*Supplementary material for the manuscript entitled*

**Beta diversity of Antarctic and sub-Antarctic benthic communities reveals a major role of stochastic assembly processes**

Nelson Valdivia1, 2 \*, José Garcés-Vargas1, 2, Ignacio Garrido 2, 6, 7 Iván Gómez1, 2, Pirjo Huovinen1, 2, Nelso P. Navarro2, 3, Erasmo C. Macaya2, 4, 5, Luis Miguel Pardo1, 2

1Instituto de Ciencias Marinas y Limnológicas, Facultad de Ciencias, Universidad Austral de Chile, Valdivia, Chile

2Centro FONDAP de Investigación Dinámica de Ecosistemas Marinos de Altas Latitudes (IDEAL), Universidad Austral de Chile, Valdivia, Chile

3Laboratorio de Ecofisiología y Biotecnología de Algas (LEBA), Universidad de Magallanes, Punta Arenas, Chile

4Laboratorio de Estudios Algales (ALGALAB), Departamento de Oceanografía, Universidad de Concepción, Concepción, Chile

5Núcleo Milenio Ecología y Manejo Sustentable de Islas Oceánicas (ESMOI)

6Laboratorio Costero de Recursos Acuáticos de Calfuco, Facultad de Ciencias, Universidad Austral de Chile, Valdivia, Chile.

7QuébecOcéan, Département de biologie, Université Laval, Québec, Canada

\*Corresponding author

Email: nelson.valdivia@uach.cl

Phone: +56632221557

Fax: +56632221315

Orcid:

NV: 0000-0002-5394-2072

JG-V: 0000-0002-6542-9348

IG: 0000-0001-8381-3792

NPN: 0000-0002-9173-5736

EMM: 0000-0002-9878-483X

LMP: 0000-0002-8179-5057

Table S1 List of macrobenthic taxa identified in subtidal rocky habitats in Strait of Magellan, Yendegaia Fjord, and Fildes Bay

|  |  |  |  |
| --- | --- | --- | --- |
| Taxon | Strait of Magellan (STRA) | Yendegaia Fjord (YEND) | Fildes Bay (FILD) |
| ALGAE |  |  |  |
| Chlorophyta |  |  |  |
| Ulvophyceae | *Ulva* sp. 1 |  | *Monostroma hariotii* Gain 1911 |
| Rhodophyta | *Callophyllis variegata* (Bory) Kützing 1843 | *Sarcopeltis skottsbergii*  (Setchell & N.L. Gardner) Hommersand, Hughey, Leister & P.W. Gabrielson 2020. | *Callophyllis atrosanguinea* (J.D.Hooker & Harvey) Hariot 1887 |
|  | *Sarcopeltis skottsbergii*  (Setchell & N.L. Gardner) Hommersand, Hughey, Leister & P.W. Gabrielson 2020. |  | *Georgiella confluens* (Reinsch) Kylin 1956 |
|  | *Hildenbrandia* sp. 1 |  | *Sarcopeltis antarctica* Hommersand, Hughey, Leister & P.W. Gabrielson 2020. |
|  | *Hymenena durvillei* (Bory) Kylin 1924 |  | *Myriogramme manginii* (Gain) Skottsberg 1953 |
|  | *Hymenena* sp. 1 |  | *Pantoneura plocamioides*Kylin 1919 |
|  | *Lithothamnium* sp. 1 |  | *Phycodrys* sp. 1 |
|  | Rhodophyta sp. 2 |  | *Plocamium cartilagineum* (Linnaeus) P.S.Dixon 1967 |
|  | Rhodophyta sp. 3 |  | Rhodophyta sp. 1 |
|  |  |  | *Trematocarpus antarcticus* (Hariot) Fredericq & R.L.Moe 2009 |
| Phaeophyceae | *Macrocystis pyrifera* (Linnaeus) C.Agardh 1820 | *Macrocystis pyrifera* (Linnaeus) C. Agardh 1820 | *Adenocystis utricularis* (Bory) Skottsberg 1907 |
|  |  |  | *Ascoseira mirabilis*Skottsberg 1907 |
|  |  |  | *Desmarestia anceps* Montagne 1842 |
|  |  |  | *Desmarestia antarctica* R.L.Moe & P.C.Silva 1989 |
|  |  |  | *Desmarestia menziesii*J.Agardh 1848 |
|  |  |  | *Himantothallus grandifolius*(A.Gepp & E.S.Gepp) Zinova 1959 |
|  |  |  | *Iridaea cordata* (Turner) Bory 1826 |
|  |  |  | *Palmaria decipiens* (Reinsch) R.W.Ricker 1987 |
|  |  |  | *Phaeurus antarcticus*Skottsberg 1907 |
| PORIFERA | *Cliona chilensis* Thiele, 1905 |  | Porifera sp. 1 |
|  | Desmospongiae sp. 1 |  | Porifera sp. 2 |
|  | *Mycale magellanica* (Ridley, 1881) |  |  |
| CNIDARIA |  |  |  |
| Hydrozoa | *Antholoba achates* (Drayton, 1846) |  | *Symplectoscyphus* sp. 1 |
| PLATHELMYNTA |  |  |  |
| Turbellaria |  |  | Turbellaria |
|  |  |  |  |
| ANNELIDA |  |  |  |
| Polychaeta | *Chaetopterus variopedatus* (Renier, 1804) | *Harmothoe ernesti* Augener, 1931 | *Eunoe rhizoicola* Hartmann-Schröder, 1962 |
|  | *Idanthyrsus macropaleus* (Schmarda, 1861) | *Platynereis australis* (Schmarda, 1861) | Flabellifera |
|  | Polychaeta | *Pherusa* sp. 1 | Lumbrineridae |
|  |  | Nereidae | Maldanidae |
|  |  | *Eunoe rhizoicola* Hartmann-Schröder, 1962 | Nereidae |
|  |  | Lumbrineridae sp. | Oenonidae |
|  |  | *Neanthes kerguelensis* (McIntosh, 1885) | Orbinidae |
|  |  | *Thelepus setosus* (Quatrefages, 1866) | *Pherusa* sp. 1 |
|  |  | *Streblosoma* sp. 2 | *Philobrya sublaevis* Pelseneer, 1903 |
|  |  | *Timarete nasuta* Ehlers, 1897 | Phyllophoridae |
|  |  |  | *Streblosoma* sp. 1 |
|  |  |  | *Terebellidae* sp. |
| MOLLUSCA |  |  |  |
| Polyplacophora | *Chiton bowenii* King, 1832 | *Chiton* sp. 1 | *Leptochiton kerguelensis* Haddon, 1886 |
|  | Polyplacophora |  | *Hemiarthrum setulosum* (Carpenter in Dall, 1876) |
|  | *Tonicia* sp. 1 |  | *Stenosemus exaratus* (Sars GO, 1878) |
|  |  |  | *Tonicina zschaui* (Pfeffer, 1886) |
| Gastropoda | *Adelomelon ancilla* (Lightfoot, 1786) | *Acteon* sp. 1 | *Pellilitorina pellita* (Martens, 1885) |
|  | *Margarella violacea* (King, 1832) | *Amphissa* sp. 1 | *Nacella concinna* (Strebel, 1908) |
|  | *Nacella deaurata* (Gmelin, 1791) | *Balsis* sp. | *Eatoniella ebenina* Ponder & Worsfold, 1994 |
|  | *Nacella flammea* (Gmelin, 1791) | *Balsis subantarctica* (Strebel, 1908) | *Margarella antarctica* (Lamy, 1906) |
|  | *Trophon geversianus* (Pallas, 1774) | Buccinulum sp. 1 | *Laevilacunaria antarctica* (Martens, 1885) |
|  | *Trophon* sp. 1 | *Capulus ungaricoides* (d'Orbigny, 1841) | *Laevilitorina caliginosa* (Gould, 1849) |
|  |  | *Cerithiopsilla* sp. 1 |  |
|  |  | *Eatoniella* sp. 1 |  |
|  |  | *Fissurella oriens* Sowerby I, 1834 |  |
|  |  | *Fissurella picta* (Gmelin, 1791) |  |
|  |  | *Fusitriton magellanicus* (Röding, 1798) |  |
|  |  | *Lottia* sp. 1 |  |
|  |  | *Margarella expansa* (Sowerby I, 1838) |  |
|  |  | *Margarella violacea* (King, 1832) |  |
|  |  | *Mathilda magellanica* Fischer, 1873 |  |
|  |  | *Nacella deaurata* (Gmelin, 1791) |  |
|  |  | *Nacella flammea* (Gmelin, 1791) |  |
|  |  | *Nacella mytilina* (Helbling, 1779) |  |
|  |  | *Onoba fuegoensis* (Strebel, 1908) |  |
|  |  | *Onoba* sp. 1 |  |
|  |  | *Pareuthria cerealis* (Rochebrune & Mabille, 1885) |  |
|  |  | *Pareuthria plumbea* (Philippi, 1844) |  |
|  |  | *Pareuthria powelli* Cernohorsky, 1977 |  |
|  |  | *Savatieria* sp. 1 |  |
|  |  | *Trophon* sp. 2 |  |
|  |  | *Turbonilla* sp. 1 |  |
|  |  | *Turritella algida* Melvill & Standen, 1912 |  |
|  |  | Volutidae |  |
|  |  | *Xymenopsis* sp. 1 |  |
| Bivalvia |  | *Acesta patagonica* (Dall, 1902) | *Aequiyoldia eightsii* (Jay, 1839) |
|  |  | *Aulacomya atra* (Molina, 1782) | *Kidderia bicolor* (von Martens, 1885) |
|  |  | *Brachidiontes* sp. 1 | *Limatula hodgsoni* (Smith, 1907) |
|  |  | *Carditella* sp. 1 | Limidae |
|  |  | *Choromytilus chorus* (Molina, 1782) | *Liothyrella uva* (Broderip, 1833) |
|  |  | *Eurhomalea exalbida* (Dillwyn, 1817) | *Nucula pisum* Sowerby, 1833 |
|  |  | *Gaimardia trapesina* (Lamarck, 1819) |  |
|  |  | *Hiatella arctica* (Linnaeus, 1767) |  |
|  |  | *Mactra* sp. 1 |  |
|  |  | *Mytilus platensis*d'Orbigny, 1842 |  |
|  |  | *Mytilus* sp. 1 |  |
|  |  | *Neolepton concentricum* (Preston, 1912) |  |
|  |  | *Nucula pisum* Sowerby, 1833 |  |
|  |  | *Pandora* sp. 1 |  |
|  |  | *Perumytilus purpuratus* (Lamarck, 1819) |  |
|  |  | *Thyasira* sp. 1 |  |
|  |  | *Tindaria striata* (King, 1831) |  |
|  |  | *Yoldia* sp. 1 |  |
|  |  | *Zygochlamys patagonica* (King, 1832) |  |
| Opisthobranchia | *Berthella platei* (Bergh, 1898) | Nudibranchia | *Doris kerguelenensis* (Bergh, 1884) |
|  | *Flabellina falklandica* (Eliot, 1907) |  |  |
| BRANCHIPODA |  | *Magellania venosa* (Dixon, 1789) |  |
|  |  | *Magellania* sp. 1 |  |
|  |  | *Terebratella dorsata* (Gmelin, 1791) |  |
| NEMERTEA |  |  | *Antarctonemertes valida* (Bürger, 1893) |
|  |  |  | Nemertea sp. 1 |
|  |  |  | *Parborlasia corrugatus* (McIntosh, 1876) |
| ARTHROPODA |  |  |  |
| Pygnogonida |  |  | Picnogonida sp. 1 |
| Crustacea |  |  |  |
| Amphipoda | *Peramphitoe femorata* (Kroyer, 1845) | *Peramphitoe femorata* (Kroyer, 1845) | *Bovallia gigantea Pfeffer, 1888* |
|  |  | *Aora parda* Alonso, 2012. | *Cheirimedon femoratus* (Pfeffer, 1888) |
|  |  | *Gondogeneia* sp. 1 | *Cylindryllioides mawsoni* Nicholls, 1938 |
|  |  | *Heterophoxus* sp. 1 | *Djerboa furcipes* Chevreux, 1906 |
|  |  | *Iphimedia* sp | *Eurymera monticulosa* Pfeffer, 1888 |
|  |  | *Oradaera* sp. 1 | *Eusirus laticarpus* Chevreux, 1906 |
|  |  | *Tryphosites chevreuxi* Stebbing, 1914 | Gammaraidea sp 1 |
|  |  | *Tryphosites* sp. 1 | Gammaraidea sp 2 |
|  |  | *Ventojassa beagle* Alonso, 2012 | *Gondogeneia antarctica* (Chevreux, 1906) |
|  |  |  | *Gondogeneia* sp. 1 |
|  |  |  | *Jassa* sp. 1 |
|  |  |  | *Liljeborgia longicornis* (Schellenberg, 1931) |
|  |  |  | *Oradaera* sp. 1 |
|  |  |  | *Oradarea bidentata* Barnard, 1932 |
|  |  |  | *Orchomenella ultima* (Bellan-Santini, 1972) |
|  |  |  | *Paraceradocus miersi* (Pfeffer, 1888) |
|  |  |  | *Paradexamine fissicauda* Chevreux, 1906 |
|  |  |  | *Paramoera* sp. 1 |
|  |  |  | *Parawaldeckia kidderi* (Smith, 1876) |
|  |  |  | *Pariphimedia integricauda* Chevreux, 1906 |
|  |  |  | *Proboloides* sp. 1 |
|  |  |  | *Prostebbingia brevicornis* (Chevreux, 1906) |
|  |  |  | *Prostebbingia longicornis* (Chevreux, 1906) |
|  |  |  | *Schraderia gracilis* Pfeffer, 1888 |
|  |  |  | Stenoidae sp. 1 |
|  |  |  | *Vibilia* sp. 1 |
| Isopoda |  | *Exosphaeroma gigas* (Leach, 1818) | *Cymodocella* sp. 1 |
|  |  | *Uromunna nana* (Nordenstam, 1933) | *Iathripa* sp. 1 |
|  |  |  | *Iathripa* sp. 2 |
|  |  |  | *Serolis* sp. 1 |
| Tanaidacea | Tanaidacea |  | Tanaidacea |
| Decapoda | *Halicarcinus planatus* (Fabricius, 1775) | *Eurypodius latreillii* Guérin, 1829 |  |
|  | *Munida gregaria* (Fabricius, 1793) | *Lithodes santolla* (Molina, 1782) |  |
|  | *Campylonotus vagans* Bate, 1888 | *Munida gregaria* (Fabricius, 1793) |  |
|  | *Pagurus comptus* White, 1847 | *Nauticaris magellanica* (A.Milne-Edwards, 1891) |  |
|  | *Eurypodius latreillii* Guérin, 1828 | *Pagurus comptus* White, 1848 |  |
|  | *Peltarion spinulosum* (White, 1843) | *Paralomis granulosa* (Hombron & Jacquinot, 1846) |  |
|  | *Paralomis granulosa* (Hombron & Jacquinot, 1846) | *Peltarion spinulosum* (White, 1843) |  |
|  | *Lithodes santolla* (Molina, 1782) |  |  |
| Ostracoda |  |  | Ostracoda sp. 1 |
| Cirripedia | *Balanus laevis* Bruguière, 1789 | *Balanus laevis* Bruguière, 1790 |  |
| ECHINODERMATA |  |  |  |
| Ophiuroidea |  | *Ophiactis asperula* | *Amphioplus* sp. 1 |
|  |  |  | *Ophiura* sp. 1 |
|  |  |  | *Ophiura lymani* (Ljungman, 1871) |
| Asteroidea | Asteroidea sp. 2 | *Anasterias antarctica* (Lütken, 1857) | *Anasterias antarctica* (Lütken, 1857) |
|  | *Cosmasterias lurida* (Philippi, 1858) | *Odontaster penicillatus* (Philippi, 1870) | Asteroidea sp. 1 |
|  |  |  | *Diplasterias brandti* (Bell, 1881) |
|  |  |  | *Granaster nutrix* (Studer, 1885) |
|  |  |  | *Henricia* sp. 1 |
|  |  |  | *Neosmilaster georgianus* (Studer, 1885) |
|  |  |  | *Odontaster meridionalis* (Smith, 1876) |
|  |  |  | *Odontaster validus* Koehler, 1906 |
| Echinoidea | *Arbacia dufresnii* (Blainville, 1825) | *Arbacia dufresnii* (Blainville, 1825) |  |
|  | *Loxechinus albus* (Molina, 1782) | *Pseudechinus magellanicus* (Philippi, 1857) |  |
|  | *Pseudechinus magellanicus* (Philippi, 1857) |  |  |
| Holothuroidae | *Chiridota pisanii*Ludwig, 1885 | *Chiridota pisanii*Ludwig, 1886 | *Cucumaria acuta* Massin, 1992 |
|  |  |  | Holoturidae sp. 1 |
| SIPUNCULA |  | *Golfingia margaritacea* (Sars, 1851) |  |
| BRYOZOA |  |  | *Inversiula nutrix* Jullien, 1888 |
|  |  |  | Bryozooa sp. 1 |
| TUNICATA |  | Ascidacea sp. 3 | Ascidacea sp. 1 |
|  |  |  | Ascidacea sp. 2 |
|  |  |  | *Cnemidocarpa verrucosa* (Lesson, 1830) |
|  |  |  | *Pyura setosa* (Sluiter, 1905) |
| TELEOSTEI | *Patagonotothen* sp. 1 |  | *Harpagifer antarcticus* Nybelin, 1947 |

Table S2 Estimate coefficients of permutational general linear models of beta diversity and normalised stochasticity ratio (*NST*) of three localities in subantarctic and Antarctic: Strait of Magellan (STRA), Yendegaia (YEND), and Fildes Bay (FILD). Beta diversity was expressed as incidence- and abundance-based dissimilarities (Jaccard, and Bray-Curtis, respectively). Beta diversity is expressed as observed, expected from random sampling from each species pool, and standard effect sizes from the null model (deviation). STRA is mean beta diversity in STRA (model intercept), and YEND – STRA and FILD – STRA represent the difference between each locality and STRA. Lower and upper limits of 95 % confidence interval of each estimate parameter are shown.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Response | | *R2* | Parameter | Estimate | Lower | Upper |
| Jaccard | Observed | 0.143 | STRA | 0.760 | 0.751 | 0.768 |
|  |  |  | YEND – STRA | 0.050 | 0.039 | 0.062 |
|  |  |  | FILD – STRA | 0.097 | 0.085 | 0.109 |
|  | Expected | 0.353 | STRA | 0.758 | 0.752 | 0.763 |
|  |  |  | YEND – STRA | 0.082 | 0.074 | 0.089 |
|  |  |  | FILD – STRA | 0.108 | 0.100 | 0.115 |
|  | Deviation | 0.012 | STRA | 0.028 | -0.100 | 0.157 |
|  |  |  | YEND – STRA | -0.404 | -0.585 | -0.223 |
|  |  |  | FILD – STRA | -0.140 | -0.321 | 0.041 |
| Bray-Curtis | Observed | 0.178 | STRA | 0.621 | 0.611 | 0.631 |
|  |  |  | YEND – STRA | 0.074 | 0.060 | 0.088 |
|  |  |  | FILD – STRA | 0.133 | 0.119 | 0.148 |
|  | Expected | 0.369 | STRA | 0.617 | 0.610 | 0.624 |
|  |  |  | YEND – STRA | 0.109 | 0.099 | 0.119 |
|  |  |  | FILD – STRA | 0.147 | 0.137 | 0.157 |
|  | Deviation | 0.01 | STRA | 0.038 | -0.082 | 0.158 |
|  |  |  | YEND – STRA | -0.339 | -0.508 | -0.169 |
|  |  |  | FILD – STRA | -0.135 | -0.304 | 0.035 |
| Jaccard | *NST* | 0.47 | STRA | 0.695 | 0.692 | 0.698 |
|  |  |  | YEND – STRA | -0.070 | -0.074 | -0.066 |
|  |  |  | FILD – STRA | 0.033 | 0.029 | 0.037 |
| Bray-Curtis | *NST* | 0.504 | STRA | 0.749 | 0.746 | 0.752 |
|  |  |  | YEND – STRA | -0.101 | -0.106 | -0.097 |
|  |  |  | FILD – STRA | 0.007 | 0.003 | 0.011 |

Table S3 Summary of permutational t-tests performed separately for each locality to assess whether average beta deviations and *NST* were different from zero and 0.5 (*mu*), respectively. Lower and upper limits of 95 % confidence intervals are given.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Response | | mu | Locality | Mean | Lower | Upper |
| Beta deviation | Jaccard | 0.0 | STRA | 0.028 | -0.111 | 0.171 |
|  |  |  | YEND | -0.376 | -0.523 | -0.233 |
|  |  |  | FILD | -0.112 | -0.198 | -0.027 |
|  | Bray-Curtis |  | STRA | 0.038 | -0.091 | 0.169 |
|  |  |  | YEND | -0.300 | -0.452 | -0.164 |
|  |  |  | FILD | -0.097 | -0.193 | 0.001 |
| *NST* | Jaccard | 0.5 | STRA | 0.695 | 0.692 | 0.698 |
|  |  |  | YEND | 0.625 | 0.621 | 0.629 |
|  |  |  | FILD | 0.728 | 0.725 | 0.732 |
|  | Bray-Curtis |  | STRA | 0.749 | 0.746 | 0.752 |
|  |  |  | YEND | 0.647 | 0.644 | 0.651 |
|  |  |  | FILD | 0.756 | 0.752 | 0.759 |



Fig. S1 Abundance-based beta diversity (A, B) and beta deviation (C) (Bray-Curtis dissimilarities) across the three localities.



Fig. S2 Incidence (A)- and abundance-based (B) (Jaccard and Bray-Curtis, respectively) normalised stochasticity ratios of each locality.

Diagram

Description automatically generated

Fig. S3 Incidence- (A, B) and abundance- (C, D) based multivariate variance partitioning analyses after db-RDA. The analyses were computed for observed dissimilarities (A, C) and after controlling for differences in gamma diversity (deviation, B, D). Numbers in the Venn diagrams are adjusted *R2* that represent the relative contribution of plot- (blue), site-scale (pink), and spatial (yellow) factors to observed and gamma-corrected dissimilarities.