RESTORE ACT CENTER OF EXCELLENCE FOR LOUISIANA
EXPENDITURE SUMMARY

Due within 30 days of the close of the award

CFDA/Fed Grant Number: 21.015/RCEGR260003-01-00
CEA Number: 2000249131
Subaward Agreement Number: CPRA-2015-COE-JE
Award Period (mm-dd-yyyy to mm-dd-yyyy): 08/01/2017 - 07/31/20 (including NCE)
Project Title: Plant and Soil Response to the Interactive Effects of Nutrient and Sediment Availability: Enhancing Predictive Capabilities for the Use of Sediment Diversions and Dredge Sediment for Marsh Creation
Grantee Lead Institution: Louisiana State University
Grantee Principal Investigator and Contact Information:

First name: Tracy Last name: Quirk

Title: Associate Professor Affiliation: Louisiana State University

Mailing address: 3173 Energy, Coast and Envt Bldg, Baton, Rouge, LA 70803

Phone: 225-578-6426

Email: tquirk@lsu.edu

Year	Total Award	Total this Invoice	Invoiced to Date	Remaining Amount	Percent Expended	Technical Percent Completed
Year 1	$151,667	$0	$36,609	$115,058	24%	35%
Year 2	$141,247	$19,277	$256,305	0	181%	65%
Year 3						
Year 4						
Year 5						
Total	292914	19277	292914	292914	100	100

RESTORE ACT CENTER OF EXCELLENCE FOR LOUISIANA
FINAL TECHNICAL REPORT

Due within 30 days of the close of the award

Project Title: Plant and Soil Response to the Interactive Effects of Nutrient and Sediment Availability:

Principal Investigator:	Tracy Quirk
Principal Investigator Institution:	Louisiana State University
Co-Principal Investigator:	Sean Graham
Co-Principal Investigator Institution:	Nicholls State University
Co-Principal Investigator:	
Co-Principal Investigator Institution:	
Co-Principal Investigator:	
Co-Principal Investigator Institution:	
Co-Principal Investigator:	
Co-Principal Investigator Institution:	
Co-Principal Investigator:	
Co-Principal Investigator Institution:	
Co-Principal Investigator:	
Co-Principal Investigator Institution:	
Co-Principal Investigator:	
Co-Principal Investigator Institution:	

A. Technical Activities

1) Deliverables on proposed goals and objectives.

#	**Proposed goal / objective / activity**	**Target output / deliverable**	**Completed** (Y/N)	**Comments** (If No, please describe incomplete deliverable(s) or reason why actual output / deliverable deviated from the proposed)	**Topical area (s) and research need(s) addressed** (as described in the proposal)
1	Quantify interactions between nutrient and sediment availability on nutrient cycling and bio-physical feedbacks in a created and natural brackish marsh in coastal Louisiana.	1) Plant growth responses 2) Decomposition rates 3) 15N-tracer-based nutrient cycling	Yes	We expanded this field study to 3 sites: intermediate, brackish (natural) and created	Feedbacks between plant and dynamics and environment in nutrient retention, and cycling
2	Establish relationships among nitrogen loading rate and Spartina patens growth, biomass allocation and morphology in soils with different organic/mineral matter content.	S. patens biomass and growth response to soil type and nutrients	Yes		Simulate various river diversion nutrient-loading rates into newly created and older organic soils
3	Examine interactions between nutrient and sediment availability on Spartina patens growth, biomass allocation, and morphology, and soil organic matter content.	Intermediate marsh response to elevation, nutrients and sediment deposition	Yes	Added elevation as a factor and changed to intermediate marsh community	Nutrient-vegetation empirical relationships for use in models
4			No		

#	**Proposed goal / objective / activity**	**Target output / deliverable**	**Completed** (Y/N)	**Comments** (If No, please describe incomplete deliverable(s) or reason why actual output / deliverable deviated from the proposed)	**Topical area (s) and research need(s) addressed** (as described in the proposal)
5			No		
6			No		
7			No		
8			No		
9			No		
10			No		

2) **Summary of research project**. Similar to an abstract; include sentences that describe the introduction, research questions/hypotheses, methods, results, discussion, and conclusion. 400 words max.

Marshes in the Mississippi River Delta are rapidly deteriorating due partly to inadequate sediment supply to equilibrate to a high rate of relative sea-level rise. Restoration strategies include sediment diversions and marsh creation. However, high nutrient loading into existing and newly created marshes may have potential negative impacts on belowground biomass and soil organic matter accumulation. The goal of this research is to provide critical information on the interactive effects of nutrient- and sediment availability on marsh nutrient cycling, plant productivity, decomposition and soil organic matter accumulation and accretion. In a field study across three marsh types, low nutrient-enrichment stimulated both the accumulation and decomposition of dead roots across marsh types. Intermediate marsh plugs in a greenhouse had lower species richness, stem density, aboveground biomass, root productivity at lower elevations. Nutrient-enrichment tended to negatively affect plant structure at low elevations without sedimentation and positively affect plant processes at high elevations and/or with sediment deposition. Spartina patens in a greenhouse had greater aboveground biomass and root productivity in mineral rather than organic soils. Overall, these results show that the effects of nutrient-enrichment on plant productivity and soil processes are strongly dependent on elevation and sediment availability, which have a greater influence on the vegetation and soil.

3) **Results and scientific/technical highlights**. In 5-10 bullets: list and describe key outcomes and findings; new methods, technology, and/or advanced tools developed (e.g., models, biomarkers).

- Nutrient-enrichment of 100 g N and 11g P m-2 yr-1 had a greater (negative) effect on species richness, plant productivity and decomposition than ten times that amount (1000 g N and 110 g P m-2 yr-1) across three marsh types (intermediate, brackish, and created)
- Under 100 g N and 11g P m-2 yr-1, dead root accumulation and decomposition rates were greater than with most other treatments in all three marshes.
- In the intermediate marsh, species richness was greater with sediment deposition with and without 100 g N and 11g P m-2 yr-1 as compared to these nutrient-levels alone.
- Nutrient-enrichment plots had elevated nitrate in the porewater compared to control plots, which was readily converted to ammonium.
- Under controlled conditions, low elevation (-20 cm, MHW) negatively affected species richness, density, aboveground biomass, and root productivity of an intermediate marsh community as compared to high elevation (-5 cm, MHW).
- Similarly, brackish marsh species were negatively affected by a highly organic soil compared to a mineral sediment-rich soil.
- Nutrient-enrichment affects were strongly dependent on elevation, soil type, and surface sediment deposition, and tended to be positive with greater sediment and higher elevation and negative with lower elevation and highly organic soil.

4) **Application of research results to the implementation of the Louisiana Coastal Master Plan by Coastal Protection and Restoration Authority.** Please add each targeted output/deliverable under each relevant column. Refer to section *1) Deliverables on proposed goals and objectives* on page 2 to obtain your output/deliverables and to your notes/comments from the All Hands Meeting where this was discussed in the break out groups.

COASTAL PROTECTION AND RESTORATION AUTHORITY PROGRAM AND PROJECT IMPLEMENTATION						
Planning	**Feasibility**	**Engineering and Design**	**Operations, Maintenance, and Monitoring**	**Knowledge Base**	**Stakeholder Engagement**	**Communications**
1) Plant growth responses 2) Decomposition rates 3) 15N-tracer-based nutrient cycling	1) Plant growth responses 2) Decomposition rates 3) 15N-tracer-based nutrient cycling		1) Plant growth responses 2) Decomposition rates 3) 15N-tracer-based nutrient cycling	1) Plant growth responses 2) Decomposition rates 3) 15N-tracer-based nutrient cycling	1) Plant growth responses 2) Decomposition rates 3) 15N-tracer-based nutrient cycling	1) Plant growth responses 2) Decomposition rates 3) 15N-tracer-based nutrient cycling
S. patens biomass and growth response to soil type and nutrients	S. patens biomass and growth response to soil type and nutrients		S. patens biomass and growth response to soil type and nutrients	S. patens biomass and growth response to soil type and nutrients	S. patens biomass and growth response to soil type and nutrients	S. patens biomass and growth response to soil type and nutrients

COASTAL PROTECTION AND RESTORATION AUTHORITY PROGRAM AND PROJECT IMPLEMENTATION						
Planning	**Feasibility**	**Engineering and Design**	**Operations, Maintenance, and Monitoring**	**Knowledge Base**	**Stakeholder Engagement**	**Communications**
Intermediate marsh response to elevation, nutrients and sediment deposition	Intermediate marsh response to elevation, nutrients and sediment deposition		Intermediate marsh response to elevation, nutrients and sediment deposition	Intermediate marsh response to elevation, nutrients and sediment deposition	Intermediate marsh response to elevation, nutrients and sediment deposition	Intermediate marsh response to elevation, nutrients and sediment deposition

5) Peer-reviewed publications. Please provide pdf copies.

Authors	List author names of graduate students/ Postdocs	Title	Journal	DOI (or other identifier)	Published; submitted; in prep; planned?	Date
Groseclose G. Elsey-Quirk, T.	Groseclose, G.	Effects of fertilization and sediment deposition on belowground plant productivity and organic matter decomposition in three coastal marsh types in Louisiana.	Ecology		In prep	
Day, D. Elsey-Quirk, T.	Day, D.	Interactive effects of elevation, nutrient-enrichment, and sedimentation on plant species composition and above- and belowground productivity in an oligohaline marsh: a mesocosm study.			In prep	

Authors	List author names of graduate students/ Postdocs	Title	Journal	DOI (or other identifier)	Published; submitted; in prep; planned?	Date
Day, D. Elsey-Quirk, T.	Day, D.	Nutrient-cycling in an oligohaline marsh in response to nutrient fertilization and sediment deposition: an N-15 tracer study.			In prep	
Ameen, A. Graham, S. A. Elsey-Quirk, T.	Ameen, A.	Soil organic matter content influences the plant response to nutrient-enrichment.			In prep	
Groseclose, G.	Groseclose, G.	Plant and Soil Responses to Sediment Deposition and Nutrient-Enrichment in Healthy, Deteriorating, and Newly Created Coastal Marshes in Barataria Bason, Louisiana: Implications for Mississippi River Sediment Diversions.	LSU M.S. Thesis		Published	

6) Oral presentations and posters. Please provide pdf copies.

Presenter's Name	Co-author's Name	List author names of graduate students/ Postdocs	Title	Oral or poster?	Conference or meeting name	Location & date	Completed; submitted; planned?	Proceedings published (Y/N)
Groseclose, G.	Quirk, T.	Gina Groseclose	Belowground Productivity Responses to Nutrient-Enrichment and Sediment Deposition: Predicting Effects of Mississippi River Sediment Diversions.	Oral	Coastal and Estuarine Research Federation Biennial Conference	Mobile, AL 11/4 -11/7/2019	Completed	Y
Day, D.	Quirk, T.	Donnie Day	Nutrient and sediment enrichment effects on nutrient cycling and plant species composition in coastal marshes.	Oral	Coastal and Estuarine Research Federation Biennial Conference	Mobile, AL 11/4-11/7/2019	Completed	Y
Ameen, A.	Graham, S.	Alex Ameen	Do nutrient addition and mineral sediment availability interact to enhance wetland plant growth?	Poster	Coastal and Estuarine Research Federation Biennial Conference	Mobile, AL 11/4-11/7/2019	Completed	Y

Presenter's Name	Co-author's Name	List author names of graduate students/ Postdocs	Title	Oral or poster?	Conference or meeting name	Location & date	Completed; submitted; planned?	Proceedings published (Y/N)
Groseclose, G.	Quirk, T.	Gina Groseclose	Nutrient and Sediment Enrichment Effects on Plant Productivity and Decomposition in Barataria Bay Marshes: Mississippi River Diversion Implications.	Poster	Society of Wetland Scientists Conference	Baltimore, MD, May 28-31, 2019	Completed	Y
Day, D.	Quirk, T.	Donnie Day	Plant community response to the effects of simulated nutrient and sediment loading in Sagittaria lancifolia-dominated wetlands.	Poster	Society of Wetland Scientists Conference	Baltimore, MD, May 28-31, 2019	Completed	Y
Ameen, A.	Graham, S.	Alex Ameen	Effects of nutrient and sediment-enrichment on plant biomass and porewater chemistry in brackish marsh mesocosms.	Oral	Society of Wetland Scientists Conference	Baltimore, MD, May 28-31, 2019	Completed	Y
							Planned	

7) **List other products or deliverables**. These can include white papers, patent applications, workshops, outreach activities/products. Describe and provide pdf copies, as applicable.

8) **Data.** Making data publicly assessible in a timely manner is a key goal of the data management policy of RESTORE Act Center of Excellence. All projects must ensure that data and ISO metadata are collected, archived, digitized, and made available using methods that allow current and future investigators to address new questions as they arise. Per the U.S. Department of the Treasury's Office of Gulf Coast Restoration Data Accessibility and Management Best Practices[1] *"Data are generally expected to be made publicly available at the time of publication of a peer-reviewed article relying on the data or two years after the data are collected."* All information products resulting from funded projects must be associated with detailed, machine-readable metadata (ISO format) and shared in a regional or national digital repository or data center (e.g., National Centers for Environmental Information, Gulf of Mexico Research Initiative Information & Data Cooperative, Inter-university Consortium for Political and Social Research, DataOne Dash) for discovery and long-term preservation. Metadata, a brief description of the data, and location of the data (e.g., repository, DOI) must be provided to the LA-COE to enable tracking of all data and information products.

[1] https://www.fio.usf.edu/documents/flracep/program-documents/Treasury%20RESTORE%20COE%20data%20management%20best%20practices%20Jan%202018.pdf

#	Description of data	Repository or data center	Date by when data will be made available (2 years after final report)	DOI (or similar) if data are already uploaded
1	Field data (site info, vegetation properties, soil properties, CO2 and CH4 flux rates)	Coastal Carbon Research Coordination Network	November 2020	https://preview.tinyurl.com/y5j6t3oe
2	Field data (lat, long, porewater nutrient concentrations, plant species, productivity, decomposition, accretion rates)	DRYAD	December 2021	
3	Greenhouse study 1 (porewater and tank nutrient concentrations, species composition, productivity, biomass, soil organic matter)	DRYAD	December 2021	
4	Greenhouse study 2 (porewater nutrient concentrations, above and belowground biomass and productivity)	DRYAD	December 2021	
5	N-15 field study (Dissolved inorganic N and N-15 tracer concentrations in plant parts and soil, gross and net NO3- mass balance)	DRYAD	June 2022	
6				
7				
8				

B. PARTICIPANTS AND COLLABORATORS

1) **Project participants and collaborators.** Please list researchers who are not post-doctoral researchers or students but have participated and/or collaborated in this research. This can be both unfunded and funded participants and collaborators on the research project.

First name	Last name	Institution	Project role
Charles	Schutte	Rowan University	Conducted CO2 and CH4 gas flux study

2) Mentoring and Training. Please list post-doctoral and graduate and undergraduate student participants (provide pdf copies of thesis/dissertation).

First Name	Last Name	Postdoc/ PhD/ MS/ BS	# Years involved	Institution	Thesis/Dissertation title/ research topic or tasks	Did the student graduate? Y/N	If they graduated, what is their current position?
Gina	Groseclose	MS	2.5	LSU	Plant and Soil Responses	Y	Scientist, USGS
Donnie	Day	MS	2.5	LSU	Plant community	N	
Alex	Ameen	Postdoc	1.5	Nicholls/LSU	Brackish marsh	Y	Consultant
Songjie	He	Postdoc	1	LSU	DIC analysis	Y	Postdoc
Derek	Jacobs	BS	1	LSU	Student worker	N	MS student, LSU

C. CONTINUING RESEARCH

Please describe the next steps for this work, if applicable (5 bullet points max).

• Given that nutrient-effects strongly depend on marsh elevation and sediment deposition, it will be important to incorporate this into LiDAR-based sediment transport and deposition models under scenarios of Mid-Barataria Bay sediment diversion openings
• Specifically, porewater nutrient concentrations, elevations relative to MHW, and deposition rate treatments and results to parameterize models of diversion impacts on plant community structure, productivity and decomposition
• Nutrient loads entering marshes are either transformed and removed (either through denitrification or downstream transport), assimilated or buried in organic forms in the soil. In most systems, burial may be the dominant pathway. A next step is to quantify nutrient burial rates under a range of conditions and habitat types to predict how nutrient-loading and sedimentation influence the sequestration of nutrients to enhance mass balance estimates for nutrient loads.

D. CERTIFICATION

Please submit report no later than 30 days following the close of the award to:
Danielle Johnson
Grants and Contracts Manager
AP@thewaterinstitute.org

○ Certification: I certify to the best of my knowledge and belief that this report is correct and complete for performance of activities for the purposes set forth in the award documents.
Principal Investigator:
Signature: Tracy Quirk
Digitally signed by Tracy Quirk
DN: cn=Tracy Quirk, o=Louisiana State University, ou=Department of Oceanography and Coastal Sciences, email=tquirk@lsu.edu, c=US
Date: 2020.09.17 15:21:27 -05'00'
Name: Tracy Quirk, 9/17/20
Date Signed:

○ Approval: I have evaluated the final report and associated invoice and confirm that the project is finished.
LA-COE Technical Point of Contact:
Signature: Melissa M. Baustian
Digitally signed by Melissa M. Baustian
Date: 2020.09.23 10:34:22 -05'00'
Name:
Date Signed:

◉ Approval: I have reviewed the final report and approve for payment.
LA-COE Director:
Signature: Melissa M. Baustian
Digitally signed by Melissa M. Baustian
Date: 2020.09.23 10:34:41 -05'00'
Name:
Date Signed: