

Centre for Genetic Improvement of Livestock
Animal & Poultry Science
Ontario Agricultural College
University of Guelph
Guelph, Ontario N1G2W1



**A Review of Activities
2001-2013
and
Plans for 2014-2020**

October 28, 2013

**Centre for Genetic Improvement of
Livestock**

Animal & Poultry Science

Ontario Agricultural College

University of Guelph

Guelph, Ontario N1G 2W1

A Review of Activities 2001 - 2013

and

Plans for 2014 - 2020

Contents

1	Foreword	6
2	Executive Summary	7
3	Origins and Mandate	9
4	Plans for 2014 to 2020	11
5	Personnel	13
5.1	Faculty Component	13
5.2	Adjunct Faculty	15
5.3	Staff	16
5.4	Research Associates, Post-doctoral Fellows, and Technicians . .	18
5.5	Graduate Students	21
6	Teaching	37
6.1	Undergraduate Courses	37
6.2	Graduate Courses	38
6.3	Summer Courses	39
6.4	Workshops	40
6.5	Kennedy Colloquium	40
7	Research Funding	42
7.1	Industry Partners	42
7.2	Some Numbers	44
8	Research Summary by Species	45

8.1	Dairy Cattle	45
8.1.1	Production Traits	45
8.1.2	Conformation Traits	46
8.1.3	Fertility Traits	46
8.1.4	Health Traits	46
8.1.5	Body Condition Score	47
8.1.6	Crossbreeding	47
8.1.7	Cow Profitability	48
8.1.8	Longevity	48
8.1.9	Genomics	48
8.1.10	Epigenomics	50
8.2	Beef Cattle	51
8.2.1	Beef Improvement Opportunities, BIO	51
8.2.2	Feed Efficiency and the Cow-Calf Sector	51
8.2.3	Methane Emissions and Infrared Phenotyping	51
8.2.4	Liver Function	52
8.2.5	Biological Predictors of Feed Efficiency	52
8.2.6	Feed Efficiency and Fertility	52
8.2.7	Feed Efficiency and Carcass Composition	53
8.2.8	Phenotyping and the OMAFRA research program	53
8.2.9	UoG CAST - A genetic marker for beef tenderness	53
8.2.10	Whole genome sequencing	54
8.2.11	Validation of DNA selection technologies	54
8.2.12	Development of a DNA panel to predict beef tenderness	54

8.2.13	Development of a DNA panel to predict feed efficiency .	54
8.3	Swine	57
8.3.1	Genomics	57
8.3.2	Piglet Health	57
8.3.3	Economic Indexes	58
8.3.4	Boar Taint	58
8.3.5	Protein and Lipid Deposition	58
8.3.6	PRRS Virus	58
8.4	Sheep and Goats	60
8.4.1	Meat Sheep	60
8.4.2	Dairy Sheep	61
8.4.3	Meat Goats	61
8.4.4	Dairy Goats	61
8.4.5	Genomics Areas	62
8.5	Poultry	64
8.5.1	Economics	64
8.5.2	Novel Trait Evaluation	64
8.5.3	Alternative Trait Modeling Strategies	64
8.5.4	Feed Conversion Ratio	65
8.5.5	Reproduction and other Traits	66
8.6	Aquaculture Species	67
8.6.1	Rainbow Trout	67
8.6.2	Atlantic Salmon	67
8.6.3	Atlantic Cod	68

8.6.4	Abalone	68
8.7	Theory and Strategies	69
8.7.1	Genomics Theory	69
8.7.2	Permanent Environmental Effects	69
8.7.3	Non-additive Genetic Effects	69
8.7.4	Maternal Genetic Effects	69
8.7.5	International Dairy Bull Comparisons	70
8.7.6	Robust Estimation	70
8.7.7	Software Developments	70
9	Computing Environment	71
10	WCGALP Meetings	73
11	Scientific Publications	80
12	Books	118
13	Patents	120

1 Foreword

We are pleased to present this report of CGIL activities from 2001-2013. We combined two 5-year reports with the last two years of activities. The past thirteen years have been a time of major change for CGIL both with respect to faculty members and areas of research. There were several changes in the faculty members. John Gibson, Gerald Jansen, and Sergui Golovan left CGIL in 2002, 2004, and 2008, respectively, while Niel Karrow and Flavio Schenkel started their appointments in 2002 and 2005, respectively. In addition several of the core CGIL faculties retired in this period, starting with Ann Gibbins, followed by Jim Wilton, Ian McMillan, and Larry Schaeffer.

Other major changes were related to CGILs directorship. Steve Miller became the new CGIL director in 2007, following the retirement of Dr. Jim Wilton. In 2013, Steve Miller moved to New Zealand and Flavio Schenkel became the new director. Bonnie Mallard also officially joined CGIL, after many years of joint projects and extensive collaboration. A search will be underway soon to fill Schaeffer's position in dairy cattle genomics funded by the Canadian Dairy Network and Semex Alliance.

In this period the world has moved quickly into the age of genomics and CGIL played an important role through pioneering genomic research and development, but at the same time CGIL maintained its coverage of traditional animal models and quantitative genetics, which are the foundation for current genomic applications to livestock species.

Over these 13 years, CGIL members supervised 31 PhD and 51 MSc students, in addition to 17 Coursework MSc students, published more than 330 peer reviewed papers and approved 176 research projects that brought \$42 million of research money to the University of Guelph.

CGIL continues to have a large number of international visitors and students, with a growing interest from students from countries such as Brazil and Iran. We would invite anyone in genetic improvement of livestock interested in studying in Guelph to get in touch with us.

F. S. Schenkel Director, Centre for Genetic Improvement of Livestock
Department of Animal and Poultry Science University of Guelph Guelph, Ontario, Canada N1G 2W1 519-824-4120, Ext. 58650 Email: Schenkel@uoguelph.ca

2 Executive Summary

The climate within the University of Guelph over the last 13 years has been one of diminishing resources in which faculty that retire have not been replaced, in nearly all colleges and departments. CGIL has also been impacted by this trend, but despite the losses has been able to maintain an active research program, to keep getting research funding, to keep graduate students coming into CGIL, and to be productive in numbers of papers published. Over the last 13 years, CGIL members supervised 31 Ph.D. and 51 M.Sc. students, in addition to 17 Coursework M.Sc. students, published more than 330 peer reviewed papers and approved 176 research projects that brought \$42 million of research money to the University of Guelph. CGIL continues to work hard to meet its mandate with the resources that it is able to attract. However, the remaining faculty are indeed stretched to the limit in terms of time constraints.

The world has moved quickly into the age of genomics, which is the use of DNA to unlock the mysteries of genetic improvement. CGIL has been key to getting the livestock industries to consider using DNA information as a way to increase the accuracy of genetic selections. A graduate course on Quantitative Trait Loci was developed and has been improved over the last ten years. Specialists and leaders in genomics have been brought to Guelph to give summer courses to benefit our students and faculty. At the same time CGIL needs to maintain its coverage of traditional animal models and quantitative genetics which are the foundation for current genomic studies.

On a research basis, CGIL needs to collaborate more than ever given the changes in structure and procedures for research funding organizations. CGIL is aligned with Livestock Gentec at the University of Alberta, which has leadership in the molecular genetics laboratory work. The trend of granting agencies is towards large projects, large in the sense of large amounts of money, number of collaborators, and overhead of management required to run the projects. The hope is for large returns on investment to the industry partners.

The livestock industries have also undergone changes. Dairy cattle still leads the way in genomics research and applications, but all species industries are interested in what genomics might be able to do for them, including aquaculture. Initially the role of molecular genetics was to find individual genes that have large effects on traits such as production or efficiency, but with single nucleotide polymorphisms (SNP), nearly everyone accepts that there are almost always more than one gene responsible for efficiency of production,

and that selection on one gene could be detrimental to the remaining genes for other traits.

Over the last 13 years, many animal breeding groups, not just CGIL, in Europe and North America have dwindled in size and importance due to funding cuts and the increased emphasis on genomics. However, in the last couple of years there has been an increase in the number of job opportunities around the world, for people that specialize in the traditional animal breeding training, but that are also highly skilled in the manipulation and analysis of huge amounts of genomic information. Finding people that have the total package of attributes is nearly impossible, but CGIL graduates should be capable of filling those positions. Our best people have been moving to New Zealand and Australia already.

Of importance for CGIL in the future is to build back up a critical mass of faculty to cover teaching responsibilities and all of the livestock species in an effective manner. CGIL needs another three permanently placed core faculty in animal breeding for covering all of the important livestock species, including dairy, beef, swine, sheep, goats, and aquaculture and poultry. This is important because there are so few breeding and genetics groups in North America, which include CGIL. CGIL will also need a specialized bioinformatics person capable of dealing with genome sequence data, and identifying the computer hardware and software that will be necessary.

3 Origins and Mandate

CGIL was created by an act of the Senate of the University of Guelph in June 1984. Although a centre, CGIL is still an integral part of the Department of Animal and Poultry Science, its teaching and graduate programs. Efforts were to be made to foster collaborative research with statisticians, economists, computer scientists, molecular geneticists and veterinarians. Research was also to involve extensive interaction with industry personnel in Canada and with scientists in provincial and federal governments. Livestock, in this document, includes poultry, aquaculture, dairy cattle, beef cattle, swine, sheep, goats and horses.

The objectives of CGIL, as set out to Senate were:

1. To enlarge and accelerate the University's long-term commitment to excellence of research and development in the field of animal breeding and genetics of livestock improvement.
2. To facilitate effective long-term financing for research in genetic improvement of livestock, thus increasing the efficiency of existing research programs and providing greater flexibility for development of new programs to be applied in industry.
3. To provide for advanced training in the application of quantitative genetics to livestock improvement.
4. To provide provincial and federal government agencies in the Canadian animal breeding industry with a centre to which these organizations may bring their problems in livestock breeding, contract for research and in which they may encourage technical personnel to work in concert with an active research group on solution of specific problems having to do with livestock improvement.
5. To provide leadership for change and updating of existing programs and to otherwise ensure that Canada continues in an advantageous position in the breeding of livestock and in provision of semen, embryos and animal breeding technology for export around the world.
6. To continue to serve the livestock industries by provision of genetic ratings on sires, dams and young animals for breeding purposes for breeding purposes for traits of economic importance as well as for total economic merit.

7. To continue and expand the collaborative research programs with departments of Veterinary Microbiology and Immunology, Mathematics and Statistics, Agricultural Economics and Extension Education, and Computing and Information Science as relates to animals.

The field of livestock improvement, and specifically genetics, has experienced amazing advancements over the past 27 years as a result of improved computing power and scientific advancements in the world of genomics. CGIL researchers have had a leadership role in these advancements and continue to adapt their focus to areas of importance and potential.

4 Plans for 2014 to 2020

The key plan for the immediate future is to build numbers of core faculty in animal breeding back to 1990 levels, in order to sustain the critical mass to meet the increasing demands of the livestock industry. There should be one faculty member responsible for aquaculture and poultry, one member for sheep and goats, one member for swine, and two members for cattle (dairy and beef), and one bioinformatician. This means taking an active role in finding funds to hire quality people. CGIL should hire a new computer hardware and software maintenance person, who has the vision to see what kinds of computers we need to conduct our research, and who is familiar with many different kinds of software systems like SAS, R, Fortran, C++, Linux, LaTeX, MySQL, and web development tools, as well as all software related to genomics. CGIL has relied on and been served extremely well by Bill Szkotnicki for many years, but he will reach retirement age within a couple years. There should be time for Bill and the new person to overlap.

There should be funds to keep top-notch PhD students from leaving Guelph too soon. Once trained, Guelph students should be kept for a year or two to “give back” to CGIL. Many of the good students from recent years have been attracted to New Zealand, Australia, and the UK. CGIL can keep them only if there are suitable funds to compete with the salaries they are offered elsewhere. The University of Guelph, as a whole, has fallen way behind in providing suitable funding to recent graduates. A continuous and steady influx of research funds will be essential for achieving this goal.

On a research basis, CGIL’s work will continue to concentrate on genomics, in all species. Keeping abreast of current trends and new discoveries in this area is very important. The main change will be from SNPs to whole genome sequencing, which will greatly increase the amount of data per animal. CGIL will continue to be requested to participate in such studies due to the current people that CGIL has. The computing environment at Guelph in terms of hardware and accessibility to industry data is the envy of many institutions. CGIL must not lose this edge.

CGIL should also try to further its collaborations with other institutions, as these also bring opportunities for funding, students, and data. Funding for individual projects is getting more scarce, and, therefore, the need to collaborate or to join collaborative efforts is increasing. Faculty need to get students and postdocs in order to have any chance of completing research projects.

The application, administration, and reporting on grants is consuming more and more time of each faculty member, plus university duties, committees and teaching, and without any secretarial staff, there is little time for actual research for faculty members.

CGIL may need to revamp the undergraduate teaching curriculum in animal breeding, unless more faculty can be drawn into CGIL. With a decline in faculty numbers, some undergrad courses are being taught by sessional lecturers, who have less academic and industry experience which may harm the overall quality of the courses. A plan for the immediate future is to eliminate or reduce the number of sessional lecturers by increasing the number of faculty in animal breeding.

The graduate courses should be maintained at least as they are, but ideally a new course on genomic application to animal breeding should be offered. Summer courses should be continued, bringing in outside experts in genomics and bioinformatics. These courses should attract students from other institutions as well.

The next WCGALP is in 2014 in Vancouver, and CGIL should be well represented at this meeting. Undoubtedly there will be visitors to CGIL before and after this congress as people pass through from Europe to Vancouver and back. This would be a good opportunity for visitors to give seminars or even short courses.

CGIL has had a stronger academic base over the years in Canada and currently there is a need for even more intensive academically aimed research which may not have direct commercialization itself, but which may lead to several commercial products. CGIL should serve that role.

The future of CGIL depends somewhat on the future of the Department of Animal & Poultry Science, which depends on the future of the University of Guelph, both of which are going through budgetary adjustments at this time. CGIL must therefore, seek to determine its own future over these uncertain financial times.

5 Personnel

5.1 Faculty Component

Below are pictures of the current active faculty in CGIL.

Animal Breeding and Genetcis



Flavio Schenkel



Andy Robinson

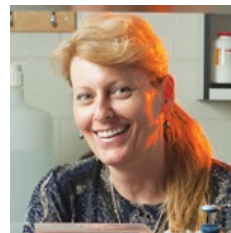
Molecular Genetics, Physiology and Immunogenetics



Niel Karrow



Jim Squires



Bonnie Mallard

The table below displays the complete history of faculty involved in CGIL research and teaching programs over the years since 1985. Changes since 2001 are below the mid cut-off line.

Name	CGIL start	CGIL end	Notes
Gerry Friars	1985	1985	Poultry and Aquaculture
Gordon Bowman	1985	1993	Swine
Ted Burnside	1985	1994	Dairy, Director 1985-1994
Brian Kennedy	1985	1994 ^a	Swine
Charlie Smith	1985	1997 ^a	Strategies Chair
Jack Dekkers	1989	1997	Dairy, moved to Iowa State
John Gibson	1996	2002	Swine, moved to ILRI Kenya
Ann Gibbins	1985	2003	Department Chair 1994-2003
Gerald Jansen	1998	2004	Dairy, moved to Italy
Jim Wilton	1985	2007	Beef, Director 1994-2007
Ian McMillan	1985	2010	Poultry, Aquaculture
Larry Schaeffer	1985	2011	Dairy
Sergui Golovan	2002	2008	Swine
Steve Miller	1999	2013	Beef, Director 2007-2013, moved to New Zealand
James Squires	1987		Swine endocrinology
Bonnie Mallard	2013		Vet. Pathobiology
Andy Robinson	1994		Swine, Department Chair 2010-2014
Niel Karrow	2002		Dairy/Sheep
Flavio Schenkel	2005		Dairy, Director 2013-
^a death year			

Ideally, the critical number of core faculty in animal breeding to maintain is five faculty, thus CGIL needs at least three more people at the current moment, in order to be effective in teaching the courses that it is expected to teach, and research, and to be responsive to industry needs.

Burnside, Kennedy, Schaeffer, Smith, Dekkers, and Miglior (Adjunct professor) won the Jay L. Lush Award in Animal Breeding from the American Dairy Science Association, in different years. Kennedy and Wilton won the Animal Breeding and Genetics Award from the American Society of Animal Science. Kennedy was the first person to have ever won those two awards together in the same year.

Schaeffer won the Hermann von Nathusius Medal from the German Livestock Society in 2010, and an award of merit from Interbull for service to international collaboration in 2011. He also had a paper rated by Thomsen-Reuters as the top cited paper in genetics in 2006.

Kennedy won Outstanding Teaching Awards within the Ontario Agricultural College.

5.2 Adjunct Faculty

Adjunct faculty serve a useful purpose in helping to obtain research funding and in mentoring graduate students by serving on their advisory committees. Adjunct faculty from industry provide links to data and the results of research find readily available applications in industry. Dr C Y Lin was housed in CGIL after the livestock genetic evaluation systems in Ottawa at Agriculture Canada were phased out in 1995.

Name	Notes	
Paul Boettcher	FAO, Rome, Italy	2000-2003
Michael Lohuis	Monsanto	2000-2003
John Gibson	Univ of New England	2002-2005
Bob Kemp	VP Genetic Programs	2000-
Ching Yonn Lin	Agriculture Canada	1997-2010
Filippo Miglior	Canadian Dairy Network	2000-
Mehdi Sargolzaei	L'Alliance Boviteq	2007-
Larry Schaeffer	Retired	2013-
Ben Wood	Hybrid Turkeys	2008-

5.3 Staff

The support staff from the Department of Animal & Poultry Science are tremendously valuable. Their work helps keep students moving forward, and faculty to expand into new areas of research.



Bill Szkotnicki

Computer hardware and software manager. Helps people with computing algorithms and programs they may want to use. Helps in creating databases, websites, collection of data from the experiment stations, use of handheld data collection devices. General problem solver. Serves the entire department.



Gail Costigan

Part time chief organizer, web maintenance, keeper of books of CGIL until August 2013. Gail now works for the Department of Animal & Poultry Science, as of September 2013.



Margaret Quinton

Statistical advisor, data analyst. Serves the entire department.



Computer teaching lab manager. Media guru, teleconferencing expert. Serves the entire department.

Richard Avery

5.4 Research Associates, Post-doctoral Fellows, and Technicians

Foreign visitors provide new blood to CGIL with new or different ways of approaching research problems. They inspire students and at the same time are inspired themselves by the CGIL environment. This is an important part of CGIL.

Name	Country	Years	Faculty
Jamrozik, Janusz	Poland	1987-2013	Schaeffer
Fatehi, Jalal	Iran	2000-2010	Schaeffer/Boettcher
Yazdi, Hossein	Iran	2001	Schaeffer
Guo, Zhiqun	China	2001	Schaeffer
Yang, Runqing	China	2001	Schaeffer
Dedkova, Ludmilla	Czech Republic	2002	Schaeffer
Nobre, Paulo	Brazil	2003	Schaeffer
Eikje, Sigbjorn	Norway	2004	Schaeffer
Li, Jiaqi	China	2005	Schaeffer
Begley, Nora	Ireland	2007	Mallard/Schaeffer
Koenig, Sven	Germany	2007	Schaeffer
Bastin, Catherine	Belgium	2008-2009	Schaeffer/Miglior
Kristiansen, Thorvaldur	Iceland	2009	Schaeffer
Boermans, Herman	Canada	2009	Karrow
Cao, Honghe	China	2008	Karrow
Li, Yong Jun	China	2011	Karrow
Or-Rashid, Mamun		2009	Karrow
Schenkel, Laila	Brazil	2012	Karrow
Sharma, Bhawani		2006-2011	Karrow
Carvalho, Roberto	Brazil	2002 -2003	Miller
Kelly, Matthew	Australia	2006 - 2008	Miller
Oudah, Elsaid	Egypt	2008	Miller
Quinton, Cheryl	Canada	2009 -	Miller
Li, Hong Hong	China	2001 - 2002	Miller
Angus, Stacey	Canada	2003	Miller
Ye, Xianghai	China	2002 - 2003	Miller
Stachowicz, Katarzyna	Poland	2010 - 2012	Miller
Caldwell, Tim	Canada	2006 -	Miller
Lu, Duc		2008	Miller
Jung-Woo	Korea	2012 - 2013	Miller
Guidolin, Diego	Brazil	2011 - 2012	Miller
El-Haroun, Ehab	Egypt	2011 - 2013	Miller
Ventura, Ricardo	Brazil	2011 -	Miller
Peripolli, Vanessa	Brazil	2012	Miller
Fontoura, Ananda	Brazil	2012	Miller

Name	Country	Years	Faculty
Haas, Livia	Brazil	2010 - 2011	Miller
Hassan-Zahraee, Ahmad	France	2010 - 2011	Miller
Banks, Larry	Canada	1999 - 2003	Miller
Jairath, Lalit	Canada	2004	Miller
Schenkel, Flavio	Brazil	2000 - 2005	Wilton / Miller
Thomas, Craig	New Zealand	2001	Miller
Tosh, Jane	Canada	2009 -	Schaeffer
Vandervoort, Gordon	Canada	-2013	Miller/Wilton
Guidolin, Diego	Brazil	2011-2012	Miller
Ye, Manhong	China	2009 - 2010	Miller/Squires
Montanholi, Yuri	Brazil	2009-2013	Miller
Abo-Ismael, Mohammed	Egypt	2012-2013	Miller
Gilmore, Jim	Canada	2004 - 2006	Squires
Sinclair, Phil	Canada	2004 - 2006	Squires
Stewart, Jennifer	Canada	2004 - 2008	Squires
Koeck, Astrid	Austria	2010-2012	Schenkel/Miglior
Pimentel, Eduardo	Brazil	2008	Schenkel
Ventura, Ricardo	Brazil	2010-2011	Schenkel
Brito, Fernanda	Brazil	2008	Schenkel
Grossi, Daniela	Brazil	2011-2013	Schenkel
Heydarpour, Mahyar	Iran	2012-2013	Schenkel
Bohmanova, Jarmila	Czech Republic	2009-2010	Schenkel
Sargolzaei, Mehdi	Iran	2006-2009	Schenkel
Kolbehdari, Davood	Iran	2005-2006	Schenkel
Piccoli, Mario Luiz	Brazil	2012	Schenkel
Munari, Danisio Prado	Brazil	2012	Schenkel
Galvao, Lucia	Brazil	2011	Schenkel
Carvalho, Roberto	Brazil	2011	Schenkel
Baldi, Fernando	Brazil	2011	Schenkel
Guitou, Horacio	Argentina	2010	Schenkel
Singh, Sanjeev	India	2007	Golovan
Hakimov, Hatam	Russia	2006-2008	Golovan
Stewart, Candace	Jamaica	2006-2007	Golovan
Duvanov, Sergei	Russia	2005-2006	Golovan
Abrahamyan, Arusyak	Russia	2005	Golovan

5.5 Graduate Students

Graduate students are the people that conduct most of the research work. Many have taken jobs within the industry, and thus the collaboration with CGIL continues strongly. Some of the students have become faculty members within CGIL. Still others have become important in their own right at other institutions or countries. CGIL is proud of all of their achievements. To date, 179 degrees have been earned within CGIL.

Numbers of Students Graduated.

Year	PhD	MSc(thesis)	MSc(coursework)
2013	2	4	0
2012	2	2	3
2011	4	3	1
2010	5	3	3
2009	1	5	3
2008	2	8	3
2007	1	5	0
2006	1	6	2
2005	2	5	0
2004	6	3	2
2003	2	2	0
2002	2	4	0
2001	1	1	0
Total	31	51	17
1985-2000	44	44	0
Grand Total	75	95	17

Chen, Liuhong. 2013. Improving accuracy of genomic prediction in dairy and beef cattle. PhD. **Schenkel**

Dowker, Mireille. 2013. Developing a breeding program for Atlantic salmon. MSc. **Robinson**

Fisher, Rebecca. 2013. Maternal supplementation with fishmeal protects against late gestation endotoxin-induced fetal programming of the ovine hypothalamic-pituitary-adrenal axis. PhD. **Karrow**

Fleming, Allison. 2013. A genetic characterization of the Hays Converter. MSc. **Miller**

Mead, Philip. 2013. Infection of monocyte-derived macrophages with a reporter Mycobacterium avium spp. paratuberculosis (MAP) strain: validation of the susceptibility SNP (-298A_iG) in the bovine MIF gene. MSc. Toxicology. **Karrow**

Weller, Denise. 2013. Associations between Canadian Holstein dairy cattle health and production traits. MSc. **Schaeffer**

Akanno, Everestus. 2012. Genome-wide selection program for improvement of indigenous pigs in tropical developing countries. PhD. **Robinson**

Chouster, Michael. 2012. MSc.(coursework) **Schenkel**

Kraus, Megan. 2012. In depth heritability and pedigree analysis of atrial fibrillation in the Standardbred racehorse. MSc. **Schenkel**

Larmer, Steven. 2012. Extent of linkage disequilibrium, consistency of gametic phase and imputation accuracy within and across Canadian dairy breeds. MSc. **Schenkel**

Lu, Duc. 2012. Applications of the Illumina BovineSNP50 beadchip in genetic improvement of beef cattle. PhD. **Miller**

Ross, David. 2012. MSc. (coursework) **Miller**

Stonos, Nancy. 2012. MSc. (coursework) **Karrow**

Storey, Bethany. 2012. Investigating associations between feed efficiency and feeding behaviour, activity and general and aggressive behaviours in young beef bulls. MSc. **Miller**

Abo-Ismael, Mohammed. 2011. Identification of quantitative trait loci and genes for feed efficiency and carcass meat quality traits in beef cattle using different genomic approaches. PhD. **Miller**

- Cain, Laura.** 2011. Variation in the endotoxin-induced ovine cortisol response and its association with immune function. MSc. **Karrow**
- Case, Lindsay.** 2011. Improving the efficiency of turkey breeding programs through selection index design, technological advancements, and management optimization. PhD. **Miller/Wood**
- Desnoyer, Jill.** 2011. The formation of androstenedione conjugates in testis tissue of the mature boar. MSc. **Squires**
- Loker, Sarah.** 2011. Genetic analysis of body condition score in Canadian Holsteins. PhD. **Schaeffer/Miglior**
- Melka, Melkaye.** 2011. Aspects of genetic diversity and implications for livestock genetic conservation. PhD. **Schenkel**
- Santos, Martha.** 2011. MSc.(coursework) **Robinson**
- Thomas, Anice.** 2011. Study of health traits and relative economic values using simulation. MSc. **Schaeffer**
-
- Glover, Paige.** 2010. Breed of sire effect on performance of first generation crossbred dairy heifers. MSc. **Schaeffer**
- Hastings, Christina.** 2010. Single nucleotide polymorphisms associated with sex and growth traits in Atlantic cod (*Gadus morhua*). MSc. **Robinson**
- Hobbes, Samantha.** 2010. MSc.(coursework) **Robinson**
- Husain, Mainul.** 2010. Using BALB/c mice as a model of food allergy to study gene expression profiles in response to common food allergens. PhD. **Karrow**
- Neuenschwander, Timothee.** 2010. Studies on disease resistance based on producer-recorded data in Canadian Holstein cattle. PhD. **Schaeffer**
- Pant, Sameer.** 2010. Identification of SNPs and chromosomal regions associated with inflammatory disease resistance in Holstein dairy cattle. PhD. **Karrow**
- Sauerteig, Eric.** 2010. MSc.(coursework) **Karrow**
- Stachowicz, Katarzyna.** 2010. Studies on rates of inbreeding and genetic diversity in Canadian dairy cattle. PhD. **Schenkel**

- Stryker, Judy.** 2010. Evaluation of dietary fish meal or soybean meal supplementation effects on bovine immune response during pregnancy and lactation. MSc. **Karrow**
- Verschoor, Chris.** 2010. Genetic variation in candidate inflammatory-related genes and its relation to infectious bovine disease. PhD. **Karrow**
- Willems, Owen.** 2010. MSc.(coursework) **Robinson**
- Wynn-Sills, Dayna.** 2010. Relationship between temperament measures in beef cattle at different time points. MSc. **Miller**
-
- Gray, Matthew.** 2009. Characterization of porcine nuclear receptors and their splice variants. MSc. **Squires**
- Jen, Kimberly.** 2009. An investigation of the efficacy of non-nutritive adsorption agents on decreasing androstenone levels in boars. MSc. **Squires**
- Kim, Yune.** 2009. Evaluation of local and systemic bovine host defense protein profiles following intramammary challenge with various strains of *Staphylococcus aureus*. MSc. Toxicology. **Karrow**
- Marshman, Melissa.** 2009. MSc.(coursework) **Karrow**
- Montanholi, Yuri.** 2009. Investigations on biological indicators for feed efficiency in cattle. PhD. **Miller/Swanson**
- Ravin, Jennifer.** 2009. MSc.(coursework) **Karrow**
- Shine, Elyse.** 2009. MSc.(coursework) **Robinson**
- Skelding, Alicia.** 2009. Association of SNP in the IL-12 and IL-23 receptor genes with milk and antibody response to MAP infection in dairy cattle. MSc. **Karrow**
- Weircinska, Paulina.** 2009. Characterization of porcine cytochrome P450 enzymes and their involvement in 3-methylindole metabolism. MSc. **Squires**
-
- Abrahamyan, Arusyak.** 2008. MSc. **Golovan**

- Billen, Machteld.** 2008. Regulation of CYP17A1 Activity and its Potential Implications on the Development of Boar Taint. MSc. **Squires**
- Core, Sarah.** 2008. Eye white percentage as a predictor of temperament in beef cattle. MSc.(coursework) **Miller**
- Colley, Adam.** 2008. MSc. **Golovan**
- DeVries, Brent.** 2008. MSc.(coursework) **Robinson**
- Duvanov, Sergei.** 2008. MSc. **Golovan**
- Fisher, Rebecca.** 2008. Effect of maternal endotoxemia on the offspring hypothalamic-pituitary-adrenal axis and fever response later in life. MSc. Toxicology. **Karrow**
- Godsmark, James.** 2008. MSc. (coursework) **Karrow**
- Husain, Mainul.** 2008. PhD. **Golovan**
- Jafarikia, Mohsen.** 2008. Marker assisted selection using SNP haplotype blocks in dairy cattle. PhD. **Robinson**
- Lowerison, Mark.** 2008. Genetic improvement and prediction of dry matter intake in beef bulls. MSc. **Miller**
- Nixon, Melissa.** 2008. Genetic analysis of Canadian Holstein cows milked by an automatic milking system. MSc. **Schaeffer**
- Yeh, Eva.** 2008. An investigation into the effects of plasma lipids on blood clotting activity in laying hens. MSc. **Squires**
-
- Caldwell, Timothy.** 2007. Dietary energy and breed effects on growth, health and body composition of yearling beef bulls. MSc. **Miller**
- Caswell, Barbara.** 2007. Genotype by environment interactions in carcass traits of crossbred beef steers and heifers. MSc. **Wilton**
- Kang, Ji Hyoun.** 2007. MSc. **Golovan**
- Leyva, Ivan .** 2007. Association of SNPs in the CCL2, CXCL8, CCR2, and CXCR1 genes with health and production traits in Canadian Holsteins. PhD. **Karrow**

Mount, Jeremy. 2007. Inflammation induced chemokine gene expression in bovine mammary gland explants. MSc. Toxicology. **Karrow**

Zwambag, Andrew. 2007. Genetic improvement of beef tenderness in a multi-breed beef population utilizing genetic markers. MSc. **Miller**

Burd, Sarah. 2006. MSc.(coursework) **Robinson**

Daetwyler, Hans. 2006. QTL detection for economically important traits in Canadian Holstein sires. MSc. **Schenkel**

Heydarpour, Mahyar. 2006. Influence of population structure on estimates of direct and maternal parameters. PhD. **Schaeffer**

Phillips, Karen. 2006. MSc. Toxicology (coursework) **Karrow**

Stewart, Candace. 2006. MSc. **Golovan**

Tazari, Mahmood. 2006. Strategy for improving genetic aspects of fertility and hatchability in breeding lines of white leghorns, and choosing hens for second cycle of production. MSc. **McMillan**

Verschoor, Chris. 2006. MSc. **Golovan**

You, Qiumei. 2006. Evaluation of immune responsiveness and hepatic gene expression in high, medium, and low endotoxin stress responsive sheep. MSc. **Karrow**

Bergen, Reynold. 2005. Genetic improvement of carcass composition and fat partitioning in steers using yearling bull measurements. PhD. **Miller**

Kabaroff, Leah. 2005. The acute phase response to E. coli LPS in pregnant and non-pregnant ewes. MSc. Toxicology. **Karrow**

Lanthier, France. 2005. Skatole production and metabolism in the pre-pubescent intact male pig. MSc. **Squires**

Palucci, Valentina. 2005. Non-additive genetic effects for fertility traits in Canadian Holsteins. MSc. **Schaeffer**

- Peacock, John.** 2005. Characterization of the pig nuclear receptor CAR and its role in boar taint. MSc. **Squires**
- Quinton, Cheryl.** 2005. Genetic improvement of Atlantic salmon for New Brunswick aquaculture. PhD. **McMillan**
- Terner, Michael.** 2005. The role of CYP2A6 and CYP2E1 in the metabolism of 3-methylindole in porcine hepatocytes. MSc. **Squires**
-
- Barrett, Ryan A.** 2004. Joint evaluation of milking shorthorn dairy cattle for production traits. MSc. **Jansen**
- Harris, Katherine.** 2004. MSc.(coursework) **Robinson**
- Kolbehdari, Davood.** 2004. Fine mapping of quantitative trait loci using linkage and linkage disequilibrium analysis in half-sib designs. PhD. **Jansen**
- Mamaghani, Shadi.** 2004. MSc. (coursework) **Karrow**
- Muir, Bethany.** 2004. Genetics of lactation persistency and relationships with reproductive performance in Holsteins. PhD. **Schaeffer**
- Musani, Solomon.** 2004. Combining breed and family information to detect QTL in crosses of outbred populations. PhD. **Jansen**
- Roso, Vanerlei.** 2004. Genetic evaluation of multi-breed beef cattle. PhD. **Miller**
- Sinclair, Philip.** 2004. 16-Androstene steroid metabolism and its impact on the development of boar taint. PhD. **Squires**
- Stewart, Jennifer.** 2004. Identification of candidate genes involved in the development of boar taint Research. MSc. **Squires**
- Svab, David.** 2004. A study of aggressive behaviour in domestic boars reared in groups. MSc. **Squires**
- Vander Voort, Gordon.** 2004. Comparison of single and multiple trait statistical methods for QTL detection in dairy cattle. PhD. **Jansen**
-

Ansell, Jennifer. 2003. The impact of unrecorded culling of first lactation daughters on sire genetic evaluations for production traits. MSc. **Robinson**

Ledwidge, Sarah. 2003. Associations between specific bovine leukocyte antigen DRB3 alleles and mastitis in Canadian Holsteins. MSc. **Jansen**

Van Dorp, Renate. 2003. Risk factors and genetics of two health traits in Holstein cows: Locomotion and subclinical mastitis. PhD. **Schaeffer**

Ye, Xianghai. 2003. Identification of quantitative trait loci in swine using a candidate gene approach. PhD. **Robinson**

—

Moghadesi, Seyed. 2002. Genetic aspects of sexual maturity in rainbow trout. MSc. **McMillan**

Sullivan, Peter. 2002. Genetic evaluation strategies for multiple traits and countries. PhD. **Wilton**

ten Hag, Bonita. 2002. Detecting Genetic Markers Located Within The Swine Leukocyte Antigen (SLA) Region of Porcine Chromosome 7 which are Associated with Androstenone. MSc. **Squires**

Thomson, Adrienne. 2002. An investigation of the role of hemostasis in the etiology of fatty liver hemorrhagic syndrome. MSc. **Squires**

Wang, Yachun. 2002. Genetic evaluation of calving ease in a multi-breed beef population. PhD. **Miller/Wilton**

Wood, Gillian. 2002. Genetic and environmental influences on milk acetone and milk urea nitrogen. MSc. **Jansen**

—

Quinton, Cheryl. 2001. Growth rate and spawning time in diallel crosses of three strains of rainbow trout. MSc. **McMillan**

Stella, Alessandra. 2001. Strategies for applying marker assisted selection in nucleus breeding schemes in dairy cattle. PhD. **Jansen**

—

Atagi, Yamato. 2000. Comparison of evaluations for production traits of Holstein bulls in Canada, the United States, and Japan. MSc. **Schaeffer**

- Behara, Anoul.** 2000. Genetic diversity in Canadian horse breeds based on microsatellite analysis applications for livestock conservation. PhD. **Gibson**
- Brown, Gary.** 2000. Use of phenotypic target objectives in beef cattle cross-breeding strategies to increase uniformity in production and product. MSc. **Wilton**
- Devitt, Crosby.** 2000. Genetic parameter estimates for finished steer carcass and yearling bull ultrasound measurements. MSc. **Wilton**
- Fatehi, Jalal.** 2000. Genetic aspects of advanced reproductive biotechnologies in dairy cattle. MSc. **Wilton**
- Fernandes, Tamara.** 2000. Genetic parameter estimates for ultrasound-measured carcass traits in sheep. MSc. **Wilton**
- Laborde, Facundo.** 2000. Management strategy and breed effects on the fatty acid composition in longissimus muscle of finishing steers. MSc. **Wilton/Mandell**
- Moghadam, Hooman.** 2000. Estimation of genetic parameters for different cardiovascular defects in meat-type chickens. MSc. **McMillan**
- Pan, Yule.** 2000. Identification and examination of molecular genetic markers associated with somatic cell scores of Ontario Holstein cattle. PhD. **Gibson**
- Sanei, Babak.** 2000. Investigation of environmental factors and their effects on turkey health. MSc. **McMillan**
- Wu, Longyang.** 2000. Comparison of methods for modifying animal model solutions to reduce inbreeding in finite populations. PhD. **Schaeffer**
-
- Kulak, Konrad.** 1999. Comparison of economic values for livestock trait improvement with and without risk. PhD. **Wilton**
- Liu, Xuelu.** 1999. The estimation of genetic parameters of test day dry matter intake, energy intake and milk yield of Holstein cows. MSc. **Schaeffer**
- Luo, Michael.** 1999. Bayesian inference for calving ease and stillbirth in dairy cattle. PhD. **Schaeffer/Boettcher**

Quinton, Margaret. 1999. Genetic diversity in selected populations. PhD. **McMillan**

Broring, Nilson. 1998. Genetic and economic simulation models developing specialized terminal and maternal lines of beef cattle in a nucleus breeding program implementing embryo technologies. PhD. **Wilton**

Edwards, A. Michelle. 1998. Breeding objectives for niche markets in the beef industry. MSc. **Wilton**

Kadarmideen, Haja. 1998. Statistical methods to map quantitative trait loci for binary traits in half-sib populations. PhD. **Gibson/Dekkers**

Malek, Massoud. 1998. A simulation study to evaluate optimal strategies for selection on a quantitative trait using major gene information. MSc. **McMillan/Dekkers**

Pante, Maria Josefa. 1998. Inbreeding effects and estimation of additive and non-additive genetic variances for growth of rainbow trout (*Oncorhynchus mykiss*). PhD. **McMillan**

Schenkel, Flavio. 1998. Studies on effects of parental selection on estimation of genetic parameters and breeding values of metric traits. PhD. **Schaeffer/Kennedy**

Goulden, Chantalle E. 1997. Evaluation of meat quality characteristics of two beef cattle genotypes under varying management conditions. MSc. **Wilton**

Huapaya, Gladys. 1997. Relationship between swine production traits measured in live animals at probing age and their carcass quality. MSc. **Schaeffer**

Kistemaker, Gerrit. 1997. The comparison of random regression test day models and a 305-day model for evaluation of milk yield in dairy cattle. PhD. **Schaeffer**

Ledur, Monica. 1997. Genetic effects of aging in laying hens. PhD. **McMillan**

- Shahrbabak, Mohammad.** 1997. Studies of random regression test day models and persistency for Iranian Holstein production traits. PhD. **Schaeffer**
- Uribe, Hector.** 1997. Estimation of genetic merit for conformation traits using random regression in Holsteins. PhD. **Schaeffer/Kennedy**
- Yeganeh, Hassan.** 1997. A simulation program for the design of broiler nucleus breeding strategies. PhD. **Gibson**
-
- Gallivan, Catherine.** 1996. Breeding objectives and selection indexes for genetic improvement of Canadian sheep. PhD. **Smith**
- Khumnirdpetch, Vanida.** 1996. Bovine somatotropin as a genetic indicator for milk production in potential dairy sires. PhD. **Schaeffer/Hacker**
- Miller, Stephen.** 1996. Studies on genetic evaluation and the effect of milk yield on profit potential in a multi-breed beef cattle population. PhD. **Wilton**
- Wang, Zhiquan.** 1996. Inbreeding and genetic variances with finite locus models under selection. PhD. **Smith**
-
- Archer, Alfred Ainsley.** 1995. Multiple trait method to estimate 305-day lactation yields for Holstein dairy cattle. MSc. **Schaeffer**
- Broring, Nilson.** 1995. Evaluation of body condition scores, ultrasound live measurements and carcass fat depth measurements as predictors of fatness on beef cattle. MSc. **Wilton/Colucci**
- Handley, Joanne.** 1995. Expected progeny differences in young beef bulls for carcass traits. MSc. **Wilton**
- Nejati-Javaremi, Ardeshir.** 1995. Alternative methods for defining relationship, assigning haplotypes and measuring linkage in animal breeding. PhD. **Smith**
- Sivanandian, Balananthasivam.** 1995. Efficiency of selection index and comparison of alternative indexes. MSc. **Smith**

- Ten Hag, Jeromy.** 1995. Estimation of the economic value of lactation persistency in dairy cattle. MSc. **Dekkers**
- Uimari, Pekka.** 1995. Robustness of statistical methods for detection of major genes for quantitative traits. PhD. **Kennedy/Dekkers**
- Vander Voort, Gordon.** 1995. Economic evaluation of progeny testing programs for AI firms operating in a competitive market. MSc. **Dekkers**
- Wang, Yibin.** 1995. Detection and estimation of associations between genetic markers and QTL in segregating populations. PhD. **Gibson**
-
- Al-Hafedh, Yousef.** 1994. Estimation of genetic parameters and comparison of breeding strategies for *Tilapia nilotica*. PhD. **McMillan**
- Brisbane, James.** 1994. Control and prediction of inbreeding in genetic improvement schemes for livestock. PhD. **Gibson**
- Koots, Ken.** 1994. Studies on the genetic and economic parameters required for beef cattle improvement. PhD. **Gibson**
- Kulak, Konrad.** 1994. Lifetime profitability measures and their relationships to lifetime and first lactation traits in Holstein cows. MSc. **Dekkers**
- Miglior, Filippo.** 1994. Impact of inbreeding on dairy cattle. PhD. **Burnside**
-
- Canavesi, Fabiola.** 1993. Sire by herd interaction effect when variances across herds are heterogeneous. MSc. **Schaeffer**
- Leitch, Helen.** 1993. Selection strategies for dairy cattle nucleus breeding programs. PhD. **Burnside/Smith**
- Lohuis, Michael.** 1993. Strategies to improve efficiency and genetic response of progeny test programs in dairy cattle. PhD. **Smith**
- Uribe, Hector.** 1993. Genetics and epidemiology of health traits in Holstein cattle. MSc. **Kennedy**
-

- Amer, Peter.** 1992. Economic evaluation of beef cattle genotypes using neo-classical production theory. PhD. **Smith/Kemp**
- Fan, Liqun.** 1992. Genetic parameter estimation and feed efficiency measurements for dry and lactating beef cows and preweaning calves. PhD. **Wilton**
- Jeyaruban, Gilbert.** 1992. Genetic evaluation and selection in egg-laying poultry. PhD. **Gibson**
- Mpofu, Ntombizakhe.** 1992. Genetic and economic evaluation of dairy cattle breeding strategies for Zimbabwe. PhD. **Burnside**
- Tierney, Jennifer.** 1992. The effect of preferential treatment on production genetic evaluations. MSc. **Schaeffer**
- Tosh, Jane.** 1992. Effects of data structure on genetic evaluation of livestock. PhD. **Wilton**
- Wang, Lizhen.** 1992. Estimation of genetic parameters and responses to selection for production traits in broiler populations. PhD. **McMillan**
-
- Bondoc, Orville.** 1991. Deterministic genetic analysis fo nucleus breeding schemes for dairy cattle in developing countries. PhD. **Smith**
- Gomez-Raya, Luis.** 1991. Estimation and prediction of genetic variance, heritability, and response in selected populations. PhD. **Kennedy**
- Leon-Velarde, Carlos.** 1991. A simulation model to analyze the bio-economic function of cows in intensive dairy farms using a systems approach. PhD. **McMillan**
- Moore, Robert.** 1991. Parameter estimates between production and management traits in first lactation using milk recording data. PhD. **Kennedy**
- Saefuddin, Asep.** 1991. Simulation studies of populations with transgenes under selection. MSc. **Gibson**
-
- Villanueva, Beatriz.** 1990. The effect of truncation selection on genetic parameters of correlated traits. PhD. **Kennedy**

Douglas, Franklin. 1989. Evaluation of the genetic parameters of the Jamaica Hope breed. MSc. **Burnside**

Fiss, Charles. 1989. Contribution of breed, cow weight and milk yield to the biological characteristics of beef breeding systems. MSc. **Wilton**

Graham, Nancy. 1989. Investigation of preferential treatment for milk yield in Canadian Holsteins. MSc. **Smith**

Iwaisaki, Hiroaki. 1989. Distributional and genetic properties of and selection for ratio indexes. PhD. **Wilton**

Kouchehbaghian, Mohammad. 1989. Comparison of egg production models. MSc. **McMillan**

Lee, William. 1989. An investigation into the breeding of broiler chickens for carcass composition traits by means of in vivo measurements. MSc. **McMillan**

Tempelman, Robert. 1989. Additive and dominance genetic variation of production and conformation traits in Canadian Holsteins. MSc. **Burnside**

Armstrong, Susan. 1988. Direct and maternal genetic effects on weaning weight, feed intake and economic optimization in beef production. MSc. **Wilton**

Fan, Liqun. 1988. Carcass characteristics, distribution of tissues and predictions of lean content from carcasses in beef cattle. MSc. **Wilton**

Raheja, Kashmiri. 1988. Genetic relationships between fertility and production in Holstein dairy cattle. PhD. **Burnside**

Sullivan, Brian. 1988. Estimation of variance components for lactation traits of Canadian dairy goats. MSc. **Kennedy**

Sullivan, Peter. 1988. Regional heterogeneity of variances and its effect on sire evaluation in the Ontario and Quebec dairy cattle populations. MSc. **Schaeffer**

- Rapitta, Andrea.** 1987. The heritability of the concentration of progesterone in milk from dairy cows. MSc. **Burnside**
- Winkelman, Anne.** 1987. Heterogeneity of variances among herds and its effects on dairy sire evaluation. MSc. **Schaeffer**
-
- Ali, Tagelsir.** 1986. Accounting for covariances among test-day yields in predicting 305-day milk yield in dairy cows. PhD. **Schaeffer**
- Aziz, Daib.** 1986. Estimation of genetic and environmental influences on growth of Suffolk and Dorset lambs. PhD. **Schaeffer**
- De Rose, E. Paola.** 1986. Comparison of evaluation procedures for performance-tested beef bulls. MSc. **Wilton**
- Leitch, Helen.** 1986. Genetic and phenotypic aspects of administration of recombinant bovine somatotropin to Holstein cows. MSc. **Burnside**
- Scott, Kathleen.** 1986. Effects of selection for lean growth on reproductive performance in gilts. MSc. **Kennedy**
- Shem, Martin.** 1986. Dry season feeding practices in smallholder farms in the Kilimanjaro region - Tanzania. MSc. **McMillan**
- Trus, David.** 1986. Direct and maternal effects in beef cattle. MSc. **Wilton**
- Winkelman, Dianne.** 1986. A comparison of selection methods using the pilot organism *Tribolium castaneum*. MSc. **McMillan**
-
- Jansen, Gerald.** 1985. Selection and mating strategies to improve quadratic merit. PhD. **Wilton**
- Kemp, Robert.** 1985. The effects of positive assortative mating and preferential treatment of progeny on the estimation of breeding values. PhD. **Wilton**
- McMorris, Michael.** 1985. Breeding system, cow weight and milk yield effects on various biological and economic parameters in beef production. MSc. **Wilton**
- McWhir, James.** 1985. Prediction of beef cattle market traits from information on sire performance in central test stations. MSc. **Wilton**

—

6 Teaching

The teaching program has been key to CGIL over the years. From the undergrad courses in animal breeding students have become interested in graduate training. Graduate courses have attracted many foreign visitors, and summer courses have been an effective way of making CGIL known around the world.

Unfortunately, with a decline in faculty numbers, some undergrad courses are now taught by sessional lecturers. The quality of the coverage and depth of the material may not be as high as when faculty (with years of experience) taught these same courses. Graduate level courses are still taught by faculty, with exception of a single course. Students have changed interests from traditional quantitative genetics and animal breeding to the more popular molecular genetics and genomics. The traditional courses, however, are still as important and more relevant than they ever were.

6.1 Undergraduate Courses

Over the past 13 years, the curriculum for the Animal Science (B.Sc. (Agr.) and Animal Biology (B.Sc.) programs has remained static. CGIL personnel continue to be actively involved in the teaching of genetics courses to students in these two majors as well as interested students from other majors. Enrolment in undergraduate genetics courses has increased dramatically with the enrolment in Quantitative Genetics (MBG-3060) increasing by 350% over this time period. A new course at the second year level co-taught between CGIL faculty and faculty from Plant Agriculture was introduced in 2013; MBG-2400 Fundamentals of Plant and Animal Genetics. Other courses have also seen sizeable increases in enrolment as genetics courses are taken by students in the Animal Science and Animal Biology majors as well other majors, including Molecular Biology and Genetics (MBG), Biological Science (BIOS), Human Kinetics (HK) and Bio-Medical Science (BIOM). Quantitative Genetics (MBG-3060) is required for Animal Biology (ABIO) majors and is an elective for Animal Science (ANSC) majors. Animal Breeding Methods (ANSC-4030) has been offered prior to 2001 (formerly Advanced Animal Breeding). In 2007, Companion Animal Genetics (ANSC-4020) was added as an elective.

Applied Animal Breeding (MBG-3090) is was initially required for the ANSC majors and an exclusion elective for students in the ABIO Major. Cur-

ricular changes seven years ago saw the addition of MBG-3090 as an elective for ABIO creating some duplication of content between the required and restricted elective courses in ABIO. Recently, due to that overlapping course content and further curricular reform, MBG-3090 was phased out and the ABIO and ANSC genetics course requirements were harmonized; MBG-2400 followed by MBG-3060 followed by one additional course from MBG-4030, ANSC-4020 or ANSC-4050 (see below). MBG-2400, MBG-3060, ANSC-4030 and ANSC-4020 are all taught by CGIL personnel. Additionally, the following elective courses are taught by CGIL personnel as well:

- ANSC-4050 Biotechnology in Animal Science, formerly Recombinant DNA in Animal Science, and
- ANSC-4090 Animal Endocrinology, formerly ANSC-4080, and
- ANSC-4650 Comparative Immunology

Individual CGIL faculty are also involved in other courses outside of genetics.

- AGR-4700 Research in Animal Biology I (formerly AGR-4400)
- AGR-4710 Research in Animal Biology II (formerly AGR-4410) which are independent research courses for undergraduates.
- POPM-4230 Population Medicine (OVC) - Karrow
- VETM-3390 - Golovan
- MBG-6020 - Golovan
- DAGR-3000 Beef Production, Diploma - Miller
- DAGR-2000 Animal Science, Diploma - Miller
- AGR-2500 Field Trip, Mexico - Miller
- AGR-4500 Agri-Food Industry Problem Solving - Miller
- UNIV-1200 First Year Seminar - Schenkel
- STAT-6950 Statistics I - McMillan, ended 2009
- STAT-6960 Statistics II - McMillan, ended 2009

6.2 Graduate Courses

The core graduate courses in Animal Breeding and Genetics are the following:

ANSC-6210	Principles of Selection in Animal Breeding
ANSC-6240	Topics in Animal Genetics and Genomics
ANSC-6370	Quantitative Genetics and Animal Models
ANSC-6380	Estimation of Genetic Parameters
ANSC-6390	QTL and Markers
ANSC-6450	Topics in Animal Biotechnology
ANSC-6330	Genomics and Proteomics in Animal Science

The numbers of students in these courses fluctuates from year to year. Usually the enrollment is below 10, and could be deemed not important, but for those doing a degree in CGIL, these courses are critical and not available anywhere else in the university.

6.3 Summer Courses

CGIL started the summer course idea in animal breeding in the 1990's, and the idea was to hold one or two such courses every year, bringing in interesting researchers to give lectures on their work. Let the experts give their perspectives. Most courses created a little income for CGIL, when held in Canada.

Now there are many universities and countries (The USA (Iowa State, Wisconsin, Georgia), Spain, Italy, Germany) offering summer courses. Thus, it has become harder to schedule the courses, and harder to compete with the quality of lecturers being offered. Certain instructors tend to attract the bigger audiences. Another factor is the cost of sending students to attend these courses. Thus, now courses are considered when the opportunities arise, such as when we know a particular person will be visiting Guelph.

Year	Place	Size	Instructor	Topic
2013	Canada	25	Daetwyler / Hickey	Genomic Analyses
2012	Canada	40	Schaeffer	Animal Models
2010	Norway	35	Schaeffer	Animal Models
2010	Germany	60	Schaeffer	Animal Models
2008	Canada	30	Gondro / Kinghorn (UNE)	Evolutionary Algorithms
2008	Canada	25	Rekaya (UGA)	Bayesian Methods
2007	Canada	25	Schaeffer / Szkotnicki	Applications using R
2005	Canada	25	Tempelman (MSU)	Analysis of Gene Expression Studies Using Microarrays
2005	Canada	35	Hayes (AUS)	Gene Detection and Marker Assisted Selection
2003	Canada	20	Kachman (UNL)	Bioinformatics
2001	Canada	30	Dekkers (ISU)	Economic Aspects of Applied Breeding Programs

6.4 Workshops

A big part of graduate student training are the weekly workshops in CGIL during the Fall and Winter semesters. Every week a student or faculty member presents their research in hopes of feedback. The purpose is to make people feel comfortable in presenting their research, taking questions, and to receive new ideas about their work. These workshops have carried on every year since CGIL began in 1985. A list of the presenters and their subjects are given on the CGIL website.

6.5 Kennedy Colloquium

Brian Kennedy began the tradition of traveling to Ithaca, New York and Cornell University, taking a few graduate students with him. For one and a half days there would be an exchange of presentations from CGIL and from Cornell on animal breeding research. It soon became an alternating ordeal, in which the Cornell group would travel to Guelph one year, and then CGIL would travel to Cornell. Later, Michigan State's animal breeding group also joined in, and it became a three way exchange. After Brian passed away

in 1994 it became known as the Kennedy Colloquium. Around 2005, the faculty of animal breeding at Cornell retired, and those at Michigan State also retired, so that the Colloquium came to an end. There was a final Kennedy Colloquium in Guelph with invited speakers from around the world, and with over 50 participants in 2008.

The meetings were important for CGIL graduate students to hear other scientists and to appreciate that there were other ways to conduct research than those at Guelph, a broadening of views, so to speak. There has never been an exchange like it in all of animal breeding in the world.

7 Research Funding

Research funding after 2000 has become the era of big collaborative grants due to the nature of genomics research which requires expensive genotyping of individual animals. The costs of genotyping have decreased from 2000 to 2013, but the number of SNP (single nucleotide polymorphism) markers has increased more than 100 fold. Currently we are entering the phase of complete genome sequencing. That means having billions of pieces of information per animal. That means needing computers and software that can deal with massive amounts of information. That means needing adequate laboratory supplies and storage facilities, as well as up-to-date equipment.

Now it is virtually impossible for a researcher to get funding for themselves alone. Genome Canada has forced researchers to form large collaborative groups that span universities across Canada and the United States, and involves nutritionists, geneticists, veterinarians, and economists. Whether this is good or bad for science remains to be decided. To be sure, the obligation on researchers is to stay on the milestones proposed in the initial grant application. Any deviation faces a major review. Thus, spontaneity and exibility to change directions when it is obvious to everyone that the change is necessary, is currently more difficult to have in research. Also, the individual spark to try something different and new is also very restricted, within the framework of these large grants. Creativity may suffer overall. However, this is the system that CGIL must now function within for the foreseeable future.

7.1 Industry Partners

Research funding is enhanced through collaborations with industry, working on industry problems, or problems in which the industry can see an economic return. Below are the industry groups that either provided funding or helped CGIL faculty to obtain research funding from 2001 to 2013. We gratefully acknowledge their contributions.

NSERC	OMAFRA	AAFC
DFO-Dairy Farmers of Ontario	DairyGen	Canadian Dairy Network
Genex Swine Group	Ontario Centre for Agricultural Genomics	CEPOQ Sheep Quebec
Ontario Pork	Poultry Industry Council	Shaver Poultry Breeding Farms Ltd
Food Systems Biotechnology Centre	Alltech, Inc.	Genome Canada
Huntsman Marine Science Centre	Aqua Net	Cooke Aquaculture
Beef Improvement Ontario	Geno (Norway dairy AI)-GENCOR	MITACS
NSERC Discovery	NSERC Engage	National Institute of Health
Ontario Swine Improvement	Canadian Centre for Swine Improvement	L'Alliance Boviteq
Semex	OGI	Ontario Research Development Challenge Fund
Ontario Cattlemen's Association	CanWest DHI	Dairy Automation Limited NZ
Canadian Simmental Association	Agriculture Adaptation Council	Genome Alberta
Alberta Livestock and Meat Agency	Alberta Livestock Genomics Program	Ontario Sheep Marketing Agency
Canadian Beef Cattle Research Council	Pfizer Animal Genetics	Canadian Sheep Breeders Association
Canadian Foundation for Innovation	Lallemand, Inc.	Centre of Excellence for Goat Research and Innovation
Ontario Goat Association	Gartshore Memorial Sheep Research Fund	Canadian Institutes of Health Research
Interpath Pty. Ltd. Australia	Selected Bioproducts Ltd.	JSR Genetics (swine)
Socit des leveurs de chvres laitires de race du Qubec (SECLRQ)	Ontario Goat (Ontario Goat Breeders Association)	

7.2 Some Numbers

Below is a table by year, of the number of new research grants obtained in that year, and the total amounts awarded to those grants. There were a total of 176 grants. These grants represent those of CGIL faculty as Principal Investigators and as co-applicants. Double counting has been avoided when known. Most grants are 3-yr grants, but definitely not all. One can notice a wave or cycle effect over the years. Except for 2005, new grants totalled more than \$1 million per year.

Numbers of new grants and
total amounts awarded by year.

Year	Number	Totals
2001	18	3,331,632
2002	15	1,697,455
2003	17	1,351,310
2004	19	5,058,427
2005	5	315,804
2006	10	8,557,200
2007	15	2,184,067
2008	11	1,995,114
2009	12	1,527,461
2010	28	5,928,346
2011	5	6,747,866
2012	12	1,439,200
2013	9	2,328,621
Total	176	42,462,503

8 Research Summary by Species

8.1 Dairy Cattle

The importance of the Canadian dairy industry to the national and provincial economies has made dairy cattle research a key component of CGIL activities since 1985. A summary of the activities in dairy cattle research follows:

8.1.1 Production Traits

The millennium began with the official introduction of the Canadian Test Day Model, the first such adoption of a test day model, using random regressions, in the world. Studies on random regression models (RRM) were being conducted every where. In Canada, research focussed on fine tuning the system that was begun. Variance parameters had to be estimated each time the model was modified. In 2007 the length of lactations was extended from 305 days to 365 days in terms of which test day records should be included in genetic evaluations. The effects of pregnancy on test day records were found to decrease yields after a cow was 90 days in calf. Adjustment factors were developed to apply to records before going into genetic evaluation. Comparisons between Legendre polynomials and spline functions were made, but no changes were made to the system. Test day models were developed for lifetime production in which there were random regressions both within and across lactations. The effect of unrecorded culling of heifers on sire EBVs was examined.

Robust estimation was found to reduce the effects of outlier test day yields on bull evaluations. Milk urea nitrogen and lactose yield were examined for inclusion into the test day model. The use of structural equation models on production and somatic cell scores were studied for the causes and effects of disease (mastitis) on production and vice versa. Mixture models were applied to separate diseased and non-diseased animals based on their production and somatic cell scores. Mixture models were also used with a new trait, the ratio of fat to protein yields, which looked promising. In 2001 there was a study of an international test day model between Italy, Canada, New Zealand, and the United States. A study on Milking Shorthorn populations was also completed. There was a short study on automated milking systems and cow behaviour.

8.1.2 Conformation Traits

The type classification system underwent changes during 2001-2011. New Feet and Leg traits were included and parameters of these traits were estimated. This led to studies on locomotive disorders in cattle and their economic impact. In 2005 the type classification systems of all breeds were re-vamped in a major way by Holstein Canada. A new system of genetic evaluation for type was proposed so that the old data and new data could be analyzed simultaneously as different, but highly correlated, traits. There were several studies on reclassification records, but because of the manner in which reclassifications occur there will always be biases introduced to the system. Thus, reclassifications should never be mixed with first classification records.

A multiple trait evaluation system utilizing genetic correlations among all traits was attempted, as well as a random regression model applied over rounds of classification. Neither study made a significant impact on CDN or producers and were therefore, not adopted. Finally the data were examined to see the number of herds that had more than one breed of dairy cattle being classified. A multibreed evaluation system was examined, but again the interest in this approach was lacking.

8.1.3 Fertility Traits

Reproduction and other economic traits became more important during the last decade. In 2004 a four trait system was developed, parameters estimated, and genetic evaluations produced as a pilot project. The next year expanded the number of traits to 16, with eight traits for first calf heifers and 8 for cows. Non-additive genetic variances were estimated for some of the fertility traits, but the magnitude of this source of genetic variation was not large enough to warrant changes to the 16-trait system. The fertility system was adopted by CDN in 2006. Another study looked at the relationship of persistency of milk and fat production with fertility traits.

8.1.4 Health Traits

In 2007 Canada began a National Health Recording Program, but relatively few dairy producers participated in the program, and those few were not consistent in their recording of disease events. Eight main disease traits were

chosen to be evaluated. Several different approaches to the analysis of these data were taken. Heritabilities were very low and estimates varied depending on how the data were edited prior to analysis. A survey of producers on the health recording program was taken to determine their commitment to the program and to see if they could provide information that would assist in helping with edits of the data. The response to the survey was about 35%. Many of the responses were inconsistent with the data that was already in the system. In the end, a suitable genetic evaluation program for health traits could not be recommended for routine usage. There were separate studies on mastitis and Johne's disease. In 2010 another attempt was begun to evaluate the health traits.

8.1.5 Body Condition Score

In 2008 body condition scores became available from Holstein Canada through the type classification program, and from Valacta in Quebec. The Quebec data had monthly BCS observations while the Holstein Canada system had only one BCS observation per animal (when classified). Analyses looked at each source separately and at how the two might be combined. The goal was to develop a genetic evaluation system for BCS.

8.1.6 Crossbreeding

Semex Alliance began a project with the Norwegian Red company, GENO, to have Norwegian Red bulls (NR) bred to Holstein cows in Canada. Herds signed up to provide data on the offspring through the completion of their first lactation record and later. Similar projects in Ireland and the US were also undertaken by GENO. Data accumulated over a five year period, and analyses were run and re-run several times. The results (in Canada and elsewhere) were that crossbred animals could be more profitable than purebreds, through easier calvings and better reproductive abilities, with little loss on the production side of the equation. Production, conformation, and fertility traits were studied. Conformation of crossbreds would never be rated as highly as for purebreds. Ayrshire crosses to Holsteins were also shown to be economically useful. Crossbreeding in dairy cattle has a long uphill battle in Canada.

8.1.7 Cow Profitability

A computer simulation of a large cow population with over 200 genetic traits per animal was used to study the impact of health traits on overall profitability during the life of a cow. Daily expenses of cows and income from production could be considered during the simulation. Selection was not practiced as every cow was given the opportunity to keep producing as long as it was able. The current Lifetime Profit Index was found to be nearly as efficient as the best possible index from the simulation. The contribution of health traits to the index was small.

8.1.8 Longevity

Various studies were made on the LPI, to determine factors that affect longevity. A random regression model was proposed and studied to evaluate animals for survival. Observations in the random regression model were the survival curves of each animal.

8.1.9 Genomics

The hottest new area of research was genomics. The use of information from the DNA of animals to predict genetic merit and to use for selection. A 2006 study showed that genetic change could be enhanced by two to four times over the conventional progeny testing system by using dense marker maps of the cow genome. Studies were begun with Semex to genotype proven dairy bulls for 3,000 SNPs (single nucleotide polymorphisms). Within a short time there were SNP panels with 10,000 SNPs, and then 50,000 SNPs. Today there are panels with over 1 million SNPs. Studies on *Imputation* were begun. That is, if an animal is genotyped with a 3K or 6K SNP panel, is it possible to predict or project the animal's genotypes for the 10K, 50K, or larger panels? The answer is yes, and numerous imputation algorithms have appeared and studies comparing these algorithms, for speed and accuracy.

Some of the early studies (using SNP panels) looked at linkage disequilibrium in various breeds of dairy cattle in Canada. There was a major study of rates of inbreeding and genetic diversity in Canadian populations. A simulation program was developed (QMSim) for generating populations of animals with which to study the impact of selection on SNPs. The dairy industry has

adopted the technology very quickly, both in Canada and around the world. A two step approach was adopted in Canada where the first step is to evaluate animals with the usual Test Day Model, and the second step is where animals that have been genotyped are evaluated using the genotypes to form a more accurate genetic relationship matrix. Then the two evaluations are merged into one genomic EBV.

Markers are also used to find genes with large effects, and then studies of the importance of these genes to a biological pathway in various organs can be made. Work in genomics has replaced all other types of studies being made in CGIL. Research on new linear model methods to evaluate dairy records has ceased in favour of studies using SNP panels and genotyped animals. In Canada, Holstein Canada is collected hair and blood samples of cows and sending these for genotyping when requested. The number of genotyped animals is exploding around the world, such that it is becoming difficult to store and process all of this information per animal.

In the next decade we can expect more work in this area, in particular full genome sequencing. This is where the entire genome will be sequenced, giving 3.5 billion pieces of information per animal. This has forced us at CGIL to purchase hardware that will allow us to do parallel processing on hundreds of CPUs. The limits of computing hardware are always being tested. Selection bias, increased rates of homozygosity, decreased genetic diversity, identification of genes, and better models for the analysis of genomic data will occupy CGIL and the world in the next decade.

Genomics has changed the nature of progeny testing dairy bulls. Young bulls are used over a very short time span and new bulls appear soon after complete with new genomic evaluations which are as accurate as completed progeny tests, but available at least 4 years sooner.

With the success of genomics in dairy cattle, all livestock species want to apply genomics too, but not all species can benefit to the same degree as dairy. Genomics is here to stay, and is an area that is rapidly changing and evolving. New discoveries can change the direction of research very quickly. CGIL must be vigilant of all new technology and methods in this area.

8.1.10 Epigenomics

This area includes the effects of environment on genotypes to change their expression, both gene and miRNA expression in calves that are infected with *Mycobacterium-avium* spp. paratuberculosis (MAP). This includes looking at miRNA in High and Low immune responding cows and their role in calf gut development and human health.

8.2 Beef Cattle

8.2.1 Beef Improvement Opportunities, BIO

The collaborative research and development relationship with BIO dates back to 1993. CGIL has enabled BIO to deliver multi-breed genetic evaluations and research has continued to support this system. Genetic evaluation research has included important traits such as calving ease and carcass traits, feed efficiency and female fertility. The work of CGIL was instrumental in allowing BIO to secure the Leachman Cattle Company (LCC) as one of their genetic evaluation clients. The LCC is one of the most important genetic providers of cattle genetics in North America and the ability of BIO to deliver genetic evaluations on multiple breeds along with composite breeds, a CGIL ingenuity, was instrumental in this success.

In the past few years the collaboration with BIO has expanded into genomics. Through CGIL leadership, BIO is now a major player in Canada in the area of beef cattle genomics. The first tenderness and feed efficiency genomic predictions based on high density SNP data appeared in 2013.

8.2.2 Feed Efficiency and the Cow-Calf Sector

The purpose of this study was to investigate how beef cows differ in performance (size, intake, fertility, calf weaning weight) in relation to their efficiency predictions (genomic and based on own and progeny records for feed intake). Biological measures to predict and to monitor biological responses to improvement in feed efficiency including: a) Energy metabolism (using an indirect calorimeter); b) Key-organs in energy partitioning, targeted hormones, and c) metabolites involved in performance and reproduction. This project also involved the search for SNPs that were involved in metabolic processes.

8.2.3 Methane Emissions and Infrared Phenotyping

The goals have been to establish a standard operating procedure, employing gold standard methodology, for the infrared scanning of dairy cattle in order to assess feed efficiency and methane emission from ruminal fermentation and to further develop an automated system for capturing infrared images and performing imaging interpretation. The project considered further testing of

an automated system for capturing infrared images and interpretation. Studies on greenhouse gases were also part of this project.

8.2.4 Liver Function

The goal was to demonstrate and further develop the ability to predict differences in feed efficiency between cattle based on advanced liver measures. The five liver metabolic/architecture complementary streams for assessing feed efficiency in beef cattle are as follows: a) Liver histology measures; b) Oxygen consumption by the liver tissue; c) Concentration of mitochondria in liver tissue; d) Blood parameters that indicate liver function and; e) Bile salts and bile immunoglobulins.

8.2.5 Biological Predictors of Feed Efficiency

The purpose was to investigate biological phenomena related to feed efficiency, aiming to increase our understanding of the factors that influence the efficiency of feed utilization by beef cattle and also to identify factors that could be used to select more efficient cattle and to nutritionally manipulate cattle for better productivity. The approach includes short-term trials (112d for feedlot cattle) and long-term trials (24 months with replacement beef heifers and primiparous beef cows).

8.2.6 Feed Efficiency and Fertility

The goal was to investigate potential associations between feed efficiency and sperm fertility traits in young beef bulls. This included scrotum circumference measurements and semen collection through electroejaculation of young beef bulls tested for feed efficiency over 4 years (110 bulls in total). Semen was analyzed for sperm motility, sperm viability and progressive motility. Carcass composition was also evaluated through ultrasound and carcass dissection. These traits were then related to feed efficiency measures, including residual feed intake. Results indicated that young beef bulls with higher feed efficiency have decreased sperm motility, sperm viability and scrotum circumference.

8.2.7 Feed Efficiency and Carcass Composition

The potential of infrared thermography was tested in these bulls and models for predicting feed efficiency were developed. Individual daily feed intake was assessed using an automated feeding system. Ultrasound for body composition, body weight assessment and infrared thermography imaging every 28 days for 140 days of trial per year. At the end of the trial bulls were processed and carcass composition and meat quality were evaluated. This study demonstrated the need for including body composition data (ultrasound traits) for a better prediction of feed efficiency. Moreover, the findings provided insights on infrared thermography indicating that thermographs of body extremities are moderately associated to feed efficiency.

8.2.8 Phenotyping and the OMAFRA research program

The beef cattle genetics research program at CGIL has always been distinctly different to the other species due to the active and ongoing involvement of the “live animal” research at facilities such as Elora and New Liskeard. The beef genetics research program has amassed a very valuable database including pedigree and phenotype records dating back to the 1970’s with continuous recording to the present.

Due to a very large CFI grant secured by Dr Miller, the feedlot and meat quality facilities were restored with state of the art facilities. These facilities enabled unique phenotypes to be collected on efficiency and meat quality, that paved the way for continued advancements in genomics, but also the development of unique approaches to phenotyping for feed efficiency, which is described in more detail below.

8.2.9 UoG CAST - A genetic marker for beef tenderness

This project discovered and commercialized the SNP in Calpastatin that is related to improvements in beef tenderness. This SNP was patented and licensed to Merial who has delivered this SNP information to beef cattle breeders throughout the world. Many trials were done in North America to validate the effectiveness of this SNP and repeatedly this SNP was shown to have a significant effect on beef tenderness.

8.2.10 Whole genome sequencing

This project is sequencing the key founders and genotyping all the major beef cattle breeds in Canada. Included are over 300 sequenced ancestors and 10,000 high-density genotypes. The project will allow the imputation of genome wide information and develop genomic predictions for meat quality and feed efficiency traits, of critical importance to the industry. This project is in collaboration with University of Alberta, along with the major beef breed associations, BIO, BeefBooster and Semex in Canada. International partners include the Meat Animal Research Centre, United States Department of Agriculture and the Co-operative Research Centre for Beef Genetic Technologies Australia, Ag Research New Zealand, TEAGSC Ireland and the Scottish Agriculture College.

8.2.11 Validation of DNA selection technologies

The DNA tests need to be validated in populations that are independent from the original discovery populations prior to use in industry. Suitable populations with the required phenotypic measures are very limited and the result is a delay in the delivery of these technologies to industry. Although this work does not result in a scientific publication in a peer reviewed manuscript, the results are very important for the application of this technology in industry.

8.2.12 Development of a DNA panel to predict beef tenderness

This work has identified a number of important genomic regions influencing beef tenderness. These regions have been fine mapped and a panel of 2500 informative SNP was developed and genotyped across 1100 animals. The result is a prediction of genetic merit of tenderness with an accuracy of 40% based on a DNA test.

8.2.13 Development of a DNA panel to predict feed efficiency

Feed represents the largest single variable cost in beef production and the efficiency of its use has a significant genetic component. This project is continuing under the Genome Canada project and is on-track for a joint analyses of more

than 8000 animals with efficiency phenotypes and high density genotypes in Canada.

Other studies over this period included the following:

- Stayability in Simmental cattle: The stayability of a beef cow in the herd is of economic importance because of the costs involved in raising replacement heifers. A random regression model was applied to Simmental herd data.

A joint project with the Canadian Simmental Association will have amassed over 10,000 genotypes on Simmental cattle that will have a tremendous influence on the North American evaluation for the breed. The unique work at CGIL is generating 1500 phenotypes on Simmental influenced cattle that will form the foundation of future work to predict meat quality and efficiency for the breed.

- Milk composition of cows: The chemical composition and physical properties of milk and colostrum and their effects on feed efficiency of cows was studied.
- Glucocorticoids as biomarkers.
- Beef tenderness at different ageing times.
- Linkage disequilibrium in Angus, Charolais, and their crossbreds. The question was whether there was enough LD to be useful for genetic evaluation of animals using genomics.
- Meat quality, carcass lean percentage, carcass fat partitioning, and the leptin gene.
- Percentage of white in the eyes and relationship to temperament. This research resulted in the one of the largest media events around beef cattle genetics research at CGIL. It involved a prediction of animal temperament (exposed eye-white). The larger audience outside agriculture could relate to this perhaps through experiences with their own pets. Exposed eye-white could be used as a performance measure of cattle temperament, allowing genetic selection for this trait.
- Epistatic losses on preweaning gain.
- Genetic evaluations for calving ease.

- Maternal productivity.

8.3 Swine

8.3.1 Genomics

Genomics also became of interest to the swine industry. Early studies used radiation hybrid mapping techniques to locate known GenBank entries from the human genome to highly similar regions of the porcine genome. A complete comparative map of the human and porcine genomes was created along with detailed maps of two specific porcine chromosomes of interest for reproductive studies; SSC3 and SSC6. Using the detailed maps of SSC3 and SSC6, candidate genes were identified for analysis in relation to ovulation rate and litter size. QTL were identified with strong associations to ovulation rate in a small experimental herd, however, these associations did not carry through to litter size in a large, commercial breeding stock population. Later work looked at applying a genome wide selection scheme to swine production systems in developing countries, for indigenous species.

CGIL is also involved in the first genomic selection project in pigs in Canada in collaboration with the Canadian Centre for Swine Improvement. The project aims to generate genomic tools to improve production and meat quality in pigs. Pigs from the three major breeds (Landrace, Large-white and Duroc) were genotyped and basic genomic research was carried out to describe genome parameters for the three breeds and, based on that, genomic predictions were evaluated with respect to bias and precision (accuracy) of prediction. A 5K SNP panel has been used.

8.3.2 Piglet Health

An adverse intra-uterine environment caused by maternal stress (i.e. bacterial infection during pregnancy) can have a profound effect on the genetic programming of various fetal organs and tissues; the timing of the stressor dictates which tissues are most susceptible. For example, it is well known that the hypothalamus-pituitary-adrenal axis (HPAA) is highly susceptible to stress-induced fetal programming during early and late gestation. These alterations in tissue programming are thought to prime the offspring for the environment in which they will live. However, if the in-utero environment does not match the ex-utero environment, this can increase the risk of disease to offspring.

A ruminant maternal BEIS model was developed to study the effects of stress on the developing fetal neuroendocrine-immune system. Using this stress model, maternal supplementation with n-3 PUFA, in the form of fishmeal, during late pregnancy has been shown to provide health benefits to ruminant offspring. Fishmeal and fish oil are the most commonly used sources of omega-3. However, with sustainability of the fishing industry in question, researchers are trying to find alternative sources of omega-3, and algae may be the solution to this problem. The objectives of the present study are to:

1. assess omega-3 enrichment in the pregnant sow and piglet as a result of maternal supplementation with algae meal, and
2. explore the health benefits of algae meal supplementation during pregnancy on fetal, neonatal, and weaner pig health by assessing porcine immune function and tissue-specific gene expression profiles.

8.3.3 Economic Indexes

A study was made to derive economic weights for sow productivity traits in nucleus populations. Strategies of selection for closed nucleus herds were also studied. Another paper looked at the effect of genetic selection on the management of boars and the selection process.

8.3.4 Boar Taint

A longterm area of research in swine has dealt with the study of boar taint, and in particular the metabolism inputs and outputs such as steroid hormone synthesis, nuclear receptor transactivation, gonadotropin releasing hormone, and nitrogen retention. This area of research has also led to most of the patents in CGIL.

8.3.5 Protein and Lipid Deposition

A minor study was made on developing predictions of protein and lipid deposition rates from body weight and feed intake curves for pigs on test up to 120 kg body weight. The next step is to estimate genetic parameters of these curves and determine how they can be used to make dietary recommendations through the growing period.

8.3.6 PRRS Virus

CGIL is involved in a major Genome Canada study of two key viruses that have a significant impact on the Canadian swine industry; PCVAD (Porcine Cirovirus variants) and the PRRS (virus, which is the Porcine Respiratory and Reproductive Syndrome). Again, genomics are being used to try to find major genes that might help make pigs resistant to the virus. The project involves CGIL, University of Alberta, Iowa State, Kansas State, USDA, and University of Saskatchewan. CGIL's component is to look at strategies to apply genomics, assuming useful genes can be found.

8.4 Sheep and Goats

8.4.1 Meat Sheep

The main industry partners are CEPOQ (Centre d'expertise en production ovine du Quebec) and OMAFRA. The data that were kept separately by each group were merged into one, online database which is accessible by individual producers. CEPOQ and OMAFRA have control over what information goes into the database, and producers can extract data on their animals, plus genetic evaluations on their ewes and genetic evaluations on rams that have been used in several flocks.

The database was designed using open source software. The first part was getting pedigree information into the database. Every new animal that now goes into the database their parents must already be in the database. Pedigree information is critical to genetic analyses. All weights and dates are pre-checked before being admitted. Thus, the quality of the data has improved immensely since the adoption of the database. CEPOQ personnel have been particularly keen on keeping the quality at a high level.

Two multiple trait genetic evaluation systems were developed using the data from the database. One system was for growth traits of lambs, including direct and maternal genetic effects as well as lamb survival and ultrasound measurements on fat and loin. The second system was for ewe reproduction traits, particularly number of lambs born and number weaned. Every weekend, data are extracted from the database for all animals in the database, and genetic evaluations are run through the night. New genetic evaluations are available every Sunday. A number of producers are now very reliant on having this information.

Research was also done on developing new selection indexes, for helping producers to select the best rams and ewes. There were 4 indexes available prior to 2013, and now there are 6. The six new indexes make use of all of the genetic evaluations for growth and reproduction, which was not the case for the old indexes.

8.4.2 Dairy Sheep

CEPOQ initiated a project in Quebec for a dozen or more flocks that are keen on producing milk from sheep. There is a 2 year project for collecting milk, fat, and protein information from these few flocks and for developing a genetic evaluation system for the ewes and rams.

The data will go into the same database as the meat sheep data. New tables for dairy information will be added to the database. The data will need to be studied and genetic parameters estimated, if possible, from the records. A genetic evaluation system then needs to be developed. This will hopefully be ready to go by 2015.

8.4.3 Meat Goats

In spring 2013 there was an interest in collecting and analyzing meat goat data. All of summer 2013 was used to try to find enough meat goat data to be analyzed. As of this report, there does not seem to be enough good quality data.

The idea was to duplicate the sheep database, just for goats. The breeds and terminology need to be modified, but otherwise the sheep system should be suitable for Meat Goats. The prospects of success with this project seem to be low.

8.4.4 Dairy Goats

Currently, genetic evaluations for dairy goats are run by the Canadian Centre for Swine Improvement. This has been the case since the late 1990's. However, if the meat goats were successful in being set up with the sheep database system, then it is logical that dairy goats could be added too, similar to dairy sheep with the meat sheep system. There is a graduate student at CGIL that is very interested in working on the meat goat system, for use in Brazil.

There was one study of the arthritis encephalitis virus in goats.

A project funded through the Canadian Agricultural Adaptation Program has begun through Société des éleveurs de chèvres laitières de race du Québec (SECLRQ) and Ontario Goat. The general objective of the proposed project

was to assess the potential of genomic selection for goat herd improvement on productivity by using genomics to improve herd performance and health. Specifically, to use new technologies available in genomics (SNP chips) to genotype Canadian dairy goats; To estimate SNP effects (Single Nucleotide Polymorphism) in relation to the performance of dairy goat breeds used in Canada; To develop methods to include genomics in the estimation of breeding values; To estimate pilot genomic evaluations for different traits currently measured on dairy goat farms; and To provide recommendations on use of genomics for goat selection in Canada.

8.4.5 Genomics Areas

For sheep and goats, genomics projects are underway to identify SNPs associated with Johnne's disease, and to identify genes contributing to the ovine stress response phenotype. Glucocorticoids help to maintain physiological homeostasis during microbial infections, in part, by regulating the inflammatory and immune response. Dysfunctional communication between the neuroendocrine and immune systems contributes to the pathogenesis of inflammatory diseases in livestock, and genetics as well as maternal stress-induced epigenetic programming of the fetus likely influence disease susceptibility and outcome. Over the past 7 years, an acute bacterial endotoxin inflammatory stress (BEIS) model has been optimized to study the ovine stress response during simulated bacterial infection. The stress model has been used to study the genetics and epigenetics of the stress response and it's relationship with the host immune response.

Future objectives are to:

1. fine map genomic regions of interest that were previously identified in a genome-wide association study to identify putative genetic variants that contribute to the stress response phenotype,
2. validate associations between stress responsiveness and immunity using various infection models, and
3. identify gene pathways that are subject to BEIS programming during fetal development. The identification of genes and their SNPs, and enhanced understanding of gene-by-environment interaction during fetal development will contribute to improving animal health and food quality, reducing our dependence on antibiotics in agriculture, and enhance

our understanding of the pathways that regulate the neuroendocrine-immune system in mammals.

A genetically modified MAP isolate is used to understand bovine and ovine intestinal epithelial cell and immune cell gene regulation during viral co-infection, exposure to mycotoxins, and probiotic treatment.

8.5 Poultry

Poultry research has concentrated predominantly in turkeys with most work completed in collaboration with the primary breeding company, Hybrid Turkeys. There have been five major areas of research: economic modeling, breast meat yield, feed efficiency, egg production and livability.

8.5.1 Economics

A bio-economic model was developed for the turkey industry that could be used for the calculation of turkey production economic values suitable for selection indexes. Another use of the model was as an optimization tool to identify the best slaughter weight to maximize either farm or integrated company profit.

8.5.2 Novel Trait Evaluation

Breast meat yield (BMY) research focused on alternative in-vivo measures of such as ultrasound and conformation scores compared to sibling testing. Feed efficiency has a large effect on turkey industry profitability, consequently, there have been a number of areas of concurrent research in the field. These have included alternative methods of modeling efficiency such as residual feed intake, feed conversion ratio and residual gain. Phenotypic measurement of feed efficiency is with the development and continued study of automated RFID feed stations for measurement of feed intake in a grouped housing setting. The use of infrared imaging as a means to identify feed efficient animals was also examined.

8.5.3 Alternative Trait Modeling Strategies

Important traits such as livability and egg production have their own unique data structure and problems when modeling each trait. Livability was examined as an indicator of bird welfare. The walking ability and leg strength traits were shown to be highly predictive of livability. Egg production was modeled using random regression to examine genotype by environmental ($G \times E$) interactions with season having significant effect on production.

8.5.4 Feed Conversion Ratio

Historically, feed conversion ratio (FCR) had been the primary driver for selection for feed efficiency in the poultry industry, however, as time goes on there has been more and more interest in residual feed efficiency traits. The majority of the focus in the poultry industry is with residual feed intake (RFI), pertaining to the proportion of feed consumed that is not accounted for via body weight maintenance or body weight gain. Infrared imaging, as used in beef cattle, was applied to turkeys, as well as ultrasound measures of breasts muscle depth, both having aims on feed efficiency. Recently, the objectives for turkey feed efficiency research have shifted attention to other feed efficiency traits, as well as improving the accuracy and providing further data on the more established traits.

The research group at CGIL has investigated several previously unstudied traits in the turkey. The first being residual body weight gain (RG), the proportion of body weight gain not accounted for by feed intake or body weight maintenance. The second trait is residual intake and body weight gain (RIG). RIG is a linear combination of both RFI and RG (and can be optimized to include different proportions of either trait, depending on the species), which offers the phenotypic and genetic benefits of both its component traits. Lastly, the breakdown of RFI into two components, the proportion due to maintenance requirements and the proportion due to body weight gain on an individual bird basis via random regression models allows for the discrimination between animals with similar RFI and shows improved accuracy compared to the more widely used version of a fixed linear regression of RFI.

Alongside classic feed efficiency research a newly developed individual feed intake measurement system (designed with industry partner Hybrid Turkeys) has been utilized to study short term feed behaviour (STFB) traits, and more accurately gather feed efficiency data. These STFB traits (meal size, number of meals, meal duration, feeding rate) have proven to have correlations with feed efficiency in the turkey. In addition, measuring feed intake in an open group pen as opposed to individual pens, allows for the development of social hierarchies. These social effects, which are usually unaccounted for in turkey feed efficiency studies, allow for a more accurate estimation of feed efficiency traits, given that they will be housed in groups pens when birds are placed in the commercial turkey industry.

8.5.5 Reproduction and other Traits

- The effects of seasons on regulation of reproduction in turkeys was conducted.
- Survival and fitness using multiple trait models were studied.
- Optimum slaughter weights were examined.
- Genotype by environment interactions on egg production were studied.

In chickens, the effects of ageing on fitness traits of laying hens was studied, as well as sudden death syndrome and its link to ascites and body weights.

8.6 Aquaculture Species

Aquaculture research has been conducted using a variety of methods, in a variety of locations, with a goal of making targeted improvement in a number of fish species. Research has taken place in both the controlled setting of the Alma Research Centre, as well as in commercial production environments on both coasts of Canada. Highlights of the research activities, by species, are summarized below.

8.6.1 Rainbow Trout

Trials at the Alma Research Centre were to develop and test a fast growing, late maturing, spring-spawning strain of rainbow trout, which was started in 1991. The research involved the production, evaluation and selection of second, third and fourth generation fish using such traits as weight, length, age at sexual maturation, spawning date and egg volume, size and number. The resultant synthetic strain combined spring spawning and fast growth. Funding for the project ended in 2009 and all fish were removed from the Centre. The results of the project have never been analyzed, and there are no longer any genetic studies of rainbow trout being conducted at the University of Guelph.

A separate study on industry fish looked at rates of inbreeding and its effects on hatchery raised rainbow trout.

8.6.2 Atlantic Salmon

Research on Atlantic salmon has been completed on both the east and west coast of Canada. In the east, research on Atlantic salmon was done in partnership with (New Brunswick) NB salmon producers at the Huntsman Marine Science Centre in St Andrews, NB. Through this research a new strain of Atlantic salmon was developed, characterised by fast growth, good carcass quality, and low grilse incidence. Additionally, genetic improvement strategies were developed for new management practices, wherein broodstock are reared in freshwater (FW) facilities, while market stocks are reared in seawater (SW) net pens.

A second project in the east, completed in partnership with Cooke Aqua-

culture Inc. in New Brunswick involved the application of genomic selection techniques, proven effective in dairy bulls by CGIL researchers, and adapting these for improvement of salmon broodstocks. Improvements were made in the area of growth rate in saltwater, adaptation rate to seawater, disease resistance and delaying sexual maturity relative to a conventional breeding program. The project has since moved towards selecting fish for resistance to sea lice, which causes losses to Cooke Aquaculture Inc. The success of the genomics project in the east led to additional research being completed in western Canada with the genomic technologies developed in the east coast project integrated into existing broodstock development programs in British Columbia, with a goal to ensure that salmon farming remains sustainable in British Columbia, and reaches its full potential.

Simulation studies were conducted to determine the advantages, if any of applying genomic EBVs to Atlantic salmon. The results showed that usual EBV from BLUP methods (best linear unbiased prediction) were still more accurate than genomic EBVs. Applying genomics does not decrease generation intervals, and thus does not increase genetic change, as it does in dairy cattle.

8.6.3 Atlantic Cod

In an effort to support the development of cod aquaculture in Atlantic Canada a multi-partner collaborative study was initiated to fast-tracking selective breeding and subsequent rearing of offspring to pin-point the best brood stock families that produce fast-growing, disease-resistant, high-quality cod in sea cage conditions. The goal of this project was to produce two elite broodstocks, originating from local cod populations, for industrial partners to use to build commercial-scale cod aquaculture operations in both New Brunswick and Newfoundland and Labrador.

8.6.4 Abalone

Work has also been done with Abalone (sea snails), investigating potential breeding strategies that could be implemented in hatcheries for species restoration and commercial purposes.

8.7 Theory and Strategies

8.7.1 Genomics Theory

With the rapid arrival of genomics, many studies needed to be made to become comfortable with working with marker genotypes. There were early studies on

- Estimation of genome wide haplotype effects in half-sib designs.
- Transmission disequilibrium tests for QTL detection.
- Precision of estimated QTL positions in granddaughter designs.
- Power of QTL detection in fixed or random models in half-sib designs.
- Application of genome wide selection in dairy cattle.
- Use of marker haplotypes to refine covariances among relatives for breeding value estimation.

8.7.2 Permanent Environmental Effects

A cumulative permanent environmental effects model was proposed for situations with repeated records per animal. The computational framework for this model was outlined.

8.7.3 Non-additive Genetic Effects

Computational simplifications of a non-additive genetic model with one record per animal were presented. The methods were later applied to fertility data in dairy cattle. The non-additive components were relatively small compared to the additive component.

8.7.4 Maternal Genetic Effects

The effect of population structure on the estimation of maternal genetic effects in multiple trait situations was studied. Data structure was found to be im-

portant for obtaining unbiased estimates of the additive by maternal genetic covariance.

8.7.5 International Dairy Bull Comparisons

A model for multiple trait international dairy bull evaluations was published. The properties of such evaluations and what factors could cause biases in the evaluations were also studied.

8.7.6 Robust Estimation

Robust methods were proposed to handle outlier records. Outliers are records that could be due to recording errors, or could be due to deliberate manipulations of animals within contemporary groups to make one or more animals look better than other animals. Robust methods tend to mute the impact of these anomalies. Two studies were made in which methods were developed and then applied to different kinds of data.

8.7.7 Software Developments

Software for use in genomic studies, called QMsim, was developed for quick genomic studies. This software simulates data where genotypes are determined by a number of QTLs. Many generations of random or selective matings can be made, with specified mutation rates for SNPs and QTLs to give a population of records with certain amounts of linkage disequilibrium. Then different methodology for genomic analyses can be applied to the simulated data.

Another program was developed and reported, called FImpute, which is a very fast imputation program using both pedigree and genomic data. There have been many studies comparing the accuracy and speed of FImpute to many other available software packages. FImpute seems to be the fastest software for large problems, and with high accuracy, making it very suitable for practical use.

9 Computing Environment

Powerful computational systems have always been a priority for CGIL. With the ever increasing amounts of genomic data requiring huge amounts of storage, high performance memory, and processing speed on many processor cores, the need is ever increasing. New algorithms for imputation and genetic evaluation as well as local database storage of SNP panel data that are more and more dense will require that we continue to maintain state of the art computing infrastructure for CGIL researchers.

Currently all of our systems are high performance linux systems housed in the main computer room at the university where they have clean UPS backed power and excellent climate control with very high speed access to the internet and so users can access these facilities from anywhere and easily develop and distribute research applications. Our current strategy involves maintaining growable raid based storage systems and adding high performance nodes on an incremental basis as funding becomes available.

Some highlights of our current computing environment are:

- One important aspect of our systems is the maintenance of a secure file system for home directories. We accomplish this with two raid 6 filesystems each currently consisting of 24 enterprise 3T drives which provides our users with approximately 39T of safe and reliable storage. Also a second system with the same capacity is maintained and home directory mirroring is performed daily. With raid 6 two drives can fail simultaneously without incurring data loss and with the daily mirroring the probability of data loss is extremely small. The state of these systems is also constantly monitored with automated emails informing systems administrators if something goes wrong. All of the other nodes in our environment have access to the home directory via NFS.
- Our newest machine “phi” is a new fast 32 core system with 2 Intel Phi parallel processing co-processors on board with 240 cores each. This system is based on the Intel (R) Xeon CPU E5-2680 2.90GHz with 128GB 1600 MHz ECC memory acquired in 2013.
- We have two new fast 32 core systems based on the Intel(R) Xeon CPU E5-2690 2.90GHz with 128GB 1600 MHz ECC memory acquired in 2012.
- Two somewhat older 24 core systems obtained in 2011 for beef genomics

work (X56903.47GHz with 96GB 1333MHz ECC memory). One of these serves as an introductory system for new CGIL users.

- Several other large memory, multi-core Xeon based units that are available for large numerical processes.
- In addition to the home directory structure mentioned above each independent server unit has a file system designated as scratch storage. This space can be much faster than the home directory and can be used to speed up long running processes that do a lot of IO.
- Consistent and fully updated software packages such as SAS, R, MATLAB, ACSL, ASREML, etc. and others as required.
- Specific software related to bioinformatics as required such as PLINK, Beagle, samtools, bcftools, DMU, gebv, fimpute, etc...
- Access to efficient language compilers for C++, C, FORTRAN, etc.
- Database support with MySQL and web server support.
- Document creation and publication support.

In the future with next generation sequencing poised to deliver significantly to our projects, the computing and storage requirements are expected to jump considerably once again and we have been working on planning and configuring a new system that will provide access to over 135TB of high performance storage space. We are also developing expertise in the use of many core systems such as the Intel phi mentioned above. Parallel computational solutions and algorithms will definitely be needed in future research work if we can hope to explore and find patterns in these huge data sets.

10 WCGALP Meetings

The biggest event for animal breeders and geneticists is the World Congress on Genetics Applied to Livestock Production (WCGALP), which occurs every four years. CGIL hosted this Congress in 1994. Subsequent congresses were held in Armidale, Australia (1998), Montpellier, France (2002), Brazil (2006), and Leipzig, Germany (2010). The last three are documented here, as far as CGIL's participation in the scientific program. Keep in mind that there is a restriction of one presentation per person, but a researcher may be co-author on more than one presentation. The Congresses are attended by around 1000 scientists. In 1994 when the congress was in Guelph, attendance was close to 1500.

Germany 2010

- Case, L.** , Miller, S. P., Wood, B. 2010. Genetic Parameters of Feed Efficiency Traits in the Turkey (*Meleagris gallopavo*).
- Szkotnicki, W.** , Kennedy, D., Miller, S., Schaeffer, L. 2010. A Web 2.0 System for Managing Sheep Records and Genetic Evaluations.
- Glover, P.** , Fatehi, J., Burnside, E.B., Schaeffer, L.R. 2010. Breed of Sire Effect on Fertility of First Generation Crossbred Heifers 477
- Cartwright, S.** , Begley, N., Schaeffer, L., Burnside, E., Karrow, N., Mallard, B. 2010. Variation in Immune Response between Canadian Purebred Holstein and Crossbred Norwegian Red Calves and First Calf Heifers.
- Quinton, C.** , Wood, B., Miller, S. 2010. Genetic Parameters For Survival And Leg Strength In The Turkey.
- Bohmanova, J.** , Sargolzaei, M., Schenkel, F. 2010. Comparison of linkage disequilibrium on bovine autosomes and the X chromosome
- Quinton, M.** , Wilton, J., Robinson, A. 2010. Selection of terminal sires and dams for meat producing animals sold under a grid pricing system.
- Schenkel, F.** , Squires, J. 2010. Reducing Boar Taint in Pigs Using SNP Markers.

- Miller, S.** , Lu, D., Vander Voort, G., Sargolzaei, M., Caldwell, T., Wang, Z., Mah, J., Plastow, G., Moore, S. 2010. Beef tenderness QTL on BTA25 from a whole genome scan with the Illumina Bovine SNP50 Beadchip
- Lu, D.** , Miller, S., Sargolzaei, M., Vander Voort, G., Caldwell, T., Abo-Ismael, M., Wang, Z., Mah, J., Plastow, G., Moore, S. 2010. Genome Wide Association Scan for Signals of Recent Selection in Angus Beef Cattle.
- Loker, S.** , Miglior, F., Sewalem, A. 2010. Genetic Analysis Of Body Condition Score With Milk Production Traits in Canadian Holsteins.
- Abo-Ismael, M.** , Squires, J., Swanson, K., Lu, D., Wang, Z., Mah, J., Plastow, G., Moore, S., Miller, S. 2010. Fine mapping QTL and candidate genes discovery for residual feed intake on Chromosomes 5, 15, 16, and 19 in beef cattle.
- Jamrozik, J.** , Schaeffer, L. 2010. Multiple-Trait Finite Mixture Model Applied to Milk Yield and SCS of Canadian Holsteins.
- Vander Voort, G.** , Wang, Z., Plastow, G., Moore, S., Miller, S. 2010. Utilization of gap-weighted kernels for genomic analysis in a multi-breed beef cattle population.

Brazil 2006

- Jamrozik, J.** , J. Fatehi, G.J. Kistemaker, L.R. Schaeffer. 2006. Genetic evaluation model for female reproductive traits of Canadian dairy cattle.
- Strabel, T.** , J. Jamrozik. 2006. Alternative measures of lactation persistency from random regression models with Legendre polynomials.
- Fatehi, J.** , J. Jamrozik, L.R. Schaeffer. 2006. Phenotypic and genetic trends in Canadian Holstein female reproductive traits.
- Wilton, J. W.** , C. Van Groningen, C.J.B. Devitt, J.A.L. Cranfield. 2006. Across breed sire rankings in an integrated beef supply chain with multiple markets.
- Caswell, B. H.** , J.W. Wilton, S.P. Miller, I.B. Mandell. 2006. Interactions between sire breed and management strategy in carcass traits of crossbred beef steers and heifers.
- Montanholi, Y. R.** , F.S. Schenkel, S.P. Miller, K.C. Swanson, I.B. Mandell. 2006. Infrared images taken in beef cows: repeatability of the measurements.
- Schenkel, F. S.** , S.P. Miller, S.S. Moore, C. Li, A. Fu, S. Lobo, I.B. Mandell, J.W. Wilton. 2006. Association of SNPs in the leptin and leptin receptor genes with different fat depots in beef cattle.
- Quinton, V. M.** , I. McMillan, J.J. Tosh, E.G. Boulding. 2006. Breeding designs for a small-scale northern abalone hatchery.
- Palucci, V.** , L.R. Schaeffer, F. Miglior, V. Osborne. 2006. Non-additive genetic effects for fertility traits in Canadian Holsteins.
- Sharma, B. S.** , I. Leyva, F. Schenkel, N.A. Karrow. 2006. Polymorphisms in the bovine TLR4 gene and associations with milk somatic cell score and other health related traits in Canadian Holstein cows.
- Cao, H.** , L.C. Kabaroff, Q. You, A. Rodriguez, B.A. Mallard, M. Quinton, N.A. Karrow. 2006. Ovine hepatic gene expression profiles following systemic challenge with *Eshcherishia coli* lipopolysaccharide.
- Kolbehdari, D.** , J.A.B. Robinson, L. R. Schaeffer. 2006. Mapping of QTL using regression on multiple marker haplotypes.

- Miller, S. P.** , B.J. Hayes, M.E. Goddard. 2006. Positioning single nucleotide polymorphisms on an existing bovine map using a genetic algorithm and estimates of linkage disequilibrium.
- Jafarikia, M.** , A. Susanto, J.A.B. Robinson, L.R. Schaeffer. 2006. Method for obtaining QTL solutions without inverting the IBD matrix.
- Leyva, I.** , F.S. Schenkel, B.S. Sharma, G.B. Jansen, N.A. Karrow. 2006. Evaluation of DNA pooling for low frequency SNP detection and the association of a SNP in the CXCR2 chemokine receptor gene with health and production traits in Canadian Holstein bulls.
- Roso, V. M.** , F.S. Schenkel. 2006. AMC - A computer program to assess the degree of connectedness among contemporary groups.

France 2002

- Burnside, E. B.** , Y. Pan, G. B. Jansen, Y. Plante, G. E. Vander Voort, D. Petitclerc. 2002. Confirmation of QTL for protein yield and mammary system in a large half-sib family of Holsteins.
- Carvalho, R.** , S. A. Queiroz, F. S. Schenkel, L. Fries. 2002. Potential consequences of bias in fixed effect estimates, given by mixed model equations, when an usual assumption is not met.
- Devitt, C. J. B.** , J. W. Wilton, I. B. Mandell, T. L. Fernandes, S. P. Miller. 2002. Genetic evaluation of tenderness of the longissimus in multi-breed populations of beef cattle and the implications of selection.
- Fernandes, T.** , J. W. Wilton, I. B. Mandell, C. J. B. Devitt. 2002. Genetic parameter estimates for meat quality traits in beef cattle managed under a constant finishing program.
- Fries, L. A.** , F. S. Schenkel, V. M. Roso, F. V. Brito, J.L.P. Severo, M. L. Piccoli. 2002. “Epistzygosity” and epistatic effects.
- Hernandez, A.** , N. A. Karrow, B. N. Wilkie, B. A. Mallard. 2002. High and low immune responsiveness of dairy cattle: microarray analysis of gene expression associated with high and low immune response phenotypes.
- Jamrozik, J.** , L. R. Schaeffer. 2002. Bayesian comparison of random regression models for test-day yields in dairy cattle.
- Jiang, Z.** , J. A. B. Robinson, A. M. Gibbins, J. P. Gibson, A. L. Archibald, C. S. Haley. 2002. Mapping of QTLs for prolificacy traits on SSC8 using a candidate gene approach.
- Lin, C. Y.** , K. Togashi. 2002. Simultaneous improvement of lactation milk and persistency.
- Liu, Y.** , G. B. Jansen, C. Y. Lin. 2002. A mixture model approach for QTL mapping in production traits of dairy cattle.
- McKay, L. R.** , L. R. Schaeffer, I. McMillan. 2002. Analysis of growth curves in rainbow trout using random regression.
- Melville, J. S.** , A. M. Gibbins, J. A. B. Robinson, J. P. Gibson, A. L. Archibald, C. S. Haley, Z. Jiang. 2002. A Meishan positive QTL for prolificacy traits found at the NCOA1 locus on SSC3.

- Miller, S. P.** 2002. Beef cattle breeding programs: progress and prospects.
- Piccoli, M. L.** , V. M. Roso, F. V. Brito, J. L. P. Severo, F. S. Schenkel, L. A. Fries. 2002. Additive, complementarity (additive by additive), dominance, and epistatic effects on preweaning weight gain of Hereford \times Nelore calves.
- Quinton, C. D.** , S. M. Moghadasi, L. R. McKay, I. McMillan. 2002. Genetic parameters of body weight, female spawning date, and age at sexual maturation in rainbow trout.
- Quinton, V. M.** , I. McMillan, R. W. Fairfull. 2002. Changes in the variance structure of egg production over three laying cycles in White Leghorns.
- Robinson, J. A. B.** , V. M. Quinton. 2002. Genetic parameters of early neo-natal piglet survival and number of piglets born.
- Samore, A. B.** , P. J. Boettcher, J. Jamrozik, A. Bagnato, A. F. Groen. 2002. Genetic parameters for production traits and somatic cell scores estimated within a multiple trait random regression model in Italian Holsteins.
- Schenkel, F. S.** , C. J. B. Devitt, J. W. Wilton, S. P. Miller, J. Jamrozik. 2002. Random regression analyses of feed intake of individually tested beef steers.
- Severo, J. L. P.** , F. V. Brito, F. S. Schenkel, V. M. Roso, M. L. Piccoli, L. A. Fries. 2002. Consequences of extensions to the additive-dominance model on preweaning weight gain of *Bos taurus* \times *Bos indicus* calves.
- Strabel, T.** , J. Jamrozik. 2002. The effect of incorrect estimated variance-covariance components on genetic evaluation of dairy cattle with random regression models.
- Szkotnicki, W. J.** , L. R. Schaeffer. 2002. Testing the quality of random number generators.
- Togashi, K.** , C. Y. Lin. 2002. Optimal strategy to modify the shape of the lactation curve.
- Tosh, J. J.** , J. W. Wilton, D. Kennedy. 2002. Heritability of fertility in four seasons for ewes under accelerated lambing.
- van Dorp, T. E.** , L. R. Schaeffer, P. J. Boettcher, D. Kelton, M. M. Shoukri. 2002. Genetic selection programs for resistance to mastitis.

- Vander Voort, G.** , G. B. Jansen. 2002. Comparison of QTL mapping models with multiple traits and multiple intervals in a half-sib design in dairy cattle.
- Wang, Y.** , S. P. Miller, F. S. Schenkel, J. W. Wilton, P. J. Boettcher. 2002. Performance of a linear-threshold model to evaluate calving ease and birth weight in a multibreed beef population.
- Wilton, J. W.** , C. J. B. Devitt, S. P. Miller. 2002. Sensitivity of rankings of beef sires for non-linear multiple trait breeding objectives.
- Wood, G.** , P. J. Boettcher, D. Kelton, J. Jamrozik, G. B. Jansen. 2002. Identification of genetic and environmental influences on milk urea nitrogen.
- Ye, X.** , J. A. B. Robinson, Z. Jiang, A. M. Gibbins, J. P. Gibson. 2002. Polymorphisms of histone deacetylase 1 and 3 genes and fatty acid binding protein 3 and 4 genes and their associations with economic traits in swine.

11 Scientific Publications

2013 - 32

- Abo-Ismael, M. K.** , M. Kelly, J. Squires, K. Swanson, S. Bauck, S. P. Miller. 2013. Identification of single nucleotide polymorphisms in genes involved in digestive and metabolic processes associated with feed efficiency and performance traits in beef cattle. *Journal of Animal Science*. 91:2512-2529
- Akanno, E.C.** , F. S. Schenkel, M. Sargolzaei, R. M. Friendship, J. A. B. Robinson. 2013. Opportunities for genome-wide selection for pig breeding in developing countries. *Journal of Animal Science*, 31:4617-4627.
- Akanno, E. C.** , F S Schenkel, R M Friendship and J A B Robinson. 2013. Relative economic returns from selection schemes for a nucleus swine breeding program. *Livestock Research for Rural Development* 25(3). Available at <http://www.lrrd.org/lrrd25/3/akan25053.htm>.
- Akanno, E.C.** , F. S. Schenkel, V. M. Quinton, R. M. Friendship, J. A. B. Robinson. 2013. Meta-analysis of genetic parameter estimates for reproduction, growth and carcass traits of pigs in the tropics. *Livestock Science*, 152:102-113.
- Awda, B.** , S.P. Miller, Y.R. Montanholi, G. Vander Voort, T.R. Caldwell, M. Buhr. 2013. The relationship between feed efficiency traits and fertility in young beef bulls. *Can. J. Anim. Sci.* 93:185-192
- Ayres D.R.** , R.J. Pereira, A.A. Boligon, F.F. Silva, F.S Schenkel, V.M. Roso, and L.G. Albuquerque. 2013. Linear and Poisson models for genetic evaluation of tick resistance in crossbred Hereford x Nelore cattle. *Journal of Animal Breeding and Genetics*. Available at doi: 10.1111/jbg.12036
- Basarab, J.A.** , K.A. Beauchemin, V.S. Baron, K.H. Ominski, L.L. Guan, S.P. Miller, J.J. Crowley. 2103. Reducing GHG emissions through genetic improvement for feed efficiency: effects on economically important traits and enteric methane production. *Animal* 7(2):303-315
- Chen, L.** , F. Schenkel, M. Vinsky, D. H. Crews Jr., and C. Li. 2013. Accuracy of predicting genomic breeding values for residual feed intake in

Angus and Charolais beef cattle. *Journal of Animal Science*, 91:4669-4678. doi:10.2527/jas.2012-5715

- Dawson, L.** , M. Buob, D. Haley, S. Miller, J. Stryker, M. Quinton, G. Mason. 2013. Providing elevated 'getaway bunks' to nursing mink dams improves their health and welfare. *Appl. Anim. Behav. Sci.* 147(1) 224-234
- de Lange, C.F.M.** , A. Rakhshandeh, N. Karrow, J. Htoo, S. Miller. 2013. Impact of immune system stimulation on ileal nutrient digestibility and utilization of methionine plus cysteine intake for whole body protein deposition in growing pigs. *British Journal of Nutrition* 27:1.
- Espigolan, R.** , Baldi, F., A.A. Boligon, F.R.P. Souza, D.M. Gordo, R.L. Tonussi, D.F. Cardoso, H.N. Oliveira, H. Tonhati, M. Sargolzaei, F.S. Schenkel, R. Carvalheiro, J. A. Ferro, and L.G. Albuquerque. 2013. Study of whole genome linkage disequilibrium in Nellore cattle. *BMC Genomics*, 14:305. doi:10.1186/1471-2164-14-305
- Gray, M.A.** , Squires E. J. 2013 Effects of nuclear receptor transactivation on steroid hormone synthesis and gene expression in porcine Leydig cells. *Journal of Steroid Biochemistry and Molecular Biology* 133:93-100
- Gray, M.A.** , Squires E. J. 2013 Effects of nuclear receptor transactivation on boar taint metabolism and gene expression in porcine hepatocytes. *Journal of Steroid Biochemistry and Molecular Biology* 133:110-119.
- Huber, L.** , Squires, E.J., C.F.M. de Lange 2013. Dynamics of nitrogen retention in entire male pigs immunized against gonadotropin-releasing hormone. *Journal of Animal Science* in press
- Jamrozik, J.** , S. McGrath, R.A. Kemp, S.P. Miller. 2013. Estimates of genetic parameters for stayability to consecutive calvings of Canadian Simmentals by random regression model. *J. Anim. Sci.* 91:3634-3643.
- Karrow, N. A.** , K. Golibonski, N. Stonos, F. Schenkel, A. Peregrine 2013. Genetics of helminth resistance in sheep. *Canadian Journal of Animal Science* (In Press).
- Koeck, A.** , F. Miglior, J. Jamrozik, D.F. Kelton and F.S. Schenkel. 2013. Genetic associations of ketosis and displaced abomasum with milk production traits in early first lactation of Canadian Holsteins. *Journal of Dairy Science*, 96:4688-4696. doi:10.3168/jds.2012-640

- Lu, D.** , M. Sargolzaei, C. Li, M. Abo-Ismael, G. Vander Voort, Z. Wang, G. Plastow, S. Moore, S.P. Miller. 2013. Association analyses for feed efficiency traits in beef cattle using preserved haplotypes. *Genome* (Accepted: Aug 13)
- Lu, D.** , Miller, S.P., M. Sargolzaei, M. Kelly, G. Vander Voort, T. Caldwell, Z. Wang, G. Plastow, S. Moore. 2013. Genome wide association analyses for growth and feed intake traits in beef cattle. *Journal of Animal Science*. 91(8):3612-3633
- Melka, M. G.** , Stachowicz, K., Sargolzaei, M., Miglior, F. and Schenkel, F. 2013. Assessment of genetic diversity in five Canadian dairy breeds using pedigree data. *J. Animal Breeding and Genetics*. Available at doi:10.1111/jbg.12050
- Montanholi, Y.R.** , S. Lam, V. Peripolli, G. Vander Voort, S. P. Miller. 2013. Associations between chemical composition and physical properties of milk and colostrum with feed efficiency in beef cows. *Can. J. Anim. Sci. Short Communication*. Published on web Aug 1. 10.4141/CJAS2013-054
- Montanholi, Y.R.** , A.B.P. Fontoura, K.C. Swanson, B. Coomber, S. Yamashiro, S.P. Miller. 2013. Small intestine histomorphometry of beef cattle with divergent feed efficiency. *Acta. Veterinaria. Scandinavica*. 55:9-14
- Montanholi, Y.R.** , K.C. Swanson, R. Palme, G. Vander Voort, L. S. Haas, S.P. Miller. 2013. Glucocorticoids as biomarkers for feed efficiency in cattle. *Livest. Sci*. 155:130-136
- Oh, S.** , C.G. Balch, R.L. Cliff, B.S. Sharma, H.J. Boermans, H.V.L.N. Swamy, M. Quinton, N.A. Karrow. 2013. Exposure to Penicillium Mycotoxins Alters Gene Expression of Enzymes Involved in the Epigenetic Regulation of Bovine Macrophages (BoMacs). *Mycotoxin Research* (Jul 28 Epub)
- Sangsoo D. K.** , M. Antenos, J. E. Squires, G. M. Kirby. 2013. Cytochrome P450 2A5 and Bilirubin: Mechanisms of Gene Regulation and Cytoprotection. *Toxicology and Applied Pharmacology* in press
- Soliman, A.** , R.J. Heck, A. Brenning, R. Brown, S. Miller. 2013. Remote Sensing of Soil Moisture in Vineyards Using Airborne and Ground-Based Thermal Inertia Data. *Remote. Sens*. 5(8) 3729-3748

- Stonos, N.** , S.K. Wootton, M. Quinton, N.A. Karrow. 2013. Seroprevalence of Caprine Arthritis Encephalitis Virus in Ontario Goat Herds. *Small Ruminant Research* 114: 284.
- Subedi, S.** , Feng, Z., Deardon, R. and Schenkel, F.S. 2013. SNP Selection for Predicting Quantitative Traits. *Journal of Applied Statistics*, 40(3): 600-613.
doi: 10.1080/02664763.2012.750282
- Utsunomiya, Y.T.** , Adriana S Carmo, Roberto Carneiro, Haroldo HR Neves, Mrcia C Matos, Ludmilla B Zavarez, Ana M Prez O'Brien, Johann Silkner, John McEwan, John B Cole, Curtis P Van Tassell, Flvio S Schenkel, Marcos VGB da Silva, Laercio R Porto Neto, Tad S Sonstegard and Jos F Garcia. 2013. Genome-wide association study for birth weight in Brazilian Nelore cattle (*Bos primigenius indicus*) points to previously described orthologous genes affecting human and bovine height.
BMC Genetics, 14:52. doi:10.1186/1471-2156-14-52
- Willems O.W.** , S.P. Miller, B.J. Wood. 2013. Aspects of selection for feed efficiency in meat producing poultry. *World's Poult Sci J.* 69: 77-88.
- Willems, O.W.** , Miller, S.P., Wood, B.J. 2013. Assessment of residual body weight gain and residual intake and body weight gain as feed efficiency traits in the turkey (*Meleagris gallopavo*). *Genetics Selection Evolution* 45:26
- Zwambag, A.** , M. Kelly, F. Schenkel, I. Mandell, J. Wilton, S. Miller. 2013. Heritability of beef tenderness at different aging times and across breed comparisons. *Can. J. Anim. Sci.* 93:3077-312.

2012 - 29

- Cartwright, S. L.** , L. R. Schaeffer, E. B. Burnside, B. A. Mallard. 2012. Adaptive immune response survival and somatic cell score between post-partum Holstein and Norwegian Red × Holstein first-calf heifers. *J. Anim. Sci.* 90:2970-2978.
- Case, L.A.** , Wood, B.J., Miller, S.P. 2012. Investigation of body surface temperature with infrared imaging and its correlation to feed efficiency in the turkey (*Meleagris gallopavo*). *J. Therm. Biol.* 37(5):397-401

- Case, L.A.** , Wood, B.J., Miller, S.P. 2012. Genetic parameters of feed efficiency and its constituent traits in the turkey (*Meleagris gallopavo*). *Genet. Sel. Evol.* 44:2-5
- Case, L.A.** , Wood, B.J., Miller, S.P. 2012. The investigation of ultrasound technology to measure breast muscle depth as a correlated trait to breast meat yield in the turkey (*Meleagris gallopavo*). *J. Anim. Sci.* (Jun 5. Epub ahead of print)
- Doelman, J.** , H. Cao, N. Purdie, J. Kim, K. Swanson, V. Osborne, J. Tey, A. Ali, Z. Feng, N.A. Karrow, J. Cant. 2012. Transcript profiling of the ruminant liver indicates a unique program of transcriptional regulation of ketogenic enzymes during food restriction. *Comparative Biochemistry and Physiology Part D Genomics and Proteomics AHP.*
- Eijke, L. S.** , L. R. Schaeffer, T. Ådnøy, G. Klemetsdal, J. Ødegård. 2012. A method for the prediction of multitrait breeding values for use in stochastic simulation to compare progeny testing schemes, with large progeny groups for proven sires. *J. Anim. Breed. Genet.* 129:188-194.
- Epifano F.** , Genovese S., Squires E.J., Gray M.A. 2012. Nelumal A, the active principle from *Ligularia nelumbifolia*, is a novel farnesoid X receptor agonist. *Bioorg Med Chem Lett.* 22(9):3130-5.
- Fisher, R.E.** , N.A. Karrow, H.J Boermans. 2012. Maternal stress and the programming of the Hypothalamic-Pituitary-Adrenal Axis. *Advances in Neuroimmune Biology* 3: 31.
- Fisher, R.E.** , M. Steele, N.A. Karrow. 2012. Fetal Programming of the Neuroendocrine-immune System and Metabolic Disease. *Journal of Pregnancy* 2012: 1.
- Husain, M.** , S. Golovan, P. Rupa, Y. Mine, H.J. Boermans, N.A. Karrow. 2012. Spleen transcriptome profiles of BALB/c mouse in response to egg ovomucoid sensitisation and challenge. *Food and Agricultural Immunology* 23: 227.
- Jamrozik, J.** , S. McGrath, R.A. Kemp, S.P. Miller. 2012. Genetic analysis of female fertility traits in Canadian Simmentals. *Livest. Sci.* 150(1) 302:309
- Jamrozik, J.** , L. R. Schaeffer. 2012. Test-day somatic cell score, fat-to-protein ratio and milk yield as indicator traits for sub-clinical mastitis in dairy cattle. *J. Anim. Breed. Genet.* 129:11-19.

- Koeck, A.** , F. Miglior, D.F. Kelton, F.S. Schenkel. 2012. Genetic association of body condition score with disease resistance in first lactation Canadian Holsteins. *Canadian Journal of Animal Science*, 92: 285-289. doi:10.4141/CJAS2012-047
- Koeck, A.** , F. Miglior, D.F. Kelton, F.S. Schenkel. 2012. Short communication: Genetic parameters for mastitis and its predictors in Canadian Holsteins. *Journal of Dairy Science*, 95:7363-7366.
- Koeck, A.** , F. Miglior, D.F. Kelton, and F.S. Schenkel. 2012. Health recording in Canadian Holsteins - data and genetic parameters. *Journal of Dairy Science*, 95:4099-4108.
- Koeck, A.** , F. Miglior, D.F. Kelton, F.S. Schenkel. 2012. Alternative somatic cell count traits to improve mastitis resistance in Canadian Holsteins. *Journal of Dairy Science*, 95:432-439.
- Lu, D.** , M. Sargolzaei, M. Kelly, C. Li, G. Vander Voort, Z. Wang, G. Plastow, S. Moore, S.P. Miller. 2012. Linkage disequilibrium in Angus, Charolais, and Crossbred beef cattle. *Front. Gene.* 3:152. doi: 10.3389/fgene.2012.00152
- McGregor, E.M.** , C.P. Campbell, S.P. Miller, P.P. Purslow, I.B. Mandell. 2012. Effect of nutritional regimen including limit feeding and breed on growth performance, carcass characteristics and meat quality in beef cattle. *Can. J. Anim. Sci.* 92(3):327-341
- Melka, M.G.** , F. Miglior, M. Sargolzaei, F.S. Schenkel. 2012. Genetic diversity of Guernsey population using pedigree data and gene-dropping simulations. *Animal*, 7:192-201.
- Melka, M. G.** , F. S. Schenkel. 2012. Analysis of genetic variation in Brown Swiss, Jersey and Holstein populations using genome-wide single nucleotide polymorphism markers. *BMC Research Notes*, 5:161. <http://www.biomedcentral.com/1756-0500/5/161>
- Oh, S.** , N.A. Karrow, H.J. Boermans, H.V.L.N. Swamy, B.S. Sharma 2012. Immunotoxicity of Penicillium Mycotoxins on Viability and Proliferation of Bovine Macrophage Cell Line (BOMACs). *The Open Mycology Journal* 6: 11.
- Pant, S.D.** , F.S. Schenkel, C.P. Verschoor, N.A. Karrow. 2012. Use of breed-specific single nucleotide polymorphisms to discriminate between Holstein and Jersey dairy cattle breeds. *Animal Biotechnology* 23: 1.

- Salim, H.** , K. M. Wood, M. K. Abo-Ismael, P. L. McEwen, I. B. Mandell, S. P. Miller, J. P. Cant, K. C. Swanson. 2012. Influence of feeding increasing levels of dry corn distillers grains plus solubles in whole corn grain-based finishing diets on total tract digestion, nutrient balance, and excretion in beef steers. *J. Anim. Sci.* 90(12):4441-4448
- Shindo, S.** , Sakuma, T., Negishi, M., Squires, E. J. 2012. Phosphorylation of serine 212 confers novel activity to human estrogen receptor. *Steroids* 77:444-53.
- Stryker, J.A.** , R. Fisher, Q. You, B. McBride, N.A. Karrow 2012. Effects of dairy fish meal and soybean meal on the ovine innate and acquired immune response during pregnancy and lactation. *Animal* July 6: 1.
- Subedi, S.** , Feng, Z., Deardon, R., Schenkel, F.S. 2012. SNP Selection for Predicting Quantitative Traits. *Journal of Applied Statistics*. DOI: 10.1080/02664763.2012.750282.
- Wang, Z.** , M.G. Colazo, J.A. Basarab, L.A. Goonewardene, D.J. Ambrose, E. Marques, G. Plastow, S.P. Miller, S.S. Moore. 2012. Impact of selection for residual feed intake on breeding soundness and reproductive performance of bulls on pasture-based multi-sire mating. *J. Anim. Sci.* 90(9):2963-2969
- Wiercinska, P.** , Lou Y., Squires, E.J. 2012. The roles of different porcine cytochrome P450 enzymes and cytochrome b5A in skatole metabolism. *Animal, An International Journal of Animal Bioscience* 6(5):834-45.
- You, Q.** , C.P.Verschoor, S.D. Pant, J. Macri, G.M. Kirby, N.A. Karrow. 2012. Proteomic Analysis of Plasma from Holstein Cows Testing Positive for *Mycobacterium avium* subsp. *paratuberculosis* (MAP). *Veterinary Immunology and Immunopathology* 148: 243.

2011 - 23

- Archile-Contreras A.** , M. Cha, I.B. Mandell, S.P. Miller, P.P. Purslow. 2011. Vitamins E and C may increase collagen turnover by intramuscular fibroblasts; potential for improved meat quality. *J. Agric. and Food Chem.* 59:608-614
- Brito, F.V.** , J. Braccini Neto, M. S., J. A.Cobuci, F.S. Schenkel. 2011. Accuracy of genomic selection in simulated populations mimicking the

extent of linkage disequilibrium in beef cattle. *BMC Genetics*, 12:80
doi:10.1186/1471-2156-12-80

- Case, L.A.** , B.J. Wood, S.P. Miller. 2011. Seasonal based genetic regulation of reproductive traits in the turkey (*Meleagris gallopavo*) related to temperature and day length analysed using random regression. *Livest. Sci.* 140(1):24-31
- Feng, Z.** , W. Wong, X. Gao, F. Schenkel. 2011. Generalized genetic association study with samples of related individuals. *The Annals of Applied Statistics* 5:2109-2130.
- Henderson, L.** , F. Miglior, A. Sewalem, J. Wormuth, D. Kelton, J.A.B. Robinson, K.E. Leslie. 2011. Short communication: Genetic parameters for measures of calf health in a population of Holstein calves in New York State. *Journal of Dairy Science* 94: 6181-6187.
- Henderson, L.** , F. Miglior, A. Sewalem, D. Kelton, J.A.B. Robinson, K.E. Leslie. 2011. Estimation of genetic parameters for measures of calf survival in a population of Holstein heifer calves from a heifer rearing facility in New York State. 2011. *Journal of Dairy Science* 94: 461-470.
- Husain, M.** , H.J. Boermans, N.A. Karrow. 2011. Mesenteric lymph node transcriptome profiles in BALB/c mice sensitized to three common food allergens. *BMC Genomics* 12: 12.
- Jamrozik, J.** , L. R. Schaeffer. 2011. Alternative parameterizations of the multiple-trait random regression model for milk yield and somatic cell score via recursive links between phenotypes. *J. Anim. Breed. Genet.* 128:245-326.
- Jen, K.** , Squires E. J. 2011. Efficacy of non-nutritive sorbent materials as intestinal-binding agents for the control of boar taint. *Animal* 5(11):1814-20.
- Jen, K.** , Squires E. J. 2011. In vitro assessment of the effectiveness of non-nutritive sorbent materials as binding agents for boar taint compounds. *Animal, An International Journal of Animal Bioscience* 5(11):1821-8.
- Keirstead N. D.** , Hayes M. A., Vander Voort, G. E., Brooks A. S. , Squires E. J., Lillie, B. N. 2011. Single nucleotide polymorphisms in collagenous lectins and other innate immune genes in pigs with common infectious diseases. *Veterinary Immunology and Immunopathology* 142, 1- 13.

- Kim, Y.** , H. Atalla, B. Mallard, C. Robert, N.A. Karrow. 2011. Changes in Holstein cow milk and serum proteins during intramammary infection with three different strains of *Staphylococcus aureus*. *BMC Veterinary Research* 7: 51.
- Loker, S.** , C. Bastin, F. Miglior, A. Sewalem, L. R. Schaeffer, J. Jamrozik, A. Ali, V. Osborne. 2011. Genetic and environmental relationships between body condition score and milk production traits in Canadian Holsteins. *J. Dairy Sci.*
- Pant, S.D.** , C.P. Verschoor, A.M. Skelding, F.S. Schenkel, Q. You, G.A. Biggar, D.F. Kelton, N.A. Karrow. 2011. Bovine IFNGR2, IL12RB1, IL12RB2 and IL23R polymorphisms and MAP infection status. *Mammalian Genome* 22: 583.
- Pant S.D.** , Verschoor C.P., Schenkel F.S., You, Q., Kelton D.F., Karrow N.A. 2011. Bovine PGLYRP-1 polymorphisms and their association with resistance to *Mycobacterium avium* spp. paratuberculosis. *Animal Genetics* 95:176-82. doi:10.1111/j.1365-2052.2010.02153.x
- Qanbari, S.** , Gianola, D., Hayes, B., Schenkel, F., Miller, S., Moore, S., Thaller G., Simianer, H. 2011. Application of site and haplotype frequency based approaches for detecting selection signatures in cattle. *BMC Genomics* 12:318 doi:10.1186/1471-2164-12-318
- Quinton, C.** , B.J. Wood, S.P. Miller. 2011. Genetic analysis of survival and fitness in turkeys with multiple-trait animal models. *Poultry Science* 90(11):2479-2486
- Saber, Q.** , D. Gianola, B. Hayes, F. Schenkel, S. Miller, S. Moore, G. Thaller, H. Simianer. 2011. Application of site and haplotype-frequency based approaches for detecting selection signatures in cattle. *BMC Genomics* 12:318
- Schaeffer, L. R.** , E. B. Burnside, P. Glover, J. Fatehi. 2011. Crossbreeding results in Canadian dairy cattle for production, reproduction, and conformation. *The Open Agriculture Journal*.
- Stachowicz, K.** , Sargolzaei, M., Miglior, F., Schenkel, F.S. 2011. Rates of inbreeding and genetic diversity in Canadian Holstein and Jersey Cattle. *Journal of Dairy Science*. 94 :5160-5175 doi: 10.3168/jds.2010-3308

- Verschoor, C.P.** , S.D. Pant, Q. You, F.S. Schenkel, D.F. Kelton, N.A. Karrow. 2011. Single nucleotide polymorphisms alter the promoter activity of bovine MIF. *Animal Biotechnology* 22:143-150.
- Verschoor, C.P.** , S.D. Pant, G.A. Biggar, F.S. Schenkel, B.S. Sharma, N.A. Karrow. 2011. Identification of SNPs in interferon gamma, interleukin-22 and their receptors and correlations to health and production-related traits in Canadian Holstein Bulls. *Animal Biotechnology* 22: 7-15.
- Wood, K.M.** , H. Salim, P.L. McEwen, I.B. Mandell, S.P. Miller, K.C. Swanson. 2011. The effect of corn or sorghum dried distillers grains plus solubles on growth performance and carcass characteristics of cross-bred beef steers. *Anim. Feed. Sci. Tech.* 165:23-30

2010 - 29

- Bohmanova, J.** , Sargolzaei, M., Schenkel, F.S. 2010. Characteristics of linkage disequilibrium in North American Holsteins. *BMC genomics*, 11:421. doi:10.1186/1471-2164-11-421.
- Cartwright, S. L.** , L. R. Schaeffer, E. B. Burnside, B. A. Mallard. 2010. Antibody and cell-mediated immune responses, survival and somatic cell count between Holstein and Norwegian Red \times Holstein first calf heifers during the peripartum period. *J. Dairy Sci.* (submitted).
- Cartwright, S. L.** , N. Begley, L. R. Schaeffer, E. B. Burnside, B. A. Mallard. 2010. Antibody and cell-mediated immune responses and survival between Holstein and Norwegian Red \times Holstein Canadian calves. *J. Dairy Sci.* (submitted).
- Case, L.A.** , S.P. Miller, B.J. Wood. 2010. Determination of optimum slaughter weight to maximize gross profit in a turkey production system. *Can. J. Anim. Sci.* 90:349-356
- Case, L.A.** , S.P. Miller, B.J. Wood. 2010. Factors affecting breast meat yield in Turkeys. *World Poultry Science Journal* 66:189-201
- Case, L.A.** , M.J. Kelly, S.P. Miller, B.J. Wood. 2010. Genotype by environment interaction as it relates to egg production in turkeys (*Meleagris gallopavo*). *J. Anim. Sci.* 88:1957-1966.

- Fisher, R.E.** , N.A. Karrow, M. Quinton, E.J. Finegan, S.P. Miller, J.L. Atkinson, H.J. Boermans. 2010. Endotoxin exposure during late pregnancy alters ovine offspring hypothalamic-pituitary-adrenal and febrile responsiveness later in life. *Stress* 13: 334-342.
- Garber, A.F.** , J.J. Tosh, S. E. Fordham, S. Hubert, G. Simpson, J.E. Symonds, J.A.B. Robinson, S. Bowman, E.A. Trippel. 2010. Survival and growth traits at harvest of communally reared families of Atlantic cod (*Gadus morhua*). *Aquaculture* 307: 12-19.
- Girgis, G.N.** , J.R. Barta, C.K. Girish, N.A. Karrow, H.J. Boermans, T.K. Smith. 2010. Effects of feed-borne *Fusarium* mycotoxins and an organic mycotoxin adsorbent on immune cell dynamics in the jejunum of chickens infected with *Eimeria maxima*. *Veterinary Immunology and Immunopathology* 138: 218-23.
- Gray, M. A.** , Pollock C.B., Schook, L.B., E. J. Squires. 2010. Characterization of the Porcine Pregnane X Receptor, Farnesoid X receptor and their Splice Variants. *Experimental Biology and Medicine* 235: 718-736.
- Jafarikia, M.** , J. A. B. Robinson, L. R. Schaeffer, D. Kolbehdari, G. Vander Voort. 2010. Detection of recombination hotspots in dairy cattle by using pedigree and genotype information. *J. Dairy Sci.* (submitted).
- Jamrozik, J.** , L. R. Schaeffer. 2010. Application of multiple-trait finite mixture model to test-day records of milk yield and somatic cell score of Canadian Holsteins. *J. Anim. Breed. Genet.* 127:1-8.
- Jamrozik, J.** , J. Bohmanova, L. R. Schaeffer. 2010. Selection of locations of knots for linear splines in random regression test-day models. *J. Anim. Breed. Genet.* 127:87-92.
- Jamrozik, J.** , J. Bohmanova, L. R. Schaeffer. 2010. Relationships between milk yield and somatic cell score in Canadian Holsteins from simultaneous and recursive random regression models. *J. Dairy Sci.* 93:1216-1233.
- Jamrozik, J.** , L. R. Schaeffer. 2010. Recursive relationships between milk yield and somatic cell score of Canadian Holsteins from finite mixture random regression models. *J. Dairy Sci.* 93:5474-5486.
- Karrow, N.A.** , Q. You, C. McNicoll, J. Hay. 2010. Activation of the ovine hypothalamic-pituitary-adrenal axis and febrile response by interleukin-6: a comparative study with bacterial lipopolysaccharide endotoxin. *Canadian Journal of Veterinary Research* 74: 30-33.

- Leung, M.C.K.** , Bowley, K.-L., Squires E.J. 2010. Examination of Testicular Gene Expression Patterns in Yorkshire Pigs with High and Low Levels of Boar Taint. *Animal Biotechnology* 21:77-87.
- Melka M. G.** , Schenkel F.S. 2010. Analysis of genetic diversity in four Canadian Swine breeds using pedigree data. *Canadian Journal of Animal Science*, 90: 331-340.
- Montanholi, Y.R.** Swanson, K.C., Palme, R., Schenkel, F.S., McBride, B.W., Lu, D., Miller, S.P. 2010. Assessing feed efficiency in beef steers through feeding behaviour, infrared thermography and glucocorticoids. *Animal*, 4: 692-701. doi:10.1017/S1751731109991522
- Or-Rashid, M.M.** , R. Fisher, N. Karrow, O. AlZahal, B. McBride. 2010. Fatty acid profile of colostrum and milk of ewes supplemented with fishmeal and the subsequent plasma fatty acid status of their lambs. *Journal of Animal Science* 88: 2092-102.
- Pant, S.D.** , F.S. Schenkel, C.P. Verschoor, Q. You, D.F. Kelton, S.S. Moore, N.A. Karrow. 2010. A principal component regression based genome wide analysis approach reveals the presence of a novel QTL on BTA7 for MAP resistance in Holstein cattle. *Genomics* 95: 176-82.
- Pimentel, E.C.G.** , M. Sargolzaei, H. Simianer, F.S. Schenkel, Z. Liu, L.A. Fries, S.A. de Queiroz. 2010. Use of direct and iterative solvers for estimation of SNP effects in genome-wide selection. *Genetics and Molecular Biology*, 33:198-204.
- Schaeffer, L. R.** 2010. Cumulative permanent environmental effects in a repeated records animal model. *J. Anim. Breed. Genet.* 128:95-99.
- Skelding, A.** , Schenkel, F., Sharma, B., Verschoor, C., Pant, S., Biggar, G., Boermans, H, Karrow, N. 2010. Identification of single nucleotide polymorphisms in the bovine interleukin-12 and interleukin-23 receptor genes and their association with health and production traits in Holstein cows. *Journal of Dairy Science*, 93:4860-4871.
- Tosh, J.J.** , A.F. Garber, E.A. Trippel, J.A.B. Robinson. 2010. Genetic, maternal, and environmental variance components for weight and length of Atlantic cod at two points in life. *Journal of Animal Science* 88: 3513-3521.

- Verschoor, C.P.** , S.D. Pant, Q. You, D.F. Kelton, N.A. Karrow. 2010. Gene expression profiling of PBMCs from Holstein and Jersey cows sub-chronically infected with Mycobacterium avium spp paratuberculosis. *Veterinary Immunology and Immunopathology* 137: 1-11.
- Verschoor, C.P.** , S.D. Pant, Q. You, F.S. Schenkel, D.F. Kelton, N.A. Karrow. 2010. Polymorphisms in the gene encoding bovine interleukin-10 receptor alpha are associated with Mycobacterium avium ssp. Paratuberculosis infection status. *BMC Genetics* 11: 23.
- Wiercinska, P.** , Squires, E.J. 2010. Chlorzoxazone metabolism by porcine cytochrome P450 enzymes and the effect of cytochrome b5. *Drug Metabolism and Disposition* 38:857-862.
- Wood, K.M.** , M.J. Kelly, S.P. Miller, I.B. Mandell, K.C. Swanson. 2010. Effect of crop residues in haylage-based rations on the performance of pregnant beef cows. *Can. J. Anim. Sci.* 90(1):69-76

2009 - 22

- Alain, K.** , N.A. Karrow, C. Thibault, J. St. Pierre, M. Lessard, N. Bissonnette. 2009. Early innate immune responses during mastitis in dairy cows involving the osteopontin gene. *BMC Genomics* 10: 444.
- Begley, N.** , F. Buckley, E. B. Burnside, L. R. Schaeffer, K. Pierce, B. A. Mallard. 2009. Immune responses of Holstein and Norwegian Red x Holstein calves on Canadian dairy farms. *J. Dairy Sci.* 92:518-525.
- Bohmanova, J.** , J. Jamrozik, F. Miglior. 2009. Effect of pregnancy on production traits of Canadian Holstein cows. *J. Dairy Sci.* 92:2947-2959.
- Bohmanova, J.** , F. Miglior, J. Jamrozik. 2009. Use of test-day records beyond three hundred five days for estimation of 305-d breeding values for production traits and somatic cell score of Canadian Holsteins. *J. Dairy Sci.* 92:5314-5325.
- Bohmanova, J.** , F. Miglior, J. Jamrozik, B. J. Van Doormaal, K. J. Hand, D. Lazenby. 2009. Genetic analysis of return over feed in Canadian Holsteins. *Animal*.

- Billen, M.** , Squires, E.J. 2009. The role of porcine cytochrome b5A and cytochrome b5B in the regulation of cytochrome P45017A1 activities. *Journal of Steroid Biochemistry and Molecular Biology* 113: 98-104.
- Brown, J.A.** , C. Dewey, C.F.M. Delange, I.B. Mandell, P.P. Purslow, J.A.B. Robinson, E.J. Squires, T.M. Widowski. 2009. Reliability of temperament tests on finishing pigs in group-housing and comparison to social tests. *Applied Animal Behaviour Science* 118: 28-35.
- Eijke, L. S.** , L. R. Schaeffer, T. Ådnøy, G. Klemetsdal, J. Ødegård. 2009. Sampling of estimated breeding values, multi-trait, for use in large scale stochastic simulation. *Genet. Sel. Evol.*(submitted).
- Gray, M.A.** , Peacock, J.N., Squires, E.J. 2009. Characterization of the Porcine Constitutive Androstane Receptor (CAR) and its Splice Variants. *Xenobiotica* 39:915-930.
- Heinrich A.** , Duffield, T.F., Lissemore, K.D, Squires, E.J., Millman, S.T. 2009. The impact of meloxicam on postsurgical stress associated with cauterly dehorning. *J. Dairy Sci.* 92:540-547.
- Loker, S.** , F. Miglior, J. Bohmanova, J. Jamrozik, L. R. Schaeffer. 2009. Phenotypic analysis of pregnancy effect on milk, fat, and protein yields of Canadian Ayrshire, Jersey, Brown Swiss, and Guernsey breeds. *J. Dairy Sci.* 92:1300-1312.
- Loker, S.** , F. Miglior, J. Bohmanova, L. R. Schaeffer, J. Jamrozik, G. Kistemaker. 2009. Short communication: Effect of preadjusting test-day yields for stage of pregnancy on variance component estimation in Canadian Ayrshires. *J. Dairy Sci.* 92:2270-2275.
- Mader, C.J.** , Y.R. Montanholi, Y. Wang, S.P. Miller, I.B. Mandell, B.W. McBride, K.C. Swanson. 2009. Relationships between measures of growth performance and efficiency with carcass traits, visceral organ mass, and pancreatic digestive enzymes in feedlot cattle *J. Anim. Sci.* 87:1548-1557
- Montanholi, Y.R.** , K.C. Swanson, F.S. Schenkel, B.W. McBride, T.R. Caldwell, S.P. Miller. 2009. On the determination of residual feed intake and associations of infrared thermography with efficiency and ultrasound traits in beef bulls. *Livest. Prod. Sci.* 125: 22-30.

- Mount, J.A.** , N.A. Karrow, J.L. Caswell, H.J. Boermans, K.E. Leslie. 2009. Assessment of bovine mammary chemokine gene expression in response to lipopolysaccharide, lipotechoic acid + peptidoglycan and CpG oligodeoxynucleotide 2135. *Canadian Journal of Veterinary Research* 73: 49-57.
- Nixon, M.** , J. Bohmanova, J. Jamrozik, L. R. Schaeffer, K. Hand, F. Miglior. 2009. Genetic parameters of milking frequency and milk production traits in Canadian Holsteins milked by an automated milking system. *J. Dairy Sci.* 92:3422-3430.
- Sargolzaei, M.** , Schenkel, F.S. 2009. QMSim: A large scale genome simulator for livestock. *Bioinformatics*, 25:680-681. First published January 28, 2009, doi:10.1093/bioinformatics/btp045.
- VanRaden, P.M.** , C.P. Van Tassel, G.R. Wiggans, T.S. Sonstegard, R.D. Schnabel, J.F. Taylor, F.S. Schenkel. 2009. Reliability of Genomic Predictions for North American Holstein Bulls. *Journal of Dairy Science*, 92: 16-24.
- Verschoor, C.P.** , S.D. Pant, F.S. Schenkel, B.S. Sharma, N.A. Karrow. 2009. SNPs in the bovine IL-10 receptor are associated with somatic cell score in Canadian dairy bulls. *Mammalian Genome* 20: 447-54.
- Wiggans, G.R.** , T. S. Sonstegard, P. M. VanRaden, L. K. Matukumalli, R. D. Schnabel, J. F. Taylor, F. S. Schenkel, C. P. Van Tassell. 2009. Selection of single-nucleotide polymorphisms and genotype quality for genomic prediction of genetic merit of dairy cattle. *Journal of Dairy Science*, 92:3431-3436.
- Yeh, E.** , Wood, R.D., Leeson, S., Squires, E.J. 2009 Effect of dietary omega-3 and omega-6 fatty acids on clotting activities of Factors V, VII and X in Fatty Liver Haemorrhagic Syndrome-susceptible laying hens. *British Poultry Science* 50: 382-392.
- Zamaratskaia, G.** , E.J. Squires 2009. Biochemical, nutritional and genetic effects on boar taint in entire male pigs. *Animal: An International Journal of Animal Bioscience* 3: 1508-1521.

2008 - 24

- Bohmanova, J.** , F. Miglior, J. Jamrozik, I. Misztal, P. G. Sullivan. 2008. Comparison of random regression models with Legendre polynomials and linear splines for production traits and somatic cell score of Canadian Holstein cows. *J. Dairy Sci.* 91:3627-3638.
- Core, S.** , S. Miller, T. Widowski, G. Mason. 2008. Eye white percentage as a predictor of temperament in beef cattle. *J. Anim. Sci.* 87:2168-2174
- Core, S.** , S. Miller, M. Kelly. 2008. Development of the laser remote caliper as a method to estimate surface area and body weight in beef cattle. *Studies by Undergraduate Researchers at Guelph (SURG)*, Vol. 1, No. 2, Winter 2008, 57-72
- Daetwyler, H.** , F.S. Schenkel, M. Sargolzaei, J.A.B. Robinson. 2008. A Genome Scan to Detect Quantitative Trait Loci for Economically Important Traits in Holstein Cattle Using Two Methods and a Dense Single Nucleotide Polymorphism Map. 2008. *Journal of Dairy Science* 91: 3255-3236
- Girish, C.K.** , T.K. Smith, H.J. Boermans, N.A. Karrow. 2008. Effects of feeding blends of grains naturally contaminated with *Fusarium* mycotoxins on performance, hematology, metabolism and immunocompetence of turkeys. *Poultry Science* 87: 421-32.
- Golovan, S.P.** , H.A. Hakimov, C.P. Verschoor, S. Walters, M. Gadish, C. Elsik, F. Schenkel, D.K.Y. Chiu, C.W. Forsberg. 2008. Analysis of *Sus Scrofa* Liver Proteome and Identification of Proteins Differently Expressed Between Genders, and Conventional and genetically enhanced lines. *Comparative Biochemistry and Physiology- Part D: Genomics and Proteomics*, 3:234-242.
- Heydarpour, M.** , L. R. Schaeffer, M. H. Yazdi. 2008. Influence of population structure on estimates of direct and maternal parameters. *J. Anim. Breed. Genet.* 125:89-99.
- Jamrozik, J.** , J. Fatehi, L. R. Schaeffer. 2008. Comparison of models for genetic evaluation of survival traits in dairy cattle: a simulation study. *J. Anim. Breed. Genet.* 125:75-83.
- Leyva, I.** , G. Piguetti, N.A. Karrow. 2008. Genotype-specific IL8RA gene expression in bovine neutrophils in response to *Escherichia coli* lipopolysaccharide challenge. *Animal Genetics* 39: 298-300.

- Leyva, I.** , F. Schenkel, J. Martin, N.A. Karrow. 2008. Polymorphisms in the 5' upstream sequence from CXCR1 chemokine receptor gene, and their association with somatic cell score in Holstein cattle in Canada. *Journal of Dairy Science* 91: 407-417.
- Lin, C.Y.** 2008. Efficiency of QTL-assisted selection in the presence of correlation between identified and residual genotypes. *J. Anim. Sci.* 79:22-28.
- Montanholi, Y.R.** , N. E. Odongo, K. C. Swanson, F. S. Schenkel, B. W. McBride, S. P. Miller. 2008. Application of infrared thermography as an indicator of heat and methane production and its use in the study of skin temperature in response to physiological events in dairy cattle (*Bos taurus*). *Journal of Thermal Biology*, 33: 468-475.
- Pant, S.D.** , F.S. Schenkel, I. Leyva, B.S. Sharma, N.A. Karrow. 2008. Identification of polymorphisms in bovine TLR-2 and CARD15, and associations between CARD15 polymorphisms and milk somatic cell score in Canadian Holsteins. *Developments in Biologicals*. 132: 331-336.
- Peacock J.** , Lou Y., Lundström K., Squires E. J. 2008. The effect of a c-8G_T polymorphism on the expression of cytochrome b5A and boar taint in pigs. *Animal Genetics* 39:15-21.
- Pearson, W.** , M.W. Orth, N.A. Karrow, M.I. Lindinger. 2008. Effects of simulated digests of *Biota orientalis* and a dietary nutraceutical on interleukin-1- induced inflammatory responses in cartilage explants. *American Journal of Veterinary Research* 69:1560-8.
- Purslow, P.P.** , I.B. Mandell, T.M. Widowski, J. Brown, C.F.M. deLange, J.A.B. Robinson, E.J. Squires, M.C. Cha, G. VanderVoort. 2008. Modelling quality variations in commercial Ontario pork production. *Meat Science* 80: 123-131.
- Sargolzaei, M.** , F. S. Schenkel, G. B. Jansen, L.R. Schaeffer. 2008. Extent of Linkage Disequilibrium in Holstein Cattle in North America. *Journal of Dairy Science*, 91: 2106-2117.
- Schaeffer, L.R.** , J. Jamrozik. 2008. Random regression models: a longitudinal perspective. *J. Anim. Breed. Genet.* 125: 145-146.
- Sharma, B.S.** , J. Mount, N.A. Karrow. 2008. Functional characterization of a single nucleotide polymorphism in the 5' UTR region of the bovine Toll-like-4 receptor gene. *Developments in Biologicals*. 132: 247-253.

- Yeh, E.** , Wood, R.D, Squires, E.J. 2008 Influence of plasma lipid composition on activity of Factors V, VII and X in Single Comb White Leghorn and Fatty Liver Haemorrhagic Syndrome-susceptible laying hens. *British Poultry Science* 49:760-769.
- You, Q.** , N.A. Karrow, H. Cao, A. Rodriguez, B.A. Mallard, H. J. Boermans. 2008. Variation in the ovine cortisol response to systemic bacterial endotoxin challenge is predominantly determined by signalling within the hypothalamic-pituitary-adrenal axis (HPAA). *Toxicology and Applied Pharmacology* 230: 1-8.
- You, Q.** , N.A. Karrow, H. J. Boermans, M. Quinton, B.A. Mallard. 2008. Enhanced cutaneous hypersensitivity reactions are associated with ovine high and low acute stress responsiveness. *Veterinary Dermatology* 19, 174-83.
- Zamaratskaia, G.** , Dahl, E., Madej, A, Squires, E.J, Andresen, Ø2008. Studies on 5-androst-16-en-3-one binding to porcine serum, plasma and testicular cytosolic fraction and to human serum. *J. Steroid Biochem. Mol. Biol.* 111:24-28.
- Zamaratskaia, G.** , Y. Lou, J. Peacock, L. Rydhmer, H.K. Andersson, R.K. Juneja, G. Chen., Lundstrom, K., E.J. Squires 2008. Effect of polymorphism in the porcine cytochrome b5 (CYB5A) gene on androstenone and skatole concentrations and sexual development in Swedish swine populations. *Animal* 2 (2) 190-196

2007 - 18

- Carvalho, R.** , F. S. Schenkel, Luiz Alberto Fries, S. A. De Queiroz, S. P. Miller. 2007. Empirical properties of solutions from Henderson's mixed model equations when sires are non-randomly used across contemporary groups. *Biometric Brazilian Journal*, 25(3):7-21.
- Carvalho, R.** , F. S. Schenkel, Luiz Alberto Fries, S. A. De Queiroz, S. P. Miller 2007. Alternative genetic evaluation models under parental selection. *Brazilian Journal of Mathematics and Statistics*, 25(2):41-57.
- Jamrozik, J.** , J. Fatehi, L. R. Schaeffer. 2007. Application of robust procedures for estimation of breeding values in multiple-trait random regression test-day model. *J. Anim. Breed. Genet.* 124:3-11.

- Kolbehdari, D.** , J.A.B. Robinson. 2007. QTL Mapping Using Multiple Markers Simultaneously. *American Journal of Agricultural and Biological Science* 2:195-201.
- Kolbehdari, D.** , L. R. Schaeffer, J. A. B. Robinson. 2007. Estimation of genome-wide haplotype effects in half-sib designs. *J. Dairy. Sci.* 124:356-361.
- Lanthier, F.** , Lou, Y., E. J. Squires 2007 Skatole metabolism in the intact pre-pubescent male pig: the relationship between hepatic enzyme activity and skatole concentrations in plasma and fat. *Livestock Science* 106:145-153.
- Leung, M.C.K.** , T.K. Smith, N.A. Karrow, H.J. Boermans. 2007. Effects of feedborne *Fusarium* mycotoxins with and without a polymeric glucmannan mycotoxin adsorbent on feed intake, body weight, hematology, and nutrient digestibility of mature beagles. *American Journal of Veterinary Research* 68, 1122-1129.
- Leyva, I.** , F. Schenkel, B., Sharma, G. B. Jansen, N. Karrow. 2007. Identification of single nucleotide polymorphisms in the CCL2, IL8, CCR2, and IL8RA genes and their association with health and production in Canadian Holsteins. *Animal Genetics*, 38: 198-202.
- Lillie, B.N.** , Keirstead, N.D., Squires, E.J., M. A. Hayes 2007. Gene polymorphisms associated with reduced hepatic expression of porcine mannan-binding lectin C *Dev. Comp. Immunol* 31: 830-846.
- Liu, Y.** , Jansen, G. B. and Lin, C.Y. 2007. Accounting for heterogeneity of variances to improve the precision of QTL mapping in dairy cattle. *Anim. Sci. J.* 78:371-377.
- Macciotta, N. P.** , F. Miglior, A. Cappio-Borlino, L. R. Schaeffer. 2007. Fit of different functions to the individual deviations in random regression test day models for milk yield in dairy cattle. *Italian J. Anim. Sci.* 6:153-155.
- Miglior, F.** , A. Sewalem, J. Jamrozik, J. Bohmanova, D. M. Lefebvre, R. K. Moore. 2007. Genetic analysis of milk urea nitrogen and lactose and their relationships with other production traits in Canadian Holstein cattle. *J. Dairy Sci.* 90:2468-2479.

- Murray, D.** , R. Meidinger, J. P. Phillips, A. Ajakaiye, S. P. Golovan, M. Fan, R. R. Hacker, C. W. Forsberg. 2007. Transgene and mitochondrial DNA are indicators of efficient composting of transgenic pig carcasses. *Bioresource Technology* 98(9):1795-1804.
- Palucci, V.** , L. R. Schaeffer, F. Miglior, V. Osborne. 2007. Non-additive genetic effects for fertility traits in Canadian Holstein cattle. *Genet. Sel. Evol.* 39:181-193.
- Pant, S.D.** , F.S. Schenkel, I. Leyva-Baca, B.S. Sharma, N.A. Karrow. 2007. Identification of polymorphisms in bovine CARD15, and their associations with health and production traits in Canadian Holsteins. *BMC Genomics* 8, 421.
- Pearson, W.** , M.W. Orth, N.A. Karrow, N.J. MacLusky, M.I. Lindinger. 2007. Anti-inflammatory and chondroprotective effects of nutraceuticals in a cartilage explant model of inflammation. *Molecular Nutrition and Food Research* 51, 1020-1030.
- Zamaratskaia, G.** , Gilmore, W.J., Lundstrom, K., E.J. Squires 2007. Effect of testicular steroids on catalytic activities of cytochrome P450 enzymes in porcine liver microsomes *Food and Chemical Toxicology* 45 (4): 676-681.
- Zamaratskaia, G.** , Lou, Y., Chen, G., Lundstrom, K. Andresen, O., E.J. Squires 2007. Effect of hCG stimulation on plasma androstenone concentrations and cytochrome b5 levels in testicular tissue. *Reproduction in Domestic Animals.* 42: 105-108.

2006 - 27

- Bergen, R.** , S.P. Miller, J.W. Wilton, D.H. Crews Jr., I.B. Mandell. 2006. Genetic correlations between live yearling bull and steer carcass traits adjusted to different slaughter end points. 1. Carcass lean percentage. *J. Anim. Sci.* 84:546-557.
- Bergen, R.** , S.P. Miller, J.W. Wilton, I.B. Mandell. 2006. Genetic correlations between live yearling bull and steer carcass traits adjusted to different slaughter end points. 2. Carcass fat partitioning. *J. Anim. Sci.* 84:558-566.

- Cao, H.** , L.C. Kabaroff, Q. You, A. Rodriguez, B.A. Mallard, M. Quinton, H.J. Boermans, N.A. Karrow. 2006. Characterization of ovine hepatic gene expression profiles in response to *Escherichia coli* lipopolysaccharide using a bovine cDNA microarray. *BMC Veterinary Research* 2: 34-40.
- Cao, H.** , L.C. Kabaroff, Q. You, A. Rodriguez, B.A. Mallard, Q. Margaret, N.A. Karrow. 2006. Ovine hepatic gene expression profiles following systemic challenge with *Escherichia coli* lipopolysaccharide. Proceedings of the 8th World Congress on Genetics Applied to Livestock, August 13-18, Brazil.
- Kabaroff, L.** , A. Rodriguez, H. Boermans, N.A. Karrow. 2006. Assessment of the ovine acute phase response and hepatic gene expression in response to *Escherichia coli* endotoxin. *Veterinary Immunology and Immunopathology* 113: 113-124.
- Kabaroff, L.** , H. Boermans, and N.A. Karrow. 2006. Changes in ovine maternal temperature and serum cortisol and IL-6 concentrations after challenge with *E. coli* LPS during pregnancy and early lactation. *Journal of Animal Science* 84: 2083-2088.
- Karrow, N.A.** 2006. Activation of the hypothalamic-pituitary-adrenal axis and autonomic nervous system during inflammation and altered programming of the neuroendocrine-immune axis during fetal and neonatal development: lessons learned from the model inflammagen, lipopolysaccharide. *Brain Behaviour and Immunity* 20, 144-158.
- Keefe, G.** , Squires, E.J., Walsh, R., Wilson, J.B., Leslie, K.E. 2006. Impact of a progesterone-releasing intravaginal device on plasma progesterone levels in lactating dairy cattle. *Bovine Practitioner* 40:108-112.
- Kolbehdari, D.** , G. B. Jansen, L. R. Schaeffer, O. B. Allen. 2006. Transmission disequilibrium test for quantitative trait loci detection in livestock populations. *J. Anim. Breed. Genet.* 123:191-197.
- Kolbehdari, D.** , G. B. Jansen, I. McMillan, L. R. Schaeffer. 2006. Precision of estimated QTL positions in granddaughter designs using combined haplotype sharing TDT and linkage analysis. *Livestock Science* 105:137-143.
- Lanthier, F.** , Lou, Y., Turner, M.A., E.J. Squires. 2006. Characterizing developmental changes in plasma and tissue skatole concentrations in the pre-pubescent intact male pig. *J. Anim. Sci.* 84:1699-1708.

- Leyva, I.** , F. Schenkel, B.S. Sharma, G.B. Jansen, N. A. Karrow. 2006. Evaluation of DNA pooling for low frequency SNP detection, and the association of CXCR1+777 SNP with health and production traits in Canadian Holstein bulls. Proceedings of the 8th World Congress on Genetics Applied to Livestock, August 13-18, Brazil.
- Lillie, B.N.** , Keirstead, N.D., Squires, E.J., M. A. Hayes 2006. Single nucleotide polymorphisms in porcine mannan-binding lectin A. Immunogenetics. 58(12):983-93.
- Lin, Z.** , Lou, Y., Squires, E.J. 2006. Functional polymorphism in porcine CYP2E1 gene: its association with skatole levels J. Steroid Biochem. Mol. Biol. 99: 231-237
- Liu, Y. X.** , J. Zhang, L. R. Schaeffer, R. Q. Yang, W. L. Zhang. 2006. *Short Communication*: Optimal random regression models for milk production in dairy cattle. J. Dairy Sci. 89:2233-2235.
- Mandell, I. B.** , C. P. Campbell, V. M. Quinton, J. W. Wilton. 2006. Effects of skeletal separation method and postmortem ageing on carcass traits and shear force in cull cow beef. Can. J. Anim. Sci. 86:351-361.
- Miglior, F.** , A. Sewalem, J. Jamrozik, D. M. Lefebvre, R. K. Moore. 2006. Analysis of milk urea nitrogen and lactose and their effect on longevity in Canadian dairy cattle. J. Dairy Sci. 89:4886-4894.
- Quinton, V.M.** , J.W. Wilton, J.A.B. Robinson, P.K. Mathur. 2006. Economic weights for sow productivity traits in nucleus pig populations. Livestock Science 99:69-77.
- Schaeffer, L. R.** 2006. Strategy for applying genome-wide selection in dairy cattle. J. Anim. Breed. Genet. 123:1-6.
- Schenkel, F.S.** , Miller, S.P., Jiang, Z.H., Mandell, I.B., Ye, X., Li, H., Wilton, J. W. 2006. Association of a single nucleotide polymorphism in the calpastatin gene (CAST) with carcass and meat quality traits in beef cattle. Journal of Animal Science, 84: 291-299.
- Sharma, B.S.** , G.B. Jansen, N.A. Karrow, D. Kelton, Z. Jiang. 2006. Detection and mapping of an AFLP marker for clinical mastitis in Canadian Holsteins. Journal of Dairy Science 89: 3653-3663.

- Sharma, B.S.** , I. Leyva, F. Schenkel, N.A. Karrow. 2006. Relevance of polymorphisms in TLR4 on health traits in Canadian Holsteins. *Journal of Dairy Science* 89: 3626-3635.
- Sharma, B.S.** , I. Leyva, F. Schenkel, N.A. Karrow. 2006. Polymorphisms in the bovine TLR4 gene and associations with milk somatic cell score and other health related traits in Canadian Holstein cows. *Proceedings of the 8th World Congress on Genetics Applied to Livestock*, August 13-18, Brazil.
- Sherry, J.P.** , J.J. Whyte, N.A. Karrow, A. Gamble, H.J. Boermans, N.C. Bols, D.G. Dixon, K.R. Solomon. 2006. The effect of creosote on vitellogenin production in rainbow trout. *Archives of Environmental Contaminant Toxicology* 50: 65-68.
- Sinclair, P.A.** , Gilmore, W.J., Lin, Z., Lou, Y., E.J. Squires. 2006. Molecular cloning and regulation of porcine SULT2A1: Relationship between SULT2A1 expression and sulfoconjugation of androstenone. *J. Mol. Endocrinol.* 36: 301-311
- Turner, M.A.** , Gilmore, W.J., Lou Y., E. J. Squires. 2006. The role of CYP2A and CYP2E1 in the metabolism of 3-methylindole in primary cultured porcine hepatocytes. *Drug Metabolism and Disposition* 34:848-854.
- Van Groningen, C.** , C.J.B. Devitt, J. W. Wilton, J. A. L. Cranfield. 2006. Economic evaluations of beef bulls in an integrated supply chain. *J. Anim. Sci.* 84:3219-3227.

2005 - 30

- Barrett, R.** , F. Miglior, G. Jansen, J. Jamrozik, L. R. Schaeffer. 2005. Joint international evaluation of Milking Shorthorn dairy cattle for production traits. *J. Dairy Sci.* 88:3326-3336.
- Bergen, R.** , S.P. Miller, J.W. Wilton. 2005. Genetic correlations among indicator traits for carcass composition measured in yearling beef bulls and finished feedlot steers. *Can. J. Anim.* 85:463-473.
- Bergen, R.** , S.P. Miller, I.B. Mandell, W.M. Robertson. 2005. Use of live ultrasound, weight and linear measurements to predict carcass composition of young beef bulls. *Can. J. Anim. Sci.* 85:23-35.

- Forsberg, C. W.** , S. P. Golovan, A. Ajakaiye, J. P. Phillips, R. G. Meindinger, M. Z. Fan, J. M. Kelly, R. R. Hacker. 2005. Genetic opportunities to enhance sustainability of pork production in developing countries: a model for food animals. In: *Application of gene-based technologies for improving animal production and health in developing countries*, edited by H. P. S. Makker, G. J. Viljeon. Springer/Kluwer. pp 793. ISBN:1-4020-3311-7.
- Guo, T.L.** , R.P.Chi, N.A. Karrow, L.X. Zhang, S.B. Pruet, D.R. Germolec, K.L. White, Jr. 2005. Thalidomide enhances both primary and secondary host resistances to *Listeria Monocytogenes* infection by a neutrophil-related mechanism in female B6C3F1 mice. *Toxicology and Applied Pharmacology* 209, 244-54.
- Jamrozik, J.** , J. Fatehi, G. J. Kistemaker, L. R. Schaeffer. 2005. Estimates of genetic parameters for Canadian Holstein female reproduction traits. *J. Dairy Sci.* 88:2199-2208.
- Jiang, Z.** , S. De, M. D. Garcia, K. B. Griffin, X.L. Wu, Q. Xiao, J. J. Michal, B. S. Sharma, G. B. Jansen. 2005. An independent confirmation of a quantitative trait locus for milk yield and composition traits on bovine chromosome 26. *J. Anim. Breed. Genet.* 122:281-284.
- Karrow, N.A.** , J.A. McCay, R.D. Brown, D.L. Musgrove, T.L. Guo, L. Butterworth, M.L. Stern, A.E. Munson, D.R. Germolec, K.L. White, Jr. 2005. Oral Exposure to Atrazine Modulates Cell-mediated Immune Function and Decreases Host Resistance to the B16F10 Tumor Model in Female B6C3F1 Mice, *Toxicology* 209, 15-28.
- Kolbehdari, D.** , G. B. Jansen, L. R. Schaeffer, O. B. Allen. 2005. Power of QTL detection by either fixed or random models in half-sib designs. *Genet. Sel. Evol.* 37:601-614.
- Lin, C.Y.** 2005. A simultaneous procedure for deriving restricted selection indexes with multiple restrictions. *J. Anim. Sci.* 83:531-536.
- Lin, C.Y.** 2005. An iterative procedure for deriving selection indexes with constant restriction. *J. Anim. Sci.* 83:2313-2318.
- Lin, Z.** , Lou, Y., Squires, E.J. 2005. Identification of a single nucleotide polymorphism in porcine testis cytochrome P450-C17 (CYP17) and its effect on steroidogenesis. *Biochemical Genetics* 43:531-542.

- Lin Z.H.** , Lou Y.P., Peacock, J., Squires, E.J. 2005. A novel polymorphism in the 5' untranslated region of the porcine cytochrome b5 (CYB5) gene is associated with decreased fat androstenone level. *Mammalian Genome* 16 (5): 367-373.
- Moghadam, H. K.** , I. McMillan, J. R. Chambers, R. J. Julian, C. C. Tranchant. 2005. Heritability of sudden death syndrome and its associated correlations to ascites and body weight in broilers. *Can. J. Anim. Sci.* 46:54-57.
- Quinton, C. D.** , I. McMillan, B. D. Glebe. 2005. Development of an Atlantic salmon (*Salmo salar*) genetic improvement program: Genetic parameters of harvest body weight and carcass quality traits estimated with animal models. *Aquaculture* 247:211-217.
- Robinson, J.A.B.** , M.M. Buhr. 2005. Impact of Genetic Selection on Management of Boar Replacement. *Theriogenology* 63: 668-678.
- Roso, V.M.** , Schenkel, F.S., Miller, S.P., Wilton, J.W. 2005. Additive, dominance, and epistatic loss effects on preweaning weight gain of crossbred beef cattle from different *Bos taurus* breeds. *Journal of Animal Science*, 83:1780-1787.
- Roso, V.M.** , Schenkel, F.S., Miller, S.P., Schaeffer, L.R. 2005. Estimation of genetic effects in the presence of multicollinearity in multibreed beef cattle evaluation. *Journal of Animal Science*, 83:1788-1800.
- Schenkel, F.S.** , Miller, S.P., Ye, X., Moore, S.S., Nkrumah, J.D., Li, C., Yu, J., Mandell, I.B., Wilton, J.W., Williams, J.L. 2005. Association of single nucleotide polymorphisms in the leptin gene with carcass and meat quality traits in beef cattle. *Journal of Animal Science*, 83:2009-2020.
- Sinclair, P.A.** , Raeside, J.I., Renaud, R., Squires, E.J. 2005. Synthesis of free and sulfoconjugated 16-androstene steroids by the leydig cells of the mature domestic boar. *Journal of Steroid Biochemistry and Molecular Biology* 96 :217-228.
- Sinclair, P.A.** , Hancock, S., Squires, E.J. 2005. Metabolism of the 16-androstene steroids in primary porcine hepatocytes. *Journal of Steroid Biochemistry and Molecular Biology*, 96 : 79-87.
- Sinclair, P.A.** , Squires, E.J. 2005. Testicular sulfoconjugation of the 16-androstene steroids by hydroxysteroid sulfotransferase: its impact on

the concentrations of 5-androstenone in plasma and fat of the mature domestic boar. *J. Anim. Sci.* 83: 359-365.

- Stewart, J.D.** , Lou, Y., Squires, E.J., Coussens, P.M. 2005. Using Human Microarrays to Identify Differentially Expressed Genes Associated with Increased Steroidogenesis in Boars. *Animal Biotechnology* 16:139-151.
- Strabel, T.** , J. Szyda, E. Ptak, J. Jamrozik. 2005. Comparison of random regression test-day models for Polish Black and White cattle. *J. Dairy Sci.* 88:3688-3699.
- Sullivan, P.G.** , J.W. Wilton, L.R. Schaeffer, G.J. Jansen, J.A.B. Robinson, O.B. Allen. 2005. Genetic evaluation strategies for multiple traits and countries. *Livestock Production Science* 92: 195-205.
- Wang, Y.** , Schenkel, F.S., Miller, S.P., Wilton, J. W. 2005. Comparison of models and impact of missing records on genetic evaluation of calving ease in a simulated beef cattle population. *Canadian Journal of Animal Science*, 85:145-155.
- Yang, R. Q.** , H. Y. Ren, L. R. Schaeffer, S. Z. Xu. 2005. Estimation of genetic parameters for lactational milk yields using two-dimensional random regressions on parities and days in milk in Chinese Simmental cattle. *J. Anim. Breed. Genet.* 122:49-55.
- Zamaratskaia, G.** , Babol, J., Madej, A., Squires, E.J., Lundström, K. 2005. Free oestrone in adipose tissue and its relation to androstenone and skatole in entire male pigs *Reproduction in Domestic Animals* 40 (2): 156-160.
- Zamaratskaia, G.** , Squires, E.J., Babol, J., Andersson, H.K., Andersson, K., Lundström, K. 2005. Relationship between the activities of cytochromes P4502E1 and P4502A6 and skatole content in fat in entire male pigs fed with and without raw potato starch. *Livestock Production Science* 95:83-88.
- Zavadilova, L.** , J. Jamrozik, L. R. Schaeffer. 2005. Genetic parameters for test-day model with random regressions for production traits of Czech Holstein cattle. *Czech J. Anim. Sci.* 50:142-154.

- Ajakaiye, A.** , M. Z. Fan, C. W. Forsberg, J. P. Phillips, S. P. Golovan, R. G. Meidinger, T. Archbold, R. R. Hacker. 2004. Digestion and absorption of calcium associated with soybean meal is completed by the end of the small intestine in the transgenic phytase Enviropig. *The FASEB Journal; Experimental Biology*. 18:(4)p526.
- Cao, H.** , J.A.B. Robinson, Z.H. Jiang, J.S. Melville, S.P. Golovan, M.W. Jones, A. M. V. Gibbins. 2004. A High-resolution Radiation Hybrid Map of Porcine Chromosome 6. *Animal Genetics* 35: 367-378.
- Fagundes, J. I.** , J. F. P. Lobato, F. S. Schenkel. 2004. Effect of stocking rates on milk production of primiparous beef cows and on growth of their calves. *Brazilian J. Genet.* 33:412-419.
- Fernandes, T.L.** , J.W. Wilton, J.J. Tosh. 2004. Estimates of genetic parameters for ultrasound-measured carcass traits in sheep. *Can. J. Anim. Sci.* 84:361-365.
- Jamrozik, J.** 2004. Implementation issues for Markov Chain Monte Carlo methods in random regression test-day models. *J. Anim. Breed. Genet.* 121:1-13.
- Jamrozik, J.** , I. Strandén, L. R. Schaeffer. 2004. Random regression test-day models with residuals following a Student's-t distribution. *J. Dairy Sci.* 87:699-705.
- Karrow, N.A.** , T.L. Guo, K.B. Delclos, R.R. Newbold, C. Weis, D.R. Germolec, K.L. White Jr., J.A. McCay. 2004. Nonylphenol alters the activity of splenic NK cells and the numbers of leukocyte subpopulations in Sprague-Dawley rats: a two-generation feeding study. *Toxicology* 196, 237-245.
- Lin Z.** , Lou Y., Squires E.J. 2004. Molecular cloning, expression and functional characterization of cytochrome P450 2A6 gene in pig liver. *Animal Genetics* 35 :314-316.
- Lin Z.** , Lou Y., Squires E.J. 2004. Molecular cloning and functional analysis of porcine SULT1A1 gene and its variant: a single mutation in SULT1A1 causes a significant decrease in sulfation activity. *Mammalian Genome* 15: 218-226.
- Liu, Y.** , G. B. Jansen, C. Y. Lin. 2004. Quantitative trait loci mapping for dairy cattle production traits using a maximum likelihood method. *J. Dairy Sci.* 87:491-500.

- Muir, B. L.** , J. Fatehi, L. R. Schaeffer. 2004. Genetic relationships between persistency and reproductive performance in first-lactation Canadian Holsteins. *J. Dairy Sci.* 87:3029-3037.
- Mutsvangwa, T.** , Gilmore, J., Squires, E.J., Lindinger, M.I., B. W. McBride. 2004. Chronic metabolic acidosis increases mRNA levels for components of the ubiquitin-mediated proteolytic pathway in skeletal muscle of dairy cows. *J. Nutr.* 134: 558-561.
- Pan, Y.** , G. B. Jansen, T. F. Duffield, S. Hietala, D. Kelton, C. Y. Lin, A. S. Peregrine. 2004. Genetic susceptibility to *Neospora caninum* infection in Holstein cattle in Ontario. *J. Dairy Sci.* 87:3967-3975.
- Potter, B. A.** , J. F. P. Lobato, F. S. Schenkel. 2004. Effects of post-partum management of primiparous cows on growth of beef calves up to one year of age. *Brazilian J. Anim. Sci.* 33:426-433.
- Quinton, C. D.** , L. R. McKay, I. McMillan. 2004. Strain and maturation effects on female spawning time in diallele crosses of three strains of rainbow trout (*Oncorhynchus mykiss*). *Aquaculture* 234:99-110.
- Roso, V.M.** , Schenkel, F.S., Miller, S. P. 2004. Estimation of the degree of connectedness between test groups of station-tested beef bulls. *Canadian Journal of Animal Science*, 84: 37-47.
- Schaeffer, L. R.** 2004. Application of random regression models in animal breeding. *Livest. Prod. Sci.* 86:35-45.
- Schenkel, F.S.** , Miller, S.P., Wilton, J.W. 2004. Herd of origin effect on weight gain of station-tested beef bulls. *Livestock Production Science*, 86:93-103.
- Schenkel, F.S.** , Miller, S.P., Wilton, J.W. 2004. Genetic parameters and breed differences for feed efficiency, growth, and body composition traits of young beef bulls. *Canadian Journal of Animal Science*, 84:177-185.
- Schenkel, F.S.** , Devitt, C. J. B., Wilton, J. W., Miller, S. P., Jamrozik, J. 2004. Random regression analyses of feed intake of individually tested beef steers. *Livestock Production Science*, 88:129-142.
- Squires, E.J.** , Sueyoshi, T., Negishi, M. 2004. Cytoplasmic localization of PXR and ligand-dependent nuclear translocation in mouse liver. *Journal of Biological Chemistry* 279:49307-49314.

- Sullivan, P.G.** , J.W. Wilton, L.R. Schaeffer, G.B. Jansen, J.A.B. Robinson, O.B. Allen. 2004. Genetic evaluation strategies for multiple traits and countries. *Livest. Prod. Sci.* 92:195-205.
- Swamy, H.V.** , T.K. Smith, N.A. Karrow, H.J. Boermans. 2004. Effects of feeding blends of grains naturally contaminated with *Fusarium* mycotoxins on growth and immunological parameters of broiler chickens. *Poultry Science* 83, 533-43.
- Tao, W.** , B. Mallard, N.A. Karrow, B. Bridle. 2004. Construction and calibration of a bovine immune-endocrine cDNA microarray. *Veterinary Immunology and Immunopathology* 101, 1-17.
- Tosh, J.J.** , J.W. Wilton. 2004. Impact of relative emphasis on growth and litter size in a maternal index for selecting sheep. *Can. J. Anim. Sci.* 84:713-715.
- van Dorp, T. E.** , P. Boettcher, L. R. Schaeffer. 2004. Genetics of locomotion. *Livest. Prod. Sci.* 90:247-253.
- Wilton, J.W.** 2004. Genomic and computing strategies in the optimization of the genetic component of specification beef. *J. Anim. Sci.* 81:E24-27.
- Wood, G. M.** , P. J. Boettcher, D. F. Kelton, G. B. Jansen. 2004. Phenotypic and genetic influences on test-day measures of acetone concentration in milk. *J. Dairy Sci.* 87:1108-1114.
- Yang, R.** , L. R. Schaeffer, J. Jamrozik. 2004. Robust estimation of breeding values in a random regression test-day model. *J. Anim. Breed. Genet.* 121:221-228.
- Zamaratskaia, G.** , Babol, J., Madej, A., Squires, E.J., Lundström, K. 2004. Age-related variation of plasma concentrations of skatole, androstenone, testosterone, oestradiol-17 beta, oestrone sulphate, dehydroepiandrosterone sulphate, triiodothyronine and IGF-1 in six entire male pigs *Reproduction in Domestic Animals* 39 (3): 168-172

2003 - 21

- Alizadeh, Z.** , N.A. Karrow, S. Sharif, B.N. Wilkie, B.A. Mallard. 2003. Biological effect of varying peptide binding affinity to BoLA-DRB3*2703 allele. *Genetics, Selection and Evolution.* 35 (Suppl. 1), S51-65.

- Almeida, L.S.P.** , J.F.P. Lobato, F.S. Schenkel. 2003. Effect of weaning age and supplementation on growth and carcass characteristics of beef steers. *Brazilian J. Anim Sci.* 32:1713-1721.
- Bergen, R.** , D. Crews, S.P. Miller, J.J. McKinnon. 2003. Predicting lean meat yield in beef cattle using ultrasonic muscle depth and width measurements. *Can. J. Anim. Sci.* 83:429-434.
- Boermans, H.** , N. A. Karrow, T. Smith, H. V. Swamy. 2003. Effects of feeding blends of grains naturally contaminated with fusarium mycotoxins on growth and immunological parameters of broiler chickens. *Poultry Sci.* 82:.
- Boettcher, P. J.** , J. Fatehi, M. M. Schutz. 2003. Genotype-by-environment interactions in conventional versus pasture-based dairies in Canada. *J. Dairy Sci.* 86:383-389.
- Broring, N.** , J.W. Wilton, P.E. Colucci. 2003. Body condition score and its relationship with ultrasound backfat measurements for beef cows. *Can. J. Anim. Sci.* 83:593-596.
- Diaz, G.J.** , E.J. Squires. 2003. Phase II in vitro metabolism of 3-methylindole metabolites in porcine liver *Xenobiotica* 33 : 485-498
- Fagundes, J. I.** , J. F. P. Lobato, F. S. Schenkel. 2003. Effects of two stocking rates on natural pasture and two weaning ages on performance of primiparous beef cows. *Brazilian J. Anim. Sci.* 32:1722-1731.
- Fatehi, J.** , J. J. Shannon, P. J. Boettcher. 2003. Genetic parameters for feet and leg traits evaluated in different environments. *J. Dairy Sci.* 86:661-666.
- Forsberg, C. W.** , J. P. Phillips, S. P. Golovan, M. Z. Fan, R. G. Meidinger, A. Ajakaiye, D. Hilborn, R. R. Hacker. 2003. The Enviropig physiology, performance, and contribution to nutrient management, advances in a regulated environment: The leading edge of change in the pork industry. *J. Anim. Sci.* 81:E68-E77.
- Hernández, A.** , N.A. Karrow, B.A. Mallard. 2003. Evaluation of immune responses of cattle as a means to identify high or low responders and use of a human microarray to differentiate gene expression. *Genetics, Selection and Evolution* 35 (Suppl.1), S67-81.

- Karrow, N.A.** , D. Bennie, H.J. Boermans, N.C. Bols, D.G. Dixon, A. Gamble, R. Ganassin, J. Parrott, K.R. Solomon, J. Sherry. 2003. Effects of exposure to various sites within the Hamilton Harbour on *Oncorhynchus mykiss* pronephros macrophage function and B cell numbers. *Journal of Great Lakes Research* 29, 280-295.
- Karrow, N.A.** , T.L. Guo, L.X. Zhang, J.A. McCay, D.L. Musgrove, V.L. Peachee, D.R. Germolec, K.L. White, Jr. 2003. Thalidomide modulation of the immune response in female B6C3F1 mice: a host resistance study. *International Immunopharmacology* 3, 1447-1456.
- Kulak, K.** , J. Wilton, G. Fox, J. Dekkers. 2003. Comparisons of economic values with and without risk for livestock trait improvement. *Livest. Prod. Sci.* 79:183-191.
- Ledur, M. C.** , L. E. Liljedahl, I. McMillan, L. Asselstine, R. W. Fairful. 2003. Genetic effects of aging on fitness and non-fitness traits in laying hens housed three per cage. *Poultry Sci.* 82:1223-1234.
- Schaeffer, L. R.** 2003. Computing simplifications for non-additive genetic models. *J. Anim. Breed. Genet.* 120:394-402.
- Schumann, B.E.** , Squires, E.J., Leeson, S., Hunter, B. 2003. Effect of hens fed dietary flaxseed with and without a fatty liver supplement on hepatic, plasma and production characteristics relevant to fatty liver hemorrhagic syndrome in laying hens. *Brit. Poult. Sci* 44 :234-244.
- Swamy, H.V.** , T. K. Smith, E.J. MacDonald, N.A. Karrow, B. Woodward, H.J. Boermans. 2003. Effects of feeding a blend of grains naturally contaminated with *Fusarium* mycotoxins on growth and immunological measurements of starter pigs, and the efficacy of a polymeric glucomannan mycotoxin adsorbent. *Journal of Animal Science* 81, 2792-803.
- Thomson, A.E.** , Gentry, P.A., E.J. Squires. 2003. Comparison of the coagulation profile of Fatty Liver Haemorrhagic Syndrome-susceptible laying hens and normal laying hens. *Brit. Poult. Sci.* 44: 626-633.
- Wagter, L. C.** , B. A. Mallard, B.N. Wilkie, K.E. Leslie, P.J. Boettcher, J.C.M. Dekkers. 2003. Relationship between milk production and antibody response to ovalbumin during the peripartum period. *J. Dairy Sci.* 86:169-173.

Wood, G.M. , P. J. Boettcher, G. B. Jansen, J. Jamrozik, D. F. Kelton. 2003. Estimation of genetic parameters for concentrations of milk urea nitrogen. *J. Dairy Sci.* 86: 2462-2469.

2002 - 29

Babol, J. , Squires E.J., Gullett, E.A. 2002. Factors affecting the level of boar taint in entire male pigs as assessed by consumer sensory panel. *Meat Sci.* 61: 33-40.

Carvalho, R. L. A. Fries, F. S. Schenkel, L. G. de Albuquerque. 2002. Effects of heterogeneity of residual variance among contemporary groups on genetic evaluation of beef cattle. *Brazilian J. Anim. Sci.* 31:1680-1688.

Cottrill, M. A. , S. P. Golovan, J. P. Phillips, C. W. Forsberg. 2002. Inositol phosphatase activity of the *Escherichia coli* agp-encoded acid glucose-1-phosphatase. *Can. J. Microbiol.* 48:801-809.

Dal-Farra, R. A. , V. M. Roso, F. S. Schenkel. 2002. Environmental effects and heterosis on weight gain from birth to weaning and on visual scores at weaning of beef cattle. *Brazilian J. Anim. Sci.* 31:1350-1361.

Fatehi, J. , A. Stella, J. J. Shannon, P. J. Boettcher. 2002. Genetic parameters for feet and leg traits evaluated in different environments. *J. Dairy Sci.* 86:661-666.

Fishback, A. G. , R. G. Danzmann, M. M. Ferguson, J. P. Gibson. 2002. Estimates of genetic parameters and genotype by environment interactions for growth traits of rainbow trout (*Oncorhynchus mykiss*) as inferred using molecular pedigrees. *Aquaculture* 206:137-150.

Gibson, J.P. , Z.H. Jiang, J.A.B. Robinson, A.L. Archibald, C.S. Haley. 2002. No Detectable Association of the ESR PVUII Mutation with Sow Productivity in a Meishan \times Large White F2 Population. *Animal Genetics* 33: 448-450.

Guo, T.L. , X.L. Zhang, E.K. Leffel, V.L. Peachee, N.A. Karrow, D.R. Germolec, K.L. White Jr. 2002. Differential stimulation of IgE production, STAT activation and cytokine and CD86 expression by 2,4-dinitrochlorobenzene and trimellitic anhydride. *Journal of Applied Toxicology* 22, 397-403.

- Jamrozik, J.** , L. R. Schaeffer, K. A. Weigel. 2002. Estimates of genetic parameters for single and multiple country test day models. *J. Dairy Sci.* 85:
- Jamrozik, J.** , L. R. Schaeffer, K. A. Weigel. 2002. Genetic evaluation of bulls and cows with single and multiple country test day models. *J. Dairy Sci.* 85:1617-1622.
- Jiang, Z.** , H. He, N. Hamasima, H. Suzuki, A. M. Gibbins. 2002. Comparative mapping of *Homo sapiens* chromosome 4 (HSA4) and *Sus scrofa* chromosome 8 (SSC8) using orthologous genes representing different cytogenetic bands as landmarks. *Genome* 45:147-156.
- Jiang, Z.** , J. S. Melville, H. Cao, S. Kumar, A. Filipski, A. M. Gibbins. 2002. Measuring conservation of contiguous sets of autosomal markers on bovine and porcine genomes in relation to the map of the human genome. *Genome* 45:769-776.
- Jiang, Z.** , O. J. Rottmann, J. Chen, H. Liu, O. Krebs, F. Pirchner. 2002. A missence mutation in the follicle stimulating hormone receptor (FSHR) gene shows different allele effects on litter size in Chinese Erhualian and German Landrace pigs. *J. Anim. Breed. Genet.* 119:335-341.
- Karrow, N.A.** , T.L. Guo, E.K. Leffel, L.X. Zhang, J.A. McCay, D.R. Germolec, K.L. White, Jr. 2002. An in-depth evaluation of sodium metasilicate hypersensitivity using BALB/c mice. *American Journal of Contact Dermatitis* 13, 133-139.
- Laborde, F.L.** , I.B. Mandell, J.J. Tosh, J.G. Buchanan-Smith, J.W. Wilton. 2002. Effect of management strategy on growth performance, carcass characteristics, fatty acid composition and palatability attributes in cross-bred steers. *Can. J. Anim. Sci.* 82:49-57.
- Ledur, M. C.** , L. E. Liljedahl, I. McMillan, L. Asselstine, R. W. Fairful. 2002. Genetic effects of aging on egg quality traits in the first laying cycle of White Leghorn strains and strain crosses. *Poultry Sci.* 81:1439-1447.
- Lin, C.Y.** 2002. Partitioning of genetic value associated with identified genotype and residual genotype. *Anim. Sci. J.* 73:263-268.
- Liu, Y.** , G. B. Jansen, C. Y. Lin. 2002. The covariance between relatives conditional on genetic markers. *Genet. Sel. Evol.* 34:657-678.

- McMillan, I.** , V. M. Quinton. 2002. Selection strategies for limiting the increase in ascites while increasing growth in broilers. *Poultry Sci.* 81:737-744.
- Mwansa, P.B.** , D.H. Crews, Jr., J.W. Wilton, R.A. Kemp. 2002. Multiple trait selection for maternal productivity in beef cattle. *J. Anim. Breed. Genet.* 119:391-399.
- Pante, M. J. R.** , B. Gjerde, I. McMillan, I. Misztal. 2002. Estimation of additive and dominance genetic variances for body weight at harvest in rainbow trout (*Oncorhynchus mykiss*). *Heredity* 83:333-341.
- Schenkel, F.S.** , Miller S.P., Jamrozik, J., Wilton, J.W. 2002. Two-step and random regression analyses of weight gain of station-tested beef bulls. *Journal of Animal Science*, 80:1497-1507.
- Schenkel, F.S.** , Schaeffer, L.R., Boettcher, P.J. 2002. Comparison between estimation of breeding values and fixed effects using Bayesian and empirical BLUP estimation under selection on parents and missing pedigree information. *Genetics Selection Evolution*, 34:41-59.
- Stella, A.** , G. B. Jansen, P. J. Boettcher, J. P. Gibson, M. M. Lohuis, G. Pagnacco. 2002. Accounting for uncertainty in QTL location in marker-assisted pre-selection of young bulls prior to progeny test. *J. Anim. Breed. Genet.* 119:15-24.
- Stella, A.** , M. M. Lohuis, P. G. Pagnacco, G. B. Jansen. 2002. Strategies for continual application of marker assisted selection in an open nucleus population. *J. Dairy Sci.* 85:2358-2367.
- Swamy. H.V.** , Smith, T.K., MacDonald, E.J., Boermans, H.J., Squires, E.J. 2002. Effects of feeding a blend of grains naturally-contaminated with *Fusarium* mycotoxins on swine performance, brain regional neurochemistry and serum chemistry and the efficacy of a polymeric glucomannan mycotoxin adsorbent. *J. Anim. Sci.* 80:3257-3267.
- Thomson, A.E.** , Squires, E.J., Gentry, P.A. 2002. Assessment of factor V, VII and X activity, the key coagulant proteins of the tissue factor pathway in poultry plasma. *Br. Poult. Sci* 43: 313-321.
- Tosh, J.J.** , J.W. Wilton. 2002. A terminal-sire index for selecting rams. *Can. J. Anim. Sci.* 82:591-593.

Wang, Y. , A. Stella, P.J. Boettcher. 2002. Genetic parameters and relationships with longevity of defective type characteristics of Canadian Holstein cattle. *J. Dairy Sci.* 85:457.

2001 - 31

Boettcher, P.J. 2001. 2020 Vision: The future of dairy cattle breeding from the academic perspective. *J. Dairy Sci.* 84:E62-E68.

Boettcher, P.J. , L. K. Jairath, P.M. VanRaden. 2001. Evaluation of sire predicted transmitting abilities for evidence of x-chromosomal inheritance for dairy production traits. *J. Dairy Sci.* 84:256-265.

Devitt, C.J.B. , J.W. Wilton. 2001. Genetic correlation estimates between ultrasound measurements on yearling bulls and carcass measurements on finished steers. *J. Anim. Sci.* 79:2790-2797.

Friars, G. W. , I. McMillan, V. M. Quinton, F. M. O'Flynn, S. A. McGeachy, T. J. Benfey. 2001. Family differences in relative growth of diploid and triploid Atlantic salmon (*Salmo salar* L.). *Aquaculture* 192:23-29.

Gibson, J. P. , V. M. Quinton, P. Simeanea. 2001. Responses to selection for growth and backfat in closed nucleus herds of Hampshire and Duroc pigs. *Can. J. Anim. Sci.* 81:17-23.

Golovan, S. P. , R. G. Meidinger, A. Ajakaiye, M. Cottrill, M. Z. Wiederkehr, D. J. Barney, C. Plante, J. W. Pollard, M. Z. Fan, M. A. Hayes, J. Laursen, J. P. Hjorth, R. R. Hacker, J. P. Phillips, C. W. Forsberg. 2001. Pigs expressing salivary phytase produce low-phosphorus manure. *Nat. Biotechnol.* 19:741-745.

Golovan, S. P. , M. A. Hayes, J. P. Phillips, C. W. Forsberg. 2001. Transgenic mice expressing bacterial phytase as a model for phosphorus pollution control. *Nat. Biotechnol.* 19:429-433.

Hayes, B.J. , S.P. Miller. 2001. Tactical selection and mating strategies to exploit across and within breed dominance variation. *J. Anim. Breed Genet.* 117:347.

Jamrozik, J. , D. Gianola, L. R. Schaeffer. 2001. Bayesian estimation of genetic parameters for test day records in dairy cattle using linear hierarchical models. *Livest. Prod. Sci.* 71:223-240.

- Jiang, Z.H.** , Gibson, J.P., Archibald, A.L., Haley, C.S. 2001. The porcine gonadotropin-releasing hormone receptor gene (GnRHR): genomic organization, genetic polymorphisms and association with prolificacy. *Genome* 44:7-12.
- Jiang, Z.** , C. Renier, C. Andre, F. Galibert. 2001. RH mapping of canine TOAST markers: a new strategy for species-specific primer design to prevent amplification of host orthologous gene products especially with similar sizes. *Mammalian Genome* 12:799-801.
- Kadarmideen, H. N.** , J. C.M. Dekkers. 2001. Generalized marker regression and interval QTL mapping methods for binary traits in half-sib family design. *J. Anim. Breed. Genet.* (In press).
- Laborde, F.L.** , I.B. Mandell, J.J. Tosh, J.W. Wilton, J.G. Buchanan-Smith. 2001. Breed effects on growth performance, carcass characteristics, fatty acid composition and palatability attributes in finishing steers. *J. Anim. Sci.* 79:355-365.
- Ledwidge S.A.** , Mallard, B.A., Gibson, J.P., Jansen, G.B., Jiang, Z.H. 2001. Multi-primer target PCR for rapid identification of bovine DRB3 alleles. *Animal Genetics* 32(4): 219-221.
- Luo, M. F.** , P.J. Boettcher, L.R. Schaeffer, J.C.M. Dekkers. 2001. Estimation of genetic parameters of calving ease in first and second parities of Canadian Holsteins using Bayesian data analysis. *Livest. Prod. Sci.* 74:175-184.
- Luo, M. F.** , P.J. Boettcher, L.R. Schaeffer, J.C.M. Dekkers. 2001. Bayesian inference for categorical traits with an application to variance component estimation. *J. Dairy Sci.* 84:694-704.
- Nadesalingam, J.** , Plante, Y., Gibson, J.P. 2001. Detection of QTL for milk production on chromosomes 1 and 6 of Holstein cattle. *Mamm. Genome* . 12:27-31.
- Pagnacco, P. G.** , G. B. Jansen. 2001. Use of marker haplotypes to refine covariances among relatives for breeding value estimation. *J. Anim. Breed. Genet.* 118:69-82.
- Pan, Y.** , Boettcher, P.J., J.P. Gibson. 2001. Bayesian segregation analysis of somatic cell scores of Ontario Holstein cattle. *J. Dairy Sci.* 84:2796-2802.

- Pante, M. J. R.** , B. Gjerde, I. McMillan. 2001. Effect of inbreeding on body weight at harvest in rainbow trout (*Oncorhynchus mykiss*). *Aquaculture* 192: 201-211.
- Pante, M. J. R.** , B. Gjerde, I. McMillan. 2001. Inbreeding levels in selected populations of rainbow trout (*Oncorhynchus mykiss*). *Aquaculture* 192: 213-224.
- Perry, G.M.L.** , Danzmann, R.G., Ferguson, M.M., Gibson, J.P. 2001. Quantitative trait loci for upper thermal tolerance in outbred strains of rainbow trout (*Oncorhynchus mykiss*). *Heredity* 83: 333-341
- Plante, Y.** , Gibson, J.P., Nadesalingam, J., Mehrabani-Yeganeh, H., Vander Voort, G., Jansen, G. 2001. Detection of quantitative trait loci affecting milk production traits on 10 chromosomes of Holstein cattle. *J. Dairy Sci.*84(6):1516-24.
- Schaeffer, L. R.** 2001. Multiple trait international bull comparisons. *Livest. Prod. Sci.* 69:145-153.
- Schaeffer, L. R.** , M. Calus, X. Liu. 2001. Comparison of alternative genetic evaluation methods for conformation traits. *Livest. Prod. Sci.* 69:129-137.
- Sinclair, P.A.** , Squires, E.J., J.I. Raeside. 2001. Early postnatal plasma concentrations of testicular hormones, pubertal development and carcass leanness as potential indicators of boar taint in market weight intact male pigs. *J. Anim. Sci.* 79:1868-1876.
- Sinclair, P.A.** , Squires, E.J., Raeside, J.I. Britt, J.H., Hegdpeth, V.G. 2001. The effect of early postnatal treatment with a gonadotropin-releasing hormone agonist on the developmental profiles of testicular hormones in the intact male pig. *J. Anim. Sci.* 79:1003-1010.
- Squires, E.J.** , R.J. Julian. 2001. The effect of dietary chloride and bicarbonate on blood pH, haematological variables, pulmonary hypertension and ascites in broiler chickens. *Br. Poult. Sci.* 42:207-212.
- Stella A.** , G.B. Jansen, P.J. Boettcher, J.P. Gibson, M.M. Lohuis, G. Pagnacco. 2001. Accounting for uncertainty in QTL location in marker-assisted preselection of young bulls prior to progeny test. *J. Anim. Breed. Genet.* 119:15-24.

- Wade, C.M.** , J.W. Wilton, S.P. Miller. 2001. Determination of breeding strategies for beef cattle bull breeders selling bulls into two competing markets on a non-linear price grid. *Can. J. Anim. Sci.* 81:169-177.
- Walton, J-P.** , R.J. Julian, E.J. Squires. 2001. The effect of dietary flax oil and antioxidants on ascites and pulmonary hypertension in broilers using a cold temperature model. *Br. Poult. Sci* 42:123-129.

12 Books

Faculty usually end up writing books or chapters for books as a result of their teaching. Teaching, of course, is based on their research. Writing a book is not an easy venture, and can take one or more years. Second editions are bound to be necessary within ten years.

Wilton, J. W. and B. A. Caswell. 2007. Applied Animal Genetics. MBG3090DE Course Manual. University of Guelph, Guelph, Ontario, Canada.

Wilton, J. W. and B. A. Caswell. 2008. Applied Animal Genetics. MBG3090DE Course Manual. 2nd Edition. Guelph, Ontario, Canada.

Wilton, J. W. , Quinton, V.M., and Quinton, C.D. 2013. Optimizing Animal Genetic Improvement. ISBN 978-09919468-0-8. University of Guelph.

Squires, E. J. 2011. Applied Animal Endocrinology. 2nd Edition. CABI Publishing, Wallingford, Oxon, UK.

Swanson, K. C. and S. P. Miller. 2006. Factors regulating feed efficiency and nutrient utilization in beef cattle. In: J. France and E. Kebreab (Eds.) Mathematical Modelling in Animal Nutrition. CAB International, Wallingford, UK.

Karrow, N. A. , B. Sharma, R. Fisher, B.A. Mallard. 2011. Epigenetics and Animal Health, Comprehensive Biotechnology, 2nd Edn. Elsevier.

Verschoor, C. P. , S. D. Pant, and N.A. Karrow. 2010. Unraveling the genetics of bovine Johne's disease: Lessons learned from human inflammatory bowel disease. Veterinary Immunology and Immunopathology. Eds. L. Neumann and S. Meier. NOVA Publishers, ISBN 978-1-61761-656-3.

Karrow, N. A. and E. J. Squires. 2005. Novel Discoveries & Technologies in Neuroendocrine-Immune Research. Animal production and animal science worldwide, World Association for Animal Production book of the year. Wageningen Academic Publishers, The Netherlands, pp 99-108.

Schaeffer, L. R. 2002. Intellectual Property, Case Study. CABI Publishing. Rothschild and Newman editors.

- Schaeffer, L. R.** 2002. Encyclopedia of Animal Science. 3 pages. Marcel Dekker, Inc.
- Schaeffer, L. R.** 2010. Encyclopedia of Sustainability Science and Technology. 60 pages. Modeling in Animal Breeding. Springer, NY.
- Grosu, H.** and L. R. Schaeffer. 2013. History of Genetic Evaluation Methods in Dairy Cattle. Romanian Press (December 2013).
- Squires, E. J.** and M. Bonneau. 2012. Boar taint: Its biological causes and practical means to alleviate them. Encyclopedia of Meat Science.
- Bonneau, M.** and Squires, E.J. 2004. Boar taint: Causes and measurement. In Encyclopedia of Meat Sciences, Eds. W.K. Jensen, C. Devine and M. Dikemann, Elsevier, Oxford, pp 91-96.
- Squires, E. J.** and Bonneau, M. 2004. Boar taint: Control, Encyclopedia of Meat Sciences, Eds. W.K. Jensen, C. Devine and M. Dikemann, Elsevier, Oxford, pp 97-103.
- Dekkers, J. C. M.** 1995. Genetic improvement of dairy cattle for profitability. Pp. 307-328 in: M. Ivan (Ed.), Animal science research and development: Moving toward a new century. Centre for Food and Animal Research. Ottawa.

13 Patents

Patents held much importance through the early 2000's, but lately there has been less push for patenting research findings about markers. Most people realize that finding markers with large effects are not numerous, and it costs a lot to validate that the marker actually works. Plus, a patent on a marker virtually stops everyone from using that marker. There are other nearby markers that serve the purpose as well. The total genomic approach also does not focus on individual markers, but on the entire set of SNPs. Thus, patents have become less useful due to the time to apply and the entire process.

Year Began	Title	Faculty
2006	Genetic Markers for Skatole Metabolism	Squires
1999	Novel Enzymes and Metabolites Involved in Skatole Metabolism	Squires
2010	Method and compositions for control of boar taint	Squires
2005	Method of detecting and reducing boar taint using nuclear receptors	Squires
2006	Genetic markers in 8 genes for boar taint	Squires
2004	Porcine sulfotransferase 2A1 polynucleotide sequence, protein, and methods of use for same	Squires
1999	Assess pig's ability to metabolize skatole	Squires and Diaz
2004	Polymorphisms in the Cyp2A6 gene	Squires
2004	Polymorphisms in the Sulfotransferase 1A1 gene	Squires
1998	Method of reducing boar taint	Squires, Babol, Lundstrom
1997	Method for determining predisposition to boar taint	Squires
2010	Bovine CAST Gene SNP and Meat Tenderness	Schenkel, Miller, Jiang
2010	Genetic marker identification in Atlantic Cod	Robinson, Hastings, others
2013	Genetic markers associated with the susceptibility to mastitis in dairy cattle	Karrow