

AT A GLANCE

Founded: 2007

Most recent renewal: 2012

Program Director: Patrick Keeling, University of British Columbia

Fellows and advisors: 28

Institutions represented: 18, in 4 countries

Fields and subfields: microbiology; evolutionary biology; bioinformatics; biochemistry and molecular biology; cell biology; marine and freshwater biology; oceanography; ecology; genetics; taxonomy; mycology; virology; zoology

Interaction meetings: 1; in Toronto, Canada

Relevant knowledge users: educators (e.g., at middle and high schools, science centres and outreach organizations); environmental organizations; public policy-makers (e.g., departments and ministries of environment)

INTEGRATED MICROBIAL BIODIVERSITY

Explores the diverse microbial world that surrounds and permeates human life. Program members are transforming our understanding of biodiversity and changing approaches to medicine and health, environmental sustainability and evolutionary biology itself.

The program in Integrated Microbial Biodiversity achieved substantial research advances in 2015/2016. In April, the program held its second CIFAR-supported field study, SeaFar16, at the Caribbean Research & Management of Biodiversity (CARMABI) field station in Curaçao. The study afforded a subset of program fellows the opportunity to conduct exploration-driven research as a group. Participants learned from each other's experimental systems and approaches through collaborative dialogue,

sample collection, onsite analysis and experimental design. This interaction included a creative component as portions of the field study were filmed using video-enabled drones, submarines and digital cameras. This footage will be combined along with fellow interviews to produce a series of short video documentaries. Targeting a variety of stakeholder audiences, these documentaries will highlight the collaborative nature, discovery research components and environmental underpinnings that the program has achieved during its tenure.

In June 2016, the program also underwent an external peer review as it approached the end of its second five-year term. The review took place in Toronto, Canada, concurrent with the program's annual meeting. To assess the program's achievements over the past five years and its proposal for an additional term, an international review panel consisted of subject-matter experts from the United Kingdom, the United States and Germany. Their collective assessment will be competitively considered alongside those of other CIFAR programs undergoing review in 2016.

Research

- A special issue of the *Proceedings of the National Academy of Sciences* was released in August 2015, resulting from the Integrated Microbial Biodiversity program-led Sackler colloquium that took place in 2014. The *PNAS* issue includes nine research articles involving the work of CIFAR fellows. Overall, the colloquium and its resulting publications have led to a major change in understanding how two organisms interact within an endosymbiotic partnership.
- A CIFAR-supported collaboration between their trainees helped CIFAR fellows **John Archibald** (Dalhousie University) and **Julius Lukeš** (Czech Academy of Sciences) to complete a genomic and microscopy-based exploration of an enigmatic, single-celled 'kinetoplastid' endosymbiont living inside a common marine amoeba. They discovered that the kinetoplastid sustains itself by 'drinking' the interior liquid of the amoeba in which it resides. This type of endosymbiont-host connectivity has never been previously observed, and provides expanded knowledge of the complex ways in which single-celled microbes interact in the context of endosymbiosis.
 - > Cenci U, Moog D, Curtis BA, Tanifuji G, Eme L, **Lukeš J, Archibald JM**. 2016. Heme pathway evolution in kinetoplastid protists. *BMC Evol Biol*. 16: 109.
- In a collaborative project, CIFAR fellows **Alastair Simpson** and **Andrew Roger** (both Dalhousie University) examined two salt-loving protozoans and completed the first examination of the genomic changes that are induced by very-high-salt living conditions. They found a particular evolutionary signature in the protein sequences in these organisms and uncovered several clues that may explain how these organisms counterbalance the salt in their environment. This work is currently submitted for publication.

Other notable publications

- Orsi WD, Smith JM, Liu S, Liu Z, Sakamoto CM, Wilken S, Poirier C, **Richards TA, Keeling PJ, Worden AZ, Santoro AE**. 2016. Diverse, uncultivated bacteria and archaea underlying the cycling of dissolved protein in the ocean. *ISME J*. (8 March 2016).
- Flegontov P, Michálek J, **Janoušek J**, Lai DH, Jirků M, Hajdušková E, Tomčala A, Otto TD, **Keeling PJ**, Pain A, Oborník M, **Lukeš J**. 2015. Divergent mitochondrial respiratory chains in phototrophic relatives of apicomplexan parasites. *Mol Biol Evol*. 32(5): 1115-1131.

IdeasExchange

- During the program's second CIFAR-supported field study to Curaçao, fellows provided interviews and filmed video footage to be edited into short documentaries tailored for different stakeholder audiences, such as educators, policy-makers and environmental organizations. These documentaries will be shared and distributed through a variety of channels.

Global Academy

- The program in Integrated Microbial Biodiversity trains the next generation of researchers by embedding them into its annual program meeting. Each year, graduate students and postdoctoral fellows working in the labs of program fellows participate in a dedicated poster session during the meeting, and several trainees give research presentations during the main sessions. In 2015/2016, trainees of participating CIFAR fellows were also invited to participate in the Curaçao field study to gain exposure and experience in the full breadth of research being conducted by the program.

To learn more: <https://www.cifar.ca/research/integrated-microbial-biodiversity/>

Fellows and trainees in the Integrated Microbial Biodiversity program collect sand samples and small invertebrates for microbiome surveys during their SeaFar16 field study in Curaçao.

