Socioeconomic Analysis of The Nature Conservancy's Galveston Bay and Calcasieu Lake Oyster Reef Restoration Projects

Results from Subject Matter Expert Interviews and Human Dimensions Public Survey

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Executive Summary

The study utilized an Ecosystem Service Logic Model to systematically identify potential socioeconomic metrics for monitoring the impacts of oyster reef restoration in both Galveston Bay and Calcasieu Lake. To ensure local relevance, a detailed analysis of these potential outcomes and metrics was conducted through expert interviews and an online public survey from August to September 2023. The insights gleaned from expert interviews shaped the formulation of survey questions, distribution strategies, and project details and provided concrete evidence of linkages within the Ecosystem Service Logic Model, reinforcing the foundation for the monitoring plan.

The public survey, strategically disseminated through flyers in key locations and amplified via social media, including a targeted Facebook advertising campaign, garnered 136 responses on the Qualtrics platform between November 1st and December 7th. Following a documented filtering process to exclude spam, incomplete submissions, and those lacking proper consent, 79 survey responses were deemed suitable for analysis.

Findings for the Beezley Reef site highlighted respondents' widespread understanding of restoration concepts. However, awareness of the TNC Beezley project was relatively low. Most respondents asserted that their occupations were not linked to Galveston Bay. Uses of the study site include activities like recreational fishing, boating/kayaking, and social gatherings. Noteworthy concerns included apprehension about pollution, water quality, wildlife loss, biodiversity depletion, and the potential loss of access to natural areas. Regarding the project's impact, most respondents did not report significant effects from the reef construction, with a few exceptions. Overall perceptions of the project were predominantly positive, with select comments providing insights into participant values and perspectives.

Respondents similarly reported a good understanding of restoration for the Calcasieu site, although awareness of the TNC project was below 50%. A substantial percentage (41%) indicated job ties to Calcasieu Lake, encompassing roles such as wholesale/retail buyers of shrimp, fish, and oysters, commercial fishing, and natural resource management. Popular activities included recreational fishing, birding, wildlife viewing, and social gatherings. Shoreline erosion, a primary focus of the TNC Calcasieu Lake Oyster Reef Restoration Project, generated great concern from over 50% of respondents, coupled with apprehensions about severe storms. The site demonstrated a likelihood of subsistence fishing. Most respondents indicated experiencing no impacts from the project. Comments conveyed a positive sentiment toward the Calcasieu Lake Oyster Reef Restoration Project.

Lastly, expert interviews and survey data generated evidence to support the linkages between socioeconomic outcome categories, including economic activity, property protection, human health, and cultural values. These results were used to support the development of site-specific socioeconomic monitoring plans.

Introduction

With increasing restoration activity along the Gulf of Mexico, there is increasing interest to enhance the reporting of restoration progress and benefits to the environment, people, and the economy. This work aims to develop a socioeconomic monitoring plan for two oyster reef restoration sites: Lake Calcasieu in Louisiana (West Cove Oyster Reef) and Galveston Bay (Beezley Oyster Reef). The following describes the framework the contracted project team (the Community Resilience Group at Harte Research Institute for Gulf of Mexico Studies) used to develop a socioeconomic monitoring plan for the Calcasieu Lake oyster reef restoration site and a human dimensions analysis. This work aims to provide The Nature Conservancy and its partners with a pilot socioeconomic monitoring plan that can be implemented for monitoring the Beezley Reef (Galveston-Trinty Bay) oyster reef restoration site and adjacent human communities. This pilot plan is envisioned to serve as recommendations for holistic monitoring of oyster reef restoration projects and as a model for other practitioners, funders, and planners interested in evaluating the multiple benefits of restoration activities.

To inform these plans, a human dimensions analysis was conducted to validate existing ecosystem-service models for oyster reef restoration. The human dimensions analysis consisted of 1.) a series of expert interviews were conducted during August and September 2023 and 2.) a public survey .

Expert Interviews Methods

This project uses the framework provided by Ecosystem Service Logic Models to understand the socioeconomic outcomes of restoration. These models capture the impacts of restoration as they cascade through the biophysical system to result in social and economic outcomes (Figure 1). The model components include the intervention, biophysical changes, human activity changes, socioeconomic outcomes, and potential metrics for monitoring (Olander et al. 2021).

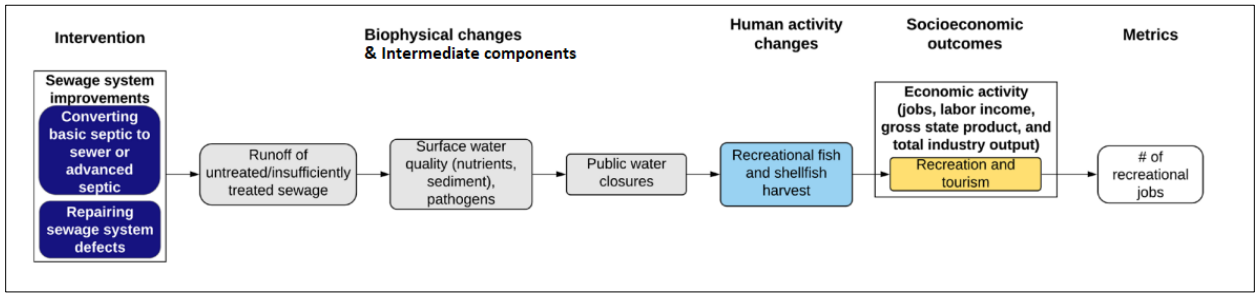


Figure 1. Simplified Ecosystem Service Logic Model. Image adapted from Olander et al. 2021.

Models for oysters consider various restoration approaches, and linkages between restoration activity, bio-physical changes, human activity, and socioeconomic outcomes have been identified (Warnell et al. 2020).

Survey Methods

Survey Development

Following the interviews and analysis of interview feedback, a public survey was developed. The survey was designed to gain a better understanding of human use of restoration sites, assess people's knowledge of TNC restoration projects, and inquire about the impacts (positive or negative) of restoration activity. Further, the survey design was guided by restoration project goals and outcomes, oyster reef ecosystem service logic models (see Appendix A), and feedback from expert interviews. The survey design, questions, distribution images, and text were all reviewed and approved by the Texas A&M University-Corpus Christi IRB Institutional Review Board (IRB) (Study IRB Number: TAMU-CC-IRB-2023-0844).

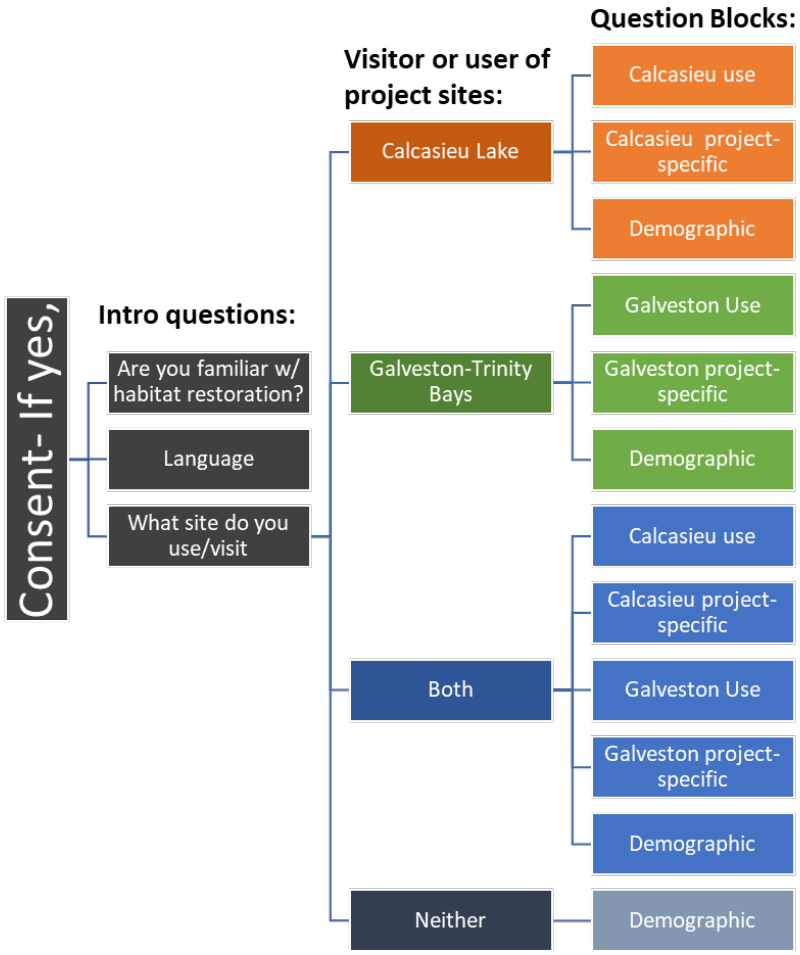


Figure 2. TNC Oyster Reef Restoration Public Survey Design

The survey targeted users and visitors of each study site and collected demographic information. The survey was offered in English, Spanish, and Vietnamese. The survey allows for free-text explanation and user input at various locations—written feedback provided clarification, examples, and an overall better understanding of participants' perceptions. Data collection is divided into survey blocks (Figure 2). All survey participants were required to complete a Captcha to help reduce spam. Next, following IRB protocol, participants had to acknowledge consent to participate in the survey. Introductory questions

ask about language preference, knowledge of habitat restoration, and if the user is a visitor or user of the project sites. The survey flow directs participants to the blocks associated with the area(s) they use. A use block, project-specific block, and demographic questions block are assigned for each site. If the users do not use either of the study sites, they are directed to the demographic questions and end of the survey.

The use questions were designed to understand the most common activities near the restoration area (See Appendix C. Public Survey Questions). This information can be used to understand how various user groups may be affected by current and future restoration activity. Surveyed activities cover a range of physical, recreational, spiritual, health, and social activities. Further, the survey gathers feedback on participants' environmental concerns in the area. This information can help support the need for the project or understand where restoration interacts with these concerns. The participant ranked their concerns from "not at all concerned" to "concerned" for several topics relating to habitats, wildlife, pollution, and environmental change.

The project-specific questions are designed to collect participants' knowledge and perception of TNC's oyster reef restoration projects. The questions are designed to understand if the project sites are used for subsistence fishing, associated with the participant's livelihood, and ask how this project has affected them or local businesses (positively or negatively).

Demographic questions can give insight into the type and diversity of users who utilize the project site and what demographic is less likely to be aware of restoration projects. It may also give insight into specific demographics with unique use and or knowledge. Three questions were chosen to make the survey as quick as possible: race/ethnicity, age, and household income.

Survey Distribution

The survey was distributed via flyers placed in locations of interest and through social media, including Facebook paid advertising. During November 3rd-8th, two HRI staff traveled to Lake Charles, LA, and Baytown, TX, to distribute survey flyers (figure). Flyers were distributed at the following Locations:

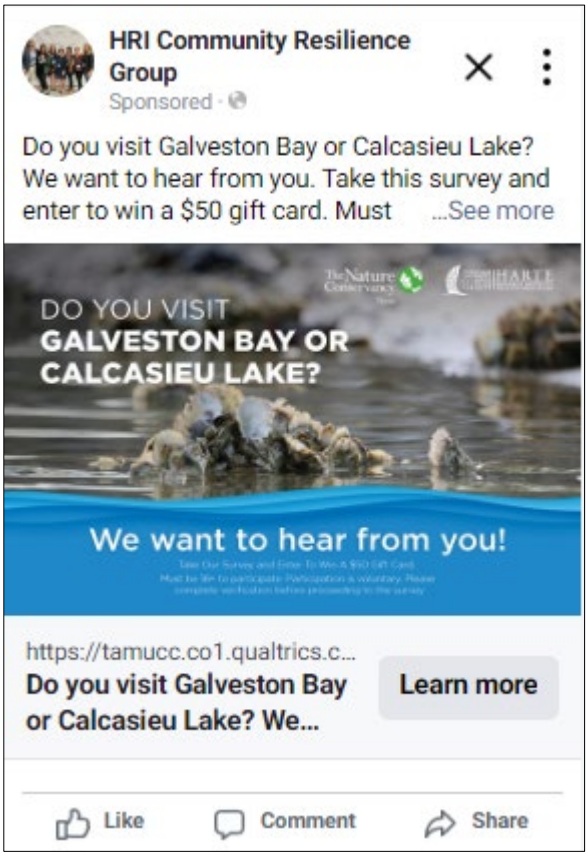
Calcasieu Lake site

- Libraries in Cameron and Calcasieu Parish
- Visit West Cove Boat Ramp
- Brown's Grocery (Hackberry)
- Hackberry Rod & Gun
- Hackberry Recreation Center
- Sabine National Wildlife Refuge
- West Cove Boat Ramp
- Louisiana Department of Wildlife
- Louisiana Sea Grant
- Visit Lake Charles (Visitor Bureau)
- Cameron Prairie NWR Visitor Center

Beezley Reef Site

- Galveston Bay Foundation
- Baytown Nature Center- Education Center
- Prestige Oysters
- Eagle Point Fishing Camp
- Thompson Boat Ramp
- San Leon Gil Hooley (restaurant)

Figure 3. Survey flyers were printed and distributed near the Calcasieu Lake and Beezley Reef sites. Flyer design credit J. Conchola, Harte Research Institute for Gulf of Mexico Studies.



A Facebook ad was made live on November 16th and ran through November 29th. The ad was made available in English, Spanish, and Vietnamese. Facebook ads alternate through various feeds, including Facebook Feed, Marketplace, Video feeds, Stories, Banners, and Instagram Explore, Stories, and Feed.

The ad had a budget of $400 and received a total of 525 clicks. The ad reached over 30,000 people and received 535 clicks through the Meta Audience Network and Facebook. Instagram was not a significant app for reaching the target audience. The demographic of people who clicked on the ad are as follows:

Demographic	Percent of Respondents (N=525)
Women	54%
Men	45%
Age 65+	53%
Age 55-64	21%
Age 45-54	9%
Age 35-44	8%
Age <34	9%

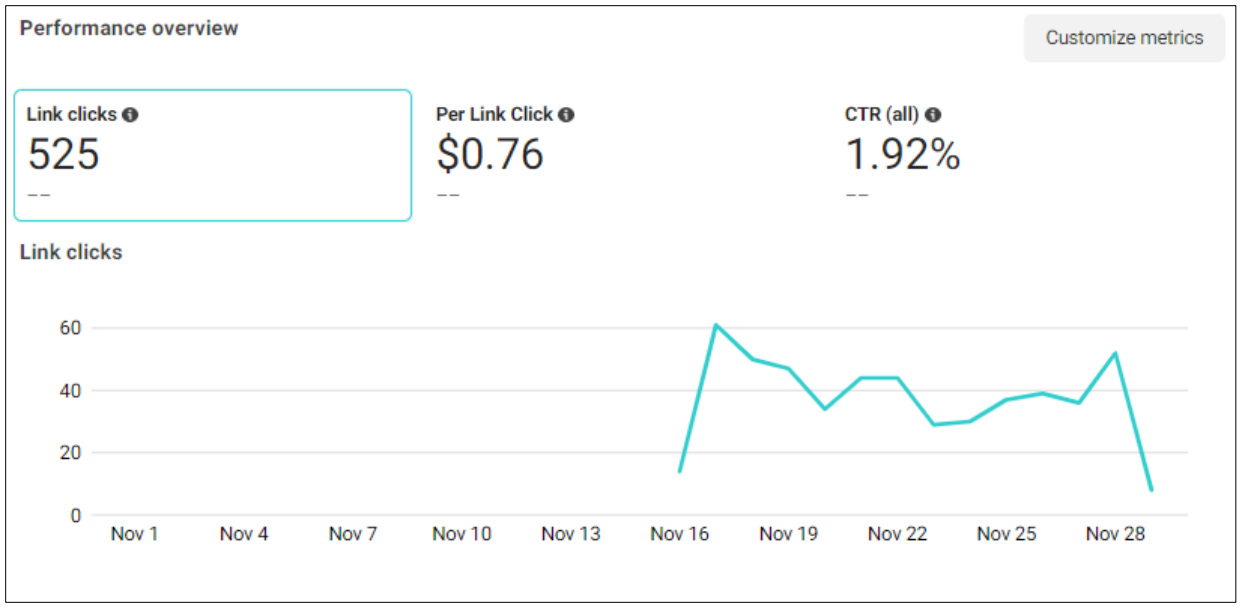


Figure 4. Facebook ad traffic during November 2023.

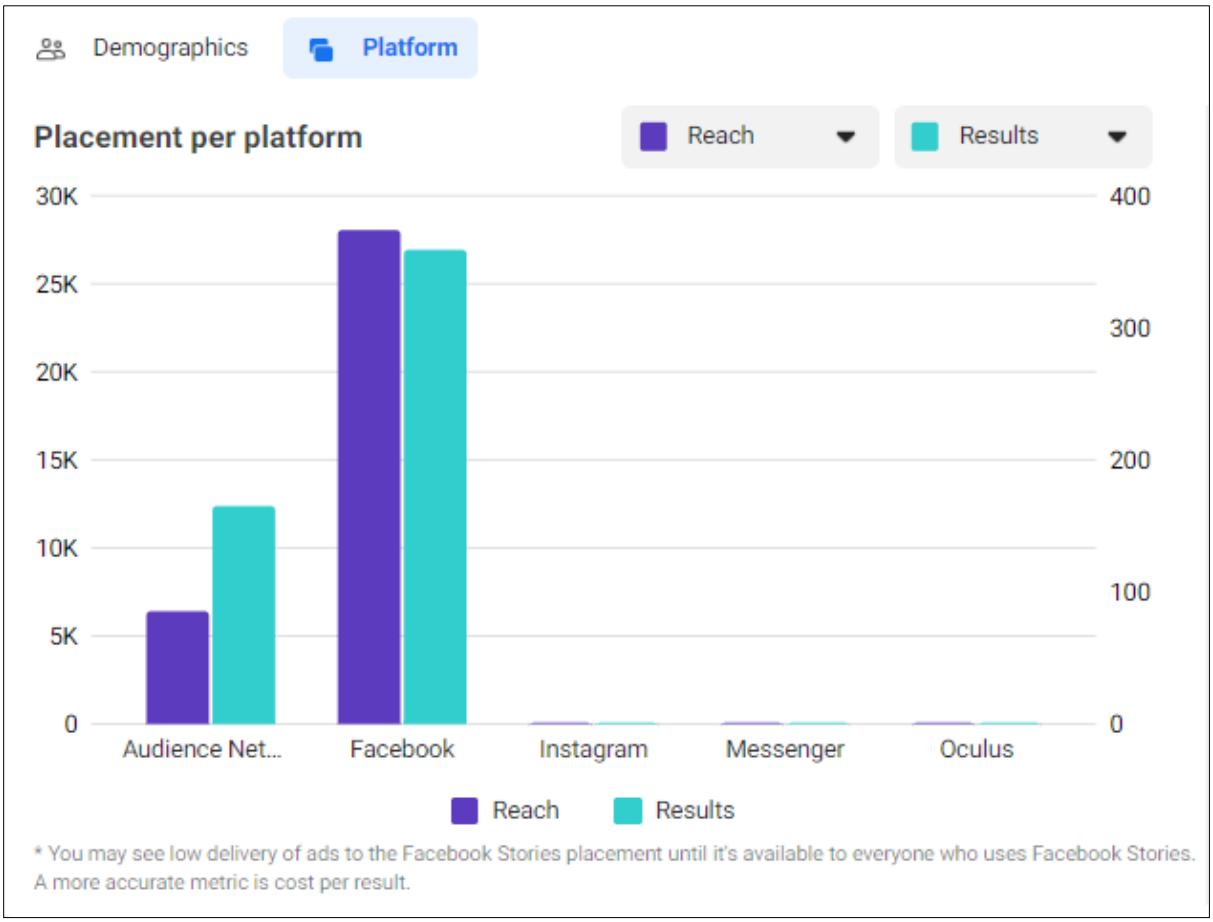


Figure 5. Facebook ad reach by platform from November 16th to the November 29th, 2023.

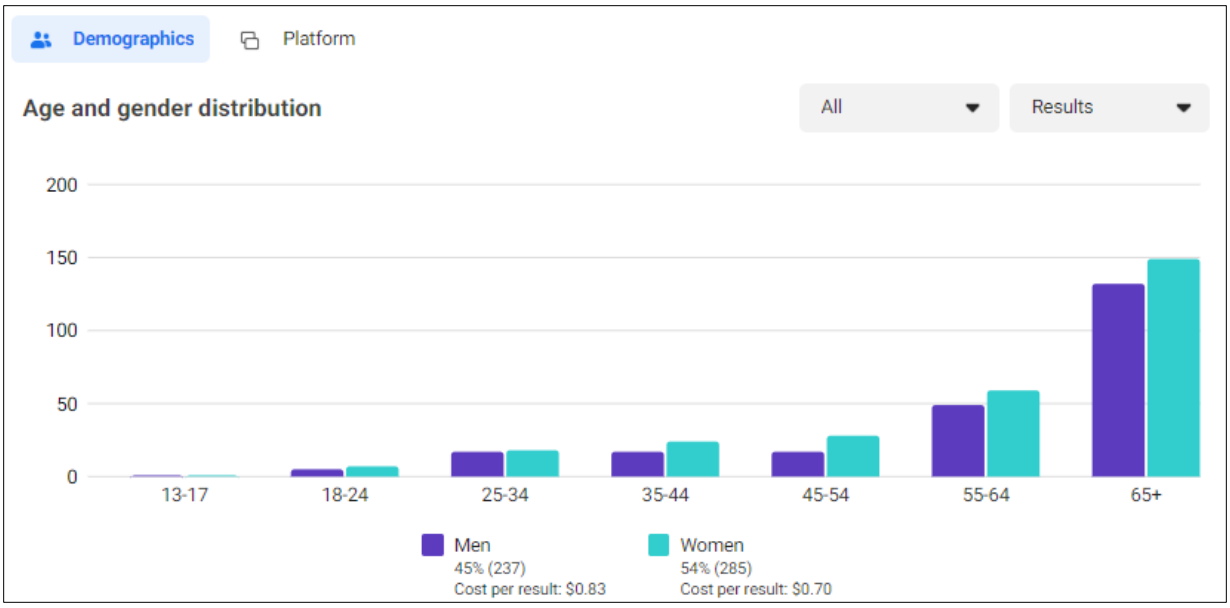
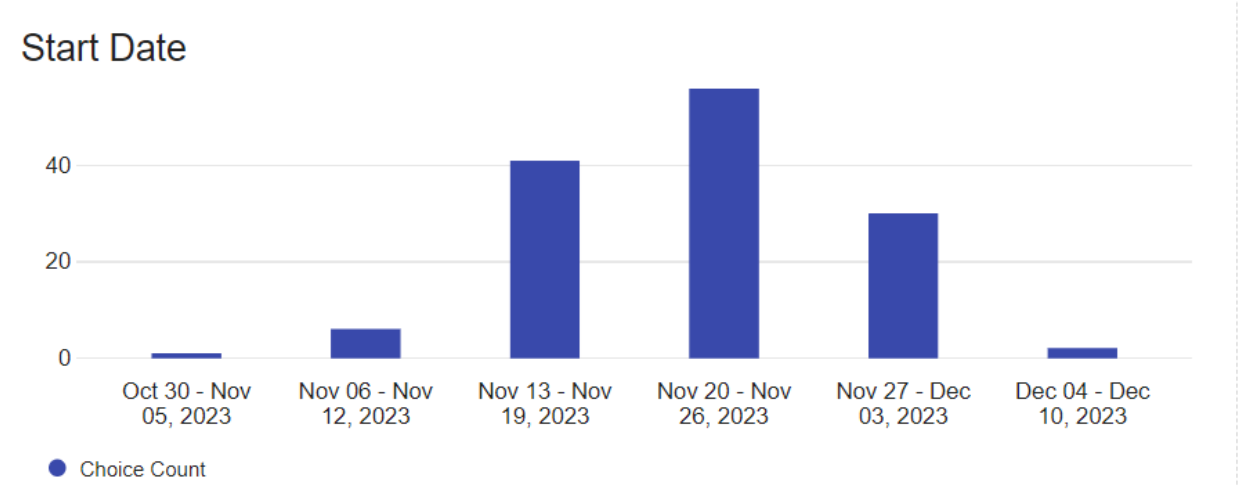


Figure 6. Facebook ad clicks by sex and age.

Survey Length and Data Management

The survey was hosted on Qualtrics and was made available November 1st, 2023. The majority of the responses were started during the period of November 13 – December 3, concurrent with the Facebook advertisement. Further access through the survey made through the QR code (available in the flyer) resulted in 6 survey visits, most survey visits were accessed through the link (130) corresponding to the Facebook ad.



The survey will be maintained through the end of December. A total of 136 survey responses were collected as of December 7th, 2023. The data was downloaded, and data quality was assessed. The following data filters were applied to reduce the number of spam and fake responses: 1.) survey consent had to be yes. 2.) Captcha response values greater than >0.4 (range 0-1) 3.) Survey Progress greater than 10% 4.) Duration of survey > 120 seconds. 5.) Text answers had to be legible and appropriate answers to the question. From the 136 responses, 79 were found to be appropriate for analysis.

Table 1. Filtering criteria for public survey responses.

Filter Criteria	**filtered records**	**Data records remaining**
starting records		*136*
Consent granted	38	98
Captcha score >0.4	3	95
Progress >10%	7	88
Duration > 120 seconds	5	83
Readable and appropriate text	4	79

Expert Interview Results: Beezley Reef

Interviews with experts of the Beezley Reef site resulted in several coded segments (Figure 7) related to survey distribution ideas (n=9 coded segments), information gaps (n=10), potential partners (n=8), and evidence to support the socioeconomic linkages from the ecosystem service logic model (n=68) (see also Figure 47).

Interviewees offered a variety of suggestions regarding survey distribution, including social media, physical locations near the study, and several organizations and events (for a fully developed list, see *Appendix E. Public Survey Distribution Suggestions from Experts*). From the interviews, a list of partners also emerged; these partners may help with survey distribution and in future studies, for example, Texas Parks and Wildlife, Galveston Bay Foundation, Texas Master Naturalist, oyster garden groups, and other academic groups.

Several comments addressing monitoring gaps highlight the need for additional information, including socioeconomic data, macrofauna, and fish assemblages. Other suggested monitoring parameters encompass the frequency of use by recreational boats, oyster harvest data (both before and after restoration), filtration capacity of oysters, sedimentation levels at restored reefs, and the impacts of cultivation on reef regeneration.

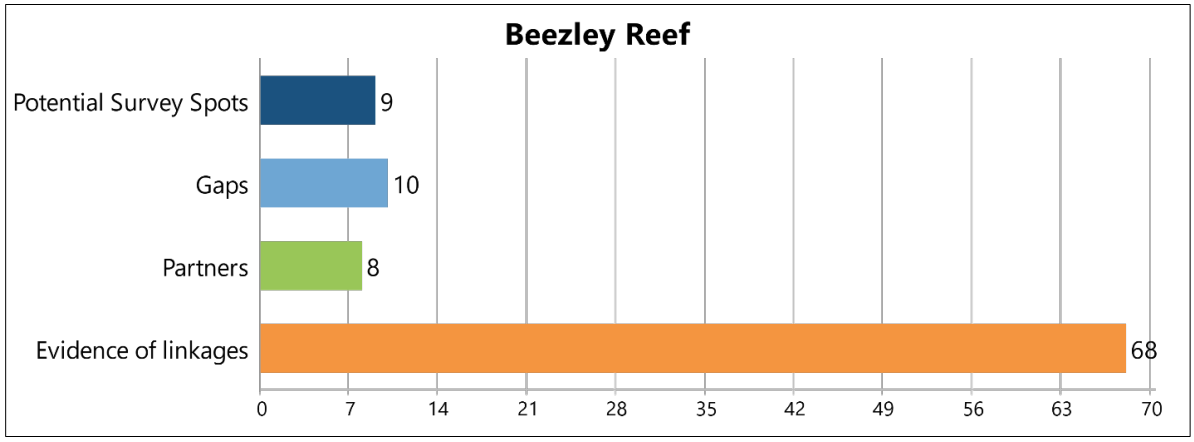


Figure 7. Beezley Oyster Reef Expert Interview: Number of Coded Segments by Code Category

A total of 68 coded segments from the interviews correspond to evidence of linkages (Figure 12). Of these, eight coded segments correspond to socioeconomic outcomes, 29 to human activity outcomes, and 31 to intermediate components (Figure 8).

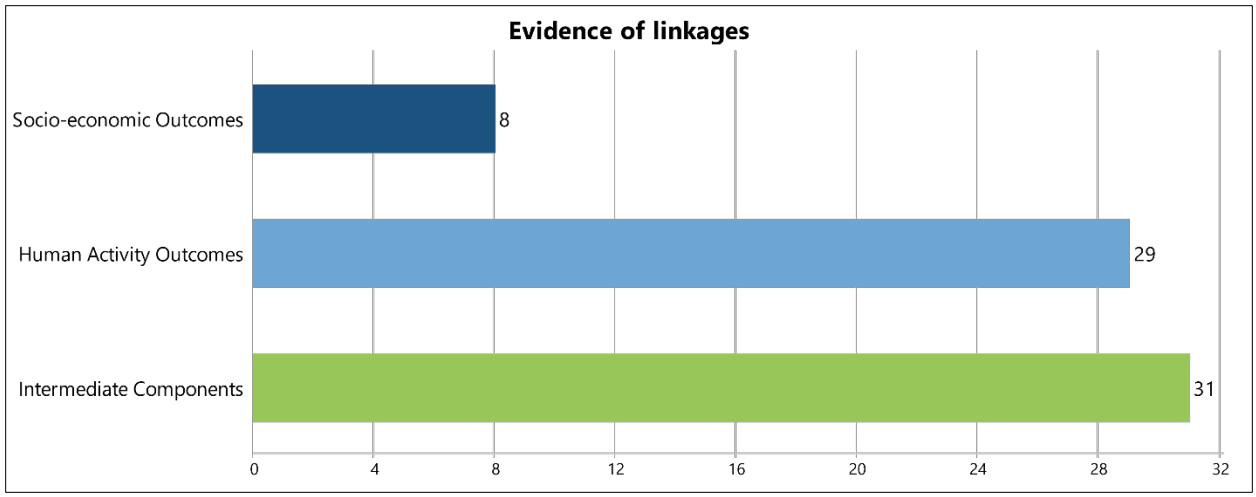


Figure 8. Beezley Oyster Reef Expert Interview: Number of Coded Segments by Evidence Linkage Category

Socioeconomic outcomes identified as a potential result of this restoration project were coded in the categories of cultural value (n=3) and economic activities (n=5). As a cultural value, the reef design is expected to enhance the ecosystem's resilience and ecosystem services. The restoration project generates economic activity through the construction and possibly by enhancing oyster and non-oyster harvests in the future. This can promote economic activity in the areas of recreational and commercial fishing.

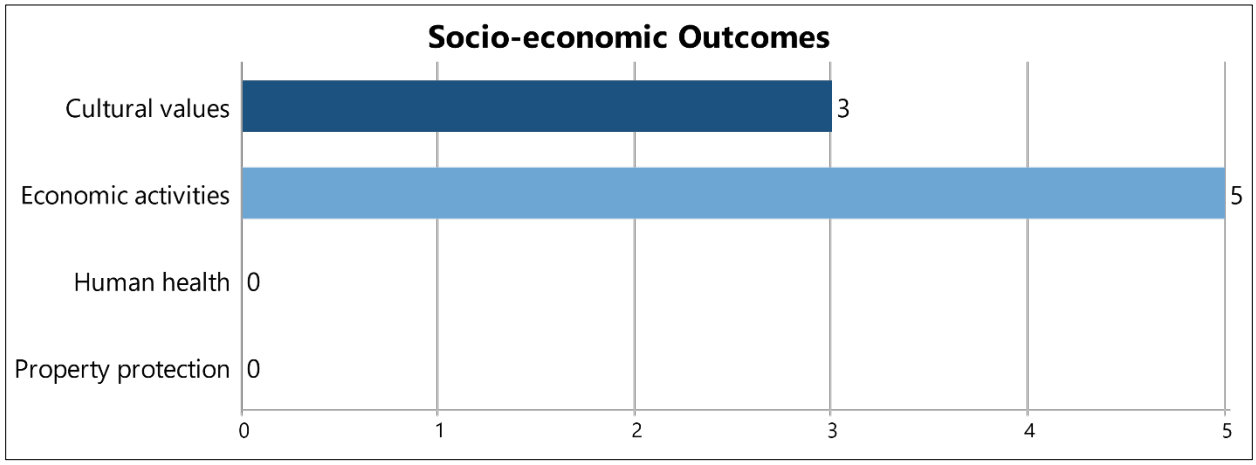


Figure 9. Beezley Oyster Reef Expert Interview: Number of Coded Segments by Type of Socioeconomic Outcome

The study identified 29 comments related to human activities in the area, as depicted in Figure 10. Among these, those focusing on educational activities (n=12) highlighted the positive influence of programs like the Galveston Bay Foundation, San Leon Oyster Festival, and various media channels in fostering awareness about oyster reef restoration. However, some comments emphasized the need for increased education, mainly targeting commercial oyster harvesters. Given the longstanding presence of oyster harvesters in the area, spanning many generations, reef harvesting in Galveston Bay holds cultural significance, with additional local festivals celebrating the cultural aspects surrounding oysters. A significant portion of comments centered around oyster harvest (n=7), recognizing the potential for restoration to enhance both harvestable reefs and non-oyster harvest activities like fishing (n=2). These

observations collectively highlight the connection between educational initiatives, cultural practices, and the economic aspects of oyster harvest within the study area.

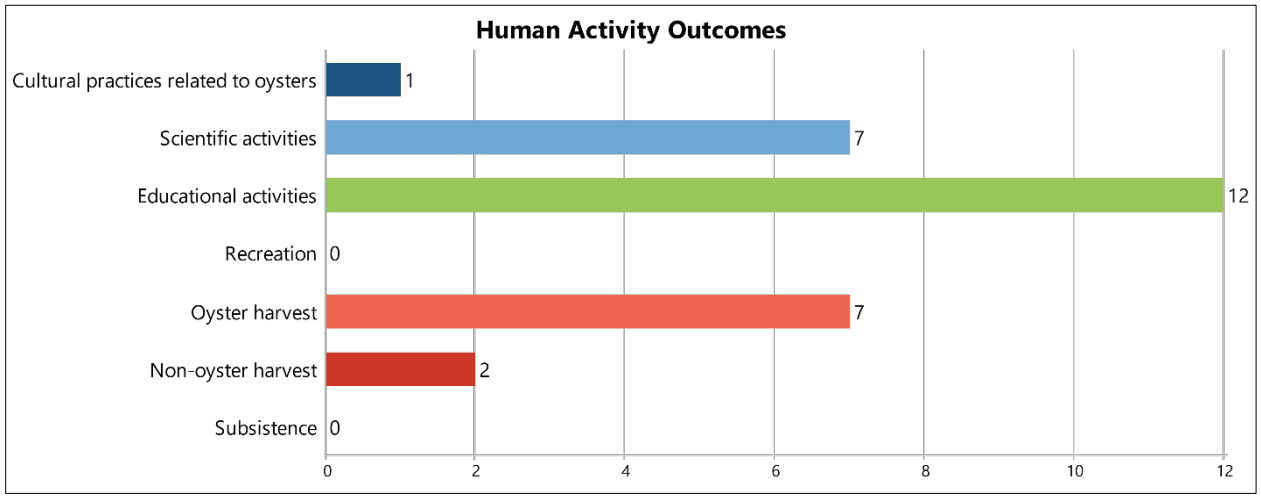


Figure 10. Beezley Oyster Reef Expert Interview: Number of Coded Segment by Type of Human Activity Outcome

Lastly, several coded segments (n=31) support the intermediate components, evidence that links the restoration to the socioeconomic outcomes (Figure 11). The comments affirm that the reef design has the potential to significantly improve oyster recruitment and ensure the enduring presence of habitat. The enhancement of oyster reefs is regarded as a proactive measure that contributes to the overall improvement of habitat conditions and plays a vital role in bolstering biodiversity, marine wildlife populations, and water quality. Insights gathered from interviews highlight the perception that a primary objective of the project is to enhance oyster harvest, aligning with the overarching goal of promoting sustainability and ecological health in the targeted area.

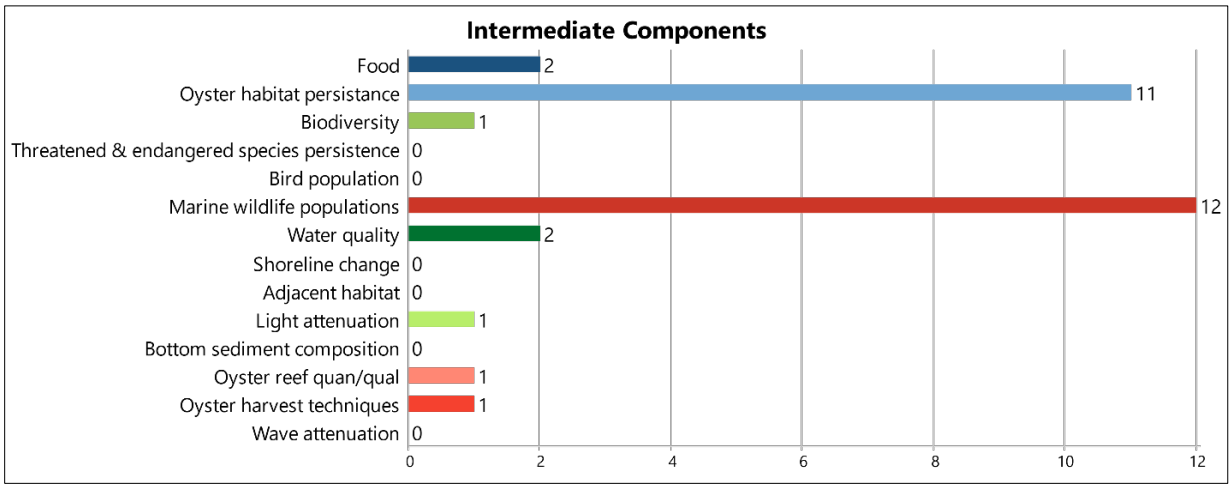


Figure 11. Beezley Oyster Reef Expert Interview: Number of Coded Segments by Type of Intermediate Component

Expert Interview Results: Calcasieu Lake

Interviews with experts of Calcasieu Lake resulted in a number of coded segments (Figure 12) in the related survey distribution ideas (n=8 coded segments), information gaps (n=6), potential partners (n=5), and evidence to support the socioeconomic linkages from the ecosystem service logic model (n=70) (Figure 48).

Interviewees offered a variety of suggestions regarding survey distribution, including social media, physical locations near the study site, such as public boat ramps, festivals, and local businesses and public areas that locals frequent (for a fully developed list, see *Appendix E. Public Survey Distribution Suggestions from Experts*). From the interviews, a list of partners also emerged; these partners may help with survey distribution and future studies, for example, Chevron (previously involved in messaging for restoration), Coastal Restoration Coalition of Louisiana, local municipalities, and the Just Imagine Southwest Louisiana Campaign.

Certain comments addressing monitoring gaps describe specific informational needs, including a desire for more comprehensive data on the shoreline protection facets of the project. Additionally, there was a call for implementing a survey targeting both commercial and recreational charter fishermen who frequent the area, recognizing the potential impact on their activities. Another significant suggestion highlighted the importance of monitoring the vertical relief of the reef to assess its settling (sinking) rate.

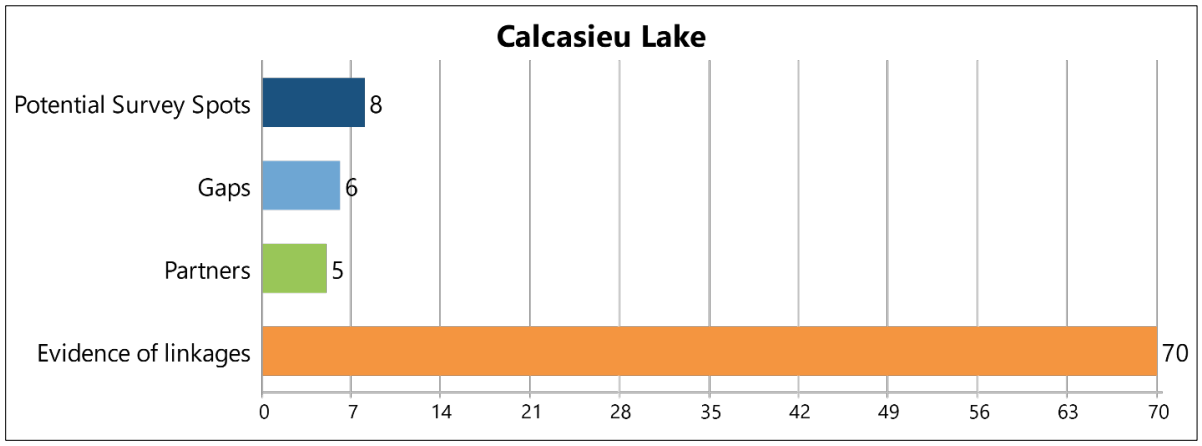


Figure 12. Calcasieu Lake Oyster Reef Expert Interview Number of Coded Segments by Code Category

A total of 70 coded segments from the interviews correspond to evidence of linkages (Figure 12). Of these, 18 coded segments correspond to socioeconomic outcomes, 15 to human activity outcomes, and 37 to intermediate components (Figure 13).

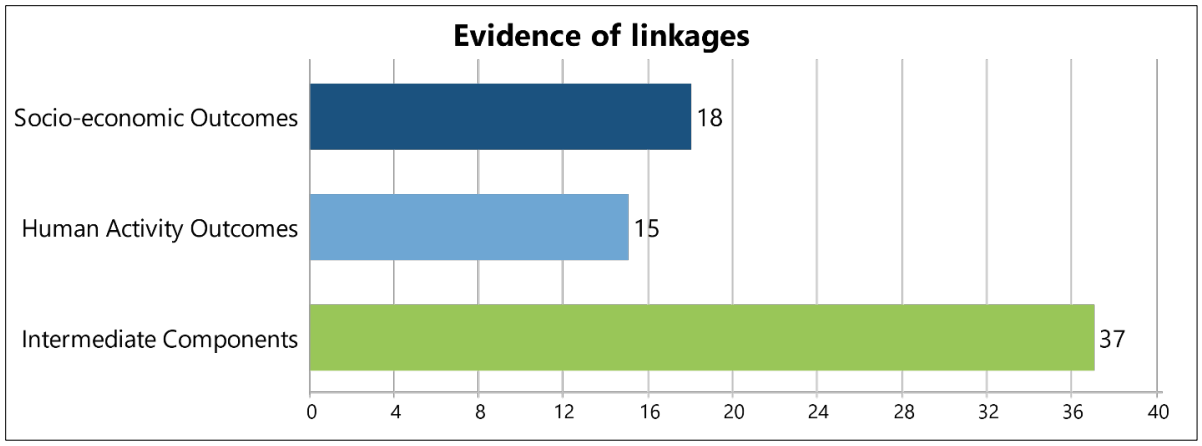


Figure 13. Calcasieu Lake Oyster Reef Expert Interview: Number of Coded Segments by Evidence Linkage Category

Socioeconomic outcomes identified as a potential result of this restoration project were coded in the categories of cultural value (n=1), economic activities (n=8), and property protection (n=9) (Figure 14). One respondent highlighted the cultural value of these restoration projects, asserting that they hold the potential to enhance the quality of life and bolster the resilience of coastal communities. These initiatives contribute significantly to the environmental elements that draw people to the area, influencing individuals' decisions to reside here. The interconnection between the physical landscape, tourism, and regional economic development is evident, with potential outcomes such as increased commercial and recreational fishing activity. Moreover, most interviewed experts familiar with the project acknowledged its primary objective: safeguarding the marsh shoreline of West Cove from wave and flood activity, thereby extending crucial protection to the landward road in this location (segments coded for property protection, n=9).

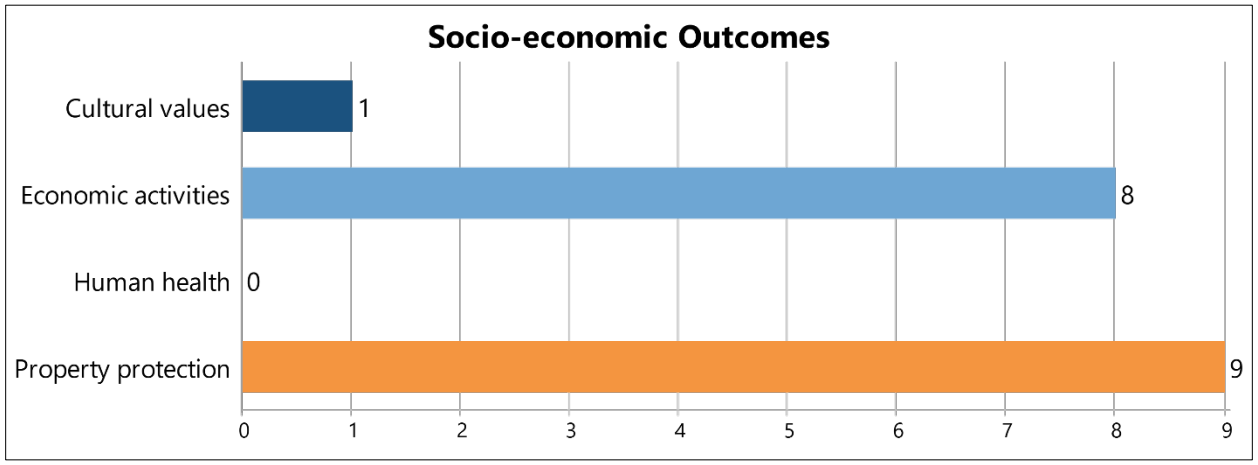


Figure 14. Calcasieu Lake Oyster Reef Expert Interview: Number of Coded Segments by Type of Socioeconomic Outcome

Human activities reported for this area (Figure 15) include possible fishing, including commercial and sport fishing, tournaments, oyster, and crab harvesting. Educational activities related to this project are minimal (TNC and Chevron have done some education), but overall outreach related to restoration is promoted through the *Louisiana Coastal Master Plan* and *Just Imagine Southwest Louisiana Campaign*.

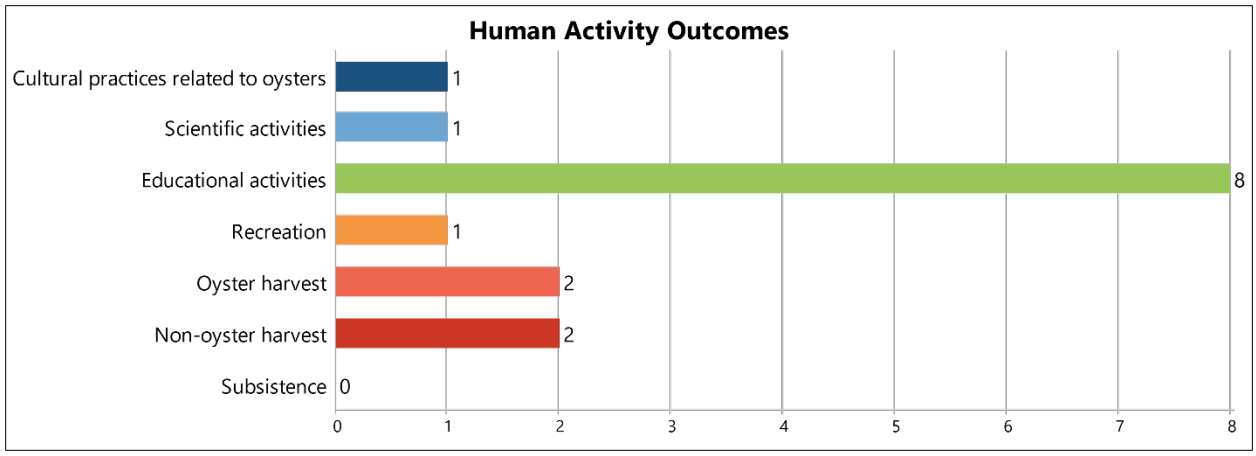


Figure 15. Calcasieu Lake Oyster Reef Expert Interview: Number of Coded Segments by Type of Human Activity Outcome

Lastly, a number of coded segments (n=37) support the intermediate components, evidence that links the restoration to the socioeconomic outcomes (Figure 16). The comments consistently affirm that the oyster restoration efforts at West Cove not only enhance the habitat and persistence of oysters but also play a vital role in creating a conducive environment for various estuarine species. Furthermore, the restoration acts as a dynamic living shoreline, offering stability to the shoreline itself and providing essential protection to the adjacent habitats.

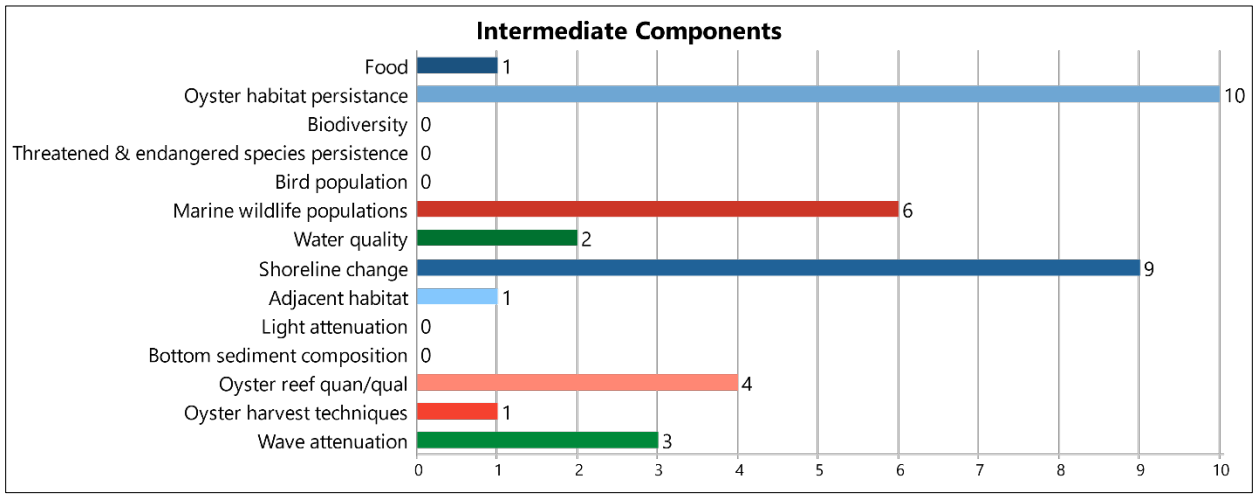


Figure 16. Calcasieu Lake Oyster Reef Expert Interview: Number of Coded Segments by Type of Intermediate Component

Public Survey Results

From November 1st to December 7th, 136 survey responses were captured through the Qualtrics platform. After filtering spam, incomplete surveys, and surveys without consent, 79 survey responses were used for analysis. The surveys were primarily completed in English (n=76 or 96%), and 3 (4%) were completed in Spanish. No responses were completed in Vietnamese.

Of the respondents, 52 (66%) visit Galveston Bay, 15 (19%) visit Calcasieu Lake, and 12 (15%) reported visiting both (Figure 17). Of the respondents who visit both sites, 3 (25%) were most familiar with Galveston Bay, 5 (42%) were most familiar with Calcasieu Lake, and 4 (33%) were most familiar with both sites. A total of 59 responses were collected for the Beezley Reef site. Surveys were recorded between November 15th, 2023 and December 7th, 2023. For Calcasieu Lake, 24 responses were recorded between November 13th, 2023, and November 30th, 2023.

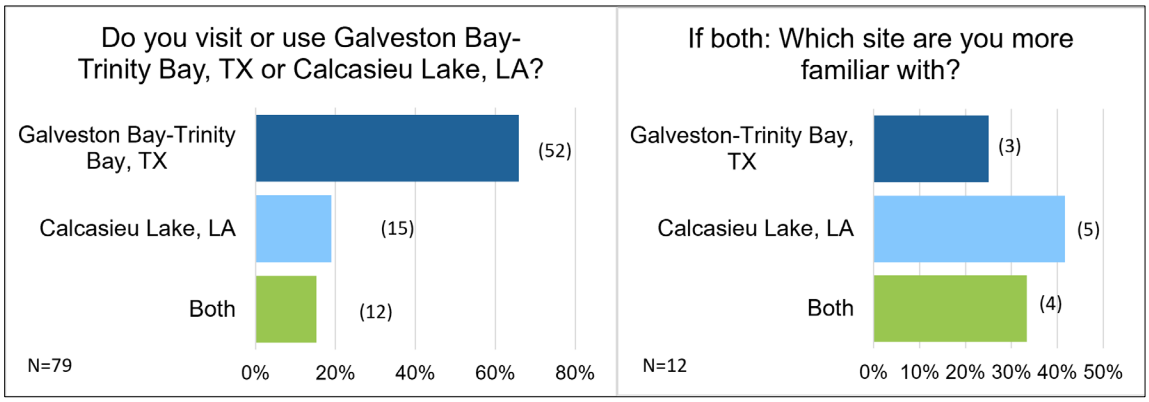


Figure 17. Respondents who visit the project sites, if both, which site is most familiar.

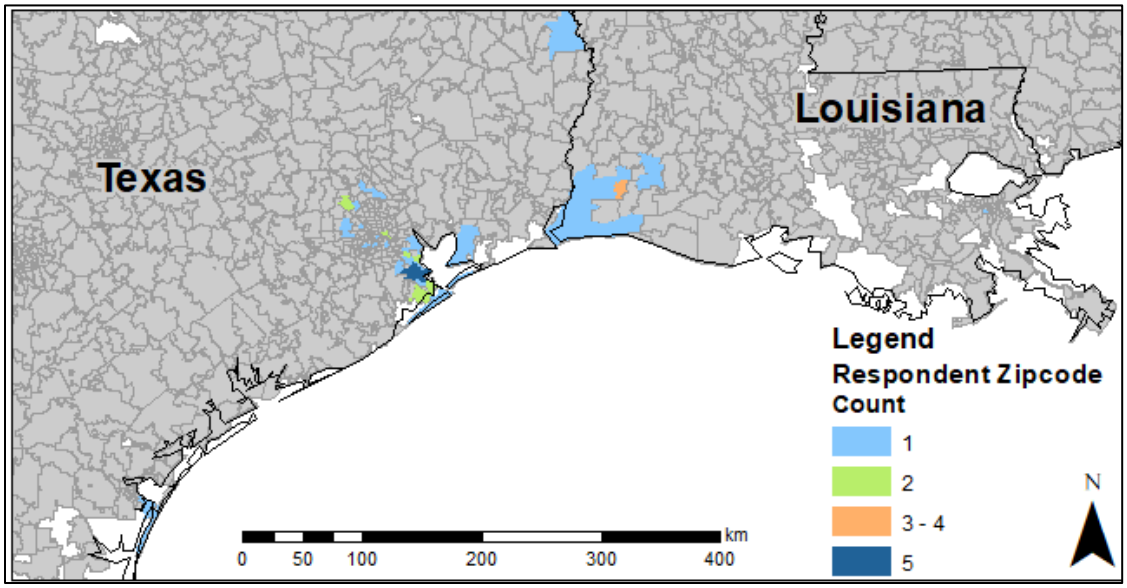


Figure 18. The map shows the number of respondents by zip code in East Texas and coastal Louisiana.

Lastly, 70 respondents provided a zip code. Most respondents (93%) have zip codes in Texas and Louisiana. In Texas, most zip codes correspond to the Houston metropolitan complex and communities

surrounding Galveston Bay. Many of the respondents in Louisiana are from the Cameron Parish communities and areas surrounding Lake Charles. Three respondents reported zip codes outside of these two states: on from southeast Florida, one in Alabama and one respondent from California.

Public Survey Results: Beezley Reef

Community Use and Environmental Concerns in Galveston-Trinity Bay

When asked, "Have you heard of habitat restoration?" the majority, comprising 90% or 52 respondents, indicated they were familiar with the concept (Figure 19). In contrast, 10% or six respondents reported not having heard of habitat restoration. A significant portion of the respondents who confirmed awareness expressed knowledge of specific habitat restoration efforts, specifically oyster, marsh, coral, and seagrass restoration (see Appendix F. Additional Graphs, Figure 49). The results highlight a demographic of respondents that is knowledgeable of restoration.

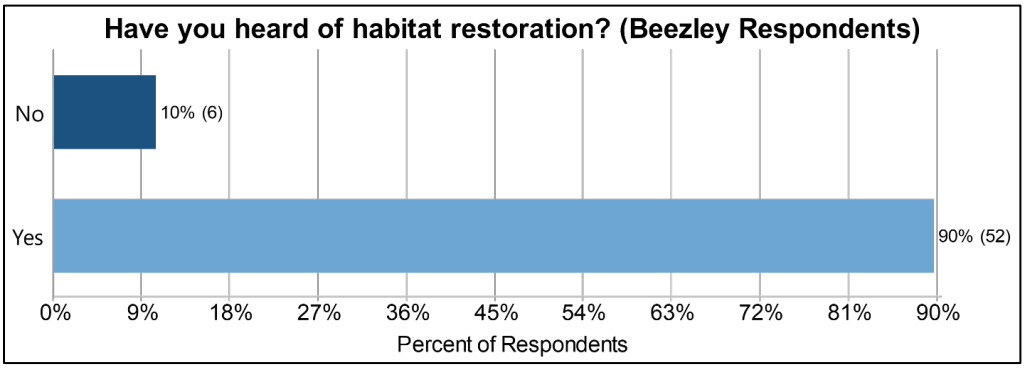


Figure 19. Graph of respondent knowledge of habitat restoration (Beezley respondents).

Figure 20 summarizes responses to the question, "Is your job tied to oyster reefs in Galveston Bay-Trinity Bay?" Most respondents, comprising 87%, reported that their jobs are not tied to oyster restoration sites. This large portion suggests that the surveyed population generally does not have direct employment connections to oyster restoration activities. Conversely, 13% of respondents indicated that their jobs are linked to oyster restoration sites. From the text responses, we find that those whose jobs are tied to oyster reefs in the area predominantly do so through restoration and conservation activities.

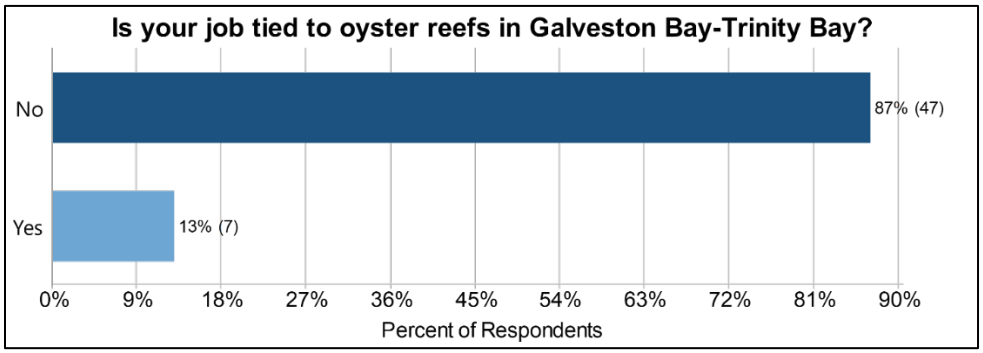


Figure 20. Graph of respondents whose jobs are tied to oyster reefs of Galveston Bay-Trinity Bay.

The bar graphs in Figure 21 depict the diverse uses of Galveston Bay – Trinity Bay as reported by respondents. Most participants, constituting 65%, identified the area primarily for social gatherings, showcasing its significance as a communal space. Boating and kayaking emerged as the second most

prevalent activity, with 59% of respondents engaging in these water-based recreational pursuits. Recreational fishing ranked closely behind at 57%, underscoring the bay's importance for anglers. Additionally, 52% of participants reported utilizing Galveston Bay – Trinity Bay for birding and wildlife viewing, highlighting its ecological appeal. These findings collectively emphasize the multifaceted nature of Galveston Bay, serving as a hub for social interactions, outdoor recreation, and appreciation of the diverse natural environment.

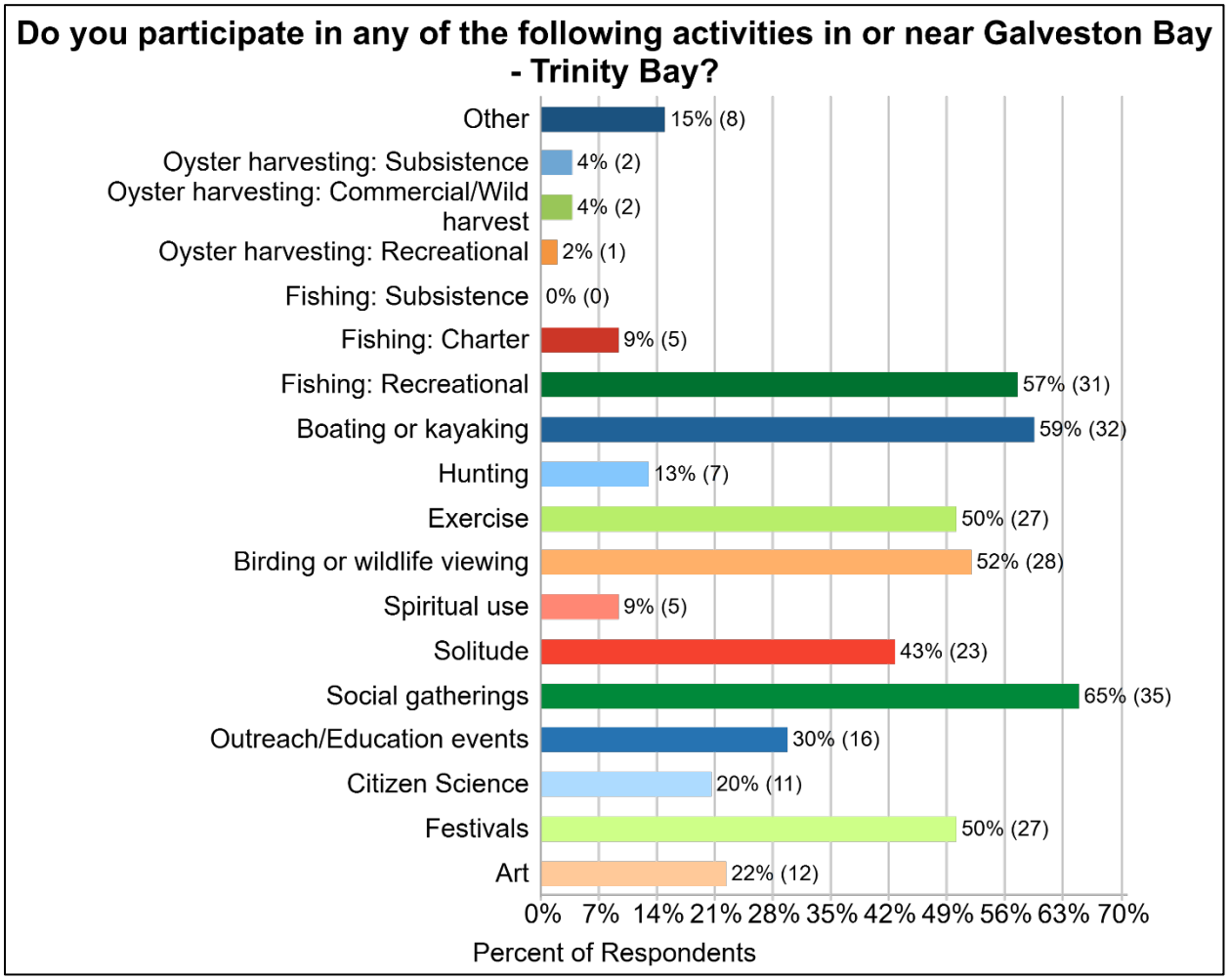


Figure 21. Respondents reported use of Galveston Bay-Trinity Bay.

The bar graph in Figure 22 illustrates respondents' reported environmental concerns for Galveston Bay, based on a scale ranging from *not concerned at all* to *very concerned*. The findings reveal great concern about great concern for pollution, with 82% of respondents reporting being very concerned. Water quality emerged as the second-highest environmental concern, with 65% of respondents being very concerned. Loss of wildlife or biodiversity ranked closely behind at 63% of participants being very concerned. Furthermore, 61% expressed profound concern about the potential loss of access or the ability to use natural areas.

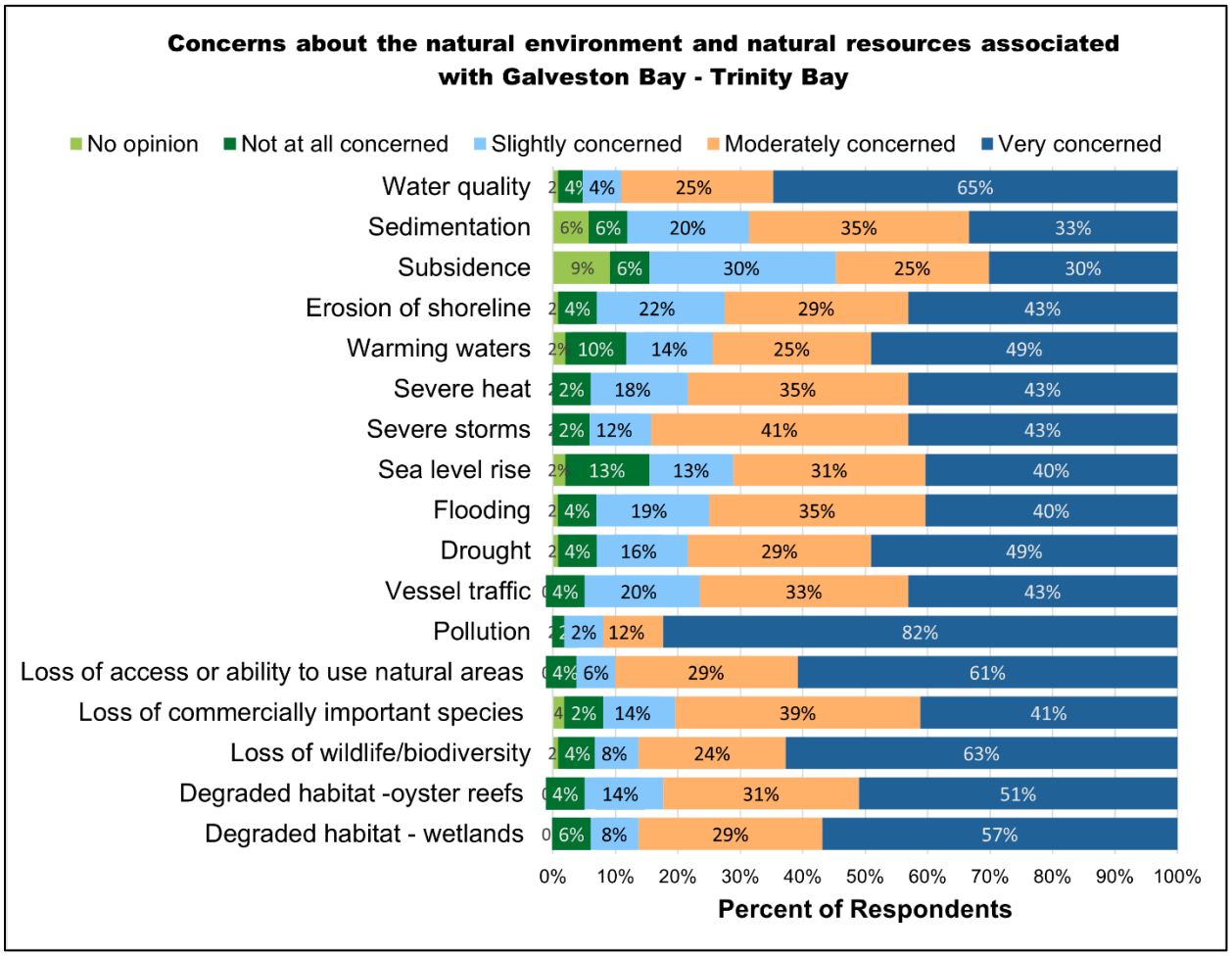


Figure 22. Respondents reported environmental concerns in Galveston Bay- Trinity Bay.

Public Response to TNC Beezley Reef Restoration

The following questions were explicitly about the TNC Beezley Reef Restoration Project. The survey results regarding participant knowledge of the TNC Beezley Reef Restoration Project indicate a mixed level of awareness among respondents (Figure 23). Approximately 34% of participants were aware of the project, while a majority of 66% were not previously informed about it. Comments from those aware of the project suggest they possess general awareness but lack detailed knowledge. One participant highlighted that their awareness was due to the necessity of learning about potential obstructions to recreational navigation. Others cited sources such as work, friends, or proximity to the project site as factors contributing to their awareness.

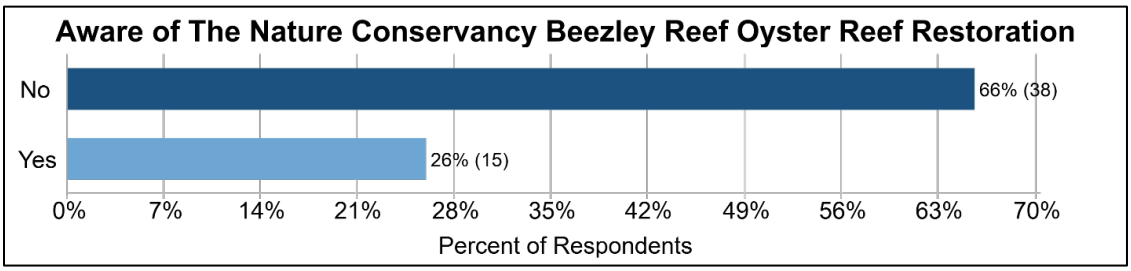


Figure 23. Respondent's awareness of the Beezley Oyster Reef Restoration Project

The survey results concerning subsistence fishing near the Beezley Reef project site revealed a notable lack of familiarity among respondents (Figure 24), with 61% expressing uncertainty by selecting "I don't know." The second most common response was "no," which 19% of participants chose. Two respondents provided additional feedback, indicating awareness of commercial fishing activities. One participant remarked on the general prevalence of fishing and crabbing in the area, emphasizing the widespread engagement in these activities without specifying their subsistence nature. Comments by people who responded with "no" state that subsistence fishing is unlikely because of the cost and describe it as a luxury. The predominance of "I don't know" responses highlights the need for further investigation and other means for determining the role of subsistence fishing near the Beezley Reef project site.

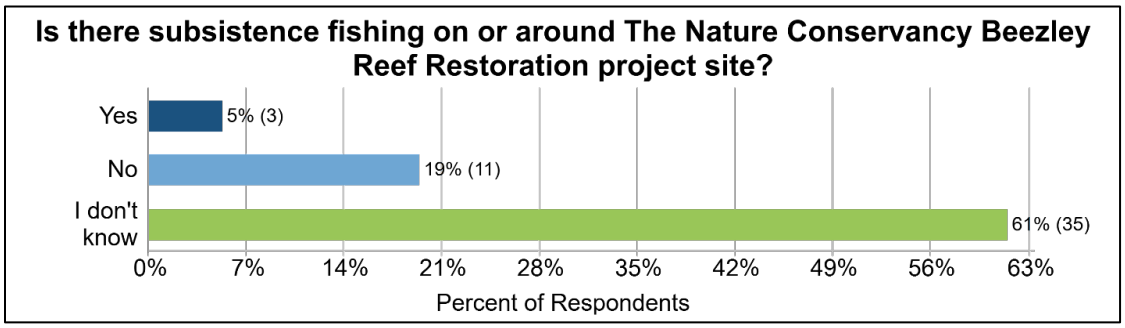


Figure 24. Responses regarding subsistence fishing near the Beezley Reef Restoration Project site.

The survey results regarding the impact of the TNC Beezley Reef restoration project on respondents' jobs indicate that the majority (81%) reported no direct influence on their employment (Figure 25). In contrast, 7% acknowledged that their jobs were affected, with one respondent noting that the project provided funding for their program. Another respondent expressed support for the restoration initiative, emphasizing positive observations of its effects on the ecosystem. Conversely, a participant voiced serious concerns about the potential negative consequences for oyster harvesting, highlighting that the placement of boulders could be dangerous.

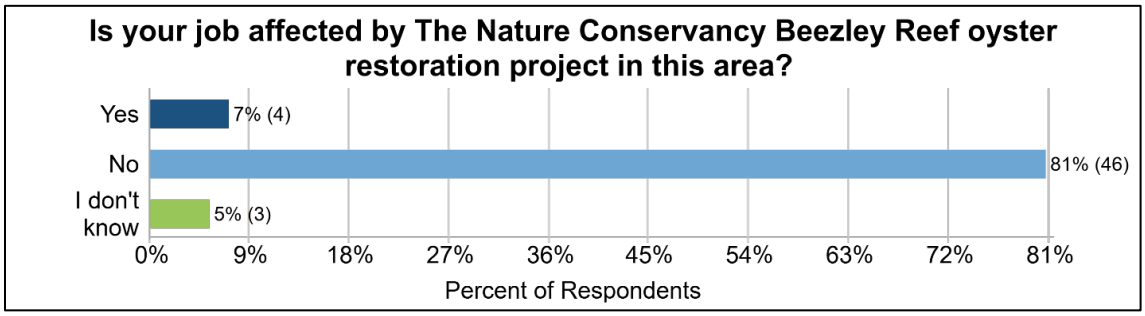


Figure 25. Respondents whose jobs were affected by the Beezley Reef Restoration Project.

The survey results pertaining to the impact of the TNC Beezley Reef restoration project on respondents revealed that 58% reported no discernible impact; In comparison, 13% indicated being affected (Figure 26). Additionally, a notable 26% responded with "I don't know," reflecting a degree of uncertainty. Among those who reported benefiting from the project, the majority expressed positive sentiments, particularly highlighting improvements in ecosystem health and overall positive outcomes. However, there were nuanced perspectives, with one comment expressing reservations about the experimental approach taken in the restoration process. Another participant voiced a desire for more detailed information.

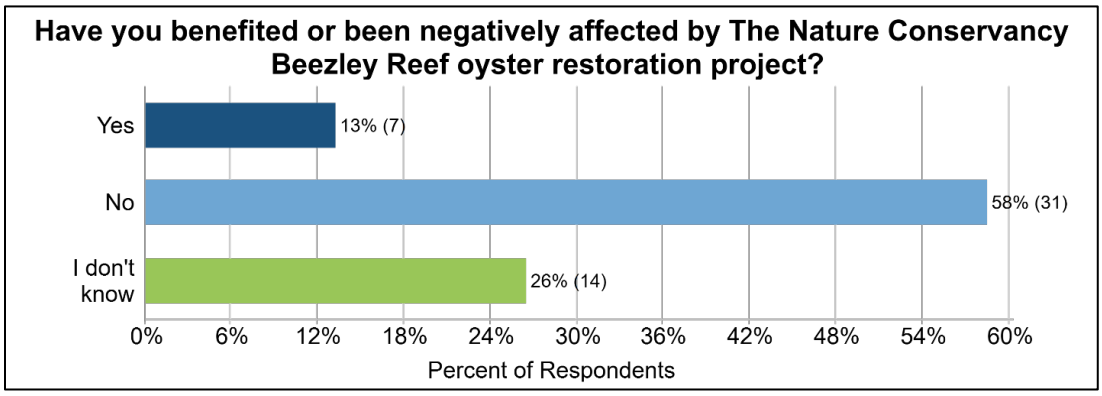


Figure 26. Respondents affected by the Beezley Reef Restoration Project.

The survey results concerning the impact of the Beezley Reef Restoration project on local businesses (Figure 27) indicated that a significant portion of respondents (66%) expressed uncertainty with "I don't know." Meanwhile, 28% reported no knowledge of local businesses being affected, and 6% acknowledged positive effects. Among those who recognized benefits, one respondent highlighted positive impacts on businesses such as kayak rental, natural areas, and surrounding parks, emphasizing the connection between the local ecology and the economy. However, a negative comment expressed a contrasting viewpoint, suggesting that self-policing reefs are perceived as an insult to the oyster community and may contribute to a negative perception of the fishery.

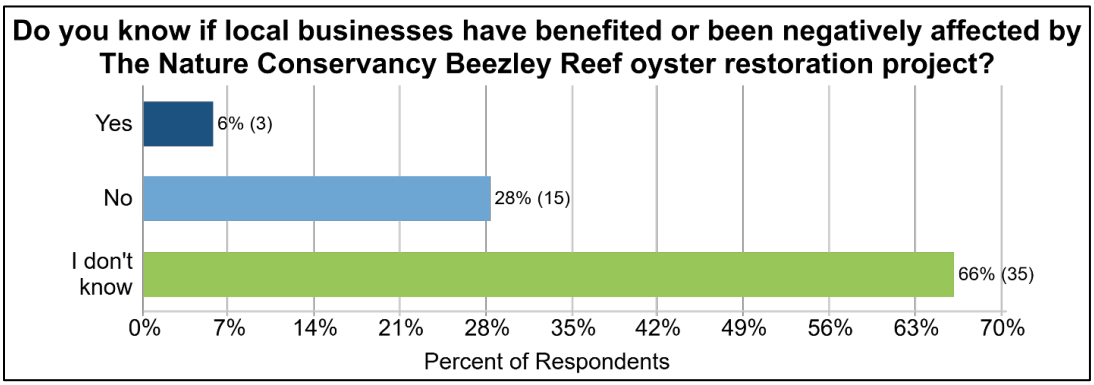


Figure 27. Responses regarding businesses affected by the Beezley Reef Restoration Project.

Perceptions of Beezley Reef Oyster Reef Restoration Project

Survey respondents actively contributed additional insights and perspectives, providing valuable context. In the survey, participants were allowed to share their thoughts specifically on the Beezley Reef Restoration Project, and these remarks were subsequently categorized into positive, negative, or neutral sentiments. Positive sentiments encompass expressions of support for restoration initiatives, positive emotions such as "happy" or "excited," and affirming language such as "support" and "beneficial." Conversely, negative comments encompass expressions of dissatisfaction, the use of terms like "reduce" or "wrong," and the conveyance of negative emotions such as "disappointed" or "dissatisfied." Lastly, neutral comments are characterized by statements that relay factual information without conveying either positive or negative sentiments. This categorization aims to distill the diverse range of participant responses, offering a nuanced understanding of the sentiments surrounding the Beezley Reef Restoration Project.

Of the 25 comments provided by the Beezley Reef respondents, 60% were of positive sentiment (Figure 28). The compiled positive comments reflect a widespread appreciation for the Beezley Reef Restoration Project, emphasizing the crucial role healthy oyster reefs play in creating habitat, enhancing water quality, and contributing to carbon capture. Respondents expressed satisfaction with the initiative, acknowledging the benefits it brings to the ecosystem and its positive impact on fish populations. Some comments highlight a desire for personal involvement, whether by wanting to add oyster beds near properties or engaging in volunteer opportunities. The support extends to the coexistence of commercial oyster harvesting and restoration efforts. Participants stress the importance of continued support for restoration, and one comment refers to the need for more federal investment in Gulf restoration. The overarching sentiment is a call for accelerated restoration efforts, driven by the belief

that conservation education is key and that the preservation of ecology is intertwined with economic well-being. Overall, respondents' express gratitude for the Beezley Reef Restoration Project, emphasizing its role in safeguarding natural resources.

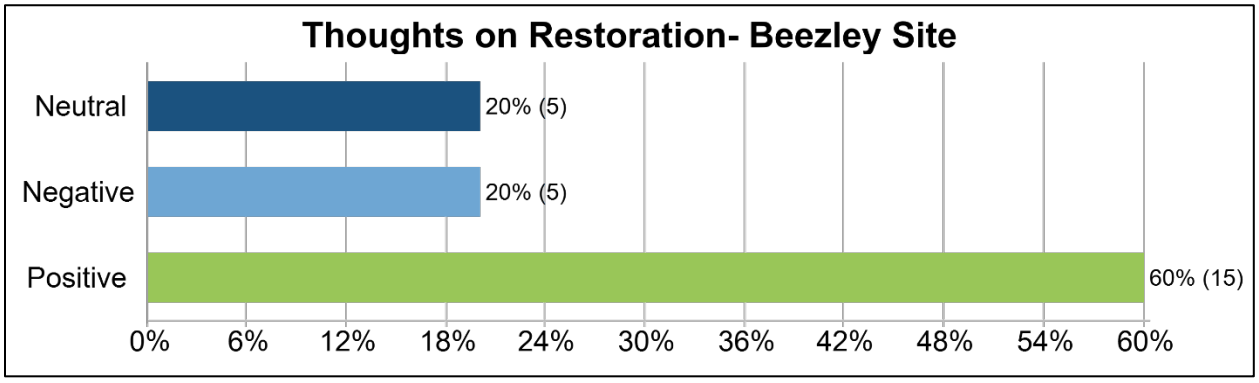


Figure 28. Perceptions of the Galveston Bay Oyster Reef Restoration Project are expressed in survey comments.

The negative comments (20%) center around concerns about the Beezley Reef Restoration Project and primarily focused on the impact on the commercial oyster industry and recreational boating. One respondent notes the challenges faced by commercial oyster harvesters due to closures. Another expresses dissatisfaction with the placement of oyster reefs, emphasizing the adverse effects on sailing, especially for organized events like regattas. The specific concern is raised regarding the depth of the bay, highlighting the need for careful consideration to avoid limiting access for recreational sailors and boaters. Additionally, there is criticism about the lack of consultation with experienced parties, such as the oyster industry, in planning and executing reef restoration projects. The negative impact on boater traffic is highlighted in reference to recent oyster reefs created as part of another project, underscoring the importance of effective communication and collaboration with relevant communities to prevent adverse consequences.

Respondent Demographics- Beezley Reef

Demographic profiles of survey respondents to the Beezley Reef Site public survey are presented in Figure 29, Figure 30, and Figure 31. In terms of household income, 41% of respondents report an annual income exceeding $90,000, while 14% fall within the income range of $20,000-$30,000. The remaining respondents, comprising less than 8%, are distributed across various income ranges. Regarding race and ethnicity, the majority (66%) identify as White, with 13% indicating Hispanic ethnicity and 11% checking more than one category. The age distribution of respondents at this site is notably varied, with approximately 20% in each age group 25-34, 35-44, 55-64, and 65-74, showcasing a well-balanced representation across different age demographics.

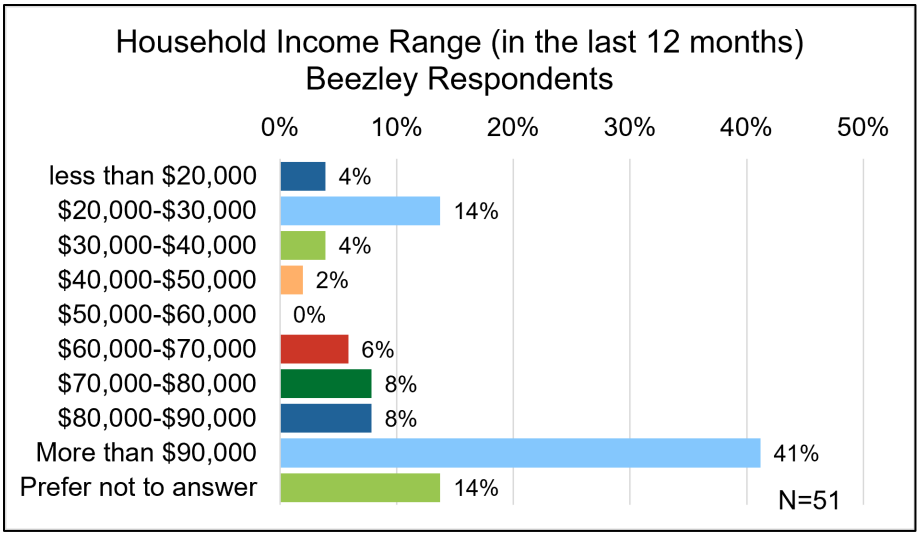


Figure 29. Beezley Respondents Demographics: Household Income

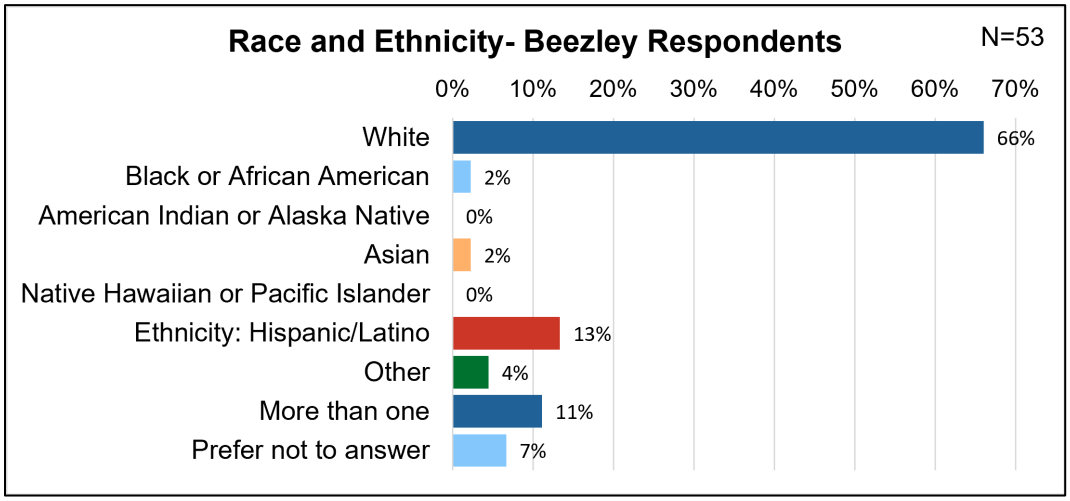


Figure 30. Beezley Respondents Demographics: Race & Ethnicity

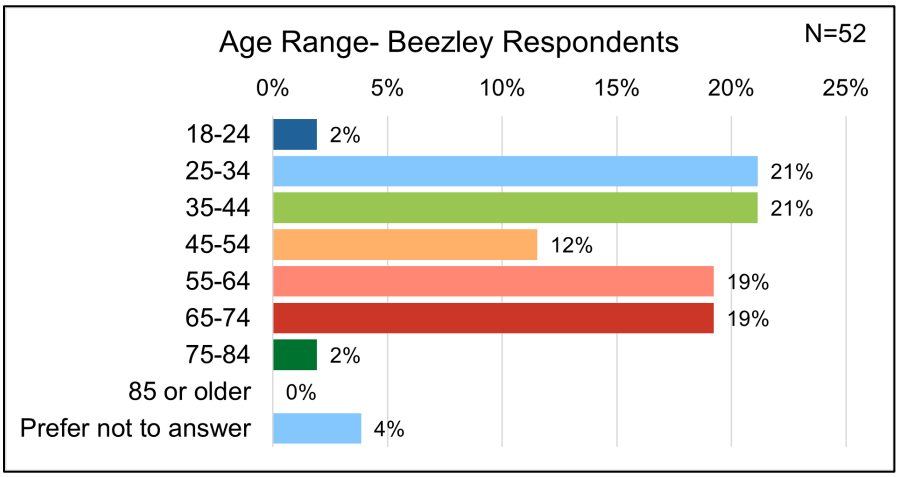


Figure 31. Beezley Respondents Demographics: Age

Public Survey Results: Calcasieu Lake

Community Use and Environmental Concerns in Calcasieu Lake- West Cove

When asked, "Have you heard of habitat restoration?" the majority, comprising 92% or 22 respondents, indicated that they were familiar with the concept (Figure 32). In contrast, 8% or 2 respondents reported not having heard of habitat restoration. A significant portion of the respondents who confirmed awareness expressed knowledge of specific habitat restoration efforts, specifically oyster, marsh, coral, and seagrass restoration (see Appendix F. Additional Graphs, Figure 48). The results highlight a demographic of respondents that is knowledgeable of restoration.

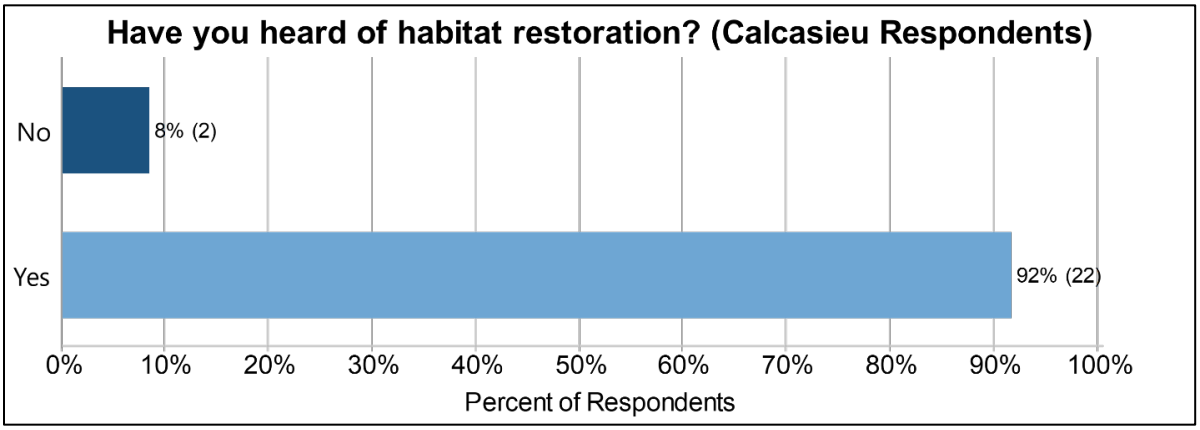


Figure 32. Graph of respondent knowledge of habitat restoration (Calcasieu respondents).

Figure 33 summarizes responses to the question "Is your job tied to oyster reefs in Calcasieu Lake?" The survey results reveal a notable split, with 59% (13 individuals) responding "no" and 41% (9 individuals) indicating "yes." Among those who affirmed a link to oyster reefs, specific job roles include a wholesale/retail buyer of shrimp, fish, and oysters from Calcasieu Lake, one respondent reported a collaboration with commercial fishermen and oystermen actively opposing LNG expansion that negatively impacts their fisheries, a retired commercial fisherman, and employment in natural resource management. These diverse roles highlight the various professional connections to oyster reefs, ranging from direct involvement in seafood industries to advocacy against environmental threats and contributions to natural resource management in the vicinity.

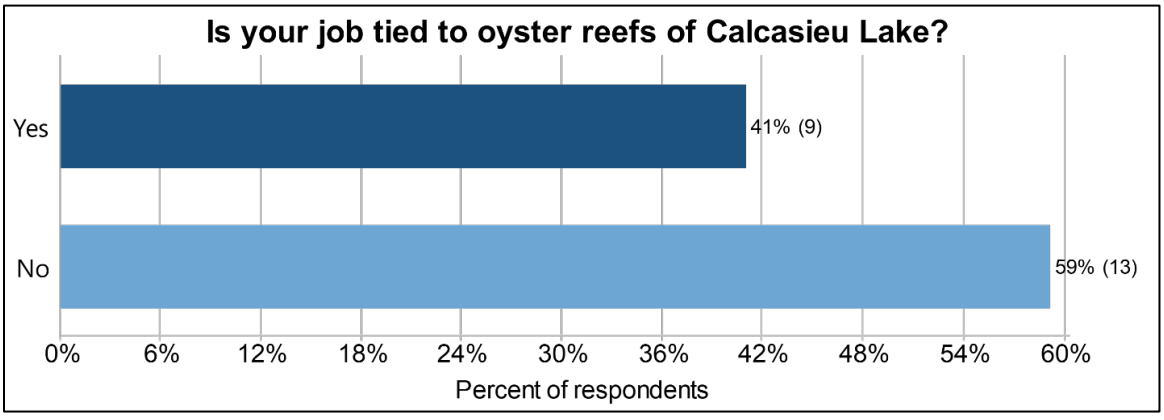


Figure 33. Graph of respondents whose jobs are tied to oyster reefs of Calcasieu Lake.

The bar graph in Figure 34 depicting the uses of Lake Calcasieu-West Cove by survey respondents reveal a diverse range of activities. The most common activities, each reported by 50% of respondents (11 individuals), include birding or wildlife viewing, social gatherings, and recreational fishing. Festivals follow closely behind, with 45% of respondents (10 individuals) engaging in such events. Boating and kayaking also feature prominently, with 41% of respondents (9 individuals) enjoying these water-based activities. The findings highlight the diverse nature of Lake Calcasieu-West Cove, catering to various recreational interests such as nature observation, social interactions, fishing, and participation in festivals.

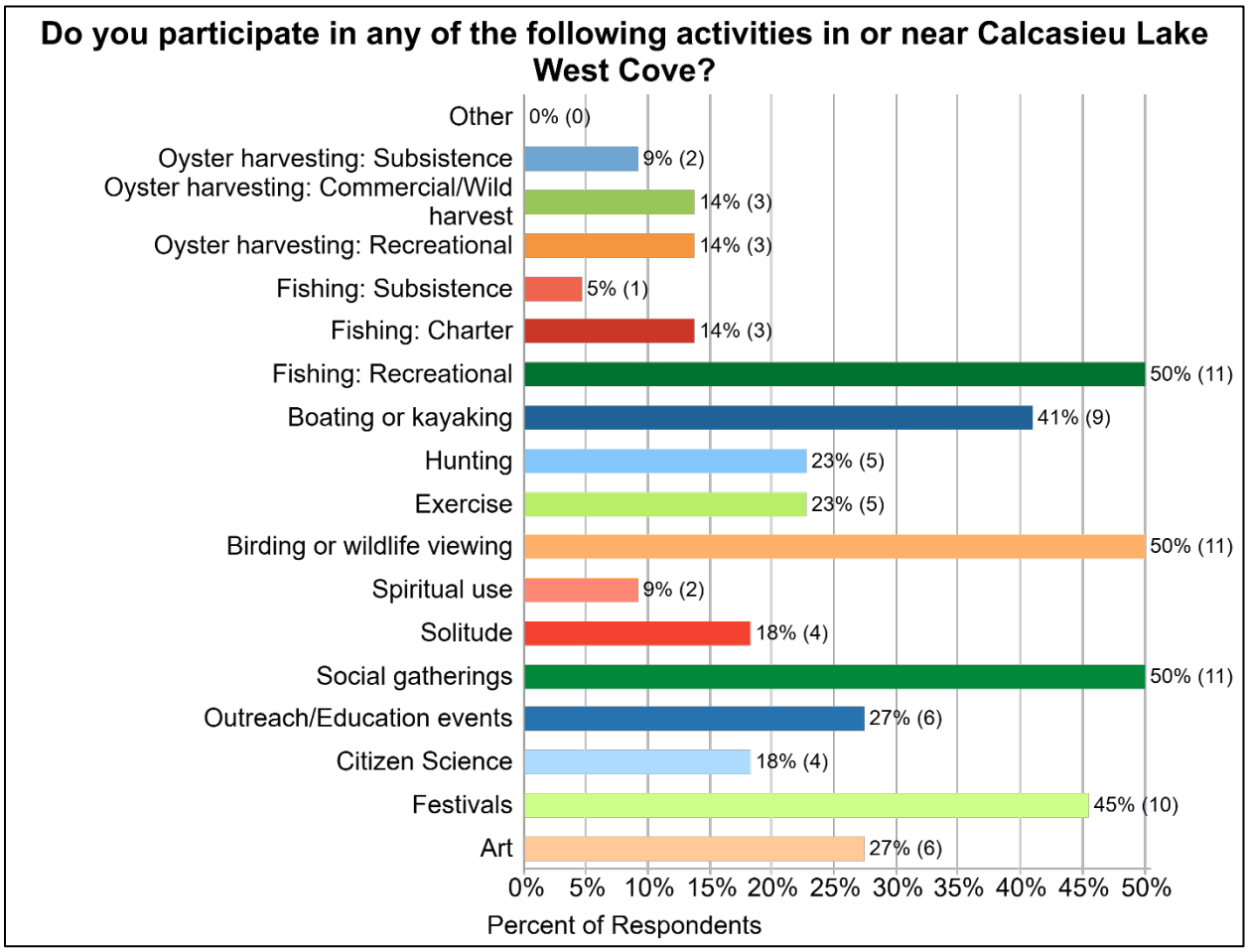


Figure 34. Respondents reported use of Calcasieu Lake-West Cove.

The bar graph in Figure 35 illustrating reported environmental concerns for Calcasieu Lake-West Cove reveals distinct trends based on respondents' levels of concern, measured on a scale from not concerned at all to very concerned. A substantial majority of participants, constituting 57%, express high concern about shoreline erosion, a primary issue addressed by the TNC Calcasieu Lake Oyster Reef Restoration Project. Additionally, 52% of respondents indicate very high levels of concern regarding severe storms, emphasizing the region's vulnerability to extreme weather events. Water quality emerges as a significant worry for 48% of participants, along with a parallel concern for the loss of access or the ability to use natural areas. Furthermore, 48% of respondents express apprehension about severe heat.

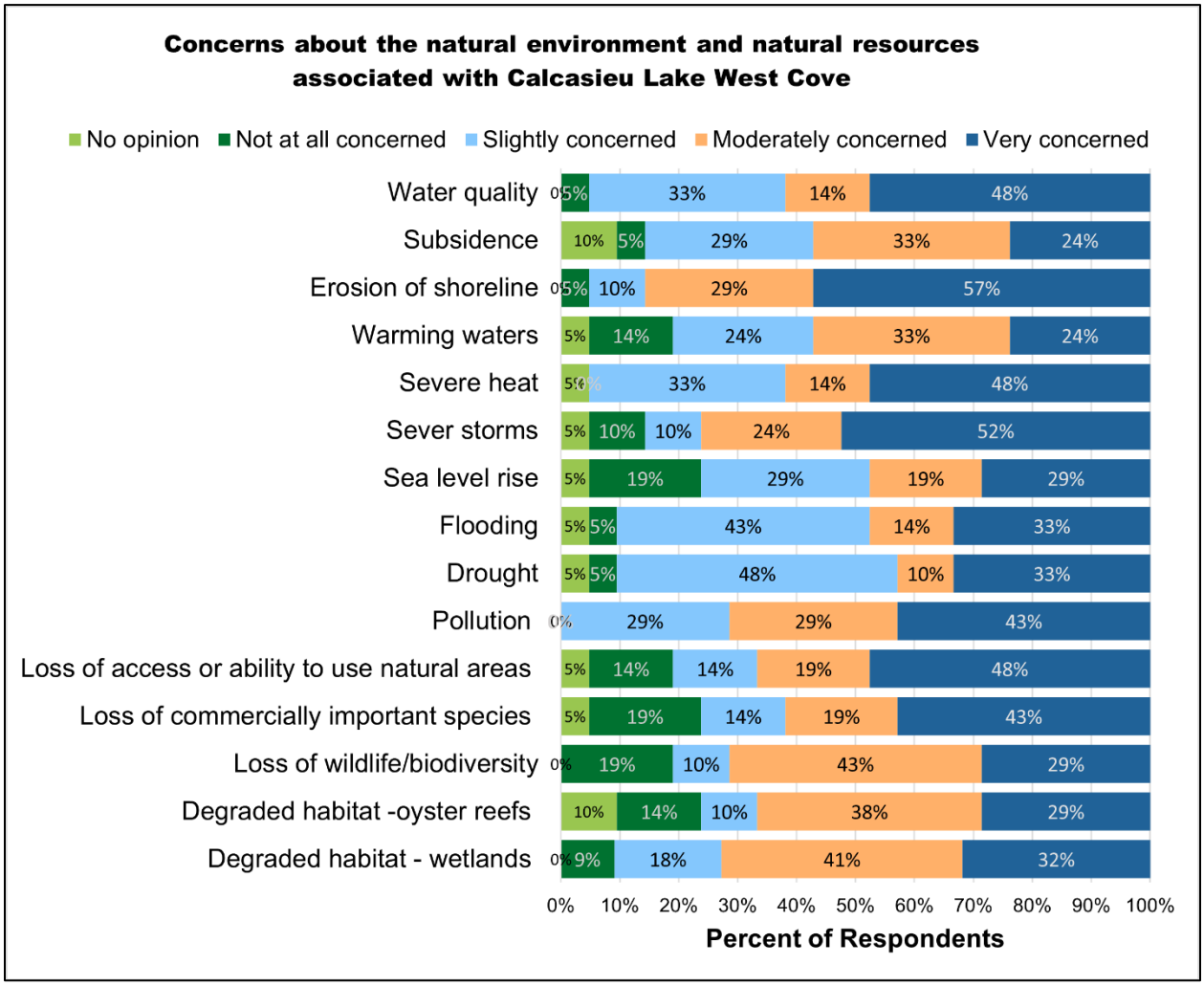


Figure 35. Respondents reported environmental concerns in Calcasieu Lake West Cove

Public Response to TNC West Cove Reef Restoration

The following questions were explicitly about the TNC West Cove Reef Restoration Project. The survey results regarding participant knowledge of the TNC West Cove Reef Restoration Project indicate a mixed level of awareness among respondents (Figure 23). Approximately 36% of participants were aware of the project, while a majority of 64% were not previously informed about it. Respondents who provided additional context stated that their knowledge of the project was because of their direct involvement in the project through planning and or construction or due to the proximity of their work site.

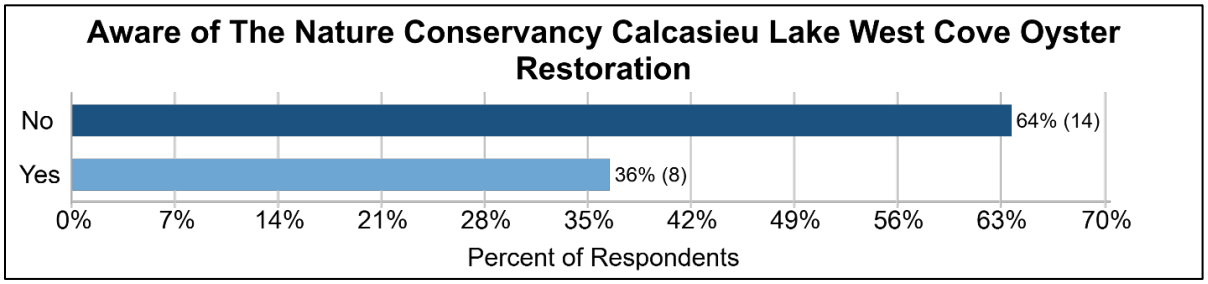


Figure 36. Figure 36 Respondent's awareness of the Calcasieu Lake Oyster Reef Restoration Project

The survey results on subsistence fishing near the Calcasieu Reef Project site indicate that 64% of respondents answered "no," while 36% suggested "yes" when asked about engaging in subsistence fishing (Figure 37). The comments provided additional insights into this aspect, revealing diverse perspectives. Some respondents acknowledged the existence of subsistence harvesting, noting that they knew individuals who practiced this. One comment highlighted the Hackberry area, which has a longstanding tradition as a fishing community. Others emphasized the importance of fishing for low-income neighbors, highlighting it as a primary food source. However, concerns were raised regarding potential health risks due to CDC limits on fish consumption in the area, attributed to pollution and historical toxins in waterways, impacting the health of community members who heavily rely on fishing. Additionally, some respondents affirmed that many people in the community pursue fishing as a career to provide for their sustenance.

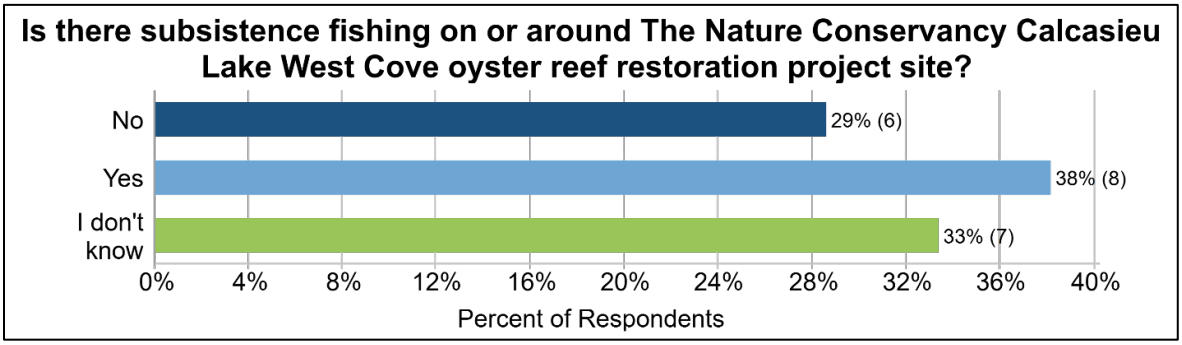


Figure 37. Responses regarding subsistence fishing near the Calcasieu Lake Oyster Reef Restoration Project site.

The survey results regarding the impact of the TNC Calcasieu Lake restoration project on respondents' jobs (Figure 38) indicate that 88% responded with "no," while 14% answered "yes." Comments provided further insight, revealing positive sentiments toward the project's impact. Participants expressed that the restoration project was perceived as a benefit, and some comments highlighted overall support for the initiative. Additionally, one respondent expressed interest in being actively involved in the project.

Notably, a participant involved in sampling work in West Cove specified that the construction of the reef did not adversely affect their sampling activities. These findings suggest that, for the majority of respondents, the TNC Calcasieu Lake restoration project did not have a reported impact on their employment, with positive feedback and support expressed by those who did observe an effect.

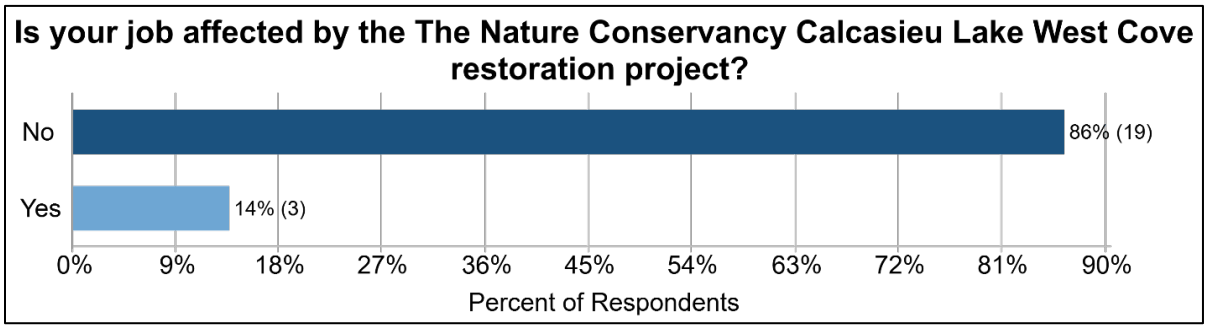


Figure 38. Respondents whose jobs were affected by the Calcasieu Lake Oyster Reef Restoration Project.

The survey results on the impact of the TNC Calcasieu Lake Reef restoration project indicate that most respondents (82%) reported no discernible effect from the project (Figure 39). A small percentage (9%) of respondents stated that they did observe an impact. Furthermore, only one public comment was provided, expressing the concern that the project resulted in the cessation of public use of a boat ramp. While the overwhelming response suggests that most participants did not perceive any impact on their activities or the environment, the comment highlights a specific concern related to access for boating.

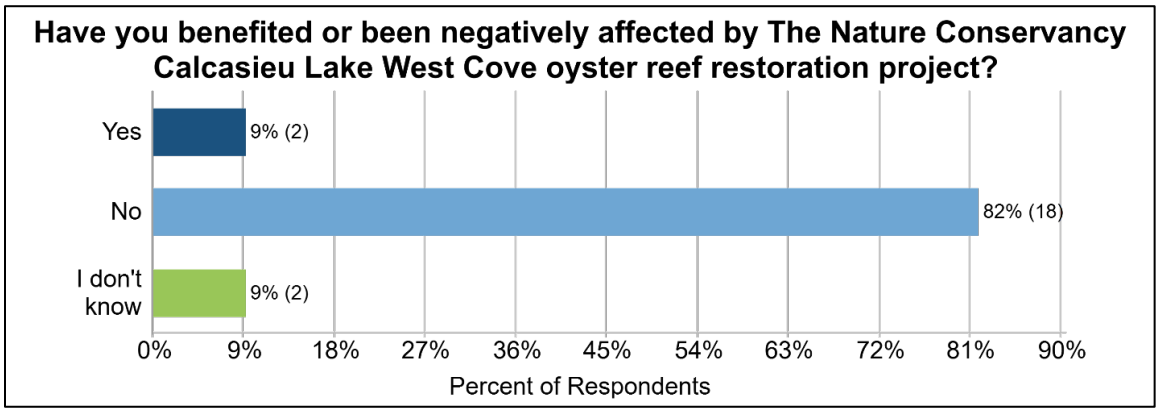


Figure 39. Respondents affected by the Calcasieu Lake Oyster Reef Restoration Project.

The survey results concerning the impact of the TNC Calcasieu Lake Restoration project on local businesses (Figure 40) indicated that a significant portion of respondents (68%) expressed uncertainty with "I don't know." Meanwhile, 23% reported no knowledge of local businesses being affected, and 9% acknowledged positive effects. Respondents did not provide additional comments to support these answers.

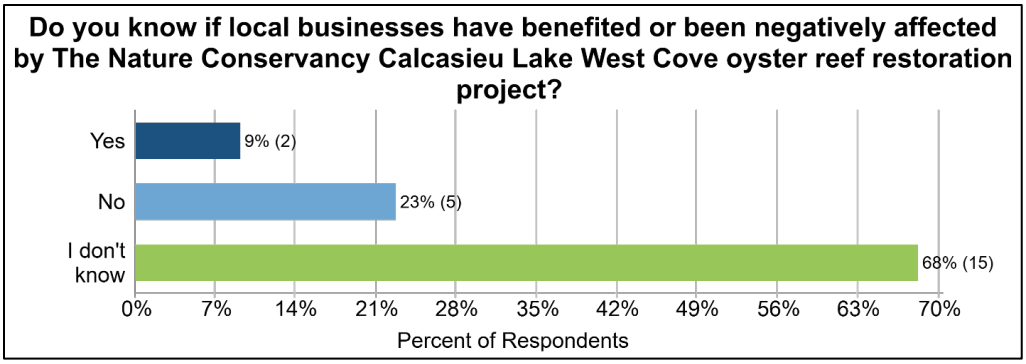


Figure 40. Responses regarding businesses affected by the Calcasieu Lake Oyster Reef Restoration Project.

Perceptions of Calcasieu Lake West Cove Oyster Restoration Project

Survey respondents actively contributed additional insights and perspectives, providing valuable context. In the survey, participants were allowed to share their thoughts on the Calcasieu Lake Oyster Reef Restoration Project, and these remarks were subsequently categorized into positive, negative, or neutral sentiments. Positive sentiments encompass expressions of support for restoration initiatives, positive emotions such as "happy" or "excited," and affirming language such as "support" and "beneficial." Conversely, negative comments encompass expressions of dissatisfaction, the use of terms like "reduce" or "wrong," and the conveyance of negative emotions such as "disappointed" or "dissatisfied." Lastly, neutral comments are characterized by statements that relay factual information without conveying either positive or negative sentiments. This categorization aims to distill the diverse participant responses, offering a nuanced understanding of the sentiments surrounding the Calcasieu Lake Oyster Reef Restoration Project.

The sentiment toward the Calcasieu Lake restoration project, as reflected in the seven received public comments, is overwhelmingly positive, with 71% expressing favorable views. The comments highlight the respondents' extensive experience and expertise, with one Certified Master Naturalist emphasizing over 40 years of utilization and study in the areas affected by the project. The sentiment is further supported by descriptors such as "outstanding," emphasizing the project's essential role in addressing water quality, carbon capture, habitat provision, and erosion control. The positive tone extends to expressions of happiness and gratitude, with a call to use the project to advocate for addressing the true causes of environmental degradation, including concerns about industrial colonization of waterways. Additional positive sentiments are conveyed by individuals familiar with and supportive of the TNC oyster restoration project, citing its success in shoreline protection and stabilization. There is anticipation for the project's next phase, reflecting an overall excitement and support for ongoing restoration efforts.

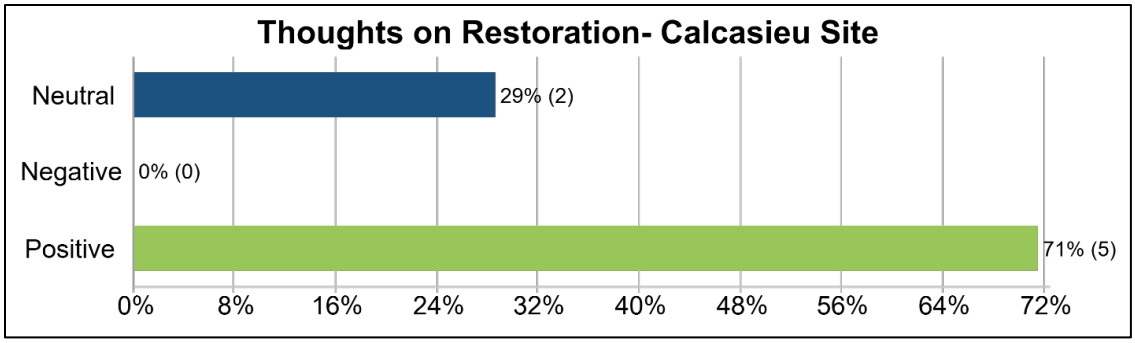


Figure 41. Perceptions of Calcasieu Lake Reef Restoration Project as expressed in survey comments.

Respondent Demographics- Calcasieu Lake

Demographic profiles of survey respondents to the Beezley Reef Site public survey are presented in Figure 42, Figure 43, and Figure 44. Regarding household income, 55% of respondents reported an annual income exceeding $90,000, while 23% preferred not to answer. The remaining respondents are distributed across various income ranges. Regarding race and ethnicity, the majority (77%) identify as White. The age distribution of respondents at this site is notably varied, with 32% of respondents from the age group of 25-24 and 27% in the age group of 55-64.

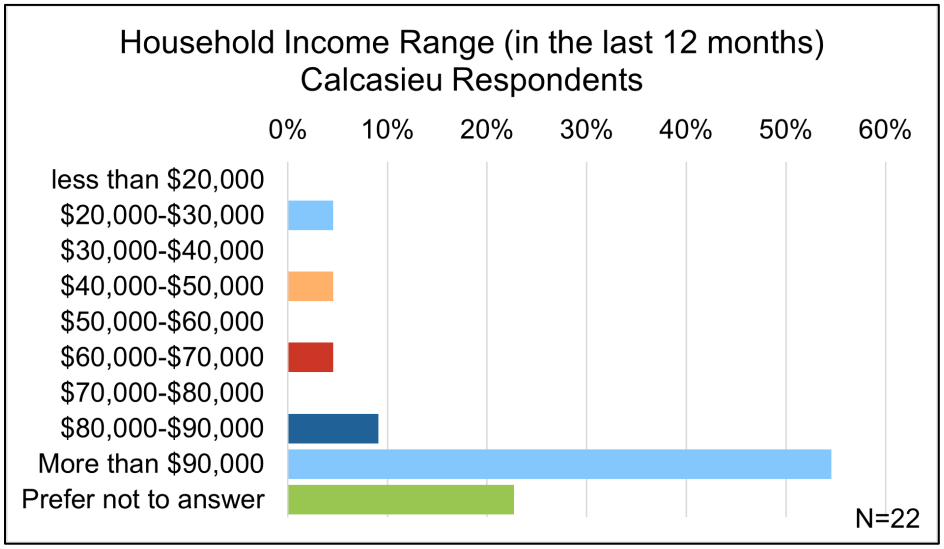


Figure 42. Calcasieu Respondents Demographics: Household Income

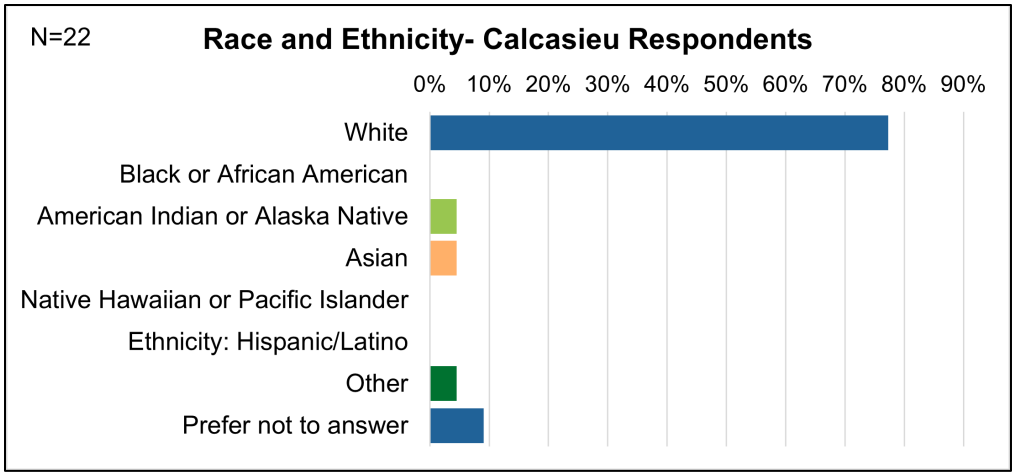


Figure 43. Calcasieu Respondents Demographics: Race and Ethnicity

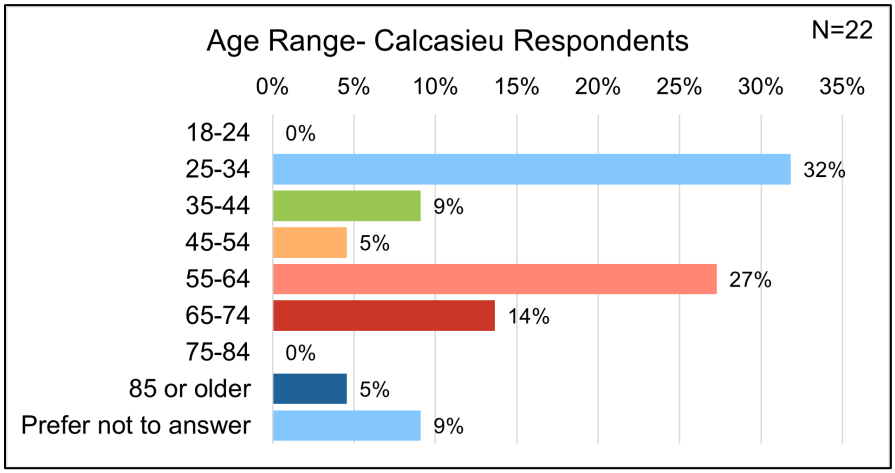


Figure 44. Calcasieu Respondents Demographics: Age

Evidence of Linkages for Ecosystem Service Logic Models

Beezley Reef Site

In this study, we delve into the survey responses, employing a methodological process of coding and categorization to unveil evidence of linkages within the Ecosystem Service Logic Model (Appendix A. Oyster Reef Restoration Ecosystem Service Logic Models). Through this systematic analysis, we have identified distinct connections in key socioeconomic outcome categories (Figure 45), with coding supporting linkages in economic activity (9%), property protection (42%), human health (6%), and cultural values (43%).

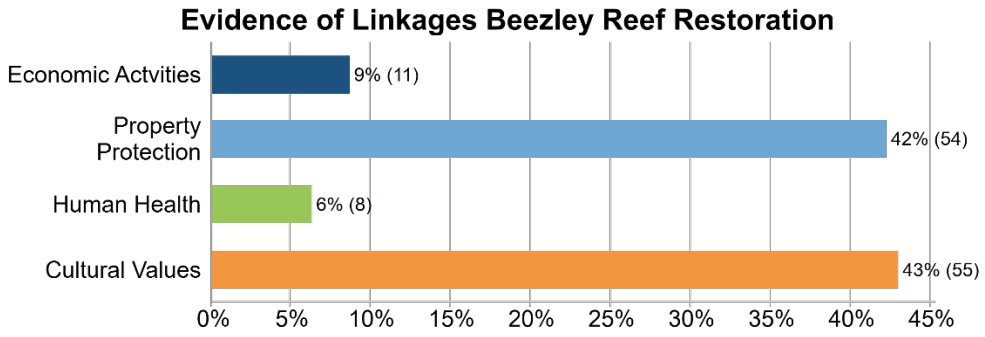


Figure 45. Number and percent of coded segments of survey answers and text that provide evidence of Beezley Reef study site linkages.

In our analysis of the evidence of linkages within the Ecosystem Service Logic Model, the examination of socioeconomic activities revealed insightful free-text responses and comments from participants (9%). Many respondents highlighted the perceived benefits to businesses and nature centers, emphasizing economic gains derived from wildlife viewing and fishing activities. A notable aspect emerged in the form of financial support provided by the project to entities engaged in planning, monitoring, or implementing outreach initiatives associated with these projects. Furthermore, the comments reflected concerns about potential impacts on oyster fishermen and apprehensions regarding closures. Amidst these concerns, a recurrent theme emerged, suggesting that the project's contribution to fostering a healthier ecosystem might positively affect the local economy.

Numerous survey responses find a connection to property protection, notably concerning erosion. The coded segments align closely with recorded concerns regarding shoreline erosion. While it's crucial to note that the primary objective of this project is not to address erosion, it's noteworthy that erosion stands out as a significant concern in the Galveston Bay region. Acknowledging and considering this prevalent concern in the context of future restoration projects could potentially amplify support for such initiatives within the community.

The analysis of evidence of linkages found linkages related to human health, in particular food security for communities. Respondents expressed concerns about food security, emphasizing worries associated with overharvesting of oysters. Some participants acknowledged the existence of subsistence fishing in the area by answering a targeted question. Comments further highlighted how restoration affects the availability of edible species, such as crabs.

The evidence of linkages analysis reveals a compelling connection to cultural values in the survey responses. Participants demonstrated a high level of general knowledge about oyster reef restoration,

although they lacked awareness of the TNC Beezley Reef Project. Notably, the use-related questions shed light on the multifaceted cultural significance of the area. Most respondents (65%) expressed using the site for social gatherings, while festivals garnered a notable 50% acknowledgment, emphasizing their integral role in local culture. Additionally, spiritual use, reported by 9% of participants.

Calcasieu Lake Reef Site

For the Calcasieu Lake site, linkages for the Ecosystem Service Logic Model (Appendix A. Oyster Reef Restoration Ecosystem Service Logic Models) were found to support outcomes and metrics in key socioeconomic outcome categories (Figure 46), with coding supporting linkages in economic activity (21%), property protection (30%), human health (11), and cultural values (37).

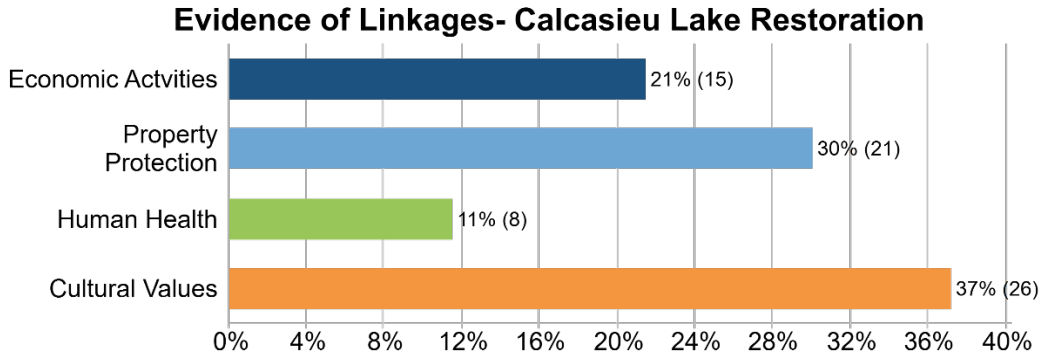


Figure 46. Number and percent of coded segments of survey answers and text that provide evidence of linkages for the Calcasieu Reef study site.

The evidence of linkages analysis finds a connection to socioeconomic activities within the survey responses. Numerous participants provided insightful comments and free-text responses detailing their occupations and work, revealing a diverse range of professions linked to commercial fishing, retail shrimp and oyster businesses, and other roles associated with restoration and environmental endeavors. These responses highlight the economic implications and livelihoods intertwined with the oyster reef restoration projects.

Numerous survey responses support a connection to property protection. The concern for shoreline protection is the primary source of evidence for this linkage. No additional comments or responses were recorded to support additional links.

The analysis of evidence of linkages found linkages related to human health, in particular food security for communities. Some participants acknowledged the existence of subsistence fishing in the area by answering a targeted question. The comments provided additional insights into this aspect, noting first-hand knowledge of subsistence fishing in the area.

The evidence of linkages analysis reveals a compelling connection to cultural values in the survey responses. Participants demonstrated a high level of general knowledge about oyster reef restoration, and some awareness (36%) of the TNC West Cove Reef Project. Notably, the use-related questions shed light on the multifaceted cultural significance of the area. A significant portion of respondents (50%) expressed using the site for social gatherings, while festivals garnered a notable 45% acknowledgment, emphasizing their integral role in local culture. Additionally, spiritual use, was reported by 9% of participants.

Conclusion

In conclusion, this study employed an Ecosystem Service Logic Model to systematically identify socioeconomic metrics for monitoring the impacts of oyster reef restoration in Galveston Bay and Calcasieu Lake. Through a comprehensive analysis, combining insights from expert interviews and a targeted online public survey conducted from August to September 2023, the study successfully identified uses, concerns, thoughts, and opinions on the TNC restoration projects, and other socio-cultural information of the study sites. This data provided valuable input and reinforced the linkages within the Ecosystem Service Logic Model, enhancing the foundation for the monitoring plan developed for each site. This comprehensive approach enhances our understanding of the intricate interplay between oyster reef restoration and various ecosystem services and provides a foundation for informed decision-making, strategic planning, targeted interventions, and monitoring.

Acknowledgments

This work was made possible with support from The Nature Conservancy contract # 68866582v1-2. Thanks to the community participants and subject matter experts who shared their knowledge with the project team. This work was conducted under IRB # TAMU-CC-IRB-2023-0844. Special thanks to the GEMS team that produced the inaugural ecosystem service logic models that made this study possible.

References

Denzin, Norman K., and Yvonna S. Lincoln, eds. 1998. *Collecting and Interpreting Qualitative Materials*. Thousand Oaks, Calif: Sage Publications.

Olander, Lydia, Christine Shepard, Heather Tallis, David Yoskowitz, and Kara Coffey. 2021. "GEMS Phase II Report: Coastal Restoration."

Warnell, Katie, Rachel Karasik, Sara Mason, Alicia Zhao, Shubhi Sharma, and Claudia Sandoval. 2020. "Evidence Library for Oyster Reef Restoration in the Gulf of Mexico." https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/26484/GEMS-Evidence-Library.pdf?sequence=2.

Appendix A. Oyster Reef Restoration Ecosystem Service Logic Models

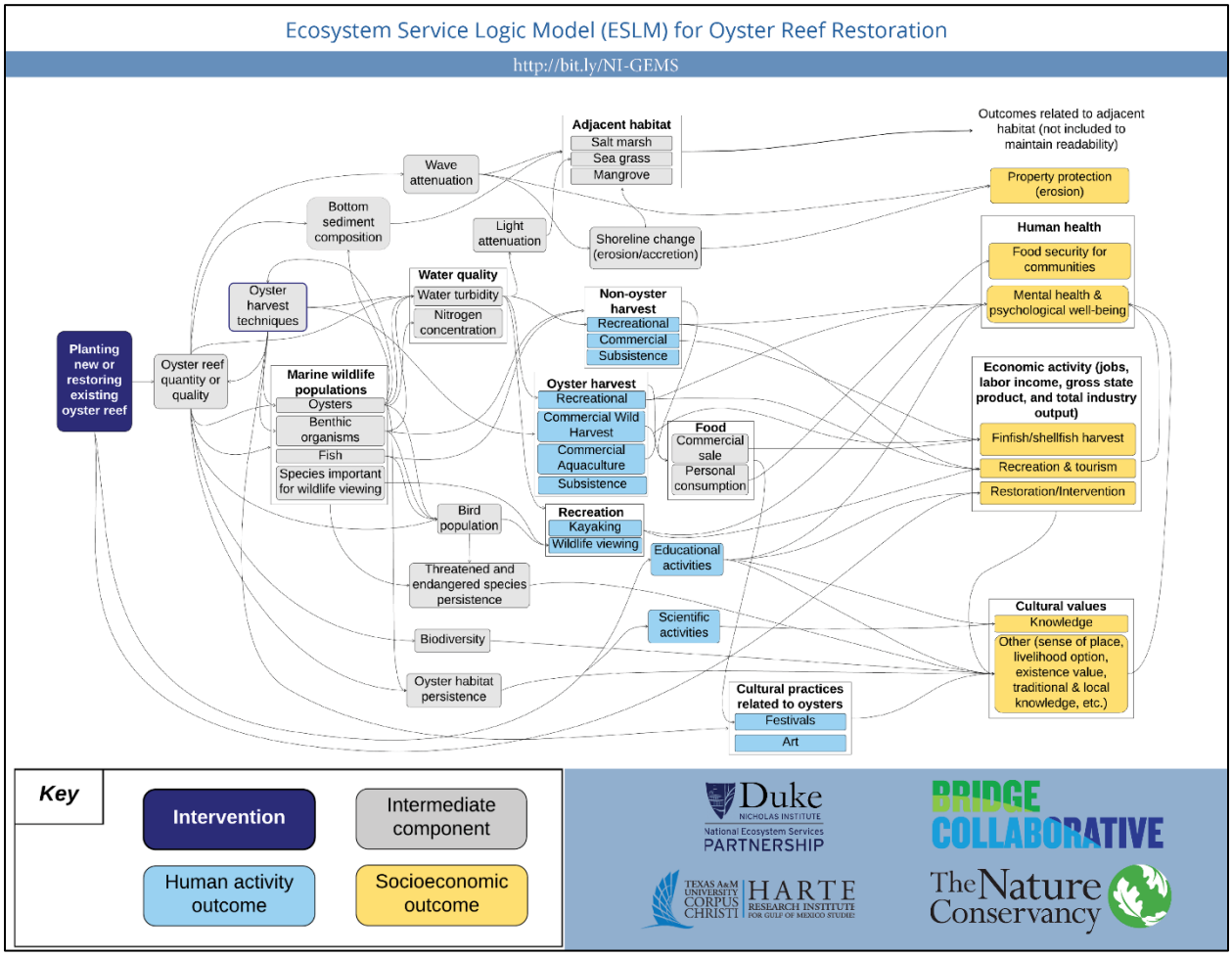


Figure 47. Ecosystem Service Logic Model most applicable to Galveston Bay project site.

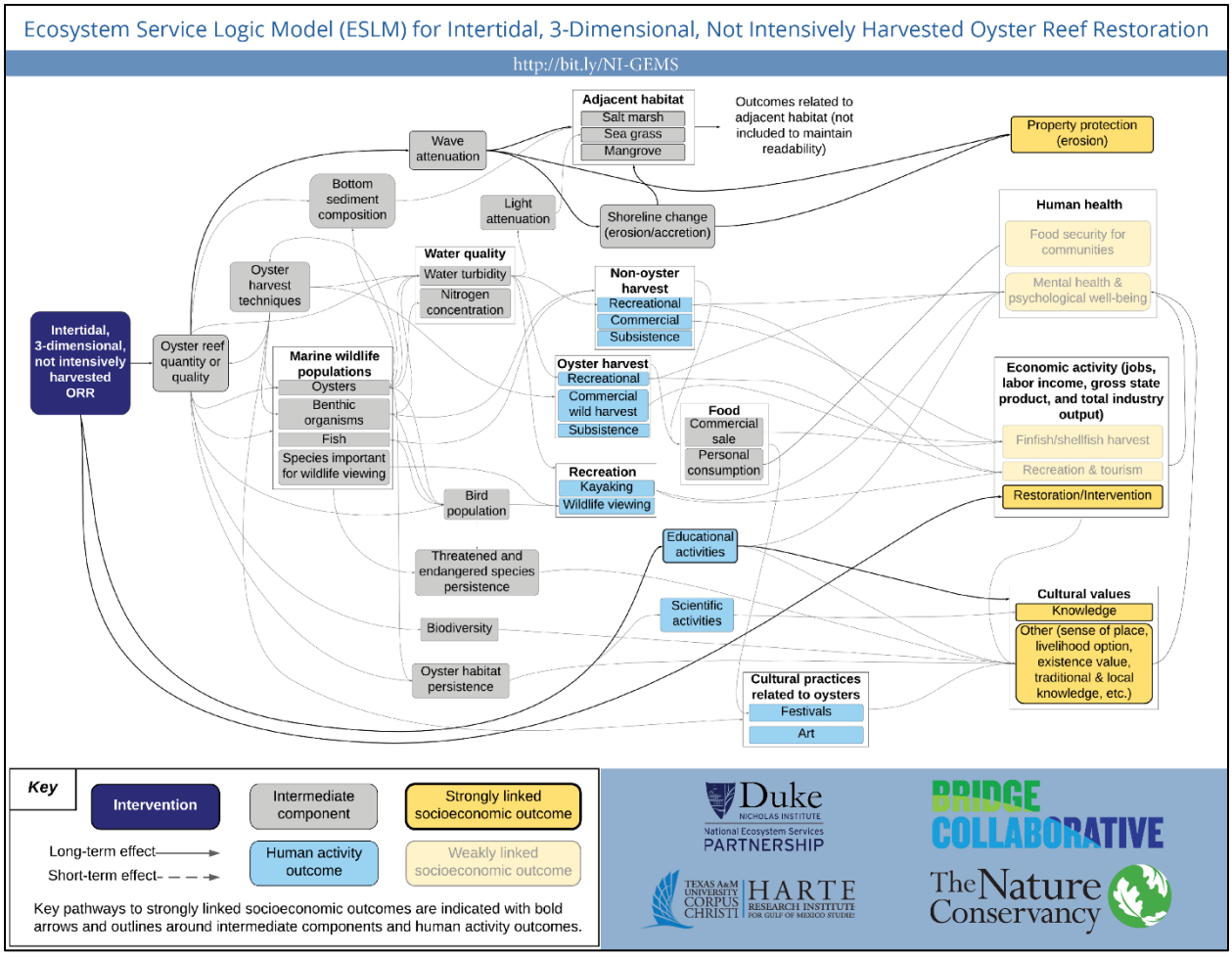


Figure 48. Ecosystem Service Logic Model most applicable to Calcasieu Lake project site

Appendix B. Expert Interview Questions

1. Are you familiar with the Galveston or Lake Calcasieu restoration project?
2. What type of restoration is this project?
3. What are primary outcomes/goals of the restoration?
4. What was the overall cost of the project? Can you share the budget?
5. Were there jobs created because of this project? If yes, how many?
6. How do you capture success (metrics) in monitoring?
7. Is there monitoring in the short/long term? If not, who is? If so, what is being monitored
8. Are there other types of metrics to communicate success/ or benefits of these projects that you would like to see monitored?
9. Has there been education, outreach, or community engagement efforts surrounding this restoration? Or in restoration in general?
10. Who are your partners in these efforts (community, industry, academic)?
11. For public surveys, are there events or occasion or event where you would recommend, we distribute public surveys?
12. Is there someone we can connect with to help make the introduction?
13. Would you be willing to help distribute a public survey for this project?

Appendix C. Public Survey Questions

Q1.1 **Consent to Participate in a Research Study at Texas A&M University-Corpus Christi, The Nature Conservancy's Oyster Reef Restoration Project**

Introduction:

The form provides information to help you decide to participate in a research study. Please read the information below and ask questions before you make a choice.

Who is doing this study?

A study team led by Dr. Diana Del Angel is doing this research study. Other research professionals may help them. This project is funded by The Nature Conservancy and is being conducted in partnership with Texas A&M University-Corpus Christi. The study team will not receive any personal payment because of your decision.

Why is this research being done?

The questions are designed to help the project team develop a monitoring plan and collect data regarding the socioeconomic benefits of two oyster reef restoration projects. This information will be used to help The Nature Conservancy develop a monitoring program for their oyster reef restoration sites.

Who can be in this study?

We are asking you to be a part of this research study because you may live, travel to, or interact with the study site in some way.

What will I be asked to do?

If you agree to be in this study, you will be asked to complete a 10 to 15-minute survey.

What are the risks involved in this study?

This research involves minimal risks (risks that you may experience in everyday life even if you do not participate in this study). Potential risks include: Confidentiality risk: Your participation will involve collecting information about you. There is a risk of loss of confidentiality. Your confidentiality will be protected to the greatest extent possible. You do not have to give any information to the study that you do not want to give.

Survey Questions: Questions involve basic demographic information and questions around your usage of bay and oyster reef resources and opinion on restoration projects. You do not have to answer questions you do not want to.

What about protecting my information?

Your participation involves collecting information about you.

Your information will be protected by:

• Anonymous survey: The survey will not ask or collect any identifiers from you. Your identity will not be known by the research team. Please do not include any identifiers in the study documents.

• No identifiers linking you to this study will be included in any report that might be published or presented.

• Sharing with others: We will share your information only when we must. We will only share the

information that is needed. We will ask anyone who receives your information from us to protect your confidentiality.

What happens to my data after the study is done?
Once data analysis is complete, your identifiers will be removed from the research data, after such removal, the de-identified information could be used for future research studies or distributed to another investigator for future research studies without additional informed consent from the subject or the legally authorized representative.

What will I receive if I am in the study?
Online survey participants can choose to enter into a lottery for a gift card of $50.

Do I have to participate?
No. Being in a research study is voluntary.

What if I change my mind?
You may quit at any time. Your decision not to participate or to stop participating at any time will not affect your current or future relationship with Texas A&M University-Corpus Christi or any collaborating institution. If you withdraw from the study early for any reason, the information that already has been collected will be kept in the research study and included in the data analysis. No further information will be collected for the study.

Who can I contact with questions about the research?
You can call Diana Del Angel at 361-825-2089 or email at Diana.DelAngel@tamucc.edu with questions at any time during the study.

Who can I contact about my rights as a research participant?
You can contact Texas A&M University-Corpus Christi Institutional Review Board (IRB) with questions or complaints about this study at irb@tamucc.edu or 361-825-2497. The IRB is a committee of faculty members, statisticians, researchers, community advocates, and others that ensures that a research study is ethical and that the rights of study participants are protected. CONSENT TO PARTICIPATE If you DO NOT AGREE to participate in the research study, click "no" below and exit this form or do not fill out the survey.

To participate in this research study, click "yes" below to continue to begin filling out the survey. By clicking "yes", you agree to participate in the study. By participating in this study, you are also certifying that you are 18 years of age or older.

- ○ Yes
- ○ No

End of Block: Consent

Start of Block: Intro Questions

Q2.1 Language:

- English
- Spanish
- Vietnamese

Q2.2 What is your zipcode?

_____

Q2.3 Do you visit or use Galveston Bay-Trinity Bay, TX or Calcasieu Lake, LA?

- Calcasieu Lake, LA
- Galveston Bay-Trinity Bay, TX
- Neither
- Both

Q2.4 Which site are you more familiar with?

- Calcasieu Lake, LA
- Galveston-Trinity Bay, TX
- Both

Q2.5 Have you heard of habitat restoration?

- Yes
- No

Q2.6 What kind of habitat restoration are you familiar with?

_____

_____

_____

_____

_____

End of Block: Intro Questions

Start of Block: Calcasieu Lake Use

Q3.1 The following questions pertain to the map below.

Q3.2 Is your job tied to oyster reefs of Calcasieu Lake? Please Explain.

- Yes _____
- No _____

Q3.3 Do you participate in any of the following activities in or near Calcasieu Lake West Cove?

- [ ] Art
- [ ] Festivals
- [ ] Academic research/Citizen science
- [ ] Outreach/Education events
- [ ] Social gathering/socializing
- [ ] Solitude
- [ ] Spiritual use
- [ ] Birding or wildlife viewing
- [ ] Exercise (swimming, walking, running, biking, etc)
- [ ] Hunting
- [ ] Boating or kayaking
- [ ] Fishing: Recreational
- [ ] Fishing: Charter
- [ ] Fishing: As primary food source (subsistence)
- [ ] Oyster harvesting: Recreational
- [ ] Oyster harvesting: Commercial/wild harvest
- [ ] Oyster harvesting: As primary food source (subsistence)

☐ Other, please describe _____

☐ I do not use this area.

Q3.4 Do you have any of the following concerns about the natural environment and natural resources associated with Calcasieu Lake West Cove?

	Not at all concerned	Slightly concerned	Moderately concerned	Very concerned	No opinion
Degraded habitat or reduction in ecological quality of wetlands	○	○	○	○	○
Degraded habitat or reduction in ecological quality of oyster reefs	○	○	○	○	○
Loss of wildlife or biodiversity (plant, animals, etc)	○	○	○	○	○
Loss of commercially important species	○	○	○	○	○
Loss of access or ability to use natural areas (oyster reefs, marsh, open water, etc)	○	○	○	○	○
Pollution (marine debris, trash, contaminants etc)	○	○	○	○	○
Drought	○	○	○	○	○
Flooding	○	○	○	○	○
Sea level rise	○	○	○	○	○
Severe storms	○	○	○	○	
Severe heat	○	○	○	○	
Warming waters	○	○	○	○	
Erosion of shoreline	○	○	○	○	
Subsidence	○	○	○	○	
Water quality	○	○	○	○	
Other, please describe	○	○	○	○	○

End of Block: Calcasieu Lake Use

Start of Block: Calcasieu Lake Project Specific

Q4.1 The Nature Conservancy's Calcasieu Lake oyster reef restoration project is located on the east shoreline of West Cove. This intertidal oyster reef was built with gabions that are exposed during low tide and are covered at high tide. The most current phase of this project was constructed in 2022. The restoration design aims at reducing erosion on the west shoreline of the Calcasieu Lake complex while creating habitat and enhancing ecological benefits in the area. This project is one of many restoration projects in the region.

Q4.2 Were you previously aware of The Nature Conservancy Calcasieu Lake West Cove oyster reef restoration project? If "Yes", please explain.

- Yes _____
- No

Q4.3 Do people fish as a primary food source or to meet nutritional needs (i.e. subsistence harvest) on or around The Nature Conservancy Calcasieu Lake West Cove oyster reef restoration project site? Please explain.

- Yes _____
- No _____
- I do not know.

Q4.4 Is your job affected by the The Nature Conservancy Calcasieu Lake West Cove restoration project? Please explain.

- Yes _____
- No _____
- I don't know

Q4.5 Besides your job, have you benefited or been negatively affected by The Nature Conservancy Calcasieu Lake West Cove oyster reef restoration project? If so, how?

- ○ Yes _____
- ○ No _____
- ○ I don't know

Q4.6 Do you know if local businesses have benefited or been negatively affected by The Nature Conservancy Calcasieu Lake West Cove oyster reef restoration project? If so, how?

- ○ Yes _____
- ○ No _____
- ○ I don't know

Q4.7 Do you have other comments about The Nature Conservancy Calcasieu Lake West Cove oyster reef restoration project?

- ○ Yes, please describe. _____
- ○ No

End of Block: Calcasieu Lake Project Specific

Start of Block: Additional Comments

Q9.1 Do you have additional thoughts on oyster reefs, restoration, or bay habitat resources? If so, please explain.

_____

_____

_____

_____

_____

End of Block: Additional Comments

Start of Block: Demographic

Q5.1 What is your Race/Ethnicity? (Select all that apply).

- ☐ White
- ☐ Black or African American
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Native Hawaiian or Pacific Islander
- ☐ Ethnicity: Hispanic/Latino
- ☐ Other _____
- ☐ Prefer not to answer

Q5.2 What is your age range?

- ○ 18-24
- ○ 25-34
- ○ 35-44
- ○ 45-54
- ○ 55-64
- ○ 65-74
- ○ 75-84
- ○ 85 or older
- ○ Prefer not to answer

Q5.3 What is your household income range (in the last 12 months)?

- ○ less than $20,000
- ○ $20,000-$30,000
- ○ $30,000-$40,000
- ○ $40,000-$50,000
- ○ $50,000-$60,000
- ○ $60,000-$70,000
- ○ $70,000-$80,000
- ○ $80,000-$90,000
- ○ More than $90,000
- ○ Prefer not to answer

End of Block: Demographic

Start of Block: End of Survey-TNC

Q6.1 Thank you for participating in this survey. To express our gratitude you have the opportunity to enter your name and email address into a drawing for a $50 gift card. To enter: write down or copy the survey receipt number that you see below, and then click the following link to the gift card entry form. There you will enter the unique survey receipt number you see below and your email address. You will be notified by email if your email address was selected as the winning entry.

https://tamucc.co1.qualtrics.com/jfe/form/SV_aXCfZ0dgj6o7mfk

This is your receipt number to enter the drawing: ${e://Field/Random%20ID}

Note that the link to the survey form is external, and your survey responses will not be associated with your email address. Your responses remain anonymous.

End of Block: End of Survey-TNC

Start of Block: Trinity Bay & Galveston Bay Use

Q7.1 The following questions pertain to the map below.

Q7.2 Is your job tied to oyster reefs in Galveston Bay-Trinity Bay? Please explain.

- ○ Yes _____
- ○ No _____

Q7.3 Do you participate in any of the following activities in or near Galveston Bay-Trinity Bay?

- [ ] Art
- [ ] Festivals
- [ ] Academic research/Citizen science
- [ ] Outreach/Education events
- [ ] Social gathering/socializing
- [ ] Solitude
- [ ] Spiritual use
- [ ] Birding or wildlife viewing
- [ ] Exercise (swimming, walking, running, biking, etc)
- [ ] Hunting
- [ ] Boating or kayaking
- [ ] Fishing: Recreational
- [ ] Fishing: Charter
- [ ] Fishing: As primary food source (subsistence)
- [ ] Oyster harvesting: Recreational
- [ ] Oyster harvesting: Commercial/wild harvest
- [ ] Oyster harvesting: As primary food source (subsistence)

☐ Oyster harvesting: Aquaculture

☐ Other, please describe _____

☐ I do not use this area.

7.4 Do you have any of the following concerns about the natural environment and natural resources associated with Galveston Bay-Trinity Bay?

	Not at all concerned	Slightly concerned	Moderately concerned	Very concerned	No opinion
Degraded habitat or reduction in ecological quality of wetlands	○	○	○	○	○
Degraded habitat or reduction in ecological quality of oyster reefs	○	○	○	○	○
Loss of wildlife or biodiversity (plant, animals, etc)	○	○	○	○	○
Loss of commercially important species	○	○	○	○	○
Loss of access or ability to use natural areas (oyster reefs, marsh, open water, etc)	○	○	○	○	○
Pollution (marine debris, trash, contaminants etc)	○	○	○	○	○
Vessel Traffic	○	○	○	○	○
Drought	○	○	○	○	○
Flooding	○	○	○	○	○
Sea level rise	○	○	○	○	○
Severe storms	○	○	○	○	○
Severe heat	○	○	○	○	○
Warming waters	○	○	○	○	○
Erosion of shoreline	○	○	○	○	○
Subsidence	○	○	○	○	○
Sedimentation	○	○	○	○	○

Water quality	○	○	○	○	○	
Other, please describe	○	○	○	○	○	

End of Block: Trinity Bay & Galveston Bay Use

Start of Block: Trinity Bay and Galveston Bay Project Specific

Q8.1 The Nature Conservancy's Galveston Bay Sustainable Oyster Reef Restoration Project funded the construction of Beezley Reef Restoration in 2021. This 3-part oyster reef complex is part sanctuary and part harvestable oyster reef. The sanctuary reef (at the center of the complex) is designed to be a broodstock sanctuary reef, supplying oyster larva to harvestable areas. The new oyster habitat in this reef complex will help filter coastal waters, enhance water quality, and provide food and shelter for over 300 different species of fish, shrimp and crabs, and other invertebrates.

Q8.2 Were you previously aware of The Nature Conservancy Beezley Reef oyster restoration project in this area? If "Yes", please explain.

- ○ Yes _____
- ○ No

Q8.3 Do people fish as a primary food source or to meet nutritional needs (i.e. subsistence harvest) on or around The Nature Conservancy Beezley Reef oyster reef restoration project site? Please explain.

- ○ Yes _____
- ○ No _____
- ○ I do not know.

Q8.4 Is your job affected by The Nature Conservancy Beezley Reef oyster restoration project in this area? If so, how?

- ○ Yes _____
- ○ No _____
- ○ I don't know

Q8.5 Have you benefited or been negatively affected by The Nature Conservancy Beezley Reef oyster restoration project? If so, how?

- ○ Yes _____
- ○ No _____
- ○ I don't know

Q8.6 Do you know if local businesses have benefited or been negatively affected by The Nature Conservancy Beezley Reef oyster restoration project?

- ○ Yes _____
- ○ No _____
- ○ I don't know

Q8.7 Do you have other comments about The Nature Conservancy Beezley Reef oyster restoration project?

- ○ Yes, please describe. _____
- ○ No

End of Block: Trinity Bay and Galveston Bay Project Specific

Appendix D. Coding System and Code Frequency Expert Interviews

Table 2. Interview Coding System and frequency of coded segments from interview notes

Code System	Frequency	Description/Notes
Potential Survey Spots	17	Facebook groups, grocery stores, fishing ramps, or sources where the online survey could be provided to users.
Gaps	16	Knowledge; Additional uses
Partners	13	All entities mentioned by experts as partnering in some capacity in this restoration projects.
Evidence of linkages	0	Linkages within the GEMS models used. Some experts directly talked about benefits of oyster reefs and possible outcomes.
Socioeconomic Outcomes	0	
Cultural values	0	
Other	4	Sense of place, livelihood option, existence value, traditional and local knowledge, etc.
Knowledge	0	Awareness of restoration or project
Economic activities	0	Jobs, labor income, gross state product, and total industry output
Restoration/intervention	8	
Recreation and tourism	4	
Finfish/shellfish harvest	1	
Human health	0	
Mental health and psychological well-being	0	
food security for communities	0	
Property protection	9	Erosion
Human Activity Outcomes	0	
Cultural practices related to oysters	0	
Art	1	
Festivals	1	
Scientific activities	8	
Educational activities	20	
Recreation	0	
Wildlife viewing	0	
Kayak	1	
Oyster harvest	0	
Subsistence	4	
Commercial aquaculture	0	
Commercial wild harvest	5	
Recreational	0	

Non-oyster harvest	1	
Commercial	1	
Recreational	1	
Subsistence	0	
Intermediate Components	0	
Food	0	
Personal consumption	1	Subsistence
Commercial sale	2	
Oyster habitat persistence	21	
Biodiversity	1	
Threatened & endangered species persistence	0	
Bird population	0	
Marine wildlife populations	0	
Species important for wildlife viewing	0	
Fish	2	
Benthic organisms	1	
Oysters	15	
Water quality	0	
Nitrogen concentration	2	
Water turbidity	2	
Shoreline change	9	Erosion/accretion
Adjacent habitat	0	
Mangrove	0	
Sea grass	0	
Salt marsh	1	
Light attenuation	1	
Bottom sediment composition	0	
Oyster reef quan/qual	5	
Oyster harvest techniques	2	
Wave attenuation	3	

Appendix E. Public Survey Distribution Suggestions from Experts

Beezley reef, Galveston Bay, TX

- Galveston Bay Foundation https://galvbay.org/
  - Oyster Gardener Network
  - https://galvbay.org/events/
  - https://www.facebook.com/GalvestonBayFoundation/
  - https://www.instagram.com/gbayfoundation/
- Baytown Nature Center
  - https://baytown.org/708/Baytown-Nature-Center
  - https://www.facebook.com/BaytownCityHall/
  - Nature Nurture Fest Saturday October 14th https://baytown.org/904/Nurture-Nature-Festival
- Adopt a beach – closer to Beezley- near ship channel dredging, and they have opinions
- Texas Master Naturalists – Houston/Galveston Chapter (contact Galv. County Sea grant Extension Agent listed below to help distribute to Master Naturalists)
- Texas Sea Grant
- Texas Parks & Wildlife
  - Oyster Licensing mailing list
- Facebook
  - Local fishing and harvest groups/pages
  - Local tourism groups/pages
- Recreational fishing guides at Thompson boat ramp near site
- Houston Chronicle
- Go to Baytown? Maybe some of these fishing or water-use websites …
- Coastal Conservation Chapter in the area
- Commercial harvesters: Maybe on opening day at the oyster docks go and talk to them

West Cove reef, Calcasieu Lake, LA

- Engage with youth, veterans
- USFWS and Sabine National Wildlife Refuge
  - There is a boat ramp at the end of West Cove. There are a lot of folks there that are familiar with the area. That would be a good place to start.
- Louisiana Department of Wildlife & Fisheries
  - Oyster Task Force
- Louisiana Sea Grant
  - https://www.facebook.com/LASeaGrant
- Coastal Conservation Association
  - https://www.facebook.com/CCALouisiana/
  - https://ccalouisiana.com/about-us/chapters-and-chapter-presidents/
- Coastal Protection and Restoration Authority (CPRA) https://coastal.la.gov/
  - https://www.facebook.com/LouisianaCPRA/
  - https://www.facebook.com/LouisianaCPRA/

- Natural Resources Conservation Service (NRCS)- Louisiana https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/louisiana
    - https://www.facebook.com/USDA.NRCS/

- Cameron County staff and the local government
- "Just Imagine Southwest Louisiana Campaign"
    - https://www.visitlakecharles.org/just-imagine-swla/
    - https://www.facebook.com/imagineswla
    - https://www.instagram.com/imagineswla/
    - https://www.visitlakecharles.org/just-imagine-swla/connect/
- Locally in Hackberry, it's pretty small, everyone goes to Brown's Grocery, everyone goes there. Maybe a flyer. Also fishermen give guided tours and they may want to be involved.
- Coastal Restoration Coalition of Louisiana
    - State of the Coast usually in the New Orleans Convention Center
    - https://www.crcl.org/
    - https://www.linkedin.com/company/coalition-to-restore-coastal-louisiana/
- Grand Isle Facebook group
- Venice Facebook group
- Get the word out to the marinas too
- Local Libraries

Appendix F. Additional Graphs

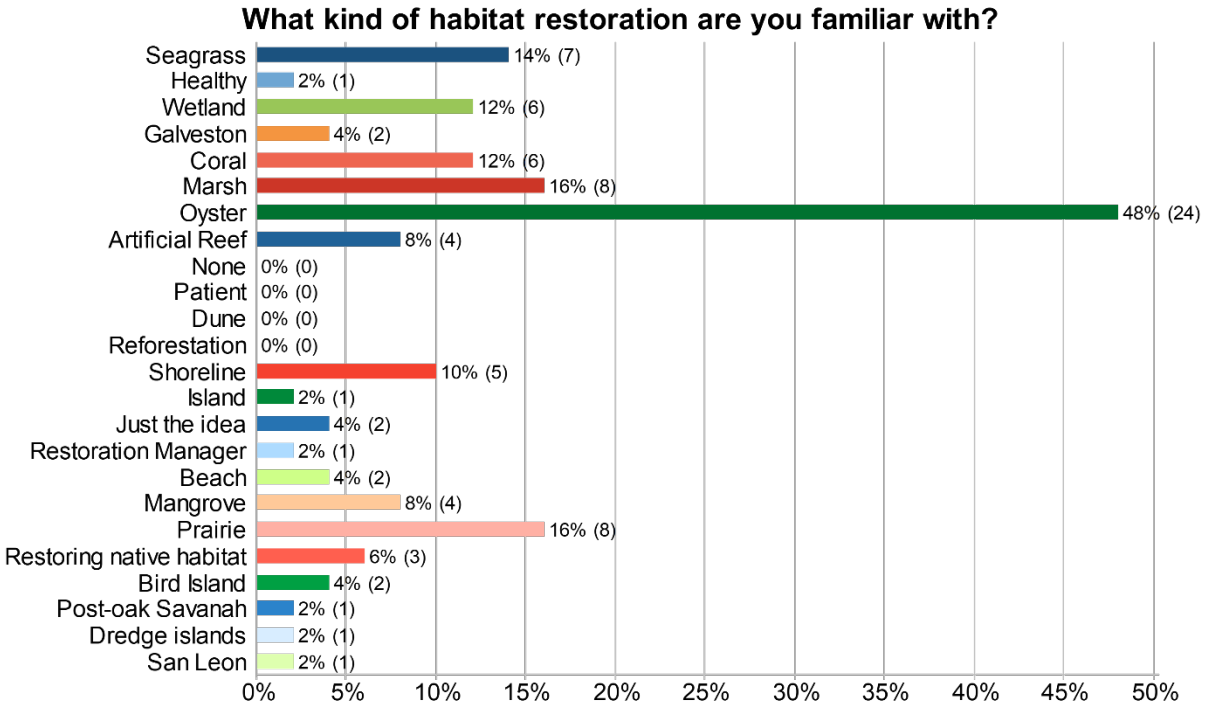


Figure 49. Free text coded into categories for the question regarding knowledge of habitat restoration for the Beezley Reef survey.

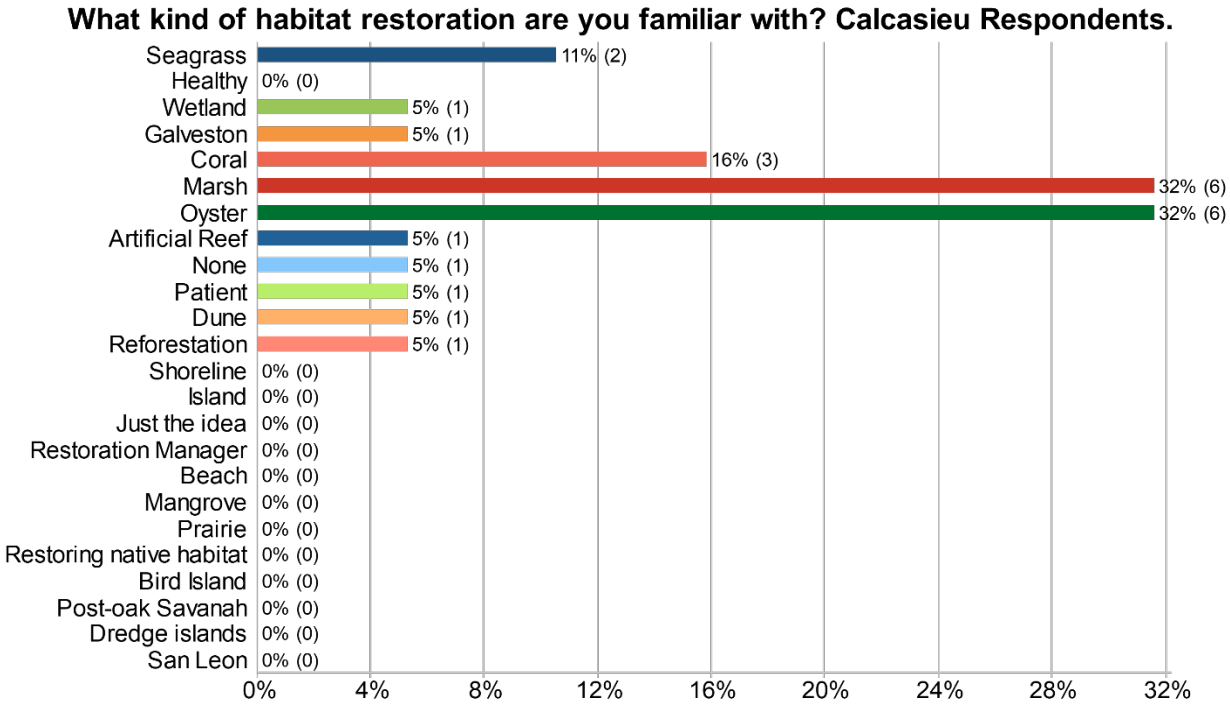


Figure 50, Free text coded into categories for the question regarding knowledge of habitat restoration for the Calcasieu Lake survey.

Appendix G. Coding System and Code Frequency for Evidence of Linkages to Socioeconomic Outcomes: Public Survey

Code System	Frequency	Description/Notes
Socioeconomic Outcomes		
Economic Activities	9	Comments provided by participants regarding impact to jobs, business, and recreation
Restoration/Intervention	14	Benefit from construction, planning, monitoring or association with restoration
Finfish/shellfish harvest	3	Oyster harvesting: Commercial/wild harvest Oyster harvesting: Subsistence
Recreation & Tourism	0	Social gathering/socializing Birding or wildlife viewing Exercise (swimming, walking, running, biking, etc) Hunting Boating or kayaking Fishing: Recreational Fishing: Charter Oyster harvesting: Recreational
Property Protection	0	
Property Value	0	
Erosion	75	Concern for shoreline erosion
Human Health	0	
Mental Health & Psychological Well-being	0	Solitude
Food Security for Communities	16	Fishing: Subsistence
Cultural Values	0	
Other	0	sense of place, livelihood option, existence value, traditional & local knowledge Spiritual use Art Festivals Social gathering/socializing
Knowledge	81	Awareness of restoration or project Academic research/Citizen science Outreach/Education events
	29	Oyster Restoration