



Yearbook 2018

Department of Animal Breeding and Genetics

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Welcome

— Our vision at the Department of Animal Breeding and Genetics is
"Improved use of animal genetic resources"

To achieve this vision we perform research and education within two areas of science: Molecular Genetics & Bioinformatics and Quantitative Genetics & Animal Breeding. We provide information on how breeding programs can improve health, fertility, production and performance of animals.

We work with cattle, buffalo, pig, sheep, chicken, horse, dog and cat. We also work with some wild species. We perform research and education in these thematic areas:

- molecular genetics
- bioinformatics
- quantitative genetics
- applied breeding

The department also comprises the Animal Genetics Laboratory, which does parental testing as well as various molecular genetic tests of disease and coat colour genes.

Furthermore, we host the SLU Centre for Bioinformatics (SLUBI), and the Interbull Centre. SLUBI is tasked to provide bioinformatics support across SLU by acting as a hub with dedicated bioinformaticians based at every faculty. The Interbull Centre is an internationally recognized institution; it provides genetic information services for improvement of livestock to a worldwide network. It is also the only European Union Reference Centre (EURC) in the field of animal breeding.

We do fundamental research on molecular genetics, bioinformatics and systems biology, which later can be applied in breeding programs. Some examples are disease gene tests and genetic evaluations. We do research on data from experiments at the Swedish Livestock Research Centre Lövsta, from own field studies in commercial farms and sometimes in natural populations. We also perform

research on data from the industry, simulated data and data from the public domain.

We believe that excellence in teaching is a core value of universities and we teach at both BSc and MSc levels in several programs at SLU: the Animal Science MSc program, two professional programs (Animal Science and Veterinary Medicine), the Ethology and Animal Welfare and the Equine Science BSc programs as well as the BSc program Sport and Companion Animals.

During 2018 Lotta Rydhmer and Dirk-Jan de Koning have served as head of department and deputy head of department, respectively.

For more information about our department please visit our homepage:

www.slu.se/en/departments/animalgenetics



SLU campus in Uppsala

ILLUSTRATION: FREDRIK SAARKOPPEL

Highlights of 2018

Success story

EU Horizon 2020 has chosen the B3Africa project as a success story. Project leader is Erik Bongcam-Rudloff, professor at our department and head of bioinformatics infrastructure SLU Centre for Bioinformatics (SLUBI).

The resurgence of diseases like Ebola points to the need for coordinated global responses to health threats, which means doing biological research in standardised ways. But there is a problem: regions store and manage biological samples (biobanks) differently.

Tissue samples, genetic information and other vital sources of biological data used to understand human health need to be managed the same, regardless of the source country. IT systems used to process the samples and analyse the data need to be able to work together. Researchers working in the field or lab need to follow the same practices to ensure the findings are reliable.

“We desperately needed a globally standardised approach to make sure that no matter where a disease or health crisis breaks out, research can quickly respond, knowing that everyone is on the same page. Thanks to EU support for our B3Africa project, and working with our research partners, we’ve created a platform with technical and intellectual resources to bridge European and African biobanking and biological research,” says Erik Bongcam-Rudloff.

B3Africa’s seven-country international consortium, including Kenya, Nigeria, South Africa and Uganda, has integrated available open-source software, services and tools, as well as public databases, for use by African and European biobanks and research institutions.

From SLU news 27 august 2018

New breeding index offers new possibilities

Since 2013 young sport horses are described for 50 traits for conformation, gaits and jumping ability at young horse tests. A publication by Åsa Viklund and Susanne Eriksson shows that these traits are inherited and can be used as a tool in breeding.

“The results were implemented directly and it is very rewarding to contribute with research that comes to use so quickly,” comments Åsa Viklund.

The breeding index for all 50 traits is available at www.blup.se



The breeding value shows the potential of these horses.
PHOTO: JULIO GONZALEZ

New infrastructure: Gigacow

Gigacow is a new investment in infrastructure from our university with the aim to increase the exchange between researchers, industry and farmers. The goal is to combine genomic breeding evaluation with better measurements for optimization of production in an environment where both techniques and climate are changing rapidly.

Project coordinator is Tomas Klingström, researcher at the Department of Animal Breeding and Genetics.

Quality and Impact Evaluation

The duty of the Swedish University of Agricultural Sciences, SLU, is to develop knowledge of biological natural resources and how to use them in a sustainable manner. In order to see how SLU meets the objectives, the SLU Board initiated a research evaluation called Quality and Impact 2018. The process involved self-evaluation, bibliometric report and interview with the evaluation panel.

Lotta Rydhmer, head of department, says: "We got high scores in the evaluation, and I am happy and proud of our department. The panel saw and understood not only what we have achieved but also our vision and ambitions for the future. According to the panel, we make concrete contributions to solving real societal problems."

In the report, the evaluation panel wrote "A unique characteristic of [our department] is the very broad and comprehensive research approach, integrating state of the art technologies with aspects of economic viability, sustainability and ethical responsibility in breeding."

News from Interbull Centre

The International Bull Evaluation Service, with short form INTERBULL – a permanent sub-committee of ICAR (International Committee for Animal Recording) supports the dairy industry with accurate genetic information on bulls of the major dairy breeds for use by importers and exporters, thereby facilitating selection of best genetics for different countries, environments or breeding goals.

The Interbull Centre is the operational unit of Interbull, and resides within the Department of Animal Breeding and Genetics.



Launch of Genotype Exchange Platform

In recent years, the International Genotype Exchange Platform "GenoEx" has been developed at the Interbull Centre. On 1 June 2018, ICAR and the Interbull Centre announced and officially released the first of the services for this platform: Parentage SNP Exchange (GenoEx-PSE).

The main purpose of the GenoEx-PSE database is to provide a service for exchanging standardised sets of SNP for genotyped animals to facilitate and streamline parentage analysis activities carried out by organisations that are responsible for parentage integrity.

Interbull Centre becomes EU reference centre

As a result of the new Animal Breeding Regulation (EU Regulation 2016/1012), the European Commission issued a call for the selection and designation of an European Union Reference Centre for the "scientific and technical contribution to the harmonisation and improvement of the methods of performance testing and genetic evaluation of purebred breeding animals of the bovine species".

The European Commission chose the Interbull Centre as the European Union Reference Centre (EURC).

The Interbull Centre assumed its role as the EURC on 1 November 2018, at the same time as the new EU Animal Breeding Regulation came into force.

The team at the Interbull Centre is proud to have produced a good application, and wishes to thank the European Commission, ICAR, INTERBULL, SLU and Jordbruksverket for their support and the trust they have placed in the Interbull Centre's activities and capabilities.

An overwhelming goodbye

— "I am thinking about retiring once more"

After 43 years in research it was time for Nils Lundeheim to retire in December 2018. The department of Animal Breeding and Genetics celebrated his work and achievements with a symposium focused on pig breeding.

"The symposium was an overwhelming experience, it was so nice that I honestly consider retiring once more," Nils Lundeheim recalls.



Nils Lundeheim - our teacher and friend.

PHOTO: LOTTA RYDHMER

Current and former colleagues, collaboration partners from the industry and other acquaintances had come to wish farewell and celebrate Nils Lundeheim's life at SLU.

"I had no idea they were all coming and it was nice to see everybody gathered."

Pig breeding and pig production

The focus of Nils Lundeheim's research has been on pig breeding and pig production and therefore he himself opened the symposium with an overview of the development of Swedish pig breeding and production during the last 100 years.

"Unfortunately we do not have that much pig breeding in Sweden any longer. Today most of the genetic material comes from abroad. Effective pig breeding is expensive and the comparatively low number of pigs produced in Sweden was not considered to balance this. That is a shame and the consequence is that we in Sweden cannot influence breeding to the same extent as before."

Identifying factors that influence health and welfare of the pigs, and how possible negative impact can be reduced, have been a particular focus for Nils Lundeheim. He has used statistical analyses to understand the connection between disease and production in pigs. He and his research group were first in the world to analyze the genetic background of a joint disorder, osteochondrosis, in pigs.

"The cartilage in a joint grows when the animal grows, and is successively transformed into bone material. In pigs that grow too fast, that conversion is disturbed. The cartilage gets thicker and thicker, leading to deformation, cracks and pain. We were able to include that information in the Swedish genetic evaluation and in the 1980s we were the first to introduce a breeding program to counteract this problem," Nils Lundeheim explains.



In cooperation with animal scientists and veterinarians, Nils Lundeheim has studied many different species, but the pig is his personal favourite. PHOTO: JENNY SVENNÅS-GILLNER

Failure and success in statistics

Nils Lundeheim was one of the first generation of scientists at the department that in the 1970s started to use computer programs for statistical analysis of herd book data.

“A funny detail is that I failed the exam in basic statistics as a student,” he reveals.

He sees a clear advantage in being able to handle information and numbers in order to draw conclusions. To promote the understanding of students he has developed a computer program that simulates the effects of crossbreeding.

“That should be helpful for students to understand how crosses between breeds will influence production. Crossbreeding is the opposite of inbreeding and can counteract disease problems, and also promote health and wellbeing of the animals,” he explains.

As a retired researcher Nils Lundeheim is planning to do some genetic analyses of ‘old’ data from the Swedish pig breeding organization. This type of data is really a gold mine, according to him.

“You need some peace and quiet to do this kind of work and I have plenty of that now. I also appreciate that I still have access to the department and am welcome to participate in seminars and other activities.”

Neighbor with Astrid Lindgren

Nils Lundeheim comes from a small farm in Vimmerby, which is also the birthplace of one of the most famous Swedish authors, Astrid Lindgren.

“The first combine that I ever saw was the one that my father hired for some years in the 1950s from Astrid’s brother Gunnar, who at that time ran the farm where Astrid got quite much inspiration for her writing. But I did not know Astrid personally.”

He is now planning to spend quite some time in Vimmerby to take care of the family farm. There is always much to fix and repair.

“But it is also OK to take it easy. That is actually allowed,” he concludes with a smile.

Text: Natalie von der Lehr

Future research leaders

— Fights, flights and genes: contribution of behaviour genetics to equine athletic performance

Marina Solé Berga is one of the young researchers at the department who has received a grant from Formas for future research leaders. Find out more about Marina and her research.



PHOTO: ANDREJ TARSKI

- 2007: Bachelor degree in Biology, UB Spain
- 2009: MSc in Animal Breeding and Reproductive Biotechnology, IAMZ-UPV-UAB, Spain
- 2013: PhD in Equine Breeding and Conservation Genetics: *Phenotypic and genetic characterization of morpho-functional traits in purebred Menorca horses: development of new strategies for use in its conservation and breeding program*. Department of Genetics, UCA, Spain
- 2013 - 2016: Postdoctoral researcher at the Meragem research group, UCO-US, Spain
- 2016 - 2018: Postdoctoral researcher at the Unit of Animal Genomics (GIGA-Medical Genomics), ULg, Belgium
- 2018: Postdoctoral researcher at SLU

What is your research about?

Behaviour strategies and developed cognitive abilities are key factors in managing everyday challenges like stress. Fear/anxiety and anger/aggression greatly influence health, quality of life and social interactions. They deteriorate wellbeing, and personal and public economics, both in humans and animals. Although much is known about the physiology and neuroanatomy of such emotions, little is known about their genetics - most importantly, why some individuals are more susceptible to pathology under stress.

Horse competitions are stressful and while some recover quickly after a race others do not. The capacity to tolerate or cope with stress varies between individuals, and between sexes. The Coldblooded Trotter is an ideal genetic model to identify genes for racing success, and recent preliminary results suggest that genes for cognitive ability may play a key role. This opens up for my study on the psychology of athletic performance using the horse as a genetic model. Aiming for improved welfare, I will map genes that regulate cognitive traits important for horses' competition success and ability to handle stress. I will capitalize on the favourable population structure, the extensive phenotypic variation in behaviour and the detailed existing data on performance. My plan is to combine state-of-the-art genomics technologies with deep knowledge of equine behaviour to identify genomic regions associated with psychological phenotypes critical for athletic performance.



Horse competitions are stressful and while some horses recover quickly after a race others do not. Marina Solé is going to study the psychology of athletic performance using the horse as a genetic model. PHOTO: JULIO GONZALEZ

Apart from carrying out the research – how do you plan the coming three years?

I am planning to have several students working on this project, either internship graduate students or master students. Regarding my research profile, I am planning to continue my collaboration with Gabriella Lindgren at SLU, she is co-applicant and my mentor. At this early stage of my career, I believe that this project grant will allow me to start an independent research line but always in close collaboration with senior scientists since I think it is the best way to succeed. In this sense, I will also continue my collaboration with Spanish scientists.



Marina has had an interest for horses for a long time and rides herself. PHOTO: JENNY SVENNÅS-GILLNER

I am planning to improve my teaching skills participating in pedagogical courses offered at SLU, and I want to be involved in teaching either in Sweden or Spain. My objective is to qualify for “docent”. During the next 3 years I will apply for other grants to acquire more funding and hold PhD students in the future .

What does the grant you received mean for your scientific work and career as a scientist?

This type of grant is an excellent starting point for a young scientist to carry out innovative research projects, acquire expertise in project management, grow up as independent scientist and enhance competitiveness.

What more should be done to support young researchers?

Young researchers need to have more support to ensure a more stable career development plan in the Swedish academic environment. The process as it stands is long and not always straightforward. In my opinion it would be better if a tenured position is supported by the university, otherwise this situation creates a lot of instability for our research and academic career.

Future research leaders

— NextGenCharr - application of next generation sequencing for improving Arctic charr aquaculture in Sweden

Christos Palaiokostas is one of the young researchers at the department who has received a grant from Formas for future research leaders. Find out more about Christos and his research.



PHOTO: ANDREJ TARSKI

- 2006: MSc Sustainable Management of Aquatic Environment, University of Thessaly, Greece
- 2010: MSc Aquaculture, Stirling University, UK
- 2013: Phd in Aquaculture on Analysing sex determination in farmed fish using Next Generation DNA
- 2015 - 2018: Postdoctoral research fellow, Stirling University and Roslin Institute (University of Edinburgh), UK
- 2018: Junior lecturer at SLU

What is your research about?

Arctic charr is a species of fundamental importance for Swedish aquaculture with great potential for further expansion. A national breeding program for Arctic charr, following classical selection approaches, has been running for over 30 years and formed the foundations for its successful farming across the country.

Nevertheless, the industry nowadays faces several challenges, with the reduced fertility and subsequent low survival of Arctic charr eggs posing a major threat towards its sustainability. The national breeding program at its current state cannot provide effective solutions as has been evident over the years. Up to now no genomic information has ever been applied in the Arctic charr breeding program.

Interestingly enough, to our knowledge no study has ever applied next generation sequencing for studying reduced fertility and egg survival in any farmed fish.

Overall, this project aims to enhance the Swedish Arctic charr breeding program with genomic information derived through next generation sequencing. Since the national breeding program has been responsible for disseminating improved genetic material over the country, advancements achieved through the current project are expected to influence the entire Arctic charr farming sector of Sweden.



Char caught at Nordkymhalvoya in Norway. PHOTO: KERSTIN HOLMGREN

Apart from carrying out the research – how do you plan the coming three years?

Since collaboration is essential for every researcher I am hoping of establishing and strengthening research networks with colleagues from abroad. Furthermore, I am responsible for the national breeding programs of Arctic charr and rainbow trout and as such I also regularly visit the fish farm, which is located in Kålarne, Jämtland.

Regarding my pedagogic tasks I am at the moment (co)supervising three PhD students. Their projects are about genetics/breeding of Nile tilapia strains in Tanzania. In addition, I give lectures regarding aquaculture genetics and reproduction in both BSc and MSc courses at SLU.

What does the grant you just received mean for your scientific work and career as a scientist?

The Formas grant was very important for my career. First of all, it provided me with the necessary funding for conducting my research. Furthermore, it was my first ever grant as a principal investigator (PI). From my experience getting the first grant as a PI is a major hurdle one has to overcome in the academic career.

What more should be done to support young researchers?

I have been particularly lucky until now, since all my previous departments were fully supportive and helpful. Providing courses like grant writing was very helpful and probably played its role in me getting the Formas grant. Mentorship from the senior staff is very important, especially for maximizing a young researcher's chances of getting a research grant. Offering the above type of training is critical for young researchers.



Low fertility is a challenge for aquaculture in Sweden. PHOTO: CHRISTOS PALAIOKOSTAS

Teaching and outreach

The Department of Animal Breeding and Genetics is involved in a variety of teaching and outreach activities. We believe that it is important to interact with society, both in Sweden and abroad.

Clinical genomics for veterinary students

A new course organized by our department gives veterinarians and students the possibility to learn more about genetics, genomics and testing of genetic diseases. The course was offered for the first time as a distance learning course during autumn 2018.

“We saw the need for this course as the possibilities for genetic testing is increasing. There are a number of tests commercially available but the interpretation of the results is not always easy. Veterinarians sometimes find themselves in a situation where pet owners have questions about test results and to be able to answer these questions they need to have the right background knowledge,” says study director Anna Johansson who has designed the course with Tomas Bergström, Sofia Mikko, Göran Andersson and Gabriella Lindgren from the Department of Animal Breeding and Genetics.

So far the course is offered outside the existing study programs and is aimed primarily towards veterinarians and veterinary students at the end of their studies.

“But we designed the course for a broad audience so that also other students with minimal knowledge of genetics can participate. Besides from the clinical aspects the course offers basic knowledge about genetics and genetic diseases.”

The course will be offered again in autumn 2019, this time as an evening class.

“That increases the possibilities for more contact and group discussions. We hope it is an attractive format and that students and professionals also can take this course in addition to their regular studies or work.”

Genetic testing for so called monogenetic diseases that occur due to a single genetic mutation is

already common in many breeding programs. For horses, testing of fur colour is of great interest. Many companies now offer genetic testing for various traits such as risk for diseases of companion animals like dogs and cats.

“It is important to be aware of these tests, what they offer and what they actually can achieve.”



Genetic tests may reveal the genotype but knowledge is needed to interpret the test results.

PHOTO: CHARLOTTA LANTZ, SLU

EMABG - International Master program

Together with five other European universities our department received financing from the European Union for “The European Master in Animal Breeding and Genetics” (EMABG).

The 2-year Master program responds to a sharply increased demand of industry and academia for people very well skilled within high throughput genomic markers as well as phenotypic data from automated recording systems. This has resulted in dramatic change in the understanding of genetic mechanisms and in the way livestock and aquaculture species are bred.

Read more at emabg.eu

Workshop in Uganda

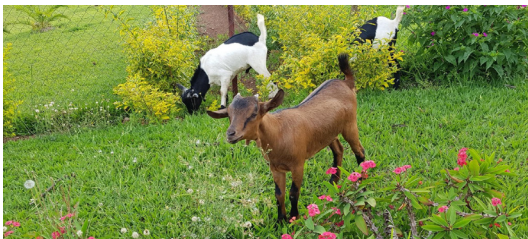
Juliette Hayer from our department and Maja Malmberg from the Department of Biomedical Science and Veterinary Public Health were involved in organizing a workshop on Bioinformatics and Metagenomics together with the College of Veterinary Medicine, Animal Resources & Biosecurity (COVAB), Makerere University, Uganda. The aims of the workshop were to introduce graduate students/fellows to bioinformatics and high throughput sequencing data analysis. The workshop consisted of four full days of training in bioinformatics and metagenomics questions, data handling, taxonomic classification and visualization.



Maja Malmberg with participants of the workshop at Makerere University in Uganda. PHOTO: PRIVATE

Teaching MSc students in Rwanda

Lotta Rydhmer, Erling Strandberg and Erik Bongcam-Rudloff were teaching students from the second batch of the MSc program in Animal Production at the University of Rwanda. The courses were Animal Breeding, Management of Animal Genetic Resources and Bioinformatics.



Goats in Rwanda. PHOTO: LOTTA RYDHMER

Podcast about animal breeding

Dirk-Jan de Koning was interviewed about animal breeding by the podcast "Shaping our Food" on stage at the annual science festival SciFest in Uppsala. Lotta Rydhmer was also interviewed on the same topic in episode #2 of the podcast.

<http://shapingourfood.libsyn.com/2-varfr-behver-vi-djuravel>



Dirk-Jan de Koning is interviewed by Lisa Beste.

PHOTO: NATALIE VON DER LEHR

Course in Iran

Elena Flavia Mouresan and Dirk-Jan de Koning gave a course on genome-wide association studies (GWAS) and genomic selection in animal breeding at the University of Gullan in Iran in september 2018.

28 participants from the whole country, ranging from PhD students to professors, took part of the course. Participants came mostly from universities, but also the industry and research stations.



Teachers and the participants of the course in Iran.

PHOTO: PRIVATE

The best of two worlds

Christian Bengtsson is employed by the company VikingGenetics at the same time as he is pursuing his studies as a PhD student at the Department of Animal Breeding and Genetics. He is looking forward to gaining deeper knowledge and connecting the two worlds of industry and academia.

“I have always wanted to become a researcher. I think learning new things is fun and with all the knowledge and expertise at SLU I have the opportunity to learn even more,” Christian Bengtsson comments.

He started his PhD studies in September 2018 after having won a competition within the National Food Strategy for Sweden. He and his supervisor Hans Stålhammar from VikingGenetics pitched the research project “Tinder for Cows”.

“I saw a need for more employees with a PhD at VikingGenetics. There was also a need for more knowledge about how to use DNA-information for breeding on a herd level in an optimal way. Christian was a good candidate for this position, he was already working at VikingGenetics and had the appropriate education and experience. He was also ready to move on to new challenges,” Hans Stålhammar explains.

Tinder for Cows

The aim of the PhD project is to improve matings at the herd level taking into account the benefit of the higher reliability of the genomic breeding value estimation for livestock, the knowledge if the female is a carrier of specific haplotypes and the possibility to control the genetic inbreeding for individuals. This development aims to improve the productive performance of the individual cows and increase profitability in milk and beef production.

In short Christian Bengtsson describes the project as “Tinder for Cows” – matching females with the optimal sire.

Network and collaboration

SLU and VikingGenetics have a history of collaboration and both Christian Bengtsson and Hans Stålhammar are valuing the opportunity of strengthening the connection.

“For us it is of value that one of our employees can focus in depth on a highly relevant issue for the company. That can be hard to achieve otherwise. For Christian this provides an excellent opportunity to develop and strengthen his own network, both in Sweden and on an international level,” Hans Stålhammar points out.

Christian Bengtsson agrees.

“I feel at home both at SLU and VikingGenetics and am hoping to be able to continue combining the two worlds even after my PhD studies.”



Christian Bengtsson PHOTO: ANDREJ TARSKI

Maximillian Manzi defended his thesis in december 2018. Now he is back in his home country Rwanda where he applies his knowledge in his work for the Rwanda Agricultural Board.

“My thesis was about studying the average levels and variability in performance traits of the Ankole cows and their crossbreeds with high producing imported dairy cows, using the animal performances and pedigree records generated at different research stations in Rwanda.

I have moved back to join the Rwanda Agricultural Board and do some teaching at the University of Rwanda. The wider knowledge I have gained during my PhD has for instance enabled me to be at the forefront in developing the National Strategy for sustainable utilization of Animal Genetic Resources in Rwanda.

Defending my thesis and being awarded a PhD meant a lot to me. The PhD is the highest academic degree and I always have the ambitions of challenging myself.

Having a PhD means that I have the opportunity to push myself to new greater heights.

Sweden has orderly and effective implementation procedures, I miss that in Rwanda. From the department I miss the coffee breaks (fika-time) and the weekly seminars.“



Congratulations Dr Maximillian Manzi!

PHOTO: PRIVATE

Visit our homepage

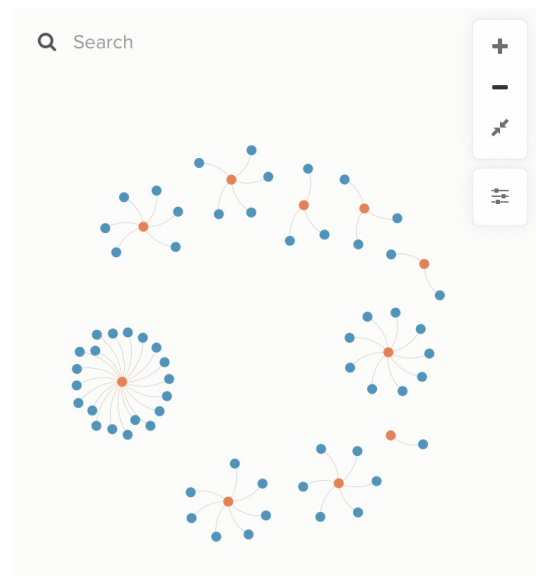
On our homepage you can find news about ongoing research projects and publications.: www.slu.se/en/departments/animalgenetics/

We have also created an interactive map of our research projects where you can find all our projects visualized in one graph. You can change the view yourself and connect projects in various clusters for example by animal, research section, principal investigator or funding and see how the graph changes. If you click on the project you will get additional information.

In the settings in the picture to the right, the orange dots represent a species and the blue dots the different research projects.

Try yourself!

<https://kumu.io/ErlingS/dept-animal-breeding-and-genetics-research-projects#research-projects>



The interactive map of our projects. When zooming in, project titles appear.



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