New records of soft bottom bivalves (Mollusca) from the continental shelf and upper slope of the northern Pacific Ocean of Colombia

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This paper presents an inventory of the species of molluscs collected on the continental shelf and upper slopes (70–500 m depth) on the Pacific side of Colombia. In 2002, 39 trawl samples were taken on soft bottoms by the RV ARC ‘Malpelo’. Thirty-eight species of bivalves were collected, comprising living animals and dead collected shells. Information on abundance, Colombian distribution and depth range is provided. Thirty-four species represent the first records for the Colombian Pacific, significantly increasing the number of shelf and slope species known in the region.

Keywords: biodiversity, soft bottoms, Choco, Bivalvia, checklist, benthic macrofauna

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INTRODUCTION

For the Panamic Province of the tropical eastern Pacific Ocean (Baja California, Mexico to northern Peru), several monographs have characterized the molluscan fauna. Hertlein & Strong (1955) recorded the presence of 211 species of gastropods, bivalves and scaphopods, based on collections from the ‘Askoy’ cruise in 1941 (Hertlein & Strong, 1955) in Panama, Colombia and Ecuador. Subsequently, Olsson (1961) presented a thorough work on the neritic bivalves species found from Panama to Peru, including several locations on the Colombian coast. This work was followed by Olsson (1971), who documented gastropods and bivalves found in the Gulf of Panama. Based in part on these previous publications, Keen (1971) presented the first inventory of the tropical eastern Pacific molluscs, including 3325 species of monoplacophorans, aplacophorans, polyplacophorans, scaphopods, cephalopods, bivalves and gastropods. Due to intensive sampling, the Gulf of California is the best documented area within the Panamic Province. Hendrickx et al. (2007) listed 2194 marine mollusc species dwelling in these bottoms, of which 565 were bivalves.

The most recent and specific contribution related to Pacific mollusc taxonomy and distribution was made by Coan & Valentich-Scott (2012), recording 890 bivalve species distributed from the central Pacific coast of Baja California, Mexico, including the Gulf of California, to northern Peru. A considerable number of these species are presumed to inhabit in the Colombian Pacific waters, taking into account that their geographical distribution areas range from the Gulf of California to Peru. However, for most of the species presented in the aforementioned publications, there are no documented records of their presence in Colombian waters.

According to Miloslavich et al. (2011), in the Pacific coastal waters of Costa Rica, Panama, Colombia and Ecuador, 875 species of molluscs are known. These authors pointed out that even for relatively well known groups such as molluscs, echinoderms and fish, the inventories are by no means complete, and further discoveries should be expected.

In the Colombian Pacific Díaz et al. (1998) recorded 883 species of molluscs, but estimated the presence of about 1813 mollusc species. The latter number could be much closer to what might be found in the area, taking into account the low sampling effort and that the actual data are mostly representative of species from shallow coastal environments, such as mangroves, rocky shores, sandy beaches and coral and rocky reefs (e.g. Malpelo and Gorgona Islands). Modest emphasis was given to the shelf, upper slope and the deep-water soft bottom fauna.

Thus, the purpose of this paper is to present the first inventory of the bivalve mollusc species collected on the continental shelf and upper slope surveys carried out by the Invemar projects in Colombia. The data presented herein will contribute to the knowledge about the regional fauna and their geographical and bathymetric distributions.

MATERIALS AND METHODS

Study area

The Colombian Pacific Ocean has nearly 1300 km of shoreline and is a component of the Panama Basin. The Colombian Pacific Basin is located between 01°30’N to 7°10’N and
between 77°40′W to 82°00′W (Murcia & Giraldo, 2007). The basin is bounded on the north by the Gulf of Panama; the coast of Colombia, composed of the departments of Choco, Valle del Cauca, Cauca and Nariño, in the east; the Ecuadorian coast and the submarine Carnegie Ridge, to the south; and the Pacific Ocean, territorial waters of Panama (30 km) and the Cocos Ridge to the west (Murcia & Giraldo, 2007). Longitudinally these boundaries include the coastline to the outer limits of the exclusive economic zone which includes Malpelo Island (644 km from continental coast), with 339,500 km² among estuarine, coastal and ocean waters, with depths up to 4000 m (Martínez et al., 2007). The most important geomorphological features are Gorgona and Malpelo Islands (Murcia & Giraldo, 2007). Our study includes the area off Choco Department, the largest in shoreline on the Pacific side of the country (Figure 1). The Panama Basin is dominated almost exclusively by biogenic sediments seasonally controlled by primary productivity, except for northern and eastern margins consisting mainly of terrigenous sediments (Betancur & Martínez, 2003). The dominant ocean waves, like the wind and current in the Colombian Pacific Basin, come from the south-west (Murcia & Giraldo, 2007).

**Collection and processing of specimens**

A collection campaign was carried out on the Colombian Navy RV ARC ‘Malpelo’ in the framework of the project Invemar-Macrofauna III (Biodiversity baseline study of the northern Colombian Pacific coastal and shelf areas) from 6–13 October 2002. Sampling was performed in several locations along the continental shelf and the upper slope of the northern coast of the Colombian Pacific (Figure 1). A total of 39 demersal trawls were performed with an epibenthic trawl net (3 knots by 10 minutes) at depths of 70, 150, 300 and 500 m. In this methodology the opening of the net in each trawl was unknown, making it semi-quantitative sampling, however all collected species and specimens were quantified. All collected specimens were preserved dry or in 70% ethanol.

The sediments were characterized using a nested set of sieves (or gradation tests) according to the methodology of Folk (1974). The results of samples indicate the following mud/sand proportions: Station P3E20 was composed of mud 60% and sand 40%; Stations P1E22, P3E17, P14E9 and P15E7, 70/30%; Stations P1E21, P3E18, P14E10, P14E11 and P15E6, 75/25%; Stations P1E23 and P15E5, 80/20%; and Station P1E24, 90/10% (Perea & Posada, 2004). Other oceanographic parameters were unfortunately not sampled.

Specimens were identified using the most current taxonomic literature available on the region such as Dall (1908), Strong & Hertlein (1940), Grau (1959), Rost (1955), Soot-Ryen (1955), Olsson (1961), Keen (1971), Coan et al. (2000) and Coan & Valentich-Scott (2012), among others.
The taxonomic arrangement of the species follows the criteria of Coan & Valentich-Scott (2012). In the systematic account the species considered as new records for the area are highlighted (*). Specimens were deposited in the mollusc collection of the Museo de Historia Natural Marina de Colombia (MHNMC) in Santa Marta.

We have included data for both live collected and dead collected specimens and clearly demarcate them as ‘specimens’ and ‘valves’. We do present ‘maximum collection depth’ from either live or dead material, but this is not to indicate that the species is currently living at this depth. Instead it allows us to compare our distributions with the monographs by Keen (1971) and Coan & Valentich-Scott (2012), who made no distinction between living or dead specimens in their bathymetric reporting.

RESULTS

A total of 38 species, represented by live collected specimens and dead valves, were identified. We herein provide a taxonomic list of the species, geographical locality and depth range.

**SYSTEMATICS**

Class BIVALVIA Linnaeus, 1758
Family NUCULIDAE Gray, 1824
Genus *Ennucula* Iredale, 1931
*Ennucula taeniolata* (Dall, 1908)
(Figure 2A, B)


**MATERIAL EXAMINED**

4 specimens and a valve INV MOL9665 (P14E12a), 474–475 m.

**GEOGRAPHICAL DISTRIBUTION**

Mexico (Gulf of California) (Coan & Valentich-Scott, 2012). In Colombia* collected off Baudo Bay.

**DEPTH RANGE**

474 to 1275 m (herein; Coan & Valentich-Scott, 2012).

**REMARKS**

This is a minor range extension and represents the southern record for the species as well as the shallowest record.

Genus *Nucula* Lamarck, 1799
*Nucula iphigenia* Dall, 1896
(Figure 2C, D)


**MATERIAL EXAMINED**

1 specimen INV MOL9664 (P15E7a), 300 m.

**GEOGRAPHICAL DISTRIBUTION**

Panama to Peru (Coan & Valentich-Scott, 2012). In Colombia* collected off Decampado Bight.

**DEPTH RANGE**

9 to 128 m (Coan & Valentich-Scott, 2012; herein).

**REMARKS**

The Colombian records, albeit with dead collected specimens, represent a new maximum collection depth for this species.

Genus SOLEMYIDAE Gray, 1840
Genus *Solemya* Lamarck, 1818
*Solemya pervernicosa* Kuroda, 1948
(Figure 2E, F)


**MATERIAL EXAMINED**

1 specimen INV MOL9714 (P15E5a), 65–67 m.

**GEOGRAPHICAL DISTRIBUTION**

USA (Alaska) to Peru; Sakhalin Island to Japan (Coan & Valentich-Scott, 2012). In Colombia* collected off Decampado Bight.

**DEPTH RANGE**

40 to 1510 m (Coan & Valentich-Scott, 2012).

**REMARKS**

Previously only known from the type locality in the Gulf of Panama and one sample off Tumbes Peru. This specimen represents the shallowest record for the species.

Family NUCULANIDAE Adams & Adams, 1858
Genus *Saccella* Woodring, 1925
*Saccella fastigata* (Keen, 1958)
(Figure 2G, H)


**MATERIAL EXAMINED**

5 specimens INV MOL9676 (P14E9a), 70 m; 2 specimens INV MOL9677 (P15E51), 65–67 m; 2 specimens INV MOL9678 (P1E21b), 70 m; 2 valves INV MOL9679 (P3E17b) 76–78 m; 3 valves INV MOL9680 (P14E10b), 115–116 m; 1 valve INV MOL9752 (P15E6a), 119–128 m; 2 valves INV MOL9753 (P15E6b), 115–127 m.

**GEOGRAPHICAL DISTRIBUTION**

Mexico to Peru (Coan & Valentich-Scott, 2012). In Colombia* collected off Humboldt Bay, Baudo Bay, Gulf of Cupica and Decampado Bight.

**DEPTH RANGE**

9 to 128 m (Coan & Valentich-Scott, 2012; herein).

**REMARKS**

The Colombian records, albeit with dead collected specimens, represent a new maximum collection depth for this species.

*Saccella hindsii* (Hanley, 1861)
(Figure 2I, J)


**MATERIAL EXAMINED**

1 specimen INV MOL9715 (P3E17a), 74–80 m; 2 valves INV MOL9716 (P3E17a), 74–80 m; 1 specimen and 7 valves INV MOL9717 (P14E9b), 70–72 m; 1 specimen and 4...
Valves INV MOL9718 (P7E13b), 76 m; 1 specimen and 1 valve INV MOL9719 (P15E5b), 70–71 m.

Geographical distribution
Mexico to Panama (Coan & Valentich-Scott, 2012). In Colombia* collected off Gulf of Tibuga, Gulf of Cupica, Decampado Bight and Baudo Bay.

Depth range
16 to 100 m (Coan & Valentich-Scott, 2012).

Family YOLDIIDAE Dall, 1908
Genus Orthoyoldia Verrill & Bush, 1897
Orthoyoldia panamensis (Dall, 1908) (Figure 2K, L)

MATERIAL EXAMINED
3 specimens INV MOL9657 (P14E12a), 474–475 m; 1 specimen INV MOL9658 (P3E18b), 143–145 m; 1 specimen INV MOL9659 (P14E10a), 120–121 m.

GEOGRAPHICAL DISTRIBUTION
Mexico to Peru (Coan & Valentich-Scott, 2012). In Colombia* collected off Gulf of Cupica and Baudo Bay.

DEPTH RANGE
64 to 864 m (Coan & Valentich-Scott, 2012).

Family MYTILIDAE Rafinesque, 1815
Genus Amygdalum Megerle von Mühlfeld, 1811
Amygdalum pallidulum (Dall, 1916)
(figure 2M, N)

MATERIAL EXAMINED
1 specimen INV MOL9652 (P15E5b), 70–71 m; 1 specimen INV MOL9653 (P1E21b), 70 m; 1 specimen INV MOL9654 (P3E18b), 143–145 m; 1 specimen INV MOL9655 (P14E9a), 70 m.

GEOGRAPHICAL DISTRIBUTION
USA (California) to Gorgona Island, Cauca, Colombia (Coan & Valentich-Scott, 2012). Also collected in Colombia off Humboldt Bay, Gulf of Cupica, Decampado Bight and Baudo Bay.

DEPTH RANGE
40 to 400 m (Coan & Valentich-Scott, 2012).

Family ARCIDAE Lamarck, 1809
Genus Anadara Gray, 1847
Anadara concinna (Sowerby, 1833)
(figure 2O, P)

MATERIAL EXAMINED
2 valves INV MOL9742 (P15E6a), 119–128 m; 2 valves INV MOL9743 (P15E6b), 115–127 m.

GEOGRAPHICAL DISTRIBUTION
Mexico to Ecuador (Coan & Valentich-Scott, 2012). In Colombia* collected off Decampado Bight.

DEPTH RANGE
Intertidal to 128 m (Coan & Valentich-Scott, 2012; herein).

Remarks
While we have not collected live specimens in Colombia, this dead collected specimen represents a new maximum collection depth for the species.

Family PECTINIDAE Rafinesque, 1815
Genus Delectopecten Stewart, 1930
Delectopecten zacae (Hertlein, 1935)
(figure 2S, T)

MATERIAL EXAMINED
1 specimen INV MOL9681 (P1mE24b), 492–500 m; 10 valves INV MOL9682 (P1mE24b), 492–500 m; 2 specimens INV MOL9683 (P3E20b), 489–491 m. 34 valves INV MOL9684 (P3E20b) 489–491 m; 618 valves INV MOL9685 (P3E20a), 482–490 m; 24 specimens INV MOL9686 (P3E20a), 482–490 m; 9 specimens INV MOL9687 (P15E7a), 300 m; 5 specimens INV MOL9688 (P1E23b), 329–339 m.

GEOGRAPHICAL DISTRIBUTION
Mexico to Peru, Galapagos Islands, Ecuador (Coan & Valentich-Scott, 2012). In Colombia* collected off Gulf of Cupica, Octavia Bay, Marzo Cape and Decampado Bight.

DEPTH RANGE
10 to 1840 m (Keen, 1971).

Genus Pseudamussium Mörch, 1853
Pseudamussium fasciulatum (Hinds, 1845)
(figure 2U, V)

MATERIAL EXAMINED
17 valves INV MOL9656 (P14E11a1), 272–295 m.

GEOGRAPHICAL DISTRIBUTION
Mexico to Ecuador (Coan & Valentich-Scott, 2012). In Colombia* collected off Baudo Bay.

DEPTH RANGE
31 to 333 m (Grau, 1959).

Family LUCINIDAE Fleming, 1828
Genus Lucinisca Dall (1901)
Lucinisca fenestrata (Hinds, 1845)
(figure 2W, X)

**Material Examined**
5 valves INV MOL9745 (P15E6a), 119–128 m; 4 valves INV MOL9746 (P15E6b), 115–127 m.

**Geographical Distribution**
Mexico to Ecuador (Coan & Valentich-Scott, 2012). In Colombia* collected off Decampado Bight.

**Depth Range**
13 to 128 m (Coan & Valentich-Scott, 2012; herein).

**Remarks**
The presence of 9 dead valves at two stations suggests that this small, non-commercial species is living in Colombia. This represents a new maximum collection depth for the species.

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**Genus Neophysema Taylor & Glover, 2005**

**Neophysema aphanes** Taylor & Glover, 2005

(Figure 3A, B)


**Material Examined**
6 valves INV MOL9730 (P3E18b), 143–145 m; 1 valve INV MOL9731 (P14E9a), 70 m; 3 valves INV MOL9732 (P3E17a), 74–80 m; 2 specimens and 4 valves INV MOL9733 (P14E9b), 70–72 m; 2 valves INV MOL9734 (P3E17b), 76–78 m; 1 valve INV MOL9735 (P14E10a), 120–121 m; 4 valves INV MOL9736 (P14E10b), 115–116 m; 2 valves INV MOL9737 (P15E5b), 70–71 m; 1 valve INV MOL9738 (P1E21b), 70 m; 1 specimen and 1 valve INV MOL9739 (P7E13b), 76 m.

**Geographical Distribution**
Mexico, Gorgona Island—Cauca Colombia, Galapagos Islands—Ecuador (Coan & Valentich-Scott, 2012). Herein new distribution in Colombia off Humboldt Bay, Gulf of Cupica, Gulf of Tibuga, Decampado Bight and Baudo Bight.

**Depth Range**
4 to 250 m (Coan & Valentich-Scott, 2012).

**Remarks**
A strong note of caution was given by Coan & Valentich-Scott (2012) on this species. *Thyasira flexuosa* exhibits an extremely variable shell shape. Efforts to define the species based on shell shape alone have led to much confusion on delimiting the species morphologically, as well as its distribution globally. Thus, we have chosen to qualify the species with the cf. (compared to) designation.

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**Family THYASIRIDAE Dall, 1900 (1895)**

**Genus Trachycardium Moörch, 1853**

**Trachycardium belcheri** (Broderip & Sowerby, 1829)

(Figure 3G, H)


**Material Examined**
1 valve INV MOL9650 (P1E22a), 148–150 m; 1 valve INV MOL9651 (P1E22b), 163–168 m.

**Geographical Distribution**
Mexico to Peru (Coan & Valentich-Scott, 2012). In Colombia* collected off Humboldt Bay.

**Depth Range**
14 to 200 m (Coan & Valentich-Scott, 2012).

**Remarks**
While only one dead valve of this species was collected, this record represents the southernmost and deepest records for this recently described species. *Channelaxinus oliveri* is very thin, fragile, and small. It is unlikely that it would be transported long distances after death.

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**Family CARDIIDAE Lamarck, 1809**

**Genus Microcardium Thiele, 1934**

**Microcardium panamense** (Dall, 1908)

(Figure 3I, J)

MATERIAL EXAMINED
8 valves INV MOL9643 (P1E22b), 163–168 m; 70 valves INV MOL9644 (P14E11a1), 272–295 m; 9 valves INV MOL9645 (P1E22a), 148–150 m; 50 valves INV MOL9646 (P3E18a), 146–152 m; 64 valves INV MOL9647 (P3E18b), 143–145 m; 2 specimens INV MOL9648 (P1E22a), 148–150 m; 18 specimens INV MOL9649 (P3E18a), 146–152 m; 1 specimen INV MOL9754 (P15E6a), 119–128 m; 9 valves INV MOL9755 (P15E6a), 119–128 m; 1 valve INV MOL9756 (P15E6b), 115–127 m.

GEOGRAPHICAL DISTRIBUTION
Mexico to Peru (Coan & Valentich-Scott, 2012). In Colombia* collected off Humboldt Bay, Gulf of Cupica, Baudo Bay and Decampado Bight.
DEPTH RANGE
68 to 333 m (Keen, 1971; Coan & Valentich-Scott, 2012).

Family VESICOMYIDAE Dall & Simpson, 1901
Genus Pliocardia Woodring, 1925
‘Pliocardia’ donacia (Dall, 1908) (Figure 3K, L)


MATERIAL EXAMINED
3 valves INV MOL9741 (P14E11a1), 272–295 m.

GEOGRAPHICAL DISTRIBUTION
Panama (Coan & Valentich-Scott, 2012). In Colombia*, collected off Baudo Bay.

DEPTH RANGE
272 m to 2325 m (herein; Coan & Valentich-Scott, 2012).

REMARKS
This species was previously only known from the holotype, which is represented by a single, dead collected, left valve. The shell is thin and fragile and likely not transported long distances. The new records greatly extend the known bathymetric range, as well as providing the first opportunity to observe the right valve of the species. There are many generic uncertainties within the family Vesicomyidae, thus we follow Coan & Valentich-Scott (2012) in the tentative placement of this species into the genus Pliocardia.

Family TELLINIDAE Blainville, 1814
Genus Macoma Leach, 1819
Macoma panamensis Dall, 1900 (Figure 3M, N)


GEOGRAPHICAL DISTRIBUTION
Mexico to Panama (Coan & Valentich-Scott, 2012). In Colombia*, collected off Humboldt Bay.

DEPTH RANGE
22 to 150 m (Coan & Valentich-Scott, 2012; herein).

REMARKS
The presence of 12 dead valves at two stations suggests that this small, non-commercial species is living in Colombia. These valves represent a new maximum collection depth for the species.

Genus Psammotreta Dall, 1900
Psammotreta pura (Gould, 1853) (Figure 3Q, R)


MATERIAL EXAMINED
8 valves INV MOL9722 (P1E22a), 148–150 m.

GEOGRAPHICAL DISTRIBUTION
Mexico to Peru (Coan & Valentich-Scott, 2012). In Colombia* collected off Humboldt Bay.

DEPTH RANGE
Intertidal to 150 m (Coan & Valentich-Scott, 2012; herein).

REMARKS
While only collected at one station, the presence of 8 dead valves suggests that this thin, non-commercial species is living in Colombia. These valves represent a new maximum collection depth for the species.

Genus Tellina Linnaeus, 1758
Tellina nicoyana Hertlein & Strong, 1949 (Figure 3S, T)


MATERIAL EXAMINED
22 valves INV MOL9666 (P15E5a), 65–67 m; 12 valves INV MOL9667 (P7E13b), 76 m; 10 valves INV MOL9668 (P14E6b), 70–72 m; 14 valves INV MOL9669 (P14E9a), 70 m; 4 valves INV MOL9670 (P15E6b), 70–71 m; 2 specimens INV MOL9671 (P15E5b) 70–71 m; 1 specimen INV MOL9672 (P3E17a), 74–80 m; 7 specimens INV MOL9673 (P14E9a), 70 m; 8 specimens INV MOL9674 (P14E6b), 70–72 m; 51 specimens INV MOL9675 (P15E5a), 65–67 m.
**GEOGRAPHICAL DISTRIBUTION**
Costa Rica to Peru (Coan & Valentich-Scott, 2012). In Colombia* collected off Gulf of Tibuga, Gulf of Cupica, Decampado Bight and Baudo Bay.

**DEPTH RANGE**
55 to 200 m (Coan & Valentich-Scott, 2012; Cruz, 1996).

*Tellina lyrica* Pilsbry & Lowe, 1932
(Figure 3U, V)

**MATERIAL EXAMINED**
1 specimen INV MOL9660 (P15E5a), 65–67 m; 1 valve INV MOL9661 (P15E5a), 65–67 m; 1 valve INV MOL9662 (P14E9a), 70 m; 1 valve INV MOL9663 (P1E22a), 148–150 m; 2 valves INV MOL9759 (P15E6a), 119–128 m; 1 valve INV MOL9760 (P15E6b), 115–127 m.

**GEOGRAPHICAL DISTRIBUTION**
Mexico to Peru (Coan & Valentich-Scott, 2012). In Colombia* collected off Humboldt Bay, Decampado Bight and Baudo Bay.

**DEPTH RANGE**
15 to 150 m (Coan & Valentich-Scott, 2012; herein).

**REMARKS**
A single dead valve of this species was collected at 150 m, but living specimens were not collected deeper than 67 m. While the valve collected at the deepest station could have been transported from shallower depths, it is unlikely for such a thin, fragile species. This represents a new maximum collection depth for the species.

*Tellina carpenteri* Dall, 1900
(Figure 3W, X)

**MATERIAL EXAMINED**
1 specimen INV MOL9672 (P1E21b), 70 m; 2 valves INV MOL9727 (P14E10a), 120–121 m; 3 valves INV MOL9728 (P1E22b), 163–168 m; 2 valves INV MOL9729 (P1E22a), 148–150 m.

**GEOGRAPHICAL DISTRIBUTION**
USA (Alaska) to Panama (Coan & Valentich-Scott, 2012). In Colombia* collected off Humboldt Bay and Baudo Bay.

**DEPTH RANGE**
15 to 150 m (Coan & Valentich-Scott, 2012; herein).

**REMARKS**
While only collected at one station, the presence of 8 dead valves suggests that this fragile, non-commercial species is living in Colombia. These valves represent a new maximum collection depth for the species.

*Tellina pristiphora* Dall, 1900
(Figure 4A, B)

**MATERIAL EXAMINED**
9 valves INV MOL9695 (P1E22a), 148–150 m; 14 valves INV MOL9696 (P1E22b), 163–168 m; 2 valves INV MOL9761 (P15E6a), 119–128 m.

**GEOGRAPHICAL DISTRIBUTION**
Mexico to Peru (Olsson, 1961; Keen, 1971; Coan & Valentich-Scott, 2012). In Colombia* collected off Humboldt Bay and Decampado Bight.

**DEPTH RANGE**
22 to 333 m (Keen, 1971; Coan & Valentich-Scott, 2012).

**Family SOLECURTIDAE** d’Orbigny, 1846
**Genus Solecurtus** Blainville, 1824
*Solecurtus guaymasensis* (Lowe, 1935)
(Figure 4C, D)

**MATERIAL EXAMINED**
5 valves INV MOL9689 (P1E22a), 148–150 m; 8 valves INV MOL9690 (P1E22b), 163–168 m.

**GEOGRAPHICAL DISTRIBUTION**
Mexico to Ecuador (La Plata and Galapagos Islands) (Coan & Valentich-Scott, 2012). In Colombia* collected off Humboldt Bay.

**DEPTH RANGE**
7 to 168 m (Coan & Valentich-Scott, 2012; herein).

**REMARKS**
While only collected at one station, the presence of 8 dead valves suggests that this fragile, non-commercial species is living in Colombia. These valves represent a new maximum collection depth for the species.

**Family VENERIDAE** Rafinesque, 1815
**Genus Lirophora** Conrad, 1863
*Lirophora kellettii* (Hinds, 1845)
(Figure 4E, F)

**MATERIAL EXAMINED**
1 valve INV MOL9747 (P15E6b), 115–127 m.

**GEOGRAPHICAL DISTRIBUTION**
Mexico to Peru (Coan & Valentich-Scott, 2012). In Colombia* collected off Decampado Bight.

**DEPTH RANGE**
27 to 127 m (Coan & Valentich-Scott, 2012; herein).

**REMARKS**
This single dead valve represents a new maximum collection depth for the species.

**Genus Callocardia** Adams, 1864
*Callocardia catharina* Dall, 1902
(Figure 4G, H)

Material examined
2 valves INV MOL9748 (P15E6a), 119–128 m.

Geographical distribution
Mexico to Peru, Galapagos Islands, Ecuador (Coan & Valentich-Scott, 2012). In Colombia* collected off Decampado Bight.

Depth range
13 to 128 m (Keen, 1971; herein).

Remarks
These two dead valves represent a new maximum collection depth for the species.

Genus Cyclinella Dall, 1902
Cyclinella jadisi Olsson, 1961 (Figure 4I, J)

MATERIAL EXAMINED
1 valve INV MOL9749 (P1E22b), 163–168 m.

GEOGRAPHICAL DISTRIBUTION
Mexico to Ecuador (Coan & Valentich-Scott, 2012). In Colombia* collected off Humboldt Bay.

DEPTH RANGE
Intertidal to 168 m (Coan, 2001; herein).

REMARKS
This single dead valve represents a new maximum collection depth for the species.

Family CORBULIDAE Lamarck, 1818
Genus Caryocorbula Gardner, 1926
Caryocorbula nasuta (Sowerby, 1833)
(Figure 4K, L)

MATERIAL EXAMINED
6 specimens INV MOL9700 (P1E21b), 70 m; 20 specimens INV MOL9701 (P15E5b), 70–71 m; 15 specimens INV MOL9702 (P14E9b), 70–72 m.

GEOGRAPHICAL DISTRIBUTION
Mexico to Peru, Galapagos Islands, Ecuador (Coan & Valentich-Scott, 2012). Previously known to Colombia in Del Gallo Island (Nariño) (Olsson, 1961). Also collected off Humboldt Bay, Decampado Bight and Baudo Bay.

DEPTH RANGE
Intertidal to 229 m (Coan & Valentich-Scott, 2012).

Genus Varicorbula Grant & Gale, 1931
Varicorbula obesa (Hinds, 1843)
(Figure 4M, N)

MATERIAL EXAMINED
1 specimen INV MOL9697 (P3E18a), 146–152 m; 3 specimens INV MOL9698 (P15E3b), 70–71 m; 15 specimens INV MOL9702 (P14E9b), 70–72 m.

GEOGRAPHICAL DISTRIBUTION
Mexico to Colombia (Gulf of Cupica) (Coan & Valentich-Scott, 2012). Also collected in Gulf of Cupica, Gulf of Tibuga and Baudo Bay.

DEPTH RANGE
Intertidal to 229 m (Coan & Valentich-Scott, 2012).

Genus Pandora Bruguière, 1797
Pandora radiata (Sowerby, 1835)
(Figure 4O, P)

MATERIAL EXAMINED
1 valve INV MOL9750 (P3E18b), 143–145 m; 1 valve INV MOL9751 (P14E10b), 115–116 m.

GEOGRAPHICAL DISTRIBUTION
USA (California) to Peru. In Colombia*, collected off Gulf of Cupica and Baudo Bay.

DEPTH RANGE
55 to 76 m (Coan & Valentich-Scott, 2012; herein).

REMARKS
This is a very rare species (see Coan, 1990, for reported records), and it has never before been collected south of Veraguas, Panama.

Family PERIPLOMATIDAE Dall, 1895
Genus Periploma Schumacher, 1817
Periploma lagartillum Olsson, 1961
(Figure 4S, T)

MATERIAL EXAMINED
2 valves INV MOL9704 (P7E13b), 76 m; 2 valves INV MOL9705 (P14E9a), 70 m; 1 specimen INV MOL9706 (P3E18a), 146–152 m.

GEOGRAPHICAL DISTRIBUTION
Mexico to Panama (Coan & Valentich-Scott, 2012). In Colombia*, collected off Gulf of Cupica, Baudo Bay and Gulf of Tibuga.

DEPTH RANGE
In beach drift (Coan & Valentich-Scott, 2012), in Colombia 70 to 152 m.

REMARKS
In Colombia 5 specimens of this fragile species were collected from three stations, indicating that the species likely lives in the region. The type specimens and all subsequently collected specimens were dead collected in beach drift. This record represents a significant increase in the maximum collection depth for the species.
**Periploma teevani** Hertlein & Strong, 1946  
(Figure 4U, V)


**MATERIAL EXAMINED**
1 valve INV MOL9703 (P15E5a), 65–67 m.

**GEOGRAPHICAL DISTRIBUTION**
Mexico to El Salvador (Coan & Valentich-Scott, 2012). In Colombia* collected off Decampado Bight.

**DEPTH RANGE**
55 to 90 m (Coan & Valentich-Scott, 2012).

**Family CUSPIDARIIDAE** Dall, 1886
**Genus Cardiomya** Adams, 1864
**Cardiomya planetica** (Dall, 1908)  
(Figure 4W, X)


**MATERIAL EXAMINED**
2 specimens INV MOL9711 (P15E5b), 70–71 m; 1 specimen INV MOL9712 (P3E17a), 74–80 m; 1 specimen INV MOL9713 (P1E21b), 70 m.

**GEOGRAPHICAL DISTRIBUTION**
USA (Alaska) to Panama, Galapagos Islands, Ecuador, Japan (Coan & Valentich-Scott, 2012). Peru (Paredes & Cardozo, 2003). In Colombia* collected off Humboldt Bay, Gulf of Cupica and Decampado Bight.

**DEPTH RANGE**
25 to 3000 m (Coan et al., 2000).

**Genus Cuspidaria** Nardo, 1840
**Cuspidaria parapodema** Bernard, 1969  
(Figure 4Y, Z)


**MATERIAL EXAMINED**
1 specimen INV MOL9709 (P3E18a), 146–152 m; 1 specimen INV MOL9710 (P1mE24b), 492–500 m.

**GEOGRAPHICAL DISTRIBUTION**
USA (California) to Costa Rica (Coan & Valentich-Scott, 2012). In Colombia* collected off Gulf of Cupica and Octavia Bay.

**DEPTH RANGE**
39 to 500 m (Coan & Valentich-Scott, 2012; herein).

**Genus Krylovina** Valentich-Scott *in* Coan & Valentich-Scott, 2012
**Krylovina lynnae** Valentich-Scott & Coan *in* Coan & Valentich, 2012  
(Figure 4AA, AB)


**MATERIAL EXAMINED**
1 specimen INV MOL9707 (P3E18a), 146–152 m; 6 specimens INV MOL9708 (P3E18b), 145–145 m.

**GEOGRAPHICAL DISTRIBUTION**
Panama (Coan & Valentich-Scott, 2012). In Colombia* collected off Gulf of Cupica.

**DEPTH RANGE**
84 to 152 m (Coan & Valentich-Scott, 2012; herein).

**REMARKS**
This represents the first record of this genus and species, since their original description in 2012, and extends the maximum collection depth for the species.

**DISCUSSION**
In the past two decades, many new records and descriptions of new species of marine bivalves have been added in the Panamic Province of the tropical eastern Pacific Ocean (e.g. Landa-Jaime & Arciniegas-Flores, 1998; Paredes & Cardozo, 2003, 2008; Coan & Valentich-Scott, 2010; Valentich-Scott & Coan, 2010; Valentich-Scott & Skoglund, 2010; Valentich-Scott & Garfinkle, 2011). These recent publications highlight the large gaps in our understanding of bivalve diversity, abundance and geographical and bathymetric distributions in the region. Significant efforts have also been made to describe bivalve species abundance and composition patterns in the Panamic Province and their relationship to environmental parameters (e.g. Zamorano *et al*., 2007b; Ríos-Jara *et al*., 2008). The information presented in this paper is part of the first national effort to study the fauna inhabiting the shelf and slope soft bottoms of the northern Pacific coast of Colombia, a heretofore poorly sampled and reported region of the Panamic Province.

Coan & Valentich-Scott (2012) reported 890 bivalve species in the Panamic Province from intertidal depths to the abyssal plain. Of these, 49 species were specifically reported from Colombian waters. An early dredging expedition by Hertlein & Strong (1955) yielded 26 bivalve species from four Colombian offshore localities. Olsson (1961) reported 105 bivalve species from mostly intertidal habitats along the Pacific Colombian shores. We have herein verified and illustrated an additional 34 bivalve species in the Colombian Pacific.

In this taxonomic contribution we have included records of dead shells (valves) as evidence that the species inhabits the Colombian Pacific benthos. Many records herein extend the known distributional and depth collection ranges for each species. Dead shell records have proven to be useful in estimating the composition of the living community. Death assemblages of bivalve shells cannot provide temporal information and can be subject to post-mortem transport, but they do provide exceedingly useful data. Kidwell (2013) stated ‘these dead individuals are the direct empirical evidence of the former existence of populations on some spatial scale and within some past time frame’, and thus they should not be discounted when reporting species distributions within a region.
Historically, there has been intense benthic fisheries exploitation in the Colombian Pacific by industrial and artisanal fleets, mainly of shrimp caught from shallow to deep water (70–250 m) using bottom trawls (Rodríguez et al., 2012). These fisheries have shown environmental impacts on the benthic biodiversity and associated seafloor habitats. These impacts are a result of excessive fishing effort, poor trawl choices and lack of appropriate management measures based on ecosystem resource assessments (Rodriguez et al., 2012). This intensive trawling could transport dead bivalves within our sample area, and also dislodge and kill living bivalves, possibly lowering living bivalve populations and diversity.

During sampling operations, a large amount of terrestrial plant material was observed (sticks and sunken leaves). Observations like these have previously been documented for deep waters (e.g. Wolff, 1979; Gracia & Ardila, 2010). In this plant material a diversity of associated fauna was found, including molluscs and other organisms (e.g. Xylopagurus hermit crabs). Given the presence of a large number of rivers that flow into the Colombian Pacific, it is expected that rivers deposit a great amount of plant material. This type of substrate is important to consider in future collections as source of a diverse fauna of wood-boring organisms and other fauna that also live externally attached on it. The wood associated and boring bivalves (e.g. superfamilies Pholadoidea and Mytiloidea) were not included in this study. It is very likely that additional sampling of this substrate will increase the number of bivalve species known in the region.

In conclusion, we have provided many new geographical and bathymetric records for the marine bivalve fauna in the Colombian Pacific and the Panamic Province. We suggest that efforts to understand the diversity of the Colombian malaco fauna on the Pacific coast should be expanded, including additional benthic sampling techniques (grab, box corer, etc.) and recording additional environmental information at each sampling station.

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