Food and Agriculture Organization of the United Nations

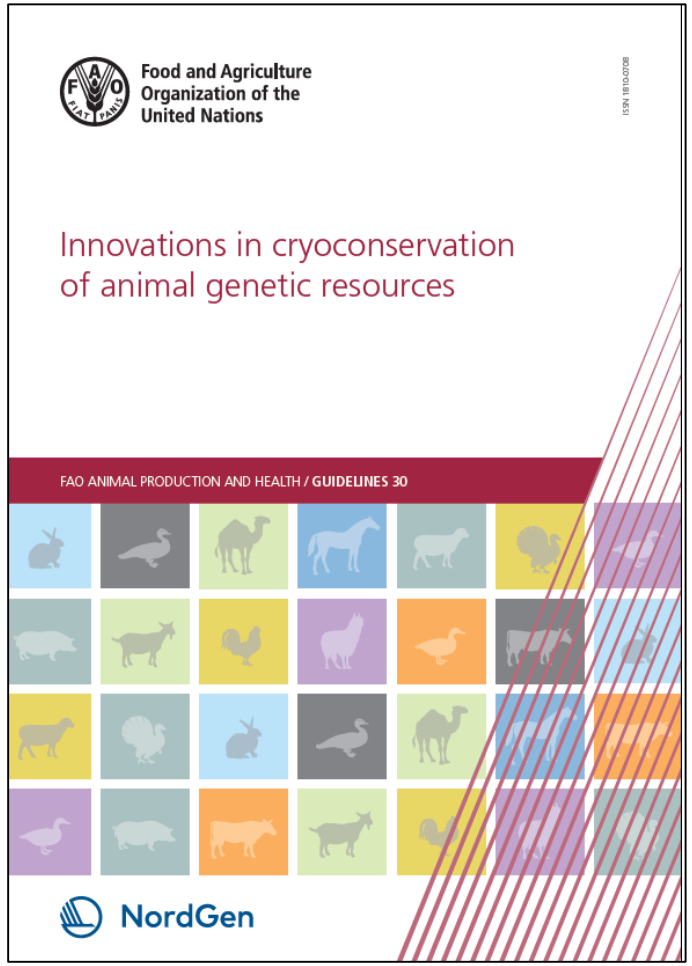
SUSTAINABLE DEVELOPMENT GOALS

Innovation in cryoconservation of animal genetic resources

Webinar series

Background

- In 2020 and 2021, FAO prepared guidelines on *Innovation in cryoconservation of animal genetic resources*
  - International authors including from EU Horizon 2020 project IMAGE
  - In cooperation with Nordic Genetic Resources Center (NordGen)
- Guidelines were reviewed by ITWG-AnGR and CGRFA
  - Commission requested FAO to build capacity
- This is the tenth in series of webinars that started in 2022
  - One per chapter
  - Dedicated page on FAO Animal Genetics and NordGen websites
    https://www.fao.org/animal-genetics/events/intergovernmental-technical-working-group-on-angr/webinars/en/
    https://www.nordgen.org/en/cryo-conservation-webinars/



Section 10: Capacity building and training

- Overview of Section 10 (Paul Boettcher, FAO)

Country examples:

- Michèle Tixier-Boichard, France
- Lilian Villamor, Philippines (recording)
- Badr Benjelloun, Morocco
- Samuel Paiva and Connie McManus, Brazil
- Harvey Blackburn, USA

Q & A (Moderator – Jaap Boes)

Food and Agriculture Organization of the United Nations

SUSTAINABLE DEVELOPMENT GOALS

Thank you

Food and Agriculture Organization
of the United Nations

Capacity building, training and outreach

Paul Boettcher
FAO-Rome

IMPLEMENTING THE GLOBAL PLAN OF ACTION FOR ANIMAL GENETIC RESOURCES

Introduction

- Knowledge and skills are critical components for proper operation of cryconservation programmes
- Global Plan of Action for Animal Genetic Resources reflects this in Strategic Priority 14
  - *strengthen national human capacity for characterization, inventory, and monitoring of trends and associated risks, for sustainable use and development, and for conservation.*
- Three domains:
  - academic and technical training in national universities and research centres;
  - specialized training for gene bank staff; and
  - outreach and capacity building for gene bank stakeholders.

Academic and technical training

- Undergraduate => one-way knowledge transfer
  - nearly all future stakeholders will have university training
  - role of livestock in global food security and livelihoods and local importance of livestock and production systems
  - introduction to topics of breeding, reproductive biology and data
  - basics of animal genetic diversity and role of cryoconservation
- Graduate school <=> two-way transfer of knowledge
  - specialized instruction plus research
    - genetics and genomics
    - reproductive physiology and cryobiology
    - data management
  - individual universities may not be able to cover all topics
    - cooperation projects
    - international exchange

Specialized training of gene bank staff

- Staff should have high deal of expertise when hired, but additional capacity building will be needed
  - expand skillset
  - “keep up” with technological developments
- Continuous improvement is a key aspect of quality management
  - improve efficiency and decrease costs
  - enhance staff productivity and safety
  - ensure client satisfaction
- Various modes to build capacity
  - on-the-job training
  - exchange with other gene banks
  - continuing education
  - cooperation with other stakeholders, including the private sector

Outreach and capacity building with stakeholders

- Informing stakeholders builds trust in gene bank
  - increased financial support
  - increased provision and utilization of material
- Efficiency of operations can be increased
  - help ensure greater quality of incoming material
  - improve impact of accessed samples
- Greater awareness by stakeholders of important policies and regulations
  - sanitary regulations
  - Nagoya Protocol and national laws on access and benefit sharing

- The relative importance of different topics and optimal delivery methods will vary from country to country
- Each country and gene bank will need to develop its own capacity and outreach programme
- There is the opportunity to learn from one another

Thank you!

Training and dissemination : a necessary component for any gene banking strategy

Michèle TIXIER-BOICHARD
University Paris-Saclay, INRAE, AgroParisTech, GABI, Jouy-en-Josas, France,

Coordinator or the CRB-Anim infrastructure for genetic resources https://crb-anim.fr
Coordinator of the H2020 IMAGE project
Chair of the governing board of the French National Gene Bank and of @BRIDGe BRC

Guidelines for cryoconservation of animal genetic resources

Outline

- Objectives and public
- Tools
- Examples

Objectives and targeted public (1)

- General training:
  - Provide a vision of the overall strategy
    ⇒ for decision makers, funders, livestock keepers
  - Provide a comprehensive set of knowledge
    ⇒ academic training : researchers, gene bank manager
    typically a ‘summer school’ with PhD students and group works

Objectives and targeted public (2)

- Specialized ⇒ for gene bank staff and users
  - Reproductive biotechnologies
  - Quality management
  - Information system
  - …

Tools

- Face to face sessions, one day to a week
- Practicals
- Webinars
- Flyers can be useful, to provide a contact

Three examples from H2020 IMAGE project

- The‘dialogue forum’ : each year

- A capacity building week

  Argentina (2018), Columbia (2018, 2019) : mixed public, **in spanish**

  See also presentation of Badr Benjelloun for Morocco

- A user-driven workshop

Dialogue forum

- A yearly 'dialogue forum' with stakeholders :
  organisation Waltraud Kugler (SAVE) & academic partners

- Establish a large list of stakeholders (policy makers, breeders, farmers, academics)

- Select a few 'hot topics' for 1 day
  Economic optimization / Nagoya protocol / Sanitary regulations
  produce a report
  share take-on messages and sometimes take action (i.e sanitary regulations)

⇒ a gene bank may take advantage of existing events/ fairs to organize its own forum

Typical outline of a capacity building week

- ✓ What is genetic diversity and why it is important
- ✓ Characterization of genetic diversity
  - Pedigree data (*phenotypes generally already considered)*
  - Basic concepts of Molecular Genetics and Population Genetics
  - Genomic characterization and Landscape Genetics
- ✓ Conservation of AnGR : place of gene banking, *in situ / ex situ* complementarity
- ✓ FAO mission on AnGR
- ✓ Examples of conservation programs
- ✓ Field trip
- ✓ Presentations by students

Colombia

Local organizers
AGROSAVIA (Carlos Lucero et al.)

4 Lecturers from IMAGE groups
Oscar Cortes (UCM), Michel Naves (INRA)
Luis Gama (ULisbon), Paul Boettcher (FAO) – By Skype

33 participants "in situ" 7 remotely

Argentina

Local organizers
INTA
Maria Rosa Lanari
Lilia Mellucci

3 Lecturers from IMAGE partners
Roswitha Baumung (FAO)
Maria Wurzinger (BOKU)
Luis Gama (ULisbon)

22 participants "in situ"
16 Argentina (Various parts)
3 Peru, 2 Uruguay , 1 Bolivia

All lectures in Spanish

A user-driven workshop

- ✓ Targets: breeders and gene bank manager
- ✓ Lessons from case studies
  - ❖ Recovering lost families in a poultry line from a semen bank
  - ❖ Recovering a whole line of trout by combining the use of frozen semen with a mirror group of females

    ⇒ illustrating the practical limitations for recovering a whole line from gene bank only
- ✓ Practising the use of the MoBPS simulating tool to guide the user :
  - ❖ Theory and practice
  - ❖ How to simulate the impact of using semen from the gene bank in a population

    ⇒ In silico testing before using real and ‘precious’ material

Examples from CRB-Anim infrastructure

- Specialized training on Reproductive Biotechnologies
  summer school on image analysis for fertility studies in mammals
  with practicals
  about 20 students from various countries
  ⇒ enhance the reproductive quality of biological material for the gene bank

- Training to a quality management standard for gene banks (in France : NFS 96 900)
  now replaced by ISO 20387

Examples from CRB-Anim infrastructure

- A series of six webinars (in english) as part of a bilateral cooperation between France and Thailand + reciprocal visits

- Address all steps to set up a multi-species gene bank in the frame of a national effort for the preservation and valuation of chicken genetic resources

- All recorded and made available on VetAgro Sup on-line training channel

Take-home messages

- Involve a range of stakeholders in the public as well as in the presentations
- Balance theory and real case studies
- Technical training requires specific equipment (academics)
- Advantageous to use native language to maximise involvement of participants

→ next

Capacity Building, Training And Outreach for conservation of animal genetic resources

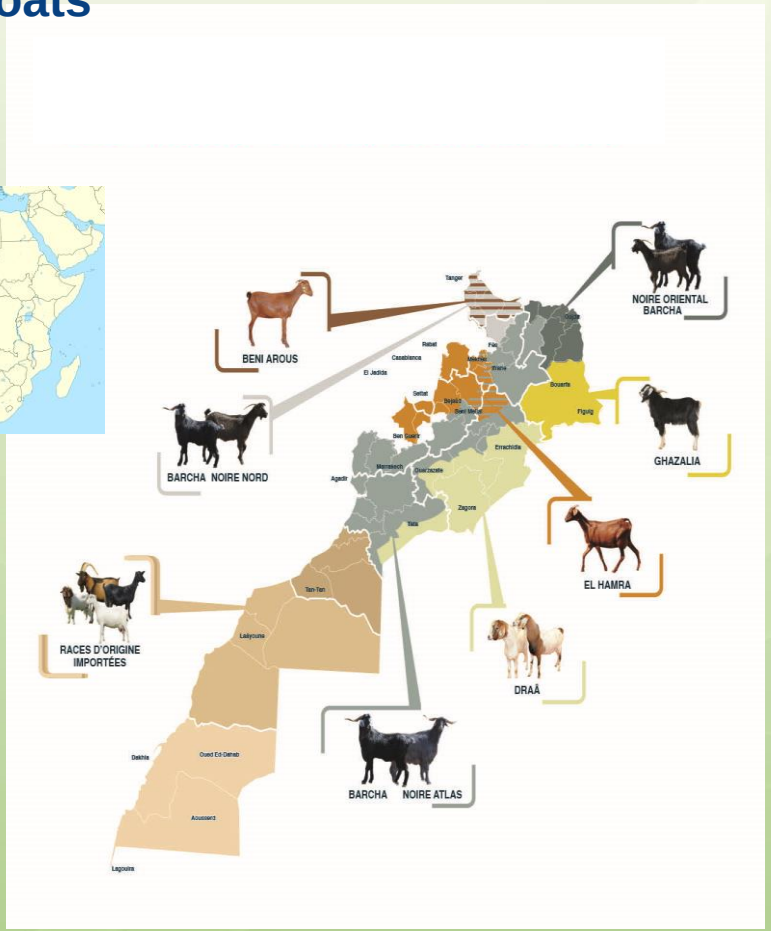
Badr Benjelloun

- Scientist in livestock genomics
- The National Institute for Agronomic Research INRA Morocco-Head of the Regional Centre of Tadla
- Visiting scientist at Laboratoire d'Ecologie Alpine en France
- PI in Morocco/at INRA within many international projects
  - NextGen (EU FP7), IMAGE (H2020), Scala-Medi (Prima-S1)

Outline

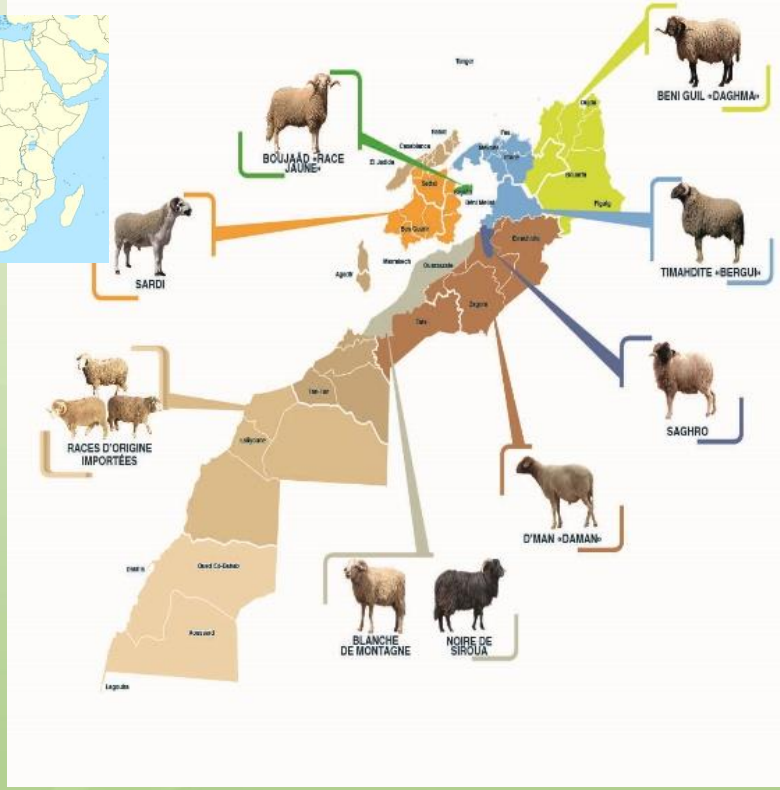
- Situation of sheep and goats in Morocco
- Conservation & cryoconservation
- Genome diversity in sheep and goats
- IMAGE dissemination week in Morocco

Goats



- ~6.5 M
- 98% local breeds
- Diversity in morphology/phenotypes
- Raised/well adapted to harsh environments

Sheep



- ~20 M
- 99% local breeds

(40% standardised)

- Diversity in morphology/phenotypes
- Adapted to harsh environments

Conservation of livestock genetic resources

In vivo conservation

e.g.The national sheep plan (since 1980)

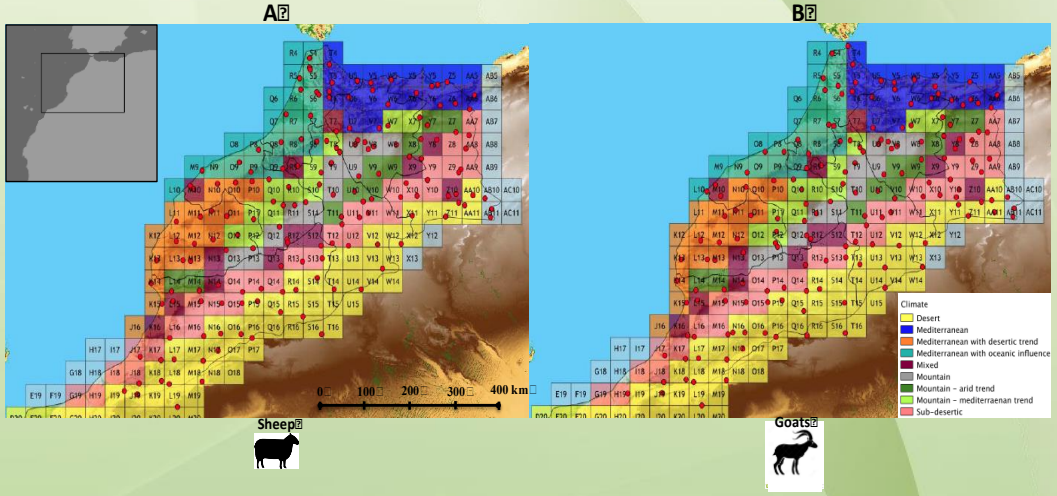
areas "cradles" of breeds

Cryoconservation

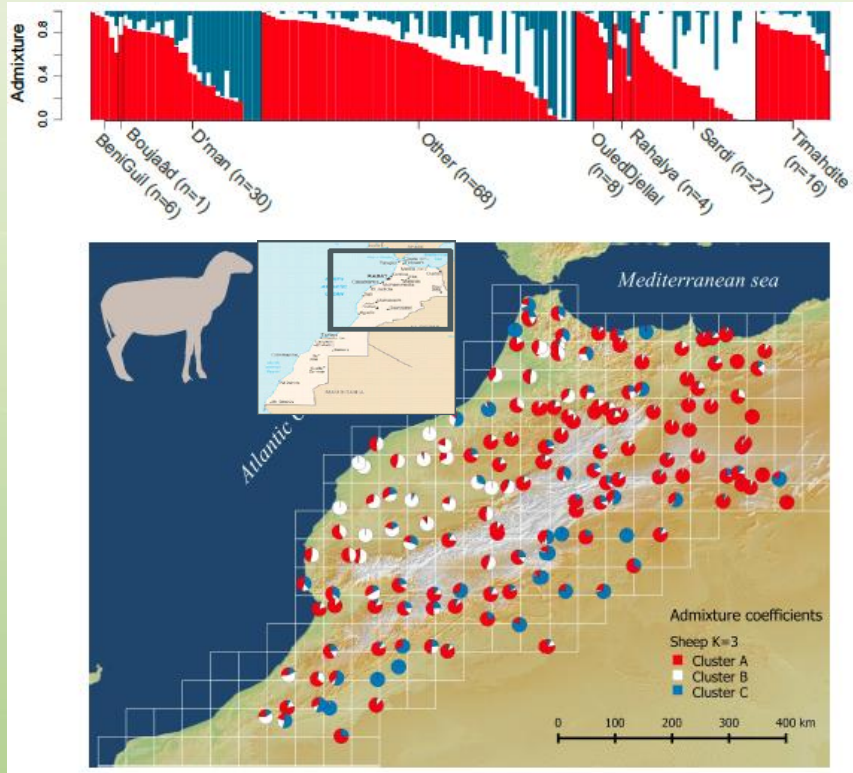
Gene bank for plants (INRA Settat)	~70 K accessions	Since 2003
The National Centre for Genetic Resources (INRA Rabat)	Plants - animals - microorganisms	Ready by the end of 2023

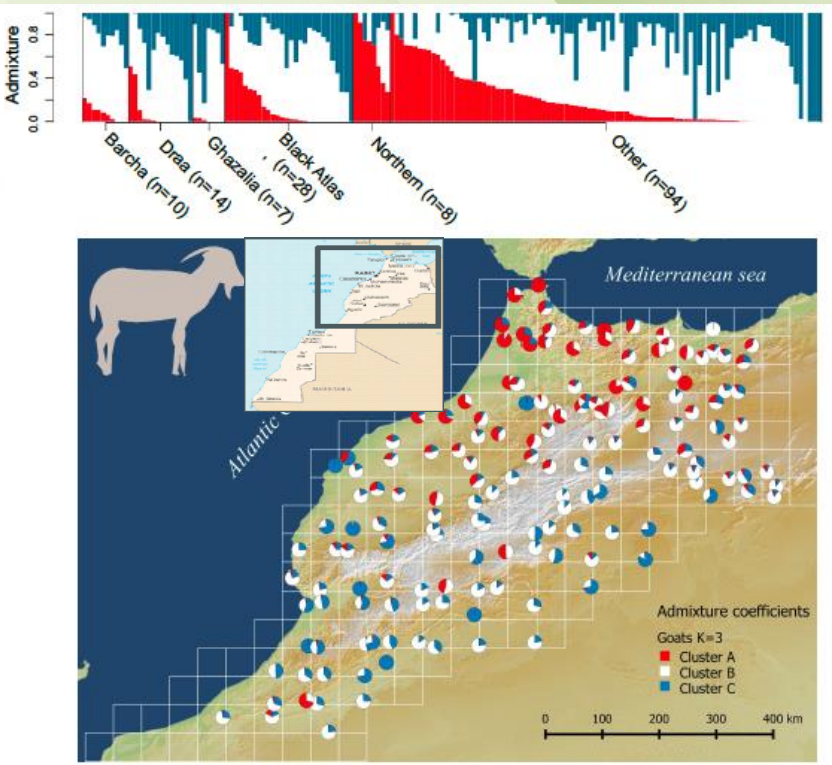
Genome analyses of Moroccan sheep and goats

Whole genomes of 160 sheep and 161 goats representative of the environmental variation and breed diversity



Structuration



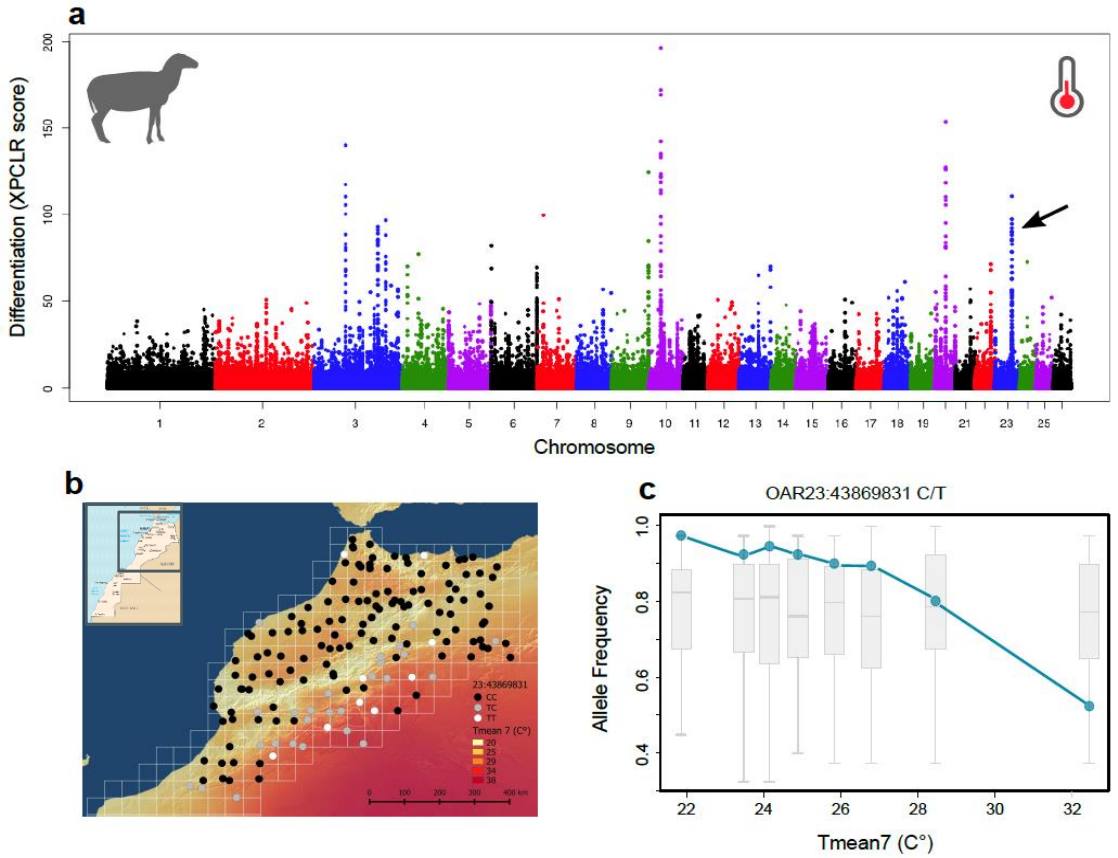


Signatures of selection

Selection signatures associatied to environmental pressure

Selection signatures associated to breeds

Epigenetic marks associated to heat stress



Capacity building week

- One day international workshop/conference
  - Audience: decision makers, breeder association, administration, scientists, universities, technicians, …

    10 January 2020 in Rabat

- 4 days training workshop
  - Audience: 20 selected young researchers & post-graduate students

    21 – 24 January 2020 in Beni Mellal

One day workshop

IMAGE
Innovative Management of Animal Genetic Resources

Séminaire international sur

LA CRYOCONSERVATION DES RESSOURCES GÉNÉTIQUES ANIMALES ET LES OPPORTUNITÉS POUR UN DÉVELOPPEMENT DURABLE DE L'ÉLEVAGE AU MAROC

Rabat - 20 janvier 2020
Salle de conférences de l'INRA

المعهد الوطني للبحث الزراعي
Institut National de la Recherche Agronomique

Objectif

Echanger les connaissances sur la conservation des ressources génétiques. Discuter les apports des nouvelles approches de biobanking et de génomique pour une meilleure conservation et un développement durable de l'élevage au Maroc.

Participants

Décideurs, professionnels, acteurs de développement, scientifiques et techniciens

Programme

09:00-09:30	Inscription et buffet d'ouverture
09:30-10:00	Allocutions d'ouverture
10:00-10:15	Impact des changements climatiques sur les animaux et les systèmes d'élevage. **Dr Abdelmajid Bechchari, Dr Bouchra El Amiri, Dr Badr Benjelloun** -INRA Maroc
10:15-10:35	Diversité et valorisation des ressources génétiques locales au sein des animaux d'élevage au Maroc. Cas des petits ruminants. **Dr Badr Benjelloun, Dr Hayat Lionboui, Dr Fouad Elame**-INRA Maroc, **Dr Abderrahmane Janoune**-ANOC, Mr **Khalid Boukhari**-DDFP
10:35-10:55	Stratégies de gestion et de conservation des animaux d'élevage au Maroc. **Dr Mouad Chentouf, Dr Mustapha Ibnelbachyr**-INRA Maroc
10:55-11:15	Stratégies mondiales de conservation des ressources génétiques animales (*in vitro* et *in vivo*). **Dr Gregoire Leroy**-FAO, **Dr Sipke-Joost Hiemstra**- CGN Pays Bas, ERFP Europe, **Dr Paul Boettcher**-FAO
11:15-11:30	Analyse économique de la diversité génétique chez les animaux d'élevage, **Dr Dominic Moran**-Univ. Edimbourg Écosse
11:30-11:50	Implémentation, gestion et utilisation des banques de gènes animales. **Dr Michèle Tixier Boichard** INRA France, **Dr Coralie Danchin**-IDELE France
11:50-12:20	11h50-12h20: Success stories: (i) La banque de gènes des plantes de l'INRA-Maroc. **Dr Ali Sahri**-INRA Maroc ; (ii) Les banques de gènes des animaux en France. **Dr Michèle Tixier-Boichard**-INRA France
12:20-13:20	Débat entre les décideurs, professionnels, acteurs de développement, de la recherche et de la formation sous le thème: Opportunités pour la conservation efficiente des ressources génétiques animales et pour un développement durable de l'élevage au Maroc.
12:20-13:20	Conclusions et recommandations
13:30 - 14:30	Déjeuner

L'élevage constitue l'une des composantes principales de l'agriculture marocaine. La stratégie du Plan Maroc Vert a fait du développement de ses filières (lait, viandes et oeufs) l'un des objectifs primordiaux en visant l'agrégation des acteurs et l'augmentation des productions via l'amélioration de la conduite alimentaire et sanitaire et l'amélioration génétique des animaux.

La conservation des ressources génétiques est incontournable dans toute stratégie de gestion et de développement des animaux d'élevage. Elle permet de maintenir la diversité génétique qui reste capitale pour la durabilité de tout programme d'amélioration génétique. Elle permet également de préserver des caractères importants en terme zootechnique et/ou adaptatifs en vue de l'amélioration de la production animale et la durabilité des espèces animales dans des contextes diversifiés. Les techniques utilisées vont de la conservation *in situ* à la conservation *ex situ* et *in vitro* de plusieurs types de matériel reproducteur.

Programme

09:00-09:30	Inscription et buffet d'ouverture
09:30-10:00	Allocutions d'ouverture
10:00-10:15	Impact des changements climatiques sur les animaux et les systèmes d'élevage. **Dr Abdelmajid Bechchari, Dr Bouchra El Amiri, Dr Badr Benjelloun -INRA Maroc**
10:15-10:35	Diversité et valorisation des ressources génétiques locales au sein des animaux d'élevage au Maroc. Cas des petits ruminants. **Dr Badr Benjelloun, Dr Hayat Lionboui, Dr Fouad Elame-INRA Maroc, Dr Abderrahmane Janoune-ANOC, Mr Khalid Boukhari-DDFP**
10:35-10:55	Stratégies de gestion et de conservation des animaux d'élevage au Maroc. **Dr Mouad Chentouf, Dr Mustapha Ibnelbachyr-INRA Maroc**
10:55-11:15	Stratégies mondiales de conservation des ressources génétiques animales (*in vitro* et *in vivo*). **Dr Gregoire Leroy-FAO, Dr Sipke-Joost Hiemstra- CGN Pays Bas, ERFP Europe, Dr Paul Boettcher-FAO**
11:15-11:30	Analyse économique de la diversité génétique chez les animaux d'élevage, **Dr Dominic Moran-Univ. Edimbourg Écosse**
11:30-11:50	Implémentation, gestion et utilisation des banques de gènes animales. **Dr Michèle Tixier Boichard INRA France, Dr Coralie Danchin-IDELE France**
11:50-12:20	11h50-12h20: Success stories: (i) La banque de gènes des plantes de l'INRA-Maroc. **Dr Ali Sahri-INRA Maroc ;** (ii) Les banques de gènes des animaux en France. **Dr Michèle Tixier-Boichard-INRA France**
12:20-13:20	Débat entre les décideurs, professionnels, acteurs de développement, de la recherche et de la formation sous le thème: Opportunités pour la conservation efficiente des ressources génétiques animales et pour un développement durable de l'élevage au Maroc.
12:20-13:20	Conclusions et recommandations

One day workshop

- (i)Theoretical and empirical impacts of climate changes on breeding systems
- Diversity and valorization of local genetic resources in livestock species in Morocco
- Strategies for management and conservation of FAnGR in Morocco
- Global strategies for the conservation of animal genetic resources (in vitro and in vivo)
- Economic Analysis of Genetic Diversity in Farm Animals
- Implementation, management and use of animal gene banks
- Two "success stories", the plant Bio-bank of INRA-Morocco, and the Animal Bio-bank in France CRB-Anim

Debate: Opportunities for efficient conservation of animal genetic resources and for sustainable livestock development in Morocco

Training workshop

Scope

About one third of domestic breeds are considered to be at risk of extinction, as reported by the FAO (DAD-IS, 2019). The Global Plan of Action for Animal Genetic Resources identified conservation as a Strategic Priority Area to be addressed. In order to preserve the genetic diversity of livestock in complementarity to *in-vivo* conservation, *ex-situ in-vitro* cryoconservation of animal reproductive material represents an excellent and cost-effective alternative. New progress in structural and functional genomics and novel methods in reproductive technology allow for an unprecedented characterization of animal genetic resources and for an effective use of cryo-preserved material.

Aim of the course

Give an update on the role of biobanking for a sustainable management of farm animal genetic resources (FAnGR) with a focus on the use of novel methods in genomics, reproduction, economics and the possibility to carry out practical cases of interest to participants.

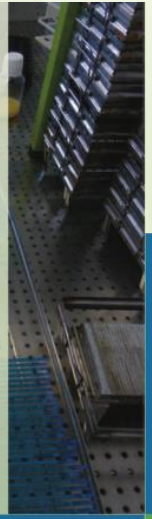
Learning goals

- How to assess neutral and adaptive genetic diversity in the era of whole genome data?
- How to effectively conceive and manage efficient genebanks?
- How could the use of cryo-conserved material help to restore profitable traits?
- Can we facilitate the effective use of gene bank samples in breeding by novel genomeassisted methods and tools?
- How to sustainably manage indigenous populations?

Target audience

Target audience of the course are PhD students, post-docs and researchers interested in conservation of animal genetic resources and in genomic characterization of neutral and adaptive diversity.

A prerequisite for participants of the course is a strong interest in the conservation of animal genetic resources and a basic knowledge in genetics of farm animals and in currently available genomic tools, i.e. SNP or sequence data. The applicants are therefore asked to provide a short CV (not more than 2 pages) and to hand in a paragraph describing their motivation for the course. The maximum number of participants is 20 and a selection procedure will be applied in order to have a good fit between scope of the course and the participants.



Summarized content of the course

- Assessment of genomic diversity
- Progress in genotyping
- Adaptive/productive introgression
- Functional genomics
- Economic assessment of conservation
- Conservation strategies
- Conception and use of animal genebanks
- Sustainable Management of livestock populations
- Legal issues
- Practical exercises

المعهد الوطني للبحث الزراعي

IMAGE

Innovative Management of Animal Genetic Resources

is a project funded by the Horizon 2020 Research and Innovation Programme of the European Union under grant 677353, which relies on a comprehensive consortium of 28 partners from 18 countries. IMAGE aims to enhance the use of genetic collections and to upgrade animal gene bank management by further developing genomic methodologies, biotechnologies and bioinformatics for a better knowledge and exploitation of animal genetic resources. For more information, please visit : **www.imageh2020.eu**

Organizing commitee (workshop & training)

Badr Benjelloun, Michèle Tixier-Boichard, Hayat Lionboui, Mohammed BenBati, Tarik Benabdelouahab, Kaoutar Elfazazi, Samir Fakhour, Otman Sebbata, Reddad Tirazi, Abdelmajid Bechchari, Mustapha Ibnelbachyr, Mouâd Chentouf, Imane Thami Alami, Fouad Elame, Bouchra El Amiri, Abdessamad Ouhrouch, Fatima Ezzahra Labdidi, Ichrak Hayah, Moussa El Fadili, Paul Boettcher, Sipke-Joost Hiemstra

INRA - Avenue de la Victoire, B.P. 415 R.P., Rabat - Maroc
Tél. : +212 53 777 09 55 - Fax : +212 53 777 00 49
www.inra.org.ma

المعهد الوطني للبحث الزراعي

Post-graduate course on

BIOBANKING FOR A SUSTAINABLE MANAGEMENT OF FARM ANIMAL GENETIC RESOURCES :

NOVEL APPROACHES IN GENOMICS, REPRODUCTIVE TECHNOLOGIES AND ECONOMICS

21 to 24 January 2020
Beni Mellal city, Morocco

Languages:

This course is organized by
The National Institute of Agronomic Research in Morocco INRA-Maroc
in the frame of the IMAGE H2020 project

المعهد الوطني للبحث الزراعي
Institut National de la Recherche Agronomique

IMAGE
Innovative Management of Animal Genetic Resources

Training workshop

Scope

About one third of domestic breeds are considered to be at risk of extinction, as reported by the FAO (DAD-IS, 2019). The Global Plan of Action for Animal Genetic Resources identified conservation as a Strategic Priority Area to be addressed. In order to preserve the genetic diversity of livestock in complementarity to *in-vivo* conservation, *ex-situ in-vitro* cryoconservation of animal reproductive material represents an excellent and cost-effective alternative. New progress in structural and functional genomics and novel methods in reproductive technology allow for an unprecedented characterization of animal genetic resources and for an effective use of cryo-preserved material.

Aim of the course

Give an update on the role of biobanking for a sustainable management of farm animal genetic resources (FAnGR) with a focus on the use of novel methods in genomics, reproduction, economics and the possibility to carry out practical cases of interest to participants.

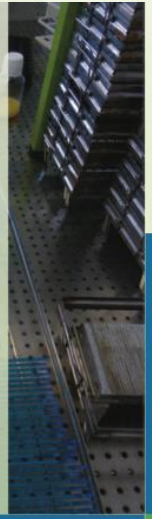
Learning goals

- How to assess neutral and adaptive genetic diversity in the era of whole genome data?
- How to effectively conceive and manage efficient genebanks?
- How could the use of cryo-conserved material help to restore profitable traits?
- Can we facilitate the effective use of gene bank samples in breeding by novel genomeassisted methods and tools?
- How to sustainably manage indigenous populations?

Target audience

Target audience of the course are PhD students, post-docs and researchers interested in conservation of animal genetic resources and in genomic characterization of neutral and adaptive diversity.

A prerequisite for participants of the course is a strong interest in the conservation of animal genetic resources and a basic knowledge in genetics of farm animals and in currently available genomic tools, i.e. SNP or sequence data. The applicants are therefore asked to provide a short CV (not more than 2 pages) and to hand in a paragraph describing their motivation for the course. The maximum number of participants is 20 and a selection procedure will be applied in order to have a good fit between scope of the course and the participants.



Summarized content of the course

- Assessment of genomic diversity
- Progress in genotyping
- Adaptive/productive introgression
- Functional genomics
- Economic assessment of conservation
- Conservation strategies
- Conception and use of animal genebanks
- Sustainable Management of livestock populations
- Legal issues
- Practical exercises

المعهد الوطني للبحث الزراعي

IMAGE

Innovative Management of Animal Genetic Resources

is a project funded by the Horizon 2020 Research and Innovation Programme of the European Union under grant 677353, which relies on a comprehensive consortium of 28 partners from 18 countries. IMAGE aims to enhance the use of genetic collections and to upgrade animal gene bank management by further developing genomic methodologies, biotechnologies and bioinformatics for a better knowledge and exploitation of animal genetic resources. For more information, please visit : **www.imageh2020.eu**

Organizing commitee (workshop & training)

Badr Benjelloun, Michèle Tixier-Boichard, Hayat Lionboui, Mohammed BenBati, Tarik Benabdelouahab, Kaoutar Elfazazi, Samir Fakhour, Otman Sebbata, Reddad Tirazi, Abdelmajid Bechchari, Mustapha Ibnelbachyr, Mouâd Chentouf, Imane Thami Alami, Fouad Elame, Bouchra El Amiri, Abdessamad Ouhrouch, Fatima Ezzahra Labdidi, Ichrak Hayah, Moussa El Fadili, Paul Boettcher, Sipke-Joost Hiemstra

INRA - Avenue de la Victoire, B.P. 415 R.P., Rabat - Maroc
Tél. : +212 53 777 09 55 - Fax : +212 53 777 00 49
www.inra.org.ma

المعهد الوطني للبحث الزراعي

Post-graduate course on

BIOBANKING FOR A SUSTAINABLE MANAGEMENT OF FARM ANIMAL GENETIC RESOURCES :

NOVEL APPROACHES IN GENOMICS, REPRODUCTIVE TECHNOLOGIES AND ECONOMICS

21 to 24 January 2020
Beni Mellal city, Morocco

Languages:

This course is organized by
The National Institute of Agronomic Research in Morocco INRA-Maroc
in the frame of the IMAGE H2020 project

المعهد الوطني للبحث الزراعي
Institut National de la Recherche Agronomique

IMAGE
Innovative Management of Animal Genetic Resources

Training workshop

Scope

About one third of domestic breeds are considered to be at risk of extinction, as reported by the FAO (DAD-IS, 2019). The Global Plan of Action for Animal Genetic Resources identified conservation as a Strategic Priority Area to be addressed. In order to preserve the genetic diversity of livestock in complementarity to *in-vivo* conservation, *ex-situ in-vitro* cryoconservation of animal reproductive material represents an excellent and cost-effective alternative. New progress in structural and functional genomics and novel methods in reproductive technology allow for an unprecedented characterization of animal genetic resources and for an effective use of cryo-preserved material.

Aim of the course

Give an update on the role of biobanking for a sustainable management of farm animal genetic resources (FAnGR) with a focus on the use of novel methods in genomics, reproduction, economics and the possibility to carry out practical cases of interest to participants.

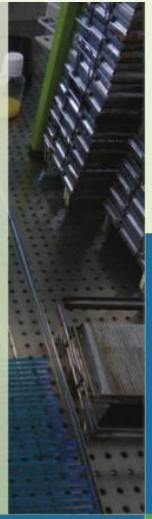
Learning goals

- How to assess neutral and adaptive genetic diversity in the era of whole genome data?
- How to effectively conceive and manage efficient genebanks?
- How could the use of cryo-conserved material help to restore profitable traits?
- Can we facilitate the effective use of gene bank samples in breeding by novel genomeassisted methods and tools?
- How to sustainably manage indigenous populations?

Target audience

Target audience of the course are PhD students, post-docs and researchers interested in conservation of animal genetic resources and in genomic characterization of neutral and adaptive diversity.

A prerequisite for participants of the course is a strong interest in the conservation of animal genetic resources and a basic knowledge in genetics of farm animals and in currently available genomic tools, i.e. SNP or sequence data. The applicants are therefore asked to provide a short CV (not more than 2 pages) and to hand in a paragraph describing their motivation for the course. The maximum number of participants is 20 and a selection procedure will be applied in order to have a good fit between scope of the course and the participants.



Summarized content of the course

- Assessment of genomic diversity
- Progress in genotyping
- Adaptive/productive introgression
- Functional genomics
- Economic assessment of conservation
- Conservation strategies
- Conception and use of animal genebanks
- Sustainable Management of livestock populations
- Legal issues
- Practical exercises

المعهد الوطني للبحث الزراعي

IMAGE

Innovative Management of Animal Genetic Resources

is a project funded by the Horizon 2020 Research and Innovation Programme of the European Union under grant 677353, which relies on a comprehensive consortium of 28 partners from 18 countries. IMAGE aims to enhance the use of genetic collections and to upgrade animal gene bank management by further developing genomic methodologies, biotechnologies and bioinformatics for a better knowledge and exploitation of animal genetic resources. For more information, please visit : **www.imageh2020.eu**

Organizing commitee (workshop & training)

Badr Benjelloun, Michèle Tixier-Boichard, Hayat Lionboui, Mohammed BenBati, Tarik Benabdelouahab, Kaoutar Elfazazi, Samir Fakhour, Otman Sebbata, Reddad Tirazi, Abdelmajid Bechchari, Mustapha Ibnelbachyr, Mouâd Chentouf, Imane Thami Alami, Fouad Elame, Bouchra El Amiri, Abdessamad Ouhrouch, Fatima Ezzahra Labdidi, Ichrak Hayah, Moussa El Fadili, Paul Boettcher, Sipke-Joost Hiemstra

INRA - Avenue de la Victoire, B.P. 415 R.P., Rabat - Maroc
Tél. : +212 53 777 09 55 - Fax : +212 53 777 00 49
www.inra.org.ma

Post-graduate course on

BIOBANKING FOR A SUSTAINABLE MANAGEMENT OF FARM ANIMAL GENETIC RESOURCES :

NOVEL APPROACHES IN GENOMICS, REPRODUCTIVE TECHNOLOGIES AND ECONOMICS

21 to 24 January 2020
Beni Mellal city, Morocco

Languages:

This course is organized by
The National Institute of Agronomic Research in Morocco INRA-Maroc
in the frame of the IMAGE H2020 project

المعهد الوطني للبحث الزراعي
Institut National de la Recherche Agronomique

IMAGE
Innovative Management of Animal Genetic Resources

Training workshop

Summarized content

- Assessment of genomic diversity
- Progress in genotyping
- Adaptive/productive introgression
- Functional genomics
- Economic assessment of conservation
- Conservation strategies
- Conception and use of animal genebanks
- Sustainable Management of livestock populations
- Legal issues
- Practical exercises

- 11 lectures
- 4 sessions of group work
- 1 field trip Farms in Tadla area
- 1 closing trip
- 20 attendants from 4 countries

Agenda

Tuesday 21 Jan 2020

09:00 - 10:30 **Lecture 1**
Introduction to genetic diversity in Livestock species
Domestication, local adaptation, diversification of livestock species.
Badr Benjelloun & Michèle Tixier Boichard
Coffee-break

11:00 - 12:30 **Lecture 2**
Conservation strategies (*in situ, ex situ*).
Sipke-Joost Hiemstra
Lunch

13:30 - 15:00 **Lecture 3**
Building genebank collections and using stored material.
Sipke-Joost Hiemstra
Coffee-break

15:30 - 17:00 **Lecture 4**
Advances in cryoconservation technologies
Philippe Monget & Bouchra El Amiri

17:00 - 19:00 **Forming groups**
19:30 *Dinner*

Wednesday 22 Jan 2020

09:00 - 10:30 **Lecture 5**
Genome neutral and adaptive diversity.
Gwendal Restoux & Badr Benjelloun
Coffee-break

11:00 - 12:30 **Exercise**
Introduction to Linux and Measures of genomic diversity from SNP data.
Badr Benjelloun & Gwendal Restoux
Lunch

13:30 - 15:00 **Lecture 6**
Functional genomics.
Julie Demars

15:30 - 17:00 **Exercise**
Neutral/Adaptive diversity and decisions for balancing conservation/production.
Gwendal Restoux & Badr Benjelloun.

17:00 - 19:00 **Group work**
19:30 *Dinner*

Thursday 23 Jan 2020

09:00 - 10:30 **Lecture 7**
Equipment and infrastructure and quality management.
Michèle Tixier Boichard & Bouchra El Amiri
Coffee-break

11:00 - 12:30 **Lecture 8**
Economic assessment of diversity and gene banking policies.
Dominic Moran Lunch

13:30-16:30 **Field trip**
visit of Sardi herds in Tadla area.

17:00-19:00 **Group work**
Decision on conservation in a given situation: Moroccan goats
19:30 *Dinner*

Friday 24 Jan 2020

09:00 - 10:00 **Lecture 9**
Current solutions on genotyping/sequencing and advances -Potential of nanopore technologies for genotyping for instance – IMAGE multispecies DNA chip.
Michèle Tixier Boichard & Badr Benjelloun

10:00 - 11:15 **Lecture 10**
Adaptive/productive introgression - genome editing e.g. Introgression of blue egg in poultry.
Michèle Tixier Boichard
Coffee-break

11:30 - 12:30 **Lecture 11**
Legal issues, property of the cryopreserved material, Nagoya Protocol.
Michèle Tixier Boichard
Lunch

13:30 - 16:00 **Group presentations and discussion**
Coffee-break

16:00 - 19:00 **Debate** on a draft of "Moroccan sheep and goats' conservation *ex situ* program".
19:30 *Dinner*

Saturday 25 Jan 2020

Pleasure trip in the Atlas area

Training workshop

Group work

Group	Countries	# of participants	Case study
1	Morocco Nigeria	4	National program of Moroccan local cattle breeds combining in and ex situ conservation
2	Tunisia Morocco	4	Conservation and improvement of dairy Sicilo-Sarde sheep breed in Tunisia
3	Morocco Tunisia	4	Conservative program of dromedary in Morocco
4	Nigeria Tunisia Morocco	4	Conservative program of Muturu cattle in Nigeria
5	Sudan Morocco Tunisia	5	In situ and ex situ conservation of Kenana dairy cattle in Sudan

Organizing Committee

- Faouzi Bekkaoui
- Imane Thami Alami
- Otmane Sebbata
- Abdenbi Salahi
- Michèle Tixier Boichard
- Mustapha Ibnelbachyr
- Mohammed Benbati
- Bouchra El Amiri
- Hayat Lionboui
- Abdelmajid Bechchari
- Reddad Tirazi
- Tarik Benabdellouahab
- Samir Fakhour
- Kaoutar El Fazazi
- Mouad Chentouf
- Fouad Elame
- Moussa El Fadili
- Abdessamad Ouhrouch
- Fatima Ezzahra Labdidi
- Ichrak Hayah
- Paul Boettcher
- Sipke-Joost Hiemstra
- ……

Closing trip of the training

Thanks!!

Closing trip of the training

Capacity Building, Training and Outreach activities for Gene Bank in the Philippines

Food and Agriculture Organization of the United Nations
Webinar Presentation
February 28, 2023

Lilian P. Villamor
Department of Agriculture-Philippine Carabao Center National Headquarter and Gene Pool

Philippine Carabao Center National Headquarters and Gene Pool

Office of the Deputy Executive Director for Production & Research

Claro N. Mingala
Scientist III

Research & Development Division

Marvin A. Villanueva
Officer-In-Charge

Accounting Section

Cherry Pearl C. Rivera
Head

Reproduction & Physiology Section

Danilda H. Duran
Head

Animal Breeding & Genomics Section

Ester B. Flores
Head

Production Systems & Nutrition Section

Mary Rose D. Uy
Head

Biosafety & Environment Section

Ma. Wynne A. Pagaduan
Head

Carabao-based Enterprise Development Section

Joel F. Cabading
Office-in-charge

Socio-Economics & Policy Section

Estela P. Valiente
Officer-In-Charge

Animal Genetic Resources Section

Ester B. Flores
Head

Product Development & Innovation Section

Patrizia Camille O. Saturno
Office-in-Charge

Business Development & Commercialization Unit

Zadieshar G. Sanchez
Head

Processing & Marketing Unit

Joel F. Cabading
Head

Cryobank Unit

Lilian P. Villamor
Head

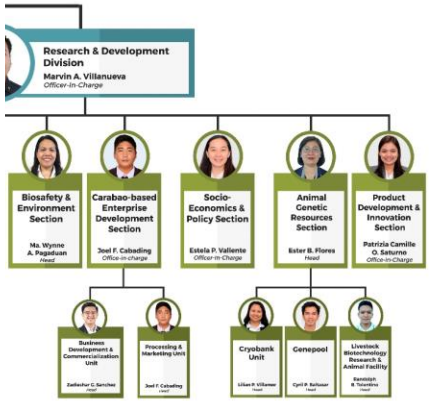
Genepool

Cyril P. Baltazar
Head

Livestock Biotechnology Research & Animal Facility

Randolph B. Tolentino
Head

Production & Research



PHILIPPINE CARABAO CENTER

NETWORKDIRECTORY

NHQGP
DA-PCC NATIONAL HEADQUARTERS AND GENE POOL
Science City of Muñoz, Nueva Ecija
Telephone No.: (+63) (044) 456.0734
Email: pccoed2021@gmail.com

MMS
DA-PCC AT MARIANO MARCOS STATE UNIVERSITY
Batac City, Ilocos Norte
Telephone No.: (+63) (077) 792.3187
Mobile No.: (+63) 927.965.5724
Email: pccmmsu@gmail.com

CSU
DA-PCC AT CAGAYAN STATE UNIVERSITY
Tuguegarao City, Cagayan
Telephone No.: (+63) (078) 377.9315
Email: pccpiat07@yahoo.com

DMM
DA-PCC AT DON MARIANO MARCOS MEMORIAL STATE UNIVERSITY
Rosario, La Union
Mobile No.: (+63) 920.982.9666
Email: pccdmmmsu2020@gmail.com, pccoed2021@gmail.com

CLS
DA-PCC AT CENTRAL LUZON STATE UNIVERSITY
Science City of Muñoz, Nueva Ecija
Telephone No.: (+63) (044) 940 3061
Mobile No.: (+63) 917.566.3278
Email: pccclsu@gmail.com

UPL
DA-PCC AT UNIVERSITY OF THE PHILIPPINES AT LOS BAÑOS
Los Baños, Laguna
Telephone No.: (+63) (049) 536.2729
Mobile No.: (+63) 915.714.4314
Email: pccuplb@gmail.com

VSU
DA-PCC AT VISAYAS STATE UNIVERSITY
Baybay City, Leyte
Telephone No.: (+63)(053) 563.7649
Mobile No.: (+63) 917.145.4772
Email: pccvsu@gmail.com

WVS
DA-PCC AT WEST VISAYAS STATE UNIVERSITY
Calinog, Iloilo
Telephone No.: (+63) (033) 323.4781
Mobile No.: (+63) 999.991.6115, (+63) 928.945.7760
Email: pccwvsu@yahoo.com

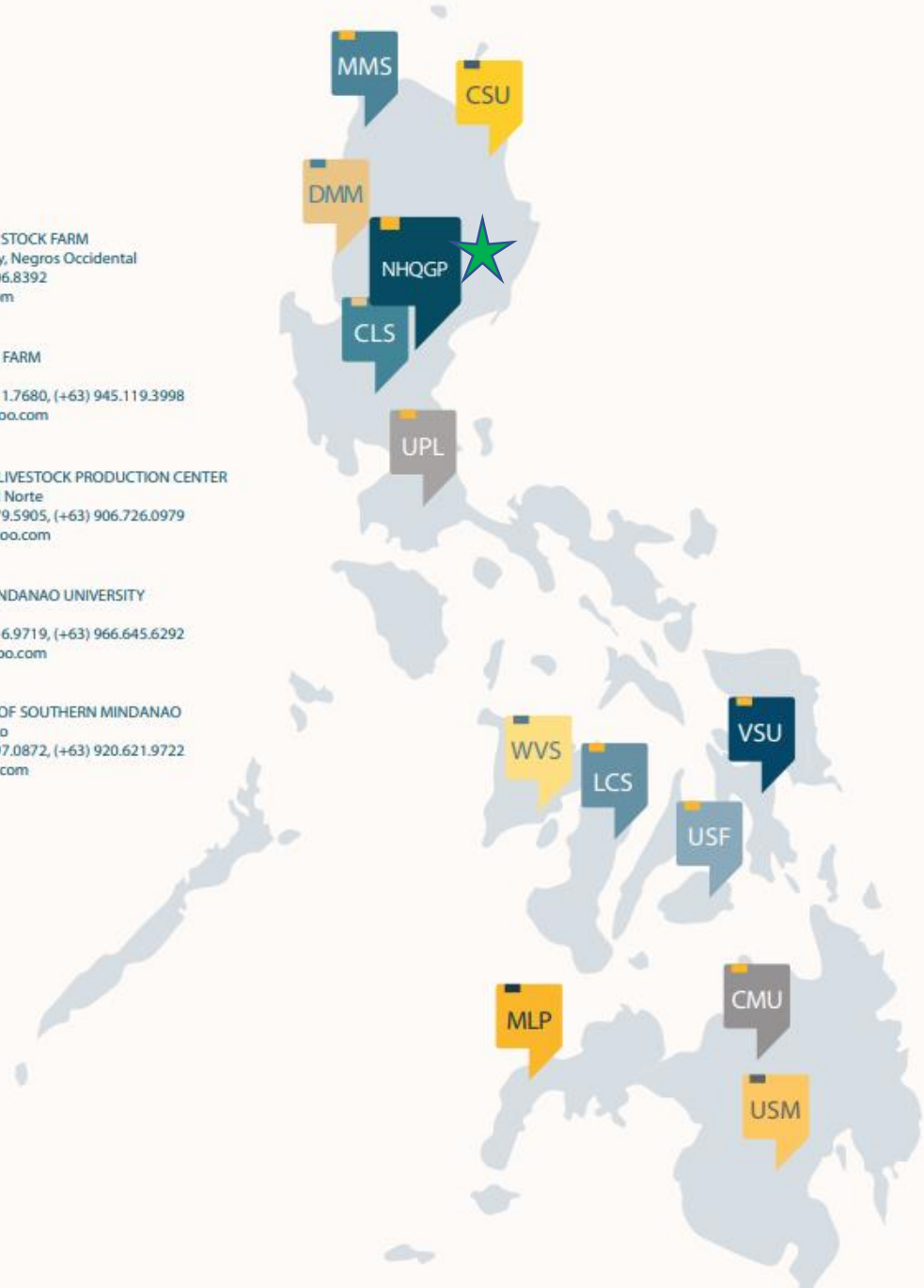
LCS
DA-PCC AT LA CARLOTA STOCK FARM
La Granja, La Carlota City, Negros Occidental
Mobile No.: (+63) 919.006.8392
Email: pcclcsf@yahoo.com

USF
DA-PCC AT UBAY STOCK FARM
Ubay, Bohol
Mobile No.: (+63) 997.111.7680, (+63) 945.119.3998
Email: pccusf.ubay@yahoo.com

MLP
DA-PCC AT MINDANAO LIVESTOCK PRODUCTION CENTER
Kalawit, Zamboanga del Norte
Mobile No.: (+63) 910.179.5905, (+63) 906.726.0979
Email: pcc_mlpc09@yahoo.com

CMU
DA-PCC AT CENTRAL MINDANAO UNIVERSITY
Maramag, Bukidnon
Mobile No.: (+63) 939.916.9719, (+63) 966.645.6292
Email: pccmusuan@yahoo.com

USM
DA-PCC AT UNIVERSITY OF SOUTHERN MINDANAO
Kabacan, North Cotabato
Mobile No.: (+63) 919.397.0872, (+63) 920.621.9722
Email: usm_pcc@yahoo.com



Conservation, Propagate, and Promote the Carabao

Gene Pool for Philippine Carabao @ PCC Cagayan State University

https://www.agriculture.com.ph/2018/08/28/native-carabaos-are-forever/

PCC identifies Calayan Island as another native carabaos sanctuary

Posted on June 8, 2017 | by Ma. Cecilia C. Irang and Lilian P. Villamor

CPG Native Carabao Conservation: Current status and way forward

Posted on December 26, 2019 | by Lilian P. Villamor

Water buffalo products

Photo retrieved from https://www.pcc.gov.ph/carabao-rises-to-new-found-importance-as-farmers-beast-of-fortune/

Photo by AMParaguas

https://www.facebook.com/PCCMilkaKrem/photos/pcb.286748792965273/2867456962989 16/?type=3&theater

https://www.azurestandard.com/healthy-living/organic-buffalo-compost-gardening-buffaloam/

Outline

1. Educational background of researchers
2. Status of Cryobank
3. Collaboration with other institutions
4. Internal Training
5. Public outreach

Educational background and skills of the researchers

Lilian P. Villamor
Senior Science Research Specialist

Ph.D. Agricultural Science, Tokyo University of Agriculture, Japan (2022)

AIVHIE JHOY E. CUANANG
Science Research Specialist I

MSc. Biology (on-going)
Central Luzon State University, Philippines

Cryopreservation; Genetic diversity of swamp buffalo & native animals

THERESE PATRICKA C. CAILIPAN
Science Research Specialist I

MSc. Biology (on-going)
Central Luzon State University, Philippines

Cryopreservation; MtDNA and Y-linked DNA genetic markers; Microbial assessment of frozen semen

JETRO P. MAGNAYON
Science Research Analyst

MSc. Biology (on-going)
Central Luzon State University, Philippines

Microbial assessment of frozen semen; Databanking

What inspired you to establish the Cryobank in the Philippines?

Dr. Libertado C. Cruz,
First Director of the Philippine Carabao Center &
Academician of National Academy of Science and Technology

" First, I realised that there are distinctly **indigenous animal species of economic importance** and are **important genes** … and there was no efforts in the Philippines on this concern.

Secondly, I know that we need to continuously improve our farm animals genetically and selecting the best performers. **Conserving their genetics is needed for future usage.**

Inauguration of the National Livestock Cryobank (2021)

Second from left: Department of Agriculture Secretary Dr. William Dar led the unveiling of the facility marker of the National Livestock Cryobank (NLC)

Philippine Carabao Center
Records Section-AFMD
Ref. No.: PCC211221033705
Date: 12-21-2021 | 3:43 pm

Republic of the Philippines
OFFICE OF THE SECRETARY
Elliptical Road, Diliman
1100 Quezon City

PHILIPPINE CARABAO CENTER
Manila Liaison Office
RECEIVED
BY: _____ DATE: 12-14-21

ADMINISTRATIVE ORDER
NO. 31
Series of 2021

SUBJECT: **DECLARING THE DEPARTMENT OF AGRICULTURE PHILIPPINE CARABAO CENTER-CRYOBANK AS THE NATIONAL CRYOBANK OF ANIMAL GENETIC RESOURCES (NCAGR) TOWARDS CONSERVATION AND MANAGEMENT PROGRAM**

Republic of the Philippines
OFFICE OF THE SECRETARY
Elliptical Road, Diliman
1100 Quezon City

MEMORANDUM CIRCULAR
NO. 04
Series of 2022

SUBJECT: **IMPLEMENTING GUIDELINES FOR THE NATIONAL LIVESTOCK CRYOBANKING PROGRAM**

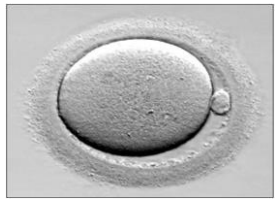
National Livestock Cryobank (NLC) Facility

Status of Animal Genetic Resources in the National Livestock Cryobank

REPRODUCTIVE

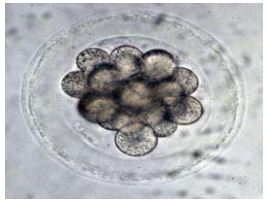
https://www.imperial.ac.uk

Semen



https://www.ncbi.nlm.nih.gov

Oocytes



https://www.ivis.org/

Embryo

NON-REPRODUCTIVE

https://www.ucsfbenioffchildrens.org/

Blood

DNA

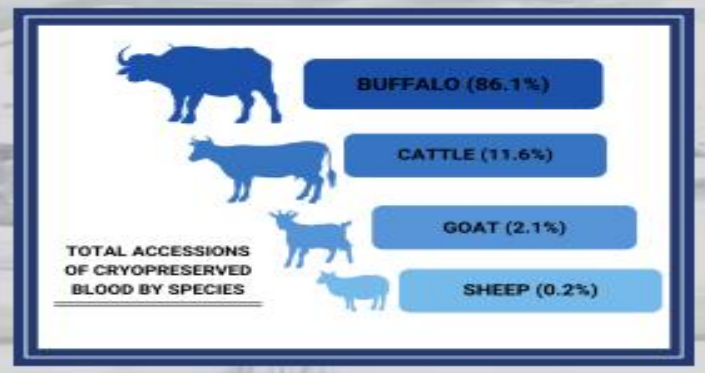
http://www.brahman.com.au/

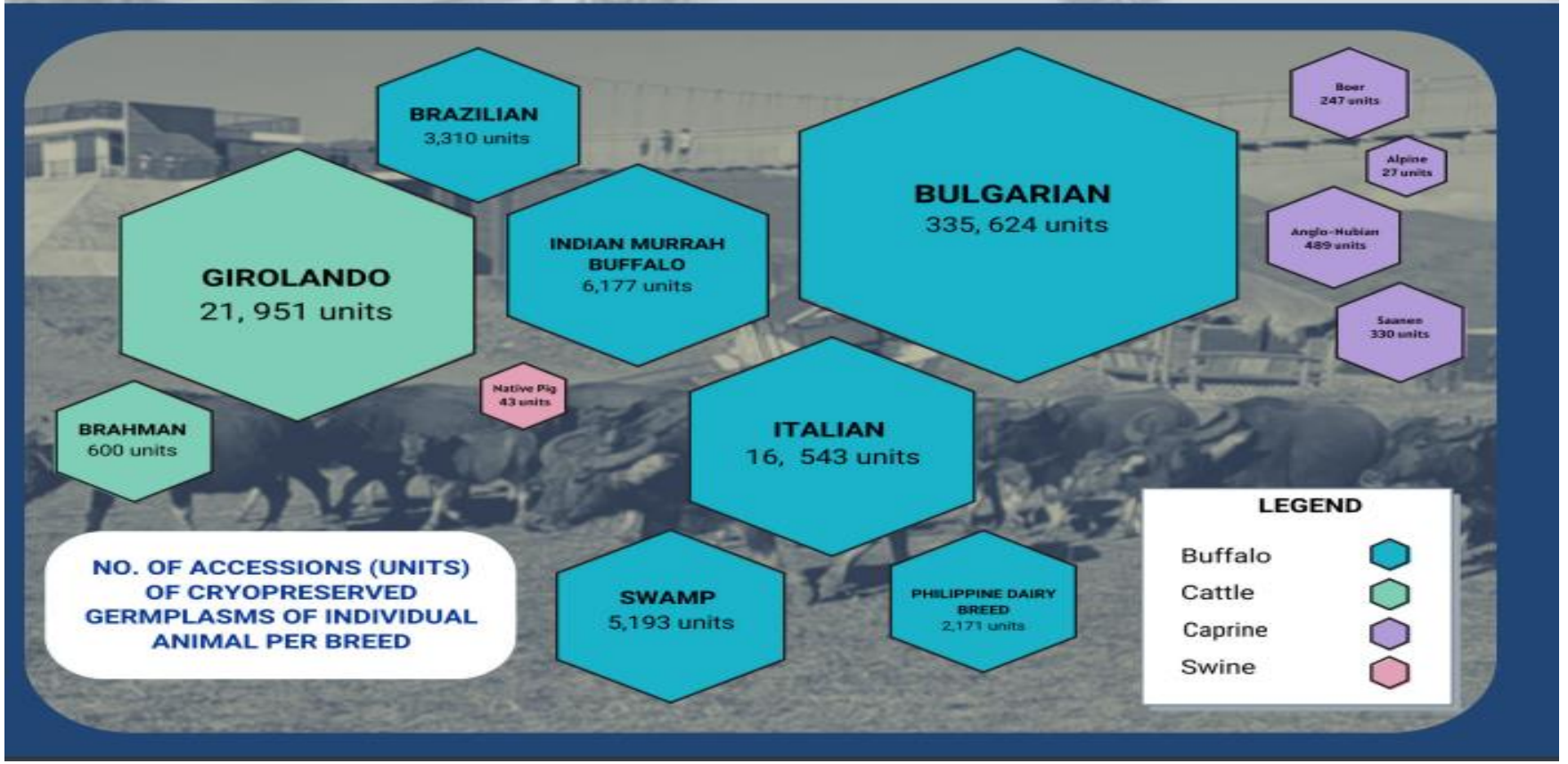
Hair

STATUS OF NLC

AS OF DECEMBER 2022

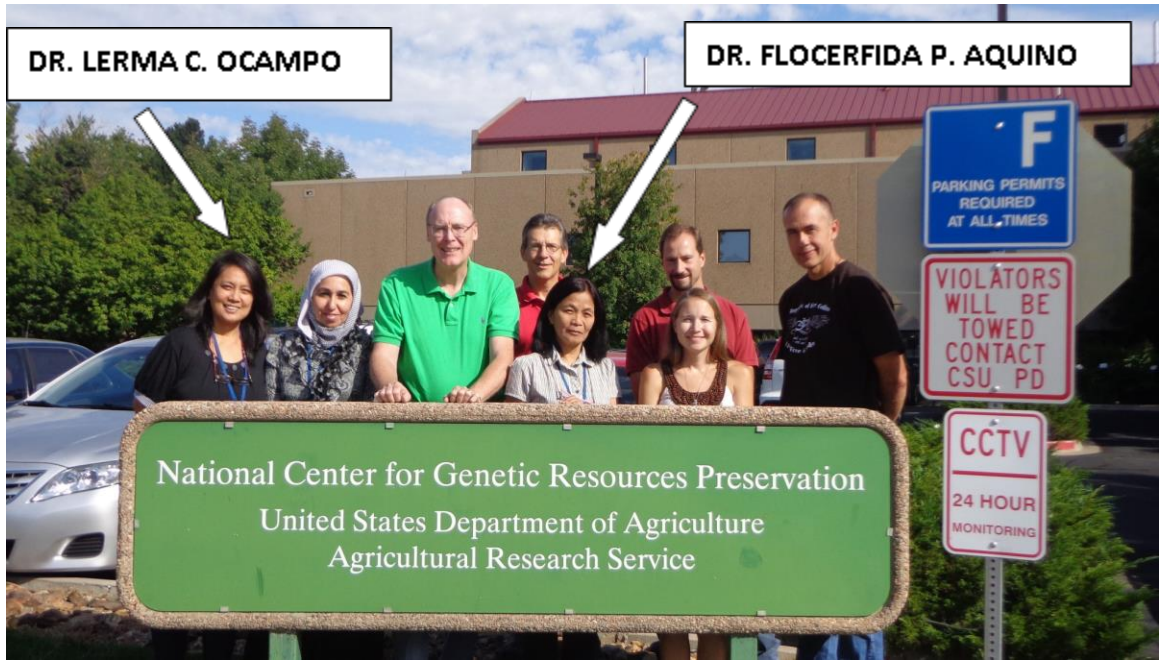
PERCENTAGE OF ACCESSIONS OF GERMPLASM PER SPECIES



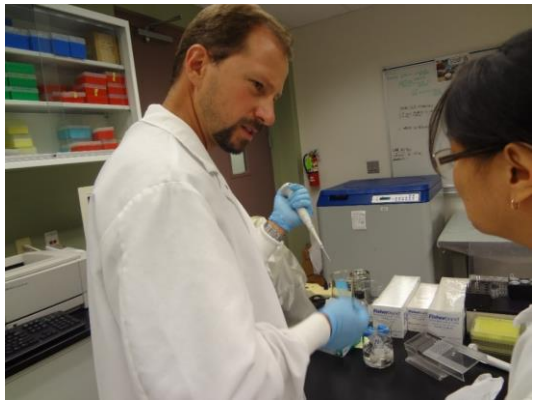


NO. OF ACCESSIONS (UNITS) OF CRYOPRESERVED GERMPLASMS OF INDIVIDUAL ANIMAL PER BREED

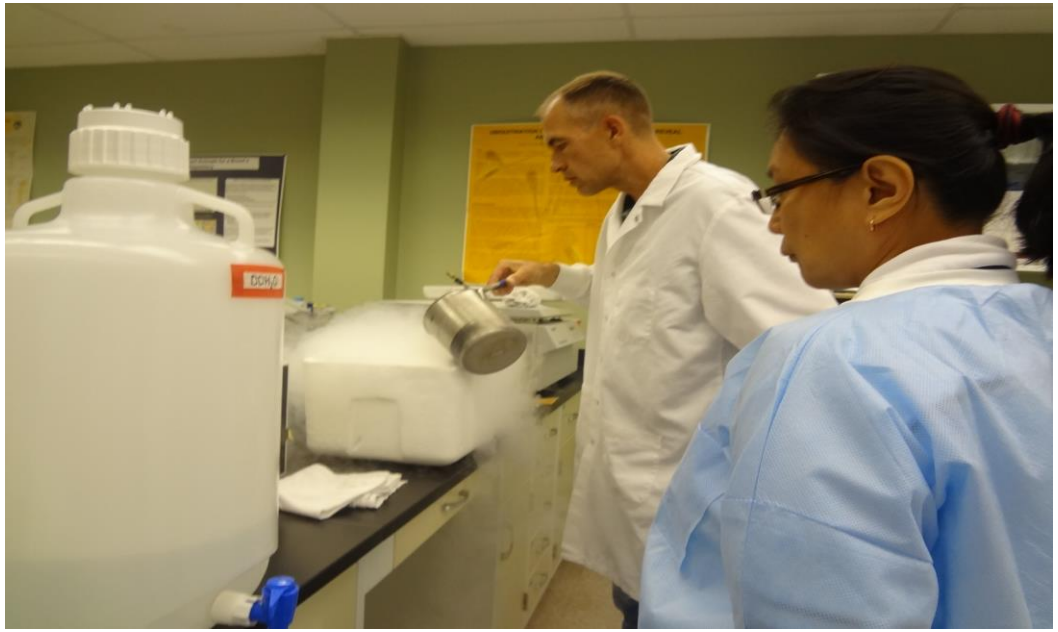
Collaboration with USDA for training (Part 1)



National Center for Genetic Resources Preservation, USDA (2014)

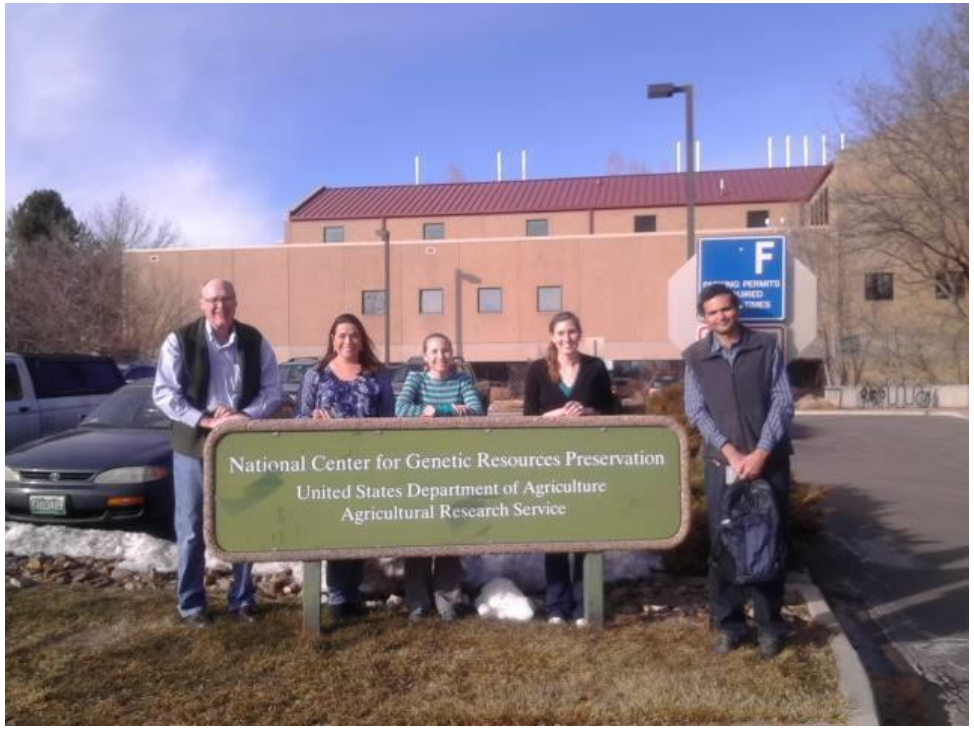


Dr. Ocampo with Mr. Spiller on semen data recording and sampling for CASA analysis.



Dr. Ocampo with Dr. Purdy LN2 styro preparation for chicken sperm freezing

Collaboration with USDA for training (Part 2)



National Center for Genetic Resources Preservation, USDA (2016)

Training in Cryopreservation at Korea Dairy Cattle Improvement (2011)

Collaboration with Taiwan Livestock Research Institute

Delegates from the Philippines and Japan for exposure visits to laboratory facilities, modern techniques in animal production and quality control of farm animals by private farmers

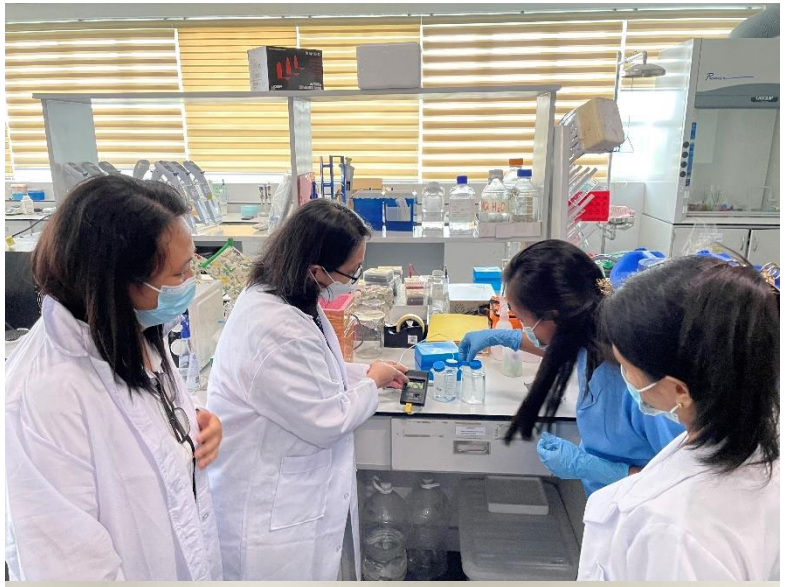
Technical Training in the University of the Philippines

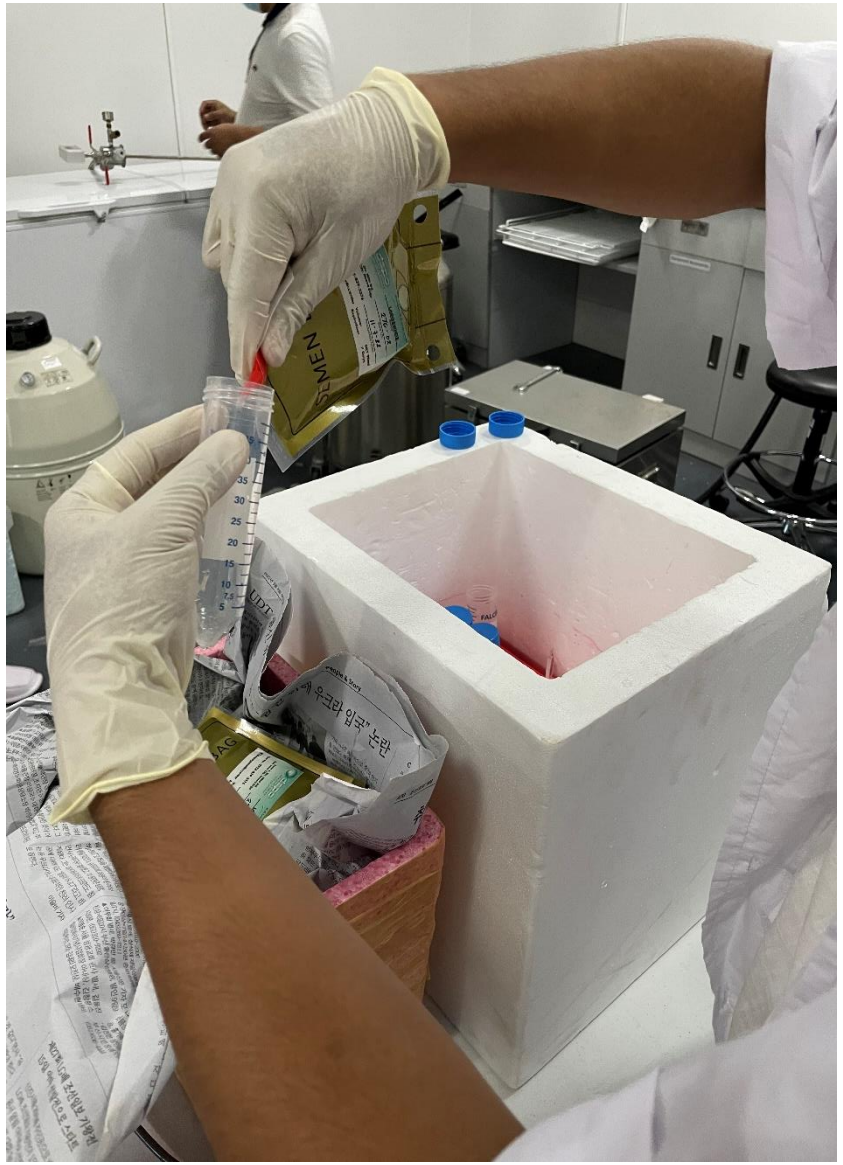
PCC researchers learn technical know-how on molecular phylogenetics

https://www.pcc.gov.ph/pcc-researchers-learn-technical-know-how-on-molecular-phylogenetics/

Internal Training of PCC Researchers

Dr. Lerma C. Ocampo trains NLC researchers on boar semen cryopreservation

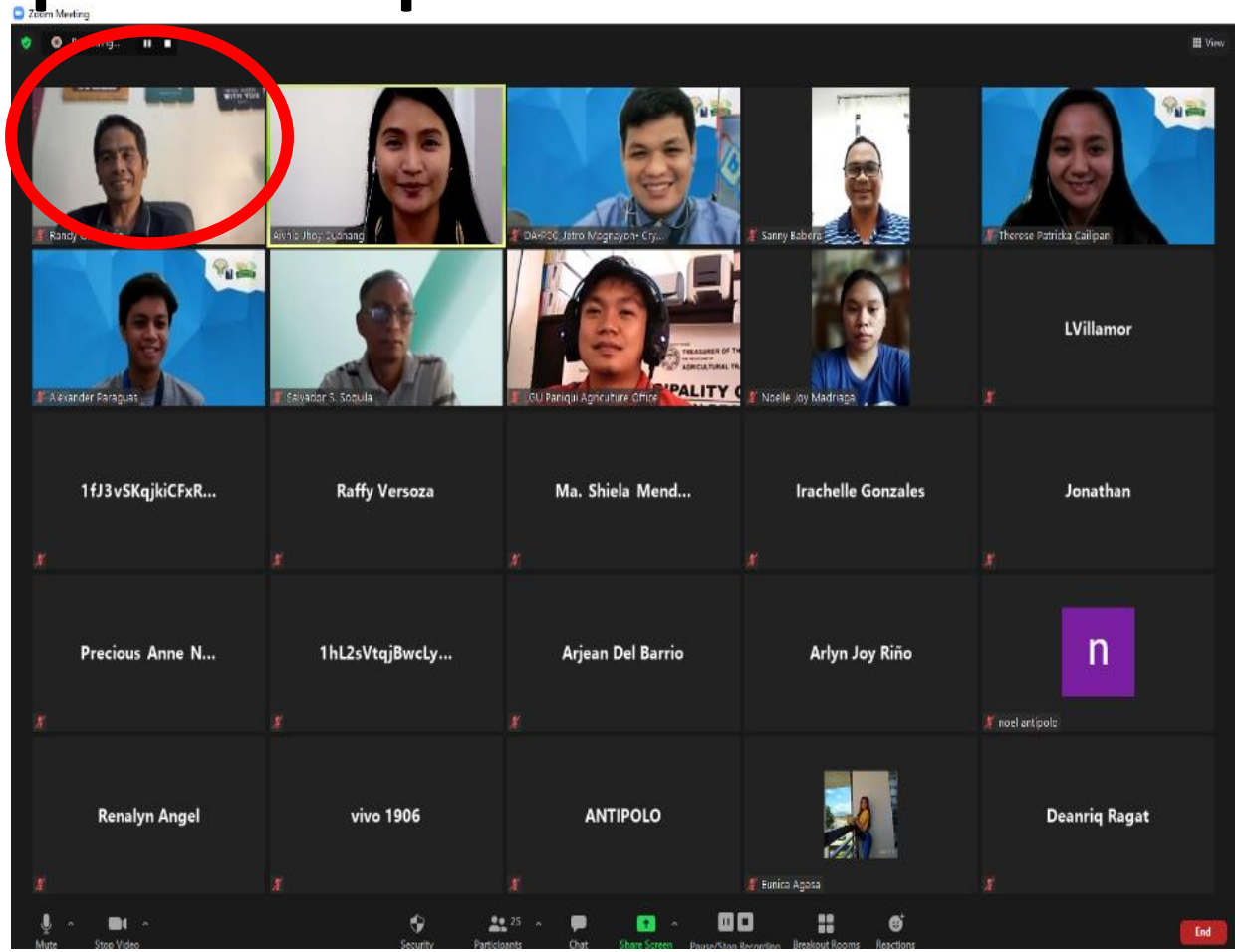


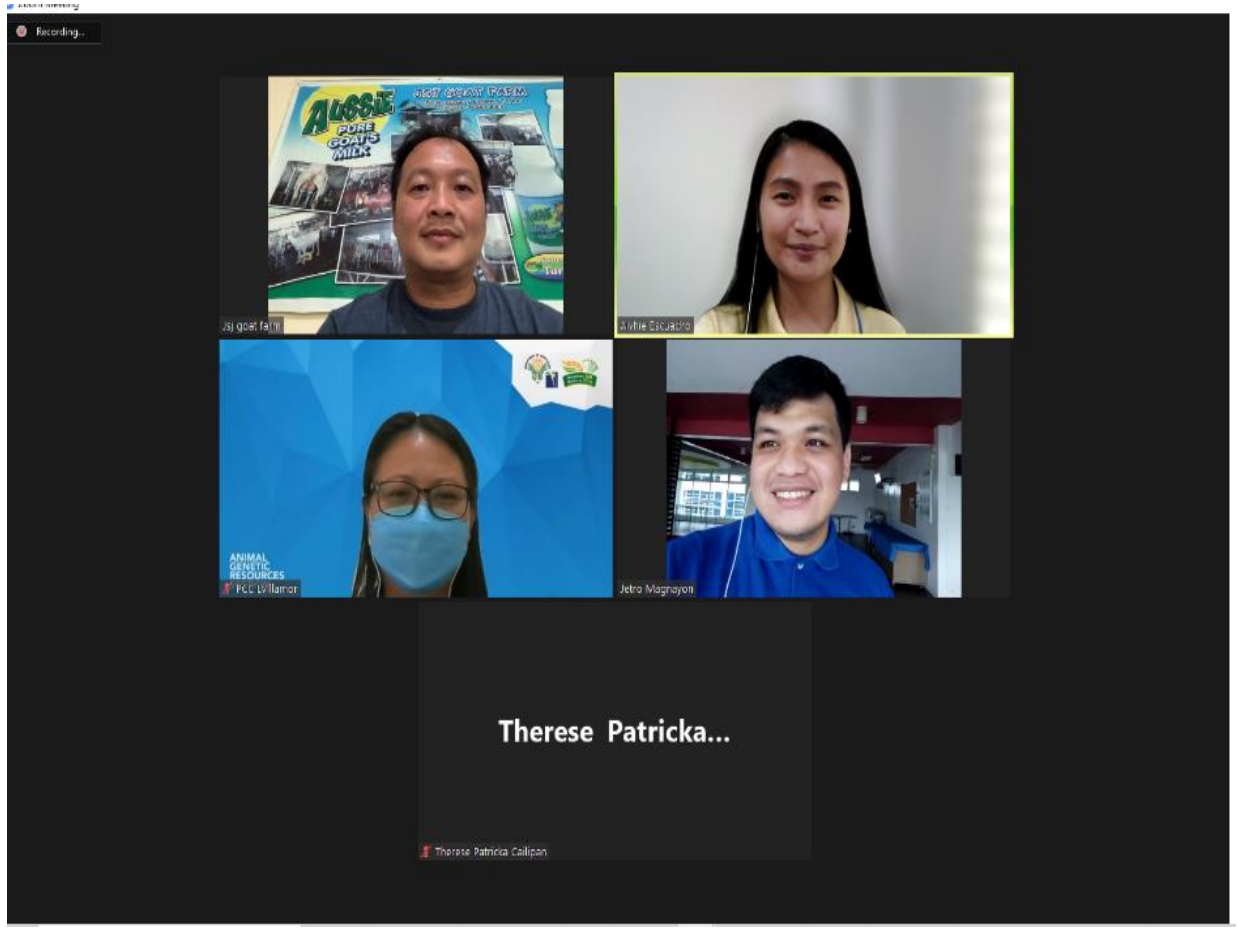


Internal Training of PCC Researchers

Ms. Emma Venturina (Third from Left) and Mr. Matthew Peralta (Sixth from Left) from PCC Semen Processing Laboratory facilitate buffalo and cattle semen cryopreservation

Public outreach: Information dissemination for private and public partnerships





Public outreach: Goat semen cryopreservation

Collect goat semen for cryopreservation at ROVallerio Dairy Farm, Pampanga

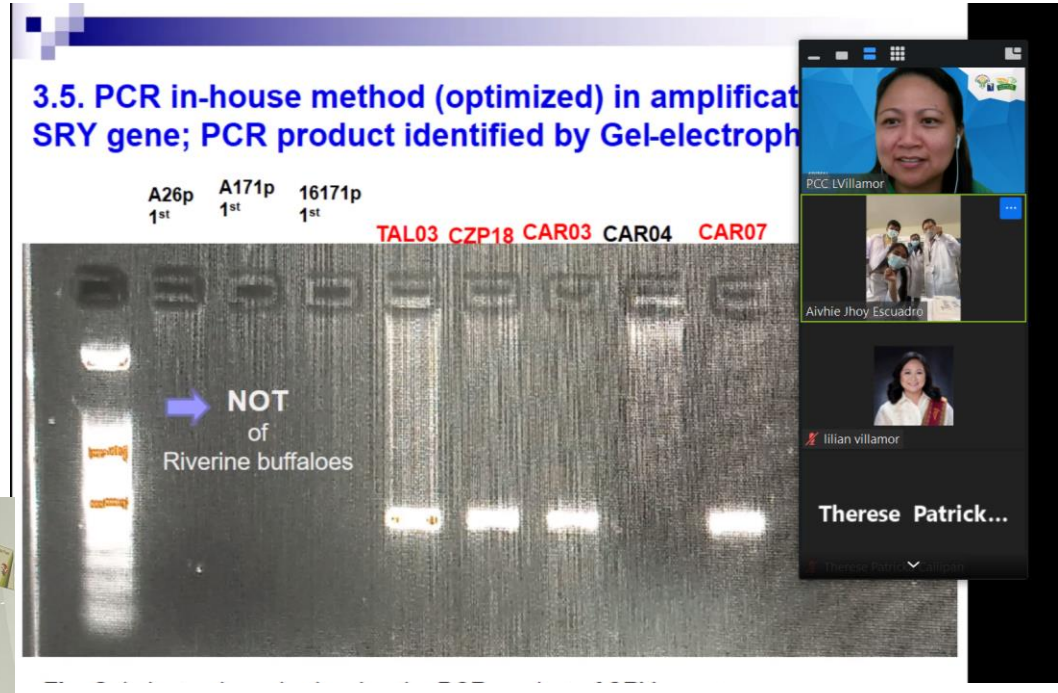
Collect goat semen for cryopreservation at Small Ruminant Center, Central Luzon State University

Public outreach activities: Molecular analysis training

Molecular and phylogenetic training workshop to graduate students from Central Luzon State University (2018) and researchers from Philippine Carabao Center and Department of Agriculture attached agencies (2022)

Public outreach activities: Molecular analysis training

Dr. Chuvan Tuat from Vietnam with NLC researchers, Ms. Escuadro and Ms. Cailipan (2021)



Conclusion

Capacity building and training are vital in developing the Philippine National Livestock Cryobank strategy, involving three aspects:

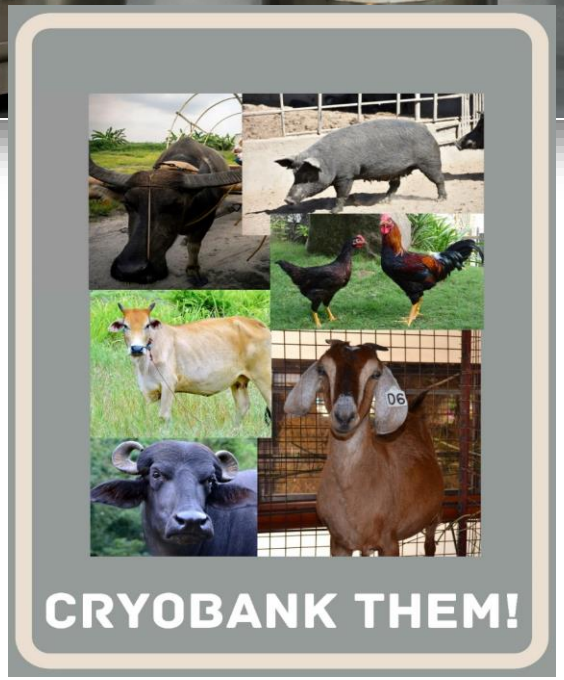
1. Collaboration with international and national research centres
2. Dissemination of knowledge with the cryobank bank researchers
3. Public outreach for Cryobank public and private stakeholders and future researchers.

How do you envision the bright future of the National Livestock Cryobank in the Philippines?

"I would like to see more aggressive efforts to **use the facility on the national scale**, involving more economically important animals, and active participation of the private entities in the industry .

We the program should also consider **establishment of second facility on other areas**, particularly outside of the country as a back up bank."

Dr. Libertado C. Cruz
(First PCC Director)



FAO Webinar on CAPACITY BUILDING, TRAINING AND OUTREACH for animal genebanking

Cryopreservation of AnGR in Brazil

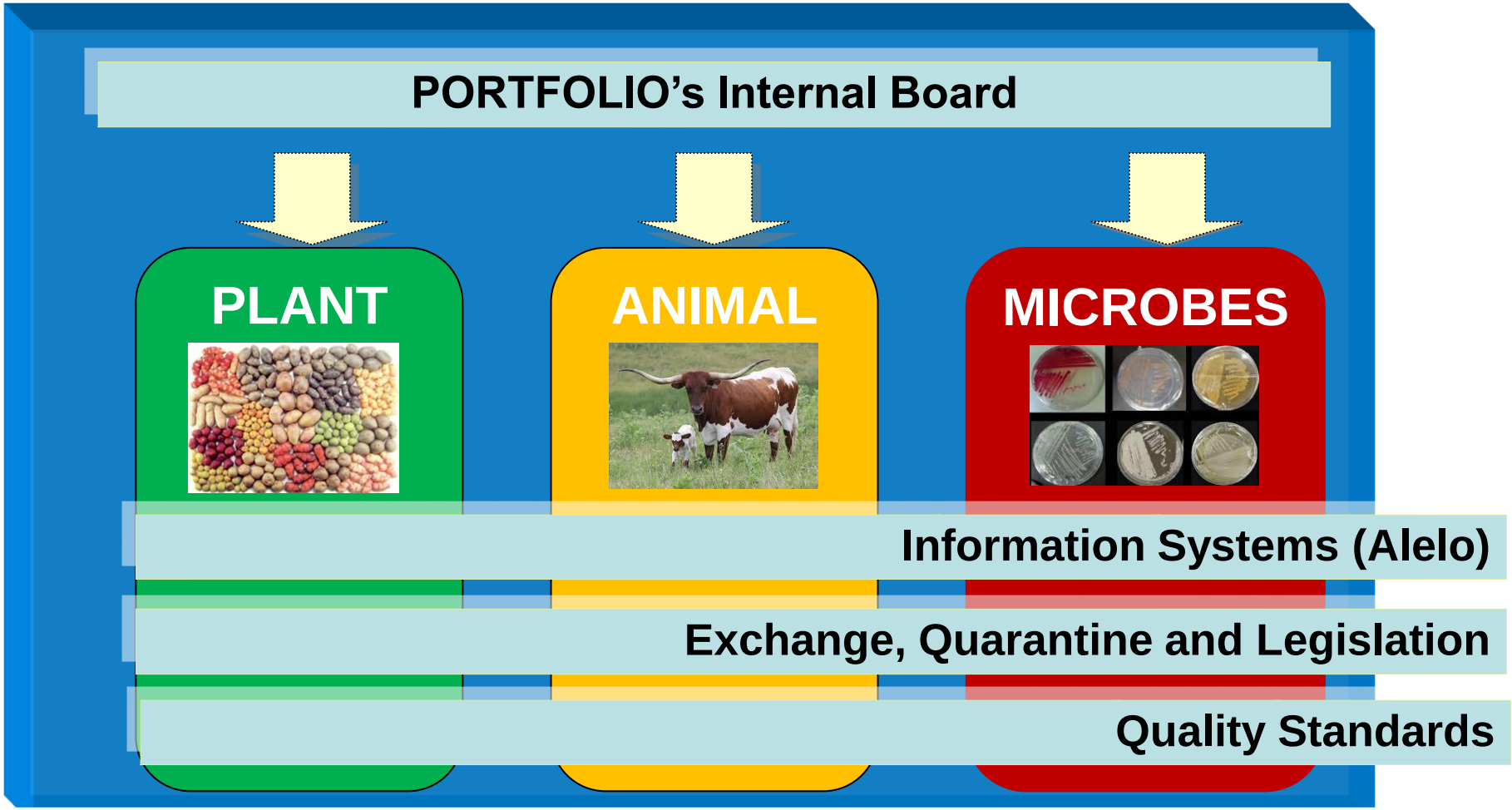
Concepta McManus (University of Brasilia) and Samuel Paiva (Embrapa)

02/28/2023

UnB

Embrapa

Brazilian Portfolio: Genetic Resources



Embrapa Conservation Portfolio

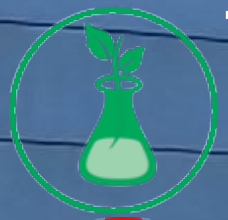
Ex situ – long term (low temperatures)

In situ (live - ecosystems)

Embrapa Biobank, Brasilia-DF, Brazil

Embrapa Biobank in numbers (2023)

(Seeds, microorganisms backup collections, animal semen, embryos, tissue and DNA)

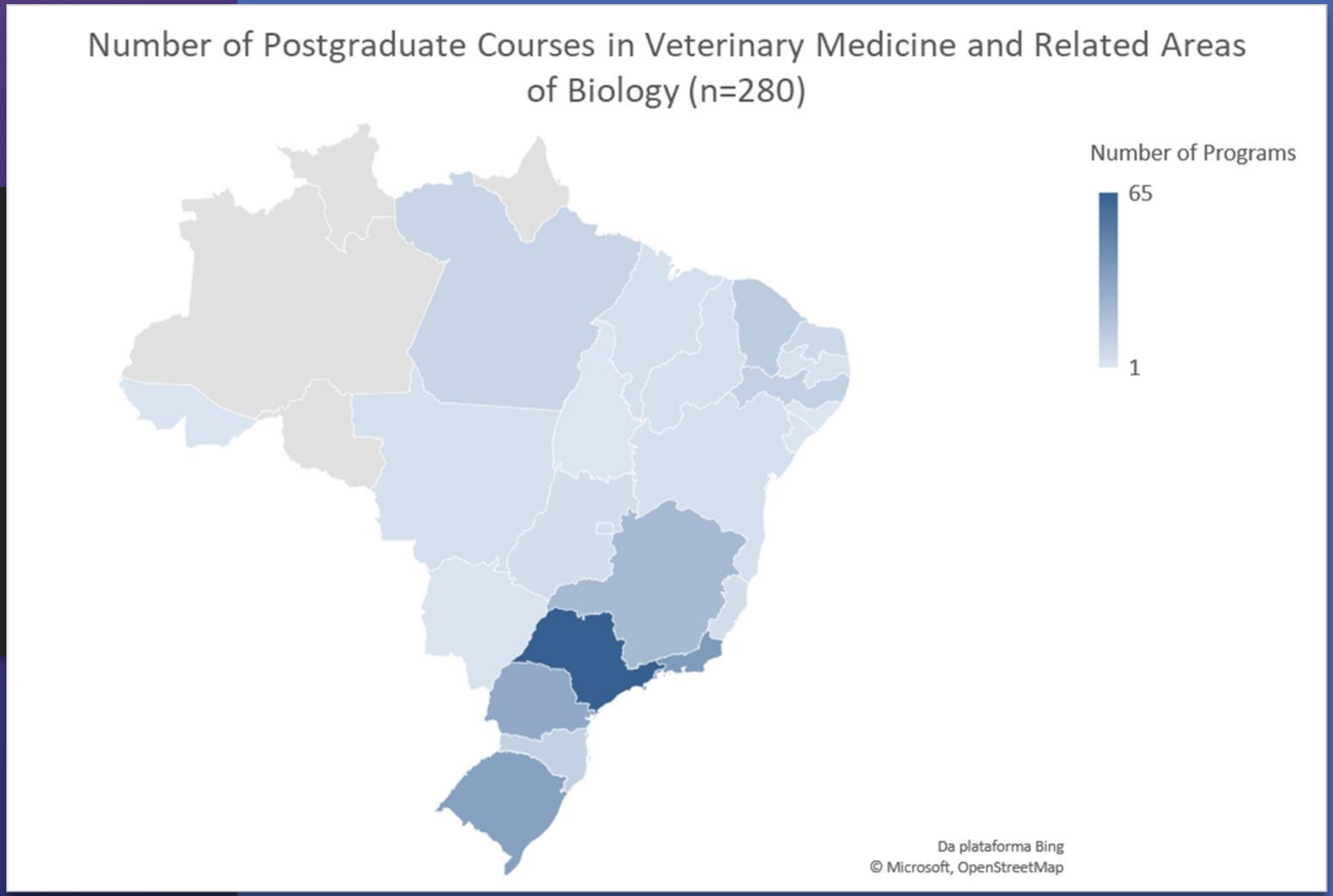
	Genus	*Species*	*Accesions*	*Samples*
	339	1,117	118,637	-
	25	35	28,002	1,731,815
	340	327	7,166	12,317

Source: https://alelo.cenargen.embrapa.br/numeros/Executar?acao=BGE.numeros

Educational background Staff

- 3 research scientists with PhD (genetics and breeding, animal physiology and molecular biology)
- 1 technician with Master computer sciences
- 2 technicians with Master in biology and agricultural sciences

Current programmes National universities



Approaches that are being used to update the skills of staff on new technologies

Ministry of Science and Technology

Ministry of Agriculture and Livestock

Ministry of Education

NETWORKING!!!

Genebank Questions

- Who is working in the area?
- With what species?
- Identification of new groups?
- What techniques?

Scopus

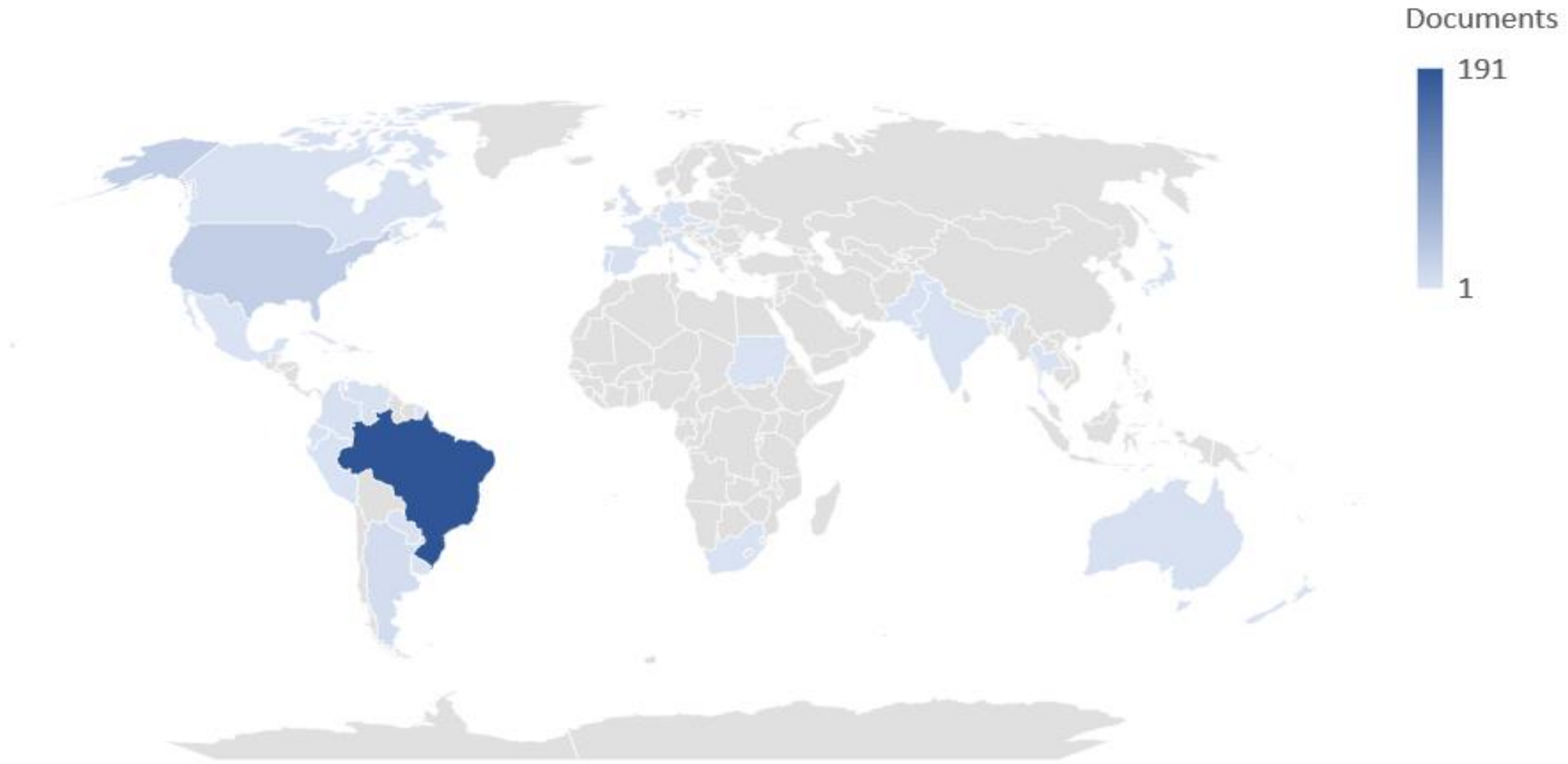
Brazil

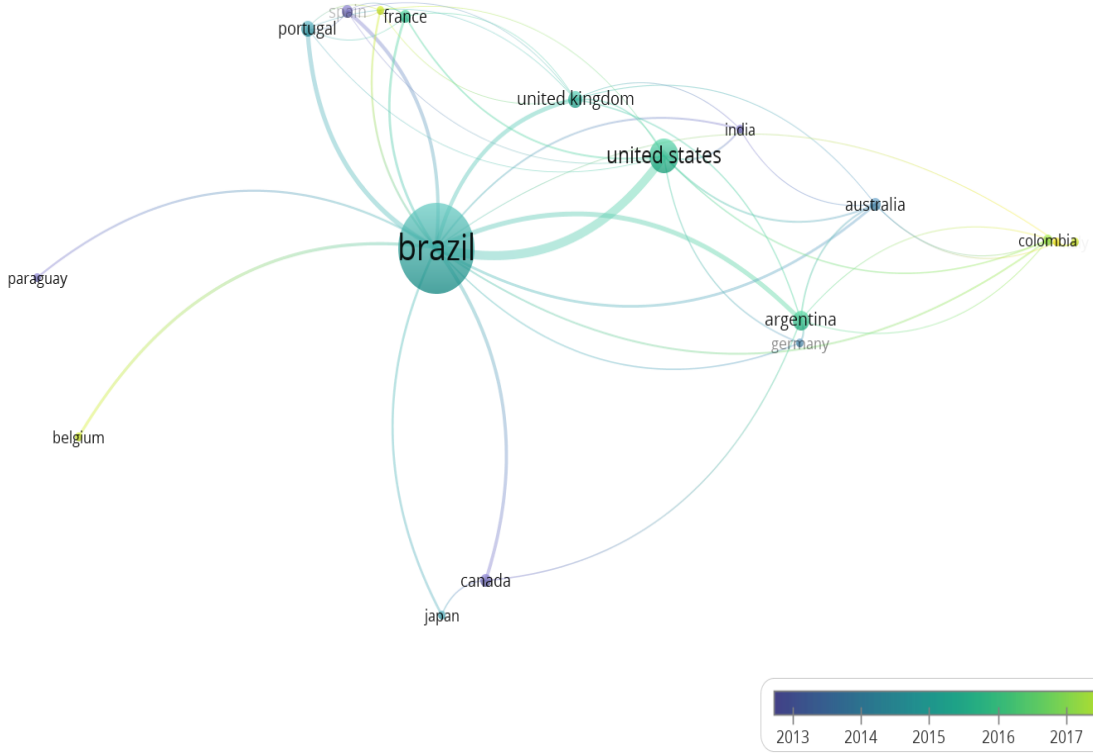
Animal

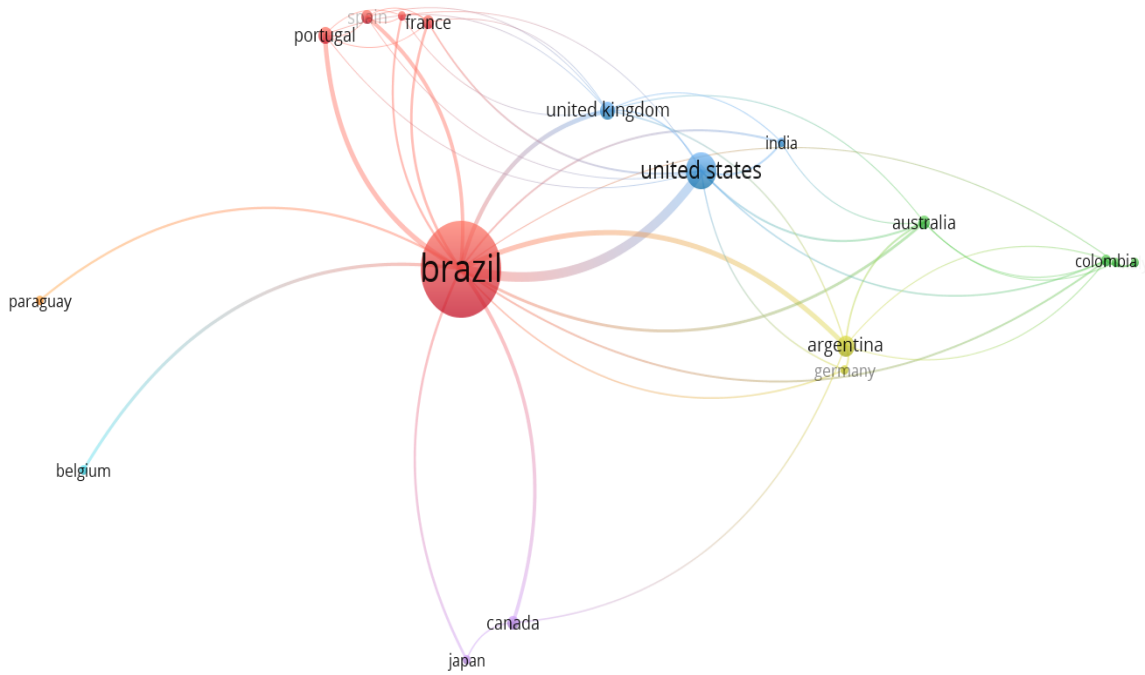
Cryopreservation OR (gene AND bank) OR germplasm OR biobank OR (gonad AND tissue)

208 scientific documents

Collaboration

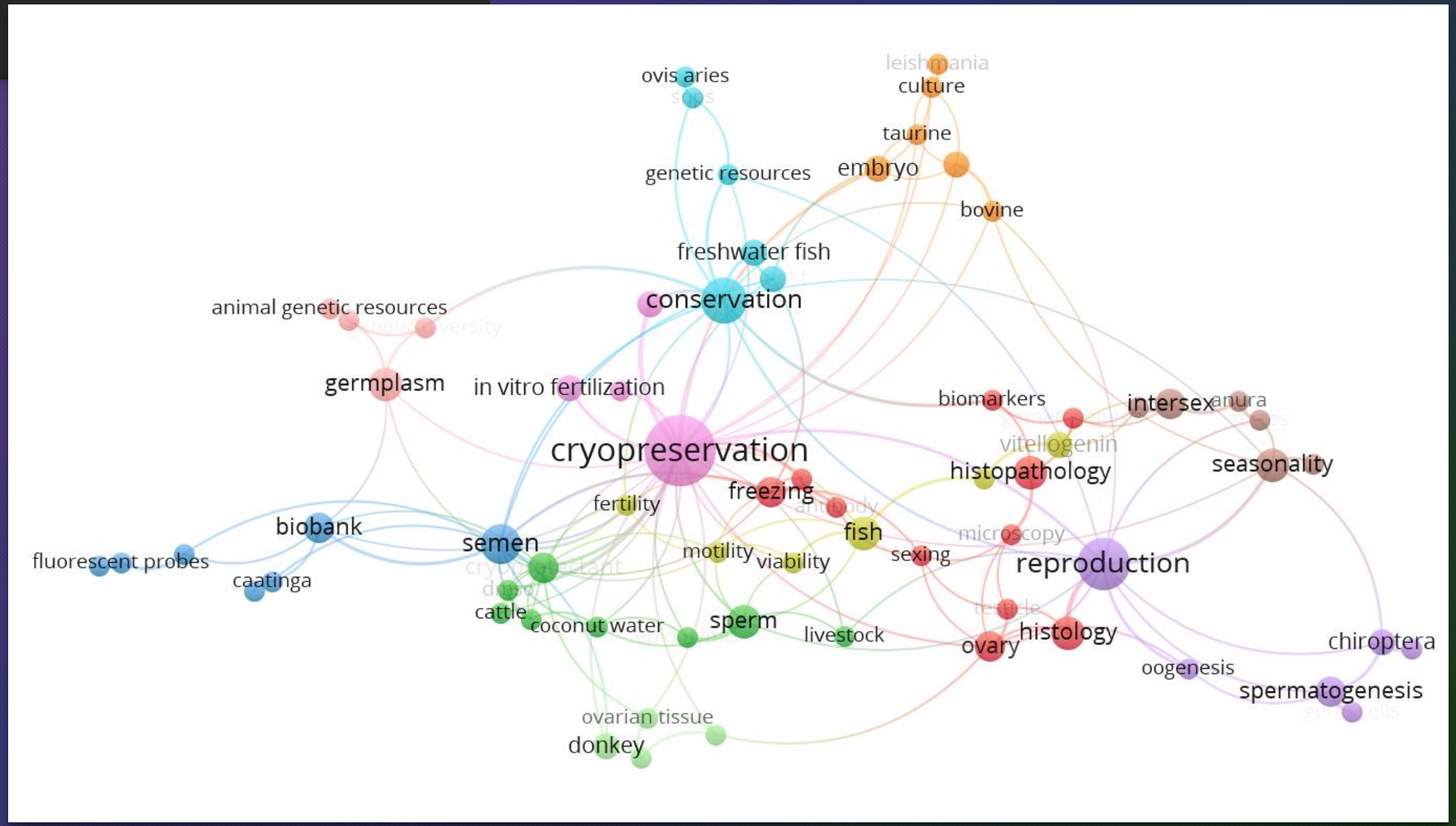




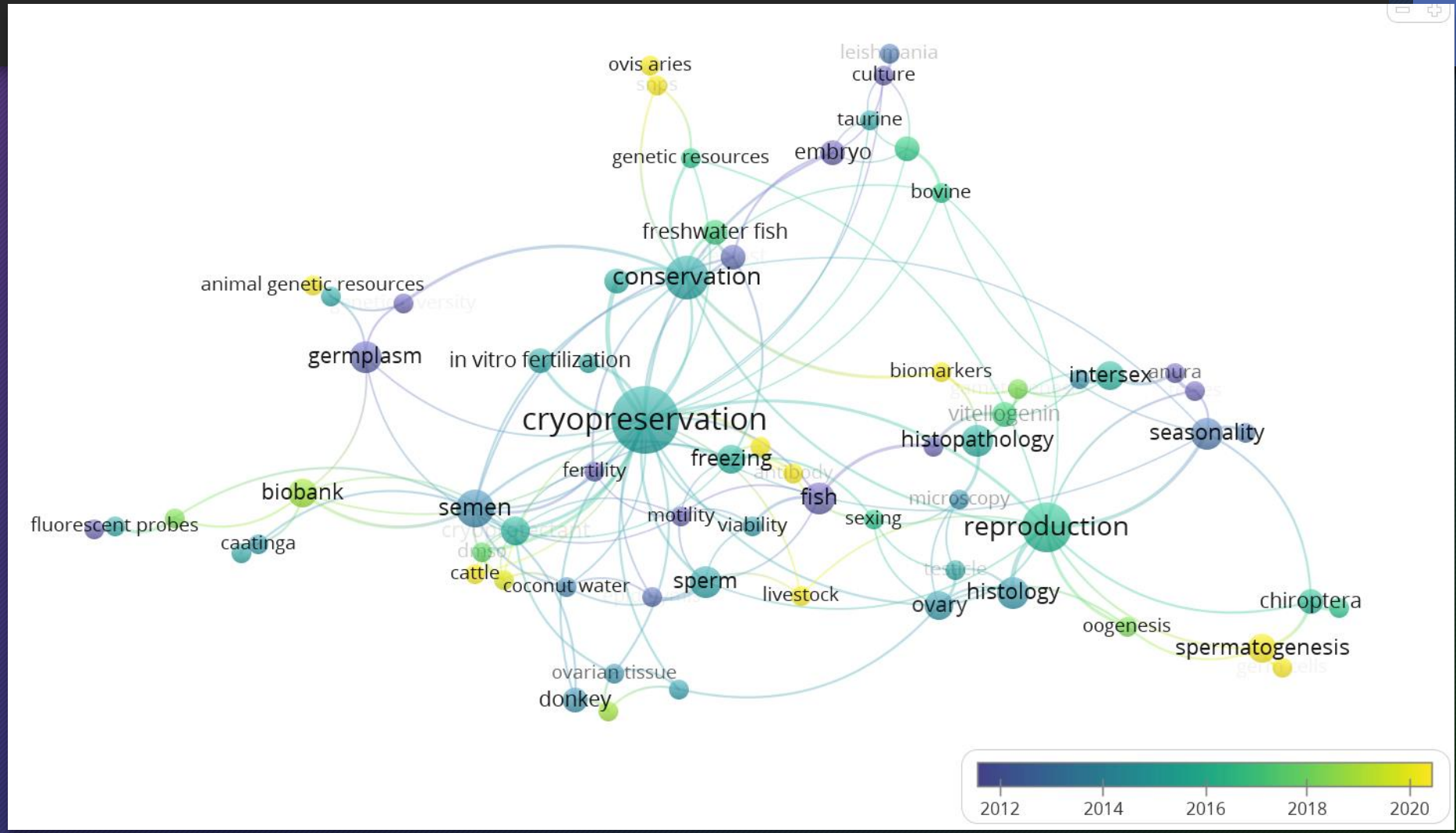


Collaboration

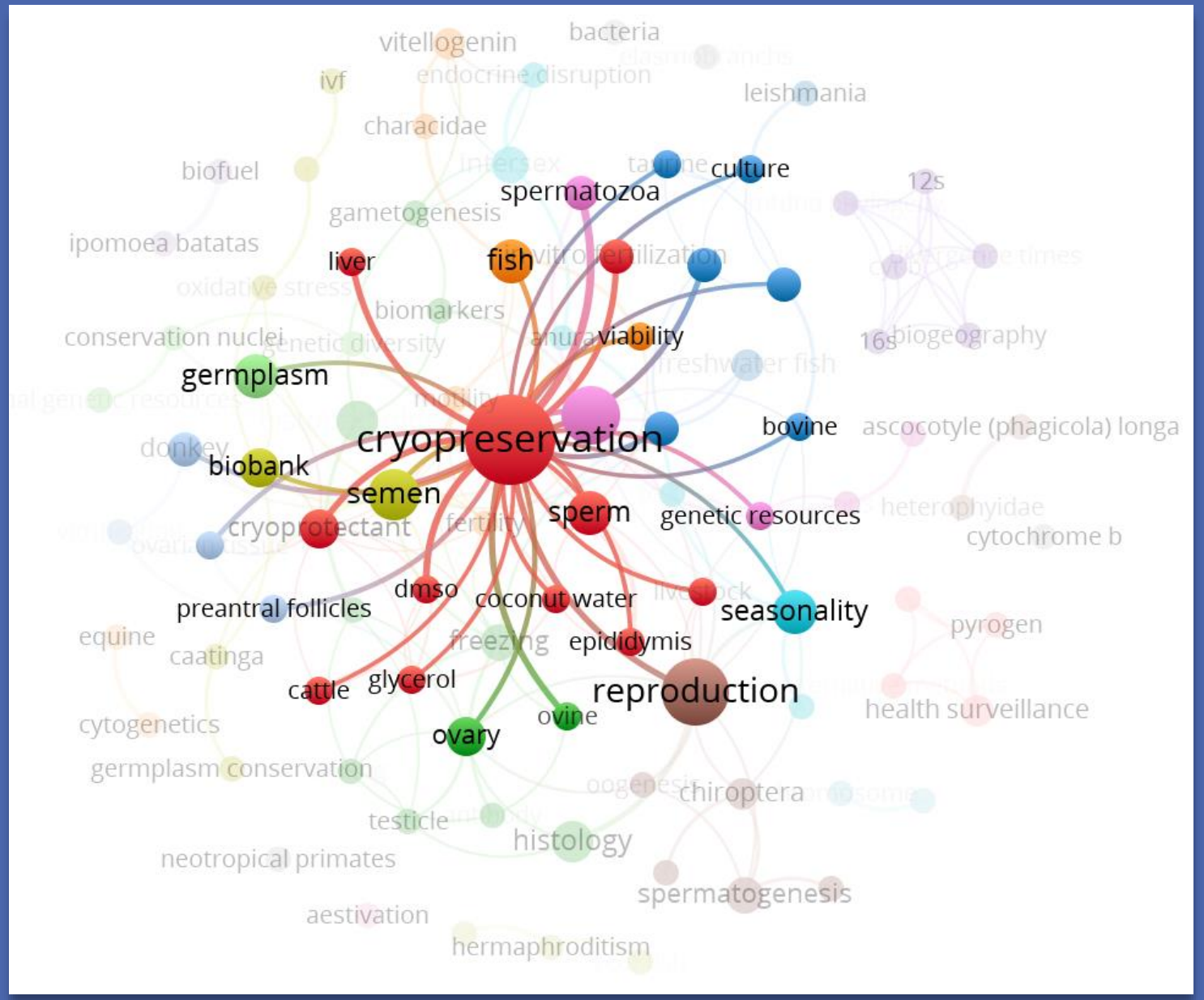
Keyword Analysis

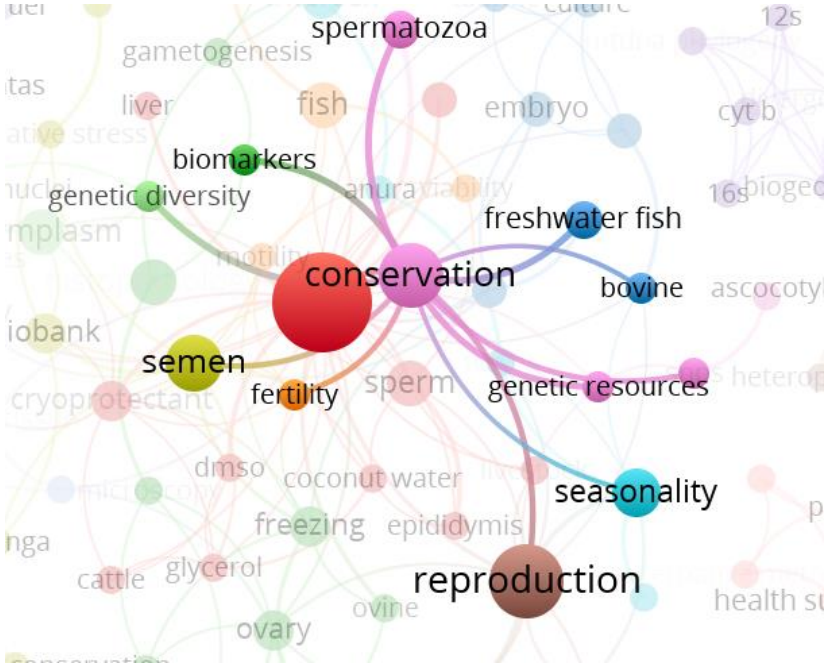


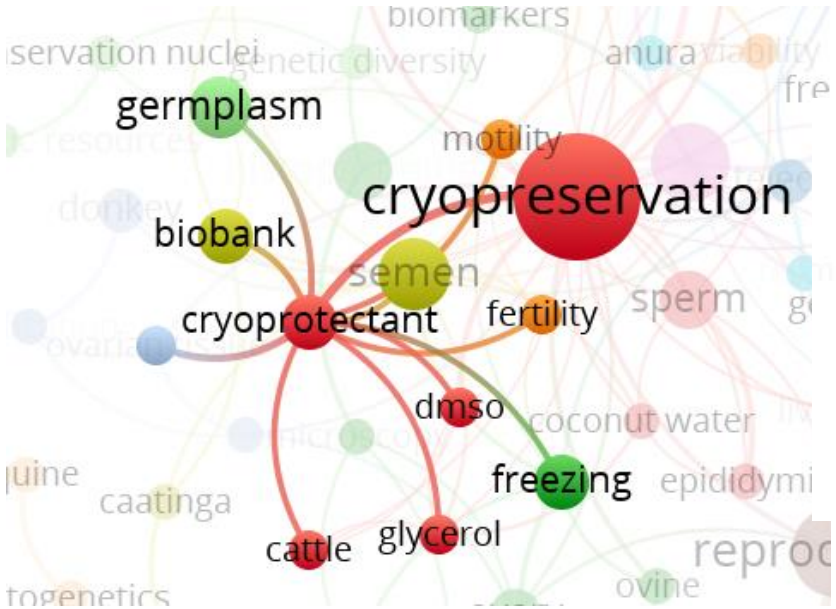
Timeline

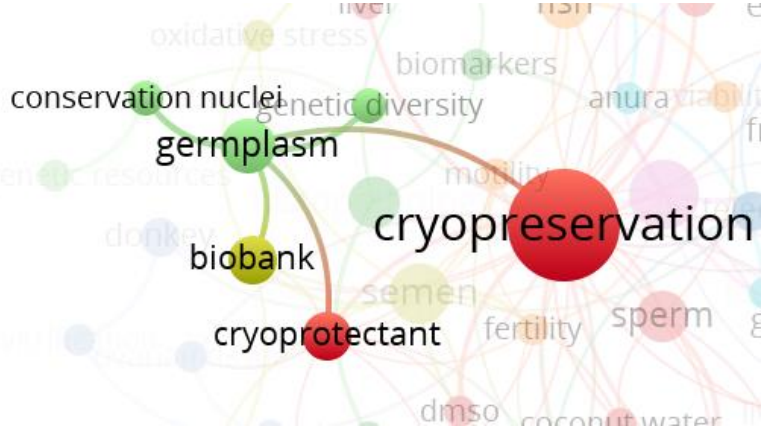

ovis aries
leishmania
culture
taurine
genetic resources
embryo
bovine
freshwater fish
conservation
animal genetic resources
germplasm
in vitro fertilization
biomarkers
intersex
anura
vitellogenin
cryopreservation
histopathology
seasonality
freezing
fertility
biobank
fish
microscopy
semen
motility
viability
sexing
reproduction
fluorescent probes
caatinga
cattle
coconut water
sperm
livestock
ovary
histology
chiroptera
oogenesis
spermatogenesis
ovarian tissue
donkey
2012
2014
2016
2018
2020

Main links Cryopreservation



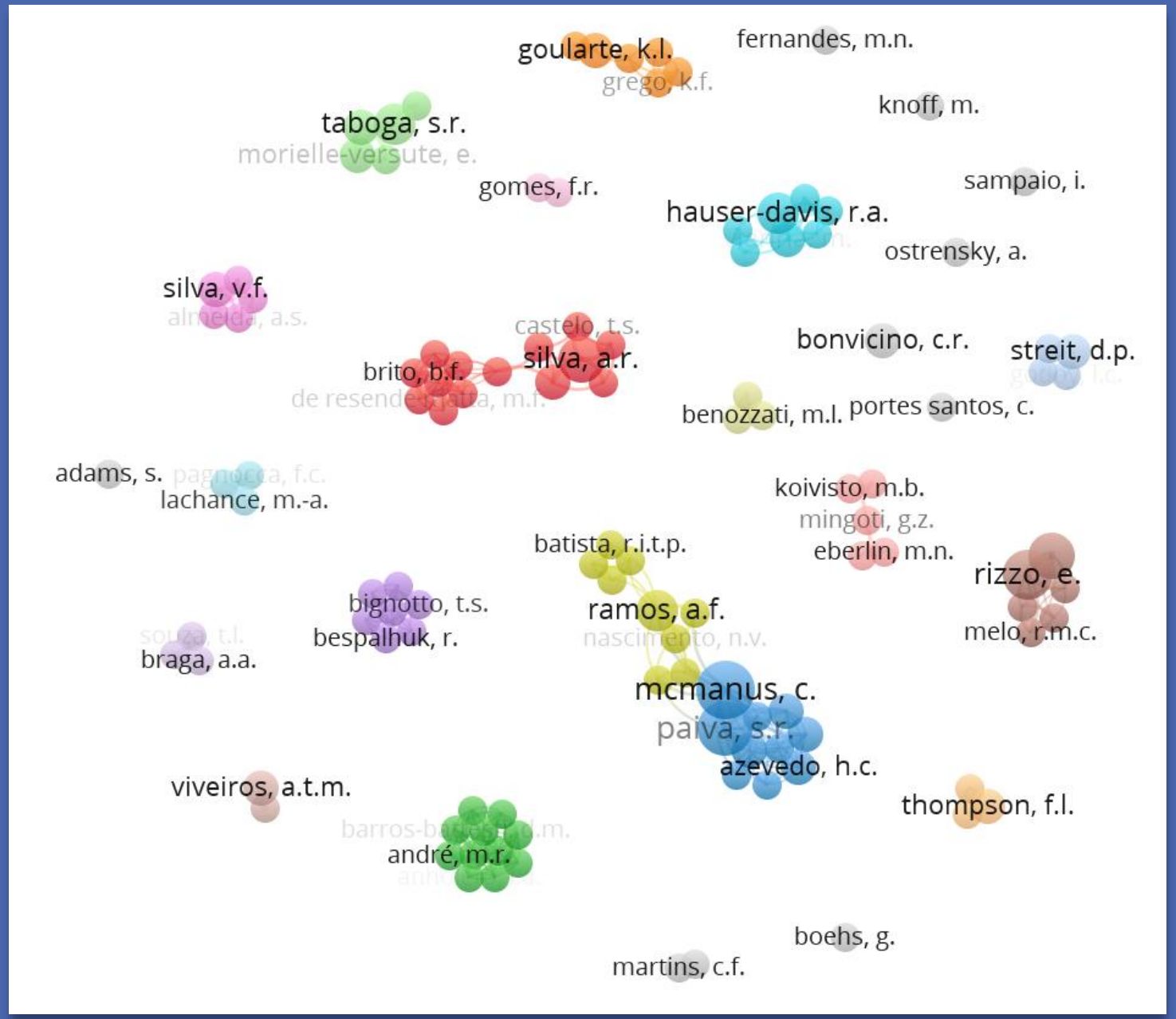


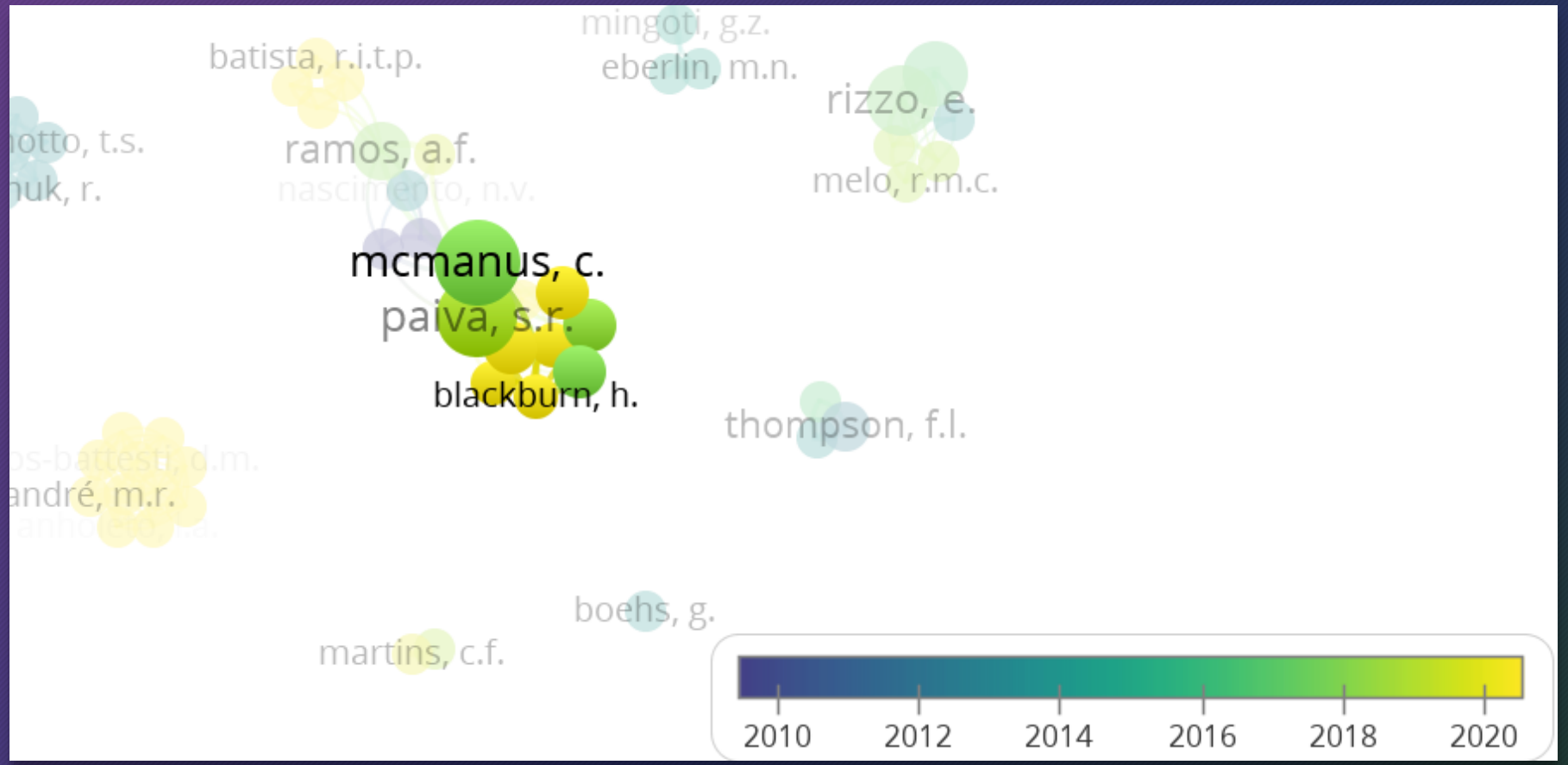




Main links Cryopreservation

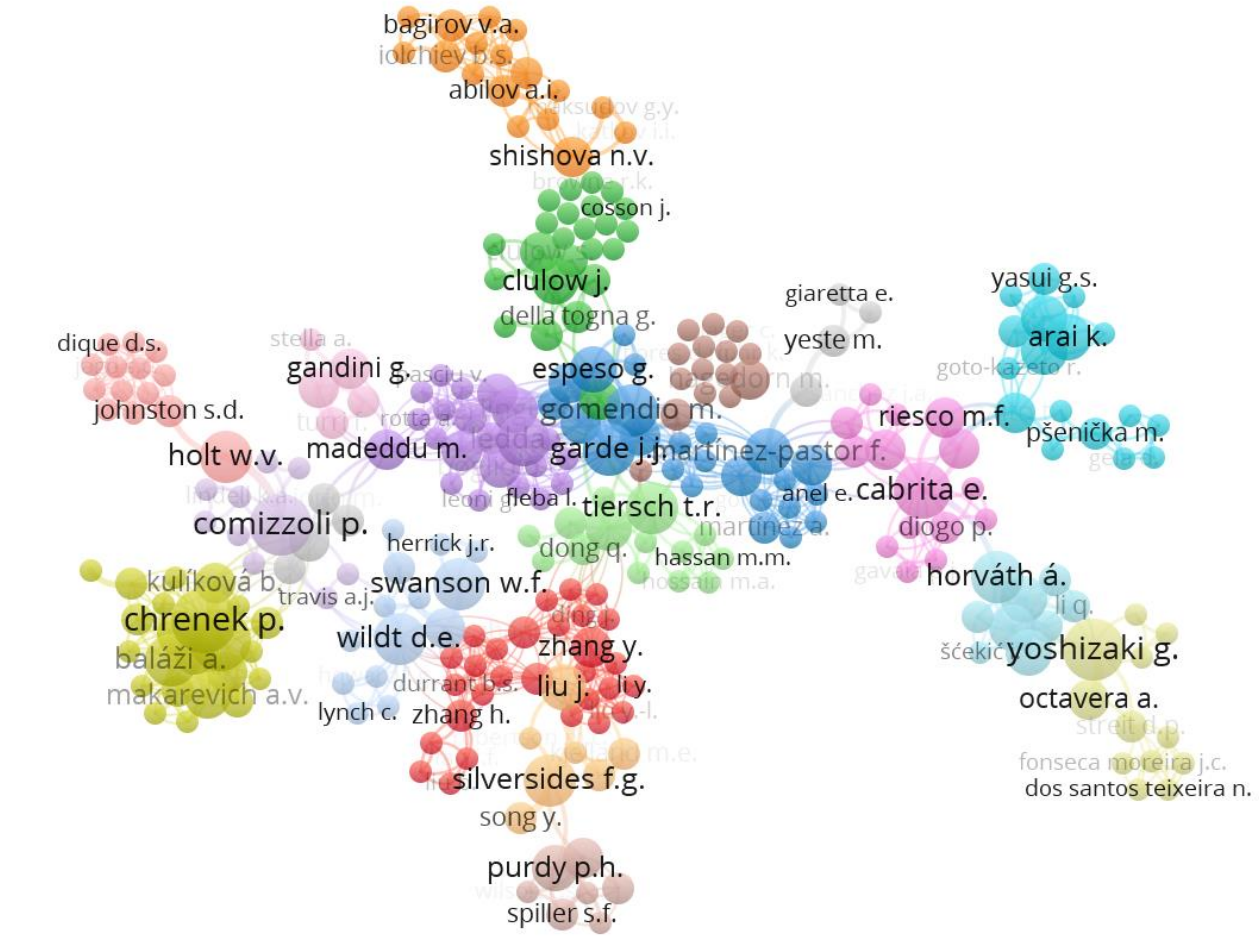
Research Groups

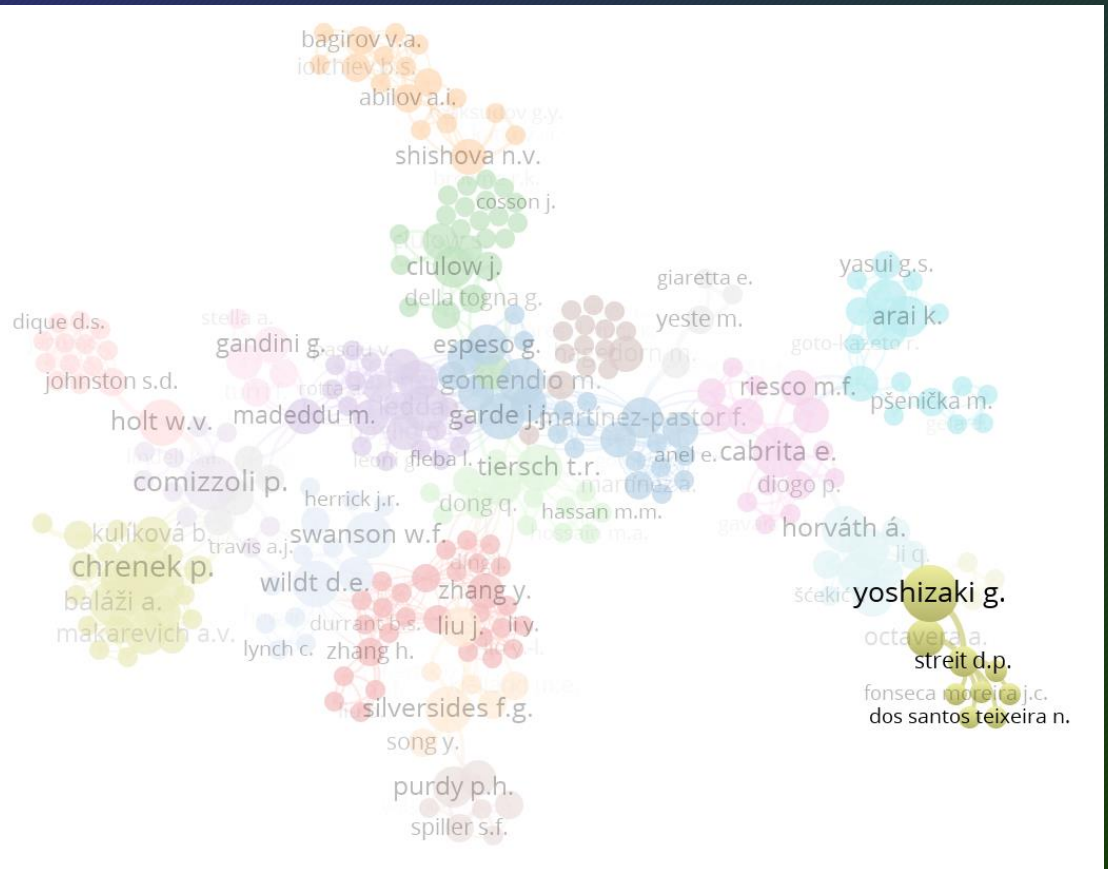




Timeline for Inteactions

World


bagirov v.a.
abilov a.i.
shishova n.v.
cosson j.
clulow j.
della togna g.
giaretta e.
yeste m.
yasui g.s.
arai k.
dique d.s.
gandini g.
espeso g.
johnston s.d.
gomendio m.
riesco m.f.
pšeničkа m.
holt w.v.
madeddu m.
garde j.j.
martínez-pastor f.
cabrita e.
fleba l.
tiersch t.r.
anel e.
comizzoli p.
herrick j.r.
dong q.
hassan m.m.
diogo p.
horváth á.
kulíková b.
travis a.j.
swanson w.f.
chrenek p.
wildt d.e.
zhang y.
yoshizaki g.
baláži a.
liu j.
li y.
makarevich a.v.
lynch c.
zhang h.
octavera a.
fonseca moreira j.c.
silversides f.g.
dos santos teixeira n.
song y.
purdy p.h.
spiller s.f.

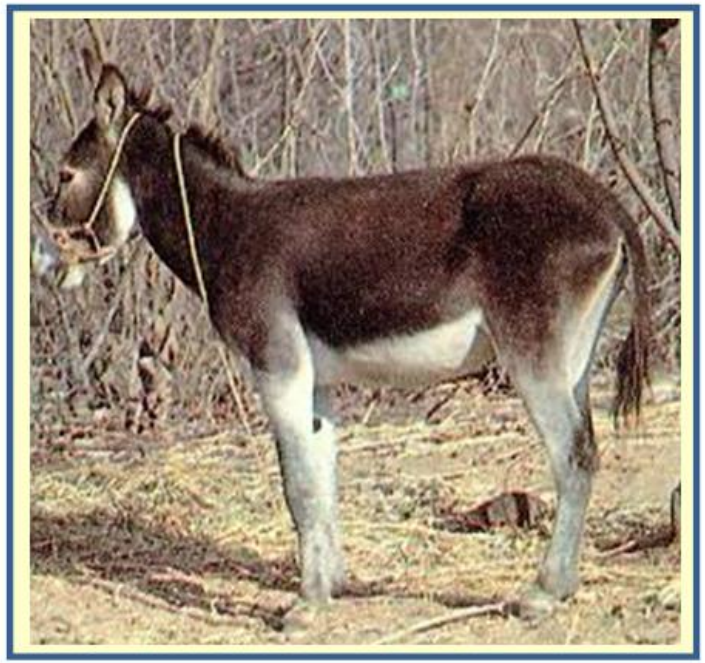

bagirov v.a.
abilov a.i.
shishova n.v.
cosson j.
clulow j.
giaretta e.
yasui g.s.
dique d.s.
gandini g.
espeso g.
yeste m.
arai k.
johnston s.d.
gomendio m.
riesco m.f.
pšeničkа m.
holt w.v.
madeddu m.
garde j.j.
martínez-pastor f.
cabrita e.
fleba l.
tiersch t.r.
anel e.
comizzoli p.
herrick j.r.
dong q.
hassan m.m.
diogo p.
horváth á.
kulíková b.
travis a.j.
swanson w.f.
chrenek p.
wildt d.e.
zhang y.
yoshizaki g.
baláži a.
liu j.
li y.
makarevich a.v.
lynch c.
zhang h.
octavera a.
streit d.p.
fonseca moreira j.c.
silversides f.g.
dos santos teixeira n.
song y.
purdy p.h.
spiller s.f.

Public Outreach

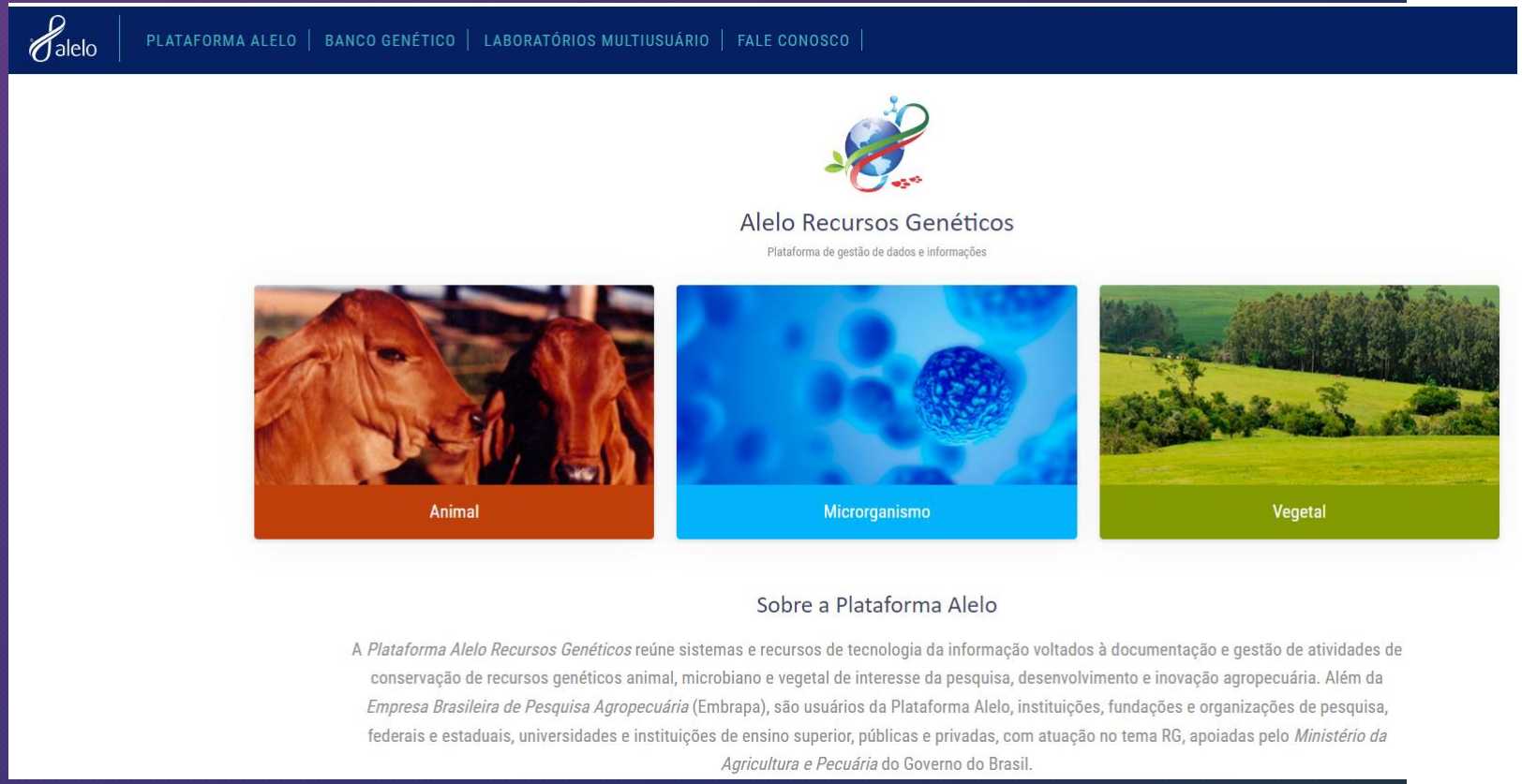
Jumentos no Brasil

Concepta McManus[1], Samuel Paiva[2], Helder Louvandini[3], Cristiano Melo[1], Luiza Seixas[1]

[1] Universidade de Brasília (UnB)
[2] EMBRAPA Recursos Genéticos e Biotecnologia, Brasília, DF.
[3] Centro de Energia Nuclear na Agricultura (CENA/USP), Piracicaba, SP.



Fonte: http://blogdoisraelbatista.blogspot.com/2010_03_01_archive.html



Conclusion

Brazil has capacity in the area

Lacks interaction internally and externally

- Within and between species

CAPACITY BUILDING FOR GENE BANKING: USA EXPERIENCES

Harvey Blackburn

National Animal Germplasm Program ARS-USDA

https://agrin.ars.usda.gov/main_webpage_dev/ars

GENERAL EXPERIENCES FROM 1999 TO PRESENT – CAPACITY BUILDING

- Difficult to promote university training in gene banking given small number of people – maybe gene banking classes across lifeforms
- Training needs to be comprehensive – all aspects of gene bank operations
- Be prepared to change collection goals as new challenges arise
- Capacity/flexibility to incorporate new technologies when they add value

WELL FUNDED GENE BANK TEAM IS MULTIDISCIPLINARY

Geneticist

guide & monitor collection development

Information/Database

develop and facilitate information dissemination

Cryobiology

day-to-day & protocol development

Critical Areas

Stakeholder Engagement

Make sure community knows what is going on

Engineering

custom equipment via 3D plastic and metal printing

Policy formation

Assess and promote policies of interest and economic assessments

Additions to strengthen the group

OUTREACH – STAKEHOLDER SUPPORT IS ESSENTIAL (~7,000 STAKEHOLDERS FOR OUR COLLECTION)

- Stakeholders need to know goals and gene bank needs – constant attention
- Stakeholder education is a repetitive process
- Access to diverse genetic resources depends on stakeholder buy-in
- Stakeholders, especially with rare breeds, often lack technical skills & are not interested in acquiring them.