Accelerating the translation and transformation of research knowledge in genetics to enhance innovation in Canada’s sheep industry.

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How Does Genomics Accelerate Genetic Improvement

**Why Genomics**

Evolution of DNA Technology and Status of Ruminant Genome Sequence and Tools

<table>
<thead>
<tr>
<th>Item</th>
<th>Cow</th>
<th>Sheep</th>
<th>Goat</th>
<th>Yak</th>
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</thead>
<tbody>
<tr>
<td>Reference genome</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Additional animals sequenced</td>
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<td>50K SNP-chip</td>
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<td>HD SNP-Chip</td>
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<tr>
<td>Other SNP-Chips</td>
<td>✓</td>
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*ΔBV/2*

↑ Accuracy of selection
↓ Reducing Generation Interval

![RNA-Seq](Image)

Genetic Improvement

Genome Improvement

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<thead>
<tr>
<th>Item</th>
<th>DNA/Genes</th>
<th>Structural Genomics</th>
<th>mRNA</th>
<th>Transcriptome</th>
<th>Proteins</th>
<th>feed efficiency</th>
<th>health traits</th>
<th>fertility</th>
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<tbody>
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<td>Reference genome</td>
<td>rBV, BV i σBV</td>
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How Does Genomics Accelerate Genetic Improvement

Traits with genomic selection potential
i.e. Sheep, Goat
- Health
- Disease resistance
- Fertility
- Feed efficiency
- Adaptability / climate change
- Meat - cheese - milk quality

DNA Variants
SNP data
CNV
Whole genome data

Co-localized pQTL and eQTL

QTN
 Alter the transcript levels of the candidate gene
Cause of the variation in the phenotype

Genomics
Transcriptomics
Metagenomics
Proteomics
Epigenetics
Systems Biology

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Sheep producers often make breeding decisions without current knowledge of the science, existing systems and tools that they can use on farm to benefit from this research.

- Taken in isolation, a research finding can be confusing and lack any meaningful connection to the real world of production in which producers make decisions.

- Producers require more concise, layman’s terms presentation of the benefits of implementing change in their businesses, as well as a more clearly defined stepwise approach they can take to implement that change.
The study described how the farmers interact and communicate with other groups, showing the following order of importance:

1) fellow farmers
2) consultant
3) veterinarian
4) scientist
5) industry
6) merchant
The results show that the farmers made contact with their social peers more than with anyone else (half of the prior contacts were fellow farmers).

The study also described how the farmers interact and communicate with other groups, showing the following order of importance: 1) fellow farmers, 2) consultant, 3) veterinarian, 4) scientist, 5) industry and 6) merchant.
This project involves four components:
- A series of videos demonstrating real life benefit of using the results of research;
- Field days / Workshop at a producer’s farm
- Internship opportunity for senior students at UofG
- Webinars to producers

Important components of the network such as:
- Other fellow farmers taking advantage of the genetic evaluations and enrolled in the CSGES (Genovis, AgSights)
- Consultants from industry (AgSights) and government (OMAFRA and Ontario Sheep), CEPOQ and CSBA
- Veterinarians assisting the producers in the Wellington county
- Scientists (Ontario, Quebec and other provinces)

This project will provide a whole new level of unity of message across relevant organizations as well (UofG, OMAFRA, producer and service organizations) which is key to affecting change necessary to enhance and accelerate innovation in Canada’s sheep industries.
KTT: Videos

Videos:
- Genetic evaluation (GE)
- Genovis GE for Sheep
- Genomics
- Economic indexes
- Sustainable production
- Ponsonby Sheep Research Facility

Videos will be complementary to one another and will have several points of intersection, supporting the broader message of implementing tools and technologies on farms.

Video recording at Ryan and Romy Schill’s farm (Ontario; Summer 2017)
**KTT: Internships and Webinars to Producers**

**Internships:**
To train the 'future trainers' (senior students at UofG) in applied genetics and genomics in sheep to become a focal group to disseminate knowledge to the future next generation of producers (same generation of the senior students).

**Webinars to Producers:**

**2017 – 1st series of Webinars**
“The Basics of Genomics and GenOvis”.
- March 7th, 2017. Speakers: Dr. Angela Canovas and Dr. Luiz Brito (UofG)
“Find out what the field of genomics all about and how it relates to record keeping and GenOvis”.
- March 7th, 2017. Speaker: Delma Kennedy (OMAFRA)
“Small Ruminant Lentiviruses and Johne's disease on Ontario Sheep and Goats”.
- March 28th, 2017. Speaker: Nancy Stonos (OVC)

**2018 – 2nd year series of webinars**
"Genetic Improvement for Ewe Traits".
"Methods to Improve Lamb Carcass Traits Through Indirect Selection".
- February 6th, 2018. Speaker: MSc. Erin Massender (UofG)
- February 20th, 2018. Speaker: Dr. Aroa Suarez-Vega (UofG)
KTT: Webinars to Producers

http://animalbiosciences.uoguelph.ca/SheepWebinars/

- **Number of producers enrolled:**
  12-14 producers /each webinar (2017)
  15-25 producers (2018) from Ontario and Quebec enrolled in each webinar.

- Most of them, producers that are not currently enrolled in the National Sheep Genetic Evaluation System (producers interested in recording data and apply genetic evaluations / potential to increase the number of producers enrolled in Genovis/AgSights)

All webinars were announced by OMAFRA (Delma Kennedy) and were recorded and posted at the Department of Animal Biosciences (UofG) by Dr. Angela Canovas
• Field day/workshops inviting the “key” and important components of the network such as fellow farmers, consultants from industry and government, veterinarians and scientists.

• Two workshops targeted towards Ontario sheep producers (in Elora and Lindsay; July 2017) and aimed to inform producers on the latest developments in the sheep industry and encourage them to participate in the Nacional Sheep Genetic Evaluation System.

• Rideau sheep breed field day in August 2016, 2017 and 2018 at Breezy Ridge farm (Phil and Liz Smith’s farm).

• Members of the project presented several oral talks to Rideau producers in Ontario to show the benefits and preliminary results to apply genetics and genomics to improve health and production traits.
Leveraging transcriptomics and systems biology to understanding the genes and metabolic pathways associated with the genetic resistance to gastrointestinal nematode parasite infections in sheep

- Gastrointestinal nematode (GIN) infections are a common cause of morbidity and mortality in grazing sheep, with *Haemonchus contortus* being one of the most pathogenic
  - increased drug and animal management costs
  - production losses
  - decreased feed efficiency
  - reduced lamb survival

- Alternatives to anthelmintics must be explored due to:
  - emergence of anthelmintic resistance
  - public and political pressure to minimize drug use in livestock

Source: https://goo.gl/images/DqzKWt
Adaptation Climate Change

- Climate change will not only affect the sheep’s ability to fight GIN infection, but also influence the life cycle, parasite load, and pasture contamination of *H. contortus*.

- All of these factors highlight the importance of developing alternative tools, such as genetic selection for resistance to *H. contortus* infection, which can be used as part of a sustainable integrated parasite-management program.

Source: [https://goo.gl/images/DqzKWt](https://goo.gl/images/DqzKWt)

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Next steps – Correlation Indirect trait: FAMACHA as non invasive and cheaper test to measure GIN
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