Federal Ministry of
Education, Science
and Culture

THE AUSTRIAN COLLECTIONS AND DATABASES ON SPECIES DIVERSITY

An interdisciplinary study for the Global Biodiversity Information Facility

Umweltbundesamt

DAS ZUKUNFTSMINISTERIUM

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Martin Götzl
With cooperation of
Ossi Abdel-Qader, Friedrich Ehrendorfer, Andreas Geisler, Wolfgang Kainz,
Andreas Kaufmann, Michael Kiehn, Günther Kraus, Martin Lödl, Michael Malicky,
Petra Paumkirchner, Heimo Rainer, Frank Schumacher, Ernst Vitek

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Authors: Martin Götzl, Ossi Abdel-Qader, Friedrich Ehrendorfer, Andreas Geisler, Wolfgang Kainz, Andreas Kaufmann, Michael Kiehn, Günther Kraus, Martin Lödl, Michael Malicky, Petra Paumkirchner, Heimo Rainer, Frank Schumacher, Ernst Vitek

Editors: Martin Götzl (Federal Environment Agency - Austria), Andreas Geisler (Federal Ministry for Education, Science and Cultural Affairs), Michael Kiehn (Institute of Botany of the University of Vienna), Ernst Vitek (Natural History Museum of Vienna)

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1 THEMATIC BACKGROUND

1.1 Introduction

This study, which takes a look at collections and databases on biodiversity in Austria, represents a **milestone** in several ways: On the one hand, this is the first time a nationwide survey of relevant collections and database was conducted allowing for an adequate overview, while, on the other hand, an interdisciplinary approach was chosen for the planning and implementation of the survey, the interpretation of results and the assessment of where future action is necessary.

This interdisciplinary approach was possible thanks to the collaboration of a scientific project team initiated as advisory body by the Austrian National Commission on Biodiversity. The various experts concerned belong to the Commission for Interdisciplinary Ecological Studies of the Austrian Academy of Sciences, the Working Group of the Austrian Botanic Gardens, the Federal Office of Agrobiology, the Institute of Applied Microbiology of the University for Agricultural Sciences, the Institute of Botany of the University of Vienna, the Natural History Museum of Vienna, the Biology Centre of the Museum of Upper Austria, and the Herberstein Zoo.

1.2 Global Biodiversity Information Facility (GBIF)

The present study was initiated by the accession of Austria to the "Global Biodiversity Information Facility" which had been scheduled at the beginning of the study and was actually effected in October 2002.

The international data network "Global Biodiversity Information Facility" was officially initiated in March 2001 and aims to enable the worldwide exchange of biodiversity-related data via the Internet. The primary goal is to set up a network of scientific biodiversity databases. This network shall enable users to access the great variety of biodiversity-related information existing worldwide (at species level) and to use the data for individual purposes. GBIF may become an invaluable tool that is of economic, environmental, and social benefits also at national level.

The technical contributions to this network are made available by the individual members of the organisation backing GBIF and consist in providing biodiversity-related data and installing one or more Internet nodes to allow access to this data. In principle, every nation or institution can become a member of GBIF. GBIF currently has more than 40 members.

The purpose of establishing GBIF is, on the one hand, to coordinate and promote the compilation of scientific biodiversity-related data, and, on the other, to warrant their standardisation, digitisation, and global dissemination while guaranteeing a framework regulation for property rights and their protection. GBIF will closely cooperate with the UN Convention on Biological Diversity and other established programmes and organisations committed to the collection, maintenance, and use of biological information sources. Unlike the "Clearing House Mechanism" of the Convention on Biological Diversity, which is a meta-information system on biodiversity-related data, GBIF is an information system initiated by the OECD with concrete species-related content. Further information on GBIF can be found directly on the official GBIF homepage (**www.gbif.org**).

In Austria, the activities related to GBIF are also considered to be measures aiming at implementing the Global Taxonomic Initiative (GTI, **http://www.comsci.org/Bdgr/f_doc02.htm**) of the Convention on Biological Diversity (CBD, **http://www.biodiv.org**). This is because taking stock of the available data on the biodiversity documented in collections is an essential prerequisite for possible future projects in the GTI context.

1.3 Scope and implementation of the survey

The present study was commissioned by the Federal Ministry for Education, Science and Culture in June 2001 to prepare Austria's contribution to GBIF. The survey of Austrian collections and databases will serve as the basis for deciding what data can be provided to GBIF in the short, medium and long term. In preliminary talks on 21 February and 21 March 2001, the Project Advisory Council and representatives of the Austrian National Commission on Biodiversity stated that the present study is of great economic and scientific value for Austria and that it would play a significant role for different fields of research, research policy, the administration, as well as education, spatial planning, and last but not least for nature conservation.

The responsibility for the project was assigned to the Federal Environmental Agency, which was also in charge of planning the project, submitting the reports and creating an appropriate homepage (**www.biodiv.at/gbif**). The following seven working groups were responsible for data collection itself (within a total of approx. 400 man-days) and for interpretation of the data between August and November 2001.

Thematic areas	Institutions	Persons
Zoological specimen collections	Natural History Museum of Vienna	Vitek E., Paumkirchner P., Lödl M.
Botanical specimen collection	Commission for Interdisciplinary Ecological Studies of the Austrian Academy of Sciences and Institute of Botany of the University of Vienna	Ehrendorfer F., Rainer H.
Live animal collections in zoos	Herberstein Zoo	Kaufmann A.
Botanical living collections	Working Group of the Austrian Botanic Gardens and Institute of Botany at the University of Vienna	Kiehn M., Schumacher F., Abdel-Qader O.
Agricultural living collections	Federal Office of Agrobiology	Kainz W.
Microbiological living collections	Institute of Applied Microbiology of the University of Agricultural Sciences	Kraus G.
Databases	Museum of Upper Austria – Biology Centre	Malicky M.

The survey was conducted both in the public as well as the private sector and was based on a questionnaire drawn up by the Scientific Advisory Council. The interviews in the public sector were conducted in all relevant institutions owned by the federal state, federal provinces, or municipalities, such as museums, universities, botanic gardens, zoos, public offices, educational institutes, etc. In the private sector, the survey was carried out in Church institutions (convents, monasteries), associations (e.g. zoos, collector associations, etc.), and by interviewing private persons owning relevant collections or databases.

Collections and databases in the medical and pharmaceutical field were only considered in part, i.e. in the field of microbiology. From the beginning, the study was not intended to go into more detail in this particular area.

In principle, the institutions and persons managing or owning the collections and databases in either the public or private sectors were very interested in the survey, and this was reflected in the willingness to provide sound information. This factor together with the chosen surveying method, i.e. individual support by the respective working group members for every single questionnaire, ensured that all major collections and databases in all thematic areas deemed essential by the Scientific Advisory Council were included in the survey.

In view of the great variety of animal holdings in Austria (more than 70), the survey had to be restricted to the 20 most important zoological gardens and other animal holdings, respectively. However, the surveyed collections nevertheless reflect the entire taxonomic spectrum of

the animal species kept in Austrian zoos, as the responding animal holdings represent the most extensive and significant live animal collections. In terms of the privately owned botanical living collections, the survey is certainly not yet complete, especially as some keepers of collections with protected species are reluctant to disclose their data. This is mainly due to the uncertainty in view of legal provisions. However, the survey already includes collections of all relevant plant groups.

Concerning biodiversity databases, the survey includes all known large zoological and botanical databases with more than 100,000 data records in the public sector. In the private sector, comprehensive databases may still be included, since the willingness to provide information was rather low. In view of the smaller number of collection objects, the databases on living collections are smaller by a factor of about 100 compared to the databases on specimen collections. Since most of the large institutions provided extensive information on their databases, the discovery of further significant databases is hardly to be expected.

Basically, one can assume that for the public sector the existing collections and databases on biodiversity are representative. With the exception of specialised collections, this also holds true for the private sector. Therefore, this report is the first-ever comprehensive nationwide overview of Austrian collections and databases on biodiversity.

1.4 A detailed look at the study objectives

Questions to be answered relating to the content of collections and databases:

- What kind of species-related data are available in the form of collections and databases? (see questionnaire in Annex)
- Which quantity and scientific quality do the data have?
- To what extent are these data accessible (access restrictions)?
- What is the physical state of the relevant specimen collections?
- Which data have been digitised (what percentage)?
- How are the collections and databases updated?
- To what extent do these collections and databases cover the species spectrum in Austria?
- Which ranking of collections and databases according to significance and importance results from this study?
- Which taxonomic and geographical gaps can be identified based on these collections or databases?
- Clarification of relevant aspects concerning data protection.

Regarding the technical aspects of databases:

- Which operating systems are in use?
- Which database systems are in use?
- Which database environment is installed on the computers of database managers?
- Which software is in use?
- In which form is the technical maintenance of databases provided?

Drawing up proposals for future action based on the results of the survey:

Relating to the technical content of the collections and databases:
Which data can be provided for GBIF immediately, in the medium term, or only in the long term?

- What action is needed in terms of:
  - the preservation of the specimen collections?
  - the keeping and improvement of documentation?
  - the digitisation (data entry and imaging) of the existing specimen collection (incl. type collections)?
- Which taxonomic initiatives in Austria are necessary to warrant international competitiveness?

Regarding the technical aspects of databases:

- Which action is necessary regarding the set up of electronic databases?
- Which technical requirements must be met in any case to qualify new databases for the integration into GBIF?
- How can electronically stored data be networked?
- Which possibilities of superordinate networking seem appropriate?

These questions were presented in the form of a detailed questionnaire (see questionnaire in annex).

2 SUMMARY OF THE RESULTS

2.1 Current status

2.1.1 Collections

Altogether, a total of **498** collections were surveyed across Austria, **342** of which are **public** collections, while **156** are **private**. These collections comprise more than **46.5 million objects**.

In the **public** sector, the survey identified **152 conservation collections**, **129 reference collections and 61 exhibition collections**.

In the **private** sector, **22 conservation collections**, **53 reference collections and 81 exhibition collections** were identified.

The **majority** of these collections are used for **research**, the **conservation** of animal and plant species, and **teaching**.

The majority of zoological collections in the **public** sector concerns insects, followed by mammals and molluscs, reptiles, amphibians, and fish. Most botanical collections have been set up for flowering plants and ferns, followed by mosses, lichens, algae, and fungi. The collections of micro-organisms comprise, to the same extent, micro-fungi and bacteria.

In the **private** sector, the zoological collections also primarily involve insect collections, followed by birds, mammals, molluscs, reptiles, amphibians, and fish. Collections of flowering plants and fern predominate, followed by moss, algae, and lichens.

Among the specimen collections, at least **320,000 type specimens** (specimens for the description of a single type) have been identified (the actual number of type specimens in the collections is much higher, as no specific information has been provided for several more extensive insect collections). The largest number of zoological type specimens has been found with respect to **insects**, followed by **molluscs**, **arachnids**, **protozoa**, **birds**, and **mammals**.

186 collections (**37%!**) are of **historical significance**. The oldest specimens were collected between 1500 and 1850.

In terms of geography, the **majority** of zoological specimens and living collections relates to the **entire world**; there are only **few** collections that **exclusively** refer to Europe or **Austria**. **Several** zoological collections are exclusively limited to selected Austrian **federal provinces**.

The situation of **botanical specimen collections** is completely **different**: In this case, collections **specific to individual federal provinces** predominate, followed by collections focussing on Austria and Europe as well as collections with a world-wide focus. The majority of **botanical living collections**, however, is focused on gathering objects **from around the world**, followed by a focus on Europe, Austria and its federal provinces. The **microbiological** collections centre on gathering objects **from all over the world**.

90% percent of zoological and 97% of botanical specimen collections are managed by a curator, and 74% of zoological and 97% of botanical specimen collections are **regularly disinfested**.

Botanical and microbiological living collections are only 40% and 10% more intensively managed, respectively, than by **regular maintenance measures**. **Only** 6% of botanical, 30% of agricultural, and 17% of microbiological living collections are considered **optimally maintained**.

A **germination test** or **rejuvenation** is carried out for almost all agricultural living collections, but only for 23% and 8%, respectively, of microbiological and botanical living collections.

The preservation of **genetic purity** is 100% ensured for agricultural and microbiological living collections. In the case of botanical living collections, however, this level amounts to only 24%, taking into consideration that only approx. 50% of these actually require such safeguarding.

The **phytosanitary state** of agricultural living collections is considered good in 99% of all cases (1% not relevant). As for botanical living collections, this applies to 71%.

The **origin of the organisms** is known for 100% of all zoological, agricultural, and microbiological living collections (at least partly). With regard to botanical living collections, the origin of the organisms is known for 71% of all relevant collections.

Veterinary care is permanently available for all agricultural living collections. For 64% of live animal collections in zoos, this care is also available constantly. For 36%, it is available by request. **Expert animal care** is not available for 3 out of 83 live animal collections in zoos.

The majority of micro-organism strain collections (60%) is preserved by means of **conventional coolers**, while a third (33%) is preserved in liquid nitrogen.

The **documentation of the collections** is still **very heterogeneous**. Card catalogues, electronic data collections and databases are, for the most part, kept separate of each other. Simultaneous documentation by way of card catalogues, electronic data collections and

databases is provided for only one collection. 42% percent of zoological and 26% of botanical specimen collections are documented using databases, while this is true for 21% of live animal collections in zoos, 26% of botanical, 41% of agricultural, and 23% of microbiological living collections.

The identified collections are not static, but show an **enormous annual increase** by **at least 900,000 collection objects**. Most of the increase takes place in zoological specimen collections (about 700,000 objects per year), followed by botanical specimen collections (approx. 100,000 objects per year) as well as zoological (100,000), botanical (3,200), microbiological (2,200), and agricultural (259) living collections. The largest increase of collections is among protozoa and insects.

68 zoological and 11 botanical living collections offer **breeding loans.** In the case of 10 zoological and 37 botanical collections, this is possible to a limited extent. 39 zoological, 23 botanical, and 97 agricultural living collections provide the **transfer of objects**; in the case of 42 zoological and 71 botanical collections, this is possible to a limited extent.

It is possible to **borrow objects** from 39 zoological and 29 botanical specimen collections. In the case of 42 zoological and 30 botanical specimen collections, this is possible only to a limited extent.

The **scientific use of the collections** is considerable: each year, at least 15,000 zoological and 65,000 botanical specimens are borrowed for scientific purposes. Approx. 1,200 and 600 **scientific visits** are registered in the zoological and botanical specimen collections annually. For live animal collections in zoos alone, that number is about 1,900.

While access to **nearly all** zoological and botanical **specimen collections** as well as agricultural and microbiological living collections is **restricted**, 82 zoological and 44 botanical living **collections** are accessible **without any restrictions**. However, access to the majority of botanical living collections is limited.

Live animal collections in zoos are visited by **3.8 million people** a year, with about 1.8 million visiting public institutions and 2.0 million visiting private institutions. **1.2 million** people visit **botanical living collections**. In theory, more than 60% of all Austrians visit a zoo, game park, botanical garden, or greenhouse once a year. In fact, however, many of them are tourists, representing a significant economic factor.

2.1.2 Databases

In total, **113** databases have been identified throughout Austria. **85** of these are held in the **public** sector, and **28** in the **private** sector.

The number of different **data records** totals nearly **8 million**. The scope of the databases varies quite considerably: the three largest ones comprise more than 1 million data records each, 12 databases contain more than 100,000 data records, whereas the remaining databases are smaller.

About **75%** of all data records are found in the databases of the **public** sector.

Most of the databases are used for **research** and **nature conservation**. Other areas include **public relations**, the **conservation of genetic resources**, and various other purposes.

The largest number of **zoological records** by far relates to insects, followed by birds, molluscs, mammals, protozoa, arachnids, and amphibians. As for **botanical collections**, flowering plants and fern dominate, followed by lichens, fungi, mosses, and algae.

In this survey, it was easily possible to allocate 3,142,775 out of all data records to one of the nine federal provinces. Almost half of all data records refer to the province of **Upper Austria** (on account of the largest database in Austria to date being located there, ZOBODAT). 13% of the records refer to the biodiversity of Lower Austria. All other provinces account for less than 10% each of the data records.

A continuous updating and verification on scientific accuracy is done for 65% of the databases in the public sector and for 21% in the private sector.

A **scientific data description** is available for almost 100% of the records.

34% of the data records can already be retrieved via the **Internet**, however access requiring a password. Access is **not** granted to **41%** of the records, or only **in exceptional cases.** The reasons for this are that some of the databases are privately owned, that they include unfinished projects, data is not disclosed until published in the scientific community or that the databases are still under construction. Local access is possible to **25%** of the records. In this case, data can be read on-site or passed on using data carriers or paper printouts.

Of the **annual increase** in data records, the public sector accounts for 90% (more than 300,000 data records; of which, in turn, half of these are based on field observations) and the private sector for 10% (approx. 37,000 data records). However, a comparison with the number the collection objects added every year - at least 920,000 - shows that the **backlog** for collection

data not yet processed electronically is growing steadily, as long as no appropriate measures are taken to speed up data entry.

Technical aspects:

The most common **operating systems** are Windows 98, Windows 2000, and Windows NT. Most data records, however, are stored in databases that use Windows NT, Linux, or Windows 98.

MS Access is by far the most widely used **database system**, followed by Oracle and DBase. Most data records are stored using MS Access, followed by PostgreSQL, Oracle, and MS SQL servers.

Multi-user systems, which allow for error-free data input and evaluation by several users on the same data pool, are in use for about 20% of the databases (which corresponds to about 70% of the data records). Systems that guarantee a high level of **fail-safety** have been installed for only approx. 14% of the databases (corresponding to about 35% of the data records).

Software is developed by the respective institution or the private owner only for approx. 15% of the databases (corresponding, however, to about 58% of the records).

A **relational configuration** is found for about 75% of the databases (corresponding to approx. 97% of the data records).

About 76% of the databases (corresponding to about 97% of the data records) are integrated into **computer networks**, and for about 65% of the databases (i.e., about 75% of the records), a **leased Internet line** has been set up.

Dynamic websites with interactive database-query features are available for about 8% of the databases (corresponding to about 37% of the records) only. However, the operators of about 35% of the databases (corresponding to about 70% of the records) run their **own web servers**.

2.2 Need for action

Based on desired optimum conditions, the following need for action has been identified:

2.2.1 Collections

Need for action in terms of personnel for the **maintenance or management of collections** concerns 164 collections in the public sector (i.e., 48% of public collections) and 71 collections in the private sector (i.e., 46% of private collections).

In detail, such need for personnel-related action in the public sector was indicated for 90% of zoological and 48% of botanical specimen collections, and also for 88% of microbiological, 47% of botanical, 17.4% of agricultural, and 9% of live animal collections. Private collectors see the need for further personnel-related action for 74% of zoological, 60% of agricultural, 33% of microbiological and 31% of botanical living collections as well as for 31% of zoological specimen collections.

The need for action in financial terms for the **maintenance or management of collections** is required for 154 collections in the public sector (i.e., 45% of public collections) and 80 collections in the private sector (i.e., 51.3% of private collections).

In the public sector, 151 collections (i.e., 44.1% of public collections) require personnel-related action to warrant the **updating of the collections.** This also applies to 55 private collections (i.e., 35.2% of private collections). The need for further action in zoological (87%) and botanical (71%) specimen collections was considered to be particularly high. The need for financial action corresponds, for the most part, to the need for personnel-related action.

More personnel-related action is required with respect to the **documentation of collections**: This affects 176 collections (i.e., 51.5% of public collections) in the public sector and 52 collections in the private sector (i.e., 33.3 of private collections). The corresponding need for financial action concerns 162 collections (47%) in the public sector and 62 collections (40%) in the private sector.

With respect to **digitisation,** need for financial action was identified for 88 public (76%) and 10 private (19%) specimen collections, while 71 public (61%) and 5 private (10%) specimen collections were found to require additional personnel-related action.

For the **digitisation** of existing type collections need for action in terms of personnel affects 71 public specimen collections (i.e., 61% of public specimen collections) and 5 private specimen collections (i.e., 10% of private specimen collections).

Personnel-related and financial action with respect to **expert animal care** is required for 2 public collections (i.e., 9% of public collections) and 47 private collections (i.e., 91% of private collections).

Personnel-related action is also necessary to **improve the conditions under which animals are kept.** This affects 2 collections in the public sector (i.e., 9% of public collections) and 30 collections (i.e., 49% of private collections) in the private sector. Need for financial measures to improve animal keeping conditions affects 5 public collections (i.e., 23% of public collections) and 50 private collections (i.e., 82% of private collections).

2.2.2 Databases

Personnel-related and financial action with respect to **data processing services** by administrators and programmers is required for approx. 30% of the databases (i.e., about 50% of all data records).

The **digitisation** of the entire data material from the individual collections (excluding imaging) would require enormous personnel-related input. The complete entry of all currently available collection data would require a workload of no less than **950 (!) man-years**. But since the annual increase in collection objects exceeds the corresponding increase in data records, the required personnel-related input will grow even further in the future.

2.3 Austria's contribution to GBIF

In the short run, the quickest solution would be to supply GBIF with data that is already available in the form of a database, and, in principle, is accessible through the Internet. An additional requirement for institutions operating databases would be to have a suitable database-server system as well as a competent programmer who is able to take care of all the necessary computer-related "interface work" in the course of the standardisation process implemented by ENBI (European Network for Biodiversity Information; project under the 5th EU Framework Programme for Research and Technological Development). Assuming that database owners are interested in having their databases integrated into a global network and that the required electronic-data-processing experts have sufficient capacity, the expected timeframe for Austrian databases of the public sector to become available for GBIF can be assessed as follows:

Time needed to make databases available, in years	Parameter requirements have been met			Number of corresponding databases in the public sector
	Integration into WWW	Database-server system	Programmer(s)	
1	Yes	Yes	Yes	6
2	Yes		Yes	3
		Yes	Yes	
3	Yes	Yes		8
			Yes	
4	Yes			7
		Yes		
5 or > 5				61
Total				*85*

3 THE SITUATION OF COLLECTIONS AND DATABASES IN AUSTRIA

3.1 The situation of Austrian collections and databases at a glance

3.1.1 The value and benefits of the Austrian collections and databases at regional, national, and international level

The value and benefits of the taxonomic collections and databases can be illustrated at various levels. Although this is beyond dispute among experts and has been known for a long time, taxonomy currently receives less attention in research policy than other, considerably more popular, areas of research. For this reason the importance of the collections and databases will be clearly emphasised in this report in order to appreciate all current and planned Austrian projects aiming at recording biodiversity.

In this context, it must also be stressed that the surveying and recording of biodiversity and the unimpeded access to existing collections, inter alia due to Austria's accession to the Convention on Biological Diversity, represent a national duty.

The results of the survey impressively underpin the significance of the collections and databases in many respects and specifically demonstrate that:

- there is a multitude of collections and databases in Austria, the majority of which are very large and record high annual increases,
- the number of type specimens in domestic collections is particularly high in an international comparison,
- the collections and databases are of major historical significance and, in terms of content, have a very extensive systematic and geographical scope,
- the collections and databases are used in very different fields,
- the collections are used extensively by many scientists, but also by the general public, and that
- the collections represent an important resource for the borrowing and transferring of objects, but also for the conservation and reintroduction of endangered or locally extinct species.

In general terms, the collections and databases have the following established or potential **value** and **benefits**:

The value of the collections and databases for science and research:

- The collections are an enormous resource of highly scientific valuable information and specimens on biological diversity and genetic material. In particular, the high number of type specimens must be emphasised (globally, Austria is the country with the highest number of botanical type specimens; cf. Holmgren et al., 1990[1]).

- The collections not only facilitate the documentation of the Austrian flora and fauna, but also of the former crown lands and beyond this to some extent on a global basis, from the late 18th century up to today. In this way, existing taxonomic and geographic gaps can be identified and closed in the longer-term.

- The systematic-taxonomic exploration and recording of the fauna and flora is an important basis for numerous other scientific research disciplines (e.g. systematics, ecology, ethology, pharmacy. etc.). However, the value added results not until practically applied, i.e. in the developing disciplines. Landscape planning, the drafting of environmental opinions, and the planning of conservation activities are examples for this. These disciplines would not be possible without the taxonomic classification of animals and plants, which also play a fundamental role in pharmaceutical research when developing new medicines. Furthermore, taxonomic knowledge also is, for instance, a prerequisite for the suitable medicinal treatment of mushroom poisoning or contagious and parasitic diseases.

- As a basic biological discipline, taxonomy importantly contributes to all biodiversity research strategies of the EU Framework Programmes for Research.

- Austria's botanical research, along with the United Kingdom and the United States of America, takes the position of a world leader.

- In Austria there are important living collections of animals and plants, which are used nationally and internationally in a variety of ways in research and teaching.

- The collections in Austrian institutions are internationally acknowledged and represent one of the pillars of the scientific reputation of our country.

[1] Holmgren, P.K., Holmgren, N.H. and Barnett, L.C. (eds.) (1990). Index Herbariorum, 8th ed. Regnum vegetabile vol. 120. New York Botanical Garden, Bronx.

- The existing data material allows for an active exchange of collection objects and information about these objects between national and international institutions.

- Biodiversity related scientific research activities and also the production of geographic distribution maps will be greatly accelerated by using digital card catalogues that are organised in the form of databases.

- The fast query features of digitally recorded information helps scientists carry out research projects and therefore contributes to increased efficiency. In addition, work for non-scientific tasks, e.g. in the administrative field of the federal state (preparation of environmental expert opinions, landscape planning, etc.), is simplified, also saving time and money.

- Eased data access, facilitated by digitisation, avoids parallel work and increasingly allows research projects to build on each other.

The value of the collections and databases for the conservation of plants and animals as well as for the protection of species and nature:

- Basically, all collections contribute to the acceleration and support of activities for the protection of species and nature (e.g. the efficient implementation and monitoring of "Natura 2000" areas).

- The digitised collections facilitate the immediate provision of lists of endangered species in areas worthy of protection (e.g. for the administration).

- The digitised collection data also offer considerable advantages by allowing automated creation and updating of distribution maps, which are, e.g., particularly important for observing the spread of non-native species in terms of geography and time.

- The living collections are very important for the "ex-situ" conservation of numerous animal and plant species outside their natural habitat, whether wild or captive bred. They represent a possibility of conservation and a reintroduction pool for species whose survival in the "wild" is at risk or that are threatened by extinction.

- Research under "ex-situ" conditions is also necessary in order to understand and prepare management methods for "in-situ" conservation, which may facilitate the survival and stabilisation of endangered populations and ecological relationships.

The value of the collections and databases for business and economic development:

- The agricultural and microbiological living collections provide valuable contributions for a sustainable and positive development of the Austrian economy (e.g. as a genetic pool for the sustainable development of agriculture, especially for biodiversity within agriculture, as well as for plant cultivation and subsequently for the seed industry).

- Agricultural collections mediate knowledge about the quality characteristics of the traditional country varieties and the "expertise" required for the processing of agricultural products.

- Microbiological and botanical collections are of highest importance for the pharmaceutical industry. Likewise, the use of secondary metabolic products from micro-organisms (e.g. antibiotics) or metabolites from primary metabolism (e.g. citric acid) is of high significance. In addition, micro-organisms are used for fermentation and catabolic processes, and they are particularly important for processing milk.

- Generally, highly accurate knowledge of national biological resources is necessary to be able to warrant Austria's competitiveness in the biotechnology sector.

- The information retrievable from Austrian collections and databases provides the basis for quick decisions of policy and administration.

The value of the collections and databases for the general public:

- The collections generally represent a significant cultural heritage.

- Agricultural and microbiological collections are highly important for the sustainable provision of food for the Austrian population.

- Living collections such as zoos and botanic gardens constitute an important educational function by ensuring vivid mediation of knowledge. Various programmes that aim to clarify the patterns of life, the behaviour and needs of animals and plants or to teach about species-appropriate handling of animals are of high educational value.

- Emphasising the degree of risk of extinction that threatened animal and plant species are confronted with, is important for sensitising the population to the progressive loss of biodiversity.

- Distribution maps ensure the quick information of the general public about particularly bothersome or medically significant species and facilitate the prompt and correspondingly efficient application of measures for the protection of the human population (e.g. the occurrence of hornets, ticks, gnats, or the appearance of pollen from specific plant species with relevance for allergy sufferers, etc.).

- The digitised recording and presentation of biodiversity relevant data (e.g. via the Internet) is an important contribution to improving the "Public Understanding of Science".

- The collections, both materially and morally, enable the general public to participate in conservation projects.

- The collections represent a significant supply of constructive and relaxing recreational activities.

3.1.2 The problematic situation of collections and databases in Austria

The problematic situation of collections and databases in terms of conservation and maintenance:

- Generally, financial investment in taxonomic research is far too small. This is because even in Austria taxonomic research is considered to be of little value, in contrast to the research disciplines developing from it and thus deriving added value from taxonomic activity.

- The majority of all collections show an urgent need for financial and personnel-related action. The situation of manpower is quite unsatisfactory for the majority of the collections.

- The maintenance of the collections by curators is often provided merely on paper and does not ensure continuous scientific work on the collections due to the acute lack of time. In the universities, this is caused, for example, by the double burden of administrative activities and teaching.

- The acute shortage of personnel jeopardises the access for other countries to the documents of biodiversity kept in Austrian collections. However, allowing access is undoubtedly a requirement of the Convention on Biological Diversity.

- Based on an international study (Parnell, 2001[2]), which deals with the desirable ratio between the number of collection objects and curators, only in the Austrian herbariums more than 100 additional curators should be employed.

- The lack of scientific work with the available collection material, but also the lack of replacement staff for outgoing curators, inevitably result in a loss of taxonomic knowledge.

- The ongoing preservation of collections is deemed to be at risk in several cases; in fact for a high percentage, the conditions are considered sufficient, but often the meaning is "only just sufficient".

- The conservation and adequate maintenance of collections is generally considered to be insufficient for micro-organisms. Even for those collections where storage conditions are considered adequate, so-called "back up" systems that enable the storage of duplicates are only provided for in exceptional cases. A breakdown of the applied conservation system would result in an irretrievable loss of collection objects. The establishment of a national centre for the storage of micro-organisms under optimum conditions would therefore be of help.

- The lack of legal protection for Austria's public gene banks is jeopardising the ongoing maintenance of a partly irretrievable gene pool of native wild and cultivated species and strains and breeds, respectively.

- For agricultural collections, need for action is required with regard to the reliability of genetic purity during rejuvenation of seed collections. Remedy could be provided by implementing quality control through traceable offspring.

- Several of the larger institutions keeping extensive collections suffer from an acute shortage of space for the storage of specimen and living collections (e.g. accommodation for hibernation or quarantine).

- For the modernisation of animal keeping facilities and greenhouses financial means are lacking.

- Conditions for keeping live animal collections in zoos partly need improvement.

2 Parnell, J. (2001). The monetary value of herbarium collections. In: Biological Collections and Biodiverty eds. B.S. Rushton, P. Hackney and C.R. Tyrie).

- In several cases, the lack of capacity for the conservation and maintenance of collections precludes fulfilment of the obligations of international agreements (Convention on Biodiversity, EU Zoo Directive).

The problematic situation of collections and databases with regard to the updating, documentation, and digitisation of the collections:

- For most of the specimen collections, satisfactory taxonomic updating and documentation is not practicable due to shortage of personnel. New material added to the collections often remains unprocessed for years and may not be integrated. However, taxonomic updating should be a matter-of-course for internationally acknowledged collections.

- For live animal collections (zoos) need for financial action is primarily required for updating the animal stocks.

- The updating of the micro-organism strain collections is overdue for practically all collections.

- In the case of botanical living collections, personnel shortcomings in documenting the collections are noticeable first. Adequate documentation, however, is of great importance and absolutely necessary for scientific and conservation-related issues.

- The data recording of the Austrian collections represents an enormous problem and reveals major shortcomings in many places. Thus, several zoological specimen collections are neither documented by a card catalogue, nor an electronic data collection nor a database. New additions are often not recorded and the names of the discovery locations as well as taxonomy is not up-to-date.

- Basically, the digital recording of collection data is only satisfactory in the agricultural sector (almost 100%). In all other fields, an enormous need to catch up has to be articulated, as even in the most extensive areas of collection (zoological specimen collections and botanical specimen and living collections) only between 10 and 15% of the data material has been recorded in databases. This unsatisfactory condition becomes obvious in view of the estimated number of man-years required for the complete digital recording of the data: at least 950 (!) man-years of work would be required.

- Even if the number of databases in some fields appears high, most databases are only under construction and, therefore, currently contain a comparatively small number of data records. In addition, the majority of databases are only available locally. Therefore, techni-

cal changes and external assistance will be necessary to make this information available via the Internet.

- Personnel problems in most public collections prevent the digital recording of objects. However, access to the information of several public collections via the Internet should be possible in order to reduce search times on the one hand and to save human resources on the other, as much of the work connected with the borrowing of objects would then be unnecessary.

- With regard to the maintenance of databases by qualified experts (or at least by technically experienced biologists with corresponding professional experience), approx. 50% of the relevant institutions face a shortage of administrators and 70% a shortage of programmers.

- Most databases are not created by professional computer specialists, but by persons who are responsible for the maintenance of the collections.

- The heterogeneity of the databases is regarded as another problem, as the use of various operating and database systems in fact hampers or prevents direct networking. Accordingly, there is an exceptional need for action to obtain the most compatible data structure possible.

- There is also a need for action in regard to the production of digital pictures and the geographic positioning of discovery locations. Such information could be used by numerous institutions in a variety of ways if made publicly available via an Internet connection (e.g. in nature conservation or for spatial planning, etc.).

Taxonomic and geographical gaps of the collections:

- There are gaps in the zoological specimen collections primarily with regard to protozoa, certain insect orders and invertebrates (with the exception of molluscs and insects). Naturally, there are major gaps in all phyla and classes of the animal kingdom in the live animal collections in zoos due to the incredible diversity of the global animal world. In contrast to the specimen collections, however, the closure of these gaps is not the primary aim of the zoos.

- Taxonomic gaps in the botanical specimen and living collections particularly have been identified with regard to plant groups originating from the tropics and the southern hemisphere. Frequently, in this case, only selective stocks are available. Concerning agricultural collections, taxonomic gaps in the wild varieties of cultivated plants should be closed.

- Compared to natural occurrences, the number of micro-organisms of Austrian collections is estimated to be very small.

- Geographic gaps of zoological specimen collections relating to the federal territory of Austria could only be found with regard to local collections. Thus the fauna of the province of Burgenland is only recorded by local insect collections. The city of Vienna and the province of Lower Austria, in turn, do not have separate vertebrate collections. With regard to live animal collections in zoos, there is neither the possibility nor the attempt to cover the entire species spectrum of all orders of the animal kingdom of Austria (as far as they are already known at all).

- Geographic gaps of botanical specimen collections refer to the higher alpine regions.

- The number of botanical living collections focusing on Austria is rather small. There is by far no complete coverage of the native flora, particularly of special locations. Nevertheless, the complete, ex-situ conservation of endangered plant species in particular is a declared goal of the operators of botanical living collections in Austria.

- In the agricultural sector, a wide-ranging collection and recording activity for wild plants is still necessary.

- Unfortunately, an inventory of Austrian micro-organisms is almost missing. It would be desirable to run projects that use bio-resources (e.g. national parks) and - perhaps limited to specific biotopes - initiate the recording of the diversity of Austrian micro-organisms.

Necessary taxonomic initiatives:

- The improvement of the personnel situation with regard to curators is an absolute prerequisite for Austria's ability to be competitive in zoological and botanical taxonomy. Only in this way will a comprehensive scientific examination of the individual collections be feasible.

- In addition, with regard to botanical specimen collections, the participation of Austrian working groups in international flora projects and the monographic handling of plant groups should be promoted even more. Furthermore, in the field of botanical living collections, improving personnel and financial resources could optimise the scientific "output" and thus the number of publications.

- In the agricultural field, the recording of all plant genetic resources across Austria is an important initiative, which has already been commenced.

- Because of the major gaps in the field of micro-organisms the primary task is to ensure the preservation of existing collections. Furthermore, research projects to identify micro-organisms, thereby using classic and modern molecular methods, would be necessary.

3.1.3 The most important next steps to be taken

- Long-term financial guarantee for a national structure to ensure the mutual exchange of information regarding GBIF activities and the co-ordination of Austrian expert contributions.
- Creation of an operational GBIF National Focal Point for Austria.
- Ongoing maintenance of the homepage **www.biodiv.at/gbif** as a national information hub including the updating of textual information and of the meta-database on the Austrian collections and databases.
- Continuous "updating" of information on collections by the individual working groups or the institutions backing them.
- Financial guarantee for the individual working groups to be able to update information of the meta-database, which is particularly important for the use of this database by the general public and experts.
- Compilation of not yet considered GBIF-relevant databases (e.g. Austrian based documentation of flora and fauna of foreign areas, like, e.g., the Austrian rain forest in Costa Rica, or the mapping of the Central European Flora).
- Processing of the surveyed databases to enable their networking via the Internet, as Austria's contribution to GBIF.
- Establishing technical standards for the creation of new databases as a prerequisite for their networking.
- Implementation of a pilot project for linking selected databases to the GBIF network.
- Development of a funding concept for data entry in order to accelerate the transfer of information from card catalogues into databases (particularly the information on all type specimens), thereby integrating the relevant federal ministries and provinces.
- Acceleration of taxonomic initiatives: e.g., completion of specialised literature on Austria's flora and fauna.
- Setting up a course for the training of curators.
- Revival of taxonomic courses at university level.
- Creation of a number of positions for curators in the zoological and botanical specimen collections that is appropriate to the size and importance of the collections.

3.2 The Situation of Austrian collections and databases in detail

3.2.1 Collections

3.2.1.1 The value and benefits of the Austrian collections and databases at regional, national, and international level

Zoological and botanical specimen collections:

The public collections and also many private collections represent a major Austrian cultural heritage. They are not just an important source for biodiversity-related information and for the documentation of the flora and fauna of the most diverse regions of the world (both from the modern age and from the past). They are also of historic value.

Austria's public collections represent an enormous resource of collection material of the highest scientific value, which is of major importance nationally and internationally not just because of the scope of the collections, but also due to the significant type material (on a global scale Austria is the country with the highest number of botanical type specimens; Holmgren et al., 1990[3]). However, the quality of maintenance does not correspond with the high quality of the collections. The number of competent curators is by far inadequate for the majority of the collections (cf. Section 3.2.1.6.2 on "Conservation and maintenance of the collections").

Live animal collections in zoos:

The live animal collections in Austrian zoos contain numerous species of wild animals, which are at risk of extinction in their natural habitat or which already have become extinct. The situation is similar for old and threatened breeds of domestic animal. The collections represent a pool for endangered species breeding programmes and for reintroduction projects and are the basis for scientific research work, particularly ethological research, that is not always feasible in the field. In this area, at least the scientifically managed institutions work both at the national and international level.
From a cultural viewpoint, zoos have always illustrated the handling of animals by human beings. In this regard, much has changed in recent decades. The zoo has developed from a place where the "captured" animals were put on show into an "Ark".

[3] Holmgren, P.K., Holmgren, N.H. and Barnett, L.C. (eds.) (1990). Index Herbariorum, 8th ed. Regnum vegetabile vol. 120. New York Botanical Garden, Bronx.

Today, modern zoos attempt to present animals in their habitats and therefore frequently keep animals together in the same habitat. Consequently, zoo animals act as ambassadors for their species in the wild. Adequate educational programmes inform about the ways of life, the needs, and the behaviour of animals and draw attention to the threat and danger from human behaviour. Countless kindergartens, school classes and families are visiting zoos annually, and by help of various programmes learn how to deal with animals, obtain first-hand knowledge and information from knowledgeable experts and are also offered a chance to participating directly and indirectly in the preservation of the animal world.

Botanical living collections:

The Austrian botanical living collections are acknowledged nationally and internationally to have great scientific importance. Especially collections with public sponsorship conduct an active exchange with other collections throughout the world. In particular, smaller teaching and exhibition collections in the private sector are of major regional significance and of high educational value.

Valuable educational work is carried out for the protection of biotopes and species by public and private collections. Conservation and protection collections are particularly important at the national and regional levels. In this context, the "Arche Noah" Association should be mentioned as an example, which makes an important contribution to the preservation of the biodiversity of cultivated plants in Austria. Numerous Austrian collections also play a vital international role as protection, conservation, and research collections. These include, e.g., the Erica-collection at the Schönbrunn Botanic Garden, the cactus-collection in the Botanical Garden in Linz, or the bromeliad-collection in the Botanical Garden of the University of Vienna.

Agricultural living collections:

In view of the importance of the "International Treaty for Genetic Resources for Food and Agriculture", reference must be made to the significance of domestic collections and their value for a sustainable, positive development of the Austrian economy and Austrian agriculture in particular.
Generally, all collections form a valuable part of the country's cultural heritage and, in view of their public accessibility, constitute an important infrastructure for the dissemination of knowledge. Over and above this, the knowledge associated with the collections, such as the "expertise" for making fruit must, is of great significance. As agricultural living collections are mainly tailored towards a regional focus, they act as knowledge disseminators for the quality traits of traditional country varieties adapted to microclimates. Without these collections, these genetic pools are at risk of being lost. In addition, these collections also contribute to the

distribution and conservation of genetic diversity through the option of transferring collection material. In the past, these collections also represented an invaluable base for scientific research and will do so increasingly in the future in view of the international contractual agreements under the "International Treaty for Plant Genetic Resources for Food and Agriculture".

Microbiological living collections:

Apart from the use for basic scientific research, micro-organisms are mainly utilised in applied sectors. Amongst others, these include the production of secondary metabolic products (e.g. antibiotics) or of metabolites from primary metabolism (e.g. citric acid). Furthermore, the use of micro-organisms for fermentation and the use of microbial catabolic processes is to be mentioned. In these sectors there are a number of current and planned research projects, making intensive use of the existing collections.

The most important field of application for prokaryotes is the processing of milk and milk products. Austria's position with respect to the industrial use of micro-organism strain collections has suffered from the fact that numerous pharmaceutical companies merged into international company groups. These often concentrate research, for which micro-organism strain collections are established and used, in one location, but seldom in Austria. Long-term preservation of microbiological living collections could be ensured by establishing a national centre for prokaryotes and micro-fungi.

3.2.1.2 Relevance of private collections and associated problems

Zoological specimen collections:

Private collections frequently exhibit a relatively high degree of coverage of species that are to be found in the local fauna. In many cases, the representation of individual groups of animals is even better in local private collections than in public ones. Therefore, the latter often cannot adequately comply with the documenting requirements without the support of the private collections.

The scope of the individual collections ranges from several ten thousand collection objects up to several hundred thousand. Some private collections also comprise a significant amount of type material, reaching a considerable coverage, such as for the orders of Coleoptera (beetles) and Lepidoptera (butterflies).

All together, the private collections represent a supplement to the public collections that should not be underestimated, which is why unresolved ownership often raises a major problem in case of the death of the collector. In certain cases, this results in the destruction of the collection and not – as would be desirable in the context of the conservation of this heritage – in its integration into collections of the public sector.

Here are a few examples of extensive collections held by private institutions:

- The Kremsmünster Observatory owns historically significant scientific collections, which, however, cannot be adequately processed or updated due to time and capacity problems and shortage of available personnel. Therefore, there is so far no possibility of assessing the real value of these collections.
- The collections in the "House of Nature" in Salzburg include a multitude of observation data, which is of vital significance for the understanding of the local fauna.
- The collections at the Museum of Tyrol, the "Ferdinandeum", exhibit a high degree of coverage of native species.

Botanical specimen collections:

Due to the dedicated and precise work, the quality of private collections is generally very high. The majority of private individuals is interested in the complete documentation and has therefore frequently established databases to obtain an overview of their collections. In some cases private collections are already situated in public institutions, but are kept separate from the main collections.

It is estimated, that a further 500,000-750,000 specimens in the hands of private collectors have not yet been covered by the present study. Sooner or later, these collections will certainly fall into the hands of public institutions through purchase, donation, etc., which then may be regarded as an important supplement to the public collections.

In daily scientific work, integration of private collections is taking place in various projects conducted by public institutions (The Flora of Austria, The mapping of the Central European Flora). The botanical collecting activity of private individuals also has resulted in the so far only compilation of all plant species occurring in Austria today (Exkursionsflora für Österreich - Adler, Fischer und Oswald, 1994[4]). A further example is a local plant guide for the province of Burgenland, which was produced with the aid of local collectors (Fally und Fischer, 2000[5]).

[4] Adler, W., Oswald, K. und Fischer, R. (1994). Exkursionsflora von Österreich. Fischer M.A. (Hrsg.), Stuttgart; Wien: 1994.

Live animal collections in zoos:

By far the majority of live animal collections in zoos (61 collections) are in private hands. This includes many species of wild animals that are not represented in public collections.

For many, a zoo continues to be the only place, where animals can be experienced, observed, heard, and smelt or where a "relationship" with animals can be established. While providing this opportunity, a lot of private institutions are performing tasks in the public interest.

Four out of five scientifically managed Austrian institutions, equalling 30 collections in total, are privately owned. Besides exemplary animal keeping, they are playing an immensely important role in public relations, in education and information as well as in the preservation of species and nature. Animal caretakers are offered opportunities for apprenticeship and also prospective zoologists and veterinary surgeons obtain part of their education as well as the opportunity to write their theses in these institutions, many in the course of research projects.

Partly, considerable financial means are invested into research, training, education (maintenance of zoological schools), and into international breeding and reintroduction projects. Only three of these private scientific institutions (all associations) obtain (inadequately to some extent) regular support from public funds for further (scientific) personnel, modernisation and expansion of animal keeping facilities. However, the referring potential is by far not utilised. Similarly, several of the non-scientific establishments (not yet) offer unutilised potentials in terms of opportunities for research, training, and education.

The acceptance of confiscated animals, as well as the use of the required technical competence, takes a lot of time and effort, in many cases without appropriate compensation from public funds, even though the institutions are often faced with further personnel and financial problems by accommodating and caring for the animals.

The study reveals, that there are undoubtedly also private establishments, which do not meet the demands of modern animal keeping nor do fulfil the duties of a zoo and which also show no tendency of ever doing so. Maybe, the implementation of the EU Zoo Directive will be a positive intervention in this regard. For the first time, this directive defines the term 'zoo' and will require a licence for the operation, which may only be granted under certain conditions.

For years, the Austrian Zoo Organisation (OZO) has been doing educational work for zoo operators as defined by the EU Zoo Directive and provides valuable support through consultation and training of specialist staff. In addition, jointly with the Austrian Federal Chamber of Vet-

[5] Fally, J. und Fischer, M.A. (2000). Pflanzenführer Burgenlands. Eigenverlag Mag. Dr, Josef Fally, Deutschkreuz, Bgld.

erinary Surgeons, OZO has submitted a proposal to the competent agencies for the implementation of the EU Zoo Directive, which had to be implemented by 9 April 2002. Up to now, there is certainly still no overview of all wild animal holdings in Austria that are subject to the Zoo Directive, and particularly not regarding compliance or non-compliance with the criteria required as a prerequisite for the stipulated licence.

Botanical living collections:

In the private sector a total of 32 botanical living collections were surveyed, allowing for a first-time overview of the significance and benefit of Austrian plant collections in private hands.

The high and somewhat unknown scientific value of the collections came as a surprise. A close examination of all data proved that the collecting activity represented far more than a leisure-time pursuit for the owners of the collections. Several collections have been in existence for over 50 years and are still being extended. The owners prove to be true experts with regard to the systematic content of the collection and have high botanical expertise. Many collectors are also members of corresponding associations. In addition, there are frequent contacts with foreign collectors. Due to the intensive financial commitment of the collection owners, the quality of individual collections is very high. For example, costs for extensions to the collection, for cultivable land (up to several hectares), for greenhouses (up to 100 square meters) etc. are borne by the collection owners. Private collections also represent a significant contribution to public relations. Especially in rural areas, private exhibition collections are frequented by many visitors and thus directly contribute environmental educational benefits.

There are private collections for the most diverse plant groups and geographical plant regions. The content of the private collections tremendously enriches the biological diversity of Austrian botanical living collections and provides substantial support for the functions and activities of botanic gardens. The Austrian flora is increasingly taken into consideration, particularly through strictly regionally active collectors and associations. As a result, the appropriate genetic resources are protected. But also many native wild plants from the so-called "Red Lists" of endangered Austrian plants are cared about. In general, public institutions, without the potential of private collections, would only be able to cultivate or safeguard the large number of species either inadequately or not at all. It is therefore extremely important to continue the Austrian activities in the field of conservation and sustainable use of biological diversity by integrating the private collections. Already in the course of this survey, scientifically valuable contacts with private collectors were established. Intensifying contacts between the private and the public sector is mainly desired by both sides and also encourages appropriate measures for research and nature conservation. Most private collections are accessible upon prior appointment.

The main motivation of the private collectors for participating in the survey was the wish to present their collections to a wider public. There was, therefore, a willingness to answer the questions.

Beyond the number of surveyed botanical living collections, a substantially greater number of scientifically important private collections is expected for Austria. However, the available time for this investigation was not sufficient to locate all of them. It is assumed that other important collections, particularly in western Austria, were not taken into account. Therefore, it is desirable to complete or extend the pool of private collections.

The reasons for sporadic refusals of a part of the contacted private collection owners were, first and foremost, the scepticism with regard to the legal status of their collections. In particular, collections from non-European habitats are subject to the provisions of the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on Biological Diversity (CBD), to which Austria attaches great importance. However, lack of knowledge and legal uncertainty frequently prevail among private collectors in this respect, above all with regard to the CITES directives. As a consequence the owners of private collections classify more species "illegal" than do actually fall into this category. These concerns must be removed through increased information activities.

Agricultural living collections:

The quality of the recorded private collections (fruit collections) may be comparable to the public collections, although often duplicates of other collections are involved. However, this should not in any way lower the importance of the individual collections, since through duplication at various locations the maintenance of diversity is ensured. This is also true for disease infestation, which in the worst case may result in the destruction of an entire collection (e.g. through conflagration).

The importance of private collections primarily lies in the local spectrum of varieties and in the availability of scions. In the past, however, public collections were mainly consulted for the sake of scientific use and research.

Access to private collections is generally given, albeit only partly to a limited extent. These restrictions, however, only serve to prevent the destruction of collections by vandalism, in order to safeguard the survival of often irrecoverable collections.

As with the public collections, there are problems due to the non-replacement of curators. In contrast to the public collections, however, these work-intensive activities are carried out predominantly on a honorary basis anyway.

Microbiological living collections:

The clarification of ownership of microbiological living collections has proven to be somewhat problematic. It was thus frequently difficult to unequivocally classify the existing collections at university institutes to the public or private sector, as many microbiologists employed by universities (from diploma holders to university professors) build up strain collections with great personal commitment, but without remuneration. In many cases strains are also acquired from other collections as an exchange between scientific colleagues, whereby personal agreements are frequently reached regarding the application and use of these strains. In the scientific world, it is quite common, for example, that professors, who are appointed to another university (even abroad), take with them the collection(s) they originally set up.

A separate issue refers to questions of property rights of micro-organisms (patent rights, etc.), if these are to be used commercially.

3.2.1.3 Identification of taxonomic gaps based on the recorded collections

Zoological specimen collections:

In the case of zoological specimen collections it is particularly remarkable that the protozoa strain (single-cell animal organism), with the exception of a globally acknowledged collection of ciliates (Prof. Foissner, Salzburg University, specimens are stored at the Museum of Upper Austria - Biology Centre), is most poorly recorded both by the public and the private collections.

It comes as a surprise that Evertebrata (invertebrate animals) are also sparely represented in the collections, with the exception of Mollusca (molluscs) and Insecta (insects).

Among the insects, the lesser known and less "popular" orders, such as the orders of Siphonaptera (fleas), Thysanura (bristle tails) and Strepsiptera (twisted-wing parasites), are poorly represented in the surveyed collections.

Botanical specimen collections:

With regard to the Austrian flora only small taxonomic gaps prevail. In the large herbariums, virtually the entire native biodiversity is represented and even the lesser and small herbariums often record more than 70 % of the native flora. Austrian herbariums (e.g. herbariums in Graz, Innsbruck, and Vienna) also comprise a considerable number of old stocks of the former Austrian crown lands. Gaps particularly exist with regard to plant groups from the tropics and from the southern hemisphere, where often only selective stocks are available. It would, however, make little sense for each Austrian institution to acquire such material. Attention should rather be directed to selective supplementation in compliance with the focus of the collection. This is particularly true for the large herbariums in Graz, Innsbruck, Linz, and Vienna.

Live animal collections in zoos:

Naturally, due to the incredible diversity in the global animal world the collections show very large taxonomic gaps in all phyla and classes of the animal kingdom, from the primitive animals and insects via the Mollusca (molluscs), Echinodermata (echinoderms), Chordata (chordates) and others including birds and mammals.

Even by taking into consideration the fact that not all live animal holdings could be identified in Austria, no substantial shift in the present recorded taxonomic spectrum should be expected on account of unrecorded collections. In the end - particularly taking into account a modern standard of animal keeping and the necessary financial funds - it will never be possi-

ble to maintain taxonomically complete collections. This would not appear meaningful in each of the sectors anyway.

In general, the keeping of animals in zoos is moving away from the "collection" concept in the classic sense to the creation of near-natural habitats for animals. In doing so, priority is given in particular to those groups and species of animals included in the international programmes for breeding and protection of species, which also safeguard the educational and scientific role of zoos.

Modern zoos play a vital role in the preservation of biological diversity through public relations, education and science and by participation in breeding programmes for the conservation of animal species and reintroduction projects. These projects frequently involve large bird and mammal species. In doing so, the simultaneous protection of the respective habitat of the animal species in question also provides benefit for other, smaller animal species, which are often not kept or bred insufficiently by zoos.

Botanical living collections:

As a rule, botanical living collections are "overview collections" or research and teaching collections involving one or several field(s) of specialisation. Many of the specialised collections surveyed here are of world wide significance.

Because of difficult cultivation conditions there are taxonomic gaps in the specialised collections, particularly in the case of tropical species. As botanical living collections collaborate in networks on a global basis, these gaps are however not of prime importance.

Agricultural living collections:

With the exception of wild varieties of cultivated plant species no significant taxonomic gaps could be identified within agricultural living collections. Passport data (i.e. information regarding origin, location of discovery, status, breeder, storage conditions, etc.) are fully documented for native species. However, a more extensive taxonomic identification of agricultural seed collections (gene banks) is partly not available. That is to say that the class and species were well recorded, but for a few objects the botanical variety and the morphological descriptions have not been determined.

Microbiological living collections:

The tremendous biodiversity of micro-organisms makes the identification of taxonomic gaps difficult. Therefore, the number of existing species, both for bacteria and for fungi, is the sub-

ject of intense speculation among microbiologists (the reported number of species lies between a few 100,000 and more than 10 million). To date, some 100,000 species of micro-fungi have been reported.

Against the backdrop of these figures, the Austrian collections of recorded micro-organism species must be regarded as insignificantly small. Nevertheless, collections with a taxonomic focus are globally respected establishments (e.g. the trichoderma collection of Prof. C.P. Kubicek at the Vienna University of Technology, the collection of dimorphic fungi (yeasts) of Prof. H. Prillinger at the Institute of Applied Microbiology at the University of Agricultural Sciences and the ophiostoma collection of Prof. E. Halmschlager at the Institute of Forest Entomology, Forest Pathology and Forest Protection at the Vienna University of Agricultural Sciences, etc.).

In fact, any initiative aiming at recording the biodiversity of micro-organisms can only be welcomed and would contribute to the scientific exploration of a group of organisms that so far has enjoyed too little attention in Austria.

3.2.1.4 Gaps of species collections regarding the geographic coverage of Austria

Zoological specimen collections:

The geographical coverage of zoological specimen collections can only be answered with regard to the local collections. Naturally, collection objects from most Austrian regions are represented in the large public collections, but this survey was unable to identify the geographic reference of the collection objects in detail. For instance, the fauna of Burgenland is documented only by local insect collections, whereas for all other groups no collections do exist. On the other hand, e.g., no separate vertebrate collections have so far been established for Tyrol and Vienna.

Botanical specimen collections:

As already mentioned, the native flora is well covered by collections of the public institutions. However, the existing stocks are often based on old collections, which need to be regularly supplemented or validated by new collections. Apart from the flora of the higher alpine regions, where several areas are still underrepresented, there are no significant gaps.

Live animal collections in zoos:

With the exception of the Alpine Zoo in Innsbruck and the Happ Reptile Zoo, no other zoo exclusively or even just to some extent concentrates on the fauna of Austria. As the name already implies, the Alpine Zoo - as the only theme zoo in Austria - specialises on animals from the alpine region, both on those that once lived in this area and on those still living there today. The Happ Reptile Zoo explicitly focuses on the native fauna. The main focus lies with reptiles living in Carinthia, above all snakes. The specific aim is making visitors familiar with the life and the nature of these animals and therefore to overcome the fear of snakes. However, neither of the two institutions claims complete geographic coverage of Austria.

In principle, quality in live animal keeping is to prefer over quantity. This is because there is neither the possibility to cover the species spectrum (including the sub-species and local variants) of all the zoological orders appearing in Austria (to the extent that these are known), nor does this make sense. Much more important is the "in-situ" conservation of the native fauna: In this regard, Austria is among those countries, where wildlife conservation, coupled with targeted education of the population and awareness raising activities, is promising and, above all, also practicable.

Botanical living collections:

All together, nine botanical living collections focusing on "Austria" in terms of content and further eight collections focusing on the respective federal provinces were surveyed by this feasibility study. Compared to the 83 collections with a "world wide" focus, the need for action to preserve and expand the collections of Austrian flora is evident. In this context, consideration should be given not only to the cultivation of the species themselves, but also to the coverage of genetic variability on the one hand and the preservation of genetic integrity on the other.

Several very comprehensive Austrian collections cover the alpine regions at species level relatively well. This diversity of alpine plants in domestic collections can be explained by the existence of a number of alpine gardens as part of the botanic gardens as well as by a high number of private collectors having specialised on alpine plants. Compared to the neighbouring alpine countries, Austrian living collections thus contribute a great deal to the preservation of the threatened world of mountain plants. Several collections have even specialised on specific regional plant stocks or altitudes.

In the course of climatic change (global warming), the mountain flora is moving to ever higher altitudes (e.g. Pauli et al., 1996[6]). For this reason many native mountain plants are directly threatened with extinction. Also in this regard, alpine plant collections are extremely valuable and therefore indispensable for the conservation of species. In order to optimise the value of the collections for science and species protection as well as conservation, future need for action in the area of alpine plant collections is particularly required with regard to the documentation of origin, the preservation of genetic diversity, and the integrity of the cultivated material.
A further geographic focus is formed by collections in eastern Austria, which cover the Pannonian plant groups. In this case, private collectors, associations, the Higher Federal Research Institute for Horticulture in Vienna and the Botanical Garden of the University of Vienna care for the Pannonian flora. As the natural habitats in eastern Austria are at great risk due to anthropogenic interventions, their conservation and the preservation of biological diversity through numerous collections are prerequisites for ongoing environmental and conservation measures.

Various associations and institutions are active in the preservation of the genetic resources of old strains of fruit and crops, including "Arche Noah", "Ökokreis Waldviertel“ (Waldviertel Ecological Group), Zwettl monastery, the Federal Office of Agrobiology in Linz and the Federal College in Klosterneuburg (e.g. particularly for strains of wine, as well as pipfruit and drupe). These institutions perform valuable conservation work to prevent the disappearance of (old) Austrian strains.

Plants from so-called special locations are rarely collected due to the comparatively difficult conservation conditions. Even for the botanic gardens the maintenance of plant collections from wet locations (moors and coastal areas) and salt or serpentine locations are associated with high financial commitment. Austria is, therefore, still far away from completely covering all native species from special locations by botanical living collections.

In conclusion, the compilation of botanical living collections in Austria is regarded as the first important step in order to be able to plan future initiatives for new collections, thereby coming closer to the aim of the complete ex-situ conservation primarily of the endangered domestic plant species. In this regard, the Working Group of the Austrian Botanic Gardens has set itself the task of cultivating as many of the species mentioned in the "Red Lists" of endangered plants in Austria as possible.

[6] Pauli, H., Gottfried, M. and Grabherr, G. (1996). Effects of Climate Change on Mountain Ecosystems-Upward Shifting of Alpine Plants. World Resource Review 8 (3): 382-390.

Agricultural living collections:

There are no essential gaps in the gene banks of agricultural-horticultural cultivated plants and for breeds of production animals. However, it is necessary to carry out ongoing collection and recording activity with regard to wild plants.

Microbiological living collections:

The distribution of micro-organisms is linked far less to geographic conditions than it is for plants or animals. Their occurrence corresponds more to the specific conditions of biotopes and ecosystems. Unfortunately, stocktaking of Austrian bound micro-organisms, even only in limited areas, is almost completely missing. Therefore, it would be desirable to run projects building upon Austrian bioresources (e.g. national parks). This approach - perhaps limited to specific biotopes - could pave a way towards the recording of the diversity of micro-organisms.

3.2.1.5 Problems regarding the transfer or publication of collection data, which arise due to access restrictions or data protection

Zoological specimen collections:

Contrary to some fears of the study authors, there are no problems with regard to the requirements of data protection (transfer or publication of data on zoological specimen collections). Collection data may generally be published. Problems are occurring only with new collection objects, which - for whatever reasons - were acquired in an "inequitable" manner (e.g. without a conservation or collecting licence; as new arrivals from countries that have banned the export of biodiversity-relevant material under their legislation as provided by the "Convention on Biological Diversity"). Usually, employees from the public collections, in so far as their own work is concerned, are on the lookout for new collection objects that comply with the law. Occasionally, however, illegally acquired material may enter the collections, which then under no circumstances should be rejected or destroyed, as it constitutes an enormous scientific documentary value.

Nevertheless, to permit the transfer of information, the intellectual property rights of database owners must be resolved in advance. In many cases, the owners also seek financial compensation for the use of this information - there is still no clear and standard solution at hand.

Botanical specimen collections:

No significant restrictions regarding the transfer or publication of botanical specimen collection data have been identified. All respondents are greatly interested in the integration of their collections and data into the current national projects and particularly into the regional ones (e.g. the flora of Austria, the mapping of the flora of Central Europe, the mapping of mosses in Austria, Red Lists, regional flora, etc.).

Live animal collections in zoos:

Databases are only used by the scientific institutions, the Alpine Zoo in Innsbruck, the Salzburg Zoo, the Schönbrunn Zoo, and the Zoo and Natural Reserve Herberstein, as well as the Safaripark Gänserndorf. These databases are only retrievable locally or via the Internet using a password, and mainly involve the ARKS (Animal Record Keeping System) programme, a global database of animal species kept in zoos, which is financed by members of ISIS (International Specimen Identification System), who have exclusive access rights.

Basically, each institution is free to transfer its own data. Only two of the surveyed institutions (with 5 collections in total) do not allow publication of their collection data. The data from one further institution (with 7 collections) may only be published in part.

Botanical living collections:

Virtually all representatives of the surveyed botanical living collections are willing to make their data available without restrictions. It is absolutely in the interest of these institutions, associations, and private collections to present their collections to a wider public. Only in some cases specific data may not be disclosed. In the case of private collectors, this mainly involves personal details such as home address or telephone number. Private owners, who were not interested in the publication of data or publicity about their collections, simply did not participate in the survey at all.

Agricultural living collections:

In the case of agricultural living collections, data protection requirements regarding the transfer and publication of collection data hardly play any role. Future problems could however arise due to increasing restrictions regarding the transfer of collection material because of international contractual agreements under the "International Treaty for Plant Genetic Resources for Food and Agriculture". This agreement, as a follow-up agreement to the "Convention on Biological Diversity", governs the international exchange of plant genetic resources. The annex to the agreement lists the species that may be transferred freely between the coun-

tries. All species that are not mentioned, and these represent the majority of cultivated plant species with major significance for Austria, are subject to bilateral regulations between donor and recipient countries. Consequently, when the "International Treaty for Plant Genetic Resources for Food and Agriculture" comes into effect, and the majority of agricultural-horticultural cultivated plants will be subject to the mentioned bilateral agreement, the native collections will gain further importance as a genetic pool for domestic plant cultivation and for the Austrian agricultural seed business.

Microbiological living collections:

There are no problems regarding the transfer or publication of collection data from the collections at university institutes. In addition, the collection holders proved to be very co-operative and also unanimously welcomed Austria's accession to GBIF. It was somewhat more difficult to obtain information from a few federal institutes or federal offices. In these cases, the publication of the data was only agreed upon partly.

3.2.1.6 Summary details on the need for action

3.2.1.6.1 Need for action with regard to the level of knowledge about the existing collections

Zoological specimen collections:

During the course of the interviews concerning public zoological specimen collections, in several cases the impression came up that due to competence problems, lack of personnel consistency and the fact that particularly at university institutes hardly any full-time official curators are employed much of the collection material is not processed and that only vague knowledge of individual parts of the collections is available.

Botanical specimen collections:

Detailed information on the content of botanical reference collections is often inadequately documented and only available from the collection managers due to their many years of experience. In the case of their retirement, the knowledge is only available to a limited extent. This is why the statements quoted in this study under the heading "Documentation of the collections" are of particular importance.

Live animal collections in zoos:

As already mentioned before, it was not possible to conduct a complete survey of all Austrian animal holdings, although the most important collections were certainly recorded. Nevertheless, the continued surveying of all animal holdings is desirable and particularly important in view of the implementation of the EU Zoo Directive in Austria.

Botanical living collections:

A high percentage of the specialised collections of the public sector was already known to science by name, but also unknown collections have been identified. In contrast, many collections in the private sector were completely unknown so far, and a quite significant number of unknown collections is still to be expected.

Agricultural living collections:

The passport data of all collections (information regarding origin, location of discovery, status, breeders, storage conditions, etc.) are at least documented by card catalogues. As mentioned before, the recording of the morphological descriptions and particularly the molecular biological descriptions should be given priority in order to warrant their lasting use. For future scientific use, knowledge of the quantitative and qualitative (molecular biological) traits will be indispensable.

Microbiological living collections:

The microbiological living collections show a very heterogeneous picture: on the one hand, several of the large university collections hold exemplary processed molecular data for parts of their collections. On the other, and this applies to almost all the collections, the number of species had to be roughly estimated, as many strains have not yet been adequately defined. Thus, a major demand for future scientific work can be deduced.

3.2.1.6.2 Need for action with regard to the preservation and maintenance of the collections

Zoological specimen collections:

To safeguard their preservation and maintenance 72.2% of the surveyed zoological specimen collections exhibit an urgent need for action in terms of personnel and 74.2% for financial action. 93.8% of the collections are currently managed by a curator, who, for the main part of the collections, however, only formally works as the collection manager and may not be scien-

tifically active in the collection for lack of time due to other duties. For virtually all the collections an extremely unsatisfactory situation regarding personnel was identified: working groups responsible for maintaining a collection often only consist of the curator and occasionally of diploma holders and students, who are changing frequently and who are, therefore, not always familiar with the collection stock. Therefore, maintenance of the Austrian zoological specimen collections must be generally classified as inadequate.

The real function of a curator is that of a "collection keeper", requiring a great deal of time, if administered target-oriented and sensible. This includes scientific development, selective completion, organising, providing for disinfestation (pest control), etc. However, this work may often not be performed, not due to lack of enthusiasm for work and interest, but because the competent curator of a specific collection is often overtaxed by the scale of the collection. In addition, the curator is charged with other activities and functions, like, e.g., administrative tasks, accounting, or the organisation of exhibitions.

In any case, in order to be internationally competitive scientific work on the collection material is indispensable. This should not, therefore, be entrusted only to scientists from abroad, who either borrow collection objects or also work on site. In this context, also the partly insufficient competency of curators with respect to their own collections has to be mentioned, with which the scientific users of the collections are confronted. These comments apply in particular to the Museum of Natural History in Vienna, which - as far as the scale and the historical importance of its collections are concerned - is unique.

Botanical specimen collections:

In general, the botanical specimen collections are in a good state of preservation. Nevertheless, several of the larger institutions suffer from a shortage of space (e.g. the herbariums at the Karl Franzen University in Graz, at Innsbruck University and at Vienna University) or even severe shortage of space (e.g. the herbariums at the Museum of Natural History in Vienna). A special case is the storage of collections at the University in Innsbruck which are exposed to a too high level of humidity and are accommodated in cellars, which do not ensure flood control.

State-of-the-art maintenance is often problematic, as the maintenance of collections at universities must be carried out in parallel with day-to-day research and teaching. In many areas the collections are understaffed, often to a considerable extent. In line with an international study (Parnell, 2001[7]), in which the financial aspects of botanical collections are highlighted, one curator should be provided for 75,000 to 100,000 specimens to ensure adequate man-

[7] Parnell, J. (2001). The monetary value of herbarium collections. In: Biological Collections and Biodiversity (eds. B.S. Rushton, P. Hackney and C.R. Tyrie).

agement of a botanical specimen collection. For the Austrian **herbariums**, this would mean that **some 100 additional curators** would have to be employed. The following table shows a comparison between the actual situation and the ideal state of affairs:

Herbarium	Number of curators currently employed	Number of specimens in the collections	Ideal number of curators, projected by Parnell
Museum of Natural History in Vienna	3	5.500,000	73[a]
Vienna University	1	1.300,000	17[a]
Graz University	3	805,000	8[b]
Museum of Upper Austria in Linz	1	784,000	8[b]
Museum of Tyrol	2	550,000	5-6[b]
Museum of Styria	2	450,000	4-5[b]

[a] A capacity of 1 curator for 75,000 specimens was considered necessary because of the high number of type specimens in the collections of these institutions.
[b] The calculation was based on a capacity of 1 curator for 100,000 specimens.

The table takes into account the scientific maintenance of the collections. However, for an optimum management the appointment of laboratory technicians and assistant personnel should also be considered, which mainly concerns the historical collections (need for restoration). In the herbarium at the Museum of Natural History, for example, some 300,000 specimens are unprocessed and therefore not accessible. Also the collections of other institutions are confronted with similar problems.

Live animal collections in zoos:

Because of their economic situation and the lack of public grants, numerous Austrian zoos are not in a position to employ additional personnel (such as persons to take care of the animals, scientific personnel, and teachers), and thus to exhaustively use their potential, eventhough this is in the public interest and definitely the intention and goal of many collection owners. The same applies to the expansion and modernisation of the animal holdings, although this is the aim in most cases and several zoos already build on appropriate plans for implementation. There is a definitive need for action in this regard, which should be quickly implemented after thorough inspection of the facts relating to compliance with the criteria of the EU Zoo Directive.

Botanical living collections:

Need for action in terms of personnel was reported for 43% of all surveyed collections and need for financial action for 50%. There were obviously fewer nominations in the private sector than in the public one. Private collectors in most instances maintain their collections using their own financial means and do not necessarily require additional personnel. However, in the

public sector qualified personnel for the maintenance of specialised collections is frequently lacking. In many institutions there is a high demand for the appointment of new specialist staff familiar with the various demands of plant collections. Both the appointment of new staff and the training of specialised gardeners on site are associated with high costs. However, skilled maintenance through in-house curators and correspondingly qualified gardeners is a prerequisite for the continued existence of a living collection and particularly for its expansion.

Many collections show a technical need to catch up, being associated with financial costs. This is because many plants require closely regulated environmental conditions for their survival, as may be created, for example, in modern, high-tech greenhouses. The provision of space for hibernation or quarantine accommodation represents another problem. Furthermore, in scientific collections, one must face up to the challenge of cultivating plant species with unknown cultivation conditions in relatively large numbers and virtually at the same time, which is often problematic or even impossible due to the lack of flexibility as regards space and personnel.

The closing of existing collections is often not feasible (above all for reasons relating to the protection of endangered species).

In considering the cultivation or storage conditions of the surveyed living collections in more detail, the difficult financial circumstances of the Austrian collections become evident. Optimum conditions were indicated for only around 6% of the collections. In approximately 59% of the collections conditions were considered adequate, which, according to comments by the collection owners, however often means "only just adequate". Problematic cultivation or storage conditions are indicated for some 10% of all collections and in these cases the ongoing preservation of the collections is thought to be seriously at risk.

Public collections also find themselves confronted with little flexibility in employment issues and with an annually granted and late allocated budget, clearly making the respective plans for the preservation and extension of collections and parts thereof more difficult.

Agricultural living collections:

The preservation and maintenance of agricultural living collections is currently not at risk. Problems may arise from the lack of replacement staff for curators, which is true both for the private and public collections.

Legal protection is required for the public gene banks in the context of the "Convention on Biological Diversity" (Austrian Law Gazette 213/95), the "Global Plan of Action" (a technical action plan for the world wide conservation of plant genetic resources in agriculture) and the already mentioned "International Treaty for Genetic Resources for Food and Agriculture".

Need for action is required to ensure genetic purity during rejuvenation of the seed collections. In this case quality control is required, i.e. traceable offspring.

Microbiological living collections:

By and large, the preservation and sufficient maintenance of Austrian micro-organism collections is considered inadequate.

Apart from collections, whose preservation is at risk in the short and medium term, there are also collections, where the storage conditions were described as adequate, but for which so-called back-up systems are only available in exceptional cases. For these, the failure of a freezer would acutely jeopardise the strains and in consequence cause the irretrievable loss of resources.

The surveyed data on conservation methods and cooling temperatures only to a limited extent throw light on the quality of the conservation. The optimum conservation method may be different for each group of organisms. Therefore, many fungi, for example, may already be stored over the long term by just using simple methods (fusarium in sterile clay test tubes at room temperature).

Cryoconservation (storage of biological material at low temperatures) at temperatures below -130°C may be considered ideal for most micro-organisms, as in this case - according to today's level of knowledge - vitality is preserved with no time limit. This also holds true for lyophilised (freeze-dried) cultures, whereas, however, this method is not suitable for part of the micro-organisms (among others for practical reasons).

The cryoconservation method at -80°C used with most collections is thought to be adequate for a period of 10 to 15 years. Thereafter, the strains should be recultivated and preserved once again. As many collections were only established in the last decade, there will be a need for extensive action in the foreseeable future.

It would therefore be reasonable to establish a centre for prokaryotes and micro-fungi in Austria, where micro-organism strains could be preserved in the long term under optimum conditions. Currently, micro-organisms are occasionally collected, identified, and characterised (in fact partly using molecular methods), but they are not preserved due to the lack of financial and personnel means as well as a lack of expertise. As a result, unique bioresources are often lost, even though preservation constitutes just a small share of the necessary work. The idea of establishing such a centre was welcomed by most of the collection managers. This should not devalue individual collections or the respective institutions nor should their undoubtedly necessary financial support be questioned, since microbiological work cannot be conducted with-

out an appropriate collection. However, in a national centre appropriately equipped with financial and personnel resources all necessary prerequisites could be created in order to establish an internationally acknowledged collection on a major scale, as is already the case in most European countries. In the largest collection of micro-fungi (Institute of Applied Microbiology at the University of Agricultural Sciences in Vienna) many collection objects from other micro-fungi strain collections (from the three next largest Austrian collections) have already been preserved.

3.2.1.6.3 Need for action with regard to an improvement in the documentation of collections and their digitisation

Zoological specimen collections:

The competent and appropriate acquisition of data, in compliance with international standards and enabling the immediate provision of information on the collection stock of an institution, is indispensable for a competitive and scientifically sound collection. Data recording allows for considerable advantages for ecological statements, information regarding landscape changes and alterations in terms of the species composition of a particular region. This is particularly significant with regard to local collections. In this context, the automated preparation of up-to-date area maps, which could greatly facilitate access to distribution data, is of vital importance.

However, data recording represents an enormous problem in Austria and reveals major deficiencies in many places. Several zoological specimen collections neither have a card catalogue, nor an electronic data collection, nor a database. New additions are often not recorded and discovery location names and taxonomy are not up-to-date.

In accordance with GBIF, access to data of individual public collections via the Internet should be easily possible; not only to save time but also for practical reasons. For instance, in many cases borrowing of collection objects would not be necessary any more. Online data access should primarily be promoted with regard to ecological data, imaging, and type material. However, in view of the personnel situation, the digitisation of collection objects of the zoological specimen collections does not appear feasible in most public collections in the coming years.

Botanical specimen collections:

In general, apart from the situation of personnel in charge of collection management, attention must be devoted to the documentation of collections. In this context, the number of botanical specimen databases indicated in the section "Collections per recorded species" at first

glance appears to be quite high. However, it is certainly a problem that several databases are only in the process of development (such as the herbariums at the Museum of Styria, the Innsbruck and Vienna Universities/Institute of Botany and the Museum of Natural History in Vienna) and that these were not produced by professional computer specialists, yet by persons responsible for the technical aspects of herbariums. The heterogeneity of the existing databases constitutes a further problem, since the use of different operating and database systems hampers or prevents direct networking. There is, therefore, an exceptional need for action to obtain the most compatible data structure possible.

An alternative would be the installation of a superimposed system, linking released data from the existing local systems and making these data retrievable via online search engines. This strategy is already widespread in online library catalogues (e.g. the Karlsruhe virtual catalogue **- http://www.ubka.uni-karlsruhe.de/kvk.html**), but still only in the process of development in the field of biology (e.g. the "International Plant Names Index" - **http://www.ipni.org** or the project by Prof. Behrendson from the Berlin Dahlem Herbarium - **http://www.bgbm.org/biocise/**).

Digitisation, in this context, is understood as the development of digital pictures as well as the geographic positioning of discovery locations. It has become an international standard to display type collections digitally and to make them retrievable via the Internet (e.g.: New York Botanical Garden **- http://www.nybg.org/bsci/hcol/vasc/**; National Herbarium of the Netherlands **- http://www.nationaalherbarium.nl/#types/**; Swedish Museum of Natural History - **http://www.nrm.se/fbo/data/types.html.en**), thus enabling the general public to have direct access to the collection stocks.

The Museum of Natural History in Vienna, which is ranked among the 10 best museums in the world (The Sunday Times) and is of similar significance as the previously mentioned renowned international institutions with regard to the size of the collections and particularly with respect to the number of type collections, is however far away from such documentation possibilities due to inadequate financial and personnel means.

The second major consideration concerns the geographic positioning of discovery locations. Such information subsequently may be used by many institutions (at the federal, provincial, and municipal levels) in a variety of ways (e.g. in nature conservation, for spatial planning, etc.), as soon as it is available via publicly accessible interfaces (Internet connection).
Showpiece projects are already under way: e.g. the "Natureweb" at the Vorarlberg's Natural History Museum (**www.natureweb.at**) or the Salzburg mapping project (**www.bot.sbg.ac.at**).

However, in many fields of the collection system direct computer access possibilities are still lacking and still need to be designed (e.g. the herbariums at Vienna University/Institute for Botany and at the Museum of Natural History) or implemented (e.g. the herbarium of the Museum of Upper Austria).

Live animal collections in zoos:

Need for action in terms of personnel aiming at improving documentation concerns the management and updating of inventories, but also the conversion to computer recording. Scientific employees, who are able to collect data and use it appropriately, could find a wide field of activity here but can not be financed adequately or at all by private and public owners or collection keepers without additional financial support. There is also a need for financial action to ensure the procurement of computers and software and the implementation of technical projects.

Botanical living collections:

Only 11 of the total of 120 recorded collections do not provide any documentation. In 43 collections documentation is carried out using card catalogues and in 50 collections through electronic data collections, mostly in "Word" or "Excel" formats. Parallel documentation by card catalogues and by using electronic means is common. There are 31 databases (mostly MS Access) as additional documentation means. However, many of the databases are still under construction and contain only a comparatively small number of data records. As virtually all databases are only available locally, technical changes and external assistance will be required to make this data available via the Internet.

For the existing electronic data collections the recording standard for the relevant collection objects is generally considered to be good. However, additional personnel and appropriate funding is necessary in order to translate these into databases in the medium term. As in public institutions no additional personnel can be assigned to this time-consuming data entry, one solution could be seen in the contract funding of third party personnel.

The interviewed stakeholders of the public institutions clearly expressed their wish to catch up with the technological backlog in terms of digitisation, that Austria has to face compared with other European countries. In this regard, the limiting factors in the process are not so much the technical requirements than rather the personnel costs.

Agricultural living collections:

All interviewed curators expressed the intention to record their collections in databases, if not yet done. This activity is supported by the Federal Office of Agrobiology through the provision of database systems.

No problems are to be reported on account of different data structures of the agricultural-horticultural databases, as a standardisation of data was prepared and has been applied since 1997 on the initiative of IPGRI, the "International Plant Genetic Resources Institute" of FAO. All Austrian gene banks are using this data structure in order to make an international data exchange possible. At the same time, in 2002 the passport data (see previous section) of all plant genetic resources are collected by the Federal Office of Agrobiology in the course of the EPGRIS (European Plant Genetic Resources Information Infra-Structure)-project in order to make the data available online via a pan-European database. Another future task will be the compilation of growth characteristics in the form of digitised pictures, making them quickly retrievable from the databases in addition to the passport data.

Microbiological living collections:

An improvement of documentation is desirable for many collections. More than 25% of the collections are recorded in card catalogues as minimal versions of the documentation, whereas databases represent the exception. Particularly collections located at universities are usually recorded in electronic data collections or in databases by own initiative of diploma or doctoral thesis writers, as neither the personnel nor the financial means are available for a different form of data entry.

3.2.1.6.4 Need for action with regard to the updating of collections

Zoological specimen collections:

To some extent, growth of public zoological specimen collections takes place at least partly automatic, as private collections must be acquired to ensure their preservation. Non-preservation would result in a loss of cultural heritage. These and other new objects resulting from the collecting activity itself should be processed, classified, and recorded as quickly as possible in order to warrant the continuous closing of geographical and systematic gaps and to complete documentation as much as possible.

However, as already indicated in the previous sections, satisfactory documentation of data and taxonomic updating is not possible for most collections due to lack of time and personnel. New

material added to the collections often remains unprocessed for years and cannot be integrated. Nevertheless, for internationally acknowledged collections particularly the taxonomic updating of collection objects is an important prerequisite to also remain competitive in the future.

Botanical specimen collections:

In representation of the need for action to update the botanical specimen collections, the herbarium at the Museum of Tyrol, the Ferdinandeum, merits special attention due to the need for restoring the damage caused by the penetration of floodwaters in 1986. Although the affected collections were relocated after the catastrophe to a new, very well equipped building, the still extensive stocks of floodwater effected "silty" specimen represent a major historic burden. Since its recovery in 1986, only 10 % of the herbarium material has been restored as currently only one person is entrusted with the restoration.

Live animal collections in zoos:

Particularly privately owned zoos see a need for action and would gladly extend their collections further, which, apart from systematic reasons, may have definite economic motivations. In these cases, the need for financial action in order to ensure the necessary investments for updating the animal stocks is of prime importance. An increase in the number of animal species however also necessarily triggers the need for additional personnel and consequently results in increasing personnel costs - a cycle that particularly for the private collections represents a major impediment towards enhancing their attractiveness.

Botanical living collections:

The standard of updating of the surveyed botanical specialised collections is considered good. Difficulties and shortcomings can mainly be found in the documentation of the collections. However, this is still thought to be a serious shortcoming, as the documentation essentially contributes to the scientific and conservation-related significance of the collections and is therefore absolutely necessary for the respective collections.

Agricultural living collections:

All agricultural living collections are continuously updated. Only a few (fruit) collections with a focus on "local varieties" are nearing completion. There was no reference to any need for action beyond the issues already mentioned.

Microbiological living collections:

As mentioned earlier, practically all microbiological living collections are in need of being updated. However, before extending the collections, the institutions or collection keepers should be given the possibility to secure the future of the existing collection objects.

3.2.1.6.5 Need for action with regard to the conditions for animal keeping and expert animal care

Live animal collections in zoos:

According to the assessment by the collection keepers, the animal keeping conditions are in need of improvement in 19 collections, acceptable in 19 collections, and excellent in 45 collections. Most zoos employ qualified animal caretakers. More than half of the surveyed institutions indicate a need for action in terms of personnel, but do not have the necessary funds to bear these personnel costs. In this context it becomes obvious that with a small budget, employment preference goes to animal caretakers while scientific personnel may only be employed, if at all, as the second alternative. Only one institution does not employ any animal caretakers and even considers them unnecessary.

The need for financial action in terms of the animal keeping conditions and expert animal care also arises repeatedly by accepting officially confiscated animals, which is however compensated for only in the rarest of cases by the public.

Agricultural living collections:

As the only animal genetic collection at the Federal Office of Agrobiology (at the former insemination centre at Wels) is maintained by veterinary surgeons, the conditions currently can be regarded as optimal. Future problems will arise through the eventually non-replacement of vacancies.

3.2.1.7 Necessary collection-related and taxonomic initiatives to maintain Austria's international competitiveness

Zoological and botanical specimen collections:

Whereas at the international level the value of taxonomic research has already been acknowledged (see, for example, the Global Taxonomy Initiative of CBD), public collections in Austria

suffer from a massive need for action in terms of personnel and an associated need for financial action.

As may be taken from the tables and charts of the section "Need for Action in View of the Actual State", practically only the private collections do not show any need for financial action. In contrast, the public collections are struggling with financial and therefore also personnel problems.

In many cases only one person, namely the official curator, is responsible for the management of a collection (as applies currently for most collections at the Museum of Natural History in Vienna). Also the international reputation of the public collections is at risk or in several cases has already been adversely affected by their serious under-maintenance. An increase of personnel of the individual working groups to maintain international competitiveness is therefore indispensable. Important fields of activity of each collection manager, such as the taxonomic updating of collections and the elimination of gaps (in geographic or systematic terms), can currently not be carried out.

The lack of training for curators represents a further major shortcoming in Austria (but also internationally). The currently applied "learning by doing" certainly shows several advantages, yet only functions to a limited extent with regard to the prevailing conditions. Knowledge of fundamental issues (e.g. disinfestation, use of archive quality materials, etc.) and above all the specialised knowledge about the collections must be reacquired continuously, as a transfer of this knowledge is not feasible due to the lack of overlap with replacement staff. In order to build up a reasonable knowledge of the in-house collection (to be able to assign handwriting on old labels to a particular author, for instance) a learning and acquisition process over several years is required. These challenges should be taken into account in the personnel planning. Therefore, the Project Advisory Council considers a university course for curators a possible solution.

In addition, with regard to the botanical specimen collections, initiatives should particularly focus on the encouragement of Austrian working groups to participate in international flora projects and the monographic processing of plant groups. At the moment, Austria on the one hand is participating in several international projects, but on the other this proportion is not very high compared internationally and should therefore be extended in line with the major significance of the Austrian collections.

Live animal collections in zoos:

Austria is particularly renown internationally due to its scientifically managed institutions - the Alpine Zoo in Innsbruck, the Salzburg Zoo, the Schönbrunn Zoo, the Zoo and Natural Reserve Herberstein (which are all organised in the Austrian Zoo Organisations, OZO) and the House of the Sea ("Haus des Meeres") - and considerably contributes to the activities of the international zoo associations EAZA (European Association of Zoos and Aquaria) and WAZA (World Association of Zoos and Aquariums). These activities should in any case be kept at the current level.

For example, the Alpine Zoo in Innsbruck for the first time succeeded in the continued breeding of bearded vultures in human captivity and in the first breeding of fish otters in zoos. The EEP (European Endangered Species Breeding Programme) for the bald ibis is also being coordinated in Innsbruck. Salzburg Zoo is heading a project involving the reintroduction of the Przewalski horse in Mongolia and participating in various research programmes (cheetah, rhinoceros, griffon vultures, etc.). Schönbrunn Zoo - together with many different national and international activities, such as veterinary assistance for chimpanzees in Africa, etc. - just recently succeeded in artificially inseminating an African elephant cow that gave birth to a healthy young elephant calf. At the Herberstein Zoo, the first prey simulator for cheetahs was constructed, allowing zoo cheetahs to hunt almost like in nature. This kind of simulator is nowadays used in zoos around the world. In addition, Herberstein Zoo owns and administers nearly 100 hectares of a large "Natura 2000" area with unique species of wild animals, including numerous first-time discoveries for Austria. Until today, this area has been maintained and scientifically handled at own cost.

However, substantially more important than a taxonomic "upgrade" would be the political and economic support for the activities of scientifically managed zoos. Furthermore, it is important to create a positive setting in order to enable the economic survival of also the reputable, not (yet) scientifically managed zoos in private and public ownership, that to a large degree are performing functions in the public interest.

Although during the last years the sum of public funds committed to schools and universities has been increasing, cutbacks of funds for specific areas resulted in an insufficient use of the respective possibilities and potentials. A positive change against this trend should be aimed at.

Botanical living collections:

In those public institutions, where the personnel and financial situation may be considered satisfactory, the initiatives definitely comply with the international standard.

Excellent and internationally acknowledged work is carried out selectively, as is documented, for example, by collaboration for reference publications covering botanic gardens and species protection (cf. inter alia, the chapter "Science and Horticulture" in the "Action Plan for Botanic Gardens in the European Union"[8]). However, the scientific "output" could be optimised by further improvement of personnel and financial resources. Scientific living collections also could be even better used by publications, but the necessary personnel and the funding for the scientific employees are also lacking here (e.g. a small number of curators).

Important private collections are still to some extent unknown and unusable by Austrian scientists. Nevertheless, on the occasion of the survey for the present study valuable contacts have been made and intensified, respectively.

Agricultural living collections:

In the future the main focus will have to be placed on recording and publishing evaluation data (data on specific properties recorded using laboratory analytical methods, such as the protein or sugar content and particularly the molecular biological data about genetic properties, which are becoming more and more important for modern breeding). In this regard, the current publications of passport data of the public gene pool collections on the Internet may be considered just the beginning of a necessary activity. An Austrian wide compilation of all plant genetic resources was launched only recently in the course of the EPGRIS project of FAO/IPGRI by the Federal Office of Agrobiology in Linz. This initiative is of very high importance for the documentation of the agricultural genetic resources of Austria.

Microbiological living collections:

As already mentioned before, the inconceivably large biodiversity of micro-organisms hampers placing emphasis on individual taxonomic groups that should take priority for research. Primarily, the already existing collections should be supported in so far as their preservation can be secured for the future. Furthermore, research projects enabling the identification of micro-organisms using classical as well as modern molecular methods would be necessary. Only then would Austria be in the position to describe and also make use of these organisms.

[8] Bramwell, D. and Kiehn, M. (2000). Sciences and Horticulture. In: Action Plan for Botanic Gardens in the European Union, Cheney, J., Navarrete Navarro, J. and Wyse Jackson, P. (eds.), pp.: 13-20. Wetteren, Belgium.

3.2.2 Databases

3.2.2.1 The value and benefits of the Austrian databases at the regional, national, and international level

By using databases, collection keeping institutions primarily benefit from a tremendous saving of time with regard to their tasks, as answers to specialised questions may be provided substantially faster. Most of the surveyed databases were established with the aim of making digital card catalogues available for scientific use. Basic evaluations for scientific publications (e.g. distribution maps, various charts, etc.) can thus be prepared and printed out in a very short time.

The administration of collection objects is also eased. For example, upon a request to borrow collection objects, the person responsible for a herbarium can determine the location of the appropriate specimen at the touch of a button. Without digital support, this search would have to be done by hard work - often lasting days. Furthermore, by using databases, standard labels for individual specimen are easy and quick to produce.

The benefits of databases for nature conservation is growing with the increasing amount of data on specific areas. As an example, a pilot project which is being carried out by the Biology Centre of the Museum of Upper Austria and the Department for Nature Protection of the Government of Upper Austria, based on the "ZOBODAT" database, is to be mentioned here. This project aims at providing the competent nature conservation authorities with lists of endangered species from conservation areas via the Internet and at the touch of a button.

A further important benefit of databases and the fast analysis features building thereon is their use in preparing information for the general public. For instance, the provision of information about the appearance of particularly conspicuous, occasionally bothersome or medically significant species, such as hornets, ticks, gnats, etc, is to be mentioned here. By help of biodiversity databases distribution maps for these species can be simply and accurately produced and steps to protect the population can be initiated in good time.

3.2.2.2 Summary details on the need for action

3.2.2.2.1 With regard to the improvement of the documentation and digitisation of collections

Most of the extensive collections with more than 100,000 objects do at least provide a card catalogue. However, in contrast to databases, these are usually sorted by only one criterion (e.g. systematic or geographic affinity). Digital data collections (e.g. text files, etc.) only show a relatively small advantage over card catalogues, as a comprehensive search is also only possible using one criterion and a specific search of extensive collections is long-lasting even on a computer. Therefore, the complete digital recording of all collection data by databases should be aimed at. However, this aim is currently still a long way off in Austria, as only some 8.7 million digitally recorded data records contrast with the total of more than 46.5 million objects in Austrian collections (see the following table). Therefore, the need for the digital recording of collection objects is certainly enormous.

Specialised field	Number of surveyed collection objects	Number of digitally recorded data records
Agricultural living collections	10,842	52,040
Botanical living collections	271,117	29,806
Botanical specimen collections	10.631,000	3.356,459
Live animal collections in zoos	46,882	18,653
Zoological specimen collections	35.543,710	5.248,721
Microbiological living collections	27,473	7,286
Total	*46.531,024*	*8.712,965*

Assessing the degree of digitisation of Austrian collections:

On the one hand, this assessment is based on the survey figures, which are presented in the preceding table and on the other on information provided by the collection owners or collection keepers on data from field observations, for which no specimen examples exist. This number of actual field observations is not mentioned in the table. In addition, the numerical ratio of data records to objects should be noted, which is not 1 to 1 in many areas. In part, there is more than one data record for a collection object, but there may also be data of several objects be collected in one data record.

- **Agricultural collections:**

Basically, there is one data record for each object of an Austrian collection. The considerably higher number of data records (see table) of the databases compared to the number of collec-

tion objects is explained by the fact that, to some extent, the databases also contain international data, which do not relate to Austrian collections. The **degree of digitisation** is very high for the Austrian collection objects and exceeds **more than 99%**.

- **Botanical living collections:**

Basically, there is one data record per object. The **degree of digitisation** amounts to approximately **11%**.

- **Botanical specimen collections:**

Basically, there is one data record per object. Roughly 1.2 million data records have been compiled for the existing collection objects. The remaining data records in the table relate to field observations. The **degree of digitisation** amounts to approximately **11%**.

- **Live animal collections in zoos:**

Basically, there is one data record per object. The recorded objects are all stored in the ISIS database and the rest of the objects are recorded in the form of card catalogues. The **degree of digitisation** amounts to approximately **40%**.

- **Zoological specimen collections**

In the case of zoological specimen collections an average of one data record per 3.5 objects is expected (this average value is derived from the following table). Approx. 1.5 million data records have been set up for the existing collection objects. In addition, the databases contain many field observations. The **degree of digitisation** is approximately **15%**.

Systematic group	Approximate number of objects	Numerical ratio of objects to data records
Mollusca (molluscs)	11.000,000	10:1
Ciliata (ciliates)	7.000,000	10:1
Coleoptera (beetles)	4.500,000	2:1
Lepidoptera (butterflies)	4.500,000	3:1
Hymenoptera (hymenopterans)	2.300,000	2:1
Hemiptera (true bugs)	1.800,000	2:1
Remaining species	4.000,000	2:1

- **Microbiological living collections:**

Essentially, there is one data record per object. The data are mainly available in the form of card catalogues. The **degree of digitisation** amounts to approximately **27%**.

Cost estimation for the complete digital data compilation of all Austrian biodiversity-relating objects:

Provided that under realistic conditions 6 hours per day are invested by one person for digital data recording activities and a man-year is calculated as 200 working days net, the following estimations result:

Specialised field	Number of objects to be recorded	Number of objects per data record	Recorded objects per hour	Required working years[a]
Agricultural LC[b]	Only new objects	1	10	In accordance with the additions
Botanical LC	240,000	1	10	20.0
Botanical SC[c]	9.500,000	1	10	792.0
Zoological LC	28,000	1	10	1.2
Zoological SC	30.000,000	3.5	50	143.0
Microbiol. LC	20,000	1	20	0.8
Total	*39.788,000*			*957*

[a] A realistic number of 1200 hours per annum was assumed for the calculation
[b] LC: Living collections
[c] SC: Specimen collections

According to this estimate, there is a need of **950 (!) man-years** for the complete digital recording (data entry) of all the collection data currently available.

The preceding table shows that the biggest recording effort results from the specimen collections, more specifically the botanical specimen collections. This is due to the considerable scope of the specimen collections and, with regard to botanical collections, particularly because of the extensive textual labels, which often provide a lot of additional detail.

Based on the database survey and the additional comments of the curators of the museums the following statement can be made:
The medium-sized collections (e.g. the museums of the various federal provinces) are partly most advanced with regard to the technical examination of the collection material and degree of digitisation of the collection data. This is because of the manageable number of existing objects compared to the experts employed.

The following collections exhibit a relatively high degree of digitisation:

- the collection of Vorarlberg's Natural History Museum in its own database with partial copies in the "ZOBODAT" database
- the natural sciences collection of the Museum of Tyrol in its own database with partial copies in the "ZOBODAT" database
- the Museum of Natural History in Salzburg: the zoology section is partly included in the "ZOBODAT" database

- the Herbarium of the University of Salzburg : data acquisition in its own database
- the Museum of Carinthia: the zoology section is partially included in the "ZOBODAT" database
- the Museum of Upper Austria / Biology Centre in Linz: the zoology section is partially included in the "ZOBODAT" database

The following institutions have just begun to digitally record their collections or have digitally recorded a relatively small percentage of their collections only:

- Museum of Styria
- Herbarium of the University of Graz
- Herbarium of the University of Vienna

The situation at the Museum of Natural History in Vienna is particularly problematic, as it owns at least half of the existing specimens in Austria in each collection field. In this case, at least 4 additional positions would have to be added to the existing administrative position of one computer technician in order to service the existing computer workstations.

For the other areas of the survey the situation is often much better, particularly with regard to the zoos and the agricultural collections. In these two areas, functioning international database systems have already been installed, which are already accesible via the Internet.

3.2.2.2.2 Technical maintenance of the databases by administrators and programmers

As a starting point for the development of realistic implementation scenarios required for the networking of Austrian databases as a contribution to GBIF, the survey also rated the best technical administrators and the best technical programmers of each institution or private database owner. The findings are summarised in the following table:

Rating of the best technical administrators and programmers	Number of institutions or private database owners with at least one	
	Administrator	Programmer
Qualified technicians with more than 20 years of professional experience in the field of technology and biology (incl. knowledge of several operating systems and programming languages)	0	0
Qualified technicians with more than 10 years of professional experience in the fields of technology and biology (incl. knowledge of several operating systems and programming languages)	2	2
Technicians or biologists with professional experience in the fields of technology and biology (incl. knowledge of several operating systems and programming languages)	4	3
Biologists with relevant experience with one operating system or with one programming language	20	4
Biologists with a beginner's knowledge of computers	1	1
No specialist staff at all	14	31

The survey shows that for the day-to-day maintenance of databases good coverage by computer administrators is provided for around half of the institutions (particularly the small and medium-sized ones). However, programmers are only employed in around 30% of the institutions. 14 institutions or database owners do not employ any administrators and 31 institutions or database owners do not employ any programmers. Qualified technicians for the maintenance of databases are only available at the Biology Centre of the Museum of Upper Austria and at the University of Salzburg. Furthermore, one technician's position is filled at the Museum of Natural History, whereas, however, besides the maintenance of 120 computer workstations no time resources remain for work on a biodiversity database.

Basically, the available computer facilities of the respective institutions are mainly only then used for specific functions (e.g. the management and maintenance of an extensive database), if additional technicians are employed. Therefore, although all universities and several museums do in fact have a leased line and computer networks, multi-user database systems are only then available if at least one administrator is employed for their maintenance.

In principle, a biologist with professional experiences in the technical and biological sector would in most cases be adequate for the smooth maintenance of an appropriate database.

4 AUSTRIA'S CONTRIBUTION TO GBIF

4.1 What types of data can be made available to GBIF?

During the initial phase of the global network of databases that is envisaged by GBIF, Austria could supply data that has already been set up as databases, particularly if the databases are already accessible via the Internet. An additional requirement for institutions operating databases should be to have a suitable database-server system as well as a competent programmer being able to execute all necessary electronic-data-processing "interface work" as part of a process to standardise all databases, thus ensuring access via appropriate "search engines". Basically, only that data could be made available that has been approved by the respective owner. The terms and conditions for releasing data will yet have to be clarified.

Assuming that database owners are interested in having their databases integrated into a global network, that the required personnel of electronic-data-processing experts have sufficient capacity, and that ENBI has set up a standard for the "interfaces", the expected timeframe for Austrian databases to become available for GBIF, based on current information, can be assessed as follows:

Period in years	Parameter requirements have been met			Number of existing databases in the public sector
	Integration into WWW	Database-server system	Programmer(s)	
1	Yes	Yes	Yes	6
2	Yes		Yes	3
		Yes	Yes	
3	Yes	Yes		8
			Yes	
4	Yes			7
		Yes		
5				61
Total				*85*

4.2 Proposals for the implementation of GBIF from an Austrian point of view

In principle, the use of data networks shows several advantages: unlike collections that are bound to a place physically, data stored in databases can be copied easily and transmitted quickly over vast distances. Databases which are installed on an external computer (e.g., computing centre) can be maintained centrally, and thus the institutions participating in such a data network can save the employment of additional technical staff or to allocate scientific staff for these activities, respectively. In addition, many institutions would not have to hire external companies for various programming tasks.

For reasons of saving costs and personnel, it does not make sense for each institution operating a database to offer its own Internet-based query system. Therefore, there are principally two possible scenarios for an Austrian and, subsequently, international biodiversity platform:

The computer centre

In this case, all data are stored in a centralised system. The computer centre supplies all programs necessary to evaluate the data. The advantage is relatively low personnel costs and other overheads (10-15 persons could cover all of Europe. It is estimated that a pure Austrian solution to cover, e.g., the six fields of specialisation considered by the study would require the same number of staff). In addition, by this solution all data would be easy to save and retrieve. Also the rights to using such data could be clarified with relative ease.

A problem to face is the reluctance of database operators to give up control of their data or to share it with other institutions. Also a failure of the computer centre would prove detrimental, since it would result in the collapse of the entire system. Therefore, at least two redundant centres would have to be set up.

The federated database

In this variant, every institution operates its own database and transmits data, through a standardised interface, to one or several evaluation nodes, which do not store data by themselves. The advantage of this solution is that every operator can decide which data will be passed on to third parties. The network nodes could be set up in a redundant fashion, so that the user would not be affected by the failure of one node.

The disadvantage of this system is the time and financial expenditure for each institution to maintain and ensure the availability of the respective database. If several databases would fail, the user would experience some delay. Granting rights to use the data by this variant is very complex and time-consuming, since each operator would have to go through that process individually. It would be an exception, though, if only that data were provided by the common network that may be accessible by all users without any restrictions.

4.3 Realistic approach and sequence of measures to be taken

Following numerous talks with database operators, it seems realistic to assume that a mixture of the scenarios outlined will prevail, but not every institution will necessarily be able, or want, to operate a database. It would also be possible for one institution with the required number of personnel to manage the data of several other institutions.

Currently, the 5th EU Framework Programme research project ENBI (European Network of Biodiversity Information) is being launched. Among its objectives is the technical standardisation of the interfaces of a federated database. It is therefore recommended that Austria should stand back and monitor the developments and then adapt existing databases to this standard.

From a technical point of view, it will not be necessary for each GBIF member to operate its own network node. In contrast, it would be fully sufficient to equip 5 to 10 institutions in Europe with an "evaluation machine" resulting from the ENBI project. It would then be relatively easy to filter and evaluate the data for its relevance to Austria (in terms of geographic occurrence of species or type of document storage).

As a crucial preliminary step towards an extensive data network, increased data acquisition should already be started now. Logically, it would start with collection objects that have already been tested taxonomically and, if necessary, revised by experts.

4.4 What future purpose does GBIF serve, and what are its benefits and objectives?

The goal of GBIF is to make world wide distributed information on biodiversity available to a wide group of users by setting up a database network. Primarily, the intention is to provide information on species level and further on to link such information to data on other levels (molecules, genes, ecosystems).

The GBIF project consists of two main pillars: on the one hand, there is an enormous number of complex data on biological diversity all over the world, which has been collected for decades (e.g., in Austria, since the 17th century) and which is of great importance to society for various reasons. On the other hand, these data are usually available only locally, and not in electronic form. Therefore, they can be used only to a limited extent. As a result, the initiative "Global Biodiversity Information Facility" primarily aims at making more efficient use of already available information. Subsequently, however, this is also to trigger innovative research, additions to existing collections as well as acceleration of the publication of scientific research.

GBIF is intended to provide support for the following areas:

- Use of natural resources: GBIF opens and accelerates access to biodiversity-related information, which due to their topicality, accuracy, and scientific thoroughness safeguard sound decision-making on the use of natural resources.
- Biological research: The main motivation of the GBIF concept is to make contributions to science. GBIF is to show up synergies between existing projects and stimulate national efforts in the area of bio-informatics.
- Knowledge management: GBIF will give a crucial impetus to the further development of international biodiversity projects whose aim is to promote the exchange of data by establishing and providing the appropriate systems and standards. Consequently, GBIF will globally increase the efficiency of scientists and computer experts working in this field, while facilitating access to new data. This will free up personnel resources at the national level. The GBIF catalogue of known biological species, as the central product, will, through electronic links, grant access to other databases and meta-data.

According to the Business Plan of the GBIF project, the following objectives will be aimed at over the next 10 to 15 years:

- The essential information on 85% of species of natural history are to be captured in electronic form, and be retrievable via the Internet.
- The electronic catalogue of biological species is to include at least 90% of all explored species.
- Complete networking of all necessary databases.
- Full functionality of search engines.
- Every member state is to have properly trained staff to ensure the optimal use of GBIF

A description of the planned phased implementation of the entire project can be found on the official homepage (**www.gbif.org**).

4.5 Proposal for the future structure of mutual data exchange and of the co-ordination among National Focal Point (NFP), National Board, Scientific Community, and the competent ministries

The central elements of a future structure of information and co-ordination should be the BMLFUW (the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, being Austria's official representative and direct contact for GBIF), the BMBWK (the Austrian Federal Ministry of Education, Science and Culture, as the initiator of this feasibility study), the Federal Environment Agency, in its capacity as the organising GBIF-National Focal Point, and the Scientific Advisory Council of this feasibility study including all its members, that is, representatives of the Austrian Academy of Sciences, the Museum of Natural History, the Institute of Botany of the University of Vienna, the Working Group of the Austrian Botanic Gardens, the Biology Centre of the Museum of Upper Austria, the Federal Office for Agrobiology, the Herberstein Zoo, and the Institute of Applied Microbiology at the University of Agricultural Sciences (National Board).

The GBIF organisation disseminates information on two levels: first, it informs the public through its website (**www.gbif.org**) and second, it disseminates information via e-mail to the official contact points or its representatives of each member state, respectively.

To ensure the dissemination of relevant information to the National Board by way of a short report drawn up by the BMLFUW or the NFP, a meeting should be held twice a year. These meetings would be organised by the NFP. Urgent information would be sent out to members of the National Board and BMBWK by e-mail whenever necessary. Members of the National Board would communicate this information to scientific institutions by using predefined mailing lists.

As part of the "working sessions", advanced national projects should be initiated, examined, and co-ordinated in terms of content, serving as Austria's contribution to GBIF, and the progress of such projects should be monitored and documented on the occasion of these sessions. These meetings are expected to result in specific recommendations regarding future action and proposals for the appropriate implementation of projects. The National Board would thus be the co-ordinator of Austria's contributions to the GBIF initiative.

Consequently, the National Focal Point would be responsible for the organisation of the working sessions mentioned above, the proper processing and dissemination of relevant information on GBIF and Austria's contribution to the members of the National Board and the answering of questions of third parties as well as the provision of support to BMLFUW in its capacity as the direct GBIF contact point. As regards the answering of technical questions, the National Focal Point, responsible for organisational matters, should co-operate more closely

with the Museum of Natural History and the Austrian Academy of Sciences and additional experts for special animal and plant groups at other institutions. Matters of electronic data processing, particularly questions dealing with the set up of a network of databases, should be directed to the Biology Centre of the Museum of Upper Austria. Experts of different institutions, as soon as they have been appointed, will be listed, by name and address, on the website **www.biodiv.at/gbif**.

5 RESULTS

As the survey was carried out between August and November 2001, the resulting data reflect the situation of the collections and databases within this period.

Certain figures in the tables appear in green or red, indicating special features in connection with the scope or status of the Austrian collections and databases. **Green figures** indicate particularly significant and favourable features demonstrating the high value of the collections and databases. **Red figures** indicate a status requiring improvement or an urgent need for action.

The following abbreviations have been used for the tables and illustrations:

AG LC (agricultural living collections)
Agric. (agricultural)
Assoc. (Association)
BO LC (botanical living collections)
BO SC (botanical specimen collections)
CC (conservation collections)
DB (databases)
DR (data records)
EC (exhibition collections)
Fed. gov. (Federal government)
Fed. prov. (Federal province)
LC (living collections)
Microbiol. (microbiological)
MO (microorganism/s)
MO LC (microbiological living collections)
Munic. (Municipality)
Nf (need for)
NfA (need for action)
RC (reference collections)
SC (specimen collections)
ZO LC (live animal collections in zoos)
ZO SC (zoological specimen collections)

5.1 Collections

5.1.1 Actual status of collections

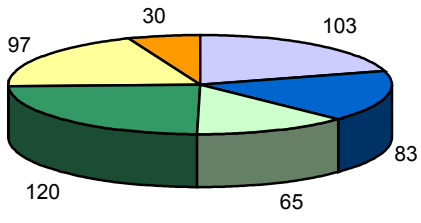
5.1.1.1 Number of collections, correlation between the collection owners and type of collection, primary purpose, and use category of collections

Number of surveyed collections

In total, **498 collections** across Austria were identified. The collections may be allocated to the fields of zoology, botany, agriculture, and microbiology as follows:

Specialised Areas	Specimen collections	Living collections
Zoology	103	83
Botany	65	120
Agriculture		97
Microbiology		30
Total	*168*	*330*

Fig.1: Number of collections in the individual disciplines



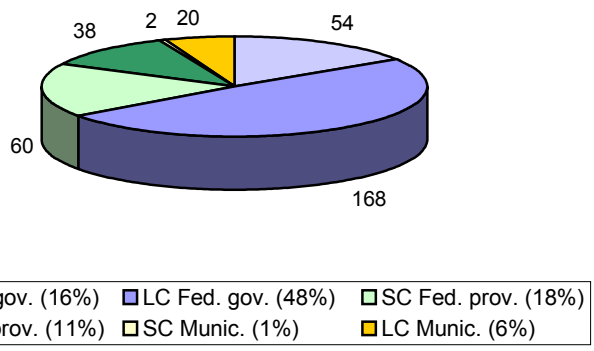
Number of collections in the public and private sector

Public sector:

342 collections were identified in the public sector.

Owner of collections	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
Federal government	19	35	17	69	58	24
Federal province	48	12		4	34	
Municipality	1	1	5	15		
Total	*68*	*48*	*22*	*88*	*92*	*24*

Fig. 2: Number of collections in the public sector

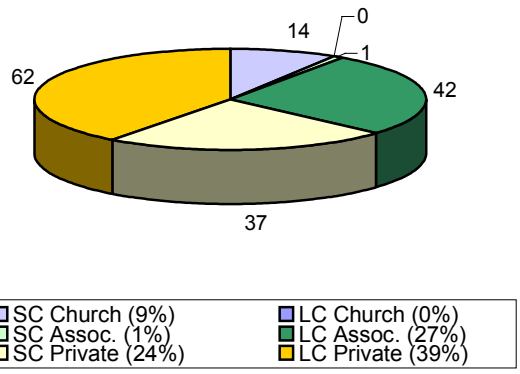


Private sector:

156 collections were identified in the private sector.

Owner of collections	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
Church	10	4				
Association	1		34	5	3	
Private	24	13	27	27	2	6
Total	*35*	*17*	*61*	*32*	*5*	*6*

Fig. 3: Number of collections in the privat sector



Number of collections per owner based on primary purpose of collections

The collections were classified as conservation collections, reference collections, and exhibitions collections according to their primal purpose.

Public sector:

In the public sector, **152 conservation collections**, **129 reference collections**, and **61 exhibition collections** were identified.

Owner of collections	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
Conservation collections[a]						
Federal government				32	57	24
Federal province				1	34	
Municipality				4		
Total				*37*	*91*	*24*
Reference collections[b]						
Federal government	19	35		11	1	
Federal province	47	12				
Municipality	1	1		2		
Total	*67*	*48*		*13*	*1*	
Exhibition collections[c]						
Federal government			17	26		
Federal province	1			3		
Municipality			5	9		
Total	*1*		*22*	*38*		
Sum total	*68*	*48*	*22*	*88*	*92*	*24*

[a] Conservation collections serve to conserve organisms (such as cultivation crops, but also organisms in various species protection breeding programmes).
[b] Reference collections serve to compare organisms (such as "classical" museum collections).
[c] Exhibition collections serve to display special themes for visitors to such collections (such as in museum or zoo exhibitions).

Fig. 4: Primary purpose of collections in the public sector

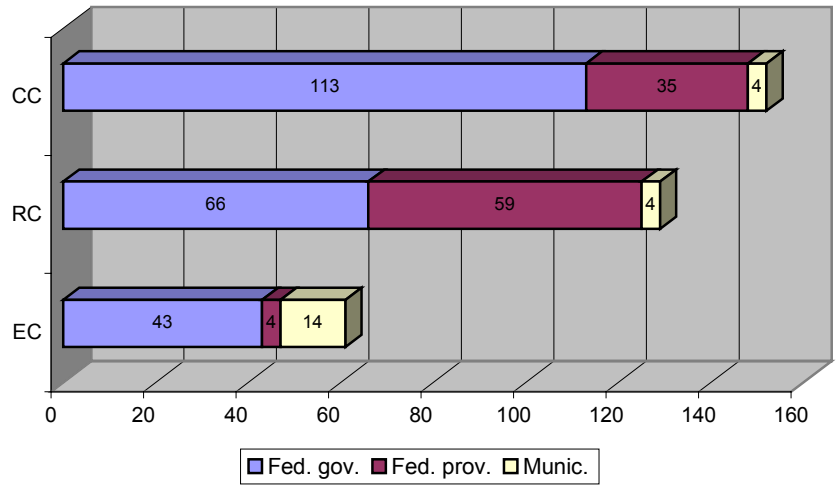
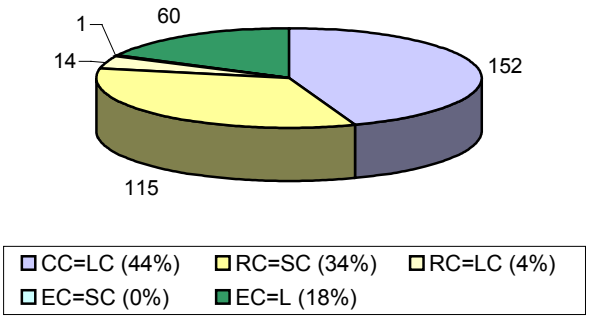


Fig. 5: Percentage of specimen and living collections among the various collection types



Private sector:

In the private sector, **22 conservation collections**, **53 reference collections**, and **81 exhibition collections** have been identified.

Owner of collections	**Specimen collections**		**Living collections**			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
Conservation collections						
Association			1	3	3	
Private				7	2	6
Total			*1*	*10*	*5*	*6*
Reference collections						
Church	10	4				
Association	1					
Private	23	13		2		
Total	*34*	*17*		*2*		
Exhibition collections						
Association			33	2		
Private	1		27	18		
Total	*1*		*60*	*20*		
Sum total	*35*	*17*	*61*	*32*	*5*	*6*

Fig. 6: Primary purpose of collections in the private sector

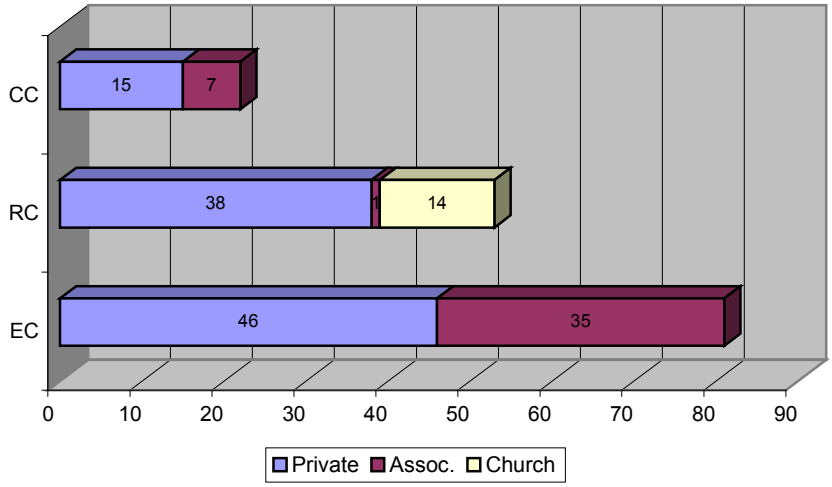
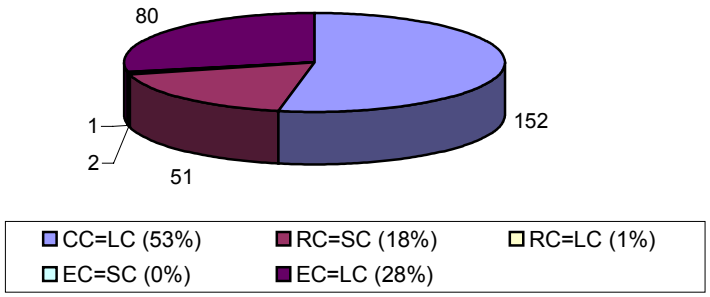


Fig. 7: Percentage of specimen and living collections among the various collection types



Number of collections per use category based on the individual specialised areas

The collections were allocated to the following categories in accordance with their use - collection owners were offered to choose several categories per collection, so that identical collections my be quoted repeatedly.

Use of collections	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
Research	89	62	74	55	65	30
Conservation	8	1	73	62	97	30
Teaching	53	24	77	55	13	19
Exhibition collection	63	9	82	83	4	
Public relations	46	12	82	74	6	
Taxonomic reference	90	65	13	23	5	23
Nature conservation	58	36	72	19		
Geographical reference	86	56	18	20		5
Historic documentation	77	43	5	14		2
Crop collection		5		19	94	
Reintroduction		1	46	5	2	
Farm animal collection			13		1	
Others	2		22	3		

Fig. 8: Number of specimen collections per use category

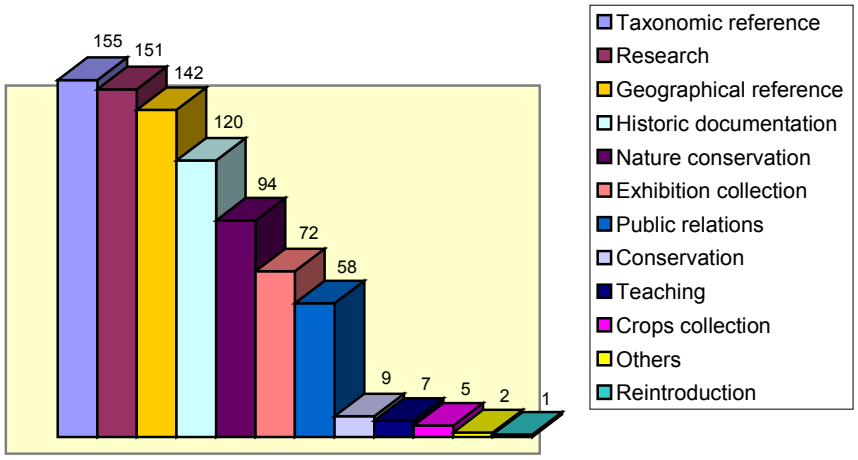
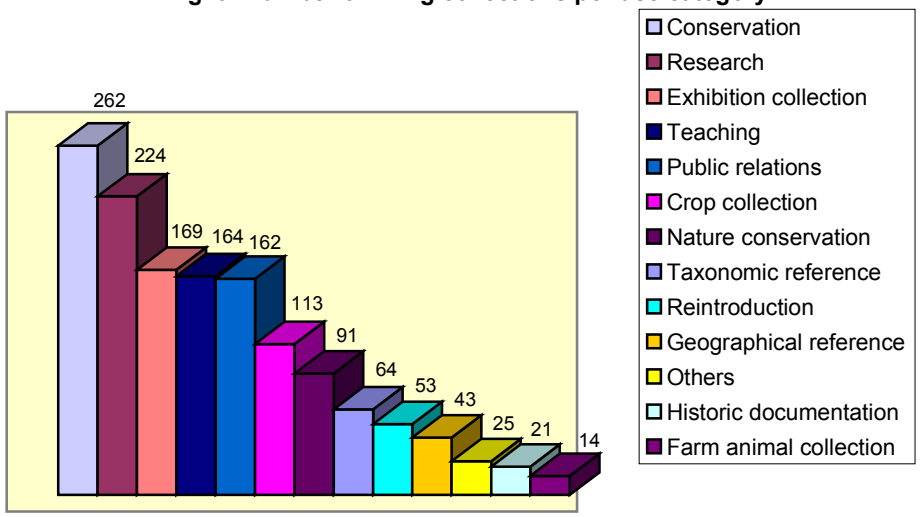


Fig. 9: Number of living collections per use category



Number of collections per use category based on owners

The collections were allocated to the following categories in accordance with their use - collection owners were offered to choose several categories per collection, so that identical collections my be quoted repeatedly.

Use of collections	Public sector			Private sector		
	Federal government	Federal province	Municipality	Church	Association	Private
Research	176	89	7	5	38	70
Conservation	144	43	11		42	38
Teaching	121	38	12	6	34	30
Exhibition collection	81	43	21	8	42	54
Public relations	89	34	17	4	38	46
Taxonomic reference	92	64	6	9	8	41
Nature conservation	57	49	7	2	38	40
Geographical reference	65	60	2	7	16	36
Historic documentation	54	57	5	9	1	16
Crop collection	70	37	1		5	5
Reintroduction	25	3	3		15	13
Farm animal collection	4		2		3	5
Others	1		3		8	15

Fig. 11: Number of collections per use cetagory in the private sector

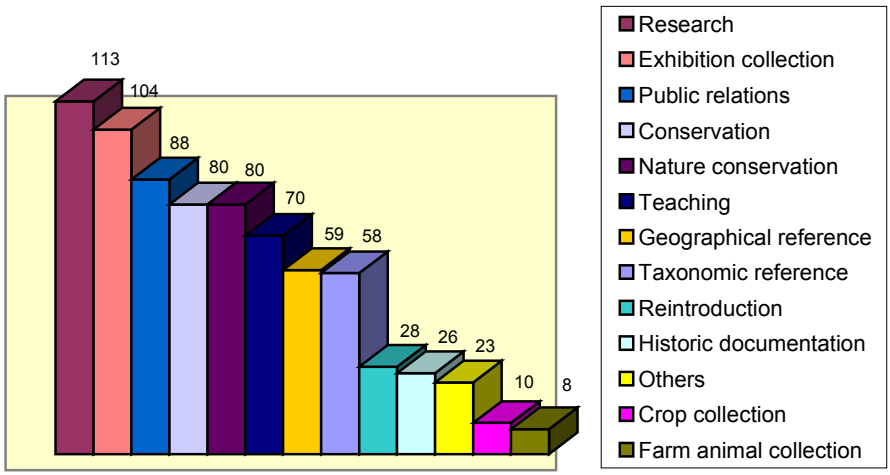
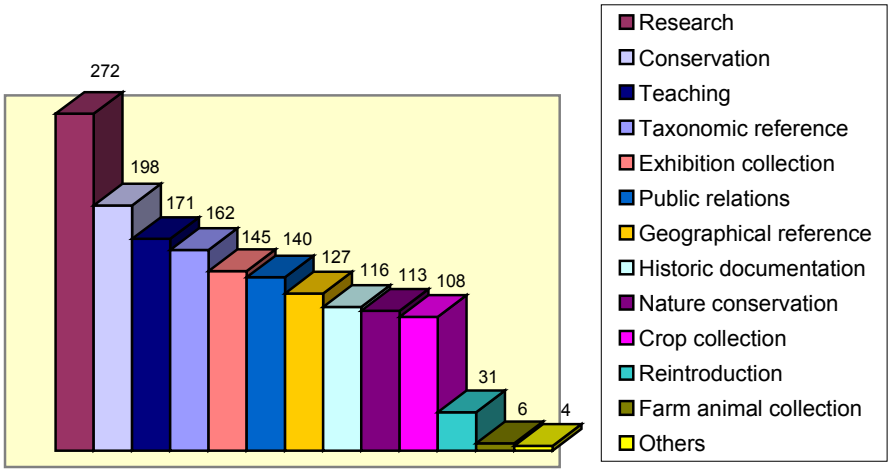


Fig. 10: Number of collections per use category in the public sector



5.1.1.2 Absolute number of collection objects in the collections

All together, the collections comprise at least **46,531,024 collection objects**.

Owner of collections	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
Public sector						
Federal government	20.933,500	8.218,000	32,969	204,502	8,754	24,016
Federal province	12.651,788	2.127,500		6,500	1,615	
Municipality	1,500	40,000	1,311	23,040		
Private sector						
Church	290,822	28,000				
Association	250,000		6,848	5,600	263	
Private person	1.416,100	217,500	5,754	31,475	210	3,457
Total	*35.543,710*	*10.631,000*	*46,882*	*271,117*	*10,842*	*27,473*

5.1.1.3 Systematic content of collections

Explanatory note: The following tables present the systematic content of collections using the traditional systematic classification system for reasons of historical comparability.

Number of collections or collection parts based on their systematic content

Unlike with living collections, specimen collections often contain collection objects belonging to several systematic categories (e.g. mammals and birds or algae, mosses and mushrooms, etc.). Therefore, the number of specimen collections or collection parts in relation to the respective systematic category is much higher than the total number of specimen collections kept as one collection by individual institutions and collectors.

Public sector:

Systematic content of collections	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
VERTEBRATES (Vertebrata)						
Fish (Pisces)	8		1			
Reptiles (Reptilia)	8		2			
Amphibia (Amphibia)	8		1			
Mammals (Mammalia)	11		3		1[a]	
Birds (Aves)	10		3			
INVERTEBRATES (Evertebrata)						
var. Invertebr. (Evertebr. varia)	7					
Arthropods (Arthropoda)	2		1			
Insects (Insecta)	115		6			
Crustaceans (Crustacea)	5					
Cnidarians (Cnidaria)			1			
Annelids (Annelida)	4		1			
Sponges (Porifera)			1			
Arachnids (Arachnida)	2					
Echinoderms (Echinodermata)			1			
Molluscs (Mollusca)	11		1			
PROTOZOANS (Protozoa)						
Ciliates (Ciliata)	1					
Micro-preparations[b]	1					

[a] Gene bank (animal sperma collection) of endangered farm animals
[b] Various protozoans without ciliates, but also algae

Systematic content of collections	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
PHANEROGAMS (Phanerogamae)						
Flowering plants and **ferns**		27		88	91[a]	
CRYPTOGAMS (Kryptogamae)						
Algae		13				
Lichen		17				
Mosses		17				
Fungi		12				
MICROORGANISMS						
Microfungi						13
Prokaryotes	1					11

[a] 15 arboreta und 76 gene banks (seed collections)

Private sector:

Systematic content of collections	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
VERTEBRATES (Vertebrata)						
Fish (Pisces)	2		6			
Reptiles (Reptilia)	2		8			
Amphibia (Amphibia)	2		4			
Mammals (Mammalia)	4		11			
Birds (Aves)	6		13			

INVERTEBRATES (Evertebrata)						
Var. invertebrates (Evertebrata varia)	2					
Arthropods (Arthropoda)	1		2			
Insects (Insecta)	51		7			
Crustaceans (Crustacea)	2					
Tunicates (Tunicata)			1			
Cnidarians (Cnidaria)			1			
Annelids (Annelida)	1		1			
Sponges (Porifera)			1			
Arachnids (Arachnida)	1		2			
Echinoderms (Echinodermata)			1			
Molluscs (Mollusca)	7		3			

Systematic content of collections	**Specimen collections**		**Living collections**			
	Zoological	Zoological	Zoological	Botanical	Agricultural	Microbiol.
PHANEROGAMS (Phanerogamae)						
Flowering plants and **ferns**		9		32	5[a]	
CRYPTOGAMS (Kryptogamae)						
Algae		3				
Lichen		3				
Mosses		7				
Fungi		1				
MICROORGANISMS						
Microfungi						2
Prokaryotes						4

[a] Arboria (fruit trees)

Number of specimen collections or collection parts with type specimens in relation to systematic content

The compiled specimen collections comprise at least **316,552[a] type specimens**.

Systematic content of collections	Zoological specimen collections	
	Number of collections	Number of type specimens
VERTEBRATES (Vertebrata)		
Mammals (Mammalia)	13	420
Birds (Aves)	13	1,000
Total		*1,420*
INVERTEBRATES (Evertebrata)		
Insects (Insecta)		
Flies (Diptera)	12	6,200
Hymenopterans (Hymenoptera)	13	12,000
True bugs (Hemiptera)	10	2,070
Beetles (Coleoptera)	21	789
Dragonflies (Odonata)	7	10
Butterflies (Lepidoptera)	18	168
Total[a]		*21,237*
Other invertebrates		
Various (Evertebrata varia)	6	20
Crustaceans (Crustacea)	6	500
Annelids (Annelida)	4	6
Arachnids (Arachnida)	4	1,504
Molluscs (Mollusca)	15	5,080
Total		*7,110*
PROTOZOANS (Protozoa)		
Ciliates (Ciliata)	1	2,000
Sum total[a]		*31,767*

[a] For several very large insect collections, the number of type specimens could not even be estimated. The actual number of type specimens in the Austrian zoological specimen collections is therefore substantially higher then indicated.

Systematic content of collections	Botanical specimen collections	
	Number of collections	Number of type specimens
PHANEROGAMS (Phanerogamae)		
Flowering plants and **Ferns** [a]	13	260,318
CRYPTOGAMS (Kryptogamae)		
Algae	4	2,500
Lichen	6	4,806
Mosses	6	3,500
Fungi	8	7,700
Various pteridophytes		5,150
Total		*23,656*
Various botanic collections		811
Sum total [a]		*284,785*

[a] For the botanical specimen collections in the herbaria of the University of Graz and the Museum of Upper Austria in Linz (flowering plants), no information on the number of type specimens could be provided. At both institutes the labelling of specimens as types is just at the beginning. Therefore, a larger actual number (than shown here) of type specimens also has to be assumed for the botanical specimen collections.

5.1.1.4 Historical significance of the collections

Specimen collections are considered historically valuable if their specimens are especially old, i.e. collected prior to 1850. As regards the botanical living collections, historical significance either refers to the point in time the collection was founded or to the fact that the collection was started by a botanist or scientist of historical importance. But sometimes also collection objects exist that are almost 200 years old.

With regard to the agricultural collections, additional criteria were used to classify the historicity, i.e. that often traditional local varieties or species and varieties that are no longer available on the market are concerned.

Number of collections or collection parts of historical significance in relation to the systematic content of the collections

Systematic content of collections	Specimen collections		Living collections			
	Zoological[a]	Botanical[a]	Zoological[b]	Botanical[c]	Agric.[d]	Microbiol.
VERTEBRATES (Vertebrata)						
Various (Vertebrata varia)	3					
Fish (Pisces)	2		1			
Reptiles (Reptilia)	1		1			
Amphibia (Amphibia)	1					
Amphibia and **Reptiles**	1					
Mammals (Mammalia)	2		2		1	
Birds (Aves)	2		1			
INVERTEBRATES (Evertebrata)						
Insects (Insecta)						
Various (Insecta varia)	1					
Flies (Diptera)	1					
Beetles (Coleoptera)	2					
Neuropterans (Neuroptera)	1					
Butterflies (Lepidoptera)	2					
True bugs (Hemiptera)	1					
Other invertebrates						
Various (Evertebrata varia)	3					
Crustaceans (Crustaceae)	1					
Molluscs (Mollusca)	2					

PHANEROGAMS (Phanerogamae)						
Flowering plants and **Ferns**		14		18	96	
CRYPTOGAMS (Kryptogamae)						
Algae		8				
Lichen		8				
Mosses		7				
Fungi		6				

[a] Zoological specimen collections whose oldest specimens were collected between 1500 and 1850. The oldest botanical specimens were collected prior to 1850. Collections which may be of historical significance in ecological terms (destruction of natural habitat) are not taken into account.
[b] At Schönbrunn Zoo, the origins of 4 living collections date back to 1752. At Herberstein Zoo, 1 living collection (fallow deer) originated in 1664.
[c] Living collections established between 1799 and 1922
[d] All agricultural living collections were classified as historically significant, since, irrespective of their inception date, they comprise traditional country varieties or varieties and types no longer available on the market.

5.1.1.5 Geographical coverage

Explanatory note: The following abbreviations are used in the various tables: Austria (A), Burgenland (B), Carinthia (C), Federal Provinces (Fed. Prov.), Living Collections (LC), Lower Austria (N), Upper Austria (U), Salzburg (S), Styria (St), Tyrol (T), Vienna (W), Vorarlberg (V).

Number of collections or collection parts by geographic region based on the systematic content

Various geographical foci were used to classify the collections accordingly.

Systematic content	Zoological specimen collections				Zoological living collections			
	World	Europe	A	Fed.Prov.	World	Europe	A	Fed.Prov.
VERTEBRATES (Vertebrata)								
Fish (Pisces)	7			1: C,N,V	6	1		1: C
Reptiles (Reptilia)	8			1: N,V	9	1		1: C
Amphibia (Amphibia)	8			1: N,V	4	1		
Mammals (Mammalia)	10	1		1: C,N,St,V	13	1	1[a]	
Birds (Aves)	11	1		1: C,N,V	15	2		
INVERTEBRATES (Evertebrata)								
Insects (Insecta)								
Various (Insecta varia)	5			1: C,N,V				
Proturans (Protura)	1							
Zorapterans (Zoraptera)	1							
Bristletails (Silverfish)	1							
Diplurans (Diplura)	1		1					
Mayfly (Ephemeroptera)	3							
Twisted-wing parasites (Streps.)	1							
Mantids (Mantodea)	2					1		
Archaeognathans (Archaeognatha)	1							
Flies (Diptera)	7	1	2	1: C,N,V				

Fleas (Siphonaptera)	1							
Thrips (Thysanoptera)	1							
Webspinners (Embioptera)	1							
Phasmids (Phasmatodea)	2				4			
Rock crawlers (Grylloblattodea)	1							
Hymenopterans (Hymenoptera)	9	2	1	1: C,N,V	1			
Orthopterans (Orthoptera)	6		1		1		1	
Beetles (Coleoptera)	13	4	2	1: C,V	1			
Snakeflies (Raphidioptera)	3							
Caddisflies (Trichoptera)	2	1	1	1: B				
Dragonflies (Odonoata)	5	1		1: B,N				
Neuropterans (Neuroptera)	4	1		1: B				
Earwigs (Dermaptera)	2			1: C				
Cockroaches (Blattodea)	2			1: C,N	2			
Dobsonfly (Megaloptera)	2							
Butterflies (Lepidoptera)	13	3	2	1: B,N,V	2			
Scorpionflies (Mecoptera)	2			1: B				
True bugs (Hemiptera)	6		2	1: C,N,V				
Springtails (Collembola)	1		1					
Booklice (Psocoptera)	1							
Stoneflies (Plecoptera)	3							
Termites (Isoptera)	2							

Other invertebrates								
Various (Evertabrata varia)	7			1: C				
Arthropods (Arthropoda)	2		1		2	1		
Crustaceans (Crustaceae)	6							
Tunicates (Tunicata)					1			
Cnidarians (Cnidaria)					2			
Annelids (Annelida)		1			2			
Sponges (Porifera)					2			
Arachnids (Arachnida)	3	1			2			
Echinoderms (Echinodermata)					2			
Molluscs (Mollusca)	11	2	1	1: C,N,V	2	1		
PROTOZOANS (Protozoa)								
Ciliates (Ciliata)	1							
Micro-preparations[b]	1							

[a] Gene bank (animal sperm collection) for endangered working animals
[c] Various protozoans without ciliates, but also algae

Systematic content	**Botanical specimen collections**				**Botanical living collections**			
	World	Europe	A	Fed. Prov.	World	Europe	A	Fed. Prov.
PHANEROGAMS (Phanerogamae)								
Flowering plants and **ferns**	22	30	30	1: B 1: N 4:U 3: S 1: T 1: V 1: B,N,W 4: C,U,S, St,T 1: N,U,St,V	83	8	9	1: N,T 3: U,St
					Agricultural botanic LC			
					5	54	20	1: U,St 4: V 15: T

CRYPTOGAMS (Kryptogamae)								
Algae	8	12	11	1:S 1: T 1: C,N,U,St 1: C,St,T				
Mosses	12	17	17	1.B 3:U 2: S 1: T 1:V 2: C,N,U,S,St 1: C,St,T 1: U,S,T				
Fungi	8	9	9	1: U 2: B,N,St,W 1: C,N,U,S,St				
Lichen	9	13	13	2: U 1: N 1: T 1: V 3: C,N,U,S,St 1: C,St,T				

Systematic content	**Microbiological specimen collections**			**Microbiological Living collections**		
	World	Europe	Austria	World	Europe	Austria
Prokaryotes	1			9	1	4
Microfungi				10	1	3

5.1.1.6 State of collections

As all information presented here exclusively refers to the status at the time of the survey, it is not possible to use it as a basis for making a general statement about future developments. Despite the fact that the qualitative status has been described as "sufficient" in many cases, severe future problems will have to be expected in some areas.

Specimen collections:

5.1.1.6.1 Current maintenance of specimen collections by a curator

It is to be noted here that the formal position of a curator exists only in a few public institutions. "Current maintenance" is a term that includes more than the exclusive storage of collections. As no details regarding maintenance were surveyed, no statement can be made about the quality of the maintenance.

Maintenance	Zoological specimen collections		Botanic specimen collection	
	Number	%	Number	%
Yes	93	**90.3**	63	**96.9**
No	10	**9.7**	2	**3.1**
Total	*103*	*100.0*	*65*	*100.0*

5.1.1.6.2 Regular disinfestation of specimen collections

Regular disinfestation	Zoological specimen collections		Botanic specimen collection	
	Number	%	Number	%
Yes	76	**73.7**	63	**96.9**
No	5	4.9	0	0.0
Not applicable	15[a]	14.6	2[a]	3.1
Not available	7	6.8		
Total	*103*	*100.0*	*65*	*100.0*

[a] e.g. alcoholic preparations

Living collections:

5.1.1.6.3 Current management of living collections in terms of scientific content

Management in terms of scientific content in this context implies more than just measures to ensure the collection's survival, which is of course necessary to a limited extent for every living collection.

Maintenance	Botanical living collections		Microbiological living collections	
	Number	%	Number	%
Yes	48	40	3	10
No	72	**60**	27	**90**
Total	*120*	*100*	*30*	*100*

5.1.1.6.4 Storage or cultivation conditions for living collections

Storage or cultivation conditions	Botanical LC		Agricultural LC		Microbiological LC	
	Number	%	Number	%	Number	%
Optimal	7	6.0	29	29.9	5	16.7
Adequate	71	59.0	68	70.1	22	73.3[a]
Problematic	12	**10.2**			3	**10.0**
Not applicable						
Not available	30	24.8				
Total	*120*	*100.0*	*97*	*100.0*	*30*	*100.0*

[a] Depending on the storage conditions and various conservation methods, recultivation of micro-organism strains after 10 to 15 years is absolutely necessary. Since many collections were only established in the last decade, action will be necessary in the near future.

5.1.1.6.5 Germination test or rejuvination of living collections

Germination test or rejuvination[a]	Botanical LC		Agricultural LC		Microbiological LC	
	Number	%	Number	%	Number	%
Completely	10	8.4	92	**94.8**	7	23.3
In part	2	1.7	5	5.2	16	53.4
None	27	**22.7**			7	**23.3**
Not applicable	56[b]	46.2				
Not available	25	21.0				
Total	*120*	*100.0*	*97*	*100.0*	*30*	*100.0*

[a] Rejuvination is the restoration of plants and micro-organisms to youth.
[b] Pure exhibition collections

5.1.1.6.6 Preservation of genetic purity for living collections

Genetic purity ensured	Botanical LC		Agricultural LC		Microbiological LC	
	Number	%	Number	%	Number	%
Completely	29	**24.4**	97	**100**	30	**100**
In part	10	8.4				
No secured	4	3.4				
Not available	21	17.6				
Not applicable	56[a]	46.2				
Total	*120*	*100.0*	*97*	*100*	*30*	*100*

[a] Pure exhibition collections

5.1.1.6.7 Phytosanitary status of living collections

Phytosanitary status	Botanical LC		Agricultural LC	
	Number	%	Number	%
Good	85	**70.8**	96	**98.9**
Problematic	9	7.5		
Not available	26	21.7		
Not applicable			1[a]	1.1
Total	*120*	*100.0*	*97*	*100.0*

[a] Animal sperm collection

5.1.1.6.8 Known origin of collection objects of living collections

Data on the origin relate to where the objects of a collection come from. This can be, for instance, the natural habitat, another botanic garden or zoo or also any other known source of origin. In the case of zoological living collections, the origin only then is not known if officially impounded animals are acquired whose origin is difficult to elicit. Another reason for unknown origin is the acquisition of existing collections without records on the origin of the animals.

Origin of collection objects	**Zoological LC**		**Botanical LC**		**Agric. LC**		**Microbiol. LC**	
	No. of LC[b]	% of objects	No. of LC[b]	% of objects	No. of LC[b]	% of objects	No. of LC[b]	% of objects
Known at least in part	82	mammals 94 birds: 93 rest: 99-100	49 (39[d])	flower. pl. + ferns: 71,4 (52.7[d])	97	mam-mals100 flower. pl. 95.7	30 (11[d])	prok.: 98 (35[d]) micro-fungi: 95 (58)
Not known or not relevant[a]	1		71		0		0	
Total	*83*		*120*		*97*		*30*	

[a] Not relevant – relates to origin data for pure exhibition and teaching collections, for instance.
[b] Number of living collections with collection objects of known origin.
[c] Weighted % of collection objects with known origin.
[d] Number of prokaryote living collections with objects whose original location in nature is known and % of objects whose original location in nature is known.

5.1.1.6.9 Secured offspring from the original location in the wild

Secured offspring from the original location in nature	**Botanical living collections**	
	Number[b]	%[c]
Known at least in part	25	Flowering plants: 45.1
Not known or not relevant[a]	95	
Total	*120*	

[a] Not relevant – relates to origin data for pure exhibition and teaching collections, for instance. Not relevant for zoological living collections as these animals usually do not stem from the natural habitat, but from offspring from other zoos.
[b] Number of living collections with collection objects, whose secured direct offspring from the location in the natural habitat is known.
[c] Weighted % of collection objects with secured direct offspring from the location in the natural habitat.

5.1.1.6.10 Veterinary care for living collections

Veterinary care	Zoological living collections		Agricultural living collections	
	Number	%	Number	%
Always available	53	63.9	1[a]	100.0
As needed	30	36.1		
Lacking	0	0.0		
Total	*83*	*100.0*	*1*	*100.0*

[a] Animal sperm collection.

5.1.1.6.11 Expert animal care

Expert animal care	Zoological living collections		Agricultural living collections	
	Number	%	Number	%
Available	79	95.2	1[a]	100.0
Necessary	3	3.6		
Not necessary	1	1.2		
Total	*83*	*100.0*	*1*	*100.0*

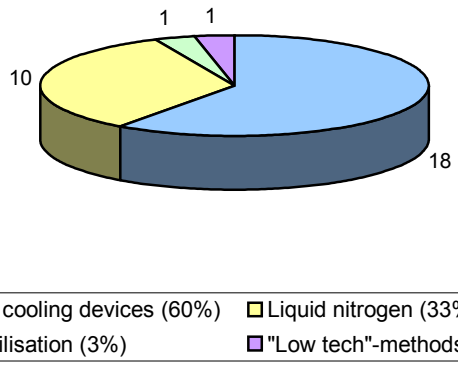
[a] Animal sperm collection.

5.1.1.6.12 Preservation of micro-organism strain collections

In the case of the application of mixed preservation methods, the predominantly applied method was used for the assessment.

Method of preservation	Microbiological living collections	
	Number	%
Conventional cooling devices	18	60.0
Liquid nitrogen	10	33.3
Lyophilisation	1	3.3
"Low tech" methods	1	3.3
Total	*30*	*100.0*

Fig.12: Preservation methods for MO collections

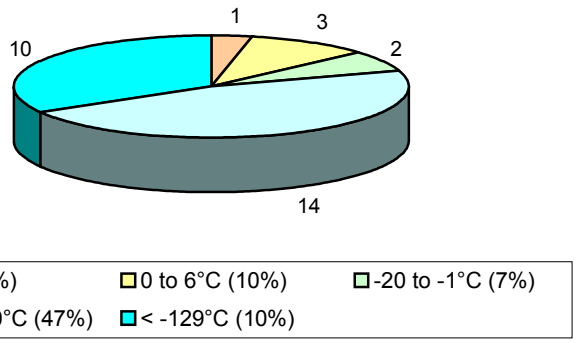


5.1.1.6.13 Cooling temperatures for keeping micro-organism strain collections

In the case of the application of different cooling temperatures, the predominantly applied storage temperature was used for the assessment.

Cooling temperature in °C	Microbiological living collections	
	Number	%
> 6	1	3.3
0 to 6	3	10.0
- 20 to - 1	2	6.7
- 89 to - 70	14	46.7
< - 129	10	33.3
Total	*30*	*100.0*

Fig.13: Cooling temperatures for storing MO collections

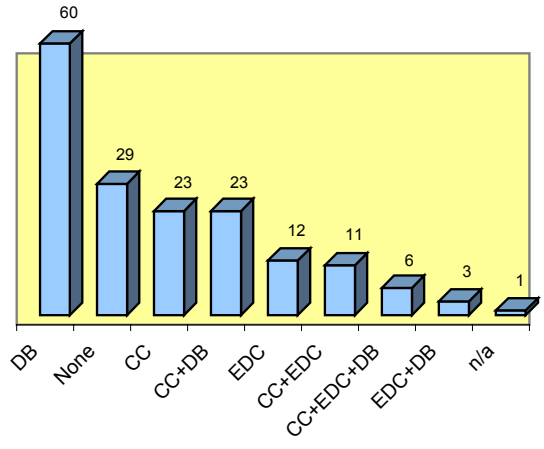


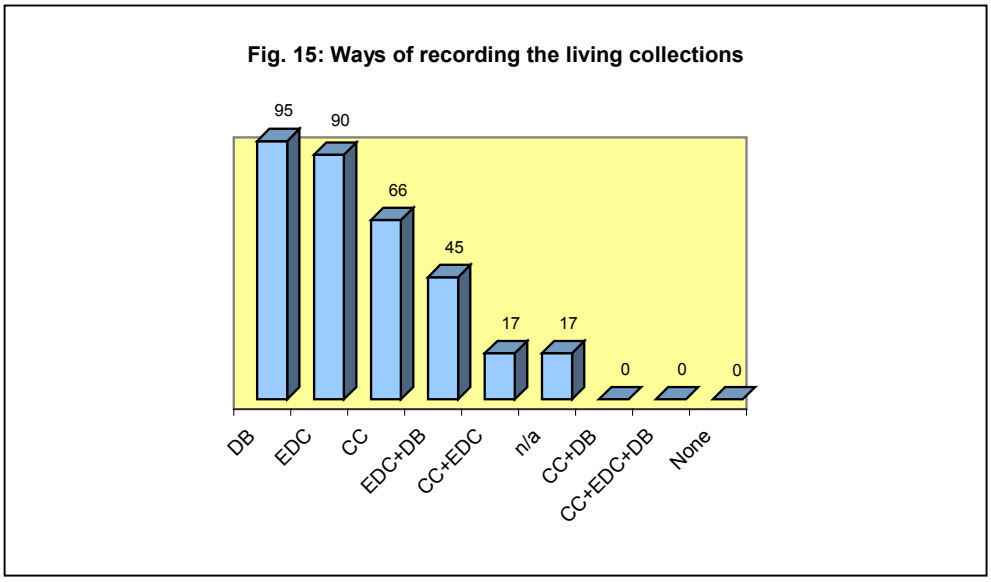
5.1.1.7 Documentation of the collection data

Type of records for the collections	Specimen collections				Living collections							
	Zoological		Botanical		Zoological		Botanical		Agricultural		Microbiol.	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
CC[a]	14	13.6	9	13.8	26	31.0	28	23.3	4	4.1	8	27.0
EC[b]	6	5.8	6	9.2	34	41.0	35	29.2	6	6.2	15	50.0
DB[c]	43	**41.7**	17	**26.2**	17	**21.0**	31	**25.8**	40	**41.2**	7	**23.0**
CC + EC	8	7.8	3	4.6			15	12.5	2	2.1		
CC + DB	18	17.5	5	7.7								
EC + DB	1	1.0	2	3.1					45	**46.4**		
CC+EC+DB	1	1.0	5	7.7								
None	11	**10.6**	18	**27.7**	6	**7.0**	11	**9.2**	0	0.0	0	0.0
n/a[d]	1	1.0										
Total	*103*	*100.0*	*65*	*100.0*	*83*	*100.0*	*120*	*100.0*	*95*	*100.0*	*30*	*100.0*

[a] card catalogue
[b] electronic data collection
[c] database
[d] not available

Fig. 14: Ways of recording the specimen collections





5.1.1.8 Growth of collections

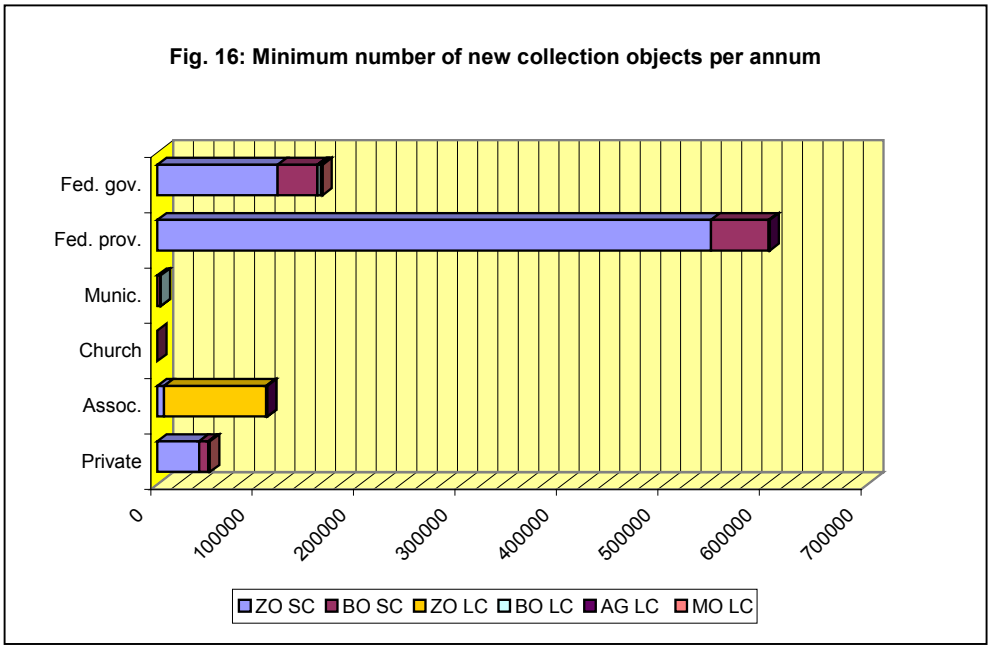
The growth of collections refers to the number of new objects added to an existing collection. This study aimed at surveying the growth of each of the individual collections, since this factor informs about the status of individual collections, e.g. whether the collection is under construction, established, or perhaps even stagnating. Collections may stagnate if resources for collection maintenance are lacking. Nevertheless, they may enjoy high botanic value or be of great value as genetic resources (e.g. historical collections or established reference collections). In this case, the need to act is urgent in order to prevent the possible decay of such collections. In the following, the information on the growth of collections is intended to point out the continuously increasing need for action with regard to the management of collections. For this documentation, the surveyed data was summarised for each owner group.

Minimal growth of new collection objects per annum of the individual specialised areas, related to the respective owner groups

The study identified an annual growth of at least 928.768 collection objects. The following table shows the absolute figures for additions to the various specialised areas. Parentheses contain the number of collections to which the additions relate to and the total number of collections per specialised area. Since for several collections no corresponding data was available, the real absolute annual growth is certainly higher than the stated numbers.

Owner of collections	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
	Number of new collection objects per annum					
Public sector						
Federal Government	118,520 (17 of 19)	38,890 (29 of 35)	476 (5 of 17)	2,869 (31 of 69)	133 (58 of 58)	2,010 (24 of 24)
Federal Province	545,475 (35 of 48)	56,900 (10 of 12)		910 (3 of 4)	84 (34 of 34)	
Municipality		3,000 (1 of 1)	332 (5 of 5)	32 (2 of 15)		
Private sector						
Church	2 (1 of 10)	100 (1 of 4)				
Association	6,500 (1 of 1)		100,615 (17 of 34)[a]	1,050 (2 of 5)	22 (3 of 3)	
Private	41,100 (18 of 24)	8,850 (13 of 13)	1,089 (17 of 27)	564 (10 of 27)	20 (2 of 2)	225 (5 of 6)
Total	***711,597***	***107,740***	***102,512***	***5,425***	***259***	***2,235***

[a] This growth rate mainly results from the fish farm at the Alpine Zoo of Innsbruck.

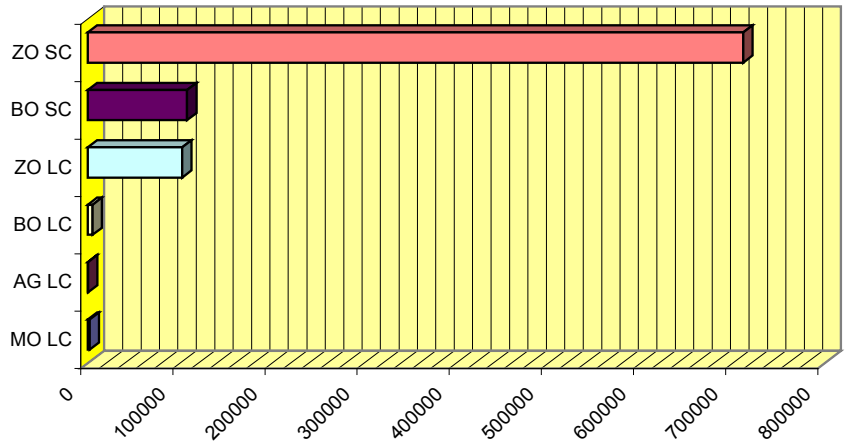


Minimum number of new collection objects per annum related to their systematic classification

Systematic classification	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricultural	Microbiol.
	Number of new collection objects per annum					
VERTEBRATES (Vertebrata)						
Various	3,707		102,269[a]		50[b]	
INVERTEBRATES (Evertebrata)						
Insects (Insecta)	269,450		n/a			
Other invertebrates	10,390		243[a]			
PROTOZOANS (Protozoa)						
Ciliates (Ciliata)	400,000					
Var. zool. objects	28,050					
PHANEROGAMS (Phanerogamae)						
Various		67,520		> 5,425[d]	209	
CRYPTOGAMS (Kryptogamae)						
Fungi		3,800				
Lichen		10,500				
Mosses		6,000				
Algae		350				
Var. bot. objects		19,570				
MICROORGANISMS						
Prokaryotes						1,065
Microfungi						1,140
Var. microbiol. obj.						30
Total	***711,597***	***107,740***	***102,512***	***5,425***	***259***	***2,235***

[a] The actual number of additions is certainly higher and could not be determined either because of the large number of offspring of some animal groups or since no relevant data was made available at all.
[b] Animal sperm collection
[c] Additions have been reported, however no reliable information on these could be acquired.
[d] Approx. 76% of the collections show an increase of objects, the amount however could only be quantified for 40% of the collections. The annual growth thus lies markedly above that of the reported value.

Fig. 17: Minimum number of new collection objects per annum in the individual disciplines



5.1.1.9 Transfer, borrowing and lendability of collection objects

Number of living collections with breeding loans

Possibility of breeding loans	Living collections		
	Zoological	Botanical	Agricultural
Yes	**68**	**11**	
In part	10	**37**[a]	
No	5	61[b]	97[c]
Not available		11	
Total	*83*	*120*	*97*

[a] The breeding loan option depends on the spectrum of tribes, their use by lenders, and the loan conditions themselves.
[b] Decision of principle made by the individual institutions, which was or may be based on reasons relating to data protection, species protection, or the cultivation method (e.g. difficult cultivation), as it does involve extremely rare and fragile objects. This decision may also be temporary and only apply until the scientific research related to the objects comes to an end.
[c] Animal sperm and seed collections.

Number of living collections with the transfer option for collection objects

Possibility of transfer	Living collections			
	Zoological	Botanical	Agricultural	Microbiological
Yes	**39**	**23**	**97**	
In part	**42**	**71**[a]		**29**
No		13[b]		1
Not available	2	13		
Total	*83*	*120*	*97*	*30*

[a] The transfer of collection material depends on the spectrum of tribes, their use by lenders, and the loan conditions themselves.
[b] Decision of principle made by the individual institutions, which was or may be based on reasons relating to data protection, species protection, or the cultivation method (e.g. difficult cultivation), as it does involve extremely rare and fragile objects. This decision may also be temporary and only apply until scientific research related to the objects comes to an end.

Number of specimen collections with the transfer option for collection objects

Possibility of borrowing	Specimen collections	
	Zoological	Botanical
Yes	**39**	**29**
In part[a]	**42**	**30**
No[a]	20	6
Not available	2	
Total	*103*	*65*

[a] Reasons explaining why there is only a restricted possibility or no possibility at all to borrow collection objects may, for instance, be both of curatorial nature (fragility of the preparation, alcoholic preparations) and also the lack of personnel, transport problems as well as existing regulations (e.g. CITES), or also due to basic considerations of the collection owner.

5.1.1.10 Scientific use of collections

Number of borrowed specimens per annum

For specimen collections, the number of borrowed specimens is a vital parameter that reflects the scientific use of collections. As other important parameters and the context have not been assessed, collections with a low lending rate may still be of high value (e.g. irreplaceable collections that are currently not subject to scientific research at national or international level).

Explanatory note: The borrowing of objects involves a large amount of effort: e.g. picking out the object, preparation work, packaging, and mailing costs, "keeping record" of the object lent out, monitoring the returned objects, providing restoration work if necessary, and rearranging the objects after their return incur considerably costs and are very time consuming. In addition, a not negligible risk of loss has to be taken into account.

Number of specimens loaned out per annum	Specimen collections	
	Zoological	Botanical
	> 15,121[a]	**65,429**

[a] As in many cases no information was provided, the actual number is much higher.

Number of scientific visitors to specimen collections and zoological living collections in the public and private sector

For specimen collections and zoological living collections, the number of scientific visitors is an important parameter that reflects the scientific use of collections. As other important parameters and the context have not been assessed, collections that are not visited as frequently by scientists may still be of high value.

Collection owner	Specimen collections		Living collections
	Zoological	Botanical	Zoological
Federal government	694	438	500
Federal province	574	137	
City			40
Church	7	2	
Association			318
Private			1,011
Total	***1,275***	***578***	***1,869***

5.1.1.11 Use of collections by the public

Number of collections open to the public

Access for visitors	Specimen collections		Living collections			
	Zoological	Botanical	Zoological	Botanical	Agricul-tural	Microbiol.
Unrestricted	**3**		**82**	**44**		
Restricted	40	8		57	92	10
Not accessible	5	2		6		1
Only for scientists	**54**	**55**	**1**	**9**	**5**	**19**
Not available	1			4		

Number of day-to-day visitors of living collections per owner group

Owner of collections	Living collections	
	Zoological	Botanical
Public sector		
Federal government	1.600,000	778,195
Federal province		5,500
Community	235,000	212,600
Total	*1.835,000*	*996,295*
Private sector		
Association	950,000	21,000
Private person	1.073,500	205,495
Total	*2.023,500*	*226,495*
Sum total	***3.858,500***	***1.222,790***

5.1.2 Need for action in view of the actual state of collections

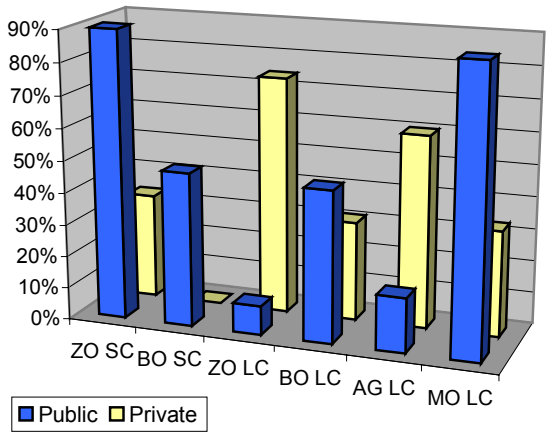
5.1.2.1 Preservation and maintenance

Need for action in terms of personnel to preserve and maintain the collections

There is a need for action:
in the public sector for 164 collections (i.e., **47.9 %** of public collections) and
in the private sector for 71 collections (i.e., **45.5 %** of private collections).

Need for action in terms of personnel	Specimen collections				Living collections							
	Zoological		Botanical		Zoological		Botanical		Agricultural		Microbiol.	
	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%	Num ber	%
Public sector												
Yes	61	**89.7**	23	**47.9**	2	9.1	41	**46.6**	16	**17.4**	21	**87.5**
No	7	10.3	25	52.1	20	90.9	32	36.4	76	82.6	3	12.5
Not available							15	17.0				
Private sector												
Yes	11	**31.4**	0	0.0	45	**73.8**	10	**31.2**	3	**60.0**	2	**33.3**
No	24	68.6	17	100.0	16	26.2	18	56.3	2	40.0	4	66.7
Not available							4	12.5				

Fig. 18: Need for action in terms of personnel to preserve and maintain the collections

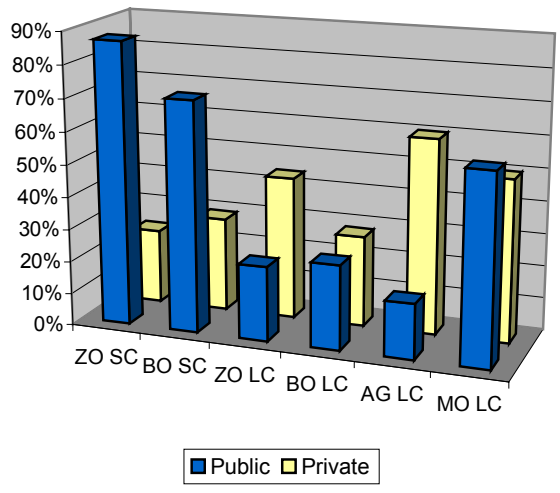


Need for financial action to preserve and maintain the collections

There is a need for action:
in the public sector for 154 collections (i.e., **45.0 %** of public collections) and
in the private sector for 80 collections (i.e., **51.3 %** of private collections)

Need for financial action	Specimen collections				Living collections							
	Zoological		Botanical		Zoological		Botanical		Agricultural		Microbiol.	
	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%
Public sector												
Yes	**61**	**89.7**	**20**	**41.7**	**5**	**22.7**	**48**	**54.5**	**0**	**0.0**	**20**	**83.3**
No	7	10.3	28	58.3	17	77.3	34	38.6	92	100.0	4	16.7
Not available							6	6.8				
Private sector												
Yes	14	**40.0**	0	0.0	50	**82.0**	10	**31.3**	3	**60.0**	3	**50.0**
No	21	60.0	17	100.0	11	18.0	17	53.1	2	40.0	3	50.0
Not available							5	15.6				

Fig. 19: Need for financial action to preserve and maintain the collections



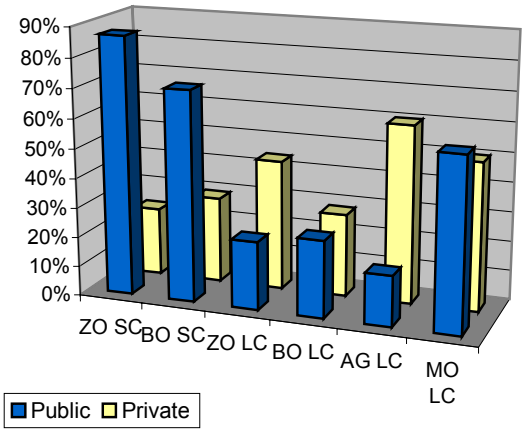
5.1.2.2 Updating

Need for action in terms of personnel required for the updating of collections

There is a need for action:
in the public sector for 151 collections (i.e., **44.1 %** of public collections) and
in the private sector for 55 collections (i.e., **35.2 %** of private collections)

Need for action in terms of personnel	Specimen collections				Living collections							
	Zoological		Botanical		Zoological		Botanical		Agricultural		Microbiol.	
	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%
Public sector												
Yes	59	**86.8**	34	**70.8**	5	**22.7**	23	**26.1**	16	**17.4**	14	**58.3**
No	9	13.2	14	29.2	17	77.3	37	42.1	76	82.6	10	41.7
Not available							28	31.8				
Private sector												
Yes	**8**	**22.9**	**5**	**29.4**	**27**	**44.3**	**9**	**28.1**	**3**	**60.0**	**3**	**50.0**
No	27	77.1	12	70.6	34	55.7	14	43.8	2	40.0	3	50.0
Not available							9	28.1				

Fig. 20: Need for action in terms of personnel regarding the update of collections



Need for financial action regarding the updating of collections

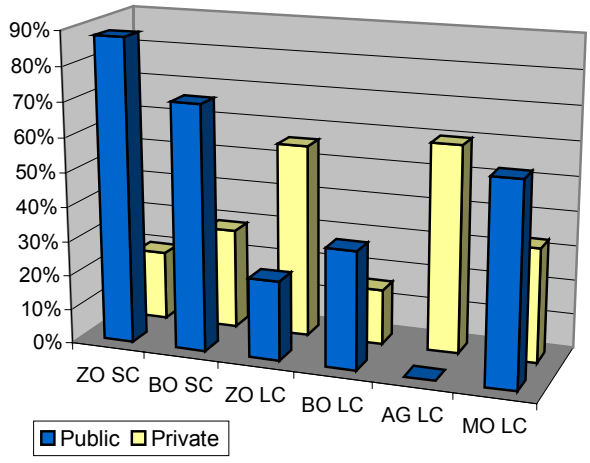
There is a need for action:

in the public sector for 143 collections (i.e., **41.8 %** of public collections) and

in the private sector for 56 collections (i.e., **35.9 %** of private collections)

Need for financial action	Specimen collections				Living collections							
	Zoological		Botanical		Zoological		Botanical		Agricultural		Microbiol.	
	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%
Public sector												
Yes	60	**88.2**	34	**70.8**	5	**22.7**	30	**34.1**			14	**58.3**
No	8	11.8	14	29.2	17	77.3	30	34.1	92	100.0	10	41.7
Not available							28	31.8				
Private sector												
Yes	7	**20.0**	5	**29.4**	34	**55.7**	5	**15.6**	3	**60.0**	2	**33.3**
No	28	80.0	12	70.6	27	44.3	18	56.3	2	40.0	4	66.7
Not available							9	28.1				

Fig 21: Need for financial action regarding the update of collections



5.1.2.3 Documentation

Need for action in terms of personnel for the update of collections

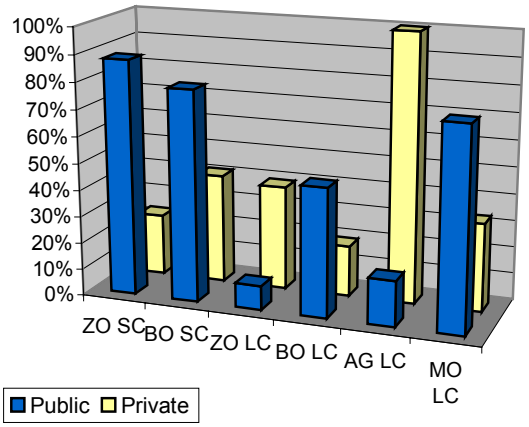
There is a need for action:

in the public sector for 176 collections (i.e., **51.5 %** of public collections) and

in the private sector with 52 collections (i.e., **33.3 %** of private collections)

Need for action in terms of personnel	Specimen collections				Living collections							
	Zoological		Botanical		Zoological		Botanical		Agricultural		Microbiol.	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Public sector												
Yes	60	**88.2**	38	**79.2**	2	**9.1**	42	**47.7**	16	**17.4**	18	**75.0**
No	8	11.8	10	20.8	20	90.9	29	33.0	78	82.6	6	25.0
Not available							17	19.3				
Private sector												
Yes	8	**22.9**	7	**41.2**	24	**39.3**	6	**18.8**	5	**100.0**	2	**33.3**
No	27	77.1	10	58.8	37	60.7	16	50.0			4	66.7
Not available							10	31.2				

Fig 22: Need for action in terms of personnel for the documentation of collections



Need for financial action regarding the documentation of collections

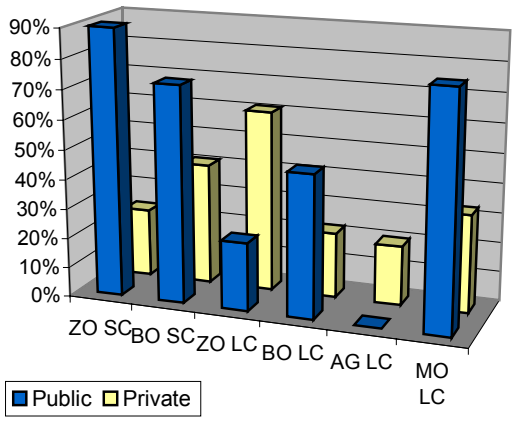
There is a need for action:

in the public sector for 162 collections (i.e., **47.4 %** of public collections) and

in the private sector for 62 collections (i.e., **39.7 %** of private collections)

Need for financial action	Specimen collections				Living collections							
	Zoological		Botanical		Zoological		Botanical		Agricultural		Microbiol.	
	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%	Num-ber	%
Public sector												
Yes	61	**89.7**	35	**72.9**	5	**22.7**	42	**47.7**			19	**79.2**
No	7	10.3	13	27.1	17	77.3	28	31.8	92	100.0	5	20.8
Not available							18	20.5				
Private sector												
Yes	8	**22.9**	7	**41.2**	37	**60.7**	7	**21.9**	1	**20.0**	2	**33.3**
No	27	77.1	10	58.8	24	39.3	15	46.9	4	80.0	4	66.7
Not available							10	31.2				

Fig 23: Need for financial action regarding the documentation of collections



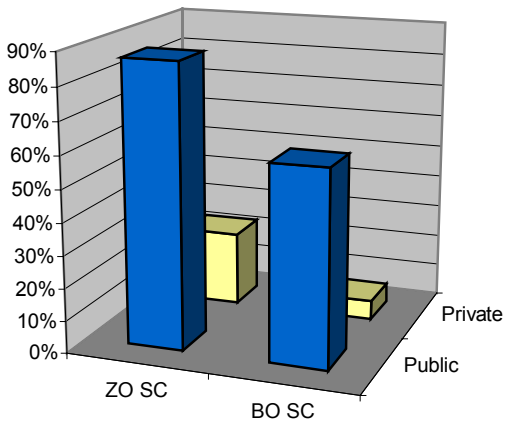
5.1.2.4 Digitisation

Need for action in terms of personnel for the digitisation of existing specimen collections

There is a need for action:
in the public sector for 88 specimen collections (i.e., **75.9 %** of public specimen collections) and in the private sector for 9 specimen collections (i.e., **17.3 %** of private specimen collections).

Need for action in terms of personnel	Specimen collections			
	Zoological		Botanical	
	Number	%	Number	%
Public sector				
Yes	59	**86.8**	29	**60.4**
No	9	13.2	19	39.6
Private sector				
Yes	8	**22.9**	1	**5.9**
No	27	77.1	16	94.1

Fig 24: Need for action in terms of personnel for the digitisation of specimen collections

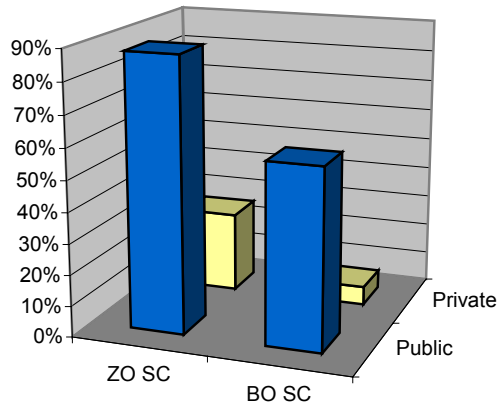


Need for financial action regarding the digitisation of existing specimen collections

There is a need for action:
in the public sector for 88 specimen collections (i.e., **75.9 %** of public specimen collections) and
in the private sector for 10 specimen collections (i.e., **19.2 %** of private specimen collections)

Need for financial action	Specimen collections			
	Zoological		Botanical	
	Number	%	Number	%
Public sector				
Yes	60	**88.2**	28	**58.3**
No	8	11.8	20	41.7
Private sector				
Yes	9	**25.7**	1	**5.9**
No	26	74.3	16	94.1

Fig. 25: Need for financial action regarding the digitisation of specimen collections

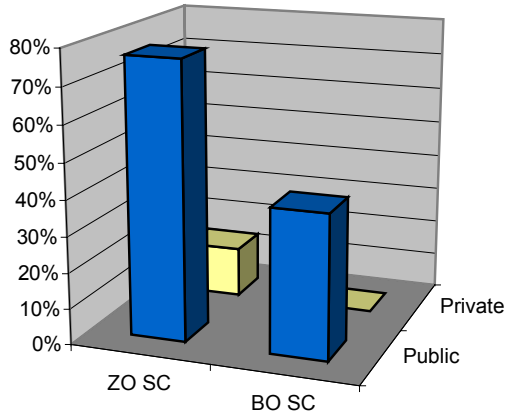


Need for action in terms of personnel for the digitisation of existing type collections

There is a need for action:
in the public sector for 71 specimen collections (i.e., **61.2 %** of public specimen collections) and
in the private sector for 5 specimen collections (i.e., 9.6 % of private specimen collections)

Need for action in terms of personnel	Specimen collections			
	Zoological		Botanical	
	Number	%	Number	%
Public sector				
Yes	52	**76.5**	19	**39.6**
No	16	23.5	29	60.4
Private sector				
Yes	5	**14.3**		
No	30	85.7	17	100.0

Fig. 26: Need for action in terms of personnel for the digitisation of type collections

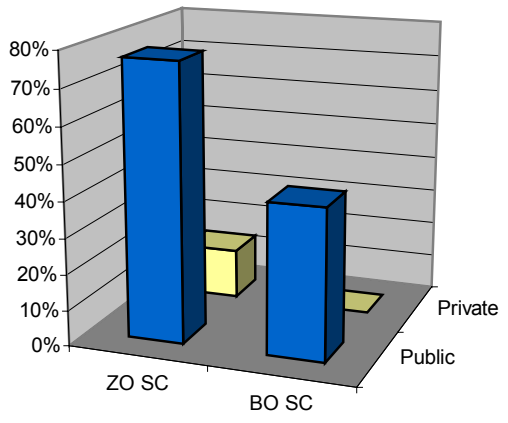


Need for financial action regarding the digitisation of existing type collections

There is a need for action:
in the public sector for 72 specimen collections (i.e., **62.1 %** of public specimen collections) and in the private sector for 5 specimen collections (i.e., 9.6 % of private specimen collections).

Need for financial action	Specimen collections			
	Zoological		Botanical	
	Number	%	Number	%
Public sector				
Yes	52	**76.5**	20	**41.7**
No	16	23.5	28	58.3
Private sector				
Yes	5	**14.3**	0	0.0
No	30	85.7	17	100.0

Fig. 27: Need for financial action regarding the digitisation of type collections



5.1.2.5 Expert animal care

Need for action in terms of personnel required for expert animal care

There is a need for action:
in the public sector for 2 collections (i.e., 9.1 % of public collections) and
in the private sector for 47 collections (i.e., **77.0 %** of private collections).

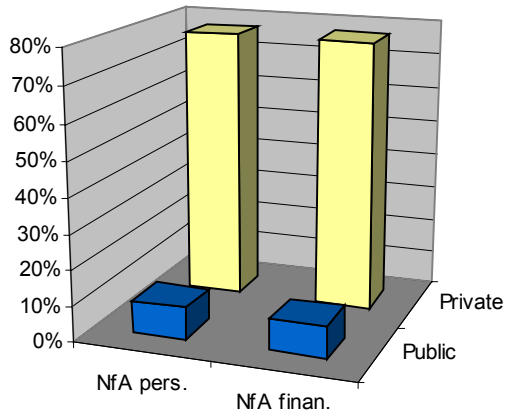
Need for action in terms of personnel	Zoological living collections	
	Number	%
Public sector		
Yes	2	9.1
No	20	90.9
Private sector		
Yes	47	**77.0**
No	14	23.0

Need for financial action regarding expert animal care

There is a need for action:
in the public sector for 2 collections (i.e., 9.1 % of public collections) and
in the private sector for 47 collections (i.e., **77 %** of private collections)

Need for financial action	Zoological living collections	
	Number	%
Public sector		
Yes	2	9.1
No	20	90.9
Private sector		
Yes	47	**77.0**
No	14	23.0

Fig. 28: NfA in terms of personnel and need for financial action regarding expert animal care



5.1.2.6 Conditions for animal keeping

Need for action in terms of personnel to improve the animal keeping conditions

There is a need for action:
in the public sector for 2 collections (i.e., 9.1 % of public collections) and
in the private sector for 30 collections (i.e., **49.2 %** of private collections)

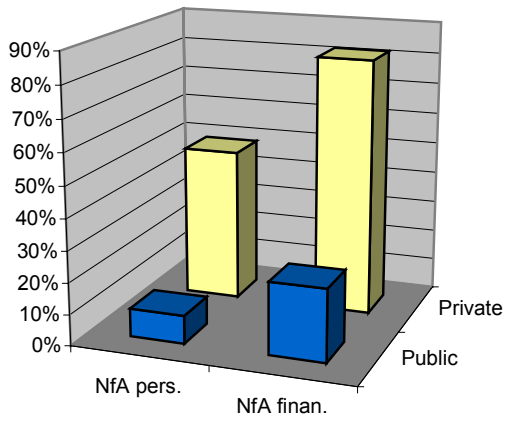
Need for action in terms of personnel	Zoological living collections	
	Number	%
Public sector		
Yes	2	9.1
No	20	90.9
Private sector		
Yes	30	**49.2**
No	31	50.8

Need for financial action to improve the animal keeping conditions

There is a need for action:
in the public sector for 5 collections (i.e., **22.7 %** of public collections) and
in the private sector for 50 collections (i.e., **82.0 %** of private collections)

Need for financial action	Zoological living collections	
	Number	%
Public sector		
Yes	5	**22.7**
No	17	77.3
Private sector		
Yes	50	**82**
No	11	18

Fig. 29: NfA in terms of personnel and nf financial action to improve the conditions under which animals are kept



5.2 Databases

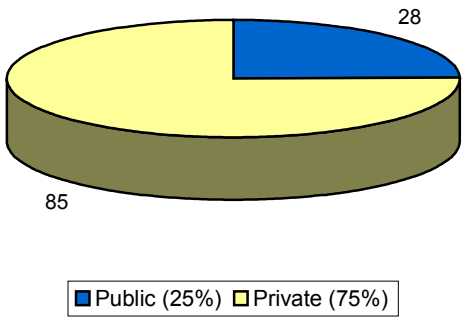
5.2.1 Actual state of databases

5.2.1.1 Number and scope of surveyed databases

Number of databases

In total, the survey determined **113 databases** across Austria of which 85 are public and 28 are private (Note: databases from institutions with partial or complete legal capacity that derive a major share of their budget from public funds were classified as belonging to the public sector).

Fig. 30: Number of databases in the public and private sector



Scope of databases

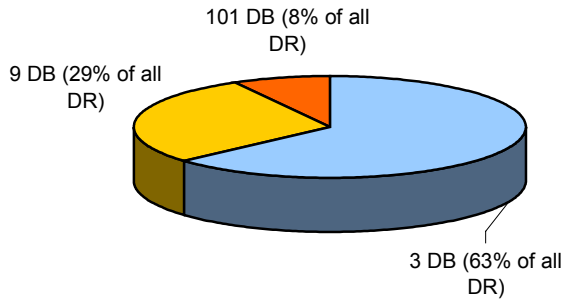
Owner of databases	Total number of data records
Public sector (federal government, federal provinces, municipalities)	6.613,834
Private sector (associations, individuals)	2.099,131
Total	*8.712,965*[a]

[a] Note: As the content of the surveyed databases partly overlap, the number of **different data records** is estimated at **7.5 to 8 million**. For example: Parts of the private database of Dr. Christian Wieser, the database of the Museum of Tyrol, and the Birdlife database are included in the ZOBODAT database of the Museum of Upper Austria.

Percent distribution of data records in the databases

Number of data records per database	Number of databases	Total number of data records in these databases	% of data records in all databases
> 1 million	3	5.495,000	63.1
< 1 million and > 100,000	9	2.509,371	28.8
< 100,000	101	708,594	8.1
Total	*113*	*8.712,965*	*100.0*

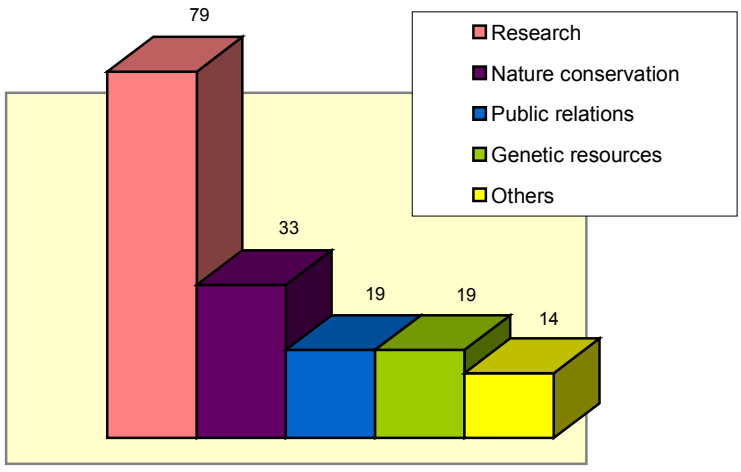
Fig. 31: Percent distribution of data records in the database



Number of databases per use category

Use of databases	Number of databases
Research	79
Nature conservation	33
Public relations	19
Genetic resources	19
Others	14

Fig. 32: Number of databases per use category



5.2.1.2 Geographical coverage

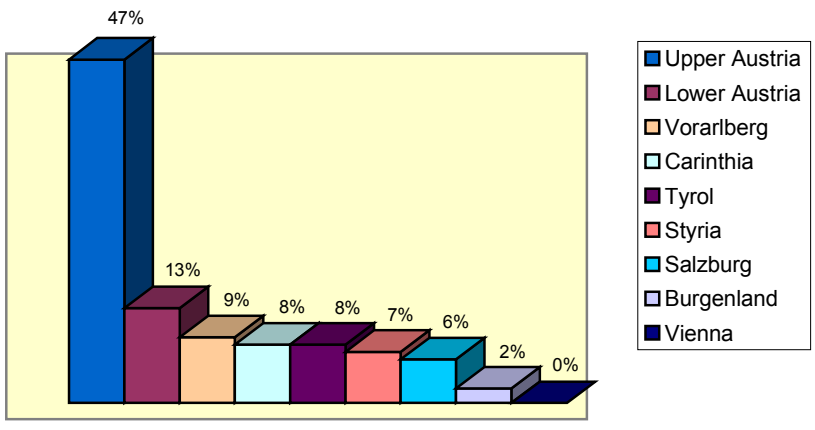
Number of databases and data records relating to specific geographical regions in Austria

Only databases with precise data on the number of data records per federal province were taken into account. A large number of the database keepers were however unable to provide such information.

Geographical region	Number of databases	Number of data records	%[a] of the data records of all databases
Burgenland	7	70,004	2.2
Carinthia	5	260,113	8.3
Lower Austria	9	404,493	12.9
Upper Austria	7	1.470,048	46.8
Salzburg	6	190,031	6.0
Styria	8	228,055	7.3
Tyrol	5	239,834	7.6
Vorarlberg	5	280,000	8.9
Vienna	4	197	0.0
Total	*56*	*3.142,775*	*100.0*

[a] The percentage rate relates to the number of data records which can be allocated to a specific geographical region.

Fig. 33: Percentage of DR relating to a specific geographical region



5.2.1.3 Systematic content

Number of databases and data records based on their systematic content

Systematic content	Number of databases	Number of data records
VERTEBRATES (Vertebrata)		
Fish (Pisces)	6	4,000
Reptiles (Reptilia)	9	Not available
Amphibia (Amphibia)	7	8,000
Mammals (Mammalia)	14	90,500
Birds (Aves)	14	1.050,000
INVERTEBRATES (Evertebrata)		
Insects (Insecta)		
Various (Insecta varia)	2	7,000
Flies (Diptera)	5	310,790
Hymenopterans (Hymenoptera)	3	160,000
Beetles (Coleoptera)	9	702,000
Snakeflies (Raphidioptera)	1	1,356
Caddisflies (Trichoptera)	1	60,000
Neuropterans (Neuroptera)	2	6,350
Dobsonflies (Megaloptera)	1	145
Butterflies (Lepidoptera)	7	2.297,371
Scorpionflies (Mecoptera)	1	272
True bugs (Hemiptera)	2	23,000
Stoneflies (Plecoptera)	1	6,000

Other invertebrates		
Tartigrades (Tartigrada)	1	280
Arthropods (Arthropoda)	2	Not available
Tentaculata (Tentaculata)	1	50
Acanthocephala (Acanthocephala)	1	120
Crustaceans (Crustacea)	1	10,000
Cnidarians (Cnidaria)	1	360
Plathelminths (Plathelminthes)	1	750
Annelids (Aannelida)	1	7,500
Nemathelminths (Nemathelminthes)	1	3,000
Sponges (Porifera)	1	100
Arachnids (Arachnida)	2	40,000
Echinoderms (Echinodermata)	1	30
Molluscs (Mollusca)	6	136,150
Ciliates (Ciliata)	1	65,000
PROTOZOANS (Protozoa)		
Various (Protozoa varia)	1	7,400
PHANEROGAMS (Phanerogamae)		
Flowering plants and **ferns**	42	2.513,044
CRYPTOGAMS (Kryptogamae)		
Algae	2	300
Lichen	6	139,200
Mosses	9	21,300
Fungi	3	30,000

[a] Myriapoda and Isopoda, 1 per collection

5.2.1.4 State of databases

Continuous update of data as well as verification of scientific accuracy by specialists

Continuous update and verification	Number of databases	% of databases	% of data records
Public sector			
Yes	73	**64.6**	**75.7**
No	12	**10.5**	**0.2**
Private sector			
Yes	24	**21.2**	**23.6**
No	4	3.5	0.5
Total	*113*	*100.0*	*100.0*

5.2.1.5 Documentation of the data

Scientific data description

Scientific data description	Databases		Data records	
	Number	%	Number	%
Available	102	**90.3**	8,703,145	**99.9**
Not available	11	9.7	9,820	0.1
Total	*113*	*100.0*	*8,712,965*	*100.0*

5.2.1.6 Data increase

In total, almost 70 % of the databases (i.e. 79 databases) reported an annual increase.

Increase per owner group	New data records per annum	% of total increase
Private	36,900	10.3
Public	322,583	89.7
Total	*359,483*	*100.0*

5.2.1.7 Accessibility of databases

Type of access	% of databases	% of data records
Public sector		
No access	49.6	25.8
Local access	16.8	16.0
Via www	5.3	0.5
Via www using a password	3.5	33.7
Total	*75.2*	*76.0*
Private sector		
No access	15.9	15.0
Local access	4.4	8.8
Via www	0.9	0.0
Via www using a password	3.6	0.1
Total	*24.8*	*24.0*
Sum total	*100.0*	*100.0*

[a] No access (or access only in exceptional cases) applies in the event of unfinished projects or scientific data being retained until publication, or during the establishment of a database. As for private owners, they are naturally free to allow access to their database or not.
[b] The data can be read on-site or passed on via storage media or as print-out.

5.2.2 Need for action in respect of the actual situation of databases

5.2.2.1 Maintenance of databases

Need for action in terms of personnel for the maintenance of databases

For 9 databases, lack of electronic data processing staff for the maintenance and programming was mentioned as a concrete need for action. In 8 cases, lack of staff for data recording was mentioned.

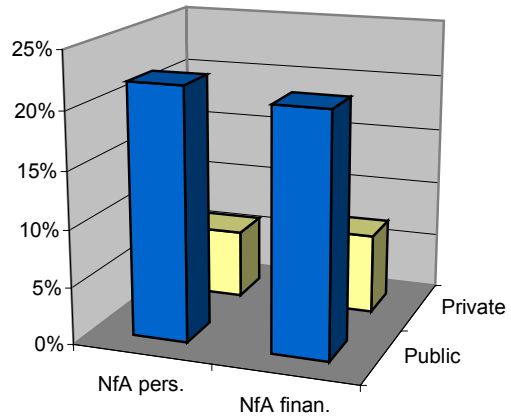
Need for action in terms of personnel	Databases		Data records
	Number	%	%
Public sector			
Yes	25	**22.1**	**36.4**
No	60	53.1	39.5
Private sector			
Yes	7	**6.2**	**13.9**
No	21	18.5	10.2
Total	*113*	*100.0*	*100.0*

Need for financial action for the maintenance of databases

Additional funds to finalise data entry contracts were considered necessary in 9 cases, in 7 cases for the conclusion of services contracts to employ computer personnel, and in 5 cases for the development of hardware and software.

Need for financial action	Databases		Data records
	Number	%	%
Public sector			
Yes	24	**21.2**	**36.5**
No	61	54.0	39.4
Private sector			
Yes	8	**7.1**	**14.0**
No	20	17.7	10.1
Total	*113*	*100.00*	*100.0*

Fig. 34: NfA in terms of personnel and nf financial action for maintenance of databases

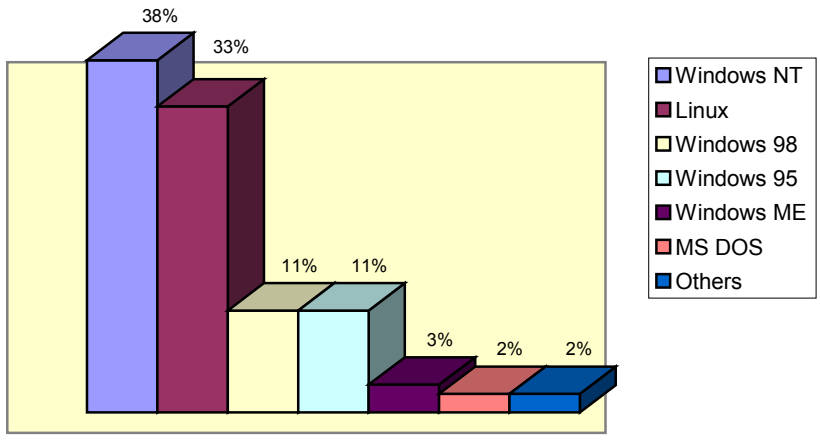


5.2.2.2 Used software

Used operating systems

Operating system	Number of databases	Number of data records
Linux	3	2.932,500
Mac OS 8	1	41,900
Mac OS 9.1	1	0
Mac OS	1	3,000
MS DOS	2	129,710
Solaris	3	41,540
VMS	1	6,000
Windows 3.1	1	70,000
Windows 95	15	938,471
Windows 98	36	1.002,776
Windows ME	6	246,650
Windows NT	19	3.290,845
Windows 2000	22	55,853
Windows XP	2	360
Total	*113*	*8.759,605*

Fig. 35: Pecentage of DR per used operating system

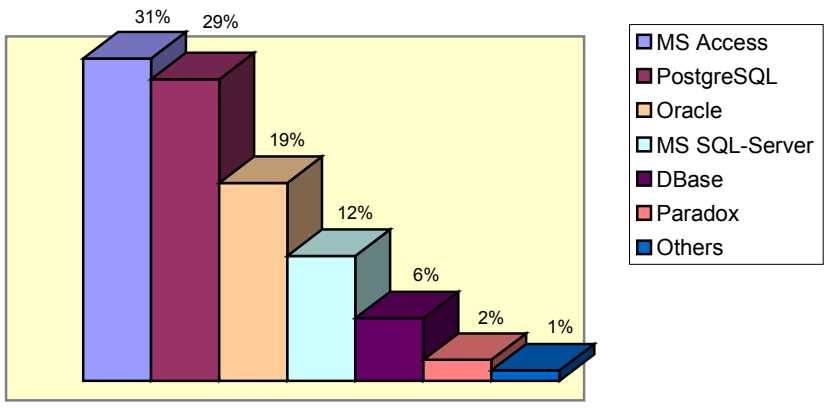


Used database systems

Due to the occasional application of multi-user systems, multiple mention was made for several database systems, since for access to these systems different operating- and database systems are in use.

Database system	Number of databases	Number of data records
DBase	8	580,621
F & A	2	11,000
Filemaker	3	44,900
Interbase	2	1,500
Isis	1	19,710
MS Access	81	3.201,934
MS SQL-Server	4	1.287,000
MySQL	2	2,500
Oracle	9	1.948,040
Paradox	3	211,500
PostgreSQL	1	2.930,000
Windib	1	17,000

Fig. 36: Percentage of DR per database system



Share of multi-user systems

Multi-user systems facilitate error-free data entry and evaluation with regard to the same data pool by several users.

Multi-user systems	Databases		Data records
	Number	%	%
Public sector			
Yes	16	**14.1**	**69.5**
No	69	61.1	6.4
Private sector			
Yes	7	6.2	0.4
No	21	18.6	23.7
Total	*113*	*100.0*	*100.0*

Percentage of systems with high reliability

In principle, reliability is a relative term: this study only classified mainframe systems based on UNIX or Linux as safe.

Operational safety secured	Databases		Data records
	Number	%	%
Public sector			
Yes	11	9.7	34.4
No	74	**65.5**	**41.5**
Private sector			
Yes	5	4.4	0.2
No	23	**20.4**	**23.9**
Total	*113*	*100.0*	*100.0*

Software development in the various institutions / by private owners

Software development directly at the institution / by private owners	Databases		Data records
	Number	%	%
Public sector			
Yes	11	**9.7**	**54.6**
No	74	65.5	21.3
Private sector			
Yes	6	5.3	2.6
No	22	19.5	21.5
Total	*113*	*100.0*	*100.0*

5.2.2.3 Structure of databases

Relational configuration

Relational configuration	Number of databases	% of databases	% of data records
Yes	83	73.4	96.9
No	30	26.6	3.1
Total	*113*	*100.0*	*100.0*

Configuration of databases with own tables for species, habitats, and specimen

The survey assessed whether the databases have their own tables for "Species", "Habitat", and "Specimen". These details are intended to provide information on the costs for a potential necessary restructuring of the databases.

Use of tables for species, habitats, and specimens	Number of databases	% of databases	% of data records
Yes	79	69.9	96.8
No	34	30.1	3.2
Total	*113*	*100.0*	*100.0*

5.2.2.4 Information on the existing infrastructure of the various institutions and the private owners

Integration of databases into computer networks

Existence of a computer network	Databases		Data records
	Number	%	%
Public sector			
Yes	75	**66.4**	**75.1**
No	10	8.9	0.8
Private sector			
Yes	11	9.7	9.2
No	17	15.0	14.9
Total	*113*	*100.0*	*100.0*

Existence of a leased line to the Internet

Existence of a leased line	Databases		Data records
	Number	%	%
Public sector			
Yes	69	**61.1**	**74.8**
No	16	14.2	1.1
Private sector			
Yes	5	4.4	0.4
No	23	20.3	23.7
Total	*113*	*100.0*	*100.0*

Provision of own web server

Provision of own web server	Databases		Data records
	Number	%	%
Public sector			
Yes	38	**33.6**	**69.8**
No	47	41.6	6.1
Private sector			
Yes	3	2.7	0.2
No	25	22.1	23.9
Total	*113*	*100.0*	*100.0*

Use of dynamic web pages on own web server

Dynamic web pages allow users the interactive retrieval of information from databases.

Use of dynamic web pages on own web server	Databases		Data records
	Number	%	%
Public sector			
Yes	7	6.2	**37.3**
No	78	69.0	38.6
Private sector			
Yes	2	1.8	0.0
No	26	23.0	24.1
Total	*113*	*100.0*	*100.0*

6 Annex

6.1 Questionnaire to survey information on the Austrian collections and databases

6.1.1 Questions on the individual collections

General questions:

1. **Name** of the collection
2. **Institution/keeper**
3. **Owner** (federal government, federal province, municipality, association, private individual)
4. **Location of the collection**
5. **Current contact person**
6. **Type** of collection (living collection, specimen collection)
7. **Primary aim** of the collection (conservation collection, reference collection, exhibition collection).
8. **Use** of the collection (teaching, research, public relations, nature conservation, exhibition collection, collection of useful plants, preservation, taxonomic reference, geographic reference, historical documentation, resettlement, or other category)
9. **Systematic content** (**zoology**: vertebrates: classes; with insects: orders; with invertebrates excluding insects: strains; **botany**: data on the following categories: phanerogam, cryptogam fungi, cryptogam mosses, cryptogam lichen, cryptogam algae, **micro-organisms**: procaryotes, micro-fungi).
10. **Systematic focus** (e.g. orchidaceae: bulbophyllum; cactaceae: gymnocalycium).
    (Explanatory note: this data serves to specify the systematic content of the collection and the differentiated query features for the recorded collections).
11. **Number** of **collection objects**
12. **Recorded geographic region** (worldwide, Europe, Austria, and all federal provinces).
13. **Geographic focus**
    (Explanatory note: details such as altitudes or climatic regions (Alpine foothills, Mainzer Sand, Pannonicum) or continents and countries).
14. **Collection date:** from which date or up to which date were the objects continually recorded?
15. How is the collection **recorded**? (no recording, card catalogue, electronic data collection, database)

16. **Accessibility/availability** of the **material** (freely accessible, restricted access, accessible only for scientific work, not accessible)
    (Explanatory note: "freely accessible": without personal restriction and available at all times, however taking into consideration opening times and fees as well as the motto "look, but do not touch."
    "Restricted access": The collection may only be viewed with prior appointment or in a guided tour)
17. **Borrowing** of collection objects (yes/in part/no)
18. **Transfer of living material** (yes/in part/no)
19. Possibility of **breeding loans** (yes/in part/no)
20. Is there **agreement on the publication** of data? (yes/no)

Special questions:

1. **Status** of the collection (growth: yes/no; if "yes": extent of growth/year)
2. **Maintenance of the collection** (Is there currently a curator?: yes/no)

For specimen collections:

3. Is there a periodic **disinfestation** of the collection? (yes/no)
4. What are the **storage conditions** like? (optimum/adequate/problematic)
5. Estimated **number** of **type specimen**.
6. Is there an ongoing **inspection** of the collections by **specialists**? (yes/no)
7. To what extent is the **origin** (place of discovery) of the collection objects known?
8. Is it possible to estimate the extent to which these collections cover the respective **species spectrum** in Austria?
9. Estimated **number of visitors** per annum.
10. Estimated **number of borrowed specimen** per annum.

For living collections:

11. Is there a **germination test** / **rejuvenation**? (yes/in part/no)
12. Is preservation of **genetic purity** ensured? (yes/in part/no)
13. What is the **plant's state of health**? (good/problematical)
14. What are the **cultivation conditions** / **storage conditions** like? (optimum/adequate/problematical)
15. Estimated **number of species.**
16. To what extent is the **origin of the collection objects** known?

17. To what extent is the **location in the wild/natural occurrence of the collection objects** known?
18. What is known about **secured direct breeding** from locations in the wild?
19. Is it possible to estimate the extent to which these collections cover the respective **species spectrum** in Austria? (yes/no/not relevant)
20. Is it possible to estimate the extent to which these collections cover the respective **spectrum of varieties** in Austria? (yes/no/not relevant)
21. Estimated **number of visitors** per annum

Questions on the need for action:

22. Is there a need for action in terms of personnel and finances for the **preservation / maintenance** of the collection? (yes/no, with explanatory notes)
23. Is there a need for action in terms of personnel and finances regarding the **update** of the collections? (yes/no, with explanatory notes)
24. Is there a need for action in terms of personnel and finances regarding the **improvement** of the **documentation** of collections? (yes/no, with explanatory notes)
25. Is there a need for action in terms of personnel and finances regarding the **digitisation** of the existing **specimen collections** and **type collections**? (yes/no, with explanatory notes)

<u>For zoological living collections (zoos)</u>:

26. Is **veterinary care** provided? (at all times/as needed/lacking)
27. Is **expert animal care** provided? (available/necessary/not necessary, with explanatory notes)
28. Is there a need for action in terms of personnel and finances regarding **expert animal care**? (yes/no, with explanatory notes)
29. What are the **conditions for animal keeping** like? (excellent/acceptable/need improvement)
30. Is there a need for action in terms of personnel and finances regarding the **conditions for animal keeping**? (yes/no, with explanatory notes)

<u>For micro-organism strain collections:</u>

31. Does the collection have an **ecological** or **pathological focus**? (yes/no, with explanatory notes)
    Is the collection **used technologically**? (yes/no, with explanatory notes)

32. What **conservation methods** are used? (lyophilisation (freeze-dried), conventional refrigerators, liquid nitrogen, "low tech", other)
33. **Cold-storage temperatures** used (details for the ranges in °C)

6.1.2 Questions on the individual databases

General questions:

1. **Name** of the database
2. **URL** of the database
3. **Institution**
4. **Contact person**
5. **Use** of the database (science, nature conservation, genetic resources, the general public, other)
6. **Geographic scope** (worldwide, Europe, Austria and all federal provinces)
7. **Systematic content** (**zoology**: with vertebrates: classes; with insects: orders; with invertebrates excluding insects: strains; **botany**: details of the following categories: phanerogam, cryptogam fungi, cryptogam mosses, cryptogam lichens, cryptogam algae)
8. **Theme** / **content** of the database
9. Is it possible to assess the **number of species**? (yes/no, number)
10. **Number** of **data records**
11. **Status** of the database (growth yes/no; if "yes": extent of growth/year)
12. **Collection date:** from which date or up to which date were the objects continually recorded?
13. Is a **scientific data description** available (minimum requirement: species, location, legend, date, collection)? (yes/no)
14. **Period** of data recording
15. **Accessibility/availability** of the **data** (www, www – with password, locally, no access)
16. Is the data **checked** for its scientific accuracy by **specialists** or **updated on a continuous basis**? (yes/no)
17. Is there a need for action in terms of personnel and finances regarding the establishment of **electronic databases**?

Questions regarding technology and on the maintenance of the database:

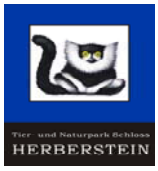
1. What **operating system**(**s**) and **database system**(**s**) are installed on your servers?
2. Is your database **relational** (if yes, are there separate tables for SPECIES, LOCATION and SPECIMEN?)

3. Can your database be used by **several users** simultaneously (with secure transactions)? (yes/no)
4. Can your database be used **around the clock**, i.e. are there down times? (yes/no)
5. Is there a **computer network** available in your institution? (yes/no)
6. Does your institution have a **permanent connection** (leased line) to the **Internet** available? (yes/no)
7. Does your institution operate its **own web server**? (yes/no)
8. Does your institution operate a **web server with database connection**? (yes/no)
9. Is **software developed** in your institution? (yes/no)
10. How many of your employees have **administrator knowledge** and/or **programmer knowledge**?
    (Explanatory note: the question serves to classify the institution for possible later maintenance of network nodes).

6.2 List of names of systematic groups used in Latin, German and English

Latin	German	English
Acanthocephala	Kratzer	Thorney-headed worms
Amphibia	Lurche	Amphibia
Annelida	Ringelwürmer	Annelids
Archaeognatha	Felsenspringer	Briestletails
Arthropoda	Gliederfüßer	Arthropods
Arachnida	Spinnentiere	Arachnids
Aves	Vögel	Birds
Blattodea	Schaben	Cockroaches
Bryophyta	Moose	Mosses
Ciliata	Wimpertierchen	Ciliates
Cnidaria	Nesseltiere	Cnidarians
Coleoptera	Käfer	Beetles
Collembola	Springschwänze	Springtails
Crustacea	Krebse	Crustaceans
Dermaptera	Ohrwürmer	Earwings
Diplura	Doppelschwänze	Diplurans
Diptera	Fliegen	Flies
Echinodermata	Stachelhäuter	Echinoderms
Embioptera	Fußspinner	Webspinners
Ephemeroptera	Eintagsfliegen	Mayflies
Bryophyta	Pilze	Fungi
Evertebrata	Wirbellose Tiere	Invertebrates
Grylloblattodea	Grillenschaben	Rock crawlers
Hemiptera	Schnabelkerfen	True bugs
Hymenoptera	Hautflügler	Hymenopterans
Insecta	Insekten	Insects
Isoptera	Termiten	Termites
Kryptogamae	Sporenpflanzen	Cryptogams
Lepidoptera	Schmetterlinge	Butterflies and Moths
Lichenes	Flechten	Lichen
Mammalia	Säuger	Mammals
Mantodea	Fangschrecken	Mantids
Mecoptera	Schnabelfliegen	Scorpionflies
Megaloptera	Schlammfliegen	Dobsonflies and Alderflies
Mollusca	Weichtiere	Molluscs
Nemathelminthes	Schlauchwürmer	Nemathelminthes
Neuroptera	Netzflügler	Lacewings

Odonata	Libellen	Dragonflies
Orthoptera	Heuschrecken	Orthopterans
Phanerogamae	Phanerogamen	Phanerogams
Phasmatodea	Gespenstschrecken	Stick insects
Pisces	Fische	Fish
Plathelminthes	Plattwürmer	Flatworms
Plecoptera	Steinfliegen	Stoneflies
Porifera	Schwämme	Sponges
Prokaryota	Prokaryoten	Procaryotes
Protozoa	Einzellige Tiere	Protozoans
Protura	Beintastler	Proturans
Pteridophyta	Farne	Ferns
Psocoptera	Stabläuse	Booklice
Phycophyta	Algen	Algae
Raphidioptera	Kamelhalsfliegen	Snakeflies
Reptilia	Kriechtiere	Reptiles
Siphonaptera	Flöhe	Fleas
Spermatophyta	Blütenpflanzen/Samenpflanzen	Spermatophytes
Strepsiptera	Fächerflügler	Twisted-wing parasites
Tardigrada	Bärentierchen	Tardigrada
Tentaculata	Kranzfühler	Tentaculata
Trichoptera	Köcherfliegen	Caddisflies
Tunicata	Manteltiere	Tunicata
Thysanoptera	Fransenflügler	Thrips
Thysanura	Borstenschwänze	Silverfish
Vertebrata	Wirbeltiere	Vertebrates
Zoraptera	Bodenläuse	Zorapterans



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der Universität für Bodenkultur

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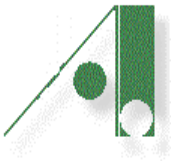
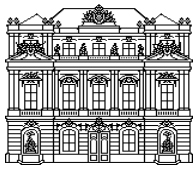
der Universität Wien



Bundesamt für Argrabiologie

Biologiezentrum
des Oberösterr. Landesmuseums

Naturhistorisches Museum Wien



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