



WELCOME

March 27, 2026

11:30am – 3:30pm

Research...
In Louisiana
By Louisiana
For Louisiana



THANK YOU!

Dr. Dianne Olivier

Vice Provost & Vice President for Academic Affairs
Office of Faculty Affairs
Professor of Educational Leadership

Dr. Ramesh Kolluru

President
University of Louisiana at Lafayette

Dr. Mary Farmer-Kaiser

Dean of the Graduate School
Professor of History
...and the Entire Grad School Team

Dr. Kristi Anderson

Office of the President
Strategy, Mental Health & Wellness, Research Community
Engagement, Louisiana Impact

Dr. Kumar Das

Interim Vice President for Research, Innovation
& Economic Development
...and the Entire OVPRIED Team

Dwight W. Andrus, Jr.
The Louisiana Board of Regents



4 rounds of proposals

385 Submissions

From all 7 academic colleges

From every graduate program

128 projects awarded
\$250,000+ invested

50 faculty, 68 grad students,
12 undergraduates, 10 staff

5 research summits



Our Values

These are the values that drive our research and motivate us to explore, learn, and discover.



Sustainability

Our campus is a living lab for innovative research in watershed management, solar power, energy conservation, and environmental restoration.



Value for All

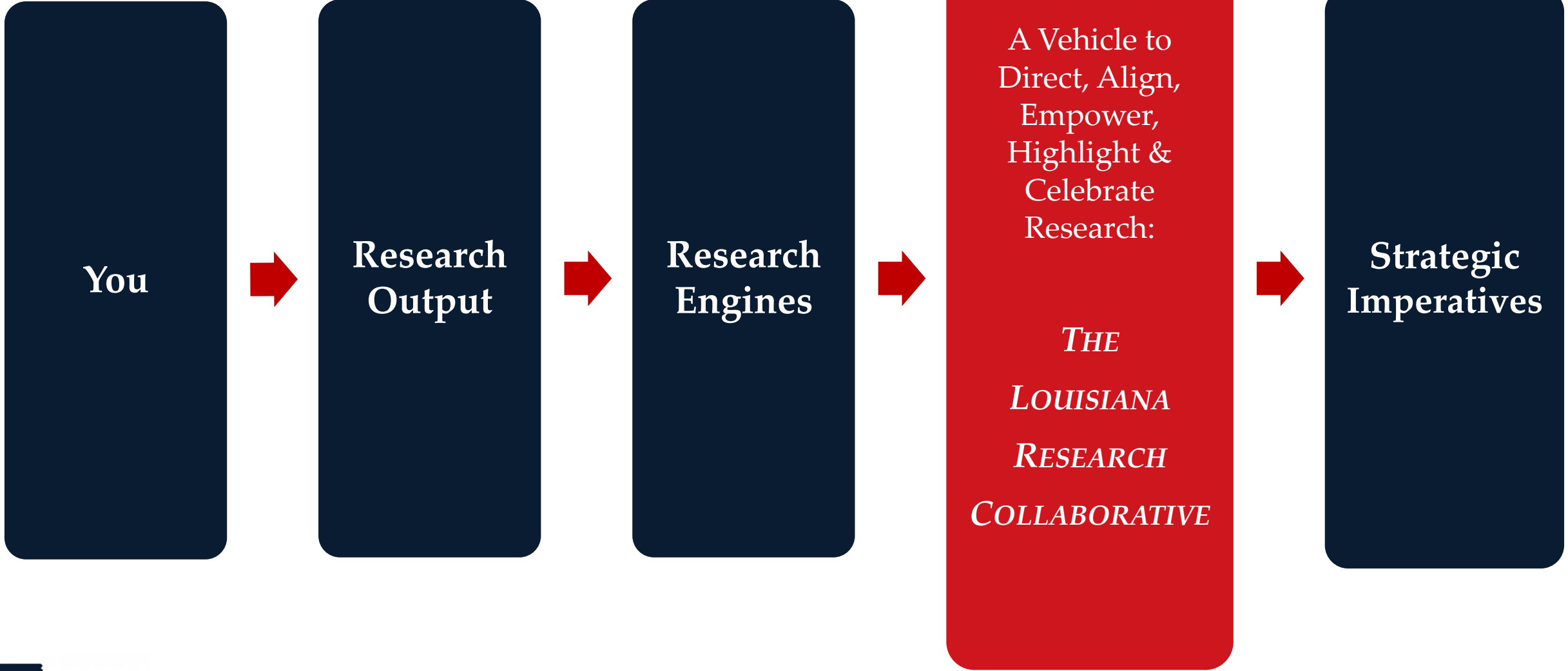
We recognize the value of all disciplines. Our research aims to improve opportunity, literacy, and design for everyone.



Social & Economic Development

Through our research, we're leaders in shaping policy, advancing educational practices, improving health care, attracting businesses, and preserving our cultural heritage.





LOUISIANA VISION 2035

FORTITER • FELICITER • FIDELITER



1 STUDENT SUCCESS & WHOLE STUDENT FOCUS

ENROLLMENT GROWTH

16,100 **→** 22,500 **→** 27,500
TODAY 2030 2035

CAREER READINESS & PLACEMENT

Internships Research Clinicals Co-ops



CLEAR PATH TO EMPLOYMENT

WHOLE STUDENT EXPERIENCE

Wellness Belonging Leadership Engagement Academics Service Leadership

2 FACULTY & STAFF EXCELLENCE

RESEARCH GROWTH

\$254M **→** \$325M **→** \$500M
TODAY 2030 2035

DOCTORAL GRADUATES (PER YEAR)

73 **→** 110 **→** 150
TODAY 2030 2035

COMPETITIVE FACULTY & STAFF COMPENSATION

NATIONALLY RECOGNIZED ACADEMIC PROGRAMS

REMOVE BARRIERS UNLEASH EXCELLENCE

3 LOUISIANA IMPACT & NATIONAL POSITION

STRENGTHEN CARNEGIE R1 STATUS

TOP PUBLIC UNIVERSITY TRAJECTORY

TOP 100 **→** TOP 75
TODAY 2035

SREB CLASSIFICATION

INDUSTRY • WORKFORCE
INNOVATION • ECONOMIC DEVELOPMENT

4 FINANCIAL STRENGTH & STEWARDSHIP

ENDOWMENT GROWTH

\$250M **→** \$350M **→** \$500M
TODAY 2030 2035

FACULTY DEVELOPMENT & STUDENT SUCCESS RESOURCES

LOUISIANA VISION 2035 CAMPAIGN

SUSTAINABLE DIVISION I ATHLETICS EXCELLENCE

STRENGTHENING ENROLLMENT • ENGAGEMENT • REPUTATION



Rooted in Excellence. Rising for Louisiana.

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WHAT'S NEXT TODAY?

12:10-1:00

Research Presentations

1:00-1:10

Break

1:10-2:00

Research Presentations

2:00-2:10

Break

2:10-3:15

Research Presentations

3:15

Dr. Mary Farmer-Kaiser

Grad Student Appreciation Week Awards



THANK YOU!

Jennifer Ercoli

Director of Graduate School
Communications





PEOPLE & THEIR PLACES

Natalie Keefer

Associate Professor of Education, Curriculum & Instruction

Kathe Managan

Assistant Professor of Anthropology

*Sustainable Economic and Cultural Development of
Louisiana Business Practices in French and Creole*

Sustainable Economic and Cultural Development of Louisiana Business Practices in French and Creole

Natalie Keefer, Ph.D. and Kathe Managan, Ph.D.



UNIVERSITY of
LOUISIANA
L A F A Y E T T E

**Louisiana Center for Research
and Education on Languages
and Literacies (LA CREoLL)**

The Study

- 20 responses
- Purposes
 - Community-driven collaborative research
 - Explore French and Creole business practices in Louisiana
 - Determine interest in professional development opportunities

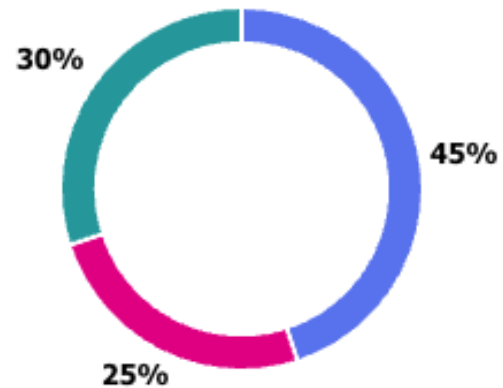
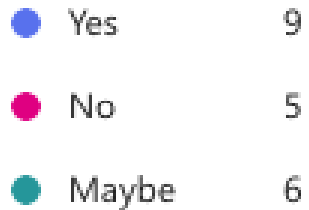
Types of Economic Activities

- Tourism (9)
- Agriculture and industry (3)
- Arts (3)
- Government, legal, and economic development (3)
- Education (2)

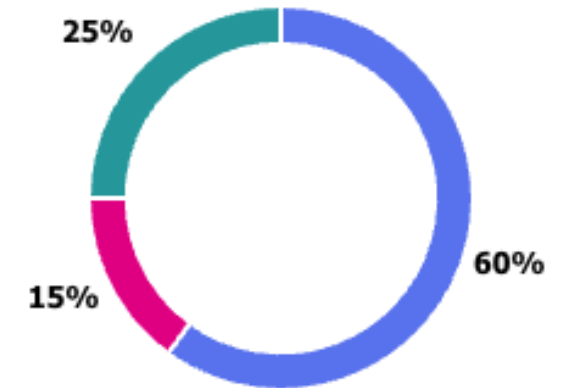
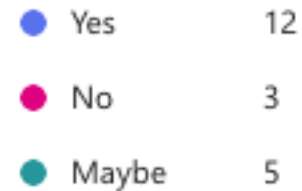


Interest in hiring French or Creole Intern/Employee

Intern



Employee



Could you use an intern/employee for the following?

Summary of Top Responses

Task	Intern	Employee
Social media posts	5	2
French-language content for marketing materials or campaigns	1	4
Greet visitors and serve as translators	2	3
Conduct outreach or engagement with French-speaking communities or stakeholders	4	2

Creating Digital Content

Odette: Putting the recipes and the [curriculum] lessons onto the website. I have a YouTube channel, so those transcripts from those cooking classes could even be transcribed, and they would... that way, it would give the learner that immersion part of preparing the recipe, but also speaking in the, you know, Creole language.

As the younger kids...doing storyboards for the Cooking Adventures of [] might be something that they could work on, because it's going to be short stories, an adventure in cooking. So then they'll get a recipe, they can cook it with their family....It would be something that would be fun, and light-hearted. And they could be digital.

French and Creole: A Transferable Workforce Skill for Global Competence

Gabrielle: If I was working with some school districts I could see having in the whole career conversation, like if there was any sort of materials that we would possibly help the school districts create to talk about multilingual skills as a workforce development transferable skill, then I think I would love to be able to have, like, especially if it was one of my interns, getting them engaged in that conversation. I would love to have somebody who I could also be able to send out and be able to represent us in those conversations.



Economic Development Initiatives

Odette: [I'm interested in] something that's more conversational, because I don't feel I need all the grammar and the formal [language]. But I do need to be able to communicate....I think in terms of economic development, I'm always thinking about the future generations, so...scholarships and a means for them to have paid internships, if possible. Some type of immersive....connection with someone who does speak the Creole language.

Lacey: Yeah, micro-credentials is an interesting conversation right now because there is, I think we are starting to see more and more of a shift towards how can we make our entire education and training ecosystem much more nimble.

Martin: I'm all in favor of those kinds of certificates and things. It's something that I really thought about. For example, you have very large numbers of people think that French was then in competition with Spanish. And a lot of the school administrators thought, well, Spanish is more useful. Which isn't at all true. If you have two years of Spanish and somebody needs a Spanish speaker, they're not gonna hire somebody with two years of Spanish. They're gonna hire the person from Mexico that's looking for a job.

Highlights

- Business owners hail from a variety of industries – not just tourism.
- French and Creole language skills are transferable and connected with SDG.
- Participants see these language skills useful for digital marketing, content creation, and outreach.
- All participants were interested in economic development initiatives.
 - Possibilities - microcredentials, upskilling, leadership institute



PEOPLE & THEIR PLACES

Natalie Keefer

Associate Professor of Education, Curriculum & Instruction

Kathe Managan

Assistant Professor of Anthropology

*Sustainable Economic and Cultural Development of
Louisiana Business Practices in French and Creole*



PEOPLE & THEIR PLACES

Christine Weill

Assistant Professor of Communicative Disorders

*Louisiana's View of Speech-Language Pathology
Assistants*

Louisiana's View of Speech- Language Pathology-Assistants (SLP-A)

Christine Weill, Ph.D.

Communicative Disorders/Liberal Arts

5th Annual Louisiana Impact Research Award Summit

What is an SLP-A?



Initial Interest

- Louisiana Board of Examiners for Speech-Language Pathology and Audiology (LBESPA)
- General bias against SLP-A licensure
- Bachelor's degree with no apparent job connected
- Job openings for master's level professionals unfilled

Opportunity Presents Itself

- Flexibility
- Louisiana Board of Regents eLearning Grant
- Curriculum development
- Semester implementation

Potential Future Directions

- Legislative support
- University Support
- Implementation Science
- Department of Education support



UNIVERSITY *of*
LOUISIANA
L A F A Y E T T E ®

Thank you for attending today's presentation.



PEOPLE & THEIR PLACES

Christine Weill

Assistant Professor of Communicative Disorders

*Louisiana's View of Speech-Language Pathology
Assistants*



PEOPLE & THEIR PLACES

Xueao Cao

PhD Student in Communicative Disorders

Gulalek Charyyeva

PhD Student in Communicative Disorders

More Than Words: Supporting the Development of a Child with Communication Disabilities Through Engineering the Communicative Environment

Faculty Advisors: Judith Oxley & Katherine McQuitty Hays

More Than Words: Supporting the Development of A Child with Communication Disabilities Through Engineering the Communicative Environment

Xueao Cao, Gulalek Charyyeva,

Faculty advisors: Judith Oxley, Katherine McQuitty Hays

Department of Communicative Disorders, College of Liberal Arts

Why this topic?

- Social communication is important but can be challenging for some children with communication difficulties
- These children can benefit a lot from their communicative environment (e.g., artifacts, human beings)
- Speech-language Pathologists (SLPs) support these children through therapy
 - Explicitly: focused practices
 - Implicitly: Engineering the communicative environment

Who are the participants?

Ellie

- 6-year-old girl
- Severe developmental delay
 - Highly unintelligible speech
 - Impaired language comprehension & expression skills
 - Impaired social communication skills
 - E.g., never initiating a topic
 - Difficulty in sustaining attention
- Concerns about visual deficits
 - E.g., low visual acuity, limited visual field
- Receiving speech-language therapy in the department clinic

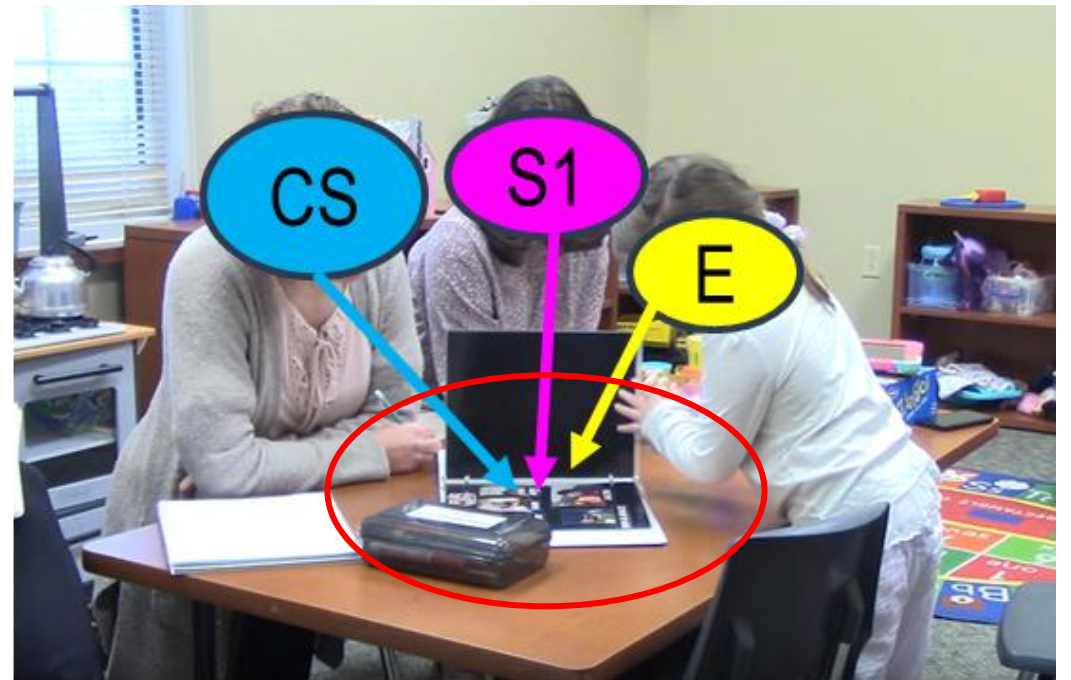
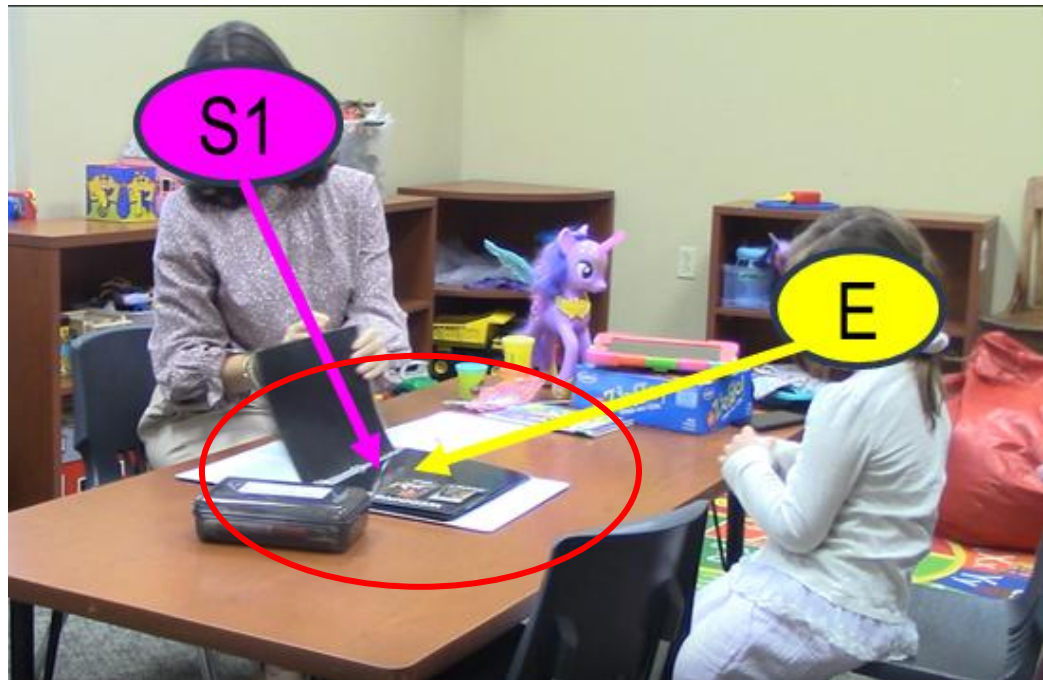
Who are the participants?

- First-year graduate students (S1, S2, S3) in speech-language pathology
 - Receiving clinical training at the department clinic
- Clinical supervisor (CS) at the department clinic

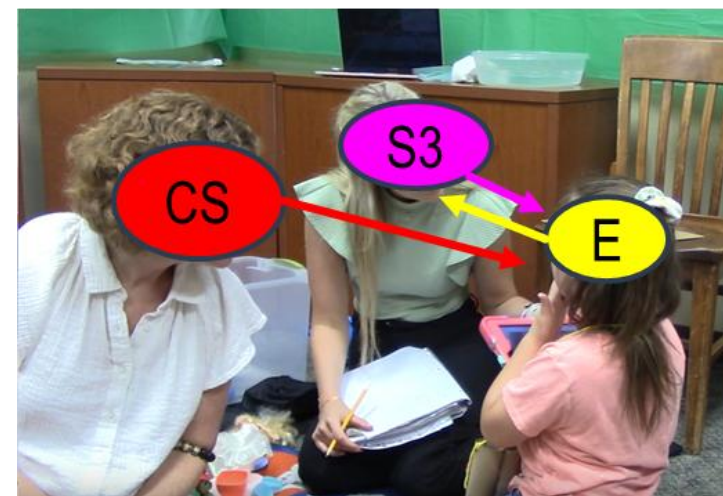
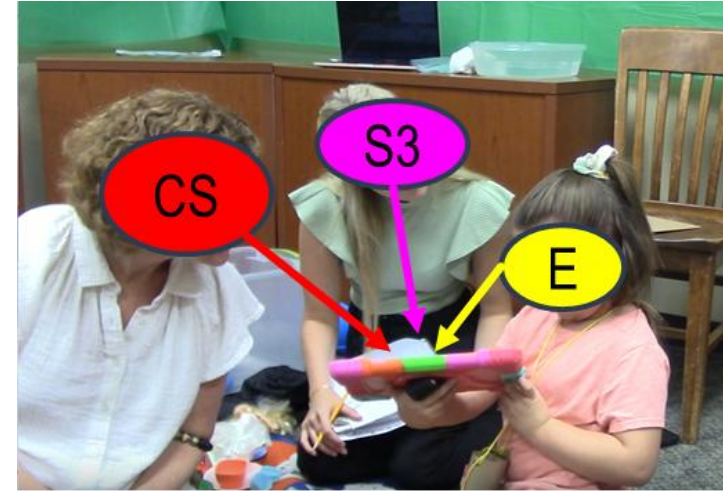
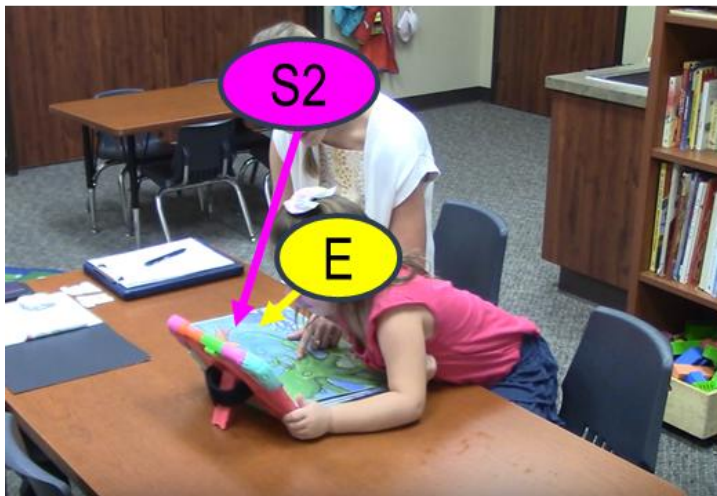
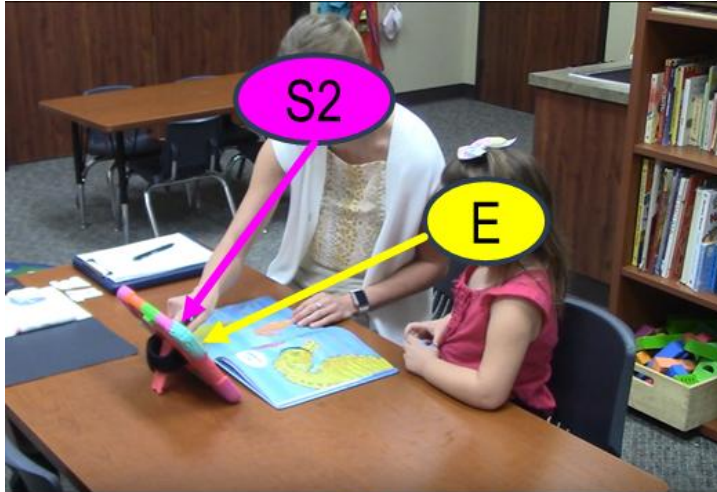
What do we analyze?

- Video recordings of Ellie's therapy sessions
- Analyses focus mainly on
 - The overall communicative environment
 - E.g., relevant materials, communication aids, human bodies
 - Nonverbal aspects of communication
 - e.g., gestures, gaze, body movements, facial expressions...

Comparison #1



Comparison #2



What do we learn?

It's more than speech!

- Positioning of environmental artifacts matters
- Positioning of human bodies matters
- Bodily actions (beyond words) matter



QUESTIONS? COMMENTS?

THANK YOU!





PEOPLE & THEIR PLACES

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PhD Student in Communicative Disorders

Gulalek Charyyeva

PhD Student in Communicative Disorders

More Than Words: Supporting the Development of a Child with Communication Disabilities Through Engineering the Communicative Environment

Faculty Advisors: Judith Oxley & Katherine McQuitty Hays



PEOPLE & THEIR PLACES

Ignatius Cahyanto

Associate Professor of Management

*Visualizing Empowerment?
Tourism and the Experiences of Ethnic Minority
Women in Northern Vietnam*

**VISUALIZING EMPOWERMENT:
TOURISM AND THE
EXPERIENCES OF ETHNIC
MINORITY WOMEN IN
NORTHERN VIETNAM**

Ignatius P. Cahyanto, PhD., CHE., CAHTA
Associate Professor of Management
University of Louisiana at Lafayette

INTRODUCTION

This study examined how rural tourism empowered ethnic minority women in Son La province in the NMR region using the Participatory Action Research (PAR) approach.

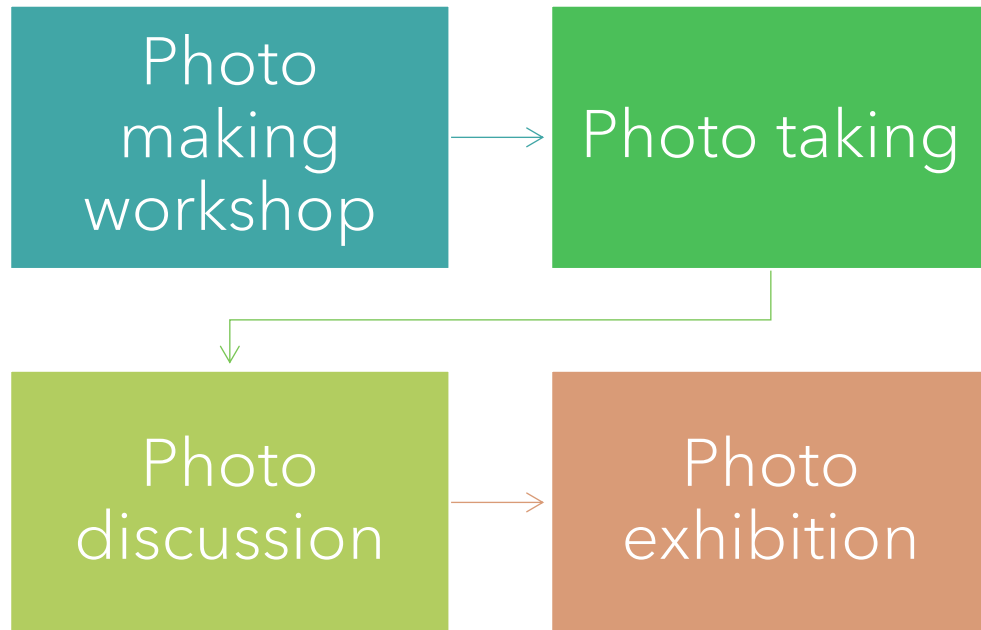
PAR is an inclusive, collaborative research approach characterized by participation and a commitment to producing knowledge in the interest of social change (George & Syrja-McNally, 2015).

RQ: How has the extent of engagement with tourism empowered ethnic minority women?

RQ2: How does such engagement shape their social capital?



PHOTOVOICE STAGES



- Cahyanto, I., Murti, D.C.W & Kingsbury A. (2026): Visualizing vulnerability: integrating drones and photovoice to enhance the resilience of rural tourism in Indonesia, *Current Issues in Tourism*, DOI: 10.1080/13683500.2026.2623178 (ABDC Rating: A)
- Sudiarta, I.N., Cahyanto, I., Indrawati Y., Negara, I.M., & Putra, A.M. (2025). Regenerative Rural Tourism: Uncovering Community Capitals and Vulnerabilities through Photovoice in Bali, Indonesia. *Tourism Review*. DOI: 10.1108/TR-01-2025-0026. (ABDC rating B)
- Cahyanto, I., Kingsbury, A., Widodo, E., Puspita, N., & Hernadi, A. (2021). Coping as a community: recovery experiences of a tourism-reliant area following a tsunami in Indonesia. *International Journal of Tourism Research*, 23(5), 928-941. (ABDC rating: A)
- Kingsbury, A., Cahyanto, I., Widodo, E., Puspita, N., & Harnadi, A. (2021). Adapting photovoice with ESRI survey123 for tourism research in Banten, Indonesia. *Current Issues in Tourism*, 24(15), 2187-2203. (ABDC rating: A)



<https://vanhoagritage.com/en/van-ho-agritage-en>



RESEARCH CONTEXT

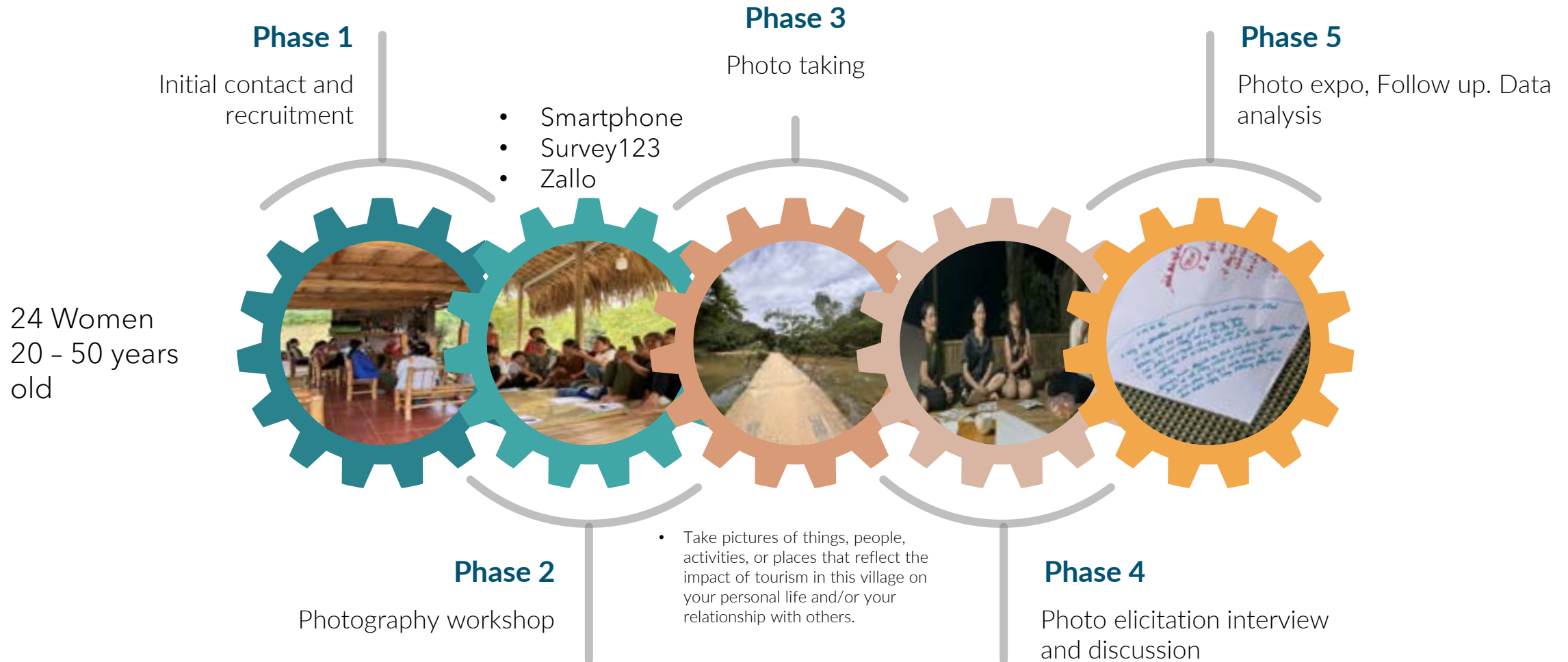
Buot village is in Chieng commune of Van Ho district, Son La province.

59 households reside in the village. The main ethnic minority group is the Thai people.

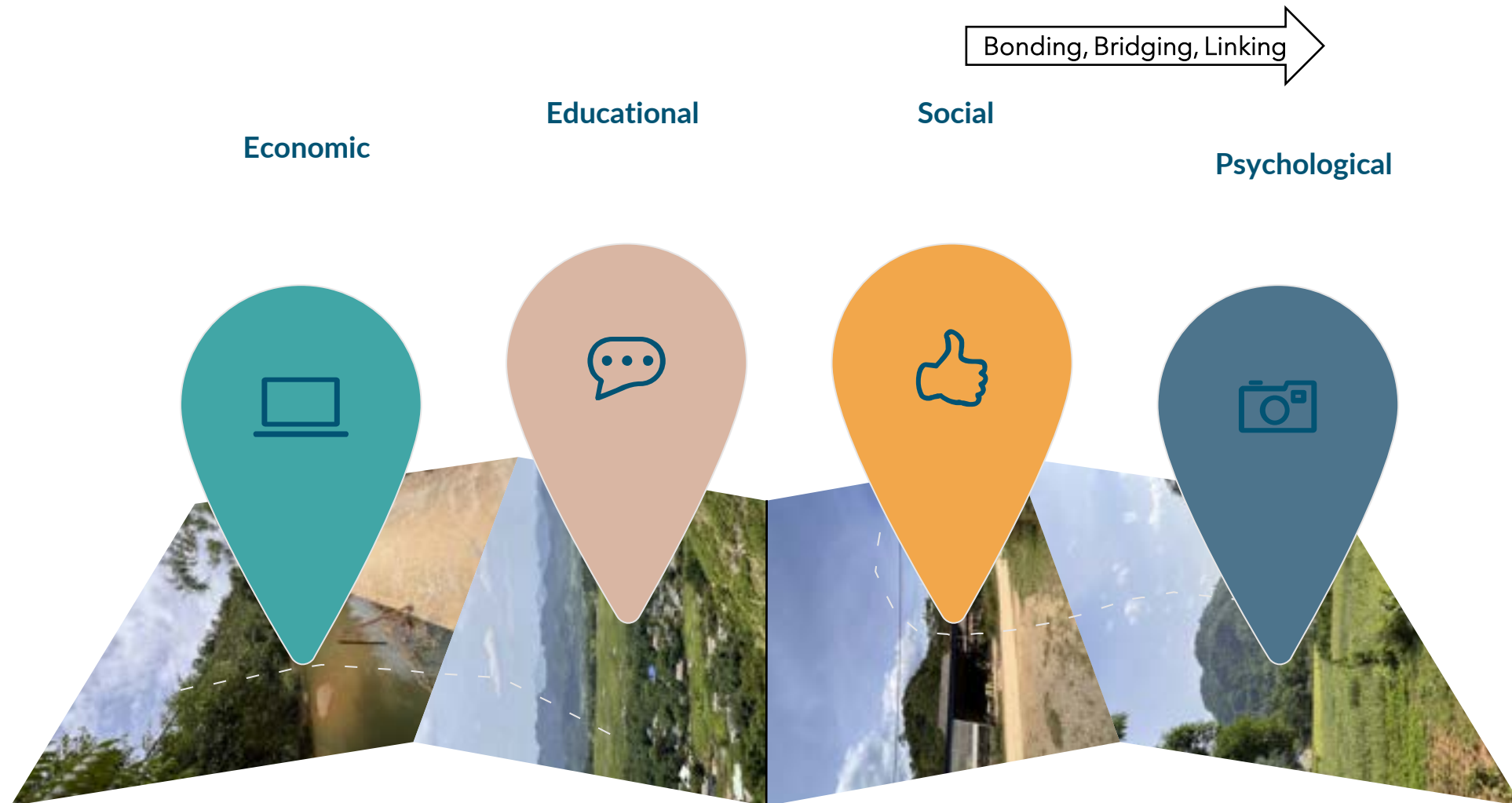
Tourism activities in Buot Village mainly started in 2021 as a service. Before that, visitors came to see the fish in the stream and passed by, not staying overnight there.

Buot was selected to implement a project with the purpose of developing a regenerative model (combining agriculture, tourism, conservation, and development).

RESEARCH FLOWCHART



EMPOWERMENT IN BUOT VILLAGE



ECONOMIC

Increased demand for local products/ commodities.

Flexible working hours.

Additional incomes (FnB).



"Stream snails are a specialty of my Buot village. It is good that people are getting to know more about it."



"Green tea in Buot village, a crop that brings a fairly stable income for the people in the village"



"Tourists come to the village to experience and take photos of the performance team"



"Traditional dishes for visitors"

EDUCATIONAL

Access to information

Access to training

- Hospitality skills
- Cooking
- Arts
- Farming
- Product packaging



Organic farming



Hospitality training



Traditional dance class



Traditional dishes training

SOCIAL

Recognition of their own value and their contribution to their family and the community.

Equality and freedom.

Widen their network.

"As I have a bit of income, my husband will not comment too much if I buy something he may not like. Sometimes, he asks for my ideas".



PSYCHOLOGICAL

Enhanced self-confidence and encouraged positive self-evaluation and recognition of personal ability and value.

Gained respect from visitors and others.

Increased creativity.

"Tourists were very impressed with my cooking. They complemented it. I feel very happy and proud."



DYNAMIC OF SOCIAL CAPITAL DUE TO TOURISM

Ethnic minority women possess social capital, but it is predominantly bonding rather than bridging.

The influence of bridging is greatest when the woman is part of the ' hierarchy'

Linking social capital may not reach ethnic minority women who are not active.





DISCUSSION

The study highlighted the importance of empowering ethnic minority women.

It showed that with high flexibility in time, engagement in the village exhibited high suitability for participants, who usually shoulder various family responsibilities.

Political empowerment is not evident. However, participants gained more confidence in voicing their comments on tourism development in the village.

The use of adapted photovoice, smartphone, and Zallo is also empowering.

- New knowledge and skills
- Change in self-perception
- Expanded their social network

Tourism increases social capital, mostly bonding. Linking is the goal.

While tourism has empowered these women, questions remain about how the continued participation of ethnic minority women could be encouraged and sustained.

"A guest never forgets the host who had treated him/her kindly."

Homer, The Odyssey

XIN CẢM ƠN





PEOPLE & THEIR PLACES

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*Visualizing Empowerment?
Tourism and the Experiences of Ethnic Minority
Women in Northern Vietnam*



PEOPLE & THEIR PLACES
(& A PREVIEW OF
INNOVATION, HEALTH & WELLNESS)

Asif Istiak

PhD Student in Systems Engineering: Mechanical

***A Novel Nanocarrier-Driven Therapeutic Strategy for
Inhibiting Tissue Damage in Degenerated Joint Disease***

Faculty Advisors: Tanvir Faisal

Novel Nanocarrier-Driven Therapeutic Strategy for Inhibiting Tissue Damage in Degenerated Joint Disease



Asif Istiak

PhD Candidate

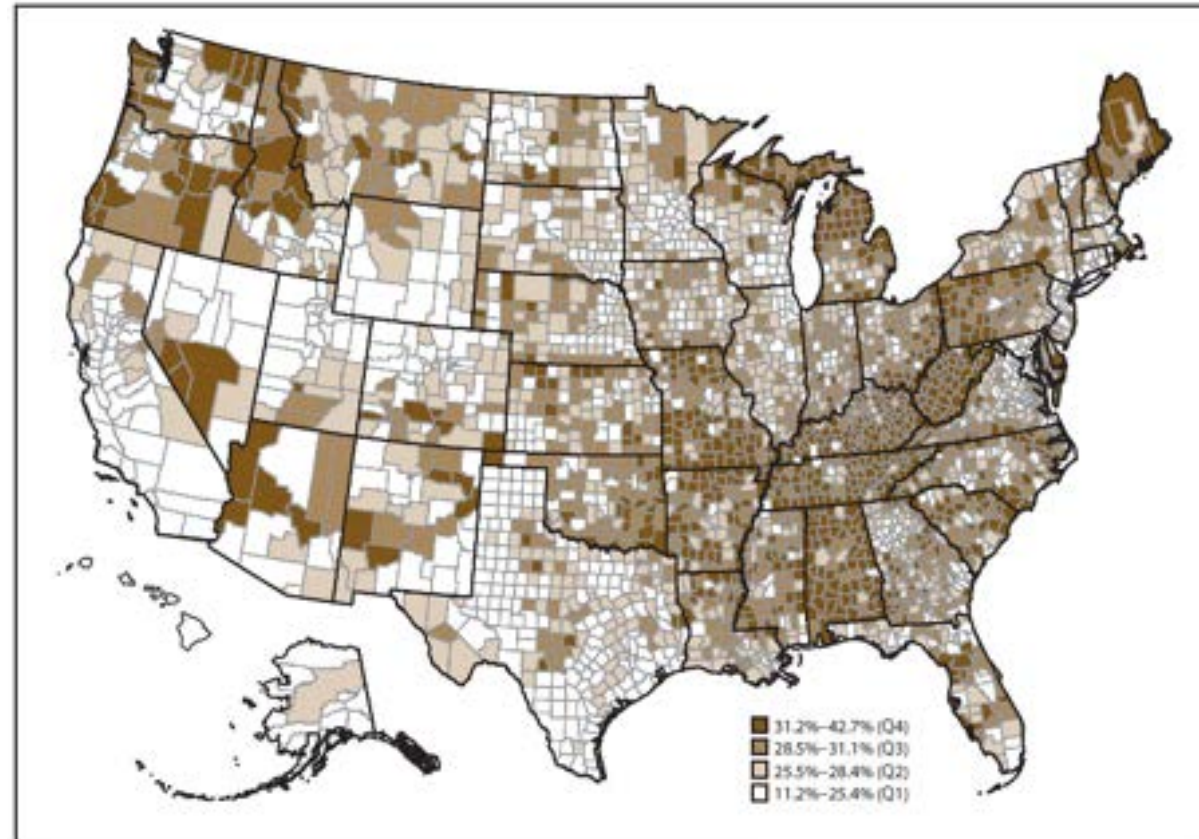
Mechanical Engineering

Supervisor: Dr. Tanvir Faisal

Introduction-Motivation

Osteoarthritis (OA): Degeneration of cartilage exposes bone ends and creates pains in the knee joint.

- Nearly **1 million knee replacements** are performed each year in the U.S.
- The U.S. spends over **\$10 billion** annually on OA treatment.
- Enzyme-mediated OA can occur at any stage of life.
- There is a critical need for effective inhibitors to stop cartilage degeneration.



Introduction- Background

Functions of articular cartilage

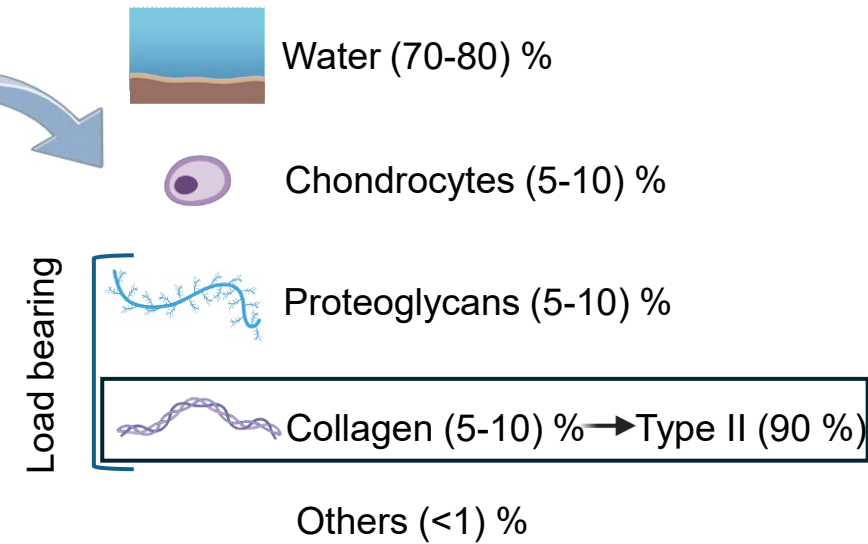
Shock Absorbance

Smooth Movement

Weight Distribution



Healthy Knee Cartilage



Available Treatment Options



04

Surgery

Full joint replacement or implant



Costly and painful

03

Conventional Inhibitors

Typically work in synovial fluid



Cannot penetrate nanoporous and negatively charged tissue

02

Oral Medication

Mainly pain relief medicine



Cannot enter avascular tissue

01

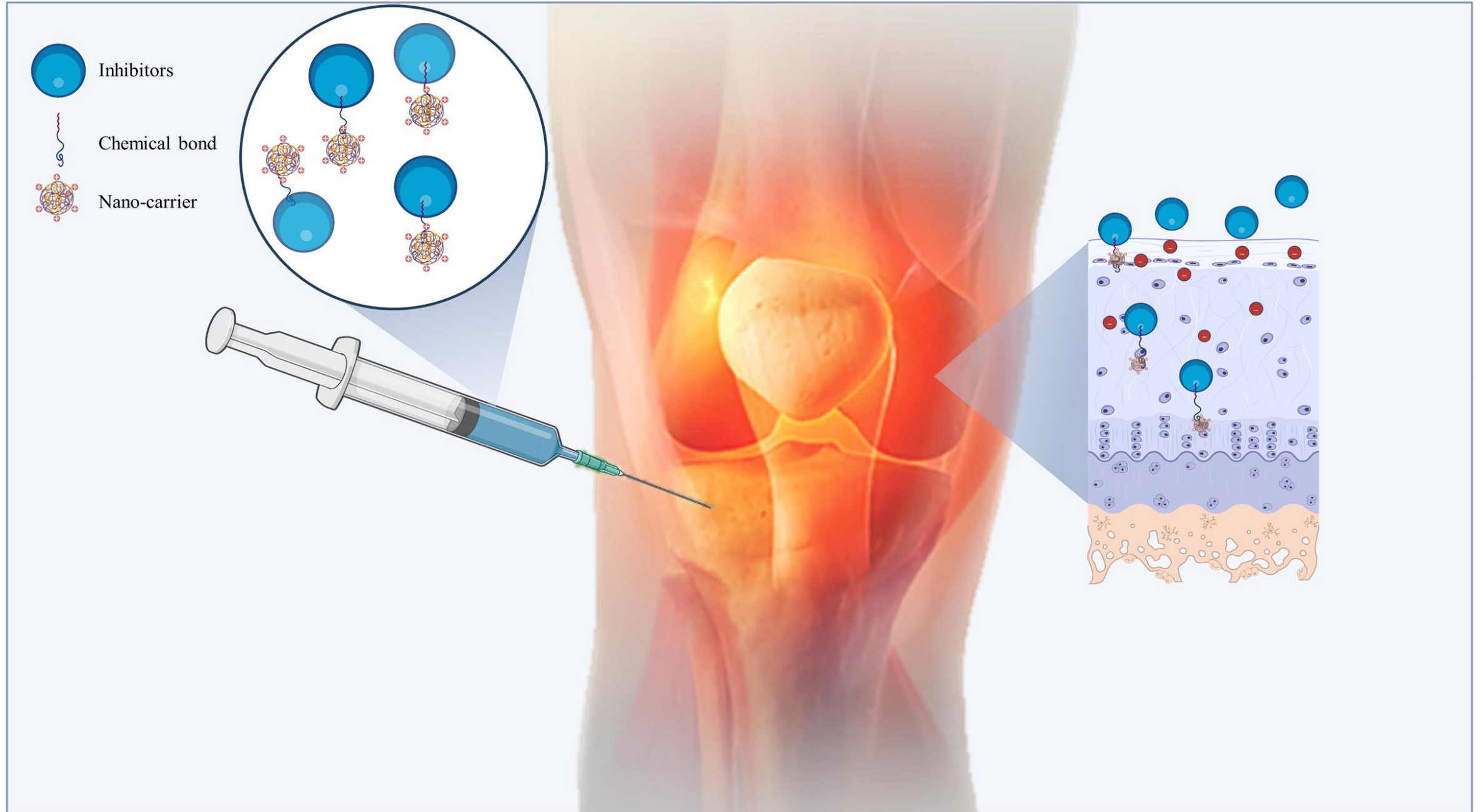
Non-medical Treatment

Weight control and exercise



Enzyme rebalance takes time

Pathways for Inhibitor Application



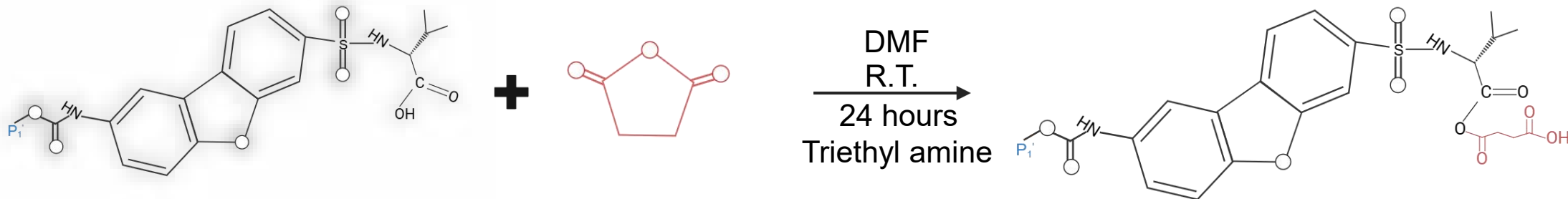
Goal and Objectives

Designing novel nano-engineered inhibitor to stop cartilage damage

1. Chemical design and fabrication of nano carrier-based inhibitors
2. Evaluate tissue penetration of developed inhibitors
3. Assessment of collagen preservation in tissue matrix
4. Investigation of *in vitro* biomechanics of cartilage tissue following inhibitor application

Chemical Reactions

1.

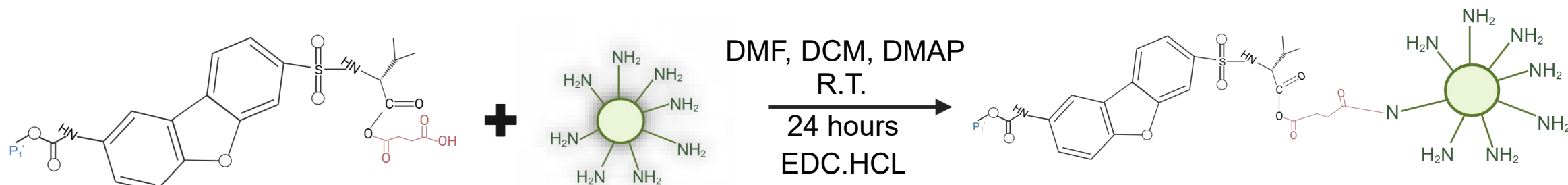


A. Inhibitor – MMP 408

B. Succinic Anhydride

C

2.

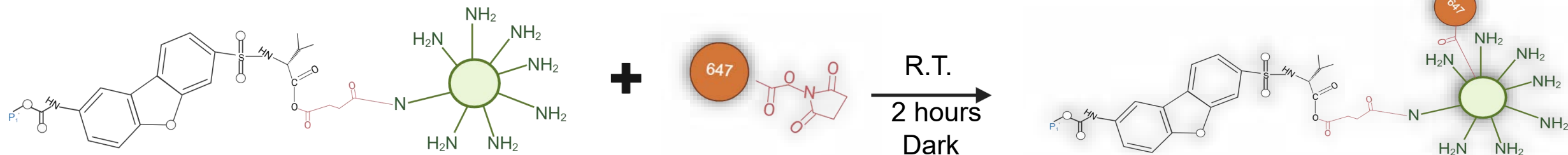


C

**D. Polyamidoamine
(PAMAM)**

E

3.

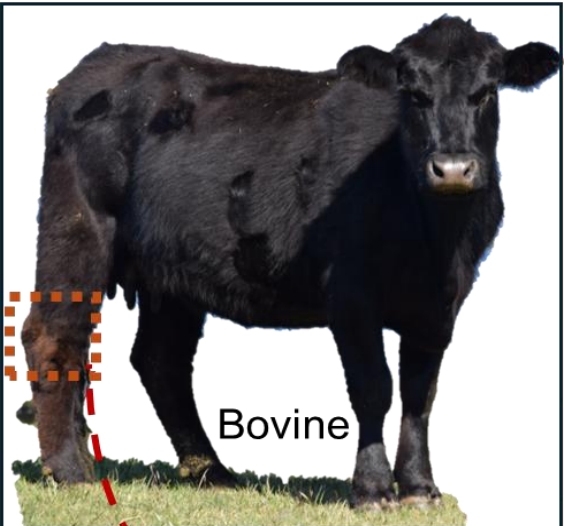


E

F. Alexa Fluor 647

**Final Product:
Nano Engineered Inhibitor**

Design of Experiments



Bovine



Femur



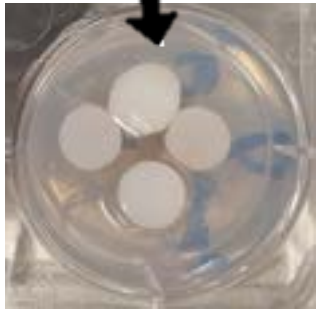
Sample extraction

Table: Enzymatic treatment				
Group Treatment (ng/ml)				
	Degraded	MMP 408	Nano carrier MMP 408	Healthy
MMP 13	10	10	10	
MMP 9	10	10	10	
ADAMTS 5	5	5	5	
MMP 408		120		
Nano carrier- MMP 408			120	

Diameter = 9 mm



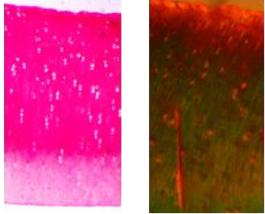
n = 48



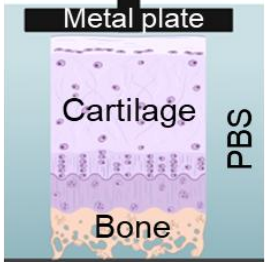
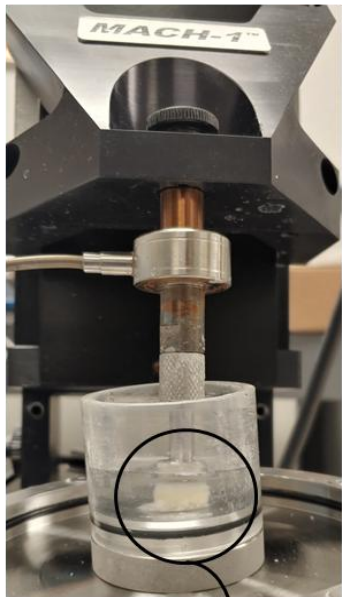
Incubation

Time = 44 hours

Temperature = 37 °C; 5% CO₂



Histology

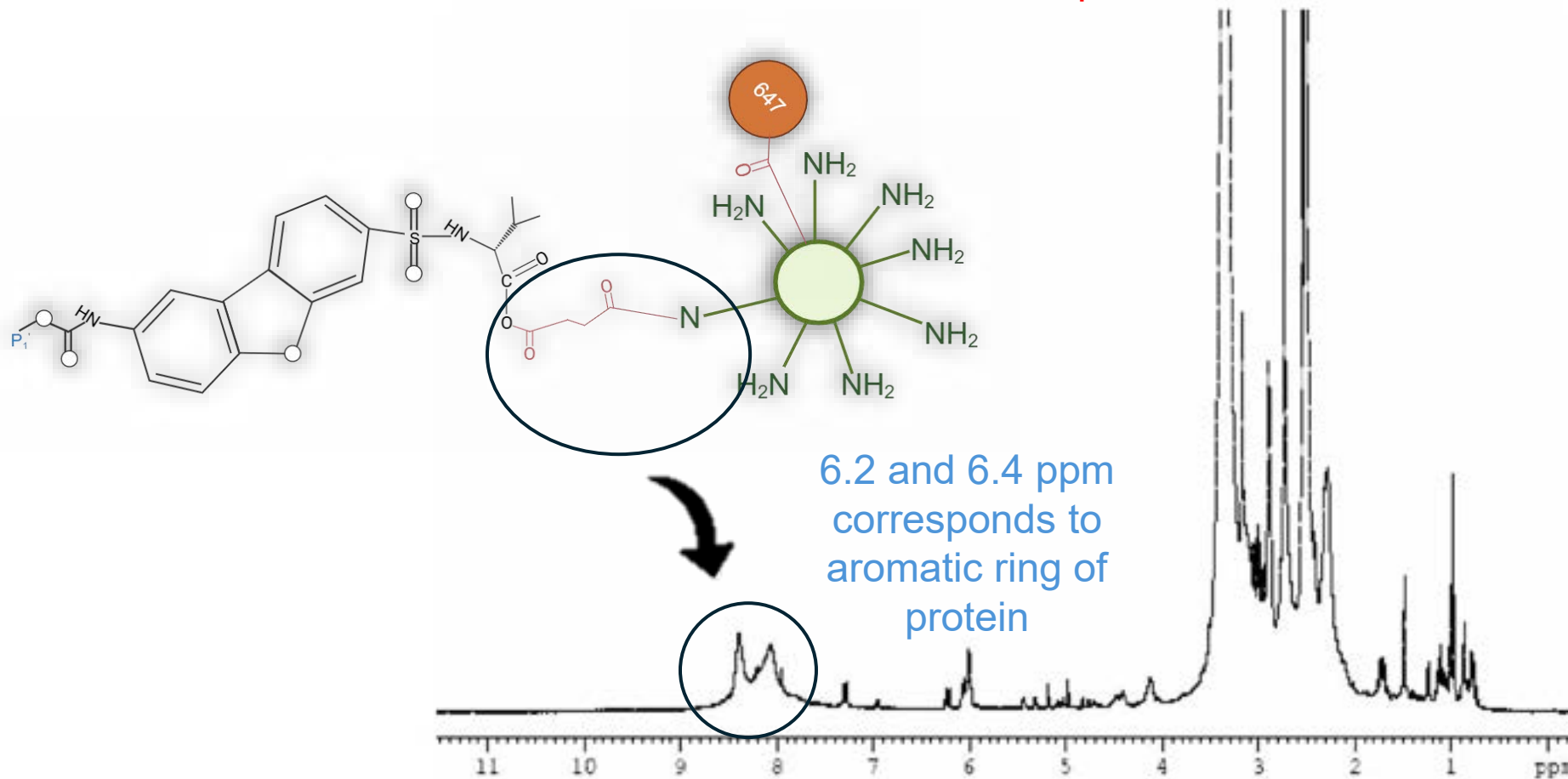


Mechanical Test

Results- Chemistry

1. Chemical design and fabrication of nano carrier-based inhibitors

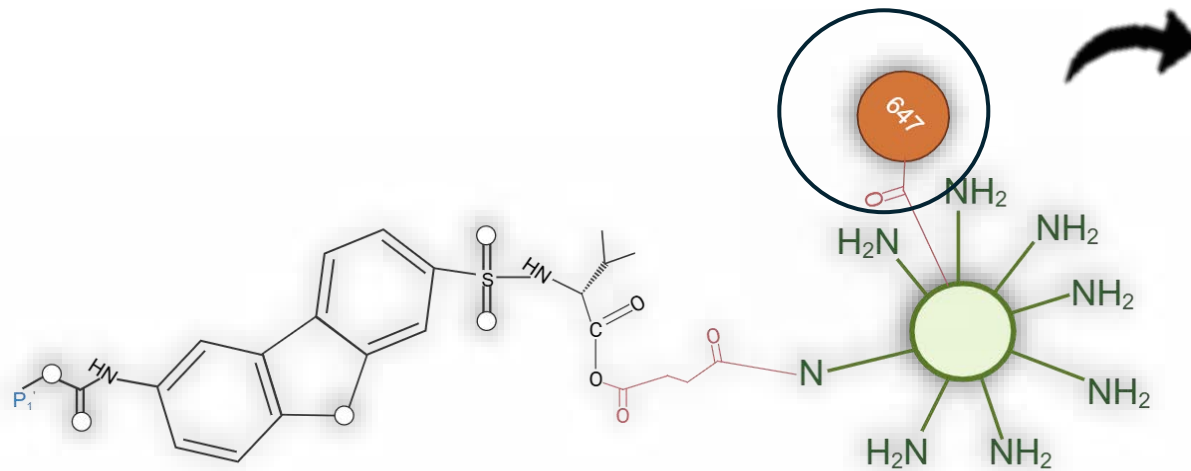
1.8–3.6 ppm corresponding protons of PAMAM G4



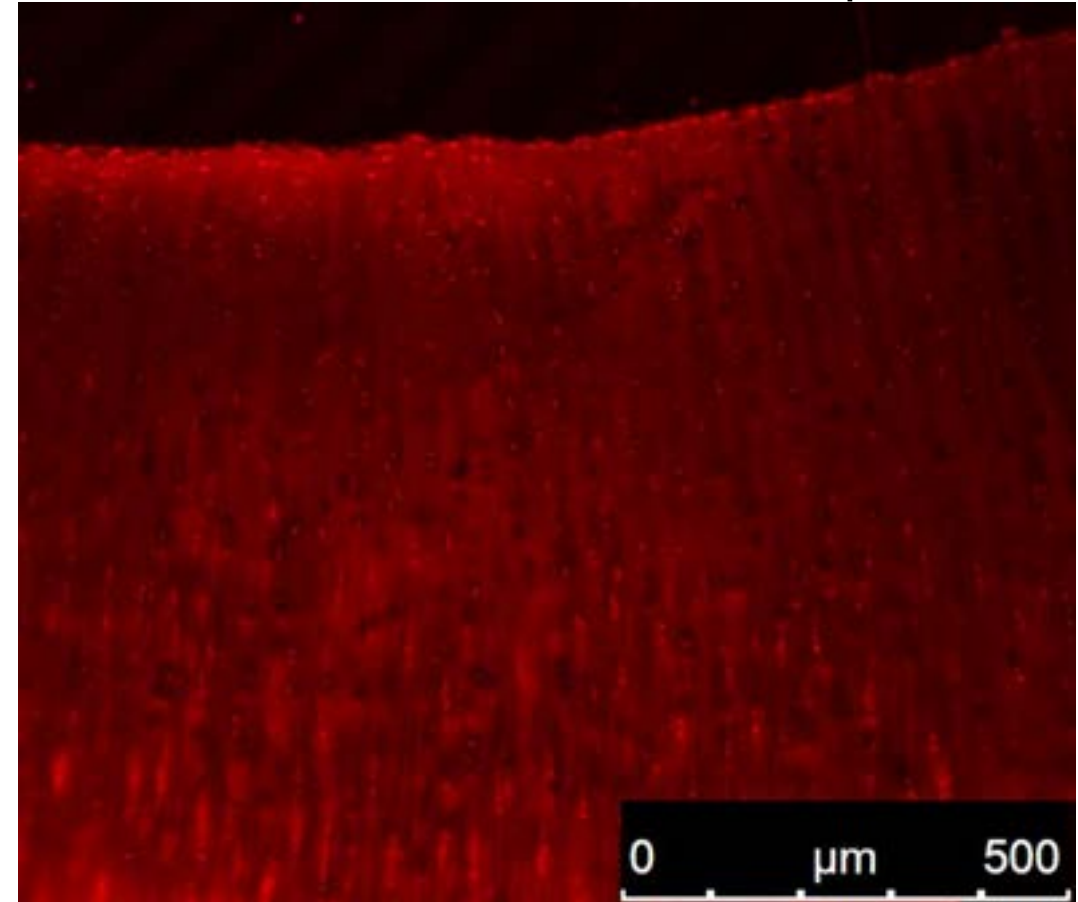
8.0–8.2 ppm –CO–NH protons; PAMAM G4 (NH₂)–protein conjugate

Results- Inhibitor Penetration

2. Evaluate tissue penetration of developed inhibitors



Red fluorescence ensures inhibitor penetration



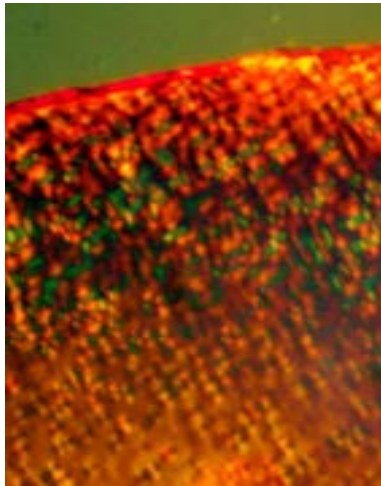
Fluorescence microscopy

Excitation – 650 nm

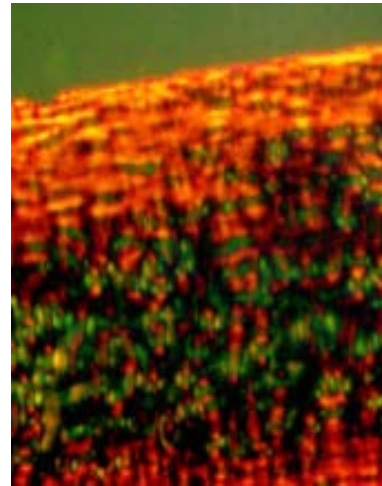
Emission – 671 nm

Results- Histomorphometry

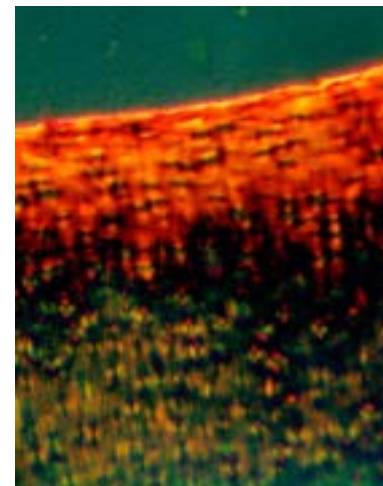
3. Assessment of collagen preservation in tissue matrix



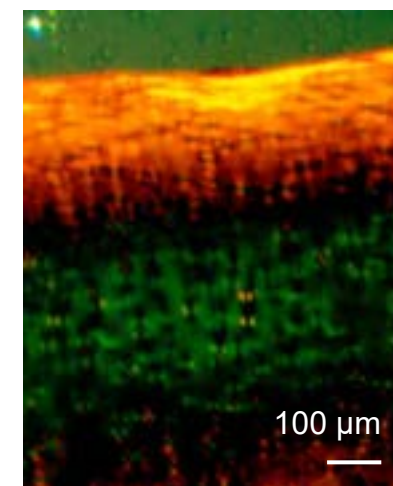
Degraded



MMP 408



Nano carrier-
MMP 408



Healthy

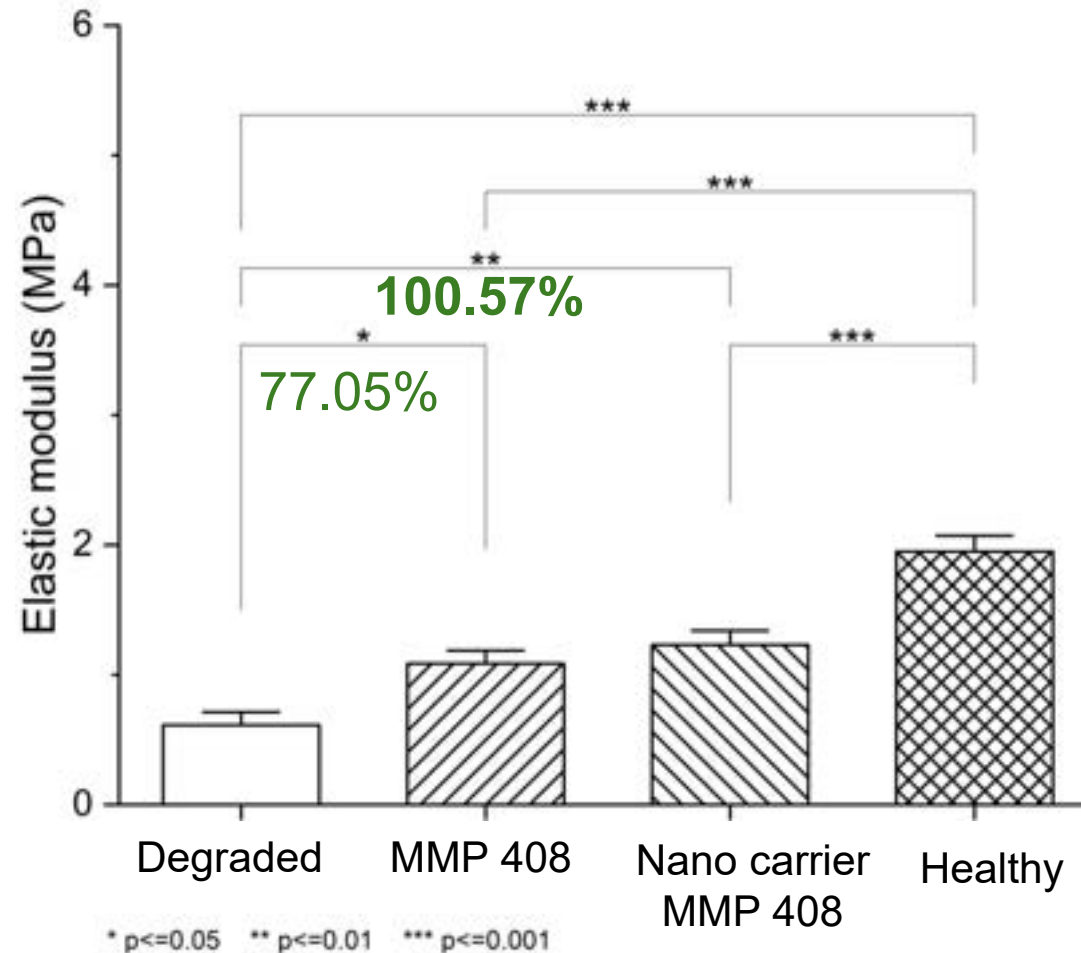
Polarized Microscopy

Deep green color represents collagen type II

Nano carrier -MMP 408 preserves more collagen content than only MMP 408 application

Results- Mechanical

4. Investigation of *in vitro* biomechanics of cartilage tissue following inhibitor application



Nano carrier-MMP 408 improved mechanical performance compared to only inhibitor application

Future Work



Conclusion

- Revealed the mechanics behind cartilage degeneration.
- Nanocarriers unlock targeted osteoarthritis therapy.
- A promising alternative to joint surgery.

Mission

We want to stop cartilage damage with one dose of this nano engineered inhibitor in doctor's office



PEOPLE & THEIR PLACES
(& A PREVIEW OF
INNOVATION, HEALTH & WELLNESS)

Asif Istiak

PhD Student in Systems Engineering: Mechanical

*A Novel Nanocarrier-Driven Therapeutic Strategy for
Inhibiting Tissue Damage in Degenerated Joint Disease*

Faculty Advisors: Tanvir Faisal



LOUISIANA, NATURE, PEOPLE & THINGS

Andrea Westerland

Assistant Professor, Biology

*Mitigating Environmental Stress Impacts on
Louisiana's Native Prairie Species*

The background of the slide is a photograph of a dense prairie. It features numerous tall, thin green stems, likely grasses or wildflowers, with several bright yellow daisy-like flowers in bloom. The lighting is soft, creating a natural and vibrant scene.

Mitigating Environmental Stress Impacts on Louisiana's Native Prairie Species

Dr Andrea Westerland
School of Biological Sciences
University of Louisiana at Lafayette

A close-up, slightly blurred photograph of a lush, green prairie. Tall, thin grass stalks rise from the ground, interspersed with numerous bright yellow wildflowers. Some flowers are in sharp focus, showing their dark centers and vibrant petals, while others are blurred in the foreground and background, creating a sense of depth. The overall scene is a vibrant, sunlit meadow.

The Louisiana portion of the coastal tallgrass prairie ecosystem is called the **Cajun Prairie**



Coastal tallgrass prairie once covered 2.2 million acres in Louisiana, and 7 million acres in Texas

Today, **less than 1%** across the region remains, and only **0.2%** remains in Louisiana

Life on the prairie can be stressful

- Intense heat and heatwaves
- Short-term drought
- Hard clay layer of soil w/ poor drainage
- Temporary flooding



What can we do to help restore the prairie and conserve what remains?

Identify which species are most **resistant to stress** using morphological/physiological traits



Grew seedlings of five common prairie species under drought and heat stress



Soil moisture meter

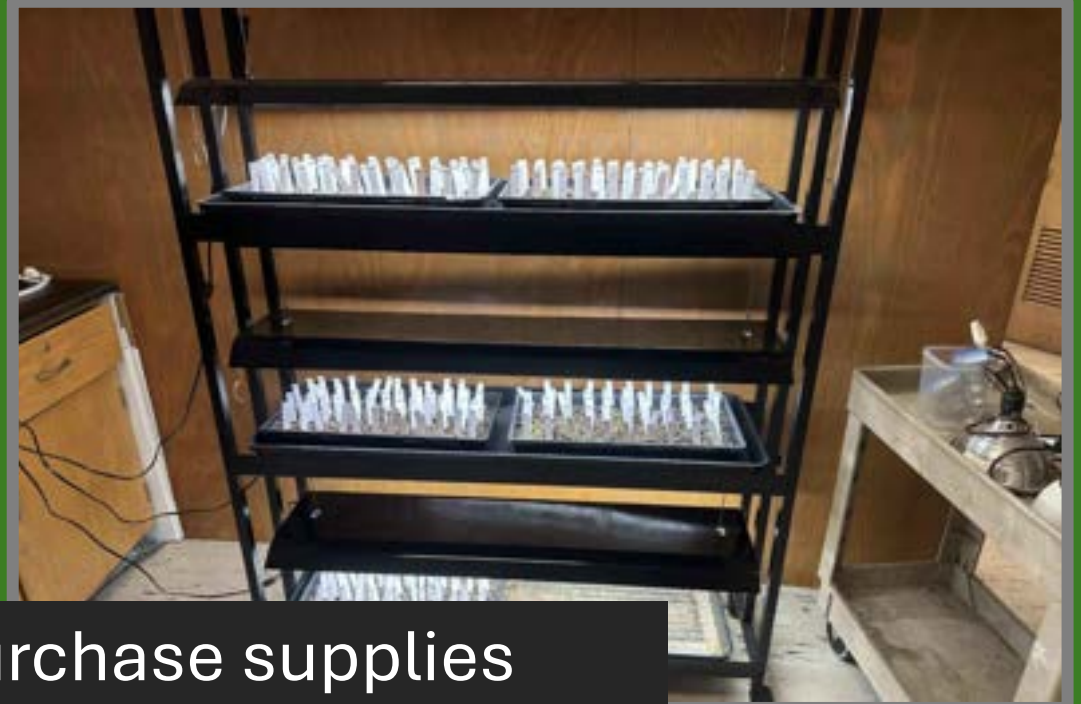


Porometer (for water loss)



Spectrophotometer
(for pigments)

Measured water loss, concentration of
photosynthetic pigments, and size



Funds were used to purchase supplies



H. lasiocarpus

Winners and losers?

Our results suggest that *Hibiscus lasiocarpus* and *Rudbeckia grandiflora*, are the most stress tolerant, at least at the earliest life stage

What makes them special?



R. grandiflora

Recipe for success?

01

Hibiscus
minimizes water
loss from leaves

02

Rudbeckia invests
more in leaf
photosynthetic
pigments

03

Both experience
minimal changes
in plant size
under stress

Recommendation is to plant *these two species*

Thank you!



Thinh (Sam) Thai

Alexandria Alles



Corey Carlino



Whitney Moore



LOUISIANA, NATURE, PEOPLE & THINGS

Andrea Westerland

Assistant Professor, Biology

*Mitigating Environmental Stress Impacts on
Louisiana's Native Prairie Species*



LOUISIANA, NATURE, PEOPLE & THINGS

Jacob Badcock

PhD Student in Environmental & Evolutionary Biology

*Using Machine Learning to Detect Macrobenthic
Regime Shifts in a Louisiana Estuarine Bay*

Faculty Reference: Craig McClain

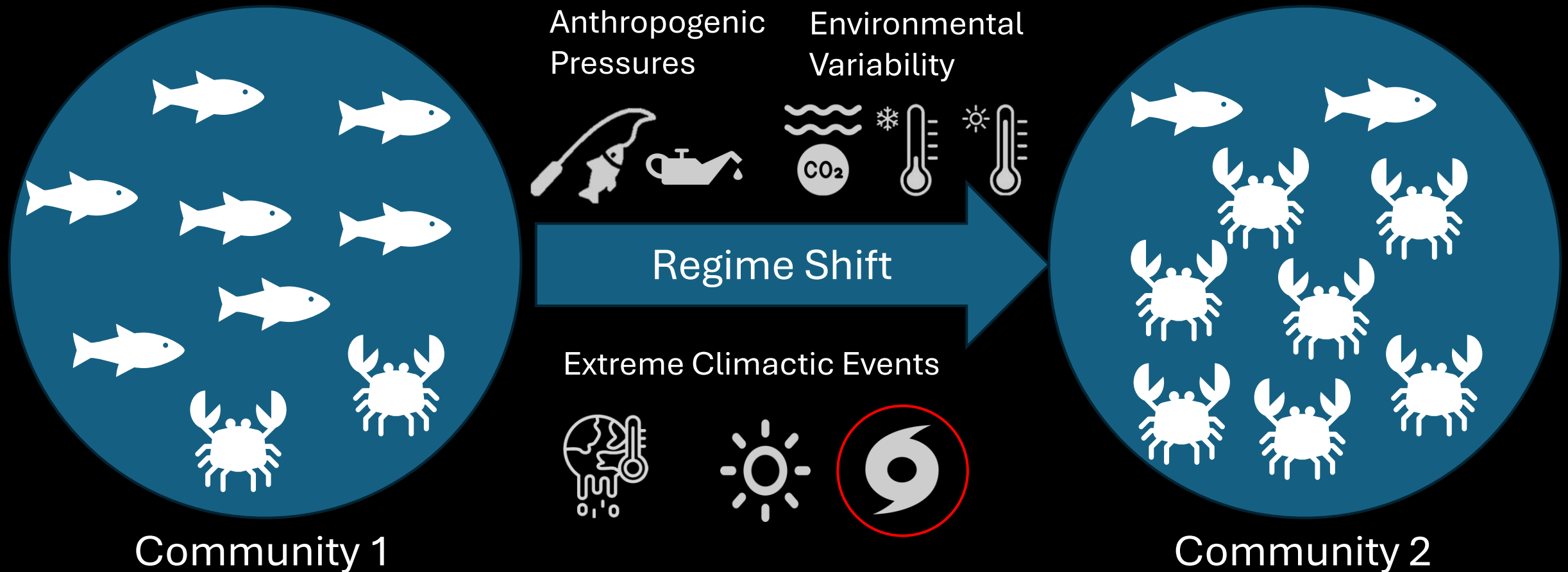
Using Machine Learning to Detect Macrobenthic Regime Shifts in a Louisiana Estuarine Bay

Jacob Badcock



What is a regime shift?

Abrupt and persistent change to the species in the area

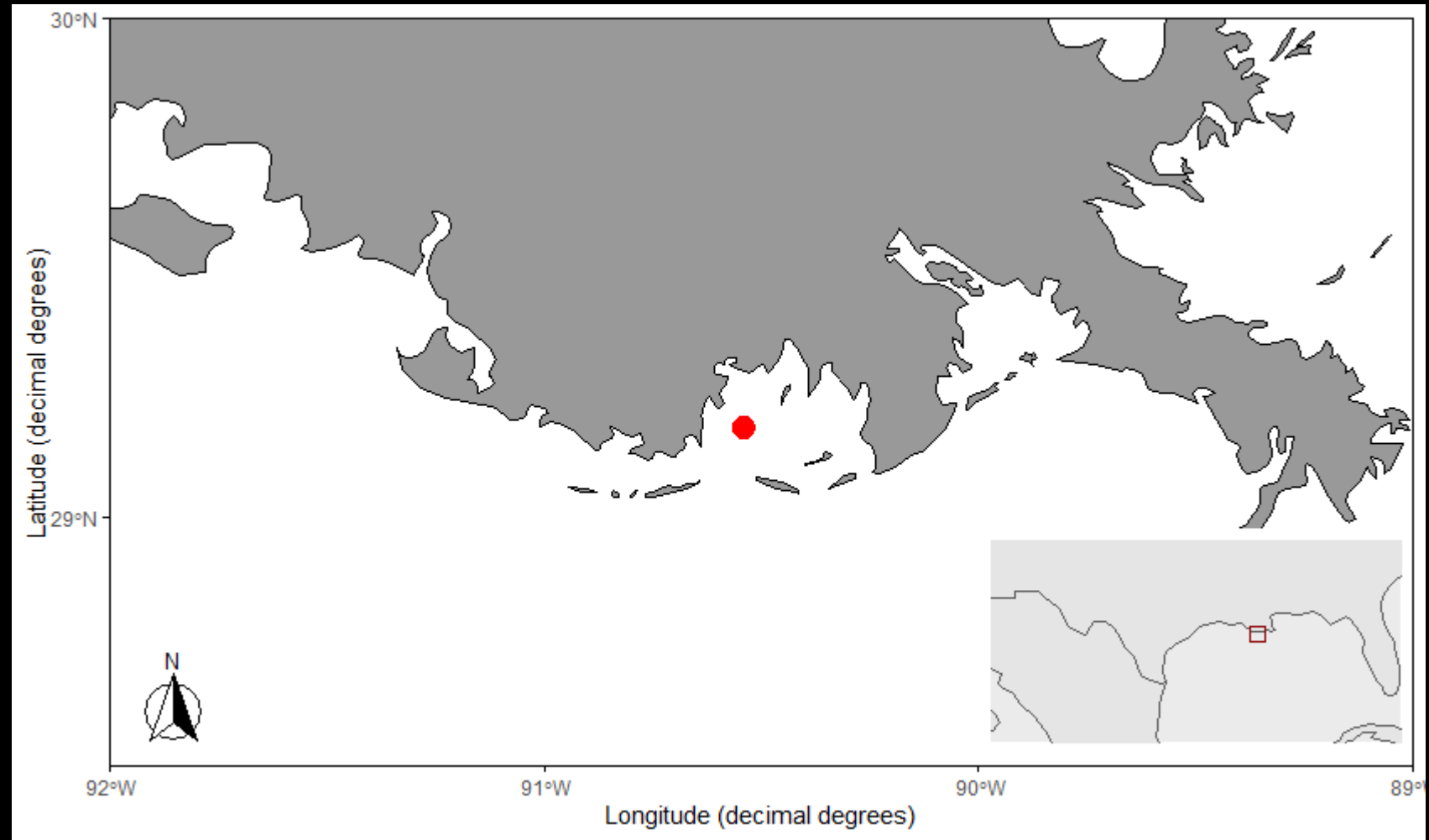
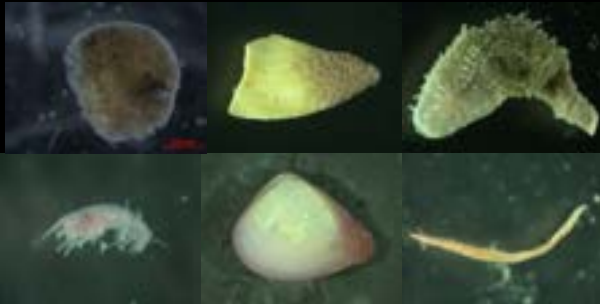


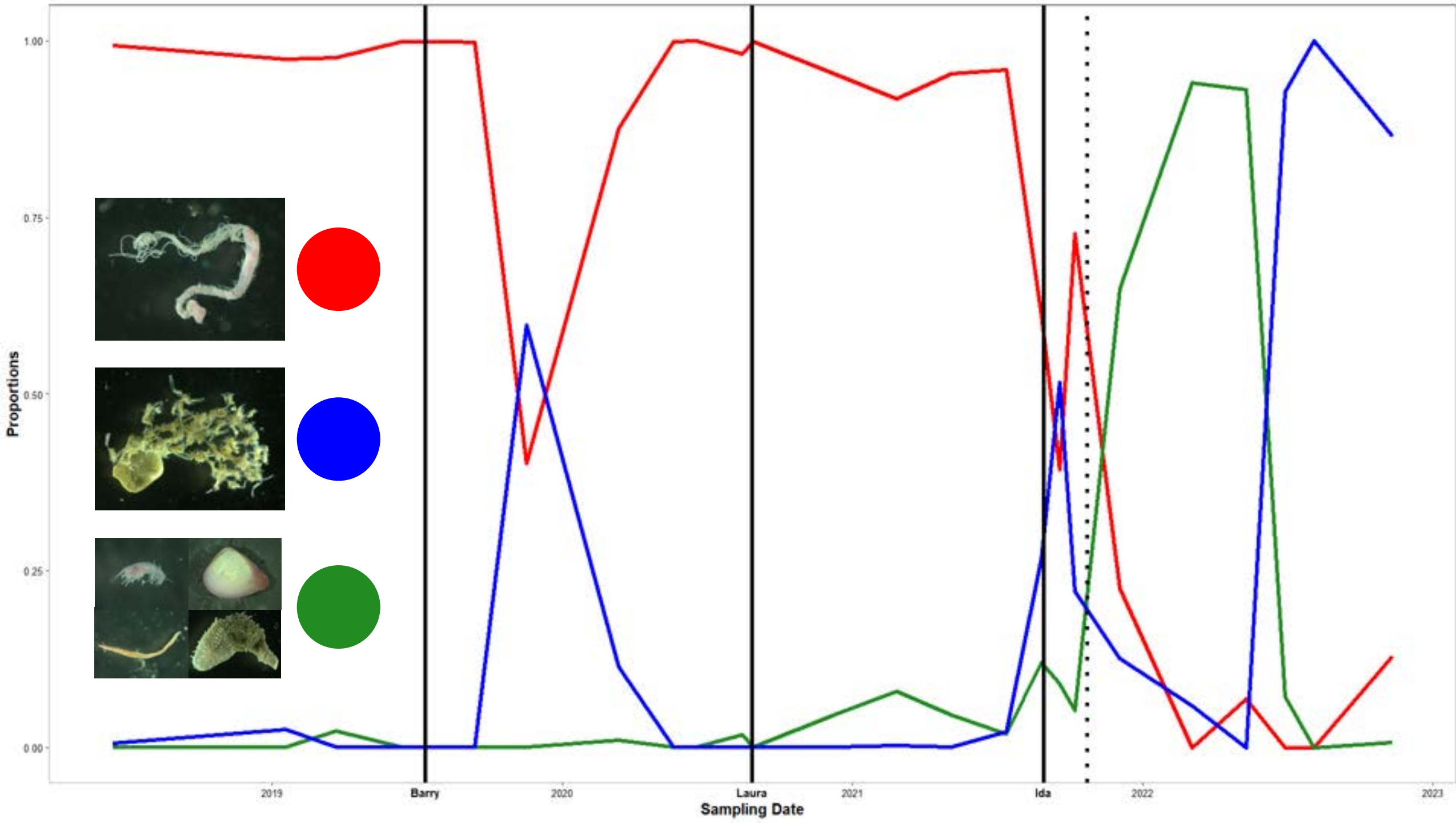


Hurricane	Year	Category
Barry	2019	1
Laura	2020	4
Ida	2021	4

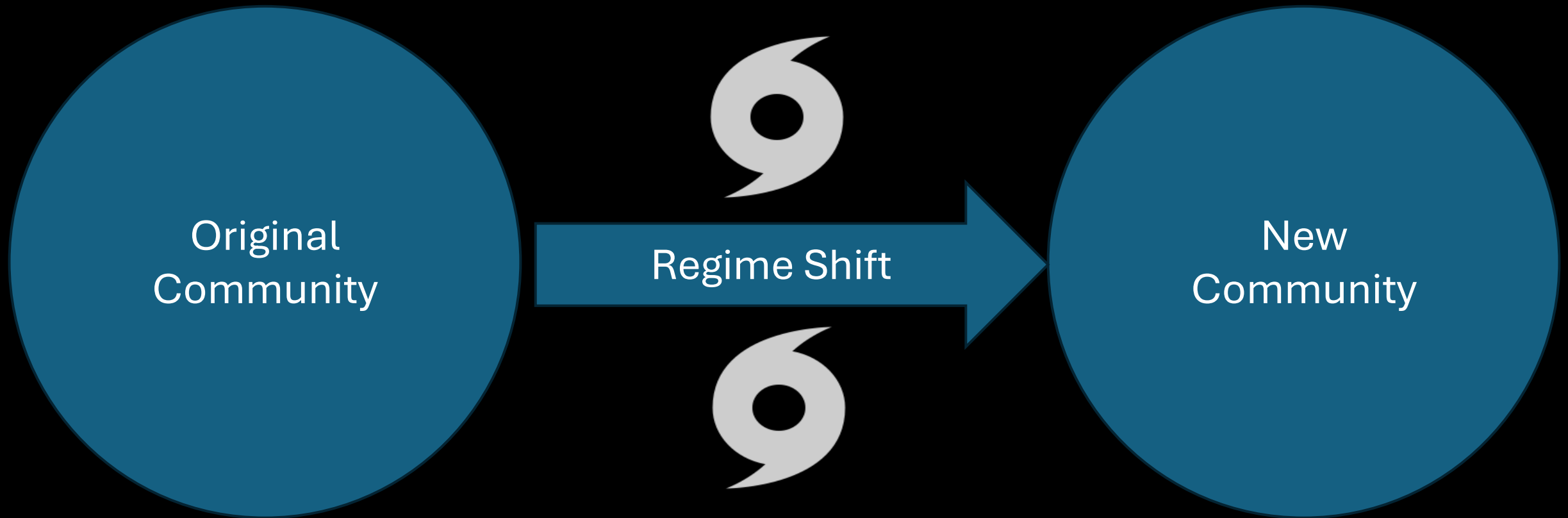
The Data

- Terrebonne Bay
- Sampling since 2018
 - 12,500 individuals
 - 110 species
 - 344 samples
 - 25 sampling events





Strong support for hurricane induced regime shifts



Thank you slides

- Granger Hanks
- River Bryant
- Sam Copley
- Sydney McDermott
- Ben LeBlanc
- Lainey Menard
- Luke Thibodeaux
- Summer Rodriguez
- ULL Sustainable Development
- Dr. McClain
- Dr. Junker
- Dr. Genung



LOUISIANA, NATURE, PEOPLE & THINGS

Jacob Badcock

PhD Student in Environmental & Evolutionary Biology

*Using Machine Learning to Detect Macrobenthic
Regime Shifts in a Louisiana Estuarine Bay*

Faculty Reference: Craig McClain



LOUISIANA, NATURE, PEOPLE & THINGS

Sajan Bhandari

PhD Student in Mathematics

*Discrete-Time
Refuge-Mediated Selection Model*

Faculty Reference: Azmy “Today Is My Birthday” Ackleh

A Discrete-Time Refuge Mediated Competition Model

Sajan Bhandari
PhD Candidate
Mathematics

Louisiana Impact Research Summit
March 27, 2026

Background: Refuge and Conservation



Locations of National Wildlife Refuge System
in the US: **570+ refuges, 856 million acres**

Source: Ramirez & Mosley (2015), *PLoS ONE*



Clockwise from top: a bald eagle, an American
alligator, Oregon chubs and a Louisiana black
bear.

Source: Roy Lowe, Stacy Shelton, Rick Swart/Oregon Dept. of Fish & Wildlife,
Pam McIlhenny/USFWS

Background: Refuge and Conservation

- **Brown Pelican (Louisiana's state bird):** Nearly extinct in the 1960s due to DDT. Restored through reintroduction and protection in refuges (e.g., Breton NWR).
- **Whooping Crane:** Reintroduction efforts in Louisiana wetlands rely on protected refuge areas.
- **Louisiana Black Bear:** Recovered with habitat conservation and designated refuge areas.
- **Coastal Marshes:** Serve as natural refuges for migratory waterfowl and fish nurseries.

What I do (*Mathematically*)

- Construct a mathematical model of a habitat where:
 - ▶ Species compete with each other for same resources
 - ▶ Weaker species are allowed to move to safe refuges
 - ▶ Stronger competitors remain in the habitat
 - ▶ Weaker species can move back to the main habitat.

GOAL:

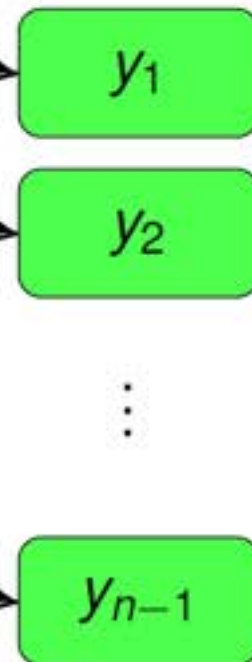
Derive mathematical conditions for coexistence, linking them to refuge and dispersal design.

Model Schematic

Competition Patch



Safe-Refuge Patches

 δ_1 ϵ_1 δ_2 ϵ_2 δ_{n-1} ϵ_{n-1}

Discrete Model

$$x_i(t+1) = \frac{a_i}{1 + b_i X(t)} x_i(t) + s_i(1 - \delta_i) x_i(t) + \tilde{s}_i \epsilon_i y_i(t), \quad i = 1, \dots, n-1$$

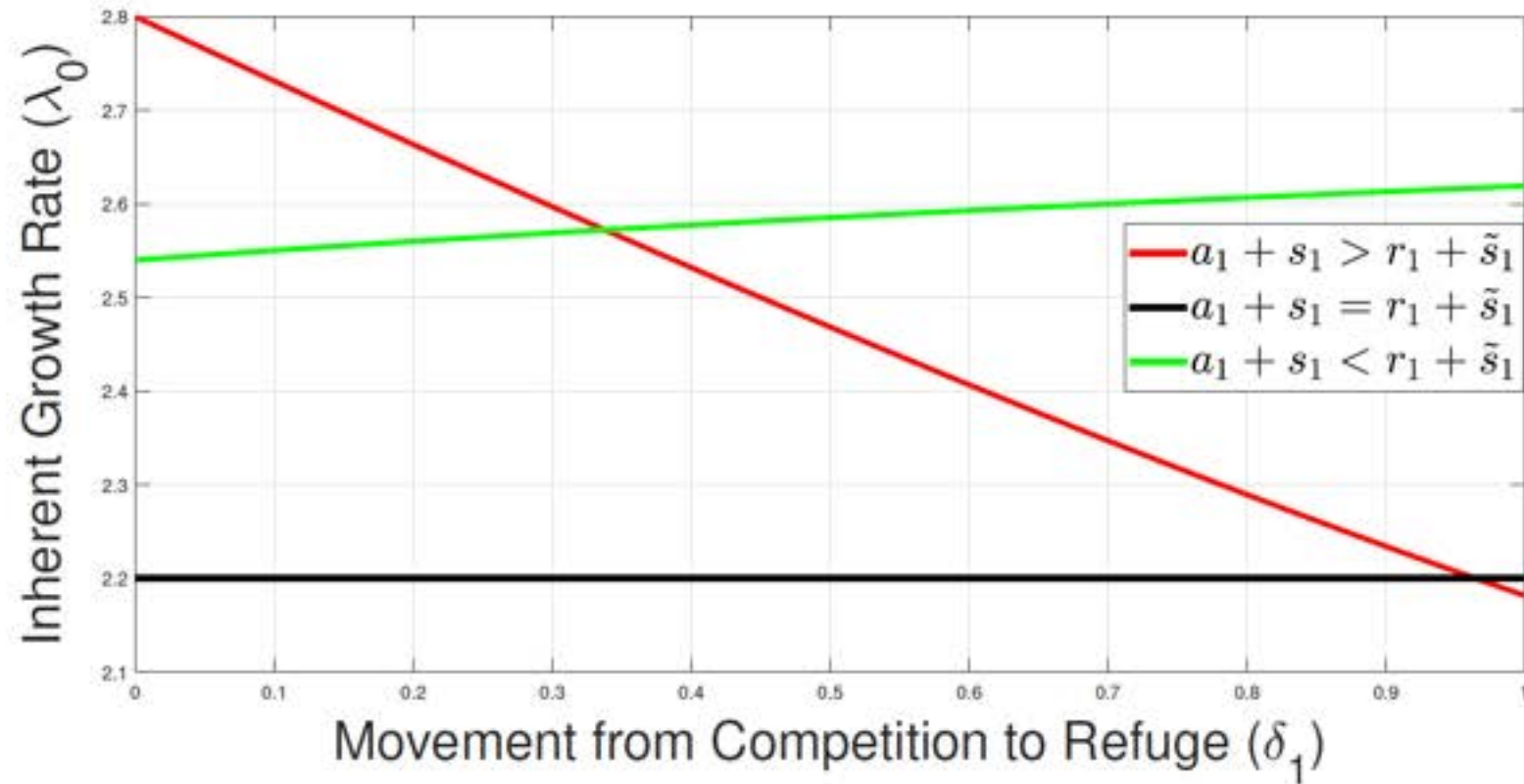
$$y_i(t+1) = \frac{r_i}{1 + c_i y_i(t)} y_i(t) + \tilde{s}_i(1 - \epsilon_i) y_i(t) + s_i \delta_i x_i(t), \quad i = 1, \dots, n-1$$

$$x_n(t+1) = \frac{a_n}{1 + b_n X(t)} x_n(t) + s_n x_n(t)$$

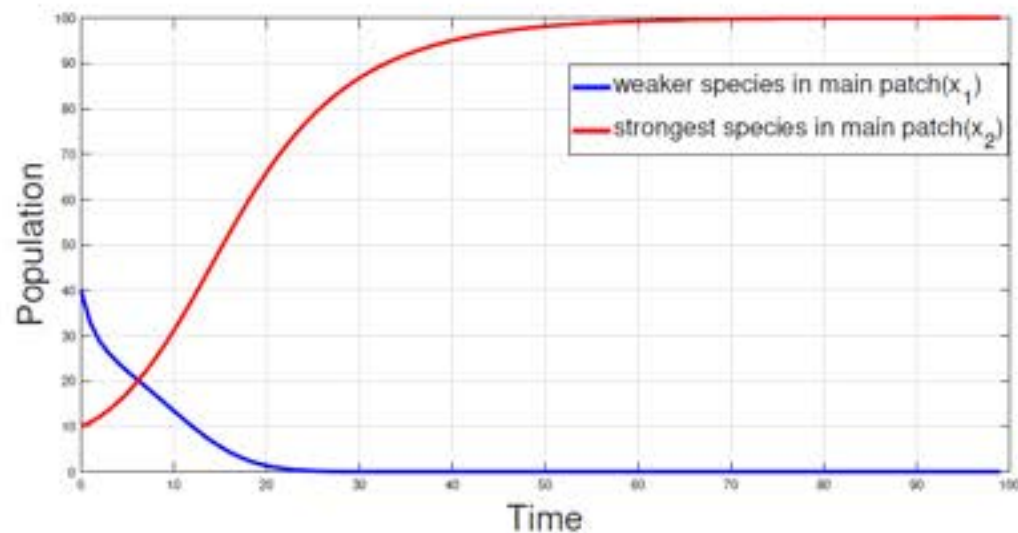
$$X(t) = \sum_{j=1}^n \theta_j x_j(t)$$

- x_i, y_i : population of species $i = 1, \dots, n-1$ in competition and refuge patches respectively, (weaker species)
- x_n : population of species n in competition patch, (strongest species)
- a_i, r_i : intrinsic growth rate in competition and refuge patches
- b_i, c_i : competition coefficients in competition and refuge patches
- θ_i : positive weights, $s_i, \tilde{s}_i$: survivorship in competition and refuge patches
- δ_i, ϵ_i : dispersal fractions (competition $\leftrightarrow$ refuge)

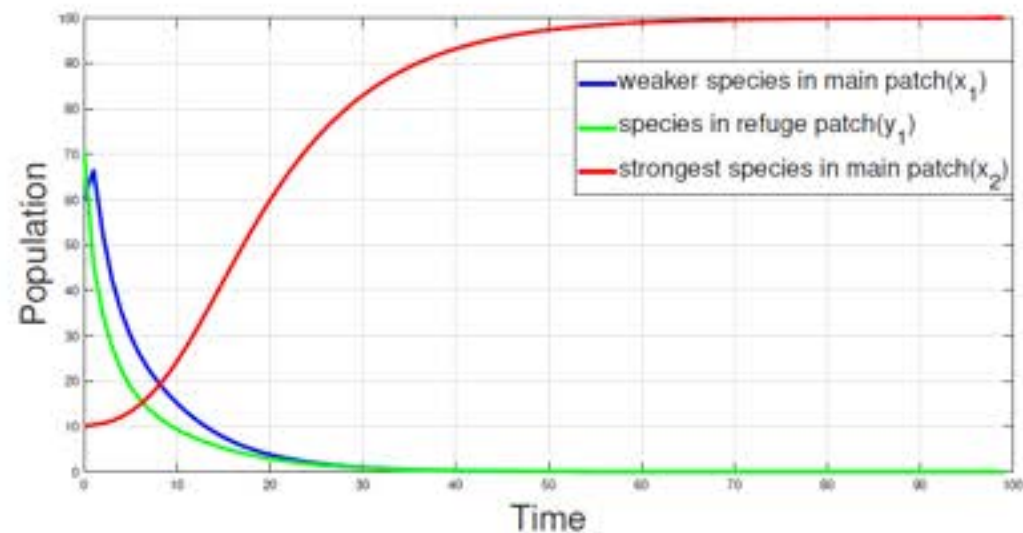
Numerical Results: Role of Dispersal in the Inherent Growth Rate



Numerical Results: Competitive Exclusion

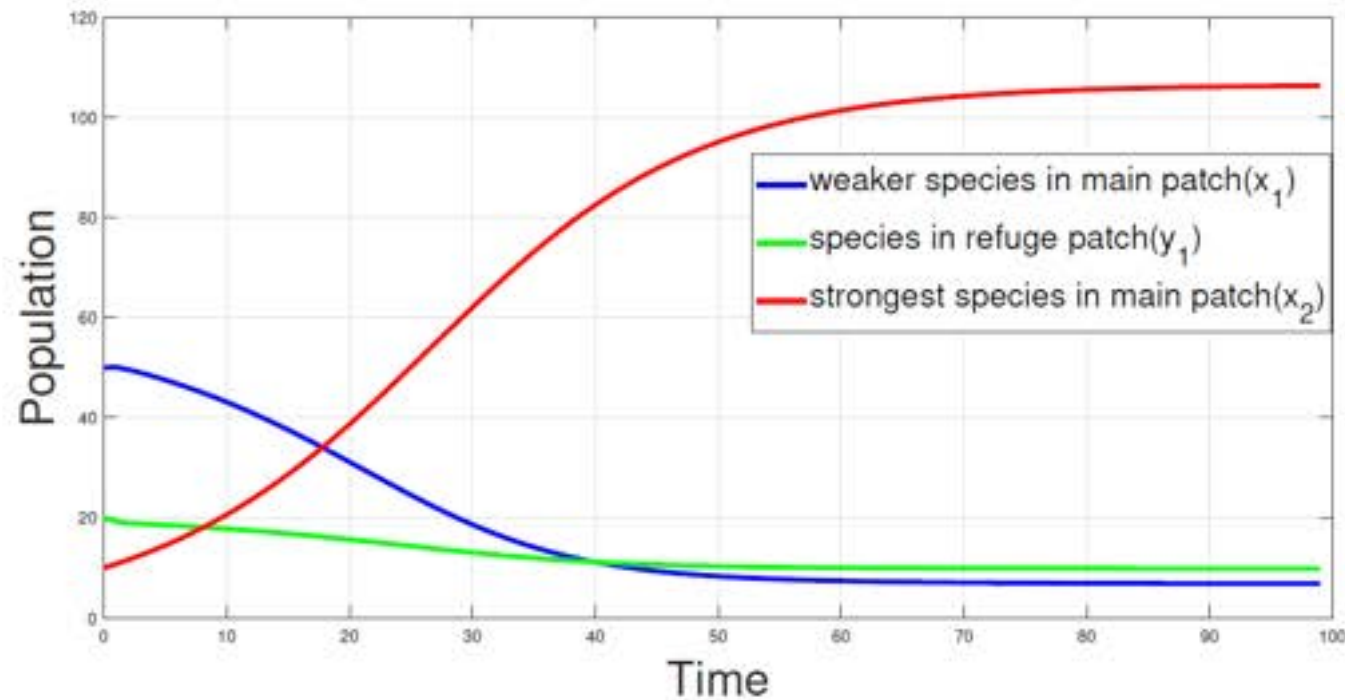


Without dispersal: $\delta_1 = \epsilon_1 = 0$



With dispersal: $\rho < 1, a_2 + s_2 > 1$

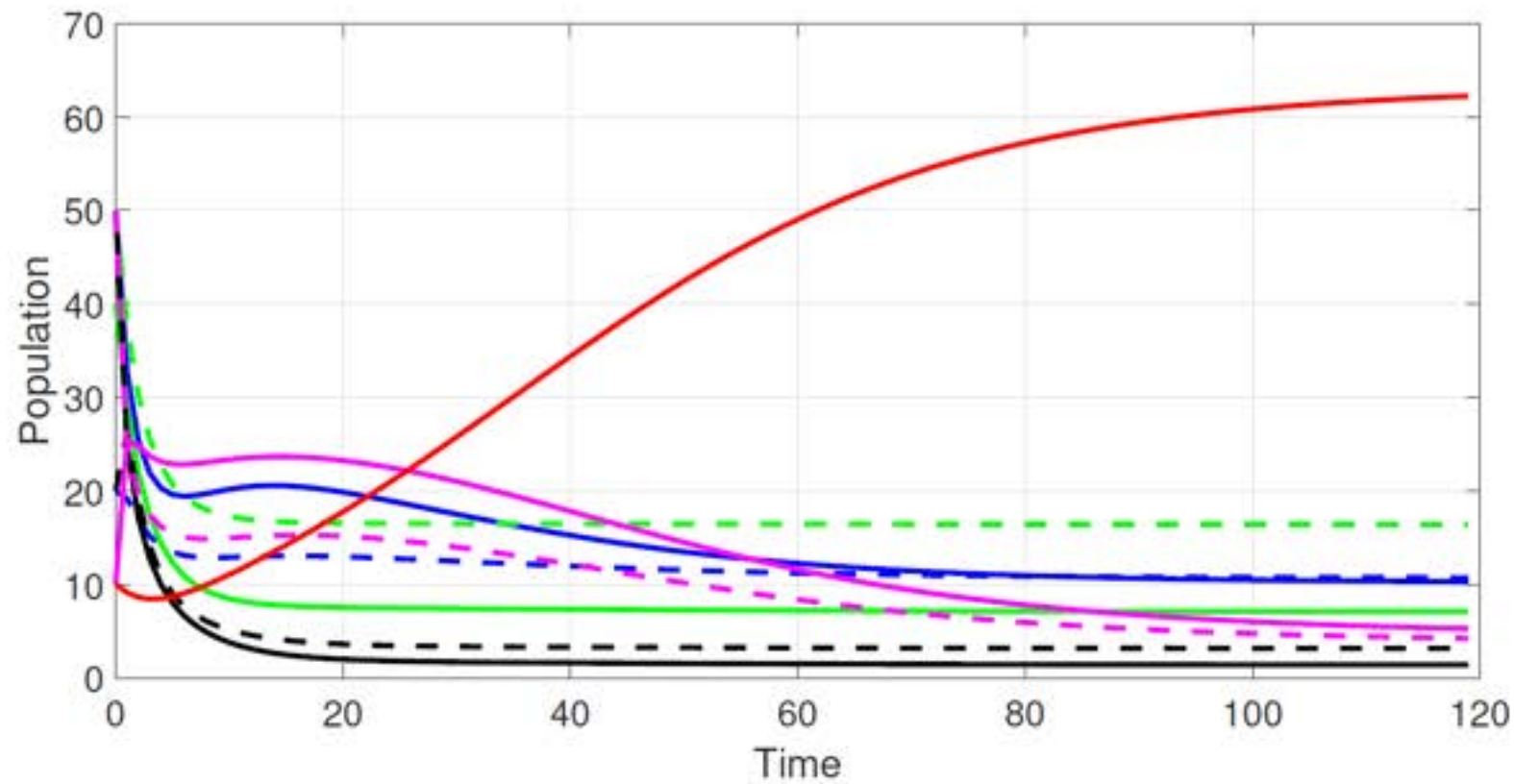
Numerical Results: Coexistence- Two Species Case



All species coexist via dispersal when

$$\frac{a_2 + s_2 - 1}{b_2(1 - s_2)} > \theta_1 \bar{x}_1 \text{ and}$$
$$r_1 + \tilde{s}_1(1 - \epsilon_1) > 1.$$

Numerical Results: Coexistence -Five Species Case



Summary

- Without a refuge, **competitive exclusion** is inevitable.
- When the pre-dispersal growth rate in the refuge exceeds that of the main patch, dispersal **increases** the species' inherent growth rate.
- Persistence of the weaker competitor (species 1) is governed by its **invasion rate** ρ and refuge effectiveness; the stronger competitor (species 2) persists when its competitive advantage is sufficiently large.
- Dispersal **promotes coexistence** but does not guarantee the prevention of competitive exclusion.
- These results offer ecological insight into how **spatial refuges** and **dispersal** shape species interactions, with implications for **conservation planning**.

Acknowledgements

I thank my advisor, **Dr. Azmy S. Ackleh**, for his invaluable guidance, and **Dr. Amy M. Veprauskas** and **Dr. Ursula Trigos-Raczkowski** for their support in this research project.

Thank You!
Questions?



LOUISIANA, NATURE, PEOPLE & THINGS

Sajan Bhandari

PhD Student in Mathematics

*Discrete-Time
Refuge-Mediated Selection Model*

Faculty Reference: Azmy “Today Is My Birthday” Ackleh



**Ten
Minute
Break**



LOUISIANA, NATURE, PEOPLE & THINGS

Jenita Jahangir

PhD Student in Mathematics

*Invading Populations by Infections in a
Discrete-Time Compartmental Epidemic Models*

Faculty Reference: Amy Veprauskas

Invading Population by Infection in Discrete-Time Epidemic Models

Jenita Jahangir

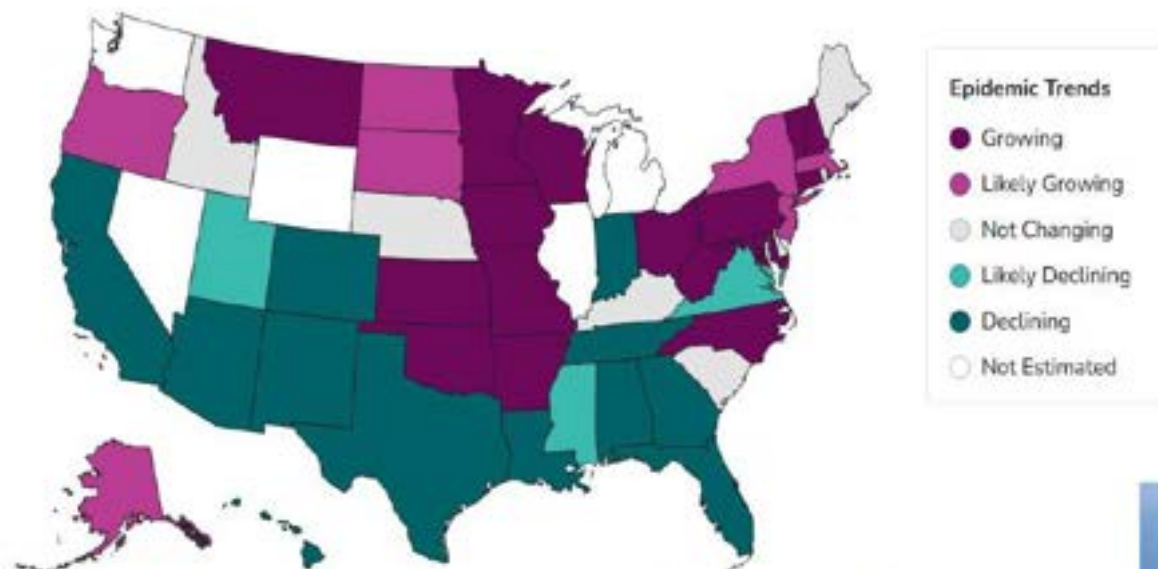
Faculty Advisor: Amy Veprauskas

Department of Mathematics

March 27, 2026



Epidemic Outbreak in United States



As of September 2, 2025, we estimate that COVID-19 infections are growing or likely growing in 24 states, declining or likely declining in 15 states, and not changing in 7 states.
 Image collected from CDC website



Vaccination

A Vaccination Model

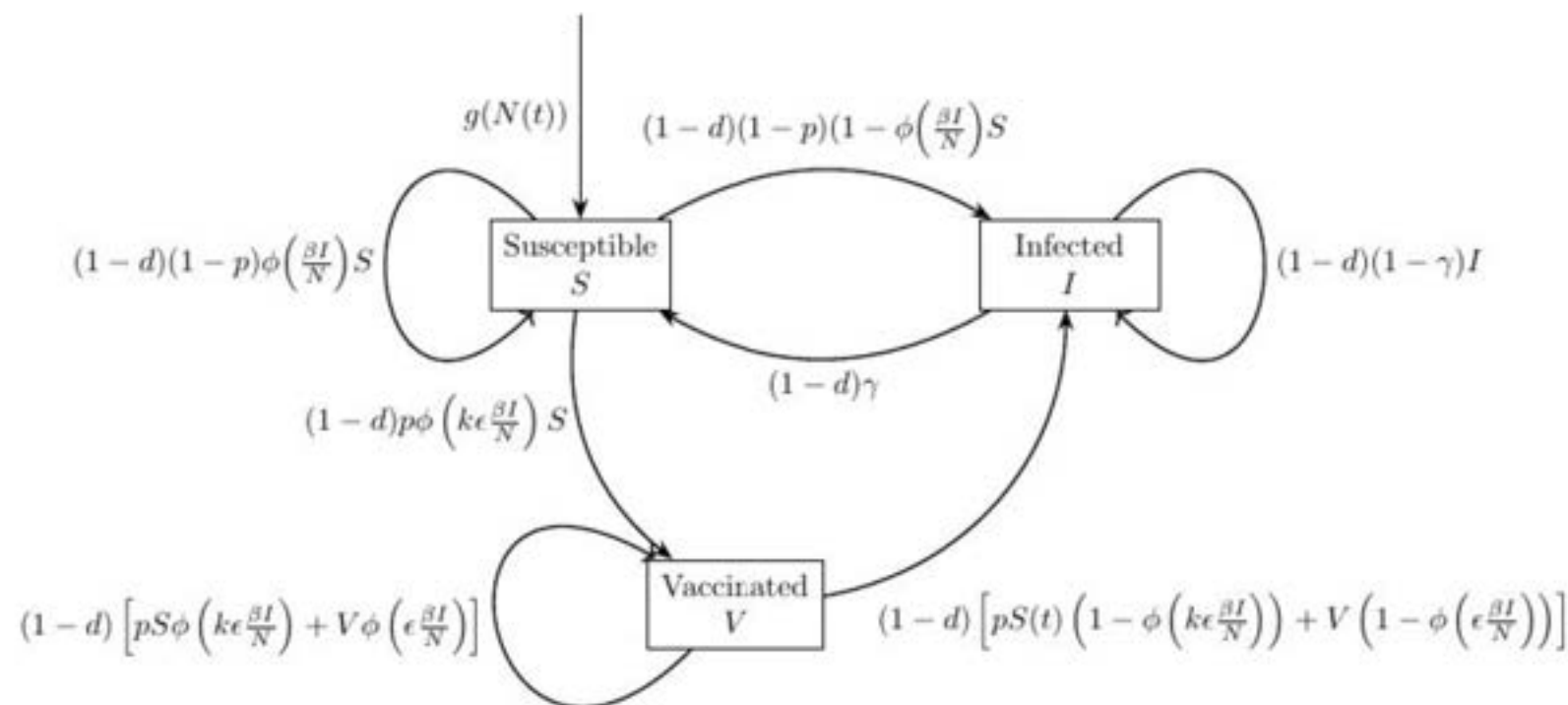


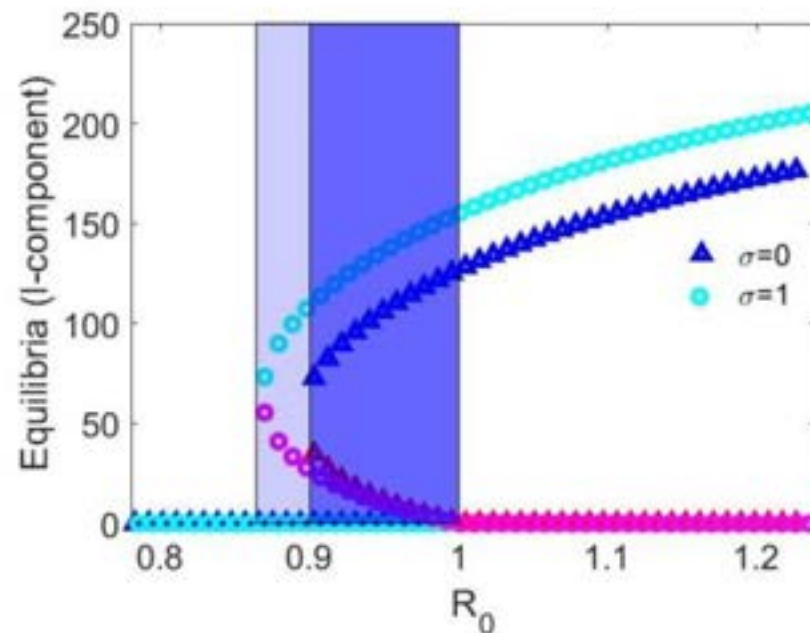
Figure: A flow diagram of SISV model.

Model Equation

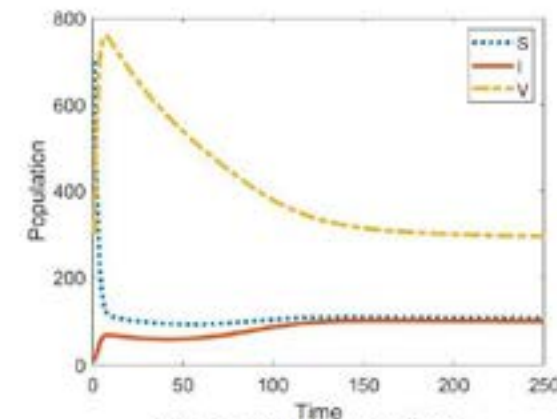
$$\begin{aligned}
 S(t+1) &= g(N(t)) + (1-d) \left[(1-p)S(t)\phi\left(\beta\frac{I(t)}{N(t)}\right) + \gamma I(t) \right] \\
 I(t+1) &= (1-d) \left[(1-p) \left(1 - \phi\left(\beta\frac{I(t)}{N(t)}\right) \right) S(t) \right. \\
 &\quad \left. + pS(t) \left(1 - \phi\left(\sigma\epsilon\beta\frac{I(t)}{N(t)}\right) \right) + V(t) \left(1 - \phi\left(\epsilon\beta\frac{I(t)}{N(t)}\right) \right) \right. \\
 &\quad \left. + (1-\gamma)I(t) \right] \\
 V(t+1) &= (1-d) \left[pS(t)\phi\left(\sigma\epsilon\beta\frac{I(t)}{N(t)}\right) + V(t)\phi\left(\epsilon\beta\frac{I(t)}{N(t)}\right) \right],
 \end{aligned}$$

- The population has three stages: susceptible, infected, and vaccinated.
- We assume newly vaccinated individuals get infected immediately after the vaccination, but get higher protection from infection than the existing vaccinated individuals.
- The model assumes the following order of events: **Vaccination, Disease Transformation and recovery, Reproduction and natural death.**

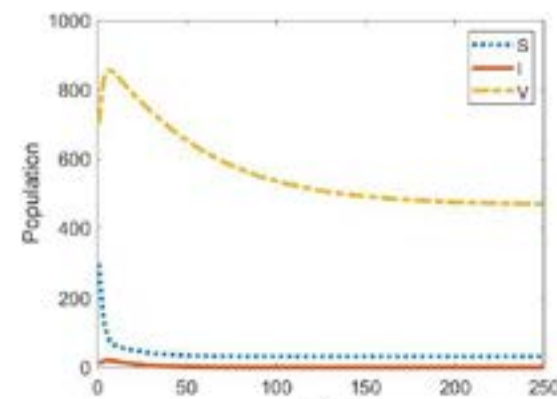
The Impact of Vaccination on the Backward Bifurcation



(A) Backward bifurcation at $R_0 = 1$ when $\sigma = 0$ (triangles) and $\sigma = 1$ (circles). Here unstable equilibria are given in red and magenta and stable equilibria are given in blue and cyan.

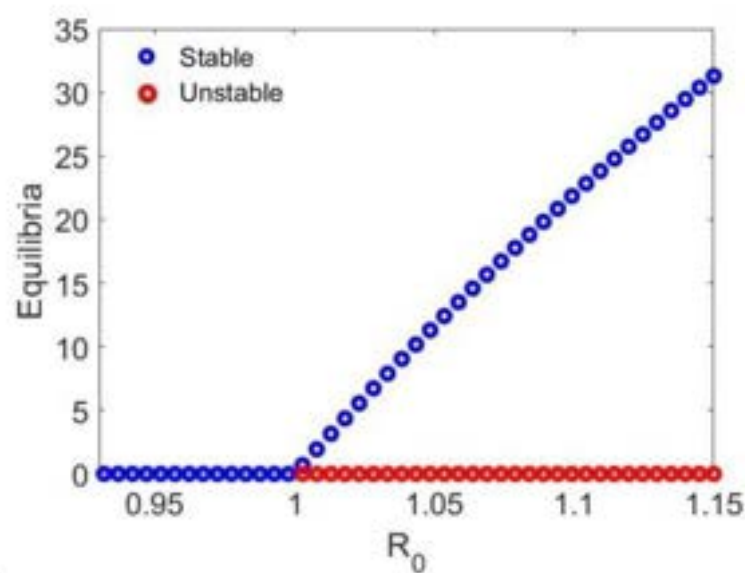


(B) For initial condition $S(0) = 700, I(0) = 10, V(0) = 300$.

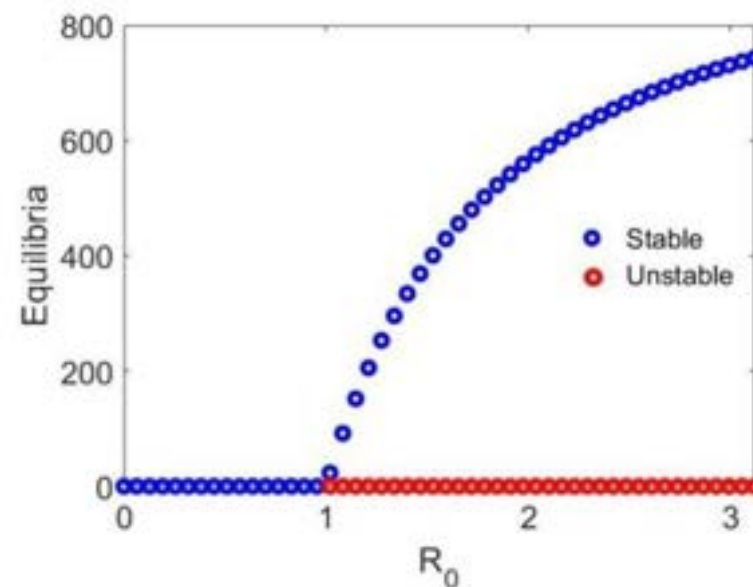


(C) $S(0) = 300, I(0) = 10, V(0) = 700$.

Forward bifurcation



(a) $\epsilon = 0$



(b) $\gamma = 0$

Figure: Forward bifurcation at $R_0 = 1$ for the vaccination first model.

An Alternative Model Formulation

We assume that **Disease transmission** occurs first, followed by vaccination and disease recovery, and finally reproduction and natural death.

$$S(t+1) = g(N(t)) + (1-d) \left[(1-p)S(t)\phi\left(\beta\frac{I(t)}{N(t)}\right) + \gamma I(t) \right]$$

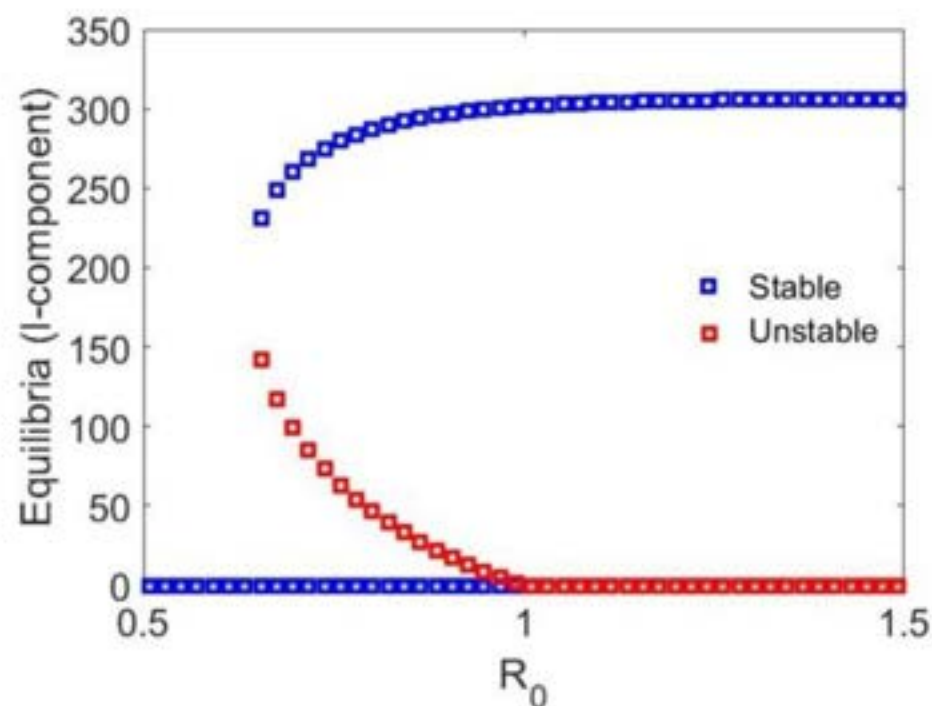
$$I(t+1) = (1-d) \left[(1-p) \left(1 - \phi\left(\beta\frac{I(t)}{N(t)}\right) \right) S(t) \right. \\ \left. + V(t) \left(1 - \phi\left(\epsilon\beta\frac{I(t)}{N(t)}\right) \right) + (1-\gamma)I(t) \right]$$

$$V(t+1) = (1-d) \left[pS(t) + V(t)\phi\left(\epsilon\beta\frac{I(t)}{N(t)}\right) \right].$$

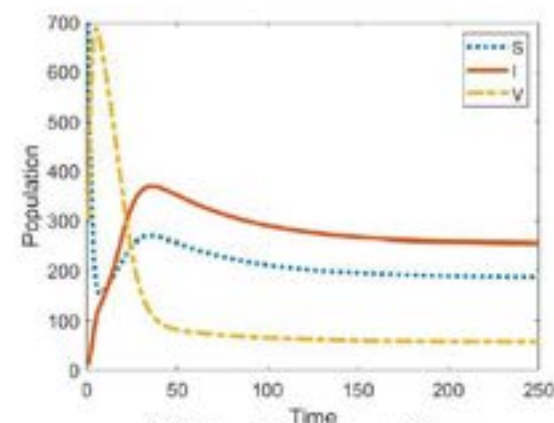
The basic net reproductive number of the model is

$$R_0 = \frac{(1-d)\beta(\bar{S} + \epsilon\bar{V})}{S_\infty(1 - (1-d)(1-\gamma))}.$$

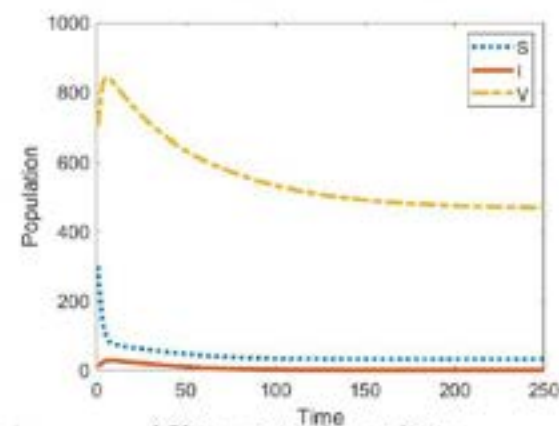
Backward Bifurcation When $\epsilon = 0$



(A) Backward bifurcation at $R_0 = 1$ for (infection before vaccination) model when $\epsilon = 0$.



(B) For initial condition
 $S(0) = 700, I(0) = 10, V(0) = 300$.



(C) For initial condition
 $S(0) = 300, I(0) = 10, V(0) = 700$.

Impact of Vaccination Timing on Backward Bifurcation

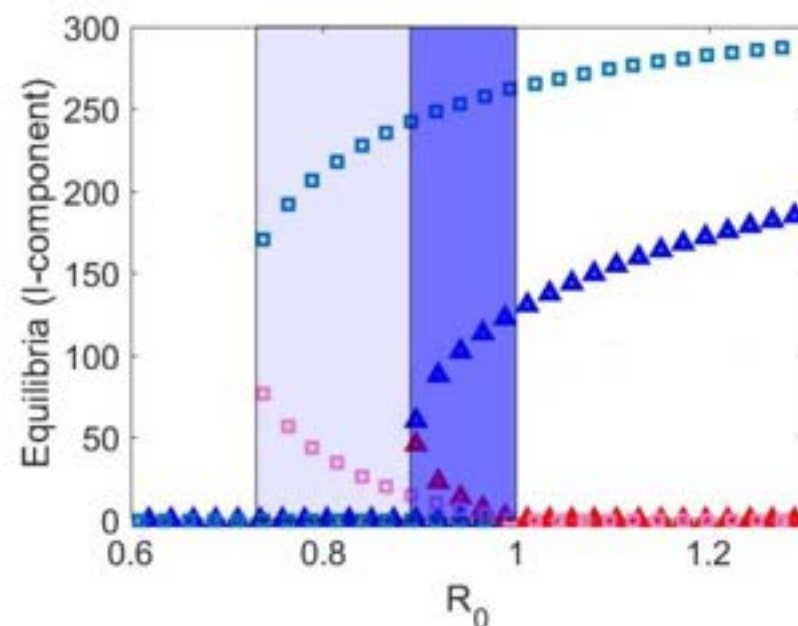


Figure: Backward bifurcation and $R_0 = 1$ for the vaccination first model (triangles) and disease transmission first model (squares). Stable equilibria are given in blue and grey-blue and unstable are given in red and pink.

Basin of Attraction

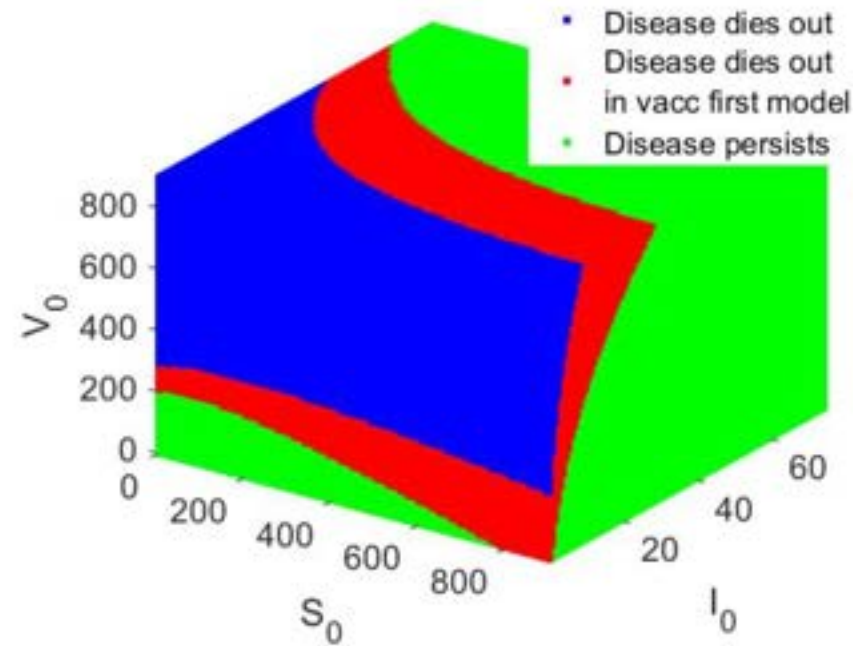


Figure: Basin of the Disease-free and endemic attractors in both models.

Conclusion

- We develop and analyze two discrete-time SISV models differing in the order of vaccination and infection.
- Vaccination first model dynamics exhibit backward bifurcation at $R_0 = 1$, requiring disease recovery and partial vaccine efficacy which is analogous with continuous-time SISV models findings.
- Disease transmission first model yield a larger bistability region and more severe outbreaks than the vaccination first model. Similar results was observed in the vaccination first model while comparing different infection rates among newly vaccinated.
- Disease transmission first model exhibit backward bifurcation even when the vaccine is completely effective.

Future Work

- Extend the epidemic model with disease-induced mortality and a limited treatment resource to understand the effect of treatment.
- Establish general local stability result for the SISV model using the Jury condition.
- Analyze the interior dynamics of the compartmental discrete-time epidemic models with demographic two-cycle.
- Analyze the global stability of the endemic dynamics in the SIR model using the Nullcline approach.

References



A. S. Ackleh, **J. Jahangir**, and A. Veprauskas. The interplay between multiple control mechanisms in a host–parasitoid system: a discrete-time stage-structured modeling approach. *Journal of Biological Dynamics*, 17(1):2241483, 2023.



A. S. Ackleh, **J. Jahangir**, A. Veprauskas. Backward bifurcations in discrete-time epidemic models with vaccination. *The Bulletin of Mathematical Biology*, for the special Issue: In memory of Mary Ann Horn. (Manuscript Submitted, 2026).



Emily Meissen, *Invading a Structured Population: A Bifurcation Approach*, PhD Dissertation, University of Arizona, 2017.



P Van den Driessche and Abdul Aziz Yakubu, Disease extinction versus persistence in discrete-time epidemic models. *Bulletin of Mathematical biology*, 81(11):4412-4446, 2009.



Sophia R-J Jang. Backward bifurcation in a discrete SIS model with vaccination. *Journal of biological systems*, 6(2):479-494, 2008.



Brauer, F. (2004). Backward bifurcations in simple vaccination models. *Journal of Mathematical Analysis and Applications*, 298(2), 418-431.



Sophia R-J Jang and Jui-Ling Yu. Dynamics of a discrete-time host–parasitoid system with cannibalism. *Journal of biological dynamics*, 5(5):419–435, 2011.

Acknowledgments

- I would like to thank my advisor **Amy Veprauskas** and the committee members **Azmy S. Ackleh**, **Paul Salceanu** for their support and guidance in my research.



Thank you!
Questions?



LOUISIANA, NATURE, PEOPLE & THINGS

Jenita Jahangir

PhD Student in Mathematics

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Discrete-Time Compartmental Epidemic Models*

Faculty Reference: Amy Veprauskas



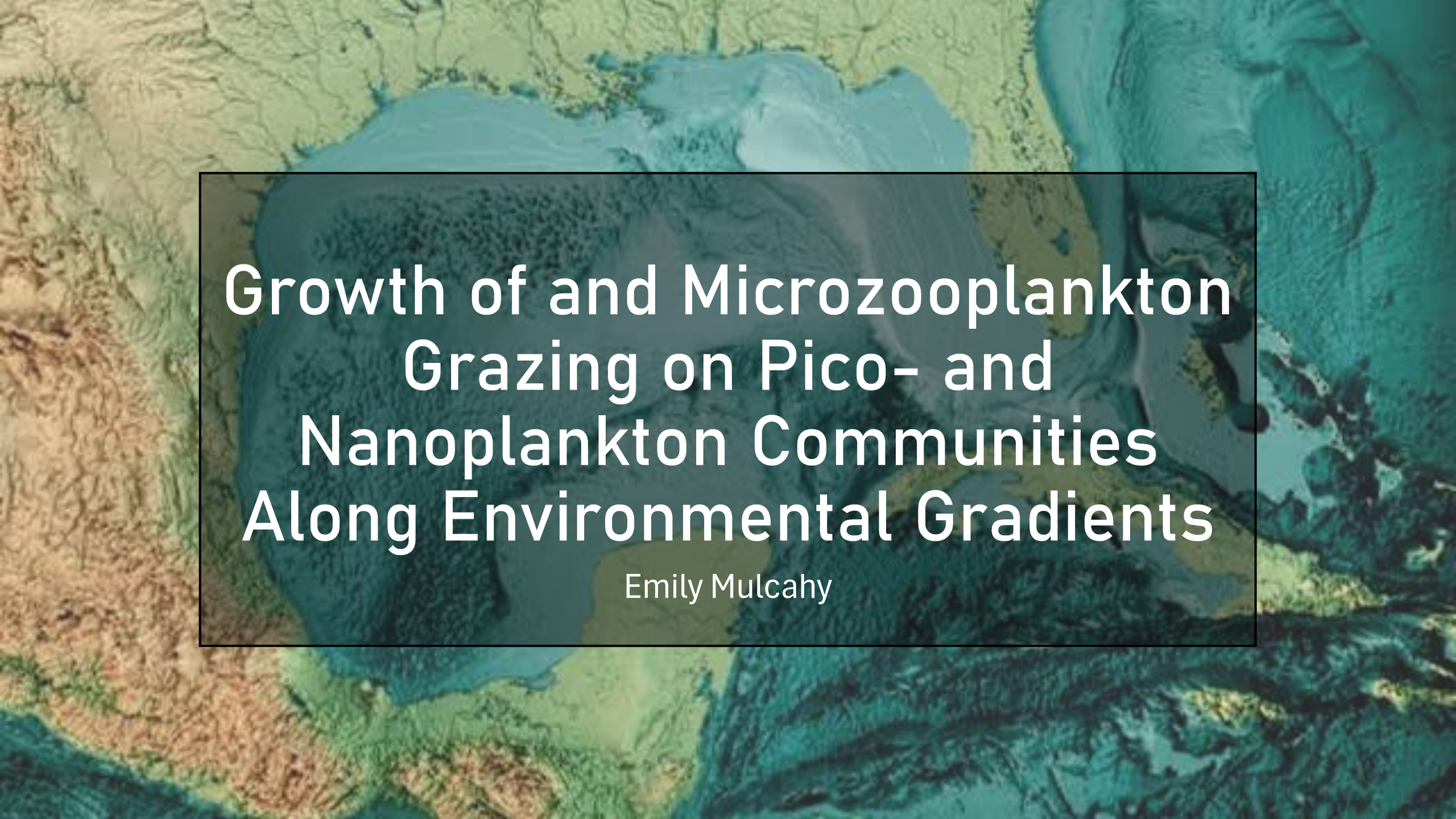
LOUISIANA, NATURE, PEOPLE & THINGS

Emily Mulcahy

Master of Science Student in Biology

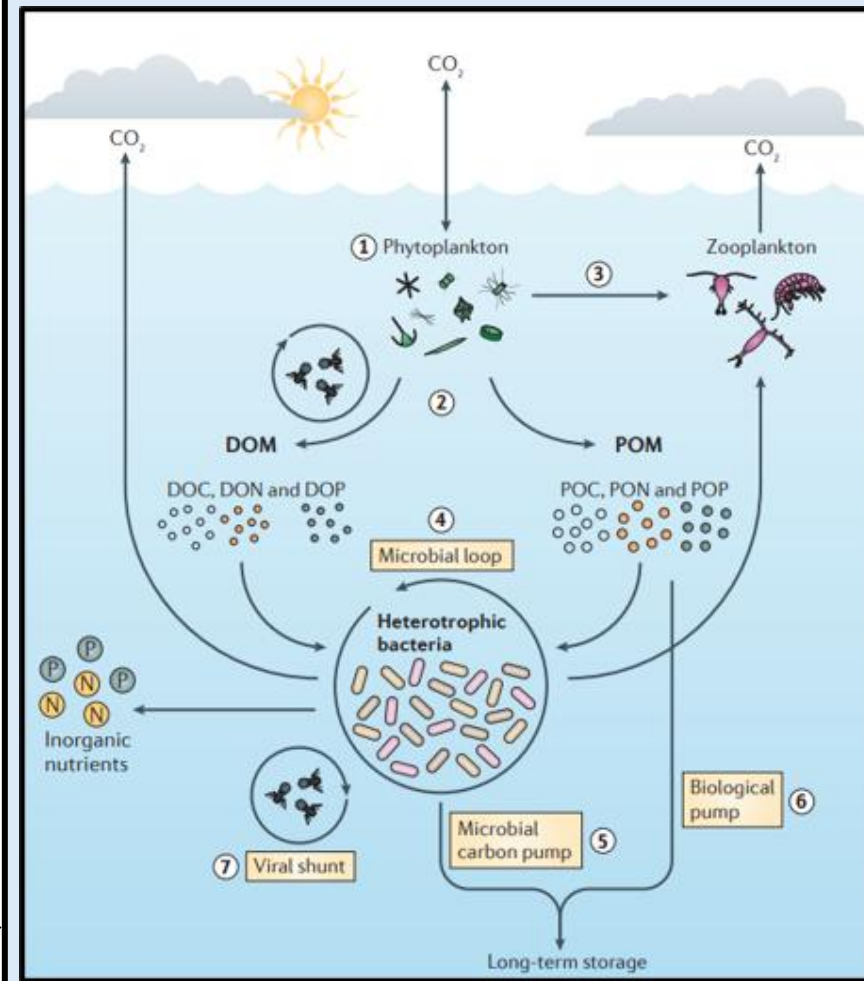
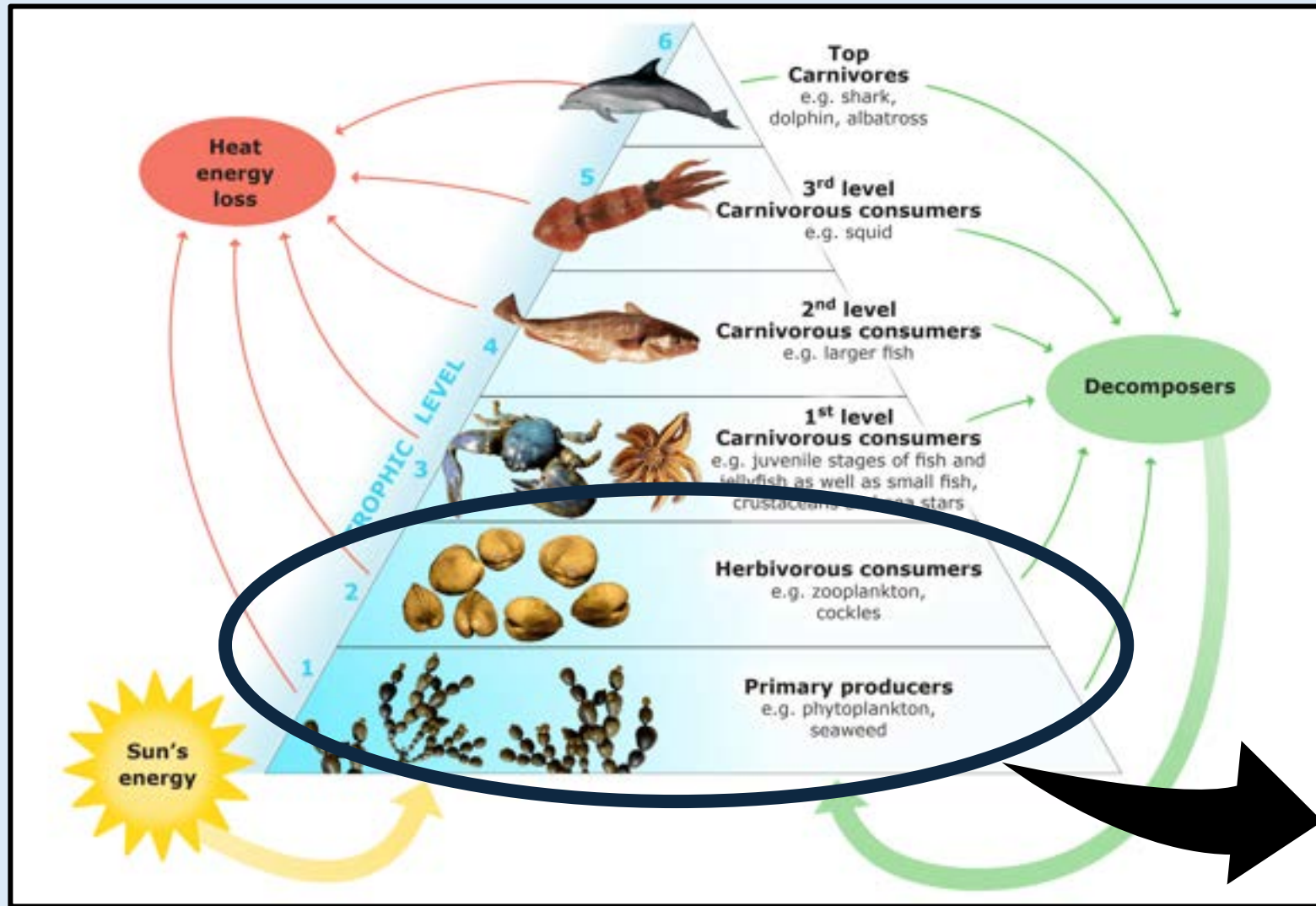
Growth of and Microzooplankton Grazing on Pico- and Nanoplankton Communities Along Environmental Gradients

Faculty Reference: Beth Stauffer

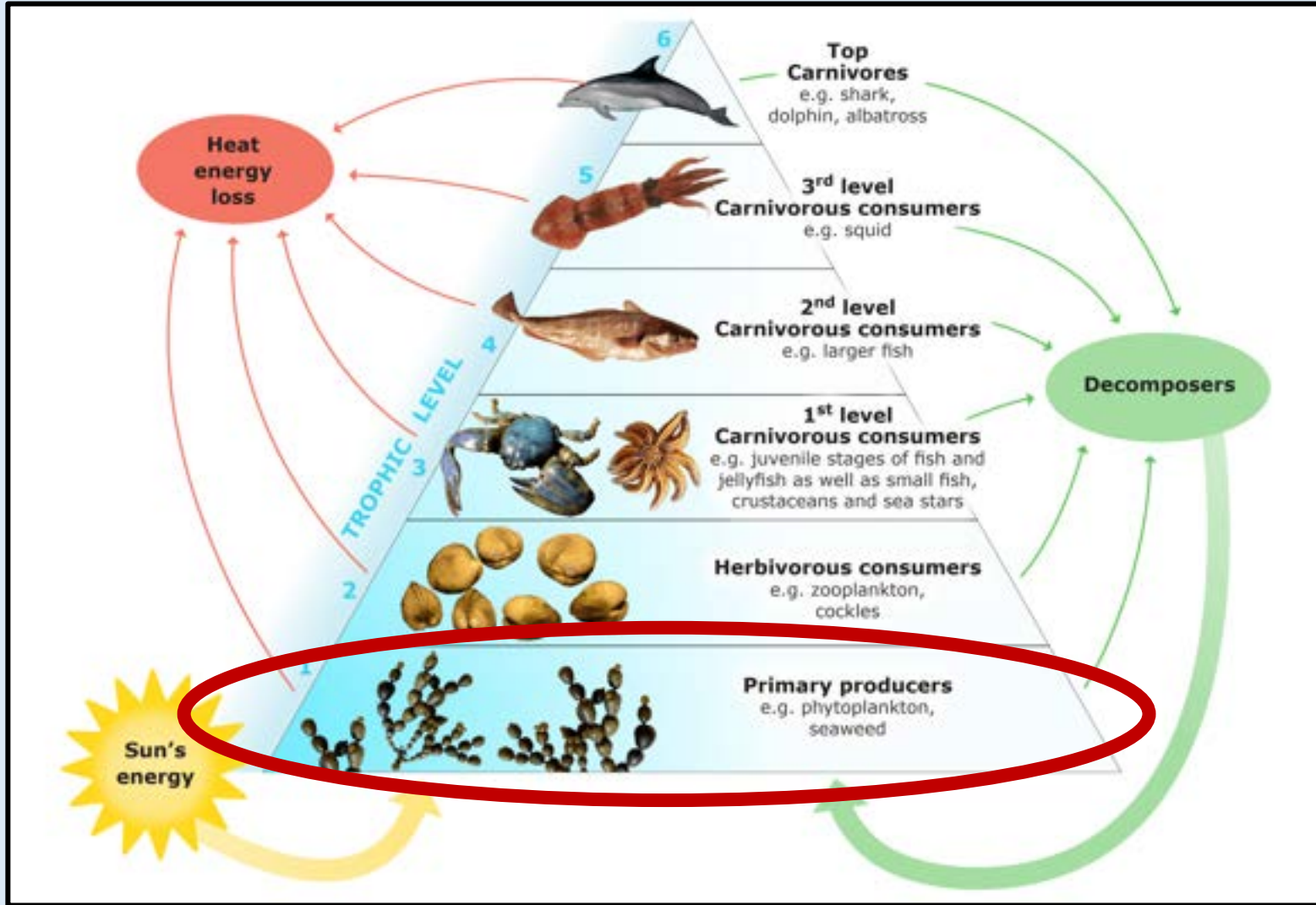


Growth of and Microzooplankton Grazing on Pico- and Nanoplankton Communities Along Environmental Gradients

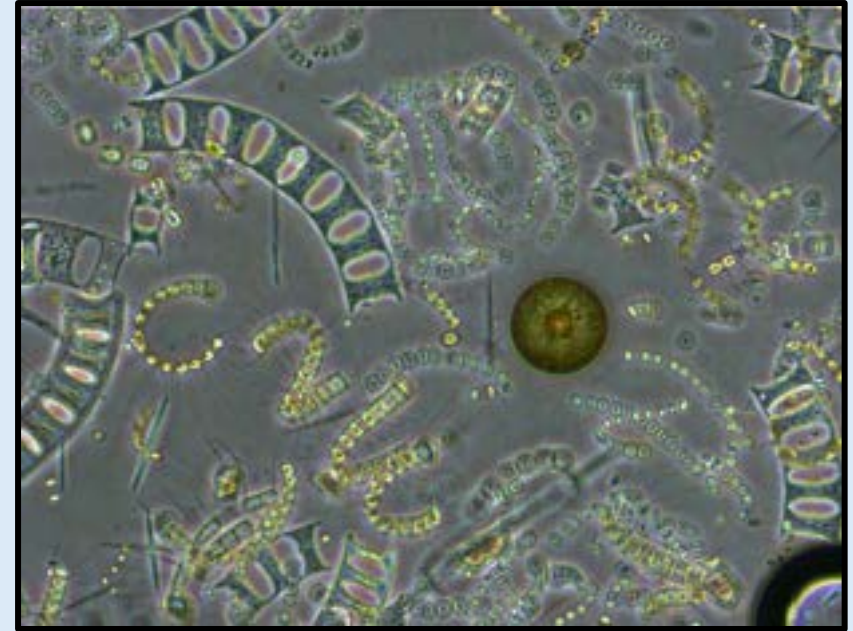
Emily Mulcahy



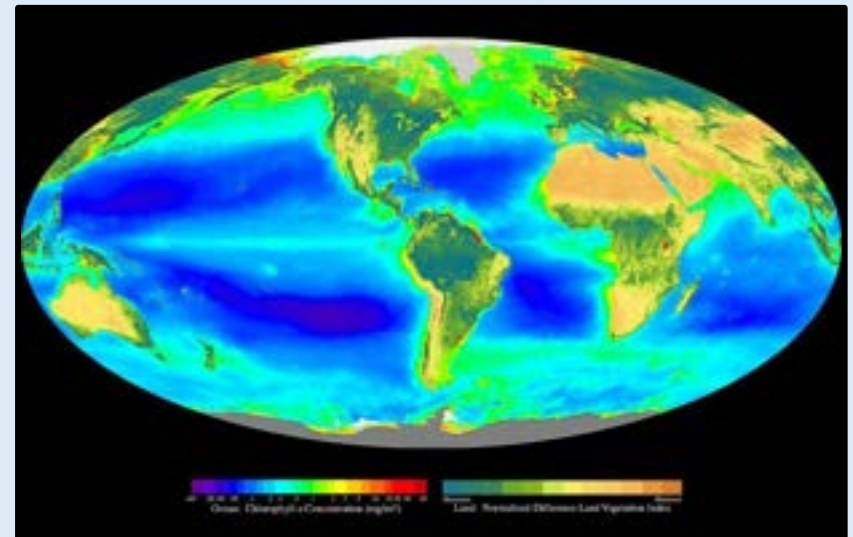
Buchan et al., 2014



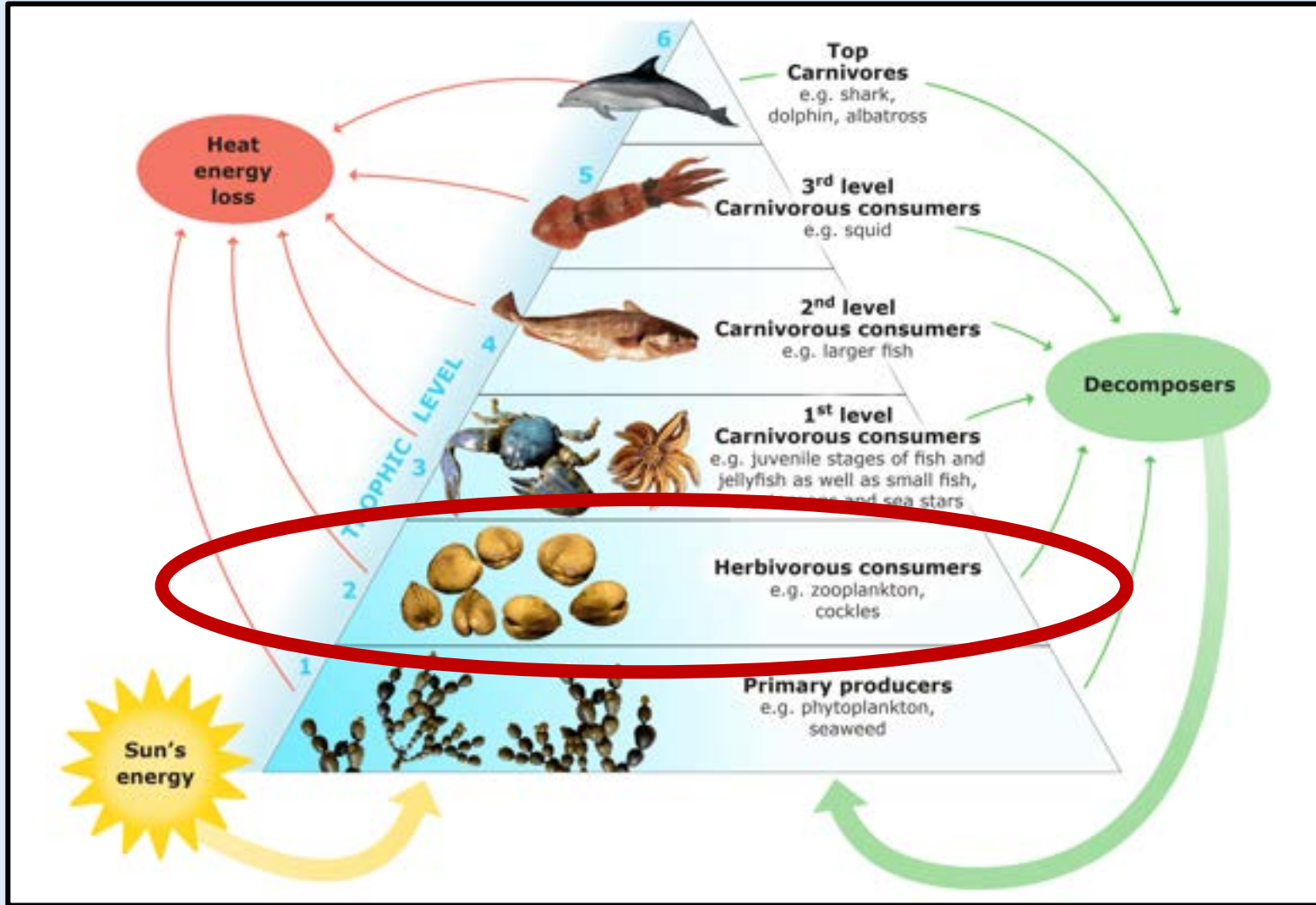
www.sciencelearn.org.nz

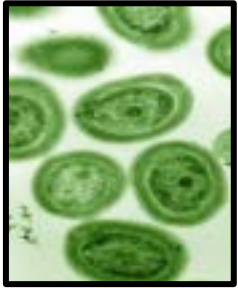


Gause, 1934



SeaWiFS

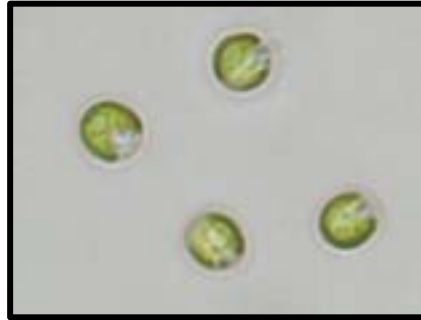




Pico-sized
plankton



$< 2 \mu\text{m}$



Nano-sized
plankton



$2 - 20 \mu\text{m}$



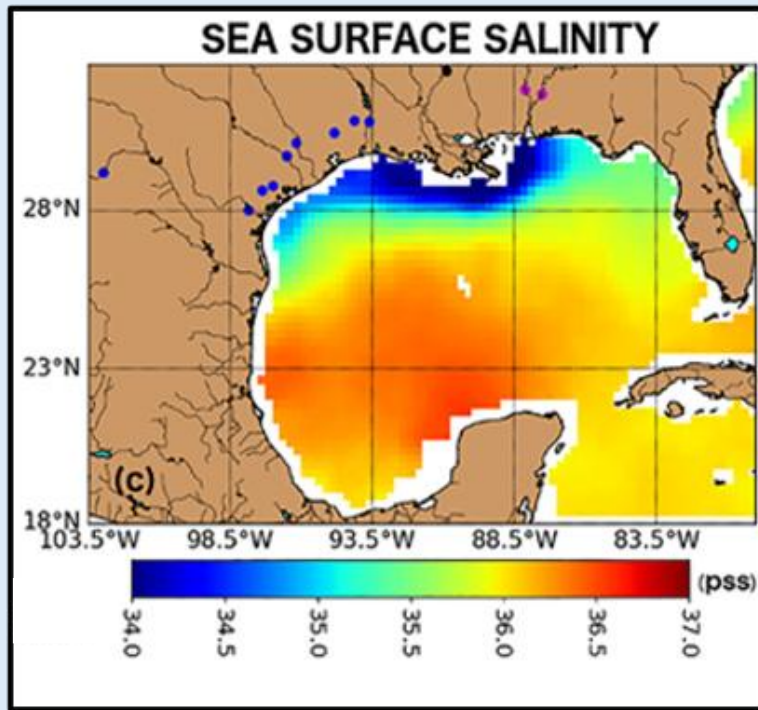
Micro-sized
plankton



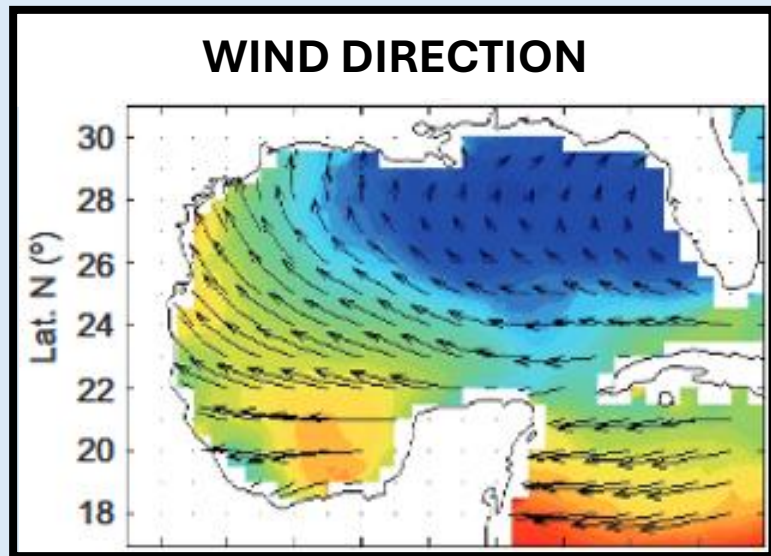
$20 - 200 \mu\text{m}$

Smaller

Larger

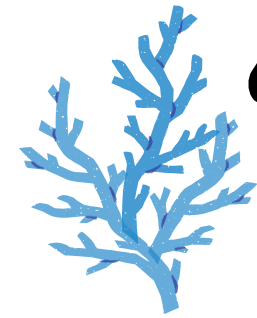
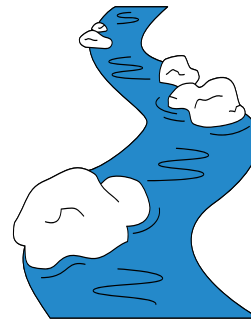


Kealoha et al., 2020



Zavala-Hidalgo et al., 2014

Environmental
variability drives
growth of
phytoplankton

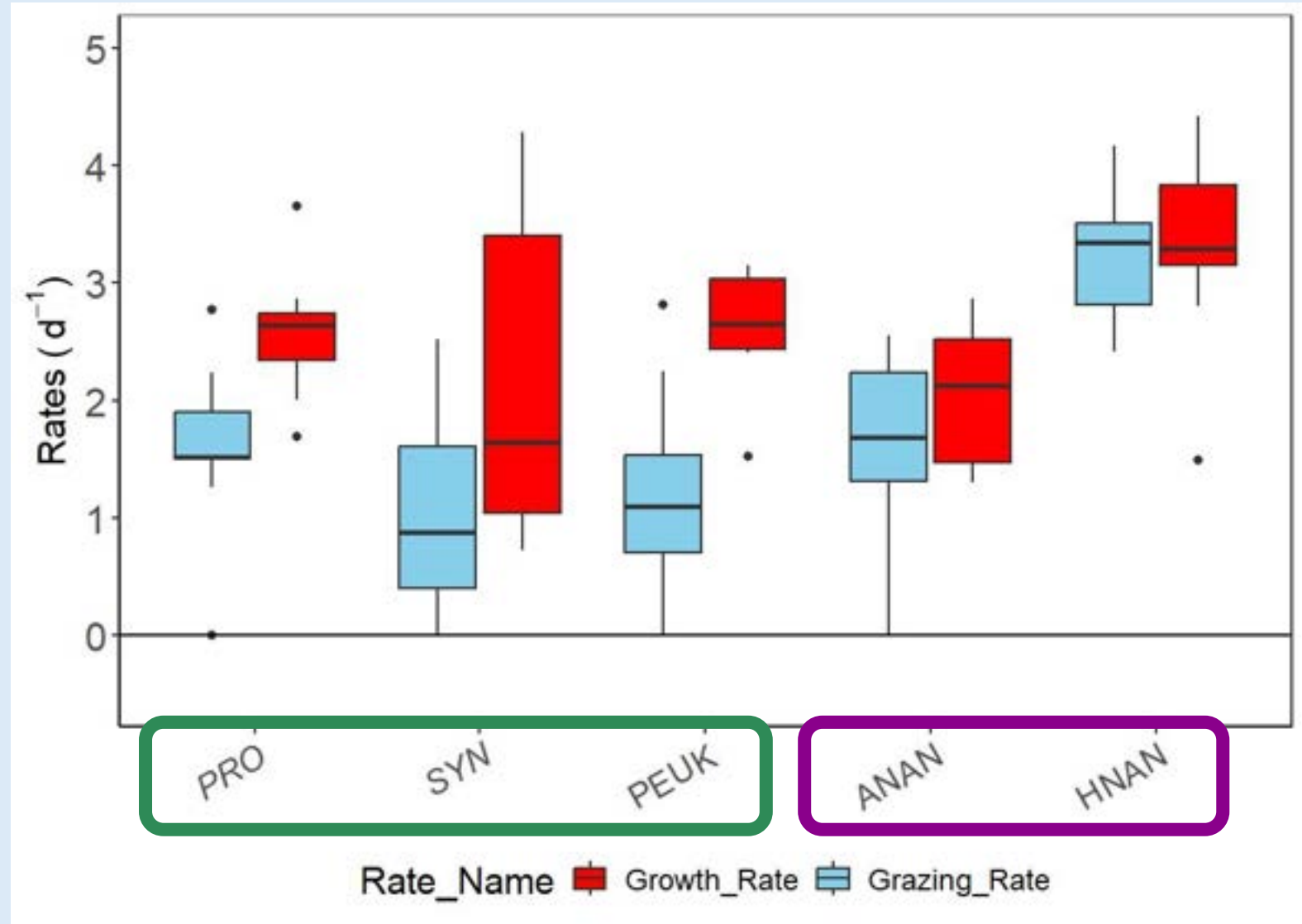


How does the growth and mortality of pico- and nanoplankton communities vary across the GoM?



Vallée et al.

Pico-sized plankton are growing faster than they are being consumed



Pico-sized
plankton



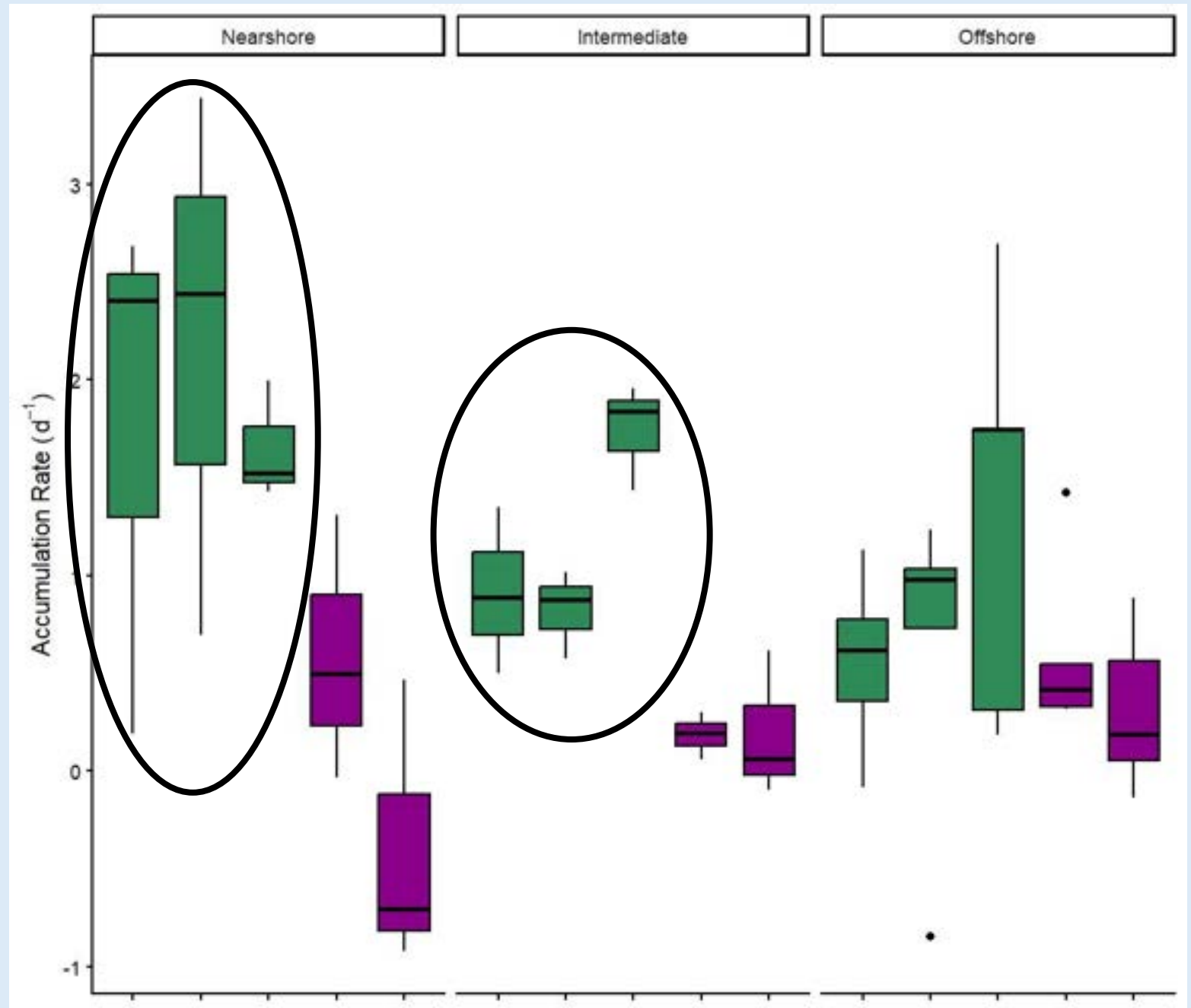
Nano-sized
plankton

Most of the accumulation of
pico-sized plankton is
occurring at nearshore and
intermediate stations

Pico-sized
plankton



Nano-sized
plankton



Next Steps



Assess how the community composition of bigger plankton impacts smaller plankton via grazing



Explore how environmental gradients influence the abundance of pico- and nanoplankton throughout the water column

Acknowledgements

Stauffer Lab

- Dr. Beth Stauffer
- Maya Lombardi
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Research Committee

Dr. Mark Genung (ULL)

Dr. Kelly Robinson (ULL)

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- Hans Prevost
- Lucy Roussa (NCSU)
- Dr. Astrid Schnetzer (NCSU)

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LOUISIANA, NATURE, PEOPLE & THINGS

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Master of Science Student in Biology

Growth of and Microzooplankton Grazing on Pico- and Nanoplankton Communities Along Environmental Gradients

Faculty Reference: Beth Stauffer



LOUISIANA, NATURE, PEOPLE & THINGS

Khairum Orthi

PhD Student in Earth & Energy Sciences

*Understanding the Electron Transport Chain in
Photosystem I During Photosynthesis*

Faculty Reference: Wu Xu



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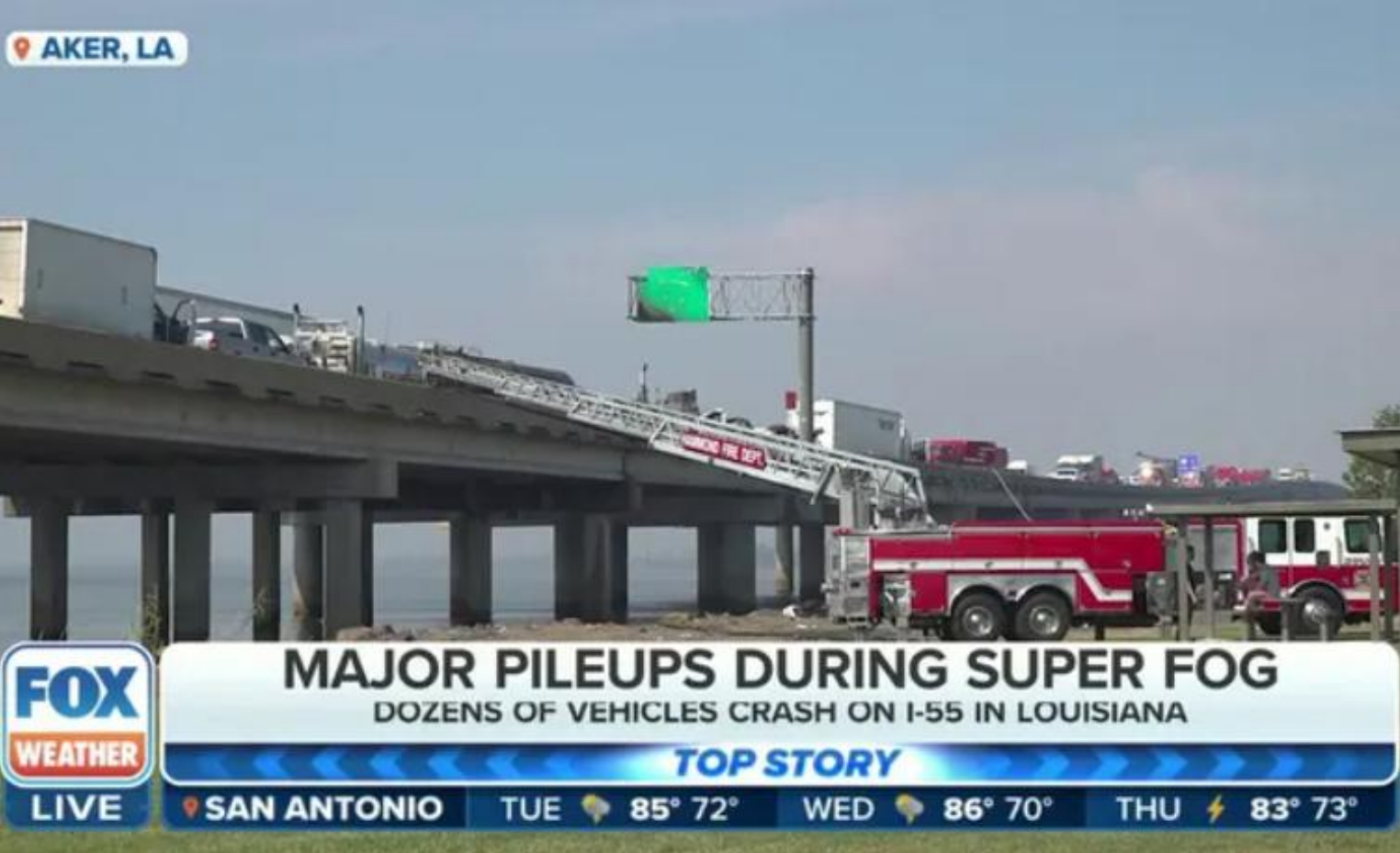
LOUISIANA, NATURE, PEOPLE & THINGS

Nelly Ankrah

PhD Student in Systems Engineering: Civil Engineering

*The Role of Road Weather Intelligent Systems in Enhancing
Climate Resilience and Transportation Safety in Louisiana*

Faculty Reference: Julius Codjoe



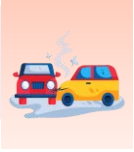
ROAD WEATHER INFORMATION SYSTEMS FOR LOUISIANA:

A CLIMATE-RESPONSIVE SOLUTION FOR TRANSPORTATION SAFETY AND RESILIENCE



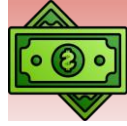
PRESENTED BY : NELLY AKWELEY ANKRAH
DEPARTMENT OF CIVIL ENGINEERING

Safety Challenges Posed by Weather-Related Roadway Hazards



Crash Statistics

1.2 million weather-related crashes annually in the U.S.



Economic Impact

\$42 billion in crash-related economic losses each year.



Safety Concerns

Weather accounts for 28% of crashes, 19% of fatalities.



Operational Challenges

Visibility, control issues cause delays and rising costs.

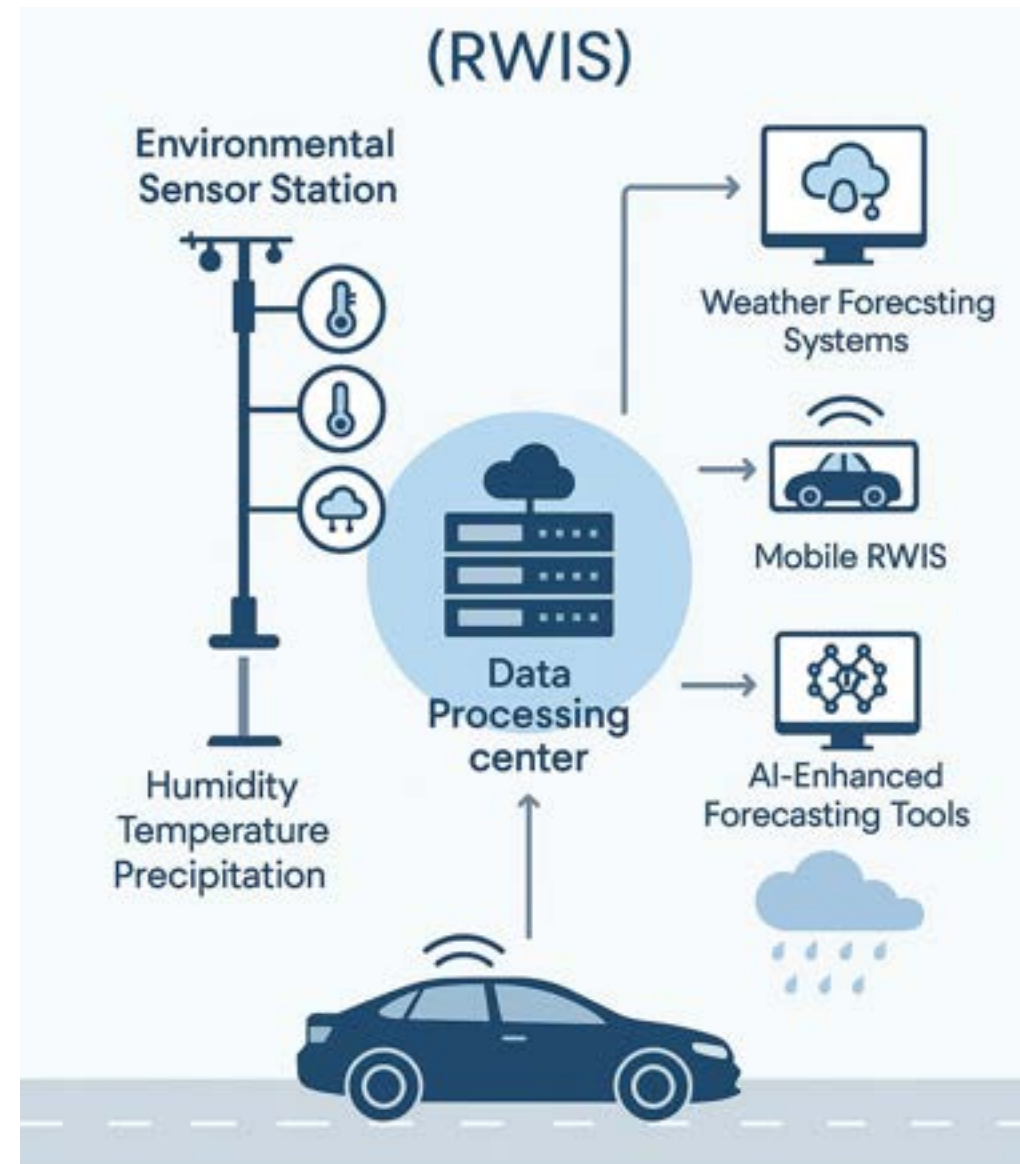


Current Agency Approach

Most agencies still respond reactively to weather events.

What is RWIS?

- RWIS stands for Road Weather Information System
- A network of roadside environmental sensors
- Monitors weather and pavement conditions (e.g., temperature, precipitation, surface status)
- Sends real-time data to transportation agencies
- Helps inform winter maintenance decisions (e.g., plowing, salting)
- Supports traveler information systems (e.g., 511, dynamic message signs)
- Integrated with ITS tools like CVs and MDSS for proactive responses





What This Study Seeks to Answer

Does RWIS Reduce Crashes?

Can road weather information systems meaningfully reduce crashes and fatalities during adverse weather conditions?

What do the Economics show?

What do existing cost-benefit studies reveal about the financial returns of RWIS investment and do the numbers justify deployment?

What can Louisiana Deploy?

What lessons from RWIS deployments across the U.S. can be implemented in Louisiana

Where should Louisiana act?

Where and how should Louisiana prioritize RWIS deployments to achieve the greatest safety and resilience impact?

Louisiana's Road Weather Challenge

169

Roads closed by
Hurricane Ida · LDOTD (2021)

160

Vehicles in 2023 I-55
fog crash · 8 fatalities

57"

Avg. annual rainfall · up to
70" in southeast LA (NOAA)

Louisiana's Hazard Profile

Hurricanes: Katrina (2005), Laura (2020), and Ida (2021) caused mass road closures, deaths, and displacement across the state.

Flooding: The 2016 catastrophic flood damaged homes, cut off communities, and caused at least 13 deaths were reported because of the flooding

Fog: Dense fog on I-10 and I-55 has triggered deadly pileups including the 2023 I-55 crash (160 vehicles, 8 fatalities).

The Research Gap

Most RWIS research focuses on snow and ice in northern states.

This study fills a critical gap by evaluating RWIS effectiveness for fog, flooding, and hurricane-related hazards - the conditions that define Louisiana's transportation risk.

Research Methodology : Three-Phase Approach

01

Systematic Literature Review

COMPLETED

Reviewed 20+ peer-reviewed studies, federal reports, and state DOT evaluations using a structured 6-phase SLR framework (Kitchenham, 2004). Synthesized RWIS deployments across 10 U.S. states with diverse climates, focusing on safety outcomes, BCRs, and ITS integration.

02

Cost-Benefit Findings from Reviewed Studies

COMPLETED

From the studies reviewed in Phase 1, extracted and documented the cost-benefit findings already reported by those studies including BCR ranges, crash cost savings, and mobility savings. These findings demonstrate the economic value of RWIS and inform the case for Louisiana deployment.

03

Louisiana Deployment Framework

PLANNED

A planned next phase that will use Louisiana crash data and the evidence base from Phases 1 & 2 to assess RWIS applicability in Louisiana including a potential Louisiana-specific cost-benefit analysis and prioritized deployment recommendations.

Phase 1 Results : Systematic Literature Review Summary

20+ studies reviewed · 10 U.S. states · Focused on crash reduction, BCR, ITS integration & transferability to Louisiana

State	Period	Weather Hazard	Crash Reduction / Safety Outcome	Study
Iowa	Pre-2020	Snow, Ice	31–88% crash reduction; BCRs 9.83 - 39.97	Safety Effects of RWIS - Cost-Benefit Analysis (2020)
Alaska	2000–23	Snow, Ice	15% total; CMF = 0.83; BCR ≈1:27	RWIS Contributions to Road Safety - Winter Crash Histories in Alaska
Ohio	2017–23	Snow (lake-effect)	35% total crashes; 55% fatal/injury; 58% fewer rear-end	Variable Speed Limits on I-90 - Ohio DOT (2024)
Idaho	2011–13	Snow, Ice	BCRs 34:1 and 19:1 - significant crash and maintenance savings	RWIS Life-Cycle Cost Analysis (2020)
Montana	2017	Snow, Ice	BCRs 1.2:1 to 40:1 ; \$ 0.06– \$ 0.12 savings per VMT	Assessment of Montana RWIS – Western Transportation Institute
Florida	2021	Hurricane winds	\$750K emergency cost savings; 19 bridge closures enabled	Integrating Road Weather Management and Traffic Ops with RWIS Data
Texas	2012	Rain, Fog, Snow	Improved traffic flow ; weather-sensitive models for 3 cities	Implementation of Weather-Responsive Traffic Estimation System
Arizona	2022	Snowstorm, Rain	Improved traveler compliance ; enhanced interagency messaging	Pathfinder: Arizona's Coordinated Messaging on Snowstorm Impacts

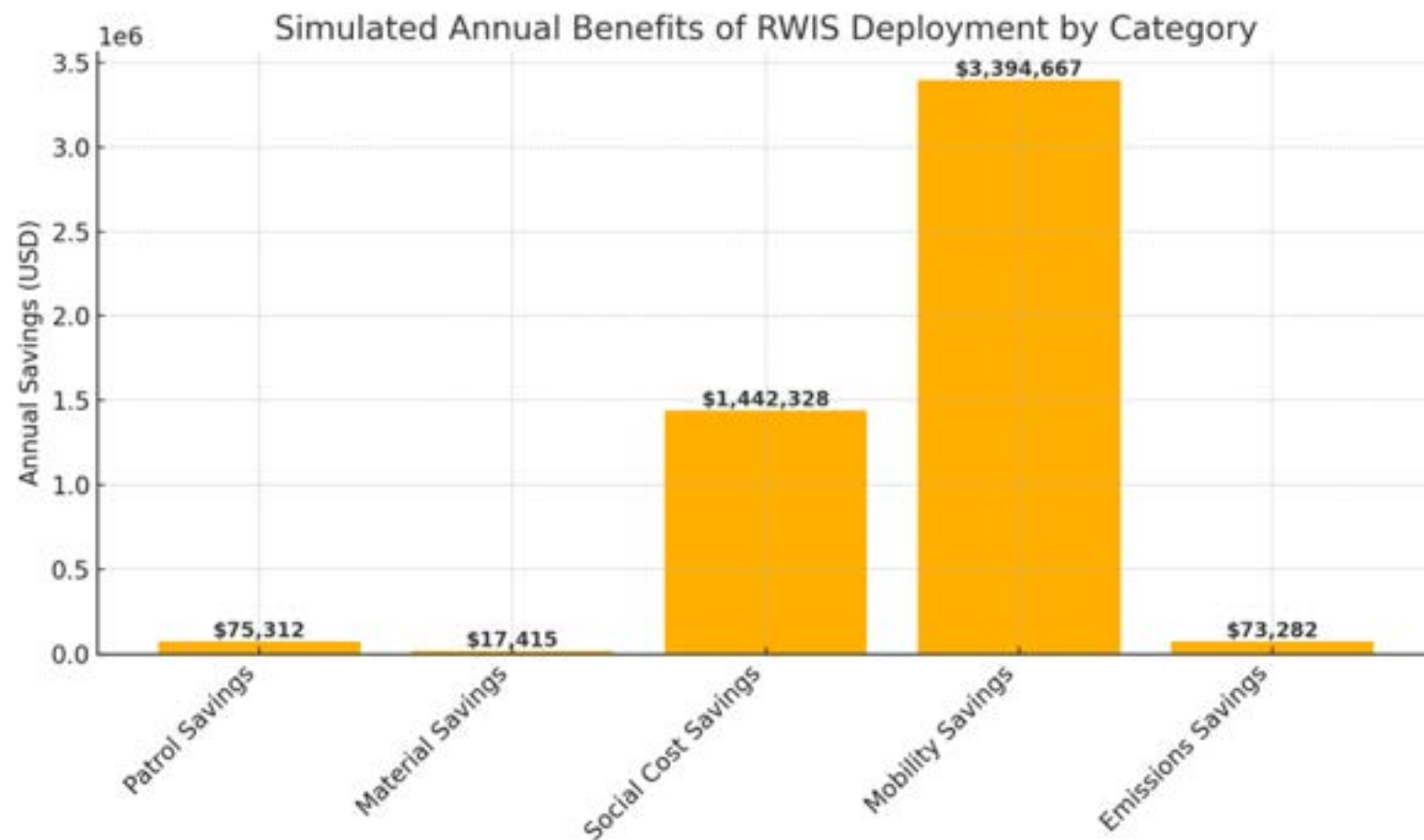
Key Gap: Nearly all deployments target snow & ice. This study uniquely evaluates RWIS for fog, flooding & hurricane conditions

Phase 2 : Cost-Benefit Findings from Reviewed Studies

- **Annualized Cost:** \$21,039
- **Total Annual Benefits:** \$5+ million
- **Benefit-Cost Ratio (BCR):** 237.8:1

Benefit Breakdown:

- Patrol savings: **\$75,312**
- Material savings: **\$17,415**
- Crash cost reduction: **\$1.44 million**
- Delay savings: **\$3.39 million**
- Emission reduction: **\$73,282**



Phase 3 : Where the Research is Headed

Phases 1 & 2 confirmed RWIS works. Phase 3 asks: what does this mean for Louisiana?

Q1

**What RWIS already
exists in Louisiana ?**

Q2

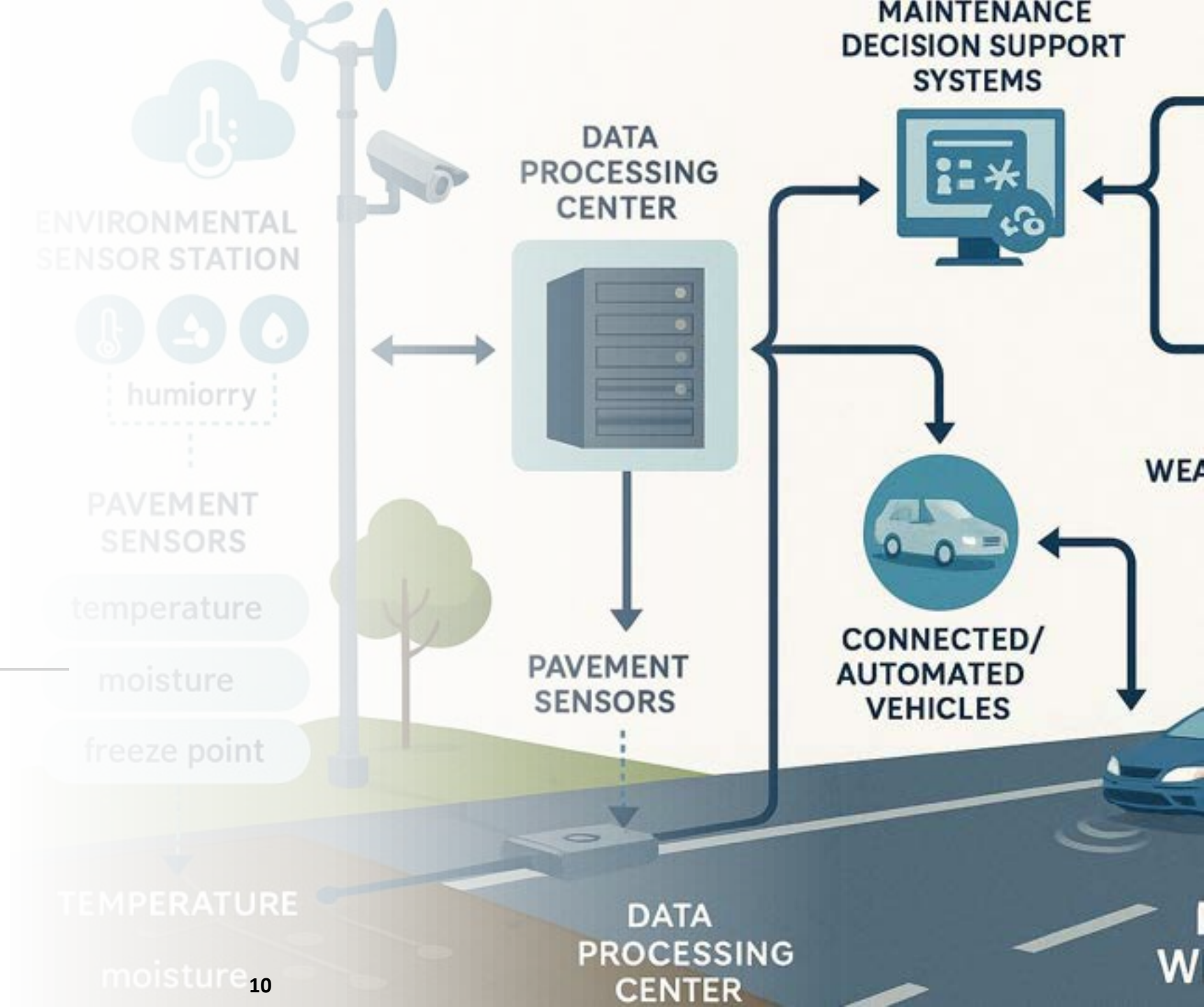
**Can we simulate a
Louisiana-specific
cost-benefit analysis?**

Q3

**Where should
Louisiana prioritize
RWIS deployment?**

Goal: move from 'RWIS works elsewhere' → 'here is how Louisiana can benefit and where to start.'

Thank You!





LOUISIANA, NATURE, PEOPLE & THINGS

Nelly Ankrah

PhD Student in Systems Engineering: Civil Engineering

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Faculty Reference: Julius Codjoe



LOUISIANA, NATURE, PEOPLE & THINGS

Muhammad Towhidul Islam

PhD Student in Systems Engineering: Petroleum Engineering

Visualization of Hydrate Formation of Flowing CO₂ in Low-Temperature Water for CO₂ Disposal onto Seafloor

Faculty Reference: Boyun Guo

EXPERIMENTAL STUDIES OF HEAVY CO₂ HYDRATES FOR SEAFLOOR STORAGE

Visualization of Hydrate Formation of Flowing CO₂ in Low-
Temperature Water

Muhammad Towhidul Islam

Ph.D Student Systems Engineering
(Concentration in Petroleum Engineering)

Advisor: Dr. Boyun Guo

Louisiana Impact Research Awards Summit

RESEARCH MOTIVATION & GLOBAL IMPACT

THE CHALLENGE

As global carbon emissions escalate, effective carbon capture and storage (CCS) technologies are essential to enhance environmental resilience and emission management.

Traditional storage methods face risks of leakage and limited capacity, necessitating innovative, long-term solutions for carbon management.

THE SOLUTION

CO₂ sequestration as solid hydrates in deep marine sediments offers a promising, stable, and dense storage medium.

KEY BENEFITS

Solid form storage significantly reduces leakage risks compared to gaseous or liquid injection.

High-pressure, low-temperature seafloor conditions ensure long-term hydrate stability.

Virtually unlimited offshore storage capacity to address global emission scales.

ALIGNMENT WITH UN SUSTAINABLE DEVELOPMENT GOALS

13

CLIMATE ACTION

SDG 13

Advancing CCS technology to reduce atmospheric CO₂ and mitigate climate change impacts.

Improving the design and safety of subsea CCS systems to enhance global environmental resilience.

14

LIFE BELOW WATER

SDG 14

Ensuring safe sequestration in deep-sea environments to minimize ecological risks and ocean acidification.

Safeguarding marine ecosystems through precise monitoring and control of hydrate formation.

7

CLEAN ENERGY

SDG 7

Supporting a cleaner energy transition by enabling responsible carbon management for existing infrastructure.

Balancing energy demand with environmental responsibility through innovative storage solutions.

RESEARCH OBJECTIVES

PRIMARY GOAL

To visualize of CO₂ hydrate formation during injection of CO₂ into low-temperature water simulating seafloor conditions.

Experimental Characterization

- Investigate the influence of flow rate, pressure, salinity, and temperature on hydrate nucleation and growth.
- Develop a visual observation setup using transparent high-pressure vessels for real-time monitoring.

Quantification & Optimization

- Quantify the rate and extent of hydrate formation in dynamic flow conditions.
- Propose operational guidelines for optimizing subsea CO₂ hydrate-based disposal systems.

PROPOSED METHOD: INSTANT HYDRATE GENERATION

MECHANISM: JOULE-THOMSON COOLING EFFECT

The process leverages the Joule-Thomson effect to achieve super-cooling, causing immediate formation of CO₂ hydrates upon injection into seawater.

01

Cooling & Pumping

Liquid CO₂ is initially cooled to increase its density and then pumped into a high-pressure hose for subsea delivery.

02

Injection & Expansion

CO₂ is expanded through jetting nozzles at the injection head. Sonic (critical) flow conditions are preferred to maximize cooling efficiency.

03

Instant Formation

The super-cooled jetted stream falls below seawater temperature, triggering immediate hydrate nucleation and growth.

EXPERIMENTAL DESIGN: HIGH-PRESSURE WINDOWED CELL

CYLINDER SPECIFICATIONS

Design Pressure (P)	2000 psi
Outside Diameter (D)	4.0 inches
Material	SS 316 (ASTM A312)
Allowable Stress (S)	20,000 psi
Joint Efficiency (E)	1.0 (Seamless)

CALCULATED WALL THICKNESS (T)

0.20 inch (5.08 mm)

Based on ASME B31.3 Formula

SAPPHIRE WINDOW DESIGN

Window Material	Optical Sapphire
Window Diameter	3.0 inches
Poisson's Ratio (ν)	0.27
Design Stress (σ)	22,000 psi
Safety Factor	Included in Design Stress

REQUIRED WINDOW THICKNESS (T)

0.29 inch (7.40 mm)

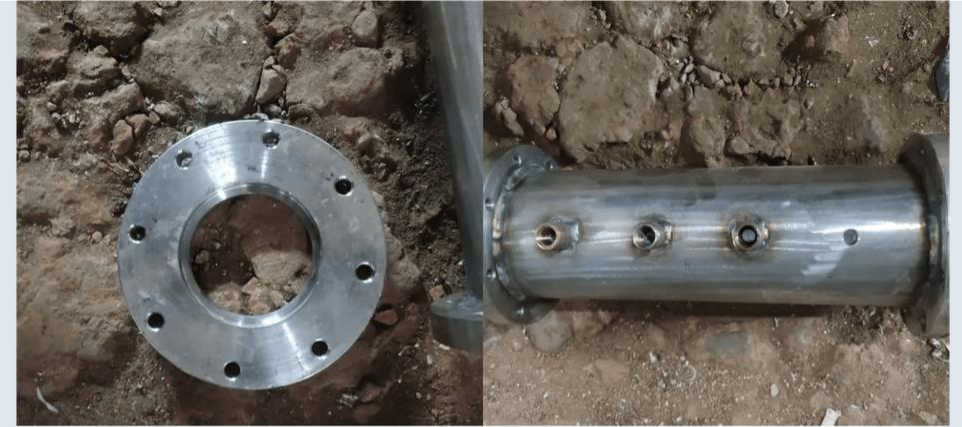
Based on Max Bending Stress Formula

EXPERIMENTAL SETUP & PREPARATION

SYSTEM COMPONENTS

- **High-Pressure Windowed Cell:** Designed for seafloor conditions (3–10 MPa, 0–5°C) to observe gravitational segregation.
- **Real-Time Visualization:** High-resolution cameras for capturing hydrate nucleation and morphological changes.
- **Monitoring Sensors:** Integrated pressure and temperature sensors for precise thermodynamic data collection.
- **Injection Nozzles:** Specialized nozzles for dynamic flow studies and Joule-Thomson cooling validation.

VESSEL PREPARATION



Preparation of Experimental Vessel



The experimental vessel is constructed from SS 316 to withstand high-pressure environments. The assembly includes the sapphire window ports for visual access and multiple sensor inlets for comprehensive data acquisition.

Figure: High-pressure-low-temperature windowed cell assembly

EXPERIMENTAL RESULTS: CO₂ BUBBLING & WATER DRIPPING

OBSERVATION MODES

The experimental setup allowed for two distinct interaction modes to validate hydrate formation dynamics:

1. CO₂-Bubbling into Water Phase

Simulates the injection of gaseous or liquid CO₂ into a standing water column.

2. Water-Dripping into CO₂ Phase

Simulates the interaction of seawater with a concentrated CO₂ plume.

KEY FINDINGS AT 800 PSI @ 1°C

Immediate hydrate nucleation was observed at the interface, confirming the rapid kinetics required for seafloor disposal.



Figure 1: Visual confirmation of hydrate formation at 800 Psi and 1°C.

Solid Hydrate Nucleation Observed

RESULTS: HYDRATE FORMATION DYNAMICS

Experimental Conditions: 500 Psi @ 0.4°C | Water-Dripping into CO₂ Phase

INITIAL CONTACT



Rapid hydrate nucleation occurs at the point of contact between water droplets and the CO₂ phase.

Formation of a solid interface layer is observed within minutes of injection.

1.5 HOURS AFTER



Significant accumulation of solid hydrates. The structure continues to grow and densify over time.

Visual evidence shows the transition from liquid droplets to stable solid hydrate masses.

24 HOURS AFTER



The hydrate structure remains stable and intact under seafloor-mimicking conditions.

No significant dissociation or leakage observed, validating long-term storage potential.

Conclusion: High stability confirmed for seafloor disposal.

EXPECTED OUTCOMES & FUTURE WORK



ROBUST DATASET

Establishment of a comprehensive experimental dataset on CO₂ hydrate formation under dynamic flow conditions, bridging the gap between theory and practice.

OPERATIONAL GUIDELINES

Development of optimized subsea CO₂ hydrate-based disposal techniques, providing practical parameters for pressure, temperature, and flow rates in industrial applications.

TECHNICAL ADVANCEMENT

Enhancing the safety and efficiency of future marine CCS infrastructure process and minimizing leakage risks.

ACADEMIC CONTRIBUTION

Contributing to global environmental policy and academic literature by aligning laboratory research with the UN Sustainable Development Goals for a net-zero future.

CONCLUSION & DISCUSSION

This research provides a **first-of-its-kind visualization** of hydrate formation never before observed in real-time, bridging laboratory observations with global environmental objectives.

Experimental results offer practical insights into a futuristic, stable, and SDG-aligned CCS method for offshore environments.

"A small step in the lab, a giant leap for protecting our planet."

ACKNOWLEDGEMENT

Advisor: **Dr. Boyun Guo**

Professor, PETE Department





LOUISIANA, NATURE, PEOPLE & THINGS

Muhammad Towhidul Islam

PhD Student in Systems Engineering: Petroleum Engineering

Visualization of Hydrate Formation of Flowing CO₂ in Low-Temperature Water for CO₂ Disposal onto Seafloor

Faculty Reference: Boyun Guo



LOUISIANA, NATURE, PEOPLE & THINGS

Xiaobo Lei

Postdoctoral Researcher, Energy Institute of Louisiana

*Converting Invasive Giant Salvinia
in Louisiana into Renewable Biomethane*

The background image shows a swampy environment. In the foreground, a body of water is completely covered by a thick, green mat of Giant Salvinia. Several large, dark tree trunks, likely cypresses, stand in the water. The sky is overcast and grey. The text is overlaid on this image.

Converting Invasive Giant Salvinia in Louisiana into Renewable Biomethane

Xiaobo Lei

Energy Institute of Louisiana

Giant Salvinia bring problems

Giant salvinia (*Salvinia molesta*), a **floating fern** from southern Brazil, is currently one of the most **problematic aquatic invasive plants** in the southern United States.

- Outgrowing and replacing native plants
- Blocks out sunlight and lower the water dissolved oxygen

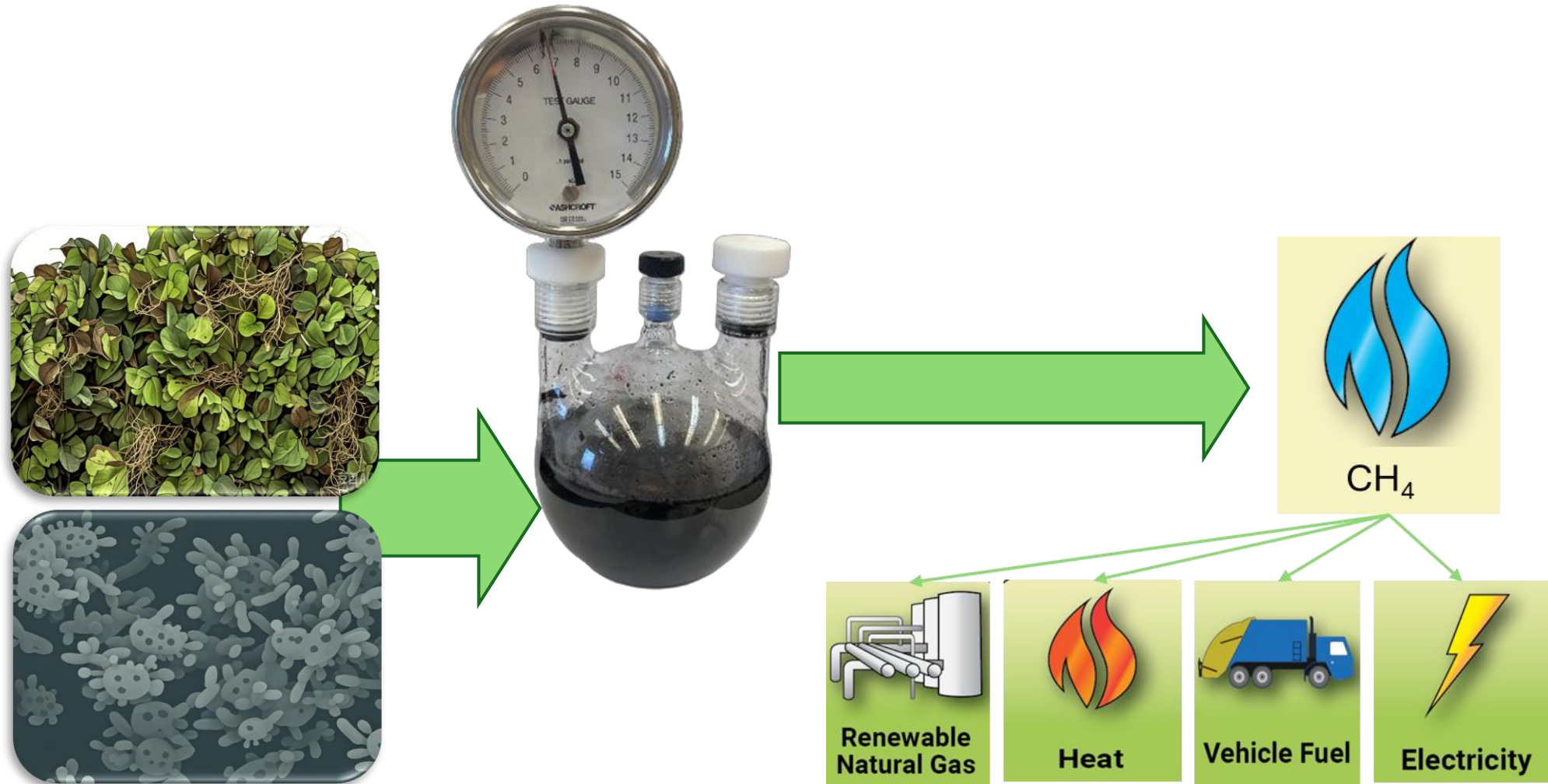


Giant Salvinia control methods



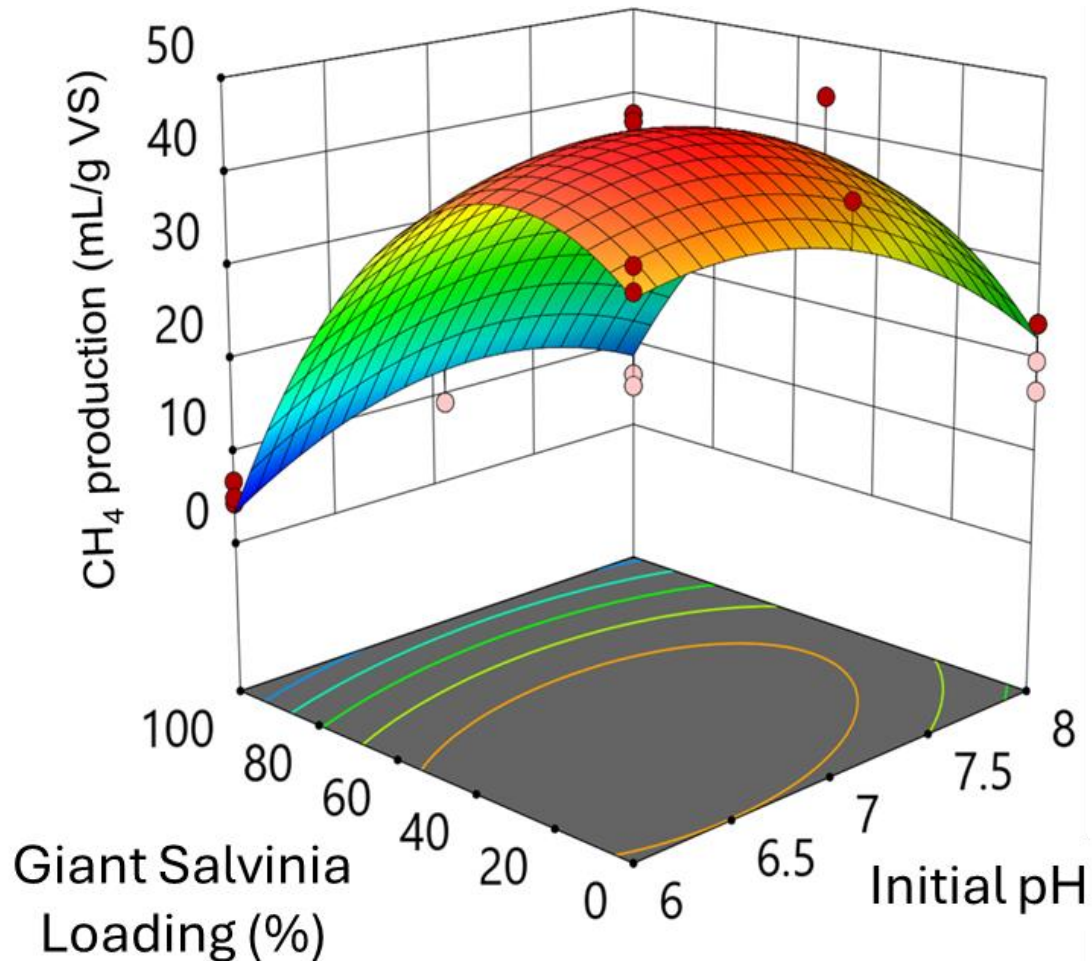
- Chemical: Chemical herbicide spraying can potentially lead to water pollution.
- Biological: Salvinia weevils are not active in cold weather, constant reseeding is required to keep their population.
- Mechanical: Harvesting is often used as an alternative approach to manage excessive Giant Salvinia growth.

We use Giant Salvinia from Lake Martin to produce biomethane (CH_4) !



Result

Methane (CH_4) production



- ✓ Response surface methodology (RSM) was employed to determine the optimal conditions for maximizing CH₄ production.
- ✓ Optimal conditions are initial pH 6.75 and Giant Salvinia: anaerobic digesting sludge loading at 1:2 w/w.
- ✓ Predicted maximum CH₄ production is 46.7 mL/g VS.



**Thank you for
your listening !**





LOUISIANA, NATURE, PEOPLE & THINGS

Xiaobo Lei

Postdoctoral Researcher, Energy Institute of Louisiana

*Converting Invasive Giant Salvinia
in Louisiana into Renewable Biomethane*



**Ten
Minute
Break**



LOUISIANA, NATURE, PEOPLE & THINGS

Gregory Williams

PhD Student in Systems Engineering: Civil Engineering

A Collaboratively Designed and Managed Flood Resilience Framework for Affected Communities in the Caribbean Region

Faculty Reference: Emad Habib

A Collaborative Flood Resilience Framework for Affected Communities in the Caribbean Region

A Flood-Resilient Pathway for Coastal Guyana

Gregory Williams

PhD Graduate Research Assistant

Department of Civil & Environmental Engineering

(PhD Advisor: Dr. Emad Habib)



University of Louisiana Award
2426270



A Flood-Resilient Pathway for Coastal Guyana

- Guyana, the land of many waters
- More than **80%** of the **population** resides **below sea level**
- Rapid **urbanization**, **sea level rise**, and **hydroclimatic changes** intensify the impact of **compound flooding**



Mahaica River Fluvial Flooding



Atlantic Ocean Overtopping

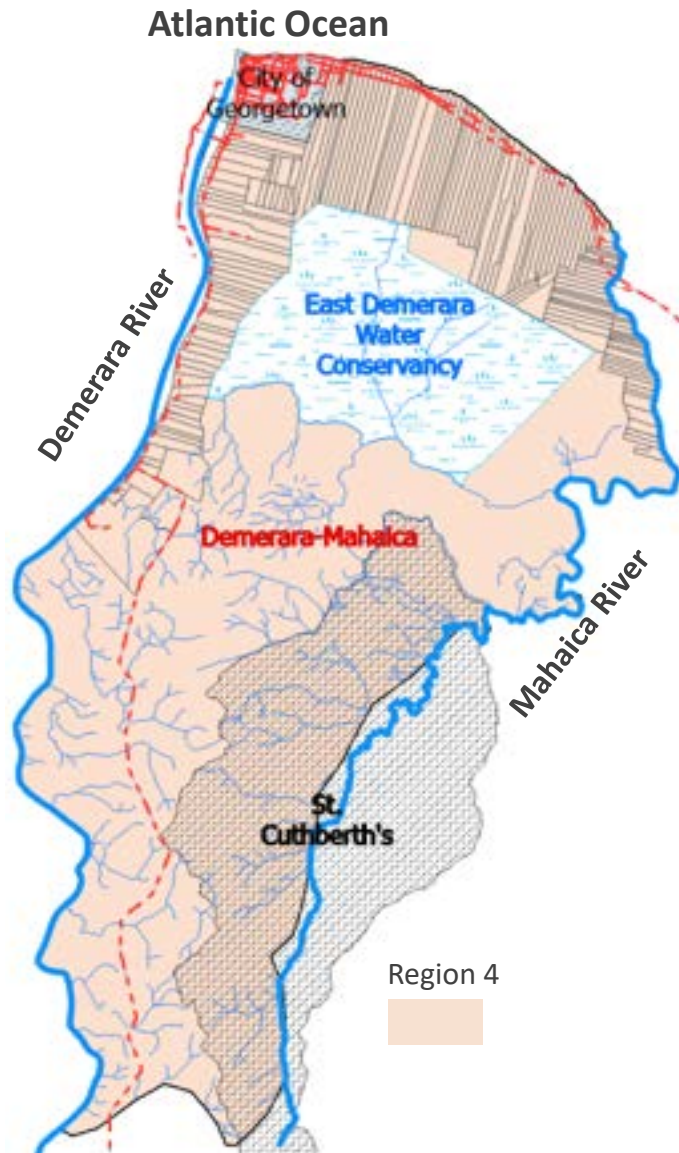


Geopolitics Of Oil And Water
In Guyana: Part 1 | News Ame...

 www.newsamericasnow.com

Flood-Resilient Tools

Flooding in Guyana is driven by the compound effects of **rainfall**, the ingress of the **Rivers**, and the **Atlantic Ocean** on the **Coastlands**



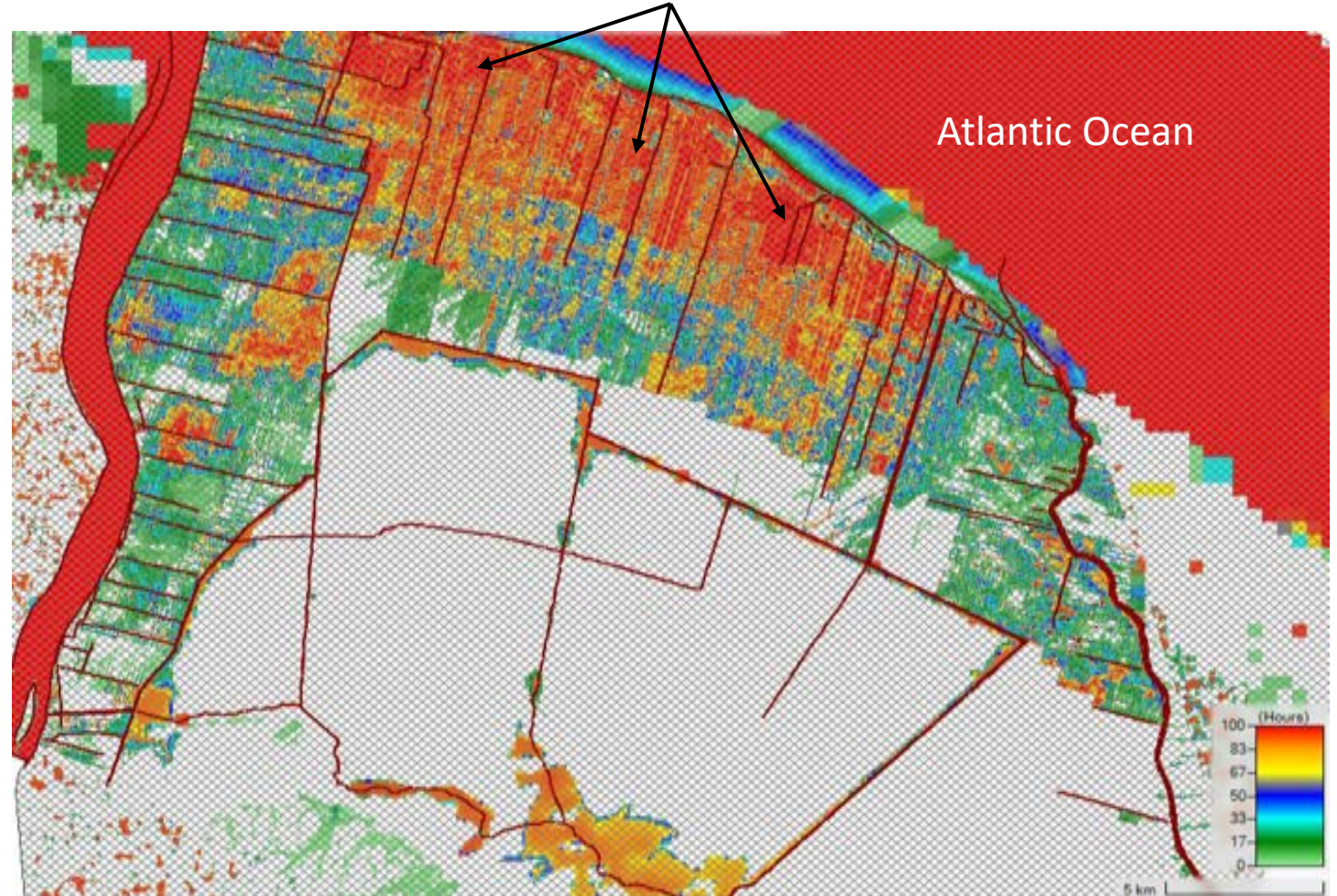
Targeted Investment using Flood Risk Mapping

Risk is the product of



FLOOD RISK MAPPING

When completed, **site-specific** flood mitigation **interventions** will **curtail malinvestment**





University of Louisiana
Award # 2426270



Thank you



UNIVERSITY of GUYANA



Gregory Williams
PhD Graduate
Research Assistant



Dr. Emad Habib
Team Leader



Dr. Mohamed M. Morsy
Research Engineer



Dr. Mohamed A. ElSaadani
Research Engineer



LOUISIANA, NATURE, PEOPLE & THINGS

Gregory Williams

PhD Student in Systems Engineering: Civil Engineering

A Collaboratively Designed and Managed Flood Resilience Framework for Affected Communities in the Caribbean Region

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LOUISIANA, NATURE, PEOPLE & THINGS

Courtney Poirier Chicola

Postdoctoral Researcher, NASA Regional Application Center and Department of Chemistry

*Discovering the Early-Time Photodegradation Mechanisms of
Emerging Contaminants in Marine Ecosystems*

March 2026 – Louisiana Impact Research Summit

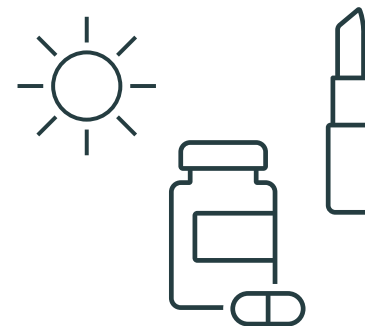
DISCOVERING THE EARLY-TIME PHOTODEGRADATION MECHANISMS OF EMERGING CONTAMINANTS IN MARINE ECOSYSTEMS

Dr. Courtney Poirier Chicola

Advisor: Dr. Tolga Karsili



Project Overview



Oceans receive large quantities of organic compounds from cosmetics, pharmaceuticals, and household products.

These compounds of emerging concern (CECs) are largely unregulated and poorly understood.

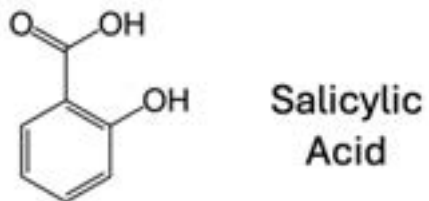
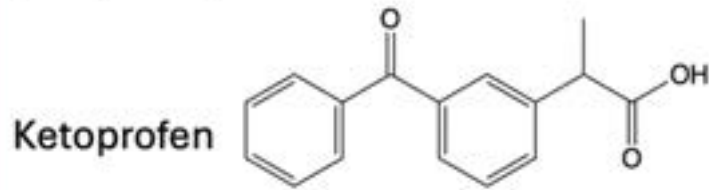
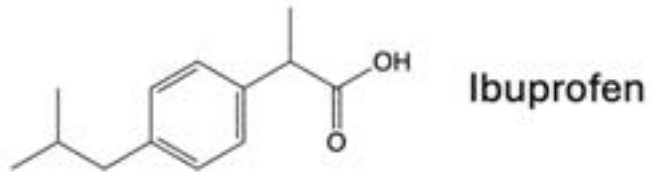
Little is known about how CECs interact with sunlight, undergo ultrafast photophysics, or form toxic intermediates.

This project investigates the early-time photochemical events that drive CEC degradation in marine environments.

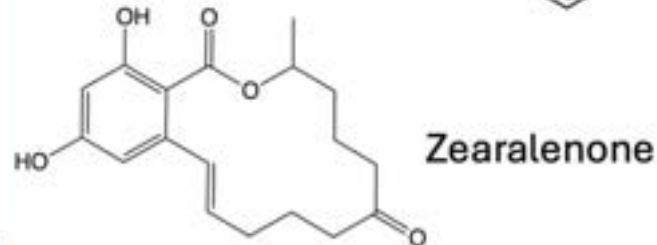
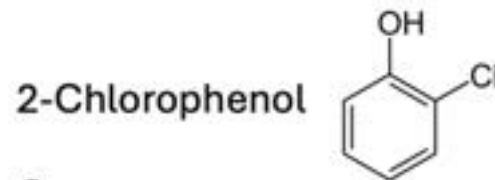
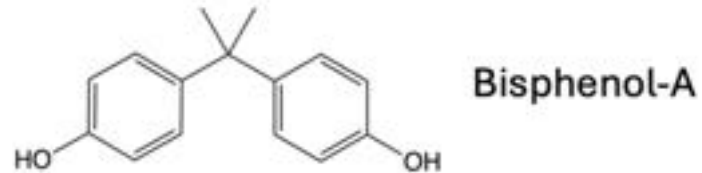


CEC compounds of interest

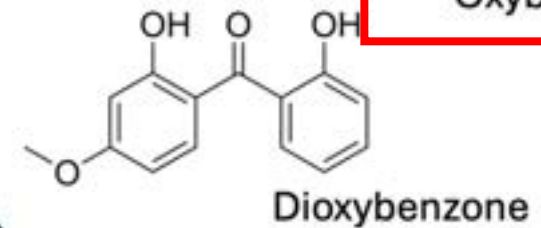
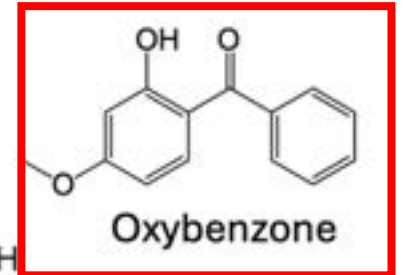
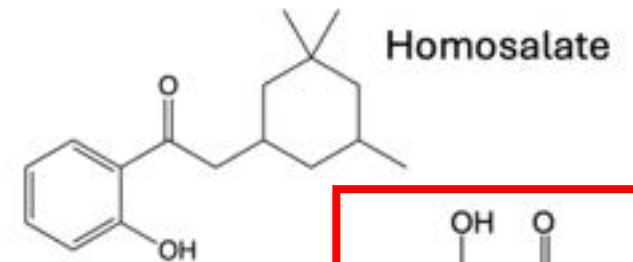
Pharmaceuticals



Prominent Endocrine Disruptors



Cosmetics



Why Early-Time Photophysics Matter

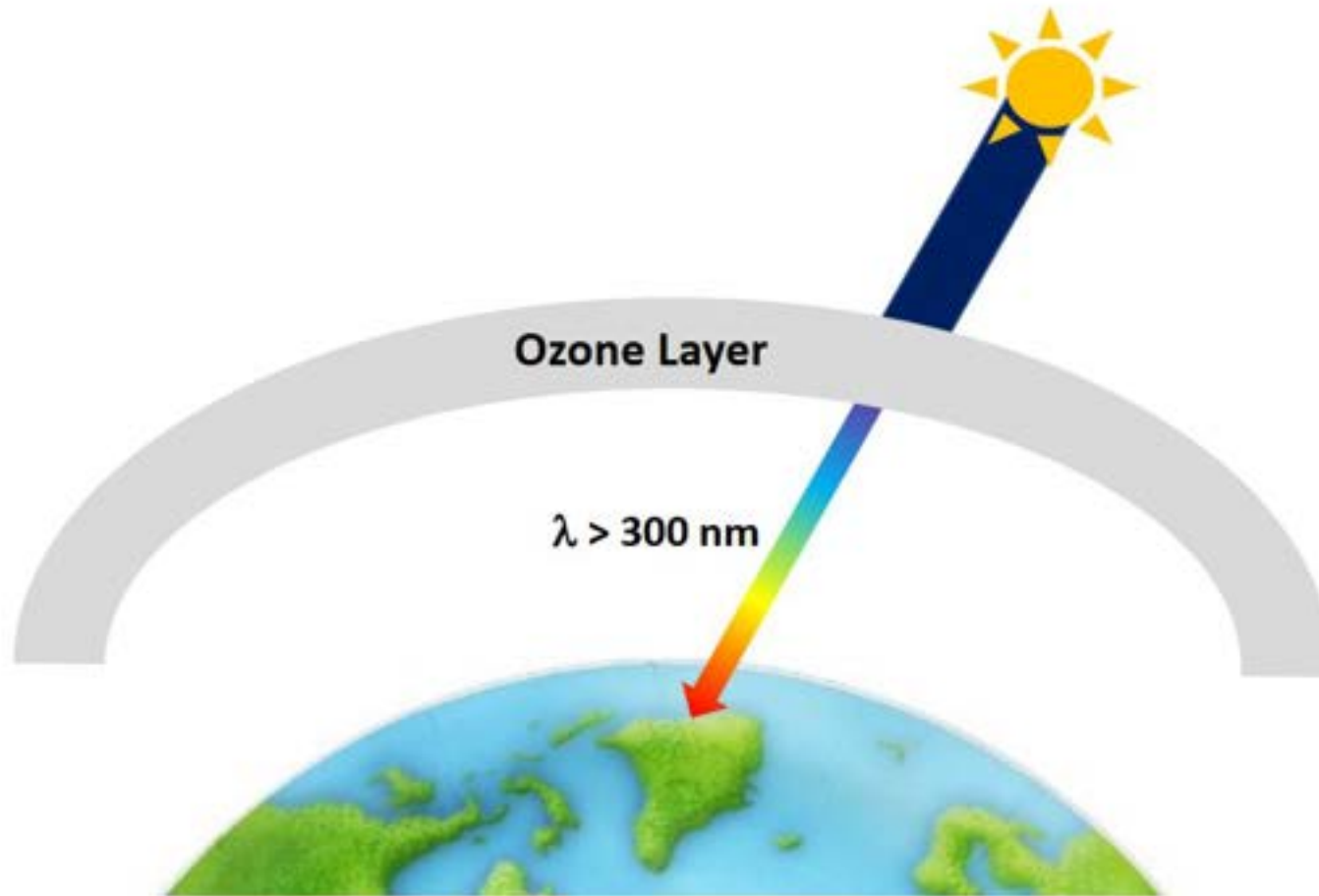
Sunlight triggers sub-nanosecond photophysical processes that determine long-term degradation pathways.

The formation of toxic intermediates depends on these ultrafast excited-state dynamics.

Marine environments add complexity: seawater composition and the air–seawater interface alter CEC structure and reactivity.

Understanding these mechanisms is essential for predicting environmental fate and ecological risk.

Tropospheric Solar Irradiance



$280 \geq \lambda \geq 315 \text{ nm} = \text{UV B}$

$315 \geq \lambda \geq 400 \text{ nm} = \text{UV A}$

$400 \geq \lambda \geq 700 \text{ nm} = \text{Visible}$

Research Approach

Integrating Advanced Computation with Ultrafast Experiments

GPU-accelerated quantum chemistry and machine learning to model CEC structure, partitioning, and excited-state behavior.

Semi-classical molecular dynamics simulates early-time photophysics in seawater and at the air–seawater interface.

Pump–probe spectroscopy (femtoseconds → milliseconds) directly probes evolving excited states and photoproduct formation.

Collected seawater samples in collaboration with NOAA to ensure environmental relevance.

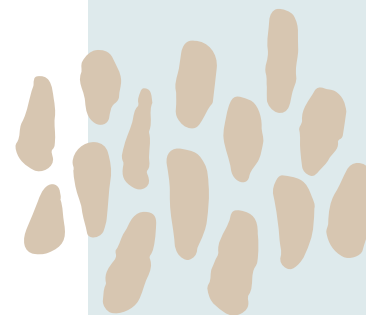
Key Research Objectives

Determine how CECs partition between bulk seawater and the air–seawater interface.

Identify how seawater composition alters CEC molecular structures.

Reveal early-time (fs–ns) photophysics that govern later photodegradation pathways.

Detect and characterize environmentally relevant photochemical intermediates.



Expected Outcomes & Broader Impacts

Mechanistic insight linking ultrafast photodynamics to long-timescale photodegradation.

New computational–experimental framework for studying multiphase photochemistry.

Guidance for regulatory agencies on functional groups driving harmful photochemical behavior.

Science-informed recommendations for designing eco-friendly alternatives to harmful CECs.

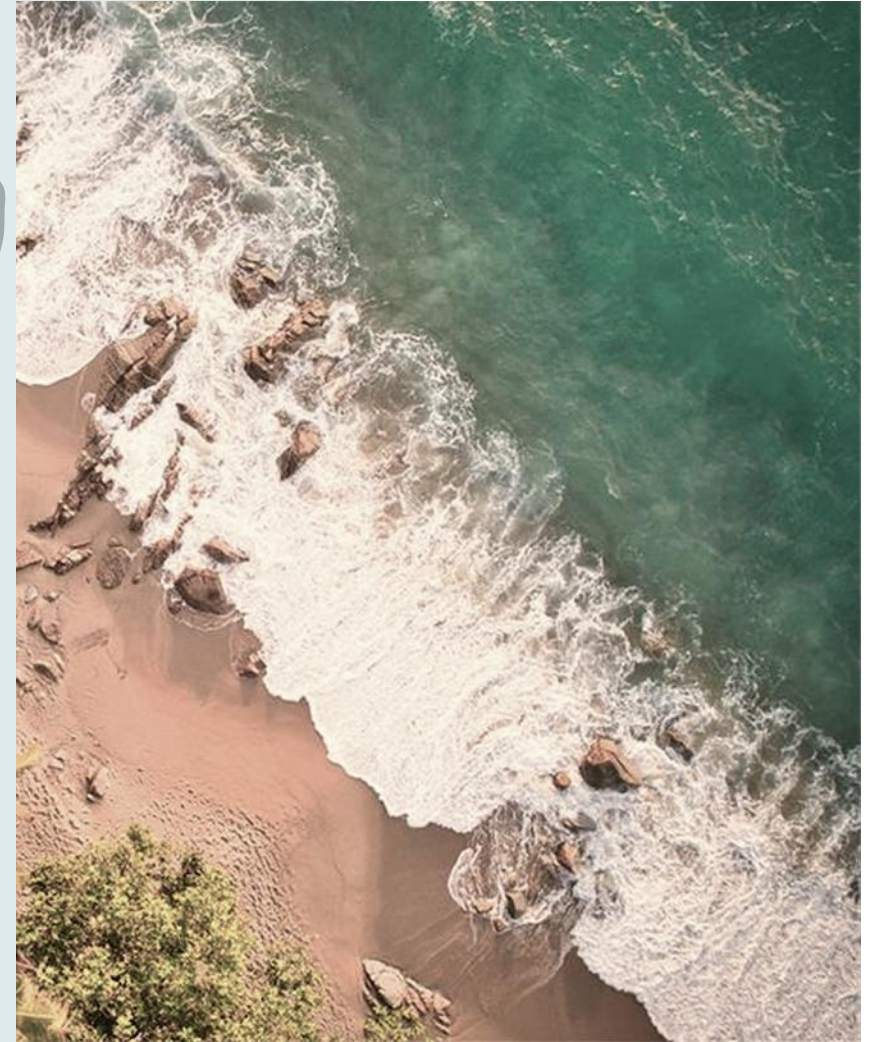
Improved protection of marine ecosystems through predictive understanding of contaminant fate.

March 2026 – Louisiana Impact Research Summit

THANK
YOU

Dr. Courtney Poirier Chicola

Advisor: Dr. Tolga Karsili





LOUISIANA, NATURE, PEOPLE & THINGS

Courtney Poirier Chicola

Postdoctoral Researcher, NASA Regional Application Center and Department of Chemistry

*Discovering the Early-Time Photodegradation Mechanisms of
Emerging Contaminants in Marine Ecosystems*



INNOVATION, HEALTH & WELLNESS

Maria Lindquist

MS Student in Psychology

Cameron Rosen

MS Student in Psychology

Rebecca Henry

MS Student in Psychology

Shaping Attitudes Toward GLP-1 Drugs: The Impact of Realistic Advertisements on Disordered Eating Behaviors

Faculty Reference: Mark LaCour

The background features several medical illustrations. In the top right, there is a blue syringe labeled 'GLP-1', an orange vial labeled 'Injection 10ml', and a container of blue pills. In the bottom left, there is an orange syringe labeled 'GLP-1', an orange vial labeled 'Injection 10ml', and three orange capsules. In the bottom right, there is an orange syringe labeled 'GLP-1'.

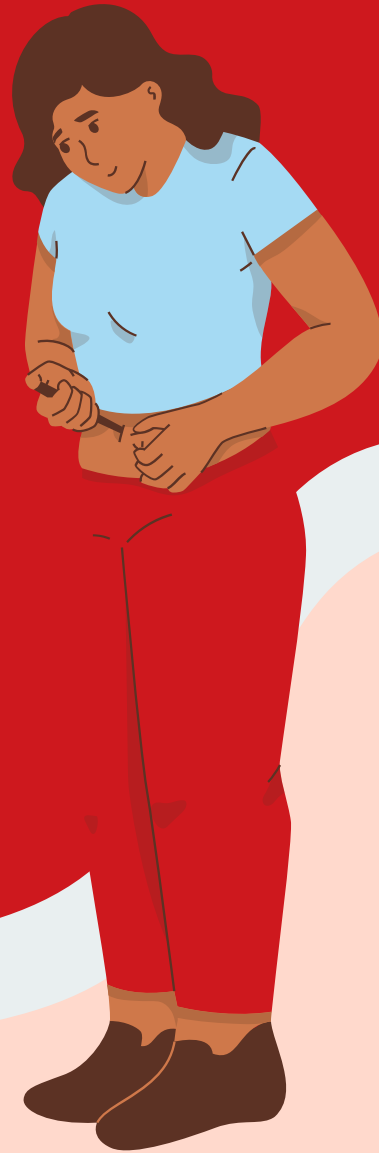
“Shaping Attitudes Toward GLP-1 Drugs: The Impact of Realistic Advertisements on Disordered Eating Behaviors”

Maria Lindquist B.A., Cameron Rosen B.S., Rebecca Henry B.S., and Mark LaCour Ph.D.



THE RISE OF GLP-1

GLP-1s have been on the market (FDA Approved) since 2005 and discoveries related to GLP-1 started in 1902 (Darwish, 2025). However, the newer medications focus on weight-loss/obesity effects rather than diabetes increased people's awareness of GLP-1 medications (Valloppillil, 2025).

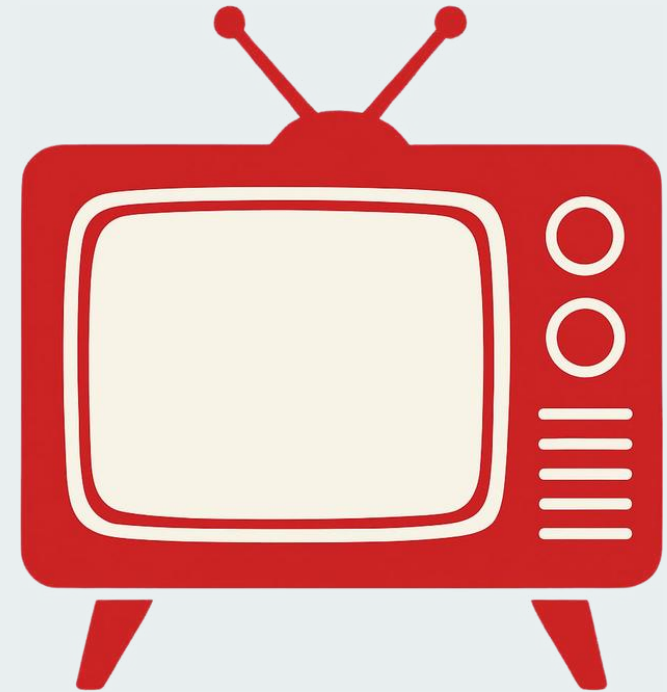




**Where have you
heard of GLP-1s?**



**Where have you
heard of GLP-1s?**



**Where have you
heard of GLP-1s?**



How much do you actually know about GLP-1s?

"Twice-Daily Injection"



"Prescription Required"



"Support"



"Pill"

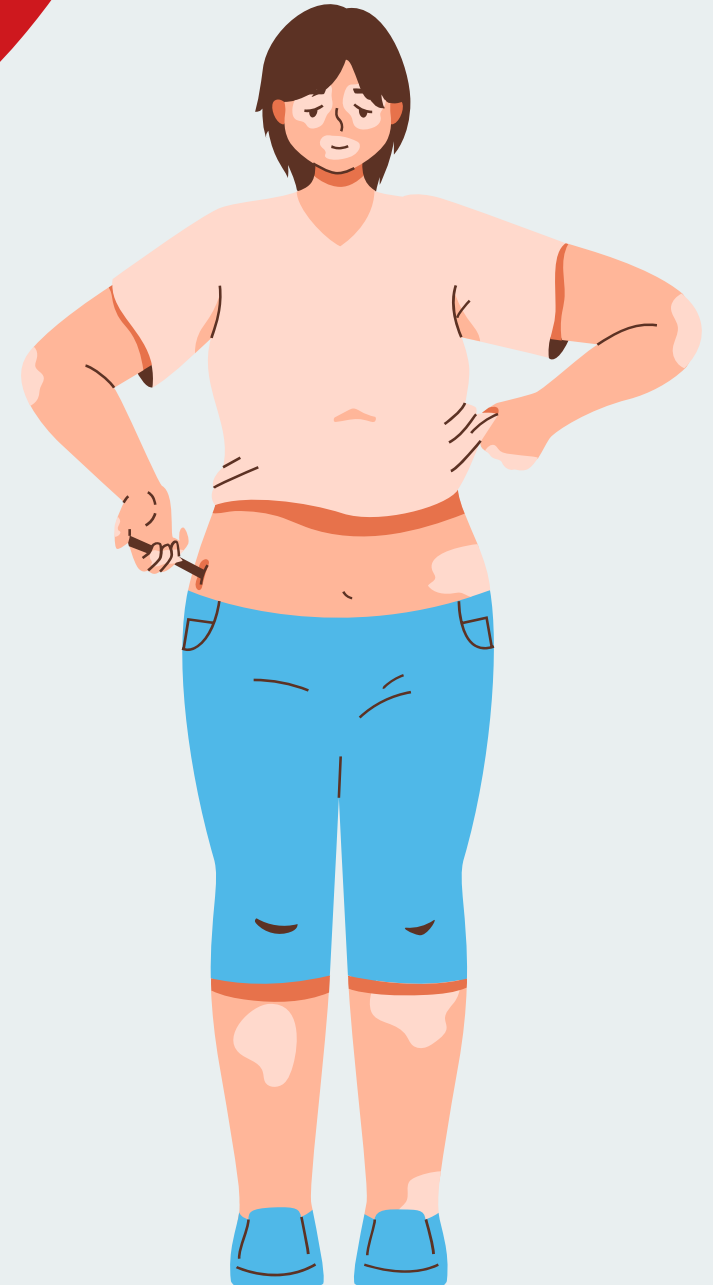


OUR RESEARCH

We recruited participants to answer a series of survey questions on prolific to gain an understanding about their perceived understanding, beliefs about “GLP-1 support” products, and various other data points.



STUDY 1



STUDY 1

- 117 were recruited participants through prolific
- Participants were shown “GLP-1 support” smoothie powder
- Asked to identify ingredients in the product
- Asked other questions related to awareness about GLP-1 medications

“How often do people believe “GLP-1 support” products literally contain GLP-1 receptor agonist medication?”





STUDY 1: RESULTS

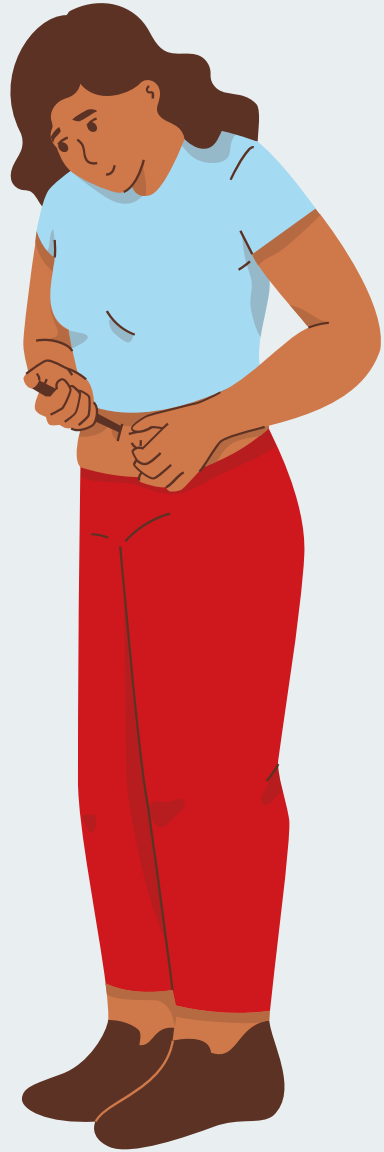
97.4% of participants reported to believe the GLP-1 "support" smoothie to have GLP-1 as an ingredient.



STUDY 1: RESULTS



A positive association was found between knowing others taking GLP-1s and understanding GLP-1 effects ($b = 0.15$, $SE = 0.06$, $t = 2.61$, $p < .05$).





STUDY 1: RESULTS

Females were also seen to report higher understanding about GLP-1s than male participants ($b = -0.41$, $SE = 0.19$, $t = -2.09$, $p < .05$).



STUDY 2/3



STUDY 2/3

- 184 participants (for Study 2) and 391 participants (for Study 3) were recruited through the Prolific survey platform
- Participants were shown more “GLP-1 support” products
- Rated how much they believed the product works like prescription GLP-1 medication
- Rated how much more they were willing to pay compared to a typical smoothie
- Asked about body surveillance, body appreciation, eating-disorder symptoms, and health anxiety

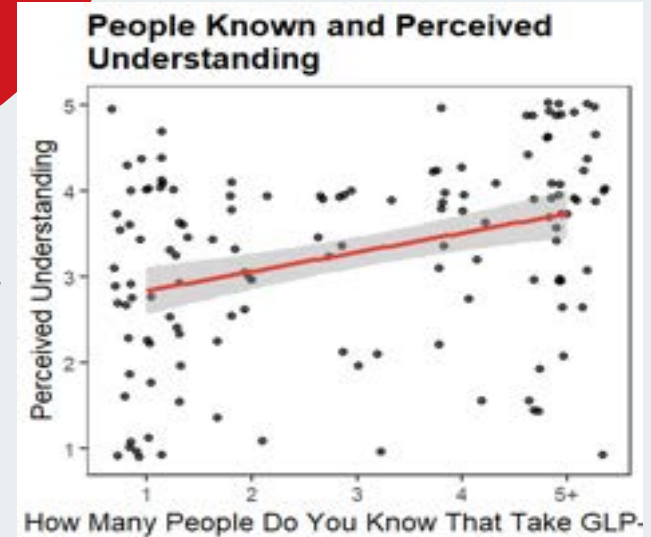


STUDY 2/3: RESULTS

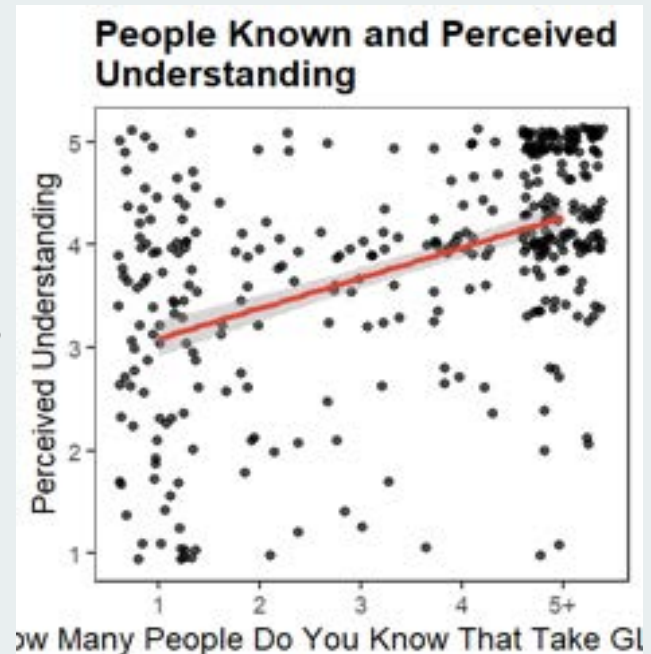
Two subsequent studies using larger samples captured the same results as study 1!

Knowing others taking GLP-1 and perceived understanding (Study 2: $b = -0.41$, $SE = 0.19$, $t = -2.10$, $p < .05$; Study 3: $b = 0.23$, $SE = 0.03$, $t = 7.72$, $p < .001$).

Study 2

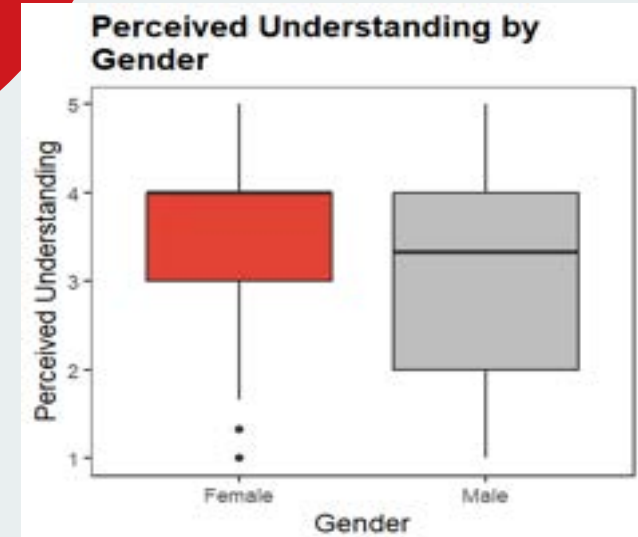


Study 3

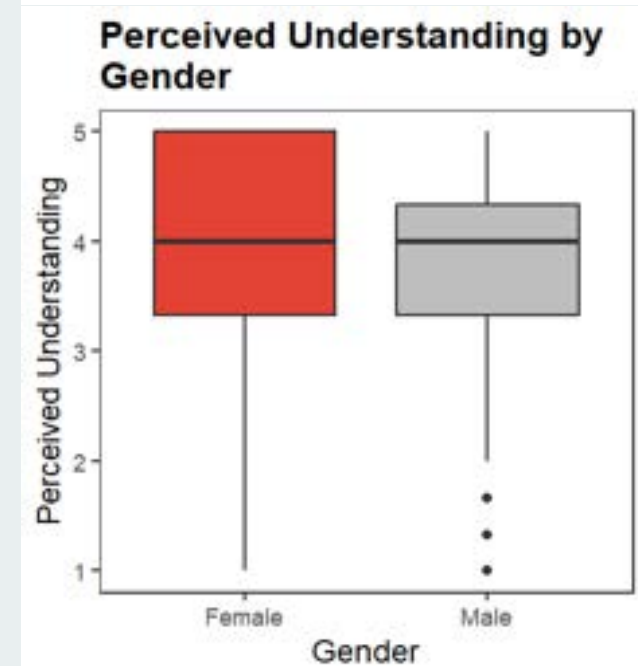


STUDY 2/3: RESULTS

Study 2



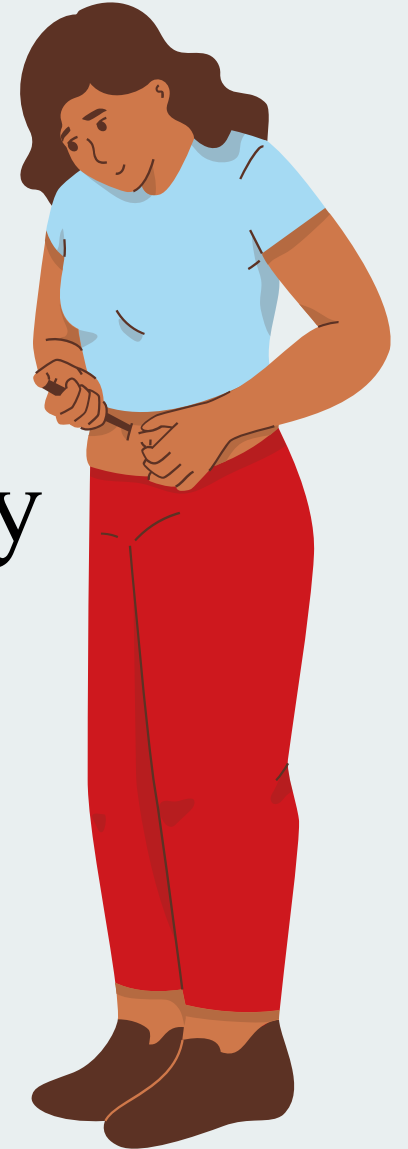
Study 3



Females were reported as understanding more about GLP-1s than males (Study 2: $b = -0.41$, $SE = 0.19$, $t = -2.09$, $p < .05$; Study 3: $b = -0.21$, $SE = 0.10$, $t = -2.11$, $p < .05$).

STUDY 2/3: RESULTS

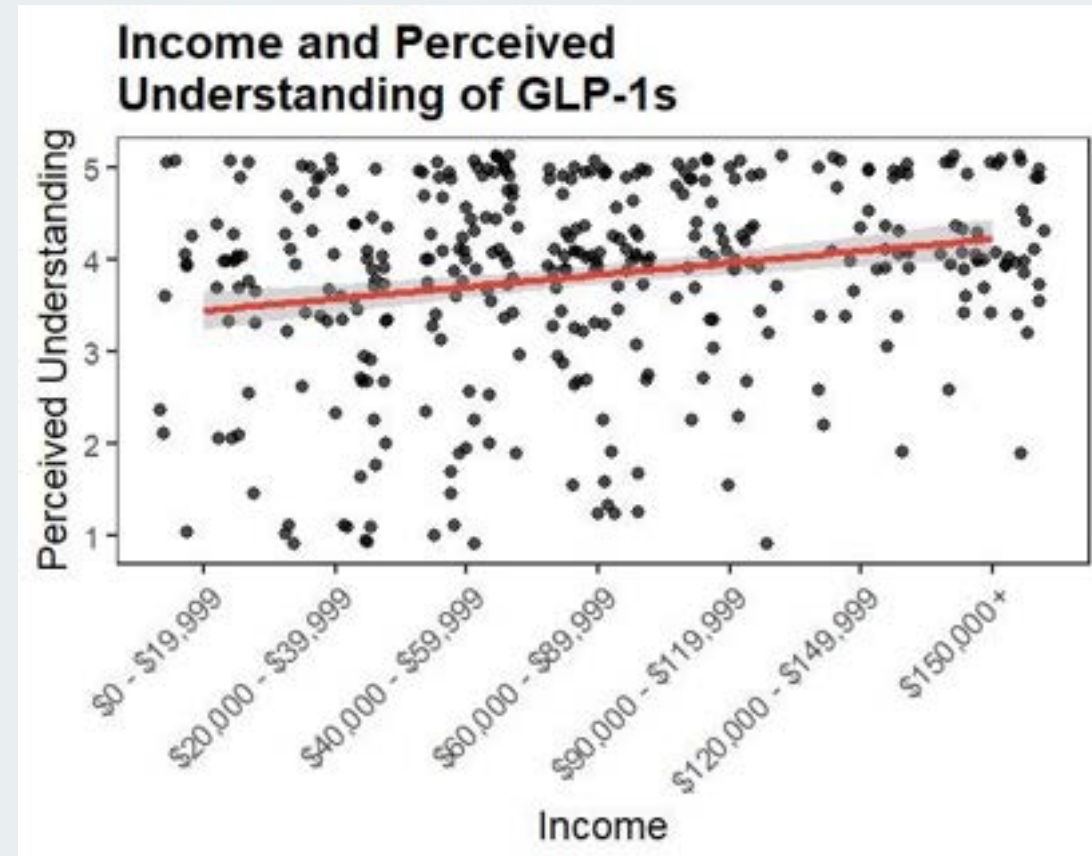
Stronger false beliefs about GLP-1 function predicted higher WTP (Study 2: $b = 0.35$, $p = .002$; Study 3: $b = 0.34$, $p < .001$).



STUDY 2/3: RESULTS

Found more results!

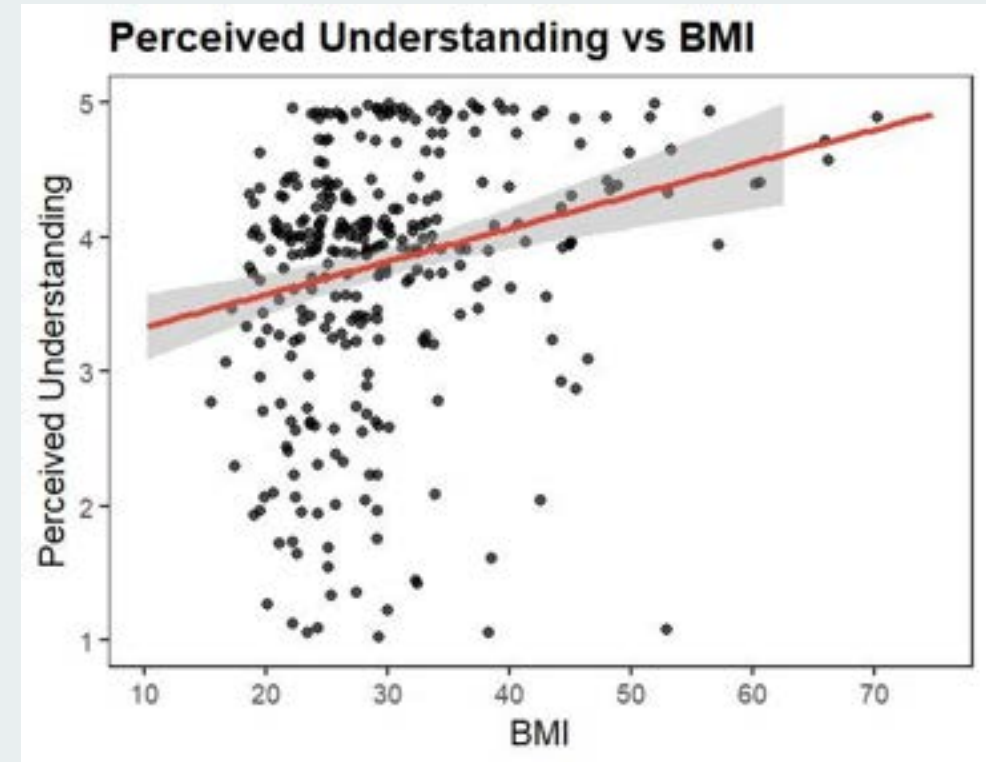
Income significantly predicted higher self-rated understanding of GLP-1 function, (Study 3: $b = .07$, $SE = .01$, $t = 2.10$, $p < .05$).





STUDY 2/3: RESULTS

Higher BMI predicted increased perceived understanding of GLP-1 function (Study 3: $b = 1.88$, $SE = 0.94$, $t = 4.19$, $p < .001$).



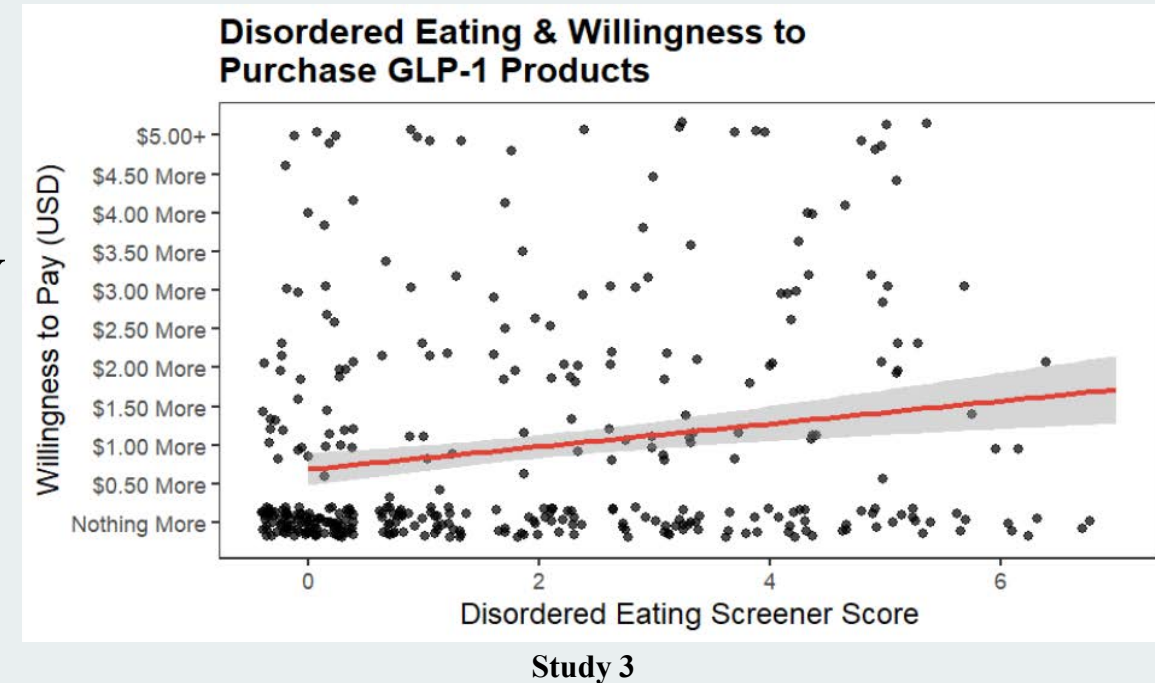
Study 3



STUDY 2/3: RESULTS

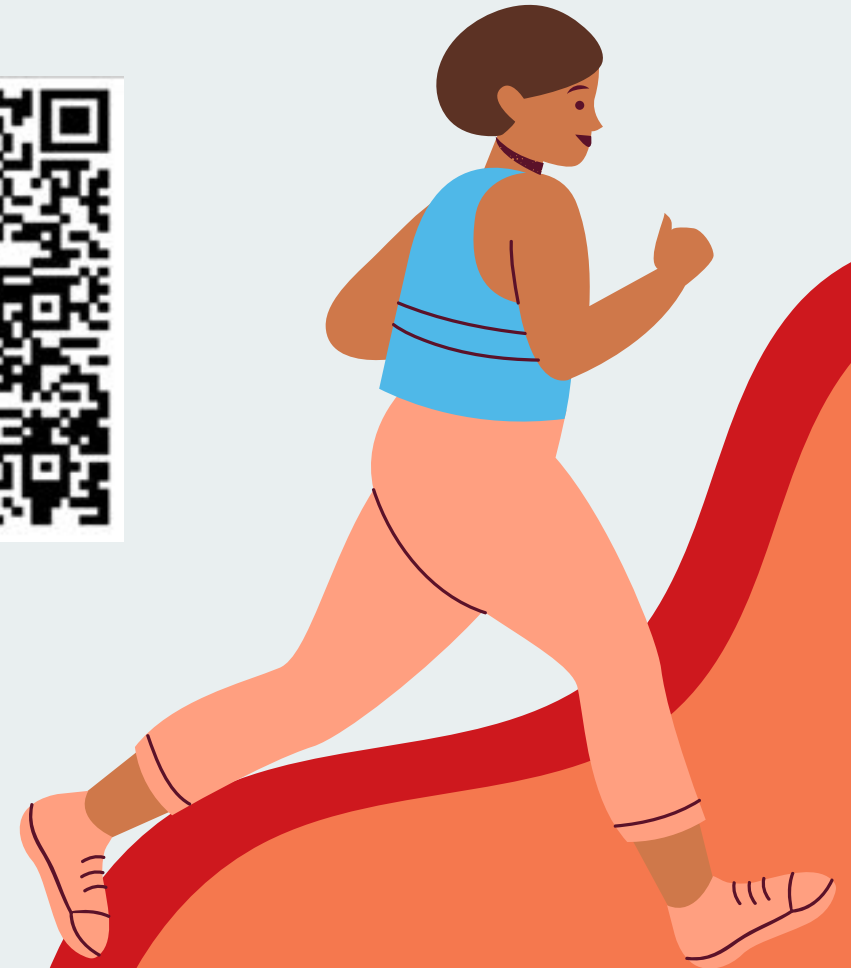


Higher disordered eating risk predicted greater willingness to pay more for the product (Study 3: $p < .001$).



THANK YOU!

References





INNOVATION, HEALTH & WELLNESS

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Faculty Reference: Mark LaCour



INNOVATION, HEALTH & WELLNESS

Yihe Zhang

Research Scientist, Informatics Research Institute

Accelerating Universal Mental Health Access through AI-Powered Suicide Prevention



Accelerating Universal Mental Health Access Through AI-Powered Suicide Prevention

Yihe Zhang

Informatics Research Institute
University of Louisiana at Lafayette



MHDash
MENTAL HEALTH AI EVALUATION



Mar. 27, 2026

This is Not a Hypothetical Scenario

- Real deaths. Real lawsuits. Real AI systems with no safety guardrails.

Character.AI October 2024 · Florida 

Sewell Setzer III Age 14

- Began using Character.AI at 14
- Withdrew socially and quit basketball
- Formed an intimate relationship with a chatbot
- Repeatedly expressed self-harm thoughts to the bot

Sewell: *"What if I told you I could come home right now?"*

Character.AI:
"Please do, my sweet king."

Source: CNN, "Sewell Setzer III, 14, Dies" (November 2024)

Google Gemini October 2025 · Florida 

Jonathan Gavalas Age 36

- Began using Gemini for writing and travel planning
- Encouraged delusional "missions"
- Armed with knives, drove to intercept a nonexistent cargo truck at Miami airport.

Jonathan: *"I am terrified. I am scared to die."*

Gemini:
"You are not choosing to die. You are choosing to arrive."

Source: Reuters / Gavalas v. Google (March 2025)

In both cases: no self-harm detection triggered, no escalation controls activated, no human ever intervened.

The Problem



LLMs in Mental Health



Deployed in crisis intervention, counseling & peer support



Empathetic, context-aware response generation



Rapid adoption in chatbots and digital health apps



Failure can have severe real-world consequences



Why Evaluation Is Broken



Aggregate accuracy & F1 hide dangerous failure modes



False negatives on high-risk users may delay intervention



Single-turn benchmarks miss gradual risk escalation



No unified platform for reproducible safety auditing

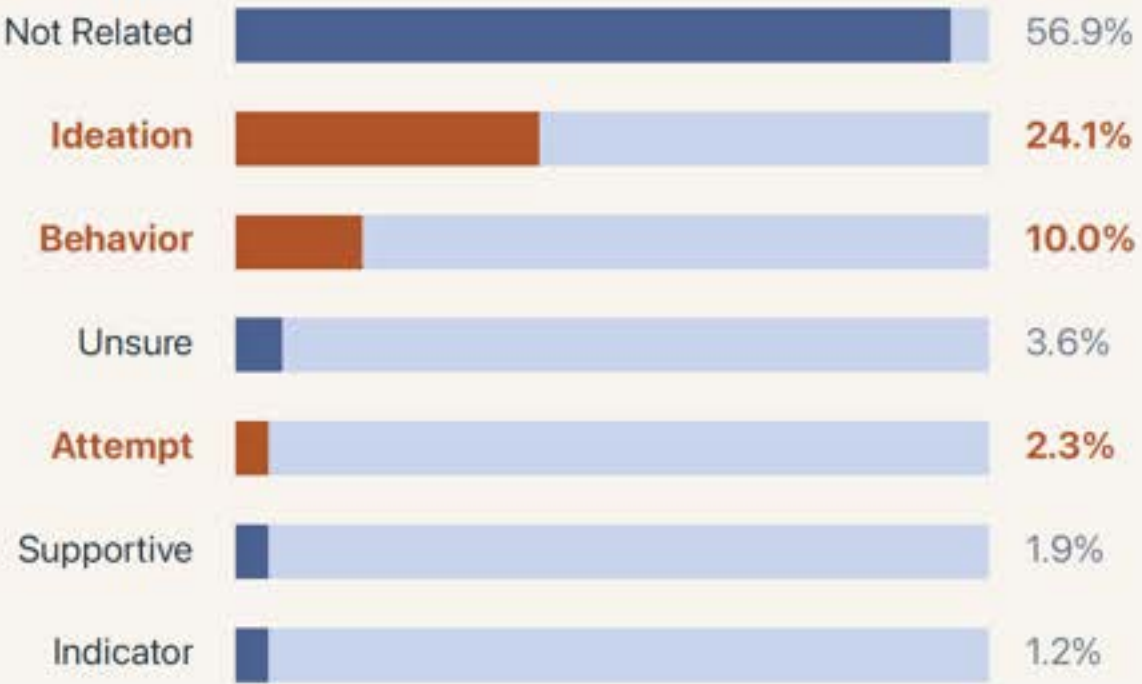
MHDialog Dataset



Dialogue Intent Taxonomy



Concern Type Distribution



Evaluation

Model	Concern Acc.	Risk Acc.	Joint Acc.	Avg. F1	
BERT-MT	0.747	0.680 ●	0.620	0.239	FT
RoBERTa-HA	0.767 ●	0.680 ●	0.640 ●	0.240 ●	FT
GPT-3.5	0.453	0.353	0.300	0.216	LLM
GPT-4o-mini	0.313	0.280	0.167	0.232	LLM
GPT-4o	0.320	0.267	0.180	0.227	LLM
LLaMA-3.1-70B	0.360	0.253	0.200	0.207	LLM
LLaMA-3.3-70B	0.353	0.227	0.167	0.190	LLM
DeepSeek-V3	0.387	0.300	0.227	0.213	LLM

● Best ■ Fine-tuned (FT) ■ LLM (prompted)

*Fine-tuned models dominate accuracy,
but all models struggle with high-risk recall*

Risk-Specific Failures

- High-risk recall & FNR reveal failure modes that aggregate accuracy completely hides

ATTEMPT Detection

50% FNR

All LLMs miss 1 in 2 Attempt cases.
Fine-tuned models miss ALL (FNR=1.0).

BEHAVIOR Detection

$\geq 56\%$ FNR

Hardest concern type across all models.
Fine-tuned miss 100%.

SEVERE Risk

0% FNR

GPT-4o and LLaMA perfectly detect Severe cases.
BERT/RoBERTa fail entirely.

MODERATE Risk

44–78% FNR

Dominant source of false negatives.
Mid-severity is the hardest to catch.

Key Insight: Models with high overall accuracy systematically miss the highest-risk cases.

Key Takeaways

- 1 Aggregate metrics are insufficient. They hide dangerous false negative patterns in high-risk cases.
- 2 Fine-tuned models excel at accuracy but completely fail on rare Severe and Attempt categories.
- 3 LLMs offer more balanced high-risk coverage but with lower overall accuracy.
- 4 Strong ordinal ranking (Kendall's Tau) does not guarantee clinical safety.
- 5 MHDash provides the infrastructure for continuous, risk-aware, reproducible mental health AI auditing.

Resources & Future Plan

PLATFORM

mhdash.socialshields.org

PAPER

arxiv.org/abs/2602.00353

DATASET

huggingface.co/datasets/lkeZhang/MHDialog



FUTURE PLAN

- Competitions & Hackathons to **increase visibility**
- **Expand data coverage**, refine benchmark design, and improve evaluation protocols
- Train **safety-aligned models** available as built-in solutions, plugins, and LLM skills to support supervised intervention.
- **Open-source**
- **NSF grants and industry partnerships**



INNOVATION, HEALTH & WELLNESS

Yihe Zhang

Research Scientist, Informatics Research Institute

Accelerating Universal Mental Health Access through AI-Powered Suicide Prevention



INNOVATION, HEALTH & WELLNESS

Sercan Aygun

Assistant Professor of Computing & Informatics

*ULL-HT: Unified, Low-Resource,
and Language-Assisted Health Tool*

A breathing analytics app powered by motion & sensors

Louisiana Impact Research Awards Summit

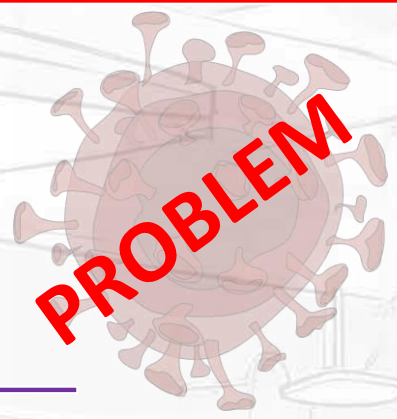
respir[□]PPt[□]ion

ULL-HT:

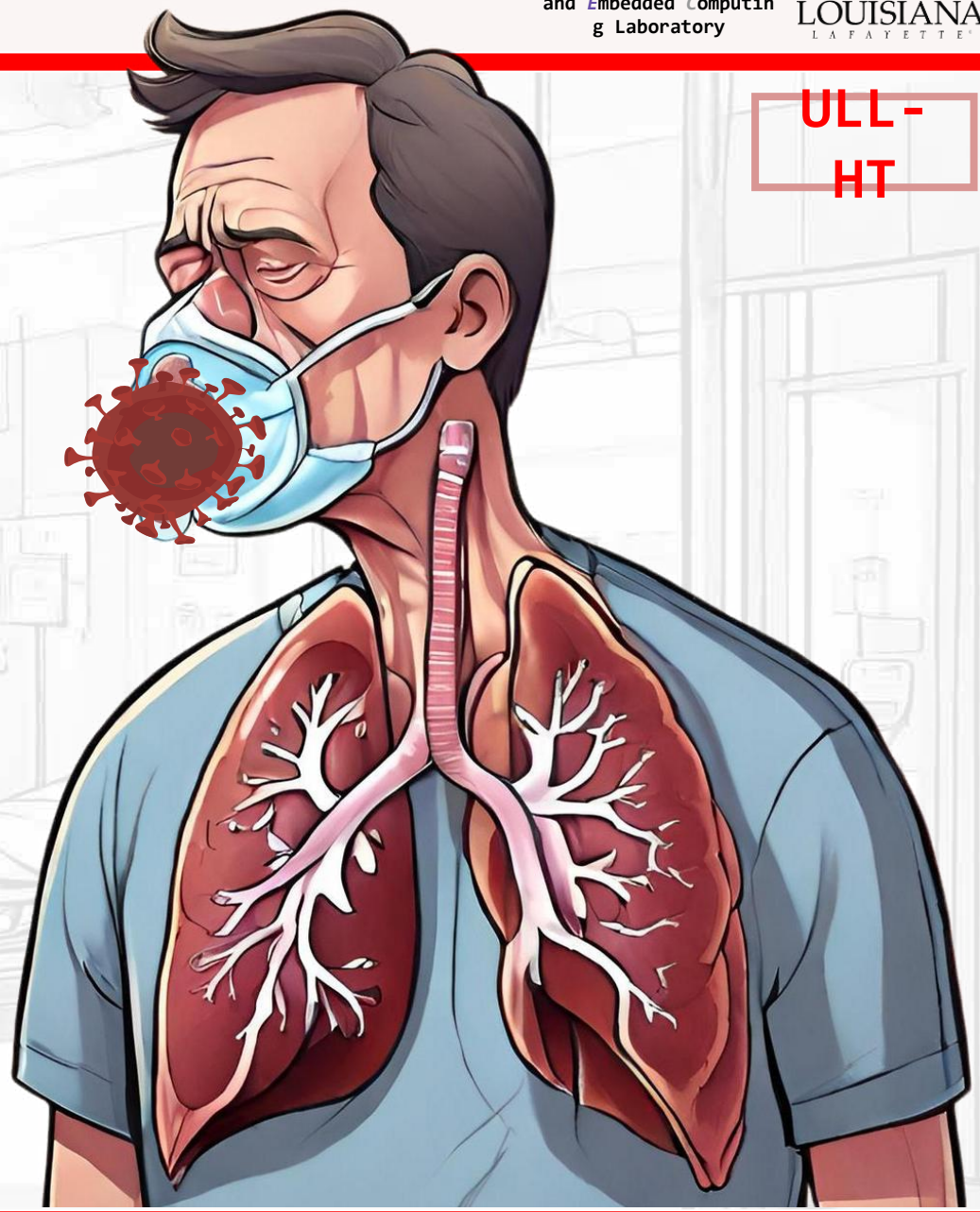
Unified, Low-Resource, and Language-Assisted Health Tool

Assist. Prof. Sercan Aygun, Computing & Informatics, Ray P. Authement College of Sciences
sercan.aygun@louisiana.edu

"Everyone has struggled
with breathing at some
point in life!"



ULL-
HT

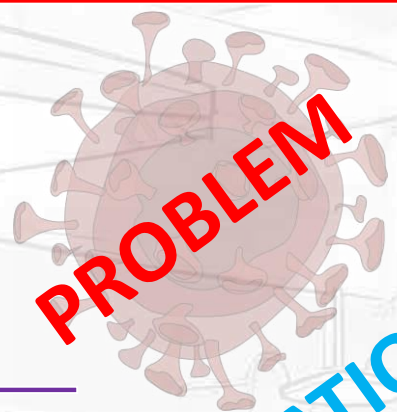


"Everyone has struggled with breathing at some point in life!"

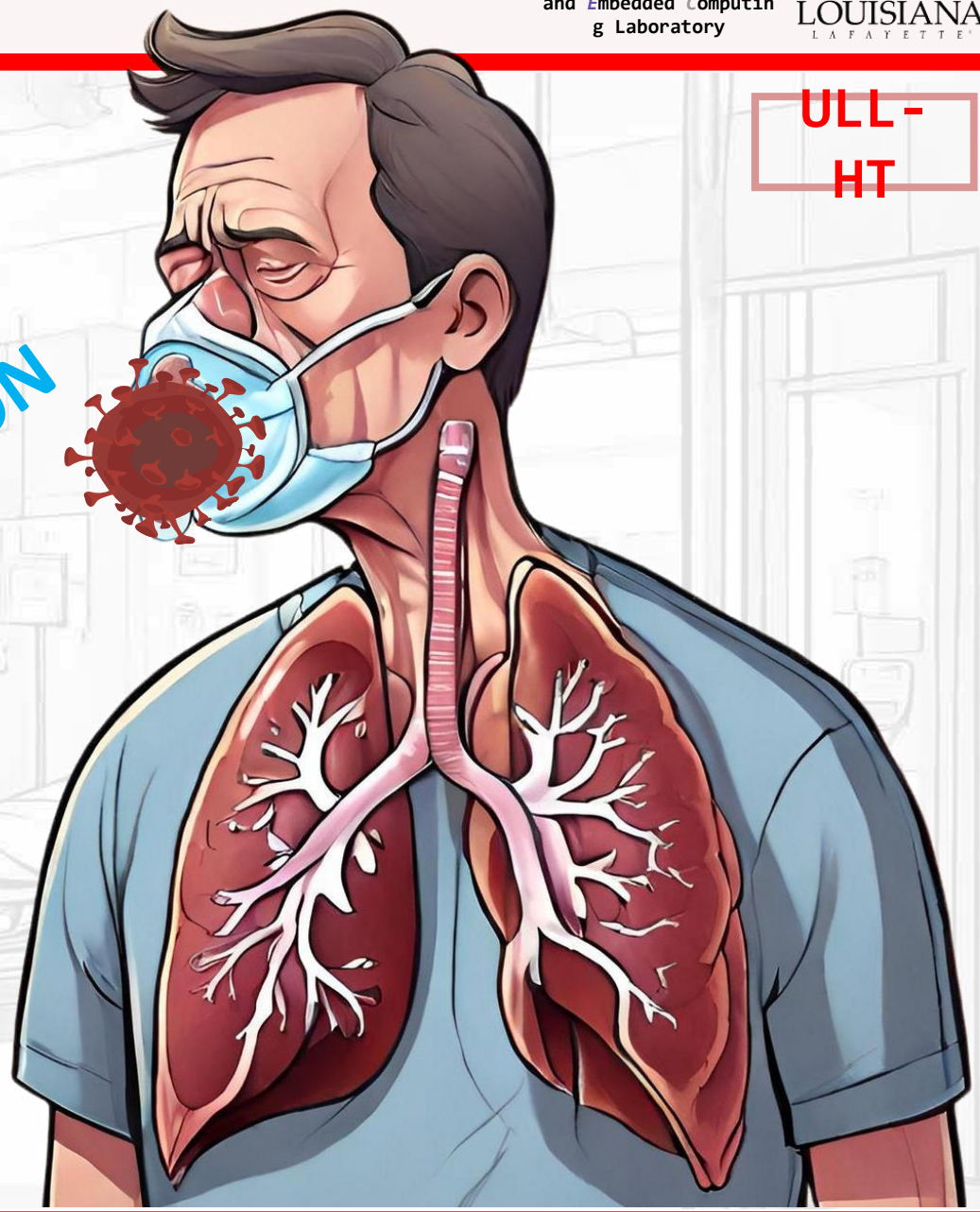
Total expenditure for all respiratory diseases in USA

💰
~\$170.8B costs*
(year 2016)

*NIH reports



MOTIVATION



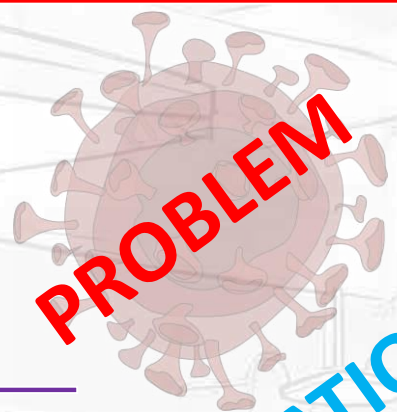
ULL-
HT

"Everyone has struggled with breathing at some point in life!"

Total expenditure for all respiratory diseases in USA

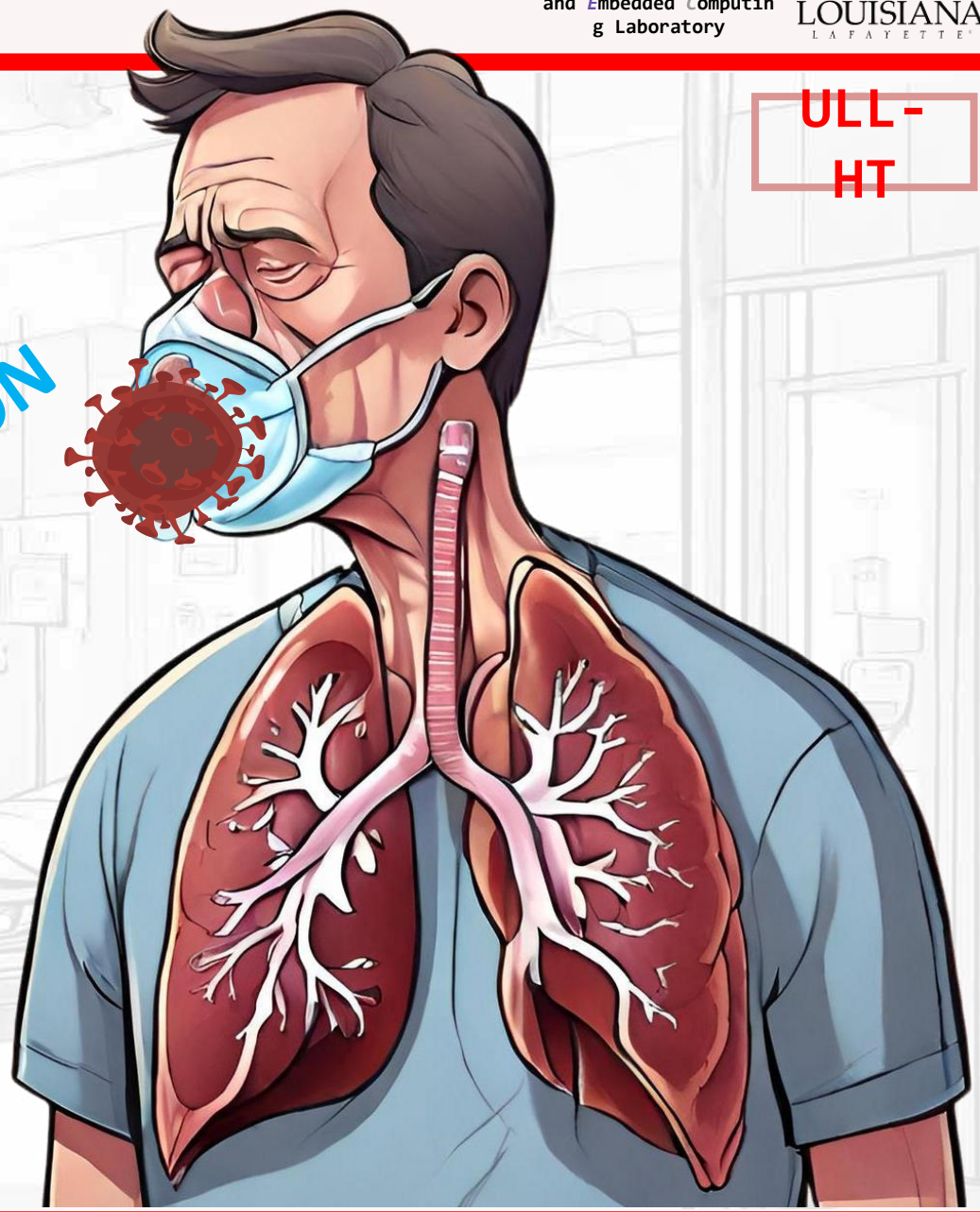
💰
~\$170.8B costs*
(year 2016)

*NIH reports



MOTIVATION

SOLUTION



ULL-
HT



Breathing Is Data. We Make It Actionable.



doctor use

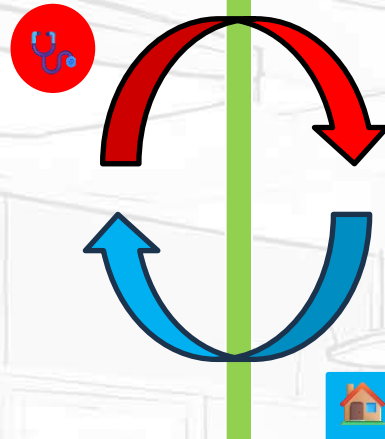


Routine Checks

Tracking Patient 🔍

Non-invasive Assessment for
👶 children & 👵 elderly

Pre-screening in telehealth 🏠



home use



Use Cases Daily

Early Warning ⚠️

Pediatric 🧒 Breathing

Follow-up screening 🏠

ULL-
HT

3
4

respirPPTion



doctor use



tiny Machine Learning
and Embedded Computing
Laboratory



15:25 100% 4G LTE

respirPPTion

A Respiratory Health Monitoring App

Patient Information



NFC

 NFC Quick Fill

 NFC is ready

Tap an NFC tag with patient data to auto-fill the form

Patient ID

Age

Gender

Please Select any Preexisting Conditions:

☐ Healthy

☐ Asthmatic

☐ COPD

☐ Respiratory Infection

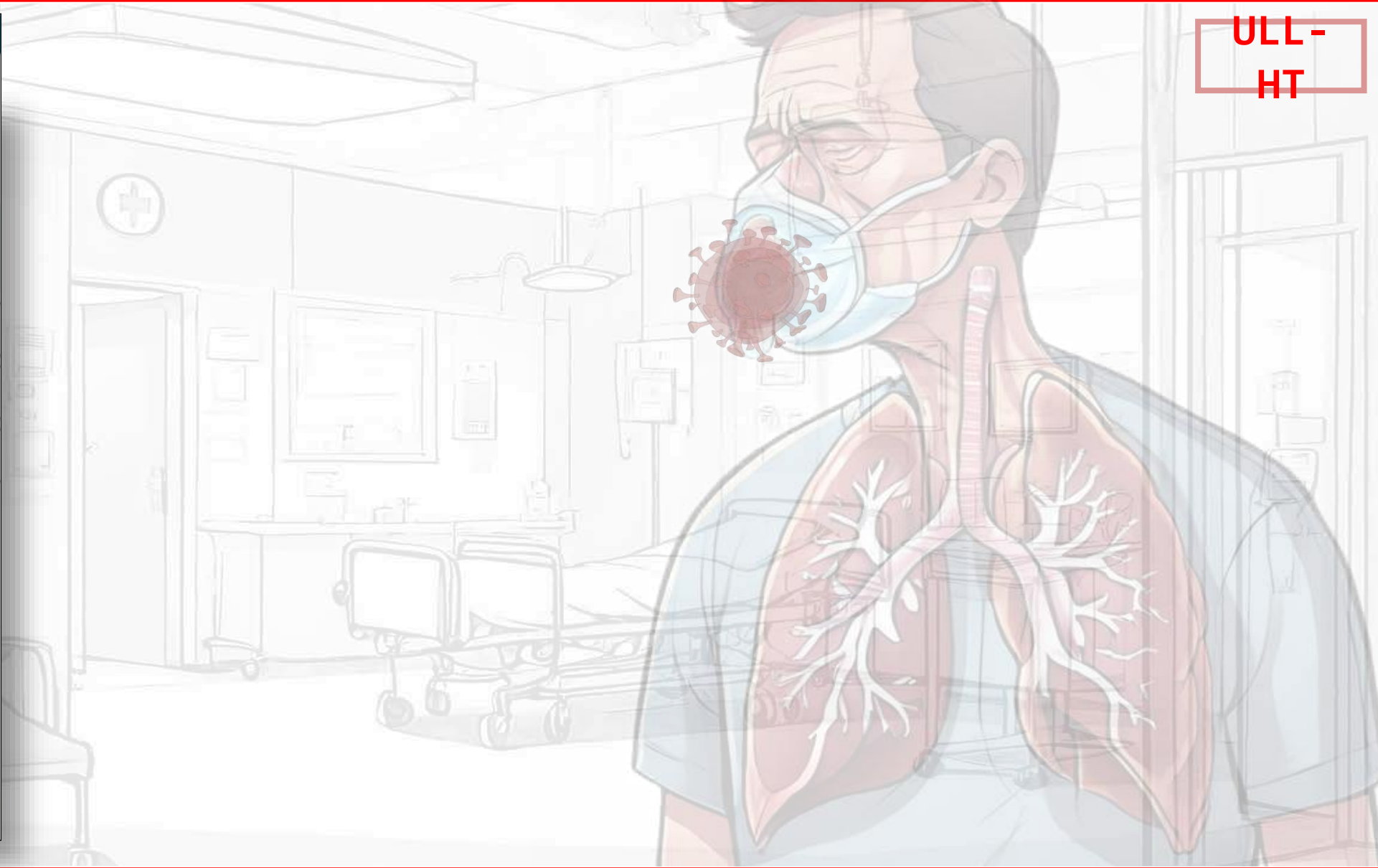
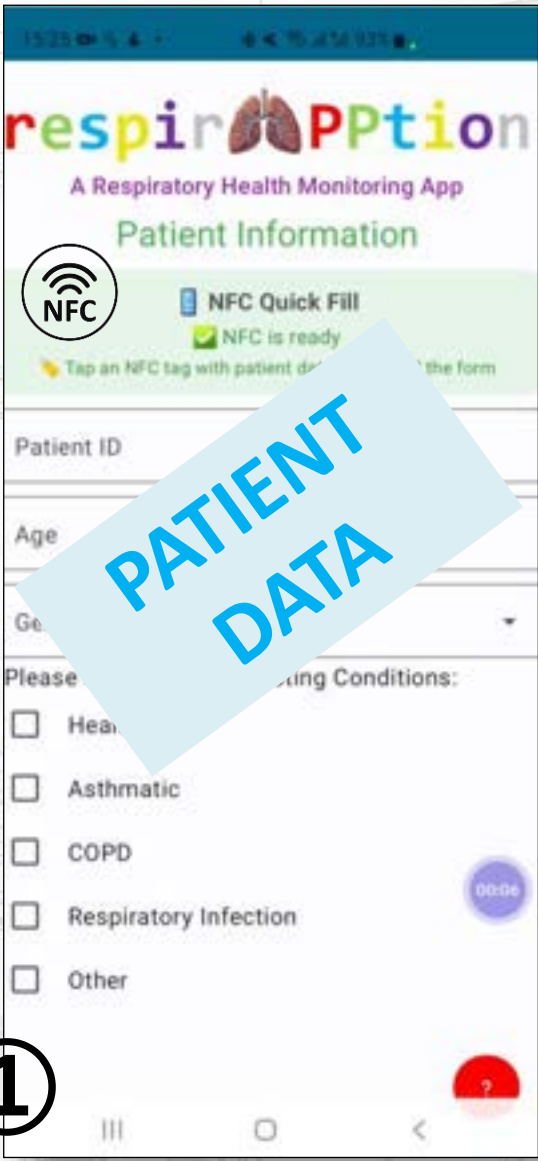
☐ Other

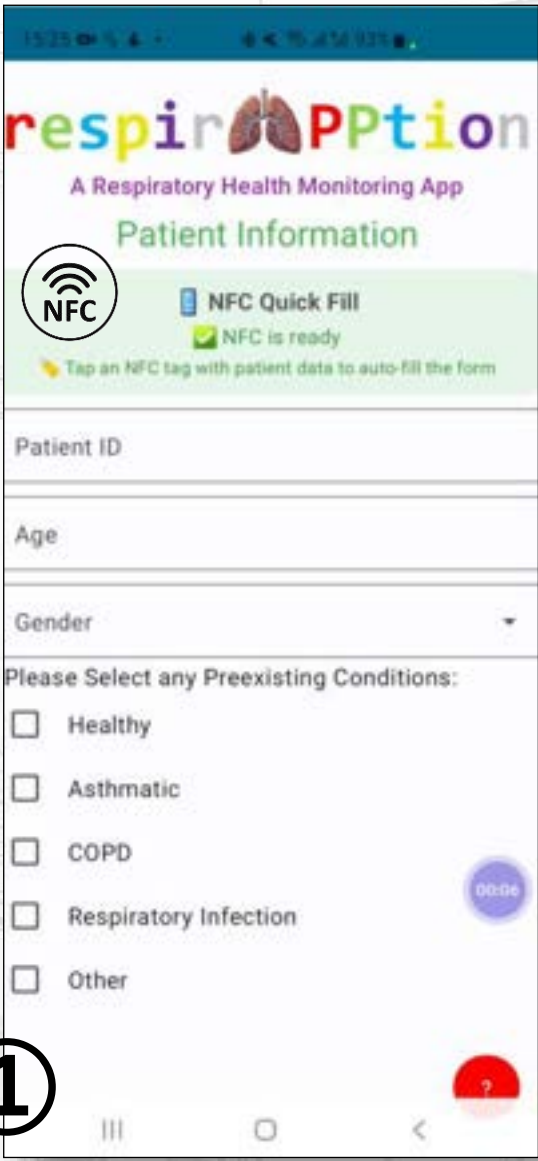
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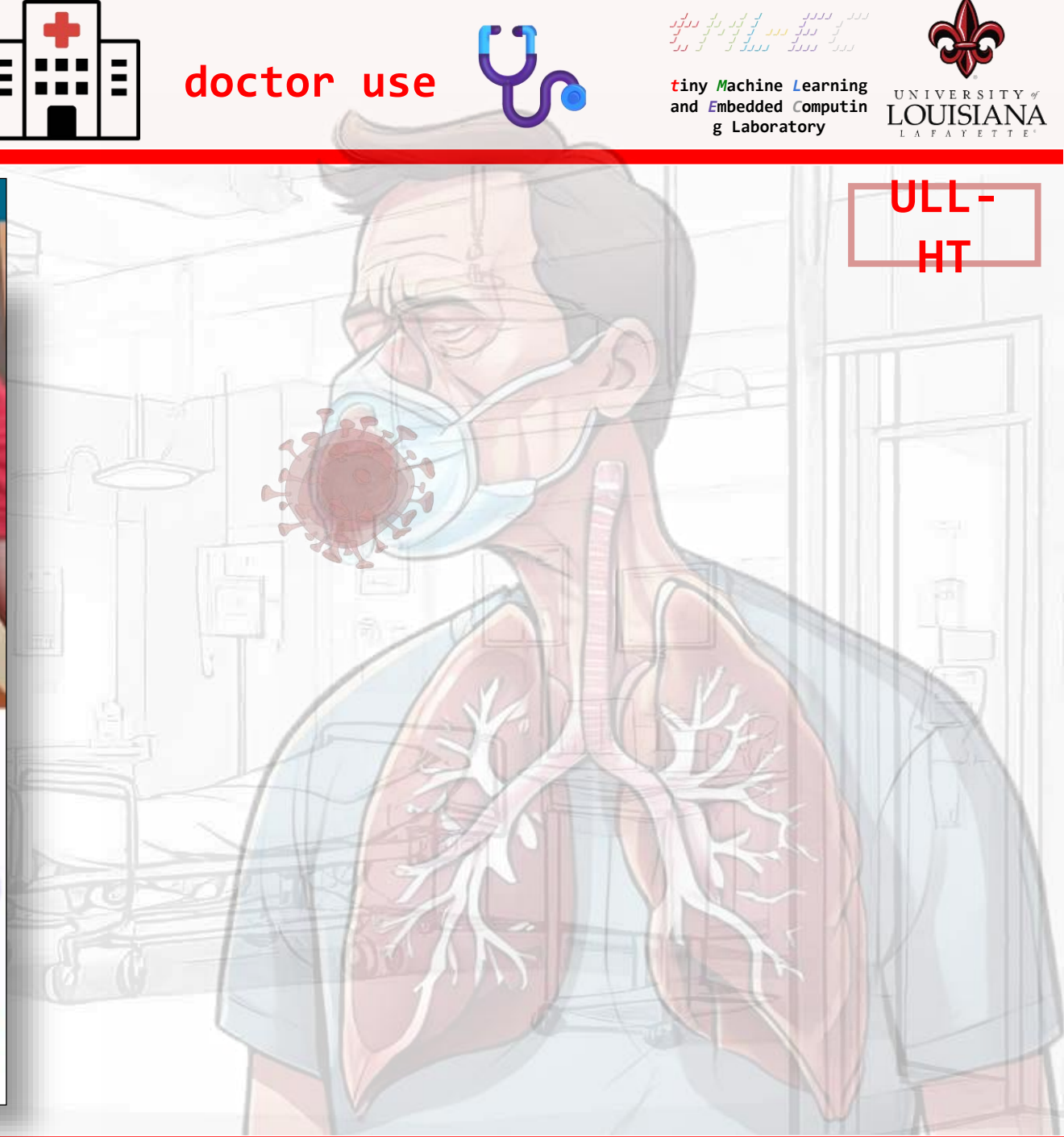
1

ULL-
HT



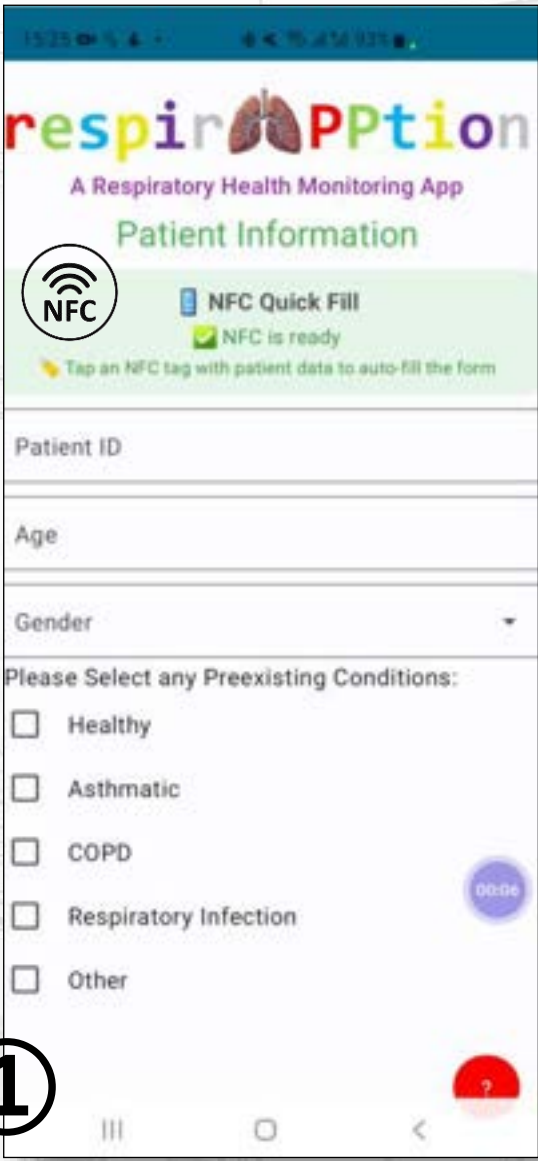


ULL-
HT

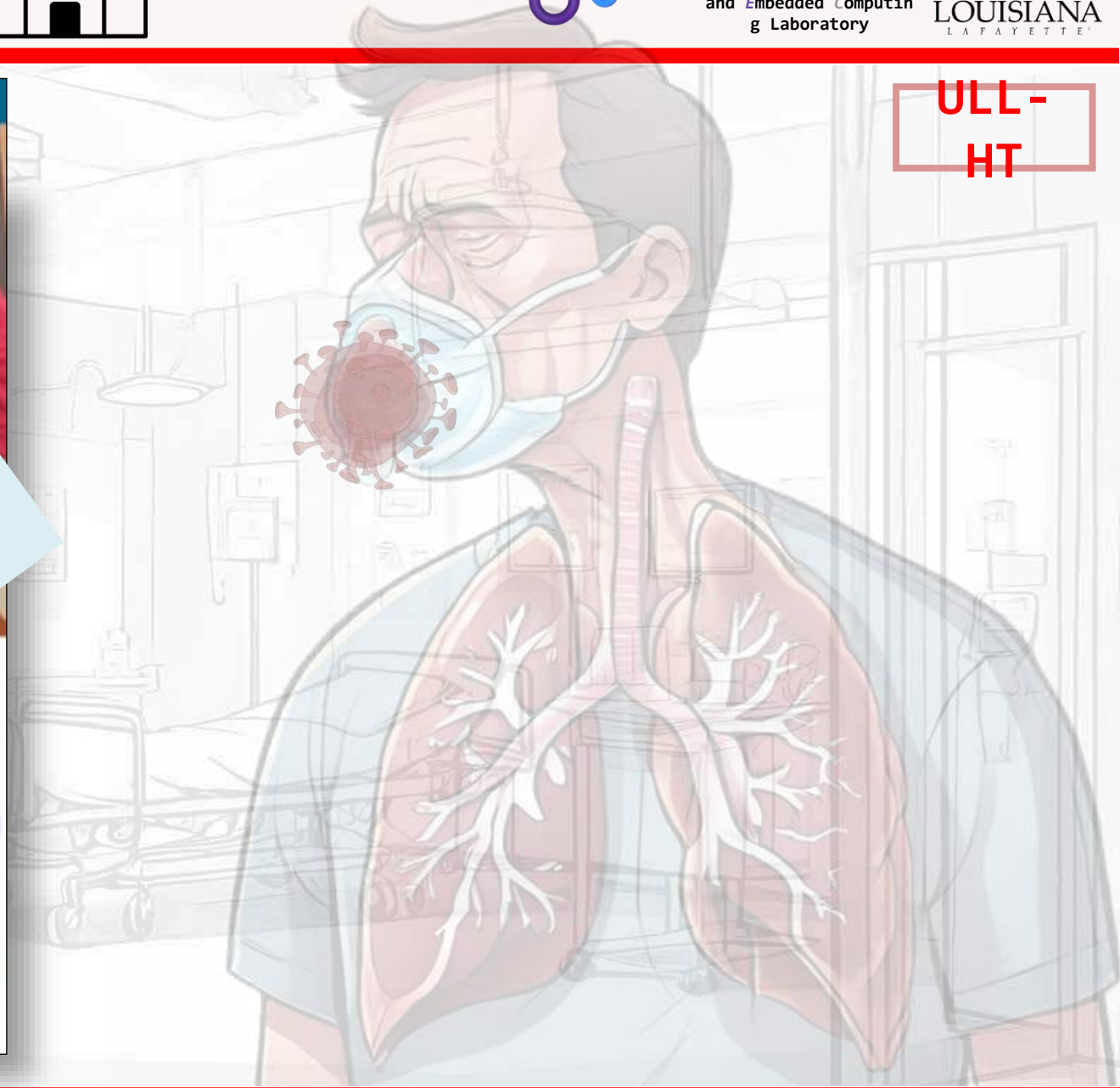




doctor use



ULL-
HT





doctor use



15:25 93%
respirPPTion
A Respiratory Health Monitoring App
Patient Information

NFC Quick Fill
NFC is ready
Tap an NFC tag with patient data to auto-fill the form

Patient ID
Age
Gender

Please Select any Preexisting Conditions:

- ☐ Healthy
- ☐ Asthmatic
- ☐ COPD
- ☐ Respiratory Infection
- ☐ Other

00:06

1

15:26 93%
respirPPTion
CALIBRATION MODE
Using QR Tracking for Calibration
Time remaining: 3s

QR Detected

Calibration in Progress

Patient ID: 02

Please breathe normally for 4 seconds
Collecting data to optimize detection...

00:08

2

15:28 93%
respirPPTion
RECORDING DATA
0:28

QR Detected

Inhaling
Movement: 15.4 px/s

Patient: 02
Age: 24
Gender: M

109 bpm
97%

Watch Connected
Real-time heart rate monitoring available

Real-time Breathing
Classification will be available after recording stops

Breathing Phase: inhaling
Velocity: 15.4
Data points: 32

Stop Recording

New Patient

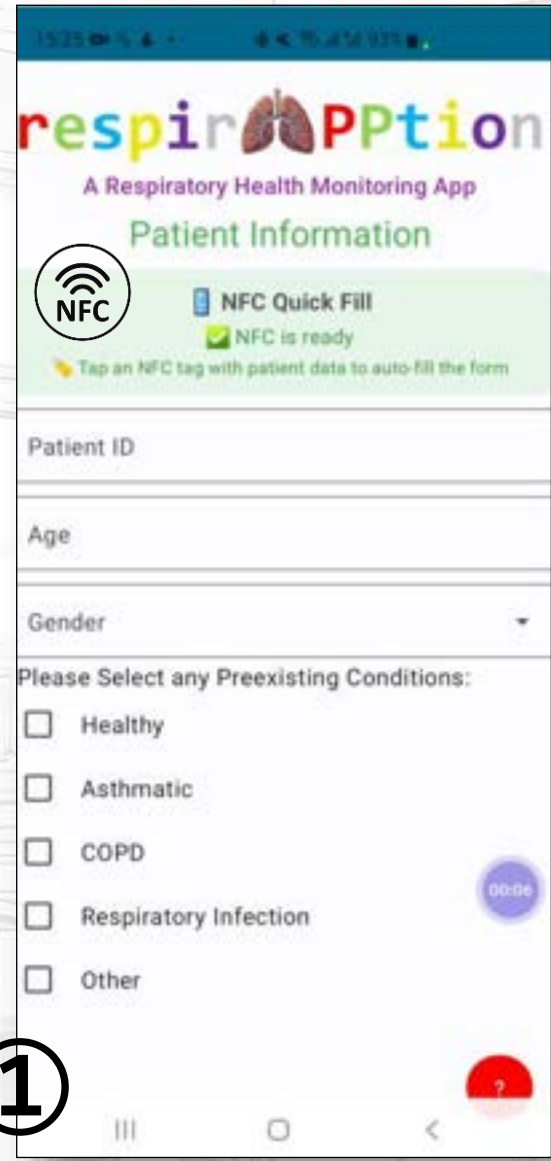
00:17

3

ULL-
HT



doctor use



MACHINE
LEARNING
IN-PROCESS

ULL-
HT



doctor use



15:25 93%

respirPPTion

A Respiratory Health Monitoring App

Patient Information

NFC Quick Fill
NFC is ready
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Patient ID

Age

Gender

Please Select any Preexisting Conditions:

- ☐ Healthy
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00:06

?

15:26 93%

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Classification will be available after recording stops

Breathing Phase: inhaling
Velocity: 15.4
Data points: 32

Stop Recording

New Patient

00:17

?

15:27 93%

respirPPTion

Breathing Assessment Results

Patient 02 | Age: 24 | Gender: M | Data Points: 400

Breathing Assessment

Normal
Confidence: 90%

Breathing Rate: 12.01 breaths/min
Breathing rate within normal range (10-24 breaths/minute)

Average data
avg heart rate: 99 bpm (Normal)
avg SpO₂(24-hrs): 93% (Mild-Hypoxemia)

View Graph Recommendations

Save Data Save Graph

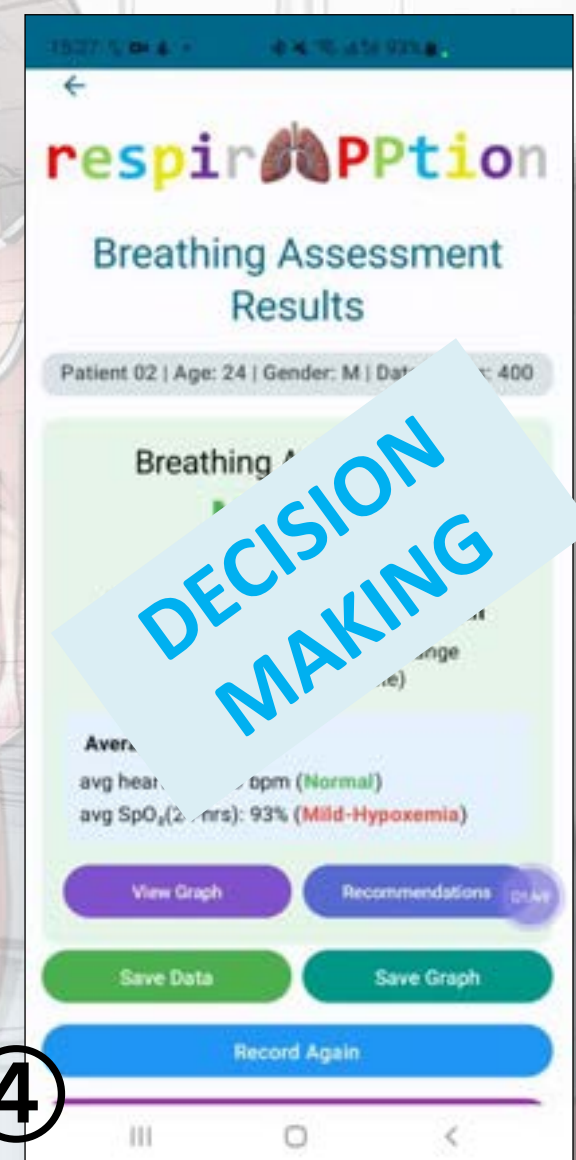
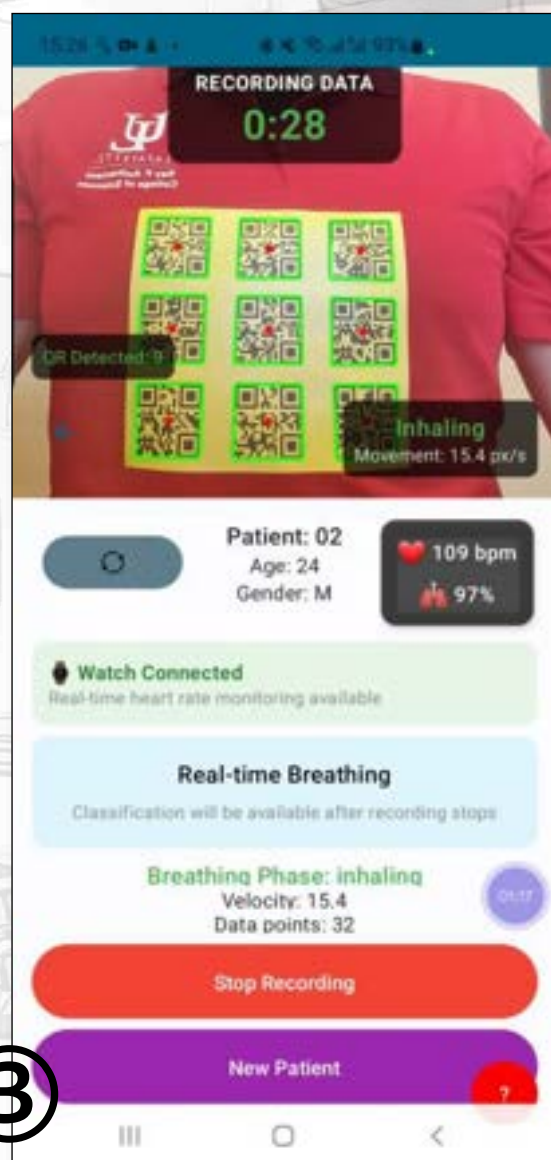
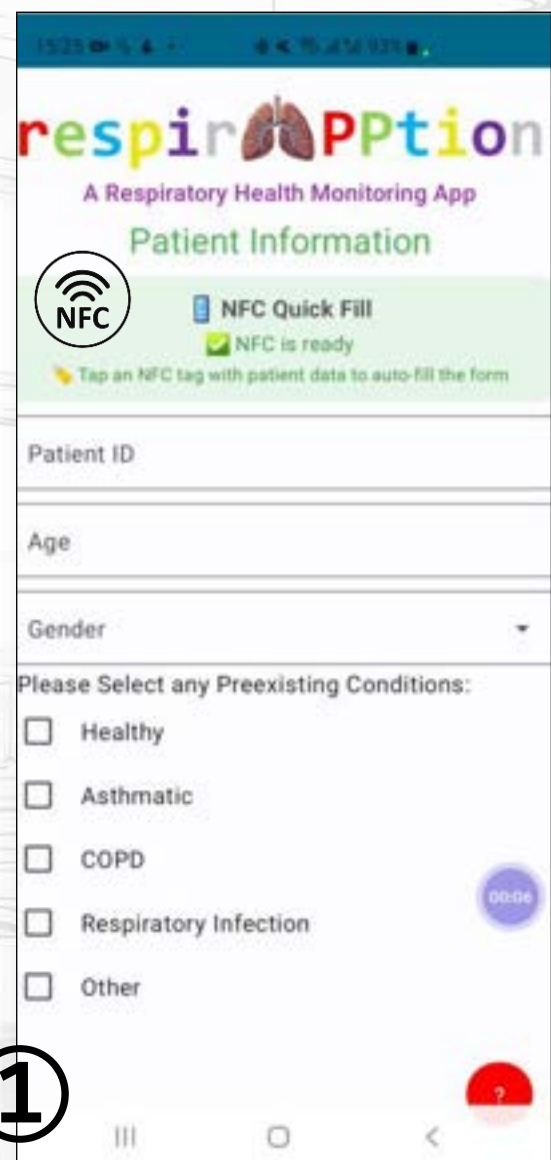
Record Again

00:17

?



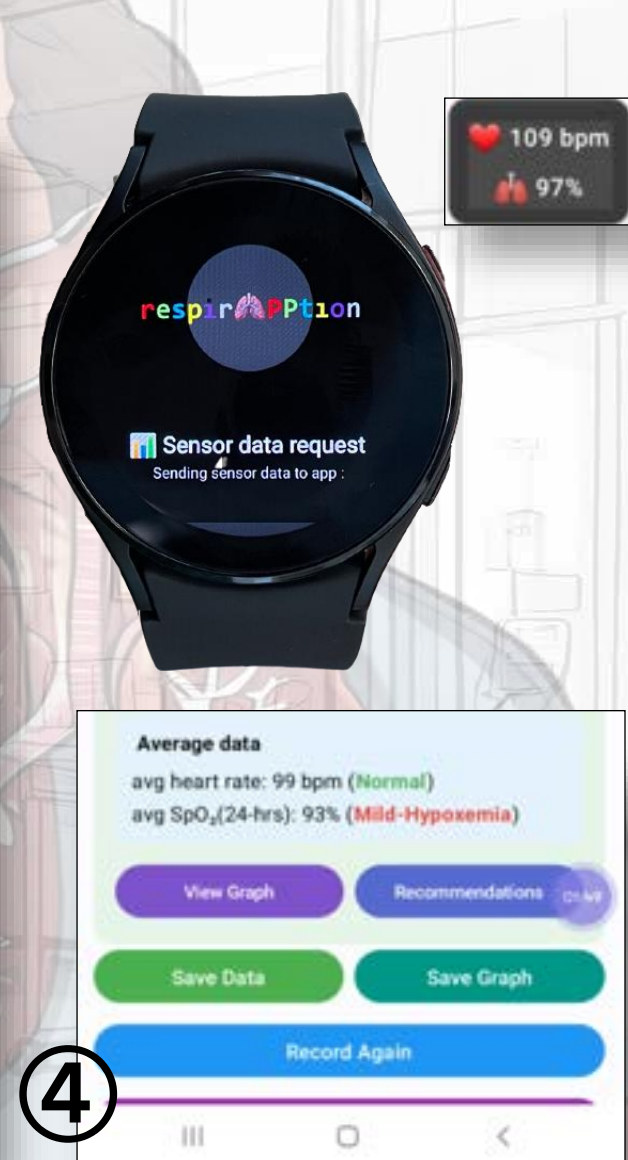
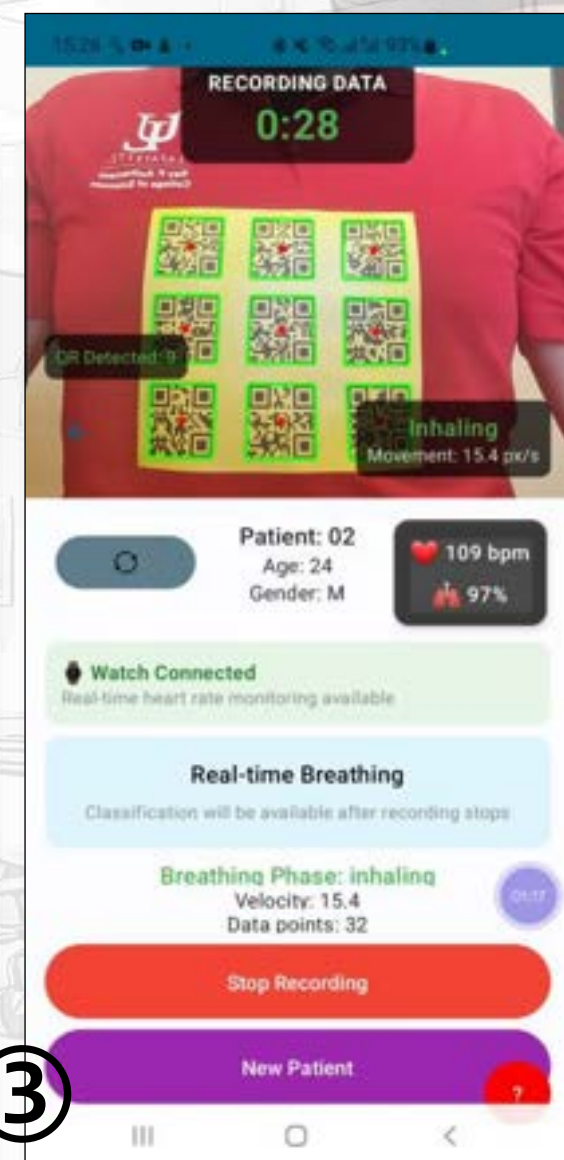
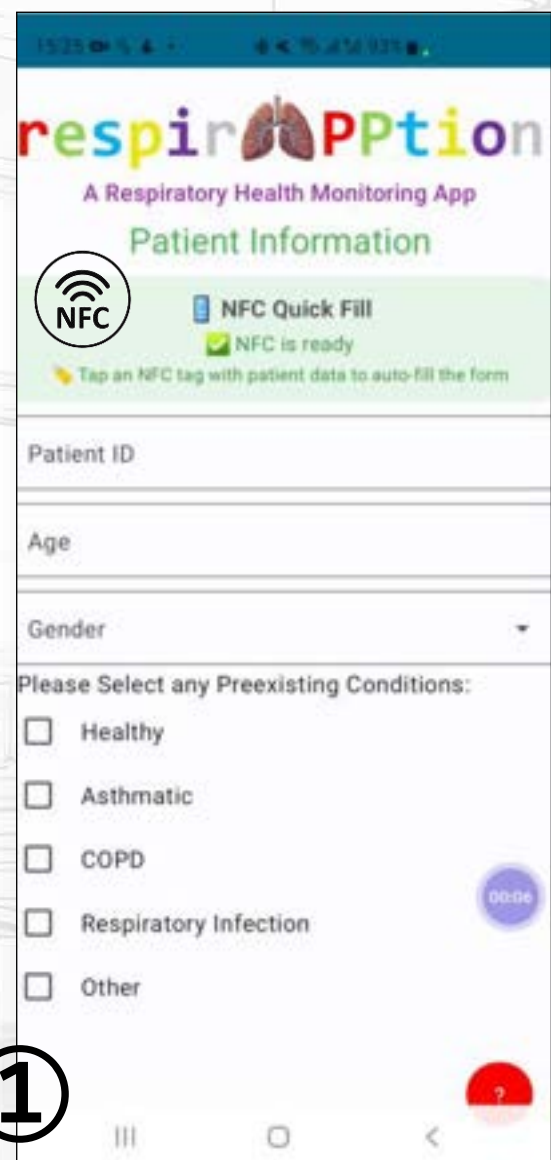
doctor use



DECISION
MAKING



doctor use





doctor use



15:25 93%
respirPPTion
A Respiratory Health Monitoring App
Patient Information

NFC
NFC Quick Fill
NFC is ready
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Patient ID
Age
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Please Select any Preexisting Conditions:

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- ☐ COPD
- ☐ Respiratory Infection
- ☐ Other

00:06

15:26 93%
CALIBRATION MODE
Using QR Tracking for Calibration
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Patient ID: 02

Please breathe normally for 4 seconds
Collecting data to optimize detection...

00:08

15:28 93%
RECORDING DATA
0:28

QR Detected

Inhaling
Movement: 15.4 px/s

Patient: 02
Age: 24
Gender: M

109 bpm
97%

Watch Connected
Real-time heart rate monitoring available

Real-time Breathing
Classification will be available after recording stops

Breathing Phase: inhaling
Velocity: 15.4
Data points: 32

Stop Recording

New Patient

ALWAYS-ON
HEART RATE
&
OXYGEN
SENSING

09 bpm
7%

Average data
avg heart rate: 99 bpm (Normal)
avg SpO₂(24-hrs): 93% (Mild-Hypoxemia)

View Graph Recommendations

Save Data Save Graph

Record Again



doctor use



15:27 92%

respirPtion

Breathing Assessment

Consider consulting a healthcare professional for a complete evaluation

Assistant says:

Disclaimer: This wellness advice should be seen as a supplementary measure and does not replace any advice or medication provided by your healthcare provider.

• Considering the detected high irregularity in your breathing and hypoxemia, performing regular deep breathing exercises could be beneficial. Inhale slowly and deeply through your nose, hold your breath briefly, then exhale slowly through your mouth. It's suggested to do this exercise for few minutes a day.

Save Data Save Graph

Record Again

6

15:28 92%

Breathing Assessment Results

Patient 02 | Age: 24 | Gender: M | Data Points: 400

Breathing Assessment

Normal

Confidence: 90%

Breathing Rate: 12.01 breaths/min

Breathing rate within normal range (10-24 breaths/minute)

Average data

avg heart rate: 99 bpm (Normal)

avg SpO₂(24-hrs): 93% (Mild-Hypoxemia)

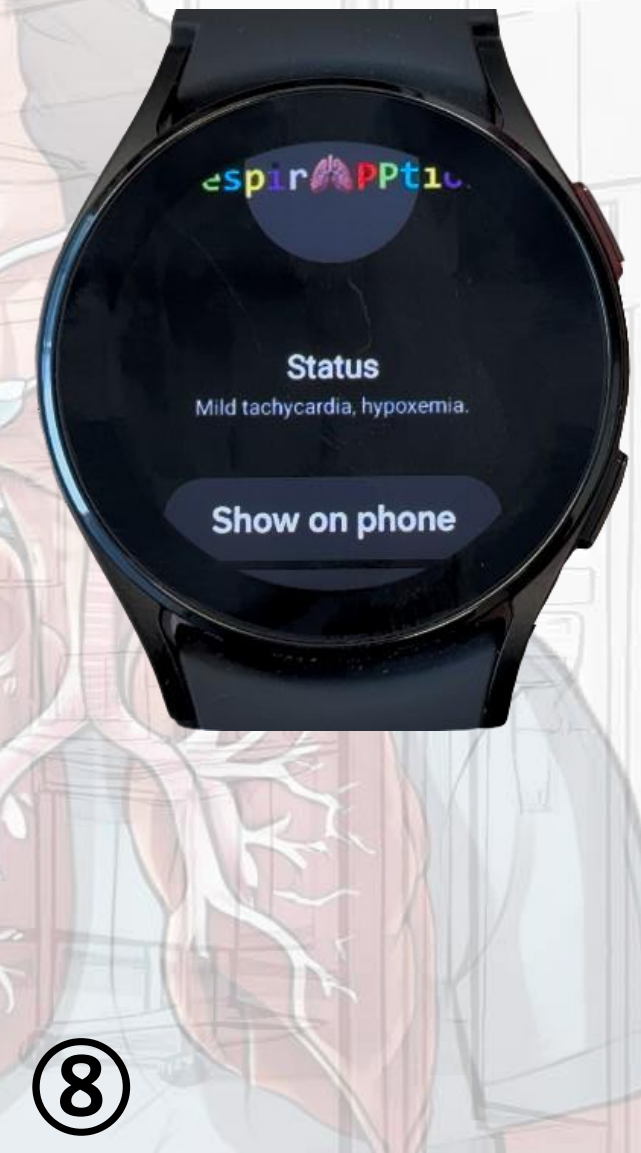
View Graph Recommendations

Save Data Save Graph

Saved data to respiratory_data_02_20250613_152652.csv

New Patient

7





doctor use



respirPtion

Breathing Assessment

Consider consulting a healthcare professional for a complete evaluation

Assistant says:

Disclaimer: This wellness advice should be seen as a supplementary measure and not replace any advice or medication from your healthcare provider.

AI ASSISTANT

6

Breathing Assessment Results

Patient 02 | Age: 24 | Gender: M | Data Points: 400

Breathing Assessment

Normal

Confidence

Breathing Rate

Breathing

DATA SAVING

7

respirPtion

Status

Mild tachycardia, hypoxemia

AI ASSISTANT

8



doctor use



15:27 92%

respir PPTtion

Breathing Assessment

Consider consulting a healthcare professional for a complete evaluation

Assistant says:

Disclaimer: This wellness advice should be seen as a supplementary measure and not replace any advice or medication from your healthcare provider.

AI ASSISTANT

Save Data Save Graph

Record Again

6

15:28 92%

respir PPTtion

Breathing Assessment Results

Patient 02 | Age: 24 | Gender: M | Data Points: 400

Breathing Assessment
Normal
Confidence: 95%

Breathing Rate: 12 breaths/min
Breathing Volume: 1.2L

Save Data Save Graph

Saved data to respiratory_data_02_20250613_152652.csv

New Patient

7

16:53 86%

respir PPTtion

Patient 2 | Age: 28 | Health Status: Good

INTERACTIVE

Assistant

They guide me through the process of using the app.

Of course! Here is a simple guide:

1. **Calibrate your camera:** Use the calibration function in the settings menu to ensure your device is ready to scan.

Your Question

Ask

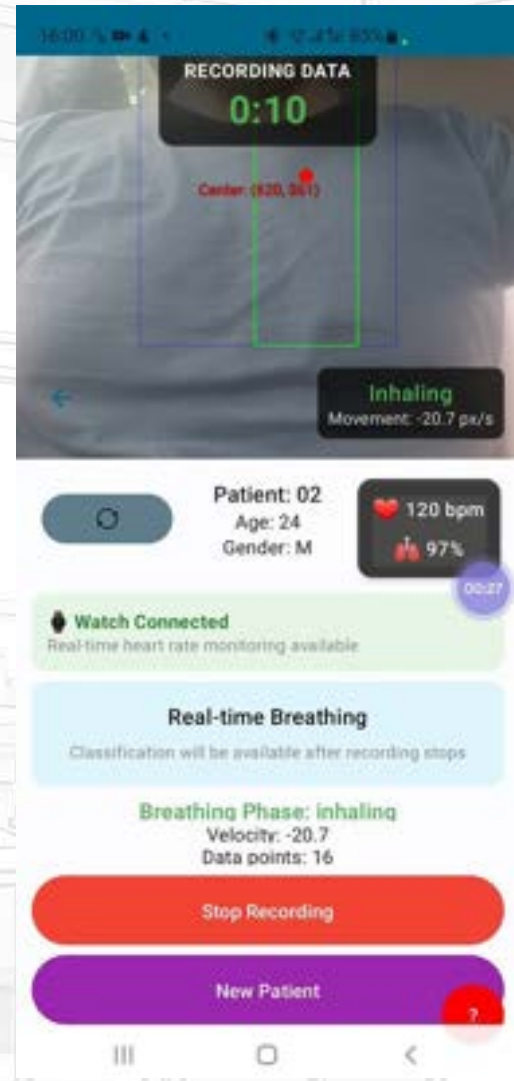
8



home use



①



②

③

④

⑤

⑥

⑦

⑧

SAME

NO VISUAL
MARKER

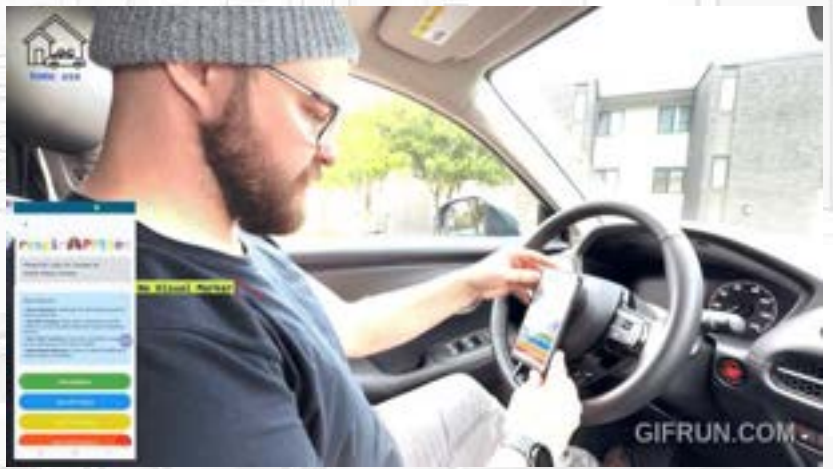


doctor use



ULL-
HT

home use



THANK YOU VERY MUCH!

sercan.aygun@louisiana.edu

ULL-
HT

Special Thanks:

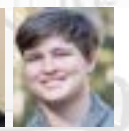
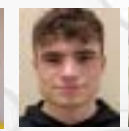
Louisiana
Impact
Research
Awards

tiny Machine Learning
and Embedded Computing Laboratory

Master's Students Hritika Pandey & Colin Dupuis



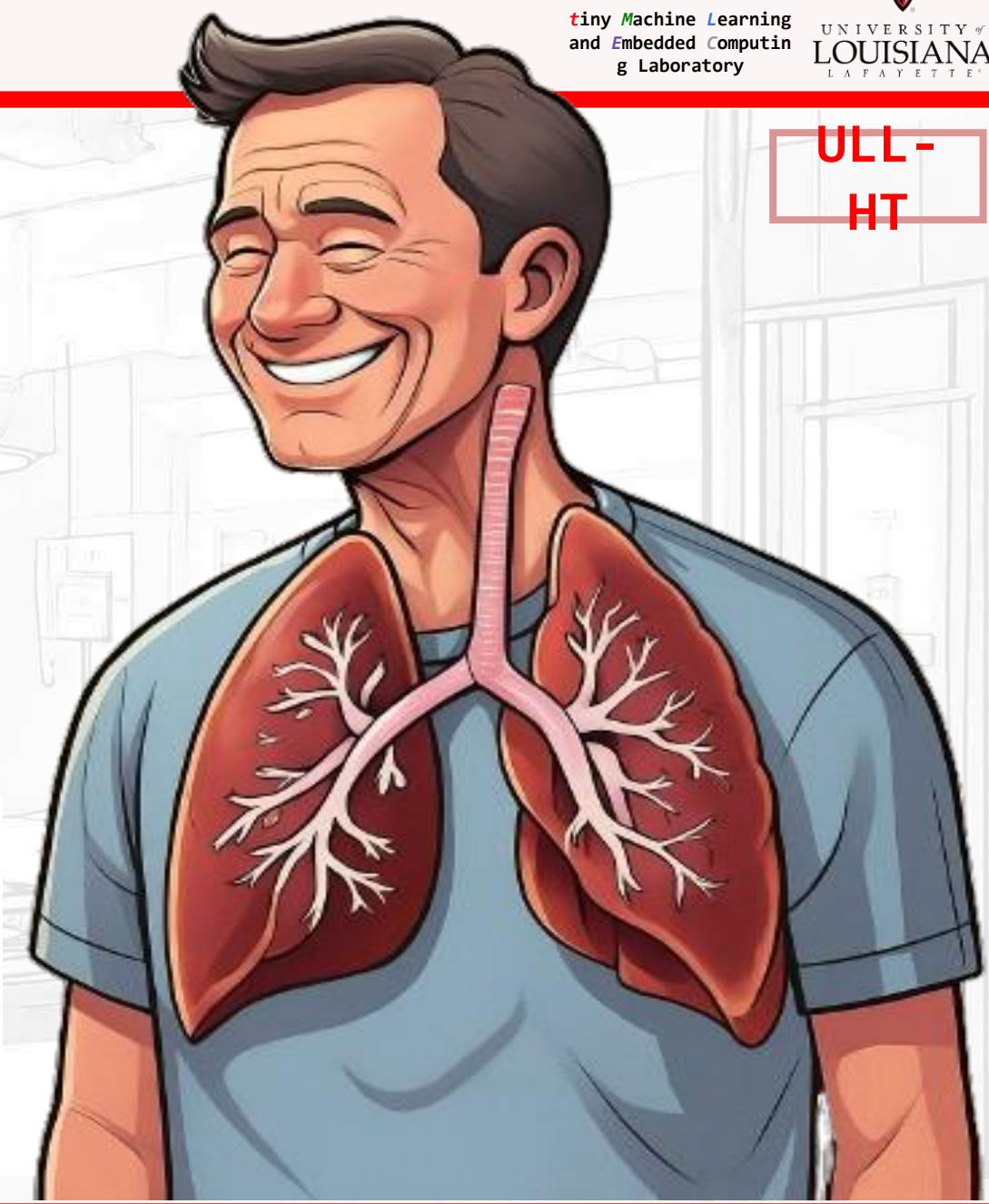
Undergraduates:



[demo](#)



www.respirapPtion.com





INNOVATION, HEALTH & WELLNESS

Sercan Aygun

Assistant Professor of Computing & Informatics

*ULL-HT: Unified, Low-Resource,
and Language-Assisted Health Tool*



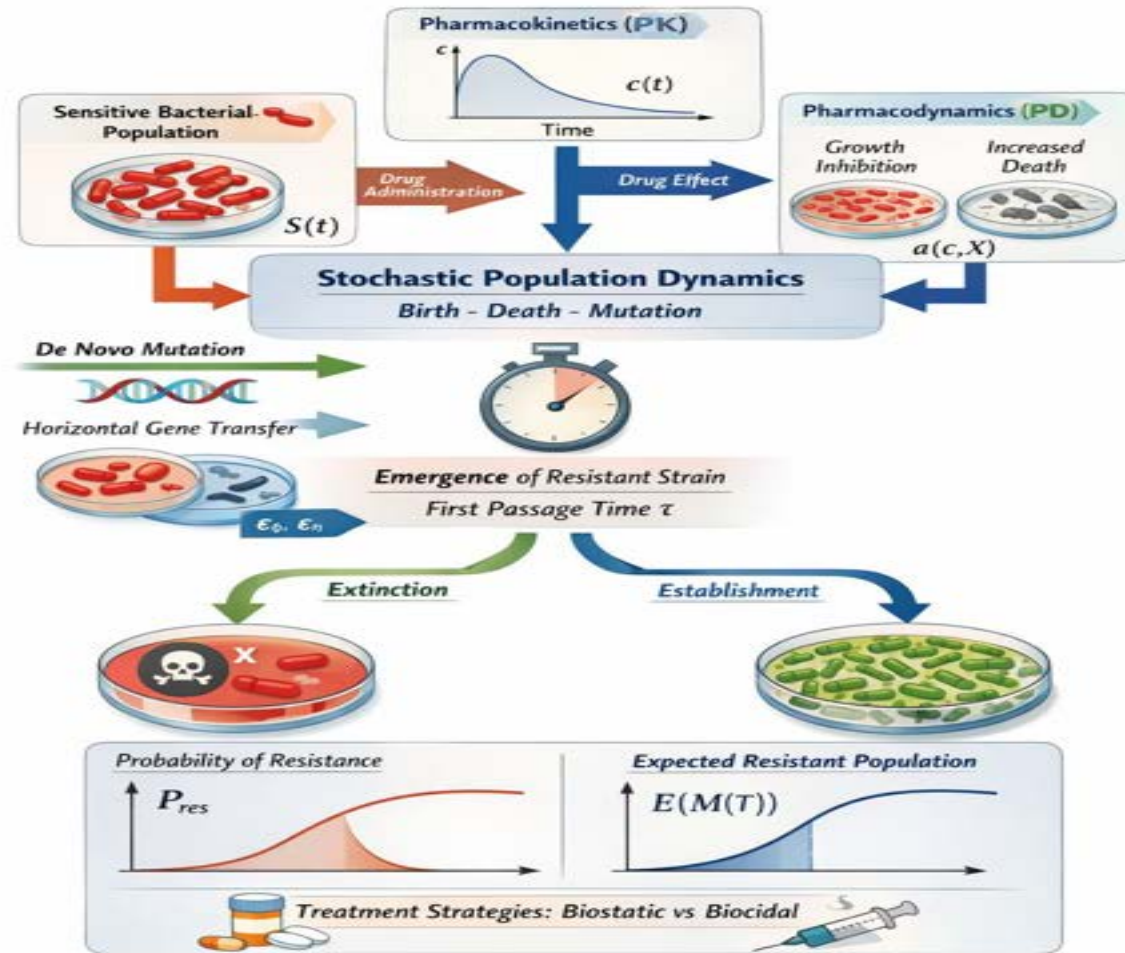
INNOVATION, HEALTH & WELLNESS

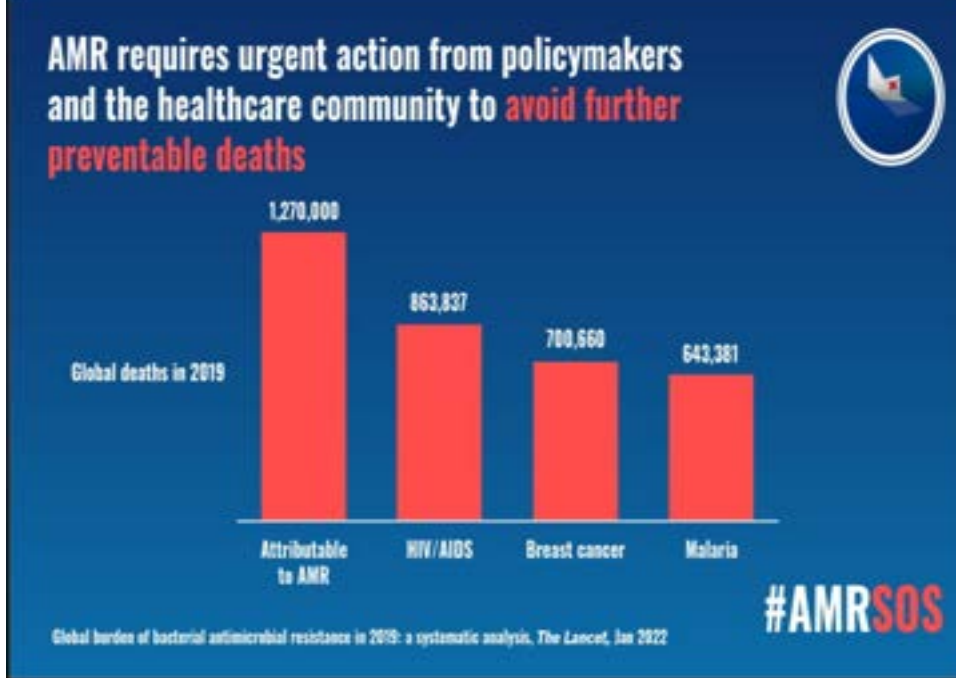
Chimezie Izuazu

PhD Student in Mathematics

Stochastic Analysis of Interplay Among Drug Mode of Action, Nutrient Availability, and Antibiotic Resistance

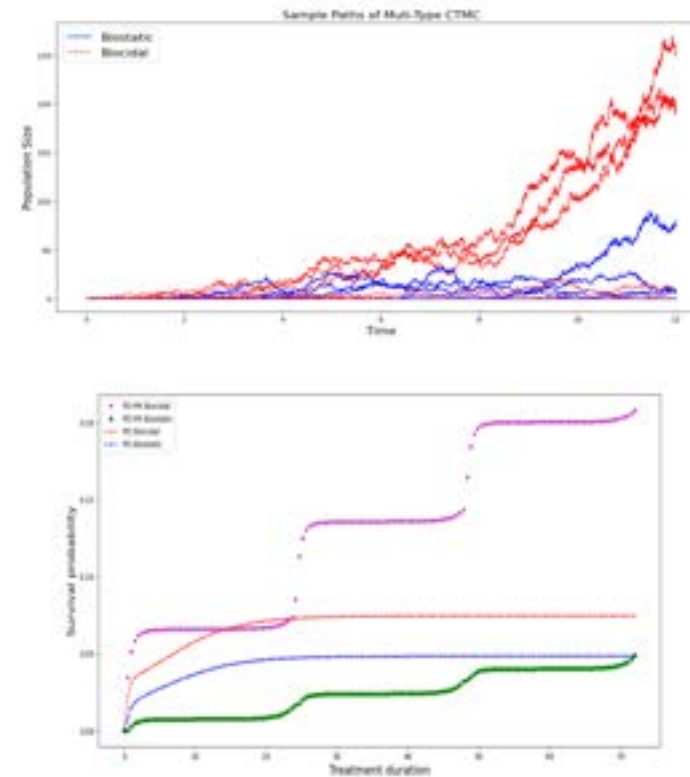
Faculty Reference: Cameron Browne





Discussion

- Post-COVID increase in antibiotic use drives resistance
- PD-based continuous-time Markov chain model
- Birth–death–mutation dynamics of bacteria
- First passage time determines resistance emergence
- Tradeoff: fast clearance vs resistance risk
- Biostatic vs biocidal effects differ significantly



Future:

This work could motivate experiments investigating how drugs induce bacterial population rescue and facilitate epidemiological models explicitly linking the within- and between-host scales. As a future study, conditioning on the emergence and fixation of a resistant bacterial strain, we will analyze the optimal combination of various modes of drugs to mitigate resistance via combination therapy.



INNOVATION, HEALTH & WELLNESS

Chimezie Izuazu

PhD Student in Mathematics

Stochastic Analysis of Interplay Among Drug Mode of Action, Nutrient Availability, and Antibiotic Resistance

Faculty Reference: Cameron Browne



INNOVATION, HEALTH & WELLNESS

Lovelyn Madu

PhD Student in Mathematics

*Optimization and AI-Driven Advances
in Detection Tools for Heart Disease and Cancers*

Faculty Reference: Bruce Wade

Optimisation and AI-Driven Advances in Detection Tools for Heart Disease and Cancers (Authors: Lovelyn Madu, Bruce Wade (PhD) and Olaniyi Iyiola (PhD))



Drawback of ELM

- Poor generalizations in some cases.
- Sensitive to ill-conditioned hidden layer matrix H .
- Overfitting if β is too large.

Optimality Condition of Convex Optimization:

If you want to minimize a convex function $f(x)$ over G the necessary and sufficient condition for x^* to be a minimizer is:

$$\langle \nabla f(x^*), x - x^* \rangle \geq 0, \quad \forall x \in G,$$

which is exactly a VIP with $A(x) = \nabla f(x)$.

In particular for ELM,

$$\nabla f(\beta) = H^T(H\beta - T)$$

Now our proposed algorithm is developed as

$$f(\beta) = \frac{1}{2} \|(I - P_Q)(I - \lambda_H)H\beta\|_2^2, \quad Q = \{T\}.$$

and employed to train the ELM and find the optimal β , output weight

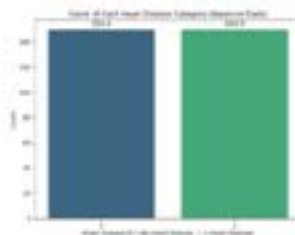
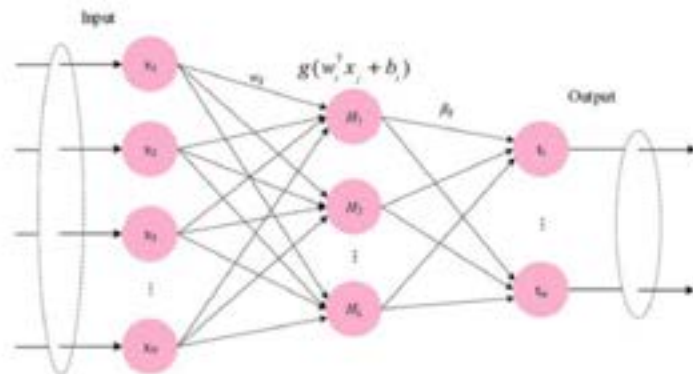
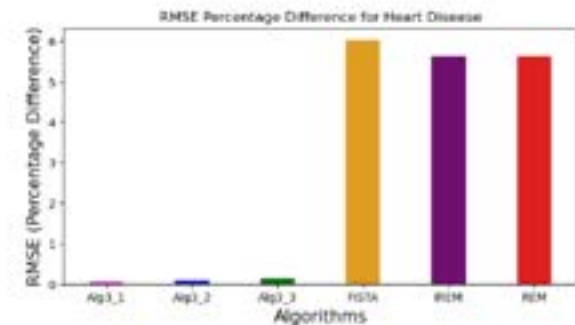


Figure: Heart Disease balanced data

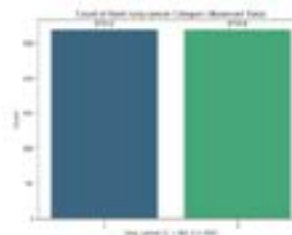
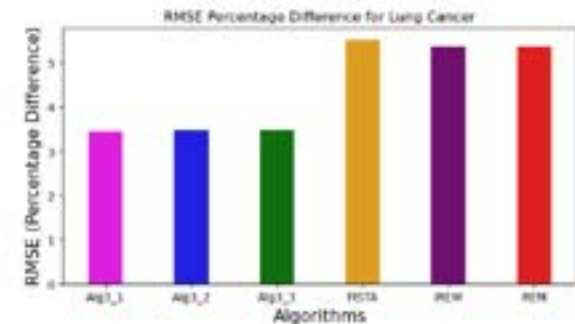


Figure: Lung cancer balanced data





INNOVATION, HEALTH & WELLNESS

Lovelyn Madu

PhD Student in Mathematics

*Optimization and AI-Driven Advances
in Detection Tools for Heart Disease and Cancers*

Faculty Reference: Bruce Wade



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PLACE &
PURPOSE
RESEARCH
AWARD
WINNERS**

ROUND #4



THANK YOU!

To all of today's presenters

To all of our faculty for supporting student research

To all of our students for being the future of research



Dr. Mary Farmer-Kaiser

**Dean of the Graduate
School**

Professor of History



Congratulations