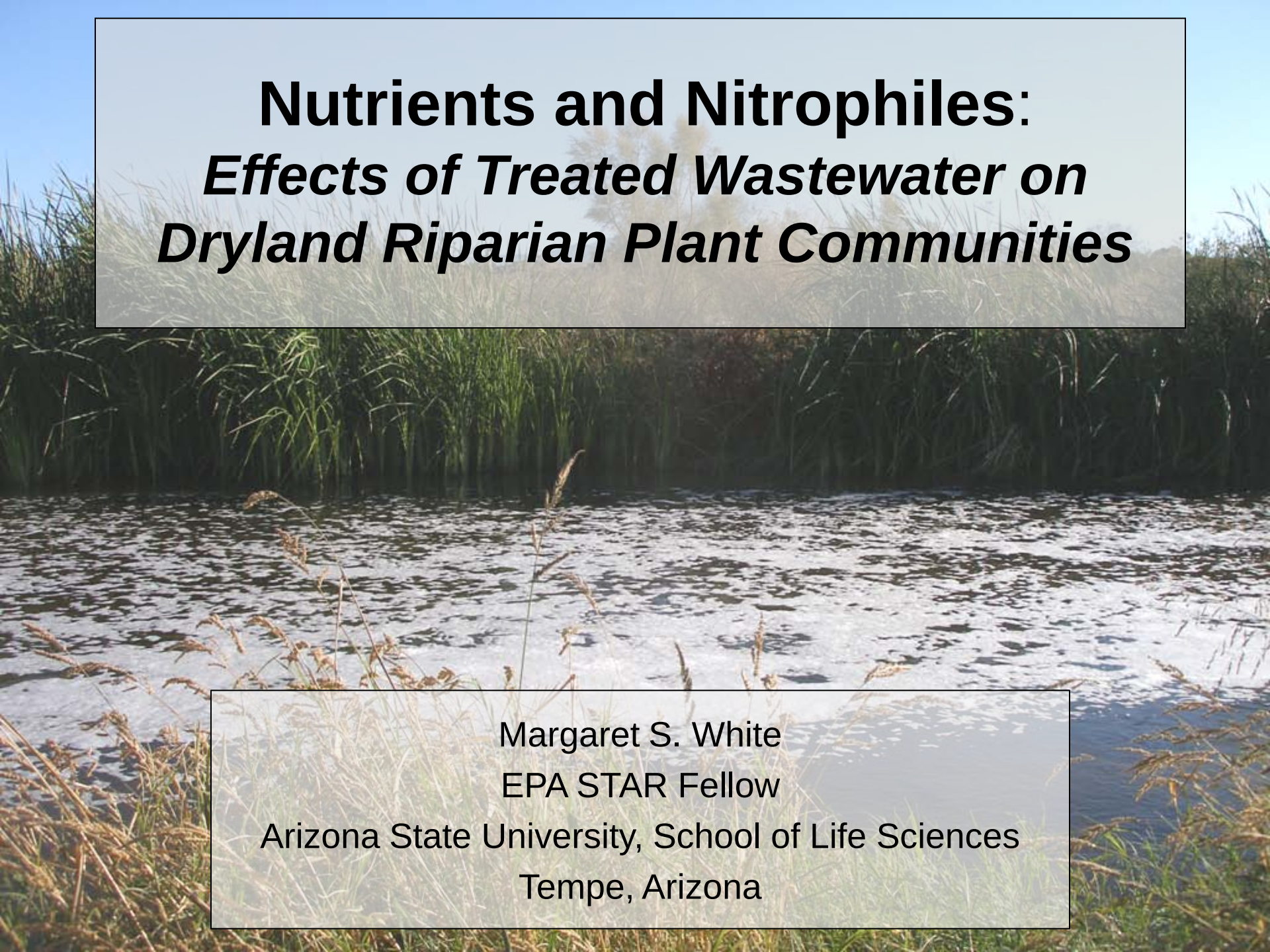
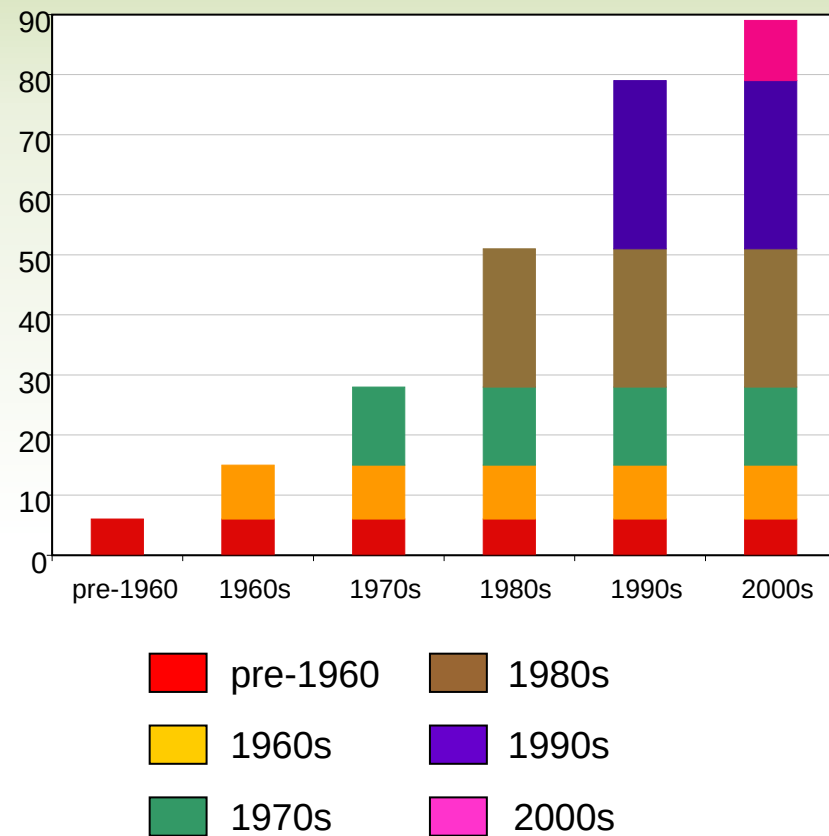


The background of the slide is a photograph of a river or stream. The water is dark and reflects the sky. On the left bank, there is a dense growth of tall, green reeds. In the foreground, some dry, brown reeds are visible. A semi-transparent white box with a black border is positioned in the upper half of the image, containing the title text.

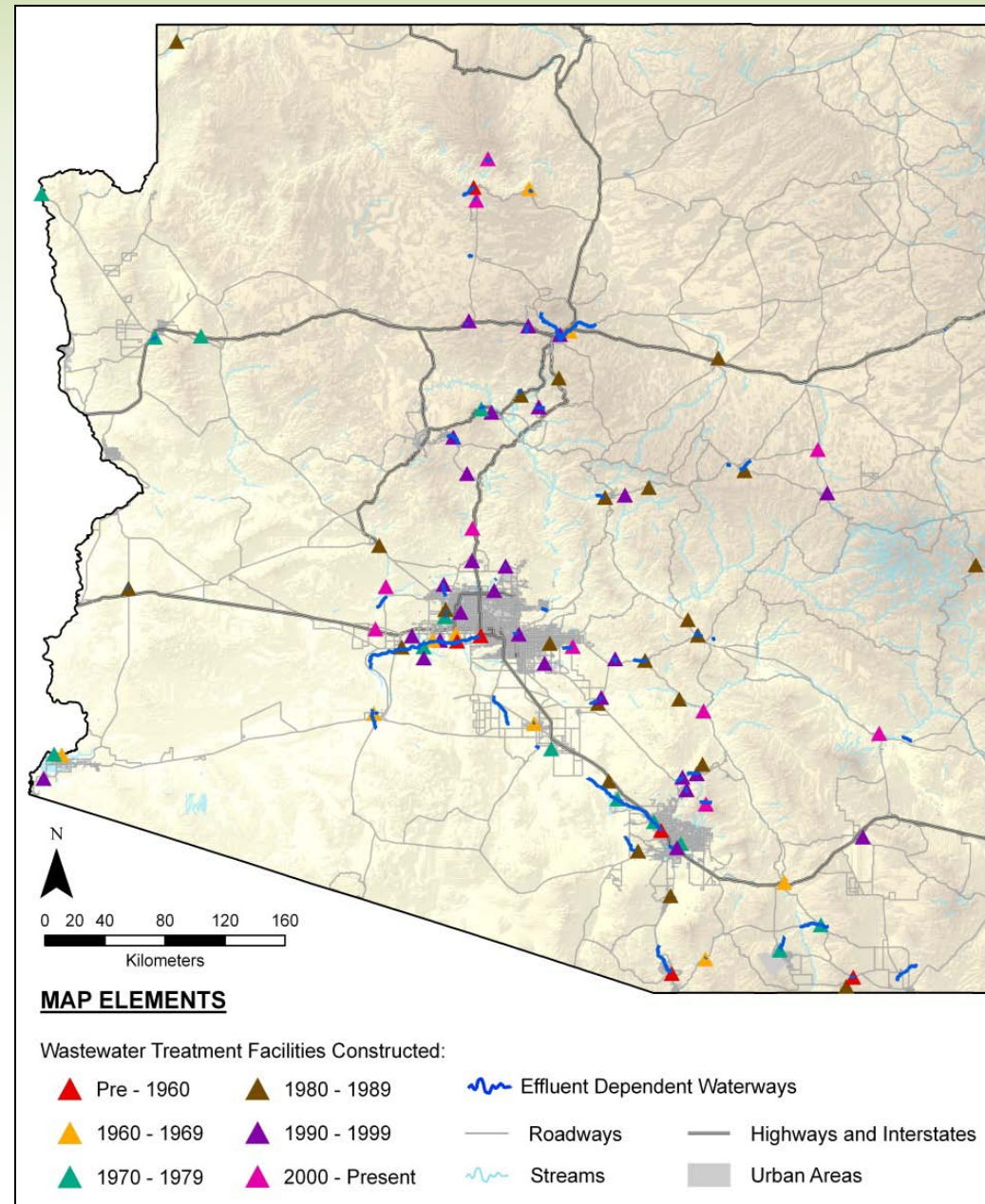
Nutrients and Nitrophiles: ***Effects of Treated Wastewater on*** ***Dryland Riparian Plant Communities***

Margaret S. White
EPA STAR Fellow
Arizona State University, School of Life Sciences
Tempe, Arizona

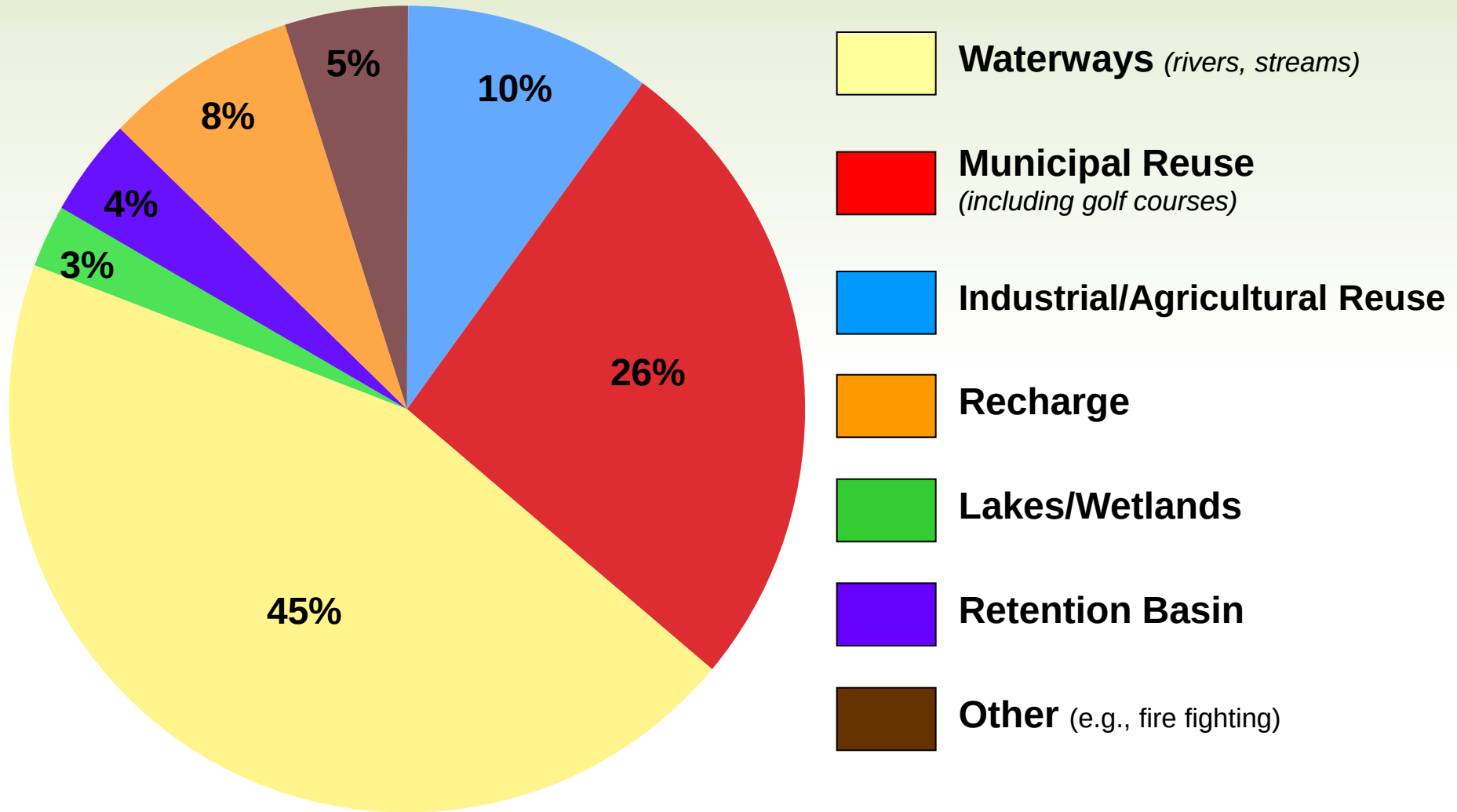
Patterns in Treated Wastewater



Treated wastewater generation and discharge has increased in both volume and abundance.



But Where Does It All Go?



Hydrogeomorphic Conditions

**B: Interrupted waterway,
shallow groundwater**



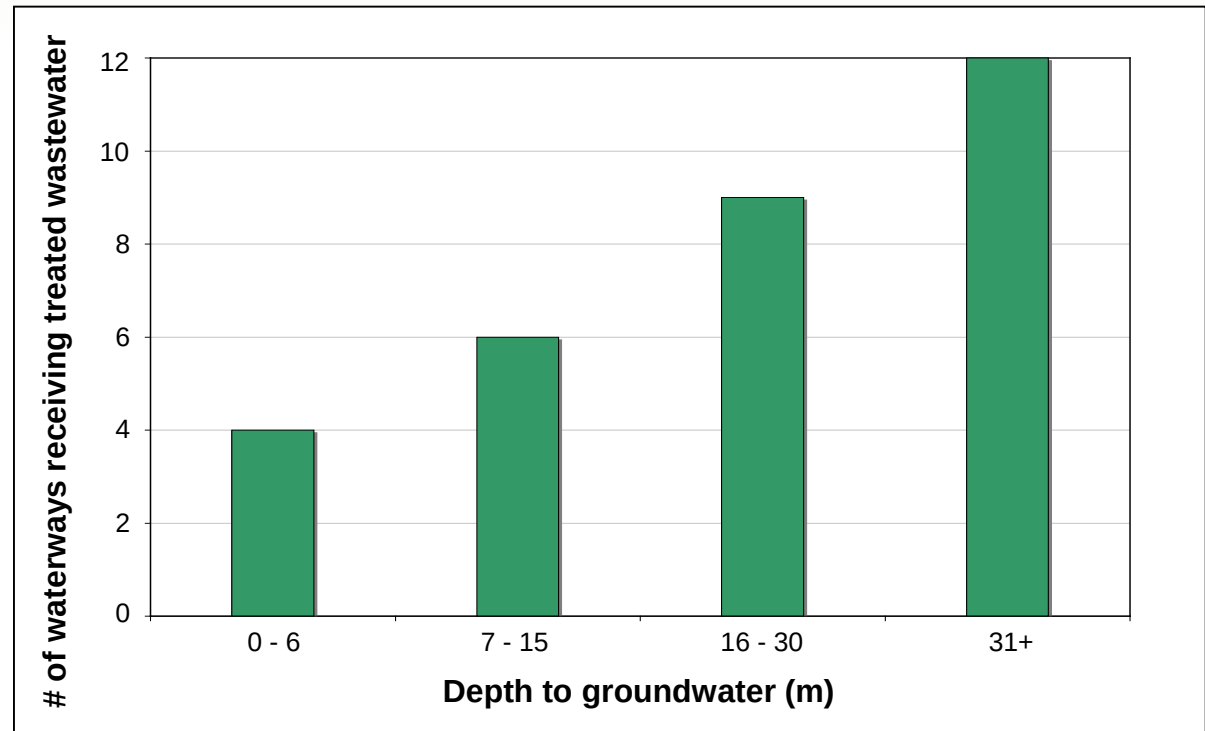
A: Perennial waterway



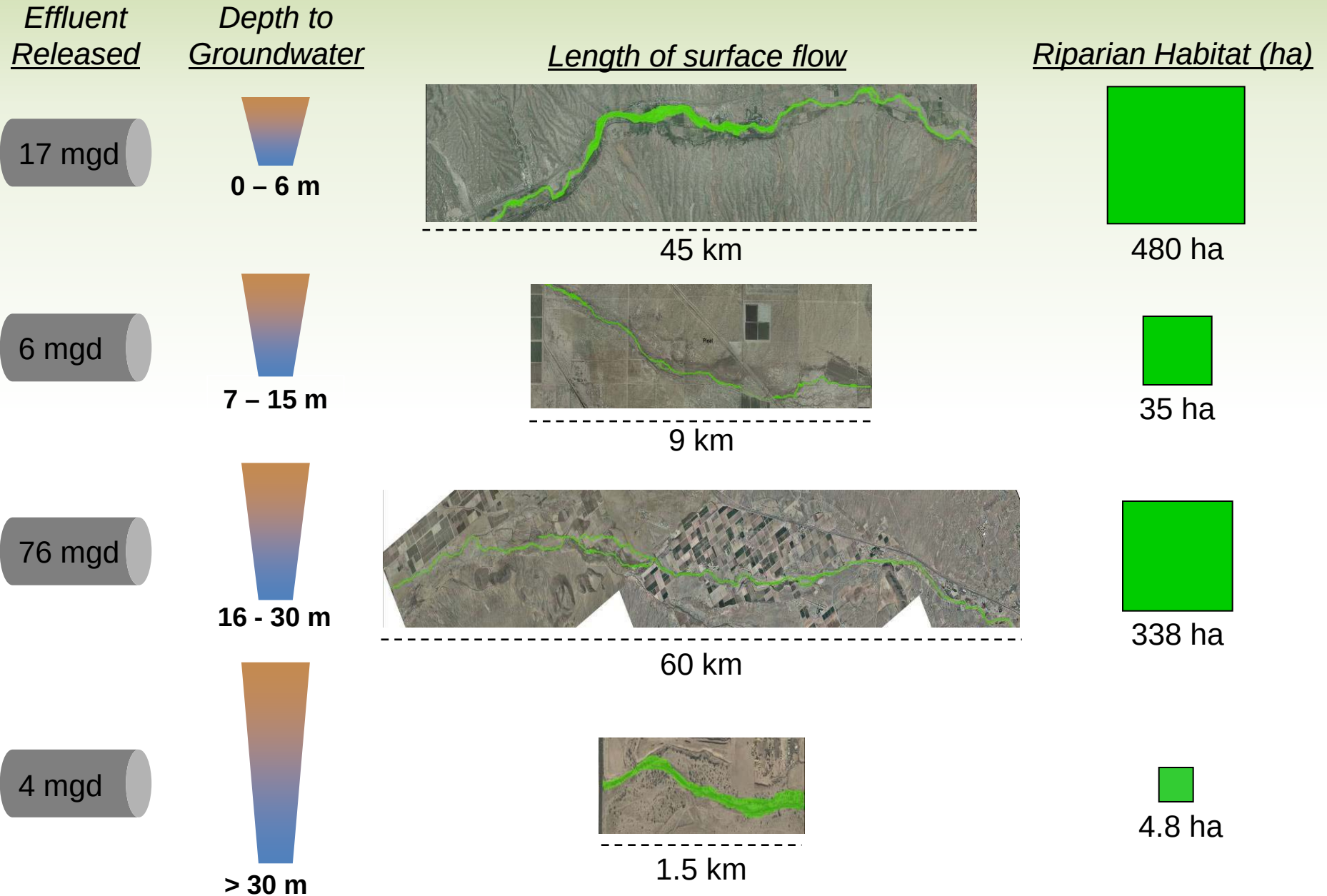
**C: Interrupted waterway,
deep groundwater**



D: Ephemeral channel



Variability in Riparian Response



Experiment: Research Questions

- *How do seed banks from sites with varying hydrogeomorphic conditions (ephemeral, effluent-dominated, and perennial) respond to the introduction of treated wastewater?*
- *How do changing nutrient conditions affect streamside community metrics in an effluent-dominated system?*



Greenhouse Study

Seed Bank Types



Ephemeral



Effluent-dominated



Perennial

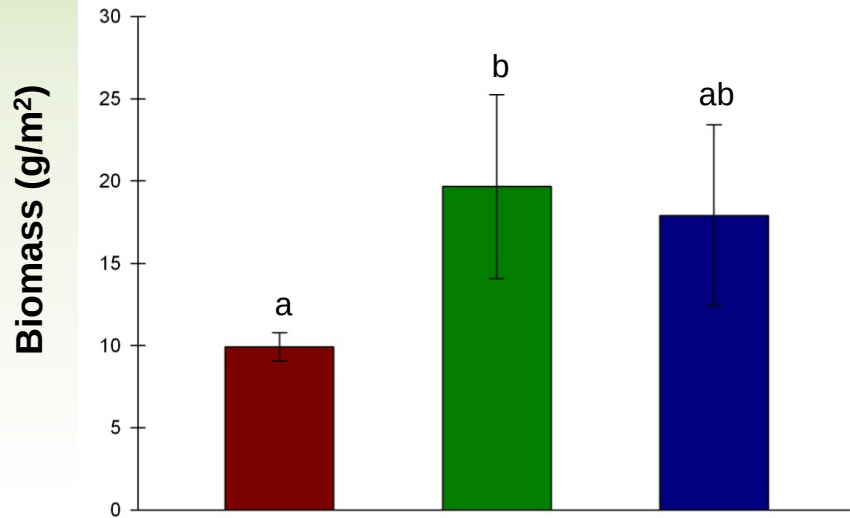
X

Nutrients – 9 Treatments

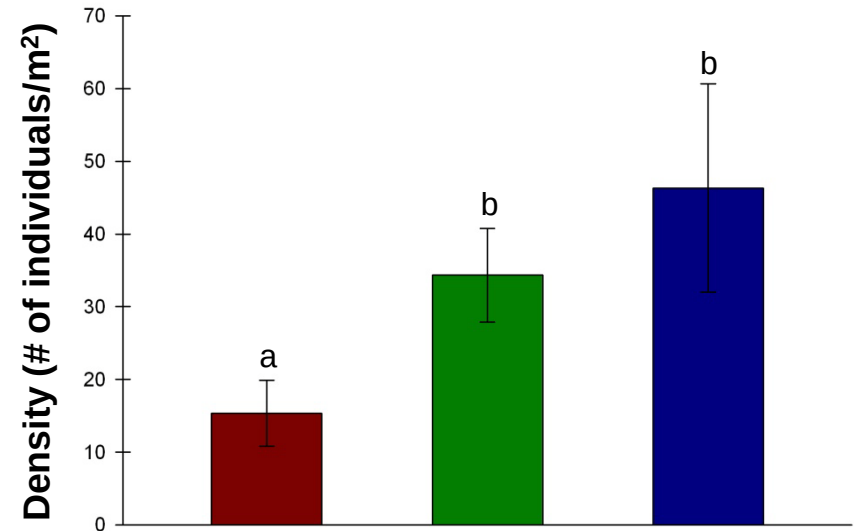
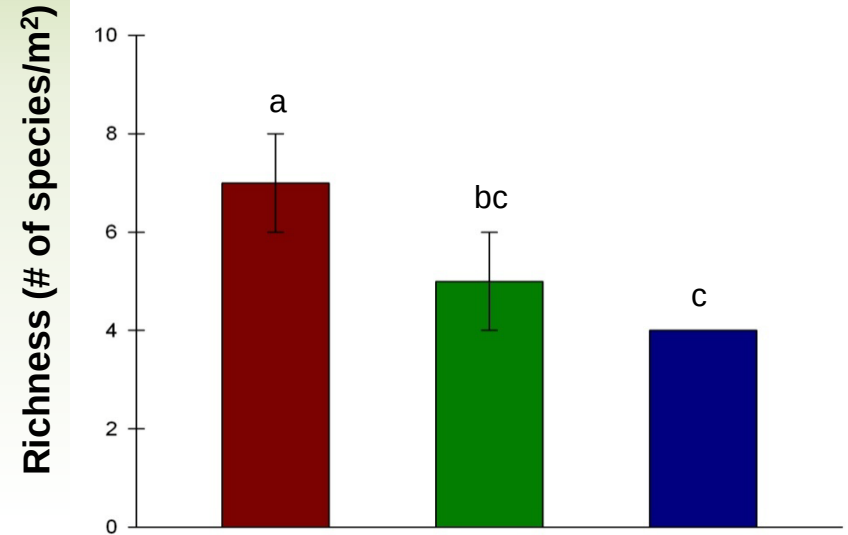
	Low P	Med P	High P
Low N	1:1	1:4	1:6
Med N	10:1	10:4	10:6
High N	30:1	30:4	30:6

- 9 “treatment” stations containing 3 replicates of each seed bank type
- n = 81 pots total (n=27 pots per river),
- Data collected for 16 weeks from August - December 2008.

Influence of Hydrogeomorphic setting



- Hydrologic conditions and geomorphic setting of a river has a significant influence on riparian plant community response to the introduction of water.



■ Ephemeral ■ Effluent-dominated ■ Perennial



Community Composition & Hydrology



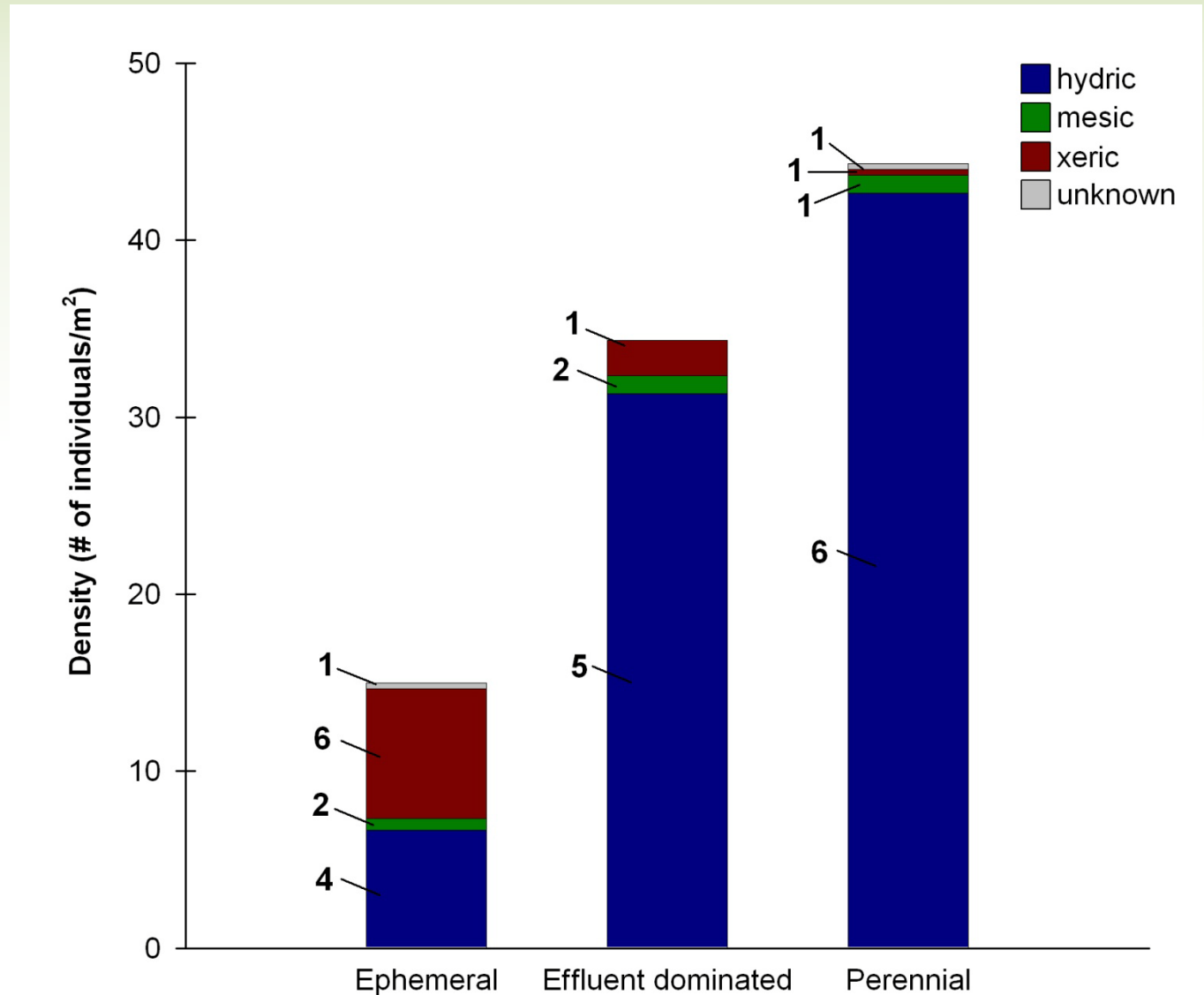
Pseudognaphalium canescens



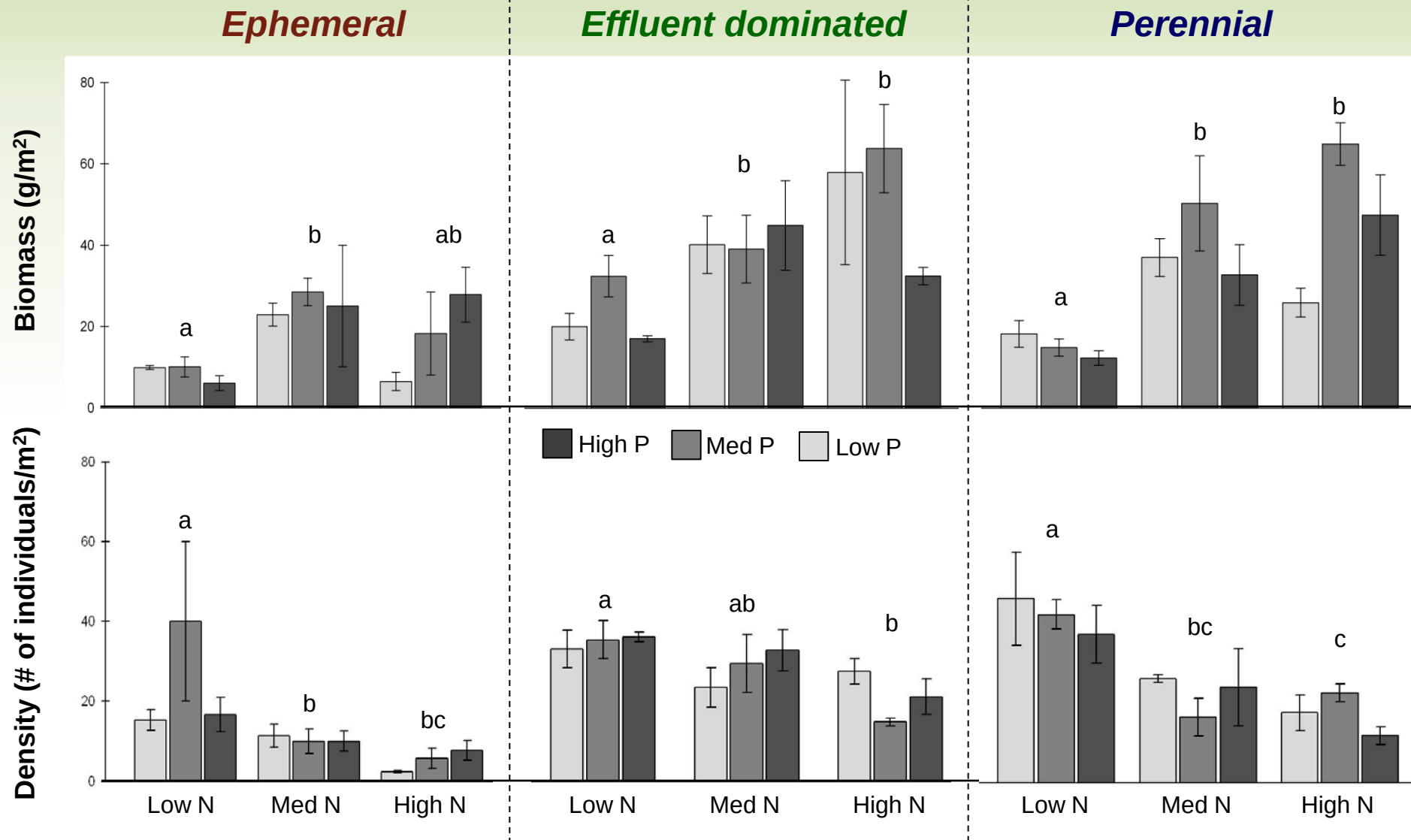
Nicotiana obtusifolia



Cyperus odoratus



Nutrients & Community Response



Biomass increased while density decreased with increasing nitrogen in all three settings. Response was significantly higher in wet river" systems.

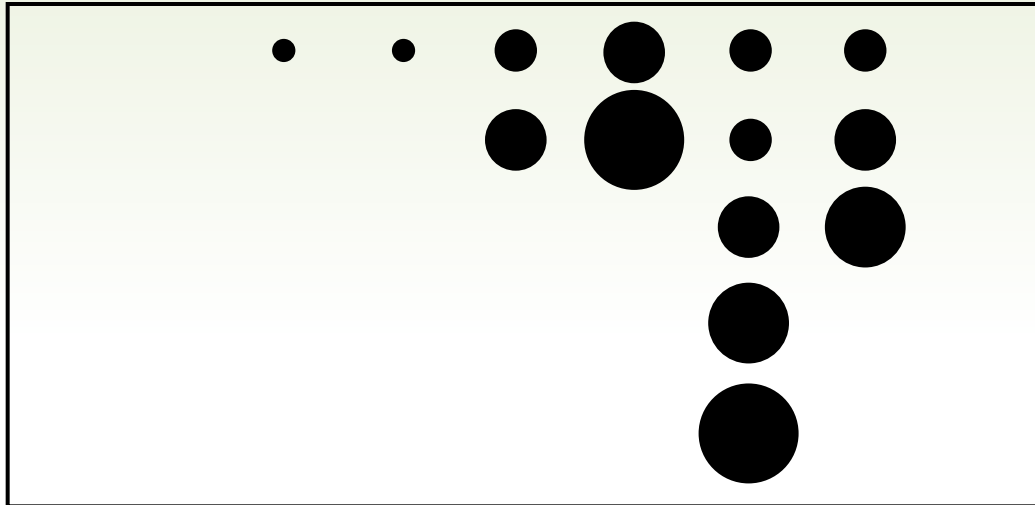


Nutrients & Composition, Experiment

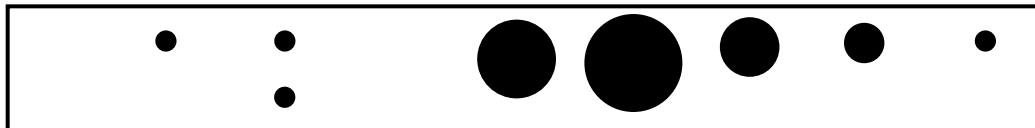
Ellenberg N scale (1 = low N, 9 = high N)



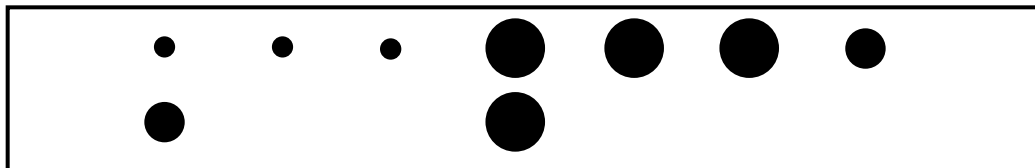
Effluent-dominated



Perennial

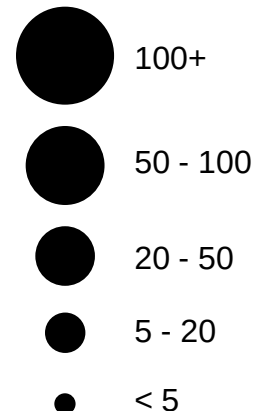


Ephemeral



Higher biomass response and tendency toward nitrophilic species in the effluent-dominated system

Biomass (g/m²)

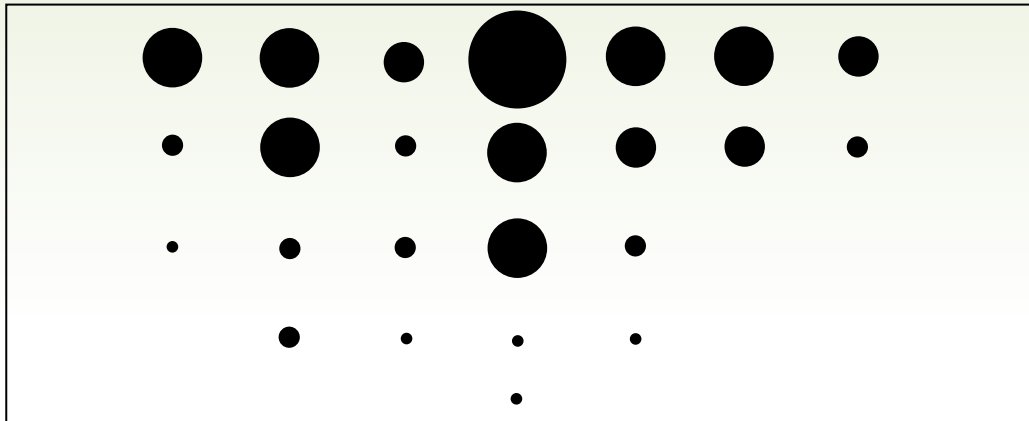


Nutrients & Composition, Streamside

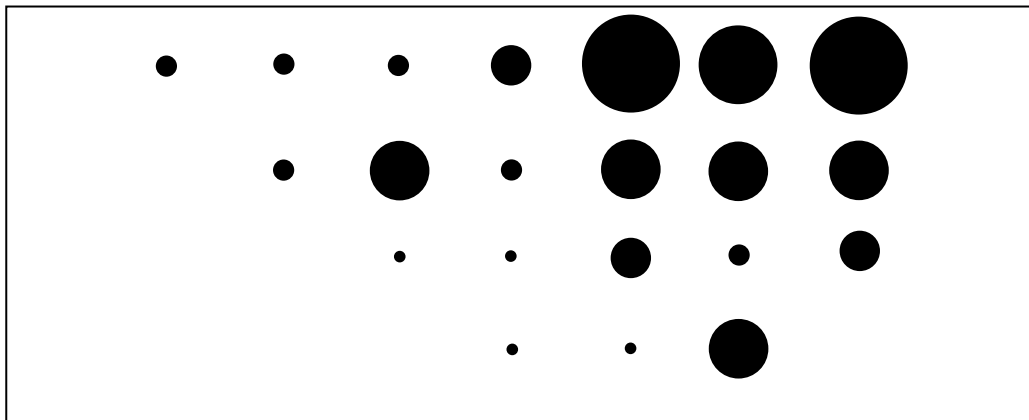
Ellenberg N scale (1 = low N, 9 = high N)



San Pedro River



Santa Cruz River

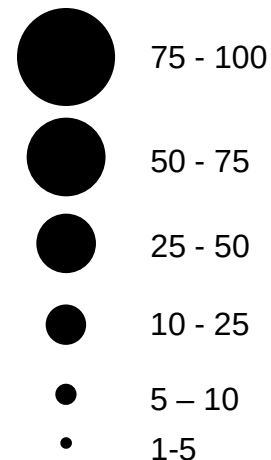


Conium maculatum



Polygonum lapathifolium

Cover class (%)



Implications for Riparian Ecosystems

Opportunities:

- Treated municipal wastewater is an increasing water source for riparian ecosystem recovery. Vegetation develops rapidly after water is introduced.
- Riparian development is greater in waterways with shallow groundwater tables than in ephemeral waterways with deep water tables.

Constraints:

- Elevated nutrients influence both quantity and composition of vegetation that develops along effluent-dominated systems.
- Clear shift toward more nitrophilic species.
- No statewide or regional plan for how best to use treated wastewater. No guarantee that effluent will remain instream (ongoing trends for water reuse).



Ongoing (O) & Needed (N) Research

- (O) Statewide GIS assessment of development of effluent-dominated waterways and riparian habitat development through time based on hydrogeomorphic setting.
- (O) In-depth investigation of plant community response (patch change/turnover, woody vegetation, floodplain data) along the upper and lower Santa Cruz River using the San Pedro river as a control.
- (O) Policy analysis to identify gaps and provide recommendations for utilizing treated wastewater for environmental flows.
- (N) Streamside and aquatic community responses following treatment plant upgrades on Santa Cruz and other rivers statewide.