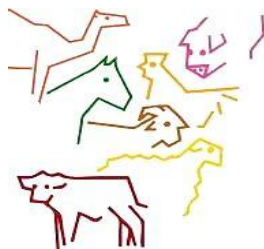


# *Ex situ* conservation of farm animal genetic resources in Europe

Workshop AnGR Ex-Situ  
Conservation in Spain

17 June 2015, Madrid

Sipke Joost Hiemstra



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# This talk

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- Introduce myself
- Why genetic diversity conservation efforts?
- Gene banks for AnGR
- Development of Dutch gene bank for farm animals
- Collaboration and networking in Europe
- Plans for the (near) future

# My background

- Programme Manager - Centre for Genetic Resources, the Netherlands (CGN)
  - Plant Genetic Resources
  - Forest Genetic Resources
  - **Animal Genetic Resources**
- Statutory Research Tasks for Ministry
- 5-year programmes
- [www.cgn.wur.nl](http://www.cgn.wur.nl)
  
- Chair of ERFP WG Ex Situ Conservation (EUGENA network)

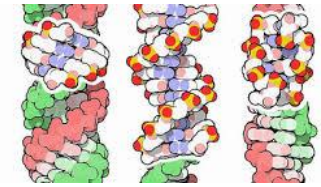


# Main activities - CGN-Animal Genetic Resources

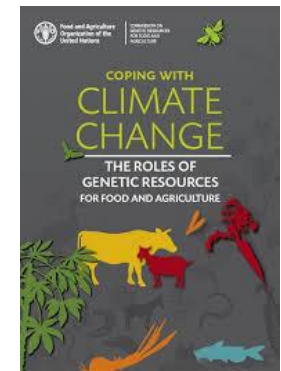
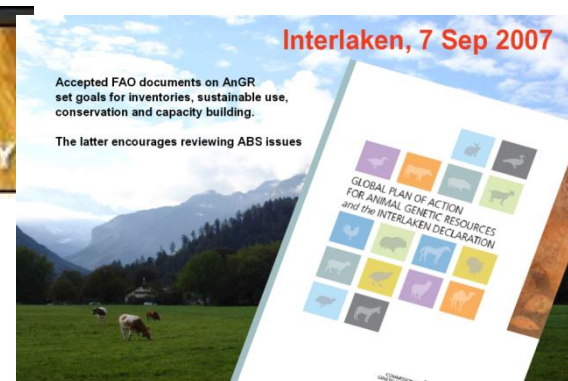
- *Ex situ* conservation
  - Gene bank collections
- Support for *in situ* management
  - small populations of Dutch origin
  - minimising inbreeding rates
  - breeding programs
  - use of gene bank germplasm
- Policy advice
- National Focal Point
- Supportive research
  - Cryobiology and conservation genetics/genomics



# Loss of genetic diversity will ....



- Threaten global food and nutrition security
- Reduce the possibility to adapt to climate change
- Result in less options to improve the sustainability of livestock production
- Reduce the options to improve the quality of our our food
- Erode our agricultural landscapes and threaten our bio-cultural heritage



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# Purposes of AnGR Gene Banks → *Ex situ*

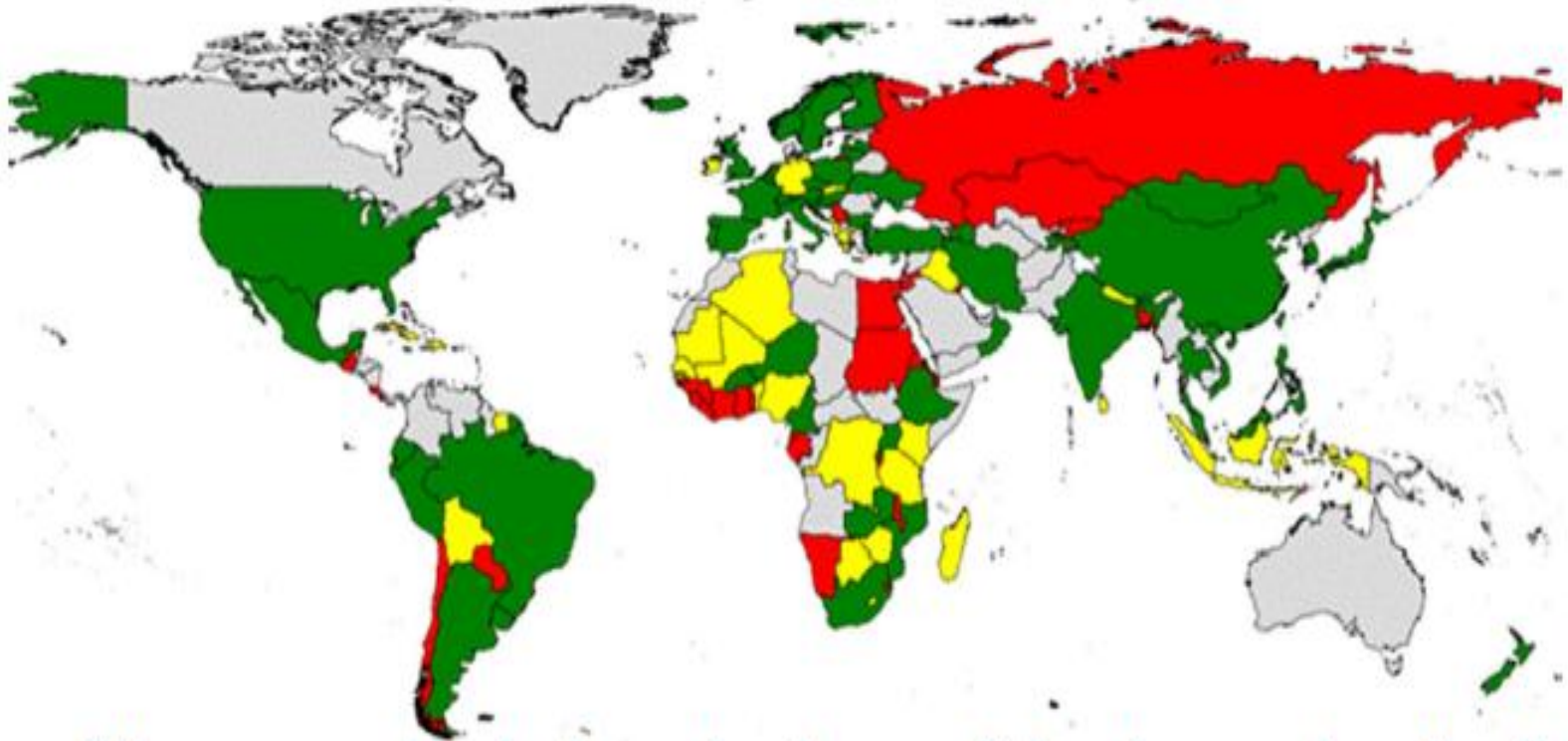
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- To support *in situ* conservation
- Insurance for future generations
- To be able to recreate extinct breeds/breeding lines
- As a back-up in case genetic problems would occur
- To allow development of new lines or breeds
- For research and genetic characterization purposes



**In vitro gene banks have been established by 64 countries and a further 41 countries are planning to do so.**

State of development of *in vitro* gene banks for animal genetic resources



**Many of these gene banks in early stages of development; collections often with gaps;**

Source: draft 2nd State of the World on Animal Genetic Resources – Beate Scherf - Outcomes and Highlights – CGRFA Rome 19-23 January 2015

## Gene bank collection sizes - selected countries (Paiva et al `14)

Country	Species	Breeds/lines	Animals	Number of doses/straws
Austria	5	29	491	12,095
Brazil	12	25	416	71,867
Canada	9	31	3,077	261,083
Colombia	3	16	400	47,800
Finland	2	6	268	399,600
France	9	181	4,337	352,068
India	8	38	276	123,483
Italy	4	30	1,230	296,945
Netherlands	7	59	5,691	309,088
Norway	2	18	1,071	283,850
Poland	2	9	214	53,382
Portugal	3	36	399	195,046
Sweden	1	7	256	75,744
Ukraine	4	30	209	130,805
United States	38	149	16,397	709,657
<b>Total</b>			<b>34,732</b>	<b>3,322,513</b>



# Dutch gene bank collections @CGN

Species	# breeds	# donors/breed	# straws
Cattle	19	1 - 4,781	221,925
Chicken	31	1 - 20	18,828
Dog	5	1 - 8	342
Duck	3	14 - 34	1,588
Goat	4	1 - 33	5,555
Goose	1	7	76
Horse	8	1 - 37	25,769
Pig	21	1 - 69	75,081
Sheep	9	8 - 71	27,738
Rabbit			



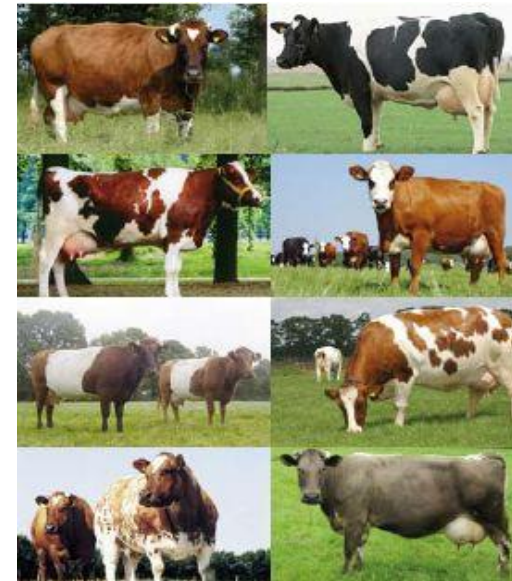
# Aim of Dutch AnGR Gene Bank

## *Long term*

- To safeguard all rare/native/endangered breeds of farm animals in the gene bank
- To promote and facilitate conservation of back-up samples of all (commercial) breeds in the gene bank

## *Short term*

- To support breeding programs of endangered breeds - by distribution of gene bank semen
- Facilitate scientific research projects

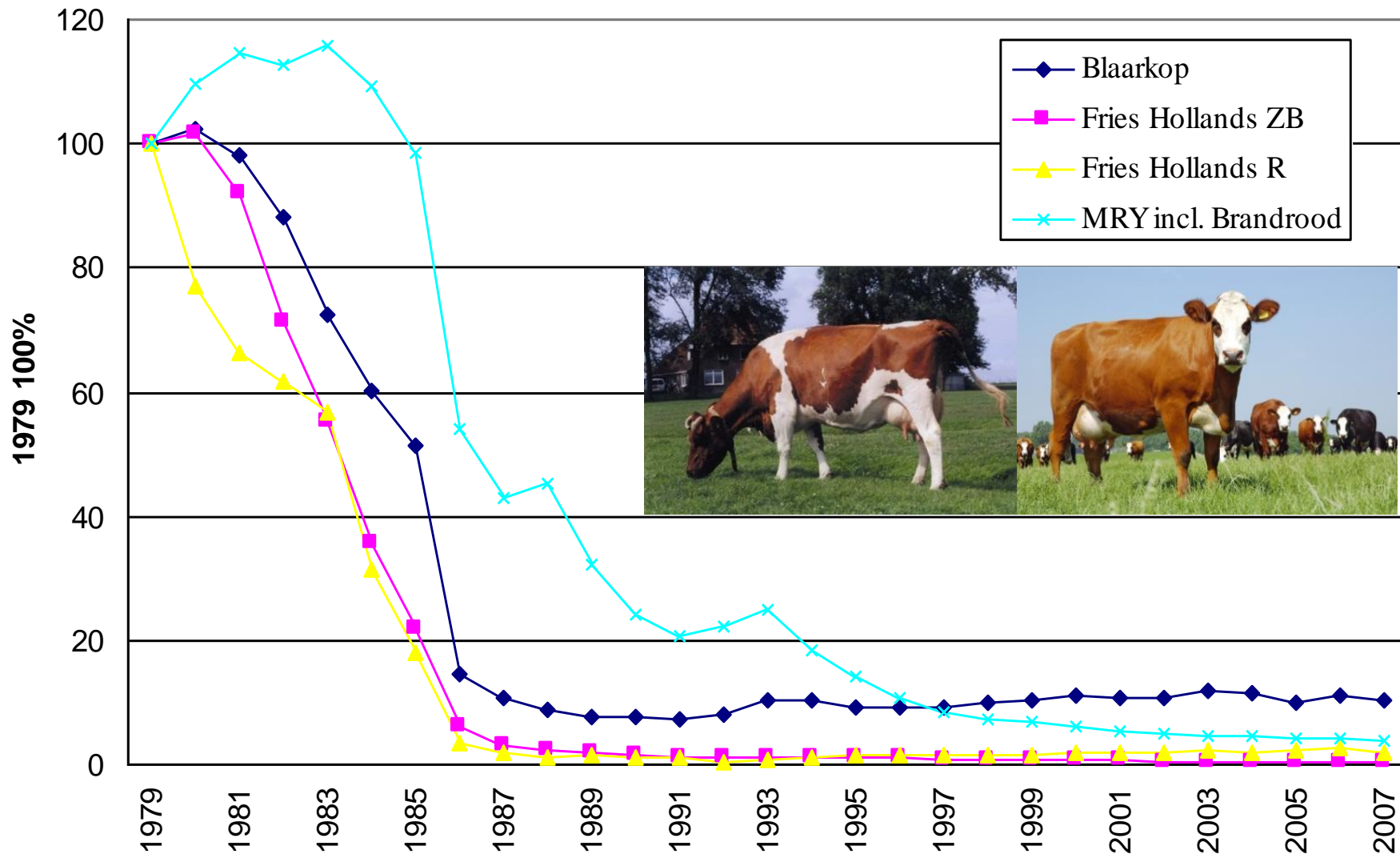


# History of Dutch Gene Bank Farm Animals

- **1976** – Foundation of Dutch Rare Breeds (**SZH**)
- **1993** – Start Gene Bank Foundation for Farm Animals (**SGL**) (founded by Royal Dutch Cattle Syndicat, Holland Genetics and SZH; support of the Research Institute for Animal Science)
- **1993 - 2003** – **SGL** started with cattle, followed by horse and pig
- **2004 – today** – Mandate of **CGN** includes farm animals
- **2005** – **SGL** collections transferred to **CGN**
- Major animal diseases (FMD, Classical Swine Fever, Avian Influenza) → increased **awareness** about importance cryopreservation
- **2010 - 2014** → Collections of Dutch cattle, pig, sheep, goat, chicken, horse, duck, goose, rabbit breeds in **CGN** gene bank
- **2015 – 2019** → Start of new 5 year programme



## % change in population size 1979 - 2007



# Rare breeds and **widely used** breeds in gene bank

## Cattle

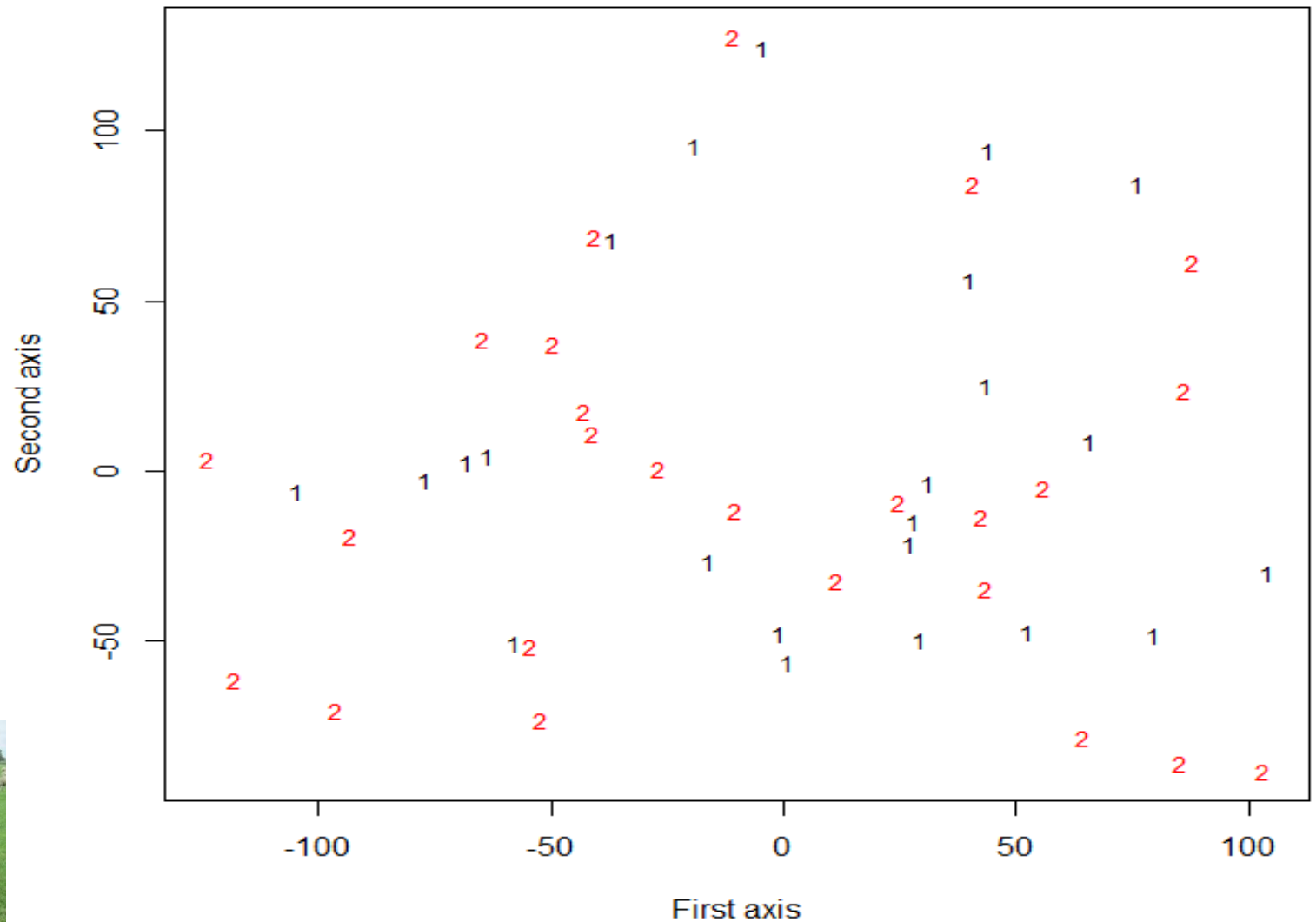
- Groningen White Headed
- Deep Red
- Dutch Friesian Red & White
- Coloursided White-back
- Dutch Friesian Black and White
- Meuse Rhine-Yssel
- Holstein Friesian





# SNP analysis – Dutch Friesian Red&White

- Clusteranalysis live (1) and cryo (2)



# Funding of Dutch livestock national gene bank

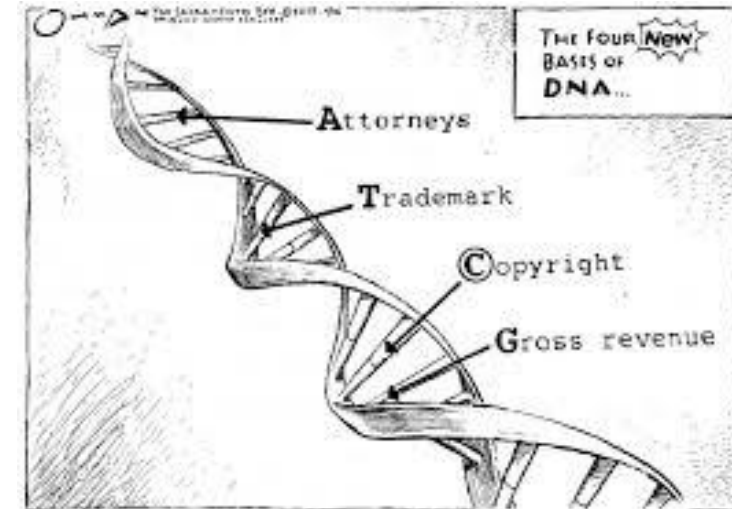
- 5-year programme funding by Ministry of Economic Affairs
  - Cryolab, cryostorage facilities, access to animal facilities
  - Dedicated expertise (not necessarily full time staff)
    - Day-to-day project and laboratory management
    - Cryobiology and reproductive technology
    - Conservation genetics and breeding
    - Data base management
- Contributions + co-funding of animal breeding sector
  - Cash contribution of breeding companies for (20% of) maintenance costs
  - 'Transfer/gift' of genetic material from breeders/breeding industry  
(*"in kind"*: value of semen and embryo's; labour costs)





# Ownership of gene bank material in Dutch national gene bank

- Default: Transfer of ownership from breeder to CGN/gene bank
  - Public gene bank – long term perspective
- Sometimes ownership of (part of) material stays with the owner of donor animal
- Specific arrangements in contract with owner of donor animal
  - e.g. embargoperiod for use



# Legal arrangements for national gene banks

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- Acquisition Agreements
  - Provider/owner of donor animals <-> Gene bank
- Access rules of Gene bank
  - E.g. type of use, agreement of breed society, ....
- Access Agreements
  - User/applicant <-> Gene bank

Model agreements or rules at European and global level ?

- MAA
- Principles/criteria - regulating access <-> Nagoya Protocol ABS
- MTA

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# NL Gene bank - Sanitary/veterinary issues

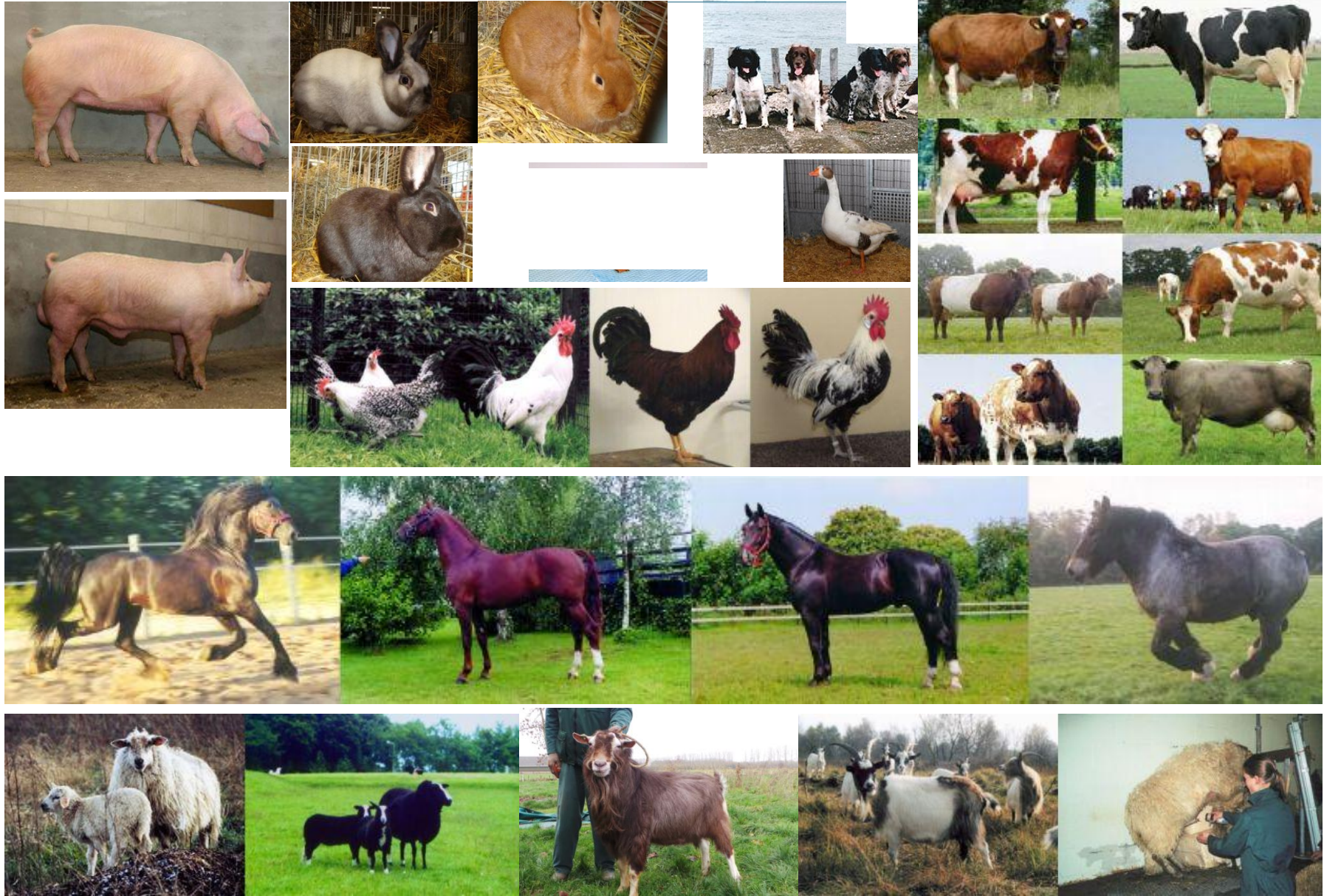
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- Storage at two locations for safety reasons (Wageningen and Utrecht)
- Separate containers by species
- Cattle: Derogation for gene bank in national veterinary legislation for cattle semen collection centres
  - on farm collection  
(conditions, almost similar to EU certified collection centres)
  - safe distribution of “old semen”  
(that does not comply with current EU legislation)

- National gene banks sometimes need specific veterinary rules
- Derogation at European level for conservation purposes?



# Species and breeds in CGN genenbank



Zoeken in genenbank collectie landbouwhuisdieren



## Overzicht

Diersoort	Ras	Aantal donoren	
Cattle	unknown	1	<a href="#">Toon</a>
Cattle	Belgisch Blauw	12	<a href="#">Toon</a>
Cattle	Blonde d'Aquitaine	3	<a href="#">Toon</a>
Cattle	Brandrood	19	<a href="#">Toon</a>
Cattle	Brown Swiss	2	<a href="#">Toon</a>
Cattle	Fleckvieh	1	<a href="#">Toon</a>
Cattle	Fries Hollands (FH) zwartbont	168	<a href="#">Toon</a>
Cattle	Fries Hollands fundamementfoklijn	9	<a href="#">Toon</a>
Cattle	Fries Roodbont	49	<a href="#">Toon</a>
Cattle	Groninger Blaarkop	77	<a href="#">Toon</a>
Cattle	Heidekoe	6	<a href="#">Toon</a>
Cattle	Holstein Friesian (zwartbont en roodbont)	4717	<a href="#">Toon</a>
Cattle	Jersey	2	<a href="#">Toon</a>
Cattle	Lakenvelder	30	<a href="#">Toon</a>
Cattle	Maas-Rijn-IJssel	244	<a href="#">Toon</a>
Cattle	Marchigiana	1	<a href="#">Toon</a>
Cattle	Montbéliarde	3	<a href="#">Toon</a>
Cattle	Piemontese	1	<a href="#">Toon</a>
Cattle	Verbeterd Roodbont	13	<a href="#">Toon</a>
Cattle	Witrik	12	<a href="#">Toon</a>



# Plans for the next years 2015-2019

- Establishment of core collections for all Native Dutch Breeds
- Develop/implement new technologies for cryopreservation and reproduction
  - Female genotypes – in addition to semen
  - Embryo's (cattle, horse)
  - Ovarian tissue, primordial germ cells, (somatic cells)

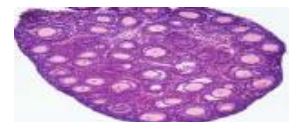
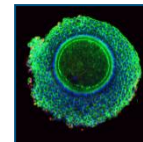
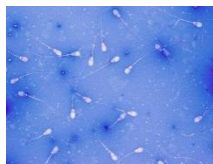
BIOLOGY OF REPRODUCTION 83, 15–19 (2010)  
Published online before print 17 March 2010.  
DOI 10.1095/biolreprod.110.083733

## Production of Donor-Derived Offspring from Cryopreserved Ovarian Tissue in Japanese Quail (*Coturnix japonica*)<sup>1</sup>

Jianan Liu,<sup>3,4</sup> Yonghong Song,<sup>3,4</sup> Kimberly M. Cheng,<sup>3</sup> and Frederick G. Silversides<sup>4</sup>

Faculty of Land and Food Systems,<sup>3</sup> University of British Columbia, Vancouver, British Columbia, Canada  
Agassiz Research Centre,<sup>4</sup> Agriculture and Agri-Food Canada, Agassiz, British Columbia, Canada

- Genomics and conservation: use of sequence information



# Opportunities <-> genomics technology



*Genetic markers for breeding and conservation of farm animal genetic diversity*

**Past 30 years**

**Last decade**

**Nowadays**

Pedigree

SNP chip

Whole Genome  
Sequence (WGS)

No markers

Subset of markers

All markers

Genealogic records

Improvement technology



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# REFP EUROPE



# European Regional Focal Point for Animal Genetic Resources



- Network of National Coordinators
- Supporting the *in situ* and *ex situ* conservation and sustainable use of AnGR in European countries.
- To facilitate the implementation of the FAO Global Plan of Action for AnGR in Europe.
- Cooperate and liaise with EU, FAO, CBD and EAAP
- To stimulate the funding and organisation of regional projects, research, workshops and national programmes
- To stimulate and coordinate the maintenance and further development of national/regional AnGR databases and to encourage European information networking on AnGR

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# ERFP Working Groups and Task Forces

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## 2015

### ■ Working Groups

- **Ex situ conservation (cryo-conservation)**
- Documentation and information

### ■ Task Forces

- Access and Benefit Sharing
- Collaboration with EU

---

# WG Ex Situ → **EUGENA**

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Establishment/strengthening of the  
European Gene Bank Network for  
Animal Genetic Resources (EUGENA)



# EUGENA - network

A Genebank for AnGR is defined as:

- a repository for *ex situ* conservation and sustainable use of AnGR
- held by a host institution
- authorized and/or recognized by a national authority
- a genebank may be constituted by one or more repositories (*in vitro* or *in vivo*) collaborating as a network.



# Objectives of the **EUGENA** network (1)

- to contribute to the long-term conservation and maintenance of AnGR in *ex situ* collections in ERFP Member States
- to support Genebanks in ERFP Member States to fulfil their individual roles and objectives;
- to improve monitoring and assessment of AnGR kept in *ex situ* collections in ERFP Member States by sharing information on Genebank collections;
- to improve Genebank operations and procedures in ERFP Member States by sharing information;
- to use synergies for *ex situ* conservation and sustainable use of AnGR by joint activities of Genebanks in ERFP Member States;



# Objectives of the **EUGENA** network (2)

- to facilitate a quality improvement of the Genebanks in ERFP Member States;
- to increase the efficiency of ex situ conservation and sustainable use of transboundary breeds;
- to promote harmonization of acquisition and access terms for ex situ conservation and sustainable use throughout the Genebanks in ERFP Member States;
- to facilitate a regional European approach for international cooperation and exchange of AnGR in the context of the implementation of the Nagoya Protocol for Access and Benefit Sharing;
- to create an element of a European research infrastructure for conservation/sustainable use of AnGR



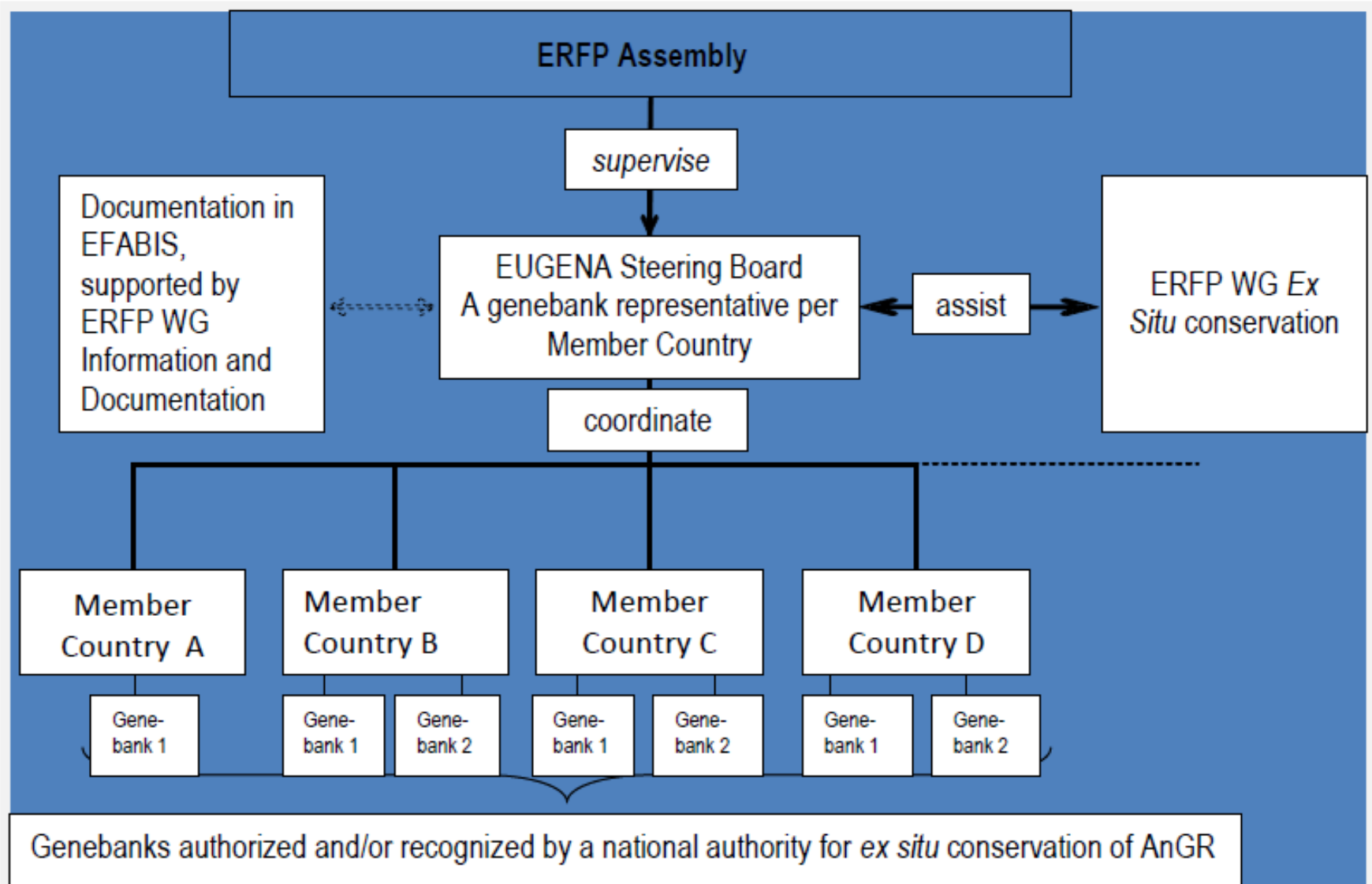
# Participation in the EUGENA

---

- At European level
  - ERFP Member Country and the ERFP Secretariat sign the EUGENA Memorandum of Understanding
  - MoU in preparation
- At national level
  - Agreement between Member Country representative and the representative(s) of the genebank(s) for the participation in the EUGENA.



# Organizational structure and governance - EUGENA





# Plant Genetic Resources – similar strategy



European Cooperative Programme for Plant Genetic Resources  
ECP/GR

**aegis**

*A European Genebank Integrated System*

ABOUT ECPGR ▾ WORKING GROUPS ▾ MEETINGS ▾ RESOURCES ▾ FUNDING OPPORTUNITIES ▾ CONTACTS IN ECPGR ▾ AEGIS ▾ EU

Homepage / AEGIS / About AEGIS

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## About AEGIS



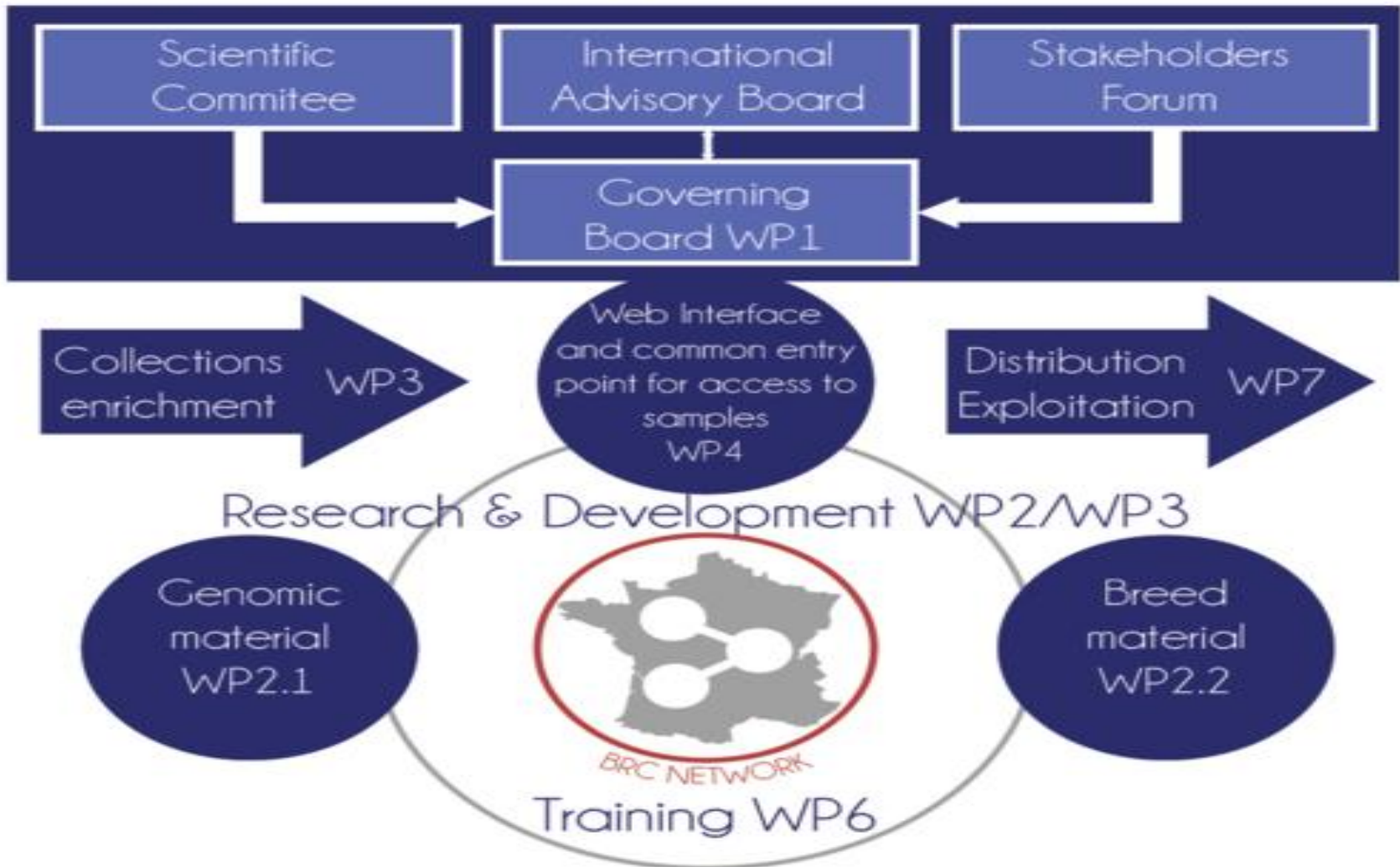
*Malvasija dubrovacka* - European Accession N. VIT00046  
(Photo by: Edi Maletic, University of Zagreb, Croatia)

**aegis** A European Integrated System

- About AEGIS
- Objectives
- Benefits
- Structure
- AEGIS and the Treaty
- Membership
- European Collection
- AQUAS
- Documents and other info

# Network of Biobanks in France (CRB-Anim)

## CRB-Anim Governance



# Next steps at European level

- Building EUGENA network



- Development of Horizon 2020 Research Proposal to support EUGENA
  - IMAGE (submitted)
  - Coordinated by INRA France, Michele Tixier-Boichard



# IMAGE

## Key strategic objectives → Enhance the use and upgrade the management of gene bank collections

- Engagement of stakeholders and the general public
- Rationalization of collections
- Better (genomic) characterization of collection material
- Develop and anticipate novel reproductive technologies
- Data integration and data sharing
- Integrating germplasm collections and collections of other biological material
- New tools to enable/to facilitate the use of collections
- Clear and transparent access rules (<-> ABS)
- Upgrade quality management of gene banks

# → European WebPortal for genetic collections

*Current information about genebanks in Europe:*

- EFABIS is entry point at European level
- Upload of aggregated breed data to EFABIS
- Automatic upload from CryoWEB and upload-tool for other gene bank databases
- Some general and survey information on ERFP website
- Gene bank collections disconnected from genomic collections

→ *Designing a web portal serving user and provider interests*

→ *Meta-information + linkages to specific databases*



News

About

Network

Breeds

Library

Help/FAQ

Language of:

Interface:

Content:

User name:

Password:

Webmaster

Citation

Disclaimer



## Single Breed Reports

- Breed Data Sheets
- Empty Breed Data Sheets

## Breeds Population Reports

- Early Warning Tool
- Single breed population structure & inbreeding, through time
- Comparing breeds on population structure
- Population structure charts

## Other Information

- Breeds by species and country
- Status of reporting by country
- Image browser
- Transboundary breed
- Cross-table generator
- Conservation programmes

## Annual regional statistics

- Degree of completeness of EFABIS
- Number of breeds with population
- Frequency of updating the population size in EFABIS
- Degree of completeness of EFABIS based on population
- Trends of population size by species
- Population trends over the years

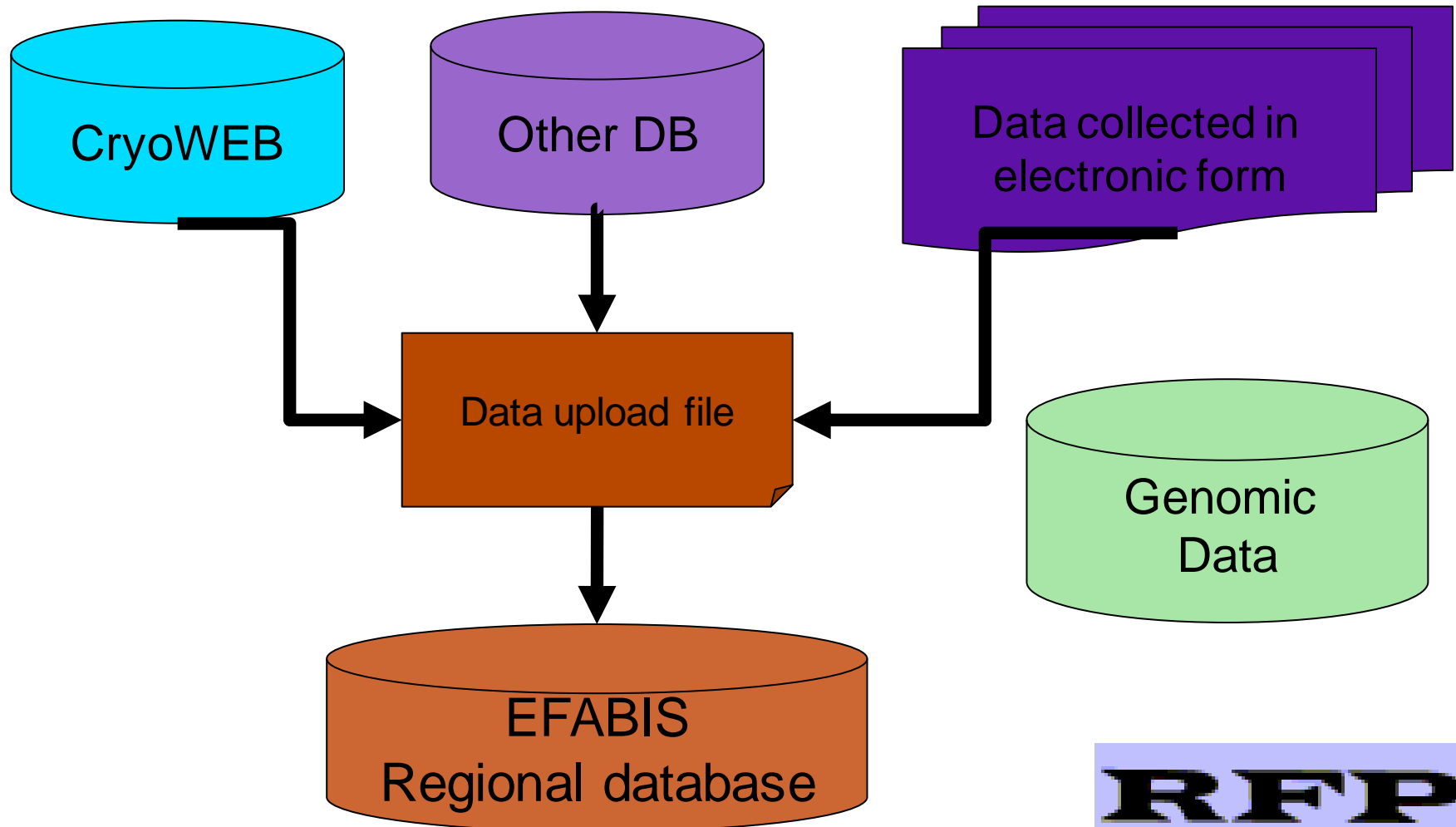
## Transboundary genebank data

- Transboundary breed overview
- Cryodata charts per transboundary breed
- Cryodata charts per country
- Search material

## Transboundary genebank data

- Transboundary breed overview
- Cryodata charts per transboundary breed
- Cryodata charts per country
- Search material

# Cryobank data at European level (EFABIS)







## Survey Results – 25 national Gene Banks in Europe

<b>Species represented in national gene bank collections</b>	<b>Percentage of countries</b>
Cattle	92%
Sheep	64%
Goat	52%
Horse	60%
Pig	56%
Chicken	20%
Rabbit	8%
Duck	8%
Bee	8%
Dog	4%
Goose	4%

<b>Type of genetic material in European gene banks</b>	<b>Percentage of countries</b>
Semen	84%
Embryos	44%
Embryonic cells	4%
DNA/blood	44%
Ovarian cells/oocytes	20%
Gonadal tissue	4%
Somatic cells/tissue	20%

**RFP**  
**EUROPE**

Hiemstra et al. WCGALP,  
2014

**Percentage of countries**

**Host institution for gene bank collections**

- Public or semi-public institution 72%
- Breeding association or AI centre 8%
- Network of organizations 20%

**Legal basis for national gene bank**

- National/regional law or regulation 38%
- Agreement on (research) program 31%
- Not mentioned 31%

**Ownership of genetic material**

- Public or semi-public ownership 56%
- Breeding association or AI centre 8%
- Provider or depositor 4%
- Mixed public-private 32%

Hiemstra et al. WCGALP, 2014





What it is

EURISCO is a web-based catalogue that provides information about ex situ plant collections maintained in Europe.

EURISCO is based on a European network of ex situ National Inventories (NIs) that makes the European plant genetic resources data available everywhere in the world. The EURISCO Web Catalogue automatically receives data from the NIs through country National Focal Points (NFPs).

The EURISCO Catalogue contains passport data about 1.1 million samples of crop diversity representing almost 5,700 genera and more than 36,000 species (genus-species combinations including synonyms and spelling variants) from 43 countries (updated February 2015).

These samples of crop diversity represent more than half of the ex situ accessions maintained in Europe and roughly 16% of total worldwide holdings. EURISCO is a one-stop shop window using international standards for information on ex situ plant collections that enables users to search and access information on food crops, forages, wild-and-weedy species, including cultivars, landraces, farmers' varieties, breeding lines, genetic stocks and research material.

Following the mandate and guidance given by the ECPGR Steering Committee, EURISCO is hosted at and maintained by [IPK Gatersleben](#) on behalf of [Biodiversity International](#), which acts as the legal entity of the Secretariat of the [European Cooperative Programme for Plant Genetic Resources \(ECPGR\)](#), in collaboration with and on behalf of the National Focal Points for the National Inventories.

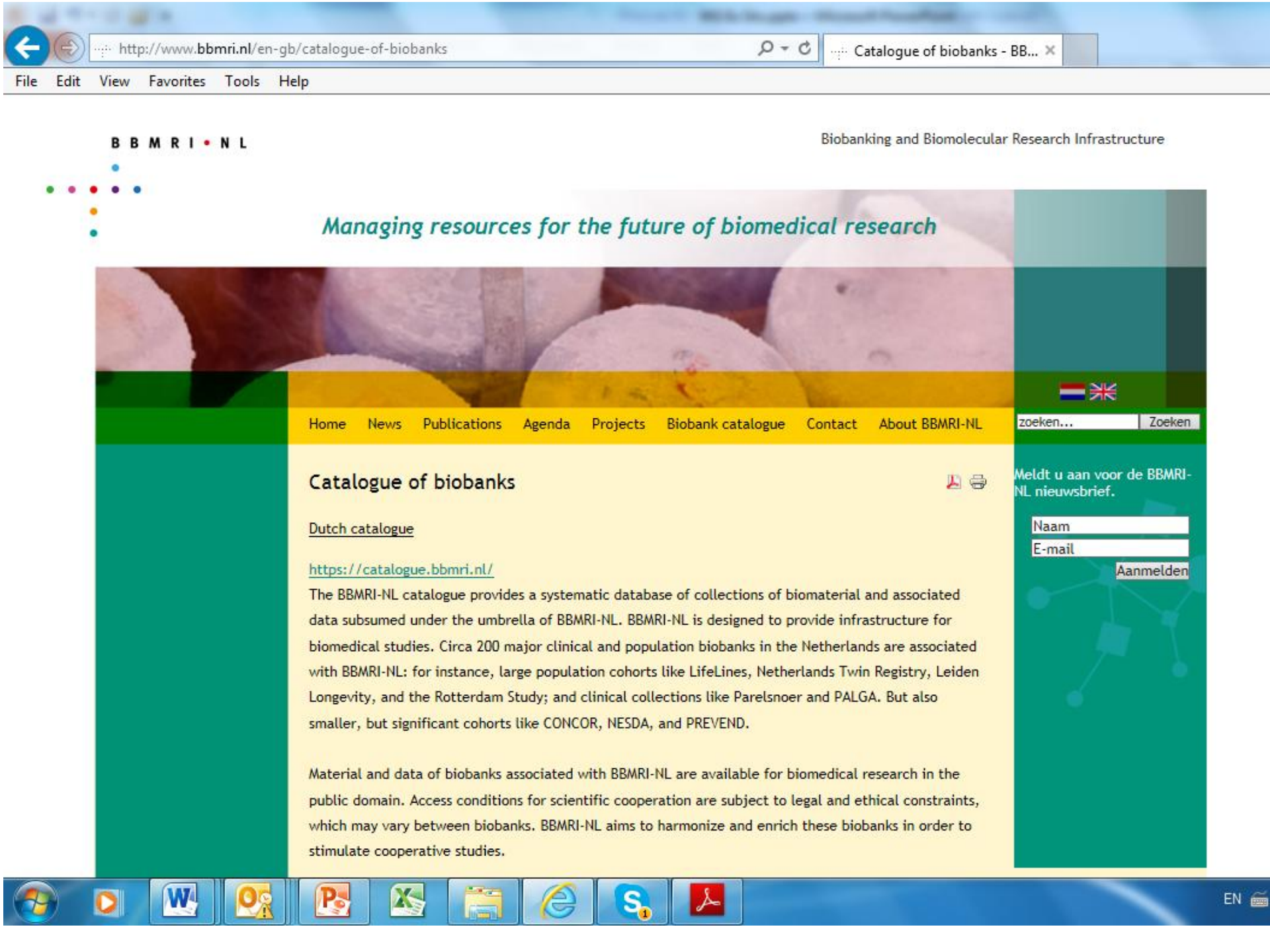
EURISCO is working with NFPs to improve the search mechanisms, data and metadata standards, web services and other necessary components of an Internet-based information infrastructure for ex situ plant genetic resources. EURISCO makes data from the NIs available to users around the world. These data are made available according to the existing data policy - legal notice and terms of use.

Citing EURISCO

Citing data: Users of EURISCO data shall always give credit to the Catalogue. Use the following format to cite data retrieved from the EURISCO Catalogue: "EURISCO Catalogue, <http://eurisco.ecpgr.org>, date of data consultation (YYYY-MM-DD)"

How it works and who participates

IPK Gatersleben's responsibilities



## Managing resources for the future of biomedical research

Home News Publications Agenda Projects Biobank catalogue Contact About BBMRI-NL

zoeken... Zoeken

### Catalogue of biobanks

#### Dutch catalogue

<https://catalogue.bbmri.nl/>

The BBMRI-NL catalogue provides a systematic database of collections of biomaterial and associated data subsumed under the umbrella of BBMRI-NL. BBMRI-NL is designed to provide infrastructure for biomedical studies. Circa 200 major clinical and population biobanks in the Netherlands are associated with BBMRI-NL: for instance, large population cohorts like LifeLines, Netherlands Twin Registry, Leiden Longevity, and the Rotterdam Study; and clinical collections like Parelinoer and PALGA. But also smaller, but significant cohorts like CONCOR, NESDA, and PREVEND.

Material and data of biobanks associated with BBMRI-NL are available for biomedical research in the public domain. Access conditions for scientific cooperation are subject to legal and ethical constraints, which may vary between biobanks. BBMRI-NL aims to harmonize and enrich these biobanks in order to stimulate cooperative studies.

Meldt u aan voor de BBMRI-NL nieuwsbrief.

Naam

E-mail

Aanmelden



SLU Biobank  
Sample collection database



[Login](#) | [Logout](#) | [Contact us](#)

Home

Find sample collections

Links

- SLU Biobank
- BBMRI.se
- Catalog of European Biobanks (User: guest, Password: catalogue)
- Svensk Nationell Datatjänst (SND)
- Molecular Methods Database
- NCI Biospecimen Research Database
- SciLifeLab - Uppsala

**Found Sample Collections**

	English Name	Organization	Species Kingdom	Species Binominal	Material type	Number of sample done	Type of omics experime	Categories of Data Coll	
1	Swedish local chicke...	Sveriges Lantbruksu...	Animalia	Gallus gallus	Whole blood@DNA...	211			<a href="#">View</a>
2	Swedish sheep breeds	Sveriges Lantbruksu...	Animalia	Ovis aries	Whole blood@DNA	700		Survey@Imaging data	<a href="#">View</a>
3	Foreign sheep breed...	Sveriges Lantbruksu...	Animalia	Ovis aries	Whole blood@DNA	5			<a href="#">View</a>
4	Canine Biobank	Sveriges Lantbruksu...	Animalia	Canis familiaris	Whole blood@Seru...	10200	Genomics@Transcri...	Register data@Medi...	<a href="#">View</a>
5	Sheep breeds and pr...	Sveriges Lantbruksu...	Animalia	Ovis orientalis	Other (specify below)	6700		Survey@Imaging data	<a href="#">View</a>
6	Lepus samples	Sveriges Lantbruksu...	Animalia	Lepus timidus, Lepu...	DNA@Tissue@Faec...	1200	Genomics@Other (s...	Register data@Othe...	<a href="#">View</a>
7	Wild mink	Sveriges Lantbruksu...	Animalia	Neovison vison	Whole blood@Tissue	500		Physiological measu...	<a href="#">View</a>
8	Lövsta sows - Oxyto...	Sveriges Lantbruksu...	Animalia	sus scrofa	Whole blood@DNA	0			<a href="#">View</a>

Page 1 of 1 | Edit | 1 - 8 of 8

# *Purposes of AnGR Gene Banks → Ex situ*

---

- *To support in situ conservation*
- *Insurance for future generations*
- *To be able to recreate extinct breeds/breeding lines*
- *As a back-up in case genetic problems would occur*
- *To allow development of new lines or breeds*
- *For research and genetic characterization purposes*



---

# Conclusions

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- Added value at European level:
  - Transparency of what 'we' have in genetic collections
  - Exchange of knowledge and protocols
  - Clarify ownership and access conditions
  - Collaboration between (in situ and ex situ) actors at national level
  - Networking at European level
  - Better characterization for future use
  - Development of innovative methods for conservation and use



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**Thank you for your attention**

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