

Abstracts – US Culture Collections Network Workshop May 19-20, 2014, State College, PA

Culture Collection Resources in Penn State's College of Agricultural Sciences

David M. Geiser, Fusarium Research Center, Dept of Plant Pathology and Environmental Microbiology

Vija Wilkinson, Mushroom Culture Collection and Spawn Lab, Dept of Plant Pathology and Environmental Microbiology

María del Mar Jiménez-Gasco, *Verticillium* Collection, Dept of Plant Pathology and Environmental Microbiology

Chobi DebRoy, *E. coli* Reference Center, Dept of Veterinary and Biomedical Sciences

Penn State's College of Agricultural Sciences houses a diversity of unique culture collection resources that serve research, discovery and education. You will hear about four of these collections at this meeting. Within the Department of Plant Pathology and Environmental Microbiology there are three significant collections: the Fusarium Research Center (FRC), the Mushroom Culture Collection and Spawn Lab, and the *Verticillium* collection. With over 20,000 accessions, the FRC houses the world's largest collection of cultures of *Fusarium*, a key group of pathogenic and economically important fungi. The Mushroom collection contains a diversity of mostly saprophytic macrofungi, particularly edibles, and spawn inoculum for commercial mushroom cultivation. The *Verticillium* collection contains a representation of the diversity of this important genus of soilborne plant pathogens, particularly of vegetative compatibility groups (VCGs) that facilitate assessment of pathogen populations. The Department of Veterinary and Biomedical Sciences houses the *E. coli* Reference Center, which houses over 70,000 strains of *E. coli* from humans, animals and the environment. Over the next two days, we will discuss the importance of these collections, the services provided, and their future prospects.

GE Organisms in the Culture Collection: What are the regulatory requirements?

John Turner, USDA APHIS, Washington DC.

APHIS regulates certain genetically engineered (GE) organisms under authority of the Plant Protection Act. Regulations at 7 CFR 340 require a permit or acknowledged notification for the importation, interstate movement, or environmental release of any organism covered by the regulations. The notification procedure is somewhat streamlined, but is limited to certain types of GE plants. Microorganisms subject to the regulations require a permit for the importation, interstate movement, or environmental release. Not all organisms are subject to the regulations. Most importantly, the regulations are limited to GE plant pests and other organisms if plant pests were used in the transformation process. Those who work with culture collections should be aware of responsibilities under the regulations, which may be relevant to how various specimens are shared, shipped, and maintained.

A Path to a National Plant Microbial Germplasm System.

Kevin McCluskey, Fungal Genetics Stock Center, University of Missouri, Kansas City

Growing out of the effort of an ad hoc group of concerned scientists in the American Phytopathological Society, the recent initiative to organize a National Plant Microbial Germplasm System had its first meeting at the USDA George Washington Carver center in Riverdale, MD during November of 2007. This workshop was jointly hosted by USDA APHIS and the APS. Subsequent meetings, both formal and ad hoc, led to the submission of a proposal for a Research Coordination Network grant from the US National Science Foundation. While this initial proposal was not selected for funding a resubmission in 2012 entitled "Research Coordination Network for a community of ex situ microbial germplasm repositories" was funded. Activities of this effort began with a meeting at the FGSC in fall of 2012 and have continued since. Meanwhile the APS Public Policy Board continues to advocate for support to fund and establish a network of collections. This is envisioned to parallel the US National Plant Germplasm System in that a linked network of smaller collections embedded in Universities or research stations and building upon the local expertise would be coordinated by a central administrative body which also coordinates formal off-site backup, up to date informatics and regulatory compliance.

Building TRUST, Implementing the Nagoya Protocol in Microbiology

Philippe Desmeth, President World Federation for Culture Collections, Brussels, Belgium

Since the mission of culture collections is to provide facilitated access to both technically and legally fit-for-use microbiological resources, it is not surprising that several initiatives to translate the Access and Benefit Sharing principles into practice were taken proactively in the culture collections community. The outcomes of these various initiatives represent a set of coherent and complementary tools to implement the ABS concept:

- The Code of Conduct **MOSAICC**ⁱ (Micro-organisms Sustainable use and Access regulation International Code of Conduct) listed on the website of the CBD.
- The **MOSAICS** Integrated Conveyance Systemⁱⁱ.
- The innovative concept of "**bundle of rights**"ⁱⁱⁱ.
- The design of "**microbial commons**"^{iv} for the exchange of (micro) biological material which would provide basic common use principles for access to both material and information.

Although developed before the Nagoya Protocol^v, they are relevant solutions for microbiologists. Furthermore, these solutions will be improved now that the Nagoya Protocol proposes a precise legal framework to abide by. In Europe the important role of culture collections, as well as other *ex situ* conservation facilities such as botanical gardens and museums, is recognized to the extent that it is included in the EU regulation via the concept of "registered sources".

Through the **World Data Centre for Micro-organisms (WDCM)**^{vi} databases system and the assignment of Identifiers specific to microbial items, WFCC contributes to build a transparent, safe and sustainable handling system of microbial diversity worldwide. A major programme has been launched by WDCM under the aegis of WFCC: the [Global Catalogue of Microorganisms \(GCM\)](#)^{vii}. GCM is a scientific tool and also a way to build safe and socio-economically balanced ABS processes at global level.

The World Federation for Culture Collections (WFCC) works towards the development of a system incorporating these developments, combining adapted legal concepts and bioinformatics.

TRUST

During the NITE BRC 10th anniversary Symposium "Impact of Nagoya Protocol on Management of Biological Resource Center" held in Tokyo, on 6 December 2012, several players in microbiology, including culture collections, have decided to build TRUST, literally and practically, because trust is a

prerequisite for lasting cooperation and because trust can be attained partly through transparent system of transfer of microbial material.

TRUST stands for TRansparent User-friendly System of Transfer for Science & Technology. It aims at managing the incidence of the CBD and Nagoya Protocol on the scientific, technical and administrative activities of culture collections, more generally, on the daily life of microbiologists.

TRUST is much more than a code of conduct. It is an integrated system having as backbone the Global Catalogue of Microorganisms and making use of the expertise gained by MOSAICC, MOSAICS, and other initiatives. The work programme comprises four activities:

1. Rearrange the findings of MOSAICC and adjust its logical flow chart to the structure of the Nagoya Protocol.
2. Refine specific procedure and make them more efficient in light of the past experience and additional Nagoya Protocol obligations.
3. Taking into account the latest developments in science, culture collections should
 - a) Make use of the latest ICT technology to develop necessary identification and tracking system; for scientific purposes first but also for any other bona fide ends.
 - b) Develop capacities of storage and processing of genomic, transcriptomic and metabolomic information. This compiled information improves definite characterization of microbial resources.
 - c) Conducted these efforts in conformity with NP provisions on Technology Transfer, collaboration and cooperation.
4. Considering the concept of "registered sources" as coined in the EU regulation implementing the Nagoya Protocol, culture collections have to develop an efficient strategy to deal with administrative handling of transfers of material, including the compulsory Prior Informed Consent. The concept of "registered sources" on ABS should be used by the culture collections community as a leverage to improve their and management capacities hence their reliability.

The TRUST work programme is executed with the voluntary contribution of experts having attended the NBRC workshop and the participation of other invited contributors. The latest TRUST workshop was held in Brussels on 15 and 16 May 2014.

Standards to Promote Data Interchange in the Life Sciences

George M. Garrity, Microbiology and Molecular Genetics Department, Michigan State University, East Lansing, MI and NamesforLife, LLC, East Lansing, MI

Although the principle role of culture collections and biological resource centers is to serve as repositories of biological materials, these organizations are also aggregators of a wide variety of information about the use and utility of the materials that they conserve. The potential value of this information has been the subject of considerable discussion within the research community, but relatively little progress has been made in developing data products that meet the needs of interested third parties. The barriers include the high cost of developing such data resources, the inability to join the highly variable and often incomplete information held in multiple collection databases, the inability to preserve data provenance, and a lack of infrastructure to make this information readily discoverable and available to potential end users (human and machine) at their point of need. The situation is not unique to culture collections, but part of a growing awareness of a need for biological data of all types to be readily available and usable for a variety of use cases. This discussion will focus on emerging data,

metadata, publishing and web standards and explore how collections might adopt these standards as part of their strategy in developing and delivering interoperable information products to the market.

Maintaining, Distributing, Building and Using the Phaff Yeast Culture Collection

Kyria Boundy-Mills, Curator, Phaff Yeast Culture Collection, University of California, Davis

The Phaff Yeast Culture Collection at UC Davis is the fourth largest collection of its kind in the world. It contains over 7,000 yeasts in the public catalog, belonging to over 800 different species, or roughly half of the known yeast species. Most strains were isolated by UC researchers including Herman Phaff, who collected yeasts around the world over a 58-year career, primarily from decaying plants and insects. The collection has survived and grown for over a century through a combination of serendipity, ingenuity, frugality and perseverance. Activities at the collection include:

- **MAINTENANCE:** A new NSF award will be used to perform a major overhaul of the collection, including validation of species by ribosomal sequencing, off-site storage, and building a more powerful database and website.
- **DISTRIBUTION:** Strains are distributed to users around the world for research in a broad range of basic and applied research such as comparative genomics, taxonomy, medical diagnostics, food spoilage, and biofuels. For example, over 100 strains were recently distributed for a major genome sequencing project in France. Visit the online strain catalog at phaffcollection.ucdavis.edu to explore the collection holdings.
- **GROWTH:** Deposits are accepted that build on the collection's strength in natural biodiversity. The collection is expanding through deposits, and internal studies such as insect-associated yeasts, olive spoilage and plant surface-associated yeasts.
- **RESEARCH:** Projects utilize the vast and deep biodiversity of the yeast collection, and start with screening large numbers of strains and species for promising characteristics such as utilization of certain carbon sources, tolerance of stresses, production of useful metabolites, or presence of certain gene homologs.

Examples of treasures in the collection include the original New Albion microbrewery yeast, wild parents of lab strain S288C, and "heirloom" wine strains from the 1940s. We have discovered yeasts that can convert cheap sugars to both intracellular oils, and secreted oils – the subject of a recently filed provisional patent that may revolutionize biofuels production.

Large numbers of undergraduate students have received training in the course of collection maintenance and research using the collection, and have gone on to jobs at food processing or biotechnology companies, and professional and graduate schools.

The Phaff collection faces challenges shared by other US culture collections, especially insufficient institutional and government support. Strategies to thrive and meet the needs of users have been developed through discussions with other culture collections in the US and around the world, a business plan, and consultation with the collection's Advisory Board. Future goals include becoming ISO certified, and increasing collection visibility and strain distribution.

The UC Davis Wine Microbe Collection

C.M. Lucy Joseph, Curator and Linda F. Bisson, Faculty Director, University of California, Davis

The UC Davis Department of Viticulture and Enology Wine Yeast and Bacteria Collection supports the teaching and research mission of the department, distributes strains worldwide, and archives commercial strains for future reference. The collection includes both commercial and spoilage organisms from fermented beverages and food products as well as other wild and laboratory research strains.

Basic funding comes from the College of Agriculture and Environmental Sciences and the V&E department, supplemented with funds from strain distribution, identification of spoilage organisms, and research grants. Researchers and commercial entities interested in wine and other fermented beverages and foods use the collection. Those who are involved in fields, such as evolution and ecology, where a large number of isolates of a single species is important have found the collection useful. We have approximately 500 *Saccharomyces cerevisiae* and more than 100 *Brettanomyces bruxellensis* strains that are considered wild yeasts as opposed to lab strains. The collection concentrates on maintaining a large number of isolates of a few commercially important species rather than a wide diversity of species.

Role of Networks of Culture Collections in Sharing Materials and Data and Possible Legal Harmonization Solutions

Arianna Broggiato and Tom Dedeurwaerdere, BIOGOV Unit, Centre for the Philosophy of Law (CPDR), Université catholique de Louvain, Louvain-la-Neuve, Belgium

In late 2013 and early 2014 a survey has been administered to the different networks of culture collections worldwide to gather information on access and dissemination of microbial cultured materials, DNA materials and data in the era of microbial genomics. The study analysed the size, provenance and destination of materials exchange and the motivations that lead to exchange and to further redistribute them. Internal institutional policies national ABS regulations have also been investigated to reveal their influence in sharing materials. The survey then investigated the patterns and timing of contributions of scientists to databases, and the related motivations

The 191 answers show the impact of network membership on redistribution by culture collections. The results of the study are further stimulating the legal research on the more appropriate standard agreements that would further widen availability of research results for the whole microbial scientific community. The principles that are analysed are: an innovative conception of non-commercial research based on public domain conditions, together with the “change of intent” clause triggering a re-negotiation process; and the viral license for transfer to third parties.

Implementing an MTA System for Global Scientific Sharing.

Anthony Cova, Addgene, Cambridge, MA

Addgene is a non-profit plasmid repository dedicated to helping scientists share their research materials. Much of Addgene's success is attributable to its focus on the needs of its researchers and the concerns of their technology transfer offices. This talk will discuss how Addgene has implemented and will continue to evolve its MTA system to account for these needs and concerns.

The MIRRI System for Insuring Regulatory Compliance

David Smith, MIRRI Steering Committee, CABI, Egham, UK

The overall goal of the Microbial Resources Research Infrastructure (MIRRI)¹ is to define the most appropriate pan-European distributed Research Infrastructure for supporting academia and bio-industry research with a broad range of state of the art authenticated reference material, associated data and advanced services to allow high quality research, development and application. This must be done in a regulatory compliant way. The delivery of this infrastructure is based on the commitment of its members to coordinate and expand holdings according to collection strength and user needs, to provide a high-quality standard among partner collections, to broaden services and data offer, and to provide a common hub platform for legal and technical advice to partners and the user community. MIRRI aims to design an open access facility with the legal status of a European Research Infrastructure Consortium (ERIC).

The establishment of the criteria for MIRRI membership will be on the management, sustainability, quality standards, etc. outlined in the OECD best practices guidelines for Biological Resource Centres² and in particular cover aspects such as:

- requirements imposed by the proposed legal structure
- proposed requirements regarding quality management, data interoperability, or risk assessment
- regulations concerning ABS/Nagoya protocol

Public resource centres are impacted by a whole array of legal issues and must coordinate its members to adhere to regulations concerning intellectual property rights, access and benefit sharing (ABS), and use of material transfer agreements (MTA) according to the Convention on Biological Diversity (CBD) and the Nagoya Protocol (NP) and to rules and regulations with respect to biosafety and biosecurity³.

The activities included

- MIRRI minimum requirements for compliance with the EU ABS regulations and national requirements; maintain dialogue with national focal points to influence decision making processes on key issues regarding microbial resources;
- Survey on gap analysis concerning biosecurity regulations in MIRRI partner collections
- Capacity building processes such as information resources to facilitate member compliance and best practice

MIRRI will play an important role as ‘European Registered Collections’, as advisors of stakeholders in the above mentioned issues at the national and European level and it will have an educational role in informing researchers about the mandatory adherence to the articles of the CBD and in other regulatory areas governing access, handling and use of microorganisms⁴.

¹Schüngel, M., Stackebrandt, E., Bizet, C. & Smith, D. (2013). MIRRI - The Microbial Resource Research Infrastructure: managing resources for the bio-economy. *EMBnet.Journal* 19.1, 5-8. (<http://journal.embnet.org/index.php/embnetjournal/article/view/706>)

²OECD (2007) OECD Best Practice Guidelines for Biological Resource Centres.

<http://www.oecd.org/health/biotech/oecdbestpracticeguidelinesforbiologicalresourcecentres.htm>

³Christine Rohde, David Smith, Dunja Martin, Dagmar Fritze, and Joost Stalpers (2013). Code of Conduct on Biosecurity for Biological Resource Centres: procedural implementation. *International Journal of Systematic and Evolutionary Microbiology* **63**, 2374-2382.

http://ijs.sgmjournals.org/content/63/Pt_7/2374.long

⁴Smith D, Fritze F, Stackebrandt E (2013) Public Service Collections and Biological Resource Centres of Microorganisms. . In: Rosenberg, E., De Long, E.F., Lory, S., Stackebrandt, E. and Thompson, F. (eds.) *The Prokaryotes - Prokaryotic Biology and Symbiotic Associations*. Springer-Verlag Berlin, Heidelberg, p. 267-304.

Preserving the Preservers; Developing Sustainability for the FGSC.

Aric Wiest, Fungal Genetics Stock Center, University of Missouri, Kansas City

The FGSC has been continuously funded by the NSF for more than 50 years. Recently, a change in the available award amounts has forced us to reexamine our revenue sources. Our modest fee structure has been adjusted and we are examining ways to diversify our revenue stream, including: safe storage, microbial preservation courses, and sample identification services. Other changes include moving to a prepayment system and scaling back our new investigator program. Finally, Institutions willing to provide salary support have been invited to make formal offers to host the FGSC for the future. To avoid gaps in staff continuity offers are requested to be made to the FGSC board by May 31st, 2014.

The University of Minnesota Mycological Culture Collection: An Introduction

Scott T. Bates, Curator of Fungi, Bell Museum of Natural History, Dept of Plant Pathology, University of Minnesota

The University of Minnesota Mycological Culture Collection was initiated by Drs. David McLaughlin and James Groth in 2002. The goal of the collection is to provide long term maintenance of strains used in a variety of studies at the University. It incorporates historical strains beginning in the 1940's as well as strains from a wide geographic area, including the tropics and Antarctic. The collection contains over one thousand isolates spanning five phyla in the Eumycota, as well as Chromistan fungi in the

Oomycota. The strains include yeasts, endophytes, agaricoid, boletoid, coralloid, and polyporoid taxa, as well as many species in the Pucciniomycotina and plant pathogenic and lichenized Pezizomycotina. Cultures from the collection represent type strains, have been used in genetic, phylogenetic and ultrastructural studies, serve as vouchers for the Assembling the Fungal Tree of Life project, and test strains for alfalfa and rose breeders.

Updates from the Culture Collection of the Center for Forest Mycology Research (CFMR)

Daniel L. Lindner and Jessie Glaeser. U.S. D.A. Forest Service, Madison, WI

The Center for Forest Mycology Research (CFMR), U.S. Forest Service, Northern Research Station, Madison, WI, is the home of one of the largest collections of wood-associated fungi in the world. The culture collection currently contains approximately 20,000 living cultures representing 1,600 species of fungi. All isolates are maintained in liquid nitrogen storage, but a “working collection” of cultures is stored in sterile distilled water at 4oC. Cultures derived from tropical fungi are more sensitive to cold temperatures and are maintained in sterile distilled water at 10 oC. Cultures remain viable in water storage for about eight years; the cultures are routinely grown on solid media, checked for contamination, and then returned to water storage over an 8 year cycle. An associated herbarium maintains dried specimens of fruiting bodies from which many of the cultures are derived. In a typical year, CFMR sends out 700 – 800 fungal cultures to other research laboratories. Information about the collection and a link to the searchable database can be found at <http://www.fpl.fs.fed.us/research/centers/mycology/culture-collection.shtml>. The CFMR is working to modernize its collections database so that all information is available via the internet; to date, all cultures and approximately 90% of herbarium specimens have been entered into an electronic database.

Update on the Status of NRRL

Todd J. Ward, Bacterial Foodborne Pathogens and Mycology Unit, USDA-ARS, Peoria, IL

The Agricultural Research Service (ARS) Culture Collection (also known as NRRL) in Peoria, IL, maintains more than 95,000 strains of agriculturally and industrially important bacteria and fungi. Most of these isolates are maintained in an open collection that distributes 6,000 – 8,000 strains annually in response to requests from scientists in the U.S. and around the world. NRRL recently received a funding increase to enhance existing foodborne pathogen collections and to acquire new foodborne pathogen collections as appropriate. This will enable us to improve staffing for the collection. However, maintenance of scientific capacity and expertise for major portions of the collection that are important to microbiological research areas outside of food safety remains a major concern. In response to the recent OSTP memo on scientific collections, ARS has put together a team to formulate agency policy. NRRL scientists are contributing to this effort along with representatives from plant, animal, insect, weed, parasite, and other microbial collections within ARS.

***E. coli* Reference Center, Department of Veterinary and Biomedical Sciences,**

Chobi DebRoy, *E. coli* Reference Center, The Pennsylvania State University, University Park, PA 16802

E. coli Reference Center (ECRC) at Penn State has the largest collection of *Escherichia coli* strains in North America. It has more than 80,000 strains that have been collected over the last 50 years from humans, bovine, porcine, avian and many other exotic species from all over the world. They are mostly clinical isolates from hosts that have been diagnosed with disease. The source of the isolates, geographic locations, tissue, year of isolation, sex and age of the host, and disease diagnoses, are documented. The strains are also characterized for their serotype and presence of virulence genes. All characteristics are recorded in Access database that can be retrieved easily. The strains are utilized by scientists for studying antimicrobial resistance, for evolutionary studies, for determining trends in virulence and pathogenicity and for research. They have been also used by companies to develop products. Complete

genome sequences of many of the pathogenic strains have been conducted in collaboration with J. Craig Venter Institute and Institute of Genome Sciences in Maryland. The sequences have been submitted to Gen Bank. Many publications on emerging diseases and outbreaks of resistant strains were generated that utilized the culture collection. The ECRC resource is heavily exploited by both academic and industrial community.

Building TRUST, Implementing the Nagoya Protocol in Microbiology

- ⁱ [MOSAICC](#) recommendations facilitate access to microbial genetic resources (MGRs) and help partners to make appropriate agreements when transferring MGRs, in the framework of the (CBD) and other applicable rules of international and national laws.
- ⁱⁱ [MOSAICS](#) stands for “Microorganisms Sustainable use and Access management Integrated Conveyance System”. It was funded by Directorate General Research of the European Commission under the Sixth Framework Program. The consortium of the MOSAICS project is made of partners from developed and developing countries, including culture collections, international organizations, branch federations and specialized research institutes. Already in 1999, the MOSAICC project had identified three necessary features for a system to implement coherently the CBD provisions on ABS. MOSAICS central objective is the development of such an integrated conveyance system that:
- has reliable tools to evaluate the economic value of microbiological resources ([EVA](#))
 - disposes of validated model documents with standard provisions to enable tracking via an uncomplicated procedure, widely applied by microbiologists ([ADAM](#))
 - combines valuation and tracking in one system for trading of microbiological resources, with balanced benefit sharing for those that are entitled to be rewarded for the services and products they provide to society ([ICS](#)).
- ⁱⁱⁱ The innovative concept of “bundle of rights” is a dynamic model of ownership management moving away from the static concept of ownership towards a flexible allotment of rights. Ownership constitutes a “bundle” of use and decision rights that are attributed to a number of stakeholders / economic agents. It is a set of operational and collective choice rights defining respectively who decides upon the use that one can make of a resource, and who decides upon the future exercise of the rights on the resource. Such scheme allows multi-ownership of a gradual level of use and decision rights. These rights can begin with basic access rights, encompassing research delivering outputs to the public domain, distribution on to third parties, exploitation rights to develop intellectual property and its ownership which may include reach through rights. Furthermore, the application of the “bundle of rights” makes possible the enforcement of the “sovereign rights of States over their natural resources” without prejudice to private rights. Unambiguous allotment of rights in advance will facilitate rightful benefit sharing “at the end of the pipe”. Dedeurwaerdere Tom. [Understanding ownership in the knowledge economy: the concept of the bundle of rights](#). BCCM News Edition 18 - Autumn 2005.
- ^{iv} This development will be complementary to the national regulations on ABS and to existing IPR laws, as it will constitute a demarcated space where material and information are relatively freely accessible provided that the outputs is injected back in this open space, to be shared again. Inside this space access and benefit-sharing are “commonly shared”. Outside this demarcated space, access and benefit-sharing will be ruled through ordinary national and international laws, including IPR and specific CBD inspired regulations. See <http://www.thecommonsjournal.org/index.php/ijc/article/view/215/144>
- ^v After 10 years of negotiation, the Nagoya Protocol on Access and Benefit Sharing (ABS) was adopted by the Conference of the Parties of the Convention on Biological Diversity (CBD) on the 30th of October 2010. The objective of this Protocol is to implement the principles imbedded in articles 15 and 8(j) of the CBD. The Protocol rules the fair and equitable sharing of the benefits arising from the utilisation of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of benefit. See <http://www.cbd.int/abs/text/default.shtml> for the text of the Protocol.
- ^{vi} The World Federation for Culture Collections (WFCC) has developed a pioneering database system by registering its members through a unique acronym and numerical identifier in its official list and urging them to catalogue their microbiological resources. This system is maintained and improved by the World Data Centre for Micro-organisms ([WDCM](#)). Combining the WDCM system and the use of more recent technology of electronic markers called “[Globally Unique Identifiers \(GUIDs\)](#)” set up a robust system to organise transfers of (micro) biological items, tracking the flow of resources and related information. This system also facilitates the application of ABS since it can potentially retrieve all kinds of information about microbiological resources, including information related to the location and movements of the resource. Combining the WDCM system and the use of more recent technology of electronic markers called “Globally Unique Identifiers (GUIDs)” set up a robust system to organise transfers of (micro) biological items, tracking the flow of resources and related information. The WDCM portal acts as an information broker between all online catalogue entries of the culture collections. See <http://www.wdcm.org> and http://bccm.belspo.be/projects/mosaics/reports/files/ics_report.pdf7.
- ^{vii} The increasing demands on culture collections for authenticated, reliable biological material and associated information have paralleled the growth of biotechnology. In the WFCC guidelines, it is pointed out that collections should publish online or printed catalogue regularly to disseminate information of strains to promote scientific and industrial usages of holdings. However, according to the statistics, only nearly one-sixth of collections registered in [CCINFO](#) have their online catalogue, which greatly hinders the visibility and hence the accessibility of strains. WDCM will construct a data management system and a global catalogue to help organize, unveil and explore the data resources of its member collections. The WFCC Global Catalogue of Microorganisms is expected to be a robust, reliable and user-friendly system to help culture collections to manage, disseminate and share the information related to their holdings. It also provides a uniform interface for the scientific and industrial communities to access the comprehensive microbial resource information.