



GGBN – Strategies for standardized exchange of genetic resources on a global scale

GGBN - Strategien für standardisierten Austausch genetischer Ressourcen auf globaler Ebene

Gabi Dröge



Botanic Garden and Botanical Museum Berlin





Global Genome Biodiversity Network

- **Network for non-human biobanks** (e.g. DNA, tissue)
- Founded in 2011
- Precursor project DNA Bank Network founded in 2007 providing virtual infrastructure
- General secretariat: Smithsonian Institution
- Technical secretariat: Botanic Garden and Botanical Museum Berlin
- <http://www.ggbn.org>

- Data standard for sharing tissue and DNA information
- Portal to make biobank sample data available
- Institutional directory
- Knowledge platform



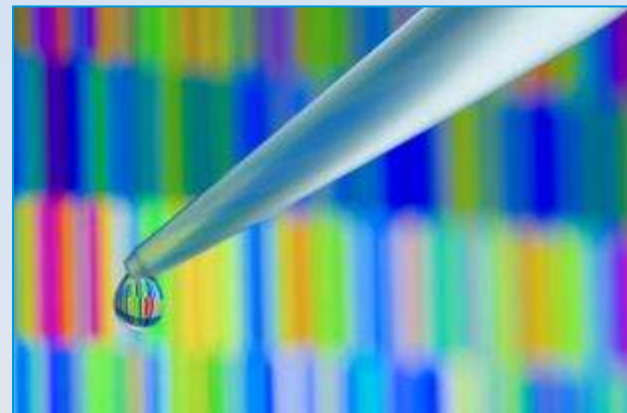
- Best practices related to management and stewardship of genomic samples
- Recruit partners with different regional and taxonomic focus
- Identify gaps in GGBN collections



- Biorepositories (contributors)
- Organizations with living or preserved specimens (contributors)
- Researchers (users)



- Memorandum of Cooperation
- Terms of Reference
- Business Model will come into force 06/2016
- Core and Associate members made a commitment to become financial or in-kind contributors
- Current funding by:





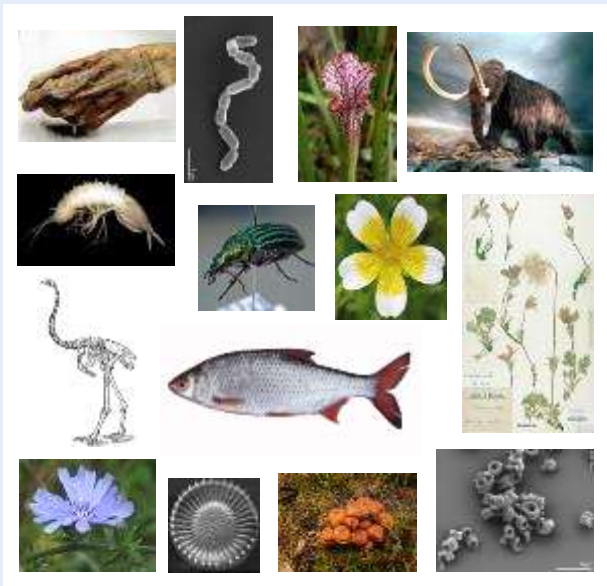
Today: 40 GGBN members worldwide





GGBN Data Portal

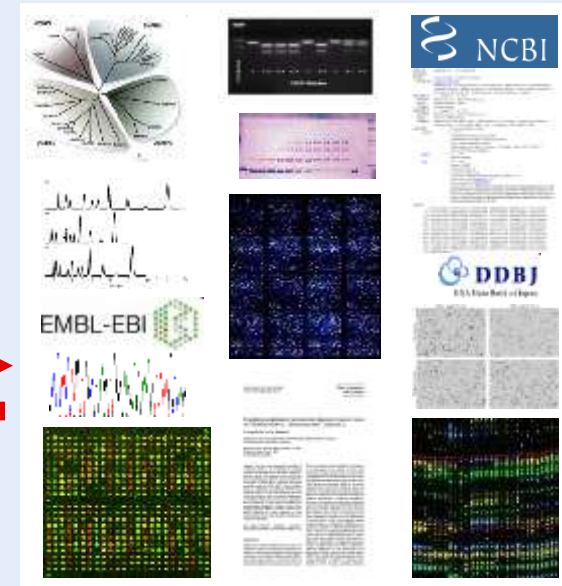
Source material / specimens



DNA & Tissue



Molecular analysis data





Global Biodiversity Information Facility (GBIF)

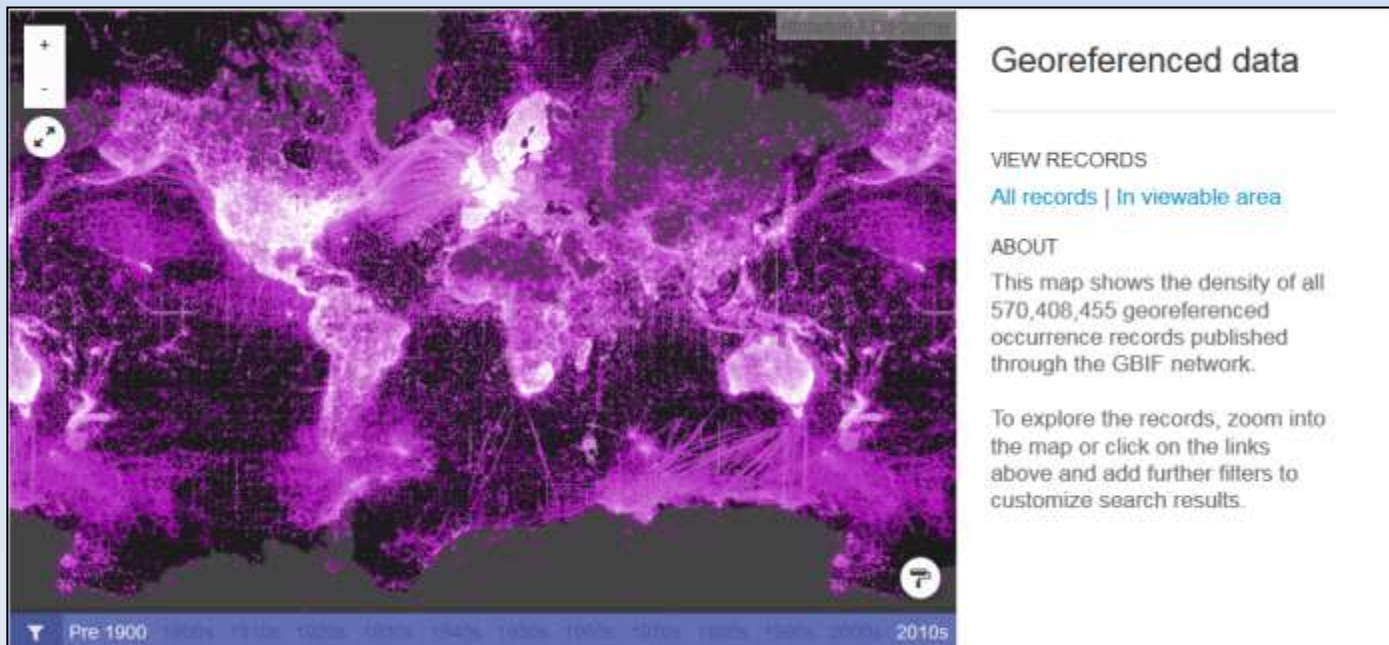
- GBIF's mission is to make the world's biodiversity data freely and universally available via the Internet.
- As a megascience initiative, GBIF aims to provide an essential global informatics infrastructure for biodiversity research and applications worldwide.
- <http://www.gbif.org>





GBIF - A data treasure of inestimable value

- > 797 data providers, including most of major natural history collections
- > 648.000.000 records





GGBN Data Portal



Global Genome Biodiversity Network



Samples	
DNA	58777
Tissues	64525
Enviros	61
Repositories	12
Vouchers	
Cultures	21660
eVouchers	2
Specimens	32968
Unknown	1454
Collections	12
Taxa	
Families	1751
Genera	7754
Species	21209
Total	
	179647

News

26. January 2016 - 'Life in Data' E5BB/GGBN paper published on Biobanking and Biopreservation

Explore GGBN

Repositories



Search



Documents




About



Cookies information



Portal: Aggregate data from multiple sources



New search

This is currently a beta (β) version

Home Search Repositories Library About Meetings Login

Log in to access shopping system

Explore Chenopodium foetidum

GGBN 4 record(s) with tissue

3 record(s) with DNA

Chenopodium foetidum

1988 specimen(s)

NCBI 42 Nucleotide record(s)

DETAILS

Loan information

DNA available ✔

Tissue available ✔

Identification(s):

Name: Chenopodium foetidum Sm.
Taxonomy: CHENOPODIACEAE (familia);

Collection Info:


Collector(s): M. Rostow
Field number: 1243/08

Collection Date: 28.09.2008
Collection Date Begin: 2008-09-28
Country: Germany (DE)
Locality: Brandenburg, Ellbufer zwischen dem Sportheim Wittenberge und der W gelegenen Straßenbrücke, Mbb 3036H2.

Other Info:

Country: Germany (DE)
Continent: Europe

Coordinates (Lat/Lon): 52.9886131267 | 11.7266664505
Biotope: sandiges Flußufer



DNA Tissue Specimen

Unit ID/Catalog Number: DB 3666
Institution Code: BGBM
Collection Code: DNA Bank
Record Basis: MaterialSample
Kind of Unit: DNA

Relation to B-10 034023S (Herbarium Berlinense / BGBM):

DNA and specimen from the same population

Extraction:

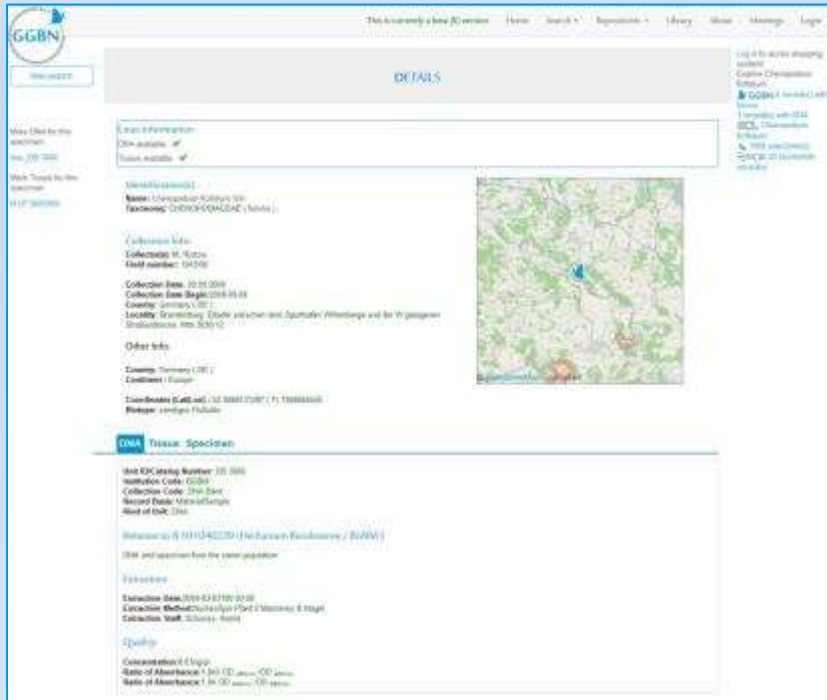
Extraction Date: 2009-03-03T00:00:00
Extraction Method: NucleoSpin Plant II Macherey & Nagel
Extraction Staff: Scholes, Astrid

Quality:

Concentration: 8.63ng/ul
Ratio of Absorbance: 1.845 OD_{260nm} / OD_{280nm}
Ratio of Absorbance: 1.94 OD_{230nm} / OD_{260nm}



Portal: Aggregate data from multiple sources



Getting live counts from other biodiversity portals for each record via web services

Explore *Chenopodium ficifolium*



1908 specimens



42 nucleotide sequences



taxon page



3 DNA samples

4 tissue samples

DETAILS

Loan information

DNA available ✓

 This species or genus was found in the CITES list (UNEP-WCMC (Comps.) 2015. More details [here](#)

Identification(s):

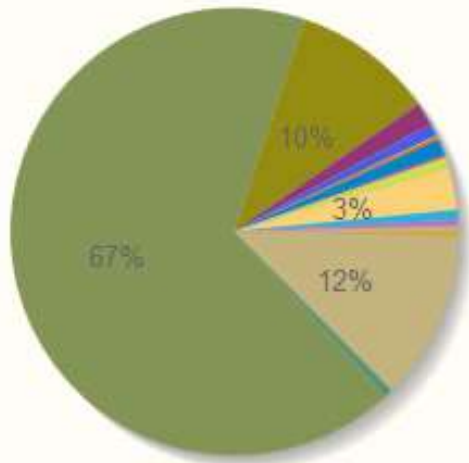
Name: *Lophophora williamsii* (Lem. ex Salm-Dyck) J.M.Coult.**Date:** DateText: 17.06.2002**Identifier:** B. E. Leuenberger**Taxonomy:** CACTACEAE (familia) ;

Warning and request for CITES registration number when ordering the sample both for curator and user.

Collection Info:

Collector(s): M. Cubr**Field number:** 33663**Collection Date:** 04.05.1995**Collection Date Begin:** 1995-05-04**Locality:** Herkunft: BG München 1970; cult. Hort. bot. Berol.

Families for the order Caryophyllales- click to refine



- Achatocarpaceae (2)
- Aizoaceae (10)
- Amaranthaceae (368)
- Cactaceae (20)
- Caryophyllaceae (2022)
- Chenopodiaceae (309)
- Cornaceae (50)
- Droseraceae (28)
- Frankeniaceae (4)
- Molluginaceae (6)
- Montiaceae (34)
- Nyctaginaceae (6)
- Phytolaccaceae (24)

Example: Samples from Caryophyllales

Above: all records (DNA, tissue, specimens)

Right: DNA / tissue samples

- Buxales (1 / 2)
- Canellales (1 / 1)
- Capparales (34 / 81)
- Caryophyllales (290 / 1197)
 - Achatocarpaceae (0 / 0)
 - Aizoaceae (2 / 4)
 - Amaranthaceae (27 / 60)
 - Anacampserotaceae (0 / 0)
 - Ancistrocladaceae (0 / 0)
 - Asteropeiaceae (0 / 0)
 - Barbeuiaceae (0 / 0)
 - Basellaceae (0 / 0)
 - Cactaceae (6 / 11)
 - Caryophyllaceae (201 / 1026)
 - Cornaceae (11 / 26)
 - Didiereaceae (0 / 0)
 - Dioncophyllaceae (0 / 0)
 - Droseraceae (10 / 14)
 - Drosophyllaceae (0 / 0)
 - Frankeniaceae (1 / 2)
 - Gisekiaceae (0 / 0)
 - Halophytaceae (0 / 0)
 - Kewaceae (0 / 0)
 - Limeaceae (0 / 0)
 - Lophiocarpaceae (0 / 0)
 - Macarthuraceae (0 / 0)
 - Microteaceae (0 / 0)
 - Molluginaceae (2 / 4)
 - Montiaceae (3 / 4)
 - Nepenthaceae (0 / 0)
 - Nyctaginaceae (2 / 2)
 - Physenaceae (0 / 0)
 - Phytolaccaceae (4 / 10)
 - Plumbaginaceae (18 / 30)
 - Portulacaceae (1 / 2)
 - Rhabdodendraceae (0 / 0)
 - Sarcobataceae (0 / 0)
 - Simmondsiaceae (1 / 1)
 - Stegnospermataceae (0 / 0)
 - Talinaceae (1 / 1)
- Celastrales (14 / 27)
- Geraniales (2 / 5)



White Paper on Data Portal



Nucleic Acids Research Advance Access published November 19, 2013

Nucleic Acids Research, 2013, 1–6
doi:10.1093/nar/gkt929

The Global Genome Biodiversity Network (GGBN) Data Portal

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ABSTRACT

The Global Genome Biodiversity Network (GGBN) was formed in 2011 with the principal aim of making high-quality well-documented and vouchered collections that store DNA or tissue samples of biodiversity, discoverable for research through a networked community of biodiversity repositories. This is achieved through the GGBN Data Portal (<http://data.ggbn.org>), which links globally distributed databases and bridges the gap between biodiversity repositories, sequence databases and research results. Advances in DNA extraction techniques combined with next-generation sequencing technologies provide new tools for genome sequencing. Many ambitious genome sequencing projects with the potential to revolutionize biodiversity research consider access to adequate samples to be a major bottleneck in their workflow. This is linked not only to accelerating biodiversity loss and demands to improve conservation efforts but also to a lack of standardized methods for providing access to genomic samples. Biodiversity biobank-holding institutions urgently need to set a standard of collaboration towards

excellence in collections stewardship, information access and sharing and responsible and ethical use of such collections. GGBN meets these needs by enabling and supporting accessibility and the efficient coordinated expansion of biodiversity biobanks worldwide.

INTRODUCTION

Genome sequencing for biodiversity analysis is at the forefront of innovation and discovery due to technological advances and the sequencing of whole genomes in the last 10 years. Information generated from biodiversity genomics will revolutionize our approach in taxonomy, phylogeny, conservation, ecological monitoring, wildlife management, agriculture, drug development, zoonotic disease forecasting and even aspects of national security. Consequently, the demand is rapidly increasing for professionally preserved, managed and documented samples that yield high-molecular weight DNA and RNA from throughout the tree of life [e.g. (1,2)]. Many ambitious projects with the potential to revolutionize biodiversity research are finding access to adequate samples needed for genome sequencing to be a major bottleneck in their workflow. Examples of these projects include the Ten Thousand Vertebrate Genomes Project (Genome10 K).

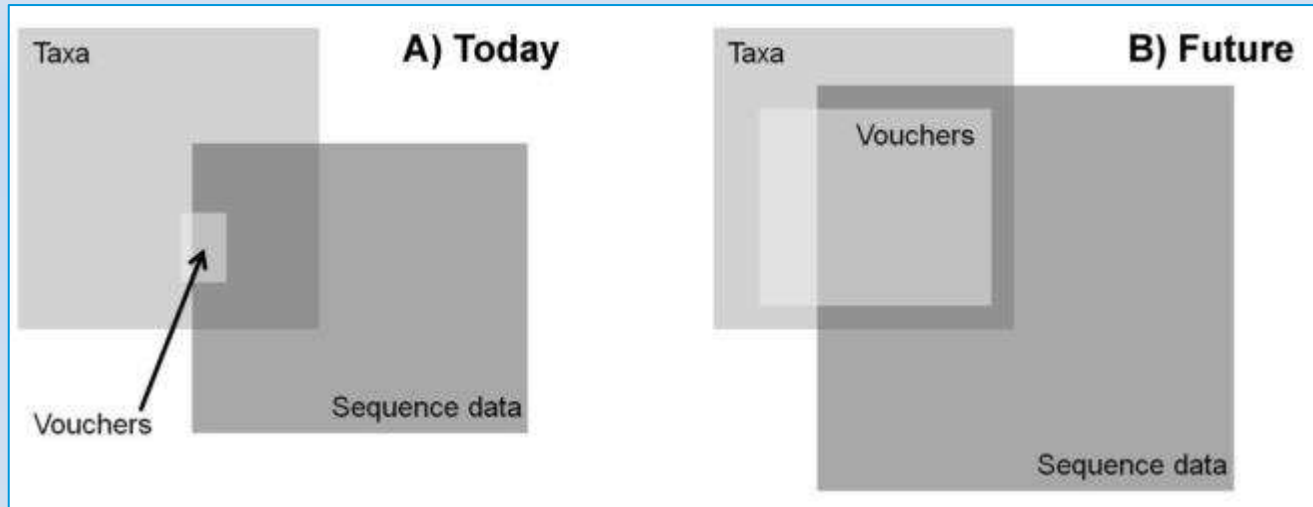
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The authors wish it to be known that, in their opinion, the first two authors should be regarded as Joint First Authors.

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Source: Droege et al. 2014

1. Every biodiversity biorepository is welcome to join GGBN.
2. Deposit your samples, vouchers and data in a GGBN collection if you don't have a DNA or tissue bank.
3. GGBN provides a virtual and physical infrastructure to make your research traceable for the future.



Portal: Pre-order samples

- Order DNA or tissue samples through GGBN portal
- Download of sample information
- Request forwarded to GGBN member holding the sample(s)
 - Institution responsible for all further steps
 - Checking availability and loaning conditions
 - Provide price offer to scientist
 - Request signing of Material Transfer Agreement
 - Shipping samples
- Citation guidelines for samples coming soon (available at ggbn.org)



Developing Best Practices Towards a Network of Trusted Biodiversity Biobanks



Developing Best Practices

- Recommendation for Biodiversity Biorepositories
 - **Collaboration with ISBER***
 - April 2013, Submitted to ISBER
 - To be included into next version of ISBER Best Practices
- GGBN Document Library
 - **Collaboration with ESBB****
 - June 2016, beta-release for member use
 - Knowledge platform for non-human biobanking

* International Society for Biological and Environmental Repositories

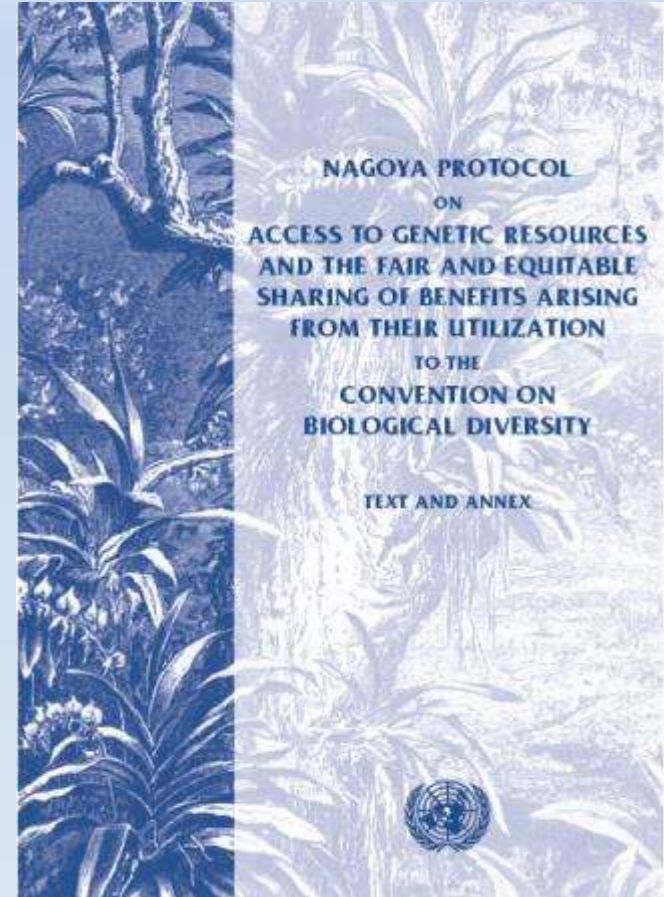
** European, Middle Eastern and African Society for Biopreservation and Biobanking





Developing Best Practices

- Access and Benefit Sharing (ABS)
Compliance
 - October 2014, Documentation available for member use
 - Material Transfer Agreements
 - Code of Conduct
 - Statement of Use of Genomic Material
 - **Collaboration with CETAF***
 - Provide trusted and transparent access to genomic samples for users and contributors through an ABS framework



* Consortium of European Taxonomic Facilities

- MTA for provision of material
 - with no change in ownership
 - with change in ownership
- MTA for receipt of material with change in ownership
- Best Practice for Access and Benefit Sharing
- Code of Conduct
- <http://wiki.ggbn.org/ggbn/Downloads>

- To be used for DNA and tissue samples, but also other genetic resources
- To be used by GGBN members and third parties as templates



GGBN Document Library



- full text search, tagging, versioning, sharing
- release prototype 06/2016

The screenshot displays the GGBN Document Library interface. The top navigation bar includes links for Home, My Files, Shared Files, Sites, Tasks, People, Repository, and Admin Tools. The user is logged in as Gabi Dröge. A search bar is present in the top right corner. The main content area is titled "Biodiversity Biobanking" and shows a list of documents. The left sidebar contains navigation options: Documents, Library, Categories, and Tags. The document list includes:

- Access and Benefit Sharing Policy for the National Museum of Natural History (2012)**
Modified 3 months ago by Administrator | 1 MB
Courtesy of the National Museum of Natural History, Smithsonian Institution (2012)
Tags: access and benefit sharing (abs), policy
Standards for Sharing Samples
Actions: Favorite, Like, Comment, Share
- Agreement on ABS for Non-Commercial Research, Swiss Academy of Sciences (2010)**
Modified 4 months ago by Katie Barker | 807 KB
No Description
Tag: access and benefit sharing (abs)
Standards for Sharing Samples
Actions: Favorite, Like, Comment, Share
- Astrin et al (2013) (The importance of biobanking in molecular taxonomy, with proposed definitions for vouchers in a molecular context)**
Modified 3 months ago by Katie Barker | 113 KB
No Description



Biodiversity is challenging

One species – three use cases



eVoucher (image)

Blood sample

Genomic DNA sample

gDNA

A few sequences, one species



No voucher

Fecal sample

Environmental DNA sample

eDNA

Thousands of sequences, dozens of species



Ancient specimen as voucher

Bone sample


Ancient DNA sample

aDNA

A few fragmented sequences, one species



GGBN Data Standard

The Global Genome Biodiversity Network (GGBN)  is a global network of well-managed collections of genomic tissue samples from across the Tree of Life, benefiting society through biodiversity research, development and conservation. This network will foster collaborations among repositories of molecular biodiversity in order to ensure quality standards, improve best practices, secure interoperability, and harmonize exchange of material in accordance with national and international legislation and conventions.

The GGBN Data Standard is a set of vocabularies designed to represent tissue, DNA or RNA samples associated to voucher specimens, tissue samples and collections. *Contributors: Gabriele Droege, Birgit Gemeinholzer, Holger Zetzsche, Astrid Schories, Katharine Barker, Walter G. Berendsohn, Sean Brady, E. Margaret Casey, Jonathan Coddington, John Deck, Anton Güntsch, Jörg Holetschek, Patricia Kelbert, Hans-Peter Klenk, Renzo Kottmann, Christopher Lewis, Jacqueline Mackenzie-Dodds, Christopher Meyer, Thomas Orrell, Ole Seberg, Jamie Whitacre, Pelin Yilmaz, Enrique Arbeláez Cortés, Boyke Bunk, René Dekker, Sonya Dyhrman, Elisabeth Haring, Thomas Knebelberger, Jon Norenburg, Michael Raupach, Thomas von Rintelen, Larissa Smirnova, Carola Söhngen, Sun Ying, Lee A. Weigt, Kenneth Wurdack, Elizabeth Zimmer, Xin Zhou.*

Contents [\[hide\]](#)

- 1 Introduction
- 2 GGBN Data Standard Terms
- 3 Dynamic Term List
 - 3.1 Index to concepts (all collections combined)
 - 3.2 GGBN Amplification Vocabulary
 - 3.3 GGBN DNA Cloning Vocabulary
 - 3.4 GGBN Gel Image Vocabulary
 - 3.5 GGBN Loan Vocabulary
 - 3.6 GGBN Material Sample Vocabulary
 - 3.7 GGBN Permit Vocabulary
 - 3.8 GGBN Preparation Vocabulary
 - 3.9 GGBN Preservation Vocabulary
 - 3.10 GGBN Single Read Vocabulary



Concept definitions in GGBN Permit Vocabulary

Concept Name:	ggbn:permitStatus
Normative URI	http://rs.tdwg.org/dwc/terms/disposition
Label	Permit Status
Definition	Information about the presence, absence or other basic status of permits associated with the sample(s).
Defined By	
	Required: Yes — Repeatable: Yes
Examples	Permit available , Permit not required , Permit not available , Unknown Material collected after 2014-10-12 cannot be in "Unknown" permit status!
Notes:	Predefined vocabulary, See permitStatus vocabulary ; entry of data is mandatory
Concept Name:	ggbn:permitStatusQualifier
Normative URI	http://rs.tdwg.org/dwc/terms/disposition
Label	Permit Status Qualifier
Definition	Description of why a certain permit was not required or why Permit Status is unknown
Defined By	
	Required: No — Repeatable: Yes
Examples	"no national requirement for a permit at date of access", "officially authorized illegal holder", "collected on private land", "pre-Nagoya"
Concept Name:	ggbn:permitText
Normative URI	http://rs.tdwg.org/dwc/terms/disposition



GGBN Data Standard

- http://terms.tdwg.org/wiki/GGBN_Data_Standard
- Based on ABCDDNA
- Is meant to be used with ABCD or DwC -> all occurrence terms are excluded (geography, scientificname etc.)
- White paper work in progress
- Include elements of other standards
- Can handle or be combined with SPREC, MIxS and BRISQ
- **Collaboration with GBIF, Genomics Standards Consortium, ESBB**



Page

[Discussion](#)

Read

[View form](#)

[View source](#)

[View history](#)

ggbn:preparationMaterials



Preparation Materials: Materials and chemicals used in the preparation of the specimen, tissue, DNA or RNA sample

Example(s): for DNA: DNeasy blood and tissue kit, CTAB;

Constraints in the context of [GGBN Data Standard](#):

- **cardinality** 0..n (=optional multiple occurrence)

Scheme: [GGBN Data Standard](#)

Collection: [GGBN Preparation Vocabulary](#)

Preparation Materials

- **URI:** <http://data.ggbn.org/schemas/ggbn/terms/preparationMaterials>
- **skos: has exact match** [mixs:nucl_acid_ext](#)

RDF feed | [Browse](#)

properties | [SMW-prop.](#)

Search for values

Classes: [Property](#) | [Concept](#) | [GGBN Data Standard](#)



Implementing the GGBN Data Standard

- Done for GGBN Data Portal
- To be done: databases of GGBN members must be updated
- Challenging:
 - different databases and software systems in use
 - many partners don't even have a database

- Open source software developed by BGBM/DNA Bank Network for management of DNA and tissue collections
- 100% in compliance with GBIF and GGBN



The screenshot shows the 'Main Menu' of the DNA Bank Network. The interface is yellow and features the following elements:

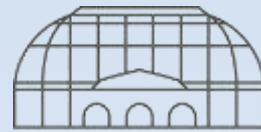
- Top Left:** 'DNA Bank Network' logo with a colorful bar below it.
- Top Center:** 'Main Menu' title.
- Top Right:** BGBM logo (a globe icon above the text 'BGBM').
- User Info:** 'Logged in as: Gabi Dröge'.
- Navigation:** A 'Logout' link and a vertical stack of four icons: a magnifying glass over a DNA helix, a shopping cart, a DNA helix over a globe, and a DNA helix.
- Summary Table:**

Summary	
Total DNA samples	36
Total Taxa with DNA	22
- Bottom:** A footer with contact information: '© DNA Bank Network | Support: contact[at]dnabank-network.org | www.dnabank-network.org | 2016'.



Second GGBN International Conference

21.-24. June 2016 Berlin



BG | Botanischer Garten &
BM | Botanisches Museum
Berlin

museum für
naturkunde
berlin





Second GGBN International Conference

- Interest Group Meeting: Access and Benefit Sharing
 - Symposium: Best practice for data and collections management
 - Workshop: ABS in natural history collections – implementation and practical management
 - <http://meetings.ggbn.org>
 - Conference held in parallel with **SPNHC*** conference
 - <http://www.spnhc2016.berlin>
- * Society for the Preservation of Natural History Collections**



Thank you

<http://www.ggbn.org>

info@ggbn.org



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GGBN Interim Executive Committee



GGBN Members

GGBN Collaborators

GGBN Task Forces

DFG

SYNTHESYS

ISBER & ESBB