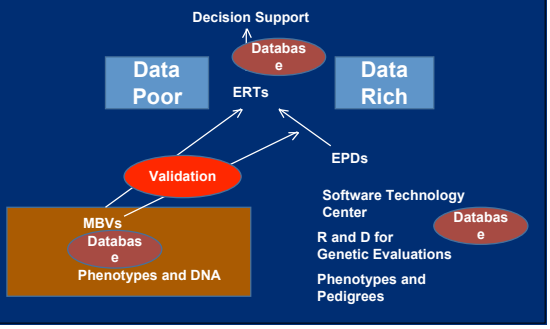
Whole Genome Selection: Projects and Validations

John Pollak
Cornell University

NBCEC VISION



What is WGS?

Selection based on genetic merit (MBV) estimated from large panel genotypic information on candidates.

The foundation information for the estimation process is derived from training data sets and subsequently applied to animals for which we may (or may not) have data.

Large Panels

Using this approach across numerous populations allows us to build a matrix of trait associations and genotypes.

Large Panels

Genotype	Birth Weight	Weaning weight	Maternal WW	Calving ease	Marbling	
Locus 1	+.5					
Locus 2	0					
Locus 3	-.2					
Locus 50,000	+1.2					
Sum (MBV)	+.6					

Large Panels

Currently there are alternative large SNP panels that are being utilized in populations for discovery but the one I will focus on is the Illunima 50K assay.

Traits and Populations NBCEC

- Healthfulness
- Animal Health
- Reproduction
- Stayability

Healthfulness

Primary Institution:

- Iowa State (Jim Reecy, Dorian Garrick, Donald Bietz)

Industry funding partner: Pfizer Animal GENETICS

Healthfulness

Cattle Resource (two years):

- Jack Cowley Cattle (California)
- DuckSmith Farms (Oklahoma)
- ISU research Herd

Healthfulness

Phenotypes:

- Fatty Acid composition
- Minerals (iron, etc)
- Carcass data
- Shear force
- Taste panel assessments

Animal Health

Primary Institution:

- Colorado State (Mark Enns, Hana Van Campen)

Partner: Pending

Animal Health

Cattle Resource:

- Rex Ranch, Nebraska
- Two years of 1600 steers, sire identified
- Fed at Lamar, Colorado

Health

Feedlot Phenotypes:

- Pulled Yes / No
- Lung scores
- Serial Ultrasound
- Feedlot performance
- Carcass data
- Temperament (chute score, flight speed)

Reproduction

Primary Institution:

- New Mexico State (Milt Thomas)

Funding:

- NRI Reproductive Grant

Reproduction

Cattle Resource:

- Discovery Brangus Population:
  - Camp Cooley, Texas
- Commercial ranches (validation)
  - Rex Ranch, Nebraska and Deseret, Florida
  - Branch Ranch and NMSU herd, New Mexico
  - Circle A Angus, Kasten Ranch, Missouri

Stayability

Rex Ranch:

- 3600 females born in 2004 monitored through their third pregnancy.

Stayability

Phenotypes:

- Heifer growth performance
  - (BW, WW, YW, Preg Wts)
- Reproductive success
- Maternal performance (two calves)

Large Panels

Genotype	Birth Weight	Weaning weight	Maternal WW	Calving ease	Marbling	
Locus 1						
Locus 2						
Locus 3						
Locus 50,000						
Sum (MBV)						

QUESTION
????

Will

WGS

Work?

USDA WGS Grant

Grant award focused on demonstrating aspects of WGS in Bovine.

1 – Discovery – (EPDs and/or phenotypes)

2 – Validation - Panels

3 – Validation - Process

Discovery

Discovery population for carcass traits (University or Missouri).

DNA: Angus Sire Repository

Phenotypes (EPDs)

Analogous to the Holstein component of the project.

Validation - Panel

Harris Ranch

Genome scan on bulls in herds involved in the Harris Ranch premium program.

Predicted genetic merit.

Phenotypic information on progeny carcass attributes.

Validation - Panel

Multiple sized panels:

50K

4K

400

How to reduce?

Large Panels

Genotype	Birth Weight	Weaning weight	Maternal WW	Calving ease	Marbling	
Locus 1						
Locus 2						
Locus 3						
Locus 50,000						
Sum (MBV)						"Profit Index"

Validation - Process

Ideally: Good old fashion selection program.

Would have a trained panel that is used for selection over multiple generations.

Compared to a control (random mated, conventionally selected).

Validation - Process

Rex Ranch

Identifies about 250 bulls a year to put on performance test.

Selects a proportion of those bulls off test for breeding.

Currently have three years of DNA samples on bulls and will collect additional cohort groups.

WGS

A fledgling process

A potentially powerful diagnostic tool

A challenge to organize and implement

An unprecedented opportunity?

We will see.

BIF (2009) should be a very interesting time.