PROCEEDINGS

Beef Improvement Federation

28th Research Symposium and Annual Meeting

Sheraton Civic Center
Birmingham, Alabama
May 15-18, 1996

1996 BEEF IMPROVEMENT FEDERATION
BOARD OF DIRECTORS

NAME	YEAR TERM EXPIRES	REPRESENTING
Bill Able	1997	Breed Association
Willie Altenburg	1999	Western BCIA
Kent Anderson	1997	Breed Association
Glenn Brinkman	1996	Central BCIA
John Crouch	1998	Breed Association
Jed Dillard	1998	Eastern BCIA
Jim Doubet	1999	Breed Association
S.R. Evans, Jr.	1999	Eastern BCIA
Galen Fink	1999	Central BCIA
Burke Healey	1998	At-Large
Roger Hunsley	1998	Breed Association
John Hough	1999	Breed Association
Gary Johnson	1997	Central BCIA
Lee Leachman	1997	At-Large
Roy McPhee	1998	Western BCIA

Don Boggs	Central Region BIF Secretary
Ron Bolze	Executive Director
Larry Cundiff	USDA ARS
Ronnie Green	Western Region BIF Secretary
Dan Kniffen	NCBA
Mike Schutz	Canadian Beef Improvement
Ronnie Silcox	Eastern Region BIF Secretary
Norman Vincel	NAAB
Richard Willham	BIF Historian

1996 Beef Improvement Federation Conference
Sheraton/Civic Center
Birmingham, Alabama
May 15 - 18, 1996

Wednesday, May 15, 1996

2:00	Board of Directors Meeting
6:00	Board of Directors Dinner
7:00	**Symposium** **The Information Highway. BIF's New Traildrive** **Moderator: Bruce Golden** **Colorado State University**
7:00	"An Introduction to the Internet and It's Uses" Bruce Golden, Colorado State University
7:45	"Your Breed Association in Cyberspace" Jim Gibb, American Gelbvieh Association
8:20	Break
8:30	"Selecting Your Next Sire in Cyberspace" Mike Bishop, ABS Global Scott Totzke, United Breeders, Inc.
8:50	"World Wide Wisdom" Sally Northcutt, Oklahoma State University
9:10	"Our Industry's Big Menu" Jamie Kaestner, Director in Industry Public Relations, NCBA
9:30	"Cyberspace for Night Owls" Question and Answer Period

Thursday, May 16, 1996

A World Wide Genetic Revolution
Moderator: Jed Dillard
Monticello, Florida

8:00 A.M.	* **Welcome** * Werner Bergen, Head Department Of Animal & Dairy Sciences, Auburn University * Len Gibbs, President, AL Beef Cattle Improvement Association
8:15	**"The Gulf Coast Miracle"** Bill Mies, Texas A & M University
9:00	**"A New Top Hand: Your Computer"** Steve Swigert, Noble Foundation
9:45	Break
10:15	**"International Evaluations"** Keith Bertrand, University of Georgia
11:00	**"Genes and the New World Map"** Jerry Taylor, Texas A & M University
11:45	**Caucus for Election of BIF Directors**
12:30 P.M.	**Annual Meeting Luncheon**
2:00	**Committee Meetings**

Genetic Prediction Committee

* **Report of Guidelines Update**
  C.M. Bailey, University of Nevada
* **Report on 5th Genetic Prediction Workshop**
  Harlan D. Ritchie, Michigan State University
* **Revisiting Direct-Maternal Correlation for Weaning Weight**
  John Pollak, Cornell University
* **Multibreed Evaluation with Field Data**
  L. Klei, American Simmental Association
  John Pollak, Cornell University
* **Red Angus Across Breed Adjustment Factors**
  Bruce Golden, Colorado State University
* **Across Breed Evaluation with Data from NC-196 Experimental Herds**
  Dale Van Vleck, USDA-ARS-USMARC
* **Across Breed Evaluation Update**
  Dale Van Vleck, USDA-ARS-USMARC

Biotechnology Committee

- **Open Discussion:** Where Are We?
- **DNA Identification Technology**
  Mike Bishop, ABS
  Tom Holm, Linkage Genetics
- **Current Applications of DNA**
  Jeremy Taylor, Texas A & M
- **Sex Preselection by Semen Sexing**

Integrated Genetic Systems

- **Update of IRM/Seedstock SPA and SPA EZ**
  Dan Kniffen, NCBA
- **Utilization of Selection Index and Multiple Trait Selection**
- **The Basic Aspect**
  Mike MacNeil, USDA-LRRL, Miles City
- **Success in the Swine Industry**
- **Australian BREEDOBJECT Computerized Approach**
  Steve Barwick and David Johnston, AGBU, Australia

6:30 P.M. Alabama Social

Friday, May 17, 1996

An Industry in Revolution
Moderator: Ronnie Silcox
University of Georgia

8:00 A.M.	"Calving Inteval Slippage" Dan Kniffen, Associate Director Research, Educational & Technical Services, NCBA
8:45	"Reproduction: The Next Era of Evolution" Bruce Golden, Colorado State University
9:30	Break
10:00	"The Carcass Revolution and Your Pocketbook" Ronnie Green, Colorado State University
10:45	"Ultrasound: Past Pitfalls and Present Promise" Lisa Kriese, Auburn University

11:30 Introduction of Seedstock and Commercial Producer Nominees
Norm Vincel, Select Sires

12:30 P.M. **Awards Luncheon**

2:00 **Committee Meetings**

Live Animal Evaluation

* **Use of Real-Time Ultrasound in National Cattle Evaluation**
  Doyle Wilson, Iowa State University
  Gene Rouse, Iowa State University
  John Crouch, American Angus Association
* **Centralized Processing and Interpretation of Real-Time Ultrasound Images**
  William Herring, University of Missouri
* **Standards for Recording and Reporting Real-Time Ultrasound Carcass Data on Individual Animals**
  Lisa Kriese, Auburn University

Central Test and Growth

* **A Summary of Steer Feedout Program Data**
  Darrah Bullock, University of Kentucky
  William Herring, University of Missouri
* **Using the World Wide Web for Test Stations**
  Brett Middleton, University of Georgia
* **Central Test Station Concept**
  Sally Northcutt, Oklahoma State University

Reproduction

* **Genetic Evaluation of Heifer Pregnancy**
  Warren Snelling USDA-LRRS, Miles City
* **Genetic Relationship Between Scrotal Circumference in Bulls and Reproductive Efficiency in Heifers**
  Dan Mosher, University of Georgia

6:00 No Host Social

7:00 **Awards Banquet**

Saturday, May 18, 1996

6:00 A.M. Board of Directors Meeting

8:00 Depart on Tours

Farm and Rocket Tour

* **Debter Herefords** - Ross, Glynn, Perry & John Ross Debter
* **Whitley Red Angus Farm** - Henry, Jane, Jim and Tim Whitley
* **Sherrod Farms** - Blake Sherrod
* **U.S. Space and Rocket Center**
* **Macedon Farms** - J.E. Horton and Son

Historic Alabama Tour

* **Lovelady Farms/Carlee Farms** -
  Ralph & Butch Lovelady; Walter Carlee
* **Autauga Farming Company** - Milton Wendland Family
* **Grey Rocks Ranch** - Mrs. S.E. Upchurch
* **Twin Valley Farms** - Dr. Ron Henderson

TABLE OF CONTENTS

Selecting Your Next Sire In Cyberspace
Beef Improvement Federation - May 15, 1996

Scott Totzke
System Administrator, Gencor - The Genetic Corporation

A BIT OF HISTORY

In 1992 a group of Ontario artificial insemination organizations, related "industry partners" and members of the research community formed a working group whose mandate was to examine the flow of data between the organizations, look for ways to improve this data flow, and ultimately, find a way to deliver information back to the farm in a timely manner. Ultimately all of the organizations involved in this group were accountable to a common customer - the herd owner.

The first phase of this project was to determine the best vehicle for exchanging data within the industry itself. Keeping in mind that whatever "cloud" we decided to plug into we had to have room for growth and that the ultimate goal was to reach our customer we set out looking at a number of possible solutions. Building an information service using existing commercial services like America Online, Compuserve, Genie and Prodigy would probably do the job, but they were too costly. We examined building our own national network of computers but this was both too costly and too limiting for future growth. At this time commercial use of the internet was just starting to be accepted and it was agreed that: (1) the internet offered us a reliable vehicle for delivering our data; (2) with access as low as $15/month it would be cost effective; and (3) it provided us with room to grow since it offered a local, national and international presence all at the same time.

With our decision made the organizations involved in this working group all went out and got themselves connected to the internet. By the middle of 1993 most of the organizations had some sort of internet connectivity and we were starting to use tools like email and ftp to exchange data that would normally be sent on tapes or diskettes...progress was being made.

Over the next few months there was a considerable evolution going on. Organizations that started out with a single dialup internet accounts registered their domains and moved to dedicated connections. We were installing firewalls and setting up ftp sites. Broad implementation of corporate email systems was being done at all organizations and soon sending email became another communications tool used with in AI industry in Ontario.

In November 1994 UBI quietly put an "Under Construction" page on the World Wide

Web. In January of 1995 we put together an online Holstein catalog - a somewhat abbreviated version of the printed one. Spring of 1995 saw our first online beef catalog and the rest is, as they say, history. The internet, and in particular the World Wide Web, have become a fundamental part of UBI's overall marketing strategy. While we haven't been able to keep our online catalogs and directories as up-to-date as we like we are taking steps to ensure that our online marketing will be as current (or better) as our printed materials.

As for the rest of the industry, the internet has become an integral part of the way we communicate. A year and a half ago FTP was offered as an alternative method of retrieving sire proofs, now it is the only method available. We have seen the rest of the Canadian AI industry look at developments in Ontario and move to follow our lead setting up their own servers and web sites; building on the framework that we laid out back in 1993.

THE FUTURE

UBI's commitment to delivering information to our customer's via the internet has really just begun. Feedback from our customers and continued interest in our site has made the decision for us: this has become an important part of our overall business plan. With increased competition the AI industry, like most other industries, now more than ever needs to be customer driven. The internet is one way they we can enhance the services that we offer our customer.

As mentioned earlier we are committed to providing the same information that we have in our printed catalogs, but it doesn't stop there. The World Wide Web is flexible and interactive. With this technology we can produce catalogs that are updated within minutes of proof information being made available to the industry. Examples of this is are our online Holstein and Jersey books that were updated with January 1996 proof information by 8:30 AM the day that proofs were released - only half an hour after the information was made available. Try doing that with a printed catalog.

We are looking to expand our online catalogs with additional sires and progeny pictures so that our customers can keep completely up-to-date on the latest sires available. The next component is to add online ordering with UBI billing your credit card or putting the order on your account.

To take things to the next level we are looking at developing an online genetic mating systems, kind of a "Sire Analyst in Cyberspace" to assist our customers in selecting the right sire for their next service. Tie that together with an online ordering system and with a couple of mouse clicks we could dispatch a technician right to the farm with the requested semen to perform the insemination.

It doesn't stop there. We are looking at letting the customers access their data (breeding history, conception rates, account balances) via the internet and maybe even provide them with data files that can be imported into herd management packages to help run their operations. As we work with this medium and our customers demand new services we will continue to look at ways of providing them services that will help make them more profitable and keep them coming back.

WHY BOTHER

OK, it all sounds good on paper but is anyone going to really use this type of information? Fair question. To answer this I think that we really need to put this whole computer/internet thing in some sort of framework that everyone can relate to. Consider the following

1) When my grandfather was born not too many people had cars they were a luxury reserved for the rich, BUT...

2) When my father was born, almost everyone (including my grandfather) had a car - it was no longer just for the rich. At the same time, television was still a new item that again was reserved mainly for the rich, BUT...

3) When I was born, everyone had televisions (even color ones) and today many homes have 2 or 3 televisions. But when I was born a computer took up a huge room in a building and cost millions of dollars. The concept of people having a personal computer at home was absurd, BUT...

4) When my son was born I was on the way to buying my third personal computer. Depending on where you live there are probably between 30 and 60 percent of homes with at least one PC.

If you just follow that progression a little bit you could probably conclude that 20 years from now most people will have a computer. Couple that with the phenomenal growth of the internet in the last few years and you can safely say that 20 years from now most people will have personal computers CONNECTED to the internet. Not the television, not the car, not the phone, not the fax machine; none of these inventions experienced the type of growth that the internet has seen in the last 5 years. Quite simply, the internet is the fast growing technology in history (with the exception of maybe fire).

The service that we are building is not just for today, but for the future.

The ABS Global Inc., World Wide Web Home Page

Prepared by Marcy Tessmann for the Proceeding of the 1996 Annual Meeting of the Beef Improvement Federation

ABS presented a *live* look at our home page at the Birmingham conference. The home page is divided into four general areas including information: About ABS, ABS' History, ABS' Sales Maps and ABS' Products.

A very simple point and click approach is all that is needed to browse the ABS page as was demonstrated. We browsed through the ABS Products area and went to the beef product line. Here the beef product line is categorized by breed to easily click on the breed of interest. Red Angus was used as the example and when chosen, the current Red Angus Sire Summary information on each ABS Red Angus bull appears in chart form. As you view this on your own, using NETSCAPE is important as it allows for easy viewing of the tables.

More information may be obtained on a particular bull by clicking on his name. The bull photo and brief information and description appear. To view any photos of relatives, the pedigree, or a list of the owner/s, labeled boxes appear lower on the screen to click on for viewing. At anytime while viewing, it is easy to go back to the previous areas by clicking on the icons at the bottom of the screen (i.e., About ABS, ABS' History, ABS' Home, and ABS' Sales Maps). These will appear at any location while you are browsing.

The ABS page was developed with the user in mind being quite simple in design and easy to use.

WORLD WIDE WISDOM

Sally L. Northcutt, Larry Burditt and David S. Buchanan
Oklahoma State University
Stillwater

The World Wide Web has many opportunities for the beef producer. By providing 24-hour, 365-day service to its users, the Web provides beef cattle enthusiasts with several advantages. The Web is visual, allowing you to browse through displays, advertisements, photographs, magazines, and other media technologies. Infinite links exist to allow you "real-time" access to educational and reference materials for use in decision making. Immediate feedback of high quality visuals, graphics, and publications, viewed on-screen or printed, makes the Web activity hard to give up once you have given it a try.

The availability of access to Internet for those people outside of the academic community has been exploding. Several of the large commercial information systems, such as CompuServe or America On Line already provide access to the World Wide Web for their subscribers. The various pieces of information on the World Wide Web are referred to as pages and each page has its own Uniform Resource Locator (URL) that acts just like your local postal address.

The following paper outlines some of the opportunities for beef producers from the infinite information pages and links on the Web. Descriptions include a cursory view of the World Wide Web Breeds of Livestock project at Oklahoma State University and its benefits to producers.

Web Materials for Beef Producers

Educational materials are at your fingertips, when you browse the Web. Publications provided by a vast majority of the state cooperative extension services are now available for immediate reading or printing, including graphics, photographs and supporting materials with each publication. Beef cattle fact sheets may be accessed, as well as meeting announcements, proceedings and research reports. In addition, software programs are available to support particular publications, and in many cases you can download the programs free of charge for use on your home computer. Through the extensive use of e-mail, questions about a topic of interest may be immediately directed to appropriate extension personnel. This allows you an opportunity to pursue feedback and team support in the decision-making process. Beef cattle discussion groups are available and are already receiving avid use by beef industry participants.

Reference materials are easy to access using the Web. An important advantage of the Web is the "real-time" access to weather reports, forecasts, charts and satellite photographs. Timely agricultural market data may also be "bookmarked" allowing easy access of this information at any time. The opportunities to view ranch listings and locations by state and region are also a tool for producers seeking contacts and wanting to develop their own home pages. The home pages available through the National Cattlemen's Beef Association are an important part of every beef producer's Web use. State beef cattle associations are beginning to pursue the Web as a way to communicate with their clientele. With the advent of breed associations developing home pages and providing sire summaries on the Web, producers can study EPDs and do sire sorts for breeds of interest. The availability of these selection opportunities are developing at a rapid rate.

Advertising is a big feature of the Web. If you are interested in locating equipment, cattle, feed, clothes, etc., the information and contact persons are somewhere on the Web. Agricultural popular press materials are increasing in availability. Some publications include options for producers to make suggestions on story ideas, submit editorials on-line, and participate in discussion groups. Software companies have home pages and demonstrations of their products as well as purchasing details, many of which can be done by "on-screen" order forms.

An important part of your search strategy should include identifying Web sites that provide many links to other sites. Home pages with many links help you "fine-tune" your search for the necessary information in a timely fashion. Each individual user of the Web begins to develop a search strategy to best capture the needed materials, and to avoid the other "junk" that is not of interest.

World Wide Web Breeds of Livestock and Livestock Library

The Department of Animal Science at Oklahoma State University has recently completed the initial phase of an on-going project to create an electronic reference site utilizing the World Wide Web feature of the Internet for the various breeds of livestock. The project has two major sites. The first is a reference of breeds of livestock for beef producers, industry personnel, students and others. A user can access this site, click on the breed name of interest, and view photographs, historical information, or link to breed association home pages. The address, phone numbers and in many cases the e-mail addresses of the individual breed registries are also available for each breed listed. In addition, the U. S. Meat and Animal Research Center Germplasm Evaluation results for Clay Center, NE, are available to allow producers to view breed comparison data for various performance measures. Commercial and seedstock producers may benefit from this information resource. Plans are to continue the growth of this portion through the inclusion of quantitative and comparative research on the various breeds. In the initial phase of the project we have focused on the history and development of each breed, but we hope to include additional types of information in future expansions of the project. Because of the nature of this electronic medium it is possible to make changes and additions as often as needed.

The second opportunity available through the Oklahoma State University site is the Livestock Virtual Library. This library serves as a "card catalog" with many links to popular agricultural sites. The livestock library provides various types of information which would be helpful to livestock producers by locating the home pages of industry organizations, commercial pages with various services and product advertisements offered, breed associations, bull tests, cattlemen's groups, on-line magazines and publications.

Approximately 331 breeds are listed in the Breeds of Livestock project, with the following species representation by number of breeds (3/19/96): Cattle 95, Goats 20, Horses 93, Sheep 90, Swine 25, other species 8. Over 60 countries access the web site each month. Web site activity for April 1996 by number of users and number of accesses (hits) is summarized as follows:

Total number of accesses	
Overall total	*173,061*
OSU users	6,644
Outside users	166,417
Total number of users	
Overall total	*17,941*
OSU users	292
Outside users	17,649
Top Pages:	
Horse breeds	6,989
Cattle breeds	6,465
Breeds of livestock	5,377
Livestock library	4,719
Animal Science home page	4,699
Sheep breeds	2,539
Horse section	2,405
Beef cattle section	2,098
Poultry breeds	1,798
Swine breeds	1,496
Breeds of chickens	1,470
Goat breeds	1,333
Angus breed page	1,247

Web site activity present does not include use by the Animal Science Department.

The addresses for the Breeds of Livestock Project and the Livestock Virtual Library are:

http://www.ansi.okstate.edu/breeds/
http://www.ansi.okstate.edu/library

We would appreciate any comments or suggestions you might have (Internet mail: burditt@okway.okstate.edu or slnbull@okway.okstate.edu)

Search Strategy

Beef producers can develop a search strategy to provide Web information for use in answering their production and management questions. It is helpful to begin with Web sites that have many links to beef cattle activities and reference materials. "Bookmarks", a listing of popularly visited home pages, may be developed on your own computer to simplify locating materials in the future. For example, producers may have bookmarks for Cattlemen on the Web and Cowtown pages (National Cattlemen's Beef Association), OSU Breeds of Livestock and Livestock Library, and Beef Improvement Federation home page. Be creative in your searching techniques. Universities have extensive publication lists for you to access.

Individual producers are developing their own home pages for specific uses. This is a non-traditional approach to advertising. These personalized pages take some work. First, a home page must be updated frequently, in order to be effective in presenting information and captivating users. Seedstock breeders are pursuing this information source for advertising, ranch information, service to clientele, and sale catalog visibility. The impact of this mode of information transfer on seedstock sales and merchandising is not yet known Any producer page needs a way to entice users, or capture their attention to visit the details of a site and encourage repeat visitors.

Implications

The World Wide Web provides some excellent opportunities for beef producers and industry representatives. The "real-time" instant access to information on the cattle industry and its participants is readily available to everyone, from producer to consumer. This immediate feedback to discuss industry issues and provide educational and reference materials is priceless. The Web can be fun and nearly "addictive", with endless links to subjects of interest. Once "hard to reach" materials may now be easily accessed. The challenge lies with the user in searching through the limitless information and putting the materials to use.

Other Selected World Wide Web URL Addresses

The following list of URL addresses illustrate the educational, reference, and commercial materials available on the Web. The list is not meant to be all-inclusive, but rather to provide a starting point for producers beginning their search strategy on the Web.

http://www.hpj.com/
High Plains Journal On-line

http://www.ansi.okstate.edu/breeds/
Breeds of Livestock Home page

http://brutus.bright.net/~sidangus
Sidey Angus Ranch Home page

http://pio.okstate.edu/
Oklahoma State University Home page

http://www.ansi.okstate.edu/
OSU Animal Science Home page

http://www.farmjournal.com/beeftoday/
Beef Today magazine sponsored from the Farm Journal

http://hoss.agsci.colostate.edu/~aga/
American Gelbvieh Association Home page

http://www.ansi.okstate.edu/meats/front.htm
OSU Meats Home page

http://www.ansi.okstate.edu/internet/agexten.html
Other Extension pages from other states

http://www.angus.org/
American Angus Association Home page

http://thunder.met.fsu.edu/new/public_html/wxhwy.html
Weather Information Superhighway

http://www.cowtown.org/
CowTown America Home page sponsored by the NCBA

http://pathfinder.com/si
Sports Illustrated Online

http://www.ansi.okstate.edu/library/
Livestock Virtual Library

http://images.jsc.nasa.gov/html/as13.htm
Apollo 13 pictures

http://www.ansi.okstate.edu/breeds/research/
Quantitive and Comparative Research in Various Breeds

http://www.usda.gov/
USDA Home page

http://www.gennis.com/aglinks.html
AG-LINKS (Numerous links to all kinds of agriculture information)

http://www.interaccess.com/consulting/zines.htm
Agricultural-related Electronic Magazines

http://pathfinder.com/pf
Progressive Farmer Online

http://www1.qfn.com/quicken
Quicken Home page

http://ncanet.org/
National Cattlemen's Beef Association Home page

http://www.agroweb.com/home.htm
Agroweb home page full of many agriculture links

http://www.ansi.okstate.edu/library/ces.html
Cooperative Extension links to all states

http://www.sound.net/~pbcs/cowsales.htm
Purebred Beef Cattle Sales and auctions home page

http://www.public.iastate.edu/~magico/pba.html
Precision Beef Alliance home page

http://www.connecti.com/~mb/beef.html
About Beef--Links to several meat links

http://www.asas.org/
American Society of Animal Science Home Page

http://www.tbp.com/
Texas Beef Producers Home page

http://.www.ubi.com/beef.html
United Breeders Inc. Home page

http://www.agpr.com/consulting/agpubs.html
Online Agricultural Journals and Magazines

http://www.fb.com/
Farm Bureau Home page

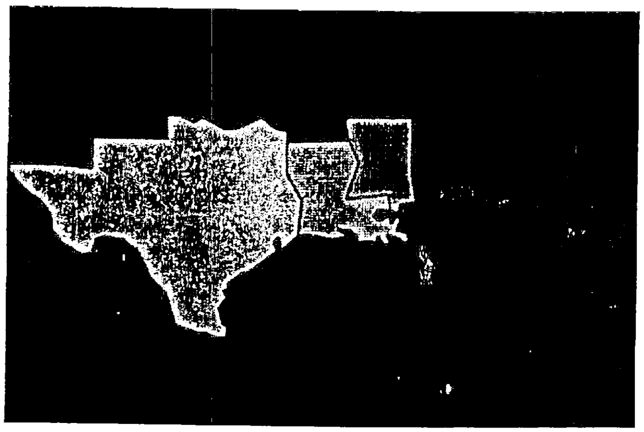
http://nalusda.gov/other_internet_sites/accessw3.html
U.S. Department of Agriculture Home page with many links

http://agricomm.com/agemploy.html
Agricomm's Employment Page

Bill Mies
Texas A & M University

THE GULF COAST MIRACLE

THE GULF COAST MIRACLE IS THAT WE CAN RAISE PRODUCTIVE BEEF CATTLE IN THESE AREAS GIVEN THE EVNIRONMENTAL CHALLENGES THAT EXIST.



THE HYBRID VIGOR THAT IS ACHEIVED BY CROSSBREEDING WITH BOS INDICUS CAME AS A BONUS WITH USE OF THESE GENETICS.

INVENTORY

9,872,000 BEEF COWS

27.9 % OF ALL BEEF COWS IN THE US

THE USE OF BOS INDICUS GENETICS HAS MADE THIS ENVIRONMENTAL ADAPTATION POSSIBLE.

THE INCREASED VARIABILITY IN TENDERNESS OF THE FINAL PRODUCT AND SOME CUTABILITY ISSUES ARE THE LIABILITIES WE ALSO INHERITED.

THE BODY OF KNOWLEDGE ABOUT THE USE OF BOS INDICUS GENETICS ON THE TOTAL BEEF SYSTEM IS GROWING RAPIDLY.

PERFORMANCE OF BRAHMAN CATTLE IN RANCH TO RAIL TESTS

1991-1995

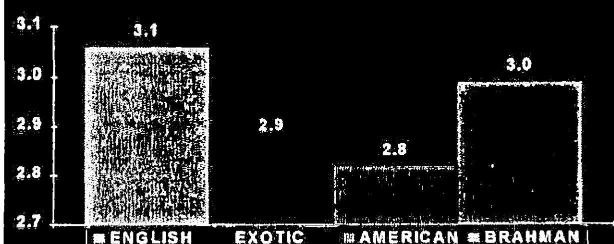
RANCH TO RAIL ANALYSIS

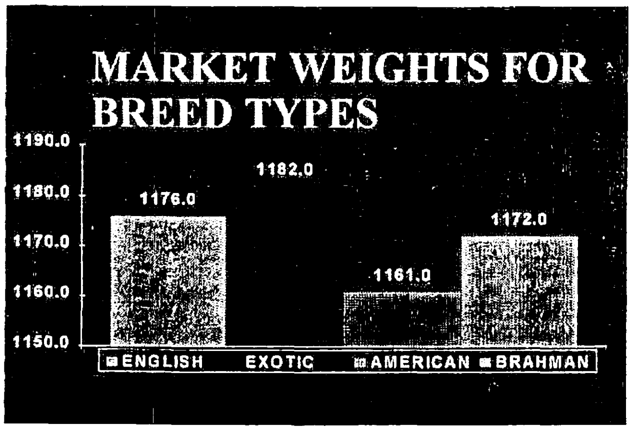
- Cattle were grouped by sire breed.
- Cattle were marketed at a target fat thickness of .4 inches.
- Cattle were sold on a Grade and Yield basis.

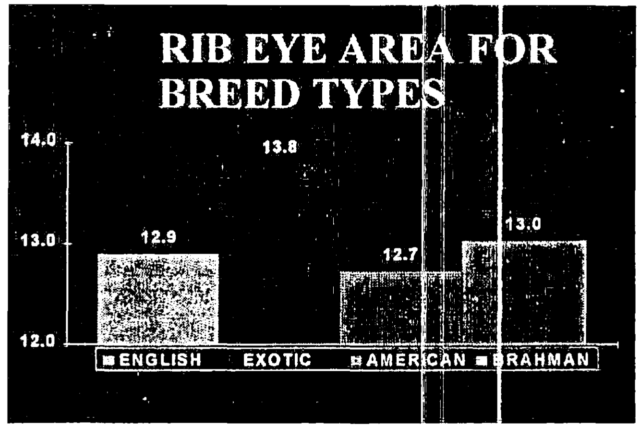
DISTRIBUTION OF CALVES

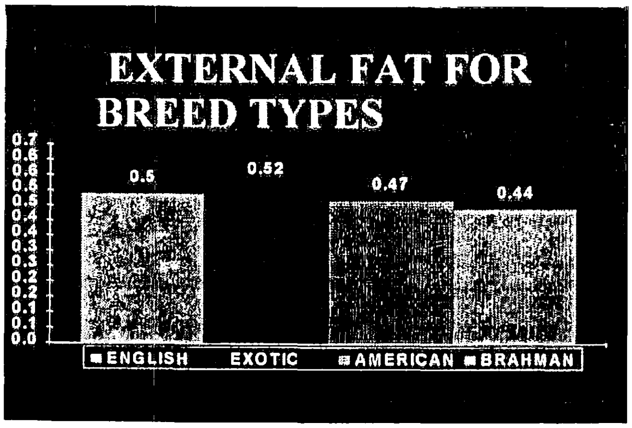
ENGLISH	1695 Head
CONTINENTAL	3013 Head
AMERICAN	2180 Head
BRAHMAN	299 Head

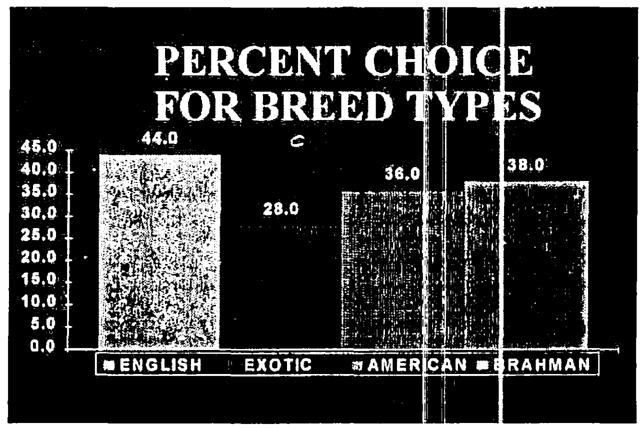
A.D.G FOR BREED TYPES

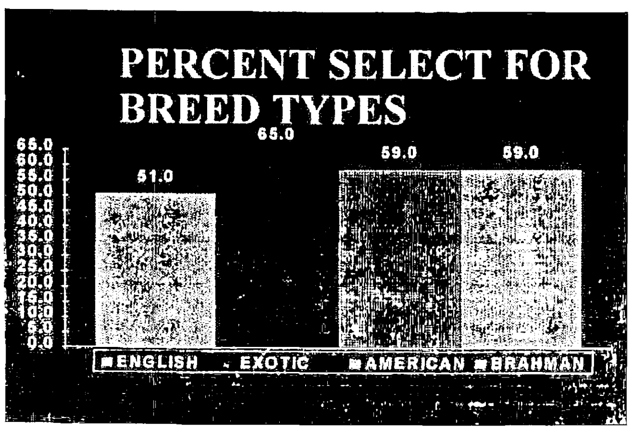



MARKET WEIGHTS FOR BREED TYPES
1190.0
1180.0
1170.0
1160.0
1150.0
1176.0
1182.0
1161.0
1172.0
ENGLISH EXOTIC AMERICAN BRAHMAN


RIB EYE AREA FOR BREED TYPES
14.0
13.0
12.0
12.9
13.8
12.7
13.0
ENGLISH EXOTIC AMERICAN BRAHMAN


EXTERNAL FAT FOR BREED TYPES
0.5
0.52
0.47
0.44
ENGLISH EXOTIC AMERICAN BRAHMAN


PERCENT CHOICE FOR BREED TYPES
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
44.0
28.0
36.0
38.0
ENGLISH EXOTIC AMERICAN BRAHMAN


PERCENT SELECT FOR BREED TYPES
51.0
65.0
59.0
59.0
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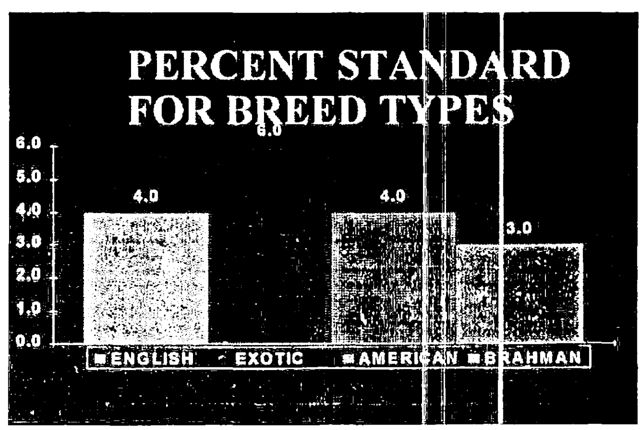
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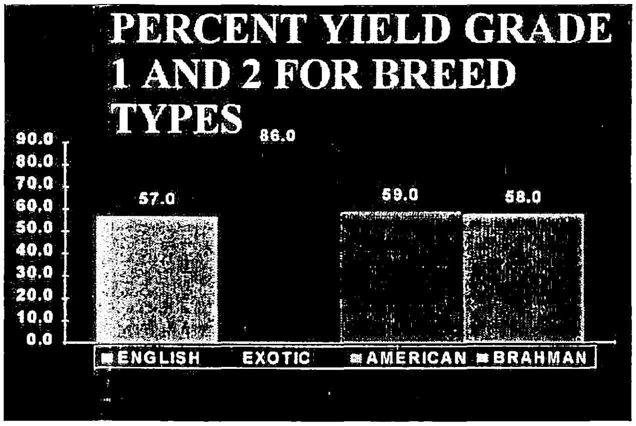

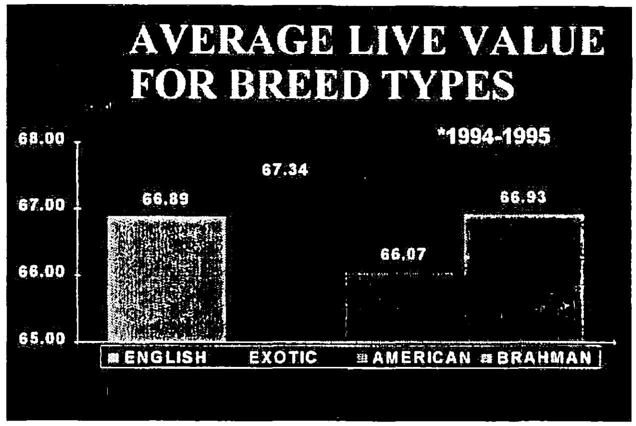

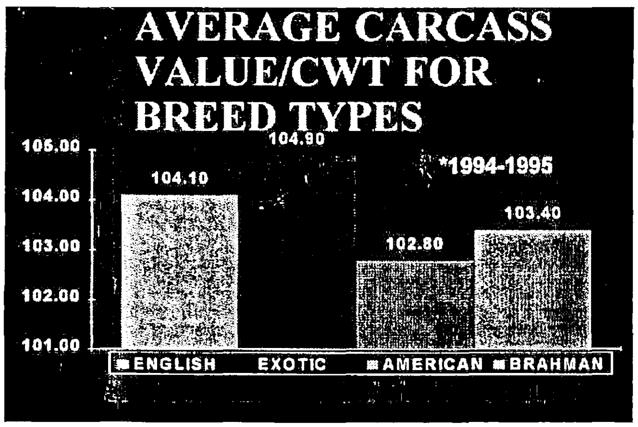

THE USE OF BOS INDICUS GENETICS IS BOTH NECESSARY AND DESIRABLE FOR EFFICIENT BEEF PRODUCTION IN MORE THAN ONE-FOURTH OF THE BEEF COWS IN THE U.S.

A New Top Hand: Your Computer

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In today's information age, we are constantly being bombarded with mountains of material about this new project or that new idea. We have access to the Internet, the information highway, which gives additional information for us to disseminate. We have at our fingertips more information than we know what to do with. This information will continue to increase as programs develop and avenues of bringing you this information continue to improve. Now, the opportunity or the challenge is to make this information work for us.

So what are you to do? Do you let this huge amount of information overwhelm you, or devise a plan to use this information to better your life? This betterment of life could come in the form of increased time for the family because one of your work activities was completed more quickly than in the past. This quality of life improvement could come in the form of increased financial wealth because you were able analyze a particular investment more carefully than in the past. There are a number of ways that a more efficient dissemination of information can help you to reach the goals you have set for you and your operation.

While the information generated from outside an organization or operation may be the largest, most time consuming, and most intimidating source, it is the internally generated information that is the most important. For it is the records or collection of data generated internally, which give you the information needed to make your managerial decisions. Don't ever forget that *the main function of a record or collection of data is to store information for use in making decisions.*

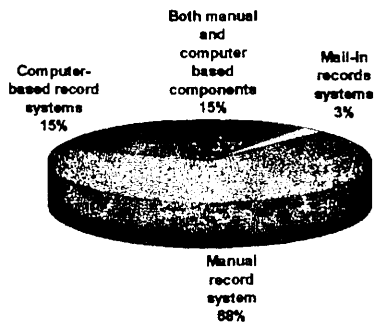
Why do you want to gather data or information at all? There are three basic purposes for having a management information system. (1) Internal reporting for yourself the manager/owner for your use in planning and controlling the routine operations, such as day-to-day expenditure. (2) Internal reporting for yourself the manager/owner for your use in making non-routine decisions, such as capital expenditures. (3) External reporting to the government, investors, and other outside parties. If you don't collect data with these purposes in mind, you are just wasting your valuable time.

Since we all know that the law requires us to gather data for external purposes (IRS), the thought of not gathering any information at all is not a good idea. So how do you decide what information to gather for your operation and how much to gather? In making this decision, you should first establish your goals for this information. If our only goal is to satisfy IRS, I would suggest that you gather your receipts in a shoebox and take them to a CPA and let them calculate your taxes!

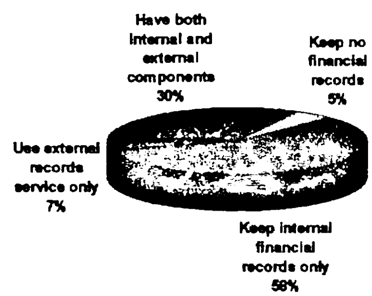
Since most operations have loftier goals than that, I would suggest that you sit down and decide what information is important to you and establish your goals from those decisions, because the general objectives for your data collection should be to provide accurate and timely information as economically as possible whenever and wherever it is needed, to develop & maintain a program that is efficient, and that provides for a appropriate amount of security. These objectives for the program must be set up as standards or bench marks against which the operations performance can be measured.

Once you have decided what information to gather and how much of it to gather, you then will have to decide how you are going to gather this information. In August of 1993, a nationwide study across thirteen states(Batte) summarized the use of information practices with various recordkeeping tools.

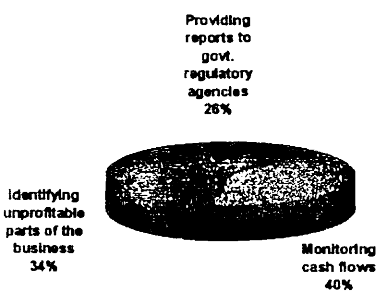
Media Used for Internal Farm Financial Records Systems



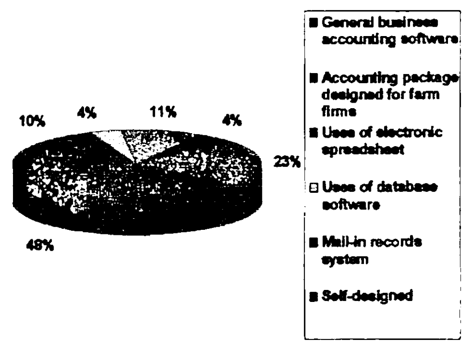
Percentage of Farmers With Financial Records



Tasks for which Farmers used Financial Records Systems



Type of Computer-Based Financial Records Used



This study indicated how the record system was used, what type of record system was used, and who the primary user was. You will note in the tables that in this study only 14.8% of the respondents had computer-based record systems. I would suggest in the two years since that survey, many producers have converted their information system from a manual record to a computer-based one. Across the country, programs given by our state extension services and others have educated the producers to the benefits of computer-based systems.

So what if you are one of the many who haven't made that jump to the computer age, or if you have made the jump and feel like you are now in quick sand. First, for those of you that haven't made the move to a computer based system. You must first decide if you really need to change from your manual system, because there are many producers who have terrific manual systems. Those producers are providing themselves with all the information they feel they need. So if you are happy with your manual system and it's providing you with the information you need to make management decisions, I would stay with it. But if you feel that you aren't getting all the information you need, or if you feel it is taking too long to generate the reports you want, or if you just want to show the kids you can use this tool too, then it is time for you to use the computer. For those of you that are floundering on the computer, or wish you had never given up on your manual system, let me encourage you not to give up, get some help from your extension service, your neighbor, or maybe an outside consultant.

The computer, by the sheer mention of it's name can cause many people to have an anxiety attack. Those of you that have those kinds of feelings should remember that *the computer is only a tool.* Just like a tractor makes you more efficient in soil preparation, a computer makes you more efficient in data preparation. This data preparation should help you to answer these three types of questions: (1)Scorecard questions-How well am I doing? (2) Attention-directing questions-Which problems should I be looking at? (3) Problem-solving questions-Of the several options available, which alternative is the best?

The *scorekeeping question* basically involves the accumulation of data for use by both the internal and external purposes. This includes the "input" or "entry" function of the computer as well as the storage function of the computer. The *attention-directing question* involves the reporting and interpreting of the information that helps the operator to direct his or her attention to the problems, inefficiencies, and opportunities in their operation. This question involves an analysis of the operation to determine areas that need attention. The *problem solving question* involves planning and forecasting, or working to solve long-term trends or problems. All of these questions involve the accumulation and interpretation of the information.

Most of the operations in the United States have basic information needs in the areas of finance and production.

Note the chart below to see how the basic questions of an operation fit into the basic needs of an operation.

		Finance	Production
Scorekeeping	-	Quicken	Ranchmaster, Cow-Calf
Attention Directing -	-	SPAFCC	SPA-PCC SPAEZ
Problem Solving	-	Quicken Bud Pro IFFS	?

There are many types of software that have the ability to meet the needs in the area of financial scorekeeping for the producer. One of the most popular ones is called Quicken, available in version5 for Windows and version8 for DOS. Priced under $50, it is affordable and meets the needs of most producers. There are other software available in the market, but Quicken has proven to be a popular choice. Being supported in both Oklahoma, Texas, and other states by the extension services, it has been proven reliable and useful for financial data collection. Quicken can also provide you with the basic financial information in the form of a balance sheet, financial statement, statement of owner equity, and a statement of cash flows. Whatever type of financial software you choose for your operation, make sure it meets your needs and the goals you have set for your operation. Your software package should at the very least be able to provide you with a balance sheet, income statement, and statement of cash flows. My choice of software packages would also provide me with the ability to account for each of my enterprises within the operation.

On the production scorekeeping side of the software, there are a variety of software packages available. There is cattle production software that has been around for several years, and packages that are hot off the press. Some packages are very expensive, $1200 to $1500, and those that are reasonably priced at $300 to $500. There is software that was developed at Universities, Breed associations, and private companies. So how do you decide which one to use? Again, I want to encourage you to make a decision about what your goals are and what information you want. Set down at your kitchen table and write your goals out on a sheet of paper. When you do that, you might find out that what you want in the way of information might be easily attained from a basic spreadsheet that is already on your computer or you might find out that you need a more in-depth program than you previously thought. When you have established your goals and chosen a software package that meets those goals, I would suggest that you check out the company to make sure there will be a commitment in the future to the continued development of the software. Technology is progressing so rapidly that a software without proper and frequent upgrading will soon be outdated. Also, I would suggest that you look at software using the Windows operating system. Most new computers are using this system, so by purchasing another system you could already be behind before you get started.

To find out which areas of the operation need attention, you will need a software that interprets and reports the data. You need this software to provide you with the information necessary to find out what is right and what is wrong about your operation. It needs to direct your attention to your weaknesses. To analyze this financial and production data, there are again a number of choices. In my opinion, one of the most complete is the Standardized Performance Analysis. Adopted by the National Cattleman's Association in 1992, this system was developed through efforts of NCA producers, the National Integrated Resource Management Coordinating Committee and Extension specialists. The SPA developers also endorsed the use of the Farm Financial Standards in preparation of the total farm or ranch financial statements. By linking the data you have gathered through your financial software (Quicken), you are able to analyze and interpret the information so that you can address the areas that need attention.

In the process of finding the area of greatest attention, we must then use the tools available to solve the problems of the operation. At this point, there are a limited number of integrated problem solving programs available for either the financial or the production sides. What is available are programs that address isolated parts of the financial and production system. There are budget programs, a few integrated financial programs, cash flow programs, but that is about it. Production problem solving programs are on the horizon as more of a demand for this kind of information increases.

There are many other software programs that have been adapted for agriculture use. From spreadsheets, to computer aided design, to data bases, individuals have used the computer for enjoyment as well as to make their operation more efficient and profitable. As software becomes more readily available every day, more and more producers will be using this tool of the future. If you are to compete in a global system, shouldn't you use all of the tools that you have at your disposal. In the future, the computer will be as common place as the tractor on the farm. So put it to work for you like you would any other investment.

References:

Batte, Marvin. Manuscript in progress reporting the NC-191 survey results, Department of Agricultural Economics, Ohio State University, August 1993.

INTERNATIONAL BEEF CATTLE EVALUATION

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There has been a great amount of interest by breeders and breed associations in several countries about the possibility of genetically evaluating seedstock on an international basis. The countries that have expressed the most interest in the possibility of international genetic evaluation are located in South America and North America, the southern portion of Africa and also include Australia and New Zealand. The production of genetic values (EPDs) on a multi-country basis provides increased marketing opportunities for U. S. and Canadian breeders and also has the potential of increasing the accuracy of evaluation because of increases in pedigree information and records. However, there are also some challenges that must be met before international genetic evaluation becomes a widespread reality. The first challenge involves forming a spirit of cooperation between competitive breed associations in different countries. Some of the important decisions that must be made cooperatively by the associations are the establishment of procedures to identify common animals across associations and countries, where to set the base, how to report the results using a common format and how to share information to provide adequate service to breeders. The second challenge deals with questions concerning analysis procedures. Some of these questions involve decisions on the type of models to use, accounting for different genetic parameters across countries, should they exist, and the importance of genotype by country interactions. The purpose of this paper is to briefly address some of the issues that will arise as breed associations begin to move towards international genetic evaluation programs.

International Evaluation: Cooperation is the Key

The former American Polled Hereford Association (APHA) , the American Hereford Association (AHA) , the Canadian Hereford Association (CHA) and the University of Georgia worked together to produce the first North American Hereford Evaluation (NHE) in 1995. There were some key issues that had to be resolved before the evaluation became a reality. One of these was the identification of animals that were in more than one association. There is no universal identification or tattoo system used in the beef industry in Canada and the U.S. Often the same animal that was registered in two associations or countries would have different tattoos recorded because one association might only use a portion of the complete tattoo. There was some attempt through the years by each association to keep track of animals that were registered in another association. Nevertheless, many animals that were dual registered were not immediately identifiable without constructing a system of checks involving combinations of birth dates, tattoos, names, parentage, and herd identification. Some animals that were in more than one association were not identified through the computer checks, but were identified by breed association personnel and breeders after the EPDs were published. It is also likely that a small percentage of the common animals have not yet been identified. Breed associations must be prepared to work together to assist in the identification of common animals.

Another potentially contentious issue that may arise when discussing joint evaluations across Canada and the U.S. is where to set the base. Canadian breed associations tend to prefer a rolling base that sets the base to the average EPDs of animals born in the last three to five years. Most American breed associations prefer to set a base at a year prior to 1977. Most breeds in Canada and the U.S. have positive genetic trend for weaning weight, yearling weight and milk. Selecting a base year in the early seventies will provide more EPDs that are greater than zero for these traits, while using the most recent three to five year average as the base will decrease the magnitude of the EPDs for the growth traits and milk. However, there is also a positive trend for birth weight; therefore, using a base year in the seventies will yield higher birth wt EPDs than picking a recent three to five year rolling average. Table 1. presents the average birth wt, weaning wt and milk EPDs of North American Herefords born in 1992 adjusted to three different bases. As illustrated in the table, as a more recent base in time is chosen, the lower the average EPD for animals born in 1992. The concern of most American breed associations is that when the genetic trend is positive for a trait, a greater proportion of animals with negative EPDs will result when a more recent base year is selected. This presents a problem when marketing cattle for weaning, and yearling wt and milk, because low and negative EPDs are more difficult to sell. Canadian breed associations have a concern that using a base fixed to a year in the early 70's will lead to some animals having large EPDs for traits such as weaning and yearling wt, and that an EPD close to zero does not reflect the average of the current crop of seedstock available for the breed. As pointed out by Pollak (1990) the choice of base is arbitrary in that it does not influence the difference between the EPDs of two animals. However, since it does affect the magnitude of EPDs, the choice of base will continue to be a volatile issue as breed associations discuss the possibility of joint analyses.

Another important consideration that must be discussed by associations contemplating combined analyses is how and to what extent to share their data banks in order to provide service to their breeders. The breed associations have invested significant time and money in their performance programs and in the collection of performance data. There is a natural reluctance to share this data with associations that have formerly been perceived as competitors. However, in order for each association to answer questions from their own breeders, it will be necessary for the associations to have access to the entire across association/country data bank used in the prediction of the EPDs. For example, questions about why an animal's EPD changed from one analysis to the next and why an animal lost records in the editing process can only be answered using the complete across association/country data set.

Other concerns that will have to be discussed are which traits to analyze, what type of common format will be used to present the results to the breeders and when and how often should analyses be conducted. Associations in different countries will need to be prepared to compromise on these and other issues if they desire international beef cattle evaluations.

International Evaluation: Some Analysis Concerns

Several research questions have to be answered before data from the same breed in two or more countries can be combined. First the data between the two countries must be connected so that the EPDs that are predicted represent a "true" across country analyses. Data connectedness arises from common germ plasm (mainly bulls) used across the countries and from sons and grandsons of common bulls that form pedigree ties across countries. For example, in the Uruguayan Hereford data base that UGA uses to conduct Uruguayan Hereford genetic evaluation, 88,758 weaning weight records are available after edits. 13,069 and 13,518 of these progeny or grandprogeny records are from 303 sires and 187 maternal grandsires, respectively, that also have 168,020 and 171,018 progeny and grandprogeny records, respectively, in Canada and the U.S. It would appear from this information that the Hereford population in Uruguay is connected to the population in Canada and the U.S.

Another concern that breeders and scientists both have when exploring the possibility of across country genetic evaluations are the existence of genotype by country interactions that would cause animals to rank differently in each country. Herring (1995) and Herring (personal communication) estimated the magnitude of sire and maternal grandsire (mgs) by country interaction for weaning weight for Hereford cattle across Canada and the U.S. The data used in this analysis was from the field data supplied by AHA, APHA and CHA. Genetic values for weaning weight were predicted for the entire combined data set using an animal model that contained contemporary group, direct and maternal genetic and dam permanent environmental effects. Homogeneous genetic and environmental parameters across associations were used in the analysis procedures. Separate data sets were formed to estimated sire and mgs by environment interactions. The sire data sets were adjusted for dam effects by subtracting the dam's direct weaning wt EPD, maternal breeding value and permanent environment effect from the each progeny record. The mgs data sets were similarly adjusted by subtracting the sire's and maternal granddam's genetic contribution and the dam's permanent environment effect from the grandprogeny records. Models that were applied consisted of country, region/country and contemporary group/region fixed effects and the random effects of sire or mgs, sire or mgs by country, sire or mgs by region/country and sire or mgs by contemporary group/region. Seven data sets have been analyzed via DFREML using the sire or mgs model. The magnitude of the sire by country and mgs by country interaction variances were 9.3 lb^2 and 0.6 lb^2, respectively. These variances were 0.3 and 0.0% , respectively, of the phenotypic variance. These results for weaning wt indicate that sires and mgs should rank the same for EPDs across the Canada and the U.S. Meyer (1995) also concluded that genotype by country interactions were not present in Angus cattle in Australia and New Zealand.

Table 2 presents actual and expected correlations between the EPDs of selected Hereford bulls that have weaning weight progeny or grandprogeny records in Uruguay and in the NHE data set. An expected correlation was computed using methods (equation [7]) presented by Notter and Diaz (1993). Because the bulls did not have infinite numbers of progeny in the two countries, the genetic variances used in the prediction of the EPDs differed and the bulls represented a selected sample of bulls available from the NHE analysis, one would not expect the actual correlations to be equal to one. The bulls that were used to compute the correlations were those that had an accuracy value $\geq .90$ for their weaning weight EPD in the NHE analysis. The actual correlation of .59 for the correlation of weaning weight EPDs between the same bulls in Uruguay and NHE was similar to the expected correlation of .63. However, the actual correlation of .37 for milk EPD of the same bulls across the two "countries" appeared to differ ($p < .05$) from the expected correlation of .46. The differences between the actual and expected correlations for the milk EPD could be an indication that genotype by country interactions exist for this trait. If genotype by environment interactions cause the true genetic correlation for the same trait between countries to be less than one, then multiple trait models or models that include genotype by environment effects may need to be used. As previously discussed by Goddard (1994), if no interactions exist and the data is pooled into one single trait analysis, the EPD of a bull will be determined by the country in which it has the most progeny data. However, if a multiple trait model is used that predicts a separate sire EPD for each country, the progeny information that a sire has within a country will mainly determine the EPD predicted within that country. Research will need to continue to determine the contribution of genotype by country interactions to EPD rank changes across countries in order to construct the proper analysis procedures.

Table 3 presents the genetic and environmental parameters for weaning weight estimated from the AHA, APHA, CHA and the Uruguayan Hereford populations. The direct heritabilities and the genetic correlations between the direct and maternal genetic effects appear to be similar across the countries. There were some differences in the maternal genetic heritabilities and the phenotypic variances across the countries. In general, if the heritabilities are equal, but the phenotypic variances are different between countries, then sires with progeny records in the country with the largest phenotypic variance will be over evaluated relative to sires with progeny in the country with the smaller phenotypic variances. Also if the phenotypic variances are similar across countries, but the heritabilities are different, then using a pooled estimate of the heritabilities will cause sires with progeny in countries where the heritability is in reality smaller to be over evaluated and the opposite would occur in the country where the heritability is actually higher. The phenotypic variance estimates across the four populations are less variable than the phenotypic variances found across sexes in Simmental field data by Garrick et al. (1989); however, they were more variable than the phenotypic variances found in populations of Angus cattle from Australia and New Zealand reported by Meyer (1995). Meyer (1995) concluded that Australia and New Zealand Angus populations could be combined and analyzed using a single set of genetic parameters. One set of genetic parameters were used in the prediction of EPDs produced in the combined NHE evaluation. These parameters were computed by averaging the parameters across AHA, APHA and CHA reported in table 3. Research should continue to assess the effect of using homogenous variances when conducting across country analyses for beef cattle.

Other analysis questions concerning genetic grouping, the handling of similar traits that are defined differently across countries and the effects and inclusion of different age-of-calf and age-of-dam adjustments across countries have not been address in this paper but will require attention as international evaluation programs develop.

Summary

Breed associations will continue to move towards international genetic evaluation provided they perceive that there is an advantage for their breeders and associations to do so. Thus far, the research indicates that genotype by country interactions do not affect the ranking of sires across Canada and the U.S. for growth and milk, and the heritabilities, genetic correlations and phenotypic variances are similar enough between the two countries to use a common set of

		Trait = Weaning Weight	
NHE	26.1	18.7	1.4
AHA	26.7	19.3	2.0
APHA	26.1	18.7	1.4
CHA	24.7	17.3	0.1
		Trait = Milk	
NHE	5.8	3.5	0.8
AHA	8.0	5.7	3.0
APHA	3.6	1.3	-1.4
CHA	3.5	1.2	-1.5

[a] AHA = American Hereford Assoc., APHA = American Polled Hereford Assoc., CHA = Canadian Hereford Assoc., NHE = North American Hereford Evaluation.

Table2. Correlations Between Weaning wt and Milk EPDs for Sires With Progeny in Uruguay and North America[a]

	Correlation	
Trait	Actual	Expected[b]
WWT	.59	.63
Milk	.37	.46

[a] 123 Sires that were in the sample had weaning wt accuracies >.90. These bulls also had maternal grandprogeny.

[b] Expected correlation computed according to methods proposed by Notter and Diaz (1993).

Table 3. Weaning Weight Genetic Parameter and Phenotypic Variance (lb^2) Estimates for Four Hereford Populations

Parameter	AHA[a]	APHA	CHA	U
h_A^2	.24	.23	.21	.23

genetic parameters in a combined analysis. However, genotype by country interactions and heterogenous parameters may be more important as attempts are made to analyze combined data sets from countries in different hemispheres.

Literature Cited

Garrick, D. J., E. J. Pollak, R. L. Quaas and L. D. Van Vleck. 1989. Variance heterogeneity in direct and maternal weight traits by sex and percent purebred for Simmental-sired calves. J. Anim. Sci. 67:2515.

Goddard, M.E. and K. T. Beard. 1994. The use of international genetic material in an importing country. Genetics and Breeding of Dairy and Beef Cattle, Swine and Horses. Proceedings of the 5th World Genetic Congress Applied to Livestock Production, 17:23.

Herring, W. O. 1995. Genotype by environment interactions and conversion procedures for three North American Hereford populations. Ph.D. Dissertation, University of Georgia.

Meyer, K. 1995. Estimates of genetic parameters and breeding values for New Zealand and Australia Angus cattle. Aust. J. Agric. Res. 46:1219.

Notter, D. R. And C. Diaz. 1993. Use of covariances between predicted breeding values to assess the genetic correlation between expressions of a trait in 2 environments. Genet. Sel. Evol. 25:353.

Pollak, E. J. 1990. A common base. In Proceedings Beef Improvement Federation Annual Meeting. Hamilton, Ontario, Canada, p. 89.

Table 1. North American Hereford EPD Averages For 1992 Born Animals Adjusted to Three Different bases.

	Trait = Birth Weight		
Source[a]	1976 Base	1982 Base	1990-1992 Base
NHE	3.3	2.5	0.2
AHA	3.2	2.4	0.1
APHA	3.4	2.7	0.3
CHA	3.5	2.8	0.4

h^2_M	.23	.30	.37	.27
r_{AM}	-.28	-.27	-.23	-.25
σ^2_P	2418.9	2555.5	2774.5	3024.2

[a] AHA = American Hereford Assoc., APHA = American Polled Hereford Assoc., CHA = Canadian Hereford Assoc., U = Uruguayan Hereford Assoc.

THE ANGLETON PROJECT: 1996 UPDATE

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Introduction

In the fall of 1989, responsibility for the Texas Agricultural Experiment Station's Angleton Research Station was transferred to the Department of Animal Science. In November 1989, a meeting involving University administration, animal geneticists from the Colleges of Agriculture and Life Sciences and Veterinary Medicine at Texas A&M University and the University of Wisconsin and representatives from the National Cattlemen's Association and the Drovers Journal was held to define the priority research needs of the beef cattle industry that could be addressed using the resources of the Angleton Station. From this meeting was born the Texas A&M University's Angleton project which visualized the integration of quantitative genetics and the emerging field of molecular genetics to address issues of beef quality. This direction was precipitated by the identification by the Value Based Marketing Task Force of the lack of identified genetics for carcass quality as being a constraint to the implementation of value based marketing. This in turn resulted in the NCA releasing an RFP for research proposals targeted at providing the industry the means to identify the genetic bases for differences in carcass quality in cattle. By Spring 1990, a proposal was submitted to the NCA by the Department of Animal Science at Texas A&M University to utilize what was know at the time as 'reverse genetics' and is now known as 'map based cloning' or 'positional cloning' to identify quantitative trait loci (QTLs) responsible for carcass merit differences. Following a peer review by the NAS this project was identified for funding by the BIC of the NLSMB and the 'Angleton Project' was born.

The Texas A&M University "Angleton" Project

In the Spring of 1990, the Texas Agricultural Experiment Station dedicated the cattle and technical resources of the Angleton Research Station to the development of a resource herd which could be used to identify genes responsible for variation in growth and carcass quality traits. An experiment was designed in which F_1 Angus x Brahman animals would be mated to both pure Angus and Brahman cattle using multiple ovulation and embryo transfer to produce large fullsib families of three quarter Angus and one quarter Brahman, or three quarter Brahman and one quarter Angus breeding. The design called for a total of 32 families with an average of 20 progeny per family for a total of 640 animals produced by embryo transfer. All of the cattle produced in this experiment were to be slaughtered to produce carcass data at approximately 20 months of age and following 150 to 170 days on feed. The Angus and Brahman breeds were selected because of their importance to U.S. beef cattle production, because they are members of two distinct subspecies (*Bos taurus* and *Bos indicus*) and because of their differences for marbling and tenderness. The genetic basis of both of these traits has been well established and the breed differences in tenderness and marbling are thought to be due to the presence of different versions (alleles) of certain genes (QTLs), in each of the breed types. The position of these genes within the genome -- to a region on a specific chromosome -- can be identified by scoring a map of DNA markers in the resource herd and sequentially testing each of the markers for an association with marbling or tenderness. A DNA marker is a small, but unique, sequence of DNA for which the location on a specific chromosome can be determined and that is variable among individuals within the resource herd. DNA markers simply provide a method that allows the determination of the breed of origin of the DNA on the chromosomes inherited from the sire and dam at the point on the chromosome where the marker is located. Markers can be assigned to chromosomes and by determining the order of the markers and the distance between the markers on each of the chromosomes we can produce what is known as a genetic map. Considering each marker individually, we compare the marbling score of all animals that inherited two pieces of Angus DNA at the marker with the marbling score of all animals that inherited two pieces of Brahman DNA at the marker to determine if there is a gene influencing marbling close to this marker. If the mean marbling scores of the two groups differs we conclude that there is a gene influencing marbling close to the marker. At this point, it may be possible to use the marker to identify superior cattle for marbling, or it may be necessary to actually identify the QTL responsible for the differences in marbling before selection using DNA markers is possible. The process of gene discovery is complex, but can most easily be accomplished by using comparative map information and the progress achieved by the human genome initiative. The order and arrangement of many genes on human and bovine chromosomes has been conserved in the evolution of the species and consequently, an examination of the genes mapped on the corresponding human can often lead to the identification of the QTL.

The Angleton project has now produced 609 progeny within the resource families. Sixty eight of these calves were born in Spring 1996 and DNA has been extracted on the remaining 541 progeny and their 82 parents and grandparents (Table 1). A total of 230 markers have been scored in these animals and a completed map of approximately 300 markers is anticipated to be completed by December 1996. The average resolution of the Angleton map is one marker every 8.0 cM. These markers are located on all 29 of the bovine autosomes and on the X and Y sex-determining chromosomes. The markers scored in the Angleton map were derived from markers produced in our laboratory at Texas A&M University (AREVALO *et al.* 1994; BHEBHE *et al.* 1994; HOLDER *et al.* 1994; BURNS *et al.* 1995a,b,c) and from markers derived from the public maps produced by the USDA MARC (BISHOP *et al.* 1994) and from the International Bovine Reference Pedigrees (BARENDSE *et al.* 1994). Data produced under the Angleton project were contributed to an International Workshop to produce a consensus genetic map of chromosome 23 (BTA23) which contains the bovine major histocompatibility complex, a cluster of genes responsible for facets of immune response (BEEVER *et al.* 1996).

Table 1. Structure and breed composition of reciprocal backcross and F_2 fullsib resource families

				No. of Progeny	
Population[a]	Family	Sire	Dam	Male	Female
(AB)A	1	U3065[d]	X18[b]	0	1
	1A	U3065	(Z6[d])	11	5
	5	U3065	X26[d]	4	4
	5A	2214[b]	X26	4	4
	7	819X4[d]	T27[d]	11	12
(BA)A	2	2850[d]	X18	4	0
	2A	2850	Z6	9	5

	6	2855[d]	X26	9	9
	8	58[c]	T27	6	14
B(AB)	10	1/8[d]	32T[b]	8	8
	12	57[d]	X3616[d]	15	2
	14	176[d]	X3713[d]	12	8
	16	740/7[b]	804/R2[c]	5	7
	16A	710\6[b]	804/R2	2	4
A(AB)	9	T5[d]	32T	13	10
	11	Independence[c]	X3616	9	2
	13	888020[d]	X3713	11	7
	15	Y6[d]	804/R2	12	9
A(BA)	17	T5	2853[d]	9	9
	19	Independence	X0223[c]	12	12
	21	888020	2864[d]	8	8
	23	Y6	X0221[c]	5	4
B(BA)	18	1/8	2853	12	9
	20	57	2857[b]	0	4
	20A	57	X0223	5	9
	22	176	2864	6	11
	24	740\7	X0221	1	1
(AB)B	25	U3065	5/6[d]	10	8
	27	946[d]	613/5[d]	0	1
	28	2850	613/5	9	4
	29	819X4	958\9[d]	6	8
	29A	2214	958\9	6	4
	31	819X4	748/7[b]	2	1
	31A	819X4	978/0[d]	7	6
	37	U3065	748/7	0	1
(BA)B	26	2850	5/6	6	11
	28	2850	613/5	9	4
	30	2855	958\9	12	8
	32	58	978\0	3	4
	38	2850	617/5[b]	0	2
(BA)(AB)	34	2850	X3713	5	8
	36	2850	804/R2	9	6
Total	42	16	19	287	254

[a]A = Angus, B = Brahman, AB and BA are Angus and Brahman sired F_1 crossbreds respectively. (AB)A denotes an Angus backcross produced by mating an AB sire to an A dam, etc.

[b]Neither parent genotyped.

[c]One parent genotyped.

[d]Both parents genotyped.

Data from chromosome 1 have also been submitted to a current International Workshop which is chaired by Dr. Taylor. Figure 1 contains the Texas A&M University Department of Animal Science (TEXAN) map for BTA1 which is presented in comparison to the other existing published maps for bovine chromosome 1.

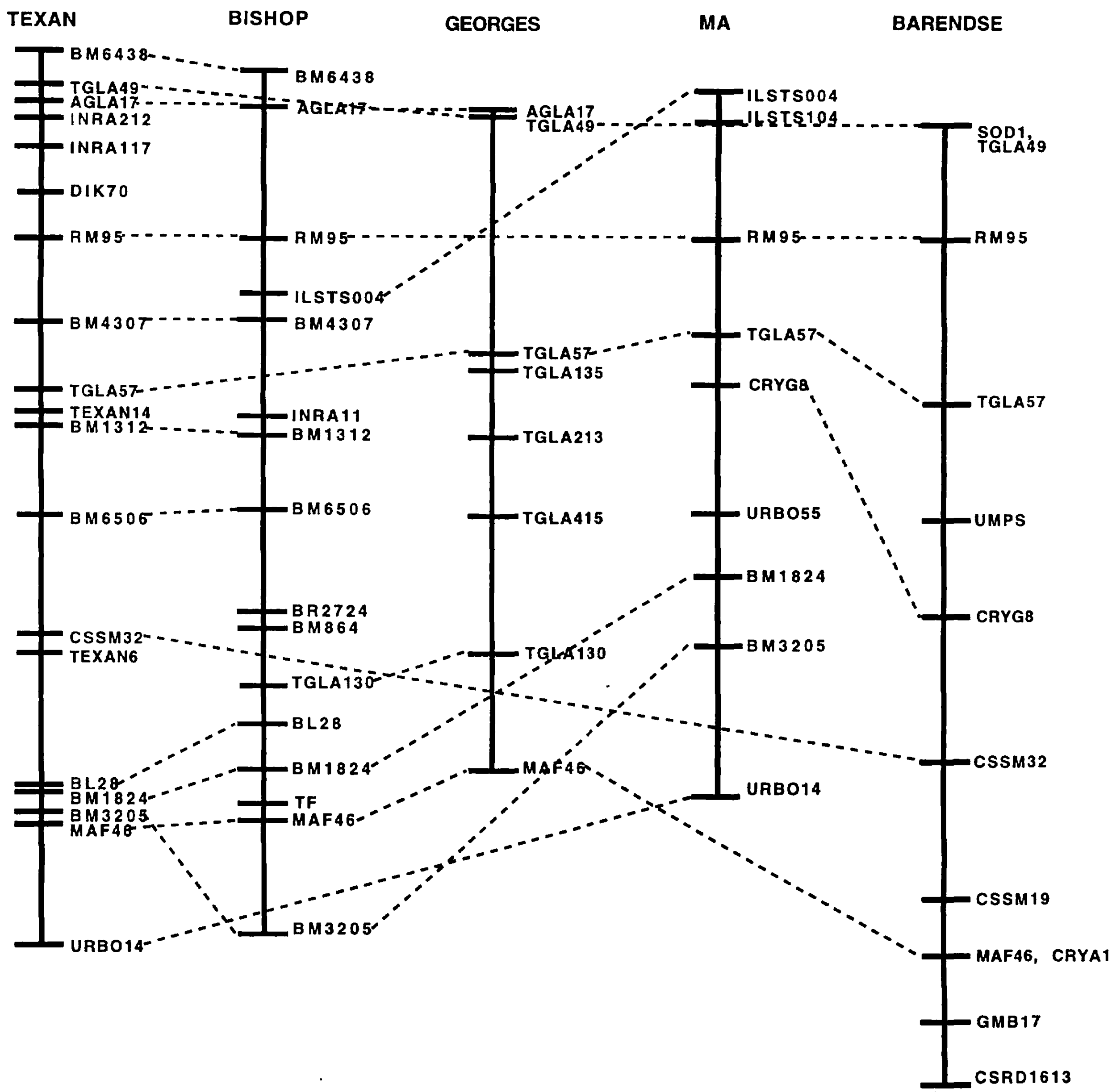


FIGURE 1: A comparison of the sex-averaged genetic maps of bovine chromosome 1.

The TEXAN map of BTA1 spans 161 cM and is oriented with BM6438 proximal to the centromere. Comparison of this map to the other published maps reveals differences both in the estimated order of certain loci and in the estimated map distances between loci. For example, the order of ILSTS004 and RM95 are inverted in the USDA MARC and Illinois Reference/Resource families (MA *et al.* 1996) maps, however, the weight of evidence from considering all 5 maps supports the locus order in the USDA MARC map. There are a number of reasons for differences in estimated locus order between maps which, in increasing order of likelihood, include: the existence of a chromosomal inversion in one of the mapping families; genotyping errors, particularly in grandparents which force a locus to the end of a linkage group to minimize the number of double recombinants; and a limited number of coinformative meioses between loci in one (or more) map and chance sampling effects. Variation in the estimates of recombination fraction among loci between maps results from true genetic differences for recombination among the individuals in the mapping populations; genotyping errors; and a limited number of coinformative meioses and sampling effects. All of these effects provide a strong argument for the need for Workshops to pool available data and construct consensus maps with a high level of statistical support for locus order and with sufficient numbers of coinformative meioses to estimate the map distances among loci with a high level of precision.

Genetic maps should be considered as tools for the purpose of localizing QTLs to chromosomal regions. The maps themselves are of somewhat secondary importance since in the process of developing a genetic map of a chromosome, we also produce an identity by descent (IBD) map for each individual in the mapping population. An IBD map indicates which grandparent contributed the DNA at each marker position on the chromosome for both the maternally and the paternally inherited chromosomes. Since most of the grandparents in the Angleton families are included in the construction of the map, and the breed of each grandparent is known, the IBD map for each progeny indicates whether the progeny inherited Angus or Brahman DNA at each marker on the maternally and paternally inherited chromosomes. These maps, provide the basis for testing for the presence of QTLs influencing carcass merit phenotypes in the Angleton families. Philosophically, this is as simple as testing whether animals that inherited two Angus alleles differ in performance from those that inherited two Brahman alleles at a given marker locus. If there is no significant difference in the performance of these genotypes, we conclude that there is no QTL closely linked to the marker (and on the same chromosome as the marker) influencing the trait. By sequentially analyzing each marker in the order they appear on a chromosome and sequentially testing each chromosome, we are able to identify the approximate chromosomal position of the QTLs that have the greatest effect on a trait. Of course, in practice the analysis is somewhat more complex than this, since we also want to identify the most likely position on the chromosome between two markers that each QTL is located. To do this, we developed a series of computer programs to produce composite interval maps of each chromosome (DARVASI *et al.* 1993; HALEY and KNOTT 1992; JANSEN 1993; JANSEN and STAM 1994; ZHENG 1994) using the algorithm of HALEY and KNOTT (1992). Our approach differs from that of HALEY and KNOTT (1992) in that all phase known information in F_2 families are utilized, we use the Kosambi mapping to align the genetic and interval maps, and our algorithm considers only the coinformative loci within different families.

While the current analysis considers the Angus and Brahman breeds to be inbred lines (since we estimate the difference between 'average' Angus and Brahman homozygotes), the existence of genetic variation within the breeds indicates that this assumption is not correct. However, we consider this analysis to be useful in the sense that any detected QTL must indicate strong frequency differences among QTL alleles between the breeds. Hence QTLs detected in this form of analysis have immediate utility for marker assisted selection in composite breeds. Conversely, if the breeds are not fixed for alternate QTL alleles, there must be QTL alleles with both smaller and larger effects within the breeds that would ultimately allow for within breed selection. However, this form of analysis will not detect QTLs for which the allele frequencies are similar within the breeds. Once all of the Angleton progeny have been slaughtered, we plan to reanalyze our data allowing for variation in the QTL alleles present in each of the parents of the Angleton progeny.

The Angleton progeny are recorded for horn/polled status, coat color, coat speckling, structural, health, weight for age and growth characteristics. Check-off funds support the collection of carcass data including maturity, marbling, quality grade, yield grade, fat thickness, ribeye area, percentage kidney-pelvic-heart fat and carcass weight. Tissue samples are brought to the Meats and Muscle Biology Laboratory at Texas A&M University for the determination of extractable lipids, moisture content, protein content, collagen analysis, 9-10-11th rib dissection, Warner-Bratzler shear force, descriptive sensory analysis (taste panel), fragmentation index, calcium dependent protease analysis, sarcomere length, fatty acid and cholesterol composition of longissimus dorsi, as well as stearyl coA desaturase and fatty acid elongase activity in the longissimus dorsi. All of these traits have been analyzed using the Angleton genetic maps to identify the location of genes that influence each of these traits. However, this part of the study remains in-progress, since we sample DNA on animals at weaning and consequently genetic data are available on an animal long before slaughter data become available. As groups of cattle are slaughtered, the analysis is updated to include the new data and evaluate the statistical support for the genes that have been identified. Currently, a total of 355 animals have been slaughtered and the final progeny group born this Spring will not be slaughtered until the Fall of 1997.

In 1993, we identified an association between a marker developed in our laboratory and the gene responsible for the black/non-black coat colors in cattle. This gene is known as the 'extension' locus and is often referred to as the 'red factor.' At the time we did not know to which chromosome this marker mapped, however, through a collaboration with the USDA MARC we determined that this gene mapped to chromosome 18 and we detected markers which flanked the gene. When we looked at the comparative genetic maps we found that many of the genes found on bovine chromosome 18 are found on mouse chromosome 8. An examination of the map of mouse chromosome 8 revealed to us that the melanocyte stimulating hormone receptor (MSHR) gene was on this chromosome. This was an exciting result because we knew that the MSHR was responsible for black/non-black coat colors in mice. However, at about this ABS Global Inc. announced that they were offering a DNA test for the red/black alleles of the MSHR gene which had been discovered by researchers at the University of Gottingen in Germany. Although we were disappointed in this outcome, the significance of our study was that it clearly demonstrates that our gene mapping approach will result in the identification of genes responsible for phenotypic differences between Angus and Brahman.

Also in 1993, it was reported in the literature that the gene responsible for the horned and polled phenotypes (the *POLL* locus) mapped to bovine chromosome 1 (GEORGES *et al.* 1993). We also had some evidence for this localization of *POLL* at the time, although we had scored the phenotypes of relatively few animals at slaughter. However, we proceeded to develop a map of chromosome 1 and in collaboration with ABS Global Inc., this map now contains 19 markers and includes two markers which flank *POLL* (BRENNEMAN *et al.* 1995; EGGEN *et al.* 1996). The region containing *POLL* contains genes that are found on human chromosome 21 and on mouse chromosome 16, but because horns are not found in either of these species there are no obvious candidate genes for *POLL* in the maps of these human and mouse chromosomes. Thus, we are unlikely to identify this gene through a candidate positional cloning approach, and the ultimate cloning of this locus will probably be require, as a first step, the construction of physical maps of the chromosome region. To this end, EGGEN *et al.* (1996) have screened a bovine YAC library for six STSs in the proximal region of BTA1 and identified 20 YACs containing the target sequences. The six STSs along with end sequences of seven YACs were subsequently used to detect overlapping clones and to construct a contig of the region putatively containing *POLL*. Mapping by FISH of 6 YACs confirmed localization of this contig to the BTA1q12-q14 region. This is quite a small physical region of DNA (perhaps only 3 Mb) and through the use of polymorphic microsatellites derived from this contig, we hope to more precisely define the position of *POLL* and ultimately to clone the locus.

The enzyme calpastatin is known to down-regulate a second enzyme calpain which is involved in the post-mortem degradation of connective tissue. Some data exist to suggest that carcasses with high levels of calpastatin in the longissimus dorsi muscle at 24 hours post-mortem tend to produce tough steaks as measured by Warner-Bratzler shear force (WBSF). The calpastatin enzyme is produced by the Calpastatin gene (*CAST*) which is known to map to the telomere of bovine chromosome 7. A marker that detects variation within the Calpastatin gene has been developed and there has been some evidence that the genetic differences detected by this marker also detect differences in beef tenderness. We scored the genotypes for this marker in a sample of the Angleton progeny. We then integrated this marker into our map of bovine chromosome 7 and tested the whole chromosome to determine whether there are any genes on the chromosome that appear to be involved in the expression of the calpastatin enzyme or with WBSF and taste panel assessments of beef tenderness (Overall Tenderness). Figure 2 shows the interval maps for Calpastatin enzyme activity, Warner-Bratzler Shear Force and Overall Tenderness on chromosome 7. The origin represents the telomere of the chromosome where *CAST* is located.

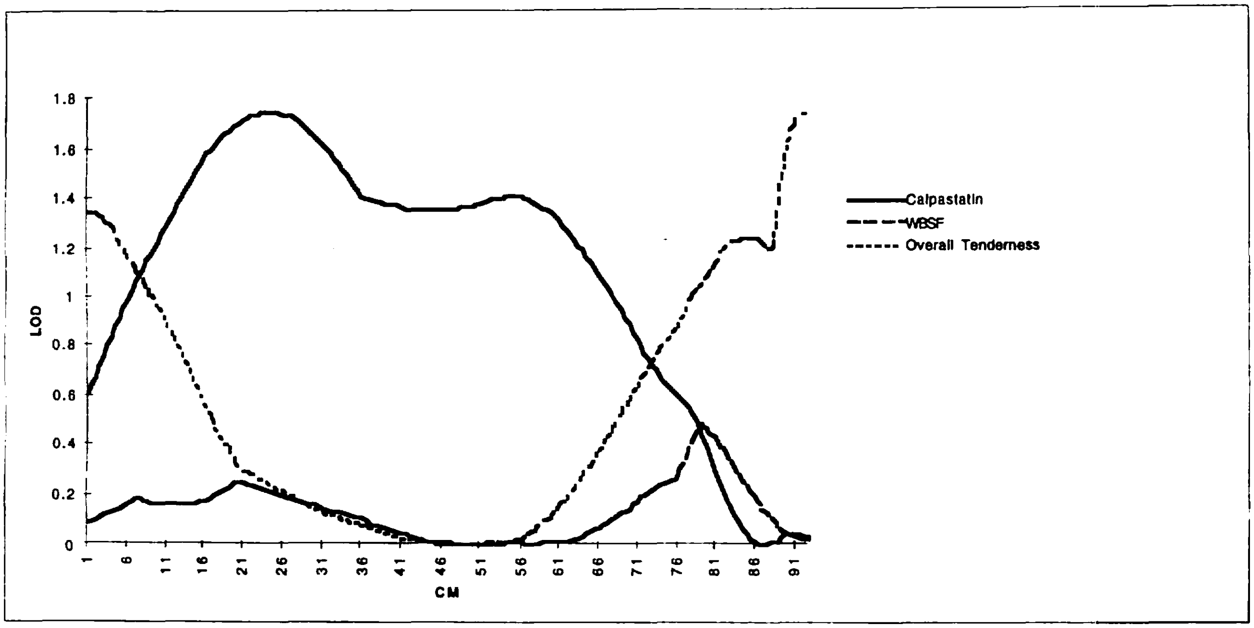


FIGURE 2: Interval maps for Calpastatin enzyme activity, Warner-Bratzler Shear Force and Overall Tenderness on chromosome 7.

Figure 2 reveals only modest evidence for the presence of a QTL on BTA7 influencing calpastatin activity (LOD = 1.75 at 24 cM), however, the estimated position of the QTL is 24 cM from *CAST* which is located at 0 cM. This may be a sampling effect, or may indicate the presence of a second gene on BTA7 involved in the regulation of calpastatin. Perhaps of more importance, there is no evidence whatsoever for a QTL differing between Angus and Brahman that influences WBSF. However, there is weak evidence for the existence of two QTL, one toward the telomere (at the location of CAST; LOD = 1.35) and the second toward the centromere (LOD = 1.74) influencing the taste panel evaluation of tenderness. While the magnitude of the LOD score necessary to conclude the presence of a QTL is a contentious issue, a LOD of 1.75 would not generally be considered sufficient to conclude the presence of a QTL, and we conclude that there are no fixed differences between Angus and Brahman that influence measures of tenderness on chromosome 7 - at least with a magnitude of effect that could be detected in this experiment. This does not preclude the existence of QTL influencing these traits for which there is QTL allele variation among Angus and Brahman cattle, however, examination of this issue must await the completion of collection of carcass data on the remaining Angleton progeny. To perhaps further confuse the issue, we did identify a QTL on chromosome 19 which influenced calpastatin activity (LOD = 3.67) but this QTL had no effect on either WBSF or Overall Tenderness.

While our study of CAST on chromosome 7 was prompted by the current interest in this gene, our approach in the Angleton project has been to screen all of the bovine chromosomes in order to detect important genes wherever they may reside. To date we have detected the presence of genes influencing nearly all of the traits examined in the study. Since we have recorded data on 62 traits and because we have identified more than one gene affecting many of the traits, a detailed list cannot be presented in this article. However, of particular importance, we have identified four genes that appear to influence marbling and another four genes that influence either taste panel or WBSF measures of tenderness. We have also detected genes that appear to influence growth post-partum, but do not influence birth weight. One of these genes which maps to chromosome 2 is located in a region of the chromosome which has only very recently been shown to contain the gene responsible for double muscling in Continental breeds of cattle (CHARLIER *et al.* 1995). While there is no evidence for double muscling in the Brahman or Angus cattle used in the Angleton study, this suggests that there is a major gene on chromosome 2 influencing growth where one (or perhaps more than one) mutation in the gene results in double muscling, but that other mutations in the gene result in significant differences in the growth rate of cattle. While we have been able to dramatically alter the growth weight of cattle through traditional selection approaches, we usually do so at the detriment of birth weight and calving difficulty. The importance of this gene may be that selection for versions of the gene which confer higher rates of growth may not confer higher birth weights. At present we do not know the identities of any of these genes, with perhaps the exception of a gene on chromosome 1 that influences both fatness and liveweight and another gene on chromosome 2 that has an effect on ribeye muscle area and dressing percent. We are using the comparative human and mouse map information to examine the regions of the human and mouse chromosomes that contain the regions containing the genes that we have identified in cattle to identify appropriate candidate genes for each trait. To confirm or deny the identities of these candidate genes, we are in the process of developing markers for each of the genes (CAI *et al.* 1995) so that they can be incorporated into our genetic map. A candidate gene that enters the map at a position where a gene that influences a trait has been detected is very likely to be the responsible gene. Using this approach we have generated evidence to suggest that the myacin light chain 1 (*MYL1*) gene is the gene on chromosome 2 that is responsible for the detected variation in ribeye area and dressing percent. The research to be conducted in the next 12 months on the project will focus heavily on this approach to gene discovery.

Before a test can be developed and offered to industry for any of the genes identified to influence carcass merit in this project the effects of variation in each gene must be validated in independent sets of cattle. In order to accomplish this we have initiated a collaboration with Linkage Genetics (Salt Lake City, UT) who are in the process of collecting DNA samples from large pedigrees in which carcass data have been gathered. Linkage Genetics will then genotype these pedigrees for the markers that we have identified for carcass merit traits in order to validate or refute our results. Where we able to independently support the presence of a gene and can develop a reliable test to detect the variation in the gene that is responsible for differences in carcass merit, we will commercialize a test. The first such test for an economically important trait such as growth or a carcass merit trait could be as near as 2 years or as far as 5 years away.

References

AREVALO, E., D.A. HOLDER, J.N. DERR, E. BHEBHE, R.A. LINN, F. RUVUNA, S.K. DAVIS and J.F. TAYLOR, 1994 Caprine microsatellite dinucleotide repeat polymorphism at the SR-CRSP-1, SR-CRSP-2, SR-CRSP-3, SR-CRSP-4, and SR-CRSP-5 loci. Animal Genetics **25:** 202.

BARENDSE, W., S.M. ARMITAGE, L.M. KOSSAREK, A. SHALOM, B.W. KIRKPATRICK, A.M. RYAN, D. CLAYTON, L. LI, H.L. NEIBERGS, N. ZHANG, W.M. GROSSE, J. WEISS, P. CREIGHTON, F. McCARTHY, M. RON, A.J. TEALE, R. FRIES, R.A. McGRAW, S.S. MOORE, M. GEORGES, M. SOLLER, J.E. WOMACK and D.J.S. HETZEL, 1993 A genetic linkage map of the bovine genome. Nature Genet. **6:** 227-235.

BEEVER, J. E., H. A. LEWIN, W. BARENDSE, L. ANDERSSON, S. M. ARMITAGE, C. W. BEATTIE, B. M. BURNS, S. K. DAVIS, S. M. KAPPES, B. W. KIRKPATRICK, R. MA, R. A. McGRAW R. T. STONE and J. F. TAYLOR. 1996 Report of the first workshop on the genetic map of bovine chromosome 23. Anim. Genet. **27**: 69-75.

BHEBHE, E., J.K. KOGI, D.A. HOLDER, E. AREVALO, J.N. DERR, R.A. LINN, F. RUVUNA, S.K. DAVIS and J.F. TAYLOR, 1994 Caprine microsatellite dinucleotide repeat polymorphism at the SR-CRSP-6, SR-CRSP-7, SR-CRSP-8, SR-CRSP-9 and SR-CRSP-10 loci. Animal Genetics **25:** 203.

BISHOP, M.D., S.M. KAPPES, J.W. KEELE, R.T. STONE, S.L.F. SUNDEN, G.A. HAWKINS, S.S. TOLDO, R. FRIES, M.D. GROSZ, J. YOO and C.W. BEATTIE, 1993 A genetic linkage map for cattle. Genetics **136:** 619-639.

BRENNEMAN, R.A., J. F. TAYLOR, J. O. SANDERS, B. M. BURNS, T. C. WHEELER, J. W. TURNER and S. K. DAVIS. 1996 The polled locus maps to BTA1 in a Bos indicus by Bos taurus cross. J. Hered. **87**: 156-161.

BURNS, B.M., J.F. TAYLOR, K.L. HERRING, A.D. HERRING, M.T. HOLDER, J.S. COLLINS, T.M. GUERRA, J.O. SANDERS and S.K. DAVIS, 1995 Bovine microsatellite dinucleotide repeat polymorphisms at the TEXAN6, TEXAN7, TEXAN8, TEXAN9, and TEXAN10 loci. Animal Genetics **26**: 128-129.

BURNS, B.M., J.F. TAYLOR, K.L. HERRING, A.D. HERRING, M.T. HOLDER, J.S. COLLINS, T.M. GUERRA, J.O. SANDERS and S.K. DAVIS, 1995 Bovine microsatellite dinucleotide repeat polymorphisms at the TEXAN11, TEXAN12, TEXAN13, TEXAN14, and TEXAN15 loci. Animal Genetics **26**: 201-202.

BURNS, B.M., J.F. TAYLOR, M.T. HOLDER, D.A. HOLDER, K.L. HERRING, A.D. HERRING, J.S. COLLINS, T.M. GUERRA, J.O. SANDERS and S.K. DAVIS, 1995 Bovine microsatellite dinucleotide repeat polymorphisms at the TEXAN16, TEXAN17, TEXAN18, TEXAN19, and TEXAN20 loci. Animal Genetics **26**: 208-209.

CAI, L., J.F. TAYLOR, R.A. WING, D.S. GALLAGHER, S.-S. WOO and S.K. DAVIS, 1995 Construction and characterization of a bovine bacterial artificial chromosome library. Genomics: **29**: 413-425.

CHARLIER, C., W. COPPIETERS, F. FARNIR, L. GROBERT, P.L. LEROY, C. MICHAUX, M. MNI, A. SCHWERS, P. VANMANSHOVEN, R. HANSET and M. GEORGES 1995 The *mh* gene causing double-muscling in cattle maps to bovine chromosome 2. Mamm. Genome **6**: 788-792.

DARVASI, A., A. WEINREB, J.I. WELLER and M. SOLLER, 1993 Detecting marker-QTL linkage and estimating QTL effect and map location using a saturated genetic map. Genetics **134:** 943-951.

EGGEN, A., L.K. DOUD, H. HAYES, B.T. MURVKE, G. JURGELLA, M. PFISTER-GENSKOW, J.F. TAYLOR, S.K. DAVIS and M.D. BISHOP, 1996 Construction of a YAC-contig in the vicinity of the polled locus in cattle. Proc. International Society for Animal Genetics. July 22-26, Tours, France. pp93-94.

GEORGES, M., R DRINKWATER, T. KING, A., MISHRA, S.S. MOORE, D. NIELSEN, L.S. SARGEANT, A. SORENSEN, M.R. STEELE, X. ZHAO, J.E. WOMACK and J. HETZEL, 1993 Microsatellite mapping of a gene affecting horn development in *Bos Taurus*. Nature Genet. **4:** 206-210.

HALEY C.S., and S.A. KNOTT, 1992 A simple regression method for mapping quantitative trait loci in line crosses using flanking markers. Heredity **69:** 315-324.

HOLDER, D.A., E. AREVALO, M.T. HOLDER, J.F. TAYLOR and S.K. DAVIS, 1994 Bovine microsatellite dinucleotide repeat polymorphism at the TEXAN-1, TEXAN-2, TEXAN-3, TEXAN-4 and TEXAN-5 loci. Animal Genetics **25:** 201.

JANSEN R.C., 1993 Interval mapping of multiple quantitative trait loci. Genetics **135:** 205-211.

JANSEN R.C. and P. STAM, 1994 High resolution of quantitative traits into multiple loci via interval mapping. Genetics **136:** 1447-1455.

MA, R.Z., J.E. BEEVER, Y. DA, C.A. GREEN, I. RUSS, C. PARK, D.W. HEYEN, R.E. EVERTS, S.R. FISHER, K.M. OVERTON, A.J. TEALE, S.J. KEMP, H.C. HINES, G. GUERIN, and H.A. LEWIN, 1996 A male linkage map of the cattle (*Bos taurus*) genome. J. Hered. (in press).

ZHENG Z.-B., 1994 Precision mapping of quantitative trait loci. Genetics **136:** 1457-1468.

Calving Intervals in Young Beef Females

By: Tom Brink and Dan Kniffen

Introduction

Getting young beef females to re-breed in a timely manner is a major challenge faced by seedstock and commercial producers alike. In a perfect world, every cow and heifer would breed back quickly and maintain a calving interval of 365 days (or less) throughout their productive lifetimes. However, in the real world of cattle production, a significant number of young females do not re-breed on time, and some do not breed back at all.

To better understand what U.S. cattle producers are experiencing in the area of calving intervals, the NCBA/IRM Cow-Calf Production Efficiency Task Force conducted an analysis of calving intervals on over 330,000 beef females aged two to four years. Calving interval data for the analysis was obtained from eight U.S. beef breed associations and from commercial herds in the North Dakota CHAPS program. Several key factors which affect calving intervals were also evaluated as a part of the study.

A brief description of the assumptions used in the analysis, as well as the overall results of the study, are presented below.

Analytical Setup/Constraints

- **Only calving intervals between 300 and 600 days were included in the analysis.** The purpose of this constraint was to exclude females with errant and/or incomplete calving records.

- **To have been included in the analysis, females must have been <30 months of age at first calving, <42 months at second calving and <54 months of age at third calving.** This constraint was used to insure that females in the study were typical in age at the time of first, second and third calving.

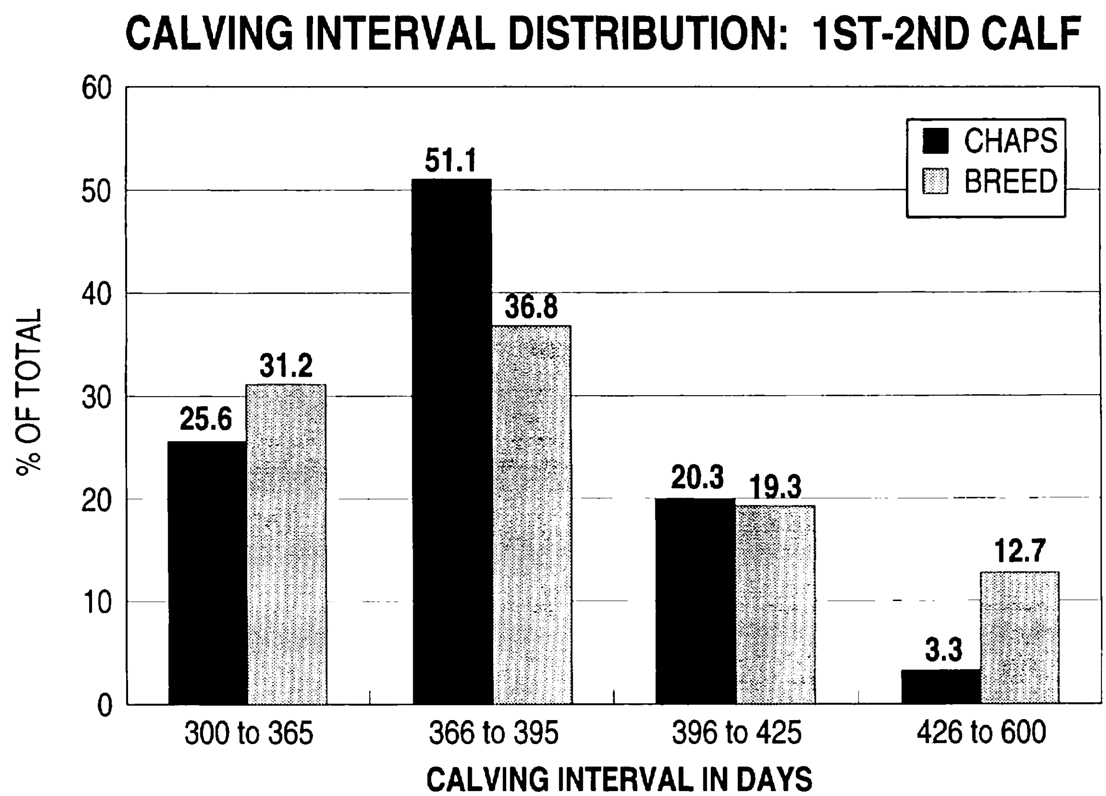
- **Only females born after 1987 were included in the analysis.**

- **Females that had twins, calves that died or were used in embryo transfer programs were excluded from the data set.**

First-Second Calf Intervals

First-to-second calf intervals averaged 380 days among the CHAPS females (standard deviation ± 24 days), and 388 days among BEEF BREED females (standard deviation ± 44 days). Average first-calf birth weights were 80.8 and 81.5 pounds in the CHAPS and BREED groups, respectively.

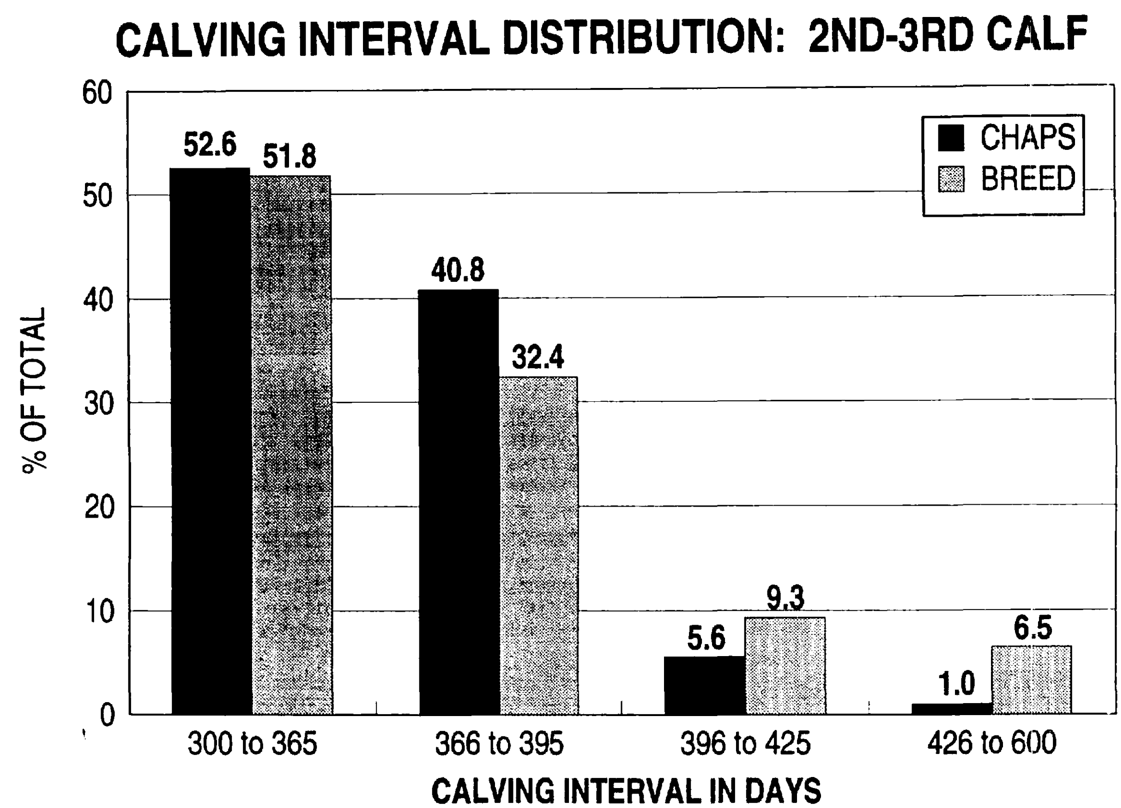
Only 26% of the CHAPS females and 31% of the BREED females had a calving interval of 365 days or less between their first and second calf. Presumably, part of the reason for these low percentages is because virgin heifers are sometimes bred earlier than the rest of the cow herd—resulting in an extended first-to-second calf interval. On the other hand, a significant percentage of the two-year-olds did breed back quickly. This would suggest that many more were, in fact, given the opportunity to maintain a 365-day calving interval, but failed to do so.



As far as elongated calving intervals are concerned, 23% of the CHAPS females and 32% of the BREED females had first-to-second calf intervals of 396 days or longer. This, of course, does not include first-calf heifers that did not breed back at all, and were culled. All of the females in the study remained in the breeding herd at least through their second calf.

Second-Third Calf Intervals

Shorter calving intervals were noted between the second and third calf, as expected. Second-to-third calf intervals averaged 365 days among the CHAPS females (standard deviation ± 21 days), and 372 days among BREED females (standard deviation ± 40 days). Average second-calf birth weights were 85.8 and 84.4 pounds in the CHAPS and BREED groups, respectively.

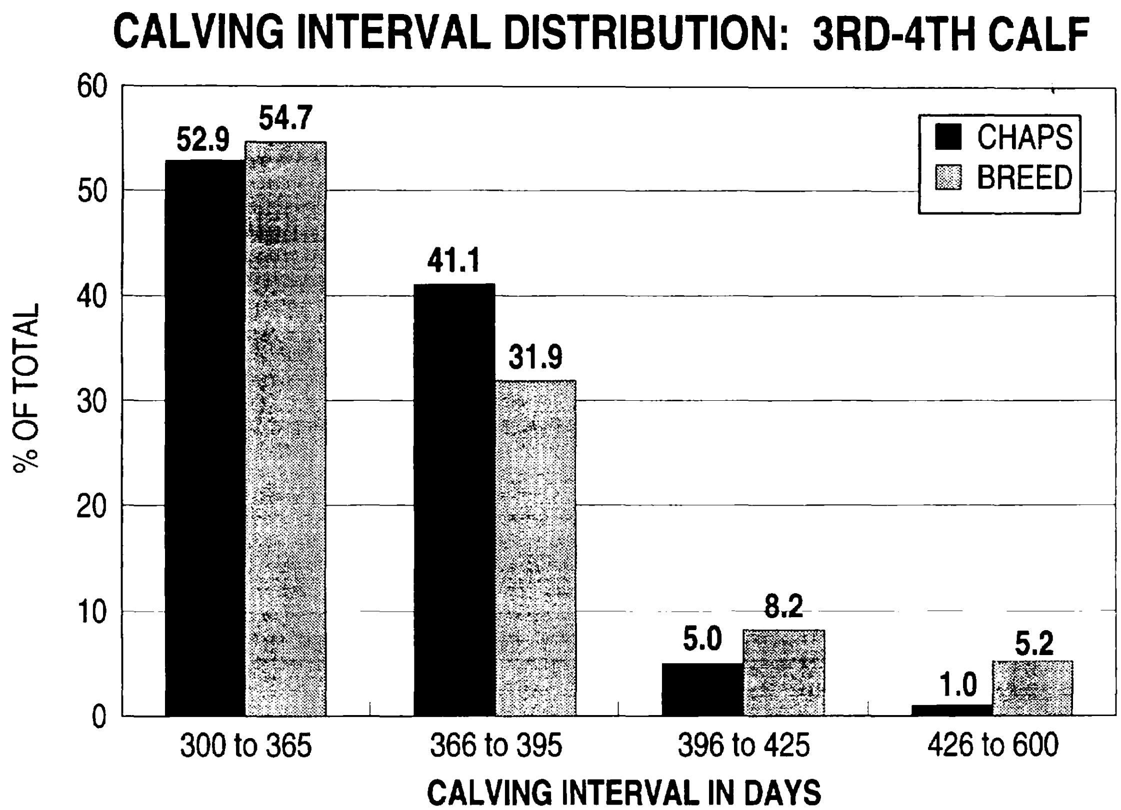


Fifty-three percent of the CHAPS females and 52% of the BREED females maintained a 365-day or shorter calving interval between their second and third calf. However, 7% of the CHAPS group and 16% of the BREED group "slipped" more than 30 days between the second and third calf.

Third-Fourth Calf Intervals

Shorter calving intervals were noted among the BREED females between the third and fourth calf. CHAPS females showed little change. Third-to-fourth calf intervals again averaged 365 days among the CHAPS females (standard deviation ± 21 days). BREED females averaged 368 days (standard deviation ± 36 days). Average third-calf birth weights were 88.0 and 85.8 pounds in the CHAPS and BREED groups, respectively.

Fifty-three percent of the CHAPS females and 55% of the BREED females maintained a 365-day or shorter calving interval between the third and fourth calf. Only 6% in the CHAPS data and 13% in the BREED data had a third-to-fourth calf interval of 396 days or longer.



Factors Affecting Calving Interval

Presented below are six individual factors that were analyzed to determine if there was a cause-effect relationship with length of calving interval. Several showed a very significant impact, while others did not.

1. ***Yearling-Weight EPD***

   The analysis clearly demonstrated that females with high yearling-weight EPDs have longer average calving intervals when compared to females with lower yearling-weight EPDs (see table below). All of the beef breeds analyzed showed a similar trend. Females in the high 20% for yearling-weight EPD in each breed had longer average calving intervals when compared to low- and intermediate-growth females of the same breed. Differences were greatest in the interval from first-to-second calf, then gradually declined and became relatively small by the third-to-fourth calf interval (all differences were statistically significant, $P<0.1$).

AVG. CALVING INTERVAL VS. YEARLING WEIGHT EPD

	------- YEARLING WEIGHT EPD ------		
	LOW 20%	MID 20%	HIGH 20%
	calving interval (days)		
1ST-2ND calf	385.9	387.8	392.3
2ND-3RD calf	370.0	371.1	372.6
3RD-4TH calf	366.2	367.4	368.1

	------- YEARLING WEIGHT EPD ------		
	LOW 20%	MID 20%	HIGH 20%
	number of females		
1ST-2ND calf	38,181	37,399	39,809
2ND-3RD calf	23,070	23,229	21,197
3RD-4TH calf	14,322	13,956	11,212

Results of the study seem to suggest that, especially as two-year-olds nursing their first calf, high-growth females direct more nutritional resources toward their own growth and maturation. Reproduction becomes a somewhat lower priority. In contrast, lower-growth females have lower nutritional requirements for growth, which may help them begin cycling and re-breed more quickly. This difference could make young, high-growth females more vulnerable to reproductive delays and/or reproductive failure during periods of reduced feed availability (such as drought).

For commercial cow/calf producers, the negative relationship between high-growth and reproductive performance in young beef females has significant implications. Too much emphasis on growth traits may lead to longer calving intervals and reduced production efficiency. Thus, the need for fast growth must be balanced with the need to maintain satisfactory reproductive performance.

2. ***Birth Weight of First Calf.*** First-calf heifers giving birth to heavy calves might be expected to have longer calving intervals than females with lighter birth-weight calves. In this analysis, however, no such relationship was observed.

   Birth weight of first calf was found to be positively correlated to yearling-weight EPD. First-calf females in the top 20% for yearling-weight EPD had average birth weights almost 6 pounds heavier than those in the bottom 20% for yearling growth (82.8 pounds versus 77.1 pounds). Despite this correlation, however, when birth weight was analyzed as an independent factor that might affect calving intervals, there appeared to be little or no impact.

3. *Milk EPD*
We anticipated that a strong correlation between milk EPD and calving interval would be observed (with high-milk females being slower to breed back). However, actual results of the analysis were inconclusive. In a few of the breeds analyzed, high-milk EPDs seemed to lead to longer calving intervals. Overall, though, no consistent pattern was detected.

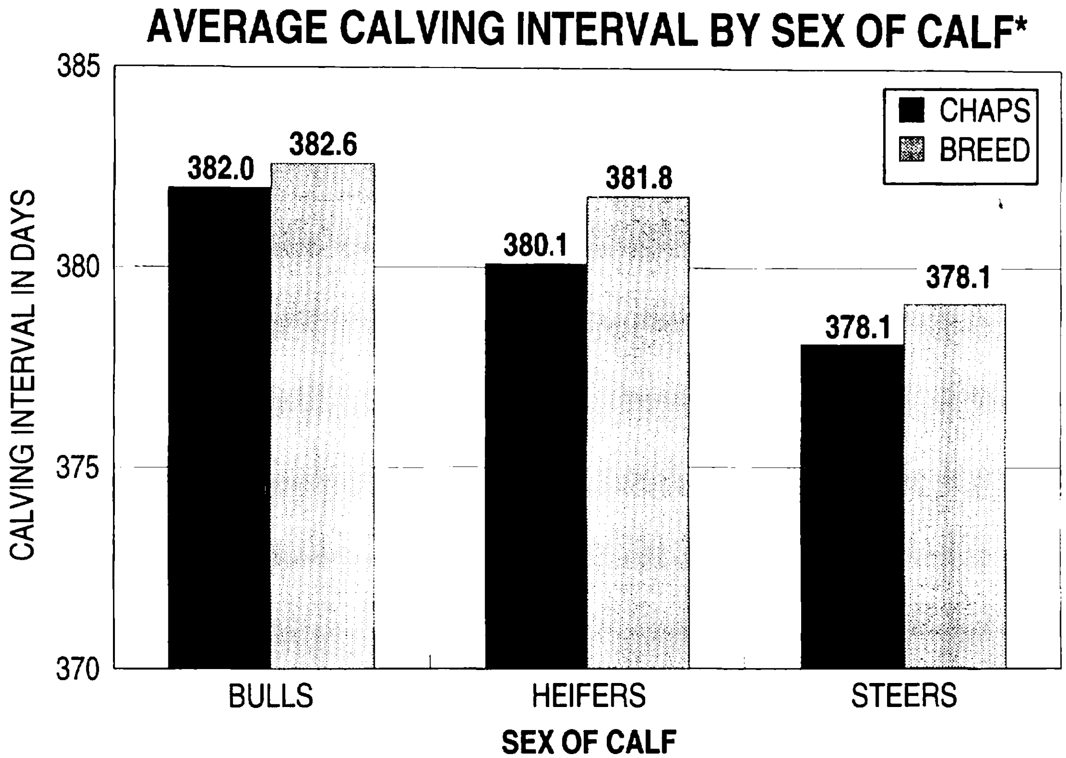
AVERAGE CALVING INTERVAL VS. MILK EPD

	MILK EPD		
	LOW 20%	MID 20%	HIGH 20%
	calving interval (days)		
1ST-2ND calf	386.8	389.9	388.9
2ND-3RD calf	371.2	371.6	370.4
3RD-4TH calf	367.2	367.7	366.7

	MILK EPD		
	LOW 20%	MID 20%	HIGH 20%
	number of females		
1ST-2ND calf	39,121	41,520	38,856
2ND-3RD calf	23,723	23,539	24,024
3RD-4TH calf	14,142	13,402	14,557

4. *Sex of Calf*

Heifers and cows nursing steer calves tend to breed back quicker and have shorter calving intervals. On average, females nursing heifer calves have intermediate length calving intervals, while those raising bull calves often have the longest calving intervals. As illustrated in the accompanying chart, both the CHAPS and BREED females showed this pattern, and it was consistently observed from the first-to-second calf through the third-to-fourth calf interval.



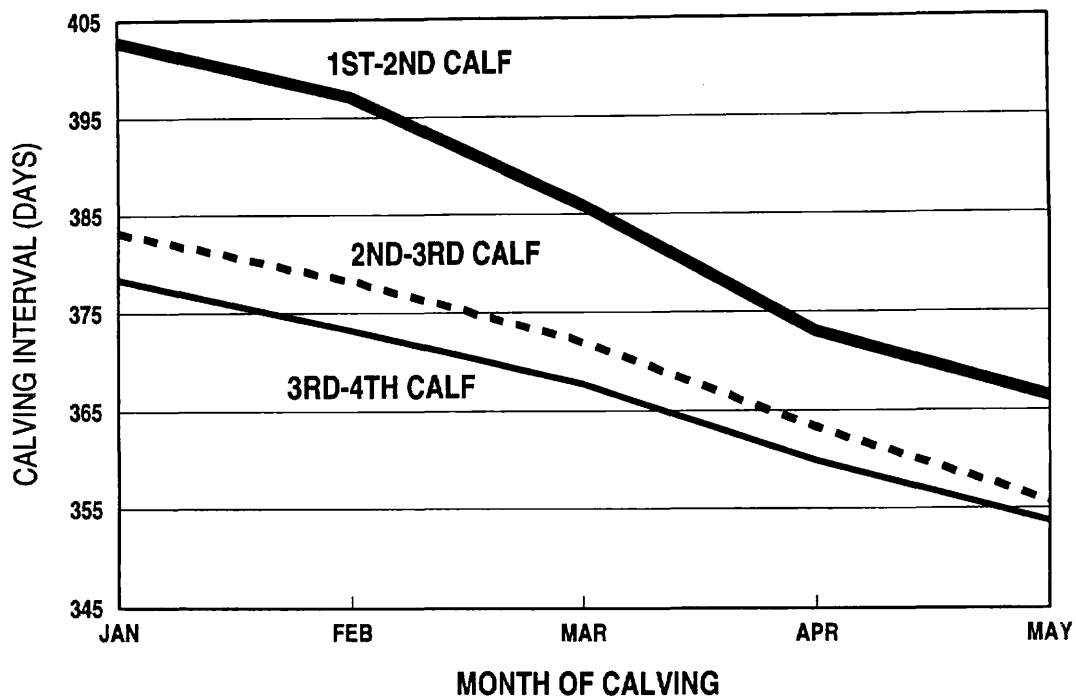
*Calves Born January 1 through March 15.

Bull calves tend to nurse more aggressively than heifer calves. The suckling stimulus has been shown to delay the return to estrous; therefore, it is not surprising that females with bull calves are generally slower to breed back. On the other hand, cows and heifers nursing steer calves tend to return to estrous even more quickly than those with heifer calves. This may suggest that castration produces a type of "calf removal effect" (young steer calves may nurse less often and less aggressively for a time immediately following castration), which lessens the suckling stimulus and results in a more rapid return to estrous.

5. *Month of Calving*

Young beef females that calve later in the spring generally have shorter calving intervals compared to females calving in the late winter or early spring. This phenomenon has been termed the "green grass effect." Heifers and cows that are on green grass at the time of calving (or shortly thereafter) often begin cycling and breed back more quickly, compared to those on dry pasture and/or harvested-forage feeds.

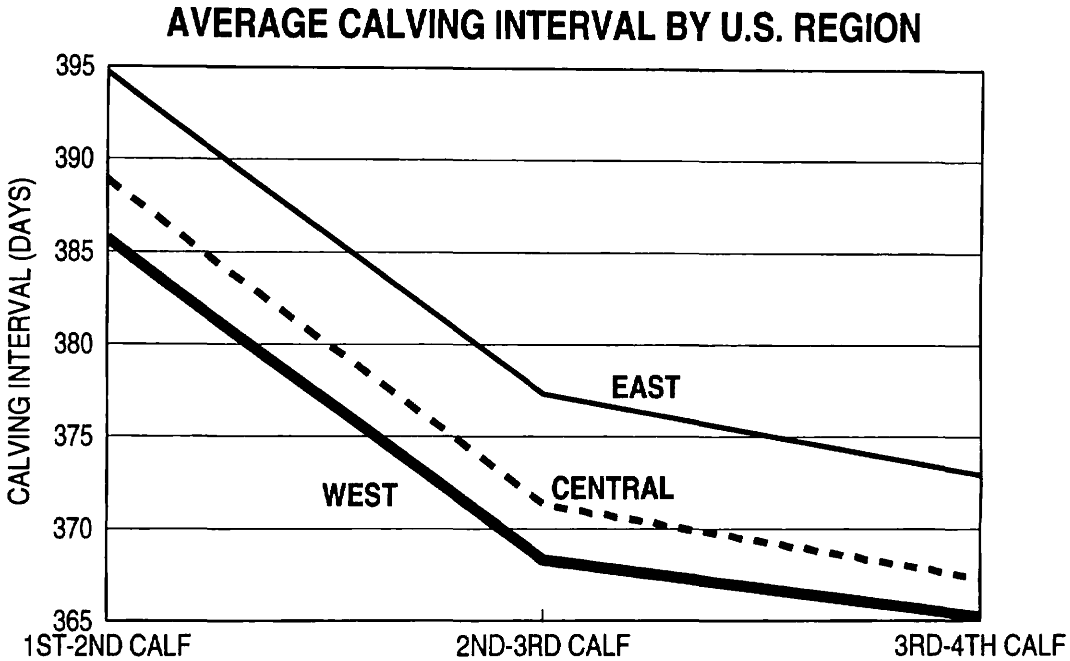
AVERAGE CALVING INTERVAL vs. MONTH OF CALVING



Both the CHAPS and BREED data showed this effect. Two- to four-year-old females calving during January and February had an average calving interval of 385.5 days, compared to 362.1 days for those calving in April and May. Not unexpectedly, females calving in March were in the middle, with an average calving interval of 375.2 days.

6. ***Region of the U.S.***

On average, the Western one-third of the U.S. has the shortest calving intervals, while the Eastern third has the longest. The Central region was characteristically in the middle. As shown in the accompanying graph, these differences were consistent from the first-to-second calf on through the third-to-fourth calf interval.



Calving intervals in the East average 8 to 10 days longer than comparable calving intervals in the West. Central region intervals were 2 to 3 days longer than those in the West, but 5 to 6 days shorter than those in the East. Larger numbers of fall-calving operations in the East (and to a lesser degree in the Central region) may provide a partial explanation of these differences. In general, fall-calving operations experience longer calving intervals compared to spring-calving herds.

The authors and the NCBA/IRM Cow-Calf Production Efficiency Task Force offer thanks to the following beef breed associations for providing much of the data that made this project possible: Angus, Charolais, Gelbvieh, Hereford, Limousin, Maine Anjou, Red Angus and Salers. We also express our appreciation to the North Dakota Extension Service for including the CHAPS data in the analysis. Finally, we want to thank and recognize Farnam Companies, Inc., for their financial support of the calving interval study.

Reproduction: The Next Era of Genetic Evaluation

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Introduction

Fertility is not a trait, just like *growth* is not a trait. Fertility and growth are categories of traits and traits are the attributes that we measure, classify or score. A great deal of effort has been used to develop measures of fertility but we are only just beginning to see EPDs for genetic components of these measures.

Research and intuition seems to be telling us that the genes that affect fertility in bulls are, to some degree, different than the genes that affect fertility in cows. And cow fertility is affected by many different genes from heifer fertility. Therefore, it is probably practical to talk about EPDs for traits in bulls, cows or heifers.

Regardless of how we classify fertility traits, it is difficult to argue against the merit of EPDs that will allow breeders to select for improved probability of conception at a given age. According to Melton (1995) variation of reproduction can be many times more important than the variation in carcass characteristics when affecting profitability of a conventional cow-calf enterprise (i.e., markets calves at a young age). Of course, the relative emphasis any one breeder places on any trait in a selection program depends on selection objectives and marketing programs.

Even for breeders that are currently experiencing high conception rates, improving inherent female fertility may improve profitability by reducing the amount of feed and care inputs to sustain observed fertility. Also, it can be speculated that inherently fertile cattle may have less risk of non-conception in periods of drought or disease.

Bull Fertility

Much is unknown about the genetics of fertility in bulls. We do know that fertility of yearling bulls is often affected by age of puberty. Obviously, bulls not reaching puberty by breeding season are a problem. And the genetics of age of puberty have been well documented in reviews by Brinks (1995) and Martin, et al. (1992). From this work it is clear that scrotal circumference is an indicator of age at puberty and EPDs are currently available in two US beef breed national cattle evaluations for scrotal circumference.

However, very little is understood about the genetics of bull fertility after puberty. Research shows that post puberty variation in scrotal circumference is likely to be low to moderately related to variation in semen output when semen is collected for use in artificial insemination (Carter, et al., 1980; Colter and Foote, 1979; Almquist, et al., 1976; Hahn, et al., 1969).

However, there is not sufficient research about the relationship of age at puberty or scrotal circumference to post-pubertal probability of conception in mates in pasture breeding. With the advent of low cost animal identification through technologies such as DNA fingerprinting, future studies will be able to estimate the genetic component of bull fertility in competitive pasture mating. In single sire, or more likely in multi-sire pastures, it has been speculated that there may be a behavioral component to ability to settle females that is not accounted for by variation in scrotal circumference after puberty.

Female Fertility

Indicator traits vs traits you want to change. Often, the trait that we are applying selection to, explains only part of the variation in the trait that we want to improve. These traits are called ***indicator*** traits. For example, birth weight is an indicator trait of calving difficulty. Virtually every sire summary contains EPDs for birth weight. But the probability of experiencing calving difficulty is the trait we are really trying to affect. The probability of experiencing calving difficulty is the ***economically relevant trait*** that is partially described by the ***indicator trait***, birth weight.

When selecting on **phenotypic performance**, sometimes more progress can be made by selection for the indicator trait than for the economically relevant trait. This occurs in rare situations where the heritability of the indicator trait is high, the heritability of the economically relevant trait is low (or the trait is hard to measure), and there is a strong genetic correlation between the two traits.

Many animal breeders make the mistake of applying this logic to selection using EPDs. This has resulted in producing and using EPDs for indicator traits rather than EPDs for the economically relevant trait. Again, EPDs are widely available for birth weight but not calving difficulty. Undoubtedly, some of this is a result of our lack of experience in applying appropriate analytical techniques. This is especially true for traits measured in categories.

The Dogma of Heifer Pregnancy.

The relationship between scrotal circumference and yearling heifer pregnancy is an example of a fertility trait where we seem to have not recognized the distinction between the ***indicator*** trait and the ***economically relevant trait***. Scrotal circumference indicates age at puberty very well. And between breed differences in average yearling scrotal circumference can relate strongly to between breed differences in yearling pregnancy rate (Gregory, et al. 1991). However, this between breed relationship may not be consistent in all environments (Martin, et al., 1992) and may not be as strong within a breed.

Even more importantly, recent studies (Evans, et al., 1996; Snelling, et al. 1996) indicate that the relationship between yearling heifer pregnancy and scrotal circumference may not be as strong within breed and may be inconsistent (Table 1). These studies also indicate that the heritability of inherent yearling heifer fertility may be higher then previously believed. These studies used analytical techniques that are more appropriate than traditional techniques for the analysis of traits measured in categories.

Table 1. Heritability of yearling heifer pregnancy on the underlying scale (h^2_{yh}), heritability of yearling scrotal circumference (h^2_{sc}), genetic correlation between yearling heifer pregnancy on the underlying scale and yearling scrotal circumference ($r_{yh \bullet sc}$), heritability of breeding or rebreeding as a three year old (h^2_{rb}), and the genetic correlation between scrotal circumference and rebreeding as a three year old.

Study	h^2_{yh}	h^2_{sc}	$r_{yh \bullet sc}$	h^2_{rb}	$r_{rb \bullet sc}$
Evans, et al., 1996	.14	.69	-.16		
Snelling et al., 1996	.21	.45	.43	.17	-.09
Snelling et al., 1996	.30	.75	-.40	.49	-.45
Doyle et al., 1996	.30			.13	

The *threshold model* techniques account for the non-normal distribution of the error in observing traits in categories (Hoeschele, et al., 1995; Gianola and Foulley, 1983). This is especially important for a trait like yearling heifer pregnancy where the incidence is typically greater than eighty percent. These techniques have only recently been implemented in genetic evaluation software. It is likely that their wide implementation will be rapidly adopted for many different types of traits.

Using the threshold model techniques we can now produce EPDs for the probability of a bull's daughters conceiving as yearling heifers. These EPDs will result, at least in part and maybe entirely, from data on yearling heifer pregnancy testing so beef breeds need to begin collecting these data. Pregnancy data is the easiest type of data to measure and record. All that is needed, besides the usual management information, is an indication if a yearling heifer were exposed to a bull and an indication if she was open or pregnant at pregnancy test or calving. The most reliable data will come from beef breed associations that practice inventory based reporting. It will be difficult to ensure there is no reporting bias in data from breed associations with more typical reporting policies.

The threshold model is based on the theory that a trait that is observed in categories (i.e., pregnant or open) is affected by many small, continuous genetic and environmental effects. These small effects are expressed on an "underlying" scale. Some of these effects increase the chances of an animal becoming pregnant and some of them reduce this chance. On this underlying scale there is a point, called the threshold, at which an animal will either be pregnant or open. If the sum of all the effects on an animal is greater than the threshold value then the animal will be pregnant. If the sum of all the effects is less than the threshold then the animal will be open.

When we talk about selection for pregnancy it is important that we realize that what we want to improve is the *inherent fertility*. Inherent fertility is the same thing as the fertility measured on the underlying scale of the threshold model theory. This means the heritability of heifer pregnancy on the underlying scale is important, but not the heritability of heifer pregnancy on the observed scale. The results from the studies that use threshold techniques for estimating heritability on the underlying scale are encouraging (Table 1). When selecting using EPDs the heritability only needs to be large enough to ensure the accuracy of the EPDs can be large enough at sufficiently young ages to be useful. Combining observations on pregnancy with scrotal circumference information should result in sufficient levels of accuracy. Therefore, **we recommend that beef breed associations begin immediately collecting the simple information necessary to begin production of these EPDs.**

The dilemma still remains as to how to use the yearling scrotal circumference information to *indicate* yearling heifer puberty. One alternative is to use a multiple trait model. Because scrotal circumference is measured only on bulls and pregnancy on heifers, this is a computationally desirable solution because the computation is simplified. If this procedure is implemented then a great deal of education must be supplied to the users of the EPD. If the pregnancy EPD is solved multiple trait with the scrotal circumference EPD (and both EPD are made available) **the accuracy of selecting bulls for higher probability of pregnancy in their yearling daughters using both pieces of information will be lower than using only the heifer pregnancy EPD**. This is because the scrotal circumference observations have already supplied all the information they can to improve the accuracy of the heifer pregnancy EPD in the multiple trait analysis. Using the scrotal circumference EPD would then add error to the selection decision.

This is the dilemma of publishing EPDs for both the indicator traits and the economically relavant traits. Conceivably, we could conclude that we should discard indicator EPD or at least not put indicator trait EPDs in the sire summaries. Using the indicator trait EPD in place of, or in conjunction with the EPDs for the economically relevant trait to make selection decisions is always less accurate then using the EPDs for the economically relevant traits alone.

An alternative way to use the scrotal circumference information may be to form additive genetic groups in the analysis that produces yearling heifer pregnancy EPD.

This analysis allows for accounting for a certain amount of the non-linear relationship that may exist between scrotal circumference and heifer pregnancy.

Martin et al. (1992) showed that pregnancy of heifers developed in superior environments may not have as strong a genetic relationship to scrotal circumference of their sires as would heifers developed in limiting environments. Possibly, using the contemporary groups solutions from yearling and/or weaning weight analyses may allow for categorization of the environments in the pregnancy EPD analyses. Interaction terms or heterogeneous variances could be included to account for the relationship between environmental effects and genetic effects on observed pregnancy.

Rebreeding as a two-year-old.

For many breeders with high fertility in heifers bred to calve as two-year-olds, improving the genetics of rebreeding to calve as a three-year-old may also be very important. This may be particularly true in the breeds with high growth because the females may have trouble partitioning energy between lactation, growth and energy needed to sustain fertility.

There is not a great deal of scientific literature on heifer rebreeding. In an analysis that included data on females calving for both the first and second time as three-year-olds, Snelling (1996) used a threshold model to estimate the heritability and genetic correlation to yearling scrotal circumference (Table 1) of calving as a three year old given they were selected. However, because the data included some heifers that were open as yearlings, the results are difficult to interpret. Of particular concern is the estimate of the relationship of rebreeding to scrotal circumference. In an analysis by Toelle and Robison (1985) the relationship between scrotal circumference and rebreeding rate was also negative or not different than zero in some analyses.

Less encouraging are the results of another study by Doyle, et al. (1996). In a group of Angus females that all calved as two year olds, the heritability of rebreeding was not different from zero (Table 1). But, because rebreeding is only a component of a measure of sustained cow fertility, it may not even be necessary to develop a rebreeding EPD.

Sustained Cow Fertility.

Given that a cow was selected and bred as a heifer, a great deal of the economic viability of cow-calf production depends on keeping the cow bred past a break even ownership period. According to Dalsted and Gutierrez (1989) the breakeven ownership period for a cow is when her time adjusted salvage value and the sum of net returns from production of calves in time, minus the value of a repacement heifer is equal to zero.

This period can vary depending on market forces, but is typically thought to be when the cow reaches the age of five to six years in most market situations (Snelling, et al., 1994).

Several traits have been developed to attempt to provide breeders with a useful selection tool to improve the genetic merit for cows producing past their break-even ownership period. Calving date and calving interval were two traits originally proposed for selection for sustained fertility. However, as pointed out by Bourdon and Brinks (1983), calving interval is at best not repeatable and at worst negatively repeatable. This means that selection for shorter calving intervals may actually apply selection toward animals that calved late in previous calving seasons. For the rare situation of a breeder that does not have a fixed breeding season calving interval may be relevant.

As pointed out by Bourdon (personal communication) calving date is also not a useful trait because it is not the calving date that is economically important. Rather it is whether a cow has a calf or not that affects profitability. Also, both calving date and calving interval may be very sensitive to incomplete reporting of data for breed associations that do not have inventory based reporting. And even when inventory based reporting is practiced, there is still problems with using data on cows that were allowed to skip a year of calving.

Recently, Snelling, et al. (1994) introduced ***Stayability*** as a trait in beef cattle. It is defined as the probability that a cow will reach or exceed a point in time in her productive life. Specifically, Snelling et al. selected the age of six years as being the minimum age of a female for predicting genetic merit for sustained fertility. Other studies have confirmed the hypothesis that this is a heritable trait in beef cattle using the threshold model (Hyde, et al. 1996; Hyde et al., 1995) and this trait has been adopted by two beef breed associations as a component in their national cattle evaluations with other breeds currently working on development efforts.

Stayability has several properties that may make it the trait of choice for selecting for improved cow reproduction. Most notable of these properties is that it requires only calving records (i.e., pedigree information) and some ownership and transfer records. These type of data tend to be the most abundant data in beef breed association's data bases. It also seems to be less sensitive to problems of incomplete reporting than other measures of sustained fertility. For example, if a breeder does keep open cows as a policy, this effect seems to separate relatively cleaning in the contemporary group effect (as long as it is done independent of sire).

Breed associations that practice inventory based reporting and have good cow culling reasons information will be at a distinct advantage as the accuracy of the stayability EPD should substantially improve. This will result from being able to reduce the error by accounting for animals culled that did not have reproductive failure and also by applying a modification to the threshold techniques currently used. The modification is called a survival time analysis. This will allow the inclusion of observations on animals that were not yet six year of age at the time of the analysis.

Conclusions

It has surprised us that EPDs for fertility seem to be the area that has received the least emphasis in national cattle evaluation. In part this is undoubtedly due to the difficulty in developing analytical techniques that handle the threshold concept of pregnancy status. It is clear that breakthroughs have been made and it turns out that pregnancy data is some of the cheapest and easiest information to collect. Because of the potential economic benefits of EPDs for fertility, beef breed associations are encouraged to prepare these data for analyses and the shops contracting national cattle evaluation services are encouraged to adopt and develop these analyses.

Do we print the indicator traits EPD?

The dilemma of what we do with indicator trait information is formidable. The scrotal circumference EPD is an example. If the scrotal circumference EPD is used with the heifer pregnancy EPD, to select sires that produce fertile yearling females, then the accuracy of the selection decisions will be lower than if the heifer pregnancy EPD alone is used. If we do not make the EPD available then we have a risk of breeders not collecting scrotal circumference information. Additionally, many breeders may want the scrotal circumference EPDs not as a selection tool, but as a partial explanation of the heifer pregnancy EPDs. Clearly, withholding information because of concern it will be misused is a policy that would be a poor substitute for a strong educational effort. We must also recognize that the same educational effort must be made for correct use of other EPDs such as calving difficulty EPD vs. birth weight EPD.

Citations

Almquist, J. O., R. J. Branas and K. A. Barber. 1976. Postpubertal Changes in Semen Production of Charolais Bulls Ejaculated at High Frequency and the Relation Between Testicular Measurements and Sperm Output. J. Anim. Sci. 42:670.

Bourdon, R. M., and J. S. Brinks. 1983. Calving Date Versus Calving Interval as a Reproductive Measure in Beef Cattle. J. Anim. Sci. 57:1412.

Brinks, J. S., 1995. Genetics of Reproduction in Beef Cattle. Dept. of Anim. Sci. Colorado St. Univ.

Carter, A. P., P.D.P. Wood and P. A. Wright. 1980. Association Between Scrotal Circumference, Live Weight and Sperm Output in Cattle. J. Reprod. Fert. 59:447.

Coulter, G. H. and R. H. Foote. 1979. Bovine Testicular Measurements as Indicators of Reproductive Performance and their Relationship to Productive Traits in Cattle: A Review. Theriogenology 11:297.

Dalsted, N. L. and P. H. Gutierrez. 1989. How Long Do You Keep Her? BEEF. Spring 1989. P.15.

Doyle, S. P., R. D. Green, B. L. Golden, G. L. Mathiews, C. R. Comstock and D. G. LeFever. 1996. Genetic Parameter Estimates for Heifer Pregnancy Rate and Subsequent Rebreeding Rate in Angus Cattle. J. Anim. Sci. (Abstract) 74 suppl.1 (in press).

Evans, J. L., B. L. Golden, C. R. Comstock, K. L. Long R. M. Bourdon, C. H. Mallinckrodt and R. D. Green. 1996. Genetic Parameter Estimates for Heifer Pregnancy Rate in Hereford Cattle. J. Anim. Sci. (Abstract) 74 suppl. 1 (in press).

Gregory, K. E., D. D. Lunstra, L. V. Cundiff and R. M. Koch. 1991. Breed Effects and Heterosis in Advanced Generations of Composite Populations for Puberty and Scrotal Traits of Beef Cattle. J. Anim. Sci. 69:2795.

Gianola, D., and J. L. Foulley. 1983. Sire Evaluation for Ordered Categorical Data with a Threshold Model. Genet. Sel. Evol. 15:201.

Hoeschele, I. B. Tier and H.-U Graser. 1995. Multiple-trait Genetic Evaluation for One Polychotomous Trait and Several Continuous Traits with Missing Data and Unequal Models. J. Anim. Sci. 73:1609.

Hahn, J., R. H. Foote and G. E. Siedel Jr., 1969. Testicular Growth and Related Sperm Output in Dairy Bulls. J. Anim. Sci. 29:41.

Hyde, L. R., C. R. Comstock, B. L. Golden and J. B. Gibb. 1995. Stayability EPD for Gelbvieh Cows. Proc. West. Sect. Am. Soc. Anim. Sci. 46:253.

Hyde, L. R., B. L. Golden, C. R. Comstock and D. P. Husfeld. 1996. Stayability EPD for Charolais Cattle. Proc West. Sec. Am. Soc. Anim. Sci. (in press).

Melton, B. E., 1995. Conception to Consumption: The Economics of Genetic Improvement. Proc. Beef Improvement Federation 27th Research Symposium & Annual Meeting.

Snelling, W. M., M. D. McNeil and B. L. Golden. 1996. Genetic Evaluation of Heifer Pregnancy. Proc. Beef Improvement Federation 28th Research Symposium & Annual Meeting.

Snelling, W. M., B. L. Golden and R. M. Bourdon. 1994. An EPD for Stayability of Beef Cows. Proc. 5th World Congr. On Genet. Appl. To Livest. Prod. Guelph, Ontario.

Toelle, V. D., and O. W. Robison. 1985. Estimates of Genetic Correlations Between Testicular Measurements and Female Reproductive Traits in Cattle. J. Anim. Sci. 60:89.

Proceedings, Annual Meeting of Beef Improvement Federation
May 15-17, 1996, Birmingham, Alabama

Carcass EPDs: Put Up or Shut Up!!

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IS MEASUREMENT OF CARCASS PERFORMANCE JUSTIFIED?

The past ten year history of the "carcass merit/value-based marketing" issue in the beef industry has burned up a tremendous amount of energy. Most of this energy has been consumed by making the repeated argument from both industry **and** academia that: "We do not get paid on the basis of performance in the carcass, and until we do, there is little justification for collecting carcass data. Furthermore, "value-based marketing" is a buzz term made up by the packing industry, for the benefit of the packing industry, that seems to keep getting delayed in its implementation." While this argument may appear to be historically true, it also is somewhat short-sighted. The fact of the matter is that the business of selling beef and beef products has become more challenging due to competition of products from the poultry and pork industries.

The response of the beef packing and retail industries is beginning to be seen through the development of new closely-trimmed boxed beef and through the development of alliance and branded beef programs. In the past two years, Excel, IBP and Monfort-ConAgra have all developed 1/4 inch trim (or less) boxed-beef specifications. Industry consensus is that approximately 40% of all boxed-beef trade fell into this category by the end of 1995, with this percentage expected to increase in 1996 (NCA, 1995). New industry names like CAB, CHB, CSB, Supreme Angus Beef, IBT, "Breed-X" Alliance, Farmland Supreme Beef Alliance, etc. are rapidly multiplying. All of these programs provide "payment" based on end product performance specifications. One does not have to be very astute to realize the impact of these marketing changes on the cow-calf industry. Furthermore, the Long Range Plan for the consolidated organizations of the beef industry lists "improving quality and consistency" of beef as its #1 leverage point. Collectively, these points reveal that **measurement of carcass performance is needed not today, but yesterday!**

SURE CARCASS MERIT IS IMPORTANT, BUT IN A DOWN-CYCLE OF THE CATTLE MARKET?

Traditionally, we have thought that in relative economic terms, reproductive efficiency is about twice as important as growth performance which is about five times as important as carcass merit (Melton et al., 1979). More recently, Bryan Melton of Iowa State has theoretically analyzed the importance of these three types of traits under a more current, value-based type of marketing system. As Bryan said last year at this same meeting, the former 10 reproduction: 5 growth: 1 product ratio is now closer to 2 reproduction: 1 growth: 1 product (Melton, 1995). While this says that reproductive performance is still the MOST important trait category for commercial cow-calf producers, it also says that we do need to be paying closer attention to carcass and end-product performance than in the past.

Some folks have argued in the last several months, as calf prices have continued to fall, that we were only concerned with carcass performance when the market was "rosy". Now that the market has gone into a down-turn, these same folks are arguing that the only things that matter to a cow-calf producer in the next five years are to keep costs to a minimum and to maximize reproduction and growth for their environment. Such a short-term rooted philosophy, while understandable given the current climate of the cattle market, is ill-advised. This turn of the cattle cycle will pass as others have. Some folks will not be in business at that point, and we will likely continue to lose market share to our other animal protein competitors ***UNLESS*** we plan for the long term to do something about it. It is certain that we have room to improve reproductive performance genetically with some of the new methodologies being aimed at female fertility as we have heard from Bruce Golden earlier in this meeting (eg. stayability, first calf heifer conception rate, days to calving, etc.). This will also ultimately help us to better compete with the lower cost of production associated with litter-bearing species. But we will not be able to sell it for a desirable return if it is not acceptable to our consumers. The 1990s cliche of "produce it and they will come" does not apply here. Just because we produce it does not mean that our customers will want to buy it. The American automobile industry learned this the hard way.

Commercial cow-calf producers in 1996 need to be able to manage risk associated with poor carcass performance. Those producers who are successful in making it to 1998 will be even more challenged in this area. The challenge to the seedstock industry is inescapable: ***your customers need reliable, user-friendly, and accurate tools to assess the carcass merit of your seedstock, i.e.*** **the need for carcass EPD can no longer be paid lip service, IT IS REAL.**

DEFINING CARCASS MERIT

Rex Butterfield summed up the definition of "ideal" carcass merit quite simply when he said:

> *"The ideal carcass is one which yields a maximum percentage of muscle, a minimum percentage of bone and enough fat to meet the minimum quality requirements of the marketplace. It must be produced economically within the limits of functionally efficient cattle."*

This objective coincides with the fact that consumer preferences are "to keep the taste fat and get rid of the waste fat" (National Retail Consumer Beef Study (1989)). Excess fat production can be lowered substantially by changing feeding practices. However, it is generally thought that this will reduce the palatability of the end-product. Industry evolution in recent years has also resulted in specification markets for retail lean beef versus "white table cloth" niches. While these niche markets provide greater opportunities for matching diverse biological types to economic environments, they do dictate the need for genetic identification of specific components of carcass performance.

Our current USDA grading system uses yield grade (1 to 5) to predict the percentage of boneless, closely-trimmed retail cuts in the round, rib, loin, and chuck. Fat thickness and area of the ribeye at the 12th rib, along with hot carcass weight and percentage kidney, pelvic and heart fat, are used to predict yield grade in the carcass. The other side of the USDA grading system is quality grade (Standard through Prime) which is based on the amount of intramuscular fat visible in the cross section of the ribeye area at the 12th rib in "A" maturity carcasses.

Fortunately, collective research results over the past 25 years have indicated that genetic variation exists both between and within breeds for these measures of carcass merit. Levels of heritability for measures of retail yield and palatability are all in excess of what is generally observed for growth traits (Table 1). This indicates that genetic improvement from selection within breeds for these measures should be possible.

TABLE 1. HERITABILITY (h^2) ESTIMATES OF CARCASS TRAITS IN BEEF CATTLE (ADAPTED FROM MARSHALL, 1994)

Trait	No. Studies	Avg. h^2
Retail yield (%)	7	.43
Retail weight (lb)	5	.43
Carcass weight (lb)	11	.37
Ribeye area (in^2)	10	.37
12th rib fat (in)	7	.41
Marbling (or Quality Grade)	11	.35
Warner-Bratzler Shear Force (kg)	6	.27
Sensory Panel Tenderness (1 to 8)	3	.13

(Numerical average of literature estimates)

Larry Cundiff and co-workers at the Roman L. Hruska U.S. Meat Animal Research Center have also reported that the magnitude of genetic variability between breeds is roughly equivalent to that within breeds (Table 2). This infers that improvement is also possible in carcass desirability of slaughter cattle through proper breed selection implemented in designed crossbreeding programs. This is particularly important since we also know that there is a genetic antagonism between carcass retail yield and carcass marbling (Cundiff et al., 1990).

TABLE 2. RELATIVITY OF VARIATION WITHIN AND BETWEEN BREEDS FOR CARCASS PARAMETERS IN BEEF CATTLE (ADAPTED FROM CUNDIFF ET AL. (1990))

Trait	Number of Additive Genetic Std. Deviations Between Most Divergent Breeds
Retail product (%)	5.8
Retail product weight (458 days)	8.2
Marbling score	5.3

[a]Assumption is made here that within a breed there exists approximately six genetic standard deviations of variation in any trait.

HOW MANY OF THESE CARCASS MEASURES DO WE NEED?

Before discussing how particular types of data might be helpful in genetic improvement programs, it is important to provide some framework for what carcass merit EPD might look like.

Many times lots of pieces of information are given to producers without any suggestion of how the pieces of the puzzle fit together into a picture. The carcass merit area is certainly one that might suffer from this problem.

Since the current USDA grading system is two-pronged for retail yield (i.e. yield grade) and palatability (i.e. quality grade), there are a number of factors used to estimate differences among carcasses. The attempt can be made to provide information for all of the components including ribeye area, fat thickness and carcass weight for retail yield and marbling for quality grade. There are strong arguments for including each of these traits as a part of national cattle evaluation (NCE) programs including: 1) specification marketing provides impetus for producers to need to know performance in each of the criteria to make sure they "fit the window", and 2) the need exists within some breeds to improve certain components (eg. excess carcass size, inferior muscling, etc.) while they may be acceptable in terms of the composite trait. The other advantage to component trait reporting is that more information exists regarding genetic parameters for the components along with the fact that any errors made in the component traits are magnified in the composite trait (eg. retail yield %). **Thus, it appears that the attempt should be made to provide predictions for the components. While this would provide a lot of valuable information, the overall message might fall between the cracks if the composite trait(s) of yield and quality grade are not also reported.**

As an animal breeder who has "grown up" alongside of the development and implementation of EPDs in within-breed national cattle evaluation, I have fluctuated between thinking that we need to give producers "indexes" versus all of the individual pieces of the "index". It now seems clear to me, as is the case described for carcass traits above, that we should present the information both ways and allow the producers to access those which are most meaningful and useful to them. So, if we are to present both the components of the grading system as well as the composite traits, how should they be expressed to be most meaningful?

Let's tackle the component traits first. Traditionally, we have presented most EPD as a deviation from the base of zero in units of the trait (lb of birth, weaning, yearling or mature weight, cm of scrotal circumference, days of gestation length, etc). This is possible because we are using differences between animals on the basis of EPD to select upon (within an accuracy level). As long as the breeder knows what range of EPD is acceptable for a given trait in his/her herd, this works great. It also works well for traits that are being selected "for". However, a lot of the traits in which we are interested in beef cattle breeding are what we refer to as secondary traits. While we are not selecting for "increased" performance in these traits, we do want to manage risk associated with them by having a handle on whether animals are acceptable or not. Most of the carcass traits we are discussing here fall into this category. For example, we are not necessarily interested in increasing tenderness of beef, we just want to know if it is tender enough to be satisfying. Quality grade, carcass weight, level of fatness, yield grade 1 or 2, all fall into this type of framework. This makes these kinds of traits ones which need to be checked to see if they are O.K. after the primary criteria of reproductive ability and adequate growth performance have been documented.

Bruce Golden, one of my colleagues at Colorado State has done some very forward thinking regarding these types of traits. About two years ago, he and his associates at the CSU Center for the Genetic Evaluation of Livestock developed new carcass EPDs for the North American Limousin Foundation (Anderson, 1995). Instead of presenting a plus or minus units of marbling score EPD, they presented this trait as the probability that an animal would fall into an "acceptable" range of marbling (for NALF Slight90 or higher, corresponding to high Select or higher). Now the producer has a "checkpoint" to look at for marbling after he/she has identified a given animal based upon all other measures of performance to see if they "fit" on the basis of acceptability for marbling. This is an excellent example of identifying a window of acceptability for a given market in one of the components of carcass merit, here the retail lean beef niche market.

Currently, an effort has been initiated by the National Cattlemens Beef Association to develop EPD for carcass traits along these lines. The idea is to ensure that breeding animals selected for use in commercial cow herds "fit the projected window" for these traits by using these probability-based EPD. In addition to our group at Colorado State, Georgia, Iowa State, Cornell, Auburn, and the U.S. Meat Animal Research Center are planning to collaborate on this effort. Given that we can amass the carcass data, the components are likely to be reported universally in this format in the future.

BUT, WHAT ABOUT THE COMPOSITE TRAITS?

I envision a two or three part system for reporting carcass composite traits. The first EPD needed is one that predicts the retail yield potential of an animal's slaughter progeny at a standard slaughter age. For example, the system could be based on percentage retail cuts in the four primal regions of loin, rib, round and chuck at a standard slaughter age of 15 to 17 months (i.e. to simulate USDA yield grade).

The second part of this system should consist of a breeding value estimate that would tell the potential of an animal's progeny to have carcasses that yield consistently palatable products. In the current USDA grading system, intramuscular fatness (i.e. marbling) is used to place cattle into quality grades. This is probably the most cursed and yet highly praised part of the industry. The best summary of the value of the quality grading system comes from work done by Smith et al. (1987) shown in Figure 1. If one is a protagonist on the value of marbling, these results indicate the ability of the quality grades to narrow the variation in overall palatability when moving from Standard up through Prime grade classes. The "risk factor" of getting a bad-eating piece of product goes down from 59.1% in Standard to 5.6% in Prime. Thus, the pro- viewpoint is from the perspective of an insurance policy. The antagonist viewpoint is that the system is not nearly "tight" enough because of the overlap of palatability between all four grades. This observation, coupled with the tradition of the feedlot industry being driven to overfeed cattle to try to bump them into low Choice as well as increase dressing %, has resulted in several calls from within the industry to either eliminate or change the quality grading system.

The real issue here is the need to be able to directly and objectively estimate tenderness. Consider the following conceptual hypothesis concerning the importance of the three sensory characteristics across the various quality grades. Under this model, the variability observed in overall consumer acceptance within the Prime grade is all due to tenderness since there is adequate marbling present to insure flavor and juiciness. As grade declines, however, the relative importance of the three characteristics shifts, placing increasing amounts of importance on flavor and juiciness. The take home message is that when the percentage of slaughter cattle falling into the various quality grade classes (based on National Beef Quality Audit (1992)) is weighted by the percentage unacceptable within each grade (from figure 1), **approximately 20% of the slaughter mix is presumed to be unpalatable. Furthermore, using the conceptual model above, the majority of that problem can be attributed to inadequate tenderness.** This is the logic forming the basis for the current attention being given by the industry to improvement of beef tenderness (NCA Beef Tenderness Plan, 1994). The problem, however, is that the only direct way to genetically address tenderness is by obtaining progeny shear force data. As we will see later, this is, at best, a costly and difficult proposition.

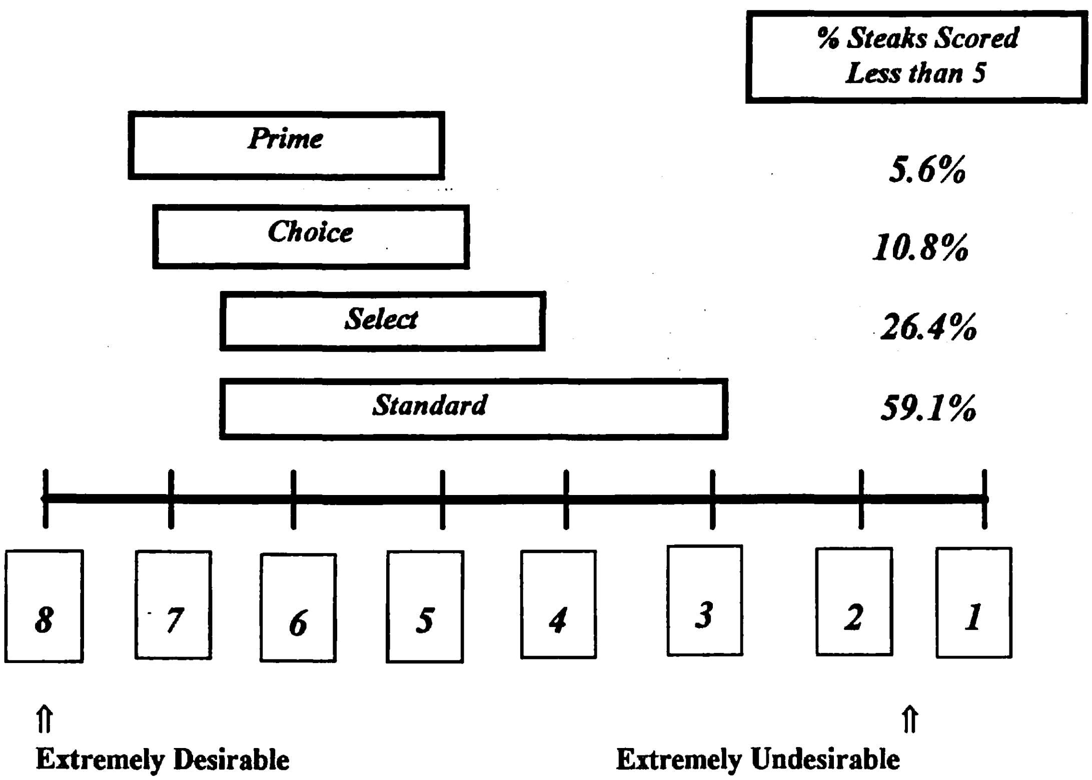

FIGURE 1. RELATIONSHIP BETWEEN PALATABILITY AND USDA QUALITY GRADE (SMITH ET AL., 1987)

Given all of that background on the palatability portion of carcass merit, what is needed for a quality EPD? Since it is known from research results that the genetic relationship between percentage retail product yield and marbling is negative and antagonistic (Cundiff et al., 1990), **the EPD for yield should be coupled to the EPD for quality.** This can be accomplished by expressing the quality EPD in terms of the potential of an animal's slaughter progeny for quality grade, marbling score or **most preferably tenderness at a specified industry target yield grade.** Such a system will allow definition of animals that excel in both characteristics simultaneously.

WHY DO CARCASS EPD NOT ALREADY EXIST?

If there is such a need for carcass EPD and the genetic basis of these traits is relatively high, why are they not already available? Getting carcass EPDs for the beef industry appears to be similar to our Congressional gridlock on getting a balanced budget. We all know that we need them and we want them -- but very few are willing to step up to bat and take the sacrificial swing. Some of the factors contributing to this problem were discussed at an ultrasound symposium in 1990 (Wilson, 1992). It is helpful to reiterate those points and others which have prevented carcass EPD in the past.

The largest hindrance to collecting carcass information has been that we have had to solely rely on progeny data. This type of information requires **time, expense and labor** to collect and also requires cooperation in the packing plant for accurate individual identification of carcasses. The combination of these factors has resulted in limited amounts of progeny data being placed into breed performance databases. The American Angus Association has had the most concerted effort in designed progeny testing of sires. Approximately 39% of their currently published sires have carcass information (1,652 of 4,237 with published EPD (Angus, 1995)). While this proves the difficulty of obtaining progeny data for carcass traits, it also emphasizes that useful carcass information can be obtained on a meaningful percentage of the breed. For instance, of the top 100 sires in the Angus breed on the basis of registrations, 76 of these have carcass EPDs. These sires represent 56,000 of last year's registrations. Several other breed programs are attempting to build databases with Limousin, Simmental, Brangus, Red Angus, and Salers having published carcass reports (see Table 3). Programs like the NCBA's Carcass Data Collection Service and various state programs (eg. OK Steer Feedout, Texas A&M Ranch to Rail, Rocky Mountain Ranch to Rail, etc.) are helping in this area. According to West Texas A&M University, as of April 1996, a total of 160,801 steers, 17,873 heifers and 1,972 bulls had been processed by the NCBA program.

The second hindrance has been the lack of ability to determine true carcass value differences on live, yearling seedstock cattle to circumvent the need for progeny data. Ultrasound imaging technology has been pursued over the past ten years as the primary means to obtain these live animal measures. **A third question relates to whether there is adequate heritable variation in young breeding cattle for these measures of carcass merit. Additionally, are there antagonisms between some of these traits which need to be given attention, particularly in the area of increasing mature size and decreasing reproductive efficiency when selecting for leanness?** The last question is perhaps the most looming one of all. **When differences between young, immature breeding cattle are measured, do they ultimately relate to those observed between their slaughter progeny?** While this may seem to be intuitively true, realistically it may not be. The yearling bull is a physiologically different beast than a 15 to 17 month old slaughter steer or heifer.

TABLE 3. SUMMARY OF SEVERAL CURRENT NATIONAL CATTLE EVALUATION PROGRAMS -- CARCASS MERIT

Breed	Total Sires	Total Published Sires	No. Carcass Sires	No. Published Carcass EPD	Traits	RT Ultra-Sound
Angus	80,700	4,237	1,159	514	1,2,3,4,5	Eval.
Brangus	15,058	1,093	317	317	1,6?	Y
Gelbvieh	10,366	809	Starting	N/A	1,2,3,4	N
Limousin	31,615	1,735	402	232	1,2,3,4	N
Red Angus	19,161	1,247	536	67	1,3,4	N
Salers	9,140	670	270	270	1,2,3,4	N
Simmental	41,231	2,736	816	284	1,4,5	Eval.

No Program/No Immediate Plans
Charolais
Hereford
Santa Gertrudis

Traits: 1=Carcass weight, 2=ribeye area, 3=fat thickness, 4=marbling, 5=%retail cuts, 6=ribeye shear force.

RT Ultrasound: Eval.=developing or evaluating for performance recording, Y=yes are collecting ultrasound data and pursing in genetic prediction, N=not collecting ultrasound data for use in genetic prediction.

HOW TO QUICKLY AMASS FIELD DATA: REAL-TIME ULTRASOUND??

Given the requirements described to obtain carcass EPD and the problems with obtaining adequate data for genetic evaluation, what is the solution? For the past five years, a national consortium of universities has been working in a project called NC-196 which has had as one of its three objectives to determine the efficacy of using real-time ultrasound imaging to measure body composition and carcass merit traits in beef cattle (Bertrand et al., 1994; Green et al., 1994; Wilson et al., 1994). Much of this research was further discussed and summarized at this past December's 5th BIF Genetic Prediction Workshop (D. Wilson (Ed.)). The conclusions drawn from a compilation of this research indicate: 1) assessment of retail yield amount or percentage on the basis of 12th rib fat thickness (FT) and 12th rib longissimus muscle (LMA) area is slightly less effective using ultrasonic measures on the live slaughter animal as compared to direct measures on the carcass postmortem (Hamlin et al., 1995; Herring et al., 1994; Perkins et al., 1992b); 2) FT is a better predictor of cutability than is LMA in the current cattle population (Hamlin et al., 1995; Herring et al., 1994) although not so of retail product weight, 3) ultrasonic measures of these retail yield indicators appear to be under a moderate degree of genetic control (weighted average h^2 of .37 for FT and .26 for LMA (Shepard et al., 1996; Evans et al., 1995; Robinson et al., 1993; Johnson et al., 1993; Duello et al., 1993; Arnold et al., 1991; Turner et al., 1990; Lamb et al., 1990; deRose et al., 1988), 4) genetic correlation estimates between ultrasonic predictors of carcass merit and other economically important traits are sparse but indicate some antagonism between LMA and mature size (Shepard et al., 1996; Johnson et al., 1993), 5) prediction of intramuscular fatness and palatability traits is more difficult using ultrasound, although rapid progress has been made in the past 24 months (Wilson et al., 1995), and 6) data to estimate relationships between ultrasonic measures in yearling bulls and slaughter steer carcass retail yield and palatability are very limited and thus far have resulted in a very unclear understanding of this relationship (Diles et al., 1996a,b; Wilson et al., 1995; Evans et al., 1995; Steinkamp, 1995; Schalles et al., 1992). Lisa Kriese discusses the use of ultrasound data in the following paper in these proceedings. so I will not belabor the issue here, except to say that *we need to be sure that we have clear and substantive proof that #6 above is favorable before using ultrasound data for genetic prediction.*

In reality, if we want carcass EPDs, we must be willing to bite the bullet and collect the necessary progeny information, whether it be in the form of carcass or ultrasound data. In the interim period until we have more information on the effectiveness of yearling ultrasound data, we need to get serious about amassing carcass data. Several breed associations have now recognized this and are implementing more serious attempts at designed sire evaluation. The part that commercial producers can play in this game is to demand carcass information on the seedstock they purchase. It is amazing what consumer demand can do to move something off of dead center. Seedstock producers can also work to develop calf buy-back programs to get carcass data. We can get the standard information if we try hard to do so. The only area that might be a little tough (no pun intended) is the trait of tenderness.

WHAT ABOUT TENDERNESS?

It seems like we have heard more about beef tenderness in the past two years than in all of the previous 100. As stated previously, beef is perceived to currently have a toughness problem, particularly in relation to cattle of *Bos indicus* descent. There are two ways to handle this problem; tenderize the product post-mortem or genetically fix it. We know that we can electrically stimulate or inject carcasses with calcium chloride post-mortem to reduce toughness problems. However, as my friend Donnell Brown has stated, *"saying that the use of these technologies is the solution to the tenderness problem is like saying that we need not be concerned with growth performance because we have implant technology available or that we need not be concerned with calving ease in first calf heifers because there are companies that make mechanical calf pullers".*

We have been working on the tenderness issue at Colorado State intensively for the past 18 months in a project for the National Cattlemens Beef Association as a part of the National Beef Tenderness Plan. In Phase I of the project, we evaluated tenderness of rib steaks from Limousin- and Charolais-sired steers and heifers aged to end-points of 1, 4, 7, 14, 21, and 35 days post-mortem (Wulf et al., 1996; Green et al., 1996a). We evaluated sire differences in tenderness and in aging response and concluded that: 1) tenderness as assessed by shear force was heritable ($h^2 = .38 \pm .20$); 2) 24-hour calpastatin activity, previously defined by Koohmaraie et al. (1995) as a primary contributing factor to tenderness variation, was highly genetically related to shear force and was heritable ($h^2 = .48 \pm .21$); 3) aging time was overwhelmingly the single most important factor contributing to acceptable ribeye tenderness, and 4) a DNA test for differences in the calpastatin gene revealed statistically significant differences in ribeye tenderness.

Given that previous research had documented a major contributor of tenderness variation to be percentage *Bos indicus* inheritance (Sherbeck et al., 1995; Crouse et al., 1989), we conducted a second phase of this project using 585 cattle of varying Brahman percentage. Those data were presented at the January NCBA Annual Convention in San Antonio (Green et al., 1996b; O'Connor et al., 1996). Major results of this phase of the work were that: 1) aging effects were even more pronounced than in phase I and showed a greater total aging time (21-d) required to insure acceptable tenderness, 2) Brahman inheritance did impair the ultimate tenderness of rib cuts, 3) use of a non *Bos indicus* heat tolerant source of germ plasm did improve tenderness, and 4) a DNA test for differences in the calpastatin gene did detect significant differences in tenderness, taste panel tenderness ratings, and calpastatin activity.

At this point in time, breeders should position themselves on the tenderness issue by collecting progeny shear force data. The recommendation has been made out of our phase I NCA project that shear force data on steaks aged 14 days is needed on 35 progeny per sire in a designed test in order to discriminate the top 10% from the bottom 10% of sires for ultimate beef tenderness (Wulf et al., 1996). While this is relatively costly ($10 to $15 or more per head), perhaps we will be able to make this more economically attractive in the future. This is most necessary in the *Bos indicus* sources of germ plasm and should be a high priority piece of information for producers in the southern geographical zones of the U.S. who are using cattle of Brahman or other Zebu inheritance. For other breeds/breeders, tenderness is one of those "look-see" types of traits. Once you know where you are, you may not need to be too concerned. So a quick look now may be all that is needed.

DNA TO THE RESCUE.......

A lot of attention has been focused, as of late, on the DNA stairway to carcass heaven. Yesterday, we heard Jeremy Taylor summarize results from the large industry-funded carcass gene mapping project that is now being completed after five years of intensive effort at Texas A&M (Taylor et al., 1995). Other researchers have also been looking at various candidate genes, or gene markers to link to economically important trait loci ("ETL"), to see if they are useful as "carcass tests". The calpastatin probe mentioned above is an example of the candidate gene approach (Green et al., 1994, 1996) while the Texas A&M project is an example of the marker approach. These technologies are likely to yield significant accuracy-enhancers for traditional carcass EPDs generated from progeny data. However, there are some significant hurdles which remain to be overcome before "marker-assisted selection" can be widely used. For example, gene markers may not have the same linkage relationships with carcass traits across differing breeds and families. Secondly, understanding pleitropic effects of so-called "ETLs" is no simple task. For qualitative traits like black/red or polled/horned, DNA testing either is, or will be, readily available. Unfortunately, this is unlikely to be the case in the near future for most of our economically important multigenic traits like those discussed here.

Perhaps a more immediate impact will be made by DNA technologies in "bar-coding" of cattle for identity. This application of DNA testing has much farther reaching implications than today's available parentage testing. Ability to DNA identify cattle, and the carcass products which they ultimately produce, would be the ultimate quality control mechanism. *Maybe dreaming, maybe not?*

WE CANNOT SACRIFICE REPRODUCTION

A last point needing emphasis concerns the relationship between carcass measures and measures of reproductive efficiency. There is generally a lack of this type of information in the research literature. The best existing data relating actual carcass measures to reproductive traits comes from a study by MacNeil et al. (1984) at the U. S. Meat Animal Research Center. Table 4 provides a summary of that information and indicates antagonistic relationships between selection to increase retail product yield and age at puberty, services required to settle a cow and mature size. When one considers these estimates in concert with the experiences of the swine industry with pale, soft, and exudative pork (PSE), a definite red flag is raised. **Use of any data for the genetic improvement of carcass merit needs to include potential effects on reproduction and maternal ability to prevent the loss of functional efficiency in the cow herd.**

TABLE 4. GENETIC CORRELATIONS BETWEEN MEASURES OF CARCASS MERIT AND REPRODUCTIVE EFFICIENCY (MACNEIL ET AL., 1984)

Female Trait	Postweaning Gain	Carcass Weight	Fat Trim Weight	Retail Prod. %
Age at puberty	.16	.17	-.29	.30
Wt. at puberty	.07	.07	-.31	.08
Services/conception	1.33	.61	.21	.28
Gestation length	-.10	.03	-.07	.13
Calving difficulty	-.60	-.31	-.31	-.02
Birth weight	.34	.37	-.07	.30
Mature weight	.07	.21	-.09	.25

IMPLICATIONS

Collectively, the information presented in this paper leads to the conclusion that the opportunity exists in the current cattle population to produce the kind of cattle desired at the end product level. Terminal sire lines selected for carcass merit matched with maternal dam lines where emphasis is placed on reproductive efficiency and matching of production potential to environmental resources offer the means to this end. **However, for this type of system to be effective, carcass merit expected progeny differences (EPD) like those described herein must be implemented in national cattle evaluation programs. Progeny data for fat thickness, ribeye area, carcass weight, marbling score, and shear force are needed. DNA markers may be of use to provide additional improvement in accuracy in the future but face significant hurdles yet before being widely useful. Short-term solution to the tenderness problem is available through post-mortem modifications, but in the long-term *Bos indicus* breeders must identify genetically tough sire lines. Commercial beef producers should begin ASAP to not only ask for, but DEMAND carcass information from their seedstock suppliers. Seedstock producers , in turn, should develop strategic alliances with their customers to get carcass information from their calves to jump start this process. In the end, all parties in the industry will reap the rewards.**

In the words of Harlan Ritchie, if we want to become like another ruminant industry, we can sit and do nothing. Our choice is clear, we need to use up our energy to go get the data and thus the carcass EPDs, and quit burning the energy discussing why we can't!

Literature Cited

American Angus Association. 1995. Fall Sire Evaluation Report, October 1995.

Anderson, K. J. 1995. Opportunities to reduce costs through the use of EPDs. Proc. Annual Mtg. of Beef Improvement Federation, Sheridan, WY. pp 101-109.

Crouse, J. D., L. V. Cundiff, R. M. Koch, M. Koohamaraie, and S. C. Seideman. 1989. Comparisons of Bos indicus and Bos taurus inheritance for carcass characterstics and meat palatability. J. Anim. Sci. 67:2661.

Cundiff, L. V., K. E. Gregory, and R. M. Koch. 1990. Growth and carcass characteristics of diverse breeds of cattle used for beef production. In: Proceedings of 2nd Annual Conf. of Amer. Assoc. of Bovine Pract., Kansas City, MO.

de Rose, E. P., J. W. Wilton, and L. R. Schaeffer. 1988. Estimation of variance components for traits measured on station-tested beef bulls. J. Anim. Sci. 66:626.

Diles J. J. B., R. D. Green, H. H. Shepard, L. J. Hughes, and G. L. Mathiews. 1996a. Variation within and between groups of genetically identical nuclear transfer Brangus bulls and steers for growth measures over time. Prof. Anim. Scientist (accepted).

Diles, J. J. B., R. D. Green, H. H. Shepard, L. J. Hughes, G. L. Mathiews, and M. F. Miller. 1996b. Relationships between body measurements obtained on yearling Brangus bulls and measures of carcass merit obtained from their steer, clone-mates. Prof. Anim. Scientist (accepted).

Duello, D. A., D. E. Wilson, and G. H. Rouse. 1993a. The relationship between real-time ultrasound and carcass measurements of 12-13th rib fat thickness and longissimus muscle area in beef cattle. J. Anim. Sci. (submitted).

Duello, D. A., D. E. Wilson, and G. H. Rouse. 1993b. Adjustment procedures and genetic parameter estimates of serial growth and ultrasonically measured carcass traits in performance-tested yearling bulls, J. Anim. Sci. (submitted).

Melton, B. E. 1995. Conception to consumption: The economics of genetic improvement. Proc. Annual Mtg. Beef Improvement Federation, Sheridan, WY. pp 40-87.

Melton, B. E., E. O. Heady, and R. L. Willham. 1979. Estimation of economic values for selection indices. An. Prod. 28:279.

NCA. 1992. Improving the consistency and competitiveness of beef: Final report of the national beef quality audit -- 1991.

NCA. 1993. Issues....affecting the beef industry. August/September 1993.

NCA. 1994. National Beef Tenderness Plan. July 1994.

NCA. 1994. Long Range Plan for the Beef Industry. Long Range Plan Task Force Report.

Perkins, T. L., R. D. Green, and M. F. Miller. 1992b. Evaluation of alternative ultrasound measurement sites as estimators of yield grade factors in beef cattle. Proceedings Western Sect. Amer. Soc. Anim. Sci. 43:294.

Robinson, D. L., K. Hammond, and C. A. McDonald. 1993. Live animal measurement of carcass traits: Estimation of genetic parameters for beef cattle. J. Anim. Sci. 71:1128.

Schalles, R. R. 1992. Ribeye area EPD's for Brangus cattle. In: Proceedings of "Looking Under the Hide" Symposium, Brinks Brangus Field Day, October 1992.

Shackelford, S. D., M. Koohmaraie, L. V. Cundiff, K. E. Gregory, G. A. Rohrer, and J. W. Savell. 1994. Heritabilities and phenotypic and genetic correlations for bovine postrigor calpastatin activity, intramuscular fat content, Warner-Bratzler shear force, retail product yield and growth rate. J. Anim. Sci. 72:857.

Shepard, H. H., R. D. Green, B. L. Golden, K. E. Hamlin, T. L. Perkins, and J. B. Diles. 1996. Genetic parameter estimates for live animal ultrasonic measures of carcass merit in Angus cattle. J. Anim. Sci. 74:761.

Sherbeck, J. A., J. D. Tatum, T. G. Field, J. B. Morgan, and G. C. Smith. 1995. Feedlot performance and palatability traits of Hereford and Hereford X Brahman steers. J. Anim. Sci. 73:3613.

Smith, G. C., J. W. Savell, H. R. Cross, Z. L. Carpenter, C. E. Murphey, G. W. Davis, H. C. Abraham, F. C. Parrish, and B. W. Berry. 1987. Relationship of USDA quality grades to palatability of cooked beef. J. Food Quality 10:269.

Steinkamp, K. 1995. Validation of real-time ultrasound measurements in live Angus cattle to predict body composition. Proc. Annual Mtg. of Beef Improvement Federation, Sheridan, WY. pp 263-265.

Taylor, J. R., S. K. Davis, J. O. Sanders, J. W. Turner, J. W. Savell, R. K. Miller, and S. B. Smith. 1995. Localization of genes influencing carcass merit in a Bos indicus x Bos taurus cross. Proc. Annual Mtg. Beef Improvement Federation, Sheridan, WY. pp 247-258.

Turner, J. W., L. S. Pelton, and H. R. Cross. 1990. Using live animal ultrasound measures of ribeye area and fat thickness in yearling Hereford bulls. J. Anim. Sci. 68:3502.

Evans, J. L., B. L. Golden, D. R. C. Bailey, R. P. Gilbert, and R. D. Green. 1995. Genetic parameter estimates of ultrasound measures of backfat thickness, loineye muscle area, and gray shading score in Red Angus cattle. Proc. Western Sect. Amer. Soc. Anim. Sci. 46:202.

Green, R. D. 1995. Is it possible to lower costs in an era of increasing technology? Proc. of Annual Mtg. of Beef Improvement Federation, Sheridan, WY, pp 90-100.

Green, R. D. 1995. Why do carcass EPD not already exist? Proceedings of 5th BIF Genetic Prediction Workshop, Kansas City, MO, December 1995. pp 69-75.

Green, R. D., N. E. Cockett, J. D. Tatum, D. M. Wulf, D. L. Hancock, and G. C. Smith. 1996a. Association between polymorphisms in the bovine calpastatin gene and measures of beef palatability from Limousin- and Charolais-sired steers and heifers. J. Anim. Sci. (submitted).

Green, R. D., N. E. Cockett, J. D. Tatum, S. F. O'Connor, D. L. Hancock, and G. C. Smith. 1996b. Association between polymorphisms in the bovine calpastatin gene and measures of beef palatability from *Bos taurus* and *Bos taurus-Bos indicus* steers and heifers. J. Anim. Sci. (submitted).

Green, R. D., N. E. Cockett, M. F. Miller, D. L. Hancock, C. Bidwell, L. S. Barrett, J. B. Morgan, and J. D. Tatum. 1994. Characterization of TaqI polymorphisms in the bovine calpastatin gene. Proceedings 5th World Congress on Genetics as Applied to Livestock Production 19:450.

Gregory, K. E., L. V. Cundiff, and R. M. Koch. 1995. Genotypic and phenotypic (co)variances for growth and carcass traits of purebred and composite populations of beef cattle. J. Anim. Sci. 73:1920.

Hamlin, K. E., R. D. Green, L. V. Cundiff, T. L. Wheeler, and M. E. Dikeman. 1995. Real-time ultrasonic measurement of fat thickness and Longissimus muscle area in diverse biological types of beef steers: II. Relationship between real-time ultrasound measures and carcass retail yield. J. Anim. Sci. 73:1725.

Herring, W. O., S. E. Williams, J. K. Bertrand, L. L. Benyshek, and D. C. Miller. 1994. Comparison of live and carcass equations predicting percentage of cutability, retail product weight and trimmable fat in beef cattle. J. Anim. Sci. 72:1107.

Johnson, M. Z., R. R. Schalles, M. E. Dikeman, and B. L. Golden. 1993. Genetic parameter estimates of ultrasound-measured Longissimus muscle area and twelfth-rib fat thickness in Brangus cattle. J. Anim. Sci. 71:2623.

Koohmaraie, M., J. Killefer, M. D. Bishop, S. D. Shackelford, T. L. Wheeler, and J. R. Arbona. 1995. Calpastatin based methods for predicting meat tenderness. In: A. Ouli, D. Demeyer, and F. Smulders (Ed.). "Expression, Regulation and Role of Proteinases in Muscle Development and Meat Quality". pp 395-412. ECCEAMST (European Consortium for Continuing Education in Advanced Meat Science and Technology), Utrecht, The Netherlands.

Lamb, M. A., O. W. Robison, and M. W. Tess. 1990. Genetic parameters for carcass traits in Hereford bulls. J. Anim. Sci. 68:64.

Macneil, M. D., L. V. Cundiff, C. A. Dinkel, and R. M. Koch. 1984. Genetic correlations among sex-limited traits in beef cattle. J. Anim. Sci. 58:1171.

Marshall, D. 1994. Breed differences and genetic parameters for body composition traits in beef cattle. J. Anim. Sci. 72:2745.

Wilson, D. E. 1995. Carcass and live animal evaluation. Proceeding of 5th BIF Genetic Prediction Workshop, Kansas City, MO, December 1995. pp 25-34.

Wilson, D.E. 1992. Application of ultrasound for genetic improvement. J. Anim. Sci. 70:973.

Wulf, D. M., J. D. Tatum, R. D. Green, J. B. Morgan, B. L. Golden, and G. C. Smith. 1996. Genetic influences on beef palatability in Charolais- and Limousin-sired steers and heifers. J.Anim. Sci. (accepted).

ULTRASOUND: PAST PITFALLS AND PRESENT PROMISE

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In 1988, a group of interested researchers attended a workshop at Cornell University to observe the use of ultrasound to measure 12th rib fat thickness (BF) and longissimus muscle or ribeye area (LMA) in finished cattle. Ultrasound technology for livestock was not a new technology. It was first introduced for livestock in the 1950's. However, it was not until the late 70's and early 80's that ultrasound equipment advanced sufficiently to be of real use in livestock. At the Cornell workshop, an individual from each institution represented received instruction on how to obtain and interpret ultrasound images. It was then left to the researchers to return home, acquire the technology and determine how ultrasound technology could best be used.

At this same time, increased emphasis was being placed on carcass characteristics and value in the beef industry. Could ultrasound possibly be a link between the live animal and carcass characteristics? At what age could cattle be measured and accurately predict carcass measurements? Did the technology hold any promise?

12th Rib Fat Thickness and Longissimus Muscle Area

Several institutions began studies using ultrasound technology. There were numerous questions to answer prior to using this technology extensively in the beef cattle industry. The first questions to be answered were could measurements be taken accurately and when do measurements need to be taken for the best results. The results of several researchers have shown (Brethour, 1992, Perkins et al., 1992, Waldner et al., 1992 and Herring et al., 1994) that ultrasonic measurement of BF and LMA in beef cattle can be measured with accuracy and repeatability. Researchers found cattle with large amounts of BF or LMA were generally underestimated using ultrasound. Conversely, cattle with small

Table 1. Frequency comparison of ultrasonically measured backfat (BF) and longissimus muscle area (LMA) in lives steers to corresponding carcass measurements

BF		LMA	
± in	Cumulative %[b]	± in^2	Cumulative %[b]
.04	58	0.47	32
.08	84	0.95	79
.12	90	1.42	88
.16	98	1.90	97
.20	100	2.40	100

[a] 127 steers killed within 7 days after scanning with Techicare 210 DX II
[b] Total percentage of steers whose ultrasonic measurements was within the indicated range of the actual corresponding carcass measurement

amounts of BF or LMA were overestimated using ultrasound. Houghton (1988) presented a frequency distribution of cattle which could be measured within a certain set limit for BF and LMA (Table 1). From the data, most cattle were measured within a very acceptable range. However, some cattle will fall outside the accepted range and this must be accepted as part of the technology. Waldner et al. (1992) serially slaughtered Brangus bulls from 4 mo. of age until 24 mo of age. They found cattle could be most accurately measured for BF and LMA at 12 mo of age (Table 2). Examining the differences seen in the Waldner study and using the results from the Houghton study indicates most animals can be measured within .10 inches for 12th rib fat and 1.20 square inches for longissimus muscle area. Additional research has shown that the technicians taking and interpreting BF and LMA images are important. For quality images to be taken, the technician must be knowledgeable about cattle anatomy, ultrasound technology and experienced taking and interpreting images (McLaren et al., 1991, Waldner et al., 1992, Herring et al., 1994). As technicians gain experience, their ability to interpret images also increases and therefore decreases measurement error. Also, the type of ultrasound machine technicians use does not seem to be important once the technician is trained and experienced in measuring BF and LMA. In general, ultrasound measurements on individual animals will not be exact. However, ultrasound images need to be taken by experienced technicians for best results. Care must be taken when using raw ultrasound values to make decisions as with any unadjusted weight or measure.

Table 2. Absolute differences between scanned and carcass measurements for backfat (BF) and longissimus muscle area (LMA) in serially slaughtered Brangus bulls.

Age	BF, in	LMA, in^2
8	--	1.54
12	.05	1.16
16	.05	1.69
20	.15	1.63
24	.26	2.28

The next step is to determine whether ultrasound measures can be effectively used in genetic evaluations. Genetic parameters need to be estimated from data to determine genetic relationships between yearling ultrasound and carcass measurements for BF and LMA. The direction and magnitude of these genetic correlations will help determine whether ultrasound technology can be successfully used in genetic evaluation programs.

To date, there have been few studies completed which were able to look at the genetic aspects of ultrasound for BF and LMA. Arnold et al. (1989) and Turner et al. (1990) studied yearling ultrasound records from Hereford cattle. Johnson et al. (1993) examined yearling Brangus data, while Evans and Golden (1995) worked with 2000 Red Angus observations. Shepard et al. (1996) analyzed records from the American Angus

Table 3. Reported heritability estimates for yearling ultrasound 12th rib backfat (BF) and longissimus muscle area (LMA).

Investigator and Year	Breed	h^2_{BF}	h^2_{LMA}
Arnold et al., 1989	Hereford	.26	.28
Turner et al., 1990	Hereford	.04	.12
Johnson et al., 1993	Brangus	.14	.40
Kriese (unpublished)	Brangus	.29	.37
Evans and Golden, 1995	Red Angus	.53	.46
Shepard et al., 1996	Angus	.56	.11

Association. Additionally, in 1989, a herd of purebred Brangus cattle was established at Auburn University to determine if genetic selection could be effective in increasing ribeye area based on ultrasonic measurement of ribeye area at yearling age. To date 719 yearling ultrasound and 465 carcass records have been collected from bulls, steers and heifers for BF and LMA. A review of the heritability estimates is found in Table 3. In general, heritability estimates for BF and LMA using yearling ultrasound records are lower than estimates seen in the literature for carcass 12th rib fat or longissimus muscle area. However, these heritabilities are well in the range of other traits currently being used in genetic evaluation programs (i.e. birth or weaning weight).

Given that heritability estimates for yearling ultrasound BF and LMA were seen to be lower than heritability estimates of carcass 12th rib fat and longissimus muscle area, the next question to ask is whether yearling ultrasound measurements for BF and LMA are the same traits as measured in the carcass. To answer this question, genetic correlations between BF and carcass BF (CBF) and LMA and carcass LMA (CLMA) must be estimated.. To date, the only study with an estimate of these correlations is the Auburn Brangus study. Using all bull, steer and heifer yearling records in a multiple trait analysis, the genetic correlation between BF and CBF was estimated to be .84. Additionally, the genetic correlation between LMA and CLMA was estimated to be .81. Both of these correlations suggest yearling ultrasound measurement of 12th rib fat thickness and longissimus muscle area are not the same trait in the carcass, but are controlled by many of the same genes. If yearling ultrasound measurements were used to select potential breeding stock, this means the producer would be selecting indirectly for carcass 12th rib fat or longissimus muscle area.

Two other genetic correlations are also of interest. For ultrasound technology to be useful in the purebred cattle industry, cattle must be selected at yearling. Therefore, it is important to have estimates of the genetic correlations between BF and LMA and CBF and CLMA. Arnold et al. (1989) estimated the genetic correlation between BF and LMA to be .48. This is similar to the correlation found by Golden and Evans (1995) of .40 and Kriese (unpublished data) of .23. Estimates of the genetic correlation between CBF and CLMA include -.37 (Arnold et al., 1989) and -.50 (Kriese, Brangus study). Arnold et al. (1989) hypothesized the genetic correlation between BF and LMA was an indication of growth, while the correlation between CBF and CLMA was an indication of maturity. Evans and Golden (1995) hypothesized selecting cattle with small amounts of backfat based on ultrasound at yearling age would result in progeny with more, instead of less, backfat at slaughter. They worked with models of the typical animal growth curve combined with the genetic correlation estimates to form this hypothesis. Currently, it appears these two genetic correlations are antagonistic and represent different points on the growth curve. However, the relationships between a bull selected on yearling ultrasound data and his progeny's carcass data must be investigated.

To investigate the genetic relationships among BF and LMA in bulls and CBF and CLMA in steers an eight-trait modified bivariate analysis was completed using the Auburn Brangus data. From this analysis, the genetic correlation between BF in bulls and CBF in steers was .76 (Table 4). This genetic correlation suggests Brangus bulls with less 12th rib fat thickness at yearling will sire calves with less 12th rib fat thickness at slaughter. This finding does not support the hypothesis presented by Evans and Golden (1995). However, one consideration in using 12th rib fat thickness in bulls at yearling as a selection criterion is the relatively low variation in 12th rib fat thickness generally seen in yearling bulls not developed on high energy diets that will show genetic differences for 12th rib fat thickness. Additionally, the genetic correlation between LMA in bulls and CLMA in steers was .48. Although this is not as high as the genetic correlation seen when all sexes were analyzed together, it is still favorable and indicates genetic change can be achieved.

Table 4. Estimates of Heritabilities and Genetic Correlations among Yearling Ultrasound and Carcass Traits in Brangus Bulls and Steers[1]

	Bull				Steer			
Trait	BF	CBF	LMA	CLMA	BF	CBF	LMA	CLMA
Bull BF	.46							
Bull CBF	.34	.09						
Bull LMA	.27	.58	.73					
Bull CLMA	.07	.27	.85	.23				
Steer BF	.90	.19	.46	.25	.67			
Steer CBF	.76	.37	.45	.30	.84	.50		
Steer LMA	.39	.28	.71	.43	.59	.25	.79	
SteerCLMA	.19	.28	.48	.32	.16	-.26	.75	.67

[1] BF = ultrasound measured backfat, CBF = carcass measured backfat, LMA = ultrasound measured ribeye area, CLAM = carcass measured ribeye area, All ultrasound measurements were taken at yearling age and between the 12th and 13th rib. Heritability estimates on diagonal, genetic correlations below diagonal.

Intramuscular Fat

As discussed in the previous section, yearling measurement of 12th rib fat and longissimus muscle area can be taken accurately and repeatably. In the last three years, ultrasound technology and software to measure percent intramuscular fat and marbling have been developed. This latest ultrasound technology must answer the same questions as 12th rib fat and longissimus muscle area to determine its accuracy and repeatability. However, at this time, measurement of percent intramuscular fat is system dependent. Currently, there are no less than five different algorithms to measure percent intramuscular fat each with there own set of hardware and software configurations.

To begin to assess different systems or technologies, 82 Brangus cattle were used which were part of a real-time ultrasound selection study conducted at the Lower Coastal

Plains Substation in Camden, AL. Steers, bulls and heifers were represented in this population and were fed a corn silage based finishing ration.

In June 1995, cattle were measured for percent intramuscular fat using three technologies. Two squeeze chutes were placed in the cattle working area. Cattle entered the first squeeze chute and were measured on the left side using technology developed by Animal Ultrasound Services, Inc. (AUS). Cattle left this squeeze chute and immediately entered a second squeeze chute. Cattle were measured on the left side with technology developed by Iowa State University and on the right by technology developed by Kansas State University (KSU). Two different images were taken on each animal using the Iowa State technology (ISUA and ISUB). ISUA and ISUB were averaged to give a third percent intramuscular fat estimate (ISUC). Animal Ultrasound Services, Inc. and Iowa State technologies estimated intramuscular fat percentage. Kansas State technology measured marbling and used a prediction equation to estimate intramuscular fat percentage.

One technician for each technology measured all cattle and interpreted the images. Each technician was highly skilled with the respective system. Cattle were measured once for percent intramuscular fat using each technology. Both the ISU and AUS technologies measured percent intramuscular fat using an Aloka 500V ultrasound unit with a 17.2 cm, 3.5 MHz tranducer. The KSU technology measured cattle using an Aloka 210DX ultrasound unit with a 10.7 cm, 3.5 MHz transducer.

Cattle were divided into two slaughter groups due to marketing limitations of the slaughter facility. The first group was slaughtered six days after measurement of percent intramuscular fat. The second group was slaughtered 29 days after measurement. Cattle were transported nine hours and slaughtered at Central Packing in Center Hill, FL, and carcass measurements of backfat, ribeye area, USDA quality grade, percent kidney heart and pelvic fat and USDA yield grade obtained. The same USDA grader was not present at each slaughter time to evaluate carcasses. A 1.0 in steak was removed from the longissimus muscle on the left side of the carcass. The steak was transported to Auburn University and chemically analyzed for percent intramuscular fat using an ether extractable fat procedure (AOAC, 1988) with petroleum ether.

Percent intramuscular fat data were analyzed with correlation and analysis of variance procedures of SAS (SAS, 1988). For these analyses, percent intramuscular fat as determined by the ether extractable fat percentage procedure (ETHER) was used as the true value of percent intramuscular fat. The USDA grader's evaluation of marbling in the ribbed carcass was converted to a percent intramuscular fat (CARC) value using the regression equation of Savell et al. (1986). Even though CARC was produced from a prediction equation, the value of CARC is primarily dependent on the USDA grader's ability to accurately grade cattle. The USDA grader's evaluation of marbling was also converted to a numerical score (traces = 300, slight = 400, small = 500, etc., MARB). ETHER values were compared to AUS, ISUA, ISUB, ISUC and KSU values of percent intramuscular fat in the Pearson and Spearman Rank correlation analyses within slaughter group. MARB values were also compared to ETHER, AUS, ISUA, ISUB, ISUC and KSU values of percent intramuscular fat by slaughter group in correlation analyses. As mentioned previously, KSU technology measures marbling score and was translated into a percent intramuscular fat percentage. KSU marbling score was not analyzed in this correlation analysis since it would produce the same Pearson and Spearman Rank correlations as the percent intramuscular fat estimate.

To determine how each technology, including the USDA grader, compared to percent intramuscular fat determined by ether extractable fat percentage, ETHER was subtracted from each technologies estimate of percent intramuscular fat (DIFF). Additionally, the absolute value of this difference was taken (ADIFF). DIFF measures whether each technology over or under estimated the true percent intramuscular fat. ADIFF indicates the magnitude of the measurement and interpretation error. These two differences were analyzed using the GLM procedure of SAS. Independent variables included in the model were sex of calf, slaughter group and technology (CARC, ISUA, ISUB, ISUC, AUS and KSU). Two way interactions of slaughter group by sex of calf, technology by slaughter group and technology by sex of calf were also included in the model, plus the three way interaction of technology by slaughter group by sex of calf. Animal within sex of calf and slaughter group was included in the model to account for animal differences and used as the error term for main effects of slaughter group and sex of calf and the interaction of slaughter group by sex of calf. Residual error was used to test the effects of technology and remaining two- and three-way interactions.

Table 5 describes the population of cattle slaughtered in this study by sex and slaughter group. Although cattle were to be slaughtered when measuring 10 mm backfat using real-time ultrasound, slaughtered bulls and steers did not meet this target endpoint on average in slaughter group 2. This resulted in lower USDA Yield Grades and marbling scores in slaughter group 2. Carcass weights, ribeye area and percent ether extractable fat were similar across slaughter groups.

Table 6 contains Spearman Rank correlation coefficients by slaughter group of percent intramuscular fat as determined by ether extractable fat procedures and the USDA graders evaluation of marbling compared to ultrasound technologies estimate of intramuscular fat percentage. In slaughter group 1, all Spearman Rank correlation coefficients were significantly different from zero ($P<.05$) except for AUS technology. Neither the correlation between ETHER and AUS or MARB and AUS were statistically different from zero. From the results in Table 2, the KSU technology had the highest rank correlations with both ETHER and MARB. Again, the KSU technology measured marbling, while the other technologies measured percent intramuscular fat. Also, the KSU technology had a slightly higher Spearman Rank correlation with ETHER than the USDA grader had with ETHER. ISU technologies produced higher Spearman Rank correlations with MARB than ETHER and were moderate in their success.

KSU technology correlated slightly lower with ETHER and MARB in slaughter group 2 than was seen in slaughter group 1. The Spearman Rank correlations between KSU and ETHER and KSU and MARB were still similar with the USDA grader's evaluation of marbling. However, the USDA grader did correlate better in slaughter group 2 with ETHER than any of the ultrasound technologies and was consistent across slaughter groups. The three

ISU technologies did not correlate well with either ETHER or MARB in slaughter group 2. All Spearman Rank correlation coefficients were not significantly different from zero (P>.05) between the ISU technologies and ETHER. ISUB and ISUC technologies correlated negatively with MARB in slaughter group 2. The AUS technology produced Spearman Rank correlations between AUS and MARB and AUS and ETHER that were intermediate in magnitude.

In the analysis of variance of DIFF, the three way interaction of technology by slaughter group by sex of calf was significant (P<.01) (Table 7). Each technology overestimated percent intramuscular fat by an average 1.22%. Cattle slaughtered in the second group were estimated more closely for percent intramuscular fat than cattle slaughtered in the first group (1 = 1.50%, 2 = .87%, P<.01). Table 8 contains least squares means by technology, slaughter group and sex of calf for DIFF. Looking within slaughter group 1, all technologies overestimated percent intramuscular fat across all sexes. The USDA grader and AUS technologies overestimated percent intramuscular fat significantly more than KSU or ISU technologies in slaughter heifers and steers (P<.05). For slaughter bulls, AUS significantly overestimated percent intramuscular fat more than other technologies (P<.05). Looking across sexes in slaughter group 1, all technologies overestimated percent intramuscular fat equally except for AUS. AUS significantly overestimated percent intramuscular fat in bulls as compared to heifers and steers.

Examining DIFF results across slaughter group 2, all technologies again overestimated percent intramuscular fat except CARC, which underestimated percent intramuscular fat in slaughter bulls and steers. Slaughter group 2 was killed 29 days after ultrasound measurement. In general, heifers and steers were overestimated by a smaller percent intramuscular fat than slaughter group 1. However, this was not statistically significant. This is not surprising since these cattle were on feed longer and deposited additional amounts of fat. However, slaughter bulls were overestimated by the same amount using the KSU and ISU technologies in slaughter group 2 as was seen in slaughter group 1. This may indicate bulls slaughtered in group 2 had deposited all the intramuscular fat physiologically possible at time of measurement and were only gaining weight during the additional 29 days of feeding.

In general, bulls were overestimated more for percent intramuscular fat than either heifers or steers. From this analysis, the KSU and ISU technologies were as good in predicting percent intramuscular fat as USDA grader evaluations, which is the current industry standard.

The same patterns were seen when the absolute differences between ETHER and the technologies were analyzed. The ADIFF analysis shows how accurately cattle were measured. The three way interaction of technology, slaughter group and sex of calf was a significant source of variation in this analysis (P<.01) Examining least squares means for this interaction (Table 9), showed KSU and ISU technologies more accurately estimated percent intramuscular fat in heifers and bulls in slaughter group 1 than the USDA grader or AUS (P<.05). For steers in slaughter group 1, AUS did not as accurately estimate percent intramuscular fat as other technologies (P<.05). The same trends were seen in slaughter group 2.

From this validation study using 82 Brangus cattle, there are differences between currently available ultrasound technologies estimating percent intramuscular fat in live cattle. In this study all technologies, including the USDA grader, on average overestimated percent intramuscular fat as compared to percent intramuscular fat measured by ether extractable fat procedures. KSU and ISU technologies did not overestimate percent intramuscular more than USDA grading methods. Examining actual and absolute values of the differences between the technology and the ether extractable fat values, KSU and ISU technologies were at least as accurate as the USDA grader. KSU and ISU technologies will estimate percent intramuscular fat within 1.4% regardless of sex. AUS technology overestimated percent intramuscular fat percentage significantly more than other technologies and was not as accurate as other technologies in estimating intramuscular fat percentage using this set of cattle.

Where are we and Where are we going with Ultrasound Technology?

In my opinion, ultrasound is a strong viable option in predicting carcass EPDs in young cattle for 12th rib fat and longissimus muscle area. Several studies have estimated heritabilities for these two traits and a few have estimated genetic correlations between these traits. There appears to be antagonistic genetic correlations between ultrasound measures and carcass measures of the same trait. However, should ultrasound measurements just be used to estimate carcass EPDs? The answer is probably not. A strong analysis would combine carcass data with ultrasound measurements in a multiple trait analysis. This would account for any antagonistic correlations present. A young sire could have several hundred ultrasound measurements taken on progeny prior to his first progeny slaughtered and have a moderately accurate prediction. Carcass data would just solidify the EPD predictions on that young sire.

Current ultrasound technology for intramuscular fat or marbling is still developing. From the study completed in Alabama in 1995, it appears prediction of percent intramuscular fat in finished cattle is system dependent. As inexperienced technicians begin to use the various systems, percent intramuscular fat predictions will be affected by both system used and technician. From this first examination of the technologies, it appears promising, but still has room for refinement. The question of whether this technology can be used for genetic improvement is not even close to a preliminary answer.

From this comes a few pitfalls. The pitfalls are the same ones present in 1988 and are some of the same pitfalls seen in traditional progeny tests. To determine whether ultrasound measurement for carcass traits will be a good genetic predictor of carcass traits, large quantities of data must be present. Universities have started research projects attempting to answer some of these questions, but can not afford extremely large cattle populations. Therefore, researchers need producers to cooperate in measuring cattle to build the data bases to answer the questions. While it is easy to measure cattle at yearling age, the technology does not come without a cost and carcass data is even more expensive.

Many producers are saying the technology (especially for 12th rib fat and longissimus muscle area) is not accurate enough. Measuring within .05 inches on 12th rib fat and 1.2 square inches for longissimus muscle area on an animal is just not close enough. However, much of the problem may not lie with the technology, but with how the measurements are being used. Little research has been completed on age or weight adjustment factors so measurements can become adjusted. Few people calculate a ratio with the ultrasound measurements. Producers are using a raw, unadjusted measurement to select cattle on. Mistakes can definitely be made using raw, unadjusted data.

But many of the pitfalls are the result of our beef industry clamoring to improve the quality and consistency of our product. Immediate answers and fixes are needed. Find the genetic misfits and eliminate them from the population. Conducting traditional progeny tests will take 4 to 5 years to find misfit carcass sires. In the mean time, he may have sired many progeny and has daughters in production because of other desirable attributes. So, ultrasound technology has been hurried along trying to be the tool which can rapidly fix carcass problems. Producers have been involved from the start, because without producers, enough data could not have been collected to have the answers we currently do on ultrasound.

If ultrasound measurements are deemed unusable in genetic evaluation programs, the only option left is traditional progeny tests for genetic improvement of carcass traits. In 1987, an initiative was set forth to evaluate beef cattle for carcass traits. Researchers have the technology to produce EPDs for carcass traits, but for most breeds there is not enough carcass data collected. If ultrasound technology fails, the beef industry is back to square one and must hope that molecular biology will bring the answer. However, with good data bases of ultrasound measurements, a multiple trait model and some carcass data, I believe we can make progress in identifying the misfits and change cattle populations positively.

Literature Cited

AOAC. 1988. Official Methods of Analysis, 14th ed. Association of Official Analytical Chemists, Washington, D.C.

Arnold, J.A., J.K. Bertrand and L.L. Benyshek. 1989. In: Proceedings for the Third Genetic Prediction Workshop. BIF. October 16-19, 1989. p. 52.

Bethour, J.R. 1992. The repeatability and accuracy of ultrasound in measuring backfat of cattle. J. Anim. Sci. 70:1039

Evans, J.L. and B.L. Golden. 1995. Do ultrasound measurements in yearling seedstock reflect carcass merit in slaughter progeny? In:Amer. Red Angus Journal. 8:34.

Herring, W.O., D.C. Miller. J.K. Bertrand and L.L. Benyshek. 1994. Evaluation of machine, technician, and interpreter effects on ultrasonic measures of backfat and longissimus muscle area in beef cattle. J. Anim. Sci. 72:2216.

Houghton, P.L. 1988. Application of ultrasound in commercial feedlots and breeding programs. pp 89-99. Beef Improvement Federation Proc., Albuquerque, NM.

Johnson, M.Z., R.R. Schalles, M.E. Dikeman and B.L. Golden. 1993. Genetic parameter estimates of ultrasound-measured longissimus muscle area and 12th rib fat thickness in Brangus cattle. J. Anim. Sci. 71:2623.

McLaren, D.G., J. Novakofski, D.F. Parrett, L.L. Lo, S.D. Singh, K.R. Neumann and F.K. McKeith. 1991. A study of operator effects on ultrasonic measures of fat depth and longissimus muscle area in cattle, sheep and pigs. J. Anim. Sci. 69:54.

Perkins, T.L., R.D. Green, K.E. Hamlin, H.H. Shepard and M.F. Miller. 1992. Ultrasonic prediction of carcass merit in beef cattle: Evaluation of technician on ultrasonic estimates of carcass fat thickness and longissimus muscle area.

Robinson, D.L., C.A. McDonald, K. Hammond and J.W. Turner. 1992. Live animal measurement of carcass traits by ultrasound: Assessment and accuracy of sonographers. J. Anim. Sci. 70:1667.

SAS. 1988. SAS/STAT User's Guide:Statistics (Release 6.03). SAS Inst., Inc., Cary, NC.

Savell, J.W. , H.R. Cross and G.C. Smith. 1986. Percent ether extractable fat and moisture content of beef longissimus muscle as related to USDA marbling score. J. Food Sci. 51:838.

Shepard, H.H., R.D. Green, B.L. Golden, K.E. Hamlin, T.L. Perkins and J.B. Giles. 1996. Genetic parameter estimates of live animal ultrasonic measures of retail yield indicators in yearling breeding cattle. J. Anim. Sci. 74:761.

Turner, J.W., L.S. Pelton and H.R. Cross. 1990. Using live animal ultrasound measures of ribeye area and fat thickness in yearling Hereford bulls. J. Anim. Sci. 68:3502.

Waldner, D.N., M.E. Dikeman, R.R. Schalles, W.G. Olson, P.L. Houghton, DJ Unruh and L.R. Corah. 1992. Validation of real-time ultrasound technology for predicting fat thickness, longissimus muscle areas, and composition of Brangus bulls from 4 months to 2 years of age. J. Anim. Sci. 70:3044.

Table 5. Simple means and standard deviations of cattle population by slaughter group and sex used in ultrasound intramuscular fat percentage validation study

	Slaughter Group 1			Slaughter Group 2		
Variable	Bull	Heifer	Steer	Bull	Heifer	Steer
Number	7	18	16	24	7	8
Carcass Wt, kg	366.95 ± 33.27	263.81 ± 30.23	331.36 ± 29.08	369.20 ± 36.84	263.83 ± 28.90	346.19 ± 39.86
Ultrasound Backfat, mm	8.97 ± 2.94	10.81 ± 2.90	9.85 ± 3.34	5.03 ± 1.75	9.13 ± 3.02	5.99 ± 2.21
Carcass Backfat, mm	8.89 ± 4.34	10.07 ± 4.02	11.67 ± 5.68	5.82 ± 1.59	7.98 ± 2.29	7.94 ± 3.94
Carcass REA, cm^2	87.47 ± 10.91	69.61 ± 8.23	77.06 ± 9.12	84.33 ± 10.42	69.12 ± 7.08	79.27 ± 10.80
KHP, %	2.14 ± .80	2.61 ± .32	2.34 ± .35	1.40 ± .66	2.71 ± .49	2.44 ± .73
USDA Yield Grade	2.43 ± .61	2.83 ± .38	2.88 ± .96	1.50 ± .71	2.14 ± .38	2.50 ± 1.07
Ether Extractable Fat, %	2.37 ± .61	3.29 ± 1.27	3.68 ± 1.53	2.44 ± .59	3.41 ± .82	3.65 ± 1.29
Slaughter Age, days	453.71 ± 26.63	453.39 ± 30.81	467.56 ± 29.64	479.38 ± 31.31	464.00 ± 31.30	484.38 ± 30.26
Marbling Score, units	398.57 ± 40.59	471.67 ± 62.71	489.38 ± 67.57	192.08 ± 42.01	408.57± 101.40	305.00± 122.12

Table 8. Least squares means of technology by slaughter group by sex of calf for DIFF (%) [a]

	Slaughter Group 1			Slaughter Group 2		
	Sex			Sex		
Technology[b]	Heifer	Bull	Steer	Heifer	Bull	Steer
CARC	1.90^{d}	1.88^{c}	1.73^{d}	$.97^{c}$	$-.80^{d}$	$-.58^{d}$
KSU	1.07^{c}	1.13^{c}	$.97^{c}$	$.32^{c}$	$.79^{c}$	$.61^{c}$
ISUA	1.11^{c}	1.43^{c}	$.87^{c}$	$.38^{c}$	1.48^{e}	$.30^{c}$
ISUB	$.89^{c}$	1.23^{c}	$.79^{c}$	$.45^{c}$	1.50^{e}	$.10^{c,d}$
ISUC	1.00^{c}	1.33^{c}	$.84^{c}$	$.42^{c}$	1.51^{e}	$.20^{c}$
AUS	2.03^{d}	4.48^{d}	2.29^{d}	3.29^{d}	2.90^{f}	1.88^{d}

[a] DIFF = Each technologies estimate of percent intramuscular fat minus percent ether extractable fat.
[b] CARC = USDA grader's estimation of percent intramuscular fat, KSU = Kansas State University ultrasound technology, ISUA, ISUB, ISUC = Iowa State University ultrasound technology, AUS = Animal Ultrasound Services, Inc. technology
[c,d,e,f] Different subscripts within columns indicate significant differences among technologies ($P<.05$).

Table 6. Spearman rank correlation coefficients for percent ether extractable fat and USDA marbling score by slaughter group with ultrasound technologies measuring percent intramuscular fat

	Slaughter Group 1						Slaughter Group 2					
	MARB[a]	KSU	ISUA	ISUB	ISUC	AUS	MARB	KSU	ISUA	ISUB	ISUC	AUS
ETHER	0.69	0.72	0.34	0.42	0.49	.11[ns]	.69	.58	-.07[ns]	.06[ns]	.06[ns]	.13
MARB		0.75	0.57	0.57	0.64	-.12[ns]		.65	-.12[ns]	-.19	-.19	.28

[a] ETHER = percent intramuscular fat as determined by ether extractable fat procedures, MARB = USDA grader's evaluation of marbling, KSU = Kansas State University ultrasound technology, ISUA, ISUB, ISUC = Iowa State University ultrasound technology, AUS = Animal Ultrasound Services, Inc. technology.

[ns] Spearman Rank Correlation Coefficients not significantly different from zero (P>.10)

Table 7. Analysis of variance table and level of significance

Variable	df	Dependent Variable[a]	
		DIFF	ADIFF
Slaughter Group[b]	1	P<.05	P<.05
Sex of calf[b]	2	P<.05	n.s.[d]
Slaughter group x sex of calf[b]	2	n.s.	n.s.
Technology[c]	5	P<.01	P<.01
Technology x slaughter group[c]	5	P<.01	P<.05
Technology x sex of calf[c]	10	P<.01	P<.01
Technology x slaughter group x sex of calf[c]	10	P<.01	P<.01
R-square		.78	.68
Mean. %		1.22	1.55

[a] DIFF = Each technologies estimate of percent intramuscular fat minus percent ether extractable fat . ADIFF = absolute difference of DIFF.
[b] Animal within slaughter group and sex used as error term to test effects.
[c] Residual error used as error term to test effects.
[d] n.s. = not significant (P>.10).

Table 9. Least squares means of technology by slaughter group by sex of calf for ADIFF (%) [a]

	Slaughter Group 1			Slaughter Group 2		
	Sex			Sex		
Technology[b]	Heifer	Bull	Steer	Heifer	Bull	Steer
CARC	2.05^{d}	1.88^{d}	1.74^{c}	1.16^{c}	$.85^{c}$	$.81^{c}$
KSU	1.26^{c}	1.13^{c}	1.29^{c}	$.50^{c}$	$.84^{c}$	1.07^{c}
ISUA	1.41^{c}	1.43^{c}	1.34^{c}	$.47^{c}$	1.48^{d}	1.39^{c}
ISUB	1.28^{c}	1.23^{c}	1.26^{c}	$.48^{c}$	1.53^{d}	1.08^{c}
ISUC	1.34^{c}	1.32^{c}	1.27^{c}	$.42^{c}$	1.52^{d}	1.22^{c}
AUS	2.27^{d}	2.58^{e}	2.58^{d}	3.29^{d}	3.03^{e}	1.88^{c}

[a] ADIFF = Absolute value of each technologies estimate of percent intramuscular fat minus percent ether extractable fat
[b] CARC = USDA grader's estimation of percent intramuscular fat, KSU = Kansas State University ultrasound technology, ISUA, ISUB, ISUC = Iowa State University ultrasound technology, AUS = Animal Ultrasound Services, Inc. technology
[c,d,e] Different subscripts within columns indicate significant differences among technologies (P<.05).

Minutes of BIF Genetic Prediction Committee Meeting
May 16, 1996 Birmingham, Alabama

Meeting called to order at 2:00 pm by Larry Cundiff. Keith Bertrand was acting Secretary in place of Richard Willham.

The following reports or presentations were given.

1. Curtis Bailey provided a report on the just completed BIF Guidelines. The Guidelines have had extensive changes and additions since the last one that was released in 1990. The Guidelines are 160 pages in length andwill cost $10 if purchased at the meetings and $15 after the meetings.

2. Harlan Ritchie presented a report on the Fifth Genetic Prediction Workshop that was held in Kansas City on December 7 and 8, 1995. The purpose of the Workshop was to present current information on bovine growth and development, the usefulness of live animal ultrasound measures, the development and usefulness of genetic values for carcass traits and the genetic relationships between carcass traits and other important growth and reproductive traits. Harlan listed the top 7 research needs chosen by participants in a survey sent out after the Workshop. This list will be included in Harlan's report that will be in the Proceedings.

3. Several presenters provided information to the committee on several research topics. All the presentors will provide a paper in the Proceedings. The presentors and their presentation titles are listed:

   a. John Pollak - ' Revisiting Direct-Maternal Genetic Correlation for Weaning Wt';
   b. Bert Klei - 'Multibreed Evaluation with Field Data';
   c. Bruce Golden - 'Red Angus Breed Adjustment Factors';
   d. Dale Van Vleck - 'Across Breed Evaluation Update';
   e. Dale Van Vleck - 'Across Breed Evaluation with Data from NC-196 Experimental Herds';
   f. Jim Veneer - 'Analysis of Disposition Scores in Limousin Cattle'.

John Pollak recommended that sire summaries should report a total maternal or maternal weaning wt EPD instead of the milk EPD. The maternal weaning wt EPD is a genetic value that is a combination of both growth and milk. Brett Middleton recommended that breed associations maintain the actual biological breed percentage of the cattle in their pedigree and performance files to make it easier to account for heterotic effects in genetic evaluation. No action was taken on either of these recommendations.

FIFTH GENETIC PREDICTION WORKSHOP SUMMARY

Harlan D. Ritchie
Michigan State University

The Fifth Genetic Prediction Workshop was held on December 8-9, 1995 in Kansas City, MO. Like its 4 predecessors, it provided a volume of information too large to adequately summarize in a short time frame. The paragraphs that follow are an attempt to highlight a few key points from each session.

GROWTH AND DEVELOPMENT SESSION

- Predicting the average compositional endpoint of a group of live animals can be accomplished with reasonable accuracy. However, we are a long way from achieving this degree of accuracy with individual animals.

- Accurate live evaluation of individual animals is hampered by differences in stage of maturity, plane of nutrition, implant strategies, environment, etc.

- In a discussion of slaughter endpoints, there appeared to be consensus favoring an age- or time-constant endpoint. However, it was pointed out that weight- and fat-constant endpoints can be adjusted to a time-constant basis.

- Subcutaneous fat thickness is the best single indicator of carcass composition.

- Between-breed comparisons at MARC have shown that marbling and % lean in the carcass are strongly antagonistic traits. However, recent Angus field data suggest that these traits may not be antagonistic within a breed.

- Between breeds, ribeye area (REA) is rather closely associated with % lean. Within breeds, this relationship is very low - close to zero.

- Genetic improvement of carcass traits should be approached by using 2 strategies:

  - In spite of its expense, progeny testing should continue to be used whenever feasible.

  - Continue to work on live animal evaluation technologies for the prediction of carcass traits.

CARCASS AND LIVE ANIMAL EVALUATION SESSION

- An ideal measure of carcass composition would be "total meat yield", defined as boneless, closely-trimmed boxed subprimals plus lean trim. Research has shown this measure to have more precision than the U.S. Yield Grade formula.

GENETIC PREDICTION OF BODY COMPOSITION SESSION

- Carcass EPD's on high accuracy sires can be used effectively to increase marbling without increasing subcutaneous fat.
- There is a need for additional research on potential antagonisms between reproduction traits and carcass traits.
- Price appears to be the greatest barrier to increasing beef's percentage of total meat market share.
- Selection indexes which include economic weighting of traits are starting to be developed and used in Australia and New Zealand.

WORKING SESSIONS

- The Workshop concluded with concurrent sessions on:
  - Guidelines for carcass and live animal testing and
  - Genetic prediction methodology.
- Recommendations from these sessions will be published in the new BIF Guidelines book.

RESEARCH NEEDS

- A committee consisting of academic and industry representatives developed a list of 27 research needs. All of those in attendance were asked to rank these needs from 1 to 27. The ranks listed in Table 1 represent the averages from 72 respondents.

- Relationship of carcass REA to % meat yield is low unless hot fat trimming is used. An ultrasound measure of certain muscles in the round and/or rump may be preferable to REA but difficult to perform at line speed.

- Relationship between marbling and meat palatability is disappointingly low, accounting for only 5-10% of the variation in shear force. Nevertheless, marbling continues to be important because it provides insurance against cookery abuse and because of economics in the marketplace. But we need to continue searching for other indicators of palatability and/or direct measures of tenderness.

- The 1995 Beef Quality Audit has revealed a tremendous consistency problem in size of cuts within individual boxes of beef. Purveyors and retailers want the carcass weight window narrowed from the current 550-950 lbs to approximately 600-850 lbs.

- Biological types (breeds) will probably have to decide whether to aim for the quality market, the lean market, or settle for the commodity market.

- TOBEC (Total Body Electrical Conductivity) and VIA (Video Image Analysis) show promise for assessing meat yield of carcasses in commercial processing plants.

- Review of real-time ultrasound (RTU) research:

    - Accuracy of RTU estimates of fat and REA continues to improve.

    - Adding a visual muscle score to RTU live animal estimates improved accuracy of predicting retail product.

    - RTU estimate of rump fat thickness looks promising for helping predict retail product.

    - Relationship between RTU estimates of bulls and actual carcass cut-out of steers has been variable. Recent studies with Brangus cattle is encouraging.

    - When Angus sires had more than 15 steer progeny, there was a high rank correlation between their carcass EPD's and RTU of the progeny.

    - RTU estimate of marbling needs more work, but recent results look promising.

    - In summary, RTU results are too promising not to continue with development of this technology.

    - Two factors are <u>critical</u> in use of RTU:

        - Interpretation proficiency

        - Repeatable equipment operation

Table 1. Rank of Research Needs by Genetic Prediction Workshop Participants

	Research need	Average rank[a]
1-T.	Research on methods to measure tenderness directly	8.4
1-T.	Characterization of available RTU software for IM fat	8.4
3.	Estimate genetic relationships between traits measured by RTU	9.2
4.	Collect data on reproductive traits for National Cattle Evaluation	9.3
5.	Collect currently available RTU data and develop methods for incorporation into National Cattle Evaluation	9.9
6.	Validation of RTU IM fat measurements through selection studies	10.5
7.	Estimate relationships between carcass and reproductive efficiency traits	10.9
8.	Effect of slaughter endpoint on animal rankings	11.7
9.	Investigate the consequences of relative lean growth	12.3
10.	Find a new segregate for tenderness	12.7
11.	Cost/benefit analysis of collecting live animal RTU data	12.8
12-T.	Determine what components affect relative lean growth per unit of input	12.9
12-T.	Determine effects of environment on RTU imaging	12.9
14.	Validation of across breed/hybrid EPD's	13.5
15.	Best location for RTU fat measurements	13.6
16.	Develop multiple-trait selection indexes	13.7
17.	Develop analyses to provide probabilities of hitting windows of acceptability for carcass traits	13.8
18.	RTU measurements of fat area vs. fat depth	14.7
19.	Study usefulness of visual scoring systems for muscle and fat	15.1
20.	Marker assisted selection for carcass traits	15.4
21.	Develop techniques for finding genes with large effects	15.5
22-T.	Accuracy/risk assessment of across breed EPD's	15.7
22-T.	Research on genetic X environment interactions	15.7
24.	Develop a management-based recording system (enhanced data reporting and guidelines for the system)	15.8
25.	Combining ability of specific breeds in crossbreeding systems	16.4
26.	Basic physiology research	17.7
27.	Re-evaluate some of the early breeds in MARC's GPE program	20.8

[a]Averages from 72 respondents

MULTIPLE-BREED EVALUATION

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Introduction

Perhaps the major reason for a multiple breed evaluation would be to compare animals of different breeds utilizing information from pooled data sets. This pooling of data is not likely to happen soon. There is still reason, however, to consider procedures that allow for data sets that include measurements on animals of various breeds and breed compositions. This is because some of the current data sets used for national cattle evaluations include such animals. One such database belongs to the American Simmental Association (**ASA**). This database includes many crossbred animals produced during the process of grading up to Simmental (backcrosses to Simmental sires). Also, it has the various Simmental-Brahman crosses needed to produce a purebred Simbrah ($\frac{5}{8}$S:$\frac{3}{8}$B). Finally, to a much lesser extent, progeny of sires from breeds other than Simmental (or Brahman) are included. Our objective is to describe a multiple breed evaluation (**MBE**) procedure designed for this data set but which may serve as a prototype for other multiple breed applications.

The Simmental MBE

In the current evaluation for Simmental cattle, only progeny of purebred Simmental sires are evaluated and contemporary groups (**CG**) are defined on a within-percentage Simmental basis. These features result in breed and heterosis effects being confounded with (and removed by) the CG effects. It means that F_1s resulting from mating a Simmental cow to a bull of another breed are not evaluated. By incorporating the ideas of an MBE, these animals (~20,000) can be included if they meet other criteria for evaluation. Another major assumption of the current Simmental genetic evaluation is that the dams of F_1s have the same genetic ability as a purebred Simmental born in 1986 (the base year), i.e., 0. Because of this assumption, no direct comparisons of EPDs can be made between 50%, 75%, and purebred Simmental animals even though they are evaluated in the same within-breed genetic evaluation. This assumption, which affects ~750,000 animals, can be relaxed with an MBE.

Another benefit of an MBE is that Simmental and Simbrah animals can be evaluated simultaneously. By combining the data, all progeny of an animal influence its EPD. This should lead to higher accuracies for the Simbrah animals (~35,000). Also, every Simmental or Simbrah animal will have one set of EPDs that can be used in either population. Currently some Simmental animals have two sets of EPDs.

In summary, the Simmental MBE aims to evaluate more animals, to evaluate the current animals better, and to include Simmental and Simbrah cattle in the same evaluation.

Current Simmental Evaluation Model

A multiple-trait animal model is currently used for the Simmental and Simbrah genetic evaluations. The model includes contemporary group, direct and maternal additive genetic, and permanent environmental effects. Contemporary groups are defined by sex, percent Simmental and management codes within breeder herds. Records are pre adjusted for age of dam effects, which are divided into 12 discrete classes. In the evaluation, heterogeneous variances are used for different sex-by-percent Simmental subclasses. Evaluations are obtained simultaneously for birth weight, direct and maternal weaning weight, postweaning gain and permanent environment for weaning weight.

Simmental MBE Model

Switching to an MBE requires various model modifications to account properly for the various breed and breed combinations represented in the data. In the Simmental data (~3 million records), an animal's breed composition is identified by four out of a possible 63 breeds.

Differences in genetic origin of the animals are incorporated by adding direct and maternal additive breed and heterosis effects to the model. In the Simmental MBE, maternal components are only used for weaning weight. In addition to these new effects in the model, the age of dam (**AOD**) effect becomes breed dependent and is included in the model; records are no longer pre adjusted for AOD. In the current MBE, the heterogeneous variances depend on the sex and percent Simmental of the calf, similar to the current system. Whether these should depend more specifically on breed composition of the calf will be addressed in future research.

Finally, because of the multiple breed component of the MBE, contemporary groups are redefined. Each of the modifications is described in more detail in the following sections.

MBE Contemporary Group

For the MBE, a CG is formed with all animals of the same sex managed the same way. Animals of different percent Simmental are no longer separated into different contemporary groups as they are in the current evaluation. This can lead to larger contemporary groups, which is beneficial for estimation purposes. Combining animals of different percentage into one CG is also required for estimating breed and heterosis effects.

Estimation Considerations

Before describing the other effects in the model, it is useful to think about the problem of estimating the various effects. For example, a calf's weaning weight observation impacts the estimates or predictions of nine different effects: 1) contemporary group, 2) age of dam, 3) direct and 4) maternal heterosis, 5) direct and 6) maternal additive breed, 7) direct and 8) maternal animal additive genetic, and 9) permanent environmental effects.

Instead of estimating all these effects from the data, one could pre adjust the records for some effects, e.g., 2) through 6), and estimate others. The question that arises is how to obtain good values to be used as adjustments for the effects. An obvious choice for the heterosis and breed effects would be to use the many crossbreeding studies that have been conducted over the last decades. This approach assumes the animals in the experiments were a representative sample of the same founder populations that contributed to the animals in the MBE data set.

Another approach is to incorporate in the model all necessary effects. When this model is used, the data determine the estimates. Because most crossbreds in the Simmental data set resulted from upgrading, confounding of effects can make this impossible. For instance, the best estimate of direct heterosis for a cross requires both purebreds as well as the reciprocal F_1s, all in the same contemporary groups. This will hardly ever be the case in field data. Another problem with this approach is that some of the breeds in the data are represented by a small number of animals. Estimating effects based on these few animals can be inaccurate. For some of these breeds, not only is information lacking in the data but good estimates from the literature may be wanting. Grouping breeds by biological type and estimating effects for biological types instead of breeds can solve this problem.

A combination of the two alternatives is provided with a Bayesian approach, i.e., the literature values are combined with the information contained in the data. Bayesian methodology requires specification of a "prior." The prior has a mean (μ_p), the literature values, and a prior variance ($\mathbf{V}_p$). The μ_p is our "best guess" prior for looking at the data while $\mathbf{V}_p$ quantifies our certainty about that guess: large values indicate uncertainty; small values indicate certainty. A typical system of equations, $\mathbf{Cb} = \mathbf{y}$, becomes $\left(\mathbf{C} + \mathbf{V}_p^{-1}\right)\mathbf{b} = \mathbf{y} + \mathbf{V}_p^{-1}\mu_p$ when prior information is incorporated. This method is similar to BLUP for the additive genetic animal effects, where μ_p is zero while $\mathbf{V}_p$ is the genetic (co)variance matrix.

There are two extreme cases. With little or no confidence in prior information, the prior is known as non informative or flat. The value for $\mathbf{V}_p$ is chosen to be very large , $+\infty$, resulting in $\mathbf{V}_p^{-1}$ and $\mathbf{V}_p^{-1}\mu_p$ being close to zero and the estimate for $\hat{\mathbf{b}}$ is $\mathbf{C}^{-1}\mathbf{y}$ as when no prior information was used. With complete confidence in the prior information, the value of $\mathbf{V}_p$ is close to zero, $\mathbf{V}_p^{-1}$ is very large, overwhelms $\mathbf{C}$, and $\hat{\mathbf{b}} \approx \mu_p$, the prior mean. This is effectively equivalent to pre-adjusting the records. With intermediate values for $\mathbf{V}_p$, the information coming from priors and data is combined. With enough information from data, however, the prior is overwhelmed (ignored).

Priors can be incorporated in the Simmental MBE for all effects except CG (i.e., flat priors for CG). Non informative priors were subsequently chosen for the AOD curves because in preliminary analyses it was observed that the information in the data overwhelmed any reasonable choices for uncertainty about AOD curve priors. The prior means (μ_p) for the other effects were obtained from various crossbreeding and germplasm evaluation experiments reported in the literature (Cunningham and Kirschten, 1996). The values chosen for the prior variances $\mathbf{V}_p$ are described in more detail in the sections for heterosis and breed.

Age of Dam Curves

The AOD effect is divided into twelve discrete subclasses in the current Simmental and Simbrah. Also, separate AOD adjustment factors are being used for different percent Simmental-by-sex subclasses. It is clear from these percent Simmental subclasses that different AOD adjustments should be used for dams from different genetic origin in the Simmental MBE.

Work at the University of Georgia has shown that, instead of using discrete AOD classes, better adjustments for age can be made by fitting a continuous AOD curve, e.g., a 4th order polynomial (Nelson et al., 1992; Bertrand et al., 1994). For an MBE, separate curves for sex within the different breeds are fit. In contrast with the current Simmental evaluation where records are pre adjusted for the AOD effect, AOD curves in the Simmental MBE are estimated simultaneously with all the other effects in the model. The general form of the fourth order AOD polynomial is:

$$y_{ij} = b_0^{ij} + b_1^{ij} \times age + b_2^{ij} \times age^2 + b_3^{ij} \times age^3 + b_4^{ij} \times age^4 \qquad (2)$$

where y_{ij} is the observation for trait i (birth weight, weaning weight, post weaning gain) for animal of sex j (male or female), b_n^{ij} is the n^{th} order regression coefficient for trait i and sex j, with b_0 indicating the intercept, and age^n: is AOD to the n^{th} power. A maternal additive genetic breed effect for weaning weight is fitted in the Simmental MBE; as a result, the intercept for the weaning weight polynomial is not necessary (n=1,..,4 instead of n=0,..,4). For birth weight and post weaning gain, differences in intercepts, within sex and trait, can be interpreted as average maternal breed differences.

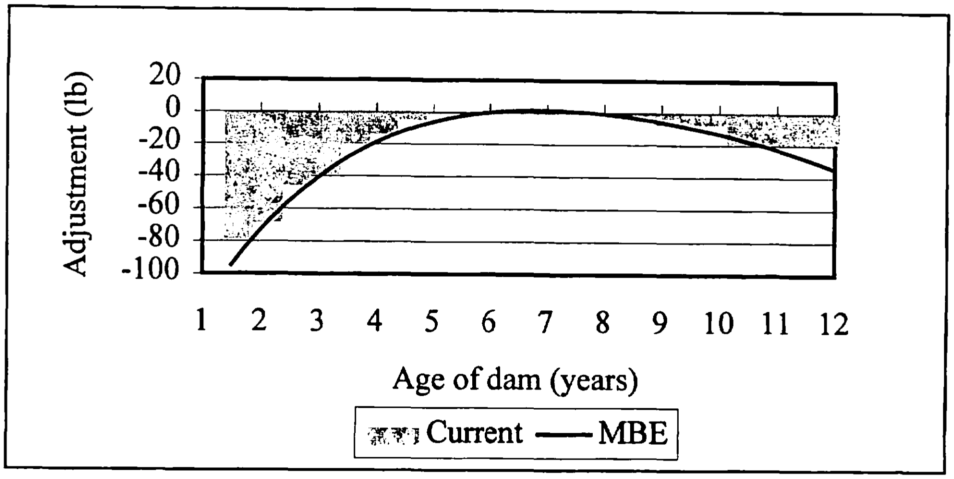
Example I. Relation between age of dam curves and breed composition of the dam

Breed composition of dam	AOD curve
Simmental	AOD_{SIM}
Angus	AOD_{ANG}
F_1 (SIM × ANG)	$\frac{1}{2}AOD_{SIM} + \frac{1}{2}AOD_{ANG}$
Simbrah	$\frac{5}{8}AOD_{SIM} + \frac{3}{8}AOD_{BRH}$

McConnel (1996) showed that the AOD curves for crossbred dams can be computed as the weighted average of the breeds represented, as illustrated in Example I. To avoid having to estimate age of dam curves for the 63 different breeds represented in the data, dam breeds were grouped by breeds and biological types. The biological types used were Simmental, Angus, Hereford, Brahman, British, Continental, and others.

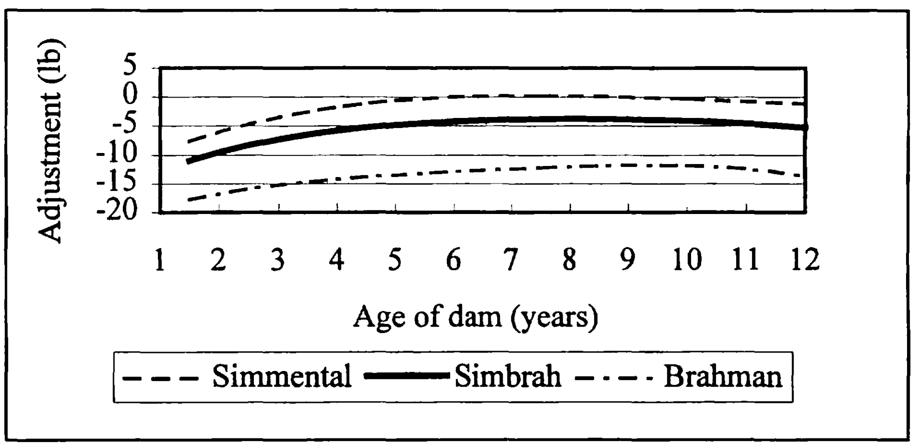
In Figure 1 a comparison is given of the current step-wise AOD adjustment for weaning weight (**WWT**) of calves out of purebred Simmental cows and the corresponding continuous curve. The largest impact of this change is for the younger dams and the oldest; e.g., for the 2.5- to 3-year-old dams the WWT AOD adjustment was ~-42 lb for all dams falling in this age group. When using the WWT AOD curve, a calf of a 2.5-year-old dam has ~65 lb added to its weight while the calf from the 3-year-old has ~42 lb added to its weight.

Figure 1. Weaning weight age of dam effect for male calves from Simmental cows for the current and multiple breed evaluation.



It is well documented that F_1s (Bos Taurus × Bos Indicus) weigh less at birth than reciprocal crosses resulting from mating Bos Indicus sires to Bos Taurus dams (e.g., Reynolds et al., 1980; Thallman et al., 1992; Rohrer et al., 1994). This can be viewed as a maternal breed of founder effect for birth weight (**BWT**). The Simmental MBE does not incorporate this effect in the model. Figure 2 shows that this effect is reflected in the intercept $\mathbf{b}_0$ of the AOD curve; e.g., the BWT of a bull calf out of a mature Brahman dam (6 years old) is adjusted by ~ 13 lb to be comparable to the record of a calf of a mature Simmental cow.

Figure 2. Birth weight age of dam effect for dams of male calves from various genetic origin using the multiple breed evaluation.



Also, Figure 2 illustrates the use of breed specific AOD curves to create the curve for a crossbred dam. In this case the Simbrah AOD curve is 5/8 the AOD curve for Simmental plus 3/8 the AOD curve for Brahman. A male calf of a 6-year-old Simbrah cow has its BWT adjusted by 5/8 × 0 + 3/8 × (13) = ~ 4.8 lb.

Heterosis

One of the benefits of cross breeding animals is the influence of heterosis on their performance (e.g., Cundiff et al., 1992; Gregory and Cundiff, 1991). Heterosis will influence the direct performance of a crossbred animal and the maternal performance of crossbred dams. Direct heterosis effects are included in the MBE model for all traits; a maternal heterosis effect is also included for weaning weight.

Heterosis occurs due to the interaction of genes inherited from different breeds. It is observed as the deviation of the performance of a crossbred animals from the weighted average of the parental breeds. Heterosis can be caused by either dominance, the interaction of individual genes, or epistasis, the interaction of gene complexes. Results from the Meat Animal Research Center support the hypothesis that heterosis is primarily due to dominance (Gregory and Cundiff, 1991). This allows heterosis to be modeled as being proportional to the probability of getting genes from different breeds at a locus. It is further assumed that no difference exists between reciprocal crosses in the amount of heterosis expressed.

The 63 different breeds represented in the data could lead to some 2000 different F_1s. Heterosis effects (three direct and a maternal) cannot be estimated for each of these. Most of these breed combinations are represented by a only few animals, if any at all. Also, many of the breed combinations are not represented in the literature (e.g., Longhorn × Africander maternal) Therefore the breeds were grouped by four biological types: British (**B**), Continental (**C**), Zebu (**Z**), and others (**O**). This leads to 10 combinations:, **B×B**, **B×C**, **B×Z**, **B×O**, etc. For example, Angus× Hereford crosses would be included in the **B×B** combination.

Example II. Computing the contributions to heterosis.

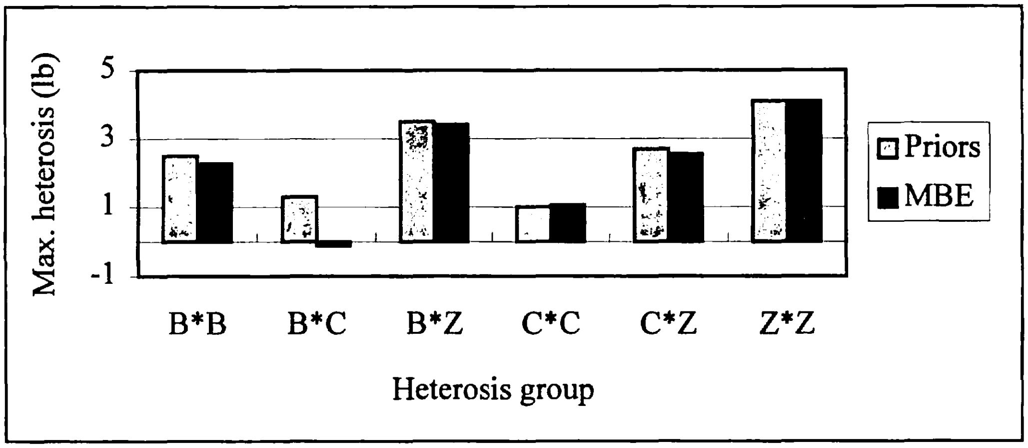
	dam		
sire	½ Simmental	¼ Angus	¼ Brahman
½ Simmental		1/8 h_{BC}	1/8 h_{CZ}
¼ Angus	1/8 h_{BC} [1)]		1/16 h_{BZ}
¼ Hereford	1/8 h_{BC}	1/16 h_{BB}	1/16 h_{BZ}

[1)] h_{ij} = F_1 heterosis for breeds i and j, where B = British, C = Continental and Z = Zebu.

Example II illustrates the procedure to determine the fraction of F_1 heterosis that can be expected in an animal. The cross between a Simmental × (Angus×Hereford) sire and a Simmental × (Angus×Brahman) dam yields an expected heterosis of $1/16\ h_{BB} + 3/8\ h_{BC} + 1/8\ h_{BZ} + 1/8\ h_{CZ}$, where h_{BB}, h_{BC}, h_{BZ} and h_{CZ} denote the heterosis (lb) in an F_1 of breeds of the various types.

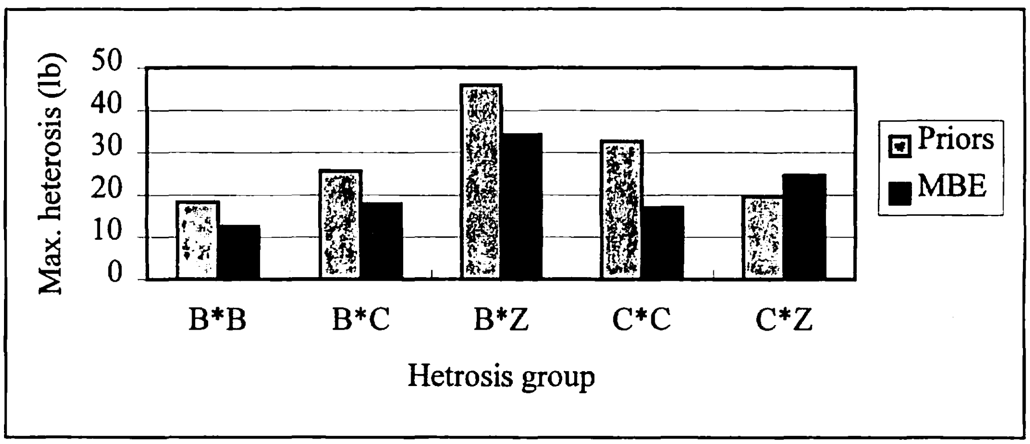
Prior means for heterosis effects were obtained from the literature (Cunningham and Kirschten, 1996). The associated prior variance for the i[th] trait is $\sigma^2_{r,i} / 2500$, where $\sigma^2_{r,i}$ is the residual variance for trait i. Direct heterosis results for BWT are in Figure 3. The MBE estimates are in general close to the prior values except for the B*C combination. Estimates can be close to the priors because the priors were close to what the data predict and/or the information in the data is insufficient to modify the prior belief. The latter is the case for the Z*Z class where the data provide no information.

Figure 3. Direct heterosis priors and MBE solutions for birth weight.



The combination with the most data (B*C) shows a slightly negative heterosis estimate. As mentioned earlier estimating direct heterosis -- well -- requires purebreds and crosses, which are rare in a population such as the Simmental (upgraded from primarily Hereford and Angus). From these results and similar results for the other direct heterosis effects, it appears that most emphasis must be placed on the priors to account for direct heterosis.

Figure 4. Maternal heterosis priors and MBE solutions for weaning weight.



Maternal heterosis priors and MBE solutions are in Figure 4. In general, the values of the MBE are smaller than those indicated by the prior values. In contrast to direct heterosis, maternal heterosis is relatively easy to estimate from field data. To obtain a clean estimate for maternal heterosis, one needs purebreds of one breed, F_1s, and the backcross to the original purebred in one contemporary group. This can be the case in field data where upgrading is happening.

Breed of Founder

To account for breed composition differences, animals' pedigrees are traced as far as possible and breed of the founders, the most distant animals in each line of the pedigree, checked. All the genes in an animal come from these "founders." Knowing the breeds of all the founders and how many generations each is removed determines the genetic (breed) composition of the animal. The expected genetic merit of an animal is the weighted average of breed of founder (**BOF**) effects as illustrated in Example III. The term 'breed of founder' is used to indicate that this effect accounts for the genes from animals of various breeds (founders) that contributed to the Simmental population. The 'founder' is to emphasize that these animals need not be representative of any registered population.

Example III. Illustration of breed of founder effect.

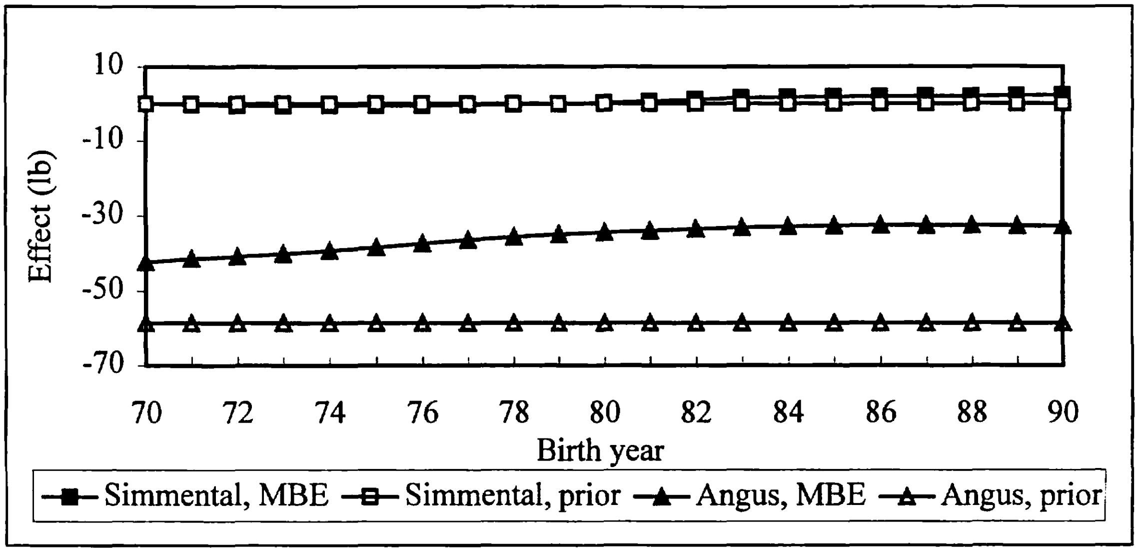
Breed composition:	½ Simmental, ¼ Angus, ¼ Hereford
Breed of founder effect:	$\frac{1}{2} BOF_{SIM} + \frac{1}{4} BOF_{ANG} + \frac{1}{4} BOF_{HER}$

To allow for any genetic trend, yearly BOF effects are defined. This means that not only do we account for the ¼ Hereford genes in an animal but whether the Hereford genes were sampled in 1970 or 1990 or a mixture of several years. Some breeds are grouped because small numbers of observations; 12 BOF effects (rather than 63) were included in the model for each year. These are Simmental, Angus, Hereford, Brahman, Charolais, Gelbvieh, Limousin, American, British, Continental, dairy, and mixed.

Large fluctuations among the yearly estimates can occur if only a few founders of a given breed (group) come into the population each year. To compensate for this an auto-regressive structure (Wade and Quaas, 1993) was used in the prior (co)variance matrix, V_p, for the year within breed effects. Specifying a high correlation between successive years indicates a prior belief that these BOF should not change drastically from year to year. It 'smoothes' the estimates quite effectively. When the prior variance is assumed to have an auto-regressive structure, two parameters have to be defined, the correlation ρ_i and the variance for trait i. For the Simmental MBE, default values are $\rho_i = \sqrt{.95}$ for all traits and the variance = $\sigma^2_{r,i} / 250$. Prior means for a breed were constant across years; the constants were obtained from the literature (Cunningham and Kirschten, 1996).

The BOF effects were fit by the procedure of Westell et al. (1988): unknown parents were matched to appropriate BOF effects, 3 direct and one maternal. The procedure was modified slightly (Quaas, 1988) to handle crossbred founders, e.g., numerous "black baldies."

Figure 5. Priors and MBE solutions for weaning weight direct breed of founder effect.

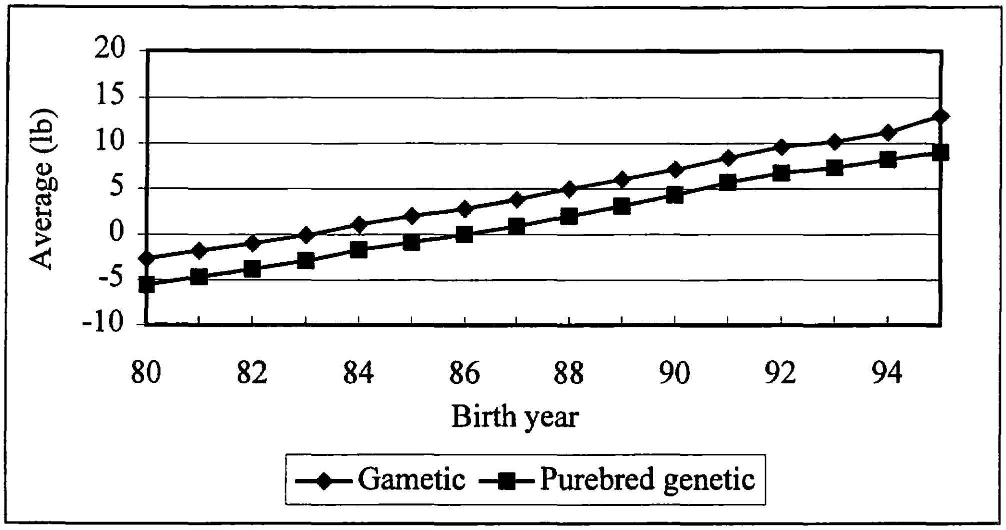


In Figure 5 the BOF priors and MBE solutions for WWT are given for Simmental and Angus. These values are represented on a breeding value scale. This figure shows that the prior mean for Simmental was assumed to be zero while the prior mean for Angus was constant at ~-60 lb. The MBE solutions show that a slight increase occurred in the Simmental BOF effect. The figure also shows that the prior means were lower than the BOF effect for the Angus in the Simmental population. Over time the difference between founders from the Angus and the Simmental breeds has reduced by approximately 10 lb over time. This might largely be due to the influx of Angus bulls in the later years compared to the early years when most of the Angus founders were dams. It is also due to the genetic trend that has occurred in the Angus population.

Gametic and Genetic Trends

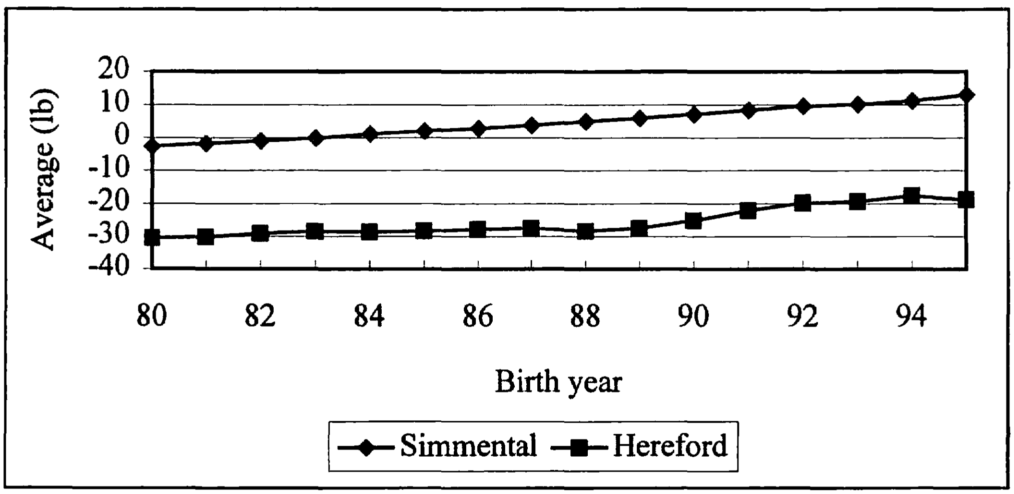
To show genetic changes over time, genetic trends are traditionally computed as the average expected progeny difference (**EPD**) for a well-defined group of animals by birth year. For the current Simmental evaluation, the average EPD for purebred Simmentals is computed to show the genetic trend in the population. With an MBE, it becomes difficult to define some groups of animals; e.g., purebred Simmentals are defined but there are no comparable groups for other breeds. To overcome this problem a trend, referred here as the gametic trend, is computed as the within-year least squares regression of EPD on breed composition. The resulting value attempts to quantify the genetic merit of genes of a particular origin (breed) present in animals born in a particular year. This differs from the BOF trends, which quantify genes entering the population in a given year. The gametic trend quantifies <u>all</u> the founder genes that contribute to a calf crop. In the traditional genetic trend, only a pre defined subset of animals are considered, e.g., purebreds; the gametic trend is computed using all animals in the population. All animals that have a fraction of Simmental genes contribute to the estimation of the Simmental gametic trend.

Figure 6. Simmental genetic and gametic trend for weaning weight.



The relationship between the gametic and genetic trends for WWT is shown in Figure 6. The genetic base is set so that the EPDs for purebred Simmentals born in 1986 average zero. Purebred Simmental was defined under the ASA rules and bylaws, and the designation was supplied with the animal's record. The two trends are essentially parallel. The difference can be accounted for by the maximum of 1/8th of genetic material from another breed that is allowed in purebred Simmental females (for males this is 1/16th).

Figure 7. Simmental and Hereford gametic trend for weaning weight.

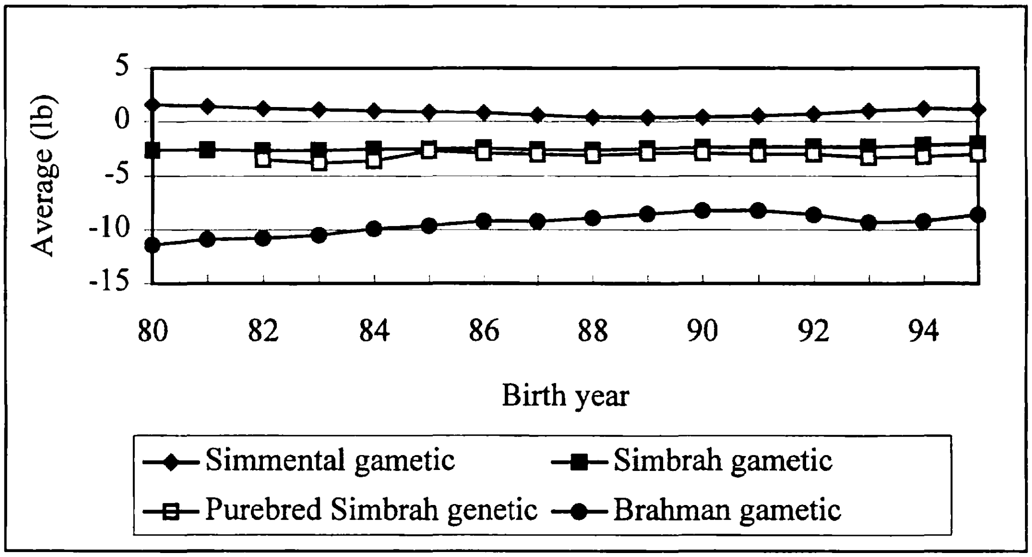


Gametic trends can be used to show differences in selection practices on genes for each of the different breeds. Figure 7 shows the gametic trends for Simmental and Hereford. Note from this figure that between 1980 and 1988, the gametic trend for Hereford was essential zero. This can be contributed to the large number of founder dams in those years. Since 1988, not many Hereford founders have been added to the population, and the increasing gametic trend observed can be attributed to selection on the Hereford genes in the population. In contrast, the Simmental gametic trend has increased steadily over these years. This is most likely due to selection on

Simmental genes and the relative small number of Simmental founder animals coming into the population.

The gametic trend can be used to show trends in any type of crossbred animal in the population. In Figure 8 the relationship between the Simmental, Brahman and Simbrah milk gametic trends as well as the purebred Simbrah milk genetic trend is shown. The Simbrah gametic trend is derived as 5/8 × Simmental gametic trend + 3/8 × Brahman gametic trend. The purebred Simbrah genetic could not be computed before 1982 because of the small number of animals in this group before that time. This problem does not occur with the gametic trend. Moreover, Figure 8 also shows that the gametic and purebred genetic trends for Simbrah are similar; the difference being that a purebred Simbrah is not always a $5/8^{th}:3/8^{th}$ animal and is allowed to have $1/16^{th}$ of another breed in its genetic makeup.

Figure 8. Gametic and genetic trends for milk.



Summary

1) The multiple-breed evaluation allows for the forming of true contemporary groups, and no subdivision has to be made to account for differences in genetic composition of calves.
2) Average age of dam curves can be used to account for dams of mixed genetic origin.
3) Priors can be used effectively for combining field and research information in a genetic evaluation.
4) Upgrading data does not yield good estimates for direct heterosis and more emphasis needs to be placed on research information when incorporating this effect in the model.
5) Time trends are observed for the breed of founder effects.
6) Gametic trends can be used to describe genetic trends in animals of different breed composition.

Literature cited

Bertrand, J. K., A. H. Nelson, and B. K. Middleton. 1994. National cattle evaluation: two refinements to the system. Proc. Beef Improvement Federation Fourth Genetic Prediction Workshop, Kansas City, Kansas.

Cundiff, L. V., R. Nunez-Dominguez, G. E. Dickerson, K. E. Gregory, and R. M. Koch. 1992. Heterosis for lifetime production in Hereford, Angus, Shorthorn, and crossbred cows. J. Anim. Sci. 70:2397.

Cunningham, B. E., and D. Kirschten. 1996. Breed and heterosis effects estimated from published breed evaluation and crossbreeding studies. Mimeograph. American Simmental Association, Bozeman, MT.

Gregory, K. E, and L. V. Cundiff. 1991. Breed effects and heterosis in advanced generations of composite populations for growth traits in both sexes. J. Anim. Sci. 69:3202.

McConnel, M. B. 1996. Modeling the age of dam effects in crossbred populations. Honors thesis, Cornell University, Ithaca, NY.

Nelson. A. H., L. L. Benyshek, J. K. Bertrand, and M. H. Johnson. 1992. Non-linear age of dam adjustments for weaning weight in Hereford cattle. J. Anim. Sci. 70 (Suppl. 1):138 (Abstr.).

Quaas, R. L. 1988. Additive genetic model with groups and relationships. J. Dairy Sci. 71:1338.

Quaas, R. L., D. J. Garrick, and W. H. McElhenney. 1989. Multiple trait prediction for a type of model with heterogeneous genetic and residual covariance structures. J. Anim. Sci. 67:2529.

Reynolds, W. L., T. M. DeRouen, S. Moin, and K. L. Koonce. 1980. Factors influencing gestation length, birth weight and calf survival of Angus, Zebu and Zebu cross cattle. J. Anim. Sci. 51:860.

Rohrer, G. A., J. F. Taylor, J. O. Sanders, and M. A. Thallman. 1994. Evaluation of line and breed of cytoplasm effects on performance of purebred Brangus cattle. J. Anim. Sci. 72: 2798.

Thallman, M. A., J. F. Taylor, J. O. Sanders, and R. L. Quaas. 1992. Non-traditional genetic effects in reciprocal cross Brahman × Simmental F_1 calves produced by embryo transfer. J. Anim Sci. 70 (Suppl. 1): 140 (Abstr.).

Wade, K. M., and R. L. Quaas. 1993. Solutions to a system of equations involving a first-order autoregressive process. J. Dairy Sci. 76:3026.

Westell, R. A., R. L. Quaas, and L. D. Van Vleck. 1988. Genetic groups in an animal model. J. Dairy Sci. 71:1310.

Across Breed EPDs for Red Angus Using Additive Genetic Groups

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Introduction

Several methods have been proposed to convert predictions of additive genetic merit, such as expected progeny differences (EPD) produced in one breed association's national cattle evaluation to the base and scale of predictions made in a national cattle evaluation for another breed association (Godard, 1985; Wilmink, *et al., 1986*) with the current method of choice in the United States beef industry developed by Núñez-Dominguez, *et al., 1993*. Conversions of EPD allow for comparisons of the genetic merit of seed stock of different breeds and seed stock of the same breed but evaluated in different national cattle evaluation programs. The later case can occur when international evaluation is not performed for a breed with registries in multiple countries (Benyshek, *et al.,* 1994) or when registries (and thus the national cattle evaluations) are divided for the same breed based on a color variant such as the Red Angus and Black Angus in the United States.

Also, conversion of EPD to a breed association base and scale may be useful for seed stock that are from parents of multiple breed origin. Large breeders or groups of breeders of composite, synthetic, mixed percentage or unregistered pure bred seed stock may produce on farm EPD (Quaas and Pollack, 1980). Converting these EPD to the base and scale of at least one of the original breed's EPD from national cattle evaluation may help achieve both selection and marketing goals.

In a previous study (Golden. *et al.,* 1994) we developed a strategy that used EPD from one breed association national cattle evaluation to form additive genetic groups (Quaas and Pollak, 1981; Robinson, 1986; Quaas, 1988; Westell *et al.,* 1988; Van Vleck, 1990) in another breed association national cattle evaluation. The reason we did this was to produce EPD for grouped animals that were more similar to their other association's EPD. This technique also resulted in EPD with more accuracy for the foundation animals with phantom parents in the other association EPD groups.

The objective of the study we present here was to develop a method for converting EPD from one evaluation to the base and scale of EPD from another evaluation using equations based on additive genetic group parameter estimates where the additive genetic groups were formed using EPD from the breed to which the conversion was being made. Also, we show an example of the application of the conversion.

Methods

Conversion Equations

Designate breed A as the breed with EPD to which the base and scale are to be converted and breed B is the breed from which the EPD are to be converted . I.e., he objective is to convert EPD produced in the analysis of data for breed B to the base and scale of the EPD from the analysis of data for breed A. Also, this method requires a certain portion of known foundation animals in B have EPD produced in the analysis of A. Foundation animals are defined as animals with unknown parents in an analysis. The model for the analysis of data for A and B is,

$$\mathbf{y} = \mathbf{X}\mathbf{b} + \mathbf{Z}\mathbf{u}_d + \mathbf{e}$$

Where, **y** is a vector of observations, **X** is an incidence matrix relating observations in **y** to fixed effects and covariates in **b**, **Z** is an incidence matrix of zeros and ones relating observations in **y** to $\mathbf{u}_d$, $\mathbf{u}_d$ is a vector of additive random direct genetic effects (breeding values) on **y**, $\text{var}[\mathbf{y}] = \mathbf{ZGZ'} + \mathbf{R}$, $\text{var}[\mathbf{u}_d] = \mathbf{A}\sigma^2_d = \mathbf{G}$ and $\text{var}[\mathbf{e}] = \mathbf{I}\sigma^2_e = \mathbf{R}$. The **G** and **R** are not necessarily the same for the analysis of A and B because A and B represent two different populations with some common animals.

For the analysis of A, $E[\mathbf{u}_d] = \mathbf{0}$ and for the analysis of B, $E[\mathbf{u}_d] = \mathbf{Qg}$ where **Q** is a matrix of independent covariates relating fractional fixed additive genetic group effects to **y** and **g** is a vector of fixed additive genetic group effects. I.e., the analysis of B includes additive genetic groups based on EPD for the same trait and component for animals in the analysis of the A data and are foundation animals in the B data. The number of groups in **g** depends on both the desired resolution of group differences and the amount of data available for each group. In our previous analysis (Golden *et al.*, 1994) we designated three groups for the value of the A EPD, high, medium and low A EPD. These three groups were of equal size. A forth group for animals of the same breed as A but with unknown A EPD was designated in our previous analysis. There was a fifth group for all other foundation animals in the analysis of B data.

The rules for grouping are based on the idea that the unknown or "phantom" parents are members of the groups (Westell, *et al.*, 1988). The A EPD of the known foundation animals are the indicator of the genetic merit of the phantom parents and therefore, the groups are formed from the known foundation animal's EPD.

Over specifying the grouping may lead to estimates of group effects with too high an error to be useful. However, it is also important to have enough group solutions to obtain an adequate description of the difference in scale between the analysis of A and B data.

The vector $\hat{\mathbf{g}}$ is an estimate of a linear function of the elements of **g**. Let us assume that the linear function estimated is,

$$E[\hat{g}_i] = g_i - g_p \qquad [1]$$

Where p is the number of groups specified and i = 1 to p. Let us also assume that g_p is the parameter of the group for all foundation animals in B that did not have A EPD (or were not of breed A). This means that each $\hat{g}_i$ for $i < p$ is an estimate of the average additive genetic merit of the foundation animals who's phantom parents are in the ith group because g_p defines the base from which the predictions of breeding value, $\hat{\mathbf{u}}_d$, deviate. Therefore,

$$E[\hat{g}_i] = \frac{\sum_{j=1}^{n_i} (u_{ij} - \phi_{ij})}{n_i}$$

where ϕ_{ij} is the Mendelian sampling effect for the jth animal who's phantom parents are in the ith group. The u_{ij} are the true values of the breeding values of these animals. These animals also have a prediction of u_{ij} from the analysis of the A data.

Because $E[\phi_{ij}] = 0$ another estimate of the genetic merit of the phantom parents of the animals in the ith genetic group is,

$$\bar{u}_i^A = \frac{\sum_{j=1}^{n_i} \hat{u}_{ij}^A}{n_i} \qquad [2]$$

where $\hat{u}_{ij}^A$ is the prediction from the analysis of A data for the breeding value for the jth animal who's phantom parents are in the ith group in the analysis of the B data. This estimate, $\bar{u}_i^A$, deviates from the intercept (base) for the A analysis. Therefore, the difference between $\hat{g}_i$ and $\bar{u}_i^A$ is an estimate of the difference between the base of analysis A and the base of analysis B. This results in p-1 estimates of the difference in base.

$$\alpha_i = \bar{u}_i^A - \hat{g}_i \qquad [3]$$

For analyses where p-1 > 1 an estimate of the change in scale between the vectors $\hat{\mathbf{u}}^A$ and $\hat{\mathbf{u}}^B$ can be obtained by comparing the difference between $\hat{g}_i$ and $\hat{g}_{i'}$ with the difference between $\bar{u}_i^A$ and $\bar{u}_{i'}^A$ for $i \neq i' \neq p$. The converted prediction is obtained by,

$$\dot{u}_k = \bar{u}_i^A + \theta_{i \leftrightarrow i'}(\hat{u}_k^B - \hat{g}_i) \qquad [4]$$

where $\hat{u}_k^B$ is the breed B prediction of the breeding value for animal k and

$$\theta_{i \leftrightarrow i'} = \frac{\bar{u}_i^A - \bar{u}_{i'}^A}{\hat{g}_i - \hat{g}_{i'}} \qquad [5]$$

for $i \neq i'$, is the slope of the conversion in the interval between i and i'. The ith and i'th groups should be adjacent and i or i' should be chosen as the $\hat{g}_i$ closest to $\hat{u}_k^B$. This will result in an extrapolation between each adjacent $\bar{u}_i^A$ and $\bar{u}_{i'}^A$, forming a segmented curve. Using a segmented curve may allow for us to approximately account for any non-linear relationship that may occur between the EPD from the two analyses. However, caution should be taken that any error in the group solutions not be interpreted as a non-linear relationship.

For traits modeled with an additive maternal genetic component, such as weaning weight, the relationships described in equations [1] through [5] should be identical for both the additive direct and maternal components.

An Example

As described in our previous study (Golden, *et al.,* 1994), additive genetic groups were included in the national cattle evaluation for the Red Angus Association of America (RAAA). We encourage you to read that paper for a complete discussion of the models, methods and data used for the study we describe here. The additive genetic groups have been in all RAAA national cattle evaluation since 1993. The only difference was that the total amount of data increased, including the number of foundation animals with AAA

EPD (Table 1). The data we used for the study presented here were the RAAA herd book data used for the 1996 RAAA national cattle evaluation.

Five genetic groups were included for each additive genetic component of each trait. The first three groups for each additive genetic component reflected the magnitude of EPD for foundation animals that received an EPD from the American Angus Association (AAA) for that additive genetic component. Equal numbers of animals were assigned to groups one through three depending on whether the AAA EPD for a foundation animal was among the lower third, middle third or highest third of animals with AAA EPD, respectively (i.e., low, medium and high groups). Animals were assigned to the forth genetic group if they were registered with the AAA but had no AAA EPD available. The AAA did not publish EPD if they were of very low accuracy or were for some of the very oldest animals. The fifth genetic group was for all other foundation animals in the RAAA herd book. All genetic group solutions were expressed as a deviation from the solutions for group five (i.e., p = 5 for equation [1]).

Equations [2], [3], [4] and [5] were applied to the results of the 1995 RAAA national cattle evaluation using AAA EPD from the 1995 AAA national cattle evaluation. The RAAA adjusts their EPD before publishing the national cattle evaluation results so that a constant base point is maintained in all national cattle evaluations. Therefore, an additional component was included in equation [4] to account for the base adjustment factor. Also, equation [4] was modified to convert EPD instead of predicted breeding values, so that the final equation for converting an RAAA EPD to the base and scale of an AAA EPD was,

$$\dot{EPD}_k = \overline{EPD}_i^A + \theta_{i\leftrightarrow i'}(EPD_k^B - \tau - \hat{g}_i) \qquad [6]$$

where EPD_k^B was the EPD for animal k from the RAAA on the base published in the RAAA national cattle evaluation, $\overline{EPD}_i^A$ was the mean AAA EPD for the animals who's phantom parents made up the i'th genetic group in the RAAA analysis, i was chosen as the group closest to the value of EPD_k^B-τ, $\dot{EPD}_k$ was the EPD for animal k from the RAAA converted to the base and scale of an EPD from the AAA and τ was the base adjustment factor applied to the RAAA EPD to adjust them to a constant base. Their were a different set of α_i, $\theta_{i\leftrightarrow i'}$, and τ's for each additive genetic component of each trait. Because there were three groups that were formed from known AAA EPD, there were two values of $\theta_{i\leftrightarrow i'}$.

Discussion

Table 2 shows the group solutions, $\hat{g}_i$, expressed as deviations from group five, as per equation [1]. Table 2 also contains the estimates of $\bar{u}_i^A$ as per equation [2]. The agreement between the $\hat{g}_i$ and $\bar{u}_i^A$ were reasonable with the potential exception of the medium and high post weaning gain additive genetic groups. This discrepancy was likely due to the high error in the estimation of the group solution for the low post weaning gain genetic group. There were virtually no AAA animals in this group that had observations on progeny in the RAAA for post weaning 160-d gain. Therefore, this estimate was not used to obtain conversions. This was probably not a problem as there were very few animals where a conversion would have been desired in this group because they are a low group and in the opposite direction of most selection criteria.

The τ for birth weight direct, weaning weight direct, weaning weight indirect due to the dam (MILK) and post weaning 160-d gain were -1.12, 3.20, 3.53 and 1.50, respectively. The estimates of the EPD base difference and $\theta_{i \leftrightarrow i'}$ are in table 3. In order to determine the base difference on the EPD scale and account for the constant base adjustment, the base difference was determined as,

$$\frac{\alpha_i}{2} - \tau$$

While allowing for accounting for non-linearity of the scaling between the RAAA and AAA EPD, the conversion method may be too complex for general use. We propose two alternatives for simplifying the computation.

Calculating a conversion for an animal with a 22 lb RAAA weaning weight direct EPD results in an AAA equivalent EPD of 27 lb. The first method for simplifying the computation substitutes the average of all group solutions and slopes into equation [6], instead of identifying the parameters for the specific group closest to the EPD to be converted. If the average of the group solutions and the slopes are the 22 lb RAAA EPD also converts to a 27 lb AAA EPD.

The second method for simplifying the computation is to take the average of the parameters as was done above, but use a slope of 1 instead. This results in a conversion of the 22 lb EPD to a 22 lb AAA equivalent. This is probably the less desirable of the three alternatives because there is clear evidence of scaling differences. Using a slope of one would ignore these differences.

Implications

Using additive genetic groups in a national cattle evaluation to develop parameter estimates for equations that convert the EPD to another national cattle evaluation's base and scale may validate or improve on the current method. Much of the improvement will come from the opportunity to use potentially large amounts of data to determine the parameter estimates used in the conversion equations. It is anticipated that an additional small improvement may come from a reduction in error because the other method requires one additional independently solved component in the process of developing conversion equations. The method we discussed here allowed for the simultaneous solution of the average relationship between two breed's predictions, without the intermediate data set necessary for methods currently used in the beef industry. However, the recovery of small amounts of error could be offset by using only breed association data, with its inherent systematic errors, rather than data from well designed experiments. Beef breed association data are susceptible to sources of systematic error because of

Table 1. Number of animals with at least one phantom parent in a genetic group

Component [b]	Group [a]				
	1	2	3	4	5
BWT	429	429	428	498	62602
WW	452	452	451	423	62602
MILK	452	452	451	423	62602
GN	384	384	383	627	62602

[a] Groups 1, 2, and 3 were the low, medium and high American Angus Association (AAA) EPD groups , respectively, for the component. Animals in Group 4 were registered with the AAA but had unknown AAA EPD for the component. Animals in Group 5 were all other animals with at least one unknown parent.

[b] The component designations BWT, WW, MILK and GN were additive direct genetic effect on birth weight, additive direct genetic effect on weaning weight, additive indirect genetic effect due to the dam on weaning weight, and additive direct genetic effect on 16-d post weaning gain, respectively.

current reporting practices that promote incomplete reporting of information. It is likely that a combination of both these approaches will continue to contribute to conversions of EPD between breeds.

Literature Cited

Benyshek, L. L., W. O. Herring and J. K. Bertrand. 1994. Genetic evaluation across breeds and countries: prospects and implications. Proc. 5th World Congress on genet. Applied to Livest. Prod. 17:153.

Goddard, M. 1985. A method of comparing sires evaluated in different countries. Livest. Prod. Sci. 12:321.

Golden, B. L., R. M. Bourdon and W. M. Snelling. 1994. Additive genetic groups for animal evaluated in more than one breed association national cattle evaluation. J. Anim. Sci. 72:2559.

Quaas, R. L., and E. J. Pollack. 1980. Mixed model methodology for farm and ranch beef cattle testing programs. J. Anim. Sci. 51:1277.

Quaas, R. L., and E. J. Pollack. 1981. Modified equations for sire models with groups. J. Dairy Sci. 64:1868.

Robinson, G. K. 1986. Group effects and computing strategies for models for estimating breeding values. J. Dairy Sci. 69:3106.

Quaas, R. L. 1988. Additive genetic model with groups and relationships. J. Dairy Sci. 71:1338.

Van Vleck, L. D. 1990. Breeding value prediction with maternal genetic groups. J. Anim. Sci. 68:3998.

Westell, R. A., R. L. Quaas and L. D. Van Vleck. 1988. Genetic groups in an animal model. J. Dairy Sci. 71:1310.

Wilmink, J. B., A Meijering and B. Engel. 1986. Conversion of breeding values for milk from foreign populations. Livest. Prod Sci. 12:223.

Table 2. Group Solutions (GS) expressed as deviations from the Red Angus group and average EPD from the American Angus Association[a] (Avg).

Group[c]	BWT[b] GS	BWT[b] Avg	WW GS	WW Avg	MILK GS	MILK Avg	GN GS	GN Avg
1	0.0	-.24	3.64	1.90	-1.85	-2.45	.02	-7.05
2	2.87	2.09	10.40	14.33	5.91	4.47	9.34	5.60
3	4.67	4.96	19.76	28.56	11.55	11.88	16.55	18.56
4	1.59	-	13.84	-	-1.92	-	4.80	-

[a]Values are in pounds and GS are expressed on the EPD scale instead of predicted breeding values (i.e., they were divided by two).

[b] The component designations BWT, WW, MILK and GN were additive direct genetic effect on birth weight, additive direct genetic effect on weaning weight, additive indirect genetic effect due to the dam on weaning weight, and additive direct genetic effect on 16-d post weaning gain, respectively.

[c]Groups 1, 2, and 3 were the low, medium and high American Angus Association (AAA) EPD groups , respectively, for the component. Animals in Group 4 were registered with the AAA but had unknown AAA EPD for the component. Animals in Group 5 were all other animals with at least one unknown parent.

Table 3. The EPD base differences, and slopes of the conversion equation[a], $\theta_{i\leftrightarrow 2}$, for each of the American Angus Association EPD groups.

Group[c]	BWT[b] Base diff	BWT[b] $\theta_{i\leftrightarrow 2}$	WW Base diff	WW $\theta_{i\leftrightarrow 2}$	MILK Base diff	MILK $\theta_{i\leftrightarrow 2}$	GN Base diff	GN $\theta_{i\leftrightarrow 2}$
1	..88	.82	-4.94	1.87	-4.12	.89	-8.57	1.36
2	.35	-	.73	-	-4.96	-	-5.25	-
3	.1.41	1.85	5.60	1.52	-3.20	1.31	.51	1.80

[a] The slope, $\theta_{i\leftrightarrow 2} = \theta_{2\leftrightarrow i'}$.

[b] The component designations BWT, WW, MILK and GN were additive direct genetic effect on birth weight, additive direct genetic effect on weaning weight, additive indirect genetic effect due to the dam on weaning weight, and additive direct genetic effect on 16-d post weaning gain, respectively.

[c]Groups 1, 2, and 3 were the low, medium and high American Angus Association (AAA) EPD groups , respectively, for the component. Animals in Group 4 were registered with the AAA but had unknown AAA EPD for the component. Animals in Group 5 were all other animals with at least one unknown parent.

COMPARISON OF SIRE BREEDS WITH RECORDS FROM THE REGIONAL CROSSBREEDING PROJECT NC-196

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Other sources of data to use together with records from the GPU project at MARC to compare breeds of sires are rare. The NC-196 regional project data is one. Records were obtained from seven agricultural experiment stations involved in NC-196. Montana had only horned and Polled Herefords so those data were not used because of probable lack of heterosis. Ohio records included only one breed with breed association EPD's so those records were not used due to lack of any direct comparisons between breeds of sire. From the other five states, a total of 3,490 birth, 3,238 weaning (205-d) and 1,372 yearling (365-d) weights of progeny were available for sires of nine breeds having EPDs. The number of sires and number of progeny with weaning weights are shown in Table 1. Yearling weight (YWT) was available only from Iowa (only Angus and Simmental sires) and from Oklahoma (only Gelbvieh and Limousin sires). Horned Herefords were only at Kansas-Louisiana and were deleted from the analyses reported here. The lack of direct comparisons and small numbers of progeny for some breeds contributed to large sampling variances of breed of sire differences relative to sampling variances from MARC records, even though the number of NC-196 records was about 75% of the number for MARC for birth weight (BWT) and weaning weight (WWT). Brief descriptions of the records by station also illustrate the difficulty in determining the best possible model for each station and the necessity to do the analyses separately by station. Solutions are then pooled by inverse of sampling variances.

DATA

Iowa State University

Four calf crops (1991 through 1994) were obtained from IA. Angus and Simmental sires were mated to crossbred dams with varying amounts of Angus, Simmental, Holstein, Brown Swiss, and Charolais inheritance (R. L. Willham, personal communication). Crossbred calves were produced in two locations and had an average heterozygosity of 62%.

Louisiana State University and Kansas State University

Crossbred calves were produced at Louisiana State University and finished at KS between 1989 and 1993. Six breeds of sire (Angus, Brahman, Charolais, Gelbvieh, Polled Hereford, and Simmental) were mated to rotational-cross cows with varying percentages of Angus, Brahman, Charolais, and horned Hereford inheritance (Andries, et al., 1994). Gelbvieh and Simmental sires were also mated to Brahman x Angus, Brahman x Charolais, Brahman x Hereford dams. The majority of matings produced crossbred progeny with expected breed heterozygosity ranging from 66 to 100%.

Michigan State University

Growth records were obtained from calves produced at MI between 1983 and 1991 (Cunningham et al., 1985). Five breeds of sire (Angus, Polled Hereford, Simmental, Gelbvieh, and Shorthorn) were mated to dams with varying amounts of Angus, Charolais, Gelbvieh, Holstein, Shorthorn, and Simmental inheritance. Purebred Angus and Polled Hereford calves and crossbred calves with heterozygosity ranging from 25 to 100% were produced.

Oklahoma State University

Data were obtained on calf crops born between 1978 and 1986. Five breeds of sire were mated to seven F_1 cow groups (Hereford-Angus/Angus-Hereford, Simmental-Angus, Simmental-Hereford, Brown Swiss-Angus, Brown Swiss-Hereford, Jersey-Angus, and Jersey-Hereford) (Marshall and Frahm, 1985). In 1976 and 1977, calves were sired by Brahman and Charolais sires. The 1978 through 1981 calves were sired by Charolais and Limousin bulls, and calves born between 1982 and 1985 were sired by Limousin and Gelbvieh bulls. Weights at birth, and 205-d and 365-d were available only for the 1982-85 calves. All matings resulted in calves that were 100% heterozygous.

South Dakota State University

Records were collected on calves born between 1975 and 1990. Seven breeds of sire (Angus, Charolais, Limousin, Polled Hereford, Salers, Simmental, and Tarentaise) were mated to purebred, F_1, and rotational cross cows with differing percentages of Angus, Hereford, Simmental, and Tarentaise inheritance (Marshall et al., 1990). Calves were raised in two locations and had an average heterozygosity of 61%.

STATISTICAL ANALYSES

All stations reported BWT and WWT records. Only OK and IA reported YWT records. Analyses on all traits were done by station to obtain estimates of components of variance to use to estimate breed of sire differences. Analyses were done using a sire model and MTDFREML (Boldman et al., 1993). Models included a fixed effect for breed of sire as well as a fixed subclass variable which included sex of calf and age of dam for all stations, and location, management, and rearing codes as needed within each station (Table 2). For KS, OK, and SD, the subclass variable also included breed of dam. For MI and IA, fixed covariates representing the fraction of genes from each breed contributing to the dam were used in place of a breed of dam class factor due to the large number of distinct types of crossbred cows. The model also included fixed covariates for julian birth date and fraction heterozygosity of the calf, and random effects for year of birth and sire. For MI and IA, determination of heterozygosity of the dams was not possible. For other stations, heterozygosity was confounded with breed of dam. Heterozygosity was not used as a covariate for OK due to consistent heterozygosity of 100% for calves.

Progeny from registered sires with published expected progeny differences (EPD) were used in analyses similar to those previously done on data from the Germ Plasm Evaluation program conducted at the U. S. Meat Animal Research Center (MARC) at Clay Center, Nebraska (Notter and Cundiff, 1991; Nuñez-Dominguez, et al., 1993; Cundiff, 1993; and Barkhouse et al., 1994). Estimates of sire breed differences within each station were obtained using the mixed model described above. Estimates of breed of sire solutions contrasted from Angus and their sampling variances were obtained using MTDFREML. Solutions and variances were pooled over stations using a generalized least-squares procedure, i.e., weighting by the inverse of the sampling variance-covariance matrices. Once pooled, breed of sire solutions were added to the raw mean for Angus to obtain "least-squares means" for each breed of sire.

Analyses to obtain regression coefficients for progeny performance on sire EPD used the models described above with the random sire effect left out. An additional covariate for EPD of the sire was used. Regression coefficients were obtained for each station using the MIXED procedure of SAS (1989). Coefficients of regression and standard errors were obtained for each station and pooled over all stations. Homogeneity of coefficients of regression across breed of sire was tested by including the interaction between the EPD covariate and the effect of interest in the model. Breed of sire means were adjusted for genetic trend and sire sampling as described by Notter and Cundiff (1991). Mean EPD and Beef Improvement Federation accuracies needed to adjust for sire sampling to a 1993 base were obtained from the most recent (1995) national cattle evaluation for each breed (Table 3). Adjustment factors to add to within-breed EPD to allow comparisons across breeds were obtained as for MARC data using the pooled regression coefficients.

RESULTS

Breed of Sire Solutions

Pooled breed of sire solutions to mixed model equations and standard errors of the differences from Angus are in Table 4 for NC-196 and for MARC. Many of the NC-196 estimates are considerably different from those from MARC analyses. Genetic trend may account for some of the differences due to when sires at MARC and the NC-196 stations were born corresponding to the samples of sires used. The differences are greatest for Brahman for WWT (-17 for NC-196 vs 27 for MARC), Salers for WWT (-24 vs 18), Charolais (.9 vs 9.5 for BWT and -13 vs 25 for WWT), Limousin (-4.5 vs 4.4 for BWT and -17 vs 8 for WWT), and Tarentaise for WWT (-2 vs 11). All of those comparisons were basically at one station, sometimes with few progeny; e.g., 31 Brahman and 62 Charolais at Kansas-Louisiana and 41 Salers and 58 Tarentaise at South Dakota. Only Limousin had a large number of progeny and they essentially were compared only with Gelbvieh in Oklahoma as there were only four Limousin calves at South Dakota. The comparisons all have large standard errors, which were about twice the SE of MARC solutions. Due to the data structure, the only YWT comparison for Angus vs Simmental was at Iowa and was 2.2 lb in favor of Simmental in Iowa compared to 25 lb in favor of Simmental at MARC. Over the four stations having the Simmental - Angus comparison for BWT and WWT, the comparisons were similar to those at MARC (6.4 vs 8.4 for BWT and 21 vs 21 for WWT).

This result suggests that management in Iowa and MARC after weaning may be different. The standard errors are relatively large. In addition, maternal heterosis could not be modeled at Iowa. The only other YWT comparison was at Oklahoma for Limousin vs Gelbvieh with the difference in Oklahoma, 28 lb, and at MARC, 30 lb, both in favor of Gelbvieh.

Regression of Progeny on EPD

The coefficients of regression of progeny on sire EPD are in Table 5 by station and pooled over the NC-196 stations. For BWT and WWT, the pooled coefficients are slightly larger than those estimated at MARC but within the standard errors. The regressions show that, on average, the expected superiority in EPD for BWT and WWT was exhibited in progeny at the NC-196 stations. The story is different for YWT with two different breeds at each of only two stations. The pooled regression of .62 was only about half as large as that typically estimated from the MARC data.

Table 6 confirms that bulls used in the NC-196 project, which were born generally later than the MARC bulls, often had quite different weighted EPDs than the MARC bulls. For BWT, EPDs of NC-196 bulls were about a pound greater than for MARC bulls for the Simmental, Limousin, and Tarentaise breeds; and 1.94 lb greater for Gelbvieh and 2.44 lb for Salers. Polled Hereford EPD was .84 lb less for NC-196 bulls than for MARC bulls . The largest differences for WWT between EPDs for NC-196 and MARC bulls were 26.1 lb for Simmental, 10.4 lb for Angus and 8.5 lb for Charolais in favor of NC-196 bulls but 13.3 lb in favor of the Salers bulls at MARC, compared to the seven Salers bulls used at South Dakota. The largest differences in YWT involved the Angus and Simmental bulls used for the 1991 through 1994 calf crops at Iowa: 51.5 lb for Iowa Angus bulls vs 30.9 lb for MARC Angus bulls and 28.8 lb for Iowa Simmental bulls vs -26.1 lb for MARC Simmental bulls with earlier generations of bulls used at MARC having smaller EPD for YWT, especially the Simmental bulls.

Adjusted Breed Means

Table 7a lists the weighted breed of sire solutions with the raw mean for Angus added and after adjustment for EPD of bulls used in the NC-196 project compared to the average EPD of animals of the breed born in 1993: MARC solution + $b(EPD_{NC\text{-}196} - EPD_{Breed})$ where b is the coefficient of regression, EPD is the weighted average EPD of NC-196 bulls, and EPD is the average EPD for animals in the national population born in 1993.

After adjustment for sires to a 1993 base, the largest differences for the NC-196 analyses compared to the MARC analyses (Table 7b as differences from Angus) are for BWT (with NC-196 listed first): Limousin, -3.3 vs 6.2 lb; Charolais, .2 vs 9.2 lb; Gelbvieh, 1.7 vs 7.9 lb. For WWT, the differences are relatively greater: Brahman, -17 vs 24 lb; Charolais, -13 vs 27 lb; Limousin, -17 vs 16 lb; and Tarentaise, -2 vs 19 lb. For two breeds, the differences, although smaller, were in the other direction; Salers, 24 vs 13 lb; and Polled Hereford, 18 vs 10 lb. These adjusted breed of sire solutions show that differences in average EPD of MARC and NC-196 bulls do not explain the differences in breed of sire solutions from MARC and NC-196 records.

For YWT, the Simmental - Angus adjusted comparison was: -3 lb for Iowa and 60 lb for MARC. The Limousin - Gelbvieh comparison was more similar: -20 lb for Oklahoma and -17 lb for MARC.

Adjustment Factors for Across-Breed EPD

The breed table factors from NC-196 records to adjust within-breed EPDs to an Angus base are calculated from the Table 7a differences by subtracting the difference between the 1993 average EPD for each breed and the base Angus breed. These factors are shown in Table 8 for NC-196 and MARC. The largest differences between the NC-196 factors and MARC factors for BWT are: Limousin, -1.3 for NC-196 vs 8.2 lb for MARC; Charolais, 1.8 vs 10.8 lb; and Gelbvieh, 4.8 vs 10.9 lb. For WWT, the largest differences are for: Brahman, 3.3 vs 40.6 lb; Charolais, 9.2 vs 42.9 lb; Limousin 13.9 vs 34.4 lb; and Salers, 10.3 vs 29.9 lb. These discrepancies involve breeds with few NC-196 progeny (Brahman, 31; Charolais, 62; Tarentaise, 38; Salers, 41) and comparisons at one station.

Although the YWT comparisons are limited to Iowa and Oklahoma, the difference between breed table factors from NC-196 (27 lb) and MARC (89 lb) for Simmental vs Angus is large, whereas, the Limousin vs Gelbvieh adjustments are similar; -23 lb for NC-196 and -20 lb for MARC.

Pooling of NC-196 and MARC Records for Adjusted Breed of Sire Solutions

When NC-196 and MARC adjusted breed of sire solutions are pooled by weighting by inverse of sampling variances, the combined solutions are heavily weighted toward the MARC solutions. Elements on diagonals of the sampling variance matrix for NC-196 for BWT are 2 to 5 times these for MARC and 4 to 10 times for WWT. The much larger sampling variances for NC-196 are also illustrated in Table 4 by the much larger standard errors of differences from Angus for NC-196 solutions compared to MARC breed of sire solutions.

CONCLUSIONS

1. Differences in breed table factors for across-breed comparisons between NC-196 and MARC analyses may be due to sampling variance (i.e., are chance results).

2. No information is available for maternal weaning weight and MILK from NC-196 records.

3. Information on yearling weight is limited 1) to Angus and Simmental at Iowa with a large discrepancy between the Angus-Simmental differences for Iowa and MARC and 2) to Limousin and Gelbvieh at Oklahoma with a similar difference there and at MARC. In addition, the regression of progeny YWT on sire EPD is about half as large at Iowa and Oklahoma as at MARC.

4. For most direct breed comparisons, numbers of progeny are limited with usually only

about two breeds per station having enough progeny to provide a reasonable standard error of difference. The consequence is that pooling of MARC and NC-196 results in adjustment factors which are similar to those from MARC alone.

5. Further analyses (more time to think) are needed to investigate differences between breed table factors using MARC records alone and NC-196 records alone.
6. Time would be needed to develop programs to pool analyses of NC-196 records with the MARC records, especially for calculation of variances of adjusted breed solutions.

LITERATURE CITED

Andries, K. M., R. R. Schalles, and D. F. Franke. 1994. Estimates of direct and maternal heritability and correlations for birth weight and weaning weight from hybrid cattle. J. Anim. Sci. 72(Suppl.1):148. (Abstract)

Barkhouse, K. L., L. D. Van Vleck, and L. V. Cundiff. 1994. Breed comparisons for growth and maternal traits adjusted to a 1992 base. Proc. Beef Improvement Federation Ann. Mtg. p. 197. West Des Moines, IA.

Barkhouse, K. L., L. D. Van Vleck, and L. V. Cundiff. 1995. Mixed model methods to estimate breed comparisons for growth and maternal traits adjusted to a 1993 base. Proc. BIF Research Symposium, Sheridan, WY. May 31-June 3, 1995. pp 218-239.

Boldman, K. G., L. A. Kriese, L. D. Van Vleck and S. D. Kachman. 1993. A manual for use of MTDFREML: A set of programs to obtain estimates of variances and covariances USDA Meat Animal Research Center, Clay Center, NE.

Cundiff, L. V. 1993. Breed comparisons adjusted to a 1991 basis using current EPD. Proc. Beef Improvement Federation Ann. Mtg. p. 114. Asheville, NC.

Cunningham, B. E., W. T. Magee, and H. D. Ritchie. 1985. Effects of selection and crossbreeding on the cow-calf unit. I. Effects on birth and survival traits. J. Anim. Sci. 61 (Suppl. 1):72.

Marshall, D. M. and R. R. Frahm. 1985. Comparisons among two-breed cross cow groups. II. Feedlot and carcass performance of three-breed cross calves. J. Anim. Sci. 61:856.

Marshall, D. M., M. D. Monfore, and C. A. Dinkel. 1990. Performance of Hereford and two-breed rotational crosses of Hereford with Angus and Simmental cattle: calf production through weaning. J. Anim. Sci. 68:4051.

Notter, D. R., and L. V. Cundiff. 1991. Across-breed expected progeny differences: Use of within-breed expected progeny differences to adjust breed evaluations for sire sampling and genetic trend. J. Anim. Sci. 69:4763.

Nuñez-Dominguez, R., L. D. Van Vleck, and L. V. Cundiff. 1993. Breed comparisons for growth traits adjusted for within-breed genetic trend using expected progeny differences. J. Anim. Sci. 71:1419.

SAS. 1989. User's Guide (Version 6, 4th Ed., Vol. 2). SAS Inst. Inc., Cary, NC.

Table 1. Number of sires (S) and progeny (P) having weaning weights by breed of sire[a] at NC-196 stations

	Iowa		Kansas		Michigan		Oklahoma		South Dakota	
Breed of sire	S	P	S	P	S	P	S	P	S	P
Polled Hereford	-	-	10	34	21	172	-	-	19	468
Angus	24	781	11	42	4	57	-	-	8	110
Brahman	-	-	5	31	-	-	-	-	-	-
Simmental	4	235	12	133	12	56	-	-	11	152
Limousin	-	-	-	-	-	-	22	368	2	4
Charolais	-	-	11	62	-	-	-	-	-	-
Gelbvieh	-	-	31	236	9	69	9	149	-	-
Tarentaise	-	-	-	-	-	-	-	-	9	38
Salers	-	-	-	-	-	-	-	-	7	41
Total	28	1016	80	538	46	354	31	517	56	813

[a] -. indicates breed of sire not used.

Table 2. Fixed effects included in subclass variables within station

Station	Subclass effects
Iowa[a]	Sex of calf, age of dam, location
Kansas	Breed of dam, sex of calf, age of dam
Michigan[a,b]	Age of dam, rearing code, pen number
Oklahoma	Breed of dam, sex of calf, age of dam
South Dakota	Breed of dam, sex of calf, age of dam, location

[a]Breed of dam represented by covariates for the amount of each breed contributing to the cow.
[b]Sex of calf = steer.

Table 3. Mean EPD (lb) of animals born in 1993 from most recent National Cattle Evaluation for each breed

Breed of sire	BWT	WWT	YWT
Pooled Hereford	3.10	23.4	39.5
Angus	3.20	24.9	41.6
Brahman	1.06	8.3	14.2
Simmental	.40	7.1	12.2
Limousin	1.20	6.5	12.0
Charolais	1.58	9.0	13.5
Gelbvieh	.20	4.5	8.5
Tarentaise	2.52	9.5	15.2
Salers	.80	8.0	13.4

Table 4. Breed of sire solutions (lb) and standard errors (Angus as constraint) for birth weight (BWT), weaning weight (WWT), and yearling weight (YWT) pooled across stations for NC-196 and for MARC

	NC-196			MARC		
Breed of sire	BWT	WWT	YWT	BWT	WWT	YWT
P. Hereford	2.0 ± 2.2	9 ± 9	-	4.4 ± 1.0	6 ± 5	-2 ± 9
Hereford	-	-	-	4.0 ± 1.1	-3 ± 5	-11 ± 9
Angus	0	0	0[a]	0	0	0
Shorthorn	-	-	-	7.3 ± 1.3	19 ± 6	26 ± 11
Brahman	14.6 ± 3.7	-17 ± 17	-	13.9 ± 1.1	27 ± 5	-26 ± 10
Simmental	6.4 ± 1.7	21 ± 8	2.2 ± 13[a]	8.4 ± 1.3	21 ± 6	25 ± 11
Limousin	-4.5 ± 2.9	-17 ± 13	0[b]	4.4 ± 1.4	8 ± 6	-12 ± 11
Charolais	.9 ± 3.0	-13 ± 15	-	9.5 ± 1.0	25 ± 5	36 ± 9
Maine-Anjou	-	-	-	11.1 ± 1.6	22 ± 7	29 ± 13
Gelbvieh	2.3 ± 2.3	21 ± 11	27 ± 12[b]	6.6 ± 1.3	26 ± 6	18 ± 10
Pinzgauer	-	-	-	6.9 ± 1.3	9 ± 6	-5 ± 11
Tarentaise	3.5 ± 3.7	-2 ± 16	-	4.9 ± 1.8	11 ± 8	-12 ± 15
Salers	3.8 ± 4.4	-24 ± 20	-	5.8 ± 1.3	18 ± 6	22 ± 11

[a]Only Angus vs Simmental difference is estimable at Iowa.
[b]Only Limousin vs Gelbvieh difference is estimable at Oklahoma.

Table 5. Estimates of regression coefficient of progeny performance on EPD of the sire for birth weight (BWT), weaning weight (WWT), and yearling weight (YWT)by station and pooled across stations

Station	BWT	WWT	YWT
Iowa	1.5 ± .1	1.3 ± .3	.5 ± .3
Kansas	.3 ± .2	1.0 ± .3	-
Michigan	.6 ± .4	.2 ± .7	-
Oklahoma	1.2 ± .3	1.0 ± .3	.7 ± .2
South Dakota	1.5 ± .3	.7 ± .3	-
NC-196	1.25 ± .09	.98 ± .13	.62 ± .18

Table 6. Weighted mean EPD (lb) and BIF accuracies for birth weight (BWT), weaning weight (WWT), and yearling weight (YWT) for NC-196 sires and mean EPD for MARC sires

	NC-196						MARC		
	BWT		WWT		YWT		BWT	WWT	YWT
Breed of sire	EPD	ACC	EPD	ACC	EPD	ACC	EPD	EPD	EPD
P. Hereford	2.00	.76	17.6	.77	-[a]	-	2.84	13.9	25.2
Angus	2.97	.92	29.5	.91	51.5	.88	2.82	19.1	30.9
Brahman	1.45	.60	7.3	.56	-	-	1.01	6.1	9.0
Simmental	.77	.75	10.6	.75	28.8	.74	-.37	-15.5	-26.1
Limousin	.18	.92	-2.6	.89	-4.2	.86	-.76	-7.6	-11.5
Charolais	1.52	.61	9.7	.60	-	-	1.48	1.2	3.3
Gelbvieh	.57	.62	3.3	.57	6.6	.51	-1.37	-2.8	-5.3
Tarentaise	.68	.90	2.0	.89	-	-	1.66	-4.9	-.2
Salers	-1.32	.77	-5.3	.70	-	-	1.12	8.0	13.5

[a]-, indicates breed not in analysis.

Table 7b. Breed of sire solutions adjusted to base year of 1993 for NC-196 and MARC analyses as a differences from Angus

	NC-196			MARC		
Breed of sire	BWT	WWT	YWT	BWT	WWT	YWT
P. Hereford	3.4	18	-	4.3	10	3
Angus	0	0	0[a]	0	0	0
Brahman	13.8	-17	-	13.6	24	-34
Simmental	5.5	22	-3[a]	8.9	37	60
Limousin	-3.3	-17	0[b]	6.2	16	4
Charolais	.2	-13	-	9.2	27	36
Gelbvieh	1.7	22	20[b]	7.9	28	21
Tarentaise	5.7	-2	-	5.5	19	-6
Salers	6.3	24	-	5.0	13	8

[a]Only Angus vs Simmental difference is estimable from Iowa.
[b]Only Limousin vs Gelbvieh difference is estimable from Oklahoma.

Table 7a. Breed of sire solutions (lb) unadjusted (U) and adjusted (ADJ) to a base year of 1993 for birth weight (BWT), weaning weight (WWT), and yearling weight (YWT) for NC-196 records

	BWT		WWT		YWT	
Breed of sire	U	ADJ	U	ADJ	U	ADJ
Polled Hereford	83.6	85.4	464	469	-	-
Angus	81.6	82.1	455	451	924[a]	920[a]
Brahman	96.1	95.9	438	438	-	-
Simmental	88.0	87.6	477	473	928[a]	917[a]
Limousin	77.2	78.8	438	447	913[b]	922[b]
Charolais	82.5	82.3	442	444	-	-
Gelbvieh	84.0	83.8	477	477	939[b]	942[b]
Tarentaise	85.1	87.8	453	460	-	-
Salers	85.4	88.4	431	444	-	-

[a] Only Angus vs Simmental difference is estimable from Iowa.
[b]Only Limousin vs Gelbvieh difference is estimable from Oklahoma.

Table 8. Adjustment factors (lb) for across-breed EPD for birth weight (BWT), weaning weight (WWT), and yearling weight (YWT) by breed of sire (Angus as base) pooled over stations for NC-196 and for MARC

	NC-196			MARC		
Breed of sire	BWT	WWT	YWT	BWT	WWT	YWT
P. Hereford	3.3	19.1	-	4.4	12.5	5.1
Angus	0	0	0[a]	0	0	0
Brahman	16.1	3.3	-	15.7	40.6	-6.6
Simmental	8.4	39.8	27.3[a]	11.7	54.8	89.4
Limousin	-1.3	13.9	0[b]	8.2	34.4	33.6
Charolais	1.8	9.2	-	10.8	42.9	64.1
Gelbvieh	4.8	46.9	23.3[b]	10.9	48.4	54.1
Tarentaise	6.4	24.2	-	6.2	34.4	20.4
Salers	8.8	10.3	-	7.4	29.9	36.2

[a]Only Angus vs Simmental difference is estimable from Iowa.
[b]Only Limousin vs Gelbvieh difference is estimable from Oklahoma.

THE ACROSS-BREED EPD TABLES ADJUSTED TO A 1994 BASE

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INTRODUCTION

This report is the 1996 update of estimates of sire breed means from data of the Germ Plasm Evaluation (GPU) project at the U.S. Meat Animal Research Center (MARC) adjusted to a 1994 base using EPDs from the most recent national cattle evaluations.

Changes from the 1995 update are:

1) Herefords are now combined into one breed.
2) Weaning weights of 51 grand progeny of 8 Hereford sires, of 63 grand progeny of 9 Angus sires, and of 51 grand progeny of 3 Brahman sires were added to the maternal analyses.
3) The model to obtain coefficients for regression of progeny weights on sire EPD was changed to include random dam maternal effects. The pooled regression coefficients were reduced slightly.
4) The format of tables was changed so that values used in calculation of the breed table adjustments are in one table for each trait.
5) The programs were redesigned to pass solutions and regression coefficients directly without manual entry to reduce errors.

METHODS

The calculations are as outlined in the 1996 BIF Guidelines. The basic steps were outlined by Notter and Cundiff (1991) with refinements by Núñez-Dominguez et al. (1993), Cundiff (1993, 1994) and Barkhouse et al. (1994, 1995). All calculations were done with programs written in Fortran language with estimates of variance components, regression coefficients, and breed effects obtained with the MTDFREML package (Boldman et al., 1995). All breed solutions were estimated as a difference from Angus. The table values to add to within-breed EPDs are relative to Angus.

For completeness, the basic steps in the calculations will be reviewed.

Models for Analysis of MARC Records

The fixed effects in the models for birth weight, weaning weight (205-d) and yearling weight (365-d) were: breed of sire (12), dam line (Hereford, Angus, MARC III Composite), sex (female, male), age of dam (2, 3, 4, 5-9, ≥10 yr), year of birth (70-76, 86-90, 92-94) and a covariate for day of year at birth. Dam of calf was included as a random effect to account for correlated maternal effects for cows with more than one calf (2809 dams for BWT, 2621 for WWT, 2508 for YWT). For estimation of variance components needed to estimate breed of sire effects, sire of calf was used as a random effect (374).

Variance components were estimated with a derivative-free REML algorithm. At convergence, the breed of sire solutions were obtained as were the sampling variances of the estimates to use in constructing the prediction error variance for pairs of bulls of different breeds.

For estimation of coefficients of regression of progeny performance on EPD of sire, the random sire effect was dropped from the model. Pooled regressions, regressions by sire breed, by dam line, and by sex of calf were obtained. These regressions are monitored as accuracy checks and for possible genetic by environment interactions. The pooled regression coefficients were used as described later to adjust for genetic trend and bulls used at MARC.

The fixed effects for the analyses of maternal effects included breed of maternal grandsire (12), maternal dam line (Hereford, Angus, MARC III), breed of natural service mating sire (14), sex of calf (2), birth year-GPU cycle-age of dam subclass (56), and mating sire breed-GPU cycle-age of dam subclass (29) with covariate for day of year of birth. The subclasses are used to account for confounding of years, mating sire breeds, and ages of dams. Ages of dams were (2, 3, 4, ≥5 yr). For estimation of variance components and estimation of breed of maternal grandsire effects, random effects were maternal grandsire (339) and dam (1564 daughters of maternal grandsires). For estimation of regression coefficients of grand progeny weaning weight on maternal grandsire EPD, both maternal grandsire and dam (daughter of MGS) were dropped from the model.

Adjustment of MARC Solutions

Calculations of across-breed adjustment factors rely on solutions from records at MARC for breed of sire or maternal grandsire, and on within-breed EPDs. The calculations are simplified because records from MARC are not included in within-breed EPD calculations.

The basic calculations for BWT, WWT, and YWT are as follows:

MARC breed of sire solution adjusted for genetic trend:

$$M_i = MARC\ (i) + b[EPD(i)_{1994} - EPD(i)_{MARC}]$$

Breed Table Factor to add to EPD for bull of breed i:

$$A_i = (M_i - M_x) - (EPD(i)_{1994} - EPD(x)_{1994})$$

where,

MARC(i) is solution from mixed model equations with MARC data for breed of sire i,

$EPD(i)_{1994}$ is the average within-breed EPD for breed i for animals born in 1994,

$EPD(i)_{MARC}$ is the weighted (by number of progeny at MARC) average of EPD of bulls of breed i having progeny with records at MARC, b is the pooled coefficient of regression of progeny performance at MARC on EPD of sire (for 1996: 1.04, .90, and 1.24 for BWT, WWT, YWT),

i denotes breed i, and

x denotes the base breed x, which is Angus in this report.

The calculations to arrive at the Breed Table Factor for milk are more complicated because of the need to separate the direct effect of the maternal grandsire breed from the maternal (milk) effect of the breed.

MARC breed of maternal grandsire solution for WWT adjusted for genetic trend:

$$MWWT(i) = MARC(i)_{MGS} + b_{wwt}[EPD(i)_{94WWT} - EPD(i)_{MARCWWT}] + b_{MLK}[EPD(i)_{94MLK} - EPD(i)_{MARCMLK}]$$

MARC breed of maternal grandsire solution for milk adjusted for genetic trend and direct genetic effect:

$$MILK(i) = [MWWT(i) - .5\, M(i)] - [\overline{MWWT} - .5\, \overline{M}]$$

Breed table factor to add to EPD for MILK for bull of breed i:

$$A_i = [MILK(i) - MILK(x)] - [EPD(i)_{94MLK} - EPD(i)_{MARCMLK}]$$

where,

$MARC(i)_{MGS}$ is solution from mixed model equations with MARC data for MGS breed i for WWT,

$EPD(i)_{94WWT}$ is the average within-breed EPD for WWT for breed i for animals born in 1994,

$EPD(i)_{MARCWWT}$ is the weighted (by number of grand progeny at MARC) average of EPD for WWT of MGS of breed i having grand progeny with records at MARC,

$EPD(i)_{94MLK}$ is the average within-breed EPD for MILK for breed i for animals born in 1994,

$EPD(i)_{MARCMLK}$ is the weighted (by number of grand progeny at MARC) average of EPD for MILK of MGS of breed i having grand progeny with records at MARC,

b_{WWT}, b_{MLK} are the coefficients of regression of performance of MARC grand progeny on MGS EPD for WWT and MILK (for 1996: .57 and 1.17), M(i) = M_i is the MARC breed of sire solution for WWT direct adjusted for genetic trend,

$\overline{MWWT}$ and $\overline{M}$ are unneeded constants corresponding to unweighted averages of MWWT(i) and M(i) for i = 1,...,12, the number of sire and maternal grandsire breeds.

RESULTS

Tables 1, 2, and 3 (for BWT, WWT and YWT) summarize the data from, and results of, MARC analyses to estimate breed of sire differences and the adjustments to the breed of sire effects to a 1994 base. The last column of each table corresponds to the "breed table adjustment" factor for that trait. The number of MARC progeny with records was the same for 1996 as for 1995 except for a change of 1 or 2 for three breeds. Thus, changes from 1995 are expected to be small. Any changes would be due to slightly different pooled regression coefficients because of including dam effects in the model used to estimate the pooled regression coefficients. Changes could also be due to any changes in edits or genetic parameters used for the National Cattle Evaluations. A more likely reason for slight changes is the average genetic change from the previous base year of 1993 to the current base year of 1994.

Table 4 summarizes the calculations for the table adjustment for MILK EPDs. Because daughters of the MGS are still producing calves, some new grand progeny had records; 51 more Hereford, 48 more Angus, and 51 more Brahman. The greatest change in table values was for Brahman. Most of the other changes in 1996 compared to 1995 were in the 1-2 lb range.

Table 5 summarizes the average BIF accuracy for bulls with progeny at MARC weighted by number of progeny or grand progeny. Table 6 reports the estimates of variance components from the records that were then used in the mixed model equations to obtain breed of sire and breed of MGS solutions.

Table 7 updates the coefficients of regression of MARC progeny on EPD for BWT, WWT and YWT. The changes from the 1995 analyses may be partially due to rounding to one decimal last year and two decimals this year, as well as to including random dam effects in the models used to estimate the coefficients of regression. Despite having essentially the same data, the pooled regressions for BWT and YWT are becoming closer to the expected regressions of 1.00. The coefficient for WWT, however, seems to have edged away from 1.00 slightly more than before. The standard errors of the specific breed regression coefficients are large relative to the regression coefficients. Nevertheless, one noticeable pattern, which may have a biological basis, is the decrease in the Brahman regression from birth to yearling age with regression coefficients of 1.47 for BWT, .92 for WWT, and .59 for YWT. Brahman sired calves from purebred Brahman dams are known to be smaller than calves from dams of other breeds. The YWT regression drops to .59 (with large SE) but may be due to Brahman response to Nebraska winters. Although the regressions by sex for YWT are still quite different, they are becoming closer to 1.0. Another puzzle is why the regression for WWT for

Hereford cows is so low (.44 ± .13) relative to the expected regression of 1.00 and especially relative to Angus cows. The difference in regression coefficients for Hereford and Angus dams, if real, suggests different responses when sire breeds are mated to Hereford or Angus dams. A similar, but less extreme, pattern is shown for the regression of grand progeny performance on MGS EPD for WWT with the Hereford regression less than .5 and the Angus regression greater than .5.

The coefficients of regression of grand progeny on MGS EPD for WWT and MILK are shown in Table 8. The differences in coefficients of regression on milk EPD and on WWT EPD for heifer and steer calves continue but the standard errors for regression coefficients associated with heifers and steers overlap for both milk EPD and WWT EPD.

Prediction Error Variances of Across-Breed EPD

The standard errors of differences in the solutions for breed of sire and breed of MGS differences from the MARC records can be adjusted by theoretical approximations to obtain variances of adjusted breed differences (Van Vleck, 1994: Van Vleck and Cundiff, 1994). These variances of estimated breed differences can be added to prediction error variances of within-breed EPDs to obtain prediction error variances (PEV) or equivalently standard errors of prediction (SEP) for across-breed EPDs (Van Vleck and Cundiff 1994, 1995). The variances of adjusted breed differences are given in the upper triangular part of Table 9 for BWT, lower triangular part of Table 9 for YWT, upper triangular part of Table 10 for direct WWT, and lower triangular part of Table 10 for MILK. How to use these to calculate standard errors of prediction for expected progeny differences of pairs of bulls of the same or different breeds was discussed in the 1995 BIF proceedings (Van Vleck and Cundiff, 1995).

Even though the variances of estimates of adjusted breed differences look large, especially for YWT and MILK, they generally contribute a relatively small amount to standard errors of predicted differences. For example, suppose for WWT a Salers bull has an EPD of 15.0 with prediction error variance of 75 and a Hereford bull has an EPD of 30.0 with PEV of 50. The difference in predicted progeny performance is (Salers adjustment + Salers bull's EPD) - (Hereford adjustment + Hereford bull's EPD):

$$(28.9 + 15.0) - (9.8 + 30.0) = 43.9 - 39.8 = 4.1.$$

The prediction error variance for this difference is (use upper Table 10 at intersection of row for HE and column for SA):

V(Salers breed - Hereford breed) + PEV(Salers bull) + PEV(Hereford bull):

$$23.7 + 75 + 50 = 148.7$$

with

standard error of prediction $\sqrt{148.7} = 12.2$.

If the difference between the Salers and Hereford breeds in 1994 was estimated perfectly, the variance of the estimate of the breed difference would be 0 and the standard error of prediction between the two bulls would be:

$\sqrt{0 + 75 + 50} = 11.2$ which is only slightly smaller than 12.2.

REFERENCES

Barkhouse, K. L., L. D. Van Vleck, and L. V. Cundiff. 1994. Breed comparisons for growth and maternal traits adjusted to a 1992 base. Proc. BIF Research Symposium, Des Moines, IA, May, 1994. pp 197-209.

Barkhouse, K. L., L. D. Van Vleck, and L. V. Cundiff. 1995. Mixed model methods to estimate breed comparisons for growth and maternal traits adjusted to a 1993 base. Proc. BIF Research Symposium, Sheridan, WY. May 31-June 3, 1995. pp 218-239.

Barkhouse, K. L., L. D. Van Vleck, S. D. Kachman, and L. V. Cundiff. 1995. Effect of random sire and dam effects on estimates and standard errors of breed comparisons. Am. Soc. Anim. Sci. Midwest Section Ann. Mtg. Abstracts: 46.

Boldman, K. G., L. A. Kriese, L. D. Van Vleck, C. P. Van Tassell, and S. D. Kachman. 1995. A manual for use of MTDFREML. A set of programs to obtain estimates of variances and covariances (Draft). USDA-ARS-USMARC. Clay Center, NE

Cundiff, L. V. 1993. Breed comparisons adjusted to a 1991 basis using current EPD's. Proc. BIF Research Symposium, Asheville, NC, May, 1993.

Cundiff, L. V. 1994. Procedures for across breed EPD's. Proc. Fourth Genetic Prediction Workshop, Beef Improvement Federation, Kansas City, MO, Jan. 1994.

Notter, D. R., and L. V. Cundiff. 1991. Across-breed expected progeny differences: Use of within-breed expected progeny differences to adjust breed evaluations for sire sampling and genetic trend. J. Anim. Sci. 69:4763.

Nuñez-Dominguez, R., L. D. Van Vleck, and L. V. Cundiff. 1993. Breed comparisons for growth traits adjusted for within-breed genetic trend using expected progeny differences. J. Anim. Sci. 71:1419.

Van Vleck, L. D., and L. V. Cundiff. 1994. Prediction error variances for inter-breed genetic evaluations. J. Anim. Sci. 71:1971.

Van Vleck, L. D., and L. V. Cundiff. 1995. Assignment of risk to across-breed EPDs with tables of variances of estimates of breed differences. Proc. BIF Research Symposium, Sheridan, WY. May 31-June 3, 1995. pp 240-245.

Van Vleck, L. D. 1994. Prediction error variances for inter-breed EPD's. Proc. Fourth Genetic Predication Workshop, Beef Improvement Federation, Kansas City, MO, Jan. 1994.

Table 1. Breed of sire solutions from MARC, mean breed and MARC EPDs used to adjust for genetic trend to 1994 base and factors to adjust within breed EPDs to Angus equivalent - BIRTH WEIGHT (lb)

Breed	Number Sires	Number Progeny	Raw MARC Mean (1)	Mean EPD Breed 1994 (2)	Mean EPD MARC Bulls[a] (3)	Breed Soln at MARC + Ang (4)	Breed Soln at MARC vs Ang (5)	Adjust to 1994 Base + Ang (6)	Adjust to 1994 Base vs Ang (7)	Factor to adjust EPD to Angus (8)
Hereford	67	858	85	3.2	1.7	90	4.3	92	5.6	5.3
Angus	56	509	86	2.9	2.7	86	.0	86	.0	.0
Shorthorn	25	181	87	2.0	1.0	93	7.2	94	8.0	8.9
Brahman	26	395	100	.6	.9	100	13.8	99	13.3	15.6
Simmental	28	422	85	.4	-.5	95	8.6	96	9.4	11.9
Limousin	20	387	80	1.2	-.9	91	4.6	93	6.6	8.3
Charolais	61	555	88	1.5	1.4	96	9.6	96	9.5	10.9
Maine-Anjou	15	174	94	-.2	1.1	97	11.1	96	9.7	12.8
Gelbvieh	24	365	89	.0	-1.3	93	6.5	94	7.7	10.6
Pinzgauer	16	435	84	-.1	-.4	92	6.4	93	6.6	9.6
Tarentaise	7	199	80	2.5	1.7	91	4.9	92	5.7	6.0
Salers	27	189	85	.8	1.2	92	5.6	91	5.0	7.1

Calculations:
(4) = (5) + (1, Angus)
(6) = Raw Angus mean + b[(2) - (3)] with b = 1.04
(7) = (6) - (6, Angus)
(8) = (7) - (7, Angus) - [(2) - (2, Angus)]

Table 2. Breed of sire solutions from MARC, mean breed and MARC EPDs used to adjust for genetic trend to 1994 base and factors to adjust within breed EPDs to Angus equivalent - WEANING WEIGHT (lb)

Breed	Number Sires	Number Progeny	Raw MARC Mean (1)	Mean EPD Breed 1994 (2)	Mean EPD MARC Bulls[a] (3)	Breed Soln at MARC + Ang (4)	Breed Soln at MARC vs Ang (5)	Adjust to 1994 Base + Ang (6)	Adjust to 1994 Base vs Ang (7)	Factor to adjust EPD to Angus (8)
Hereford	66	814	506	22.9	9.8	495	1.7	507	8.4	9.8
Angus	56	464	493	24.3	18.6	493	.0	498	.0	.0
Shorthorn	25	170	521	12.5	7.8	511	17.8	515	16.9	28.7
Brahman	26	334	540	4.0	5.6	519	26.2	518	19.6	39.9
Simmental	27	368	470	8.0	-16.4	516	22.5	538	39.4	55.7
Limousin	20	338	445	6.9	-8.2	503	9.6	516	18.1	35.5
Charolais	60	484	492	10.1	1.6	519	26.4	527	29.0	43.2
Maine Anjou	15	155	460	.2	2.7	515	22.1	513	14.7	38.8
Gelbvieh	24	336	484	4.8	-2.5	519	26.3	526	27.7	47.2
Pinzgauer	16	415	478	.5	-6.1	501	8.3	507	9.2	33.0
Tarrentaise	7	191	476	9.5	-4.8	504	10.5	516	18.3	33.1
Salers	27	176	525	8.9	8.2	511	18.0	512	13.5	28.9

Calculations:
(4) = (5) + (1, Angus)
(6) = Raw Angus mean + b[(2) - (3)] with b = .90
(7) = (6) - (6, Angus)
(8) = (7) - (7, Angus) - [(2) - (2, Angus)]

Table 3. Breed of sire solutions from MARC, mean breed and MARC EPDs used to adjust for genetic trend to 1994 base and factors to adjust within breed EPDs to Angus equivalent - YEARLING WEIGHT (lb)

Breed	Number: Sires	Number: Progeny	Raw MARC Mean (1)	Mean EPD: Breed 1994 (2)	Mean EPD: MARC Bulls[a] (3)	Breed Soln at MARC: + Ang (4)	Breed Soln at MARC: vs Ang (5)	Adjust to 1994 Base: + Ang (6)	Adjust to 1994 Base: vs Ang (7)	Factor to adjust EPD to Angus (8)
Hereford	66	750	848	39.1	17.0	848	-7.2	875	6.7	9.1
Angus	56	431	855	41.5	30.6	855	.0	868	.0	.0
Shorthorn	25	168	918	19.9	14.8	881	26.3	888	19.1	40.7
Brahman	26	290	839	6.9	9.5	827	-27.6	824	-44.3	-9.7
Simmental	27	332	795	14.0	-27.9	880	25.3	932	63.7	91.2
Limousin	20	334	740	12.9	-12.4	844	-11.4	875	6.4	35.0
Charolais	60	450	852	15.1	3.6	893	38.1	907	38.9	65.3
Maine-Anjou	15	154	791	-.2	4.0	884	28.9	879	10.2	51.9
Gelbvieh	24	334	819	8.8	-4.1	872	17.2	888	19.7	52.4
Pinzgauer	16	347	838	1.2	-9.8	849	-6.1	862	-6.0	34.3
Tarentaise	7	189	807	15.2	-.2	842	-13.4	861	-7.8	18.5
Salers	27	173	898	14.6	13.9	877	22.3	878	9.6	36.5

Calculations:
(4) = (5) + (1, Angus)
(6) = Raw Angus mean + b[(2) - (3)] with b = 1.24
(7) = (6) - (6, Angus)
(8) = (7) - (7, Angus) - [(2) - (2, Angus)]

Table 4. Breed of maternal grandsire solutions from MARC, mean breed and MARC EPDs used to adjust for genetic trend to 1994 base and factors to adjust within-breed EPDs to Angus equivalent - MILK (lb)

Breed	Number MGS	Number Gprog	Number Daughters	Raw MARC Mean (1)	Mean EPD Breed WWT (2)	Mean EPD Breed MILK (3)	Mean EPD MARC WWT (4)	Mean EPD MARC MILK (5)	Breed Soln at MARC MMWT + Ang (6)	Breed Soln at MARC MMWT vs Ang (7)	Adjust to 1994 Base MWWT + Ang (8)	Adjust to 1994 Base MWWT vs Ang (9)	Adjust to 1994 Base MILK (10)	Factor to adjust MILK EPD to Angus (11)
Hereford	60	1076	279	473	22.9	8.6	2.3	-.1	477	-9.9	499	-3.3	-12.6	-5.7
Angus	47	472	140	487	24.3	10.4	11.2	3.7	487	.0	502	.0	-5.1	.0
Shorthorn	22	251	69	527	12.5	3.3	7.8	8.0	519	31.5	516	13.5	-.1	12.1
Brahman	22	269	92	517	4.0	2.4	3.4	2.0	529	42.1	530	27.7	12.8	25.9
Simmental	27	796	152	513	8.0	.8	-16.5	-.7	525	37.7	540	38.1	13.3	28.0
Limousin	20	764	150	477	6.9	1.0	-8.3	.1	487	-.1	497	-5.7	-19.9	-5.4
Charolais	54	843	183	504	10.1	1.3	.7	1.6	506	19.5	511	9.1	-10.5	3.8
Maine-Anjou	14	355	63	536	.2	-.1	1.6	-1.5	521	33.5	521	19.1	6.6	22.3
Gelbvieh	24	635	138	537	4.8	1.5	-2.7	-.3	527	39.9	533	31.0	12.0	26.0
Pinzgauer	15	545	133	504	.5	-.5	-3.5	3.5	511	23.8	508	6.1	-3.6	12.4
Tarentaise	6	341	78	513	9.5	.8	-5.9	4.7	518	31.4	523	20.3	6.0	20.7
Salers	25	350	87	534	8.9	2.0	6.8	5.9	519	31.5	515	12.9	1.1	14.6

Calculations:

(6) = (7) + (1, Angus)

(8) = (6) + b_{WWT} [(2) - (4)] + b_{MLK} [(3) - (5)] with b_{WWT} = .57 and b_{MLK} = 1.17

(9) = (8) - (8, Angus)

(10) = [(9) - Average (9)] - .5[(7, Table 2) - Average (7, Table 2)]

(11) = (10) - (10, Angus) - [(3) - (3, Angus)]

Table 5. Mean weighted[a] accuracies for birth weight (BWT), weaning weight (WWT), yearling weight (YWT), maternal weaning weight (MWT) and milk (MILK) for bulls used at MARC

Breed	BWT	WWT	YWT	MWWT	MILK
Hereford	.63	.64	.53	.58	.47
Angus	.80	.80	.74	.74	.65
Shorthorn	.79	.78	.65	.80	.75
Brahman	.55	.60	.40	.59	.41
Simmental	.96	.96	.96	.96	.96
Limousin	.96	.95	.93	.95	.92
Charolais	.62	.62	.60	.60	.58
Maine-Anjou	.40	.40	.24	.43	.27
Gelbvieh	.68	.61	.57	.69	.64
Pinzgauer	.78	.68	.62	.69	.63
Tarentaise	.96	.95	.94	.95	.95
Salers	.82	.76	.62	.75	.75

[a]Weighted by number of progeny at MARC for BWT, WWT, and YWT and by number of grand progeny for MWWT and MILK.

Table 6. REML estimates of variance components (lb^2) for birth weight (BWT), weaning weight (WWT), yearling weight (YWT), and maternal weaning weight (MWWT) from mixed model analyses

	Direct			Maternal
Analysis[a]	BWT	WWT	YWT	MWWT
Direct				
Sires (374) within breed (12)	11.5	152	751	
Dams (2621) within breed (3)	31.3	1097	1534	
Residual	67.3	1540	4213	
Maternal				
MGS (339) within MGS breed (12)				213
Daughters within MGS (1564)				821
Residual				1229

[a](Numbers) for weaning weight.

Table 7. Pooled regression coefficients (lb/lb) for weights at birth (BWT), 205 days (WWT), and 365 days (YWT) of F_1 progeny on sire expected progeny difference and by sire breed, dam breed, and sex of calf

	BWT	WWT	YWT
Pooled	1.04 ± .07	.90 ± .08	1.24 ± .07
Sire breed			
Hereford	.96 ± .12	.79 ± .11	1.15 ± .11
Angus	.80 ± .17	.44 ± .20	1.42 ± .19
Shorthorn	.91 ± .45	.77 ± .45	1.02 ± .34
Brahman	1.47 ± .29	.92 ± .29	.59 ± .28
Simmental	1.36 ± .30	1.16 ± .30	1.42 ± .31
Limousin	1.08 ± .39	1.22 ± .47	1.93 ± .50
Charolais	1.18 ± .19	.87 ± .21	1.24 ± .20
Maine-Anjou	.29 ± .51	.69 ± .54	.92 ± .76
Gelbvieh	.74 ± .24	.94 ± .41	.83 ± .32
Pinzgauer	1.23 ± .17	1.28 ± .19	1.50 ± .15
Tarentaise	.75 ± .86	.72 ± .61	1.33 ± .89
Salers	1.11 ± .39	1.09 ± .52	1.17 ± .56
Dam breed			
Hereford	1.02 ± .11	.44 ± .13	.99 ± .11
Angus	1.17 ± .09	1.13 ± .09	1.32 ± .08
MARC III	.71 ± .16	.77 ± .19	1.36 ± .18
Sex of calf			
Female	1.03 ± .09	.92 ± .09	1.28 ± .13
Male	1.05 ± .09	.89 ± .09	1.07 ± .12

Table 9. Variances (lb^2) of adjusted breed differences to add to sum of within breed prediction error variances to obtain variance of differences of across breed EPDs for bulls of two different breeds[a]. Birth weight above diagonal and yearling weight below diagonal

	HE	AN	SH	BR	SI	LI	CH	MA	GE	PI	TA	SA
HE	.0	.6	1.0	.7	1.1	1.2	.7	1.8	1.0	1.0	2.8	1.0
AN	39.6	.0	1.2	.8	1.3	1.3	.9	2.0	1.2	1.1	2.9	1.1
SH	73.5	81.4	.0	1.5	1.7	1.8	1.1	2.3	1.4	1.4	3.4	1.1
BR	57.6	61.1	111.9	.0	1.6	1.6	1.2	2.2	1.4	1.2	3.0	1.4
SI	76.9	86.3	116.1	116.3	.0	.9	.9	2.5	1.7	1.7	3.5	1.7
LI	78.9	88.5	119.2	118.2	61.4	.0	.9	2.5	1.7	1.7	3.5	1.7
CH	49.3	58.5	75.2	87.6	60.3	63.6	.0	2.1	1.1	1.2	3.1	1.1
MA	129.9	140.7	164.5	165.4	172.3	174.4	143.2	.0	1.6	2.2	4.0	2.3
GE	72.0	82.7	96.4	106.3	113.1	114.4	78.1	118.2	.0	1.4	3.2	1.3
PI	70.7	81.9	102.6	94.9	115.2	117.8	83.1	157.4	96.0	.0	2.7	1.4
TA	188.5	200.4	229.5	207.9	234.8	237.9	206.4	274.6	220.6	185.2	.0	3.3
SA	71.0	79.5	81.0	109.8	114.2	117.4	73.6	162.4	95.2	102.1	227.7	.0

[a]For example, a Hereford bull has within breed PEV of 300 for YWT and that for a Shorthorn bull is 200. Then the PEV for the difference in EPDs for the two bulls is 73.5 + 300 + 200 = 573.5 with SEP = 23.9.

Table 8. Pooled regression coefficients (lb/lb) for progeny performance on maternal grandsire EPD for weaning weight (MWWT) and milk (MILK) and by breed of maternal grandsire, breed of maternal grandam, and sex of calf

Type of regression	MWWT	MILK
Pooled	.57 ± .06	1.17 ± .09
Breed of maternal grandsire		
Hereford	.78 ± .10	.87 ± .16
Angus	.67 ± .21	1.25 ± .31
Shorthorn	.34 ± .35	.50 ± .36
Brahman	1.22 ± .31	-.29 ± .86
Simmental	.51 ± .22	1.18 ± .58
Limousin	.72 ± .34	2.53 ± .33
Charolais	.27 ± .18	.68 ± .27
Maine-Anjou	-.11 ± .39	1.03 ± .98
Gelbvieh	.71 ± .29	1.42 ± .36
Pinzgauer	.48 ± .15	.39 ± .35
Tarentaise	.15 ± .72	.80 ± .82
Salers	1.02 ± .35	2.59 ± .37
Breed of maternal grandam		
Hereford	.34 ± .10	1.18 ± .15
Angus	.66 ± .07	1.17 ± .11
MARC III	.58 ± .27	.57 ± .55
Sex of calf		
Female	.53 ± .08	1.28 ± .13
Male	.60 ± .08	1.07 ± .12

Table 10. Variances (lb^2) of adjusted breed differences to add to sum of within breed prediction error variances to obtain variance of difference of across breed EPDs for bulls of two different breeds. Weaning weight direct above diagonal and MILK below the diagonal

	HE	AN	SH	BR	SI	LI	CH	MA	GE	PI	TA	SA
HE	.0	12.7	24.7	16.0	23.3	24.3	15.4	38.9	21.7	19.1	46.6	23.7
AN	37.4	.0	27.8	18.2	27.0	27.9	19.1	43.1	25.7	23.3	51.2	27.1
SH	57.9	65.9	.0	35.8	37.9	39.2	26.0	52.6	31.8	32.5	62.7	28.3
BR	53.3	60.9	90.8	.0	34.4	35.3	26.3	49.0	31.2	24.7	51.0	34.9
SI	54.0	63.0	85.5	88.9	.0	18.3	17.6	53.4	34.9	33.9	62.4	37.1
LI	58.2	67.6	90.0	93.2	52.1	.0	18.9	54.1	35.3	34.9	63.7	38.5
CH	34.5	43.1	59.5	68.4	43.6	48.1	.0	44.7	24.5	24.7	54.1	25.2
MA	75.4	85.8	105.9	107.6	105.9	110.2	84.6	.0	33.8	46.7	74.9	51.8
GE	47.4	56.2	71.0	79.5	76.0	80.2	52.4	73.3	.0	28.2	58.2	31.1
PI	57.2	67.6	85.4	79.1	88.0	92.4	65.6	104.9	75.3	.0	44.1	32.1
TA	132.5	143.9	166.0	149.7	165.0	169.4	144.2	180.5	153.6	141.9	.0	62.0
SA	49.2	58.0	66.3	82.4	77.4	81.8	51.5	97.7	63.1	77.6	157.8	.0

1994 AVERAGE EPDs FOR EACH BREED

For selection of breeding stock, it is important to know how expected progeny differences (EPDs) for an individual animal compare to the current breed average. Mean non-parent EPDs are useful for making comparisons within breeds. They cannot be used to compare different breeds because EPDs are estimated from separate analyses for each breed. The means are for all calves born in 1994 from the most recent (1995-1996) genetic evaluations. The 1994 birth year was chosen because limited data were available on calves born in 1995 for yearling weight and other traits.

1994 ALL ANIMAL NON-PARENT AVERAGE EPDs FROM 1995-1996 GENETIC EVALUATIONS

Breed	Birth wt. lb.	Wean. wt. lb.	Yrlg. wt. lb.	Milk lb.	Total Mat., lb.	Yrlg. ht. in.	Scot. circ. cm.	Calv. ease dir., %	Calv. ease mat., %	Gest. length days	Stay-ability	Carc. wt.	Rib-eye area	Marb-ling	Fat thick.
Angus	+2.9	+24.3	+41.5	+10.4		+.5	+.17					+3.9[a]	+.17[a]	+.00[a]	-.01[a]
Beefmaster	+.22	+4.5	+8.8		+3.1										
Brahman	+.59	+4.02	+6.94	+2.43											
Brangus	+1.4	+15.0	+25.8	+1.2	+8.7		+.22						+.15		
Charolais	+1.51	+10.13	+15.12	+1.27											
Gelbvieh	+.0	+4.8	+8.8	+1.5	+3.9			+1.06	+1.16	-.1					
Hereford	+3.2	+22.9	+39.1	+8.6	+20.0		+.2								
Limousin	+1.20	+6.9	+12.9	+1.0	+4.5		+.04			-.17					
Maine Anjou	-.2	+.2	-.2	-.1	+.2										
Pinzgauer	-.1	+.5	+1.2	-.5	-.3										
Red Angus	+.31	+21.52	+34.36	+8.22	+18.98						+4.95				
Salers	+.8	+8.9	+14.6	+2.0	+6.5		+.01								
Shorthorn	+2.0	+12.5	+19.9	+3.3	+9.6										
Simmental	+.4	+8.0	+14.0	+.8	+4.8			+2.2	+3.2						
Tarentaise	+2.52	+9.5	+15.2	+.8											

[a]For progeny of sires born in 1992.

Minutes

Biotechnology Committee
Beef Improvement Federation
May 16, 1996
Birmingham, AL

The BIF Biotechnology Committee convened for its annual meeting at 2:00 p.m. on Thursday, May 16, 1996 during the annual BIF convention in Birmingham, AL. Chairperson Ronnie D. Green of Colorado State University called the meeting to order and briefly summarized the functions of BIF's newest standing committee. He also referred attendees to review the new BIF Guidelines document to see the Biotechnology Committee Section. Green also acknowledged the efforts of Burke Healey in serving as the BIF Biotechnology Committee chairman for the past two years as well as Sue DeNise, Jeremy Taylor, and Daniel Pomp for inputs for the committee's contribution to the new Uniform Guidelines for Beef Cattle Improvement document.

The Committee then heard presentations from three speakers. Dr. Jeremy Taylor (Texas A&M University) followed up his presentation on developments in the bovine gene map from the earlier morning general session. Sam Comstock, research associate at Colorado State University's Center for the Genetic Evaluation of Livestock, then gave an overview of research work being performed for the North American Limousin Foundation to calculate probabilities of being carriers for the protoporphyria recessive from genotypes known on only a portion of sires used in the breed. Tom Holm (Linkage Genetics, Salt Lake City, Utah) then presented an overview of currently available technology being used for DNA identification (i.e. "DNA fingerprinting").

Chairperson Green then asked the audience for input regarding committee meeting format. The attendees were in general agreement that this committee time should be used for "educational" purposes as these technologies develop. Thus, informal presentations in a classroom fashion were encouraged. Green indicated that discussion of technology developments with sexed semen would be discussed as one topic at next year's meeting and solicited input on other topics of interest. There being no further business, the meeting adjourned at 4:15 p.m.

Respectfully submitted,

Ronnie D. Green, Ph.D.
Chairperson

DNA-based Identification Technology
Tools for the New Beef Industry

Tom Holm
Linkage Genetics Inc.
Salt Lake City, Utah

The Basics of DNA-based Animal Identification

DNA-based individual identification technology has become the standard method for solving issues of parent verification and forensic identity in humans and domestic animal species. Linkage Genetics has been a pioneer in developing and implementing this technology in cattle and we currently offer parent verification services to meet a wide range of needs for the global beef industry.

Linkage Genetics has developed a system for Bovine individual identification based on the use of eleven highly polymorphic short tandem repeat (STR) markers. STR markers have proven to be extremely useful for parentage control and individual identification because they are highly abundant in the Bovine genome (over 1000 have been identified), they are evenly distributed across the genome, they are highly variable, and the data collection process can be automated since these markers utilize the polymerase chain reaction (PCR).

STR markers reveal differences between chromosomes and thus individuals due to variation in the number of copies of a short repeated segment of DNA. The most common type of repeat in mammals are CA/TG repeats and individual markers may contain between 2 and 30 copies of the repeated sequence. Since these chromosomal segments have different sizes it is possible to separate or "tag" them by gel electrophoresis methods. These tagged chromosomal segments can then be monitored as they are passed from a prospective parent to an offspring.

Linkage Genetics has developed a highly efficient and automated method for tracking the transmission of chromosomal segments for eleven STR markers. These markers have been specifically chosen for individual identification in cattle because they are evenly distributed onto eleven different chromosomes, they are easy to read and score, and they are polymorphic across a large number of both beef and dairy cattle breeds. Our data from 12 different beef breeds representing English, Continental and Bos *Indicus* cattle reveal that the probability that a random individual will be excluded as a potential parent is >0.9999 when both parents are available for testing and is >0.998 when a single parent is available.

An important consideration for wide spread use of individual identification technology in beef cattle is the cost of testing.

Linkage Genetics has developed an automated DNA-based system that is more cost effective than conventional techniques. We have increased the efficiency of using our eleven markers by putting them into "multiplex" reactions that allow for the utilization and analysis of more than one marker at a time. We have further increased the efficiency of our system by automating the data collection process with the implementation of automated fluorescent genotyping. Although our system is state of the art for DNA typing, and is comparable to systems used by the largest human laboratories, we remain committed to further refinement of the techniques and procedures. Future enhancements will further increase efficiencies and reduce testing costs.

Applications of DNA-based Identity Testing in Beef Cattle

Many breed associations including Charolais, Red Angus, Braunvieh, Senepol and Braford have made the transition from classical blood typing to DNA typing for their routine parent verification needs. Most breed associations who have not yet made the transition to DNA have plans to do so in the foreseeable future. Eventually all breed associations will use DNA typing for registering animals. In addition to these routine tests, however, DNA technology has proven to be valuable for a large number of other applications in the beef cattle industry.

Linkage Genetics currently offers DNA typing services to sire verify offspring that are produced in multi-sire breeding programs. Confirming parentage of calves born in multi-sire pastures is essential for genetic evaluations and offers a number of management benefits to the breeder. These include shorter calving season with a more uniform calf crop, identification of the most fertile bulls that produce the most offspring, and increased efficiency of pasture management.

Since DNA testing can be done on a variety of sample types (including tissue), an important application of DNA identification technology is to track carcasses back to their sires. The ability to sire verify carcasses will be critical to the beef industry as we continue to collect more carcass data and move to a value-based marketing system. DNA testing can aid both the seed stock and cow-calf segments of the industry by providing information feedback on individual animals and their sires from the feeding, packing and retail levels of the beef industry. Linkage Genetics is currently working with several seed stock and cow-calf producers in this information feedback process.

Minutes of the Meeting

Integrated Genetic System Committee
May 16, 1996
Birmingham, AL

Committee chairman Dr. John Hough called the meeting to order at 2:00 p.m. and reviewed the committee's objectives and meeting itinerary.

Dr. Dan Kniffen from the National Cattleman's Beef Association in conjunction with Dr. Eddie Hamilton (Great Plains Veterinary Educational Center) updated the committee on the latest developments in Integrated Resource Management, the Seedstock SPA program and breed association's involvement in Seedstock Standardized Performance Analysis (SPA). Dan also presented an overview of the newly released SPA EZ program.

Dr. Kniffen also reported on the SPA meeting held with breed association representatives December 7, 1995 in Kansas City prior to the Genetic Prediction Workshop. The association personnel felt SPA-type data collection and reporting could be very beneficial to their members. To further encourage association activity in SPA reporting, the general consensus of this committee was that BIF should recommend seedstock breed associations adopt SPA data collection and some form of whole-herd data reporting.

The rest of the committee meeting was devoted to selection index and multiple-trait selection. Dr. Mike MacNeil (USDA, Miles City) opened the discussion with a review of the basic aspects of selection index and multiple-trait selection. Dr. MacNeil set the groundwork for the other committee speakers to further develop.

Next, Dr. Russ Nugent (Tyson Foods) related experiences of the swine industry in multiple-trait selection. Tyson Foods plays a very large role in the production of pork in the United States. Dr. Nugent shared many of the multiple-trait selection principals used by major corporate swine producers. Swine producers have natural selection advantages over beef cattle such as shorter generation intervals and many more progeny per mating. Although, beef producers have advantages as well, such as prolific artificial insemination and highly developed national cattle evaluations.

Dr. David Johnston (AGBU, University of New England, Australia) reviewed and demonstrated the Australian BREEDOBJECT program developed by Dr. Steve Barwick of the same institution. This very sophisticated software package utilizes a computerized approach to multiple-trait selection. This program calculates relative economic values based on a large number of input parameters. Those in attendance were quite impressed with the capabilities and potential of the software program.

It was then announced Dr. Scott Newman (CSIRO, Australia) and Dr. Rick Bourdon (Colorado State University) are planning a conference entitled "BIF Systems Workshop II: Multiple-Trait Selection Technology for North American Beef Production." The program is planned for November 14-16, 1996 in Estes Park, Colorado. The plans are for a "working" session, with a limited number of attendees. The committee felt BIF should contribute monetarily along with normal support in planning and implementation.

The meeting was adjourned at 5:15 p.m.

INTEGRATED RESOURCE MANAGEMENT
IRM

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Previous Beef Improvement Federation Proceedings (BIF) contain information explaining the various segments of the current IRM programs for the cattle industry (BIF Proceedings 1994, BIF Proceedings 1995 and BIF Guidelines 1996). Implementation of IRM programs at the local level continue to expand, thereby, increasing the involvement of more producers across the country. Participation centers around the desire to improve efficiency either through better record keeping or adoption of different management techniques. Improving the overall efficiency of the beef industry is the primary focus for the development of IRM tools. Many of the IRM meetings incorporate the introduction of new management tools and the applications of the information generated by the tools.

The simple development of a tool, technique or piece of information has no value if it is not utilized by the intended audience. If for example, cryo-preservation had not been applied to the storage of semen or embryos for use in the beef industry, the value of this technique would have a limited value to the beef industry. Such is the same scenario for all management or measurement tools. Similarly, if you possess one of the more than 93,000 IRM Redbooks distributed in 1996, but never write any data in the book or use it, then basically it is of no value to you.

Benefits that can be derived from the use of measurement type tools can only be recognized following the application of the tool. Individual managers must then determine the value of the information generated for their particular farm/ranch.

Many cattle producers have recognized the need for more of the management type information generated after completion of a Standardized Performance Analysis (SPA). However, producers often lack the time or necessary data to complete the full analysis. Recognizing the importance of the cost-of-production and break even information for producers and in an attempt to increase the utilization of the SPA management information, SPA-EZ was developed. During the current market cycle knowing the break even cost for cow-calf producers will be fundamental to the many critical decisions that will need to be made. With the NCBA IRM SPA guidelines, cost-of-production and break even information will provide the critical information all producers will need.

The information generated by the EZ form is as accurate as the data used to compile the analysis. The level of detail used to allocate expenses for the enterprise in the three page analysis is less detailed as compared to the full analysis. The intent of EZ is to identify and initiate the analysis/cost-of-production process with producers. The basic data necessary comes from the Redbook, tax records and the development of a simple cost basis balance sheet. Most producers already collect all the data necessary to complete EZ. However, many will find it necessary to record additional data to achieve a full SPA. Following completion of the SPA-EZ, managers will have some of the strategic information for the decision making process at their fingertips. After completing EZ for one or two production cycles and with the collection of the appropriate data, producers are then prepared to successfully complete a full SPA.

As with SPA, the information calculated by EZ can be entered into the national IRM database. Upon submission of an individual analysis a producer will receive a report card with their data, the national data and a comparison of their performance to the information in the database. The report card will indicate a percentile ranking for each variable as compared to the same variable in the national data. The comparison information should only be used for a benchmark comparison to determine a relative level of performance. The most significant comparison that can be made using the SPA data is several years of analysis from one farm/ranch. The comparison to previous years performance is the best indicator of trends and the financial health and stability of the enterprise.

Historical information provides the data necessary to develop trend lines around production parameters. The amount and direction of change in a variable is best indicated by several years of information. The simple comparison between any two given years may effect the impact of abnormal environmental conditions or a short term change in management philosophy that is not representative of the true change if there is any. Management decisions based on these short term performance results may lead to incorrect decisions. This information is the basis from which an IRM team can review previous performance and help identify future goals for the enterprise. When you have completed an analysis you should begin to assemble the IRM team. The team should include as broad of a base of expertise as can be assembled. Many teams include beef extension specialists, nutritionists, veterinarians, ag lenders, estate planners and other participants the team identifies as important.

The time spent reviewing the information generated by an analysis is the most critical step in the entire process. Application of the information to the management of the cow-calf enterprise and the use for setting goals for the future is when the true value of a SPA is finally realized. Determination of changes in cost-of-production and levels of performance will indicate the impact of management changes.

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CONCEPTS RELATING GENETIC IMPROVEMENT TO PROFITABILITY AND THEIR USE IN THE SWINE INDUSTRY[1]

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Introduction

Causing genetic change in profitability is not a new idea for the Beef Improvement Federation. Five years ago, Bourdon (1992) discussed the genetic tradeoffs among economically important traits. At that same meeting the systems committee also dealt with economic values of various traits (MacNeil and Newman, 1992). Further, at an American Society of Animal Science symposium held that year, Harris and Newman (1992) developed a comprehensive of review of how genetic evaluation might become economic improvement. At the genetic prediction workshop held in 1994, we again broached the subject (Barwick, 1994; Melton, 1994; and Newman et al., 1994). Most recently, Melton (1995) provided us a framework for the economics of genetic improvement. Here, our first goal is to sift and winnow from these previous presentations and other sources the essence of selection index as a means to achieve improved profitability.

The swine industry with its more prolific females and shorter generation intervals has been an early adopter of formalized selection indexes as the basis of multiple trait selection. Their experiences can provide guidance in implementing this technology in beef production. Again there is ample precedent for our examination of the swine industry's successes and failures. Stoecker (1993) presented an inventory of competitive tools at work in the swine industry and Rothschild (1994) shared the rapidly growing opportunities for pork producers to result from molecular genetics. Here, our second goal is to focus on the experiences of a large commercial company in using multiple trait selection as a profitable innovation.

Basic Concepts

Selection index is a technology to maximize genetic improvement in a specified objective. To calculate a selection index requires that we know which traits are economically important and the relative contribution of each to profitability. Also required are estimates of the phenotypic standard deviation and heritability for each trait, and the genetic and phenotypic correlations among the complete set of traits. When performance of relatives of the candidates for selection has been recorded, the accuracy of the index can also be improved by including that information. Throughout this paper we assume a desire on the part of producers to maximize profitability.

It is discovering and quantifying a complete set of traits that are economically

[1]U.S. Department of Agriculture, Agricultural Research Service, Northern Plains Area is an equal opportunity/affirmative action employer and all agency services are available without discrimination. Cooperation of Montana Agric. Exp. Sta., Montana State Univ. is recognized. Contribution No. J-5050 of the Montana Agric. Exp. Sta. Journal Series.

important that is new to our conventional way of thinking about genetic improvement. This requires that we develop a comprehensive and systematic way of relating changes in performance levels at the animal level to changes in profitability at the enterprise or production system level. The need for developing a comprehensive set of traits is perhaps best illustrated by a simple analogy. In the not so distant past, we as an industry attached considerable emphasis to increased growth, but with the passage of a couple generations of fairly intense selection other things began to get out of hand. These undesirable correlated responses occurred because there are genetic antagonisms between growth and other important traits in beef cattle. Lesson learned?! Selection index is a technology to balance the emphasis put on various traits in the absence of any one trait of overwhelming importance.

Not only are traits which are "easy" to measure important for true genetic improvement. Selection index can also exploit the existence of genetic correlations to put pressure on those traits that are difficult or impossible to measure. For example, forage intake from grazing represents a major input to cow-calf producers and as such merits consideration in a genetic improvement program, but nobody wants to measure it directly. Given that forage intake is genetically correlated with mature size, using mature size as an indicator trait in a selection index where pressure was to be placed on forage intake might be a better alternative.

With a technology for describing the production system in hand, the effect on profitability of changing each trait by one unit while holding all other traits constant is determined. Profitability implies a buy-sell transaction takes place and thus seemingly suggests that its is maximized by producing the product of greatest value to the customer at least cost. These changes in profitability are usually referred to as relative economic values. It is the relative economic values which provide direction to the selection program. The knowledge that most genetic improvement is made by seedstock breeders and recognition of consumers as implicit customers has led to the philosophy that seedstock selection decisions be based on ultimate customer satisfaction. Said differently, seedstock selection decisions should be made in a way that maximizes profitability for the entire industry as though it were one vertically integrated production system.

With generation intervals of five or more years and substantive genetic improvement requiring more than a single generation, it is obvious that relative economic values pertain to the long-run. The relative economic values should not be greatly influenced by year-to year fluctuations in prices. For example, calculation of relative economic values based in part on 1993 or 1996 prices for feeder cattle is probably misleading. It would be preferable to use the average prices received by farmers for feeder cattle over the past 10 to 15 years, adjusted for inflation.

Existence of industry-wide specifications for beef product do not suggest that there should be industry-wide selection indexes. Different production systems have different economic structures. Different breeding systems exploit germplasm in different ways. Finally, existence of genotype by environment interaction results in different biological interrelationships among traits depending on the environment in which production takes place. All these factors will result in different relative economic values and hence different selection indexes.

The remaining genetic and phenotypic statistics either already are, or potentially are, part of the current systems used to calculate expected progeny differences (EPD). If there were multiple trait calculation of EPD for all economically important traits simultaneously, then selection index is the sum of the EPD weighted by the relative economic values. With EPD calculated for each traits separately the correlations between traits may be incorporated into the selection index with the economic weights. However, it has been suggested that in many practical applications weighting the EPD by their relative economic values is an adequate approximation to the complete index. The outcome of these mathematical calculations is that, using an appropriate set of relative economic values, every animal can be assigned a single number which measures its contribution to profitability relative to every other animal. Thus, given a hypothetical situation where only four traits {reproduction(R), growth(G), carcass(C), feed intake(F)} contribute to profit and have relative economic values 10, 2, 3, and -1 respectively, the selection index(I) is:

$$\mathbf{I = 10 \cdot EPD_R + 2 \cdot EPD_G + 3 \cdot EPD_C - 1 \cdot EPD_F}$$

Given maximum profit as the goal of our breeding program, it then becomes a simple task to consistently rank all candidates for selection. Note that whether the EPD are within- or across-breed has no effect on the selection index. Nor does the accuracy of the EPD have any effect on the selection index.

Swine Industry Experiences

Pork producers use genetics to meet the needs of a fast paced and rapidly changing industry. The onset of across herd genetic evaluation, wide spread artificial insemination, commercial studs with a wide variety of available breeding stock, marker assisted selection, and an international genome base provide the modern pork producer with more genetic technologies than ever before. Competitive pork producers realize and exploit the large potential contribution of improved genetics to profitability of the production system.

Today's market hog is produced from at least one, and generally two, crossbred parents. Parent lines trace back to "purebred" grandparent (and sometimes great grandparent) lines. These progenitor lines were produced using within line selection based on selection indexes developed specifically for them. These selection indexes contain estimated breeding values for a variety of traits weighted by their relative economic values and genetic correlations.

Use of specialized sire and dam lines offers several important advantages. Existing between-breed differences for economically important traits can be exploited to produce parent stocks with near optimal additive genetic makeup and that generally expresses high levels of hybrid vigor. Further, each specialized (great-)grandparent line can be selected differently, emphasizing those traits it contributes to the final cross. Genetic antagonisms, such as the unfavorable relationship of lean growth rate with reproductive rate, reduce the rate of genetic progress in a composite or pure-line parent-stocks. However, their impact on genetic improvement is greatly reduced by selection for complementary traits in specialized sire and dam lines.

For example, a line contributing to the final crossbred parent boar line can be selected for lean growth and meat quality, but ignoring maternal traits. Conversely, maternal lines are selected for productivity (e.g. number of pigs weaned per sow per year) and for efficient lean growth, but ignoring meat quality traits. Note that the economic importance of efficient lean growth necessitates selection for components of it in all specialized lines, whether maternal or paternal in ultimate usage.

Whether breeding stock is purchased or produced internally, similar principles apply. Breeding stock producers first define a breeding or genetic objective based on a model of the production system. Heavy emphasis is placed on the long-term economic objective of the breeding stock producer's customer base. Though somewhat segmented into farrowing, nursery, and finishing phases of production, it is quite common for swine producers to retain some financial interest in the market hog from conception at least to slaughter. Many current swine slaughter facilities have already implemented carcass quality (and are planning on implementing meat quality) based buying incentive programs for purchasing live hogs. This causes further integration of the individual producer from farrowing through marketing the pork at the retail or consumer level. Thus, individual hog producers have added incentive to select and pay for breeding stock based on a variety of traits. These traits may include, but are not limited to, feed consumption or conversion, lean tissue production or growth rate, measures of muscling and fat cover, structural soundness, and measures of reproductive ability such as number born, litter weight at weaning, and farrowing interval. Packer meat quality programs could add measures such as pH, color, firmness, marbling, and other traits to the multitude of traits considered in defining the production system.

Relative economic values for each trait are then established using the production system model. These relative economic values are the recognition that economic return from a one standard deviation increase in one trait will not be equal to a similar increase in another trait. Only economically important traits and indicators of economically important traits that will respond to selection are ultimately used by the breeding stock producer. See et al. (1996) provided relative economic values of some potential selection criteria for growth and carcass traits in a swine production system (Table 1). For reproductive traits, general industry estimates put the value of an extra pig born at about $13.50, and the value of an extra pound of 21-day weaning weight at about $0.50. It is not efficient to measure or base selection on traits without economic value and thus these traits are not pursued.

Use of genetic relationships, both among animals and among traits, is routine to improve accuracy of predicting overall genetic merit, especially in young animals and when sequential culling is practiced. Potential replacement stock and established breeding animals are retained for breeding or culled based on the most current prediction of their genetic merit.

Table 1. Relative economic values for growth, efficiency and carcass quality traits in pork

production.

Trait	Units	Standard deviation	Economic value, $
Feed/gain	lb./lb.	0.25	-18.00
Average daily gain	lb.	0.20	3.00
Days to 250 lbs.	days	13.0	-0.12
10th rib back-fat	in.	0.20	-15.00
Loin muscle area	sq. in.	0.80	5.68
pH		0.25	33.80
Intramuscular fat	%	1.00	17.00
Tenderness	kg	1.10	-5.00

The wide variety of potential traits contains some favorable (e.g. feed conversion and growth rate) and some unfavorable (e.g. growth rate and back-fat) genetic correlations. Further, initial selection decisions are often made before any individual animal expresses all the traits that determine its ultimate genetic merit. Examples include initial selection among potential breeders which first occurs at weaning (3-4 week old pigs) before expression of female reproductive ability and longevity, and the carcass or meat quality attributes. In this instance information from relatives and from genetically correlated traits is found to be particularly important for improving the accuracy of selection decisions. Use of specialized sire and dam lines, high reproductive rates characteristic of swine, short generation intervals, and intense selection yield rapid genetic improvement and also facilitate near-maximum exploitation of hybrid vigor.

Conclusion

Selection index provides a systematic means for making selection decisions that are consistent with improved profitability. This technology permits us to exploit information on relatives and to use correlated traits to improve accuracy. The emphasis applied to each trait is scaled by the importance of that trait in determining overall profitability. The swine industry currently finds use of multiple trait selection index a practical technology for decision making when it comes to choosing future parents. The beef industry needs to make progress toward providing genetic evaluations that will result in improved profitability for commercial producers. The difficulty of deriving relative economic values for use in selection index suggests a niche for recording financial information consistent with this goal.

Literature Cited

Barwick, S. A. 1994. B-OBJECT: A PC-program to derive economic weights for beef cattle. Proc. 4th Genetic Prediction Workshop. Beef Improvement Fed. January 21-22, Kansas City, Missouri. 10 pages.

Bourdon, R. 1992. Prioritizing trait selection. Proc. Beef Improvement Fed., 24th Annual Mtg. May 6-9, Portland Oregon. p. 103-108.

Harris, D. L. and S. Newman. 1992. How does genetic evaluation become economic improvement? Proc. Symp. Appl. of Expected Progeny Differences (EPDs) to

Livestock Improvement. Amer. Soc. Anim. Sci., 84th Annual Mtg. August 10, 1992. Pittsburgh, Pennsylvania. p. 3-1 to 3-30.

MacNeil, M. D. and S. Newman. 1992. Relative economic values for traits affecting profitability of beef production in Canada. Proc. Beef Improvement Fed., 24th Annual Mtg. May 6-9, Portland Oregon. p. 40-43.

Melton, B. E. 1994. Economic values in index based selection. Proc. 4th Genetic Prediction Workshop. Beef Improvement Fed. January 21-22, Kansas City, Missouri. 5 pages.

Melton, B. E. 1995. Conception to consumption: The economics of genetic improvement. Proc. Beef Improvement Fed., 27th Annual Mtg. May 31-June 3, Sheridan, Wyoming. p. 40-87.

Newman, S., M. MacNeil, B. Golden, and S. Barwick. 1994. Implementation and use of selection indexes in genetic improvement schemes for beef cattle. Proc. 4th Genetic Prediction Workshop. Beef Improvement Fed. January 21-22, Kansas City, Missouri. 11 pages.

Rothschild, M. F. 1994. What can be learned from our competing industries? Lessons from the pig industry. Proc. Beef Improvement Fed., 26th Annual Mtg. June 1-4, West Des Moines, Iowa. p. 10-12.

See, T., K. Zering, and O. W. Robison. 1996. Economic value of pork quality traits. Proc. National Swine Improvement Federation. Des Moines, IA. (in press).

Stoecker, R. 1993. Competitive tools in today's pork industry. Proc. Beef Improvement Fed., 25th Annual Mtg. May 26-29, Asheville, North Carolina. p. 75-84.

BREEDOBJECT: A MULTIPLE TRAIT SELECTION AID FOR BEEF BREEDERS

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Introduction

Beef breeders have to strike a balance in the emphasis they give to different aspects of beef cattle performance. Antagonisms can occur among traits and trade-offs have to be made even where there are not obvious antagonisms (Nicol and Barwick 1995a). The desired trait balance for improvement can be difficult to assess. BREEDOBJECT is a PC-based procedure that provides individual breeders (bull breeders or bull buyers) and groups of breeders with a systematic way of dealing with these issues. This summary briefly introduces the approach.

About BREEDOBJECT

BREEDOBJECT is a software program developed in Australia at the Animal Genetics and Breeding Unit (AGBU) (Barwick et al. 1992; 1994). It addresses trait balances and antagonisms by assessing what is best for commercial herd profit. It does not try to determine a universally best breeding direction, since what is needed can change for different circumstances. BREEDOBJECT uses the breeder's view of how animals will be used (as terminal sires, as straightbreds or as sires influencing only the maternal side), in what sort of commercial herd, and for what sort of product and market. This view determines the required breeding direction. It is specific to the breeder, or group of breeders if it is a consensus view. In this way we say the BREEDOBJECT approach is 'customised'.

BREEDOBJECT performs three functions, the first two of which are necessary for the third.

1. It estimates the economic value of improving traits
2. It derives the best combination of the available EBVs for ranking
3. It ranks animals for progeny profit

BREEDOBJECT first helps resolve how important traits are to profit in typical commercial herds where animals will be used. This is the step driven by the breeder's

[1] AGBU is a joint institute of NSW Agriculture and the University of New England

estimates of production variables and costs for commercial beef production. It determines the direction for the breeding effort. BREEDOBJECT then assesses what this means for the emphasis justified on each EBV (Schneeberger et al. 1992). Lastly, these emphases are used to rank animals for their ability to improve profit in the commercial herd.

BREEDOBJECT is designed for use with BREEDPLAN EBVs. Similar principles can be applied to combining EBVs or EPDs from any genetic evaluation scheme.

Benefits

BREEDOBJECT can help both breeders and buyers of bulls. It provides a mechanism for breeding for profit, and it focuses breeding on the commercial product and commercial herd where this is produced.

BREEDOBJECT helps

- bull buyers source bulls that suit their needs. Bulls from all sources within a breed can be readily compared for the buyer's intended purpose
- breeders match bulls to different clients
- buyers and breeders interpret genetic evaluations by combining and simplifying EBVs.

Combining EBVs (or EPDs) into a single (Index) EBV for an intended purpose is an effective way of controlling the amount of performance information on animals that now confronts the decision maker.

A further advantage is the ability to rate all animals on a common basis, including those for example, which may be extreme for one trait and only average for others. Potentially valuable animals are not needlessly excluded from consideration.

Example Use of BREEDOBJECT

Sire Rankings

Bull breeders wanting rankings of sale animals for different types of clients can provide these as aggregate (Index) EBVs in sale catalogues. For many bull buyers, using BREEDOBJECT is then as simple as learning to read the new style of information in catalogues. Bull breeders might also provide customised rankings as a service to individual breeders. Bull breeders further, can use their knowledge of their clients, and their judgement of industry trends, to produce a ranking for use in their own selection program.

Bull buyers have a good idea of the performance needed from progeny and of the production circumstances under which this must occur. From this, switched on buyers can produce a BREEDOBJECT ranking of the sale bulls available from any number of potential sources. It is usually necessary to get permission to access the EBVs on such sale bulls, but owners usually give this permission to prospective purchasers. In Australia, extracts of these EBVs can be obtained from the Agricultural Business Research Institute, the licensed commercialiser of BREEDPLAN.

The following is an example of a regular BREEDOBJECT output. This is a ranking of bulls for yearling beef production, based on a combined assessment of their BREEDPLAN EBVs.

Rankings of Bulls for Yearling Beef Production

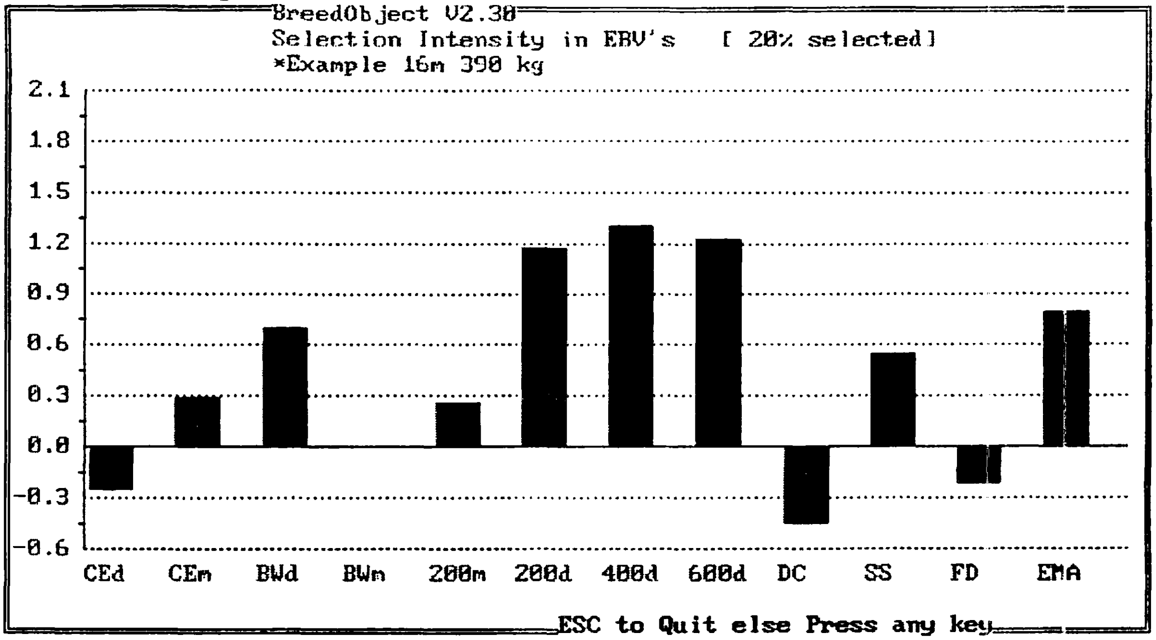
Ident	EBV+									Yearling
	BWd	200m	200d	400d	600d	DC	SS	FD	EMA	$INDEX
37	4.9	14	38	72	85	0.5	0.9	0.4	2.5	+37
71	6.6	7	36	64	83	-3.8	1.3	0.3	2.6	+36
34	5.5	3	31	60	74	-2.5	0.7	0.4	5.2	+35
25	8.3	2	34	54	82	-4.3	0.3	-0.4	2.6	+31
27	4.6	15	32	57	74	0.3	1.9	0.5	-1.0	+26
125	1.6	8	28	48	67	-1.4	0.4	1.8	0.4	+24
91	3.0	11	16	38	50	-5.3	1.1	0.7	1.0	+23
77	1.5	11	12	26	40	-5.6	0.1	1.0	1.2	+18
53	1.4	10	12	25	39	-5.9	1.0	1.0	-1.3	+16
531	8.5	14	36	52	70	5.9	1.2	1.3	-1.3	+15
151	5.1	7	18	31	49	2.4	-0.5	-0.1	2.1	+13
113	2.7	-1	16	33	50	1.9	1.5	0.4	-1.2	+11

+EBVs in turn: Birth Weight (direct), Milk, 200, 400 and 600 day Weight, Days to Calving, Scrotal Size, Fat Depth, Eye Muscle Area

Trait Economic Values

The above example Index rankings target commercial herd performance where straightbred steers are pasture-finished at 390 kg at 16 months. The herd had a weaning rate of 80 per cent and only a small problem with difficult calvings. The economic values for traits affecting profit in this example were:

Selection Example



When there is a lot of concern about calving ease, sires with low birth weight EBVs are often chosen above all else. The greater calving ease achieved this way comes at a high cost in lost response in other valuable traits.

BREEDOBJECT Availability

BREEDOBJECT is available commercially through the Agricultural Business Research Institute (ABRI). BREEDPLAN users can have Index EBVs processed and added to BREEDPLAN reports. Alternatively, PC software is available for purchase that does all of the necessary processing. The BREEDPLAN EBVs for animals of interest can be obtained on disc from ABRI.

In Australia, there are industry consultants who offer startup services to individual breeders. These help in the set-up phase in which the economic values of trait improvements are assessed. BREEDOBJECT is also being used by some Breed Societies to assist breed development (eg. Nicol and Barwick 1995b).

Literature Cited

Barwick, S. A., Fuchs, W., Davis, G. P. and Hammond, K. 1992. A breeding objective and selection index package for use with BREEDPLAN. Proc. Aust. Assoc. Anim. Breed. Genet. 10: 565-568

Barwick, S. A., Henzell, A. L. and Graser, H.-U. 1994. Developments in the construction and use of selection indexes for genetic evaluation of beef cattle in Australia. Proc. 5th World Congr. Genet. Appl. Livestk. Prod. 18: 227-230

Nicol, D. and Barwick, S. A. 1995a. The breeding challenge - Balancing the EBVs for commercial profitability. Proc. 4th National Beef Improvement Association Conference, 27-28 September, Wagga Wagga, p. 55-57

Nicol, D. and Barwick, S. A. 1995b. A young bull proving scheme for Australian Angus. Proc. Aust. Assoc. Anim. Breed. Genet. 11: 238-241

Schneeberger, M., Barwick, S. A., Crow, G. H. and Hammond, K. 1992. Economic indices using breeding values predicted by BLUP. J. Anim. Breed. Genet. 109: 180-187

V2.30	BREEDOBJECT	*Example 16m 390 kg

Calculate Economic Values for Breeding Objective

These are your:	Economic Values	Rel. Econ. Values
Sale Liveweight Dir.	0.608 $/kg	9.7 $
Sale Liveweight Mat.	0.416 $/kg	2.9 $
Dressing %	4.456 $/%	4.6 $
Saleable Meat %	3.508 $/%	5.2 $
Fat Depth (rump)	0.588 $/mm	0.7 $
Cow Weaning Rate	1.108 $/%	9.9 $
Bull Fertility	0.029 $/mate	0.2 $
Cow Survival Rate	2.165 $/%	3.7 $
Cow Weight	0.031 $/kg	0.6 $
Calving Ease - dir.	0.520 $/%	1.7 $
Calving Ease - mat.	0.267 $/%	0.9 $

Straight Breeding

The values in the left column are the values for a unit of improvement in each trait when the other traits are unchanged. The right column (relative economic values, or REVs) shows the value of a standard amount of change in each trait. The REVs indicate which traits are of most importance to the breeding direction. In this example, improvement in cow fertility (cow weaning rate) and in growth (sale weight) are about of equal importance.

Selection

What happens if you select sires based on the Index in this case? Here we look at an example using the published EBVs on sires from a breed Sire Summary.

The EBVs used in the Index are those for Calving Ease (direct and maternal), Weights at Birth, 200 (direct and maternal), 400 and 600 days, Days to Calving, Scrotal Size, and Scanned Fat Depth and Eye Muscle Area. Assume we select the top 20 per cent of sires, on Index, from all those published.

The bar chart below shows how much selection emphasis there is on each EBV when selection is on the Index. The individual EBVs (in abbreviated form) are indicated along the bottom of the chart. The bars show the size and the direction of the emphases. Each bar represents the difference, in standard units, between the mean of the top 20 per cent of sires and the mean for all sires. This difference is the intensity of selection.

The bar chart shows that the top 20 % of sires have markedly better than average EBVs for growth and considerably better EBVs for days to calving, scrotal size and eye muscle area. The selected sires' calving ease EBVs are slightly below average. Recall that for the example considered there was not much calving difficulty. The Index derived consequently does not give much attention to calving ease. This is easily modified for cases where there is greater concern about calving ease.

Minutes

Live Animal and Carcass Evaluation Committee Meeting
Friday, May 17, 1996
Birmingham, Alabama

The meeting was called to order by Chairman, John Crouch, at 2:00 p.m. The following presentations were given and are listed in these proceedings:

1) "The Use of Real-Time Ultrasound Data in National Cattle Evaluation"
Dr. Gene Rouse, Iowa State University

2) "Report of RTU Subcommittee Meetings Relative to Technician Certification Guidelines and Measurement Adjustments"
Dr. William Herring, University of Missouri

3) "Real-Time Ultrasound Hardware and Software Evaluation"
Dr. Lisa Kriese, Auburn University

Following these presentations, a lively discussion was held relative to the entire process of ultrasounding live cattle for carcass merit. Support was voiced for an organization of ultrasound practitioners to serve as a governing body and an educational arm of the trade.

An ultrasound seminar/workshop was recommended in the fall of 1996.

There being no further business, the meeting adjourned at 4:30 p.m.

Respectively Submitted,

John Crouch, Chairman

Committee Report:

Use of Real-Time Ultrasound in National Cattle Evaluation

G. Rouse, D. Wilson, and S. Greiner, Iowa State University and
J. Crouch, American Angus Association

Technicians have been certified through the BIF program to measure ribeye area, subcutaneous fat cover and, more recently, percent intramuscular fat with real-time ultrasound. The recent genetic prediction workshop, December 1995, reviewed the technology and a consensus opinion related that real-time ultrasound data should be collected on yearling seedstock contemporary groups of bulls, steers, and heifers with the goal to incorporate these data into carcass EPD's.

Why should real-time ultrasound information be incorporated into carcass EPD's? Several areas will be addressed relating to this question, including:

- Accuracy
- Genetic relationships between bulls, steers, and heifers for carcass traits
- Time and cost of carcass data collection

Research at ISU and other institutions has demonstrated the potential for real-time ultrasound to accurately predict carcass traits (REA and external fat thickness) in the live animal. Consumer demand for a leaner end product and the move toward value based marketing has underlined the importance for beef producers to be concerned about the final products they produce. Ultrasonic measurements offer beef producers another tool for making genetic progress in carcass traits. Incorporation of ultrasound measurements into breed improvement program databases also offers promise for enhancing carcass expected progeny differences.

As the industry begins to produce leaner animals, external fat thickness will be less predictive of differences in retail product yield. Ribeye area has been the standard as an indicator of total muscle in the beef carcass. Other measures of muscle mass, however, would be helpful in determining carcass composition.

This study is a collaborative project between Iowa State University and the U.S. Meat Animal Research Center (MARC) in Clay Center, Nebraska. The objective is to determine the efficacy of using real-time ultrasound measurements and other live animal measures to predict retail product in the beef carcass. Prediction models can be compared to models derived using traditional carcass measures (yield grade parameters). Additionally, development of carcass retail product prediction equations applicable to the live animal would add another level of capability to genetic evaluation.

Two-hundred-eighty-two steers from Cycle V of the Germplasm Evaluation study at U.S. MARC were utilized in this study. Steers were scanned on one of four dates in the summer of 1994 (May to July), with approximately 70 animals per scanning date. Sire breeds consisted of Hereford, Angus, Brahman, Boran, Tuli, and Belgian Blue. Dam breeds were Hereford, Angus, and MARC III (Angus x Hereford x Pinzgauer x Red Poll).

Animals were measured four to five days prior to slaughter using an Aloka 500V real-time ultrasound machine with a 17 centimeter transducer. Three images per steer were collected. The first was a cross-sectional image using a wave guide taken between the 12th and 13th ribs to measure external fat thickness and REA. Body wall thickness was measured between the 12th and 13th ribs 1.5 inches ventral to the *longissimus dorsi* muscle, perpendicular to the external body surface. Rump fat measurements were taken at the meat P8 site over the *gluteus medius* muscle on the rump. Visual muscle scores were assessed using a scale of 1 = light muscled to 9 = heavy muscled (system developed by Bob Long, Texas Tech).

Cattle were slaughtered at a commercial packing facility and routine carcass measures were taken 24 hours postmortem. One side of each carcass was transported to MARC and fabricated into boneless retail cuts trimmed to .3 inches fat thickness. Retail product was calculated and expressed as a percentage of carcass weight or as total pounds.

Table 1. Means, standard deviations, minimum, and maximum values for live animal, carcass, and ultrasound measures.

Trait	Mean ± std. dev.	Minimum	Maximum
Live weight, lb	1206 ± 140	780	1610
Carcass weight, lb	735 ± 89	472	991
Carcass fat thickness, in	.38 ± .16	.10	1.0
Carcass REA, in^2	11.78 ± 1.24	9.1	15.5
Carcass KPH, %	2.78 ± .60	1.0	4.5
Carcass yield grade	3.04 ± .71	1.26	5.46
RTU fat thickness, in	.39 ± .14	.09	.79
RTU REA, in^2	11.94 ± 1.16	9.18	15.84
RTU rump fat thickness, in	.41 ± .13	.14	.90
RTU body wall thickness, in	2.05 ± .29	1.32	2.94
Muscle score	4.49 ± 1.5	2.0	9.0
Carcass retail product, %	70.4 ± 3.8	60.6	79.9
Carcass retail product, lb	244.3 ± 29.3	170.0	323.0

Table 1 lists the means, standard deviations, and minimum and maximum values for live animal and carcass traits. The diversity of sire breeds used in this study resulted in a great deal of variation in carcass and live animal traits. Ultrasound measured traits of fat thickness and REA had smaller standard deviations and less variation than the same traits measured on the carcass.

Table 2 relates the accuracy of ultrasound measures compared to carcass measurements for fat thickness and ribeye area. The mean and absolute differences reflect bias when comparing the ultrasonic measurement to the carcass measurement. Both fat thickness and ribeye were over-predicted when measured ultrasonically compared to measurements taken on the carcass in the cooler. The mean absolute differences for both traits are larger than the mean differences, indicating that some images were interpreted to be larger and some smaller than actual carcass measurements. Ultrasound measurements of REA and fat thickness had positive correlations with carcass measures of the same traits (r=.91 for REA and r=.93 for fat thickness). Standard errors of prediction currently are being used as the standard to certify ultrasound technicians for accuracy. Current Beef Improvement Federation guidelines for certification allow maximum standard errors of prediction of .10 inches and 1.1 square inches for fat thickness and ribeye area, respectively. The low standard errors of prediction in this study are indicative of an experienced technician and reflect the ability to accurately rank animals when ultrasound measures are compared to carcass data.

Table 2. Accuracy of ultrasound measurements.

	Fat thickness, in	REA, in^2
Bias (carcass-ultrasound)	-.01	-.16
Mean absolute difference	.04	.42
Standard error of prediction	.06	.52

Correlation coefficients between live animal and carcass traits with retail product percent or weight are reported in Table 3. Fat thickness, measured ultrasonically or in the carcass, has a strong negative correlation with percentage retail product but has no significant correlation with total pounds of retail product. Ribeye area is positively correlated with both pounds and percentage of retail product but has a stronger relationship to weight of retail product in the beef carcass. Correlations for carcass ribeye area were higher than those found for ultrasound-measured ribeye area, perhaps due in part to bias involved in ultrasound measurements. Muscle score correlations were similar to those found for ribeye area. Body wall thickness and rump fat were negatively related to percentage retail product and are thought to be additional indicators of carcass fat. Rump fat measures have been used in Australia and may be most useful in leaner cattle who have less 12th rib fat. Limited work has been done with body wall thickness in cattle; however, it is used to predict percentage of retail cuts in lamb carcasses.

Table 3. Correlations between retail product and live animal, carcass, and ultrasound measures.

	Retail product, %	Retail product, lb
Live weight	-.28	.84
Carcass weight	-.24	.87
Carcass fat thickness	-.75	
Carcass REA	.38	.66
RTU fat thickness	-.76	
RTU REA	.27	.61
RTU rump fat thickness	-.66	
RTU body wall thickness	-.48	
Muscle score	.37	.53

$p < .001$

Results of stepwise regression analysis for predicting percent retail product using RTU and live animal measures or carcass measures are shown in Tables 4 and 5. Fat thickness (either measured on the carcass or with RTU) accounted for a large proportion of the variation found in percent retail product. This may be a function of the variation in fat thickness in the population of cattle used in this study. Comparison of the R^2 values for RTU vs. carcass fat thickness indicates that RTU fat thickness accounts for more of the variation found in percent retail product than carcass fat thickness. The lower R^2 for carcass fat thickness may be partially due to errors involved in taking carcass measures that result from hide pulls and other slaughter/chilling processes. Both RTU rump fat thickness and muscle score accounted for 3.7% of the variation found in percent retail product. Muscle score was a more important parameter in the prediction model than RTU REA (partial R^2 value .037 vs. .015, Table 4). Although body wall thickness is also a measure of fat thickness, it accounted for a very small proportion of the variation in percent retail product. Table 5 indicates that carcass measures account for 67.6% of the variation found in retail product. These carcass measures correspond with the USDA yield grading equation currently used by the industry to predict differences in carcass yield. Using live animal and RTU measured traits accounted for 68.0% of the variation in percent retail product (Table 4). Mean square errors (MSE) for possible prediction models using live animal and RTU measures compared to carcass measures alone were similar (MSE=2.16 lb for live animal/RTU measures and MSE=2.17 lb for carcass measures).

Table 4. Stepwise regression for prediction of percent retail product using real-time ultrasound and live animal measures.

	Model R^2	Partial R^2	MSE
RTU fat thickness	.575	.575	2.47
RTU rump fat thickness	.612	.037	2.37
Muscle score	.649	.037	2.26
Live weight	.660	.012	2.22
RTU REA	.675	.015	2.18
RTU body wall thickness	.680	.005	2.16

Table 5. Stepwise regression for prediction of percent retail product using carcass measures.

	Model R^2	Partial R^2	MSE
Carcass for thickness	.560	.560	2.52
Carcass REA	.609	.050	2.37
Carcass weight	.660	.051	2.22
Carcass KPH	.676	.016	2.17

Table 6 shows the stepwise regression results for prediction of pounds of retail product using RTU and live animal measures. Final weight alone accounted for 70.5% of the variation found in pounds of retail product. Although muscle score and REA are both indicators of muscle content, muscle score was more predictive of pounds of retail product than REA (R^2 =.094 vs. .026). Ultrasound fat thickness and rump fat were less predictive of pounds of retail product than percent retail product. Using live animal and RTU measures accounted for 87.5% of the variation in total pounds of retail product.

Table 6. Stepwise regression for prediction of pounds of retail product using ultrasound and live animal measures.

	Model R^2	Partial R^2	MSE
Live weight	.705	.705	15.9
Muscle score	.799	.094	13.2
RTU fat thickness	.843	.044	11.6
RTU REA	.870	.026	10.6
RTU rump fat thickness	.875	.005	10.4

Table 7 lists possible regression models for predicting pounds of retail product from carcass measures. Carcass weight accounted for a large proportion of the variation found in pounds of retail product (R^2 = .766). Carcass weight is more indicative of pounds of retail product than live weight due to differences in dressing percentages. Carcass fat thickness accounted for an additional 10% of the variation in pounds of retail product, with REA and KPH accounting for 2.5% and .4% respectively. Using all four carcass traits accounted for 89.5% of the variation in pounds of retail product. Carcass measurements have more predictive power for pounds of retail product than a combination of live animal and RTU traits.

These results suggest that using a combination of live animal and RTU traits can be useful in predicting percent or pounds of retail product in the beef carcass. Possible prediction models for predicting percent or pounds of retail product using live animal and RTU measures were similar in their predictive power and accuracy as compared to models derived from carcass measurements alone. However, more of the variation in pounds of retail product may be accounted for than percent retail product.

Other measures such as rump muscle depth, ribeye depth, or fat area also may be added to investigate their potential predictive power. The diverse sire lines represented in this study may be looked at separately in order to determine the potential accuracy of prediction within a group of cattle with less variation and more similar composition.

Table 7. Stepwise regression for prediction of pounds of retail product using carcass measures.

	Model R^2	Partial R^2	MSE
Carcass weight	.766	.766	14.2
Carcass fat thickness	.866	.100	10.8
Carcass REA	.890	.025	9.7
Carcass KPH	.895	.004	9.6

Predicting percent intramuscular fat on live cattle is a technology that has been developed more recently with real-time ultrasound than ribeye area and subcutaneous fat cover.

Izquierdo et al. (1996) reported on a multiple regression model developed at Iowa State University to predict intramuscular fat percentage (IFATP) percentage in live beef animals by using ultrasound techniques. During four years (1991-1994), 710 bulls and steers were scanned by using a real-time ultrasound (RTU) Aloka 500 machine with a 17 cm, 3.5 Mhz transducer. A longitudinal image obtained without a guide placed across the 11th, 12th and 13th ribs was used to collect a *longissimus dorsi* (*ld*) to compute the image processing parameters. Image processing parameters included: Fourier parameters (13), histogram parameters (17) and texture parameters at four different angles (4*24). Animals were slaughtered and a meat sample of the *ld* between the 12th and 13th ribs was collected to measure the actual percent IFAT. Figure 3 shows a representative image collected from a live beef steer to predict percentage intramuscular fat.

Correlations of the image processing parameters with actual percent IFAT and cross-correlations along them were calculated to discard parameters highly correlated with each other. Stepwise selection based on root mean square error, Cp Mallows' statistic as a measure of bias, and R^2 were used to determine the best parameters to be included in the prediction model for IFATP. Data were randomly divided into two sets: one set was used to develop the model and the other was used to validate it. Two models were developed to predict IFATP. One model was based on image analysis parameters only; the other model included image analysis parameters plus ultrasound-measured 12-13th rib fat cover thickness. Both models were validated with a set of 318 independent images. The images belonged to animals with an actual IFATP mean of 4.91 $\pm$ 2.03 with a range of 1.61 to 14.09%. The regression of the predicted on the actual IFATP resulted in a slope of 0.97 and an intercept of 0.47 (not statistically different from zero) indicating the model was unbiased.

Figure 3. Sample real-time ultrasound image taken longitudinally across the last three ribs of a beef steer.

The distribution of the residuals indicated they were uncorrelated having a mean of zero. The distribution of the residuals also indicated that IFATP was predicted with an error <0.5% in 30% of the animals, <1% in the 53%, <1.5% in the 73% and <2% in 84.3% of the animals.

Correlation between actual and predicted IFATP was 0.6. If actual percent IFAT was: a) smaller than 3%, the mean of absolute residuals was 1.03 with a maximum residual of 2.82; b) between 3 and 6%, the mean absolute residual was 0.85 with a maximum of 2.78; c) between 6 and 9%, the mean absolute residual was 1.65 with a maximum of 4.24; and d) if larger than 9% (10 animals) the mean was 5.32 with a maximum of 8.46. As shown in Table 3, similar results were obtained for the model including fat thickness. In conclusion, the validation of the models showed the appropriateness of real-time ultrasound and image analysis techniques to predict IFATP. The similarity of the validation results for both models, with and without fat thickness, demonstrated the robustness of the model based only on image processing parameters.

Hassen et al (1996) tested the Iowa State University developed percentage intramuscular fat prediction model on an independent set animals being used in a feedlot trial at Iowa State University. The prediction model tested was similar to the one developed by Izquierdo et al. (1996) in that the model contained only parameters from image Fourier transformation and texture parameters, excluding covariate parameters (fat thickness, sex and animal age) used in earlier developed models. The steers serially scanned during the feeding program (140 days) and then within two days of the actual slaughter date. Chemical fat extraction data was available from 85 of the carcasses to compare with the real-time ultrasound prediction. The model provided a reasonably accurate prediction with a mean bias of 0.13%. For 47.1% of the steers percent intramuscular fat was predicted within + 0.5%, and for 77.6% of the steers, prediction was within +1%. Pearson product moment correlation between predicted and actual percentage intramuscular fat was 0.74 (p<.01), and the square root of the mean square error of prediction indicated a prediction error of 0.9%.

Table 3. Absolute residual means between intramuscular fat predictions and actual chemical fat for four classes of actual intramuscular fat.

Actual Fat, %	n	Residual Mean, %	SD
Model without a carcass fat thickness covariate:			
1-3	57	1.03	.66
3-6	183	.85	.66
6-9	68	1.65	1.09
>9	10	5.32	1.82
Model with a carcass fat thickness covariate:			
1-3	57	.92	.68
3-6	183	.88	.65
6-9	68	1.67	1.13
>9	10	5.39	1.75

Heritability and Genetic Correlation Estimates

Beginning in 1991 and continuing through 1995, serial scanned real-time ultrasound images were collected on more than 1,000 bull and steer progeny from the ISU beef cattle research breeding project. The majority of the progeny are sired by registered Angus bulls with the remainder being sired by registered Simmental bulls. Dams used in the study originate from the ISU composite lines of small, medium and large frame size. Heifers produced in this project are used as replacement females, so the composite lines are being bred up to three frame size Angus lines and one Simmental frame size line. The final scan on all bulls and steers was obtained within 5 days prior to slaughter. Average age at slaughter was 440 days. Routine carcass data was collected on

The genetic relationship between bulls, steers and heifers for ribeye area and subcutaneous fat was discussed at the genetic prediction workshop. Concern was specifically expressed regarding subcutaneous fat cover–are we measuring the same trait when fat cover is measured on a yearling bull and used in selection to produce fed steers and heifers. There are conflicts in the literature regarding this genetic relationship. Disregarding ultrasound information–actual carcass data comparisons between steers, bulls and heifers are very limited. Is there a better way to evaluate this genetic relationship than by using serial scanning as a tool to evaluate the rate of change in muscle and fat deposition of all three sexes? Real-time ultrasound did not cause this genetic relationship but certainly can serve as a research tool to better understand this genetic relationship.

Progeny testing sires for carcass traits is expensive and time consuming. Cost ranges from $4,000–$5,000 per sire and the bull will be four to five years of age before acceptable accuracy is obtained. Estimates indicate that a similar degree of accuracy can be obtained at a younger age on a bull for about $750. Consideration should also be given to the use of real-time ultrasound as a method to obtain progeny carcass data. In many cases, contemporary groups will be larger when carcass data is collected ultrasonically, since all the cattle do not need to be slaughtered on a given day.

Currently, we are in an interim period in the technology transfer of real-time ultrasound information. A growing number of BIF certified technicians are available to scan live cattle accurately for ribeye area, subcutaneous fat cover and percent intramuscular fat. It is time for these data to be incorporated into the development of carcass EPD's.

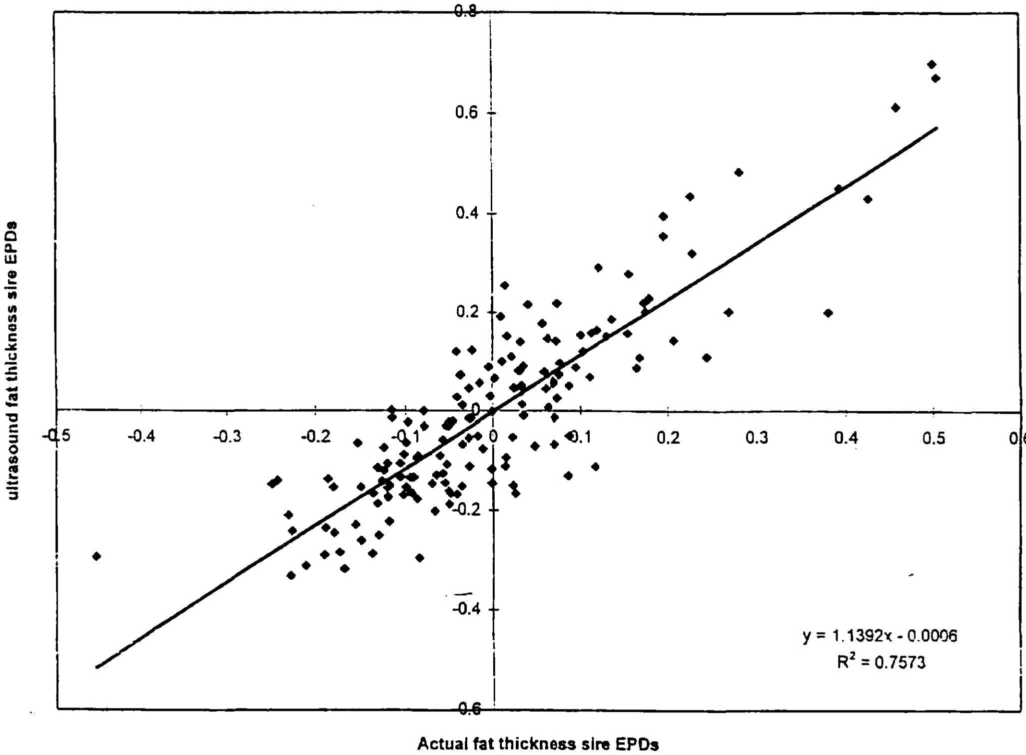


Figure 4. Relationship between sire EPD determined from actual carcass and ultrasound 12-13th rib fat thickness.

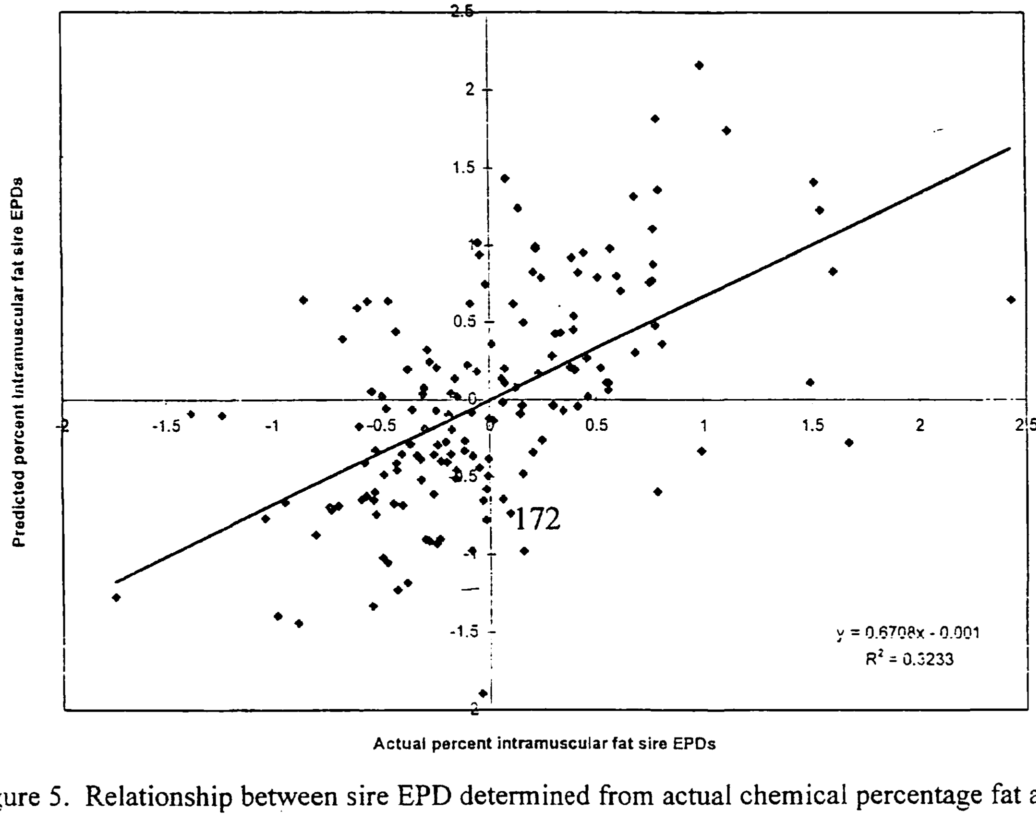


Figure 5. Relationship between sire EPD determined from actual chemical percentage fat and ultrasound predicted percentage fat sire EPD.

Table 6. Genetic correlations between fat traits for Angus bulls and steers and for Angus and Simmental bull and steer data combined.

	PIFAT[a]	UPIFAT[b]	MARB[c]	CFAT[d]	UFAT[e]	HCW[f]
PIFAT		.76(.82)[g]	~1(~1)	.30(.54)	.26(.49)	-.47
UPIFAT			.86(.89)	.69(.76)	.42(.61)	-.23
MARB				.19(.43)	.15	-.43
CFAT					.95(.99)	-.17
UFAT						NC[h]

[a]Chemical percentage intramuscular fat
[b]Ultrasound percentage intramuscular fat
[c]Marbling score
[d]Carcass fat thickness, 12-13th rib
[e]Ultrasound fat thickness, 12-13th rib
[f]Hot carcass weight
[g]First number is for Angus bulls and steers, numbers in brackets indicate estimation from Angus and Simmental progeny data combined
[h]Estimation procedure did not converge

Table 7. Sire EPD ranks correlations for carcass measured fat traits compared to ultrasound measured traits.

	Bulls	Steers	Overall
C%fat vs. U%fat	.54	.62	.57
C%fat vs. Marbling	.56	.63	.64
U%fat vs. Marbling	.50	.62	.53
Cfat vs. Ufat	.77	.81	.84

each carcass. In addition, a rib slice was removed from the 12th rib facing and used to determine total lipid content in the lean tissue using chemical extraction. All ultrasound measurements were collected and processed by BIF Certified technicians.

An analysis is underway to determine the relationships between carcass and ultrasound measures and ultrasound measured trait heritabilities and genetic correlations. The analysis is only partially complete, and the results present here are preliminary. The genetic parameter estimates have been arrived at using multiple-trait derivative-free restricted maximum likelihood procedures. The results are summarized by Angus sired bull and steer progeny, combined Angus and Simmental sired bull and steer progeny, and finally combining all data together. Heritability estimates for chemical fat percent, ultrasound predicted percent fat and USDA marbling score are presented in Table 4. Heritability estimates for 12-13th rib carcass fat thickness and 12-13th rib ultrasound fat thickness are presented in Table 5.

At this point in the analysis, genetic correlations have only been estimated for Angus sired progeny and for combined Angus and Simmental sired progeny. Genetic correlations between bull measured traits and steer measured traits have not yet been estimated. Genetic correlation estimates are presented in Table 6.

Expected progeny differences (EPD) have been computed for all of the sires used in the project for carcass measured traits and ultrasound measured traits. Rank correlations between the various categories of EPD are given in Table 7. Graphical comparison of carcass fat EPD and ultrasound fat thickness EPD.

A general summary based upon the results obtained to date would indicate: 1) More genetic variation exists within steers than bulls for ultrasound measured traits, 2) Genetic correlations indicate that carcass percentage fat, ultrasound predicted percentage fat and marbling are expressions of the same genes and that these traits are also genetically correlated to external fat thickness, 3) Ultrasound percent fat measures can be used to classify low and high EPD sires for chemical (actual) percentage fat, and 4) Ultrasound fat thickness measures can be used to accurately classify all levels of EPDs for carcass fat thickness.

Table 4. Heritability estimates for chemical and ultrasound predicted percentage intramuscular fat (age end point).

	Chemical Percentage Fat	Ultrasound Percentage Fat	USDA Marbling
Angus bulls	.08	.20	.00
Angus steers	.42	.84	.73
All bulls	.23	.40	.21
All steers	.44	.02	.40
Overall	.36	.53	.40

Table 5. Heritability estimates for 12-13th rib fat thickness as measured on the carcass and using ultrasound prior to slaughter (age end point).

	Carcass Fat Thickness	Ultrasound Fat Thickness
Angus bulls	.06	.46
Angus steers	.40	.55
All bulls	.31	.73
All steers	.41	.65
Overall	.39	.67

Central Test & Growth Committee Meeting
Birmingham, Alabama
Minutes

The meeting was called to order by Chairman Ronnie Silcox at 2:05 pm, on Friday, May 17, 1996. Silcox opened the meeting by listing the topics on the agenda. Silcox introduced William Herring, University of Missouri, to present a summary of the North Central Steer Feedout Program database. Objectives of this effort included descriptive statistics for postweaning performance and carcass merit. The North Central database included 4,544 observations from 4 states representing 30 sire breeds and 6-7 years of records.

Darrh Bullock, University of Kentucky, followed Herring in presenting the Southern Region Feedout database results (9 states, 4,108 observations). Bullock included discussion on problems with handling these data. Data from North Carolina, Tennessee, and Mississippi will be retrieved shortly. Bullock stated that data editing and standardization procedures were needed. Distribution and usage of the data were additional concerns discussed. Discussion was held on the need for feedout guidelines, a central collection point for the data, and a subcommittee to address these issues. Discussion was held with regards to the standardization procedures presented at the 1996 BIF convention in Sheridan, WY. Bullock made the motion to form a subcommittee for developing guidelines on steer feedout database collection and use (seconded by Larry Nelson). Motion passed unanimously. Subcommittee members included: Darrh Bullock, Doug Hixon, Sally Northcutt, William Herring, and Robert Stuart. Nelson requested an IRM approach be considered, addressing the economic aspects relative to the steer feedout data. Other considerations mentioned were cost of gain calculations and shrink adjustments used. Silcox noted that the Central Test and Growth Committee would be able to make updates to the BIF Guidelines once the publication is available on the Web.

Brett Middleton, University of Georgia, presented "Using the World Wide Web for Test Stations". Discussion included opportunities for sire summaries on the Web and listings of livestock improvement links.

Sally Northcutt, Oklahoma State University, presented a summary of questionnaire responses from various bull test stations. Discussion was held to determine the use of these results by other test stations and the potential for another survey to be conducted next year. Hayes Walker, American Beef Cattlemen (ABC), was introduced by Silcox. Anyone not listed on the ABC bull test mailing list was asked to contact Walker after the meeting.

Silcox adjourned the meeting at 4:35 pm.

Respectfully submitted,

Sally L. Northcutt
Secretary

National Steer Feedout Database: Present Status and Future Possibilities

William Herring[1], Darrh Bullock[2], and David Lalman[1]
[1] University of Missouri and [2] University of Kentucky

Steer feedouts have provided many cow/calf producers the opportunity to gain retained ownership experience. Most feedouts request only small group consignments from producers resulting in a low financial risk for each consignor. Since most feedouts are coordinated by state extension and cattleman's association personnel, education is the priority. These activities allow cattlemen that have never explored retained ownership the opportunity to 1) gain experience in the feeding phase, 2) understand the importance of various carcass traits, 3) experience "value-based" marketing, and 4) explore how cattle resulting from their breeding and management program perform in such a system.

There are at least 48 state sponsored feedouts across the United States. While each of these programs provides a wealth of information for its participants, their may be unrecognized benefits of reviewing the feedout data collectively. If compiled there are probably tens of thousands of carcass and performance records. While this would not be a "designed" study with statistical inferences, the power of having many observations could prove to be useful in answering many applied questions.

Consignors to these programs represent most cow-calf "systems" that are prevalent in the beef industry. Feedyard and carcass performance could be described for many of these systems if we were equipped with background information about those cow-calf systems represented in the data. The Beef Improvement Federation Central Test and Growth Committee has recommended a list of information to be gathered by feedouts (BIF, 1995). Additional management information would need to be included to provide systems analyses. Realizing these data would be collected with different formats and scales, a standardized form may be necessary in order to enhance uniform data collection.

With potentially thousands of observations represented over time for most sire breeds, feedyard and carcass trends could be evaluated for each of those breeds. To maximize usefulness, this would require many records collected in a standardized format.

In an effort to facilitate a national database, steer feedouts from Iowa, Missouri, Nebraska, and North Dakota were compiled. Before edits, there were 4,544 steer records representing 30 sire breeds. Numerous traits were represented, but the ones most common across states were feedlot average daily gain, hot carcass weight, ribeye area, fat thickness, USDA Quality Grade, and USDA Yield Grade. Means and standard deviations for traits are shown in table 1.

Table 1. Means and standard deviations for North-Central region feedouts.

Trait	Mean	SD
Average daily gain, lb/d	3.13	.50
Hot carcass weight, lb	768	82
Ribeye area, in^2	13.33	1.58
Fat thickness, in	.40	.17
Yield grade	2.58	.74
Quality grade[1]	9.38	1.13
Days on feed	2.01	25

[1]9=Select+; 10=Choice-; etc.

With the development of value-based marketing, various pricing "grids" have evolved. Some of these grids favor leaner, higher cutability carcasses, while others favor higher marbling carcasses. In an effort to identify sire breeds that might excel in these two scenarios and provide an example of one of the uses of a national steer feedout database, cattle from the North-Central region database were evaluated under two windows of acceptability: a high cutability and a high marbling window. To fit into the high quality window, steers must have had a carcass weight between 650 and 850 lbs, Quality Grade of at least low Choice, Yield Grade of no more than 3.0 and an average daily gain of at least 2.5 lbs/d. Data were analyzed with a linear model accounting for effects of year, state, location within state, and sire breed. Least squares means by sire breed for cattle conforming to the high quality window are presented in table 2. Although there were 30 sire breeds represented in the data, only those breeds with at least 100 progeny are presented. Not suprisingly, the British breeds rank highest due to increased marbling. These results changed little when the data were adjusted to a days on feed constant.

Table 2. Least squares means by sire breed for High Quality window.

Breed	n	% Conformance	n	% Conformance[1]
Red Angus	139	28.6	119	29.6
Shorthorn	117	24.5	117	24.2
Angus	936	21.8	805	21.4
Saler	242	19.3	233	18.2
Simmental	892	18.3	840	17.7
Hereford	123	16.7	122	16.2
Charolais	484	16.1	383	15.1
Gelbvieh	296	16.0	283	15.4
Limousin	132	11.6	110	10.1

[1]Adjusted to a days on feed constant.

To qualify for the high cutability window, cattle had to have carcass weights between 700 and 900 lbs, Quality Grade of high Select or better, Yield Grade less than 2.5, and have an average daily gain of at least 2.5 lbs/d. The same statistical model was used. The least squares means for the high cutability window are presented in table 3.

Breeding rankings tended to be opposite for this window, favoring the Continental breeds.

Table 3. Least squares means by sire breed for High Cutability window.

Breed	n	% Conformance	n	% Conformance[1]
Simmental	892	28.0	840	29.2
Shorthorn	117	27.9	117	30.2
Saler	242	26.9	233	29.1
Charolais	484	26.3	383	28.9
Gelbvieh	296	22.6	283	24.2
Limousin	132	21.6	110	24.3
Red Angus	139	18.1	119	18.8
Angus	936	13.8	805	15.5
Hereford	123	9.5	122	11.3

[1]Adjusted to a days on feed constant.

As this database expands, other useful analyses can be performed. However, more extensive and similar information must be recorded by feedouts that participate in this effort. The greatest use of these data in the future may be the identification of profitable beef production "systems" that produce a consistent, high quality end product.

NATIONAL STEER FEEDOUT DATABASE: POTENTIAL PROBLEMS AND SOLUTIONS (SOUTHERN STATES REPORT)

Darrh Bullock[1] and William Herring[2]
[1]University of Kentucky
[2]University of Missouri

The need for a National steer feedout database has been described in the previous paper. The purpose of this paper is to outline some potential problems with a national database and some possible solutions to those problems. Also included are basic statistics from the Southern region feedout database.

Most of the problems associated with a multi-state collection of field records deals with logistics. The National Feedout Database is no exception. One problem is getting the information in to a central collection point. This effort usually requires several correspondences with each participating institution, by the collector, even when all that is required is sending in the raw data on disk without any modification. It would further complicate the issue to require the data in a specific format. The solution to this problem can only come through cooperation from the participating programs.

Another problem is the lack of standardization. Most states collect the same information including: feedlot performance, carcass characteristics and economic analysis. Though many of these variables are the same, in different states, they may be called different names or vice-versa. Particularly with the economic data, each state has a different way of computing and reporting many variables with the same names. Standardization of the information that comes in to a central collection point is essential. Without it, misleading information will result. The solution may be to set up standard guidelines for all of the raw data that is to be sent in. Once the raw data is collected the analyzer of the data can calculate the variables of their choice. It is not BIF's intention to dictate what information the individual programs collect or report, but to be certain we have uniform values in a compiled data set.

Editing the data is another potential problem, but will be greatly eased with standardization.

Distribution and usage of a National data set is of concern to many of the participating programs. Without proper controls, misleading information could result from improper analysis of the data set. Guidelines should be drafted to address these issues.

In summary, the information that can be derived from a National steer feedout data base is enormous and could be very beneficial to the beef industry. However, we do need to take the appropriate steps to insure the data is uniform from the participating programs and analysis of the data is meaningful. The Beef Improvement Federation is the key to accomplishing these objectives.

Table 2. Number of steers and means for traits measured in Southern Feedout database.

TRAIT	N	MEAN	SD	MIN	MAX
INWT	4078	631	94	315	985
INVAL	2965	459	61	275	707
SLWT	4014	1176	124	704	1682
SLVAL	2789	815	102	447	1166
HCW	3858	747	83	510	1023
CARCVAL	1293	794	123	458	1176

Table 3. Number of steers and means for traits measured in Southern Feedout data base.

TRAIT	N	MEAN	SD	MIN	MAX
FAT	3530	0.41	0.18	0.03	2.0
REA	3816	13.0	1.6	7.0	19.8
KPH	3183	2.1	0.6	0.3	4.5
YG	3587	2.6	0.8	0.09	5.54
QG	3767	8.7	1.6	4.0	14.0
ADG	3690	3.0	0.62	0.05	4.97

Correlations between yield and quality grades with other traits were computed and are shown in Table 4. Once again, these phenotypic correlations are similar to other studies and are basically what we would expect.

Southern Region Steer Feedout Database

At the 1995 American Society of Animal Sciences Southern Section Meeting it was proposed that data from each of the state steer feedout programs be compiled into a regional dataset. The participating states agreed and the University of Kentucky was selected as the collection site. Table 1 indicates the participating states and the number of records sent in. Tennessee and Mississippi have also agreed to send their data in. The data from each state represents at least one years data from 1992 to 1995.

Table 1. Participating states and number of steers included in the Southern Region Steer Feedout Database.

STATE	N
Alabama	499
Florida	333
Georgia	381
Kentucky	826
Louisiana	776
North Carolina	Unknown
Oklahoma	1050
South Carolina	171
Virginia	72
TOTAL	4108

Tables 2 and 3 show the number of steers, mean, standard deviation, minimum and maximum values for each variable. The variables included are: initial weight (INWT), initial value (INVAL), live slaughter weight (SLWT), live slaughter value (SLVAL), hot carcass weight (HCW), carcass value (CARCVAL), 12th rib backfat thickness (FAT), 12th rib ribeye area (REA), percent kidney, pelvic and heart fat (KPH), USDA yield grade (YG), USDA quality grade (QG) with select+ = 9; choice- = 10; etc., and feedlot average daily gain (ADG). The standard deviations and minimum/maximum values indicate a great deal of variation, as seen in other beef audits.

Table 4. Correlations between yield and quality grades and several other traits in Southern Feedout data base.

TRAIT	YG	QG
INWT	.04	.10
SLWT	.17	.14
ADG	.07	.18
FAT	.80	.24
REA	-.52	-.13
YG		.34

These parameters simply indicate the feasibility of putting together a nation database. However, due to differences in how economic information is collected and recorded much editing is needed before a combined economic summary can be computed. The cooperation from participating programs was essential to the success of this project.

WORLD WIDE WEB RESOURCES FOR TEST STATIONS [1]

Brett Middleton

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Introduction

The Internet is unquestionably a very fashionable, if not down-right faddish, topic these days. When we encounter endless dramatic promises of online miracle cures for every problem known to modern culture, it's hard to avoid the impression that the Internet is the snake-oil of the 90s. We can only hope that our skepticism doesn't lead us to dismiss some of the real benefits of the medium along with the exaggerations. There are some trends in genetic improvement programs that may firmly establish the Internet (particularly the World Wide Web) as an essential resource for central test stations and their clientele. In fact, these trends will affect *any* producer or organization that markets or purchases multiple breeds of seedstock cattle.

With each year that passes there is a significant increase in the computing power available for genetic evaluation. And the *rate* of increase is increasing — computing strategies that are only a dream today may become reality in mere months. This will have an impact on our improvement programs that may not have occurred to many in the industry as yet.

Naturally, everyone knows that the accuracy of our evaluations increases as computing power increases, because we can bring better statistical and computational models into play. But, the *frequency* of our evaluations *also* increases along with computing power. We have moved from annual evaluation to biannual evaluation over the last 20 years, and we are now about to leapfrog into an era of *continuous* evaluation. Can't happen? Well, not only has the dairy industry been debating this for several years, the swine industry has actually implemented this scheme for two major breeds, and is extending it to others. The beef industry won't be far behind.

So, what does this have to do with test stations and the Internet? The net may be our only hope of controlling the information overload that these changes will produce.

Our system of disseminating genetic values to the industry is *already* inadequate to the task of timely delivery, and will completely bog down under the demands of high-frequency evaluation. The traditional printed sire summary is largely irrelevant these days, and will become completely so. The industry is all too familiar with the tribulations of getting new EPDs in time to meet sale deadlines, the frustration of printing catalogs that become outdated within days, and other such annoyances. Those who deal with multiple breeds, such as test stations and AI studs, are already well aware of the tedium of gathering data from more than one source. Breed associations have long since lost their enthusiasm for the deluge of EPD-update requests that

[1] Presented to the BIF Central Test and Growth Committee at the 1996 Beef Improvement Federation Annual Meeting, May 15-18, Birmingham, AL.

However, the rapid pace of developments, coupled with the immaturity of Internet technology, may create the same problem that resulted in BIF's very existence: multiple organizations doing similar things in different ways breed chaos. Time, communication and competition will take care of much of this, as it has throughout BIF's history, but our Internet cure-all still has not addressed the issue of pulling together information from multiple sources. Inasmuch as the breed databases are likely to be divided among sites, we need another model to fulfill our promise of simplified access to scattered resources.

A Model for Resource Location

Fortunately, the Internet has just the solution. In fact, it has several of them, all of which depend on the fact that resources on the Web do not have to *be* together to *appear* to be together.

One popular solution is to make use of some of the major Web keyword indices such as the Lycos index (http://www.lycos.com/) or the Alta Vista index (http://www.altavista.digital.com/). These indices are constructed by "Web robots," which are programs that seek out documents throughout the Web and add the document locations and keywords to the service's index database. Unfortunately, using these indices is not as simple and direct as we might desire. For example, a search on one service using the words "bull" and "test" returned a list of more than 2,000 documents, including information on Groupe Bull (a computer maker), AIDS research, and cigar smoking. If you are just looking for a simple list of test stations on the net, with no nonsense, then this is not the solution.

A second solution is to try the popular Yahoo! index (http://www.yahoo.com). Unlike the indices listed above, Yahoo! does not attempt to construct a full-text keyword index from every document on the Web. Rather, they assign documents to their own chosen keyword categories. This is a very organized way of finding information. However, Yahoo!'s categories can be somewhat arbitrary, and they do not have a livestock orientation (there is no category for bull test stations).

The best solution under current Web technology is to find a site that maintains a specialty index on some specific topic. The voluntary effort of some partisan creates these indices, and they are sometimes part of a loose association of other such indices known as the World Wide Web Virtual Library. One example is the Livestock Section of the WWW Virtual Library (http://www.ansi.oksate.edu/library/) hosted by Oklahoma State University. Specialty indices depend on the "good citizenship" of users to become established as a key resource for a topic: users are expected to contribute organizational suggestions and point out the addresses of relevant documents that the index maintainer may have missed. But, with a dedicated maintainer and the good will of the user community a specialty index can rapidly become a must-visit site.

As it happens, we at the University of Georgia have just begun an effort to establish a specialty index dedicated to Livestock Improvement Online, located on the Web at http://www.ads.uga.edu/lio/. Our primary target audience for the index is the livestock industry, including producers, extension, and educators, though we will certainly list items of interest to researchers. The index currently includes the known sire summaries and bull tests, as well as bracket each new evaluation. Even a move to a quarterly evaluation schedule would be far too much for this creaking distribution system to handle.

Thus, we need a new model for communication within this industry; one that allows for the rapid flow of genetic information among all segments, and simplified access to information from multiple sources. The Internet is that model, and so should be of interest to anyone involved with modern performance programs.

Now that the "why" has been addressed, the remainder of this paper will cover some of the "what" and "where." The discussion centers on some of the resources that station personnel can *use*, rather than those that they can *provide* to their customers and colleagues. (Others have the expertise to address this topic better than I.)

A Model for Access to Genetic Values

To the best of my knowledge, the first beef sire summary to reach the Web was the *Fall 1995 Simmental Sire Summary*, hosted by Oklahoma State University. This site is simply a variation on the traditional printed sire summary, and is probably no more useful than the print edition, though it is certainly more accessible (at least to those who are net-connected). We can expect to see more summaries in this form during the early stages of this revolution, just as the first online video terminals were treated as "punched cards under glass." It just takes time to rearrange one's thinking to exploit a new medium.

This initial trickle has become a stream within the last few weeks, with the American Hereford Association (AHA) joining the flow, hosted by the University of Missouri, followed by a commercial organization (Bridger Systems, Inc.) that offers free hosting services to all beef breeds and is presently serving five on a site titled "AgDirect." This rush to the Web may well become a flash flood before summer is well underway.

However, the AHA and AgDirect services are not simply "sire lists under glass." These sites follow the new paradigm of Web-searchable databases. As with sire-selector programs offered for personal computers, sires in the database are accessed individually (by name or registration number), or in groups that meet certain standards selected by the user. For example, the user may choose to list only sires with a weaning EPD of at least +20 and a birth EPD no higher than +3.

Although each of the services has its advantages and disadvantages, both must be recognized as prototypes of the proper future model for delivering genetic information to the industry. The "time to publish" is reduced from weeks of typesetting, printing and distribution to mere hours, or even minutes, of database update time. Furthermore, the system can (and should and must) be extended to incorporate more than just "published" sires. I expect it will soon become common to include all active sires and nonparent bulls in these databases, and eventually to incorporate all active animals in the breed, with updates published on a daily basis. We can also expect that these databases will encourage new types of services, such as customized subsets of data that can be downloaded to a PC for further analysis.

Larry Cundiff's new table of nonparent EPD averages for the various breeds, and the MARC Across-Breed EPD table.

In addition to providing links to material found elsewhere, we also offer hosting services for sire summaries, educational material, and nearly any other non-commercial livestock-improvement resource that is looking for a home. We maintain an FTP site (ftp://ftp.ads.uga.edu) in addition to our Web site, so we can also host downloadable documents, data and software.

We would appreciate your support for the project, and we encourage you to visit and give us your comments.

A Digest of Baseline Data

As promised, our Internet snake-oil treatment has made genetic information quickly accessible and easy to locate. However, we still fall short in one respect: the Internet surfer with multi-breed interests still has to peruse a number of sire summaries both on and off the net to obtain one essential resource. That resource is the baseline data — genetic trends, EPD averages, percentile charts, etc. — that is published as part of nearly every sire summary, and which is needed to properly interpret EPDs within a breed.

For the benefit of bull tests, AI studs and others involved in multi-breed programs, perhaps it is time we established a complete digest of this information that summarizes all breeds. The digest would have a single maintainer and a uniform format, and be regularly updated with the cooperation of the breed associations. One person with a little effort and cooperation could save untold man hours of drudgery throughout the industry.

BIF, through the efforts of Larry Cundiff, has taken a step in this direction by publishing his annual list of nonparent EPD averages for a number of the breeds. But is this sufficient for the needs of the industry? Or is there a need for a more complete selection of data, updated on a rolling basis as breeds complete their evaluations throughout the year? If there is a need, the Internet has now given us the tools to do it right.

SPOTLIGHT ON CENTRAL BULL TESTING AND DEVELOPMENT CENTERS

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Oklahoma State University

In an effort to improve communications between central bull testing centers, a questionnaire was mailed to all bull feeding facilities listed with the BIF Central Test and Growth Committee. The primary reasons for conducting this survey were:

- Update the test station mailing list.
- Describe the use of stations by seedstock breeders and bull buyers.
- Compile ideas on future goals of test stations.
- Determine the use of various technologies in test station programs.

Approximately 122 questionnaires were mailed to bull test stations listed with the American Beef Cattlemen magazine produced by Hayes Walker. Of those feeding facilities contacted, 47 responses were returned representing 103 test stations. Twenty-nine states were represented in the United States and two provinces in Canada were respondents. The responses were estimated to represent 11,209 bulls fed annually. Relative to bull sales held each year, the survey responses encompassed 67 sales (54 spring and 13 fall), with 5,467 bulls selling annually.

Facility Type and Feeding Period

Central bull tests represented in the responses consisted of 40 confinement, five forage and two on-farm programs. Of the confinement facilities, the majority were using a 112-day feeding period. Other feeding periods included 140-day (two stations), 100-day, 105-day, 120-day, 126-day, and 133-day tests. Forage facilities used a range of 160 to 280 day programs. All participants in the questionnaire were asked if an on-farm program was available in their state, with 56% of the states indicating this type of program was in place. Across all stations an average of nine breeds were fed, ranging from 3 to 15 breeds.

Numbers of bulls fed and sold annually were of interest based on the size of test station. Stations were categorized as 'Small' (less than 200 head fed annually) and 'Large' (200 or more bulls fed annually). Of the confinement feeding programs, 23 stations were categorized as Small and 17 were Large size. All forage programs fed less than 200 head annually. Table 1 presents the numbers of bulls fed and sold annually by size group.

Survey participants were asked to describe their feeding rations. Some stations chose not to provide this information. Average values for the confinement facilities were as follows: NEm = .73 (n=11), NEg = .50 (n=13), TDN = 71.5% (n=16), protein = 14.9% (n=17). When asked about the collection of feed efficiency data, 30% of the respondents indicated these data were being collected (41% and 12% for Small and Large programs, respectively). Four respondents collected individual feed conversion data, and six stations captured pen conversions (primarily for billing purposes). Also, one station used cost per pound of gain (by pen) and another respondent had interest in feeding sire groups for efficiency data.

EPDs, Sale Order and Ultrasound Scanning

Twenty-one percent of the respondents indicated that bulls were fed in groups (or indexed) based on the EPDs available. Twenty-four percent of the responses provided carcass EPDs on the bulls, either on bull reports and/or sale catalogs. When asked about sale bull strategies, 27% of the responses grouped sale bulls based on their EPDs. Nearly 98% of all stations conducted some soundness screening of sale bulls. Table 2 describes the persons used in the screening process. Numbers of responses are given with each description. Most evaluations were conducted by veterinarians in combination with other committee members (testers, extension personnel). In addition, 40.9% of the respondents indicated that frame score criteria were currently in place. The vast majority of these criteria were minimum frame requirements.

Most stations used a rotation of breeds to determine breed sale order (Table 3). As one might expect, some form of index was used in placing bulls in sale order. The type of index utilized varied with individual responses (Table 4). Components of the various index formulas are described. Respondents indicated that ADG, WDA and adjusted yearling weight were still very prevalent in these formulas. The EPD percentiles appeared in six responses.

When asked about ultrasound scan usage, 70% of the respondents were scanning bulls; of these, 59% used a certified technician to perform the scans. The types of scan data provided at the stations is described in Table 5. Responses indicate the presentation of actual and adjusted measures.

Tables 6 and 7 present the responses by size of program. EPD groups were used more by Large than Small size programs. Frame score criteria were more prevalent at small test stations. As an additional question, it was interesting to find that 30% of the respondents used World Wide Web technology, with more use by the large test stations. Some 33% of those not using the Web plan to do so in the future.

Financial Support and Future Goals

University support in some form was received by 87% of the respondents. Table 8 describes the sources of support and indicates a large participation through extension services. Thirty-two respondents had extension personnel actively involved in regular test station activities.

Each respondent was asked to describe their top five goals for the future of their test station feeding facility. By summarizing the responses, the participants may have choices in more than one category. Table 9 indicates the emphasis to be placed on providing and promoting quality bulls and implementation of EPDs and carcass data. Also, some stations are evaluating their role in the industry and in search of cost-cutting measures.

Plans are to conduct another questionnaire for the 1997 BIF meetings to survey cost cutting measures and progress towards these goals. The authors would like to express their thanks to all participants in completing the questionnaires and their prompt responses. If additional details about questionnaire results (index formulas, station addresses) are desired please contact us (405-744-6060; e-mail slnbull@okway.okstate.edu).

Table 1

Small vs. Large

No. Bulls Tested	Small	Large
Total	3,184	8,025
Average	110	472
No. Bulls Sold		
Total	2,042	3,385
Average	73	212

Table 2

Responsible for Evaluating and Culling Bulls

Vet or Vet with Others	19
Committee of Various People	16
Test Manager & Staff/Committee	11
Not Evaluated	1

Table 3

Breed Sale Order

Rotation of Breeds	12
Avg. Price of Previous Year	3
Voted on by Consignors/Buyers	2
Lottery	1
Index Across Breeds	1

Table 4

Bull Sale Order

Index	41
Average Daily Gain (ADG)	25
Weight per Day of Age (WDA)	12
Adj. Yearling Weight	11
EPD Percentiles	6
452-d Adj. Yearling Weight	1
Multiple Performance Traits	3
Phenotype	1

Table 5

Ultrasound Data

Backfat (BF)	29
Rib Eye Area (REA)	23
% Intramuscular Fat	8
Adj. Yearling REA	7
Adj. Yearling BF	3
Adj. % Intramuscular Fat	3
REA per cwt	1

Table 6

Small vs. Large Progams[a]

	Small	Large
EPD Groups:		
Feeding	19%	24%
Catalog	21%	31%

[a]Confinement only

Table 7

Small vs. Large

	Small	Large
Frame Score	48%	31%
Ultrasound	66%	77%
WWW	17%	47%

Table 8

University Extension Support

Supervisory (personnel)	32
Advisory Staff	8
Financial Only	2
None	5

Table 9

Primary Goals for the Future

• Promote & Provide Quality Bulls	20
• Use Index & EPDs More Effectively	17
• Educate Producers on Performance	17
• Use of Ultrasound & Carcass Data	16
• Expand, Utilize, Renovate Facilities	14
• Reduce Cost of Tests	6
• Question Viability of Testing	6
• Test Contemporary Groups	3
• Test Composite	2
• Establish WWW Site	1

Reproduction Committee Minutes
May 17, 1996
Birmingham, Alabama

The meeting of the BIF Reproduction Committee was brought to order by Chairman Bruce Cunningham at 2:00 PM. Chairman Cunningham discussed the agenda for the meeting which consisted of two presentations by Dan Moser, University of Georgia and Warren Snelling, USDA, Miles City, MT.

Dan Moser of the University of Georgia presented his work regarding the relationship of scrotal circumference in males and reproductive performance in females.

Warren Snelling described research into the genetic evaluation of reproductive traits using data from the L1 Hereford Herd at the USDA Livestock and Range Research Station located at Miles City, MT.

GENETIC EVALUATION OF HEIFER PREGNANCY[1]

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Introduction

While reproductive performance is a primary factor influencing profitability of cow-calf production, genetic evaluation and sire selection for female fertility have received little attention. Except for measures of puberty, fertility traits are regarded as too lowly heritable to allow improvement through selection. Most national cattle evaluations have not addressed reproduction, leaving producers unable to include EPDs for reproductive traits in selection criteria. Stayability evaluations, implemented by the Red Angus Association of America (Snelling et al., 1994), predict EPDs for the probability that a cow who enters production will reproduce and stay in production for a number of years. The stayability EPDs, however, provide no indication of which heifers will enter production. Because pregnancy is the major criteria determining which potential replacement heifers will be kept in the cow herd, EPDs for heifer pregnancy are a logical compliment to stayability EPDs. Considering the investment required to develop potential replacements, selection based on heifer pregnancy EPDs should reduce the amount of that investment wasted on heifers that are not pregnant after their first breeding season. Initial results are encouraging for development and implementation of heifer pregnancy EPDs using threshold model methods.

Required Information and Analysis

As with any EPD, the information needed for genetic evaluation of heifer pregnancy includes ancestry, observations, and details about environment and management. Pedigree records are required to determine relationships among individuals and ascertain the degree to which observations are influenced by genes shared by related individuals. Unlike production traits that are measured on a continuous scale, there are only two possible observations for pregnancy: pregnant or open. Observations are needed on all heifers exposed, not just those that were pregnant. Genetic evaluation of pregnancy also requires knowledge of which individuals were treated alike and had similar factors influencing their observation. Heifer pregnancy may be influenced by factors such as herd, birth year, and pre- and post-weaning management treatments. If heifers are bred naturally, the bull in a single-sire pasture will influence pregnancy of heifers in that pasture. Different technicians may affect pregnancy of artificially bred heifers. Other factors, such as synchronization of estrus, should also be considered to designate contemporary groups of heifers with equal opportunity to be pregnant. Much of the information needed for breed-wide pregnancy evaluations may be obtained through implementation of inventory-based reporting programs.

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[1]USDA, Agricultural Research Service, Northern Plains Area, is an equal opportunity/affirmative action employer and all agency services are available without discrimination. Cooperation of Montana Agric. Exp. Sta., Montana State Univ is recoginzed.

Because pregnancy is observed as either pregnant or open, genetic analysis with a threshold model is more appropriate than analysis as a continuous trait. Applied to heifer pregnancy, the threshold concept suggests each heifer has a value for pregnancy (due to her genetics and environment) on an unobservable continuous underlying scale. This value is observed as either pregnant or open depending on whether it is greater than or less than the underlying threshold value. With theoretical development (Gianola and Foulley, 1983; Harville and Mee, 1984; Hoeschele et al., 1995) coupled with advances in computing technology (Golden, 1994), implementation of threshold models to analyze pregnancy is currently feasible. While accounting for environmental and management factors that influence the probability of a heifer being pregnant, the threshold analyses can predict individual additive genetic merit. These predictions allow comparison based on differences in probabilities that daughters will conceive and remain pregnant as heifers.

Research Results

Data from Fort Keogh Livestock and Range Research Laboratory, Miles City, MT, were used to explore application of threshold models to pregnancy records. Primary objectives of this study were to estimate heritabilities and predict breeding values for yearling and two-year-old pregnancy using a threshold model approach. Because previous heritability estimates of pregnancy in beef cattle were made with linear continuous trait methods, a secondary objective was to compare threshold model and linear heritability estimates.

Pedigree and breeding records were obtained from two research populations at Fort Keogh (Table 1). One data set represented the Selection Criteria Study (SCS), a population of linecross Herefords that was randomly selected and mated from 1976 to 1988. After first exposure to breeding as yearlings, females were randomly culled and all females older than 5 yr were removed from the population. Further description of the SCS cattle and management is provided by Nelsen et al. (1984). The second population studied was the Miles City Line 1 Herefords. This line was closed in 1934 after mating 2 half-sib bulls to 49 females in 1934. Postweaning growth has been the primary selection criteria throughout the history of the line. This study considered complete Line 1 pedigree records but limited breeding records to those heifers first exposed as yearlings in 1978 and later. MacNeil et al. (1992) provides greater detail of the history, management and environment of Line 1. In both populations, all matings were natural service in single-sire pastures. Pregnancy was diagnosed by rectal palpation or ultrasound following each breeding season.

Single-trait threshold model analyses were conducted for yearling and two-year-old pregnancy in SCS and Line 1. Heritabilities were estimated with marginal maximum likelihood (MML) using an expectation-maximization-like procedure (Hoeschele et al., 1987). Data were also subjected to analysis using continuous trait methods (MTDFREML, Boldman et al., 1993) using observations of 0 for open females and 1 for pregnant females. Besides individual animal effects, the yearling analyses considered year $\times$ mating pasture contemporary group effects and effects of the heifer's age (days) and age of her dam (2, 3, 4, 5 to 9, and $\geq$10 years). Because of the single-sire pastures, these contemporary groups about -.5 to +.5 (Table 4). On the observed scale, there might be a 15% to 20% difference in pregnancy of daughters of the extreme individuals when compared in a contemporary group with an 80% pregnancy rate. The range of predicted breeding values increased with estimated heritability, so the greatest difference between extremes was observed for Line 1 two-year-old pregnancy and the least for SCS two-year-old pregnancy. Ranges and standard deviations of predicted breeding values of sires and bulls born in the last year of each data set indicate sires and yearling bulls may be distinguished by expected differences in pregnancy of yearling and two-year-old female offspring.

Table 4. Description of predicted breeding values[a]

	Minimum	Maximum	Mean	SD
SCS yearling pregnancy				
All animals	-.58	.51	.00	.15
Sires	-.47	.43	-.01	.20
Yearling bulls[b]	-.27	.23	.00	.14
SCS two-year-old pregnancy				
All animals	-.42	.30	.01	.10
Sires	-.33	.29	.00	.12
Yearling bulls[b]	-.14	.16	.02	.09
Line 1 yearling pregnancy				
All animals	-.61	.61	.01	.12
Sires	-.44	.47	.02	.23
Yearling bulls[b]	-.49	.55	.08	.20
Line 1 two-year-old pregnancy				
All animals	-1.09	1.22	.00	.19
Sires	-.99	.80	.03	.35
Yearling bulls[b]	-.71	1.08	.05	.34

[a]Breeding values on the underlying standard normal scale.
[b]Yearling bulls born in the last year of each data set.

Implications

These results show the potential of threshold model methods for predicting individual genetic merit for female reproduction. Breed-wide evaluations may be implemented, but will require collection of sufficient data. Inventory-based reporting schemes may facilitate collection of the needed information. This information includes complete breeding records of all females exposed, not just those that became pregnant and calved. Records of different management treatments, service sires, breeding pastures, and other factors affecting pregnancy are needed to compare females within appropriate contemporary groups. These evaluations will provide breeders with the opportunity to select sires based on expected differences in pregnancy of their daughters.

synchronized and bred artificially prior to natural exposure. The total breeding season length was about 65 days and the average pregnancy rate over 12 years of records was 78%.

Fixed effects. Estimated effects of a yearling heifer's age and age of her dam varied across data sets (Table 3). All data sets suggested the probability of becoming pregnant increased with age at the start of breeding. In both SCS and Line 1, this effect was minuscule and not significant. Heifer age was highly significant in the field data, which indicated the probability of pregnancy increased by about .5% per day of age. Age of the heifer's dam appeared to have potentially important effects, but the magnitude and direction of these effects were different in each data set. In SCS and the field data, heifers from young dams were less likely to be pregnant. For SCS, heifers out of two- and three-year-old dams had lower probabilities of pregnancy than heifers from older dams. Only heifers from two-year-old dams were affected in the field data. In Line 1, heifers from three-year-old dams appeared more likely to become pregnant than heifers with dams in other age groups. These results do not suggest that the age of a heifer's dam should be considered when selecting potential replacements, without additional evidence to indicate age of dam has a significant impact on heifer pregnancy.

Table 3. Effects of heifer age and age of dam on yearling pregnancy[a]

	SCS	Line 1	Field data[b]
Age of heifer (days)	.002 ± .006	.001 ± .005	0.013
Age of heifer's dam (years)			
2	-.32 ± .22	-.06 ± .20	-0.25
3	-.38 ± .23	.34 ± .20	-0.01
4	.14 ± .27	-.08 ± .20	-0.07
5 to 9	0	0	0.01

[a]Effects expressed on the underlying standard normal scale. Effects may be expressed as deviations from 50% probability using $[\Phi(i)-.5]\times 100$, where $\Phi(i)$ is the probability of i in standard deviation units.
[b]Evans et al., 1996.

In SCS, two-year-olds that calved without assistance were just as likely to be pregnant after their second breeding season as those that did not calve. Line 1 heifers that did not calve as two-year-olds appeared somewhat more likely to be pregnant than those that calved unassisted. Two-year-old SCS heifers who were assisted at calving had lower subsequent pregnancy than those that calved unassisted, while calving assistance did not reduce the following pregnancy of Line 1 two-year-olds. The lack of an effect of assistance on postpartum pregnancy of Line 1 two-year-olds may reflect that assistance was provided early in labor, while SCS were not provided assistance until somewhat later. Doornbos et al. (1984) and Bellows et al. (1988) observed higher pregnancy in females provided early assistance compared to females whose labor was prolonged until a calf was born or emergency assistance was required.

Breeding values. On the underlying scale, the spread between extreme predicted breeding values for pregnancy was somewhat greater than one standard deviation unit, from also included the effect of service sire. The two-year-old analyses also considered whether or not the heifer calved, and if assistance was provided at calving.

Table 1. Description of Fort Keogh pregnancy records

	SCS	Line 1
Animals in pedigree	2032	6727
Yearling pregnancy		
records	679	765
% pregnant	86.3	79.9
Two-year-old pregnancy		
records	504	600
% pregnant	79.8	77.3

Heritability estimates. The threshold model MML heritability estimates ranged from .17 to .49, with estimates from Line 1 somewhat higher than those from SCS (Table 2). Transformed from the observed to the underlying scale (Dempster and Lerner, 1950), REML heritability estimates were less than .04.

Table 2. Heritabilities of pregnancy estimated with threshold model (MML) and continuous (REML) methods

	SCS		Line 1	
	MML	REML	MML	REML
Yearling pregnancy	.21	.002	.30	.04
2-year-old pregnancy	.17	.002	.49	.01

While these estimates were obtained from relatively small data sets and cannot be considered extremely reliable, they suggest that some reported heritability estimates might be low, in part, because of the analytical methods used. Milagres et al. (1979) obtained similar results comparing continuous trait ANOVA to binary trait χ^2 methods in a study of calving rate of Hereford heifers. Half-sister ANOVA yielded a heritability estimate of .02 ± .04 while an estimate of .22 ± .12 was obtained using χ^2. Other heritability estimates for pregnancy are .06 in Hereford heifers (Toelle and Robison, 1985); and .34, .08, and .10 in Angus, Hereford, and Polled Hereford heifers, respectively (Buddenberg et al., 1989).

Using a threshold model approach, but a regression technique (Method $\Re$; Reverter et al., 1994) instead of marginal maximum likelihood to estimate heritability, Evans et al. (1996) obtained an estimate of .14 ± .11 from field data with pregnancy records of 861 yearling Hereford heifers on a single ranch. In their study, heifers were estrous

Literature Cited

Bellows, R. A., R. E. Short, R. B. Staigmiller, and W. L. Milmine. Effects of induced parturition and early obstetrical assistance in beef cattle. J. Anim. Sci. 66:1073.

Boldman, K. G., L. A. Kriese, L. D. Van Vleck, and S. D. Kachman. 1993. A manual for use of MTDFREML. A set of programs to obtain estimates of variances and covariances. [Draft]. ARS, USDA.

Buddenberg, B. J., C. J. Brown, Z. B. Johnson, J. E. Dunn, and H. P. Peterson. 1989. Heritability estimates of pregnancy rate in beef cows under natural mating. J. Anim. Sci. 67:2589.

Dempster, E. R. and I. M. Lerner. 1950. Heritability of threshold characters. Genetics 35:212.

Doornbos, D. E., R. A. Bellows, P. J. Burfening, and B. W. Knapp. 1984. Effects of dam age, prepartum nutrition and duration of labor on productivity and postpartum reproduction in beef females. J. Anim. Sci. 59:1.

Evans, J. L., B. L. Golden, C. R. Comstock, K. L. Long, R. M. Bourdon, C. H. Mallinckrodt, and R. D. Green. Genetic parameter estimates for heifer pregnancy rate and scrotal circumference in Hereford Cattle. Colorado State Univ., Fort Collins (Mimeo).

Gianola, D. and J. L. Foulley. 1983. Sire evaluation for ordered categorical data with a threshold model. Genet. Sel. Evol. 15:201.

Golden, B. L. 1994. Future needs in computing strategies. Proc. 5th World Congr. on Genet. Appl. to Livest. Prod. Guelph, Ontario.

Harville, D. W. and R. W. Mee. 1984. A mixed-model procedure for analyzing ordered categorical data. Biometrics 9:226.

Hoeschele, I., D. Gianola, and J. L. Foulley. 1987. Estimation of variance components with quasi-continuous data using Bayesian methods. J. Anim. Breedg. Genet. 104:334.

Hoeschele, I., B. Tier, and H.-U. Graser. 1995. Multiple-trait genetic evaluation for one polychotomous trait and several continuous traits with missing data and unequal models. J. Anim. Sci. 73:1609.

MacNeil, M. D., J. J. Urick, S. Newman, and B. W. Knapp. 1992. Selection for postweaning growth in inbred Hereford Cattle: the Fort Keogh, Montana Line 1 example. J. Anim. Sci. 70:723.

Milagres, J. C., E. U. Dillard, and O. W. Robison. 1979. Heritability estimates for some measures of reproduction in Hereford heifers. J. Anim. Sci. 49:668.

Nelsen, T. C., R. E. Short, J. J. Urick, and W. L. Reynolds. 1984. Genetic variance components of birth weight in a herd of unselected cattle. J. Anim. Sci. 59:1459.

Reverter, A., B. L. Golden, R. M. Bourdon, and J. S. Brinks. 1994. Method $\mathfrak{R}$ variance components procedure: Application on the simple breeding value model. J. Anim. Sci. 72:2247.

Snelling, W. M., B. L. Golden, and R. M. Bourdon. 1994. An EPD for stayability of beef cows. Proc. 5th World Congr. on Genet. Appl. to Livest. Prod. Guelph, Ontario.

Toelle, V. D. and O. W. Robison. 1985. Estimates of genetic correlations between testicular measurements and female reproductive traits in cattle. J. Anim. Sci. 60:89.

GENETIC RELATIONSHIPS BETWEEN SCROTAL CIRCUMFERENCE IN BULLS AND REPRODUCTIVE EFFICIENCY IN HEIFERS

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Introduction

Reproductive efficiency is the most economically important factor in commercial cow-calf production. Cattlemen commonly cull females expressing low fertility. Often, little is known of the inherent fertility of a herd sire, especially when used via artificial insemination. Scrotal circumference (SC) has economic value in beef cattle, largely due to its relationship to reproductive traits in females. Genetic correlations between SC and many production traits are favorable. This paper re-examines relationships between SC and other traits, and adds further evidence that SC and SC expected progeny differences (EPD) should be included in beef cattle selection programs.

Selection on Phenotypic Scrotal Circumference

As important as reproductive performance is to profitable beef production, limited progress has been observed in selection for age at puberty, calving rate or other reproductive traits expressed in females. Such traits are generally low in heritability, and are difficult and expensive to measure. Expression of such traits may be masked by good management practices such as heat synchronization, artificial insemination, and fixed calving seasons. Much greater genetic progress can be made through sire selection than via cow culling, as sire selection affords a much wider range of potential genetics. In order for genetic improvement of cow herd reproduction to occur, an accurate measure of the sire's genetics for fertility is needed.

Scrotal circumference is an easily measured, useful indicator of fertility in bulls. It has been shown to be favorably related to sperm production and early sexual maturity. Several studies have demonstrated that SC has a desirable relationship with sexual maturity in heifers, expressed as age at puberty, age at first estrus, or age at first breeding. Brinks et al. (1978) were the first to suggest a relationship between SC in bulls and age at puberty in heifers, following Land's (1973) similar work with mice and sheep. Toelle and Robison (1985) and Morris et al. (1992) found favorable relationships between SC (measured both at weaning and at a year of age) and age at breeding, age at first calving, return to breeding after first calving, and calving interval. Smith et al. (1989) found that for every increased centimeter of sire SC, age of puberty of daughters decreased .796 days. In addition, both bull and heifer calves of larger SC bulls had lighter birth weights, but heavier weaning and yearling weights.

To further demonstrate these favorable relationships, a study was conducted at The University of Georgia, with support from the North American Limousin Foundation (Moser et al., 1996). Nine pairs of Limousin bulls were acquired, with each pair composed of one large yearling SC bull (~36 cm) and one small SC bull (~28 cm) from the same contemporary group.

As much as possible, bulls with similar EPD for birth, weaning, and yearling weight were chosen, to remove any effects due to growth. Prior to breeding, bulls were subjected to a breeding soundness exam (BSE; Ball et al., 1983). Least-squares means for breeding soundness of sires are listed in Table 1. Motility scores and total BSE scores were higher for bulls with large phenotypic SC, compared with bulls with small phenotypic SC. Total abnormalities were lower for large SC sires. This study confirms the BSE rating system in which a minimum yearling SC of 30 cm is given a grade of "good" or better.

Table 1. Least-Squares Means and Standard Errors for Breeding Soundness Traits of Sires by SC Group

	SC Line	
	Large	Small
Number of bulls	9	9
Primary abnormalities, %	6.67 ± 1.51	7.25 ± 1.61
Secondary abnormalities, %	11.22 ± 2.45	16.13 ± 2.60
Total abnormalities, %	17.33 ± 2.28	23.37 ± 2.42
Scrotal circumference score	32.89 ± 2.58[b]	19.33 ± 2.58[c]
Morphology score	36.44 ± 3.37	29.66 ± 3.37
Motility score	17.78 ± 1.46[d]	11.22 ± 1.46[e]
Total BSE[a] score	87.11 ± 5.69[f]	60.00 ± 5.69[g]
Percentage rated "Satisfactory"	100 ± 12[h]	44 ± 12[i]
Percentage rated "Satisfactory" or Questionable"	100 ± 8	89 ± 8

[a] Breeding soundness exam.
[bcdefghi] Superscripted means within a row lacking a common superscript differ ($P < .05$).

These bulls were each pasture mated to between 15 and 20 Brangus-Hereford crossbred cows each year for one to three years. Complete performance data was collected on 407 progeny, including age at puberty and pregnancy data on 205 heifer offspring. Least-squares means for growth traits of progeny are listed by line in Table 2. Birth weight was greater for progeny of large SC bulls, despite the fact that these sires were similar for birth weight EPD. Growth and composition measurements were nearly identical between the groups, as expected, since the lines were selected to have similar growth EPD.

Least-squares means for reproductive traits are listed by line in Table 3. Weaning testicular weight was greater for sons of high SC bulls. A 6.9-day advantage in age at puberty for daughters of the large SC line was observed, but was not statistically significant. Using the regression of age at puberty on sire SC reported by Smith et al. (1989), the 7.8 cm average difference in sire SC would be expected to result in a 6.2-day advantage in age at puberty. This demonstrates that although selection for SC can improve age at puberty somewhat, improvement of one cycle (21 days) or more is not likely. In addition, similar percentages of both large and small SC line heifers were cycling at 11, 13, and 15 months of age.

Table 2. Least-Squares Means and Standard Errors for Growth Traits of Progeny by SC Group

	SC Line	
	Large	Small
Number of progeny	221	186
Birth weight, lb.	84 ± 2.4[a]	80 ± 2.5[b]
Adjusted weaning weight, lb.	465 ± 5.6	457 ± 6.2
Weaning height, in.	45.2 ± .39	45.1 ± .41
Weaning backfat, in.	.11 ± .01	.11 ± .01
Weaning ribeye area, $in.^2$	5.9 ± .26	5.8 ± .27
Adjusted yearling weight, lb.	695 ± 8.2	703 ± 10.0
Yearling height, in.	48.2 ± .58	48.3 ± .58
Yearling backfat, in.	.11 ± .02	.11 ± .02
Yearling ribeye area, $in.^2$	8.1 ± .55	8.1 ± .55

[ab] Superscripted means within a row lacking a common superscript differ ($P < .05$).

Table 3. Least-Squares Means and Standard Errors for Reproductive Traits of Progeny by SC Group

	SC Line	
	Large	Small
Weaning scrotal circumference, cm	20.8 ± .7	20.0 ± .8
Weaning testicular weight, g	197 ± 16[a]	157 ± 19[b]
Percentage cycling at 11-mo. msmt.	12 ± 4	12 ± 5
Percentage cycling at 13-mo. msmt.	32 ± 7	22 ± 8
Percentage cycling at 15-mo. msmt.	92 ± 4	88 ± 4
Age at puberty, d	425.5 ± 5.7	432.4 ± 6.3
Pregnancy percentage	89 ± 4	89 ± 5
Yearling pelvic area, cm^2 (heifers)	160 ± 1.7	161 ± 1.9

[ab] Superscripted means within a row lacking a common superscript differ ($P < .05$).

Selection on Scrotal Circumference EPD

Several breed associations include an evaluation for SC as part of their national cattle evaluation programs. The North American Limousin Foundation first calculated SC EPD in 1993, after data collection for this project was complete. Complete performance data on the project sires and their contemporary group mates were assembled, and non-parent SC EPD from the January 1995 Limousin national cattle evaluation were used to group sires. Four sires with SC EPD greater than .53 cm were categorized as the high SC EPD group (range of .74 to .99 cm). The low SC EPD group consisted of five sires with SC EPD less than -.61 cm (range of

-.71 to -1.63 cm). The remaining nine sires, with SC EPD ranging from -.58 to .49 cm, made up the average SC EPD group. Bulls assigned to the high and low SC EPD lines had SC EPD that were 2.5 standard deviations (1 SD = .228 cm) greater than and less than the breed average (-.039 cm), respectively. Results of breeding soundness examinations are listed by SC EPD group in table 4. When bulls were grouped by SC EPD, no significant differences in breeding soundness were found between groups, although abnormalities tended to be lower and scores tended to be higher as SC EPD increased. Adjusted phenotypic SC of the sire was a better indicator of his breeding soundness than was his SC EPD. We would expect SC EPD to be a useful predictor of the breeding soundness of a bull's sons. These results indicate that use of SC EPD in selection does not reduce the need to individually evaluate sires for breeding soundness prior to use.

Table 4. Least-Squares Means and Standard Errors for Breeding Soundness Traits of Sires by SC EPD Group

	SC EPD Group		
	High	Average	Low
Number of bulls	4	9	5
Primary abnormalities, %	5.00 ± 2.11	6.13 ± 1.49	9.80 ± 1.89
Secondary abnormalities, %	12.25 ± 3.98	14.75 ± 2.81	12.60 ± 3.56
Total abnormalities, %	17.25 ± 3.77	20.25 ± 2.67	22.40 ± 3.37
Scrotal circumference score	32.00 ± 4.70[b]	27.78 ± 4.70[bc]	18.40 ± 4.21[c]
Morphology score	40.00 ± 4.94	28.78 ± 3.29	35.20 ± 4.42
Motility score	17.50 ± 2.75	13.89 ± 1.83	13.20 ± 2.46
Total BSE[a] score	89.50 ± 10.49	70.44 ± 6.99	66.40 ± 9.38
Percentage rated "Satisfactory"	100 ± 23	67 ± 15	60 ± 21
Percentage rated "Satisfactory" or "Questionable"	100 ± 12	89 ± 8	100 ± 11

[a] Breeding soundness exam.
[bc] Superscripted means within a row lacking a common superscript differ ($P < .05$).

Least-squares means for growth traits are listed by SC EPD line in Table 5. Weaning ribeye area was greater for average SC EPD line calves than for low SC EPD line calves. No other differences in growth or composition traits were found between the SC EPD lines.

Least-squares means for reproductive traits are listed by SC EPD line in Table 6. Weaning testicular mass was greater for high and average SC EPD line calves than for low SC EPD line calves. At both the 11-month and 13-month measurements, a greater percentage of high SC EPD line heifers had reached puberty than average or low SC EPD line heifers. If heifers are to calve by two years of age, they must conceive by 15 months of age. Fertility of first estrus in beef heifers is lower than third estrus (Byerley et al., 1987). It follows that heifers sired by bulls with high SC EPD would have more opportunities to conceive in time to calve by two years of age. If producers breed heifers earlier than mature cows, it is especially important that heifers reach puberty by 13 months of age. By the 15-month measurement, more average SC

EPD line heifers had reached puberty than low SC EPD line heifers. The high SC EPD line heifers also had a lower age at puberty than either average (18 days) or low (25 days) SC EPD line heifers. The fact that a significant difference in age at puberty was found between SC EPD groups is encouraging, since the EPD used to group sires were based only on the individual performance and pedigree information of the sires. If proven sires with high-accuracy SC EPD had been used in the study, even more difference in the groups might have been found.

Table 5. Least-Squares Means and Standard Errors for Growth Traits of Progeny by SC EPD Group

	SC EPD Line		
	High	Average	Low
Number of progeny	108	179	120
Birth weight, lb.	83 ± 2.7	83 ± 2.6	79 ± 2.7
Adjusted weaning weight, lb.	468 ± 8.5	465 ± 6.7	452 ± 7.6
Weaning height, in.	45.3 ± .43	45.1 ± .41	45.0 ± .42
Weaning backfat, in.	.11 ± .01	.11 ± .01	.11 ± .01
Weaning ribeye area, in.^{2}	5.9 ± .27^{ab}	6.1 ± .26^{a}	5.7 ± .27^{b}
Adjusted yearling weight, lb.	697 ± 11.7	698 ± 10.5	700 ± 11.1
Yearling height, in.	48.2 ± .59	48.3 ± .59	48.4 ± .59
Yearling backfat, in.	.10 ± .02	.11 ± .02	.11 ± .02
Yearling ribeye area, in.^{2}	8.1 ± .55	8.4 ± .57	8.1 ± .56

^{ab} Superscripted means within a row lacking a common superscript differ (P < .05).

Table 6. Least-Squares Means and Standard Errors for Reproductive Traits of Progeny by SC EPD Group

	SC EPD Line		
	High	Average	Low
Weaning scrotal circumference, cm	21.2 ± 1.0	20.5 ± .9	19.9 ± .9
Weaning testicular weight, g	196 ± 17.8^{a}	191 ± 17.7^{a}	151 ± 19.1^{b}
Percentage cycling at 11-mo. msmt.	23 ± 5^{c}	8 ± 4^{d}	8 ± 5^{d}
Percentage cycling at 13-mo. msmt.	44 ± 6^{e}	25 ± 5^{f}	16 ± 6^{f}
Percentage cycling at 15-mo. msmt.	88 ± 5	94 ± 4	84 ± 5
Age at puberty, d	414.3 ± 5.2^{g}	432.0 ± 4.3^{h}	439.3 ± 5.1^{h}
Pregnancy percentage	87 ± 6	90 ± 5	89 ± 6
Yearling pelvic area, cm^2, (heifers)	161 ± 1.8	163 ± 1.5	159 ± 1.7

^{abcdefgh} Superscripted means within a row lacking a common superscript differ (P < .05).

Importance of Age at Puberty

Age at puberty has economic importance for both bulls and heifers. Animals reaching puberty at an earlier age can produce offspring earlier, reducing the length of the period when they must be maintained, but are not economically productive. Most heifers reach puberty and conceive at an adequately early age, if nutrition and management is sufficient for them to do so. By selecting for earlier age at puberty, it may be possible to reduce inputs (and thus, costs) while still maintaining a high conception rate and an early calving date (Martin et al., 1992). In addition, several indicators of lifetime fertility and productivity have been shown to be favorably correlated to age at puberty. Werre and Brinks (1986) reported that heifers from lines of Hereford cattle with earlier puberty tended to conceive earlier each year through four breeding seasons, except for the third season. Morris and Cullen (1994) found favorable relationships between age at puberty and both yearling and lifetime pregnancy rate. Both SC and age at puberty are favorably correlated with both weaning and yearling weight (Bourdon and Brinks, 1982).

Conclusions

Sire selection using SC EPD has been shown to be more effective in reducing age at puberty of daughters than was selection on phenotypic SC. In this study, significant differences were found between SC EPD groups for daughter age at puberty, but not between phenotypic groups. Beef breed associations that include scrotal circumference data in their national cattle evaluation programs provide producers with useful information to improve female reproductive traits in their herds. Until more sophisticated tools such as heifer fertility EPD are available, SC EPD is the best indication of a sire's genetics for inherent fertility. Commercial producers should combine selection of high SC EPD sires with well-designed crossbreeding systems to reduce age of puberty of heifers.

References

Ball, L., R. S. Ott, R. G. Mortimer, and J. C. Simons. 1983. Manual for breeding soundness examination of bulls. J. of the Soc. for Theriogenology. 12:1.

Bourdon, R. M. and J. S. Brinks. 1982. Genetic, environmental and phenotypic relationships among gestation length, birth weight, growth traits and age at first calving in beef cattle. J. Anim. Sci. 55:543.

Brinks, J. S., M. J. McInerney, and P. J. Chenoweth. 1978. Relationship of age at puberty in heifers to reproductive traits in young bulls. Proc. West. Sec. Am. Soc. Anim. Sci. 29:28.

Byerley, D. J., R. B. Staigmiller, J. G. Berardinelli, and R. E. Short. 1987. Pregnancy rates of beef heifers bred either on puberal or third estrus. J. Anim. Sci. 62:958.

Land, R. B. 1973. The expression of female sex-limited characteristics in the male. Nature 241:208.

Martin, L. C., J. S. Brinks, R. M. Bourdon, and L. V. Cundiff. 1992. Genetic effects on beef heifer puberty and subsequent reproduction. J. Anim. Sci. 70:4006.

Morris, C. A., R. L. Baker, and N. G. Cullen. 1992. Genetic correlations between pubertal traits in bulls and heifers. Livest. Prod. Sci. 31:221.

Morris, C. A. and N. G. Cullen. 1994. A note on genetic correlations between pubertal traits of males or females and lifetime pregnancy rate in beef cattle. Livest. Prod. Sci. 39:291.

Moser, D. W., J. K. Bertrand, L. L. Benyshek, M. A. McCann, and T. E. Kiser. 1996. Effects of selection for scrotal circumference in Limousin bulls on reproductive and growth traits of progeny. J. Anim. Sci. 74:(in press).

Smith, B. A., J. S. Brinks, and G. V. Richardson. 1989. Relationships of sire scrotal circumference to offspring reproduction and growth. J. Anim. Sci. 67:2881.

Toelle, V. D. and O. W. Robison. 1985. Estimates of genetic correlations between testicular measurements and female reproductive traits in cattle. J. Anim. Sci. 60:89.

Werre, J. F. and J. S. Brinks. 1986. Relationships of age at puberty with growth and subsequent productivity in beef heifers. Proc. West. Sect. Am. Soc. Anim. Sci. 37:300.

Targets for Beef Cattle Improvement: Selection for Meat Quality

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Introduction

Beef cattle genetic improvement programs have traditionally focused primarily on live animal growth traits, however, as consumers have become more concerned with diet-health issues, emphasis on body composition traits has been increasingly important in the design of breeding programs (Marshall, 1994). Additionally, as the beef industry continues toward a value-based marketing system, the importance of acceptability of beef products will increase the emphasis that should be placed on end product characteristics. It has been suggested that a "window of acceptability" of beef be identified which would clarify an optimum range rather than a specific target for characteristics of beef products. Of the many traits associated with beef acceptability, more research is needed to clearly identify those which have sufficient impact on such a range. The industry must consider how these traits might be optimized without negative impact on growth and reproductive efficiency. Currently, USDA yield and quality grades are the only measures used to evaluate carcass composition in the U.S. beef industry, and are therefore the only traits associated with the beef product that might influence profitability.

To date, results of studies have not been reported where cattle were selected on the basis of carcass composition. Numerous studies have reported heritabilities and genetic and phenotypic covariances among carcass traits. There is a lack, however, of carcass information in the beef industry which can be traced to genetic origin. The lack of information available to producers has been cited as one of the primary reasons for the current lack of conformity in fresh beef (NCA, 1992).

Morgan et al. (1991) indicated that the single most important consumer component of beef palatability was tenderness. Further, the National Beef Quality Audit (NCA, 1992) attributed a lost profit potential of approximately $25 per head to defects associated with marbling and palatability, or carcass quality. Consumers now prefer leaner beef, but also beef that has superior palatability. However, tenderness is not as yet directly measured in beef carcasses to determine quality grade. Presently, young beef carcasses (9 to 30 mo of age) which typically receive the A (young) maturity score vary in USDA quality grade due primarily to marbling score. Although the direct relationship between marbling and tenderness is low, increased marbling decreases the probability the beef will be perceived by the consumer to be dry, flavorless and tough. It is evident that marbling and tenderness significantly impact consumer perception of beef and improvement programs designed to optimize these traits should utilize both genetic and management information.

Review of Literature

Crossbreeding has become the predominant system of mating in the United States beef industry. By providing for the use of additive (complimentarity) and non-additive (heterosis) variation among breeds, the use of crossbreeding along with accurate selection procedures can increase the efficiency of beef production. Traits that are economically important can be significantly improved though crossbreeding among cattle that are dissimilar in genetic history as a result of complimentarity and heterosis (Cundiff, 1970). Similarly, Gregory et al. (1995) concluded that because genetic variances were similar for composite breeds and their contributing purebreds for growth, carcass and meat traits, selection response would be expected to be similar within populations of each. Parameters such as heritability, genetic correlation and heterosis are measures of the genetic components of traits under selection. The scientific literature has been a significant source of information regarding the estimation of genetic parameters.

Numerous studies have reported heritability estimates for marbling score in beef cattle (Table 1). Marshall (1994), in his review, reported an average heritability of $h^2 = .35$ for marbling score based on nine studies involving both crossbred and straightbred cattle. These studies indicate that marbling score is moderately to highly heritable, or that at least a moderately large proportion of variability in marbling score is due to additive genetic effects. Moderate to high heritabilities are indicative of traits that respond to selection.

Table 1. Heritability estimates and standard errors for USDA marbling score.

	SE	Reference
.33	.15	Lamb et al., 1990
.26	.04	Wilson et al., 1993
.47	.04	Benyshek, 1981
.23	.08	Woodward et al., 1992
.45	.08	Van Vleck et al., 1992
.35		Marshall, 1994

Genetic (co)variances are estimated among traits of interest to establish genetic relationships among the traits. Genetic analyses often report heritability estimates as well as genetic correlations. In his review, Marshall (1994) noted that positive genetic and phenotypic correlations have been found for preweaning growth and marbling score (r_g = .39) indicating a favorable relationship between selection for increased weaning weight and increased marbling. He further reported that estimates of the genetic correlation between marbling score and postweaning growth were variable ($-.62 < r_g < .48$), but averaged near zero (r_g = .05). The genetic correlations among marbling and other selected carcass traits are presented in Table 2. The genetic correlation between marbling score and carcass weight has been reported to be positive (Koch et al., 1982; Lamb et al., 1990; Veseth et al., 1993). These results may suggest that the increase in carcass fatness associated with increased carcass weight is also related to the deposition of intramuscular fat. The genetic correlation between marbling score and ribeye area has been reported by Lamb et al. (1990) and Veseth et al. (1993) to be significantly positive (r_g = .57 and .51, respectively) but significantly negative by other researchers (Koch et al., 1982; Van Vleck et al., 1992). Finally, Koch (1978), Koch et al. (1982) and Lamb et al. (1990) reported that the

Table 2. Genetic correlations reported between USDA marbling score and other selected carcass traits[a].

r_g	Carcass weight	Fat thickness	Ribeye area
Marbling score	.25 (1)	.73 (3)	-.14 (1)
	.64 (2)	.16 (1)	.57 (2)
		.73 (2)	-.40 (4)
			.51 (5)

a Source: (1) Koch et al. (1982), (2) Lamb et al. (1990), (3) Koch (1978), (4) Van Vleck et al. (1992), (5) Veseth et al. (1993), (6) Gregory et al. (1995).

genetic correlation between marbling score and subcutaneous fat thickness was significantly positive (.15 $< r_g <$ .75) suggesting that at age- or time-on-feed-constant end points, the deposition of subcutaneous and intramuscular fat are strongly related.

Tenderness is typically measured objectively by Warner-Bratzler shear force (WBS) and also by means of trained sensory panels. Because these procedures are time consuming and laborious, tenderness is rarely evaluated except in research studies designed to collect such data. Studies reporting heritability estimates for Warner-Bratzler shear force and sensory panel tenderness scores are listed in Table 3. Marshall (1994), in his review, reported an average heritability estimate of h^2 = .37 for WBS based on three studies, however the range of the estimates was very large (.09 to .71). Gregory et al. (1995) estimated an average heritability of .22 for WBS, but found that the estimate was higher among composite breeds than purebreds (.31 vs. .12). Two studies indicate that the heritability of sensory panel tenderness is low to moderate and positive (Van Vleck et al., 1992; Gregory et al., 1995). Although further studies of the genetic components of tenderness are needed, the literature to date does suggest that WBS is at least moderately heritable.

Table 3. Heritability estimates and standard errors for Warner-Bratzler shear force and sensory panel tenderness score.

Trait	h^2	SE	Reference
Warner-Bratzler shear force, kg	.31	.05	Koch et al., 1982
	.53	.15	Shackelford et al., 1994
	.09	.08	Van Vleck et al., 1992
	.12	.08	Gregory et al., 1995
Sensory panel tenderness	.10	.05	Van Vleck et al., 1992
	.22	.08	Gregory et al., 1995

Table 4. Genetic correlations reported between Warner-Bratzler shear force and other selected carcass traits.

r_g	Marbling score	Fat thickness	Ribeye area
Warner-Bratzler shear force, kg	-.25 (1)[a]	.26 (1)	-.28 (1)
	-.53 (4)	-.23 (6)	-.14 (4)
	-1.00 (6)		-.48 (6)

a Source: see Table 2.

Marshall (1994) stated that genetic correlations of shear force with other carcass traits were either favorable or close to zero, suggesting that selection for improved shear force, assuming that it was practical, would be compatible with selection for improvement in most other carcass traits. Genetic correlations among WBS and other carcass traits of interest are given in Table 4. Fat thickness and WBS were reported by Koch et al. (1982) to be positively correlated (r_g = .26) but negatively correlated (r_g = -.23) by Gregory et al. (1995). The association between tenderness and fatness has been a subject of controversy in the literature, and the results reviewed here may suggest that this relationship needs further investigation. Tenderness, measured by WBS, has been reported to be weakly to moderately negatively correlated with ribeye area (Koch et al., 1982; Van Vleck et al., 1992; Gregory et al., 1995). However, Gregory et al. (1995) estimated the genetic correlation between sensory panel tenderness and ribeye area to be strongly positive (r_g = .56). Van Vleck et al. (1992) estimated this correlation to be negative and near zero (r_g = -.04). Several researchers have reported strongly negative genetic correlations between WBS and marbling score ($-1.00 < r_g < -.25$), indicating the increased marbling was associated with increased tenderness (Koch et al., 1982; Van Vleck et al., 1992; Gregory et al., 1995). Additionally, sensory panel tenderness and marbling score were positively correlated (Van Vleck et al., 1992; Gregory et al., 1995), further suggesting that tenderness and marbling are positively related. However, the phenotypic correlation between marbling and measures of tenderness in the literature have been less strong (Marshall, 1994) indicating that although selection may be jointly favorable for increased tenderness and increased marbling score, the association may be less detectable to the consumer.

Favorable relationships apparently exist among carcass traits, however, genetic antagonisms must be established between carcass traits and measures of growth and reproduction, which are important economic variables in the beef cycle. Marshall (1994) stated that there exists little experimental evidence on genetic relationships among carcass traits and reproductive performance in female relatives. MacNeil et al. (1984) predicted that selection for reduced fat trim at a constant age end point in steers would be associated with increased mature weight, increased age and weight at puberty and reduced fertility in female relatives. Also in his review, Marshall (1994) found that positive genetic and phenotypic have been reported among carcass weight, ribeye area and retail product yield and measures of pre- and post-weaning growth. He concluded that, in general, selection for increased growth rate would result in a larger carcass at a given age, increasing the weight of both muscle and fat, although the increase in fat percentage may be minimal. Positive genetic associations have also been found to exist between marbling score and preweaning growth rate (Koch et al., 1982; Lamb et al., 1990) and between marbling score and postweaning growth (Koch et al., 1982; Lamb et al., 1990). Warner-Bratzler shear force has generally been reported to have near zero genetic correlations with pre- and post-weaning growth.

Recently, the activity of the calpain-proteolytic enzyme inhibitor, calpastatin, has been implicated in the aged-tenderness system of postmortem beef. Increased levels of calpastatin activity has been associated by several researchers with decreased tenderness, and it has been suggested that its inhibition of myofibrillar proteolysis during beef aging may partially explain breed differences in tenderness. Particularly, the higher WBS and lower sensory panel tenderness means reported for heavy (> 50 %) *Bos indicus* cattle have been related to increased calpastatin levels. Shackelford et al. (1994) reported that postrigor calpastatin activity was 65 % heritable. Additionally, they found that calpastatin activity was favorably associated with growth rate, marbling and WBS, and concluded that it should be possible to select for improvements in calpastatin activity, marbling score and tenderness. The measurement of calpastatin activity, however, is time intensive and costly. Therefore it may not presently be applicable in most industry situations.

In planning designed selection programs, response to selection can be predicted as a function of heritability and selection differential (Falconer, 1981). Genetic progress expected in a trait under selection is also dependent on generation interval, where populations with longer generation interval respond more slowly to selection than those with short generation interval. When the number of traits under selection increases, the progress made with regard to any one trait is further slowed. It is therefore necessary to identify a relatively small number of traits to include in selection programs, all of which should be sufficiently heritable to respond. With regard to carcass traits, this process is made more difficult by the fact that measurement of carcass merit is difficult in potential parents, and usually involves a

Literature Cited

Benyshek, L.L. 1981. Heritabilities for growth and carcass traits estimated from data on Herefords under commercial conditions. J. Anim. Sci. 53:49.

Cundiff, L.V. 1970. Experimental results on crossbreeding beef cattle for beef production. J. Anim. Sci. 30:694.

Falconer, D.S. 1981. Introduction to Quantitative Genetics, 3rd ed. John Wiley and Sons, Inc., New York.

Gregory, K.E., L.V. Cundiff and R.M. Koch. 1995. Genetic and phenotypic (co)variances for growth and carcass traits of purebred and composite populations of beef cattle. J. Anim. Sci. 73:1920.

Koch, R.M. 1978. Selection in beef cattle III. Correlated response of carcass traits to selection for weaning weight, yearling weight and muscling score in cattle. J. Anim. Sci. 47:142.

Koch, R.M., L.V. Cundiff and K.E. Gregory. 1982. Heritabilities and genetic, environmental and phenotypic correlations of carcass traits in a population of diverse biological types and their implications in selection programs. J. Anim. Sci. 55:1319.

Lamb, M.A., O.W. Robison and M.W. Tess. 1990. Genetic parameters for carcass traits in Hereford bulls. J. Anim. Sci. 68:64.

MacNeil, M.D., L.V. Cundiff, C.A. Dinkel and R.M. Koch. 1984. Genetic correlations among sex-limited traits in beef cattle. J. Anim. Sci. 58:1171.

Marshall, D.M. 1994. Breed differences and genetic parameters for body composition traits in beef cattle. J. Anim. Sci. 72:2745.

Morgan, J.B., J.W. Savell, D.S. Hale, R.K. Miller, D.B. Griffin, H.R. Cross and S.D. Shackelford. 1991. National beef tenderness survey. J. Anim. Sci. 69:3274.

National Cattlemen's Association (NCA). 1992. Executive Summary, National Beef Quality Audit. National Cattlemen's Association, Englewood, CO.

Shackelford, S.D., M. Koohmaraie, L.V. Cundiff, K.E. Gregory, G.A. Rohrer and J.W. Savell. 1994. Heritabilities and phenotypic and genetic correlations for bovine postrigor calpastatin activity, intramuscular fat content, Warner-Bratzler shear force, retail product yield and growth rate. J. Anim. Sci. 72:857.

costly and time consuming progeny test. An alternative option would be to select parents based on molecular genetic evaluation of carcass merit, however, few if any such protocols have been developed. In the future, it is possible that sufficient advances in molecular biology will allow for the inclusion of such information in the design of selection programs. Until that time, traditional selection methodology may be the only reliable approach to improving carcass quality.

Conclusions and Implications to Genetic Improvement of Beef Cattle

The National Beef Quality Audit (NCA, 1992) clearly indicates that a large amount of potential profit is lost during the beef production cycle, due in part either to mismanagement of acceptable genetics or to genetic nonconformity. Nearly one-third of the cattle graded U.S. Choice in the audit were yield grade two or better, indicating that the genetic resources to produce lean, palatable beef that target a "window of consumer acceptability" are available. The Quality Audit further indicates that an excessive number of cattle are currently being produced which are unlikely to fall within this "window" under industry standards. If selection for superior carcass quality is to be successful, or practical, economic signals must be sent back through the production cycle to the genetic source. Further research is needed to clearly establish the genetic control of carcass quality, and its association with other economically important traits. The most significant opportunities to improve the consistency and acceptability of beef can be related to genetic management. Additionally, with the development of methods (such as molecular genetic information) to select genetically superior parents, the improvement in carcass quality should become a potentially more rapid process. Since it has been established that similar amounts of genetic variability exist within breeds and among breeds with regard to most economically important traits, selection programs designed to improve carcass quality should consider a product-related target rather than a breed-type target. The initial steps to be taken in improving the uniformity and acceptability of beef will involve identification of cattle which consistently produce acceptable beef, and perhaps more importantly, those which do not produce acceptable beef under industry standards.

Van Vleck, L.D., A.F. Hakim, L.V. Cundiff, R.M. Koch, J.D. Crouse and K.G. Boldman. 1992. Estimated breeding values for meat characteristics of crossbred cattle with an animal model. J. Anim. Sci. 70:363.

Veseth, D.A., W.L. Reynolds, J.J. Urick, T.C. Nelson, R.E. Short and D.D. Kress. 1993. Paternal half-sib heritabilities and genetic, environmental, and phenotypic correlation estimates from randomly selected Hereford cattle. J. Anim. Sci. 71:1730.

Woodward, B.W., E.J. Pollak and R.L. Quaas. 1992. Parameter estimation for carcass traits including growth information of Simmental beef cattle using restricted maximum likelihood with a multiple-trait model. J. Anim. Sci. 70:1098.

STOCHASTIC COMPUTER MODELS OF FERTILITY IN BEEF CATTLE.

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INTRODUCTION

Selection decisions should be based on sound breeding objectives. There are as many breeding objectives to consider as there are ranches that rely on the outcomes of selection decisions. However, the most common goal is to maximize profit, because almost anything can be stated in terms of dollars. Assuming that profit is the primary concern to anyone making selection decisions, it becomes important to understand the relationships of certain heritable traits to economic outcomes. Melton (1994) reported that, for a commercial cow-calf firm, selection emphasis for reproduction was twice as important as selection for production traits when measuring relative economic value. In absolute terms, weaning rate was valued at $392.63 per percentage increase and weaning weight was valued at $1.35 per kilogram increase. Based on these and similar results, it has been recommended that producers should emphasize selection for increased fertility (Moser, 1995). However, selection efforts that aim to increase only reproductive rates are not likely to be profit maximizing because intermediate optima may be the best (Bourdon and Brinks, 1987b). Determining optimum levels of reproduction is likely to be complicated if optimization models are built from traditional profit functions. A tool that may help in understanding the relationships of fertility traits with other variables of importance is computer simulation. Models of cow reproduction may be able to help producers and scientists decide which traits should be included in selection programs. The purpose of this essay is to review simulation models that can contribute to the understanding of fertility as it affects profit.

REVIEW OF LITERATURE

The trait most indicative of reproduction is weaning rate. However, this trait is difficult, if not impossible, to evaluate in the United States. Data centers only record weaning successes. One hundred percent of matings reported are successful. Therefore, industry has turned to indicator traits. Traits such as age at puberty (Gregory et al., 1991), conception rate (Johnson and Notter, 1987), and stayability (Snelling and Golden, 1994) have been used as means to predict cow or herd fertility.

Most stochastic simulation is based on the prediction equation (e.g., Jeon et al., 1990):

$$y_{ij} = \mu_i + g_{ij} + e_{ij},$$

where y_{ij} is the simulated phenotype for the i^{th} trait of the j^{th} animal; μ_i is the mean of the i^{th} trait; g_{ij} is the additive genetic effect of the i^{th} trait for the j^{th} animal; and e_{ij} is the residual effect for the i^{th} trait of the j^{th} animal. The additive genetic and residual effects are usually generated with a mean of zero and an estimated or assumed standard deviation from a specific probability density function. The residual effect can be expanded for repeated records traits or traits which involve maternal effects. The model can be modified to include breed effects and/or non-additive random genetic effects as well as other fixed effects.

Conception.

Fertility traits have been traditionally viewed as lowly heritable. However, one study reported an increase in pregnancies in a *Bos indicus* herd in which the males and females were ranked and selected based on their estimated breeding values for conception rate (Hetzel et al., 1989; Mackinnon et al., 1990). Conception can be modeled in individual cows as a threshold character (Russell, 1985). A standard normal distribution is simulated on which a point (threshold) is superimposed. A cow expresses pregnancy depending on which side of the threshold her underlying value lies. In this way, conception can be stochastically modeled to take advantage of the properties of the normal distribution. Mean conception rate must be estimated or assumed because the threshold point is defined by the proportion of cows that are expected to conceive. A herd conception rate can be calculated from the number of cows that conceive. Parameters of the underlying distribution must be known or estimated.

More detailed studies have reported the use of a variable representing a single service conception. These models assume that cows are given multiple chances to conceive as would be expected in breeding seasons that are longer than one estrous cycle. The mean single service conception rate must be known and it has been modeled as a constant throughout the breeding season (Johnson and Notter, 1987) or as a function of estrous cycle number from the beginning of the breeding season (Azzam et al., 1990). Davis et al. (1994) simulated conception rate by generating uniform random variables within different probability distributions depending on dam breed. This type of simulation characterized breed differences rather than individual genetic merit.

A disadvantage of the stochastic method is that variation on the underlying scale can not be measured directly. The known parameters are typically estimated from the proportional data and apply to the binomial distribution. Accurate conversion of binomial heritabilities to normal heritabilities depends on the location of the threshold point (e.g., Van Vleck, 1972). Adequate estimates may be obtained when the threshold point does not lie in the extreme tails of the normal distribution. Heritability of conception rate was reported separately for heifers and mature cows in beef cattle (Koots et al., 1994). The average of 19 estimates of heritability for conception rate in cows was .28 and the average of seven estimates in heifers was 0.05. Both averages were reported for the underlying normal scale.

Because the heritability of conception rate in heifers is reported to be much lower that that in cows, the ability of a heifer to get pregnant may be affected more by age at puberty or certain managerial factors.

Age at Puberty.

A model of fertility can not rely on conception rate alone. Because of management constraints (e.g., limited breeding seasons, early breeding of heifers), females must be cycling at certain times of the year to conceive. For heifers, age at puberty is the most relevant trait in determining when fertility will begin. In a review of fertility traits, Moser (1995) reported that the age at which a heifer is first able to conceive shows considerable variation between and within breeds of beef cattle. An average heritability estimate of .40 suggests that the response to selection for this trait could be favorable. Increases in age at puberty have been shown, through simulation, to affect adversely the efficiency of production (Bourdon and Brinks, 1987b). These authors stochastically simulated age at puberty in individual animals. The mean of the trait was altered between groups to model differences in age at puberty as opposed to selecting the groups divergently. A similar study stochastically modeled age at first estrus in the breeding season

(Azzam and Nielsen, 1990). All females were assumed to have reached puberty by the beginning of the breeding season.

Gestation Length.

Another factor of fertility is the length of the gestation period. One hypothesis is that shorter gestations will lead to decreased birth weights (thus decreased dystocia) and more time for postpartum uterine involution (Azzam and Nielsen, 1987). Johnson and Notter (1987) modeled gestation length to be constant at 279 days. However, gestation length has been modeled as a variable with a mean of 280.7 to 284.4 days (depending on age of dam) with a standard deviation of 6 days (Azzam et al., 1990). Burfening et al. (1981) reported an estimated heritability of .25 for gestation length and a genetic correlation with birth weight of .32 in Simmental cattle. A slightly higher estimate of heritability of .37 for gestation length, also in Simmental cattle, was reported by Wray et al. (1987).

Postpartum Interval.

Postpartum interval is a necessary component of the fertility model because, in conjunction with date of prior conception and gestation length, that interval determines when a female is eligible for subsequent conception. Johnson and Notter (1987) modeled the genetic and permanent environmental components as normally distributed with a mean of 70 days and a phenotypic standard deviation of 20 days. Because postpartum interval has a minimum (0 in the extreme), the temporary environmental component was modeled following a Pearson III gamma distribution. The resulting phenotypes were skewed heavily to the right, with most observations occurring between 20 and 100 days. Azzam et al. (1990) argued that a normally distributed phenotype was sufficient for their model with a mean of 65 days and phenotypic standard deviation of 18 days. The assumption was considered adequate because most females were ready to breed before the start of the breeding season. Postpartum interval was adjusted for individuals that experienced dystocia or had calved for the first time. Postpartum interval, however, was described more accurately for field data using three different linear hazard rate distributions (Azzam et al., 1991). Data were not simulated from these distributions.

Genetic responses to single trait selection for any of the fertility traits can be predicted with some accuracy, especially if all other components are ignored. However, the effect of fertility on a breeding objective is a function of all the fertility components. Equations to predict responses to selection are difficult to derive if they must be stated in terms of a breeding or profit objective. As a simple example, the kilograms of calf weaned (KCW), can be predicted in terms of conception rate (CR), number of cows exposed at breeding (NC), proportion of calf death loss which is a function of calving ease (FCE), and average weaning weight $\left(\overline{WW}\right)$;

$$KCW = NC(CR)[1 - FCE]\left(\overline{WW}\right).$$

This function is clearly non-linear and is further complicated by the relationship between CR and calving ease. Increases in FCE may have adverse effects on CR. Yet the description is too simple because it does not account for the dynamics of herd structure (e.g., pregnant cows that get culled before parturition or random death loss) and it does not relate KCW to profit. Detailed computer models, such as those discussed, are necessary to help better understand the relationships between profit and fertility.

LITERATURE CITED

Azzam, S.M., J.E. Kinder, and M.K. Nielsen. 1990. Modeling reproductive management systems for beef cattle. Agric. Systems. 34:103.

Azzam, S.M., and M.K. Nielsen. 1987. Expected responses to index selection for direct and maternal additive effects of gestation length or birth date in beef cattle. J. Anim. Sci. 64:357.

Azzam S.M., L.A. Werth, J.E. Kinder, and M.K. Nielsen. 1991. Distribution of time to first postpartum estrus in beef cattle. J Anim. Sci. 69:2563.

Bourdon, R.M., and J.S. Brinks. 1987a. Simulated efficiency of range beef production. I. Growth and milk production. J. Anim. Sci. 65:943.

Bourdon, R.M., and J.S. Brinks. 1987b. Simulated efficiency of range beef production. II. Fertility traits. J. Anim. Sci. 65:956.

Burfening, P.J., D.D. Kress, and R.L. Friedrich. 1981. Calving ease and growth rate of Simmental sired calves. III. Direct and maternal effects. J. Anim. Sci. 53:1210.

Calving Ease.

Selection efforts that increase growth rate and/or body weight at a given age, usually increase the incidence of dystocia which leads to increased death loss of calves and decreased fertility in cows. Two causes of dystocia that have been identified are calf birth weight (Laster et al., 1973) and cow pelvic area (Deutscher, 1978). Through computer simulation, Cook et al. (1993) concluded that selection of replacement heifers based on pelvic area did not decrease the incidence of dystocia as much as selection of sires with low expected progeny differences for birth weight. Breeding values were simulated stochastically. Dystocia was modeled both as a frequency variable (0 or 1) and as a continuous variable (score). The two measures were considered alternate methods of measuring dystocia. Both variables were functions of the ratio of dam pelvic area at calving to calf birth weight based on equations of Short et al.(1979). The equations were derived by treating the two measures of dystocia as different dependent variables in a multiple linear regression model. Small R^2 values were reported. Logistic regression analyses of incidence of dystocia on birth weight and pelvic area may increase fit of the model.

Azzam et al. (1990) modeled dystocia as a Bernoulli distributed trait with a probability of .05. This model did not consider correlations between birth weight and dystocia. However, cows that did experience dystocia had 14 days added to their postpartum interval. Bourdon and Brinks (1987a) calculated the proportion of cows experiencing dystocia by linear regression for three different age groups. For a cow that was three years old or older, which encompassed two age groups, dystocia was a function of birth weight. For a first calf heifer, dystocia was a function of birth weight and the weight of the heifer. This model did not simulate a genetic effect for calving ease or dystocia.

A genetic effect can be simulated for calving ease score which may facilitate research on the inheritance of this trait. One study reported the estimated heritabilities for calving ease score (1 to 5) to be .05 for the direct effect and .20 for the maternal effect (Burfening et al., 1981). The same authors reported genetic correlations with gestation length and birth weight of .58 and .43 respectively. Cue and Hayes (1985) suggested that calving ease parameters should be estimated for cows and heifers separately.

Cook, B.R., M.W. Tess, and D.D. Kress. 1993. Effects of selection strategies using heifer pelvic area and sire birth weight expected progeny difference on dystocia in first calf heifers. J. Anim. Sci. 71:602.

Cue, R.I., and J.F. Hayes. 1985. Correlations between calving ease and calf survival. J. Dairy Sci. 68:958.

Davis, K.C. , M.W. Tess, D.D. Kress, D.E. Doornbos, and D.C. Anderson. 1994. Life cycle evaluation of five biological types of beef cattle in a cow-calf range production system: I. Model development. J. Anim. Sci. 72:2585.

Deutscher, G.H. 1978. Factors influencing dystocia and pelvic are in beef heifers. J. Anim. Sci. 47(Suppl. 1):8 (Abstr).

Gregory, K.E., D.D. Lunstra, L.V. Cundiff, and R.M. Koch. 1991. Breed effects and heterosis in advanced generations of composite populations for puberty and scrotal traits of beef cattle. J. Anim. Sci. 69:2795.

Hetzel, D.J.S., M.J. Mackinnon, R. Dixon, and K.W. Entwistle. 1989. Fertility in a tropical beef herd divergently selected for pregnancy rate. Anim. Prod. 49:73.

Jeon, G.J., I.L. Mao, J. Jensen and T.A. Ferris. 1990. Stochastic modeling of multiple ovulation and embryo transfer breeding schemes in small closed dairy cattle populations. J. Dairy. Sci. 73:1938.

Johnson, N.H., and D.R. Notter. 1987. Simulation of genetic control of reproduction in beef cows. I. Simulation model. J. Anim. Sci. 65:68.

Koots, K.R., J.P. Gibson, C. Smith, and J.W. Wilton. 1994. Analysis of published genetic parameter estimates for beef production traits. 1. Heritability. Anim. Breed. Abstr. 62:309.

Laster, D.B., H.A. Glimp, L.V. Cundiff, and K.E. Gregory. 1973. Factors affecting dystocia and the effects of dystocia on subsequent reproduction in beef cattle. J. Anim. Sci. 36:695.

Mackinnon, M.J., D.J.S. Hetzel, N.J. Corbet, R.P. Bryan, and R. Dixon. 1990. Correlated responses to selection for cow fertility in a tropical beef herd. Anim. Prod. 50:417.

Melton , B.E. 1994. Relative genetic emphasis for profitable beef production. Technical Report of the National Cattlemen's Association. Englewood, CO.

Moser, D. 1995. Genetic evaluation of reproduction traits: Possibilities and problems. Proc. Beef Improvement Fed. 27th Res. Symp. Annu. Mtg. Sheridan, WY. p. 271.

Russell, W. 1985. Simulated selection for reproductive rate in beef cattle. J. Anim. Sci. 61:402.

Short, R.E., R.A. Bellows, R.B. Staigmiller, and J.B. Carr. 1979. Multiple linear and nonlinear regression analyses of factors causing calving difficulty. Theriogenology. 12:121.

Snelling, W.M. and B.L. Golden. 1994. Stayability as an indicator of reproduction in beef females. Proc. Beef Improvement Fed. 26th Res. Symp. Annu. Mtg. Des Moines, IA. p. 218.

Van Vleck, L.D. 1972. Estimation of heritability of threshold characters. J. Dairy Sci. 55:218.

Wray, N.R., R.L. Quaas, and E.J. Pollak. 1987. Analysis of gestation length in American Simmental cattle. J. Anim. Sci. 65:970.

MINUTES OF BEEF IMPROVEMENT FEDERATION BOARD OF DIRECTORS MEETING

Barclay Lodge
YMCA of the Rockies
Estes Park, Colorado
October 27 & 28, 1995

The Beef Improvement Federation Board of Directors held it's midyear Board meeting at the Barclay Lodge, YMCA of the Rockies in Estes Park, Colorado on October 27 & 28, 1995.

Board members present for the meeting were Glenn Brinkman, President; Ron Bolze, Executive Director; Willie Altenburg, Kent Anderson, Paul Bennett, Don Boggs, John Crouch, Larry Cundiff, Jed Dillard, Ronnie Green, Burke Healey, Roger Hunsley, John Hough, Doug Husfeld, Dan Kniffen, Lee Leachman, Mike Schutz, Ronnie Silcox, and Norman Vincel. Board members not in attendance were Gary Johnson, Craig Ludwig, Roy McPhee and Richard Willham.

Also attending the meeting were Bruce Cunningham, Lisa Kriese, Dave Maples, Curtiss Bailey and Doug Hixon.

President Brinkman called the meeting to order at approximately 7:25 p.m. on Friday, October 27, 1995 and the following items of business were transacted.

President Brinkman cleared the agenda. Additional items added to the agenda included Internet accessibility of the revised Guidelines, the National Cattlemen's Association (NCA)/Cattle Fax calving interval analysis and the simplified Standardized Performance Analysis (SPA) EZ form.

MINUTES OF THE PREVIOUS MEETING - Copies of the minutes from the previous Board meeting held May 31 - June 3, 1995 at the Holiday Inn, Sheridan, Wyoming, were distributed by Bolze. Hunsley moved to approve and wave reading of the minutes. Dillard seconded and the minutes were approved.

FINANCIAL REPORT - Bolze provided copies of the Statement of Assets, Liabilities and Fund Balance (cash basis), and copies of the Statement of Revenues and Expenses (cash basis) for the period of time including January 1, 1995 - October 27, 1995. No approval of the financial statement was necessary. Silcox questioned publication inventory. Bolze indicated that publication inventory included approximately 1000 Guidelines (6th edition), 800 BIF histories, 400-1994 proceedings, 400-1995 proceedings and minimal copies of previous years proceedings. Crouch questioned the size of proceedings in recent years with page count now exceeding 400 pages. Crouch moved and Vincel seconded to appoint a committee to develop a set of guidelines for proceedings authors. President Brinkman appointed the committee to committee to include Boggs, chairman; Crouch, Anderson and Hunsley.

1996 BIRMINGHAM CONVENTION REPORT - Healey, chairman of the 1996 Birmingham Convention Planning Committee, consisting of Kriese, Maples, Silcox, Dillard, Green, Schutz and Bolze, reported that the committee had met previously that day. Also in attendance were Brinkman and Kniffen. Kriese and Maples, Auburn Beef Extension Specialist and Alabama Beef Cattle Improvement Association Director, respectively, and co-hosts of the convention, distributed a tentative convention program and budget. The 1996 convention is scheduled for May 15 - 18, 1996, at the Birmingham Sheraton Civic Center Hotel. The convention will start with a Wednesday evening program entitled "The Information Highway - BIF's New Trail Drive". The Thursday and Friday general session themes will include "A Worldwide Genetic Revolution" and "An Industry in Revolution". The Board discussed the various topics and potential back-up speakers. Crouch moved and Leachman seconded convention program approval. Motion carried. Kriese and Maples indicated that the hosting institutions would assume all liability for potential 1996 convention losses and all potential profits. Therefore, BIF will not underwrite a 1996 potential convention loss of up to $5000. Convention standing committee meetings were scheduled. Genetic Prediction, Biotechnology and Integrated Genetic Systems would meet on Thursday. Friday committee meetings would include Live Animal and Carcass Evaluation, Reproduction and Central Test and Growth. Further discussion on the 1996 convention budget was tabled until after the 1995 convention financial report.

COMMITTEE FUNCTION - President Brinkman initiated a discussion concerning effective standing committee function at the conventions. Concern was expressed that, given BIF's recent growth in convention attendance, committee attendance has created an atmosphere less conducive to effective committee function. Crouch indicated that larger committee attendance can make it virtually impossible to vote on committee issues. Cundiff indicated that the Genetic Prediction Committee has utilized an executive committee consisting of primarily university personnel actively involved in National Cattle Evaluation (NCE) to vote on committee issues. Vincel indicated that a written explanation of committee objectives and function is needed. Healey expressed concern that some committee speakers present information too technically to laymen attendees. Cundiff expressed that technical presentations are necessary to report some research findings. Leachman suggested that specific times be designated for technical presentations within committee. Crouch indicated that cattle producers want simplicity and need technical information, however presented in laymen's terminology. Hunsley concurred by favoring practical and semi-technical information. Anderson suggested structured break out sessions for smaller group discussion as a more structured format. Boggs sited examples of where convention general session speakers had been brought back for further discussion during committee meetings. Committee chairmen were encouraged to give further thought to means by which committee attendees could assume a more active role.

GENETIC PREDICTION WORKSHOP (GPW) - Cundiff reported on the 5th Genetic Prediction Symposium and Workshop scheduled for December 8 and 9, 1995, at the KCI-

Embassy Suites. The central theme will be Genetic Improvement of Beef Cattle Body Composition. Cundiff indicated that speakers had been confirmed and preregistration numbers looked very promising. Cundiff credited Doyle Wilson, Richard Willham and Gene Rouse of Iowa State University for workshop coordination and implementation.

FRANK BAKER MEMORIAL SCHOLARSHIP FUND - Cundiff reported for the committee also including Willham, Silcox and Dixon Hubbard. Cundiff expressed disappointment in the number of applications the last two years. This may be due to a reduced number of animal breeding graduate students. He indicated that an expanded list of potential review paper topics may encourage greater participation. Cundiff moved to continue with previous plans and award two $500 scholarships to deserving applicants using a similar review process. Altenburg seconded and the motion carried. Green was added to the committee.

NORTH AMERICAN INTERNATIONAL LIVESTOCK EXPOSITION (NAILE) REPRESENTATIONS - Bolze solicited individuals to represent BIF and present BIF sponsored awards. Roger Hunsley and Kent Anderson agreed to represent BIF at the National Collegiate and National 4-H Livestock Judging Contest Awards breakfasts, respectively.

INTERNATIONAL INVOLVEMENT - Altenburg questioned how BIF could promote greater international involvement. Dillard suggested that especially given the 1996 convention location in Birmingham, Alabama, it would seem logical that Central and South American contacts could be made through current relationships that already exist between the Gulf Coast State Departments of Agriculture. Vincel suggested that the major artificial insemination (AI) firms already have established contacts with Central and South American producers and countries. Greater international involvement was viewed favorably, especially in light of impending International Cattle Evaluation efforts.

Crouch moved and Leachman seconded adjournment for the evening. Motion carried.

President Brinkman reconvened the midyear Board meeting at 8:15 a.m., October 28, 1995.

GUIDELINES REVISION REPORT - Curtiss Bailey, editor of the Guidelines revision process, outlined some of the final changes necessary in the current draft of the seventh edition of the Guidelines. Board members had previously received copies of the current draft with changes made to date. Bailey indicated that further revisions were still necessary for the acknowledgment, index and embryo transfer (ET) sections. Bruce Cunningham, chairman of the Reproduction Committee suggested the 6th edition ET information was still appropriate. Anderson discussed how the University of Georgia handled ET contemporary groups for NCE analysis. Silcox recommended that Keith Bertrand from the University of Georgia review the ET section for further revision. The Guidelines ET section was viewed as most appropriately fitting within the NCE section. Bailey requested any further Guidelines revision changes immediately to facilitate sending a final revised draft to individual Board members for final approval. Bailey suggested a higher quality printing objective similar to the 25 Year BIF History - Ideas Into Action. President Brinkman appointed a Guidelines Printing Committee consisting of Bailey, Hough, Kniffen and Bolze. The Committee was given the authority to locate a printer, and decide cost and number of copies printed. Bailey raised the question of Guidelines copyright issues. Healey and Boggs questioned if the Guidelines could be copyrighted without an intensive literature search. Schutz questioned if a copyright is necessary for an ISBN library reference number. Green indicated that no ISBN number is necessary for placement of the BIF Guidelines on a BIF homepage as part of Internet. Healey moved and Kniffen seconded not to copyright, but to allow reproduction for educational purposes.

Healey discussed discrepancies between the 6th edition and proposed revised frame score charts with specific attention to hip heights at given ages. Leachman moved and Altenburg seconded to use the 6th edition frame score chart in the 7th edition revision. Motion carried. Boggs questioned the use of the bull frame score chart for steers. Silcox agreed to make the necessary changes including 6th edition frame score chart, mature bull and female tables left in and removal of the former linear hip height adjustment equation (page 23 of 6th edition). Silcox requested that breed association representatives check the adjustment tables very closely for error. Bailey indicted that a final proof would be done by contributing authors prior to printing in time for distribution at the 1996 Birmingham convention. The Board expressed gratitude to Bailey for his diligence, adherence to schedule and for both past and future efforts resulting in publication of the 7th edition of Guidelines for Uniform Beef Improvement Programs.

INTERNET ACCESSIBILITY OF GUIDELINES - Kniffen suggested that the 7th edition of the Guidelines be available via Internet and that it could conceivably be part of "The Big Menu" from NCA. Cunningham reported that Oklahoma State University already had a homepage and that Dave Buchanan would be the likely contact person. It was suggested that Bruce Golden from Colorado State University develop a BIF homepage for demonstration as part of his 1996 BIF convention presentation. Crouch moved and Vincel seconded to approach Golden about potential for BIF homepage development. Motion carried. Green agreed to contact Golden.

1995 CONVENTION FINANCIAL REPORT - Doug Hixon, Wyoming Beef Extension Specialist and host for the 1995 BIF Convention held in Sheridan, Wyoming on May 31 - June 3, 1995, provided copies of the 1995 Convention financial report. Hixon reported that the Wyoming Beef Cattle Improvement Association had $9,931.15 left after paying all bills. The Wyoming Beef Cattle Improvement Association had agreed to evenly split profits in exchange for BIF underwriting a loss of up to $5,000. Hixon presented the Board with a check for $4,965.57. The Board expressed gratitude to Hixon and his associates who planned, coordinated and implemented the most highly attended BIF Convention to date. Hixon expressed his appreciation for the opportunity to have served BIF as Western Regional Secretary and applauded the Board's selection of Ronnie Green as his successor. Again, the Board expressed their gratitude to Hixon for his dedication and years of service in the advancement of BIF objectives.

At this point, President Brinkman reopened the 1996 Convention budget as presented by Kriese and Maples. Kniffen moved and Anderson seconded to approve the budget with $110 set as maximum registration and $50 for the tour. Motion carried. Hixon suggested labeling the tour as some type of seminar to facilitate reimbursement.

STANDARDIZED PERFORMANCE ANALYSIS (SPA) WORKSHOP - Hough reported on the SPA Workshop planned for December 7, 1995, at the KCI-Embassy Suites just prior to the GPW. He indicated that all the major national level beef breed associations had been contacted by invitation. To date, 10 breed associations were preregistered to attend. Hough indicated that a goal of the workshop was to develop uniform breed association reporting formats and standards to allow national level breed association performance programs to generate SPA reports for membership use.

1997 BIF CONVENTION DATES - Bolze presented potential 1997 convention dates in Dickinson, North Dakota as suggested by Kris Ringwall and the North Dakota Beef Cattle Improvement Association. Hough moved and Leachman seconded to schedule the 1997 BIF Convention for May 14 -17, 1997 in Dickinson, N.D., subject to hosting institutions assurance of sufficient accommodations for 500-600 potential convention attendees.

CANADIAN BEEF IMPROVEMENT (CBI) - Mike Schutz presented a historical perspective of Canadian beef cattle improvement programs. In the past, Agriculture Canada provided a 16 breed evaluation. CBI is a genetic improvement company contracting EPD generation through the University of Guelph. CBI is supportive of international evaluations. CBI will provide ultrasound services through the University of Saskatchewan with hopeful development of a national carcass program via ultrasound reference sires. CBI has developed standards for data collection and reporting according to BIF Guidelines. CBI has totally revamped the former performance recording system from scanable form technology to on-farm electronic data entry and transfer. CBI expects to be self-sufficient by the year 2000. CBI partners include the Canadian Beef Breeds Council, Canadian Association of Animal Breeders, Canadian Cattlemen's Association, Beef Improvement Ontario, Canadian Meat Council and the Quebec Beef Cattle Industry. CBI would like to explore the possibility of hosting the 1998 BIF Convention in Calgary, Alberta, Canada.

STANDING COMMITTEE REPORTS

A. Genetic Prediction - Larry Cundiff, Chairman

Cundiff reported that the significant effort of the Genetic Prediction Committee was the Genetic Prediction Workshop as reported upon earlier. No Board action required.

B. Integrated Genetic Systems - John Hough, Chairman

Kniffen presented some preliminary data on a joint NCA/Cattle-Fax study involving factors that affect calving interval from the first through subsequent calvings. Data has been supplied by breed associations. Information presented focused on age at first calving, female YW and pure milk EPD, month of first calving and sex of calf and their effect on calving interval. Numerous potentially confounding variables were cited and it was suggested that possibly the data analysis should avoid first to second calf interval due to fixed breeding seasons of yearling heifers prior to the mature cow herd breeding season.

Kniffen also presented the most current version of the SPA-EZ production calculations and financial calculations with both income statement and cost basis balance sheets.

Hough indicated that future committee efforts would focus on multiple trait selection index development and cited David Johnston and Scott Newman from Australia as current thought leaders in this area. Leachman suggest that MARC researchers have data from various index selection schemes over time. Green suggest that McNeil and other Miles City researchers have a selection index research effort currently in progress. No Board action required.

C. Live Animal and Carcass Evaluation - John Crouch, Chairman

Crouch indicated that 1996 Convention efforts would focus on pertinent issues not covered and or raised during the GPW in December. Crouch reported that 37 people went through the Iowa State University ultrasound certification program in June, resulting in 24 participants receiving certification for external fat cover and ribeye area (not marbling). He indicated that the next ultrasound training session may likely be in early 1996 and that Tommy Perkins, SW Texas State University may host an alternative training site. The next certification session would likely be in late May/early June, 1996, at ISU. Vincel asked when will ultrasound derived data be used for NCE. Hough suggested that ultrasound marbling assessment must be refined and perfected. Hunsley challenged BIF to present trait correlations and accuracies to producers to narrow the credibility gap on ultrasound. Leachman questioned the availability of trait correlations between ultrasound and carcass marbling EPD versus carcass measures and carcass marbling EPD. Green questioned the correlation between yearling bull and ½ sib slaughter steer carcass measures. Crouch indicated that ISU data reveals that ultrasound % fat prediction is more accurate than USDA grading marbling scores. Crouch indicated that currently five institutions/individuals are researching ultrasound applications as follows: Baily - Canada; Rouse and Wilson - Iowa State; Gresham - Univ of Tennessee; Berthour - Kansas State and Stouffer - Cornell. Crouch suggested bringing all five systems together for simultaneous comparison. Leachman questioned the likelihood of consensus at the GPW with either ultrasound emerging as a self supporting, stand alone concept or eventual ultrasound abandonment. Anderson cited very little variation in Limousin external fat or ribeye area data. Green suggested that, in time, tenderness may emerge as a more beneficial selection criteria and viewed BIF's role as creating greater standardization of tenderness measurement such as Warner Bratzler Shear (WBS) force values. Crouch indicated that the ultrasound training/certification process may need financial support for possibly as long as the next five years. Healey questioned BIF financial support of programs that cater to individuals means of making a living. Dillard expressed that BIF was in a position to "buy" control, consistency and continuity of ultrasound technological application and, thereby, was obligated to expose the concept to the intellectual thought process. Crouch moved and Dillard seconded BIF financial support of the 1996 ISU ultrasound certification process up to $3000. Motion carried.

D. Biotechnology - Burke Healey, Chairman
Healey indicated that Jerry Taylor, Texas A & M, would be one of the general speakers at the 1996 convention and would be brought back to the Biotechnology Committee meeting for further discussion. Healey suggested that given his BIF Vice Presidential duties and involvement with numerous other beef industry organizations, it was appropriate for him to relinquish chairmanship of the Biotechnology committee. Healey suggested Green as his successor, whereupon President Brinkman appointed Green chairman of the Biotechnology Committee. No Board action required.

E. Central Test and Growth - Ronnie Silcox, Chairman
Silcox reported that Darrh Bullock, University of Kentucky and William Herring, University of Missouri were working on standardization of data collection and calculations necessary for carcass trait EPD generation from steer feedout programs. Vincel suggested that given the location of the 1996 convention, coupled with the long standing tradition of central testing in the Gulf Coast states, that a potential convention committee topic may be exploring the relevance of central testing bulls for postweaning gain. Leachman suggested the presentation of data on limit feeding versus ad libitum consumption on bull ranking for gain. No Board action required.

F. Reproduction - Bruce Cunningham, Chairman
Cunningham brought the Board's attention to the scrotal circumference (SC) age adjustment equations in the proposed revised Guidelines. Breed specific SC adjustment information had been requested from some of the Brahman derivative breeds. Anderson indicated that Dan Moser, University of Georgia, was researching Brahman Derivative SC and age to puberty in daughters. Brinkman reported that the Brangus Sire Summary now includes SC EPD. Boggs suggested that the reproduction committee may need to address ultrasound applications to pregnancy diagnosis and/or fetal sexing with possible certification efforts. This raised questions of legality and potential conflict with the veterinary profession. Hough suggested that Jim Floyd, DVM, the Alabama State Veterinarian, could discuss usage ramifications. No Board action required.

Fact Sheets - Don Boggs, Chairman
Boggs questioned how the Board envisioned future use of Fact Sheets. Silcox indicated continued Extension usage. Crouch indicated numerous requests in recent years. Kniffen suggested inclusion on the Internet through BIF's homepage. Crouch, Hough and Boggs agreed to develop a new Fact Sheet entitled "Guidelines for Collecting Carcass Data for NCE". Timely development would permit inclusion in various regional beef cattle handbooks and/or in the next issue of the BIF Update.

1996 BIF OPERATING BUDGET - Bolze distributed copies of a proposed 1996 BIF operating budget. The proposed budget was revised to reflect the $3000 financial support of the next ultrasound certification session. Hunsley moved and Leachman seconded for revised 1996 Budget approval. Motion carried.

EXECUTIVE DIRECTOR TRAVEL - Healey moved and Vincel seconded approval of $1000 for Executive Director travel reimbursement to come out of the 1995 operating budget. Motion carried.

NOMINATING COMMITTEE - President Brinkman appointed the Nominating Committee to include Bennett, Chairman, Anderson, Altenburg and Silcox.

AWARDS COMMITTEE - President Brinkman appointed the Awards Committee to include Vincel, Chairman, Leachman, Hunsley, Boggs and Bennett. Vincel reported that the 1996 Convention Seedstock and Commercial nominee introduction process would again involve a slide presentation. He suggested that nominators take responsibility for slide preparation and that slides be submitted at the same time as applications. The Committee would handle Pioneer, Ambassador and Continuing Service Awards. The Executive Director would handle the Seedstock and Commercial Producer evaluation process.

1996 MIDYEAR BOARD MEETING - Bolze solicited Board input into time and location for the 1996 BIF Midyear Board Meeting. Board majority preferred to return to the Barclay Lodge, YMCA of the Rockies, Estes Park, Colorado. Of available dates, Board majority favored October 4,5, and 6, 1996. Leachman moved and Anderson seconded these dates. Motion carried. Dates were confirmed and reservations were made. Hough suggested that the Board consider the Noble Foundation, Ardmore, Oklahoma as a potential future meeting site. Healey agreed to explore the possibility.

BIF FUTURE - Hunsley suggested that the Board give some thought to worthy investments for future projects. Kniffen indicated that some future funds may be needed for final analysis of the NCA/Cattle-Fax calving interval project. Altenburg suggested establishment of a long range planning committee. Crouch moved and Altenburg seconded development of a BIF long range plan. Motion carried.

President Brinkman and Vice President Healey agreed to present an outline of a long range plan for BIF to the BIF Board at the 1996 Convention with in-depth discussion tentatively planned for Friday afternoon, October 4, 1996 at the midyear Board meeting.

HISTORIAN APPOINTMENT - Healy indicated that the Board had failed to appoint Richard Willham as Historian for another year at the Sheridan, Wyoming Convention Board meeting. Healey moved and Crouch seconded this appointment. Motion carried.

There being no further business, President Brinkman adjourned the 1995 BIF midyear Board meeting at 12:30 p.m.

Respectfully Submitted,
Ron Bolze, Executive Director
Beef Improvement Federation

ROGER D KOUGH
ACCREDITED BUSINESS ACCOUNTANT
190 WEST 6TH STREET
COLBY, KANSAS 67701
(913) 462-3182

Beef Improvement Federation
Ron Bolze, Executive Director

I have compiled the accompanying statement of assets, liabilities and fund balance - cash basis - of The Beef Improvement Federation, a not for profit organization, as of December 31, 1995 and the related statement of revenues and expenditures - cash basis - for the twelve months then ended. The financial statements have been prepared on the cash basis of accounting, which is a comprehensive basis of accounting other than generally accepted accounting principles.

A compilation is limited to presenting, in the form of financial statements, information that is the representation of the officers of the Federation. I have not audited or reviewed the accompanying financial statements and, accordingly, do not express an opinion or any other form of assurance on them.

Management has elected to omit substantially all of the disclosures required by generally accepted accounting principles. If the omitted disclosures were included in the financial statements, they might influence the user's conclusions about the Federation's financial position, results of operation, and cash flows. Accordingly, these financial statements are not designed for those who are not informed about such matters.

The effects on these financial statements of the above described adjustments, required under generally accepted accounting principles have not been determined by management.

Respectfully Submitted,

Roger D Kough

Roger D. Kough

May 10, 1996

BEEF IMPROVEMENT FEDERATION

STATEMENT OF ASSETS, LIABILITIES AND FUND BALANCE
CASH BASIS

December 31, 1995

ASSETS

Cash In Bank	$ 11,324.15
Certificate of Deposit	45,652.99
Total Assets	$ 56,977.14

LIABILITIES & FUND BALANCE

Current Liabilities	$ 0.00
Fund Balance - December 31, 1994	48,476.81
Current Year Excess	8,500.33
Total Fund Balance - December 31, 1995	56,977.14
Total Liabilities and Fund Balance	$ 56,977.14

See Accountant's Compilation Report

BEEF IMPROVEMENT FEDERATION

STATEMENT OF REVENUES AND EXPENDITURES
CASH BASIS

For The Twelve Months Ending December 31, 1995

REVENUES

Dues	$ 10,870.37	
Proceedings & Guidelines	2,189.00	
Interest	1,985.10	
Convention Proceeds	4,965.57	
Mid-Year Board Mtg Reimbursements	2,077.11	
Convention Reimbursements	2,000.00	
Total Revenues		$ 24,087.15

EXPENDITURES

Guideline Revisions	$ 2,426.35	
Dues	100.00	
Bank Charges	10.00	
Professional Fees	225.00	
Office Expense	363.47	
Board Meeting Expense	3,914.75	
Travel	1,000.00	
Printing	30.00	
Postage & Freight	2,892.56	
Convention Account Opening	2,000.00	
Frank Baker Scholarship Awards	1,000.00	
Convention Awards, Plaques	1,624.69	
Total Expenditures		15,586.82
Excess of Revenues over Expenditures		$ 8,500.33

See Accountant's Compilation Report

AGENDA
BIF Board of Directors Meeting
Sheraton Civic Center
Birmingham, Alabama
Wednesday, May 15, 1996

1) Clear Agenda - Glenn Brinkman
2) Minutes of Previous Meeting - Ron Bolze
3) Financial Report - Ron Bolze
4) Membership Report - Ron Bolze
5) Report of Birmingham Convention - Lisa Kriese and Dave Maples
6) Plans for 1997 Convention in North Dakota - Kris Ringwall
7) Proposal for 1998 Convention in Calgary, Alberta, Canada - Mike Schutz
8) Guidelines Revision - Final Report - Curtiss Bailey
9) Genetic Prediction Workshop Report - Larry Cundiff
10) Standardized Performance Analysis Workshop Report - John Hough
11) BIF Internet Homepage Development - Ronnie Green
12) Future Focus of BIF - Burke Healey
13) Standing Committee Reports - Plans For The Convention
    a) Biotechnology - Ronnie Green
    b) Central Test and Growth - Ronnie Silcox
    c) Genetic Prediction - Larry Cundiff
    d) Integrated Genetic Systems - John Hough
    e) Live Animal and Carcass Evaluation - John Crouch
    f) Reproduction - Bruce Cunningham
14) Frank Baker Scholarship Awards - Larry Cundiff
15) Election of New Officers - Nominations Committee - Paul Bennett, Chairman
16) Awards - Awards Committee - Norm Vincel, Chairman
17) Plans For New Director Caucuses - Norman Vincel
18) Midyear Board Meeting - October 4-5, Estes Park, Colorado - Ron Bolze
19) New Business - Glenn Brinkman
20) Adjourn

Minutes of Beef Improvement Federation
Board of Directors Meeting
Sheraton Civic Center
Birmingham, Alabama
May 15 - 18, 1996

The Beef Improvement Federation Board of Directors held it's Convention at the Sheraton Civic Center in Birmingham, Alabama on May 15 through 18, 1996.

Board members present for the meeting were Glenn Brinkman, President; Burke Healey, Vice President; Ron Bolze, Executive Director; Willie Altenburg, Kent Anderson, John Crouch, Larry Cundiff, Jed Dillard, Ronnie Green, John Hough, Roger Hunsley, Doug Husfeld, Gary Johnson, Dan Kniffen, Mike Schutz, Ronnie Silcox, Norman Vincel and Richard Willham. Board members not in attendance were Paul Bennett, Don Boggs, Lee Leachman, Craig Ludwig and Roy McPhee.

Also attending the meeting were Bruce Cunningham, Chairman of the Reproduction Committee; Curt Bailey, Editor of the Guidelines revision process; Lisa Kriese, representing the 1996 Convention hosts; Kris Ringwall, Keith Helmuth and Michelle Weber, representing the 1997 Convention hosts.

President Brinkman called the meeting to order at approximately 2:10 pm on Wednesday, May 15, 1996 and the following items of business were transacted.

President Brinkman cleared the agenda. Silcox requested discussion of the National Beef Cattle Data Base.

Bolze circulated a Board of Directors listing for correction of addresses, phone and fax numbers and for inclusion of E-mail addresses where appropriate.

Minutes of the Previous Meeting - Bolze distributed copies of the minutes from the previous Midyear Board Meeting held October 27 and 28, 1995 at the Barclay Lodge, YMCA of the Rockies, Estes Park, Colorado. Kniffen moved to approve as presented and wave reading of the minutes. Hunsley seconded and the minutes were approved as written.

Financial Report - Bolze distributed copies of the Statement of Assets, Liabilities and Fund Balance (Cash Basis) for December 31, 1995 and May 15, 1996. Bolze also provided copies of the Statement of Revenues and Expenses (Cash Basis) for the periods of time including January 1, 1995 - December 31, 1995 and January 1, 1996 - May 15, 1996. Kniffen questioned dues payment to the Composite Cattle Breeders International Alliance. Kniffen moved and Vincel seconded to discontinue dues payment to any affiliated beef cattle organization. Motion passed. Green questioned the legality of a non-profit organization fund balance. Hunsley indicated that organizations with a 501C tax status must file an income tax return if the fund balance exceeds $25,000. Anderson questioned if BIF has a cash reserve policy. President Brinkman indicated no knowledge of a current policy. Hunsley suggested maintaining one year's operating expenses in reserve. Healey stated that the current financial report does not reflect some upcoming expenses such as Guidelines printing. Altenburg indicated that the Task Force on Future Focus will incur some expense. Johnson moved for acceptance of the financial report. Dillard seconded and the motion passed.

Membership - Bolze distributed copies of the membership report. The report showed that 27 state organization, 24 breed associations and 14 other firms or individuals had paid membership dues as of May 15, 1996. Bolze indicated that dues solicitation notices had been mailed to all previously paid membership organizations the second week of January, 1996. Second notices were sent to all unpaid memberships in early April, 1996 along with telephone contact. Many of the 13 unpaid members to date indicated desire for membership, however, their checks had not yet been received.

Plans for 1996 Convention - President Brinkman recognized Lisa Kriese as Convention host and Kriese brought the Board up to date on Convention activities and preregistration numbers. The Board expressed thanks to Kriese, the Auburn University Animal Science Department, the Alabama Cattlemen's Association and the Alabama Beef Cattle Improvement Association for a job well done. President Brinkman suggested that for future conventions, the hosting institution needs to sign a contract or letter of intent specifying sole financial responsibility or opting for a BIF underwrite of up to $5000 of a Convention loss in exchange for splitting Convention proceeds. Crouch moved that such a letter of intent be developed. Altenburg seconded and the motion passed.

Plans for the 1997 Convention - President Brinkman recognized Kris Ringwall, Animal Science Department, North Dakota State University, host of the 1997 Convention. Ringwall announced that the 1997 Convention would be held in Dickinson, North Dakota on May 14 - 17, 1997. Kris introduced Michelle Weber from the Dickinson Convention and Visitors Bureau who provided further details regarding accommodations and transportation. Also attending from North Dakota State University was Keith Helmuth. Ringwall will attend the 1996 Midyear Board Meeting in Estes Park for 1997 Convention program development. Ringwall indicated that North Dakota State University will opt for BIF underwriting 1997 Convention loss up to $5000 in exchange for splitting Convention profits. The Board complimented Ringwall, Weber and Helmuth on their preparedness.

Proposal for the 1998 Convention - Schutz presented a formal proposal inviting BIF to hold their 1998 Convention in Calgary, Alberta, Canada. Schutz indicated that in addition to Canadian Beef Improvement, most other Canadian national level breed associations are headquartered in Calgary. Schutz distributed information concerning accommodations, air service and additional benefits of holding the Convention in Calgary. Schutz originally proposed the dates of May 20 - 24, 1998. Further discussion indicated a general preference for May 27 - 31, 1998 subject to lodging availability. Crouch moved and Vincel seconded to accept the Canadian proposal. Motion carried.

Guidelines Revision - Final Report - Bailey distributed complimentary copies of the seventh edition of the "BIF Guidelines for Uniform Beef Improvement Programs". Bailey indicated that the original sections were submitted by authors in February of 1995. Changes and additions were made over the next 14 months with the camera ready copy going to the printer in April of 1996. Bailey indicated that as editor, his objectives included accuracy, clarity, consistency in style and form and elimination of excessive duplication and contradictory statements. The seventh edition includes over 160 pages with an Index as a new feature. The need arose to hire the services of local word processing expertise. The National Cattle Evaluation section was typed by University of Nebraska clerical staff. Bailey explained the attempt to locate the least cost printer. Bailey suggested a thank you letter plus a complimentary Guidelines book be sent to each contributing author. President Brinkman requested that Bailey compile a time line of editorial steps for future use. Bolze indicated that Convention attendees could purchase a copy at the Convention for $10, however Guidelines would cost $15 after the Convention. Anderson questioned provision for mass purchasing. Vincel moved and Kniffen seconded $15 per single copy including postage and $10 per copy of 5 or more plus postage. Motion passed. Bolze questioned what should be done with approximately 700 - 800 6th edition Guidelines in inventory. Willham agreed to communicate with the Beef Cattle Breeding Technical committees to distribute free to students for educational purposes. The Board thanked Bailey for his dedication, persistence and adherence to the predetermined schedule resulting in the 7th edition completed for distribution at the 1996 Convention.

Genetic Prediction Workshop Report - Cundiff reported that the Fifth Genetic Prediction Workshop was held December 8 and 9, 1995 at the KCI Embassy Suites in Kansas City, Missouri. The workshop was entitled "More Than Meats the Eye - Genetic Improvement of Beef Cattle Body Composition". In excess of 100 people attended and nothing transpired requiring Board action. Cundiff indicated that Harlan Ritchie would present a workshop summary in the Genetic Prediction Committee meeting. Proceedings are available from Doyle Wilson at Iowa State University. Willham indicated that the Board had approved $1000 of financial support of the workshop if needed. However, the proceedings printing bill was $1972.88. Willham moved and Cundiff seconded to pay the full printing bill. Motion passed.

Standardized Performance Analysis (SPA) Workshop Report - Hough reported that the SPA Workshop for breed associations was held December 7, 1995 at the KCI Embassy Suites in Kansas City, Missouri with approximately 12 national level breed associations present. Hough indicated that Kniffen would report on the workshop in the Integrated Genetic Systems meeting. Hough also indicated that at this time, the Red Angus Association of American was leading the way in SPA data generation for seedstock producers.

BIF Internet Homepage Development - Green reported that Bruce Golden from CSU had developed a BIF Homepage which would be demonstrated that evening in the Convention's opening session. Green also reported that CSU could maintain the BIF Homepage for a small annual maintenance cost of approximately $500. Potential content of the BIF Homepage includes the Guidelines, quarterly updates, proceedings from conventions and Genetic Prediction workshops, Fact Sheets and the BIF 25 Year History-"Ideas Into Action". Green moved and Crouch seconded that Golden maintain the BIF Homepage with a maximum maintenance fee of approximately $500 and that Homepage content be under the direction of the executive director. Motion carried. Crouch suggested that as part of the activities of the Live Animal and Carcass Evaluation Committee activities, ultrasound activities from Iowa State University be hyperlinked to the BIF Homepage. Healey questioned this linkage indicating that the National Cattlemen's Beef Association (NCBA) has terminated ultrasound research funding and that numerous members of the U.S. Beef Breeds Council question ultrasound applications. Hunsley cited the need for appropriate adjustment factors to make raw ultrasound data useable. Crouch indicated that the Live Animal and Carcass Evaluation Committee meeting speakers would present data supporting the use of ultrasongraphy for the prediction of carcass merit and eventual inclusion into National Cattle Evaluation procedures.

National Beef Data Base (NBDB) - Silcox indicated that the USDA National Extension Service is promoting the development of the NBDB, similar to the National Dairy or National Pork Data Bases already in existence. Silcox requested Board approval to include the 7th edition of the Guidelines into the NBDB. Healey moved and Kniffen seconded to include the BIF Guidelines into the NBDB. Motion passed.

Standing Committee Reports - Plans for the Convention

A. Biotechnology - Ronnie Green, Chairman.

Green reported that Jerry Taylor, from Texas A&M, would discuss current application of DNA testing as supplemental information to his general session presentation. Sam Comstock, CSU graduate student, would present information on DNA testing for protoporhyria or light sensitivity in Limousin cattle. Tom Holm, from Linkage Genetics, would address commercial applications of DNA fingerprinting to enhance performance data bases. The session on sex preselection by semen sexing was tabled until 1997.

B. Central Test and Growth - Ronnie Silcox, Chairman.

Silcox reported that Darrh Bullock, from the University of Kentucky, and William Herring, from the University of Missouri, would provide a summary of steer feedout program data. Brett Middleton, from the University of Georgia, would discuss using the World Wide Web for central bull test stations. Sally Northcutt, from the Oklahoma State University, would present the results from a national survey of test station managers.

C. Genetic Prediction - Larry Cundiff, Chairman.

Cundiff reported that Curtiss Bailey would provide a Guidelines revision update, Harlan Ritchie, from Michigan State Universtiy, would report on the 5th Genetic Prediction Workshop, John Pollak, from Cornell University, would discuss direct-maternal correlation for weaning weight, and L.Klei, also from Cornell University, would report on the multibreed evaluation with field data. In addition, Bruce Golden, from the Colorado State University, would present the Red Angus across breed adjustment factors, Dale VanVleck, from the University of Nebraska, would present across breed evaluation with data from NC-196 experimental herds and an across breed evaluation update. In conclusion, Jim Venner, from Iowa State, would present genetic evaluation of disposition in Limousin cattle.

D. Integrated Genetic Systems - John Hough, Chairman.

Hough reported that Kniffen, from the National Cattlemen's Beef Association, would provide an update of IRM/Seedstock SPA and SPA EZ. Mike MacNeil, from Miles City, would discuss utilization of selection Indices and multiple trait selection. Russ Nugent would report on genetic progress as a result of index selection in the swine industry and David Johnston would demonstrate the computerized Australian approach to index selection called Breed Object.

E. Live Animal and Carcass Evaluation - John Crouch, Chairman.

Crouch indicated that Gene Rouse, from Iowa State, would report on the possibility of using real-time ultrasound derived data in National Cattle Evaluation. William Herring, from the University of Missouri, would present pros and cons for centralized processing and interpretation of real-time ultrasound images and Lisa Kriese, from Auburn, would focus on standards for recording and reporting real-time ultrasound carcass data on individual animals. In addition, Kriese and Herring would report on software comparison efforts from the Summer of 1995 and Spring of 1996. In depth discussion of ultrasonography application followed. Kniffen commented that ultrasonography is becoming increasingly more accurate. However, application still remains as the challenge.

F. Reproduction - Bruce Cunningham, Chairman.

Cunningham reported that Dan Moser, from the University of Georgia, would discuss the genetic relationship between scrotal circumference in bulls and reproductive efficiency in heifers. Warren Snelling, from Miles City, would present genetic evaluation of heifer pregnancy.

Task Force on Future Focus of BIF - Vice President Healey distributed preliminary information representing the collective thoughts of himself, Brinkman and Bolze relative to BIF direction over the next 5-10 years. Bolze had contacted approximately 20 former BIF thought leaders for input. Opinions varied, however, in general indicated that BIF has lost some grassroots producer involvement, performance data was subject to adjustment too minute for practical application and future BIF focus needed to emphasize whole herd evaluations rather than individual selection. Healey indicated that the Task Force would consist of 24 individuals representing producers, agricultural economists, beef extension specialists, beef cattle researchers, breed association representations and individuals involved with National Cattle Evaluation. The Task Force would include 9 Board members as a core group. Tentative arrangements had been made with the KCI Embassy Suites for June 28 and 29, 1996. Healey suggested that Future Focus results could potentially be incorporated into the 1997 Convention program planning process for Dickinson, North Dakota. Healey presented some potential critical issues including, however not limited to, 1) incorporating profitability into performance selection methods; 2) whole herd evaluation versus individual selection; 3) measuring traits for bioeconomic management decisions; 4) measuring and standardizing phenotypic traits in bull test stations and in the show ring; 5) developing indices for multiple trait selection; and 6) BIF's potential on the Internet. Hough envisioned a larger picture. Altenburg suggested a strictly visionary format with focus on how BIF could serve the industry. Johnson envisioned an expanding BIF role in influencing the future direction of the beef industry. Hunsley questioned where the industry would be in 15 - 20 years with consumer consumption being more important than production parameters. Healey stated that BIF's role involves standardizing new performance measures. Cundiff suggested creation of an additional standing committee with continual focus on directional change. Altenburg, Crouch and Vincel questioned if the process really required 24 people. Dillard suggested the need for at least 24 to keep the discussion wide open. Vincel questioned if the entire Board could accomplish the same objectives at the midyear Board meeting. Kniffen suggested that the nine Board member core group could narrow the focus prior to Board exposure. Vincel suggested past BIF leadership involvement. Green suggested waiting until September for more efficient committee function. Hough moved to precede with Task Force implementation with $2500 to help cover meals. Altenburg seconded and motion carried. President Brinkman appointed Healey as Task Force Chairman. Bolze was challenged to make contact with individual Task Force members and report back to the Board Friday evening.

Frank Baker Memorial Scholarship Awards - Cundiff, reporting for the committee also including Hough, Silcox and Willham, stated that the essay contest was widely advertised through the Beef Cattle Breeding Technical Committees. Cundiff indicated that only two individuals submitted essays, however both were viewed worthy of scholarships according to the Committee. The recipients were Denny Crews, Jr. and Lowell Gould from Louisiana State University and University of Nebraska, respectively. Green indicated that the March 1 due date conflicts with graduate students preparing abstracts for the American Society of Animal Science meetings. President Brinkman appointed Cundiff, Green and Anderson to a committee to explore attempts to increase student participation.

Election of New Officers - The Nominating Committee included Bennett, Chairman, Altenburg, Silcox and Anderson. In Bennett's absence, Altenburg presented the nomination of Burke Healey for President in 1996-97. Crouch moved and Hunsley seconded to accept the nomination by acclamation. Motion carried. Altenburg presented the nomination of Gary Johnson for Vice President, recognizing that Johnson's second three year term ends in 1997. This would require an extension of Johnson's term by one year to serve as president in 1997-98, which would require a change in the By-Laws. Healey prepared and read a proposed change in the By-Laws as follows:

> **Any of the eight sitting producer members of the Executive Board are eligible for selection to the office of president even if that member is currently in the last year of a second three year term. In such a case, the president, so elected becomes an additional full voting member of the Executive Board during his one year term as president. Such a selection in no way changes the regular rotation and election of any of the eight regularly scheduled Beef Cattle Improvement Associations' regional producer member seats on the Executive Board.**

Altenburg moved and Anderson seconded to accept Johnson's nomination by acclamation. Motion carried. Hough moved to implement the process to result in By-Law change. Altenburg seconded and the motion passed. Bolze was instructed to notify the membership so that the proposed By-Law change could be voted upon at the 1997 Convention.

Historian Appointment - Healey moved and Vincel seconded the appointment of Willham as BIF Historian.

Awards Committee - Vincel, Chairman of the Awards Committee also consisting of Leachman, Hunsley, Boggs and Bennett, presented the following recipients of awards:

Pioneer Award - Glynn Debter and Ike Eller
Continuing Service Award - Harlan Ritchie and Doug Hixon
Ambassador Award - Ed Bible

Bolze presented the following recipients of awards:

Outstanding Seedstock Producer Award - Frank Felton, Maryville, Missouri.
Outstanding Commercial Producer Award - Virgil and Mary Jo Huseman, Ellsworth, Kansas.

Caucus for the Election of New Directors - Vincel distributed copies outlining necessary caucus action for the election of new directors according to the BIF By-Laws. In the Eastern Region, Bennett's second term expired and he was not eligible for reelection. In the Central Region, Brinkman's second term expired and he was not eligible for reelection. In the Western Region, Altenburg's first term expired and he was not eligible for reelection. In the breed associations, Hough's first term expired and he was eligible for reelection. Craig Ludwig had officially resigned at the end of his first term which avoided two Board members from the same breed association. President Brinkman appointed Anderson, Silcox, Johnson and Green to chair the Breed Association, Eastern, Central and Western caucuses, respectively.

Midyear Board Meeting - Bolze indicated that a non-refundable $250 deposit had been made to reserve the Barclay Lodge, YMCA of the Rockies, Estes Park, Colorado for Friday through Sunday, October 4-6, 1996 and that 25% of the estimated total rental expenses was due shortly. Healey moved to extend the contract to include the previous day to accommodate Future Focus discussion. Hough seconded and the motion carried. Future Focus discussion is tentatively scheduled to begin at 3 pm on Thursday, October 3, with a Thursday evening and Friday morning format. The 1997 Convention program planning committee will meet Friday afternoon, October 4. Saturday, October 5 is reserved for the midyear Board meeting. Altenburg, Anderson and Kniffen agreed to provide airport shuttle service, compliments of American Breeders Service, National Cattlemen's Beef Association and North American Limousin Foundation, respectively.

New Business - Crouch indicated that the Live Animal and Carcass Evaluation Committee was planning an ultrasonography workshop for late summer/fall of 1996 targeted at certified technicians. Potential topic areas would include 1) centralized image processing; 2) ultrasound techniques; 3) BIF's role in the certification process and; 4) creation of a self governing ultrasound organization. Crouch moved and Hough seconded $1000 BIF financial support of the ultrasound workshop. After much discussion, Kniffen moved and Vincel seconded to table motion until Friday night. Motion carried.

There being no further business, President Brinkman adjourned the meeting at 6:15 pm to be reconvened Friday night.

President Healey reconvened the Board of Directors meeting at 9:40 pm Friday, May 17, 1996. Lee Leachman was in attendance. President Healey welcomed the three new Board members to the Board , including S.R. Evans, Galen Fink and Jim Doubet representing Eastern BCIA, Central BCIA and Breed Associations, respectively. Hough and Altenburg were reelected to serve a second three year term in the Breed Association and Western BCIA caucuses, respectively. President Healey presented a proposed agenda for the evening including 1) 1997 Convention program committee appointment; 2) standing committee reports; 3) continued discussion on Future Focus; 4) ultrasound financial request; and 5) Frank Baker Memorial Scholarship Committee report. Crouch moved and Dillard seconded agenda approval. Motion carried.

1997 Convention Program Planning Committee - President Healey appointed the 1997 Convention program planning committee to include Johnson, Chairman, Healey, Altenburg, Crouch, Hough, Anderson and Bolze. The 1997 Convention program planning committee will meet at 1 pm Friday, October 4, 1996 prior to the midyear Board meeting in Estes Park.

Standing Committee Reports:

A. Biotechnology - Ronnie Green, Chairman.
   Green reported that committee attendees preferred an educational format for future Biotechnology meetings. No Board action required.

B. Central Test and Growth - Ronnie Silcox, Chairman.
   Silcox reported that a subcommittee had been appointed to develop guidelines for data collection for steer feedout programs. No Board action required.

C. Genetic Prediction - Larry Cundiff, Chairman.
   Cundiff reported on a well attended meeting with much in depth discussion. No Board action required.

D. Integrated Genetic Systems - John Hough, Chairman.
   Hough reported that the committee has recommended that BIF encourage breed associations to implement whole herd reporting systems. Hough moved and Kniffen seconded for BIF to prepare a position statement recommending that breed associations implement whole herd reporting systems. Leachman suggested a draft subject to Board review at midyear prior to submission to breed associations. Motion carried. Hough reported that Rick Bourdon and Scott Newman have scheduled an Index Selection Workshop for November 14, 15 and 16, 1996 at Estes Park. Hough moved and Crouch seconded $1000 BIF financial support of the workshop. Motion carried.

E. Live Animal and Carcass Evaluation - John Crouch, Chairman.
   Crouch reported a well attended meeting with lively discussion and identification of ultrasound challenges for further discussion during the proposed ultrasound workshop. No Board action required.

F. Reproduction - Bruce Cunningham, Chairman.
   Cunningham reported much committee attendance interest in the topics presented. No Board action required.

Continued Discussion on Future Focus - President Healey read through a list of proposed Task Force members. Evans requested background information on objectives of Future Focus. Concerns were expressed about Task Force content relative to geographic region distribution, absence of Canadian representation, National Cattle Evaluation representation, international involvement, visionary versus traditional BIF focus and understanding of BIF principles and objectives. Altenburg suggested Harlan Ritchie as chairman. President Healey preferred to retain chairmanship, however suggested Harlan Ritchie or Bill Mies as facilitator. Crouch and Vincel suggested an outside, independent facilitator with no preconceived notions or hidden agendas. Dillard suggested Mies and Ritchie as primary and assistant facilitators, respectively. Leachman moved and Anderson seconded for President Healey to chair and Bill Mies from Texas A&M to facilitate the BIF Task Force on Future Focus. Motion carried. Bolze was instructed to make contact with the following list of Task Force members:

* Nine Member BIF Core Group

Burke Healey	John Crouch	Don Boggs
Gary Johnson	John Hough	Ronnie Green
Willie Altenburg	Kent Anderson	Ron Bolze

* Agricultural Economists
  - Harlan Hughes
  - Paul Gutierrez
  - Steve Swigert

* Producers

James Bennett	Barry Dunn	Steve Radakovich
Rich Benson	Frank Felton	Burke Teichert

* Academics

Jim Gosey	Larry Benyshek	Harlan Ritchie
Bill Mies	Tom Jenkins	Jim Wilton

* National Cattlemen's Beef Association
  - Jim Gibb

Note: Larry Benyshek and Jim Wilton could not attend and will be replaced by Keith Bertrand and Robert Kemp, respectively. Bill Mies and Harlan Ritchie could not attend. President Healey, Vice President Johnson and Executive Director Bolze secured the services of Larry Corah as Facilitator.

Ultrasound Financial Request - Vincel moved and Dillard seconded to remove the tabled motion for further discussion. Motion passed. Crouch expounded on the proposed objectives of an ultrasound workshop to include centralized processing, how to present and interpret data, creation of an ultrasound self governing board and preparation of an ultrasound techniques manual. Leachman expressed concern about seedstock producers printing unadjusted raw data resulting in bull buyers having a false sense of confidence. In general, the Board concurred that

BIF should not endorse use of unadjusted raw data. Hough and Anderson stated that these concerns were envisioned as a major discussionary point of the workshop. Doubet questioned if BIF budget could support the request. Brinkman indicated that this effort was in keeping with BIF's objectives of providing greater uniformity and standardization. Vincel suggested that Crouch draft a position statement after the ultrasound workshop and present it to the Board at Midyear. Green questioned if the ultrasound workshop would fulfill the continuing education requirement for certified technicians and if so, should BIF underwrite the cost of continuing education. Crouch stated that no formal continuing education program has ever been offered, nor is it required for recertification. Husfeld questioned continued financial support of a program which has not shown tremendous promise and suggested that ultrasound technicians such be, self sufficient and self governing. In response to Evans' question as to who would conduct the workshop, Crouch stated that an Ultrasound Subcommittee within the Live Animal and Carcass Evaluation Committee would assume the responsibility. Healey requested a vote to question the motion with at least two-thirds in support. Motion carried.

Frank Baker Memorial Scholarship Committee Report - Cundiff reported that to avoid conflict with graduate student attempts to prepare abstracts for ASAS meetings, the due date for essays would be February 1. Cundiff moved and Dillard seconded to continue the recognition with the new due date. Motion carried.

There being no further business, President Healey adjourned the meeting at 11:25 pm, Friday, May 17, 1996.

Respectfully Submitted,

Ron Bolze,
Executive Director

ROGER D KOUGH
ACCREDITED BUSINESS ACCOUNTANT
190 WEST 6TH STREET
COLBY, KANSAS 67701
(913) 462-3182

Beef Improvement Federation
Ron Bolze, Executive Director

I have compiled the accompanying statement of assets, liabilities and fund balance - cash basis - of The Beef Improvement Federation, a not for profit organization, as of May 15, 1996 and the related statement of revenues and expenditures - cash basis - for the four and one half months then ended. The financial statements have been prepared on the cash basis of accounting, which is a comprehensive basis of accounting other than generally accepted accounting principles.

A compilation is limited to presenting, in the form of financial statements, information that is the representation of the officers of the Federation. I have not audited or reviewed the accompanying financial statements and, accordingly, do not express an opinion or any other form of assurance on them.

Management has elected to omit substantially all of the disclosures required by generally accepted accounting principles. If the omitted disclosures were included in the financial statements, they might influence the user's conclusions about the Federation's financial position, results of operation, and cash flows. Accordingly, these financial statements are not designed for those who are not informed about such matters.

The effects on these financial statements of the above described adjustments, required under generally accepted accounting principles have not been determined by management.

Respectfully Submitted,

Roger D Kough

Roger D. Kough

May 15, 1996

BEEF IMPROVEMENT FEDERATION

STATEMENT OF ASSETS, LIABILITIES AND FUND BALANCE
CASH BASIS

May 15, 1996

ASSETS

Cash In Bank	$ 17,808.84
Certificate of Deposit	46,530.02
Total Assets	$ 64,338.86

LIABILITIES & FUND BALANCE

Current Liabilities	$ 0.00
Fund Balance - December 31, 1995	56,977.14
Current Year Excess	7,361.72
Total Fund Balance - May 15, 1996	64,338.86
Total Liabilities and Fund Balance	$ 64,338.86

See Accountant's Compilation Report

BEEF IMPROVEMENT FEDERATION

STATEMENT OF REVENUES AND EXPENDITURES
CASH BASIS

For The Period Ending May 15, 1996

REVENUES

Dues	$ 8,621.90	
Proceedings & Guidelines	958.19	
Reimbursements	711.60	
Interest	969.01	
Total Revenues		$ 11,260.70

EXPENDITURES

Office Expense	$ 49.83	
Bank Charges	35.00	
Professional Fees	55.00	
Printing	450.00	
Miscellaneous	58.89	
Postage & Freight	1,496.43	
Guideline Revisions	1,753.83	
Total Expenditures		3,898.98
Excess of Revenues over Expenditures		$ 7,361.72

See Accountant's Compilation Report

Paid BIF Member Organizations and Dues for 1996

(as of May, 1996)

State BCIA's	Dues
Alabama	$ 100
California	100
Colorado	100
Florida	100
Georgia	100
Illinois	100
Indiana	100
Iowa	100
Kansas	100
Kentucky	100
Maryland	100
Minnesota	100
Mississippi	100
Missouri	100
New York	100
New Mexico	100
North Carolina	100
North Dakota	100
Ohio	100
Oklahoma	100
Oregon	100
South Carolina	100
South Dakota	100
Tennessee	100
Texas	100

(State BCIA Con't)	Dues
Utah	$ 100
Virginia	100
Washington	100
West Virginia	100
Wisconsin	100
Wyoming	100

Breed Associations	Dues
American Angus	$ 600
American Brahman	200
American Chianina	200
American Gelbvieh	300
American Hereford	500
American Int. Charolais	300
American Murray Grey	100
American Red Brangus	100
American Red Poll	100
American Salers	300
American Shorthorn	200
American Simmental	500
American Tarentaise	100
Barzona Breeders	100
Beef Booster Cattle Ltd.	100
Beefmaster Breeders	300
Canadian Angus	100

(Breed Assoc. Con't)	Dues
Canadian Charolais	$ 200
Canadian Hays Converter	100
Canadian Hereford	100
Canadian Simmental	100
International Brangus	300
North American Limousin	500
North American South Devon	100
Red Angus Assoc. Of America	200
Santa Gertudis Breeders	200
United Braford Breeders	200

Others	Dues
American Breeders Service	$100
Beef Improvement Ontario	100
Canadian Beef Improvement	100
Composite Cattle Breeders	$ 100
Connor State Collete	100
Integrated Genetic Management	100
King Ranch	50
Manitoba Agriculture	100
National Assoc of Ani Breeders	100
National Cattlemen's Beef Assoc	100
Ronald Schlegal	50
Select Sires	100
Taylors Black Simmental	50
Accelerated Genetics	100
Turner Brothers Farms	50
21st Century Genetics	100

SEEDSTOCK BREEDER HONOR ROLL OF EXCELLENCE

John Crowe	CA	1972	Bert Crame	CA	1974
Dale H. Davis	MT	1972	Burwell M. Bates	OK	1974
Elliot Humphrey	AZ	1972	Maurice Mitchell	MN	1974
Jerry Moore	OH	1972	Robert Arbuthnot	KS	1975
James D. Bennett	VA	1972	Glenn Burrows	NM	1975
Harold A. Demorest	OH	1972	Louis Chestnut	WA	1975
Marshall A. Mohler	IN	1972	George Chiga	OK	1975
Billy L. Easley	KY	1972	Howard Collins	MO	1975
Messersmith Herefords	NE	1973	Jack Cooper	MT	1975
Robert Miller	MN	1973	Joseph P. Dittmer	IA	1975
James D. Hemmingsen	IA	1973	Dale Engler	KS	1975
Clyde Barks	ND	1973	Leslie J. Holden	MT	1975
C. Scott Holden	MT	1973	Robert D. Keefer	MT	1975
William F. Borror	CA	1973	Frank Kubik, Jr.	ND	1975
Raymond Meyer	SD	1973	Licking Angus Ranch	NE	1975
Heathman Herefords	WA	1973	Walter S. Markham	CA	1975
Albert West III	TX	1973	Gerhard Mittnes	KS	1976
Mrs. R.W. Jones, Jr.	GA	1973	Ancel Armstrong	VA	1976
Carlton Corbin	OK	1973	Jackie Davis	CA	1976
Wilfred Dugan	MO	1974	Sam Friend	MO	1976
Bert Sackman	ND	1974	Healey Brothers	OK	1976
Dover Sindelar	MT	1974	Stan Lund	MT	1976
Jorgensen Brothers	SD	1974	Jay Pearson	ID	1976
J. David Nichols	IA	1974	L. Dale Porter	IA	1976
Bobby Lawrence	GA	1974	Robert Sallstrom	MN	1976
Marvin Bohmont	NE	1974	M.D. Shepherd	ND	1976
Charles Descheemacker	MT	1974	Lowellyn Tewksbury	ND	1976

SEEDSTOCK BREEDER HONOR ROLL OF EXCELLENCE

Harold Anderson	SD	1977
William Borror	CA	1977
Robert Brown	TX	1977
Glen Burrows	NM	1977
Henry, Jeanette Chitty	NM	1977
Tom Dashiell	WA	1977
Lloyd DeBruycker	MT	1977
Wayne Eshelman	WA	1977
Hubert R. Freise	ND	1977
Floyd Hawkins	MO	1977
Marshall A. Mohler	IN	1977
Clair Percel	KS	1977
Frank Ramackers, Jr.	NE	1977
Loren Schlipf	IL	1977
Tom & Mary Shaw	ID	1977
Bob Sitz	MT	1977
Bill Wolfe	OR	1977
James Volz	MN	1977
A.L. Frau		1978
George Becker	ND	1978
Jack Delaney	MN	1978
L.C. Chestnut	WA	1978
James D. Bennett	VA	1978
Healey Brothers	OK	1978
Frank Harpster	MO	1978
Bill Womack, Jr.	AL	1978
Larry Berg	IA	1978
Buddy Cobb	MT	1978
Bill Wolfe	OR	1978
Roy Hunt	PA	1978
Del Krumwied	ND	1979
Jim Wolf	NE	1979
Rex & Joann James	IA	1979
Leo Schuster Family	MN	1979
Bill Wolfe	OR	1979
Jack Ragsdale	KY	1979
Floyd Mette	MO	1979
Glenn & David Gibb	IL	1979
Peg Allen	MT	1979
Frank & Jim Willson	SD	1979
Donald Barton	UT	1980
Frank Felton	MO	1980
Frank Hay	CAN	1980
Mark Keffeler	SD	1980
Bob Laflin	KS	1980
Paul Mydland	MT	1980
Richard Tokach	ND	1980
Roy & Don Udelhoven	WI	1980
Bill Wolfe	OR	1980
John Masters	KY	1980
Floyd Dominy	VA	1980
James Bryany	MN	1980
Charlie Richards	IA	1980
Blythe Gardner	UT	1980

SEEDSTOCK BREEDER HONOR ROLL OF EXCELLENCE

Richard McLaughlin	IL	1980	Orville Stangl	SD	1982
Bob Dickinson	KS	1981	C. Ancel Armstrong	KS	1983
Clarence Burch	OK	1981	Bill Borror	CA	1983
Lynn Frey	ND	1981	Charles E. Boyd	KY	1983
Harold Thompson	WA	1981	John Bruner	SD	1983
James Leachman	MT	1981	Leness Hall	WA	1983
J. Morgan Donelson	MO	1981	Ric Hoyt	OR	1983
Clayton Canning	CAN	1981	E.A. Keithley	MO	1983
Russ Denowh	MT	1981	J.Earl Kindig	MO	1983
Dwight Houff	VA	1981	Jake Larson	ND	1983
G.W. Cronwell	IA	1981	Harvey Lemmon	GA	1983
Bob & Gloria Thomas	OR	1981	Frank Myatt	IA	1983
Roy Beeby	OK	1981	Stanley Nesemeier	IL	1983
Herman Schaefer	IL	1981	Russ Pepper	MT	1983
Myron Aultfathr	MN	1981	Robert H. Schafer	MN	1983
Jack Ragsdale	KY	1981	Alex Stauffer	WI	1983
W.B. Williams	IL	1982	D. John & Lebert Shultz	MO	1983
Garold Parks	IA	1982	Phillip A. Abrahamson	MN	1984
David A. Breiner	KS	1982	Rob Beiber	SD	1984
Joseph S. Bray	KY	1982	Jerry Chappel	VA	1984
Clare Geddes	CAN	1982	Charles W. Druin	KY	1984
Howard Krog	MN	1982	Jack Farmer	CA	1984
Harlin Hecht	MN	1982	John B. Green	LA	1984
William Kottwitz	MO	1982	Ric Hoyt	OR	1984
Larry Leonhardt	MT	1982	Fred H. Johnson	OH	1984
Frankie Flint	NM	1982	Earl Kindig	VA	1984
Gary & Gerald Carlson	NS	1982	Glen Klippenstein	MO	1984
Bob Thomas	OR	1982	A. Harvey Lemmon	GA	1984

SEEDSTOCK BREEDER HONOR ROLL OF EXCELLENCE

R.A. Brown	TX	1991
Jim Taylor	KS	1991
R.M. Felts & Son Farm	TN	1991
Jack Cowley	CA	1991
Rob & Gloria Thomas	OR	1991
James Burns & Sons	WI	1991
Jack & Gini Chase	WY	1991
Summitcrest Farms	OH	1991
Larry Wakefield	MN	1991
James R. O'Neill	IA	1991
Francis & Karol Bormann	IA	1992
Glenn Brinkman	TX	1992
Bob Buchanan Family	OR	1992
Tom & Ruth Clark	VA	1992
A.W. Compton, Jr.	AL	1992
Harold Dickson	MO	1992
Tom Drake	OK	1992
Robert Elliott & Sons	TN	1992
Dennis, David, Danny Geffert	WI	1992
Eugene B. Hook	MN	1992
Dick Montague	CA	1992
Bill Rea	PA	1992
Calvin & Gary Sandmeier	SD	1992
Leonard Wulf & Sons	MN	1992
R.A. Brown	TX	1993
Norman Bruce	IL	1993
Wes & Fran Cook	NC	1993
Clarence, Elaine, Adam Dean	SC	1993
D. Eldridge & Y. Adcock	OK	1993
Joseph Freund	CO	1993
R.B. Jarrell	TN	1993
Rueben, Leroy, Bob Littau	SD	1993
J. Newbill Miller	VA	1993
J. David Nichols	IA	1993
Miles P. "Buck" Pangburn	IA	1993
Lynn Pelton	KS	1993
Ted Seely	WY	1993
Collin Sander	SD	1993
Harrell Watts	AL	1993
Bob Zarn	MN	1993
Ken & Bonnie Bieber	SD	1994
John Blankers	MN	1994
Jere Caldwell	KY	1994
Mary Howe di'Zerega	VA	1994
Ron & Wayne Hanson	CAN	1994
Bobby F. Hayes	AL	1994
Buell Jackson	IA	1994
Richard Janssen	KS	1994
Bruce Orvis	CA	1994
John Pfeiffer Family	OK	1994
Calvin & Gary Sandmeier	SD	1994
Dave Taylor / Gary Parker	WY	1994
Bobby Aldridge	NC	1995
Gene Bedwell	IA	1995

SEEDSTOCK BREEDER HONOR ROLL OF EXCELLENCE

Lawrence Meyer	IL	1984
Donn & Sylvia Mitchell	CAN	1984
Lee Nichols	IA	1984
Clair K. Parcel	KS	1984
Joe C. Powell	NC	1984
Floyd Richard	ND	1984
Robert L. Sitz	MT	1984
Ric Hoyt	OR	1984
J. Newbill Miller	VA	1985
George B. Halterman	WV	1985
David McGehee	KY	1985
Glenn L. Brinkman	TX	1985
Gordon Booth	WY	1985
Earl Schafer	MN	1985
Marvin Knowles	CA	1985
Fred Killam	IL	1985
Tom Perrier	KS	1985
Don W. Schoene	MO	1985
Everett & Ron Batho	CAN	1985
Bernard F. Pedretti	WI	1985
Arnold Wienk	SD	1985
R.C. Price	AL	1985
Clifford & Bruce Betzold	IL	1986
Gerald Hoffman	SD	1986
Delton W. Hubert	KS	1986
Dick & Ellie Larson	WI	1986
Leonard Lodden	ND	1986
Ralph McDanolds	VA	1986
W.D. Morris & James Pipkin	MO	1986
Roy D. McPhee	CA	1986
Clarence VanDyke	MT	1986
John H. Wood	SC	1986
Evin & Verne Dunn	CAN	1986
Glenn L. Brinkman	TX	1986
Jack & Gini Chase	WY	1986
Henry & Jeanette Chitty	FL	1986
Lawrence H. Graham	KY	1986
A. Lloyd Grau	NM	1986
Matthew Warren Hall	AL	1986
Richard J. Putnam	NC	1986
R.J. Steward/P.C. Morrissey	PA	1986
Leonard Wulf	MN	1986
Charles & Wynder Smith	GA	1987
Lyall Edgerton	CAN	1987
Tommy Branderberger	TX	1987
Henry Gardiner	KS	1987
Gary Klein	ND	1987
Ivan & Frank Rincker	IL	1987
Larry D. Leonhardt	WY	1987
Harold E. Pate	IL	1987
Forrest Byergo	MO	1987
Clayton Canning	CAN	1987
James Bush	SD	1987
R.J. Steward/P.C. Morrissey	MN	1987
Eldon & Richard Wiese	MN	1987
Douglas D. Bennett	TX	1988

SEEDSTOCK BREEDER HONOR ROLL OF EXCELLENCE

Gordon & Mary Ann Booth	WY	1995
Ward Burroughs	CA	1995
Chris & John Christensen	SD	1995
Mary Howe de'Zerega	VA	1995
Maurice Grogan	MN	1995
Donald J. Hargrave	CAN	1995
Howard & JoAnne Hillman	SD	1995
Mack, Billy, Tom Maples	AL	1995
Mike McDowell	VA	1995
Tom Perrier	KS	1995
John Robbins	MT	1995
Thomas Simmons	VA	1995
D. Borgen & B. McCulloh	WI	1996
Chris & John Christensen	SD	1996
Frank Felton	MO	1996
Galen & Lori Fink	KS	1996
Cam, Spike, Sally Forbes	WY	1996
Mose & Dave Hebbert	NE	1996
C. Knight & B. Jacobs	OK	1996
Robert C. Miller	MN	1996
Gerald & Lois Neher	IL	1996
C.W. Pratt	VA	1996
Frank Schiefelbein	MN	1996
Ingrid & Willy Volk	NC	1996
William A. Womack, Jr.	AL	1996

SEEDSTOCK BREEDER OF THE YEAR

John Crowe	CA	1972	Ric Hoyt	OR	1985
Mrs. R. W. Jones	GA	1973	Leonard Lodoen	ND	1986
Carlton Corbin	OK	1974	Henry Gardiner	KS	1987
Leslie J. Holden	MT	1975	W.T. "Bill" Bennett	WA	1988
Jack Cooper	MT	1975	Glynn Debter	AL	1989
Jorgensen Brothers	SD	1976	Doug & Molly Hoff	SD	1990
Glenn Burrows	NM	1977	Summitcrest Farms	OH	1991
James D. Bennett	VA	1978	Leonard Wolf & Sons	MN	1992
Jim Wolfe	NE	1979	R.A. "Rob" Brown	TX	1993
Bill Wolfe	OR	1980	J. David Nichols	IA	1993
Bob Dickinson	KS	1981	Richard Janssen	KS	1994
A.F. "Frankie" Flint	NM	1982	Tom & Carolyn Perrier	KS	1995
Bill Borror	CA	1983	Frank Felton	MO	1996
Lee Nichols	IA	1984			

Frank and Lynn Felton, Felton Ranch
1996 Seedstock Producer of the Year
Ron Bolze, Executive Director; Lynn and Frank Felton;
Glenn Brinkman, President

For Immediate Release

Frank Felton receives the "1996 BIF Outstanding Seedstock Producer Award".

Birmingham, Alabama - Frank Felton, owner and operator of Felton Ranch, Maryville, Missouri, has been selected as the Beef Improvement Federation (BIF) 1996 Outstanding Seedstock Producer at the Convention held at the Sheraton Civic Center in Birmingham, Alabama.

The Frank Felton family represents the fourth generation to be involved in beef cattle production. Felton Ranch got it's start in Polled Hereford cattle in 1962 and today has expanded to offering three breeds of seedstock to commercial and purebred customers. Frank Felton is recognized as the very epitome of performance breeders in the Polled Hereford breed. When one thinks of a Polled Hereford breeder who is truly performance oriented, Felton Hereford Ranch rises to the very top of the list. Frank Felton has set defined goals and his bulls have reached many of these goals in recent years. In the former APHA Sire Summary, the top 15 bulls per trait were recognized as Trait Leaders. In the last ten years Felton Hereford Ranch has bred bulls that were designated Trait Leader 28 total times. This feat is unmatched by any other beef cattle breeder of any breed. From the most recent North American Hereford genetic analysis, the top 200 active bulls per trait were recognized. Felton Hereford Ranch bred or owned a total of 49 bulls on these lists. Felton bulls were recognized on the birth weight, scrotal, maternal milk and milk & growth lists.

Reproductive performance is near the top of Felton's list of selected traits. One of Frank's very specific goals is to produce bulls with extremely superior scrotal measurements. A level not attained by any other breeder of any trait was achieved by Felton bulls. Nine out of the top 18 active bulls in the Hereford breed for scrotal circumference EPDs were bred by Felton Hereford Ranch. There are 43 Felton-bred bulls in the most recent AHA Sire Summary. These 43 bulls average 2.2 lb. for birth weight EPD, 24.3 lb. for weaning weight, 44.5 lb. for yearling weight, 1.2 cm. for scrotal circumference, 13.1 lb. for maternal milk and 25.4 lb. for milk and growth. Felton Hereford Ranch produces many bulls truly superior in many traits. Felton bulls are also noted for their muscling. Felton Hereford Ranch is certainly noted for the bulls it produces for purebred and commercial cattlemen. Nonetheless, the females produced have gained considerable recognition. In APHA's Benchmark dam recognition program over the last ten years, Frank Felton females have been recognized a total of 121 times. Very few Hereford breeders have met this level of reproductive management and production efficiency.

Foreign acceptance of Felton-bred bulls is substantial. Frank has exported semen on his bulls to several foreign countries. Felton bulls have been in great demand in Australia because of the superior performance characteristics. In the most recent Australian Hereford Sire Summary, several cattle bred by Frank Felton were published. These bulls in Australia were near the top of the list in most of the performance categories. Frank Felton is truly the prototype of a performance breeder. He wants the performance of his cattle to totally speak for itself. His main concern is to treat all his cattle alike and let the cattle sort themselves. Both commercial and purebred cattlemen know when obtaining genetics from Frank Felton, they are not only getting the best genetics, but also the utmost in integrity.

Frank Felton has been a strong supporter of BIF over the years. This is certainly understandable. The goals of BIF are extremely similar to Frank's goals for his own herd. Frank has attended nearly every BIF convention. He wants to contribute to the beef cattle industry, but also he attends these meetings to learn how to better evaluate his own cattle. Frank is always striving to improve his cattle in new areas. For example, he has systematically measured carcass traits with both ultrasound and actual carcass evaluation long before most breeders ever considered carcass traits. Frank understands the environment and resource availability of his customers like no one else, and has designed his breeding program around meeting their needs. Frank is an independent thinker, yet he carefully listens to suggestions that may enhance his operation. Frank never got caught up in fads, and largely used his own Felton bred bulls back in his program. He has occasionally tested outside sires to make sure he wasn't overlooking useful genetics. Frank culls ruthlessly for traits like temperament, hair coat, fescue tolerance, and udder quality. Of course this is in addition to his emphasis on high reproductive performance, optimum growth and milk, fleshing ability and longevity. Frank's Polled Hereford herd is undoubtedly one of the most functional nationally. In short, Frank Felton is one of the true master breeders of beef cattle in the U.S.

Frank is very civic minded as he is actively involved in his community through the Maryville Rotary Club, the First Christian Church and the Boy Scouts of America. Frank Felton was nominated by the Missouri Beef Cattle Improvement Association. BIF is pleased to honor Frank Felton for his lifetime of dedication to performance beef cattle principles with their 1996 Outstanding Seedstock Producer Award.

1996 BIF
SEEDSTOCK NOMINEES

Daniel Borgen and Brian McCulloh
Woodhill Farms, Inc.
Viroqua, Wisconsin

Woodhill Farms, Inc., Viroqua, Wisconsin, is a farm corporation comprised of Dr. Daniel and Anne Borgen, and Brian and Lori McCulloh and families. This registered Angus operation began twelve years ago and the farm presently runs 820 acres and 200 cows in southwestern Wisconsin.

Performance tested yearling Angus bulls and heifers are sold at an annual production sale at the farm in April. Prospective buyers are provided with complete performance data, consisting of weights, ratios, and EPD's for growth and carcass traits, in addition to ultra-sound data for carcass traits.

Woodhill Farms has consigned cattle to the WBIA Bull Test in Platteville as well as Wisconsin State Angus Sales. Brian McCulloh is past president of the Wisconsin Beef Improvement Association and has served as a director for the Wisconsin Cattlemen's Association and Wisconsin Angus Association.

Currently, eight (8) young Woodhill-bred herd sires are enrolled with commercial herds throughout the nation, in a Structured Sire Evaluation for carcass merit. In addition, Woodhill Farms owns eleven (11) Angus sires that are leased to A.I. organizations for the purpose of semen distribution nationally and internationally.

Woodhill Farms, Inc. has been nominated by the Wisconsin Beef Improvement Association.

Chris and John Christensen
Christensen Brothers Simmental
Wessington Springs, South Dakota

Christensen Brothers Simmentals or 3C is a family partnership producing Simmental and Red Angus seedstock. They have the desire to raise cattle that are all things to the beef production business, including maternal, growth and carcass traits.

They strive to raise cattle that require less care and management. With selection for easier calving, they have less labor in calving and also higher fertility. With emphasis on polledness, less labor is needed in dehorning and also results in a greater cattle performance. Cattle finish faster in the feedlot, requiring less time and less labor to finish.

Bulls are maintained in a contemporary group for comparison and are offered in a production sale on an annual basis.

Christensen Brothers continue to apply new technologies such as ultrasonography, progeny testing and carcass evaluation and additional tools for more precise genetic selection in the future.

Attendance at the last six BIF Research Symposium and Annual Meetings has increased their awareness for the need to continually improve their work in genetics, accurate record keeping and using the genetic selection tools already available in the beef industry.

Christensen Brothers Simmental has been nominated by the South Dakota Beef Cattle Improvement Association.

Frank Felton
Felton Ranch
Maryville, Missouri

The Frank Felton family represents the 4th generation to be involved with beef cattle production. While Frank offers 3 breeds of seedstock to his commercial and purebred customers, Felton Ranch got its start with Polled Hereford cattle in 1962. An innovator, Frank has practiced environmental stewardship through his grazing, soil, and water conservation practices.

Felton Ranch is perhaps best known for its performance oriented, multiple trait bulls that have been used in herds around the world. Currently, there are 43 Felton bulls in the main listing of the American Hereford Association Sire Summary representing almost 5,000 progeny. You will also find Felton bulls at each of the major AI studs further signifying the demand for Felton Ranch genetics.

Frank has always emphasized selection for reproductive traits in both males and females. Of the top 18 scrotal circumference EPD bulls in the Hereford breed, 9 were bred by Felton Ranch. Since the Benchmark Dam Program was initiated by the American Polled Hereford Association, Felton bred females have been recognized 121 times, further indicating his dedication and steadfast selection program.

While Frank has marketed bulls to seedstock cattlemen internationally, a strong commercial bull customer base is still his top priority. Frank is actively involved in his community through the Maryville Rotary Club (past president), the First Christian Church (Deacon), and Boy Scouts (past district chairman).

Felton Ranch has been nominated by the Missouri Beef Cattle Improvement Association.

Galen and Lori Fink
Fink Beef Genetic Systems
Manhattan, Kansas

Fink Beef Genetic Systems is a family-owned business including Galen, Lori and Meagan Fink. Located near Manhattan, Kansas, this registered Angus operation has been in existence since 1977. At that time the operation began with one female, little money and no land. The herd was developed over numerous years while both Galen and Lori held full-time positions outside of their operation. Since 1991, they have devoted all of their time to Fink Beef Genetic Systems.

Proven sires make up 80% to 90% of the genetics used in their operation. The Finks prefer these sires to have at least 100 daughters in production on AHIR, selected with heavy emphasis on all EPD areas and visual appraisal. Most female pedigrees are "stacked" 6 to 8 generations deep of these "kind". Artificial insemination has been used since 1977, and in 1990 a major embryo transfer program was engaged. Currently, 450 embryos are implanted each year. The Finks work closely with cooperator herds for recipient needs. The breeding herd is run on 1,000 acres of native Flint Hills grass.

Fink Beef Genetics systems markets it bulls through an annual sale and contract private treaty, while females are sold at auction or through private treaty. Fink genetics have sold into nearly every state in the nation, either by semen, embryos, bulls or females.

Several innovations in the program include: 1) Mass production of full brothers on a preset price contractual basis where producers help plan their own future; 2) Bull production in commercial herds that actually raise their own specified genetic bulls through embryo transfer; 3) "Genetics Plus", a commercial heifer supply company is the first of its kind to supply known genetics for a maternal-terminal approach to beef production; 4) "Integrated Genetic Management", a unique semen supply, calf procurement, turn-key breeding company; 5) "Little Apple Brewery and Restaurant", serving Certified Angus Beef as the main entree; 6) Innovative customer calf sales at public auction, along with alliances being built with feedyards and packing plants; and 7) Limited production of Hybrid F1 bulls using Angus, Tarentaise, Charolais and Simmental through embryo transfer.

Fink Beef Genetic Systems has been nominated by the Kansas Livestock Association Purebred Council.

Cam, Spike and Sally Forbes
Beckton Stock Farm
Sheridan, Wyoming

Beckton Stock Farm was started by the Forbes family in 1898. Starting in 1945, Waldo Forbes bought top red calves from leading Black herds, using these cattle to build the new breed of Red Angus, based on performance testing and genetic selection. Following Waldo's death in 1955, Sal Forbes built the program, and set the highest possible standard of integrity in all aspects of the operation. Today, Beckton runs 1050 mother cows on dry range, foothills and high mountain pastures, in northern Wyoming. The ranch is managed by Cam and Spike Forbes, with the goal to produce seedstock with the genetics for more efficient and cost-effective beef production in commercial environments.

Beckton uses commercial management practices wherever possible, and the breeding program is designed to provide the most accurate and valid information. For example, all of the sires are used equally on both heifers and cows, with random mating for both natural service and A.I. TheForbes believe moderate mature size of cows is more important than is currently recognized in the seedstock industry, and birth weight is limited in sire selection, both for calving ease, and to maintain moderate mature size. Overall, balanced trait selection is used for a wide variety of traits - maternal, growth, calving ease, carcass, disposition and fertility - rather than extremes in any one trait. Today, the Beckton cowherd exceeds the Red Angus female average, for every genetically measured trait.

Beckton Stock Farm has been nominated by the Wyoming Beef Cattle Improvement Association.

Mose and Dave Hebbert
Hebbert Charolais Ranch
Hyannis, Nebraska

Hebbert Charolais Ranch, located in the heart of the Nebraska Sandhills, could best be described as a "no frills" family ranching operation. Parents in the operation are Mose and Merla Hebbert, their son Dave and his wife Mickie. Dave and Mickie's sons, Matt, Jake and Josh, represent the fifth generation to have the opportunity to live and work on the ranch that has been in their family for 110 years.

Three hundred fifty functional cows are the backbone of the Hebbert Charolais operation. The cows are not pampered, but expected to utilize the grass native to the area. Over 7000 acres of grass stabilized sand dunes and meadow land provide the forage for the cowherd.

Bulls from the herd are marketed at their annual production bull sale each spring. Their goal is to produce a solid set of bulls to offer to commercial cattlemen. "Having the highest averaging bull sale in the country or claiming a national show championship is not what we are trying to achieve as purebred breeders. Our rewards come in helping our customers reach their goals. Watching their Charolais-cross calves top the market at the local auction barn or seeing the positive results of the performance of their calves in the feedlot is what keeps us excited about the seedstock business. We measure our success, in part, in terms of customer acceptance. Over 80% of the purchases made at our annual bull sale are from repeat buyers. We appreciate that show of confidence in our product".

Hebbert Charolais Ranch has been nominated by the American-International Charolais Association.

Cliff Knight and Bill Jacobs
K74 Ranch, Inc.
Sulphur, Oklahoma

K74 Ranch has been in the seedstock business since 1966. The business currently has operations in two locations - one north of Oklahoma City and the other east of Sulphur, Oklahoma. K74 is a family-owned corporation, with Clifford and Sybil Knight as the principle shareholders and Bill Jacobs as the president, manager and chief operating officer. Their registered Hereford operation has always been performance oriented and every effort has been made to select superior sires to meet the goals of the ranch. In addition, the commercial cow herd, owned by Jacobs Ranch, currently consists of 1100 cows. The ranch runs a stocker steer operation with 3,800 head grazed during the spring, summer and fall months. By making Hereford genetics available to their customers, Clifford Knight and Bill Jacobs hope to enhance quality and efficiency in the commercial and seedstock industry and to attract a new generation of low-cost producers. Innovative aspects of the K74 program include progressive use of Expected Progeny Differences for grouping sale bulls into growth, birth weight, maternal and balanced performance categories. Customer needs receive high priority through extensive performance information and the use of an EPD Index on K74 bulls. In addition, the K74 program utilizes a cell grazing system for spring and fall calving herds. The success of K74 in the industry is evidenced by customer acceptance by bull buyers, use of K74 bulls in the seedstock and commercial populations, as well as proper management of land and available resources.

K74 Ranch, Inc. has been nominated by the Oklahoma Cooperative Extension Service and the Samuel Roberts Nobel Foundation.

Robert C. Miller
Viewlawn Herds
Mabel, Minnesota

Robert Miller believes in accurate, honest and complete records. Robert has been perfecting his record keeping skills for over forty years. Robert is the third generation owner of Viewlawn Herds, located in Mabel, Minnesota, and has successful brought this operation into the 20th Century.

The Millers have always owned Angus cattle because of their good temper and easy birthing process. Viewlawn Herds has 230 registered Angus cattle. The Miller herd has been a closed herd during Robert's lifetime.

The Millers have been keeping complete performance records on their cattle for over 40 years. They sell 100 bulls each year, mostly to repeat buyers. Their bull weights are as consistent as possible. The Millers use line breeding to ensure quality bulls. They use this technique to produce the genes that they know will produce better bulls each time around. Viewlawn Herds' calving season runs from April 1 to June 10.

The Millers aren't concerned with keeping up a young herd. Just because a cow is getting older, she's not tossed aside. Cows are kept in production as long as they are still doing a good job. They have cows that have had as many as 15 calves.

The fourth generation farm has been and continues to be very successful. With three grandsons to carry on the family tradition and learning how to be successful from such a professional as Robert Miller, they are sure to accomplish any goal they set their minds on.

Viewlawn Herds has been nominated by the Iowa Cattlemen's Association.

Frank Schiefelbein
Schiefelbein Farms
Kimball, Minnesota

Schiefelbein Farms is a family operation started in 1955 by Frank Schiefelbein. From the beginning, Frank's vision was to produce cattle that worked for the cow/calf producer, the feedyard, and consumer. Since Frank liked his steaks tender and juicy, Schiefelbein Farms was also a pioneer in carcass data collection, seeking genetics that produced excellent tasting beef. Forty years later, with the addition of nine sons, seven daughters-in-law, and seventeen grandchildren, the operation continues to expand almost as fast as the family. Currently Schiefelbein Farms runs more than 500 registered Angus cows, 4,000 acres of pasture and crops, and feeds several thousand head of cattle annually.

Since 100% of the income is derived from cattle, the breeding program is very much in tune with traits that impact the bottom line. The entire herd has been forced to perform under "commercial" conditions without extra pamper and care. Cattle must be balanced in all traits, such as reproductive efficiency, calving ease, growth, and longevity.

Schiefelbein females are closely bred and provide the uniformity necessary for success in the industry. Instead of using the "bull-of-the-month club" sire selection approach, highly proven A.I. bulls form the base of the program. Only the very best bulls that conform to strict selection criteria are offered to commercial cattlemen. Tough scrutiny with a balanced traits approach allows the merchandising of only 60% of the bulls and females produced.

In order to maintain the proper breed combination for commercial cattlemen, Schiefelbein Farms is now producing a line of F-1 bulls. "Black Balancer" hybrid lines provide the opportunity to select for the specific traits of muscle, maternal or marbling. These F-1 bulls will keep the best breed combination in a herd while capitalizing on hybrid vigor.

Schiefelbein Farms has been nominated by the Minnesota Beef Cattle Improvement Association.

Ingrid & Willy Volk
Hill and Dale Farms
Franklinton, North Carolina

Ingrid and Willy Volk own and operate a purebred Gelbvieh herd known as Hill and Dale Farms near Franklinton, N.C. The couple began with a commercial herd in the late '70's, but they had always dreamed of owning a purebred herd. Since they are of German origin, they decided to raise a German breed of beef cattle, Gelbvieh, in 1990. After acquiring outstanding genetic seedstock from the Midwest in 1990, combined with the use of artificial insemination and embryo transfer, this herd presently combines one of the elite genetic Gelbvieh bloodlines of any herd in the country.

With the present day herd size of 125 purebred and 175 commercial brood cows, the use of computerized performance testing programs is essential. Individual performance records have been kept on all cattle for the past 17 years.

The Volk's astute understanding and keen interest in performance records and the cattle evaluation EPD concept has made them a leader in the promotion of these concepts to both registered and commercial cattlemen throughout the county, state and nation. They have committed themselves to continually produce middle of the road cattle that don't follow the "extreme" trends, but work diligently toward the tough standards that the cattle industry demands.

Ingrid has served the Gelbvieh industry in a very unselfish manner. She served on the Board of Directors for the N.C. Gelbvieh Association as well as Secretary-Treasurer of the Franklin County Cattlemen's Association for over ten years. She is a perfectionist and has influenced youth involved in livestock to be the best they can be.

The Volks have graciously opened their farm for educational events, such as Extension Service test plots, numerous field days, and "Wake Up To Agriculture" programs for 3rd graders in the county.

Hill and Dale Farms has been nominated by the North Carolina Beef Cattle Improvement Program.

Gerald and Lois Neher
GE-LO Farms
Anna, Illinois

Gerald and Lois Neher have been raising registered Simmental cattle on their farm near Anna, Illinois, for over twenty years. They started with a registered Polled Hereford herd and bred them artificially to Simmental sires to get their first F1 heifers. They continued to cross to Simmental bulls.

For the first fifteen years of the operation they only purchased one heifer calf. The remainder of the herd has been upbred from the original Polled Hereford herd. Through the years they have been some of the first to accept innovative practices such as progeny testing, pelvic and scrotal circumferences measurements.

More recently rotational grazing and limited input sustainable agriculture have had their attention. An attempt has been made to try to get the cow to fit the environment in an area where fesue pastures are saturated with the endophyte fungus. As they see it, the solution to the problem lies in managing the fescue rather than using other grasses which are not as suitable in the area. Interseeding the pastures with red clover has worked well on their farm.

While a reasonable profit from the cattle is what keeps the operation going, the Nehers get the most enjoyment out of seeing 4-H, FFA and young cattlemen and cattlewomen get a good start in the cattle business with high quality cattle that will work in their area. Highly fertile, moderate-sized, easy-keeping cattle from the Neher herd will fit the bill.

GE-LO Farms has been nominated by the Illinois Beef Association Beef Improvement Council and the University of Illinois Cooperative Extension Service.

C.W. Pratt
Echo Ridge Farm
Atkins, Virginia

Charles Walter "C.W." Pratt grew up on a small dairy farm in Smyth county near the village of Atkins, Virginia. By 1964, at the age of 12, C.W.'s dream of owning his own herd of Angus cattle began to unfold as he purchased his first purebred Angus heifer at $125 for a 4-H project. Ten years later his herd had grown to 27 cows. He purchased his family's present home, a small tract of land and a set of scales. In the fall of 1974, he began keeping performance records through the Virginia BCIA program and consigned cattle to his first consignment sale. All performance records have been kept through the American Angus AHIR program since 1978.

His current Angus cow herd numbers 140 brood cows and his operation has expanded to 460 owned and 160 rented acres. He sells about 60 bulls annually, thirty percent of his cow herd and forty percent of the heifer calves which are marketed through consignment sales or private treaty.

He has been utilizing artificial insemination since 1976 and currently, sixty percent of his calves are the result of AI.

He has served on many committees, oftentimes as chairman, including the Southwest Bull Test and Sale Committee, BCIA Board of Directors, Virginia Angus Association Board of Directors, Abingdon Feeder Cattle Association, Angus Legends Sale Committee and also as an advisor to the Virginia Junior Angus Association.

C.W. Pratt received the Bartenslager Award in 1987 and a number of awards at the central bull test stations, the Governor's Clean Water Farm Award in 1994 and the Evergreen District Soil and Water Farm Award in the same year.

C.W. and his wife Shirley have two children, Jason and Sara. Both Jason and Sara have 4-H steers and heifers that they exhibit at local shows.

Echo Ridge Farm has been nominated by the Virginia Beef Cattle Improvement Association.

William A. Womack, Jr.
Rocky Creek Farms
Ashford, Alabama

Rocky Creek Farms is located in the Wiregrass area of Southeastern Alabama. Ashford, Alabama, in Houston County, is home for William A. Womack, Jr. and his family.

Rocky Creek Farms is primarily a purebred Angus farm with 125 Angus cows, along with 175 commercial cows. Rocky Creek Farms has been in the cattle business for 38 years. Rocky Creek Farms was one of the charter members of the Alabama Beef Cattle Improvement Association. Believing in keeping performance information has been one of the reasons for success at Rocky Creek. All performance data has been processed by BCIA and in recent years has been moved to the American Angus Association AHIR program.

The goal at Rocky Creek is to produce cattle as good as possible in all traits without becoming extreme in any trait. Breeding objectives are to produce cattle that will breed on time, calve without assistance, grow at an acceptable rate, and produce a Choice carcass at 1050 to 1200 pounds. The only goal that has changed through the years is to cut back on harvested food and increase use of pasture during the winter.

Rocky Creek Farms has been nominated by the Alabama Beef Cattle Improvement Association.

COMMERCIAL PRODUCER HONOR ROLL OF EXCELLENCE

Bert Hawkins	OR	1978	Dan L. Weppler	MT	1981
Mose Tucker	AL	1978	Harvey P. Wehri	ND	1981
Dean Haddock	KS	1978	Dannie O'Connell	SD	1981
Myron Hoeckle	ND	1979	Wesley & Harold Arnold	SD	1981
Harold & Wesley Arnold	SD	1979	Jim Russell & Rick Turner	MO	1981
Ralph Neill	IA	1979	Oren & Jerry Raburn	OR	1981
Morris Kuschel	MN	1979	Orin Lamport	SD	1981
Bert Hawkins	OR	1979	Leonard Wulf	MN	1981
Dick Coon	WA	1979	Wm. H. Romersberger	IL	1982
Jerry Northcutt	MO	1979	Milton Krueger	MO	1982
Steve McDonnell	MT	1979	Carl Odegard	MT	1982
Doug Vandermyde	IL	1979	Marvin & Donald Stoker	IA	1982
Norman, Denton & Calvin Thompson	SD	1979	Sam Hands	KS	1982
Jess Kilgore	MT	1980	Larry Campbell	KY	1982
Robert & Lloyd Simon	IL	1980	Lloyd Atchison	CAN	1982
Lee Eaton	MT	1980	Earl Schmidt	MN	1982
Leo & Eddie Grubl	SD	1980	Raymond Josephson	ND	1982
Roger Winn, Jr.	VA	1980	Clarence Reutter	SD	1982
Gordon McLean	ND	1980	Leonard Bergen	CAN	1982
Ed Disterhaupt	MN	1980	Kent Brunner	KS	1983
Thad Snow	CAN	1980	Tom Chrystal	IA	1983
Oren & Jerry Raburn	OR	1980	John Freitag	WI	1983
Bill Lee	KS	1980	Eddie Hamilton	KY	1983
Paul Moyer	MO	1980	Bill Jones	MT	1983
G.W. Campbell	IL	1981	Harry & Rick Kline	IL	1983
J.J. Feldmann	IA	1981	Charlie Kopp	OR	1983
Henry Gardiner	KS	1981	Duwayne Olson	SD	1983

COMMERCIAL PRODUCER HONOR ROLL OF EXCELLENCE

Chan Cooper	MT	1972	Gene Gates	KS	1975
Alfred B. Cobb, Jr.	MT	1972	V.A. Hills	KS	1975
Lyle Eivens	IA	1972	Robert D. Keefer	MT	1975
Broadbent Brothers	KY	1972	Kenneth E. Leistritz	NE	1975
Jess Kilgore	MT	1972	Ron Baker	OR	1976
Clifford Ouse	MN	1973	Dick Boyle	ID	1976
Pat Wilson	FL	1973	James D. Hackworth	MO	1976
John Glaus	SD	1973	John Hilgendorf	MN	1976
Sig Peterson	ND	1973	Kahau Ranch	HI	1976
Max Kiner	WA	1973	Milton Mallery	CA	1976
Donald Schott	MT	1973	Robert Rawson	IA	1976
Stephen Garst	IA	1973	William A. Stegner	ND	1976
J.K. Sexton	CA	1973	U.S. Range Exp. Station	MT	1976
Elmer Maddox	OK	1973	John Blankers	MN	1976
Marshall McGregor	MO	1974	Maynard Crees	KS	1977
Lloyd Mygard	MD	1974	Ray Franz	MT	1977
Dave Matti	MT	1974	Forrest H. Ireland	SD	1977
Eldon Wiese	MN	1974	John A. Jameson	IL	1977
Lloyd DeBruycker	MT	1974	Leo Knoblauch	MN	1977
Gene Rambo	CA	1974	Jack Peirce	ID	1977
Jim Wolf	NE	1974	Mary & Stephen Garst	IA	1977
Henry Gardiner	KS	1974	Odd Osteross	ND	1978
Johnson Brothers	SD	1974	Charles M. Jarecki	MT	1978
John Blankers	MN	1975	Jimmy G. McDonnal	NC	1978
Paul Burdett	MT	1975	Victor Arnaud	MO	1978
Oscar Burroughs	CA	1975	Ron & Malcolm McGregor	IA	1978
John R. Dahl	ND	1975	Otto Uhrig	NE	1978
Eugene Duckworth	MO	1975	Arnold Wyffels	MN	1978

COMMERCIAL PRODUCER HONOR ROLL OF EXCELLENCE

James A. Theeck	TX	1992
Aquilla M. Ward	WV	1992
Albert Wiggins	KS	1992
Ron Wiltshire	CAN	1992
Andy Bailey	WY	1993
Leroy Beitelspacher	SD	1993
Glenn Calbaugh	WY	1993
Oscho Deal	NC	1993
Jed Dillard	FL	1993
Art Farley	IL	1993
Jon Ferguson	KS	1993
Walter Hunsuker	CA	1993
Nola & Steve Kleiboeker	MO	1993
Jim Maier	SD	1993
Bill & Jim Martin	WV	1993
Ian & Alan McKillop	ON	1993
George & Robert Pingetzer	WY	1993
Timothy D. Sutphin	VA	1993
James A. Theeck	TX	1993
Gene Thiry	MB	1993
Fran & Beth Dobitz	SD	1994
Bruce Hall	SD	1994
Lamar Ivey	AL	1994
Gordon Mau	IA	1994
Randy Mills	KS	1994
W.W. Oliver, V	VA	1994
Clint Reed	WY	1994
Stan Sears	CA	1994
Walter Carlee	AL	1995
Nicholas Lee Carter	KY	1995
Charles C. Clark, Jr.	VA	1995
Greg & Mary Cunningham	WY	1995
Robert & Cindy Hine	SD	1995
Walter Jr. & Evidean Major	KY	1995
Delhert Ohnemus	IA	1995
Olafson Brothers	ND	1995
Henry Stone	CA	1995
Joe Thielen	KS	1995
Jack Turnell	WY	1995
Tom Woodard	TX	1995
Jerry & Linda Bailey	ND	1996
Kory M. Bierle	SD	1996
Mavis Dummermuth	IA	1996
Terry Stuart Forst	OK	1996
Don W. Freeman	AL	1996
Lois & Frank Herbst	WY	1996
Mr./Mrs. George A. Horkan, Jr.	VA	1996
David Howard	IL	1996
Virgil & Mary Jo Huseman	KS	1996
Q. S. Leonard	NC	1996
Ken & Rosemary Mitchell	CAN	1996
James Sr, Jerry & James H Petik	SD	1996
Ken Risler	WI	1996

COMMERCIAL PRODUCER HONOR ROLL OF EXCELLENCE

Gary Johnson	KS	1988
John McDaniel	AL	1988
William A. Stegner	ND	1988
Lee Eaton	MT	1988
Larry D. Cundall	WY	1988
Dick & Phyllis Henze	MN	1988
Jerry Adamson	NE	1989
J.W. Aylor	VA	1989
Jerry Bailey	ND	1989
James G. Guyton	WY	1989
Kent Koostra	KY	1989
Ralph G. Lovelady	AL	1989
Thomas McAvoy, Jr.	GA	1989
Bill Salton	IA	1989
Lauren & Mel Schuman	CA	1989
Jim Tesher	ND	1989
Joe Thielen	KS	1989
Eugene & Ylene Williams	MO	1989
Phillip, Patty & Greg Bartz	MO	1990
John J. Chrisman	WY	1990
Les Herbst	KY	1990
Jon C. Ferguson	KS	1990
Mike & Diana Hooper	OR	1990
James & Joan McKinlay	CAN	1990
Gilbert Meyer	SD	1990
DuWayne Olson	SD	1990
Raymond R. Peugh	IL	1990
Lewis T. Pratt	VA	1990
Ken & Wendy Sweetland	CAN	1990
Swen R. Swenson Cattle	TX	1990
Robert A. Nixon & Son	VA	1991
Murray A. Greaves	CAN	1991
James Hauff	ND	1991
J.R. Anderson	WI	1991
Ed & Rich Blair	SD	1991
Reuben & Connee Quinn	SD	1991
Dave & Sandy Umbarger	OR	1991
James A. Theeck	TX	1991
Ken Stielow	KS	1991
John E. Hanson, Jr.	CA	1991
Charles & Clyde Henderson	MO	1991
Russ Green	WY	1991
Bollman Farms	IL	1991
Craig Utesch	IA	1991
Mark Barenthsen	ND	1991
Rary Boyd	AL	1992
Charles Daniel	MO	1992
Jed Dillard	FL	1992
John & Ingrid Fairhead	NE	1992
Dale J. Fischer	IA	1992
E. Allen Grimes Family	ND	1992
Kopp Family	OR	1992
Harold, Barbara & Jeff Marshall	PA	1992
Clinton E. Martin & Sons	VA	1992
Lloyd & Pat Mitchell	CAN	1992
William VanTassel	CAN	1992

COMMERCIAL PRODUCER HONOR ROLL OF EXCELLENCE

Ralph Pederson	SD	1983	Gary Johnson	KS	1986
Ernest & Helen Schaller	MO	1983	Ralph G. Lovelady	AL	1986
Al Smith	VA	1983	Ramon H. Oliver	KY	1986
John Spencer	CA	1983	Kay Richardson	FL	1986
Bud Wishard	MN	1983	Mr. & Mrs. Clyde Watts	NC	1986
Bob & Sharon Beck	OR	1984	David & Bev Lischka	CAN	1986
Leonard Fawcett	SD	1984	Dennis & Nancy Daly	WY	1986
Fred & Lee Kummerfeld	WY	1984	Carl & Fran Dobitz	SD	1986
Norman Coyner & Sons	VA	1984	Charles Fariss	VA	1986
Franklyn Esser	MO	1984	David J. Forster	CA	1986
Edgar Lewis	MT	1984	Danny Geersen	SD	1986
Boyd Mahrt	CA	1984	Oscar Bradford	AL	1987
Neil Moffat	CAN	1984	R.J. Mawer	CAN	1987
William H. Moss, Jr.	GA	1984	Rodney G. Oliphant	KS	1987
Dennis P. Solvie	MN	1984	David A. Reed	OR	1987
Robert P. Stewart	KS	1984	Jerry Adamson	NE	1987
Charlie Stokes	NC	1984	Gene Adams	GA	1987
Milton Wendland	AL	1985	Hugh & Pauline Maize	SD	1987
Bob & Sheri Schmidt	MN	1985	P.T. McIntire & Sons	VA	1987
Delmer & Joyce Nelson	IL	1985	Frank Disterhaupt	MN	1987
Harley Brockel	SD	1985	Mac, Don & Joe Griffith	GA	1988
Kent Brunner	KS	1985	Jerry Adamson	NE	1988
Glenn Harvery	OR	1985	Ken, Wayne & Bruce Gardiner	CAN	1988
John Maino	CA	1985	C.L. Cook	MO	1988
Ernie Reeves	VA	1985	C.J. & D.A. McGee	IL	1988
John R. Rouse	WY	1985	William E. White	KY	1988
George & Thelma Boucher	CAN	1985	Federick M. Mallory	CA	1988
Kenneth Bentz	OR	1986	Stevenson Family	OR	1988

COMMERCIAL PRODUCER OF THE YEAR

Chan Cooper	MT	1972
Pat Wilson	FL	1973
Lloyd Nygard	ND	1974
Gene Gates	KS	1975
Ron Blake	OR	1976
Steve & Mary Garst	IA	1977
Mose Tucker	AL	1978
Bert Hawkins	OR	1979
Jess Kilgore	MT	1980
Henry Gardiner	KS	1981
Sam Hands	KS	1982
Al Smith	VA	1983
Bob & Sharon Beck	OR	1984
Glenn Harvey	OR	1985
Charles Fariss	VA	1986
Rodney G. Oliphant	KS	1987
Gary Johnson	KS	1988
Jerry Adamson	NE	1989
Mike & Diana Hopper	OR	1990
Dave & Sandy Umbarger	OR	1991
Kopp Family	OR	1992
Jon Ferguson	KS	1993
Fran & Beth Dobitz	SD	1994
Joe & Susan Thielen	KS	1995
Virgil & Mary Jo Huseman	KS	1996

Virgil and Mary Jo Huseman, Huseman Ranch
1996 Commercial Producer of the Year
Ron Bolze, Executive Director;
Mary Jo and Virgil Huseman;
Glenn Brinkman, President

For Immediate Release

Virgil and Mary Jo Huseman receive the "1996 BIF Outstanding Commercial Producer Award"

Birmingham, Alabama - Virgil and Mary Jo Huseman, owners and operators of Huseman Ranch, Ellsworth, Kansas, have been selected as the Beef Improvement Federations (BIF) 1996 Outstanding Commercial Producer at their Convention held at the Sheraton Civic Center in Birmingham, Alabama.

Virgil and Mary Jo Huseman believe the only way to do something is to do it right. That has meant embracing change to create a trouble-free cowherd that profitably utilizes grass and forage and produces a quality calf. It is a philosophy that has dictated the way the Husemans manage their cow-calf operation. Although the Husemans didn't become full-time ranchers until 1979, their cowherd was established officially in 1971. At that time, they purchased a set of Angus cattle from a local producer, with the criteria being the first 100 head that calved unassisted and had a live calf. Today, the Husemans manage about 425 cows and additional replacement heifers. The herd consists of Angus and Angus-Hereford crosses. The Husemans conserve native grass for winter grazing by leaving winter pastures unstocked during the growing season. This mature grass is supplemented with other grazing on such forages as rye, triticale, brome and alfalfa during the fall, winter and early spring. When grazing is not available, alfalfa hay, prairie hay and cubes are the supplement.

Even though the Huseman's cow-herd always has been fertile and efficient, in 1983 they began adopting change in order to improve calf weaning weights, performance and visual conformation. To make this change, the Husemans soon learned they would have to invest more money than was spent in previous years to get the type of bull that was needed. While the industry was caught up in making cattle bigger, the Husemans resisted the temptation to buy bulls that would make their calves huge. They avoided taking this route primarily to maintain calving ease. With only family as employed staff, it is critical that their herd is able to calve unassisted. They concentrate on purchasing moderate growth, maternal, calving ease bulls that do not exceed a +2.5 BW EPD.

In 1990, the Husemans began artificially inseminating heifers. This has enabled them to produce daughters out of proven maternal bulls. Bull selection criteria includes using cleanup bulls stacked pedigreed for similar traits. Because this program has produced exceptional heifer and bull calves, the Husemans have been able to market commercial breeding heifers. Although they are unregistered, they have excellent genetics with several generations of calving ease. The Husemans maintains ownership on all of their cattle to some degree. For the past two years they have retained partial ownership on their steer calves all the way to the feedlot. The Husemans also have been able to collect carcass data on their cattle through this arrangement. The Husemans are counting on this type of information to help their continuous effort to improve the consistency and quality of their cowherd.

Virgil Huseman is deeply involved in all aspects of the beef business; from the production side as a cow-calf producer, stocker operator and cattle feeder and from the association side as an active leader in state and national trade associations that represent cattle interests. The Beef Industry Long Range Plan Task Force has consumed much of his time since 1993 and has led to the merger of the National Cattle's Association and the Beef Industry Council of the National Live Stock and Meat Board. Virgil believes these are interesting times in the beef business with value based marketing, price discovery, formulas, strategic alliances and mergers, all of which he has been an active participant in dealing with these issues. His ranching operation is truly a family-oriented business, but one that is also dedicated to improved quality of beef. He has been quick to adopt improvements in technology and management to bring about change. Heat synchronization, artificial insemination, rotational grazing, retained ownership and integrated resource management principals have all been used to get him closer to reaching his goals.

Under the Husemans definition of "doing things right", they believe there is always room for improvement. They may be guilty of being perfectionists, but for the Husemans, continuing to make improvements in order to achieve quality is a hard habit to break.

Virgil and Mary Jo are the proud parents of three children Clayton, Mark and Ashley that are deeply involved in the cattle operation. Virgil and Mary Jo Huseman were nominated by the Kansas Livestock Association. BIF is pleased to recognize this excellent production system with their 1996 Outstanding Commercial Producer Award.

1996 BIF
COMMERCIAL NOMINEES

Jerry & Linda Bailey
Jerry & Linda Bailey Ranch
Towner, North Dakota

Jerry Bailey has been in the commercial cattle business for 30 years at Towner, North Dakota. The Bailey ranch currently consists of 3000 acres of grass and hayland. The beef herd consists of 260 head of predominately Gelbvieh and Red Angus with some Simmental cross cows. Red Angus and Gelbvieh sires are used for replacement production, with Charolais sires being used as a terminal cross for feeder calves. The Bailey ranch selects brood cows that are of moderate size, milk very well and are of the breed combinations that maximize hybrid vigor and fertility. Through 25 years of performance testing the adjusted 205 day weights have increased from 473 pounds to 729 pounds. The Standardized Performance Analysis (SPA) trait of "pounds weaned per female exposed" is phenomenal. The past three years the Bailey herd has achieved over 590 pounds weaned per female exposed. Coupled to this growth is a calving distribution with over 90 percent of the cows calving in 63 days, producing the uniformity in the calf crop the Bailey operation has strived for the past 30 years.

The Jerry and Linda Bailey Ranch has been nominated by the North Dakota Beef Cattle Improvement Association.

Kory M. Bierle
Madsen Ranch
Midland, South Dakota

Kory and his parents own and operate a fourth and fifth generation cattle ranch in west central South Dakota. The ranch lies along the Bad River in Haakon County. Kory graduated from Black Hills State University in 1988 with a B.S. in Business Administration and an associate degree in accounting. The operation is truly a ranching operation. At the beginning of 1994 there will be less than seventy-five acres of farm ground. The farm ground that will remain will be utilized for small grain production to grow out replacement heifers.

The "new generation" ranching is requiring a different perspective concerning all facets of the business. All activities are now grouped into enterprises. These enterprises are monitored on a daily record input basis, are summarized at the conclusion of each one, and studied for profitability. Year end records are integrated as to financial and production combinations to gain an overall economic picture for future business directions. The "new generation" rancher is required to do more than "work the cattle" or "ride cows". Hopefully, Kory will learn the transition quickly and efficiently.

Madsen Ranch has been nominated by the South Dakota Beef Cattle Improvement Association.

Mavis Dummermuth
Dummermuth Farms, Inc.
Elgin, Iowa

Mavis Dummermuth and her son Kim operate the farm that Conner Dummermuth, husband and father, started in 1958. He died in 1989 after building a strong diversified family farm that includes 400 commercial crossbred cows.

The herd is really broken into two segments, with one group of about 150 primarily Angus cows bred to Simmental bulls. This "herd" is a source for half blood replacement heifers which are then bred to Angus bulls for the terminal cross. Kim is conscious of the color preference of buyers, so he wants as many black calves as possible. Their goal is to raise a 3/4 Angus calf, which will grade choice and finish at 1250 pounds.

From the early beginnings of 14 Hereford heifers, the primary Dummermuth herd is now composed primarily of black and black baldy cows which are bred to Angus. Kim studies the EPD's on all bull candidates, looking for strong weaning weight EPD's. He is also very interested in black Simmental genetics. The goal is to get the calves to wean at least 600 pounds without creep feed.

Calving season is planned with the rugged northeast Iowa winter in mind. The Dummermuth herd heifers are set to calve beginning late March with cows following by April 1. Most of the calving is finished by May 25. The goal of Kim and Mavis each year is to achieve a 100% calf crop. They reached 99% success two years ago.

Calves are backgrounded in the feedlot, usually until March and then sold at the Waukon Livestock Market. Sale weights are recorded and used as a measuring stick for the herd as a whole. Steer calves have been sold to the same buyer for the last five years. They finish at around 1200-1250 pounds and grade Choice.

Dummermuth Farms is a strong example of a truly commercial cattle operation run by environmentally conscious, hard working Iowans who use cows to make the best use of their land. Connor Dummermuth believed in keeping things simple and that's what it is. A simple commercial operation.

Dummermuth Farms, Inc. has been nominated by the Iowa Cattlemen's Association.

Terry Stuart Forst
Stuart Ranch
Caddo, Oklahoma

Terry Stuart Forst is the manager of the Stuart Ranch in Oklahoma, which was established by her great, great grandfather in 1868, and has the distinction of being the oldest ranch in the state of Oklahoma under continuous family ownership. The family operates over 40,000 acres in Bryan and Atoka counties in southeastern Oklahoma and in Jefferson county in southwestern Oklahoma. The operation consists of over 1400 mama cows, wheat pasture, a quarter horse operation and leased hunting. Cows are located on 3 separate ranches in Oklahoma. Headquarters (Bryan & Atoka counties) has a fall calving herd of 610 cows and first-calf heifers. Blue River Division (Bryan county) has a spring calving herd of 227 cows and the Waurika Division (Jefferson county) has a spring cow herd and first-calf heifers of 520 head. Also, 136 heifers have been exposed to calve in the fall of 1996. The cows and heifers are on a 60-day breeding season. Changes over time include improvements in pregnancy percentage (70 to 87.6%), calving percentage (65 to 84.9%), calf death loss (6 to 4.9%), weaning percentage (60 to 80.9%), as well as increases in pounds weaned per exposed female. The Stuart Ranch strives to be an active participant in the beef and horse industries and to produce a consistent, quality product which will return profit to the ranch, sustain a comfortable lifestyle for the owners and employees and satisfy the demands of their customers. Also, Stuart Ranch seeks to utilize their available resources in good stewardship practices for the betterment of the range, livestock, wildlife and people.

Stuart Ranch has been nominated by the Oklahoma Cooperative Extension Service and the Samuel Robets Nobel Foundation.

Don W. Freeman
Freeman Farms
Lowndesboro, Alabama

Freeman Farms is a family farm that is owned and operated by Don W. and Marilyn Freeman in Lowndes County, near Lowndesboro, Alabama. The farm consists of 800 acres of owned pasture and hayland, 1200 acres owned timber land, and 480 acres of rented pasture and hayland. In 1970 Don started farming full time, raising ½ Angus, ½ Holstein dairy calves to get a cow herd started.

In 1990 Freeman Farms had a 250 head cow-calf operation. They began keeping performance records with BCIA and also on a home computer program "Cow Card", with the goal of increasing the herd to 500 cows. With encouragement from many informed sources, Freeman began an artificial insemination program in the heifers.

Today the Freeman's run a 500 cow commercial cow-calf operation with the calving season running from November 1 through January 30. Angus, Simmental and Charolais breeds are used in the breeding program. Calves are weaned in July and August. After backgrounding, 150 head of the heaviest steers are sent to a feedlot in Kansas with retained ownership in order to obtain rate of gain and carcass data on each animal. The lighter steers are put on winter grazing and sold in early May in the West Central Alabama Feeder Cattle Marketing Association board sale. Approximately 100 of the best heifers chosen from performance records are kept for replacements. Some of these are sold by private treaty and through the BCIA heifer sale. The remaining heifers are grazed on winter crops and sold in the board sale along with the steers.

Freeman Farms has been nominated by the Alabama Beef Cattle Improvement Association.

Lois & Frank Herbst
Herbst Lazy TY Cattle Company
Shoshoni, Wyoming

Herbst Lazy TY Cattle Company is managed by Lois Herbst, and her son Frank, in central Wyoming. The original ranch was homesteaded in 1906, by Frank Herbst from Gottschee, Austria, now a part of Slovenia. The ranch has nurtured a commitment to production of quality beef for three generations. Under the second generation management of William Herbst, black Angus bulls were used in crossbreeding with the original Herefords to produce a herd with exceptionally good maternal qualities.

Bill died in October, 1990, of leukemia. Lois and son, Frank formed the Herbst Lazy TY Cattle Company and are working with proven, conservative management practices while further improving the genetic base of their black baldy cattle. In recent years, they have concentrated on developing quality replacement heifers, with some retained in the herd, and good demand from repeat buyers for those that they market.

Frank and Lois are attempting to select Black Angus bulls that genetically give them the pounds to replace the heterosis they had from crossbreeding with Hereford bulls. The bulls are selected using a study of EPD's from proven sires, and, if possible, a discussion with the breeder on all data available.

Frank and Lois are meeting their goals of maintaining and improving the maternal qualities of the herd while having increased the weaning weights by 19%.

The major goal in the Herbst family is to maintain the ranch for the next generation if they want to continue producing quality beef. To this end, Frank and Lois want to stay abreast of developing technology to enable the fourth generation an opportunity to be successful ranchers.

The Herbst Lazy TY Cattle Company has been nominated by the Wyoming Beef Cattle Improvement Association.

Mr. & Mrs. George A. Horkan, Jr.
Cleremont Farm
Upperville, VA

Cleremont Farm is a family farm of 600 acres of open land and large tracts of timberland located at Upperville, Loudoun county, Virginia. The principals are George A. Horkan, Jr., and Carl Lindgren, who is responsible for the day to day management. The farm has been active for 38 years and now operates as the Cleremont Farm general partnership. The herd was started in 1960 with the purchase of 20 Angus cows and has grown to it's present size of 260 brood cows, employing a straightbred Angus program since it's inception. The goal of Cleremont Farm is to breed and produce moderate framed working cattle that perform well on grass and hay, and to produce calves that can be sold in uniform groups based on size and performance.

Complete performance and financial records are dept on the entire herd. Cows are individually identified. Birth, weaning and yearling weights are routinely taken and an on-farm computer system is utilized to maintain both performance and financial records.

Genetic improvement in the Cleremont herd is quite evident with weaning weights having increased dramatically over the past five years. The breeding program combines the use of proven bulls through artificial insemination and performance tested natural service bulls that have been purchased through BCIA central bull test stations, BCIA consignment bull sales at Staunton and from private breeders.

For many years, feeder cattle have been marketed at the Fauquier Livestock Exchange. In recent years, because of the genetic ability of the herd, replacement heifers have been sold to other producers, privately and through the Staunton BCIA and Virginia Beef Expo sales. More recently, all calves have been backgrounded and feeders have been sold in trailer load lots direct.

George Horkan and Carl Lindgren say the most profitable improvements they have made in the management of the herd have been the use of AI as a breeding tool, a development of a replacement heifer market, selling trailer loads of steers direct and maintaining the cow herd in manageable groups to best utilize pasture and forage. Cleremont has been involved with the Virginia BCIA, Virginia Cattlemen's Association, the National Cattlemen's Association, the American Angus Association, the Virginia Angus Association, the Northern Virginia Angus Association and the Fauquier Livestock Market Association. Sire evaluation for Certified Angus Beef has been carried out on the farm.

Cleremont Farm has been nominated by the Virginia Beef Cattle Improvement Association.

David Howard
Cold Springs Farm
Hanover, Illinois

As manager of Cold Springs Farms, David Howard is a leader and innovator in the beef cattle industry of northwestern Illinois. The operation consists of approximately 200 commercial cows and a 3500 head capacity feedlot. The cow herd has been developed from a Simmental base. The feedlot finishes mostly yearling cattle, plus the calves from the cow herd.

Dave's performance testing program is based on a computer program developed by himself and programmed by his brother. The program includes birth weight, weaning weight, weaning weight ratios, and Most Probable Producing Ability (MPPA) for each cow. Data was collected for three years before using it to cull cows. This greatly increases Dave's confidence in the data. Replacement heifers must have an above average weaning weight and her dam must have an above average MPPA to be retained in the cow herd. Pelvic area is also collected on all replacement heifers. This program has been used to cull cows over the past 6 years and in that time average weaning weight has increased by 122 pounds, while weaning a 94% calf crop in 1994. In addition, the cow herd is more uniform, resulting in a more manageable cow herd.

The goal of Dave's operation is to use the natural resources at his disposal in an economical, efficient and ecologically safe manner. His innovative management includes the development of an intensive grazing system for the 200 head cow herd. Dave also attended the very first Total Quality Management (TQM) seminar sponsored by the National Cattlemen's Association, held in the spring of 1993 at Rochell, Illinois. Dave has incorporated TQM practices into the management of his total operation.

Cold Springs Farm has been nominated by the Illinois Beef Association Beef Improvement Council and the University of Illinois Cooperative Extension Service.

Ken & Rosemary Mitchell
Annan, Ontario, Canada

Ken and Rosemary Mitchell operate a 550 acre farm near Georgian Bay in Grey County, Ontario. Their cow calf operation consists of a commercial herd of 87 cows with 20 replacement heifers, and a 25 head purebred Gelbvieh herd which they manage.

The commercial cow herd was established 10 years ago with 30 cows and record keeping in Beef herd Improvement Program (BHIP) began immediately. The performance records available through BHIP have made a significant contribution to the production of the herds average weaning weights by 100 lbs. The 100 lb increase came about through replacement heifer selection using BHIP information and bull selection based on performance information available on bulls from BIO Bull Evaluation Centers. Heifer replacements are selected based on cow family performance for calving interval, cow productivity and average weaning index. The heifer herself must also have an above average weaning index. Selected bulls must provide good replacements and valuable steers. The herd consists of crossbred females with a high degree of heterosis. As a result the Across Breed EPDs produced by BIO are a very valuable tool for bull selection because different breeds are utilized for crossbreeding to maintain heterosis. Recently the Mitchell's have began an accelerated heifer replacement program. The strategy is to breed the replacement heifers to AI bulls that provide easy calving and top notch candidates for heifer replacement. This strategy is applied to the heifers they develop in the Grey Heifer Development Center.

Ken wanted to evaluate the various sires he uses for carcass merit. Being a participant of BIO-LINK (carcass information feedback program) provided the information Ken wanted. The BIO-LINK information showed an average carcass weight of 723 lb, and average lean yield of 61%, and an average days to market of 417 days. BIO-LINK also provided averages by sire for carcass traits, therefore, providing the information that Ken was keenly interested in.

Ken and Rosemary's program has successfully developed in a very quick time period. Last fall the cows were weighed at weaning time. The cows differed in weight by 900 lbs. This range was not expected but by measuring, the Mitchell's have established a new area they wish to improve. Ken is now contemplating the best approach for selection to establish the size of the most profitable cow for him, based on his farm's resources.

Ken and Rosemary Mitchell have been nominated by Beef Improvement Ontario.

James Sr., Jerry & James H. Petik
Jim Petik and Sons, Inc.
Keldron, South Dakota

Vaclav Petik came to the United States from Bohemia in 1907. In 1913 he brought his family to a homestead in northwestern South Dakota. Vaclav lost his wife in the flu epidemic of 1918. He struggled to raise four young children alone, on 160 acres of marginal land, in a harsh climate.

James, born in 1915, remained on the homestead and survived the "Dirty Thirties". By 1960, with the help of his wife, Pearl, and their five children, they built the operation into a ranch with two headquarters and a 250-head cow herd. In the late 50's and early 60's they began crossbreeding with Charolais bulls on the Hereford cows. During the mid 60's they introduced Angus into their breeding program. Today the primarily black and black baldy cow-herd has grown to 900 head. Much of the work with the cattle is still done on horseback, due to rough terrain in many of the pastures.

Though ranching is the primary focus for the Petiks, farming is also part of the operation. The Petiks raise feed grain and forage for hay and silage, and some cash crop wheat. They believe diversification has made the operation more viable.

"Our philosophy is to keep a balance between profit and stewardship. As we invest in our business, we must also invest in the land, the community, and it's people. We feel this philosophy and our goals have allowed us the privilege to see the fourth generation returning to the ranch".

Jim Petik and Sons, Inc. has been nominated by the American-International Charolais Association.

Virgil Huseman
Huseman Ranch
Ellsworth, Kansas

Ellsworth cattleman Virgil Huseman believes the only way to do something is to do it right. For the commercial cattleman, that has meant embracing change to create a trouble-free cowherd that profitably utilizes grass and forage and produces a quality calf. It is a philosophy that has dictated the way Huseman manages his cow-calf operation.

Although Huseman didn't become a full-time rancher until 1979, his cowherd was established officially in 1971. At that time, he purchased a set of Angus cattle. Those heifers were fertile, they bred, calved unassisted and continued to do that through most of their lives.

Today, Huseman along with his family manages about 425 cows and additional replacement heifers. His herd consists of Angus and Angus-Hereford crosses. In 1983, Huseman began to evaluate the quality of his calves. It was then he began adopting change in order to improve calf weaning weights, performance and visual conformation. In 1990, Huseman began artificially inseminating heifers. This program has enabled him to produce daughters out of proven maternal bulls. His criteria even includes using cleanup bulls with good pedigrees.

Virgil has played an active role in state and national trade associations that represent cattle interests. The Beef Industry Long Range Plan Task Force has consumed much of his time since 1993 and has led to the merger of the National Cattlemen's Association and the Beef Industry Council of the National Livestock and Meat Board. Virgil believes these are interesting times in the beef business with value based marketing, price discovery, formulas, strategic alliances and mergers, all of which he has been an active participant in dealing with these issues. Under Huseman's definition of "doing things right", he believes there is always room for improvement. He may be guilty of being a perfectionist, but for Huseman, continuing to make improvements in order to achieve quality is a hard habit to break.

Huseman Ranch has been nominated by the Kansas Livestock Association Purebred Council.

Q. S. Leonard
Leonard Farm
Louisburg, North Carolina

Q.S. Leonard has been in the cattle business his entire life, 74 years. Q.S. and his late brother, George W. Leonard, purchased a herd of purebred Polled Herefords in the 1940's from a herd in Georgia. By the late 1970's, the commercial cattle operation was the main enterprise on the farm, in addition to small grains, soybeans and tobacco. Through their knowledge of genetic principles and forage production, they made their cattle operation a profitable one.

Several breeds were introduced into the Polled Hereford herd in the early 1970's, with Shorthorn, Angus, Charolais, followed by Simmental. All the herd sires were performance tested with yearling weights increasing from 675 lbs. in 1970 to 925 lbs. in 1995. Since the early 1990's, the herd is primarily black Angus and black Simmental. Artificial insemination has been used since 1980 on a select group of cows. The herd bulls are all moderate framed, heavy muscled and are primarily selected on EPD figures as well as performance data. The herd is computerized on the Nebraska "PC Cowcard" program. The majority of the calving is in a 90 day period from November to January. The calves are weaned in August and September and stockered on quality pasture until sold in December or January. The top-end of the heifer crop is sold as replacement heifers.

One area in which Mr. Leonard also excels is in educating young people about animal agriculture, especially beef cattle production. For the past fifteen years, the Leonard farm has been open to youth involved in the 4-H program to select, train and exhibit heifers and steers at regional and state levels. Many of the Leonard Farm steers and heifers have been recognized as Grand and Reserve Champions at many state fairs. Many of these steers also won the carcass division of the shows.

Leonard Farm has been nominated by the North Carolina Beef Cattle Improvement Program.

Ken Risler
Huntsinger Farms, Inc.
Eau Claire, Wisconsin

Huntsinger Farms is the largest grower and processor of Horseradish in the United States. Horseradish, as cultivated in Wisconsin, needs to be part of a crop rotation and is grown on the same ground only once every five to seven years. For many years this rotation consists of only row crops. Farming is done on mostly light soils and a forage crop is included in the program to help conserve and build the land. This decision was finalized after numerous experiments were conducted that proved yields of Horseradish were greater following a forage crop. Beef cattle production was the answer to utilizing the marginal land and to converting the hay and haylage into a marketable product. This provided another enterprise that compliments and integrates with our number one crop, Horseradish.

Huntsinger Farms, Inc. has been nominated by the Wisconsin Beef Improvement Association.

AMBASSADOR AWARDS

Warren Kester	Beef Magazine	MN	1986
Chester Peterson	Simmental Shield	KS	1987
Fred Knop	Drovers Journal	KS	1988
Forrest Bassford	Western Livestock Journal	CO	1989
Robert C. DeBaca	The Ideal Beef Memo	IA	1990
Dick Crow	Western Livestock Journal	CO	1991
J.T. "Johnny" Jenkins	Livestock Breeder Journal	GA	1993
Hayes Walker, III	America's Beef Cattleman	KS	1994
Nita Effertz	Beef Today	ID	1995
Ed Bible	Hereford World	MO	1996

Ed Bible, Hereford World Magazine,
Receives the 1996 BIF Ambassador Award
Ron Bolze, Executive Director;
Ed Bible, Glenn Brinkman, President

For Immediate Release

Ed Bible receives the "1996 BIF Ambassador Award"

Birmingham, Alabama - The Beef Improvement Federation (BIF) honored Ed Bible with the Ambassador Award at the convention at the Sheraton Civic Center in Birmingham, Alabama.

Ed Bible is Vice President and Director of Communications for the American Hereford Association. He also serves as editor of the breed's official publication, *Hereford World*.

He assumed his current position in September, 1995 upon the merger of the American Hereford Association and American Polled Hereford Association (APHA). His positions at APHA included communications director, magazine editor, field staff director and chief executive officer.

He began his 23-year tenure in breed association work following a three-year stint in the University of Tennessee's Ag Communications Department. He holds B.S. and M.S. degrees in animal science and journalism from the University of Tennessee-Knoxville.

Bible served several years on the board of Livestock Publications Council and was the Council's president in 1985-86. He was inducted into the Livestock Publications Council Hall of Fame in July 1994. He is a member of American Agricultural Editors Association and is an associate member of Ag Communicators in Education.

He has served as president of the Missouri-Kansas chapter of the National Agri-Marketing Association (NAMA), was on NAMA's national executive committee and was named NAMA's Ag Communicator of the Year in 1993.

Each year, BIF recognizes the Ambassador Award Recipient as an individual from the livestock media who has promoted BIF principles and the performance beef cattle movement.

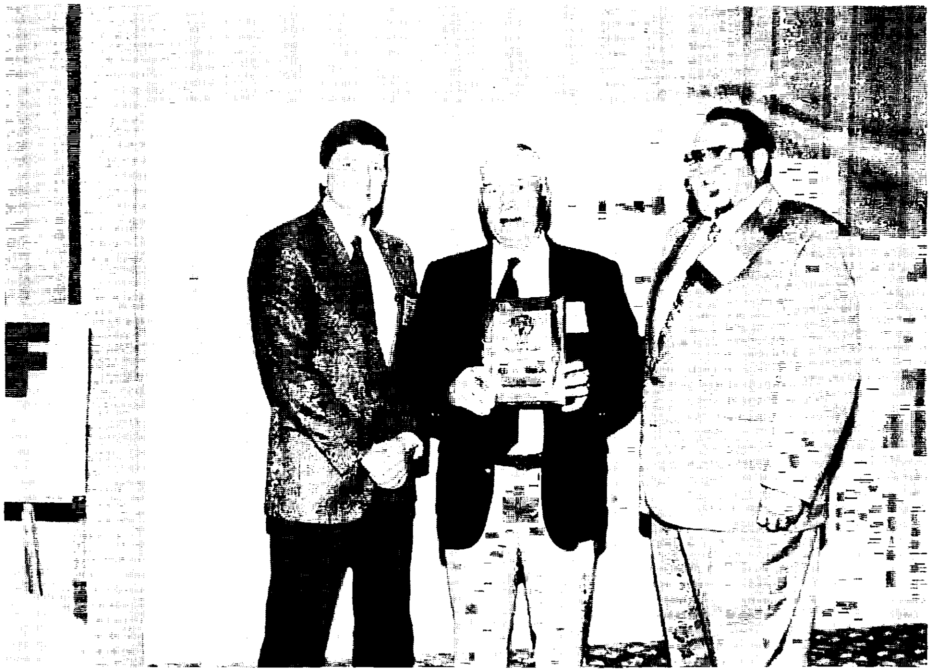
BIF is pleased and honored to recognize the many contributions of Ed Bible by presenting him with the BIF Ambassador Award.

PIONEER AWARDS

Jay L. Lush	IA	1973	Richard T. "Scotty" Clark	USDA	1980
John H. Knox	NM	1974	F.R. "Ferry" Carpenter	CO	1981
Ray Woodward	ABS	1974	Clyde Reed	OK	1981
Fred Wilson	MT	1974	Milton England	TX	1981
Charles E. Bell, Jr.	USDA	1974	L.A. Moddox	TX	1981
Reuben Albaugh	CA	1974	Charles Pratt	OK	1981
Paul Pattengale	CO	1974	Otha Grimes	OK	1981
Glenn Butts	PRT	1975	Mr. & Mrs. Percy Powers	TX	1982
Keith Gregory	MARC	1975	Gordon Dickerson	NE	1982
Bradford Knapp, Jr.	USDA	1975	Jim Elings	CA	1983
Forrest Bassford	WLJ	1976	Jim Sanders	NV	1983
Doyle Chambers	LA	1976	Ben Kettle	CO	1983
Mrs. Waldo Emerson Forbes	WY	1976	Carroll O. Schoonover	WY	1983
C. Curtis Mast	VA	1976	W. Dean Frischknecht	OR	1983
Dr. H.H. Stonaker	CO	1977	Bill Graham	GA	1984
Ralph Bogart	OR	1977	Max Hammond	FL	1984
Henry Holsman	SD	1977	Thomas J. Marlowe	VA	1984
Marvin Koger	FL	1977	Mick Crandell	SD	1985
John Lasley	FL	1977	Mel Kirkiede	ND	1985
W.L. McCormick	GA	1977	Charles R. Henderson	NY	1986
Paul Orcutt	MT	1977	Everett J. Warwick	USDA	1986
J.P. Smith	PRT	1977	Glenn Burrows	NM	1987
James B. Lingle	WYE	1978	Carlton Corbin	OK	1987
R. Henry Mathiessen	VA	1978	Murray Corbin	OK	1987
Bob Priode	VA	1978	Max Deets	KS	1987
Robert Koch	MARC	1979	George F. & Mattie Ellis	NM	1988
Mr. & Mrs. Carl Roubicek	AZ	1979	A.F. "Frankie" Flint	NM	1988
Joseph J. Urick	USDA	1979	Christian A. Dinkel	SD	1988
Bryon L. Southwell	GA	1980	Roy Beeby	OK	1989

PIONEER AWARDS

Will Butts	TN	1989	James D. Bennett	VA	1993
John W. Massey	MO	1989	O'Dell G. Daniel	GA	1993
Donn & Sylvia Mitchell	CAN	1990	M.K. "Curly" Cook	GA	1993
Hoon Song	CAN	1990	Dixon Hubbard	USDA	1993
Jim Wilton	CAN	1990	Richard Willham	IA	1993
Bob Long	TX	1991	Dr. Robert C. DeBaca	IA	1994
Bill Turner	TX	1991	Tom Chrystal	IA	1994
Frank Baker	AR	1992	Roy A. Wallace	OH	1994
Ron Baker	OR	1992	James S. Brinks	CO	1995
Bill Borror	CA	1992	Robert E. Taylor	CO	1995
Walter Rowden	AR	1992	A.L. "Ike" Eller	VA	1996
James W. "Pete" Patterson	NC	1993	Glynn Debter	AL	1996
Hayes Gregory	NC	1993			



A.L. "Ike" Eller Receives the
1996 BIF Pioneer Award
Ron Bolze, Executive Director
Ike Eller and Glenn Brinkman, President

Glenn Debter Receives the
1996 BIF Pioneer Award
Ron Bolze, Executive Director;
Glenn Debter and Glenn Brinkman, President

For Immediate Release

A.L. "Ike" Eller, Jr. receives a "1996 BIF Pioneer Award"

Birmingham, Alabama - The Beef Improvement Federation (BIF) honored Ike Eller with a Pioneer Award at the Convention held at the Sheraton Civic Center in Birmingham, Alabama.

A.L. "Ike" Eller, Jr. was born in 1933 and raised on a general livestock farm near Chilhowie (Smyth County) Virginia. He was active in 4-H and FFA and was a member of the State FFA Livestock Judging Team in 1948. He earned the B.S. and M.S. degrees in Animal Science from Virginia Tech in 1955 and 1965, respectively, and the Ph.D. in Animal Science at the University of Tennessee in 1972. Ike's Ph.D. dissertation examined measures of fatness and skeletal size in explaining weight and size differences in yearling Angus and Hereford bulls and set the stage for greater understanding of maturity patterns in beef cattle today.

Ike served his country as an enlisted man in the U.S. Army. Ike came up through the extension ranks having served as assistant county Extension Agent in Tazewell County, Virginia and County Extension Agent in Russell County, Virginia. He joined the Virginia Tech Animal Science teaching staff in 1960 and served as Extension Animal Scientist, Beef Cattle Specialist from 1961-1992. Ike served as Extension Project Leader in the Virginia Tech Animal Science Department from 1975 - 1992 and currently serves as Extension Animal Scientist Emeritus and manager of the Virginia Beef Exposition. For years, Ike assumed the lead role in the Virginia Beef Cattle Improvement Association as manager of the nationally renown Culpeper, Wytheville and Red House Central Bull Testing programs.

Through the years, service to the beef cattle industry has been one of Ike's priorities. He contributed greatly to founding the Beef Improvement Federation and has served as Eastern Regional Secretary and as Executive Director from 1982 - 1986. Ike has served in an advisory capacity for numerous groups including the Virginia Charolais, Simmental and Polled Hereford Associations; the Beef Sire Committee for Select Sires, Inc., Plain City, Ohio; the American Hereford, Angus and Polled Hereford Association performance programs; and the planning committee for the National Extension -Industry Invitational Workshop on beef cattle reproductive management. Ike's expertise has been demanded abroad through his service as a technical assistance team member in Hungary in 1977 and 1979 and in Croatia in 1993 and as a beef cattle judge at the National Beef Cattle Show and lecturer in Zimbabwe in 1985. Ike also served as a technical team member to the U.S. Virgin Islands and assisted in establishing the breed association and performance records system for the Senepol breed of cattle.

Ike has been the recipient of numerous honors and awards. BIF honored him with the Continuing Service Award in 1976. Others include the Virginia Tech Block and Bridle Club Annual Dedication, Virginia Angus Association Honorary Membership, Virginia Beef Cattle Improvement Association Superior Service Award, Southern Section of the American Society of Animal Science Distinguished Extension Worker Award, Gamma Sigma Delta Extension Award of Merit, Virginia Tech Alumni Award for Extension Excellence, Virginia Cattlemen's Association Martin F. Strate Virginia Beef Industry Service Award, American Polled Hereford Association Hall of Merit Award for Research and Education, American Society of Animal Science National Extension Award, Epsilon Sigma Phi Individual Extension Excellence Award, Epsilon Sigma Phi State Distinguished Service Award, Virginia Association of Extension Home Economists Award for Extension Achievement, Virginia Cooperative Extension Service Director's Award, Virginia Agri Business Council Extension Excellence Award, National Association of County Ag. Agents Distinguished Service Award and Progressive Farmer Magazine Man of the Year in Virginia Agriculture in 1993.

Ike is a member and Deacon of Blacksburg Baptist Church and is married to the former Carolyn Leonard of Bristol, Virginia. They are the proud parents of four children - Amy, Evelyn, John and Karen.

In short, Ike exemplifies the Pioneering spirit of BIF such that he is often referred to as Mr. BIF. BIF is honored to recognize the many contribution's of A.L. "Ike" Eller, Jr. by presenting him with the BIF Pioneer Award.

For Immediate Release

Glynn Debter receives a "1996 BIF Pioneer Award"

Birmingham, Alabama - The Beef Improvement Federation (BIF) honored Glynn Debter of Horton, Alabama with a Pioneer Award at the Convention held at the Sheraton Civic Center in Birmingham, Alabama.

The next BIF pioneer is an individual who does not set goals, but directions. Goals can be achieved, but directions are continuous and never allow one to stop.

This pioneer purchased his first bred heifers in 1948. With these cattle, a breeding and merchandising program was set into motion. Today, 250 registered and 100 commercial Hereford cattle are raised on 1,000 acres. None of these cattle are average. For average is another taboo word for this cattle operator. To be average is to be just as close to the top as to the bottom. Performance measurement and standardization on all cattle have been the mode of operation for over 30 years. Performance records allow cattle to prove themselves or cull themselves. Today, EPD's are the foundation of the breeding and culling program which produces balanced, outstanding breeding stock.

Glynn Debter is not just a dedicated cattleman. He is also a true industry spokesman and mentor of young people. Glynn has served on the boards of BIF, the Alabama Cattlemen's Association (including President), the American Hereford Association (including President in 1988), the Alabama Purebred Beef Breeds Council, Community Bank of Snead and Blount County Agribusiness Center.

Current, Glynn is the chairman of the newly merged American Hereford Association and will serve in that capacity until 1998. He is also actively involved in the National Cattlemen's Beef Association and president of the Alabama Purebred Beef Breeds Council. It is difficult to determine how many young people he has significantly changed through his sponsorship of American Junior Hereford Association banquets, field days and 4-H and collegiate judging contests.

The annual Debter production sale has long ranked as one of the south's premiere sources of germplasm. This production sale is successful because this pioneer is dedicated to customer service and providing customers with problem free cattle through sound selection practices. The sale continues to be successful because Glynn Debter sells the Hereford breed and the cattle industry wherever he goes.

Alabama has long recognized the shining light and enthusiasm in Glynn Debter. He was inducted into the Alabama Livestock Hall of Fame in 1990, was honored as the Alabama BCIA purebred producer of the year in 1988 and was honored as the 1989 BIF Seedstock producer of the year.

The U.S. Beef Cattle Industry has greatly benefited from Glynn Debter and his contributions. BIF is pleased and honored to recognize the many contributions of Mr. Glynn Debter of Horton, Alabama by presenting him with the BIF Pioneer Award.

CONTINUING SERVICE AWARD RECIPIENTS

Clarence Burch	OK	1972
F.R. Carpenter	CO	1973
E.J. Warwick	DC	1973
Robert DeBaca	IA	1973
Frank H. Baker	OK	1974
D.D. Bennett	OR	1974
Richard Willham	IA	1974
Larry V. Cundiff	NE	1975
Dixon D. Hubbard	DC	1975
J. David Nichols	IA	1975
A.L. Eller, Jr.	VA	1976
Ray Meyer	SD	1976
Don Vaniman	MT	1977
Lloyd Schmitt	MT	1977
Martin Jorgensen	SD	1978
James S. Brinks	CO	1978
Paul D. Miller	WI	1978
C.K. Allen	MO	1979
William Durfey	NAAB	1979
Glenn Butts	PRI	1980
Jim Gosey	NE	1980
Mark Keffeler	SD	1981
J.D. Mankin	ID	1982
Art Linton	MT	1983
James Bennett	VA	1984
M.K. Cook	GA	1984
Craig Ludwig	MO	1984
Jim Glenn	IBIA	1985
Dick Spader	MO	1985
Dick Spader	MO	1985
Roy Wallace	OH	1985
Larry Benyshek	GA	1986
Ken W. Ellis	CA	1986
Earl Peterson	MT	1986
Bill Borror	CA	1987
Daryl Strohbehn	IA	1987
Jim Gibb	MO	1987
Bruce Howard	CAN	1988
Roger McCraw	NC	1989
Robert Dickinson	KS	1990
John Crouch	MO	1991
Jack Chase	WY	1992
Leonard Wulf	MN	1992
Henry W. Webster	SC	1993
Robert MCGuire	AL	1993
Charles McPeake	GA	1993
Bruce E. Cunningham	MT	1994
Loren Jackson	TX	1994
Marvin D. Nichols	IA	1994
Steve Radakovich	IA	1994
Dr. Doyle Wilson	IA	1994
Paul Bennett	VA	1995
Pat Goggins	MT	1995
Brian Pogue	CAN	1995
Harlan D. Ritchie	MI	1996
Doug L. Hixon	WY	1996

Harlan D. Ritchie Receives the
1996 BIF Continuing Service Award
Ron Bolze, Executive Director;
Harlan Ritchie and Glenn Brinkman, President

Doug L. Hixon Receives the
1996 BIF Continuing Service Award
Ron Bolze, Executive Director;
Doug Hixon and Glenn Brinkman, President

For Immediate Release

Harlan D. Ritchie receives a "1996 Continuing Service Award".

Birmingham, Alabama - The Beef Improvement Federation (BIF) honored Harlan Ritchie with a Continuing Service Award at the Convention held at the Sheraton Civic Center in Birmingham, Alabama.

Harlan D. Ritchie was born in 1935 and grew up on a general livestock and grain farm in Northwest Iowa. As a youth, he was active in 4-H and vocational agriculture at county, regional and state levels. He received the B.S. in Animal Science in 1957 from Iowa State University. By the end of his sophomore year, he had achieved the highest scholastic average in the College of Agriculture. Dr. Ritchie accepted an assistant instructorship at Michigan State University where he pursued graduate work under the renowned research team of E.R. Miller, D.E. Ullrey and J.A. Hoefer. His research dealt with interrelationships between calcium, zinc, copper and iron in the growing-finishing pig.

The Ph.D was awarded in January, 1964, when Dr. Ritchie was appointed Assistant Professor at Michigan State University, with subsequent promotions to Associate Professor and Professor in 1968 and 1971, respectively. Dr. Ritchie became keenly interested in the genetics of swine improvement and worked closely with swine breeders and industry leaders throughout the 1960s in pursuit of a leaner, more muscular hog. Upon becoming a full-time faculty member in 1963, Dr. Ritchie was assigned to the department's beef cattle section. He was also appointed coordinator of the department's undergraduate curriculum, which was his major responsibility from 1964 to 1973. He conceived the idea of a scholarship fund for deserving students, which led to establishment of the Michigan Livestock Industry Scholarship Foundation in 1966. During this 9-year period, there was a doubling of student enrollment, and Michigan State's undergraduate program in Animal Science became widely recognized for its excellence. During his teaching career, Dr. Ritchie taught nine different courses and interacted with 4,000 students. He was advisor to over 200 undergraduates, six graduate students, served as faculty advisor to the Block & Bridle Club, and coached the livestock judging team.

With the advent of beef yield grading in 1965, it became apparent to Dr. Ritchie and his colleagues that the nation's cattle population was not fully equipped genetically to meet the needs of the rapidly expanding commercial feeding industry. Dr. Ritchie soon became one of the nation's leading proponents of the need to select for leaner, faster-growing cattle that would finish at a more desirable weight and younger age. In 1971, he took a 6-week leave to study 28 Continental breeds in five European countries. His widely-read staff paper, "Observations of European Breeds of Cattle," gave U.S. cattlemen an early, unbiased perspective of how these leaner, more muscular breeds might realistically fit into domestic crossbreeding programs.

In 1973, Dr. Ritchie shifted from a teaching/research to an extension/research appointment, which he holds to this day. Dr. Ritchie is best-known for his work in swine and beef cattle improvement, efficiency of beef production, beef cattle dystocia, and retained ownership programs. Recently, he has become nationally prominent for his work on food safety. His 1990 staff paper on the safety of animal products is used widely as a reference by home economists. He is recognized for his work on the economics of preconditioning and creep feeding programs, mineral supplementation of beef cow herds, development of beef replacement heifers, utilization of low-quality forages, estrus detection aids, pre-weaning health programs and drought management of beef cattle. He has authored or co-authored innumerable refereed journal articles abstracts, experiment station research papers, extension bulletin's, extension staff papers, extension newsletter articles and trade journal articles. Since 1981, he has made 95 invited presentations in 34 U.S. states, 6 Canadian provinces and 4 Australian states.

Dr. Ritchie has served as an advisor to the National Beef Board, National Cattlemen's Association, three national A.I. organizations, five national beef breed associations and five state agricultural organizations. He has officiated the national shows of 13 breeds of beef cattle and 7 breeds of swine in the U.S. and Canada, the national Angus shows in Argentina and Australia, and the national Swine Show of Mexico. His educational programs have earned him numerous honors, including two prestigious awards from the American Society of Animal Science (ASAS), the Animal Industry Service Award in 1992 and the Outstanding Extension Specialist Award in 1983. In addition to ASAS, he is a member of American Registry of Professional Animal Scientists (ARPAS) and the Council for Agricultural Science and Technology (CAST). In 1957, he married an Iowa State classmate, Lou Ellyn Hale, who passed away in 1993. They are the parents of three sons.

BIF is pleased and honored to recognize the many contributions of Harlan Ritchie by presenting him with the BIF Continuing Service Award.

FOR IMMEDIATE RELEASE

Doug L. Hixon receives a "1996 BIF Continuing Service Award"

Birmingham, Alabama - The Beef Improvement Federation (BIF) honored Doug Hixon with a Continuing Service Award at the convention held at the Sheraton Civic Center in Birmingham, Alabama.

Doug L. Hixon was born and raised on a livestock and grain farm in Iroquois County, Illinois where he developed his interest in beef cattle. Doug received his B.S. degree in Animal Science from the University of Illinois in 1968. He received his M.S. degree in ruminant nutrition from the University of Illinois in 1970, and took a position managing the Beef Cattle Research Unit. He received his Ph.D. in 1980 from the University of Illinois in nutrition and reproductive physiology. Doug functioned for 2 years as a Beef Cattle Extension Specialist at the University of Tennessee in Knoxville. In 1982 he came to Wyoming as a beef cattle extension specialist and has been promoted to full professor. Doug and his wife Marilyn, have three children, Todd, Tricia, and Tasha.

Dr. Hixon has been able to establish several programs that have had a positive impact on beef production in Wyoming. He initiated the formation of the Wyoming Beef Cattle Improvement Association (WBCIA) in 1984 and has served as its Executive Secretary since that time. Under his guidance, this organization established a Feedlot Test and Carcass Evaluation Program in the fall of 1984. Gain data, carcass information, and an economic analysis are provided to consignors to allow evaluation of their genetic programs. In the fall of 1984, the WBCIA established a Bull Test and Sale. Dr. Hixon assists with data collection and gives leadership to the organization, summarization, and distribution of the collected information from all of these continuing programs.

Working with county extension agents, Dr. Hixon provides research-based educational programs on a variety of topics related to beef cattle management. In addition, he provides educational efforts with young people in various youth organizations. Dr. Hixon is highly respected as a beef cattle judge and has served in that capacity at most of the major livestock expositions throughout the country. He has judged cattle in 26 states.

Dr. Hixon is Wyoming's representative on the four-state Range Beef Cow Symposium Committee. In 1993 over 750 ranchers and extension personnel from 16 states met in Cheyenne for the 13th biennial Range Beef Cow Symposium organized under Dr. Hixon's direction. Nationally, Doug previously served on the Board of Directors of the Beef Improvement Federation (BIF) and as the Western Regional Secretary. Doug hosted and coordinated the most heavily attended BIF Convention to date in 1995 in Sheridan, Wyoming. Dr. Hixon is the 1992 recipient of the Western Section ASAS Extension Award.

BIF is pleased and honored to recognize the many contributions of Doug Hixon by presenting him with the BIF Continuing Service Award.

1996 Beef Improvement Federation Board of Directors

Front: Ronnie Silcox, Ronnie Green, Burke Healey, Glenn Brinkman, Ron Bolze, Larry Cundiff

Middle: Mike Schutz, Dan Kniffen, John Hough, Jed Dillard, S.R. Evans, Kent Anderson

Back: Doug Husfeld, Norm Vincel, Galen Fink, Lee Leachman, Jim Doubet, Willie Altenburg, John Crouch

Not Pictured: Don Boggs, Roger Hunsley, Gary Johnson, Roy McPhee, Richard Willham

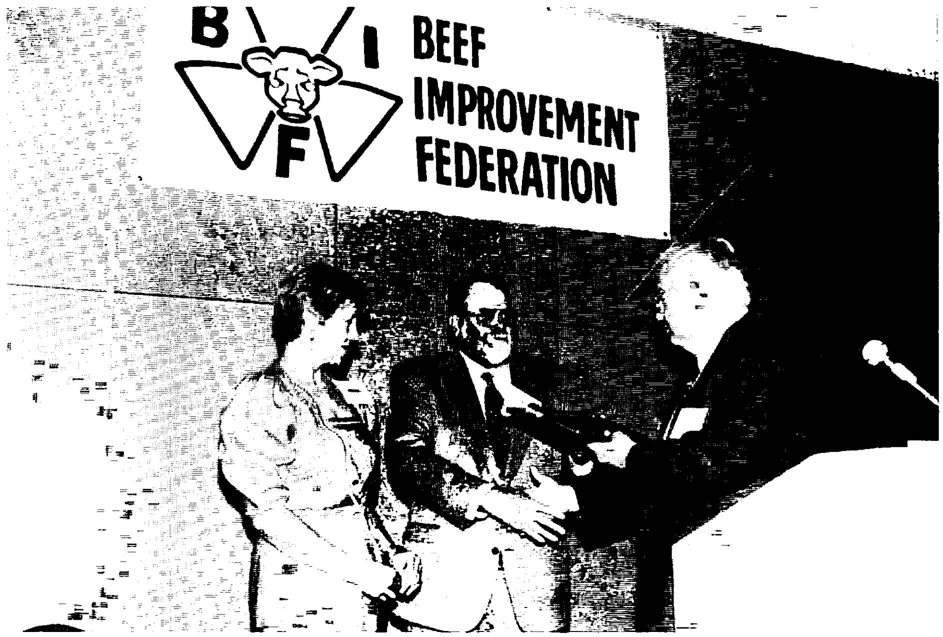
1996 Frank Baker Memorial Scholarship Recipients:
Ron Bolze, Executive Director; Glenn Brinkman, President; Denny Crews, Jr., Louisiana State University; Lowell Gould, University of Nebraska; Larry Cundiff, Committee Chairman

Dr. William "Billy" Powell, Executive Secretary, Alabama Cattlemans Association
Extends Southern Hospitality to Convention Attendees

Convention Co-Hosts, Lisa Kriese, Auburn University Beef Extension Specialist (Above) and Dave Maples, Alabama Beef Cattle Improvement Association (Right) Planned, Coordinated and Implemented One of the Best BIF Conventions Ever.

Out-Going BIF President, Glenn Brinkman, expresses his appreciation for the opporunity to serve the organization.

New BIF President, Burke Healey, expressing appreciation to former President Glen Brinkman and his wife Carolyn for contributions to BIF over the past year.



New BIF President, Burke Healey, unveiling the BIF Future Focus Task Force to create future BIF direction.

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