

GULF RESEARCH PROGRAM

Project Title: Assessing long term linkages between development of oil and gas industry related coastal infrastructure, societal wellbeing and ecosystem function, in coastal Louisiana

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Awardee: The Water Institute of the Gulf

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Project Key Personnel:

- Scott Hemmerling, The Water Institute of the Gulf

I. ORIGINAL PROJECT SUMMARY (from proposal)

Objectives: The overall objective is to assess trends, by parish, and community, in coastal Louisiana, of onshore infrastructure development since the 1950s and compare this to trends in human wellbeing and ecosystem function changes across the same time period. This will allow assessment of relative, non-monetized, benefits and costs of the expansion of this significant industry and can inform understanding of potential future status and therefore management planning efforts.

Responding to the RFA: this project will specifically analyze linkages between ecosystem functions (and associated ecosystem services), human wellbeing, and the infrastructure development associated with the development and expansion of oil and gas production in Louisiana over the past five to six decades. By quantifying changes in the oil and gas industry coastal infrastructure at Louisiana coast-wide and parish scales, the relative benefits gained through additional employment opportunities can be balanced against changes in other sectors and correlation to changes in ecosystem service delivery, in the rapidly changing Louisiana coast, assessed. Multiple ecosystem services from oil and gas extraction, commercial and recreational fishing, hunting, and subsistence food provision will all be considered and quantified. The whole methodology and approach will be applicable to other Gulf coast areas which have experienced increased coastal infrastructure supporting the oil and gas industry, and the approach and conceptual basis of relating infrastructure development and human wellbeing to a series of Habitat Suitability Indices, for assessing ecosystem function, will be applicable Gulf wide, or even nationally or globally.

Innovation: Quantifying trends over five decades in societal wellbeing at a parish, community, and Louisiana coast-wide scale is novel, as well as developing a proxy indication of trends in ecosystem function, comparing these to development of coastal infrastructure in the oil and gas industry is truly innovative. Providing data to show positive and negative changes in human wellbeing and ecosystem

function, as it relates to increased coastal development from a dominant industry, will provide the basis to inform future management planning through the comparative assessment of non-monetized cost benefit analyses.

Relevance to Gulf Research Program:

Goal 1: Through development of a decision making framework this project will highlight, for coastal areas in Louisiana, areas where high oil and gas industry infrastructure co-occurs with high ecosystem function and either low or high human wellbeing.

Goal 2: This project will specifically consider the connections between human wellbeing (including health) and the environment, providing insight into resilience through an analysis of trends and interactions over the past 50-60 years.

Goal 3: The project will provide a framework to inform decision making and advance knowledge of the interconnectivity between environmental and human health, through an ecosystem oriented approach to data integration.

II. PROJECT RESULTS

Accomplishments

Problem addressed: Globally, the coastal zone comprises highly productive, dynamic ecosystems with a long history of human communities heavily reliant upon these natural resources and associated industries. Even though significant offshore oil and gas is drilled in Federal waters within the Gulf of Mexico, a significant proportion is processed within Louisiana and therefore coastal Louisiana supports infrastructure for the drilling, shipping, refining and processing of oil and gas. Coastal Louisiana has a long history of resilient and dynamic human communities (large changes in peoples, location of communities, and dominant livelihoods), is a global hotspot for change, and multiple processes produce rapid subsidence and land loss of 42.9 km² per year (1985-2010 average), resulting in a highly dynamic human, economic and ecosystem landscape. High subsidence rates and associated high relative sea level rise, major hurricanes, land loss, and culturally diverse human communities reliant on some of the most productive coastal fisheries and oil and gas fields in North America, make coastal Louisiana an ideal location to gain unique insights into the linkages between infrastructure development related to the oil and gas industry, human wellbeing and ecosystem function.

What was done to address the problem: Trends were assessed, by parish, and community, in coastal Louisiana, of onshore infrastructure development since the 1950s and compared to trends in socioeconomic wellbeing and ecosystem function changes across the same time period. Data sets were compiled and synthesized to increase availability to managers and researchers, the technical manuscript will provide increased understanding by scientists of the linkages between oil and gas infrastructure development, ecosystem function and socioeconomic wellbeing, and the broad audience synthesis report will help support more informed decision.

What were the results:

1. Oil and gas related coastal infrastructure density rapidly expanded between 1960 and 2010, reflecting the shift from predominantly onshore and nearshore extraction to offshore and deepwater Outer Continental Shelf extraction.

2. While the shift to offshore and deepwater extraction did not result in the construction of new large refining centers, existing facilities expanded capacity and there was a growth in smaller coastal gas processing facilities and pipelines needed to transport product to the refining centers.
3. Infrastructure density was lowest, on average, across communities in Louisiana's Capital region, which includes those communities on the north shore of Lake Pontchartrain. Infrastructure density was highest in South Central, which includes Lafourche and Terrebonne Parishes, the center of Louisiana's offshore oil support industry, and have shown a consistent increase from 1960 through 2010.
4. Across the Mississippi Delta, as coastal marshes have fragmented and then become open water over the last six decades, hot spots for fish and shellfish habitat have migrated north (inland).
5. Estimated suitability of habitat for fish and shellfish varied across the coastal regions, increasing coastwide from 1960 through 2000, showing a significant decline in 2010. This period included major hurricanes, a major oil spill, and high Mississippi River flow events, but may indicate declining resilience of the coast to maintain suitable habitat for fish and shellfish.
6. Socioeconomic wellbeing has remained fairly constant through time on a coast wide basis, although regional- and community-scale differences are apparent. While the causes of these differences cannot be determined, an examination of the data identified a correlation between levels of socioeconomic wellbeing and close proximity (within a 10 minute drive) to areas with high industrial development. In addition, socioeconomic wellbeing within communities was positively correlated to a moderate proximity to areas of habitat with high potential for supporting fish and shellfish (within a 30 minute drive).
7. Many oil and gas-dependent communities, particularly those that support the offshore industry, tend to have relatively low levels of poverty and unemployment, although they often have lower levels of educational attainment, suggesting that many residents may choose to work the oil fields at the expense of completing school. In more industrialized urban areas, this process appears reversed, with higher poverty levels and unemployment, despite the presence of large petroleum refining industries.

Initial Outcomes

Implications of results for project team: The project compiled historical decadal data across coastal Louisiana at a community scale for socioeconomic metrics and coastwide for infrastructure and measures of ecosystem function, assessing direct relationships between these data sets. The identified relationships at different spatial scales, using an approach of drive time distances from communities that was fully developed within this project, identifies this as an important areas of research that has value for further work to further detail interactions at the community and parish scale. The successful collaboration between social and ecological scientists on the team has launched a solid working collaboration which project team plan to continue to pursue. The assessment of hotspots of ecosystem function was novel, and the identification of decadal coastwide increase over four decades and then coastwide decline in ecosystem function for fish and shellfish between 2000 and 2010 is a significant and novel result that warrants further targeted research effort by the team. This project resulted in engagement of the project team with key managers within the oil and gas industry, with potential for future interactions and opportunities for research.

Implications of results for research or practices of others: Change in land area (land loss) for coastal Louisiana is well tracked and documented, however this project has summarized trends in oil and gas coastal infrastructure, socioeconomic wellbeing and ability of coastal Louisiana – which provides important insight to quantify the implications of land loss. The oil and gas industry is currently

considering best approaches to protect the tens of billions of dollars invested in coastal infrastructure, the data collated within this project can assist in informing that decision making and prioritization process. The assessment of ecosystem function and socioeconomic wellbeing are novel and will add to scholarship and understanding of these fields within coastal Louisiana.

Why are the results important for science and society?: Multidisciplinary studies that fully integrate socioeconomic components, ecological data and physical (in this case infrastructure) data are challenging. This project took a fully balanced approach to assessing trends and interactions across these disciplines, presenting the results in a way that is accessible to researchers, managers, private industry and the interested public. The results are important, therefore, for their potential to generate discussion and engagement from multiple sectors in regard to coastal change, oil and gas infrastructure development and linkages to ecosystem function and socioeconomic wellbeing.

Unexpected Results

While it was known that marsh area within coastal Louisiana is declining, it was unexpected to find that the area of hotspot, or highly suitable habitat, for fish and shellfish has stayed steady or even shown slight increases with fragmentation of marshes and transition to open water habitat.

Project Relevance

Researchers, community leaders, and the private sector would be interested in the results of this project.

Researchers: Social scientists – the results and approach for calculating socioeconomic wellbeing are novel for coastal Louisiana. These results build upon other efforts of community assessment in highly vulnerable and natural resource dependent communities. Ecological scientists – the assessment of habitat value for fish and shellfish shows a decadal trend in potential habitat value for fish and shellfish (increase from 1950 through 1990s, and then decline) that has not been previously documented. Ecological theory suggests that this may be the result of coastal fragmentation and is of interest and provides incentive for further research in this area.

Community Leaders: A major focus of the project was based upon community scale analysis, and trends in components of socioeconomic wellbeing that have potential utility for parish and community level leaders and organizations. The synthetic results of infrastructure density and ecosystem function provide context for community scale discussion and decision making.

Private Sector: Colleagues from the oil and gas sector reached out during the project and have been interested to hear results and conclusions. The sector is currently assessing options for protection of coastal infrastructure, in the face of rapid and extensive land loss in coastal Louisiana, and this project provides useful information to assist in understanding linkages between physical infrastructure, ecosystem habitat potential for fish and shellfish, and socioeconomic wellbeing. As the sector considers the benefits and costs of ecosystem restoration approaches vs hard engineered structures to protect this infrastructure, understanding cross disciplinary linkages provides useful insight.

Education and Training

Number of students, postdoctoral scholars, or educational components involved in the project:

- Undergraduate students: 3
- Graduate students: 1
- Postdoctoral scholars: 0
- Other educational components: 2

The development of the broad audience 16 page synthesis report is graphics rich and designed for dissemination throughout the cross disciplinary management community with potential for communication in the broader public.

III. DATA AND INFORMATION PRODUCTS

This project produced data and information products of the following types:

- Data
- Scholarly publications, reports or monographs, workshop summary or conference proceedings

DATA

See attached Data Report.

Relationship between data sets: Multiple data sets of geospatial and tabular data were used for this multidisciplinary study and are in three broad areas; oil and gas infrastructure density, ecosystem function and socioeconomic well-being. Geospatial data for HSI, Louisiana regions and historic change in land area were used for the development of fish and shellfish habitat suitability from 1950 through 2010, geospatial layer. Geospatial layers on employment, parish annotations, coastal zone, census designated places and Louisiana communities, were used to develop the geospatial layer for historic change in socioeconomic well-being 1960 to 2010. Community drive time geospatial layer, along with growth in oil and gas infrastructure were used in the development of socioeconomic wellbeing, ecosystem function and infrastructure density for each coastal region in Louisiana.

INFORMATION PRODUCTS

Citations for project publications, reports and monographs, and workshop and conference proceedings:

Hemmerling, S.A., Carruthers, T.J.B., Hijuelos, A.C., Riley, S., and Bienn, H. 2016. Trends in oil and gas infrastructure, ecosystem function, and socioeconomic wellbeing in coastal Louisiana. WISR-001-2016. The Water Institute of the Gulf. 20pp.

Hemmerling, S.A., Carruthers, T.J.B. and Hijuelos, A.C. (in prep) Long Term Linkages between development of oil and gas related coastal infrastructure, human wellbeing and ecosystem function. AMBIO in preparation

Other activities to ensure access to information products:

Results of this research were presented by Hemmerling and Carruthers at the 2016 'State of the Coast' conference in New Orleans, Louisiana. A conference that specifically targets coastal researchers, decision makers, industry representatives from Louisiana.

The synthesis report captures all key data, results and conclusions in a graphic rich format accessible to multiple audiences - specifically to generate the broadest engagement in the results of the study by the broadest array of stakeholders. The report will be accessible on the website of The Water Institute of the Gulf, and will also be printed in hard copy and disseminated at targeted state and Gulf coast meetings and workshops, as well as among oil and gas industry partners. The Water Institute of the Gulf is coordinating an 'Industrial Infrastructure Task Force' to support alignment and coordination of efforts by industry partners to protect coastal infrastructure - this will provide an ideal venue for effective dissemination of the project outputs.