

24. November 2020

**Stellungnahme zum  
Zoologischen Forschungsmuseum Alexander Koenig -  
Leibniz-Institut für Biodiversität der Tiere, Bonn (ZFMK)**

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## Vorbemerkung

Die Einrichtungen der Forschung und der wissenschaftlichen Infrastruktur, die sich in der Leibniz-Gemeinschaft zusammengeschlossen haben, werden von Bund und Ländern wegen ihrer überregionalen Bedeutung und eines gesamtstaatlichen wissenschaftspolitischen Interesses gemeinsam gefördert. Turnusmäßig, spätestens alle sieben Jahre, überprüfen Bund und Länder, ob die Voraussetzungen für die gemeinsame Förderung einer Leibniz-Einrichtung noch erfüllt sind.<sup>1</sup>

Die wesentliche Grundlage für die Überprüfung in der Gemeinsamen Wissenschaftskonferenz ist regelmäßig eine unabhängige Evaluierung durch den Senat der Leibniz-Gemeinschaft. Die Stellungnahmen des Senats bereitet der Senatsausschuss Evaluierung vor. Für die Bewertung einer Einrichtung setzt der Ausschuss Bewertungsgruppen mit unabhängigen, fachlich einschlägigen Sachverständigen ein.

Vor diesem Hintergrund besuchte eine Bewertungsgruppe am 12. und 13. März 2020 das ZFMK in Bonn. Ihr stand eine vom ZFMK erstellte Evaluierungsunterlage zur Verfügung. Die wesentlichen Aussagen dieser Unterlage sind in der Darstellung (Anlage A dieser Stellungnahme) zusammengefasst. Die Bewertungsgruppe erstellte im Anschluss an den Besuch den Bewertungsbericht (Anlage B). Das ZFMK nahm dazu Stellung (Anlage C). Der Senat der Leibniz-Gemeinschaft verabschiedete am 24. November 2020 auf dieser Grundlage die vorliegende Stellungnahme. Der Senat dankt den Mitgliedern der Bewertungsgruppe und des Senatsausschusses Evaluierung für ihre Arbeit.

## 1. Beurteilung und Empfehlungen

Der Senat schließt sich den Beurteilungen und Empfehlungen der Bewertungsgruppe an. Das ZFMK forscht auf der Grundlage einer umfangreichen zoologischen Sammlung zur artbezogenen Biodiversität und vermittelt seine Erkenntnisse über die Wissenschaft hinaus in die Öffentlichkeit, insbesondere über Ausstellungen. Als eines der acht Forschungsmuseen in der Leibniz-Gemeinschaft erstrecken sich die Leistungen des ZFMK auf Sammlungen und Forschungsinfrastrukturen, Forschung sowie Ausstellungen und Wissenstransfer.

Die wertvollen **Sammlungen** des ZFMK umfassen derzeit ca. 5,6 Millionen zoologische Objekte (plus Biobankproben) und werden über die Forschungsprojekte laufend erweitert. Es belegt die Bedeutung und Qualität der Sammlungen, dass das Forschungsmuseum vor kurzem in das ESFRI<sup>2</sup>-geförderte Netzwerk SYNTHESYS+ aufgenommen wurde. Über das Netzwerk werden Reisen und Aufenthalte von Externen gefördert, damit sie die Sammlungen und Infrastrukturen der beteiligten Partnerinstitutionen nutzen können. Das ZFMK wird ermuntert, noch weitergehend für die externe wissenschaftliche Nutzung seiner Bestände zu werben.

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<sup>1</sup> Ausführungsvereinbarung zum GWK-Abkommen über die gemeinsame Förderung der Mitgliedseinrichtungen der Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e. V.

<sup>2</sup> *European Strategy Forum on Research Infrastructures*

Die Aufbewahrung einzelner Teilsammlungen entspricht derzeit nicht mehr den international üblichen Standards. Es wird begrüßt, dass inzwischen ein weitergehendes Maßnahmenpaket für die bessere Unterbringung der Sammlungen beschlossen wurde. Die in diesem Zusammenhang eingeplanten baulichen Maßnahmen auf dem Zentralgelände des ZFMK müssen nun zügig realisiert werden. Zur Verbesserung der Situation ist es außerdem wichtig, die Planungen für ein zusätzliches Gebäude auf dem Campus der Universität Bonn wie vorgesehen bis 2022 umzusetzen.

Bei der Digitalisierung der Sammlungsbestände verfolgt das ZFMK eine überzeugende Strategie. Die Auswahl der Objekte orientiert sich an aktuellen Forschungsfragen. Die Qualität der Digitalisate ist hoch und die bisher erreichte Erschließung angemessen. Dieser Anteil muss nun wie geplant weiter erhöht werden. Es wird begrüßt, dass das ZFMK seine Aktivitäten im Rahmen der DCOLL-Initiative<sup>3</sup> abstimmt. Neben den Sammlungen betreibt das ZFMK verschiedene exzellente Infrastrukturen, z. B. eine Biobank, ein Molekular- und ein Morphologielabor.

Auf Grundlage der Sammlungen und Infrastrukturen erarbeitet das ZFMK regelmäßig sehr gute, teilweise sogar hervorragende **Forschungsergebnisse**. Hervorzuheben sind die international stark beachteten Resultate auf dem Gebiet der Insektengenomik, die zu vielen hervorragenden Anschlussarbeiten auch an anderen Einrichtungen geführt haben, u. a. im Rahmen des vom ZFMK koordinierten Verbundprojektes GBOL (*German Barcode of Life*). Forschungsergebnisse werden sowohl in klassischen taxonomischen Zeitschriften als auch regelmäßig in anderen sehr hochrangigen *Journals* veröffentlicht. Das ZFMK wirbt zudem für Forschungsprojekte erfolgreich Drittmittel ein, sollte diese jedoch wie geplant weiter erhöhen.

Neben den wissenschaftlichen Publikationen präsentiert das ZFMK seine Sammlungs- und Forschungstätigkeit vor allem über die Ausstellungen. Es wird begrüßt, dass die Besuchszahlen seit der letzten Evaluierung gestiegen sind. Neben den Ausstellungen entwickelt das Institut zudem sehr gute Lehrformate für Kinder. Zwar verbesserte das ZFMK seine Leistungen im **Ausstellungs- und Transferbereich** seit der letzten Evaluierung, erreicht aber noch nicht das Niveau anderer Naturkundemuseen im In- und Ausland. Es sollte, wie im Bewertungsbericht näher ausgeführt, eine ambitioniertere Strategie entwickelt werden mit Blick auf die Auswahl der Themen, die Vermittlungsformate und die Besucherforschung. Das ZFMK muss für diese Aufgaben künftig mehr Ressourcen einsetzen und sollte dabei sowohl auf die Grundausstattung als auch Möglichkeiten zur Drittmittelinwerbung zurückgreifen.

Die Leistungen des ZFMK werden in **vier Zentren** erbracht. Das *Zentrum für Taxonomie und Evolutionsforschung* ist das mit Abstand größte Zentrum. Es umfasst die als „sehr gut“ bewerteten Sammlungsaktivitäten sowie die als „sehr gut bis exzellent“ eingeschätzten taxonomischen Forschungsarbeiten. Das *Zentrum für Molekulare Biodiversitätsforschung* (zmb) wird als „exzellent“ bewertet. Das 2019 eingerichtete *Zentrum für Biodiversitätsmonitoring* befindet sich noch im Aufbau und wird als „gut bis sehr gut“ bewertet. Das *Zentrum für Öffentlichkeitsarbeit und Ausstellung* wird als „gut“ eingeschätzt.

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<sup>3</sup> DCOLL = *Deutsche Naturwissenschaftliche Sammlungen als integrierte Forschungsinfrastruktur* (German Natural Sciences Collections as an Integrated Research Infrastructure)

Erfreulicherweise sind inzwischen für drei Leitungspositionen **gemeinsame Berufungen mit der Universität Bonn** vorgesehen (Direktorin bzw. Direktor, Leitung des zmb und nun zusätzlich Leitung des neuen *Zentrums*). Im Mai 2020 wurde ruhestandsbedingt die ZFMK-Führung neu besetzt. Neuer Direktor ist der bisherige, wissenschaftlich ausgezeichnet ausgewiesene Leiter des zmb. Das Berufungsverfahren zur Besetzung der damit nun vakanten Leitungsposition am zmb sollte zügig abgeschlossen werden. Es wird begrüßt, dass die Leitung des 2019 neu eingerichteten *Zentrums* zum 1. Oktober 2020 in gemeinsamer Berufung besetzt wurde.

Das ZFMK konnte den **Anteil von Wissenschaftlerinnen** seit der letzten Evaluierung erhöhen. Es muss nun erreicht werden, auch auf wissenschaftlichen Leitungspositionen mehr Frauen zu beschäftigen. Die anstehenden gemeinsamen Berufungsverfahren mit Hochschulen bieten dazu gute Möglichkeiten.

Die Betreuung der **Promovierenden** am ZFMK ist gut strukturiert. Es wird begrüßt, dass das ZFMK 2019 mit eigenen Mitteln eine International Graduate School (ZIGS) eingerichtet hat. Diese ging hervor aus einer Graduiertenschule, die im Wettbewerbsverfahren der Leibniz-Gemeinschaft eingeworben wurde. Die Zahl der Doktoranden und damit auch die Zahl der Abschlüsse sollte künftig erhöht werden.

Das ZFMK steht in einem umfangreichen **Wachstums- und Umstrukturierungsprozess**:

Während die institutionelle Förderung der Museumsaufgaben durch das Land in den vergangenen Jahren leicht rückläufig war (derzeit knapp 2,5 Mio. €/Jahr), entwickelte sich die institutionelle Förderung durch Bund und Länder sehr dynamisch. Zur Zeit der letzten Evaluierung betrug der Kernhaushalt für den laufenden Betrieb und Investitionen 4,9 Mio. € (2013) und stieg seitdem auf 7,2 Mio. € (2020).

Drei Monate nach der Begehung beschlossen Bund und Länder zudem, im Anschluss an eine positive Evaluierung durch den Wissenschaftsrat, die eine positive Bewertung des Senats berücksichtigte, das Centrum für Naturkunde (CeNak) der Universität Hamburg in die gemeinsame Förderung des ZFMK aufzunehmen. ZFMK und CeNak bilden ab Januar 2021 das „Leibniz-Institut für die Analyse des Biodiversitätswandels“ (L.I.B.) mit einem Kernhaushalt von 13,7 Mio. € (2021). Generaldirektor wird der Direktor des ZFMK. Wie bereits der Wissenschaftsrat und der Senat festgehalten hat, wird die Abstimmung zwischen den beiden Standorten eine Herausforderung für die neue Einrichtung; es wird eine anspruchsvolle Führungsaufgabe sein, sowohl eine gemeinsame Identität zu schaffen und zu sichern als auch die Arbeitsabläufe im täglichen Betrieb an zwei Standorten adäquat zu managen.<sup>4</sup>

Weitere Planungen des ZFMK zu einer Ausweitung der Arbeiten in Bonn müssen vor diesem Hintergrund beurteilt werden. Vorgesehen sind vier Teilmaßnahmen, für die zusätzliche Mittel der institutionellen Förderung in Höhe von dauerhaft 4,7 Mio. € veranschlagt wurden. Wissenschaftlich sind die Planungen zu einem großen Teil, allerdings nicht vollständig, gut nachzuvollziehen (s. im Einzelnen die Empfehlung 4 im Bewertungsbericht). Der Senat er-

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<sup>4</sup> Wissenschaftsrat: Stellungnahme zur strategischen Erweiterung des ZFMK, Bonn, durch Zusammenführung mit dem Centrum für Naturkunde (CeNak) der Universität Hamburg vom 31. Januar 2020, S. 18f. und Stellungnahme des Senats der Leibniz-Gemeinschaft vom 9. Juli 2019, S. 5.

wartet allerdings, dass vor einer etwaigen Antragstellung das L.I.B. und seine Gremien intensiv reflektieren, inwieweit die Zusammenführung der beiden Institutsteile in Bonn und Hamburg bereits so weit vorangeschritten ist, dass eine zusätzliche Ausweitung des L.I.B. am Standort Bonn gut gesteuert werden kann. In einem etwaigen Antrag in dem dafür vorgesehenen Verfahren müsste über die vorgesehene Maßnahme hinaus auf diesen Punkt eingegangen werden.

Die Erfüllung der Aufgaben des ZFMK in den drei eng aufeinander bezogenen Bereichen Sammlungen und Forschungsinfrastrukturen, Forschung sowie Ausstellungen und Wissenstransfer ist an einer Hochschule in dieser Form nicht möglich. Eine Eingliederung in eine Hochschule wird daher nicht empfohlen. Das ZFMK erfüllt die Anforderungen, die an eine Einrichtung von überregionaler Bedeutung und gesamtstaatlichem wissenschaftspolitischen Interesse zu stellen sind. Die Integration des CeNak Hamburg wird das ZFMK in den nächsten Jahren deutlich verändern. Es ist plausibel, dies durch eine Namensänderung zu verdeutlichen.

## **2. Zur Stellungnahme des ZFMK**

Der Senat begrüßt, dass das ZFMK – künftig L.I.B. – beabsichtigt, die Empfehlungen und Hinweise aus dem Bewertungsbericht bei seiner weiteren Arbeit zu berücksichtigen.

## **3. Förderempfehlung**

Der Senat der Leibniz-Gemeinschaft empfiehlt Bund und Ländern, das ZFMK – künftig L.I.B. – als Einrichtung der Forschung und der wissenschaftlichen Infrastruktur auf der Grundlage der Ausführungsvereinbarung WGL weiter zu fördern.

## Annex A: Status report

### Zoological Research Museum Alexander Koenig: Leibniz Institute for Animal Biodiversity, Bonn (ZFMK)

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## 1. Key data, structure and tasks

### Key data

Year established:	1900
Admission to joint funding by Federal and <i>Länder</i> Governments:	1957
Admission to the Leibniz Association:	1997
Last statement by the Leibniz Senate:	2013
Legal form:	Independent foundation under public law
Responsible department at <i>Länder</i> level:	Ministry of Culture and Science of the State of North Rhine-Westphalia (MKW)
Responsible department at Federal level:	Federal Ministry of Education and Research (BMBF)

### Total budget (2019)

- € 9.5 m institutional funding
- € 1.8 m revenue from project grants
- € 2.8 m revenue from services

### Number of staff (2019)

- 54 individuals in research and scientific services
- 56 individuals in service sector
- 21 individuals in administration

### Mission and tasks

According to §2 of its statutes ZFMK constitutes:

*“1. A research organization in the field of zoological biodiversity research (in particular Taxonomy and Systematics, Inventory and Protection of Biodiversity, Phylogenetics and Evolutionary Biology), also dedicated to the history of biological science and a place of teaching and learning;*

*2. A natural history and a history of science centre of collections, documentation and service;*

*3. A free of charge consultant for questions on zoological biodiversity, change of biodiversity through environmental factors and evolutionary processes;*

*4. A place of public education and participation in the field of zoological biodiversity, in particular through maintenance and development of permanent exhibitions as well as implementations of changing special exhibitions and public events; and*

*5. A forum for social and cultural science dialogues.”*

## 2. Overall concept, activities and results

The ZFMK strives to be a nationally leading institute on biodiversity research, species discovery, collections of terrestrial and limnic fauna and to contribute to the understanding of evolutionary processes. ZFMK's mission is implemented within four centres (see organisational chart in appendix 1):

1. The **Centre for Taxonomy and Evolutionary Biology** (*Zentrum für Taxonomie und Evolutionsforschung, zte*) is focused on integrative taxonomy, evolutionary biology and the development of species discrimination tools. It is the largest centre of the ZFMK and includes the collections. It is divided into the departments Arthropoda (with 6 collections) and Vertebrata (with 4 collections). Furthermore it includes the central facilities „Morphology Laboratory“, „Biodiversity Informatics“, „Biohistoricum“ and „Animal Care Facility“.
2. The **Centre for Molecular Biodiversity Research** (*Zentrum für Molekulare Biodiversitätsforschung, zmb*) is focused on molecular analyses of biodiversity with strong aspects in phylogenomics, comparative genomics, metabarcoding, and methods development/bioinformatics. It is divided into 8 research sections. In addition, the centre is responsible for the computer clusters needed for the analysis and management of genomic data. It includes the central facilities „Molecular Laboratory“, „High Performance Computing Unit“ and „Biobank“.
3. The **Centre for Biodiversity Monitoring** (*Zentrum für Biodiversitätsmonitoring, zbm*) has been established in 2019 and is in *statu nascendi*. It is divided in three research sections and focusses on the analysis of biodiversity change and monitoring. It aims at innovative technological developments and application-oriented interdisciplinary research, which relies on and advances existing infrastructures of zmb and zte.
4. The **Centre for Knowledge Transfer** (*Zentrum für Öffentlichkeitsarbeit und Ausstellungen, zöa*) focusses on public relation activities, educational programs and exhibitions in order to raise awareness for biodiversity issues and to explain biodiversity change. It is divided into the departments Public Relations and Exhibitions.

The working results of the four centres are presented in detail in chapter 7. As a research museum of the Leibniz Association, ZFMK is engaged in the three areas i) collections and research infrastructures, ii) research and iii) exhibitions and knowledge transfer. In the following, the main results in these three dimensions are summarised.

### Results

#### *Collections and Research Infrastructures*

The collections of ZFMK, comprise about 5.6 Million zoological specimens (plus Biobank samples), attracting 533 guest scientists since 2013. The institute developed an overarching collection strategy, including Access and Benefit Sharing (ABS) procedures and a digitisation strategy. Up to now, data of 12% of the ZFMK collections (or 732,138 objects) have been made available in digital form. They are accessible through a new website portal, the Digital Collection Catalogue. ZFMK delivers specimen data to portals and global initiatives as the Global Biodiversity Information Facility (GBIF) or Europeana. The Biohistoricum was



founded in 1998 as a museum and research archive for the history of biology. Since October 2008, the Biohistoricum is a central facility of the ZFMK. It contains both scientific and private partial estates and offprint collections from German-speaking countries, as well as a specialized library with more than 50,000 volumes of books.

The Biobank is a specialized archive that is complementary to other collections of the museum and is linked to them. Here ZFMK stores currently about 200,000 samples of animal DNA and fixed/viable tissue, associated with the corresponding biological data. Any scientist can deposit samples that have been or can be used for molecular analysis. The Biobank is also open to the public to conduct taxonomic, phylogenetic or ecological studies.

In addition to the collections, there are the following research infrastructures at ZFMK:

- The ZFMK operates a biodiversity data centre, which provides services and workflows for data management, archiving and publication in the areas of biodiversity research, monitoring and collection-based research. All data is archived according to existing standards, provided with a DOI (Digital Object Identifier) and published e. g. via the German Federation for Biological Data (GFBio). The ZFMK node is one of the seven GFBio Data Centres in Germany.
- The high performance computing unit (HPC) delivers server equipment that is necessary for genomic, phylogenomic, 3D-reconstruction, and collection data management applications. It consists of three separate units dedicated to genome assembly, annotation, and phylogenomic analyses.
- The library is a scientific library for zoology. The main task of the library is to support the research process by providing access to scientific literature and information.
- The morphology lab was established in 2018. The lab allows for the 3-dimensional visualisation of computer tomography (CT) scans or histological sections. It also includes an X-ray device, a scanning electron microscope (SEM) and two  $\mu$ -CT-scanners. Next to own research it also coordinates the morphological research, supervises the related infrastructure and provides training and for other ZFMK researchers. Via cooperations it can be used by external scientists.
- The molecular lab delivers the technical preconditions for comparative genomic, phylogenomic and metabarcoding work. It has equipment for high throughput barcoding/metabarcoding, genome sequencing with Oxford Nanopore technique and target DNA enrichment projects.
- The animal keeping facilities (amphibians, fishes and reptiles) are mainly used for research in the zte and exhibition purposes in the zöa.

### *Research*

Research at ZFMK is focused on evolutionary and ecological biodiversity change in extant terrestrial and freshwater fauna. It ranges from basic taxonomic work, over molecular biodiversity research, covering comparative genomics and bioinformatic methods development, phylogenomic approaches to understand the evolution of animals up to analyses of species communities using metabarcoding approaches and methods development in these fields. Additionally, scientists of the ZFMK are engaged in evolutionary analyses of

phenotypic change using 3D-reconstructions. Biodiversity informatics at the ZFMK develops novel digitisation strategies and performs theoretical work in biodiversity data science. Research at the ZFMK is highly collaborative. In the period 2017-2019, museum staff produced a total number of 581 publications, of which 383 appeared in peer-reviewed journal articles (see appendix 2). Regarding biodiversity discovery activities 326 publications dealt with taxonomy, including the description of 949 species new to science and 593 animal species having been redescribed or revised since 2013.

More details about ZFMK's research activities can be found in chapter 7 (zte and zmb) as well as chapter 3.

### *Exhibitions and Knowledge Transfer*

The permanent exhibition "Our blue planet" is divided in 5 parts, focussing on different biota. Currently, the exhibition focussing on the rainforest is under construction and should be finished 2021. Furthermore, there is a permanent exhibition on freshwater with living animals.

In addition, ZFMK realizes special exhibitions, which are presented temporarily. Since 2013 ZFMK organized 55 special exhibitions, of these 27 in the last three years.

Since 2013, all exhibitions attracted 770,000 visitors, corresponding to 110,000 per year. The number of visitors raised from 80,000 in 2013 to 167,000 in 2019.

In addition, about 1,000 educational activities were annually executed since 2013. The events cover podium discussions, public lectures, educational programs addressing specific questions on organismal biodiversity and aspects of ZFMK research.

## **3. Changes and planning**

### **Development since the previous evaluation**

#### *Structural changes*

To implement the recommendation of the last evaluation 2013 regarding the consolidation of the existing three ZFMK centres, the institute applied for additional permanent funding (minor extraordinary item of expenditure). This was approved and ZFMK receives since 2017 additional 1.5 M€ per year. ZFMK filled 28 permanent positions to strengthen the three centres. In total, since 2013, 46 academic and non-academic positions have been additionally created.

At the last evaluation ZFMK presented expansion plans for a new fourth centre, which were associated with financial requirements. In view of the Senate, these were not sufficiently embedded in the overall strategic framework and should not have been pursued further. In the following years, ZFMK developed its concept further to a new Centre for Biodiversity Monitoring, which was established in 2019. Additionally, ZFMK developed and expanded its expertise in biodiversity-/bio-informatics to allow for integrating computational tools into integrative taxonomy, molecular systematics and biodiversity monitoring.

### *Collections and Research Infrastructures*

ZFMK developed an overarching collection strategy. The regulations arising from the Nagoya Protocol on Access and Benefit-sharing (ABS), a binding international agreement, have been implemented in the ZFMK workflows, and cross-links to tissue and/or DNA vouchers are provided by the ZFMK biobank. Additionally, ZFMK created a biobank facility for archiving of living tissue and cell material.

ZFMK has developed a Digitisation Strategy, which was adopted in other German museums within the DCOLL initiative<sup>1</sup> consortium, which unites seven partner institutions including four Leibniz institutes, to become part of the German national roadmap for research infrastructures. It aims to mobilise, structure, interlink and make openly available data hidden in natural science collections in Germany. Digitisation of the collections remains foreseeable one of the major tasks for the collections.

The ZFMK successfully applied for membership in the consortium "Synthesis for Systematic Ressources" (SYNTHEYS+) of 114 organizations, funded by the European Commission. ZFMK receives between 2018 and 2023 260 k€. SYNTHEYS+ creates an integrated infrastructure for natural history collections. SYNTHEYS+ forms an element for "DiSSCo - the Distributed System of Scientific Collections" which is the European Research Infrastructure for natural science collections, under the umbrella of the European Strategy Forum on Research Infrastructures (ESFRI). Maintenance and sustainability of all SYNTHEYS+ products will be united under DiSSCo after the program ends.

### *Research*

Regarding research, ZFMK especially mentions developments within several BMBF funded projects:

- In the field of ecological biodiversity change and monitoring ZFMK co-founded and coordinated the projects "German Barcode of Life" (GBOL I, II, III). In this national consortium of over 20 museums and research institutions, a DNA barcode catalog of the German fauna and flora was developed as prerequisite of automated species detection via metabarcoding of environmental samples. GBOL II was funded between 2016-2018 with approx. 1.9 M€ at ZFMK. GBOL III starts in 2020 and will integrate aspects of species discovery, taxonomy and DNA barcoding of largely neglected insect groups (Dark Taxa).
- In the project "Automated Multisensor Station for Monitoring of Species Diversity" (AMMOD) ZFMK cooperates with the University of Bonn, Fraunhofer Institutes and other Leibniz Institutes to develop automatic species recognition tools based on phenotypic analyses. AMMOD is funded by the BMBF from 2019 to 2021 with approx. 1.5 M€ at ZFMK.
- In the project "Forensic Genetics for Species Protection" (FOGS) ZFMK collaborates with a private commercial company and lab service provider in order to develop novel tools

<sup>1</sup> DCOLL = *Deutsche Naturwissenschaftliche Sammlungen als integrierte Forschungsinfrastruktur* (German Natural Sciences Collections as an Integrated Research Infrastructure)

for the prosecution of illegal animal trade. FOGS is funded from 2019 to 2023 with approx. 1.5 M€ at ZFMK.

- In the project „Diversity of insects in Nature-protected areas“ („Diversität von Insekten in Naturschutz-Arealen“ – DINA) ZFMK collaborates with the German Nature And Biodiversity Conservation Union and other universities and research institutes to understand drivers of insect decline. The goal of the project is to assess and monitor the insect fauna in 21 selected Nature-protected areas using a Malaise trap transect approach. A particular goal of this project is to demonstrate the power of metabarcoding for the rapid and efficient assessment of the insect fauna relying on the GBOL database. DINA is funded from 2019 to 2022 with approx. 640 k€ at ZFMK.

In addition to the projects funded by the BMBF, ZFMK mentions the following important third-party funded projects:

- The collaborative project „Integrative analysis of the influence of pesticides and land use on biodiversity in Germany (INPEDIV)“ is led by ZFMK and investigates consequences of organic and conventional farming for biodiversity in protected areas. INPEDIV is funded from 2019 to 2022 with approx. 1 M€ at ZFMK by the Leibniz-Association (competitive procedure).
- In the field of taxonomy ZFMK participates with one project in the collaborative Priority Programme “Taxon-Omics – New approaches to discovering and naming biodiversity“ (*Schwerpunktprogramm - SPP*), funded by the *Deutsche Forschungsgemeinschaft* (DFG). It focusses on combining taxonomy with new approaches for discovering and naming biodiversity. This project is funded from 2018 to 2020 with approx. 280 k€ at ZFMK.

Furthermore, ZFMK emphasizes its participation in several other collaborative projects. To develop an integrated view of phylogenetics and comparative genomics ZFMK coordinates e. g. the projects 1kite (consortium with the goal to deliver novel genomic tools and transcriptomic data of over 1,000 insect species), and is involved in i5k (consortium with the goal to sequence 5,000 arthropod genomes in the next decade) or the EU-funded International Training Network “Big4” (training in the field of systematic entomology).

### **Strategic work planning for the coming years**

The former director of ZFMK retired in July 2019 and the deputy director and head of zmb now is acting director. ZFMK and the University of Bonn are in the process of jointly appointing the new director and Chair in Zoology. ZFMK expects the new director to start her or his work at ZFMK on 1 April 2020.

In addition, ZFMK and the University of Bonn are in the process of jointly appointing a head of the zbm and Chair in Biodiversity Monitoring. The head of zbm will fill additional positions within the zbm. The establishment of the zbm will lead to a reorganization of the zmb, because the zmb research groups focusing on biodiversity monitoring will be transferred to the zbm. ZFMK expects the head of zbm to start her or his work at ZFMK on 1 May 2020.

ZFMK is building a new research building at the University Campus Poppelsdorf to be finished in 2022. The new research building will house the zmb, the zbm, the Ichthyology section of the zte, the library, the Biohistoricum, the IT unit, and the biobank. ZFMK further plans

to physically connect the building with the new neighbouring building of the Zoology Institute of the University.

In August 2018, the *Land* Northrhine-Westfalia proposed in agreement with the *Land* Hamburg the integration of the Center of Natural History (Centrum für Naturkunde – CeNak) of the University of Hamburg into the ZFMK to form a “Leibniz Institute for the Analysis of Biodiversity Change” (LIB) located in Bonn and Hamburg, starting on 1 January 2021. The proposal was evaluated by the German Science Council (Wissenschaftsrat – WR). On 31 January 2020, the WR published a statement (in German, see <https://www.wissenschaftsrat.de/download/2020/8264-20.html>). Referring to this statement the Joint Science Conference (Gemeinsame Wissenschaftskonferenz – GWK) is expected to decide on the proposal in April 2020.

According to the ZFMK, an integration offers the chance to increase the quantity and quality of the collections, to enlarge the taxonomic expertise, to append expertise in environmental biology and to strengthen knowledge transfer. In 2018, CeNak received funding of approx. 3.7 M€ and had 44.7 FTE employees. According to the integration plans until 2027, the part of LIB located in Hamburg will comprise the CeNak and additional 37.5 FTE personnel (14 FTE scientists, including two new professorships, and 23.5 FTE non-scientific personnel). The part of LIB in Bonn will comprise the ZFMK and additional 8.5 FTE for administration, networking and coordination. The total additional funding for financing the integration of CeNak into ZFMK (including investments) and the additional 37.5 FTE staff will be approx. 8.8 M€ in 2021, which will rise in steps to 12.1 M€ per year from 2027 on.

### **Planning for additional funds deriving from institutional funding**

ZFMK plans to establish a new fifth Centre of Computational Biodiversity Research (Zentrum für computerbasierte Biodiversitätsforschung – zcb) to develop and integrate computational approaches into collection work, collection-based research and biodiversity monitoring. In view of ZFMK, the establishment of the new center also has to be accompanied by several structural improvements within the existing four centers. In summary, ZFMK plans to create **44 new positions**: 2 W3-professorships, 2 W2-professorships, 10 positions on paygroup EG 14, 9 on EG 13, 3 on EG 12, 3 on EG 11, 13 on EG 9, one on EG 8 and one on EG 6 (see below for details).

The personnel costs total approx. 4 M€. In addition, ZFMK plans approx. 0.5 M€ for infrastructures and approx. 0.4 M€ management costs, such that the overall costs total approx. 5 M€ per year. For the financing, the institute plans to apply for permanent additional funding (minor extraordinary item of expenditure of a scientific-strategic nature). ZFMK will contribute 0.22 M€ from its own budget, leaving approx. 4.7 M€ per year that will be needed in addition, starting 2022 (see table below).

„Extraordinary item of expenditure“: summary of funds planning

	2022	2023	2024	2025	Permanent
<b>Own funds + additional funds = „extraordinary item of expenditure“</b>	4,939 k€	4,744k€	4,851 k€	4,961 k€	4,961 k€
<b>Own funds</b> from existing funding by institution (at least 3 % of core budget)	217 k€	217 k€	217 k€	217 k€	217 k€
<b>Additional funds</b> of institutional funding	4,723 k€	4,527 k€	4,635 k€	4,744 k€	4,744 k€

The proposed increase in IT infrastructure can be housed in the new research building. However, according to ZFMK, the proposed amendments of staff cannot be housed in the new building or other existing facilities. The ZFMK is renting the so-called “Sonnenvilla”. Currently, it is planned to stop renting this office facility with the occupancy of the new building. The continuation of renting or purchasing the “Sonnenvilla” would create sufficient additional office space for the proposed staff development and needs to be realized.

In detail, ZFMK plans the following additional personnel:

The planned **new zcb** will be divided into the two units Biodiversity Data Science (based on the existing biodiversity informatics group) and Automated Species Recognition. The following **10 positions** are envisaged by ZFMK:

Unit on Biodiversity Data Science

- 1 position for the head of the zcb (W3-professorship)
- 2 scientists for ontology development and data management science (EG 14)
- 2 scientific programmers (EG 13)

Unit on Automated Species Recognition

- 1 position for the deputy head of centre (W2-professorship)
- 2 scientists for image analysis and applications for species discovery (EG 14)
- 2 scientific programmers (EG 13)

For the **zte**, ZFMK sees a need for additional expertise on museomics, morphometrics, and statistical analyses to support digitisation efforts and biodiversity data science in concert with the zcb. The following **17 additional positions** are envisaged by ZFMK:

- 1 position for the head of zte (W3-professorship)
- 2 scientists for molecular methods in museomics and morphometrics (EG 14)
- 1 post-doc for new fields in taxonomy (EG 13, non-permanent)
- 2 data manager in the arthropoda and vertebrata departments (EG 13)
- 10 technical assistances in the arthropoda and vertebrata departments (EG 9)
- 1 secretary (EG 6)

For the **zbm**, ZFMK sees a need for additional expertise in remote sensing methods and landscape/conservation/population genomics. The unit shall also include scientific staff on conservation and invasive species genomics. The following **6 additional positions** are envisaged by ZFMK:

- 1 position for the deputy head of zbm (W2-professorship)
- 4 scientists for methods in remote sensing, landscape genomics, conservation genomics and invasive species genomics (EG 14)
- 2 technical assistances for the molecular laboratory (EG 9)

In addition, ZFMK sees also a need for amendments of staff in the **scientific IT-Administration**. The following **6 additional positions** are envisaged by ZFMK:

- 1 position for HPC Administration (EG 13)
- 5 positions for Administration of species reference platform servers, HPC training, data backup management etc. (three EG 12 and two EG 11)

Finally, ZFMK sees also a need for amendments of staff in the **Administration**. The following **5 additional positions** are envisaged by ZFMK:

- 1 position for scientific events and public relation (EG 13)
- 1 position for IT support (EG 11)
- 2 positions for human resources and finance/third party-funds (EG 9)
- 1 position for accounting (EG 8)

## 4. Controlling and quality management

### Facilities, equipment and funding

#### *Funding*

In 2019, ZFMK's institutional funding was approx. 9.5 M€ including 7.1 M€ joint funding from the federal and *Länder* governments as well as 2.4 M€ from the *Land* of North Rhine-Westphalia for museum specific tasks (see position 1.1 and 1.2 in appendix 3).

Funds received from the extraordinary item of expenditure in 2017 were transferred into the core budget of ZFMK in 2018, which thus increased by approx. 1.5 M€ (position 1.1). Extra funds received from the "Action Plan of the Leibniz Research Museums" derive from an initiative of the Bundestag in 2017 for the Leibniz Research Museums to intensify activities in knowledge transfer to the public. The extra contribution disbursed 0.5 M€ in 2017 and 0.5 M€ in 2018 (position 1.2).

For the new building ZFMK received extra funds from the Ministry (see position III.). The total amount made available for the construction work is around 50 M€.

The share of third party funding was 2017 16 % of the overall budget, 2018 11 % and 2019 16 % (see position 2.). The overall income between 2017 and 2019 was 4.8 M€.

2.2 M€ were raised from federal and *Länder* governments, 1.1 M€ from the DFG, 0.8 M€ from the Leibniz-Association (competitive procedure), 0.25 M€ from the EU and 0.35 M€ from other sponsors.

### *Facilities and equipment*

For equipment and infrastructures see chapter 2. ZFMK has the following research and office buildings:

- The main building (11,222 m<sup>2</sup>) houses the exhibitions, the public relations department, the vertebrate collections, the morphology laboratory, the workshops, the taxidermy, architecture and design units, the administration, the lecture hall, the seminar room, the offices and the biohistoricum.
- The Käfer-Haus (237 m<sup>2</sup>) houses the IT department, server facilities and research staff.
- The Clas Michael Naumann Research Building (2,877 m<sup>2</sup>) houses the arthropod collections, the biobank, offices, the molecular laboratory, the histology laboratory, the library, the electron microscopy and seminar rooms.
- The Sonnenvilla (981 m<sup>2</sup>, rented) houses the arthropod collections, staff (including third party funded scientists) and two guest rooms.
- The new building on Campus Poppelsdorf (4,070 m<sup>2</sup>) will house the zmb, the zbm, parts of the zte, the IT department, the library and the biobank.

### **Organisational and operational structure**

The foundation ZFMK is organized into the foundation board, the scientific advisory board (see below), and the director. The director is appointed by the foundation board for five years with the possibility of renewal. The director's position is filled as a full professorship jointly by the University of Bonn and the ZFMK according to the "Jülicher Modell", which implies a full position at the University with an untermiated leave of absence. The director is responsible for the general strategy and has operational oversight. He is supported by his scientific advisor for research networks, interdisciplinary cooperation and science policy. She represents the director if delegated.

The deputy director is appointed in a similar scheme by the foundation board for a duration of five years with the possibility of renewal. He represents the house and director whenever delegated.

The head of the administration is appointed by the foundation board for five years with the possibility of renewal. He is legally responsible for the budget (*Haushaltsbeauftragter*).

The directorate consists of the heads of the departments, the director and the head of administration. It advises the director and serves as a link between the director and the departments. It meets every week. Decisions are made by consent. The protocols of these meetings are posted in the intranet and can be read by all staff members.

The conference of principal investigators takes place every four weeks and serves as a platform for the discussion of all matters relevant for the development of the institute's



research. It is mainly a conference for scientists on permanent positions. Representatives of the PhD students and of the technical staff take part. Typical issues are major investments, space utilization, the planning of joint research projects, support required for the exhibition group or budget issues. The conference meets every second year for a three-day retreat to discuss strategic developments.

The participation in the Monday staff meeting is voluntary. The meeting usually takes up to 15 minutes. Everybody can speak freely, ask questions and present complaints or new ideas. During the university's semester, every Monday after the staff meeting there is a scientific meeting of up to 45 minutes. Everybody can take part. The meeting is used to present research results, to discuss new PhD projects, or to report about expeditions.

The personnel assembly (*Personalversammlung*) is a meeting for the whole staff. It takes place once a year or when necessary, for example to discuss the implications of the change of the institute's legal status.

## Quality Management

The ZFMK adopted rules to ensure good scientific practice on the basis of the rules recommended by the DFG and later by the Leibniz Association. The ZFMK has an ombuds-person.

ZFMK runs an own research information system to document the institute's products and activities and fulfil reporting duties. It includes an evaluation system for internal use (*Leistungsbewertungskatalog*) and automatically generates credits for each scientist. The entries of the researchers on publications, conferences, students and many more aspects of their work are controlled for plausibility, and points for each item weighted according to the strategic goals of the institute. A higher number of points will lead with a higher probability to granting of new equipment or support for travels. Decisions are taken by the director. For each scientist, there is a performance evaluation every second year. The institute does not practise a performance-based allocation of resources. However, depending on the documented performance in-house money can be granted to prepare grant applications and necessary preliminary data.

All scientific publications of junior scientists are read by their supervisors before they are submitted to journals. Exceptions are sometimes non-scientific articles for popular media. Scientific articles are published in peer-reviewed journals only. Scientists are being motivated to publish in higher ranked journals in order to get more credits in their *Leistungsbewertung* (see above). ZFMK promotes open access publications and provides funds to finance these on request. However, due to limited funds, the number of open access publications needs to be annually restricted, upon a decision taken by the director.

Every research infrastructure is headed by a specialist in the appropriate field who is supported by technical staff and collection managers. ZFMK keeps the technical expertise of staff updated by promoting and funding technical training. Additionally, ZFMK annually reviews the technical equipment together with the facility heads and strategically invests wherever necessary, given the budget flexibility.

In compliance with the DFG regulations, ZFMK provides a primary data backup for all ZFMK projects with dedicated tape backup systems managed by the IT department. The biodiversity informatics section provides support in developing the appropriate data management and database systems. Genome sequence and related data are deposited in public data bases, meta data of analyses are deposited on the ZFMK website. This is likewise true for niche modelling data and if applicable for morphological data.

In 2018 ZFMK appointed an animal welfare officer, confirmed by the LANUV (Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen), who leads and organizes ZFMK's animal welfare committee. The committee meets at least biannually in order to ensure that the regulations, conditions and sanctions with regard the German Animal Welfare Act (*Tierschutzgesetz*) and the German Animal Welfare Experimental Animal Regulation (*Tierschutz-Versuchstierverordnung*) are observed.

### **Quality management by advisory boards and supervisory board**

The scientific advisory board (SAB) is composed of at least five and up to eight scientists. Members are appointed by the foundation board (see below) for a period of 4 years, with only one possibility for reappointment. The SAB convenes at least once per year. It also performs the regular audit required by the Senate of the Leibniz Association in-between two evaluations. The last audit took place in 2019.

The foundation board (FB) consists of up to eleven members with voting right. These are one representative of the ministry responsible for science of the *Land* North Rhine-Westphalia, one representative of the federal ministry responsible for science, one representative of the University of Bonn, the chair of the SAB, and up to seven additional persons, appointed by the ministry responsible for science of the *Land* (in consent with the federal ministry). The FB meets biannually and is reviewing the development of the house, consulting the SAB, reviewing the administrative activities, and gives discharge to the director.

## **5. Human Resources**

As of 31 December 2019, ZFMK had 131 employees (without student assistants, trainees and scholarship recipients, see annex 4); 54 persons worked in research (including 10 doctoral candidates), 56 persons had service positions (30 of them in laboratories) and 21 persons had administrative tasks. In addition, 31 student assistants, 3 trainees and 10 scholarship recipients (5 doctoral candidates and 5 post-docs) worked at ZFMK.

### **Management**

Appointments for leading scientific and administrative staff follows the guidelines of the Leibniz Association. Leading positions at institute and departmental management level are advertised publicly and internationally. The scientific director, the head of the zmb and the head of the zbm are joint appointments (W3) as chairs with the University of Bonn. Procedures are carried out with a committee from the University and one from the ZFMK.

For all appointments on the third level (section heads) the same principles as outlined above apply and internal selection committees representing all centres are formed. All

section head positions are tenure-track positions. After an initial three-year probation period contracts can be turned into permanent positions. The assessment is carried out by the directorate. In cases of doubt, fixed-term contracts can be extended.

### **Postdoctoral staff**

The institute defines postdocs as researcher holding a doctoral degree who are engaged in a temporary period of (often) mentored research for the purpose of acquiring the skills needed to complete her/his career path. Funding comes from external sources and the postdoctoral phase often ends with a permanent employment. In addition, ZFMK has established one 1-year position available for postdocs, the Margarethe Koenig Award, which is reserved for female scientists preferably of the ZFMK. As of 31 December 2019, 17 postdocs worked at ZFMK, 5 of them with scholarships.

Since the last evaluation, two scientists acquired a Habilitation at the University of Bonn. One of them accepted a call from the University of Freiburg for a W3 Professorship in Evolutionary Biology in 2016. In addition, two newly appointed scientists had already acquired the Habilitation before their appointment at ZFMK. The directorate supports these initiatives and counsels candidates. It is the explicit goal of the ZFMK to increase the number of scientists with Habilitation.

### **Doctoral Candidates**

As of December 31 2019 there were 15 PhD candidates working at ZFMK (including 5 scholarship recipients, see appendix 4). Additional 11 external PhD students employed at other institutes were co-supervised by ZFMK staff. Between 2017 and 2019 11 doctoral candidates of ZFMK successfully completed their work. ZFMK expects PhD students to finish their theses in three to four years.

ZFMK acquired funding in the competitive procedure of the Leibniz Association for a Leibniz Graduate School on Genomic Biodiversity Research (1 M€ from 2013-2016). Based on the concept developed for this school ZFMK established in 2019 the International Graduate School (ZIGS) with own funds and a dedicated part time position. The ZFMK International Graduate School supports candidates in all aspects of their PhD work, including a specific curriculum. The vast majority of courses and lectures is given by ZFMK researchers and encompasses 9 obligatory courses and modules (such as ethics in science and epistemology, principles of Systematics, Taxonomy, and Nomenclature, introductions to cladistics, to molecular systematics, scientific writing and others); 30 facultative modules are offered in addition. Every candidate has a Thesis Committee including the supervisor and two other researchers. A Supervision Agreement outlines the timeline of the PhD study and clarifies the rights and duties of all parties. An internal advisory board accompanies the development of the graduate school.

### **Non-scientific staff**

The ZFMK offers four apprenticeship training positions for the following non-scientific professions: carpenter, event management, management assistant in office communica-

tion and IT. The training programme lasts three years and in case of excellent achievements in the vocational school can be shortened to 2.5 years. Between 2017-2019, the ZFMK successfully trained three apprentices.

## **Equal opportunities and work-life balance**

### *Equal opportunities*

As of 31 December 2019, 20 out of 54 employees in the field of research and scientific services were female (37 %, see appendix 4). Out of the 5 leading scientists (acting director and head of zmb, 4 department heads) one was female (20 %). Out of 17 section heads 4 were female (24 %). In non-executive positions 11 out of 19 were female (58 %). Out of 10 doctoral candidates employed at ZFMK 2 were female (20 %).

ZFMK implemented the cascade model recommended by the Leibniz Association and has an equal opportunities officer. Female scientists of the ZFMK have founded a group to enforce gender issues at every level and to support the application of the cascade model. ZFMK did perform head hunting to get applications for the director position and for the chair of the zbm from qualified female scientists.

ZFMK's Margarethe-Koenig postdoc award has now been opened to also non-ZFMK graduates and was announced publicly the first time in 2019, in order to also attract high profile young female scientists to the ZFMK.

### *Compatibility of family and career*

The ZFMK supports young families by flexible working hours and opportunities for home work. ZFMK cooperates with the dual career office of the university and helps in finding appropriate housing, kindergarten or schools. Recently, a parent-child-office was established. Additionally, ZFMK acquired a certificate during the audit process Familie & Beruf in 2019.

## **6. Cooperation and environment**

### *University of Bonn*

Leading scientists at ZFMK are jointly appointed with the University of Bonn according to the so called „Jülicher Modell“. The following 3 joint appointments have been made or will be made:

- The planned appointment of the new director of ZFMK, head of zöa and and Chair in Zoology at the University (W3).
- The planned appointment of the new head of the zbm and Chair in Biodiversity Monitoring at the University (W3).
- The head of zmb holds a Chair in Molecular Biodiversity Research at the University (W3).

In addition, the following 4 joint appointments are planned within the proposed expansion of ZFMK (see chapter 3):

- Head and deputy head of the proposed new centre zcb (W3 and W2).
- Head of the existing centre zte (W3)
- Deputy head of the existing centre zbm (W2).

ZFMK scientists are engaged in the International Master program Organismic Biology, Evolutionary Biology and Palaeobiology (OEP). 20 scientists of ZFMK offer seminars and courses with 2-4 semester periods per week each.

Furthermore, ZFMK cooperates in various projects with the Dept. of Geography (biodiversity and climate change in Norway), the Dept. of Botany (within GBOL, see chapter 2), the Institute of Ecology & Agriculture (understanding the effects of agriculture on insect diversity), the Institute of Evolutionary Biology (incorporated chloroplasts in Sacoglossa), and the Institute for Pharmaceutical Biology on defense systems of marine Heterobranchia. The university was also partner in the Leibniz Graduate School on Genomic Biodiversity Research (see above). The new research building at the University Campus Poppelsdorf will further tighten the scientific links between the university and the ZFMK.

#### *Collaborations with universities abroad*

Among international collaborations with universities, ZFMK emphasizes the following:

- ZFMK collaborates with the Sam Ratulangi University (UNSRAT) in Manado, Indonesia, in joint projects on Biodiversity of marine Heterobranchia and in the International Master program „Indo-Pacific Coral Reef Biodiversity and Conservation“.
- There is a BMBF-funded institutional partnership since 2017 with the Ilia State University in Tbilisi, Georgia. It includes joint research projects on biodiversity issues and the development of educational programs for academic training. A joint biobank of the Caucasus fauna was established.
- One scientist of ZFMK is honorary Professor and permanent staff member of Universidade Estadual de Santa Cruz (UESC), Ilheus, Brazil. He supervises several Master and PhD candidates at UESC and several UESC scientists visited ZFMK.

In addition, there are joint activities with the *Universidade Federal de Goiás*, Brazil, the NTNU University Museum, Norway, the University of Skövde and the University of Gothenburg, Sweden, the University of North Texas and the University of California Santa Barbara, USA, and the University of Basel, Switzerland (and Zoologische Staatssammlung Munich).

#### *Collaborations with Leibniz Institutes*

The „Action Plan of the Leibniz Research Museums“ aims at strengthening the joint outreach activities of the eight research museums of the Leibniz Association in addition to individual projects. The activities within Action Plan I (2017–2019) and Action Plan II (2019–2020) were funded by the BMBF and those *Länder* in which the museums are based. The activities include e. g. the organization of the Conference of Species or the Global Summit of Research Museums.

ZFMK is one of the founding members of the Leibniz Research Alliance on Biodiversity (Leibniz Forschungsverbund für Biodiversität – LVB). LVB pools competencies and resources of

20 Leibniz institutes in order to develop solutions for the conservation and sustainable use of biodiversity through interdisciplinary research. ZFMK is also member in the Leibniz Research Alliance Historical Authenticity, which explores how contemporary conceptions of authenticity affect the way we deal with cultural heritage by examining the reconstruction and conservation of historical artefacts.

The joint projects INPEDIV (see chapter 2) and SustainCBW („Towards a future sustainable world where climate, biodiversity, natural resources and human well-being are safeguarded“) resulted from cooperation within the LVB. Funding for SustainCBW was raised in 2017 by the Potsdam Institute for Climate Impact research (PIK) and the ZFMK from the Leibniz Association. It was cooperatively led by the PIK, ZFMK, and the Museum für Naturkunde Berlin (MfN). Further project partners are the Leibniz Centre for Agricultural Landscape Research (ZALF), The Academy for Spatial Research and Planning (ARL), and the Leibniz-Institute for Agricultural Engineering and Bioeconomy (ATB).

The Leibniz Centre for Tropical Marine Research (ZMT) is partner in the collaboration with UNSRAT (see above).

#### *Involvement in and coordination of alliances*

ZFMK collaborates with several partners (including Leibniz Institutes in larger research alliances. ZFMK emphasizes the following (see chapter 2 for the thematic focus):

- The AMMOD consortium is led by ZFMK and composed of Universities, Fraunhofer institutes, GFBIO and citizen scientist groups. Involved Leibniz members are the Leibniz Institute for High Performance Microelectronics (IHP) and the Museum für Naturkunde Berlin (MfN).
- Within DINA partners are the Institut für sozial-ökologische Forschung (ISOE), Internationales Zentrum für Nachhaltige Entwicklung (IZNE), Institute for Environmental Sciences (iES Landau), Entomological Society Krefeld (EVK), Justus-Liebig-Universität Gießen (JLU) and Leibniz-Institut für ökologische Raumentwicklung (IOER).
- Within INPEDIV cooperation partners are the Museum für Naturkunde Berlin (MfN), the Senckenberg Museum (SGN), the Leibniz Centre for Agricultural Landscape Research (ZALF), the EVK, as well as the Universities of Koblenz-Landau and Bonn.

Other larger collaborative projects are given by the ones mentioned in chapter 2 like, for example, the 1kite-project, the i5k-project, the DFG priority program Taxon-Omics, FOGS or GBOL.

#### **Institution's status in the specialist environment**

In contrast to the other two natural history museums of the Leibniz Association (MfN and SGN), the ZFMK has a focus on terrestrial species-based biodiversity research. Furthermore, according to ZFMK, it was the first Leibniz Research Museum to fully integrate molecular work in its research profile by establishing the zmb and is now again entering new grounds with the recently established zbm.

Another comparable museum is the Zoological State Collection of Bavaria (ZSM), which has one of the largest zoological collections worldwide. Its research spectrum ranges from taxonomy to evolutionary biology, but does not include aspects of ecological biodiversity change, niche modelling, and dedicated knowledge transfer.

According to ZFMK, the institute is not comparable to the big national history museums outside of Germany, like the e.g. the Natural History Museum in London, because these are very large central national institutes with much more resources. ZFMK sees an advantage of the German situation in the nationwide provision of information, education and research opportunities, and the backup of collections in different places as a protection against total losses (e.g. by fire). ZFMK also sees an advantage in a healthy competition between institutes.

## 7. Subdivisions of ZFMK

### **Centre for Taxonomy and Evolutionary Biology (zte)**

[34.66 FTE, thereof 20.23 FTE Research and scientific services, 1.7 FTE Doctoral candidates, and 13.78 FTE Service staff]

The Centre of Taxonomy and Evolutionary Biology (zte) is the largest centre of the ZFMK. It is focused on integrative taxonomy, evolutionary biology and the development of species discrimination tools. It includes the central facilities „Morphology Laboratory“, „Biodiversity Informatics“, „Bat Banding Centre“, „Biohistoricum“ and „Animal Care Facility“. The centre also manages the collections comprising about 5.6 million zoological specimens. The Arthropoda department hosts the 6 collections Arachnida (90% digitised specimen), Hymenoptera (42%), Coleoptera (2.3%), Diptera (20%), Lepidoptera (1.5%) and Myriapoda (100%). The Vertebrata department hosts the 4 collections Mammalogy (14%), Ornithology (18%), Herpetology (92%) and Ichthyology (81%).

The zte collections support taxonomy and other specimen-based research with physical and virtual access to specimens via the ZFMK Digital Collection Catalogue. Zte staff enabled major progress in digitization. Scientists of the zte extend the quality of collections beyond the classical record of taxa in space and time, including storage of frozen tissue samples, images, digital X-rays, CT-scan or SEM-data, data describing environmental context, preparations of micro anatomical structures or other parts of specimens, and cross-links to tissue and/or DNA vouchers submitted to/ or provided by the ZFMK biobank.

Taxonomy and evolutionary biology are central research foci of the zte. Curators combine organismal expertise with complementary research skills. They are contributing to international collaborative projects, participate in and organize scientific meetings, and provide service to the public, guest researchers and the scientific community. Curators take part in the ZFMK public relations activities and exhibition projects (see zöa below). Research of zte is published in single (or series of) papers and complex monographs on taxonomy, faunistics, evolutionary ecology, behaviour etc., including new species discoveries or large-scale studies on phylogeny, biogeography, etc. All curators are active in teaching (courses, seminars and lectures for MSc and PhD level students, supervision of own, and co-supervision of external/ international student projects).

The zte staff contributed to larger ZFMK projects like GBOL or Taxon-Omics (see chapter 2), and lead the participation of ZFMK in DCOLL and SYNTHESYS+. Furthermore, together with the zbm (see below) the Junior Research Group Ricefish was established, which is funded by the Leibniz-Association (competitive procedure) with approx. 1 M€ from 2017 till 2021. Together with the zöa, zte staff drafted, built, and curates the new permanent exhibition “Water – Life in Flow”.

Between 2017 and 2019 the centre published 308 articles in peer-reviewed journals. In the same period the institutional funding was 13.5 M€ (Ø 4.5 M€ p.a.). The revenue from project grants totalled approx. 2.3 M€ (Ø 0.8 M€ p.a.), with 850 k€ spent from federal and *Länder* governments, 530 k€ from the DFG, 380 k€ from the Leibniz Association, and 210 k€ from EU-grants. In the same period, 3 doctoral and 30 academic degrees were completed.

### **Centre for Molecular Biodiversity Research (zmb)**

[23.2 FTE, thereof 12.7 FTE Research and scientific services, 4.5 FTE Doctoral candidates, and 6 FTE Service staff]

The Centre for Molecular Biodiversity Research (zmb) is focused on molecular analyses of biodiversity with strong aspects in phylogenomics, comparative genomics, metabarcoding, and methods development/bioinformatics. The centre is responsible for the computer clusters needed for the analysis and management of genomic data. Furthermore, it includes the central facilities „Molecular Laboratory“, „High Performance Computing Unit“ and „Biobank“.

The zmb is divided into the 8 research sections „Computational Genomics“, „Comparative Insect Genomics“, „Molecular Taxonomy“, „Phylogenetics & Evolutionary Biology“, „Statistical Phylogenetics & Phylogenomics“, „Comparative Vertebrate Genomics“, „Metabarcoding & Environmental Genomics“ and „Algorithmic Development“. The zmb is responsible for the central biobank facility of the house, for the central molecular laboratory and together with the IT department for the supervision of the HPC unit. As such, scientists of the zmb are involved in several in-house collaborations. Furthermore, scientists of the zmb have contributed to phylogenomic and comparative genomic research and have contributed to large collaborative research and infrastructure projects like GBOL, AMMOD, FOGS, DINA, INPEDIV, Taxon-Omics or SYNTHESYS+ (see chapter 2).

With the establishment of the new Centre for Biodiversity Monitoring (zbm, see below), research positions in biomonitoring will be transferred from the zmb to the zbm. In the future research within the zmb will focus on bioinformatics and genomic work and serve as a science and technology hub for the zte and zbm. The head of the zmb is responsible, together with the head of the ZFMK administration, for the supervision of constructing the new research building on the Campus Poppelsdorf. The zmb will move into the new building in 2022.

Between 2017 and 2019 the centre published 87 articles in peer-reviewed journals. In the same period the institutional funding was 7.5 M€ (Ø 2.5 M€ p.a.). The revenue from project grants totalled approx. 2.2 M€ (Ø 0.7 M€ p.a.), with 1.1 M€ spent from federal and *Länder* governments, 550 k€ from the DFG, 450 k€ from the Leibniz Association. In the same period, 7 doctoral and 10 academic degrees were completed.



**Centre for Biodiversity Monitoring (zbm)** (W3-professorship as head to be filled 2020)

[13 FTE, thereof 9 FTE Research and scientific services, 2 FTE Doctoral candidates, and 3 FTE Service staff]

The Centre for Biodiversity Monitoring (zbm) has been established in 2019 and is in *statu nascendi*. It focusses on biodiversity change and monitoring and aims at innovative technological developments and application-oriented interdisciplinary research. It is divided in the three research sections “Metabarcoding“, „Environmental Genomics“, „Environmental Biology“. A number of activities described for the zmb and zte lay the foundation for the zbm, like e. g. the projects GBOL, INPEDIV, DINA, AMMOD or sustainCBW. The zbm will rely on and advance existing infrastructures at the zmb (Metabarcoding lab, Biobank, GBOL database) and the zte (biodiversity informatics, morphological reference collections).

The future staff funded within ZFMK’s core budget will be the head of the zbm (W3), three scientists (to be appointed by the new head), three technicians and a secretariat. Additional staff can be expected from grant money funding through new and existing projects such as INPEDIV, DINA, AMMOD and others. The to-be appointed director of the centre will be free to sharpen the profile in a dialogue with the directorate. Adjustments of the concept will also depend on the outcome of the pending evaluation of ZFMK’s strategic integration of the CeNak. The zbm will be housed in the new ZFMK research building on the Campus Poppendorf.

**Centre for Knowledge Transfer (zöa)**

[16.85 FTE, thereof 5 FTE Research and scientific services and 11.85 FTE Service staff]

The Centre for Knowledge Transfer (zöa) focusses on public relation activities, educational programs and exhibitions in order to raise awareness for biodiversity issues and to explain biodiversity change. It is divided into the departments Public Relations and Exhibitions.

The permanent exhibition “Our blue planet” is divided in 5 parts, focussing on different biota (Arctic & Antarctic, Central Europe, Desert, Rainforest and Savannah). Currently, the exhibition focussing on the second part of the rainforest is under construction and should be finished 2021. Furthermore, there is a permanent exhibition on freshwater with living animals. All exhibition units were developed in cooperation with ZFMK scientists. The rainforest projects were preceded by collection trips to Gabon and Ghana, respectively, joined by zte scientists. A multilingual audio guide was implemented and offers detailed background information to an international audience.

In addition, zöa realizes special exhibitions, which are presented temporarily. Since 2013 zöa organized 55 special exhibitions (13 of them in-house), of these 27 in the last three years. Of these special exhibitions, ZFMK curates, designs, and builds between four and five by itself each year.

Since 2013, all exhibitions attracted 770,000 visitors, corresponding to 110,000 per year. The number of visitors raised from 80,000 in 2013 to 167,000 in 2019. The two major public events („Museumsmeilenfest“ and „Tag der offenen Tür“) exceeded 15,000 guests each year. The number of fans on Facebook (3000) and followers on twitter (5100) is increasing continuously.

Furthermore, about 1,000 educational activities were annually executed since 2013. For example, zöa developed a School of Taxonomy, in which high school students are getting their first hands on experience on taxonomy supervised by scientists. The events cover podium discussions, public lectures, educational programs addressing specific questions on organismal biodiversity and aspects of ZFMK research. Many of the educational programs are designed to enhance the exchange between ZFMK scientists and the public, in particular children, teenagers and high school students. Since 2013, zöa has been engaged in 37 partnerships, currently 26 educational partnerships are being actively managed (25 schools and one kindergarten).

## 8. Handling of recommendations from the previous evaluation

ZFMK responded as follows to the 11 recommendations of the last external evaluation (highlighted in *italics*, see also statement of the Senate of the Leibniz Association issued on 28 November 2013):

1. *ZFMK developed in recent years from a classic taxonomically oriented museum to an institution in which modern phylogenetic research has a central position. The museum must now reach **balance between research and collection work**.*

In order to reach this goal, ZFMK appointed a head of the zte, filled open curator positions within the zte, filled several technical positions within the zte, appointed two collection managers, appointed technical positions to the biobank, developed a collection strategy, improved the building infrastructure with the new building from which the vertebrate and arthropod collection will profit, improved the digitisation of the collections, improved and further developed the biodiversity informatics group.

2. *Some of the collections are of great scientific and historical value. Against this background, the museum must achieve a significantly better availability of the collections for science. It is therefore necessary to press ahead with the **digitisation** of inventories. Progress on this extensive task is slow. The ZFMK should also significantly expand its engagement in **international projects** for the further development of scientific collections.*

In order to reach these goals, ZFMK developed a new collection and digitisation strategy, continued the digitisation of collection specimens (2014: 76,548 or 1.31% of total collection objects digitised, 2019: 732,138 or 12% of total collection objects digitised), appointed collection managers, became engaged in international projects with major collection activities (Georgia, Indonesia), and contributed to several national and international collaborative projects like DCOLL, SYNTHESYS+ or GBOL.

3. *It is expected that the **exhibition area** will now develop greater dynamics due to the improved staffing and in particular that the permanent exhibition, which has been under renovation for years, will be completed quickly. The ZFMK should achieve significantly higher **visitor numbers**.*

In order to reach this goal, ZFMK finished parts of the rainforest exhibition and is in the process of finishing other parts, finished the desert exhibitions, increased the number of

temporary exhibitions, increased the number of visitors, appointed two additional technical positions within the Department of Exhibitions, appointed an additional position in the education section, increased the educational activities, and introduced the taxonomy factory. With the additional funding from the “Action Plan of the Leibniz Research Museums” I and II ZFMK will invest in digital objects within the exhibition in order to increase the attractiveness.

4. *ZFMK became legally independent on 1 January 2013. This now allows for a steering of the museum by its leadership, scientific advisory board and (still to be established) foundation board. ZFMK must now receive a **statute**. The Senate requests that it be presented to it by July 1, 2014 at the latest. The statutes must define the core tasks of the research museum (collection, research, public education, and exhibition) and put them in an appropriate relationship.*

In cooperation with the established foundation board statutes have been developed recognizing the need of a balance between collections, research and knowledge transfer. The Senate took note of the changed statute in March 2015.

5. *In recent years, ZFMK received high investment funds, which have partially been used for building up the Center for Molecular Biodiversity Research, whose lab-infrastructure is excellent. However, there is a great **lack of space**. The Senate therefore appreciates very much, that the funding bodies will improve the space situation.*

In order to reach this goal ZFMK is in the process of building a new research building on the University Campus. The current prognosis is to move into the new research building in 2022.

6. *Only after the internal allocation of funds has been designed in accordance with the core tasks of the Research Museum as defined in the statutes, can an overview be made of whether **additional funds** are required for the consolidation of the existing centres and collections recommended in the evaluation report.*

From 2017 on, ZFMK received additional funding to consolidate the activities in the house.

7. *The existing **expansion plans**, which are associated with high financial requirements, are not sufficiently embedded in the overall strategic framework of the museum and are currently not to be pursued further.*

In order to reach this goal ZFMK developed this concept further to a Centre for Biodiversity Monitoring, which was founded in 2019. Additionally, ZFMK developed a strategy to invest in biodiversity-/bio-informatics to fully capture the future potential of integrating informatic tools into taxonomy, systematics and biomonitoring.

8. *The **scientific advisory board** must be more closely involved in the strategic development of ZFMK. It is necessary that it meets at least once a year and carries out an audit between two evaluations.*

The scientific advisory board (SAB) is meeting annually and is engaged in frequent evaluations of our research activities and strategic development. It performed an audit of the

scientific achievements in 2019. The SAB is regularly informed by the director of important developments, new appointments and large collaborative projects. The speaker of the SAB consults the foundation board and is also head of the search commission for the new director.

9. *ZFMK has a lot of catching up to do when it comes to **gender equality**, as women are underrepresented at all levels of the scientific hierarchy. Taking into account the mandatory cascade model, the ZFMK must define up-to-date goals, time horizons for their achievement and implementation measures in order to achieve better gender equality and family friendliness at the institute.*

ZFMK defined goals within the cascade model and improved the gender balance in academic and non-academic positions to an almost balanced situation. For every new appointment ZFMK searched for potential female candidates. ZFMK has entered the process of work-and-life-balance certification which was finalized in 2019.

10. *It is now important to support the research orientation of the staff and to honor achievements in the area of the collections. In order to improve the services in the field of collections, the ZFMK should invest in **technical personnel** in particular.*

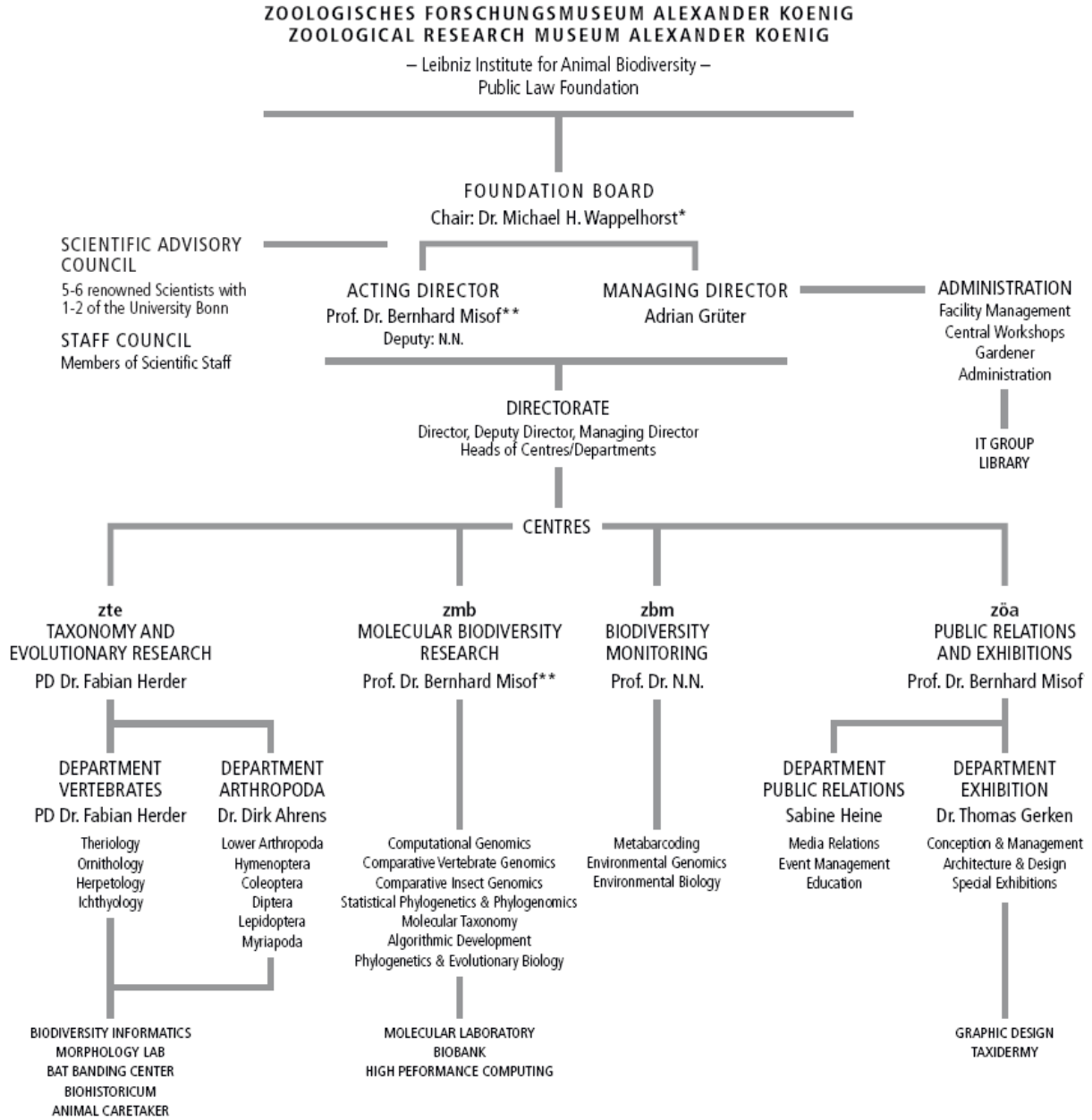
Technical staff has been hired within the consolidation process of the last years.

11. *It is recommended to work on **internal communication** and to better involve employees in important strategic decision-making processes in the future.*

Since 2014, ZFMK conducts scientific retreats every second year. In these retreats strategies, further development, and evaluations of activities were matters of discussions. These retreats served in addition to the established regular „Monday-Meetings“, the regular scientist meetings and the weekly directorate.

Appendix 1

Organisational Chart



\*Representative of the Ministry of Culture and Science (MKW), NRW

\*\*also Chairholder at the University Bonn

## Appendix 2

## Publications

	Period		
	2017	2018	2019
<b>Total number of publications</b>	<b>200</b>	<b>204</b>	<b>177</b>
Monographs	5	4	4
Individual contributions to edited volumes	16	22	6
Articles in peer-reviewed journals	125	133	125
Articles in other journals	47	30	24
Working and discussion papers	1	5	-
Editorship of edited volumes	6	10	13

## Appendix 3

## Revenue and Expenditure

Revenue		2017			2018			2019		
		k€	%	%	k€	%	%	k€	%	%
<b>Total revenue (sum of I., II. and III.; excluding DFG fees)</b>		<b>13.360,90</b>			<b>16.630,50</b>			<b>14.043,30</b>		
<b>I.</b>	<b>Revenue (sum of I.1.; I.2., and I.3.)</b>	<b>10.705,00</b>	<b>100</b>		<b>11.765,10</b>	<b>100</b>		<b>11.287,30</b>	<b>100</b>	
<b>1</b>	<b>Institutional Funding (excluding construction projects and acquisition of property)</b>	<b>8.967,00</b>	<b>84</b>		<b>10.471,00</b>	<b>89</b>		<b>9.530,30</b>	<b>84</b>	
1.1	Institutional funding (excluding construction projects and acquisition of property) by Federal and Länder governments according to AV-WGL	6.450,00			7.578,00			7.103,30		
1.2	Institutional funding (excluding construction projects and acquisition of property) not received in accordance with AV-WGL <sup>1)</sup>	2.517,00			2.893,00			2.427,00		
<b>2</b>	<b>Revenue from project grants</b>	<b>1.738,00</b>	<b>16</b>	<b>100</b>	<b>1.294,10</b>	<b>11</b>	<b>100</b>	<b>1.757,80</b>	<b>16</b>	<b>100</b>
2.1	DFG	427,2		25	267,9		21	383,3		22
2.2	Leibniz Association (competitive & strategic procedures)	33,2		2	237,1		18	568,2		32
2.3	Federal, Länder governments	1.047,00		60	721,4		56	496,2		28
2.4	EU	110,6		6	0		0	141		8
2.5	Others (e.g. AKG, AKS, AvH, ZLS)	120		7	67,7		5	168,3		10
<b>II.</b>	<b>Miscellaneous revenue (e. g. donations, rental income, entry fees, overheads, reserves)</b>	<b>1.162,90</b>			<b>1.863,60</b>			<b>2.756,00</b>		
<b>III.</b>	<b>Revenue for construction projects (institutional funding by Federal and Länder governments, EU structural funds, etc.)</b>	<b>1.493,00</b>			<b>3.001,80</b>			<b>0</b>		
<b>Expenditures</b>		<b>k€</b>			<b>k€</b>			<b>k€</b>		
<b>Expenditures (excluding DFG fees)</b>		<b>13.247,50</b>			<b>16.623,70</b>			<b>14.043,30</b>		
1	Personnel	5.982,50			7.332,60			7.686,60		
2	Material expenses	591,6			671,7			691,6		
3	Equipment investments	279			920,7			820		
4	Construction projects, acquisition of property	1.077,60			2.509,60			1.388,20		
5	Other operating expenses (PR, travel, maintenance of property, rent)	5.316,80			5.189,10			3.456,90		
DFG fees (if paid for the institution - 2.5 % of revenue from institutional funding)		156,4			175,3			176,7		
<p>[1] Includes funds from the "Action Plan of the Leibniz Research Museums" and the museum share of the state government.</p>										

## Appendix 4

## Staff

Basic financing and third-party funding / proportion of women (as of: 19/12/2019)

	Full time equivalents		Employees		Female employees		foreigners
	Total	on third-party funding	Total	on temporary contracts	Total	on temporary contracts	Total
	Number	Percent	Number	Percent	Number	Percent	Number
<b>Research and scientific services</b>	<b>46,1</b>	<b>19,8</b>	<b>54</b>	<b>38,9</b>	<b>20</b>	<b>52,6</b>	<b>10</b>
1 <sup>st</sup> level (scientific director - vacant)							
2 <sup>nd</sup> level (centre / department leaders)	5		5		1		1
3 <sup>rd</sup> level (section heads)	16,6		17	11,8	4	25	4
Junior research group leaders	2,15	100	3	100	2	100	1
Scientists in non-executive positions	16,15	24,3	19	57,9	11	54,6	1
Doctoral candidates*	6,2	74,2	10	70	2	100	3
<b>Service positions</b>	<b>43,87</b>	<b>8,88</b>	<b>56</b>				
Laboratory (upper-mid-level service)	11,21	17,84	14				
Laboratory (mid-level service)	12,5		16				
Animal care (mid-level service)	1		1				
ZÖA (mid-level service)	3,3		4				
Library (mid-level service)	1,8		2				
Information technology (upper-mid-level service)	5		5				
Preparation (mid-level service)	9,06	20,97	14				
<b>Administration</b>	<b>19,05</b>		<b>21</b>				
Managing director & Head of administration	1		1				
Staff positions (from E13)	1		1				
Internal administration (financial administration, personnel, etc.) (E11, senior service)	1,6		2				
Internal administration (financial administration, personnel, assistance, etc.) (E3 to E10)	7,45		9				
Building service (E3 to E6)	8		8				
<b>Student assistants</b>	<b>31</b>	<b>5</b>	<b>31</b>				
<b>Trainees</b>	<b>3.0</b>		<b>3</b>				
<b>Scholarship recipients at the institution</b>			<b>10</b>		<b>3</b>		<b>3</b>
Doctoral candidates			5		3		4
Post-doctoral researchers			5		3		1

\*only those PhD candidates are listed that have a contract with ZFMK



## Annex B: Evaluation Report

### Zoological Research Museum Alexander Koenig: Leibniz Institute for Animal Biodiversity, Bonn (ZFMK)

#### Contents

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Appendix:

Members of review board

## 1. Summary and main recommendations

Building on a vast zoological collection, ZFMK conducts species-related biodiversity research, especially on terrestrial fauna, engages in scientific exchange in the international research community and transfers results to the public, particularly by means of exhibitions. As one of the eight research museums in the Leibniz Association, ZFMK is active in three areas: i) collections and research infrastructures, ii) research and iii) exhibitions and knowledge transfer.

ZFMK's valuable collections comprise about 5.6 million zoological specimens (plus biobank tissue samples) and are constantly expanded in the context of worldwide research projects. In addition to the collections, ZFMK operates excellent research infrastructures, such as a molecular laboratory. On the basis of its collections and infrastructures, ZFMK regularly produces very good, in some cases excellent, research results. In addition to taxonomical studies, ZFMK's research in the field of insect genomics receives international attention. ZFMK presents its collections and research output, above all, through its permanent and special exhibitions in the museum. It is positive that ZFMK has been able to further increase visitor numbers to its exhibitions since the previous evaluation. ZFMK should nevertheless develop significantly more innovative approaches to communicating knowledge.

ZFMK's work is conducted in four centres that cooperate very closely. The Centre of Taxonomy and Evolutionary Biology (zte) is the largest centre. It includes all activities related to the management of the collections, which are rated as "very good", as well as the taxonomic research activities, which are rated as "very good to excellent". Work at the Centre for Molecular Biodiversity Research (zmb) is rated as "excellent". The Centre for Biodiversity Monitoring (zbm) was established only in 2019 and is thus still under construction. Its work so far is rated as "good to very good". Work at the Centre for Knowledge Transfer (zöa) is rated as "good".

ZFMK continues to engage in a major restructuring process. Having been an institution of the *Land* North Rhine-Westphalia, the museum became a legally independent foundation shortly before the previous evaluation 2013. This led to a more autonomous self-dependent steering of the ZFMK by its director, the Scientific Advisory Board and the newly established Board of Trustees. The evaluation 2013 had also recommended to consolidate the three centres in existence at the time. To enable this, joint funding from Federal and *Länder* governments was increased by EUR 1.5m per year beginning 2017. ZFMK used this additional funding to create 28 new positions, largely in the laboratories. At the same time, plans were made for an additional research building that is now due to be completed in 2022.

At executive level, ZFMK is also in a transition phase. The former director of ZFMK retired in July 2019. The deputy director and head of zmb was initially appointed as acting director. In May 2020, shortly after the evaluation visit, he was appointed as ZFMK's new director, following a competitive international call for applications. As a result, the position he originally held as head of a centre became vacant. As planned, this position is now supposed to be quickly refilled as a joint W3 professorship with the University of Bonn. A similar situation exists for the W3 position as head of zbm which is also vacant. ZFMK has presented plans for establishing a new fifth Centre of Computational Biodiversity Research (zcb) and reinforcing

the existing four centres. In summary, ZFMK plans to create 44 new positions, including two additional W3 and two W2 professorships (see recommendation below for an assessment of these plans).

Independently of the current evaluation by the Senate of the Leibniz Association, the Federal and *Länder* governments decided in June 2020 on the basis of an evaluation by the German Council of Science and Humanities (*Wissenschaftsrat*) to integrate the Center of Natural History (CeNak) at the University of Hamburg into ZFMK, establishing a new “Leibniz Institute for the Analysis of Biodiversity Change” (LIB) located in Bonn and Hamburg from 1 January 2021. The ZFMK director is scheduled to become Director General of LIB which will be headquartered in Bonn.

Special consideration should be given to the following main recommendations in the evaluation report (highlighted in **bold face** in the text):

#### Overall concept, activities and results (Chapter 2)

1. The **storage of certain sub-collections** no longer conforms to current technical and safety standards. ZFMK should develop a general strategy to ensure appropriate storage of its collections. In order to rapidly improve upon the current situation, it is important that the construction of the new additional building will be completed as planned in 2022. It is welcomed that ZFMK is planning further measures to improve collection storage together with the *Land* that hosts the museum.
2. With regard to **digitising** its collections, ZFMK pursues a convincing strategy, attaching importance to the quality of its digital reproductions and prioritizing the digitisation of objects in relation to current research questions. To date, twelve percent of the entire collection have been digitised, a figure comparable to other museums. As planned, this percentage should now be increased.
3. Since the last evaluation, ZFMK has improved its performance regarding the **exhibitions and transfer activities**. However, ZFMK has not yet reached the high level of other international natural history museums. It is recommended to develop a more ambitious strategy for developing innovative exhibition and presentation formats, including ways to communicate results from the extremely interesting research in molecular biology. Visitor research should also be intensified as well as the quest for new formats to engage the public in science. In addition to the cooperation with the University of Bonn, there are also good collaborative opportunities within the Leibniz Association (IWM Tübingen, MfN Berlin, DM Munich). In order to progress in these fields, it will be necessary to dedicate more and adequate resources to the work on exhibitions and knowledge transfer from existing institutional funding or third-party acquisitions.

#### Changes and planning (Chapter 3)

4. Using additional funding from the Federal and *Länder* Governments (approx. EUR 5 m per year), ZFMK plans to establish a **new fifth Centre of Computational Biodiversity Research (zcb)**. According to ZFMK, the establishment of the new centre necessitates a number of structural improvements within the existing four centres.

With regard to planning (see Status Report, p. A-9 for details), the following should be noted:

- The plans to develop the new zcb with ten additional positions (including one W3 and one W2 professorship) are coherent and are endorsed. Establishing zcb on the basis of existing expertise will enable ZFMK to assume a leading international role in biodiversity information management, a field that is constantly gaining in importance.
- The plans to establish a position of head of zte to be recruited in a joint appointment with a university (W3 professorship) and to expand zte by 17 additional positions are also coherent and endorsed. These positions will provide the necessary strengthening of the zte, in good complementarity to the zcb.
- Regarding the zbm, ZFMK should now conclude the ongoing appointment procedure for the centre head. The new head should continue to develop zbm, taking into account the recommendations of this evaluation with respect to the strategy of this centre (see chapter 7). The presented plans for expanding zbm by six additional positions (including one W2 professorship) were not sufficiently elaborated for endorsement.
- The request to create six additional positions in IT administration and five additional positions in the administration is currently not sufficiently justified.

During the site visit ZFMK presented a revised timetable to extend the realisation of its plans being evaluated here. This revised timetable should be included in the final proposal for the additional funding requested from the Federal and *Länder* governments.

When evaluating this proposal, the responsible bodies should also consider to what extent the expansion plans can be implemented in parallel with integrating CeNak.

#### Controlling and quality management (Chapter 4)

5. As planned, ZFMK should aim to continue increasing **revenue from project grants**, primarily from DFG and EU. It is welcomed that ZFMK achieved higher funding amounts in 2019 than in previous years.

#### Human resources (Chapter 5)

6. ZFMK should increase the number of **doctoral candidates** and thus also the number of degrees completed. Various third-party projects that are planned and for which funding applications have already been submitted should make this viable. Furthermore, ZFMK should seek to optimize the timing of doctoral projects in such a way that, over the years, the number of supervisions and degrees fluctuates less.
7. ZFMK has managed to increase the **proportion of female researchers** since the previous evaluation. This positive development should be continued, especially on the level of leading scientific positions. The forthcoming joint appointment procedures with universities provide a good opportunity.

## 2. Overall concept, activities and results

### Concept and activities

Building on a vast zoological collection, ZFMK conducts species-related biodiversity research, especially on terrestrial fauna, engages in scientific exchange in the international research community and transfers results to the public, particularly by means of exhibitions. ZFMK's activities are conducted in the framework of four centres that cooperate very closely. The centres deliver joint results in three areas: i) collections and research infrastructures, ii) research and iii) exhibitions and knowledge transfer. The main results in these three areas are summarised in the following (for details see Chapter 7).

### Results

#### *Collections*

ZFMK's valuable collections comprise about 5.6 million zoological specimens (plus biobank tissue samples). They are constantly expanded in the context of worldwide research projects. The museum has developed an overarching collection strategy, including proper attention to access and benefit sharing (ABS) procedures. Since 2013, the collections have been used by 533 visiting scientists. The fact that ZFMK was recently admitted to the EU-funded SYNTHESIS+ Network, which affords external scientists financial support for access to the members' collections and infrastructures, is an indication of the significance and quality of ZFMK's collections and scientific reputation (see Chapter 6). On the basis of this and possibly other measures, ZFMK should continue to advance the use of its collections by external scientists.

**The storage of certain sub-collections no longer conforms to current technical and safety standards. ZFMK should develop a general strategy to ensure appropriate storage of its collections. In order to rapidly improve upon the current situation, it is important that the construction of the new additional building will be completed as planned in 2022. It is welcomed that ZFMK is planning further measures to improve collection storage together with the *Land* that hosts the museum.**

**With regard to digitising its collections, ZFMK pursues a convincing strategy, attaching importance to the quality of its digital reproductions and prioritizing the digitisation of objects in relation to current research questions. To date, twelve percent of the entire collection have been digitised, a figure comparable to other museums. As planned, this percentage should now be increased.** It is welcomed that ZFMK coordinates its activities with seven partner institutions, including four Leibniz institutes, in the DCOLL initiative<sup>1</sup>. ZFMK is also involved in global initiatives like the Global Biodiversity Information Facility (GBIF) and Europeana.

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<sup>1</sup> DCOLL = *Deutsche Naturwissenschaftliche Sammlungen als integrierte Forschungsinfrastruktur* (German Natural Sciences Collections as an Integrated Research Infrastructure)

### *Further research infrastructures*

In addition to the collections, ZFMK operates various excellent research infrastructures which are also utilised by external users. It is very good and important that the various scientific services are continuously updated and optimised on the basis of ZFMK's own research.

The Molecular Laboratory provides all technical preconditions for comparative genomic, phylogenomic and metabarcoding work. The laboratory plays a significant role in the excellent and internationally leading infrastructure project GBOL (German Barcode of Life), in which a DNA barcode catalogue of the German fauna and flora is being developed. The consortium comprises more than 20 national museums and research institutions and is coordinated by ZFMK.

The Biobank is a specialised archive that complements the museums' other collections. Here ZFMK currently stores approx. 200,000 samples of animal DNA and fixed/viable tissue, including the GBOL samples (see above). Plans for expanding the biobank and relocating it to the envisaged new building are convincing. This will mean that what is already a unique biobank will become a highly visible special feature of ZFMK.

The High-Performance Computing Unit (HPC) is of major strategic importance to ZFMK. It provides adequate server facilities for genomic, phylogenomic, 3D-reconstruction, and collection data management applications.

The Morphology Laboratory that was established in 2018 enables the three-dimensional visualisation of computer tomography (CT) scans and histological sections. It also has an X-ray device, a scanning electron microscope (SEM) and two  $\mu$ -CT-scanners. This is also a service with high relevance for research at ZFMK.

### *Research*

On the basis of its collections and infrastructures, ZFMK regularly produces very good, in some cases excellent, research results. Activities range from basic taxonomic work via molecular biodiversity research to analyses of species communities using metabarcoding approaches and method development in these fields. ZFMK scientists are also engaged in evolutionary studies of phenotypic change using 3D-reconstructions. The biodiversity informatics team at ZFMK develops novel digitisation strategies and performs theoretical work in biodiversity data science.

Special mention should be made of achievements in the field of insect genomics, which have received much international attention and have generated many excellent subsequent activities, also outside of ZFMK. The institute significantly contributed to capacity building by initiating and coordinating collaborative work in this field. One international key collaborative project headed by ZFMK is 1KITE. The consortium aims to trace the evolutionary history of insects to an unprecedented extent.

With regard to publishing research results, ZFMK pursues a convincing strategy. On the one hand it publishes in traditional taxonomic journals whilst, on the other, articles regularly appear in high-ranking and more multi-disciplinary journals.

### *Exhibitions and knowledge transfer*

ZFMK presents its collections and research output, above all, through its permanent and special exhibitions in the museum. One very comprehensive project that has been realised in recent years is the permanent exhibition “Our Blue Planet”. It is divided into five parts, focussing on different biota (Arctic & Antarctic, Central Europe, Desert, Rainforest and Savannah). Currently, the exhibition focussing on the second part of the rainforest is under construction and should be finished in 2021. It is positive that ZFMK has been able to further increase visitor numbers to its exhibitions since the last evaluation (from 80,000 in 2013 to 105,000 in 2018). Not least due to a very attractive temporary dinosaur exhibition, 167,000 visitors were attracted to visit in 2019. ZFMK’s exhibitions are very interesting; the museum should, however, use significantly more innovative approaches to communicate knowledge. To test the effectiveness of exhibitions and other formats, ZFMK should intensify efforts in visitor research (see recommendation below). The creation of innovative approaches could be promoted by an intensified staff exchange with other internationally leading museums, e. g. via guest stays.

In addition to the exhibitions, ZFMK develops very good educational programmes, for example for local schools and kindergartens. Special mention should be made of the School of Taxonomy which offers high school students a first hands-on experience of taxonomy, supervised by scientists. The funding made available in the context of the Action Plan of the Leibniz Research Museums has also enabled ZFMK to conduct further transfer activities, such as organising major conferences like the National Conference of Species that was held in Berlin in 2016 and in Bonn in 2019.

**Since the last evaluation, ZFMK has improved its performance regarding the exhibitions and transfer activities. However, ZFMK has not yet reached the high level of other international natural history museums. It is recommended to develop a more ambitious strategy for developing innovative exhibition and presentation formats, including ways to communicate results from the extremely interesting research in molecular biology. Visitor research should also be intensified as well as the quest for new formats to engage the public in science. In addition to the cooperation with the University of Bonn, there are also good collaborative opportunities within the Leibniz Association (IWM Tübingen, MfN Berlin, DM Munich). In order to progress in these fields, it will be necessary to dedicate more and adequate resources to the work on exhibitions and knowledge transfer from existing institutional funding or third-party acquisitions.**

## 3. Changes and planning

### **Development since the previous evaluation**

ZFMK continues to engage in a major restructuring process. Having been an institution of the *Land* North Rhine-Westphalia, the museum became a legally independent foundation shortly before the previous evaluation in 2013. This led to a more autonomous steering of the ZFMK by its director, the Scientific Advisory Board and the newly established Board of Trustees. At the evaluation 2013 it had also been recommended to consolidate the three

centres in existence at that time. To enable this, joint funding from Federal and *Länder* governments was increased by EUR 1.5m per year beginning 2017. ZFMK used this additional funding to create 28 new positions, largely in the laboratories. At the same time, plans were made for an additional research building that is now due to be completed in 2022.

At the previous evaluation, ZFMK also presented expansion plans for a new fourth centre, which involved financial needs. In the Senate's view at that time, these plans were not sufficiently embedded in the overall strategic framework and were not to be pursued further. In the following years, ZFMK's former director significantly advanced the concept to create a new Centre for Biodiversity Monitoring (zbm), which was finally established in 2019. ZFMK used its own resources and raised extensive third-party funding to finance zbm. Currently, appointment procedures to fill the leadership position as a joint professorship (W3) with the University of Bonn are ongoing.

At executive level, ZFMK is also in a transition phase. The former director of ZFMK retired in July 2019. The deputy director and head of zmb was initially appointed as acting director. In May 2020, shortly after the evaluation visit, he was appointed as ZFMK's new director, following a competitive international call for applications. As a result, the position he originally held as head of a centre became vacant. As planned, this position is now supposed to be quickly refilled as a joint W3 professorship with the University of Bonn. ZFMK has presented plans for establishing a new fifth Centre of Computational Biodiversity Research (zcb) and reinforcing the existing four centres. In summary, ZFMK plans to create 44 new positions, including two additional W3 and two W2 professorships (see recommendation below for an assessment of these plans).

### **Strategic work planning for the coming years**

Independently of the current evaluation by the Senate of the Leibniz Association, the Federal and *Länder* governments decided in June 2020 on the basis of an evaluation by the German Council of Science and Humanities (*Wissenschaftsrat*) to integrate the Center of Natural History (CeNak) at the University of Hamburg into ZFMK, establishing a new "Leibniz Institute for the Analysis of Biodiversity Change" (LIB) located in Bonn and Hamburg from 1 January 2021. The ZFMK director is scheduled to become Director General of LIB which will be headquartered in Bonn. The part of LIB in Bonn will consist of ZFMK in its current form and an additional 8.5 FTE for administration, networking and coordination. The part of LIB in Hamburg will consist of CeNak and additional 37.5 FTE.

### **Planning for additional funds deriving from institutional funding**

**Using additional funding from the Federal and *Länder* Governments (approx. EUR 5 m per year), ZFMK plans to establish a new fifth Centre of Computational Biodiversity Research (zcb). According to ZFMK, the establishment of the new centre necessitates a number of structural improvements within the existing four centres.** The personnel costs total approx. EUR 4 m. In addition, ZFMK envisages approx. EUR 0.5 m for infrastructures and approx. EUR 0.4 m for management costs. Overall costs thus total approx. EUR



5 m per year. In order to finance the measure, ZFMK plans to apply for additional permanent funding from the Federal and *Länder* Governments (minor extraordinary item of expenditure of a scientific-strategic nature) from 2022 onwards. ZFMK itself will contribute EUR 0.22 m from its own budget, leaving a shortfall of approx. EUR 4.7 m per year.

**With regard to planning (see Status Report, p. A-9 for details), the following should be noted:**

- **The plans to develop the new zcb with ten additional positions (including one W3 and one W2 professorship) are coherent and are endorsed. Establishing zcb on the basis of existing expertise will enable ZFMK to assume a leading international role in biodiversity information management, a field that is constantly gaining in importance.**
- **The plans to establish a position of head of zte to be recruited in a joint appointment with a university (W3 professorship) and to expand zte by 17 additional positions are also coherent and endorsed. These positions will provide the necessary strengthening of the zte, in good complementarity to the zcb.**
- **Regarding the zbm, ZFMK should now conclude the ongoing appointment procedure for the centre head. The new head should continue to develop zbm, taking into account the recommendations of this evaluation with respect to the strategy of this centre (see chapter 7) . The presented plans for expanding zbm by six additional positions (including one W2 professorship) were not sufficiently elaborated for endorsement.**
- **The request to create six additional positions in IT administration and five additional positions in the administration is currently not sufficiently justified.**

**During the site visit ZFMK presented a revised timetable to extend the realisation of its plans being evaluated here. This revised timetable should be included in the final proposal for the additional funding requested from the Federal and *Länder* governments.**

**When evaluating this proposal, the responsible bodies should also consider to what extent the expansion plans can be implemented in parallel with integrating CeNak.**

## 4. Controlling and quality management

### Facilities, equipment and funding

#### *Funding*

In the period 2017 to 2019, ZFMK had an average annual income of EUR 11.5 m for day-to-day operations composed of EUR 7 m in institutional funding from the Federal and *Länder* Governments, EUR 2.6 m from the *Land* of North Rhine-Westphalia for museum specific tasks, EUR 1.6 m from project grants and EUR 0.3 m from ticket sales. The proportion of third-party funding (project grants and tickets) thus accounted for 16.5 percent of the

overall budget or 21 percent in relation to institutional funding from the Federal and *Länder* Governments.

In comparison with the previous evaluation, the revenue from project grants was distributed differently amongst the funding sources. Income from DFG-funded projects dropped whilst income from Federal and *Länder* Governments, the Leibniz Association and the EU went up. **As planned, ZFMK should aim to continue increasing revenue from project grants, primarily from DFG and EU. It is welcomed that ZFMK achieved higher funding amounts in 2019 than in previous years.** ZFMK should seek to initiate and head further major collaborative projects like the BMBF-funded German Barcode of Life (GBOL) consortium.

#### *Facilities and equipment*

ZFMK can boast excellent equipment and infrastructures (see Chapter 2). It is welcomed that the space situation will be significantly improved by the new building to be erected on the University of Bonn campus. There is particularly urgent need for action with regard to accommodating some of the sub-collections (see Chapter 2). It is welcomed that ZFMK takes account of sustainability aspects in its plan for the new building.

#### **Organisational and operational structure**

ZFMK's organisational structure is commensurate with its portfolio. Appropriate discussion and event formats have been established for decision-making and implementation purposes, both with regard to strategic issues and day-to-day scientific operations. They include, for example, the weekly Monday staff meeting at which anybody can ask questions and present new ideas as well as the annual Personnel Assembly at which long-term structural changes and their implications for the staff are discussed.

#### **Quality Management**

ZFMK employs appropriate measures and structures for internal quality management. Rules to ensure good scientific practice have been implemented, based on the rules recommended by the DFG and later by the Leibniz Association. ZFMK has an ombudsperson for good scientific practice. Quality management includes measures relating to third-party funding applications and publications. The museum actively supports publishing in open access journals.

ZFMK operates its own research information system to document its products and activities. It includes a performance evaluation system for internal use; each scientist undergoes a performance evaluation every second year. In compliance with DFG regulations, ZFMK provides primary data backup for all ZFMK projects.

#### **Quality management by Scientific Advisory Board and Supervisory Board**

The Scientific Advisory Board fulfils its function as an external advisory body in a fully satisfactory way. In 2019, it conducted the audit usually held at Leibniz institutes between evaluations. Particularly with regard to digitisation, the Advisory Board has repeatedly made important recommendations that have led to improvements.

The Board of Trustees also fulfils its role as a supervisory board in a fully satisfactory way. As planned, when the next amendment is made to ZFMK's establishment act, the chairperson of the Scientific Advisory Board should be included into the Board of Trustees as a non-voting member.

## 5. Human Resources

### Management

ZFMK is well managed by the new director, who has been Managing Director since 2019, and the Head of Administration, who is legally responsible for the budget. Together they very successfully developed the institute in the past years during a phase of gradual growth. ZFMK is now facing another, much more fundamental phase of change with the by now decided integration of the Center of Natural History (CeNak) and the completion of the new research building in Bonn in 2022. It will be a challenge for ZFMK's management to steer this process while at the same time run the usual day-to-day business of the museum.

In addition to their scientific work, the heads of the centres also carry out their organisational duties very well. Appointments of leading scientific and administrative staff follow the guidelines set out by the Leibniz Association. All senior positions at institute and departmental management level are advertised publicly and internationally. The same principle applies to all third-level appointments (section heads) for which internal selection committees are formed. All positions as section heads are tenure-track positions.

### Postdoctoral staff

Postdocs are very well supported at ZFMK. The outstanding collections and scientific infrastructures offer postdocs excellent opportunities for development. They also benefit from appropriate opportunities for further training. As of 31 December 2019, 17 postdocs worked at ZFMK, five of them with fellowships.

It is welcomed that ZFMK successfully supported a young scientist to obtain external funding for a junior research group under the Leibniz Competition. Given the excellent conditions at the museum, ZFMK should strive to increase the number of junior research groups through third-party funding, such as the DFG's Emmy Noether Programme, or the core budget.

It is welcomed that two researchers have completed habilitations at the University of Bonn since the previous evaluation. One of them accepted an appointment to a W3 professorship at the University of Freiburg i. Brsg. in 2016.

### Doctoral candidates

In comparison with the previous evaluation, the number of doctorates completed has dropped (from 19 between 2009 and 2011 to 11 between 2017 and 2019). This is partly due to the fact that a few major research projects had been concluded just before the previous evaluation implying that on the reporting date of 30 June 2012 only six PhD candidates were working at ZFMK. In contrast, many projects are currently ongoing which means that on the

reporting date of 31 December 2019 a total of 15 PhD candidates were working at ZFMK (including five fellowship recipients). Nevertheless, **ZFMK should increase the number of doctoral candidates and thus also the number of degrees completed. Various third-party projects that are planned and for which funding applications have already been submitted should make this viable. Furthermore, ZFMK should seek to optimize the timing of doctoral projects in such a way that, over the years, the number of supervisions and degrees fluctuates less.**

The supervision of doctoral candidates is well structured. It is welcomed that in 2019, ZFMK established an International Graduate School (ZIGS) from its own resources. It originated in the Leibniz Graduate School on Genomic Biodiversity Research, which was acquired under the Leibniz Competition and received funding of EUR 1 m between 2013 and 2016. The ZIGS programme comprises nine obligatory and 30 additional facultative courses and modules. Every candidate is assigned a Thesis Supervision Committee. A supervision agreement outlines the timeline of the PhD course and clarifies the rights and duties of all parties. An internal advisory board accompanies the development of the graduate school.

### **Technical and non-scientific staff**

In conversations during the site visit, staff members in the area of scientific support (laboratories, taxidermy, IT etc.) and in the administration expressed both, a high level of dedication to their work, and also great satisfaction with their working conditions. It is welcomed that ZFMK offers traineeships in carpentry, event management, management assistance in office communication and IT. Between 2017 and 2019, ZFMK successfully trained three apprentices.

One special feature of the museum is its relatively large number of taxidermists whose special expertise forms an important intersection between taxonomic research and the exhibitions. It is, therefore, very good that a traineeship was filled in this area in 2019, as well. ZFMK should examine whether its particular expertise in this comparatively small but very important area could be integrated in more broadly-based training structures, possibly in agreement with collaborative partners.

ZFMK offers service and administrative staff appropriate opportunities for further training. It should examine to what extent career development steps could also be defined for this group of staff who are largely permanently employed at ZFMK.

### **Equal opportunities and work-life balance**

#### *Equal opportunities*

Since the previous evaluation, ZFMK has managed to increase the proportion of women employed in research and scientific services from 26 percent (13 out of 50) to 37 percent (20 out of 54). As of 31 December 2019, one of the five leading scientists (acting director and head of zmb, 4 department heads) was female. Out of 17 section heads, four were female. In non-executive positions, 11 out of 19 were female. Two of the ten doctoral candidates employed at ZFMK were women.

It is welcomed that ZFMK has introduced the cascade model recommended by the Leibniz Association. The Margarethe Koenig Award, which funds female postdoctoral junior researchers for a year, is a concrete measure to promote women. It has been granted by ZFMK four times since 2012 at irregular intervals. It is welcomed that, this year, the award has been opened up to external female researchers. For the first time, it has been granted to a foreign researcher.

**ZFMK has managed to increase the proportion of female researchers since the previous evaluation. This positive development should be continued, especially on the level of leading scientific positions. The forthcoming joint appointment procedures with universities provide a good opportunity.** ZFMK should also increase the proportion of female doctoral students.

ZFMK implemented various measures to promote the inclusion of people with disabilities and the support of their professional development. The success of these measures is shown by the high number of 13 disabled people working at ZFMK in 2019. The measures also extend to visitors as the complete exhibition area is accessible to people with disabilities.

#### *Compatibility of family and career*

ZFMK offers its staff appropriate tools to reconcile work and family life. The museum has a parent-child workspace and supports young families by operating flexible working hours and allowing staff to work from home. ZFMK also cooperates with the Dual Career Office at the university and helps staff find suitable housing, kindergardens and schools. In 2019, the effectiveness of these measures was recognised when the audit process *berufundfamilie* (work and family) awarded ZFMK certification.

## 6. Cooperation and environment

### **Cooperation with the University of Bonn**

ZFMK cooperates closely with the University of Bonn. Besides the director, to date, ZFMK has the opportunity to jointly appoint two of the four heads of centre to professorships (W3) at the university. The leadership positions of both zmb and zbm are currently vacant; appointment procedures are ongoing or due to be launched. In the context of the planned expansion, further joint appointments are foreseen (see Chapter 2).

ZFMK staff are involved in teaching at the University of Bonn. In particular, ZFMK is engaged in the international MSc programme in Organismic Biology, Evolutionary Biology and Palaeobiology (OEP). Research cooperation takes place in various individual projects. It is to be expected that cooperation will be strengthened by the new ZFMK building on the university campus.

### **Other national collaborations**

ZFMK cooperates with the seven other research museums in the Leibniz Association, especially the two natural history museums, Museum für Naturkunde Berlin (MfN) and Sencken-

berg Museum Frankfurt/Main (SGN). Joint activities take place, above all, in the form of outreach events financed in the context of the BMBF-funded “Action Plan of the Leibniz Research Museums”, such as organising the Conference of Species and the Global Summit of Research Museums.

ZFMK is one of the founding members of the Leibniz Research Alliance on Biodiversity, which pools competencies and resources of 20 Leibniz institutes in order to develop solutions for the conservation of biodiversity. The joint project INPEDIV (see zbm, Chapter 7) resulted from cooperation within the Alliance. The project partners include MfN, SGN and the Leibniz Centre for Agricultural Landscape Research (ZALF).

Furthermore, ZFMK cooperates well with the University of Giessen in the field of biodiversity monitoring through the projects AMMOD and DINA (see zbm, Chapter 7).

### **National networks**

In the field of ecological biodiversity change and monitoring ZFMK co-founded and coordinated the projects “German Barcode of Life” (GBOL I, II, III). In this national consortium of over 20 museums and research institutions, a DNA barcode catalogue of German fauna and flora was developed as a prerequisite for automated species detection via metabarcoding of environmental samples. GBOL III starts in 2020 and will integrate aspects of species discovery, taxonomy and DNA barcoding of largely neglected insect groups (dark taxa).

ZFMK is also a partner in the DCOLL initiative<sup>2</sup> consortium, which unites seven partner institutions, including four Leibniz institutes. It aims to mobilise, structure, interlink and make openly available those data of natural science collections in Germany, which are currently difficult to access.

### **International collaborations**

Close institutional collaboration spanning many years exists with Ilia State University (ISU) in Tbilisi (Georgia). As early as 2006, a Memorandum of Understanding was signed regarding joint projects and mutual visits. In the context of this collaboration, Georgian students and young scientists are given training in methods of biodiversity research including field-work methods. In its turn, ZFMK has access to a region of high biodiversity. In 2007, the first molecular laboratory in the Caucasus region was jointly developed. This continuous cooperation has led to a collaborative project funded by the BMBF and launched in 2020, the Caucasus Barcode of Life (CaBOL), in which other partners from Germany and the Caucasus are also involved.

In addition, further international collaborations exist as part of major networks like the “Synthesis for Systematic Resources” (SYNTHESSYS+) consortium, funded by the European Commission, which comprises 114 organisations. SYNTHESSYS+ creates an integrated infrastructure for natural history collections and forms one element of “DiSSCo - the Distributed Sys-

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<sup>2</sup> DCOLL = *Deutsche Naturwissenschaftliche Sammlungen als integrierte Forschungsinfrastruktur* (German Natural Sciences Collections as an Integrated Research Infrastructure)

tem of Scientific Collections”, the European Research Infrastructure for natural science collections, under the umbrella of the European Strategy Forum on Research Infrastructures (ESFRI).

There are also various collaborations between individuals, documented by joint publications. ZFMK should examine whether further national and international institutional collaborations would be beneficial for strategically developing core areas at ZFMK. Topics might include, for instance, visitor research or biodiversity monitoring. In order to expand its international connections and visibility at all levels, ZFMK should, as planned, increase the percentage of foreign researchers on its staff.

## 7. Subdivisions of ZFMK

### **Centre for Taxonomy and Evolutionary Biology (zte)**

[34.66 FTE, thereof 20.23 FTE Research and scientific services, 1.7 FTE Doctoral candidates, and 13.78 FTE Service staff]

The Centre of Taxonomy and Evolutionary Biology (zte) is the largest centre at ZFMK, covering ZFMK’s classical collection and research activities. In the Arthropoda (arthropod) and Vertebrata (vertebrate) departments, a total of some 5.6 million zoological specimens are held for research and documentation purposes, which have attracted 533 visiting scientists since 2013. The valuable collections are constantly expanded in the context of worldwide research projects. The fact that ZFMK was recently admitted to the EU-funded SYNTHESYS+ Network is an indication of the significance and quality of the collections. However, the storage of certain sub-collections no longer conforms to current standards (see recommendation, Chapter 2).

With regard to digitising its collections, ZFMK pursues a convincing strategy, attaching importance to the quality of its digital reproductions and linking the choice of objects to be digitised to current research questions. It is welcomed that additional staff have been assigned to bioinformatics and that a new online portal (Digital Collection Catalogue) has been developed. It already enables access to data on more than one million specimens. To date, twelve percent of the entire collection has been digitised, whereby the proportion of the individual sub-collections ranges from 1.5 percent (Lepidoptera) to 100 percent (Myriapoda). In connection with its digitisation activities, ZFMK is upgrading the quality of the collections by various measures such as storage of frozen tissue samples, images, digital X-rays, CT-scan or SEM-data, data describing environmental context, preparations of micro anatomical structures or other parts of specimens, and cross-links to tissue and DNA vouchers in the ZFMK biobank. It is welcomed that ZFMK coordinates its activities in the DCOLL initiative<sup>3</sup> with seven partner institutions, including four Leibniz institutes. Moreover, ZFMK is involved in global initiatives like the Global Biodiversity Information Facility (GBIF) and Europeanana. The progress made in recent years must be continued and digitisation driven forward (see recommendation, Chapter 2).

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<sup>3</sup> DCOLL = *Deutsche Naturwissenschaftliche Sammlungen als integrierte Forschungsinfrastruktur* (German Natural Sciences Collections as an Integrated Research Infrastructure)

The work on collection management in the Centre for Taxonomy and Evolutionary Biology is rated as “very good”.

On the basis of the collections, zte undertakes extremely successful research. The curators are very good at linking collection work with research activities. In the research projects, the curators’ organismic expertise is very well combined with complementary competencies, whereby zte pursues a very broad, but nonetheless coherent, spectrum of topics. Alongside classical taxonomic research, for example, there is a focus on various evolutionary biology issues. zte also operates the morphology laboratory which provides morphological research equipment and expertise.

Special mention should be made of results in the field of butterfly phylogenomics which have delivered new knowledge on the evolutionary relationship of butterfly species. Further, very good work has been conducted in close cooperation with other ZFMK centres. Based on excellent work by zmb, for example, very good studies have been done in the field of insect genomics (see below). In 2017, the Junior Research Group “Ricefish” was also established in collaboration with zmb. It has produced very good results on the morphological and genomic foundations of the reproduction strategies of the Sulawesi ricefish. The group has received funding of approx. EUR 1 m up until 2021 under the Leibniz Competition. Additional research results in the field of freshwater species formed the foundation for the new permanent exhibition “Water – Life in Flow”, which zte conceived, built and curated in cooperation with zöa. It is very positive that zte has greatly intensified its networking within ZFMK since the previous evaluation.

zte’s publication record has improved since the previous evaluation and its publication strategy is convincing. On the one hand it publishes in traditional taxonomic journals whilst, on the other, articles regularly appear in high-ranking journals. Third-party income is also high. In addition to funding from the Federal and *Länder* Governments, projects are funded by the DFG, the Leibniz Association and the EU.

The research in the Centre for Taxonomy and Evolutionary Biology is rated as “very good to excellent”.

### **Centre for Molecular Biodiversity Research (zmb)**

[23.2 FTE, thereof 12.7 FTE Research and scientific services, 4.5 FTE Doctoral candidates, and 6 FTE Service staff]

The Centre for Molecular Biodiversity Research (zmb) was established in 2010. Its head, who successfully built up the centre, was made director of ZFMK in May 2020. zmb conducts excellent research and methods development in the field of molecular analysis of biodiversity with strong aspects in phylogenomics, comparative genomics, metabarcoding, and bioinformatics. Activities are based on its high-quality infrastructures, such as the tissue biobank, the molecular laboratory and the High Performance Computing (HPC) Unit that is operated together with the IT Department. It is very good and important that the various scientific services are continuously updated and optimised on the basis of ZFMK’s own research. Infrastructures, in particular, will benefit greatly from zmb’s planned move to the new building in 2022. The related plans for the prospective extension of the biobank are convincing, especially with regard to its use by external scientific institutions. This will mean



that what is already a unique biobank will become a highly visible special feature of ZFMK. Co-founded by ZFMK, the GBOL (German Barcode of Life, see Chapter 2) consortium is an excellent, key, research-based infrastructure project. Its outstanding work has been driven, in particular, by zmb whilst zte and zbm have also made important contributions.

In the field of basic research zmb can also boast various excellent results. Special mention should be made of achievements in the field of insect genomics, which have received much international attention and have generated many excellent subsequent activities, also outside of ZFMK. One key international collaborative project headed by ZFMK is 1KITE that aims to trace the evolutionary history of insects to an unprecedented extent. FOGS (Forensic Genetics for Species Protection) is another very good project on which ZFMK collaborates with a private commercial company and laboratory service provider in order to develop novel tools for the prosecution of the illegal trade in animals. From 2019 to 2023, FOGS has received funding of approx. EUR 1.5 m at ZFMK. It is also positive that the Junior Research Group Ricefish was established together with zte in 2017 (see above).

The publication record is excellent. Third-party income is also high. In addition to funding from the Federal and *Länder* Governments, projects are funded by the DFG and the Leibniz Association. The plans for continuing to develop zmb are convincing. With the establishment of the new Centre for Biodiversity Monitoring (zmb, see below), research positions in bio-monitoring will be transferred from zmb to zbm. In the future, research within zmb will focus on bioinformatics and genomic work and serve as a science and technology hub for zte and zbm.

It is crucial that the zmb headship, which has been vacant since May 2020, will be refilled as a joint W3 professorship with the University of Bonn.

The Centre for Molecular Biodiversity Research is rated as “excellent”.

### **Centre for Biodiversity Monitoring (zmb)**

[13 FTE, thereof 9 FTE Research and scientific services, 2 FTE Doctoral candidates, and 3 FTE Service staff]

The Centre for Biodiversity Monitoring (zmb) was established in 2019 and is thus still under construction. Currently, appointment procedures to fill the leadership position as a joint professorship with the University of Bonn are ongoing. The centre focusses on biodiversity change and monitoring and aims at innovative technological developments and application-oriented interdisciplinary research.

Some very promising and interrelated third-party projects have already been launched at zbm. In the context of AMMOD (Automated Multisensor station for Monitoring Of species Diversity), under the leadership of ZFMK's former director, for example, the very ambitious goal of developing novel technologies for the automated registration of biodiversity is being pursued. From 2019 to 2022, AMMOD has received funding from the BMBF at ZFMK of approx. EUR 1.5 m. DINA (Diversity of Insects in Nature-protected Areas) is another very good project, funded by the BMBF, in which ZFMK cooperates with the German Nature and Biodiversity Conservation Union (NABU – Naturschutzbund Deutschland e.V.) and other partners to understand the drivers of insect decline. A particular goal of this project is to demonstrate

the power of metabarcoding to efficiently assess insect fauna using the GBOL database (see zmb). From 2019 to 2022, DINA has received funding of approx. EUR 640 k at ZFMK. Furthermore, under the Leibniz Competition, zbm also acquired funding of approx. EUR 1 m from 2019 to 2022 for INPEDIV (Integrative analysis of the influence of pesticides and land use on biodiversity in Germany). The consortium is led by ZFMK and investigates the impact of organic and conventional farming on biodiversity in protected areas.

It is welcomed that even during the centre's development phase, account is being taken of the need for coordination with other institutions at home and abroad. Within the Consortium of European Taxonomic Facilities (CETAF), for example, zbm has established a CETAF Biodiversity Monitoring Group (CETAF BiodivMG) in order to develop a joint research agenda for biodiversity monitoring across Europe. In September 2019, ZFMK submitted the COST Action application "pan-European Network for harmonized BIOdiversity Monitoring" (ENBIOM) together with 35 partners from 13 European and four additional countries.

Establishing zbm at ZFMK is meaningful and is welcomed. Under the new head, greater attention should, however, be paid to establishing which user groups are the intended targets of the technologies developed in zbm. Moreover, on the basis of monitoring insect decline alone, greater account should be taken of developing concomitant avoidance strategies.

The Centre for Biodiversity Monitoring is rated as "good to very good".

### **Centre for Knowledge Transfer (zöa)**

[16.85 FTE, thereof 5 FTE Research and scientific services and 11.85 FTE Service staff]

The Centre for Knowledge Transfer (zöa) is responsible for exhibitions, public outreach and educational programmes. ZFMK presents its collections and research, above all, through its permanent and special exhibitions in the museum. The main project that has been realised in recent years is the permanent exhibition "Our Blue Planet" which focusses on five different biota (Arctic & Antarctic, Central Europe, Desert, Rainforest and Savannah). Currently, the exhibition focussing on the second part of the rainforest is under construction and should be finished in 2021. In collaboration with zte, the rainforest projects were preceded by collection trips to Gabon and Ghana. The very good permanent exhibition on freshwater with living animals was also a product of cooperation with zte. Special mention should be made of zöa's particular expertise in taxidermy (see Chapter 5).

It is positive that ZFMK has been able to further increase visitor numbers to its exhibitions since the last evaluation. The number of visitors grew from 80,000 in 2013 to 105,000 in 2018. Not least due to a very attractive temporary dinosaur exhibition, a figure of 167,000 visitors was even reached in 2019. ZFMK's exhibitions are very interesting; the museum should, however, use significantly more innovative approaches to communicating knowledge. Furthermore, only very few insights into ZFMK's typical and particularly important research in molecular biology in relation to evolutionary processes and biodiversity are offered.

In addition to the exhibitions, zöa develops very good educational programmes, for example for local schools and kindergartens. Special mention should be made of the School of

Taxonomy which offers senior school students their first hands-on experience of taxonomy, supervised by scientists. The funding made available in the context of the Action Plan of the Leibniz Research Museums has also enabled ZFMK to conduct further transfer activities, such as organising major conferences like the National Conference of Species that was held in Berlin in 2016 und in Bonn in 2019.

Overall, zöa has improved its performance since the previous evaluation. However, the opportunities for transferring ZFMK's collection and research activities to the public are not yet being fully exploited. In order to progress in these fields, it will be necessary to dedicate more and adequate resources to the work on exhibitions and knowledge transfer from existing institutional funding or third-party acquisitions (see recommendation, Chapter 2).

The Centre for Knowledge Transfer is rated as “good”.

## **8. Handling of recommendations of the last external evaluation**

ZFMK successfully addressed most of the recommendations made by the Leibniz Association Senate in 2013 (see Status Report, p. A-21f). The recommendation on gender equality still applies, even though the progress made since the last evaluation is acknowledged. Regarding exhibitions and knowledge transfer, progress has been made and visitor numbers increased. There is, however, still room for further improvement.

## Appendix

### 1. Review Board

*Chair (Member of the Leibniz Senate Evaluation Committee)*

**Wolfgang Cramer**

Institut Méditerranéen de Biodiversité et d'Ecologie Marine et Continentale/IMBE, Aix Marseille Université

*Deputy Chair (Member of the Leibniz Senate Evaluation Committee)*

**Volker Rodekamp**

Stadtgeschichtliches Museum Leipzig

*Reviewers*

**Heike Feldhaar**

Animal Population Ecology at the Department of Animal Ecology I, Bayreuth University

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**Sebastian Steinfartz**

Molecular Evolution and Systematics of Animals, Institute of Biology, University of Leipzig

absent with apologies

[Molecular Ecology]

absent with apologies

[Plant Systematics and Biodiversity]

*Representative of the Federal Government*

absent with apologies

Federal Ministry of Education and Research, Bonn

*Representative of the Länder Governments*

absent with apologies

Ministry for Science, Research and Culture Brandenburg

4 September 2020

**Annex C: Statement of the Institution on the Evaluation Report**

**Zoological Research Museum Alexander Koenig:  
Leibniz Institute for Animal Biodiversity, Bonn (ZFMK)**

The ZFMK appreciates the well balanced evaluation report which clearly highlights our achievements. We would like to express our sincere gratitude to the members of the evaluation panel and the SAE office for conducting the evaluation in a very constructive atmosphere and for taking up the challenges given by the Corona pandemic. The evaluation report clearly gives us feedback concerning the very positive development in the research departments of the museum and also clearly supports our proposed strategy of establishing a new Centre for Computational Biodiversity Research to be realized with a strategic small extraordinary expenditure. With the establishment of this centre we will be able to position ourselves at the forefront of natural history museums concerning an ever increasing relevance of open biodiversity data, research, and science transfer. We feel strongly supported to continue along that path. We will follow the recommendations in close cooperation with the Scientific Advisory Board and the Foundation Council. We would like to take the opportunity here to express our gratitude to the entire staff of the ZFMK which realized a perfect preparation of the evaluation.

Some of the recommendations have been addressed already and we would like to comment on these in short:

The evaluation panel remarks that the storage of certain sub-collections no longer conforms to current technical and safety standards. We have already developed a roadmap together with the ministry of culture and science (MKW NRW) to solve this situation.

The evaluation panel recommended to more strongly emphasize aspects of participation in our science transfer strategy. We very much appreciate these recommendations and can envision that our very successful transfer activities, for example, consistently increased visitor numbers, established long term relationships with our visitors, established education partnerships with schools, and developed the extremely successful format of taxonomy workshops, will further profit from the implementations of this recommendation. A comparative study of the effectiveness of the educational and exhibition programs of the Leibniz Research Museums, published after the ZFMK evaluation and therefore not available to the panel, shows the ZFMK leading in long term relationships with visitors, and additionally leading in effective science transfer as measured by visitor surveys. We would also like to point out that the ZFMK is leading in a national google visitor poll among all Leibniz Research Museum.