Report for the first meeting of the Research Coordination Network (RCN) for a community of ex situ microbial germplasm repositories.

With outreach, discussion, and planning sessions across three days, the first meeting of US culture collection scientists, supported by an NSF RCN grant (1203112), was held at the University of Missouri- Kansas City on September 5 - 7, 2012.

Outreach Event (September 5)

The first event for this RCN was an outreach session to present culture collection careers to local high school and undergraduate students. Entitled "Biological Resource Centers: Careers as science professionals," and publicized through the Kansas City STEM Alliance and KC Science Pioneers, this event was attended by over 50 high school students from at least six local high schools.

The six speakers at this event who are curators and laboratory directors described their collections, various uses of these collections, and paths to careers in collections. Additionally, attendees learned of opportunities for student participation in internships at the Fungal Genetics Stock Center and about the Department of Energy, Joint Genome Institute (JGI) - Adopt a Genome program. The program was captured on video for development as a potential short video or webinar and this development is ongoing.

The speakers and their topics were:

Kevin McCluskey, Curator, Fungal Genetics Stock Center, Kansas City, MO
Fungi in research, industry, food, and pharmaceutical production.

Kyria Boundy-Mills, Curator, Phaff Yeast Collection, Davis, CA
Yeast are used to make bread, wine, beer and all alcoholic spirits.

Jonathan White, Scientist, MRIGlobal, Kansas City, MO
MRI Global National Cancer Institute GMP Drug repository

Alex Idnurm, Assistant Professor, UMKC US DOE Joint Genome Institute
Adopt a genome program

David Smith, Director of Biological Resources, CAB International, Surrey, UK
Microbe collections are the foundation of the coming bio-economy.

Willie Wilson, Director, National Center for Marine Algae and Microbiota, Boothbay, ME
Collections of algae for biofuels, industry, and the environment

After the session nine students applied for an internship program at the FGSC and three students were invited to participate in this program which will take place in December 2012 through January 2013.
The students are Renee Henderson (Blue Springs South High School), Daniel Barchers (Truman High School), and Muriel Eaton (Blue Valley North High School).

Planning and Discussion Sessions

(Thursday September 6 and Friday September 7)

Thursday workshop

We convened at the UMKC Student Union at 1:00 and had a series of presentations. The participants included the following:

Rick Bennett	University of Arkansas
Kyria Boundy-Mills	UC Davis Phaff Yeast Collection
Robert Bull	Federal Bureau of Investigation
William Dolezal	Pioneer Hybrid
David Ellis	USDA National Center for Genetic Resources Preservation
Kellye Eversole	American Phytopathological Society
Daphne Fautin	National Science Foundation
David Geiser	Pennsylvania State University, Fusarium Research Center
Jessie Glaeser	USFS, Center for Forest Mycology Research
Jeffrey Jones	University of Florida
Seogchan Kang	Pennsylvania State University,
Michal Krichevsky	US Federation for Culture Collections
David Labeda	USDA NRRL Collection
Jan Leach	Colorado State University
Kevin McCluskey	UMKC, Fungal Genetics Stock Center
Joe-Ann McCoy	NC Arboretum
Ulrich Melcher	Oklahoma State University
Scott Miller	Smithsonian Institute
David Nobles	University of Texas Algal Collection
Jill Parsons	Ecological Society of America
Angela Records	American Phytopathological Society
Hannah Reynolds	University of Akron, Cave Microbe Collection
David Smith	CABI and the World Federation for Culture Collections
Marci Smith	American Phytopathological Society
John Wertz	Yale, *E. coli* Stock Center
William Wilson	Bigelow labs, National Center for Marine Algae
Daniel Zeigler	Ohio State, *Bacillus* Stock Center
Aric Wiest	UMKC, Fungal Genetics Stock Center

The agenda for the afternoon presentations was as follows:

- Ted White, Interim Dean, UMKC- School of Biological Sciences. Welcome
- Kevin McCluskey, FGSC - Inauguration of the network and collaboration
- Jeff Jones, University of Florida - History of APS/USDA ad hoc culture collection network

- David Geiser, Penn State University, Private and University collections
- Scott Miller, Smithsonian Institution - Living collections in a broader national and international context
- Daphne G. Fautin, NSF – Support for Living Stocks collections in the US
- Jill Parsons, Ecological Society of America- Shared goals
- Seogchan Kang, PSU- Data systems and culture collections
- Willie Wilson, NCMA - Tech transfer opportunities
- Robert Bull, FBI - Forensics and culture collections
- David Smith, MIRRI - The EU experience
- Rick Bennett, University of Arkansas - Towards a National microbial germplasm system

After a break, the following presentations were made under the heading "Culture Collection Success Stories"

- Mike Plamann, Director FGSC, Introduction
- John Wertz, *E. coli* stock center, Yale University
- Kyria Boundy- Mills, Phaff Yeast Collection, University of California, Davis
- Dave Ellis, USDA National Center for Genetic Resource Preservation, Fort Collins, CO
- David Labeda, USDA National Center for Agricultural Utilization Research Collection
- Hannah Reynolds, University of Akron cave microbe collection
- Jessie Glaeser, USDA Center for Forest Mycology Research, Madison Wisconsin
- Dan Ziegler, Bacillus Stock Center, Ohio State

Issues discussed included the possibility of collaborative publication, the identification of the large number of stakeholders in any national collection system, and the engagement of these stakeholder groups. Stakeholders included non-profit researchers, pharmaceutical and other industrial researchers, agricultural researchers, and plant breeders.

Abstracts from the presentations are attached to the end of this document.

Friday workshop – September 7, 2012

On Friday morning, we convened at the School of Biological Sciences conference room proximal to the Fungal Genetics Stock Center laboratory. The topics for this working session included organization of the next meeting, scheduling workshops, and developing a curriculum for the workshops.

To accommodate participants who needed to leave after lunch, the agenda was adjusted so that the discussion of the next meeting was moved to the first item. Participants agreed that the next meeting will be held in early September 2013 in Boothbay Harbor Maine. It was emphasized that this meeting should not conflict with the International Conference on Culture Collections September 23 – 27, 2013 in Beijing, China.

We next discussed workshops and the intended audience. The point was made that we need to educate the next generation of scientists/curators and that they were the likely audience.

The Fusarium Laboratory Workshop organized by John Leslie at Kansas State University was described as a good model. This workshop is one week in duration and attracts between 25 and 45 students from academia and industry. Practical, hands-on identification using morphological, physiological and molecular characters is emphasized.

The duration of a potential teaching workshop was debated. The general consensus was that a short session was not valuable and that having a session appended to a society meeting was difficult because the entire meeting got too long. This is based on the suggestion that 3 days are needed to teach basic collection practices. The possibility of giving continuing education credit for participating in workshops was raised. Because we are not accredited, we discussed issuing a "certificate of participation" in lieu of formal continuing education credit.

The "managing microbes" teaching modules developed by CABI were presented as being useful for comparison, if not directly implemented as a curriculum. These have the advantage of already having been implemented. http://www.cabi.org/Uploads/File/elearning-managingmicrobesleaflet.pdf

Three break-out groups were organized: Basic Techniques/curriculum, Databases and Networking, Impact

Reports were made by each group.

The Database report was made by Ulrich Melcher.
Lack of uniformity is seen as the most significant issue underlying database interrelateability.
A common vocabulary is more important than particular software differences. Different attribute lists were suggested including the RKG code, the NCBI attribute lists, or the CABI vocabulary. Since there was noone present from the World Data Centre for Micro-organisms, or from straininfo.net, these perspectives were not included in the analysis.
Other topics included what information should be required from the depositor of any material, and from requestors of material. Taxonomic information was considered paramount, but consideration should also be made for genomic information.

The report of the Basic Techniques/Curriculum group was made by Dave Ellis.
Basic techniques that can only be taught in a laboratory should be emphasized. The ability to do this requires that the group not be too big. The ideal size would be fewer than 25 students and 3 - 4 instructors. The target audience should be small and medium sized collections.
The program of the CABI training courses and e-learning modules were presented by D. Smith. It was suggested that we explore opportunities to disseminate training videos via the "Journal of Visual Experiments." The online videos published by the FGSC and hosted on YouTube were also described as an alternative.

The database structure used at the CGRC was offered to smaller collections and could be used via a http protocol. It was emphasized that some data was mandated by published best practice guidelines.
Teaching culture practices for preservation, preservation methods, characterization and quality assurance practices were emphasized as important. Distribution was discussed in regards to best practices such as third-party requests, end-use restrictions, packaging, denied parties and permit requirements.

The Impact group report was made by Angela Records.
In contrast to the Curriculum group, it was agreed that short specialized workshops could be valuable and the following were suggested as examples:

- Capturing Success Stories: A half-day session geared toward teaching collection managers techniques for capturing success
- Collections Overview: A workshop aimed toward educating industry, policymakers, and other stakeholders about culture collections

They emphasized that we need to develop strategies to inform the NSF of special needs of the RCN and the participating collections.

The preservation of existing material, for example in orphaned collections, needs to be done in a manner that permits backup or transfer of the material.

The main conclusion of the Impact group was that a consortium is the next-step after the RCN and they defined goals of this consortium which included carrying on the activities of the RCN as well as developing a strategic plan for funding the consortium. They also wanted to develop a set of document templates to promote the activities of the consortium. These documents included the following: jobs, publications, industries, education, cost avoidance, capture of economic impacts, impact of proper training, and future success stories.

For future progress, three working groups were established:

Curriculum	Databases	Impact
Kevin McCluskey, chair	Seogchan Kang, chair	Angela Records, chair
David Smith, co-chair	John Wertz	Jessie Glaeser
John Wertz	Ulrich Melcher	Kellye Evesole
Micah Krichevsky	Micah Krichevsky	David Geiser
David Nobles	David P. Labeda	Kyria Boundy- Mills
Bill Dolezal		Jeff Jones
Hannah Reynolds		Jan Leach
		Jill Parsons
		Dave Ellis

Additionally, a committee on endangered collections was established. This was made up of K. McCluskey, R. Bennett, and Dave Ellis. This committee will promote back up storage at the National Center for Genetic Resource Preservation at Ft. Collins, Colorado. It will also work with the World Federation for Culture Collections Endangered collection working group, as needed.

Laboratory Site Visits

On Thursday morning, Drs. Boundy-Mills and McCoy visited the FGSC laboratory and viewed the collection. Following a demonstration of flame sealing of a vacuum sealed ampoule, both visitors took the opportunity to perform and practice this protocol.

During lunch, breaks, and after the conclusion of the formal program on Friday, most participants visited the FGSC laboratory. Because of the relatively small area, these tours were limited to four or five people at any one time.

People who visited the FGSC laboratory:

K. Boundy- Mills, J. McCoy, W. Wilson, J. Wertz, D. Nobles, J. Glaeser, D. Zeigler, S. Kang, D. Labeda, D. Ellis, D. Smith, J. Leach.

While not formally part of the program Dr. David Smith of CABI, Surrey, UK and past president of the WFCC visited the FGSC laboratory on Saturday, September 9. The visit included a tour and demonstrations of some of the most simple techniques, as implemented at the FGSC. These techniques included preservation, organization and record keeping.

Abstracts from the first meeting of the Research Coordination Network for a community of ex situ microbial germplasm repositories.

9/6/12

A research coordination network for a community of *ex situ* microbial germplasm repositories
Kevin McCluskey, Fungal Genetics Stock Center, University of Missouri- Kansas City.

As the culmination of several years of concerted effort, we were recently awarded a grant from the US National Science Foundation to provide a forum in which collection curators and managers could interact. This meeting is the first of several planned activities of the RCN Grant.
While the specific outcomes of the grant are expected to be these meetings, workshops to teach collection management, and an online archive of methods and protocols, the measures by which Research Coordination Networks are judged is by their ability to spawn interdisciplinary activities and publications. To that end, we will encourage interaction in the formal activities of the RCN and also in spin-off activities such as projects designed to add value to collections, authorship on joint publications, and added value products such as webinars and promotional media.

The APS standing committee on culture collections
Jeff Jones, University of Florida, Plant Pathology Dept., Gainesville.

An American Phytopathological Society standing committee was formed in 2005 to assess and provide specific recommendations on the status and future prospects of culture collections of plant pathogens. This committee was asked to consider collections at the local, regional, and international levels. The key questions asked of the committee were: 1) What needs to be done to ensure a comprehensive, systematic, catalogued and affordable culture collection of plant pathogens? 2) At the local and regional levels, what should be done to inventory, publicize, and make accessible to researchers cultures from specific collections? What should happen to endangered or orphaned collections when the curator retires or can no longer provide for the collection? 3) At the international level, can there realistically be a centralized worldwide collection of plant pathogen cultures readily available to researchers at nominal cost, for example, through subsidies to the collection from national governments? What impact would this have on national collections? 4) Are we educating enough taxonomists in the USA to provide for the needed skills to ensure national expertise in microbial taxonomy and phylogeny in the future? There was a consensus from the committee relating to question 1 that a national collection of plant pathogens is necessary in the United States to ensure maintenance of culture collections that represent a broad phenotypic and genotypic diversity. APS was involved in developing a workshop entitled "A National Workshop on Culture Collections: Ensuring the Availability of Essential Research Resources on Microbes." The workshop included broad input primarily from the plant pathology research community for defining critical National Culture Collection System (NCCS) components, structure, implementation and possible interface strategies for potential international culture collection system efforts. As a result of this meeting a National Plant Microbial Germplasm System (NPMGS) concept was developed which would be composed of distributed expert curated, taxon specific repositories linked through a searchable database similar to the National Center for Biotechnology Information (NCBI). A central repository to house backup cultures and receive decommissioned collections would be established. This network of linked collections would assure that reference strains are no longer lost and that they are readily available for facilitating comparative research, especially of emerging pathogens.

Culture Collection Resources at the Fusarium Research Center at Penn State University
David Geiser, Pennsylvania State University

The Fusarium Research Center was founded at Penn State University in 1970 by Paul E. Nelson. A key resource of the FRC is the FRC culture collection, which consists of over 20,000 accessions of Fusarium cultures. Accessions include plant pathogens, mycotoxin producers, human pathogens, and saprophytic isolates from a wide variety of substrates, from over 100 countries on all continents except Antarctica. Collection services include storing and distributing cultures to authorized researchers, identification of isolates using morphology and molecular means, training, and supplying specialized medium components. Collection services were supported by a single FTE provided by the College of Agricultural Sciences; this position was not refilled upon the retirement of Jean H. Juba in 2011. The FRC collection is therefore at a critical juncture, looking to participate in a more secure network model that will allow enhanced culture collection services.

Living Microbial Collections in a Broader National and International Context
Scott Miller, Smithsonian Institution

We take a quick tour through the "alphabet soup" of acronyms involved in policies that influence the development and management of scientific collections. At a national level, the Interagency Working Group on Scientific Collections (IWGSC) and Interagency Microbial Forensics Advisory Board (IMFAB) are active, and the IWGSC is helping implement the federal collections policy mandates of the America COMPETES Act. National Science Foundation is assisting with parallel activities in the non-federal collections, including digitizing biological collections. Several international Conventions are especially relevant to collections, especially the Convention on Biological Diversity (CBD), the International Plant Protection Convention (IPCC), and the International Treaty on Plant Genetic Resources for Food and Agriculture. The CBD encourages development of collections (Article 9b) and has a Global Taxonomy Initiative. The CBD's Nagoya Protocol on Access and Benefit Sharing (ABS) requires countries to create national level regulations for biomaterial transfer, but encourages simplified measures for non-commercial research (Article 8a). The OECD Global Science Forum has just launched SciColl, a new international initiative to help network and strengthen scientific collections.

NSF support of non-federal living stock collections in the US. Daphne G. Fautin, Division of Biological Infrastructure, National Science Foundation

NSF has supported living stocks collections at least since 1960. At some times, living stocks grants have constituted their own program, but at some periods (as now) they have been part of a larger one. The Collections in Support of Biological Research program currently includes grants that fund collections of living microbes, plants, invertebrates, and vertebrates. Because the collections that are supported provide material for research by NSF grantees (as well, of course, as others, including those who seek NSF funding), as research has changed, the stocks that are supported have done so as well.

Developing and Innovating Living Stocks Collections
Jill Parsons, Ecological Society of America (ESA)

As part of ESA's efforts to promote the continued development of ecological science, ESA hosted a workshop on Strategies for Developing and Innovating Living Stocks Collections, with support from the National Science Foundation (NSF) and in partnership with the Meridian Institute and Tom Berger of the National Children's Museum. The August 2012 workshop brought together 34 managers of living stocks collections and other stakeholders to address the challenges of collection sustainability, development, and innovation. Participants explored the value of long-term strategic planning, identified common challenges and opportunities in the living stocks community, identified potential investments to enhance collection sustainability, and developed recommendations for next steps and continued information exchange and collaboration among living stocks collections. Suggestions for next steps included: 1) Establishing a venue for collections to clarify ownership issues, 2) Securing funding to support gathering information that demonstrates research impacts and innovation, 3) Requesting support for developing community resources, and 4) Establishing more communication and information sharing among living stocks collections, with an aim to identify best practices.

Informatics tools that support the curation of microbial collections and associated data: Lessons learned from Fusarium and Phytophthora.

Seogchan Kang, Department of Plant Pathology & Environmental Microbiology, Penn State, University Park, PA 16802

Microbial culture collections connect past, present, and future research endeavors by curating key research specimens and associated data in a format that makes them widely available. To fully realize the value of culture collections in advancing science, we should go beyond mere physical preservation of captured microbial diversity and research products. These collections must be connected intimately to active research programs and their associated expert personnel so as to ensure their continuous growth in value and content. Given the need for maintaining and integrating diverse and large datasets to support research communities, it is essential to establish a robust and user-friendly support cyberinfrastructure. Using projects on the genera Fusarium and Phytophthora as examples, I will present challenges and opportunities in building such a cyberinfrastructure.

Provasoli-Guillard National Center for Marine Algae and Microbiota (NCMA), (formerly National Center for Culture of Marine Phytoplankton – CCMP)

Dr. Willie Wilson, Bigelow Laboratory for Ocean Sciences, wwilson@bigelow.org

The NCMA is a non-profit organization that serves as a central repository to receive, maintain and distribute living cultures of algae. Spanning a broad diversity and holding approximately 3700 strains it represent the world's largest biorepository dedicated to marine algae. The core activity of the NCMA is to supply between 3000 – 4000 cultures each year to scientists, educators, biomedical researchers, and businesses worldwide. It provides a wide range of additional services including sales of growth medium, sales of nucleic acids, algal culturing techniques courses, private collections, algal characterization, screening services, scale up and biomass production, participation in sponsored research projects and a wide range of research services tailored to individual commercial objectives. Arguably the NCMA's biggest strength is just to be there to provide unbiased and unconditional advice on how to grow algae.

European microbial resource collections driving innovation and discovery: Microbial Resources Research Infrastructure

David Smith, CABI, Egham UK; d.smith@cabi.org

There have been many initiatives, projects, societies, networks, research programmes and institutions in the field of preservation of microbial resources. A plethora of acronyms are before us MINE; CABRI; EBRCN; EMbaRC; GBRCN; MIRRI; ABRCN; ISBER; BCCMTM; SBMCC; CCCCM; FCCM; CCRB; SCCCMOMB; KFCC; FORKOMIKRO; JSCC; PNCC; PNCM; TNCC; UKFCC; UKNCC; ECCO; WFCC; WDCM; ESFRI; BBMRI; EMBRC (see http://www.wfcc.info/collections/ for the expansion of these acronyms). They have delivered many useful contributions to the scientific community but the effort has been fragmented and often based upon voluntary contributions or short-term projects. Individual collections have worked with bioindustry to get solutions and products on the market see EMbaRC microbial resource success stories www.embarc.eu/embarc-update-16.pdf. The World Federation for Culture Collections (WFCC) and its World Data Centre for Microorganisms (WDCM) does a fantastic job to guide us through this myriad of institutions, organisations and initiatives. But just think if we could coordinate and increase output by working more closely with the users. What is needed is a coordinated network with common access, strategies, policies and delivery to facilitate research and innovation, providing a conduit to make best use of their potential. Microbiological resource centres must engage with their users and involve them in resource development and governance. The European Strategy Forum for Research Infrastructures (ESFRI) establishes pan-European structures to drive innovation and provide the resources, technologies and services necessary to underpin research, ensuring improved pathways to discovery. The Microbial Resource Research Infrastructure (MIRRI) www.mirri.org has been established on the ESFRI roadmap. Linking MIRRI to initiatives in Asia, Africa, South America, the USA and elsewhere gives us the infrastructure for the Global Biological Resource Network (GBRCN) - networking networks.

Progress Report – Are We Closer to Establishing a National System of Microbial Culture Collections?
A. Rick Bennett, University of Arkansas

The NSF Research Coordination Network of ex situ microbial germplasm repositories and the formation of the United States Culture Collection Network is an important step in long-term goals of implementing a National Plant Microbial Germplasm System (NPMGS). The NPMGS, as envisioned, will be a coordinated system of federal, university and industry microbial repositories linked through a searchable cyber database with a central repository to maintain back-up collections. The infrastructure for the system will be built on active, existing programs at academic and federal institutions, and national programs such as the U.S. National Plant Germplasm System and the Global Germplasm Resources Information Network (GRIN-Global). The goal of the NPMGS is to protect, preserve, and enhance our valuable microbial resources.

Strong support for the initiative has been building with federal administrators in Washington and among professional societies such as the American Phytopathological Society (APS) and the Mycological Society of America (ASM) whose membership rely on culture collections as reference strains in taxonomic research, genetics, genomics, and in cell and molecular biology research. Since the long-term success of the proposed system depends heavily on active participation by existing collections and associated research communities, it is critical to engage the various scientific societies whose diversity of focus on culture collections must be balanced with the responsibility of their participation and benefits to all.

The U.S. Culture Collection Network, initiated by this first participant meeting in Kansas City, will contribute greatly to the implementation of a national system of sustainable culture collections and build on previous workshops, meetings and symposia sponsored by APS and USDA for effective utilization of these valuable resources for knowledge building .

Culture Collection Success Stories

The Phaff Yeast Culture Collection
Kyria Boundy-Mills, Curator, Phaff Yeast Culture Collection, Food Science and Technology, University of California Davis

The Phaff Yeast Culture Collection at the University of California Davis is the fourth largest public collection of wild yeasts in the world, with over 7,000 independent isolates in the public catalog. The collection exists today due to the efforts of a series of dedicated curators going back to 1893. These curators have persisted in maintaining, expanding, utilizing and distributing the collection despite obstacles including Prohibition, economic downturns, retirements, and institutional moves. The majority of the strains in the collection were gathered in the course of his research by eminent yeast microbiologist Herman Phaff, who traveled the world studying yeast ecology and taxonomy from 1943 to 2001. The collection contains over 750 different yeast species, roughly half of the known species, ranging from a single isolate to over 500 strains per species. Yeasts were primarily isolated from environmental habitats such as decaying plant matter, insects, and soil. The diversity of species, and depth of representation of each species, make this collection a wonderful resource for studies of biogeography, genetic diversity, and contract screening. The current curator, Kyria Boundy-Mills, worked with Herman Phaff for two years, and took over the management of the collection when he passed away in 2001. Yeasts are distributed to researchers at universities, government agencies and industry for research in areas such as food spoilage, biofuels, taxonomy, physiology, and much more. She is building the collection through research projects such as yeast-insect associations and a biodiversity survey in the rain forest in Indonesia. She is utilizing the collection for studies of yeast lipid accumulation for biofuels applications. She performs contract screening projects on behalf of biotechnology companies. Future goals including upgrading the collection to a Biological Resource Center (BRC), which will require enhanced quality control standards and additional services. More information about the collection, including an online catalog and ordering system. is available at www.phaffcollection.org.

The National Center for Genetic Resources Preservation and microbial collection backup. Dave Ellis, USDA-ARS, NCGRP

The National Center for Genetic Resources Preservation (NCGRP), situated in Fort Collins, CO originally started as a back-up facility for seeds for the National Plant Germplasm System. Since then it has added infrastructure and in addition to over 900,000 seed samples the NCGRP has in their care, it also houses over 500,000 animal samples for the National Animal Germplasm System. Due to the existing infrastructure, the NCGRP has extended its secure storage capabilities to the long-term back-up of microbial cultures in liquid nitrogen. Public collections which is available for research can qualify for back-

up at the NCGRP. A signed Material Transfer Agreement (MTA) is required for depositing microbial collections with the NCGRP and this MTA clearly states that the ownership of the material back-up at NCGRP remains with the donor. For information contact david.ellis@ars.usda.gov

The ARS (NRRL) Culture Collection – An Important Resource for the Scientific Community.
David P. Labeda. USDA, ARS, National Center for Agricultural Utilization Research, Peoria, IL.

The ARS Culture Collection, also known as the NRRL Culture Collection, is one of the largest public collections of microbial germplasm in the world and an internationally recognized center of expertise for the systematics, taxonomy, and biology of various groups of microorganisms.. Begun in 1940 with the opening of the Northern Regional Research Laboratory, the holdings now include over 70,000 strains of fungi and more than 21,000 strains of bacteria. In addition, the ARS Patent Culture Collection, created in 1949, contains an additional 6,100 strains, many of which were deposited under the Budapest Treaty in association with patent applications in the United States and any of the 77 other countries that are contracting parties of this microbial patent deposition treaty. The focus of the collection has changed over the years and currently is supporting specific priority ARS research areas, including food safety and crop production. The collection distributed approximately 6,100 strains in the last 12 months to customers within the US and throughout the world and has had a tremendous impact on microbiological research and innovation as evidenced by the fact that strains from this collection have been cited in 2,681 publications and 1,925 patent applications in the last 4 years. Public access to the collection is through the online catalog available on the collection website at http://nrrl.ncaur.usda.gov which currently contains records for about 13,000 strains. The current collection database management system, including the website, runs on the Linux operating system and has continually evolved since it first was deployed in 2002 to improve collection operations. Inventory management modules were developed for both lyophilized preparations and those maintained as frozen stocks in liquid nitrogen so that this function could be centralized and address biosecurity concerns. More recently a strain request shopping cart module and strain request processing system were developed and deployed in 2010, enabling collection customers to request strains online through the website for the first time. These improvements in collection data management greatly facilitated the realignment of the various taxonomic collections, each of which had its own management and operation models, into a unified collection management model in which daily operations, including strain accessions and requests, have been standardized and are handled by a collection manager and support staff under the direction of the Research Leader for the Bacterial Foodborne Pathogens and Mycology Research Unit. The ARS Culture Collection benefits significantly from direct connections to five active research laboratories, directed by internationally recognized scientists whose research continuously generates new data and novel germplasm, and whose expertise adds tremendous knowledge and value to the collection.

Cultivating Cave Life: Bacteria and Fungi from a Low-Nutrient Ecosystem.
Hannah Reynolds and Hazel Barton. The University of Akron

The Barton lab at the University of Akron studies cave microbiology, which includes the cultivation of bacterial isolates from several different caves. Original isolate streaks are performed in the cave environment on up to 20 different media. The cave environment is poor in organic nutrients, supporting very little biomass, so isolations are best performed on nutrient-limited agar; higher nutrient media is much less successful in propagating cave bacteria. To date, these efforts have generated a bacterial isolate library in excess of 4,000 strains.
The Barton lab is also researching cave fungi to better understand the role of the cave environment in the spread of the White-nose Syndrome fungus, Geomyces destructans. Multiple niche environments in caves have been sampled for fungi, including live bats, rock surfaces, and air. Isolation on nine different media has yielded a library of over 1200 isolates. The consortia of these libraries have all been identified using the 16S ribosomal RNA gene sequence for bacteria and the intragenic spacer sequence for the fungi.
I will briefly discuss the mechanisms we employ while generating and storing these collections.

The Culture Collection of the Center for Forest Mycology Research (CFMR), U.S.D.A. Forest Service, Madison, WI
J.A. Glaeser and D.L. Lindner

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. Founded in 1932, the culture collection currently contains approximately 20,000 living cultures representing 1,600 species of fungi. Most of the cultures are stored

in sterile distilled water at 4°C, according to the protocol of Burdsall and Dorworth (1994) – a very cost effective storage procedure. Cultures derived from tropical fungi are more sensitive to cold temperatures and are maintained in sterile distilled water at 10 °C. 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. A back-up collection is kept in liquid nitrogen. 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.

Burdsall, H.H. Jr. and Dorworth, E.B. 1994. Preserving cultures of wood-decaying Basidiomycotina using sterile distilled water in cryovials. Mycologia, Vol. 86, 275-280.

The Bacillus Stock Center

Daniel Zeigler, The Ohio State University

The primary mission of the Bacillus Genetic Stock Center (BGSC) is to maintain genetically characterized strains, cloning vectors, and bacteriophage for the genus Bacillus and related organisms and to distribute these materials without prejudice to qualified scientists and educators throughout the world. Since 1978, the National Science Foundation has funded the activities of the BGSC. Accessions include the nomenclatural type strains for 51 species and subspecies of Bacillus sensu lato. The type species for the genus, the industrial workhorse B. subtilis, is well represented with 55 wild type isolates and nearly 1300 genetically characterized mutants of the model organism B. subtilis 168. Other large collections include the biological insecticides, B. thuringiensis and Lysinibacillus sphaericus; BSL1-level representatives of the B. cereus group; the moderately thermophilic genus Geobacillus; and cloning vectors for use in Bacillus and other Gram-positives.

In 2011, the BGSC distributed 2100 strains to 547 users working in 38 different nations, reflecting the international importance of Bacillus research. Since 2008, the BGSC has been explicitly cited as the source for strains used in nearly 400 peer-reviewed publications, with major research fronts spanning the topics of Biological Control, Biotechnology, Bacterial Physiology and Metabolism, Antimicrobial Agents, Genomics, Food Safety, Microbial Communities, and Green Energy. During the same period, BGSC strains have served as the basis for 27 patents granted by the USPTO. Further, the "Generally Regarded As Safe" organisms in the BGSC collection have enhanced hands-on learning experiences in many of the nation's high schools and undergraduate teaching universities.