

Modelling Ecosystem Restoration for Multiple Benefits in Urban and Natural Environments

An online workshop jointly hosted by Yunnan University (Institute of International Rivers and Eco-security) and UKCEH (the DeSCIPHER project)

1st-2nd November 2022 (each day 0800-1100 UK (GMT): 1600-1900 China)

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Overall summary

The scale of the challenges we face means that the demand for informed, excellent and relevant environmental science, shared across the globe, is greater than ever. We need to design more effective monitoring schemes, develop better and more integrated indicators for biodiversity and ecosystem resilience that show if we are really making progress, and develop ecosystem scale models for scenario analysis and planning. These needs are especially urgent in urbanising environments where the science community is addressing the holistic benefits of green and blue infrastructure. It is crucial that we take this work further and work in close international collaboration if we are to ensure timely and significant progress towards our shared environmental ambitions.

Our workshop will bring together environmental science and socio-economists to focus on progress with assessing how to best manage land for multiple benefits. Our shared objectives must seek to ensure both future health of aquatic and terrestrial ecosystems and a sustainable environment for human wellbeing. Sessions will have particular emphasis on the ecosystem service benefits provided by forestry and through establishment of engineered nature-based solutions. We explore the importance of global sharing and co-design of approaches, with a view to best account for local constraints and considerations for implementation. Only in this way can we work towards securing maximum economic benefit and ensuring the importance of tangible and sustainable success against SDGs.

To address restoration of terrestrial and aquatic environments we present examples of multiple benefit assessments in case-study urban environments from the JPI Urban Europe-NSFC DeSCIPHER project which covers case studies in three countries (UK, Norway, China). We discuss these and other similar examples from urban and rural environments in China and east Asia to identify the biggest challenges and opportunities facing ecosystem restoration practitioners from diverse perspectives across research, governance and business sectors.

Summary of agenda and discussions

(copies of slides available from presenters on request)

Day 1

Chair (Mike Hutchins, UKCEH)

- 1. A conceptual approach for assessing multiple benefits of urban nature based solutions. Combining environmental science and societal considerations and addressing issues of scale. The example of urban tree planting (Mike Hutchins (UKCEH, DeSCIPHER): 15 mins)**
 - Question: Cities studied are quite rich in rainfall, e.g. Oslo, Suzhou, but what about dry conditions, what could be approaches for NBS and SD in drier climates?

- Answer: Focus in European cities was on wetter places, but publication has considered droughts and their impacts on ES and the viability of NBS implementation, although without much detail so far; REGREEN includes 3 case studies in China, e.g. Beijing, which has a different drier climate compared to Kunming for example.

2. Interactive session 1 (1 min/participant): what are your biggest challenges with rural or urban NBS? (DeSCIPHER facilitators Stefan Reis (UKCEH)/Steven Loiselle (Earthwatch): 30 mins including discussion)

- Isabel Seifert- Dähnn and colleagues (NIVA): currently enough water, potentially too much at times in Oslo; need to know multiple purposes of NBS and knowing exactly how NBS performs when implemented; its effects can pose a challenge when communicating with practitioners and policy decision makers. Inequalities are another challenge, so a key question is how inclusivity can be addressed when designing NBS. Integrating socio-ecological benefits remains a challenge.
- Jia Haifeng (Tsinghua University): large programme of case studies in many cities is ongoing, evaluating a variety of NBS challenges. Suzhou is a provincial pilot city for NBS and has an abundance of water, flooding and water quality are the main challenges there; main challenges are (1) how to quantitatively evaluate the multiple benefits of NBS implementation, (2) how to link and optimise the combination of green and blue infrastructure, (3) cost-benefit assessment which needs clear, convincing evidence for (local) policy makers.
- Laurence Jones (UKCEH): challenge to quantify the multifunctional benefits, as we often implement an NBS e.g. for flood water management, but so far we are not very good at e.g. quantifying the social benefits. How NBS supports or affects biodiversity is another challenge.
- Yao-Yang Xu (IUE-CAS): in science and research we know that there are multiple benefits, but challenge is how to translate this into action, and how to inform policy makers and urban planners. There is top-down-design in urban planning in China, but planning cities for people is the primary objective; how to transform NBS action towards accepted and accessible solutions.
- Tao Lin (IUE-CAS): the spatial limitations for urban intensification in China is a major challenge as there is not much space left for green infrastructure; analysis of benefits is very important. Persuading local governments to use green rather than grey infrastructure is vital and so far not very well embedded in local understanding and general knowledge.
- Gillian Dick (Glasgow City Council): there is need to look at the world through an NBS lens; taking a place-based approach means that when any change is made in a space, no harm arises in terms of any of social cohesion, biodiversity, economy, environment. NBS does not constitute a solution if only focused on one sole purpose, it has to be holistic. Glasgow took an open space approach to implementing NBS; improving space holistically (e.g. for relaxation) meant people did not need to know it may have been designed for flood management, but that the overall improvement of space was beneficial for all. A big challenge is still data format and accessibility, a lot is still in PDFs, documents, reports, but needs to be possible to visualise to make it easier to communicate to the public and decision makers, and to support co-production.
- Alex Hagen-Zanker (University of Surrey): research has mostly focused on the social benefits of NBS and their potential to transform towns making them accessible and traversable, and making them a better living environment; constraints of existing infrastructure are often a

major challenge when trying to transform places and introduce new NBS.

3. Consideration of how to work towards identifying ultimate population benefits in each environmental domain. Mapping ecosystem service benefits to the recipient population. (Alex Hagen-Zanker (University of Surrey, DeSCIPHER): 15 mins)

4. Urban Nature-based Solution case studies:

Suzhou: Incorporating receiving waters responses into the framework of spatial optimization of LID-BMPs in plain river network region (Linyuan Leng (Tsinghua University, DeSCIPHER): 20 mins).

- Question: How difficult is it to apply the model to different cities with different challenges/conditions?
- Answer: Model is flexible to be adapted to other cities and locations, and should be possible to use in different situations
- Question: Which water quality aspects did you model?
- Answer: Mainly looking at water pollutant concentrations, respectively nutrient pollutant concentration reductions as an indicator for improved water quality.

Birmingham: Multiple benefit assessments of establishing urban nature based solutions for flood control, water purification, noise abatement, air pollutant removal and provision of green space access (James Miller, Yueming Qu & David Fletcher (UKCEH), Alex Hagen Zanker (University of Surrey, DeSCIPHER): 40 mins)

In both Birmingham (flood mitigation) and Suzhou (flood mitigation and water purification) there has been focus on bio-retention, green roofs and permeable paving measures. In all Birmingham studies there has been focus on tree planting.

5. Scale-dependent impacts of high nitrogen loading on aquatic ecosystem (Haijun Wang (Yunnan University): 20 mins)

6. Development of prediction system for algal bloom - a case study at Lake Dianchi (Liancong Luo (Yunnan University): 20 mins)

- Question: How well does the model work when used in real-time forecasting mode?
- Answer: good but not much data to test this

Day 2

Chair (Juan Tao, Yunnam University)

7. Ecological functions of green roofs in high density urbanization area (Tao Lin (IUE-CAS Xiamen): 15 min)

- Question: Are the cooling effects obtained over the green roofs also having an effect on the temperature in the street canyons between the skyscrapers?
- Response: focus on assessing effects is on remote sensing data
- Question: Have you looked at temperature anomaly rather than absolute LST? How do you make sure that 2014 vs 2017 comparison is fair (weather patterns comparison)?
- Response: in fact the absolute LST from RS is not comparable for different time. so we calculated the temperature difference between green roof and Xiamen island, and the

counterpart between its buffer zone and Xiamen island; we also select the RS images with similar climate conditions; papers: Zuo J, Ma J, Lin T, Dong J, Lin M, Luo J. 2022. Quantitative valuation of green roofs' cooling effects under different urban spatial forms in high-density urban areas[J]. Building and Environment, 222: 109367; Lin, M., Dong, J., Jones, L., Liu, J., Lin, T. *, Zuo, J., Ye, H., Zhang, G., Zhou, T., 2021. Modeling green roofs' cooling effect in high-density urban areas based on law of diminishing marginal utility of the cooling efficiency: A case study of Xiamen Island, China. J CLEAN PROD 316, 128277; Dong, J. , Lin, M. , Zuo, J. , Lin, T. , & Luo, J. . (2020). Quantitative study on the cooling effect of green roofs in a high-density urban area—a case study of Xiamen, china. Journal of Cleaner Production, 255, 120152.

- Question: Do you think in future it will be possible to model separately the cooling from intensive and from extensive roofs?
- Response: Yes, we will continue this work but the challenge is to find case study area, now we have obtained the data from Chengdu City which has much larger green roof area. So we can model the cooling effect for intensive and extensive roof in the near future. Welcome to join us!

8. Sponge City research in China with specific reference to case study of Guiyang (Faith Chan (University of Nottingham Ningbo): 15 min)

- Comments as to whether: (1) Guiyang managed to attract private funding for some of its SPC projects, (2) artificial wetlands are designed differently in Guiyang compared to Ningbo (for example) due to the different geographic/climatic context.

9. Migrating hydrologic data from data-rich regions to enhance the streamflow prediction (Kai Ma (Yunnan University): 20 mins)

- Question: how good are the machine learning models you described at predicting response to change (e.g. change in land use, climate)?
- Response: not much focus on this yet partly as not easy to test this sensitivity to change at the right spatial scale. More methods may be needed to look at climate change predictions.

10. A modelling study of the source of ozone pollution in China and implications for ozone control. (Kaihui Zhao (Yunnan University): 20 mins)

11. Assessing economic value of urban NBS, exploration of financing and governance mechanisms for facilitating uptake. (Isabel Seifert-Dähnn (NIVA, DeSCIPHER): 20 mins)

12. Reflective presentations:

How are cities implementing assessment systems for designing Nature-based Solutions? (Gillian Dick (Glasgow City Council): 15 mins);

- Comment as to whether and how Glasgow is using the IUCN global standard on NBS. Norwegian stakeholders perceived this to be very complicated.
- Question: about the impressive map-based tools you mention what are the biggest challenges with iteratively keeping up to date with new information e.g. new science? Answer: challenges are the 'extra bits', finding out what data exists, how often is it updated etc., trying to incorporate that information in particular with regard to data that has a limited shelf life; keeping information up-to-date is important. Aiming to make this iterative

in selecting sites when multiple potential sites are identified, putting the most important site in and re-running the model to avoid

- Link to the tool was shared with all participants: <https://co-impact.app/>

Technical challenges and an example of between-city comparisons for water quality (Mike Hutchins (UKCEH, DeSCIPHER): 10 mins)

- Comment on use of tools to identify which place(s) are the best locations to plant trees in a city for multi-objective optimal solutions – e.g. Marxan - <https://marxansolutions.org/>

Significance of rural-urban interactions (Laurence Jones (UKCEH, DeSCIPHER): 15 mins);

- Comment as to considering about solutions to changing human behaviours in urban areas towards enjoying/engaging more with nature-based solutions and natural spaces?

13. Interactive session 2 (1 min/participant): reflections: what opportunities do you see and what is your biggest take-home learning point? (DeSCIPHER facilitators Stefan Reis (UKCEH)/Steven Loisel (Earthwatch): 30 mins including discussion)

- Dr Faith Chan (University of Nottingham Ningbo): working jointly with UKCEH on NBS and implementation for a long time already; identifying more opportunities for collaborations during the workshop; specifically spatial planning/methods for NBS and sponge cities, benefits assessment, heat island effects, greenspace; natural flood management and NBS interactions highlighted; wider integration using new technologies, e.g. big data analyses, social media, citizen science etc.; could engage more with secondary schools on curriculum to include NBS, green space, ecosystem services topics.
- Mike Hutchins (UKCEH): forecasting systems are emerging topics e.g. for waste water management, which could be an area for joint progress and a focus for future collaborations. Responsibility for scientists to advance the state-of-the art, but as well with planners and decision makers to ensure that this is reflected in operational tools.
- Tao Lin (IUE-CAS): highlighted that NBS is useful and valuable for tackling key challenges; findings need to be very close to the tools actually used for urban planning; can we develop simple analysis tools for the general public, planners, policy makers, not only for experts and advanced users; in China the development strategy of an 'ecological population' is established and becoming embedded in conceptual thinking, but needs further integration of latest findings into practice to improve outcomes.
- Comments from Yunnan University: learned a lot about NBS and worked much on transboundary aspects, e.g. streamflow. Predictive modelling is a key opportunity for future development. Highlights the Importance of assessing the multiple benefits of NBS and the need to demonstrate to governments and decision makers what the real benefits are that can be realised, including monetary valuation.
- Isabel Seifert-Dähnn (NIVA): opportunities for working across country boundaries; for example very interested in learning how China addresses financing of NBS to inform Norwegian approaches. It is important to find enthusiastic role models in planning and local governments, inspire similar enthusiasm elsewhere.
- Laurence Jones (UKCEH): benefits to people and their quantification are still a major challenge; mostly done in qualitative terms, but need to advance quantification
- Stefan Reis (UKCEH): cross-boundary and cross-scale aspects are important to include in the research and the tools developed.