

# Shrimping with Diversions:

Understanding the Resilience of Southeast Louisiana  
Shrimpers in Response to Large-Scale  
Ecological Restoration Projects



**Coalition To Restore  
Coastal Louisiana**

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## Project Team:

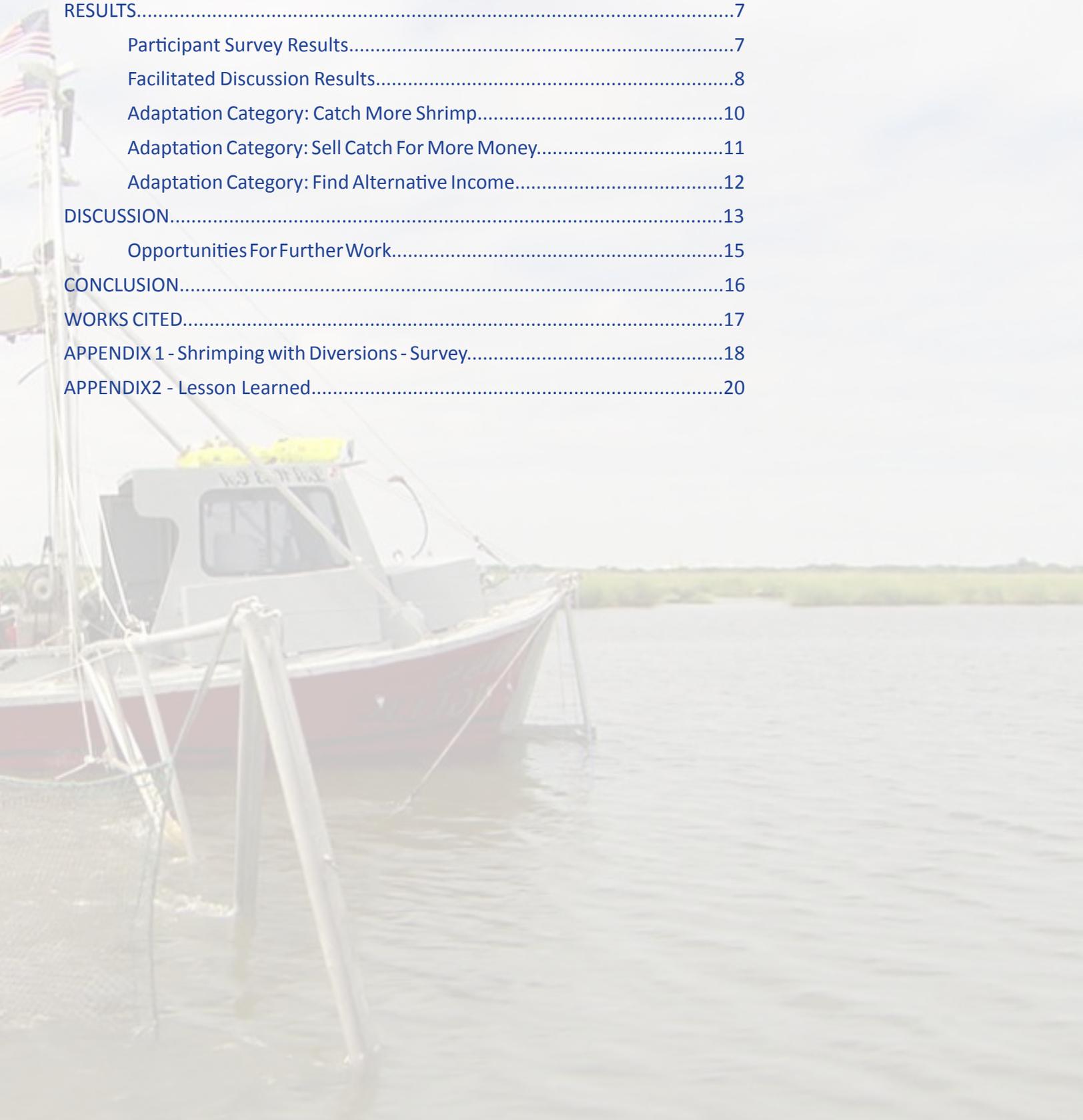
Corey Miller:	Project lead
Nic Dixon:	Facilitation lead and writing lead
Zoe Swartz:	Project assistance
Giovanna McClenachan, PhD:	Statistical analysis and writing assistance

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## ABSTRACT

Louisiana is currently planning large-scale ecological restoration projects, known as sediment diversions, to reconnect the Mississippi River to adjacent estuaries. These projects will alter environmental conditions which have the potential to economically disrupt the local shrimping industry. Through a community-based engagement process, 50 concerned shrimpers of varying socioeconomic backgrounds shared their knowledge of operating a business as a shrimper in a series of facilitated discussions. The resulting synthesis of information in this report provides a thorough understanding of shrimpers' concerns about the ecological impacts of sediment diversions on shrimp, the sociological impacts to their quality of life, the economic impacts to their business, potential ways they could adapt, and mechanisms influencing their ability to do so. These adaptations include: catching more shrimp, selling catch for more money, or finding alternative sources of income. The Coalition to Restore Coastal Louisiana (CRCL) identified why and how shrimpers would adapt and, more importantly, the avenues and obstacles to accomplishing various adaptations. The most alarming finding was that if shrimpers' concerns are realized, there is a segment of the population that will not be able to accomplish adaptation without assistance. This research provides the opportunity to understand where assistance may be needed and creates a compelling argument for developing a plan to help the most vulnerable shrimpers. Community-based approaches to understanding resilience should ultimately inform adaptation strategies to large-scale ecological restoration so that the projects can be implemented and operated with consideration of all stakeholders who may be impacted negatively or positively.

## INTRODUCTION

Louisiana is the top producer of shrimp in the United States (NOAA, 2016) with approximately 5,600 licensed commercial shrimpers (Bourgeois et al, 2016). The community of people that rely on the commercial harvest of shrimp extends beyond the number of licensed shrimpers. This includes family members who are often involved in running the business, deckhands who do not require shrimping licenses, and many supporting businesses (e.g. shrimp boat builders, equipment repairmen, vendors, dock and icehouse workers, etc.) (Mine, 2016).

Shrimping communities are a major component of southeastern Louisiana and many shrimpers have expressed concern about the future of their livelihood specifically regarding the impacts of large-scale ecological restoration projects called sediment diversions. The southeastern portion of the state accounts for more than 50% of the commercially harvested shrimp in Louisiana (Bourgeois et al, 2016). The wetlands of this region provide valuable shrimp habitat, a significant part of which falls within the area of influence of planned sediment diversions (figure 1). These projects are an integral part of the plans to address coastal land loss (CPRA, 2017). While expected to build and maintain land, there is uncertainty and concern as to how ecological changes caused by sediment diversions may affect commercial fisheries, especially shrimp. Shrimp are reliant on the estuary (Zimmerman and Minello, 1984), salinity, temperature, and dissolved oxygen are critical factors for shrimp productivity (Bourgeois et al, 2016, Zein-Eldin and Renaud, 1986, Barrett and Gillepsie, 1973). Sediment diversions, designed to mimic

a natural crevasse in the Mississippi River delivering sediment, nutrients, and fresh water as the river swells, have the potential to significantly decrease salinity in the current estuarine system to the extent and duration that it impacts local shrimp populations (Bourgeois et al, 2016). Amongst the scientific community and shrimp industry there is agreement that sediment diversions will impact shrimp populations to some degree, however the specific types and magnitude of impacts remain a point of debate and inquiry. One point of contention is that as plans for diversions advance there persists a void of a clear process to address impacts as they may arise and assist fishing-dependent communities in transition (CPRA 2017). Industry leaders have posed questions about what Coastal Restoration and Protection Authority (CPRA), and those implementing diversion plans, are doing to ensure that fishermen are taken care of in the course of it all (Louisiana Public Square 2017).

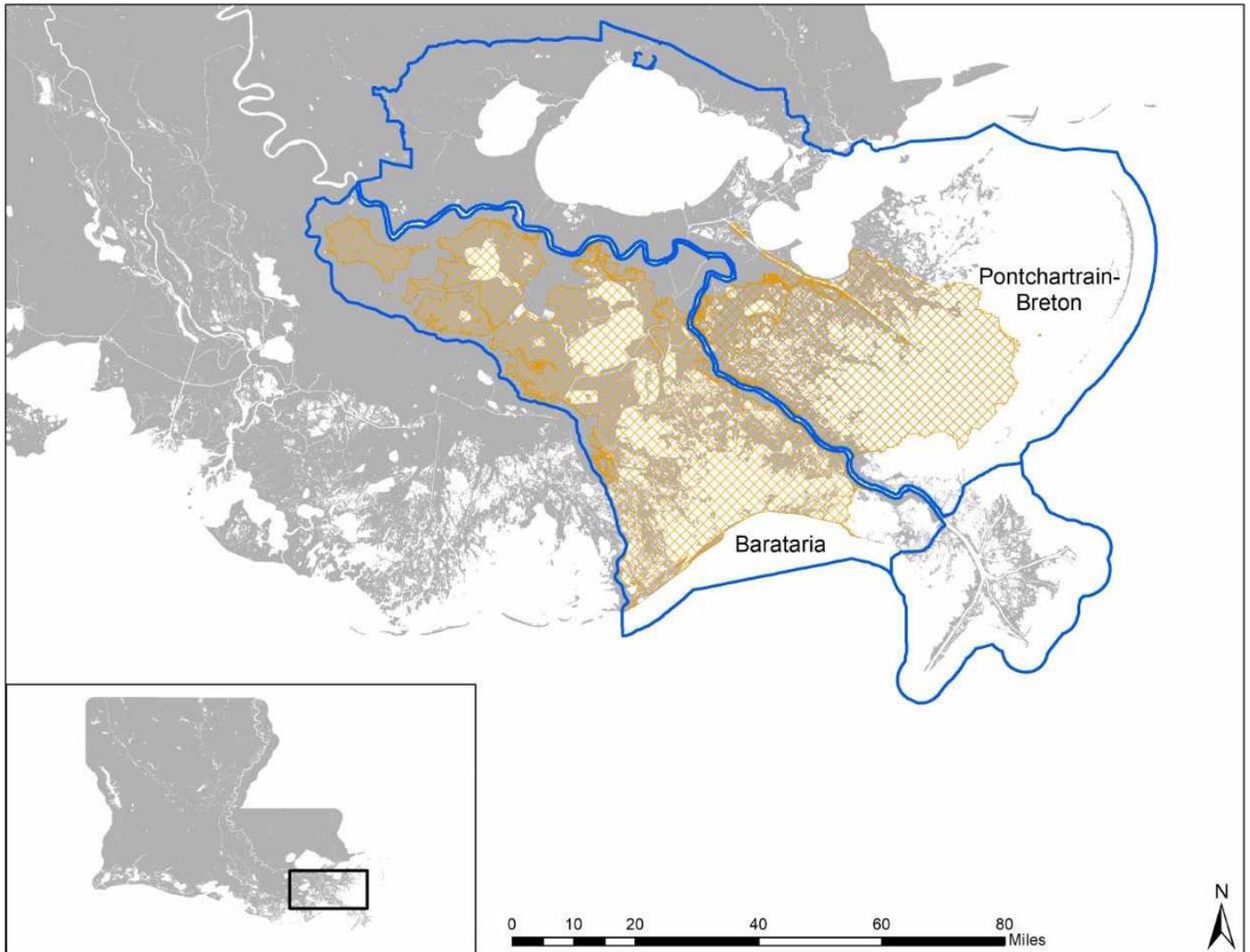


Figure 1. The anticipated area of influence of the two prominent sediment diversions are represented in yellow (CPRA 2017). The southeastern portion of the state that is responsible for more than 50% of shrimp harvest is outlined in blue.

This report is intended for coastal restoration colleagues, shrimping community members, and others interested in community-based approaches to climate change adaptation. The purpose of this work is to gain a better understanding of vulnerability and economic resilience within the southeastern shrimping community. This will help inform strategies developed to aid the shrimping community should impacts to the fishery occur. Furthermore, this report demonstrates a preliminary process framework for understanding community resilience through facilitated discussions of community needs, obstacles, and strategies for adapting to ecological disturbance.

# METHODS

A total of 50 participants were recruited using non-probability sampling to achieve representation from a diversity of locations and to be inclusive of unique communities (such as the Vietnamese and Cambodian). Recruitment was accomplished by engaging shrimping community leaders in the parishes within and near areas of influences of planned diversions and asking them to reach out to their networks to gather shrimpers who wished to discuss concerns about impacts to shrimp resulting from diversions. Participants were from 5 fishing communities across Plaquemines, St. Bernard, and Jefferson Parishes (Figure 2).

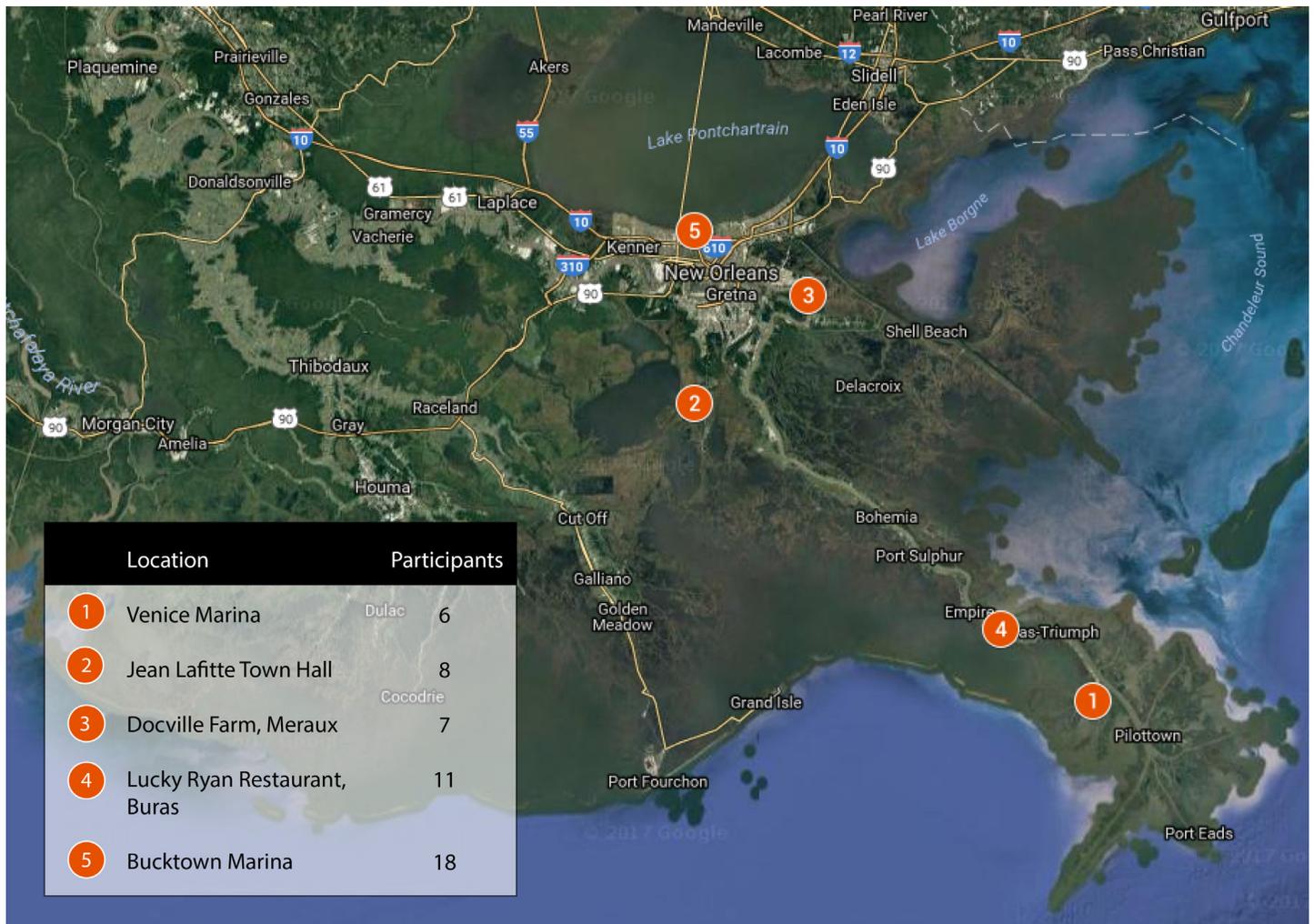


Figure 2. Map of Southeast Louisiana indicating where meetings occurred, and the corresponding number of participants.

Across the three parishes, a total of 7 small group meetings (two in each for Bucktown and Buras) were held to discuss “shrimping with diversions” through a socioeconomic lens. Groups consisted of 4-8 shrimpers and were held over a two-hour period in venues that either shrimpers or community leaders identified as convenient and rooms were arranged to accommodate transparent sharing and recording of data (for example, see figure 3). Meetings were timed to be either around noon or early evening so that meals could be provided to accommodate attendance and as a gesture of appreciation and took place between April 13 and May 2, 2017. It was important to schedule all the groups before May to accommodate the typical opening of brown shrimp season when shrimpers generally become unavailable to participate in lengthy meetings. Food was purchased from local restaurants so that it was familiar and appealing to participants and as a gesture of support for those economies.



*Figure 3. Facilitated Discussion with Cambodian Shrimper Community. CRCL employee, Zoe Swartz (far right) scribes on flip charts; Coastal Communities Consultant employee, Christina Duong (second from right) translates conversation; CRCL employee, Corey Miller (second from left) helps facilitate conversation among participants.*

Meetings began by providing food and handing out a survey (appendix 1) to gain an understanding of each shrimper's level of concern about diversions, their business operation, and other socioeconomic and demographic information including: type of boat and gear, other sources of income, age, years of shrimping experience, etc. The formal discussions began with the facilitator explaining the project and reminding participants that the objective was to hear and capture their concerns about impacts to shrimp that could result from planned diversions. It was made clear that the research team was not there to present information on sediment diversions and that keeping focus on the activity would ensure that everyone's input could be gathered in time. However, if participants did have specific questions relating to sediment diversions, they were welcomed to ask facilitators and CRCL staff after the facilitated discussion concluded.

The facilitated discussion occurred in two steps. In the first step, participants were asked "How do sediment diversions affect shrimp?" and answers were recorded on a flip chart by a scribe (see example, Figure 4). Participants often brought up how environmental components (such as water temperature, salinity, nutrients) would change as a result of operating sediment diversions, so it was necessary for the facilitator to guide participants in relating those comments to expected impacts to shrimp populations. This set the stage for the second step which participants discussed socioeconomic impacts related to each of the ecological changes to shrimp identified in step one.

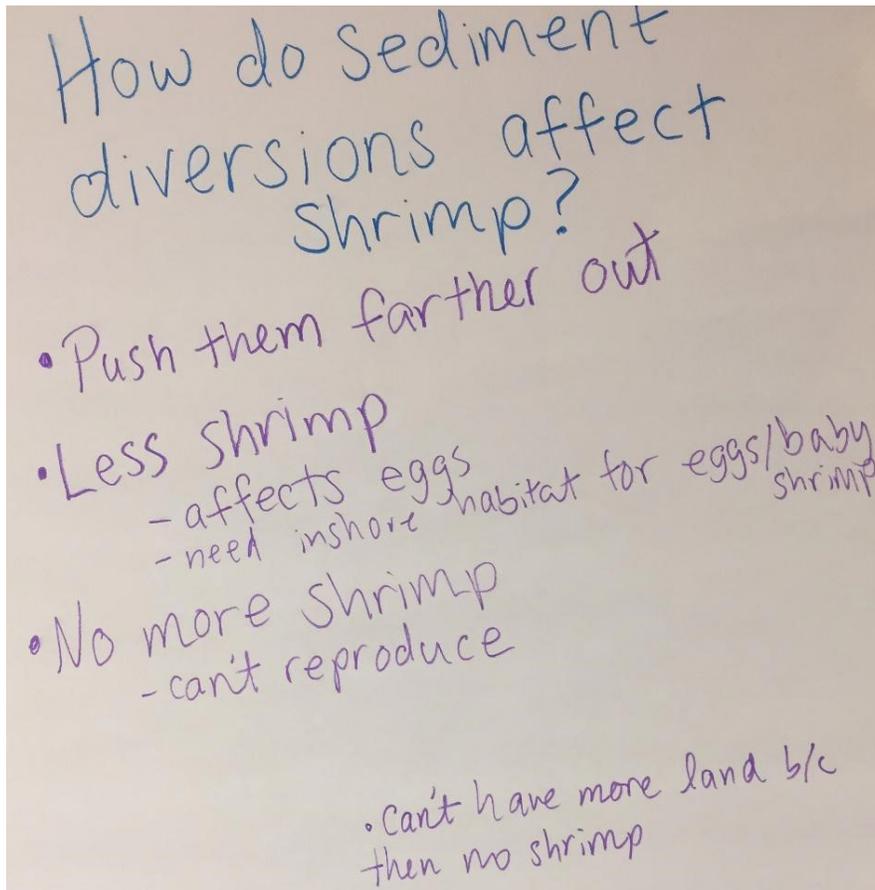


Figure 4. Picture of a flipchart from step one of the facilitated discussion in Buras, Louisiana. Comments on impacts of sediment diversions on shrimp populations were recorded as the prominent bullet points, while other comments were still noted as sub bullet points but were not discussed further in the process.

In the second step, the scribe wrote each response for ecological impacts to shrimp from the question in step one as a title on a new flip chart (e.g. if three relevant concerns were identified during step one, then a total of three flip charts were created in step 2). Each subsequent flip chart had a table with the following questions: “How does it affect you?”; “How could you deal with it?”; and “(What are the) needs and obstacles?”. The facilitator led participants in discussion of each potential impact titled on the flip charts, allowing conversations to flow as long as they were constructive, and guided the discourse to specific answers related to the three prompts. The scribe recorded participants’ comments within the table (Figure 5).

Starting with the conversation on how an ecological impact (e.g. shrimp are farther out) leads to socioeconomic impacts—these were recorded in the how does it affect you column. Then once all the issues were clearly identified, shrimpers were asked to brainstorm ways that they could adapt—these responses were recorded in the how to deal with it column of the table. Finally, participants were then asked to think one step farther to list potential obstacles to adaptation and how these obstacles could be overcome—these responses were written in the needs/obstacles column.

After the series of group discussions concluded, all the information from both steps of each facilitated discussion was digitized. Thematic analysis was conducted by synthesizing and categorizing the information gathered. The data was coded into three overarching adaptation categories and the various strategies and obstacles to achieve adaptation within each category.

Shrimp are farther out

How does it affect you?	How to deal with it	Needs/obstacles
<ul style="list-style-type: none"> <li>• Upgrade boat</li> <li>• Get new gear               <ul style="list-style-type: none"> <li>- Time investment</li> </ul> </li> <li>• Have to keep ice longer               <ul style="list-style-type: none"> <li>- upgrade freezer system</li> </ul> </li> <li>• Need a bigger boat</li> <li>• Current size boat would become obsolete               <ul style="list-style-type: none"> <li>- can't shrimp</li> </ul> </li> <li>• More time/effort spent traveling</li> <li>• Pay more for fuel + supplies               <ul style="list-style-type: none"> <li>↳ to make trip worth it</li> </ul> </li> <li>• Less income               <ul style="list-style-type: none"> <li>- Decrease opportunity for shrimping</li> </ul> </li> <li>• More dangerous               <ul style="list-style-type: none"> <li>- can't shrimp in windy conditions</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Help from state to finance upgrade + supplies</li> <li>• Get loan</li> <li>• Get access to federal waters</li> <li>• Sell boat</li> <li>• More safety training</li> <li>• Insurance</li> </ul>	<ul style="list-style-type: none"> <li>• Not enough money</li> <li>• Bad credit               <ul style="list-style-type: none"> <li>"Have to start from beginning age"</li> </ul> </li> <li>• more regulations to learn, need more training</li> <li>• hard to sell obsolete boat</li> <li>• "risk business + life"</li> <li>• many people are uninsured</li> </ul>

Figure 5. Picture of a flipchart from the second step of the facilitated discussion in Buras, Louisiana with a group of Vietnamese Fishermen. This was one of three flip chart on the wall during the discussion.

It is important to note that Cambodian and Vietnamese comprise a substantial portion of the Southeast Louisiana shrimping community. Interpretation services were provided and surveys were translated with the help of community partners at Coastal Community Consulting (CCC); this component of the research and service that CCC provided was critical to ensure a more inclusive assessment.<sup>1</sup>

<sup>1</sup> The Cambodian and Vietnamese -speaking groups were scheduled back to back in a restaurant that is frequented by both groups to maximize time with the interpreter.

# RESULTS

## Participant Survey Results

A total of 50 shrimpers participated in the facilitated discussion, and there was 88% survey participation (n=44). Ages of participants ranged from 22 to 78, with the majority (64%) between age 45 and 65. On average, participants had 35 years of experience shrimping.

Ninety percent of the participants were very concerned that diversions would impact their catch of brown shrimp and 68% were very concerned about impacts on their catch of white shrimp. All participants expressed some level of concern. All participants reported shrimping inshore at least some of the time and 86% of the participants reported that they mostly shrimp inshore.

Twenty participants were full-time shrimpers (determined by no indication of alternative income), 21 of the participants indicated harvesting at least one other fishery, and 8 participants indicated having other alternative incomes. An Analysis of variance (ANOVA) showed that full-time shrimpers were more concerned (p-value<0.005) with diversion impacts to white shrimp populations than part-time shrimpers, those who indicated other means of income besides shrimping (Figure 6).

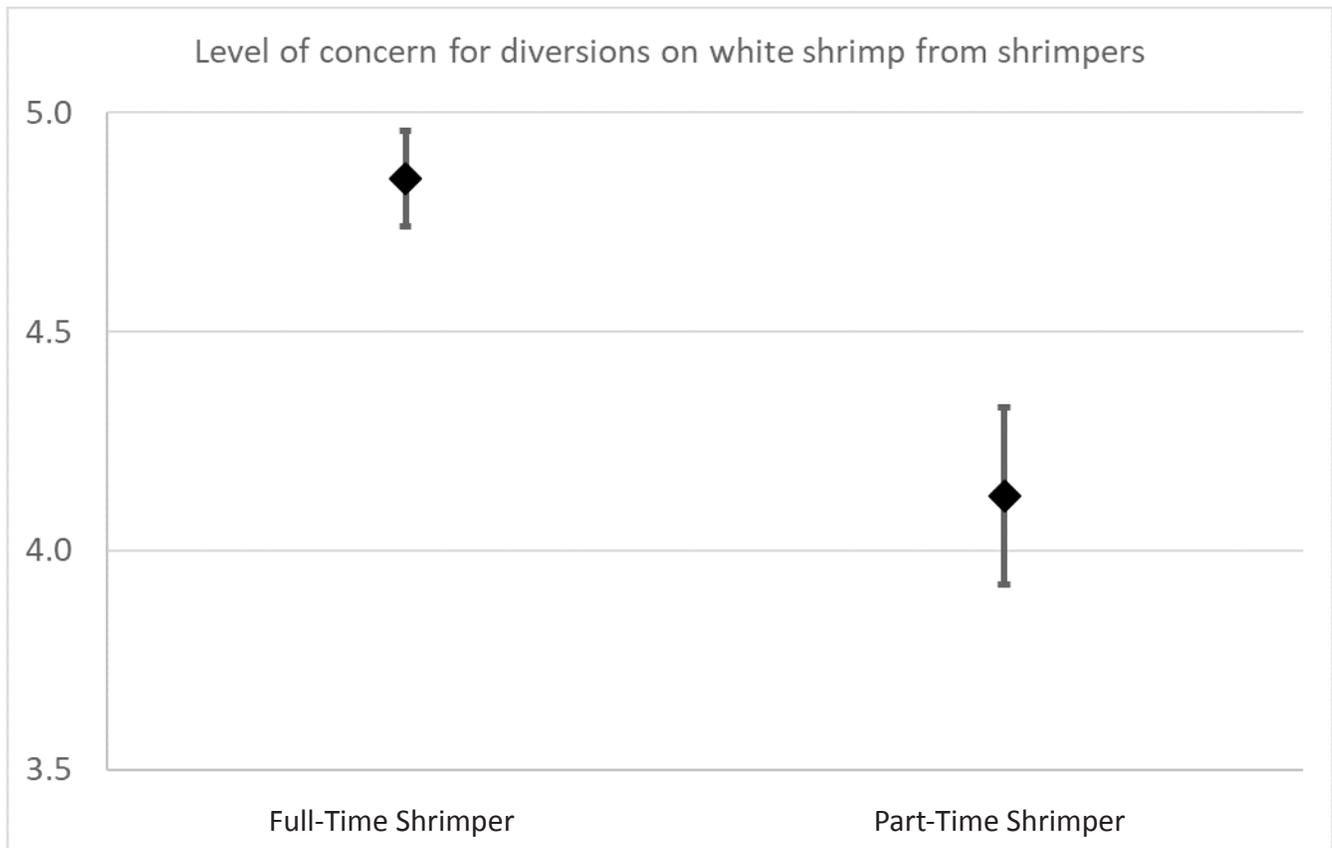


Figure 6. Graph showing differences in levels of concern (scale of 1 – 5; 5 being very concerned) for white shrimp between shrimpers who only harvest shrimp (n=20) and shrimpers with other sources of income(n=24).

## Facilitated Discussion Results

Raw data from the facilitated discussion was thematically analyzed to understand shrimper's concerns and resilience in relation to those concerns, i.e., the applicability of avenues offered when discussing "how to deal with it". The analysis involved coding all data from the facilitated discussion to summarize and organize the results. This provided insight into three main areas of interest outlined in the following sections.

### 1. Perceived impacts of sediment diversions on shrimp populations

Using the comments that were recorded during first step of the facilitated discussion, the potential impacts of sediment diversions on shrimp populations were thematically listed for each group discussion. For example, statements such as "no shrimp", "less brown shrimp", or "less shrimp" were coded as "decreases in shrimp abundance."

This resulted in three common concerns:

1. Decreases in shrimp abundance
2. Redistribution of shrimp populations to other areas
3. Smaller average size of shrimp

The first two concerns were shared amongst all regions that were sampled (Venice, Lafitte, Meraux, Buras, Bucktown). The third was a concern in all regions except Buras.

### 2. Why and how changes in shrimp populations would directly impact shrimpers' livelihoods

Data from the second step of the facilitated discussion were analyzed to understand why and how perceived changes in shrimp populations would impact shrimper's livelihoods. Comments recorded on the flipcharts that explained why ecological changes would result in lower profit and how that lower profit would impact a shrimper's business and livelihood are summarized and listed below.

Why changes in shrimp populations mean less profit before adaptation:

1. Decreased catch per unit of effort (CPUE)
2. Lower market value, fewer retail opportunities, and no bargaining power for small shrimp-- this relates specifically to the "smaller average size of catch" impact
3. Decreased fishing opportunity (i.e. shorter season)

How lowered profit could impact shrimpers' businesses/livelihoods:

1. Decreased feasibility of continued shrimping using current methods
  - a. Caused by insufficient reinvestment capital, loss of supporting services (e.g. docks, processing plants, net makers/repairmen), or unsatisfactory returns on investment
  - b. May have to stop shrimping as a result
2. Impacted quality of life
  - a. Increased burden on family
  - b. Loss of community resources
3. Adaptation may be needed

### 3. Potential avenues and obstacles to adaptation

Understanding how shrimpers would adapt to the potential conditions that would yield lowered profits was the final step in the thematic analysis. Some participants expressed that they could simply live with making less profit (a sentiment particularly expressed by those who shrimped for supplemental income). For others, it was widely recognized that adaptation may be needed depending on the shrimper's socioeconomic status and severity of the impacts to the shrimper's business. The process yielded a wide variety of specific ways in which shrimpers could adapt, the vast majority of which could be arranged by three overarching adaptation categories: *catch more (table 1)*, *sell catch for more (table 2)*, or *find alternative sources of income (table 3)*. These three adaptations are outlined in the tables below with each table providing a consolidated list of all the unique shrimper-identified avenues and obstacles to adaptation.

These "avenues/obstacles to adaptation" tables provide details on ways for the shrimper to accomplish adaptation; the potential policies, programs, or other avenues to facilitate that adaptation; and potential obstacles in the face of the adaptation. Within each table, the left column of each row contains a strategy to accomplish the adaptation category followed by avenues to facilitate that strategy; the right column has corresponding obstacles.

For example, in discussions of the scenarios when shrimp were less abundant or further out it was common to hear the strategy, "upgrade to a bigger boat" (in order to travel offshore, to other basins, and in deeper waters) to catch shrimp (see Table 1, last row). The *strategy*, "convert to an offshore vessel" is expanded upon by the *avenues to accomplish adaptation* like, "Financial assistance programs could facilitate upgrade..." and further explained by the *obstacles* to that strategy such as, "Capital investment to acquire, operate, and maintain the large vessels required for offshore could be cost-prohibitive...". In this case, the *obstacle* could be mitigated by the *strategy* but the obstacle, "Diminished quality of life due to longer hours/days at sea" (as a result of adapting to this style of shrimping) would remain unmitigated.

Table 1. Shows the summarized participant responses for strategies and avenues to accomplish the adaptation category of catching more shrimp with corresponding obstacles.

## Adaptation Category: Catch More Shrimp

Strategies And Avenues To Accomplish Adaptation	Obstacles To The Avenues
<ul style="list-style-type: none"> <li>• Improve currently owned fishing vessel by upgrading the fishing versatility and capacity. (Examples include gear and storage upgrades.)</li> <li>• Help accessing subsidies<sup>2</sup>, grants, or low interest loans to offset upgrade expenses.</li> </ul>	<ul style="list-style-type: none"> <li>• Improvements may be too expensive or require too much additional labor time from the shrimper.</li> <li>• Upgrades may not be compatible for current vessel size, configuration.</li> <li>• Current loan opportunities are unavailable or undesirable.</li> </ul>
<ul style="list-style-type: none"> <li>• Work more hours/days per trip (increase fishing effort).</li> </ul>	<ul style="list-style-type: none"> <li>• More time working places burden on business, family and overall quality of life.</li> </ul>
<ul style="list-style-type: none"> <li>• Limit entry of new commercial shrimpers to regulate fishing pressure<sup>3</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>• (Nothing formally commented; see researcher observation below.)</li> <li>• The researchers acknowledge that restrictions on access to commercial fisheries has rarely occurred without contention from some segments of the industry.</li> </ul>
<ul style="list-style-type: none"> <li>• Increase range of fishing trips (travel further to seek greater distribution/ more productive areas).</li> <li>• Access to fuel subsidies or rebates from the state based on boat type/size that would cover increased costs.</li> <li>• Access to gear and engine fuel efficiency upgrades.</li> </ul>	<ul style="list-style-type: none"> <li>• Insufficient investment capital for purchasing additional fuel and supplies to maintain boat and crew.</li> <li>• Required to be away from home for too long, dock in remote areas that are less secure and stay in temporary housing such as motels.</li> </ul>
<ul style="list-style-type: none"> <li>• Move household and shrimping business to an alternate community near areas with more shrimp (i.e. relocate to a different basin).</li> <li>• Access to relocation assistance could facilitate.</li> </ul>	<ul style="list-style-type: none"> <li>• A relocation trend may result in excessive fishing pressure in those areas and be counter-productive.</li> <li>• Families/businesses may be unable or unwilling to pay the costs of relocation.</li> <li>• Relocation may be too demanding on elderly shrimpers and families.</li> </ul>
<ul style="list-style-type: none"> <li>• Convert to an offshore<sup>4</sup> (deep water) vessel.</li> <li>• Financial assistance programs could facilitate upgrade to a larger boat (&gt; 50 ft.) and appropriate gear type suitable for offshore conditions.</li> <li>• Trainings for learning a new type of shrimping practice and business operation could assist transition.</li> </ul>	<ul style="list-style-type: none"> <li>• Capital investment to acquire, operate, and maintain the large vessels required for offshore could be cost-prohibitive (more expensive gear, larger crew, longer trips, more fuel, added supplies, etc.)</li> <li>• Offshore fishing conditions are less safe.</li> <li>• Difficulty and cost of having to learn a new type of shrimping in unknown waters.</li> <li>• Consolidating fleet in these areas could result in excessive fishing pressure.</li> <li>• Can be difficult to keep stable deckhands.</li> <li>• Diminished quality of life due to longer hours/days at sea.</li> </ul>

<sup>2</sup> Participants commented, “a subsidy will only last for so long, kills the industry by keeping more people fishing than can afford.”

<sup>3</sup> Participants expressed, “shrimpers will naturally weed themselves out.”

<sup>4</sup> “Offshore” in this context refers to the La State waters. Federal offshore shrimping requires different regulations and permits and is currently under a renewed 10 year moratorium for issuing new permits until October 26, 2026. ([http://sero.nmfs.noaa.gov/sustainable\\_fisheries/gulf\\_fisheries/shrimp/2016/am17a/index.html](http://sero.nmfs.noaa.gov/sustainable_fisheries/gulf_fisheries/shrimp/2016/am17a/index.html) ). We believe that this fact and the significant business capital required to enter this fishery were limiting factors that resulted in very minimal discussion of adaptations via transition to Federal Offshore shrimping.

Table 2. Shows the summarized participant responses for strategies and avenues to accomplish the adaptation category of selling shrimp for more money with corresponding obstacles.

## Adaptation Category: Sell Catch For More Money

Strategies And Avenues To Accomplish Adaptation	Obstacles To The Avenues
<ul style="list-style-type: none"> <li>Take steps to address the dockside price issues caused by imported shrimp placing downward pressure on local shrimp economy. Ideas that were suggested included: advocate for tariff on imported shrimp (to President Trump), federal government program that buys domestic shrimp at guaranteed price (contract), increase inspection of imports, consumer education, and proof on menu.</li> </ul>	<ul style="list-style-type: none"> <li>(Nothing formally commented; see researcher observation below.)</li> <li>However, it should be noted that these avenues are largely outside the control of individual shrimpers and could literally take an act of congress. Regardless, the researchers believe it is an important avenue to investigate since an increase in dockside price is the ONE avenue that increases economic resilience across the full range of vulnerability.</li> </ul>
<ul style="list-style-type: none"> <li>Direct market shrimp to skip steps in the supply chain and sell directly to consumers or retail vendors (restaurants, grocery stores, etc.). Selling value added products (like Vermillion Bay Sweet model<sup>5</sup>) was identified as being an effective way to accomplish direct sales. Programs to assist in training, equipment, and marketing could increase access to these models.</li> <li>Create market for smaller shrimp which currently receive almost cost-prohibitive dockside prices.</li> <li>Consumer education on superior product handling and quality could increase demand.</li> </ul>	<ul style="list-style-type: none"> <li>Direct sale requires a significant additional effort beyond selling to the dock and will only help a small percentage of shrimpers who are able to transition to that model.</li> <li>Requires more work to run direct to market business- permits, transport, time, effort, etc.</li> <li>May need to process the products to achieve greater markets by peeling, deveining, or packaging/preserving which requires buying equipment and compliance with Board of Health regulations</li> <li>Time spent selling shrimp is lost time for catching shrimp; need more employees to offset this which cost money and requires additional responsibility.</li> </ul>
<ul style="list-style-type: none"> <li>Take steps to address pricing control by docks. Incentivizing more docks and processors to be open, increasing competition. Set up a dock or processing cooperative.</li> </ul>	<ul style="list-style-type: none"> <li>Historical attempts for shrimpers to open cooperatives have faced insurmountable state/political opposition from current dock owners. This requires considerable startup capital.</li> </ul>
<ul style="list-style-type: none"> <li>Change management policy for shrimp fishery to restrict harvest time to periods yielding larger, more marketable sized shrimp.</li> </ul>	

<sup>5</sup> Direct marketing success stories are found in case studies like Vermillion Bay Sweet. (<http://louisianadirectseafood.com/announcements/vermillion-bay-sweet-one-step-away-from-the-boat>)

Table 3. Shows the summarized participant responses for strategies and avenues to accomplish the adaptation category of finding alternative income with corresponding obstacles.

## Adaptation Category: Find Alternative Income

Strategies And Avenues To Accomplish Adaptation	Obstacles To The Avenues
<ul style="list-style-type: none"> <li>• Fish other fisheries.</li> <li>• Could include existing commercially harvested saltwater or freshwater species or allow entry into currently restricted species. Allow the use of more effective finfish fishing methods such as gillnets or strike nets.</li> <li>• Leadership (in the form of lobby, unionization, or some other organization) will likely be required to enact legal changes. New management protocols could provide sustainable regulation of newly accessible fisheries.</li> <li>• Assistance with accessing subsidies or loans could support purchasing appropriate boats and/or equipment to fish other fisheries. Trainings could educate on how to harvest other fisheries</li> <li>• Saltwater species that could be utilized: redfish, mullet, speckled trout, white trout, sheepshead, crab, shark, and oysters. Freshwater species that could be utilized: catfish or garfish.</li> </ul>	<ul style="list-style-type: none"> <li>• Legacy issues of historic over-fishing practices .</li> <li>• Entry into other fisheries (e.g. mullet, oysters) is too limited. Harvestability of other saltwater species might dwindle similarly to shrimp.</li> <li>• Sport fishermen lobby seen as a strong opponent in countering efforts to allow commercial harvest of certain species.</li> <li>• Market for freshwater species is undeveloped and small.</li> <li>• Buying new gear could be too high of a cost and low interest loans are difficult to qualify for.</li> <li>• Takes time for investment to payoff, may not be feasible for older fishermen.</li> <li>• Some fisheries require an apprenticeship before fishermen can obtain a license.</li> </ul>
<ul style="list-style-type: none"> <li>• Jobs in local industry like oil, navigation, or restoration.</li> <li>• Labor jobs such as welding were identified as possible options within those industries. Training programs might help fishermen gain access to these local industry jobs. Stop eating shrimp (must spend more on groceries), may grow vegetables to supplement groceries.</li> </ul>	<ul style="list-style-type: none"> <li>• Elderly age, lack of education or experience outside of shrimping, and language barriers can be prohibitive.</li> <li>• Local industries, like oil and gas, may not be a good option because they are dwindling or have too restrictive hiring processes.</li> <li>• Undesirable changes to quality of life including loss of shrimping culture, subsistence food, and other losses of personal freedoms such as not being as autonomous.</li> </ul>
<ul style="list-style-type: none"> <li>• Relocate to a region with more job options. Assistance for finding new place to live and work could facilitate.</li> <li>• In one group discussion, a participant stated, “move me some place where I’m safer (from storms/flooding) and have security of a job paying \$15/hr” would make her content.</li> </ul>	<ul style="list-style-type: none"> <li>• Issues with no prior experience, socioeconomics, and undesirable changes to quality of life (similar to the above cell) may be exacerbated by a relocation.</li> <li>• Some shrimping communities speak English as a second language, so there could be language barrier issues.</li> </ul>
<ul style="list-style-type: none"> <li>• Sell boat and house. Buyout program to assist in fair-value liquidation of these assets. May require political will and leadership.</li> </ul>	<ul style="list-style-type: none"> <li>• Might not be able to sell boat and house (especially if a decrease in demand after diversions.) Creating a fair buyout program likely difficult since large variation between people who haven’t invested much compared to those who have been shrimping a long time.</li> <li>• Some perceived buyouts as unfair because it will wipe out supporting community.</li> </ul>
<ul style="list-style-type: none"> <li>• Provide assistance with accessing Social Services such as: supplemented income or welfare.</li> <li>• Reclassifying shrimpers as farmers/harvesters so that they can fit under Department of Agriculture and receive farm bill benefits may provide assistance.</li> </ul>	<ul style="list-style-type: none"> <li>• Not desirable to receive “handouts” and prefer a way to continue working.</li> <li>• Social services were perceived as being difficult to qualify for and to navigate bureaucratic processes.</li> <li>• May be economically infeasible for government.</li> </ul>
<ul style="list-style-type: none"> <li>• Go back to school.</li> </ul>	<ul style="list-style-type: none"> <li>• Less desirable for older people. College is expensive and risky.</li> </ul>

Some strategies for adaptation categories did not have obstacles explicitly stated in the corresponding cell (this occurred twice). In these cases, the researchers provided some insight into potential obstacles. One example (see Table 2, row 1) occurs in addressing the dockside price issues caused by imported shrimp placing downward pressure on local shrimp economy. Opportunities for assistance were identified such as developing a federal government program to buy shrimp for a guaranteed price or advocacy for a tariff on imported shrimp but individual efforts to accomplish this would not be possible and would almost certainly require a large amount of organizational effort that may not exist.

Lastly, it is worth noting that the uncertainty of impacts that diversions could have on shrimp populations was commonly mentioned as contributing to the inability to plan and an increased risk of decision making. The effects of this problem include either waiting to make investments or making more risky investments, both of which exacerbate the difficulties of adaptation and potentially hinder effectiveness. The uncertainty of diversion impacts also discouraged the succeeding generation of shrimpers from entering the industry. An avenue identified that could help address this obstacle was simply to get more up-to-date and easily accessible information on impacts of sediment diversions to the affected shrimping communities. However, a notable concern related to this obstacle was that there is a legacy of mistrust of political leaders and appointees who are typically responsible for disseminating this type of information.

## DISCUSSION

The most critical finding of this project is that some shrimpers may not be able to adapt to the potential negative impacts of sediment diversions without assistance while others may be able to do so. This is explained by the observation that the range of vulnerability and consequent ability to adapt is widely varied by socioeconomics and business operations of each shrimper and further complicated by the uncertainty of the magnitude with which impacts may occur. Shrimpers provided a robust understanding of how their concerns translate to impacts to profits and quality of life and how they could deal with that change. The level of vulnerability is directly related to each shrimper's way of operating business (size of boat, gear type, length of trips, presence of alternative incomes, etc.) and socioeconomic status (age, language access, education, etc.). The magnitude with which impacts to shrimp will occur remains uncertain which hinders shrimpers' ability to plan for adaptation, especially if that requires increased investments. The difficulty remains in the uncertainty of what the future holds for impacts to shrimp yet through this process it is apparent that potential strategies and avenues exist to enable shrimpers to adapt to a wide range of scenarios that may result.

The shrimper's ability to adapt defines their resilience. Our findings suggest that while there is a robust set of avenues to adaptation, shrimper resilience and, concomitantly, the effectiveness of adaptation varies. The reported factors from this study contributing to varied resilience among shrimpers are: age, educational background, literacy, proficiency with the English language, geography, boat/equipment type, skills/experience, investment capital, current workload (for individual and family), access to community services, political/organizational power, and ability to liquidate assets. Some shrimpers appear to have no obstacles to the avenues of adaptation that they will rely on, while other shrimpers may have insurmountable obstacles. This can be explained using two hypothetical examples. A shrimper who is young, does not have a lot invested in their shrimp business, with experience in another trait and/or opportunity to continue education is lower on a scale of vulnerability as they could adapt to alternative sources of income. By comparison, a shrimper who is much older, didn't finish high school and has only been a shrimper their whole life, and has invested significant capital in their business is much higher on a scale of vulnerability and consequently less resilient. The variance in vulnerability as dictated by these factors and others are further explained throughout the discussion.

Location of harvest is another important factor influencing resilience and ability to adapt. Due to the location of diversions and factors influencing shrimp life cycles, inshore shrimpers are less resilient than offshore shrimpers

to potential impacts of sediment diversions. This was validated in discussions of what shrimpers would need in order to adapt if the concern was that shrimp would be less abundant or further out. Participants often responded, “I would need a bigger boat to go further/ stay out longer/ fish deeper water.” In specifically recruiting shrimpers that were concerned with diversion impacts, all participants in this study reported shrimping inshore at least some of the time. Much of this concern is centered around perceived impacts resulting in decreased catch per unit effort (CPUE) and loss of profit.

Changes in quality of life was a common thread throughout discussions in which shrimpers explained how they would react to negative impacts to shrimp populations. When participants were asked, “how would you deal (with that change)?”, often, responses began by indicating they would work longer hours/days per shrimp trip to “make ends meet” (i.e., sacrifice quality of life). Here too, responses were varied depending on each shrimper’s unique circumstances. For instance, some participants who were retired from a previous career only shrimped for supplemental means and anticipated they would merely have less disposable income, i.e., they would not invest more capital to change their business operation and would sacrifice to a lower CPUE until it was cost prohibitive to do so. Conversely, others who rely on the resource more heavily suggested scenarios where there would be negative net income that led to loss of basic needs and services for their families. In both scenarios (and most discussed) a loss of quality of life would be incurred. These differences in dependence on the resource for supplemental vs necessary income were noted through analysis of the survey results where full-time shrimpers indicated significantly higher concern regarding changes to white shrimp populations than shrimpers who had some alternative source of incomes.

Overall, when discussing “how shrimpers would deal (with perceived impacts from diversions),” the responses fell into three categories of adaptation strategies: *catch more*, *sell catch for more*, and *find alternative income*. Regardless of the categorization, it became apparent that in most cases these adaptations would constitute a sacrifice of quality of life and/or require significant change that could be a large (and potentially risky) investment; for some, adapting was seen as simply not feasible without external support. Changing fishing methods (whether it is upgrading gear/boat to fish in different areas, relocating, or fishing other species) as an avenue to adaptation requires significant time and monetary investment from the shrimper and that option might not be available to them due to lack of investment capital or loan opportunities. Furthermore, this type of investment pays off over a long term, so age was noted as a limiting factor that prevented a number of fishermen from justifying the expense. Additionally, age limited the ability to find alternative income as an adaptation because it was expressed that a new skill set might be hard to develop, particularly skills that require school.

Several participants were non-English speakers, less educated, illiterate, or some combination for whom avenues to adaptation are restricted. It would be a challenge for these shrimpers to transition out of their current skill set (i.e. commercial fishing.); therefore, avenues for adaptation are largely limited to addressing downward import pressure on local dockside prices or opening access to other fisheries, both of which require significant political or organizational power, likely, outside of that which is available within their fishing community. For the shrimpers who wish to transition away from shrimping and doing so would require them to sell their boats and equipment, there was a common response, “Who would want to buy a skimmer boat around here after diversions are opened?” This indicates another potential issue of getting a fair value for liquidating investments if there is a large downturn in the industry.

The extent of change to shrimp populations resulting from sediment diversions is shrouded by uncertainty, and this uncertainty is another factor that hinders shrimpers’ ability to plan for and adapt to future conditions. *Decreases in abundance*, *redistribution to other areas*, and *smaller average size* were the three main concerns that emerged for changes to shrimp populations, almost unanimously, during group discussions. This finding was not surprising since literature on shrimp biology supports the shrimpers’ concerns over the potential fluctuation of the key environmental stimuli (e.g. salinity and temperature) that affect fundamental parameters for shrimp productivity (habitat suitability, migration, and growth rates) (Bourgeois et al, 2016, Zein-Eldin and

Renaud, 1986, Barrett and Gillepsie, 1973). However, we anecdotally detected that there were varying degrees of confidence regarding the likelihood/degree of severity that specific impacts would occur. Opinions ranged from high confidence in complete decimation of local shrimp populations, to optimistic opinions where shrimp populations might stay relatively intact or possibly even benefit (specifically for white shrimp populations). This wide range of opinions is indicative that there is still much uncertainty as to just how shrimp will react to future ecological conditions with sediment diversions in operation.

Based on our discussions with the shrimpers, we understand that this uncertainty of impacts to shrimp populations could exist for multiple reasons. First, there may not be enough information within the science community to fully understand impacts of diversions on the local shrimp populations. Second, the nature of the scientific knowledge may not be inherently compatible with the traditional ecological knowledge of shrimpers and hence, not accessible to the shrimpers. The lines of communication between the shrimping community and the restoration decision makers may need to be bolstered and better tailored. For instance, information may need to be communicated in more layman terms, in a different language, or at a time and place that is more convenient and accommodating for shrimpers. Third, in discussion with a group of shrimpers about this topic— it was stated that despite all the attempts being made to communicate information to their community, they ultimately did not trust the sources information. It seems that an effort to build trust must somehow accompany any plans to improve communication and get to a state in which all those who are working to implement and those impacted by these projects may be better informed by the various knowledge sets and ultimately make better decisions for the future.

Finally, it is notable that throughout the discussions shrimpers wanted to better understand how the plans for diversions and their operations will impact their business and livelihood and want to be included in plans for operations and management of diversions so that they may make the best-informed decisions and plan appropriately. There is often a perception that commercial fishermen and women want nothing more than a paycheck for damages (incurred and/or projected). However, mere compensation for loss was the least often mentioned form of assistance and several participants declared similarly, “I don’t want a hand-out, that’s just temporary. I want a way to keep on making a living and providing for my family as I have always done.” Therefore, until impacts are better understood, planned for, and observed it may be most wise to further investigate all the various factors influencing vulnerability and develop a process to identify those who are at the extremity of the spectrum in which they are the most vulnerable. Thereafter, transition strategies may be tailored as the most appropriate for specific vulnerabilities and these individuals may be prioritized for support. All of these factors contribute to unique and varying levels of vulnerability for individual shrimpers.

## *Opportunities for further work*

This community engagement project was a strong step forward toward understanding the range of shrimper vulnerability and identifying possible opportunities for adaptation. However, it also revealed that much more work needs to be done to answer the remaining questions and to develop an effective adaptation plan, even as we move forward with coastal restoration.

We encourage further research to better understand how future shrimp populations may change and an increased effort to disseminate this information to the shrimping community. This is crucial for bolstering shrimpers’ ability to adapt. However, for this to be successful, trust needs to be built between the shrimping community and those responsible for disseminating that information. An effort to work with shrimpers to gather information, so that they can be included in the research process as an asset to the collection of data, would both build trust and benefit the efficiency and robustness of data collection efforts. Shrimpers could collect baseline data

on shrimp populations (abundance, distribution, size) and environmental conditions (salinity, turbidity, etc.) during fishing trips. This type of data would improve understanding of baseline conditions and allow for better comparisons to data collected about shrimp populations after implementation of diversions. Current data on catch per unit of effort, operating costs, morphometric data of catch, and fishing opportunity should be collected and compared to post-diversion operation to understand the magnitude of impacts. Additionally, transitioning to future environmental conditions with diversions may be better informed with an improved understanding of the ancillary jobs and economies (deckhands, shrimp docks, marinas, etc.) that are directly related to shrimping.

Further work on establishing a benchmark for quality of life is needed so that a better comparison between pre-diversion and post-adaptation (e.g. investing in an offshore shrimping vessel, fishing other species, etc.) can be made. This would help determine the effectiveness of the adaptation strategies. Additionally, other efforts to test the success of the avenues to adaptation listed in this report will be critical for developing a plan to assist vulnerable shrimpers. Shrimpers suggested potential avenues for adaptation, but there needs to be more work done to understand the appropriateness and effectiveness of various avenues and to investigate additional strategies for assistance that did not arise through this process. Determining the impacts of sediment diversions over the range of shrimpers' vulnerability should proactively help us understand when and which shrimpers need assistance, thus allowing for the expeditious implementation and operation of the most critical restoration projects - sediment diversions.

## CONCLUSION

Sediment diversions are a cornerstone component of science-based models for restoration that maintain the largest footprint of wetlands for the foreseeable future. Based on our findings, we recognize that there are certain shrimpers who are particularly vulnerable, depending on the extent of the ecological impact of diversions, their way of operating business, and their socioeconomic status. There is potential for a combination of these factors to result in scenarios where shrimpers would be unable to withstand economic disturbances caused by sediment diversions. These shrimpers will need assistance with adaptation. This research has identified potential avenues of adaptation merit further exploration that external agents could implement to mitigate the potential impacts of sediment diversions on shrimpers with low resilience and high vulnerability. We have identified lessons learned and possible areas for improving the engagement process (See appendix 2). Ultimately, plans need to be developed for helping all communities and individuals who cannot adapt to the effects of large-scale ecological restoration projects so that implementation of these projects can restore our coast while supporting our coastal communities and people. The difficulty remains in the uncertainty of what the future holds for impacts to shrimp. Yet, through this process it is apparent that potential strategies and avenues exist to enable shrimpers to adapt to a wide range of scenarios that may result.

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# APPENDIX 1

## Shrimping with Diversions - Survey

How many years have you been a shrimper \_\_\_\_\_ Age \_\_\_\_\_

Boat size \_\_\_\_\_ another Boat size \_\_\_\_\_

Hull material \_\_\_\_\_ Hull material \_\_\_\_\_

Gear type \_\_\_\_\_ Gear type \_\_\_\_\_

storage (ice, freezer, IQF, etc.) \_\_\_\_\_ storage (ice, freezer, IQF, etc.) \_\_\_\_\_

Where do you shrimp? (1=most; 2= some; 3= rarely; 0= never)

inside/inshore \_\_\_\_\_ 3-mile state (outside) \_\_\_\_\_ Federal Offshore \_\_\_\_\_

On a scale of 1 (not at all) to 5 (very), how concerned are you that diversions will impact your catch of Brown Shrimp?

1 (not at all) \_\_\_\_\_ 2 \_\_\_\_\_ 3 \_\_\_\_\_ 4 \_\_\_\_\_ to 5 (very) \_\_\_\_\_

On a scale of 1 (not at all) to 5 (very), how concerned are you that diversions will impact your catch of White Shrimp?

1 (not at all) \_\_\_\_\_ 2 \_\_\_\_\_ 3 \_\_\_\_\_ 4 \_\_\_\_\_ to 5 (very) \_\_\_\_\_

Do you do any "value added" practices?

sell direct to individuals \_\_\_\_\_ if yes, how far do you travel \_\_\_\_\_

sell direct to restaurants or retail \_\_\_\_\_ if yes, how far do you travel \_\_\_\_\_

Do you brand for marketing \_\_\_\_\_

Sort by size \_\_\_\_\_ remove heads \_\_\_\_\_

Others \_\_\_\_\_

What other commercial fishing do you do?

- |          |          |
|----------|----------|
| 1. _____ | 2. _____ |
| 3. _____ | 4. _____ |
| 5. _____ | 6. _____ |

What other sources of income?

- |          |          |
|----------|----------|
| 1. _____ | 2. _____ |
| 3. _____ | 4. _____ |

Anything else you wish to say:

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# LESSONS LEARNED

## *Participant recruitment*

Due to grant and organizational constrictions, meetings were scheduled a month before brown shrimp season opened. This proved to be difficult timing because most shrimpers were very busy getting their boats ready and preparing for the season. Researchers attempted to recruit shrimpers for meetings by visiting shrimp docks and hanging flyers in Plaquemines Parish. However, many of the shrimpers encountered were in the middle of working and did not have time to stop and talk. It is recommended to recruit for meetings earlier in the break between shrimping seasons to better accommodate the schedules of shrimpers. Additionally, if there had been a longer time frame for project outreach, meetings could have been organized based off more specific shrimper traits (e.g. age, gear type, boat size, or reliance on shrimping a primary income source). Meeting divisions were based on geographic area but within each group shrimpers had diverse sets of traits. Organizing groups characteristically could have yielded more tailored adaptation ideas.

## *Documentation*

The strategy of recording the responses during the facilitated discussion provided a method clearly separating out impacts on shrimpers, potential adaptations, and needs and obstacles. However, at times it was difficult to differentiate between the three categories. The facilitator and the scribe sometimes needed to pause the conversation to decide how to categorize statements. In addition, it was sometimes difficult for the scribe to fully capture everything being said because sometimes multiple people would speak simultaneously. In the future, it is recommended to have a second scribe to take detailed notes on a computer so that the scribe writing on the flip chart can focus on concisely capturing the most salient points. With only one scribe, some details of responses were sacrificed for the sake of allowing the conversation to progress naturally. An audio recording or more detailed notes would also have been useful for processing the data to use as a cross reference for context. The flip charts were an effective visual aid and facilitation tool but did not allow for capturing full context of each response.

## *Language and literacy barriers*

On several occasions, researchers attempted to tell shrimpers at various docks and marinas who were not fluent in English about the project. Therefore, we recommend bringing a translated flyer and other translated explanatory material.

## *Procedure*

This process could have been strengthened by a more consistent mechanism for vetting adaptation strategies and/or reaching a consensus. Findings could be strengthened and carry more weight in future shrimper organizing efforts if both ideas with the most support and from shrimpers and outliers were identified.



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