The research activities at the Museo delle Scienze
Report 2014-2015
THE RESEARCH ACTIVITIES
AT THE MUSEO DELLE SCIENZE
REPORT 2014-2015

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MUSE - Museo delle Scienze/Science Museum has been inaugurated on 27th July 2013 and visited to December 2015 from over 1,200,000 people. Opening the new museum completed a transition process that lasted almost 10 years and that involved all the staff, with the research area taking a leading role in defining the scientific contents of the new museum. MUSE is the first museum in Italy that harmoniously blends nature, science and technology.

The building’s outline, designed by the world-famous architect Renzo Piano, recalls the profile of the surrounding mountains, with a finely balanced contrast between empty and full spaces that adds charm and prestige to the entire exhibition venue. Built on eco-compatible criteria, MUSE is a model that sets the standard for a green economy and for energy saving.

MUSE combines characteristics from both traditional natural science museums and modern science centres in a very innovative way. This brand-new layout is enriched by a strong social characteristic that underpins its vocation as a meeting place providing dialogue with visitors. To enhance local background and knowledge, acting as a social venue where people can discuss issues of global importance is the cultural objective of MUSE.

MUSE is a big open space where scientific and technological knowledge are the means used to study the relationship between man and the environment, and at the same time to provide updated information on the available choices for sustainable development. Multi-media exhibits, interactive games, hands-on experiments and the practical mixing of culture with DIY are the informal educational tools with which visitors can join the scientific debate about important local and global issues. Specimens and objects exhibited outside glass boxes (“objects at hand”) represent one of the innovative museology designs chosen to solicit visitors’ curiosity and empathic feelings.

The ultimate aim of the new museum is to be a centre of cultural interpretation at the service of society, dedicated to nature and to the promotion of sustainability, science and innovation. MUSE addresses local population by inspiring citizens but it is at the same time an extraordinary venue for cultural tourism from all over the world.

The forecast scenarios and the development programmes promoted by the European Union within the framework of the Europe 2020 programme have identified three main axes, i.e. economy, environment and society, along which to build the idea of the future of our continent. MUSE is aligned with these three pillars, as it has elected as primary feature of its philosophy the dialectic and constructive relationship between development and environmental sustainability in connection with the contemporary society.

To learn how our environment has changed since the beginning of history to our present times means to understand a journey of over 200,000 years, which involves the joint evolution of humanity’s technological skills and its relationship with nature and the landscape. This is one of the strongest and most innovative conceptual focuses of MUSE. In this respect the exhibition floor dedicated to prehistory with its succession of themes and experiences that are totally new to the international museum scene, presents a refreshingly simple and direct viewpoint.

Reflection, experimentation, a cue for the visitor to return and acquire new educational experience and informal knowledge: MUSE targets a very wide range of visitors by choosing not to focus on a specific age group. MUSE supports tourism by attracting visitors who wish to discover the thousands of relations between the MUSE’s themes and the Alpine territory, and in particular curious and attentive families, that are a must in the museum’s tradition, and school groups that find an extraordinary good educational tool in the many exhibitions and workshops offered. All this will help understand the paths to be followed in the fields of energy and of respect and conscious use of natural resources, widening the view of individuals to encompass what new technology and biotechnology we could develop in the future, so as to take steps towards a harmonious symbiosis between mankind and the environment. This is where the investment in future generations begins.

MUSE manages, in addition to the main museum in Trento, a whole network of centres for scientific dissemination, established during the
last 70 years. In Trentino there are six Satellite Branches (Alpine Botanical Garden, Astronomical observatory "Terrazza delle stelle", Geological Museum of the Dolomites, “Gianni Caproni” Aeronautical Museum, Pile-dwelling Museum of Lake Ledro, Lake Tovel Limnological Centre). In addition the MUSE has special agreement locations (Arco Arboretum, Centre for Studies Adamello "Julius Payer", The Garibaldi Bezzecca Historical Museum, Visitor Centre "Monsignor Ferrari"). In Tanzania, MUSE manages the Udzungwa Ecological Monitoring Centre, a field station annexed to a national park of outstanding biodiversity importance.

The research area
MUSE is organized in four Areas managed by the General Directorate and the Administrative Directorate: Cultural mediation, naturalistic Research, Museum Territorial branches, General Services. Each area manages different departments as shown in the picture.

The MUSE has grown and evolved over time, and specifically it comprises about 90 employees, of which 24 in the research staff, in addition to more than 150 collaborators with different non-permanent contract types. The seven research sections (= Research Units) - Botany, Limnology and Phycology, Invertebrate Zoology and Hydrobiology, Vertebrate Zoology, Tropical Biodiversity, Geology, Prehistory, carry out the traditional natural science disciplinary research activities, both basic and applied, in the field of the environment, however they are commonly dedicated to the issue of biodiversity and ecology of mountain ecosystems. Our research in this area concerns the documentation and mo-
monitoring of species and communities that are sensitive to environmental and climate change as key components of biodiversity in the mountains (alpine, tropical and sub-tropical).

In the realm of Earth and Landscape Sciences, the museum explores the geology, morphology, and hydrology of the Alpine region in order to document and reconstruct its evolution; it analyses the aspects related to the evolution of living organisms (vertebrate and invertebrate fossils) over geological time and studies the relationship between man and environment in an alpine setting during the period between the Late Glacial and ancient Holocene. In addition to the well-established educational activities inherent its institutional tasks, MUSE has an important role in the communication and dissemination of both scientific and environmental culture, in order to foster the cultural, social and economic development of well-rooted local communities and the re-emergence of identity processes in the environmental field.

Part of the about 5,000 m² surface of gallery devotes exhibits to the field of nature and biodiversity with special regards to the research activities of the MUSE and other local institutes, providing the diffusion of scientific data to the public in form of easily accessible contents. Visitors may see and meet researchers at work every day (thanks to the glass walls) and meet researchers, every day, in the four “Open Labs” located at the first floor of the gallery. Laboratories are devoted to different disciplines (from hydrobiology to botany, entomology, palaeontology, geology, vertebrate zoology), they are designed to profile MUSE researchers, master and Ph.D. students and display the relevance of their work to the public.

In the biennium 2014-2015 the MUSE promoted and participated to several research projects in collaboration with local research institutes especially with the Edmund Mach Foundation, the Kessler Foundation and the University of Trento in response to the Trento Province’s request to enhance cooperation on common research topics. The national and international collaborations with other museums and research institutes has also increased, with the boosting of large-scale research programmes in Europe and Africa in the fields of biodiversity assessment, sustainable development, environmental education.

The report provides quantitative indicators of such research activities referred to period 2014-2015, with a focus on the main results published in scientific journals. The care of MUSE’s collections that originate from the research has contributed to increase the relevance of such results (at present about 5 millions of specimens/items are hosted in the museum). Furthermore, our researchers are supported by the a team of scientific communicators, engaged in the dissemination of research results to citizens and stakeholders. Thus, this report provides also outreach activities performed in collaboration with the scientific communicators.

In conclusion, I am grateful to all the personnel who contributed with constant care, dedication, enthusiasm and professionalism to the performance of the MUSE, included the administrative employees. A special mention goes to the Provincia Autonoma di Trento (Autonomous Province of Trento) for its financial support to our research programmes and to all the sponsors who supported our activities in the last two years.

Michele Lanzinger
Director of the MUSE
MUSE - Museo delle Scienze is a new building designed by the world-famous architect Renzo Piano. The building's outline recalls the profile of the surrounding mountains, with a finely balanced contrast between empty and full spaces that adds charm and prestige to the entire exhibition venue. Built on eco-compatible criteria, MUSE is a model that sets the standard for a green economy and for energy saving.

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The research programmes
MUSE – Museo delle Scienze traces back its origin in the mid XIX century, while only in 1964 it was established with the current asset. Throughout this period it progressively evolved into a modern museum, dedicated to research, visitor interpretation and education. Research at MUSE is articulated around two mainstream areas: a multidisciplinary investigation of nature and an interest for science interpretation, education and training, based on the interconnection between nature science and society.

Environmental research focuses mainly on the Alpine region, and aims at attaining both local and global relevance, trying to be effective, integrated and useful to the local community and research area but also strategically placed at European level in key research networks, valuing international research cooperation and participation to consortia and competitive projects, delivering research products relevant at global level. Since 2008 however, research on mountain ecosystems of other areas of the world has begun, especially in biodiversity-rich mountain forests of eastern Africa.

Research on the public communication of science continuously develops new means to raise public awareness on the alpine environment, promoting the sustainable use of its resources, necessary to grant an environmentally friendly development of the local society, highlighting local assets and natural heritage, promoting public understanding of science. The role of the new science museum MUSE is to investigate and explain nature using scientific tools, addressing the challenges posed by the modern times and promoting the values of science, innovation and sustainable development.

Environmental research is increasingly called to inform the public, including the administrators, on scientifically-sound ways to manage the environment. MUSE has an exceptional potential towards this goal, as it is one of the few institutions in the Trento Province that can use its vast documentation knowledge on nature to address key issues of landscape and biodiversity planning and management.
Macroarea Biodiversity and Ecology

The MUSE’s studies on biodiversity involve the integration between ecological, physiological and molecular data of plants (algae and higher plants) and animals (arthropods and vertebrates), both at individual, population and community level, with the main aims of:

1. Assessing the ecological factors influencing the biogeographic and evolutionary patterns of species distribution and model communities;
2. Defining the population dynamics and evolutionary processes of plant and animal species in mountainous areas;
3. Analysing the data collected in order to predict how model organisms and communities will respond to climate change and environmental issues;
4. Finalizing the realization of tools aimed to the understanding of the impact of human activities on landscapes and to estimate the resilience of natural systems to the anthropization processes;
5. Identifying the factors that determine and affect biodiversity patterns both at local and global levels, and produce maps of potential biodiversity;
6. Providing stakeholders with new tools and methods for the management and conservation of habitats and species;
7. Performing actions aimed to the mitigation of adverse environmental impacts and to the re-naturalization of habitats;
8. Developing cultural and scientific tools in order to promote and disseminate the concept of a knowledge-based sustainable development.

A critical assumption of our interdisciplinary approach is the long-standing experience of the museum biological Research Unit in biodiversity documentation through the aggregation of
data in specific databases, production of scientific publications and scientific and technical reports (e.g. Red Lists, Check Lists, Action Plans, management and conservation plans). Furthermore the combination of these skills and their integration in the study of ecosystems, contributes to the study of landscape outlined below. This field of research pertains to the macroarea “Earth and Landscape Sciences”.

**Macroarea Earth Sciences and Landscape**

Economic development and quality of life (understood as a form of social development), are closely related to the quality of the environment. Research projects pertaining to this area aim to a better understanding of the geological structure, soil properties and land use of the region, and investigate recent and past changes in climatic and environmental conditions of the area. The classification of the territory in forestry areas, agricultural zones, settlements and infrastructural areas is reformulated in terms of “quality”. This scheme allows a new representation of the units according to an eco-functional approach to the study of the landscape. This moves towards the development of a model in which the ecomosaic of natural biotic and abiotic components (past, present, future) interact with anthropogenic ones. As far as we are concerned, the latter are related to the traditional use of the soils, the presence of diffuse cultural entities, parks and protected areas, to the systems of interpretation and evaluation of these units. The goals of this area are therefore:

1. To define the main components of the alpine landscape, its geological structure and past environments and ecosystems. This includes the study of present and past transformations and of the processes that have led to the most relevant changes;
2. To investigate the main features of the extant alpine landscape with reference to both instances of equilibrium and situations characterized by change (on different scales and times). This is carried out with special focus to the agents and dynamics of transformation;
3. To summarize the features of the alpine landscape and to track their changes over time.
MUSE is recognized as a research centre of excellence in the following themes:

- **Documentation and conservation of alpine flora and fauna, both terrestrial and freshwater.** These studies aim to assess and monitor the biodiversity in Trentino, create databases (which are mainly of insects and vertebrates), checklists, red lists and use these data to realize predictive models of spatial patterns of distribution in both natural and protected areas and urban areas. Such research has relevant implications for conservation because it provides knowledge used to make landscape management plans.

- **Effects of climate and environmental change on natural ecosystems and alpine biodiversity.** It consists in basic and applied researches aimed to test the effect of natural and anthropogenic impacts on alpine biodiversity, to model trends in biodiversity, to define new bioindicators of ecosystem quality, and to evaluate the species extinction risks. The researches developed on springs, glacial rivers, glacier forelands and rock glaciers have national and international relevance due to the ongoing global warming and consequent glacier retreat. These researches help to implement the algae and entomological collections.

- **Ex situ conservation, propagation, cultivation and reintroduction of alpine plant species (seed bank).** The researches maintain a long term seeds conservation centre in Trentino for endangered alpine species, crop wild relatives and neglected crops varieties. Tropical species are also in collection together with the local species enhancing the international value of the MUSE seed bank.

- **Biological diversity and conservation of tropical and sub-tropical regions.** These researches originate from the assessment of the forest vertebrate diversity of poorly known or even previously unexplored areas, and subsequently they involve analysis of biogeographic and speciation patterns, as well as focal, species-level studies, especially on mammals, on abundance estimation, ecological modeling, temporal monitoring and conservation. Most of the research and conservation activities are conducted in Tanzania’s Eastern Arc Mountains, one of the top global biodiversity hotspots. Here MUSE has a field station annexed to the Udzungwa Mountains National Park.

- **Palaeontology and palaeoichnology.** This project aims to quantify the abundance and study the relationships of dinosaurs and other terrestrial reptiles in Trentino and surrounding regions. Specific actions involve the identification of new palaeontological sites and the development of new conservation actions and valorisation projects.

- **Geodiversity.** This project aims at documenting local geodiversity in order to understand the relation between the natural environment and the dynamics of anthropic modification. These actions have high social relevance, in particular when associated with geological mapping and assessments of geological hazard.

- **Speleothems and cave waters.** These projects aim to track past climatic oscillations in Trentino by means of sampling the calcite deposited in the caves, the underground waters and the hypogaeal soils in the Province.

- **Prehistory.** These mainly refer to researches on the first human peopling of the Alps (Late Glacial and early Holocene), which highlight the close relationship between the patterns of land use and social organization of human groups and the reconstruction of ancient landscapes. The abundant examples of mobilary prehistoric art discovered in prehistoric sites of Trentino are of particular value.
**Interconnections between scientific and technological innovations and social implications**, focusing especially on sustainability issues of the sciences of life and its applications. This research is based on international networks. The aim is to enhance the role of MUSE to operate as a venue that brings culture and science together in a deliberative space, i.e. a ‘agora’ hosting dialogues where producers, policy makers and users of the scientific innovation can meet and directly face, and where science of culture and cultures of science become visible.

MUSE’s research work has a strong impact on the local context, for its vocation to provide recommendations relevant to environmental management, valuing nature for tourism, and public engagement in science. MUSE’s researchers work alongside with professionals and administrators linked to the Autonomous Province of Trento, contributing with environmental impact assessments and the provision of wildlife and protected area management plans.
The research staff and activities
Seven Research Unit are involved in research activities:

<table>
<thead>
<tr>
<th>Research Unit</th>
<th>Chief Curator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botany</td>
<td>Costantino Bonomi</td>
</tr>
<tr>
<td>Geology</td>
<td>Marco Avanzini</td>
</tr>
<tr>
<td>Invertebrate Zoology and Hydrobiology</td>
<td>Valeria Lencioni</td>
</tr>
<tr>
<td>Limnology and Phycology</td>
<td>Marco Cantonati</td>
</tr>
<tr>
<td>Prehistory</td>
<td>Giampaolo Dalmeri</td>
</tr>
<tr>
<td>Tropical Biodiversity</td>
<td>Francesco Rovero</td>
</tr>
<tr>
<td>Vertebrate Zoology</td>
<td>Paolo Pedrini</td>
</tr>
</tbody>
</table>

Each Research Unit (Section) is represented by a curator (with the role of coordinator) and a variable number of technicians and researchers (Table 1; Appendix 1). A staff of 7 scientific communicators support the scientific sections (Appendix 2).

Table 1 - Research staff in 2014-2015 (as full time equivalent).

<table>
<thead>
<tr>
<th>Research staff</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curators - chief-researchers, Section coordinators</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Researchers</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>Technicians</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Science communicators</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45</strong></td>
<td><strong>39</strong></td>
</tr>
</tbody>
</table>

In Table 2 and Appendix 3 data referred to teaching and research activity carried out in 2014/2015 are given.

Table 2 - Quantitative data on research and teaching activities (2014-2015).

<table>
<thead>
<tr>
<th>Research and teaching activities (2014-2015)</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research projects</td>
<td>57</td>
</tr>
<tr>
<td>Seminars c/o Universities and Museums and Teaching activity</td>
<td>27</td>
</tr>
<tr>
<td>In-house workshops and congresses organization</td>
<td>10</td>
</tr>
<tr>
<td>Congresses and training courses attendance</td>
<td>91</td>
</tr>
<tr>
<td>Ph.Ds</td>
<td>19</td>
</tr>
<tr>
<td>Masters and degrees</td>
<td>34</td>
</tr>
<tr>
<td>Field training/Summer schools</td>
<td>6</td>
</tr>
<tr>
<td>Stages-secondary school students</td>
<td>29</td>
</tr>
<tr>
<td>Volunteers</td>
<td>9</td>
</tr>
<tr>
<td>Public activities</td>
<td>159</td>
</tr>
<tr>
<td>Exhibitions</td>
<td>9</td>
</tr>
</tbody>
</table>

About 145 scientific papers have been produced in 2014-2015 by the MUSE research staff (see Table 3 and Appendix 4).
Table 3 - Number of publications by MUSE researchers (2014-2015).

<table>
<thead>
<tr>
<th>Type of Publication</th>
<th>Nr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific papers on ISI journals</td>
<td>93</td>
</tr>
<tr>
<td>Scientific papers on non-ISI journals</td>
<td>45</td>
</tr>
<tr>
<td>Books or book chapters</td>
<td>13</td>
</tr>
<tr>
<td>Popular science papers</td>
<td>15</td>
</tr>
<tr>
<td>Oral communications (with published abstract)</td>
<td>62</td>
</tr>
<tr>
<td>Oral communications (without published abstract)</td>
<td>28</td>
</tr>
<tr>
<td>Posters (with published abstract)</td>
<td>46</td>
</tr>
<tr>
<td>Posters (without published abstract)</td>
<td>3</td>
</tr>
<tr>
<td>Project reports</td>
<td>25</td>
</tr>
</tbody>
</table>

Among the outputs of the MUSE research activities are the following scientific journals edited by the MUSE: Preistoria Alpina (since 1963), Studi Trentini di Scienze Naturali (since 1926), Monografie del Museo Tridentino di Scienze Naturali (since 2004) and Quaderni del Museo Tridentino di Scienze Naturali (since 2007). The scientific committee is represented by curators of the MUSE and Italian and foreign experts in the different disciplines. Every two years the MUSE Research Staff edit the Research activity Report.

As a mean in the last 5 years, about 1,000 pages/year have been published. In 2014-2015, 7 volumes were printed for a total of 1,416 printed pages (Table 4).

Table 4 - Publications edited by MUSE in 2014-2015.  
Eng= in English; Ger= in German; Fre= in French

<table>
<thead>
<tr>
<th>Journal, volume</th>
<th>Title</th>
<th>N. pages</th>
<th>N. contributes (of which in foreign language)</th>
<th>N. authors</th>
<th>Print year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atti del convegno di Trento, XVII Convegno Italiano di Ornithologia</td>
<td>164</td>
<td>47 (5 in Eng)</td>
<td>132</td>
<td>2015</td>
<td></td>
</tr>
<tr>
<td>Studi Trentini di Scienze Naturali, 94</td>
<td>16th International Conference of the International Bryozoological Association</td>
<td>304</td>
<td>30 (Eng)</td>
<td>63</td>
<td>2014</td>
</tr>
<tr>
<td>Preistoria Alpina, 47</td>
<td>Miscellany and Proceedings of UISPP &quot;Occupazioni Umane in Ambienti Montani&quot;</td>
<td>336</td>
<td>23 (9 Eng, 1 Fre, 1 Ger)</td>
<td>45</td>
<td>2014</td>
</tr>
<tr>
<td>Natura alpina, 62, Fasc. 3-4.2011</td>
<td>Miscellany</td>
<td>126</td>
<td>16</td>
<td>16</td>
<td>2014</td>
</tr>
<tr>
<td>Natura alpina, 64, Fasc. 1-2.2013</td>
<td>Miscellany</td>
<td>126</td>
<td>10</td>
<td>9</td>
<td>2014</td>
</tr>
<tr>
<td>Book - MUSE ed.</td>
<td>The research activities at the Museo delle Scienze (2012-2013)</td>
<td>152</td>
<td>10 (Eng)</td>
<td>10</td>
<td>2014</td>
</tr>
<tr>
<td>Quaderni del Museo delle Scienze, 3 (2.ed)</td>
<td>La fauna del suolo</td>
<td>208</td>
<td>7</td>
<td>2015</td>
<td></td>
</tr>
</tbody>
</table>

Overall, the MUSE has collaborated with about 50 research institutions, museums, and scientific associations in Italy and abroad (Table 5, Appendixes 5, 6).
The research activities at the Museo delle Scienze: Report 2014-2015

Table 5 - Number of collaborations of the research staff of MUSE in 2014-2015.

<table>
<thead>
<tr>
<th>Type of Collaborations</th>
<th>In Italy</th>
<th>Abroad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreements (with financial support)</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Memorandum of Understanding (without financial support)</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Partnerships</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Others (co-authorship, free consultancies, etc.)</td>
<td>37</td>
<td>33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>72</strong></td>
<td><strong>55</strong></td>
</tr>
</tbody>
</table>

Funds for research activities amount at 3,407,158.19 Euros in 2014 and at 2,354,588.51 Euros in 2015.
The research activities were financed mainly by the Autonomous Province of Trento (PAT) as reported in Tables 6 and 7.

Table 6 - Funds for research activities (2014-2015).

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grant-in-aid by PAT – Research Service</td>
<td>2,525,000.00</td>
<td>1,475,000.00</td>
</tr>
<tr>
<td>PAT – other Services</td>
<td>4,005.00</td>
<td>74,005.00</td>
</tr>
<tr>
<td>Other revenues</td>
<td>878,153.19</td>
<td>805,583.61</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,407,158.19</strong></td>
<td><strong>2,354,588.61</strong></td>
</tr>
</tbody>
</table>

Table 7 - MUSE research funds: trend in the last 5 years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Grant-in-aid by PAT</th>
<th>Other revenues</th>
<th>% Other revenues/Grant-in-aid by PAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>1,990,000.00</td>
<td>647,962.55</td>
<td>25%</td>
</tr>
<tr>
<td>2012</td>
<td>2,134,700.00</td>
<td>751,233.80</td>
<td>26%</td>
</tr>
<tr>
<td>2013</td>
<td>2,701,080.00</td>
<td>742,438.25</td>
<td>22%</td>
</tr>
<tr>
<td>2014</td>
<td>2,525,000.00</td>
<td>882,158.19</td>
<td>26%</td>
</tr>
<tr>
<td>2015</td>
<td>1,475,000.00</td>
<td>879,588.61</td>
<td>37%</td>
</tr>
</tbody>
</table>
The figure shows the repartition of the research projects by the following three sources of revenue:
- institutional projects: supported by the Grant-in-aid;
- grant-based projects: financed by PAT or other institutions through grant competitions;
- on agreement projects: financed within an agreement subscribed with other institutions for research consultancies or services.

Financial data were compiled by the administration staff (Massimo Eder, Denise Eccher).
The scientific collections
The natural history and archaeological collections of the Museo delle Scienze (about 300 collections and 5,5 millions objects) are of great interest for their close relationship with the Trentino area. Besides the objects of local origin, there are many specimens coming from the rest of Italy and from foreign countries, obtained through donations, travels, exchanges and research expeditions abroad. The oldest materials were collected more than two centuries ago and the collections increase every year through many new acquisitions. As vouchers of the natural and human diversity in time and space, the collections are precious research infrastructures, always available to the research community.

<table>
<thead>
<tr>
<th>Sections</th>
<th>N. collections</th>
<th>Objects estimated</th>
<th>Items/specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botany</td>
<td>48</td>
<td>150,000</td>
<td>370,000</td>
</tr>
<tr>
<td>Geology</td>
<td>8</td>
<td>17,800</td>
<td>42,000</td>
</tr>
<tr>
<td>Invertebrate Zoology</td>
<td>17</td>
<td>4,600</td>
<td>1,800,000</td>
</tr>
<tr>
<td>Limnology and Phycology</td>
<td>12</td>
<td>8,700</td>
<td>12,500</td>
</tr>
<tr>
<td>Prehistory</td>
<td>196</td>
<td>107,500</td>
<td>3,300,000</td>
</tr>
<tr>
<td>Tropical Biodiversity</td>
<td>1</td>
<td>5,350</td>
<td>5,350</td>
</tr>
<tr>
<td>Vertebrate Zoology</td>
<td>19</td>
<td>11,500</td>
<td>15,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>301</strong></td>
<td><strong>305,450</strong></td>
<td><strong>5,544,850</strong></td>
</tr>
</tbody>
</table>

The MUSE collections are constantly investigated and cared for conservation by the staff, in order to go in depth in their documentation and study, and to make them available to the research community as to the general public. At present the 59,2% of the preserved heritage is fully catalogued with a specific software in accordance with the national standards. In 2014-2015 MUSE received several loan requests: 51 outgoing loans were approved, 44 for research purposes and 9 for temporary exhibitions. The MUSE collections specimens were described or used as material in 61 different publications written by the museum staff or by other researchers who borrowed MUSE collections objects. Acquisition and documentation increased conspicuously with 8,500 new objects, 5,789 new catalogue cards digitized and 13,298 revised.


<table>
<thead>
<tr>
<th>Collections</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research outgoing loans</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Exhibitions outgoing loans</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Publications about collections</td>
<td>32</td>
<td>29</td>
</tr>
<tr>
<td>New acquisitions (estimated specimens)</td>
<td>4,750</td>
<td>3,750</td>
</tr>
<tr>
<td>New catalogue cards</td>
<td>365</td>
<td>5,424</td>
</tr>
<tr>
<td>Catalogue card revised</td>
<td>11,270</td>
<td>2,028</td>
</tr>
</tbody>
</table>
Tropical Biodiversity
Since 1998 the museum has conducted several research expeditions in the mountain rainforests of Tanzania, that have led to a collection of 4,650 specimens of amphibians and reptiles (and mammals to a much less extent). These include over 60 species that are new to science. The tropical african herpetology collection of MUSE is now recognized one of the most important with regards to the mountain forests of Tanzania. Among the mammals, the collection includes Rhynchocyon udzungwensis, the giant elephant-shrew and the Matilda's horned viper Atheris matildae, discovered by MUSE researchers and described respectively in 2008 and 2011.

Botany
Botany collections are made up by the herbarium and the living collections of the museum’s two botanic gardens (Viote Alpine Garden and Arco Arboretum) and the seed bank. The Herbarium (TR) accounts for approx. 150,000 specimens mainly collected from the mid eighteenth century to the mid nineteen century. The major component is naturally local from Trentino and Tirol but a significant part of the collections originate from other parts of Italy, Europe and North Africa. Viote Alpine Garden grows more than 1,200 alpine species from the major mountain chains of the world, with a special interest for endemic and threatened species, Arco Arboretum includes nearly 200 species of fine and tender trees of garden interest. The seeds bank focuses on threatened and endemic species of conservation interest originating from the Eastern Alps.

Limnology and Phycology
Phycological and limnological collections of the MUSE include more than 4,000 items collected in the frame of the numerous research projects carried out by the Section. These are mostly samples of microscopic organisms – such as diatoms, cyanobacteria, algae, zoobenthos and zooplankton - collected mainly in the Alps, and namely in the Autonomous Province of Trento. Besides these recently started collections, the Section also curates four historical algae collections including 4,000 exsiccate of marine and freshwater algae originating from different locations worldwide and collected mainly in the Nineteenth Century.

Invertebrate Zoology and Hydrobiology
Invertebrate collections of the MUSE include more than 1,2 million of specimens, aquatic and terrestrial. Historical collections (1850-1950 yr) include mainly terrestrial insects (about 175,000 specimens) and marine, freshwater and terrestrial molluscs. Most part of specimens (terrestrial and aquatic) are preserved in ethanol and were collected mainly in mountain regions in Italy but also abroad (Svalbard Islands, Pakistan-Karakorum, France-Pyrenees, etc.). A collection of more than 5,000 microscope slides of aquatic insects and crustaceans is also present.

Vertebrate Zoology
The Vertebrate Zoology collections of MUSE include all classes of this taxon, with a marked prevalence of birds and mammals. Overall there are almost 11,500 specimens, of which 4,000
The research activities at the Museo delle Scienze: Report 2014-2015

were collected between 1850 and 1950, while the rest come from recent donations, acquisitions and MUSE own research. It is especially interesting the small mammal collection, that counts 6,000 specimens among insectivores and rodents. The material demonstrate the tight link of MUSE with the local environment, and it overall includes whole animals prepared as skins or wet specimens, bird nests, eggs, prepared skeletons.

Geology

Geological collections of the MUSE are constituted of rocks, minerals and fossils collected from the main localities of the Trentino-Alto Adige region and, in minor part, from Italian and foreign sites. The 16,800 specimens come from different sources, and became part of the museum heritage thanks to research activities, donations or occasional findings by privates or collaborators of the museum. Specimens, collected in a temporal range of more then two centuries, well document the local territory and testify the geological research enterprise of the Trentino area.

Prehistory

MUSE’s archaeological collections are referred to lithic materials, ceramics, bone and horn manufactures, art manufactures, wood, vegetal fibres, metal manufactures and faunas. MUSE’s archaeological finds are more than 3 millions. They mostly belong to 40 provincial prehistoric sites, studied by the Museum from the 60’s. The precious paleolithic painted stones (almost 300) with zoomorphic, antropomorphic and schematic pictures, coming from Riparo Dalmeri (Trento) are exceptionally relevant.
The main projects and results
MUSE NASSTEC project

Section of Botany

Alpine and Atlantic grasslands habitats are centres of biodiversity with high evolutionary importance for flora and fauna, which have been identified as a conservation and restoration priority. European grasslands often exist within anthropogenic landscapes, resulting from a positive interaction between natural processes and traditional human activities. However, regular land use over the past 100 years and the urban sprawl have led to irreversible degradation of biodiverse grasslands such as dry meadows and alpine meadows. Seed legislation, regulations and policies exist for agricultural and horticultural purposes in Europe, but not for native grassland species used in restoration practices. Restoration efforts are often made with non-native plant species with the absence of seed quality protocols, policies and adequate training for restoration practitioners. Networking is strategic to attain significant impact and existing associations are present in the UK (Flora locale), Germany (VWW), and a new EU initiative called NASSTEC funded under FP7 MCA ITN. NASSTEC aims to promote a better understanding of native seed science and the use of native seeds for restoration connecting academia to industry, and informing policy. Communication between academia and industry will be enhanced by this project, thus NASSTEC will integrate commercial and research priorities in order to recommend a certification scheme in Europe based on the findings of NASSTEC and meets the grower’s needs.

One project will use a combination of global database information and local scale case studies to integrate local and regional scales of ecological data. Habitat-based variation in seed and regeneration traits, functional diversity and species composition will be used as an approach for integrating patterns broad scale. Wild seed will be collected in Trentino to clarify and verify best performing seed lots to maximize restoration success through a series of experimental lab based germination, nursery, and field growth trials for unexplored species. Finally, a novel method will be used to demonstrate habitat based patterns and species prioritization to maximise the provision of ecosystem services for ecosystem recovery. The second project will take a unique approach integrating the science and policy aspects of native seed production by identifying the (i) current policies and regulations, (ii) seed quality protocols for genetic conservation and plant establishment, and (iii) certification recommendations. Emphasis will be placed on the importance and complexity of seed quality using a bottom-up approach addressed by surveying seed users and producers in Europe, the United States, and Australia with the main aim to design a certification recommendation for Europe.
The relocation of the museum into the new building offered the opportunity to re-develop the Seed Bank of the botany department. This facility cannot be easily accommodated into standard labs, but requires specific design and effective building solutions, being what you could easily define a ‘sensitive’ infrastructure, whose proper function heavily depends on the shape and layout of its components. The core of the new seed bank includes the seed drying and storage rooms that need a low humidity (15% RH) and cool (15°C) environment. In the new design these two rooms have been separated into two distinct areas that serve the two main stages of the seed processing cycle: a ‘dirty’ zone attached to the seed curation lab for initial drying and seed cleaning and a ‘clean’ zone for final drying and packaging next to the seed germination lab. The two rooms have a rectangular base to facilitate the airflow in a specific direction. The coolers and dryers are external, redundant and dedicated for each room, the temperature and RH values are electronically controlled, alarmed and logged. The cold store has been enlarged with 8 deep freezers. The germination lab has an increased capacity with 12 cooled incubators and is equipped for sterile procedures. An additional external area, close to the propagation greenhouse, is equipped with tanks for liquid nitrogen storage for experimental long term conservation of species that are short lived in conventional dry cold storage. This major upgrade and increased capacity of the museum seed storage facilities has been instrumental in developing NASSTEC, a new European project aimed at promoting the production and use of native seed for grassland restoration. NASSTEC is an FP7 Marie Curie Initial Training Network approved in June 2013 by the EU and running from 1.4.2014 to 30.3.2018. NASSTEC will train 11 Early Stage Researchers in native seed science promoting technology transfer to the existing seed companies for native seed production, delivering ecosystem services impact mitigation in the many infrastructure works (roadwork, quarries, ski slopes) impacting on grassland habitats.
The research activities at the Museo delle Scienze: Report 2014-2015

Experimental evidences of cold hardiness and thermotolerance in cold stenothermal chironomids overwintering in an Alpine stream

Section of Invertebrate Zoology and Hydrobiology

The threats posed by climate change make it important to expand knowledge concerning cold and heat tolerance in stenothermal species from habitats potentially threatened by temperature changes. Supercooling point (SCP), lower lethal temperatures (LLTs), thermal hysteresis (TH), sugars and polyols content and heat shock proteins genes (hsc70 and hsp70) expression were estimated under acute cold stress down to -30°C, to highlight the cold hardiness strategy adopted by III-IV-instar larvae of two non-biting midges species (Pseudodiamesa branickii and Diamesa cinerella) (Diptera: Chironomidae). In P. branickii, SCPs and LLTs were estimated in overwintering young (I-II instar) and mature (III-IV instar) larvae, besides their upper lethal temperatures (ULTs) under thermal stress between -20 and 37 °C.

According to TH (>2), accumulation of glucose and sucrose as main cryoprotectants, SCPs (= -6.37°C (IV instar) to -7.1 °C (I-II instar) and -6.85°C, respectively) and LLT100 (= -16.2°C (IV instar) to and -14.7°C, respectively), P. branickii and D. cinerella can be considered both as freezing tolerant but with some differences due to the Cumulative Proportion of Individual Freezing values and the LLT50 (-9.14 and -6.13°C, respectively), and to gene expression data (i.e. constitutive expression of hsps in D. cinerella, up-regulation of hsp70 in P. branickii) suggesting different levels of cold stenothermy.

Both young and mature larvae of P. branickii and were freezing tolerant but also thermotolerant (ULT50 = 31.7 ± 0.4, 32.5 ± 0.3, respectively). However, ontogenetic differences in acute tolerance were observed as in basal metabolism young larvae exhibit a higher oxygen consumption rate at any temperature tested and are overall less resistant to oxygen depletion compared to mature larvae at ≥10 °C.

These findings stimulated discussion on the validity of the different metabolic indicators in defining the level of cold hardiness of a species, even in relation to its cold stenothermy.


Benthic and hyporheic fauna from alpine streams of different origin – evidences of vertical and transversal connectivity

Section of Invertebrate Zoology and Hydrobiology

Although many of the processes involved in the relationship between hyporheic and benthic zone have been elucidated in recent years, the vertical and temporal structure of the invertebrate assemblages in alpine streams is still unclear. Our studies on benthic and hyporheic zone in two Alpine streams with different origin highlighted that the main factor in structuring the invertebrate community was the habitat (benthic, hyporheic). However, a strong similarity was detected between the two stream types in both the structure and function of the hyporheos, which was more species rich than the benthos, but with a species’ turnover similar in the two streams. Nevertheless, according to the intermediate disturbance hypothesis, the highly disturbed glacial system hosted a simplified community (hyporheos+benthos) compared to the stable spring system. Data on nutrition-habitat connections were also obtained, providing insights about the trophic-sink effect between the hyporheos and the benthos.

The vertical and transversal connectivity contributed significantly to the overall richness of the two streams investigated, favouring benthic taxa unable to survive without exploiting the hyporheic habitat e.g., for food supply or for completion of life cycle. Especially in the highly temporal heterogeneous glacial stream, the hyporheic zone was occupied more permanently, also by stygexene taxa and used as an extension of the surface habitat.

These findings suggest that the observed vertical and transversal connectivity between surface and subsurface habitat has a key role in the dispersal potential of invertebrates on glacial floodplains that through the hyporheic will colonize stream reaches created by retreating glaciers or stream reaches with limited degree of glacial influence fed by a disappearing glacier.

Molecular tools into freshwater ecology: applications in non-model organisms under environmental stress conditions

Section of Invertebrate Zoology and Hydrobiology

Over the past few decades, the integration of molecular and ecological approaches for unravelling both the genetic basis and the ecological importance of ecosystems has encountered increasing interest. A pressing challenge for the ecological and evolutionary community is to understand the molecular basis of adaptation in ecosystems and predict how organisms reply to stresses such as climate change, habitat loss or fragmentation, exposure to chemicals or pesticides.

In stressed organisms, strategic proteins are selectively translated even if the global process of protein synthesis is compromised. The determination of protein concentrations in tissues of non-model organisms (thus with limited genomic information) is challenging due to the absence of specific antibodies. Moreover, estimating protein levels quantifying transcriptional responses may be misleading, because translational control mechanisms uncouple protein and mRNAs abundances. Translational control is increasingly recognized as a hub where regulation of gene expression converges to shape proteomes, but it is almost completely overlooked in molecular ecology studies. An interesting approach to study translation and its control mechanisms is the analysis of variations of gene-specific translational efficiencies by quantifying mRNAs associated to ribosomes. We carried out several studies to propose a robust and streamlined pipeline for purifying ribosome-associated mRNAs and calculating global and gene-specific translation efficiencies from non-model insect’s species. As experimental organism we employed the dipteran Pseudodiamesa branickii (Nowicki) (Chironomidae). P. branickii is a good bioindicator of climate change, as cold stenothermal species colonizing aquatic habitats (e.g. high mountain springs and streams) threatened by global warming.

This method might found applications in molecular ecology to study responses to environmental stressors in non-model organisms.


A century of chasing the ice: delayed colonisation of ice-free sites by ground beetles along glacier forelands in the Alps

Section of Invertebrate Zoology and Hydrobiology

Climate change is affecting species distribution, composition of biological communities, and species traits. Despite the growing body of knowledge on the reaction of species to climate change, the potentially delayed response of species is still severely understudied. In this paper we modelled the time needed by ground-living invertebrates to effectively react to habitat modification induced by climate change in relation to dispersal abilities. We analyzed the occurrence pattern of alpine ground beetles (carabids) along areas recently freed by retreating glaciers in the central-eastern Italian Alps, to test how the synergic effects of time since deglaciation and environmental factors may affect the colonisation process. Different times of response to climate change in ground beetles were found. Sites already hosting the land cover type suitable for our study taxon, but ice-free for less than 100 yr, are mainly colonised by winged carabid beetles (which have high dispersal abilities and are mostly habitat generalists). No, or very few, wingless species (slow colonizers and ecologically specialized) occur within those sites. “The overall pattern suggests that within a site, suitable land cover is established prior to colonisation, due to a strong joint effect of time since deglaciation and land cover type. Long-lasting habitat development at the fine scale is likely to result in a lack of specific resources (e.g. food items, or microhabitat), which is likely to contribute to delayed colonisation, which potentially could be tied also to dispersal abilities. Whatever the reason, the existence of a time-lag often equal to or greater than 100 yr in species colonisation implies caution in predicting species’ occurrence shifts following climate change.


Cover article on Ecography, Carabus depressus (Photo by Gabriele Motta).
Physical and biological features of an active rock glacier of the Italian Alps

Section of Invertebrate Zoology and Hydrobiology

Rock glaciers are a periglacial landform characterized by distinctive environmental conditions because of the occurrence of subsurface ice (permafrost). In this paper we report on the key physical features of an active rock glacier that influence the distribution of plants and arthropods. We also perform a comparison with neighboring scree slope and alpine grassland to test whether the environmental features of the rock glacier drive the presence of specific species assemblages. Compared with scree slope and grassland, the studied rock glacier provides particular physical features that determine the presence of unique species. Plant distribution is mainly driven by grain size. Arthropod distribution is linked to grain size, with cold-adapted species found on areas with coarse-grained deep debris, which also shows a distinctive temperature regime with very low values throughout the year. On the basis of these findings, we advance the hypothesis that rock glaciers provide specific ecological conditions creating potential refugia for cold-demanding species during warm climatic periods.

In this paper we aimed to investigate the assembly processes of plant–insect networks and to elucidate its functional implications for ecosystem stability along a chronosequence of glacier retreat. We collected data on the functional role of anthophilous insect groups and performed network analysis to evaluate their relative importance in the structure of plant–insect interaction networks with increasing time since deglaciation along the primary succession of a debris-covered glacier foreland. We sampled anthophilous insects visiting the flowers of two models plant species, *Leucanthemopsis alpina* and *Saxifraga bryoides*. Insects were identified and trophic roles were attributed to each taxon. Pollinators dominated pioneer communities on the debris-covered glacier and in recently deglaciated areas, while parasitoids, predators and opportunists characterised late-succession stages. Plant species centrality varied along the succession. Pollinators showed initially higher but then decreasing centrality, while the centrality of predators and parasitoids increased with time since deglaciation. Along the same gradient link density showed an increasing trend while network centralization tended to decrease. The present study provides new insight into the initial steps of plant–insect network assembly and sheds light on the relationship between structure and dynamic in ecological networks. In particular, during the succession process, more links are formed and plant–anthophilous insect interactions change from a network dominated by pollinators to a functionally more diversified food web. We conclude that applying network theory to the study of primary succession provides a useful framework to investigate the relationship between community structure and ecosystem stability.


The five plant–insect bipartite networks for the five stages along the primary succession gradient of a glacier foreland. Plant species and insect functional groups are represented by rectangles with their sizes being proportional to the relative number of visits received and made, respectively.
International Congress and Workshop on benthic-algae-based environmental assessments

Section of Limnology and Phycology

Two important scientific events took place at the Museo delle Scienze – MUSE in Trento mid-June of 2015 (Organizer & Chair: M. Cantonati): The International Congress 9th Use of Algae for Monitoring Rivers and comparable habitats (UAMRICH) (June 15-17.2015) and The International Workshop on Benthic Algae Taxonomy (InBAT) (June 17-19.2015). The two events have been attended by 67 participants from 23 worldwide distributed countries. The International Symposia “Use of Algae for Monitoring Rivers” date back to 1991, and, since then, have offered opportunities to review and discuss benthic-algae-based assessment approaches in the different countries, as well as improvements to approaches, methods, and techniques. The main aim of these Symposia has been the standardization of methods, the improvement of directives, and the discussion of novel approaches.

The International Workshop on Benthic Algae Taxonomy (InBAT) was primarily targeted at applied ecologist and practitioners using algae and cyanobacteria for environmental assessment but has been attended also by environmental managers, practically-oriented taxonomists, university teachers and students. The general topic of the Workshop has been: “Taxonomic and ecological characterization of species relevant for environmental assessment and monitoring”. The Workshop was organized in taxonomic sessions devoted to the major algal groups with the following Taxonomic Session Chairs: Diatoms (M. Cantonati, B. Van de Vijver), Cyanobacteria (B.A. Whitten & E. Rott), Red Algae (M. Vis), Green algae & other groups (E. Shubert, S. Schneider).

The UAMRich and InBAT proceedings are being published as special series of papers on the renowned journals Science of the Total Environment (environmental sciences) and Fottea (phycology).

A special series of papers, titled ‘The Ecology of Lake Benthic Algae’ was published in the June 2014 issue of the journal *Freshwater Science*. This series of articles was edited by Dr. Marco Cantonati, Head of the Limnology & Phycoreology Section of the MUSE in Trento and Adjunct Professor at the Universities of Innsbruck (and Trento in 2014), in collaboration with three colleagues: Rex L. Lowe, Emeritus Professor at Bowling Green State University, Ohio; Dean M. DeNicola, Professor at Slippery Rock University, Pennsylvania; Martyn Kelly of Bowburn Consultancy and Adjunct Professor at the University of New Castle (England).

Even the cover of the issue (see image below) was a Trentino “product”! Finally, one of the fifteen works of the special series on lake benthic algae was chosen as featured article of the issue (see citation on the cover below). The issue with the special series of articles on lake benthic algae has been prominently featured at the *Freshwater Science* booth at JASM (*Joint Aquatic Sciences Meeting*), a major international conference that brought together as many as 3180 registered delegates belonging to 4 major scientific societies active in the fields of limnology and phycology (SFS + ASLO + PSA + SWS) (Portland, Oregon, USA, May 18-23, 2014). At this conference M. Cantonati (MUSE) organized a special session on spring habitats (Spring-habitats and spring-fed headwaters biology fifty years after the definition of crenobiology; Chairs: Cantonati M., Italy; Muotka T., Finland; J. Richardson, Canada; M. Vis, USA). The special session, with 15 oral presentations by international speakers, was well received by the Congress participants.

Five of the fifteen articles of the special series on benthic algae have been published by researchers from Trentino (several MUSE researchers, and Prof. Graziano Guella, University of Trento, Physics Dept., Laboratory of Bioorganic Chemistry) (Cantonati, MUSE, was first author of four of the five papers). The Adamello-Brenta Nature Park (and particularly Lake Tovel) was the study environment for three of the five mentioned articles. The University and Scientific Research Department of the Autonomous Province of Trento has supported in various ways the research activities which generated several of the data contained in these papers (for example within Programme Agreements with the MUSE, and with the Projects SALTO/BEST 2001-2004 and ACE SAP 2008-2011).

The works of the special series of articles include also findings of evident local interest, in particular the discovery of a species of cyanobacterium new to science in Lake Tovel, and the discovery in Lake Garda (the largest Italian lake of huge touristic value) of a species of green alga belonging to a genus previously considered to be endemic to China.

New species of coccoid cyanoprokaryote discovered in Lake Tovel (Brenta Dolomites)

Section of Limnology and Phycology

The deep littoral zone of lakes hosts a unique but understudied subset of lake periphyton. We investigated epilithic (= rock dwelling) cyanobacteria (also known as cyanoprokaryotes or blue-green algae) in a carbonate meromictic lake (Lake Tovel, southeastern Alps) to obtain information on 2 poorly known, deep-dwelling coccoid species (one new to science) and to analyze their distribution in light of the current understanding of the depth distribution of lake periphyton. Cyanoprokaryotes in Lake Tovel have distinct depth distributions among 3 zones: shallow (0–4 m), mid-depth (6–12 m), and deep (15–24 m) (Cantonati et al. 2014). The mid-depth and deep zones are characterized by high stability with favorable growth conditions and by severe light limitation, respectively. Both zones have unique taxa that frequently possess colorless sheaths or pink–red–violet cell contents. The 2 most poorly known cyanoprokaryotes found in Lake Tovel (both pink–red–violet) were a species of Geitleribactron new to science (Geitleribactron purpureum sp. nov. Cantonati et Komárek) and the rare Chlorogloea purpurea. We described and documented, respectively, these 2 species by means of light microscopy, careful comparison with the most-similar morphospecies, transmission electron microscopy (TEM), and ecological characteristics. We are the first to describe the TEM ultrastructure of a Chlorogloea species and to characterize the autecology and distribution of C. purpurea, which, in spite of its very specific habitat requirements (deep waters of carbonate oligotrophic mountain lakes), has been reported in several studies from disparate habitats and geographic locations.

Several attempts were made to isolate, amplify, and sequence 2 red species from deep layers of limestone lakes of the Alps from dried and fresh material (stones retrieved by scuba divers). Attempts done before the species description were unsuccessful, but more recent ones yielded the first published sequence for the genus Geitleribactron, allowing an interesting discussion on the evolution and taxonomic placement of this genus and of phylogenetically-related taxa (Mareš & Cantonati 2016).


Mareš J., Cantonati M., 2016 - Phylogenetic position of Geitleribactron purpureum (Synechococcales, Cyanobacteria) and its implications for the taxonomy of Chamaesiphonaceae and Leptolyngbyaceae. *Fottea* 16: 104–111.
Valagola_SEFIRA Project: Reconstruction of the development of the mountain Lake Valagola and prediction of senescing and filling rates

Section of Limnology and Phycology

The Limnology & Phycology Section has a long research tradition on different oligotrophic habitats such as springs, mountain lakes, and different types of mountain streams.

During 2013-2014, the Adamello-Brenta Nature Park (PNAB) asked the Limnology Section to study the evolution and filling of Lake Valagola to obtain suggestions for possible management improvement.

On one side the project focused on paleolimnology, with sediment cores collection in order to perform radiometric and carbon dating, and diatom and pigment analysis. On the other side, it studied the recent conditions of the lake with several sampling surveys and field assessments.

Researchers, supported by the scuba-diving unit of the Fire Brigade of Trento, assessed the morphology of the lake bottom and measured depths to generate the bathymetry of the lake, and sampled submerged plants and macroalgae from the lake bottom (with the kind assistance of M. Bąk and her colleagues of the University of Szczecin, Poland). The four species of submerged macrophytes recovered from Lake Valagola are all indicators of environments with good ecological integrity. Epiphytic diatoms were studied (M. Letáková, University of Olomouc, Czech Republic), and results are being published.

Two colleagues of the MUSE (C. Casarotto & E. Bertoni) performed geomorphological and hydrogeological observations and measurements revealing a high permeability of the Daun stadial moraine rimming the lake, characterized by a strong difference between the amounts of inflowing and outflowing water.

Sedimentation rates measured in Lake Valagola appear to be those typical for mountain and high-mountain lakes of the Alps. The estimated total age for the tarn is 15,000 years.

The analysis of sub-fossil diatom assemblages (M. Letáková & E. Stocchetti) in the sediment cores showed that more typical “lake-environment conditions” were established only recently, with the construction of an artificial concrete rim in the early 1970s. Planktic diatoms, typical of the deeper, open-water parts of lakes, show up in considerable proportions in the subfossil assemblages only after this date, suggested that the tarn might have been characterized by a long phase with fluvial-lacustrine regime before.

Finally the lake was confirmed to be meso-oligotrophic (we thank L. Cerasino, E. Mach. Foundation, for making available chemical data), mainly because of its shallowness and nutrient inputs from the nearby pastures and cattle burn.

Revealing the vertebrate diversity of the Eastern Arc Mountains

Section of Tropical Biodiversity

Also called the “Galapagos of Africa”, the Eastern Arc Mountains of Kenya and Tanzania have long been known as an outstanding region for biological diversity and endemism. Yet, knowledge on species distribution and endemism patterns remained scant up to a decade ago. However, a new study showed how updated knowledge on species occurrence from targeted surveys can change knowledge on perceived biodiversity importance.

As an international team of experts, we surveyed amphibians, reptiles, birds and mammals during 2005 - 2009, targeting mountain blocks that had been poorly surveyed. We combined new and old data to produce a database of species presence by mountain block spanning four decades of research. Species richness was regressed against survey effort, funding, ecological and human disturbance factors to analyse the best predictors of vertebrate richness across mountain blocks.

New surveys raised the number of endemic and regional endemic vertebrates by 24% (from 170 to 211 species), including 27 new species of which 23 are amphibians and reptiles. Vertebrate richness was best explained by forest area, but rainfall was also found important, especially for amphibians and reptiles. Forest elevational range was important for mammals and for block-endemic birds. Funding explained 19% of the variation in total species richness, while survey effort generally explained < 10% of variance.

The main conclusions of this work is that the biological value of the EAM has been underestimated, and strategic surveys are important even in well-recognized hotspots. The exceptional importance of these mountains was highlighted, supporting the development of a network of Nature Reserves and the inclusion within UNESCO’s natural World Heritage Sites.

Landscape genetics approach demonstrates the effects of human disturbance in endangered monkey species

Section of Tropical Biodiversity

Human activities, in its many forms - deforestation, land use, agricultural and industrial pollution - have a tremendous impact on habitat quality and degradation, jeopardizing the persistence of their wild inhabitants. Habitat quality, by determining the diet ingested by an animal, is fundamental in characterizing the highly diverse microbial communities living in the gastrointestinal tract (gut microbiota), extremely critical in host health and fitness by, for example, being responsible for host digestive efficiency (e.g., also degrading toxic substances), stimulating host immune system and protecting it from pathogenic invasion.

Classified as ‘endangered’ by the IUCN, the Udzungwa red colobus (*Procolobus gordonorum*) is among the most threatened primate species in Africa and in constant decline. These colobus are arboreal forest dwellers, mainly folivorous and highly selective feeders. Because they prefer fresh young shoots and leaves, they are highly dependent on old-growth forests, thus particularly sensitive to habitat perturbation. Thus, they provide a critical model to understanding whether anthropogenic disturbance affects their gut microbiota functional diversity. We sampled seven social groups inhabiting two forests (disturbed vs. undisturbed) in the Udzungwa Mountains of Tanzania. While Ruminococcaceae and Lachnospiraceae dominated in all individuals, reflecting their role in extracting energy from folivorous diets, analysis of genus composition showed a marked diversification across habitats, with gut microbiota α-diversity significantly higher in the undisturbed forest. Functional analysis suggests that the reduction of gut microbiota diversity in the disturbed forest may be associated with food plant diversity in natural versus human-modified habitats, pinpointing the importance of preserve pristine forests in order to conserve healthy endangered populations.

Habitat fragmentation associated to reduction of gut microbiota diversity in tropical monkey
Section of Tropical Biodiversity

A comprehensive understanding of how human disturbance affects tropical forest ecosystems is critical for the mitigation of future losses in global biodiversity. While many genetic studies of forest fragmentation have been already conducted to provide insight concerning forest biodiversity loss, relatively few have incorporated landscape data to explicitly test the effects of human disturbance on genetic differentiation among populations. In this study, we use a newly developed landscape genetic approach that relies on a genetic algorithm to simultaneously optimize resistance surfaces to investigate the effects of human disturbance in the Udzungwa Mountains of Tanzania, which is an important part of a universally recognized biodiversity hotspot. Our study species is the endangered Udzungwa red colobus monkey (Procolobus gordonorum), which is endemic to the Udzungwa Mountains and a known indicator species that thrives in large and well-protected blocks of old growth forest. Population genetic analyses identified significant population structure among Udzungwa red colobus inhabiting different forest blocks, and Bayesian cluster analyses identified hierarchical structure. Our new method for creating composite landscape resistance models found that the combination of fire density on the landscape and distance to the nearest village best explains the genetic structure observed. These results demonstrate the effects that human activities are having in an area of high global conservation priority and suggest that this ecosystem is in a precarious state. Our study also illustrates the ability of our novel landscape genetic method to detect the impacts of relatively recent landscape features on a long-lived species.

Ruiz-Lopez M.J., Barelli C., Rovero F., Hodges K., Roos C., Peterman W.E., Ting N., 2015 - A landscape genetics approach demonstrates the effects of human disturbance on a primate indicator species in an East African biodiversity hotspot. Heredity DOI:10.1038/hdy.2015.82.
The genus Atheris (Serpentes: Viperidae) in East Africa: Phylogeny and the role of rifting and climate in shaping the current pattern of species diversity

Section of Tropical Biodiversity

Past climatic and tectonic events are believed to have strongly influenced species diversity in the Eastern Afromontane Biodiversity Hotspot. In the paper we have investigated the phylogenetic relationships and historical biogeography of the East African genus of vipers *Atheris*, and explored temporal and spatial relationships between *Atheris* species across Africa, and the impact of palaeoclimatic fluctuations and tectonic movements on cladogenesis of the genus.

Using mitochondrial sequence data, the phylogeny of East African species of the genus *Atheris* shows congruent temporal patterns that link diversification to major tectonic and aridification events within East Africa over the last 15 million years. Our results are consistent with a scenario of a delayed direct west-east colonisation of the Eastern Arc Mountains of *Atheris* by the formation of the western rift. Based on the phylogenetic patterns, this terrestrial, forest - associated genus has dispersed into East Africa across a divided route, on both west-southeasterly and west-northeasterly directions (a C-shaped route). Cladogenesis in the Eastern Arc Mountains and Southern Highlands of Tanzania corresponds to late Miocene and Plio-Pleistocene climatic shifts. From a taxonomic point of view, our data confirmed the monophyly of *Atheris* as currently defined, and reveal four major East African clades, three of which occur in discrete mountain ranges. Possible cryptic taxa are identified in the *Atheris rungweensis* and *A. ceratophora* clades, further genetic and morphological investigation are needed in order to assess their taxonomic placement.

Hierarchical modelling of population growth rate from individual capture–recapture data

Section of Vertebrate Zoology

Estimating rates of population change is essential to achieving theoretical and applied goals in population ecology, and the Pradel (1996, Biometrics, 52: 703.) temporal symmetry method permits direct estimation and modelling of the growth rate of open populations, using capture–recapture data from marked animals.

We present a Bayesian formulation of the Pradel approach that permits a hierarchical modelling of the biological and sampling processes. Two parametrizations for the temporal symmetry likelihood are presented and implemented into a general purpose software in BUGS language.

We first consider a set of simulated scenarios to evaluate performance of a Bayesian variable selection approach to test the temporal linear trend on survival and seniority probability, population growth rate and detectability. We then provide an example application on individual detection information of three species of burrowing nesting seabirds, whose populations cannot be directly counted. For each species, we assess the strength of evidence for temporal random variation and the temporal linear trend on survival probability, population growth rate and detectability.

The Bayesian formulation provides more flexibility, by easily allowing the extension of the original fixed time effects structure to random time effects, an option that is still impractical in a frequentist framework.


Cory’s shearwater (Calonectris diomedea), 2010 (Wikimedia Commons).
Bayesian model selection: the steepest mountain to climb

Section of Vertebrate Zoology

Following the advent of MCMC engines Bayesian hierarchical models are becoming increasingly common for modelling ecological data. However, the great enthusiasm for model fitting has not yet encompassed the selection of competing models, despite its fundamental role in the inferential process. This contribution is intended as a starting guide for practical implementation of Bayesian model and variable selection into a general purpose software in BUGS language. We explain two well-known procedures, the product space method and the Gibbs variable selection, clarifying theoretical aspects and practical guidelines through applied examples on the comparison of non-nested models and on the selection of variables in a generalized linear model problem. Despite the relatively wide range of available techniques and the difficulties related to the maximization of sampling efficiency, for their conceptual simplicity and ease of implementation the proposed methods represent useful tools for ecologists and conservation biologists that want to close the loop of a Bayesian analysis.

This paper has been recommended by F1000Prime. F1000Prime identifies and recommends important articles in biology and medical research publications. Articles are selected by a peer-nominated global ‘Faculty’ of the world’s leading scientists and clinicians who then rate them and explain their importance.


Testing hypotheses on distribution shifts and changes in phenology of imperfectly detectable species

Section of Vertebrate Zoology

With ongoing climate change, many species are expected to shift their spatial and temporal distributions. To document changes in species distribution and phenology, detection/non-detection data have proven very useful. Occupancy models provide a robust way to analyse such data, but inference is usually focused on species spatial distribution, not phenology.

We present a multi-season extension of the staggered-entry occupancy model of Kendall et al. (2013, Ecology, 94, 610), which permits inference about the within-season patterns of species arrival and departure at sampling sites. The new model presented here allows investigation of species phenology and spatial distribution across years, as well as site extinction/colonization dynamics.

We illustrate the model with two data sets on European migratory passerines and one data set on North American treefrogs. We show how to derive several additional phenological parameters, such as annual mean arrival and departure dates, from estimated arrival and departure probabilities.

Given the extent of detection/non-detection data that are available, we believe that this modelling approach will prove very useful to further understand and predict species responses to climate change.

Comparison of methods for stable isotope ratio (δ13C, δ15N, δ2H, δ18O) measurements of feathers

Section of Vertebrate Zoology

Natural variations in the stable isotope ratios of bioelements in bird feathers are being increasingly used by animal ecologists to investigate different aspects of bird life. However, to ensure reliability of the data, a critical and very delicate aspect is the preparatory phase (cleaning, drying and subsampling) and the proper analysis, mainly in relation to δ2H and δ18O, respectively, for the presence of exchangeable Hs and of nitrogen and sulphur in keratin.

With respect to determination of the isotope ratios of C, N, O and H, in this work, we compare the cleaning mixture most commonly used in the literature (chloroform : methanol 2 : 1) with diethylether : methanol 2 : 1, which avoids the use of the carcinogenic solvent chloroform. We also compared oven-drying with air-drying of samples, as well as subsampling of feathers by cutting with surgical scissors or cryogenic pulverization. Finally, we investigated whether stable isotope ratios varied along the vane and between the rachis and vane.

The different methods compared in the three preparatory stages showed no differences performance-wise and can therefore be used interchangeably. Variability in stable isotope ratios can be considerable, both along the vane and between rachis and vane, which is because their compositions register changes in diet, area and climate. However, in this specific study, when the parts of the feather closest to the calamus were removed, the delta values were clearly more homogeneous. Finally, we demonstrate that a casein with a known δ2H value, although probably differing from keratin in the number of exchangeable Hs, can be used to normalize the δ2H values of feathers, although only in the range of values close to that of the reference material. In determining δ18O, the use of a longer gas chromatography-GC column, its frequent change and the use of a linear equation built with matrix match equivalent reference materials seems to reduce the drift of GC column performance due to the presence of nitrogen and the accumulation of sulphur.

The importance of residual habitats and crop management for the conservation of birds breeding in intensive orchards

Section of Vertebrate Zoology

Intensive orchards are artificial habitats managed according to production criteria, but they may mimic open woodlands and harbour wild species. We investigated the effect of orchard features on the true abundance (estimated with occupancy models) of some bird species widespread in orchards. Our study was carried out in Val di Non (Trento province, Italy) where apple cultivation is the most widespread and intensive. We counted blackcaps Sylvia atricapilla, chaffinches Fringilla coelebs, and greenfinches Carduelis chloris three times at 44 transects 300-m long. At each transect, we estimated the number of territories/pairs and recorded variables describing the cover of the habitats and management factors. Blackcap abundance was positively affected by the cover of shrubland and broadleaved woodland and by a low cover of coniferous forests. Chaffinch abundance was driven by a negative impact of anti-hail nets and secondarily by bare ground and urbanized areas, with chaffinches more abundant in areas with grassland ground cover and 5-10% cover of urban habitats. Greenfinch abundance increased with wetland cover, cover of other natural/semi-natural habitats and tree height and decreased with grassland cover. Both the availability of natural and semi-natural vegetation and the orchard traits determined by management can significantly affect the abundance of common species. The conservation of the remaining patches of woodland, shrubland, wetland (and other natural/semi-natural habitats) is essential for bird conservation. The already reported negative impact of anti-hail nets and the importance of the height of apple trees are confirmed; irrigation systems and bare ground may also be important factors.

The Dolo P/T Project (The Permian-Triassic ecological crisis in the Dolomites: extinction and recovery dynamics in Terrestrial Ecosystems) is funded by the Research Department of the Autonomous Province of Bolzano. Its working group is composed of researchers from the Naturmuseum Südtirol/Museo di Scienze Naturali dell’Alto Adige, Utrecht University and National Natural History Museum ‘Naturalis’, and MUSE - Museo delle Scienze. The Permian-Triassic (P-T) extinction event occurred 251.4 ±0.3 million years ago and is considered the most severe extinction event of the Phanerozoic, with a loss of at least 50% of families both within the terrestrial and the marine ecosystems, corresponding to an estimated loss of between 75% and 96% of all species.

The general aim of the project is to understand the composition and spatio-temporal relationships of the Late Permian and Early-Middle Triassic terrestrial ecosystems of the eastern Southern Alps.

The rate of extinction within the terrestrial realm and the time and mode of the plant and animal biotic recovery are investigated to understand if the Permian-Triassic ecological crisis documented in the Southern Alps mirrors the global pattern.

The climatic and environmental changes characteristic of the European Younger Dryas had a definitive impact on Late Epigravettian societies of north-eastern Italy, inducing several changes in the settlement dynamics of these human groups. As such, the aim of this project was to define a new model for interpreting these transformations through the analysis of all known archaeological sites in the Alps and the investigation of new sites in Trentino. The sites of Palù Echen, Lagét and Bus de la Lum, three open-air camps located respectively on the Folgaria (TN, 1,260 m asl), Predaia (TN, 1,430 m asl) and Cansiglio Plateau (PN, 995 m asl), confirm the continuity of seasonal frequentation of the mid-altitude mountain and provide new elements for evaluating Younger Dryas settlement strategies. Distinctive features compared to the interstadial Late Glacial are provided by considering the occupational area, the density and composition of the lithic industry, and the raw material provisioning areas. The results highlight a trend towards an increased simplification of the camp, with contraction of the activity area and execution of a wide range of activities linked to the production, acquisition and processing of food and other resources. The data on the lithic raw materials and the spatio-temporal segmentation of the reduction sequences also suggest a mobility no longer based on a few sites located in strategic positions and periodically re-occupied (as in the Alleröd period), but rather on numerous camps frequented for short periods as expression of a higher mobility pattern. No information about hunting strategies and prey choices are available from these sites. New directions for addressing this topic have emerged from the discovering of a new site, Cornafessa rock shelter, located on the Lessini Mountain at 1,250 m asl (Ala, TN). This rock shelter, investigated through a first survey in 2015, has yielded an undisturbed layer dated to the Younger Dryas, characterized by rich cultural finds such as lithic, faunal and charcoal remains in a good state of preservation.


Human peopling of the Alps during Pleistocene and Holocene
Section of Prehistory

The Prehistory section carries out studies on the history of human population of the north-Mediterranean regions. In the years 2014 and 2015 the research activities have been focused on the adaptations of Mesolithic hunters to the landscape transformations of the Alpine region during the Holocene. The archaeological evidence of Pozza Lavino (Ledro valley, Mount Tremalzo) attests a Mesolithic occupation in the western Trentino region that was hitherto almost undocumented. The site evidence, correlated to the known finds in the Brescia pre-Alps, gives support to the idea of a new route linking the western Trentino to the Po valley. Another research project was aimed at ascertain aspects of continuity and discontinuity in Sauveterrian-Castelnovian transition in north-eastern Italy, re-analyzing the lithic sequence of Romagnano Loc III rock shelter (Adige valley) from a technological point of view. The results indicate that the major changes occurred are closely related to the introduction of new knapping techniques – indirect percussion/pressure; the persistence of some characters derived from the more ancient pragmatic Sauveterrian tradition has also been highlighted.


LIFE WOLFALPS
Wolf in the Alps: implementation of coordinated wolf conservation actions in core areas and beyond

The project started in 2013 and it will end in 2018. The main goal of the WOLFALPS project is to implement and coordinate wolf conservation actions in key core areas and beyond in the Alps ecosystem, from West to East, to further support the natural wolf alpine recolonization process; it will be reached thanks to several coordinated conservation actions.

MUSE coordinate the communication strategy that involves all partners. Its definition is one of the initial, priority actions of the project, because it is designed to address all the specific actions of communication, from information given to the shepherds and hunters, educational workshops, training for teachers, and much more. One of the most interesting aspects of the communication activities LIFE WOLFALPS is the fact that it can rely on materials derived from the results of concrete actions for monitoring and conservation: so it is updated, reliable, scientific data.

In particular, the scientific communication team has been involved in the traveling exhibition “Tempo di lupi” realization. This exhibition is dedicated to wolves for the general public and aims to give correct, scientific and objective information about wolves. The exhibition is travelling across the Alps, hosted by the various project partners. Since December 2014, it was hosted in three different location, reaching about 17,300 visitors. The exhibition will travel until 2018 and after will be settle out in its permanent form in Val Grande National Park (VCO).
Assisted Reproductive Technologies (ARTs) as suitable tools to analyze women’s and men’s wishes, fears and contradictions

The project “Towards a new ‘family sayings’: opportunities, responsibilities and rights in Assisted Reproduction Technologies” was funded by the Autonomous Province of Trento and carried out in 2015. With a multidisciplinary approach, the project was coordinated by MUSE (Lucia Martinelli) and involved the Assisted Reproductive Center of Trento Autonomous Province Public Health Service; the Centre for Religious Studies of B. Kessler Foundation; the Bio-low group of Trento University. Assisted Reproductive Technologies (ARTs) were investigated as suitable tools for analyzing fears and contradictions or our society. The narrative analysis of actors involved in ARTs in Internet-based social networking sites and during a focus group with patients, revealed the ambiguous interpretation of biology innovations as promoter of new opportunities or new facade of enduring contradictions. ‘Timing’ and ‘aging’ were particularly stressed in narratives. This is quite noticeable in the case of social freezing, i.e. the autologous human oocyte cryopreservation to store women’s eggs to be used later by the same donor for non-medical reasons. This practice poses new questions about timing related to fertility decline and motherhood (Martinelli et al., 2015). In distorted information, social freezing to postpone parenthood is proposed as a suitable alternative to conventional reproduction. When this practice is proposed as a new opportunity to conciliate professional needs and pregnancy, we may question if such gap should be rather deserve proper changes in social and working organization. A more inclusive society, for instance, should find structural solutions for supporting women to conciliate motherhood with social/professional lives, instead of ‘medicalizing’ a social problem.

Experimenting new public engagement practices in synthetic biology at MUSE

As part of the 7th FP UE project SYNENERGENE (http://www.synenergene.eu/), aimed at developing responsible research and innovation (RRI) practices in synthetic biology (synbio), we experimented a fresh public engagement activity. Our format is a workshop offered to MUSE’s visitors where participants may experiment how the commonly used flavor vanillin is industrially produced with synbio technology. According to RRI vision, participants can realize the different opinions of various actors involved in this controversial technology. Three videos are presented, respectively showing the perspectives of the industry producing synbio vanillin, of an academic scientist developing synbio research, and of NGOs opposing synbio vanillin. Moreover, participants are stimulated to express their willingness to invest public support in synthetic biology research and eventually to choose an application among health, agriculture and environment. Interesting information about lay-citizens’ knowledge and opinion on synbio are collected with an ad hoc questionnaire provided to participants to collect their evaluation of the workshop and their understanding of the key messages delivered. Answers are compared with the results of questionnaires delivered to control MUSE’s visitors, not taking part to the workshop. With this interactive workshop we propose science museums as suitable agoras for experimenting effective processes of public engagement in the light of RRI, where the various actors of science innovations can come together to share information and build up scientific knowledge.
Appendix 1  The staff of the scientific sections
Tropical Biodiversity research group

FRANCESCO ROVERO  
Head of the Tropical Biodiversity Section

Born in Firenze in 1970, he is a zoologist and conservation biologist. He obtained a degree in Natural Sciences in 1995 at the University of Florence and a Ph.D. in Animal Ecology in 2000 at the University of Wales, UK. Since 1999 he is involved in research and biodiversity conservation in east Africa. In 2004-2007 he conducted post-doctoral research with MUSE on ecology and conservation of primates and forest ungulates in the Udzungwa Mountains, Tanzania. In 2008 he became the Curator of the newly established MUSE's Tropical Biodiversity Section. His main research interests are abundance estimation, habitat use and modeling, conservation status assessment, as applied mainly to threatened populations of forest mammals in Tanzania. Besides pure and applied research, he developed keen interest in ecological monitoring, protected area management, and community-based conservation strategies. This led to the establishment of the Udzungwa Ecological Monitoring Centre (www.udzungwacentre.org) that he directs since 2006, a field station annexed to the Udzungwa Mountains National Park that promotes and facilitates research in the area, and bridges between park management and community education initiatives. It became the first site in Africa of the Tropical Ecology Assessment and Monitoring (TEAM) network. He authored over 80 scientific papers and co-edited two books.

CLAUDIA BARELLI  
Research fellow

Born in Viareggio (LU) in 1972, she is a primatologist, holding a master’s degree (1999) in Natural Sciences from Florence University and a Ph.D. (2007) on primate biology from the Max Planck Institute for Evolutionary Anthropology and the Leipzig University, Germany. In 2008 she became an Alexander von Humboldt postdoctoral fellow at the German Primate Center (DPZ) and in 2010 a postdoctoral fellow within the program of Marie Curie Action-Incoming at MUSE. She has strong skills in primate ethology and ecology, focusing for the last 10 years on long-term multidisciplinary field studies addressing both evolutionary and conservation issues. Since 2009, she has developed a strong interest in conservation physiology with emphasis on developing interdisciplinary methods integrating population ecology with genetics, metagenomics, and physiological approaches for the rapid assessment of threatened populations in fragile habitats. More than 22 ISI ranked publications, for which she is primarily lead author, and internationally recognized research grants achieved.

SILVIA RICCI  
International cooperation project manager

Born in Firenze in 1970, she is a zoologist and a public science writer. In 1995 she obtained a degree in Natural Sciences at the University of Florence. In 2003 she got her Ph.D. at the University of Sydney, Australia, with a thesis on the ecology of desert rodents. Since 2004 she has been working for different publishing houses as scientific communicator. She also worked as scientific consultant, environmental educator, course tutor and translator. Her collaboration with MUSE – Science Museum of Trento started in 2008, when she conducted field research on the new species of elephant-shrew. Since 2010, she is project manager of Associazione Mazingira, an organization established within the MUSE to conduct community-based projects in Italy and abroad.
The staff of the scientific sections

ANA RODRIGUEZ-PRIETO
Research fellow

Born in Valladolid (Spain) in 1983. She graduated in Biology and Biochemistry (2009). She later completed her education with a Master of Science in Biodiversity and Biology Conservation. Her Master thesis was on plant-animal interaction and genetic structure of different populations of *Pyrus bourgeana decne* at Doñana National Park (Spain). She received her Ph.D. (2013) at the Institute of Evolutionary Biology of Barcelona on the speciation process of two Iberian voles (*Microtus duodecimcostatus* and *M. lusitanicus*), applying morphometric and phylogenetic techniques. She is currently working at MUSE on a project developing morphological and phylogenetic analyses for various species of Amphibians and Reptiles from East Africa. She was also involved in developing a portable lab for genetic analysis under tropical conditions. Her overall interest focus on the study of speciation processes in different groups of organisms, using different genetic, morphometric and phylogenetic reconstruction techniques.

EMANUEL H. MARTIN
Research fellow

Born in Rombo, Tanzania, in 1977, he is a zoologist with a degree in wildlife management obtained at the Sokoine University of Agriculture – SUA, Tanzania (2002), and Master in Management of Protected Areas obtained at the University of Klagenfurt, Austria (2009). During 2003 - 2007, he worked as a Conservation Officer at the Mokolodi Nature Reserve in Botswana, gaining wide experience in the field of biodiversity monitoring and protected area management. He was also extensively involved with training park personnel on monitoring capacity. During 2009-2015 he was recruited as full-time research collaborator by MUSE to cover the position of Site Manager of the TEAM project (Tropical Ecology, Assessment and Monitoring), a pan-tropical network of standardized biodiversity monitoring sites, coordinated in the Udzungwa Mountains by MUSE. Since February 2012 he has enrolled into a Ph.D. programme with SUA on the ecology of the forest mammals’ community.

NATHALIE CAVADA
Ph.D. student

Born in Bolzano (BZ) in 1986, she holds a degree in Biological sciences (2006) from the University of Bologna and a Master degree in Biology of Animal Behaviour from Florence University (2013). She has been focusing on the ecology of primates since year 2010, when she got involved in a rehabilitation and post-release monitoring program of howler monkeys (*Alouatta pigra*), in the forests of Belize. In 2014 she started a Ph.D. at the University of Trento, in collaboration with the Tropical Biodiversity section at MUSE. Her research interests focus on the ecology and conservation of three primate arboreal species of the Udzungwa Mountains in Tanzania, integrating the analysis on ground collected data with remote sensing and GIS techniques.
MICHELE MENEGON  
Technician  

Born in Montebelluna (TV) in 1969, since 1998 he is affiliated to MUSE where he contributes to the establishment of the Tropical Biodiversity Section. He obtained a Ph.D. in tropical ecology at the University of Manchester Metropolitan. Since 1998 he has also been conducting research and environmental cooperation in East Africa. The research is focused on global diversification patterns, species phylogenetic relationships and radiation and speciation patterns of Amphibians and Reptiles that represent the model groups. Multi-taxon mapping of evolutionary information is also used in order to define optimal conservation areas for threatened species of montane Amphibians and Reptiles. He published over 60 scientific and public science papers, books and book chapters.

Selection of papers published in 2014-2015 (total IF 2014-2015= 43.8)  


Botany research group

COSTANTINO BONOMI  
*Head of the Botany Section*

M.Sc. in Biology (Padua, 1997)  M.Phil. in Botanical Diversity (Reading and Birmingham, 2000). Curator of the herbarium, the seedbank and the museum living plants collections (the tropical greenhouse, the thematic gardens on site and the two satellite gardens). His main research interests are plant conservation biology and seed ecology. Since 2001 he is in charge of the museum’s plant conservation projects, and botanic garden management. He promoted and developed Trentino Seed Bank, now a member of Ensconet, the European Native Seed Conservation Network, funded by the EU under FP6 research infrastructures. He contributed to Plant Science Gardens and Inquire, two European education projects funded by the EU under FP6 & FP 7 Science and Society. He coordinates NASSTEC, a currently running FP7 Marie Curie Initial training Network to promote the use of native species in grassland restoration involving 7 partners and 12 Ph.D. students. He is the Italian delegate in the European Consortium of Botanic Gardens.

SERENA DORIGOTTI  
*Research Assistant*

Born in Rovereto (TN) in 1975, she graduated in Natural Sciences at the University of Padua in July 2005 with a dissertation on a palynologic analysis of an Alpine environment. Since 2006 she worked at the Educational Department of the Museum of Sciences as senior educator in Botany. She performed educational activities mainly in the museum two botanic gardens, the Viole Alpine Botanic Garden and at the Arco Arboretum. In 2011 she joined the Inquire Project, developing and evaluating a training course for teachers and educators on IBSE methodology. She is skilled and experienced expert in the creation and management of workshops based on the IBSE technique.

MAURIZIA GANDINI  
*Research Fellow*

Born in Broni (PV) in 1977, M.Sc. in Natural Sciences (Pavia, 2004), Ph.D. in Experimental Ecology and Geobotany with a focus on Dendroecology (Pavia, 2007). Post-doc (Marie Curie Action) at Trento Museum of Science. Her main research interest is climate change in relation to alpine plant ecology, with a particular focus on Global Warming impact on biodiversity and spatiotemporal patterns of species living in high-altitude environments. She is also involved in statistical elaboration of ecological dataset and ecological modelling. She currently contributes to worldwide project GLORIA and to European project LTER.
ANDREA MONDONI
Research fellow

Born in Pavia in 1978. M.Sc. in Natural Sciences (Pavia, 2003), Ph.D. in Plant Ecology (Pavia, 2007). Post-doc (Marie Curie Action) at the Trento Museum of Science. His main research interest is germination ecology and seed bank management. He investigated in detail dormancy and germination of woodland herbaceous temperate species and has a keen interest in seed longevity of alpine species. He currently carries out studies on the effects of climate change on plant regeneration. He contributed to the European project ENSCONET in FP6 and to the local project ACE-SAP.

HOLLY ABBANDONATO
Research fellow

Born in Montreal, Canada, in 1988, with a MSc in Biology, Northern Populations and Ecosystems (Tromso, Norway, 2014) and she is currently enrolled in a Ph.D. part of the NATive Seed Science TEchnology and Conservation (NASSTEC) Marie-Curie Initial Training Network (ITN) at the University of Pavia (2018) and Trento Museum of Science (MUSE). Her main research interests are in plant ecology, diversity, and horticulture, though she greatly enjoys integrating these with other fields such as conservation, entomology, geology, and anthropology. She is investigating current policy and quality aspects of native seed production in Europe for ecological restoration. She has participated in various outreach events at MUSE (Trentino TV, ENGRID Marie Sklodowska-Curie, Ecsite, Researcher’s Night) and she will contribute over 20 native seed accessions to the Trentino Seed Bank.

EMMA LADOUCEUR
Research fellow

Born in Ottawa, Canada in 1984, M.Sc. in Conservation Biology from the University of Queensland, Australia (Brisbane, 2012). Currently a Ph.D. student for the NATive Seed Science TEchnology and Conservation (NASSTEC) Marie-Curie Initial Training Network (ITN) at the University of Pavia and Trento Museum of Science (MUSE) (Pavia, 2018). Her main research interest is with restoration ecology, conservation biology, vegetation ecology and seed science. She is currently investigating species selection for biodiverse dry grassland restoration projects in the alpine biogeographic region of Europe. Her research will be of both academic and practical value to improve both the species selection process, and to maximize outcomes.
ANGELA RUGGIERO  
Project Manager  

Born in Rome in 1973, BSc in Biology at the University “La Sapienza” of Rome. M.Sc in Molecular Ecology & Fishery Biology at the University of Hull, UK where she applied molecular biology to fishery genetics for conservation biology. Her research interest is in conservation biology applied to plant and animals, restoration ecology and the evolution of species. She started at MUSE on September 2014 as project manager for NASSTEC, NA\textit{t}ive Seed Science T\textit{echnology and Conservation Marie-Curie Initial Training Network (ITN). Her role is managing the project, ensuring the timely running of the project, organise and participate to outreach activities. She worked for nine years in Ireland participating to other European Projects, mainly in plant pathology applied to mushroom disease control, managing the molecular diagnostic lab, in Teagasc, the Irish Agriculture and Food Development Authority.

RENZO VICENTINI  
Technical assistant  

Born in Rovereto in 1984, since 2009 he collaborated with the Museum of Science where he contributed to various conservation projects such as ESCONET in FP6 and ACE-SAP as well as the study of the biology of alpine endemisms. He surveyed biodiversity rich alpine grasslands and tested their biomass production to evaluate their use in the traditional therapy of phytobalneotherapy. He collaborates with the seed collection and curation of threatened species in Italy, Spain and Tanzania. Since 2011 he is actively training in tropical botany and horticulture in the UK in collaboration with the Royal Botanic Garden Edinburgh. He is also involved in the design and development of the new Tropical Glasshouse of MUSE, the tropical nursery and quarantine facilities. Before joining the Museum of Science he collaborated with Rovereto Civic Museum on the collection and digitalization of the distribution data of the flora of the provinces of Verona and Trento.


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Limnology & Phycology research group

MARCO CANTONATI
Head of the Limnology and Phycology Section

University teaching Habilitation (Venia docendi) in Limnology (Phycology) (2011), Ph.D. in freshwater ecology (1998) from the University of Innsbruck (Austria), MSc in Natural Sciences (1992) and MSc in Biology (1990) from the University of Pavia. Alumnus at the Ghislieri College (Pavia), and Garbini Prize for limnology. MC dealt with an unusually broad spectrum of aquatic biota and habitats, with internationally-recognized expertise in spring-habitat ecology and conservation, and in the ecology and taxonomy of freshwater benthic algae (particularly diatoms, cyanobacteria, red algae). He discovered several algal and cyanobacterial taxa new to science (genera and species, mostly diatoms). Adjunct Professor at the Universities of Innsbruck and Trento. Teaching in international courses (Visiting Professorships, summer schools etc.), Ph.D. theses (Supervisor 6, Opponent, Reviewer), Post-Docs mentoring, Visiting Ph.D. students, MSc Theses (15) and Bachelors (10) supervising. Member of the Editorial Board of the Journal of Limnology (+ other 3), and Guest Ed. for Freshwater Science, Science of the Total Environment, J. Limnol., Hydrobiologia, and Fottea. Author of 328 scientific contributions, of these: 63 Research Articles on ISI International Journals with IF, and 19 International Special Issues, Books or Chapters. Organization of International Congresses and Special Sessions (13), Session Chairing (14), Invited talks (19) & talks (42 international + 19 national). R&D Funding acquisition: Scientific coordinator or WP coordinator of 21 Projects (1.8 million EURO managed).

DANIEL SPITALE
Research fellow

Born in Lennep - Remscheid (Germany) in 1976, he is an independent researcher with a Ph.D. and a broad skill base in ecology. In the early stages of his research career, he focused on lake phytoplankton, and then he moved his interests on to the fields of bryology and numerical analysis of ecological data. He is capable to deal with a variety of scientific topics related to ecology, from biodiversity analysis to ecosystem ecology and conservation biology. He collaborated with the MUSE Limnology & Phycology Section on many research projects (e.g., SALTO, CRENODAT, ACE-SAP), and more recently he started working also with the MUSE Tropical Biodiversity Section and the MUSE Invertebrate Zoology and Hydrobiology Section. He is author of 38 publications with IF (updated on February 2016), and he is referee for 13 international journals of ecological disciplines.

NICOLA ANGELI
Technician

Born in Trento in 1975, he is the Specialized Technical Assistant of the Limnology & Phycology Section of the Museo delle Scienze (MUSE). M.Sc. in Natural Sciences (2000) at the University of Padua (Italy), and Ph.D. in Ecology (2006) at the University of Parma. Since 2000, he collaborates with the Limnology & Phycology Section of the MTSN/MUSE. In particular, he deals and dealt with high-mountain lakes and springs, lake inventories, biological databases, diatoms and paleolimnology, in the frame of several research projects. Moreover, since 2005 he is the technician in charge for the MUSE scanning electron
microscope (Zeiss EVO40 XVP). Since 2009, he is also in charge for the Hydrochemistry Lab, and for the Collections of the Limnology & Phycology Section. He has also been involved in the content-development project team for the new Science Museum (MUSE) and in the Prevention and Protection Service of the Museum.


Spitale D., Angeli N., Lencioni V., Tolotti M., Cantonati M., 2015 - Comparison between natural and impacted Alpine lakes six years after hydropower exploitation has ceased. *Biologia*, 70: 1597-1605. [IF2014= 0.827]

Invertebrate Zoology and Hydrobiology research group

VALERIA LENCIONI
Head of the Invertebrate Zoology and Hydrobiology Section

Born in Salò (BS) in 1970, obtained a degree in Biological Sciences in 1996 at the University of Milan (Italy) with a thesis on plankton communities from alpine lakes, and a Ph.D. in Natural Sciences in 2000 at the University of Innsbruck (Austria) on taxonomy and ecology of invertebrates in alpine springs and streams. Her present research refers mainly to taxonomy and autoecology of stream macroinvertebrates (mainly Diptera Chironomidae) and to adaptive potential of target species of aquatic insects in relation to environmental stressors (e.g. temperature variations, presence of emerging contaminants) from a physiological and molecular point of view. She is also involved in projects on invertebrate biodiversity monitoring in protected areas in collaboration with local stakeholders within the Natura 2000 Networking Programme. Since 2005 she is member of the ministerial working team engaged for the elaboration of the national quality index for lakes within to the WFD 60/2000. She is author of more than 100 scientific papers and supervisor of more than 20 Bachelor/MSc Theses. She is the chief-manager of the MUSE’s collections and Editor in-chief of the MUSE’s scientific journal “Studi Trentini di Scienze Naturali” since 2003 and the head of the Invertebrate Zoology and Hydrobiology Section since 2009.

MAURO GOBBI
Curator

Born in Milan in 1979; he is an insect ecologist with a strong focus on ecology and conservation of montane habitats. His main research interests include the effects of global change and land use changes on spatio-temporal distribution of carabid beetles (Coleoptera: Carabidae). His stronger ecological expertise is on the ecology of carabid beetles and other arthropods living at high elevations, specifically along the glacier forelands and in the periglacial landforms. His scientific activity is testified by international collaborations and by publications on ISI-ranked journals, in addition he is subject editor of “Biodiversity Data Journal” and associate editor of “Journal of Insect Biodiversity”.

FRANCESCO BELLAMOLI
Research assistant

Born in Verona in 1986, he obtained a Master’s Degree in Molecular and Industrial Biotechnology at the University of Verona in 2013. In the past he focused his studies on microbiological and phylogenetic characterization of an environmentally relevant bacterial strain with an elevated resistance to selenite and tellurite oxyanions. Subsequently he was also involved in the development and experimental verification of a combinatorial DNA library generation algorithm that allows an efficient permutation of a set of genes of interest. Since 2015 he has been collaborating with MUSE Invertebrate Zoology and Hydrobiology Section within the RACE-TN research project, focusing on the evaluation of eco-genotoxicological effects of organic and inorganic pollutants in freshwater invertebrates, performing acute toxicity tests and developing experimental comet assay protocols.
FRANCESCA PAOLI  
Research assistant  
Born in Trento in 1983, she is graduated at the University of Padua in Natural Science in 2008. From 2009 to 2013 she collaborated with the Provincial Agency for Environmental Protection of Trento as field and laboratory assistant: here she has worked in monitoring for classification of the ecological status of water bodies, according to the European Directive 2000/60. Since 2014 she works as a freelancer for applied ecology in the planning and management of aquatic environments; she worked with several public authority and private entities, dealing mainly with the study of biological components of aquatic environments (macroinvertebrates and diatoms), the hydro morphological characterization of the streams (application of indices IFF, IQH, IDRAIM) and environmental planning (preparation of territorial plans, ecological networks and monitoring plans). In 2015 she started a collaboration with the Invertebrate Zoology and Hydrobiology Section of MUSE, participating in research on the ecology and biodiversity of alpine aquatic ecosystems.

ALESSANDRA FRANCESCHINI  
Technician  
Born in Venice in 1967, she obtained a degree in Biological Science at the University of Padua in hydrobiology and macroinvertebrates. Since 1993 she collaborates with the Section of Invertebrate Zoology and Hydrobiology of the MUSE within projects on riparian zones of rivers, mountain streams and alpine lakes. She focused on riparian fauna (mainly Coleoptera Carabidae) and aquatic insects (mainly Plecoptera). She was teacher for the “Indice Biotico Esteso” (IBE) application and co-author of the IFF index “Applicazione dell’Indice di Funzionalità Fluviale”. In 2008 she was worked as chemical technician at the Environmental Agency of Trento (Italy). Since 2009 she is technical assistant of the Section of Invertebrate Zoology and Hydrobiology of the MUSE, involved both in research projects (field and laboratory work) and in entomological collections managing (cataloging, care, loan and moving managing, exhibit mounting etc.).

TERESA BOSCOLO  
Technical assistant  
Born in Napoli in 1973, she obtained a degree in Natural Sciences at the University of Bologna in 2003 whit a thesis regarding the *Macrolepidoptera* etericera in the Parco Regionale Corno alle Scale, Bologna (Italy). From 2008 to 2012 she collaborated with the Zoology Section of the Natural History Museum of Verona (Italy) as field and laboratory assistant, within research projects mainly on entomological fauna. From 2011 to 2013 she worked as taxonomist at the Natural History Museum of Ferrara (Italy) within the project “Climaparks” (Monitoring of the climatic effects on biocenosi in Parco Regionale del Delta del Po Emilia Romagna, Italy). In 2013 she started a collaboration with the Invertebrate Zoology and Hydrobiology Section of the MUSE within several projects on alpine entomofauna as expert in Coleoptera Carabidae taxonomy.
SONIA ENDRIZZI
Technical assistant
Born in Trento in 1980, she obtained a bachelor degree in Natural Science and a master degree in Conservation and Management of Natural Heritage at Bologna University, respectively in 2007 and 2011. During her academic studies she collaborated as trainee in research projects on aquatic habitats at: ISMAR-CNR, Department of Zoology of Oxford University – UK, Natural Science Museum of Trento and Edmund Mach Foundation. After her academic training she collaborated with the Hydrobiology Research Unit of E. Mach Foundation and the Milano Bicocca University involved in studies on the status and genetic characterization of native and alien crayfish and on the effects of hydropower production and agriculture on aquatic macroinvertebrates in Trentino. In 2015 she worked with the Section of Invertebrate Zoology and Hydrobiology of MUSE in research projects on the high elevation aquatic fauna (Alpine Biodiversity Project) and the monitoring of tiger mosquito in Municipality of Trento.

CHIARA MAFFIOLETTI
Technical assistant
Born in Bergamo in 1988, she obtained a degree in Natural Sciences at the University of Milan in 2014 whit a thesis regarding plants and arthropods of glacial and periglacial environments.
She is a naturalist, interested in epigean arthropods ecology, especially in recent deglaciated areas. From 2014 to 2015 she has collaborated with MUSE on monitoring invertebrates from Stelvio National Park, and at the beginning of 2016 organizing some high altitude insects’ collections. She loves insects because of their extraordinary ability to survive in high altitude environment and their indispensable application to understand ecosystems ecology.

Selection of papers published in 2014-2015 (total IF 2014-2015= 33.7)


Vertebrate Zoology research group

PAOLO PEDRINI
Head of the Vertebrate Zoology Section

Born in Trento in 1958, he obtained a degree in Natural Sciences, with a post-degree specialization in “Nature conservation and land planning and development” (University of Pavia) and “Vertebrate management” (University of Pavia). From 1983 to 1995 he has been working as consultant for several institution within the Autonomous Province of Trento (PAT) and for several National universities and research institutions; he has also been teaching in high schools. From 1995 he is curator and coordinator of the Vertebrate Zoology Section at the MUSE (previously “Museo delle Scienze”), he has also been the curator of the Environmental education Section of the same museum until 2001. He has been the supervisor of several degree theses and the author of over a hundred of scientific publication, mainly focusing on bird ecology, distribution and conservation. He attended and coordinated national and international research projects on birds (among which the projects “Biodiversità”; Rete Natura 2000; Progetto Alpi; Large Carnivore) on distribution, population trend and reproduction and ecology of alpine birds; he has been the coordinator of the action plan on threatened species conservation, of the atlas of local species distribution as well as of the red-list species assessment (Amphibians, Reptiles, Birds and Mammals). From 2011, he is project manager of many conservation actions of the LIFE+T.E.N. (Trentino Ecological Network) and LIFE+ WolfAlps.

SIMONE TENAN
Curator

Born in Rovigo in 1974, he graduated with honours in Natural Science from the University of Padua (Italy). In 2013, he was awarded a Ph.D. from the University of Pavia for a thesis entitled ‘Hierarchical Bayesian modelling: Applications in animal population ecology’. He has been focused on addressing different ecological hypotheses in the general fields of population and community ecology, by exploiting the conceptual clarity and practical utility of the hierarchical modelling framework, together with the benefits of Bayesian methods as a mode of analysis and inference. His current research programme on applied quantitative ecology if focused on the development and application of existing analytical frameworks, such as spatial and non-spatial capture-recapture models, occupancy models, and integrated population models. He also works on the formal integration of opportunistic and systematic data to improve estimates of key state variables used to describe animal populations and communities, such as abundance, occurrence and species richness.

MATTIA BRAMBILLA
Research fellow

Born in Cantù (CO) in 1980, he graduated in Natural Sciences (April 2003) and obtained a Ph.D. degree in Natural and Environmental Sciences (Jan. 2007) in Milan. His main research interests are bird ecology and conservation (with particular regards to farmland species, rails and raptors), evolution and phylogeography. Now most of his work is dedicated to conservation, and especially to biodiversity in farmland habitats, ecology and conservation of rallaids, shrikes and other birds of conservation concern, monitoring plans at the regional scale, ecological networks from local to regional scale, conservation and
management of areas and species of conservation concern, assessment of conservation status and setting of conservation targets for animal species according to EU Directives at both the national and the regional scale. He is the author of 37 ISI-ranked papers (32 as first author; 2004-2013).

FRANCO RIZZOLLI
Research fellow

Born in Trento in 1968, he obtained a degree in Natural Sciences at the Padova University with a dissertation on Hydrobiology. He works as researcher in ornithology, with a special focus on monitoring activities and databases management aimed to data analysis. He collaborates with the Vertebrate Zoology Section on researches on bird migration, nesting ecology and faunal censuses. He work on management and implementation of GIS databases; he is author of several scientific publications published both on national and international journals, especially on subjects dealing with raptors breeding ecology, bird migration and wintering water birds. He collaborated to the realization of technical documents on land planning and nature management for the Autonomous Province of Trento (PAT).

GIACOMO ASSANDRI
Ph.D. student

Born in Moncalieri (TO) in 1989. M.Sc. at the University of Pavia in 2013 with a dissertation focussed on the conservation of frugivorous birds in olive orchards. His main interests are ecology and conservation biology with a particular reference to the effects of human activity on biodiversity. My favourite model organisms are birds and dragonflies. From November 2013 Ph.D. student at the University of Pavia with a Ph.D. fellowship from MUSE (Vertebrate Zoology Section). His Ph.D. project is focussed on investigate the ecological relations between birds and agroecosystems of Trento Province and Alpine ecoregion in order to define adequate conservation measures.

ALESSANDRO FRANZOI
Ph.D. student

Born in Trento in 1985, he graduated in Natural Sciences at University of Pavia. His BSc dissertation (2009) focused on the monitoring of the bird breeding population of one of the protected areas of Trentino province, while his MSc dissertation (2011) focused on density and habitat selection of Rock Ptarmigan (Lagopus muta) in western Alps. His main interests are now bird ecology, management and conservation. He has been collaborating with MUSE on the monitoring campaigns of breeding bird population of Trentino province and on researches on bird post-nuptial migration through Alps since 2004. In 2013 he collaborated with Vertebrate Zoology department of MUSE as research assistant to project LIFE T.E.N. Since November 2013 he is attending a Ph.D. at University of Pavia with a scholarship funded by MUSE and Fondazione Edmund Mach. The Ph.D. project focuses on investigation on geographic provenance of post-breeding migratory birds on Alps, applying Stable Isotope Ratios.
MARIA CHIARA DEFLORIAN

Technician

Born in Trento in 1976, she obtained a degree in Natural Sciences at the University of Pavia with a dissertation on the ecology of the European Badger (*Meles meles*). In 2004 she attended a Master in scientific museology at the University of Padova and in 2007 a CNRS course (France) on scientific collection management. She works at MUSE since 2000, where she mainly deals with the management of the scientific collections (cataloguing, care and conservation). She curates the vertebrate collections. She is author of several publications dedicated to the study of the museum scientific collections. She conducts laboratory activities for the identification of mammals signs of presence and collaborates on research projects of the Vertebrate Zoology Section. She participates in the realization of permanent and temporary exhibitions and other activities for the public.

FRANCESCA ROSSI

Technician

Born in Firenze in 1972, she obtained a degree in Forestry at the University of Firenze in 1998. From 2001 she collaborated on bird research and monitoring projects, both on migratory and resident species. She is the referent person for the Bird Ringing Station at Passo del Brocon, which is part of the “Progetto ALPI”. For the same project she was involved in data management and preparation of annual reports. She also conducted fieldwork, management and analysis of data on the Progetto Biodiversità. She has collaborated to the provisioning of data to the Autonomous Province of Trento about faunal databases, status and phenology of faunal species of conservation relevance; assessment of the conservation value of selected sites and related management issues; monitoring work in the context of the “Rete Natura 2000 “ of Trento province. From 2013 deals with the management of the MUSE’s aquariums.

KAROL TABARELLI DE FATIS

Technician

Born in Trento in 1981. Working at MUSE – Science Museum of Trento - since 1997, he has covered several different tasks. He is currently a staff member at the Research Unit of Vertebrate Zoology, working as a technician and collection management assistant. Karol specializes in vertebrate zoology with specific focus on herpetology and ornithology, and believes in Web 2.0 as a powerful tool to share culture and information.

NATALIA BRAGALANTI

Technical assistant

Born in Cremona in 1979, she is graduated at University of Insubria (Verese) in Natural Sciences in 2004. She is a research consultant cooperating with Stelvio National Park (since 2005), Wildlife Office of Provincia Autonoma di Trento and vertebrate zoology section at MUSE (since 2012). Her expertise is on animal conservation. Her research topics are on ungulates, grouse and large carnivores. Her main skills are on field activity (in particular radiotracking and census design), Geographic Information System and database management.
SONIA ENDRIZZI
Technical assistant

Born in Trento in 1980, she obtained a bachelor degree in Natural Science and a master degree in Conservation and Management of Natural Heritage at Bologna University, respectively in 2007 and 2011. During her academic studies she collaborated as trainee in research projects on aquatic habitats at: ISMAR-CNR, Department of Zoology of Oxford University – UK, Natural Science Museum of Trento and Edmund Mach Foundation. She also worked as volunteer at LIPU. After her academic training she collaborated with the Hydrobiology Research Unit of E. Mach Foundation and the Milano Bicocca University mainly dealing with studies on the status and genetic characterization of native and alien crayfish and on the effects of hydro-power production and agriculture on aquatic macroinvertebrates in Trentino. She is consultant in the private sector for the Environmental Impact Statement on rivers. Since 2013 she works with the Vertebrate Zoology Section of MUSE in research and monitor activities on aquatic habitats. She is particularly involved in the European Project Life+T.E.N. “Trentino Ecological Network” for the characterization and restoration of aquatic habitat in agricultural environment and the conservation, management, breeding and reintroduction of threatened species Austropotamobius pallipes and Bombina variegata.

AARON IEMMA
Technical assistant

Born in Lugo (RA) in 1989, he is currently studying at the University of Trento, at the faculty of Civil and Environmental Engineering. In 2011 he applied for a national civil service programme at MUSE (previously Museo Tridentino di Scienze Naturali), during which he focused on deploying an efficient implementation of various databases. Working constantly on the integration of spatial databases and geographical software in an Open Source environment, he is from 2013 collaborating with the MUSE Vertebrate Zoology Department, with the aim to develop a multipurpose spatial database with graphical capabilities. His main interests cover a wide range of topics, including efficient computation, programming and modern pagination.


Geology research group

MARCO AVANZINI  
*Head of the Geology Section*

Curator of the geology and palaeontology department. His research focus on stratigraphy and palaeoenvironment reconstruction of Mesozoic ecosystems in the Southern Alps and Southern Europe. Has experience in palaeontological excavations and the geological mapping of the alpine area. Is author of more than 300 publications in national and international journals concerning the study of tetrapod footprints, geology and stratigraphy of the Mesozoic of the Southern Alps.

MASSIMO BERNARDI  
*Curator*

Born in Rovereto (TN) in 1984; he is a palaeontologist. He focus his research on the study of fossil vertebrates and terrestrial ecosystems around the Permian-Triassic interval. He graduated in Natural Sciences at the University of Padova (2006), and gained a Master of Science in Paleobiology at the University of Bristol (UK, 2009) where he is now a Ph.D. student. From 2006 to 2008 he was assistant of Alessandro Minelli for the Laboratory of Evolution (University of Padova). In 2010 he was lecturer at the University of Padova (Evolution). He has active collaboration with Museo di Scienze Naturali dell’Alto Adige, Geopark Bletterbach e Adamello-Brenta, Fondazione Dolomiti UNESCO, University of Padova, University of Torino, Universidade de Sao Paulo. He is curator of the Paleontological galleries of the new MUSE. As member of the Geology Section of the Museo delle Scienze he is involved in research and outreach activities concerning both vertebrate and invertebrate palaeontology.

RICCARDO TOMASONI  
*Curator*

Born in Rovereto, August 7, 1972, graduated at the University of Bologna in 1998. Since 1999 he worked as geologist freelance in various areas, bringing together technical activities in the field with scientific research and geological-environmental promotion. Since 1999 he has participated in the 1:50.000-scale geological mapping of Italy as a compiler designated by the geological Survey of the Province autonome di Trento and Bolzano and collaborated in geological, stratigrafic and paleoecological research activities on the Southalpine sedimentary succession promoted by the Geology section of the Museo delle Scienze. His passion for geology and the natural environment has led him to undertake numerous projects to safeguard and promote the local geological-environmental heritage. He contributed to cataloguing geosites in Trentino and supervised the process leading to the inclusion of the Adamello Brenta Nature Park in the European Geoparks Network under the aegis of UNESCO. He deals with the planning of geological itineraries and has participated in the development of exhibitions and displays for museums and visitor centres. Since august 2013 he is curator of the geology of the Hearth Science departement of the Museo delle Scienze.
ELENA BERTONI  
Research assistant
Graduated in Geology at the University of Ferrara with a Master’s thesis in Hydrogeology, since 2014 she collaborates with the Geology Research Unit of the Museo delle Scienze dealing with glacial geomorphology and glaciology. She run a study about the extension of the Trentino’s Glaciers during the Little Ice Age as well as their evolution up to date and participates in the measuring of the mass balance on the samples glaciers of Trentino. She is a team member of the project POLLICE which aims to reconstruct the climate change in the past through the analysis of pollen stored in ice cores taken from Adamello Glacier. She also collaborates with the Limnology and Phycology Research Unit of the Museo delle Scienze dealing with springs and with the geomorphological and hydrological evolution of alpine lakes.

ISABELLA SALVADOR  
Research assistant
Graduated in Architectural Engineering at the University of Trento, from 2007 she collaborated with the Civil and Environmental Engineering Department on Apsat project (Ambiente e paesaggio dei siti d’altura alpini) studying traditional building evolution in mountain areas in relation to socio-economic and environmental changes. In 2011 she earned a Ph.D. in Engineering of Civil and Mechanical Structural Systems from University of Trento. From the same year she cooperates with the Geology section of the Museo delle Scienze di Trento as part of the Openloc project, where she studies land use changes in upland areas and their interrelation to the traditional architecture, physical resources and environmental dynamics, in particular for highland pastures.

FABIO MASSIMO PETTI  
Research fellow
Holding a Ph.D. in Paleontology, from 2007 he cooperates with the Geology and Paleontology section of the Museo Tridentino di Scienze Naturali, benefiting of a post-doc grant funded by the Provincia Autonoma di Trento. The topic of the post-doc project is the study of dinosaur footprints as constraints in the palaeo-geographical and palaeoecological reconstructions of the Central Mediterranean area during the Late Triassic-Late Cretaceous interval. From 2007 he is assistant editor of the Bollettino della Società Paleontologica Italiana, the Italian journal devoted to Paleontology.

PAOLO FERRETTI  
Technician
Since 2001 is member of the Geology Section of the Museo delle Scienze, where he firstly joined several research activities regarding hydrogeology and quaternary geology. Afterwards he addressed his activity towards mineralogy and petrography with important discoveries in the Alpine region.
Selection of papers published in 2014-2015 (total IF 2014-2015= **11.7**)


Prehistory research group

GIAMPAOLO DALMERI
Head of the Prehistory Section

Born in Pergine Valsugana (TN) in 1952. In 1977 obtained his degree in Human Palaeontology at the University of Ferrara. He conducts research projects related to the oldest alpine human population, especially in Trentino. In the 80’s and 90’s he collaborated with numerous research projects on the Mesolithic in Trentino. In 1990, he discovered the Dalmeri rock shelter, a scientifically relevant site in many aspects, such as residential mobility, ways of life and hunting, art and rituals of the ancient hunter-gatherers of the late Upper Palaeolithic. He directed palethnological and paleoenvironmental researches at Dalmeri rock shelter (Grigno, TN) and other open-air sites such as Palù Echen (Folgaria plateau, TN), Malga Palù (Vezzene plateau, TN), Laget (Predaia plateau, TN). Currently he directs excavations at Monteterlago rock shelter (TN) and Cornafessa rock shelter (Ala, TN). Since 1997, he has coordinated more than 30 theses (undergraduate and Ph.D.) in Prehistoric Science and Cultural Heritage. He has taken part to 40 national and international conferences and workshops, and has produced about 20 posters and 30 oral communications. He is co-author of about 100 works in scientific journals. He has published over 250 scientific and educational papers and book’s chapters.

ALESSANDRO FEDRIGOTTI
Research assistant (Pile-dwelling Museum of Lake Ledro)

Born in Rovereto (TN), November 05, 1983, he graduated in Prehistoric Sciences in 2009 and earned a Ph.D. called “The pile-dwelling sites of Ledro”. Combined methodologies and approaches for the understanding of a site and its territory”; this study is related to pile-dwelling site but also to the entire context of Ledro Valley. Among his latest works we find the project “Le palafitte nel cassetto dei ricordi” and a research on prehistoric bows. He collaborates with the Pile dwelling Museum of Lake Ledro as regards education and scientific divulgation. He collaborates also in the project “Rete di Riserve Alpi Ledrensi” since 2014.

LUCA SCOZ
Research assistant (Pile-dwelling Museum of Lake Ledro)

Born in Trento, November 6, 1983, he obtained a Master degree in Prehistoric Sciences in 2007 at the University of Ferrara, with a thesis on the spatial analysis of Tagliente rock-shelter (Verona, Italy). He worked for University of Trento and he has been working in the Science Museum of Trento since 2009, in the branch office of Pile-dwelling Museum of Lake Ledro. His research concerns the settlement strategies of prehistoric hunters and gatherers in Western Trentino, investigated through archaeological field surveys and excavations. He also deals with cultural dissemination of the archaeology and history of the First World War in Trentino.
The staff of the scientific sections

ROSSELLA DUCHES
Research assistant

Born in Trento, December 06, 1982, she graduated in Prehistoric Sciences in 2007 and earned a Ph.D. in Science and Technology for Archaeology and Cultural Heritage - curriculum Quaternary and Prehistory, in 2012 at the University of Ferrara. She gained different research grants from public institutions and foundations, and her Ph.D. thesis has been recognized from University of Ferrara as one of the best works of 2012. Her principal research topics concern settlement dynamics and hunting strategies of Lateglacial human groups. She uses lithic technology as her primary research tool, applying chaîne opératoire concepts to recognize cases of behavioral variability. Her post-doc project was focused on Younger Dryas societies of the Eastern Italian Alps (YDESA project) and was aimed to evaluate the techno-economic and social changes typical of this period. She is also involved in other research projects concerning the demise of Homo neanderthalensis and the Middle to Upper Paleolithic transition, in collaboration with the University of Ferrara and other foreign institutions (Grotta di Fumane and Grotta del Rio Secco research projects).

ELISABETTA FLOR
Technician

Born in Cles (TN) February 28, 1982, has worked as a Technical Assistant for the Prehistory Department of MUSE since 2013. She is manager for the educational activities in the Prehistoric area and she is in charge of the museographic set up of the Alpine Prehistory Section of MUSE. She studies Mesolithic lithic assemblages from a technological point of view. Since 2006 she has occasionally collaborated with the Tridentine Museum of Natural Science as a technical/scientific consultant for digital inventory of the collections. She has taken part in research project as OPENLOC “Social capital and environmental capital”. And she has been part of the MUSE Project Team. She received his Master Degree in Prehistoric Sciences at University of Ferrara March 20th, 2009 with an elaborate on the technological analysis of the Sauveterrian lithic assemblage from the Romagnano Loc III rock shelter (TN). On March 21th, 2005 she received his Bachelor’s degree in Cultural Heritage Management - Archaeology at the University of Trento, with an elaborate on the technological analysis of the Sauveterrian lithic assemblage from the Pradestel rock shelter (TN).

ALEX FONTANA
Technician

Born in Aosta April 11, 1977. He graduated in 2006-2007 academic year in Natural Sciences, paleontological curriculum at the University of Parma, with a thesis on “the fauna of the ancient Bronze Age Caves of Castelcorno of Isera (TN)”. His principal research topics grants from zooarchaeology of italian contexts, with particular attention to the north-italian archaeological sites and animal exploitation. As part of the technical scientific section deals with the design, construction and management of the new zooarchaeological laboratory, collaborating and interacting closely with a prehistory and zoology sections. He collaborates with the Educational Services for the design and delivery of educational activities for schools and organized groups, according to the offer of the Museum or on educational projects with institutions or institutions outside the school in Prehistory.
STEFANO NERI
Technician

Born in Trento, April 23, 1980, has worked since 2005 at the MTSN first as educators, then from 2007 as the Technical Section of Prehistory. He received the 2004-2005 Academic Year Degree in Cultural Heritage, Archaeological and at the University of Trento, Faculty of Humanities, with thesis on “Records and GIS analysis of the archaeological record of attendance the last hunter-gatherers in Trentino”. In the technical-scientific field of the Section is responsible for operational and logistics to the archaeological excavations. Cooperates with the preparation of excavation data, as well as cataloging and archive of artifacts. It is part of Project Team MUSE and collaborates with the Educational Services for the Project Team is part of the Muses and collaborates with the Educational Services for the design and delivery of educational activities for schools and organized groups, according to the offer of the Museum or on projects educational with institutions or institutions outside the school in Prehistory. He collaborates in the activity of the scientific journal publishing “Alpine Prehistory”.


Appendix 2

The staff of the science communicators
Science Communicators group

CHRISTIAN CASAROTTO
Glaciologist

Christian Casarotto, 1975. Bachelor's Degree in Natural Science. He devotes himself to geomorphology, Geology of Quaternary Period and alpine environment evolution with its glacial dynamics. He studied the Mont Blanc, Monte Rosa e Bernina glaciers. He firstly took part to educational activities; afterwards he addressed his activity towards monitoring of alpine glacial also as part of Italian Glaciological Committee. He is involved in territorial studies of sustainable development through the valorisation of natural heritage. He join his research activities with the popularization of study results in several meeting and public communication.

PATRIZIA FAMÀ
Biologist

Ph.D. in molecular ecology of seaweeds (Stazione Zoologica A. Dohrn, Naples – University of Messina) and M.P.S. in environmental communication (University of Pisa). She has a two years’ experience as Postdoc Fellow in molecular evolutionary genetics of seaweeds (University of Geneva). Since 2009 is science communicator at MUSE. Her work focuses on the development of educational and public programs in the field of life science, primarily in contemporary biology, genetics and biotechnology, nanosience, nutrition and health sciences. She is currently responsible at MUSE (Science Museum of Trento) of three EU projects in Responsible Research and Innovation dealing with synthetic biology, technological shifts in medicine and nanotechnology [SYNERGENER -SPARKS - NANO2ALL]. She has 7 years’ experience in designing educational activities in formal and informal settings and responsible for the development and the performance evaluation of educational program. She is curator of the DNA gallery within the permanent exhibition at MUSE. In 2015, she has managed the EXPO project for Trentino Autonomous Province, conceiving three temporary exhibitions as scientific manager.

CLAUDIA LAURO
Geologist

Born in Trento in 1970, she collaborated with the Museo delle Scienze since 1993. She firstly carried out educational and research activities for the Educational, Geology and Prehistory Sections. She was also charged with technical assignments: geological-geomorphological surveys, applied geology and hydrogeology tasks for private and public offices. For the museum she has dealt with science communication since 2001, planning temporary and permanent exhibitions, natural paths and cultural events. Since 2009 she is member of the communication science team and curator of the permanent exhibition galleries dedicated to the Earth Sciences of the new museum, especially developing the subject of natural and anthropic risks.
LUCIA MARTINELLI
Bioligist

Ph.D. in Genetics at the Wageningen Agricultural University (NL), Laurea in Biological Sciences and the Bologna University (I) and Master of Scientific Journalm and Communication at the Ferrara University (I). During a 30-year experience as researcher in Italian and foreign public and industrial research institutes, she has developed and coordinated research in the field of biotechnology, focusing on gene transfer, GMO traceability and scientific communication. Since June 2011 at MUSE research main topic regards the interconnections between science innovations and society, and responsible research and innovations. Results have been disseminated in around 170 publications. The activity is based on collaborations within the Trentino research system and within International networks such as COST actions and EU projects. She has expertise in science-theatre conferences and text writing and hosting programs for the radio, both public and private nets. She is member of the boards of the Italian Association of Women Scientists and the European Platform of Women Scientists.

OSVALDO NEGRA
Zoologist

Born in Bozen, Italy, in 1966, he achieved a master degree in Biology at Parma University in 1991 (with a thesis “Ecophysiology of the autumn migration of the Sedge Warbler in a site on the Italian mainland”). In 1994 he gained a Ph.D. in Animal Biology at Pisa University (with a thesis “Stable and transient components of a bird community of the Tyrrhenian coast of Tuscany”). In 1997, he won a contest for “technician of zoology” at the Museum of Natural Sciences in Trento (MTSN), where he carried out research and science dissemination for many years and curated several temporary exhibitions about natural sciences. Since 2008 he works at MTSN as Cultural Mediator for Biodiversity and curator of the new science museum developed in Trento.

ALESSANDRA PALLAVERI
Zoologist

I got a bachelor’s degree in Natural Sciences at the University of Parma with an experimental thesis in animal behavior. In 1998 I started working at the Museum, getting involved in research activities and in science communication for the Vertebrate Zoology Department, and in planning and in the conduction of educational activities for the Educational Department. Since 2009 I have been a science communicator. I have taken part in many projects of temporary exhibitions, discovery rooms for children, visitor centers and guided paths. During 2008 and 2009 I worked on the renovation of the permanent exhibition of the former Museo Tridentino di Scienze Naturali, a kind of training for the big one: the project of the new museum, the MUSE. I was part of the project team of the new MUSE for the biodiversity area, in particular as co-curator of the 3rd floor (Alpine Nature), the Big Void, the Discovery room for kids, and as coordinator for the specimens acquisition and finding.
FRANCESCO RIGOBELLO
Botanist

Francesco Rigobello graduated in Natural Science with an experimental thesis on phytosociology in 1993. From that year he is collaborating with the Botany Section of the Museum of Science of Trento. From 2009 he is one of Science Communicators of the museum. He manages the museum’s satellite visitor centre of Tremalzo and he is involved in the project management and set up of exhibitions, educational programs and botanical gardens piloting. He projects and lead refresher courses for science teachers. He authored more than 50 scientific and divulgative papers.
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</table>
Appendix 3  Research Projects, high education and teaching
Research projects:


2. CLIMBIVEG: CLIMate change effects on BIodiversity of high-altitude environment VEGetation. Post-doc funded by Autonomous Province of Trento and co-funded by the European Union under the Seventh Framework Programme for Research (FP7), Marie Curies Actions “Bando post-doc incoming” (Maurizia Gandini) (2011-2014).

3. Develop of portable sequencing kit, in collaboration with Università degli Studi di Verona. Project funded by Fondazione Cassa di Risparmio di Trento e Rovereto, Trento, Italy (Caritro) (2012-2014).


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<td>Exhibitions</td>
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Projects by agreements

1. AQUA_TEST - Ricerca ecologica di lungo corso e ACQUA-TEST_PNAB. Project funded by the Parco Naturale Adamello Brenta (since 1998).


3. Catasto dei ghiacciai del Trentino. Project co-funded by the Ufficio Previsioni e Organizzazione of the Autonomous Province of Trento (since 2014).


10. POLLICE – Pollen and ICE. Project co-funded by FEM – Fondazione Edmund Mach and Milan Bicocca University.


13. Research applied to vertebrate wildlife management in Trentino. Project funded by the Autonomous Province of Trento (Servizio Conservazione Natura e Valorizzazione Ambientale) (since 1998).

14. Research focused on large carnivores in Trentino and central Alps. Project funded by the Autonomous Province of Trento (Servizio Foreste e fauna) (since 2014).


**Institutional projects (supported by MUSE)**

1. Avian fauna, climate and landscape change on high elevations (since 2012).

2. CYPRUS-DIATOMS - Diatoms from the running waters of Cyprus; results publication (2014-2015).


4. EBISS - Exploring the Biodiversity of Swiss Springs; results publication (2010-2015).

5. ELBA-FWS - Special series of papers on the Ecology of Lake Benthic Algae (FreshWater Science) and last ACE-SAP.A2.WP2 publications (ELBA-FWS) (2012-2014).


7. GLASSTZ - Serra tropicale Eastern Arc del MUSE. With collaboration of University of Dar es Salaam, Tanzania (since 2010).


9. MITO - Farmland Bird Index, Woodland Bird Index e andamenti di popolazione delle specie. Project funded by the Autonomous Province of Trento (2000-2015), LIPU, MATTM.


12. NATEC - New And interesting Taxa: Ecological and Taxonomical Characterization (since 2010).
13. Ornitho.it, Ornithological data base (since 2010).
17. Riparo Comafessa - Studio preliminare del sito paleolitico di montagna (since 2015).
20. UEMC - Gestione del Udzungwa Ecological Monitoring Centre. In collaboration with Tanzania Natural Parks (since 2006).

Seminars/Lectures c/o Universities and Museums and Teaching activity

12. Bonomi C., 2015 - Using GPS for seed collecting, data transfer and handling. NASSTEC summer school -Seed Collecting Strategies to face Climate Change, Jardin Botanico Atlantico, Gijon, Spain, 7 September 2015.


In-house workshops and congresses organizations

1. 9th International Symposium on Archaeological Mining History, “Research and preservation of the ancient mining areas” - MUSE - Museo delle Scienze, Trento, Italy, 5-8 June 2014.


6. Special Session Spring-habitats’ and spring-fed headwaters’ biology fifty years after the definition of crenobiology, Joint Aquatic Sciences Meeting (JASM) - Portland, Oregon, USA, 18-23 May 2014.


Congress attendances and training courses


6. 1st Annual meeting of the European Botanic Gardens Consortium - Zagreb Botanic Garden, Croatia, 6-8 June 2014.


10. 2nd Stable Isotope Course in Ecology and Environmental Sciences. Sevilla, Andalusia, Spain, 5-10 October 2015.


15. 8° Convegno Nazionale di Archeozoologia AIAZ - Lecce, Italy, 11-14 November 2015.

16. 8th Central European Diatom Meeting (CEDIATOM8) - Croatia, Zagreb, 10-13 April 2014.

17. 9th International Congress on Education in Botanic Gardens, Biodiversity for a Better world. Wild ideas worth sharing - St. Louis, Missouri, USA, 25 April - 3 May 2015.


37. Corso per la progressione in alveo e attività in ambiente fluviale. tsm-Trentino School of Management, Trento, Italy, 22 July 2014.
41. EUROGARD 7 - The 7th European Botanic Garden Conference - Paris, France, 5-10 July 2015.
42. Giornata informativa sulle Azioni Marie Skłodowska-Curie. Horizon 2020. Università degli Studi di Verona, Italy, 4 April 2014.
43. GLOBAQUA Elicitation Workshop: Restitution to stakeholders and assessment of routes to sustainable water management valuation of ecosystem services - Facoltà di Ingegneria, Mesiano, Trento, Italy, 30 September 2015.
44. GRASS GIS Course- Fondazione E. Mach, San Michele all’Adige (TN), Italy, 26-29 October 2015.
45. I 100 anni dell’erbario tropicale di Firenze - Firenze, Italy, 3 October 2014.
48. Incontro Generale NextData - CNR, Roma, Italy, 3-4 June 2014.
49. International Plant Science Conference (IPSC) from Nature to Technological Exploitations - Firenze, Italy, 2-5 September 2014.
52. Joint Aquatic Sciences Meeting (JASM = SFS+ASLO+PSA+SWS) 2014 - Portland, Oregon, USA, 19–23 May 2014.
53. La comunicazione della Pubblica Amministrazione sui Social Media. tsm-Trentino School of Management, Trento, Italy, September 2015.
54. L’importanza dei giardini come luoghi di sopravvivenza per insetti impollinatori locali e per il mantenimento della biodiversità. Giardini Trauttmansdorff, Merano (BZ), Italy, 28 October 2015.
56. NASSTEC Annual General Meeting - Università di Pavia, Italy, 19 - 22 October 2014.
57. NASSTEC exchange visit - Masaryk University, Brno, Czech Republic, 7-13 December 2014.


60. **NASSTEC exchange visit, Supervisory meeting and tour of the facility** - Scotia Seeds, Berchin, UK, 10 March 2015.

61. **NASSTEC Induction course** - Università di Pavia, Italy, 23 - 28 October 2014.

62. **NASSTEC Preparatory meeting** - Pavia and Milano, Italy, 9-10 January 2014.

63. **NASSTEC Secondment** - Masaryk University, Brno, Czech Republic 12-27 July 2015.

64. **NASSTEC Secondment** - seed production, practical work and co-supervisory meetings - Scotia Seeds, Berchin, UK, 26 June - 12 July 2015.

65. **NASSTEC Secondment** - Semillas Silvestres, seed production, practical work and co-supervisory meetings - Cordoba, Spain, 22 October - 4 November 2015.


68. **Planta Europa steering committee** - Umwelthouse Muenster, Germany, 17-18 April 2015.

69. **Preistoria del cibo. 50th Riunione dell’Istituto Italiano di Preistoria e Protostoria** - Roma, Italy, 5-9 October 2015.


73. **Sicurezza ed igiene sul lavoro - rischio Chimico. Progetto Salute S.r.l, Trento, Italy, May 2014.**


76. **Spatio-temporal Isotope Analytics Lab (SPATIAL). University of Utah, Salt Lake City, USA, 9-20 June 2014.**

77. **Spring School on Stable Isotopes in Environmental Sciences, Ecology and Physiology at Weihenstephan, Germany and Buckweis. Czech Republic, 7-13 April 2014.**

78. **Table ronde organisée en hommage à Guy Célérier** - Musée National de Préhistoire, Les Eyzies-de-Tayac, France, 24-26 June 2015.

79. **The 7th Biennial Conference of the International Biogeography Society** - University of Bayreuth, Germany, 8-12 January 2015.
80. *The National Native Seed Conference* - Santa Fe, USA, 13-16 April 2015.


84. Workshop: *Catasto dei ghiacciai italiani* - Milano, Italy, 22 May 2014.


87. Workshop: “Cineca presenta il nuovo sistema per la Ricerca Scientifica di Ateneo”, Bologna, Italy, 10 April 2014.


89. *XII Convegno degli inanellatori italiani* - Gorizia, Italy, 5-7 December 2014.

90. *XXIV Congresso Nazionale Italiano di Entomologia* - Sassari, Italy, 9-14 June 2014.


**Ph.Ds**

1. Abbandonato Holly, 2014/2017 - *Using current regulations and practices to develop a certification scheme for native seed production in Europe*. Università degli Studi di Pavia - Dottorato di Ricerca in Scienze della Terra e dell’Ambiente, curriculum NASSTEC - Ciclo XXX. Tutors G. Rossi (UniPv), C. Bonomi (MUSE), G. Laverack (Scotia Seeds, UK), H. Pritchard (Kew Gardens, UK). In progress.


4. Borsato Veronica, 2014 - *Main topics: Short visits for the identification of some algae found during the floristic and phytosociological assessment of very-shallow mountain ponds surrounded by pastures (lame, Foresta del Cansiglio, BL)*. University of Trieste. Consultant for the algae part: Marco Cantonati.


11. Letáková Markéta, 2014 - *Main topics: Epiphytic diatoms from the Valagola_SEFIRA Project, macroscopic colonies of Cymbella excisiformis in the downstream section of a SAL spring. [visiting Ph.D. student]*. University of Olomouc, Czech Republic.


18. Taxböck Lukas, 2010/2015 - *Diatoms in Swiss springs*. Institute of Systematic Botany, University of Zürich, Switzerland. Tutors: M. Cantonati (MUSE), P. Linder (the former supervisor was H. Preisig, deceased 2011). In progress.

Masters and degrees


**Field training/Summer schools (organized by MUSE’s staff)**

1. *Archeologia e Montagna, Summer School Nunatak* promossa dal Museo delle Palafitte del Lago di Ledro, dall’Università degli Studi di Trento e dalla Rete di Rilseve delle Alpi Ledrensi, 3-7 August 2015.


4. *La pieve di San Lorenzo a Vigo Lomaso*, Summer School promossa da Sovrintendenza ai Beni Archeologici e Università degli Studi di Trento, con la collaborazione di MUSE.


**Stages-secondary school students**


Volunteers


Public activities

1. AA. VV., 2015 - "Secondo me...il lupo", Drawing competition for children (age 6-11), MUSE - Museo delle Scienze, Trento, Italy, 8 May 2015.


43. Casarotto C., 2014 - Clima ghiacciai e uomini che cambiano. SOSAT, Trento, Italy, 3 September 2014.


59. Cavada N., 2015 - Modeling environmental changes in the Udzungwa Mountains of Tanzania, through impacts assessment on rain forest primates, "Ask the scientist". MUSE - Museo delle Scienze, Trento, Italy, 10 January, 7 April, 2 March 2015.
67. Defrancesco C., 2015 - Visits for the identification of some algae found and activity with the public during “Ask the Scientist” inside the Open Lab of the MUSE - Museo delle Scienze.


112. Gobbi M., 2015 - Collaborazione alla realizzazione del documentario EQUILIBRIA di Eugenio Manghi, 3-4 August 2015.


139. Research Unit of Invertebrate Zoology and Hydrobiology 2014, Notte dei Ricercatori, 26 September 2014.


143. Research Unit of Limnology and Phycology 2014 - Empowering the Next Generation of Researchers (ENGRES), 18 November 2014.


145. Rodríguez-Prieto A., 2015 – “Ask the scientist” (7 appointments).


158. Website gestionale del progetto Nasstec. URL http://nasstec.glasscube.com

159. Website Rete di Riserve Alpi Ledrensi. URL http://www.reteriservealpiledrensi.tn.it

**Exhibitions**

1. “**Coltivamo il gusto: gli Orti del MUSE**” Traditional vegetable gardens display to showcase local and global agrobiodiversity, MUSE garden, Trento, Italy, 22 May 2015 - 31 December 2015.


### Scientific papers on ISI journals


**Scientific papers on non- ISI journals**


Books or book chapters


**Popular science papers**


**Oral communications (with published abstract)**


47. Martinelli L., 2014 - Bio-objects through theatre. COST Event: Bridging the gap between Science and Art, Sirolo (AN), Italy, 12-14 May 2014.


Oral communications (without published abstract)


8. Brambilla M., Assandri G., Pedrini P., Bogliani G., 2014 - Bad, and still worsening: status of (and threats to) farmland birds in Italy. 44th Annual Meeting of the Ecological Society of Germany, Austria and Switzerland ("Integrating ecological knowledge into nature conservation and ecosystem management"), Hildesheim, Germany, 8-12 September 2014.


Posters (with published abstract)


Posters (without published abstract)


Project reports


The research activities at the Museo delle Scienze:
Report 2014-2015
Appendix 5 Collaborations: the research national network
The research activities at the Museo delle Scienze: Report 2014-2015


<table>
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<th>Agreement Type</th>
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<td>Partnerships</td>
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<td><strong>Total</strong></td>
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**Agreements**

1. Azienda Provinciale per i Servizi Sanitari, Trento
2. Casearia Monti Trentini SPA, Grigno (TN)
3. CNR-IBF Istituto di Biofisica, Povo (TN)
4. Comune di Grigno (TN)
5. Fondazione Bruno Kessler, Istituto di Scienze Religiose, Trento
6. Fondazione Dolomiti UNESCO, Cortina d’Ampezzo (BL)
7. Fondazione Edmund Mach, Biodiversity and Molecular ecology Dept., San Michele all’Adige (TN)
8. Libera Università di Bolzano, Bolzano
9. Museo Italiano della Guerra, Rovereto (TN)
11. NEROBUTTO, Tiziano e Francesco SNC, Grigno (TN)
12. Parco Naturale Adamello-Brenta, Ufficio Tecnico Ambientale, Strembo (TN)
13. Regione Emilia-Romagna, Direzione Generale Ambiente e Difesa del Suolo e della Costa, Servizio Geologico, Sismico e dei Suoli, Bologna
14. Spettabile Reggenza Unione montana Sette Comuni (Asiago, VI)
15. Università degli Studi di Trento, Facoltà di Giurisprudenza, Biodiritto, Trento
16. Università degli Studi di Milano – Bicocca, Dipartimento di Scienze dell’Ambiente e del Territorio e di Scienze della Terra (DISAT), Milano
17. Università di Padova, Facoltà di Sociologia, Padova
18. Università di Pavia, Dipartimento di Scienze della Terra e dell’Ambiente, Pavia

Memorandum of Understanding
1. Fondazione Edmund Mach, Department of Biodiversity and Molecular Ecology, San Michele all’Adige (TN)
2. Università di Ferrara, Dipartimento Biologia ed Evoluzione, Ferrara
3. Università di Genova, RIBES - The Italian seed bank network for the ex-situ conservation of the Italian native flora, Centro Universitario di Servizi, Genova
4. Università di Verona, Dipartimento di Biotecnologie, Verona

Partnerships
1. Archivio di Stato, Trento
2. Azienda Provinciale Servizi Sanitari, Centro Procreazione Medicalmente Assistita, Arco (TN)
3. Consorzio Parco Nazionale dello Stelvio, Bormio (SO)
4. Corpo Forestale dello Stato, Roma
5. Ente gestione Aree Protette Alpi Cozie, Selbertrand (TO)
6. Ente gestione Aree Protette dell’Ossola, Varzo (VB)
7. Ente gestione Parco Naturale del Marguareis, Chiusa Pesio (CN)
8. Ente Parco Nazionale Val Grande, Cossogno (VB)
9. Parco Naturale delle Alpi Marittime, Valdieri (CN)
10. Regione Lombardia, Settore Biodiversità, Milano
11. Regione Veneto, Unità di Progetto Caccia e Pesca, Unità di Progetto Foreste e Parchi, Venezia
12. Scuola superiore Sant’Anna, Robotica, Pisa
13. Soprintendenza per i Beni Architettonici e Archeologici, Trento
Others

1. Agenzia Provinciale per la Protezione dell’Ambiente, Settore Informazione e monitoraggi – U.O. Attività di Monitoraggio Ambientale, Trento
2. Alma Mater Studiorum Università di Bologna, Department of Biological, Geological and Environmental Sciences, BiGeA Geological Division, Bologna
3. CISO-Centro Italiano Studi Ornitologici, Pavia
4. CNR-Istituto delle Ricerche sulla Popolazione e le Politiche Sociali, Roma
5. CNR-Plant Virology Institute, Grugliasco (TO)
6. CNR-IRSA Istituto di Ricerca sulle Acque, Brugherio (MB)
7. CNR-ISE Istituto per lo Studio degli Ecosistemi Sezione di Idrobiologia, Pallanza (VB)
8. Comune di Terlago, Trento
9. CORA ricerche archeologiche snc, Trento
10. ENEA, Agenzia nazionale per le nuove tecnologie, l’energia e lo sviluppo economico sostenibile, Roma
11. Fondazione Edmund Mach, Centro Ricerca e Innovazione, San Michele all’Adige (TN)
12. Fondazione Lombardia per l’Ambiente Settore biodiversità e aree protette, Seveso (MB)
13. ISPRA Centro Italiano di Inanellamento, Ozzano dell’Emilia (BO)
14. Istituto di ricerche farmacologiche Mario Negri, Dipartimento Ambiente e Salute, Milano
15. Lega Italiana Protezione Uccelli, Sede Centrale, Parma
16. Museo Archeologico del Finale Chiostri di Santa Caterina, Finale Ligure Borgo (SV)
17. Museo Civico di Rovereto, Sezione Botanica, Rovereto (TN)
18. Museo Civico di Storia Naturale di Bergamo, Sezione di Zoologia, Bergamo
19. Museo Civico di Storia Naturale di Verona, Sezione di Zoologia, Verona
20. Parco Naturale Adamello-Brenta, Spiazzo (TN)
21. Parco Orobie Bergamasche, Bergamo
22. Sartori Ambiente - soluzioni per l’ecologia, Ledro (TN)
23. Soprintendenza dei beni Archeologici di Trento, Trento
24. The Italian Botanic Gardens Network, Catania
25. Università degli Studi di Milano, Dipartimento di Biologia, Milano
26. Università degli Studi di Milano, Dipartimento di Protezione dei Sistemi Agroalimentare e Urbano e Valorizzazione delle Biodiversità (Dipsa), Milano
27. Università degli Studi di Milano Bicocca, Dipartimento di Scienze Ambientali, Milano
28. Università degli Studi di Parma, Dipartimento di Bioscienze, Parma
29. Università degli Studi di Trento, Dipartimento di Economia e Management, Trento
30. Università degli Studi di Trento, Dipartimento Lettere e Filosofia, Trento
31. Università degli Studi di Trento, Dipartimento di Ingegneria Civile, Ambientale e Meccanica, Trento
32. Università del Piemonte orientale, Dipartimento di Scienze dell’Ambiente e della Vita, Alessandria
33. Università di Parma, Dipartimento di Scienze Ambientali, Parma
34. Università di Pavia, DSTA - Dipartimento di Scienze della Terra e dell’Ambiente, Laboratorio di Ecologia, Pavia
35. Università di Torino, Dipartimento di Scienze della Vita e Biologia dei Sistemi, Torino
36. Università di Venezia & IDPA-CNR, Dipartimento di Scienze Ambientali, Belluno
37. Università Politecnica delle Marche, Ancona

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**Agreements**

1. CSIC, Institute of Public Policies, Madrid, Spain
2. Foundation Conservation International, Washington DC, USA
3. Nice University, CEPAM - Cultures et Environnements Préhistoire, Antiquité, Moyen Âge CNRS, Nice, France
4. Royal Botanic Gardens, Seed conservation Department, London, UK
5. Scotia Seeds, Farnel, UK
6. Semillas Silvestres, Cordoba, Spain
7. Syngenta Seeds, Enkhuizen, The Netherlands
8. The James Hutton Institute, Dundee, UK
9. Université de Bordeaux, PACEA - De la Préhistoire à l’Actuel: Culture, Environnement et Anthropologie, Bordeaux, France
10. University of Antwerp, Faculty of Political and Social Sciences, Antwerp, Belgium
11. University of Rzeszów, Institute of Applied Biotechnology and Basic Sciences, Kolbuszowa, Poland
12. University of Turku, Department of Behavioural Sciences and Philosophy, Turku, Finland
13. University of Zagreb, School of Medicine, Zagreb, Croatia
14. Uppsala University, Centre for Research Ethics and Bioethics, Uppsala, Sweden

Memorandum of Understanding
1. Ensconet - The European Native Seed Conservation Network, Wakehurst, UK
2. German Primate Center (DPZ), Reproductive Biology Unit, Goettingen, Germany

Partnerships
1. Mediterranean Institute for Advanced Studies (IMEDEA, CSIC-UIB), Population Ecology Group, Esporles, Spain
2. Natural History Museum of Denmark, Copenhagen, Denmark
3. Triglavski Narodni Park, Bled, Slovenia
4. University of Frankfurt, Botany Institute, Frankfurt, Germany
5. University of Ljubljana, Department of Biology, Ljubljana, Slovenia
6. University of Massachusetts (UMASS), Department of Environmental Conservation, Amherst MA, USA

Others
1. Ain Shams University, Botany Department, Cairo, Egypt
2. CONICET Laboratorio de Estudios Básicos y Biotecnológicos en Algas, Bahía Blanca, Argentina
3. Cornell University, New York Cooperative Fish and Wildlife Research Unit, Department of Natural Resources, Ithaca NY, USA
4. Emory University, Environmental Studies & Population Biology, Ecology & Evolution, Atlanta, USA
5. Instituto de Investigaciones Agropecuarias (INIA), La Platina Research Station, La Plata, Santiago del Chile, Chile
6. Konrad Lorentz Institut of Ethology - University of Veterinary Medicine Vienna, Department for Integrative Biology and Evolution, Vienna, Austria
7. Max Planck Institute for Evolutionary Anthropology, Department of Primatology, Leipzig, Germany
8. Michigan State University, Department of Zoology, Lansing MI, USA
9. NIWA - Norwegian Institute Water Research, Oslo, Norway
10. Ohio University, Department of Environmental & Plant Biology, OH, USA
11. Piattaforma Ornitho.it, Sempach, Switzerland
12. Research Center Jülich Institute of Neurosciences and Medicine, Jülich, Germany
13. Southern Illinois University Carbondale, Department of Anthropology, Carbondale, USA
14. Tanzania National Parks, Arusha, Tanzania
15. The European Botanic Gardens Consortium, Richmond, UK
16. The Natural History Museum, Botany Department, Diatom Lab, London, UK
17. Toho University, Miyama, Japan
18. Universidad Nacional de Educación a Distancia, Group of Biology and Environmental Toxicology, Madrid, Spain
19. Université Laval, Département de Géographie Laboratoire de Paléoécologie Aquatique, Québec, Canada
20. University of Birmingham Edgbaston, School of Geography, Earth and Environmental Sciences, Birmingham, UK
21. University of Durham, Durham, UK
22. University of Girona, Department Environmental Sciences, Institute of Aquatic Ecology, Girona, Spain
23. University of Innsbruck, Botany Institute, Hydrobotany, Innsbruck, Austria
24. University of Innsbruck, Ecology Institute, Innsbruck, Austria
25. University of New Brunswick, Canadian Rivers Institute, Saint John, Canada
26. University of New Haven, Department of Biology and Environmental Science, Haven CT, USA
27. University of Newcastle, Newcastle upon Tyne, UK
28. University of Olomouc, Department of Botany Phycology, Olomouc, Czech Republic
29. University of Oregon, Institute of Ecology and Evolution, Eugene, USA
30. University of South Bohemia, Department of Botany, Ceske Budejovice, Czech Republic
31. University of Tübingen, Institute of Evolution and Ecology, Tübingen, Germany
32. University of Zürich, Institute of Botany Phycology, Switzerland
33. Water Development Department, Nicosia, Republic of Cyprus
Carta da foreste correttamente gestite e inchiostri con solventi a base vegetale.