

The Italian National Antarctic Museum (MNA, Section of Genoa): a national heritage and a scientific resource for the study of Antarctic biological samples

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Abstract. The Italian National Antarctic Museum (MNA, www.mna.it) was established in 1996 with the aim of preserving the collections of Antarctic organisms, geological samples and ice samples that are acquired each year in the framework of the Antarctic expeditions of the Italian National Antarctic Program (PNRA). Beginning with the first Italian Antarctic expedition held in 1985, thousands of museum vouchers have been progressively acquired by MNA, now representing a valuable Italian heritage. The structure of the MNA is that of a consortium formed by the Universities of Genoa, Siena and Trieste, each one dedicated to different researches and activities: biology and ecology (Genoa), Earth sciences (Siena), history of Antarctic exploration and marine geology (Trieste). There are also seven Associated Sections that ensure the maintenance of specific collections, such as those of cultured organisms and ice cores, which require specific conservation conditions and study protocols. With the aim of increasing outreach activities and stimulate curiosity about the unique Antarctic living forms, the MNA has established a gallery of 3D models realized by using photogrammetric techniques. The MNA collaborates with the *Barcode of Life* consortium in order to better characterize the determinations of the species in its collections and share barcodes with the whole scientific community. Overall, in the past five years, the MNA was able to establish a variety of collaborations at the international level, gaining support of leading scientist and participating to initiatives at the international level.

Key words: Italian National Antarctic Museum, biological scientific collections, data sharing, international databases

Background

In 1981 Italy signed the Antarctic Treaty (issued in 1959) and started its activities in Antarctica in 1985 together with the establishment of the Italian National Antarctic Research Program (PNRA). Since 1985, multidisciplinary studies in different fields of science were conducted each year by research groups from different universities and public bodies, progressively assembling large collections of Antarctic biological, glaciological and geological materials.

The National Antarctic Museum (MNA), named after Felice Ippolito, a great scientist, communicator and first president of the Museum, was founded on the initiative of Minister Antonio Ruberti (Law 380, November 27 1991) with the precise aim of preserving, studying and enhancing the findings acquired during the Italian scientific expeditions in Antarctica and any other evidence of the Italian presence in Antarctica. The actual establishment of the Museum took place in May 2 1996 by decree of the Minister of University and Scientific and Technological Research

(Giorgio Salvini). The Museum has the structure of an inter-university center that includes the Italian Universities of Genoa, Siena and Trieste. Each one of these hosts a Museum Section with different competences, respectively: biology and ecology (Genoa), Earth sciences (Siena), history of Antarctic exploration and marine geology (Trieste). There are also seven MNA Associate Sections, located in different Italian cities, specialized in the conservation of peculiar collections such as fungal and bacterial strains, ice cores, etc, which require specific conservation conditions and study protocols. The Museum is also entrusted with the task of promoting the dissemination of the results of the scientific activity carried out in Antarctica.

The biological collections

The biological collections of the MNA of the Genoa section have increased every year thanks to the acquisition of: i) new materials collected in Antarctica during the last expeditions; ii) 'historical' materials collected in Antarctica during the first expeditions (i.e. between 1985-1995), before the MNA establishment, that were deposited in different institutions; iii) materials entrusted to the MNA by foreign research bodies such as the *Alfred Wegener Institute* (AWI, Germany), the *British Antarctic Survey* (BAS, UK), the *National Institute of Water and Atmospheric Research* (NIWA, New Zealand) and the *Muséum national d'Histoire naturelle* (MNHN, France), with which the MNA has constant collaborations and specimens' exchanges for determination and molecular characterization. Since 2016 the number of newly acquired materials increased at a constant annual rate of 10%, reaching in 2020 more than 13,300 vouchers of animals and vegetal organisms, both marine and terrestrial, in the sole Genoa Section. Out of the seven associated collections, four belong to the MNA Genoa section:

The *Banca Campioni Ambientali Antartici* (BCAA), established in 1995 to preserve samples for chemical analyses aimed at studying the possible presence and evolution of dangerous substances for man and the environment. It is hosted by the Department of Chemistry and Industrial Chemistry of the University of Genoa and became part of MNA in 2006.

The BCAA holds 205 lots of frozen biological specimens (at -20°C and -80°C) for a total of 6,664 fish and invertebrate specimens.

The *Culture Collection of Fungi From Extreme Environments* (CCFEE), established in 2006 at the Laboratory of Systematic Botany and Mycology of the Department of Ecological and Biological Sciences (DEB), University of Tuscia, Viterbo, Italy. This collection includes Antarctic rocks colonized by fungi and fungal crops isolated from the rocks. It currently maintains 227 fungal strains, comprising "extremophile" taxa characterized by a cryptotendolytic life style.

The *Italian Antarctic Bacteria Collection* (CIBAN), established in 1990 at the Messina University, which became part of the MNA in 2006. It maintains 516 bacterial strains, mainly isolated from water samples and sponges, taken during various Italian expeditions to Antarctica. This is one of the few collections in the world dedicated to heterotrophic Antarctic bacteria.

The collection of Antarctic lichens, established in 1989 at the University of Trieste, which became part of the MNA in 2006. This collection includes 916 samples of Antarctic lichens from the Terra Vittoria area.

The MNA vouchers may be preserved in ethanol, formalin, frozen (-20°C) or dried, depending on the type of organism or the history of the sample. Together with the acquisition of new biological materials, the number of associated samples, such as permanent slides, scanning microscopy (SEM) stubs and tissue samples for genetic analysis, is also constantly increasing. The MNA is equipped with a modern laboratory with chemical hoods, safety cabinets for reagents and counters with microscopes, binoculars, etc. to allow visiting scholars and students of the University of Genoa to work on the MNA collections for their research or theses. The MNA Genoa section also has a library where all the data report and scientific literature published since the first scientific explorations of Antarctica is available in original. The vouchers of the collection are constantly checked to assess and verify their conservation status.

The collection valorization in an international context

Since 2010, the MNA has tried to actively disseminate at the international level information about

its collections and preserved species, in accordance to the Article III of the Antarctic Treaty, which provides that “*scientific observations and results from Antarctica shall be exchanged and made freely available*” (1).

The first step that was done was the sharing, through the portal “*Antarctic Field Guides*” which aims to provide the general public (not only scientists) with good quality referenced information and iconography of the main Antarctic species, of photographs of Antarctic species corresponding to MNA’s vouchers. The MNA was co-founder of this project (<http://afg.biodiversity.aq/about>) and provided dozens of images, mainly related to the Porifera. Users of this online resource can also create their own ‘virtual book’, selecting the species of interest, and print it in pdf format. Some examples of guides already available can be found at the link: <http://afg.biodiversity.aq/guides>.

The next step, and most important for the valorization of the MNA collections, was the publication of species distribution data in the form of *Data Papers* (2). The publication of data in this format requires adherence to standard biodiversity data protocols such as the *DarwinCore* format and the *Integrated Publishing Toolkit* of the *Global Biodiversity Information Facility* (GBIF-IPT, <https://www.gbif.org/ipt>), as well as a series of quality control and cross-checks that are detailed in the example of Fig. 1. The Scientific Publisher *Pensoft* (<https://pensoft.net>) offers a number of *open access* journals, such as *Zookeys*, which accept this type of contribution. The data is published under the *Creative Commons Attribution License* (CC BY 4.0), which allows freedom of reproduction, distribution, transmission of data, as long as the author of the work is appropriately named. Starting in 2013, the MNA has thus undertaken a systematic activity of publishing its collections in the form of *Data Papers*, publishing to date 9 contributions related to: Mollusca (3), Tanaidacea (4), Fungi (5), Ophiuroidea (6), Porifera (7), Bryozoa (8), Rotifera (9), Copepoda (10), plus an online dataset about the microbial strains curated by the MNA associated collection “CIBAN” (<https://www.gbif.org/dataset/f7034999-7c7a-45f3-ab30-5f6d1f0e6a64>).

Through this operation, the museum vouchers preserved at the MNA are worldwide visible and the MNA itself appears on GBIF as a *data provider* (GBIF,

<http://www.gbif.org/dataset/search?q=mna>). With this type of publications, the MNA is permanently sharing its distributional data with the scientific community (data can all be accessed here: https://www.gbif.org/dataset/search?publishing_org=4c882fee-876a-4b32-b218-67b2bdd42579).

In order to bring the public closer to Antarctic themes, in 2017 it was launched a gallery of 3D models of Antarctic organisms in order to show the biology, ecology but also beauty of Antarctic species. The virtual gallery of 3D models of the MNA, based on photogrammetric reconstructions of organisms, can be found on Sketchfab, in the Cultural Heritage section (Fig. 2). Other 3D models obtained through microtomography have been published (in the form of short videos) in Cecchetto et al. (6) and Ghiglione et al. (3) and can be also seen on youtube (e.g. https://www.youtube.com/watch?v=Sq6au-_CHy0&feature=youtu.be). The technical details of the 3D models are given in the materials and methods of these two works.

In 2011 the MNA started to collaborate with the *Barcode of Life* (<http://www.barcodeoflife.org>) in order to archive sequences of species conserved in the collection and studied in research projects funded by PNRA. Through this collaboration and the continuous exchange of specimens for molecular characterization, the MNA was able to relate with various research groups at an international level, establishing new collaborations and obtaining various benefits such as:

- i) the classification of new species for which there are no experts in Italy (11);
- ii) the classification of specimens also on a molecular and not only morphological basis thanks to the coordination of barcoding activities and the sharing of sequences (12);
- iii) the acquisition in its collections also of Antarctic materials collected in the framework of non-Italian expeditions.

On the whole, the series of activities mentioned above have allowed the MNA to obtain, in a few years, a leading role recognized at the international level in conserving biological scientific samples for current researches and for the next generations.

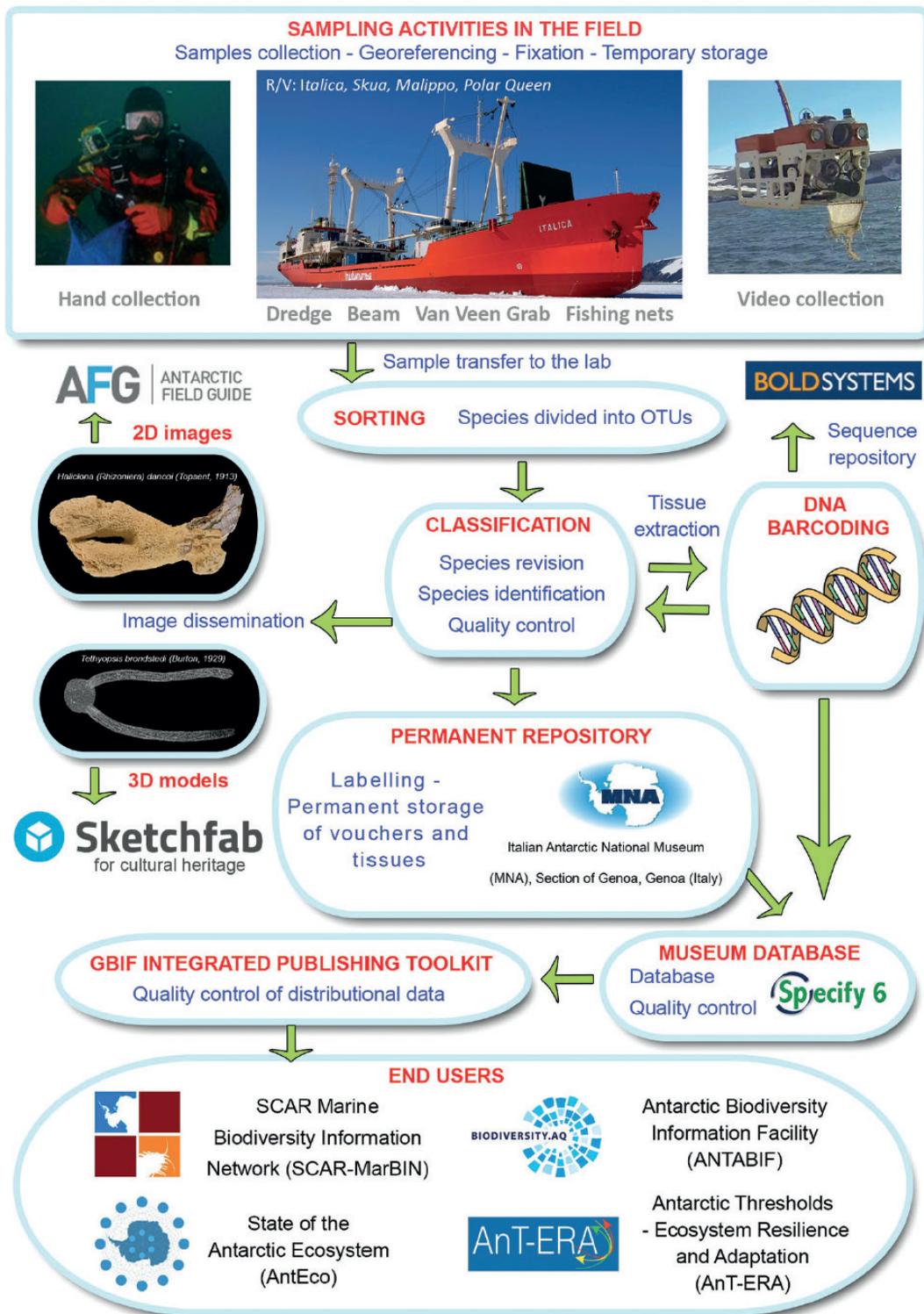


Figure 1. Example of ‘flow-chart’ concerning the processes of acquisition and management of finds at the National Antarctic Museum (Genoa headquarters) (from Ghiglione et al., 2018)



Emperor penguin - *Aptenodytes forsteri* (chick)

3D Model



MNA (Italian National Antarctic Museum) PREMIUM

FOLLOW

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Figure 2. The 3D model of Emperor Penguin (*Aptenodytes forsteri* G. R. Gray, 1844, MNA-09151) visible on Sketchfab (<https://sketchfab.com/MNA>)

References

1. Antarctic Treaty, signed in Washington on 1 December 1959, entered into force in 1961. <https://www.ats.aq/e/ats.htm>.
2. Penev L, Mietchen D, Chavan V, Hagedorn G, Smith V, Shotton D, Tuama ÉÓ, Senderov V, Georgiev T, Stoev P, Groom QJ, Remsen D, Edmunds SC, Groom Q. Strategies and guidelines for scholarly publishing of biodiversity data. *Research Ideas and Outcomes (RIO)* 2017; 3:e12431.
3. Ghiglione C, Alvaro MC, Griffiths HJ, Linse K, Schiaparelli S. Ross Sea Mollusca from the Latitudinal Gradient Program: R/V *Italica* 2004 Rauschert dredge samples. *ZooKeys* 2013; 341: 37-48.
4. Piazza P, Blazewicz-Paszkowycz M, Ghiglione C, Alvaro M, 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.
5. Selbmann L, Onofri S, Zucconi L, Isola D, Rottigni M, Ghiglione C, Piazza P, Alvaro MC, Schiaparelli S. Distributional records of Antarctic fungi based on strains preserved in the Culture Collection of Fungi from Extreme Environments (CCFEE) Mycological Section associated with the Italian National Antarctic Museum (MNA). *MycKeys* 2015; 10:57-71.
6. Cecchetto M, Alvaro MC, Ghiglione C, Guzzi 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): checklist update of the group in the Terra Nova Bay area (Ross Sea) and launch of the MNA 3D model 'virtual gallery'. *ZooKeys* 2017; 705:61-79.
7. Ghiglione C, Alvaro MC, Cecchetto M, Canese S, Downey R, Guzzi A, Mazzoli C, Piazza P, Rapp HT, Sarà A, Schiaparelli S. Distributional records of Antarctic Porifera from samples stored at the Italian National Antarctic Museum (MNA), with an update of the checklist for the Terra Nova Bay area (Ross Sea). *ZooKeys* 2018; 758:137-56.

8. Cecchetto M, Lombardi C, Canese S, Cocito S, Kuklinski P, Mazzoli C, Schiaparelli S. Bryozoa collection of the Italian National Antarctic Museum (MNA), with an updated checklist from Terra Nova Bay (Ross Sea). *Zookeys* 2019; 812:1-22
9. Garlaschè G, K. Karimullah N, Iakovenko A, Velasco-Castrillón K, Janko R, Guidetti L, Rebecchi M, Cecchetto, Schiaparelli S, Jersabek CD, De Smet WH, Fontaneto D. A data set on the distribution of Rotifera in Antarctica. *Biogeographia* 2020; 35:17-25.
10. Bonello G, Grillo M, Cecchetto M, Giallain M, Granata A, Guglielmo L, Pane L, Schiaparelli S. Distributional records of Ross Sea (Antarctica) planktonic Copepoda from bibliographic data and samples curated at the Italian National Antarctic Museum (MNA): checklist of species collected in the Terra Nova Bay area (western Ross Sea) from 1987 to 1995. *Zookeys* 2020; 969:1-22.
11. Verheye ML, Loerz AN, d'Acoz CU. *Epimeria cleo* sp. nov., a new crested amphipod from the Ross Sea, Antarctica, with notes on its phylogenetic affinities (Crustacea, Amphipoda, Eusiroidea, Epimeriidae). *Zootaxa* 2018; 4369(2):186-96.
12. Alvizu A, Eilertsen MH, Xavier JR, Rapp HT. Increased taxon sampling provides new insights into the phylogeny and evolution the subclass Calcaronea (Porifera, Calcarea). *Org Divers Evol* 2018; 18(3):279-90.

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