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National significance of natural history collections in Switzerland

Archives and resources for modern science

IMPRESSUM

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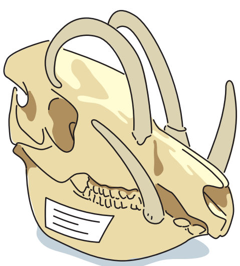
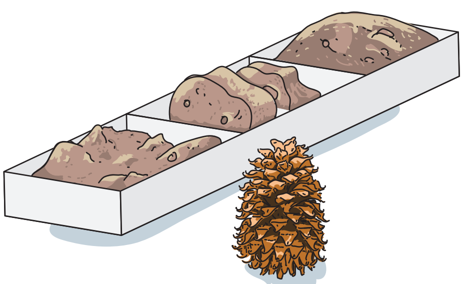
National significance of natural history collections in Switzerland

Archives and resources for modern science

Natural history collections housed and managed by public museums, botanical gardens and universities are increasingly referred to as natural science collections because they are not just records of the natural world but have great scientific value for understanding our world. This report uses the term 'natural history collections' as a synonym for 'natural science collections' to emphasise the importance of such collections for understanding our planet's natural history. They enable not only descriptions of nature in space and time but also the long-term conservation of specimens so that evolutionary processes can be studied and changes quantified.



Content



Overview

Biological and geoscience collections form an important part of our rich scientific heritage and provide the basis for much of what we know today about our planet and how we humans have influenced it. Natural history collections help us to understand our past and present better, thereby providing a basis for predicting the future. They also serve as biobanks for preserving the Earth's organismic and genomic diversity, and must not only be maintained, but also supplemented so that scientists can continue to document and explore life on Earth. As new investigative techniques emerge, we can discover more from studying such intact and well-preserved collections.

Switzerland's natural history collections in public museums, botanical gardens, universities and similar institutions constitute a national treasure, containing a wealth of stored information for science and society. Researchers' access to these collections is often hampered because the determination and digital inventorying of specimens in the collections are incomplete. This report describes the natural history collections in Switzerland and their value for research, education and the public sector. It also makes recommendations for measures and other steps to be taken to preserve and valorise these collections. Making these collections digitally accessible and developing them further, will greatly benefit Swiss science and society generally.

Context

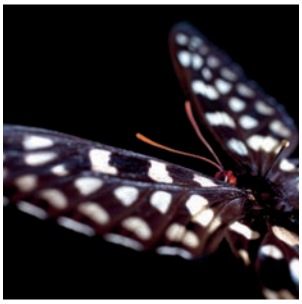
Natural history collections contain specimens of sediments, soil samples, rocks, minerals and mineral resources, fossils, animals, plants, fungi and microorganisms. Geological specimens document the Earth's history and geological evolution, with each specimen representing the geological heritage of the place where it was collected. Collections of mineral resources document the occurrence of raw materials and their use from prehistoric until recent times. Specimens from biological, archaeobiological and palaeontological collections constitute the basis for describing, naming and understanding species, their evolutionary histories and their interactions. Such collections are thus fundamental to our efforts to understand past, present and future biodiversity, and biodiversity patterns on Earth. They provide evidence of the past and present geographic distribution of species, and thus of the physical evidence of the presence of a particular species through time and space, and can be used to verify species identifications.

The world is going through a period of tremendous change mostly caused by humans. Natural history collections provide opportunities for reconstructing the past. It is only on the basis of correctly identified specimens that meaningful predictive models can be produced for the development of biodiversity, evolution and population dynamics, as well as assessing the impacts of environmental changes such as climate change, pollution and other human-caused factors (Akademie der Naturwissenschaften 2006). For research in systematics, ecology, evolution and nature conservation, several or more samples of the same species are needed to take into account intraspecific morphological and genetic variation. Collections should therefore be augmented with specimens sampled in a continuous and systematic manner over time.

In Switzerland, most natural history collections are held in public museums, botanical gardens, universities and similar research institutions, but there are also a number of privately owned collections. Over 33 million zoological and more than 13.5 million botanical and mycological specimens are stored in Swiss natural history museums and botanical gardens together with around 12.5 million archaeobiological and about 1.5 million geoscience samples (Figure 3; Appendix I). How many specimens are stored in research institutions and private collections is not known. Besides the major institutions in Geneva, Zurich, Basel, Bern and Lausanne, most cities in Switzerland house medium- or small-sized collections (Figure 1, 2; Appendix I). The bulk of material dates from the 19th and 20th centuries, with a few modern collections. The oldest specimens in the Naturhistorisches Museum in Basel and in the Felix Platter Herbarium collection at the Burgerbibliothek Bern date back to the 16th century, and the pre-Linnean collections of the Conservatoire et Jardin botaniques de la Ville de Genève to the 17th century. Swiss institutions house not only numerous collections of specimens from Switzerland, but also many specimens – approximately 68% of the total number – that originate from all around the world (Figure 3; Appendix I). Switzerland is one of the few countries in Europe whose collections have not been harmed or destroyed by armed conflicts.

A small proportion of the specimens housed in natural history collections is publicly displayed in exhibitions mainly to promote public awareness of the world around us. Visitors to natural history museums and botanical gardens may marvel at the exhibited specimens in displays, but they are usually not aware of the richness and the volume of collections that are present 'behind the scenes'. The majority of specimens housed in collections, however, are neither visible nor generally open to the public. These collections are very valuable scientifically and important for both research and education. Natural history collections and the institutions that house them are fundamental for the training of future bio- and geodiversity specialists. Taken together, the Swiss collections form an entity whose scientific value is comparable to that of the most prestigious foreign institutions. Each collection is complementary, both on a Swiss and an international scale. However, their long-term storage and maintenance are expensive as they require specifically trained staff, such as curators, collection managers and technicians, as well as climate-controlled facilities to conserve collections over the long-term for future generations. The City of Geneva, for example, is building new facilities to host the Museum of Geneva's zoological collections (AMBRE project), which have to conform to the legal requirements for housing cultural assets ('Kulturgüterschutz').

Switzerland's federal law on the 'Protection of cultural assets in the case of armed conflicts, disasters and emergencies' (Bundesgesetz 520.3) specifies that collections are cultural goods, but it contains no binding provisions to ensure their conservation and does not contribute financially to their maintenance. Natural history museums and botanical gardens are generally funded by the city, canton or community in which they are located. Some institutions receive some additional funding from other sources such as the Federal Office of Culture or from private foundations. For most natural history museums and botanical gardens in Switzerland, it is a statuary obligation to ensure that the collections are conserved and studied. They are mostly, however, evaluated according to the number of visitors, their exhibitions and their presence in the media rather than their value for research. When funding is insufficient or tight, the allocation of resources therefore generally favours making them more attractive to the public.



Swiss natural history collections – hidden treasures in museums and botanical gardens

While a small number of specimens housed in Swiss natural history collections can be admired by the general public in exhibitions, the vast majority is not on public display but safely stored in purpose-built collection facilities that are accessible for scientists. Swiss natural history museums and botanical gardens house about 47 million biological specimens and several million archaeobiological, palaeontological and geological objects. The potential for intensifying research on these collections and using them for educational and social purposes is enormous. Much of their scientific, educational and social potential still needs to be unlocked and the collections' quality and accessibility increased.

Anton Gisler's (1820–1888) botanical collections, for instance, were deposited at the Kantonsschule Altorf (UR) and later moved to the Herbaria at the University of Zürich. In both places they were only stored and not studied. In 2005 the herbaria were moved back to Canton Uri, where the very valuable lichen collection is currently being curated and revised. Its outstanding scientific value is only now being discovered and its numerous records of rare or currently unknown lichen species studied (Bürgi-Meyer and Dietrich).

Figure 1: Biological and geological objects of national and international origin in natural history collections in Switzerland (numbers divided in categories).

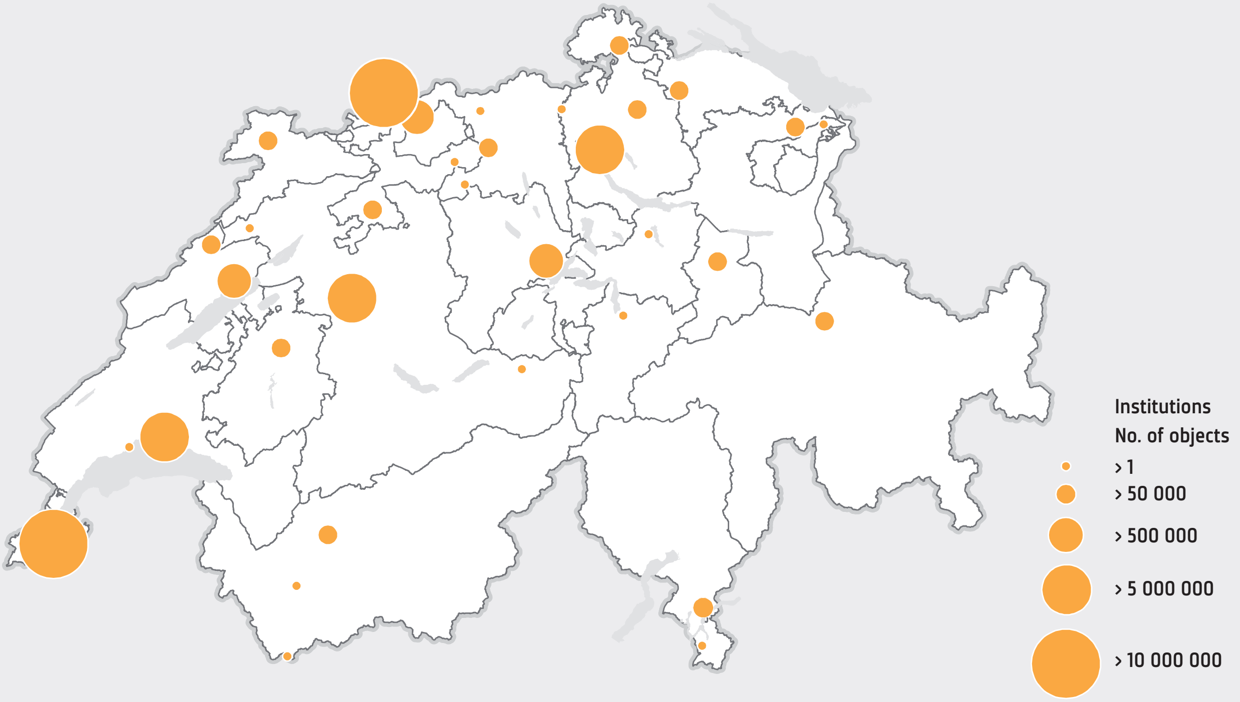


Figure 2: Biological and geological objects from Switzerland in natural history collections in Switzerland (numbers divided in categories).

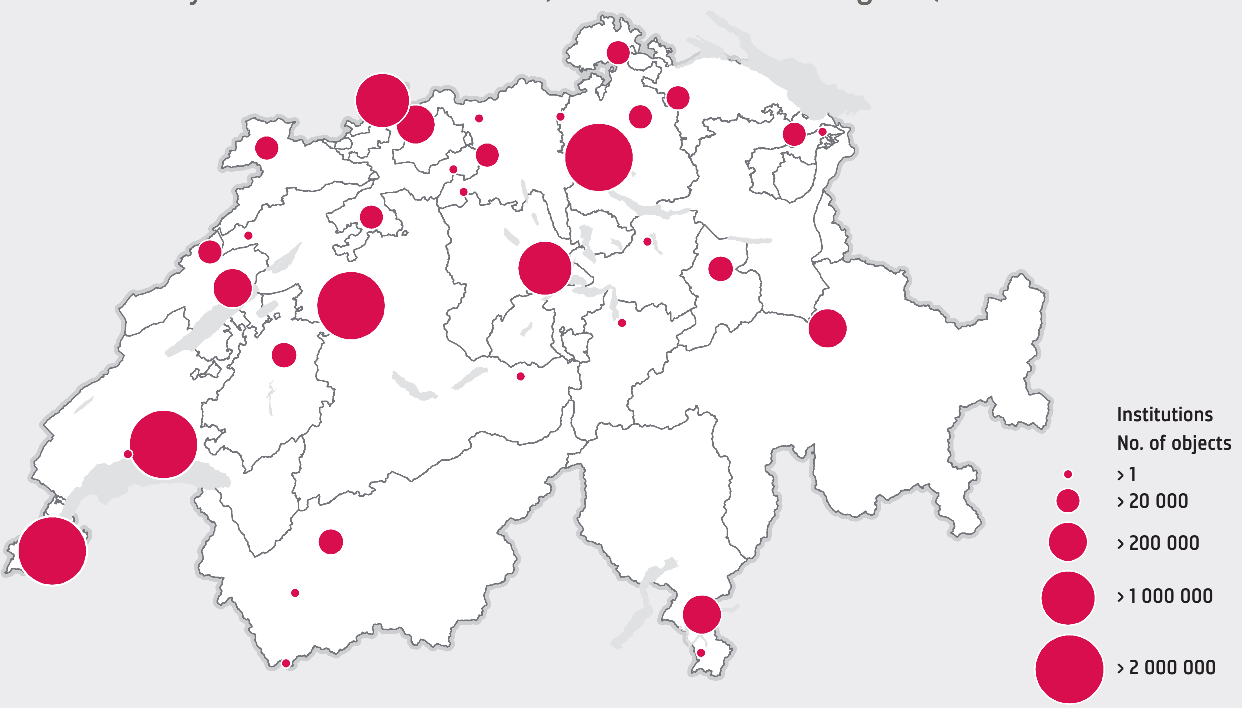
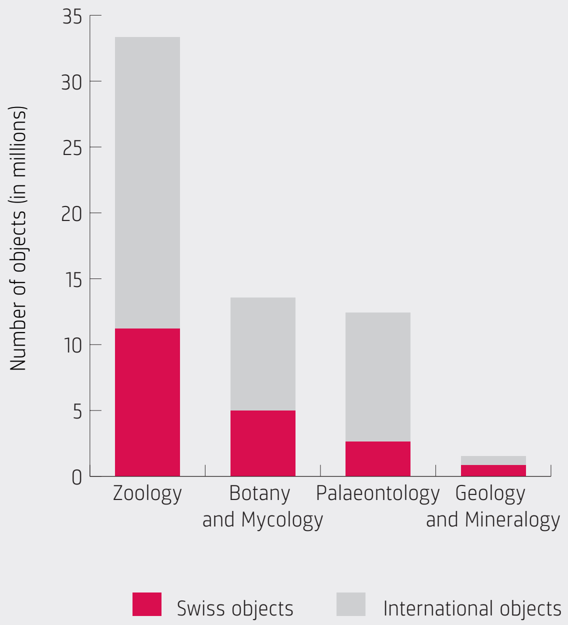


Figure 3: Number of Swiss and international objects in Swiss natural history collections grouped into different disciplines



Studying insect specimens at the natural history museum in Bern. Photo: NMBE/Lisa Schäublin

Importance of natural history collections

Natural history specimens held in Swiss institutions were, and still are, collected by scientists during expeditions or specific fieldwork campaigns in Switzerland or abroad, or for Swiss biodiversity inventory or monitoring projects. Specimens are also acquired via acquisitions, gifts and exchanges. Natural history specimens are generally tagged with information on where and when they were collected, along with the name of the collector(s) and collector number. Type specimens are of prime importance as they represent the original material used to describe species that were new for science. The aim of taxonomic studies is to ensure that each species bears one scientific name that is valid and can be used by the community at large. When species are studied by taxonomists, types are also important for nomenclature purposes and, as such, guarantee the correct naming of species. Swiss collections house an above international average number of type specimens that represent species originating from all around the world. According to one estimate (Agosti 2003; Hotspot 2006), they contain up to 150 000 biological, palaeontological and mineralogical types, but the real number is likely to be much higher. A recent digitisation and imaging project, funded by the Andrew W. Mellon Foundation, found that the Conservatoire et Jardin botaniques de la Ville de Genève alone contains more than 117 000 types of plants and fungi. Every year, more than one hundred new species are described by scientists working in Switzerland, be it plants, fungi, animals or fossils (Swiss Systematics Society).

Natural history collections are hence essential for any systematic research on the natural world, irrespective of which techniques are used and whether they are morphological or molecular. They also document biodiversity and its evolution via, for example, the study of population dynamics, community composition and biogeographic relationships. They can also be used to establish diversity indices on regional or nationwide scales, and are thus essential for the establishment of Red Lists and conservation action plans. Mineral resource collections preserve






important information and knowhow about raw materials on a national level. The geological collections are essential for allocating the stones of historical old buildings to historical quarries as part of their preservation. Moreover, specimens in the collections can be used in analysing and modelling severe human-induced environmental changes, such as the current unprecedented species loss and habitat destruction, the increase in invasive species or the deleterious effects of climate change. They also provide a basis for developing measures to preserve and sustainably use natural resources.

The collections have also proved relevant in interesting and unexpected ways, for instance in studying pathogens, the vectors of disease or changes over time in environmental contaminants. By comparing known viruses and bacteria stored in collections with emerging diseases, the history and sources of reservoirs can be tracked and identified. Stored tissue specimens or organisms, such as mosquitos, can provide information on the population dynamics and patterns of transmission of parasites and pathogens. Similarly, specimens collected over time can be used to detect and monitor the accumulation of environmental contaminants (Suarez and Tsutsui 2004). For instance, research studies comparing the thickness of eggshells of predatory birds in museum collections from the 19th and 20th centuries led to the introduction of tighter controls on pesticide use in agriculture (Green 1998; Hickey and Anderson 1968). Knowing the time of year when specimens were collected can give indications about phenological changes and the way species respond to environmental changes (Brooks et al. 2017).

Because of the Earth's complex nature, its materials are produced under a wide range of different chemical and physical conditions. It is not surprising, therefore, that many minerals, rocks, and fluids are of interest to e.g. chemists, physicists and materials scientists. In many respects the Earth acts as a laboratory providing the parameters of time, pressure and temperature that cannot be produced (yet) in the laboratory. Geological samples, such as diamonds, stishovite, or cristobalite, require specific environmental conditions for their formation – high pressure in the case of diamond, shock (e.g. meteorite impacts) in the case of the stishovite and high temperature in the case of cristobalite. These minerals provide insights into geodynamic processes or act as indicators of the way these processes operate. Chemists and physicists turn to museum collections for their materials and are increasingly working with mineralogists and petrologists in multidisciplinary research areas (Henderson 2005).

Significance of natural history collections for research and society

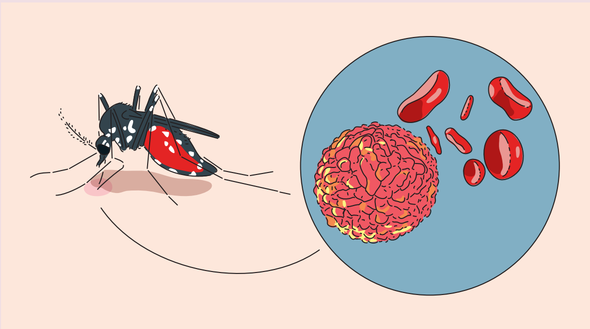
The world's ecosystems are subject to rapid changes due to human activities. These pose many challenges, such as global warming and biodiversity loss. To understand these human environmental impacts better, geological and biological changes need to be described and quantified. The specimens in natural history collections are often the only source of information about the past to compare with current biodiversity trends and thus establish reliable monitoring.

For instance, atmospheric deposition in soils can be measured by comparing soil specimens collected at different times. When the reactor accident in Chernobyl occurred, Switzerland was – thanks to the systematic forest soil collection of the Swiss Federal Institute for Forest, Snow and Landscape Research WSL – one of the few countries able to provide nationwide reference values for the radioactive contamination of soils before the event, and was therefore able to monitor the extent and spatial distribution of radioactive contamination after the event.

Environmental changes influence species distribution and composition. New species may populate new geographic regions causing new interactions, which may be invasive or parasitic. Analyses of historical plant surveys dating back to 1871, for example, revealed that plant species richness is increasing on mountain summits in correlation with global warming. The temperature increase has been more rapid over the past decade, resulting in plant species richness increasing more. This may have far-ranging and not yet known consequences for biodiversity and ecosystem functioning in these regions, and change the ecosystem services in mountain areas (Steinbauer et al. 2018).

Biological specimens can be used to study species anatomy-morphology, variability, the evolution of traits over time, evolutionary history and phylogeny, chemical composition and properties, occurrences and ecological preferences. They can be analysed to detect e.g. toxins, parasites or diseases, and studied in many other ways.

The protection of endangered species requires sound taxonomic knowledge, as well as data on the abundance and distribution of the species over time. In Switzerland, it was assumed that the bat *Pipistrellus pipistrellus* was relatively abundant and did not require special measures. However, another species *(P. pygmaeus)*, which was classified under *P. pipistrellus*, was discovered based on the morphological and genetic analyses of specimens hosted in Swiss natural history museums. The abundance and distribution patterns of the two species differ in Switzerland (Sattler et. al. 2007), and protection measures for both have been consequently revised and improved.



During the past 40 years, tiger mosquitos have spread from South-East Asia over the world. These mosquito species are highly invasive from an environmental point of view and they also threaten human and animal health, since they are vectors of disease including dengue and chikungunya fever as well as the Zika and West Nile virus. The tiger mosquito *Aedes albopictus* is firmly established in the canton of Ticino and suitable climatic conditions for its establishment north of the Alps are found in Basel and Geneva. Due to global warming, also other cities in Switzerland could soon have suitable meteorological conditions in winter for tiger mosquitos to survive (Flacio et al. 2016, Ravasi et al. 2018). Specimens of *A. albopictus* collected for scientific studies and in monitoring projects are preserved at the National Coordination Center for Invasive Mosquitoes (NCCIM) located at the University of Bellinzona, which works in close cooperation with the Museum of Natural History of Lugano. Similarly, specimens of additional invasive mosquito species, which are lately colonising wide areas in Switzerland, such as *A. japonicus* and *A. koreicus* are preserved at the NCCIM. They serve as voucher specimens. If needed, reference specimens of invasive mosquito species can be provided for research to other institutions in Switzerland. The establishment of the NCCIM allows scientists to validate mosquito specimens and to provide scientific collections of invasive mosquitos for present and future studies.

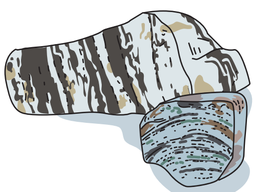
Freshwater amphipod species are commonly used as bioindicators and for ecotoxicological tests, but little was known about their distribution in Switzerland before the studies of Altermatt et al. (2014) and Fišer et al. (2017). These studies partly relied on a re-evaluation of museum specimens, which had been mostly collected in biodiversity monitoring programmes. The study of the specimens held in museums was also supplemented with an extensive and targeted field-collecting campaign to obtain a comprehensive estimation of the diversity of this group. Specimens collected during the study will be deposited in the Musée de Zoologie Lausanne and will be a valuable tool for studies of amphipod species in future.

Involving interested individuals, such as retired people, amateur naturalists or non-professional specialists, in the curatorial and revisionary work of natural history collections benefits not only those who volunteer, but also museums and botanical gardens. Several recent initiatives have involved so-called Citizen Scientists, such as the project Flora of the Canton of Zurich (Flora of the Canton of Zurich) or the 'Herbonautes' initiative of the Muséum National d Histoire Naturelle, Paris (Herbonautes initiative). Professional instruction, support and integration are, of course, essential for the success of this model, requiring the host institution to invest in both personnel and financial resources.

Recent developments in scientific techniques and methodologies have allowed scientists to extract a wealth of new information from museum and herbarium specimens. Specimens, which were mostly collected before DNA-analysis technologies became available, for example, can now be used for DNA barcoding analyses without harming them so long as non-destructive DNA extraction methods are used. These have helped species identification and the systematics of many groups of organisms (Naciri and Linder 2015). Unique specimens such as types can now be examined in detail in a non-destructive way by various scanning technologies (Sartori et al. 2016). Museum and herbarium specimens also constitute the basis for modelling the potential distribution of species, such as agricultural or forest pests.

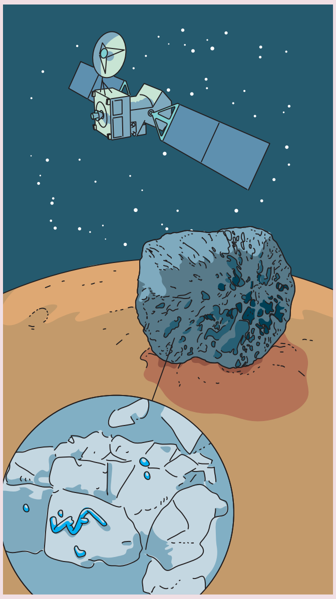
The establishment of the majority of natural history collections during the past two centuries has coincided with the extinction of many endangered populations and species. As a result, these specimens represent an invaluable source for conservation biology. Natural history collections and botanical gardens offer genetic resources for research and development. With legislation on the transfer of genetic resources becoming stricter (e.g. the Nagoya-Protocol on Access and Benefit Sharing), collections and botanical gardens provide easy alternatives to collecting specimens abroad. Thanks to the recent developments in museum genomics (Wandeler et al. 2007; Yeates et al. 2016), not only has specific DNA barcode information been unravelled but so too has a large proportion of the genome, usually irrespective of DNA degradation (Suchan et al. 2016; Schmid et al. 2017). This data from specimens across the ages can be used to answer scientific questions in the fields of systematics, evolution and ecology.

Major developments in analytical instruments and methods have opened up opportunities for exciting new work using collected geological material. The greatly enhanced sensitivity, precision and accuracy of newer analytic technologies allow investigations of hitherto somewhat impenetrable problems including those of: reconstructing environmental variations over geological time scales (for instance, climate change or ocean acidification), high precision dating of the age and duration of geological events and processes (for instance, mass extinction events), tracing the origin of samples (for instance, meteorites or archaeological artefacts) and investigating the environmental effects of weathering of mineral deposits. The use of specimens from collections in studying environmental conditions will increase in the near future. Humans contamination of the environment with radioisotopes and other pollutants such as lead, mercury and microplastics, means that specimens collected prior to these events can offer important chemical benchmarks. Engineering companies are increasingly using well-documented collections to help reduce exploration or exploitation costs, for instance, in geothermal investigations (Henderson 2005).



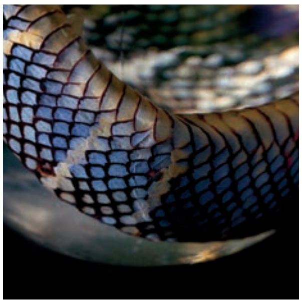
Swiss natural history collections for economy, technology and innovation

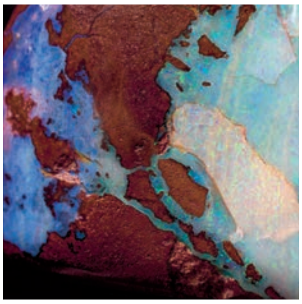
Applied geological collections often contain samples originating from locations, such as ancient mines or tunnels, that are no longer accessible. The geological museum of Lausanne is the only institution in the world that possesses drill samples from the Mont Blanc Tunnel. Thanks to these samples, the part of the tunnel destroyed in 1999 could be reconstructed much more easily and economically.

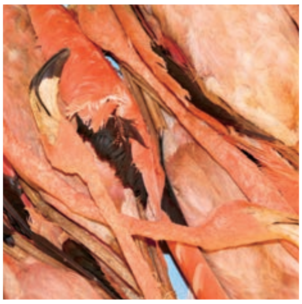


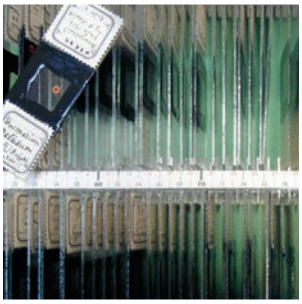
The ExoMars-Mission 2020–2021, an astrobiology project of the European Space Agency ESA and the Russian Space Agency Roscosmos, has the goal to search for traces of life on Mars. In order to prepare the mission, a Close-Up Imager has to be tested on Earth (Josset et al. 2017). Thanks to discoveries of filamentous structures in rock collections by scientists from the Natural History Museum in Bern that indicate the presence of early life on Earth, as well as its rich collection of meteorites, Switzerland is now involved in the mission to Mars (Hofmann et al. 2008; Hofmann 2017).

At the beginning of the 1990s, severe dieback symptoms on European ash *Fraxinus excelsior* were observed for the first time in north-eastern Poland. Currently, a large part of the native distribution area of *F. excelsior* is affected by a potentially lethal disease. Based on molecular data, Queloz et al. (2011) identified the pathogen as a new cryptic fungal species, which is currently known as *Hymenoscyphus fraxineus*. Recently, morphological and genetic studies have revealed that *H. fraxineus* is a pathogen introduced to Europe and most probably originates from East Asia, from where it rapidly colonised an area that was previously already colonised by the non-pathogenic *H. albidus*, a widespread fungus indigenous to Europe. Herbarium specimens revealed the early presence of *H. albidus* in European ash populations (Queloz et al. 2011).







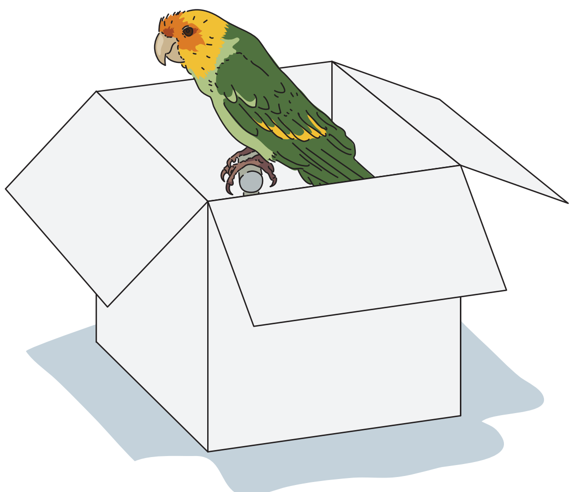


Requirements for natural history collections

The scientific naming of a specimen, i.e., assigning a scientific name based on an internationally established and hierarchically structured classification system, is essential for studying it, regardless of whether it is biological or geological. The act of naming has scientific value only if it is reproducible, which means labels must be preserved and samples maintained in collections. These collections must be organised and properly curated to enable access to specimens and associated data. At the same time, the collecting of new material must be planned for monitoring and for fundamental research in geo- and biodiversity (Brandt and Smrecak 2016; Wilson 2017).

In order to be optimally useful, a natural history collection should fulfil a number of criteria:

- → The **quality of specimen conservation** and associated data should be adequate.
- → The **organisation and curation** should be according to best-practices to ensure access to specimens and associated data.
- → There should be a long-term **strategy** for maintaining and developing the collection.
- → Specimens should be accessible via the **integration** of specimens in the collections (preparation and integration into the existing collections) and the technical/physical management of collections.
- → **Scientifical naming of species;** specimens should be reliably identified with taxonomic/systematic revision, as necessary.
- → The specimen data and images should be **digitised**.
- → **Open access** to digital specimen data and images should be assured.



In Switzerland, these criteria are only partially met because:

- → The **quality of specimen conservation** varies from one institution to another, depending on how the specimens were prepared, how they have been stored and how they have been treated over time (e.g. pest control), as well as on the budget and the available infrastructure.
- → The quality of the organisation and **curation of collections** is generally fair, but there is potential for improvement. Personnel resources are often lacking to physically and digitally handle the large numbers of specimens in collections, and institutions often lack space to store them adequately.
- → Many Swiss institutions have their own strategies, but they have no formal common **strategy** for all institutions. Protecting, maintaining and developing natural history collections have a legal basis in Swiss Federal Law, but who is responsible for what is not clearly defined at the cantonal and institutional levels, and a more stable legal basis is needed. The strategy should specify, e.g., how voucher specimens and genetic material from federal monitoring projects should be deposited in one of the existing collections. A common Swiss strategy would improve the efficiency of conservation efforts and optimise cost-effectiveness, thus ensuring the long-term preservation, development and valorisation of the collections.
- → Natural history collections serve, by their very nature, as repositories of samples, and thus grow continually. The institutions housing them must actively manage their collections and integrate new collections into the available storage areas. Many institutions today have large backlogs, with specimens waiting for the preparation and determination needed before they can be **integrated** into the collections themselves.
- → Specimens can only be correctly integrated into the collections if they have a scientific name, which can be at the family, genus or species level. However, **scientifically naming** specimens can be challenging for natural history collections as it requires a certain level of knowledge which is not always available or is even lacking (Leuzinger 2017). Larger institutions may have a small number of taxonomic specialists, but smaller institutions often do not. It is therefore essential to maintain taxonomic expertise in Swiss institutions, train future generations of taxonomists and make sure they have jobs to go to in Switzerland. For many taxa native to Switzerland, for example, no specialists are currently available in Switzerland (CBD Technical Series No. 30).
- → Some Swiss institutions have started the **digitisation** of collections, but depending on the institution, the collections involved or the specific taxon-oriented focus, it is more or less advanced. So far, only about 16.5% of biological specimens (including archaeobiology) from natural history collections in Switzerland have been digitised. For most institutions, the large-scale digitisation of the whole collection is, however, beyond their financial means.
- → The lack of financial support for data and image digitisation of collections means that **open access** to data from Swiss natural history collections is only partial.

The Digitisation Centre (DigiCenter) at the ETH Library, a service provider and competence centre in the fields of digitisation and the handling of metadata. Photo: ETH-Bildarchiv/Pierre Kellenberger

Digitisation of Swiss collections – not yet finished

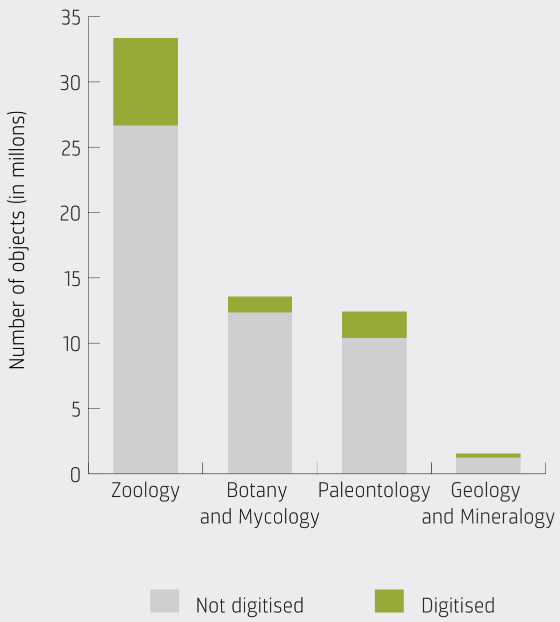
The first steps towards creating a core national infrastructure for digitising specimen data have been taken, drawing on the knowhow available in Swiss natural history collection institutions, adopting international standards and using professional data capture systems. Networking systems with other datasets/sources and connections with international databases have been established to increase accessibility to specimen data nationally and internationally (for an overview of national and international programmes, information networks and databases, see Appendix II). These initiatives should continue to develop in a collaborative manner in the interests of science, culture and Swiss (natural) history. A solid foundation for natural history collections in Switzerland is needed and they should be integrated in international and global initiatives.

In Switzerland, several large institutions already have expertise in digitising information and images of the specimens in natural history collections. ETH Zürich is currently digitising its natural history collections as part of their collection strategy to provide accessibility to its collections and archives for research, teaching and the general public. The Conservatoire et Jardin botaniques de la Ville de Genève has digitised and recorded images of its type collections and continues to digitise the general collections. The Geneva Herbaria Catalogue of the Conservatoire et Jardin botaniques de la Ville de Genève contains digital information on 339 000 specimens, accompanied by 200 600 images, which represent approximately 5% of this internationally important botanical collection of around 6 000 000 specimens.

The Swiss node of the Global Biodiversity Information Facility (GBIF.ch) was launched in 2004, to provide GBIF International (GBIF.org) with data on specimens from collections in Switzerland and to improve the conditions for data exchange in Switzerland. GBIF.ch is not only supporting several digitisation projects, but is also helping to set up the technical infrastructure for data collection, standardisation and sharing within Switzerland. Quality criteria, reflecting Swiss collection institutions realities and needs, have been defined and will facilitate the prioritising of both specimen revision and digitisation work (GBIF SWISS NODE 2014). Today, Switzerland is a full member of GBIF International, and the Swiss Node now collaborates with 24 national institutions housing natural history collections (including Swiss herbaria) and the National Databases (Info Species). It has aggregated and made digitally available nearly 1.2 million records, and ensures that data are managed and information can be exchanged with relevant international databases.

Swisstopo provides digital geological data, which are primarily used for carrying out modern geological analyses, exploring below ground and registering mineral resources. These data, together with the collections of the Earth science and mineral resource institutions, form an essential basis for the development of comprehensive geological datasets and models in the domains of natural hazards, geo-energy and raw materials, and other environmental issues (Swisstopo; GeoCover, 2013).

Figure 4: Number of digitised and non-digitised objects in Swiss natural history collections grouped into different disciplines



Goals and measures to be taken

To ensure the long-term preservation, development and valorisation of Switzerland's natural history collections, the strategies of institutions with similar objectives and functions should be coordinated and optimised at a national level and a common strategy developed. Developing a shared vision for all these collections, ranging from the smallest to the largest, would improve their quality and accessibility. It would make it easier for them to be used for research, and thus contribute to answering some of the regional and global challenges we face today, such as the effects of climate change or invasive species. Future collective actions will greatly benefit from the expertise and experience of the individual Swiss institutions.

The Swiss scientific associations and institutions hosting collections that have agreed to combine forces to this end include (for description see Appendix II):
- SCNAT,
- musnatcoll,
- GBIF.ch,
- Swiss Systematics Society,
- Info Species.

Together they form a competent body to develop a national strategy for maintaining, further developing and valorising Switzerland's natural history collections. Such an initiative should have positive and sustainable effects on the use of these collections for research, education and the public.

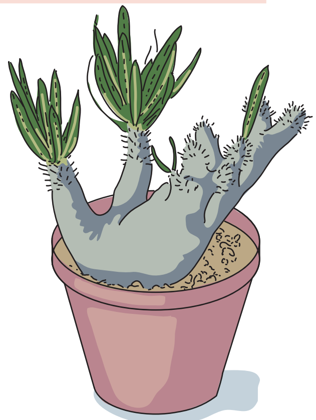
The common goals agreed on are:

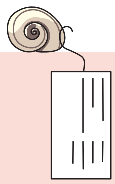
→ To develop a long-term strategy for managing the Swiss Natural History Collections, using them for scientific purposes (Swiss Natural History Collections Research Agenda) and obtaining funding to maintain and develop them further.

→ To digitise and publish specimen information as part of a decentralised research infrastructure for Swiss natural history collections that will lead to the creation of a virtual Swiss natural history museum and collaborative research platform.

→ To promote the scientific and educational use of Swiss natural history collections nationally and internationally, as well as to encourage the training needed for scientific and technical jobs related to natural history collections.

→ To integrate the Swiss natural history collections, via the creation of a national research infrastructure for scientific collections, into international efforts to mobilise biodiversity and geodiversity data in a coordinated way to benefit Swiss research.





To reach these long-term goals, the following actions should be carried out at the national level:

- → Quantitative and qualitative inventories of natural history collections preserved in Swiss institutions should be made.
- → Specimens of Swiss and foreign origin housed in Swiss natural history collections should be identified and digitised.
- → Support should be given for the taxonomic revision of collections. As Swiss institutions do not dispose of sufficient expertise/staff for a complete scientific revision of the collections, Swiss and international networking between institutions and collaboration with external scientists is indispensable. Such efforts could be promoted by the attribution of funds to museums to exchange or invite experts from abroad.
- → Systematics should be better integrated in university curriculae.
- → Specimen digital imaging, data management and data storage should be supported.
- → Digital information should be consolidated resulting in a distributed Swiss natural history collections infrastructure.
- → Scientific research in collections and in collection holding institutions should be promoted, as well as collaborations between Swiss universities and national history museums or botanical gardens.
- → Quality standards for newly generated collections from research and monitoring projects should be established.
- → Collaborations for complementarity optimisation of knowledge and material should be promoted.
- → Good conditions for retired scientists and amateurs in museums should be created. Supporting museums and botanical gardens to professionalise the help of Citizen Scientists would strengthen this important resource.

The implementation of these actions requires a collective approach and the development of a national initiative. The Swiss Academy of Sciences (SCNAT) is committed to collaborating with institutions housing natural history collections, and act as an umbrella organisation by coordinating the national initiative that aims to preserve and valorise natural history collections for research and society in Switzerland.

Glossary

Term	Definition and/or Explanations
accessibility to specimens physical access	Scientists can visit collections or collections can be loaned between institutions. Physical access results in specimens being studied and annotated, the determination of the specimen may change and DNA, flower or leaf samples may also be taken from specimens. Specimens are also usually cited in taxonomic / systematic /phylogenetic articles. Different types of data are contained within physical collections: – Specimens, including data linked to their physical structure or contents (e.g. morphological, anatomical, genetic, chemical, ...), or to where, when and how they were collected (e.g. geographic coordinates, ecology and habitat type, ...), – their labels (including the name of the collector), – historical indications such as expeditions.
accessibility to specimens digital access	Specimen data (digital capture of label data) and ideally also specimen scans or images are made available via herbarium catalogues or museum catalogues. Digital access results in use of the specimen image by a distant scientist, and possibly also digital annotation of the specimen. The specimen may also be cited in taxonomic / systematic articles. New determinations of the specimens digitally accessed are sent to the repository institutions, although much less frequently than expected.
anatomy	A branch of morphology that deals with the structure of organisms.
archaeobiology	A subfield of archaeology focusing on animal and botanical remains recovered from archaeological sites.
biobanking	A biobank is an organised entity responsible for the management and the custodianship of biological resources (synonyms: collection, biorepository, repository, biological resource centre or biospecimen resource). Biobanking will be a fundamental part and a new role of natural history collections in the future (e.g. tissue banks where material is stored in silica gel and DNA banks where samples of DNA extracted from tissues is stored) in link with the concept of museum genomics (see below). Samples stored in tissue and DNA banks are linked to physical vouchers deposited in the collections and from which verification of the taxonomic identity is always possible. This is all the more important as new technologies give access to new information on the specimens and add to their value (e.g. next-generation sequencing technology or methods).
biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (according to the Convention on Biological Diversity).
biogeography	The study of the geographical distribution of organisms and ecosystems throughout geological time and space.
bioindicator	An organism used as an indicator of the quality of an ecosystem, especially in terms of pollution.
citizen scientists	Citizen scientists are members of the general public (including the whole spectrum from laypersons to non-professional specialists) collecting and analysing data relating to the natural world, typically as part of a collaborative project with professional scientists. For projects related to natural history collections, collaborators from the general public have to be instructed by experts in order to observe professional standards.

Term	Definition and/or Explanations
collection management	The development, processing, documentation, organization, maintenance and use of collections. Work that is involved so that collections are fully accessible (e.g. accessioned and available for consultation): – Label preparation, – Specimen mounting, – Specimen conservation, – Specimen filing, – Dealing with specimen backlogs, – Nomenclatural updating according to a given classification system, – Specimen disinfection, pest monitoring and conservation treatment, – Specimen moving and taxonomic rearrangement within a collection when new identifications are proposed or new systematic treatment is applied.
cristobalite	A variety of quartz (SiO2) that forms at very high temperatures (> 1470 °C) and low pressure (< 1GPa).
cryptic species	One of two or more morphologically indistinguishable biological groups (populations) that cannot interbreed.
curator	Curators are research scientists responsible for managing and conducting collections research based on objects of natural history stored in collections. They also share research results with the public and community through exhibitions and publications.
data aggregation	Aggregating of digitised specimen data from different sources e.g. institutional databases.
database of specimens	A database is an organised collection of data that is accessed/stored electronically e.g. in a computerised system. a) Database that contains information on the specimens themselves and that is maintained within institutions for scientific and curatorial purposes. b) Database that aggregates specimen data from other sources (e.g. GBIF) that place a focus on geographic data (modelling and the 'tracking' of species), or on types (JSTOR). Depending on their focus, these aggregated databases put different emphasis on the various fields that are used, that are different from the more complete data that is databased in the institutions themselves.
databasing	The process of capturing data electronically.
digitising specimen image	Producing a digital image of a specimen (whole or parts, which may or may not include databasing of the full label data).
digitising specimen information	Digitising specimen data using the information from their labels (with associated scientific name and barcode).
DNA barcoding	A method that uses a short fragment of an organism's DNA (the 'barcode') to identify it as belonging to a particular species.
ecosystem services	The benefits people obtain from ecosystems (supporting, regulating, provisioning and cultural services; Millennium Ecosystem Assessment). This classification is superseded by the system used under 'nature's contributions to people'. This is because many services fit into more than one of the four categories. For example, food is both a provisioning service and also, emphatically, a cultural service, in many cultures (IPBES assessments).
ecotoxicology	Multidisciplinary field integrating toxicology and ecology by studying effects of toxic chemicals on biological organisms on different levels (e.g. population, community, ecosystem).

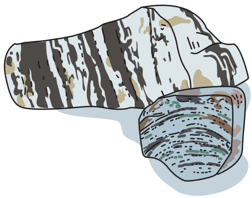
Term	Definition and/or Explanations
genetic variation	Naturally occurring differences in DNA sequences (i.e. genetic differences) among organisms in the same species. Accordingly, individuals and populations are different over space. Mutations and recombination are major sources of variation.
geodiversity	The variety of earth materials, forms and processes that constitute and shape the Earth, either the whole or a specific part of it.
herbarium	A collection of preserved plant or fungal specimens and associated data used for scientific study.
identification of specimen	Giving a scientific name to a specimen (to be distinguished from «taxonomic/systematic revision of specimen», see below).
invasive species	A species whose spread threatens biological diversity.
morphology (biology)	A branch of biology that deals with the form and structure of animals and plants or parts thereof.
museum genomics	Genome-wide analyses of museum specimens: the advent of next-generation sequencing technology and the development of cost-effective techniques for sequencing historical DNA allow for more and more genetic research to be done on museum collection-based specimen.
Nagoya Protocol on Access and Benefit-sharing	An international agreement which aims at sharing the benefits arising from the utilisation of genetic resources in a fair and equitable way.
naming of species (nomenclature)	Organisms are named based on a formal system (binomial system) by giving each a scientific name (nomenclature). The organisms are ordered into groups based on similarities or differences (classification).
palaeontology	The scientific study of life in past geological time.
pathogen	A bacterium, virus, or other microorganism that can cause a disease.
phenology	The study of cyclic and seasonal natural phenomena, especially of plant and animal life in relation to climate.
phylogenetics	The branch of biology that deals with the evolutionary development and diversification of a species or group of organisms, or of a particular feature of organisms.
population dynamics	The science studying the change in numbers, biomass, and age structure of populations.
pre-Linnean	Before Carl von Linné (1707–1778, Swedish botanist) established the binomial system of scientific nomenclature (see naming of species).
Red List	Inventory of the conservation status of biological species.
reservoirs (for pathogens)	Population of organisms or the specific environment in which an infectious pathogen naturally lives and reproduces, or upon which the pathogen primarily depends for its survival.

Term	Definition and/or Explanations
revision of taxonomic groups/ specimen(s)	Establishing what scientific names should be applied to which taxa by studying specimens to establish what species actually are based on the observations and analysis of data sets (morphological-anatomical, genetic, chemical, etc.) and the assessment of the natural variability (e.g. this is taxonomy and systematics, see below). This latter element implies taxonomic and systematics know-how as well as different steps that include the following: – The typification of names via their linkage with the specimen(s) that were used to describe the new taxon, – The study of type and non-type specimens to understand traits, species delimitation and variability, and the diagnostic features of taxa, – The assessment of the nomenclature of the taxon/taxa concerned such that correct synonymy is determined and the correct name is applied to the evolutionary units under study, – The assessment and determination of the evolutionary relationships of the taxon/taxa and the elucidation of evolutionary mechanisms that have shaped the history of the taxon/taxa, – Specimen determination/redetermination in the light of the evaluation of species, – Concepts and phylogenetic considerations.
species	The species is the basic unit of classification in biology and a taxonomic rank, as well as a unit of biodiversity.
species variability	Variation between species (inter-species variability), individual organisms or groups of organisms of any species (intra-species variability) is caused by genetic differences (genetic variation) and/or by the effect of environmental factors on the expression of the genetic potentials (phenotypic variation).
specimen	An organism, part of an organism, or naturally-occurring material that has been collected, that may or may not have undergone some preparation treatment.
specimen database	a) Database that contains information on the specimens themselves and that is maintained within institutions for scientific and curatorial purposes. b) Database that aggregates specimen data from other sources (e.g. GBIF, see Appendix II) that place a focus on geographic data (modelling and the 'tracking' of species), or on types (JSTOR). Depending on their focus, these aggregated databases put different emphasis on the various fields that are used, that are different than the more complete data that is databased in the institutions themselves.
stishovite	A variety of quartz (SiO_2) that only forms under very high pressures (> 8GPa).
systematics	The study and classification of organisms with the goal of reconstructing their evolutionary histories and relationships.
taxon (pl. taxa)	Any rank in the taxonomic classification, such as a phylum, class, order, family, genus or species.
taxonomic revision	Reassessment of scientific names of a particular group of organisms.
taxonomy	Science dealing with the description, identification, naming (nomenclature), and classification of organisms.
type specimen	Any specimen that has been designated as the name-bearer in the original published description of a taxon.
vectors of disease	Any agent that carries and transmits an infectious pathogen into another living organism.
voucher specimen	A specimen archived in a permanent collection (usually in a museum or botanical garden). It serves as physical evidence of occurrence (time and place) and of any identifications and descriptions based on it, archived with adequate collection data.

Appendixes

Appendix I. Inventory of Swiss natural history collections

Canton	Place	Institution	No. of objects	Swiss objects	No. of species with types	Objects digitised
AG	Aarau	Naturama Aargau (NAAG)	130 000	80%	0	16%
	Frick	Forschungsinstitut für biologischen Landbau (FiBL)	16 000	96%	0	30%
		Saurier Museum Frick (SMF)	1050	100%	1	0%
	Zofingen	Museum Zofingen	20 000	N/A	0	N/A
AR	Heiden	Museum Heiden	900	50%	0	0%
BE	Bern	Botanischer Garten Bern (BERN)	500 000	85%	N/A	0%
		Naturhistorisches Museum Bern (NMBE)	6 000 000	30%	2 132	30%
	Meiringen	Naturmuseum Oberhasli	300	100%	0	0%
	St-Imier	Musée de Saint-Imier (MSI)	23 000	72%	0	80%
BL	Liestal	Museum.BL (MuseumBL)	638 000	71%	0	7%
BS	Basel	Entomologische Gesellschaft Basel (EGB)	12 000	100%	0	10%
		Herbarien Basel (BAS+BASBG+RENZ)	700 000	30%	900	20%
		Naturhistorisches Museum Basel (NMB)	11 773 532	13%	42 956	10%
		Sammlung der Interkantonalen Arbeitsgemeinschaft für Anthropologie (IPNA)	40 000	N/A	0	N/A
		Universität Basel, Departement Umweltwissenschaften (UNIBAS)	13 000	58%	0	N/A
FR	Fribourg	Musée d'Histoire naturelle Fribourg (MHNF)	256 000	63%	530	32%
GE	Genève	Conservatoire et Jardin botaniques de la Ville de Genève (G)	6 000 000	15%	77 100	6%
		Muséum d'histoire naturelle de la Ville de Genève (MHNG)	15 000 000	16%	32 295	19%
GL	Glarus	Naturwissenschaftliche Sammlungen Glarus (NWSGL)	100 000	66%	28	12%
GR	Chur	Bündner Naturmuseum / Museum de la natira (BNM)	370 000	92%	N/A	N/A
JU	Porrentruy	JURASSICA	135 000	83%	0	0%
LU	Luzern	Gletschergarten Luzern (GGL)	250	100%	0	0%
		Naturmuseum Luzern (NMLU)	1 600 000	77%	N/A	67%
NE	La Chaux-de Fonds	Musée d'Histoire naturelle de La Chaux-de-Fonds (MHNC)	92 792	47%	110	11%
	Neuchâtel	Laboratoire d'archéozoologie de l'Université de Neuchâtel (UNINE-ARCZ)	5 500	95%	0	100%
		Laboratoire de botanique évolutive de l'Université de Neuchâtel : Herbier (NEU)	455 000	42%	N/A	20%
		Musée d'histoire naturelle de Neuchâtel (MHNN)	687 544	53%	1156	21%
SG	St. Gallen	Naturmuseum St. Gallen (NMSG)	350 000	39%	3	43%



Canton	Place	Institution	No. of objects	Swiss objects	No. of species with types	Objects digitised
SH	Schaffhausen	Museum zu Allerheiligen Schaffhausen (NMSH)	185 000	58%	6	11%
SO	Olten	Naturmuseum Olten (NMOL)	10 000	N/A	0	0%
	Solothurn	Naturmuseum Solothurn (NMSO)	145 000	78%	61	70%
SZ	Einsiedeln	Naturalien-Kabinett (NKEI)	15 000	35%	0	0%
TG	Frauenfeld	Naturmuseum Thurgau (NMTG)	100 000	79%	0	74%
TI	Lugano	Museo cantonale di storia naturale, Lugano (MCSN)	355 000	89%	157	52%
	Meride	Museo dei Fossili del Monte San Giorgio (MFMSG)	237	98%	0	0%
UR	Altdorf	Naturkundemuseum Kollegium Altdorf	450	75%	0	0%
VD	Lausanne	Musée cantonal de géologie, Lausanne (MCGL)	1 000 000	50%	2 870	5%
		Musée cantonal de zoologie, Lausanne (MZL)	4 000 000	66%	1 510	26%
		Musées et Jardins Botaniques cantonaux, Lausanne (LAU)	1 200 000	45%	N/A	11%
	Tolochenaz	Maison de la rivière	1 470	57%	0	98%
VS	Bourg-Saint-Pierre	Musée de l'Hospice du Grand-Saint-Bernard (HGSB)	13 000	66%	0	0%
	Champsec	Maison de la Pierre ollaire	50	100%	0	0%
	Sion	Musée de la nature Sion (MNVS)	136 000	85%	0	81%
ZH	Birmensdorf	WSL (WSL)	1 000 000	89%	0	N/A
	Dübendorf	EAWAG aquatic research (EAWAG)	18 219	23%	10	89%
	Niederweningen	Mammutmuseum Niederweningen	70	100%	0	0%
	Winterthur	Naturmuseum Winterthur (NMWIN)	130 000	79%	0	11%
	Zürich	Anthropologisches Institut und Museum, Universität Zürich (AIMZ)	7 209	N/A	0	N/A
		Botanisches Museum der Universität Zürich (UZHBOT)	30 000	31%	0	0%
		Entomologische Sammlung der ETH Zürich (ETHZ-ENT)	2 000 000	60%	1100	7%
		Erdwissenschaftliche Sammlungen der ETH Zürich (ETHZ-EWS)	600 000	75%	2 000	5%
		KULTURAMA – Museum des Menschen (KULTURAMA)	11 000	70%	0	7%
		Paläontologisches Institut und Museum (UZHPIM)	200 000	50%	500	20%
		Sukkulentensammlung (ZSS)	28 800	1%	1 661	14%
		Vereinigte Herbarien der Universität und ETH Zürich (Z+ZT)	3 800 000	50%	23 500	7%
		Zoologisches Museum der Universität Zürich (ZMZ)	1 000 000	11%	1 510	12%
	Total		60 906 373	32%	192 116	17%

Appendix II. Associations, organisations, information networks, databases and current projects or initiatives

Swiss collections, biodiversity and biodiversity data-based associations or organisations

GBIF.ch is the Swiss node of the Global Biodiversity Information Facility that honours the commitments entered into by Switzerland by the ratification of the GBIF Memorandum of Understanding. The objective of GBIF.ch to register all specimens of botanical, palaeontological and zoological collections of museums, conservatories and botanical gardens from across Switzerland so that they are digitally accessible. Observational data of all fauna, flora and mycological databases are also to be collated and made accessible via the same unique national platform: the Swiss GBIF node.
www.gbif.ch

Info Species is the Swiss Centre for Species Information. It comprises all the different national species-based databases (vascular plants, bryophytes, fungi, lichens and fauna) and aims to promote the collaboration between the different registration centres, the cantons, the confederation and third parties such as public or private persons or bodies that engage in species conservation.
www.infospecies.ch

musnatcoll.ch is the Swiss Association of Natural History Museums that represents museums within Switzerland and aims to increase the visibility of museums as well as conveying the importance of natural science collections and natural history museums as part of our national and international heritage.
www.naturalsciences.ch/organisations/musnatcoll

Nationales Bodeninformationssystem (NABODAT), affiliated with the National Soil Monitoring Network NABO, is the National Soil Information System that is continuously updated with cantonal and national soil data. Access to this application is provided for the clients of the federal government and cantons included in the NABODAT network. As mandated by the Federal Office for the Environment FOEN, the service centre is responsible for the smooth operation of the soil information system and supports users in the processing, importing and management of data. Moreover, the service centre organises, specifies and tests the advancement of the application in collaboration with the NABODAT working group and the external IT developer.
www.nabodat.ch/index.php/de

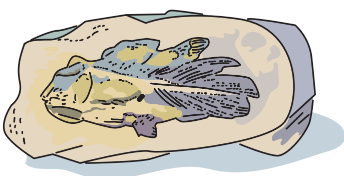
SwissBOL is an Association that acts as the centre for coordination of the activities related to the DNA barcodes in Switzerland. The SwissBOL network was founded with the goal of using DNA barcoding to capture the diversity of life in Switzerland and to use this information to monitor national biodiversity as well as enhance conservation strategies.
www.swissbol.ch

Swiss Systematics Society (SSS), unites systematic biologists from different fields who are investing in promoting the interests of systematics and taxonomy. The SSS serves as a competent interlocutor for science and society, and maintains international exchanges.
www.naturalsciences.ch/organisations/swiss-systematics

European and international associations or organisations

Natural history collections and biodiversity research

CETAF is the Consortium of European Taxonomic Facilities, a European network of Natural Science Museums, Natural History Museums, Botanical Gardens and Biodiversity Research Centers with their associated biological collections and research expertise. The 33 members that represent 59 institutions from 21 European countries and associated states are estimated to hold 68% of the worlds described biodiversity as specimens. The consortium contributes to Europe s knowledge-base by enhancing the synergies of the members collections and their research capabilities. They explore and document the natural world focusing on studying the species and their evolutionary history, advancing research in a multitude of disciplines.
wwww.cetaf.org



SPNHC is The Society for the Preservation of Natural History Collections, an international society whose mission is to improve the preservation, conservation and management of natural history collections to ensure their continuing value to society.
www.spnhc.org

Data aggregation and data mobilisation

GBIF is the Global Biodiversity Information Facility, an open-data research infrastructure funded by the world's governments and aimed at providing anyone, anywhere access to data about all types of life on Earth. Coordinated through its Secretariat in Copenhagen, the GBIF network of participating countries and organisations, working through participant nodes, provides data-holding institutions around the world with common standards and open-source tools that enable them to share information about where and when species have been recorded. This knowledge derives from many sources, including everything from museum specimens collected in the 18th and 19th century to geotagged smartphone photos shared by amateur naturalists in recent days and weeks.
www.gbif.org

Europeana aggregates digital images of all types of collections within and across Europe. It collaborates with thousands of European archives, libraries and museums to share cultural heritage for enjoyment, education and research by providing access to over 50 million digitised items such as books, music, artworks, drawings, specimens, images and documents.
www.europeana.eu/portal/en

Molecular biology and genetics

BOLD SYSTEMS is a cloud-based data storage and analysis platform developed at the Centre for Biodiversity Genomics in Canada. It consists of four main modules, a data portal, an educational portal, a registry of BINs (putative species), and a data collection and analysis workbench.
www.boldsystems.org

GGBN is the Global Genome Biodiversity Network, an international network of institutions that share an interest in long-term preservation of genomic samples representing the diversity of non-human life on Earth. This organisation provides a platform for biodiversity biobanks from across the world to develop DNA quality and tissue collection standards, improve best practices, and harmonise exchange and use of material in accordance with national and international legislation.
www.ggbn.org/ggbn_portal

NCBI is the National Center for Biotechnology Information of the USA. It has been charged with creating automated systems for storing and analysing knowledge about molecular biology, biochemistry, and genetics; facilitating the use of such databases and software by the research and medical community; coordinating efforts to gather biotechnology information both nationally and internationally; and performing research into advanced methods of computer-based information processing for analysing the structure and function of biologically important molecules.
www.ncbi.nlm.nih.gov/genbank

Tools, databases and data connectivity

BioCASe is the Biological Collection Access Service, a transnational network of primary biodiversity repositories. It links together specimen data from natural history collections, botanical/zoological gardens and research institutions worldwide with information from huge observation databases. The aim is to make the world's data on biodiversity data freely and universally accessible on the Internet through data portals and web services, a goal that BioCASe shares with related initiatives such as the GBIF and iDigBio. In the past years, BioCASe has developed into a widely accepted standard for data sharing and has laid the foundations for several thematically – both taxonomically and geographically – specialised networks. BioCASe is the CETAF node for GBIF.
www.biocase.org

GeoCASe is the Geosciences Collection Access Service. Making geosciences collection data openly and universally available to foster scientific research development internationally and to support the public use of these data are the goals and principles of GeoCASe.
www.geocase.eu

TDWG is the Biodiversity Information Standards group that focuses on the development of standards for the exchange of biological/biodiversity data, such as for for biodiversity occurrence data (Darwin Core and ABCD).
www.tdwg.org

ISTC is the Information Systems and Technology Commission of CETAF that unites bio-informaticians and developers from CETAF institutions to discuss biodiversity standards. This group has close contacts with TDWG.

Infrastructure and initiatives

Collection digitisation and data mobilisation

iDigBio is the Integrated Digitized Biocollections, the national resource for advancing digitisation of biodiversity collections in the USA, financed by their National Science Foundation. Data and images for millions of biological specimens are being made available in electronic format for the research community, government agencies, students, educators, and the general public.
www.idigbio.org

DiSSCo is the Distributed System of Scientific Collections, a new pan-European Research Infrastructure initiative of 21 European countries that developed under CETAF, with a vision to position European natural science collections at the centre of data-driven scientific excellence and innovation in environmental research, climate change, food security, one health and the bioeconomy. The mission is to mobilise, unify and deliver bio- and geo-diversity information at the scale, form and precision required by scientific communities; transforming a fragmented landscape into a coherent and responsive research infrastructure. Effectively transforming disperse and fragmented access nodes to an integrated data-driven European research infrastructure to provide open access to mass, linked, reliable and precise data for the natural world.
www.dissco.eu

e-ReColNat is a French initiative that aims to be the tool that will virtually unite all the actors that, together, are capable of providing access to the information contained in their collections. This is achieved by the creation of an image bank and collaborative tools for its exploitation, which the entire community of systematicians, professionals and amateurs has access to.
www.recolnat.org/fr

Others

LifeWatch-ERIC is the e-Science European Infrastructure for Biodiversity and Ecosystem Research, officially established as international organism by the European Commission in 2017. In general terms, LifeWatch aims to address new research fields, test innovative hypothesis, deepen scientific knowledge and above all, to provide solutions for environmental policy and management issues.
www.lifewatch.eu

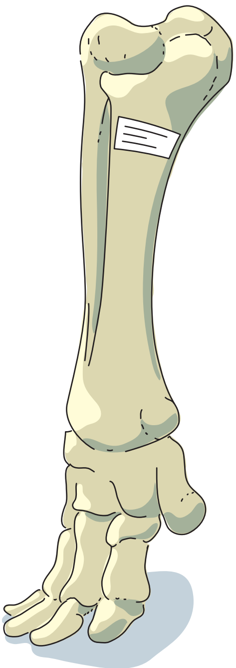
DEST is the Distributed European School of Taxonomy that represents a training platform for taxonomy that was created and run by taxonomists with the support of their institutions. The major aim of DEST is to transfer knowledge between current and future generations of taxonomists by providing high quality education and prepare students for future taxonomic careers. Other objectives of the programme are to encourage mobility, to promote integration by establishing new contacts with other researchers, and to contribute to capacity building in the trainee's institution. Since its founding, DEST had provided training to over 800 students from all over the world.
www.taxonomytraining.eu

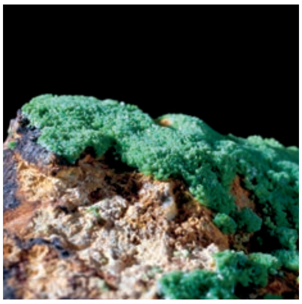
Projects

MOBILISE is a Cost Action (Mobilising Data, Policies & Experts in Scientific Collections) that aims to foster a cooperative network in Europe to support excellent research activities, and facilitate knowledge and technology transfer around natural science collections. This will prepare the ground for a future pan-European Distributed System of Scientific Collections (DiSSCo).
www.cost.eu/COST_Actions/ca/CA17106

ICEDIG is an EU-funded project that has been developed to support the new pan-European Research Infrastructure initiative, DiSSCo, in addressing the complex challenges that are still at play to digitise these collections via the ICEDIG design study. With the mission to drive 'Innovation and consolidation for large scale digitisation of natural heritage, this Horizon 2020 project is inviting stakeholders and representatives from potential industrial partners, national and European political bodies, the research community and society, to discuss the features of the project in relation to prospects for mass digitisation of natural sciences collections.
www.icedig.eu

SYNTHESYS is an EU-funded project that aims to create an integrated European infrastructure for researchers in the natural sciences and a shared, high quality approach to the management, preservation, and access to leading European natural history collections. SYNTHESYS is split into three activities: Access, Networking and Joint Research Activities that facilitate access to specimens, research that is conducted on specimens and European collaborations between the partner institutions.
www.synthesys.info/home/about-synthesys





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Participants at workshop 'Initiative Natural History Collections in Switzerland' in Bern, March 14th, 2018

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– Swiss Academy of Medical Sciences (SAMS)
– Swiss Academy of Humanities and Social Sciences (SAHS)
– Swiss Academy of Engineering Sciences (SATW)

as well as the centres of competence
– Centre for Technology Assessment (TA-SWISS)
– Foundation Science et Cité

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