Policy Plan
2017-2020

Naturalis
Biodiversity
Center

Digitising louse on glassplares

Contents

Tree in Amazon

Introduction

At Naturalis, everything we do is driven by our fascination for the beauty and diversity of nature. We want to improve our understanding of life on earth and help maintain the rich diversity of the natural world. We work on major challenges together with scientists from all continents and different disciplines. We share our fascination and latest insights with the public: museum visitors, elementary and high school students, university students, and amateur enthusiasts. The museum is the gateway to our knowledge and our enthusiasm.

The urgency of the biodiversity crisis makes our work more relevant than ever before. Our route ahead is clear: describe biodiversity and promote the better use of our natural heritage. We use our collection, our knowledge, and our data, and we combine all of these with the information of others to explain how bio-diversity has evolved and how it can disappear again. In doing this, we contribute to solutions for major current challenges from society. In our museum, but also outside of it, we enable young and old to experience how unique biodiversity is and we spark their enthusiasm for nature and science. Our approach focuses on collaboration within and outside of the organization, both in the Netherlands and internationally. We seek connections, see possibilities, are entrepreneurial, innovative, and proactive, and have an eye for talent.

During the preparations for this policy plan, we have spoken with various stakeholders and with policy-makers from different departments. We have thought about our future during dialogue sessions with more than one hundred Naturalis employees, we have considered the results from public surveys, and we have organized workshops with the Management Team and the Board of Trustees. All that input has been collected and it clearly points in a clear direction: we do not limit ourselves to knowledge about the past or even solely knowledge about the present. We discover the natural world for our future.

Noctuid moth on heather

Skull of flying fox

RMNH.MAM.37925

Cat. d.
37925
Pteropus
Reinwardt.

edulis
Sumatra.

Legit : C. G. C. Reinwardt

Ingekomen :

Cat.Jent. 1887, p. 258, d [Pt. edulis]

Reg.no. 37925

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Mission and core values

Mission

We want to describe, understand, and explore biodiversity for human wellbeing and the future of our planet.

Vision

We see biodiversity as our life support system, vital to the future of life on earth and human survival. We want to fully describe biodiversity, completely understand it, and share our fascination with everybody.

We do that by:

- expanding our biological and geological collections and increasing their accessibility;
- contributing with scientific research to the global effort to catalogue biodiversity, reconstruct its evolution, and understand the interactions between species and ecosystems;
- using the collection to tell the story of the richness of the natural world in its natural historical and cultural historical context, making it attractive to all ages, and encouraging a sense of awe;
- sharing knowledge about the natural world, taxonomy and biodiversity, in an open dialogue, to facilitate a livable society and sustainable economy.

Position

Internationally recognized authority in the area of biodiversity.

Core promise

Each contact with Naturalis strengthens my enthusiasm for and knowledge about the richness of the natural world.

Shrimp on anemone

Naturalis Herbarium Nieuwenhuizenweg

I Development 2012-2015

Fantastic developments have taken place at Naturalis over the past few years. Not only have we created an organization with a national natural history collection of international repute, but we have also made that collection digitally available in such a way that anybody throughout the world can make use of it. The number of visitors to our museum has grown by more than thirty percent. Our scientific research has grown considerably in terms of both the quality and the quantity of the output. Our researchers contribute to numerous educational programs at universities and universities of applied sciences. We have excavated and purchased a rare *Tyrannosaurus rex*, which was supported by the most successful crowdfunding campaign of recent years.

National center for biodiversity

Over the past few years, we have integrated the collections of the National Museum of Natural History Naturalis, the Zoological Museum Amsterdam, and the National Herbarium of the Netherlands, as well as the herbarium collections of the University of Groningen and the University of Amsterdam, and the geological collection of Delft University of Technology into a single national collection of 42 million objects. This is one of the top four natural history collections in the world and it is the only one that has been entirely digitized at storage unit level. Over nine million objects have been digitally recorded at a high level of detail. The Netherlands therefore has one of the most virtually accessible natural history collections in the world. For the linking and publication of all this digital natural history information, we have developed the Netherlands Biodiversity API (NBA)[1], a modern data service for all users. We supply our data to the Global Biodiversity Information Facility (GBIF)[2] and portals such as Europeana and Wikimedia. Through the Naturalis BioPortal, everybody can consult the collection data.

Thanks to investments in talent and research facilities, the academic status of Naturalis has improved. This is apparent from the external evaluation[3] that was carried out in 2015 according to the Standard Evaluation Protocol of the Royal Netherlands Academy of Arts and Sciences. An academic workplace for research and education has been realized with the help of the partner universities that were involved in the transformation. We also work closely with other museums, universities, and institutes, such as Utrecht University, the CBS-KNAW Fungal Biodiversity Centre, VU University Amsterdam, Leiden University Medical Center, the Royal Netherlands Institute for Sea Research, and the Netherlands Institute of Ecology. Together with Leiden University of Applied Sciences, Leiden University, Leiden University Medical Center,

Digitazation herbarium sheet

[1] docs.biodiversitydata.nl/

[2] www.gbif.org/

[3] www.naturalis.nl/nl/over-ons/organisatie/governance/

Exhibition T. rex in Town

and the biotechnology company BaseClear, we have set up the Center of Expertise Genomics 'Generade'.

We are becoming increasingly more successful in acquiring scholarships and grants. We have applied more focus in our research and have adapted the organization in line with this. With the introduction of the latest methods and the acquisition of new equipment, the research has been modernized. This has also resulted in more application-oriented research projects. Naturalis researchers such as Freek Vonk, Anne Schulp, and Menno Schilthuizen make regular appearances in the media and manage to fascinate many people.

Successful family museum

The number of visitors has shown a stable growth from 260,000 in 2012 to 340,000 in 2015. We mainly attract families that reside in the Netherlands with children up to about 15 years old. We have programmed more activities such as individual discovery, talk shows, presentations, demonstrations, family activities, and meetings. We have worked on the design of an entirely new permanent presentation and on the preparations for a temporary exhibition around our *T. rex* Trix.

School visits by elementary and high school students have risen considerably from 42,000 students in 2013 to 51,000 in 2015. Since 2015 we have decided to present ourselves as a national knowledge center for learning about the natural world.

Hub for biodiversity information
We have made considerable investments in our ICT infrastructure, organization, and knowledge. Individual websites and databases have been brought together in several digital platforms and a single basic infrastructure for biodiversity information. The technical connection with other research and research data infrastructures has largely been realized. We play an active and important role in the area of large scientific data infrastructures. We publish knowledge and information that is usable, findable, available, and linkable for the entire world. Our collection on the web can be accessed and consulted by everybody. Data from the field, from the lab, from the collection, and from our experts can now be brought together in a single system and be consulted for research and analysis.

A single organization, with a single name at a single location
We have brought together the collections from seven different owners and the personnel from four different organizations. We have also taken on a large number of new employees in the organization. Together, we have formed a new institute.

We have formulated our corporate story and with this we have laid the basis for our corporate identity. That has proved to be an invaluable basis for the development of the organization and has an important influence both within and outside of the organization.

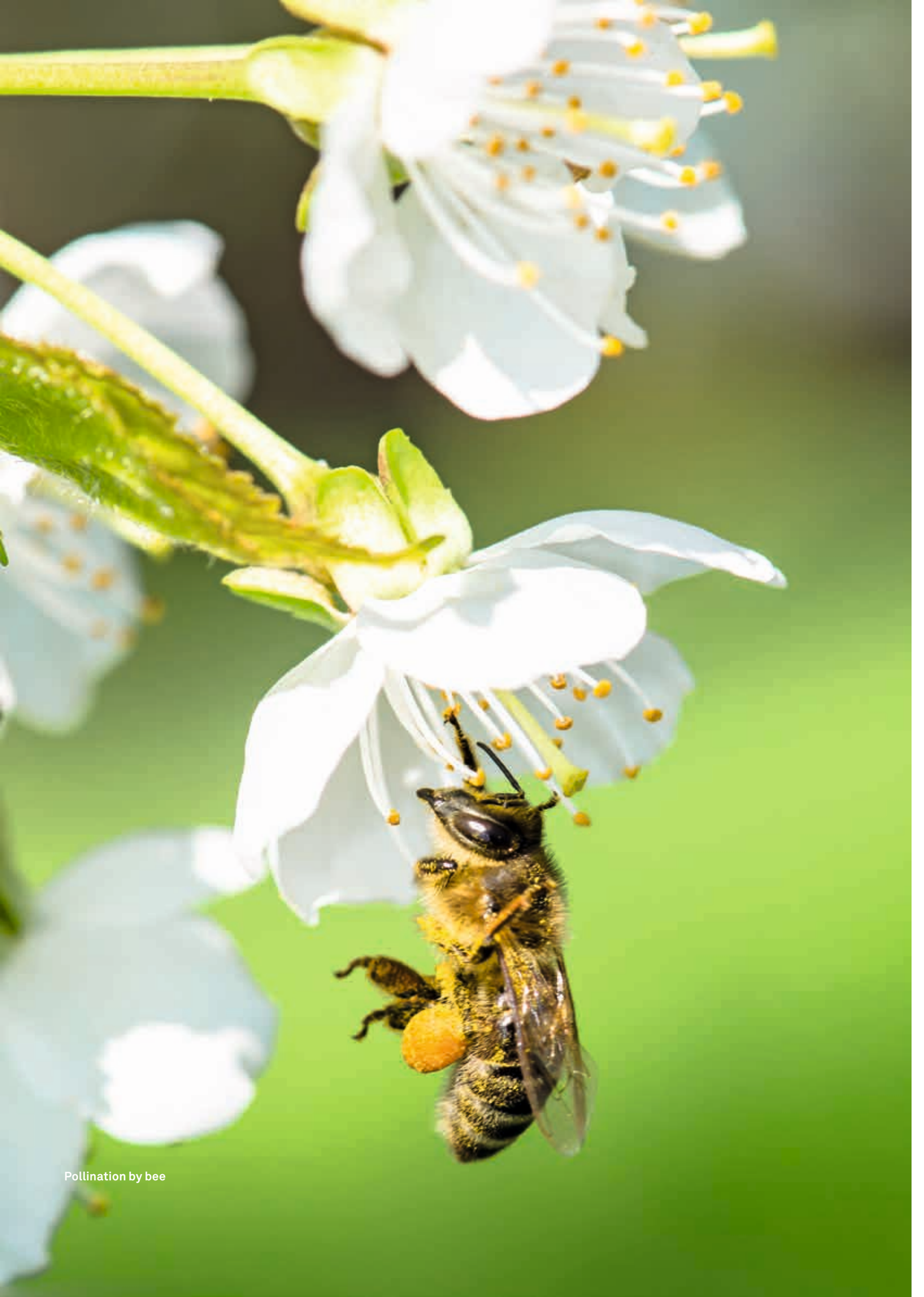
Arrival of Trix in Leiden

We have realized an active accommodation policy. The starting point was building a new institute and completely renovating the museum without the need for any additional grant resources.

Higher revenues
Naturalis receives a basic budget from the Dutch government under the culture policy and science policy. Additionally, Naturalis is now one of the i nstitutes eligible for grants from the Netherlands Organisation for Scientific Research (NWO). As an institute, we work integrally; we make no distinction between these or other revenues with respect to our activities. After all, the collection, research, and public functions are inextricably linked to each other.

During the last policy period, our financial policy was aimed at a stable and predictable exploitation with a focus on the growth of our own sources of income. For the funding of the renovation and the new building, money was borrowed from the government on the basis of a long-term budget. Our own sources of income have indeed grown, but at the same time the government has made considerable cuts to the grant from the Cultural Basic Infrastructure and the operating grant for science and research. The negative effects of this on the basic activities were temporarily alleviated by the investment grant from the Economic Structure Enhancing Fund, but that influence will be felt in the coming years.

With the fundraising for the purchase of the *T. rex* in particular, we succeeded in making many people and parties familiar with and enthusiastic about Naturalis. In a short space of time, we managed to acquire many new partners. This is vitally important from both a societal and financial point of view and it is something that we will further explore.



Pollination by bee

II Trends and challenges

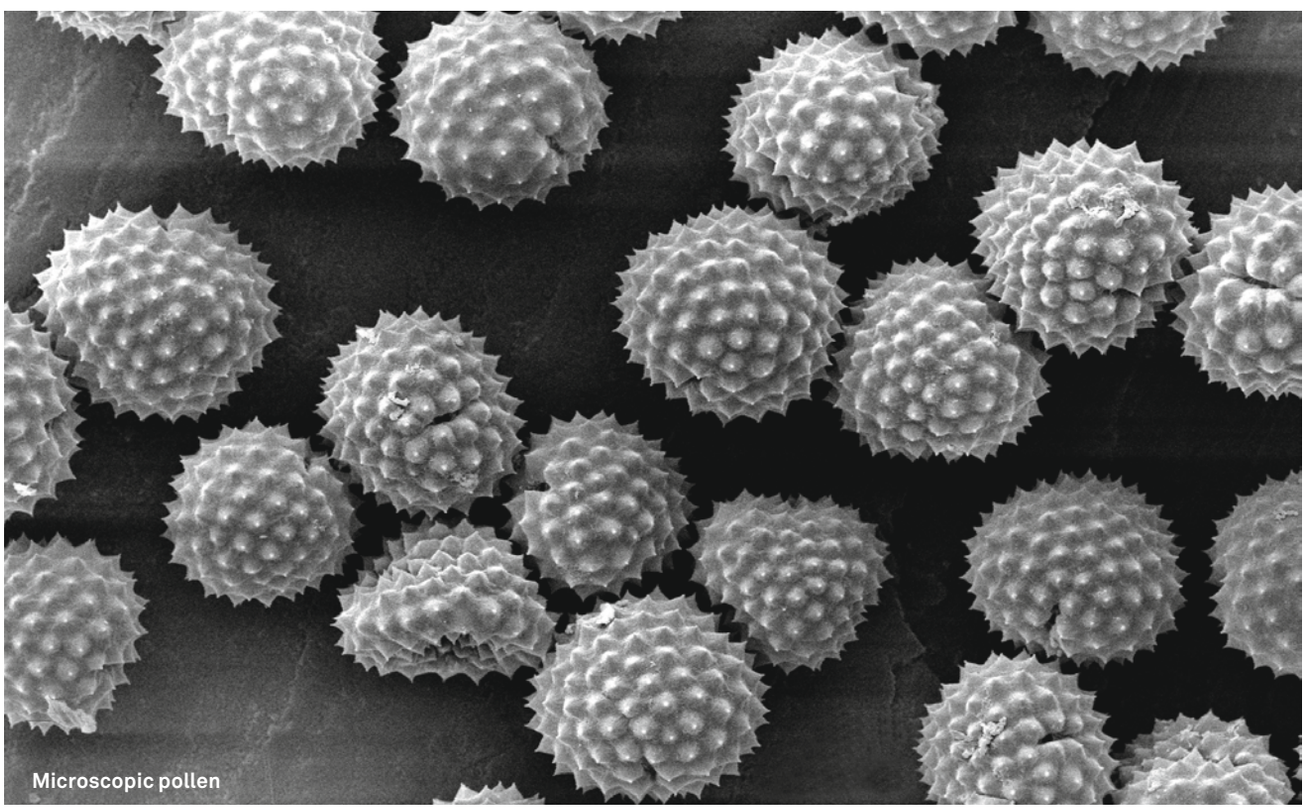
One of the biggest challenges humans face is keeping our planet habitable. Understanding and maintaining biodiversity is an essential aspect of this challenge. Relevant questions and solutions are increasingly elicited by and found in a broad societal involvement. This creates yet higher expectations of knowledge institutions. Furthermore, these institutions are in a society where openness and accessibility are assumed, and where collaboration across the boundaries of one's own discipline is the norm. We are pleased to see that the subjects of natural history, museums, and science are once again enjoying considerable interest within these developments.

Biodiversity under pressure

Life on earth is characterized by a considerable biodiversity, which apparently provides inexhaustible natural resources or ecosystem services for humans. However, the growth of the world population and the desire for greater welfare are putting the earth under considerable pressure. Whereas the demand for food, water, and energy are continuing to grow, the biodiversity is decreasing at a considerable rate. If we want to banish extreme poverty, inequality, illness, and hunger from the world[4], then we must maintain the biodiversity we still have.

From a scientific point of view, biodiversity – research into the diversity of species, characteristics and interactions, patterns, and development – is one of the most important fields of research in the 21st-century. It is estimated that during the past 250 years only ten percent of life on earth has been described. Thanks to technological and methodological advances, we can now gain an insight into what is living on our planet far

[4] UN Sustainable Development Goals



Microscopic pollen

Landscape in Morocco

faster than ever before. Over the coming years, this will enable Naturalis to describe the undiscovered diversity at an unprecedented rate. With this research, we will connect with questions from the Dutch National Research Agenda[5], such as: 'What is the importance of biodiversity and how can we maintain it?' and 'What do people and nature mean for each other and what is the optimal relationship between the two?'. Researchers at Naturalis are actively involved in elaborating the Dutch National Research Agenda routes.

Involvement

Science, innovation, culture, and art are becoming increasingly interwoven with society. Questions and solutions are therefore increasingly elicited and found outside of the research discipline. They originate from many different facets of society and emerge from curiosity, concerns about change, or an eye for opportunities. This sets different requirements for the government and knowledge institutions, as described in the Vision for Science[6]. Under the general heading of Responsible Research and Innovation (RRI), the European Commission translates this development into policy and in doing so addresses open access, gender, ethics, and science education.

Naturalis welcomes a broader societal involvement; we view it as an expansion of the possibilities with which we can approach biodiversity as a phenomenon. We strive to fulfill an international exemplary role in the active involvement of all parties.

Openness

People expect open access to information anywhere at any time. Furthermore, the way in which information is offered is becoming increasingly 'smart': the right data at the exact right time. People want information that is comprehensive and up-to-date, which combines things, and is imperceptibly present.

The national natural history collection that we manage is a very important source of information. We want to use this instrument in such a way that it is relevant for individuals on a daily basis. Whether that is by making a walk in the nature more pleasant, by improving the quality of drinking water to make it safer, or by increasing the enthusiasm of a presentation at school. This means we also need to further improve and increase the quality and scope of our collection information. We will involve society in this: crowdsourcing and citizen science are the points of priority of this policy. This development towards open and data-intensive working and publishing requires a far-reaching change in the work of our researchers and managers. We will have to get used to the use of e-infrastructures, rapid analyses, and international collaboration in research, as well as to an Open Access policy. We will actively guide our researchers and collection managers through these changes and

[5] https://vragen.wetenschapsagenda.nl/kennisinstelling/naturalis-biodiversity-center

[6] 2025 - Vision for Science choices for the future

DWDD University Evolution

make them familiar with the new possibilities so that we can become even more strongly connected with the digital, borderless knowledge infrastructure.

More collaboration

Whether on own initiative or encouraged by the government, new forms of collaboration are arising throughout society. This also occurs within science (Top Sectors, Dutch National Research Agenda, Grand Societal Challenges – Horizon 2020) and the heritage sector[7]. Collaboration between private and public parties, but also within research groups and between different disciplines, facilitates innovation.

The Netherlands has the potential for a strong national knowledge structure in the field of biodiversity. Thanks to thousands of volunteers, Dutch wildlife has been extensively described. Moreover, our country has very wide-ranging and qualitatively strong observation and measurement networks. The Netherlands can play an even bigger role in the field of biodiversity information if these national strengths are consolidated and close international collaboration is realized. We are taking initiatives to this effect at both levels.

The natural world, museums, and science are not just cool, they are also relevant

Children are wildly enthusiastic about the exciting and educational adventures of Freek Vonk; science is not boring but entertaining (think of the DWDD University on Dutch television, for example) and vital for our future. It is knowledge that counts. We consider it our mission to bring as many people as possible into contact with modern science and technology from a very young age onwards. We want to involve them in biodiversity by enabling them to gain enriching experiences with authentic objects, and through doing this we want to contribute to the acquisition of 21st-century skills. With our educational policy, we are taking the lead in the area of learning about nature. We are developing new lines of learning together with stakeholders. In realizing this, our challenge is to reach a wide public so that the diversity in education and cultural background of the Dutch population is also reflected in the profile of our museum visitors.

[7] *Musea voor morgen* - Asscher-Vonk advisory committee

Ammonite

III Activities 2017-2020

Discovering biodiversity

We will develop new concepts and methods to speed up the cataloguing of biodiversity. We will embed the national collection in a virtual world collection. We will supplement the collection and collection information, improve their quality, increase their availability, and facilitate their use. In doing this, we will prioritize those parts of the collection that are the most important for ecological and societal applications.

Planetary biodiversity discovery

Taxonomists have been describing species and mapping their mutual relationships for centuries, but it is estimated that despite this long-term worldwide effort only ten percent of the species on earth have been described so far. Naturalis will therefore join the Planetary Biodiversity Mission, the worldwide initiative to make a complete inventory of all life on earth within the next twenty years. Modern digital and molecular technologies, and the growing amount of digitally available natural historical information worldwide enable us to generate fundamental knowledge about biodiversity at a faster rate and on a larger scale. Our research groups are focusing on the development and application of new cataloguing and research methods, such as live DNA-barcoding in the field, biomonitoring, digitization, 2D and 3D imaging, and museomics[8]. However, we will not throw the more traditional research methods, such as observations, overboard. With this approach, we will be able to build further upon existing knowledge while innovating as well.

Outstanding conservation and management

Conserving and managing the national collection is a core responsibility. Collection policy, keeping the collection in a good condition, storing it safely, and making the physical collection accessible are all conditions for this. Traditionally, Naturalis collected specimens from nature, but now a growing number of carefully chosen acquisitions are taking place as well. With the purchase of the *Tyrannosaurus rex*, we discovered that it is scarcely possible for a natural history museum to attract external funding for such an acquisition. The majority of funds such as the VSB-Fonds, the Vereniging Rembrandt, and the Turing Foundation only support art acquisitions. Acquisition funds of the Dutch Ministry of Education, Culture and Science were found not to provide any opportunities for natural history acquisitions either. We therefore decided to establish our own acquisition fund.

In the coming years, we will expand and adapt our building to enable the proper management of the collection. Consequently, physical access to parts of the collection will be restricted in the upcoming period. However, this will give us the opportunity to focus on the digital collection data and on improving the management and conservation of the botany, geology, and library sections of the collection that will remain highly accessible. In 2020, the entire collection will be integrally accessible at a single location.

Enriching information and making it available

We guarantee that our data – which is just as valuable as the collection itself – are made available in a sustainable manner by means of valid heritage procedures in accordance with the manifesto of the Digital Heritage Netherlands[9] and through certified ICT procedures based on COBIT[10]. We also ensure that the data and ICT products satisfy the requirements of the FAIR[11] data approach. Thanks to the digitization, numerous new revisions and analyses of and with the collection information are possible. Many calls are

[8] The acquisition of genetic information from old collections

[9] *Manifest Netwerk Digitaal Erfgoed*: https://goo.gl/rDM3nL

[10] COBIT IT Framework: http://it.safemode.org/

[11] Findability, Accessibility, Interoperability, and Reusability

Eulalia Gasso Miracle in butterfly collection

already made upon our collection, but even greater use can be made of its potential for scientific, societal, and economic applications. We will facilitate that further use by improving the quality of information, and through further enrichment and disclosure of information. We are using our API (NBA) to encourage external application developers to build products based on the open collection data. Encouraging the use of our data, being able to show the richness of its content, and making the digitized collection visible requires a strong presence on both the fixed and mobile web. Instead of building and maintaining web portals or apps, we will have to make considerable efforts to make our data accessible and to link popular cloud applications to our infrastructure. Our collection data should be retrievable through a search engine query (even for researchers, the first search entry points are not GBIF or CoL, but Google or Yahoo). Furthermore, we will not be hesitant in donating content to Wikimedia and we will realize public data crowdsourcing activities using Facebook.

Digital collection data is not only an important source of information for external use, but is also invaluable for efficient management of the collection. By monitoring and analyzing the condition, registration quality, composition, and use of the collection on a large-scale, we will be able to allow the availability and quality of the physical and digital collection to meet the requirements concerning conservation and use better than ever before.

Virtual world collection

Together with the world's largest natural history museums, we will realize a virtual world collection by linking our collection files. By connecting our collection datasets and data infrastructure to national[12] and international[13] information infrastructures and by collaborating closely with the most important players in the field of biodiversity information, we want to improve the use, usability, and efficient management of the collection. We are developing initiatives at various levels in this context, namely:

- a global collection dashboard;
- a European scientific collection structure;
- a national infrastructure for biodiversity information.

Global collection dashboard

Together with the twelve largest natural history museums in the world[14], we are developing a shared standard that we will base the international 'collection dashboard' on. This will enable us to provide an accurate insight into the large international collections for the first time. These collections total about five hundred million objects and include more than half of

[12] Digital Collection: http://natag.dev.seecr.nl/search, NDFF: http://www.ndff.nl/, Waarneming.nl: http://www.waarneming.nl

[13] GBIF http://www.gbif.org, Europeana: http://www.europeana.eu

[14] London, Leiden, Paris, Brussels, Berlin, Copenhagen, Washington, New York, Chicago, Denver, Los Angeles, and Toronto


Woodcollection

all biological and paleontological specimens in the world. This insight will lead to better international collaboration in the area of management, conservation, digitization, acquisition, divestment, geographical focus, and the deployment of personnel.

European scientific collection infrastructure
With the European natural history museums and various other international data and biodiversity (e-) infrastructures such as CETAF[15], GBIF, Catalogue of Life (CoL), and LifeWatch, we are deploying initiatives to realize a pan-European infrastructure for scientific collections. We are actively seeking European funding for this; initially with the DiSSCo[16] initiative so that this infrastructure can find a place on the ESFRI[17] roadmap. With the help of open technology[18] and unique identifiers, we are making the collection data from within both the data and the publications linkable and citable. To achieve this, we manage, maintain, host, and use our own applications and infrastructure as equally those of the global providers of taxonomic (Catalogue of Life, Encyclopedia of Life), DNA (Barcoding of Life Database), and phylogenetic (Treebase) data. In doing this, we prioritize species or species groups that are of major importance for the preservation of natural systems, the bio-based economy, climate adaptation, and food security and health. For these species, we will jointly give priority to digitizing all information at the object level, enriching the data, and adding molecular data.

National infrastructure biodiversity information
As a national center for biodiversity, Naturalis is the link between collection holders, research organizations, species organizations, and consultancy firms. As such, we are in dialogue with the field to set up a healthy exploitation model for a structure of open biodiversity data in the Netherlands that fits within the information policy of the new Dutch Environmental Planning Act. For this we will:
- make facilities available for recording and managing observations with partners (Waarneming.nl, VOFF);
- collate the information about all Dutch species and publish that information in the Dutch Species Catalogue;
- initiate and intensify national activities related to Dutch wildlife, especially with respect to the use of data (distribution, wildlife encounter maps, and tailored reports);
- provide the platform for realizing the national biodiversity information infrastructure, which can be used by organizations[19] managing private data.

With this central hub for the collation of all biodiversity information, the Netherlands will also play a leading role in European biodiversity research.

[15] CETAF: Consortium of European Taxonomic Facilities
[16] DISSCO: Distributed System of Scientific Collections
[17] ESFRI: European Strategy Forum on Research Infrastructures
[18] Fast search mechanism such as ElasticSearch and data storage with Ceph
[19] Private Data Managing Organizations (Dutch acronym PGOs) manage databases with distribution and ecological data that have been collected by thousands of volunteers. They work together with government bodies, managers of protected areas, and scientific institutions in the Netherlands and abroad.

School of fish

Understanding biodiversity

With our excellent research into the mechanisms underlying biodiversity, we will push back the boundaries of fundamental knowledge about the development of life. Naturalis wants to be the leading national knowledge platform for biodiversity and in that capacity, it will encourage companies and government bodies to commit themselves to biodiversity research in a sustainable and programmed manner. We will strengthen our position by further concentrating our research along thematic and geographic lines. By doing this, we will claim a place in the relevant national and international networks, and invest in our role as a breeding ground for knowledge and talent.

Science with stakeholders

In the area of research policy, researchers, policymakers, and financiers will increasingly work together on the development of research missions, research agendas, and research programs. There is a need for an integral approach to research questions in terms of both breadth and depth. In terms of breadth, a growing number of different scientific disciplines is involved. Interdisciplinary and multidisciplinary research is needed to answer complex questions.

In terms of depth, there is a growing emphasis on societal and/or economic relevance. Collaboration with commercial, government, and public partners, but also between fundamental and more applied research is necessary to guarantee an optimum flow of knowledge: science in collaboration with stakeholders.

The importance of biodiversity is recognized at both the national and international levels. Within the Grand Societal Challenges of the EU, the Top Sectors, and the Dutch National Research Agenda, biodiversity is a golden thread for many questions and themes about subjects such as food production, water, energy, climate, and sustainability, even though biodiversity research is often not explicitly visible in programs and agendas. A joint effort is necessary to make biodiversity more explicit in key research agendas.

Thematic focus

On the one hand, our research focuses on questions that concern the understanding of the origin and evolution of the countless number of species on earth. We investigate the role of innovations in species formation and survival in changing conditions in the past or present, for example the origin of teeth and jaws, the development of snake venom, and wood

Koos Biesmeijer in the field

Tinde van Andel, Jeremy Miller & Michael Stech on St. Eustatius

Jòzsef Geml & Luis Morgado in Borneo

formation in herbaceous plants. On the other hand, we investigate how natural systems work, with a view to gaining a better understanding of the current state of biodiversity, insights into biodiversity patterns from the past, and an understanding of the resilience of the systems. Using our knowledge, we can help to predict the future of species and systems.

In collaboration with external partners, we will need to make clear choices concerning the focus areas of our research. By positioning Naturalis as a national center for biodiversity research, we will also strengthen the profile of the research field. Together with Dutch knowledge partners (under the flag of NERN – Netherlands Ecological Research Network), we have already used the momentum of the Dutch National Research Agenda to establish a national knowledge agenda for biodiversity: Nature4Life. This provides a clear response to the most urgent questions. We will focus our research more on practical issues and we will make it attractive for a broader range of funding instruments. Together with the commercial sector, we will use our knowledge for innovation development that is targeted at concrete societal or economic challenges. With this in mind, we will realize a focused policy to play an active role in the relevant national and international networks, advisory bodies, and committees in the area of research funding and planning.

Geographic focus

Besides profiling our national role, we also want to apply more direction and depth to our international collaborations. The national knowledge agenda must connect with a European research agenda for the long-term. Together with the largest European natural history museums, we are making efforts to realize this in line with the joint information structure and directly linked to educational programs and public outreach. Outside of Europe, we have a broad network of countries that we work in and with. We will also apply more direction and depth in this setting by working with a smaller number of countries and areas, with which we will enter into a broader, multidisciplinary collaboration that is better supported by governments and policy. We will initially focus on the Amazon Basin (including Brazil), Southeast Asia (including Indonesia and Malaysia), and the Caribbean.

Talent development

With a qualitatively strong infrastructure of state-of-the-art laboratories, collections, and ICT, we are strongly focusing on the development and supervision of scientific top talent. In view of the limited size of the organization and funds available, Naturalis will not be able to facilitate the senior top scientists; the institute will preferably be a breeding ground for talent. We give young talent the opportunity to further elaborate their ideas and to realize these in a stimulating, open, creative, and ambitious environment. By focusing on quality, we will thus support the development of talent into (top) professors in collaboration with our partner universities.

Experiencing biodiversity

With our public activities, we reach the hearts and minds of all Dutch citizens and spark their enthusiasm for the richness of the natural world. We achieve this by involving them in our work, through personal contact, and by allowing them to gain experiences not just in Naturalis, but also in the world around us.
Our ambitions are: by 2020...

- **we will be the best family museum in Europe;**
- **we will have a new permanent exhibition that attracts 350,000 visitors each year;**
- **we will lead the national knowledge center for learning about the natural world;**
- **we will be the most important center of higher education in the field of taxonomy and systematics.**

Experiencing with mind and heart

Our vision of working with the public contains three key terms[20]: fascinating, genuine and relevant. Fascination is our starting point for wanting to understand the world, but it is also a powerful tool for gaining attention and for retaining it while we tell our story[21]. 'Genuine' strengthens the fascination and stirs up people's enthusiasm and commitment. Genuine experiences and real openness are important ingredients for engaging both young and old alike. People want to be taken seriously. That is why visitors constantly ask: 'Is this real?' When a researcher passionately tells about the dinosaur he has excavated himself or the species of spider that she gave a name to, then the audience hangs on his or her every word; they have become a part of the experience.

Our primary target group for public activities consists of people with an average educational level and who have a latent interest in nature: students from elementary and high school education and families with children up to 15 years old. In addition, we focus on people who can help us reach the primary target groups:

[20] See *De Big Five van Educatie* http://www.naturalis.nl/media/library/2015/07/Big_Five_DEF.pdf

[21] See *Advies van de Verkenningscommissie Wetenschap en Technologie Primair Onderwijs* <http://www.platformbetatechniek.nl/media/files/publicaties/AdviesWenT.pdf>

T. rex in Town exhibition

Family activity “Slootjessafari”

teachers and teacher trainers, educational coaches, scientists, and parents. Taking into account age, level of education, background knowledge, and personal experiences, we make our story about the riches of the natural world relevant to everyone, and this also involves giving them an interesting and positive experience. In our educational activities, we implement our principles using the didactics of investigative learning. Our goal is to make students science wise and to encourage them, just like scientists, to ask questions about the world around them based on their curiosity.

Best family museum in Europe

Naturalis in the Pesthuis
In mid-2016 we closed our permanent exhibition for the renovation and expansion of our building. Over a period of more than eighteen years, the exhibition drew nearly five million visitors. The Pesthuis building has now been set up as a temporary exhibition space until the opening of the new permanent exhibition. The first exhibition in the Pesthuis will be the presentation of the *Tyrannosaurus rex* and the story of its discovery. *T. rex* Trix will then become a travelling exhibition that will put the Netherlands on the international map before it finally becomes a highlight in the new permanent exhibition.

In 2017 and 2018, we will organize various temporary exhibitions in the Pesthuis, including one themed around poison. At the end of 2018, the new permanent exhibition will open in the renovated and expanded building on the Darwinweg in Leiden. We expect that we will receive an average of 110,000 visitors per year in the Pesthuis during 2017 and 2018, including school visits. We will try to realize an increase in the direct revenues generated per visitor. We are working on the preparation of the educational programming.

New permanent exhibition
Based on our vision – fascinating, genuine and relevant – we are making a museum that is in every way geared towards the target group of families. A museum that also uses far more than the standard exhibition techniques to engage the public: we will build experiences, make a larger and improved version of our successful concept LiveScience, create a biodiversity garden, and give thematic activities and events a key role. LiveScience will be accessible free of charge. Here people will be able to experience the latest developments in the work of Naturalis. This includes watching researchers live or even helping them with the collection work (with the preparation of objects, for example), posing questions live to researchers who are on field expeditions, or discussing subjects with Naturalis employees. Next to the museum, a new garden will be laid that will tell the history of plant diversity. The garden will be given an educational and recreational function, and entry will also be free of charge.

With the re-opening of the permanent exhibition, we have structurally budgeted for 350,000 visitors per year. We expect that it will take several years after the re-opening for the school visits to recover and achieve the intended number of 60,000 students per year.

Education: National knowledge center for learning about the natural world[22]

The modern knowledge and network society requires different skills than in the past. Participation in such a society requires a committed, entrepreneurial, and curious attitude, as equally competencies such as creativity, collaboration, problem-solving capability, and

[22] The educational policy has been extensively described in Nature Learning Center – Powered by Naturalis Curious by Nature. (http://www.naturalis.nl/media/library/2015/07/Nature_Learning_Centre_DEF_111114.pdf)

critical thinking[23]. Natural sciences and engineering education, and – in the broadest sense – science education[24] play an important role in the development of these competencies, just as cultural education does.[25]

Naturalis is in a superb position to connect heritage, the natural world, science, and education with each other. We are therefore investing in a national knowledge center for learning about the natural world.
In doing this we will focus on four points of priority:

- Learning environments outside the school, such as museums, will acquire a more important role in the future. A shared responsibility for learning will arise between different learning environments[26]. In the coming years, we will therefore also develop lines of learning in collaboration with partners from the field of nature conservation, education, science, and technology. We are already holding discussions on this topic with the Dutch Ministry of Economic Affairs and with the *Techniekpact,* and we are working together with the Dutch Association of Science Centers and the *Stichting Nederlandse Natuurhistorische Collecties*.
- We will realize physical and digital educational products as well as supervised and unsupervised activities for use in the museum, at school, at home, and outdoors in nature. We want to organize an annual citizen science activity together with our partners. A digital environment that encourages exploring and investigating biodiversity and geodiversity will showcase this.
- We will develop a new training program for everybody who is active in learning about nature: our own educational facilitators, but also teachers or volunteers at nature conservancy organizations, for example.

[23] http://curriculumvandetoekomst.slo.nl/21e-eeuwse

[24] See also RRI in Horizon 2020

[25] http://wetenschapentechnologie.slo.nl/

[26] "Further examples are the more intensive collaboration of schools with societal and cultural institutions, science centers, (science) museums, libraries, companies, and sports clubs. This concerns the structural exchange of each other's expertise, (...) Such forms of collaboration make it possible for students to gain valuable learning experiences at suitable locations with the help of experts." *Ons Onderwijs 2032 Eindadvies - Platform Onderwijs2032*, 2016.

Citizen Science on evolution

We will realize this in collaboration with various organizations and networks, such as nature conservancy organizations, elementary teacher training colleges, science hubs, and school networks or school groups. We will support scientists in their outreach activities by means of training and advice.
- We have appointed a PhD student to investigate the aforementioned activities and to publish about this in academic journals in the field of learning about nature. We will compile manuals and develop tools, which we will make freely available.

Higher education

Naturalis is the national center for collection-based biodiversity research. Naturalis has an academic staff of five university professors and one university of applied sciences professor. Most of our researchers are also involved in educational activities. Besides many (master's) interns, the researchers supervise about forty international PhD students. We want to strengthen and expand this position in the coming years. We are doing this is close collaboration with the universities of Amsterdam, Leiden, Utrecht, and Wageningen, and with Leiden University of Applied Sciences. Our educational strategies are based on two pillars: at bachelor's level, we want to offer a good foundation in biodiversity education, and at master's level, we want to offer research-based education that is closely related to the themes of our research groups.

Impression of new Dinosaur exhibition

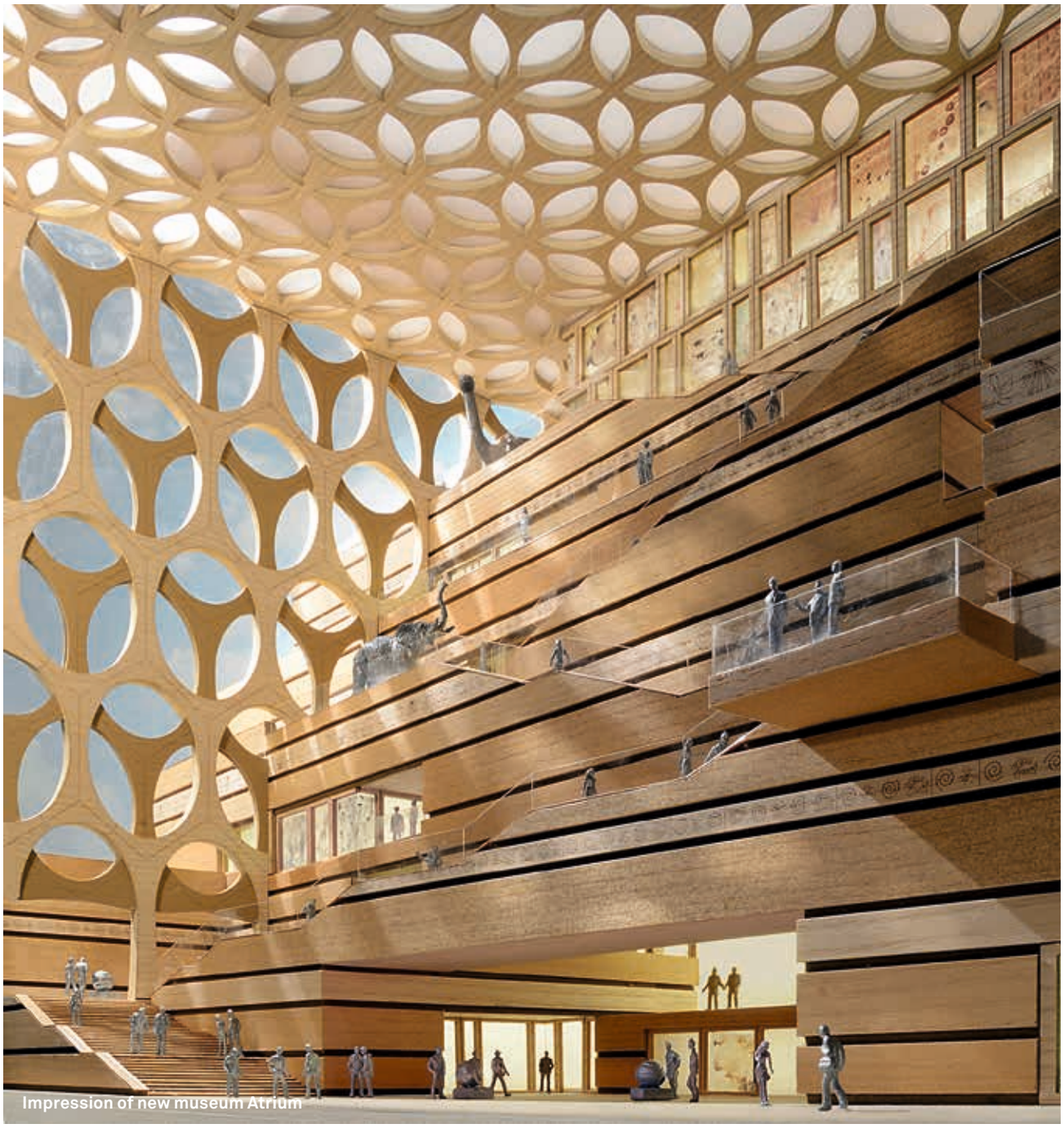
IV People, resources, and organization

A few years from now, a striking glass crown will form the highlight of the central hall in our renovated and extended complex of buildings. At the same time, it will be a symbol of our innovative organization, which is realizing our ambition to become a national center for biodiversity thanks to a rich diversity of talents, entrepreneurial attitude, and a powerful identity. This role is closely linked to our strong relationship with the Dutch government. Based on this position, we are working on a further strengthening of our financial resilience.

The organization

We require an organization of sufficient size and that is focused on collaboration if we are to achieve our goals, genuinely contribute to solving societal challenges, and be truly relevant. Naturalis is unique thanks to its combination of collection, research, education, and public responsibilities. Our organization is characterized by a large variation in age, educational level, experience, and specialization among its employees. For example, professors work alongside employees with an occupational disability. We also have hundreds of active volunteers. If we want to achieve our goals and play a relevant role in society, then we need to put the strength of this diversity to optimal use. We will therefore invest in a highly professional working environment that is focused on collaboration both within and outside of Naturalis. In consultation with each other and on the basis of shared leadership, we want to realize a working climate where the emphasis is on quality and outcomes. We will allow a further blurring of the boundaries between the sectors collection, research, and public

Staff in dialogue



Impression of new museum Atrium

by increasing the collaboration in cross-functional and thematic project teams.

The identity

We will position Naturalis as a knowledge institute that is important for the future of us all. We will be enthusiastic, open, visible, and unequivocal.
We will share our knowledge and we will focus on collaboration. That is the core of our identity. We will convey and strengthen this identity both internally and externally. In the marketing strategy, we will utilize the power of personal communication of our expert employees, just as we have successfully done during the previous years. In our message, we will explain the connection between collection, research, and society in various ways that are directed at the different target groups. In 2020, Naturalis will celebrate its bicentenary. We are making a concerted effort to acquire the predicate 'Royal' on this occasion.

The business

Naturalis is a public institution with a public task. We adhere to and apply the Culture Code of Governance. The public character determines our key activities and as well as our business model. With the implementation of the Cultural Heritage Act, the institute's mix of funding will fundamentally change from 2017 onwards. Our building and the collection management will be funded for a long-term period. This will safeguard the

Impression of new museum Biodiversity garden

continuity[27] of the basic activities. We will also receive a structural subsidy from the Dutch government for a part of the educational public activities and science activities. Our own sources of income are direct revenues, project grants, and fundraising.

Direct revenues
We distinguish five product groups that generate direct revenues:
- visitors of presentations, exhibitions, and events;
- supplying and managing digital biodiversity information;
- knowledge services such as expertise services and contract research;
- education;
- services: other services, catering, and shop.

The entrance fees are the most important source of direct revenues. The revenues from the shop and catering are related to the attendance. After the opening of the new building, we expect to structurally welcome 350,000 visitors per year. We assume a ten percent higher shop turnover per visitor, as the range of items in the shop will be better matched to the public and an active pricing policy will be pursued. We expect that other sources of direct revenues, such as the different types of services (information services, ICT services, consultancy, expert services) and income from contract research will only make a limited contribution to our budget.

Project grants and fundraising
Project grants are important for the funding of research. Each year, we budget acquiring 3.2 million euros in indirect government funding and funding from third parties (for example, from NWO, the EU, and companies). This is a considerable, but in view of the results until now, realistic challenge. More large projects will be set up in which different sources of funding, partners, and Naturalis units will be combined. We will work together with the research groups to identify subjects for such large projects that have a high chance of obtaining funding. We will involve more internal and external parties in these projects.
To realize this effort, we will adopt a more entrepreneurial approach for the promotion of subjects and the acquisition of partners and financiers.

With the large investments in the new permanent exhibition in mind, we face considerable challenges in the area of fundraising in the coming years. However, we will also continue to expand this source of income afterwards. We are working on the formation of a network of donors who are closely involved with Naturalis. This will be realized in part through the development of new propositions.

The building
At the end of 2016, the framework will be constructed for the expansion and renovation of the Naturalis building on the Darwinweg in Leiden. For the first time, the new building will house the entire collection and bring all employees together at a single location. The realization of this long-held dream demonstrates the strength of Naturalis. We believe in the added value of meeting each other: employees, but also visitors. The building will be given a powerful appearance and will form a valuable addition to the Bio Science Park in Leiden. A large biodiversity garden will be realized above the parking lot. The construction period is expected to last until the end of 2018. The personnel will be accommodated at another location during a part of the construction period.

[27] As long as we can assume that the size of the remuneration for the funding of the collection task will be modified. The remuneration for the cost of the collection task as made known to us by the Dutch Minister of Education, Culture and Science is too low to satisfactorily perform this task.