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SHORT COMMUNICATION

On the presence of the deep-sea blind lobster *Stereomastis suhmi* (Decapoda: Polychelidae) in Southwestern Atlantic waters and its circum-Antarctic distribution

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Here we report on the presence of the deep-sea blind lobster *Stereomastis suhmi* in the Southwestern Atlantic. The species identification was based on morphological traits and confirmed with genetic barcoding. The specimen analysed shows little difference from previous descriptions. This work extends the range of *S. suhmi* in America, where it was previously limited to the Pacific coasts off Chile, to the mouth of the Rio de la Plata, Argentina, and confirms its circumpolar presence with molecular data. A review of all available records shows that the overall distribution of the species is well correlated with the presence of Antarctic Intermediate Waters suggesting that the species habitat is restricted to cold and relatively low-salinity/oxygen-rich waters.

Keywords: Argentina; barcoding; Crustacea; deep-sea; new record

Introduction

Polychelidan lobsters are noticeable among reptant decapods in having chelae on almost all pereopods (always on pereopods 1–4, but sometimes also on pereopod 5). The most recent phylogenetic analyses depict polychelidan lobsters as basal in the Reptantia, recognising a separate infra-ordinal status for the polychelidans (Ahyong 2009; Bracken-Grissom et al. 2014) with four families, from which only one, the Polychelidae Wood-Mason, 1875, is extant. Although evolved from shallow-water forms, extant Polychelidae have strongly reduced eyes, are confined to deep water, and are therefore known as 'deep-sea blind lobsters'. Modern polychelids display burrowing habits (Gore 1984) and are scavengers and detritus feeders, although they appear to be also ambush predators, particularly of small epibenthic crustaceans (Cartes & Abello 1992). To date, Polychelidae contains six genera and 38 species worldwide (Chan 2010), of which only four species in three genera have been recorded from the southwestern Atlantic, all from Brazilian waters: *Pentacheles laevis*, Bate 1878; *Pentacheles validus* A. Milne Edwards 1880; *Polycheles typhlops* Heller 1862 (Dall'Occo & Tavares 2004); and *Stereomastis sculpta* Smith 1880 (Ramos-Porto et al. 2000; mentioned as [*Polycheles sculptus*] in Dall'Occo & Tavares 2004).

Recently the RV *Puerto Deseado*, belonging to CONICET, started a series of expeditions extensively surveying the Argentinian marine fauna, particularly deep-sea areas that remained largely unexplored. As part of this programme, during September 2013 the campaign 'Talud III' was carried out with the specific aim of exploring the Mar del Plata Canyon, located off Mar del Plata (around 37.5°S, 54°W), Argentina. This submarine canyon is a perpendicular cut of the continental

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slope starting at 500-m depth that becomes V-shaped between 1200 and 3700 m, and finally opens to connect the continental shelf with the abyssal plains (Violante et al. 2010). Here we report the first record of the deep-sea blind lobster *Stereomastis suhmi* Bate (1878), in the southwestern Atlantic, and discuss this new finding in the framework of the general distribution of the species and the related oceanographic features.

Materials and methods

During the 'Talud III' cruises of the RV *Puerto Deseado*, a total of 28 hauls were performed (16 with an otter bottom trawl net with 6-m headrope, 10-mm mesh size at the cod end; and 12 with a small epibenthic dredge with 0.6-m horizontal opening, 5-mm mesh size) between 774 m and 3320 m depth. The specimen of *S. suhmi* was collected with the bottom trawl, photographed immediately after it came on board and preserved in 96% ethanol. The carapace length (CL) was measured to the nearest 0.1 mm dorsally along the midline, from the base of the rostrum to the posterior margin of the carapace.

Species identification was based on morphology, following the keys and terminology in Bate's original description (Bate 1878) and Galil (2000) and Ahyong (2009). To corroborate the species identification, a tissue sample was obtained from the abdomen of the specimen and used for molecular analysis of a partial fragment of the barcode gene cytochrome *c* oxidase subunit I (COI). DNA extraction, polymerase chain reaction amplification, polymerase chain reaction product purification and sequencing were conducted following the protocols of the Canadian Centre for DNA Barcoding (CCDB protocols http://ccdb.ca/docs/; see also Ivanova et al. 2006), using the universal primers HCO2198 (5′-TAA ACT TCA GGG TGA CCA AAA AAT CA-3′), and LCO1490 (5′-GGT CAA CAA ATC ATA AAG ATA TTGG-3′) (Folmer et al. 1994). Identification was performed using standard nucleotide BLAST® (http://blast.ncbi.nlm.nih.gov/Blast.cgi) to search in the Barcode of Life (BOLD, www.barcodelife.org) and GenBank (www.ncbi.nlm.nih.gov/GenBank)

databases. The voucher specimen was deposited at the Museo Argentino de Ciencias Naturales 'Bernardino Rivadavia', Argentina under the catalogue number MACN-In 39629. The COI sequence obtained is available on GenBank under accession number KM503116, as well as in the 'Native and exotic invertebrate of Mar del Plata harbour' project (code INVMP) on the BOLD system.

Results

Material examined

One male *S. suhmi* (Fig. 1), CL 15.7 mm, (right chela is missing), Mar del Plata Canyon, continental slope of Argentina, southwest Atlantic, 38°072′S, 54°123′W, 1800 m depth, 7 September 2013, MACN-In 39629.

Morphological diagnosis and molecular identification

Carapace distinctly longer than wide; dorsal orbital notch U-shaped; median carina on abdominal tergites 2–5 with a short, upright posterior tooth in addition to strong antrorse spine; inner angle of dorsal orbital sinus spinose (Figs 1–2). Examined but not shown in figures: epipod of pereopods 1–5 vestigial; dactylus and pollex of pereopods straight; outer proximal margin of basal antennular segment with two spines; ischium and merus of pereopod 2 articulated.

The 658 nucleotides of COI sequence obtained from our specimen showed 99% similarity with the mitochondrial COI sequence of an *S. suhmi* collected by RV *Tangaora* in Campbell Plateau, New Zealand (48°45′S, 172°036′E; 700 m depth) and published in GenBank (accession number: KF828018.1). It also matched (100% similarity) a sequence of another specimen of *S. suhmi* available on the BOLD system, also from southeast of New Zealand, confirming that the Argentine specimen and the previously sequenced specimens are conspecific.

Remarks

This specimen shows little difference with Bate's (1878) original description of *S. suhmi* and further

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Figure 1 Dorsal and lateral view of a male *Stereomastis suhmi*, carapace length 15.7 mm, captured in the Mar del Plata Canyon, continental slope of Argentina, southwest Atlantic, 38°072′S, 54°123′W, at 1800 m depth, MACN-In 39629.

descriptions elsewhere (Galil 2000; Ahyong 2009). In general all spines seem blunt and smaller than in previous descriptions (Griffin & Stoddart 1995; Galil 2000) and particularly the spines of the anterolateral angle of the carapace and those posterior to the post-cervical incision, appear to be more upwardly curved (see Fig. 2). A similar pattern was described in at least one individual
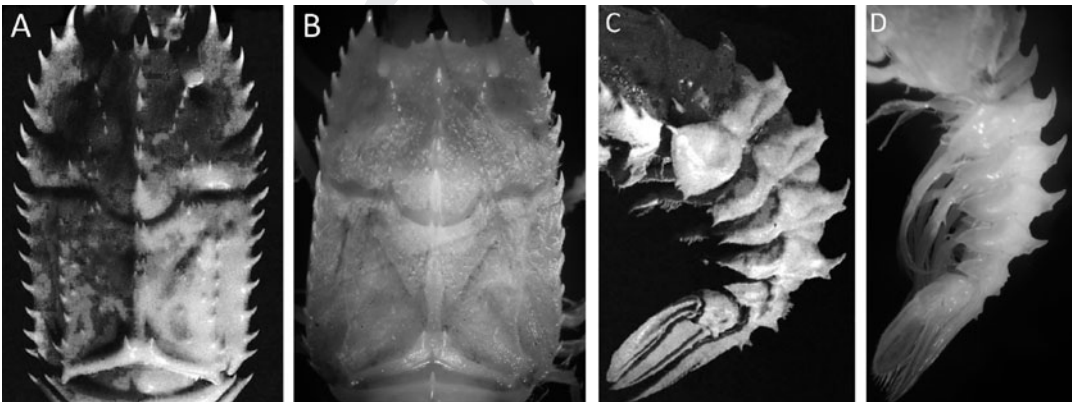
Figure 2 *Stereomastis suhmi* (Bate 1878): Comparison of previously described specimens with the one reported in this work. **A, B,** Dorsal view of the cephalothorax. **A,** Female 31.2 mm, off Cape Province, 'Africana', 31°20′S, 16°09′E, 462 m (from Galil 2000). **B,** Male of *S. suhmi*, carapace length 15.7 mm in this work, MACN-In 39629. **C, D,** Lateral view of the abdomen. **C,** Female 26.5 mm, Tasman Sea, 'Galathea' stn 626, 42°10′S, 170°10′E, 610 m. **D,** Male of *S. suhmi*, carapace length 15.7 mm in this work, MACN-In 39629. Pictures of previously described specimens are from Galil (2000), © Publications Scientifiques du Muséum National D'histoire Naturelle, 21: 285–387.

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from off southern Africa (figure 9 in Calman 1925). Spines in the branchial carina are less conspicuous, low and smooth than previous descriptions. In all other respects this specimen is a typical *S. suhmi*. There are two rostral spines plus a smaller spine on the internal orbital angle. The orbital sinus is smooth, subtriangular and deep; there is no spine at the external orbital angle. The spinal formula of the lateral edge of the carapace is 5:2:8.

Discussion

The present work extends the range of *S. suhmi* in America, from the Pacific coasts off Chile and archipelago of Tierra del Fuego (Bate 1878; Arntz et al. 1999; Boschi & Gavio 2005), to the south-western Atlantic, reaching north to almost the mouth of the Rio de la Plata (36°S). Hence, the species is expected to be present along the entire Magellanic Biogeographic Province, which encompasses the coasts from northern Chiloé Island on the eastern Pacific to the southwestern Atlantic waters, off the continent at 43°S, stretching north to reach 35°S (Fig. 3) (Boschi & Gavio 2005).

Stereomastis suhmi was recorded at depths ranging from 200 to 2200 m in southeastern Atlantic Ocean (western coast of South Africa), western Pacific Ocean (south-eastern Australia and New Zealand), and south-eastern Pacific Ocean (south-western coast of South America, west coast of Patagonia of Chile) (Calman 1925; Griffin & Stoddart 1995; Galil 2000; Ahyong 2012). To date the southernmost record of *S. suhmi* (larvae or adults) has been from the Pacific portion of the Magellanic region, south of the Beagle Channel around 2100 m depth on the continental slope (Arntz et al. 1999; Thatje et al. 2003). Although it was suggested that adult *S. suhmi* may occur in the deep of the Drake Passage and even further south (Thatje & Arntz 2004), recent polychelid lobsters are virtually absent south of the Polar front (Gorny 1999; Thatje & Arntz 2004; Griffiths et al. 2013). The only exception to date is a record of five meso-pelagic larvae of *S. suhmi* found close to South Georgia Island, between 400 and 800 m depth (Tiefenbacher 1994).

Current records of *S. suhmi* fall mostly within the so-called antiboreal or transitional region (Gorny 1999), which is located between the Subtropical and Polar fronts (Orsi et al. 1995; also known as the Subtropical and Antarctic Convergences respectively) depicting a rather circumpolar distribution (Fig. 3). Nevertheless, circumstantial records of adult *S. suhmi* far north of the Subtropical front in waters off West Africa (in the Cameroon volcanic line at c.3°S–3°E; Ocean Biogeographic Information System challenge this idea. (Specimen collected by the South Atlantic MAR-ECO 2009 cruise EurOBIS. The record is published in the Ocean Biogeographic Information System with an error in the collection depth, which is actually 997 m. Both the species ID and collection depth were confirmed by Dr Irene A. Cardoso in a personal communication to NEF.) The virtual absence of the species in areas where one would expect it to be based solely on a continuous circumpolar distribution (e.g. south-eastearn Africa) also challenges this idea.

Because the species is clearly limited to deep bottoms, an explanation of its current geographic distribution requires taking into account the circulation pattern of the deep water masses, which has proved to be the main explanatory factor for the diversity and biomass of deep-sea decapods (e.g. Cartes et al. 2014 and references therein). At the depth range and areas inhabited by adult *S. suhmi* and their larvae (Thatje et al. 2003) the predominant oceanographic feature is the presence of the cold and relative low-salinity/oxygen-rich Antarctic Interme-diate Water (AAIW) formed in the Antarctic Con-vergence zone, where it sinks and is distributed into all ocean basins, to lastly spread northward, filling most of the world's ocean at intermediate depths (c.1000 m) (Talley 1999). Branches of AAIW that flow towards the equator, carry cold and relatively fresh subantarctic water that can be identified in intermediate waters as far north as 20°N, with trace amounts as far as 60°N (Talley 1999). The new record for *S. suhmi* reported here occurred precisely within the northern limit of the Malvinas Current, which transports subantarctic waters northwards and extends all the way to the sea-floor (Boschi & Gavio 2005). Similarly, the record of *S. suhmi* close to the equator off West Africa, may be explained
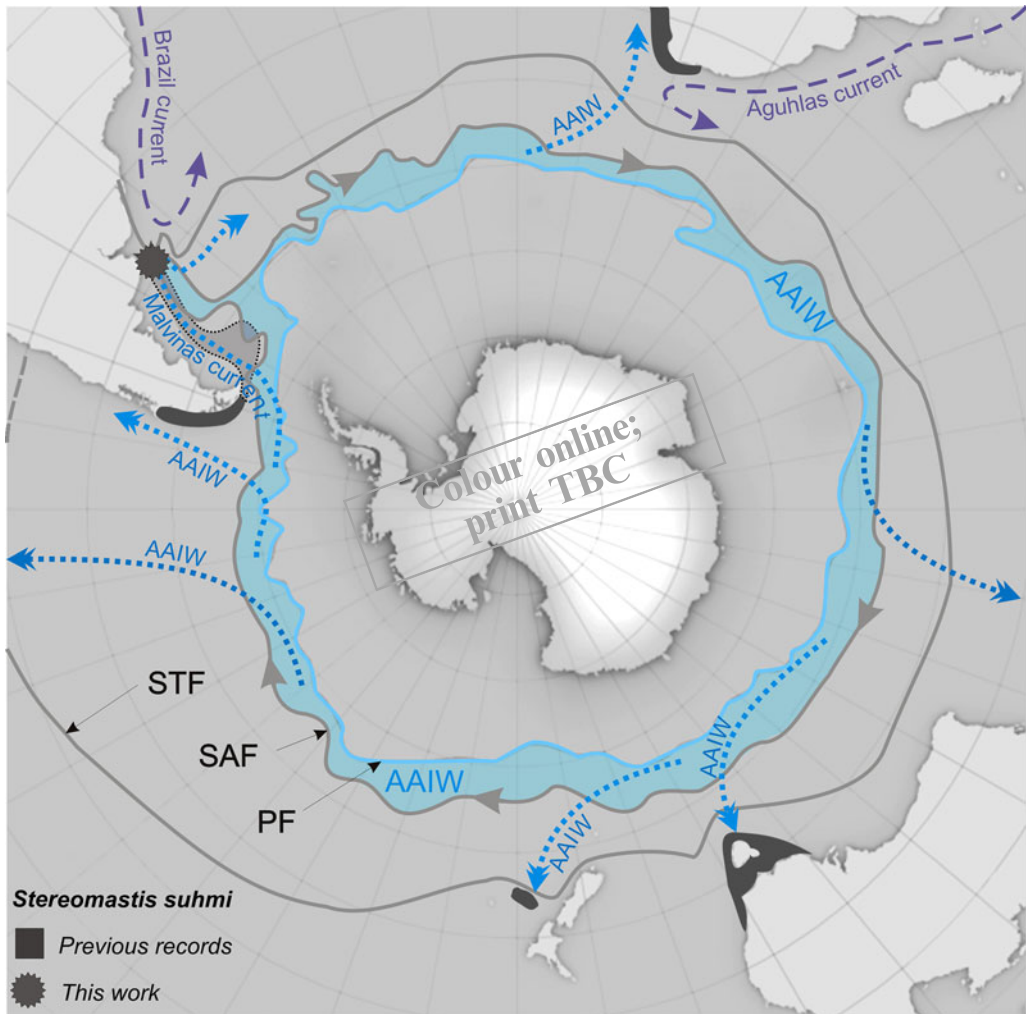
Figure 3 Schematic representation of the distribution of *Stereomastis suhmi* and oceanographic features mentioned in the text. The dark star corresponds to the location of the new record reported in this work. Dark areas in continental margins are the previously known distribution. The grey transparent shaded area marked by the dotted line between the new record and those from Chilean Patagonia and Magellan's Strait represents the hypothetical Magellanic distribution of the species in America. The area of formation of Antarctic Intermediate Water (AAIW) and the branches flowing towards the equator are in light grey, dotted lines and double-headed arrows. Dashed lines with simple-headed arrows are main surface currents. STF, Subtropical front (or subtropical convergence); SAF, Subantarctic front; PF, Polar front (also known as Antarctic convergence).

also by the presence of a branch of AAIW that stretches northeast along the African slope, reaching as far north as the Canary Archipelago (28°N) (Machín & Pelegrí 2009). In both cases many hauls were performed with different sampling gear but only one specimen was collected. The seeming rarity of the species at these two locations should not be surprising considering that both records are at the limits of AAIW branches, i.e. at the periphery of the supposed species optimal distribution.

On the other hand, the absence of *S. suhmi* in well-explored, deep-sea areas (where other Poly-chelidae are commonly found) also supports a species distribution influenced by the presence of AAIW. For example, explorations in the southern continental slope of Brazil found many polycheli-dan species other than *S. suhmi* (Ramos-Porto et al. 2000; Dall'Occo & Tavares 2004), indicating that the species does not extend north beyond the influence of the Malvinas Current. In turn, the absence of *S. suhmi* off East Africa supports the association of *S. suhmi* with cold AAIW because the Agulhas Current blocks the eastward penetra-tion of AAIW from the Atlantic (Piola & Georgi 1982). In summary, the current distribution of *S. suhmi* appears strongly correlated with the presence of intermediate subantarctic waters, suggesting that the species is restricted to cold and relative low-salinity/oxygen-rich waters.

Acknowledgements

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Ahyong ST 2009. The Polychelidan Lobsters Phylo-geny and Systematics. In: Martin JW, Crandall KA, Felder DL eds. Decapod Crustac. Phylogenetics. Boca Raton, FL, CRC Press. Pp. 369–396.

Ahyong ST 2012. Polychelid lobsters (Decapoda : Poly-chelida) off Central Queensland, with a summary of Australian and New Zealand distributions. Memoirs of the Queensland Museum - Nature 56: 1–7.

Arntz W, Gorny M, Soto R 1999. Species composition and distribution of decapod crustaceans in the waters off Patagonia and Tierra del Fuego, South America. Scientia Marina 63: 303–314.

Bate CS 1878. On the Willemoesia group of Crusta-cea. Annals and Magazine of Natural History 5: 273–283.

Boschi E, Gavio M 2005. On the distribution of decapod crustaceans from the Magellan Biogeographic Prov-ince and the Antarctic region. Scientia Marina 69: 195–200.

Bracken-Grissom HD, Ahyong ST, Wilkinson RD, Feldmann RM, Schweitzer CE, Breinholt JW et al. 2014. The emergence of lobsters: phylogenetic relationships, morphological evolution and diver-gence time comparisons of an ancient group (decapoda: achelata, astacidea, glypheidea, poly-chelida). Systematic Biology 63: 457–79.

Calman WT 1925. On macrurous decapod Crustacea collected in South African waters by the S.S. 'Pickle.' Reports of the Fisheries and Marine Biological Surveys of South Africa 4: 1–26.

Cartes J, Abello P 1992. Comparative feeding habits of polychelid lobsters in the Western Mediterranean deep-sea communities. Marine Ecology Progress Series 84: 139–150.

Cartes J E, Papiol V, Frutos I, Macpherson E, González-Pola C, Punzón A et al. 2014. Distribution and biogeographic trends of decapod assemblages from Galicia Bank (NE Atlantic) at depths between 700 and 1800m, with connexions to regional water masses. Deep Sea Research Part II: Topical Studies in Oceanography 106: 165–178.

Chan T 2010. Annotated checklist of the world's marine AQ11 lobsters (Crustacea: Decapoda: Astacidea, Glyphei-dea, Achelata, Polychelida). The Raffles Bulletin of Zoology 153–181.

Dall'Occo PL, Tavares M 2004. New and additional records of deep-water blind lobsters from Brazil (Decapoda, Polychelidae). Nauplius 12: 143–149.

Galil BS 2000. Crustacea Decapoda: review of the genera and species of the family Polychelidae Wood-Mason, 1874. Mémoires du Muséum national d'Histoire naturelle 21: 285–387.

Gore RH 1984. Abyssal lobsters, genus Willemoesia (Palinura, Polychelidae), from the Venezuela Basin, Caribbean Sea. Proceedings of the Academy of Natural Sciences of Philadelphia 136: 1–11.

Gorny M 1999. On the biogeography and ecology of the Southern Ocean decapod fauna. Scientia Marina 63: 367–382.

Griffin DJG, Stoddart HE 1995. Deep-water decapod Crustacea from eastern Australia: lobsters of the families Nephropidae, Palinuridae, Polychelidae and Scyllaridae. Records of the Australian Museum 47: 231–263.

Griffiths HJ, Whittle RJ, Roberts SJ, Belcher M, Linse K, Archambault P 2013. Antarctic crabs: invasion or endurance? PLoS One 8: e66981.

Ivanova NV, Dewaard JR, Hebert PDN 2006. An inexpensive, automation-friendly protocol for recovering high-quality DNA. Molecular Ecology Notes 6: 998–1002.

Machín F, Pelegrí JL 2009. Northward penetration of Antarctic intermediate water off northwest Africa. Journal of Physical Oceanography 39: 512–535.

Orsi AH, Whitworth III T , Nowlin WD Jr. 1995. On the meridional extent and fronts of the Antarctic circumpolar current. Deep Sea Research Part I: Oceanographic Research Papers 42: 641–673.

Piola AR, Georgi DT 1982. Circumpolar properties of Antarctic intermediate water and Subantarctic Mode Water. Deep Sea Research Part A. Oceanographic Research Papers 29: 687–711.

Ramos-Porto M, Viana GFS, Silva KCA, Cintra IHA, Coelho PA 2000. Stereomastis sculpta (Smith, 1880) (Decapoda: Polycheloidea: Polychelidae) in Brazilian waters. Nauplius 8: 249–251.

Talley L 1999. Some aspects of ocean heat transport by the shallow, intermediate and deep overturning circulations. In: Clark PU, Webb RS, Keigwin LD eds. Mechanisms of global climate change at millennial time scales, geophysical monograph series. American Geophysical Union. Pp. 1–22.

Thatje S, Arntz WE 2004. Antarctic reptant decapods: more than a myth? Polar Biology 27: 195–201.

Thatje S, Schnack-Schiel S, Arntz W 2003. Developmental trade-offs in Subantarctic meroplankton communities and the enigma of low decapod diversity in high southern latitudes. Marine Ecology Progress Series 260: 195–207.

Tiefenbacher L 1994. Decapode Crustaceen aus westantarktischen Gewässern gesammelt von der R.V. "John Biscoe", Reise 11. Spixiana 17: 13–19.