	14º47′S, 62º53′E	65m# 1.06–1.11 mm, 71f# 0.70–1.00 mm, 38 juv. 0.55–0.80 mm
“Ob”	31/5/1956	0–2800	12º20′S, 62º50′E	2m# 1.05–1.20 mm, 1♀ 1.36 mm, 1 juv. 0.92mm
“Ob”	31/5/1956	0–120	9º58′S, 62º48′E	9m# 1.16–1.20 mm,12f# 1.21–1.29 mm, 1 juv. 1.12 mm
“Ob”	1/6/1956	0–1500	7º50′S, 60º32′E	17m# 1.11– 1.16 mm, 17f# 1.17–1.36 mm
“Ob”	1/6/1956	0–130	7º50′S, 60º32′E	2m# 1.18– 1.20 mm, 1f# 1.25 mm
“Ob”	2/6/1956	0–2700	6º44′S, 59º21′E	27m# 1.14– 1.25 mm, 9f# 1.21–1.30 mm
“Ob”’	2/6/1956	0–120	6º44′S, 59º21′E	10m# 1.20–1.24 mm, 4f# 1.35–1.40 mm, 11 juv. 0.70–0.81 mm
“Ob”	2/6/1956	0–1250	5º05′S, 57º34′E	34m# 1.22–1.26 mm, 8f# 1.30–1.34 mm, 7 juv 0.65–1.02 mm
“Ob”	2/6/1956	0–120	5º05′S, 57º34′E	4m# all 1.15 mm, 1f# 1.30 mm, 15 juv. 0.66–1.0 mm

Appendix 2. (continued)

"Ob"'	4/6/1956	0–3000	1º20′S, 55º05′E	1m# 1.14 mm, 4f# 1.30–1.32 mm
"Ob"	4/6/1956	0–120	1º20′S, 55º05′E	1f# 1.23 mm, 2 juv. 1.00, 1.02 mm
"Ob"	4/6/1956	0–1800	0º51′S, 54º27′E	2m# 1.16, 1.16 mm
"Ob"	4/6/1956	0–150	0º51′S, 54º27′E	2m# 1.07, 1.09 mm, 2 juv. 1.0–1.06 mm
"Ob"	6/6/1956	0–2000	5º18′N, 53º00′E	1f# 1.38 mm
Pacific Ocean:				
SRT 662	16/7/1953	0–200	35º14′N, 152º07′E	1f# 1.2 mm
"Vityaz"	3/5/1955	200–500	37º18′N, 145º16′E	2m# 1.14–1.20 mm, 2f# 1.30–1.38 mm, 5 juv.0.65–0.80 mm
"Ob"	16/4/1956	Surface	36º32′S, 160º32′E	4m# 1.10–1.25 mm, 2f# 1.38–1.40 mm
"Ob"	17/4/1956	0–500	34º22′S, 153º59′E	2m# 1.12, 1.20 mm, 1f# 1.30 mm
"Ob"	17/4/1956	Surface	34º22′S, 153º59′E	20m# 1.10, 1.10 mm, 9f# 1.15–1.34 mm, 5 juv. 0.75–0.80 mm
"Vityaz"	11/12/1958	0–200	35º06′N, 139º58′W	1f# 1.25 mm
"Birokan"	2/2/1964	0–200	24º52′N, 151º36′W	1m# 1.15 mm, 1 juv. 0.55 mm
"Birokan"	4/11/1964	200–500	34º41′N, 172º46′E	1m# 1.22 mm, 1 juv. 1.02 mm
"Birokan"	30/11/1964	0–500	21º03′N, 122º47′W	1 juv. 0.90 mm
"Birokan"	30/11/1964	0–500	21º17′N, 122º01′W	2m# 1.15–1.21 mm, 1 juv. 1.04 mm
"Birokan"	15/1/1965	5–15	21º43′N, 105º51′W	1 juv. 0.80 mm
"Birokan"	7/4/1965	0–200	21º31′N, 116º2′W	2 juv. 0.65–0.9 mm
"Birokan"	15/4/1965	0–100	8º41′N, 104º02′W	1 juv. 0.76 mm
"Birokan"	18/4/1965	100–200	5º05′N, 107º37′W	1m# 1.25 mm
"Birokan"	10/5/1965	0–1000	13º30′N, 91º00′W	1 juv. 0.70 mm
"Adler"	13/5/1966	0-107	26º42′N, 116º6′W	1m# 1.30 mm, 1f# 1.28 mm
"Orlyk"	30/4/1967	0–100	37º00′N, 149º00′E	1 juv. 0.70 mm
"Orlyk"	5/5/1967	0–100	35º26′N, 143º53′E	1m# 1.17 mm, 4f# 1.35–1.39 mm, 2 juv. 0.95–0.98 mm
"Orlyk"	14/5/1967	0–100	33º40′N, 139º12′E	1 juv. 0.70 mm
"Orlyk"	16/5/1967	0–100	31º29′N, 138º14′E	4m# 1.20–1.25 mm, 3f# 1.32–1.35 mm, 4 juv 0.72–0.80 mm
"Orlyk"	16/5/1967	0–100	31º55′N, 138º11′E	1m# 1.30 mm
"Orlyk"	19/5/1967	0–100	27º00′N, 138º12′E	1f# 1.29 mm, 2 juv. 0.85–0.90 mm
"Orlyk"	19/5/1967	0–100	26º00N, 138º12E	2 juv.0.80–0.87 mm
"Orlyk"	21/5/1967	0–100	21º54′N, 138º18′E	1 juv. 0.95 mm
"Orlyk"	21/5/1967	0–100	21º00′N, 149º00′E	1f# 1.43 mm, 4 juv. 0.70–1.00 mm

Appendix 2. (continued)

“Orlyk”	29/5/1967	0–100	31º30′N, 149º00′E	2m#1.15–1.25 mm, 7 juv 0.63–1.00 mm
“Orlyk”	31/5/1967	0–100	33º42′N, 147º32′E	1m# 1.20 mm
“Orlyk”	29/1/1969	0–100	40º00′N, 149º00′E	3 juv.0.73–0.80 mm
“Izumrud”	24/6/1969	0–100	42º30′N, 135º00′E	1 juv. 1.07 mm
“Iskatel′”	6/9/1969	0–100	36º07'N, 142º45'E	1 juv. 0.70 mm
“Ucheny”	18/11/1970	0–100	35º57'N, 138º09'E	1 juv. 0.85 mm
“Orlyk”	3/8/1971	0–100	37º30'N, 149º00'E	1f# deformed
“Pelamida”	7/9/1976	0–100	31º00'N, 136º00'E	1m# 1.12–1.13 mm
“Shantar”	19/4/1977	0–200	33º32'N, 127º15'E	1 juv. 0.97 mm
“Vityaz”	24/2/1979	3500–4027	5º00'N, 124º04'E	1f# 1.27 mm
“Vityaz”	24/2/1979	3670–4000	5º00'N, 124º04'E	1f# 1.25 mm
“Vityaz”	24/2/1979	2995–3500	5º00'N, 124º04'E	1f# 1.22 mm
“Vityaz”	24/2/1979	2567–3045	5º00'N, 124º04'E	1f# 1.25 mm
“Vityaz”	24/2/1979	200–300	5º00'N, 124º04'E	1 juv. 0.76 mm
“Vityaz”	24/2/1979	100–200	5º00'N, 124º04'E	1m# 1.17 mm
“Vityaz”	26/2/1979	1088–2000	5º57'N, 123º40'E	1m# 1.12 mm, 2f# deformed
“Vityaz”	26/2/1979	200–300	5º57'N, 123º40'E	2 juv. 0.95–0.97 mm
“Vityaz”	26/2/1979	100–200	5º57'N, 123º40'E	1m# 1.22 mm
“Vityaz”	26/2/1979	955–1500	5º57'N, 123º40'E	1f# 1.30 mm
“Vityaz”	18/5/1979	4078–5000	5º38'N, 130º48'E	2f# deformed
“Vityaz”	18/5/1979	2613–3000	5º38'N, 130º48'E	1f# deformed
“Vityaz”	18/5/1979	100–150	5º38'N, 130º48E	2f# 1.30–1.32 mm
“Cavalerovo”	23/8/1980	0–100	31º00'N, 136º00'E	1 juv. 0.70 mm
“Cavalerovo”	29/8/1980	0–100	38º18'N, 146º35'E	1 juv. 0.75 mm
“Cavalerovo”	30/8/1980	0–100	35º43'N, 143º40'E	1f# 1.25 mm
“Cavalerovo”	1/9/1980	0–100	34º29'N, 140º45'E	1m# 1.22 mm
“Cavalerovo”	4/9/1980	0–100	30º32'N, 140º39'E	1 juv. 0.80 mm
“Cavalerovo”	4/9/1980	0–100	30º58'N, 140º1'E	4 juv.0.80–0.82 mm
“Cavalerovo”	5/9/1980	0–100	33º02'N, 139º01'E	4 juv 0.72–0.76 mm

Appendix 3. Material examined on *Halocypris angustifrontalis** (Russian Expedition)

RV	Date	Depth, m	Position	Material
Pacific Ocean: "Lira"	21/3/1966	900–1000	9°10'S, 119°00'W	N1130 f# 1.82 mm, N1131 f# 1.82 mm, N1132 f# 1.75 mm, N1133 f# 1.80 mm
SRTM8–459	22/10/1971	0–100	38°42'N, 129°42'E	N1128 f# 1.85 mm
"Pelamida"	1/6/1974	25–50	33°30'N, 149°00'E	N1134 f# 2.12 mm
"Seskar"	13/6/1975	0–100	35°30'N, 147°00'E	N1135 m# 1.85 mm
"Seskar"	28/7/1975	0–100	32°01'N, 143°01'E	N1136 f# 2.02 mm
"Ogon"	16/9/1975	0–100	40°00'N, 130°20'W	N1137 m# 1.82 mm, N1138 m# 1.77 mm, N1139 m# 1.75 mm, N1140 f# (deformed), N1141 f# 2.05 mm, N1142 f# 2.07 mm
"Pelamida"	26/4/1976	300–400	33°00'N, 149°00'E	N1143 m# 1.73 mm
"Mys Tykhy"	5/2/1980	50–100	45°25'N, 157°33'W	N1144 m# 1.95 mm, N21145 m# 1.97 mm, N1146 m# 1.92 mm, N1147 f# 2.05 mm, N1148 f# 2.10 mm, N49 f# 2.04 mm, N1150 f# 2.04 mm
"Keldysh"	17/9/1990	15–100	32°05'N, 135°54'W	N1151 m# 1.70 mm, N1152 m# 1.72 mm, N1153 m# 1.67 mm, N54 m# 1.57 mm, N1155 f# 1.72 mm, N1156 f# 1.77 mm, N1157 f# 1.87 mm, N1158 f# 1.87 mm

*All specimens are dissected. Appendages an valves in alcohol

Additional material on *Halocypris angustifrontalis*

RV	Date	Depth, m	Position	Material
Pacific Ocean:				
"Lira"	30/12/1965	55	10°58'S, 82°44'W	1m# deformed
"Lira"	13/1/1966	42	12°53'S, 86°28'W	4f# 2.00–2.05 mm
"Lira"	13/1/1966	132	16°58'S, 85°57'W	2# 2.10, 2.10 mm
"Lira"	13/1/1966	6	16°58'S, 85°57'W	1f# deformed
"Lira"	21/3/1966	900–1000	9°10'N, 119°00'W	63f# 1.75–1.90 mm, 31 juv0.92–1.51 mm
"Lira"	27/3/1966	1000	2°02'N, 125°33'W	13f#, 8 juv. all deformed
"Lira"	27/3/1966	65	2°02'N, 125°33W	14f# all deformed
"Lira"	30/3/1966	65	6°15N, 128°56'W	15f#, 8 juv. all deformed
SRTM 8–459	21/9/1966	0–100	38°15'N, 125°46'W	1m#1.85mm, 1♀2.0 mm
SRTM 8–459	21/9/1966	0–100	37°55'N, 127°21'W	1f# 1.95 mm,
SRTM 8–459	22/9/1966	0–100	37°34'N, 128°58'W	5m# 1.70–1.82 mm
"Pelamida"	2/6/1974	0–25	33°30'N, 149°00'E	1f# 2.05 mm
"Pelamida"	2/6/1974	25–50	33°30'N, 149°00'E	1f# 2.20 mm
"Seskar"	19/7/1975	0–100	33°29'N, 141°28'E	2f# 1.80–1.82 mm
"Seskar"	20/7/1975	0–100	33°30'N, 149°02'E	2m# 1.90, 1.90 mm
"Seskar"	21/7/1975	0–100	33°14'N, 149°28'E	1f# 1.81 mm
"Mys Tikhy"	3/6/ 1978	0–100	48°18'S, 155°48'W	1m# 1.85 mm, 16f# 1.91–2.02 mm
"Mys Tikhy"	3/6/1978	0–100	45°40'S, 157°35'W	1m# 1.87 mm, 17f# 1.92–2.02 mm
"Mys Tikhy"	3/7/1978	0–100	45°06'S, 157°34'W	14f# deformed
"Mys Tikhy"	3/7/1978	0–100	45°15'S, 157°12'W	1m# 1.70 mm, 8f# 1.85–2.00 mm
"Mys Tikhy"	3/7/1978	0–100	45°22'S, 157°26'W	11f# 1.90–1.95 mm

Appendix 3. (continued)

“Mys Tikhy”	4/7/1978	0–100	45°22'S, 157°26'W	1m# 1.85 mm, 9f# 1.80–1.90 mm
“Mys Tikhy”	4/7/1978	0–100	45°22'S, 157°34'W	18f# 1.82–2.02 mm, 1juv.f# 1.70 mm
“Mys Tikhy”	4/7/1978	0–100	45°37'S, 157°33'W	12f# 1.85–2.02 mm
“Mys Tikhy”	4/7/1978	500–600	45°27'S, 157°42'W	10 deformed spec.
“Mys Tikhy”	4/7/1978	100–200	45°27'S, 157°42'W	1m# 1.72, 1.75 mm, 37f# 1.82–2.12 mm
“Mys Tikhy”	4/7/1978	100–200	45°27'S, 157°42'W	1m# 1.82 mm, 16f# 1.80–1.94 mm
“Mys Tikhy'	5/7/1978	0–100	45°22'S, 157°40'W	1m# 1.95 mm, 11f# 1.80–2.02 mm
“Mys Tikhy”	5/7/1978	0–100	45°12'S, 157°40'W	1m# 1.77 mm, 26f# 1.87–2.10 mm
“Mys Tikhy”	5/7/1978	0–100	45°22'N, 157°35'W	18 deformed spec.
“Mys Tikhy”	6/7/1978	0–100	45°35'N, 157°32'W	3m#, 23f# –deformed
“Mys Dalny”	1/2/1979	0–100	46°21'S, 155°44'W	1m# –1.70 mm, 10f# 1.87–1.97 mm, juv f# 1.62 mm
“Tihookeansky”	14/7/1979	0–100	37°10'N, 127°40'W	3m# 1.65–1.80 mm
“Tihookeansky”	15/7/1979	25–50	37°10'N, 127°37'W	1m# 1.70 mm, 1f# 2.0 mm
“Mys Tikhy”	16/1/1980	0–100	43°30'S, 161°28'W	1m# –1.93 mm, 17f# 1.90–2.05 mm
“Mys Tikhy”	17/1/1980	0–100	45°21'S, 157°32'W	3f# 1.84–2.05 mm
“Mys Tikhy”	19/1/1980	0–100	45°15'S, 157°41'W	98 deformed spec.
“Mys Tikhy”	20/1/1980	0–100	45°13'S,157°30'W	46 deformed spec.
“Mys Tikhy”	21/1/1980	0–100	45°27'S, 157°42'W	200 deformed spec.
“Mys Tikhy”	23/1/1980	0–100	45°25'S, 157°30'W	14f# 1.87–2.07 mm, 4juv.f# 1.68–1.72 mm
“Mys Tikhy”	25/1/1980	0–100	45°10'S,157°32'W	44m# 1.80–1.90 mm, 363f# 1.82-2.08 mm
“Mys Tikhy”	27/1/1980	0–100	45°29'S,157°55'W	136m# 1.80–1.92 mm, 164f# 1.90–2.06 mm, 12 juv.1.65–1.68 mm
“Mys Tikhy”	27/1/1980	0–100	45°19'S,157°53'W	44m# 1.80–1.86 mm, 251f# 1.80–2.07 mm
“Mys Tikhy”	28/1/1980	0–100	45°30'S,157°24'W	20m# 1.76–1.86 mm, 226f# 1.80–2.02 mm, 6 juv.f# 1.60–1.65 mm
“Mys Tikhy”	28/1/1980	0–100	45°09'S,157°10'W	30 deformed spec.
“Mys Tikhy”	29/1/1980	0–100	45°19'S,157°10'W	10m# 1.75–1.89 mm, 74f# 1.83–2.07 mm, 12 juv.f# 1.60–1.68 mm
“Mys Tikhy”	29/1/1980	0–100	45°19'N,157°10'W	10m# 1.75–1.89 mm, 74f# 1.83–2.07 mm, 12 juv.f# 1.50–1.68 mm
“Mys Tikhy”	30/1/1980	0–100	45°30'S,157°10'W	8m# 1.87–1.95 mm, 576f# 1.90–2.10 mm, 10 juv.f# 1.7 0–1.72 mm
“Mys Tikhy”	1/2/1980	0–100	45°41'S,157°13'W	11m# 1.75–1.87 mm, 63f# 1.82–2.05 mm, 10 juv.f# 1.7 0–1.72 mm
“Mys Tikhy”	1/2/1980	0–100	45°19'S, 157°24W	276f# 1.90–2.03 mm
“Mys Tikhy”	1/2/1980	200–300	45°03'S, 157°08'W	8m# 1.75–1.78 mm, 576f# 1.90–2.02 mm

Appendix 3. (continued)

“Mys Tikhy”	1/2/1980	300–500	45°03'S, 157°08'W	5m# 1.77–1.78 mm, 142f# 1.82–2.05 mm, 9 juv.f# 1.60–1.64 mm
“Mys Tikhy”	1/2/1980	500–800	45°03'S, 157°08'W	14m# 1.84–1.90 mm, 170f# 1.90–2.02 mm
“Mys Tikhy”	1/2/1980	0–100	45°03'S, 157°08'W	23 deformed spec.
“Mys Tikhy”	1/2/1980	800–1000	45°03'S, 157°08'W	17m# 1.82–1.90 mm, 126f# 1.95–2.05 mm
“Mys Tikhy”	2/2/1980	800–1000	45°09'S, 157°32'W	8m# 1.70–1.76 mm, 512f# 1.87–2.03 mm
“Mys Tikhy”	2/2/1980	500–800	45°09'S, 157°32'W	74f# 1.85–1.96 mm
“Mys Tikhy”	2/2/1980	0–100	45°32'S,157°41'W	25f# 1.98–2.06 mm, 3juv.f# 1.5 0–1.68 mm
“Mys Tikhy”	2/2/1980	500–800	45°32'S,157°41'W	74f# 1.85–1.96 mm
“Mys Tikhy”	2/2/1980	300–500	45°32'S,157°41'W	33f# 1.82–2.03 mm
“Mys Tikhy”	2/2/1980	200–300	45°32'S,157°41'W	27f# 1.82–2.03 mm
“Mys Tikhy”	2/2/1980	100–200	45°32'S,157°41'W	48m# 1.77–1.87 mm, 888f# 1.92–2.06 mm
“Mys Tikhy”	2/2/1980	0–100	45°32'S,157°41'W	5m# 1.79–1.85 mm, 528f# 1.90–2.08 mm, 19 juv.f# 1.70–1.72 mm
“Mys Tikhy”	3/2/1980	800–1000	45°15'S, 157°32'W	5m# 1.84–1.90 mm, 56f# 1.85–1.92 mm
“Mys Tikhy”	3/2/1980	500–800	45°15'S, 157°32'W	56f# 1.90–2.10 mm
“Mys Tikhy”	3/2/1980	300–500	45°15'S, 157°32'W	18f# deformed
“Mys Tikhy”	3/2/1980	200–300	45°15'S, 157°3'W	14f# 1.90–2.03 mm
“Mys Tikhy”	3/2/1980	100–200	45°15'S, 157°32'W	1m# 1.83 mm, 62f# 1.74–1.90 mm
“Mys Tikhy”	3/2/1980	0–100	45°15'S, 157°32'W	4m# 1.835–1.87 mm, 278f# 1.82–2.04 mm
“Mys Tikhy”	4/2/1980	500–800	45°19'S, 157°40'W	2m# 1.81, 1.82 mm, 51f# 1.83–2.05 mm, 2 juv.f# 1.65–1.70 mm
“Mys Tikhy”	4/2/1980	300–500	45°19'S, 157°40'W	3m# 1.85–1.87 mm, 55f# 1.83–2.07 mm
“Mys Tikhy”	4/2/1980	200–300	45°19'S, 157°40'W	25f# 1.95–2.08 mm
“Mys Tikhy”	4/2/1980	100–200	45°19'S, 157°40'W	19 deformed spec.
“Mys Tikhy”	4/2/1980	0–100	45°19'S, 157°40'W	6f# 2.00–2.08 mm
“Mys Tikhy”	4/2/1980	800–1000	45°30'S, 157°54'W	24f# 1.90–1.98 mm
“Mys Tikhy”	4/2/1980	500–800	45°30'S, 157°54'W	3m# 1.82–1.95 mm, 51f# 1.97–2.12 mm
“Mys Tikhy”	4/2/1980	300–500	45°30'S, 157°54'W	13 deformed spec.
“Mys 'Tikhy”	4/2/1980	200–300	45°30'S, 157°54'W	3m# 1.8–1.82 mm, 1f# 1.82–1.97 mm
“Mys Tikhy”	4/2/1980	100–200	45°30'S, 157°54'W	23f# 1.95–2.03 mm
“Mys Tikhy”	4/2/1980	0–100	45°30'S, 157°54'W	36 deformed spec.
“Mys Tikhy”	4/2/1980	0–25	45°23'S, 157°33'W	1f# 1.85 mm
“Mys Tikhy”	4/2/1980	25–50	45°23'S, 157°33'W	5f# 1.87–2.09 mm

Appendix 3. (continued)

“Mys Tikhy”	4/2/1980	50–100	45°23'S, 157°33'W	243f# 1.82–2.08 mm
“Mys Tikhy”	4/2/1980	100–200	45°23'S, 157°33'W	12m# 1.85–1.90 mm, 283f# 1.92–2.07 mm
“Mys Tikhy”	4/2/1980	200–300	45°23'S, 157°33'W	22f# 1.92–2.08 mm
“Mys Tikhy”	4/2/1980	300–500	45°23'S, 157°3'W	27f# 1.90–2.02 mm
“Mys Tikhy”	4/2/1980	500–800	45°23'S, 157°33'W	48 deformed spec.
“Mys Tikhy”	4/2/1980	300–500	45°22'S, 157°31'W	48m# 1.77–1.85 mm, 248f# 1.80–2.07 mm
“Mys Tikhy”	4/2/1980	200–300	45°22'S, 157°31'W	24m# 1.85–1.92 mm, 584f# 1.88–2.10 mm
“Mys Tikhy”	4/2/1980	100–200	45°22'S, 157°31'W	4m# 1.80–1.87 mm, 128f# 1.95–2.07 mm
“Mys Tikhy”	4/2/1980	50–100	45°22'S, 157°31'W	8m# 1.82–1.96 mm, 103f# 1.91–2.06 mm, 4 juv. f# 1.75–1.77 mm
“Mys Tikhy”	4/2/1980	300-500	45°22'S, 157°31'W	1m# 1.87 mm, 92f# 1.85–2.01 mm
“Mys Tikhy”	4/2/1980	0–100	45°22'S, 157°31'W	11f# 1.95–2.05 mm
“Mys Tikhy”	5/2/1980	0–100	45°30'S, 157°40'W	200 deformed spec.
“Mys Tikhy”	5/2/1980	100–200	45°30'S, 157°40'W	9 deformed spec.
“Mys Tikhy”	5/2/1980	200–300	45°30'S, 157°40'W	2m# 1.77, 1.85 mm, 66f# 1.85–2.05 mm
“Mys Tikhy”	5/2/1980	300–500	45°30'S, 157°40'W	69 deformed spec.
“Mys Tikhy”	5/2/1980	0–100	45°30'S, 157°40W	1m# 1.83 mm, 2f# 1.87, 1.93 mm
“Mys Tikhy”	5/2/1980	200–300	45°30'S, 157°40'W	19f# 1.92–2.07 mm
“Mys Tikhy”	5/2/1980	100–200	45°30'S, 157°40'W	2m# 2.07, 2.07 mm
“Mys Tikhy”	5/2/1980	0–100	45°30'S, 157°40'W	1m# 1.82 mm, 96f# 1.90–2.06 mm, 2 juv.f# 1.72, 1.75 mm
“Mys Tikhy”	5/2/1980	500–800	45°30'S, 157°40'W	1m# 1.77–1.80 mm, 224f# 1.92–2.02 mm
“Mys Tikhy”	5/2/1980	300–500	45°30'S, 157°40'W	5m# 1.95–2.00 mm, 96f# 1.90–2.11 mm, juv.f# 1.55–1.66 mm
“Mys Tikhy”	5/2/1980	200–300	45°30'S, 157°40'W	800 deformed spec.
“Mys Tikhy”	5/2/1980	100–200	45°30'S, 157°40'W	4m# 1.87–1.90 mm, 162f# 1.90–2.07 mm
“Mys Tikhy”	5/2/1980	25–50	45°30'S, 157°40'W	7f# 1.90–2.06 mm
“Mys Tikhy”	5/2/1980	0–100	45°30'S, 157°40'W	406m# 1.77–1.91 mm, 1104f# 1.81–2.10 mm, 316 juv.f# 1.55–1.66 mm
“Mys Tikhy”	7/2/1980	0–100	45°19'S, 157°31'W	35m# 1.77–1.90 mm, 92f# 1.85–2.03 mm
“Mys Tikhy”	7/2/1980	100–200	45°19'S, 157°31W	31m# 1.82–1.95 mm, 188f# 1.92–2.03 mm

Appendix 3. (continued)				
"Mys Tikhy"	7/2/1980	200–300	45°19'S, 157°31'W	16m# 1.80–1.82 mm, 183f# 1.90–2.05 mm, 11 juv. f# 1.65–1.68 mm
"Mys Tikhy"	7/2/1980	300–450	45°19'S, 157°31'W	44m# 1.8–1.89 mm, 209f# 1.98–2.11 mm, 4 juv f# 1.55–1.60 mm