

# Curriculum Vitae

**David Irwin**  
**Professor**

**A. Date Curriculum Vitae is Prepared: 2016 February 25**

## **B. Biographical Information**

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## **1. EDUCATION**

### **Degrees**

1982 - 1986	PhD, Genetics, The University of British Columbia, Vancouver, British Columbia, Canada, Supervisor(s): Dr. Ross T. A. MacGillivray
1978 - 1982	BSc, Genetics, University of Guelph, Guelph, Ontario, Canada

### **Postgraduate, Research and Specialty Training**

1987 - 1991	Post-doctoral Fellow, Molecular Evolution, Department of Biochemistry and Molecular Biology, University of California, Berkeley, California, United States, Supervisor(s): Dr. Allan C. Wilson
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## **2. EMPLOYMENT**

### **Current Appointments**

2007 - present	Visiting Professor, Department of Pharmacology, School of Basic Medical Sciences, Peking University, Beijing, China
2007 - present	Visiting Professor, Kunming Institute of Zoology, Chinese Academy of Sciences, Kunming, Yunnan, China
2006 - present	Professor, Department of Ecology and Evolutionary Biology, Faculty of Arts and Science, University of Toronto, Toronto, Ontario, Canada
2004 - present	Professor, Laboratory Medicine and Pathobiology, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada
1991 - present	Principal Investigator, Banting Best Diabetes Centre, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada

David IRWIN

## Previous Appointments

### RESEARCH

1994 - 2008 Principal Investigator, Toronto General Hospital Research Institute, Toronto, Ontario, Canada

### UNIVERSITY

2006 - 2009 Visiting Professor, Laboratory of Biomembrane and Membrane Biotechnology, School of Medicine, Tsinghua University, Beijing, China

### UNIVERSITY - CROSS APPOINTMENT

1999 - 2006 Associate Professor, Zoology, Faculty of Arts and Science, University of Toronto, Toronto, Ontario, Canada

1996 - 1999 Assistant Professor, Zoology, Faculty of Arts and Science, University of Toronto, Toronto, Ontario, Canada

### UNIVERSITY - RANK

1999 - 2004 Associate Professor, Laboratory Medicine and Pathobiology, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada

1991 - 1999 Assistant Professor, Department of Clinical Biochemistry, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada

## 3. HONOURS AND CAREER AWARDS

### Distinctions and Research Awards

#### NATIONAL

##### Received

1987 - 1990 **Post-doctoral Fellowship**, Medical Research Council of Canada. (Research Award)  
*University of California, Berkeley, California, USA.*

1982 - 1984 **Postgraduate Scholarship**, Natural Sciences and Engineering Research Council of Canada (NSERC), Vancouver, British Columbia, Canada. (Research Award)  
*Graduate Student, University of British Columbia.*

1982 **Summer Undergraduate Research Award**, Natural Sciences and Engineering Research Council of Canada (NSERC), Guelph, Ontario, Canada. (Research Award)  
*University of Guelph.*

1981 **Summer Undergraduate Research Award**, Natural Sciences and Engineering Research Council of Canada (NSERC), Guelph, Ontario, Canada. (Research Award)  
*University of Guelph.*

#### LOCAL

##### Received

1987 - 1988 **Izaak Walton Killiam Memorial Postdoctoral Fellowship**, University of California, Berkeley, Berkeley, California, United States. (Research Award)

### Teaching and Education Awards

#### LOCAL

##### Received

2003 **Graduate Teaching Award**, Dept of Lab. Medicine & Pathobiology, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada. (Graduate Education)

#### 4. PROFESSIONAL AFFILIATIONS AND ACTIVITIES

##### Professional Associations

1998 - present                    **Member**, Society for Molecular Biology and Evolution

##### Administrative Activities

###### INTERNATIONAL

###### Canadian International Development Agency

2000 - 2004                    **Coordinator**, Canada-China Cooperation, leading Biotechnology toward the Twenty-first Century  
*Funded program, Canada and China.*

###### PROVINCIAL / REGIONAL

###### University of Toronto

2005                            **Co-Organizer**, Eastern Great Lakes Molecular Evolution Meeting, Toronto, Ontario, Canada. April 30, 2005. *Collaborators: Drs. D. Guttman (Botany), B. Chang (Zoology) and A. Baker (ROM).*

1997                            **Co-Organizer**, Eastern Great Lakes Molecular Evolution Meeting, Toronto, Ontario, Canada. May 10, 1997. *Collaborator: Dr. A Baker (ROM).*

###### LOCAL

###### Toronto General Hospital Research Institute

2005 - 2007                    **Member**, Facilities Management Committee, Max Bell Research Wing

2005 - 2007                    **Member**, Space Committee, Max Bell Research Wing

###### University of Toronto

2014 - present                    **Member**, Education Committee, Faculty of Medicine

2009 - present                    **Member**, Genome Biology and Bioinformatics Committee, Faculty of Medicine

2003 - present                    **Member**, Graduate Awards Committee, Department of Laboratory Medicine and Pathobiology, Faculty of Medicine

2003 - present                    **Member**, Graduate Admissions Committee, Department of Laboratory Medicine and Pathobiology, Faculty of Medicine

2000 - present                    **Member**, Clinical Biochemistry Division Executive Committee, Department of Laboratory Medicine and Pathobiology, Faculty of Medicine

1999 - 2004                    **Coordinator**, Banting and Best Diabetes Summer Studentship Program, Toronto, Ontario, Canada.

1996                            **Coordinator**, Department of Clinical Biochemistry Graduate Student Research Day, Toronto, Ontario, Canada.  
*June 27, 1996.*

1994 - 1997                    **Coordinator**, Department of Clinical Biochemistry Faculty Research Hour Seminar Series, Toronto, Ontario, Canada.

1994                            **Co-Coordinator**, Department of Clinical Biochemistry Graduate Student Research Day, Toronto, Ontario, Canada.  
*June 14, 1994. Collaborator: Dr. M. Krahn.*

1993 - 1997                    **Co-Coordinator**, Department of Clinical Biochemistry Graduate Student Journal Club, Toronto, Ontario, Canada.

David IRWIN

*Collaborators: Drs. H. Elsholtz and T. Cruz.*

1993 **Co-Coordinator**, Department of Clinical Biochemistry Graduate Student Research Day,  
Toronto, Ontario, Canada.  
*June 16, 1993. Collaborator: Dr. C. Prody.*

## Peer Review Activities

### ASSOCIATE OR SECTION EDITING

#### Associate Editor

1998 - present Molecular Biology and Evolution

### EDITORIAL BOARDS

#### Other

2014 - present Zoological Research  
2001 - present Molecular Phylogenetics and Evolution  
2008 - 2014 Frontiers in Biology in China  
1998 - 2002 Journal of Mammalian Evolution

### GRANT REVIEWS

#### Reviewer

Canadian Diabetes Association  
Canadian Foundation for Innovation  
Canadian Institutes of Health Research  
Manitoba Institute of Child Health  
Ministry of Education and Training, Ontario Graduate Scholarship Program  
National Science Centre, Poland  
National Science Foundation  
Natural Sciences and Engineering Research Council of Canada (NSERC)  
University Grants Committee, Hong Kong  
Wellcome Trust

### MANUSCRIPT REVIEWS

#### Reviewer

American Journal of Physiology  
Biochemical Genetics  
Biochemistry  
Biochimica et Biophysica Acta  
BMC Evolutionary Biology  
British Journal of Pharmacology  
Canadian Journal of Zoology  
Cell Research  
Cellular and Molecular Life Sciences  
Cellular Physiology and Biochemistry  
Comparative Biochemistry and Physiology  
Current Biology

Current Genomics  
Endocrinology  
European Journal of Biochemistry  
FEBS Letters  
Gene  
Gene Therapy  
General and Comparative Endocrinology  
Genome  
Genome Biology and Evolution  
Genome Research  
Genomics  
Human Molecular Genetics  
Japanese Journal of Clinical Medicine  
Journal of Cellular Biochemistry  
Journal of Endocrinology  
Journal of Experimental Zoology  
Journal of Fish Biology  
Journal of Mammalian Evolution  
Journal of Molecular Endocrinology  
Journal of Molecular Evolution  
Mitochondria  
Molecular and Cellular Endocrinology  
Molecular Biology and Evolution  
Molecular Ecology  
Molecular Phylogenetics and Evolution  
Nature  
Nature Communications  
Physiological and Biochemical Zoology  
Proceedings of the National Academy of Sciences, USA  
Protein Science  
Science China: Life Sciences  
Systematic Biology

## PRESENTATION REVIEWS

### Reviewer

New York Academy of Sciences  
Taylor and Francis Group, CRC Press

## C. Academic Profile

### 1. RESEARCH STATEMENTS

Role of glucokinase in regulating liver glucose metabolism.  
Defects in glucokinase (GCK) function in the liver leads to diabetes in humans. We have been interested in understanding the role of glucokinase in liver metabolism and have

addressed this used molecular cell biology and bioinformatics approaches. We are trying to understand the regulation of expression of the glucokinase gene in the liver, especially its induction through insulin signaling, using promoter characterization. We are also studying the posttranslational regulation of glucokinase function by better understanding the role of its regulatory partner, glucokinase regulatory protein (GCKR). By altering GCKR levels we can alter glucokinase function. Using bioinformatic approaches we have studied both the glucokinase and GCKR genes to identify sequences that are important for expression and discovered that GCKR is not essential for glucose metabolism in all species. A better understanding of the role of glucokinase, and mechanisms to alter its function, should lead to the development of novel approaches to treat diabetes.

Gene and genome evolution.

Gene sequences and organization of genes in the genome provide information of selective forces that have acted upon the gene. Changes in selective forces are signals of changes in function. By analyzing gene sequences mined from genome databases the orthology of genes can be identified, thus we can identify genes that can be used as models to understand human genes.

A better understanding of the evolutionary history of a gene should provides insight into gene function in extant species.

Origin and evolution of new genes and gene function.

I have studied many models for the origin of new gene function in vertebrates. Using various data mining approaches gene sequences can be extracted from many species, which are then analyzed to identify relationships, especially gene duplications. Examples include enzymes encoded by the lysozyme gene family, hormones of the glucagon-like gene family and the receptors for the glucagon-like peptides.

Most human genes have evolved from another gene (i.e., are members of a gene family) and have changed their function in their evolutionary history. A better understanding of mechanisms driving these processes may allow us to harness them to modify gene function.

## D. Research Funding

### 1. GRANTS, CONTRACTS AND CLINICAL TRIALS

#### PEER-REVIEWED GRANTS

##### FUNDED

- |                     |  |
|---------------------|--|
| 2011 Jan - 2016 Mar | <b>Principal Investigator.</b> Expression of the hepatic glucokinase gene in the progression and treatment of diabetes. Canadian Institutes of Health Research and National Sciences Foundation of China. Canada-China Joint Health Research Initiative. Collaborator(s): Dr. H. Tan, Peking University, Beijing, China. 150,000 CAD. [Grants] |
| 2008 - 2009         | <b>Principal Applicant.</b> Visiting Professor: Travel expenses. Kunming Institute of Zoology, Chinese Academy of Sciences. Collaborator(s): Dr. Y-P. Zhang. 42,000 RMB. [Grants] <i>Kunming Yunnan, China.</i>  |
| 2006 - 2007         | <b>Principal Applicant.</b> Visiting Professor: Travel expenses. Tsinghua University. Collaborator(s): Dr. Z. Chang. 40,000 RMB. [Grants] <i>Beijing, China.</i>   |
| 2004 - 2010         | <b>Principal Investigator.</b> Molecular Evolution of the proglucagon gene. Natural Sciences and Engineering Research Council of Canada (NSERC). 172,150 CAD. [Grants]   |

## E. Publications

### 1. PEER-REVIEWED PUBLICATIONS

#### Journal Articles

1. Wang, M.S., Su, L.Y., Li, Y., Pang, M.S., Liu, H.Q., Zeng, L., **Irwin, D.M.**, Yao, Y.G., Wu, D.D., and Zhang Y.P. Positive selection rather than relaxation of functional constraint drives the evolution of vision during chicken domestication. *Cell Research*. 2016 Feb. In Press. **Coauthor or Collaborator**.
2. Singh, P., and **Irwin, D.M.** Contrasting patterns in the evolution of vertebrate MLX interacting protein (MLXIP) and MLX interacting protein-like (MLXIPL) genes. *PLoS One*. 2016 Feb;11:e0149682. **Senior Responsible Author**.
3. Yang, Y., Zhou, T.C., Liu, Y.Y., Wang, W.X., **Irwin, D.M.**, and Zhang, Y.P. Identification of HNF4A mutation p.T130I and HNF1A mutations p.I27L and p.S487N in a Han Chinese family with early-onset maternally inherited Type 2 Diabetes. *Journal of Diabetes Research*. 2016 Jan. In Press. **Coauthor or Collaborator**.
4. Shi, H., Dong, J., **Irwin, D.M.**, Zhang, S., and Mao, X. Repetitive transpositions of mitochondrial DNA sequences to the nucleus during the radiation of horseshoe bats (*Rhinolophus*, Chiroptera). *Gene*. 2016 Jan. In Press. **Coauthor or Collaborator**.
5. Kader, A., Li, Y., Dong, K., **Irwin, D.M.**, Zhao, Q., He, X., Liu, J., Pu, Y., Gorkhali, N.A., Liu, X., Jiang, L., Li, X., Guan, W., Zhang, Y., Wu, D.D., and Ma, Y. Population Variation Reveals Independent Selection toward Small Body Size in Chinese Debao Pony. *Genome Biology and Evolution*. 2016 Jan;8:42-50. **Coauthor or Collaborator**.
6. Wang, G.D., Zhai, W., Yang, H.C., Wang, L., Zhong, L., Liu, Y.H., Fan, R.X., Yin, T.T., Zhu, C.L., Poyarkov, A.D., **Irwin, D.M.**, Hytönen, M.K., Lohi, H., Wu, C.I., Savolainen, P., and Zhang, Y.P. Out of southern East Asia: the natural history of domestic dogs across the world. *Cell Research*. 2016 Jan;26:21-33. **Coauthor or Collaborator**.
7. Yin, Q., Zhu, L., Liu, D., **Irwin, D.M.**, Zhang, S., and Pan, Y.H. Molecular Evolution of the Nuclear Factor (Erythroid-Derived 2)-Like 2 Gene *Nrf2* in Old World Fruit Bats (Chiroptera: Pteropodidae). *PLoS One*. 2016 Jan;11:e0146274. **Coauthor or Collaborator**.
8. Shao, Y., Li, J.X., Ge, R.L., Zhong, L., **Irwin, D.M.**, Murphy, R.W., and Zhang, Y.P. Genetic adaptations of the plateau zokor in high-elevation burrows. *Scientific Reports*. 2015 Nov;5:17262. **Coauthor or Collaborator**.
9. Zhou, Z.Y., Li, A., Wang, L.G., **Irwin, D.M.**, Liu, Y.H., Xu, D., Han, X.M., Wang, L., Wu, S.F., Wang, L.X., Xi, H.B., and Zhang, Y.P. DNA methylation signatures of long intergenic noncoding RNAs in porcine adipose and muscle tissues. *Scientific Reports*. 2015 Oct;5:15435. **Coauthor or Collaborator**.
10. Zhou, T.C, Sha, T., **Irwin, D.M.**, and Zhang, Y.P. Complete mitochondrial genome of the Indian peafowl (*Pavo cristatus*), with phylogenetic analysis in phasianidae. *Mitochondrial DNA*. 2015 Jun;26:912-913. **Coauthor or Collaborator**.
11. Cao, X., Sun, Y.B., **Irwin, D.M.**, Wang, G.D., and Zhang, Y.P. Nocturnal to diurnal transition in the common ancestor of haplorrhines: evidence from genomic-scan for positively selected genes. *Journal of Genetics and Genomics*. 2015;42:33-37. **Coauthor or Collaborator**.
12. Yang, L., **Irwin, D.M.**, and He, S. Genome-wide identification and characterization of teleost-specific microRNAs within zebrafish. *Gene*. 2015;561:181-189. **Coauthor or Collaborator**.
13. Sun, Y.B., Xiong, Z.J., Xiang, X.Y., Liu, S.P., Zhou, W.W., Tu, X.L., Zhong, L., Wang, L., Wu, D.D., Zhang, B.L., Zhu, C.L., Yang, M.M., Chen, H.M., Li, F., Zhou, L., Feng, S.H., Huang, C., Zhang, G.J., **Irwin, D.**, Hillis, D.M., Murphy, R.W., Yang, H.M., Che, J., Wang, J., and Zhang, Y.P. Whole-genome sequence of the Tibetan frog *Nanorana parkeri* and the comparative evolution of tetrapod genomes. *Proceeding of the National Academy of Sciences U S A*. 2015;112:E11257-1262. **Coauthor or Collaborator**.

14. Jin, L., Guo, T., Li, Z., Lei, Z., Li, H., Mao, Y., Wang, X., Zhou, N., Zhang, Y., Hu, R., Zhang, X., Niu, G., **Irwin, D.M.**, and Tan H. Role of Glucokinase in the subcellular localization of glucokinase regulatory protein. *International Journal of Molecular Sciences*. 2015;16:7377-7393. **Coauthor or Collaborator**.
15. Hu, Q., Tan, H., and **Irwin, D.M.** Evolution of the Mammalian Resistin Gene Family. *PLoS One*. 2015;10:e0130188. **Principal Author**.
16. Wang, M.S., Li, Y., Peng, M.S., Zhong, L., Wang, Z.J., Li, Q.Y., Tu, X.L., Dong, Y., Zhu, C.L., Wang, L., Yang, M.M., Wu, S.F., Miao, Y.W., Liu, J.P., **Irwin, D.M.**, Wang, W., Wu, D.D., and Zhang, Y.P. Genomic Analyses Reveal Potential Independent Adaptation to High Altitude in Tibetan Chickens. *Molecular Biology and Evolution*. 2015;32:1880-1889. **Coauthor or Collaborator**.
17. Zhu, L., Yin, Q., **Irwin, D.M.**, and Zhang, S. Phosphoenolpyruvate carboxykinase 1 gene (Pck1) displays parallel evolution between Old World and New World fruit bats. *PLoS One*. 2015;10:e0118666. **Coauthor or Collaborator**.
18. Zhou, N., Zhang, Y., Zhang, X., Lei, Z., Hu, R., Li, H., Mao, Y., Wang, X., **Irwin, D.M.**, Niu, G., and Tan, H. Exposure of tumor-associated macrophages to apoptotic MCF-7 cells promotes breast cancer growth and metastasis. *International Journal of Molecular Sciences*. 2015;16:11966-119821. **Coauthor or Collaborator**.
19. Wu, D.D., Ye, L.Q., Li, Y., Sun, Y.B., Shao, Y., Chen, C., Zhu, Z., Zhong, L., Wang, L., **Irwin, D.M.**, Zhang, Y.E., and Zhang, Y.P. Integrative analyses of RNA editing, alternative splicing, and expression of young genes in human brain transcriptome by deep RNA sequencing. *Journal of Molecular Cell Biology*. 2015;7:314-325. **Coauthor or Collaborator**.
20. Zhou, N., Wang, R., Zhang, Y., Lei, Z., Zhang, X., Hu, R., Li, H., Mao, Y., Wang, X., **Irwin, D.M.**, Niu, G., and Tan, H. Staurosporine Induced Apoptosis May Activate Cancer Stem-Like Cells (CD44(+)/CD24(-)) in MCF-7 by Upregulating Mucin1 and EpCAM. *Journal of Cancer*. 2015;6:1049-1067. **Coauthor or Collaborator**.
21. Bai, B., Zhao, W.M., Tang, B.X., Wang, Y.Q., Wang, L., Zhang, Z., Yang, H.C., Liu, Y.H., Zhu, J.W., **Irwin, D.M.**, Wang, G.D., and Zhang, Y.P. DoGSD: the dog and wolf genome SNP database. *Nucleic Acids Research*. 2015;43:D777-783. **Coauthor or Collaborator**.
22. Yang, Y., Zhou, T., Peng, M., Liu, Y., Li, Y., Wang, H., **Irwin, D.M.**, and Zhang, Y. Complete mtDNA genomes reveal similar penetrances of maternally inherited type 2 diabetes in two Chinese families. *Mitochondrial DNA*. 2015(4):1-10. **Coauthor or Collaborator**.
23. **Irwin, D.M.** Genomic organization and evolution of ruminant lysozyme c genes. *Zoological Research*. 2015;36:1-17. **Principal Author**.
24. Liu, H.Q., Li, Y., **Irwin, D.M.**, Zhang, Y.P., and Wu, D.D. Integrative analysis of young genes, positively selected genes and lncRNAs in the development of *Drosophila melanogaster*. *BMC Evolutionary Biology*. 2014;14:241. **Coauthor or Collaborator**.
25. **Irwin, D.M.**, and Tan, H. Evolution of glucose utilization: Glucokinase and glucokinase regulator protein. *Molecular Phylogenetics and Evolution*. 2014;70:195-203. **Principal Author**.
26. **Irwin, D.M.** Evolution of Receptors for Glucagon-like Sequences. *General and Comparative Endocrinology*. 2014;209:50-60. **Principal Author**.
27. Li, H., Wang, X., Mao, Y., Hu, R., Xu, W., Lei, Z., Zhou, N., Jin, L., Guo, T., Li, Z., **Irwin, D.M.**, Niu, G., and Tan, H. Long term liver specific glucokinase gene defect induced diabetic cardiomyopathy by up regulating NADPH oxidase and down regulating insulin receptor and p-AMPK. *Cardiovascular Diabetology*. 2014;13:24. **Coauthor or Collaborator**.
28. Li, Y., Wu, D.D., Boyko, A.R., Wang, G.D., Wu, S.F., **Irwin, D.M.**, and Zhang, Y.P. Population variation revealed high altitude adaptation of Tibetan Mastiffs. *Molecular Biology and Evolution*. 2014;31:1200-1205. **Coauthor or Collaborator**.



29. Wang, Y., Ning, H., Ren, F., Zhang, Y., Rong, Y., Wang, Y., Su, F., Cai, C., Jin, Z., Li, Z., Gong, X., Zhai, Y., Wang, D., Jia, B., Qiu, Y., Tomita, Y., Sung, J.J., Yu, J., **Irwin, D.M.**, Yang, X., Fu, X., Chin, Y.E., Chang, Z. GdX/UBL4A Specifically Stabilizes the TC45/STAT3 Association and Promotes Dephosphorylation of STAT3 to Repress Tumorigenesis. *Molecular Cell*. 2014;53:752-765. **Coauthor or Collaborator**.
30. Wang, G.D., Xie, H.B., Peng, M.S., **Irwin, D.**, and Zhang, Y.P. Domestication genomics: Evidence from animals. *Annual Review of Animal Biosciences*. 2014;2:65-84. **Coauthor or Collaborator**.
31. Liu, J., Wang, X.P., Cho, S., Lim, B.K., **Irwin, D.M.**, Ryder, O.A., Zhang, Y.P., and Yu, L. Evolutionary and Functional Novelty of Pancreatic Ribonuclease: a Study of Musteloidea (order Carnivora). *Scientific Reports*. 2014;4:5070. **Coauthor or Collaborator**.
32. Zhou, Z.Y., Li, A.M., Adeola, A.C., Liu, Y.H., **Irwin, D.M.**, Xie, H.B., and Zhang, Y.P. Genome-wide identification of long intergenic noncoding RNA genes and their potential association with domestication in pigs. *Genome Biology and Evolution*. 2014;6:1387-1392. **Coauthor or Collaborator**.
33. Shen, B., Fang, T., Yang, T., Jones, G., **Irwin, D.M.**, and Zhang, S. Relaxed evolution in the tyrosine aminotransferase gene tat in old world fruit bats (chiroptera: pteropodidae). *PLoS One*. 2014;9:e97483. **Coauthor or Collaborator**.
34. Fang, L., Shen, B., **Irwin, D.M.**, and Zhang, S. Parallel evolution of the glycogen synthase 1 (muscle) gene gys1 between old world and new world fruit bats (order: chiroptera). *Biochemical Genetics*. 2014;52:443-458. **Coauthor or Collaborator**.
35. Zhou, T., Shen, X., **Irwin, D.M.**, Shen, Y., and Zhang, Y. Mitogenomic analyses propose positive selection in mitochondrial genes for high-altitude adaptation in galliform birds. *Mitochondrion*. 2014;18:70-75. **Coauthor or Collaborator**.
36. Dai, M., Wang, Y., Fang, L., **Irwin, D.M.**, Zhu, T., Zhang, J., Zhang, S., and Wang, Z. Differential expression of Meis2, Mab21l2 and Tbx3 during limb development associated with diversification of limb morphology in mammals. *PLoS One*. 2014;9:e106100. **Coauthor or Collaborator**.
37. **Irwin, D.M.** Evolution of the vertebrate goose-type lysozyme gene family. *BMC Evolutionary Biology*. 2014;14:188. **Principal Author**.
38. Wu, D.D., Wang, X., Li, Y., Zeng, L., **Irwin, D.M.**, and Zhang, Y.P. "Out of pollen" hypothesis for origin of new genes in flowering plants: study from *Arabidopsis thaliana*. *Genome Biology and Evolution*. 2014;6(10):2822-2829. **Coauthor or Collaborator**.
39. Dong, J., Mao, X., Sun, H., **Irwin, D.M.**, Zhang, S., and Hua, P. Introgression of mitochondrial DNA promoted by natural selection in the Japanese pipistrelle bat (*Pipistrellus abramus*). *Genetica*. 2014;142(6):483-494. **Coauthor or Collaborator**.
40. Cao, X., **Irwin, D.M.**, Liu, Y.H., Cheng, L.G., Wang, L., Wang, G.D., and Zhang, Y.P. Balancing Selection on CDH2 May Be Related to the Behavioral Features of the Belgian Malinois. *PLoS One*. 2014;9:e110075. **Coauthor or Collaborator**.
41. Wang, Y., Zhu, T., Ke, S., Fang, N., **Irwin, D.M.**, Lei, M., Zhang, J., Zhang, S., and Wang, Z. Great roundleaf bat (*Hipposideros armiger*) is a good model for cold-induced browning of intra-abdominal white adipose tissues. *PLoS One*. 2014;9(11):e112495. **Coauthor or Collaborator**.
42. Li, Y., Wang, G.D., Wang, M.S., **Irwin, D.M.**, Wu, D.D., and Zhang, Y.P. Domestication of the dog from the wolf was promoted by enhanced excitatory synaptic plasticity: a hypothesis. *Genome Biology and Evolution*. 2014;6(11):3115-3121. **Coauthor or Collaborator**.
43. Wang, Y., Zhu, T., Ke, S., Fang, N., **Irwin, D.M.**, Lei, M., Zhang, J., Shi, H., Zhang, S., and Wang, Z. The Great Roundleaf Bat (*Hipposideros armiger*) as a Good Model for Cold-Induced Browning of Intra-Abdominal White Adipose Tissue. *PLoS One*. 2014;9:e112495. **Coauthor or Collaborator**.

44. Zhang, X., Li, H., Mao, Y., Li, Z., Wang, R., Guo, T., Jin, L., Song, R., Xu, W., Zhou, N., Zhang, Y., Hu, R., Wang, X., Huang, H., Lei, Z., Niu, G., **Irwin, D.M.**, and Tan, H. An Over Expression APP Model for Anti-Alzheimer Disease Drug Screening Created by Zinc Finger Nuclease Technology. *PLoS One*. 2013;8:e75493. **Coauthor or Collaborator**.
45. Ma, Y., Xie, H., Han, X., **Irwin, D.M.**, and Zhang, Y.P. QcReads: An Adapter and Quality Trimming Tool for Next-Generation Sequencing Reads. *Journal of Genetics and Genomics*. 2013;40:639-642. **Coauthor or Collaborator**.
46. Shao, W., Wang, D., Chiang, Y.T., Ip, W., Zhu, L., Xu, F., Columbus, J., Belsham, D.D., **Irwin, D.M.**, Zhang, H., Wen, X., Wang, Q., and Jin, T. The Wnt signaling pathway effector TCF7L2 controls gut and brain proglucagon gene expression and glucose homeostasis. *Diabetes*. 2013;62:789-800. **Coauthor or Collaborator**.
47. Su, Y.-H., Wu, D.-D., Zhou, W.-P., **Irwin, D.M.**, and Zhang, Y.-P. Rapid evolution of the mammalian HILS1 gene and the nuclear condensation process during mammalian spermiogenesis. *Journal of Genetics and Genomics*. 2013;40:55-59. **Coauthor or Collaborator**.
48. Wang, R., Gao, H., Xu, W., Li, H., Mao, Y., Wang, Y., Guo, T., Wang, X., Song, R., Li, Z., **Irwin, D.M.**, Niu, G., and Tan, H. Differential expression of genes and changes in glucose metabolism in the liver of liver-specific glucokinase gene knockout mice. *Gene*. 2013;516:248-254. **Co-Principal Author**.
49. Sun, Y.B., Zhou, W.P., Liu, H.Q., **Irwin, D.M.**, Shen, Y.Y., and Zhang, Y.P. Genome-Wide Scans for Candidate Genes Involved to the Aquatic Adaptation of Dolphins. *Genome Biology and Evolution*. 2013;5:130-139. **Coauthor or Collaborator**.
50. Wang, G.D., Cheng, L.G., Fan, R.X., **Irwin, D.M.**, Tang, S.S., Peng, J.G., and Zhang, Y.P. Signature of Balancing Selection at the MC1R Gene in Kunming Dog Populations. *PLoS One*. 2013;8:e55469. **Coauthor or Collaborator**.
51. Wang, Z.Y., Jin, L., Tan, H., and **Irwin, D.M.** Evolution of hepatic glucose metabolism: Liver-specific glucokinase deficiency explained by parallel loss of the gene for glucokinase regulatory protein (GCKR). *PLoS One*. 2013;8:e60896. **Senior Responsible Author**.
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David IRWIN

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## 2. NON-PEER-REVIEWED PUBLICATIONS

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## Commentaries

1. **Irwin, D.M.** Dead branches in the tree of life, Book review of "In Search of Deep Time: Beyond the Fossil Record to a New History of Life", by H. Gee, Free Press, 1999. Nature. 1999;403:480-481. **Senior Responsible Author.**
2. **Irwin, D.M.** Who are the parents of eukaryotes? Current Biology. 1994;4:1115-1117. **Senior Responsible Author.**
3. **Irwin, D.M.** Two steps easier than one? Current Biology. 1993;3:907-909. **Senior Responsible Author.**
4. **Irwin, D.M.** Book Review of "Protein Architecture: A Practical Approach", by A. M. Lesk. IRL Press, 1991. Human Biology. 1991;65:1043-1044. **Senior Responsible Author.**

## Letters to Editor

1. **Irwin, D.M.** Evolution of an active-site codon in serine proteases. Nature. 1988;336:429-430. **Senior Responsible Author.**

## F. Presentations and Special Lectures

### 1. INTERNATIONAL

#### Invited Lectures and Presentations

- 2014 Nov 6      Glucagon-like peptides and their receptors. Department of Pharmacology, Peking University. Beijing, China.



David IRWIN

- 2013 Nov 22 Evolution of glucose uptake by vertebrate liver cells. Shanghai Institute of Biological Sciences, Chinese Academy of Sciences. Shanghai, China.
- 2013 Nov 5 Evolution of glucose uptake by vertebrate liver cells. East China Normal University. Shanghai, China.
- 2013 Apr 11 Evolution of glucose uptake by vertebrate liver cells. Kunming Institute of Zoology, Chinese Academy of Sciences. Kunming, China.
- 2012 Jun 12 Alpha cells and the origin of glucagon-like sequences and their receptors. American Diabetes Association 72nd Annual Meeting. Philadelphia, Pennsylvania, United States.
- 2011 Nov 25 Searching for novel therapies for Diabetes: Non-mammalian glucagon-like sequences. Chinese Diabetes Society, 15th Annual Meeting. Beijing, China.
- 2011 Apr 1 Incretin hormones and the expanding families of glucagon-like sequences and their receptors. 12th International Servier-IGIS Symposium. St. Jean Cap Ferrat, France.
- 2010 Jun 1 Evolution of the mammalian lysozyme gene family. Kunming Institute of Zoology, Chinese Academy of Sciences. Kunming, China.
- 2010 Apr 9 Evolution of genes regulating glucose metabolism. College of Life Sciences, Beijing Normal University. Beijing, China.
- 2010 Apr 7 Bioinformatics in molecular biology. Department of Obstetrics and Gynecology, Peking University 3rd Hospital. Beijing, China.
- 2009 Aug 26 Evolution of genes regulating glucose metabolism. Kunming Institute of Zoology, Chinese Academy of Sciences. Kunming, China.
- 2008 Nov 11 Bioinformatics in molecular biology. Department of Pharmacology, Peking University. Beijing, China.
- 2007 Apr 4 Evolution and expression of the human proglucagon gene. School of Pharmaceutical Sciences, Peking University. Beijing, China.
- 2007 Mar 21 The human proglucagon gene. Department of Stem Cell and Regenerative Medicine, Beijing Institute of Transfusion Medicine. Beijing, China.
- 2006 Nov 8 Comparative genomics and the regulation of expression of the proglucagon gene. Department of Pharmacology, Peking University. Beijing, China.
- 2006 Jul 25 Evolution of sequence and expression of vertebrate proglucagon. Kunming Institute of Zoology, Chinese Academy of Sciences. Kunming, China.
- 2006 Apr 6 Evolution of the vertebrate proglucagon gene. Beijing Genomics Institute. Beijing, China.
- 2001 Oct 20 The human proglucagon gene. 3x3 Canada-China Cooperation, leading Biotechnology towards the Twenty-first Century. Third Scientific Workshop. Tianjin, China.
- 2001 Jul 11 The human proglucagon gene: Origin of novel function and expression. Cardiovascular Research Institute, Morehouse School of Medicine. Atlanta, Georgia.
- 2001 May 29 The human proglucagon gene. Department of Biological Sciences and Biotechnology, Tsinghua University. Beijing, China.
- 2000 Apr 8 Molecular evolution of the vertebrate proglucagon gene. 3x3 Canada-China Cooperation, leading Biotechnology towards the Twenty-first Century. Second Scientific Workshop. Vancouver, British Columbia.
- 1998 Jan 29 Molecular evolution of vertebrate proglucagon genes: Discovery of novel regulatory Mechanisms. Department of Biological Sciences, State University of New York. Albany, New York.
- 1997 May 17 Fish proglucagon genes: Evolution, splicing and expression. The Second IUBS Toronto Symposium.

David IRWIN

Toronto, Ontario.

- 1997 May 10 Molecular evolution of vertebrate proglucagon genes. Eastern Great Lakes Molecular Evolution Meeting. Toronto, Ontario.
- 1995 Feb 16 Evolution of protein processing: Alternative strategies to regulate production of proglucagon-derived peptides in mammals and fish. Department of Biological Sciences, State University of New York. Albany, New York.
- 1994 Jun 8 The origin and evolution of the cow stomach lysozyme genes. Department of Zoology, University of Hong Kong. Hong Kong.
- 1994 Jun 6 The origin and evolution of the cow stomach lysozyme genes. Departments of Biochemistry and Physiology, Chinese University of Hong Kong. Shatin, Hong Kong.
- 1994 Jun 1 The origin and evolution of the cow stomach lysozyme genes. Institute of Developmental Biology, Chinese Academy of Sciences. Beijing, China.
- 1994 May 17 The origin and evolution of the cow stomach lysozyme genes. Department of Biochemistry, Tongji Medical University. Wuhan, China.
- 1994 May 16 The origin and evolution of the cow stomach lysozyme genes. Department of Virology and Molecular Biology, Wuhan University. Wuhan, China.
- 1994 May 7 Evolution of the ruminant lysozyme gene family. Eastern Great Lakes Molecular Evolution Meeting. Rochester, New York.
- 1992 Apr 30 Evolution of the mammalian cytochrome b gene. Institute of Population Biology, University of Copenhagen. Denmark.
- 1992 Apr 29 Origin and evolution of ruminant lysozymes. Institute of Population Biology, University of Copenhagen. Copenhagen, Denmark.
- 1992 Apr 27 Convergent, concerted, and cow evolution. Department of Medical Genetics, University of Uppsala. Uppsala, Sweden.
- 1992 Apr 23 Evolution of the mammalian cytochrome b gene. Department of Genetics, University of Lund. Lund, Sweden.
- 1992 Mar 17 Origin and evolution of ruminant lysozymes. Department of Biological Sciences, State University of New York. Albany, New York.
- 1991 Sep 2 Origin and evolution of ruminant stomach lysozyme genes. Third Congress of the European Society for Evolutionary Biology. Debrecen, Hungary.
- 1990 Jul 3 Evolution of mammalian cytochrome b gene. International Congress for Systematics and Evolutionary Biology IV. College Park, Maryland.
- 1990 Feb 16 Evolution of ruminant stomach lysozyme genes. American Association for the Advancement of Science. New Orleans, Louisiana.

### Presented Abstracts

- 2010 Jun 25 Expression of TCF genes in the rodent islets is down-regulated by insulin and high fat diet feeding. American Diabetes Association 70th Meeting. Orlando, Florida, United States. Columbus, J., Wang, D., Chiang, Y.-T., Zhang, N., Shao, W., Gaisano, H.Y., Wang, Q., **Irwin, D.M.**, and Jin, T. June 25-29, 2010.
- 2006 May 24 Origin and evolution of the vertebrate glucose-dependent insulinotropic polypeptide (GIP) Gene. SMBE 2006, Annual Meeting of the Society for Molecular Biology and Evolution. Tempe, Arizona, United States. **Irwin, D.M.**, and Zhang, T. May 24-28, 2006.

David IRWIN

- 2006 May 6 Origin and evolution of the vertebrate glucose-dependent insulinotropic polypeptide (GIP) gene. Eastern Great Lakes Molecular Evolution Meeting. Buffalo, New York, United States. Presenter(s): **Irwin, D.M.**, and Zhang, T.
- 2005 Jun 19 Evolution of the proglucagon gene promoter. SMBE 2005, Annual Meeting of the Society for Molecular Biology and Evolution. Auckland, New Zealand. **Irwin, D.M.**, Yue, S., and Tsai, B. June 19-23, 2005.
- 2005 Jun 4 Variation in sequence and transcriptional activity of mammalian proglucagon promoters. The 87th Endocrine Society Meeting. San Diego, California, United States. **Irwin, D.M.**, Patel, A., and Tsai, B. June 4-7, 2005.
- 2004 Sep 5 Evolution of new hormone function: Glucagon-Like Peptide 1 in Fish. Fifth International Symposium on Fish Endocrinology. Castellon, Spain. Presenter(s): **Irwin, D.M.** Sept. 5-9, 2004.
- 2004 Jun 17 Evolution of new hormone function – loss and gain of a receptor. SMBE 2004, Annual Meeting of the Society for Molecular Biology and Evolution. State College, Pennsylvania, United States. Presenter(s): **Irwin, D.M.** June 17-20, 2004.
- 2004 Jun 16 Evolution of proglucagon receptors: Characterization and identification of fish proglucagon-derived peptide receptors. The 86th Endocrine Society Meeting. New Orleans, Louisiana, United States. Wong, K., and **Irwin D.M.** June 16-19, 2004.
- 2004 Apr 24 Evolution of new hormone function – hormones encoded by the vertebrate proglucagon gene. Eastern Great Lakes Molecular Evolution Meeting. Ithaca, New York, United States. Presenter(s): **Irwin, D.M.**
- 2003 Sep 21 Unexpected complexity in pancreatic hormone genes revealed by genome projects. Genome Sequencing and Analysis Conference (GSAC XV). Savannah, Georgia, United States. **Irwin, D.M.**, and Zhou, L. Sept. 21-24, 2003.
- 2003 Jun 26 Molecular evolution of rodent lysozyme M and P genes: gene duplication and concerted evolution. SMBE 2003, Annual Meeting of the Society for Molecular Biology and Evolution. Newport Beach, California, United States. Presenter(s): **Irwin, D.M.** June 26-29, 2003.
- 2003 Jun 19 Fugu fish proglucagon genes have different coding potential. The 85th Endocrine Society Meeting. Philadelphia, Pennsylvania, United States. Zhou, L., and **Irwin, D.M.** June 19-22, 2003.
- 2002 Jun 19 Genomic stability of the proglucagon locus. The 84th Endocrine Society Meeting. San Francisco, California, United States. Presenter(s): **Irwin, D.M.** June 19-22, 2002.
- 2002 Jun 13 Molecular evolution of vertebrate goose-type lysozyme genes. Molecular Evolution meeting. Sorrento, Italy. **Irwin, D.M.**, and Gong, Z. June 13-16, 2002.
- 2001 Jun 19 Dissociation of DNA sequences regulating tissue-specific versus nutrient regulation of human glucagon gene transcription in enteroendocrine cells. The 83rd Endocrine Society Meeting. Denver, Colorado, United States. Nian, M., Gu, J., **Irwin, D.M.**, and Drucker, D.J. June 19-23, 2001.
- 2001 Jun 7 Episodic evolution of proglucagon encoded hormones. SMBE 2001, Annual Meeting of the Society for Molecular Biology and Evolution. Athens, Georgia, United States. Presenter(s): **Irwin, D.M.**
- 2001 Apr 26 Molecular evolution of vertebrate proglucagon: Origin of new hormone function. Jacques Monod Conference on Gene and Genome Duplications and Evolution of Novel Gene Functions. Aussois, France. Presenter(s): **Irwin, D.M.** April 26-30, 2001.
- 2000 Jun 21 Characterization of 300 kilobases of the human proglucagon locus: Linkage of the proglucagon and dipeptidylpeptidase IV (DPIV) genes. The 82nd Endocrine Society Meeting. Toronto, Ontario, Canada. Presenter(s): **Irwin, D.M.** June 21-24, 2000.
- 2000 Jun 17 The evolutionary history of glucagon-like sequences encoded by the proglucagon gene and their unique receptors differ. SMBE 2000, Annual Meeting of the Society for Molecular Biology and Evolution. New Haven, Connecticut, United States. **Irwin, D.M.**, Sivarajah, P., and Wheeler, M.B. June 17-20, 2000.

David IRWIN

- 1999 Jul 4 Regulation of the human proglucagon gene. The Fourth Toronto-Stockholm Symposium on perspectives in Diabetes Research. Stockholm, Sweden. Nian, M., Drucker, D., and Irwin, D. July 4-8, 1999.
- 1999 Jun 12 Lamprey proglucagon and the origin of glucagon-like peptides. The 81st Endocrine Society Meeting. San Diego, California, United States. **Irwin, D.M.**, Huner, O., and Youson, J.H. June 12-15, 1999.
- 1998 Jun 24 Dog stomach and pancreatic proglucagons are encoded by identical mRNA transcripts. The 80th Endocrine Society Meeting. New Orleans, Louisiana, United States. **Irwin, D.M.**, and Sivarajah, P. June 24-27, 1998.
- 1997 Jun 11 Isolation and characterization of novel peptides encoded by the Xenopus proglucagon gene. The 79th Endocrine Society Meeting. Minneapolis, Minnesota, United States. **Irwin, D.M.**, Mahalingam, M., Wen, Y., Pederson, R. A., Brubaker, P.L. and Wheeler, M.B. June 11-14, 1997.
- 1996 Jul 21 Isolation and organization of the bovine lysozyme gene cluster. XXV International Conference on Animal Genetics, (International Society of Animal Genetics). Tours, France. **Irwin, D.M.**, Egan, A., Doud, L., and Bishop, M. July 21-26, 1996.
- 1996 Jun 12 The evolution of splicing of the Pit-1 transactivation domain: Target gene-specific constraints. The 78th Endocrine Society Meeting. San Francisco, United States. Majumdar, S., **Irwin, D.M.**, and Elsholtz, H. June 12-15, 1996.
- 1992 Jun 11 Evolution of the rodent lysozyme genes. International Conference on Molecular Evolution, (Molecular Biology and Evolution Society), Pennsylvania State University. University Park, Pennsylvania, United States. **Irwin, D.M.**, and Yeh, T.C. June 11-14, 1992.
- 1990 Jul 18 Convergence and accelerated evolution at replacement sites in stomach lysozyme of leaf-eating monkeys. Genetics Society of America/Canada Joint Meeting. San Francisco, California, United States. Swanson, K.W., **Irwin, D.M.**, and Wilson, A.C. July 18-21, 1990.
- 1990 Jul 18 Evolution of the cytochrome b gene of mammals. Genetics Society of America/Canada Joint Meeting. San Francisco, California, United States. **Irwin, D.M.**, and Wilson, A.C. July 18-21, 1990.

### Media Appearances

- 1993 **Interviewed.** Vive le difference episode. The Secret of Life, Public Broadcasting System TV series. United States.

## 2. NATIONAL

### Presented Abstracts

- 1985 Structure of the bovine prothrombin gene. Canadian Federation of Biological Societies. **Irwin, D.M.**, Ahern, K., Pearson, G., and MacGillivray, R.T.A. Canadian Federation of Biological Societies Proceedings 28, 49.

### Media Appearances

- 2013 May 18 **Interviewed.** Origin of Dogs. Interviewer: Bob McDonald. Quirks and Quarks, Canadian Broadcasting Corporation. Toronto, Ontario, Canada.

## 3. PROVINCIAL / REGIONAL

### Invited Lectures and Presentations

- 2004 Jan 14 Hormone gene evolution in light of genome projects. Department of Biology, University of Ottawa.
- 1999 Oct 26 Evolution of proglucagon gene structure, mRNA splicing and expression. Department of Biology, University of Ottawa. Ontario.

David IRWIN

- 1996 Nov 21 The vertebrate proglucagon gene: Discovery of alternative regulatory mechanisms and novel insulinotropic peptides. Department of Biology, University of Ottawa. Ottawa, Ontario.
- 1995 Oct 2 Non-mammalian proglucagon genes do encode glucagon-like peptide 2: Regulation by alternative splicing. Department of Biology, McMaster University. Hamilton, Ontario.
- 1995 Jan 10 Ruminant lysozyme genes: Duplication, episodic evolution, and concerted evolution. Department of Biochemistry, McMaster University. Hamilton, Ontario.

#### 4. LOCAL

##### Invited Lectures and Presentations

- 2015 Mar 12 **Invited Lecturer.** Evolution of Glucose Uptake by Vertebrate Liver Cells. Ecology and Evolutionary Biology Student Union, University of Toronto. Toronto, Canada.