

A Most Valuable Accident: Accidental Wetlands Provide Ecosystem Services in an Aridland City

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What are accidental wetlands and what services might they provide?

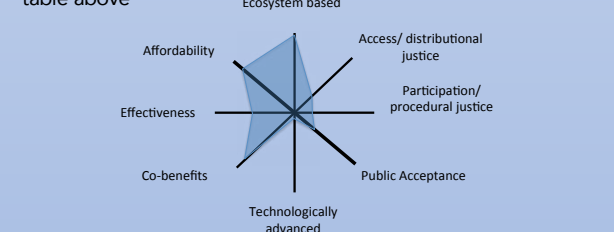
- Unplanned, unmanaged, forming in low places where water collects (i.e., dry Salt River bed in Phoenix) (Palta et al. 2017).
- In an arid environment, wetlands are cooler, greener, and receive inputs from stormwater, urban base flow, and in some places, treated wastewater. Thus, they have the potential to provide ecosystem services; but also disservices
- Colonized by native and exotic plant species; habitat for diverse bird and herpetofaunas (Banville et al. 2017, Bateman et al. 2015).
- Frequented by people experiencing homelessness (Palta et al. 2016).



Service	Accidental wetlands as service provider	Disservices associated with accidental wetlands
Water quality modulation*	Removal of pollutants transported into wetlands	Concentration of pollutants, i.e., metals, pathogens
Heat modulation*	Cooler than surrounding urban matrix	
Food provision	Potential for gardens, fish	Contamination
Protection from flooding	Capacity to absorb and/or slow down high flows	
Sanitation*	Water for bathing	Contamination; may be dumping grounds
Recreation and experience of nature*	Rare ecosystem type in urban matrix	Accessibility, safety
Habitat for organisms	Refuge for native species not otherwise present in urban environment	Also habitat for invasive species, pests

How effective are the wetlands in delivering ecosystem services?

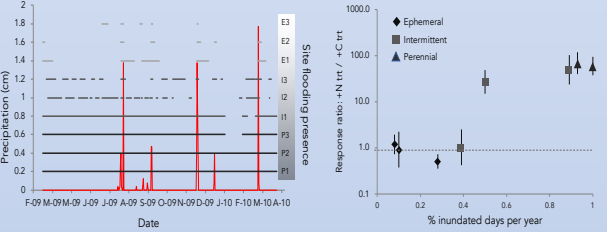
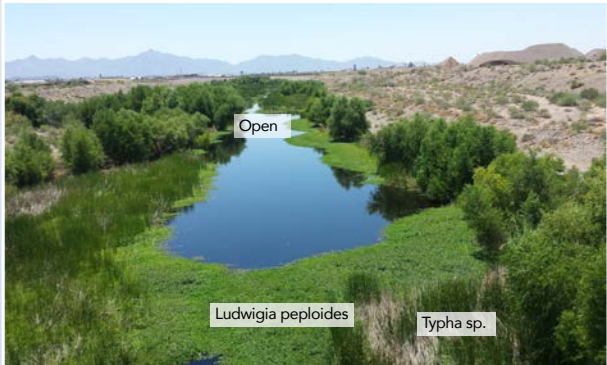
- Based upon a rubric for assessing solutions in SETS (social-ecological-technological systems), we hypothesize:
 - Social – low scores on environmental justice, public acceptance; high score on affordability
 - Ecological – high score on ecosystem-based, co-benefits, intermediate effectiveness
 - Technological – intermediate score on effectiveness, zero score on technologically advanced
- We primarily evaluate the services listed with an asterisk in the table above



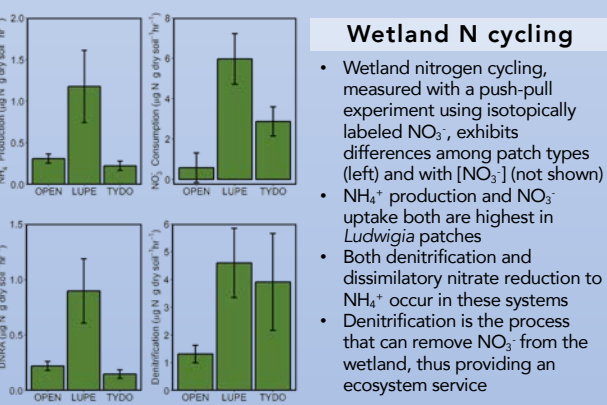
The Salt River wetlands: structure and function



- Occur in dry river bed
- Support three main patch types:
 - Vegetated: *Typha* spp, *Ludwigia peploides*
 - Unvegetated: open substrates



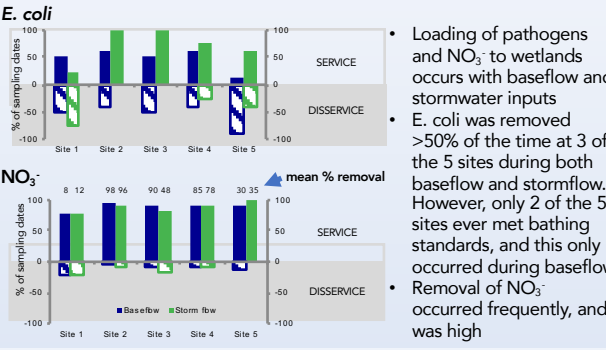
- Storms resupply wetlands but a gradient from perennial to ephemeral wetlands exists (above, left)
- Ephemeral wetlands tend to be carbon limited (above, right) whereas perennial wetlands are nitrogen limited



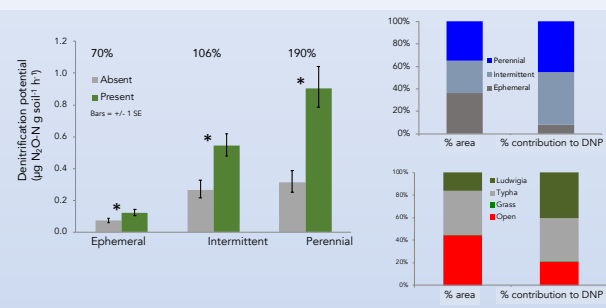
Wetland N cycling

- Wetland nitrogen cycling, measured with a push-pull experiment using isotopically labeled NO_3^- , exhibits differences among patch types (left) and with $[\text{NO}_3^-]$ (not shown)
- NH_4^+ production and NO_3^- uptake both are highest in *Ludwigia* patches
- Both denitrification and dissimilatory nitrate reduction to NH_4^+ occur in these systems
- Denitrification is the process that can remove NO_3^- from the wetland, thus providing an ecosystem service

Nitrogen and pathogen removal as ecosystem services



Presence of wetland plants and hydroperiod both increase the potential for N removal via denitrification



Human use of the wetlands

Heat refuge and sanitation for the homeless

- Based on trash surveys and environmental measurements (25 points, 4 sites), and interviews with people using the wetlands:
- >600 trash items
 - Bathing/hygiene items: 100% of points
 - Habitation items: 68% of points
 - Recreation items: 72% of points
 - Water always cooler than air
 - Air temperature as much as 6°C lower than in surrounding neighborhood
 - Privacy score higher in wetland than neighborhood
 - People interviewed cited use of water for bathing, drinking; enjoyment of nature; preference over homeless shelters

Experiencing nature

- Phoenicians are giving renewed attention to their river (John McCain initiative to 'bring back the river', etc.)
- Workshop with community leaders, city officials, NGOs, academics to envision futures for underserved South Mountain Village identified the "Mountain to River" theme as providing:
 - Sense of place
 - History and identity
 - Connectivity (via washes and corridors)
 - Flood resilience