Water plays a key role in reducing urban heat

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Heatwaves and heavy local rainfall will increase with climate change, pushing traditional urban drainage systems to their limits. These problems can be addressed using the blue-green infrastructure approach. With careful planning, solutions of this kind can also increase biodiversity and improve the quality of urban life.

Climate models all point to an increase in the duration and intensity of heatwaves and dry spells in Switzerland. Also likely to increase, however, are intense rainfall events, creating major problems for urban drainage systems. One idea currently being promoted almost as a panacea to counter both of these trends is blue-green infrastructure (BGI): put simply, this comprises waterbodies and green spaces in the urban areas – including trees and green roofs or facades. As this approach involves the retention and delayed release of rainwater, the term "sponge city" is sometimes also used, or – more broadly – nature-based solutions (NBL).

Evaporation: a crucial cooling mechanism

As now understood, BGI encompasses more than individual trees or fountains in parks: rather, this approach should be based on strategic planning and take advantage of the potential to improve urban ecology. Thus, in all BGI schemes, a central role is played by a near-natural water cycle, with watercourses and open expanses of water in the urban environment. This is the case, in particular, because evaporation of water is the predominant cooling mechanism and because waterbodies in urban areas are of vital importance both for biodiversity (serving as connectivity and migration corridors) and for the community's quality of life.

The "Cours Roger Bonvin" park – on the roof of a motorway tunnel in Sion – was landscaped with pools and 700 maple trees to provide shade and cooler temperatures in the city.
(Photo: Tiia Monto, cc 3.0)

Multifunctional facilities: an opportunity

These findings emerged from a review of the literature on BGI conducted by Eawag scientists and just published in the journal Aqua & Gas ("Urban heat reduction strategies", only available in German). In the study, not only vegetation (trees, green roofs, etc.) and areas of water (pools, fountains, etc.) but also special surfaces (e.g. permeable asphalt) and practices designed to promote cooling (creation of cold air corridors, irrigation, etc.) were analysed and classified on the basis of their urban cooling potential. Irrigation of surfaces and green spaces and the creation of cold air corridors were found to have the greatest cooling effects. A particularly attractive option are urban wetlands – a combination of vegetation and open expanses of water – which not only offer a cooler natural area for the population but also contribute to aquatic and terrestrial biodiversity. According to first-author Peter Bach of Eawag's Urban Water Management department, "The multifunctional aspect of these facilities has previously often been overlooked."

Integration into existing planning

Whereas plans for urban drainage often date back many years, an integrated approach to BGI development is widely lacking. Though isolated measures may be evaluated, the integration of an overall scheme into existing planning is the exception rather than the rule. Some cantons (e.g. Geneva, Lucerne, Aargau) have indeed developed climate adaptation or heat reduction strategies, and technical planning has been pursued in individual cities (e.g. Zurich heat reduction planning, Winterthur urban climate blueprint), but in most cases such instruments have yet to be enshrined in legislation or standards. Likewise, support programmes are rare, even though foreseeable problems arising from climate change and urbanisation would need to be tackled now. Bach concludes: "Unless BGI is systematically taken into account, we will no longer be able to meet the demands of urban stormwater management."

Planning tools for policymakers and urban developers

How do individual measures or combinations of measures affect urban temperatures? Today, these questions can be answered with the aid of microclimate modelling and mapping tools. As such information is useful for urban planners, an existing model has been further developed at Eawag for use in Switzerland. The model is known as TARGET (The Air-temperature Response to Green/blue-infrastructure Evaluation Tool). Original publication

The model considers land cover, building height and street width. Simulations in Zurich und Bern showed good agreement of temperature predictions with data collected from suitably distributed private weather stations. The model is now to be refined in a project (“Heat-Down”) funded by the Swiss National Science Foundation. In particular, the regional water cycle is also to be modelled. The TARGET module is also integrated into the much more comprehensive urban planning support system UrbanBEATS (Urban Biophysical Environments And Technologies Simulator). Legacy versions of both models can be downloaded free of charge from: www.urbanbeatsmodel.com

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