Establishing Guidelines for Incorporation of Genomic Information into Selection Tools

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Outline

- History
- Where we are
- Where we need to go
- How we might get there

NBCEC Commission

- Meetings – February 1-2:
  - Genomic Companies
  - Breed Associations
  - NBCEC Advisory Committee
  - NBCEC Marker Validation Committee
- SmartGene Workshop – May 28-29
  - Brisbane, AU
- Meeting at BIF – June 6

U.S. Genomic Companies

- Bovigen
- Igenity
- MMI

- Others coming?

Types of markers

- Parentage
- Traceability
  - Genetic ID tag
- Management tools
  - Predict a future phenotype
- Selection tools
  - Predict progeny performance
  - Produce genetic change

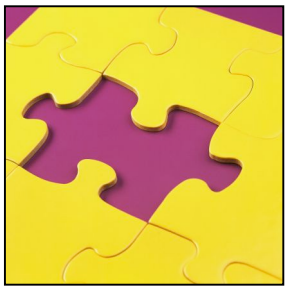
DNA markers are evolving

- Single locus
- Multiple loci
- Panels of many loci
  - Scores
  - Derived from whole genome scans

- What is on the horizon?

By itself, validation is:

Just one piece of a larger puzzle



DNA Technologies and Genetic Improvement

What's the GOAL?

DNA Technologies and Genetic Improvement

- How does the U.S. beef industry and U.S. public benefit most from DNA technologies?
- Why did the U.S. invest so much money in DNA technology?

DNA Technologies and Genetic Improvement

Goal = more efficient tools for genetic improvement

DNA Technologies and Genetic Improvement

- How can we use DNA markers to achieve:
  - Maximum speed?
  - Minimum cost?
  - Maximum control?
  - Maximum choice?
- How can we maintain flexibility to accommodate the future?

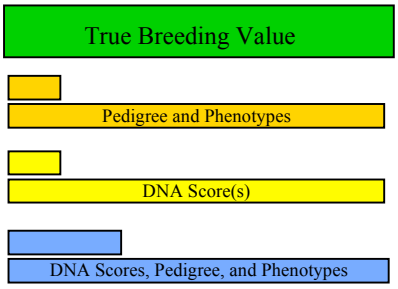
DNA Technologies and Genetic Improvement – The Question at Hand

- How do we make most effective use of:
  - DNA scores?
  - Pedigree?
  - Phenotypic data?

These are NOT independent!

We need a common currency

A common currency



A common currency

- A SINGLE estimate of breeding value based on all information available
  - DNA scores
  - Pedigree
  - Phenotypes
- With a SINGLE measure of accuracy

Higher accuracy earlier in life

Some traits

		Phenotypes	
		NO	YES
DNA Markers	NO	----	
	YES		

Some traits

		Phenotypes	
		NO	YES
DNA Markers	NO	----	
	YES		

A common currency

Pedigrees Phenotypes → **Genetic Evaluation (GE)** → **EPD**

A common currency

		Phenotypes: NO	Phenotypes: YES
DNA Markers	NO	----	EPD
	YES		

A common currency

Breed A EPD
Breed B EPD
Breed C EPD
⋮
Breed Z EPD

OR

Multi-breed EPD

Some traits

		Phenotypes: NO	Phenotypes: YES
DNA Markers	NO	----	EPD
	YES	◯	

A common currency

Pedigrees
Bovigen Score
Igenity Score
MMI Score

How do breeders and producers use these?

A common currency

Pedigrees
Bovigen Score
Igenity Score
MMI Score

Molecular Translation (MT) → **EPD-M**

A common currency

		Phenotypes: NO	Phenotypes: YES
DNA Markers	NO	----	EPD
	YES	EPD-M	

Some traits

		Phenotypes: NO	Phenotypes: YES
DNA Markers	NO	----	EPD
	YES	EPD-M	

A common currency

Pedigrees
Phenotypes
DNA Scores

→ Molecular Translation (MT) → **MA-EPD**

Genetic Evaluation (GE)

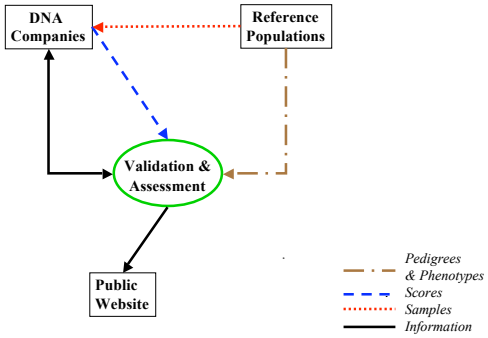
A common currency for selection

How do we get there?

		Phenotypes: NO	Phenotypes: YES
DNA Markers	NO	----	EPD
	YES	EPD-M	MA-EPD

Same units. Same measure of accuracy.

A suggested roadmap . . .



Validation

- Independent verification
- Breeds and crosses
- Production environments
- Procedures
- Statistics
- Standards

Assessment

- Relationships among:
  - Different markers for the same trait
  - Markers and non-target traits

Reference Populations

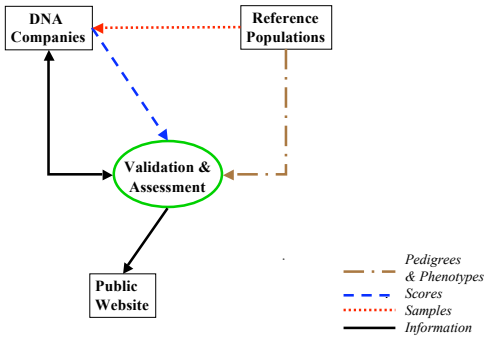
- Data = tissue (DNA), pedigrees, and phenotypes
  - Existing data
  - New herds optimally designed and managed for current and future use

Reference Populations

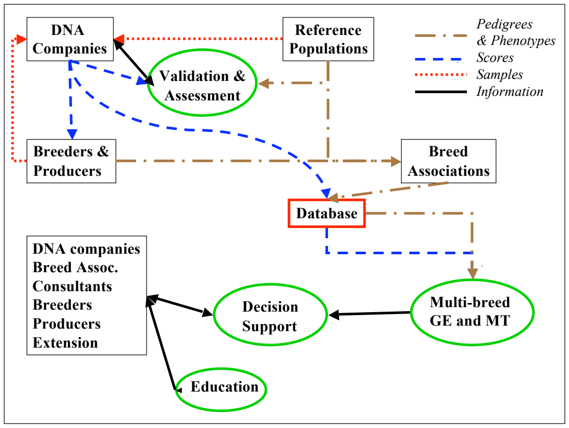
- Ownership
  - USDA-ARS
  - State Experiment Stations
  - Private Herds

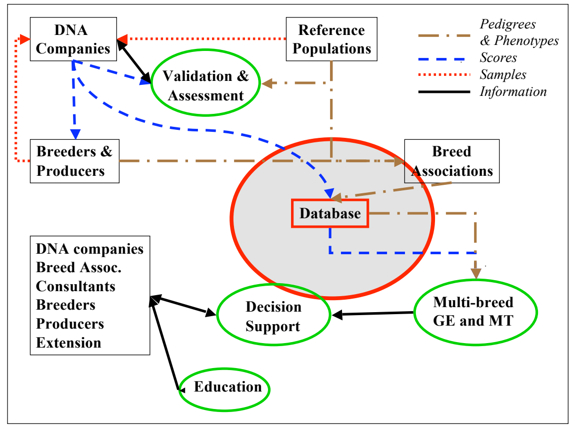
Reference Populations

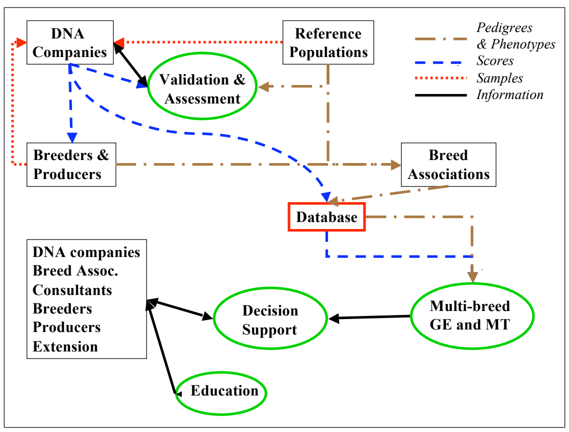
- Representative of:
  - Different breeds
  - Different production environments



The rest of the puzzle . . . .







How do we make this happen?

A suggested action plan:

- Team Approach
  - Genomic companies
  - Breed associations
  - USDA-ARS
  - State Experiment Stations
  - NBCEC

A suggested action plan:

- Components
  - Reference populations
  - Validation and assessment
  - Database
  - Software
  - Education
  - Vision

Reference Populations

- Primary players:
  - USDA-ARS
  - State Experiment Stations
  - Breed associations
  - Genomic companies
- Catalog existing data
- Design of herds
  - Locations
  - Breeds
  - Traits to measure
- Coordinating organization?

Validation & Assessment

- Primary players:
  - University scientists
  - NBCEC
  - USDA-ARS
  - State Experiment Stations
  - Genomic companies
- Responsible agency?
- Procedures, standards, reporting, statistics
- Internal and external data
- Cost

National Database

- Primary players:
  - Breed associations
  - NBCEC
  - Genomic companies
- Structure
- Cost
- Access
- Incentives

Software

- Primary players:
  - NBCEC
  - Breed associations
  - Genomic companies
- Multi-breed genetic evaluation
- Molecular translation
- End user = private company

Software

- Decision support
  - Breed associations
  - Genomic companies
  - Bull Studs
  - Breeders/producers
  - Extension
  - Consultants

Education

- Primary players:
  - NBCEC
  - Extension
- End users
  - Breed associations
  - Genomic companies
  - Bull Studs
  - Breeders/producers
  - Extension
  - Consultants

Vision Team

- Industry structure
- The future of DNA technologies
- New traits
- Data needs

Roles for NBCEC

- GE software
- MT software
- Decision support software
- Education
- New Trait R&D
- Validation and assessment ?

Roles for the Commission

- Facilitate meetings
- Encourage action
- Conduit for communication

Commission Structure

- Leadership team
- Committees:
  - Reference populations
  - Validation and assessment
  - Database
  - Software
  - Education
  - Vision

What role should BIF play?

guiding organization?

Application of DNA Markers for Beef Cattle Improvement

We ALL have a stake