

MARINE REPORTS

e-ISSN: 2822-5155

Journal homepage: <https://scopesscience.com/index.php/marep/>

Received: 18 January 2023; Received in revised form: 13 April 2023

Accepted: 23 April 2023; Available online: 17 June 2023

RESEARCH PAPER

Citation: Martínez-Campos, B. A. Dueñas L. F., León, J., & Puentes, V. (2023). Presence of the deep-sea lithodid crabs *Neolithodes agassizii* and *Paralomis pectinata* (Anomura, Lithodidae) in the Colombian Caribbean Sea. *Marine Reports*, 2(1), 1-8. <https://doi.org/10.5281/zenodo.8050512>

PRESENCE OF THE DEEP-SEA LITHODID CRABS *Neolithodes agassizii* AND *Paralomis pectinata* (ANOMURA, LITHODIDAE) IN THE COLOMBIAN CARIBBEAN SEA

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Abstract

This work aims to show the current distribution of *Neolithodes agassizii* and *Paralomis pectinata* in the Colombian Caribbean Sea, including new records and details of the feeding behavior of *P. pectinata* obtained for the first time by Remote Operated Vehicles (ROV) and towed cameras.

Keywords: *Neolithodes agassizii*, *Paralomis pectinata*, Colombian Caribbean Sea, deep-sea, new records

Introduction

The Lithodidae family comprises five genera with 116 species, and only three (3) genera with 31 species are distributed in the Atlantic Ocean. Five (5) species of the genus *Neolithodes*, eight of *Lithodes*, and 19 of *Paralomis*, are strictly distributed in the deep sea between 640 m and 2700 m of depth (Macpherson, 1988, 1994; Hall & Thatje, 2009, 2011; McLaughlin, et al. 2010; Muñoz & García-Isarch, 2013). However, several inaccuracies in the publications regarding the

distribution in the Caribbean Sea have been noted. For example, Macpherson (1994) includes the species *Paralomis grossmani* (Macpherson, 1988) within the Caribbean, citing his previous work of 1988, but in that publication the species is only recorded in French Guyana, which does not belong to the Caribbean basin. The same occurred in Hall and Thatje (2009) erroneously including the species *Paralomis arethusa* in the Caribbean citing Macpherson (1994), but the record corresponds to the Barbados Accretionary Prism that is found in the Atlantic Ocean, although the Island of Barbados belongs to the Caribbean Sea. Likewise, *Lithodes manningi* was registered in Dominica Island, but the record belongs to the North-Western Atlantic Ocean. Therefore, only 4 Lithodid species are currently distributed in the Caribbean Sea: *Neolithodes agasizii* (Smith, 1882); *Paralomis pectinata* (Macpherson, 1988); *Paralomis serrata* (Macpherson, 1988) and *Paralomis cubensis* (Chace, 1939). Only *P. serrata* has been recorded in Colombia by Macpherson (1988), and no new records of lithodid crabs have been published until now.

Material and Method

Snapshots of video surveys were taken, based on more than nine hours of Remote Operated Vehicles (ROV) video records performed over deep-sea soft bottoms. The videos were taken before, during, and after the exploratory drilling of hydrocarbon wells. ROV surveys assessed the benthos in 80–100 m long transects that ran in a cross pattern with north, south, east, and west trajectories; locations include Kronos 1, Calasú 1, Purple Angel C–1, and Gorgon A–1 exploratory wells (Figure 1). On the other hand, towed camera surveys included 25 linear transects (three hours each), recording the seafloor features and taking still images every 20 seconds. The towed camera transects were carried out in areas A, B, C, D, and E (Figure 1). Both ROV surveys and towed camera surveys were performed at depths between 375 and 2565 m. Snapshots and still images were analyzed, optimizing the quality of images using Photoshop 2020 software with filters of focus, zoom and selective exposition.

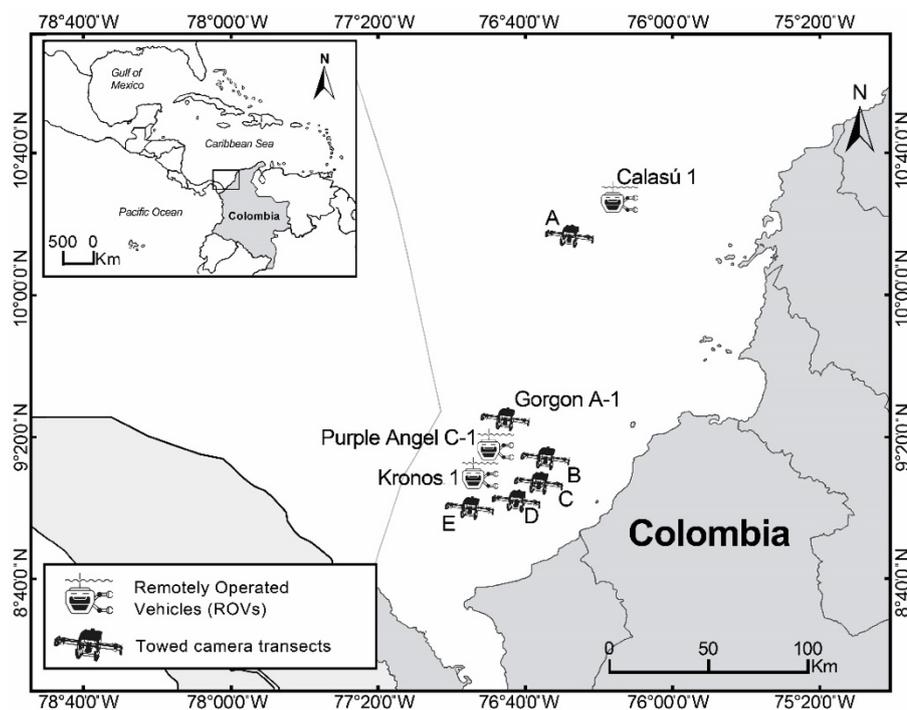


Figure 1. Survey locations in the southern Colombian Caribbean. Points A, B, C, D and E were surveyed by towed camera transects. Other areas were surveyed by Remotely Operated Vehicles (ROV).

Results and Discussion

The images led to the identification of *N. agassizii* and *P. pectinata* in the Colombian Caribbean waters registering for the first time, a feeding behavior in the last one. In the case of *N. agassizii*, the identity was confirmed by comparing some diagnostic characters with closely related species of the tropical western Atlantic based on the keys of Macpherson (1988) and Macpherson (1994), corroborating that there was no confusion with other morphologically similar species. In the case of *P. pectinata*, the snapshots were compared in detail with specimens from this species available in the invertebrate collection of the Marine Natural History Museum of Colombia – MAKURIWA. The material analyzed is described as follows:

Neolithodes agassizii (Smith, 1882) (Figure 2 A, B, C, D).

Record in the southern Colombian Caribbean Sea, about 55 Km offshore Arboletes (Antioquia). 9.2071 N, 76.8320 W at 1806 m deep, vessel Bollete Dolphin, ROV survey, 02–24–2015 at 16:16:48; one (1) specimen observed (Figure 2A). The video highlights characters such as the uniform red color, and the pyriform carapace with the edge armed with numerous and well development spines (Figure 2C). The terminal border of the median plate on the second abdominal segment shows some thick spines (Figure 2C). Walking legs are armed with long spines, spinules, and small denticles (Figure 2C). The second walking legs are longer than the first and third. Third walking legs are approximately three times the carapace length, and the merus was slightly longer than the propodus (Figure 2D).

In comparison to the other species of the Caribbean Sea, *N. agassizii* differs from *Lithodes manningi* because the latter has a pentagonal carapace poorly armed with spines, and abdominal plates with some granules but without long spines, and by the extreme length and thinness of its walking legs (Figure 3). Likewise, it differs from the other three (3) species of the genus *Paralomis* in the Caribbean since they do not have a spinose carapace or spines in the second abdominal segment; additionally, *P. serrata* and *Paralomis cubensis* (Chace, 1939) differ by the pentagonal shape of the carapace (Figure 3). Finally, *N. agassizii* differs from *Neolithodes grimaldii* (Milne-Edwards & Bouvier, 1894) because the latter has much longer spines on the ambulatory legs. The species is widely distributed in the North and Central Western Atlantic and the Gulf of Mexico. In the Caribbean, it has been recorded on Martinique Island, Lesser Antilles. The present ROV video record increases the depth range of distribution for the species in the Caribbean Sea down to 1805 m. *N. agassizii* appears to be erroneously mapped only in Venezuela (Macpherson, 1988); when the coordinates registered were plotted, some records belonged to Colombian waters. These inaccuracies in the locality were ratified by the Smithsonian National Museum of Natural History–NMNH database MNHN (2020), where the material examined by Macpherson (1988) remains deposited. In addition, all the coordinates from *N. agassizii* deposited in the United States National Museum database were plotted and other inconsistencies were found, confirming that other specimens recorded in Venezuela were in fact, from Suriname and French Guiana. Likewise, it was concluded that there are no published records for *N. agassizii* in Venezuela, although it is very possible that the species is present in the Venezuelan Caribbean as well. Published records of the 1970s were difficult to track for *N. agassizii*, but this work established a formal record for the Colombian Caribbean.

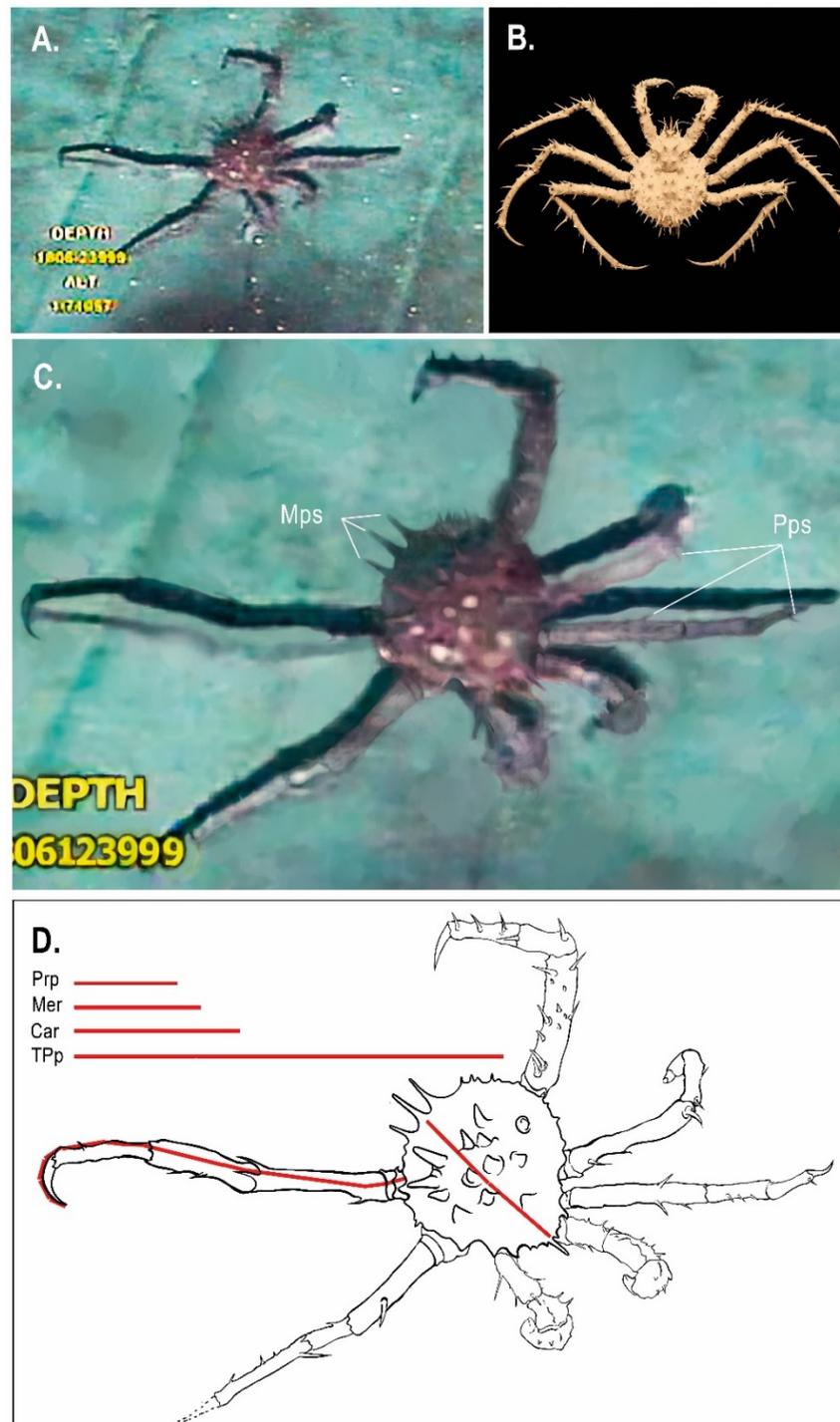


Figure 2. A. Image captured by ROV survey of *Neolithodes agassizii* found in purple angel well at a depth of 1806 m. B. Characteristic features of *N. agassizii* (IZ.056804: *Neolithodes agassizii*). Digital Image by Yale Peabody Museum of Natural History - YPM (2018), metadata updated on 17th March 2018 18:40:24. C. Optimized image to confirm identification features, Mps (Median plate spines), Pps (Pereopod spines) D. Schematic illustration of the specimen observed, showing the proportions of carapace (Car) and third pereopod (TPp), and the separated proportion of propodus and merus of this appendage. To determine the proportion is used a red bar of 1.50 x 0.1 pixels were replicated and located according to the orientation of the appendage. Once the segment of the appendage was contoured, the bars were copied and re-organized in a straight line.

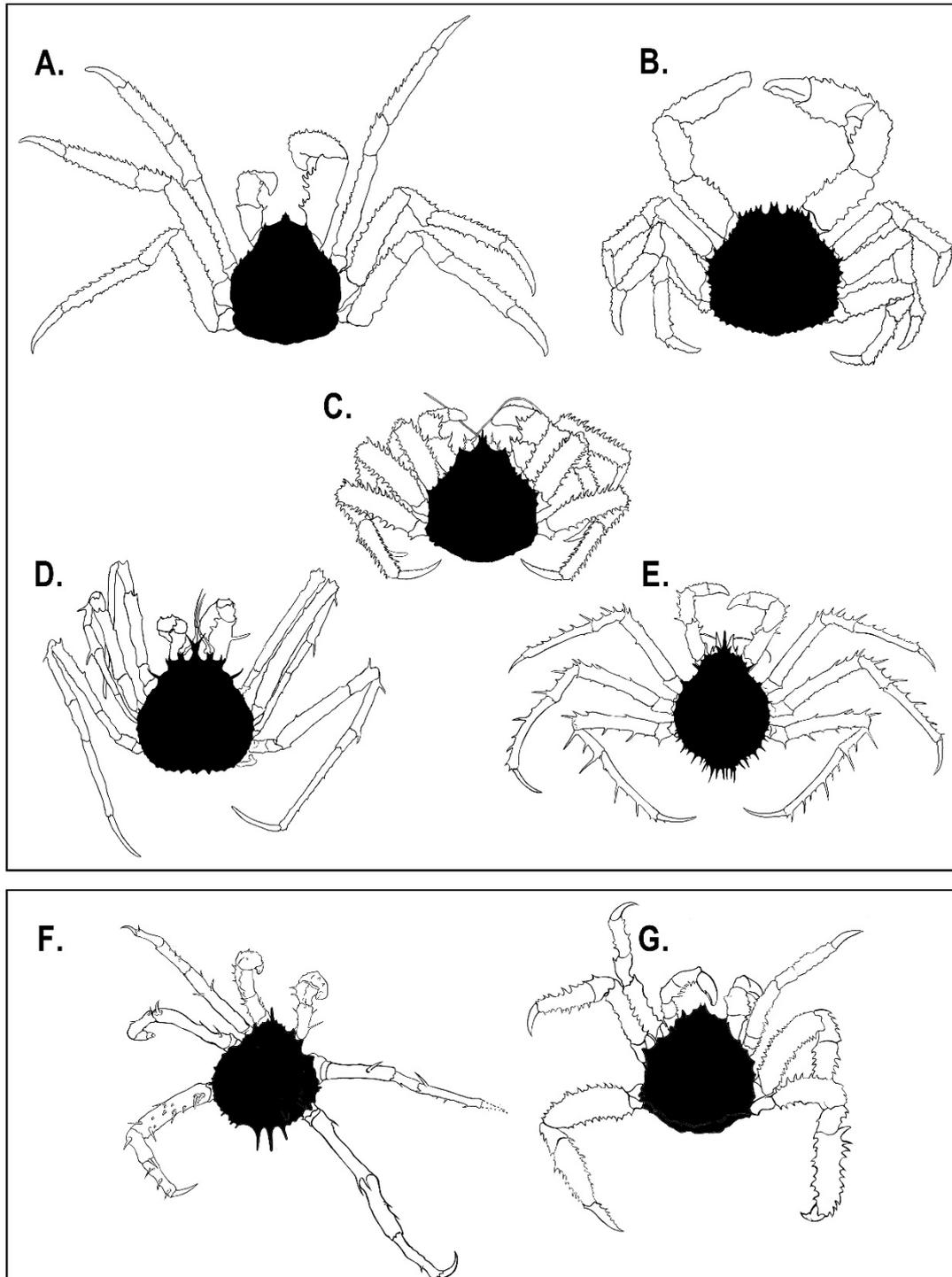


Figure 3. Schematic illustrations of the known species of the Lithodidae family in the Caribbean Sea. **A.** *P. serrata*; **B.** *P. cubensis*; **C.** *P. pectinata*; **D.** *L. manningi* (collected in the North-Western Atlantic Ocean in the boundaries of the Caribbean Sea), and **E.** *N. agassizii*, in contrast with the schematic illustration of the specimens identified as *N. agassizii* (F) and *P. pectinata* (G).

Paralomis pectinata (Macpherson, 1988), (Figure 4 A, B, C, D).

Records in the southern Colombian Caribbean Sea, about 55 km off Arboletes (Antioquia). 9.164 N, 76.832 W at 1567 m deep; vessel Bollete Dolphin; ROV survey, 08-27-2015 at

9:42:49; one (1) specimen observed, same collection data as of preceding 11:25:15. Eight (8) specimens observed off Barranquilla (Atlántico). 4♀, 4♀Nov, 2♂, 3 parasites of *Rizocephala* (not functional sex), 11.3043 N; -75.2841 W; 1200 m, Shell_Col3-CSC, MHNMC.

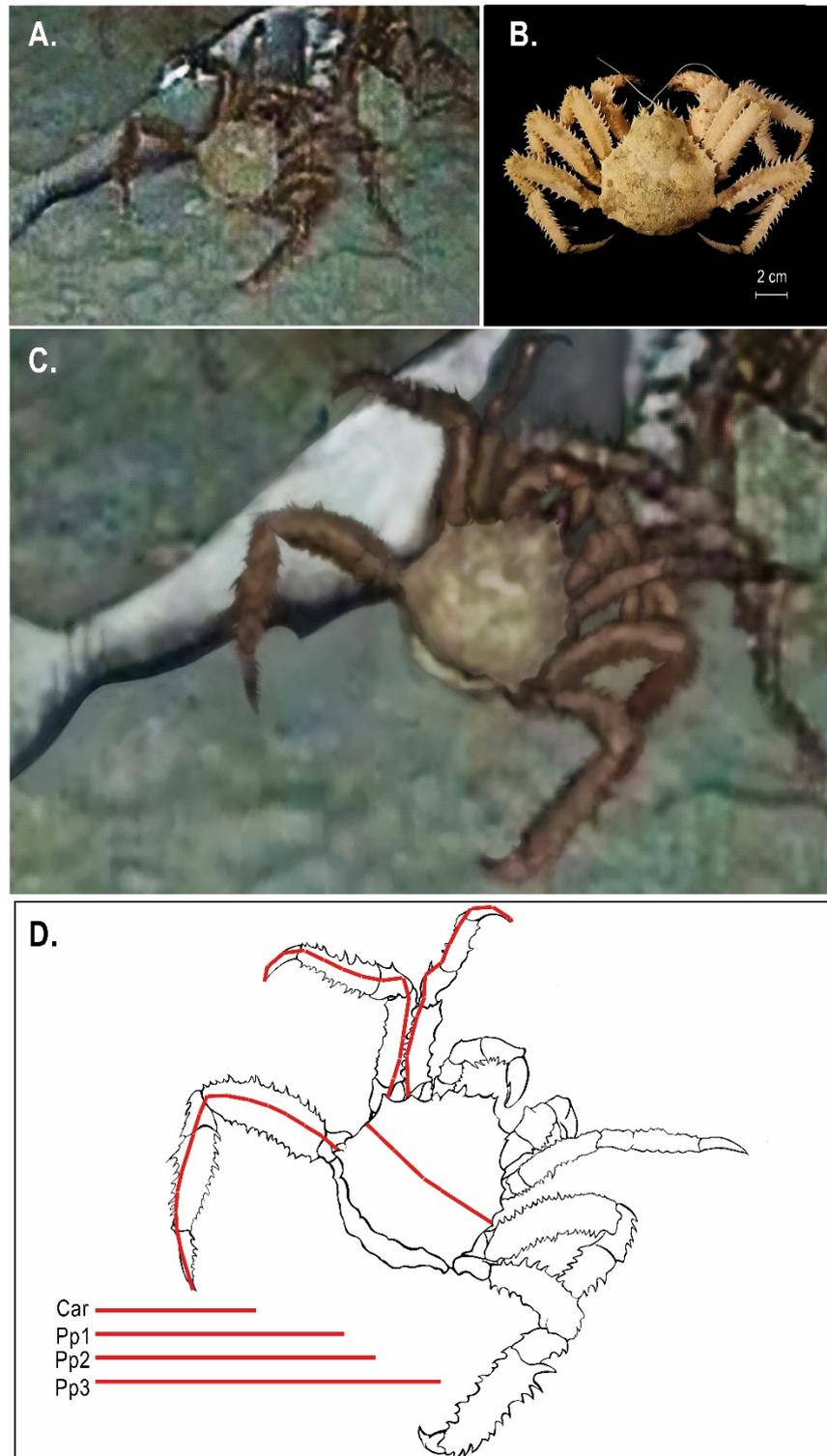


Figure 4. **A.** Image captured by ROV survey of *Paralomis pectinata* found in Kronos 1 well at a depth of 1567 m. **B.** Characteristic features of *Paralomis pectinata*. Digital Image by Martínez-Campos et al. (2017). **C.** Optimized image to confirm identification features; **D.** Schematic illustration of the specimen observed, showing the proportions of carapace (Car) and first pereopod (Pp1), second pereopod (Pp2) and third pereopod (Pp3). To determine de

proportion is used a red bar of 1.50 x 0.1 pixels were located according to the orientation of the appendage. Once the segment of the appendage was contoured, the bars were copied and re-organized in a straight line.

The species is distributed in Colombia and Venezuela between 1567–2400 m. Diagnostic characteristics of the *Paralomis* genus were observed in the video records, such as the very prominent gastric region, the subequal length of the first and second pereopod, and the third pereopod noticeably longer than the shield (Figure 4D) (Macpherson, 1988). The species corresponded to *P. pectinata* due to the sub-pentagonal shape of the carapace with the straight margin and the characteristic comb-like spinulation pattern of the pereopods observed (closeups of ROV images; Figure 4 D). The ROV images captured 9 specimens that were observed feeding on or nearby a shark corpse (organic fall) (Figure 4 A). This constitutes the first record of feeding habits obtained for the species.

The live observation of *N. agassizii* and *P. pectinata* allowed to rediscover previously hidden records and confirm that the Lithodidae family is represented in Colombia by 3 of the 4 species confirmed for the Caribbean Sea. The new evidence of *P. pectinata* is important due to its scarce records and because it allowed recording ecological aspects such as their bathymetric limits, ecosystem preferences, and feeding behavior.

Acknowledgements

Thanks to Anadarko Colombia Company (ACC), Ecopetrol, and the companies involved in this oil & gas exploratory survey. Dolphin Drilling Co. operated the Mobile Operating Drilling Unit (MODU), Subsea 7 (and its division I-TECH services) operated the ROV that took the videos analyzed here. Towed camera images were provided by SERPORT S.A and CSA Ocean Science Inc., during additional exploration studies. Thanks to the Colciencias' Post-Doctoral Program (Fondo Nacional de Financiamiento para la Ciencia, la Tecnología y la Innovación Francisco José de Caldas–COLCIENCIAS, Convocatoria 2017, Número 784) for funding a postdoctoral research position at ACC. Thanks to the “Instituto de Investigaciones Marinas y Costeras–INVEMAR for the funding and support during the analysis of the ROV videos and images, and the taxonomic identification achieved by the curators of the Museum of Natural Marine History of Colombia MAKURIWA–INVEMAR; Thanks to Janneth Beltrán of INVEMAR LabSIS for the map.

Informed consent

Not available

Ethical approval

The author declares that this study complies with research and publication ethics

Data availability statement

The authors declare that data are available from authors upon reasonable request.

Conflicts of interest

There is no conflict of interests for publishing this study.

Funding organizations

No funding available.

Contribution of authors

- B. Martinez- Campos: Conceptualization, Formal analysis, validation, writing original draft.
L.F. Dueñas: Formal analysis, draft review.
J. Leon: Analysis contribution, draft review.
V. Puentes: Data gathering, analysis contribution, supervision, editing.

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