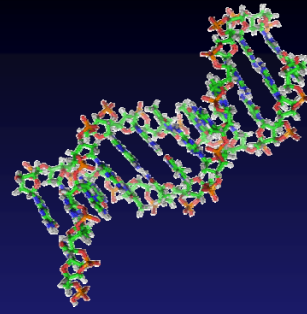# Genomic evaluations in the United States and Canada: A collaboration

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DNA sources

- **Cooperative Dairy DNA Repository (CDDR)**

  - **Progeny-test bull semen contributed by 7 artificial-insemination (AI) organizations**

  - **Currently over 20,000 bulls included**

- **Bulls and cows nominated by AI organizations**

- **Cooperator contributions to research projects**

- **Specific semen purchases**

Genotyping laboratories

- **Bovine Functional Genomics Laboratory (BFGL), USDA (Beltsville, MD)**

- **University of Missouri (Columbia, MO)**

- **University of Alberta (Edmonton, AB)**

- **Illumina (San Diego, CA)**

- **Genetics & IVF Institute (Fairfax, VA)**

- **GeneSeek (Lincoln, NE)**

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SNP selection

- **Minor allele frequency (MAF) > 0.05**

- **Portion heterozygous within 0.07 of expected**

- **SNP with clustering problems eliminated**

- **Redundant SNP eliminated**

- **38,416 SNP remained**

- **MAF uniform 0.05 to 0.50**

- **Some unreadable SNP may be recovered**

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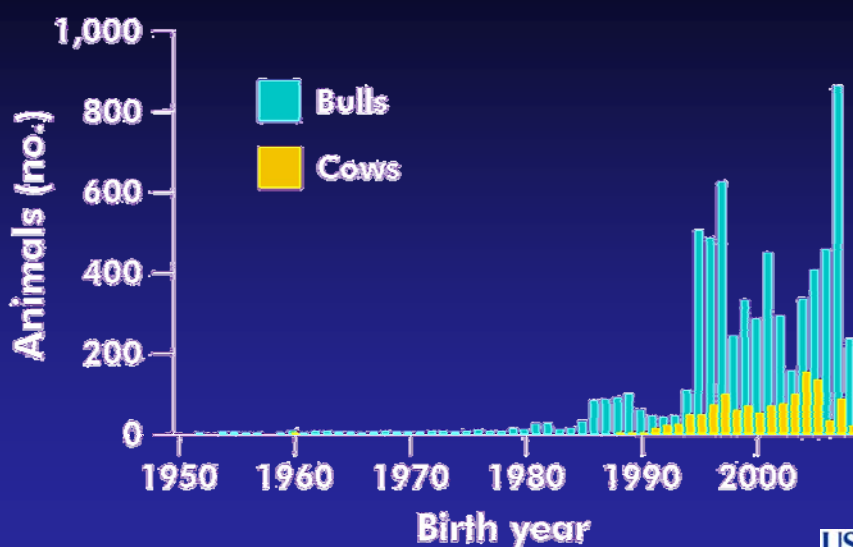
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Accurate evaluations

- **Accurate genomic evaluations require estimates of SNP effects**

- **Evaluations with high reliability provide the most information**

- **Recent animals are more useful than ones from earlier generations**

- **Reliability of genomic evaluations increases with number of predictor animals**

Holsteins genotyped
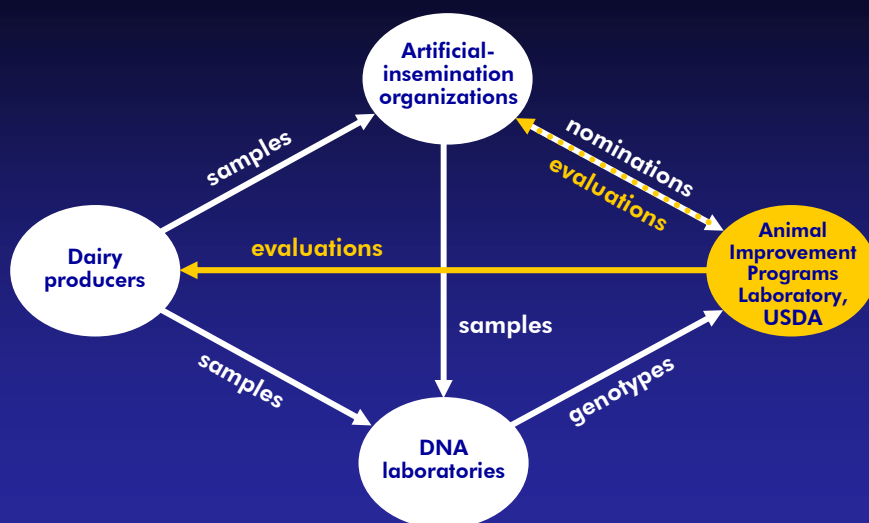
Genomic evaluation & reliability

- **Calculate parent average (PA) based only on genotyped animals with best linear unbiased prediction**

- **Combine traditional PA (or evaluation) with genomic PA and evaluation using selection index weights**

- **Update traditional evaluation with additional information from genomics**

- **Reliability from inverse of genomic relationship matrix**

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Data & evaluation flow

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4

Schedule

- **Calculate SNP effects with each of 3 annual traditional evaluations**

- **Calculate genomic evaluations 1 or more times between runs**

  - **Recalculate SNP effects if significant number of predictor animals added**

  - **Use existing SNP effects if only young animals added**

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Official release in 2009

- **Added accuracy of genomic evaluations propagated to evaluations of relatives without genotyping**

- **Public release of genomic evaluations**

  - **Cows soon after calculated**

  - **Bulls when enrolled with NAAB or Canadian AI organization**

  - **Shared by agreement with owner**

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Research at Guelph in 2004-2007

- Affymetrix 10,000 SNP panel
- About 6,000 SNP usable for genomic selection
- Many clusters
- Study of a wide range of genomic methods

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Project at Guelph-10,000 markers- 820 bulls

Trait	PA-reliability	GEBV-reliability
Protein yield	38	46
Fat yield	38	43
SCS	30	48
Conformation	39	47

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Research in Canada

- **Development of GEBV for Canadian traits using data from USDA project: summer 2008**

- **Research collaboration with USDA:**

  - **Genomic methods**

  - **Combining genomic and phenotypic data**

  - **Single SNP vs haplotypes**

  - **Other topics**

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GEBV in Canada

- **CDN: official GEBV planned for 2009**

- **Same approach as US:**

  - **One EBV figure using any genomic data available**

  - **All GEBV public when calculated**

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Benefits of collaboration

- **Share genotypes**

- **Collaborate on methods**

- **Harmonize policy**

- **Exchange domestic evaluations before release date for use in SNP effect estimation**

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Interbull

- **Can process genomic evaluations**

- **Genomics contribution to accuracy should be reported**
  - ‣ **Avoid double counting when submitted by multiple countries**
  - ‣ **Could be processed similar to parent contribution**

- **Change in 10-herd requirement needed to allow marketing bulls with only genomic information in countries without genomic evaluations**

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Implications

- **Era of genomic prediction has begun**

- **Young bull acquisition and marketing as well as cow selection will use genomic data**

- **Routine genotyping and validation will become industry rather than research responsibilities**

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Financial support

- **National Research Initiative grants, USDA**

- **Natl. Assoc. of Animal Breeders (NAAB, Columbia, MO)**
  - **ABS Global (DeForest, WI)**
  - **Accelerated Genetics (Baraboo, WI)**
  - **Alta (Balzac, AB)**
  - **Genex (Shawano, WI)**
  - **New Generation Genetics (Fort Atkinson, WI)**
  - **Select Sires (Plain City, OH)**
  - **Semex Alliance (Guelph, ON)**
  - **Taurus-Service (Mehoopany, PA)**

- **Agricultural Research Service, USDA**

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