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

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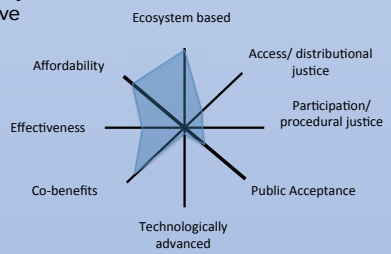
## What are accidental wetlands and what services might they provide?

- 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).

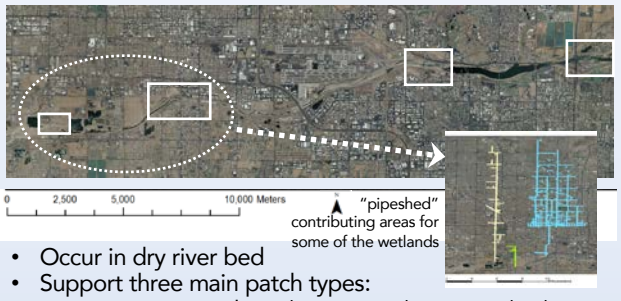
| Service | Accidental wetlands as service provider | Disservices associated with accidental wetlands |
|---|---|---|
| Water quality modulation* | Removal of pollutants transported into wetlands | Concentration of pollutants, i.e., metals, pathogens |
| Heat modulation* | Cooler than surrounding urban 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?

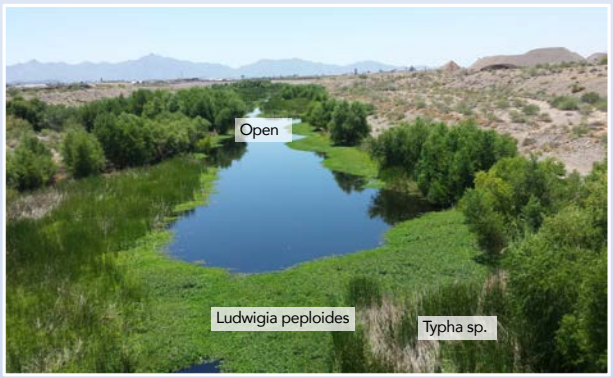
- Based upon a rubric for assessing solutions in SETS (social-ecological-technological systems), we hypothesize:
  - Social – low scores on environmental justice, public acceptance; high score on affordability
  - Ecological – high score on ecosystem-based, co-benefits, intermediate effectiveness
  -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

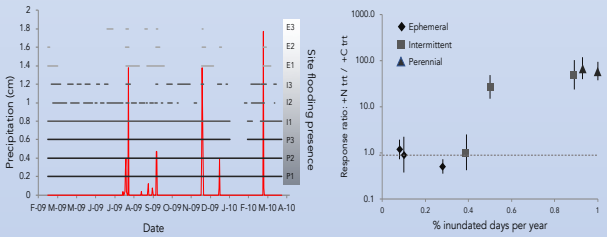



## The Salt River wetlands: structure and function

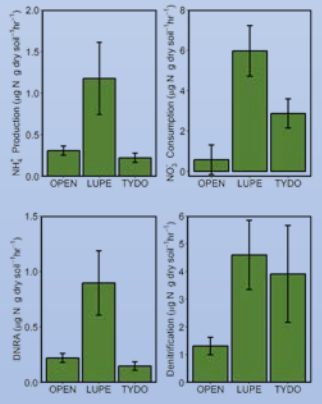



- Occur in dry river bed
- Support three main patch types:
  - Vegetated: *Typha* spp, *Ludwigia peploides*
  - Unvegetated: open substrates



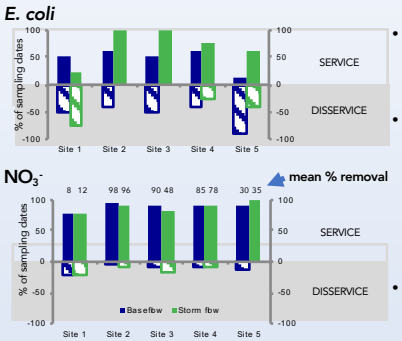

- Storms resupply wetlands but a gradient from perennial to ephemeral wetlands exists (above, left)
- Ephemeral wetlands tend to be carbon limited (above, right) whereas perennial wetlands are nitrogen limited




## Wetland N cycling

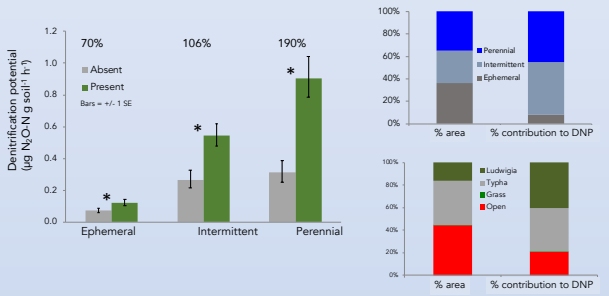
- Wetland nitrogen cycling, measured with a push-pull experiment using isotopically labeled $NO_3^-$, exhibits differences among patch types (left) and with [$NO_3^-$] (not shown)
- $NH_4^+$ production and $NO_3^-$ uptake both are highest in *Ludwigia* patches
- Both denitrification and dissimilatory 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




- Loading of pathogens and $NO_3^-$ to wetlands occurs with baseflow and stormwater inputs
- E. coli was removed >50% of the time at 3 of the 5 sites during both baseflow and stormflow. However, only 2 of the 5 sites ever met bathing standards, and this only occurred during baseflow
- Removal of $NO_3^-$ occurred frequently, and was high

## 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