DIVERSITY IS OUR MISSION

BG BM | Botanischer Garten & Botanisches Museum Berlin

BGBM Annual Report
2015 – 2016

Freie Universität Berlin

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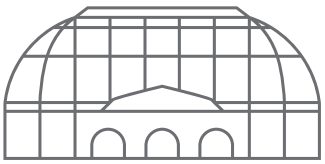

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Cover image: *Passiflora glandulosa* is a typical plant of the species-rich rainforests of South America, whose diversity is now under threat

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Foreword

BGBM Annual Report 2015 – 2016

Two years is not a long time. Not according to the calendar. And certainly not when it's your mission to preserve the biological diversity of the planet!

As far as plants are concerned, this diversity developed over millions of years and is today a defining feature of all habitats on land. Our understanding of the great value of this heritage is what guides us in our everyday work – year in, year out, and in all of our endeavours.

When it comes to exploring and preserving the world's green resources, we at the Botanic Garden and Botanical Museum Berlin (BGBM) are just as passionate about our work today as in Humboldt's time – whether on our trips around the world, at the lab or in the upkeep of our unique site. We collect and look after "humanity's green inheritance" – whether in the form of living rarities in the greenhouses and outdoor areas, dried and preserved for centuries in the herbarium, frozen as isolated genetic material in the DNA bank or as seeds in the Dahlem Seed Bank.

Our collections are the basis of everything that we do, enabling us to conduct first-rate international research, launch biodiversity programmes and offer exhibitions and educational events for tourists and the interested public from all over the world. In 2015 and 2016 alone, our work led to the discovery and scientific description of 183 new species. Our global biodiversity programmes are at the forefront of international networking and collaboration, as well as the management and publication of digital data. Last but not least, it is the green world on our doorstep that lies closest to our hearts – and above all the path from research to the practical implementation of concrete nature conservation measures.

With around 20,000 plant species on 43 hectares, we are Germany's largest botanic garden; in terms of the breadth of the plant collections, we rank second worldwide. We would like to communicate our mission, our passion for the green diversity of our planet. In order to reach even more people in the future, a particular focus over the next few years will be the touristic development of our site. We believe it is important to deal with topical issues such as sustainability and food security and to open up a dialogue about them. We have stepped up our marketing,

and we are developing new offers and formats – both in the garden and in the museum. The success of these approaches is reflected in the growing number of visitors, with more than 400,000 in 2016 alone.

Without passionate commitment from many quarters, successes and developments like those described here would not be possible – my heartfelt thanks therefore go to all members of staff, to our funders and patrons, as well as to all those who support the Botanic Garden and Botanical Museum with their dedication.

We hope that this report gives you lots of fascinating insights into our work!

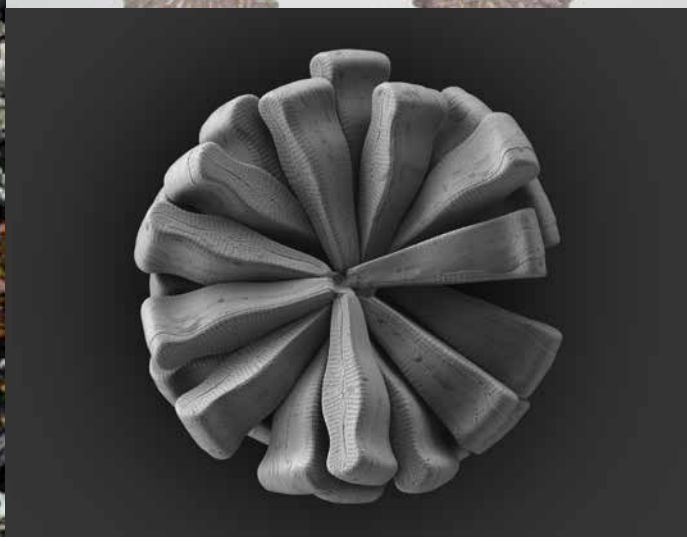
Prof. Dr. Thomas Borsch
Director of the Botanic Garden and Botanical Museum Berlin

The 43-hectare outdoor area offers unique botanical insights to visitors from all over the world

Diversity is our mission
The BGBM aims to preserve the Earth's plant diversity

There are estimated to be around half a million plant species worldwide. Along with an even greater number of algae, lichens and fungi, they are the very basis of our existence and a unique reservoir of opportunities for tomorrow. Exploring this plant diversity, imparting knowledge about it and preserving it for future generations is the job of the more than 200 employees in Germany's largest botanic garden.

As visitors stroll through the garden, they might only be dimly aware that, from a botanical point of view, they are crossing entire continents – from the Alps to the Himalayas, through Asia to America, and into the tropics of the greenhouses. The paths they walk along are fringed by countless rare wild plants that scientists have been amassing here for over three hundred years and that are tended by specially trained horticulturists. Around 20,000 different species, subspecies and varieties are cultivated in the Botanic Garden Berlin. This puts it in second place worldwide in terms of diversity and makes it a year-round magnet for specialists and visitors from all over the world.



Lichen (left), seeds (top) and microscopic diatoms (right) are all part of the BGBM's collections

A glimpse behind the scenes of the Botanic Garden and Botanical Museum reveals further treasures: the venerable brick building at the Königin-Luise-Platz entrance houses both the Botanical Museum, which is unique in Germany, as well as Germany's largest botanical library, a state-of-the-art laboratory block and a herbarium with almost 4 million specimens. Stored behind thick walls at a constant humidity and in total darkness are, among other things, parts of Alexander von Humboldt's botanical collection and 40,000 so-called type specimens – irreplaceable reference objects that are the basis for all scientific plant names and species descriptions. The collections are a true jewel in the history of science – and an important resource for current and future research. They benefit not only Berlin scientists, but also the many visiting scientists who come here from all over the world.
The institution's 300-year tradition of scientific excellence is also reflected in its current position as a pioneer in international biodiversity research. Our scientific goals are closely bound up with the effort to preserve the diversity of plants and use them sustainably.

If you take the main path towards the greenhouses you pass a modern low-rise building: the Dahlem Seed Bank. Here, under close scientific monitoring, seeds of wild plants are stored at -20°C – currently there are around 6500 seed collections from all over the world. For critically endangered plant species, their conservation in a botanic garden can be their only chance of being saved from extinction.

For all those working at the BGBM, the preservation of the Earth's biodiversity is a labour of love. Scientists, gardeners, and staff in Science Communication and Marketing make for a strong team. Together with the Administration and Scientific Services department, they turn the Botanic Garden and Botanical Museum into a place of rest and relaxation, a place of education and science, but, above all … a place where the green diversity of our planet takes centre stage!

Federal minister Dr Barbara Hendricks, Prof. Dr Peter-André Alt, President of the Freie Universität Berlin and Prof. Dr Thomas Borsch, Director of the Botanic Garden and Botanical Museum (from right to left)

Key events of 2015 and 2016

The house of seeds
The opening of the Dahlem Seed Bank

The BGBM has been collecting and preserving the seeds of rare and endangered native plant species since 1994, and thus has one of the oldest wild plant seed banks in Germany. In the spring of 2015, the seed bank moved into a purpose-built facility in the grounds of the BGBM, thus creating completely new possibilities for the storage of these botanical treasures. This was made possible thanks to a bequest from a Berlin citizen, the support of the BGBM's Verein der Freunde (association of friends) and funding from the Senate Department for Urban Development and the Environment. On 27 March 2015, the new building was opened by the federal environment minister Dr Barbara Hendricks, who is patron of the seed bank.

Seed of the Siberian sainfoin, an endangered plant species in Germany

A glimpse into the herbarium with its almost 4 million specimens – the herbarium, along with the living collection, the DNA bank and the Dahlem Seed Bank, forms part the BGBM's scientific collections

What's to be done with the treasures?
International conference of collections professionals in Berlin

In June 2016, the most important international meeting for scientific collections took place in Berlin. Together with Berlin's Museum für Naturkunde (Natural History Museum), the BGBM invited two global networks to a joint conference: the Society for the Preservation of Natural History Collections (SPNHC), which focuses on traditional collection objects such as fossils, animals and plants; and the Global Genome Biodiversity Network (GGBN), which is concerned with DNA and tissue collections. How can the archives of life be made available to researchers and the public? And how can they be maintained and developed in the most sustainable way possible? There was a lively exchange on these issues at the conference.

Conference dinner in the New Glasshouse

Light in the dark
The Christmas Garden Berlin

Millions of points of light, thousands of fairy lights, illuminated figures, trees and garden architecture – every evening from November 2016 to January 2017 the Botanic Garden was transformed into a dreamlike wonderland perfect for Advent and Christmas walks. Under the motto "The magical journey begins at dusk…", visitors were able to enjoy the garden for the first time late into the winter evenings. With more than 110,000 visitors, the event, organised in association with Deutsche Entertainment AG, was a huge success with the public – and will once again throw open its glittering portals next winter.

It takes a lot of effort to fish down the rare flamingo flower from the crown of the sabal palm

On the road with Humboldt's heirs Botanical collections are also indispensable for modern research

When Alexander von Humboldt set sail for South America on 5 June 1799, he was full of scientific anticipation: "I will collect plants and fossils, be able to make astronomic observations with excellent instruments", gushed the naturalist. "My eyes shall be constantly fixed on the mutual influence of forces, of the influence of inanimate creation on the animated worlds of flora and fauna, on that harmony!"

This enthusiasm for the natural treasures of the Earth is not showing any signs of waning. There are professionals working at the Botanic Garden and Botanical Museum in Berlin who see themselves as Humboldt's heirs. After all, the institution houses not only his walking stick but also about 3500 pressed plants that the famous scientist brought back from his trip to South America. What really connects today's Berlin botanists with their illustrious predecessor, however, is the parallels in their work. Admittedly, the former are now able to make use of the

Bizarre limestone mountains dominate the landscape in the west of the island of Cuba

most advanced methods of molecular biology when investigating the evolution and interrelationships of the different plant groups. And the no less significant advances in digitisation technology make it easier to manage and make accessible the treasure of botanical information once it has been collected. But all of this research is still based on the same foundations as in Humboldt's time: the botanists of the twenty-first century still head off to the remotest places on the planet in order to collect plants and preserve them for posterity.

"People might reasonably ask why we're still doing this", says Prof. Dr Albert-Dieter Stevens, head of the Biological Collections department at the BGBM. He sees no end of good reasons. There are still, for example, numerous habitats around the world whose biodiversity is underresearched. And even if there was a collecting expedition to a particular place a hundred years ago, it can still be worthwhile making another visit. Generally, it is only through intensive fieldwork over many years that the majority of species that grow in one place are found. Experience has shown that new field researches bring fresh surprises. Today's collecting trips also allow us to document whether species have disappeared from the region in the meantime. Or whether humans may perhaps have introduced new ones, which are now spreading further like green invaders. "If we want to recognise such problems and protect ecosystems effectively, we must first take stock", explains Albert-Dieter Stevens.

His colleague Dr Nils Köster is always drawn, for example, to an island that even Humboldt had already visited twice: Cuba. "This is a treasure island from a botanical point of view", says the BGBM's curator of tropical and subtropical living collections. Over the course of evolution, Cuba developed an unusually rich flora. This is because the island offers a whole mosaic of different habitats: rainforests and semi-deserts, karst areas with bizarre limestone cones and regions where the greenish serpentinite rocks weather to soils rich in heavy metals. Each of these landscapes has its own plants that have adapted to their specific challenges. And that often thrive nowhere else in the world.

"Our goal is to systematically record the flora of the entire island", explains Nils Köster. What species exist there in the first place, and where exactly do they occur? What are their very particular characteristics? And how can they be used? Such questions should be answered by the *Flora de la República de Cuba* – a mammoth project that was already started in the 1970s by specialists from the island republic and the GDR. Today, this long-standing partnership continues at the BGBM. Teams from Berlin and Cuba venture into the field for several weeks a year to collect plants.

The first challenge is to reach the interesting areas in the first place. The distances are considerable, the road conditions often difficult, the petrol expensive. It is important to make best use of the days in the field. So the researchers fan out every morning and collect everything that can be found – even the most unassuming herb can end up providing interesting information. But first you actually have to get your hands on the plant in question. And sometimes that's not so easy. The flamingo flower Anthurium gymnopus, for example, only grows in a few of the island's savannahs – and then high up in the crowns of sabal palms. So how are you supposed to get at such a plant? "The palm trunk is so hard that crampons don't stick in", says Nils Köster. "Only by using a long pole can you hope perhaps to fish down a couple of plants."

"We usually bring home from Cuba material for all four collection types", explains the researcher. In addition to cuttings for the living collection and seeds for the seed bank, genetic samples for the DNA bank also travel back to Berlin. And, as in the days of Humboldt, his heirs press countless plants as herbarium specimens. Multiple sets of these specimens are prepared right away: one set remains in the Botanic

The flamingo flower *Anthurium gymnopus* is a member of the arum family that only occurs in Cuba

Garden in Havana, one goes to Berlin, and further sets are destined for local herbaria in other provinces of Cuba.

Every evening, the researchers bring a large quantity of plants back to the camp in big rice sacks. There they still have several hours of work ahead of them. They must sort and label the day's collections. Date, locality and any other information must be entered into the computer. Leaf fragments must be plucked for DNA sampling and packed in silica gel for drying. The plants for the herbarium are folded and trimmed so that they fit on a sheet of cardboard – which in the case of an agave, for example, with its two-metre-long leaves, is no easy task. After that they are ushered into a plant press between newspaper and cardboard. Often, the plants then make a stopover in a drying cabinet at the Botanic Garden in Havana, before they begin the journey to Berlin – accompanied, of course, by the necessary papers. These must confirm that the collection was officially sanctioned and that the use of the material is in compliance with international agreements on the use of genetic resources, such as the Nagoya Protocol.

At the BGBM the pressed plants are then mounted onto cardboard and given a label detailing, among other things, species, origin and collection date. Before it enters the herbarium, every specimen also gets a supermarket-style barcode. This tells us, for example, whether a DNA sample has already been taken from that particular plant. All the information is then fed into the database system of the BGBM's biological collections, so that the origin of all plants and the associated samples can be traced at any time. After all, the BGBM's collection currently comprises about 3.8 million herbarium specimens and living plants of

When **Dr Nils Köster** goes on a collecting trip, he almost always brings back cuttings and other living plants. After all, he is the Botanic Garden's curator of tropical and subtropical living collections, which means that he has under his wing 1.5 hectares of tropical and subtropical vegetation in the heart of Berlin. He is eager to continue adding to the collection of exciting plants from these latitudes. His scientific interests are the arum family and the so-called epiphytes, which grow in treetops.

about 20,000 species, subspecies and varieties. It's important to keep track – ultimately, each of the collection's components can provide important information.

"The herbarium specimens are the basis of research because they last longer than the living plants", explains Dr Robert Vogt, the BGBM herbarium curator for higher plants. So when Cuban doctoral students come to Berlin to work on the flora of Cuba they make particular use of the herbarium in addition to the laboratory facilities – and they can also be sent comparative material or at least digital photos from about 30 other herbaria around the world. "There is evidently a point to our collecting zeal", says Robert Vogt.

Biologist Banessa Falcón from the Botanic Garden in Havana is trying, for example, to find out more about the approximately 50 Cuban species of the extremely diverse genus *Phyllanthus*: Are they all descended from a single ancestor? Which are their closest relatives? When did the genus arrive on the island? When and why did it split into so many different species? Working in close cooperation with the BGBM, she is seeking to answer such questions with the help of the collected material and modern molecular and bioinformatic methods.

But there are certain interesting features that can't be seen on the pressed plant. Biological processes, for example, can only be studied on a living thing. The plants in the garden and in the greenhouses are therefore not only an attraction for visitors – they are part of the scientific collection. Thanks to Humboldt's heirs, even those who stay at home are able to research green diversity many years later.

Even cacti belong to the *Caryophyllales* – shown here is *Oreocereus doelzianus* in the BGBM's collection

Cacti, carnations and co. A global approach to the study of a diverse plant group

What do spinach and cacti, carnivorous pitcher plants and decorative carnations have in common? These plants may look very different, but they all belong in the same botanical "drawer". The *Caryophyllales* order has colonised the Earth's habitats in abundant variety: worldwide, more than 12,000 species are known, which corresponds to between five and six per cent of all flowering plants. Of course, such a diverse group also throws up a wide range of exciting research questions. And the extensive collections of *Caryophyllales* in the garden and herbarium provide an excellent basis for answering them. Which is why the *Caryophyllales* were selected as one of the scientific priorities of the Botanic Garden and Botanical Museum.

The highly specialised leaf of the Venus flytrap with prey

The sandwort *Arenaria rivularis* in the Argentinan Andes

Those who are interested in plants with unusual adaptations, for example, will really strike gold with this order. Some of its members are able to withstand the aridity of deserts, others thrive in very saline soils. Some climb up to 5500 metres in the Himalayas, while another – the Antarctic pearlwort – is one of only two flowering plants that grow deep in the icy south of the planet. How did the various different *Caryophyllales* species evolve? Which species are there anyway? And in which habitats are they growing today? It is questions such as these that researchers at the BGBM are seeking to answer.

"This is particularly important for species conservation", explains Prof. Dr Walter Berendsohn, head of the BGBM's Research and Biodiversity Informatics department. Ironically, it is the seemingly hardy survivalists among the *Caryophyllales* that are often most sensitive to man-made changes. Because many of them thrive only in very specific regions and habitats. When these refuges disappear, the plants are threatened with extinction. An example of this are the carnivorous pitcher plants of the genus *Nepenthes*, which catch and digest not only insects but sometimes even rats in their pitfall-like leaves. "Many of the described species grow only in small mountainous areas in Indonesia", says Walter Berendsohn. But their future there is threatened by mining and by the establishment of oil palm plantations.

The same is true of many other *Caryophyllales* species around the world. But you can only protect them if you have first determined which are the vulnerable candidates. And that's what's often lacking. Dr Sabine von Mering, who coordinates the *Caryophyllales* Network at the BGBM, works for example on the sandworts of the genus *Arenaria*. These plants are distributed almost worldwide, but she is especially interested in the Latin American representatives. And so far very little is known about them. "We don't even know how many species there are in the Andes", says the researcher. Let alone their interrelationships and evolutionary history. So Sabine von Mering has teamed up with colleagues from Bolivia, Peru and Argentina to collect, describe and genetically study the

In 2015, the first conference of the *Caryophyllales* Network took place at the BGBM – the latest findings on this plant group are brought together and updated on the information platform www.caryophyllales.org

local sandworts. Using conventional and molecular-biological methods, she is attempting to differentiate the individual species and clarify their often complicated interrelationships.

In a similar way, doctoral students from director Prof. Dr Thomas Borsch's research group as well as other experts at the BGBM and around the world are also doing research into other groups of Caryophyllales. Their long-term goals are to produce a global overview of the diversity of the plant group and a molecular biology-based family tree that ideally includes all known species. But this monumental task can only be tackled through international cooperation.

"In 2011, we therefore started to create a wholly new network", says Walter Berendsohn. The founder members were, in addition to the BGBM, the Institute of Biology of the Universidad Nacional Autónoma de México in Mexico City and the Instituto de Botánica Darwinion in Buenos Aires. More than 150 professionals from all over the world are now involved. But their collaboration needs to be well organised. It is important to coordinate research efforts and keep communication going, exchange doctoral students and hold conferences. All of this is actively supported by the team coordinated by Sabine von Mering, Walter Berendsohn and Thomas Borsch. In 2015, for example, the first conference of the *Caryophyllales* Network took place in Berlin with more than 80 participants from 18 countries.

In addition, BGBM experts also contribute their expertise in data processing – especially since the basis for effective cooperation among network partners is a common information system into which all relevant information about the individual species can be fed and linked. "In the past, the sum of all knowledge about a particular plant group was written up in the form of a monograph, which often represented

Dr Sabine von Mering is responsible for the coordination of the *Caryophyllales* Network. Her own research on this plant group focuses on the sandworts of the genus *Arenaria*. In order to investigate their occurrence in South America, she has already participated in two expeditions. In the Andes of Bolivia, Peru and Argentina, she and her co-operation partners travelled in 4×4 vehicles at altitudes up to 5000 metres so they could collect plants and bring them back to Berlin for further examination.

a lifetime's work for one researcher", says Walter Berendsohn. And this was a static publication that could quickly become obsolete. "On the computer, on the other hand, we can integrate and regularly update existing knowledge and new findings", adds the researcher, by way of explaining the advantages of modern biodiversity informatics.

He and his team have experience in this. Over the past 25 years, they have developed information systems that can process and exploit the vast jumble of botanical research data. The computer links the classic herbarium specimen with information from field research and DNA analysis. You can tell, for example, precisely where a particular plant comes from, what its characteristics are, what species it was originally assigned to, and whether that may have changed.

At least part of this information is also supposed to be accessible to the public at all times. The website www.caryophyllales.org already provides an overview of all 749 currently recognised Caryophyllales genera, and a species checklist is in progress. In addition, the network is contributing to the World Flora Online initiative (www.worldfloraonline.org), the aim of which is to create an online inventory of all plant life on Earth.

Experts working on other plant groups are already thinking about how to use the Caryophyllales Network as a model and thus coordinate their work more effectively. "We want to get systematic botany worldwide ready for modern requirements", says Walter Berendsohn. Because, in times of climate change and global species loss, this area is more important than ever.

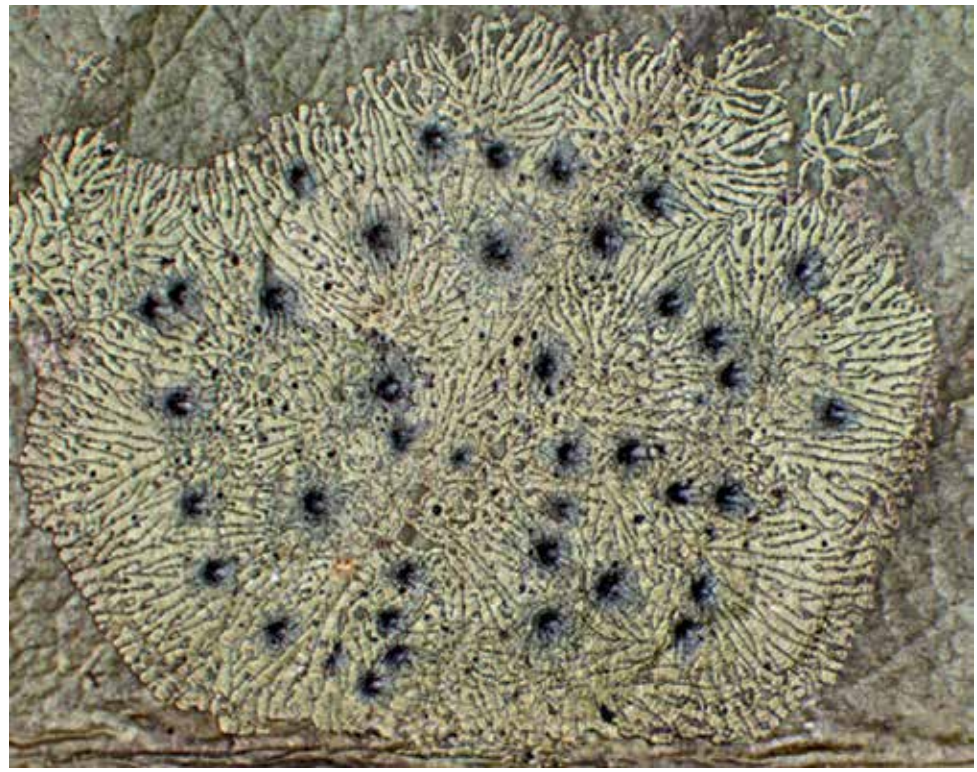
Cora accipiter Moncada, Madriñián & Lücking is one of the 70 species of *Cora* lichen newly described at the BGBM in 2016

New friends from around the world

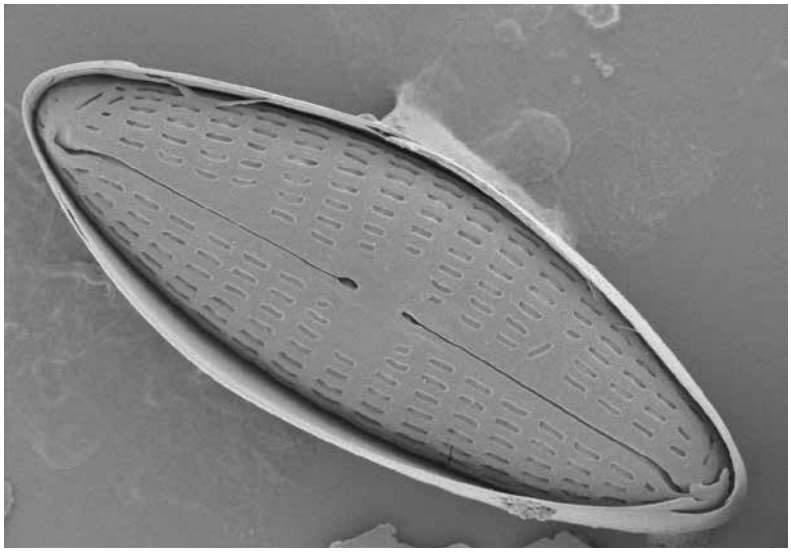
In the course of just two years, BGBM experts have described 183 previously unknown species.

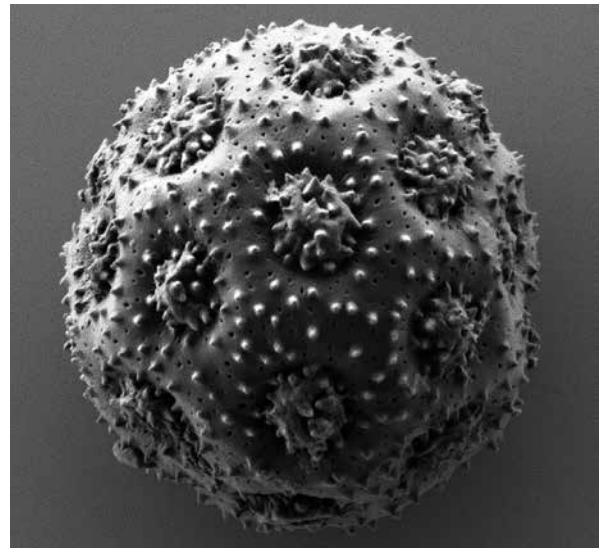
How many species are there in the world? Most experts think that a realistic figure would be around ten million. This means, though, that habitats around the world must still be hiding huge numbers of unknown organisms: only around two million species have, to date, been described by scientists.

Of these, 400,000 are vascular plants, of which a further 80,000 or so currently unknown species are thought to exist somewhere in the world. Far less research, however, has gone into fungi and lichens, an area in which the BGBM herbarium curator, Dr Robert Lücking, has specialised. “There are at least 1.5 million species of fungi, yet we know of not even 10 per cent of these”, estimates the researcher. He and his team are constantly coming across new kinds of lichen – in Colombia, for example.



Rhipsalis barthlottii Ralf Bauer & N. Korotkova (left) is a new species of cactus from Brazil. *Strigula transversoundulata* Sipman (right) is a new crustose lichen from Guyana





Under the microscope: *Navicula kongfjordensis* Stachura, Enke, Schlie, Schaub, Karsten & Jahn, a new diatom species from Spitzbergen (left) and a pollen grain of *Iresine sousae* Zumaya, Borsch & Flores Olv., with its characteristic surface structure (right)

A total of 183 new species from 36 countries were described at the BGBM in 2015 and 2016

Blumenbachia amana T. Henning & Weigend, a new species in the *Loasaceae* family

"Until around 15 years ago", recalls Robert Lücking, "no work at all could be done there, because of the guerrilla fighters and the drug cartels". For this reason, many regions of this South American country have been poorly researched: especially those that can only be reached after a three-day walk. Researchers return from these remote areas bearing countless paper bags of dried lichens, which they later examine more closely in the laboratory. For the individual species differ not only in shape or colour. They also form typical substances that they use, for example, as gold or orange sun-protection pigments to guard against damaging UV radiation. Chemical fingerprinting is another way of showing whether a species of lichen was previously unknown.

"In addition, a DNA analysis should always be carried out", continues Robert Lücking. He learned how valuable this sort of genetic information can be in the case of the *Cora* lichens from Colombia. For some time, scientists had assumed that this genus contained only one species, named *Cora glabrata*. DNA sequencing, however, made it possible to identify 200 different species. These may differ greatly in appearance:

As the BGBM curator responsible for cryptogams, **Dr Robert Lücking** is not short of work or questions for further research. His specialist area includes all lichens, mosses and fungi – large groups that have been relatively poorly researched up to now. As well as dealing with the biodiversity and ecology of tropical lichens, his work covers the evolution of fungi. And he is currently looking for methods to give a better overview of the huge range of these species, of which, up to now, our knowledge has been patchy.

some, for example, are green, others grey; some have a yellow shimmer, others look slightly blue in the light. In the herbarium, however, such differences can no longer be seen: when the plants are dried, all these shades fade to white or grey.

Anyone, then, who wishes to see the huge variety of *Cora* lichens with his or her own eyes, must climb to the humid grasslands of the South American Andes. It used to be thought that these so-called "páramos" formed a fairly uniform set of habitats. It is now clear, however, that each is like an island, housing its own species. This diversity of plant life, however, is now under threat. In particular, mining of silver, copper and other metals is, in many cases, destroying large areas of this unique vegetation. "One of the aims of our research is to provide arguments in favour of better protection for the páramos", explains Robert Lücking.

This task, however, requires a great deal of painstaking work. Every new species of lichen or plant must not only be examined, but also meticulously described and photographed. Often, a detailed scientific drawing is also needed, to depict the typical characteristics of the new species. An electron microscope can be very helpful, to show, for example, details of the plant pollen. All this takes time. Years may go by, therefore, between the discovery of a new species and scientific publication of its description.

This work is definitely worthwhile, however. Robert Lücking and his colleagues have already described around half of the 200 new Cora lichens. Other BGBM experts, too, frequently present unknown vascular plants to the public – daisies and cacti, verbenas and spurges. In 2015 and 2016, BGBM scientists described a total of 183 new species, and even nine previously unknown genera. These new additions hail from 36 countries, spread over six continents. And each of them provides another piece of the mosaic of global biodiversity.

Ex-situ cultivation of threatened plant species at the BGBM

Support for arnica & co. The BGBM's research contributes to the improved protection of native flora

A few good old friends were suddenly absent. And Johann Wolfgang von Goethe had very definitely become aware of it. "For some years, plants that used to be abundant have been disappearing from the area where I live," he noted. But at least: "What does not seem to be missing, however, is arnica, an entire cartful of which is collected annually and brought into pharmacies."

The poet would therefore be pretty horrified if he looked around him in Germany today. The intensification of agriculture and other undesirable influences has led to the continual escalation of species loss in native flora. "Even arnica is in very steep decline", says Prof. Dr Thomas Borsch, the BGBM's director. Only in the Alps are there still sizable populations of the well-known medicinal plant whose yellow flowers are a source of active ingredients in pain-relieving and anti-inflammatory ointments. In Germany's Central Uplands it is already more sparse, while in many parts of the North German Plain (Northern Lowland) arnica has already disappeared. And many other species are not faring any better.

Germany and the other parties to the UN Convention on Biological Diversity have therefore adopted a "Global Strategy for Plant Conserva-


Arnica and fragrant scabious used to be widely distributed in Germany – but now their populations are at risk in many places

tion". By the year 2020, specialists are expected to produce an overview of all known plant species together with an assessment of their risk status; develop concepts for the conservation and sustainable use of plant diversity; and, last but not least, bring the problem of impoverished flora to public attention.

But how can all this be implemented? "We can contribute a lot of specialist knowledge to these issues", says Thomas Borsch. On behalf of the Federal Agency for Nature Conservation (BfN), he and his team have for example taken a look at the genetics of endangered plants. They have concentrated on species whose worldwide distribution is centred in Germany and for which this country therefore bears a special responsibility.

"It is precisely in the genome of arnica that we came across an astonishing variability", reports Thomas Borsch. The arnicas in the Alps are genetically quite distinct from those in the Central Uplands, and these in turn have a different make-up from their fellow species in Mecklenburg-Western Pomerania. If we want to maintain diversity within the species we must therefore not confine our efforts to occurrences in individual geographical areas. However, the results also show that the often tiny stocks in the North German Plain have already lost some of their original genetic diversity. "Overall, *Arnica montana* is even more at risk than it appears at first glance", explains Thomas Borsch.

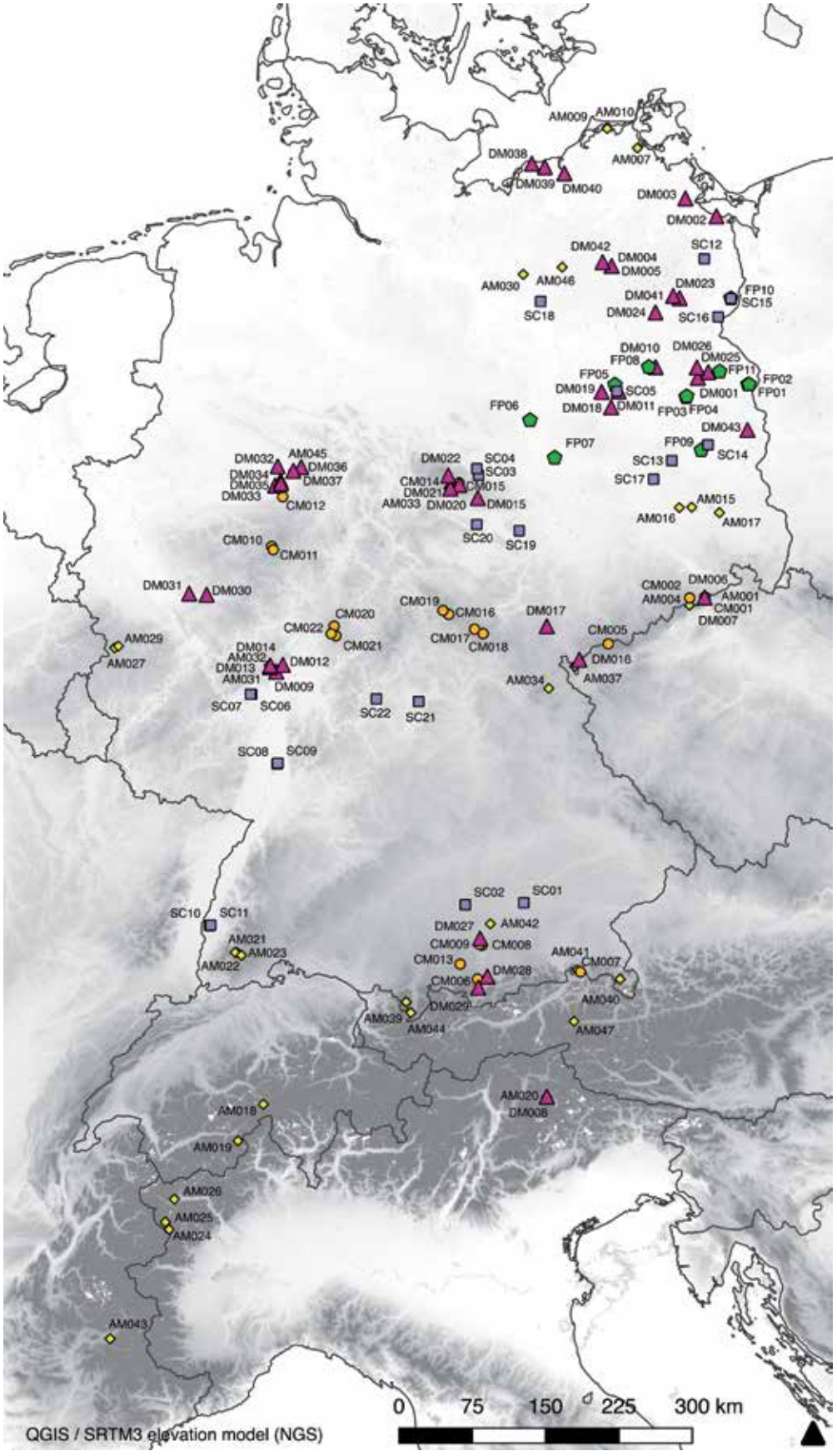
But what can be done about it? As part of a project called Wildpflanzenschutz Deutschland (WIPs-De), botanic gardens across Germany are trying, at the very least, to save the seed material of 15 endangered species. This is why the BGBM's Dr Elke Zippel is constantly on the road between the Baltic Sea and Saxony collecting seeds in often painstaking work. To ensure that the collection covers as much of the genetic diversity as possible, she aims to obtain at least 5000 seeds from 60 to 200 individuals at each collection point. Back in Berlin, the pickings are then cleaned, dried and frozen. At -20°C, the embryos dormant in the seeds can survive for decades or even centuries.

"But we don't just want to leave the seeds in the freezer", insists Elke Zippel. Our aim is rather to grow new plants from them, which will then be used either to support existing populations in the open air or to establish new ones. In 2016, for example, the BGBM team planted more than 1000 Cheddar pinks on a slope in the Oder valley, and on two dry grasslands in Berlin there are more than 2000 new fragrant scabious plants. "We must observe over the next few years how well these plants take", says the researcher. But she is optimistic. After all, 80 per cent of the newly grown plants survived the dry summer of 2016. There is ample opportunity to learn more about such endangered species at the BGBM. Here visitors can admire the beleaguered flora in the flesh, enjoy their flowers and scents and get to know their characteristics. Those already well versed in botany can even contribute to the study of native plant diversity: within the framework of the German Barcode of Life (GBOL) project, which is funded by the Federal Ministry of Education and Research, a nationwide network of research institutions is attempting to record the biodiversity of all animals, plants and fungi in Germany using their genetic fingerprint.

The model for this is the barcode found on goods in the supermarket, which allows products to be identified in seconds. Similarly, a tiny section of the genetic material of a living being is expected to reveal what species you have in front of you. Experts at the BGBM are in the process of developing such molecular-biological determination tools – for example for the grasses of the genus *Festuca* (fescues).

"The medium-term goal of GBOL is to expand the BGBM's DNA bank into a complete genetic archive of all species occurring in Germany", explains the BGBM's Dr Ralf Hand. But the necessary barcodes can only be created if you have enough plant material. Ralf Hand is in charge of procuring it, and is very glad of any help that volunteer collectors can provide. Amateur botanists often have an excellent knowledge of species and localities.

The knowledge of these plant enthusiasts is also in demand elsewhere. "Such volunteers provide a great deal of information for the nationwide Red Lists", explains Prof. Dr Walter Berendsohn, who heads the Research and Biodiversity Informatics department at the BGBM. These mammoth publications contain a schedule of all known animals, plants



By order of the Federal Agency for Nature Conservation (BfN) scientists at the BGBM have analysed the genetic material of selected endangered plant species across the whole of Germany. The map shows the places where samples were taken for five threatened species. (Graphics: V. Duwe and K. Reichel)

- *Arnica montana*
- *Crepis mollis*
- *Dactylorhiza majalis*
- *Festuca psammophila*
- *Scabiosa canescens*

Altitude (metres a.s.l.)

- 0 – 200
- 200 – 400
- 400 – 750
- 750 – 900
- 900 – 1150
- 1150 – 1400
- > 1400

Dr Ralf Hand coordinates the collecting of flowering plants as part of the "German Barcode of Life" (GBOL) project. His duties include acquiring material nationwide – from the coasts to the Alps – and identifying the species found. He is assisted in this endeavour by volunteers, who either gather material themselves or use their knowledge of the local terrain to help with fieldwork. Herbarium material is deposited in the BGBM's collections, while leaf tissue is used for the production of genetic barcodes in the laboratories of the BGBM and its partner institutions.

and fungi in Germany and indicate for each species whether it is endangered and to what extent. About every ten years, the Federal Agency for Nature Conservation issues a new version of this nationwide inventory of biodiversity. The next one is due to appear in 2020.

But how can the data from these Red Lists be used more effectively than before? What additional information must be collected? And how can the work of all involved be better coordinated? Walter Berendsohn and his team followed up on such questions in a BfN project completed in 2016. Workshops with the authors of the Red Lists were on the programme, as were legal opinions on the use of the data and the possible establishment of a separate Red List Centre based in Bonn.

"We have been particularly interested in the challenges of data processing", says Walter Berendsohn. In recent years he and his team have developed software called the "EDIT Platform for Cybertaxonomy". By using this software, the BGBM team, in collaboration with the Senckenberg Museum of Natural History in Görlitz, has for the first time succeeded in compiling a Red List for Germany's earthworms.

The secret of this software's success is its flexibility. Not only does it allow you to enter and later evaluate all possible information about a species in a highly standardised form. It can also adapt itself to the latest state of knowledge. So a species name on a Red List does not necessarily mean the same thing as it did ten years ago. "Often, for example, a species is subdivided into a number of different ones thanks to new findings", explains Walter Berendsohn. But how is the computer then supposed to deal with the information that was originally assigned only to one species? "Teaching this to the system is quite complex", says the researcher. But there is no way around it. For example, around 60 per cent of all moss species have changed their name over time – which can cause some confusion in nature conservation issues. With arnica, however, the matter is clear. It was already called Arnica montana in Goethe's time. And so it still is to this day.

The exhibition *Green Treasure Islands: Botanical Discoveries in the Caribbean*, 27 May 2016 – 26 February 2017

Caribbean dreams in Berlin
Science communication at the Botanic Garden and Botanical Museum

"I have never seen a more beautiful place." When, on 28 October 1492, Christopher Columbus sailed into a bay full of royal palms on the eastern side of Cuba, he was full of enthusiasm for this new world. He described his impressions: "Along the banks of the river were flowering trees I have never seen at home, surrounded by greenery, with flowers and fruit of the most diverse kinds, among the branches of which were little birds that sang very sweetly."

The Caribbean still works its magic today. For many people it is a dream destination, with its white sandy beaches, turquoise sea, palm trees rustling in the wind and bright coral reefs, as well as, of course, its rum and sultry rhythms. Not everyone, however, has the opportunity to see all of this in situ. But in 2016, there was a chance to soak up some tropical atmosphere in Berlin. In its Green Treasure Islands exhibition, the Botanical Museum invited visitors to experience all sorts of aspects of the Caribbean.

The special exhibition *Green Treasure Islands* also looked at the history of collecting in the Caribbean

Visitors could follow in the footsteps of researchers and explorers of previous centuries, or investigate the still unsolved botanical mysteries of this island world. There were fascinating landscapes to discover and exciting facts to learn about famous Caribbean products: rum, cigars, etc. If you wanted, you could also take home a Caribbean selfie as a souvenir. Visitors could choose their background: a traditional palm-fringed beach, but also a mountainous landscape in the Dominican Republic or cacti on the dry island of Bonaire. There were also treats for the ears: Caribbean music in the bar area, whispered descriptions of plants in a botanical study room with famous botanists from the past such as Carl von Linné, Erik Ekman and the BGBM researcher Ignatz Urban, and the sound of the elements. Visitors could use a wind machine to create their own hurricane, or imitate a tropical downpour using authentic Caribbean drums.

The exhibition continued outside the museum itself. The experience was rounded off with a walk through the greenhouses and the grounds of the Botanic Garden, where numerous Caribbean plants – the national flower of Cuba, cacti and ritual trees, tobacco and other crop plants, etc. – waited to be discovered. The overarching aim was to show all aspects of this fascinating world, and to discuss interesting issues for the benefit of visitors.

It is an approach that Dr Patricia Rahemipour wishes not only to continue, but to expand. "A museum should be fun", emphasises this exhibition expert, who has been head of the Science Communication department as well as the Botanical Museum since 2016. It is also important, she feels, to reach out to new target groups, who do not count botany as one of their main interests. "To do so", she explains, "we have to relate our displays to people's everyday lives."

Future exhibitions, therefore, should again concentrate on other exciting aspects of botany, and emphasise the relationship between people

Adolf Engler's archive was transferred to the BGBM from California in 2016

and plants. The 2017 exhibition, then, focuses on the tastes of Mexico, and on the many crop plants that have left the country to conquer the world. These include, for example, dahlias, which here are only known as ornamental plants. In many other cases, however, Mexico has added flavour to the world's menus, with crops such as tomatoes and beans, chilli and avocados, vanilla and agave.

Once all this has been savoured to the full, the next exhibition is planned for 2018. This will concentrate on Germany's house plants. It is no coincidence that Patricia Rahemipour and her team already know the topics for the next few years. Previously, exhibitions were prepared in the shorter term, but now the exhibition team has developed a five-year plan. "This makes it easier for us, for example, to organise loans and to include the exhibition in our general marketing concept", explains the expert.

BGBM science communication, though, is by no means limited to exhibitions and the museum. In the future, visitors will be able to view display boards throughout the gardens – previously they were only in the Main Tropical Greenhouse and in the Caucasus outdoor area. This has been made possible by support from the scheme for improving regional economic structures ("GRW"), which has enabled us to bring the tourist infrastructure in the garden up to date. When conveying scientific knowledge, messages will be geared to particular target groups. "Families with small children", explains Patricia Rahemipour, "tend to be interested in quite different things from, for example, groups of older people or visitors with some scientific expertise".

There is also an in-house publisher, which, in addition to scientific material such as the journals *Willdenowia* and *Englera*, publishes the exhibition catalogues. "We intend to extend the range of publications still further in the future", says Patricia Rahemipour. The plan, for example, is to publish a recipe book linked to the cooking-themed Mexico exhibition, as well as a series on the history of science. The BGBM also owns a vast specialist botanical library with more than 200,000 titles. Then there is the archive containing documents on the history of the garden, the museum and its collection, and on various researchers, as well as a collection of photographs.

"This archive was destroyed in the Second World War", explains Patricia Rahemipour. "But since then it has been reconstituted, and we are adding to it little by little." One of the most recent arrivals is part of the legacy of Adolf Engler, director of the Botanic Garden and Botanical Museum from 1889 to 1921. In the course of his highly productive life as a researcher, this botanist accumulated an extensive collection of special editions, with publications by expert colleagues.

"Scientists used to give each other copies of these publications, with a dedication, as gifts", explains Patricia Rahemipour. These signed special editions can give us a fascinating insight into the networks of past generations of researchers. The BGBM team was therefore excited when

Since 2016 **Dr Patricia Rahemipour** has been head of the BGBM's Science Communication department. She has, however, a rather unusual background for someone working in a botanical research institution. She is an archaeologist, and an expert in the history of science and exhibition design. This gives her a useful outside perspective on the many aspects of botanical research, and helps her to assess which interesting aspects should best be communicated to the public. These aspects are then brought together in exhibitions, which convert non-experts into fascinated plant-enthusiasts.

the Engler collection, kept until recently in the US, was brought back to Berlin. After lengthy customs procedures, the time finally came: in November 2016, our colleagues were able to unpack large wooden chests full of historical documents. Engler's legacy now proudly fills 17 metres of shelving.

This, however, is far from being the BGBM's only historical treasure. The Willdenow Herbarium, for example, is Berlin's botanical Fort Knox. A separate room, to which there are only two keys, houses the botanical bequest of Carl Ludwig Willdenow. This doctor and pharmacist, who, from 1801 until 1812, was director of the Royal Botanic Garden in Schöneberg, did not travel much himself for research. However, thanks to his excellent contacts he was able to collect material from the most exciting expeditions of his time. Just one scientist, for example, his student Alexander von Humboldt, left him 3500 herbarium specimens of South American plants.

In their own right, these specimens, witnesses to a past age, can tell fascinating stories; it is particularly exciting to see them in connection with, for example, Humboldt's diaries. We can then combine the scientific and cultural-historical aspects to form an overall picture. And this is also the aim of a research association established in 2016, under the name "Kosmos Berlin – Forschungsperspective Sammlungen" ("Cosmos Berlin – Collections Research Perspectives").

"We wanted to bring all the Berlin collection-housing institutions together around one table", explains Patricia Rahemipour. Different institutions and areas of expertise can then work together in this network to research particular issues – an idea that has met with a great deal of interest. The association includes, as well as the BGBM, the Berlin State Museums, the Museum of European Cultures, the Ethnological Museum, the German Museum of Technology and the German Historical Museum, the Berlin City Museum, as well as the Coordination Centre for Scientific University Collections in Germany. Regular meetings are held, with a sort of colloquium for scientific exchange, as well as salon evenings. Once a year, a large-scale workshop takes place, to discuss strategy for the following year and to establish joint research projects.

The research in question concerns the history of the collections themselves. At the time of the former GDR, for example, there were two natural history museums in Berlin: one in the East and one in the West. So what happened to these two institutions after Reunification? Investigating these questions sheds light on the political upheavals of that time. "We are trying", says Patricia Rahemipour, "to tell the history of Berlin through its collections." And that is a fascinating and worthwhile exercise. Because the capital is still home to more collections than anywhere else in Germany. When describing itself, the network even refers to Berlin as the "City of Things".

Stephanie Henkel has known the Botanic Garden since she was a small child – and has now landed her dream job. After studying at Berlin's Freie Universität for over ten years, the art historian and economist provided strategic support to ministries, associations and foundations on behalf of major communication and advertising agencies. At the BGBM, which is a cultural-historical institution as well as being a scientific one, she can now perfectly combine her expertise in these areas with her fascination for nature. Since 2015, she has been managing the Marketing and Events division and trying to infect as many people as possible with her enthusiasm for the BGBM.

Welcome to the capital's garden! A modern marketing strategy is set to establish the BGBM as one of Berlin's top attractions

With the autumn twilight, familiar figures began to stir in the greenhouses of the Botanic Garden: the tiger, Shere Khan, stole through the undergrowth with obviously sinister intent. The snake Kaa and Baloo the bear, the panther Bagheera and the human boy Mowgli lived out their adventures against an authentic backdrop of palm trees, ferns and lianas. And even a whole band of monkeys tumbled acrobatically down the artificial rocks in the Main Tropical Greenhouse to the delight of the public.

By turning the impressive plant world of the greenhouses into the setting for the Jungle Book, the theatre company Drehbühne Berlin, together with the Botanic Garden, created a completely new experience: the theatre safari! An exciting expedition led visitors in small groups to a total of seven stations, where actors, dancers and puppeteers with large animal figures brought scenes from Rudyard Kipling's classic to life. The production was so well received that it will continue to be on the programme.

Right: *The Jungle Book – A Theatre Safari* premiered in 2016 in the greenhouses of the Botanic Garden

Since 2008, the Botanical Night has welcomed thousands of visitors every year for a summer night's dream

Since autumn 2015, Stephanie Henkel has been head of Marketing and Events at the BGBM. She is responsible, among other things, for developing and organising events like these together with various partners. "We certainly don't want to make the Botanic Garden the umpteenth event location in Berlin", she stresses. Rather, it's about providing an incentive to as many people as possible to discover Dahlem's green treasury through theatre, music or festivals and to experience the magic of the place – maybe even for the first time. "Of course, our goal is to turn event visitors into permanent friends of the garden or at least get them talking about the garden among their circle of friends", explains the marketing expert. "That's why it's important to us that new events incorporate the garden's contents and emphasise its special features".

When it came to the strategic planning of the events calendar, particular attention was paid to the dark season of the year. This is a time when visitor numbers are traditionally lower than in spring and summer due to the absence of colourful displays in the park. But when something special is offered that suits the ambiance of the garden, there is a great demand for it. Stephanie Henkel experienced this not only with Mowgli's *Jungle Book* adventures in the autumn. The "Christmas Garden Berlin", during which the outdoor areas were transformed into an illuminated artwork for the first time during the pre-Christmas season 2016, also proved to be a huge draw. Instead of sinking into hibernation, the garden now attracted lively public interest even after sunset. "Visitors were very taken by the rather tranquil, contemplative atmosphere – particularly as it was such a complete contrast to the hectic Christmas markets", says Stephanie Henkel. "This is an instance where the concept and the majestic tranquillity of the place are such a perfect fit for one another."

These new events complement the mainstays of the BGBM calendar. One of those has been, for years, the summer festival known as "Botan-

The Christmas Garden Berlin transforms the unique grounds into a luminous wonderland

ical Night", which in 2016 attracted around 12,000 visitors. Then there are the summer concerts on the open-air stage, the Tropical (Cocktail) Nights and the Palm Symphony, during which the greenhouses become classical concert halls. And of course also the major plant shows and markets, such as the perennials market, the cactus and the orchid shows. After such events, Stephanie Henkel is repeatedly approached by guests who have discovered the charm of the Botanic Garden for the first time or rediscovered it – and want to come back. The Dahlem jewel is set to inspire even more people in the future, both from Berlin and around the world. Finally, the capital's tourism agenda makes provision for emphasising the city's "green" attractions in addition to the classic sights. And so, of course, the BGBM perfectly fits the bill. After all, it is the largest botanic garden in Germany and the world's number two in terms of biodiversity. And the existence of the Botanical Museum Berlin makes the place completely unique – nowhere else do you get "under one roof" objects on 43 hectares and botanical knowledge from a 300-year-old tradition.

There is no doubt, therefore, that the institution has the makings of a visitor magnet. It's just a question of showing off its assets in the best possible way. Which is why the approximately 12.6 million euros, which was allocated to the BGBM in 2015 from the subsidy fund of the scheme for improving regional economic structures ("GRW"), has come in extremely useful.

Projects financed by GRW funds include the development of a modern visitor information and signage system, the renewal of garden paths, a new visitor centre, modernisation of ticket sales and an overhaul of the website. Planning for all of this started in 2016 and implementation will take until 2020.

Please don't water! Many mountain plants need it dry

New worlds under glass
The renovation and technical modernisation of greenhouses can save a lot of energy

"Building a new greenhouse to overwinter and suchlike the southern plants, which now make more frequent pilgrimages to us, arouses my sensory attention." Goethe again. And again the poet hit the nail on the head. Because building or renovating a greenhouse requires attention in abundance. Countless details must be taken into consideration when finding new solutions to horticultural, technical, architectural and buildings preservation problems. The Botanic Garden's professionals now have plenty of experience with such challenges. In the past ten years, around 40 million euros have been invested in construction schemes to improve the infrastructure.

The latest addition is two greenhouses in the so-called Alpine Garden, which were completed in 2015 and 2016. "This is the nursery of our outdoor facilities", explains Karsten Schomaker, the Botanic Garden's operations manager. This is where perennials that would not survive their first weeks in the open air can be propagated and grown. And, as the name suggests, plants from the Alpine region have also found a home here. Five different rocks form artificial rock shelters, with stems and leaves sprouting out between the cracks. And for species that rely on a harsh mountain climate, a blower system even simulates the cold wind that sweeps around the peaks.

The new greenhouses at the BGBM house rare Mediterranean plants and the nursery for the outdoor areas

"When building these greenhouses, we benefited greatly from all the knowhow that we had accumulated over the years in various refurbishment projects", stresses Karsten Schomaker. Thus, some of the listed public greenhouses, which had been built at the beginning of the twentieth century according to plans by the royal architect Alfred Koerner, were now, a hundred years or so later, in need of rejuvenation. Because their energy footprint was horrific. "In 2003, the greenhouses consumed 830,000 euros a year in energy costs", says Karsten Schomaker. "Which would equate to 1.3 to 1.4 million at today's prices." So a more economical approach was needed to protect both the budget and the environment.

It all started with the structure that is emblematic of the Botanic Garden: the Main Tropical Greenhouse built between 1905 and 1907, with its more than 1100 plant species. This imposing building made of steel and glass manages to do without supporting pillars inside. With a floor area of 60 by 30 metres and a height of 26 metres, it is still one of the largest cantilevered greenhouses in the world today. But its technology was by now outdated. So the Main Tropical Greenhouse was completely renovated between 2006 and 2009. "We wanted to conserve this historic piece of architecture while at the same time reducing energy consumption by at least half", explains Karsten Schomaker.

For this, architects and construction companies had to dig deep into their professional trick boxes. Even the question of the right glass became a real challenge. In the end, a special thermal insulation glass was chosen, which lets 80 per cent of the daylight through to the growing plants – including a certain amount of UV that the plants need for photosynthesising. "This glass had to be specially approved for the purpose: it's not something you can get off the shelf", recalls Karsten Schomaker.

In the meantime, sufficient heating in the greenhouse is provided by modern underfloor heating and low-temperature façade heating, which heats all the bars in the glass façades up to 38 degrees. At the same time, this protects the façade from condensation, thus preserving the steel structure. Only if these two heat sources are not enough, on particularly cold winter days, is it also heated by the air conditioning. Further energy is saved by two 17-metre-high towers camouflaged as tree trunks. Inside, rotating fans send the rising warm air back to the ground. In addition, one of the artificial trunks conceals a high-tech

The heating supply under the public greenhouses

Towers camouflaged as tree trunks ensure that warm air is distributed through the Main Tropical Greenhouse

material that stores heat from the air during the day and then releases it at night.

A bigger problem than the temperature, however, was the regulation of humidity. The ventilation system does contain packets of silica gel that absorb moisture and then release it when needed. But that alone was not enough to dry the entire volume of air in the Main Tropical Greenhouse. And nor was it desirable, on energy-saving grounds, just to open the windows, as is common in other greenhouses.

So the overly humid air is now fed outside and the heat contained within it recovered through heat exchangers. The whole thing is controlled by a special "climate calculator" for greenhouses. It manages to keep the humidity in the Main Tropical Greenhouse at the desired 80 per cent. On winter days, temperatures reach at least 21 degrees and drop to 18 degrees at night.

"Thanks to the refurbishment, the Main Tropical Greenhouse now consumes about 70 per cent less primary energy", says Karsten Schomaker. As a result of this alone, the Botanic Garden saves 165,000 euros in energy costs and 570 tons of carbon dioxide emissions each year. Reason enough, then, to think about the other great energy guzzlers of the Botanic Garden. In renovating the latter, the researchers benefited greatly from the experiences they had gained at the Main Tropical Greenhouse. This applies, for example, to construction work on the Victoriahaus, which contains numerous tropical and subtropical marsh and aquatic plants but is famous above all for its spectacular water lilies. The tropical giant water lily *Victoria amazonica*, to which this greenhouse owes its name, is truly impressive with flowers up to 30 centimetres in diameter and two-metre wide leaves that can even support the weight of children. However, the building was so dilapidated that from 2006 it was no longer able to accommodate plants or visitors. Between 2013 and 2016, however, the Victoriahaus was renovated and is set to reopen soon. At the same time, three kilometres of pipes in the heat supply network of the Botanic Garden were renewed and insulated. And, so that the greenhouses are no longer dependent solely on district heating, in December 2015 a biogas-powered cogenerator went into operation.

But this push towards modernising the greenhouses has not just been

Karsten Schomaker is one of the Botanic Garden's technical experts. He studied mechanical engineering and economics and specialised in environmental and sustainability management. At the BGBM, he was first responsible for Technology, Infrastructure and Environment, but since 2011 he has been managing the entire operation. This means he is in charge of the technical supervision of the garden's development and its technical infrastructure. He is also responsible for ensuring compliance with sustainability and environmental goals.

limited to the jewels of the Botanic Garden. Even the nurseries that are not open to the public were getting on in years. Unlike the listed historic buildings, these propagation greenhouses were completely rebuilt – and all in the same style. "The uniform design has saved us a lot of time and money", explains Karsten Schomaker. The horticultural specialists decided on relatively large greenhouses with 4.5 metre high walls. This not only makes it easier to control the greenhouse climate, but also allows for the cultivation of large plants. However, the very stuffy conditions that some species need in order to grow can't really be achieved in a building like this. "That's why we now have some smaller greenhouses within the big ones", explains the expert.

Since the new nurseries were planted in 2011, several generations of new plants have grown successfully in them. The offspring of the titan arum, for example, which is famed for having the largest "flower" (actually a spathe and spadix) in the world, are thriving very well. In the fern area, too, there is abundant growth. And there is a separate propagation department for aquatic plants, which the director Prof. Dr Thomas Borsch has developed together with the manufacturer. This is home to a special collection comprising numerous representatives of the water lily family, which often have very special needs. In other pools, some of these are propagated so that they can later be shown in public display areas such as the Victoriahaus.

Meanwhile, experts from other botanic gardens are also interested in all these facilities. "People from all over the world come to us now and see how we've been doing things", reports Karsten Schomaker. The Main Tropical Greenhouse in particular has once again acquired model status – just as it did more than a hundred years ago. The specialist attention that was bestowed on it is bearing fruit.

How does a herbarium work? Dr Gerald Parolly gives explanations to students as part of the Master's module "Collection management and curation"

Green learning

At the Freie Universität Berlin, BGBM experts offer a whole series of courses

In the heart of Dahlem, students can embark on an exciting expedition into the world of plants: experts from the Botanic Garden and Botanical Museum Berlin are keen to pass on their knowledge to a new generation of scientists. Director Prof. Dr. Thomas Borsch, for example, gives lectures and courses at the Freie Universität (FU) Berlin on the evolution and diversity of plant life. Students can learn, for instance, current methods of researching genetic links between plants, based on DNA sequencing. These sorts of molecular-phylogenetic analyses are of great importance nowadays in the study of biology.

Some of the BGBM's curators also teach at the FU. Their own experience helps them to convey very clearly what is important in curating and using scientific collections. Every winter semester, for example, Dr Nils Köster and Dr Gerald Parolly teach a special module for Master's students in "Collection management and curation": the only place in

Students carry out germination tests at the Dahlem Seed Bank

Germany where such a module is on offer. In this course, up to twenty FU students learn how to collect and document seeds or herbarium material, how to work with databases and convey knowledge to visitors in easily understood texts. “The course as a whole is, of course, based around plants”, says Nils Köster, “but the content is also transferable to jobs in zoos or in natural history museums.”

The course, of eight full days, goes down very well with the participants, mostly studying biology or related subjects, but also some geology or geography students. They particularly like its practical approach. How do you identify exotic plants, with very little literature to guide you? And how do you arrange a greenhouse so as to give the most natural impression of the vegetation of a particular region? These are the sorts of questions discussed during the course, from a very practical angle, which soon shows where theoretical knowledge acquired at university is useful, and where something else is needed. “Identifying plants, for example, requires a lot of practice”, says Nils Köster. “You can’t usually just learn this at university.” Making further progress requires some initiative. The BGBM course has already encouraged a fair few students to regularly take out a field guide, sit down in a meadow, and get to work. Mission accomplished.

You don’t need to be a biology student, however, to gain insight into the secrets of scientific collecting. In the 2016/2017 winter semester, the Science Communication department developed a series of lectures to be given as part of the FU’s “Open Lecture Hall” series. Once a week, anyone interested could attend one of the “Collections and Collectors in Berlin” lectures to find out more about the various collections, their treasures and their histories.

Career steps in Dahlem Junior scientists at the BGBM

Anyone who chooses to pursue doctoral studies or take up a postdoctoral post at the Botanic Garden and Botanical Museum Berlin will become part of an international team. In 2015 and 2016, seventeen young people from ten countries were among the institution's junior scientists.

All doctoral programmes are located at the Faculty of Biology, Chemistry and Pharmacy of the Freie Universität Berlin, but the BGBM is responsible for their content and supervision. The topics are mostly based on the BGBM's scientific collections, biodiversity programmes and collaborative international projects.

The training of the doctoral candidates takes place within the framework of the "Plant Sciences" doctoral programme of the Dahlem Research School, where particular emphasis is placed on the quality of the supervision. In addition, there are courses that prepare students for the various challenges of a scientific career. The spectrum ranges from scientific writing to producing a successful application to time and project management.

Even those who have already reached the next rung of the career ladder can take part in these events. In addition, as part of their work at the BGBM, postdoctoral researchers have the opportunity to deepen their knowledge and work on their scientific profile. In doing so, they gain experience that qualifies them in particular for future professional activities at institutions with scientific collections or for careers at the interface of science and politics.

Dubán Canal Gallego works on the large genus *Philodendron*, of which many more than 500 species grow in the tropical rainforests of Central and South America. For his doctorate, he is researching the interrelationships and the evolutionary history of these plants. He is able to derive some of the necessary information from herbarium specimens and the BGBM's living collection. For almost six weeks in February and March 2016, he travelled to Colombia to collect plants. Based on all these samples, he was able to reconstruct a family tree of *Philodendron* with the help of DNA sequencing. The current species diversity of the genus mainly developed over the last ten million years, when the Andes underwent the most intensive phase of mountain formation.

Virginia Duwe investigates the genetics of endangered plant species as part of a project funded by the Federal Agency for Nature Conservation. For her doctorate, she has been concentrating on mountain arnica and northern hawksbeard, one of whose centres of worldwide distribution is here in Germany. How great is the genetic diversity of these species? And what does that mean for their conservation? In order to find out, the researcher carefully examined 30 arnica and 20 hawksbeard populations nationwide – and arrived at quite distinct sets of results. While the hawksbeard plants in different regions of Germany have a fairly similar genetic make-up, the individual populations of arnica differ markedly. Effective conservation measures must therefore be tailored to each species individually.

Dr Katy Elizabeth Jones works as a postdoctoral fellow at the BGBM and researches the evolution and diversity of the *Lactuca* genus (lettuces). The approximately 200 species of this group, which belongs to the daisy family, typically contain a milky white sap and usually have yellow flowers. The focal points of their natural distribution are around the Mediterranean and in the Caucasus, as well as in the Himalayas. From there, many representatives of this group spread to North America, Africa and the Canary Islands, where new species emerged. Using modern genetic methods, Dr Jones intends to reconstruct this complicated history and get a better understanding of the wild relatives of lettuce & co. Apart from working in Berlin, she has also worked in a laboratory in Memphis, USA and has collected plants in their natural habitat of the Caucasus.

Watering for the advanced
The BGBM's traineeships are very much in demand among prospective horticulturists

How do you germinate rare seeds from the remotest regions of the world? What are the needs of botanical rarities from the Caucasus or the Seychelles? And how can these often quite particular requirements be met in Berlin? The horticulturists of the Botanic Garden and Botanical Museum Berlin are confronted with such questions on a daily basis. It takes not only expert knowledge, but also a sure instinct and a great deal of experience to be able to answer them. For those that want to be successful in a job that is as varied as it is challenging, the three-year training scheme is only the beginning of a lifelong learning process.
The Berlin institution offers a total of four traineeships every year in the care of perennials and ornamental plant cultivation. It is looking for real

Three of the apprentices from the class of 2016

Thorsten Laute has an MSc in horticulture and worked for years in landscape gardening and orcharding before coming to the Botanic Garden. Since 2009, he has been the lead instructor responsible for training the BGBM's junior horticulturists. In 2011, he also took over the management of the Field and Logistics division, overseeing nearly 50 employees whose job it is to care for the outdoor facilities, procure soil and other materials and dispose of green waste.

plant enthusiasts who are likely to be inspired by botanical challenges. "We want people with a glint in their eyes", says training director Thorsten Laute. But that alone is not enough. The training course requires a combination of brains, strength and fine motor skills. Sometimes, heavy wheelbarrows need to be moved. At other times, fine and delicate seedlings have to be separated in such a way that they don't come to any harm. Dealing with milling machines, vehicles and other technology is just as much a part of the programme as specialist research in the library or working with databases. And even watering is an art in itself, which the apprentices must approach slowly and cautiously.

So they gradually become consummate professionals. Ideally they should know and take into account every peculiarity of their green charges, but keeping an eye on all of the approximately 20,000 plant species and subspecies of the Botanic Garden is almost impossible – which is why trainees can specialise and focus on, for example, aquatic plants or orchids with their very particular needs.

Many helping hands
The friends and supporters of the Botanic Garden and Botanical Museum

Maintaining and caring for this green jewel in the heart of Dahlem, carrying out botanical research throughout the world: without help, the BGBM staff would not be able to manage all this. The involvement of all volunteers, those providing practical help and those providing financial support, is therefore particularly important.

Since 1987, then, the Verein der Freunde des Botanischen Gartens und Botanischen Museums Berlin-Dahlem (Association of Friends of the Botanic Garden and Botanical Museum Berlin-Dahlem) has supported scientific projects which would otherwise have had difficulties finding funding. The areas receiving most support from the association, which currently has around 800 members, include collecting trips, the digitisation of historical collections, visits to Berlin by guest scientists as part of the BGBM's international cooperation activities, materials for smaller research projects and the presentation of botanical content in the garden or the museum.

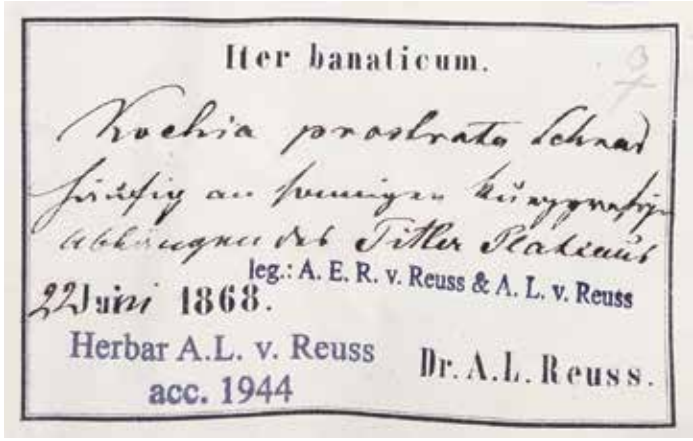
Green sponsorships

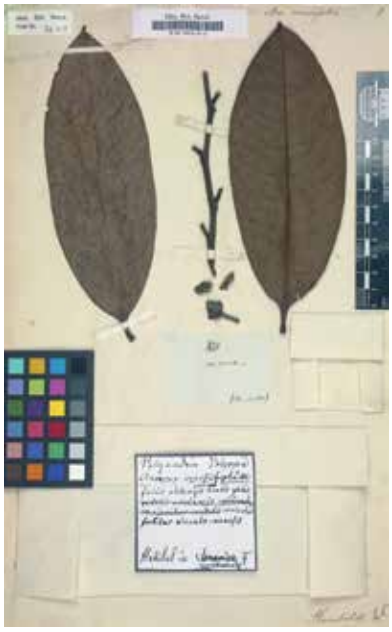
Anyone wishing to support the Botanic Garden with a public, living gesture can do so by sponsoring a particular plant species for at least a year. Depending on the species, the annual cost is between 250 and 1500 euros. The BGBM has been arranging plant sponsorships with companies and private individuals since the year 2000, and new ones are added each year. The sponsor can of course choose which species to sponsor. Some may be looking for a plant from a specific region, or one with spectacular flowers, with a particular scent or a bizarre name: there are around 20,000 species in the Botanic Garden, and one is bound to fit the bill. You can even sponsor your favourite bench. www.bgbm.org/de/pflanzenpatenschaften

Volunteering

There are many different ways of providing voluntary support to the team at the Botanic Garden and Botanical Museum Berlin. Depending on individual interests and skills, opportunities exist outdoors, in the greenhouses or in the herbarium, for example. Volunteers can help prepare for exhibitions in the museum or work with the press and PR team. Many BGBM events and plans would be impossible without these helping hands. For all these reasons, we should like to express our heartfelt thanks to these volunteers!

Are you interested in volunteering at the BGBM? Get in touch with us at: c.maass@bgbm.org



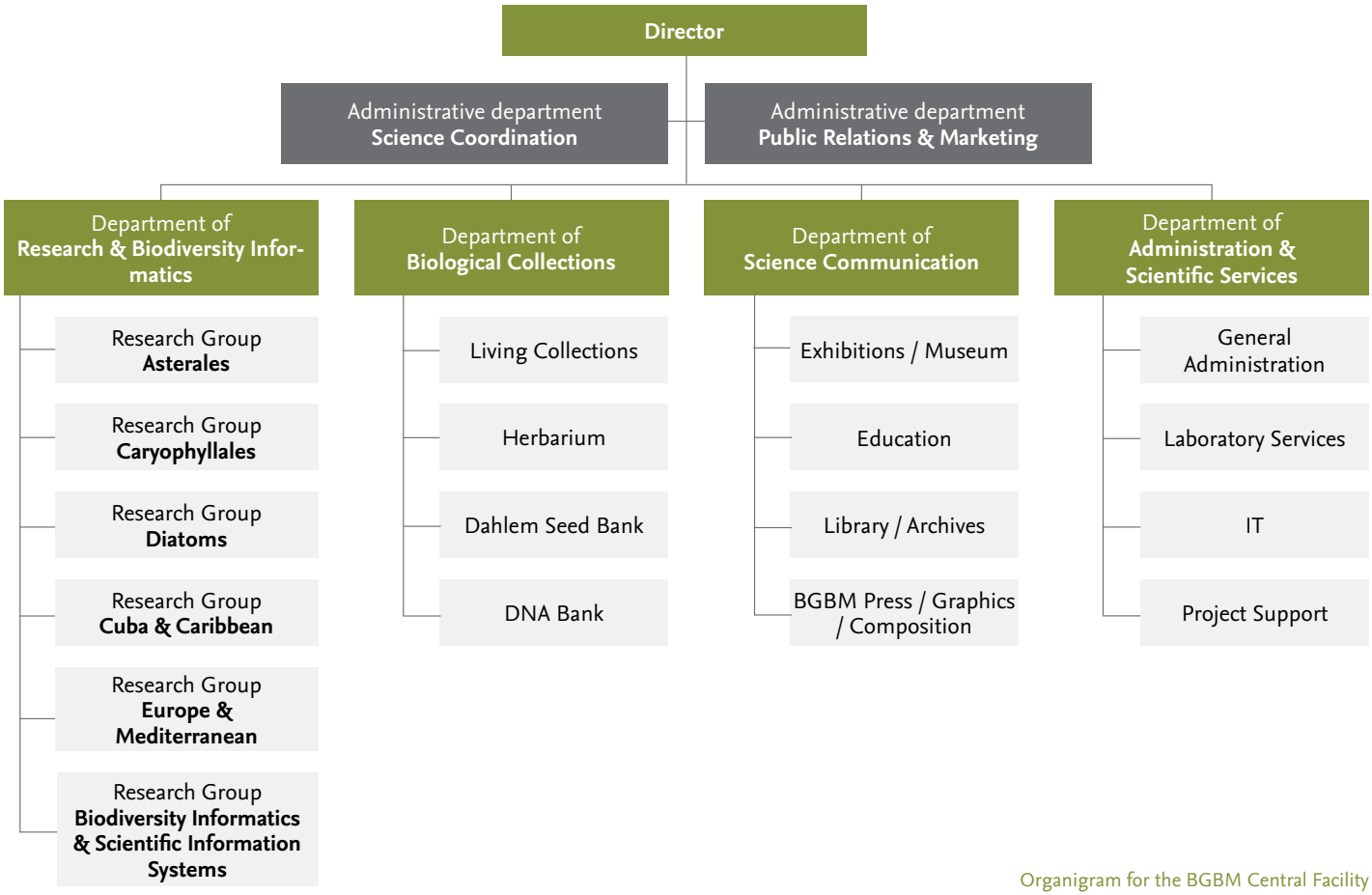


The Herbonauts

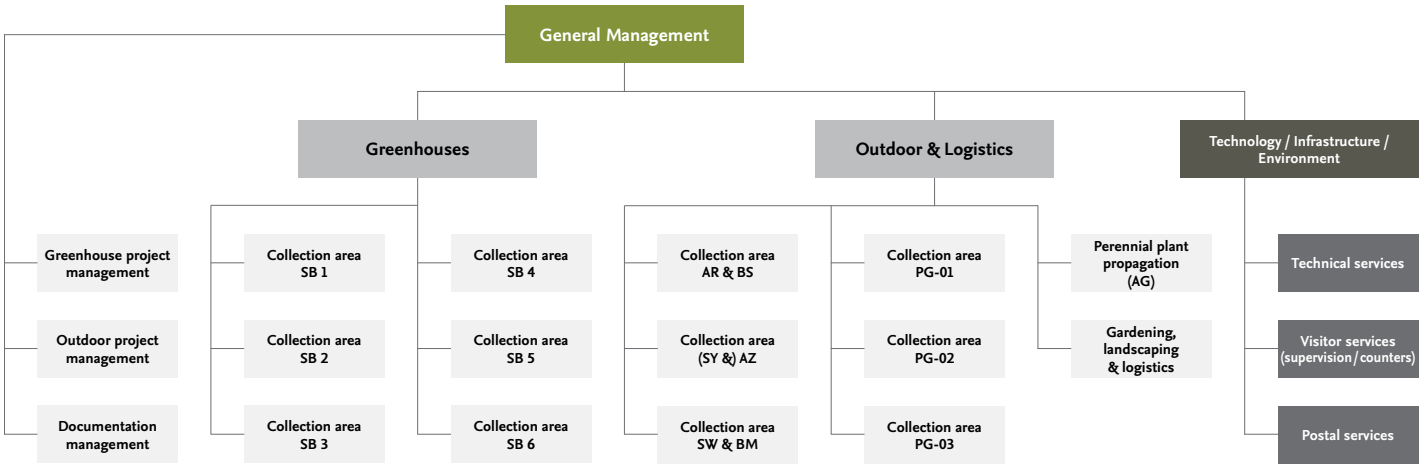
Almost four million specimens are stored in the herbarium, beneath the inner courtyard of the Botanical Museum at the Königin-Luise-Platz – and many of these are still not recorded in a database. To remedy this, the Verein der Freunde is supporting a project that allows all those interested to become "herbonauts". These volunteers will need to take the information on country of origin, and other details, from the labels of the herbarium specimens and enter it into a database, via a web portal. Where specimens are labelled in old German or Cyrillic script, this can be a real challenge.

If you would like to become involved, you can find more information at www.herbonauten.de

Organisation



Organigram for the BGBM Central Facility



SB 1 Tropics & ferns
SB 2 Bromeliads, orchids & tropical useful plants
SB 3 Tropical marsh & water plants, aroids
SB 4 Succulents
SB 5 Southern hemisphere, East Asian & carnivorous plants
SB 6 Mediterranean plants & tree ferns

Organigram for the BGBM Gemeinschaftsbetrieb

Facts and figures

Staff and affiliated scientists

2015 – 2016

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Dr. Zippel, Elke
Zoellner, Carolin

Dubán Canal Gallego, Colombia; Virginia Duwe, Germany; Andrea Belen Escobari Vargas, Bolivia; Arsen Gasparyan, Armenia; Luis Demetrio Mora Hernández, Mexico; Elmira Maharramova, Azerbaijan; Teresa Ortuño Limarino, Bolivia; Nana Silakadze, Georgia; Demet Töre, Turkey; Vanessa Di Vincenzo, Germany.

Doctoral students

2015–2016

Visiting scientists

2015

International: M. Abdalla, Sudan; Prof. Dr. H. Akhani, Iran; Prof. Dr. I. A. Al-Shehbaz, USA; Prof. Dr. Dr. J. Antonovics, USA; D. Araújo, Brazil; Dr. Z. Asanidze, Georgia; Prof. Dr. S. Bancheva, Bulgaria; Prof. Dr. R. Berazaín Iturralde, Cuba; P. van den Boom, Netherlands; Prof. Dr. J. M. Burke, USA; T. Chatrenoor, Iran; Dr. C. Cocquyt, Belgium; Prof. Dr. R. Cortés, Colombia; J. da Costa Lima, Brazil; Dr. N. Douglas, USA; Dr. P. Dvořák, Czech Republic; Dr. J. Espejo Cardemil, Chile; B. Falcón, Cuba; M. Fallding, Australia; Prof. Dr. H. Flores-Olveira, Mexico; Dr. R. L. Gayoso Coelho, Brazil; Dr. S. A. Ghazanfar, UK; A. Gholipour, Iran; V. Gonçalez, Brazil; Dr. P. Gonella, Brazil; Dr. M. Haji Moniri-Anbaran, Iran; Dr. P. Hajkova, Czech Republic; N. Hernández Monterrey, Cuba; J. Jefferson Sampaio, Sweden; Dr. L. Kipriyanova, Russia; Dr. C. Klak, South Africa; Prof. Dr. M. Kolanowska, Poland; Dr. M. Kulikovskiy, Russia; Dr. J. Lovo, Brazil; D. Lyskov, Russia; Prof. Dr. J. Ma, China; M. Malekmohammadi, Iran; D. Martin, USA; Dr. M. C. Martinez-Habibe, Colombia; Dr. S. Mayorov, Russia; Prof. Dr. I. Mendez, Cuba; Prof. Dr. B. Moncada, Colombia; Dr. A. Monro, UK; Dr. D. B. Montesinos-Tubée, Netherlands; Dr. A. Moore, USA; T. Nagy, Hungary; Dr. M. Nesbitt, UK; Prof. Dr. H. Ochoterena Booth, Mexico; N. Oledrzynska, Poland; Dr. C. Pannell, UK; Prof. Dr. A. Paukov, Russia; F. Pérez Uribbe, Brazil; Prof. Dr. V. Plasek, Czech Republic; Prof. Dr. R. Pollawatn, Thailand; P. Ponkai, Thailand; Prof. Dr. R. Primack, USA; H. Rainer, Austria; Dr. R. Rankin, Cuba; S. Raukov, Russia; Tim Robertson, Denmark; Prof. Dr. E. Rott, Austria; Dr. C. F. Catarino de Sá, Brazil; T. Shagholi, Iran; Prof. Dr. S. Shetekauri, Georgia; Prof. Dr. A. Shipunov, USA; Prof. Dr. C. Sletten Bjora, Norway; S. Souza Almeida Jacques, Brazil; T. R. Stoughton, USA; Dr. A. Sukhorukov, Russia; Prof. Dr. M. Timaná de la Flor, Peru; Prof. Dr. I. Valdespino, Panama; Dr. M. Vinkler, Czech Republic; N. Vlasova, Russia; A. Watson, Chile; J. Watson, Chile; S. Wongphakdee, Thailand; K. Yildiz, Turkey; Y.-J. Lu, Taiwan; M. Zaika, Russia; Dr. G. Zare, Turkey; Prof. Dr. S. Zarre, Iran; B. Zemanova, Czech Republic.

National: C. Beilschmidt, Marburg; F. Brambach, Göttingen; Dr. S. Caspari, Schiffweiler; Dr. C. Coiffard, Berlin; Dr. M. Diepenbroek, Bremen; Dr. P. Erzberger, Berlin; W. Ewest, Bernau; Dr. A. Fleischmann, München; C. Forgiarini, Freising/Rio Grande do Sul; F. Fraga, Trier; C. Friedl, Potsdam; Dr. D. Harpke, Gatersleben; C. Hoffmann, Weißwasser; Dr. N. Holstein, Bonn; Dr. T. Janßen, Berlin; S. Kahl, Potsdam; Dr. N. Karam, Berlin; Prof. Dr. B. König-Ries, Jena; Prof. Dr. S. Liede-Schumann, Bayreuth; F. Löffler, Jena; Dr. H. Manitz, Jena; L. Nikolov, Köln; K. Opasjumruskit; Jena; C.-T. Pfaff, Leipzig; M. Ristow, Potsdam; Dr. A. Rockinger, München; U. Schindler, Bremen; C. Schneider, Schiffweiler; T. Schneider, Schiffweiler; H. Sperling, Berlin; Dr. D. Triebel, München; Prof. Dr. G. Wagenitz, Göttingen; F. Wagner, Regensburg.

2016

International: Dr. A. Aptroot, Netherlands; Prof. Dr. M. Arbo, Argentina; F. Ávila, Colombia; R. Bijmoer, Netherlands; Dr. T. E. Boza Espinosa, Switzerland; Prof. Dr. M. Cáceres, Brazil; Dr. M. Callmander, Switzerland; Prof. Dr. J.-M. Cardiel, Spain; L. Cardoso, Brazil; Dr. I. Castañeda, Cuba; A. Ciftci, Turkey; X. Cornejo, Ecuador; Prof. Dr. K. Coskuncelebi, Turkey; Dr. T. Croat, USA; Prof. Dr. P. Dimopoulos, Greece; B. Falcón, Cuba; Dr. A. Field, Australia; J. Florence, France; P. Fröden, Sweden; Dr. T. Fulcher, UK; Dr. V. Funk, USA; C. Gallagher, Australia; Dr. D. Geiger, USA; M. Gold, UK; Dr. P. González, Cuba; S. Güven, Turkey; Prof. Dr. J. Gutiérrez, Cuba; Prof. Dr. David Hawksworth, UK; Dr. Z.-F. Jia, China; N. Jogan, Slovenia; R. Jorge Trad, Brazil; Dr. A. Kahraman, Turkey; Dr. E. Leandro de Lima, Brazil; Dr. S. van der Linde, UK; S. Lobo, Costa Rica; Prof. Dr. S. Makbul, Turkey; L. Marinho, Brazil; L. Mauad, Brazil; Dr. J. Milne, Australia; Prof. Dr. B. Moncada, Colombia; Dr. D. Montesinos, Peru; T. Mota Machedo, Switzerland; Prof. Dr. T. Nagata, Japan; Prof. Dr. H. Ochoterena Booth, Mexico; S. Okur, Turkey; N. Oledrzyska, Poland; C. Oliveira Andrino, Brazil; Dr. C. Pannell, UK; Prof. Dr. U. Peintner, Austria; Dr.

C. Pennesi, Italy; E. Price, UK; Dr. R. Rabeler, USA; H. Rainer, Austria; M. Ramirez, Mexico; Prof. Dr. Rosa Rankin, Cuba; Dr. N. Salazar Allen, Panama; M. Santos, Brazil; A. Sassone, Argentina; C. Schollaardt, Netherlands; Dr. T. Schuster, Australia; K. Šemberová, Czech Republic; Prof. Dr. A. Strid, Denmark; Prof. Dr. T. Tønsberg, Norway; Prof. Dr. I. Valdespino, Panama; J. L. Villar, Spain; Võ Thi Phi Giao, Vietnam; Dr. J. de Vos, UK; Dr. G. Weerakoon, Sri Lanka; Dr. P. Windisch, Brazil; A. Xavier-Leite, Brazil; Dr. B. Xu, China; M. Zaika, Russia; Z. Zakeri, Iran.

National: Dr. A. Algergawy, Jena; F. Brambach, Göttingen; Dr. C. Coiffard, Berlin; Dr. M. Diepenbroek, Bremen; M. Dinies, Berlin; Dr. S. Dressler, Frankfurt am Main; Dr. H.-J. Esser, München; Dr. J. Felden, Bremen; M. Ferrari, Leipzig; Dr. D. Frank, Halle; F. Geiger, Potsdam; Dr. T. Gregor, Frankfurt am Main; H. Hartmann, Berlin; G. Hensel, Merseburg; A. Herrmann, Potsdam; K. Kaiser, Berlin; Dr. N. Karam, Berlin; Dr. D. Killmann, Koblenz; A. Kleinsteuber, Karlsruhe; Dr. A. Kocyan, Potsdam; Dr. I. Kostadinov, Bremen; Dr. M. Lehnert, Bonn; F. Löffler, Jena; S. Lozada, Potsdam; H. Machon, Berlin; Dr. H. Manitz, Jena; P. Marquardt, Leipzig; Prof. Dr. C. Müller-Birn, Berlin; Prof. Dr. U. Müller-Doblies, Berlin; C.-T. Pfaff, Leipzig; Dr. S. Pfanzelt, Oldenburg; U. Raabe, Marl; R. Rauschkolb, Tübingen; M. Ristow, Potsdam; Prof. Dr. J. Rohwer, Hamburg; Dr. U. Schiefelbein, Rostock; U. Schindler, Bremen; Dr. C. Schirarend, Hamburg; D. Schneck, Waldsieversdorf; K. Schulz, Dresden; Dr. M. Stocker, Bremen; U. Täglich, Merseburg; M. Weinrebe, Bremen; Prof. Dr. G. Wiegleb, Cottbus; Prof. Dr. C. Wirth, Leipzig.

Volunteers

2015 – 2016

Evelin Bartels; Detlef Böhm; Mario Brand; Sabine Brocher; Ingrid Bulkowski; Lotte Burkhardt; Uschi Christahl; Sonja-Maria Czérkus-Yavuz; Gabriele Deroche; Anne Döpfner; Regina Ehrich; Gabriele Ellendt; Heidemarie Franke; Claus Fricke; Wolfgang Frohberg; Gudrun Genschow; Bettina Gmelin; Irene Grametzki; Barbara Grusche; Seok Hyun Han; Petra Hansel; Sebastian Hofman; Margit Jaroschewski; Almut Jörg; Margit Keipke; Jürgen Klawitter; Anja Clara Kraft; Hartmut Krebs; Christina Kronawitter; Marianne Kubicki; Katharina Kurras; Erik Lachmann; Alina Lebherz; Erich Liebert; Dr. Erica Mahr; Anna Maler; Helga Malks; Gerhard Neumann; Nikolaus Nolden; Regina Ostrower; Tjalda Picksak-Schmidt; Miriam Rathsmann; Maria Rosken; Hans J. Schäfers; Gudrun Scharte; Silke Schaube; Cora-Beate Schaumann; Karin Schenk; Heide-Marie Schrader; Jutta Schrader; Birgit Schubert; Rodney Smith; Regina Stark; Tom Stawowy; Dr. Olaf Steffen; Aglaia Szukala; Timo Thurm; Bernd Wagner; Dietmar Weinert; Inge Weinert; Sabine Zehrer.

Voluntary Ecological Year

2015 – 2016

Valentine Dutrannoy; Lina Gerndt; Johanna Koen; Teresa Lange; Lisa Paul; Ece Sarioglu.

Publications

Articles in peer-reviewed journals

Aptroot A. & **Lücking R.** 2016: Editorial: A first collaborative attempt at a global revision of *Trypetheliaceae* (*Ascomycota*: *Dothideomycetes*: *Trypetheliales*). – Lichenologist **48:** 607 – 608. – DOI: 10.1017/S0024282916000517.

Aptroot A. & **Lücking R.** 2016: A revisionary synopsis of the *Trypetheliaceae* (*Ascomycota*: *Trypetheliales*). – Lichenologist **48:** 763 – 982. – DOI: 10.1017/S0024282916000487.

Aptroot A., Cáceres M. E. S., Johnston M. K. & **Lücking R.** 2016: How diverse is the lichenized fungal family *Trypetheliaceae* (*Ascomycota*: *Dothideomycetes*): a quantitative prediction of global species richness. – Lichenologist **48:** 983 – 1011. – DOI: 10.1017/S0024282916000463.

Arana M. D., Mynssen C. M., **Zimmer B.** & Ponce M. M. 2016: Typification of names of South American taxa related to *Woodsia montevidensis* (*Woodsiaceae*). – PhytoKeys **63:** 13 – 18. – DOI: 10.3897/phytokeys.63.8366.

Arcadia L. & **Lücking R.** 2016: (320) Proposal to amend Article 20.2. – Taxon **65:** 903 – 905. – DOI: 10.12705/654.35.

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Species newly described by BGBM authors

2015 – 2016

Name	Organism	Country of origin
Acantholichen albomarginatus Dal-Forno, Marcelli & Lücking[1]	lichen	Brazil
Acantholichen campestris Dal-Forno, Spielmann & Lücking[1]	lichen	Brazil
Acantholichen galapagoensis Dal-Forno, Bungartz & Lücking[1]	lichen	Ecuador (Galapagos)
Acantholichen sorediatus Dal-Forno, Sipman & Lücking[1]	lichen	Costa Rica
Acantholichen variabilis Dal-Forno, Coca & Lücking[1]	lichen	Colombia
Ampliotrema sanguineum Lücking[2]	lichen	Venezuela
Architrypethelium lauropaluanum Lücking, M. P. Nelsen & Marcelli[3]	lichen	Brazil
Astrochapsa lobata Lücking[2]	lichen	St. Kitts & Nevis
Astrochapsa sipmanii Weerakoon & Lücking[4]	lichen	Singapore
Astrochapsa submuralis E. L. Lima, Lücking & M. Cáceres[5]	lichen	Brazil
Astrothelium aurantiacocinereum Lücking, Naksuwankul & Lumbsch[3]	lichen	New Caledonia
Astrothelium carassense Lücking, M. P. Nelsen & Marcelli[3]	lichen	Brazil
Astrothelium cryptolucens Lücking, M. P. Nelsen & N. Salazar[3]	lichen	Panama
Astrothelium fijiense Lücking, Naksuwankul & Lumbsch[3]	lichen	Fiji
Astrothelium laevithallinum Lücking, M. P. Nelsen & Marcelli[3]	lichen	Brazil
Astrothelium leucosessile Lücking, M. P. Nelsen & Aptroot[3]	lichen	Panama
Astrothelium macrostomoides Lücking, M. P. Nelsen & Benatti[3]	lichen	Brazil
Astrothelium megacrypticum Lücking, M. P. Nelsen & N. Salazar[3]	lichen	Panama
Astrothelium nicaraguense Lücking, M. P. Nelsen & T. Orozco[3]	lichen	Nicaragua
Astrothelium norisianum Lücking, M. P. Nelsen & Aptroot[3]	lichen	Panama
Astrothelium obtectum Lücking, M. P. Nelsen & Benatti[3]	lichen	Brazil
Astrothelium sordithecium Lücking, M. P. Nelsen & Marcelli[3]	lichen	Brazil
Astrothelium subendochryseum Lücking, M. P. Nelsen & Marcelli[3]	lichen	Brazil
Astrothelium subinterjectum Lücking, M. P. Nelsen & Jungbluth[3]	lichen	Brazil
Bathelium porinosporum Lücking, M. P. Nelsen & Gueidan[3]	lichen	Vietnam
Bellevalia juliana Bareka, Turland & Kamari[6]	vascular plant	Greece
Blumenbachia amana T. Henning & Weigend[7]	vascular plant	Brazil
Calenia surinamensis van den Boom & Sipman[8]	lichen	Surinam
Chapsa angustispora E. L. Lima, Lücking & M. Cáceres[5]	lichen	Brazil
Chapsa multicarpa Lücking, Parnmen & Lumbsch[9]	lichen	Thailand
Chapsa thambapanni Weerakoon, Jayalal & Lücking[10]	lichen	Sri Lanka
Clandestinotrema hepaticola Lücking[2]	lichen	Venezuela
Cora accipiter Moncada, Madriñán & Lücking[11]	lichen	Colombia
Cora applanata Moncada, Soto-Medina & Lücking[11]	lichen	Colombia
Cora arachnodavidea Moncada, Dal-Forno & Lücking[11]	lichen	Colombia
Cora arborescens Dal-Forno, Chaves & Lücking[11]	lichen	Costa Rica
Cora arcabucana Moncada, C. Rodríguez & Lücking[11]	lichen	Colombia
Cora aturucoa Lücking, Moncada & C. Vargas[11]	lichen	Colombia
Cora auriculeslia Moncada, Yánez-Ayabaca & Lücking[11]	lichen	Ecuador
Cora barbifera Moncada, Patiño & Lücking[11]	lichen	Colombia
Cora barbulata Lücking, Dal-Forno & Lawrey[9]	lichen	Costa Rica
Cora boleslia Lücking, E. Morales & Dal-Forno[11]	lichen	Bolivia
Cora canari Nugra, Dal-Forno & Lücking[11]	lichen	Ecuador
Cora caraana Lücking, Martins & Lucheta[11]	lichen	Brazil
Cora casasolana Moncada, R.-E. Pérez & Lücking[11]	lichen	Mexico
Cora caucensis Moncada, M. Gut. & Lücking[11]	lichen	Colombia
Cora celestinoa Moncada, Cabrera-Amaya & Lücking[11]	lichen	Colombia
Cora comaltepeca Moncada, R.-E. Pérez & Herrera-Camp.[11]	lichen	Mexico

Name	Organism	Country of origin
Cora corani Lücking, E. Morales & Dal-Forno[11]	lichen	Bolivia
Cora corelleslia Moncada, A. Suárez-Corredor & Lücking[11]	lichen	Colombia
Cora crispoleslia Moncada, J. Molina & Lücking[11]	lichen	Colombia
Cora dalehana Moncada, Madriñán & Lücking[11]	lichen	Colombia
Cora davibogotana Lücking, Moncada & Coca[11]	lichen	Colombia
Cora davicrinita Moncada, Madriñán & Lücking[11]	lichen	Colombia
Cora davidia Moncada, L. Vargas & Lücking[11]	lichen	Colombia
Cora dewisanti Moncada, A. Suárez-Corredor & Lücking[11]	lichen	Colombia
Cora dulcis Moncada, R.-E. Pérez & Lücking[11]	lichen	Mexico
Cora elephas Lücking, Moncada & L. Vargas[11]	lichen	Colombia
Cora fuscodavidiana Lücking, Moncada & L. Vargas[11]	lichen	Colombia
Cora garagoa Simijaca, Moncada & Lücking[11]	lichen	Colombia
Cora gigantea Lücking, Moncada & Coca[11]	lichen	Colombia
Cora gomeziana Dal-Forno, Chaves & Lücking[11]	lichen	Costa Rica
Cora guajalitensis Lücking, Robayo & Dal-Forno[11]	lichen	Ecuador
Cora hafecesweorthensis Moncada, Lücking & R. Peláez[11]	lichen	Colombia
Cora haledana Dal-Forno, Chaves & Lücking[11]	lichen	Costa Rica
Cora hawksworthiana Dal-Forno, P. Nelson & Lücking[11]	lichen	Costa Rica
Cora hochesuordensis Lücking, E. Morales & Dal-Forno[11]	lichen	Bolivia
Cora hymenocarpa Lücking, Chaves & Lawrey[11]	lichen	Costa Rica
Cora imi Lücking, Chaves & Lawrey[11]	lichen	Costa Rica
Cora leslactuca Lücking, Moncada & R. Peláez[11]	lichen	Colombia
Cora maxima Wilk, Dal-Forno & Lücking[11]	lichen	Bolivia
Cora minutula Lücking, Moncada & Yánez-Ayabaca[11]	lichen	Ecuador
Cora palaeotropica Weerakoon, Aptroot & Lücking[11]	lichen	Sri Lanka
Cora palustris Dal-Forno, Chaves & Lücking[11]	lichen	Costa Rica
Cora parabovei Dal-Forno, Kukwa & Lücking[11]	lichen	Bolivia
Cora paraciferrii Lücking, Moncada & J.E. Hern.[11]	lichen	Colombia
Cora paraminor Dal-Forno, Chaves & Lücking[11]	lichen	Costa Rica
Cora pastorum Moncada, Patiño & Lücking[11]	lichen	Colombia
Cora pikynasa J.-M. Torres, Moncada & Lücking[11]	lichen	Colombia
Cora pseudobovei Wilk, Dal-Forno & Lücking[11]	lichen	Bolivia
Cora pseudocorani Lücking, E. Morales & Dal-Forno[11]	lichen	Bolivia
Cora putumayensis L. J. Arias, Moncada & Lücking[11]	lichen	Colombia
Cora quillacinga Moncada, F. Ortega & Lücking[11]	lichen	Colombia
Cora rothesiorum Moncada, Madriñán & Lücking[11]	lichen	Colombia
Cora rubrosanguinea Nugra, Moncada & Lücking[11]	lichen	Ecuador
Cora sanctae-helenae Lücking[12]	lichen	St. Helena
Cora schizophylloides Moncada, C. Rodríguez & Lücking[11]	lichen	Colombia
Cora smaragdina Lücking, Rivas Plata & Chaves[11]	lichen	Costa Rica
Cora soredavidia Dal-Forno, Marcelli & Lücking[11]	lichen	Brazil
Cora subdavicrinita Moncada, J. Molina & Lücking[11]	lichen	Colombia
Cora suturifera Nugra, Besal & Lücking[11]	lichen	Ecuador
Cora terrestris Dal-Forno, Chaves & Lücking[11]	lichen	Costa Rica
Cora terricoleslia Wilk, Dal-Forno & Lücking[11]	lichen	Bolivia
Cora trindadensis Lücking,M. Cáceres, N. G. Silva & R. J. V. Alves[12]	lichen	Trinidad
Cora udebeceana Moncada, R. Peláez & Lücking[11]	lichen	Colombia
Cora urceolata Moncada, Coca & Lücking[11]	lichen	Colombia

Name	Organism	Country of origin
Cora verjonensis Lücking, Moncada & Dal-Forno[11]	lichen	Colombia
Cora viliewoa Lücking, Chaves & Soto-Medina[11]	lichen	Costa Rica
Cora yukiboa Mercado-Díaz, Moncada & Lücking[11]	lichen	Puerto Rico
Cyphellostereum bicolor Lücking & Timdal[13]	lichen	Kenya, Tanzania, Mauritius
Dictyonema album Lücking & Timdal[13]	lichen	Kenya, Tanzania, Mauritius
Dictyonema gomezianum Lücking, Dal-Forno & Lawrey[9]	lichen	Costa Rica
Dictyonema krogiae Lücking & Timdal[13]	lichen	Kenya, Tanzania, Mauritius
Dictyonema tricolor Lücking & Timdal[13]	lichen	Kenya, Tanzania, Mauritius
Dyplolabia dalywaiana Rivas Plata, Bawingan & Lücking[14]	lichen	Thailand
Echinoplaca basalis W.B. Sanders & Lücking[15]	lichen	USA
Enterographa paruimae Sipman[8]	lichen	Guyana
Eugeniella palleola Breuss & Lücking[16]	lichen	Nicaragua
Euphorbia lemesiana Hadjik., Hand, Christodoulou & Frajman[17]	vascular plant	Cyprus
Fissurina carassensis Lücking, Parnmen & Lumbsch[9]	lichen	Brazil
Fissurina duplomarginata Weerakoon & Lücking[4]	lichen	Singapore
Fissurina lumbschiana Weerakoon, Jayalal & Lücking[10]	lichen	Sri Lanka
Fissurina tuberculifera Weerakoon, Jayalal & Lücking[10]	lichen	Sri Lanka
Glaucotrema bahianum Lücking[2]	lichen	Brazil
Glaucotrema thailandicum Naksuwankul, Lücking & Lumbsch[18]	lichen	Thailand
Grammonema rostockensis Stachura, Enke, Schlie, Schaub, Karsten & Jahn[19]	diatom	Norway
Graphis bukittimaensis Weerakoon & Lücking[4]	lichen	Singapore
Graphis cilindrospora E. L. Lima, Lücking & M. Cáceres[5]	lichen	Brazil
Graphis koratensis Pitakpong, Kraichak & Lücking[20]	lichen	Thailand
Graphis mahaeliyensis Weerakoon, Jayalal & Lücking[10]	lichen	Sri Lanka
Graphis paraschiffneri Lücking & Breuss[16]	lichen	Nicaragua
Graphis singaporensis Weerakoon & Lücking[4]	lichen	Singapore
Gyalideopsis pusilla Lücking & Tønsberg[21]	lichen	USA
Gyalideopsis sessile W. B. Sanders & Lücking[15]	lichen	USA
Halamphora woelfeliae Stachura, Enke, Schlie, Schaub, Karsten & Jahn[19]	diatom	Norway
Hieracium barrelieri Gottschl., Raimondo, Greuter & Di Grist. [22]	vascular plant	Italien
Iresine sousae Zumaya, Borsch & Flores Olv.[23]	vascular plant	Mexico
Isoetes haussknechtii Troia & Greuter[24]	vascular plant	Greece
Klaprothiopsis dyscrita T. Henning & Weigend[25]	fossil plant	Dominican Republic
Leucodecton minisporum Lücking[2]	lichen	Dominican Republic
Leucodecton uatumense Lücking[2]	lichen	Brazil
Malmidea cineracea Breuss & Lücking[16]	lichen	Nicaragua
Myriotrema arimense Lücking[2]	lichen	Trinidad and Tobago
Myriotrema maroense Lücking[2]	lichen	Venezuela
Navicula kongfjordensis Stachura, Enke, Schlie, Schaub, Karsten & Jahn[19]	diatom	Norway
Nigrovothelium bullatum Lücking, Upreti & Lumbsch[3]	lichen	India
Ocellularia arachchigei Weerakoon, Lücking & Lumbsch[26]	lichen	Sri Lanka
Ocellularia baorucensis Lücking[2]	lichen	Dominican Republic

Name	Organism	Country of origin
Ocellularia buckii Lücking[2]	lichen	Brazil
Ocellularia caraibica Lücking[2]	lichen	Puerto Rico
Ocellularia comayaguana Lücking[2]	lichen	Honduras
Ocellularia coronata Lücking & Pérez-Ortega[27]	lichen	Cuba
Ocellularia daniana Lücking[2]	lichen	Cuba
Ocellularia dussii Lücking[2]	lichen	Guadeloupe
Ocellularia endoperidermica Lücking[2]	lichen	Ecuador
Ocellularia fuscospora Lücking & Pérez-Ortega[27]	lichen	Cuba
Ocellularia granpiedrensis Lücking[2]	lichen	Cuba
Ocellularia gueidaniana Weerakoon & Lücking[4]	lichen	Singapore
Ocellularia imshaugii Lücking[2]	lichen	Jamaica
Ocellularia klinhomii Naksuwankul, Lücking & Lumbsch[18]	lichen	Thailand
Ocellularia liamuiga Lücking[2]	lichen	St. Kitts & Nevis
Ocellularia macrospora Lücking[2]	lichen	Puerto Rico
Ocellularia maricaoensis Lücking[2]	lichen	Puerto Rico
Ocellularia nigririmis Lücking & Pérez-Ortega[27]	lichen	Cuba
Ocellularia pichinchensis Lücking[2]	lichen	Ecuador
Ocellularia radiata Lücking[27]	lichen	Cuba
Ocellularia ratnapurensis Weerakoon, Lücking & Lumbsch[26]	lichen	Sri Lanka
Ocellularia rivasplatana Weerakoon & Lücking[4]	lichen	Singapore
Ocellularia rotundifumosa Naksuwankul, Lücking & Lumbsch[18]	lichen	Thailand
Ocellularia subudupiensis Weerakoon & Lücking[4]	lichen	Singapore
Pycnotrema fissurinum Lücking[2]	lichen	Puerto Rico
Rhabdodiscus albodenticulatus Weerakoon, Lücking & Lumbsch[26]	lichen	Sri Lanka
Rhabdodiscus trinitatis Lücking[2]	lichen	Trinidad and Tobago
Rhipsalis barthlottii Ralf Bauer & N. Korotkova[28]	vascular plant	Brazil
Sticta arbusculotomentosa Moncada & Betancourt[29]	lichen	Colombia
Sticta fuscotomentosa Moncada, Coca & Lücking[9]	lichen	Colombia
Sticta gallowayana Moncada & Lücking[29]	lichen	Colombia
Sticta globulifuliginosa Moncada & Lücking[29]	lichen	Colombia
Sticta hirsutofuliginosa Moncada & Lücking[29]	lichen	Colombia
Sticta jaguirreana Moncada & Lücking[29]	lichen	Colombia
Sticta macrofuliginosa Moncada & Lücking[29]	lichen	Colombia
Sticta minutula Moncada & Lücking[29]	lichen	Colombia
Sticta phyllidiofuliginosa Moncada & Lücking[29]	lichen	Colombia
Sticta plumbeociliata Moncada & Lücking[29]	lichen	Colombia
Sticta subfilicinella Moncada, Coca & Lücking[29]	lichen	Colombia
Strigula transversoundulata Sipman[8]	lichen	Guyana
Tamarix minoa J. L. Villar, Turland, Juan, Gaskin, M. A. Alonso & M. B. Crespo[30]	vascular plant	Greece
Thelotrema heladiwense Weerakoon, Jayalal & Lücking[10]	lichen	Sri Lanka
Topeliopsis subtuberculifera Weerakoon, Jayalal & Lücking[10]	lichen	Sri Lanka
Tricharia duotela W. B. Sanders & Lücking[15]	lichen	USA
Trypethelium tolimense Lücking, Moncada & M. Gut.[3]	lichen	Colombia
Viridothelium tricolor Lücking, M. P. Nelsen &N. Salazar[3]	lichen	Panama
Viridothelium vonkonratii Lücking, Naksuwankul & Lumbsch sp. nov[3]	lichen	Fiji

Sources (the full bibliographical references can be found in the list of publications on pages 53–67):

[1)]Dal Forno et al. 2016 – Mycologia 108: 38 – 55. [2)]Lücking R. 2015 – Opusc. Philolichenum 14: 1 – 57. [3)]Lücking et al. – Lichenologist 48: 639 – 660. [4)]Weerakoon et al. 2015 – Lichenologist 47: 157 – 166. [5)]De Lima et al. 2016 – Phytotaxa 278: 163 – 170. [6)]Bareka et al. 2015 – Pl. Biosyst. 149: 703 – 709. [7)]Henning et al. 2015 – Phytotaxa 236: 196 – 200. [8)]Boom & Sipman 2016 – Folia Cryptog. Estonica 53: 101 – 110. [9)]Ariyawansa et al. 2015 – Fungal Diversity 75: 27 – 274. [10)]Weerakoon et al. 2015 – Nova Hedwigia 101: 77 – 88. [11)]Lücking et al. 2016. – Fungal Diversity 84: 139-207. [12)]Lücking et al. 2015 – Bryologist 118: 293 – 303. [13)]Lücking & Timdal – Willdenowia 46: 191 – 199. [14)]Kalb et al. 2016 – Phytotaxa 268(2): 110 – 122. [15)]Sanders & Lücking 2015 – Bryologist 118: 170 – 177. [16)]Breuss & Lücking 2015 – Lichenologist 47: 9 – 20. [17)]Hand et al. 2015 – Bot. J. Linn. Soc. 179: 295 – 307. [18)] Naksuwankul et al. 2016 – MycoKeys 17: 47 – 63. [19)]Stachura-Suchoples et al. 2015 – Polar Biol. 39: 1933 – 1956. [20)]Pitakpong et al. 2015 – Lichenologist 47: 335 – 342. [21)]Lücking & Tønsberg 2016 – N. Am. Fungi. 11: 1 – 4. [22)] Gottschlich et al. 2015 – Phytotaxa 208: 70 – 74. [23)]Flores-Olvera et al. 2016 – Willdenowia 46: 165 – 174. [24)]Troia & Greuter 2015 – Willdenowia 45: 391 – 403. [25)]Poinar et al. 2015 – J. Bot. Res. Inst. Texas 9: 369 – 379. [26)]Li et al. 2016 – Fungal Diversity 78: 1 – 237. [27)]Lücking & Pérez-Ortega 2015 – Lichenologist 47: 305 – 322. [28)]Bauer & Korotkova N. 2016 – Kakteen Sukk. 67: 281 – 287. [29)]Moncada et al. 2015 – Revista Acad. Colomb. Ci. Exact. Nat. 39: 50 – 66. [30)]Villar al. 2015 – Willdenowia 45: 161 – 172.

Online resources and databases

The BGBM makes available databases and online resources that on the one hand are used for the cataloguing of our own collections and on the other present fundamental biodiversity data on groups of organisms or geographical regions. More general service portals are also hosted at the BGBM:

1. Digitised collections at the BGBM

Virtual Herbarium – digital specimen images from the Berlin herbarium – access to the Berlin data in the JACQ system (see below)
http://ww2.bgbm.org/herbarium/default.cfm

BoGART – database of the BGBM's living collection
http://ww2.bgbm.org/bogartdb/BogartPublic.asp

BioCASE-BGBM – Biological Collection Access Service for Europe. Portal for BGBM collections
http://search.biocase.org/bgbm

LICHCOL – database of the Berlin lichen and fungus herbarium
http://archive.bgbm.org/scripts/ASP/lichcol [will be integrated into the BGBM Herbarium database in the JACQ system – see below].

DNA Bank – information system for the BGBM's DNA collection (access via the portal of the Global Genome Biodiversity Network) ***http://data.ggbn.org/ggbn_portal/search/result?institution=BGBM%2C+Berlin***

2. Taxonomic information systems on organism groups

AlgaTerra – information system on terrestrial and limnic microalgae (regularly updated)
http://www.algaterra.net

Campanula Portal – global online monograph of the genus *Campanula* (bellflowers) regularly updated)
https://campanula.e-taxonomy.net/portal

Cichorieae Portal – global online monograph of the *Compositae* tribe *Cichorieae* (regularly updated)
http://cichorieae.e-taxonomy.net/portal

Caryophyllales Portal – global synthesis of species diversity in the angiosperm order *Caryophyllales* (regularly updated)
http://caryophyllales.org

3. Floras and checklists

Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity – directory of vascular plants and their distribution in Europe and the Mediterranean region (regularly updated)
http://ww2.bgbm.org/EuroPlusMed/query.asp

Med-Checklist – a critical inventory of vascular plants of the circum-Mediterranean countries (as published in book form)
http://ww2.bgbm.org/mcl

Flora Hellenica Database (Arne Strid) ***http://www.florahellenica.com***

Flora of Cyprus – a dynamic checklist – online Flora of the vascular plants of Cyprus with illustrations, distribution maps and identification keys (regularly updated)
http://www.flora-of-cyprus.eu

Flora of Cuba Database/Base de Datos de Especímenes de la Flora de Cuba – database of Cuban flora herbarium specimens with version 10.0 (2014) to version 11 (2016) distribution maps
http://ww3.bgbm.org/FloraOfCuba

The Spermatophyta of Cuba – A Preliminary Checklist
http://wfospecimens.cybertaxonomy.org
http://portal.cybertaxonomy.org/flora-cuba

4. Service portals for collections data

BioCASE – Biological Collection Access Service for Europe. Portal for European Biodiversity
http://search.biocase.org/europe (direct access to search catalogue)

BioCASE – Biological Collection Access Service for Europe. Portal for German Phytodiversity
http://search.biocase.de/botany (direct access to search catalogue)

EDIT Specimen and Observation Explorer for Taxonomists – access portal for collection data worldwide, optimised for taxonomists
http://search.biocase.org/edit

GBIF-D Algae & Protozoa – Global Diversity Information Facility's data portal for algae and protozoa
http://protists.gbif.de/protists

VH/de – Virtuelles Herbarium Deutschland – digitised collections information from German herbaria
http://vh.gbif.de/vh

GGBN – Global Genome Biodiversity Network
http://www.ggbn.org

WFO Specimens – World Flora Online initiative – specimen explorer prototype for phytotaxonomists
http://wfospecimens.cybertaxonomy.org

5. Web services

UTIS – Unified Taxonomic Backbone for the European Biodiversity Observation Network (EU BON)
http://cybertaxonomy.eu/eu-bon/utis

Name catalogue REST API – access to the data held in the different databases of the EDIT platform (e.g. including the "Catalogue of Life")
https://cybertaxonomy.eu/cdmlib/rest-api-name-catalogue.html

6. Software

EDIT Platform for Cybertaxonomy – open-source software tools and services covering all aspects of the taxonomic workflow
www.cybertaxonomy.eu

BioCASE software components for the networking and preparation of collections data in the BioCASE, GBIF and GGBN network
http://biocase.org/products/index.shtml

AnnoSys – web-based system for correcting and enriching biological collections data
https://annosys.bgbm.fu-berlin.de

JACQ Virtual Herbaria – unified and jointly administered specimen management system for herbaria (in collaboration with the Natural History Museum and the University of Vienna)
http://herbarium.univie.ac.at/database/collections.htm

7. Archived systems

The following information systems are still available for consultation, but are no longer updated:

Bohlmann Files – database of natural substances in the *Compositae*.
Access: ***n.kilian@bgbm.org***

DERMBASE – database of scientific names of the sac fungi family *Dermateaceae* (*Ascomycetes*)
http://ww2.bgbm.org/projects/dermbase/query.cfm

IOPI-GPC – International Organization for Plant Information, Provisional Global Plant Checklist
http://archive.bgbm.org/IOPI/GPC/default.asp

Names in Current Use for Extant Plant Genera (NCU-3e) – standard list of generic names and publication citations for algae, fungi, and plants
http://archive.bgbm.org/iapt/ncu/genera/Default.htm

IAPT Registration of Plant Names Trial – International Association for Plant Taxonomy's trial database for the registration of newly published plant names)
http://archive.bgbm.org/registration/QueryForm.htm

Research

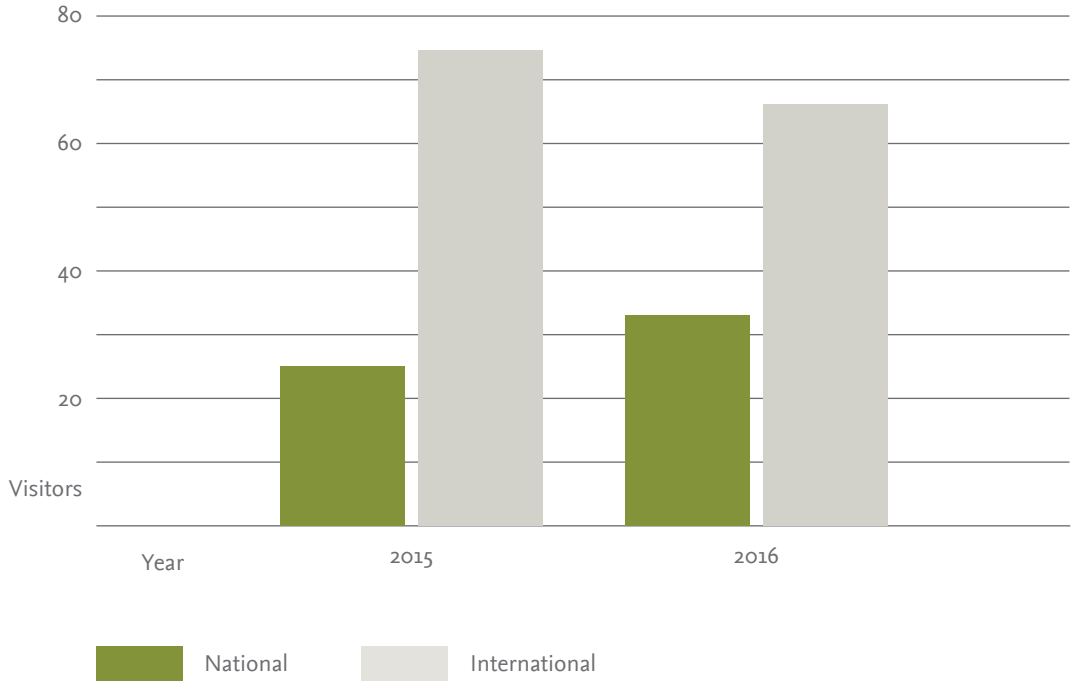
Externally funded projects

Funding organisation	Project title	Project manager(s)	Term
BfN	R & D project: Research for the preparation of the Red Lists 2020 – preparatory phase (FKZ 3511 861100).	Berendsohn	2011 – 2015
BfN	R & D project: Research for the preparation of the Red Lists 2020 – preparatory phase. Sub-project: Cooperation checklists (FKZ 3515 860301).	Berendsohn	2015 – 2018
BfN	Integration of ex-situ and in-situ measures for the protection of endangered flowering plants in Germany – a model project for the implementation of the Global Strategy for Plant Conservation (GSPC) (FKZ 3512 86 0400).	Borsch	2012 – 2016
BfN	Implementation of EU regulation 511/2014: Identification of potential users of genetic resources in Germany (Az Z 1.2532 02/2016/F/18Z).	Borsch	2016 – 2017
BfN	WIPs-De joint project: Establishment of a national network for the protection of endangered wild plant species for which Germany has a special responsibility. Sub-project: Sampling region Northeast, seed collection and storage (FKZ 3513685B04).	Stevens	2013 – 2018
BMBF	Pilot project in partnership with the Botanic Garden of Bogotá (FKZ 01DN13030).	Borsch	2013 – 2016
BMBF	Joint project GBOL – German Barcode of Life. Sub-project 5a: Botany – flowering plants (FKZ 01LI1101E).	Borsch	2012 – 2015
BMBF	German Barcode of Life II (GBOL2): From Science to Application. Sub-project 4: Verification of seeds and tree nursery products (FKZ 01LI150E).	Borsch	2016 – 2018
BMBF	German Barcode of Life II (GBOL2) – Environmental DNA in the context of the European Water Framework Directive: Diatoms (FKZ 01LI150E).	Jahn/ Zimmermann	2016 – 2018
BMBF	EDAPHOBASE – information system, data repository, data infrastructure and service platform for soil zoology. Sub-project 6: Integration and link-up with GBIF (FKZ 01LI1301F).	Güntsch/Müller	2013 – 2017

Funding organisation	Project title	Project manager(s)	Term
BMUB	ABS – Access & Benefit Sharing: Raising awareness among users of genetic resources in Germany and advising the competent authorities on the enforcement of EU regulation 511/2014 (AZ: NI4-70132-11/21.1).	Borsch	2015 – 2016
DFG	BiNHum – Biodiversity Network of the Humboldt-Ring: Indexing / processing of existing digital object data, adaptation of established database systems and development of a data portal (BE 2283/8-1).	Güntsch/ Berendsohn	2012 – 2015
DFG	StanDAP-Herb – a process-optimised standard method for the indexing of digital herbarium specimens (BE 2283/12-1).	Güntsch/ Berendsohn	2014 – 2017
DFG	AnnoSys II – a generic annotation system for biodiversity data (LIS programme: Scientific literature provision and information systems) (BE 2283/4-2).	Berendsohn/ Güntsch	2014 – 2017
DFG	GFBio – German Federation of Biological Data: Infrastructures for research data (GU 1109/3-1).	Güntsch	2013 – 2015
DFG	GF Bio II – German Federation of Biological Data: Infrastructures for research data (GU 1109/3-2).	Güntsch	2015 – 2018
DFG	Expansion of the DNA bank network in the Global Genome Biodiversity Network (GGBN) (GZ GU 1109/5-1).	Dröge/Güntsch	2013 – 2015
DFG	ABCD 3.0 – a community platform for the development and documentation of the ABC standard for natural history collections data (GU 1109/6-1).	Güntsch	2014 – 2019
DFG	Development of a subject indexing system for collections of the northern hemisphere flowering plant genus *Campanula* (Program LIS: Scientific literature provision and information systems) (Kl 1175/1-1).	Kilian	2012 – 2015
DFG	Algae registration: Establishment of a global registration and an index of scientific names and types of algae (JA 874/8-1).	Jahn/Güntsch/ Berendsohn	2016 – 2019

Funding organisation	Project title	Project manager(s)	Term
EU	EU BON – Building the European Biodiversity Observation Network (GA Nr. 308454).	Güntsch/ Berendsohn	2012 – 2017
EU	SYNTHESYS III – Synthesis of Systematic Resources III (Network Activities) (GA Nr 312253).	Berendsohn	2013 – 2017
EU	SYNTHESYS III – Synthesis of Systematic Resources (Access) (GA Nr 312253).	Jahn	2013 – 2017
EU	Access to digital resources of European heritage (Europeana DSI) (GA Nr. CEF-TC-2014-2 003).	Berendsohn	2015 – 2016
EU	Access to digital resources of European heritage (Europeana DSI 2) (GA Nr. CEF-TC-2015-1-01).	Berendsohn	2016 – 2017
EU	BigPicnic: Big questions – engaging the public with responsible research and innovation on food security (GA Nr. 710780).	Rahemipour	2016 – 2019
VolkswagenStiftung	Developing tools for conserving the plant diversity of the South Caucasus (Az 89 950).	Borsch	2016 – 2018
Verein der Freunde	Morphological and genetic stability of diatom cell lines in culture	Enke	2014 – 2015
Verein der Freunde	The genus *Philodendron* (*Araceae*) in Colombia: a collecting expedition as a basis for the study of its phylogeny	Köster	2014 – 2016
Verein der Freunde	Continuation of the *Flora de Cuba* project and a project on the endemism of the flora of Cuba and the Caribbean	Fuentes/Borsch	2014 – 2015
Verein der Freunde	Phylogeny and family classification in the *Caryophyllales* raphides clade	Hernández/ Borsch	2014 – 2015
Verein der Freunde	Collecting trips to the North Caucasus (Krasnodar region)	Korotkova/Parolly	2014 – 2015
Verein der Freunde	Research and collecting trips in Armenia	Borsch/Sipman	2014 – 2015
Verein der Freunde	Research and collecting trips on the Greek island of Lesbos	Raus/Sipman	2015
Verein der Freunde	How the lettuce come to America – the ancestry of the endemic lettuces of North America (*Lactuca* species, *Asteraceae*, tribe *Cichorieae*)	Kilian	2015

Visiting scientists in the herbarium



Hosted scientific events

2015 – 2016

Scientific events at the Botanic Garden and Botanical Museum Berlin

***Caryophyllales* 2015.** International conference; Organiser: *Caryophyllales* Network. 13 – 18 September 2015, 61 pts*.

Biodiversitätsbildung als Querschnittsthema von Biologie, Politik und Ethik – Qualifizierungsmaßnahmen an Botanischen Gärten. Modul 4. (Biodiversity Education as an Interdisciplinary Theme of Biology, Politics and Ethics – Skills Development at Botanic Gardens. Module 4.) Organiser: University of Kassel. 12 – 14 November 2015, 30 pts.

IUBS 2015 – Frontiers in Unified Biology: 32rd IUBS General Assembly and Conference. International conference; Organiser: International Union of Biological Sciences. Funded by the German Research Foundation (DFG). 14 – 16 December 2015, 120 pts.

Genetische Ressourcen, Gesetze und gute Praxis. (Genetic Resources, Laws and Good Practice.) Workshop; Organiser: Freie Universität Berlin – Botanic Garden and Botanical Museum, Alexander König Zoological Research Museum Bonn, Global Nature Fund (GNF). Funded by the Federal Ministry for the Environment, Nature Conversation, Building and Nuclear Safety (BMUB). 1 – 2 March 2016, 120 pts.

Environmental Samples. International workshop; Organiser: Global Genome Biodiversity Network. 20 June 2016, 25 pts.

GGI Gardens. International workshop; Organiser: Global Genome Initiative (GGI). 20 June 2016, 15 pts.

Global Plants Initiative (GPI) Plenary Session and Steering Committee Meeting. Organiser: Global Plants Initiative. 25 June 2016, 30 and 9 pts, respectively.

SYNTHESYS-iDigBio Digitization Software Training Workshop. International workshop, Organiser: Synthesis of Systematic Resources (SYNTHESYS), Integrated Digitized Biocollections (iDigBio). 25 June 2016, 25 pts.

Museum Environments. International workshop; Organiser: ProtectHeritage. 25 – 26 June 2016, 14 pts.

AGM of the German Association of Botanic Gardens 2016. Organiser: German Association of Botanic Gardens (VBG). 22 – 25 September 2016, 141 pts.

Co-hosted events outside the BGBM

German-Russian workshop on Science Cooperation and Biodiversity in Pyatigorsk. International workshop, in partnership with the Komarov Institute (Botanical Institute of the Russian Academy of Sciences St Petersburg). Pyatigorsk, 22 – 26 June 2015, 25 pts.

German-Russian workshop on e-Taxonomy. International workshop, in partnership with the Kuban State University Krasnodar. Krasnodar, 16–17 May 2016.

GGBN 2016. International conference, in partnership with the Museum für Narurkunde Berlin; Organiser: Global Genome Biodiversity Network. Funded by the German Research Foundation. Berlin, 21 – 24 June 2016, 150 pts.

SPNHC 2016. International conference, in partnership with the Museum für Narurkunde Berlin; Organiser: Society for the Preservation of Natural History Collections (SPNHC). Berlin, 21 – 24 June 2016, 304 pts.

pts = participants

Collections

Living collection (outdoor area and greenhouses)

Living collections holdings	2015	2016
Families	307	304
Genera	3 180	3 087
Taxa (species, subspecies, varieties etc.)	18 597	18 036
Accessions	32 497	31 964
of which wild provenances (%)	58,5	59,1

Living collections arrivals/releases	2015	2016
Incoming accessions	1 857	1 252
Outgoing accessions	4 523	1 785
Accessions released to other gardens	89	610

Plant (parts) made available	2015	2016
for teaching	8 322	13 263
for research	1 157	1 228

Dahlem Seed Bank	2015	2016
Holdings (number of accessions)	6 514	6 557
New additions (number of accessions)	202	43
Inclusions in the Index Seminum, of which	3 157	
seed samples sent out	4 064	
domestic	833	
international	3 231	
Recipients of seed samples	199	

Herbarium Berolinense B

Herbarium holdings	2015	2016
Total number of specimens	c. 3.78 m	c. 3.81 m
Type specimens	> 40 000	> 40 000
Garden herbarium	50 304	50 674

Herbarium new additions	2015	2016
Total new additions, of which	36 612	24 858
through donation	28 353	17 800
through exchange	3 486	3 266
through purchase	1 318	50
through our own collecting activities	3 108	3 366
New additions to the garden herbarium	347	376

Herbarium – loans, exchange, visitors	2015	2016
Loan enquiries	240	301
Loans from B to other institutions, number of specimens (shipments)	3 486 (125)	3 182 (132)
Loans to B from other institutions, number of specimens (shipments)	4 056 (55)	2 064 (41)
Number of institutions with whom B had loan exchanges	176	104
Specimens permanently given to exchange partners	6 318	8 609
Visiting scientists	98	99

Digital herbarium	2015	2016
Newly digitised specimens, of which	3 231	18 555
on account of loan enquiries	413	645
in the context of projects	2 818	17 910
Total number of specimens available online	151 789	170 344
Downloads	69 257	72 302

DNA Bank

	2015	2016
Holdings (number of DNA samples)	15 952	19 277
New additions, of which	1 474	3 281
through donation, exchange with partners	174	81
through our own research activities	1 300	3 200
DNA samples sent out (number)	156	31
DNA samples sent out (recipients)	11	6

Library

Holdings and catalogues

	2015	2016
Monographs and bound journals	208 520	210 797
Current journals with print editions	786	715
Offprints	143 976	144 075
CD-ROMs, DVDs and video cassettes	503	510
Microfilm and microfiche titles	4 175	4 178

New additions

	2015	2016
Monographs, of which	1 150	1 213
through purchase	193	161
through exchange / donation	957	1 052
Bound journals, of which	990	957
through purchase	247	255
through exchange / donation	743	902
Offprints	149	99
CD-ROMs and DVDs	5	7
Expenditure on contributions to databases and online journal packages	32 227 €	38 181 €

BGBM Press: Publications
2015 – 2016

Willdenowia

Online platform: *http://www.bioone.org/loi/will*

Willdenowia 45(1) [pp. 1–160]. April 2015.
Willdenowia 45(2) [pp. 161–280]. August 2015.
Willdenowia 45(3) [pp. 281–470]. December 2015.

Willdenowia 46(1) [pp. 1–200]. April 2016.
Willdenowia 46(2) [pp. 201–290]. August 2016.
Willdenowia 46(3) [pp. 291–488]. December 2016.

Englera

Berendsohn W. G., Gruber A. K., Rodríguez D. & Galán P. 2016: **Nova Silva Cuscatlanica. Árboles nativos e introducidos de El Salvador. Parte 3: Angiospermae – Familias R a Z y Gymnospermae.** – Berlin: Botanic Garden and Botanical Museum Berlin; Antiguo Cuscatlán: Asociación Jardín Botánico La Laguna, El Salvador. – Englera 29(3).

Strid A. 2016: **Atlas of the Aegean flora. Part 1: Text & plates.** – Berlin: Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin. – Englera 33(1).

Strid A. 2016: **Atlas of the Aegean flora. Part 2: Maps.** – Berlin: Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin. – Englera 33(2).

Annual Report 2012 – 2014

Botanischer Garten und Botanisches Museum Berlin (Hrsg). 2015: Die Welt in einem Garten. BGBM Jahresbericht 2012 – 2014. [ed. 1 & 2]. – Berlin: Botanischer Garten und Botanisches Museum Berlin, Freie Universität Berlin.

Botanischer Garten und Botanisches Museum Berlin (Hrsg). 2016: The world in a garden. BGBM annual report 2012 – 2014. – Berlin: Botanischer Garten und Botanisches Museum Berlin, Freie Universität Berlin.

Other publications

Abarca N. & Jahn R. (Hrsg.) 2015: IUBS 2015 – Frontiers in Unified Biology. Abstracts and program of the 32nd International Union of Biological Sciences General Assembly and Conference, 14 – 16 December 2015, Berlin, Germany. – Berlin: Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin. – DOI: 10.3372/IUBS2015.

Botanischer Garten und Botanisches Museum Berlin (Hrsg). 2015: Saatgutbank Dahlem Seed Bank. – Berlin: Botanischer Garten und Botanisches Museum Berlin-Dahlem.

Burkhardt L. 2016: Verzeichnis eponymischer Pflanzennamen. Index of Eponymic Plant Names. Index de Noms Eponymes des Genres Botaniques. – Berlin: Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin. – DOI: 10.3372/epolist2016.

Fietkau C., Rosenbusch S., Anders E. & **Hohlstein G.** 2015: Mit Arnika unterwegs. – Berlin: Botanischer Garten und Botanisches Museum Berlin & Botanikschule Berlin. – DOI: 10.3372/arnika2015.

Fuentes Bazan S. & Grotz K. (Hrsg.) 2016: Islas del Tesoro verde. Descubrimientos botánicos en el Caribe. – Berlin: Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin. – DOI: 10.3372/Islas_Tesoro_verde.

Greuter W. & Rankin Rodríguez R. 2016: Espermatófitos de Cuba: inventario preliminar. Parte general. The Spermatophyta of Cuba: a preliminary checklist. General part. – Berlin: Botanischer Garten & Botanisches Museum Berlin-Dahlem; La Habana: Jardín Botánico Nacional, Universidad de La Habana. – DOI: 10.3372/cubalist.2016.1.

Greuter W. & Rankin Rodríguez R. 2016: Espermatófitos de Cuba: inventario preliminar. Parte II: Inventario. The Spermatophyta of Cuba: a preliminary checklist. Part II: Checklist. – Berlin: Botanischer Garten & Botanisches Museum Berlin-Dahlem; La Habana: Jardín Botánico Nacional, Universidad de La Habana. – DOI: 10.3372/cubalist.2016.2.

Grotz K. (Hrsg.) 2015: Saatgutbank Dahlem Seed Bank …Ausstellung für die Tasche. …Exhibition in your pocket. – Berlin: Botanischer Garten und Botanisches Museum Berlin-Dahlem.

Grotz K. (Hrsg.) 2015: modellSCHAU. Perspektiven auf botanische Modelle. modelSHOW. Perspectives on botanical models. – Berlin: BGBM Press, Botanischer Garten und Botanisches Museum Berlin (BGBM), Freie Universität Berlin.

Grotz K. & Fuentes Bazan S. (Hrsg.) 2016: Grüne Schatzinseln. Botanische Entdeckungen in der Karibik. Green Treasure Islands. Botanical discoveries in the Caribbean. – Berlin: BGBM Press, Botanischer Garten und Botanisches Museum Berlin (BGBM), Freie Universität Berlin. 284 Seiten.

Quaisser C., Giere P., **Häffner E., Rahemipour P.**, Schwarz D. & Voss M. (Hrsg.) 2016: Green Museum – how to practice what we preach? 2016 SPNHC conference, 31st Annual Meeting, June 20–25, 2016, Berlin, Germany. 2nd, revised edition. – Berlin: Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin. – DOI: 10.3372/SPNHC2016.2 (ed. 2); 10.3372/SPNHC2016 (ed. 1).

Schaumann C.-B. & Stevens A.-D. 2016: Der Moosgarten im Botanischen Garten Berlin. – Berlin: Botanischer Garten und Botanisches Museum Berlin, Freie Universität Berlin und Friederike-Schaumann-Stiftung.

Botanical Museum

New permanent exhibitions

Dahlem Seed Bank: visitor information outside the new building
Completion/opening March 2015
Curators: Elke Zippel, Albert-Dieter Stevens, Thomas Dürbye (concept, texts) & Kathrin Grotz (coordination)
Design: bertron schwarz frey

Aquatic plants: Labelling of the aquaria and pools in the renovated Victoriahaus
Completion September 2015
Curators: Nils Köster (concept, texts) & Kathrin Grotz (coordination)
Design: bertron schwarz frey

Special exhibitions

16 May 2014 – 22 February 2015
Caucasus: Plant Diversity between the Black & Caspian Seas
Curators: Kathrin Grotz, Nadja Korotkova, H. Walter Lack, Gerald Parolly
Design: Yvonne Rieschl
Supported by the cooperation partners of the Caucasus Initiative in Armenia, Azerbaijan und Georgia and by the WWF

22 May 2015 – 28 February 2016
modelSHOW: Perspectives on Botanical Models
Curator: Kathrin Grotz
Design: Yvonne Rieschl

27 May 2016 – 26 February 2017
Green Treasure Islands: Botanical Discoveries in the Caribbean
Curators: Susy Fuentes, Kathrin Grotz
Design: Yvonne Rieschl
Supported by the cooperation partner Jardín Botánico Nacional, Universidad de la Habana, Cuba

Gallery exhibitions

27 November 2014 – 8 February 2015
The German Forest: Photographs by Sabine Wenzel

13 February 2015 – 7 June 2015
Symbioses: Works by Bärbel Rothhaar, Anja Schindler & Werner Henkel

19 March – 15 April 2015
1001 Worlds: Students Paint World Landscapes
Exhibition of works by students of the advanced art course at the Königin-Luise-Stiftung

16 June – 30 August 2015
The Last of their Kind: Endangered Wild Plants in Botanic Gardens
Exhibition organised by the Verband Botanischer Gärten

16 September – 1 November 2015
KOSMOS: Digital Botanic Art by Macoto Murayama
In collaboration with Frantic Gallery, Tokyo

6 November 2015 – 31 January 2016
Artist in Residence: Viktoriia Teletien
In collaboration with the Kulturamt Steglitz-Zehlendorf

18 February 2016 – 29 May 2016
A Stroll around the Leaf Margin: Objects and Drawings by Detel Aurand

11 June 2016 – 25 September 2016
New is only the Word: Globalisations of Useful Plants from Prehistory to the Modern Age
Exhibition organised by the Brandenburgisches Landesamt für Denkmalpflege und Archäologisches Landesmuseum

11 June 2016 – 6 November 2016
Garden=Theatre: Plants in Shakespeare's World
Exhibition organised by the Verband Botanischer Gärten (VBG)

29 September 2016 – 8 January 2017
Dove vai? / Where are you going?: Collages, Paintings and Drawings by Gudula Fisauli

Collaborations in external exhibition projects

2 November 2016 – 1 May 2017
Extremes! Nature, Culture and the Humboldt Current
Exhibition at the Humboldt-Box
BGBM staff on the curatorial team: Kathrin Grotz & Patricia Rahemipour

Travelling exhibitions

Coffee: A Global Success (produced by the BGBM)
Exhibition dates: 12 June 2015 – 3 January 2016
Exhibition venue: Senckenberg Museum für Naturkunde, Görlitz

Exhibitions featuring objects from the BGBM

Dead Wasps Fly Further
Exhibition dates: 2 – 29 March 2015
Exhibition venue: Museum für Naturkunde Berlin

One God: Abraham's Legacy on the Nile
Exhibition dates: April – September 2015
Exhibition venue: Bode-Museum, Museumsinsel, Berlin

New is only the Word: Globalisations of Useful Plants from Prehistory to the Modern Age
Exhibition dates: 16 April – 11 October 2015
Exhibition venue: Bundesgartenschau 2015 (horticultural show) in and around Brandenburg

"Árbol – Barra" by Maximilian Pecher
Exhibition dates: 3 – 12 July 2015
Exhibition venue: Projektraum, Kunstquartier Bethanien, Berlin

Simple. Natural. Life: The Life Reform Movement in Brandenburg 1890–1939
Exhibition dates: 10 July – 22 November 2015
Exhibition venue: Haus der Brandenburgisch-Preußischen Geschichte, Potsdam

Rainforest
Exhibition dates: 20 March – 29 November 2015
Exhibition venue: Ausstellungszentrum Lokschuppen, Rosenheim

Around the World: Forster – Humboldt – Chamisso – Ottinger
Exhibition dates: 2 December 2015 – 27 February 2016
Exhibition venue: Staatsbibliothek zu Berlin, Haus Potsdamer Straße 33

Welcome to the Anthropocene: The Earth in Our Hands
Exhibition dates: 5 December 2014 – 31 January 2016
Exhibition venue: Deutsches Museum, Munich

Born & Welcome
Exhibition dates: 2 January – 4 December 2016
Exhibition venue: MACHmit! Museum für Kinder, Berlin

PARKOMANIA: The Landscaped Gardens of Prince Pückler
Exhibition dates: 14 May – 18 September 2016
Exhibition venue: Bundeskunsthalle, Bonn

German Colonialism: Past and Present
Exhibition dates: 14 October 2016 – 14 May 2017
Exhibition venue: Deutsches Historisches Museum Berlin

The British View: Germany – Memories of a Nation
Exhibition dates: 8 October 2016 – 9 January 2017
Exhibition venue: Martin-Gropius-Bau, Berlin

Extremes! Nature, Culture and the Humboldt Current
Exhibition dates: 2 November 2016 – 1 May 2017
Exhibition venue: Humboldt-Box, Berlin

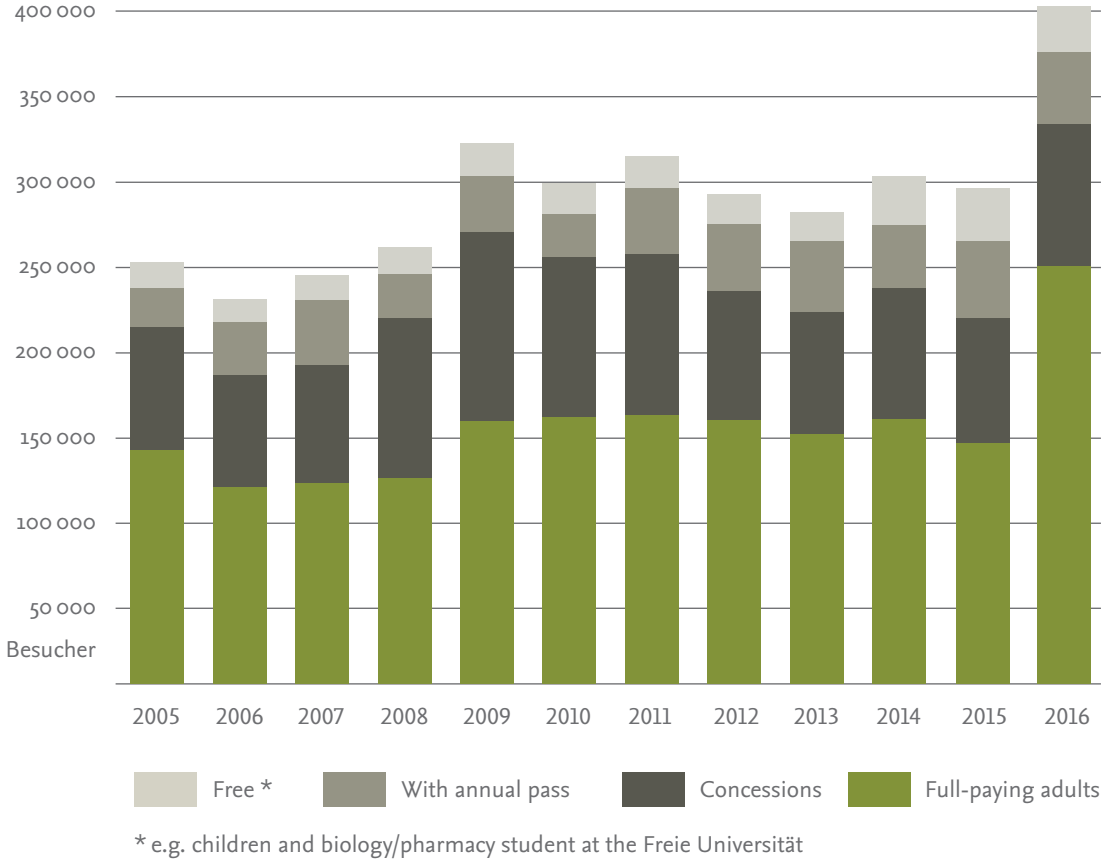
Rameses: Divine Ruler on the Nile
Exhibition dates: 17 December 2016 – 18 June 2017
Exhibition venue: Badisches Landesmuseum, Karlsruhe

Press and public relations *

	2015	2016
Press releases	29	30
Newsletter	12	12
Print mentions	571	471
TV reports	40	48
Radio reports	88	93
Online posts	320	213

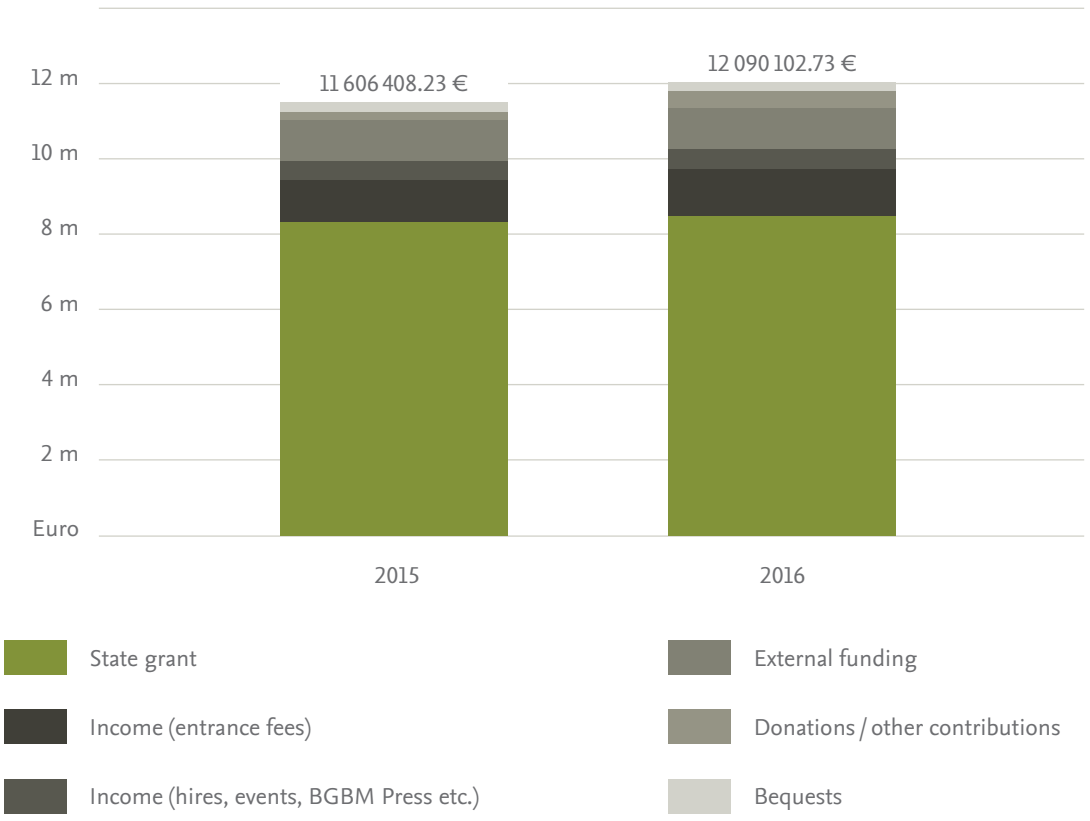
* Figures without using clipping service

Visitor numbers



* e.g. children and biology/pharmacy student at the Freie Universität

Budget



Events

Our best-attended* events (top 10)

2015

Perennials markets (11–12 April and 5–6 September)	26 000
Botanical Night (18 July)	12 000
Halloween (25 October)	10 000
Summer concerts (14 dates between 1 May and 28 August)	6 060
Tropical Nights (3 dates between 16 January and 2 February)	4 640
Cactus fair (14–17 May)	4 250
Palm Symphony (4 dates between 7 and 28 February)	2 500
Wine festival (18–21 June)	2 030
Bonsai exhibition (8–10 May)	1 660
Bird exhibition (9–11 November)	1 575

2016

Christmas Garden Berlin (17 November 2016 – 8 January 2017)	110 000
Perennials markets (2–3 April and 3–4 September)	30 000
Halloween (30 October)	14 000
Botanical Night (16 July)	12 000
Jungle Book (29 September – 23 October)	6 400
Tropical Nights (8 dates between 15 January and 6 February)	5 670
Summer concerts (12 dates between 3 June and 26 August)	5 300
Wine festival (23–26 June)	4 000
Palm Symphony (4 dates between 13 February and 5 March)	2 370
Orchid show (16–18 September)	2 300

* Figures rounded up, projection/extrapolation (e.g. in the case of group tickets) on the basis of ticket sales

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