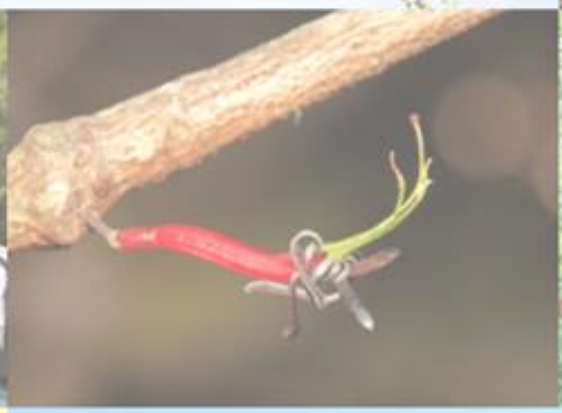
Kyoto University Museum, Kyoto Univ.
The Union of Japanese Societies for Natural History
co-organized International Symposium

Network of Natural History Museums

as a Tool for Promoting Research, Collection building, Education and Outreach: Case Studies from Asian Regions

Lecture & Panel Discussion
Proceedings



Inamori Hall, Shirankaikan,
Yoshida Campus, Kyoto University
Sept. 4 (13:20-16:30), 2019

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Introduction

Hiroshi Kitazato

Tokyo University of Marine Science and Technology, Japan; Advisor of the Union of Japanese Societies for Natural History

Why is Museum Network Important?

Museum provides a community. Museum community work most effectively through persons who consists the system. 'Persons' with diverse roles serve as important components of Museum system.

Museum Networks Strengthen Museum Activities

Each museum has own characters, regions, size, and different professions. The pros of establishing museum networks is that it can cover weak points of other museums. Connections between museums can bring new advantageous characters and complement its museum function, such as regional scale collections, multiple Yield exhibitions, etc.

From Networks to Commons

Museum network should operate based on 'mutual help' between museums. Each museum share its knowledge, data base, and exchange human resources with other museums; which builds from the idea of managing the 'commons'. A network that manages the commons show both advantageous and weak points, and Museums should be independent. Museum collections and data base should be controlled by statutes and rules that preventpower games –such as colonization and/or hierarchy of the systems.

Network of Natural History Museums' as a Tool for Promoting Research, Building Collections, Education and Outreach: Case Studies from Asian Regions

Hiroshi KITAZATO
Tokyo University of Marine Science and Technology, Japan; Advisor of the Union of Japanese Societies for Natural History

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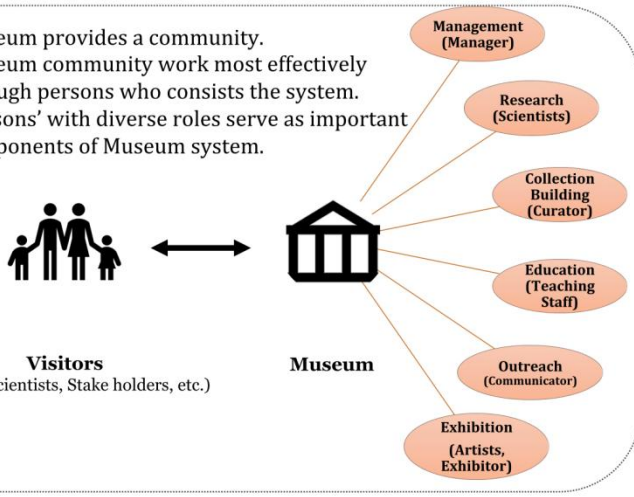
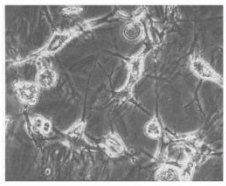
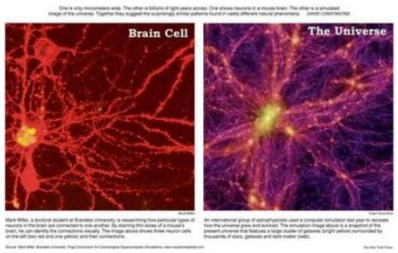


Network Systems Found in Nature

Reticulosphaera socialis Grell

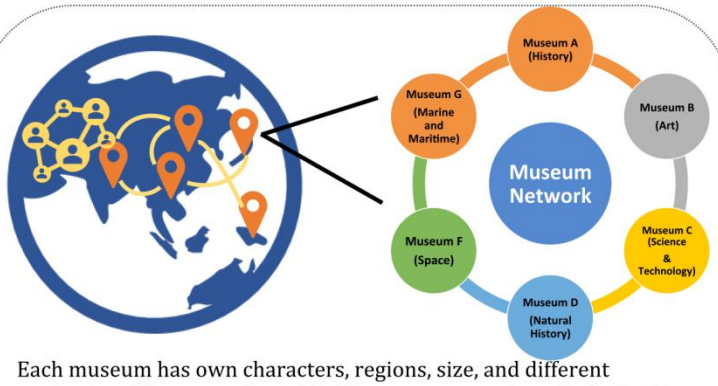




Communication network by cells | Information network by neural system | Energy network By nabrae

Networking is an effective system for transferring energy, information, communication and others among systems.

Museum Networks Strengthen Museum Activities



Each museum has own characters, regions, size, and different professions.**The pros of establishing museum networks** is that **it can cover weak points of other museums.** Connections between museums can bring new advantageous characters and complement its museum function, such as regional scale collections, multiple field exhibitions, etc.

Networking Case Studies

① **Strengthen research abilities** in museums. Research professions of Scientists at one museum are limited. Research collaboration networks widen researches at each or regional museums. It allows **construction of big data bases** among museums at regional scale. Which can be extended to a global scale.

② **Strengthen educational system for natural histories**. Systematic biology curriculum has been enhanced at European Universities through their museum networks (SYNTHESYS).

③ **Help to rescue museums and museum collections.** Museums sometimes face vigorous natural hazards. On March 11, 2011, Northeastern Japan experienced big Earthquake (M9.0) and Tsunamis. Museum networks have played a big role to rescue museum collections of northern Japan.

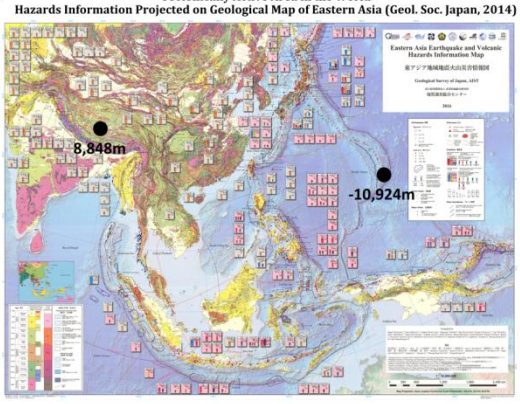
④ **Citizen Science** is now common procedure to carry out science communication between science and local citizens. Museum network play an active contact point for gathering information from citizens.

From Networks to Commons

Museum network should operate based on 'mutual help' between museums. Each museum **share its knowledge, data base, and exchange human resources with other museums**; which builds from the idea of managing the 'commons'. **A network that manages the commons** show both advantageous and weak points, and Museums should be independent. Museum collections and data base should be controlled by statutes and rules that prevent power games –such as colonization and/or hierarchy of the systems.

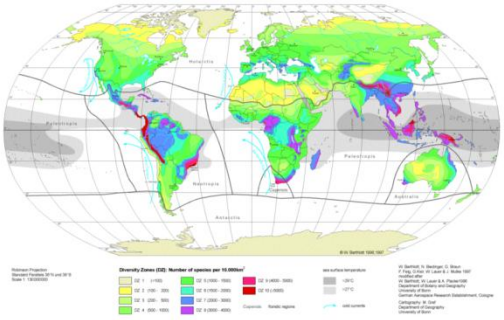
Why Asia?

Tectonically Active Area in the World
Hazards Information Projected on Geological Map of Eastern Asia (Geol. Soc. Japan, 2014)

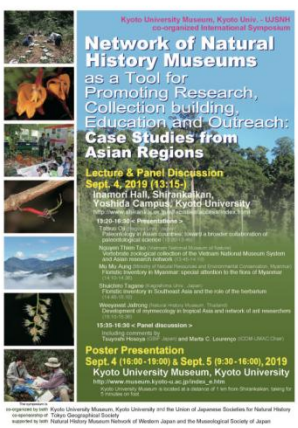


- Diverse Nature in Asia
- Wide range of Natural History Museums found in Asia
- High Geodiversity
- Active tectonics, frequent hazards
- High Biodiversity

Global map showing high biodiversity of vascular plants



International Symposium



Lecture and Panel discussion
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Inamori Hall, Shirankaikan,
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Poster Presentation
September 4. 16:00 - 19:00
&
September 5, 9:30 - 16:00
Kyoto University Museum, Kyoto Univ.

Organized by
Kyoto University Museum, Kyoto Univeritiy & the Union of Japanese Societies for Natural History (UJSNH)
Co-sponsored of
UJSNH & Tokyo Geographical Society
Supported by
Natural History Museum Network of Western Japan & the Museological Society of Japan

Presentations

Paleontology in Asian countries: toward a broader collaboration of paleontological science

Tatsuo Oji

University Museum, Nagoya University, Japan

Key words: Paleontology, Network, Rescue of collections

International collaboration and network are necessary in the science of paleontology, and advanced establishment of network among museum and societies have been built in Europe and north American countries. However, similar effort has not been achieved in Asian countries until recently. Here I report the recent activities of networking Asian societies of paleontology, initiated by the collaboration between the Palaeontological Society of China and Palaeontological Society of Japan. We aim to establish Asian Palaeontological Association, and we will have the 1st Asian Palaeontological Congress in this year. Such collaboration and network will expand our view of paleontology, and also promote young scientists to have more global standpoint. In the presentation, rescue operation of museum collections after the Tsunami disaster in 2011 in northern Japan, based on the networking of paleontologists and museums are also presented.

Biological Inventory in Myanmar: Special Attention to the Flora of Myanmar

Mu Mu Aung, PhD

Forest Research Institute, Forest Department, Myanmar

Key words: inventory, diversity, flora, new record, new species, Myanmar

Myanmar is geographically located in the mainland South East Asia, with a land area of 676,577 km2, and a coastline of 2,832 km. It lies between latitudes 9° 32' N to 28° 31'N and longitudes 92° 10' E to 101° 11'E, and is bordered by the China in the north-east, Laos and Thailand in the east, Bangladesh and India in the west. About 42.92% of the country's total land area is still covered with natural forests. Myanmar is situated at the convergence of three major floristic regions: the Indian, Sino-Japanese and Indo-Chinese (Takhtajan, 1986). Myanmar is endowed with a rich diversity of habitat types arising largely from its unusual ecological diversity. With its wealth of plant diversity, Myanmar constitutes a significant component of the Indo-Myanmar biodiversity hotspot with a conservative estimated of total plant diversity the hotspot reveals about 13,500 vascular plant species (Van Dijk et al., 2004). However, while neighboring countries floristic diversity has been exposed through international projects, such as Flore du Cambodge, du Laos et du Vietnam, and Flora of Thailand, thus far, no reliable sources of Myanmar's flora have been published except a brief checklist of spermatophyte 11,800 species contributed by Kress et al. (2003). Myanmar is botanically one of the most fascinating regions in the world. From the mangrove forests and coral reefs of the Andaman Islands in the south, to the snow-capped

peaks of Mt. Kakaboradzi (5,881 m) in the north, the highest mountain in Southeast Asia, Myanmar embraces incredible floral and faunal diversity. However, inventory works are far from being complete, and still very limited specimens are available in world herbaria, and much remains to be learnt of its flora as well as of its floristic relations with neighboring regions of Asia. Myanmar is so-called “Floristic Blank”, and due to this situation, each flora of neighboring country will not be completed. As a result, Myanmar shares its flora with the neighboring countries. Therefore Myanmar flora is very important also for completing the whole Continental Asian floristic knowledge.

To help improve this situation, the National Museum of Nature and Science (Japan) and Forest Department, Ministry of Natural Resources and Environmental Conservation (Myanmar), have newly started an inventory project to provide contributions to the Flora and Fauna of Myanmar since 2016. The main purpose of the present floristic research program is to clarify the species diversity of flowering plants, mosses, lichen and fungi for updating the flora of Myanmar and carrying out the fundamental taxonomic research for their future conservation more based on scientific evidence. This joint research project has been carrying out under the memorandum of Understanding (MoU) between Forest Department and National Museum of Nature and Science (NMNS), Japan. Field explorations were carried out in the Htamanthi Wildlife Sanctuary, Mt. Zalon Reserved Forest Sagaing Region, Indawgyi Wildlife Sanctuary, Kachin State, Natma Taung National Park (Mt. Victoria), Chin State, Tanintharyi Nature Reserve, in the vicinity of Dawei (formerly Tavoy), and Lampi Island Marine National Park, Tanintharyi Region, Pyin Oo Lwin, Taunggyi, Kayin & Loikaw, Bago Mountain Range, Minbu-Arakan Range, Pyi-Arakan Range, Hlawga National Park, Moulamiyaing (Moulmein) Reserved Forests from 2016 and present.

As the results of fundamental inventories for the contributions to the knowledge on the flora of Myanmar, twenty two taxa of monocotyledonous plants and eighteen taxa of dicotyledonous plants representing were newly recorded and also nine new species were discovered. These results are presenting by a series paper **"*Contributions to the Flora of Myanmar*"**, and other scientific papers. We published **"A Field Guide to Aquatic Plants of Myanmar"** by the project. These data would be very important for the materials to the revised flora of Myanmar and future conservation activities. Forest Department (FD), Ministry of Natural Resources and Environmental Conservation, Myanmar and National Museum of Nature and Science (NMNS), Japan newly started "Updating Flora of Myanmar Project". On the other hand, the project to establish the biodiversity specimens center including expanded herbarium (RAF) supported by JICA in cooperation with NMNS has been started in 2019. After a few years we could have an important and modernized herbarium which would play a role as an information center of "plant diversity and its conservation in Myanmar".

Floristic inventory in Southeast Asia and the role of the herbarium

Shuichiro Tagane

The Kagoshima University Museum, Kagoshima University, Japan

Southeast Asia has one of the richest plant diversity in the world. However, we have not known the accurate species diversity yet. In recent years, 300–450 vascular plant species are being described from SE Asia every year, and regional flora projects go very slowly. The problem is that the number of herbaria and their accumulation of plant specimens are very poor in the region. Number of specimens/100km^2 (collection density) is estimated to be only 16, 10 and 43, in Cambodia, Laos and Vietnam, respectively (Middleton 2019), whereas more than 1,100 in Japan and United Kingdom. The diversity is rapidly being lost by land use change and forest degradation caused by human activities. Thus, we urgently need to explore local flora to develop better strategies for conservation.

Since 2011, to contribute to assess the states and trends of plant diversity in SE Asia, we have carried out botanical inventories using a standardized belt-transect method (10 × 10 subplots of 10 m × 5 m) at 156 sites in various forest types at elevations from 24 m to 4,095 m, in Brunei, Cambodia, China (Guangxi), Indonesia (Java, Kalimantan, Sulawesi, Sumatra), Japan (Ryukyu), Laos, Malaysia (Borneo, Peninsula), Myanmar, Philippines, Taiwan, Thailand and Vietnam (Fig. 1). Through the surveys, 44,629 voucher specimens including more than 30,000 species were gathered with their silica-dried leaves for DNA analysis, photos taken in the field and digitized specimen images. This collection is a firm foundation for understanding regional flora

Fig. 1 Surveyed sites in Southeast Asia.

and has been used for taxonomic and phylogenetic studies by numerous researchers. Based on this collection, picture guides were also published for the flora of Cambodia, Indonesia and Vietnam (freely available from https://sites.google.com/site/pictureguides/).

Our results clearly showed how plant diversity in SE Asia is still low-estimated. 19–28% of a total plant species that we collected from Cambodia, Laos and Vietnam is revealed to be new species or new to each country (Table 1). Among these, it is notable that the flora of Mt. Langbian and Hon Giao area in Bidoup Nui Ba National Park, Southern Highland of Vietnam, composed many new species (16.9% and 27.7%, respectively). They all are endemic to these areas, and have not been collected and/or studied before. Thus far, 81 species in 36 families were described based on our newly collected specimens since 2015, but we estimate more than 1,000 species to be described in our collection. In this way, we need more efforts to accumulate plant specimens to clarify a total flora of Southeast Area.

Herbarium has played a key role for documenting the local flora: accumulation of specimens, species identification, providing correct or appropriate scientific names according to a latest nomenclature system and revisions on particular groups, and

Table 1. Proportion of new vascular plant species and new country records in our surveyed sites in Southeast Asia at this moment. The proportion will be more or less changed when we finally examine undeterminated species.

Countries	Areas	No. of species examined (A)	No. of described species (B)	No. of new species (C) (%= C/A x 100)	No. of new country records (D) (%=D/A x 100)	No. of species not yet identified
Cambodia	Bokor National Park	666	642	24 (3.6%)	102 (15.3%)	57
Laos	Nam Kading National Protected Area	188	179	9 (4.7%)	34 (18.0%)	351
Vietnam	Mt. Langbian, Bidoup Nui Ba National Park	118	98	20 (16.9%)	1 (0.8%)	25
Vietnam	Hon Giao, Bidoup Nui Ba National Park	94	68	26 (27.7%)	0 (0%)	40
Myanmar	Khao Yai National Park	559	556	3 (0.5%)	1 (0.1%)	116
Thailand	Thanintharyi Nature Reserve	270	265	5 (1.8%)	10 (3.7%)	153

comprehensive data-bank (provide data for floristic studies). Also, herbaria across the world have always worked cooperatively to support researchers with their studies. To accelerate documenting plant diversity in Southeast Asia, we should encourage these activities and develop international collaboration and network of both researchers and herbarium more and more.

References: D.J.Middleton, K. Armstrong, Y. Baba, H. Balslev, K. Chayamarit, R.C.K. Chung, B.J. Conn, E.S. Fernando, K. Fujikawa, R. Kiew, H.T. Luu, Mu Mu Aung, M.F. Newman, S. Tagane, N. Tanaka, D.C. Thomas, T.B. Tran, T.M.A. Utteridge, P.C. van Welzen, D. Widyatmoko, T. Yahara, K.M. Wong. (2019) Progress on Southeast Asia's Flora projects. Gardens' Bulletin Singapore 71 (2): 267–319. 2019.

Development of Myrmecology in Tropical Asia and Network of Ant Researchers

Weeyawat Jaitrong

Natural History Museum, National Science Museum,
Technopolis, Khlong 5, Khlong Luang, Pathum Thani, Thailand

Myrmecology (ant research) in tropical Asia has been constantly developing after the establishment of the International Network for the Study of Asian Ants (ANeT) in 1999. The aim (mission) of ANeT has been encouraging ant researchers in Asia and entering them in world myrmecological activity by offering a platform for education, communication and information exchange. Another important mission of ANeT was to support the next generation of myrmecologists in Asia. To realize these goals ANeT has organized meetings (seminars and workshops) every other year at various locations around Asia. The first and the last (12^{th}) conferences were held in Bangkok, Thailand.

Since the ANeT was started our activity has been expanded to include: 1) establishment of the Ant Museum in 2001 by Decha Wiwatwitaya, spreading knowledge about ants to entire Thailand, 2) publishing more and more scientific papers written by ANeT members, with a lot of joint papers by myrmecologists of different countries, 3) growing several promising ant researchers in each country in Asia, 4) having named more than 200 Asian ant species mainly by Asian myrmecologists, 5) carrying out ant courses in some countries such as Sri Lanka (Sriyani Dias) and Thailand (Decha Wiwatwitaya), 6) founding of a new journal, Asian Myrmecology, in 2007 with the help of European scientists (11 volumes already issued), releasing papers that have been cited widely in the world. Furthermore, we are now having several substantial ant collections in tropical Asia that will be used by

taxonomists and ecologists of any country in the world.

Our programs were not always successful, but we have been enjoying everything and will continue improving our research environment.

Guest's Presentation

PRISC: The Portuguese Research Infrastructure of Scientific Collection

Marta C. Lourenço

National Museum of Natural History and Science,
University of Lisbon, Portugal; Principal Investigator of PRISC

Introduction: What is PRISC?

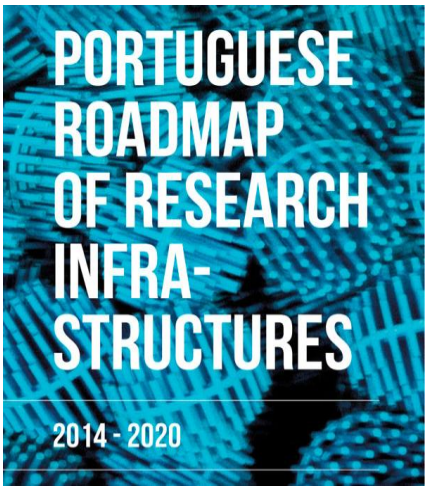

Fig. 1 The Portuguese Roadmap (FCT 2014).

PRISC is the Portuguese Research Infrastructure for Scientific Collections. It was created in 2015 and inscribed in the *Portuguese Roadmap of Research Infrastructures 2014-2020* (Fig. 1) by the governmental research funding agency, *Fundação para a Ciência e Tecnologia* (FCT)[1]. PRISC addresses a contemporary challenge, not exclusively Portuguese: how to select, preserve and make accessible for the future collections generated by past and present research and development (R&D) activities?

R&D activities have always generated huge volumes of material specimens, equipment and documents. However, few R&D institutions – university departments, research institutes, laboratories – have vocation or motivation to select and preserve material collections and associated data for future R&D or public outreach. And when they do, they lack the space, time and expertise to do it according to minimal international standards. Therefore, when R&D projects are concluded and papers published, these collections often become orphaned. If not trashed altogether immediately, they are put aside and stored in corridors, offices, attics and basements,

[1] See https://www.fct.pt/apoios/equipamento/roteiro/2013/docs/Portuguese_Roadmap_of_Research_Infrastructures.pdf, accessed 16 December 2019.

where they remain dormant, invisible and inaccessible, sometimes for decades. Ultimately, many are irreversibly lost.

Dormant and inaccessible collections mean inefficiency of research, economic and public potential. It also means a waste of time and public funds, apart from a breach in research ethics. The *European Code of Conduct for Research Integrity* (ESF/ALLEA, 2011, revised in 2017)[2] indicates that primary and secondary research data should be stored in a secure and accessible form so that studies can be replicated or elaborated upon. R&D institutions acknowledge the importance of these good practices, but there is not much they can do by themselves. This is where PRISC enters.

Fig. 2 PRISC members.

Following recommendations by the *OECD Global Science Forum Report on Roadmapping Large Research Infrastructures* (2008)[3], the *ESFRI Strategy Report* (2010)[4] and the German Research Council recommendations on *Scientific Collections as Research Infrastructures* (2011)[5], four university museums in Portugal (Fig. 2) – the National Museum of Natural History and Science (MUHNAC, University of Lisbon)[6], the Natural History and Science Museum (MHNC, University of Porto)[7] and the Botanical Garden and Science Museum (JB, MC, University of Coimbra)[8] – mobilised their expertise and resources to contribute to the transformation of a landscape that is presently heterogeneous, invisible, underused and dispersed, into an accessible, coherent and sustainable infrastructure of scientific collections with visible and meaningful impact for science, the economy and society.

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[2] See https://allea.org/wp-content/uploads/2017/05/ALLEA-European-Code-of-Conduct-for-Research-Integrity-2017.pdf, accessed 16 December 2019.

[3] See http://www.oecd.org/science/inno/41929340.pdf, accessed 16 December 2019.

[4] See https://ec.europa.eu/research/infrastructures/pdf/esfri-strategy_report_and_roadmap.pdf, accessed 16 December 2019.

[5] See http://umac.icom.museum/wp-content/uploads/2017/05/10464-11-11_engl.pdf, accessed 16 December 2019.

[6] National Museum of Natural History and Science, University of Lisbon, https://museus.ulisboa.pt/, accessed 16 December 2019.

[7] Natural History and Science Museum, University of Porto, https://mhnc.up.pt/, accessed 16 December 2019.

[8] Botanic Garden https://www.uc.pt/jardimbotanico and Science Museum https://www.uc.pt/jardimbotanico, University of Coimbra, accessed 16 December 2019.

In order to achieve that, PRISC provides six services – Public & Open Access, Storage Space, Conservation, Consulting, Outreach and Training – to R&D institutions, SMEs, the industry and individuals (Fig 3), ultimately through a single online access point (CONNEXION Platform, under construction). Moreover, PRISC aims at increasing the visibility and use of scientific collections, museums and heritage by the culture and tourism sectors, the research community, and society at large. In the long-term, PRISC aims at full preservation and open access of all scientific collections in Portugal. Presently, PRISC is receiving funding from the Portuguese government and the European Union for its implementation stage. Full operation, i.e. providing all services in all territory, including Madeira and Azores, should be achieved in 2021.

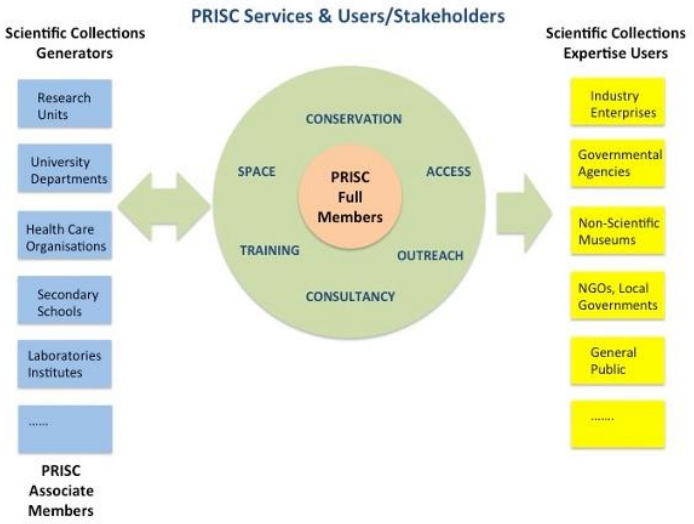

Fig. 3 PRISC services and users.

PRISC resources cover c. 6 million objects and specimens. It is currently providing services to over 150 institutions in Portugal, Africa, Brasil and other countries (Fig. 4, Fig. 5).

Fig. 4 PRISC providing services of Access and Conservation in Portugal.

Fig 5. PRISC is a multi-site infrastructure and its services can be provided *in situ* (in PRISC's facilities and laboratories) or *ex-situ* (in users' facilities).

The Specificity of PRISC

PRISC has two unique characteristics in the European research infrastructure landscape. The first is that it is a 'material' infrastructure. PRISC is not only concerned with data about scientific collections, but first and foremost, with the preservation and use of their materiality for research, education and culture. This means that PRISC is a much more expensive infrastructure than any e-infrastructure and long-term sustainability is a challenge. The second unique characteristic is its broadband disciplinary scope. PRISC covers not only life and earth sciences' collections (*naturalia*) but also collections of historic scientific instruments and equipment (*artificialia*) (Fig. 6), including living collections in botanic gardens, scientific archives, and historic spaces of research and teaching, such as historical laboratories and astronomical observatories, for example. Uses for research may be significantly different but these collections and heritage were frequently generated together and are essential sources for interdisciplinary knowledge about the past and present of science, nature and the universe.

Fig. 6 PRISC encompasses naturalia and artificialia.

Regardless of disciplines or provenance, PRISC uses the following working definition of 'scientific collection': "Scientific Collections are *organised* assemblages of *selected* material evidence of the natural environment or scientific human activity, accompanied by the necessary *associated information* that makes them sources for research, education and culture in a wide range of cross-disciplinary fields". This includes, for example, rocks, fossils, minerals, scientific, engineering and medical

instruments and equipment, prototypes, herbaria, botanic gardens and arboreta, zoology specimens, ethnographical and archaeological artefacts, anthropological and osteological collections, ethno-botanicals, chemicals, soil & ice cores, DNA, seed & tissue banks, sound archives and specific documental sources (e.g. seismograms, medical records, climatological records, scientific drawings, field notebooks, manuscripts, photographs), and many more. Some PRISC scientific collections are organised in museums, some are not. Their provenance is the whole world and even beyond (e.g. meteorites). Their time frame ranges from millions of years ago to yesterday.

Infrastructures: The Future of Scientific Collections and Museums or Just Another Trend?

Certainly, all collections, museums, libraries and archives should be considered infrastructures. They are used time and time again for different purposes – just like the transportation, communication, sewage, water, and electric systems – and they are too expensive to maintain thus the costs should be shared by users or subsidized. So, a realignment and repositioning of scientific museums towards an infrastructure model is, in principle, a good thing for their long-term sustainability. Moreover, across Europe, many of these museums are in universities who understand better the concept of research infrastructure than the concept of a museum itself.

In 2018, the European Roadmap of Research Infrastructures[9] included for the first time a material infrastructure of bio- and geodiversity. It's called DisSCo – Distributed System of Scientific Collections[10]. It comprises 120 institutions – mostly museums – from 21 countries in Europe, covering 1.5 billion specimens and 80% of world species. DisSCo employs 5,000 scientists and 16,000 research users per year. In terms of public visitors, it comprises 10 million on site and 25 million through the web. Services provided by DisSCo are three: i) e-Science services, ii) Physical and Remote Access services; and iii) Support and Training services.

The inclusion of DisSCo in the ESFRI 2018 Roadmap is of major importance to

[9] See http://roadmap2018.esfri.eu/, accessed 16 December 2019.
[10] See https://www.dissco.eu/, accessed 16 December 2019.

material scientific collections in Europe and the world, recognizing for the first time their paramount role for European research and development, along with other more 'traditional' infrastructures (e.g. mass spectrometry, the meteorological and seismographic grid). PRISC is part of DisSCo and fully committed to its implementation, although it covers only a part of PRISC's scientific collections (*naturalia*).

The idea of infrastructure poses some challenges to museums, though. The first is that museums themselves have a poor idea of what an infrastructure means. They understand the idea of a network – working together and corralling resources, they have been doing that for a long time – but an infrastructure means that *plus* providing services to users. Traditionally, museums see themselves as 'content producers' and a shift towards 'service providers' is a major cultural and institutional change. Both can – and should – be done, but it is a challenge.

The second is the eternal sustainability question: who pays the bill? Certainly, the idea of infrastructure is helpful because it potentially introduces a pay-per-use business model. However, most scientific collections are public and should be in open access, which creates a challenge for public users (researchers, general public). PRISC is more inclined towards a hybrid business model, combining funding from users and from generators. If research projects that predictably generate scientific collections allocated a small percentage of their budget (say 2-4 %) to their preservation and open access, that percentage could be used to fund PRISC. The principle exists already for open access publications and public outreach, and several research units that we have consulted agreed to do that. Ultimately, the matter is political. Governments and countries need to ask themselves if they really want their scientific collections and heritage preserved and accessible for future generations of researchers and general audiences.

Acknowledgments

PRISC is funded by EU program FEDER/COMPETE and *Fundação para a Ciência e Tecnologia* (FCT), project POCI-01-0145FEDER-022168. I am grateful to the PRISC members for the images included in this text.

Comments to the symposium discussion

Tsuyoshi Hosoya

National Museum of Nature and Science

There are already a number of initiatives in the natural history in Asia that are moving forward to the similar directions. Naturally, they have a number of duplications in their activities that are unnecessary or costly. To reduce such inconvenience, we need alliance. Alliance also means “helping each other”. The advanced should give hands to the developing. Since we already have a number of active groups, we need to align our activity in more concerted manner. In case of natural history collections, the data should be as opened as possible, following FAIR principle (Findable, Accessible, Interoperable, and Reusable), following international standard such as Darwin Core. Digitization should be promoted more widely to increase interoperability, thus promoting more alliance.

The symposium is

co-organized by both Kyoto University Museum, Kyoto University
and the Union of Japanese Societies for Natural History

co-sponsorship of Tokyo Geographical Society

supported by both Natural History Museum Network of Western Japan
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