International Genomic Co-Operation.

Who, what, where, when, ***why & <u>how</u>***?

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Background.

- MACE evaluations.
  - 1995 with 9 countries.
  - Direct involvement of Interbull.
  - Objective - more accurate proofs for members.
- Prior to MACE.
  - Exchange of files and conversion equations
  - Ad hoc, less accurate & more costly.
- Genomics – a new type of data.
  - *Potential* for greater accuracy.
  - How will we share…What is role of Interbull?
    - Conversion equations, S-GMACE, GMACE, Multi-country Genomic Evaluations.
  - Ad hoc, less accurate & more costly.
- Opportunity for more discussion.

Our approach!

- Objective: To review genomic co-operation to-date and to update members on some new developments in this area.
- Approach: The 5 W's!
  - "In journalism, the Five Ws (also known as the Five Ws (and one H), or Six Ws) is a concept in *news style, research and in police investigations* that are regarded as basics in information-gathering. It is a formula for getting the *"full"* story on something". http://en.wikipedia.org/wiki/Five_Ws

Who is Collaborating?

- Potentially all countries.
  - Genomic evaluations will become the *"standard"* for identification of elite animals (Goddard, 2009).
- Interbull Survey – 2008.
  - 5 groups (& 9 countries) were collaborating.
  - Another 8 indicated that they would collaborate.
  - 17 countries in total.
  - More are collaborating now.
  - Appetite for collaboration is growing.

What are they collaborating on?

- Genomic evaluations. Collaboration through 4 main guises;
  - Sharing expertise & knowledge.
    - Workshops, forums, conferences…..
  - Sharing software.
    - Genomicselection.net (Coffey & Mrode, 2009).
  - Sharing phenotypes.
    - National proofs, sire-dam pedigree files.
  - Sharing genotypes.
    - Currently bi & multi-lateral sharing (in main).
    - Future - how will we share?

When did the collaboration start?

- Relatively recently - a new technology.
  - US & Canada – 2008.
  - Interbull Survey – 2008.
  - Clubware – 2008.
  - Ireland & New Zealand – 2008.
  - EuroGenomics – 2009.
  - Intergenomics (Brown Swiss) – 2009
  - File of genotypes (Berry et al…) – 2009

Where are they collaborating?

- Range of cattle breeding organisations.
  - National Evaluation Centres, AI companies, Herdbooks, universities & research organisations.
- Role of Interbull?
  - Interbull survey. 18 responses – 8 indicated storing/exchange of genotypes.
  - What about genomic evaluations?
    - Local, international (through Interbull) and/or combination of both?

Why are they collaborating (i)?

1. To increase their reference population (& hence reliability of evaluations). For example;
   - Ireland. Moving from no genotypes, to ~1,000 domestic genotypes to ~3700 domestic & international genotypes in training population. *70% by sharing!*

Trait	Parent Average Only	Genotypes + Domestic Proofs	Genotypes + (Domestic & MACE proofs)
Protein kg	0.302	0.418	0.523

   - Simulation work (40k genotypes) suggests reliability increases to 80% (Vanraden et al., 2009).
   - Maximum accuracy with full sharing of all relevant information (Vanraden 2009, Goddard 2009, Harris, Zumbach….a few hours ago!).

Why are they collaborating (ii)?

2. To avoid repeat genotyping.
   - Analysis of international files from 10 countries indicates that of 20,739 bulls with MACE proofs, 522 were genotyped more than once (Berry, 2010).
   - “Squandering” of €110k (US$138k).
   - Does not include bulls from EuroGenomics. Costs are likely to double/treble/quadruple?
   - What about further re-genotyping in the future?
   - As member countries if we were asked to contribute €2-300k for a new initiative, how would we respond….?!

Why are they collaborating (iii)?

3. Smaller breeds.
   - Smaller groups thinking big, e.g., Intergenomics Brown Swiss (Jorjani, et al 2010).
4. Algorithms and software.
   - Thinking in the public domain, e.g., genomicselection.net (Coffey et al 2009).
5. Traits difficult to measure.
   - Sharing of phenotypes for collaborative research. Must learn from the lessons of fertility. Pooling of resources around new traits, e., disease, GHG..
6. Higher density chips & sequencing.
   - Additional genotyping in the future.

Why are they *not* collaborating?

- Protect investments in genotyping. Need return on capital invested.
  - Issues around proven bulls in training populations.
  - Prepared to share younger bulls.
- Why should other countries that have not yet invested in genotyping be given access to a global pool of genotypes?
  - More accurate identification of elite animals for these countries. Genotypes are better than GMACE.
  - These countries are now genotyping and will be genotyping in the future.
  - A catalyst to break the impasse?

How will we collaborate (i)?

1. Sharing all genotypes and expertise for a breed.
   - Intergenomics (Brown Swiss)….
2. Sharing of genotypes and expertise amongst a consortium, with different resource inputs.
   - North America, EuroGenomics….
3. Swapping of genotypes in bi-lateral agreements.
   - Ireland, Poland, Italy, Switzerland, NZ….
4. Swapping of information on genotyped animals.
   - File of genotyped animals (Berry et al., 2010).
   - Increasing interest in moving from swapping information (4) to direct sharing (1) amongst *many* countries.

How will we collaborate (ii)?

- IGenoP (**I**nternational **Gen**omic Evaluation **P**artnership) – a new concept.
  - Purpose**:** to facilitate national cattle animal evaluation units in the provision of accurate genomic evaluations on their national base and scale.
  - Members: open to all national cattle animal evaluation units that are members of Interbull.
  - Currently 12 countries have expressed an interest.
    - Ireland, UK, Poland, Italy, South Africa, Spain, Japan, Switzerland, Israel, Belgium, Australia & NZ (all are co-authors on this paper).
  - Currently 13,285 genotypes, of which 11,801 have MACE proofs. A further 6,871 bulls due for genotyping.

IGenoP – Key Principles.

- Open sharing of knowledge, tools and expertise.
- GEBV's should be made available to all breeders availing of the service.
- Genotypes hosted at Interbull Centre.
- Each partner contributes all owned genotypes to the pool.
- Partners can use the genotypes in the shared pool for all relevant research, development & implementation.
- Partners will not provide genotypes to 3rd parties.
- Commitment to only publish GEBV's on their countries base and scale.

IGenoP – Some Issues?

- IGenoP is still just a concept. Many issues up for discussion.
  - Will all participants be able to undertake required genomic evaluations for their respective country? If not, what are the options? Potential role of Interbull?
  - What about sharing of phenotypes – how extensive?
  - Should there be a minimum contribution of genotypes?
- Meeting for all interested countries at **12.45 tomorrow in the Epsilon room**.
  - Information/discussion meeting to plan next steps.
- If interested, have a very quick lunch & come along!

IGenoP – Motivation

- Why have 12 member countries expressed an interest in IGenoP?
  1. To return the most accurate proofs for the member countries that they represent.
  2. To avoid duplication (time, effort & money).
     - Cost of genotyping.
     - Cost of bi and multi-lateral agreements.
  3. To work in full co-operation with partner countries.
- Strong preference to see these functions reside within Interbull (lists, genotypes, phenotypes) and within the relevant steering & technical groups.
  - Can we learn from implementation of MACE….?

Conclusion

- Greater accuracy of selection through collaboration.
- Several types of collaboration are under way.
- The nature of collaboration is evolving. IGenoP is an example of this evolving process.
- Can IGenoP act as a catalyst for greater global co-operation?
  - It would save a lot of our technical problems!
  - Opportunity to develop a streamlined international genomic evaluation process for everyone's benefit?
- Would it be timely to undertake another Interbull survey regarding perspectives on international genomics co-operation & evaluation?

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