


ASSOCIATION OF ECOSYSTEM RESEARCH CENTERS

The Role of Ecosystem Research Centers in the Bioeconomy

Congressional Briefing
September 17, 2026 | 10:00 - 11:00 AM
Rayburn 2325

AERC Mission:

Advancing an understanding and appreciation of ecosystem research and environmental science in the search for solutions to complex, large-scale problems. The goal of the AERC is to promote the optimal use of limited scientific resources in the search for solutions to complex, large-scale environmental problems.

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SPEAKERS:

Dr. Bernard Engel
Glenn W. Sample Dean of Agriculture, Professor of Agricultural & Biological Engineering, Purdue University
A Healthy Bioeconomy Requires a Healthy Ecosystem

Dr. Jennifer Tank
Galla Professor of Biological Sciences, Director of the Notre Dame Environmental Change Initiative, University of Notre Dame
Conservation Practices and the Bioeconomy: Ecosystem Research That Protects Farming and Freshwater

Mr. Dewey R. Houck II
Founder & Owner, Cypress Point Oyster Company; Retired SVP & Chief Data Analytics Officer, Boeing Defense, Space & Security
What Restorative Aquaculture Means to a Healthy Ecosystem

PURDUE UNIVERSITY

College of Agriculture

A Healthy Bioeconomy

Requires a Healthy Ecosystem

2026

Why ecosystem research matters for agriculture, resilience, and economic growth

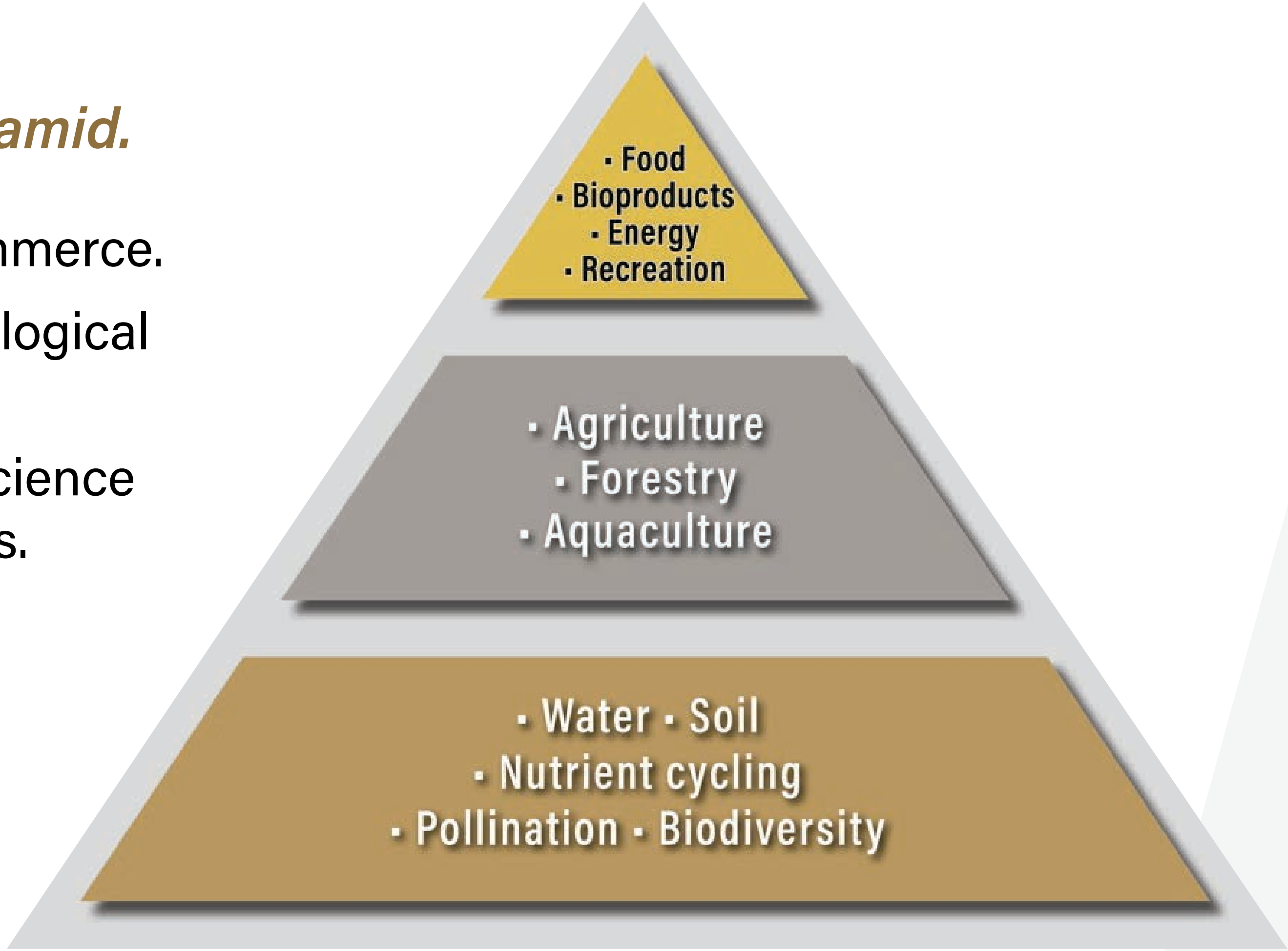
Bernard A. Engel, Ph.D., P.E.

Glenn W. Sample Dean of Agriculture
Professor of Agricultural and Biological Engineering
Purdue University

The bioeconomy rests on natural capital

Think of it as a bioeconomy pyramid.

- ***Roads and bridges*** support commerce.
- ***Ecosystem services*** support biological production systems.
- ***Research centers*** provide the science needed to sustain those services.



Natural systems do real economic work

Ecosystem services are not amenities. They are infrastructure.

My Research Journey: A Framework for Sustainable Water Management

Observations become integrated models, then practical decisions

1. OBSERVE

In situ monitoring
Streamflow, weather and field measurements

Remote sensing
Weather, vegetation vigor and soil moisture

Reference data
Soils, crops and management information

2. INTEGRATE

MULTISCALE MODELING

- **Field**
- **Watershed**
- **Regional**

Shared data and consistent processes connect scales

3. DECIDE

Site-specific guidance
Actions tailored to local conditions

Scenario comparison
Explore tradeoffs before implementation

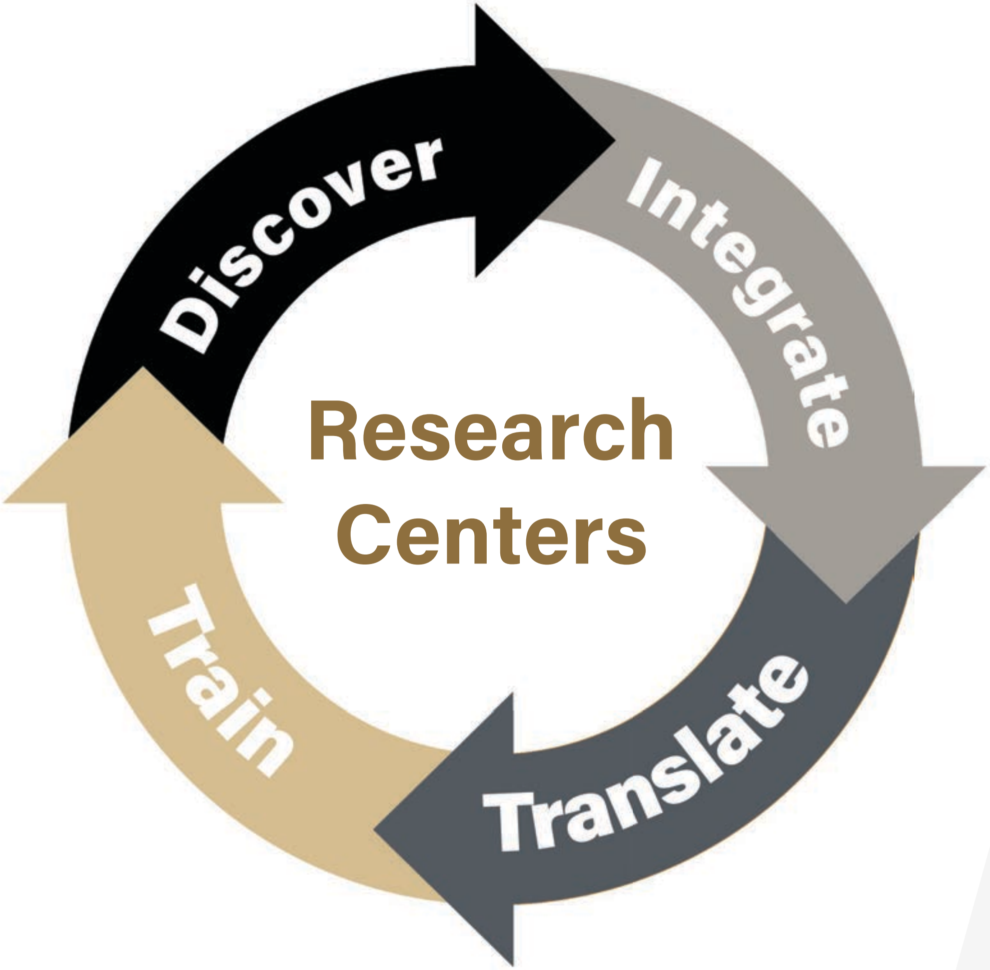
Accessible outputs
Maps, indicators and downloadable results

Decisions generate new observations, improving the next cycle

Why Ecosystem Research Centers Matter:
From Data to Decisions

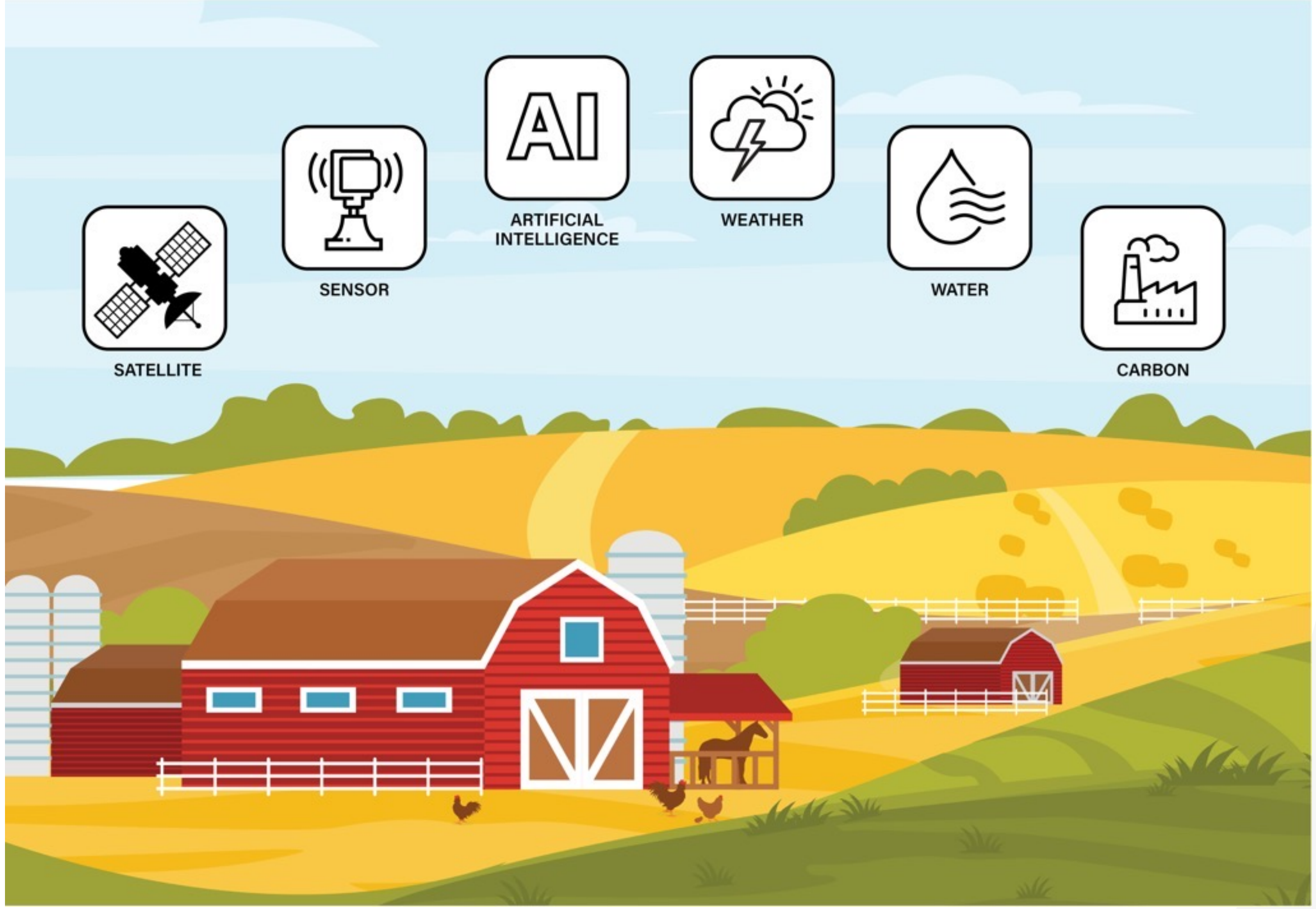
Ecosystem research centers connect data, models, people, and policy.

Turning science into practical solutions.



The Future: The next generation bioeconomy will be data-driven and ecosystem-aware

Emerging tools will allow us to manage ecosystems with greater precision.



A Healthy Bioeconomy
Requires a Healthy Ecosystem

- **Ecosystem services** are essential economic assets, not environmental luxuries.
- **Research centers** turn ecosystem science into actionable decisions and economic value.
- **Investment in ecosystem research** strengthens agriculture, rural communities, environmental resilience, and national competitiveness.

Conservation practices and the bioeconomy: ecosystem research that protects farming and freshwater

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Streams and Ditches: Running Through Farm Country

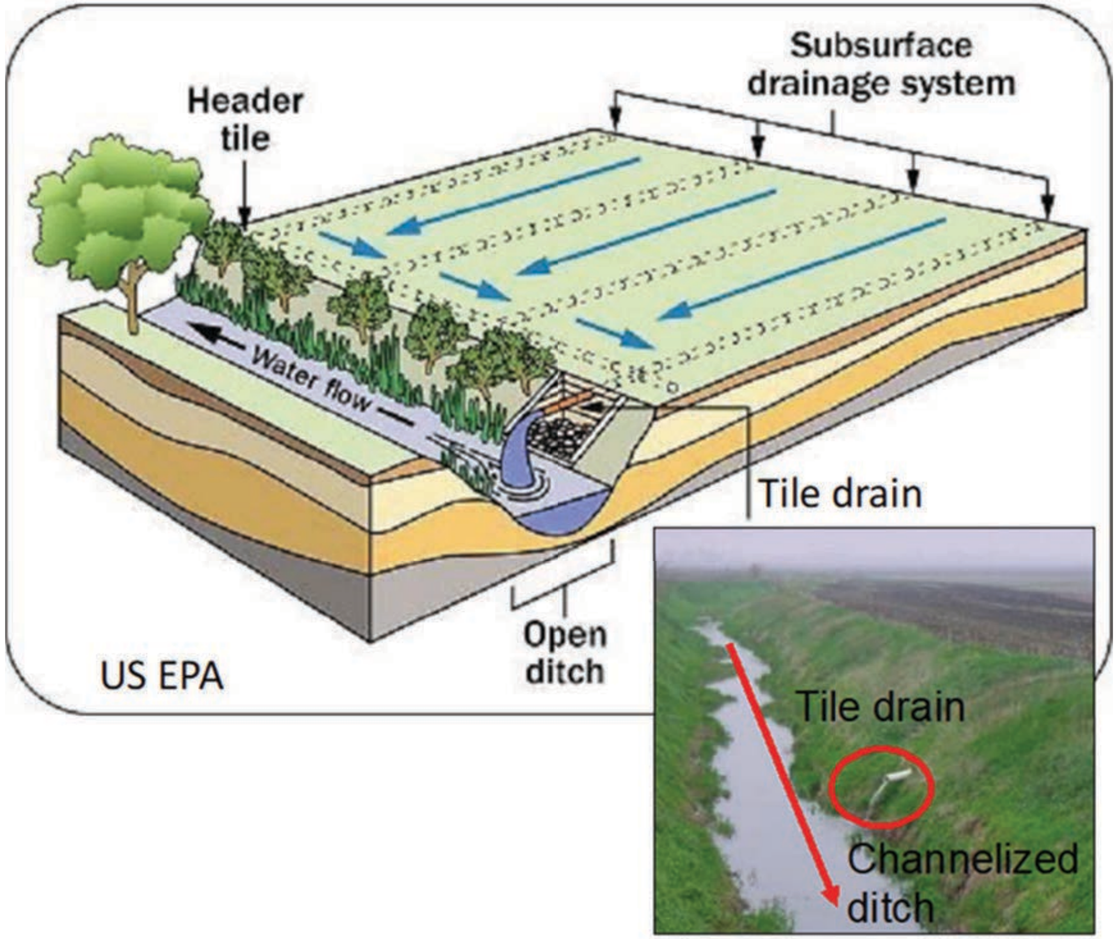
- Driving through the corn belt, here is what most of us see: miles of channel built to move water off a field as quickly as possible.

- Farmland is heavily tile-drained – underground pipes connect fields directly to the nearest ditch or stream, with little buffer between fields and waterways.

- For ~20 years, my research team, through our project called **The Indiana Watershed Initiative (IWI)** has asked the question:

- *Can agroecosystems, both fields and the waterways that drain them, work more like a sponge, not a pipe?*

The goal: keep fertilizer nutrients on fields, protecting water quality, save farmers money.



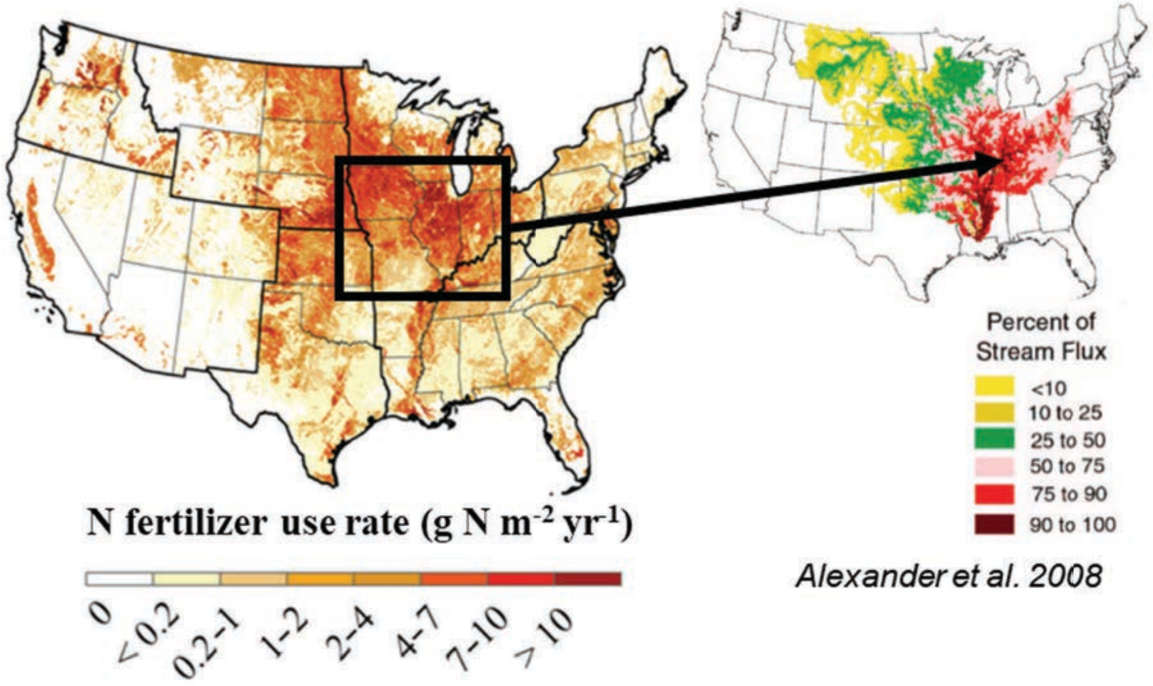
THE PROBLEM

The Challenge Cuts Both Ways:
For Farmers & for Downstream Water

- **Lost Fertilizer Dollars.** When nitrogen and phosphorus leave a field, that is fertilizer the farmer paid for – and it represents a direct economic loss.

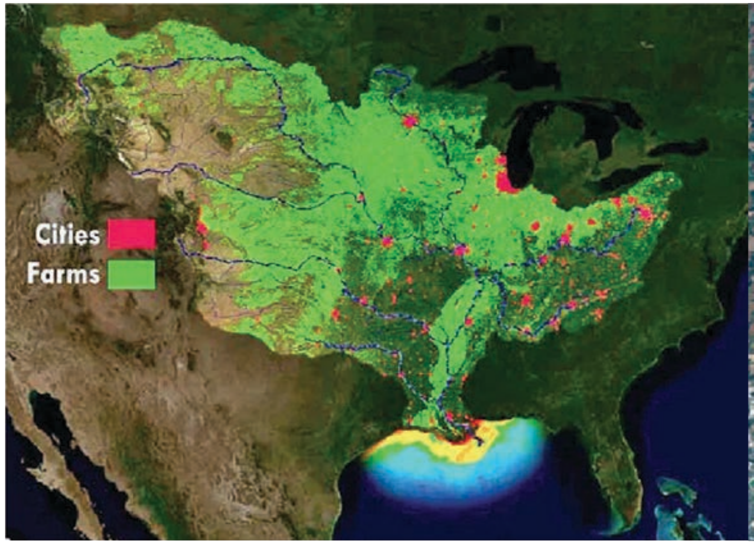
- **Degraded Downstream Water Quality.** These same nutrients fuel downstream algal blooms and the low-oxygen “dead zones” that form as a result.

Any practice that keeps nutrients on the field – or helps the waterway do more work – pays off twice.



Cao et al. 2018

Alexander et al. 2008



Gulf of Mexico (NO_3^-)

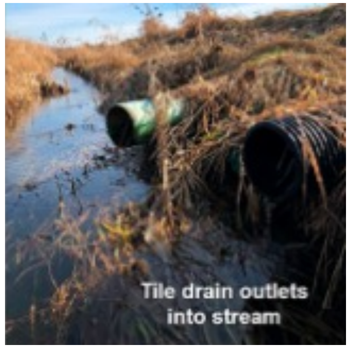
Western Lake Erie (dissolved P)

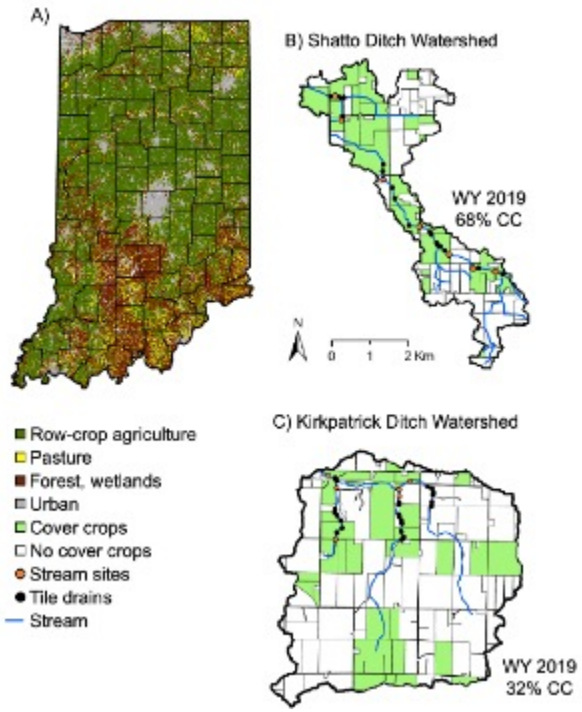
FIELD-LEVEL FIX

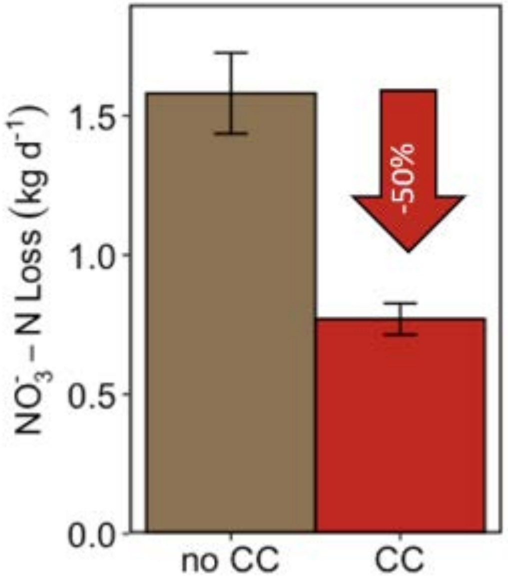
Cover Crops: Watershed-Scale, Working-Lands Evidence

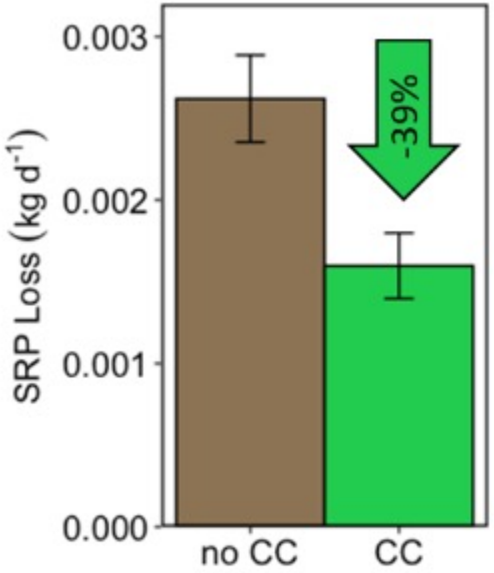
- Starting in 2017, we tested cover crops, implemented at scale across two small Indiana watersheds, monitoring two ditches draining real "working lands", over multiple years of real weather and farm management.
- For the four years of the USDA grant, farmers were paid to plant cover crops in the fallow season. We have continued monitoring even after payments stopped – and the water-quality benefit held.
- **Water Quality:** ~50% lower nitrate-N losses, ~39% lower dissolved phosphorus losses leaving tile drains from fields with cover crops. These are meaningful reductions, keeping fertilizer nutrients on fields, not entering waterways.

Cover crops work, but only for farmers who keep planting them, and the adoption has real costs after incentives end.









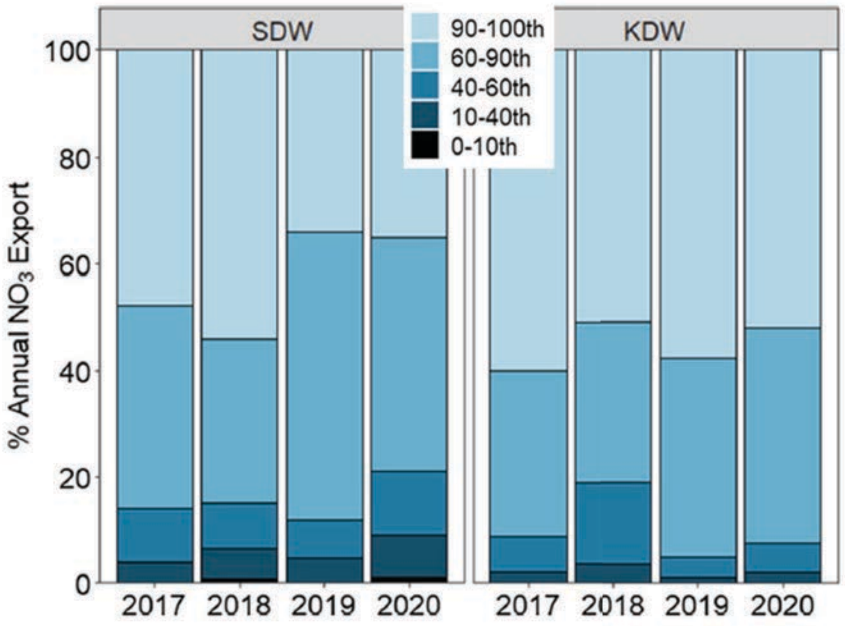
Storms Overwhelm Field-Level Fixes

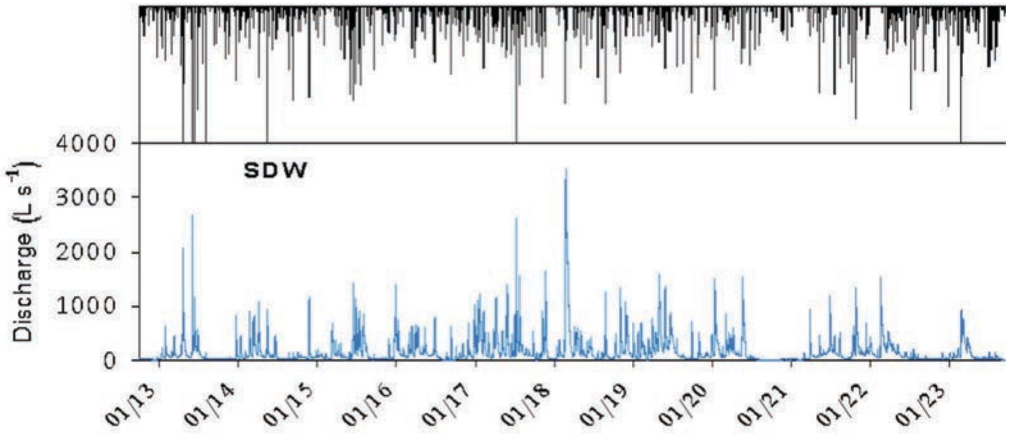
- During large storms, water moves through tile drains so fast that even a well-managed field can't hold everything back.

- **>50%** of annual nitrate export happens during just the top **10%** of storm flows.

- If we can't stop every storm from moving nutrients off the field, **can the waterway itself be designed to retain and process more of that runoff?**

Field practices (cover crops) alone aren't enough – during storms, the waterway itself has to act like a sponge.



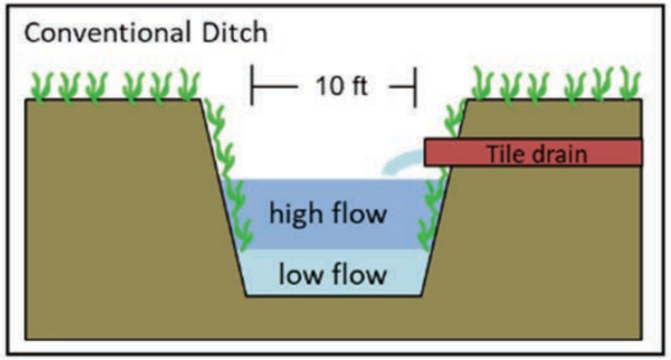


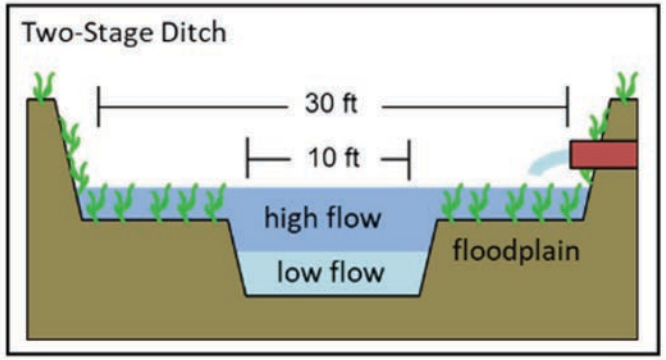
THE REDESIGN

Two-Stage Ditches
Design and Mechanism

- **Conventional ditches:** trapezoidal, steep-banked, built to move water fast – like a pipe. And you have to dredge to maintain them.
- **Two-stage design** carves floodplain benches into the banks – ~3x channel width, longer residence time in storms.
- Floodplain soils and vegetation become the “bioreactive sponge” for floodwater.
- **Shatto Ditch (IN):** 4.1 miles, longest two-stage ditch in the world; ~20 yrs of data.

Beyond water quality: no more dredging costs, no bank failures – the ditch pays for itself and improves water quality.



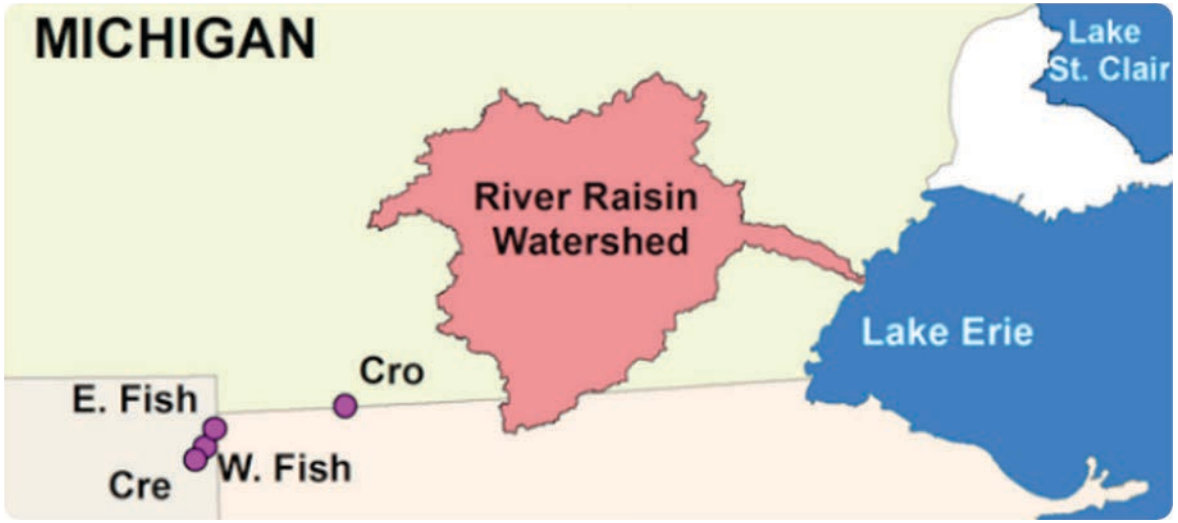


MEANINGFUL IMPLEMENTATION

Watershed-Scale Payoff
and the Cost

- **Question:** How much difference can two-stage make?
- Applied a SWAT model to River Raisin (WLEB; >75% agriculture); two-stage built on all eligible headwater reaches (75% of stream miles).
- **For farmers?** The two-stage is self-cleaning channel with stable banks, no woody vegetation growth due to frequent inundation. It also eliminates recurring dredging costs farmers already pay.
- **Cost to build?** One-time cost of 10$/ft or $53K per mile is an investment in rural infrastructure.

A nature-based watershed solution approaches the water-quality benefit of an engineering fix 10x more expensive – also saving farmers money.



River Raisin Watershed, Western Lake Erie Basin — modeled with two-stage design on all eligible headwater reaches (75% of stream miles). Christopher et al. 2017 (Ecol. Eng)

Nitrate Reduction

10%

reduction in annual nitrate export (273K kg N/yr) = ~$400K in fertilizer N

Phosphorus Reduction

31%

reduction in phosphorus export – approaching GLWQA targets

Watershed Buildout

$47M

Full watershed-scale nature-based design

Treatment Upgrade

$500M

One wastewater treatment plant upgrade (Toledo)

THE UNANTICIPATED OUTCOME

Added Insight from **Long-Term, Working-Lands Research**

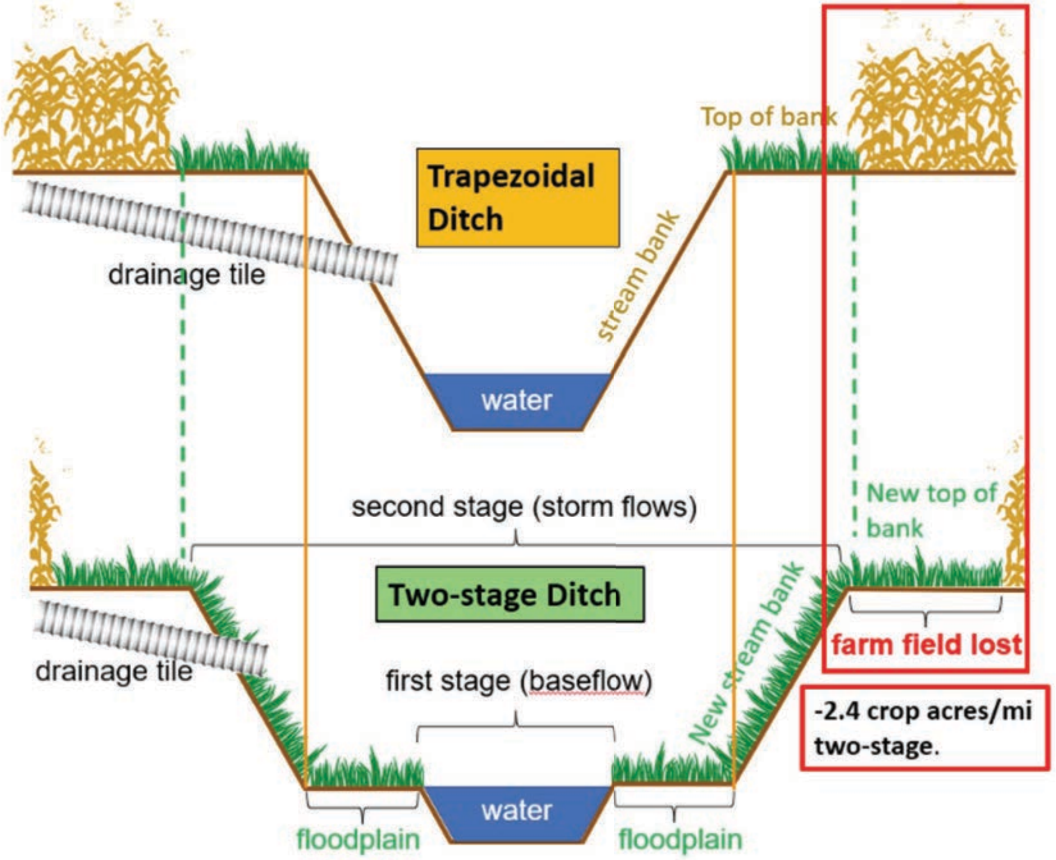
- **The science isn't always the gap.** Modeling is compelling, but demonstration projects are critical to identify which practices work – and what hurdles limit their uptake.

- And for farmers and the two-stage, implementation comes with additional challenges.

- **The Cost of Lost Land.** Currently NRCS/EQIP covers 70% of two-stage installation cost but doesn't compensate farmers for lost land (Indiana cropland: $10-15K/acre).

- **Optimize Existing Programs.** Concrete example of a need for ecosystem research that can demonstrate how existing programs can be refined to work better.

GOAL: Conservation practices that work on real-world farms→ benefitting both farmers and freshwater.



Long-Term Ecosystem Research Makes Innovation Possible

- The IWI data spans 20 years. The cover crop result alone took 10yrs of watershed monitoring.
- We couldn't have documented these outcomes in a 3-yr grant or on a small test plot – it required sustained investment in long-term infrastructure and people.
- The IWI example: seed grant → 5-year federal partnership → continued NSF funding → enhanced by farmers' own checkoff dollars.

USDA

USDA Conservation Innovation Grant
seed funding

→

USDA Regional Conservation Partnership Program
5-year regional project

→

NSF DISES Program
continued basic research

NSF

Sustained throughout by industry, foundations and partnerships:

INDIANA SOYBEAN ALLIANCE® | INDIANA CORN Marketing Council | Kosciusko County Soil And Water Conservation District | WALTON FAMILY FOUNDATION | USGS science for a changing world

TRAINING THE NEXT GENERATION

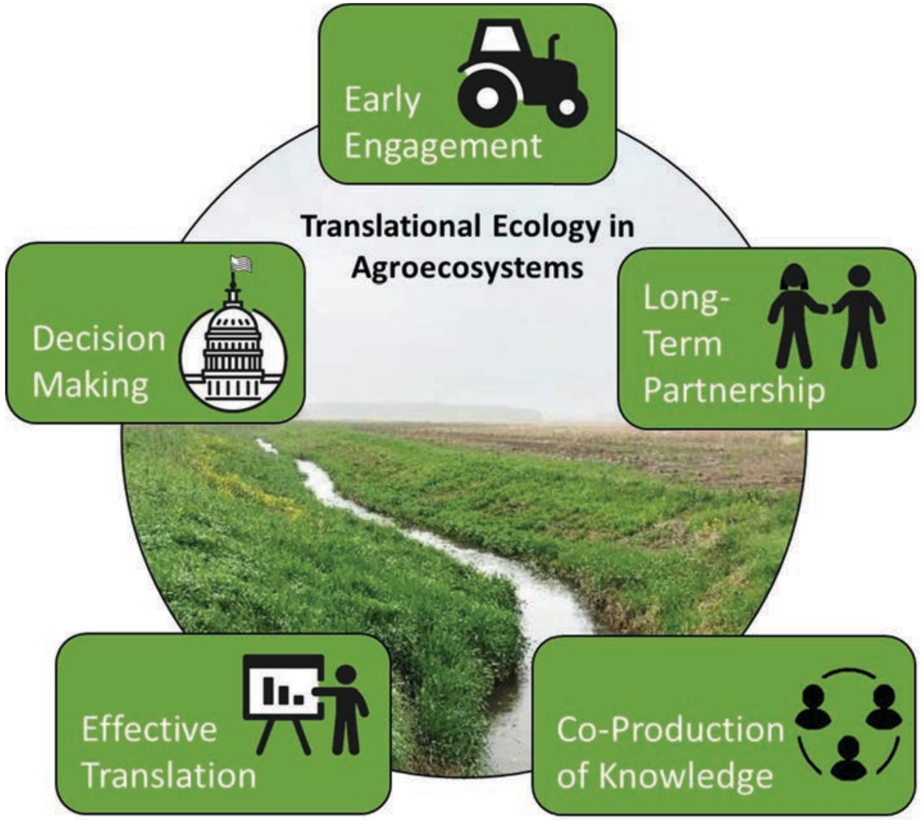
Real-World Problems Train Better Scientists

- **Co-benefit:** This type of ecosystem research doesn't just produce important quantitative data and impactful papers — it also produces the next generation of scientists.

- For the IWI project, every graduate student interacted directly with farmers, conservations partners, and agency staff. Training in the real world, not just in the lab.

- This **Translational Ecology Framework**, with commitment to early engagement, trusted partnerships, and co-produced knowledge develops an invaluable "toolbox" → scientists who know how to work across the research-management-policy continuum.

Ecosystem research centers don't just generate invaluable data — they train the next generation of scientists who can turn evidence into action.



RESTORATIVE AQUACULTURE AND THE

ecosystem services oysters provide

Dewey Houck,
Cypress Point Oyster Company

What specific ecosystem services are provided by oysters ?

Shoreline Protection

- Wave breaks
- Erosion control

Habitat and Biodiversity

- Home for wildlife
- Safe nurseries
- More species:

Water Quality

- Clearance rate (30-40 gal/hr)
- Particle removal

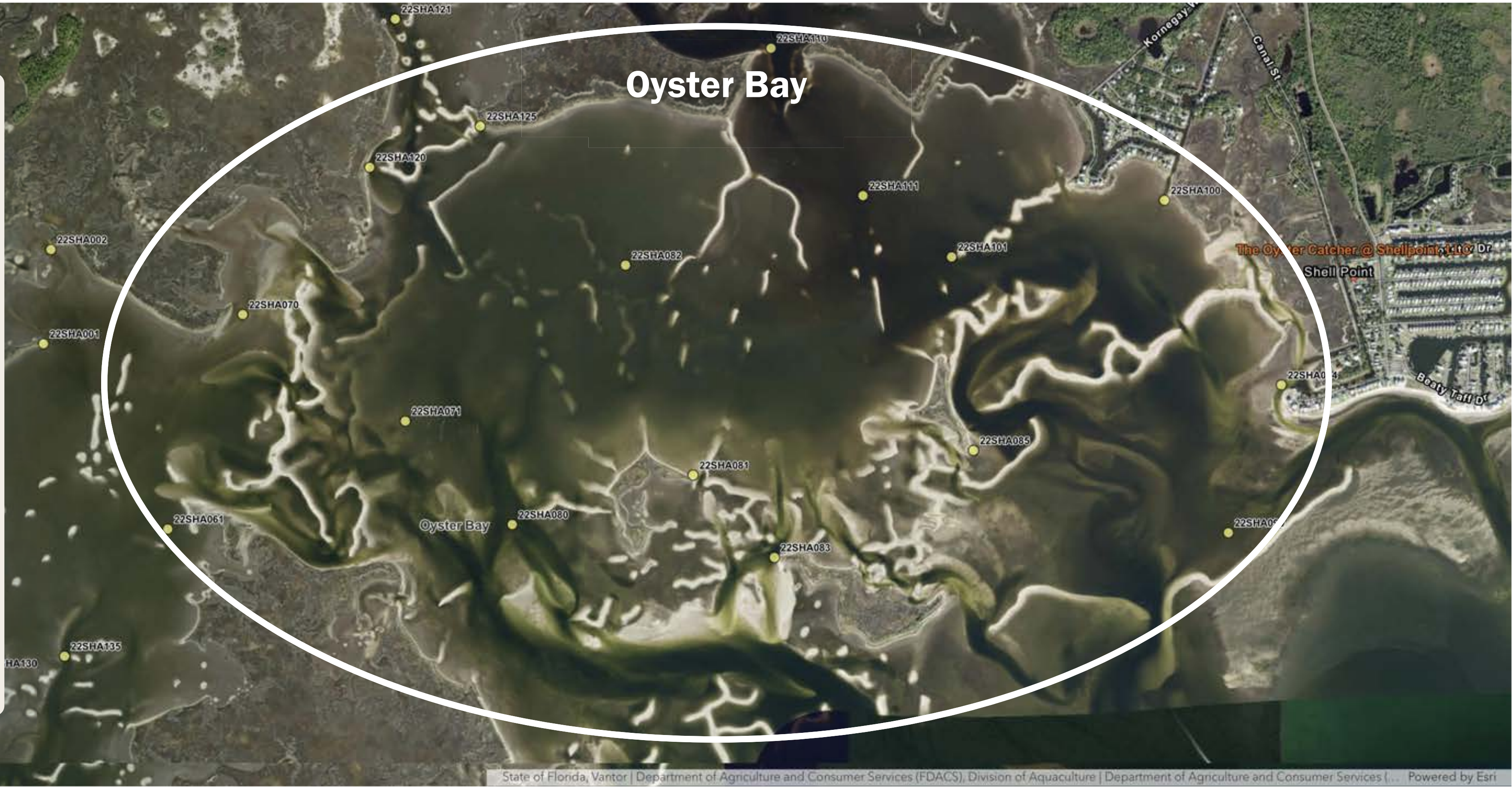
Nutrient Cycling and Carbon

- Nitrogen removal
- Carbon fixing

Photo Credit: Skip Kemp

Scope and scale of our oyster ecosystem in 1990

- 4 Billion Gallon Embayment
- Shallow(6’) estuary with high suspension feeder biomass
- 65+ oyster reefs
- 115 acres of reef
- 75 million live oysters
- Clearance time equals tidal residence time
- Clear water attractor state

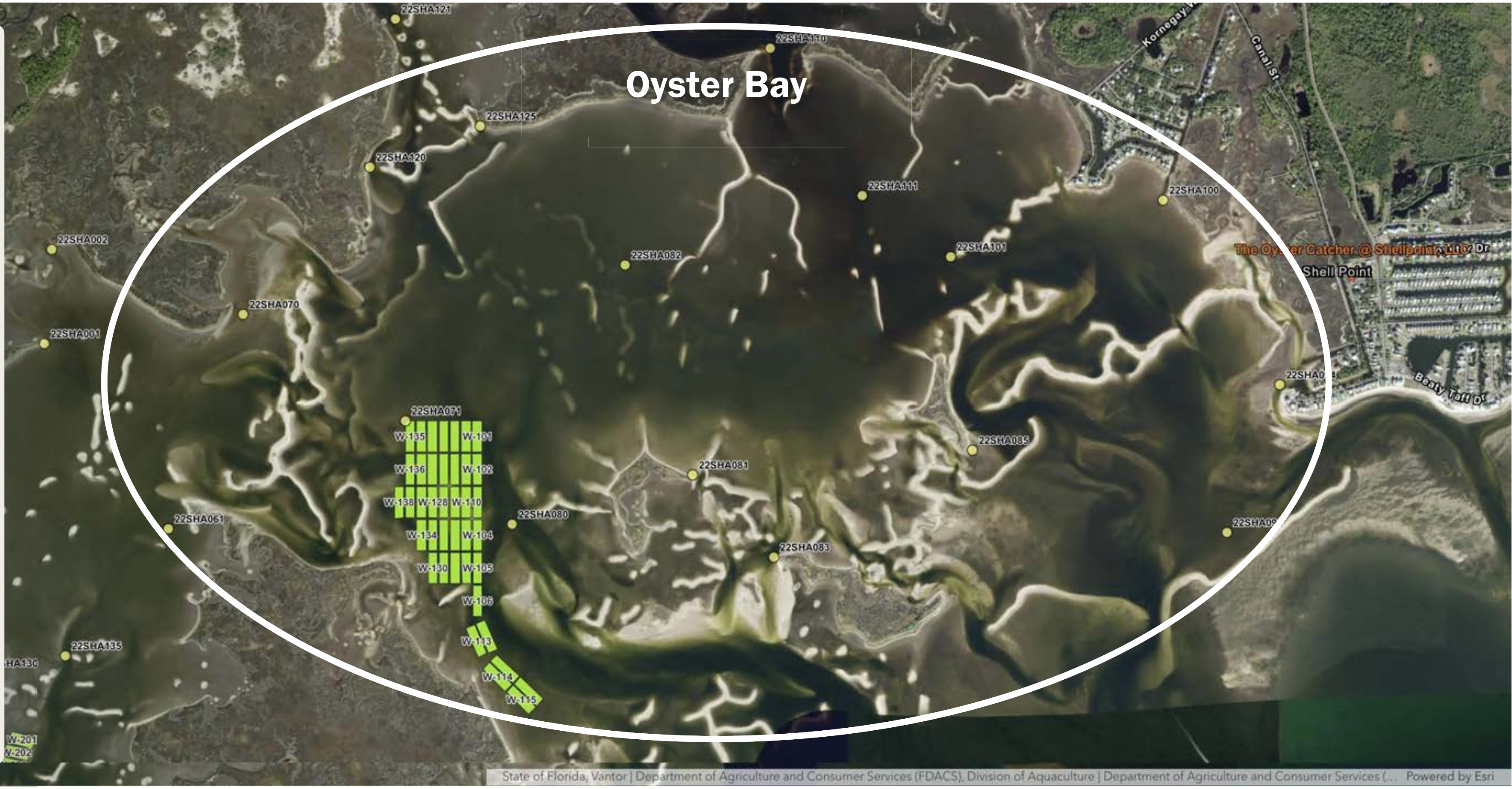


The ecosystem collapse – when bivalve clearance time exceeds tidal residence time

- 2007-2011: Severe drought, upstream water diversion, overharvesting and loss of hard reef surface/cultch
- There aren't enough oysters left to continuously filter the bays
- System flips to a turbid, phytoplankton-dominant state
- USG declares a Federal Fishery Disaster in 2012
- Apalachicola Bay closes to commercial harvest in 2020

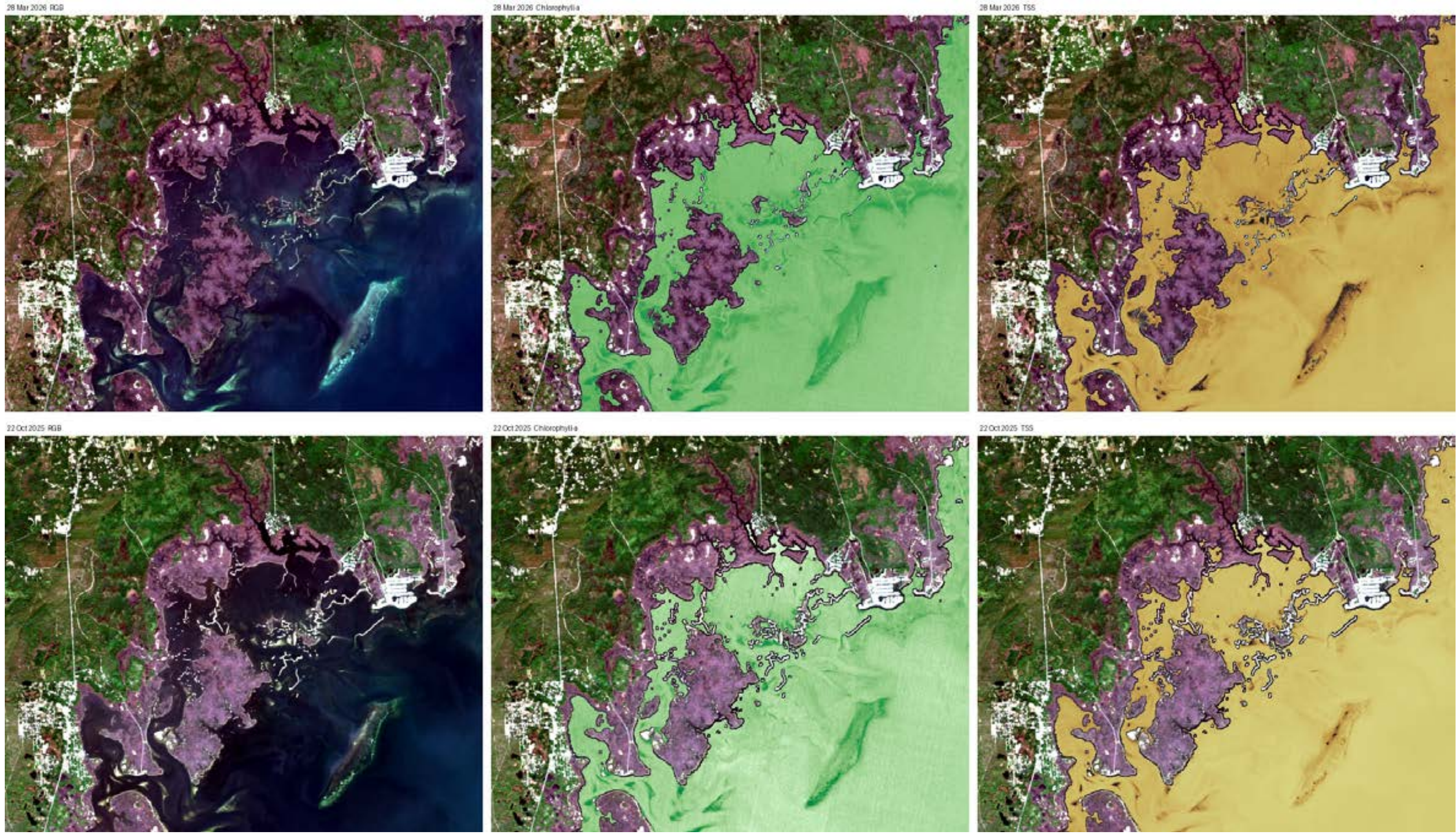
Restorative aquaculture – oysters back in the bay

- 45 individual oyster water column leases
- 33.3 acres of water leased
- Begun in 2012/13
- Administered by Florida Dept of Ag
- 22% of original oyster population
- Continuous water quality monitoring
- Zero wild oysters
- Clearance time ?
- Partial restoration of ecosystem services



The partnership – Understanding the Impact

- How do we understand if we're making a difference?
- Data scale requires academic involvement
- FSU C&ML operates a bivalve hatchery
- FSU C&ML maintains two environmental monitoring stations on oyster leases
- 2025 – Trilateral Public Private Partnership with Cypress Point, Bay Shellfish and the Lab



Thank You

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