



OPISTHOBRANCHS FROM BERNARDO O'HIGGINS NATIONAL PARK (S. CHILE)

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Key words: Mollusca, Gastropoda, Opisthobranchia, Magellan Region, fjords, taxonomy, distribution, biogeography.

ABSTRACT

The Magellan Region, ranging from Northern Patagonia Icefield (45°S) to Cape Horn (56°S), is formed by a complex net of fjords and channels created by glacial and post-glacial processes. The knowledge on the group Opisthobranchia (Mollusca: Gastropoda) generated in the Magellan Region began at the end of the 19th century and it continued toward the first half of the 20th century. After a long ceasing period, the studies were intensified during the last years. Nevertheless, there are several and extensive areas of channels and fjords on which opisthobranchs have not been reported. A project of territorial characterization of the Bernardo O'Higgins National Park, an extensive protected area (35,000 km²) that is located in the heart of fjords and channels zone, it allowed to carry out a baseline study of marine

ecosystems of shallow bottoms adjacent to the park. The objective of this work is to get to know the species of opisthobranchs (*sensu lato*) found in the survey, pointing out findings about taxonomy, distribution and biogeography. Twenty-three sites were sampled by means of SCUBA diving at 5–15 m depth. The obtained animals were sieved, fixed, sorted, preserved in alcohol 70%, identified, measured and photographed. Forty-three individuals belonging to eight different species were registered; all of them new records for the park. These correspond to 15% of total species of gastropods recorded in the study. The family Discodorididae was the best represented with two species: *Diaulula variolata* (d'Orbigny, 1837) and *D. punctuolata* (d'Orbigny, 1834); other families were represented by one species each: Acteonidae, Diaphanidae, Chromodorididae, Flabellinidae, Onchidorididae and Tritoniidae. The records of *Toledonia perplexa* and *D. variolata* suppose an extension of their known distributions. Although this report represents a progress in knowledge of the marine fauna of the park, the species scarcely represent 14% of opisthobranchs known in the latitudinal band 45–55°S. Therefore, more intensive studies are necessary to improve the malacologic knowledge of the area.

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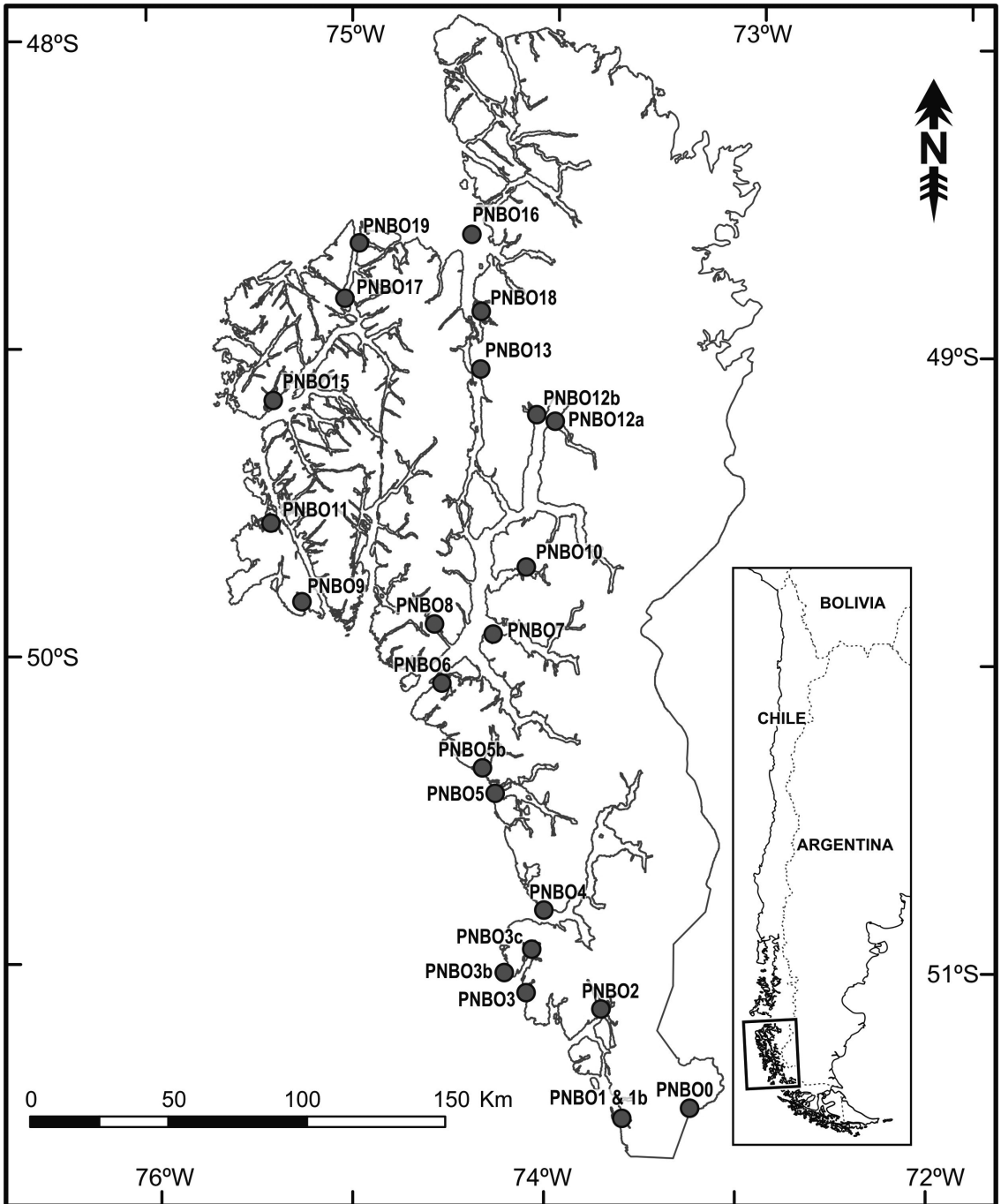


Figure 1:
Geographic situation of Bernardo O'Higgins National Park and location of sampling sites (PNBO).

INTRODUCTION

The Magellan Region, referred as the Patagonian shelf located at the southern tip of South America, ranging from 45°S (Northern Patagonia Icefield) to 56°S (Cape Horn Archipelago) is formed by a complex net of fjords, channels and internal seas created by glacial and post-glacial processes for about 85–90% of the last 800,000 years (McCulloch *et al.*, 1997). This resulted in a geomorphologic area with roughly 32,000 km of shoreline (Guzmán, 1992), which, in the early times of surveys, got to have great importance from a biological and ecological point of view.

Great part of the knowledge on the molluscs generated in the Magellan Region began to be gestated at the end of the 19th century and it continued actively at beginning and first half of the 20th century. Dell (1971), starting from the “Royal Society Expedition to Southern Chile, 1958–1959”, carried out an exhaustive recapitulation of the investigations and reports generated previously. Years later, Reid and Osorio (2000) elaborated a detailed study on the molluscs of the north area of the Magellan Region, contributing valuable taxonomical and ecological information. Almost, in the same period, several reports generated starting from the research cruises “Victor-Hensen” (*e.g.* Linse, 1997, 2002) and “*CIMAR-FIORDOS*” (Osorio and Reid, 2004; Osorio *et al.*, 2005, 2006; Cárdenas *et al.*, 2008) were published.

The group Opisthobranchia presented, however, a parallel development of researches in the region and the subsequent generation of knowledge. From the firsts expeditions focused on the area and subsequent detailed studies carried out (see, for example, Bergh, 1884; Eliot, 1907; Odhner, 1926; Marcus, 1959), many years lapsed so that the knowledge of the group was intensified. In this way, three extensive works providing new information on a couple of species were published: “Nudibranchia and Sacoglossa of Chile” (Schrödl, 1996a), “Sea slug

of Southern South America” (Schrödl, 2003) and “Opisthobranchs from the Chilean coast” (Fischer, 2006). The former consisted basically on a study of the external morphology and distribution of 42 species of the Chilean and southern Argentinean coasts. The second is a systematic, biogeographical and biological study of 65 species of the same area, where also an exhaustive summary of previous investigations is provided. The last work essentially gathers taxonomic, morphological and histological studies of several nudibranch species stemming from a thesis research. At the same time, those researchers together with other collaborators developed numerous detailed studies of several groups and some studies of the distribution and zoogeography (*e.g.* Fischer and Ortea, 1996; Schrödl, 1997a, 1997b; Fischer *et al.*, 1997; Schrödl, 1999a, 1999b; Schrödl and Millen, 2001; Schrödl and Wägele, 2001; Fischer and Cervera, 2005; Schrödl *et al.*, 2005). On the other hand, other authors studied groups mainly of the Magellanic and Patagonic coasts (*e.g.* Muniain and Ortea, 1997; Valdés and Muniain, 2002; Muniain *et al.*, 2007).

However, there is a lack of knowledge from several areas of the channels and fjords. Besides the abovementioned specific studies, there are few recent reports of molluscs including some opisthobranch species (*e.g.* Reid and Osorio, 2000; Osorio and Reid, 2004). The project of territorial characterization of Bernardo O'Higgins National Park, which is placed in the Chilean fjord and channels zone, allowed developing a survey carrying out a baseline study of marine ecosystems and diversity of shallow bottoms adjacent to the park. A prior exhaustive check to the work that reported molluscs from the surrounding area to the park (*e.g.* Dell, 1971), allowed to recognize 64 species of benthic molluscs (29 gastropods), among which there were no records of opisthobranchs. The objective of this work is to get to know the species of opisthobranchs found in the survey, detailing taxonomical findings and its areas of biogeographical distribution.

TAXA

- 1. Annelida: Polychaeta (n=57; 26.6%)
- 2. Mollusca: Polyplacophora (n=13; 6.1%)
- 3. Mollusca: Gastropoda (n=52; 24.3%)
 - 3'. Opisthobranchia (n=8; 3.7%)
- 4. Mollusca: Bivalvia (n=22; 10.3%)
- 5. Crustacea: Malacostraca (n=42; 19.6%)
- 6. Echinodermata: Asterozoa (n=12; 5.6%)
- 7. Others (n=16; 7.5%)

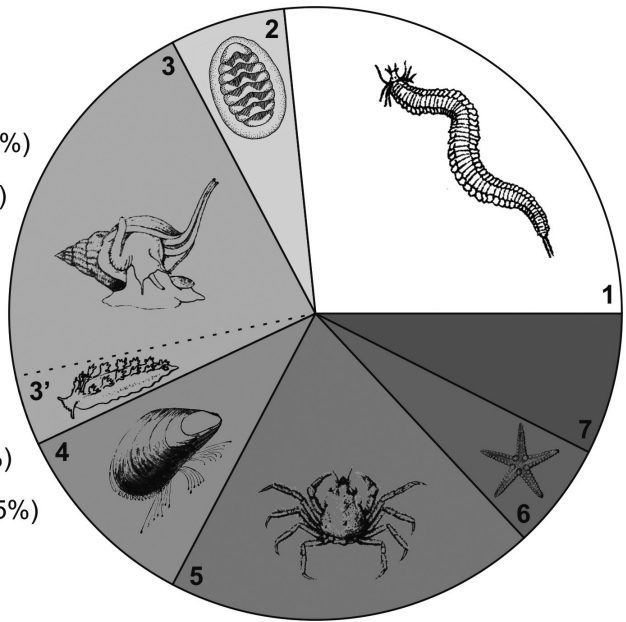


Figure 2:

Pie chart showing the number of species (n) and percentages of free-living benthic marine non-colonial invertebrates from the Bernardo O'Higgins National Park.

MATERIAL AND METHODS

Bernardo O'Higgins National Park is placed in the Chilean geopolitical regions of *Aysén* and *Magallanes*, between 48.0–51.6°S and 73.3–75.8°W (Fig. 1). With more than 35,000 km², it is the largest national park in the country and one of the most extensive in the world. Its coastal line is developed basically by way of countless channels and fjords along more than 400 lineal kilometres of the South-eastern Pacific, corresponding to ~9% of length of the continental Chilean territory.

On board *L/M Nueva Galicia* two campaigns were done between January and March (2010). Twenty-three sites (Fig. 1) were sampled quantitatively (replicated quadrants) doing SCUBA diving at 5–15 m depth. The animals obtained in the immersions were sieved at 0.5 mm and fixed in buffered 5% formaldehyde, and then they were sorted, preserved in alcohol 70%, identified, measured and photographed, using a stereo-microscope for the smallest ones.

For the identification and characterization of species (*i.e.*, distribution and taxonomical observations) Schrödl's works were mostly used (Schrödl, 1996a, 2003) and all specific taxonomical works carried out in the area. In the biogeographical scope, the distributions were settled as 'Magellanic species' or widespread distribution species, following the classification of biogeographic 'provinces' proposed for the coastal molluscs of Latin America by Stuardo (1964), the zoogeographic description of Brattström and Johanssen (1983) and the revision for the Chilean coast of Camus (2001).

RESULTS

Forty-three individuals belonging to eight different species were registered; all of them are new records for the park (Table 1). These correspond to 15.4% of the total benthic species of gastropods recorded in the survey (52), and to 3.7% of the total species of free-living benthic marine non-colonial invertebrates (Fig. 2).

The family Discodorididae was the best represented with two species and all the other families presented one species (Table 1): Acteonidae (*Acteon biplicatus*, Fig. 3A), Diaphanidae (*Toledonia perplexa*, Fig. 3B), Chromodorididae (*Tyrinna nobilis*, Fig. 3C), Discodorididae (*Diaulula punctuolata* and *D. variolata*, Figs. 3D–E, respectively), Flabellinidae (*Flabellina falklandica*, Fig. 3F), Onchidorididae (*Acanthodoris falklandica*, Fig. 3G) and Tritoniidae (*Tritonia challengeriana*, Fig. 3H).

Adding the survey's sites (PNBO, see Table 1 and Fig. 1) in where the species were registered; *Toledonia perplexa* extends its geographical distribution toward the north and *Diaulula variolata* extends its geographical distribution toward the south (Fig. 4). From a biogeographic point of view (Fig. 4), 38% of the species showed a Magellanic distribution: *Acteon biplicatus*, *Toledonia perplexa* and *Acanthodoris falklandica*; the last one being distributed until the intermediate area among the Magellanic and Peruvian provinces. The remaining 62% demonstrated a widespread distribution: "Peruvian-Magellanic" (*Diaulula variolata* and *Tyrinna nobilis*), "Peruvian-Magellanic-Patagonic" (*Diaulula punctuolata*) or reaching Antarctic and sub-Antarctic regions (*Flabellina falklandica* and *Tritonia challengeriana*).

DISCUSION

Without a doubt, knowledge regarding Opisthobranchia of southern South America – particularly on Nudibranchia and Sacoglossa– has had a notable increase in the last couple of years through the works of Michael Schrödl (see, for example, Schrödl, 1996a, 2003; Schrödl and Grau, 2006), María Angélica Fischer (e.g. Fischer and Ortea, 1996; Fischer, 2006), and Claudia Muniaín and Ángel Valdés (e.g. Muniaín *et al.*, 1996; Muniaín and Ortea, 1997; Valdés and Muniaín, 2002; Muniaín *et al.*, 2007). Nevertheless, there are numerous groups in which a lack of information still exists, for example, Cephalaspidea and lower Heterobranchia.

For that reason, the species *Acteon biplicatus* was included in this work. In spite of that species not being a "true opisthobranch", it was in the "limbo" of the general taxonomic report carried out on the gastropods of the Bernardo O'Higgins National Park.

Species diversity

The taxonomic and distributional database published on the Chilean molluscs (Valdovinos, 1999) points out the presence of 59 species of Opisthobranchia (*sensu lato*, i.e. including Acteonidae and others) on the latitudinal band 45–55°S, which corresponds to the concept "Magellan Region" given in this work. Subsequently, Schrödl (2003) in the development of his work where the taxonomic adjustments of various species were performed, points out the presence of 34 Nudipleura (sea slugs) on the extensive area from 41° toward the southern Strait of Magellan. And finally, Fischer (2006) points out 44 species of Opisthobranchia (*sensu lato*) on the Magellanic Province. The results of our work, which is adjusted to the latitudinal band 48–52°S (see Fig. 1), corresponded to 14% of the species pointed out by Valdovinos (1999), 18% of those by Schrödl (2003) and 18% of those by Fischer (2006); considering eight reported species of Opisthobranchia (*sensu lato*) compared to Valdovinos' and Fischer's works, and only our six species of Nudipleura compared to Schrödl's work.

Although it is certain that the number of species identified could seem extremely low, this report presents a considerable number of opisthobranch species in regard to the total gastropods species found (~15%, see Fig. 2). Several detailed reports of molluscs generated in the last years have reported a low number of opisthobranch species ranging from 0% to 21% (Table 2). Therefore, our 15% of opisthobranchs regarding the total gastropods reported does not represent a low quantity, but rather a normal value, considering the sampling methodology and the bathymetric range studied.

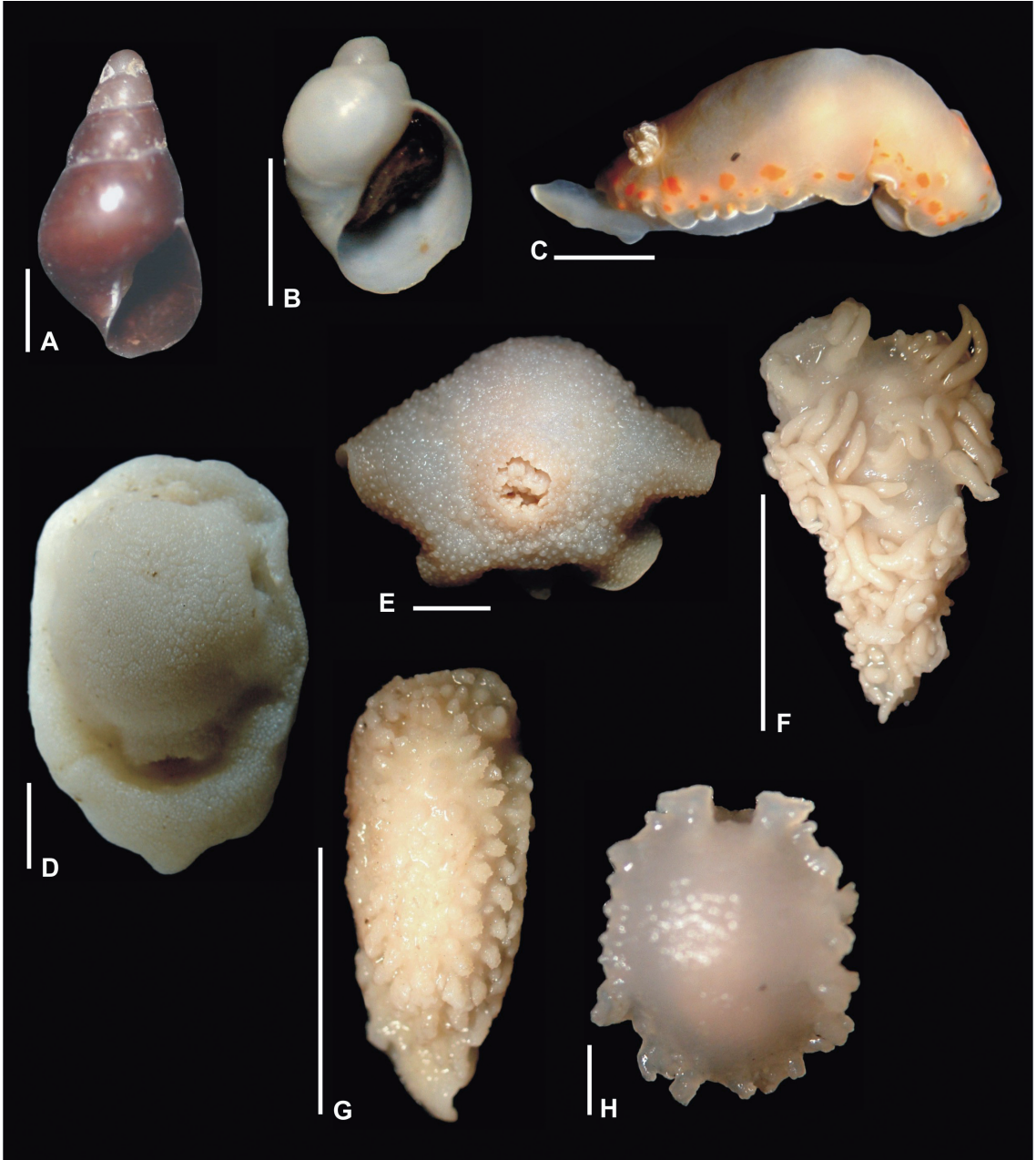


Figure 3:

Opisthobranchia (sensu lato) from Bernardo O'Higgins National Park: A, *Acteon biplicatus*; B, *Toledonia perplexa*; C, *Tyrinna nobilis*; D, *Diaulula punctuolata*; E, *Diaulula variolata*; F, *Flabellina falklandica*; G, *Acanthodoris falklandica*; H, *Tritonia challengeriana*.

Scale bars: A,B,H= 1 mm; C-G= 1 cm.

Table 1:
Opisthobranchia from Bernardo O'Higgins National Park (PNBO), showing stations of occurrence (PNBO stations, see Fig. 1) and number of individual collected (in parenthesis).

Family	Species	PNBO Station (and individuals)
Acteonidae	<i>Acteon biplicatus</i> (Strebel, 1908)	6(13); 16(5)
Diaphanidae	<i>Toledonia perplexa</i> Dall, 1902	6(5); 8(1); 16(8)
Chromodorididae	<i>Tyrinna nobilis</i> Bergh, 1898	4(2); 5(2)
Discodorididae	<i>Diaulula punctuolata</i> (d'Orbigny, 1834)	4(1)
	<i>Diaulula variolata</i> (d'Orbigny, 1837)	3(2)
Flabellinidae	<i>Flabellina falklandica</i> (Eliot, 1907)	3(1)
Onchidorididae	<i>Acanthodoris falklandica</i> Eliot, 1907	3(1); 16(1)
Tritoniidae	<i>Tritonia challengeriana</i> Bergh, 1884	4(1)

Taxonomical and distributional remarks

Acteon biplicatus is distributed from 43°S (Cárdenas *et al.*, 2008) to Tierra del Fuego and Falkland/Malvinas Islands (Castellanos *et al.*, 1993), presenting a bathymetric range of 16–152 m (Strebel, 1908). This species presents a similar morphology to *A. elongatus* Castellanos, Rolán and Bartolotta, 1987, but both can be differentiated in the fact that *A. elongatus* do not have columellar teeth and have a much more elongated aperture.

Toledonia perplexa is distributed from 48.7°S (new record of this study) to Cape Horn (USNM, 2011) and Falkland/Malvinas Islands (Dell, 1990). With regard to the morphological similarity of this species, there is a taxonomical problematic with *T. limnaeaeformis*, because the diagnostic characters that separate both species often causes a confusion. Dell (1990) commented that the main difference among these species is the more elongated last whorl, giving a wider abapical extension in *T. perplexa*.

Although Marcus (1976) figured a specimen of *T. limnaeaeformis* with that abapical extension and she only separates both species in their diameter/height ratio (60–69% for *T. limnaeaeformis* and 72–84% for *T. perplexa*). Nowadays it is known that *T. perplexa* is a Magellanic species and *T. limnaeaeformis* is a Kerguelenian species, but there is no real certainty on the distribution of *T. limnaeaeformis*, since several misidentifications were reported on the Magellan Region (*e.g.* Dell, 1990; Forcelli, 2000). Therefore, new comparative records of species of the genus at intermediate locations should elucidate the affinity of both species.

Tyrinna nobilis is distributed from Los Hornos, northern Chile, Juan Fernández Islands, toward the Chilean and Argentinean Patagonia, reaching the Valdes Peninsula in the Atlantic coasts (Schrödl *et al.*, 2005). Despite its widespread distribution, Schrödl (2003) considers it as a species from the Magellanic Province, but in our work it is remarked as having a widespread “Peruvian-Magellanic” distribution (see Fig. 4). The different species of the genus *Tyrinna*

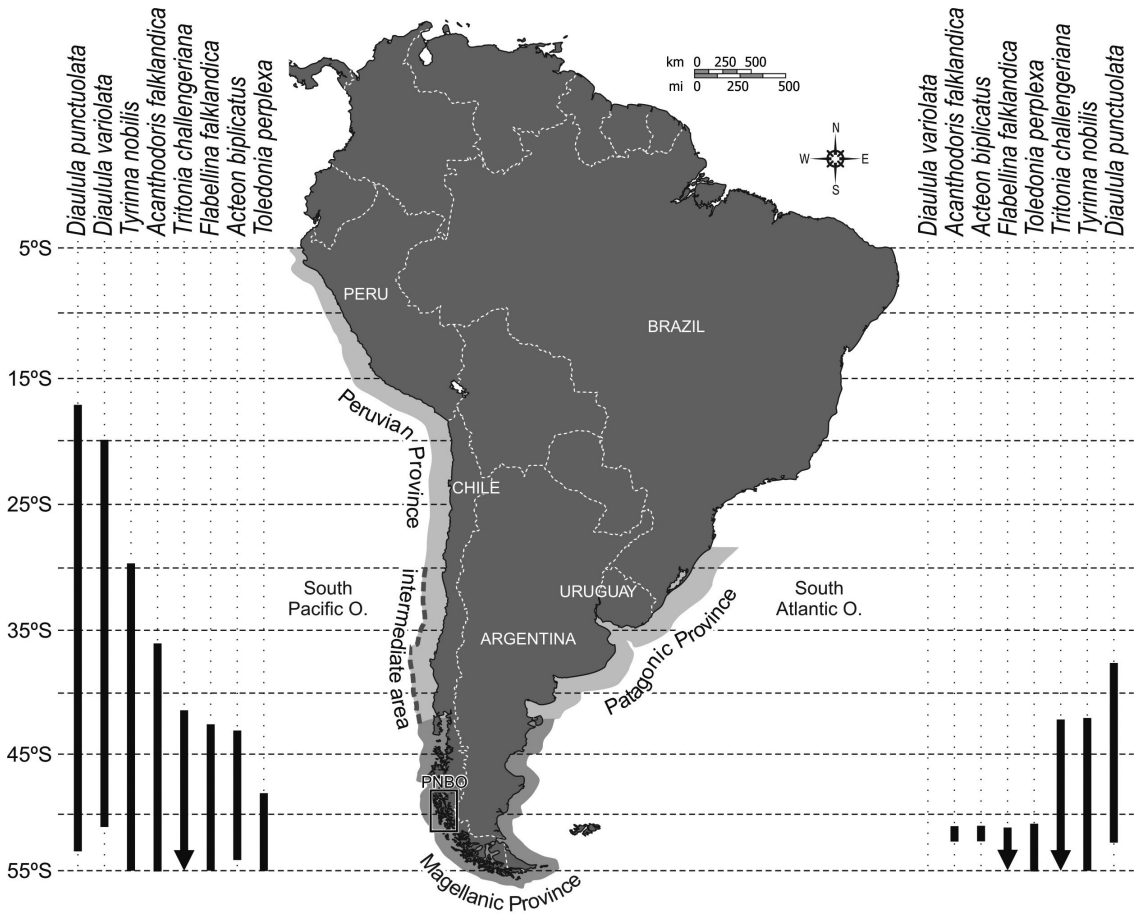


Figure 4:

Biogeographic distribution of opisthobranchs of Bernardo O'Higgins National Park (PNBO area) embracing the South American continent and the Falkland/Malvinas Islands. Biogeographic provinces were taken from Stuardo (1964), Brattström and Johanssen (1983) and Camus (2001). Arrows indicate the continuity of distribution toward Antarctic or sub-Antarctic areas.

were revised by Schrödl and Millen (2001), who pointed out that along the Chilean coast only *Tyrinna nobilis* would exist.

Diaulula punctuolata is distributed from Callao, Peru (Dall, 1909), toward the Guaitecas Islands (Odhner, 1926) to the Strait of Magellan (Abraham, 1877); reaching Atlantic coasts, the Falkland/Malvinas Islands (Eliot, 1907) and Argentinean Patagonia (Schrödl, 1996a, 1999a). Various works focussed on this species have been carried out (e.g.

Bergh, 1898; Marcus, 1959; Millen, 1982; Schrödl, 1996a, 1996b), being the anatomical study of Valdés and Gosliner (2001) the last taxonomic adjustment and assignment in the genus *Diaulula*.

Diaulula variolata is distributed from Arica, Chile (Schrödl, 2003), toward southern Chile (Zagal and Hermosilla, 2007) up to 51°S (new record of this study). This species, just as *D. punctuolata*, was studied by several researchers (e.g. Bergh, 1898; Marcus, 1959; Millen, 1982; Schrödl, 1996a, 1996b)

Table 2:
Opisthobranchia recorded in malacological reports since 1970 in the Pacific side of the Magellanic Province (i.e. fjords and channels region), taking into account studies where subtidal samples were collected.

Report	Latitude and depth	Number of species	
		Total Gastropoda	Opisthobranchia
Dell (1971)	40.5–55.9°S; 0–32m	38	0 (0%)
Reid and Osorio (2000)	45.6–46.7°S; 0–15m	33	2 (6.1%)
Linse (2002)*	45.1–55.8°S; 8–2505m	42	2 (4.8%)
Ríos <i>et al.</i> (2003)	52.6–52.8; 30–50m	38	3 (7.9%)
Osorio and Reid (2004)	43.7–46.5°S; 0–330m	7	1 (14.3%)
Osorio <i>et al.</i> (2005)	43.7–46.5°S; 0–330m	19	4 (21.1%)
Ríos <i>et al.</i> (2005)	48.0–53.9°S; 24–732m	8	1 (12.5%)
Osorio <i>et al.</i> (2006)	43.7–45.8°S; 62–345m	30	3 (10%)
Ríos <i>et al.</i> (2007)	53.0–53.6°S; ~8m	9	0 (0%)
Cárdenas <i>et al.</i> (2008)	45.6–46.7°S; 22–353m	39	2 (5.1%)
Ríos <i>et al.</i> (2010)	52.3–52.5; ~16–~61m	1	0 (0%)
This survey	48.7–51.5°S; 5–15m	52	8 (15.4%)

*Only shelled molluscs were considered in this review.

due to the taxonomical problematic that it presented (see Schrödl, 2003), and finally it was validated as *D. variolata* (Valdés and Gosliner, 2001).

Flabellina falklandica is distributed from the Chiloé Island, Chile, toward the Strait of Magellan and Tierra del Fuego, Falkland/Malvinas, South Georgia and Crozet Islands (Schrödl, 2003). In the same work two additional species of the genus were recognized as found on the Chilean coast (*Flabellina* sp.1 and *Flabellina* sp.2), highlighting that there was an ongoing revision of the genus on the South Pacific coast; their results have, however, not been published yet. Ramirez *et al.* (2003) recorded *Flabellina* (sic) cf. *falklandica* for

Peruvian sea, but that record requires confirmation, given that *Flabellina* sp.2 is distributed from Ancón, Perú, toward central Chile (Schrödl, 2003) and *F. cerverai* Fischer, van der Velde & Roubos, 2007 was described for Coquimbo, northern Chile.

Acanthodoris falklandica is distributed from Coliumo Bay, Chile (Schrödl, 1996a; 1997a), toward the Chilean Patagonia (Odhner, 1926; Marcus 1959), to Cape Horn and the Falkland/Malvinas Islands (Schrödl, 2003). This species has been associated to the brown kelp *Macrocystis pyrifera* (see Schrödl *et al.*, 2005). Consequently, a specimen of our study was collected in a dense meadow of *M. pyrifera* (Palacios, pers. com.).

Tritonia challengeriana presents a widespread distribution from Ancud Bay, Chile (Schrödl, 1996a) toward the Chilean and Argentinean Patagonia (Schrödl, 1996a; 1996b), Falkland/Malvinas Islands (Eliot, 1907) to the Antarctica (Schrödl *et al.*, 2005). This specie presents an external similarity to *T. odhneri* Marcus, 1959, but *T. odhneri* differs because it presents some white lines along the foot and at the gills (see Schrödl *et al.*, 2005). In addition, *T. odhneri* inhabits exposed sectors with strong currents, while *T. challengeriana* inhabits both protected and exposed fjords (Schrödl *et al.*, 2005). In our study it was collected in a station with low exposure (pers. obs.).

Final considerations

Although this report represents a progress in knowledge of the marine fauna of the park, the species scarcely represent about 13% of the total known species of gastropods in the park after the study (including those not found in the sampling) and 14% of opisthobranchs known in the latitudinal band 45–55°S. Therefore, more intensive studies are necessary in all bottoms to improve the malacologic knowledge of the area.

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REFERENCES

- Abraham PS (1877). Revision of the Anthobranchiate Nudibranchiate Mollusca, with description or notices of forty-one hitherto undescribed species. Proceedings of the Zoological Society of London, (1877): 196–269.
- Bergh R (1884). Report on the Nudibranchiata collected by H.M.S. Challenger during the years 1873–1876. Report on the scientific results of the voyage of H.M.S. Challenger, 1873–1876, Zoology, 26: 1–154.
- Bergh LSR (1898). Die Opisthobranchier der Sammlung Plate. Zoologische Jahrbücher Supplement, 4: 481–582.
- Brattström H, Johanssen A (1983). Ecological and regional zoogeography of the marine benthic fauna of Chile. Sarsia, 68: 289–339
- Camus PA (2001). Biogeografía marina de Chile. Revista Chilena de Historia Natural, 74: 587–617.
- Cárdenas J, Aldea C, Valdovinos C (2008). Chilean marine mollusca of Northern Patagonia collected during the CIMAR-10 Fjords Cruise. Gayana, 72 (2): 202–240.
- Castellanos ZA, Landoni NA, Dadon JR, (1993). Catálogo descriptivo de la malacofauna marina Magallánica 12. Opisthobranchia. Comisión de Investigaciones Científicas, Buenos Aires: 1–29+9.
- Dall WH (1909). Report on a collection of shells from Peru, with a summary of the littoral marine Mollusca of the Peruvian Zoological Province, Proceedings of the U. S. National Museum, 37: 147–294.
- Dell RK (1971). The marine mollusca of the Royal Society Expedition to Southern Chile, 1958–59. Records of the Dominion Museum, 7 (17): 155–233.
- Dell RK (1990). Antarctic Mollusca, with special reference to the fauna of the Ross Sea. Bulletin of the Royal Society of the New Zealand, 27: 1–311.
- Eliot CNE (1907). Nudibranchs from New Zealand and the Falkland Islands. Proceedings of the Malacological Society of London, 7: 327–361.
- Fischer MA (2006). Opisthobranchs from the Chilean coast. Radboud University Nijmegen, 173 pp.
- Fischer MA, Ortea J (1996). New Records of the Genus *Ancula* Loven, 1846 (Nudibranchia: Goniadorididae) on the American Pacific Coast. The Veliger, 39 (1): 90–92.
- Fischer MA, Cervera JL (2005). Checklist of the opisthobranchs (Mollusca: Gastropoda) from the

- Chilean coast deposited at the "Colección de Flora y Fauna Profesor Patricio Sanchez Reyes, Pontificia Universidad Católica de Chile". *Iberus*, 23: 1–16.
- Fischer MA, Cervera JL, Ortea JA (1997). First record of the genus *Janolus* Bergh, 1884 (Opisthobranchia: Arminacea: Zephyrinidae) from the Pacific Coast of South America, with the description of a new species. *The Veliger*, 40 (3): 234–239.
- Forcelli DO (2000). *Moluscos Magallánicos. Guía de moluscos de Patagonia y Sur de Chile*. Vázquez Mazzini Editores, Argentina. 200 pp.
- Guzmán L (1992). Visión panorámica sobre los ambientes terrestres y acuáticos de Magallanes. In: VA Gallardo, O Ferretti, HI Moyano, eds, *Oceanografía en Antártica*. ENEA-Proyecto Antártica-Italia. Centro EULA-U. de Concepción, Chile. pp. 479–492.
- Linse K (1997). Die Verbreitung epibenthischer Mollusken im chilenischen Beagle-Kanal. *Berichte zur Polarforschung*, 228: 1–131.
- Linse K (2002). The shelled Magellanic Mollusca: with special reference to biogeography relations in the Southern Ocean. *Theses Zoologicae*, 34: 1–252.
- Marcus Er (1959). *Lamellariacea und Opisthobranchia*. Reports of the Lund University Chile Expedition 1948–49, No. 36. *Lund Universitets Arsskrift, N. F.* (2), 55: 1–133.
- Marcus Ev (1976). A taxonomic survey of the genus *Toledonia* Dall, 1902 (Opisthobranchia, Diaphanidae). *Zoologica Scripta*, 5: 25–33.
- McCulloch RD, Clapperton CM, Rabassa J, Currant AP (1997). The glacial and post-glacial environmental history of Fuego-Patagonia. In: C McEwan, LA Borrero, A Prieto, eds, *Patagonia: Natural history, prehistory and ethnography at the uttermost end of the Earth*. British Museum Press, London. pp. 12–31.
- Millen SV (1982). A new species of dorid nudibranchs (Opisthobranchia: Mollusca) belonging to the genus *Anisodoris*. *Canadian Journal of Zoology*, 60: 2694–2705.
- Muníaín C, Ortea J (1997). First record of sacoglossan (= Ascoglossan, Opisthobranchia) from Patagonia (Argentina): description of a new species of genus *Elyisia* Risso, 1818. *The Veliger*, 40 (1): 29–37.
- Muníaín C., Valdés A, Ortea J (1996). Redescription of *Tyrinna nobilis* Bergh, 1898 (Opisthobranchia: Chromodorididae) from Patagonia, Argentina. *Journal of Molluscan Studies*, 62: 265–273.
- Muníaín C, Gallardo C, Penchaszadeh PE (2007). Reproductive biology of the nudibranch *Doris fontainei* D'Orbigny, 1835 (Gastropoda: Opisthobranchia) from the Magellanic Region. *The Nautilus*, 121 (3): 139–145.
- Odhner NH (1926). Die Opisthobranchien. Further Zoological Results of the Swedish Antarctic Expedition 1901–1903, 2: 1–100.
- Osorio C, Reid DG (2004). Moluscos marinos intermareales y submareales entre la Boca del Guafo y el Estero Elefantes, sur de Chile. *Investigaciones Marinas*, 32 (2): 31–89.
- Osorio C, Reid DG, Ramajo L (2005). Moluscos en los canales del Sur de Chile entre Boca del Guafo y Estero Elefantes (Cimar 7 Fiordos). *Ciencia y Tecnología del Mar*, 28 (1): 91–98.
- Osorio C, Peña R, Ramajo L, Garcelón N (2006). Malacofauna bentónica de los canales oceánicos del Sur de Chile (43°–45° S). *Ciencia y Tecnología del Mar*, 29 (1): 103–114.
- Ramírez R, Paredes C, Arenas J (2003). Moluscos del Perú. *Revista de Biología Tropical*, 51 (Suppl. 3): 225–284.
- Reid DG, Osorio C (2000). The shallow-water marine mollusca of the Estero Elefantes and Laguna San Rafael, southern Chile. *Bulletin of the Natural History Museum of London, Zoology*, 66 (2): 109–146.
- Ríos C, Mutschke E, Morrison E (2003). Biodiversidad bentónica sublitoral en el estrecho de Magallanes, Chile. *Revista de Biología Marina y Oceanografía*, 38 (1): 1–12.
- Ríos C, Mutschke E, Montiel A, Gerdes D, Arntz WE (2005). Soft-bottom macrobenthic faunal associations in the southern Chilean glacial fjord complex. *Scientia Marina*, 69 (Suppl. 2): 225–236.
- Ríos C, Arntz WE, Gerdes D, Mutschke E, Montiel A (2007). Spatial and temporal variability of the benthic assemblages associated to the holdfasts of the kelp *Macrocystis pyrifera* in the Straits of Magellan, Chile. *Polar Biology*, 31: 89–100.
- Ríos C, Mutschke E, Montiel A (2010). Estructura de la comunidad macrofaunística bentónica en la boca oriental del Estrecho de Magallanes, Chile austral.

- Anales del Instituto de la Patagonia (Chile), 38 (1): 83–96.
- Schrödl M (1996a). Nudibranchia y Sacoglosa de Chile: Morfología exterior y distribución. *Gayana Zoologica*, 60: 17–62.
- Schrödl M (1996b). Opisthobranchs (Gastropoda) collected by the research “Victor Hensen”. *Berichte zur Polarforschung*, 160: 52–54.
- Schrödl M (1997a). Range extensión of Magellanic nudibranchs (Opisthobranchia) into Peruvian faunal province. *The Veliger*, 40 (1): 38–42.
- Schrödl M (1997b). On the Magellanic nudibranch *Gargamella immaculata* Bergh, 1894, and its synonymy to *G. latior* Odhner, 1926. *Spixiana*, 20: 81–20.
- Schrödl M (1999a). Zoogeographic relationships of Magellan Nudibranchia (Mollusca: Opisthobranchia), whit special reference to species of adjacent región. *Scientia Marina*, 63 (Suppl. 1): 409–416.
- Schrödl M (1999b). The genus *Berthella* Blainville, 1825 (Notaspidea: Pleurobranchidae) from Magellanic waters. *Journal of Molluscan Studies*, 65: 399–409.
- Schrödl M (2003). Sea slugs of southern South America. *ConchBooks*, Hackenheim, Germany. 165 pp.
- Schrödl M, Millen SV (2001). Revision of the nudibranch gastropod genus *Tyrinna* Bergh, 1898 (Nudibranchia: Doridoidea). *Journal of Natural History*, 35: 1143–1171.
- Schrödl M, Wägele H (2001). Anatomy and histology of *Corambe lucea* Marcus, 1959 (Gastropoda: Nudibranchia), whit discussion of the systematic position of Corambidae. *Organisms, Diversity & Evolution*, 1: 3–16.
- Schrödl M, Grau JH (2006). Nudibranchia from the remote southern Chilean Guamblin and Ipún islands (Chonos Archipelago, 44–45° S), with re-description of *Rostanga pulchra* MacFarland, 1905. *Revista Chilena de Historia Natural*, 79: 3–12.
- Schrödl M, Alarcón MA, Bedriñana LR, Bravo FJ, Bustamante CM, Carvalho R, Försterra G, Gallardo C, Häussermann V, Salmen A (2005). Nudipleura (Gastropoda, Opisthobranchia) from the southern Chilean Comau Fjord, with redescription of *Polycera priva* Er. Marcus, 1959. *Vita Malacologica*, 3: 23–33.
- Stuardo J (1964). Distribución de los moluscos marinos litorales en Latinoamérica. *Boletín del Instituto de Biología Marina*, 7: 79–91.
- Strebel H (1908). Die Gastropoden. *Wissenschaftliche Ergebnisse der Schwedischen Südpolar-Expedition 1901–1903*. Stockholm: Lithographisches Institut des Generalstabs. 6. Zoologie, II: 1–111.
- USNM (2011). National Collection of the Smithsonian National Museum of Natural History, USNM. Online <<http://invertebrates.si.edu/>> (accessed on January, 2011).
- Valdés A, Gosliner TM (2001). Systematics and phylogeny of the caryophyllidia-bearing dorids (Mollusca, Nudibranchia), with description of a new genus and four new species from Indo-Pacific deep water. *Zoological Journal of the Linnean Society*, 133: 103–198.
- Valdés A, Muniaín C (2002). Revision and taxonomic reassessment of magellanic species assigned to *Anisodoris* Bergh, 1898 (Nudibranchia, Doridoidea). *Journal of Molluscan Studies*, 68: 345–351.
- Valdovinos C (1999). Biodiversidad de moluscos chilenos: base de datos taxonómica y distribucional. *Gayana*, 63 (2): 111–164.
- Zagal C, Hermosilla C (2007). Guía de invertebrados marinos del Sur de Chile. *Quebecor World Chile*, Santiago de Chile, 263 pp.