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Biodiversity in La Reserva de la Biósfera Bahía de los Ángeles y Canales de Ballenas y Salsipuedes: Naming of a New Genus, Range Extensions and New Records, and Species List of Heterobranchia (Mollusca: Gastropoda), with Comments on Biodiversity Conservation within Marine Reserves

Hans Bertsch
Instituto de Investigaciones Oceanológicas, Universidad Autónoma de Baja California, Ensenada, BC, México
(Mailing address: 192 Imperial Beach Blvd. #A, Imperial Beach, CA 91932 USA)
hansmarvida@sbcglobal.net

ABSTRACT Biosphere reserves are significant means for the conservation of habitats and biodiversity, but require detailed knowledge of their fauna and flora to develop effective management plans. This study reports the known occurrence of 117 species of heterobranch mollusks (including 8 unnamed species) within La Reserva de la Biósfera Bahía de los Ángeles y Canales de Ballenas y Salsipuedes. The new genus *Trivettea* Bertsch is named. Range extensions and/or first records to and within Bahía de los Ángeles are given for 23 species. *Triopha catalinae*, *Jorunna osae*, *Jorunna tempisquensis*, *Tritonia* sp., *Eubranchus madapamensis*, *Facelina* sp. and *Cuthona hamanni* are reported for the first time from the Gulf of California.

Key words: Reserva de la Biósfera Bahía de los Ángeles y Canales de Ballenas y Salsipuedes, conservation, biodiversity, marine reserves, Heterobranchia Mollusca, *Trivettea* Bertsch gen. nov.

INTRODUCTION

La Reserva de la Biósfera Bahía de los Ángeles y Canales de Ballenas y Salsipuedes (Figures 1 and 2) was formally established by decree of the Mexican government on 5 June 2007. It is in the upper Gulf of California, along the eastern coast of the Baja California peninsula, centered at approximately 29º 00' N; 113º 20' W. The reserve consists of 387,956 hectares, ranging from sea level to over 2000 m deep in the Canal de Ballenas.

Canal de Ballenas is one of the regions in the Gulf of California with the greatest biological productivity (Álvarez Borrego & Lara Lara, 1991). Within its waters and protected areas have been found 126 species of sea birds, 17 insular reptile species, five species of marine turtles, seventeen species of toothed and baleen cetaceans, whale sharks, and numerous species of fish, macroalgae and invertebrates (see chapters 7 through 12 in Danemann & Ezcurra, 2008). The reserve is considered one of the three most important areas for the conservation of biodiversity in the peninsula of Baja California and the Gulf of California (Enriquez Andrade & Danemann, 1998).

Biosphere reserves (Lluch Cota *et al*., 1993; Danemann *et al*., 2008) and marine protected areas (Sala *et al*., 2002) play significant roles in the preservation and sustainable use of their human and natural resources in the Gulf of California and

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Figure 1. Map of the Gulf of California, drawn by Jan Kocian.

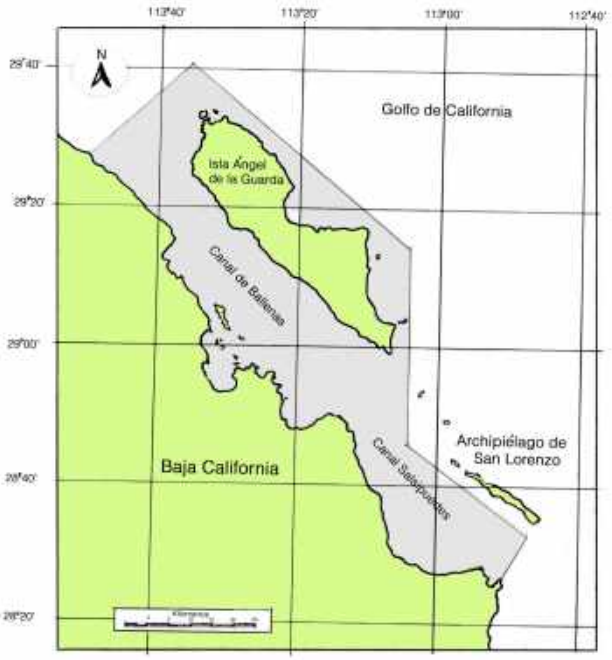

Figure 2. Bahia de Los Angeles Reserve Area, drawn by Jan Kocian.

globally (Edgar *et al*., 2007). In addition tophysical oceanographic data (Álvarez Borrego, 2002 and 2008), geology and geography (Carreño and Helenes, 2002; Delgado Argote, 2008) and human cultural and Marlett, 2011; activities (Vargas *et al.* 2008; Bertsch, Bowen *et al.*, 2014) decision-making must be based on proper identification of the fauna and flora of these regions and their natural history (Burley, 1988; National Research Council, 2001; Sala *et al*, 2003). Oftentimes the invertebrate fauna is slighted, because of lack of taxonomic data, researchers, or presumed non-significance of the organisms. Although not all species are of immediate commercial value nor exploitable, their ecological roles within the entire community contribute to the health of the total local and global ecosystems and cannot be overlooked. The Heterobranchia gastropods are a case in point.

Steinbeck & Ricketts (1941) reported the first species of opisthobranchs from this region. They collected *Aplysia californica* Cooper, 1863, *Berthellina ilisima* (Marcus & Marcus, 1967), *Aegires albopunctatus* MacFarland, 1905, and *Melibe leonina* (Gould, 1852) from Puerto Refugio, at the north end of Isla Ángel de la Guarda. They noted (1941: 227), "This was a strange collecting place. The water was quite cold, and many of the members of both the northern and the southern fauna occurred here." Even in the hottest months, the waters around Bahía de los Ángeles (due to upwelling between the coast and Isla Ángel de la Guarda) are always colder than anywhere else in the Gulf of California (Robinson, 1973). Steinbeck and Ricketts (1941: 168-169) "did not have the time for the long careful collecting which is necessary before the true picture of the background of life can be established." However, recent research in the past four decades and my long-term observations support their prescient observation on the admixture of northern and southern faunal elements.

Data I collected from 1984-2010 show a temporal displacement of reproduction, with the northern (occurring regularly in southern California) species *Doriopsilla cf. albopunctata* (Cooper, 1863) laying eggs earlier in the year, in times of colder water, than the southern (occurring in Panamá and the Islas Galápagos) *Berthellina ilisima* (see graph in Bertsch & Marlett, 2011). In fact, the entire Gulf of California faunal province has a strong mixture of southern and northern species. Bertsch (2010) reported that 55% of the nudibranchs in the Gulf of California occur also in southern California, 78.4% of the species occur southward into the Mexican and Panamic provinces, and 37.9% occur both to the north and the south.

It should also be noted that the type localities of twelve valid species of Nudibranchia are inside this reserve (Table 2).

This report on the biodiversity of the Heterobranchia at BLA is based on 30+ years of monitoring sites at, and all known literature records from, this region (Table 1). A total of 117 species are reported, including 8 undescribed species.

The following abbreviations are used: BC, Baja California; BCS, Baja California Sur; BLA, Bahía de los Ángeles; CA, California; Gulf, Gulf of California. Numbers in parentheses preceded by the letter M, G or LC indicate images of the specimens archived in the author's collection.

MATERIALS AND METHODS

Over a period of three decades I made subtidal and intertidal observations at sites within the Gulf of California (Table 1), which resulted in the new records presented here. Data were recorded *in situ* with a pencil on a plastic underwater slate and with underwater film (Nikonos II) and digital (Nikon COOLPIX P310, inside an Ikelite housing) cameras.

The collection of specimens was kept to the minimum necessary for taxonomic purposes (Minteer *et al*., 2014), in order not to disturb population sizes at the BLA localities where I am conducting an ongoing long-term ecological monitoring study of the community composition (Bertsch *et al*., 1998; Bertsch and Hermosillo, 2007; Bertsch, 2008 and 2011).

Additional records were obtained from primary tropical eastern Pacific molluscan literature (e.g., Steinbeck and Ricketts, 1941; McLean, 1961; Bertsch, 2008) and holotype or paratype occurrences within the BLA biosphere reserve region and secondary sources or summaries (e.g., Lance, 1961; Keen, 1971; Skoglund, 1991; Trowbridge, 2002; Behrens, 2004; Behrens and Hermosillo, 2005).

The new data in this paper and all species reported from previous studies are recorded in Table 2.

RESULTS

CEPHALASPIDEA

Bullidae

Haminoea vesicula (Gould, 1855)

Known to occur from Prince William Sound, Alaska (Lee and Foster, 1985) to the southern end of the Gulf of California (Keen, 1971), González Cibrián (2012) recently reported it from Bahía Concepción. These first reports from BLA are its northernmost-known occurrence in the Gulf.

Punta la Gringa, BLA: Twelve specimens with egg masses; 1.8m deep; 5 April 1990.

Cuevitas, BLA: One specimen, 3m deep; 6 April 1990.

This species may be more common than

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these records indicate, since the spring algal bloom can obscure them.

APLYSIOMORPHA

Aplysiidae

Aplysia juliana Quoy & Gaimard, 1832

This circumtropical species has been reported in the Gulf at Puerto Peñasco and Isla San Esteban, Sonora (Marcus and Marcus, 1967), from Bahía de Banderas (Hermosillo González, 2006), and south to Paita, Perú (Keen, 1971). This is its first record from BLA.

Punta la Gringa, BLA: Fifteen specimens, in copulating groups under algal cover; approximately 4.6m deep; 30 June 1987.

Stylocheilus striatus (Quoy & Gaimard, 1832)

In the eastern Pacific, this circumtropical species ranges the full length of the Panamic province (*sensu* Keen, 1971), with a southernmost report from the Islas Galápagos (Hickman and Finet, 1999). Although it has been reported commonly from locations in the northern, central and southern portions of the Gulf, from Puerto Peñasco (Marcus and Marcus, 1967), Bahía San Carlos (Angulo Campillo, 2000) and the La Paz region (Bertsch, 1970, and Angulo Campillo, 2000), this is its first record from the BLA region.

Isla Cabeza de Caballo, BLA: Four specimens, 14, 13, 12, and 13 mm under a single rock; 12.5m deep; SW corner of the island (bay west of the lighthouse), 3 November 2009.

SACOGLOSSA

Limapontiidae

Ercolania boodleae (Baba, 1938)

The only Gulf record of *Ercolania boodleae* is from the far northern region at Puerto Peñasco (Trowbridge, 2002). The following records report its presence in the central Gulf.

Punta la Gringa, BLA: One specimen, 5 mm; less than 2 m deep; 30 June 1987 (M2800).

Cuevitas, BLA: One specimen, 8 mm; less than 2 m deep; 5 April 1991 (M3468).

Bay west of Punta Prieta, Mulegé: One specimen, 5 mm; 8' deep; 23 March 1994 (M4333).

Note that the record by Ferreira and Bertsch (1975) of the NW Atlantic *Ercolania fuscata* (Gould, 1870) was based on a mis-identification. The specimens collected by Antonio J. Ferreira (6 specimens, 5 mm and smaller; 26-27 December 1971; a few kilometers north of Puerto Peñasco) are actually *E. boodleae*. Therefore *Ercolania fuscata* should be deleted as a species occurring in the Gulf (and the eastern Pacific).

UMBRACULIDA

Tylodinidae

Tylodina fungina Gabb, 1865

Although this species ranges from Cayucos, CA, to the Islas Galápagos (Behrens and Hermosillo, 2005), inside the Gulf it has only been reported from Guaymas (DuShane, 1966) and fairly commonly in the La Paz region (McBeth and Bowlus, 1969; Angulo Campillo, 2000, and pers. observ.). These are the first records from BLA.

Town of BLA: one specimen, 3m deep; on rocks at boat ramp of Villa Vitta Hotel, 31 August 1979 (M720).

Punta la Gringa, BLA: Three specimens, 47, 22 and 22 mm; approximately 6.1m deep; 30 June 1987.

Isla Mitlan, BLA: Nine specimens, 28, 23, 23, 32, 18mm on *Aplysina*, 12.8m deep; 18 mm, 12.8m deep; 18 and 15 mm, 14.6m deep; 24 mm, 14m deep; north end of island, 30 June 1987.

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NUDIBRANCHIA—DORIDINA

Polyceratidae

A note on the correct spelling of the family name: The plural of "ceras" is"cerata," based on the Greek κερασ, κερατ–(*keras, kerat-*, "horn"). Hence Polyceratidae should be used, following correct Greek declension rules. See also the established usages for the ammonite genus *Ceratites*, and the ceratopsian dinosaurs.

Limacia cockerelli (MacFarland, 1905)

Behrens and Hermosillo (2005) reported the range of this species as Alaska to Cabo San Lucas, BCS. It is fairly often observed in the Californian and Oregonian provinces. This documents its recurring presence at several localities on both sides of the central Gulf and at BLA.

Puerto Lobos, Sonora: One specimen, 8 mm in length; intertidal; 5 April 1969; leg. Wesley M. Farmer (M633).

Isla Mitlan, BLA: Two specimens; subtidal; 30 June 1987; leg. T. Gosliner, H. Bertsch & S. Millen. Two specimens, 14 and 12 mm on side of boulder; 12.8m deep; 5 November 1993.

West Islas Gemelos, BLA: Two specimens, 7 and 5 mm; 2.7m deep; western end of island, 16 March 2000.

Cuevitas, BLA: One individual, 3 mm; 2.1m deep; 20 July 1994. One specimen, 5 mm; 1.5m deep; 22 July 1994.

Punta la Gringa, BLA: One individual, 8 mm, on partly eaten encrusting bryozoan; 3.4m deep; 16 February 1992. One individual, 3 mm, on orange encrusting bryozoan; 1.8m deep; 22 July 1993. One specimen, 8 mm; 1.8m deep; 22 July 1993 (M4101). One specimen, 6 mm; 5.8m deep; 23 July 1995. One specimen, 8 mm; 1.8m deep; 21 March 1996. One specimen, 12 mm; 3.7m deep; 30 October 2012 (M6861). One specimen, 6 and 8 mm; 2.7m deep; 5 August 2009. One specimen, 6 mm; 2.6m deep; 14 May 2011. Two specimens, 4 and 6 mm; 4.9 and 5.5m deep; 15 May 2011. One individual, 12 mm; 3.7m deep; 30 October 2012 (M6859). Two specimens, 4 and 4 mm; 3m deep; 13 February 2014 (M6936).

Limacia janssi (Bertsch & Ferreira, 1974)

This species has a wide distribution throughout the Panamic province (*sensu* Keen, 1971), from the southern Gulf of California (Isla Partida), along the Mexican coast (Bahía de Banderas) to Costa Rica (type locality) and Panamá (Hermosillo *et al.*, 2006). These records establish its sporadic occurrence in the central portion of the Gulf.

Punta la Gringa, BLA: Two specimens, approximately 4.5m deep; 30 June 1987. Two specimens, 7 and 9 mm; 3.4m deep; 18 February 2007. One specimen, 8 mm; 4m deep; 18 February 2008. One specimen, 6 mm; 3.7m deep; 1 November 2009. One specimen, 8 mm, with egg mass; 2.4m deep; 8 December 2009. One specimen, 5 mm; 3m deep; 23 March 2010. Eighteen individuals, 3-9 mm in length; 1.5-3.5m deep; 1 November 2011 (M7029). One specimen, 6 mm; 3.4m deep; 30 October 2012 (M6857). Two specimens, 7 and 6 mm; 2.8m deep; 22 May 2013.

Bahía de los Ángeles is the only sympatric site reported for *Limacia cockerelli* and *L. janssi*. Previously these species were reported jointly as *Limacia* sp. (Bertsch, 2008). Both of these species have been observed twice on the same research diving day (30 June 1987 and 30 October 2012).

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Roboastra tigris Farmer, 1978

Based on species composition and specimen abundance, Bertsch *et al*. (1998) divided Bahía de los Ángeles geographically into two opisthobranch faunal communities: Region 1 (Cuevitas and Punta la Gringa, rocky shore sites north of town) and Region 2 (the islands and the southeastern outer side of the bay). My observations indicate that *Roboastra tigris* is a characteristic member of Region 2 (15 of 16 BLA individuals were observed there), found at depths of 4.5 to 11.9m deep (average 9.3m).

Triopha catalinae (Cooper, 1863)

The reported range of this species is from the Aleutian Islands, Alaska, to El Tomatal, BC (Bertsch and Aguilar Rosas, 1984); it is also known from Japan. Seven animals observed at BLA are the first records from the Gulf. It is now known to occur on both sides of the BC peninsula, at approximately the same 29º N latitude.

Isla Cerraja, BLA: One specimen, 22 mm; 11m deep; 28 April 1986 (M2652).

Puerto Don Juan, western entry point, BLA: Two specimens, 9 and 11 mm; 5.5m and 4m deep; 7 April 1990.

Los Gemelos, BLA: One specimen 18 mm; 6.1 m deep; 4 April 1997 (Figure 3, M5479).

Punta la Gringa, BLA: One specimen, 12 mm; 4.6m deep; 9 March 1986. One specimen, 24 mm on encrusting bryozoan (under same rock as a *Polycera alabe*); 5.2m deep; 21 March 2010. One specimen, 22 mm; 4.9m deep; 15 May 2011.

Dorididae

Aldisa sanguinea (Cooper, 1863)

Commonly reported in the Oregonian and Californian provinces, this species occurs from Otter Crest, Oregon (Behrens and Hermosillo, 2005) to Islas San Diego and Espíritu Santo in the southern Gulf of California (Ferreira and Bertsch, 1975). This record extends its Gulf range northward 550 km.

Punta la Gringa, BLA: One specimen, 12 mm; 4.3m deep; 31 October 2003.

Diaulula aurila (Marcus & Marcus, 1967)

This species is known from Bahía Tortugas (Bertsch *et al*., 2000) and Punta Rosarito (Goddard and Schickel, 2000) on the Pacific coast of BC, at Bahía Banderas on the Mexican coast (Hermosillo González, 2006), and south to Costa Rica and its type locality, Panamá. Previous reports of its presence in the Gulf (e.g., Behrens and Hermosillo, 2005) were premature; these were actually specimens from Bahía Tortugas.

González Cibrián (2012) reported a single specimen of this species from Bahía Concepción, some 300 km south of BLA; these additional records from BLA further confirm its presence in the Gulf.

Punta la Gringa, BLA: One specimen, 22 mm; 7m deep; 19 July 2003. One specimen, 13 mm; 4.6m deep; 2 May 2010. Two specimens, 28 and 20 mm, copulating pair; 4 m deep; 21 June 2011. One specimen, 24 mm; 2.7m deep; 27 February 2012. One specimen, 13 mm, 4.9m deep; 13 October 2014.

Figure 3. ***Triopha catalinae, 18mm, Los Gemelos, 4 April 1997. (Photo M5479, by Hans Bertsch (HB))***

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Jorunna osae Camacho García & Gosliner, 2008

This species has only been reported from the Osa and Tempisque Conservation Areas (8º-10º N) of Costa Rica. These new records represent a significant northerly range extension of over 2800 km, into the southern and central Gulf for the first time.

Las Cruces, BCS: One specimen, 10 mm; intertidal; 20 July 1969 (LC69-293).

Bahía San Carlos, Sonora: One specimen, 13 mm; intertidal; 25 December 1970 (G70-142).

Punta la Gringa, BLA: One specimen, 7 mm; 4.3m deep; 13 February 2014 (Figure 4, M6948; image by Mike Miller).

Figure 4. *Jorunna osae*, 7mm, Punta la Gringa, 13 February 2014. (Photo M6962, by Mike Miller)

Jorunna tempisquensis Camacho García & Gosliner, 2008

Previous reports of this species are only from the Costa Rican conservation areas and the Bahía de Banderas region. This individual represents a northward range extension of approximately 1200 km, and its first record in the Gulf.

Punta la Gringa, BLA: One specimen, 21 mm; 3.4m deep; 13 March 1992 (Figure 5, M3840).

Figure 5. *Jorunna tempisquensis*, 21mm, Punta la Gringa, 13 March 1992. (Photo M3840, by HB)

These two species of *Jorunna* share a similar gray and dark-spotted dorsal coloration. *Jorunna osae* has mantle glands on the margin and an erect gill, whereas *J. tempisquensis* lacks these glands and has a spreading gill.

Chromodorididae

Cadlina sp.

Reddish-brown medial bands encircling the white rhinophores distinguish this unnamed species of

Cadlina. It has been reported from Isla Isabel (Islas Revillagigedo), Bahía de Banderas, Costa Rica and Panamá (Hermosillo *et al*., 2006) and "Baja California" (Camacho Garcia *et al.*, 2005). The latter is based on specimen 1 (below, Isla Mitlan). This and the following three other records document its presence inside the Gulf at BLA.

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Isla Mitlan, BLA: One specimen, 7 mm; 30 June 1987; leg. T. Gosliner, H. Bertsch and S. Millen (M2801).

Punta la Gringa, BLA: One specimen, 10 mm; 3m deep; 9 March 1986 (M2621). One specimen, 8 mm; 6.1m deep; 4 November 1993. One specimen, 9 mm; 3.7m deep; 18 February 2007.

Felimare agassizii (Bergh, 1894)

Although this species has been reported from Puerto Peñasco (Marcus & Marcus, 1967) to the Islas Galápagos (Behrens & Hermosillo, 2005), and is seasonally very common in the La Paz region of the southern Gulf (personal observations), I have found this species only once at BLA.

Punta la Gringa, BLA: One individual, 25 mm; approx. 6.1m deep; 30 June 1987.

Mexichromis antonii (Bertsch, 1976)

Although this species ranges from Bahía San Carlos, Sonora, in the central Gulf (Kerstitch and Bertsch, 1984), to Panamá (Hermosillo *et al*., 2006), this is its first record from BLA.

Punta la Gringa, BLA: One specimen, 9 mm; 6.1m deep; 6 July 2010.

Incertae sedis

Family undet. (formerly Tritoniidae)

***Trivettea* Bertsch, genus nov.**

Type species by monotypy: *Trivettea papalotla*

Synonymy:

Tritonia sp. 1. Behrens and Hermosillo, 2005: 92; Hermosillo *et al.*, 2006: 100.

Tritonido sp. mariposa. Hermosillo González, 2006: 136.

Tritoniid. Bertsch, Miller and Grant, 1998: 36; Bertsch, 2008: 338.

Figure 6. *Trivettea* (genus nov.) *papalotla*, 10mm, Punta la Gringa, 28 June 1996. (Photo M5010, by HB)

Tritonia papalotla Bertsch, Valdés & Gosliner, 2009: 431-446 (includes life cycle and reproductive history from BLA, and annual and monthly densities at BLA and Bahía de Banderas).

DIAGNOSIS

"Dendronotacean" with retractile, digitiform respiratory organs and prominent ridged dorsal vessels (figure 6, M5010); uniseriate radula lacking a distinct central cusp (feeds on zoanthid anthozoans); possesses both a receptaculum seminis and a bursa copulatrix.

This species was originally placed within the Dendronotina, Tritoniidae. Comparative descriptions and illustrations of how other dendronotaceans differ in the external features are clearly presented in various publications (e.g., Gosliner *et al.*, 2008, and Behrens and Hermosillo, 2005). These are detailed here to distinguish the unique genus *Trivettea*.

Branching, dendritic gill tufts characterize species of *Dendronotus*, *Bornella*, *Tritonia*,

Tochuina, *Marionopsis* and *Marionia*. *Doto* species have grape-like cerata (the bulbous growths increase the ceratal surface area for respiratory exchange). Along with the distinctive oral hood, species of *Melibe* have large, flat cerata, sometimes disc-shaped or branched distally. *Crosslandia* and *Notobryon* have one or two pairs of dorsal lobes (or parapodia), bearing branched respiratory structures. The palmate, ventrally-curled dorsal appendages of *Hancockia* may be branched or not. Species of *Lomanotus* have a series of lobed appendages along the side of the body, which may be continuous or clumped together in one or two lobes. Not only do members of all these genera lack the retractile, digitiform respiratory organs, they do not have prominent middorsal ridging.

The radulae of the other dendronotacean genera (MacFarland, 1966; Behrens, 1992; Valdés *et al.*, 2006) have a prominent rachidian and one or more lateral teeth (e.g., *Dendronotus* and *Tritonia*), are uniseriate with a single central tooth with a prominent cusp (e.g., *Doto*), or are greatly reduced or absent (e.g., *Melibe*).

All other dendronotaceans (and of course, the aeolidaceans) share the derived condition of the loss of the bursa copulatrix (Odhner, 1936; Ghiselin, 1966). The ancestral (primitive) state of having both the receptaculum seminis and the bursa copulatrix is shared by the species of *Trivettea* gen. nov. with the basal nudipleura.

Despite its original placement within the Dendronotina, ongoing molecular DNA analyses nests the *Trivettea* clade apart from other dendronotaceans, as a basal cladobranch. Results of these analyses (with a Bayesian phylogenic analysis of 16S, CO1 and M3) will be published separately (Hulett, Mahguib, Bertsch, Gosliner & Valdés, in prep.). At present, the phylogeny of the Cladobranchia lacks a general resolution.

ETYMOLOGY

The genus name is a combination of tr- (indicating its original placement within *Tritonia*), and Ivette (in honor of granddaughter Adriana Ivette Cadena, who has generously and attentively helped me on research expeditions to BLA), with a feminine -a termination.

RECORDS and DISTRIBUTION

I first observed individuals of *Trivettea* Bertsch gen. nov. *papalotla* on 29 July 1982 at Punta la Gringa, BLA. Since then numerous individuals have been recorded at this site (Bertsch, 2008; Bertsch *et al.*, 2009). It is also known from Isla Magdalena, Bahía Magdalena, BCS (type locality), and Bahía de Banderas (Hermosillo González, 2006).

Figure 7. Egg mass of *Trivettea* (genus nov.) *papalotla* on *Epizoanthus*, 6.1m deep, Punta la Gringa, 24 September 1982. (Photo M1009, by HB)

Its lecithotrophic egg masses (Figure 7, M1009) have been observed at BLA inner shore sites (Punta la Gringa and Cuevitas) from May through December.

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NUDIBRANCHIA–DENDRONOTINA

Tritoniidae

Tritonia sp.

Synonymy:

Tritonia sp. 2. Camacho García, Gosliner & Valdés, 2005: 96.

Lolo's Wall, Puerto Refugio region, Isla Ángel de la Guarda: One individual, 10 mm; 15.2 m deep; 13 July 2014, recorded by Craig Hoover (Figure 8; image by C. Hoover).

Figure 8. *Tritonia* sp., 10 mm, Puerto Refugio, 13 July 2014. (Photo by Craig Hoover)

This unnamed species has only been reported from the Islas Galápagos (Camacho García *et al*., 2005), on the yellow gorgonian *Pacifigorgia darwini* (Hickson, 1928). This represents this tritoniid's first report elsewhere, and its first in the Gulf, a range extension of some 4000 km. Given the known prey specificity of tritoniids on gorgonians (Smith & Gosliner, 2003), this might possibly suggest that *P. darwini* is also not restricted to the Islas Galápagos.

NUDIBRANCHIA—AEOLIDINA

Flabellinidae

Flabellina bertschi Gosliner & Kuzirian, 1990

This species is known to occur from Catalina Island, southern CA, to Panamá (Behrens and Hermosillo, 2005). In the Gulf it has only been reported from the north at Puerto Peñasco (type locality) and in the southern La Paz area, at Punta Perico and Calerita and Islas San Diego and Cerralvo (Gosliner and Kuzirian, 1990; Angulo Campillo, 2003). This is its first report from the central Gulf, at BLA. Although rare in the Gulf, this species is common along the southern Mexican coast in Bahía de Banderas, comprising 6% of the cnidarian-feeding nudibranchs (Hermosillo González, 2006).

Punta la Gringa, BLA: One specimen, 6 mm; 3.7m deep; 21 September 1985 (M2435).

Eubranchidae

Eubranchus cucullus Behrens, 1985

The type locality of this species is Puerto Refugio, Isla Ángel de la Guarda. It is also known from southern México and Panamá (Behrens and Hermosillo, 2005). These records establish its presence on the mainland BC peninsula.

Las Arenas, east of La Paz, BCS: Two specimens, 10 and 13 mm; 7.6m deep; 9-10 June 1985 (M2025 and 2035).

Cuevitas, BLA: One specimen, 7 mm; 6.7m deep; 20 December 1994 (M4612).

Eubranchus madapamensis (Rao, 1968)

Originally described from Madapam, India, it is now known from widely scattered sites across the Indo-Pacific, from Tanzania to the Hawaiian Islands (Gosliner *et al.*, 2008). Its eastern Pacific record is based upon only one specimen collected at Bahía de Banderas (Hermosillo González, 2006). This new discovery represents only the second report of this species from Mexican Pacific waters, the first in the Gulf, and a 1200 km northward extension from its reported distribution at Bahía de Banderas.

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Punta la Gringa, BLA: One specimen, 12 mm; 9.1 m deep; 15 June 1996 (Figure 9, M4953).

Figure 9. *Eubranchus madapamensis,* 12 mm, Punta la Gringa, 15 June 1996. (Photo M4953, by HB)

Aeolidiidae

Limenandra confusa Carmona, Pola, Gosliner & Cervera, 2014

This species was originally reported in the eastern Pacific from Las Cruces in the southern Gulf of California (Bertsch, 1972), as the Mediterranean species *Limenandra nodosa* Haefelfinger & Stamm, 1985. Genetic studies have shown that organisms previously considered *L. nodosa* from the Pacific Ocean are actually members of a complex of two sibling, geographically separate cryptic species: *L. nodosa* occurring in the Atlantic-Mediterranean, and *L. confusa* occurring in the Pacific. Carmona *et al*., 2014b, cite genetic, internal anatomical and biogeographic differences. This is similar to that found in the nomenclatural untangling of the *Spurilla neapolitana* (Delle Chiaje, 1841) complex by Carmona *et al*. (2014a).

This species has been reported from numerous localities across the Indo-Pacific, from Tanzania to Hawaii (Gosliner *et al*., 2008, as *Baeolidia nodosa*) In the eastern Pacific it is known from Costa Rica (Carmona *et al*., 2014b), the southern coastline of México at Bahía de Banderas (Hermosillo González, 2006), and in the Gulf of California from the La Paz region (Bertsch, 1972; Angulo Campillo, 2003) and Bahía Concepción (González Cibrián, 2012). These are the first records from BLA. Most individuals (81%) were observed in November and December.

Puerto Don Juan, west side of entrance: One specimen, 11 mm; 3.7m deep; 30 November 1997.

Punta la Gringa: Five individuals, 8, 8, 7, 7 and 7 mm; 4.6m deep; 24 November 1994 (M4541). One individual, 9 mm; 5.5m deep; 19 December 1994 (M4573). One specimen, 8 mm; 3.7m deep; 21 December 1994 (M4634). Two specimens, 8 and 10 mm; 4.3m deep; 28 December 2000. One specimen, 7 mm; 5.1m deep; 10 November 2001. One specimen; 5.5m deep; 4 June 2004.

Cuevitas: Two specimens, one 12 mm; 6.1m deep; 28 September 1996 (M5101). Two specimens, 8 and 11 mm; 7.6m deep; 28 November 1999 (M6051).

Facelinidae

Facelina sp.

Cuevitas: Two specimens, 30 mm; 4.6m deep, on 25 February 1997 (Figure 10, M5404).

Figure 10. *Facelina* sp.., 30 mm, Cuevitas, 25 February 1997. (Photo M5404, by HB).

Noumeaella rubrofasciata Gosliner, 1991

The northernmost record of this species is Catalina Island, CA; it is known from both coasts of BC, from West Islas San Benito, BC, and Punta Colorada, BCS, southeast of La Paz (Gosliner, 1991), and from southern México, Costa Rica and Panamá (Behrens and Hermosillo, 2005). These records extend the range of this species over 650 km northward inside the Gulf.

Barco Hundido, reef between Islas Cabeza de Caballo and Ventana, BLA: Five individuals, 8, 12, 15, 10 and 10 mm; 12.2m deep; 4 April 1997. One specimen, 8 mm; 3.7m deep; 15 March 2000 (M6215)

Tergipedidae

Cuthona hamanni Behrens, 1987

This extremely rare species is only known from four specimens collected in May and July 1982 at La Jolla, CA (Behrens, 1987).

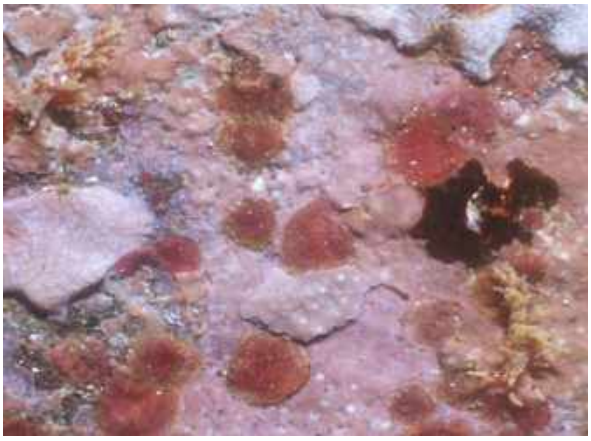

Figure 11. *Cuthona hamanni*, 7 mm, Punta la Gringa, 23 July 1995. (Photo M4771, by HB).

These individuals found at Punta la Gringa represent a significant southward range extension, and its first report from outside the CA marine faunal province and in the Gulf of California.

Punta la Gringa, BLA: Two specimens, 7 mm; 1.8m deep; 23 July 1995 (Figure 11, M4771).

DISCUSSION

Knowledge of the biodiversity of biosphere reserves and marine protected areas is an important first step in the protection of their resources. The total number of species (α-diversity) is not as significant as the species composition (β-diversity) within ecological communities (Dornelas *et al*., 2014). Long-term quantitative monitoring (such as Nybakken, 1978, Hermosillo González, 2006, and Bertsch, 2008) is required to assemble these inventories, make provincial-level comparisons (Bertsch, 1993), and to understand the niche each species occupies within the ecosystem. Ecosystem health depends on the fully functioning presence of members of all their trophic levels (Bellwood *et al*., 2004; Mumby *et al*., 2006; Mora *et al*., 2006).

This paper reports the presence of 117 known species of Heterobranchia from La Reserva de la Biósfera Bahía de los Ángeles y Canales de Ballenas y Salsipuedes. This inventory provides an important base line for ongoing detailed analyses of the natural history of these organisms.

The effectiveness of reserves depends upon good management and enforcement of regulations against poaching and overfishing, controlling external threats such as pollution and coastal development, and appropriate size of and spacing between them (Mora *et al*., 2006).

Human activities have seriously damaged the marine ecosystems of the Gulf of California, by preventing freshwater inflow from the Colorado River, overfishing of predatory fish species and invertebrates

such as the sea cucumber *Parastichopus*, use of non-selective shrimp trawling, conversion of estuaries (primary nursery grounds for numerous species of fish and invertebrates) for coastal aquaculture, and loss of marine habitats for coastal "touristic" development (Brusca, 2004).

Marine reserves, in addition to their protective features, can be key elements in marine conservation education teaching programs (Gubbay, 1995), that will train our children and grandchildren how to respect and care for their endangered oceans and inhabitants, so they too may be able to experience "the abundance of life here [that] gives an exuberance, a feeling of fullness and richness" (Steinbeck & Ricketts, 1941: 47). I hope this report on the BLA reserve Heterobranchia will aid our search for understanding, appreciation and conservation of oceans' life.

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Table 1. Latitude and longitude of sites for new records of Heterobranchia.

BAHÍA DE LOS ÁNGELES	
Puerto Refugio, Isla Ángel de la Guarda	~ 29º 32' N; 113º 33' W
Isla Mitlan	29º 04' 10" N; 113º 31' 15" W
Cuevitas	29º 03' 45" N; 113º 32' 34" W
Punta la Gringa	29º 02' 34" N; 113º 32' 15" W
Isla Cerraja	~ 28º 59' 47" N; 113º 3' 09" W
Barco Hundido, between Islas Ventana and Cabeza de Caballo	28º 59' 26" N; 113º 29' 45" W
Cabeza de Caballo (south end)	28º 57' 57" N; 113º 28' 43" W
W. Isla Gemelos	28º 57' 22" N; 113º 28' 58" W
Entrance, Puerto Don Juan	28º 57' 02" N; 113º 26' 46" W
Town, boat ramp	28º 56' 59.9" N; 113º 33' 22" W
BAJA CALIFORNIA SUR	
Bay W. of Punta Prieta, Mulegé	26º 54' 48" N; 111º 57' 25" W
Las Cruces	24º 12' 42" N; 110º 04' 57" W
Las Arenas	24º 03' 29" N; 109º 50' 16" W
SONORA	
Puerto Lobos	30º 16' N; 112º 51' W
Bahía San Carlos	27º 57' N; 111º 06' W

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Table 2: Species of Heterobranchia (Mollusca: Gastropoda) currently known from La Reserva de la Biósfera Bahía de los Ángeles y Canales de Ballenas y Salsipuedes.

References for occurrence: [1]McLean, 1961; [2]Steinbeck & Ricketts, 1941; [3]Bertsch, 2008; [4]HOLOTYPE LOCALITY; [5]PARATYPE LOCALITY; [6]Bertsch, this paper; [7]Bertsch, 2002; [8]Behrens, 2004; [9]Behrens & Hermosillo, 2005; [10]Skoglund, 1988; [11]Trowbridge, 2002; [12]Keen, 1971; [13]Lance, 1961; [14]Skoglund, 1991.

"Higher Heterobranchs"

Acteonidae

Acteon traskii Stearns, 1897[1]
Rictaxis sp.[10]

"Opisthobranchia"

CEPHALASPIDEA

Bullidae

Bulla gouldiana Pilsbry, 1895[1, 3]

Haminoeidae

Haminoea angelensis Baker & Hanna, 1927[1]
Haminoea vesicula (Gould, 1855)[6]
Haminoea virescens (Sowerby, 1833)[1, 3]

Atyidae

Atys casta Carpenter, 1864[1]

Aglajidae

Navanax aenigmaticus (Bergh, 1893)[3]
Navanax inermis (Cooper, 1863)[3]
Navanax polyalphos (Gosliner & Williams, 1972)[3]

Cylichnidae

Cylichna atahualpa (Dall, 1908)[10]
Acteocina carinata Carpenter, 1857)[1]
Acteocina infrequens (C. B. Adams, 1852)[1]

Retusidae

Sulcoretusa paziana (Dall, 1919)[1]

APLYSIOMORPHA

Aplysiidae

Aplysia californica Cooper, 1863[2, 3]
Aplysia cedrosensis Bartsch & Rehder, 1939[9]
Aplysia juliana Quoy & Gaimard, 1832[6]
Aplysia parvula Mörch, 1863[3]
Aplysia vaccaria Winkler, 1955[3]
Phyllaplysia padinae Williams & Gosliner, 1973[3]
Stylocheilus striatus (Quoy & Gaimard, 1832)[6]

SACOGLOSSA

Placobranchidae

Elysia diomedea (Bergh, 1894)[3]
Elysia hedgpethi Marcus, 1961[3]

Limapontiidae

Ercolania boodleae (Baba, 1938)[6]
Placida dendritica (Alder & Hancock, 1843)[11]
Stiliger fuscovittatus Lance, 1962[11]

Hermaeidae

Aplysiopsis eneromorphae (Cockerell, in Cockerell & Eliot, 1905)[11]

UMBRACULIDA

Tylodinidae

Tylodina fungina Gabb, 1865[6]

NUDIPLEURA—PLEUROBRANCHOMORPHA

Pleurobranchidae

Berthella stellata (Risso, 1826)[3]
Berthellina ilisima (Marcus & Marcus, 1967)[2, 3]
Pleurobranchus digueti Rochebrune, 1895[3]

NUDIPLEURA—NUDIBRANCHIA

DORIDINA

Goniodorididae

Ancula lentiginosa Farmer, in Farmer & Sloan, 1964[12]
Okenia angelensis Lance, 1966[4]
Okenia angelica Gosliner & Bertsch, 2004[4]
Trapania goslineri Millen & Bertsch, 2000[4]

Onchidorididae

Acanthodoris pina (Marcus & Marcus, 1967)[3]
Acanthodoris rhodoceras Cockerell, in Cockerell & Eliot, 1905[3]

Aegiretidae

Aegires albopunctatus MacFarland, 1905[2, 3]

Polyceratidae

Limacia cockerelli (MacFarland, 1905)[6]
Limacia janssi (Bertsch & Ferreira, 1974)[6]
Polycera alabe Collier & Farmer, 1964[5]
Polycera hedgpethi Marcus, 1964[3]
Polycerella glandulosa Behrens & Gosliner, 1988[4]
Roboastra tigris Farmer, 1978[6]
Tambja abdere Farmer, 1978[3]
Tambja eliora (Marcus & Marcus, 1967)[3]
Triopha catalinae (Cooper, 1863)[6]

Dorididae

Aldisa sanguinea (Cooper, 1863)[6]
Diaulula aurila (Marcus & Marcus, 1967)[6]

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Diaulula nivosa Valdés & Bertsch, 2010[4]
Discodoris ketos (Marcus & Marcus, 1967)[3]
Doris pickensi Marcus & Marcus, 1967[3]
Geitodoris mavis (Marcus & Marcus, 1967)[3]
Jorunna osae Camacho-García & Gosliner, 2008[6]
Jorunna tempisquensis Camacho-García & Gosliner, 2008[6]
Peltodoris lancei Millen, in Millen & Bertsch, 2000[4]
Peltodoris rosae Valdés & Bertsch, 2010[4]
Rostanga pulchra MacFarland, 1905[3]
Rostanga sp.[3]
Sclerodoris tanya (Marcus, 1971)[3]
Taringa aivica Marcus & Marcus, 1967[3]
Thordisa nieseni Chan & Gosliner, 2007[3]

Conualevidae
Conualevia marcusi Collier & Farmer, 1964[5]

Chromodorididae
Cadlina sp.[6]
Felimida baumanni (Bertsch, 1970)[3]
Felimida dalli (Bergh, 1879)[3]
Felimida galexorum (Bertsch, 1978)[3]
Felimida marislae (Bertsch, in Bertsch, Ferreira, Farmer & Hayes, 1973)[3]
Felimida norrisi (Farmer, 1963)[3]
Felimare agassizii (Bergh, 1894)[6]
Felimare californiensis (Bergh, 1879)[3]
Felimare ghiselini (Bertsch, 1978)[3]
Mexichromis antonii (Bertsch, 1976)[6]
Mexichromis tura (Marcus & Marcus, 1967)[3]
Tyrinna evelinae (Marcus, 1958)[3]

Dendrodorididae
Dendrodoris stohleri Millen & Bertsch, 2005[4]
Dendrodoris sp. (non *fumata*)[3]
Doriopsilla albopunctata (Cooper, 1863)[3]
Doriopsilla janaina (Marcus & Marcus)[3]
Doriopsilla sp. (non *gemela*)[3, 7]

Incertae sedis
Trivettea papalotla (Bertsch, Valdés & Gosliner, 2009)[5] (*Trivettea* gen. nov., Bertsch)

DENDRONOTINA

Tritoniidae
Tritonia pickensi Marcus & Marcus, 1967[3]
Tritonia sp.[6]

Bornellidae
Bornella sarape Bertsch, 1980[3]

Dendronotidae
Dendronotus cf. venustus MacFarland, 1966[3]

Hancockiidae
Hancockia californica MacFarland, 1923[8]

Dotoidae
Doto kya Marcus, 1961[3]
Doto lancei Marcus & Marcus, 1967[3]

Tethyidae
Melibe leonina (Gould, 1852)[3]

ARMININA

Arminidae
Histiomena convolvula (Lance, 1962)[3]

Dironidae
Dirona picta MacFarland, in Cockerell & Eliot, 1905[3]

Zephyrinidae
Janolus barbarensis (Cooper, 1863)[3]

AEOLIDINA

Flabellinidae
Flabellina bertschi Gosliner & Kuzirian, 1990[6]
Flabellina cynara (Marcus & Marcus, 1967)[3]
Flabellina iodinea (Cooper, 1863)[3]
Flabellina telja Marcus & Marcus, 1967[3]

Eubranchidae
Eubranchus cucullus Behrens, 1985[4]
Eubranchus madapamensis (Rao, 1968)[6]
Eubranchus misakiensis Baba, 1960[3]
Eubranchus rupium (Möller, 1842)[9]
Eubranchus rustyus (Marcus, 1961)[13]

Aeolidiidae
Anteaeolidiella chromosoma (Cockerell, in Cockerell & Eliot, 1905)[3]
Berghia major (Eliot, 1903)[3]
Cerberilla pugnoarena Collier & Farmer, 1964[4]
Limenandra confusa Carmona, Pola, Gosliner & Cervera, 2014[6]

Facelinidae
Anetarca armata Gosliner, 1991[8]
Bajaeolis bertschi Gosliner & Behrens, 1986[4]
Facelina sp.[6]
Favorinus elenalexiarum García & Troncoso, 2001[3]
Hermissenda crassicornis (Eschscholtz, 1831)[3]
Noumeaella rubrofasciata Gosliner, 1991[6]
Phidiana lascrucensis Bertsch & Ferreira, 1974[3]

Embletoniidae
Embletonia gracilis Risbec, 1928[14]

Tergipedidae
Cuthona hamanni Behrens, 1987[6]
Cuthona longi Behrens, 1985[4]
Cuthona sp. (yellow)[3]
Phestilla lugubris (Bergh, 1870)[3]