

18. März 2021

**Stellungnahme zum
Leibniz-Zentrum für Marine Tropenforschung, Bremen (ZMT)**

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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.¹

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. Ihr stand eine vom ZMT erstellte Evaluierungsunterlage zur Verfügung. Die wesentlichen Aussagen dieser Unterlage sind in der Darstellung (Anlage A dieser Stellungnahme) zusammengefasst.

Wegen der Corona-Pandemie musste der für den 5. und 6. Mai 2020 vorgesehene Evaluierungsbesuch am ZMT in Bremen abgesagt werden. Die Bewertung erfolgte im Rahmen eines schriftlichen Ersatzverfahrens, das der Senatsausschuss Evaluierung (SAE) am 17. April 2020 in Umsetzung eines Grundsatzbeschlusses des Senats der Leibniz-Gemeinschaft vom 31. März 2020 eingerichtet hatte. Der Senat hält im Grundsatzbeschluss fest, dass das Ersatzverfahren ein Notbehelf ist und ausschließlich auf Einrichtungen angewendet wird, die im Regelturnus von sieben Jahren evaluiert werden. Die Bewertungen, auf deren Grundlage der Senat Stellung nimmt, sind auf zentrale Kernfragen der Entwicklung und Perspektive einer Leibniz-Einrichtung fokussiert. Ausführliche Einschätzungen und Schlussvoten zu Teilbereichen und Planungen für „kleine strategische Sondertatbestände“ müssen regelmäßig entfallen.

Die Bewertungsgruppe erstellte den Bewertungsbericht (Anlage B). Das ZMT nahm dazu Stellung (Anlage C). Der Senat der Leibniz-Gemeinschaft verabschiedete am 18. März 2021 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 Leibniz-Zentrum für Marine Tropenforschung (ZMT) erforscht die Funktion tropischer und subtropischer Küstenökosysteme. Das Institut untersucht das Zusammenspiel der verschiedenen natürlichen und anthropogenen Prozesse in diesen Lebensräumen. Dabei verbindet es experimentelle Forschung und theoretische Modellierung. Das Ziel ist die Gewinnung von Erkenntnissen, die zur nachhaltigen Nutzung der dortigen Ressourcen führen. Neben der Forschung liegt deshalb der Schwerpunkt auf *capacity building* und Beratung in den Zielregionen.

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

Seit der vergangenen Evaluierung hat das ZMT wichtige wissenschaftliche Leistungen in Bezug auf geologische Prozesse und die Wirkung menschlichen Handelns auf Küstensysteme erbracht. Die **Ergebnisse** wurden wie empfohlen verstärkt in international hochrangigen Zeitschriften publiziert. Dieser Weg sollte konsequent weiterverfolgt werden. Eine große Rolle spielt die Mitwirkung in internationalen Forschungskonsortien wie der *All Atlantic Cooperation for Ocean Research and Innovation*, in der das Institut auch koordinierend tätig ist. Es wird begrüßt, dass das ZMT die Beteiligung an solchen langfristigen Großprojekten weiterhin als eine strategische Priorität ansieht. Die Arbeiten des ZMT sind für das Umweltmanagement in tropischen Küstenregionen von hoher Relevanz. In seinen Zielregionen erbringt das Institut wichtige Transferleistungen, insbesondere im Bereich des *capacity building*.

Das ZMT setzt einen breiten **interdisziplinären Ansatz** in enger Verbindung von Natur- und Sozialwissenschaften um, der für den Erfolg des Instituts sehr wichtig ist. Dafür ist die Abteilung „Sozialwissenschaften“ gleichberechtigt neben den Abteilungen „Biogeochemie und Geologie“, „Ökologie“ und „Theoretische Ökologie und Modellierung“ in der Struktur des Instituts verankert. Das ZMT sollte nun den eingeschlagenen Weg zu einer noch intensiveren methoden- und fächerübergreifenden Zusammenarbeit fortsetzen.

Vor diesem Hintergrund wird begrüßt, dass das ZMT derzeit mit zusätzlichen Mitteln der institutionellen Förderung eine Arbeitsgruppe *Data Science* und ein Datenportal, in dem erstmals Forschungsdaten aus den Sozialwissenschaften und der Meereskunde verknüpft werden, aufbaut. Dies eröffnet vielfältige Möglichkeiten zur Bearbeitung neuer interdisziplinärer Forschungsfragen. Die **strategische Arbeitsplanung** sieht außerdem den Aufbau von Forschungsgruppen zur Untersuchung von Adaptions- und Transformationsprozessen vor. Zu einer ersten Planung dieser Maßnahme für eine weitere Erhöhung der institutionellen Förderung gab die Bewertungsgruppe einige Hinweise. Wie das ZMT in der Institutsstellungnahme erläutert, hat das Land Bremen zum 1. Januar 2021 einen vom ZMT überarbeiteten Antrag in dem für Sondertatbestände vorgesehenen Verfahren bei der Gemeinsamen Wissenschaftskonferenz vorgelegt.

Das ZMT **kooperiert** mit vier Universitäten in gemeinsamen Berufungen. Ende 2020 waren jeweils drei Wissenschaftlerinnen und Wissenschaftler gemeinsam mit der Universität Bremen und der Jacobs Universität Bremen berufen sowie jeweils einer mit den Universitäten in Oldenburg und Kiel. Auch mit Partnerinstitutionen in tropischen Küstenregionen, mit den deutschen Meeresforschungseinrichtungen (KDM) sowie innerhalb der Leibniz-Gemeinschaft gibt es enge Verbindungen.

Der komplexe fachübergreifende Anspruch des ZMT und die inzwischen erreichte Größe des Instituts erfordern es, die **wissenschaftlichen Leitungspositionen** zu stärken. Das Institut und seine Gremien haben das erkannt und sehen grundlegende Veränderungen vor. Die derzeit vakante Institutsleitung wird nun als eigenständige Aufgabe besetzt und nicht mehr mit einer Abteilungsleitung verbunden; das Verfahren steht kurz vor dem Abschluss. Die Abteilungsleitungen sollen, so erläutern die für das ZMT zuständigen Fachressorts, künftig eine eigene personelle und finanzielle Verantwortung erhalten und nicht mehr aus dem Kreis der Gruppenleitungen rotierend bestimmt werden. Die dadurch deutlich aufgewerteten Positionen sollten künftig durchgehend, wie bereits im April 2020 in

einem Fall geschehen und nun für eine weitere Abteilung geplant, als eigenständige Aufgabe besetzt werden. Vor diesem Hintergrund ist es wichtig, dass der Kooperationsvertrag mit der Universität Bremen nun wie geplant zügig überarbeitet wird, um das Zusammenspiel bei gemeinsamen Berufungen für Leitungspositionen zu verbessern.

Die neue Institutsleitung wird ermutigt, gemeinsam mit den Abteilungsleitungen und unter Einbeziehung der Forschungsgruppen die Profilierung des ZMT weiter voranzutreiben und die dazu notwendigen organisatorischen Veränderungen am Institut zu gestalten. Der Senat bittet die neue Leitung, über die wissenschaftlich-strukturellen Planungen und die bereits eingeleiteten Maßnahmen zur Weiterentwicklung des Instituts bis zum 30. Juni 2023 zu berichten und den neuen Kooperationsvertrag zwischen ZMT und Universität Bremen beizufügen.

Der **wissenschaftliche Nachwuchs** wird durch die neu eingerichtete *ZMT Academy* in der Karriereentwicklung unterstützt. Es ist sehr positiv, dass sich die internationale Ausrichtung des ZMT auch in einem hohen Anteil ausländischer Beschäftigter, viele von ihnen aus den Tropen, widerspiegelt. Der Anteil von Frauen am wissenschaftlichen Personal lag Ende 2019 bei 54 %. Zwei der vier Abteilungen und sieben der 19 Arbeits- und Nachwuchsgruppen wurden von **Wissenschaftlerinnen** geleitet. Aufgrund der Vakanzen waren Ende 2020 am ZMT jedoch keine Wissenschaftlerinnen auf Abteilungsleitungsebene mehr tätig, und auf Gruppenleitungsebene waren es nur noch fünf. Die anstehenden Besetzungen sollten dazu genutzt werden, wieder zu einem höheren Anteil von Wissenschaftlerinnen auf Leitungsebene zu kommen, wie es das Institut auch vorsieht.

Die **Ausstattung** des ZMT mit Mitteln der institutionellen Förderung ist zur Erfüllung des derzeitigen Aufgabenspektrums auskömmlich. Der Anteil der Drittmittel am Gesamtbudget wurde seit der letzten Evaluierung empfehlungsgemäß erhöht und diversifiziert. Die bei der DFG eingeworbenen Mittel erreichen ein gutes Niveau. In seiner Stellungnahme weist das Institut auf eine mittlerweile erreichte Steigerung der EU Mittel hin. Es ist positiv, dass 2019 eine Einigung zur Finanzierung eines neuen Gebäudes erreicht wurde, welches die Abteilungen des Instituts an einem Standort zusammenführt. Es soll 2024 bezogen werden.

Die am ZMT verfolgte Verbindung von natur- und sozialwissenschaftlicher Forschung erlaubt es, die Prozesse in Ökosystemen ganzheitlich zu betrachten und Handlungsempfehlungen zu entwickeln. Diese langfristig und transdisziplinär angelegte grundlagen- und anwendungsorientierte Forschung zu Küstensystemen ist in dieser Form an einer Hochschule nicht möglich. Eine Eingliederung des ZMT in eine Hochschule wird daher nicht empfohlen. Das ZMT erfüllt die Anforderungen, die an eine Einrichtung von überregionaler Bedeutung und gesamtstaatlichem wissenschaftspolitischem Interesse zu stellen sind.

2. Zur Stellungnahme des ZMT

Der Senat begrüßt, dass das ZMT 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 ZMT als Einrichtung der Forschung und der wissenschaftlichen Infrastruktur auf der Grundlage der Ausführungsvereinbarung WGL weiter zu fördern.

Annex A: Status report

Leibniz Centre for Tropical Marine Research GmbH, Bremen (ZMT)

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1. Key data, structure and tasks

Key data

Year established:	1991
Admission to joint funding by Federal and <i>Länder</i> Governments:	2009
Admission to the Leibniz Association:	2009
Last statement by the Leibniz Senate:	2014
Legal form:	Limited liability company (GmbH)
Responsible department at <i>Länder</i> level:	Ministry of Science and Ports, Land Bremen
Responsible department at Federal level:	Federal Ministry for Education and Research

Total budget (2019)

- € 7.61m institutional funding
- € 2.85m revenue from project grants
- € 0.07m revenue from services

Number of staff (2019)

- 84 individuals in research and scientific services
- 28 individuals in service sector
- 15 individuals in administration

Mission and tasks

Statutory mission (quoted from “Articles of Association”):

„The institute has inter alia the following tasks: (i) interdisciplinary scientific research in priority areas of tropical marine ecology, and related fields, (ii) scientific evaluation of application projects in the field of tropical marine ecology and related fields, (iii) academic education and training in Germany and in tropical countries, (iv) transfer of research results, (v) provision of expert scientific advice, and (vi) provision of advice, particularly to the Free Hanseatic City of Bremen and the Federal Government on issues of marine research, particularly its expansion and development as well as on matters of scientific cooperation with countries in the tropics.“

Organisation

ZMT is organised in four Scientific Departments (Biogeochemistry and Geology, Ecology, Social Sciences, Theoretical Ecology and Modelling), complemented by a Research Infrastructure Department, and the Science Management. As of December 2019, the scientific departments were composed of 19 working groups and junior working groups (see Chapter 7). In order to facilitate the interdisciplinary work, ZMT activities are structured in crosscutting programme areas (see Chapter 2).

2. Overall concept, activities and results

ZMT has the vision to enable people in tropical coastal regions to live healthy, self-determined, and safe lives that offer them positive perspectives in terms of education and personal development. ZMT operationalises its vision by:

- conducting empirical research in the field and the laboratory
- supporting the development of academic structures in tropical coastal countries
- collecting, evaluating, and providing research data to the scientific community, as well as to policy- and decision-makers and the public
- offering academic training, in particular for doctoral candidates
- providing advice to industry, policy, and civil society in the field of sustainable use of tropical coastal ecosystems
- supporting the formation of South-South networks as a contact hub.

ZMT focuses on the coastal zones of the South Atlantic and Indonesia for long-term, large-scale collaboration while nurturing more partnerships on a smaller scale. Research at ZMT spans across various disciplines and methodologies in natural and social sciences ranging from ecology to biogeochemistry, geology, theoretical physics, mathematical modelling, geography, economics, sociology, and anthropology. The institute is structured in an interdisciplinary manner, with the overarching programme areas crosscutting the departments. In 2019, according to ZMT, 37% of all running projects had co-PIs from different departments, and 61% were characterised by interdepartmental collaborations.

Until 2019, ZMT had three programme areas: Impact of Change on Ecosystem Functioning and Services, Drivers and Effects of Coastal and Marine Governance and Use, and Strategic Management. The programme areas organise all ZMT activities. The institute developed this structure further into five programme areas, active from 2020 on. ZMT points out that all programme areas now implement an interdisciplinary view and inherently integrate ecosystems and societal issues.

- Programme Area 1 “Aquatic Resource Use and Protection” (PA1) aims to contribute to the scientific basis for the sustainable use of aquatic organisms for food production, feed, fertiliser, and other marine natural products.
- Programme Area 2 “Global Change Impacts and Social-Ecological Responses” (PA2) studies the causes and consequences of ecological, societal, and economic changes on a global scale (e.g. global warming, deoxygenation, global pollution, changes in policies and norms) that affect tropical coastal systems, including social-ecological feedbacks and interactions with climate.
- Programme Area 3 “Coastal Development and Hinterland Dynamics” (PA3) addresses the causes and consequences of human interventions in the coastal zone and its hinterland on matter fluxes, eutrophication, pollution, habitat and ecosystem distribution, diversity and wellbeing of organisms and people, ecosystem services, and socio-economic conditions and governance.

- Programme Area 4 “Knowledge Systems and Ecosystem Design” (PA4) generates knowledge to forecast future ecosystem services, creating a scientific basis for the concept of ecosystem design that entails the implementation of novel ecosystems in degraded areas to provide those ecosystems with prioritised services.
- Programme Area 5 “Strategic Management and Development” (PA5) coordinates knowledge exchange, consulting activities, and collaboration with non-scientific international and national partners and capacity development, which is realised by the Office for Knowledge Exchange (OKE), Public Relations (PR), and the ZMT Academy.

Activities and results

ZMT engages in research, capacity development, and knowledge transfer, including consulting activities.

Between 2017 and 2019, ZMT staff published on average 122 articles in peer-reviewed journals per year (half of which with open access), 13 individual contributions to edited volumes and 35 policy briefs, stakeholder and general reader’s publications (see Appendix 2).

The impact of ZMT's activities on academia and beyond is described in the brochure “*Concepts, Collaborations, Common Grounds – The Impact of Our Work Beyond Research and Academia*” (2019). Examples include the development of an academic infrastructure in Brazil, the ongoing scientific collaboration between the Red Sea countries Jordan and Israel, the scientific advice mechanism of the Benguela Current Commission in Southern Africa, and the establishment of a BSc course in Papua New Guinea.

Further examples that are suitable to map out the impact of completed projects:

In 2015, a workshop organised by ZMT involving the *German Marine Research Consortium* (KDM), the *French Marine Science Research Institute*, and South Atlantic riparian state representatives led to the signing of the Belém-Statement (2017) between the EU, Brazil, and South Africa to increase research and innovation cooperation and a subsequent call in the framework of *Blue Growth BG08*. ZMT leads two out of five work packages in the EU-funded *All Atlantic Cooperation for Ocean Research and Innovation* project that coordinates and supports the activities.

From 2012 to 2016, ZMT coordinated the third phase of the bilateral German-Indonesian research programme *Science for the Protection of Indonesian Coastal Ecosystems*. The overarching goals included understanding environmental impacts on coastal ecosystems and marine resources, and the effects of climate change on the ocean-atmosphere system, the carbon cycle and the monsoon system. 12 Indonesian and 14 German universities and research institutions conducted 32 projects, 17 of them led by ZMT scientists (subdivided into six topics, of which ZMT had phrased four topics). As a result, 134 peer-reviewed papers were published, and 17 BSc, 39 MSc, and 22 doctoral degrees were completed.

In the framework of their consulting activities, ZMT staff was contracted by the *Permanent Court of Arbitration* in The Hague to assess the environmental effects of construction activities on coral reefs in the South China Sea (2016). ZMT staff spoke to the mayor of Cape Town at the *Parliament of Western Cape* about the potential of groundwater usage in the

region (2018) and represented Germany at the *G7 Microplastic Science Advice Roundtable* in Washington (2019).

3. Changes and planning

Development since the previous evaluation

Since the last evaluation, the institute leadership was extended with the appointment of a managing director in 2017, who oversees ZMT jointly with the scientific director (see Chapter 5) and leads the Research Infrastructure Department.

ZMT has seen the following changes in the leadership of departments:

- 2019: new leadership of the Department of Ecology [Zimmer] with working group *Mangrove Ecology* in joint appointment with the University of Bremen (since 2014).
- 2016: new leadership of the Department of Social Sciences [Hornidge] with working group *Development and Knowledge Sociology* in joint appointment with the University of Bremen (since 2015).
- April 2020: new leadership of the Department of Theoretical Ecology and Modelling [Haerter] with working group *Complexity and Climate* in joint appointment with Jacobs University Bremen.

Changes in working groups:

- 2017: new working group *Reef Systems* in the Department of Ecology [Bejarano].
- 2019: new working group *Submarine Groundwater Discharge* in the Department of Biogeochemistry and Geology. Leadership [Moosdorf] in joint appointment with the University of Kiel. The working group builds on a previous junior research group [Moosdorf, 2014-2019] in the same department.
- 2019: new working group *Fish Ecology & Evolution* in the Department of Ecology. Leadership [Puebla] in joint appointment with the University of Oldenburg.
- May 2020 (planned): new working group *Data Science and Prediction* in the Department of Theoretical Ecology and Modelling, funded as part of DigiZ [Chennu] (see below).
- One working group in the Department of Biogeochemistry and Geology (*Group Dynamics and Wetland Biotopes*, 2016) and one working group in the Department of Ecology (*Coral Reef Ecology*, 2015) were concluded. One working group in the Department of Ecology and one working group in the Department Social Sciences are currently phasing out after the leader's retirement (2019) and the leader's appointment elsewhere (2020), respectively.

Changes in Junior research groups:

- 2013-2018: junior research group *Human agency, resilience, and diversity on coral reefs* [Ferse], funded by BMBF.

- 2014-2019: junior research group *Sea Level and Coastal Change* [Rovere], funded by the German Excellence Initiative.
- 2019: new junior research group *Coral Climatology* [Wu], funded by BMBF.
- 2019: new junior research group *Deliberation, Valuation, and Sustainability* [Fujitani], funded by BMBF.

As of April 2020, ZMT has 16 working groups and four junior research groups. In line with this expansion of research groups, ZMT has grown from 105 employees in 2012 to 127 in 2019 (excluding student assistants, trainees, and scholarship recipients).

In 2014, ZMT established the Office for Knowledge Exchange (OKE) with one core-funded position and varying third-party funded personnel to coordinate and target the interdisciplinary research and transfer activities. OKE's purpose is to initiate transdisciplinary dialogue and engage stakeholders within ZMT projects, develop ZMT capacities to work at the science-stakeholder interface, advise project leaders on transdisciplinary activities, acquire funds for transfer projects, and develop standards for knowledge exchange. To transfer ZMT's research results, OKE publishes policy briefs on sustainable management and use of coastal ecosystems aimed at policymakers in partner countries. Since 2016, OKE also supports transfer activities to the business sector, to international organisations, and to development cooperation. To guide ZMT's transfer activities, OKE published ZMT's *Transfer Strategy* and two internal handbooks on knowledge exchange and technology transfer as guidelines for ZMT staff.

To support doctoral candidates, postdoctoral and guest researchers, as well as alumni, ZMT established the ZMT Academy in 2018. The academy provides courses as part of a structured doctoral programme, but also services and trainings for personal and career development. ZMT set up an alumni database with the aim to maintain close relationships to its former students, researchers, and guests. ZMT points out that its alumni are an important asset for new project developments. As a result of alumni meetings, a consortium was formed to develop and submit a proposal for EU Horizon 2020 in 2019. ZMT alumni co-organise alumni events and in many cases secure funding for the events themselves.

ZMT describes its increased visibility as a partner for research and governance bodies in the tropics. The institute took part in agenda-setting processes and expert committees on both the national and the international level, such as the Roundtables of the Federal Government or the G7 Science Advice Roundtables. ZMT took on coordinating roles in academic networking processes and with stakeholders outside of academia. To increase visibility, the Public Relations group was enlarged from one to two science communicators.

Strategic work planning for the coming years

ZMT intends to reflect future scientific developments in the directional changes in new hires, successions, junior research groups, and additional working groups (funding to be applied for). A possible topic currently under close consideration is pollution.

ZMT faces two changes on the leadership level:

- The present scientific director at ZMT will pass on the directorate in July 2020. The search committee installed by the Supervisory Board has short-listed applicants.

ZMT expects the position to be filled in late 2020. The director will be hired as joint appointment with University of Bremen and will also lead a scientific working group.

- The head of the Department of Social Science left ZMT in March 2020. ZMT plans to refill the position.

In 2019, ZMT was granted additional permanent funding as part of the *Sondertatbestand DigiZ* (Digital ZMT) to establish the new scientific working group *Data Science and Prediction* in the Department of Theoretical Ecology and Modelling. The group leader has been selected in an open procedure and will take on his post in May 2020. ZMT aims to extend the available methods with this working group. Additionally, a new technical support group for research data management is planned as part of *DigiZ*. According to ZMT, the additional resources will allow researchers to combine large data sets from different disciplines and employ data science and geostatistical methods to investigate hypotheses about patterns of human-nature interactions. ZMT emphasizes the intention to facilitate open access to data, publications, and research procedures, as part of the *DigiZ* infrastructure. Planned elements include a research data portal, a research data app, a co-working platform, and a data storage system.

Planning for additional funds deriving from institutional funding

Ecosystems will transform and adapt to environmental changes, in consequence altering human-nature relationships. ZMT conducts pilot activities on the adaptation to environmental change and plans to extend these activities. For this purpose, the institute intends to apply for additional institutional funding (Extraordinary item of expenditure; *Sondertatbestand*) under the title "Adaptation to global Change, transformative Development and Civil society" (ACDC) to develop five new working groups. The Scientific Advisory Board and the Supervisory Board approved of presenting it to the evaluation board.

The groups will focus on the responses of organisms, species, and ecosystems to changing global environmental circumstances. Building on previous research experience from all departments, ZMT aims to develop active and transformative adaptation strategies in the new groups. In detail, the planning includes the following topics, working groups, and measures.

1. Anthropogenic Pressure: A working group Coastal Pollution will study the qualitative and quantitative nature of stressors derived from human activity in coastal ecosystems, including pollutants such as plastic, heavy metals, nutrients, and pharmaceutical agents.
1 x senior scientist (E14), 1 x scientist (E13), 1 x doctoral researcher (E13, 60%)
2. Natural Acclimatisation: A working group Molecular Acclimatisation will investigate the physiological, ecological, and behavioural responses to the above pressures through molecular biological approaches on various domains of life.
1 x senior scientist (E14), 1 x scientist (E13), 1 x doctoral researcher (E13, 60%)

3. Natural Biological Adaptation: A working group *Adaptation Modelling* will address the evolutionary response at the species level, as well as shifts in taxa at the community level.
1 x senior scientist (E14), 1 x scientist (E13), 1 x doctoral researcher (E13, 60%)
4. Assisted Biological Adaptation: A working group *Assisted Evolution* will focus on methods to increase the resilience of key ecosystem processes and services through actively modifying species or communities (e.g. transplanting individuals, exchanging symbionts, changing genomes and gene pools).
1 x professorship (W2), 1 x scientist (E13), 1 x doctoral researcher (E13, 60%)
5. Societal Transformative Development: A working group *Prioritisation* will focus on prioritisation mechanisms for ecosystem services and the development of transformative adaptation strategies to accomplish sustainable human-nature interactions.
1 x senior scientist (E14), 1 x scientist (E13), 1 x doctoral researcher (E13, 60%)
6. Additional support staff: 2 service positions for OKE, 1 service position for public relations, 7 technical service positions for laboratories, 1 diver, 1 drone pilot and data specialist.

These personnel costs sum up to € 757k for the starting year 2023. In addition, investments amounting to € 300k are planned for the starting year 2023. As incentive initiative, start-up funding will be provided for competitive internal funding for research projects. This initiative will sum up to € 200k in the first year and € 400k per year in the following years.

„Extraordinary item of expenditure“: summary of funds planning

	2023	2024	2025	2026	Permanently
Own funds + additional funds = „extraordinary item of expenditure“	€ 2342k	€ 2287k	€ 2334k	€ 2443k	€ 2500k
Own funds from existing funding by institution (at least 3 % of core budget)	€ 238k				
Additional funds of institutional funding	€ 2104k	€ 2049k	€ 2096k	€ 2205k	€ 2262k

4. Controlling and quality management

Facilities, equipment, and funding

Funding

In 2019, ZMT's revenue amounted to € 10.5 million, with € 7.6 million coming from institutional funding (see Appendix 3) and € 2.9 million from project grants (27 % of total revenue). These funds came from Federal and *Länder* governments (40 %), the DFG (18 %), the EU (14 %), and other sources.

Building

ZMT has long stated a need for a new building. The need for this new building was acknowledged in the last evaluation in 2013. The State of Bremen and the Federal Government decided on the financing of this new building in 2019. Completion of the construction process is planned for 2024 and ZMT expects the building to contribute to staff well-being, creativity, and productivity.

Facilities

ZMT's research facilities are organised in the Research Infrastructure Department (44.25 FTE), headed by the managing director. The facilities include the Marine Experimental Ecology Facility (MAREE), a flexible infrastructure of seawater aquaria and tanks for controlled experiments. Technical extensions added to the laboratory in 2016 allow for simulating pre-industrial, present-day, and future atmospheric CO₂ concentrations for ocean acidification experiments. The biology laboratory provides measurement facilities for enzymatic activity measurements, fatty acid and carbohydrates determination, and molecular biological and microbiological analyses. The instruments of the chemistry laboratory were extended since the last evaluation and laboratory staff attended advanced training courses. The geology laboratory prepares samples for scanning electron microscopy and X-Ray tomography and conducts the analysis. The laboratories provide preparation services for field campaign, online support during field stays, analytical work in the lab, quality assurance, and research data support.

ZMT's Scientific Diving Centre supports the planning and organisation of dive expeditions and provides equipment and certified divers where needed. As an essential element of ZMT's research activities, the centre enables observation and sampling activities in physiological studies, ecological field experiments and surveys, environmental data acquisition, and sedimentological as well as biogeochemical sampling. The centre supported research projects with more than 1000 dives between 2014 and 2019. ZMT points out that not a single dive-related accident or illness happened at ZMT while operating scientific diving expeditions. The diving centre offers scientific diving courses with a worldwide recognised qualification. The centre has trained and certified 65 scientists from 17 countries since 2013.

The MEDIA Unit (Management of Electronic resources, Data, Information, and open Access) and the IT Unit provide library, research data management, and information technology services. These services include an open access contact point (implemented in 2014) and central open access funding (established in 2017).

Organisational and operational structure

The Institute is a non-profit limited liability company (*gemeinnützige GmbH*) and is governed by three external bodies (the Shareholders' Meeting¹, the Supervisory Board, and the International Scientific Advisory Board) and one internal body (the Management). The

¹ The Shareholder's meeting decides, among other things, on amendments to the Articles of Association and the use of annual earnings (subject to approval by the Joint Science Conference)

Management includes the scientific director and the managing director, who are jointly responsible for internal disciplinary matters and external legal matters.

The scientific director and the managing director jointly take all strategic decisions with overarching scientific and financial relevance for the institute. They are supported by the Science Management, Public Relations, the Office for Knowledge Exchange, and the ZMT Academy (see Chapter 3). While the scientific director heads one research department, the other research department heads advise and support the directors on the course of future research and agenda-setting activities. The research agenda and the allocation of funding is managed via the Programme Budget, which is subject to approval by the Scientific Advisory Board and the Supervisory Board.

Within each department, the working group leaders are jointly responsible for the continued shaping of the research strategy. Each leader makes internal decisions concerning their respective working group. Decisions that affect several working groups are made by the directors after consultation with the department or the working groups' leaders, depending on the kind of decisions.

Quality Management

ZMT implemented a broad range of quality control measures to manage its activities. The Institute adopted the Leibniz Association's guidelines for good scientific practice. Internal documents describe the self-commitment of ZMT scientists.

The publication strategy reflects the aim of addressing a range of stakeholders in tropical countries with publications in high ranking international journals and spin-off products in local journals, stakeholder media, and with policy briefs. ZMT encourages its researchers to publish open access. In 2012, ZMT set up an archive for scientific data. Following a recommendation of the last evaluation, ZMT adopted an Open Data Policy in 2015. Research data is stored in the archive and – following quality-checks – submitted to sustainable information systems, which guarantee long-term availability of content through the commitment of the hosting institutions. ZMT plans for an open data portal to be established as part of the *DigiZ* infrastructure (see Chapter 3).

ZMT has established policies, procedures, and guidelines concerning fieldwork safety, laboratories and workshops, animal welfare, and administration. These measures include protocols and control mechanisms to ensure adherence to safety, ethical, and legal standards.

Quality management by advisory board and supervisory board

The Supervisory Board consists of up to eight members. The board is chaired by one representative of the State Government of Bremen, Ministry of Science and Ports (as chairperson) and a representative of the Federal Ministry for Education and Research (as vice chair). Further members are a representative of the University of Bremen and up to five other persons. The Supervisory board meets twice a year. The board is tasked with the supervision of ZMT's management, decisions on annual financial statements and pro-

gramme budgets, amendments of the Rules of Procedure, and the appointment of members of the International Scientific Advisory Board, of the directors, and the department leaders.

The International Scientific Advisory Board consists of up to nine renowned scientists from Germany and abroad, including scientists from tropical countries. The Scientific Advisory Board advises the Supervisory Board and the ZMT leadership on visions and perspectives of ZMT. The Scientific Advisory Board meets once a year for two days to assess the strategic plans of ZMT, to review the research agenda and the programme budget, and to evaluate internal proposals for core funding research. The Scientific Advisory Board audits ZMT at least once between external evaluations, most recently in 2017.

5. Human Resources

On December 31st, 2019, ZMT employed 127 persons (without student assistants, trainees, and scholarship recipients, see Appendix 4). 84 persons worked in research and scientific services (including 19 doctoral candidates), 28 in services, and 15 in administration (see Appendix 4). Additionally, on December 31st, 2019, ZMT hosted 22 scholarship recipients, 34 guest researchers, 5 trainees and 32 student assistants.

Leadership Level

The scientific director is hired by a procedure initiated by the Supervisory Board, which also decides about installing either a search committee or a joint commission. The procedure, following the Leibniz rules, involves a Leibniz representative appointed by the president of the Leibniz Association. The director is appointed for a five-year term with the option of renewed appointment. The current scientific director has led ZMT since 2010 and will serve until July 2020 (see Chapter 3).

The managing director is – at the same time – head of the Research Infrastructure Department and is hired for a five-year term with the option of renewed appointment. The current managing director was hired in 2017.

Department heads are appointed by the Supervisory Board upon recommendation by the Scientific Advisory Board for a five-year period with the option of renewed appointment. Scientific working group leaders are either appointed by joint commissions with universities (professors) or by internal procedures of ZMT (see Chapter 3 for changes on the leadership level). Of the 19 working group leaders, eight are jointly appointed as professors with a university (see Chapter 6). Before opening a position, ZMT negotiates the affiliations with the partner universities and the Supervisory Board is asked for approval. Appointment committees represent ZMT and the university and follow the rules of the university. Generally, a member of the Scientific Advisory Board of ZMT and external expert reports are included in the procedure. In specific cases, ad personam calls allow for appointment (i) in tenure track procedures of junior research group leaders, (ii) in specific programmes such as the female professorship programme of the Leibniz Association, or (iii) to attract extremely high-profile scientists such as ERC grantees.

Postdoctoral staff

As of December 2019, ZMT in its 19 research groups employed 27 postdoctoral researchers who completed their PhD in the last five years and hosted five postdoctoral researchers with scholarships. These postdocs receive tailored support services as part of the ZMT Academy. Postdocs' applications for a junior research group or their own research project are supported through peer advice, expert review, external training, and support in administrative matters. ZMT organises a yearly postdoc retreat and provides networking opportunities within and outside the Leibniz Association. Junior research group leaders additionally receive specific leadership training.

Tenure track procedures for professorial positions are rare given the size of ZMT. They are possible in the case of exceptionally successful junior research groups. A rigorous procedure of appointment with a university is a prerequisite. One junior ZMT scientist was successful in internal tenure track development since the last evaluation and now leads a working group in a joint professorial appointment. In addition, one ZMT postdoc achieved the position of a workgroup leader at ZMT in a competitive procedure.

ZMT points to the success of early postdoctoral researchers in the competition for follow-on positions at other research institutes or outside academia. For example, a former ZMT postdoc took over the position as Science Director at the Charles Darwin Foundation for the Galápagos Islands and another one accepted a professorial position at the University of Queensland in Brisbane.

Doctoral Candidates

As of December 31st, 2019, 36 doctoral candidates worked at ZMT, of which 19 were employed on a contract while 17 held a scholarship. 23 doctoral candidates came from abroad, the majority of them on a scholarship from DAAD or their national government. On average, 13.3 doctoral degrees were completed annually over the period 2017 – 2019.

ZMT's Doctoral Studies Programme was established in 2011 and integrated into the ZMT Academy in 2018. Each doctoral candidate is assigned one scientific supervisor and supervisory panel consisting of at least two further academic staff members from different ZMT departments. The panel and the doctoral candidate meet every 6-12 months to discuss progress and future directions. Each student has to attend mandatory courses and trainings. ZMT proposes a three-year timeline for successful completion of the doctorate. To enhance graduate students' career opportunities, ZMT organises a biannual Career Day to show career paths of alumni in the field of marine research outside academia.

Non-scientific staff

ZMT offers vocational training of IT specialists for system integration and assistants for media and information services. As of December 31st, 2019, five trainees worked at ZMT. Offers for advanced training range from professional and soft skills, to trainer qualifications, language courses, and customized specialist training.

Equal opportunities and work-life balance

As of December 31st, 2019, the proportion of women in “Research and Scientific Services” was 54%. In terms of individual scientific status groups, 64% of doctoral students (including scholarship holders) were female, while 37% of working group and junior research group leaders were women.

ZMT follows DFG's Research-Oriented Standards on Gender Equality and the Guidelines on Gender Equality in the Leibniz Association. In 2018, the institute was certified under the audit *berufundfamilie*. ZMT provides measures for a family-friendly environment and plans to advance its policies. The institute points to the intended introduction of additional measures to improve the equality in recruitment processes in science, and various aspects with regards to duty travels, including support for childcare during duty travels.

6. Cooperation and environment

ZMT cooperates with local universities on joint professorial appointments. As of December 2019, four joint appointments exist with the University of Bremen, two with the Jacobs University Bremen, one with the University of Kiel, and one with the University of Oldenburg.

As the institute points out, the collaborations with all partner universities include academic teaching. The international Master's programme ISATEC, tailored to the tropical coast zone and resource management, is offered jointly with the University of Bremen. The graduate schools located in Bremen collaborate with the ZMT Academy. ZMT staff offer courses and summer schools abroad and supervise the practical fieldwork of Master's students from external international MSc programmes. As a partner in the Bremen Research Alliance and in the German Excellence Cluster of the University of Bremen (MARUM: The Ocean Floor – Earth's Uncharted Interface) ZMT cooperates with local partners in research, transfer, and training activities.

The scientific director at ZMT served as scientific vice-president of the Leibniz Association during the period 2011 – 2017. Within the Leibniz Association, ZMT collaborates closely with other institutes in a wide range of disciplines such as the Leibniz Institute German Collection of Microorganisms and Cell Cultures DSMZ, the Leibniz Institute of Plant Biochemistry IPB, the Leibniz Centre for European Economic Research ZEW, and the Zoological Research Museum Alexander Koenig ZFMK. ZMT is represented in the groups or networks “*Sustainable Food Production and Healthy Nutrition*”, “*Biodiversity*”, “*INFECTIONS '21*”, and “*Crises in a Globalised World*”. Four projects under ZMT lead and two projects where ZMT was a partner have been successful in the competitive funding procedure of the Leibniz Association since 2013.

42 Memoranda of Understanding commit ZMT to research or joint funding acquisition initiatives with research institutions and universities in 24 countries. The collaborations include research projects, student exchange, education, stakeholder dialogue, and advice. ZMT regularly hosts foreign delegations and is actively involved with international organ-

isations addressing topics connected to coastal research, sustainability, and capacity development. Since 2008, ZMT strengthens its international ties by offering up to five scientists from developing countries fellowships for a three-month research stay at ZMT.

ZMT points out its cooperation with *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ). GIZ commissioned ZMT for projects with local partners in India, Brazil, and South Africa. The institute's international research collaborations led to the build-up of field stations, in Bragança (Brazil) and in central Java (Indonesia). Both field stations were operated in cooperation with local partners and are highlighted by the institute as prime examples of how ZMT can support infrastructure build-up and hand-over to local institutions. ZMT plans to extend its field stations in new collaborations with University Cheikh Anta Diop (UCAD Dakar) for the development of a multidisciplinary field station in the Sine-Saloum region of central coastal Senegal.

Institution's status in the specialist environment

The focus of ZMT is on interdisciplinary and holistically integrated research in and on coastal ecosystems in the tropics with an empirical methodology at the local level. ZMT aims to complement the canon of German marine research institutes that investigate climate change and water transport processes on a global scale, conduct open marine and polar research, as well as coastal research in extratropical regions (e.g. the Alfred Wegener Institute – Helmholtz Centre for Polar and Marine Research AWI, GEOMAR, Helmholtz Zentrum Geesthacht HZG, and the Potsdam Institute for Climate Change Impact PIK). Other institutes focus on comparative studies of ecosystems not bound to the tropics (e.g. Senckenberg am Meer Wilhelmshaven and the Leibniz Institute for Baltic Sea Research IOW).

Internationally, many institutes and universities work on similar aspects as ZMT but have either a more local, a less multidisciplinary, or a more applied approach. Local or regional research in particular in tropical countries is usually driven by the country's need to manage living resources along the coastlines and to support governance for their communities. For example, Labomar at Universidade Federal do Ceará (Fortaleza, Brazil) was founded as a laboratory for marine studies with a focus on the preservation of ecosystems and the analysis of environmental impacts.

Highly competitive institutions active in similar fields as ZMT include the Smithsonian Environmental Research Centre (SERC, Edgewater, Maryland, USA), which analyses environmental challenges in coastal ecosystems, and the Australian Institute of Marine Sciences (AIMS, Townsville, Queensland), which investigates marine biodiversity in Australia, impacts of and adaptation to climate change, water quality, and ecosystem health with a regional focus on Australia.

7. Subdivisions of ZMT

Department I – Biogeochemistry and Geology

(20.2 FTE, thereof 14 FTE Research and scientific services, 5.3 FTE Doctoral candidates, and 0.9 FTE Service staff)

The department investigates the physicochemical and biogeochemical effects of natural change and human activities. It focuses on changes in the abiotic environment in the present and the recent past, their interactions with the living world, and future trajectories. The research activities span from hinterland to coastal ecosystems and further to the ocean. Empirical, non-site-specific approaches driven by data acquisition are used with the aim to provide an integrative perspective of the land-ocean continuum. The department develops, calibrates, tests, and improves models and scenarios of future developments. The toolbox includes geospatial analyses, biogeochemical, sedimentological, geochemical, microbiological, and molecular analytical methods.

Two junior research groups at the department were concluded since the last evaluation, with one group leader taking on a position as working group leader at ZMT and the other group leader taking up a permanent position at the University of Bremen. One new third-party funded junior research group was established in 2019. One junior research group leader secured funding from Leibniz funding line promoting women in academic leadership positions for five years. With the conclusion of this funding in 2020, the group leader will leave the department to take up a professorial position at Hochschule Bremen in summer 2020.

The department's activities span across the globe. The research groups studied the role of coastal wetlands in carbon storage in Indonesia. In Costa Rica, on Galápagos, and off Mauritania the carbonate chemistry in reefs was investigated. Supplementing this field data with laboratory evidence collected in the ZMT laboratory MAREE, the department documented the influence of anthropogenic CO₂ uptake on the historical (past 300 years) disruption of coral growth by ocean acidification. The department conducted exchange programs to train students and early-career scientists from Indonesia and China in state-of-the-art analytical methods.

In the future, the department plans to intensify the research on pollution and adaptation. Additionally, the department aims to provide analyses of the attributes of the carbonate system or other water quality, ocean CO₂ uptake, and plastic pollution.

As of December 31st, 2019, the department consists of the following working groups (WG) and junior research groups (JRG):

- WG *Geoecology and Carbonate Sedimentology* (since 2010, 7 people) focuses on the effects of eutrophication, acidification, plastic pollution, sea-level change, and other factors that lead to shifts in carbonate-secreting biological communities. These factors have effects on services such as coastal protection and habitat provision.
- WG *Submarine Groundwater Discharge* (since 2019, 3 people) conducts research at all scales on the interaction between groundwater and ocean.
- WG *Ecological Biogeochemistry* (since 2010, 1 person) investigates the biogeochemical and ecological response to present and past environmental change.
- WG *Carbon and Nutrient Cycling* (since 2010, 2 people) studies factors controlling the spreading of oxygen minimum zones, CO₂ sink and the source functions of major coastal upwelling systems, effects of rising CO₂ level on benthic ecosystems, and the fate of carbon mobilised by tropical peat soil degradation.

- JRG *Tropical Marine Microbiology* (since 2012, 4 people) focuses on microbial community dynamics and the biological agents of biogeochemical processes, along with the impact on of anthropogenic and environmental change.
- JRG *Coral Climatology* (since 2019, 3 people) analyses isotopes and element signatures in long-living tropical corals for the reconstruction of climate and environmental change.

Over the period 2017 – 2019, the department published on average 43 articles in peer-reviewed journals as well as six working and discussion papers per year. During the period 2017 – 2019, the department's average yearly revenue from third-party funding was € 1.1 million, with € 700k from federal and *Länder* governments and € 316k from the Leibniz Association. On average, 3.7 department members received their doctoral degree and 0.7 their habilitation per year.

Department II – Ecology

(22.40 FTE, thereof 12.8 FTE Research and scientific services, 9.6 FTE Doctoral candidates, and 0.0 FTE Service staff)

In order to understand ecosystem processes and services and to deliver background information for the sustainable use and management of coastal resources and services, the department of Ecology measures responses to environmental changes at different organismic levels, including (i) the individual physiological level, (ii) the species and population level, and (iii) the community and ecosystem level, and how these responses are linked to changes in ecosystem processes and services. The aim is to predict future spatial distributions of species, ecosystems, and their services as a basis for science-based spatial conservation planning and prioritisation. The department combines field studies and manipulative experiments both in the field and in ZMT's MAREE laboratory. Methods from physiology, nutrient and element analysis organic chemistry, genetics and genomics, and environmental metabolomics are employed for ecosystem compartment analysis.

Three working groups underwent substantial changes since the last evaluation. In 2015, one working group leader took up a professorial position at the University of Bremen. Two working group leaders retired in 2014 and 2019, respectively, both positions having been refilled.

The group leadership changes have led to a re-orientation of the department towards covering the major assemblages of organisms along tropical coasts, and a re-focus on holistic perspectives on ecosystems. The department studied the role of pollution and eutrophication in coral reefs and the resulting effects on fish diversity and composition. Building on these studies, the department has further investigated resulting changes in the hydrodynamics of coastal habitats, and, therefore, drivers of transport and dynamics of organic matter. Studies conducted by the department identified mangrove crabs and herbivorous fish as important players in the basal ecosystem process. The department contributed to knowledge exchange within the scientific community by inviting the IUCN SSC-Mangrove Specialist Group to its annual workshop in 2017 and organizing an associated international symposium on Mangrove Ecology, Conservation, and Restoration.

In light of the planned institute extension, the department plans to focus more on the individual responses to environmental stressors and on assisted biological adaptation. Additionally, the department aims to continue its role in the programme areas with studies on macroalgal use, the degradation of vegetated coastal systems, marine and coastal fauna and flora, and ecosystem design.

As of December 31st, 2019, the department consists of the following working groups and junior research groups:

- WG *Mangrove Ecology* (since 2014, 7 people) studies how community composition and environmental conditions, in particular fluxes of materials into and out of mangrove sediments, drive ecosystem processes and services of mangroves.
- WG *Fish Ecology and Evolution* (since 2019, 2 people) investigates the ecology and evolution of fish in rapidly changing tropical marine ecosystems. The methods employed include high-throughput DNA sequencing, whole-genome and transcriptome sequencing, and metabarcoding of environmental DNA.
- WG *Reef Systems* (since 2017, 3 people) uses diverse integrated ecological datasets to understand how reef system functioning and services are eroded by perturbations and species loss or sustained and restored through management actions.
- WG *Experimental Aquaculture* (since 2010, 8 people) focuses on physiological acclimatisation and adaptation mechanisms of organisms to tropical conditions. Molecular methods, omics methods, as well as classical physiological methods such as oxygen consumption or photosynthesis measurements are used.
- WG *Fisheries Biology* (since 2010, retired in 2019, currently completing projects, 3 people) studies impacts of environmental change on individuals and populations of economically relevant fish, focusing on acclimation mechanisms and trophic relationship or connectivity, as well as large-scale changes in the structure of various tropical ecosystems.
- JRG *Algae and Seagrass Ecology* (since 2012, 4 people) addresses the interactions among seagrass and macroalgae and their community dynamics and performance under environmental change, linking functional traits of seagrasses to the environment and ecosystem functions and services.

The department's employees published an annual average of 44 articles in peer-reviewed journals and 7.3 working and discussion papers over the period 2017 – 2019. In the same period, average yearly revenues from project grants were € 665k, which were obtained predominantly from the DFG (€ 209k), the EU (€ 128k), Federal and *Länder* governments (€ 118k), and the Leibniz Association (€108k). 2.3 doctoral degrees were completed in the department on average every year.

Department III – Social Sciences

(14.2 FTE, thereof 9.7 FTE Research and scientific services, 4.5 FTE Doctoral candidates, and 0.0 FTE Service staff)

The department studies changing human-coastal relations by focusing on the interconnectedness of environmental change processes along tropical coasts with socio-political and economic transformation processes. The focus lies on the role of social actors and

actor constellations (i.e. networks, markets, types and degrees of inequalities), institutional structures, discourses, and political and economic regimes in marine and coastal resource governance and everyday life. The research aims for an empirically based understanding of the interrelated societal and ecological change processes along tropical coasts. The department groups employ quantitative and qualitative methods – including experiments, mental models, and grounded theory – as well as network analysis and multi-agent modelling. The research activities include comparative case studies, the estimation of statistical models and non-market valuation, and impact evaluation.

One working group and one junior research group were added to the department in 2015 and 2019, respectively. These groups extended the range of methods available in the department contributed to the interdisciplinary exchange at ZMT. The department projects combine expertise in sociology, economics, human geography, area studies, sustainability studies, and anthropology. The department staff showed how individual patience and willingness to cooperate relate to ecologically sustainable behaviour of fishers in Zanzibar. Projects addressed the geographic mobility and adaptation of practices and policies relating to environmental change in Singapore, Jakarta, and Manila. The department collaborates with practitioners to improve governance on the East African coast and to finance ecosystem services in Colombia.

The department leader has recently moved to DIE in Bonn as director, a replacement is planned. ZMT aims to further strengthen the department's activities with regards to institutional regime shifts, social-ecological network analyses and environmental change adaptation, transregional social learning processes, and behavioural change and decision support research.

The department is structured in the following working groups and junior research groups (as of December 31st, 2019):

- *WG Development and Knowledge Sociology* (since 2015, 6 people) conducts empirical local-level research projects to investigate marine and coastal epistemologies, processes to envision coastal futures through technology and infrastructure-based governance, and coastal transformation processes.
- *WG Institutional and Behavioural Economics* (since 2010, 5 people) studies the institutions that influence societal and economic behaviour of individuals and collectives in their everyday life with a particular focus on behaviour affecting coastal ecosystem use and management.
- *WG Social-ecological Systems Analysis* (since 2010, 4 people) investigates coastal livelihood dynamics and trajectories of social inequality development related to environmental change and policy interventions. Of particular interest is the role of social-ecological networks and the impact of potentially transformative innovations in tropical countries.
- *JRG Deliberation, Valuation and Sustainability* (since 2019, 1 person) examines the impact of coastal tourism in transdisciplinary collaboration with stakeholders by focusing on the interplay between different types of information, values, and deliberation in shaping perceptions and decisions.

Between 2017 and 2019, the department members published an annual average of 25 articles in peer-reviewed journals, 9 articles in edited volumes, and 7.7 working and discussion papers. The revenue from project grants in the same period averaged € 447k per year, which were obtained from DFG (€ 144k), federal and *Länder* governments (€ 119k), EU (€ 96k), and the Leibniz Association (€ 66k). 3.3 doctoral degrees were completed in the department on average every year.

Department IV – Theoretical Ecology and Modelling

(12.5 FTE, thereof 8.5 FTE Research and scientific services, 4 FTE Doctoral candidates, and 0.0 FTE Service staff)

The department develops theoretical models to study the interactions that affect coastal ecosystems and socio-economic communities. The considered factors in ecology range from sub-individual organismic processes to communities and ecosystems, while in meteorology the global as well as the molecular dissipation scale is considered. The department combines approaches from applied mathematics, statistical physics, and complex systems science with theoretical ecology, economics, and meteorology.

A new department leader took on the leadership of one working group recently joined the department. One additional working group is currently being set up.

The department's activities apply to environmental problems and interactions in the tropics. In applied projects, the department addressed the relationship between time preferences and the use of destructive fishing gear in Zanzibar. Research on the accumulation of plastic debris in coastal environments of southern Brazil and Senegal and the impact of plastic on seabirds depends on organismal traits. The department cooperates with regional actors and develops approaches for conceptual and technical data infrastructure towards science-based management of marine systems.

The new working group Data Science and Prediction aims to contribute to all ZMT research fields and will explore new data-gathering technologies, such as drones, and apply innovative approaches, such as deep-learning and pattern recognition approaches.

The following working groups were part of the department as of December 31st, 2019, or will soon be established:

- *WG Complexity and Climate* (from 04/2020 on) investigates convective cloud clustering and extreme weather events and links the effects to coastal socio-ecosystems. It develops theoretical models to better understand convective self-organisation and addresses climate impacts, especially from precipitation and storminess, on the local environment, with a particular emphasis on island environments.
- *WG Resource Management* (since 2010, 6 people) focuses on resource exploitation and sustainable fisheries management, taking into account the effects of resource use and or protection on the food web and social-ecological system dynamics. Research also includes the role of climate variability and change in regulating resource productivities.

- *WG Systems Ecology* (since 2010, 8 people) investigates the organisation of complex biological, ecological, and socio-economic systems and focuses on the relationship between biodiversity and ecosystem functioning, biogeochemical cycling of carbon, biogenic calcification and ocean acidification, the impact of pollution on marine megafauna, and the collapse of ancient societies.
- *WG Spatial Ecology and Interactions* (since 2010, 2 people) studies how actors respond to environmental change and how actor traits and behaviour affect self-organisation, functioning, and dynamics of a given ecosystem. Research focuses on coral reefs, coastal regions and habitats, and marine trophic nets.
- *WG Data Science and Prediction* (from 05/2020 on) will aim to understand the dynamics and to forecast the development of complex social-ecological systems based on heterogeneous and discontinuous data.

Between 2017 and 2019, the department members published an annual average of 29 articles in peer-reviewed journals and four policy briefs. The revenue from project grants in the same period averaged € 315k p.a., which were obtained from federal and *Länder* governments (€ 147k), DFG (€ 70k), DAAD (€ 58k), and GIZ (€ 32k). Four doctoral degrees were completed in the department on average every year.

8. Handling of recommendations from the previous evaluation

ZMT responded as follows to the seven recommendations of the last external evaluation (highlighted in italics, see also statement of the Senate of the Leibniz Association issued on 20th March 2014, pages B-2/B-3):

- 1) *“The continued growth ZMT is planning must be based on more concrete department-spanning objectives and be defined, above all, in terms of quality and a clearly defined research focus. To achieve this, the departments must draw up further joint research hypotheses that will drive the work of the institute as a whole and generate a long-term research perspective for ZMT. At the level of individual working groups the themes must be more clearly interrelated for this purpose and embedded in the department-spanning objectives.”*

ZMT strengthened its interdisciplinary approach by reshaping and refocussing the programme areas, all of which include all four scientific departments. ZMT highlights that in 2019, its yearly strategy retreat explicitly focussed on modes of interdisciplinarity. All work groups relate their work to the programme areas. Core budget-funded projects at ZMT require PIs from different departments. The departments collaborate in joint projects (see Chapter 2).

- 2) *“ZMT must also continue to sharpen its profile if it is to become even more visible as a significant partner in tropical marine ecology at the international level. To achieve this, both the discipline-based work in the departments and the interdisciplinary interaction must be systematically advanced and even more effectively coordinated. The social sciences have a particular role to play in this as it is their input that is helping the institute to acquire a unique tropical marine context-specific interdisciplinary character.”*

ZMT highlights reshaped programme areas and their contribution to the sharpened research profile along four interdisciplinary research lines across all four scientific departments. The discipline-based work within ZMT's departments has been strengthened. ZMT has acquired five third-party funded junior research groups and five professorships were (re-)filled. A new group on Data Science and Prediction will start in 2020 (see Chapter 3).

The Social Sciences actively contribute to all programme areas with empirical research and capacity development activities on questions of resources, governance, public discourses, and the link between ecological changes and social inequalities.

- 3) *“Building on its current research strategy, ZMT should improve its publication performance both in terms of quality and quantity.”*

ZMT's publication output has increased from 80 articles in peer-reviewed journals in the evaluation year 2013 to 125 articles in 2019 (see Appendix 2). This results in 2.97 publications per year per full-time equivalent employee (in research and scientific services, including only staff who hold a doctoral degree) in 2019 compared to 1.37 in 2013. The citations per year that the publications of ZMT received have increased from 1,698 in 2014 to 4,155 in 2019.

The average Impact Factor of ZMT according to the ISI Journal citation report is 3.917. In 2016, ZMT started a ZMT policy brief series supported and issued by the Office for Knowledge Exchange. Six briefs have been published so far.

- 4) *“As planned, it is wise for the institute to try to achieve greater diversity in its third-party funding. The proportion of DFG and EU funding, in particular, should be increased significantly. The ambitious plans to increase the proportion of third-party funding for research from currently approx. 14% to at least a third of the overall budget are meaningful and necessary in order to implement the institute's strategic goals. In this context, ZMT should try to convince funders of the major interdisciplinary added value of its social science approach for the natural science objectives addressed at the institute.”*

ZMT reached a stable level of third-party funding at around 25 percent of overall revenue (equates to 34% of the core funding), especially from DFG and EU, but also from BMBF and others (see Appendix 3). A support mechanism for proposal preparation has been implemented. Alternative funding sources are actively addressed to diversify the range of third-party funding. ZMT has participated in the BMBF-funded Enabling Innovation and Sectoral Development to improve contacts with industry. ZMT points to its participation in agenda-setting processes (see Chapter 3).

- 5) *“It is welcomed that the Land Bremen envisages the construction of a new building, which should be completed as soon as possible, as a lasting solution.”*

ZMT has entered the preparation phase for the new building (see Chapter 4).

- 6) *“The institute should make its data collections available to the scientific community via open access.”*

ZMT implemented an open access policy and an open data policy (see Chapter 4). Open access to publications increased from 25% in 2013 to 54% in 2019.

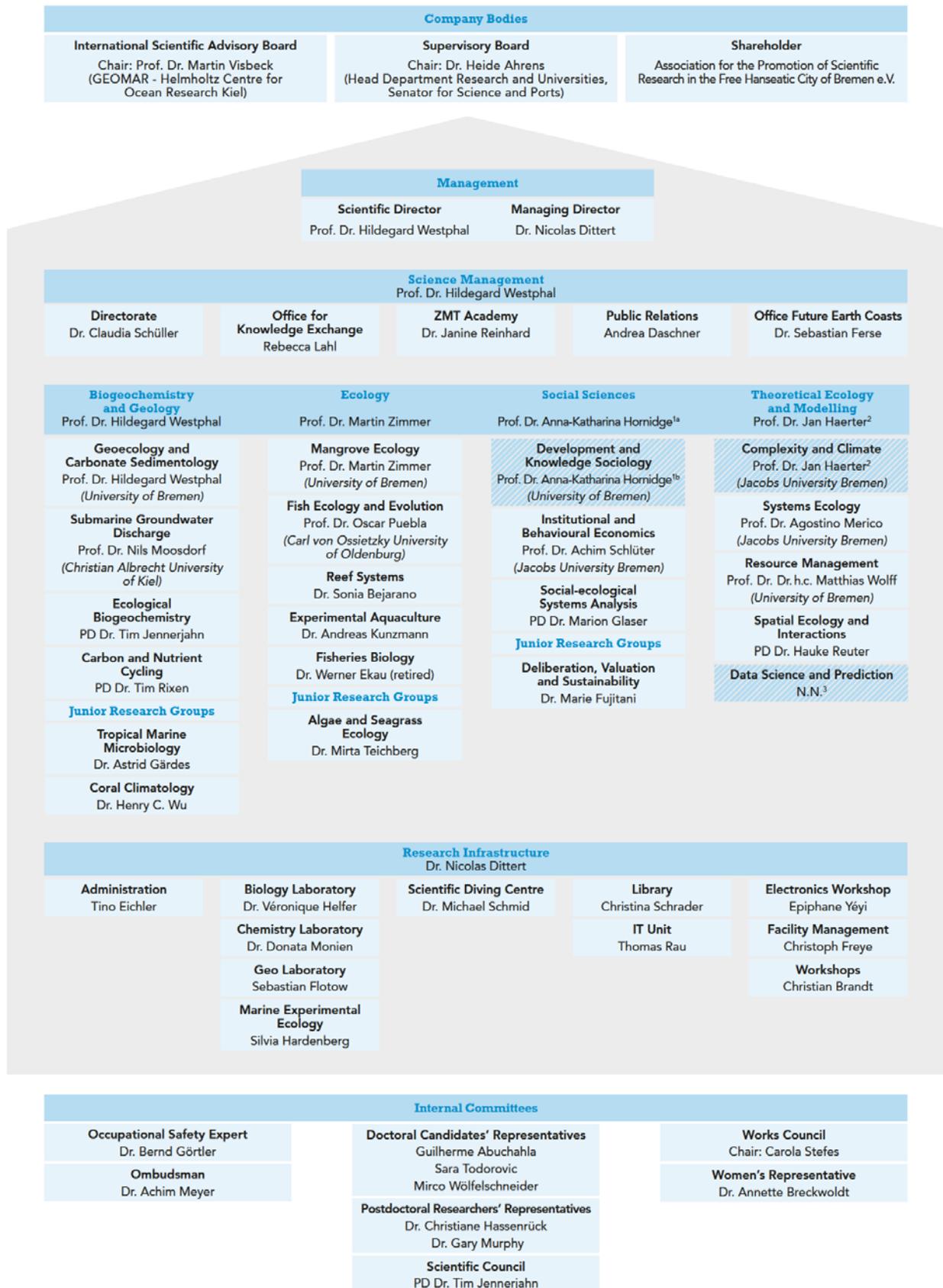
7) *“ZMT should continue increasing the number of trainees in order to fulfil the expectations of the Federal and Länder Governments vis-à-vis the Leibniz Association”*

The number of trainees increased from four in 2013 to five in 2019. Two laboratory staff will participate in the qualifying examination for training supervision (*Ausbilder-Eignungsprüfung*) to serve as the main training supervisors for trainees at ZMT.

ZMT aims to take on one trainee every two years in the MEDIA Unit and to reach a training proportion of 7% (trainees out of all employees; currently at 4%). Dual study courses in Computer Science (B.Sc.) were introduced in 2018 in cooperation with the Hochschule Bremen. Along with training opportunities in the chemistry and biology laboratories in cooperation with the University of Bremen, ZMT expects these opportunities to contribute to the targeted 7% training proportion.

Appendix 1

Organisational Chart



^{1a)} until 29/03/2020; followed by Prof. Dr. Achim Schlüter as interim department head

^{1b)} until 29/02/2020

²⁾ from 01/04/2020

³⁾ in final stages of hiring process

Appendix 2

Publications and expert reviews

	Period		
	2017	2018	2019
Total number of publications	177	191	157
Monographs	0	1	0
Individual contributions to edited volumes	10	11	18
Articles in peer-reviewed journals	100	140	125
Articles in other journals	4	1	3
Policy briefs, stakeholder and general reader's publications	61	33	10
Editorship of edited volumes	2	5	1

	Period		
	2017	2018	2019
Number of written expert reviews	2	2	4

Appendix 3

Revenue and Expenditure

Revenue		2017			2018			2019		
		k€	% ¹⁾	% ²⁾	k€	% ²⁾	%	k€	% ²⁾	%
Total revenue (sum of I., II. and III.; excluding DFG fees)		11,429			11,929			11,198		
I.	Revenue (sum of I.1.; I.2., and I.3.)	10,507	100 %		11,520	100 %		10,546	100 %	
1.	<u>Institutional funding (excluding construction projects and acquisition of property)</u>	7,792	74 %		8,771	76 %		7,612	72 %	
1.1	Institutional funding (excluding construction projects and acquisition of property) by Federal and <i>Länder</i> Governments according to AV-WGL	7,792			8,771			7,612		
1.2	Institutional funding (excluding construction projects and acquisition of property) not received in accordance with AV-WGL	0			0			0		
2.	<u>Revenue from project grants</u>	2,628	25 %	100 %	2,651	23 %	100 %	2,853	27 %	100 %
2.1	DFG	373		14 %	394		15 %	511		18 %
2.2	Leibniz Association (competitive procedure)	737		28 %	526		20 %	212		8 %
2.3	Federal, <i>Länder</i> Governments	1,244		47 %	1,310		49 %	1,135		40 %
2.4	EU	66		2 %	203		8 %	404		14 %
2.5	Industry	0		0 %	72		3 %	54		2 %
2.6	Foundations	81		3 %	17		1 %	59		2 %
2.7	GIZ	0		0 %	0		0 %	148		5 %
2.8	DAAD	66		2 %	90		3 %	265		9 %
2.9	Other	63		2 %	39		1 %	65		2 %
3.	<u>Revenue from services</u>	87	1 %		97	1 %		67	1 %	
3.1	Revenue from commissioned work	75			90			67		
3.2	Revenue from seminars	12			7			0		
II.	Miscellaneous revenue (e. g. membership fees, donations, rental income, funds from reserves)	1,123			614			452		
III.	Revenue for construction projects (institutional funding by Federal and <i>Länder</i> Governments, EU structural funds)	0			0			200		
Expenditures		k€			k€			k€		
Expenditures (excluding DFG fees)		11,429			11,929			11,198		
1.	Personnel	6,359			6,532			7,579		
2.	Material expenses	975			999			1,303		
3.	Equipment investments	446			524			273		
4.	Construction projects, acquisition of property	0			0			12		
5.	Other operating expenses	3,650			3,874			2,033		
DFG fees (if paid for the institution – 2.5% of revenue from institutional funding)		200.9			204.5			209.9		

¹ Figures I.1, I.2 and I.3 add up to 100 %. The information requested here is thus the percentage of “institutional funding (excluding construction projects and acquisition of property)” in relation to “Revenue from project grants” and “Revenues from Services”.

² Figures I.2.1 to I.2.7 add up to 100 %. The information requested here is thus the percentage of the various resources of “Revenue from project grants”.

Appendix 4

Staff

(Basic financing and third-party funding / proportion of women (as of: 31/12/2019))

	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
Research and scientific services	67.6	35	84	71	45	76	30
1st level (scientific directors)	1.0	0	1	0	1	0	0
2nd level (department leaders or equivalent)	2.0	0	2	0	1	0	0
3rd level (group leaders or equivalent)	11.4	0	12	0	2	0	3
Junior research group leaders	3.5	80	4	100	3	100	3
Further academic staff in executive positions	3.6	0	4	50	3	33	0
Further academic staff (scientific services)	8.9	0	12	67	12	67	0
Scientists in non-executive positions (A13, A14, E13, E14 or equivalent)	25.1	55	30	97	13	92	16
Doctoral candidates (A13, E13, E13/2 or equi.)	12.1	58	19	100	10	100	8
Service positions	26.7	3	28				
Laboratory (from E13, senior service)	2.0	0	2				
Laboratory (E9 to E12, upper-mid-level service)	11.2	8	12				
Occupational Safety (from E13, senior service)	0.9	0	1				
Workshops (E5 to E8, mid-level service)	1.0	0	1				
Library (E9 to E12, upper-mid-level service)	1.0	0	1				
Information technology – IT (from E13, senior service)	1.0	0	1				
IT (E9-E12, upper-mid-level service)	3.0	0	3				
IT (E5-E8, mid-level service)	1.0	0	1				
Technical (incl. Diving, service, from E13, senior service)	1.0	0	1				
Technical (incl. Diving, service) (E9-E12, upper-mid-level service)	3.5	0	4				
Technical (large equipment, service) (E5-E8, mid-level service)	1.0	0	1				
Administration	13.4	0	15				
Head of resources (i.e. of the administration)	1.0	0	1				
Staff positions (from E13, senior service)	1.0	0	1				
Internal administration (financial admin., personnel, etc., E9-E12, upper-mid-level service)	6.3	0	7				
Internal administration (financial administration, personnel, etc.) (E5-E8, mid-level service)	5.0	0	6				
Student assistants	16	34	32				
Trainees	5	0	5				
Scholarship recipients at the institution	17	87	22		15		19
Doctoral candidates	17	100	17		13		15
Post-doctoral researchers	5	60	5		2		4

Annex B: Evaluation Report

Leibniz Centre for Tropical Marine Research GmbH, Bremen (ZMT)

Contents

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Appendix:

Members of review board

1. Summary and main recommendations

The Leibniz Centre for Tropical Marine Research (ZMT) in Bremen conducts research on the interactions that determine the functioning of coastal ecosystems. In order to gain a holistic perspective on these ecosystems, the institute pursues a broad and ambitious interdisciplinary approach. It combines experimental and theoretical modelling methods from the natural and social sciences. An important element in its activities is the transfer of research results to local actors and policymakers in tropical countries.

Since the last evaluation, ZMT has developed well and achieved important results. The institute has established new working groups in each of the four scientific departments and has extended its research portfolio. To foster group interaction at institute-level, ZMT has developed its programme areas further.

The institute places a high priority on knowledge transfer. Its activities are diverse and of high relevance to the environmental management of tropical coastal regions. Based on its research, the institute advises policy- and decision-makers on mitigation and adaptation strategies. It provides relevant input to international organizations, such as the UN and the EU, but also to other relevant actors in the target regions. The transfer of research results to decision-makers was strengthened with the establishment of the Office for Knowledge Exchange in 2014.

ZMT has very good research facilities at its disposal that are set to be improved with the addition of expertise in data science and a new research data portal. It is welcomed that ZMT plans to combine its facilities under one roof in a new building. The institute's measures for quality management in its activities are detailed and appropriate.

Until now, the institute's director was at the same time head of a research department. From 2010 to June 2020, the head of the Department of Biogeochemistry and Geology held this position. Her competent management facilitated ZMT's positive development. After ten years in office, she decided to pass on the roles of scientific director and department head. She still has her own working group in the department. As of July 2020, the institute has an interim scientific director. In addition, the head of the Department of Social Sciences became director of the German Development Institute (*Deutsches Institut für Entwicklungspolitik*) in Bonn in March 2020. This is a notable success. Nevertheless, the responsible bodies now have to fill three leadership positions: the institute's director and two of the four department heads. It is of great importance for ZMT's strategic development that internationally renowned scientists are recruited for these positions.

It is welcomed that the institute employs international staff, many of whom come from tropical countries. Postdocs and doctoral students receive very good support through the ZMT Academy, established in 2018. Moreover, ZMT has strong local and international partnerships. The institute actively contributes to capacity building and the training of scientists from partner countries.

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. It should be a strategic priority to attract further large-scale and long-term interdisciplinary research projects. To advance interdisciplinarity, special consideration should be given to a close integration of natural and social sciences at ZMT.
2. In accordance with a recommendation in the previous evaluation, ZMT has improved its publication performance by increasing the number of articles in peer-reviewed journals. Moreover, more research results are published in internationally visible journals. ZMT should aim to further improve its publication record. Within the research projects pursued, ZMT should highlight its contributions by increasingly taking on responsible roles that are reflected in the status of principal investigator and first author.

Changes and planning (chapter 3)

3. It is welcomed that the establishment and reorientation of research groups in all of ZMT's departments reflect developments in the respective disciplines. However, it is not always clear what strategic contributions for ZMT are expected from new groups. Before establishing junior research groups, in particular, it is important to determine whether the groups are aligned with ZMT's strategic goals, to ensure that the groups find their ideal environment at the institute. The upcoming appointments of new working group leaders will provide opportunities to develop the departments strategically.
4. ZMT has reshaped the programme areas as an instrument to secure and strengthen interdisciplinary cooperation. Advancing joint projects remains an important task. The relevant tools (e.g. programme areas) should be focused on the promotion of such projects.

Modelling, in particular organismic, agent-based and participatory modelling, is an indispensable tool fostering integration between disciplines, in particular between ecology and social sciences, and between scientists and stakeholder. Therefore, these types of modelling should not only be preserved but strengthened.

5. ZMT is currently setting up a new working group on Data Science and Prediction, financed as part of an extraordinary item of expenditure: Digital ZMT (*Sondertatbestand DigiZ*, approved in 2019). In parallel with the new working group, a support group for research data management will be set up. This support group will develop a research data portal for tropical coastal regions. It is laudable that ZMT plans to embrace and actively contribute to open science and that the portal links social science data with marine science data for the first time globally. ZMT should ensure that the new data portal offers sufficient advantages over research data repositories such as DRYAD or GeneBank to attract high user numbers and provide a benefit to the research community.
6. The institute plans to establish further research groups that investigate adaptation processes to global change, transformative development and civil society. The proposed topics, such as societal transformative development, seem very broad. The institute should define the focus of the proposed working groups more clearly in order to specify what additional expertise will be required. This holds true for the social sciences in

particular, which should have an important role in ZMT's research activities relating to adaptation to environmental change. The institute should clarify how the planned working groups are incorporated. To realize its plans, the institute intends to apply for additional institutional funding (extraordinary item of expenditure/*Sondertatbestand*). The planned proposal should consider these recommendations and reflect the strategic priorities of the new scientific director.

Controlling and quality management (chapter 4)

7. In line with a recommendation in the last evaluation, ZMT has adopted an Open Data Policy, which should be pursued more rigorously. ZMT should consistently provide links to all its relevant datasets and repositories on the institute's website.

Human resources (chapter 5)

8. The plan to strengthen the scientific director's role is welcomed. For the first time, this position was advertised without being connected additionally to a department leadership role. This is appropriate, given ZMT's size. The scientific director will be appointed for five years, and reappointment is possible.

However, the advertisement for the position includes some unexpected limitations that are not acceptable in the international sphere in which ZMT is active. The advertisement was published in German. It stated that applications should be written in German and that English applications would only be considered if the applicant could satisfactorily show that they would acquire a good knowledge of German in a short span of time. It is good to see that the procedure aims for a joint appointment with the University of Bremen. It is necessary that this joint appointment is implemented.

9. To reflect the institute's growth, the role of the department heads should be strengthened. In recent years, ZMT has begun to advertise department head positions externally, instead of appointing them from among existing working group leaders. This development is welcomed and should be gradually adopted for all departments.
10. Since the last evaluation, the institute has increased the proportion of women among staff in research and scientific services from 44% to 54%. In leadership positions, however, the share of women is considerably lower (seven out of 19 on 31 December 2019). The institute implemented the cascade model in its programme budget in 2013. In the cascade model, the institute aims for equal representation among group leaders. The upcoming appointments of new leaders for departments and working groups provide good opportunities that should be used to recruit female scientists for leadership positions.

2. Overall concept, activities and results

The Leibniz Centre for Marine Tropical Science (ZMT) in Bremen investigates the structure and functioning of coastal ecosystems in the tropics. In its activities, ZMT aims to understand the interactions between different processes that take place within such ecosystems, and to contribute to a sustainable use of resources on tropical coasts. To this

end, the institute examines the physical and biological processes that determine how ecosystems function, as well as the social-ecological and socioeconomic processes that shape the interaction between the human population and the ecosystem.

Understanding these interactions requires a holistic view. At ZMT, this is pursued in a broad and ambitious interdisciplinary approach through the institute's four research departments (Biogeochemistry & Geology, Ecology, Social Science, and Theoretical Ecology & Modelling; see chapter 7). These bring different methodologies to the study of coastal ecosystems. The aim is to conduct research on many pressing topics in marine environments that face climate change effects, overexploitation, and coastal urbanization. The institute's interdisciplinary approach is implemented within and across its working groups and scientific departments, forming an integral part of ZMT. The individual working groups bring together scientists from different disciplines.

Results

Research

The broad interdisciplinarity that stretches from the natural to the social sciences is an important factor for ZMT's success. In view of this, it is good to see that the institute is developing a theory-based common understanding of the approaches, methods and implementation of interdisciplinarity. ZMT's programme areas are designed to foster interdisciplinary interaction at institute level.

A noteworthy achievement is ZMT's coordination of the third phase of the Science for the Protection of Indonesian Coastal Ecosystems initiative (2012–2016). This initiative involved 36 universities and institutes, 12 of which were located in Indonesia. Another good example of ZMT's large-scale activities is its long-term engagement in the EU's South Atlantic initiative, which resulted in the institute taking on a prominent role in the All Atlantic Cooperation for Ocean Research and Innovation initiative. Since 2018, ZMT has coordinated two of the five projects in this initiative, which involves partners in six different countries, four of which are in the tropics. **It should be a strategic priority to attract further large-scale and long-term interdisciplinary research projects. To advance interdisciplinarity, special consideration should be given to a close integration of natural and social sciences at ZMT.**

In accordance with a recommendation in the previous evaluation, ZMT has improved its publication performance by increasing the number of articles in peer-reviewed journals. Moreover, more research results are published in internationally visible journals. ZMT should aim to further improve its publication record. Within the research projects pursued, ZMT should highlight its contributions by increasingly taking on responsible roles that are reflected in the status of principal investigator and first author.

Transfer

In line with its mission, ZMT sees the transfer of research results to policymakers and local actors in tropical regions as a defining feature of its activities. The activities are diverse and of high relevance to environmental management in tropical coastal regions.

The priority ZMT gives to the transfer of scientific knowledge is reflected in the establishment of the Office for Knowledge Exchange (OKE). The OKE was established in 2014 in response to a recommendation in the previous evaluation. It aims to engage stakeholders in ZMT projects, aid capacity development, acquire funding for transfer projects, and develop standards for knowledge exchange. To this end, the OKE publishes policy briefs, hosts workshops, and develops strategies for the institute's knowledge exchange and transfer activities. The OKE is a very good addition to the institute's activities and makes strong contributions to knowledge and technology transfer. It is expected that the OKE will contribute to further co-learning and capacity-building activities at ZMT. The expertise developed in the OKE should be applied to systematically monitor and measure the impact of ZMT's activities in the target regions.

ZMT also takes on notable and important roles in the coordination of networks that bring together scientists, policymakers and civil society representatives. ZMT's participation in committees of the UN and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services is commendable and ensures the relevance of ZMT's activities on key topics at an international level. The transfer of knowledge via social enterprises and spin-off companies founded by ZMT staff is welcomed.

3. Changes and planning

Development since the previous evaluation

Since the last evaluation, the institute has introduced new topics, especially by establishing new working groups in all departments. The Department of Biogeochemistry and Geology introduced new groups on groundwater-ocean interactions and sedimentology. The Department of Ecology strengthened its focus on ecosystems with two new working groups on Reef Systems and Fish Ecology and Evolution. In the Department of Social Sciences, new expertise on perception and valuation was added. The Department of Theoretical Ecology and Modelling extended its capacities to develop theoretical models of physical processes and to apply approaches from data science. **It is welcomed that the establishment and reorientation of research groups in all of ZMT's departments reflect developments in the respective disciplines. However, it is not always clear what strategic contributions for ZMT are expected from new groups. Before establishing junior research groups, in particular, it is important to determine whether the groups are aligned with ZMT's strategic goals, to ensure that the groups find their ideal environment at the institute. The upcoming appointments of new working group leaders to replace those who are retiring will provide opportunities to develop the departments strategically.**

The previous evaluation in 2014 stated that ZMT had seen impressive growth following its admission to the joint funding provided by the Federal and *Länder* governments in 2009. It was recommended that further development should be based on more concrete department-spanning objectives and a clearly defined research focus. As a result, **ZMT has reshaped the programme areas as an instrument to secure and strengthen interdisciplinary cooperation. Advancing joint projects remains an important task.**

The relevant tools (e.g. programme areas) should be focused on the promotion of such projects.

One important element in ZMT's interdisciplinary approach is its expertise in theoretical modelling. The inclusion of new working groups on climate modelling and data science is strategically useful. However, **modelling, in particular organismic, agent-based, and participatory modelling, is an indispensable tool fostering integration between disciplines, in particular between ecology and social sciences, and between scientists and stakeholder. Therefore, these types of modelling should not only be preserved but strengthened.**

The institute has developed its international network since the last evaluation. This network and the relationships with partners in different tropical countries around the globe provide excellent opportunities that ZMT should use to conduct innovative research projects that cannot be pursued by many other institutions.

Strategic work planning for the coming years

ZMT is currently setting up a new working group on Data Science and Prediction, financed as part of an extraordinary item of expenditure: Digital ZMT (*Sondertatbestand DigiZ*, approved in 2019). It is expected that this working group will provide good opportunities and vehicles for interdisciplinary collaboration at ZMT. In parallel with the new working group, a support group for research data management will be set up. This support group will develop a research data portal for tropical coastal regions. The portal will be hosted by ZMT and aims to support open access to data, publications and research procedures. It is laudable that ZMT plans to embrace and actively contribute to open science and that the portal links social science data with marine science data for the first time globally. ZMT should ensure that the new data portal offers sufficient advantages over research data repositories such as DRYAD or GeneBank to attract high user numbers and provide a benefit to the research community.

The institute plans to establish further research groups that investigate adaptation processes to global change, transformative development and civil society. The proposed topics, such as societal transformative development, seem very broad. The institute should define the focus of the proposed working groups more clearly in order to specify what additional expertise will be required. This holds true for the social sciences in particular, which should have an important role in ZMT's research activities relating to adaptation to environmental change. The institute should clarify how the planned working groups are incorporated. To realise its plans, the institute wants to apply for additional institutional funding (extraordinary item of expenditure/*Sondertatbestand*). The planned proposal should consider these recommendations and reflect the strategic priorities of the new scientific director.

4. Controlling and quality management

Facilities, equipment and funding

In 2019, ZMT received EUR 7.6m in institutional funding from the Federal and *Länder* governments. The institutional funding will continue to increase from 2020 in the context of DigiZ.

As recommended at the time of the last evaluation, ZMT has increased and diversified its third-party income. The institute should continue on this path. Third-party funding grew substantially from EUR 1.2m in 2012 to EUR 2.9m in 2019. During the current reporting period (2017–2019), third-party funding accounted on average for 25% of the institute's overall income, an increase from an average of 16% in the 2010–2012 period. ZMT has achieved a greater diversity in its third-party funding. Funding obtained from the DFG has increased to a good level. However, a large share of third-party funding still comes from the Federal and *Länder* governments (40%). The level of EU funding also leaves room for improvement. ZMT should consider which EU funding lines provide good opportunities. Additionally, the institute could consider increasing its funding from foundations and industry.

ZMT maintains four scientific laboratory units focussed on the research fields of ecology (in the Marine Experimental Ecology Facility, MAREE), biology, chemistry, and geology, with a good number and quality of facilities. The use of standard operating procedures and defined protocols in the laboratories is welcomed. The institute could consider advancing its facilities by adding e.g. a dynamic light experimental ecological facility, facilities to measure carbon export, and creative space in an innovation lab for the social sciences.

It is welcomed that ZMT plans to improve its digital infrastructure facilities with the aid of the additional funding as part of DigiZ (see chapter 3). The institute should ensure that the necessary computational hardware for big data analysis is provided, possibly in cooperation with local partners.

The institute has established its own scientific diving centre. This centre supports ZMT scientists, but also provides scientific diving training courses outside of ZMT. Consequently, the diving centre provides important services to scientists at ZMT and beyond. The evaluation board acknowledges the excellent safety record.

At the time of the last evaluation in 2013, the construction of a new building was recommended. The financing for this urgently needed building was finally agreed in 2019 and a new building will be developed for ZMT in the coming years. It is welcomed that ZMT's unsatisfactory rental situation in multiple different locations will be resolved. The Federal and *Länder* governments have provided additional funding in recent years to cover rental expenses for additional office and laboratory space.

Organisational and operational structure

The organisational structure – with a scientific director and a managing director, four departments and 18 working groups within these departments – is clear and coherent. The role of leading scientists should be strengthened (see chapter 5).

Quality management

ZMT has implemented good measures for quality management. In the laboratories, ZMT has established clear rules, standard operating procedures and process guides for quality assurance. In order to assess the scientific success of interdisciplinary projects, the institute should ensure that transparent criteria are specified to monitor the impact across disciplines.

The publication strategy serves the institute's goals. The commitment to open access is commendable. **In line with a recommendation in the last evaluation, ZMT has adopted an Open Data Policy, which should be pursued more rigorously. ZMT should consistently provide links to all its relevant datasets and repositories on the institute's website.**

Quality management by advisory board and supervisory board

The scientific advisory board meets yearly and provides valuable advice on ZMT's developments. In between evaluation periods, the advisory board conducts an audit of the institute as a whole and of its individual units.

Given that many of ZMT's activities concern the Global South directly, it is important that representatives are adequately included. Representatives from international institutions (e.g. the UN or authors on the International Panel for Climate Change) should also be involved. In future appointments to the advisory board, ZMT should aim to increase diversity in this direction, as well as the share of female members (at the moment only one out of seven).

5. Human Resources

The institute saw a significant growth in personnel between its admission to the Leibniz Association in 2009 and the last evaluation in 2013. Since then, staff numbers have increased moderately to a total of 127 employees (plus student assistants, trainees, scholarship recipients and guest researchers) as of 31 December 2019.

In light of a recommendation at the time of the last evaluation, it is pleasing to see that 36% of ZMT staff in research and scientific services were foreign nationals. Particularly noteworthy is the fact that, in the last few years, 21% of employed scientists and 42% of guest researchers at the institute came from tropical or sub-tropical countries.

Leadership level

From 2010 to July 2020, the head of the Department of Biogeochemistry and Geology acted as scientific director. Her competent management facilitated ZMT's positive development. After ten years in office, she decided to pass on the roles of scientific director and department head. She still has her own working group in the department. As of July 2020, the institute has an interim scientific director.

The plan to strengthen the scientific director's role is a welcome development. For the first time, this position was advertised without being connected additionally to

a department leadership role. This is appropriate, given ZMT's size. The scientific director will be appointed for five years, and reappointment is possible.

However, the advertisement for the position includes some unexpected limitations that are not acceptable in the international sphere in which ZMT is active. The advertisement was published in German. It stated that applications should be written in German and that English applications would only be considered if the applicant could satisfactorily show that they would acquire a good knowledge of German in a short span of time. It is good to see that the procedure aims for a joint appointment with the University of Bremen. It is necessary that this joint appointment is implemented.

The department heads are appointed by the Supervisory Board on the SAB's recommendation from among the working group leaders, for a period of up to five years; reappointment is possible. This appointment procedure dates back to the 1990s, when ZMT was founded as a small institution. **To reflect the institute's growth, the role of the department heads should be strengthened. In recent years, ZMT has begun to advertise department head positions externally, instead of appointing them from among existing working group leaders. This development is welcomed and should be gradually adopted for all departments.**

The fact that the head of the Department of Social Sciences became director of the German Development Institute (*Deutsches Institut für Entwicklungspolitik*) in Bonn in March 2020 is a success. However, it will be an important task for ZMT's Supervisory Board to advertise the position internationally and fill it in a joint appointment with a university as soon as possible. The same applies to the upcoming appointment of the head of the Department of Biogeochemistry and Geology.

Postdoctoral staff and doctoral candidates

In 2018, ZMT established the ZMT Academy to support its junior researchers and to systematically enhance the ties to the institute's alumni and former guest researchers. The academy offers an excellent programme for postdocs and doctoral students. The ties to the alumni through the academy also provide useful links for deepening international cooperation.

Currently, 52% of doctoral candidates complete their doctoral degree in less than four years. The institute should aim for an average doctoral period of less than four years. It is expected that the number of doctoral candidates will increase after the leadership positions are filled and new groups are established.

As most postdocs will continue their career elsewhere, the high level of training, supervision, and advice they receive at ZMT is greatly appreciated. It is encouraging that three ZMT postdocs gained leadership positions at national and international research institutes. The institute should check whether additional support can be provided to its postdocs looking for positions in other institutions. Further successful applications of ZMT researchers to international institutes will help cement ZMT as an internationally renowned centre.

Support staff

ZMT offers vocational training in IT system integration, media and information services, and the chemistry and biology laboratories. It is welcomed that the institute has increased the number of trainees in line with a recommendation in the last evaluation.

Equal opportunities and work-life balance

Since the last evaluation, the institute has increased the proportion of women among staff in research and scientific services from 44% to 54%. In leadership positions, however, the share of women is considerably lower (seven out of 19 on 31 December 2019). The institute implemented the cascade model in its programme budget in 2013. In the cascade model, the institute aims for equal representation among group leaders. The upcoming appointments of new leaders for departments and working groups provide good opportunities that should be used to recruit female scientists for leadership positions.

ZMT has implemented well-structured measures to support equal opportunities and is appropriately certified. The institute's support for families through the provision of childcare places is welcomed. It is good that the institute plans to pursue further family-friendly measures, including an agreement on mobile working.

6. Cooperation and environment

As of May 2020, seven ZMT scientists were appointed jointly with the University of Bremen (4) and Jacobs University Bremen (3), while one was appointed jointly with the University of Kiel and one with the University of Oldenburg. The increase in the overall number of joint professorial appointments and the number of local partner universities is welcomed. It is expected that future recruitments in leadership personnel (see chapter 5) will be jointly appointed with partner universities.

The institute makes important contributions to teaching at the University of Bremen as part of the ISATEC joint Masters programme. It is particularly noteworthy that the institute also contributes to the education of international students by offering regular courses and summer schools abroad.

ZMT and its expertise provide valuable input in collaborations with Leibniz Institutes. It is an active partner in the research alliances Sustainable Food Production and Healthy Nutrition, Biodiversity, INFECTIONS '21, and Crises in a Globalised World. The former scientific director made a significant contribution to the Leibniz Association when she served as vice-president from 2011 to 2017.

The collaborations ZMT pursues in coastal tropical nations are very strong. They include joint efforts in the establishment of the new field station with UCAD Dakar, which will add an interesting scientific and societal contrast with the other partnerships. ZMT should continue to build additional collaborations for research and capacity building when suitable opportunities in tropical countries arise. ZMT uses the opportunities provided by the German Academic Exchange Service (DAAD) to offer a large number of guest

researchers from tropical countries opportunities to visit the institute for prolonged periods, thereby contributing to capacity building in tropical countries.

Increased collaboration with other European and international research institutes in ZMT's research areas should be considered for the future to provide additional synergies or strengthen core abilities.

Institution's status in the specialist environment

ZMT contributes to the relevant research communities through novel expertise and research that is difficult to find at other research institutions in Germany. With its interdisciplinary and holistic approach to studying tropical regions, ZMT serves a unique role in the research environment and has developed a good reputation. The combination of different disciplines, together with the institute's many national and global collaborations, establishes ZMT's strong brand in marine science for Germany.

7. Subdivisions of ZMT

Department of Biogeochemistry and Geology

[20.2 FTE, of whom 14 FTE research and scientific services staff, 5.3 FTE doctoral candidates, and 0.9 FTE service staff]

The Department of Biogeochemistry and Geology conducts research on the physicochemical and biogeochemical effects of natural change and human activities. It consists of four working groups of different sizes (two of them, with only one or two scientists each, seem subcritical in size), and two junior research groups. The diversity in the groups' physical, chemical and biological research is impressive. Across these fields, the department's groups collaborate very closely and achieve a good integration of activities.

Since the last evaluation, the department has developed well: it produces a meritorious publication output that is highly cited. In addition, the department has further increased its third-party funding to a very good level. However, funding sources should be diversified and EU and foundation funding opportunities targeted. Since the last evaluation, the department has offered very good support to young scientists. Junior research group leaders have obtained interesting positions and, in one case, an ERC starting grant.

Department of Ecology

[22.40 FTE, of whom 12.8 FTE research and scientific services staff, 9.6 FTE doctoral candidates, and 0.0 FTE service staff]

The Department of Ecology aims to understand the structure, processes and services of tropical coastal ecosystems and how they respond to global change and human use. The six working groups cover a good selection of research areas, from mangrove ecology to fish ecology and aquaculture. In these different areas, a remarkably wide range of approaches is applied, ranging from field work to lab techniques. The investment in new-generation technologies for DNA sequencing is appreciated.

Since the last evaluation, the department has developed well. The new department head, a researcher with an excellent reputation in his field, joined in 2014. The department's research results are published in high-quality peer-reviewed journals in the field of marine ecology. The department's interdisciplinary approach and its experience in research projects across the globe should be used to publish more reviews, meta-analyses, and perspectives. This would make the department even more visible in the field. Its contributions to capacity building are very important in all areas where its researchers operate. Competitive third-party funding has increased significantly since the last evaluation. The department should build on the recent successes in securing EU funding and increase this further.

Department of Social Sciences

[14.2 FTE, of whom 9.7 FTE research and scientific services staff, 4.5 FTE doctoral candidates, and 0.0 FTE service staff]

The Department of Social Sciences studies human-coastal relations by focussing on the interconnectedness of societal and ecological environmental change processes along tropical coasts. This line of research, despite being very pertinent and of increasing importance, is not followed by many other institutions across the world, especially not with a transdisciplinary approach. It is therefore very much worthwhile for ZMT to ensure that the department's working groups (at present: three and one junior group) are clearly tied into this promising field.

The department has seen good developments since the last evaluation. It combines approaches from sociology, economics, human geography, area studies, sustainability studies and anthropology. The research and transfer activities are remarkable and some produce outstanding results. As recommended at the time of the last evaluation, third-party funding has been increased and diversified. Research results are well-publicised. However, the department should strive to further improve its publication record.

At the end of February 2020, the former head of department left ZMT to become Director of the German Development Institute (DIE) in Bonn. The vacancy is a challenge. The appointment of a professor is key to the future of the department and should aim to strengthen social science research at ZMT (including the associated interdisciplinarity). It is expected that the promising lines of research laid out above will be further developed under the new department leadership to reflect even better current insights in the environmental social sciences.

Department of Theoretical Ecology and Modelling

[12.5 FTE, of whom 8.5 FTE research and scientific services staff, 4 FTE doctoral candidates, and 0 FTE service staff]

The Department of Theoretical Ecology and Modelling conducts theoretical and modelling research on the interactions affecting coastal ecosystems and socio-economic communities. The modelling of natural, biological and social factors is an important element for ZMT's inter- and transdisciplinary research profile. Moreover, the field of big

data analytics in particular offers many possible applications for ZMT, ranging from satellite remote sensing to the analysis of eDNA/environmental data.

Since the last evaluation, the department has developed well. The department's leadership changed recently with the appointment of a new department head. The new leader's working group and the new working group on Data Science and Prediction, which is currently being established with additional institutional funding (see chapter 3), bring the number of groups in the department to five. Both new groups are expected to lead to strategically useful expansions and should be complemented by appropriate investments in computing infrastructure. In addition to these developments and in order to aid interdisciplinary research, the department should also increase its capacities in ecological and social-ecological modelling, particularly in grid-based, agent-based and participatory modelling (see chapter 3). The department should apply these capacities to integrative modelling projects that include the knowledge and perspectives of stakeholders and different domain experts. Integrative activities within the department should be extended.

8. Handling of recommendations of the last external evaluation

ZMT has addressed the recommendations made by the Leibniz Association Senate in 2014 (see status report, p. A-20ff). The recommendations to further advance interdisciplinary cooperation, in particular between natural and social sciences, is still relevant (recommendations 1 and 2) and should inform the strategic decisions on establishing future working groups within the departments. Moreover, the institute should increase open data availability (recommendation 6). Progress regarding the quality and quantity of publications (recommendation 3) is acknowledged. The institute should continue on this trajectory.

14 December 2020

Annex C: Statement of the Institution on the Evaluation Report

Leibniz Centre for Tropical Marine Research GmbH, Bremen (ZMT)

We would like to thank the group of experts very much for carrying out this evaluation in such detail and depth, despite the adverse circumstances caused by the COVID-19 pandemic. The detailed comments and recommendations show the understanding for the work of ZMT and will be motivation for us to continue on the path we have taken.

Summary and main recommendations (chapter 1)

We are pleased about the positive overall assessment of ZMT by the committee. The positive comments on the importance of our research approaches, the interdisciplinarity and the overall good acquisition of third-party funding encourages us to continue on our work. We are glad that we have been able to implement responses to critical comments from the last evaluation to a large extent and will continue to do our utmost to implement them fully in the future. As an institute that is also dependent on political developments in many areas, some processes are difficult to control. On the other hand, we see a great opportunity for addressing these issues even more specifically through the Sondertatbestände (STB).

Overall concepts, activities and results (chapter 2)

Attract large-scale long-term interdisciplinary projects:

We are pleased that the Evaluation team recognizes our success in attracting large-scale, long-term projects. However, we also see that we need to pay increased attention to this important field, which the committee rightly addressed. The leading roles that we play in some national and EU projects (All Atlantic Ocean Research Alliance [AANChOR], BioDiversa-EASMO [commitment Nov2020], World Mangrove Centre in Indonesia) must be used for further engagement. We expect that our newly established programme areas will strengthen our capability to make better use of our natural and social sciences' competences to apply for large-scale and long-term interdisciplinary projects.

Publication Strategy:

We appreciate the Evaluation team's recognition on the achievements we have made in publishing in high impact-journals. We aim to increase the role of our PIs by taking more leadership in visible, high-impact articles as first authors. In addition to the ZMT's publication performance in peer-reviewed journals at a high level, the institute aims, according to its mandate, to also significantly increase its presence in regional journals and policy briefs, especially in the areas that are important for its tropical partners.

Changes and planning (chapter 3)

Strategic orientation of working groups:

We fully agree that the establishment of new working groups is a key element for ZMT's strategic orientation. The establishment of new groups must be the result of a strategic process based on discussions within the departments and the programme areas. We will make this strategic process more clear by formulating our scientific goals in a consolidated research strategy.

Importance of programme areas (PAs):

We welcome very much the recommendation to strengthen the importance of the programme areas, a continuous discussion process that we are working on. The programme areas are developing into a hub for the development of larger networking projects. If successful, the Sondertatbestand ATLab (formerly ACDC) that will be submitted by the end of the year, will provide an additional ZMT internal competitive research budget, that creates momentum within the programme areas to address newly emerging research questions.

The Modelling department has been substantially expanded through the already established STB DigiZ. The new director (who most likely will be appointed soon), with her strong background in agent-based modelling and mangrove research will increase the competencies already available in this department and further bridge between natural and social sciences at ZMT towards transformative processes.

DigiZ and open science:

DigiZ gives unique possibilities to materialise an open science approach, which is particularly important for our Global South cooperation. DigiZ will adhere to FAIR/CARE principles and is already active and networked in European (e.g. AANChOR) and national (e.g. National Research Data Infrastructure - NFDI) structures. It will also be possible to implement the Open Data Policy much better in this framework. DigiZ will provide a data base which joins social and natural marine science data, but it will provide it for a region that is particularly in need of an open access provision of this knowledge commons.

We will use state-of-the-art technologies to develop the data portal together with regional specialists (World Data Center PANGAEA, QualiService) and offer integrated web services (e.g. via Apache Lucene™) that go beyond the pure, monolateral connection of subject-specific databases (DRYAD, GeneBank, etc.). As a result, we expect to reach high user numbers, increase awareness and multiply benefits for the research community.

Sondertatbestand, strategic expansion:

The new Sondertatbestand (to be applied for 1 January 2021) has been revised and re-structured into a more flexible and adaptive Adaptation and Transformation Lab (ATLab), that helps initiating transdisciplinary processes for tropical communities to better adapt and transform towards sustainability. This strengthens the balance between natural and social sciences within ATLab and the societal relevance of ATLab, reflected also by the suggested creation of a further social science research group focusing on research into transdisciplinary processes. Due to the COVID-19 pandemic, the current proposal has been evaluated by the International Advisory Board, which clearly recommended, together with the Supervisory Board, that the proposal should be submitted by the Senate of Bremen by the end of this year.

Controlling and quality management (chapter 4)

Facilities, Equipment, Funding:

We are pleased with the committee's recognition of the Institute's positive development in the areas of facilities, equipment, and funding in recent years. Also, EU projects have al-

ready been approved (in AANChOR two pilot projects - 300T€, EASMO in the BioDiversa programme - 900T€).

Rigorous Open Data Policy:

We totally agree, being a mainly tax-funded institute, to adhere in our data policy to FAIR/CARE principles and will implement the Open Data Policy. With our open access strategy being constantly implemented further, we have already achieved a substantial improvement of data availability. As indicated above, for primary data DigiZ will provide a unique opportunity to set standards in the field of open access data availability in tropical marine sciences.

Human resources (chapter 5)

Role of new scientific director and German job advert:

We welcome the agreement of the Evaluation Committee to strengthen the scientific director's role and to release them from the management of a scientific working group and department leadership. Considering the crucial importance of knowing the particularities of the German federal science and administration system and laws for the successful promotion and governance of ZMT, we understand that the recruitment commission organized by the Senate of Bremen, had announced the position in German. Despite this fact, applicants were successfully acquired, also with the help of an internationally active personnel consultant, from Australia, the UK, and Germany and presented themselves to the commission. An internationally competitive female candidate was found, and we expect finalization of contractual negotiations with the University of Bremen soon.

Organisational and operational structure:

Following the statement of the Evaluation Committee to strengthen the scientific Director's role, there is a clear agreement between the institute's management and the Supervisory Board, that a revision of the rules of procedures of the Institute is due. It will be initiated at the next meeting of the Supervisory Board and involve the new director. This review of the rules of procedure will include the reorganisation of the tasks of the management (now without a separate department) and the heads of departments as well as the redistribution of responsibilities.

Gender balance:

Of course, we regret the departure of a department head and the resignation of the previous director, that have thrown the gender ratio at the scientific management level out of balance. At the same time, ZMT recognizes it as a very valuable qualification feature when its female colleagues make such an outstanding career leap!

Like many other enterprises, ZMT faces the problem of finding competent female leadership personalities. We make every effort to make job openings particularly attractive for women, to formulate job advertisements accordingly, and to actively promote networks with external help. Thus, we are working specifically to fill the job pool, supervisory board and, above all, the scientific advisory board in a gender-neutral and geographically balanced manner.

Cooperation & environment, subdivisions of ZMT (chapter 6,7)

We are pleased by the consistently positive feedback on the status of our collaborations and the scientific development of the departments.

Handling of the recommendations of the previous evaluation (chapter 8)

And finally we acknowledge the conclusion of the Evaluation Committee that ZMT has been able to implement the recommendations from the former evaluation and will continue to further improve its interdisciplinary path and the development of its open data policy. The Sondertatbestände will provide a considerable boost here.