Assessing the effectiveness of urban gardens as green infrastructure in the Washington, DC area

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Urban agriculture has many benefits

***Figure 1**: The multifaceted benefits of urban agriculture (Duchemin, Wegmuller and Legault, 2008). Aspects related to social benefits are marked in orange, environmental aspects in green and economic aspects in blue. Multiple colors indicates benefits on multiple levels.*

Green space reduces runoff

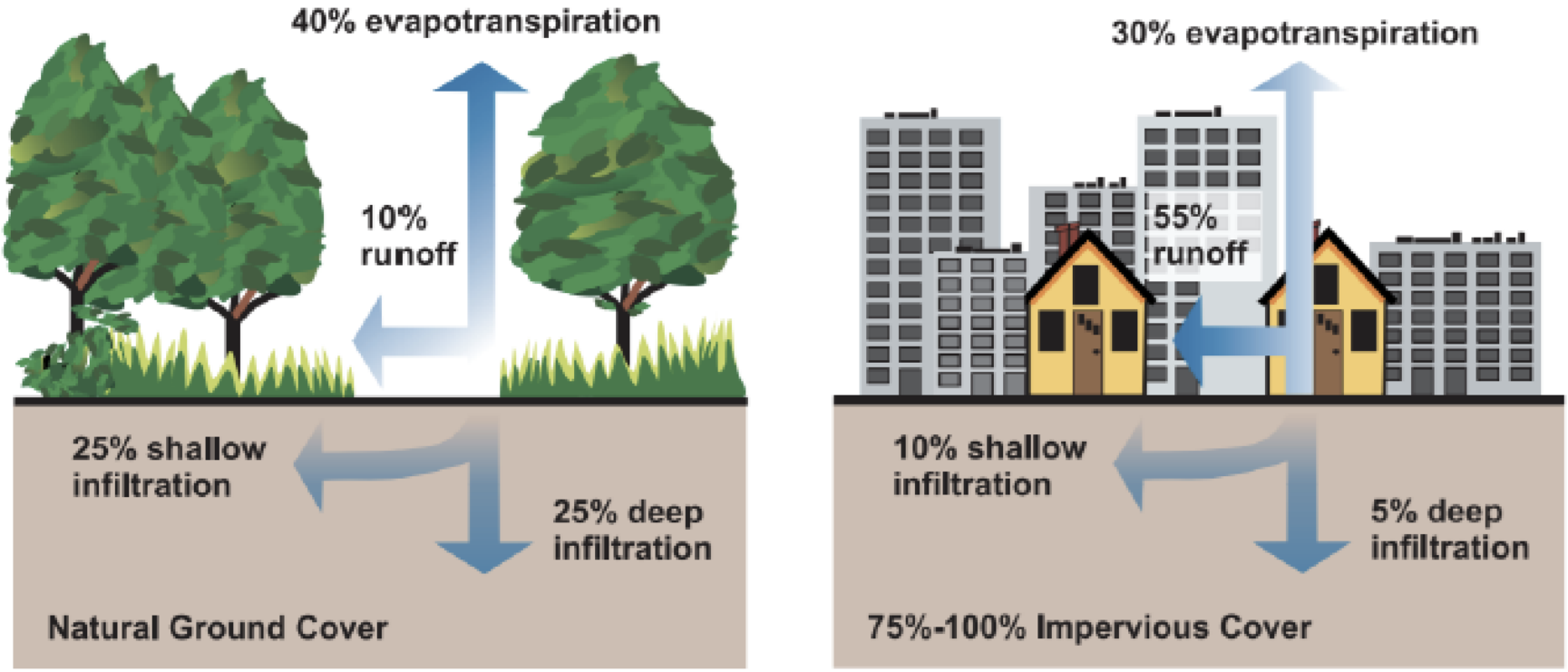


***Figure 2**: Simplified illustration of the relationship between impervious cover and surface runoff during a rainfall event in a natural landscape compared to an urban area (EPA, 2003).*

Urban gardens in Washington, DC

- DC Department of Parks and Recreation oversees 30 community gardens
- Survey by NGO Rooting DC suggests that over 150 community gardens exist
- Increasing in number and popularity
- Runoff quantity and quality has not been measured

Research Questions/Goals

- Develop methods appropriate to small plots with no consistent slope, with different vegetation cover and soil properties
- Use these methods to quantify runoff quantity and quality from plots in planted beds and adjacent grassy plots in DC-area urban gardens

Methods: Field Equipment

Runoff collector – installed at one planted bed and one grassy plot at each of 4 urban farms.

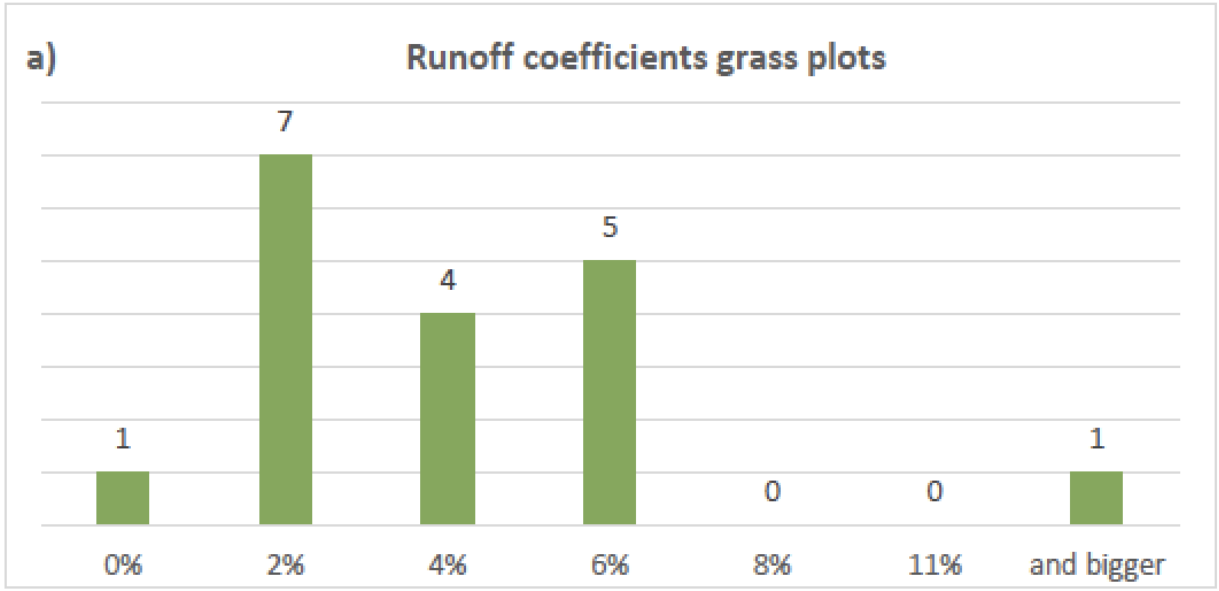
Rainfall simulator – designed to simulate heavy rain events that would generate runoff on a vegetated surface

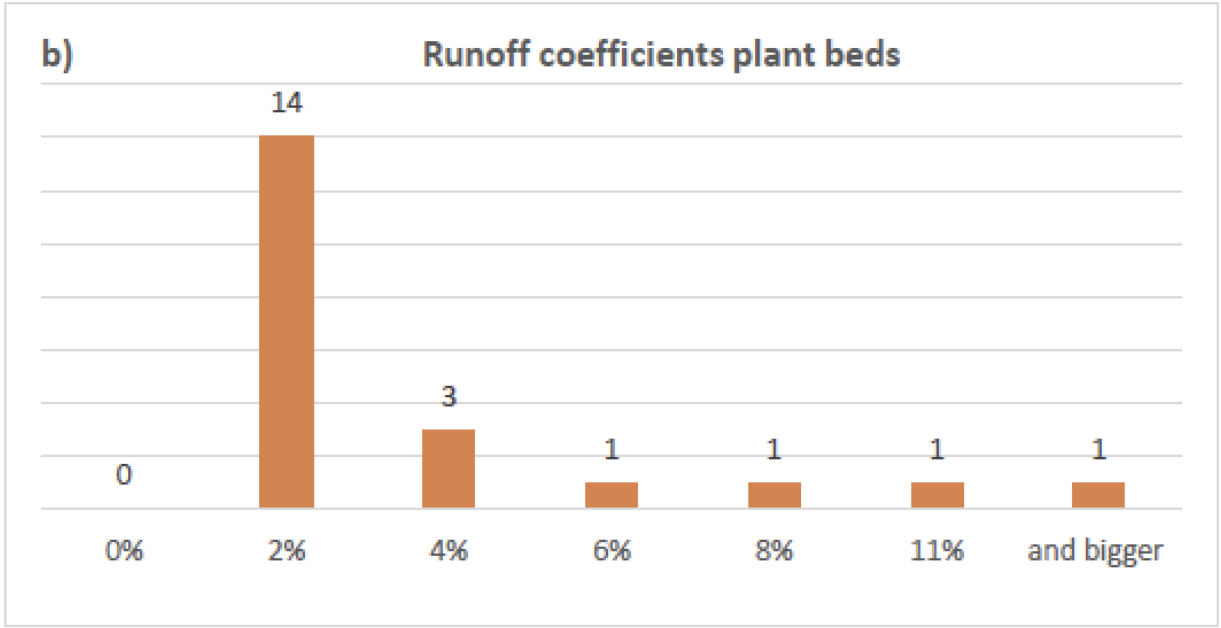
Methods: Field Sites and Protocols

- Sites: Eco-City Farms (2 sites), Washington Youth Gardens, K Street
- Rainfall intensity and runoff volume measured to calculate runoff coefficient
- Concentrations of nutrients and dissolved metals in runoff measured
- Soil properties (metal and nutrient concentrations, hydrologic soil group, soil texture, soil organic matter, bulk density)

Runoff coefficients in grass plots and plant beds

Runoff coefficient = Runoff/Precipitation





Variation in runoff coefficient among gardens

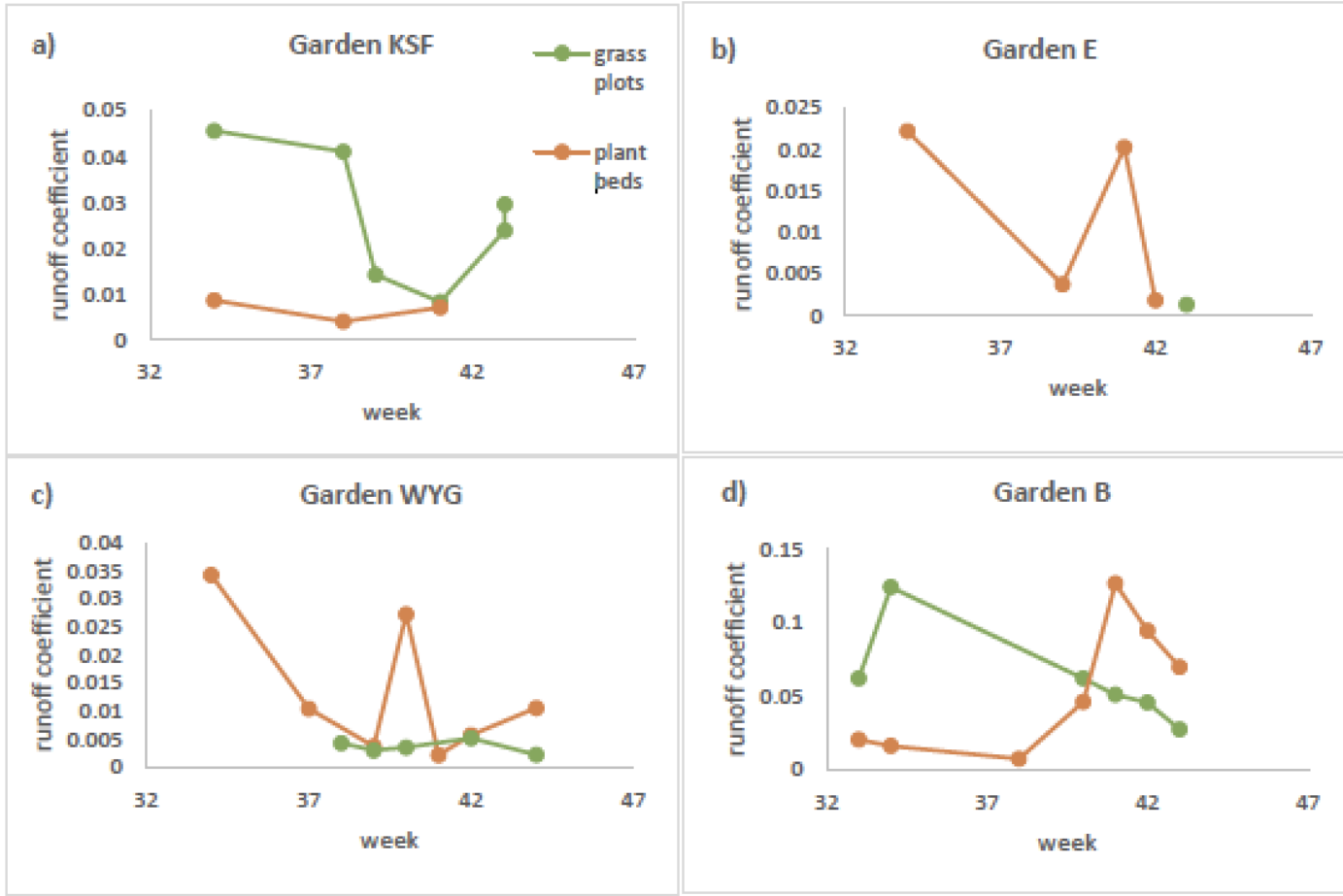
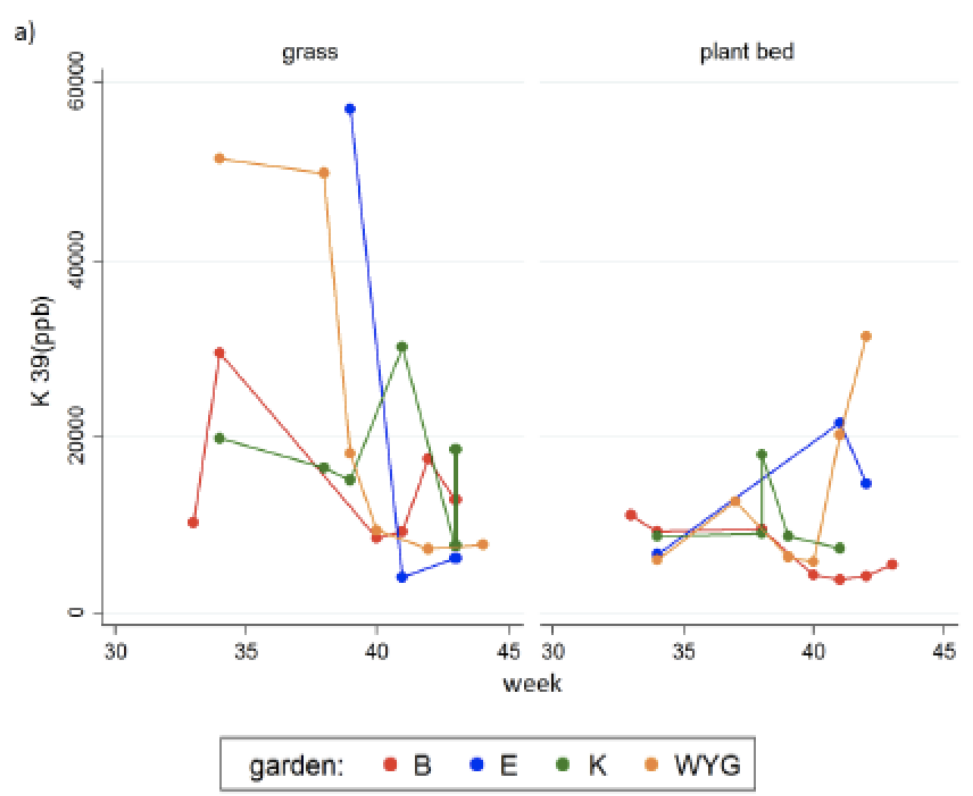


Figure 21: Runoff coefficient trends in each garden;
K-Street Farm (a), Edmonston Farm (b), Washington Youth Garden (c), and Bladensburg Farm (d)

Dissolved nutrients and metals

- Nitrate, phosphate, ammonium
- Be, Na, Mg, Al, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Mo, Ag, Cd, Sb, Ba, Hg, Tl, Pb measured
- Only Mn and K showed evidence of being different in runoff than in simulated rainfall
- No clear trends for Mn or K

Potassium (K)



Lessons learned

- Important to characterize the quality of synthetic rainwater (tap water) by collecting a blank sample before every simulation
- Important to carefully control simulated rainfall intensity
- Increase number of plots per garden
- Simulations cannot be conducted on days with high winds (>6 m/s)
- Investigate how urban gardens compare to other green infrastructure (e.g. green roofs, bioswales) in terms of runoff quantity and quality

Ongoing work

- DCWRRI funded
- Monthly rainfall simulation and runoff collection at 4 DC-area gardens (Eco-City, Washington Youth Garden, Common Ground)
- 2 planted beds and one grassy plot at each site
- Sampling green roof sites and grassy plots at American University
- Consistent methodology, monthly sampling throughout 2018 growing season

Thank you!
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