Kimmel Grant Recommendations:

Benoît St-Onge
University of Quebec at Montreal
"Automated mapping and spatial analysis of the urban forest using LIDAR to improve management"
Request: $10,000

Project Summary
Urban forests have both positive and adverse effects on human well-being, while their sustainability, given climate change and invasive species, is at risk. Setting targets for key attributes such as optimal tree density, age/size distribution, species variety, in this context will thus require precise data on public and private trees. Tree detection performed using airborne lidar 3D models can provide information on the size of most urban trees, and can also identify species or species groups with a good accuracy. We propose to test these methods on existing lidar data for the City of Montreal, used as a case study representative of North American cities, and derive the above-mentioned key attributes. From these we will produce indicators at the neighborhood level for the entire island of Montreal (500 km2) such as: local density and height of trees, species biodiversity, etc. The overarching goal is to develop methods for characterizing a) individual trees and b) features of the urban forest at the neighborhood level.

This project will be carried out in close collaboration with the City of Montreal, Canada. Having started to work on the above goals with them in 2018, but without external funding, the foundations of the proposed project are already laid out. Because the software tools will have to be delivered and explained to the personnel of the City of Montreal at the end of the project, the City's personnel will be autonomous for applying the methods as soon as 2019, as well as in the future, such that updating the data outputs will be possible. These outputs, i.e. a map of all individual trees visible from the air (both public and private) and their attributes and species, as well as maps of neighborhood level indicators, will help guide the City of Montreal in decisions for creating an urban forest that has a positive impact of human health and wellbeing, and that is more resilient to climate change and invasive insect species. The results will be disseminated at three levels: at the City of Montreal itself (one-day workshop), at the regional level (during a presentation at a conference attended by municipal actors from the entire province of Quebec, Canada), and internationally (during a presentation at one conference in the U.S.A., and in a paper in one international journal). Based on Montreal's case, we hope that the adoption the proposed approach and related technology by other municipalities will be facilitated.

Brandon Kyle Winfrey
Monash University, Australia
"Enhancing Tree Health in Water Sensitive Urban Design: Role of Mycorrhizae"
Request: $10,000

Project Summary

Stormwater control measures (aka, Water sensitive urban design (WSUD) approaches) capture and treat urban runoff that would otherwise impact ecosystem and human health. Urban trees that are planted in WSUD play significant roles in mitigating pollution and hydrologic effects from stormwater [1], enhancing aesthetics [2], and microclimate cooling [3]. However, growing conditions for trees in these systems may be compromised for other design goals, such as promoting infiltration through coarse filter media [4]. Stormwater biofilters are a widely adopted WSUD approach that remove pollutants from stormwater runoff by supporting removal processes in a vegetated filter media bed designed to promote infiltration, thereby protecting waterways and public health. Microbial communities in stormwater biofilter filter media play crucial roles in processing pollutants and supporting plant growth. Consequently, the capacity of biofilters to remove nutrients and metals is affected and, at times, driven by the microbial communities that are present [5]. Trees are in integral part of many stormwater biofilters and are present in roughly one out of five of all surveyed roadside biofilters in Australia [6].

Vesicular arbuscular mycorrhizal fungi (VAM) associate with most terrestrial plants [7]. VAM establish a mutualistic association with plants in natural ecosystems and have been observed in biofilters [8]; VAM can improve the supply of nutrients and water for plants, enabling them to increase their photosynthetic capacity and growth, even under water stressed conditions [9]. Pollutant removal in stormwater biofilters corresponds to plant health [10], which can diminish during dry periods; inoculating biofilter plants with VAM may facilitate plant physiological processes that improve drought tolerance, mitigate the effects of these dry periods on plant health, and thereby improve pollutant removal in subsequent wet periods.

The aims of this research are to 1) evaluate effectiveness of inoculating biofilter tree roots with VAM using two common methods, 2) test the response of inoculated biofilter plants (forb and tree species) to remove nutrients and metals following a prolonged dry period in VAM and control roots, and 3) determine effects of VAM on biofilter plant health during and following a prolonged dry period.

The work proposed in this application leverages a larger project which evaluates the same inoculation methods and resulting effects on two forb species common in Australian biofilters.