

Société canadienne  
d'écologie et d'évolution



Canadian Society for  
Ecology and Evolution

Tuesday, September 27, 2016

Dear Dr. Naylor and Fundamental Science Review panelists,

The Canadian Society for Ecology and Evolution would like to express its gratitude to Minister of Science Duncan for her leadership in establishing this review. We are grateful for the opportunity to provide our views on ways that we can work together to improve Canada's research ecosystem. We would also like to thank the Panel for its efforts in bringing together many submissions and for its thoughtful deliberations in synthesizing the best advice for the Minister.

Working with our members across the country, we have sought to identify a number of critical areas where Canada has not yet achieved, or maintained, international leadership. Areas of particular concern to us include the clear erosion of research support at a time when Canada's research community has had to grow substantially and insufficient progress in achieving reasonable representation among under-represented groups, including women and aboriginals, in the academy. On this latter point, there are important international examples that can readily be adapted for the Canadian research environment and we believe that institutions should be expected to achieve progress.

We have matched our responses to the questions (**in bold**) that you have provided. We will be pleased to discuss any of these suggestions.

Sincerely,

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QUESTIONS:

**1. Is the federal funding ecosystem meeting the needs of the Canadian research community? As the needs change, is the ecosystem able to adapt and accommodate?**

The federal funding ecosystem addresses a broad cross-section of the research community and does not overtly omit particular sectors. It is important to note that this does not imply that all sectors and groups have an equal opportunity, based on excellence, to be funded. Nor does it imply that the funding ecosystem is healthy in the context of international research. In fact, in comparisons with other countries that keep statistics on per capita R&D spending (or GERD), Canada ranks poorly, falling well behind even some of the poorest nations, such as Tanzania<sup>1</sup>. Furthermore, among nations for which temporal data on GERD is available, Canada's R&D spending has declined between 2003 and 2013, one of the only nations for which this is true<sup>2</sup>. So, the funding ecosystem is broadly-based but spread extraordinarily thinly. The consequence is that the research community, which has grown sharply over recent years in response to strong needs that have been met primarily by the provinces, is in a state of starvation.

The substantial research fund infusion to the granting councils and for indirect costs of research in the 2016 budget was timely and helpful, reversing nearly a decade of inflation-adjusted stagnation in the availability of research funding. Among granting councils, real research funding (i.e. in inflation-adjusted, or constant, dollars) has declined between 6.4-10% between 2007 and 2013<sup>3</sup>. At the same time, Canada's research community, employed largely through provincially-funded university systems, grew substantially (estimated by ~10% between 2007 to 2010<sup>3</sup>), exacerbating the research funding gap. Finally, unusually large proportions of funding the previous government allocated to research was "fettered", tied to partnership programs with industry. Consequently, the infusion of new money was vital in terms of building the foundations for a healthier research funding environment in Canada. It was, however, only a small infusion relative to the total research enterprise and particularly relative to higher performing comparator nations in the R&D sector. Canada has a long way to go to become internationally competitive in GERD. The CFREF program may have significant benefits in its tactical areas of focus, but because of the extreme concentration of its associated funds, these impacts are likely be narrow (although potentially important). Such a program is unlikely to yield important improvements broadly across Canada's research landscape.

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<sup>1</sup> *Nature* **537**, S2–S3 (01 September 2016), Table 1

<sup>2</sup> *Nature* **537**, S2–S3 (01 September 2016), Figure 1

<sup>3</sup> CAUT Education Review (2013) Vol 13(1): 1



It is important to note that the “star system” that appears to represent the underlying philosophy behind programs like CFREF and CERC are will be more effective if the leaders chosen for those programs are surrounded by broad arrays of excellent people and research facilities to match them. Recruiting talented members of the research programs of CFREF and CERC leaders will be more likely to succeed when the research ecosystems in which these leaders are embedded are also thriving. In short, strongly emphasizing ecosystem-based approaches is required. This means rapid growth in the number of NSERC Discovery, CIHR Operating, and SSHRC Insight grants, respectively, without allowing grant sizes to continue to erode. With the critically important exception of Budget 2016, these programs are failing to keep up with growth in researcher demand in Canada, or even inflation.

A healthy funding ecosystem is one in which excellent researchers who propose strong research programs and projects have a commensurately high probability of being funded. Given the sharp erosion of unfettered research support since 2006, the most critical gap is in this area among the tri-councils (e.g. for Discovery Grants at NSERC).

**4. Could the application processes for funding be improved? If so, what would you suggest? Are there issues with the matching programs associated with various funding programs? If so, how could this be improved?**

Matching programs have grown sharply since 2006, while unfettered research has eroded in inflation-adjusted terms (we note, with gratitude, exceptions such as Budget 2016) and still further declined in terms of demand-adjusted fund availability. In particular, SSHRC has seen a sharp rise in the requirement that work be tied to external partner priorities. While partnered funding programs are a welcome addition to the ecosystem, they have come at the apparent expense of unfettered research support.

The requirement for matching funding on operating grants should be relaxed and made optional across the granting councils. It should be neutral in terms of a criterion for funding success for research operating funds.

Programs that make it difficult for excellent researchers to succeed and to have a reasonable prospect of stable support are perverse, undermining the immense investment in those researchers required to bring them to the academy and make them internationally competitive in the first place. It is the epitome of penny-wise and pound-foolish programming to make it harder for excellent researchers to find success.

Researchers are a portable commodity and many will move if the research environment here is not characterized by excellence broadly and deeply. It is not a matter simply of supporting research stars. Leaders achieving such successes want to be part of an excellent research community very broadly.

**5. Does the federal science funding community (e.g. the granting councils, the CFI agencies or organizations that distribute funds supporting investigator-led research) consult the research community to ensure that their programs are aligned to the changing needs of researchers? If so, how? If not, should it and how should it?**

The granting councils currently operate substantially behind a "one way mirror", where they solicit and receive comments, but strategic decisions are then taken in a manner that is essentially opaque. Given that the research community operates, indeed exists, largely on the foundations of open communication of understanding, opaque decision-making erodes trust. As but one example among a constellation, the introduction of a particularly dysfunctional version of the Common CV (CCV) by NSERC was a thoroughly botched, even disastrous, exercise that took years to repair. NSERC is still working on recovering the trust of the research community. As another example, CIHR changes to peer review in recent grant competitions have critically degraded trust that granting decisions are defensible.

The pace of decision-making lags badly behind the rate of evolution in the way research is performed and programmatic responses to new approaches to research are slow. There are many potential responses to this issue, but the least challenging and perhaps most likely to succeed is simply to make research funds more flexible once they are awarded to excellent researchers. While programs like NSERC Discovery Grants offer great flexibility, others are much less so. Nevertheless, even for NSERC DGs, allowing flexibility to pursue interdisciplinary research that can include short-term, but substantive (e.g. up to 50% of grant funds in a given year over two years), work with colleagues in the social sciences and humanities (SSH).

No agency can possibly evolve as rapidly as an individual researcher's area of expertise. Institutional evolution is likely always to trail behind that of an individual's needs. The consequence is that one of the best ways imaginable to enable the funding ecosystem to respond to the needs of individual researchers is to give those researchers greater discretion over how they can use their research funds. While this obviously must not imply a lack of accountability, expanding the availability of unfettered research funds moves the decision about research directions and evolution

into the hands of individual researchers who have specific expertise in how to get the research job done.

This leads to the recommendation that unfettered research funds should be dramatically enhanced. The signals sent since 2006 have been quite clear: there is a preference for fettered research that serves short term economic interests. Unfettered research has eroded in real terms. But tying down research programs to external interests is antithetical to rapid evolution and the need for researchers to be able to pivot quickly to adapt and accommodate new discoveries.

**7. Is there a need for the federal government to improve the balance across funding elements (e.g. investments in principal researchers, funding of research staff and other direct costs of research, funding of infrastructure and equipment operations and maintenance, and reimbursement of indirect costs)? If so, how can this balance be achieved? What is the appropriate federal role in supporting infrastructure operating costs? Do CFI and granting councils programs work in a complementary fashion?**

CFI needs to move toward regular budgetary support from its current, intermittent infusions every few years. The budgetary allotment for CFI should similarly reflect the need for research infrastructure to both grow at a reasonable and competitive pace internationally and to renew existing infrastructure at a reasonable rate. At present, many universities are working with infrastructure that is outdated.

To this end, the \$2 billion research infrastructure infusion in Budget 2016 was an excellent signal that renewal and growth is possible. The pace of this work needs to be maintained.

Big ticket infrastructure makes great headlines but CFI has had insufficient resources to avoid the foreseeable consequence that the personnel needed to operate new CFI infrastructure were treated as a kind of externality.

Funding emphasis should account for the need for excellent personnel, whether those are principal investigators, research staff, including postdoctoral researchers, or students. Tremendous research infrastructure is useless without support for the right people. Scholarship support across all levels, from Undergraduate Student Research Awards, to Post-Graduate Scholarships and Postdoctoral Research Fellowships, are the foundations of the research pyramid and the basis of a healthy research



ecosystem. These need to be coupled with continued, rapid growth in unfettered research funding.

With the proviso that the research ecosystem moves away from its current starvation diet, it then becomes possible to recommend that CFI funding be enhanced to effectively match the personnel costs associated with funded infrastructure projects. The current 40:40:20 ratio for funding the infrastructure itself can be used as a template to establish a far more convincing personnel support program from CFI, such as a 50:50 salary support scale for students through postdoctoral researchers who will specialize in operating excellent research infrastructure. In other words, the Infrastructure Operating Fund needs to be dramatically enhanced. Any matching fund support for critical personnel from CFI should count equally, rather than forcing this support to originate with provincial counterparts to CFI or private interests. In particular, federal and provincial scholarships to students or PDFs should be treated as valid matching funds, enabling excellent young researchers to receive training in the best-equipped facilities.

**8. Comment on career supporting funding versus project-based funding. What are the pros and cons of each structure? Should support structures be higher at the front end of careers and less so as they are established?**

A healthier funding ecosystem for research will not be achieved by starving established researchers. This is simply a recipe to stifle careers and diminish the prospects for researchers whose contributions have been excellent for the longest time. Under no circumstances should improvements in funding to early career researchers come at the expense of other parts of the research community, which would be an obviously perverse strategy to pursue.

Canada's model of supporting research programs in a relatively stable way is probably inextricable from Canada's relatively strong performance in terms of demonstrating basic science literacy in society (Canada is 1<sup>st</sup> out of 35 countries surveyed<sup>4</sup>) and in terms of international reviews of the excellence of programs such as Discovery Grants at NSERC.

In fact, the international review of the Discovery Grant program at NSERC emphasized, in clear terms, that its focus on sustaining stable (i.e. high success rate for DG

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<sup>4</sup> Council of Canadian Academies (2012) Science Culture: Where Canada Stands.



applications) is “not incompatible with, and in fact encourages, a high degree of excellence across a broad range of field...”<sup>5</sup>. This comment comes with no provisos. Canada’s research excellence is high relative to its small funding levels, in all likelihood, because of relatively stable support for research programs.

The current, career-supporting funding structure has proven to be very effective in keeping Canadian research ahead internationally relative to the funding levels researchers in this country receive.

An important complement to career-supporting funding is strategic network grant support. Such funding structures encourage individual excellence but also require that research accomplishments extend beyond the boundaries of narrow disciplines, allowing the development of collaborations across institutions. Such strategic grants have often been very prescriptive in their topics, so increasing the availability of such grants and reducing the emphasis on government-directed research topics would be valuable.

### **9. What should the balance be between funding risky, novel, or emerging research versus research with established lines of inquiry? Do current programs and review processes achieve the right balance?**

“Established lines of inquiry” represent lines of knowledge that are yielding discoveries, which leads researchers to continue to push the boundaries of those fields. There is no cogent argument to be made that this pursuit is less worthy than trying something that is labeled “risky”. By the standards of his day, Charles Darwin was working in a well-established line of inquiry, for example, and many of his predecessors in natural history agreed with the mutability of species even if they had not identified the particular mechanism through which they changed. Could it be argued that Darwin’s pursuits were less worthy than “risky” research? Could we make that argument about the discovery and application of CRISPR gene editing technologies? CRISPR discoveries too reflect long effort in a well-established field and, like Darwin’s natural selection, could hardly be more revolutionary.

The foundation of discovery is healthy investment in a diverse array of unfettered research pursuits. To this end, growing investments in programs like CIHR operating grants or NSERC Discovery Grants are key to finding the next breakthrough idea.

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<sup>5</sup> Report of the International Review Committee on the Discovery Grants Program, Page 7, retrieved from NSERC Sept 5, 2016 ([http://www.nserc-crsng.gc.ca/\\_doc/Reports-Rapports/Consultations/international\\_review\\_eng.pdf](http://www.nserc-crsng.gc.ca/_doc/Reports-Rapports/Consultations/international_review_eng.pdf))

There is value in pursuing so-called risky research enterprises, but this should not be in the context of a zero-sum funding environment, in which unfettered research funds are diminished so that they can be redirected toward someone's subjective conception of "riskier" work. An argument to support such an endeavor would need to include evidence that the rewards from such "risky" research exceeded the opportunity cost of defunding many other scientists. Such evidence probably does not exist (I am not aware of any statistical analysis that shows such a trend) because it is unlikely that a typical attempt to invest in risky research endeavours is more successful in terms of output than simply maintaining a broadly healthy research funding ecosystem. Implicit to the argument that it is better to fund high-risk, high-reward research is that most scientists are cautious incrementalists whose achievements are always modest. Yet, in the Canadian funding ecosystem, excellence as defined by peer review and expert evaluation determines grant success. It is imprudent and misguided to caricature the majority of researchers as afraid to take "risks".

Argument from specific examples (e.g. SNOlab) to general rules ("therefore, it is better to fund high risk, high reward research) relies on inductive reasoning. In other words, this argument is illogical.

With the caveat that stable operating funds must not be degraded again and should in fact be enhanced substantially, pursuing research avenues that seem especially likely to yield breakthroughs is an eminently worthy idea.

**10. What should the balance be between funding research to meet government priorities and having research priorities determined by the research community? Do current programs and review processes achieve the right balance?**

There is much latitude for governmental research priorities and perhaps even an acute need to identify such a list. As with the balance between mislabeled "risky" research and established lines of inquiry, supporting governmental research priorities should not come at the cost of failing to build a healthier and more stable research funding ecosystem that reduces the emphasis and reliance on fettered/partnered/matched funds.

There is room here for a newly appointed Chief Scientific Officer to identify government

research priorities and the support those priorities should receive if they are to be pursued, provided this effort is at the direction of elected policy makers. The CSO should not attempt to push or pull governmental research directions, but give policy makers options instead. This will be more likely to succeed if the CSO reports to Cabinet and the executive directly, as permitted in every strong model of science advice among comparator nations (e.g. United States, UK, Australia, New Zealand, etc.).

**11. Can you identify the peer-review processes (federal or otherwise) that you have participated in, either as an applicant or a reviewer? Do you have suggestions to improve the process in terms of rigour, fairness, and effectiveness?**

I have been a member of an Evaluation Group (1503) for NSERC and as a panelist for the International Polar Year and NASA. I have served as a reviewer on many grant applications domestically and internationally. Colleagues within CSEE contribute similarly.

There is no doubt that each of these processes was rigorous and effective and they all appeared to be fair. There are many models to achieve such successful standards and I have seen no evidence to suggest that one approach that I have participated in is systematically worse – or better – than another. It is likely that review processes that exclude face-to-face, in-depth evaluations are less reliable than conference model systems, such as the Discovery Grant Evaluation Group model. The goal for grant review panels should always be the transparent, reproducible ranking of excellent applications. That is, were a grant review panel to meet a second time, grant proposals would receive a similar ranking and funding.

A significant gap in every review and grant panel process I have seen is the absence of formal recognition and training around hidden biases. The consequence of failures to account for hidden biases will be that some groups may be disadvantaged relative to others, which can exacerbate well-known problems, such as the “leaky pipeline”, where women scientists do not achieve higher academic ranks or comparable successes relative to male colleagues.

All grant reviewers should receive at least a précis on how to address problems of bias relating to gender and cultural diversity. Grant review panelists should receive formal training on these issues as part of their introduction to the grant review process. Achieving greater equity on these fronts complements existing training and recognition of biases in grant success (not just differences in success that may have arisen

because of differences in research intensity or research excellence) between large and small academic institutions.

**14. Are current federal programs supporting the needs of multidisciplinary researchers? If not, how can the situation be improved? Does the funding ecosystem work collaboratively and effectively across disciplines?**

Interdisciplinarity has been grafted retroactively onto funding systems. These efforts have raised the profile and potential of interdisciplinary research. There is much more to accomplish.

A Discovery Integrator program supported stably to enable sustained interdisciplinary research programs, not just projects, would be useful and timely. Such a program should require the participation of groups of researchers coming from at least two research councils to pursue researcher-identified frontiers. Such a program would need to pay particular attention to including researchers normally working within the SSHRC domains to avoid overemphasis on “narrow interdisciplinarity” between researchers working in closely related fields, particularly if they already have support from both CIHR and NSERC.

**17. Identify the unique barriers that the following groups face in obtaining support for investigator-led research. Do current programs address these barriers? What else could be done to address these barriers?**

- 1. students, trainees, and early career researchers**
- 2. women**
- 3. aboriginals and other underrepresented groups**

1. At present, there are many more excellent students and trainees than there are scholarships to support them. Scholarship programs, if they have grown at all, have done so modestly and have not kept up with demand. This problem is particularly acute from PhD to PDF. Excellence-based support for scholarships should be greatly enhanced in all research councils, with the goal of doubling support in the next four years.

2. Career transitions for women researchers at all career stages appear to be difficult, leading to the “leaky pipeline” trend, in which women researchers achieve higher academic ranks at a pace which is much lower than that of male colleagues. Given the well-described and documented role of hidden biases in

all aspects of the academic enterprise, it is more appropriate to describe this phenomenon as the “filtered pipeline”, a system in which women are not merely lost passively but are effectively removed through inequalities in evaluations and expectations.

It is time to end this inequality and to do so will require decisive engagement that has been lacking. The first issue confronting Canadian researchers is that data on current employment rates for women (and indeed any other underrepresented group) and socioeconomic indicators are no longer collected by Statistics Canada.

A top priority is to reinstate the UCASS survey at Statistics Canada. This should happen immediately<sup>6</sup>. It is a basic function to maintain national awareness of the scope of the challenge, but UCASS was ended in 2011. The result is that time series data on employment trends for women and underrepresented groups are unreliably available after 2010, making policy decisions more challenging.

Ending discrimination on the basis of gender or other aspects of individual identity requires action at every level within the federal research funding ecosystem, from individual researchers through to whole granting councils and institutions. For individual researchers, ensuring that all grant applications include a single additional criterion around strategies for recognizing and accommodating diversity is a trivial change that would lead to rapid, national-scale awareness of these issues. Awareness of these issues is a precursor to changing them. Indirect research costs awarded to institutions should include a clear requirement that institutions are accountable in terms of recognizing and accommodating women researchers and underrepresented groups. These costs could be “taxed” at a small (at most, 1% of indirect costs), marginal rate if such strategies were deemed seriously deficient and only restored once the strategies achieved a reasonable minimum standard.

Creating a Federal Athena SWAN certification process for academic institutions should be an immediate national priority. This system has achieved rapid national success in the United Kingdom and should be adapted for Canada and encouraged for every academic institution that receives federal grant support. Any academic institution that achieves even a bronze standard Athena SWAN

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<sup>6</sup> At the time of submission, Minister Duncan has announced UCASS restoration. This development is commendable and deserves to be recognized. CSEE would like to offer its unequivocal support. UCASS data are critical to solving challenges discussed here.

certification should automatically receive full indirect costs of research, making the development of additional gender strategies unnecessary.

3. At a minimum, the UCASS survey system should be expanded to measure diversity in the academy. Systematic underrepresentation of aboriginals and other groups is likely to be widespread and the concept of the leaky (or filtered) pipeline might apply as directly to aboriginal and other underrepresented groups as it does to women researchers. A precursor to change is awareness. A broadly expanded UCASS survey is the most sensible place to begin this process.

**18. Are there international programs, structures, models, or best practices that Canada should consider adopting? If so, please explain why these should be considered.**

We strongly recommend the creation of a body similar to the Equality Challenge Unit ([www.ecu.ac.uk](http://www.ecu.ac.uk)), which runs the Athena SWAN program in the UK (see above). Furthermore, we urge that expectations around progress in all research institutions receiving federal money be transitioned into existence over the next 2-4 years, with as much as 1% of indirect costs of research from federal granting moneys being added to allocations to institutions that meet expectations.

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