



COUNCIL ON DAIRY CATTLE BREEDING ACTIVITY REPORT

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USCDCB.COM

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ABOUT CDCB

The Council on Dairy Cattle Breeding (CDCB) provides premier dairy genetic information services through industry collaboration centered around a mission to help optimize cow health and productivity in herds worldwide. This non-profit organization is responsible for calculating and distributing the genetic evaluations and genomic predictions, for managing the national database, and for analyzing and distributing dairy cattle data in the United States. The CDCB drives continuous improvement and maintains the integrity of the world's largest animal database, building on a quality foundation with more than eight decades of recorded U.S. dairy animal performance. The CDCB is a collaboration between four sectors of the U.S. dairy industry: Dairy Records Providers (DRP), Dairy Records Processing Centers (DRPC), National Association of Animal Breeders (NAAB) and Purebred Dairy Cattle Association (PDCA).

This report was prepared for the 2017 CDCB Industry Meeting held at the Alliant Energy Center, Madison, WI, on October 3, 2017.

————— **CDCB CORE VALUE** —————
**PROVIDING PREMIER DAIRY GENETIC INFORMATION
SERVICES & INDUSTRY COLLABORATION**
—————

WORD FROM THE CHAIR John M. Meyer



The focus of the Council on Dairy Cattle Breeding (CDCB) has been, and continues to be, the accurate production of the triannual U.S. dairy cattle genetic evaluations. The U.S. has always been the gold standard globally for dairy genetic evaluations, and everything we do at the CDCB is centered around maintaining that important status.

The CDCB is governed by the four sectors of the dairy industry that represent U.S. dairy producers. Those organizations are the Purebred Dairy Cattle Association (PDCA), Dairy Records Providers (formerly DHIA), National Association of Animal Breeders (NAAB), and Dairy Records Processing Centers (DRPC). The cooperation among these parties is essential to maintaining the world's gold standard status in genetic evaluations.

Each of the four sectors have three representatives on the CDCB Board of Directors. Additionally, we have two non-voting, advisory members of the CDCB Board.

The talented people employed by the CDCB are an important asset to maintain the USA in the global leadership position. CEO João Dürr leads the staff from the Council's offices in Bowie, Md. Currently, the CDCB employs nine full-time staff and three consultants.

Ultimately, every function the CDCB performs is done with the dairy farmer and seed stock producer in mind. It is the dairy cattle breeders who support everything the CDCB does, so they must continue to find value in the services offered. Many thanks to all across the industry who make the CDCB work.

Other allied dairy industry organizations are also vitally important. The research and development that business and industry have done to develop new products and services has been, and will continue to be, critical to dairy farmers' future success.

When the groundwork was being laid for the "new" CDCB close to 10 years ago, some of the conversations revolved around what role, if any, the Council might play in future dairy genetics research. To date, there has been limited research activity at the CDCB level. In the future, however, it is realistic to believe the CDCB may work more closely than ever with USDA, private industry, colleges and universities, and others at the research coordination and development level.

Obviously, in the next 10 years, we will continue to see rapid advances in biotechnology that will help breeders develop better dairy cattle through mutual cooperation. It is my hope the CDCB will be on the cutting-edge of new dairy genetic research that will be an asset to the dairy community.

In the end, the U.S. dairy industry is successful largely because dairy farmers around the globe continue to place high value on U.S. dairy seed stock. Through constant, never-ending improvement, we will ensure we maintain the gold standard in dairy genetics worldwide.

Thank you for your continued support of the CDCB.

WORD FROM THE CEO João Dürr



***“The best time to plant a tree is 20 years ago.
The second best time is now.” Chinese proverb***

The Council on Dairy Cattle Breeding (CDCB) is the result of the U.S. dairy industry working together for the common good, empowering dairy farmers to fulfill their essential role of feeding the world. Effective collaboration is built over trust and shared visions, and success requires willingness to take risks and competence to innovate. The CDCB Board of Directors has faced this challenge with diligence, establishing a new organizational structure, developing priorities and creating conditions for the formation of a skilled team to run the operations. All those that have volunteered their time and leadership to serve on the CDCB Board deserve the respect and gratitude of the dairy community for steering the dairy industry into a new stage of excellence and international prominence.

Having successfully transitioned services from the USDA to the CDCB, two main avenues started to be paved during the past 12 months: taking ownership over the legacy and shaping the future. The U.S. has built the largest database of dairy phenotypic and genomic information over more than a century and has led genetic advancement, largely due to the cutting-edge evaluation methodologies developed and implemented by the USDA Animal Genomics and Improvement Laboratory (AGIL). In accordance with the non-funded cooperative agreement between USDA-ARS and the CDCB from

March 2013, CDCB is entitled to make use of all software previously developed by AGIL for the U.S. genetic evaluations, and AGIL continues providing research and development to the national program. This cooperation ensures that the same service excellence continues to be delivered to dairy farmers.

A considerable effort is underway to improve the system documentation on current business rules and operational procedures, and this process allows the staff to identify opportunities for improvement and to enhance customer support. Having surpassed the landmark of two million genotypes in July 2017, maintaining the same accuracy level and delivering results per the tightly-arranged service calendar requires constant investment in analytical and computational efficiency. In addition, frequent expansion of the product portfolio (breed base representation, livability, gestation length) also demands more resources for development, validation, implementation and user education. In the past year, quality control of genomic data has received special attention – in close collaboration with CDCB-certified genomic nominators and laboratories – resulting in revised guidelines and more objective quality standards. The CDCB Board and staff have defined new data access policies and procedures, both for external users and for member stakeholders, ensuring dairy farmers’ data is well-protected and is used to return maximum value. By establishing volunteer working groups of experts representing different stakeholders, the industry has been involved in the technical assessment of projects proposed to the Board of Directors. Finally, a new collaboration with Look East PR to enhance communications among CDCB members, industry stakeholders and dairy producers has already produced promising results, such as the CDCB Connection newsletter and the 2017 Industry meeting organization.

CDCB’s plans for the immediate future include officially launching six health genomic evaluations in April 2018 (with a test run in December 2017), developing residual feed intake evaluations in 12 to 18 months and expanding a winning team fully dedicated to serve dairy farmers.

Looking forward to another great year working for the dairy industry!

CDCB BOARD OF DIRECTORS AND COMMITTEES

The CDCB is a collaborative effort between four sectors of the U.S. dairy industry that represent U.S. dairy producers, data records processors, breed associations and AI companies. Dairy Records Providers (DRP), Dairy Records Processing Centers (DRPC), National Association of Animal Breeders (NAAB) and Purebred Dairy Cattle Association (PDCA) have equal representation on the CDCB Board of Directors.

DAIRY RECORDS PROVIDERS	Dan Sheldon Treasurer Woody Hill Farms	Jay Mattison National DHIA	Pat Baier AgSource Cooperative Services	
NATIONAL ASSOCIATION OF ANIMAL BREEDERS	Charles Sattler Secretary Select Sires, Inc.	Gordon A. Doak NAAB	Nate Zwald ABS Global	
PUREBRED DAIRY CATTLE ASSOCIATION	John M. Meyer Chair Holstein Association USA, Inc.	Neal Smith American Jersey Cattle Association	Boyd Schaufelberger Schaufine Farms	
DAIRY RECORDS PROCESSING CENTERS	John Clay Vice Chair Dairy Records Management Systems	Ted Foster Foster Brothers Farm, Inc.	Bill Verboort AgriTech Analytics	
NON-VOTING ADVISORY MEMBERS OF THE CDCB BOARD OF DIRECTORS 2017 (1 YEAR TERM)	Juan Tricarico Innovation Center for U.S. Dairy	Don Bennink North Florida Holsteins		
NON-MEMBERS SUPPORTING THE CDCB BOARD OF DIRECTORS	Paul VanRaden USDA ARS Industry Liaison	Jack Gravelle CDCB Attorney Porter Wright Morris & Arthur LLLP	João Dürr CDCB Chief Executive Officer	Duane Norman CDCB Technical Advisor & Industry Liaison

CDCB OFFICERS AND FINANCE COMMITTEE

On behalf of the entire industry, the CDCB extends sincere gratitude to the officers who provided leadership from 2015–2017: Jay Mattison as Chair, Gordon Doak as Vice Chair, John Clay as Secretary and Neal Smith as Treasurer. In August 2017, the CDCB Board elected new officers for 2017–18, including John M. Meyer, Chair; John Clay, Vice Chair; Charles Sattler, Secretary; and Dan Sheldon, Treasurer. The CDCB Finance Committee is comprised of Dan Sheldon, Neal Smith, Charles Sattler and John Clay.

CDCB PERSONNEL

João Dürr, CEO
Ezequiel Nicolazzi, Technical Director
Duane Norman, Technical Advisor & Industry Liaison
George Wiggans, Technical Advisor
Kristen Parker Gaddis, Geneticist
Kendra Randall, Administrative Assistant

Leigh Walton, Technical Applications Manager
Jay Megonigal, Data Scientist
Ike Nnabugwu, Systems Administrator
Rohith Shetty, Programmer
Marius Temzem, Database Administrator
Kaori Tokuhisa, Genomic Data Analyst

CDCB STAFF RECOGNIZED FOR CONTRIBUTIONS

To celebrate the 100th year of the Journal of Dairy Science® (JDS), a prestigious group of 18 research legends – including Dr. H. Duane Norman and Dr. George R. Wiggans – were inducted into the inaugural “JDS Club 100”. These individuals who have authored or coauthored 100 or more papers in the journal were honored during a ceremony July 26 during the American Dairy Science Association meeting in Pittsburgh, Penn. The paper,



Genomic selection for producer-recorded health event data in US dairy cattle, was also acknowledged as among the top 100 most highly-cited papers published in the JDS since 2014. This paper resulted from the PhD research of Kristen Parker Gaddis, now CDCB geneticist, and involved collaboration with Christian Maltecca of North Carolina State University, John Cole of AGIL and John Clay of DRMS.

Leigh Walton received the NAAB Distinguished Service Award in Green Bay, Wis., on October 13, 2016. Leigh has provided excellent, proactive customer service for many years at USDA AIPL and then continued his career with the CDCB, and he was instrumental in a successful transfer of genetic evaluation file postings and results from USDA servers to the new CDCB servers.

DAIRY RECORDS PROVIDERS

AgSource Cooperative Services
 Arizona DHIA
 Dairy Lab Services
 Dairy One Cooperative Inc.
 DHIA West
 Gallenberger Dairy Records
 Heart of America DHIA
 Idaho DHIA
 Indiana State Dairy Association
 Integrated Dairy Herd Improvement
 Jim Sousa Testing
 Lancaster DHIA
 Mid-South Dairy Records
 Minnesota DHIA
 Northstar Cooperative DHI Services
 Puerto Rico DHIA
 Rocky Mountain DHIA
 San Joaquin DHIA
 Southern DHA Affiliates
 Tennessee DHIA
 Texas DHIA
 Tulare DHIA
 United Federation of DHIA's
 Washington State DHIA

GENOMIC NOMINATORS

ABS Global, Inc.
 Alta Genetics USA
 Accelerated Genetics
 American Jersey Cattle Association
 Bio-Genesys Ltd.
 Brown Swiss Cattle Breeders' Association
 Genetic Visions-ST LLC
 Genex Cooperative, Inc.
 Holstein Association USA, Inc.
 Holstein Canada
 National Association of Animal Breeders, Inc.
 Neogen Coporation dba Geneseek
 New Generation Genetics, Inc.
 Select Sires Inc.
 Semex Alliance
 VHL Genetics
 Zoetis Genetics

PUREBRED DAIRY CATTLE ASSOCIATION

American Guernsey Association
 American Jersey Cattle Association
 American Milking Shorthorn Society
 Brown Swiss Cattle Breeders' Association
 Holstein Association USA, Inc.
 Red and White Dairy Cattle Association
 U.S. Ayrshire Breeders' Association

DAIRY RECORDS PROCESSING CENTERS

AgriTech Analytics
 AgSource Cooperative Services
 Dairy Records Management Systems
 DHI-Provo

GENOMIC LABORATORIES

Bio-Genesys Ltd.
 EuroFins Bio Diagnostics Inc.
 GeneSeek
 Genetic Visions-ST LLC
 VHL Genetics
 Weatherbys Ireland DNA Laboratory
 Zoetis Genetics

CDCB DATA PROVIDERS

CDCB IN NUMBERS

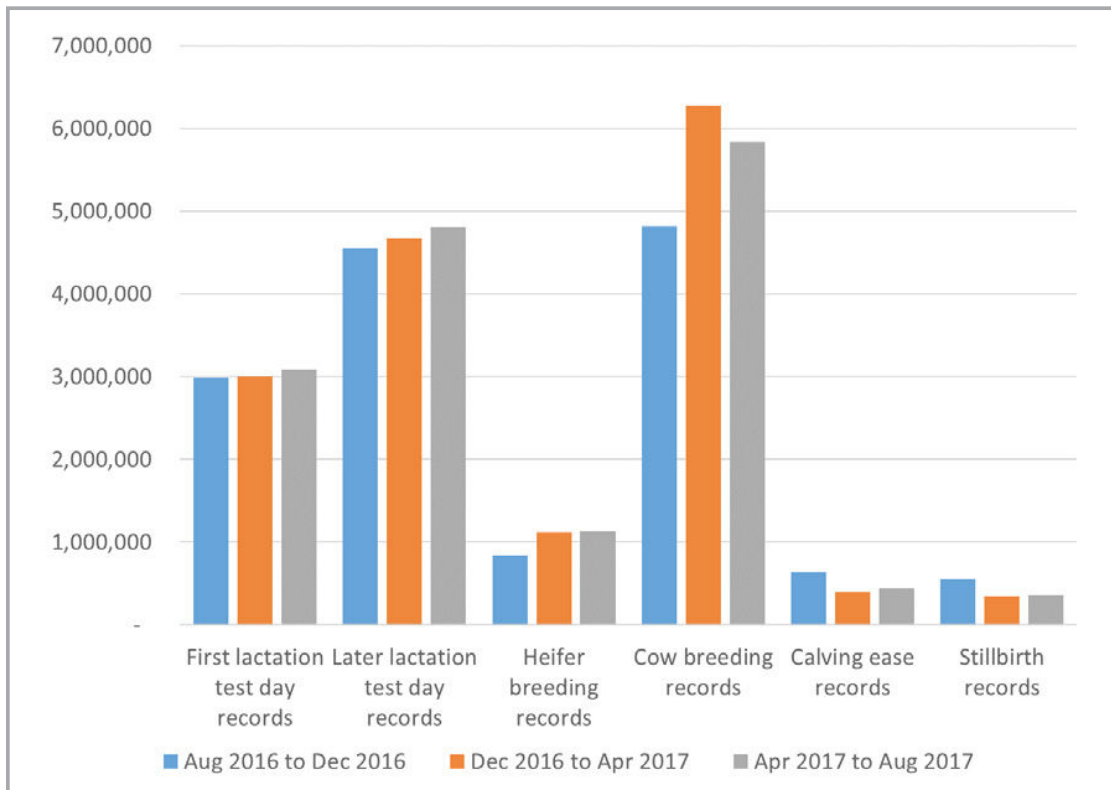
CDCB hosts and manages the cooperator databases – phenotypic and genomic – of U.S. dairy herd data, a strategic asset in providing value and leadership to the U.S. dairy industry. Management and performance benchmarks, as well as genetic and genomic evaluations, are derived from these data.

In January 2017, 4.4 million dairy cows in 16,400 herds were enrolled in dairy herd improvement services (DHI) and voluntarily contributed data to the CDCB system (Table 1). From this pool, approximately 23 million new test day records, 20 million breeding records and 2.7 million calving ease records are added annually to the official genetic evaluations provided by the CDCB (Figure 1).

Table 1 - Dairy cow enrollment in DHI test by breed (January 1, 2017)

BREED	HERDS	COWS
Ayrshire	63	3,205
Brown Swiss	142	10,079
Guernsey	84	3,948
Holstein	13,344	3,594,876
Jersey	838	321,706
Milking Shorthorn	24	1,170
Red and White	4	330
Mixed	1,873	466,995
Total	16,372	4,402,309

FIGURE 1 - Phenotypic records added to official evaluations since December 2015



Since the start of the U.S. genomic evaluations in 2009, the CDCB has accumulated over two million genotypes total for the five dairy breeds evaluated (Figures 2 to 5).

FIGURE 2 - Holstein genotypes added monthly to CDCB database since January 2009

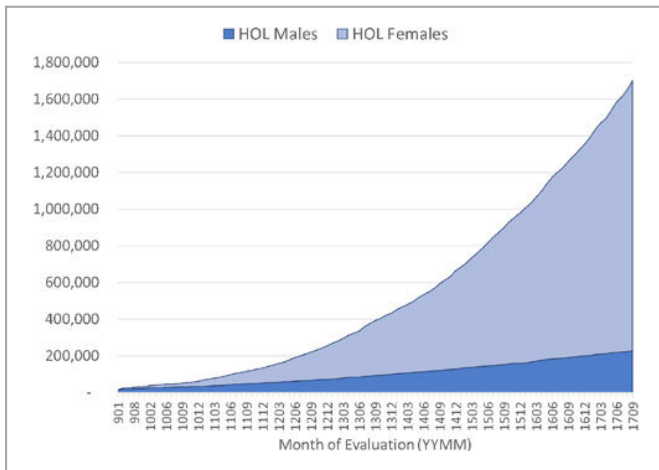


FIGURE 3 - Jersey genotypes added monthly to CDCB database since January 2009

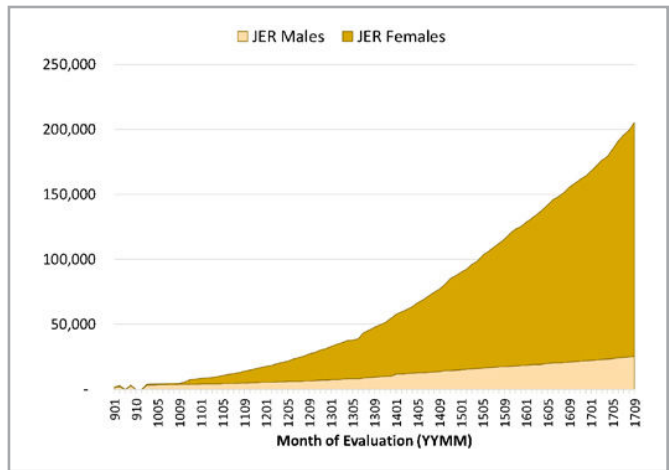


FIGURE 4 - Brown Swiss genotypes added monthly to CDCB database since August 2009

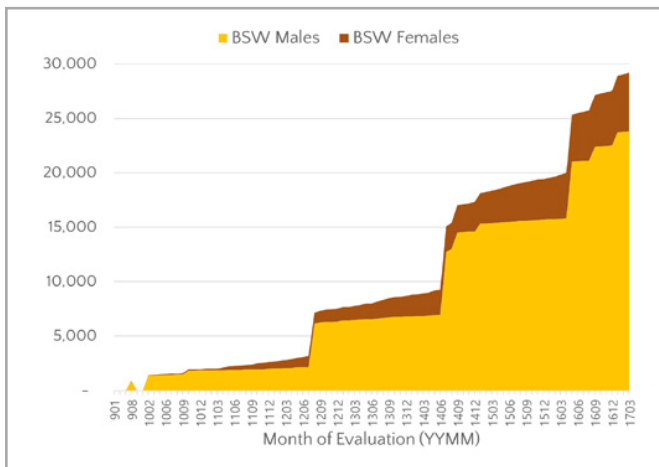
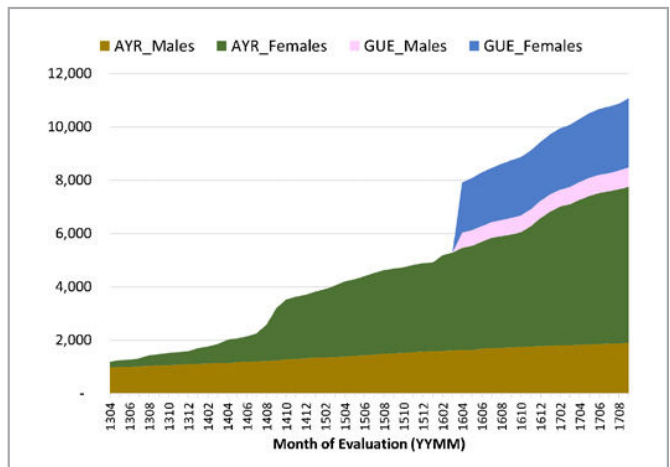


FIGURE 5 - Ayrshire and Guernsey genotypes added monthly to CDCB database since April 2013



Animals from 55 countries have been added to the CDCB database, on a proportion of 5.9 females per male and 2.5 predicted (young) per predictor animal (with own or progeny phenotypic records). Ninety percent of the animals are from North America.

Table 2 - Number of genotyped animals in the CDCB database by continent of origin (September 2017)

CONTINENT	PREDICTOR		PREDICTED		TOTAL
	FEMALES	MALES	FEMALES	MALES	
Africa	7	0	529	76	612
Asia	43	1,826	5,605	1,365	8,839
Eastern Europe	25	448	2,783	785	4,041
Europe	258	16,156	72,540	54,835	143,789
Latin America	397	2	15,935	868	17,202
North America	484,813	31,288	1,021,265	164,283	1,701,649
Oceania	99	474	9,410	2,688	12,671
Total	485,642	50,194	1,128,067	224,900	1,888,803

Although CDCB genomic predictions are tailored for U.S. animals, CDCB predictions are relevant for most foreign populations as U.S. and Canadian bulls are predominantly used as sires of the genotyped animals in all continents, as shown in Figure 6.

FIGURE 6 - Country of sire on genotypes used by the CDCB by continent (September 2017)

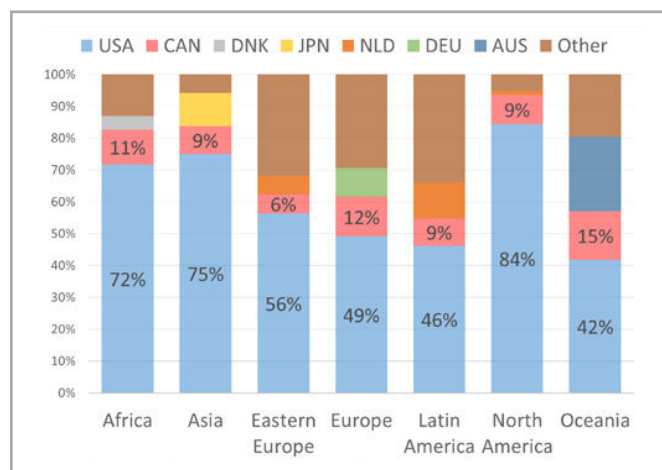
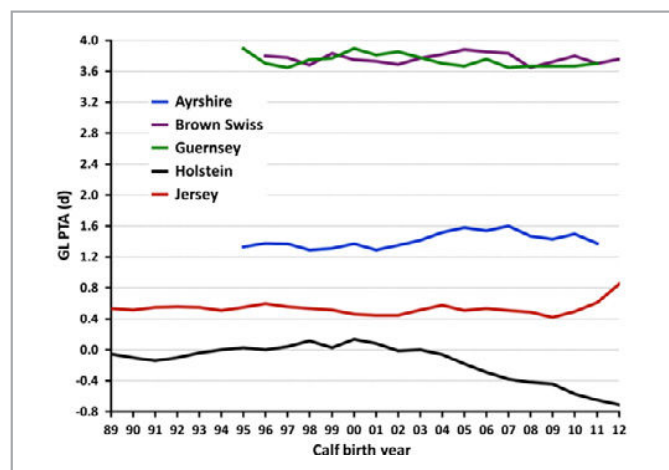


FIGURE 7 - Genetic trend for Gestation Length (GL), for females by breed (August 2017)



Finally, Figure 7 shows the estimated female genetic trends for gestation length, which is the latest trait added to the CDCB portfolio.

PROGRESS ON KEY INITIATIVES

INFRASTRUCTURE CHANGES

The CDCB adopted a new domain name in January 2017, and website, FTP and email addresses migrated to uscdcb.com. During this transition, the CDCB email system moved to the cloud to provide better client service, and the landline provider and office phone numbers changed. Read more in Future Developments about other infrastructure changes planned before the end of 2017.

GENOMIC NOMINATOR WORKSHOP

The first CDCB Genomic Nominators Workshop was held in Linthicum Heights, Md., on May 17. About 25 personnel attended, representing AI companies, breed associations, genomic laboratories and NDHIA. Event objectives were to review the genomic nomination process, exchange experiences among genomic nominators and present the new quality certification evaluation procedures. Following successful reports, CDCB will host this workshop annually.

ENHANCED COMMUNICATIONS FOCUS

Early in 2017, CDCB solicited proposals to engage support in public relations and promotion. After careful evaluation, the proposal from Look East PR was chosen. CDCB's key contact is Amy te Plate Church, with 20 years of dairy industry and communication experience.

CDCB CONNECTION NEWSLETTER

CDCB Connection was launched on June 8 to provide timely updates about U.S. dairy genetic evaluations and activities. The newsletter will be emailed after each monthly official genomic evaluation. The newsletter is the first result of our new collaboration with Look East PR to enhance communications among CDCB members, industry stakeholders and dairy producers. Interested subscribers can contact CDCB to receive the newsletter.

INTERNSHIP PROGRAM 2017

For the second year, the CDCB has offered internships to benefit CDCB, support the Animal Genomics and Improvement Laboratory (AGIL) and expose students to national genetic and management programs.

Ten students applied this year, and two were selected:

- **Isaac Haagen**, PhD Candidate, Animal Science, Pennsylvania State University under the guidance of Dr. Chad Dechow
- **Maci Lienemann-Mueller**, MSc Candidate, Animal Biology, University of California-Davis under Dr. Alison Van Eenennaam.

Isaac assisted CDCB and AGIL to determine the accuracy and effectiveness of multi-breed genetic evaluations, research that has been under development at AGIL. Maci investigated innovative strategies for managing recessive disorders in dairy cattle. Isaac and Maci also surveyed the international research published on dairy genetics to provide statistics on current trends. Both interns greatly exceeded CDCB and AGIL expectations, covering important future development topics.

NATIONAL DHI BENCHMARKS

The CDCB provides national benchmarks on behalf of the National DHIA by publishing annual statistics that include DHI participation, state and national standardized lactation averages by breed for cows on official test, summary of herd averages, Dairy Records of milk from DHI herds, reasons that cows in DHI programs exit the herd and reproductive status of cows in DHI programs.

TWO MILLION GENOTYPES IN THE DATABASE

Thanks to many collaborative efforts, a new milestone in dairy genetics was achieved on July 10, 2017, when the two millionth individual animal genotype was recorded in the U.S. dairy database. Since the first U.S. Holstein sires were genotyped in 2008, the resulting database has grown tremendously – clearly the largest in the world with genotypes for 278,984 males and 1,662,922 females from the five largest dairy breeds (as of July 10). In 2016 alone, nearly half a million genotypes were submitted to the CDCB.

CDCB DATA REQUEST POLICY

The CDCB Board of Directors adopted a new policy in August for external data requests in commercial and research applications. With the size and integrity of the CDCB cooperator database, it has an important role

to support research and innovation to benefit dairy farmers. This policy will help researchers understand data availability and processes, in a consistent and transparent manner.

CDCB END USER AGREEMENT

As a non-profit organization mandated to provide value to dairy farmers and the organizations that contribute to the U.S. database, one of the key CDCB functions is to protect the use of the data and products resulting from CDCB evaluations. In that spirit, the CDCB adopted an end user agreement in August 2017. All CDCB queries and download files from CDCB's FTP site, are covered by the CDCB data request policy. The terms of the agreement are shown to users at each interaction with CDCB online services. In marking "I agree" to the terms, the user accepts to acknowledge CDCB as the source of the results being accessed, whenever the information is made available in any format to third parties.

CUSTOMER SERVICE ENHANCEMENTS

On August 1, CDCB officially moved to a new system to document and ticket customer service. Based on the Redmine platform, this new system was launched

in May for gradual testing, and there was minimum impact for CDCB clients with multiple benefits. The same system is currently being adopted for a more dynamic documentation to benefit nominators and laboratories.

NEW QUALITY CERTIFICATION STANDARDS FOR GENOTYPING LABS

New Quality Certification Requirements for Genotyping Labs went into effect September 1, after development by the GENLAB CDCB working group and approval by the Board of Directors. Key points in the new standards include:

- A new CDCB Genomic Laboratory "proficiency test" to be first conducted in late 2017/early 2018 and thereafter once every two years;
- The requirement of ISO certification (or equivalent) for genomic laboratories, including a two-year tolerance for current CDCB genomic laboratories with proven records but without ISO certification;
- A one-time CDCB certification laboratory fee of \$1000 for labs applying to become certified;
- New QC metrics for submitted genotypes to assess CDCB lab performance.



FUTURE DEVELOPMENTS

Several developments are in progress at the CDCB, including these priority projects.

RESEARCH ON MULTI-BREED EVALUATION METHODS

USDA-ARS-AGIL is performing research to evaluate the feasibility of obtaining accurate genomic predictions of transmitting ability (GPTAs) for crossbred animals. The computations use marker effects of five dairy breeds weighted by each breed's genomic contribution to the crossbreds. Estimates of genomic breed composition, labeled breed base representation (BBR), have been reported since May 2016 for all 1.6 million genotyped dairy animals. Animals with > 94% of any breed are rounded to 100%, and contributions of other breeds are set to 0%.

The strategy first calculates all-breed scale GPTAs for each pure breed. Foreign information from multi-trait across-country evaluation (MACE) and foreign dams are included by converting their values from within-breed to the all-breed base. Marker effects for each breed are blended by BBR to compute evaluations for crossbreds (<94% purebred) for those same traits. All-breed GPTAs are then converted to within-breed GPTAs. Preliminary results showed correlations of GPTAs for purebreds computed on the all-breed vs. current within-breed scales of 0.97 to 0.99 for most traits and breeds. Most importantly, crossbred GPTAs for 44,023 crossbreds were obtained, and 20,367 of those had no previous GPTAs because of breed check edits. These animals are the ones who will benefit most from this new methodology. Research is ongoing to evaluate the full impact and implications of implementing this methodology.

CDCB PROGRAM FOR COLLECTION OF FEED EFFICIENCY DATA

Feed efficiency is one of the most economically important traits not yet directly included in dairy cattle genetic improvement, mainly due to recording costs. A five-year project funded by the USDA National

Institute of Food and Agriculture has generated an unprecedented data set of approximately 5,000 residual feed intake (RFI) records from U.S. Holstein cows in nine research herds. Genomic predictions for RFI have been successfully computed by USDA Animal Genomics and Improvement Laboratory (AGIL), demonstrating the feasibility to include this promising new trait into U.S. genomic evaluations. The CDCB is working to continue data collection through partnerships with herds capable of generating RFI data. CDCB is committed to fund some data collection costs and develop partnerships to expand the program. Discussions for international data exchange are also under way. The goal is to offer genomic predictions for RFI to the U.S. dairy industry as early as 2018 if a steady data stream is secured.

NEW CDCB WEB PORTAL (AND SUPPORTING INFRASTRUCTURE)

CDCB staff are finalizing the last details for the brand new CDCB web portal, which will be hosted in a new server and designed in the modern platform, WordPress. The new website will maintain the current CDCB domain name uscdcb.com. The functionalities of the query system will not be modified in this first stage, although they will be displayed differently. Instead of three different access points, all queries will be available to the user on a single page according to individual user access permissions. Query access will require personal registration for public and private queries; all users will need to register to access the new system. A new independent FTP-server has been set up and will only allow secure connections (SFTP). This new independent setting of servers will allow maintenance or failure of one system without interfering with the functionality of the other. To enhance service continuity, both servers will have failover servers standing by in case of hardware malfunction.

INTERBULL REPORT Marj Faust

Interbull works with organizations around the world that compute national genetic and genomic evaluations, such as the CDCB. A key Interbull service involves receiving national evaluations, blending them with comparable evaluations from other countries, and returning higher reliability blended evaluation data to the participating country. The Interbull Center also is sanctioned and serves as the Technical Reference Center for the European Union responsible for harmonizing and validating the genetic and genomic evaluations of participating countries to ensure the quality and integrity of the genetic ranking information. The U.S. and more than 35 countries around the world use the services of Interbull (ISO 9001:2015 Certified) with the goal of providing the most reliable genetic and genomic rankings back to dairy producers and the wider dairy genetic industry.

During 2017, Interbull has made strides to deliver additional services. One is a SNP exchange where countries can upload, store and exchange parentage SNPs on bulls to facilitate improved parentage results. In conjunction, a new accreditation service will be offered by ICAR that will test laboratories on the accuracy of their SNP parentage results; specifics on accreditation are included in an [application for Accreditation of DNA Centres](#). Interbull is nearing completion on another exchange service whereby Interbull will serve the single global repository for uploading, storing and exchanging trait designation data on Holsteins, based on a request

by the World Holstein Friesian Federation to harmonize this information for affiliated breed organizations. Two significant new service opportunities are being investigated by Interbull:

- **InterGenomics-Holstein:** Spring-boarding from success in Brown Swiss, Interbull is evaluating a genotype pooling and genomic evaluation service for countries with small Holstein reference populations and insufficient resources to develop their own national genomic evaluations.
- **SNP MACE:** A SNP blending methodology analogous to the blending of traditional national genetic and genomic evaluations conducted currently. This methodology was first invented to overcome many of the concerns of bias due to selection that is threatening the value of current evaluation results and to improve accuracy of all participating countries' genomic evaluation results by incorporating data from others.



U.S. REPRESENTATIVE TO THE INTERBULL STEERING COMMITTEE

At the 2017 Interbull Annual Meeting in Tallinn, Estonia, Marj Faust of Data Driven Genetics was recognized for eight years of service as U.S. representative on the Interbull Steering Committee. As her term has expired, Gordon Doak of NAAB will now represent the U.S.

Thank you, Marj, for your valuable counsel to the dairy community.

Outgoing U.S. representative, Marj Faust was recognized by Interbull Chair, Reinhard Reents, for valuable service to the global dairy genetics community.

CDCB WORKING GROUPS

In early 2017, the CDCB established four working groups, which are a collaboration of industry representatives, academics and staff, to develop and finetune CDCB services. The CDCB thanks all those who have dedicated their time to these efforts.

Dairy Evaluation Review Team (DERT) provides independent, objective and impartial reviews of the CDCB triannual dairy genetic evaluation results prior to the public (official) release in April, August and December. Their feedback to CDCB staff is intended to reduce the likelihood that inaccurate predictions be released. Group members have signed a confidentiality agreement that applies to sensitive pre-release material. Representatives from NAAB and breed associations also assist the CDCB staff to check the material. Any reduction in errors in evaluations released is a contribution which CDCB and the entire industry greatly appreciates. The current team, listed below, was established for the April 2017 genetic release. We thank Chuck Sattler and Angie Coburn who served for over 6 years through 2016.

Team reviewers: *Mark Chamberlain, Sam Comstock, Tom Lawlor, Ryan Starkenburg and Bob Welper*

Pursuing Data Quality Team (PDQ) provides independent, impartial advice and strategic guidance for dairy data quality. PDQ makes recommendations to improve quality and uniformity of data collected by the dairy industry, thereby promoting the highest reasonable accuracy of genetic and management information. The group has developed definitions to advance uniformity in the recording systems for health and management traits, and changes were recommended to improve recording of reproductive traits. The team is currently evaluating future initiatives that will be most beneficial to pursue and continually improve accuracy of information entering the CDCB collaborator database.

Team members: *Angie Coburn (chair), Sam Comstock, Burke Day, Jenny DeMunck, Jana Hutchison, Erick Metzger, Duane Norman and Steven Sievert*

Genetic Evaluation Methods Group (GEM) provides independent, objective and impartial advice and strategic guidance to AGIL and CDCB staff through the development of dairy genetic evaluations. The August 2017 release of Gestation Length (GL) of service sires was endorsed by GEM approved by the CDCB Board.

GEM recommended that CDCB release test results for six health traits in December 2017, followed by an official release in April 2018. The group offered four recommendations about health traits that were approved by the CDCB Board. 1) The PTA for cows born in the base year for each breed will average zero, like production traits; 2) the evaluation units be percentage points of each health incidence above or below the breed base; 3) animals with greater disease resistance receive positive values; and 4) nomenclature of the traits be "trait resistance." The group is continuing to review how whether to present health dollars and how to deal with the opportunities for feed efficiency research. Group members have signed a confidentiality agreement that applies when test evaluation results being examined should remain secret.

Group members: *Chuck Sattler (chair), Chad Dechow, Tom Lawlor, Christian Maltecca, Ezequiel Nicolazzi and Paul VanRaden*

Genomic Laboratory Guidelines Task Force (GENLAB) was assembled to develop guidelines for CDCB's quality certification (QC) program for laboratories generating genomic data on behalf of genomic nominators. The task force initiated operation in April 2017, held four conference calls with email interaction between meetings, and presented quality certification recommendations that were accepted by the CDCB board in August 2017.

Their recommendations included:

1. CDCB charge a SNP chip validation fee, because the developers benefit from the CDCB database, which requires a substantial amount of staff time.
2. Only successful genotyping laboratories will receive CDCB lab certification. Labs are required to demonstrate they plan to undergo, or already have undergone, ISO (or similar) certification to be eligible to submit genotypes. There will be a two-

year exception for current labs in good standing but without ISO certification. There will be a one-time fee, a new set of QC metrics and an annual auditing by CDCB staff. Under consideration is an annual workshop for genomic labs, similar to the 2017 CDCB nominators workshop.

3. No audit required of labs by an additional outside organization. Participants agreed an ISO-17025 certification (or similar) is an effective method to document and certify the process. Thus, CDCB staff

will monitor the quality of data received and the labs' capacity to interact with systems.

4. Illumina will provide hair follicle samples so all genomic labs can perform the same test starting in 2018. This strategy will have minimum costs as biological samples can be stored at room temperature.

Task Force Participants: Ezequiel Nicolazzi (convener), Michael Bishop, Michael Cowan, Emily Piper, Jiansheng Qiu, Wim van Haeringen and George Wiggans



CHANGES IN GENETIC EVALUATIONS

DECEMBER 2016 REVISED CONFORMATION EVALUATION FOR NON-HOLSTEIN BREEDS

The genetic evaluation software implemented in 2014 for most other traits was applied to linear type in the Ayrshires (AY), Brown Swiss (BS), Guernseys (GU), Jerseys (JE), and Milking Shorthorn (MS), and to BS milking speed and mobility. All (co) variance component estimates were updated. The main advantage of the new software is that all traits are solved together instead of performing separate analyses for traits introduced at different times. Correlations of new with previous predicted transmitting abilities (PTAs) for progeny tested bulls born since 1995 for 14 traditionally scored linear type traits averaged 0.97 or 0.98 in four breeds and 0.89 in MS. The genetic correlations with other countries estimated by Interbull were similar before and after these changes. Rear teat placement rear view and rear teat placement side view were added as new traits for JE.

VARIANCE ADJUSTMENTS AND HERITABILITY FOR COW LIVABILITY

Cow livability (CL) evaluations were revised with variance adjustments that now include different heritabilities (h²) by parity. The CL records were pre-adjusted for parity-year variance and weighted based on h² to account for the changes in variance with the mean. Heritabilities of CL from the first five lactations were all less than 1%, respectively, and averaged 0.6% when weighted by number of

lactations. The new h² are equivalent to about 3% on the underlying scale but are lower than the previous estimate of 1.3% for h² per lactation on the observed scale.

CHANGES IN THE COMPARISON OF GENOMIC AND TRADITIONAL EVALUATIONS REPORT

Three new traits (Livability, Cow conception rate, and Heifer conception rate) were added to the "Comparison of Genomic and Traditional evaluations" report.

APRIL 2017 COW LIVABILITY AND REVISED BODY WEIGHT COMPOSITE IN NET MERIT

Cow livability (LIV), previously introduced as an indicator of the percentage of cows not dying in the milking herd, was incorporated in lifetime net merit dollars (NM\$) and the other merit indexes. Cows that die provide zero income in contrast to those sold for beef. Relative emphasis assigned to LIV is 7%, but is counteracted by decreasing emphasis on productive life (PL) from 19% to 13%. Expected genetic progress for PL will remain the same, while cows dying in the milking herd will decrease.

Body size composite (BSC) was updated by Holstein Association USA in August 2016 to better predict actual body weights, and that change is now in NM\$. The previous formula using BSC is replaced by a new formula using body weight composite (BWC). Major differences are that BWC is estimated from more recent data, each unit of BWC is associated with larger differences in body weight, and BWC uses dairy form to account for

presence or absence of fat in addition to skeletal size. Changes were made for the other breeds as well. Use of BWC instead of BSC in NM\$ reduces the selection against stature, body depth, rump width and dairy form.

Economic values for other traits were updated with more current data, resulting in a small reduction in milk price, a shift in value of fat relative to protein, and less emphasis on somatic cell score. The 2014 and 2017 NM\$ indexes were correlated by 0.99 for recent bulls.

CORRECTION OF SCS PARENT AVERAGES FOR NON-GENOTYPED HEIFERS

A coding mistake introduced in the August 2016 evaluation caused females to receive a better SCS (traditional) evaluation than was accurate and consequently impacted evaluations that use SCS information, such as multi-trait productive life and net merit. The cause was in the way that cows' unknown parent groups contribute to SCS evaluations, and the correction mainly affected heifers' parent averages that were not published but were released to Dairy Records Processing Centers.

REVISION OF REAR UDDER WIDTH FOR BROWN SWISS

Interbull evaluations for rear udder width (RUW) will be used for Brown Swiss. In April, RUW for Brown Swiss will be published according to two criteria: 1) if a bull has a traditional or Interbull RUW evaluation, then the evaluation with the highest reliability, usually Interbull, is considered official; 2) if a bull does not have either of the above evaluations, then the official value of RUH is used as the official value for RUW.

AUGUST 2017

GESTATION LENGTH EVALUATIONS

Genetic evaluations of males and genomic predictions of both sexes now provided predictors for gestation length (GL), expressed in days. Differences in GL are useful to determine accurately when to move cows to maternity pens for calving, and to understand correlated effects on other traits like calving ease and stillbirth. The evaluation model defines GL as a trait of the service sire. Maternal effects on GL are small compared to direct genetic effects. The all-breed model also included crossbred matings.

CHANGES IN UNKNOWN PARENT GROUP DEFINITIONS

For some traits, the most recent unknown parent groups had previously been merged together across all breeds if the most recent group had too few records, but is now changed to merge separately by breed with the next most recent group. This change primarily affects traditional parent averages (PA) of recent calves with missing parents. Genomic evaluations were affected little and Holsteins hardly at all. In the other breeds, the youngest animals that had missing pedigree changed as a result of breed differences in the last group. The PA differences were small for most traits, but greater for a trait like milk yield due to larger breed differences.

TYPE COMPOSITE CORRECTION

CDCB and AIPL have revised the programs that are used to obtain the feet/leg composite used within

merit indexes in Holsteins. At the time of its original development, PTA for Feet and Legs Score (FLS) were not available. This PTA was therefore obtained from a highly correlated trait, Rear Leg Rear View (RLR). The merit functions were updated to use the actual PTAs for FLS in the FLC formula. Changes were small due to the high correlation with RLR.

INTRODUCTION OF NEW EDITS IN CALVING TRAITS

A new set of edits was applied to the incoming calving ease (CE) and stillbirth (SB) phenotypic data. Among these changes, CDCB now requires pedigree and lactation data to be included in the database before the calving event is processed. This change reduced the number of incorrect data entering our system, and convergence properties are improved. Another advantage is error files are returned back to the submitting organizations, highlighting areas that can be addressed with producers. The CDCB is hoping to have daily processing of CE and SB records, similar to the procedures used for lactation data.

REDUCED COMPUTATION IN HOLSTEIN EVALUATIONS

Until recently, monthly genomic evaluations have fully reprocessed all genotyped animals; however, computation took 6 days. The time to process increased every month leaving no time to correct errors and meet distribution deadlines. Thus some of the weekly evaluation techniques were adopted in the monthly processing. Now only the new animals, those with changed pedigree, and parents and siblings

of these animals are imputed. The imputed genotypes from the last full run are used for the other animals. For single gene effects and haplotypes affecting fertility, the weekly process also is used because the monthly process requires the full imputation results. These changes reduced the evaluation time to under 2 days. There are small differences from full recalculation because the imputed genotypes of ancestors and more distant relatives do not fully benefit from the new animals, and genotypes for newly qualifying non-genotyped dams are not generated, so genotypes for existing non-genotyped dams continue to be used. This rapid calculation procedure relies on results from full runs for starting values for imputation and SNP effect estimates. Full runs are done monthly so these prior values are available for the weekly and following monthly run. Because the timing of these full runs is flexible, it eliminates deadline concerns and acknowledges the increased computing time expected when the number of SNP used in the evaluation increases.

For more details, see <https://www.uscdcb.com/News/News.htm>

INTRODUCING NEW GENETIC EVALUATIONS FOR HEALTHIER COWS

The dairy industry is poised to make foundational leaps in the ability to breed healthier cows with the introduction of CDCB genomic evaluations for six direct health traits. Dairy producers will soon be able to incorporate these new health traits into their breeding programs with official evaluations in April 2018.

Just as other genetic evaluations currently produced by CDCB, the health evaluations are based on sound research and national data. Foundational research has been published in several peer-reviewed journal articles, one of which is among the top 100 most highly cited papers published in the Journal of Dairy Science since 2014 (Parker Gaddis et al., 2014). Data editing and validation are based on peer-reviewed methods (e.g., Parker Gaddis et al., 2012). The new evaluations follow similarly-tested methods as those for traits currently included in CDCB genetic and genomic evaluations and developed by scientists at the Animal Genomics and Improvement Laboratory (AGIL; ARS, USDA). Furthermore, one of the traits will also undergo international validation through Interbull.

Dairy cattle that are more susceptible to common health events impact the profitability of dairy farms. The most recent estimates of direct treatment costs of the health events were obtained from literature. Steps were taken to ensure these estimates reflect the fact that the derivation of Net Merit already accounts for related losses such as decreases in production and fertility. CDCB has also accounted for the adjustments made to yield records that were indicated as having abnormal or sick test days. For the first time, this will provide producers with a realistic

estimate of the savings provided by selecting animals more resistant to health events.

The CDCB selected six of the most common and costly health events to initially release, based on previous research. These health events were selected with consideration of incidence, expected heritability and reporting consistency. The six new health traits for which CDCB will provide genetic and genomic evaluations are listed below with their description:

- **Hypocalcemia:** typically results after calving due to low total blood calcium levels, also commonly referred to as milk fever
- **Displaced abomasum:** enlargement of the abomasum with fluid and/or gas which causes movement to the left or right side of the abdominal cavity, usually requiring veterinary intervention
- **Ketosis:** build up of ketone bodies typically occurring due to negative energy balance in early lactation
- **Mastitis:** infectious disease causing inflammation of the mammary gland; one of the most common and costly disease of dairy cattle
- **Metritis:** infection of the endometrium (lining of uterus) after calving
- **Retained placenta:** retention of fetal membranes more than 24 hours after calving

The CDCB health evaluations will be presented as percentage points of event resistance above or below the breed average. Evaluations of cows born in the base year will average zero, similar to yield traits. Favorable values for resistance to the health event will

receive positive values. For example, assume the resistance to clinical mastitis is 90%, which represents a 10% incidence rate. If Bull X has a PTA equal to +3.0 for mastitis resistance, daughters of Bull X would, on average, be more resistant to mastitis by 3.0 percentage points more than the population average. The resistance rate among Bull X's daughters should average 93% (90 + 3.0), given a significant number of daughter records. Alternatively, let's assume that Bull Y has a PTA equal to -4.0 for mastitis resistance. His daughters would be expected to have an average resistance to mastitis equal to 86% (90 - 4.0) as observations are accumulated.

Accurate health evaluations require the continued cooperation among many industry sectors. Producers provide the most critical component of the health evaluations by actively reporting health events on-farm, and this is essential to develop a robust national database. The cooperation of the Dairy Records Providers and the Dairy Records Processing Centers are critical to facilitate the transfer of health data from the farm to the CDCB database. Evaluations for direct health traits are only possible due to the cooperation of these groups with CDCB.

The research and development of these new health evaluations would not have been possible without the continued collaboration between CDCB and AGIL. Throughout development, the CDCB working groups – Pursuing Data Quality Team (PDQT) and Genetic Evaluation Methods (GEM) – provided invaluable input. These committees are composed of representatives from various sectors of the dairy industry such as data providers, AI organizations and breed associations, as well as academia.

FINANCIAL REPORT

Provided here are the Council on Dairy Cattle Breeding (CDCB) audited financial statements for fiscal year (FY) 2016 and 2015 (January–December). The CDCB is in a solid financial position, and 2016 followed a similar pattern to 2015 regarding operating expenses and investments in infrastructure.

Financial statements are prepared monthly and reviewed by the CDCB Board of Directors. In addition, the accounting firm Clark, Schaefer, Hackett & Co. performed a complete audit for year ended December 31, 2016 and 2015. The audit documented the following financial statements present fairly, in all material respects, the financial position of the Council on Dairy Cattle Breeding as of December 31, 2016 and 2015, and changes in net assets for the years ended in accordance with accounting principles generally accepted in the United States.

2016 AND 2015 AUDITED FINANCIAL STATEMENTS

ASSETS	2016	2015
Cash	\$5,455,963	\$5,237,174
Accounts Receivable	644,245	470,876
Property & Equipment (net book value)	401,525	279,350
Other	<u>62,807</u>	<u>52,729</u>
Total Assets	<u>\$6,564,590</u>	<u>\$6,040,129</u>
LIABILITIES		
Accounts payable	\$ 438,511	\$ 163,525
Notes payable	-	299,966
Unrestricted Net Assets	<u>6,126,079</u>	<u>5,576,638</u>
Total Liabilities & Unrestricted Net Assets at December 31, 2015	<u>\$6,564,590</u>	<u>\$6,040,129</u>
REVENUES	2016	2015
Female Fees	\$ 537,384	\$ 524,346
Male Fees		
Initial Fees	906,742	975,670
AI Service Fees	1,628,750	1,466,600
Other	<u>4,531</u>	<u>11,802</u>
Total Revenues	<u>\$3,077,407</u>	<u>\$2,978,418</u>
COST OF OPERATIONS	2016	2015
Salaries, Service and Administration	\$2,357,134	\$1,724,639
Depreciation and Amortization	167,337	54,768
Interest Expense	<u>3,495</u>	<u>3,234</u>
Total Cost of Operations	<u>\$2,527,966</u>	<u>\$1,782,641</u>
Increase in Net Assets	<u>\$549,441</u>	<u>\$1,195,777</u>

CDCB repaid all notes payable due during 2016. Unrestricted net assets at year-end 2016 were \$6,126,079 – a 9% increase over year-end 2015.

FY 2016 revenues of \$3,077,407 represent a 3.3% increase in 2016 total revenues compared to FY 2015. The number of genomic evaluations during FY 2016 included: Females 361,023 (92%); Males 31,416 (8%); and a subset of 2,452 bulls (7%) paid artificial insemination (AI) fees in FY 2016. Revenue reported for FY 2016 included female initial fees at 17%, Male initial fees at 30%, and Male AI fees at 53%.

The CDCB continued building staff capacity in FY 2016 which resulted in greater payroll and employee benefit expense. Also, there was additional capital expenditures for hardware and software as the CDCB completed the operations infrastructure. The CDCB reported net income from operations \$549,441 for FY 2016.

The CDCB Board and staff greatly appreciate the efforts of Neal Smith and Vickie White of the American Jersey Cattle Association for their professional expertise in working with the CDCB accounts and funds.



COUNCIL ON DAIRY CATTLE BREEDING

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