Abstract: Marine biogenic skeletal production is the prevalent source of Ca-carbonate in today’s Antarctic seas. Most information, however, derives from the post-mortem legacy of calcifying organisms. Prior imagery and evaluation of Antarctic habitats hosting calcifying benthic organisms are poorly present in the literature, therefore, a Remotely Operated Vehicle survey was carried out in the Ross Sea region Marine Protected Area during the 2013–2014 austral summer. Two video surveys of the seafloor were conducted along transects between 30 and 120 m (Adelie Cove) and 230 and 260 m (Terra Nova Bay “Canyon”), respectively. We quantified the relative abundance of calcifiers vs non-calcifiers in the macro- and mega-epibenthos. Furthermore, we considered the typology of the carbonate polymorphs represented by the skeletonized organisms. The combined evidence from the two sites reveals the widespread existence of carbonate-mixed factories in the area, with an overwhelming abundance of both low-Mg and (especially) high-Mg calcite calcifiers. Echinoids, serpulids, bryozoans, pectinid bivalves and octocorals prove to be the most abundant animal producers in terms of abundance. The shallower Adelie Cove site also showed evidence of seabed coverage by coralline algae. Our results will help in refining paleoenvironmental analyses since many of the megabenthic calcifiers occur in the Quaternary record of Antarctica. We set a baseline to monitor the future response of these polar biota in a rapidly changing ocean.

Keywords: Antarctica; Ross Sea region MPA; remotely operated vehicles; carbonate factories; benthos; carbonate polymorphs

1. Introduction

The majority of studies concerning Antarctic marine carbonates rely upon outcrop, seafloor and core sediment sample evidence (e.g., [1–10]). On the contrary, little visual information on their source factories is available and this is particularly true regarding deep-sea habitats. Seafloor imagery (photos and videos) documenting benthic habitats within the reach of scuba diving abound (e.g., [11–19]), whilst considerably fewer studies...
imaged habitats from 50 m down to bathyal depths [20]. The geo-referenced transects by means of towed cameras are equally scant (e.g., [21–24]). The utilization of Remotely Operated Vehicles (ROV) and other robots to study Antarctic benthic habitats, although still limited to date (e.g., [13,25,26]), represents one of the best options for investigating the deep seabed.

Polar marine biota are predominantly non-calcifying organisms; however, the mineralized parts of calcifying organisms endure a higher level of preservation post-mortem. This represents a taphonomic bias when attempting to reconstruct former benthic environments since paleoecological interpretations are by large necessarily based upon skeletal remains ([10,27,28]).

Calcified invertebrates and plants play an important role in carbon cycling and storage in Antarctic waters [29]. Bryozoans, mollusks, echinoderms, cnidarians together with barnacles, forams and serpulids are among the major contributors to the past and today Antarctic calcifier fauna [5]. In terms of CaCO₃ production rates, Antarctic echinoderms are abundant from the shelves to the deep-sea [30], and incorporate high-Mg calcite showing standing stocks 15 times higher than those measured in the Arctic [29]. Bryozoans represent another major calcifier component in Antarctic waters with a wide range of carbonate mineralogies, from completely aragonitic, mixed, and to entirely calcitic, and producing 800 up to 23,700 mg CaCO₃/year under near-freezing conditions [31]. Further calcifiers that abundantly colonize the Antarctic seafloor are cnidarians, which can be composed of aragonite (scleractinians [32]) or calcite/aragonite (gorgonians and stylasterids [33,34]), and crustose coralline algae whose tissue skeletons contain high-Mg calcite [35].

With the aim to document the relative role of calcifiers in Antarctic benthic communities, we conducted two Remotely Operated Vehicle (ROV) surveys during the 2013–2014 austral summer in shelf areas of Terra Nova Bay area (Ross Sea, Antarctica) in proximity of the Italian research station “Mario Zucchelli”.

One dive explored the Adelie Cove from 30 m down to 120 m, while the second surveyed the shallower portion of an elongated depression in the Terra Nova Bay (TNB) in a depth range of 230–260 m, which is informally referred to as “TNB Canyon” [36]. From the deeper parts of this depression, which seems to act as a natural sink for the abundant organic matter produced during the summer phytoplanktonic bloom, new species of polychaetes were also recently described [37,38].

Here, we present the results of such ROV explorations with a focus on the calcifying component. The scope of this paper is to provide (i) the first ROV study on benthic ecosystems in this sector of the Ross Sea region Marine Protected Area, (ii) an assessment of the relative abundance of calcifiers in the macro- and mega-epibenthos and (iii) the typology of carbonate polymorphs secreted by the calcifiers identified along the transects.

2. Materials and Methods
2.1. Study Area

The Ross Sea region Marine Protected Area (RSRMPA) was established in December 2017 under Conservation Measure 91-05 (2016) [39]. After several years of laborious negotiations that have resulted in a significant reduction in area for protection, the MPA finally reached a consensus in 2016. By now, the RSRMPA encompasses a surface of ca. 1.55 million km², which represents the world’s largest marine protected area established under an international agreement to date.

The Ross Sea is counted amongst the least human-impacted marine environments worldwide due largely to its remoteness, intense seasonality and extensive ice cover [24]. In the 19th and 20th centuries, commercial hunting of whales and seals was in force, resulting in the loss of thousands of individuals [40]. Between the 20th and 21st centuries, intensive fishing of toothfish resulted in over-exploitation and depletion of stocks [41,42] until 1996, when CCAMLR initiated a program to reduce the Antarctic toothfish biomass exploitation by fishing activities by 50% within 35 years [43].
Human activity in the area is strictly regulated after the establishment of the RSRMPA, encompassing a vast area (1.12 million km²) under full protection (General Protection Zone, GPZ) where commercial fishing is prohibited, a special research zone (SRZ) where the krill and commercial toothfish research fishery is regulated and a zone where research for krill is regulated (krill research zone, KRZ, Figure 1) [44].

Terra Nova Bay is a coastal marine area of ca. 30 km² located between the Adélie Cove and Tethys Bay within the RSRMPA and is part of the no-take General Protection Zone (GPZ) of the RSRMPA (Figure 1). There, the Italian summer station “Mario Zucchelli” is located on a small rocky peninsula along the coast of northern Victoria Land between the tongues of the Campbell and Drygalski glaciers (74°42’ S, 164°07’ E, Figures 1 and 2).

Since 1986, the area has been the focus of a variety of biological studies on benthic, nektic and pelagic aspects of resident communities (Table 1). Systemic biological research in TNB resulted in the discovery of a variety of taxa new to science, including ampharetids, amphipods, Porifera and coralline algae (e.g., [37,38,45–49]). Checklists of species from TNB are systematically published and updated by the Italian national Antarctic Museum (MNA, Section of Genoa) [49–53]. The evidence of high diversity at both species and community levels fuelled the establishment of the Antarctic Specially Protected Area (ASPA) No. 161 of Terra Nova Bay (a coastal marine area encompassing 29.4 km² between Adélie Cove and Tethys Bay immediately to the south of the Italian Mario Zucchelli Station, MZS) and ASPA No. 173, which encompassed Cape Washington and Silverfish Bay in the northern Terra Nova Bay (a reproduction site for the for Antarctic silverfish Pleurogramma antarctica Boulenger, 1902).

Due to intrinsic difficulties, scant visual information is available about resident benthic communities in the RSRMPA, especially those that are out of reach by scuba diving. Only fragmentary information has been provided by cameras and, in later times, by ROV and other devices [15–19,50,54–59].

Rocky cliffs alternating with occasional beaches characterize the coastline of TNB. Offshore the Mario Zucchelli Station, the seafloor is mostly composed of granitic rocks, with patches of gravels, coarse sands and muddy sediments. A large incision (“TNB Canyon”) following the shoreline at ca. 0.4 km from the coast characterizes the seafloor geomorphology (Figure 2).

The benthic associations populating the coastal hard bottoms down to ~20 m are governed mainly by ice disturbance and melting. Here, macroalgae (mainly Iridaea cordata (Bory de Saint-Vincent, 1826) and Phyllophora antarctica (A. Gepp and E.S. Gepp, 1905)), polychaetes, molluscs and peracarid crustaceans dominate the substrate [60–64]. Further south, the coastline is indented by an embayment known as Adélie Cove (Figure 2), which is the home of the Adélie penguin Pygoscelis adeliae (Hombron and Jacquinot, 1841) rookery hosting more than 7000 breeding pairs (Figure 2). Here, the seafloor is mostly constituted by coarse sands and muddy sediments [65,66].
Figure 1. The Ross Sea region Marine Protected Area (RSRMPA). Map of the RSRMPA established in 2017. The Marine Protected Area is composed by i) the General Protection Zone (GPZ), a fully protected area where no fishing is permitted; ii) a Special Research Zone (SRZ), where the research fishing for krill and toothfish is limited; a iii) Krill Research Zone (KRZ), with controlled research fishing for krill.
Figure 2. Location of visual benthic surveys. Map showing the location of ROV benthic surveys and of the extracted frames used for taxonomical identification at Terra Nova Bay “Canyon” and Adélie Cove.

Table 1. Scientific literature reporting information on the biological components investigated and sampling methods for Terra Nova Bay. NA was used when sampling method was not recovered. SCUBA is the acronym for Self-Contained Underwater Breathing Apparatus.

| Area               | Method                           | Research target                                      | Reference |
|--------------------|----------------------------------|------------------------------------------------------|-----------|
| Terra Nova Bay     | Grab                             | Foraminifera                                         | [4]       |
| Terra Nova Bay     | Grab/SCUBA                       | Nudibranchia                                         | [67]      |
| Terra Nova Bay     | ROV                              | Shallow- and deep-water benthic communities          | [68]      |
| Terra Nova Bay     | Fishing gears                    | Fish fauna                                           | [69]      |
| Terra Nova Bay     | SCUBA                            | Phytobenthos                                         | [70]      |
| Terra Nova Bay     | SCUBA                            | Phytobenthos                                         | [61]      |
| Terra Nova Bay     | SCUBA                            | Shallow-water benthic communities                    | [64]      |
| Terra Nova Bay     | Schell- and deep-water mollusc communities | Demospongiae                                      | [72]      |
| Terra Nova Bay     | ROV                              | Benthic communities                                  | [54]      |
| Terra Nova Bay     | SCUBA                            | Shallow-water soft-bottom communities                | [78]      |
| Terra Nova Bay     | Grab/Dredge                      | Coastal benthic communities                          | [74]      |
| Terra Nova Bay     | Grab/Dredge                      | Trematomus bernacchii T. centronotus (Pisces, Nototheniidae) | [75] |
| Terra Nova Bay     | Grab                             | Benthic shallow-water communities                    | [76]      |
| Terra Nova Bay     | Ice-core                         | Sympagic algae                                       | [77]      |
| Terra Nova Bay     | SCUBA                            | Iruida cordata (Gigartinaeaceae, Rhodophyta)         | [62]      |
| Terra Nova Bay     | Grab                             | Adamussium colbecki                                  | [16]      |
| Terra Nova Bay     | Grab                             | Shallow-water soft-bottom Polychaeta                 | [78]      |
| Terra Nova Bay     | Hauls                            | Trematomus hansoni                                   | [79]      |
| Terra Nova Bay     | ROV                              | Trematomus loemnbergii (Pisces, Nototheniidae)       | [55]      |
| Terra Nova Bay     | Grab/Dredge                      | Adamussium colbecki                                  | [80]      |
| Terra Nova Bay     | Planktonic net                   | Pleuragramma antarcticum                             | [81]      |
| Terra Nova Bay     | Grab/Dredge/SCUBA                | Benthic Polychaeta                                    | [82]      |
| Terra Nova Bay     | Grab/Dredge, SCUBA, ROV          | Benthic littoral communities                          | [83]      |
| Terra Nova Bay     | Grab/Dredge                      | Shallow- and deep-water mollusc                      | [84]      |
| Terra Nova Bay     | SCUBA                            | Astroidea                                            | [85]      |
| Terra Nova Bay     | SCUBA/Grab/Dredge                | Macrophytobenthos                                    | [86]      |
| Terra Nova Bay     | Hauls                            | Trematomus neumesi (Pisces, Nototheniidae)           | [87]      |
| Terra Nova Bay     | Trammel and gill nets            | Coastal Fish Fauna                                   | [88]      |
| Terra Nova Bay     | SCUBA/Dredge                     | Adamussium colbecki, Sterechinus neumayeri, Odontaster validus | [89] |
| Terra Nova Bay     | Grab                             | Sea urchins, sea stars and brittle stars             | [90]      |
| Terra Nova Bay     | Box corer                        | Benthic bacterial community                           | [65]      |
| Ross Sea           | Camera Tows                      | Benthic megafauna community                           | [91]      |
| Terra Nova Bay     | SCUBA                            | Epiphytic diatom communities                          | [66]      |
| Terra Nova Bay     | Mooring and cages                | Seawater temperature                                 | [92]      |
| Terra Nova Bay     | SCUBA/Grab/Dredge/ROV            | Porifera                                             | [50]      |
2.2. Benthic Visual Surveys

During the 2013–2014 austral summer, three ROV dives were performed in TNB in the frame of the XXIX Antarctic Italian expedition. The first one aborted due to bad meteorological conditions, while the following two were successful. The visual benthic surveys explored the seafloor offshore the Adélie Cove up to 120 m depth and TNB “Canyon” (a depressed segment of the seafloor) between 220 and 300 m depth (Table 2). The activities were performed onboard the “Malippo” and “Skua” motor vessels when the weather conditions were favorable.

Video footage and still photographs were acquired using a ROV Pollux III (max working depth 500m) equipped with an underwater acoustic tracking system (USBL, Linkquest, TrackLink 1500 MA) which was connected to a Trimble dual-antenna system providing position and heading depth every 1 s. Three laser beams spaced 10 cm apart provided the scale bar on the videos. The ROV was equipped with a digital camera (Canon EOS 550, Canon EF-S 10–22mm f/3.5–4.5 USM lens with double Speedlite 270EX flash, Canon, Tokyo, Japan) and a high-definition video camera (SONY HDR-HD7, Tokyo, Japan).

Table 2. Benthic surveys metadata. The table reports the technical information on the ROV surveys performed at Terra Nova Bay.

| ROV   | Date       | Site               | Latitude      | Longitude     | Duration h:mm | Length | Depth Range |
|-------|------------|--------------------|---------------|---------------|---------------|--------|-------------|
| Dive 2| 01/02/2014 | Terra Nova Bay     | 74°41.319' S  | 164°08.549' E | 03.15         | 2372 m | 230–260 m   |
| Dive 3| 03/02/2014 | Adélie Cove        | 74°46.399' S  | 164°01.405' E | 02.52         | 1954 m | 30–120 m    |

2.3. Taxonomical Identification and Habitat Characterization

High-resolution images were collected with a digital camera during the surveys and analyzed for the taxonomic composition of biological communities. A total of 169 images were examined for Dive 2 and 148 for Dive 3. When necessary, the images were coupled with low-definition video recording to improve taxonomic identification efficiency. Macrofauna and megafauna were identified to the lowest possible taxonomic rank by considering previous knowledge established in more than 35 years of research activities in the area and the large collection of museum vouchers curated by the Italian National Antarctic Museum (MNA, Section of Genoa; online database available at: https://steu.shinyapps.io/MNA-generale/ (accessed on 27 July 2021)). Organisms unidentifiable at the genus or species level were categorized as morpho-species or morphological categories. The abundances of taxa along the exploration tracks were calculated and mapped by counting the number of taxa in each frame. Information about the different substrates and habitat explored was reported as a percentage of bottom covering. These percentages were converted to aerial extensions by considering that each image displayed 3 m (width) × 2 m (height) of seabed on average, which corresponded to 6 m².

3. Results

3.1. Adélie Cove

Dive 3 explored ca. 2000 m of seafloor in length characterized by hard substrate between 30 m and 120 m depth. Along the entire transect, more than 7400 specimens belonging to 79 different taxa and 10 Phyla were classified (Table 3). Up to 100 m depth, the
seafloor was characterized by a dense coverage from coralline algae of the order Hapalidiales (Figure 3A–C) with an extent of 351.6 m². Below 100 m, patches of hard substrate started to alternate with soft substrate. Among the most abundant taxa, we noticed that the regular echinoid Sterechinus neumayeri (Meissner, 1910) and the pectinid Adamussium colbecki (Smith, 1902) counted to 3046 and 521 specimens, respectively (Figure 3). Below 70 m depth, sponges and soft cnidarians were the dominant faunal components. Up to 30 different taxa of Porifera were identified along the ROV track. The morpho-species belonging to the genus Haliclona were common, counting over 290 specimens. Isodictya erinacea (Topsent, 1916) (134 ind.), Dendrilla membranosa (Pallas, 1766) (84 ind.) and Isodictya kerguelenensis (Ridley and Dendy, 1886) (27 ind.) were also identified (Figure 3B,E,F). An individual of the Demospongia Stylocordyla chupachups (Uriz, Gili, Orejas and Pérez-Porro, 2011) was also recorded.

Cnidarians were mostly represented by octocorals of the genus Thouarella (332 ind.), together with the soft coral Alcyonium antacticum (Wright and Studer, 1889) (258 ind., Figure 3, Table 3). Bryozoans were sporadic along the track with 74 individuals censused.

Beside S. neumayeri, echinoderms were abundant in the surveyed area. Holothurians were largely represented (Figure 3C,D,F) and amounted to more than 1000 individuals; however, they cannot be confidently determined from images as their taxonomy largely depends on microscopic features, i.e., the shape of the calcareous ossicles. Ophiuroids and asteroids were also very frequent with more than 270 specimens identified.

The serpulid polychaete Serpula narconensis (Baird, 1864) was recurrently observed to colonize both hard substrates and fouling other megafauna, amounting to 603 specimens (Figure 3).

Sources of biogenic carbonates were different at Adélie Cove site. Firstly, the seafloor was characterized by the coralline algae of the order Hapalidiales belonging to a new genus and new species (I. Moro, pers. comm. 2021) in course of description. Secondly, a noticeable portion of the benthic community included calcifiers, with 13 taxa and more than 4450 individuals counted, which corresponded to ca. 60% of the identified organisms. The major contributors were S. neumayeri, S. narconensis and A. colbecki, amounting to 4170 individuals. Other echinoderms such as ophiuroids, asteroids and crinoids also concurred to the calcifiers component, with 6 different taxa and 248 individuals. A smaller contribution was provided by sponge specimens of the class Calcarea (35 ind.) and by octocorals belonging to the family Isidiidae (3 ind.).
Figure 3. Benthic assemblages at Adélie Cove. (A) Hard substrate with pebble and boulders encrusted by coralline algae (Hapalidiales spp.) at 76 m with the echinoid Sterechinus neumayeri (s) and the serpulid Serpula narconensis (sn); (B) Assemblage dominated by the sponges Isodyctia erinacea (ie), Isodyctia kerguelensis (ik) and specimens belonging to the genus Haliclona (hc) colonizing hard substrate covered by coralline algae at 82 m, with the subordinate presence of Serpula narconensis (sn), cnidarians such as Fannyella rossii (Gray, 1872) (f), specimens of the genus Thouarella (t) and unbranched gorgonians (ug) and individuals of Holothuroidea spp. (h). (C) The portion of seafloor at 99 m dominated by cnidarians of genus Thouarella (t) and Alcyonium antarcticum (aa), with polychaetes Serpula narconensis (sn) and Perkinsiana magalhaensis (p), echinoderms such as Ophiacantha vivipara (Ljungman, 1871) (ov), Ophiuroidea sp. (o) and Holothuroidea sp. (h) and Chelicerata Pycnogonida sp. (py); note the presence of the sponge Latrunculia biformis (l) (D) assemblage dominated by cnidarians at 100 m including Fannyella rossii (f), Alcyonium antarcticus (aa) and specimens of genus Thouarella (t) and subordinately by sponges represented by Rossella nuda (rn), Haliclona sp. (h) and individuals of class Calcarea (c), with the presence of the serpulid Serpula narconensis (sn), bryozoans belonging to genus Reteporella (r), Ophiuroidea such as Ophiacantha vivipara (ov) and Ophiuroidea sp. (o) and Holothuroidea sp. (h); (E) aggregations of the echinoid Sterechinus neumayeri (s) and the pectinid Adamussium colbecki (a) at 82 m with sponges Dendrilla membranosa (d) and Haliclona sp. (hc); (F) seafloor dominated by sponges at 112 m comprising D. membranosa (d) and specimens of genus Haliclona (hc) and class Calcarea (c), with sporadic presence of cnidarians of genus Thouarella (t) and echinoderms belonging to Ophiuroidea (o) and class Holothuroidea (h); observe the lack of coralline algae (Hapalidieles spp.) cover. Yellow letters refer to calcifier fauna.
Table 3. Summary of the taxa identified. List of taxa identified in the ROV dives. The number of individuals counted and the skeleton mineralogy of calcifier organisms are also reported. AC refers to the “Adelie Cove” site; TNB refers to the “Terra Nova Bay” site.

| Phylum  | Class       | Order     | Family    | Genera            | Species                      | AC (ind.) | TNB (ind.) | ind. Mineral |
|---------|-------------|-----------|-----------|-------------------|------------------------------|-----------|------------|-------------|
| Rhodophyta | Florideop hycea | Hapalidiales | Calcarea   | Calcarea spp.     |                      | 35        | 0          | 35 Calcite  |
|         |             |           |           | Dendroceridae     | Darwinella                  |           |            |             |
|         |             |           |           |                  | Dendrilla                   |           |            |             |
|         |             |           |           |                  | Dendrilla membranosa (Pallas, 1766) | 84        | 0          | 84 Calcite  |
|         |             |           |           |                  | Haliclona sp. 1             | 5         | 0          | 5 Calcite   |
|         |             |           |           |                  | Haliclona sp. 2             | 269       | 1          | 270 Calcite |
|         |             |           |           |                  | Haliclona sp. 3             | 1         | 0          | 1 Calcite   |
|         |             |           |           |                  | Haliclona sp. 4             | 10        | 23         | 33 Calcite  |
|         |             |           |           |                  | Haliclona sp. 5             | 6         | 37         | 43 Calcite  |
|         |             |           |           |                  | Calci                          |           |            |             |
|         |             |           |           |                  | Haliclona scotti (Grant, 1841) | 84        | 0          | 84 Calcite  |
|         |             |           |           |                  | Haliclona sp. 1             | 269       | 1          | 270 Calcite |
|         |             |           |           |                  | Haliclona sp. 2             | 1         | 0          | 1 Calcite   |
|         |             |           |           |                  | Haliclona sp. 3             | 10        | 23         | 33 Calcite  |
|         |             |           |           |                  | Haliclona sp. 4             | 6         | 37         | 43 Calcite  |
|         |             |           |           |                  | Haliclona sp. 5             | 4         | 0          | 4 Calcite   |
|         |             |           |           |                  | Calyx                          |           |            |             |
|         |             |           |           |                  | Calyx arcurarius (Topsent, 1913) | 6         | 61         | 67 Calcite  |
|         |             |           |           |                  | Lyycopodina                   |           |            |             |
|         |             |           |           |                  | Lyycopodina vaciceti (van Soest and Baker, 2011) | 0         | 2          | 2 Calcite   |
|         |             |           |           |                  | Inflataella                  |           |            |             |
|         |             |           |           |                  | Inflataella helli (Kirkpatrick, 1907) | 0         | 3          | 3 Calcite   |
|         |             |           |           |                  | Isodictya erinacea           |           |            |             |
|         |             |           |           |                  | Isodictya kerguelenensis (Ridley and Dendy, 1886) | 37        | 0          | 37 Calcite  |
|         |             |           |           |                  | Latrunculida                 |           |            |             |
|         |             |           |           |                  | Latrunculida (Latrunculida) biformis (Kirkpatrick, 1908) | 6         | 5          | 11 Calcite  |
|         |             |           |           |                  | Mycale                       |           |            |             |
|         |             |           |           |                  | Mycale sp. 1                 |           |            |             |
|         |             |           |           |                  | Tedania                      |           |            |             |
|         |             |           |           |                  | Tedania (Tedaniopsis) oxeata (Topsent, 1916) | 0         | 15         | 15 Calcite  |
|         |             |           |           |                  | Styloclavida                 |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 1           |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 2           |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 3           |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 4           |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 5           |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 6           |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 7           |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 8           |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 9           |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 10          |           |            |             |
|         |             |           |           |                  | Styloclavida sp. 11          |           |            |             |
|         |             |           |           |                  | Suberites caminatus (Ridley and Dendy, 1886) | 10        | 8          | 18 Calcite  |
|         |             |           |           |                  | Demospongiae sp. 1           | 5         | 9          | 14 Calcite  |
|         |             |           |           |                  | Demospongiae sp. 2           | 0         | 61         | 66 Calcite  |
|         |             |           |           |                  | Demospongiae sp. 3           | 134       | 0          | 134 Calcite |
|         |             |           |           |                  | Demospongiae sp. 4           | 6         | 5          | 11 Calcite  |
|         |             |           |           |                  | Demospongiae sp. 5           | 0         | 1          | 1 Calcite   |
|         |             |           |           |                  | Demospongiae sp. 6           | 0         | 1          | 1 Calcite   |
|         |             |           |           |                  | Demospongiae sp. 7           | 0         | 1          | 1 Calcite   |
|         |             |           |           |                  | Demospongiae sp. 8           | 1         | 2          | 3 Calcite   |
|         |             |           |           |                  | Demospongiae sp. 9           | 0         | 5          | 5 Calcite   |
|         |             |           |           |                  | Demospongiae sp. 10          | 0         | 1          | 1 Calcite   |
|         |             |           |           |                  | Demospongiae sp. 11          | 3         | 0          | 3 Calcite   |
|         |             |           |           |                  | Rossella fibula (Schulze and Kirkpatrick, 1910) | 0         | 25         | 25 Calcite  |
|         |             |           |           |                  | Rossella nuda (Topsent, 1901) | 2         | 0          | 2 Calcite   |
|         |             |           |           |                  | Rossella racovitzae (Topsent, 1901) | 0         | 1          | 1 Calcite   |
|         |             |           |           | Rossellidae       | Rossella                     |           |            |             |
|         |             |           |           |                  | Rossella sp. 1               | 0         | 28         | 28 Calcite  |
|         |             |           |           |                  | Rossella sp. 2               | 0         | 5          | 5 Calcite   |
|         |             |           |           |                  | Rossella sp. 3               | 0         | 1          | 1 Calcite   |
|         |             |           |           |                  | Rossella villosa (Burton, 1929) | 0         | 3          | 3 Calcite   |
|         |             |           |           |                  | Porifera sp. 1               | 0         | 1          | 1 Calcite   |
|         |             |           |           |                  | Porifera sp. 2               | 0         | 5          | 5 Calcite   |
|         |             |           |           |                  | Porifera sp. 3               | 0         | 7          | 7 Calcite   |
|         |             |           |           |                  | Porifera sp. 4               | 2         | 0          | 2 Calcite   |
|         |             |           |           |                  | Porifera sp. 5               | 0         | 40         | 40 Calcite  |
|         |             |           |           |                  | Porifera sp. 6               | 0         | 10         | 10 Calcite  |
Porifera sp. 7  0  8  8
Porifera sp. 8  0  8  8
Porifera sp. 9  5  0  5
Porifera sp. 10  0  4  4
Porifera sp. 11  0  4  4
Porifera sp. 12  4  0  4
Porifera sp. 13  0  2  2
Porifera sp. 14  2  0  2
Porifera sp. 15  2  0  2
Porifera sp. 16  1  0  1
Porifera sp. 17  1  0  1
Porifera sp. 18  1  0  1
Porifera sp. 19  0  1  1
Porifera sp. 20  0  1  1

Cnidaria

Actiniaria

Alcyoniidae

Alcyonium (Wright and Studer, 1889)

Alcyonium sp. 1

Prinnoisis

Prinnoisis (Delicitisisis) delicatula (Hickson, 1907)

Isididae

Isididae sp. 1

Nepthheidae

Gersemia

Gersemia antarctica (Kükenthal, 1902)

Hydrozoa

Hydrozoa sp. 1

Hydrozoa sp. 2

Mollusca

Bivalvia

Pectinidae

Adamsium (Smith, 1902)

Mollusca sp. 1

Mollusca sp. 2

Gastropoda

Nudibranchia

Tritoniidae

Doris

Doris sp.

Gastropoda sp. 1

Gastropoda sp. 2

Neogastropoda

Buccinidae

Neobuccinum eatoni (E. A. Smith, 1875)

Neobuccinum sp. 1

Mollusca sp. 1

Mollusca sp. 2

Annelida

Polychaeta

Sabellidae

Perkinsiana

Perkinsiana magalhaeensis (Kinberg, 1867)

Perkinsiana sp. 1

Serpula

Serpula narcomensis (Baird, 1864)

Serpulidae sp. 1

Terebellida

Flabelligeridae

Flabagraiveria

Flabagraiveria mundata (Gravier, 1906)

Arthropoda

Malacostraca

Crangonidae

Notocragon

Notocragon antarcticus (Pfeffer, 1887)

Chorismus

Chorismus antarcticus (Pfeffer, 1887)

Pycnogonida

Pycnogonida sp. 1

Bryozoa

Cheilostomatidae

Klugella

Klugella buski (Hastings, 1943)

Reteporellidae

Reteporella

Reteporella sp. 1

Fasciculiporidae

Fasciculipora ramosa (d'Orbigny, 1842)

Horneridae

Hornera

Hornera sp. 1
3.2. *Terra Nova Bay* "Canyon"

Dive 2 explored over 2300 m of seabed between 230 m and 260 m depth, transiting an area of hard substrate covered by a thin layer of soft sediment and sporadic segments of mobile substrate with patches of organic matter in degradation (Figure 4). In total, 10 Phyla, 86 different taxa and more than 4700 specimens were identified and mapped (Table 3). The sessile megafauna was dominated by cnidarians and sponges that densely colonized the hard substrates. The octocorals of family Isididae (bamboo coral), such as *Primnoisis (Delicatisis)* *delicatula* (Hickson, 1907), dominate the assemblages in the investigated area, with over 850 individuals counted and mapped (Table 3). A total of 11 morpho-species of alcyonaceans were identified, corresponding to more than 1200 individuals. Among these, the most frequent taxa in the whole investigated area included the genus *Thouarella* (420 ind.), *Arntzia gracilis* (Molander, 1929) (81 ind.) and *Alcyonium antarcticum* (27 ind., Figure 4).

The phylum Porifera comprised 39 different taxa with 473 organisms detected. *Isodictya erinacea* and *Calyx arcuarius* (Topsent, 1913) were abundant, with 62 and 61 individuals recognized, respectively. Specimens belonging to the hexactinellid genus *Rossella* were also frequent (53 ind.). One individual of *Stylocordyla chupachups* was also identified.

Erect bryozoans occurred consistently along the transect, with the genera *Reteporella* (Busk, 1884) and *Hornera* (Lamouroux, 1821) and the species *Klugella buski* (Hastings, 1943) as main representatives (92, 35 and 50 individuals, respectively).

The echinoderms were less common when compared to the Adélie Cove site, with *Ophiuroidea* representing the most abundant taxa (360 ind.). Holothurians colonizing the substrate and epibionts on cnidarians were also frequently observed (Figure 4). The echinoid *S. neumayeri* was occasionally present, counting 57 individuals (Figure 4). Crinoids were also a consistent presence.

| Phylum           | Class                  | Order                     | Family       | Genus               | Species                        | Individuals |
|------------------|------------------------|---------------------------|--------------|---------------------|--------------------------------|-------------|
| Chordata         | Aascidacea             | Styelida                  | Cnemiocarpa  | Cnemiocarpa sp. 1   |                                | 7           |
|                  |                        |                           |              | Cnemiocarpa verscosa | (Lesson, 1830)                 | 2           |
|                  | Tunicata               |                           |              | Tunicata sp. 1      |                                | 3           |
|                  |                        |                           |              | Tunicata sp. 2      |                                | 1           |
|                  |                        |                           |              | Tunicata sp. 3      |                                | 4           |
|                  |                        |                           |              |                     |                                | 7           |
| Ophiuroidea      | Euryalida              | Gorgonocephalida          | Astrotoma    | Astrotoma agassizii | (Lyman, 1875)                   | 0           |
|                  |                        |                           |              | Ophiurida           | Ophiurida                      | 1           |
|                  |                        |                           |              | Ophiurida           | Ophiurida                      | 2           |
|                  |                        |                           |              | Ophiurida           | Ophiurida                      | 3           |
| Hemichordata     | Graptolitidea          | Cephalodiscidea           | Cephalodiscus| Cephalodiscus densus| (Andersson, 1907)               | 1           |
|                  |                        |                           |              |                     |                                | 7           |
|                  |                        |                           |              |                     |                                | 8           |
| Asteroidea       | Forcipulatida          | Asteriida                 | Marthasteria | Marthasterias sp. 1 | 10                              | 10          |
|                  | Valvatida              | Odontasteridae            | Odontaster   | Odontaster validus  | (Koehler, 1906)                 | 24          |
|                  |                        |                           |              |                     |                                | 0           |
|                  |                        |                           |              |                     |                                | 24          |
| Echinodera ta    | Bryozoa sp. 1          |                          |              |                     |                                | 37          |
|                  | Bryozoa sp. 2          |                          |              |                     |                                | 7           |
|                  |                        |                          |              |                     |                                | 57          |
|                  |                        |                          |              |                     |                                | 94          |
|                  | Asteroidea sp. 1       |                          |              |                     |                                | 25          |
|                  | Asteroidea sp. 2       |                          |              |                     |                                | 20          |
|                  | Asteroidea sp. 3       |                          |              |                     |                                | 1           |
|                  | Asteroidea sp. 4       |                          |              |                     |                                | 1           |
|                  |                        |                          |              |                     |                                | 45          |
|                  |                        |                          |              |                     |                                | 1           |
|                  |                        |                          |              |                     |                                | 1           |
|                  |                        |                          |              |                     |                                | 1           |
|                  |                        |                          |              |                     |                                | 1           |
|                  |                        |                          |              |                     |                                | 24          |
|                  |                        |                          |              |                     |                                | 0           |
|                  |                        |                          |              |                     |                                | 24          |

3.2. *Terra Nova Bay* "Canyon"

Dive 2 explored over 2300 m of seabed between 230 m and 260 m depth, transiting an area of hard substrate covered by a thin layer of soft sediment and sporadic segments of mobile substrate with patches of organic matter in degradation (Figure 4). In total, 10 Phyla, 86 different taxa and more than 4700 specimens were identified and mapped (Table 3). The sessile megafauna was dominated by cnidarians and sponges that densely colonized the hard substrates. The octocorals of family Isididae (bamboo coral), such as *Primnoisis (Delicatisis)* *delicatula* (Hickson, 1907), dominate the assemblages in the investigated area, with over 850 individuals counted and mapped (Table 3). A total of 11 morpho-species of alcyonaceans were identified, corresponding to more than 1200 individuals. Among these, the most frequent taxa in the whole investigated area included the genus *Thouarella* (420 ind.), *Arntzia gracilis* (Molander, 1929) (81 ind.) and *Alcyonium antarcticum* (27 ind., Figure 4).

The phylum Porifera comprised 39 different taxa with 473 organisms detected. *Isodictya erinacea* and *Calyx arcuarius* (Topsent, 1913) were abundant, with 62 and 61 individuals recognized, respectively. Specimens belonging to the hexactinellid genus *Rossella* were also frequent (53 ind.). One individual of *Stylocordyla chupachups* was also identified.

Erect bryozoans occurred consistently along the transect, with the genera *Reteporella* (Busk, 1884) and *Hornera* (Lamouroux, 1821) and the species *Klugella buski* (Hastings, 1943) as main representatives (92, 35 and 50 individuals, respectively).

The echinoderms were less common when compared to the Adélie Cove site, with *Ophiuroidea* representing the most abundant taxa (360 ind.). Holothurians colonizing the substrate and epibionts on cnidarians were also frequently observed (Figure 4). The echinoid *S. neumayeri* was occasionally present, counting 57 individuals (Figure 4). Crinoids were also a consistent presence.
The polychaete *S. narconensis* and specimens of the genus *Perkinsiana* (Knight-Jones, 1983) were recurrent, amounting to 823 and 94 individuals, respectively (Figure 4, Table 3).

The site presented high densities of the Antarctic shrimps of the species *Chorismus antarcticus* (Pfeffer, 1887) (174 ind., Figure 5B).

---

Figure 4. Benthic assemblage at Terra Nova Bay “Canyon”. (A) Seafloor at 245 m characterized by hard substrates with a prevalence of the calcifier cnidarian *Primnoisis (Delicatisis) delicatula* (pd), specimens of genus *Thouarella* (t) and unbranched gorgonian (ug); other macrobenthic organisms included the polychaetes *Serpula narconensis* (sn) and *Perkinsiana magalhaensis* (p), the echinoid *Sterechinus neumayeri* (s) and the crustacean *Chorismus antarcticus* (c); (B) assemblage at 265 m comprising the sponges *Calyx arcuarius* (ca), *Isodyctia erinacea* (ie) and *Suberites caminatus* (sc); the cnidarians *Primnoisis (Delicatisis) delicatula* (pd); and specimens of genus *Thouarella* (t), *Serpula narconensis* (sn) and *Ophiacantha vivipara* (ov); (C) hard substrate at 248 m with high densities of unbranched gorgonians (ug), *Primnoisis (Delicatisis) delicatula* (pd); and specimens of genus *Thouarella* (t), *Serpula narconensis* (sn) and *Ophiacantha vivipara* (ov); (D) bottom at 272 m colonized by *Primnoisis (Delicatisis) delicatula* (pd), *Thouarella* sp. (t), unbranched gorgonians (ug) and sponges *Haliclona* sp. (hc); among the calcifiers, individuals of *Serpula narconensis* (sn) fouling the bryozoan *Hornera* sp. (ho)
and the crustacean *Chorismus antarcticus* (c) were observed; note whitish patches of decaying organic matter; (F) hard bottom at 281 m colonized by sponges *Haliclona* sp. (hc), *Primnois* (*Delicatissis*) *delicatula* (pd), *Thouarella* sp. (t) and unbranched gorgonians (ug); note the serpulids *Perkinsiana magalhaensis* (p) and *Serpula narconensis* (sn), the crinoid *Notocrinus virilis* (Mortensen, 1917) (n) and *Chorismus antarcticus* (c). Yellow letters refer to calcifier fauna.

**Figure 5**. Composition of biological assemblages and depth profile of the visual surveys. Percentage composition of benthic community (bars) and depth (lines) of frames extracted from video recordings performed in the Adélie Cove (A) and the Terra Nova Bay Canyon (B). Colors refer to the different calcifiers groups. “Decapods” class represents an abundance of *Chorismus antarcticus* and *Notocrangon antarcticus*. Black lines refer to bathymetric profile of frames. In A, colored depth profile segments represent portions of seafloor characterized by coralline algae (Hapalidiales spp.) covering.

### 4. Discussion

#### 4.1. Adélie Cove.

The shallow situation observed in Adélie Cove reveals the occurrence of four main calcifiers in the order of relative abundance: Hapalidiales coralline algae, which predominates in the shallower part of the transect (30–100 m, Figure 5) (which belong to a new genus and a new species, currently under study); *S. neumayeri*, *A. colbecki* and *S. narconensis*. Algal thalli calcify by large in the polymorph high-Mg calcite. *S. neumayeri* is characterized by a high-Mg exoskeleton (mean 9.58 mol% MgCO₃ [30]). *S. narconensis* is equally made up of high-Mg calcite [36]. The shell of *Adamussium colbecki* possesses low-Mg calcite [92], with minor presences of myostrocal aragonite [94,95].

Subordinate to such main skeletal carbonate producers, other mega-epibenthic components representing a minor contribution of post-mortem carbonates were observed in the ROV frames. For instance, high-Mg calcitic ossicles and spicules derive from other
echinoderm groups such as asteroids, ophiuroids, crinoids and holothuroids (e.g., [30]); bryozoans produce particles of mixed mineralogy, but with a net prevalence of calcite at polar latitudes [6,95]; the calcareous sponges shed spicules (actines) composed of Mg-calcite [96]. Only one aragonite producer was identified by the ROV survey, i.e., two individuals of the gastropod *Neobuccinum eatoni*. This species was repeatedly documented in the Terra Nova Bay area between 15–100 m of depth, as documented by MNA vouchers (S. Schiaparelli, pers. comm.).

4.2. Terra Nova Bay “Canyon”

The carbonate-producing organisms were ca. 50% (>2300 ind., Figure 5) of the overall benthic community, with the bamboo coral *P. delicatula* and *S. narconensis* as main contributors (858 and 828 ind., respectively). Octocorals such as the *Primnoisis* contribute to the carbonate sediment by shedding calcified internodes post-mortem, which is made up of high-Mg calcite [97] together with the serpulids, as mentioned above.

The erect calcitic bryozoans *Reterporella* spp., *Hornera* spp. and (although only lightly calcified) *K. buski* contribute significantly (ca. 10%) to the TBN carbonate-mixed factory. Although minor producers in absolute terms, other octocorals, ophiuroids (high-Mg calcite) and decapods (low-Mg calcite: [98]), which are represented by the shrimps *Notocrangon antarcticus* and *Chorismus antarcticus*, were also a noticeable component among calcifiers, amounting to 50 and 174 individuals (Figure 5, Table 3). A minor high-Mg calcite contribution was accounted by the sporadic presence of *S. neumayeri* (57 ind.) and of the crinoid *Anthometrina adriani* (Bell, 1908) (38 ind.).

4.3. Ross Sea Carbonate Factories: Traits, Legacy and Future

The ROV surveys disclosed the supremacy of calcitic megabenthos over other calcifiers inside the carbonate-mixed factories of shallow to relatively deep settings in the Ross Sea. The taphonomic resilience of calcite polymorphs finds confirmation in the paleontological legacy of Quaternary Antarctica. By referring only to megabenthic organisms, shallow-water deposits are often enriched by *A. colbecki* shells [7], while more distal and deeper situations document their richness in bryozoans, isidids, serpulids and echinoids [1,5,10,27,99].

The mega-epibenthos carbonate-mixed factories only accounts for part of the total carbonate biogenic production in the study context. Therefore, these results are conservative and somewhat biased in terms of carbonate polymorphs. It does not account for any additional skeletal input derived by infauna, which could be relevant especially at shallow depths (such as the aragonitic bivalves *Aequiyoldia eightsii* (Jay, 1839) and *Laternula elliptica* (P. P. King, 1832)), relative to the holopelagic input (mainly aragonitic pteropods), the occasional aragonitic and vateritic otolith shed by fishes (e.g., [100]), but mostly the important contribution provided by macrobenthos (such as molluscs, which are predominantly aragonitic) and microbenthos (mainly calcitic foraminifers and subordinate ostracods and serpulids). Furthermore, our case studies deal with intermediate water situations in the range of 30–260 m, but do not account for other important factories in the Ross Sea, i.e., the very shallow ones [101] which are significantly represented in the fossil record [1,7] as well as the offshore banks [5,20]; all of these are meritable for exploration in the future.

The current structure of marine communities inhabiting the Ross Sea region Marine Protected Area as described here could well change some traits in the near future under the pressure of global climatic perturbations. Indeed, Antarctic organisms are exposed to increasing pressure from multiple stresses, including seawater warming (e.g., [102,103]) and freshening [104], changes in sea ice dynamics and productivity (e.g., [105,106]) and ocean acidification (e.g. [107]). In particular, ocean acidification and the decrease in seawater pH and carbonate ion concentration due to the absorption of large amounts of CO2 by the oceans are expected to be the most critical changes facing Antarctic waters (e.g., [108–111]). Antarctic calcifying organisms, which are already living close to aragonite and
calcite undersaturation, may not be able to cope with the projected changes, resulting in potential cascading consequences that might ultimately affect food webs and higher trophic levels. However, the responses of Antarctic marine calcifiers to ocean acidification may vary among taxa depending on their ability to actively control seawater chemistry at the site of calcification, with some species being more vulnerable than others. Additional studies on the physiology of marine calcifiers living at high-latitudes in the Southern Ocean are required to understand their long-term ability to adapt to ocean acidification and other climate-related changes.

5. Conclusions

Our study recognized the relative abundance and typology of macro- and mega-epibenthic calcifiers from two sectors of the Ross Sea of contrasting bathymetric setting. As expected from carbonate factories located at high latitudes, calcitic taxa (mainly high-Mg calcite) present an almost total dominance.

With the exception of the shallow depths of Adélie Cove where coralline algae strongly prevailed, calcifiers equalize and are, on occasion, quantitatively comparable to other non-calcifying megabenthic taxa. Many such calcifiers are among the more common taxa encountered in the Quaternary record of Antarctica. As shown by ROV imagery, the original living carbonate factories are far more diverse than resulting fossil assemblages. This suggests an obvious taphonomic loss of important ecological information with respect to the structure and diversity of the original communities.

The ROV transects represent an important in situ photographic documentation of the current situation of carbonate-mixed factories in the Ross Sea. They provide, therefore, a geo-referenced and replicable baseline that is useful for monitoring future effects of progressive ocean acidification and global warming, both in terms of the hypothesized decline of calcifying vs non-calciﬁying mega and macrobenthos, and of a selective taxon-based resilience.

Author Contributions: Conceptualization, M.T., G.C. and S.S.; methodology, G.C., S.C. and L.A.; formal analysis, G.C.; investigation, S.C., C.M., P.M. and S.S.; resources, P.M. and S.S.; data curation, S.S. and S.C.; writing—original draft preparation, G.C., S.S. and M.T.; writing—review and editing, G.C., M.T., S.S., L.A., C.M. and P.M.; funding acquisition, P.M. and S.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by the GEOSMART (grant No. PNRA2013/AZ2.06, 29 May 2014–29 May 2017) and GRACEFUL (grant No. PNRA16_00069, 11 October 2017–10 October 2020) projects and funded by the Italian National Antarctic Research Program. This contribution is supported by the Ph.D. program in the Cultural and Natural Heritage of the University of Bologna (GC).

Acknowledgments: We thank the captain and helmsman of the motor vessel Malippo for their expert assistance during the ROV activities. We thank April Stabbins for kindly reading the manuscript and revising the English language. G.C. thanks the J-1 Exchange Visitor Program of the State Department U.S. and the Temple University of Philadelphia, PA, U.S., hosting institution during part of the manuscript preparation and submission. This is an Ismar-CNR Bologna scientific contribution n. 2044. This paper is also an Italian contribution to the CCAMLR CONSERVATION MEASURE 91-05 (2016) for the Ross Sea region Marine Protected Area, specifically, for addressing the priorities of Annex 91-05/C and a contribution to the SCAR-ANTOS Expert Group (https://www.scar.org/science/antos/home/ access date 27 July 2021).

Conflicts of Interest: The authors declare no conflicts of interest.

References
1. Speden, I.G. Fossiliferous Quaternary marine deposits in the McMurdo Sound region, Antarctica. New Zealand J. Geol. Geophys. 1962, 5, 746–777, doi:10.1080/00288306.1962.10417636.
2. Ward, B.L.; Webb, P.-N. Late Quaternary Foraminifera from raised deposits of the Cape Royds-Cape Barne area, Ross Island, Antarctica. J. Foraminif. Res. 1986, 16, 176–200.
3. Domack, E.W. Biogenic Facies in the Antarctic glacimarine environment: basis for a polar glacimarine summary. *Palaeogeogr. Palaeoclim. Palaeoecol.* 1988, 63, 357–372, doi:10.1016/0031-0182(88)90105-8.

4. Violant, D. Distribution of living benthic foraminifera from Terra Nova Bay (Antarctica)—preliminary data. *Natl. Sci. Comm. Antarct.* (ed) *Oceanogr. Campaign.* 1987, 88, 233–237.

5. Taviani, M.; Reid, D.E.; Anderson, J.B. Skeletal and isotopic composition and paleoclimatic significance of late Pleistocene carbonates, Ross Sea, Antarctica. *J. Sediment. Res.* 1993, 63, 84–90, doi:10.1306/D4267A96-2826-11D7-86480000102C1865D.

6. Rao, C.P.; Amini-Zargar, Z.; Franklin, D.C. Grain-size, biota, mineralogy and oxygen and carbon isotopes of sediments, Davis Station and Prydz Bay, Antarctica: evidence for occurrence and recession of shelf ice. *ANARE Res. Notes* 1995, 94, 33–34.

7. Berkman, P.A.; Andrews, J.T.; Björck, S.; Colhoun, E.A.; Emslie, S.D.; Goodwin, I.D.; Hall, B.L.; Hart, C.P.; Hirakawa, K.; Igarashi, A.; et al. Circum-Antarctic coastal environmental shifts during the late Quaternary reflected by emerged marine deposits. *Antarct. Sci.* 1998, 10, 345–362, doi:10.1017/S0954102098000406.

8. Robert, C.; Anderson, J.; Armienti, P.; Atkins, C.; Barrett, P.; Bohaty, S.; Bryce, S.; Claps, M.; Curran, M.; Davey, F.J.; et al. Quaternary Strata in CRP-1, Cape Roberts Project, Antarctica. *Terra Antarct.* 1998, 5, 31–61.

9. Remia, A.; Hart, C.; Oliverio, M.; Taviani, M. Bottom carbonate production in Little America Basin, Ross Sea, Antarctica. *Terra Antarct. Rep.* 2003, 153–157.

10. Frank, T.D.; James, N.P.; Shultis, A.I. Lack of synsedimentary chemical alteration in polar carbonates (Ross Sea, Antarctica): resolution of a conundrum. *J. Sediment. Res.* 2020, 90, 449–467, doi:10.2110/jsr.2020.26.

11. Nakajima, Y.; Watanabe, K.; Naito, Y. Diving observations of the marine benthos at Syowa Station, Antarctica. *Men. Natl. Inst. Polar. Res.* 1982, 23, 44–54.

12. Dayton, P.K.; Robilliard, G.A.; Paine, R.T.; Dayton, L.B. Biological accommodation in the benthic community at McMurdo Sound, Antarctica. *Ecol. Monogr.* 1974, 44, 105–128, doi:10.2307/1942321.

13. Dayton, P.K.; Jarrell, S.C.; Kim, S.; Parnell, P.; Thrush, S.F.; Hammerstrom, K.; Leichter, J.J. Benthic responses to an Antarctic regime shift: food particle size and recruitment biology. *Ecol. Appl.* 2019, 29, e01823, doi:10.1002/eva.1823.

14. Berkman, P.A. Diving in Antarctica. In *Arctic Underwater Operations: Medical and Operational Aspects of Diving Activities in Arctic Conditions*, Rey, L., Ed.; Springer: Dordrecht, the Netherlands, 1985; pp. 123–132. ISBN 978-94-011-9655-0.

15. Taviani, M.; Amato, E. Diving in Antarctica: third Italian expedition in Terra Nova Bay. *Boll. Oceanogr. Teor. Appl.* 1989, 7, 43–53.

16. Cattaneo-Vietti, R.; Chiantore, M.; Albertelli, G. The population structure and ecology of the Antarctic scallop *Adamussium Colbecki* (Smith, 1902) at Terra Nova Bay (Ross Sea, Antarctica). *Sci. Mar.* 1997, 61, 15–24.

17. Piazza, P.; Cummings, V.; Lohrer, D.; Marini, S.; Marriott, P.; Menna, F.; Nocerino, E.; Peirano, A.; Schiaparelli, S. Divers operated underwater photogrammetry: applications in the study of Antarctic benthos. *ISPRS-International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* 2018, XLII-2, 885–892, doi:10.5194/isprs-archives-XLII-2-885-2018.

18. Piazza, P.; Cummings, V.; Guzzi, A.; Hawes, I.; Lohrer, A.; Marini, S.; Marriott, P.; Menna, F.; Nocerino, E.; Peirano, A.; et al. Underwater photogrammetry in Antarctica: long-term observations in benthic ecosystems and legacy data rescue. *Polar. Biol.* 2019, 42, 1061–1079, doi:10.1007/s00300-019-02480-w.

19. Piazza, P.; Gattone, S.A.; Guzzi, A.; Schiaparelli, S. Towards a robust baseline for long-term monitoring of Antarctic coastal benthos. *Hydrobiologia* 2020, 847, 1753–1771, doi:10.1007/s10750-020-04177-2.

20. Buvillant, J.S., and Dearborn, J.H. *The fauna of the Ross Sea: Part 5: general accounts, station lists and benthic ecology*; New Zealand Oceanographic Institute Memoirs No. 32; Department of Scientific and Industrial Research, Wellington, New Zealand, 1967.

21. Hanchet, S.M.; Mitchell, J.; Bowden, D.; Clark, M.; Hall, J.; O’Driscoll, R.; Pinkerton, M.; Robertson, D. Preliminary report of the New Zealand RV Tangaroa IPY-CAML Survey of the Ross Sea Region, Antarctica, in February–March 2008. In *Proceedings of CCAMLR Doc. Working Group on Ecosystem Monitoring and Management (WG-EMM-08)*, Commission for the Conservation of Antarctic Marine Living Resources, Hobart, Australia, 23 July–1 August 2008.

22. Bowden, D.A.; Schiaparelli, S.; Clark, M.R.; Rickard, G.J. A lost world? Archaic crinoid-dominated assemblages on an Antarctic seamount. *Deep Sea Res. Part II Top Stud. Oceanogr.* 2011, 58, 119–127, doi:10.1016/j.dsr2.2010.09.006.

23. Campos, L.S.; Barboza, C.A.M.; Bassoi, M.; Bernardes, M.; Bromberg, S.; Corbisier, T.N.; Fontes, R.F.C.; Gheller, P.F.; Hajdu, E.; Kawall, H.G.; et al. Environmental processes, biodiversity and changes in Admiralty Bay, King George Island, Antarctica. In *Adaptation and Evolution in Marine Environments, volume 2: the Impacts of Global Change on Biodiversity*, Verde, C., di Prisco, G., Eds.; Springer: Berlin/Heidelberg, Germany, 2013; pp. 127–156. ISBN 978-3-642-27349-0.

24. Cummings, V.J.; Bowden, D.A.; Pinkerton, M.H.; Halliday, N.J.; Hewitt, J.E. Ross Sea benthic ecosystems: macro- and mega-faunal community patterns from a multi-environment survey. *Front. Mar. Sci.* 2021, 8, doi:10.3389/fmars.2021.629787.

25. Gutt, J.; Barratt, I.; Domack, E.; d’Udekem d’Acoz, C.; Dimmler, W.; Grémadre, A.; Heilmayer, O.; Isla, E.; Janussen, D.; Jorgensen, E.; et al. Biodiversity change after climate-induced ice-shelf collapse in the Antarctic. *Deep Sea Res. Part II Top Stud. Oceanogr.* 2011, 58, 74–83, doi:10.1016/j.dsr2.2010.05.024.

26. Gutt, J.; Barnes, D.K.A.; Lockhart, S.J.; van de Putte, A. Antarctic macrobenthic communities: a compilation of circumpolar information. *Nat Conserv.* 2013, 4, 1–13.

27. Taviani, M.; Claps, M. Biogenic Quaternary carbonates in the CRP-1 drillhole, Victoria Land Basin, Antarctica. *Terra Antartica* 1998, 5, 411–418.
28. Taviani, M.; Hannah, M.; Harwood, D.M.; Ishman, S.E.; Johnson, K.; Olney, M.; Riesselman, C.; Tuzzi, E.; Beu, A.G.; Blair, S.; et al. Palaeontological characterisation and analysis of the AND-2A Core, ANDRILL Southern McMurdo Sound Project, Antarctica. Terra Antarct. 2008, 15, 113–146.

29. Lebrato, M.; Iglesias-Rodriguez, D.; Feeley, R.A.; Greeley, D.; Jones, D.O.B.; Suarez-Bosche, N.; Lampitt, R.S.; Cartes, J.E.; Green, D.R.H.; Alker, B. Global contribution of echinoderms to the marine carbon cycle: CaCO3 budget and benthic compartments. Ecol. Monogr. 2010, 80, 441–467, doi:10.1890/09-0553.1.

30. McClintock, J.B.; Amsler, M.O.; Angus, R.A.; Challener, R.C.; Schram, J.B.; Amsler, C.D.; Mah, C.L.; Cuze, J.; Baker, B.J. The Mg-calcite composition of Antarctic echinoderms: important implications for predicting the impacts of ocean acidification. The J. Geol. 2011, 119, 457–466, doi:10.1086/660890.

31. Smith, A.M. Age, Growth and carbonate production by erect rigid bryozoans in Antarctica. Palaeogeogr. Palaeoclim. Palaeoecol 2007, 256, 86–98, doi:10.1016/j.palaeo.2007.09.007.

32. Margolin, A.R.; Robinson, L.F.; Burke, A.; Waller, R.G.; Scanlon, K.M.; Roberts, M.L.; Auro, M.E.; van de Flierd, T. Temporal and spatial distributions of cold-water corals in the Drake Passage: insights from the last 35,000 years. Deep. Sea. Res. Part II Top Stud. Oceanogr. 2014, 99, 237–248, doi:10.1016/j.dsr2.2013.06.008.

33. Cairns, S.D.; Macintyre, I.G. Phylogenetic implications of calcium carbonate mineralogy in the Stylasteridae (Cnidaria: Hydrozoa). PALAIOS 1992, 7, 96–107, doi:10.2307/3514799.

34. Thresher, R.E.; Tilbrook, B.; Fallon, S.; Wilson, N.C.; Adkins, J. Effects of chronic low carbonate saturation levels on the distribution, growth and skeletal chemistry of deep-sea corals and other seamount megabenthos. Mar. Ecol. Prog. Ser. 2011, 442, 87–99, doi:10.3354/meps09400.

35. Chave, K.E. Aspects of the biogeochemistry of magnesium I. Calcareaous marine organisms. J. Geol. 1954, 62, 266–283, doi:10.1086/626162.

36. Canese, S.; Mazzoli, C.; Montagna, P.; Schiaparelli, S.; Taviani, M. The Terra Nova Bay ‘Canyon’: ROV survey of nearshore shallow to deep carbonate factories. In Proceedings of the XII International Symposium on Antarctic Earth Sciences ISAES, Goa, India, 13–17 July 2015; pp. 13–17.

37. Schiaparelli, S.; Jirkov, I.A. A Reassessment of the Genus Amphitectus Grube, 1850 (Polychaeta: Ampharetidae) with the description of Amphitectis teresae Sp. Nov. from Terra Nova Bay (Ross Sea, Antarctica). Ital. J. Zool. 2016, 83, 531–542, doi:10.1080/11250003.2016.1259359.

38. Schiaparelli, S.; Jirkov, I.A. Contribution to the taxonomic knowledge of Ampharetidae (Annelida) from Antarctica with the description of Anage giacomoborei Sp. Nov. Eur. J. Taxon. 2021, 733, 125–145, doi:10.5852/ejt.2021.733.1227.

39. CCAMLR Conservation Measure 91-05: Ross Sea region Marine Protected Area. 2016, https://www.ccamlr.org/en/measure-91-05 (accessed on 10 December 2020).

40. Ainley, D.G. A History of the exploitation of the Ross Sea, Antarctica. Polar. Rec. 2010, 46, 233–243, doi:10.1017/S003224740999009X.

41. Blight, L.K.; Ainley, D.G. Southern Ocean not so pristine. Science 2008, 321, 1443–1443, doi:10.1126/science.321.5895.1443b.

42. Ainley, D.G.; Blight, L.K. Ecological repercussions of historical fish extraction from the Southern Ocean. Fish. Fish. 2009, 10, 13–38, doi:10.1111/j.1467-2979.2008.00293.x.

43. Pinkerton, M.; Hanchet, S.; Bradford-Grieve, J. Finding the role of Antarctic toothfish in the Ross Sea ecosystem. Water Atmos. 2007, 15, 20–21.

44. Brooks, C.M.; Crowder, L.B.; Österblom, H.; Strong, A.L. Reaching consensus for conserving the global commons: the case of the Ross Sea, Antarctica. Conserv. Lett. 2020, 13, e12676, doi:10.1111/conl.12676.

45. Alvizu Gomez, A.; Xavier, J.; Rapp, H. Description of new chiaichte-bearing sponges provides insights into the higher classification of Calcaronea (Porifera: Calcarea). Zootaxa 2019, 4615, 201, doi:10.11646/zootaxa.4615.2.1.

46. Calcina, B.; Pansini, M. Four new demosponge species from Terra Nova Bay (Ross Sea, Antarctica). Zoosystema 2000, 22, 369–381.

47. Bertolino, M.; Calcina, B.; Pansini, M. Two new species of Poecilosclerida (Porifera: Demospongiae) from Terra Nova Bay (Antarctic Sea). J. Mar. Biol. Assoc. UK 2009, 89, 1671–1677, doi:10.1017/S0025315409000915.

48. Sciuto, K.; Moschin, E.; Alongi, G.; Cecchetto, M.; Schiaparelli, S.; Caragnano, A.; Rindi, F.; Moro, I. Tethysphytum antarcticum Gen. et Sp. Nov. (Hapalidiales, Rhodophyta), a new non-geniculate coralline alga from Terra Nova Bay (Ross Sea, Antarctica): morpho-anatomical characterization and molecular phylogeny. Eur. J. Phycol. 2021, 1–12, doi:10.1080/09670262.2020.1884351.

49. Ghiglione, C.; Alvaro, M.C.; Griffiths, H.J.; Linse, K.; Schiaparelli, S. Ross Sea Mollusca from the latitudinal gradient program: R/V Italica 2004 Rauschert dredge samples. Zooneks 2013, 37–48, doi:10.3897/zooneks.341.6031.

50. Ghiglione, C.; Alvaro, M.C.; Cecchetto, M.; Canese, S.; Downey, R.; Guzzii, A.; Mazzoli, C.; Piazza, P.; Rapp, H.T.; Sarà, A.; et al. Porifera collection of the Italian National Antarctic Museum (MNA), with an updated checklist from Terra Nova Bay (Ross Sea). Zooneks 2018, 137–156, doi:10.3897/zooneks.758.23485.

51. Piazza, P.; Blaszewicz-Paszkowycz, M.; Ghiglione, C.; Alvaro, M.C.; Schnabel, K.; Schiaparelli, S. Distributional records of Ross Sea (Antarctica) Tanaidacea from museum samples stored in the collections of the Italian National Antarctic Museum (MNA) and the New Zealand National Institute of Water and Atmospheric Research (NIWA). ZooKeys 2014, 451, 49–60, doi:10.3897/zookeys.451.8373.

52. Cecchetto, M.; Alvaro, M.C.; Ghiglione, C.; Guzzii, A.; Mazzoli, C.; Piazza, P.; Schiaparelli, S. Distributional records of Antarctic and sub-Antarctic Ophiuroidea from samples curated at the Italian National Antarctic Museum (MNA): check-list update of
the group in the Terra Nova Bay Area (Ross Sea) and launch of the MNA 3D Model ‘Virtual Gallery’. ZooKeys 2017, 61–79, doi:10.3897/zookeys.705.13712.

53. Bonello, G.; Grillo, M.; Cecchetto, M.; Giallain, M.; Granata, A.; Guglielmo, L.; Pane, L.; Schiaparelli, S. Distributional Records of Ross Sea (Antarctica) Planktic Copepod from bibliographic data and samples curated at the Italian National Antarctic Museum (MNA): checklist of species collected in the Ross Sea sector from 1987 to 1995. ZooKeys 2020, 969, 1–22, doi:10.3897/zookeys.969.52334.

54. Bono, R.; Bruzzzone, G.; Caccia, M.; Grassia, F.; Spirandelli, E.; Veruggio, G. ROBY goes to Antarctica. In Proceedings of OCEANS’94 OSATES, Brest, France, 13–16 September 1994, IEEE Xplore: New York, NY, USA, 1994, Volume 3, pp. 621–625.

55. Bono, R.; Bruzzzone, G.; Caccia, M.; Spirandelli, E.; Veruggio, G. Romeo goes to Antarctica [Unmanned Underwater Vehicle]. In Proceedings of the IEEE Oceanic Engineering Society. OCEANS’98, Nice, France, 28 September–1 October 1998, IEEE Xplore: New York, NY, USA, 1998, Volume 3, pp. 1568–1572.

56. Povero, P.; Chiantore, M.; Misic, C.; Budillon, G.; Cattaneo-Vietti, R. Land forcing controls pelagic-benthic coupling in Adelie Cove (Terra Nova Bay, Ross Sea). Polar Biol. 2001, 24, 875–882, doi:10.1007/s003001000286.

57. Asper, V.L.; Smith, W.O. Abundance, distribution and sinking rates of aggregates in the Ross Sea, Antarctica. Deep Sea Res. Part I Oceanogr. Res. Pap. 2003, 50, 131–150, doi:10.1016/S0967-0637(02)00146-2.

58. Palozzi, R.; Vacchi, M.; Bono, R.; Catalano, F.; Rovere, A.D. Italian underwater exploration in Antarctica: scientific diving and ROV operations. Underw. Technol. 2010, 29, 87–93, doi:10.3723/ut.29.087.

59. Cecchetto, M.; Lombardi, C.; Canese, S.; Coco, S.; Kuklinski, P.; Mazzoli, C.; Schiaparelli, S. The Bryozoa collection of the Italian National Antarctic Museum, with an updated checklist from Terra Nova Bay, Ross Sea. ZooKeys 2019, 812, 1–22, doi:10.3897/zookeys.812.26964.

60. Cormaci, M.; Furnari, G.; Scammacca, B.; Casazza, G. Il Fitobenthos di Baia Terra Nova (Mare Di Ross, Antartide): osservazioni sulla flora e sulla zonazione dei popolamenti. In Actas Del Semin. Int. Oceanografiia in Antartide, Gallardo VA, Ferretti O, Moyano HI Eds. Centro EULA, Universidad de Concepción: Concepción, Chile, 1992, pp. 395–408.

61. Cormaci, M.; Furnari, G.; Scammacca, B. The benthic algal flora of Terra Nova Bay (Ross Sea, Antarctica). Bot. Mar. 1992, 35, 541–552.

62. Cormaci, M.; Furnari, G.; Scammacca, B.; Alongi, G. Summer biomass of a population of Iridea cordata (Gigartinaceae, Rhodophyta) from Antarctica. Hydrobiologia 1996, 326, 267–272, doi:10.1007/BF00047817.

63. Gambi, M.C.; Mazzella, L. Quantitative and functional studies on coastal benthic communities of Terra Nova Bay (Ross Sea, Antarctica); hard bottoms. In Actas Del Semin. Int. Oceanografiia in Antartide, Gallardo VA, Ferretti O, Moyano HI Eds. Centro EULA, Universidad de Concepción: Concepción, Chile, 1992, pp. 409–415.

64. Gambi, M.C.; Loreniti, M.; Russo, G.F.; Scipione, M.B. Benthic associations of the shallow hard bottoms off Terra Nova Bay, Ross Sea: zonation, biomass and population structure. Antarct. Sci. 1994, 6, 449–462, doi:10.1017/S0954102094000696.

65. Baldi, F.; Marchetto, D.; Pini, F.; Fani, R.; Michaud, L.; Lo Giudice, A.; Berto, D.; Giani, M. Biochemical and microbial features of shallow marine sediments along the Terra Nova Bay (Ross Sea, Antarctica). Cont. Shelf Res. 2010, 30, 1614–1625, doi:10.1016/j.csr.2010.06.009.

66. Majewska, R.; Gambi, M.C.; Totti, C.M.; De Stefano, M. Epiphytic diatom communities of Terra Nova Bay, Ross Sea, Antarctica: structural analysis and relations to algal host. Antarct. Sci. 2013, 25, 501.

67. Cattaneo-Vietti, R. Nudibranch molluscs from the Ross Sea, Antarctica. J. Molluscan Stud. 1991, 57, 223–228.

68. Di Geronimo, I.; Rosso, A. First Italian Oceanographic expedition in the Ross Sea, Antarctica. Benthos: a preliminary report. In Oceanographic Campaign 1987–88; National Scientific Commission for Antarctica, Genova, Italy, Data Rep Part I, pp. 407–421.

69. Vacchi, M.; Greco, S.; La Mesa, M. Ichthyological survey by fixed gears in Terra Nova Bay (Antarctica). Fish list and first results. Mem Biol Mar. Oceanogr. 1991, 19, 43–55.

70. Cormaci, M.; Furnari, G.; Scammacca, B. Carta della vegetazione marina di Baia Terra Nova (Mare Di Ross, Antartide). Biologia Marina 1992, 1, 313–314.

71. Di Geronimo, I.; Cattaneo-Vietti, R.; Gambi, C.; Casazza, G.; Cormaci, M.; Scammacca, B. Prime osservazioni sulle comunità bentoniche costiere di Baia Terra Nova (Mare Di Ross, Antartide): bionomia e distribuzione. In Atti del 9th Congresso Associazione Italiana di Oceanologica e Limnologia, S. Margerita Ligure, Italy, 20–23 November 1990; pp. 635–646.

72. Sarà, M.; Balduzzi, A.; Barbieri, M.; Bavestrello, G.; Burlando, B. Biogeographic traits and checklist of Antarctic demospogens. Polar Biol. 1992, 12(6), 599–585.

73. Albertelli, G.; Arnaud, P.M.; Cattaneo-Vietti, R. Ecological aspects of the macrobenthos of the Ross Sea: the coastal and deep-sea bivalve molluscs of Terra Nova Bay. Natl. Sci. Comm. Antarct. (ed.) Oceanogr. Campaign. 1994, 88, 49–66.

74. Russo, G.F.; Gambi, M.C. First quantitative data on coastal soft bottoms populations off Terra Nova Bay (Ross Sea, Antarctica): bivalve molluscs. Natl. Sci. Comm. Antarct. (ed.) Oceanogr. Campaign. 1994, 90, 187–190.

75. Vacchi, M.; La Mesa, M.; Castelli, A. Diet of two coastal nototheniid fish from Terra Nova Bay, Ross Sea. Antarct. Sci. 1994, 6, 61–65.

76. Cattaneo-Vietti, R.; Gambi, M.C. Ecological studies on benthos at Terra Nova Bay (Ross Sea, Antarctica): an overview of the Italian Research Programme (1987–92). Ambiente Antarct. CNR 1995, 6, 18–23.

77. Lazzara, L.; Nuccio, C.; Massi, L.; Innamorati, M. Le Microalghe simpatiche di Terra Nova Antartide, nell’estate 1994/95. G Bot Ital 1995, 129, 425–425, doi:10.1080/11263509509436156.
80. Gambi, M.C.; Castelli, A.; Guizzardi, M. Polychaete Populations of the shallow soft bottoms off Terra Nova Bay (Ross Sea, Antarctica): distribution, diversity and biomass. Polar. Biol. 1997, 17, 199–210, doi:10.1007/s003000050123.

81. La MESA, M.; Vacchi, M.; Castelli, A.; Diviacco, G. Feeding ecology of two nototheniid fishes, Trematomus Hansoni and Trematomus Loenhergii, from Terra Nova Bay, Ross Sea. Polar. Biol. 1997, 17, 62–68, doi:10.1007/s003000050105.

82. Chiantore, M.; Cattaneo-Vietti, R.; Albertelli, G.; Misei, C.; Fabiano, M. Role of filtering and biodeposition by Adamussium colbecki in circulation of organic matter in Terra Nova Bay (Ross Sea, Antarctica). J. Mar. Syst. 1998, 17, 411–424, doi:10.1016/S0924-7936(98)00052-9.

83. Guglielmo, L.; Granata, A.; Greco, S. Distribution and abundance of postlarval and juvenile Pleuragramma antarcticum (Pisces, Nototheniidae) off Terra Nova Bay (Ross Sea, Antarctica). Polar. Biol. 1997, 19, 37–51, doi:10.1007/s003000050214.

84. Cantone, G.; Castelli, A.; Gambi, M.C. Benthic polychaetes off Terra Nova Bay and Ross Sea: species composition, biogeography, and ecological role. In Ross Sea ecology. Italian Antarctic Expeditions (1986–1995), Faranda F.M., Guglielmo L., Ianora A Eds.; Springer: Berlin/Heidelberg, Germany, 2000; pp. 551–561. ISBN 978-3-642-64048-3.

85. Cattaneo-Vietti, R.; Chiantore, M.; Gambi, M.C.; Albertelli, G.; Cormaci, M.; Di Geronimo, I. Spatial and vertical distribution of benthic littoral communities in Terra Nova Bay. In Ross Sea Ecology: Italian Antarctic Expeditions (1987–1995); Faranda, F.M., Guglielmo, L., Ianora, A., Eds.; Springer: Berlin/Heidelberg, Germany, 2000; pp. 503–514 ISBN 978-3-642-59607-0.

86. Cattaneo-Vietti, R.; Chiantore, M.; Schiaparelli, S.; Albertelli, G. Shallow- and deep-water mollusc distribution at Terra Nova Bay (Ross Sea, Antarctica). Polar. Biol. 2000, 23, 173–182, doi:10.1007/s003000050024.

87. Cerrano, C.; Bavestrello, G.; Calcina, B.; Cattaneo-Vietti, R.; Sára, A. Asteroids eating sponges from Tethys Bay, East Antarctica. Antarct. Sci. 2000, 12, 425–426, doi:10.1017/S095410200000050X.

88. Cormaci, M.; Furnari, G.; Scammacca, B. The macrophytobenthos of Terra Nova Bay. In Ross Sea ecology. Italian Antarctic expeditions (1986–1995); Faranda, F.M., Guglielmo, L., Ianora, A., Eds.; Springer: Berlin/Heidelberg, Germany, 2000; pp. 493–502 ISBN 978-3-642-64048-3.

89. La MESA, M.; Vacchi, M.; Zunini Sertorio, T. Feeding plasticity of Trematomus neumeci (Pisces, Nototheniidae) in Terra Nova Bay, Ross Sea, in relation to environmental conditions. Polar. Biol. 2000, 23, 38–45, doi:10.1007/s003000050006.

90. Vacchi, M.; La MESA, M.; Greco, S. The coastal fish fauna of Terra Nova Bay, Ross Sea, Antarctica. In Ross Sea ecology. Italian Antarctic expeditions (1987–1995); Faranda, F.M., Guglielmo, L., Ianora, A., Eds.; Springer: Berlin/Heidelberg, Germany, 2000; pp. 457–468. ISBN 978-3-642-59607-0.

91. Chiantore, M.; Cattaneo-Vietti, R.; Elia, L.; Guidetti, M.; Antonini, M. Reproduction and condition of the scallop Adamussium colbecki (Smith 1902), the sea-urchin Sterechinus neumayeri (Meissner 1900) and the sea-star Odontaster validus Koehler 1911 at Terra Nova Bay (Ross Sea): different strategies related to inter-annual variations in food availability. Polar. Biol. 2002, 25, 251–255, doi:10.1007/s00300-001-0331-1.

92. Chiantore, M.; Guidetti, M.; Cavallero, M.; De Domenico, F.; Albertelli, G.; Cattaneo-Vietti, R. Sea urchins, sea stars and brittle stars from Terra Nova Bay (Ross Sea, Antarctica). Polar. Biol. 2005, 29, 467, doi:10.1007/s00300-005-0077-2.

93. Barry, J.P.; Grebmeier, J.M.; Smith, J.; Dunbar, R.B. Oceanographic versus seafloor-habitat control of benthic megaunal communities in the S.W. Ross Sea, Antarctica. Antarct. Res. Ser. 2003, 78, 327–354. doi: 10.1029/07ars21.

94. Trevisiol, A.; Bergamasco, A.; Montagna, P.; Sprovieri, M.; Taviani, M. Antarctic seawater temperature evaluation based on stable isotope measurements on Adamussium colbecki shells: kinetic effects vs. isotopic equilibrium. J. Mar. Syst. 2013, 126, 43–55, doi:10.1016/j.jmarsys.2012.10.012.

95. Sfriso, A.A.; Tomio, Y.; Rosso, B.; Gambaro, A.; Sfriso, A.; Corami, F.; Rastelli, E.; Corinaldesi, C.; Mistri, M.; Munari, C. Microplastic accumulation in benthic invertebrates in Terra Nova Bay (Ross Sea, Antarctica). Environ. Int. 2020, 137, 105587, doi:10.1016/j.envint.2020.105587.

96. Barrera, E.; Tevesz, M.J.S.; Carter, J.G. Variations in oxygen and carbon isotopic compositions and microstructure of the shell of Adamussium colbecki (Bivalvia). PALAIOS 1990, 5, 149–159, doi:10.2307/3514111.

97. Mazzoli, C.; Montagna, P.; Anderson, J.; Taviani, M.; Zorzi, F. Mineralogy of Antarctic Modern Biogenic Carbonates. In Proceedings of XII International Symposium on Antarctic Earth Sciences (ISAES), Goa, India, 13–17 July 2015.

98. Sethmann, I.; Wörheide, G. Structure and composition of calcareous sponge spicules: a review and comparison to structurally related biominerals. Micron 2008, 39, 209–228, doi:10.1016/j.micron.2007.01.006.

99. Rollion-Bard, C.; Cuif, J.-P.; Blamart, D. Optical observations and geochemical data in deep-sea hexa- and octo-corallia specimens. Minerals 2017, 7, 154, doi:10.3390/min7090154.

100. Dodd, J.R. Magnesium and strontium in calcareous skeletons: a review. J. Palaeontol. 1967, 41, 1313–1329.

101. Taviani, M.; Beu, A.; Lombardo, C. Pleistocene macrofossils from CRP-1 Drillhole, Victoria Land Basin, Antarctica. Terra Antarct. 1998, 5, 485–491.

102. Avallone, B.; Balassone, G.; Balsamo, G.; Di Giacomo, G.; Marmo, E.; Cusciello, M.G.; Motta, C.M.; Tammaro, S.; Filosa, S. The oothelis of the Antarctic teleost Trematomus bernacchii: scanning electron microscopy and X-Ray diffraction studies. J. Submicrosc. Cytol. Pathol. 2003, 35, 69–76.
103. Mayewski, P.A.; Bracegirdle, T.; Goodwin, I.; Schneider, D.; Bertler, N. a. N.; Birkel, S.; Carleton, A.; England, M.H.; Kang, J.-H.; Khan, A.; et al. Potential for Southern hemisphere climate surprises. J. Quat. Sci. 2015, 30, 391–395, doi:10.1002/jqs.2794.

104. Haumann, F.A.; Gruber, N.; Münnich, M.; Frenger, I.; Kern, S. Sea-ice transport driving Southern Ocean salinity and its recent trends. Nature 2016, 537, 89–92, doi:10.1038/nature19101.

105. Grange, L.J.; Smith, C.R. Megafaunal communities in rapidly warming fjords along the West Antarctic peninsula: hotspots of abundance and beta diversity. PLOS. ONE. 2013, 8, e77917, doi:10.1371/journal.pone.0077917.

106. Smith, W.O.; Sedwick, P.N.; Arrigo, K.R.; Ainley, D.G.; Orsi, A.H. The Ross Sea in a sea of change. Oceanography 2012, 25, 90–103.

107. McNeil, B.I.; Matear, R.J. Southern Ocean acidification: a tipping point at 450-Ppm atmospheric CO2. PNAS 2008, 105, 18860–18864, doi:10.1073/pnas.0806318105.

108. Orr, J.C.; Fabry, V.J.; Aumont, O.; Bopp, L.; Doney, S.C.; Feely, R.A.; Gnanadesikan, A.; Gruber, N.; Ishida, A.; Joos, F.; et al. Anthropogenic ocean acidification over the Twenty-First Century and its impact on calcifying organisms. Nature 2005, 437, 681–686, doi:10.1038/nature04095.

109. Gutt, J.; Bertler, N.; Bracegirdle, T.J.; Buschmann, A.; Comiso, J.; Hosie, G.; Isla, E.; Schloss, I.R.; Smith, C.R.; Tournadre, J.; et al. The Southern Ocean ecosystem under multiple climate change stresses—an integrated circumpolar assessment. Glob. Change. Biol. 2015, 21, 1434–1453, doi:10.1111/gcb.12794.

110. Gutt, J.; Isla, E.; Xavier, J.C.; Adams, B.J.; Ahn, I.-Y.; Cheng, C.-H.C.; Colesie, C.; Cummings, V.J.; Prisco, G. di; Griffiths, H.; et al. Antarctic ecosystems in transition—life between stresses and opportunities. Biol. Rev. 2021, 96, 798–821, doi:10.1111/brv.12679.

111. Servetto, N.; de Aranzamendi, M.C.; Bettencourt, R.; Held, C.; Abele, D.; Movilla, J.; González, G.; Bustos, D.M.; Sahade, R. Molecular Mechanisms Underlying Responses of the Antarctic Coral Malacobelemnon Daytoni to Ocean Acidification. Mar. Environ. Res. 2021, 105430, In Press, doi:10.1016/j.marenvres.2021.105430.