

# CENTRE FOR COMPARATIVE GENOMICS AND EVOLUTIONARY BIOINFORMATICS (CGEB) ANNUAL REPORT: July 1, 2011 - June 30, 2012

## Section 1 - Overview of C/I and its Mission

### 1.1 C/I MISSION STATEMENT

- Provide a brief description of the Centre mission or mandate and the types of activities the C/I undertakes in fulfillment of its mission.
- Describe any deviations from activities listed in the original Senate Proposal.

The CGEB Centre was officially approved by the Dalhousie Senate in June, 2008 with the mission to foster collaborations amongst ten comparative genomics/ bioinformatics and microbial evolution researchers at Dalhousie. The main focus of the Centre's research is understanding how microbial genomes evolve and diversify, however the research programs collectively span computational biology, biological oceanography, computer science, statistical modeling and comparative genomics, with a strong focus on method and theory.

Specifically, the CGEB Centre's goals are to: 1) recruit top-notch postdoctoral fellows and Ph.D. students to CGEB labs through the provision of Tula Foundation stipends and research allowances; 2) maintain a CGEB seminar series to attract world-class speakers to interact with CGEB principal investigators and trainees; 3) fund CGEB trainees to attend and present their work at national and international scientific meetings; and 4) provide an intellectual forum that promotes collaborations between CGEB members and facilitates applications for external research funding. *For each of the last four years, we have met or exceeded all of these goals.*

### 1.2 CURRENT YEAR'S ACTIVITIES

- List and provide a brief description of the specific activities undertaken in the current fiscal year.

#### A. CGEB Seminar Series

The seminar series has successfully hosted 15 well-attended seminars this past year. These were either sponsored (or co-sponsored) by funding from the Tula Foundation.

- Dr. Josh Neufeld, University of Waterloo, July 2012. "*Exploring the uncharted microbial frontier through targeted recovery of taxonomic novelty*"
- Dr. Maureen O'Malley, University of Sydney, July 2012. "*Prokaryote evolution: Is there something special about it?*"
- Dr. Chris Field, Dalhousie University, May 2012. "*Robustness issues and analysis in molecular evolution*"
- Dr. Yuji Inagaki, University of Tsukuba, Japan, May 2012. "*The Matryoshka project: research on organelle evolution and phylogenomics of protists*"
- Dr. Stephen Montgomery, Stanford University, April 2012. "*Genetics of gene expression using next generation sequencing*"

- Dr. Marc Robinson-Rechavi, University of Lausanne, February 2012. "*Does gene duplication affect evolution*"
- Dr. Joel Dacks, University of Alberta, January 2012. "*And then there were 5: The discovery of a new adaptin complex helps resolve the evolution of the eukaryotic membrane-trafficking system*"
- Dr. Matthew Spencer, Liverpool, U.K., October 2011. "*Identifying changes in evolutionary processes using stochastic mapping and covarion models*"
- Dr. Kamran Shalchian-Tabrizi, University of Oslo, October 2011. "*Eukaryote phylogenomics: closing the gaps in the tree of life*"
- Dr. Rob Knight, University of Colorado: "*Spatial and temporal variability in the human microbiome*", September 22, 2011
- Dr. Andrew Lang, Memorial University: "*Gene transfer agents: capturing phage and putting them to work*", September 15, 2011
- Dr. Elisabeth Tillier, University of Toronto: "*Coevolution reveals a network of human proteins involved in ciliopathies and cancer*", August 9, 2011
- Dr. Yuji Inagaki, University of Tsukuba, Japan: "*Recent progress in placing novel protistan lineages in the tree of eukaryotes*", August 5, 2011
- Dr. Donald Baird, Environment Canada and UNB, and Dr. Mehrdad Hajibabaei, University of Guelph: "*Biomonitoring 2.0: A high-throughput genomics approach for comprehensive biological assessment of environmental change*", August 4, 2011
- Dr. Trevor Lawley, Wellcome Trust Sanger Institute, UK: "*Transmission and evolution of Clostridium difficile*", June 9, 2011

## **B. Regular Weekly and Monthly Joint Lab Meetings**

In addition to weekly lab meetings of the Roger/Archibald/Slamovits/Simpson/Gray/Doolittle labs, we also hold CGEB 'joint lab meetings' that include all ten CGEB labs' faculty members, undergraduate and graduate students, postdocs, and lab personnel. The joint lab meetings are held on the first Thursday of every month and continue year-round. The purpose of these meetings is to introduce CGEB faculty and trainees to the ever-expanding group of trainees in the various labs. Faculty members and/or their students and postdocs provide an overview of their research program in a seminar-style format, with adequate time allotted for questions, constructive criticism and open discussion.

## **C. Journal Clubs**

The *CGEB Journal Club* (initiated in 2007) includes all CGEB labs' trainees and faculty members who are interested in participating. The group meets on bi-weekly Tuesdays throughout the year for participants to select and present a current research paper for analysis and discussion. Many of our trainees have stated that this activity is invaluable and an integral part of their overall training.

We also hold a second, more specialized journal club in *Statistical Evolutionary Bioinformatics (SEB)* that meets intermittently to discuss the latest literature and/or current topics in computational biology, protein evolution, and genomics.

## **D. Publications and Presentations**

During the reporting period, CGEB faculty and trainees have published 70 papers (*see Section 2.2.1*), including contributions in high impact journals such as *Nature*, *Current Biology*, *Proceedings of the National Academy of Sciences USA*, and *PLoS Biology*. The international profile of CGEB researchers is further demonstrated by the 32 invited presentations given at international conferences or invited

seminars (*see Section 2.3*). In addition, CGEB trainees contributed to 63 presentations at domestic and international events (*see Section 2.4*).

### **E. CGEB Developed Software**

A large portion of CGEB research efforts is directed at development of computer software tools for evolutionary modeling analyses and bioinformatics. Since 2007, CGEB has produced 27 bioinformatics software tools (*see Section 2.9 for 2011-2012 list*). These are ‘open-source’ software tools (or suites of tools) for analysis of genomic data that have been created, published and made available (or soon will be) to the international scientific community through free web access.

### **F. External Funding**

CGEB researchers have been extremely successful in attracting external funding, garnering a total of ~\$2,000,000 of external grant support over 2011-2012 from Natural Sciences and Engineering Research Council of Canada, Canadian Institutes for Health Research, Canada Foundation for Innovation, Canada Research Chairs (CIHR), the Canadian Institute for Advanced Research, and the Tula Foundation (*see Section 3.2.2*).

## **1.3 COMING YEARS’ ACTIVITIES**

The main core activities that have really sustained the productivity of the CGEB Centre to date (*see above descriptions*) will continue in the next few years. These include:

- CGEB Joint lab meetings (once a month)
- CGEB Journal club (twice a month) plus occasional Statistical Evolutionary Bioinformatics journal club meetings.
- The CGEB Seminar Series
- Sponsorship of Student Travel/Presentation at domestic and international meetings.
- Meetings of CGEB PIs to discuss Centre business (annual meetings plus occasional *ad hoc* meetings)

In addition to these activities, next year we will try to convene a poster session/CGEB mixer to take place on an afternoon/early evening to which all members of the CGEB community will be invited. The purpose of this activity will be to further the opportunities for CGEB PIs, Associates and trainees to interact to discuss their research and to facilitate future collaborative research projects or grant applications. We will fund this ‘mixer’ using the CGEB New Opportunities fund (*see Section 3.1 – III, pg. 22*).

## SECTION 2 – DETAILED DESCRIPTION OF C/I ACTIVITIES

### 2.1 CORE GROUP OF PERSONNEL AFFILIATED WITH THE C/I

#### Summary of C/I Personnel

Position	Number
Faculty Members	10
Administrative Staff	1
Technical Staff	4
Associates	4
Postdoctoral Fellows	19
Doctoral Students	18
Master's Students	6
Other (i.e. Undergraduates / Honours students)	11
Total	73

#### 2.1.1 List faculty attached to the C/I are involved in research (*include names, rank, affiliations*)

1. Dr. Andrew Roger, Professor and Tier I Canada Research Chair, Biochemistry and Molecular Biology
2. Dr. W. Ford Doolittle, Professor Emeritus, Biochemistry and Molecular Biology
3. Dr. John Archibald, Professor, Biochemistry and Molecular Biology
4. Dr. Claudio Slamovits, Assistant Professor, Biochemistry and Molecular Biology
5. Dr. Michael Gray, Professor Emeritus, Biochemistry and Molecular Biology
6. Dr. Joseph Bielawski, Associate Professor, Biology
7. Dr. Alastair Simpson, Associate Professor, Biology
8. Dr. Robert Beiko, Assistant Professor and Tier II Canada Research Chair, Computer Science
9. Dr. Christian Blouin, Associate Professor, Computer Science, and Biochemistry and Molecular Biology
10. Dr. Edward Susko, Professor, Mathematics and Statistics

#### 2.1.2 List C/I administrative and technical staff involved in the C/I (*include names, role*)

1. Wanda Danilchuk, CGEB Administrator
2. Jacquie De Mestral, Lab Manager – Roger lab
3. Marlena Dlutek, Lab Manager – Archibald lab
4. Naoko Tanifuji, Lab Technician – Archibald lab
5. Danielle Wentzell, Lab Technician – Slamovits lab

### 2.1.3 Optional – list other research personnel in other categories not covered in 2.1.1 and 2.1.2 but included in Summary Table; note that graduate students will be listed in 2.4

There were 19 Postdoctoral Fellows supervised in CGEB labs over the past year:

Laura Eme; Biochem. (ongoing); supervisor: A.J. Roger  
Matt Brown; Biochem. (ongoing); supervisor: A.J. Roger  
Eleni Gentekaki, Biochem. (ongoing); supervisor: A.J. Roger  
Martin Kolisko, Biochem. (ongoing); supervisor: A.J. Roger  
Huaichun Wang; Math & Stats (ongoing); co-supervised by A.J. Roger & E. Susko  
Ryan Gawryluk; Biochem. (completed 2012): supervisor: A.J. Roger  
Anastasios Tsaousis; Biochem. (completed 2012): supervisor: A.J. Roger  
Julia Hopkins; Biochem. (ongoing); supervisor: J. Archibald  
Shinichiro Maruyama; Biochem. (ongoing); supervisor: J. Archibald  
Takuro Nakayama; Biochem. (ongoing); supervisor: J. Archibald  
Goro Tanifuji; Biochem. (ongoing); supervisor: J. Archibald  
Eunsoo Kim; Biochem. (completed 2011); supervisor: J. Archibald  
Katherine Dunn; Biology (ongoing); supervisor: J. Bielawski  
Mahdi Shafiei; Biology (ongoing); supervisor: J. Bielawski  
Morgan Langille; Comp. Science (ongoing); supervisor: R. Beiko  
Conor Meehan; Comp. Science (ongoing); co-supervised by R. Beiko & J. Bielawski  
Susana Breglia; Biochem. (ongoing); supervisor: C. Slamovits  
Gillian Gile; Biochem. (ongoing); supervisor: C. Slamovits  
Shehre-Banoo Malik; PDF-CIFAR Junior Fellow, Biochem; supervisor: C. Slamovits

We currently have four CGEB “Associate” members:

1. Dr. Hong Gu, Associate Professor, Mathematics and Statistics
2. Dr. Christopher Field, Professor Emeritus, Mathematics and Statistics
3. Dr. Robert Lee, Adjunct Professor, Biology
4. Dr. Julie LaRoche, Professor of Biology (Marine Geochemistry), and Tier I Canada Research Chair

Visiting (International) Researchers:

Roger lab: Dr. Ryoma Kamikawa, Ass’t Prof., University of Tsukuba, Japan (July 1-26, 2012)  
Simpson lab: Dr. Wonje Lee, Professor, Kyungnam University, Korea (Feb. 2011-present)

## 2.2 PUBLICATIONS ASSOCIATED WITH C/I

Summary of Publications: total of **70** for past year

Publication Type	Number
Peer-reviewed journals	50
Books and book chapters	12
Other non-refereed publications	8

### 2.2.1 List of Publications (*include only those publications in print in the reporting period*)

[Note: CGEB faculty and trainees' names are highlighted in bold]

Adl SM, **Simpson AGB**, Lane CE, Lukes J, Bass D, Bowser SS, **Brown MW**, Burki F, Dunthorn M, Hampl V, **Heiss A**, Hoppenrath M, Lara E, Legall L, Lynn DH, McManus H, Mitchell EAD, Mozley-Stanridge SE, Parfrey LW, Pawlowski J, Rueckert S, Shadwick LL, Schoch C, Smirnov A, Spiegel FW (2012) The revised classification of eukaryotes. *Journal of Eukaryotic Microbiology, in press* [2.659: 2.097].

**Archibald JM** (2012) Plastid origins. In: *Organelle Genetics: evolution of organelle genomes and gene expression*, C. Bullerwell (ed.), pp. 19-38, Springer-Verlag (invited book chapter)

**Archibald JM** (2012) The evolution of algae by secondary and tertiary endosymbiosis. In: *Advances in Botanical Research*, G. Piganeau (Ed.), Elsevier Press, *in press*.

**Archibald, JM** (2012) Lynn Margulis (1938-2011). *Current Biology* 22: R4-6 (invited article)

**Archibald JM** (2011) Origin of eukaryotic cells: 40 years on. *Symbiosis* 54: 69-86.

**Archibald JM** and Hoef-Emden, K (2012) Phylum Cryptophyta (Cryptomonads). In: *Handbook of Protoctista, 2<sup>nd</sup> ed.*, L. Margulis, L. (Ed.), Jones & Bartlett Publishers (in press; invited chapter).

Bay, RA and **Bielawski JP** (2011) Recombination detection under evolutionary scenarios relevant to functional divergence. *Journal of Molecular Evolution*, Dec; 73(5-6): 273-286.

**Beiko RG** (2011) Telling the whole story in a 10,000-genome world. *Biology Direct*, July 30; 6: 34.

**Bielawski JP** (2012) Detecting the signatures of adaptive evolution in protein coding genes. In *Current Protocols in Molecular Biology, in press*.

**Breglia SA**, Yubuki N and Leander BS (2012) Ultrastructure and molecular phylogenetic position of *Heteronema scaphurum*: A eukaryovorous euglenid with a cytoproct. *Journal of Eukaryotic Microbiology, in press*.

**Brown MW**, Silberman JD, Spiegel FW (2012) A contemporary evaluation of the acrasids (Acrasidae, Heterolobosea, Excavata). *European Journal of Protistology* 48(2): 103-123.

**Brown MW**, **Kolisko M**, Silberman JD and **Roger AJ** (2012) Aggregative multicellularity evolved independently in the eukaryotic supergroup Rhizaria. *Current Biology*, Jun 19; 22(12): 1123-1127.

Chan CX, **Beiko RG** and Ragan MA (2011) Lateral transfer of genes and gene fragments in *Staphylococcus* extends beyond mobile elements. *Journal of Bacteriology*, Aug; 193(15): 3964-3977.

Corradi N and **Slamovits CH** (2011) The intriguing nature of microsporidian genomes. *Briefings in Functional Genomics* 10(3): 115-124.

**Doolittle WF** (2012) Evolutionary biology: A ratchet for protein complexity. *Nature*, Jan 8; 481(7381): 270-271.

**Doolittle, WF** (2012) Postphylogenetics. In *Microbes and Evolution: The World That Darwin Never Saw*, R. Kolter & S. Maloy (Eds.), pp. 269-274, ASM Press, Washington.

**Doolittle WF** (2012) Population genomics: how bacterial species form and why they don't exist. *Current Biology*, Jun 5; 22(11): R451-453.

**Doolittle WF** (2012) Craig Venter's new life: The realization of some thought experiments in biological ontology. In *Thought Experiments in Science, Philosophy and the Arts*, M. Frappier, L. Meynell & J.R. Brown (Eds.), pp. 160-176, Routledge.

**Doolittle, WF** and Zhaxybayeva O (2012) What is a prokaryote? Introductory chapter for 4<sup>th</sup> edition of *The Prokaryotes*, a 9-volume reference book and fully hyperlinked Online-Encyclopedia, edited by Eugene Rosenberg, Edward F. DeLong, Fabiano Thompson, Stephen Lory, Erko Stackebrand, *in press*.

**Doolittle WF**, Lukeš J, **Archibald JM**, Keeling PJ, and **Gray MW** (2011) Comment on "Does constructive neutral evolution play an important role in the origin of cellular complexity?" *Bioessays*, Jun; 33(6): 427-429.

Flegontov P, **Gray MW**, Burger G and Lukes J (2011) Gene fragmentation: a key to mitochondrial genome evolution in Euglenozoa? *Current Genetics*, Aug; 57(4): 225-232.

Garvin MR, **Bielawski JP** and Gharrett AJ (2011) Positive Darwinian selection in the piston that powers proton pumps in complex I of the mitochondria of a Pacific salmon. *PLoS One*, Sept; 6(9): e24127.

**Gaston D**, **Susko E** and **Roger AJ** (2011) A phylogenetic mixture model for the identification of functionally divergent protein residues. *Bioinformatics*, Oct 1; 27(19): 2655-2663.

**Gile GH** and **Slamovits CH** (2012) Phylogenetic position of *Lophomonas striata* Bütschli (Parabasalida) from the hindgut of the cockroach *Periplaneta americana*. *Protist*, Mar; 163(2): 274-283.

**Gray MW** (2012) Evolutionary origin of RNA editing. *Biochemistry*, Jun 21 [Epub ahead of print; PMID: 22708551]

**Gray MW** (2011) The incredible shrinking organelle. *EMBO Reports*, Sep 1; 12(9): 873.

**Gray, MW** and **Archibald JM** (2012) Origins of mitochondria and plastids. In: *Advances in photosynthesis and respiration (Genomics of chloroplasts and mitochondria)*, R. Bock & V. Knoop (Eds.), Springer (in press; invited book chapter)

**Gu H**, **Dunn KA** and **JP Bielawski** (2011) Likelihood Based Clustering (LiBaC) for Codon Models. Contributed chapter in *Codon Evolution Mechanisms and Models*, Gina M. Cannarozzi & Adrian Schneider (Eds.), Oxford University Press.

Halary S, **Malik SB**, Lildhar L, **Slamovits CH**, Hijri M and Corradi N (2011) Conserved meiotic machinery in *Glomus spp.*, a putatively ancient asexual fungal lineage. *Genome Biology and Evolution*, Aug; 3: 950-958.

**Harding T**, **Brown MW**, Plotnikov A, Selivanova E, Park J, Gunderson JH, Baumgartner M, Silberman, JD, **Roger AJ** and **Simpson AGB** (2012) Amoeba stages in the deepest branching heteroloboseans, including *Pharyngomonas*: Evolutionary and systematic implications. *Protist* (*in press*).

**Heiss AA**, Walker G and **Simpson AG** (2011) The ultrastructure of *Ancyromonas*, a eukaryote without supergroup affinities. *Protist*, Jul; 162(3): 373-393.

**Hleap, JS** (2011) Familia Heterodontidae. In: Guía para la identificación de especies de tiburones rayas y quimeras de Colombia. Bogotá, D.C.: Colombia. Ministerio de Ambiente y Desarrollo Sostenible; Corporación para el Desarrollo Sostenible del Archipiélago de San Andrés, Providencia y Santa Catalina - CORALINA; Gobernación de San Andrés, Providencia y Santa Catalina; Fundación SQUALUS, pp. 51-57.

**Hleap, JS**, Bessudo S, Lara G and Soler G (2011) Familia Sphyrnidae. In: Guía para la identificación de especies de tiburones rayas y quimeras de Colombia. Bogotá, D.C.: Colombia. Ministerio de Ambiente y Desarrollo Sostenible; Corporación para el Desarrollo Sostenible del Archipiélago de San Andrés, Providencia y Santa Catalina - CORALINA; Gobernación de San Andrés, Providencia y Santa Catalina; Fundación SQUALUS, pp. 157- 169.

**Hleap JS**, Mejía-Falla, PA and Cárdenas, H (2012) Morphometric relationships of the round ray *Urotrygon rogersi*: quantitative implications under linear models. *Revista de Biología marina y oceanografía* 47(1): 35-50.

Jackman JE, Gott JM and **Gray MW** (2012) Doing it in reverse: 3' to-5' polymerization by the Thg1 superfamily. *RNA*, May; 18(5): 886-899.

Kamikawa R, Inagaki Y, **Roger AJ** and Hashimoto T (2011) Splintrons in *Giardia intestinalis*: spliceosomal introns in a split form. *Communicative and Integrative Biology*, Jul; 4(4): 454-456.

Koenig JE, Bourne DG, **Curtis B**, **Dlutek M**, Stokes HW, **Doolittle WF** and Boucher Y (2011) Coral-mucus-associated *Vibrio* integrons in the Great Barrier Reef: genomic hotspots for environmental adaptation. *ISME Journal*, Jun; 5(6): 962-972.

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Lukeš J, **Archibald JM**, Keeling PJ, **Doolittle WF** and **Gray MW** (2011) How a neutral evolutionary ratchet can build cellular complexity. *IUBMB Life*, Jul; 63(7): 528-537.

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Park JS, De Jonckheere JF and **Simpson AG** (2012) Characterization of *Selenaiion koniopes* n. gen., n. sp., an Amoeba that represents a major lineage with Heterolobosea, isolated from the Wieliczka salt mine. *Journal of Eukaryotic Microbiology* [Epub ahead of print].

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**Parks DH**, **MacDonald NJ** and **Beiko RG** (2011) Classifying short genomic fragments from novel lineages using composition and homology. *BMC Bioinformatics*, Aug. 9; 12: 328.

**Roger AJ, Kolisko M and Simpson AGB** (2012) Phylogenomic analysis. In *Evolution of Virulence in Eukaryotic Microbes*, pp. 44-69, L.D. Sibley, B.J. Howlett, and J. Heitman (Eds.), Wiley-Blackwell.

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**Stairs CW, Roger AJ and Hampl V** (2011) Eukaryotic pyruvate formate lyase and its activating enzyme were acquired laterally from a Firmicute. *Molecular Biology and Evolution*, Jul; 28(7): 2087-2099.

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**Zou L, Susko E, Field C and Roger AJ** (2012) Fitting nonstationary general-time-reversible models to obtain edge-lengths and frequencies for the Barry-Hartigan Model. *Systematic Biology* [Jun 20; advance access doi: 10.1093/sysbio/sys046].

**Zou L, Susko E, Field C and Roger AJ** (2011) The parameters of the Barry and Hartigan general Markov model are statistically nonidentifiable. *Systematic Biology*, Dec; 60(6): 872-875.

### 2.3 PARTICIPATION IN RELEVANT EVENTS FOR RESEARCH DISSEMINATION (including conferences, workshops, symposia, etc.)

What is the number of C/I personnel who participated in <u>international</u> events?  - here we have included those events attended outside of Canada	Professors & Number of Events (i.e. professors who presented at the events)	Students & Number of Events (i.e. students who attended the events)
	Professors: <b>10</b> # of events: <b>32</b>	Students/PDFs: <b>22</b> # of events: <b>12</b>
What is the number of C/I personnel who participated in <u>domestic</u> events?  -here we have included events at Dalhousie and elsewhere in Canada	Professors & Number of Events (i.e. professors who presented at the events)	Students & Number of Events (i.e. students who attended the events)
	Professors: <b>10</b> # of events: <b>22</b>	Students/PDFs: <b>23</b> # of events: <b>13</b>

## 2.4 STUDENT RESEARCH ACTIVITIES

- provide Student Name, Degree, Supervisor, completed/in progress, thesis title (*if applicable*)

### **Student Name / Degree / Status / Supervisor / Thesis Title (if applicable)**

Courtney Stairs; PhD student (in progress); A.J. Roger  
Michelle Leger; PhD student (in progress); A.J. Roger  
Tommy Harding; PhD student (in progress); co-supervised by A.J. Roger & A. Simpson  
Dan Gaston; PhD (completed 02/2012); A.J. Roger; “Phylogenomic approaches to the analysis of functional divergence and subcellular localization”  
Martin Kolisko; PhD (completed 10/2011); A.J. Roger; “Molecular phylogeny of amitochondriate excavates”  
Ryan Gawryluk; PhD (completed 08/2011); A.J. Roger; “Comparative proteomics: studies on composition and evolution of mitochondrial proteome in eukaryotic microbes (protists)”  
Liwen Zou; PhD (completed 08/2011); A.J. Roger; “Complex models of nucleotide substitution”  
Bruce Curtis; PhD student (in progress); J. Archibald  
Christa Moore; PhD student (in progress); J. Archibald  
Joseph Mingrone; PhD student (in progress); co-supervised by E. Susko & J. Bielawski  
Sergio Hleap Lozano; PhD student (in progress); C. Blouin  
Haibin Liu; PhD (completed 08/2011); C. Blouin; “Biological information extraction using patterns of characters, tag sequences and subgraphs”  
Aaron Heiss, PhD (completed 08/2012); A. Simpson; “Studies on morphology and evolution of ‘orphan’ eukaryotes”  
Renny Lee, PhD student (in progress); C. Slamovits  
Donovan Parks, PhD (completed 2012); R. Beiko; “Georeferenced trees and the phylogenetic similarity of biological communities”  
Christopher Whidden, PhD student (in progress); R. Beiko  
Dennis Wong, PhD student (in progress); R. Beiko  
Norman MacDonald; PhD student (not completed); R. Beiko  
Javier Alfaro; Masters (completed 09/2012); A.J. Roger; “Protein sequence evolution through structurally constrained phylogenetic models”  
Susan Sharpe; Masters student (in progress); A.J. Roger  
Robert Eveleigh; Masters (completed 05/2011); co-supervised by J. Archibald & R. Beiko; “Being *Aquifex aeolicus*: untangling a hyperthermophile’s checkered past”  
Mike Porter; Masters student (in progress); R. Beiko  
Wei Chen; Masters student (in progress); co-supervised by J. Bielawski & H. Gu  
Goldis Radjabalipour; Masters student (not completed); co-supervised by J. Bielawski & E. Susko  
Rebecca Gibault; Honours (completed); J. Archibald  
Katherine Richman; Honours (completed); J. Archibald  
Cornelius Mutsaers; Honours student (in progress); A.J. Roger  
Jessica Johnson-Mackinnon; Honours student (in progress); A. Simpson  
Jasmin Astle; NSERC-USRA undergraduate student (in progress); J. Bielawski  
Shelley MacDonald; NSERC-USRA undergraduate student (in progress); J. Bielawski  
Wilson Chan; summer student (in progress); C. Blouin  
Kyle Nguyenpi; summer student (completed); C. Blouin  
Alex Safatli; summer student (in progress); C. Blouin  
Mandy McConnell; summer student (in progress); C. Slamovits  
Julie Shay; summer student (completed); C. Slamovits

### **Visiting (International) Students:**

Simpson lab: Qianqian Zhang, Visiting Scholar (VSGS student), China (2011-2012)

Roger lab: Guifre Torruella, PhD student, Institut de Biologia Evolutiva, Spain (Sept.-Dec. 2012)

### **PRESENTATIONS BY STUDENTS (Section 2.4) AND POSTDOCS (listed in Section 2.1.3):**

Total presentations = **63**

[students/postdoc's names are highlighted in bold]

**Alfaro, J.** A site-independent structurally constrained phylogenetic model of protein evolution. Mechanisms of Protein Evolution, Denver, CO, December 2011 (Wright Keynote Presentation)

**Breglia, S.A.** and Leander, B.S. Ultrastructure and molecular phylogenetic position of *Heteronema scaphurum*: a eukaryovorous euglenid with a cytoproct. Maritime Protistologists Meeting, Dalhousie University, December 9, 2011 (oral presentation)

**Brown, M.W.** Finding homes for outcast protistan lineages through phylogenomics; the case of the breviate. Canadian Institute for Advanced Research – Integrated Microbial Biodiversity Program, 2012 Annual Meeting, Quebec City, May 2012 (oral presentation)

**Brown, M.W.**, Silberman, J.D., Spiegel, F.W., **Kolisko, M.**, Roger, A.J. Independent evolution of multicellularity in the eukaryotic super-group Rhizaria. Maritime Protistologists Meeting, Dalhousie University, Halifax, December 2011 (oral presentation)

**Brown, M.W.**, Silberman, J.D., Spiegel, F.W. A contemporary evaluation of the acrasids (Acrasidae, Heterolobosea, Excavata). Maritime Protistologists Meeting, Dalhousie University, Halifax, December 2011 (poster)

**Brown, M.W.**, Silberman, J.D., Spiegel, F.W., **Kolisko, M.**, Roger, A.J. Evolutionary history of aggregative multicellularity, insights from phylogenomics of *Guttulinopsis*. VI European Congress of Protistology, Freie Universität, Berlin, Germany, July 2011 (oral presentation)

**Brown, M.W.**, Silberman, J.D., Spiegel, F.W. A contemporary evaluation of the acrasids (Acrasidae, Heterolobosea, Excavata). VI European Congress of Protistology. Freie Universität, Berlin, Germany, July 2011 (awarded best poster presentation prize)

**Curtis, B.E.** Cryptophyte and chlorarachniophyte nuclear genomes reveal evolutionary mosaicism and fate of nucleomorphs. CIFAR Integrated Microbial Biodiversity Program Meeting, Quebec City, May 2012 (oral presentation)

**Curtis, B.E.** and Archibald, J.M. Endosymbiotic gene transfer, endosymbiotic gene replacement and genome / proteome mosaicism. *Guillardia theta* and *Bigeloviella natans* Genome Jamboree. DOE Joint Genome Institute, Walnut Creek, CA, September 2011 (oral presentation)

**Gaston, D.** and Roger A.J. Functional divergence and convergent evolution in glyceraldehyde-3-phosphate dehydrogenases of Archeplastida and Chromalveolata. Annual Meeting of Society for Molecular Biology and Evolution, Dublin, Ireland, June 23-26, 2012 (poster)

- Gawryluk, R.** and Roger, A.J. The proteome of *Acanthamoeba castellanii* mitochondria. Maritime Protistologists Meeting, Dalhousie University, Halifax, December 2011 (oral presentation)
- Gentekaki, E.** Protistan phylogeography and population structure: Insights from the ciliated protist *Carchesium polypinum*. Brief introduction to genomics. Chinese Academy of Sciences in Guangzhou, Guangdong, China, August 2011 (invited seminar and series of training sessions)
- Gentekaki, E., Curtis, B.,** Beiko, R., **Tsaousis, A.,** Archibald, J. and Roger, A. Extensive lateral gene transfer in *Blastocystis sp. Nand II strain*. Joint PSA/ISOP Meeting, Seattle, WA, July 2011 (oral presentation)
- Gile, G.H.** Progress in bioinformatic characterization of the PPC proteome. *Guillardia theta* and *Bigelowiella natans* Genome Jamboree, DOE Joint Genome Institute, Walnut Creek, CA, September 7-9, 2011 (invited talk)
- Gile, G.H.** *Phylogenetic position of Lophomonas: Implications for character evolution in Parabasalia.* European Congress of Protistology, Berlin, Germany, July 2011 (invited talk)
- Harding, T., Alfaro, J.,** Roger, A.J. & Simpson, A.G.B. Acidic features of proteins: A molecular signature in the halophilic protist *Halocafeteria seosinensis*. Annual Meeting of the Society for Molecular Biology and Evolution, Dublin, Ireland, June 2012 (poster)
- Harding, T., Brown, M.W., Park, J.S.,** Roger, A.J. and Simpson, A.G.B. *The origin of the Heterolobosea: Insights from the amoeboid stage of Pharyngomonas.* VI European Congress of Protistology, Berlin, Germany, July 2011 (poster)
- Harding, T.** Evolution on the Edge: How Protists Have Adapted to Hypersaline Environments. Department of Biochemistry and Molecular Biology, Dalhousie University, Halifax, April 26, 2012 (departmental seminar)
- Harding, T., Brown, M.W.,** Park, J.S., Roger, A.J., Simpson, A.G.B. The origin of the Heterolobosea: Insights from the amoeboid stage of *Pharyngomonas kirbyi*. Maritime Protistologists Meeting, Dalhousie University, Halifax, December 2011 (oral presentation)
- Heiss A.A.** and Simpson A.G.B. The flagellar apparatus of the enigmatic amoeboflagellate *Breviata anathema*. Maritime Protistologists Meeting, Dalhousie University, December 9, 2011 (oral presentation)
- Hleap, J.S.** and Blouin, C. Defining evolutionary modules in protein structures. 3DSIG 2011: The 7th Structural Bioinformatics and Computational Biophysics Meeting, Vienna, Austria, July 15-16, 2011 (poster)
- Hleap, J.S.,** Susko, E. and Blouin, C. Significant clustering on geometric morphometrics data: defining evolutionary modules in complex biological datasets. SBE 2012, Dublin, Ireland, June 23-26, 2012 (poster)

**Hleap, J.S.** Shaping proteins shapes: A composite approach to protein structure evolution. Department of Biochemistry and Molecular Biology, Dalhousie University, April 12, 2012 (departmental seminar)

**Hopkins, J.F.** Proteomic investigation of plastid / PPC proteins in *B. natans*. *Guillardia theta* and *Bigelowiella natans* Genome Jamboree, DOE Joint Genome Institute, Walnut Creek, CA, September 2011 (oral presentation)

**Kim, E.** and Archibald, J.M. RNA-Seq Data. *Guillardia theta* and *Bigelowiella natans* Genome Jamboree, DOE Joint Genome Institute, Walnut Creek, CA, September 2011 (oral presentation)

**Kolisko, M.** Phylogenomic analyses of *Carpodiemonas*-like organisms. Maritime Protistologists Meeting, Dalhousie University, December 9, 2011 (oral presentation)

**Langille, M.** Computational insights of pathogenic bacteria and the ocean microbiome. Biology Seminar Series, University of New Brunswick, Fredericton, October 28, 2011 (oral presentation)

**Lee, R.** High rates of retrogene formation in the giant nuclear genomes of Dinoflagellates. SMBE 2012, Dublin, Ireland, June 23-26, 2012 (poster)

**Lee, R., Malik, S.-B., Gile G.H.,** Lai H., Dowler S., Keeling P.J. and C.H. Slamovits. Analysis of expressed sequence tags of the marine dinoflagellate *Oxyrrhis marina*, an emerging model for alveolate biology and evolution. Maritime Protistologists Meeting, Dalhousie University, December 9, 2011 (oral presentation)

**Leger, M.** Mitochondrion related organelles: common themes in adaptation to anaerobiosis, Biochemistry Department, Dalhousie University, March 15, 2012 (departmental seminar)

**Leger, M.,** Hug, L.A. and Roger, A.J. A hydrogenosome in the free-living excavate *Andalucia incarcerata*: Common themes in mitochondrial reduction in anaerobic eukaryotes. VI European Congress of Protistology, Freie Universität, Berlin, Germany, July 2011 (invited talk)

**Malik S.-B.** and J.M. Logsdon Jr. *Msh4* and *Msh5* genes distributed broadly among diverse eukaryotes indicate the early evolution of crossover interference in eukaryotes. Meiosis Gordon Research Conference, Colby-Sawyer College, NH, June 3-8, 2012 (poster)

**Malik S.-B.,** Leander B.S. and Slamovits, C.H. Evolution of DNA repair, meiosis and mi/siRNA effector proteins in algae and parasites with secondary endosymbiotic plastids. Faculty of Medicine Postdoctoral Research Day, Dalhousie University, October 2011 (poster)

**Malik, S.-B.,** Pightling A.W., Logsdon J.M. Jr., Corradi N., Archibald J.M. and C.H. Slamovits. Microbial sex >1 BYa: Myth or fact? CIFAR Junior Fellow Academy Retreat, Banff, 2012 (invited talk)

**Malik, S.-B.,** Pightling A.W., Logsdon J.M. Jr., Corradi N., Archibald J.M., Roger A.J., Leander B.S. and Slamovits, C.H. Toolkits for DNA repair & cryptic sex in "asexual" emerging model protists. Canadian Institute for Advanced Research, Integrated Microbial Biodiversity Program Annual Meeting, Quebec City, May 2012 (invited talk)

**Malik S.-B.**, Pightling A.W., Logsdon J.M. Jr., Corradi N., Leander B.S. and Slamovits, C.H. Conserved meiotic machinery reveals potential cryptic sex in “asexual” eukaryotic microbes. Eastern Cereal and Oilseed Research Center, Agriculture and Agri-Food Canada, Ottawa, 2012 (invited talk)

**Malik, S.-B.**, Pightling A.W., Logsdon J.M. Jr., Slamovits C.H. and Archibald, J.M. A model for meiosis and DNA repair in *Guillardia theta* and *Bigelowskiella natans*. *Guillardia theta* and *Bigelowskiella natans* Genome Jamboree, DOE Joint Genome Institute, Walnut Creek, CA, September 2011 (invited talk)

**Maruyama, S.** and Archibald, J.M. Green and red algal phylogenetic signals in nuclear genes shared by eukaryotes bearing secondary plastids of green algal origin: looking beyond endosymbiotic versus lateral gene transfer. Society for Molecular Biology & Evolution, Dublin, Ireland, June 23-26, 2012 (poster)

**Maruyama, S.** and Archibald, J.M. Sex-determining locus in *G. theta*. *Guillardia theta* and *Bigelowskiella natans* Genome Jamboree, DOE Joint Genome Institute, Walnut Creek, CA, September 2011 (oral presentation)

**Meehan, C.** Who and Where? Species assignment and distribution of microbiomes (invited talk); GenGIS software tutorial for geospatial metagenomic data analysis (invited workshop tutorial). Metagenomics Methods and Data Analysis Workshop, University of Waterloo, Nov. 2-3, 2011

**Meehan, C.** Environmental Distribution, Adaptation and Evolution of the Lachnospiraceae, Core Members of Mammalian Digestive System Microbiomes, SBE 2012, Dublin, Ireland, June 23-26, 2012 (poster)

**Mingrone, J.** A Selection Switching Model of Codon Evolution - Inferring Population Genetics Parameters, Centre for Comparative Genomics & Evolutionary Bioinformatics, Dalhousie University, February 2, 2012 (joint lab seminar)

**Moore, C.E.** and Archibald, J.M. Nucleomorph genome sequence of the cryptophyte alga *Chroomonas mesostigmatica* reveals lineage-specific gene loss and genome complexity. Annual Meeting of the Society for Molecular Biology and Evolution, Dublin, Ireland, June 23-26, 2012 (poster)

**Moore, C.E.** *A small genome that ‘thinks big’: the complete nucleomorph genome of the cryptophyte alga Chroomonas*. ISOP/PSA Joint Meeting, Seattle, WA, July 13-16, 2011 (oral presentation). **Won the Eukaryotic Cell Young Investigator Award for this presentation.**

**Parks, D.H.** Methods to Study Human Microbiome: Workshop II, Toronto, October 15-18, 2011 (workshop participant)

**Parks, D.H.** Extending phylogenetic beta-diversity measures to split systems. Comparative Genomics and Evolutionary Bioinformatics, Dalhousie University, March 1, 2012 (joint lab seminar)

**Parks, D.H.** GenGIS: A geospatial information system for genomic data. Annual Meeting of the Society for Molecular Biology and Evolution, Kyoto, Japan, July 26, 2011 (oral presentation)



**Parks, D.H.** and Beiko, R.G. Applying network-based measures of phylogenetic beta diversity. Society for Molecular Biology and Evolution, Dublin, Ireland, June 23, 2012 (poster)

**Parks, D.H.** and Beiko, R.G. Quantifying beta-diversity over phylogenetic trees and networks. Society for Molecular Biology and Evolution, Kyoto, Japan, July 26, 2011 (poster)

**Parks, D.H.** and Beiko, R.G. Statistical analysis of metagenomic profiles. Society for Molecular Biology and Evolution, Kyoto, Japan, July 26, 2011 (poster)

**Porter, M.** Methods to Study Human Microbiome: Workshop II, Toronto, October 15-18, 2011 (workshop participant)

**Shafiei, M.** Bayesian Inference of Metabolic Divergence among Microbial Communities, Joint Mathematics and Statistics Colloquium, Dalhousie University, February 13, 2012 (oral presentation)

**Stairs, C.W.** and Roger, A.J. Mitosomes of the free-living protist *Mastigamoeba balamuthi* contain only Complex II of the respiratory chain. Department of Biomedical Chemistry, University of Tokyo, Japan, April 2012 (invited talk)

**Stairs C.W., Brown, M.W,** and Roger, A.J. Unikont mitochondrion evolution: an in silico study of the free-living anaerobes *Mastigamoeba balmuthi* and Prince's Cove Biflagellate Breviate. Kanto Protist Club biannual seminar series, Juntendo University, Japan, June 2012 (invited talk)

**Stairs C.W., Brown, M.W,** van der Giezen, M. and Roger, A.J. The mitochondrion-related organelles of a novel breviate: Enigmatic organelles in a microaerophilic lineage of eukaryotes. Society for Molecular Biology and Evolution, Dublin, Ireland, June 23-26, 2012 (poster)

**Stairs, C., Brown, M.W.** and Roger, A.J. Mitochondrion evolution in a novel breviate: Insights from RNAseq. Maritime Protistologists Meeting, Dalhousie University, December 9, 2011 (oral presentation)

**Tanifuji, G.** Examples for the genome study. Special seminar in Department of Anatomy, Iwate Medical University, Iwate, Japan, July 2011 (invited departmental seminar)

**Tanifuji, G.** and Archibald, J.M. Comparative analysis of nucleomorph and nuclear genomes: investigation of the plastid and PPC proteomes. *Guillardia theta* and *Bigelowiella natans* Genome Jamboree, DOE Joint Genome Institute, Walnut Creek, CA, September 2011 (oral presentation)

**Tanifuji, G.** and Archibald J.M. Comparative analysis of nucleomorph and nuclear genomes in cryptophytes and chlorarachniophytes. Maritime Protistologists Meeting, Dalhousie University, December 9, 2011 (oral presentation)

**Tanifuji, G., Kim, E.,** Onodera, N.T., **Gibeault, R.,** Dlutek, D., Cawthorn, R.J., Fiala, I., Lukeš, J., Greenwood, S.J. and Archibald, J.M. *Genomic characterization of Neoparamoeba pemaquidensis (Amoebozoa) and its kinetoplastid endosymbiont.* 19th Annual Meeting of the Society for Molecular Biology and Evolution, Kyoto, Japan, July 2011 (poster)

**Tsaousis, A.** The Fe/S cluster biosynthetic machineries and the evolution of microbial eukaryotes along with their organelles. Maritime Protistologists Meeting, Dalhousie University, December 9, 2011 (oral presentation)

**Wang, H.-C.** An unexpected predictor based on maximum likelihoods of sequence sites for inferring positively selected sites. Centre for Comparative Genomics & Evolutionary Bioinformatics, Dalhousie University, April 12, 2012 (joint lab seminar)

**Wang, H.-C.** Modeling heterogeneous processes of protein evolution for inferring phylogenies, Math and Statistics, Dalhousie University, February 6, 2012 (departmental seminar)

**Whidden, C.** Inferring the network of life via agreement forest based models. Society for Molecular Biology and Evolution, Dublin, Ireland, June 23-26, 2012 (oral presentation)

**Wong, D.** Finding lateral gene transfer in microbial communities using metagenomic (sequence) data. iEvoBio 2012, Ottawa (oral presentation)

**Wong, D.** Methods to Study Human Microbiome: Workshop II, Toronto, October 15-18, 2011 (workshop participant)

**Zhang, Q.** and Simpson, A. Insights into the phylogeny of systematically controversial haptorian ciliates (Ciliophora, Litostomatea) based on multigene analyses. Maritime Protistologists Meeting, Dalhousie University, December 9, 2011 (oral presentation)

## **2.5 COURSES TAUGHT BY MEMBERS OF THE C/I WITH SIGNIFICANT CONTENT RELATED TO THE C/I MISSION STATEMENT**

BIOC 3400: Nucleic Acids Biochemistry. J. Archibald and C. Slamovits; ~ 85 undergraduates

BIOC 5910: Biochemistry and Molecular Biology - seminar course. A.J. Roger; ~ 4 graduate students

BIOL 1010.03: Principles of Biology I. A. Simpson (+ 4 others); > 900 undergraduates

BIOL 2004.03: Diversity of Life II. A. Simpson (+ 2 others); ~ 240 undergraduates

BIOL 2030: Genetics and Molecular Biology. J. Bielawski (33% of course); 200 undergraduates

BIOL 3046: Molecular Evolution. J. Bielawski; 47 undergraduates

BIOL 3102.03: Microbial Eukaryotes, Biodiversity and Evolution. A. Simpson; ~ 28 undergraduates

BIOL 5705: Systematics and Taxonomy, and Modern Biology (Graduate Modules).

J. Bielawski; 10 graduate students; BIOL 5705.03: A. Simpson; 2 graduate students

CSCI 4181/6802: Algorithms in Bioinformatics. R. Beiko; 6 graduate/undergraduates

INFX 1615: Concepts of Computing. C. Blouin; ~70 undergraduates

INFX 1616: Applications of Computing. C. Blouin; ~70 undergraduates

STAT1060: Introductory Statistics for Science and Health Sciences. J. Bielawski (20% of course; 436 undergraduates

STAT 4066: Advanced Statistical Theory I. E. Susko; 3 undergraduates

STAT 4100/5100: Survival Analysis. E. Susko; 8 graduate / 2 undergraduates

STAT 5067: Advanced Statistical Theory II. E. Susko; 6 graduate students

## 2.6 MEDIA ENGAGEMENT

- Media Interviews (*print, broadcast, radio etc.*)
  - Please send samples where appropriate (*e.g. newspaper clipping, interview transcript*)
- 1. Andrew Roger: Interviewed on *CBC Radio* (“*Information Morning*”) after being awarded a Fellowship in the Royal Society of Canada (2012)  
- see related *Dal News* article entitled “*A Royal Recognition for Dal Scientists*” (copy attached)
- 2. John Archibald: Invited Keynote Address in Lisbon, Portugal for the book launch of “*On the Origin of Eukaryotic Cells*”, in Honour of the late Lynn Margulis (1938-2012)
- 3. W. Ford Doolittle: Canadian Institute for Advanced Research - interview/video production at Hart House, Toronto (May 17, 2012)

## 2.7 OUTREACH STRATEGY

- Provide information on events organized by C/I to meet the outreach strategy related to mission.

See **Section 1.2 (Activities)** for a full list of CGEB seminar series invited guest lectures.

## 2.8 TECHNOLOGY DEVELOPMENT, PATENT OR COMMERCIALIZATION ACTIVITIES

See **Section 2.9 (Other Activities....)** for technology development activities in the form of CGEB Developed software.

## 2.9 OTHER ACTIVITIES RELATED TO KNOWLEDGE EXCHANGE OR MOBILIZATION

- Provide list and relevant details

### CGEB Developed Software:

#### **2012:**

Program name: pr4design, pr4addbranch, pr4deltaxa and pr4list

Authors: Ed Susko

Description: Software to determine the probability of correctly resolving a split for a given tree, substitution process and sequence length,

Website: <http://www.mathstat.dal.ca/~tsusko>

#### **2010-2011:**

**Program name:** *RITA* (Rapid Identification of Taxonomic Assignments)

Author: Robert Beiko

**Description:** A hybrid classification system that uses composition and homology information to assign metagenomic DNA fragments to their appropriate originating genomes. The Web version is available at <http://ratite.cs.dal.ca/rita>, and a standalone at <http://kiwi.cs.dal.ca/Software/RITA>.

**Program name:** *glsphyl, glsphylest, wlsnphyl, wlsphylest*

**Author:** Ed Susko

**Description:** Software for estimating trees and constructing confidence intervals for trees using least squares distance methods.

**Website:** <http://www.mathstat.dal.ca>

**Program name:** *Proteus*

**Authors:** Joe Bielawski and Joey Mingrone

**Description:** The code base has grown, now containing > 45,000 lines of code. The software has stationary and non-stationary codon models implemented under both a likelihood and, albeit crude, Bayesian framework. Covarion models are close to being completed. Anticipated first release within one year.

**Program name:** *Codon Optimal Likelihood Discoverer (COLD)*

**Authors:** Joe Bielawski, Kathy Dunn and Toby Kenney

**Description:** A program that calculates and maximizes the log-likelihood for complex user- defined codon models.

**Website:** <http://www.mscs.dal.ca/~tkenney/Cold/>

**Program name:** *lenergy*

**Authors:** Ed Susko, Javier Alfaro and Andrew Roger

**Description:** A maximum likelihood method that implements novel independent sites, structure-based, free-energy models of protein evolution.

## SECTION 3 – FINANCIAL INFORMATION (APRIL 1 – MARCH 31):

### 3.1 Does the C/I have a separate overall operating and administrative budget?

Yes.

**Name of Funding Source:** Tula Foundation, and Dalhousie University (Faculties of Medicine, Science, Computer Science and Office of the Vice President)

#### Annual Operating/Administration Funds in Reporting Year:

##### I. TULA FOUNDATION

A. *Administration/Seminar Series/Student Travel* (\$50,000 per annum): this covers \$25,000 toward the Administrator’s salary, \$15,000 for seminar series speakers, and \$10,000 for student/postdoc travel to meetings. This support commenced in August 2007, with an 8-year commitment from Tula (i.e. 2007-2015). Aggregate over 8 years: \$200,000

B. *Research Traineeships (for Postdocs & PhD students)*: these are 5-year ‘slots’ awarded to PIs for their trainees’ stipends, plus research expense allowance. Listed below are current slots that are still active (5 others have already ended their 5-year terms):

Archibald lab: \$64,000/year (April 2011 - 2016)

Blouin lab: \$27,500/year (May 2008 – 2013); 2<sup>nd</sup> slot \$27,500 (Sept. 2010 – 2015)

Beiko lab: \$27,500/year (May 2008 – 2013); 2<sup>nd</sup> slot \$27,500 (May 2010 – 2015)

Susko lab: \$49,000/year (Sept. 2008 – 2013)

Simpson lab: \$64,000/year (Nov. 2008 – 2013)

Slamovits lab: \$64,000/year (Dec. 2011 – 2016)

##### II. DALHOUSIE UNIVERSITY

The Faculties of Medicine, Science, and Computer Science, and the Office of the Vice President, Academic & Provost collectively committed funding for Years 1-5 (i.e. 2008-2012) to at least match the \$25,000/year committed by the Tula Foundation for CGEB administration (*see table below*).

#### CGEB - Financial Commitments from Dalhousie:

	Faculty of Medicine	VP, Academic & Provost	Faculty of Science	Faculty of Comp. Science	TOTAL
Year 1: 2008-2009	\$15,000	\$10,000	N/A	N/A	<b>\$25,000</b>
Year 2: 2009-2010	\$15,000	\$10,000	\$1,000	\$1,000	<b>\$27,000</b>
Year 3: 2010-2011	\$10,000	\$10,000	\$6,000	\$3,000	<b>\$29,000</b>
Year 4: 2011-2012	\$10,000	\$10,000	\$7,000	\$4,000	<b>\$31,000</b>
Year 5: 2012-2013	\$10,000	\$10,000	\$8,000	\$5,000	<b>\$33,000</b>

### III. OTHER – CGEB NEW OPPORTUNITIES FUND

Another source of funds available to finance CGEB activities is our *New Opportunities Fund*. This is a “special purpose account” (68292) that was opened to receive transfers of revenue that was generated from CGEB members’ activities. The first source of revenue for this fund came from the *Society for Molecular Biology and Evolution Conference* that resulted in a net income of \$39,181.46. Second, Drs. Doolittle & Gray had been maintaining an account from a 1981 conference that had generated net revenue of \$10,073.15. Thirdly, another symposium (“*Mitochondria, Ribosomes & Cells*” in 2008) generated net revenue of \$106.01. The current balance in our account is \$39,697.28.

The purpose of this fund is to provide additional partial funding or ‘seed’ monies for CGEB activities, the costs of which either exceed existing allocated funds (e.g. the Trainee Travel to Meeting fund, the Seminar Series fund) or one-time events/activities/opportunities that fall under the CGEB mandate. Through this fund CGEB co-sponsored the *CIFAR-IMB Workshop on Eukaryotic Genome Annotation* at Dalhousie in 2010 with the Canadian Institute for Advanced Research (CIFAR). To date these funds have also been used for costs associated with recruitment of potential trainees to CGEB labs (e.g. interview travel and accommodation costs), as well as the initial CGEB website design.

### 3.2 What research grants/awards directly related to the mission statement were awarded to the academic and research population within the C/I not listed above?

#### 3.2.1 Honours, Awards and Distinctions Received by CGEB Members:

[includes new awards received from 2011-2012, ongoing salaried fellowships and scholarships, and lifetime fellowships and honorary memberships]

John Archibald

- New Investigator Award, Canadian Institutes of Health Research (5-yr. salary) (2008-2013)
- Fellow, Canadian Institute for Advanced Research, Integrated Microbial Biodiversity Program (2012-2017); previously Scholar (2009-2012)

Robert Beiko

- Canada Research Chair (Tier II) in Bioinformatics (2007-2012): \$100,000/year Renewed for 2012-2017

Christian Blouin

- Dean’s Award for Excellence in Teaching, Faculty of Computer Science (2012)

W. Ford Doolittle

- Inducted into the Discovery Centre Hall of Fame, N.S. (2011)
- Elected Member, The Norwegian Academy (2009-present)
- Institute Fellow, Canadian Institute for Advanced Research (2008-present)
- Member, U.S. National Academy of Sciences (2002-present)
- Fellow, American Academy of Microbiology (1999-present)
- Fellow, Royal Society of Canada (1991-present)
- Fellow, American Association for the Advancement of Science (1985-present)

Michael Gray

- Fellow, Royal Society of Canada (1996-present)

Andrew Roger

- Elected Fellow, Royal Society of Canada (2012)
- President of the International Society of Evolutionary Protistology (2012-2014)
- Fellow, Canadian Institute for Advanced Research - Integrated Microbial Biodiversity Program (2012-2017); previously 2007-2012
- Canada Research Chair (Tier I) in Comparative Genomics and Evolutionary Bioinformatics (2010-2017): \$200,000/year

Alastair Simpson

- Seymour Hutner Young Investigator Prize from International Society of Protistologists (2012)
- Fellow, Canadian Institute for Advanced Research - Integrated Microbial Biodiversity Program (2012-2017); previously Scholar (2009-2012)

Claudio Slamovits

- Scholar, Canadian Institute for Advanced Research - Integrated Microbial Biodiversity Program (2012-2017); previously 2009-2012

Edward Susko:

- CRM-SSC Prize in Statistics from Statistical Society of Canada and the Centre de recherches mathématiques (2011)

### **3.2.2 Current External Research Grants and other Funding**

Collectively CGEB faculty members received [**~ \$2,000,000**] from external research grants and other funding during this reporting period. Grants involving more than one CGEB faculty as co-applicants were only counted once (i.e. for the primary P.I.) to obtain the above total.

#### **John Archibald:**

- 2011-2016 **Canadian Institutes of Health Research – Operating Grant:** *Endosymbiosis, parasitism, and genome evolution*: \$115,000/year
- 2009-2014 **NSERC Discovery Grant** – *Genome and proteome evolution in nucleomorph-containing algae*: \$34,000/year
- 2007-2012 **Tula Foundation**, CGEB Molecular Biology Research Fellowship (funding for postdoctoral fellowship plus research allowance): \$64,000/year
- 2007-2012 **Canadian Institute for Advanced Research, Program in Integrated Microbial Biodiversity**—research allowance for program members: \$25,000/year

#### **Robert Beiko:**

- 2011-2014 **Genome Canada, Large-Scale Applied Research Projects:** *Biomonitoring 2.0: A high-throughput genomics approach for comprehensive biological assessment of environmental change* (co-applicant with M. Hajibabaei, Guelph, P.I.): ~\$3 million (not counted in above total)

- 2010-2013 **Canadian Institutes of Health Research - Emerging Team Grant: Canadian Microbiome Initiative:** *Modeling and mapping microbial diversity and function with marker genes, genomes and metagenomes: \$223,000/year (with co-PIs: W.F. Doolittle, J. Bielawski & M. Ereshefsky)*
- 2009-2012 **Genome Canada, Competition in Applied Genomics Research – BEEM:** *Bioproducts and enzymes from environmental metagenomes: ~ \$10,000,000 over 3 years (8 co-applicants with E. Edwards, P.I. – not counted in above total)*
- 2008-2013 **Tula Foundation** – funding for PhD student traineeship plus research allowance: \$27,500/year
- 2010-2012 **Tula Foundation** – funding for PhD student traineeship plus research allowance: \$27,500/year
- 2007-2012 **NSERC - Discovery Grant:** *New computational methods for metagenomics: \$23,000/year*
- 2007-2012 **Canada Research Chairs (CIHR) – Canada Research Chair (Tier II) in Bioinformatics:** \$100,000/year

**Joseph Bielawski:**

- 2011-2012 **ACEnet/Sun Microsystems Research Fellowship:** \$20,000
- 2010-2013 **Canadian Institutes of Health Research – Emerging Team Grant: Canadian Microbiome Initiative:** *Modeling and mapping microbial diversity and function with marker genes, genomes and metagenomes: \$223,000/year (with co-PIs: W.F. Doolittle, R. Beiko & M. Ereshefsky)*
- 2009-2013 **NSERC – Discovery Grant:** *Evolutionary analysis of protein diversification: model improvement, assessment and application to real data: \$36,250/year*
- 2007-2012 **Tula Foundation** – funding for CGEB postdoctoral fellowship plus research allowance: \$49,000/year

**Christian Blouin:**

- 2010-2015 **NSERC – Individual Discovery Grant:** *Exploring the landscape of phylogenies: \$24,000/year*
- 2009-2014 **CFI (Infrastructure Operating Funds):** *A high performance computational platform for bioinformatics: \$12,000/year*
- 2010-2015 **Tula Foundation** – CGEB funding for PhD student traineeships plus research allowance: \$27,500/year
- 2008-2013 **Tula Foundation** – CGEB funding for PhD student traineeship plus research allowance: \$27,500/year

**W. Ford Doolittle:**

- 2010-2013 **Canadian Institutes of Health Research - Emerging Team Grant: Canadian Microbiome Initiative:** *Modeling and mapping microbial diversity and function with marker genes, genomes and metagenomes: \$223,000/year (with co-PIs: J. Bielawski, R. Beiko, M. Ereshefsky)*
- 2011-present **Canadian Institute for Advanced Research: ESG – Evolution Speakers Fund:** \$12,909



**Michael Gray:**

2009-2011 **Tula Foundation**, CGEB Molecular Biology Research Fellowship (funding for postdoctoral fellowship plus research expenses): \$64,000/year for 2.5 years (i.e. to Sept. 30, 2011)

**Andrew Roger:**

2011-2016 **Natural Sciences and Engineering Research Council of Canada (NSERC) Discovery Grant** – *Phylogenomic approaches to ancient relationships amongst eukaryotes*: 54,000/year (plus \$120,000 over 3 years as an Accelerator Supplement)

2011-2012 **Canada Foundation for Innovation/NSRIT/Dalhousie University Faculty of Medicine** – *A new laboratory for comparative genomics and evolutionary bioinformatics*: \$301,664 (renovations and equipment grant accompanying CRC; currently awaiting final approval by CFI, with matching funds from NSRIT)

2010-2017 **Canada Research Chairs – Tier I (CIHR) in Comparative Genomics and Evolutionary Bioinformatics**: \$200,000/year (includes 7-yr. salary award, 20% of which is research allowance)

2008-2013 **Canadian Institutes of Health Research, Operating Grant** – *Major transitions in eukaryotic cell evolution*: \$719,381 over 5 years

2008-2013 **Canadian Institute for Advanced Research, Program in Integrated Microbial Biodiversity**— research allowance for program members: \$25,000/year

2007-2015 **Tula Foundation**, Centre for Comparative Genomics & Evolutionary Bioinformatics (CGEB) - administration, seminar series and student travel funds: \$50,000/year

2007-2012 **Tula Foundation**, CGEB Molecular Biology Research Fellowship (funding for postdoctoral fellowship plus research expenses): \$64,000/year

**Alastair Simpson:**

2009-2014 **NSERC – Individual Discovery Grant: *Microbial eukaryote diversity and evolution in extraordinary environments***: \$34,000/year

2008-2013 **Tula Foundation**, CGEB Molecular Biology Research Fellowship (funding for postdoctoral fellowship plus research expenses): \$64,000/year

2008-2013 **CIHR Operating Grant** (*co-applicant with A.J. Roger, P.I.*: \$143,876/year – *not counted in above total*)

2007-2012 **Canadian Institute for Advanced Research, Program in Integrated Microbial Biodiversity** - research allowance for program members: \$25,000/year

**Claudio Slamovits:**

2011-2016 **Canada Foundation for Innovation – Leaders Opportunity Fund: *A laboratory for microbial parasite genetics and evolution***: \$5,000/year (maintenance fund)

2010-2015 **NSERC Discovery Grant: *Genomes of alveolate protists: structure, function and evolution***: \$27,000/year

2009-2014 **Canadian Institute for Advanced Research, Program in Integrated Microbial Biodiversity**— research allowance for program members: \$25,000/year

**Ed Susko:**

2008-2013 **NSERC – Discovery Grant: *Statistical evolutionary bioinformatics***: \$21,000/year

2008-2013 **Tula Foundation** – CGEB Postdoctoral Research Fellowship (funding for postdoctoral fellowship plus research expenses): \$49,000/year