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Mitacs Accelerate Proposal Application

INSTRUCTIONS

- Please make sure you are using the latest version of this form posted on **www.mitacs.ca/en/programs/accelerate/apply-now**
- Please **do not modify, remove** text or instructions in each section/subsection **or reformat** this form in any way. A modified form will result in a delay in the internship evaluation process.
- Detailed information on how to write your proposal can be found in the *Accelerate Guide: Writing your proposal document*.
- Send your draft proposal to your Mitacs Business Development Representative **prior** to obtaining all signatures and submitting.
- The proposal should be written and submitted **at least eight (8) weeks prior to the planned start date of the internship.**
- The start date of the internship has to be **after** research approval and the **receipt** of the partner funds at Mitacs.
- Partner funds can be sent directly to Mitacs prior to approval to expedite the process.
- If applicable, proposals with a not-for-profit partner must seek partner and project eligibility approval before proceeding. Please contact a Mitacs Business Development Representative to discuss the eligibility of an NFP organization **BEFORE** submitting your application (see section 2.7).
- If applicable, conflict of interest declarations must be received by Mitacs **before** submitting your application (see section 4.1/4.3).
- If you cannot see the items listed in the drop downs, please refer to the Appendix B: Options and type the corresponding answer on the space provided.

Please note:

If required, your **Mitacs Business Development Representative** can assist you with:

- Identifying your Office of Research Services (ORS) or equivalent representative.
- Assessing the eligibility and completeness of the proposed research.

APPLICATION CHECKLIST

A complete internship application package must include the following :

- ☐ The proposal application **completed and signed** by all parties in Word form. *The Mitacs Accelerate Memorandum* (see Section 7) with signatures must be submitted as a scanned PDF file.
- ☐ List of six external expert, arms-length reviewers and their contact information.
- ☐ Intern(s) CV (a CV template is available on the Mitacs website).
- ☐ Lead Academic Supervisor's CV **only** for projects with **6 IUs and up** (CCV as per Tri-Council or other CV format).
- ☐ Excel budget spreadsheet: *Accelerate Resource Plan and Invoicing*.
- ☐ Any supplementary documents (as applicable).
- ☐ Appendix A - Accelerate Intern Consent Form signed.

*** An incomplete application or a modified form will result in a delay in the internship evaluation process.**

For more information, contact a **Mitacs Business Development representative**.

Mitacs Accelerate Proposal Application

1. Research Proposal Summary

1.1.	**Title of project:**	Estimating the benefit of green infrastructure to urban ecosystems: A synthesis and case-study		
1.2.	**Type of project:** Please indicate (x)	(X) Standard		
		(_) Cluster (minimum of 6 internships and 3 interns)		
		(_) Masters Fellowship (maximum 3 internships)		
		(_) PhD Fellowship (maximum 6 internships)		
1.3.	**Number of Internship units:**	One (1)		
1.4.	**Keywords to identify reviewers:** (3-10 specific keywords; 50% technically related, 50% discipline-related)	Green infrastructure, urban ecology, cities, climate change, low-impact development, stormwater management, biodiversity, ecosystem services		
1.5.	**Academic discipline:**	Life Sciences		
1.6.	**Project priority sectors:**	Environmental Science & Technology	Sustainability & Environment	Life Sciences (not health)
	Please **rank up to three** top priority sector(s) of your project:	1	2	3

1.7. List of participants:

Supervisor(s)	Department	Academic Institution
Dr. J. Scott MacIvor	Biological Science	University of Toronto Scarborough

Partner organization(s)	Contact name at partner organization	Province of organization	Partner Legal Status
Toronto and Region Conservation Authority	Namrata Shrestha	Ontario	Not for Profit Canadian Corporation
Ontario Climate Consortium	Glenn Milner	Ontario	Not for Profit Canadian Corporation

1.8. Proposed work plan for internship unit(s) (IU):

Please summarize the work plan for the project by showing which intern will work when. This table provides a high level overview of the proposed research project and information about intern(s) to the reviewers. Please refer to the **Accelerate Guide: Writing your proposal** to assist you.

			Year 1						Year 2						Year 3					
		Months	1-4		5-8		9-12		1-4		5-8		9-12		1-4		5-8		9-12	
Intern Name	**Degree Program**	**IU**																		
Alessandro Filazzola	PDF	1	X	X																
Total Internship Units		1																		
Total Project Funding	**$ 15,000**																			

2. Description of Proposed Research

2.1. Project title:

Estimating the benefit of green infrastructure to urban ecosystems: A synthesis and case-study

2.2. Research Abstract (Approx. 200 words):

Global urbanization continues unabated, with more than 50% of the worlds' population living in cities. Cities are conventionally viewed as a threat to local biodiversity because natural habitat is replaced with development. However, more recently, there is greater acknowledgement from the public and private sectors that supporting local environments sustains critical ecosystem services, which in turn improves human health and biodiversity conservation. Consequently, urban planning and design has shifted towards green infrastructure (GI), such as green roofs and retention ponds, to increase connections between city and nature in an era of climate change. The contribution of GI to some ecosystem services has been proven (e.g. stormwater management, building cooling), but the contribution to biodiversity conservation remains unspecified. Using a systematic literature review, this project will (i) determine effect estimates that relate different GI types and characteristics to the impacts on natural systems, and (ii) compile relevant data to develop different implementation scenarios GI for Toronto and region. This study will inform natural system planning and improve quantification of GI on urban ecosystems. Findings from this research will have global ramifications that allow city planners to optimize GI implementation for sustainable development and decrease the impacts of cities on natural systems.

2.3. Background and review of relevant prior work (minimum 500 words):

Urbanization is occurring globally and this threatens the biodiversity of natural systems. More than 50% of the human population currently live in cities and urban centers are projected to increase in both extent and density in the future (Grimm et al. 2008; Seto et al. 2011; United Nations & of Economic and Social Affairs 2016). Cities threaten biodiversity because their development replaces natural habitat with materials and does not support pre-existing plant or animal species (Aronson et al. 2014). This extreme form of land-use change can result in significant shifts in species assemblages and overall lower biodiversity in city centers (Miller & Hobbs 2002; Shochat et al. 2006). Human development can also have indirect impacts beyond land-use change, such as increasing habitat fragmentation (Aronson et al. 2014), invasive species introductions (Cadotte et al. 2017), alteration of nutrient deposition/cycling, and redistribution of water (Grimm et al. 2008). However, urban areas are also home to some species of conservation concern (Aronson et al. 2014; Ives et al. 2016). Thus, there is a critical need to explore strategies to mitigate the effects of urban development on biodiversity.

One strategy is to utilize green infrastructure (GI) in urban development to reduce impacts on natural systems associated with buildings. Though there are variety of definitions of GI in the literature, for this study GI is defined as the natural vegetative systems and green technologies that collectively provide society with a multitude of environmental, social, and economic benefits (Green Infrastructure Ontario 2014). City developers use GI mainly for stormwater management (e.g. water sheds off of buildings and roads, exacerbating treatment facility operations and flooding), and urban cooling (e.g. in warm seasons, cities accumulate heat and results in more energy used for cooling buildings). Plants reflect and redistribute heat in ways that lead to cooler buildings and cities, both having impacts on human health and well-being (Norton et al. 2015; Miles & Band 2015; Coutts & Hahn 2015). The benefits of green infrastructure for regulating municipal and ecosystem services have been proven and are frequently recommended (Tzoulas et al. 2007; Schilling & Logan 2008; Lepczyk et al. 2017); for example, the city of Toronto has a mandatory green roof by-law and construction standard, as well as an incentive program and public engagement strategy. However, there is less evidence for GI contributing to biodiversity conservation (Williams et al. 2014). Materials used in GI construction provide a template for habitat creation and enhance wildlife in cities, but this can be dependent on building features (MacIvor 2016) and local landscape factors, such as location relative to building density (Braaker et al. 2014). For instance, green roofs can provide native vegetation on urban buildings that can support arthropod communities (Kadas 2006; Colla et al. 2009) and bird species (Fernandez-Canero & Gonzalez-Redondo 2010). Some of the considerations that determine whether green infrastructure improves urban biodiversity includes spatial distribution both vertically and horizontally (Blank et al. 2017), connectivity (Braaker et al. 2014), composition (Blanusa et al. 2013), design (MacIvor & Ksiazek 2015), and patch size (Lepczyk et al. 2017). For example, the height of green roofs have shown to be correlated with pollinator visitation (MacIvor et al. 2016). Data on these GI characteristics are retrievable through collaboration with the Toronto and Region Conservation Authority (partner). With the wide-

spread implementation of green infrastructure, often on an ad-hoc basis, urban planners have an interdisciplinary challenge to balance the delivery of municipal services and urban biodiversity. Tools that permit the transfer of knowledge to support these goals will provide a lens with regards to the effects of GI on biodiversity conservation. This is especially important because land use planning are increasingly relying on GI to enhance the landscape's capacity to provide ecosystem function and services.

Green infrastructure can mitigate the impacts of urban development on natural systems, but these effects have not been quantified. This project will aim to improve understanding of green infrastructure and their specific characteristics on natural systems and develop a model that defines the future scenarios of green infrastructure implementation Toronto and region. Specifically, we intend to explore the different forms of GI, the characteristics of each GI type, and the response from natural systems (Table 1). The goals of this project will be to:

1) Conduct a systematic review to summarize the literature to determine effect estimates that relate different GI types and characteristics to the impacts on natural systems.
2) Using findings from the review, develop different scenarios of GI implementation and urban development for the City of Toronto and region.

Toronto and region is an ideal case study for this project as it has highly heterogeneous landscape (i.e. transition from urban core to rural greenbelt) that provides opportunities for different forms of green infrastructure. In addition, the City of Toronto has policy targeted towards green infrastructure implementation (e.g. Green Roof Bylaw 2006) as well as have extensive data repository (e.g. natural areas, urban forest, green roofs) that allows for land use scenario development. The in-depth literature review and prototype in Toronto can be used to inform other jurisdictions of the how to measure benefits of green infrastructure for biodiversity and urban ecosystem functions. The output of this study will be used in a broader project led by TRCA to provide input into the scenario modeling to quantify and map the habitat function for various urban biodiversity groups (as well as other ecosystem service co-benefits) under different land use and climate scenarios in the Toronto and region.

Table 1: Research topics to be examined in the context of this project including the different types of GI, the characteristics of GI implementation, and the measurable response of natural systems.

Research topics	Focus	Relevant Citations
Green infrastructure types	Green roofs, bioswales, home/community gardens, retention ponds, urban tree canopy (i.e. plantings)	(Tzoulas et al. 2007; Lepczyk et al. 2017)
Green infrastructure features	Patch size, shape, connectivity, height,	(Braaker et al. 2014; MacIvor 2016; Aronson et al. 2017)
Measures of natural systems	Biodiversity, productivity, invasion, pollinator richness, richness of rare species	(Garmendia et al. 2016; Brunbjerg et al. 2018)

2.4. **General objective** of the research project broken down into sub-objectives, activities, themes, or subprojects, as applicable:

The Objective of this research program is to quantify the benefits of green infrastructure on urban biodiversity and other positive impacts for natural systems. This research objective is broken into two major components:

1) Sub-project A: A review of the literature summarizing the effect sizes of the topics listed in Table 1 including different forms of green infrastructure, their specific characteristics, and impact on natural systems. This will be accomplished using either a systematic review or meta-analysis of the available scientific and grey literature.
2) Sub-project B: Using Toronto and region in Ontario as a case study, develop a tool that can communicates the effectiveness of different GI implementation for biodiversity conservation. This tool will be a set of scenarios relevant to Toronto and region that provide different levels of GI adoption and

can be published as a Shiny R application for open use. The data that will be used will be a combination of available data on natural areas, other green infrastructure, municipal plans, and relevant findings from the literature.

2.5. Details of internships or subprojects:

a. Name of Intern

Alessandro Filazzola

b. Specific objectives of the internship or subproject

Sub-project A is intended to conduct a systematic review of the literature to summarize the effects of green infrastructure on natural systems. Sub-project B uses Toronto and region as a case study to develop a tool that quantifies different levels of implementation for green infrastructure.

c. Methodologies

Sub-project A: A systematic literature search will be conducted using Web of Science and Google Scholar for all articles between 1980 and 2018. This time frame was chosen because it captures the majority of the literature on green infrastructure and with articles that have some measured estimates. The review will include all studies globally. The intended purpose of this search is to capture all articles that have documented both green infrastructure implementation and a measure of natural systems (e.g. Table 1). The search terms that will be used are: (green infrastructure OR low*impact development OR blue-green infrastructure) AND (biodiversity OR diversity OR species OR ecosystem OR ecology). These terms have returned 1,026 results (as of May 2018) and once refined for relevancy will likely return between 200-400 peer-reviewed manuscripts that explicitly examine green infrastructure effects on natural systems. Depending on the similarities in methodologies between papers, it can be possible to conduct a meta-analysis to compare different forms of green infrastructures and response from natural systems. These findings will have implications for the efficacy of different forms of green infrastructure and the expected response on urban ecology. This review will identify research gaps or potential challenges associated with implemented green infrastructures.

Sub-project B: Using Toronto and region as a case study, models will be developed that characterize different implementation levels of green infrastructure. The City of Toronto has an Open Data Catalogue with datasets including green roof permits, green spaces in neighbourhoods, tree cover, and land-use (e.g. parks, recreational, commercial). Combined with climate data provided by the Ontario Climate Consortium, city development plans, and urban ecology data from the Toronto Regional Conservation Authority, it will be possible to generate different scenarios of GI implementation. Results from the literature review in sub-project A will be used to guide the maximum representation of green infrastructure implementation and the consequences it will have for urban ecology. The model will have three lenses that include different land-use coverage (i.e. native landscapes to fully developed), climate scenarios (based on representative concentration pathways; (IPCC 2014), and green infrastructure implementation (Figure 1). Ordinations will be used to determine the forms of green infrastructure that associate most with the respective measures of natural systems. Data matrices (i.e. rasters) are currently available that project climate change and urbanization for the City of Toronto. This project will develop the third axis of green infrastructure implementation based on a range of values from the maximum possibility of implementation at a 1 km^2 resolution.

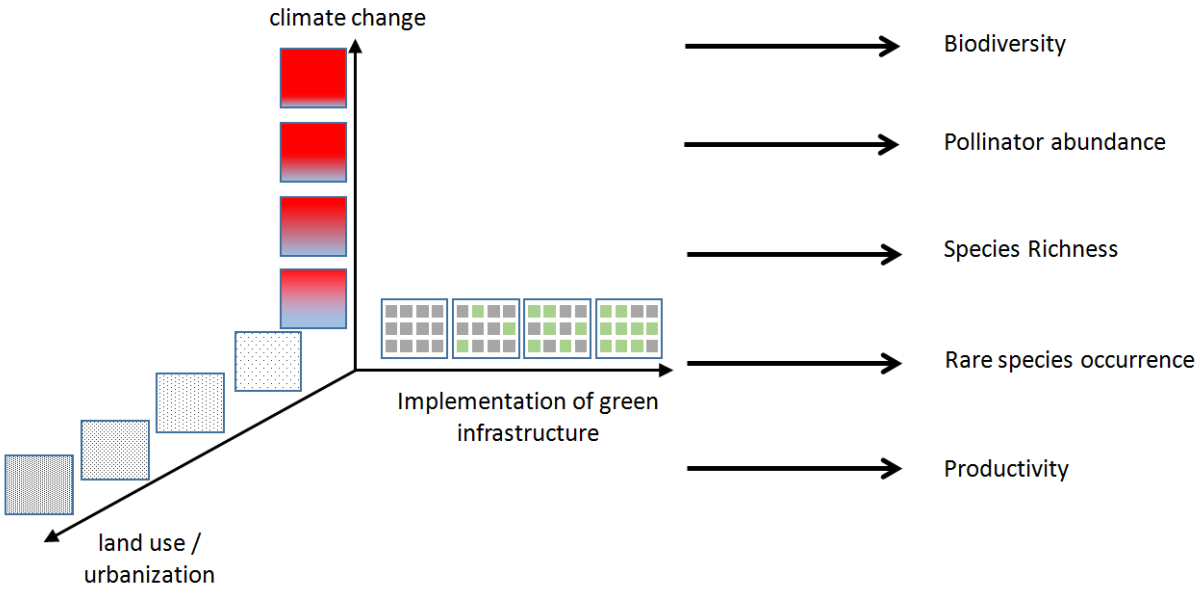

Figure 1: Approach to modelling different levels of implementation for green infrastructure with climate scenarios and urbanization. The measure response will be the effects on natural systems shown on the right.

d. Timeline

The timeline for this project is four months. The first two months will be spent examining the literature and preparing the metadata for the systematic review and analyses (Figure 2). Using the findings from the review, the second two months will focus on developing and validating the model. The latter two months will also be spent writing the systematic review into a publishable manuscript with the co-authors (Figure 2).

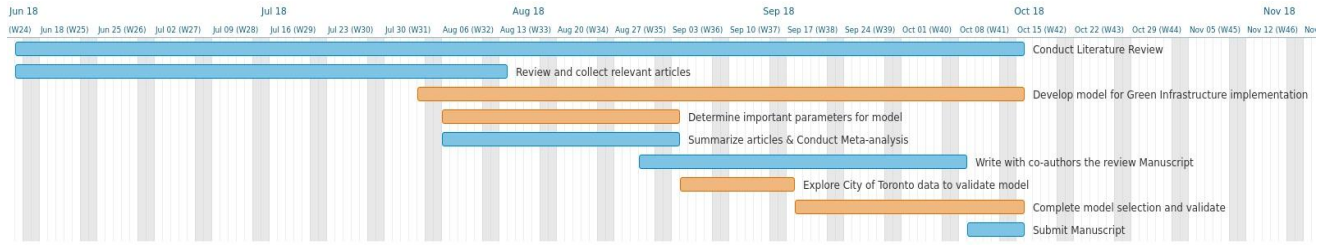

Figure 2: A Gantt chart describing the timeline for tasks within the project separated into Sub-project A (conduct literature review) and sub-project B (develop model for green infrastructure implementation).

e. Expected deliverables

The expected outcome from sub-project A is a peer-reviewed journal article and the outcome from sub-project B is a tool that projects different scenarios of green infrastructure implementation for the City of Toronto. The tool will be a dataset projected on Toronto and region that provides different levels of green infrastructure implementation and will be released in the form of a Shiny R application so that it is publically available.

f. Benefit to Intern

The benefit to the intern is first authorship on the peer-reviewed article and authorship on the application used for GI implementation. These products both complement the intern's previous research in community ecology and sustainable development. The intern currently has an existing positive relationship with the entire team and will continue as a collaborator on similar topics in the future.

g. Interaction

60% partner interaction and 40% of academic interaction.

h. Justification

More time will be spent with the partner organization because a larger proportion of the team contributing to the MITACS project (i.e. individuals from the Toronto Regional Conservation Authority and Ontario Climate Consortium) are present at the same location. Therefore, a weekly ratio of time spent at respective institutions would be 3:2 (days per week) at the partner and academic institutions respectively.

i. Partner Interaction

1) The expertise present at both the partner and academic locations is necessary for the project's completion. Consequently, activities will be conducted at both locations and there is nothing preventing or limiting the execution of any activities at one site, but not the other. Presence at the partner's site is solely to facilitate collaboration among individuals working on similar project ideas.

2) The partner organization will provide a workspace, datasets that are relevant to the project's success, and expertise in the form of collaboration.

2.6. Relevance to the partner organization and to Canada:

The partner organization, Toronto and Region Conservation Authority, is committed to ecosystem function and associated ecosystem services in the Greater Toronto Area. In this regards it is involved in various land use and conservation planning activities including land acquisition, protection, restoration, and assisting its municipal partners in planning for land use and climate change. This includes promoting and advising on appropriate design and placement of Green Infrastructure (GI) in the built portions of the jurisdiction. For this project TRCA proposes to be an active partner and provide the required funding as well as in-kind support to advance the ecosystem science and management through application of green infrastructure. Particularly, TRCA will provide working space, data, GIS support, staff support, and access to internal and external stakeholders for consultation and transfer of knowledge. The post-doc will work closely and regularly with the Senior Research Scientists, Ecology in the Research and Knowledge Management team.

For TRCA, this project will provide robust scientific foundation to incorporate the GI concepts and data in its key strategy for ecosystem function (specifically biodiversity habitat) and the associated ecosystem services. The Terrestrial Natural Heritage System Strategy (TNHSS) was developed in 2007, which is being updated to reflect the latest science of urban ecosystem management. This includes incorporating the contribution of natural areas as well as other GI across the landscape to achieve the desired ecosystem goals and objectives. This project will provide the required guidance from literature and will strengthen development of the most likely scenarios of GI elements across the Toronto and region by incorporating the specific characteristics of GI for achieving the desired ecosystem function and services.

2.7. Project economic orientation (for submissions with a NFP organization ONLY):

This project will inform land use planning and climate adaptation planning to (i) mitigate and/or minimize economic costs associated with compromised urban ecosystems, and (ii) strategic investments are made to maximize benefit to urban ecosystems ensuring continued provision of ecosystem services for urban sustainability and resilience.

2.8. Relationship (if any) to past/other Mitacs Accelerate internships, Mitacs Elevate fellowships, or current applications in submission to any Mitacs program:

None

2.9. References:

Aronson, M.F., Lepczyk, C.A., Evans, K.L., Goddard, M.A., Lerman, S.B., MacIvor, J.S., Nilon, C.H., & Vargo, T. 2017. Biodiversity in the city: key challenges for urban green space management. Frontiers in Ecology and the Environment 15: 189–196.

Aronson, M.F.J., La Sorte, F.A., Nilon, C.H., Katti, M., Goddard, M.A., Lepczyk, C.A., Warren, P.S., Williams, N.S.G., Cilliers, S., Clarkson, B., Dobbs, C., Dolan, R., Hedblom, M., Klotz, S., Kooijmans, J.L., Kühn, I., Macgregor-Fors, I., McDonnell, M., Mörtberg, U., Pysek, P., Siebert, S., Sushinsky, J., Werner, P., & Winter, M. 2014. A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers. Proceedings. Biological sciences 281: 20133330.

Blank, L., Vasl, A., Schindler, B.Y., Kadas, G.J., & Blaustein, L. 2017. Horizontal and vertical island biogeography of arthropods on green roofs: a review. Urban Ecosystems 20: 911–917.

Blanusa, T., Vaz Monteiro, M.M., Fantozzi, F., Vysini, E., Li, Y., & Cameron, R.W.F. 2013. Alternatives to Sedum on green roofs: Can broad leaf perennial plants offer better 'cooling service'? Building and Environment 59: 99–106.

Braaker, S., Ghazoul, J., Obrist, M.K., & Moretti, M. 2014. Habitat connectivity shapes urban arthropod communities: the key role of green roofs. Ecology 95: 1010–1021.

Brunbjerg, A.K., Hale, J.D., Bates, A.J., Fowler, R.E., Rosenfeld, E.J., & Sadler, J.P. 2018. Can patterns of urban biodiversity be predicted using simple measures of green infrastructure? Urban Forestry & Urban Greening 32: 143–153.

Cadotte, M.W., Yasui, S.L.E., Livingstone, S., & MacIvor, J.S. 2017. Are urban systems beneficial, detrimental, or indifferent for biological invasion? Biological Invasions 19: 3489–3503.

Colla, S.R., Willis, E., & Packer, L. 2009. Can green roofs provide habitat for urban bees (Hymenoptera: Apidae)? Cities and the Environment (CATE) 2(1): 4

Coutts, C., & Hahn, M. 2015. Green infrastructure, ecosystem services, and human health. International Journal of Environmental Research and Public Health 12: 9768–9798.

Fernandez-Canero, R., & Gonzalez-Redondo, P. 2010. Green roofs as habitat for birds: A review. Journal of Animal Veterinary Advances 15: 2041–2052.

Garmendia, E., Apostolopoulou, E., Adams, W.M., & Bormpoudakis, D. 2016. Biodiversity and green infrastructure in Europe: Boundary object or ecological trap? Land Use Policy 56: 315–319.

Grimm, N.B., Faeth, S.H., Golubiewski, N.E., Redman, C.L., Wu, J., Bai, X., & Briggs, J.M. 2008. Global change and the ecology of cities. Science 319: 756–60.

IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of working groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change. Geneva, Switzerland.

Ives, C.D., Lentini, P.E., Threlfall, C.G., Ikin, K., Shanahan, D.F., Garrard, G.E., Bekessy, S.A., Fuller, R.A., Mumaw, L., Rayner, L., Rowe, R., Valentine, L.E., & Kendal, D. 2016. Cities are hotspots for threatened species. Global Ecology and Biogeography 25: 117–126.

Kadas, G. 2006. Rare invertebrates colonizing green roofs in London. Urban Habitat 66–86.

Lepczyk, C.A., Aronson, M.F.J., Evans, K.L., Goddard, M.A., Lerman, S.B., & MacIvor, J.S. 2017. Biodiversity in the city: Fundamental questions for understanding the ecology of urban green spaces for biodiversity conservation. BioScience 67: 799–807.

MacIvor, J.S. 2016. Building height matters: nesting activity of bees and wasps on vegetated roofs. Israel Journal of Ecology & Evolution 62: 88–96.

MacIvor, J.S., & Ksiazek, K. 2015. Invertebrates on Green Roofs. In Green Roof Ecosystems, pp. 333–355. Springer.

Miles, B., & Band, L.E. 2015. Green infrastructure stormwater management at the watershed scale: urban variable source area and watershed capacitance. Hydrological Processes 29: 2268–2274.

Miller, J.R., & Hobbs, R.J. 2002. Conservation where people live and work. Conservation Biology 16: 330–337.

Norton, B.A., Coutts, A.M., Livesley, S.J., Harris, R.J., Hunter, A.M., & Williams, N.S.G. 2015. Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes. Landscape and Urban Planning 134: 127–138.

Schilling, J., & Logan, J. 2008. Greening the Rust Belt: A green infrastructure model for right sizing America's shrinking cities. Journal of the American Planning Association 74: 451–466.

Seto, K.C., Fragkias, M., Güneralp, B., & Reilly, M.K. 2011. A meta-analysis of global urban land expansion. PLoS ONE 6: e23777.

Shochat, E., Warren, P.S., Faeth, S.H., McIntyre, N.E., & Hope, D. 2006. From patterns to emerging processes in mechanistic urban ecology. Trends in Ecology & Evolution 21: 186–191.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., & James, P. 2007. Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. Landscape and Urban Planning 81: 167–178.

United Nations, D., & of Economic and Social Affairs, P.D. 2016. The World's Cities in 2016 – Data Booklet. (ST/ESA/ SER.A/392).

Williams, N.S.G., Lundholm, J., & Scott MacIvor, J. 2014. Forum: Do green roofs help urban biodiversity conservation? Journal of Applied Ecology 51: 1643–1649.

3. Declarations

3.1. Will the proposed research be taking place outside of the lab or normal business environment?

Yes___ No_X_

If yes, please complete the following section to indicate what (if any) impact there may be on the environment.

a. Main characteristics of the location (i.e. physical description & coordinates).

b. Principal activity(ies): for each activity, list the environmental elements affected.

c. Are authorizations, permits, or licenses required to undertake any activity during the internship?
Yes___ No___

If yes, please list and include copies with your application.

3.2. Does the proposed research involve living human subjects (including conducting interviews) or human remains, cadavers, tissues, biological fluids, embryos, or fetuses?

Yes___ No_X_

If yes, the proposal must be approved by the participating academic institution's Research Ethics Board*, and a valid Ethics approval is required for the duration of the research project. Access to funding may be denied for projects that do not have ethical approval.

Please note: Mitacs may request a copy of the report to ensure compliance.

3.3. Does the proposed research involve animal subjects?

Yes___ No_X_

If yes, the proposal must be approved by the participating Institution's Animal Care Committee*, and a valid approval from the committee is required for the duration of the research project.

Please note: Mitacs may request a copy of the report to ensure compliance.

3.4. Is a biohazards review required?

Yes___ No_X_

If yes, the necessary review/report must be conducted in accordance with your academic institution's policies*, and a valid biohazards approval is required for the duration of the research project.

Please note: Mitacs may request a copy of the report to ensure compliance.

3.5. Have any participants declared a Conflict of Interest (COI)* as part of this application?

Yes___ No_X_

If yes, please attach the signed conflict resolution letter.

** if you have any questions about the requirement for Research Ethics/Animal Care/Biohazards review or academic institution/Conflict of Interest Policies at your institution, please contact your corresponding institution's research office.*

4. Participants

Duplicate relevant section(s) as needed for multiple interns or supervisors.

4.1. Academic supervisor:

Name:	Dr. J. Scott MacIvor
Academic Institution:	University of Toronto Scarborough
Department:	Biological Sciences
Address (at academic institution):	1265 Military Trail, office: SY364
City, Province, Postal Code:	Toronto, Ontario, M1C 1A4
Phone:	416-208-8191
Permanent Email:	Scott.macivor@utoronto.ca
Alternative E-mail:	

4.1.1. Is the academic supervisor**:

a. An owner or a co-owner of the partner organization: Yes___ No_X_

b. A relative of an owner or co-owner of the partner organization: Yes___ No_X_

c. An employee of and/or a participant in the day-to-day management of the partner organization: Yes___ No_X_

d. A relative of the intern and/or partner supervisors of the proposed project: Yes___ No_X_

If yes to any of the above, please click here to complete the **Conflict of Interest Declaration** and send it to accelerate@mitacs.ca **BEFORE** submitting your application.**

For any additional academic supervisors copy and paste Section 4.1. below:

4.2. Partner organization:

Legal name:	Toronto and Region Conservation Authority	
Operating name (if different):		
Contact name:	Namrata Shrestha	
Position:	Senior Research Scientist	
Department:	Research & Knowledge Management	
Address:	101 Exchange Ave	
City, Province, Postal code:	Vaughan, Ontario, L4K 5R6	
Phone:	416-661-6600	
Email:	nshrestha@trca.on.ca	
Website:	https://trca.ca/	
Partner size (number of employees):	100-499	
Legal status:	Not for Profit Canadian Corporation	
If Not for profit Canadian Corporation	Other	
NAICS Code (First three digits)*:		
* Click here for a list of North American Industry Classification System codes.		
Is this the **first time** the partner has collaborated with the academic institution? :	No	

Legal name:	Toronto and Region Conservation Authority	
Operating name (if different):	Ontario Climate Consortium	
Contact name:	Glenn Milner	
Position:	Project Manager	
Department:		
Address:	101 Exchange Ave	
City, Province, Postal code:	Vaughan, Ontario, L4K 5R6	
Phone:	416-661-6600 ext. 5844	
Email:	gmilner@trca.on.ca	
Website:	https://climateconnections.ca/	
Partner size (number of employees):	1-49	
Legal status:	Not for Profit Canadian Corporation	
If Not for profit Canadian Corporation	Other	
NAICS Code (First three digits)*:		
* Click here for a list of North American Industry Classification System codes.		
Is this the **first time** the partner has collaborated with the academic institution? :	No	

4.2.1. Invoicing Partner Contact

Partner contributions must be received by Mitacs BEFORE any funds are awarded to the academic institution. **Costs can only be incurred after research approval of the proposal** and the **receipt** of the partner funds at Mitacs**.**

a. Please describe any applicable **invoicing requirements** (vendor setup, PO, etc.):

Invoicing contact name:	
Email:	

b. Invoicing Partner address:

☐ Address same as filled in Section 4.2.
☐ If invoicing address different than Section 4.2, please fill out the following:

Legal name:	
Address:	
City, Province, Postal code:	
Name of contact:	
Phone:	
Email:	

c. Have these funds been leveraged against other federal or provincial programs? Yes___ No___

If yes, please provide details:

4.2.2. Partner Funds at academic institution. *IF APPLICABLE*

To be completed only if Partner funds were sent as an exception to the academic institution**. If no** please proceed to section 4.3.:

a. Is there a **research agreement** in place with the academic institution that governs the use of these partner funds?

Yes__ No___

If yes please speak with your BD representative, fill out the *addendum to research agreement document*, and submit that document with your completed application.

If no please complete the following:

b. ORS/UILO or equivalent agrees to send these funds to Mitacs: Yes___ No___

If yes, please provide:

Academic institution account number:	

c. The partner agrees by signing this application that the funds can be forwarded: Yes___ No___

If yes, please provide:

Name of the consenting partner representative	

d. **Invoicing academic institution contact** to receive Mitacs invoice:

Name:	
Department:	
Email:	

e. Is the GST or HST, and QST (if applicable) to be included with invoice to academic institution? Yes___ No___

If no, tax(es) will be invoiced directly to the industry partner.

4.3. Intern(s) identified:

4.3.1. Intern #1 information ** MANDATORY **

Name:	Alessandro Filazzola	
Degree program during internship (college/masters/PhD/PDF):	PDF	
Expected year of graduation:	MM	YYYY
If PDF, indicate month/year PhD received:	04	2018
Academic institution:	University of Toronto	
Department:		
Address at academic institution:	1265 Military Trail, SY364	
City, Province, Postal code:	Toronto, Ontario, M1C 1A4	
Phone:	416-262-3673	
Permanent phone or Cell phone		
Permanent email:	Alex.filazzola@outlook.com	
Alternative email:		
Citizenship:	**Canadian**	
Gender:	**Male**	

4.3.2. Conflict of interest. Is the intern:

a. An owner or a co-owner of the partner organization: Yes___ No_X_

b. A relative of an owner or co-owner of the partner organization Yes___ No_X_

c. An employee of and/or a participant in the day-to-day management of the partner organization:

Yes___ No_X_

d. A relative of the academic and/or partner supervisors of the proposed project: Yes___ No_X_

If yes to any of the above, please click here to complete the **Conflict of Interest Declaration** and send it to accelerate@mitacs.ca **BEFORE** submitting your application.

4.3.3. Demographic information. **OPTIONAL**

Please indicate (x) if you are:

Francophone:	(_)	A person with a disability:	(_)
Indigenous:	(_)	First in your family to attend college or university:	(_)
Member of a visible minority group - *includes persons who are non-Caucasian in race or non-white in colour and who do not report being Indigenous*			(_)

Social Media: Please provide usernames if you wish to connect with Mitacs by social media:

LinkedIn:	
Twitter:	
Facebook:	

For any additional interns copy and paste Section 4.3. below:

4.4. Intern(s) to be determined (TBD):

4.4.1. TBD#1

Degree program during internship (college/masters/PhD/PDF):	
academic institution:	
Department:	

For any additional TBD interns, copy and paste Section 4.4. below:

5. Resource Plan and Invoicing

All Accelerate projects are required to complete the Accelerate Resource Plan and confirm the Invoicing schedule on the Excel Budget spreadsheet template. Please refer to the **Accelerate Guide: Writing your proposal** to assist you

6. Suggested Reviewers

6.1. Reviewer's comments. Please select ONE of the following:

___ We consent to receive reviewer's comments in either official language (French or English).
___ We request to only receive reviewer's comments in the language of which this proposal is submitted.

6.2. Please provide the names and contact information of at least **SIX (6) arms-length** reviewers.

An arms-length reviewer must:

- Be a recognized expert in the research topics and technical aspects covered by the proposal;
- NOT be from the same academic institution as the intern(s) or the academic supervisor(s); and

- NOT have had any collaboration with the intern(s) or the academic supervisor(s) or the partner(s) during the past five (5) years or planned for the near future.

Please note that neglecting to suggest reviewers who qualify as arms-length will delay the review of your application.

Reviewer 1:

Name:	Dr. Hitesh Doshi
Academic institution:	Ryerson University
Department:	Architectural Science
Email:	hdoshi@ryerson.ca

Reviewer 2:

Name:	Dr. Reid Coffman
Academic institution:	Kent State University
Department:	Architecture & Environmental Design
Email:	rcoffma4@kent.edu

Reviewer 3:

Name:	Dr. Usman Khan
Academic institution:	York University
Department:	Civil Engineering
Email:	usman.khan@lassonde.yorku.ca

Reviewer 4:

Name:	Dr. Darko Joksimovic
Academic institution:	Ryerson
Department:	Civil Engineering
Email:	darkoj@ryerson.ca

Reviewer 5:

Name:	Dr. Marc Johnson
Academic institution:	University of Toronto, Mississauga
Department:	Biology
Email:	marc.johnson@utoronto.ca

Reviewer 6:

Name:	Dr. Justin Podur
Academic institution:	York University
Department:	Environmental Studies
Email:	jpodur@yorku.ca

Potential conflict of interest. ***OPTIONAL***

Please list reviewers you would prefer Mitacs not to contact.

Name:	
Academic institution / Research Group:	

Name:	
Academic institution / Research Group:	

7. Mitacs Accelerate Memorandum

The participants listed below confirm that the information presented accurately reflects their intention to apply to the Mitacs Accelerate program. The participants have also agreed to set in place an internship based upon the attached proposal. The participants acknowledge that they have read, understood and agreed to abide by and uphold the Project Responsibilities applicable to each of them, available for reference at: http://www.mitacs.ca/en/programs/accelerate/project-responsibilities which include and are not limited to the following: It is understood that the partner organization contribution shall be provided to Mitacs Inc. prior to commencement of the internship; in the event that the sponsor organization funds are at the academic institution, the academic institution shall forward these funds to Mitacs. Upon research approval and the reception of the partner funds at Mitacs, Mitacs shall forward the funds to the academic institution as a research grant to the supervising professor, and the internship stipend/salary will be paid to the student by the academic institution from the grant. Costs associated with this proposal as outlined in the budget can only be incurred after research approval of the proposal and the receipt of the partner funds at Mitacs.

Mitacs is unable to assume liability for any losses including—but not limited to—accidents, illness, travel, or other losses that may occur during the internship period. All undersigned parties agree that they are responsible for ensuring that they have appropriate insurance and meet any institutional policies regarding health, safety, and travel preparation requirements. All parties also agree that the intern will provide Mitacs with a final report and that all participants will complete an exit survey within one month of project completion.

All parties involved with Mitacs Accelerate are bound by the standard intellectual property (IP) terms of the academic institution where the intern is enrolled; except where intellectual property is covered by separate agreements to which the academic institution and the sponsor organization are parties and that are active during the dates of the internship. By signing this memorandum, you are acknowledging that you agree to the terms of the academic institution where the intern is enrolled. institution-specific IP policies regarding Accelerate internships can be found at Frequently Asked Questions (FAQ).

The participants listed below agree that Mitacs can disclose the provided personal information included in this proposal (e-mail, LinkedIn, Twitter, Facebook, etc.) to the program's funding partners. Mitacs can use this information for the purpose of communication and to evaluate the program and its outcomes during and after participants' program tenure. The participants also agree that Mitacs will post the title of the project, the public project overview, the name of the partner(s) organization(s), the name of the intern(s), the name of supervisor(s) and the involved academic institution on www.mitacs.ca/en/projects and may be used by Mitacs to publicize Mitacs Accelerate. Mitacs Privacy Policy can be found at www.mitacs.ca/en/privacy-policy.

Internship participants (intern, supervising professor, and partner) further agree to the following addendum(s):

Mitacs does not require, inspect, or enforce any additional terms as outlined by participants in the above addendum.

7.1. Title of the Project:

Estimating the benefit of green infrastructure to urban ecosystems: A synthesis and case-study

7.2. Public Project Overview:

Globally cities are expanding and this has a negative impact on natural systems. Green infrastructure (GI), such as green roofs, retention ponds, or urban tree canopies, is used to mitigate the impacts of extreme weather and provide resources for people in the city. However, GI can also provide a benefit for native species and wildlife by providing a habitat for them to live. Although this is commonly suggested, to our knowledge, no one has attempted to quantify the effects of GI on natural systems. Within this project, we will conduct a literature review and use available data to quantify the response of natural systems to different levels of GI implementation for

the City of Toronto and region. Implications from this research will reduce the human impact on ecosystems and contribute to sustainability in the world.

7.3. Participant Signatures:

Please sign, scan and save in PDF format

7.3.1. Intern:

Name:	Alessandro Filazzola	
Department:	Biology	
Academic institution:	University of Toronto	
Signature:		Date: May 29 2018

7.3.2. Academic Supervisor:

Name:		
Department:		
Academic institution:		
Signature:		Date:

7.3.3. Partner Organization:

Name:		
Department:		
Title/Position:		
Organization:		
Financial Commitment:	$	
	The partner organization commits to the funding contribution specified directly above and the payment schedules outlined in the attached *Accelerate Resource Plan and Invoicing* schedule. These are key conditions of the application and by signing below this proposal, the partner organization agrees to these conditions.	
Signature:		Date:

7.3.4. Office of Research Services Representative or equivalent:

Name:		
Title/Position:		
Academic institution:		
Signature:		Date:

For any additional participants include corresponding details and signature line below:

Appendix A – Accelerate Intern Consent Form

USE AND DISCLOSURE OF PERSONAL INFORMATION PROVIDED TO MITACS

1. All personal information collected is subject to privacy legislation and Mitacs Privacy Policy for Program Participants. For a description of Mitacs' commitment to protect the personal information provided by program applicants, please see http://www.mitacs.ca/en/privacy-policy.
2. All the information supplied in this application will be made available to Mitacs staff responsible for managing the application, for activities including identifying appropriate peer reviewers, administering and monitoring awards, compiling statistics, and evaluating the program.
3. Information supplied in this application will be made available to internal and/or external reviewers, being composed of experts recruited from the academic, public and private sectors. All reviewers are required to commit to keep the application information confidential.
4. Contact information in this application may be used by Mitacs staff to contact you in future for:
   a. Invitations to be profiled in stories or news items, to speak at or attend events, to provide a spotlight story and/or blog post;
   b. Communications about opportunities for Mitacs alumni; and
   c. Research surveys for Mitacs alumni.

   You will have the opportunity to unsubscribe from emails sent to you, once all commitments regarding the internship that is the subject of this application are complete.
5. Your name, academic institution and department, and the title of your project may be provided to the federal, provincial and academic institution funders of the Accelerate program, to:
   a. Enable Mitacs to report on funding contract commitments; and
   b. Allow the funders to evaluate the program.

   Note that all Canadian provincial and federal governments, and academic institutions, are bound by privacy legislation and are therefore bound to keep your personal information confidential.
6. Your name and contact information may be provided to the academic institution at which this internship takes place to enable the academic institution to manage the award and for reporting purposes.

I, the undersigned, do hereby give CONSENT to the use and disclosure of the information contained in my application for the purposes as described above.

Alessandro Filazzola	_____	May 29 2018
Intern Name	Signature	Date

Appendix B - Drop Down - Options

Please delete if not applicable

Please refer to the drop down of the section, and type the corresponding answer on the space provided.

1.5. Academic discipline:

- Business
- Computer Science
- Earth Sciences
- Engineering
- Life Sciences
- Mathematical
- Sciences Social Sciences, Arts & Humanities
- Physical Sciences

1.6. Project priority sectors:

- Indigenous Affairs
- Advanced Manufacturing
- Aerospace
- Agriculture & Food
- Aquaculture & Fishing
- Automotive
- Biotechnology
- Clean Technology
- Commercial Services
- Construction
- Education
- Energy & Utilities
- Entertainment & Media
- Environmental Science & Technology
- Finance & Insurance
- Forestry
- Green/Alternative Energy
- Health and Related Sciences & Technology
- Information & Communications Technology
- Life Sciences (not health)
- Manufacturing & Construction
- Mining
- Nanotechnology
- Natural Gas
- Natural Resources
- New & Digital Media
- Ocean Tech
- Oil & Gas
- Pharmaceuticals
- Public Service, Policy, & Governance
- Sustainability & the Environment
- Technology
- Tourism
- Transportation
- Water
- Other (please describe)

1.8. List of Participants:

Partner Legal Status:

- For Profit Canadian Private Corporation
- Crown Corporation
- Not for Profit Canadian Corporation

4.2. Partner organization:

Partner size (No. employees):

- 1 to 49
- 50 to 99
- 100 to 499
- 500 and higher

Legal status:

- For Profit Canadian Private Corporation
- Crown Corporation
- Not for Profit Canadian Corporation

If NFP:

- Charitable Organizations
- Economic Development Organizations
- Health Organizations
- Industry Associations
- Social Welfare Organizations
- Other

4.3. Intern(s) identified:

4.3.1. Citizenship:

- Canadian:
- Permanent Resident:
- Foreign:

Gender

- Female
- Male
- Other gender identity