Characterising SuDS Pond sediments in relation to Water Quality, Biodiversity & Ecosystem Functioning: implications for provision of multiple benefits (Ref IAP2-18-105)

Heriot – Watt University: Institute for Infrastructure and Environment, Institute of Life and Earth Sciences, School of Energy, GeoScience, Infrastructure and Society
In partnership with Newcastle University

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Overview

SUDS ponds are an important part of Blue\Green Infrastructure (Allen et al, 2018). They help to alleviate flood risk and provide a number of further benefits, including e.g. recreational and amenity value, biodiversity habitats, and water quality improvements.

The proposed project will build upon the scientific research carried out within the BGC and UFR projects (funded by EPSRC) and aim to study the ecosystem functioning (Costanza et al, 2017) and services / benefits provided by SuDS ponds and compare them with non-SuDS urban ponds (Jarvie et al 2017, Krivtsov et al, in preparation). In particular, previous research investigated differences in macroinvertebrate communities between inflow and outflow points, and linked them to differences in water quality and the performance characteristics of the ponds. However, the role of planktonic organisms, and the details of their involvement in technological functioning of these SUDS components, is currently understudied.

The proposed project will focus on characterising suspended sediments and understanding their impact on pond ecology, with a particular focus on benthic, periphytonic and planktonic microbiota. The project will also aim to study the provision of multiple benefits, including biodiversity and amenity values.

Methodology

Characterisation of suspended sediments
A considerable proportion of pollutants in aquatic ecosystems is absorbed to sediment particles. Suspended sediments also alter penetration of light, and thus influencing the dynamics of primary producers. Hence characterisation of sediments, and in particular of suspended particulate matter, is important for describing patterns of ecosystem dynamics but not fully understood in this context. Therefore, an important part of the project is analysis of water quality, sediments chemistry and particle size distribution.

Ecological surveys
Within the project, it is intended to gather information on the biological community of the ponds and adjacent areas, and a number of ecological surveys (e.g. vegetation, fungi, vertebrate animals) will be planned in that respect.

It is also intended to characterise the planktonic community of the ponds studied, and in particular the presence/absence of cyanobacteria, and the

abundance of diatoms. The preliminary hypothesis is that the planktonic, benthic and periphytonic community in these ponds is instrumental for water quality improvements, but may be limited both by catchment characteristics physical factors and by nutrients.

Site selection
A number of sites has already been established within the previous HW research (Jarvie et al 2017, Krivtsov et al, in preparation) and these may be supplemented by further opportunities (e.g. the J4M8 distribution park and Houston Industrial Estate).

Analysis and modelling
As part of the study, it is intended to collect information on the ponds' inflow and outflow, volumes, depth profiles and catchment areas; for that, information from land managers and local authorities (e.g. West Lothian Council and Edinburgh City Council) will be sought. That information will be combined with meteorological data (downloaded from the met office website) to run a simple hydrological model (with support from Newcastle University). This will allow estimation of the ponds' hydraulic loadings and retention times, and provide indispensable background information for further analysis of ecological patterns and assessment of overall ecosystem functioning.

Timeline

#	Research Activity	Y1	Y2	Y3	Y3.5 (6m)
1	Agree detailed aims	x			
2	Literature review	x	x	x	
3	Data collection	x	x		
4	Data analysis		x	x	
5	Training/Workshops.	x	x	x	x
6	Progress meetings	x	x	x	x
7	Thesis writing and submission of drafts			x	x
8	Final thesis				x

Training & Skills

The student will receive and have access to the full variety of the extensive IAPETUS2-cohort training, including workshops and cohort meetings. This will enable the PhD student to develop broader transferable skills and knowledge.

As part of the PhD programme at Heriot-Watt University, the student will be offered training and development opportunities. It is anticipated that over the course of the PhD study, the student will develop knowledge skills and expertise to undertake independent research in his/her field or future employment in policy or practice. The student's training needs will be identified within the first year of study. These will be compiled into a training and development plan tailor made to the specific student needs and skills set. As part of annual progress monitoring, training undertaken will be recorded and discussed with the student. To develop key skills and expertise such training and skills development will broadly be on:

Plant ID course
Freshwater ecology ID courses
Training in methods of water chemistry, Image Analysis and Microscopy

It is expected that training in Ecological Surveying techniques will be facilitated by the environmental consultancy 'Where the wild stuff is' http://www.wildstuff.site/

References & Further Reading

1. Allen, D., Haynes, H., Olive, V., Allen, S. & Arthur, S., 29 Aug 2018, The short-term influence of cumulative, sequential rainfall-runoff flows on sediment retention and transport in selected SuDS devices, Urban Water Journal.
2. Costanza, R., de Groot, R., Braat, L., Kubiszewski, Fioramonti, I., Sutton, L., Farber, P., & Grasso, S. 2017. Twenty years of ecosystem services: How far have we come and how far do we still need to go? Ecosystem Services, 28: 1-16.
3. Jarvie, J. A., Arthur, S. & Beevers, L. C., 16 Feb 2017, Valuing multiple benefits, and the public perception of SUDS ponds, Water. 9, 2, 128.
4. Krivtsov et al, in preparation, The Ecological Performance of SUDS ponds.

Further Information

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