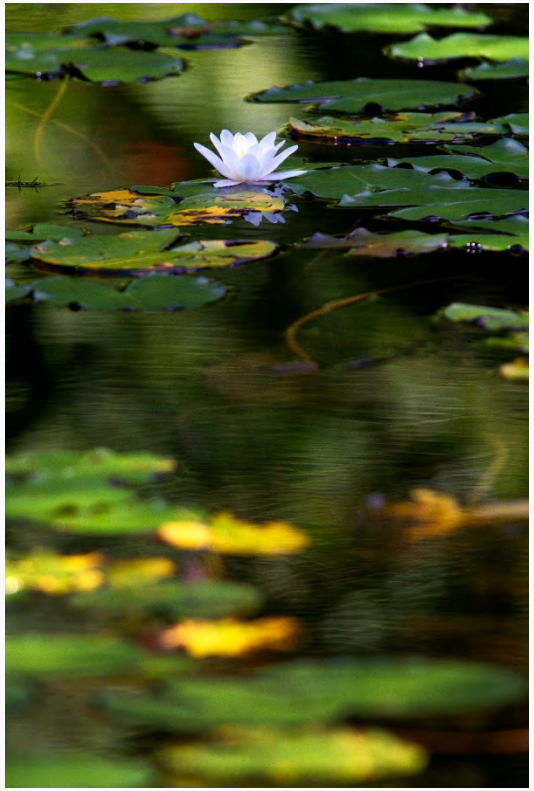

(Re)Connecting **MUSEUM** to **WATER**

Heritage, research, outdoor education and SDGs for integrated museums

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Science Communicator,
MUSE Science Museum, Trento (Italy)
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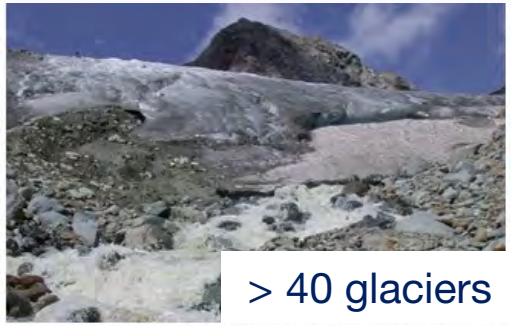
17/12/2021

1. Water in the surroundings

A highly mountain region

Trentino
(Autonome Province of Trento):

Area:	6 207,12 km²
Population:	544 585 inhabitants
Pop. Density:	88 inhab./km²
	(Italy: 206 inhab./km²)
Municipalities:	166 «Comuni»



> 40 glaciers

The Dolomites UNESCO World Heritage

Trentino encompasses
an extraordinary variety of (aquatic)
environments, landforms
and climatic conditions.

80% of land surface > 600 m asl

2,000 km of running waters, streams and rivers

300 lakes

River Adige

Lake Garda

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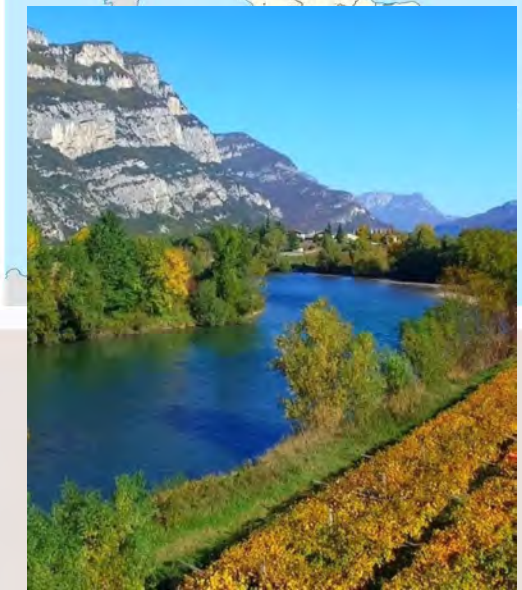
An intensively cultivated valley bottom

Trento: 115.000 inhabitants, capital city of the Autonomous Province of Trento, lies in a wide glacial valley just south of the Dolomite Mountains, where the Fersina and Avisio rivers join the Adige River (the second longest in Italy). The broadly curving course of the Adige River was straightened around 1850.



Trento and the river Adige

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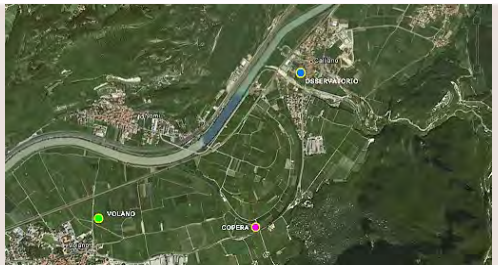
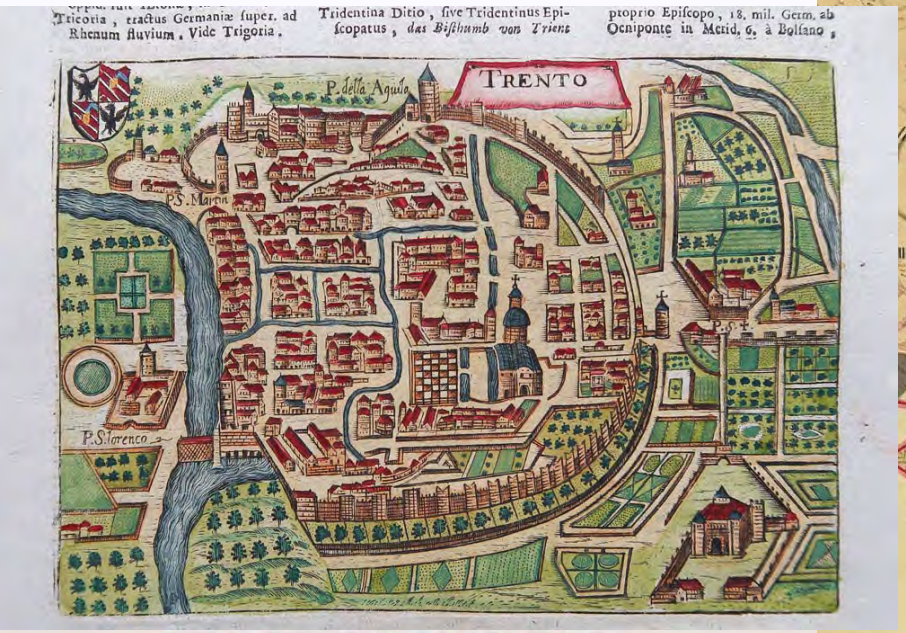


A small town that has excluded the river from its centre



Verona, on the other hand…

MUSEUMS Tools for Promotin and Cultural Water

Water in the mind: the “old museum” researches

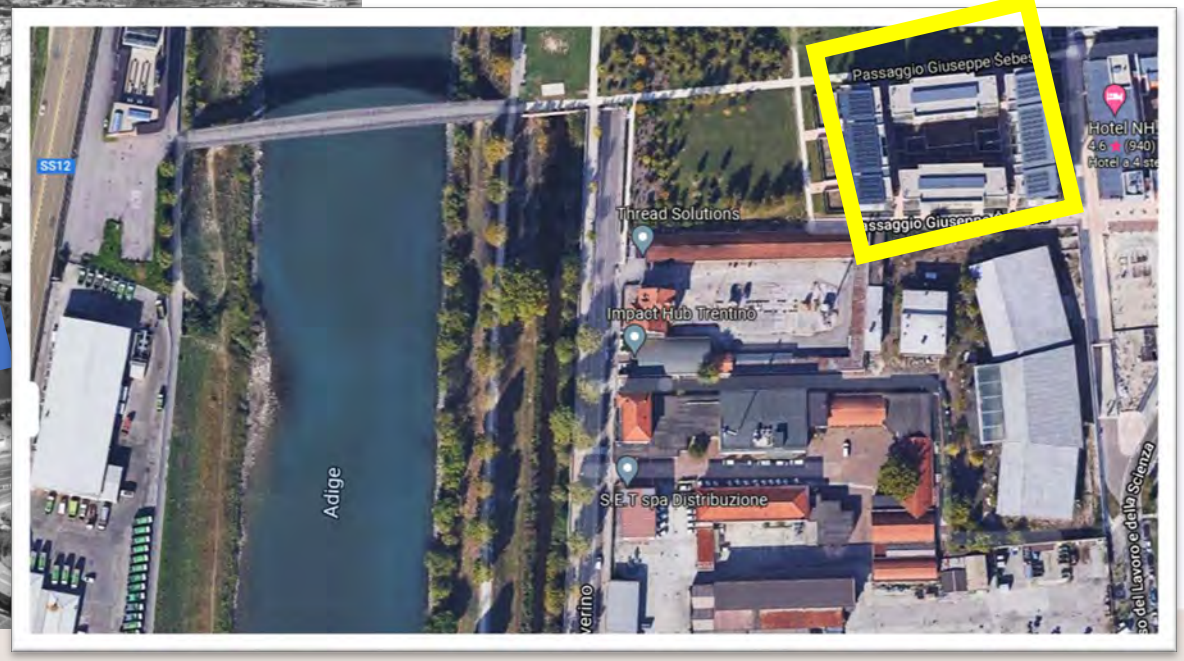
museo tridentino
di scienze naturali

Born as a local museum collecting and monitoring “natural objects” in the surrounding territory, the (former) MTSN has a long tradition of field researches in hydrobiology and limnology.

A museum that moves toward the river…

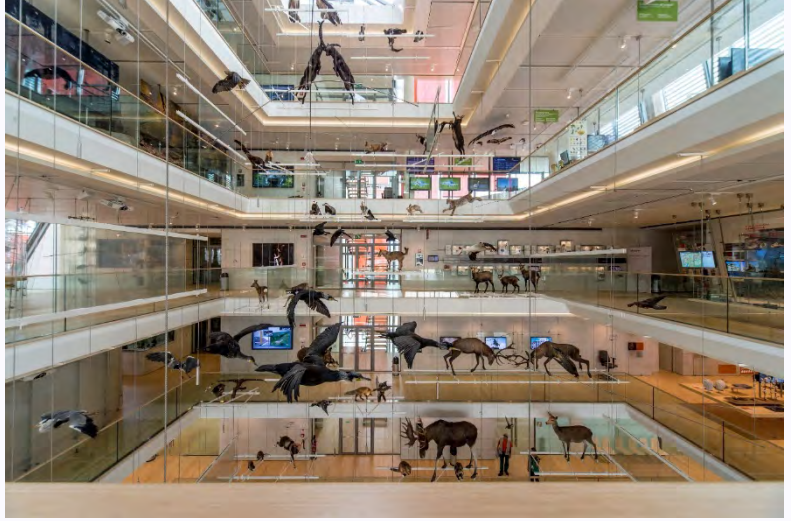
In 1992 Michelin tires factory, the largest industrial compound of the region, moved the production away.

In the same place, in 2006 the local government financed the development of a new quarter for the city, including a new scientific museum… to respond to the number of visitors attracted by the new museology of our “traditional museum” (MTSN).

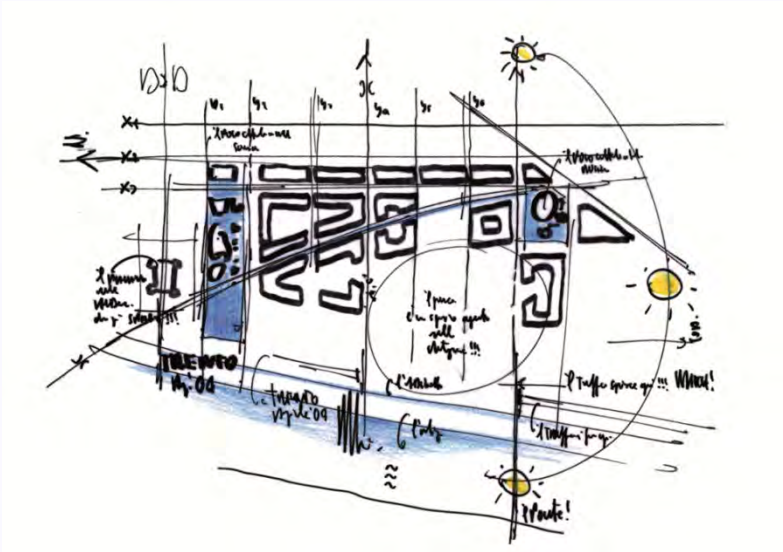


A narrow stream/channel flows between the new museum and the river Adige, the Adigetto, a small water body with heavy organic pollution but still a bit of riverine vegetation… a potential source of aquatic colonizers.

The 27th of July 2013
24 Hours of Opening Ceremony
(30,000 participants)



MUSE - Science Museum of Trento:
a creation of the famous architect Renzo Piano… … and of a team of almost 40 people (scientists and curators, project managers, educators, designers, architect & interior designers...



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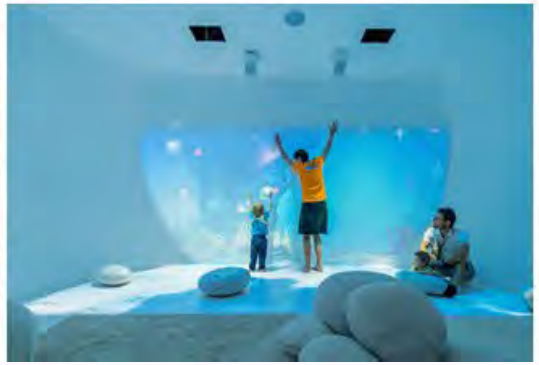
MUSE in a nutshell… floating on water!

The “promise” of MUSE – Science Museum of Trento

A journey into the fabulous space of MUSE to appreciate the **uniqueness of the Alpine nature** and to imagine **smart solutions for our common sustainable future**.

Numbers:

12,600 m^2 of space; 500,000 visitors/year; 200,000 students/year; 50ML €/year the positive impact on city economy; 240 FTE employees.

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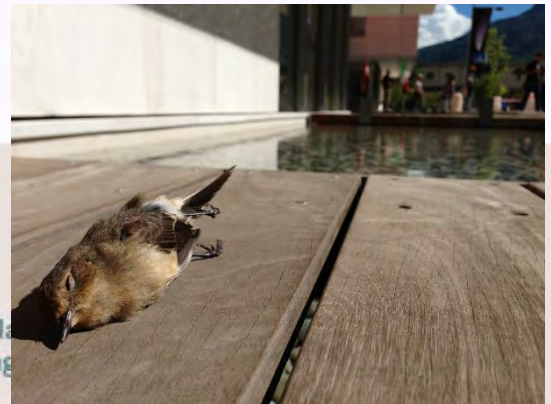
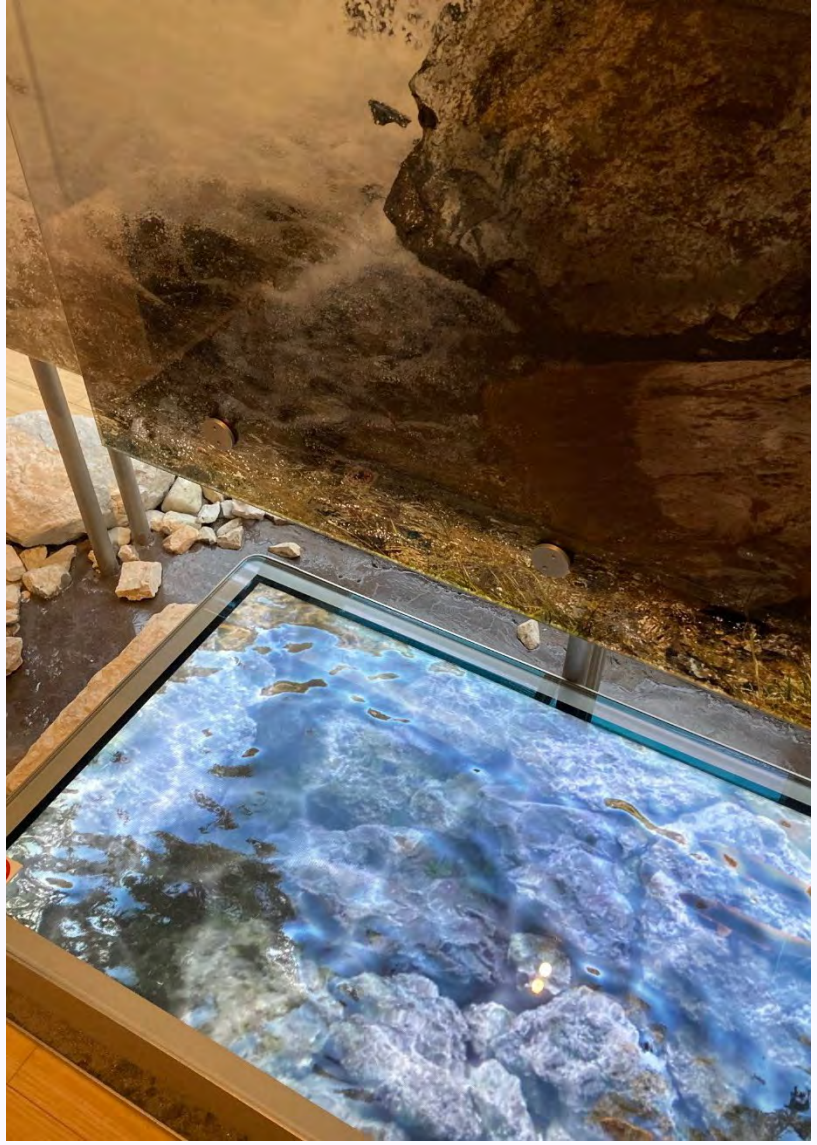
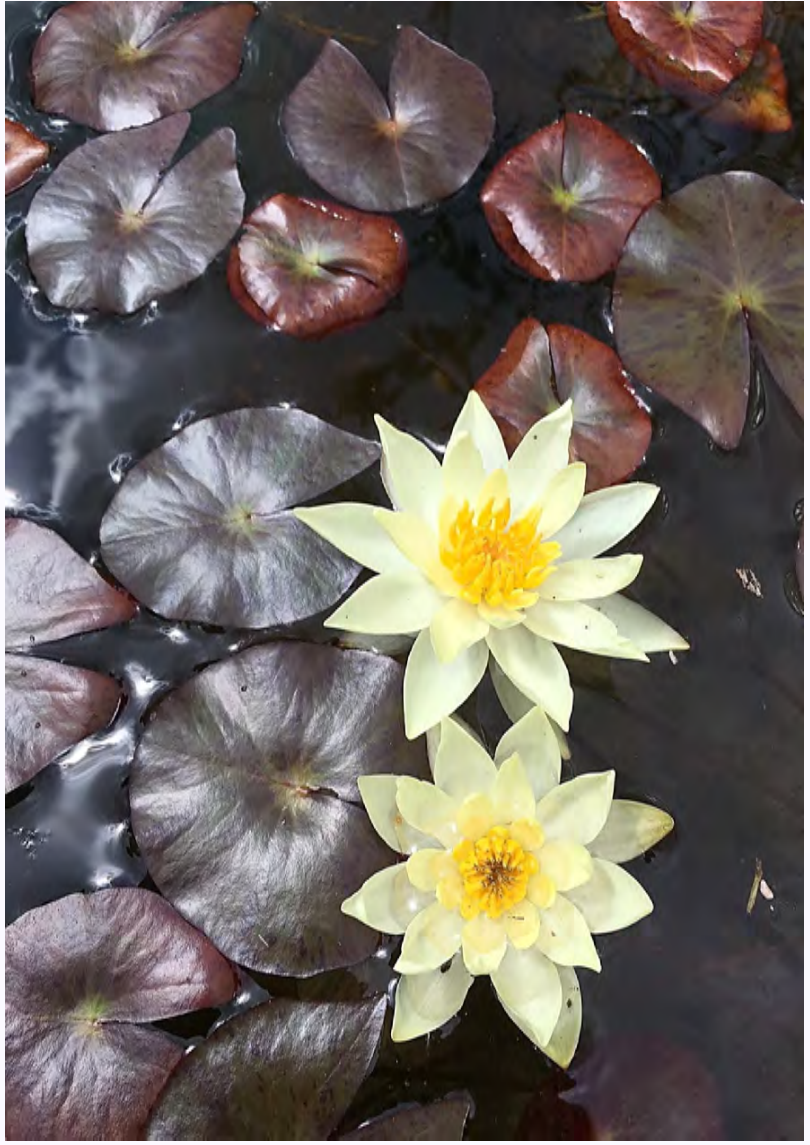
Water to reflect, and more…

The whole building is surrounded by water
in shallow squared pools.
In the basic aim of the architects, the role
of this “caged” water is merely aesthetic, to allow
the intriguing reflection of a transparent, light structure,
apparently without weight (“gravity zero”),
but…



2. Water inside the museum





Water and the SDGs: the mid-term communication strategy of MUSE

The **SDGs** are the new **«comprehensive mission» of MUSE**

The **key message** concerning the **"necessary reconnection" between (aquatic) environments and humankind** are the following:

- **Reconnection** of (aquatic) environments and humankind **is necessary for current society**, so it is a ***must*** in the science communication actions of MUSE.
- **Science-museums** (like MUSE) **provide data and knowledge dissemination to citizens, education and decision makers**.

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How does this mission be carried out (hopefully at best) by MUSE?

Let's start with an «aquatic» journey
from the top to the bottom of the museum…

4° floor of MUSE - Science communication actions, data and knowledge dissemination to citizens, education and decision makers on: **climate changes and glaciers.**

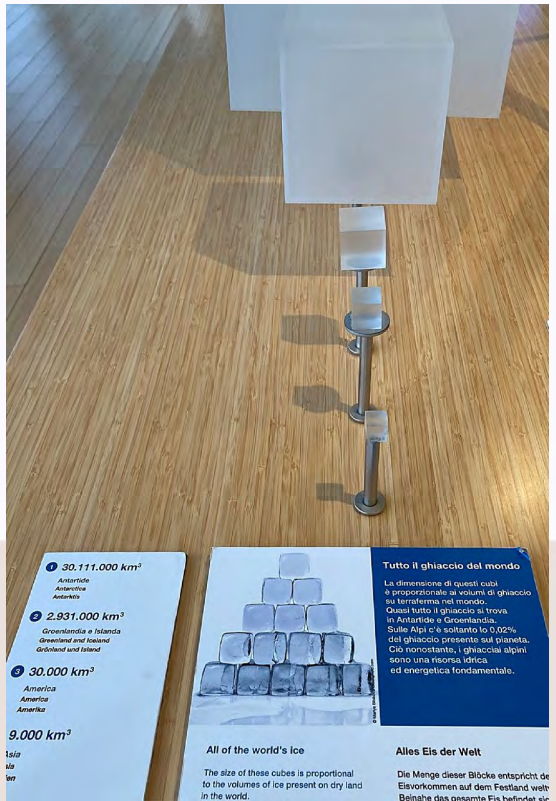
(Frozen) Water as a sensitive and threatened environment

A small-scale replica of a glacier tongue, variously exposed to sunlight, exemplifies the melting of glaciers and makes it clear how much the phenomenon is influenced by the outside temperature.

(Frozen) Water as memory of the past and home to unexpected biodiversity

Thematic and interactive exhibits point out the role of the frozen water of glaciers (and Antarctica) as natural archive and “chemical memory” of past climates.

Enlarged models of tiny invertebrates inhabiting the ice surfaces “unveil” the presence of animal biodiversity in an environment that is commonly perceived as unsuitable for life.



13 CLIMATE ACTION

15 LIFE ON LAND

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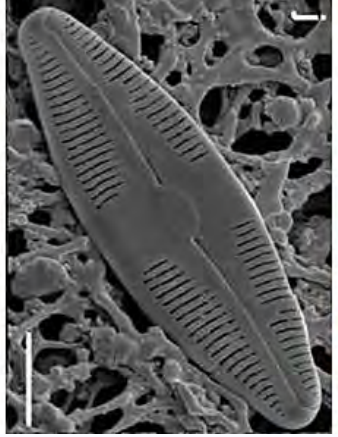

3° floor of MUSE - Science communication actions, data and knowledge dissemination to citizens, education and decision makers on: **high-** & **low-altitude water environments, springs, streams, rivers and lakes.**

Water as a “fluid environment” changing with the altitude and the seasons

On Alps, like on other mountain systems, there are many different but connected environments along a virtual line of descent from peak to valley bottom.

The “altitudinal stratification” affect ecosystems on land as well in lotic and lentic waters.

Land and water conditions change throughout the year.

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BE

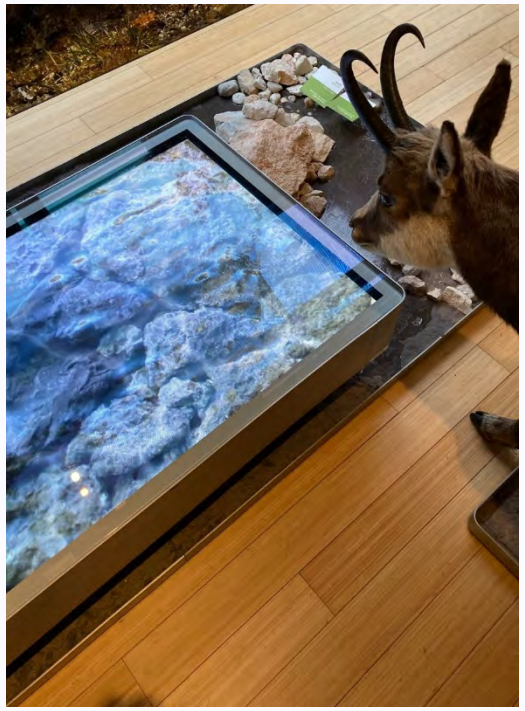
MUS

6 CLEAN WATER AND SANITATION

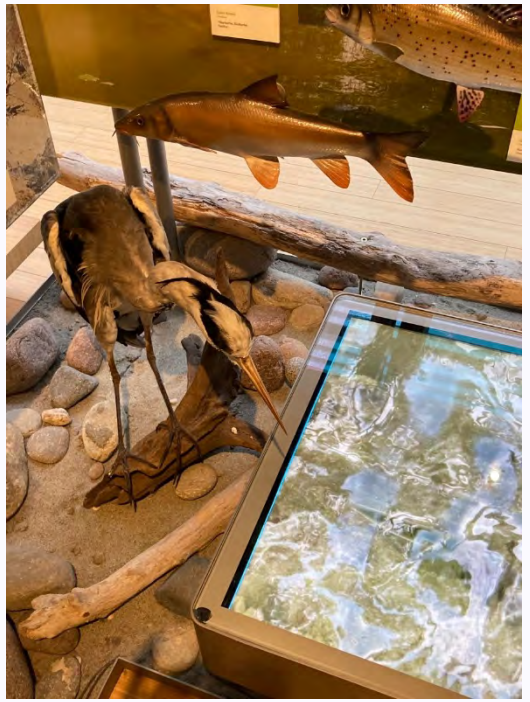
14 LIFE BELOW WATER

g the Natural

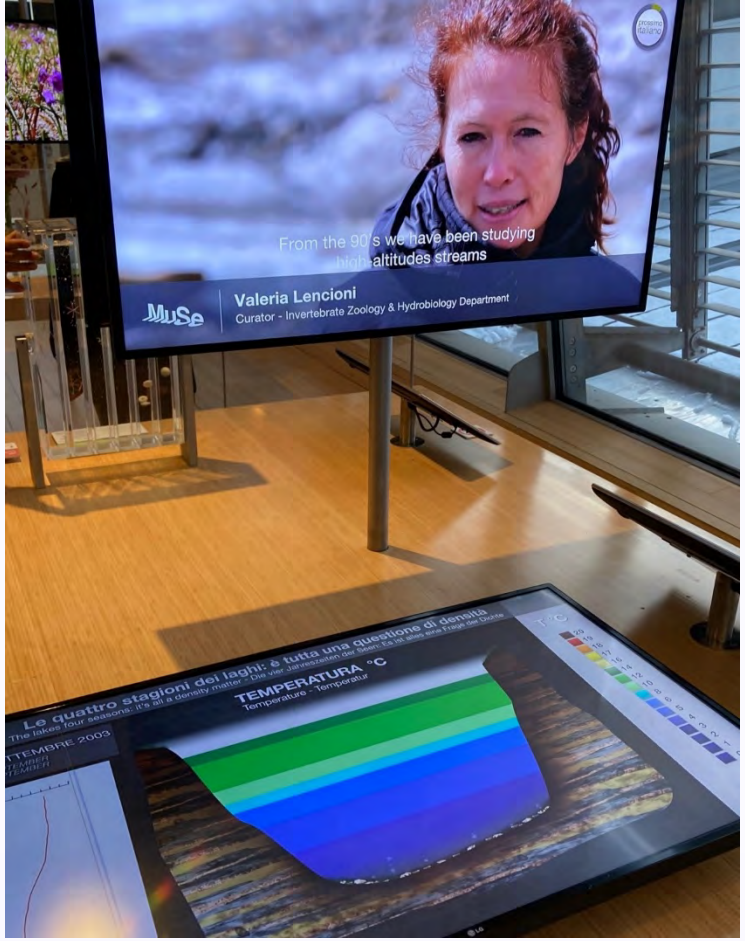
Heritage

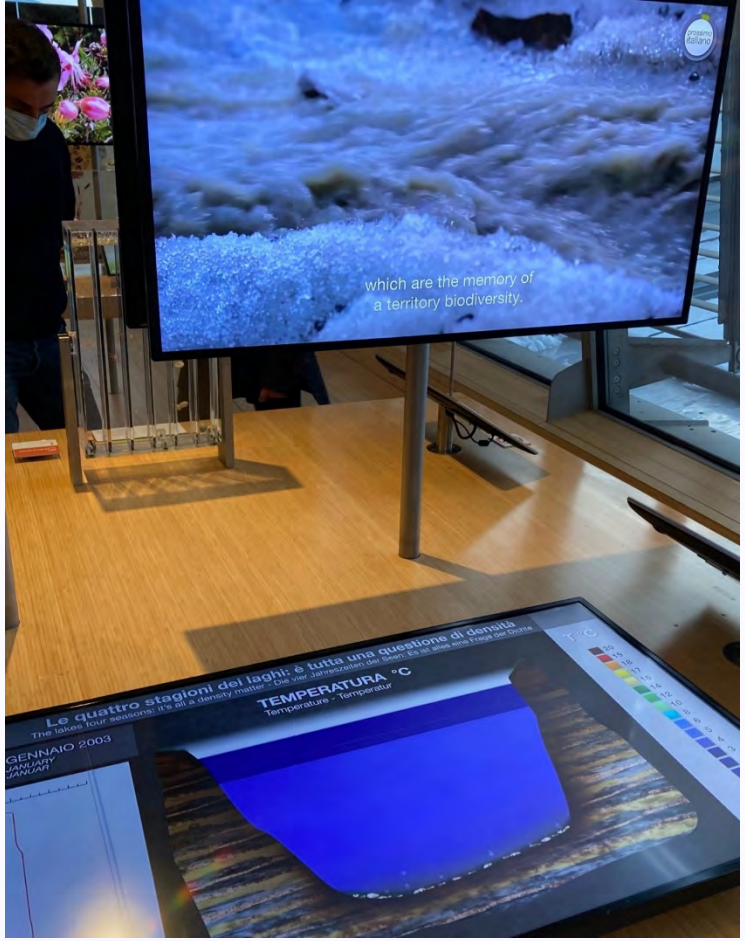


(Virtual water where “true” water is too heavy)



To suggest continuity in the aquatic environments from the heights down to the lowland plains, computer graphics were used to represent the flowing water of Alpine streams and then rivers in places where structural constraints in the building did not allow the installation of real aquariums.

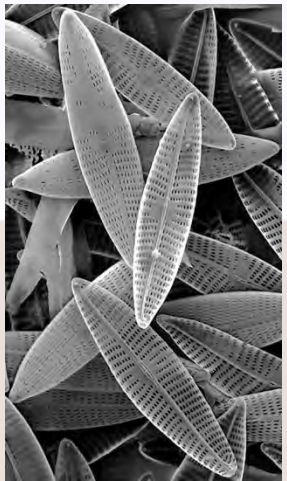




Thematic and interactive exhibits point out the changes that occur in aquatic environments as the seasons change.

14 LIFE BELOW WATER

Enlarged pictures of diatoms and other freshwater algae "unveil" the microscopic presence of phytoplankton and its pivotal ecological role inside the alpine spring biotas.



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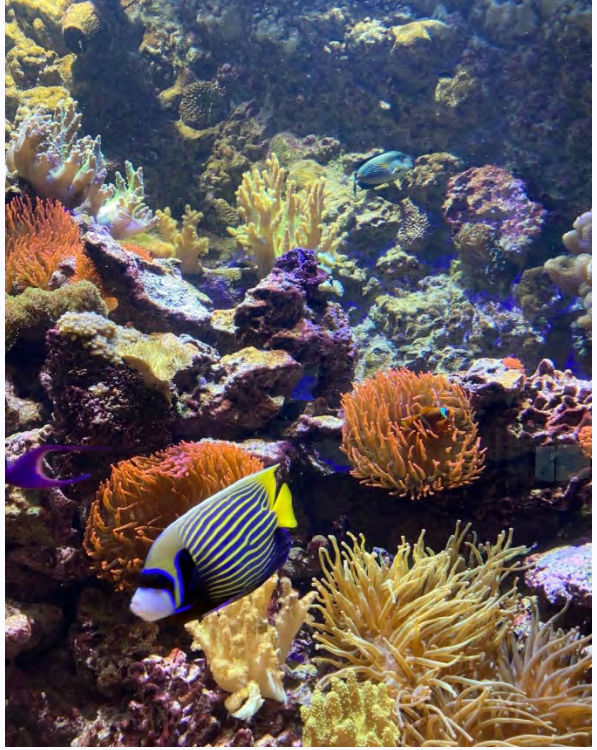
Tools for Promoting the Natural and Cultural Water Heritage

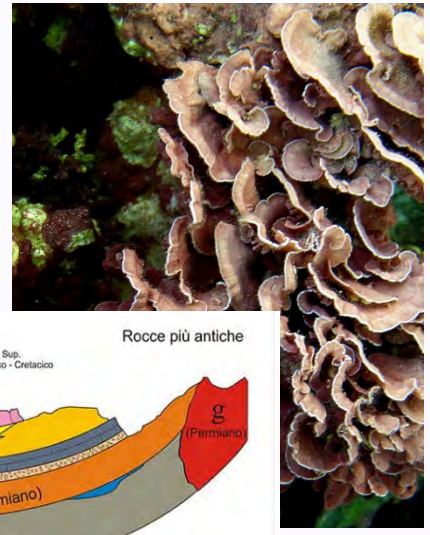
2° floor of MUSE - Science communication actions, data and knowledge dissemination to citizens, education and decision makers on: **geological and geomorphological role of water, protection of the territory.**

Water in the territory, today and in the past

Interactive exhibits and computer simulations make it easier to understand that water could also act as an a hydro-geological risk factor causing (as surface water, in liquid or solid form, or as groundwater) many kinds of instability (floods, landslides and avalanches).

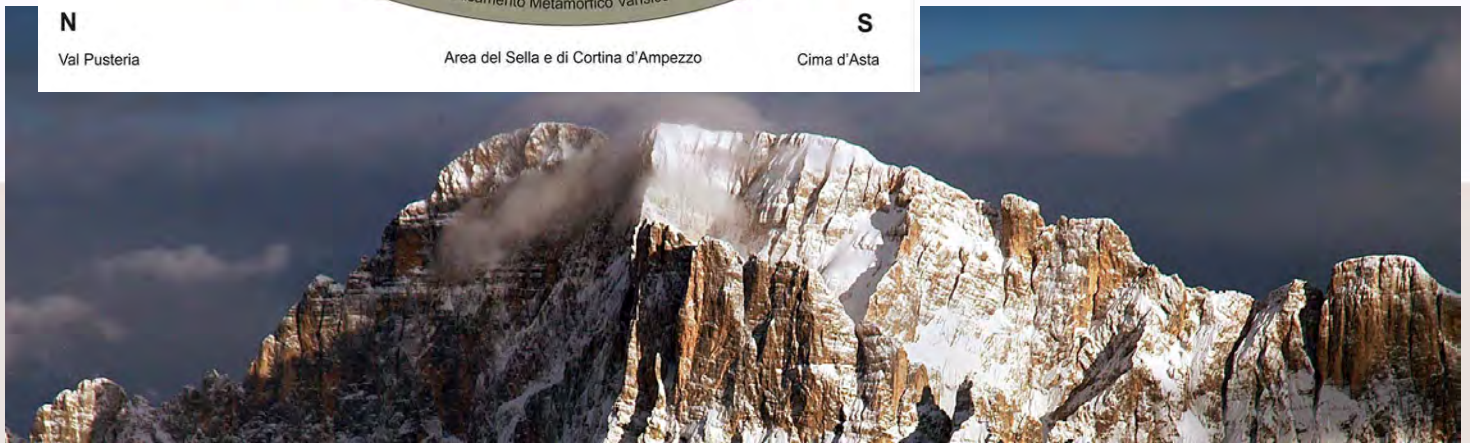
Diagrams and explanatory schemes underline that the hydro-geological risk is strongly influenced by human action: population density, urbanization, abandonment of mountain land, unauthorized building, deforestation, environmentally unfriendly agriculture could easily aggravate instability.





Water in the Deep Time

A tropical marine aquarium evokes the coral reefs and highlights the role of saltwater aquatic environments (barrier reefs, atolls, lagoons and deep sea) in the lithogenesis of several rock types widely represented in the mountain massifs of the Alpine chain.



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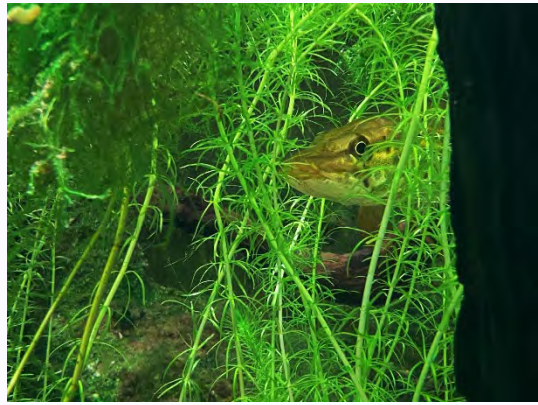
1° floor of MUSE - Science communication actions, data and knowledge dissemination to citizens, education and decision makers on: **sustainability, conservation of the aquatic biodiversity, aquatic resources, water supply, water use, water pollution** (in partnership with private companies).

Water in the Antropocene

Natural objects and human artefacts, infographics and interactive exhibits, old documentary clips and “impossible interviews” explore the complex and contradictory world of our recent interactions with the planet, the use of its resources, the survival of other living beings and the future of life on Earth (and in the water…)



Water and humankind, the ancient connection

Local archeological finds, multimedia presentations, uniquely lifelike replicas of prehistoric humans belonging to hunters-gatherers or early Neolithic agriculturalists in the Alps and two freshwater aquaria representing Alpine archeological sites facing waterbodies remind of the strong dependence of the ancient humankind from water supply and from the water as source of different kind of biological resources (fish, mussels, plants).

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Ground floor of MUSE. Science communication actions on water: landscape, recovery of traditional water cultures and… something engaging for schools!

Landscape, historical use and transformation of Adige river, legends and myths.

Natural, historical and anthropogenic aspects of Adige river… and rafting!

Water-tasting of the various Trentino streams and comparison with bottled water.

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BEYOND MUSE

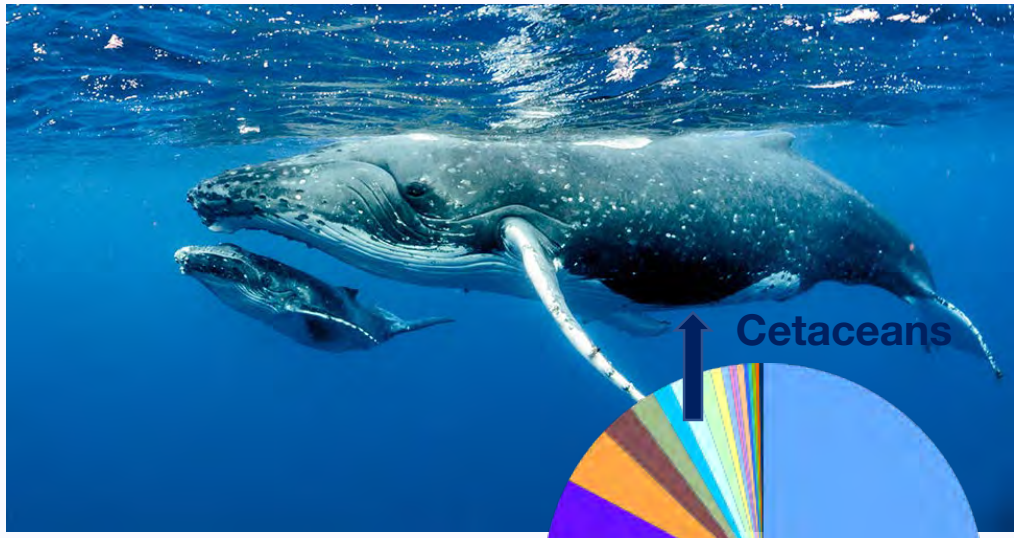
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
6 CLEAN WATER AND SANITATION
11 SUSTAINABLE CITIES AND COMMUNITIES
15 LIFE ON LAND

MUSE

-1° level of MUSE - Science communication actions, data and knowledge dissemination to citizens, education and decision makers on:
role of water as ecological driver in evolution (of Mammals)

Water in the evolution

Stretched over four billion years, the long “tale” narrated in the underground part of the museum explores the milestones in the history of life, highlighting the continuous role of water in “shaping” living beings, from the enigmatic Ediacaran biota to the “secondarily aquatic” Cetaceans.



15 LIFE ON LAND
14 LIFE BELOW WATER

Water (in tanks) from the top to the basement

+3

+2

+1

-1

Numbers:
10 aquaria, from 2.1 to 4.5 m^3;
>300 individuals belonging to
>50 different species

«A world of fishes» activity

Esox cisalpinus, an Italian endemism

Pseudotropheus saulosi, an endemic species of Lake Malawi

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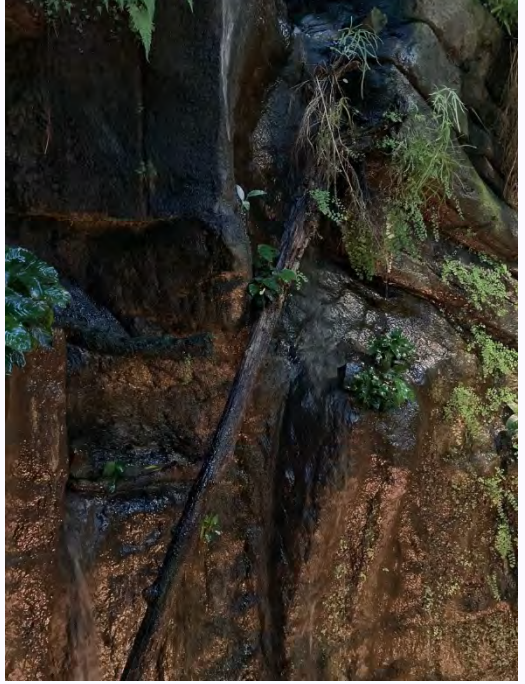
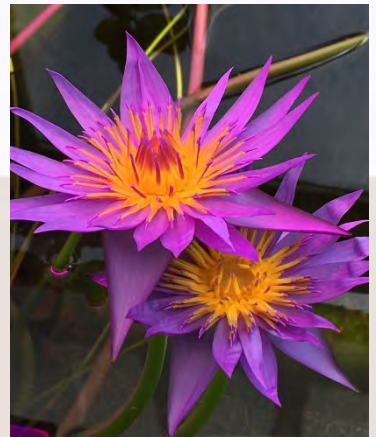
14 LIFE BELOW WATER

MUSE



Water in the greenhouse (and in the Tropics)

Taking inspiration from a mountainous region of Tanzania covered by rain- and misty-forest and rich in water (the Udzungwas) where the museum has been conducting research and conservation projects for two decades, the MUSE greenhouse give an impressive first glimpse of the astonishing terrestrial and aquatic biodiversity in the (African) intertropical regions.



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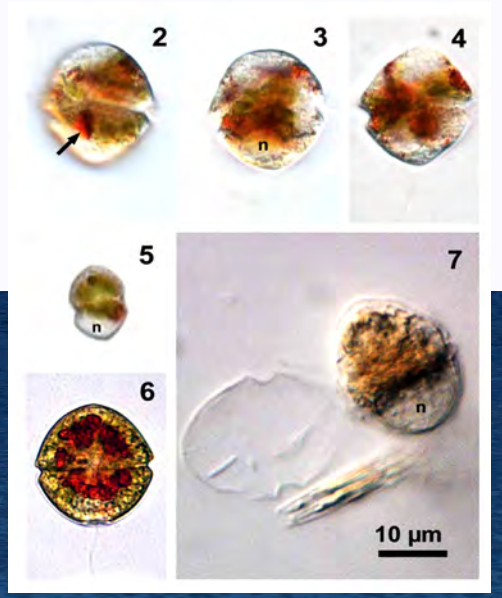
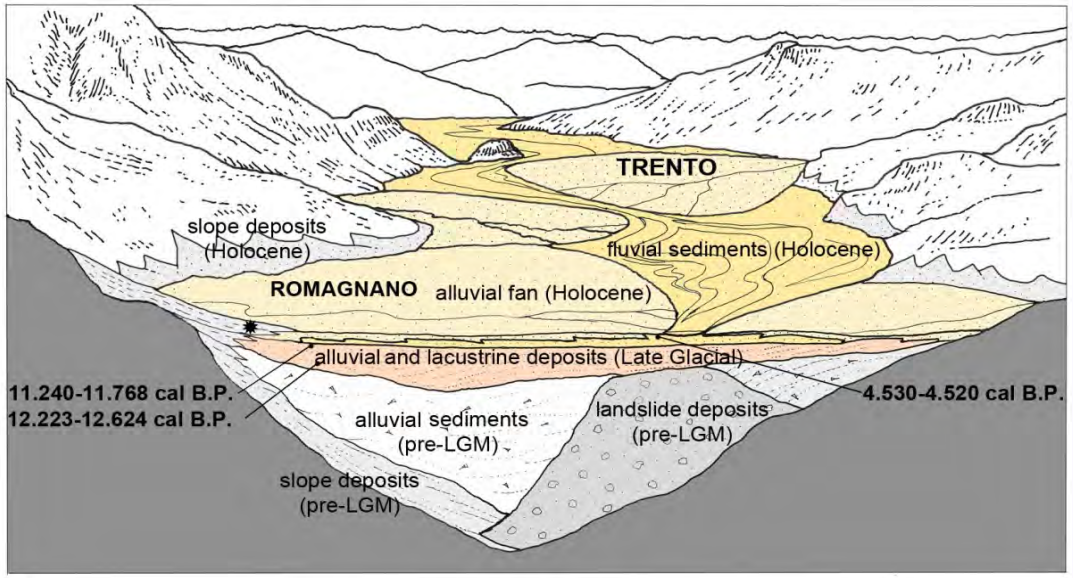
3. Water outside the museum





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A network of water (museums)

Museo delle Palafitte in Ledro

Lake Tovel Limnological Station

The “red” lake

Science & theatre

Interpretation

Summer schools for University students

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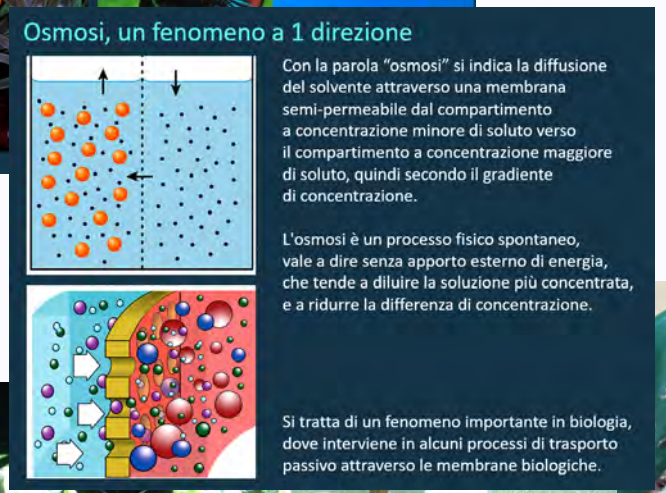
14 LIFE BELOW WATER

4 QUALITY EDUCATION

Water as opportunity for *Citizen Science* and for training to research

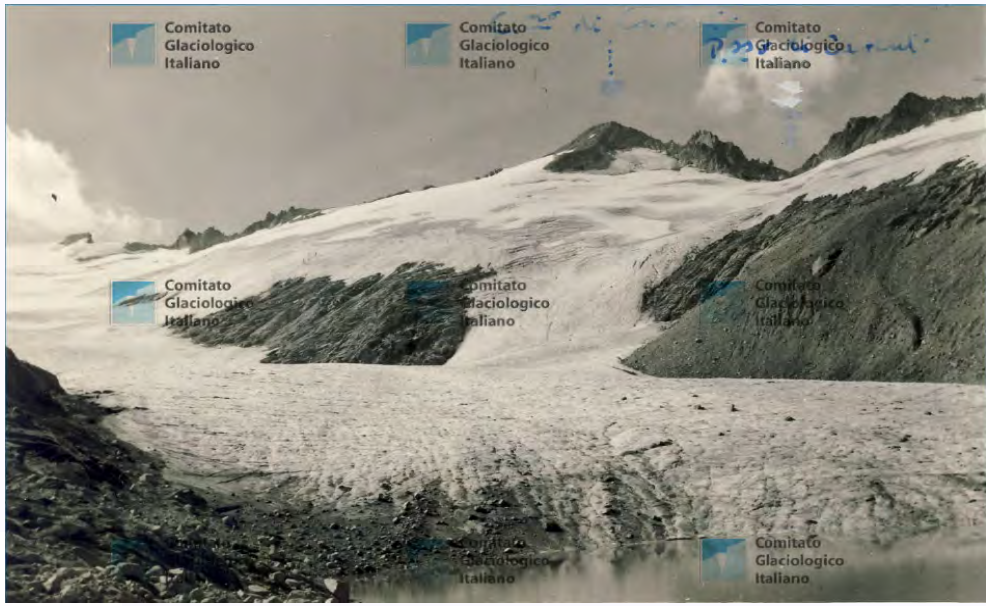


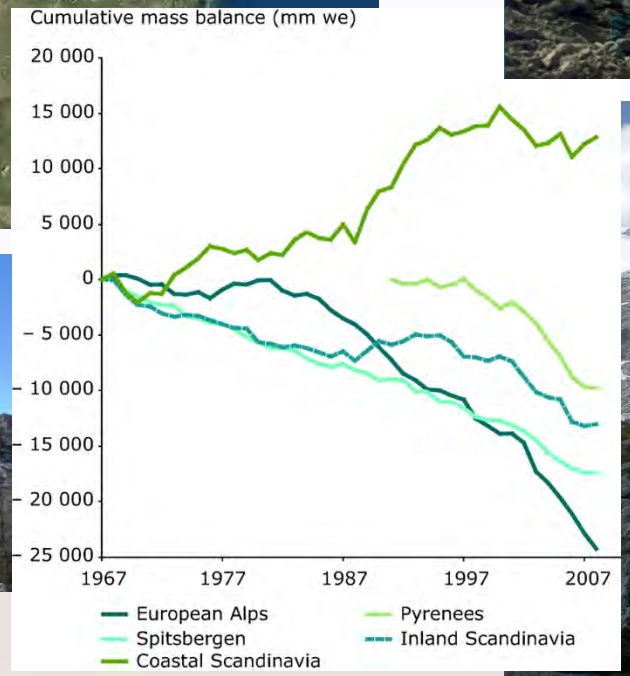
CRONACA

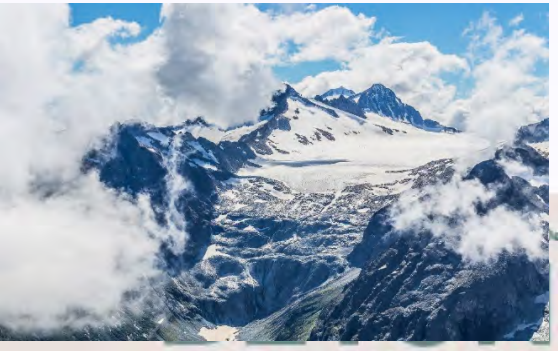
L'agonia dei ghiacciai trentini, l'esperto: "Tra vent'anni in Trentino saranno quasi estinti"

I ghiacciai presenti sul nostro territorio sono poco più di 130. Negli ultimi anni al di sopra dei 2500 metri abbiamo assistito ad un aumento della temperatura di circa 2 gradi. Casarotto: "Occorre annullare gli effetti dei gas serra se vogliamo mitigare questa drammatica situazione"

Monitoring the glaciers retreat







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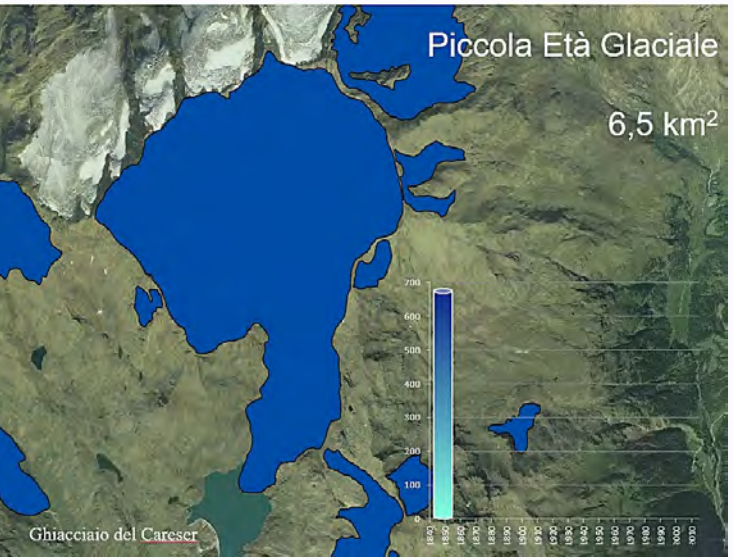
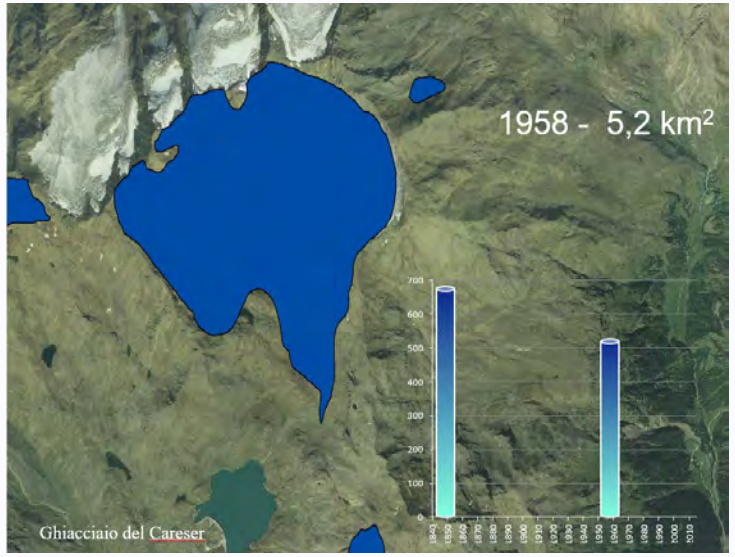
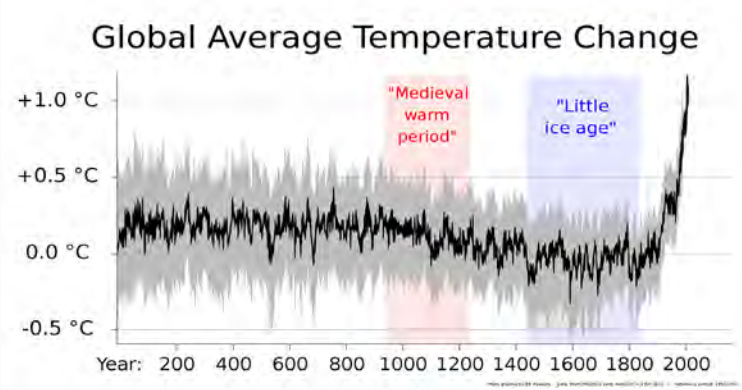
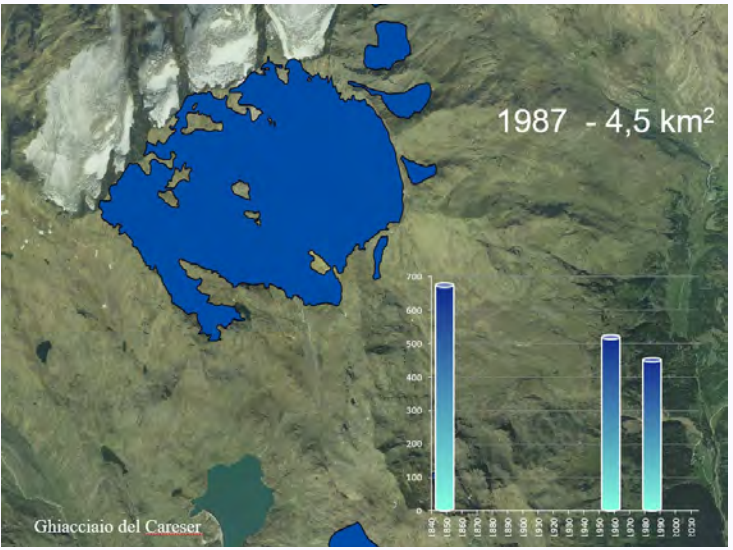
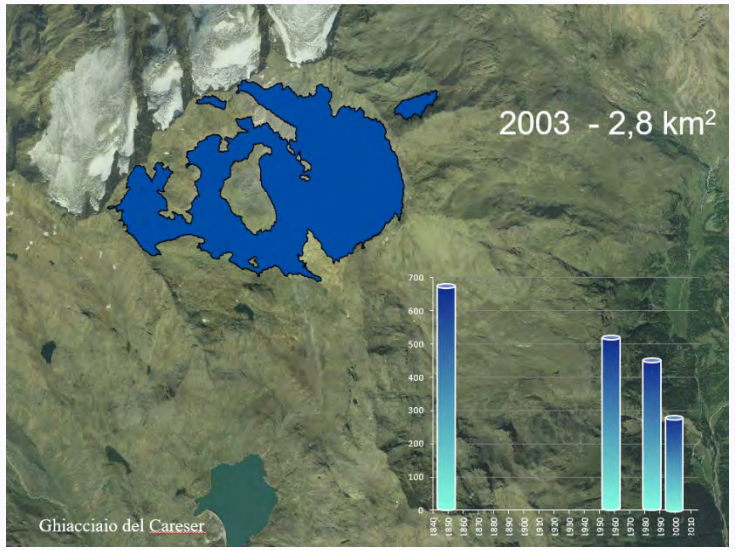


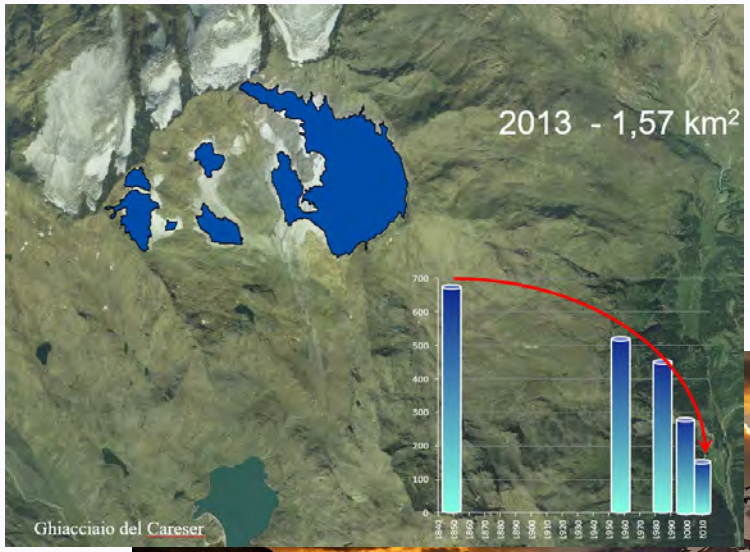




Monitoring the climate changes from the Little Ice Age (LIA)







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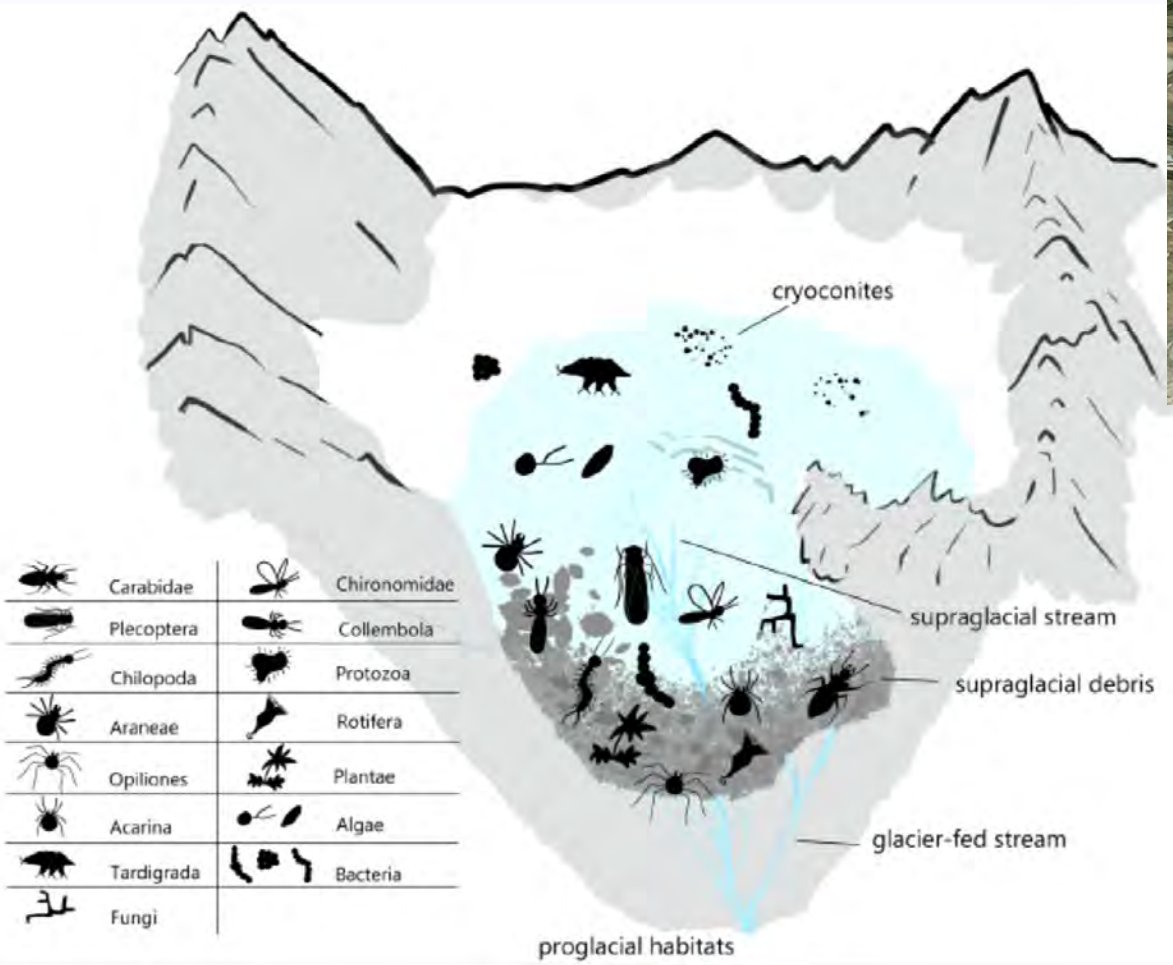
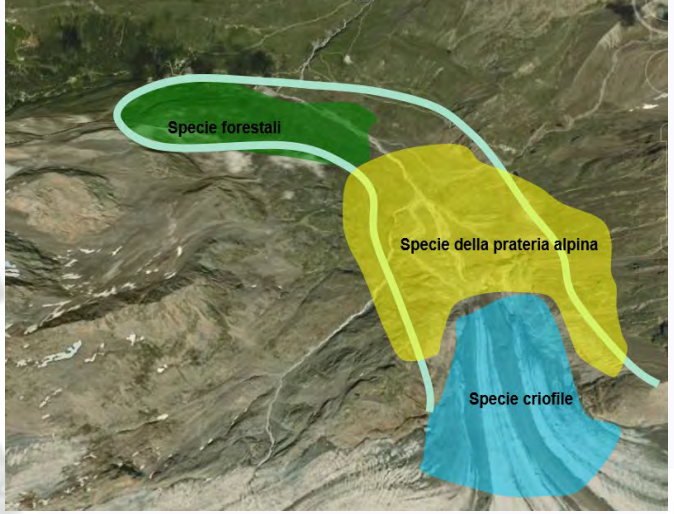
Tools for Promoting the Natural and Cultural Water Heritage

Life on frozen water





Estimated biodiversity >100 species per glacier (the composition of species varies from glacier to glacier).

frontiers in Ecology and Evolution

ORIGINAL RESEARCH
published: 29 January 2021
doi: 10.3389/fevo.2020.616562

The Consequences of Glacier Retreat Are Uneven Between Plant Species

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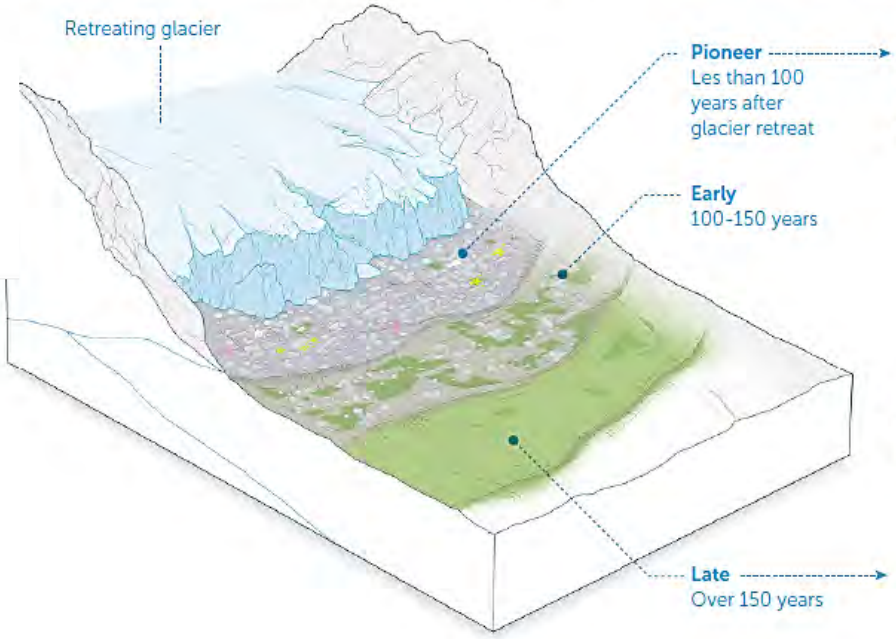
volving ecosystems

'hen glaciers retreat, newly exposed terrain is colonized by ant species. As the effects of **global warming shift the ynamic of plant communities**, different **stages** can be seen:



In **pioneer** communities (on recently deglaciated areas) positive associations prevail, with early colonizer plants **facilitating** the establishment of others.

Moss campion
(*Silene acaulis*)

In **late** stages, **competition** becomes more prevalent. Fewer, more competitive late colonizers push other species out.

Alpine sedge
(*Carex curvula*)

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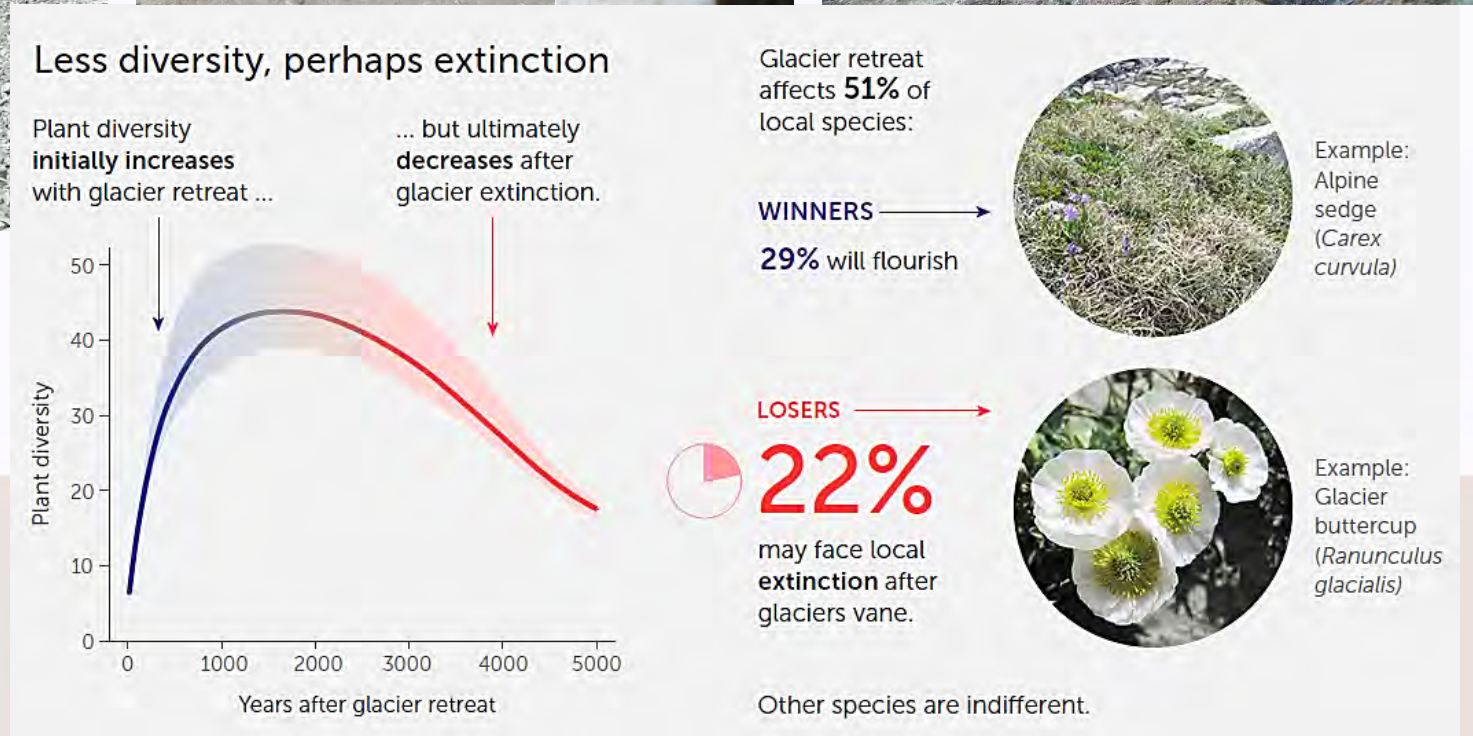
Estimating the “biodiversity balance”

Debris-covered glaciers (particularly widespread in the great mountain ranges of Asia) are also spreading in the Alps as a result of the deglaciation processes underway due to climate change and the parallel increase in slope instability and physical degradation of the embedded rocks.



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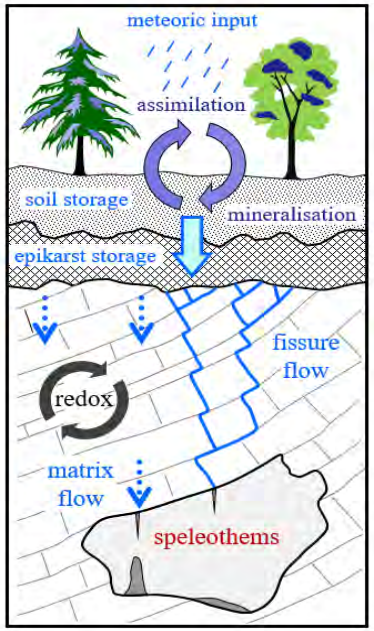

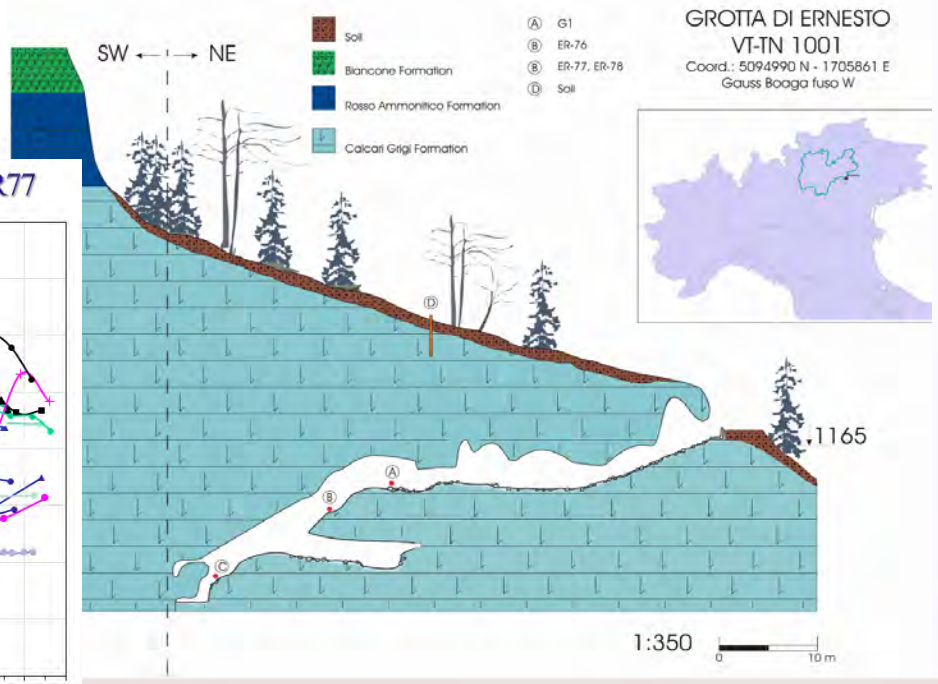

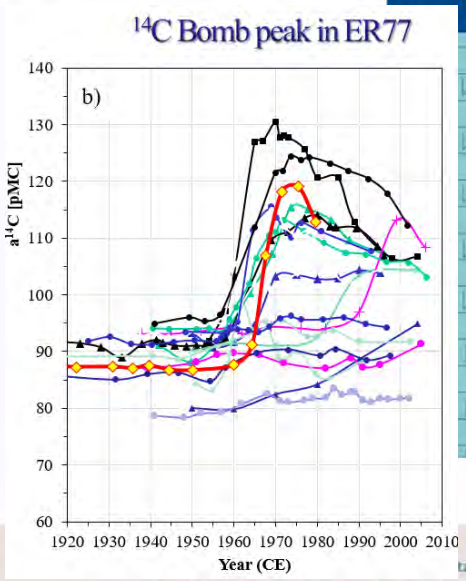

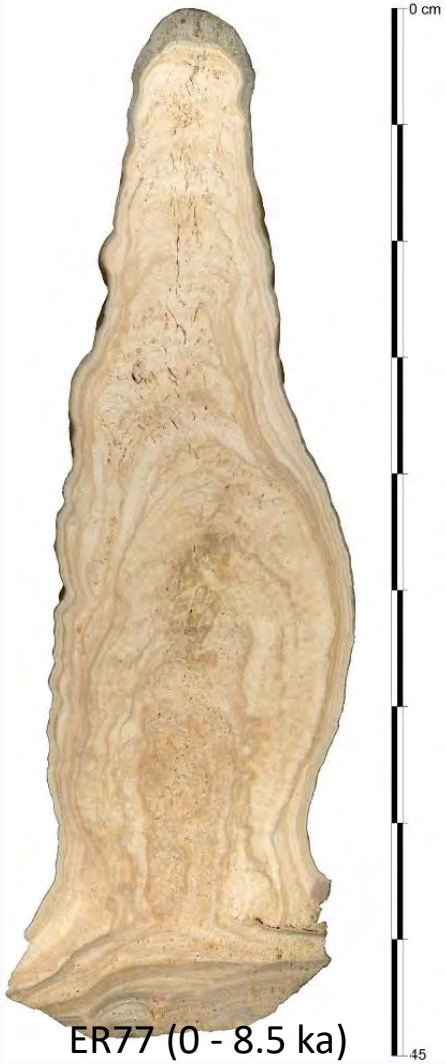

ER77 (0 - 8.5 ka)

Searching for climate changes in cave water

Mean Holocene growth rates around 50 micron/year. Acceleration in the last 200 years to >150 micron/year
Slow growing about 5mm for the Anthropocene

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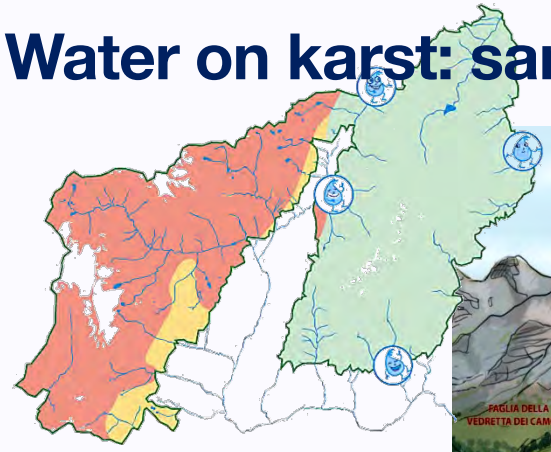
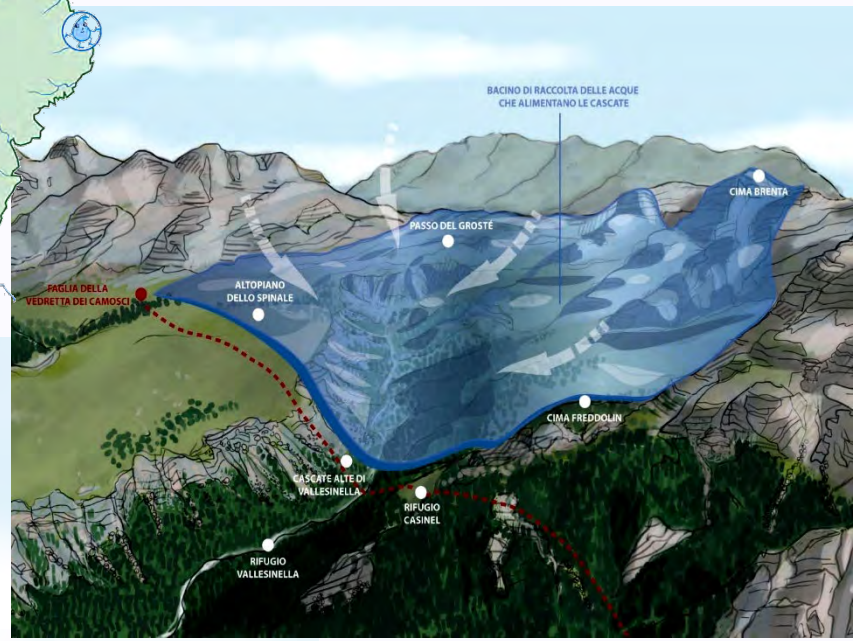
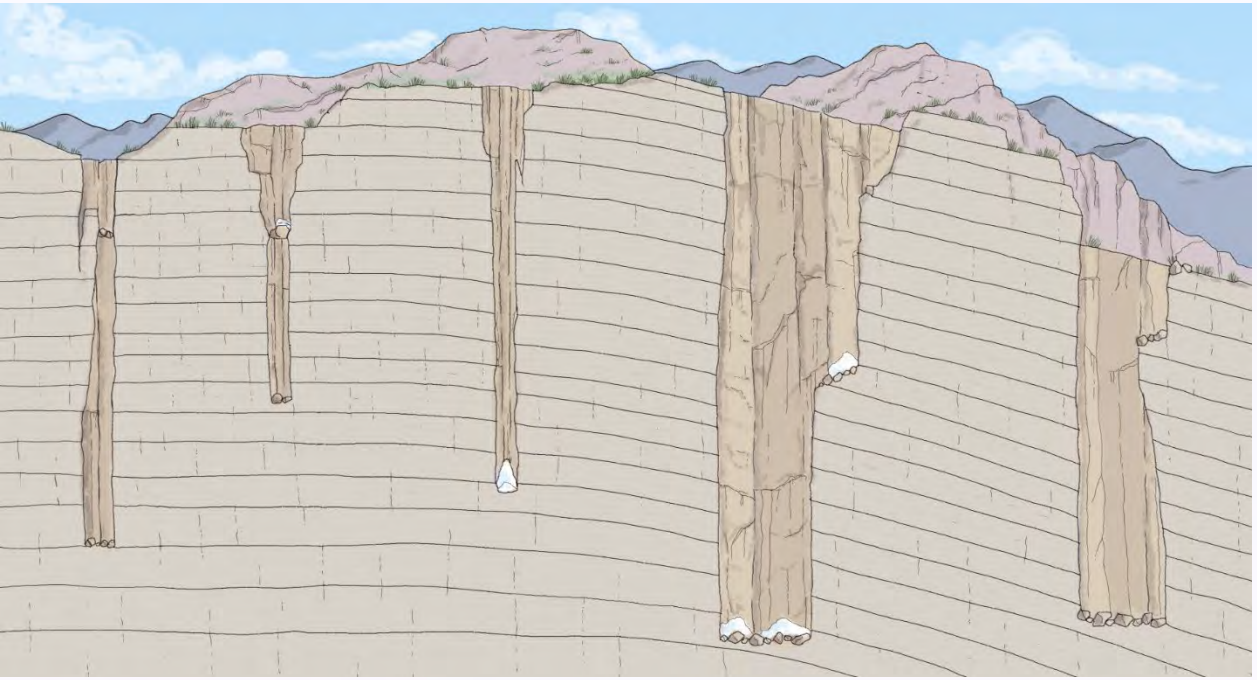
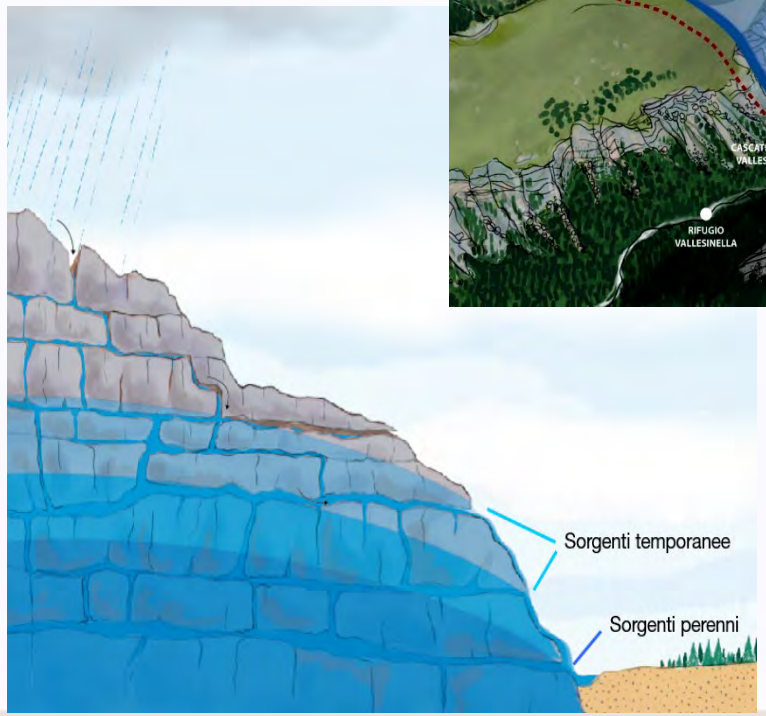
Water on karst: sampling the spring biotas









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Investigating the ancestors' water

Monitoring Vertebrate populations in wetlands

The effectiveness of a network of small protected wetlands in preserving birds has been tested by investigating changes in species occurrence and relating them to their ecology.

Generalist species increased their occurrence rates, whereas species with stricter requirements, generally underwent contraction, suggesting that the conservation of isolated wetlands is not enough to preserve the more specialized species.

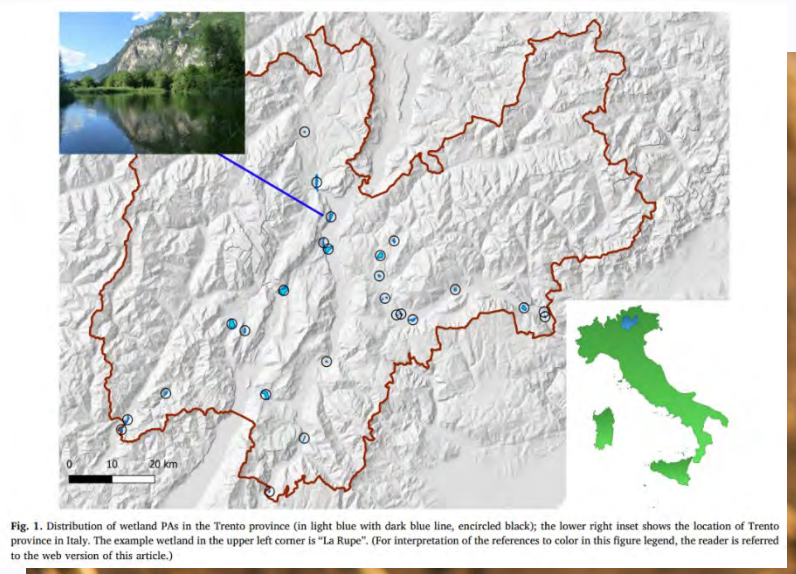


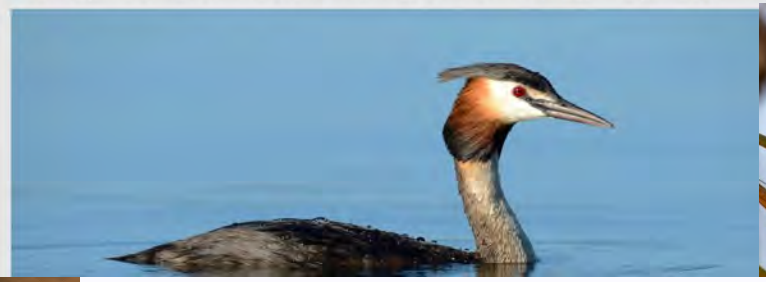
Fig. 1. Distribution of wetland PAs in the Trento province (in light blue with dark blue line, encircled black); the lower right inset shows the location of Trento province in Italy. The example wetland in the upper left corner is "La Rupe". (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

La rilevazione in 26 aree protette

Le zone umide, scrigni di biodiversità

In trent'anni il 43% delle specie ornitologiche censite è aumentato

Lo studio del MUSE, pubblicato sulla rivista internazionale Biological Conservation, racconta 30 anni di tutela e studio delle aree umide in Trentino. Il 43% delle specie di avifauna censite in 26 differenti biotopi è andato incontro ad espansione; in calo il cannareccione e il migliarino di palude.



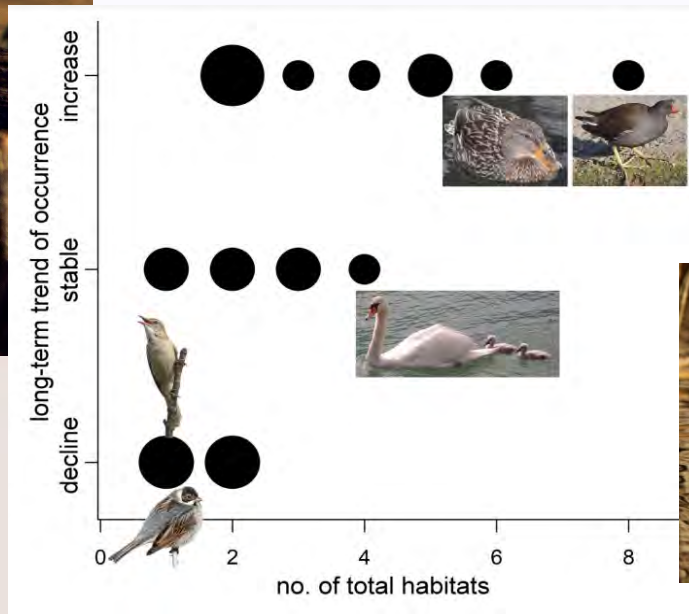


Fig. 2. Graphical representation of the relationship between the number of habitats used by a species and its long-term trend of occurrence within the study network of protected wetlands. Dot size is proportional to the number of species. Example species (from bottom to top, and from left to right) are reed bunting *Emberiza schoeniclus*, great reed warbler *Acrocephalus arundinaceus*, mute swan *Cygnus olor*, mallard *Anas platyrhynchos* and moorhen *Gallinula chloropus*.

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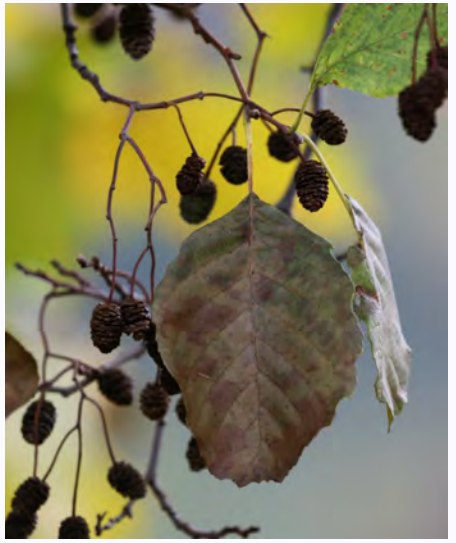
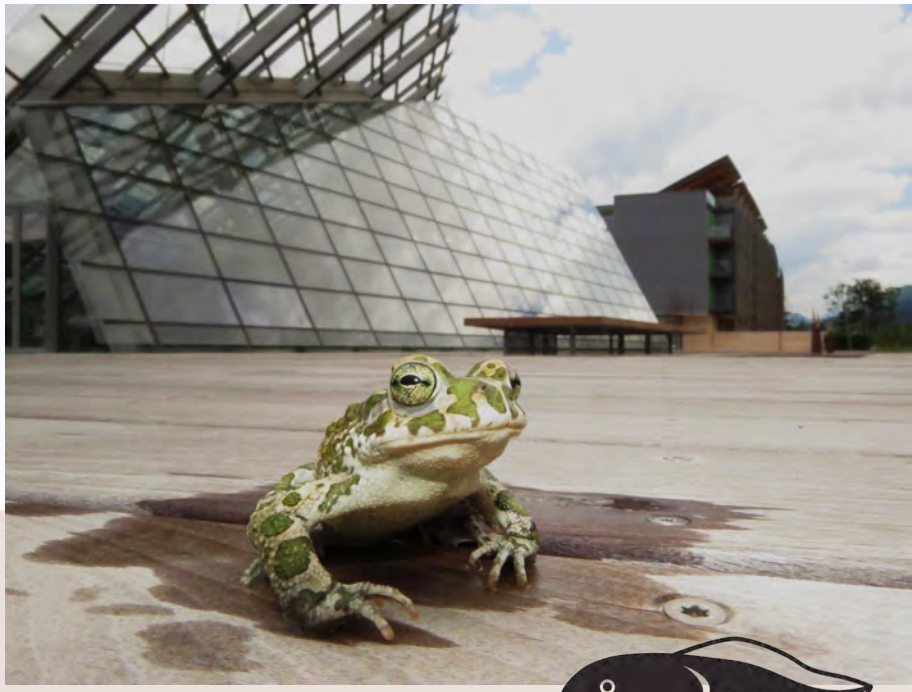
4. Water around the museum





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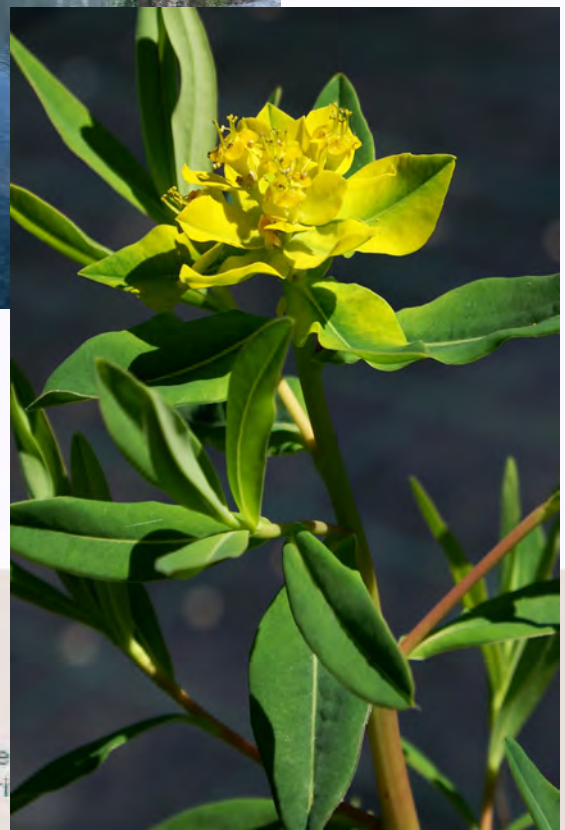
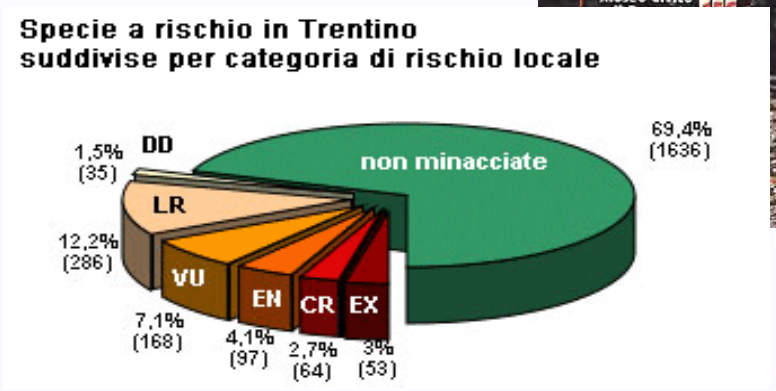
Water, from mirroring to reflection





Waterplants in Trentino:
~ 120 species (hygrophytes + hydrophytes)
~ 1/3 facing different levels
of threat (from VU to EX)

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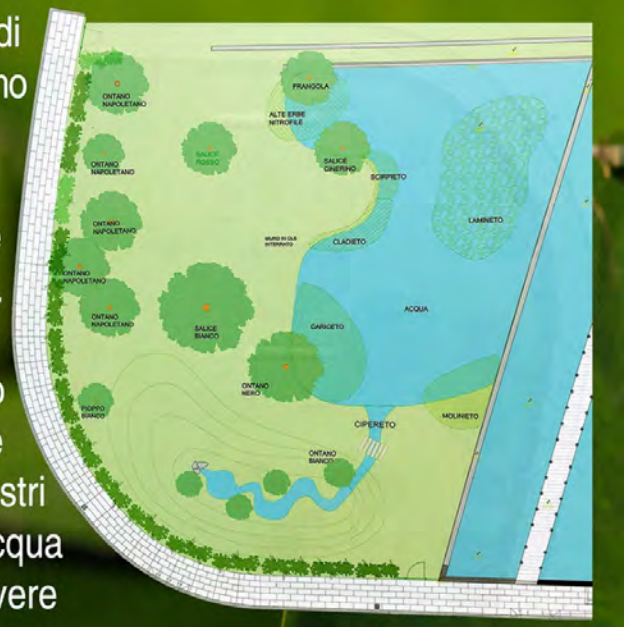
Waterplants nursery in Mattarello (TN)

Working with water

Restoring water (and hope for nature!)

L'imperativo è diversificare

Lungo le sponde di un lago o uno stagno naturale le piante si diversificano soprattutto in base al livello dell'acqua. Per poter ospitare il maggior numero possibile di piante acquatiche e palustri uno specchio d'acqua artificiale dovrà avere fondali a varie prondità.



Nannufaro o Ninfea gialla
Nuphar lutea

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Acqua per le piante acquatiche

Nell'area all'interno di questo cantiere si sta lavorando per realizzare un piccolo specchio d'acqua dolce. Questo permetterà di ricreare attorno al museo un frammento vitale degli ambienti umidi un tempo presenti in fondovalle, e riportarvi le numerose piante acquatiche che li popolavano e che sono la base di un'intricata rete ecologica funzionale alla vita di molti altri organismi.

Giaggiolo acquatico
Iris pseudoacorus

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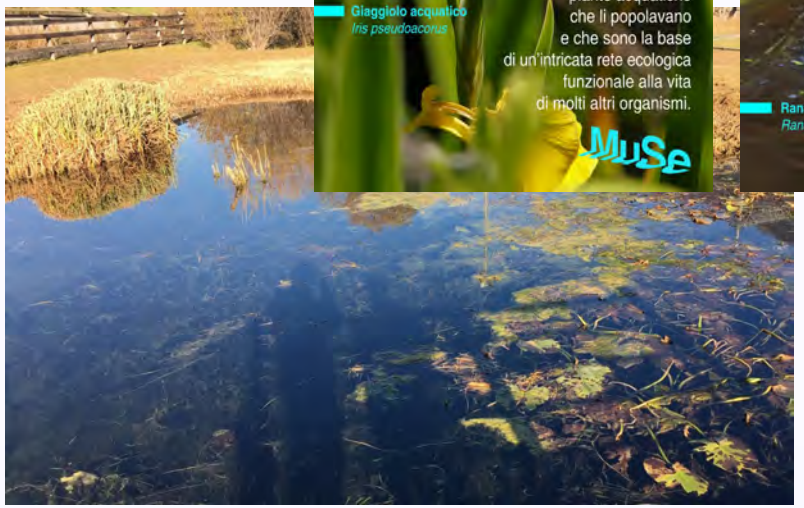

Un'interfaccia vitale

Le zone umide, in particolare la cosiddetta *fascia riparia* (le sponde, l'acqua bassa), hanno una grande importanza biologica in quanto rappresentano l'*ecotone*, cioè la zona di transizione tra gli ambienti terrestri e quelli acquatici, e sono vitali per molti organismi che vivono "a cavallo" dei due mondi: chi, come gli uccelli acquatici, nidifica a terra ma si alimenta in acqua e chi, come gli anfibi e numerosi insetti, ha uova e larve acquatiche e adulti che possono vivere del tutto a terra.

Rana di montagna
Rana temporaria

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Le zanzare: ospiti indesiderati?

Le zanzare sono insetti che, per riprodursi, colonizzano grandi e piccole raccolte d'acqua, anche in città.

Da oltre 10 anni la zanzara tigre, *Aedes albopictus*, ha invaso anche la nostra città, già popolata da zanzare locali tra cui la *Culex pipiens*, nota come "zanzara comune".

Zanzara tigre
Aedes albopictus

Per ridurre il livello di molestia da zanzare locali e aliene, stiamo tenendo sotto controllo la loro numerosità utilizzando apposite trappole dislocate in tutto il Parco del MUSE.

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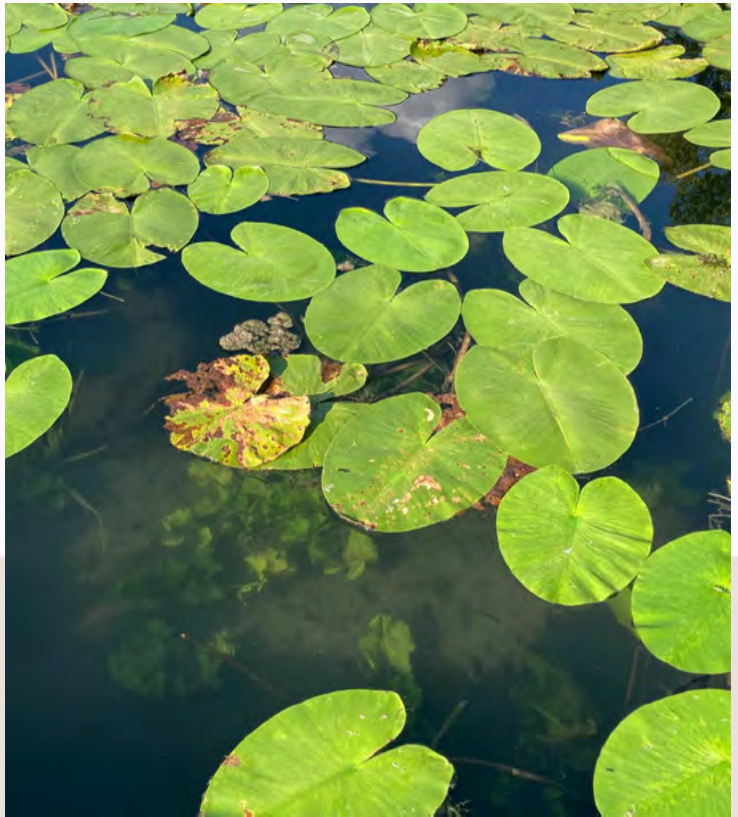

Thanks for the attention