



## The rare deep-living hyperiid amphipod *Megalanceoloides remipes* (Barnard, 1932): complementary description and symbiosis

REBECA GASCA<sup>1</sup> & STEVEN H.D. HADDOCK<sup>2</sup>

<sup>1</sup>*El Colegio de la Frontera Sur (ECOSUR), Unidad Chetumal. P.O. Box 424, Chetumal, Quintana Roo 77014 Mexico*

<sup>2</sup>*Monterey Bay Aquarium Research Institute, 7700 Sandholdt Road, Moss Landing, California 95039, USA*

### Abstract

A female ovigerous specimen of the rare deep-living hyperiid *Megalanceoloides remipes* (Barnard, 1932) was collected with a remotely operated submersible (ROV) at a depth of 2,094 m in the Farallon Basin, Gulf of California. The specimen was found to be symbiotically associated with the siphonophore *Apolemia* sp. Eschscholtz, 1829. Hitherto, this species was known only from two other specimens, one from the South Atlantic and another from the Indian Ocean; the present record is the first from the Pacific Ocean. Previous descriptions lacked morphological details of different appendages; these data are provided here. In addition, we present the first data on its symbiotic association from *in situ* observations. The colors of the hyperiid and of some parts of the Apolemid were very similar, thus supporting the notion that some hyperiids tend to mimic the color of its host.

**Key words:** pelagic amphipods, hyperiids, Physosomata, symbiotic associations

### Introduction

The study of the biology, diversity, and ecology of the midwater planktonic fauna of the southern and central Gulf of California has been a goal for more than ten years for the Monterey Bay Aquarium Research Institute (MBARI). The institution has launched several oceanographic expeditions in the region. The discovery of new species and an increase of the biological and ecological knowledge about different groups of the deep-living zooplankton have resulted from these efforts (e.g., Gasca 2005, Thuesen & Haddock 2013, Gilly *et al.* 2013). Particularly, the hyperiid amphipods represent an interesting group in the community because of their association with different taxa of gelatinous zooplankton including siphonophores, medusae and salps (Gasca *et al.* 2007, 2015).

The superfamily Lanceoloidea was reviewed recently by Zeidler (2009); he proposed the family Megalanceolidae to contain two genera: *Megalanceola* Pirlot, 1935 and *Megalanceoloides* Zeidler, 2009. Both genera include deep-living forms and very little is known about their symbiotic associations. The latter genus is monotypic, represented only by *M. remipes* (Barnard 1932) a very rare deep-living species that was previously known only from two specimens, one female from the South Atlantic (Barnard 1932) and another from the Indian Ocean (Vinogradov 1964). Several morphological details of the species are missing even in the type description because the specimen was damaged, incomplete (Zeidler 2009). In addition, there are no previous data about its symbiotic associations with gelatinous zooplankton. In this contribution we document the record of a third specimen obtained from deep waters of the southern Gulf of California, Eastern Pacific. We also provide photographs and a video of the live specimen *in situ* and taxonomical illustrations of the preserved specimen, in order to compare it with previous morphological accounts of the species. The specimen was found in association with the siphonophore *Apolemia* sp., maybe one of the many still-undescribed species of this genus.

### Materials and methods

The specimen examined, an ovigerous female, was collected during the oceanographic cruise of the MBARI,

carried out aboard the R/V “Western Flyer” in 7–16 March 2015, in the southern Gulf of California, Eastern Pacific Ocean. It was detected and then captured with the remotely operated submersible (ROV) “Doc Ricketts” on 8 March in Farallon Basin (25° 27' 109° 51'N) at a depth of 2,094 m. The specimen was first seen grasped to the end of a species of the physonect siphonophore *Apolesia*; it was captured individually with a “detritus sampler” (D722-DS8) and brought to the surface. The siphonophore escaped during the capture process, but the video shows the behavior of both symbionts in the water column before the sampling approach. Later on, the hyperiid was fixed and preserved in 70% ETOH for further taxonomic examination. It was partially dissected and drawings were made with the aid of a camera lucida attached to an Olympus SZ7 stereomicroscope with a 1.6X objective. The main taxonomical characters used in hyperiid taxonomy were illustrated, especially those appendages for which no previous information was available, like the second antenna (Zeidler 2009). The voucher specimen including the slides with the dissected appendages was deposited in the collection of zooplankton held at El Colegio de la Frontera Sur, Unidad Chetumal, Quintana Roo, Mexico (ECO-CH-Z-09312). Digital photographs were taken from the live specimen immediately after it was brought to the surface with a NIKON D5300 camera and a NIKON SMZ 1500 microscope. Digital video is available at (<http://w2.ecosur-qroo.mx/cna/rebeca/D722%20D8%20Amphipod.mov>).

## **Taxonomy**

### **Order AMPHIPODA Latreille, 1816**

### **Suborder HYPERIIDEA Milne-Edwards, 1830**

### **Infraorder PHYSOSOMATA Pirlot, 1929**

### **Family MEGALANCEOLIDAE Zeidler, 2009**

### **Genus *Megalanceoloides* Zeidler, 2009**

#### ***Megalanceoloides remipes* (Barnard, 1932)** (Figures 1–4)

*Lanceola remipes* Barnard 1932; *Megalanceola remipes* Vinogradov 1964; Vinogradov *et al.* 1996.

**Material examined.** Adult female, collected 8 March 2015 in Farallon Basin (25° 27' 109° 51'N), southern Gulf of California, Eastern Pacific by ROV submersible, depth: 2,094 m.

**Remarks.** This species was redescribed by Zeidler (2009) based on the holotype female from south-west Atlantic, but some of the appendages were missing in this specimen and were not described in the original work by Barnard (1932). Our morphological comments emphasize these appendages/characters in order to complement the description of the species.

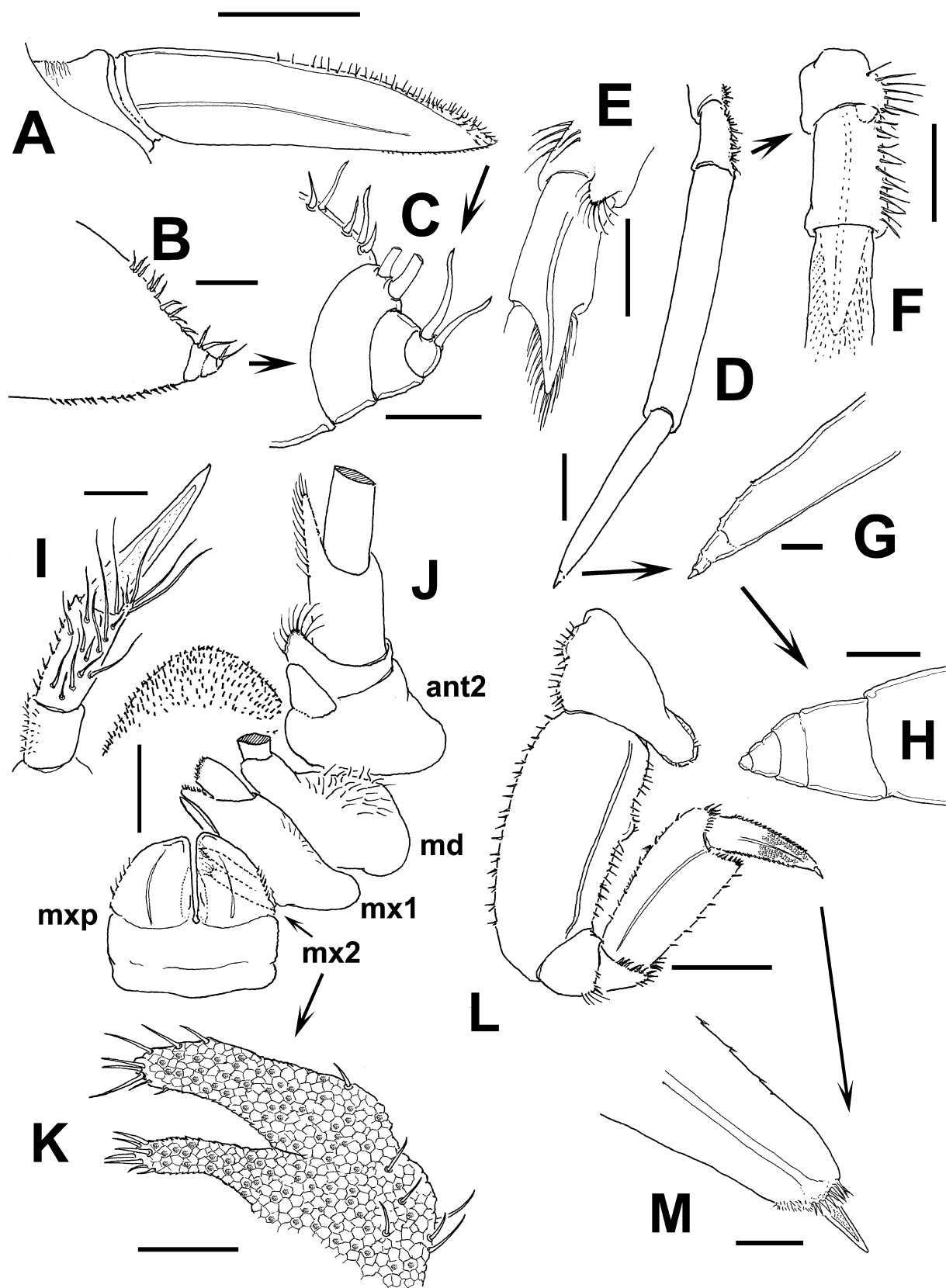
The specimen examined is an ovigerous female. Total length: 25 mm. Some of the characters of previous descriptions (Barnard 1932, Vinogradov 1964, Zeidler 2009) can be clearly seen in the illustrations, like the relatively slender pereon, not laterally broadened; however, the specimen from the Gulf of California was carrying eggs and its body is dorsoventrally broadened (Fig. 3). Most appendages are identical to previous descriptions. Particularly, the complete second antenna was not seen before by any of the other authors. This appendage is much longer than the first antenna, ensiform, with a characteristic pointed lobe on S2 and a larger lobe on S3 (Fig. 2, 3E, F), S4 elongated, S5 0.62X, S4 with 4 terminal segments (Fig. 3D, G, H). Some doubts about the structure and segmentation of the maxillae 2 (Mx2) were left in Zeidler (2009) and only a general view was provided by Vinogradov (1964). The bilobed Mx2 is here illustrated showing the spinulation pattern and the reticulate surface (Fig. 3K), the outer lobe has 9 spinules, 4 of which are terminal; the inner lobe has 7 spinules set in a terminal cluster. The basal segment has 6 long terminal spinules. In the specimen from the Gulf of California the basis of P VI and VII are not as abruptly narrowed proximally (Fig. 4J, L) like in previous descriptions (Zeidler, 2009, fig. 28). Uropods 1–3 with external margins denticulated as well as both sides of endopods and exopods.



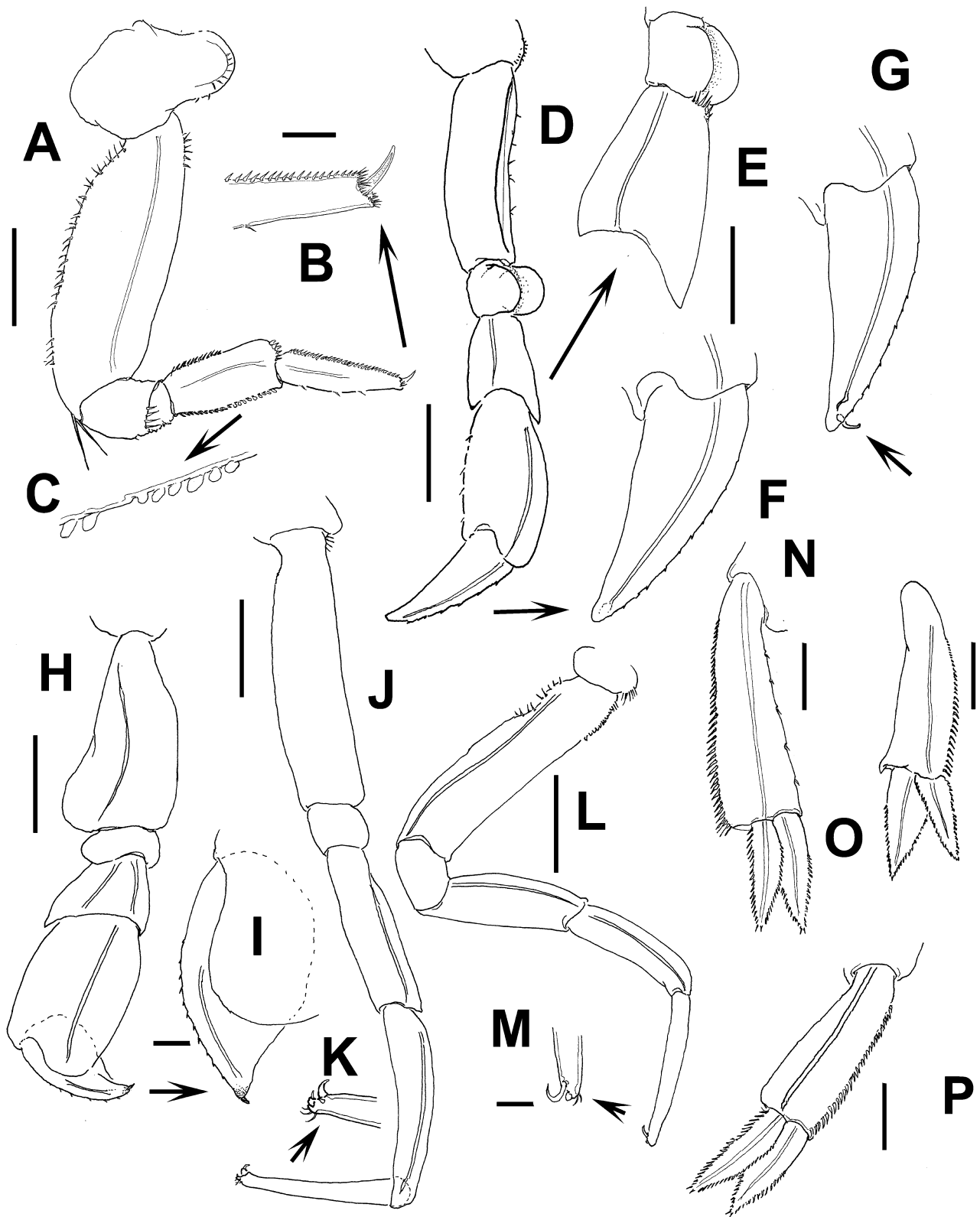
**FIGURE 1.** *Megalanceoloides remipes* (Barnard, 1932) ovigerous female from the Gulf of California photographed in vivo (2.5 mm), lateral view. Scale bar: 5 mm.



**FIGURE 2.** *Megalanceoloides remipes* (Barnard, 1932), ovigerous female from the Gulf of California photographed in vivo, ventral view. Scale bar: 5 mm.



**FIGURE 3.** *Megalanceoloides remipes* (Barnard, 1932) from the Gulf of California. A. antenna I; B, C. details of apical segments; D. antenna II, lateral view; E. details of proximal segments of antenna II, ventral view; F. same, lateral view; G, H. details of apical segments of antenna II; I. mandibular palp; J. mouthparts, ventral view including antenna II (ant2), mandible (md), first maxilla (mx1), second maxilla (mx2), and maxilliped (mxp); K. second maxilla; L, M. PI and details of distal segments. Scale bars: A, D–F, I, J, L = 1 mm; B, G, K, M = 0.25 mm; C, H = 0.1 mm.



**FIGURE 4.** *Megalanceoloides remipes* (Barnard, 1932) from the Gulf of California. A–C. PII with details of distal segment and ornamentation of S6; D–F. PIII with details of S6; G. P IV S6 and S7; H. PV; I. PV detail of S6 and S7; J. PVI; K. same, detail of S6 and S7; L. PVII; M. same, detail of S6 and S7; N. UR1, dorsal view; O. UR2, dorsal view; P. same, ornamentation pattern. Scale bars: A, D, H, J, L = 1 mm (B, I, K, M = 0.25 mm; E, F = 0.5 mm).

**Differences from previous specimens.** The size of our specimen (25 mm) is intermediate between the female collected from the Indian Ocean (19 mm) (Vinogradov, 1964) and the type specimen (40 mm) from the South Atlantic Ocean (Barnard, 1932).

In our specimen the A1 has a reticulate surface, with three distal segments; Barnard (1932) reported no minute apical joints in the holotype, a character that was recently corrected by Zeidler (2009) by mentioning that these small segments are subequal in length. The Californian (Fig. 3B,C) and the Indian Ocean (Vinogradov 1964, fig. 4) specimens clearly have three subequally long apical segments. The terminal segment has five setae in the Indian Ocean specimen (Vinogradov 1964, fig 4), but only two long setae in the California specimen (Fig. 3B, C). Also, the penultimate A1 segment is unarmed in our specimen from California (Fig. 3C) and has at least two setae in the Indian Ocean specimen (Vinogradov 1964, fig. 4).

**Mandible palp.** The terminal segment of the palp represents about the 50% of the appendage (Zeidler 2009, fig. 28C), but some variation was found in the other specimens; it is slightly longer (55.1% of palp length) in the Indian Ocean specimen (Vinogradov 1964, fig. 4) and in the Pacific Ocean female (52.3%) (Fig. 3I). Also, the second segment is hirsute in both the Indian (Vinogradov 1964, fig. 4) and Pacific specimens (Fig. 3I), but appears to have a weaker ornamentation in the holotype (Zeidler 2009, fig. 28C).

Based on the examination of the holotype specimen and with reference to the Indian Ocean specimen described by Vinogradov (1964), Zeidler (2009) stated that the second maxillae has four long apical setae and the inner lobe is armed with 3 setae (Zeidler 2009); in our specimen from California the outer lobe has also 4 subequally long apical setae plus other 4 subapical ones. Also, the inner lobe has 7 subequally long apical setae (Fig. 3K), thus differing from the other specimens.

The basis of pereopod 2 has two distal setae but these are relatively short, unequally long in the Indian Ocean specimen (Vinogradov 1964, fig. 4) whereas these elements are equally long and longer in the Californian specimen (Fig. 4A). Pereopod 3 was not illustrated by Vinogradov (1964), but in the holotype the small apical dactylus arises from within a distal brush of short hair-like elements (Zeidler 2009, fig. 28); in the Pacific Ocean specimen the insertion area of the dactylus is naked (Fig. 4F).

In the Indian Ocean specimen the dactylus of pereopod 5 is very small, the terminal margin of the S6 is rounded (Vinogradov 1964, fig. 5); in the Californian specimen the dactylus is more prominent and the distal margin of the S6 is relatively acute, not rounded (Fig. 4H,I).

In the Indian Ocean specimen the dactylus of pereopod 6 is simple, claw-like (Vinogradov 1964, fig. 5), whereas it has also a small curved adjacent element in the specimen from California (Fig. 4K). The dactylus of pereopod 7 has also some additional differences: in the holotype the small apical claw-like dactylus arises alone from a heavily hirsute surface (Zeidler 2009, fig. 28), but in the Pacific Ocean specimen the insertion area of the dactylus is naked and the dactylus has a few accompanying setae (Fig. 4M).

**Symbiosis.** The amphipod was found grasping a siphonophore of the physonect genus *Apolemia* (Eschscholtz, 1829) with the dactyls of P VI and VII. The siphonophore was not identified but could be one of the species recently described for the zone (Siebert et al., 2013). It was not collected because it was lost during the capture process as can be seen in the supplementary online video (<http://w2.ecosur-qroo.mx/cna/rebeca/D722%20D8%20Amphipod.mov>). Digital photographs of *M. remipes* were taken when alive (Figs 1, 2). The *in vivo* color of the hyperiid was very similar to some parts of the siphonophore (i.e. gastrozooids).

**Distribution.** This is the first record of this species from the Pacific Ocean. The only additional records are from the South Atlantic (41°43'S 42°20'W) and the Indian Ocean (03°11'N 67°02'E); in both cases it was found at depth samplings from 2000 m to surface (Zeidler 2009).

## Discussion

The importance of capturing planktonic organisms, especially symbionts, as they dwell in the water column is of great value because new information is provided about their biology and behaviour; these kinds of data are unavailable from standard net samples. The fact that we were able to observe the way in which the amphipod was associated with the siphonophore supports the value of the ROV as a tool to survey the deep-water fauna. Also, it might explain the lack of previous data on the symbiosis of this species and probably other hyperiids with gelatinous zooplankton. It is likely that the sampling method used in the capture of the other two known specimens prevented further knowledge of their associations. The female from the Gulf of California is in perfect condition

because it was captured individually and could be photographed and all appendages were intact to allow a complete morphological comparison.

Vinogradov *et al.* (1996) mentioned that lanceolid hyperiideans are commensal or parasites of deep-water cnidarians and ctenophores. In many cases it has been observed that the amphipod takes the colour or shape of parts of the host (Lützen 2005, Madin and Harbison 1977 Harbison *et al.* 1977). Here we observed that while *M. remipes* was attached to the end of *Apolesia* sp. it had the same color as parts of the siphonophore. There are three possible ways in which the amphipods acquire the host color: by independently producing similar pigments, by feeding upon the host, or by being its commensal and thus getting the same color as a result of eating the same food as the siphonophore. We cannot state what was happening in this case. If they behave like other hyperiideans (Laval 1972) then the mimicry can be a result of either feeding process. Another interesting thing is that, as suggested by the images in the video, some morphological characters of the amphipod like the long antennae and the foliaceous legs could be mimetic, looking like parts of the siphonophore.

## Acknowledgements

The Monterey Bay Aquarium Research Institute organized this scientific expedition and allowed us to examine the hyperiids. The David and Lucile Packard Foundation supported the expedition. The specimens were collected under permits DGOPA-02919/14 and CTC/01700/15 given by the Mexican Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA) and the Secretaría de Relaciones Exteriores (SRE), respectively. Eduardo Suárez-Morales prepared the line drawings of the specimen. We appreciate the constructive comments from anonymous reviewers and the editorial processing by Gordan Karaman.

## References

- Barnard, K.H. (1932) Amphipoda. *Discovery Reports*, 5, 1–326.  
<http://dx.doi.org/10.5962/bhl.part.27664>
- Gasca, R., Hoover, R. & Haddock, S.H.D. (2015) New symbiotic associations of hyperiid amphipods (Peracarida) with gelatinous zooplankton in deep waters off California. *Journal of the Marine Biological Association of the United Kingdom*, 95 (3), 503–511. [Published online, 24 October 2014.]  
<http://dx.doi.org/10.1017/S0025315414001416>
- Gasca, R., Suárez-Morales, E. & Haddock, S.H.D. (2007) Symbiotic associations between crustaceans and gelatinous zooplankton in deep and surface waters off California. *Marine Biology*, 151, 233–242. Published online, 27 September 2006.  
<http://dx.doi.org/10.1007/s00227-006-0478-y>
- Gilly, W.F., Beman, J.M., Litvin, S.Y. & Robison, B.H. (2013) Oceanographic and biological effects of shoaling of the oxygen minimum zone. *Annual Reviews of Marine Science*, 5, 393–420.  
<http://dx.doi.org/10.1146/annurev-marine-120710-100849>
- Harbison, G.R., Biggs, D.C. & Madin, P. (1977) The association of Amphipoda Hyperiidea with gelatinous zooplankton—II. Associations with Cnidaria, Ctenophora and Radiolaria. *Deep Sea Research*, 24, 465–488.  
[http://dx.doi.org/10.1016/0146-6291\(77\)90484-2](http://dx.doi.org/10.1016/0146-6291(77)90484-2)
- Lützen, J. (2005) Amphipoda (amphipods). In: Rohde, K. (Ed.), *Marine Parasitology*. CSIRO Publishing Melbourne and CABI Wallingford Oxon, pp. 165–169.
- Madin, L.P. & Harbison, G.R. (1977) The associations of Amphipoda Hyperiidea with gelatinous zooplankton I. Associations with Salpidae. *Deep Sea Research* 24, 449–463.  
[http://dx.doi.org/10.1016/0146-6291\(77\)90483-0](http://dx.doi.org/10.1016/0146-6291(77)90483-0)
- Siebert, S., Pugh, P.R., Haddock, S.H.D. & Dunn, C.W. (2013) Re-evaluation of characters in Apolemiidae (Siphonophora), with description of two new species from Monterey Bay, California. *Zootaxa*, 3702 (3), 201–232.  
<http://dx.doi.org/10.11646/zootaxa.3702.3.1>
- Thuesen, E.V. & Haddock, S.H.D. (2013) *Archeterokrohnia doerckhettiae* (Chaetognatha: Phragmophora: Heterokrohniidae), a new species of deep-sea arrow worm from the Gulf of California. *Zootaxa*, 3717 (3), 320–328.  
<http://dx.doi.org/10.11646/zootaxa.3717.3.2>
- Vinogradov, M.E. (1964) Hyperiidea Physosomata from the northern part of the Indian Ocean. *Trudy Instituta Okeanologii Akademii Nauk SSSR*, 65, 107–151. [In Russian]
- Zeidler, W. (2009) A review of the hyperiidean amphipod superfamily Lanceoloidea Bowman & Gruner, 1973 (Crustacea: Amphipoda: Hyperiidea). *Zootaxa*, 2000, 1–117.