Improvement of Pollinator Habitat on USACE Levees via Pollinator-facilitating Seed Mixtures and eDNA Analysis

Reference SON: *2023-1945-Improving pollinator habitat along Federally managed levees.*

Lead PI(s): *Mark Johnson (ERDC-CERL)*

Project Development Team (PDT): *ERDC-CERL: Heidi Howard, Jinelle Sperry, Daniel Gambill, Aron Katz, Sasha Tetzlaff, Patrick Wolff, Dylan O'Hearn*

Proponent(s)/District Collaborators: *Yari Johnson (Sacramento District), Lorena Guerrero (Levee Safety Center), Anthony Heddlesten (Rock Island District), Joseph Lundh (Rock Island District), Andrew Barnes (Rock Island District), Daniel Rose (Rock Island District)*

Other Partners: *Tim Lecher (University of Illinois), Rabin Bhattarai (University of Illinois), Franz Lichtner (ERDC-CRREL)*

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Research Need

The U.S. Army Corps of Engineers manages or monitors a network of approximately 8,000 levees spanning nearly 30,000 miles. Pollinator species have experienced drastic declines, with numerous pollinators becoming federally listed under the Endangered Species Act. The loss of pollinator biodiversity is of substantial importance, as it reduces plant reproductive success, diminishes ecosystem services provided by pollination, and drives economic losses. Given that levees are built on riparian corridors, appropriate management of levee habitats could significantly improve connectivity and migration routes for impactful pollinators. Most levee management guidelines limit the use of flowering plants and have consistent mowing, reducing the effectiveness of this habitat for supporting pollinator ecosystem services. If levee habitat can be assessed and improved for pollinator communities while ensuring levee functionality and structural integrity, pollinator habitat could be greatly enhanced across the country, improving pollinator populations and providing more ecosystem services.

Project Purpose & Objectives

To improve pollinator habitat associated with levees, while maintaining (or improving) levee stability, we are conducting a study that combines erosion analysis of pollinator-supporting species (i.e., forbs interseeded with low-growing grasses) and pollinator community assessment via cutting-edge environmental DNA (eDNA) analysis. Three primary objectives are proposed for this project:

- Evaluate viability of pollinator-facilitating plant species for levee functionality in a controlled and natural environment.
- Establish baseline efficacy of current pollinator habitat on USACE levees and test efficacy of developed seed mixtures for pollinator diversity and levee functionality in a real-world setting.
- Develop regional guidelines for the design and application of pollinator-facilitating seed mixtures for levees.

Value of Research and Development (Payoff)

Pollinators provide a variety of ecosystem services for both humans (crop pollination, food production, etc.) and natural systems (food chain, natural plant community propagation, breakdown of detritus, etc.). Estimates have found that pollinators provide approximately 150 dollars/hectare and over 10 billion dollars in the United States in ecosystem services. These estimates typically focus solely on crop production and not the value gained in natural systems, indicating the number is most likely much higher. This suggests, that for every acre of levee land that establishes pollinator-friendly plant communities, hundreds of dollars could be gained in ecosystem services for the local community. Further, our results and guidance documents will help land managers make confident decisions on how best to improve pollinator habitat while maintaining levee functionality.

We will also demonstrate the utility of eDNA analysis for reducing the cost and improving capabilities of large-scale levee pollinator improvement needs. Studies suggest that eDNA surveys can be upwards of 70 times more cost-efficient than conventional methods which, if adopted across the USACE, would represent millions of dollars in savings. eDNA surveys for pollinator species could facilitate a more complete survey effort (including for federally listed endangered/threatened pollinator species), bypass the need for traditional surveys, and, due to the flexibility in collection and sampling processes, be used across the diverse lands managed by the USACE.

Products and Deliverables

Journal Articles (JAs)

Anticipated publication in the journal *Science of the Total Environment* highlighting the impact of plant community biodiversity on levee stability and pollinator biodiversity for Texas or Louisiana levees (Dec 2026).

Anticipated publication in the journal *Environmental DNA* highlighting the utility of eDNA analysis for assessing the performance of a novel levee seed mixture (Oct 2028).

Technical Reports (TRs)

Anticipated- Johnson M.D., H. Howard, J. Sperry, D. Gambill, A.D. Katz, S. Tetzlaff, P. Wolff, D. O'Hearn. Update on novel seed mixture development and artificial testing., Technical Report. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi (Sep 2026).

Anticipated- Johnson M.D., H. Howard, J. Sperry, D. Gambill, A.D. Katz, S. Tetzlaff, P. Wolff, D. O'Hearn. Guidelines for developing pollinator-facilitating novel seed mixtures for use on levee systems, Technical Report. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi (Oct 2028).

Anticipated- Johnson M.D., H. Howard, J. Sperry, D. Gambill, A.D. Katz, S. Tetzlaff, P. Wolff, D. O'Hearn. Residual pollinator eDNA analysis on levee systems, a summary and guide for future work. Technical Report. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi (Oct 2028).

Other Reports/Models/Tools/Datasets

Anticipated- Dataset of performance metrics for tested seed mixtures on our experimental levee. This will include measurements for bare ground percentage, aerial coverage, erosion metrics, and categories of cover crop, weeds, seeded grasses, and seeded pollinators (Sep 2026).

Anticipated- Raw Illumina NextSeq Arthropod CO1 results (FASTA files; Oct 2028).

Anticipated- Dataset of all taxa detected with our eDNA analysis and the associated plant community (Oct 2028).

Conference Presentations/Webinars/Workshops

Anticipated- Interim project webinar where we will present our study design and preliminary results (Sep 2026).

Anticipated- Academic conference (BSA, ESA, etc.) and workshop/demonstration day to discuss transitioning these approaches across USACE (Fall 2028).

Anticipated- Final project webinar where we will present our results, conclusions, and recommendations (Dec 2028).

Images

Picture 1. Clearing the experimental levee plots at the University of Illinois Urbana-Champaign to test the various pollinator seed mixtures.

Wet to Mesic Prairie	**Mesic to dry Prairie**	**Midwest Mesic Pollinator + Buffalo Grass**	**Low-Profile Prairie**	**Wet-to-Mesic Prairie + Buffalo Grass**	**Midwest Mesic Pollinator**	**Mesic to dry Prairie + Buffalo Grass**
Mesic to dry Prairie + Buffalo Grass	Wet to Mesic Prairie	Low-Profile Prairie	Wet-to-Mesic Prairie + Buffalo Grass	Mesic to dry Prairie	Midwest Mesic Pollinator + Buffalo Grass	Midwest Mesic Pollinator
Midwest Mesic Pollinator	Wet to Mesic Prairie	Mesic to dry Prairie	Wet-to-Mesic Prairie + Buffalo Grass	Midwest Mesic Pollinator + Buffalo Grass	Low-Profile Prairie	Mesic to dry Prairie + Buffalo Grass

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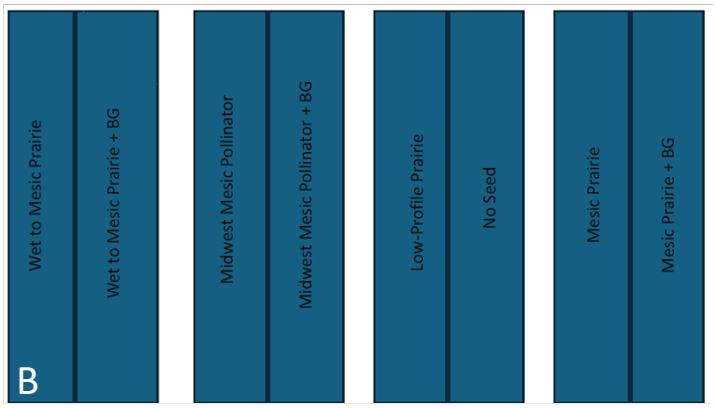

Picture 2. The two experimental designs we used test the performance of our developed seed mixtures. The first shows a randomized block design, with individual plots (10ft by 10ft) running horizontally along an experimental levee (A; Picture 3). The second shows each seed mixture planted along a vertical stripe of our experimental levee (B; Picture 4 and 5).

Picture 3. The seeded and marked off randomized block individual plots.

Picture 4. Seeded vertical stripe on experimental levee prior to jute cloth application.

Picture 5. Experimental vertical stripes on experimental levee.

Picture 6. Erosion pins that were deployed within our experimental plots to assess seed mixture erosion prevention.