Vegetation communities' effect on dynamic patchwork mosaic successional processes in the Middle Rio Grande Jonathan Tyrrell¹, Kim D. Eichhorst², Ara S. Winter³





OVERVIEW

- The Middle Rio Grande (MRG) has historically been a dynamic patch mosaic (DPM) ecosystem with a primary successional driver, overbank flooding.
- The inhibition of successional processes in the Middle Rio Grande (MRG) threatens the long-term viability of the riparian "bosque" ecosystem.
- We analyzed the 22-year Bosque Ecosystem Monitoring Program (BEMP) vegetation dataset at multiple sites in the MRG.
- We used a Bayesian multilevel model of to determine how species abundance affects changes in community composition over time.

BACKGROUND

- DPM riparian ecosystems are composed of distinct patches of vegetation communities which form a mosaic at the reach scale (from the headwater to delta).
- In riparian ecosystems with a history of heavy disturbance, DPM vegetation communities are critical for ecosystem viability.
- The reach-wide resilience conferred by these dynamic and diverse patches depends on regular disturbance and turnover of vegetation.
- Disruption of overbank flooding, a central force of succession, threatens to degrade DPM community structure throughout the MRG.
- Assemblages have lost their patchy quality and become homogenized at the reach scale.
- The bosque is dominated by Rio Grande cottonwood (*Populus deltoides* ssp. *wislizenii*), willow species (*Salix spp.*), Russian olive (*Elaeagnus angustifolia*), and saltcedar (*Tamarix spp*.).
- As DPM ecosystems are degraded there is uncertainty in the longterm outcomes of community-level interactions.

RESEARCH QUESTION

How do features of vegetation communities in the MRG, such as density and abundance of dominant species, affect DPM community dynamics: species diversity, turnover rates, and beta diversity?

Albuquerque Bernalillo County Water Utility Authority – Bernalillo County – Bosque School – City of Albuquerque – Crawford McKee Foundation – The Goodman Family – Great Rio Grande Watershed Alliance – Middle Rio Grande Conservancy District – Mid Rio Grande Stormwater Quality Team – National Science Foundation - LTER Sevilleta – NM Game and Fish - Share With Wildlife – University of Arizona Soil and Water Conservation District – Contributors to the Cliff Crawford Endowment at Bosque School – Contributors to the Cliff Crawford Endowment at UNM – And individuals committed to BEMP's success & financial wellbeing.

Hypothesis:

• Mean annual density of cottonwood, Russian olive, and Siberian elm.

diversity.

BEMP depth to groundwater and precipitation datasets: Collected monthly by BEMP staff, UNM students, and K-12th grade community scientists and volunteers at all BEMP sites. Represented as mean annual depth to groundwater (cm) and cumulative annual precipitation (mm)

Bayesian linear model of understory turnover predicted by cottonwood relative density, precipitation, depth to groundwater, accounting for multi-leveling using site, and correcting for non-linear effects of time with a Gaussian process.

shading.

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• High relative abundance and density will limit turnover and diversity, as dominance by few species will inhibit novel growth and diversification.

BEMP vegetation cover dataset: Collected annually by Phil Tonne and the BEMP vegetation crew at all BEMP sites since 2000. Cover information is determined for all species (in centimeters) at 10 transects of 30 meters per BEMP site. The following values were determined in R Statistical:

• Mean annual relative abundance of cottonwood, Russian olive, and Siberian elm.

Total understory turnover per site

• Total diversity per site: Shannon's diversity and Simpson's

PRELIMINARY **FINDINGS**



- The priors (incorporation of additional data represented as a student t distribution) are weakly informative.
- We expect the effects to be centered near zero but could be positive or negative – we also allow for a slight chance of extreme values (narrow, long tails).



Our Current Funders

Land Use Partners

City of Albuquerque Open Space Division – Middle Rio Grande Conservancy District – Pueblos of Santo Domingo, Santa Ana, and Bosque del Apache. State Parks – USFWS National Wildlife Refuges of Valle de Oro, Sevilleta, and Bosque del Apache.



BOSQUE SCHOOL Challenging Education

NEXT STEPS

- Refine factor selection for Bayesian linear model
- Repeat model for nonnative canopy species and other community composition and dynamics information
 - Diversity (Shannon's and Simpson's)
 - Beta diversity
 - Rank mean abundance change
- Addition factors to consider as predictors:
 - Temperature
 - Precipitation

2003 0.50 -0.25 -0.00 -2006 2008 2007 0.75 -0.25 -<u>0.00</u> 2011 2012 2013 0.25 -0.00 -2016 2017 0.75 -0.50 - 💊 🐤

Relative Density of Cottonwood and Total Understory Turnover (Sites 1-26 from 2001-2017)



0.000.250.500.751.000.000.250.500.751.00 Relative Density of Cottonwood per Site