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Hitch-hiking in the deep sea: Amphipods embrace sea spiders in the Southeast Pacific Ocean

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In the vast and largely unexplored depths of the ocean, naturalists continue to uncover surprising biological associations. One such new association was observed in November 2024 during the Fkt241011 expedition aboard the research vessel *Falkor(too)* to the Chilean Margin in the Southeastern Pacific Ocean, where individuals of the deep-sea pycnogonid genus *Colossendeis* were observed by the remotely operated vehicle (ROV) *SuBastian* with amphipods clinging to their appendages (Figure 1). The first one was found in a sediment patch, along with sea pigs, sea lilies, and abundant sea pens, within an otherwise rocky, steep area at approximately 3160 m depth; the temperature was 1.77°C and the O_2 concentration was 159 μM. The second association was observed in a flat, sedimented seafloor with scattered small rocks at 2670 m depth, in an area characterized by brittle stars, corals, isopods, and sea cucumbers. The ambient temperature was 1.87°C and the O_2 concentration was 154 μM. The association may be common and widespread in the area, given that the two observations, situated in newly mapped submarine canyons, were separated by only approximately 225 km. The specimens were collected and identified, using the available literature and taxonomic expertise, as the pycnogonid *Colossendeis colossea* (Wilson, 1881) and the amphipod *Mesopleustes abyssorum* (Stebbing, 1888). For more details on the taxonomic identification of *M. abyssorum*, see Appendix S1 and Appendix S1: Figure S1. The specimens were later preserved in 96% ethanol and deposited in the collections of the Museo Nacional de Historia Natural de Chile (MNHNCL), under collection numbers AMP-16031 to 16033 and PYCN-15014 to 15015.

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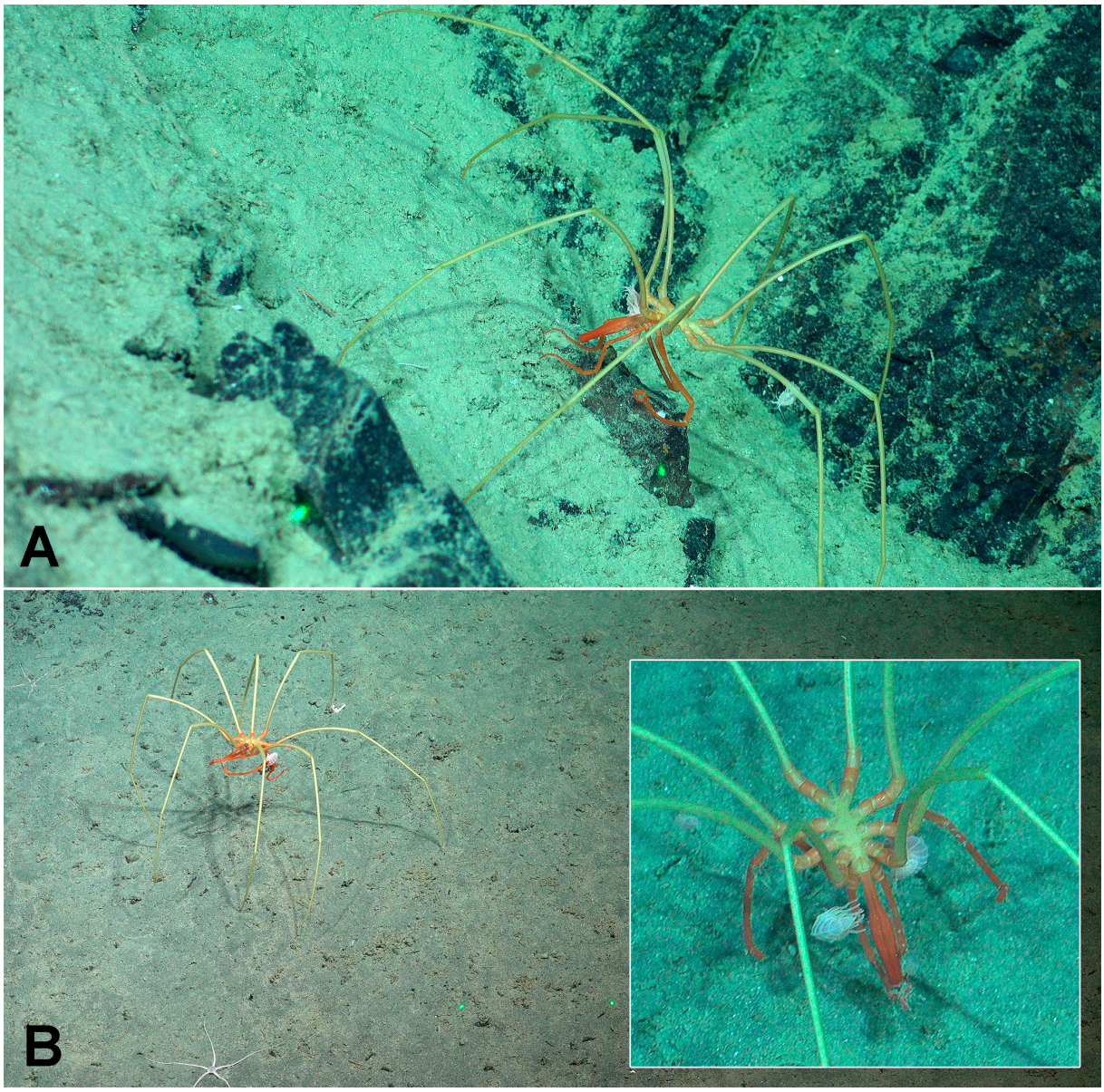


FIGURE 1 Field in situ observations of the amphipod *Mesopleustes abyssorum* clinging to the pycnogonid *Colossendeis colossea*, made by the remotely operated vehicle (ROV) *SuBastian* in two different locations of the Chilean margin, during the Fkt241011 expedition onboard the research vessel *Falkor(too)*. (A) Observation during S0759 dive (specimen MNHNCL PYCN-15015; 49.49° S, 76.88° W, at 3155 m depth), on November 24, 2024. The pycnogonid carries three amphipod individuals (MNHNCL AMP-16032), two larger ones attached to the right palp and oviger, and a smaller one attached to the left leg III. (B) Observation during S0763 dive (specimen MNHNCL PYCN-15014; 51.47° S, 76.22° W at 2698 m depth), on November 28, 2024. This pycnogonid carries an amphipod on the right palp and one on the left oviger (MNHNCL AMP-16033, see detail). Laser points (green) are 10 cm apart. Photo credit: Schmidt Ocean Institute.

Pycnogonids, or sea spiders, are a remarkable group of marine arthropods characterized by their long legs, relatively narrow bodies, and highly specialized feeding and reproductive structures. Several internal organs, such as the digestive diverticula and the gonads, extend into their legs, and specialized ovigers are used by males of most species for carrying eggs (Arnaud & Bamber, 1987). Pycnogonids occur from shallow waters to hadal depths and are typically slow-moving benthic predators or scavengers that feed using a long proboscis on sessile invertebrates such as hydroids, bryozoans, and soft corals (Arnaud & Bamber, 1987; Dietz et al., 2018). Yet, many aspects of their biology and behavior remain poorly understood, particularly in deep-sea environments (Brenneis & Wagner, 2023).

Associations between pycnogonids and epibionts are not uncommon; interactions with sessile organisms such as bryozoans and gastropod egg cases are frequently

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reported (Lane et al., 2018). However, interactions with other mobile arthropods are exceedingly rare. The amphipods of the family Pleustidae include species often associated with sessile or mobile invertebrates such as octocorals, polychaetes, and echinoderms (Kodama et al., 2024; Schwentner & Lörz, 2021), exhibiting a varied degree of specificity and dependency (Schwentner & Lörz, 2021), to obtain shelter, food, or reproductive advantages. However, associations with arthropods other than decapod crustaceans, such as pycnogonids, have only rarely been reported. The only previously documented case of such an association involves the same amphipod species reported here. Nearly 100 years ago, Chevreux (1927), without graphic evidence, described *M. abyssorum*, a member of the family Pleustidae, attached to the pycnogonid *C. colossea*. The observation received little attention in the ecological literature and, although it has been recently confirmed by images of collected specimens, this time on *Colossendeis macerrima* Wilson, 1881 (Seid et al., 2025), our findings represent the first in situ description and imagery of the association between these two species. The new observations presented here raise intriguing questions about the biogeography, biological function, and ecological relationships of amphipods and pycnogonids. Given that this observation represents the first record of the widely distributed *M. abyssorum* in the Southeastern Pacific, the full extent of their range and genetic relationships remain unclear. What benefits, if any, does the association between the two organisms confer?

Although the possibility that the interaction observed here is incidental cannot be discarded, its apparent specificity and recurrence within a relatively constrained search space suggest instead an underrecognized ecological strategy. Although *M. abyssorum* presents a typical morphology for species with commensal habits, its pereopods lack prehensile adaptations, which usually occur in species that live attached to larger hosts performing grooming behaviors (Vader, 1983), as in the amphipod *Isaeopsis chiloensis* Pérez-Schultheiss & Pardo, 2020 which occurs in association with several species of cancrid crabs (Pérez-Schultheiss & Pardo, 2020). Unlike *I. chiloensis*, which uses its prehensile pereopods, *M. abyssorum* embraces the pycnogonid limbs with a long dactylus that allows for a very stable attachment that persists even during and after collection (see Seid et al., 2025, and observations herein).

Previous records of this amphipod, except two (Appendix S1: Table S1), were obtained from seafloor samples without evidence of an association with pycnogonids. This was also the case for two smaller male specimens collected from mud sediments in this survey, whose association with pycnogonid hosts could not be established (MNHNCL AMP-16031). This suggests that *M. abyssorum* does not live exclusively on *Colossendeis*, and may use them for transportation, in a phoretic commensalistic relationship. Notably, each of the two filmed pycnogonids (MNHNCL PYCN-15014-15; Figure 1) hosted two large amphipod individuals (>17 mm in length), a male and a female, attached to the palps and ovigers (MNHNCL AMP-16032-33; Figure 1). On PYCN-15015, an additional, smaller ovigerous female (13.9 mm) was observed moving away from the body of the pycnogonid, clinging to the walking legs (Figure 1A).

M. abyssorum has an exceptionally wide geographic distribution, having been reported in the Pacific, Atlantic, Indian, and Southern Oceans at depths from approximately 690 to 3500 m (Brandt et al., 2012; Appendix S1: Table S1, Figure S1). Such a wide distribution range is unusual for peracarids, because they lack planktonic larval stages and are generally considered poor dispersers. Recent integrative taxonomic work has shown that some carnivorous active swimming amphipods, such as *Rhachotropis abyssalis* Lörz, 2010 (Lörz et al., 2023) and *Alicella gigantea* Chevreux, 1899 (Maroni et al., 2025), can indeed achieve multi-oceanic distributions. However, the validity of such broad ranges has been questioned for many other species: What appears to be a single cosmopolitan species may in fact represent a complex of cryptic taxa that have long been overlooked (e.g., Brandt et al., 2012; Havermans, 2016). *M. abyssorum* is not a strong swimmer, but it may achieve effective dispersal through phoresy by clinging to the more mobile *Colossendeis*. Long-legged pycnogonids are not only seafloor walkers but also effective swimmers, capable of traveling long distances when carried by currents in a spread-legs posture (Arnaud & Bamber, 1987; Staples, 2014). However, whether *M. abyssorum* represents a single species with a worldwide distribution or a complex of cryptic taxa remains an open question.

Our observed association may also provide additional advantages to *M. abyssorum*, beyond its potential role in dispersal. Despite the limited number of observations precluding firm conclusions, in both documented cases, the amphipods associated with pycnogonid hosts were large individuals (>17 mm), and each host carried both a male and a female. If this pattern is supported by future observations, it may suggest that pycnogonids represent opportunistic biological platforms that may enhance mate encounter rates and brooding success in an otherwise sparsely populated deep-sea environment, offering ecological advantages that extend well beyond dispersal. Another possibility is that the amphipods are engaging in a form of commensalism, using the pycnogonid as a mobile substrate to access food particles or avoid benthic predators. In the deep sea, where food is often scarce and

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patchily distributed, such a strategy may offer significant energetic advantages. Similar relationships have been observed in the snailfish *Careproctus* sp., which is transported by lithoid crabs (Yau et al., 2000), and the amphipod *Caprella subtilis* Mayer, 1903, which is transported by the sea cucumber *Ellipinion kumai* (Mitsukuri, 1912) (Lindsay & Takeuchi, 2008). However, the amphipods exploiting the hosts' feeding currents or detritus for nutrition, like in the case of anemones on hermit crabs (Karplus, 2024), seems less likely considering the feeding mode of pycnogonids, which catch prey with the proboscis. For the pycnogonid, the presence of amphipods may be neutral or potentially detrimental if they interfere with sensory or reproductive appendages, though no obvious signs of stress or behavioral change were observed during the ROV footage. Alternatively, the amphipods may cling on the long appendages of the pycnogonid incidentally, and not selectively, as has been reported for other deep-sea amphipods such as *Amathillopsis spinigera* (Heller, 1875), which attach non-selectively to a variety of substrates (Brix et al., 2025). Whether this interaction is accidental, a dispersal capacity for a nonmobile species, or a form of adaptation to seafloor environments with scarce food resources could be revealed with studies that involve more in situ observations, population genetic studies and trophic ecology.

The discovery of a recurring association between *M. abyssorum* and *Colossendeis* spp. invites broader reflection on the nature of interspecific interactions in the deep sea. In ecosystems where energy sources are scarce and environmental conditions are extreme, even subtle biological associations may play critical roles in survival and resource acquisition. These observations underscore the importance of direct in situ exploration in revealing hidden ecological interactions and adaptations that take place in remote and unexplored deep-sea ecosystems such as submarine canyons. Documenting and understanding such associations is essential not only for taxonomy and biodiversity assessments but also for building a more complete picture of deep-sea ecosystem functioning.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The specimens examined in this study are deposited in the Chilean National Museum of Natural History under collection numbers AMP-16031 through AMP-16033, PYCN-15014, and PYCN-15015, and are available for loan to qualified researchers by contacting comunicaciones.mnhn@mnhn.cl.

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