

The “New” Urban River: Dry Aquifer but Fertile Surface Flow



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Urbanization and rivers

Wild
Rivers



Urban
Rivers

Hassayampa
River

San Pedro
River

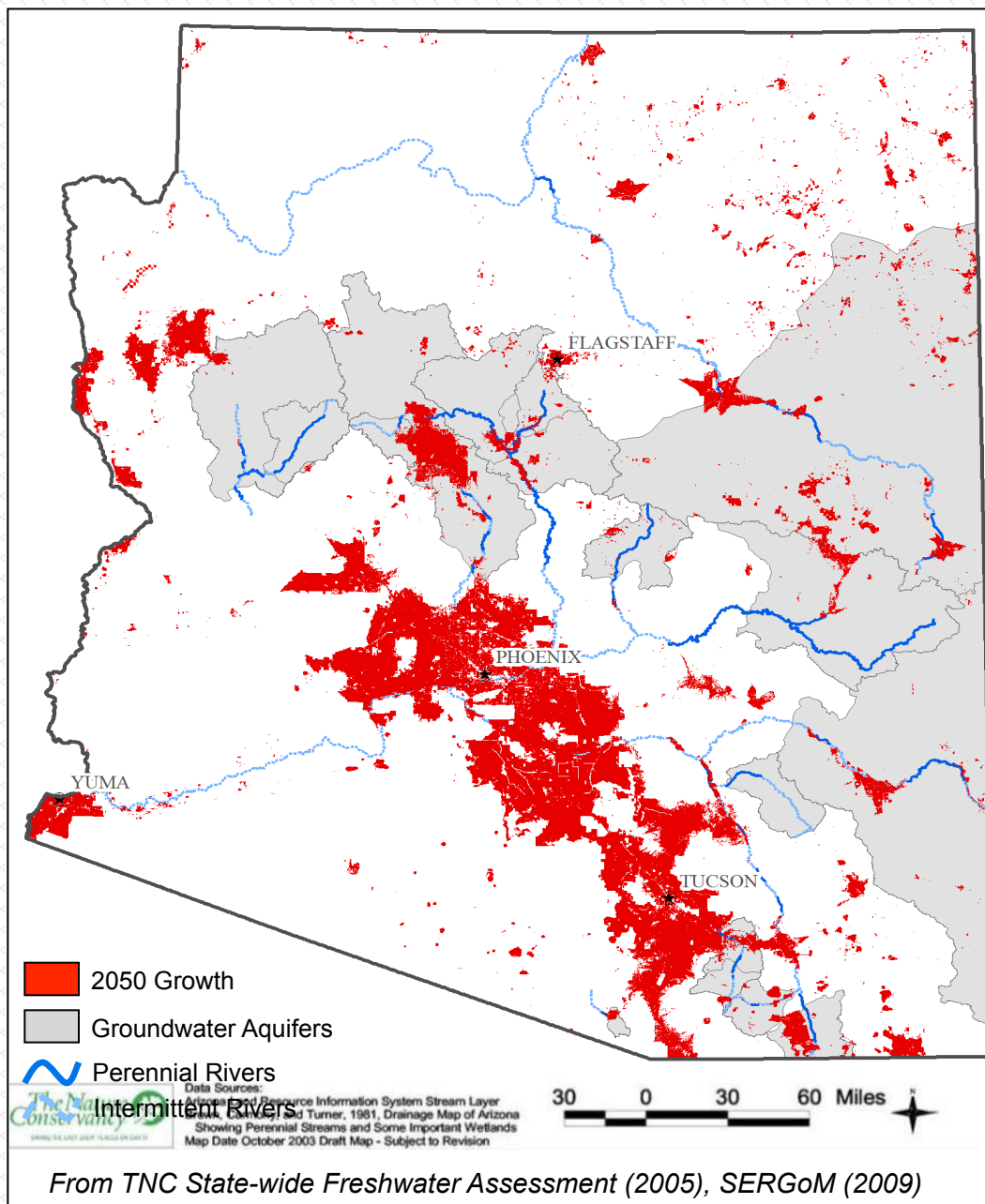
Verde
River

Agua
Fria

Santa Cruz
Tucson

Salt River-
Phoenix



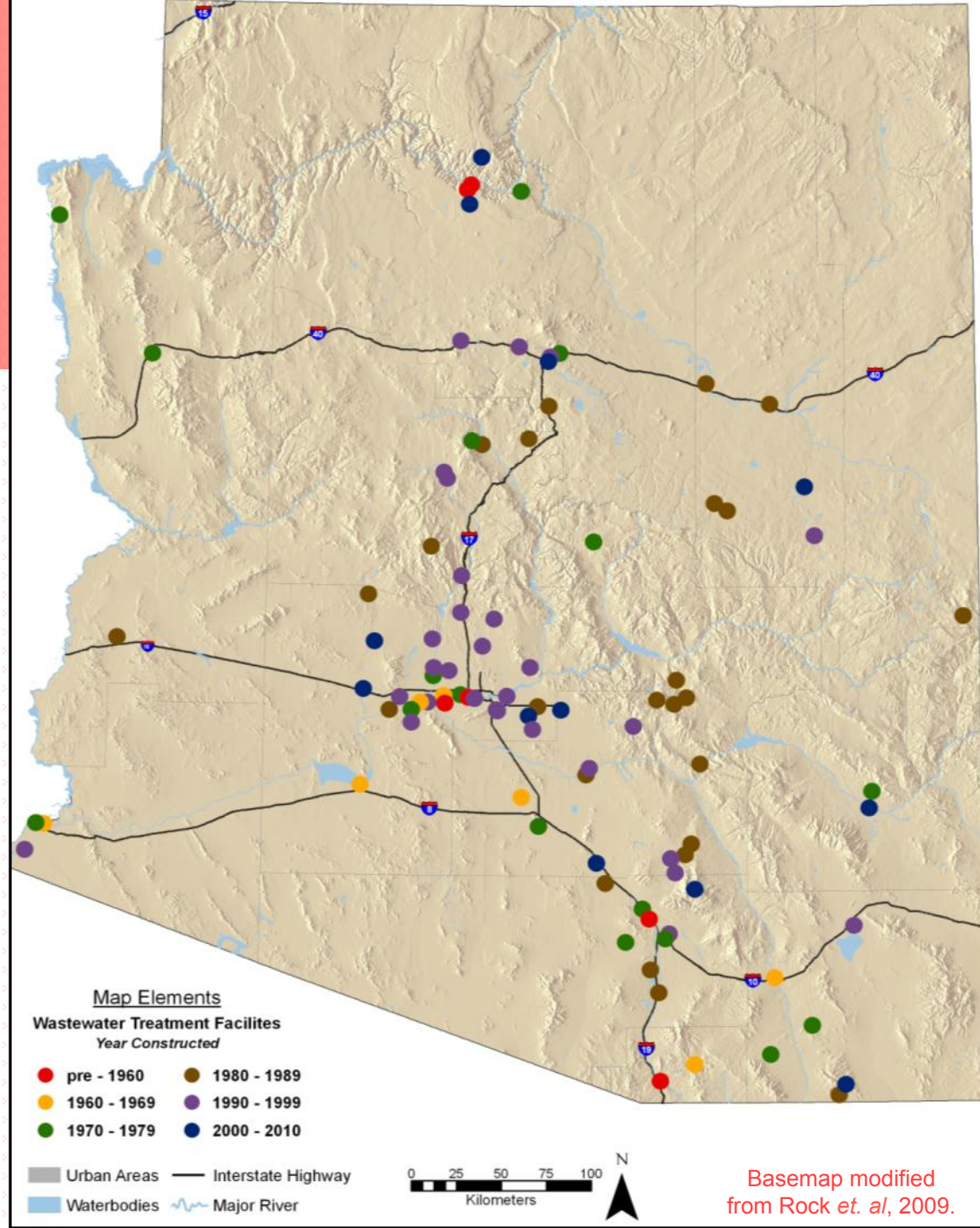


Intensifying water resource demands → increased groundwater withdrawals and stream drying

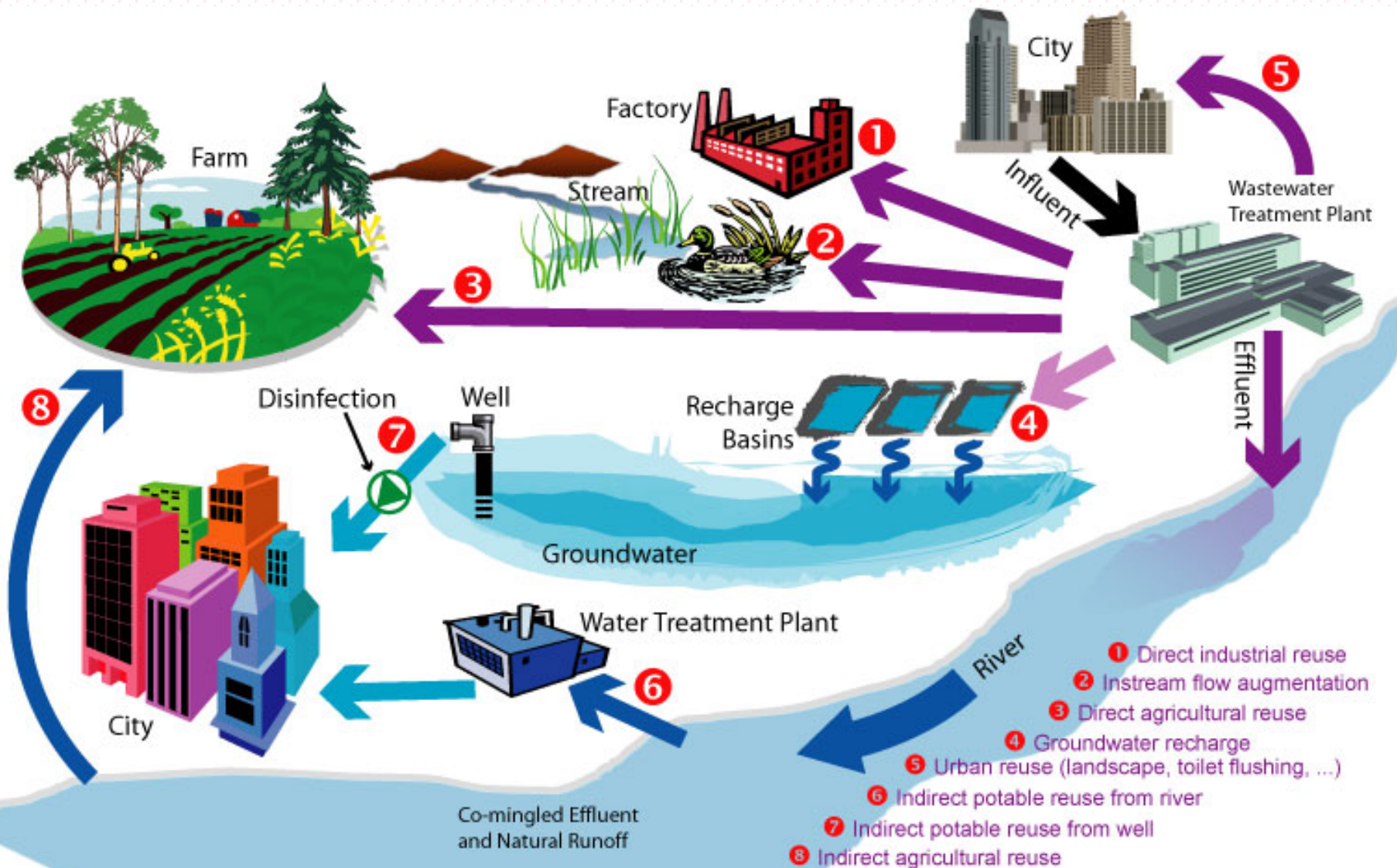


Wastewater Plant Trends

- Before 1970, < 20 municipal wastewater treatment plants
- 1990: > 80 municipal wastewater treatment plants



Water Reuse



Research Questions

Effluent-dependent urban rivers differ in **water quantity** and **water quality** from wild rivers

How do these changes influence riparian vegetation composition and abundance?



Amado, AZ, extinction point of effluent (Sam Treese)

Greenhouse Experiment

Seed Bank Types



Ephemeral



Effluent-dominated

X



Perennial

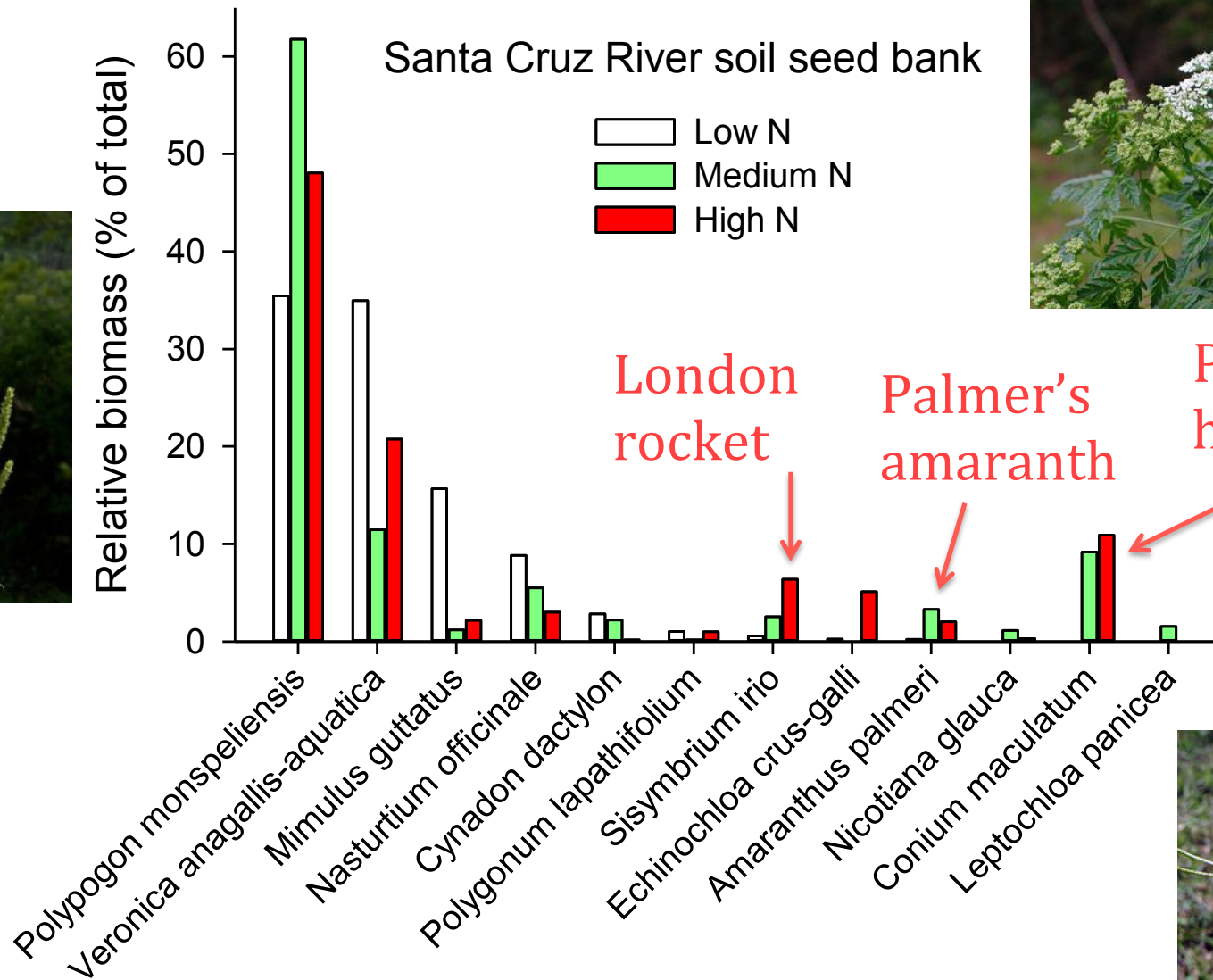
Nutrient concentrations in mg/l

	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, 3 replicates
- n = 81 pots total (n=27 pots per river)
- Data collected for 16 weeks, 2008



Results: Compositional shifts towards nitrophiles



Nutrient Concentrations

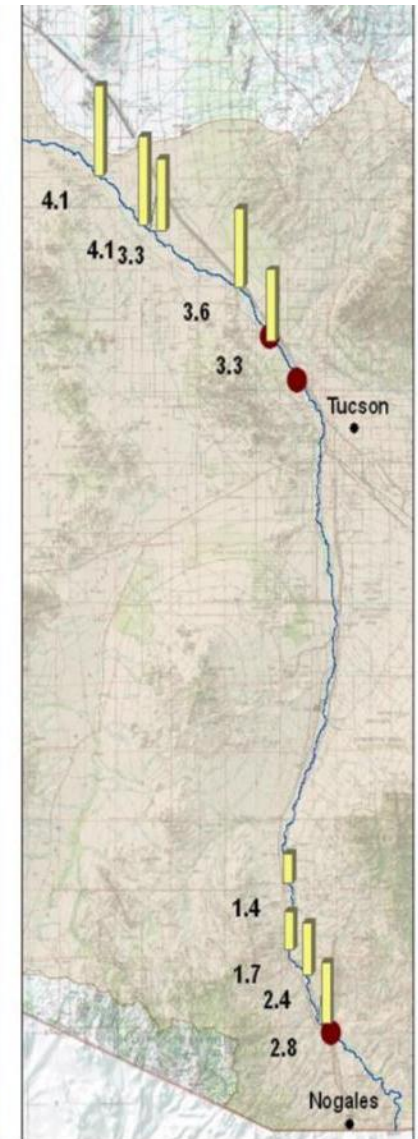
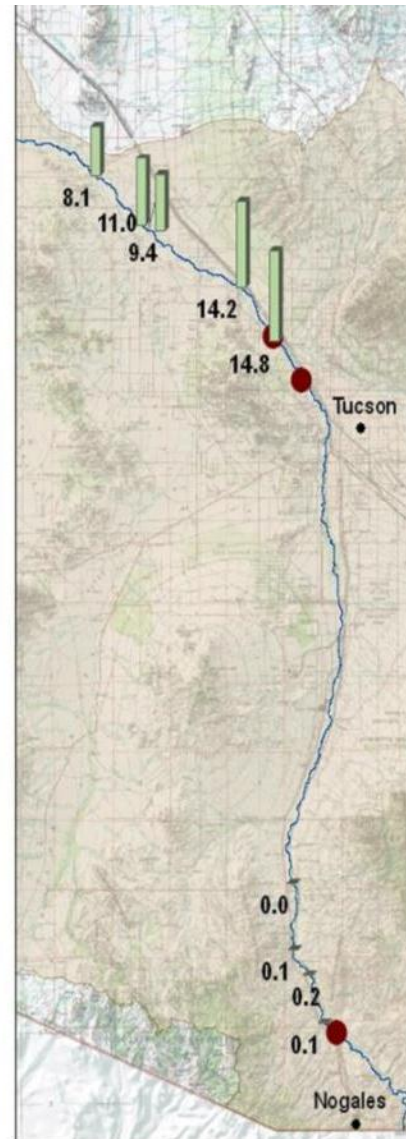
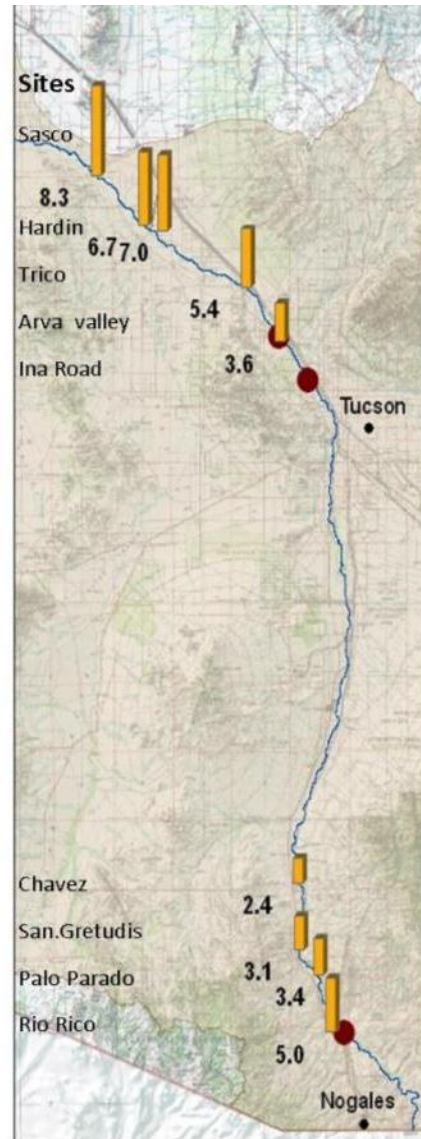
Nitrate/nitrite

Ammonia

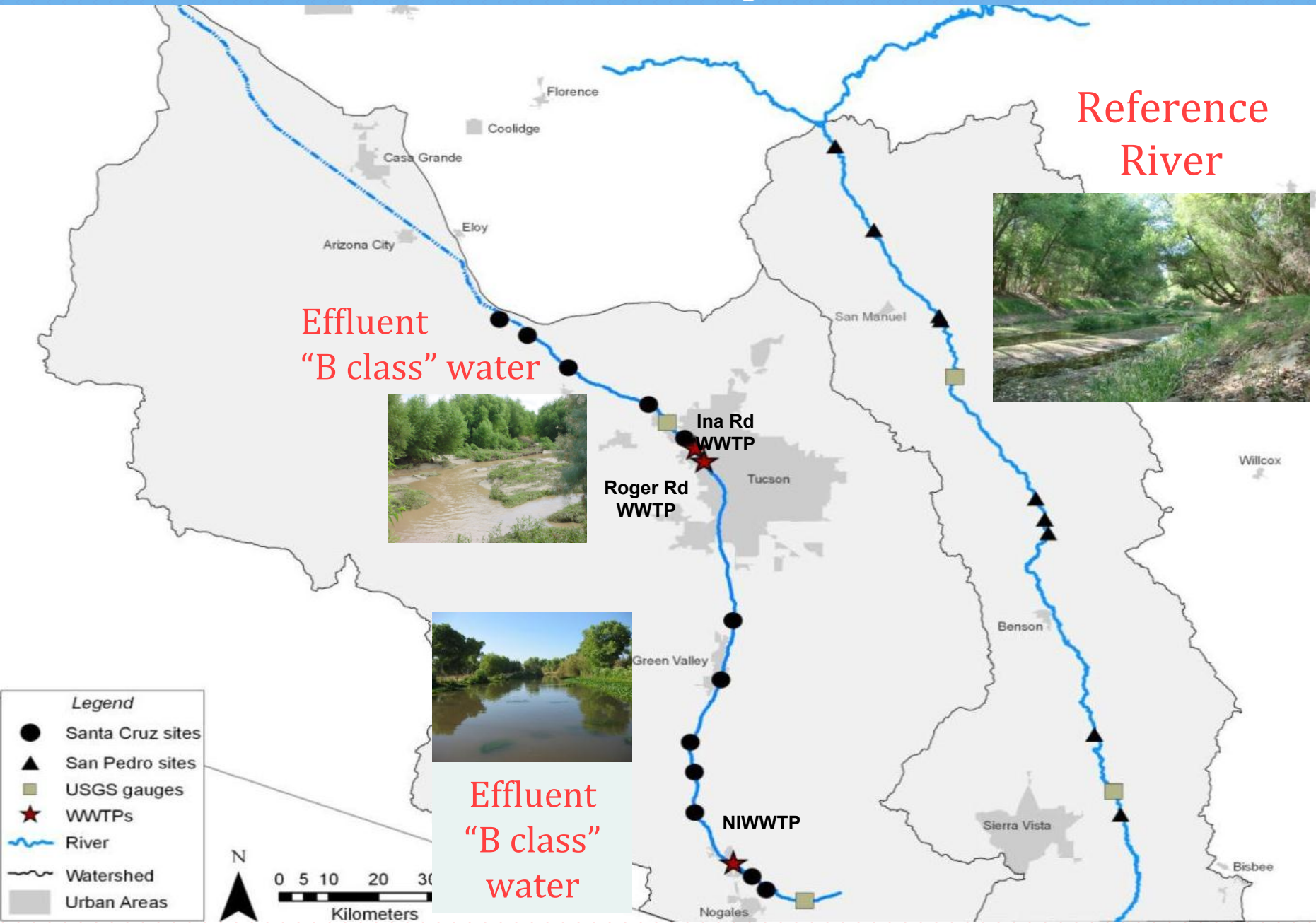
Total P

Legend

- Mean NO₃/NO₂ (mg/L)
- Mean NH₄ (mg/L)
- Mean Total P (mg/L)
- Waste water treatment facilities



Field Study Sites



Field Data Collection on Plant Cover

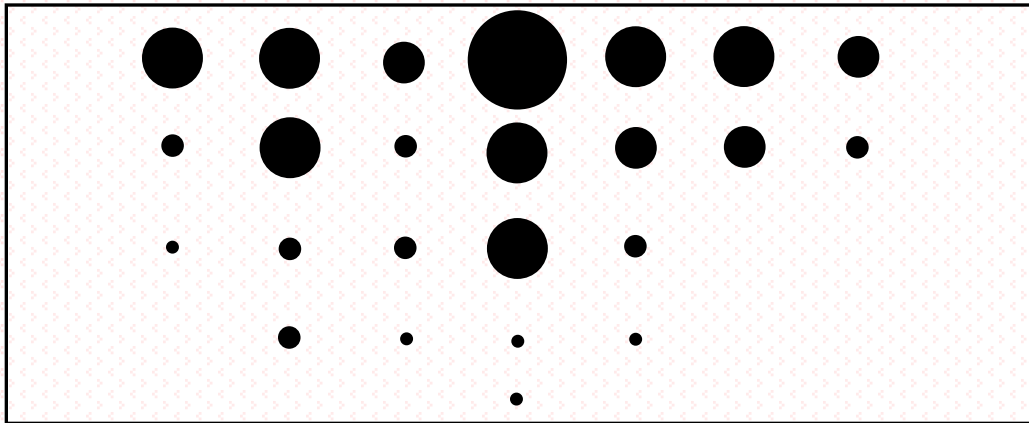


Nitrophiles abundant on effluent reaches

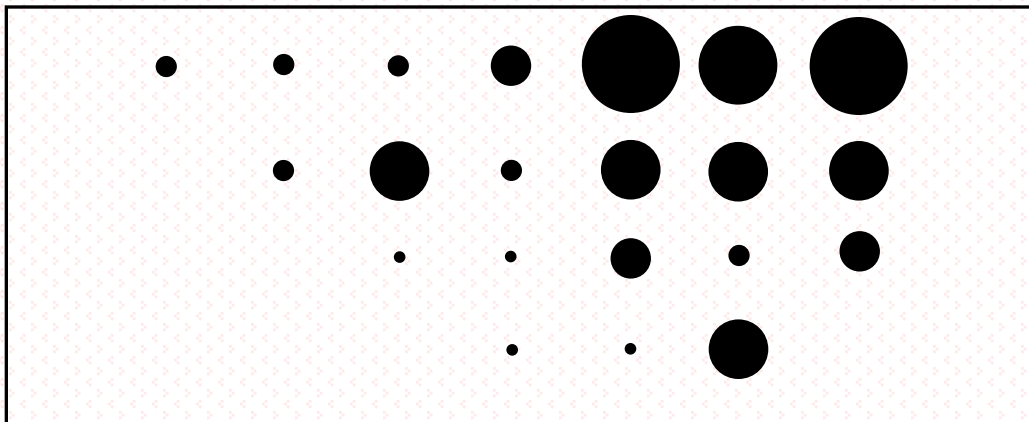
Ellenberg N scale (1 = low N, 9 = high N)

1 2 3 4 5 6 7 8 9

San Pedro River



Santa Cruz River

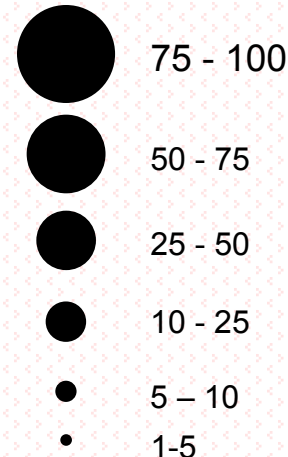


Poison hemlock
(*Conium maculatum*)

Curly top knotweed
(*Polygonum lapathifolium*)



Cover class (%)



Cursed buttercup
(*Ranunculus sceleratus*)



Research Questions

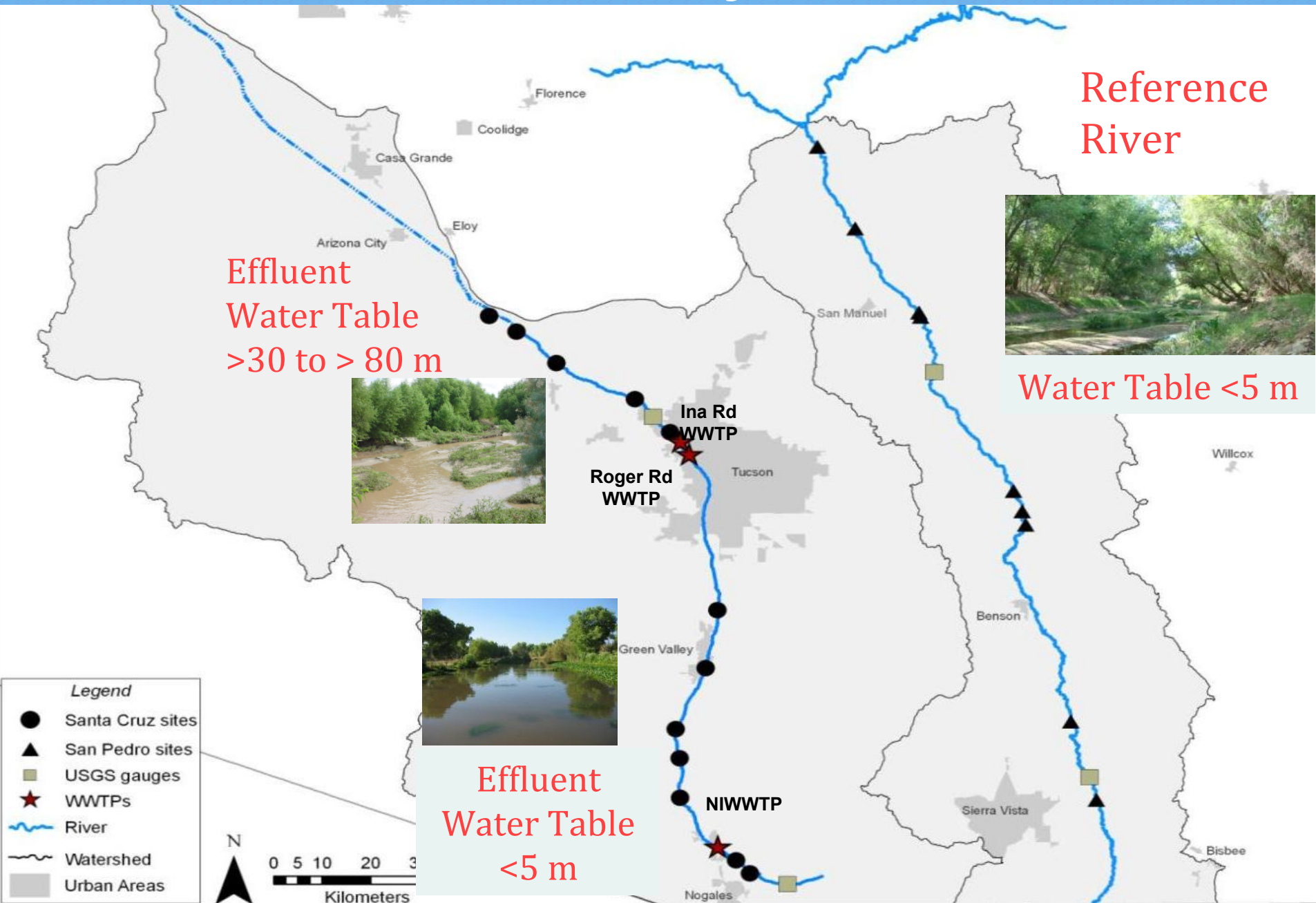
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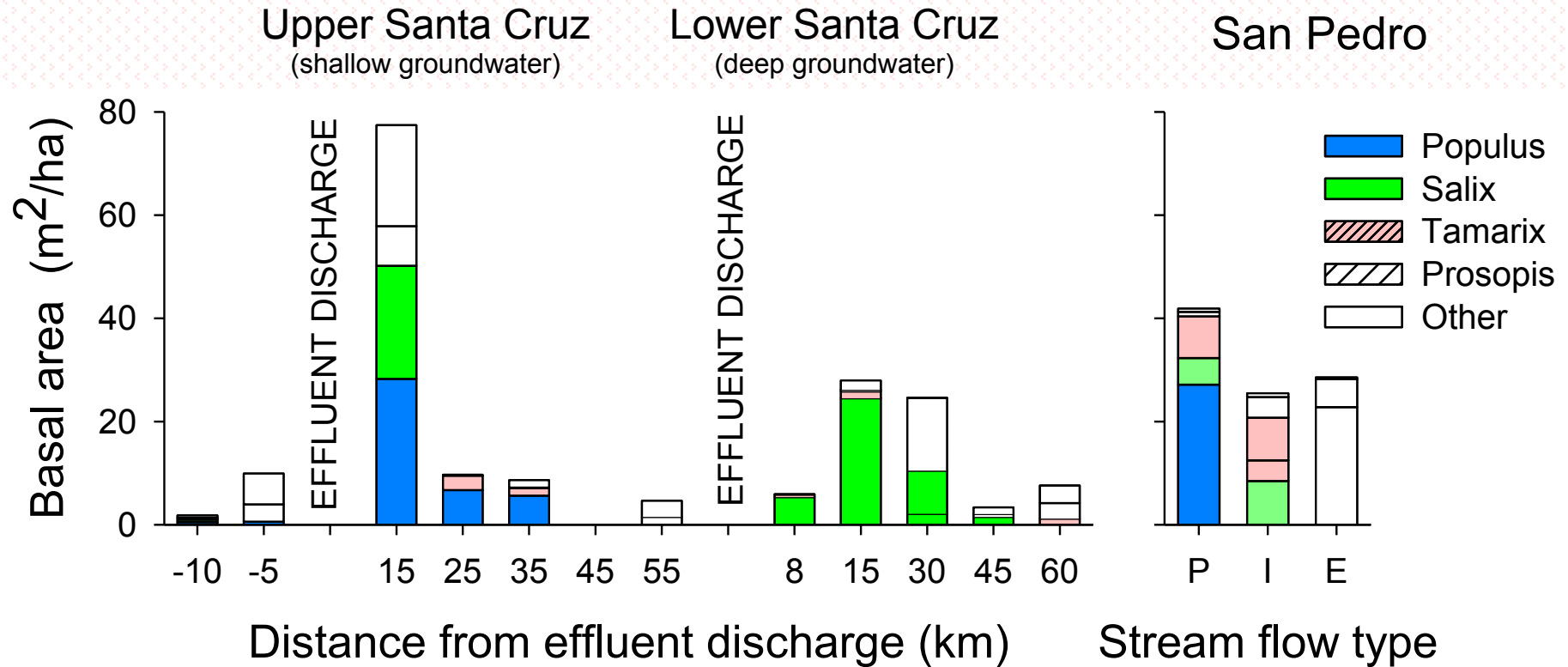


Amado, AZ, extinction point of effluent (Sam Treese)

Field Study Sites

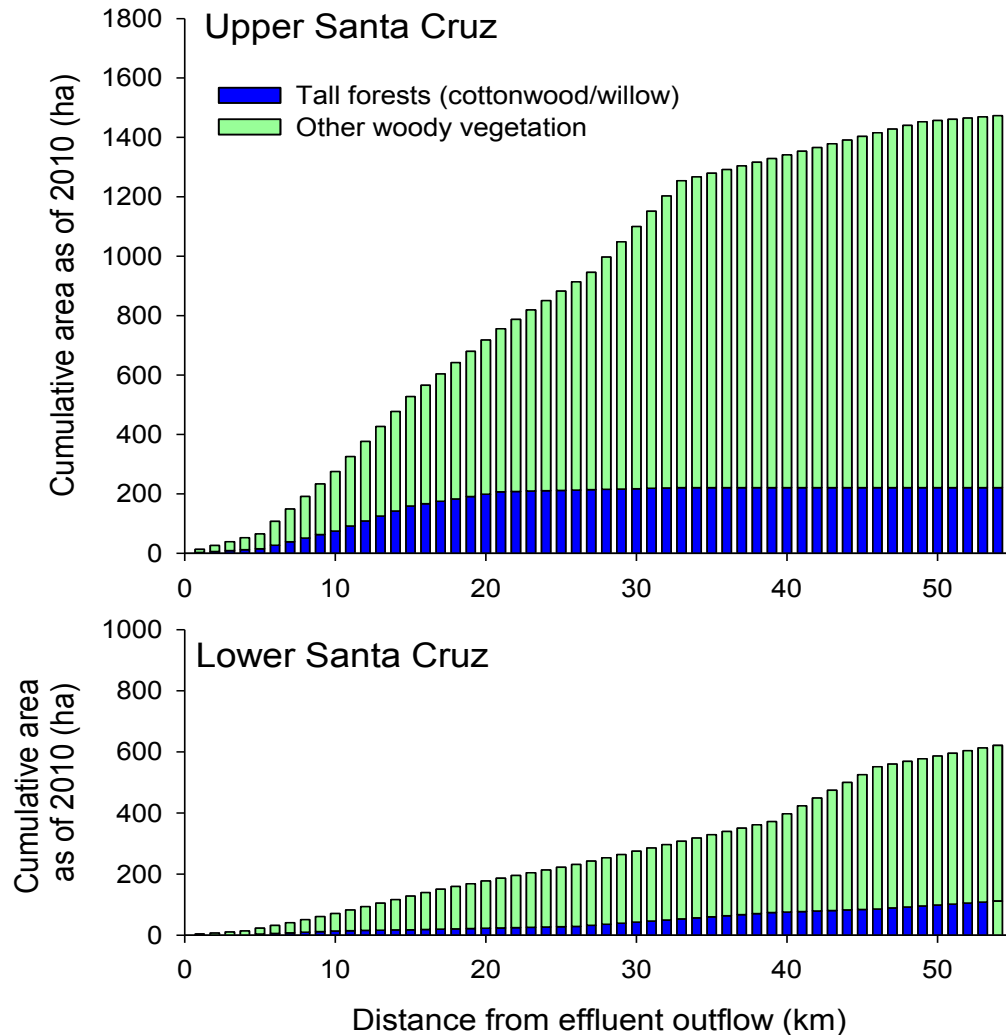


Forest area and composition differs

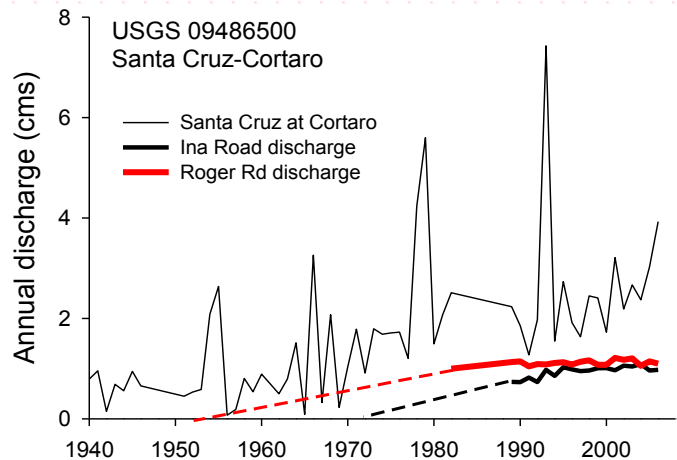
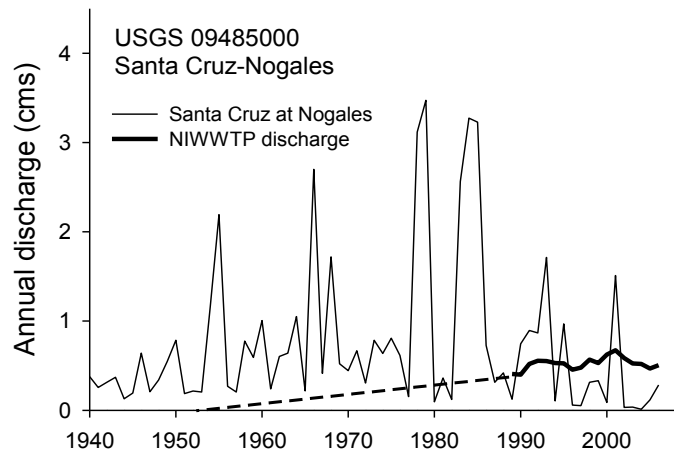


Riparian forest area >2x greater on shallow water table effluent reach

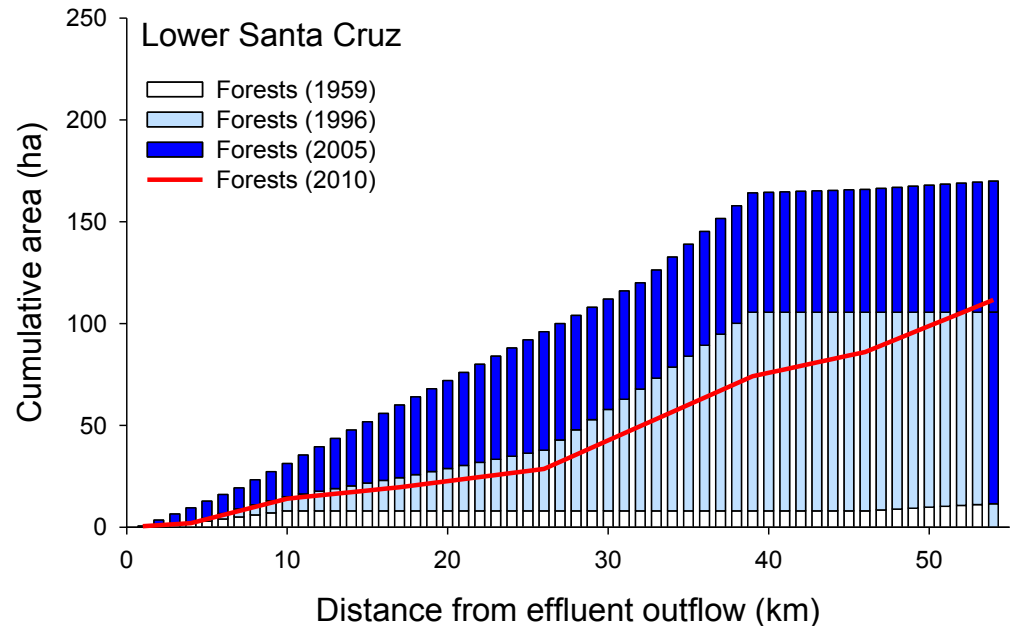
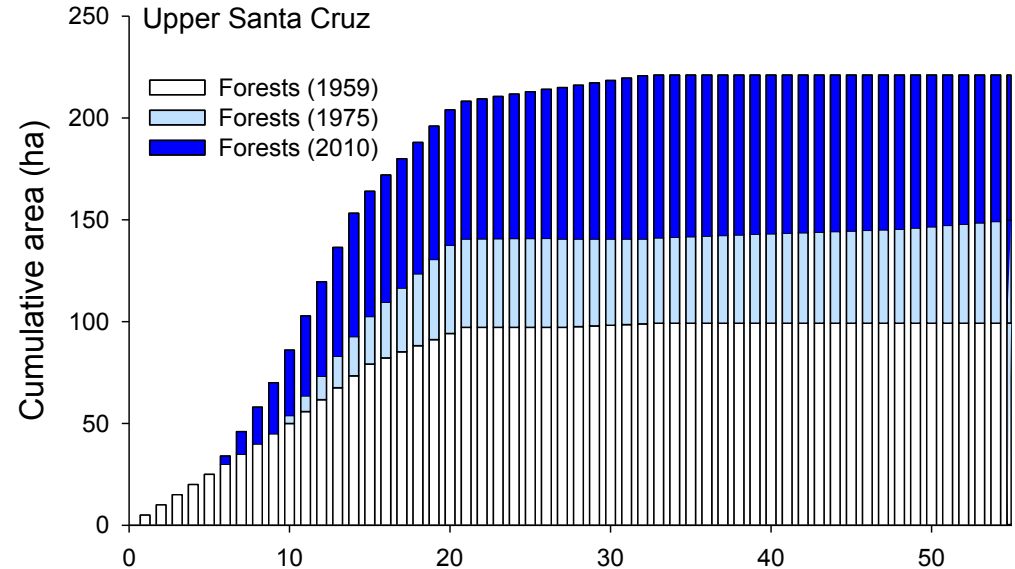
Preliminary data



Riparian forest dynamics



Preliminary data



Conclusions

- **Direct effects of nutrients:** High nitrogen concentration shifted herbaceous species composition toward nitrophiles (and toward native species)
- **Direct effects of water:** The shallow water table effluent reach supported >2x as much riparian forest as deep water table reach despite less effluent discharge

Remaining Questions

- Why so few Fremont cottonwoods (compared to Goodding willow) in the Tucson reach?
 - Water fluctuations/drought tolerance?
 - Recruitment- water recession patterns?
- Why so few mesquite (and so many Athel tamarisk) in the Tucson reach?
 - Different successional trajectories without the floodplain canopy?
 - When and where does Athel recruit? Does it store water in its roots?
- How quickly will the vegetation change in response to changes in water quality?

Acknowledgments



National Science Foundation
WHERE DISCOVERIES BEGIN