

**The Importance of
Gulf of Mexico Marine Dependent Industries
and Measuring Sea Grant Programming
Benefits on those Industries**



Prepared by the Sea Grant Gulf of Mexico Economics Working Group

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Introduction

The National Sea Grant program was established in 1966 to maximize the social and economic benefits provided by the nation's oceans, coasts, and Great Lakes. The program was designed to accomplish this goal by combining the academic resources of the nation's universities with public and private sector partners to work on coastal and marine issues. The program was modeled after the success of the Land Grant model with the same general goal of applying the academic assets of U.S. universities to problems and issues relevant to general citizens. The National Sea Grant Program employs the resources of more than 300 academic institutions and 3,000 academicians, extension agents, outreach specialists, and educators to create and maintain a healthy coastal environment and economy (NSGCP 2015a).

The four essential elements of the National Sea Grant program are: applied research, extension, education, and communications. Sea Grant supports approximately 500 applied research projects per year on a multitude of marine and coastal issues. Sea Grant supported research has led to: improved monitoring of environmental conditions, development of pharmaceuticals and other industrial materials derived from ocean environments, new uses and markets for seafood byproducts, and improved management of fish stocks. Important findings of the applied research supported by Sea Grant are disseminated to impacted stakeholders, including coastal community members and decision makers, through a network of more than 300 outreach experts including Sea Grant extension agents and specialists. In addition to their role in communicating research findings to the public, Sea Grant extension staff work with coastal communities on numerous projects including: improving tourism opportunities, helping aquaculture facilities develop environmentally sound practices, providing technical assistance to fishers on the correct use of gear designed to reduce bycatch (such as turtle excluder devices), and helping communities deal with natural disasters (NSGCP 2015a).

Educational outreach is another important element of the Sea Grant program. Sea Grant works extensively with K-12 educators to not only provide environmental literacy education in the classroom, but also to provide students with learning opportunities outside of the classroom. Sea Grant also actively supports post-secondary education in a number of disciplines; through its history, Sea Grant has trained more than 12,000 college and graduate students. The last major element of the Sea Grant program is communications. Every Sea Grant state program employs communication staffers who provide precise, dependable, science-based information on coastal and marine issues to the general public. Sea Grant communications span the gamut from written communication (brochures, posters, articles, and books) to electronic media (websites, radio, and videos) to reach as large an audience as possible (NSGCP 2015a).

Although Sea Grant provides immeasurable benefits to the general public, recent changes in the political landscape have changed the manner in which Sea Grant must present and market these benefits. The recent push for greater accountability of government agencies and programs has created an environment where government funded programs, including Sea Grant, must measure and highlight their economic impacts as a means of justifying their performance and value. In 2006, return on investment measures were added to Sea Grant national program reporting requirements; in 2009, economic benefits were included in the reporting requirements as well (Farrow et al. 2012).

Measuring Economic Impacts

Economic impacts measure the economic activity associated with an industry, event, or policy within a regional economy. Economic impacts are calculated using one of several methodologies (such as IMPLAN or REMI) that capture the interaction between industry sectors as expenditures and production create economic output, incomes and taxes, thereby supporting jobs and businesses. The scope of the term “region” is variable, considering economic impacts can be measured at a number of different spatial levels (city, county, state, or national). Economic impacts often calculated include: employment, labor income, output, and value-added. Basic definitions and unit of measurement of these four metrics are presented in Figure 1. In addition to these more commonly used economic impact metrics; Sea Grant has included the following additional metrics in their reports: jobs created, jobs sustained, businesses created, and businesses sustained. For the purposes of Sea Grant reporting, a job/business created is a new position/business created and filled as a direct result of Sea Grant activity, while a job/business sustained is an existing, filled position/business that is supported as a direct result of Sea Grant activity. In general terms, economic impacts are created by three different types of effects: direct effects, indirect effects, and induced effects (see Figure 2). Direct effects are those impacts directly due to an event, industry, or policy being examined. Indirect effects are those impacts due to purchases of goods and services by support industries of an event, industry, or policy being examined. Lastly, induced effects are mostly impacts due to spending of income in the region by employees of an event, industry, or policy being examined.

Figure 1. Commonly Used Economic Impact Metrics

<u>Impact Metric</u>	<u>What It Measures?</u>	<u>Unit of Measurement</u>
Employment	Jobs that result from the industry, event, or policy	Jobs
Output	Effect of direct spending on overall regional activity	Dollars
Labor Income	Wages and salary paid to those employed	Dollars
Value-added	Contribution to regional gross domestic product (GDP)	Dollars

Figure 2. Different Types of Economic Impact Effects

<u>Effect Type</u>	<u>What It Includes?</u>
Direct	Effects caused by the event, industry, or policy being analyzed
Indirect	Effects due to increased business (sales, income, employment, etc.) for industries supplying good or services to the event, industry, or policy being examined.
Induced	Effects generated from increased employment due to the event, industry, or policy being examined.

Measuring the Marginal Benefits of Sea Grant Programming

While greater accountability and oversight through documented accomplishments and benefits are valid goals, lack of clearly defined techniques and rules for calculating these impacts can lead to confusion and uneven reporting across different state Sea Grant programs. Although the calculation of many economic impact metrics (jobs created and sustained, businesses created and sustained, output, and value-added) are easily accomplished for an industry or business using input-output analysis, determining the marginal effect on those industries that can be attributed to Sea Grant programs is difficult. For instance, if Sea Grant, working with private fishers, develops a more efficient harvesting technique or approach that is widely adopted and leads to increased jobs and income in the fishery what part of these benefits should be attributed to Sea Grant? Whereas it stands to reason that the new technique or approach would not have been implemented, and the subsequent economic impacts realized, without Sea Grant; it also stands to reason that the new approach would not have been implemented without the private fishers that worked with Sea Grant in developing the new approach. As this example shows, the collaborative nature of Sea Grant program work can make attributing and allocating project economic benefits among multiple entities difficult.

The problem of measuring and estimating economic benefit performance metrics is exacerbated by the broad scope of Sea Grant work which requires applying these metrics to a number of very different projects. Economic benefits associated with projects that concern private industries (fishing, aquaculture, etc.) might be easy to calculate (although, as noted above, attribution of impacts is difficult) since these benefits often involve market impacts. Market impacts are those economic impacts that can be measured in the marketplace. Examples would include a business increasing its number of employees, revenue, or income. However, many Sea Grant projects produce benefits that are much more difficult to quantify because they involve nonmarket benefits. Nonmarket benefits are those that do not lead to an easily measurable marketplace transaction and, as such, are much harder to quantify. Many outreach, education, and communication programs all provide benefits, but quantifying the economic consequences of these activities in a defensible manner is usually very difficult if not impossible. Using education as an example, it is possible that Sea Grant educational programs might inspire children and motivate them in a manner that increases future scholastic performance. Such a program would likely have positive economic benefits (higher earnings as adults, more productive members of society, more engaged citizens, etc.), but monitoring and measuring these as quantitative impacts is costly and time consuming¹.

Another major difficulty in measuring the marginal economic benefits resulting from Sea Grant projects is that many of these projects involve the conservation and restoration of natural resources, and the ecosystem services associated with those resources are difficult to value.

¹ An example of just such an experiment and the long term impact of education is being conducted by John List an economics professor at the University of Chicago (The Griffin Experiment - <http://www.bloomberg.com/news/articles/2011-02-23/chicago-economist-s-crazy-idea-for-education-wins-ken-griffin-s-backing>). In a project started in 2011 List is attempting to examine the impacts of free all day preschool and parenting classes on success in school, graduation rates, employment, income, and incarceration rates. The lifetime cost of the study is anticipated to be approximately \$10 million and is being funded by Kenneth Griffin a successful hedge fund manager.

Ecosystem services are the aspects of ecosystems utilized for human benefit and can be divided into supporting, provisioning, regulating, and cultural services (Turner, Georgiou, and Fisher 2008). Ecosystem services are varied in nature; examples include wildlife habitat, recreation, waste regulation, climate regulation, water supply, disturbance regulation, erosion prevention, and food. Many of these services provide non-market benefits, and while it is possible to value (monetize) these services many of the techniques used to do so (i.e., contingent valuation, travel cost method, hedonic price analysis, and recreational demand modeling) are costly and time consuming often requiring intricate survey work as part of the analysis.

Measuring Benefits in a Defensible Manner

In an effort to lessen the burden of calculating performance metrics, two internal documents have been created by Sea Grant staff to provide best practices and general guidelines on measuring economic benefits of Sea Grant programs in a reliable, consistent, and economically justifiable manner. The first document was titled ‘Report on the Economic Impact Assessment Methods Inventory for the Sea Grant Network’ (2012) and was developed by Maine Sea Grant staff members. The report provided background information on what constitutes an economic impact as well as information on different types of impacts and the different metrics available to quantify those impacts. The document also provided an inventory of impacts reported by the different state Sea Grant programs during 2010 and 2011. Included with each impact reported was a brief description of the program, industry or resource being evaluated, the benefit metric used, and the economic method used in the analysis. The report provided some guidelines on measuring economic impacts and outlined the need for further guidance on acceptable and best practices in reporting economic metrics.

The second document was created by the National Sea Grant Office and is titled ‘2014-2017 National Performance Measure and Metrics.’ This document, while not confined to economic impacts, provided guidance to the state Sea Grant programs on what performance measures and metrics are reportable. With regards to economic impacts the report defined a number of metrics and the best reporting practices associated with each as they pertain to Sea Grant activities including: jobs created and sustained, businesses created and sustained, income generated, and non-market impacts related to ecosystem services. In addition, the report also outlined a number of economic impact valuation practices that were not deemed appropriate by the National Sea Grant Office, such as calculating the economic impacts of employment and expenditures funded directly from a Sea Grant award and including the in-kind values associated with volunteer involvement (NSGCP 2015b).

Both of these reports were useful in clearing up some of the confusion as to what benefits Sea Grant programs should quantify and what metrics should be used. The document created by Maine Sea Grant allowed state programs to compare the impacts they had been reporting, including the metrics used, to what other Sea Grant programs were reporting. In addition, the report outlined the need for more thorough guidance on how state programs should measure economic impacts and benefits. The National Sea Grant Office document provided some of that guidance through 1) definitions of economic impacts as they relate to Sea Grant activities, and 2) guidelines on what constitutes a reportable economic impact and what metrics are available for calculating appropriate metrics.

Purpose of this Final Report

This Final Report adds to those previous reports in a couple of ways. First, this document provides a number of examples of Sea Grant programming, specific to the Gulf of Mexico Region Sea Grant Programs (Alabama-Mississippi, Louisiana, Texas, and Florida). The benefits and impacts reported for those programmatic activities are discussed. This report is unique in that it is written by Sea Grant economists and provides our views, based on our knowledge of economics, on those program achievements that involve benefits that can be quantified using economic metrics. We note that some of these benefits can't be quantified in a defensible manner and are best highlighted using qualitative measures. In addition, we suggest that measuring the marginal benefits associated with Sea Grant programming is more defensible and appropriate than claiming the economic benefits or impacts associated with an entire industry.

In addition, this report provides measures of the economic importance of marine-dependent industries in the Gulf of Mexico region, including the economic metrics associated with commercial and recreational fishing, marine and coastal tourism and recreation, as well as other marine dependent industries. That portion of the report provides an avenue for Sea Grant programs to provide qualitative impacts of programming, where quantitative analysis is not possible, while still displaying the importance of the programming using hard numbers. In those cases where quantitative analysis directly related to Sea Grant activities is not possible, it is highly likely that the programming impacted an industry (commercial fishing, recreational fishing, birding tourism, etc.) that has easily calculated economic impacts and the qualitative Sea Grant impacts can be magnified by displaying the economic importance of the industry to the local or regional economy. An example where such an approach might be justified is Texas Sea Grant's Monofilament Recovery & Recycling program, which both educates the public about the dangers of discarding old fishing line into the environment where it can harm marine wildlife and birds, and encourages recycling through a network of fishing line recycling bins. While such a program is clearly beneficial it would be impossible to measure the economic impact it has had on marine life and birds – there is simply no way to calculate the number of animals saved by the program. An impact statement related to this program could measure the amount of fishing line collected through the recycling network, state how this fishing line is no longer in the environment where it has been shown to kill birds and marine wildlife (Sea Grant should cite a reputable source in this case), and point out that birding tourism generates \$X of economic impacts for the state of Texas (once again, citing a reputable source). In this example, Sea Grant would highlight the importance of birding tourism and explain qualitatively how the Monofilament Recovery & Recycling program benefits the birding tourism industry without taking credit for all economic benefits generated by birding tourism.

The remainder of this report provides information on industries, organizations, and groups (Sea Grant Partners) in the Gulf of Mexico region which benefit from the work of the Sea Grant programs within the Gulf of Mexico region. Available secondary data were used to display the economic importance of Sea Grant Partners to the Gulf region using a number of economic impact metrics including employment, output, and value-added to the region. In addition, specific examples of the benefits of Sea Grant programming in the region are presented in a series of vignettes. For each vignette recommendations are made on what impacts Sea Grant

programs can present that are reasonable and defensible based on available descriptive data and economic theory.

Select Marine Dependent Industries in the Gulf of Mexico and Their Economic Impacts

The Gulf of Mexico is a critical asset both to the states that border it and the United States as a whole. It is a crucial source of resources to multiple industries including commercial and recreational fishing, tourism, and oil and gas exploration. In 2012, Gulf of Mexico ocean related activities and industries accounted for approximately \$161 billion of gross domestic product (5.9% of the total GDP of Gulf states - see Figure 3 for a state level breakdown), \$34 billion in wages (9.5% of all Gulf state wages), 581,350 jobs (7.0% of all Gulf state Jobs), and 25,185 businesses (NOEP 2013). The Gulf States account for approximately 17% of all United States output (GDP). The economic importance of marine dependent industries in the Gulf of Mexico to both the regional and broader US economy as a whole makes the local Sea Grant programs' roles in the region vitally important to the success of the entire National Sea Grant Program.

Figure 3. Percentage of GDP Due to Ocean Related Activities and Industries, 2012

	<u>% of GDP from Ocean Activities and Industries</u>
Alabama	1.3%
Florida - Gulf	1.6%
Louisiana	10.0%
Mississippi	1.7%
Texas	8.5%
All Gulf States	5.9%

Although the Gulf of Mexico is home to a number of marine dependent industries the focus of this section is narrowed to include those that Sea Grant is actively involved with which include: commercial fishing, seafood processing, and seafood retailing (both fish/seafood markets and restaurants), recreational fishing, and environmental recreation and related tourism.

Commercial Fishing

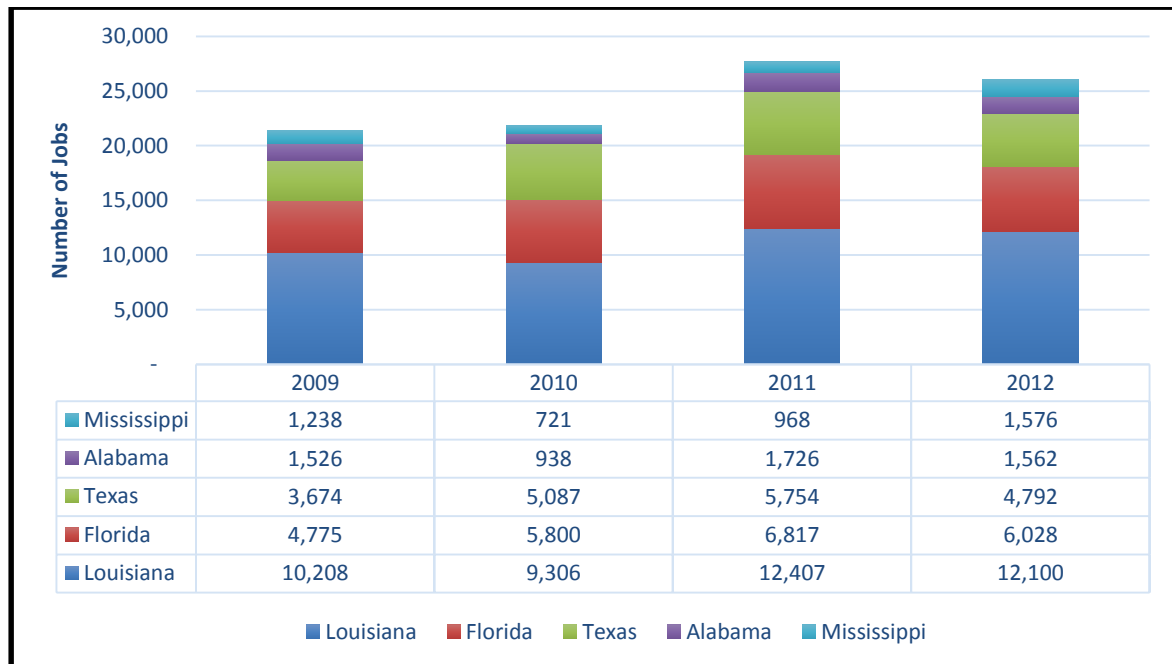
In 2012, commercial fishers in the Gulf of Mexico landed 1.7 billion pounds of fish and shellfish with a dockside value of \$763 million. On a regional basis, Gulf of Mexico landings revenue trailed only the North Pacific and New England commercial fisheries among U.S commercial fishing regions. Shrimp (\$392 million) and menhaden (\$87 million) were the two largest contributors to landings value representing approximately 51% and 11% of total landings value, respectively. At the state level, Louisiana (\$331 million) and Texas (\$194 million) accounted for the highest landings revenue (NMFS 2013).

Figure 4. Gulf of Mexico Commercial Fishing Landings Revenue by State, 2012

	Landings Revenue (millions of dollars)	Percentage of Gulf Total
Alabama	47	6%
Louisiana	331	43%
Mississippi	49	7%
Texas	194	25%
W. Florida	142	19%
Total	763	100%

The economic impacts associated with commercial fishing in the Gulf of Mexico are quite large. Figures 5 through 7 provide National Marine Fisheries Service estimates of the employment, output, and value-added (GDP) impacts of commercial fishing for the Gulf States over the period 2009 to 2012² (NMFS 2010, NMFS 2011, NMFS 2012, NMFS 2013). These impacts include direct, indirect, and induced impacts. In 2012, over 26,000 jobs, \$1.58 billion in output, and \$731 million of GDP were the result of the commercial fishing industry in the Gulf States.

Figure 5. Employment Impacts of Commercial Fishing by State



² Commercial fishing economic impacts for the State of Florida are not Gulf specific and include impacts associated with the Atlantic Coast. 2012 data is the most recent available on these economic impacts.

Figure 6. Output Impacts of Commercial Fishing by State

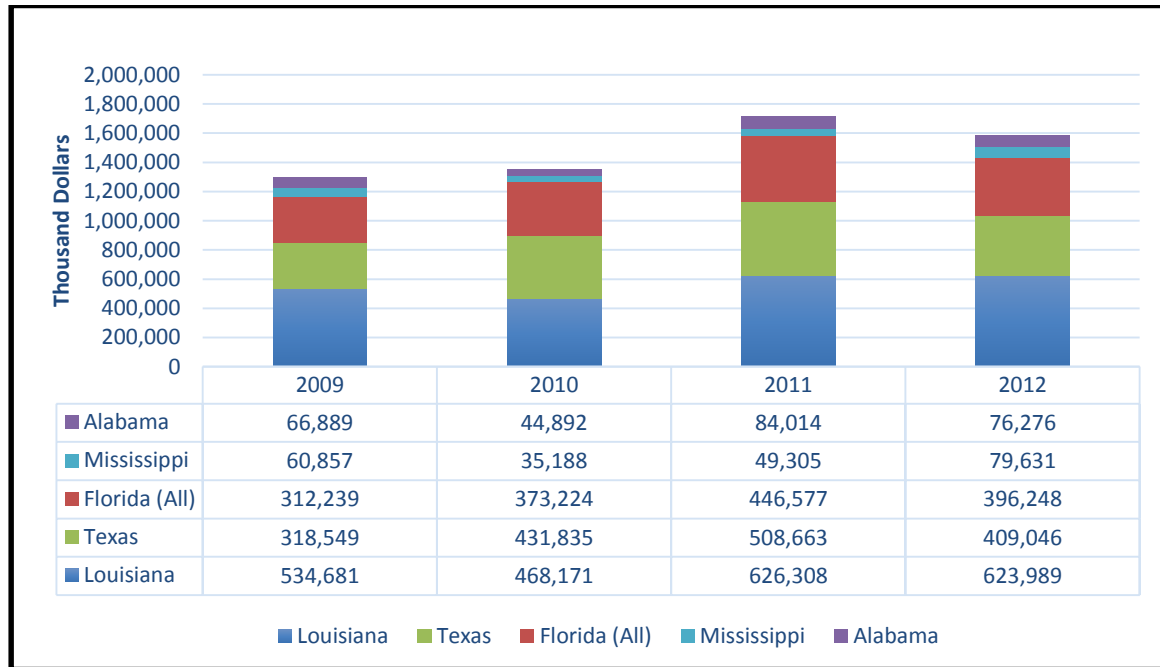
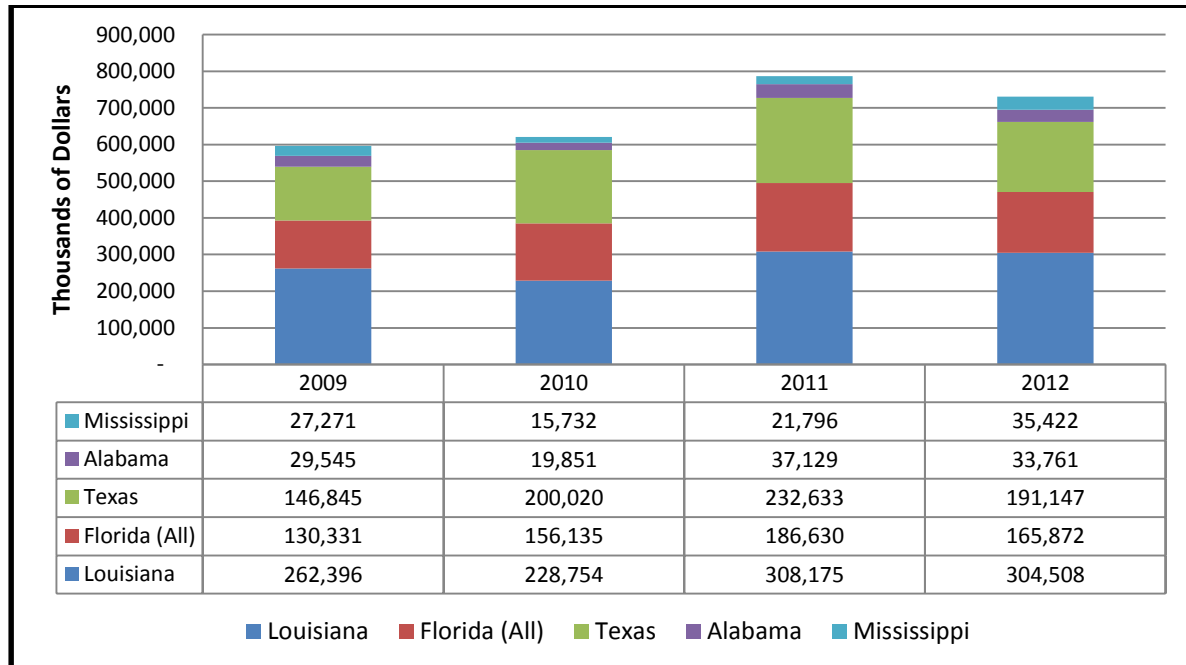


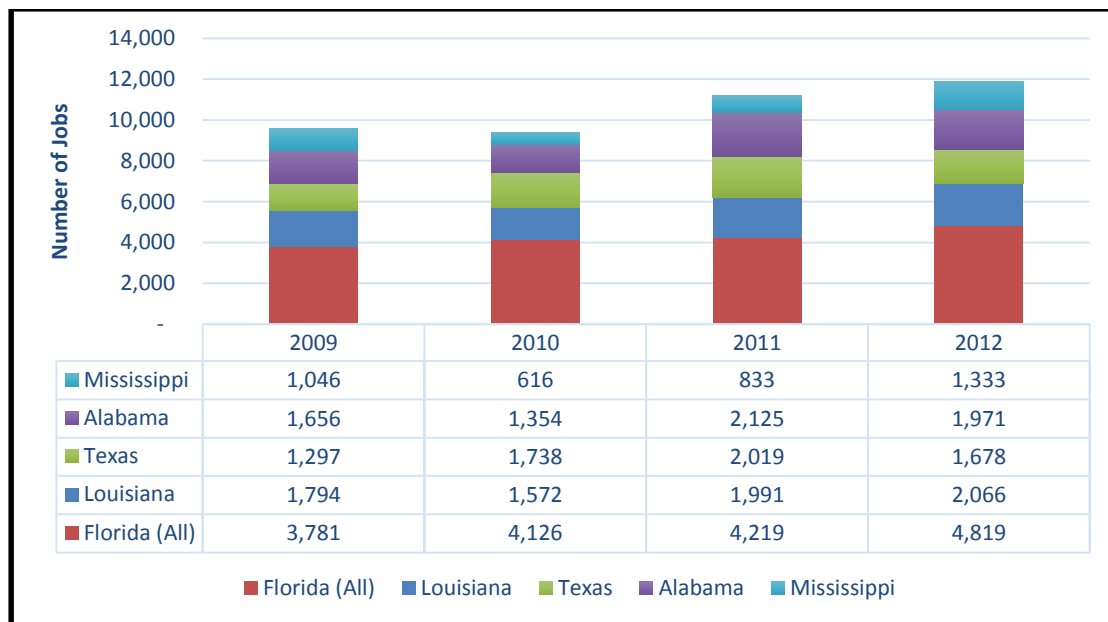
Figure 7. Value-Added Impacts of Commercial Fishing by State



Seafood Processing

The large amount of seafood harvested by the Gulf States commercial fishing industry (1.7 billion pounds in 2012) serves as a valuable input for the regions seafood processing industry. In 2011, the Gulf States were home to 714 seafood processing establishments that employed 6,720 individuals and had a combined payroll of \$190 million (NMFS 2013). Estimates of the economic impacts linked to the Gulf States seafood processing industry are displayed in Figures 8, 9, and 10³. These estimates were generated by the National Marine Fisheries Service and include direct, indirect, and induced effects. In addition, it should be noted that these impacts include the effects of imported seafood that was processed, in some manner, in the Gulf States. Although Louisiana and Texas have larger commercial fisheries than Florida as measured by both pounds of fish harvested and dockside revenue, Florida is by far the largest processor of seafood due to the large amount of imported seafood processed in the state.

Figure 8. Employment Impacts of Seafood Processing by State



³ Seafood processing economic impacts for the State of Florida are not Gulf specific and include impacts associated with the Atlantic Coast. 2012 data is the most recent available on these economic impacts.

Figure 9. Output Impacts of Seafood Processing by State

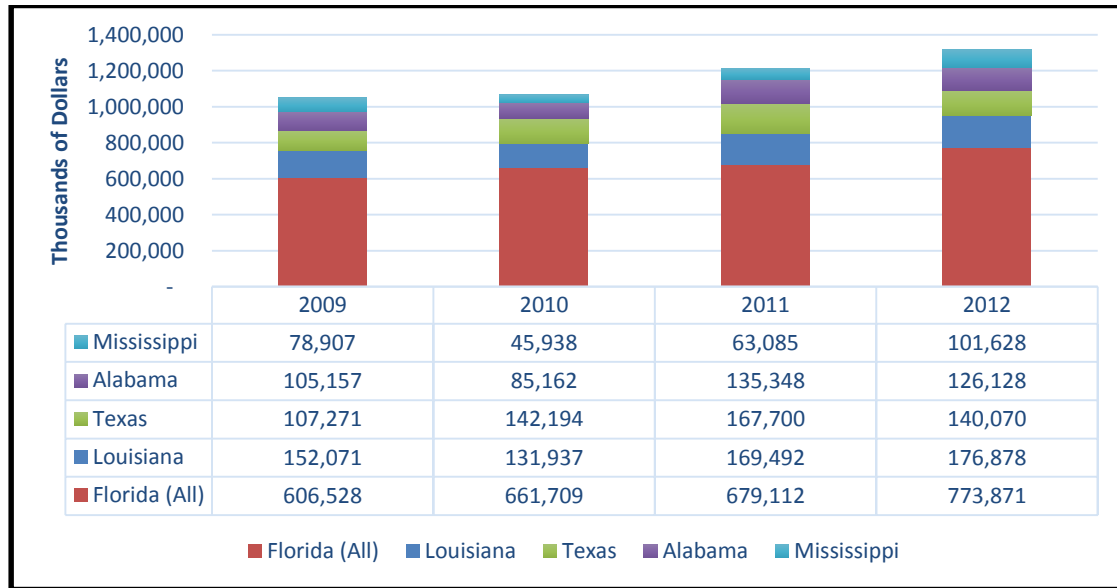
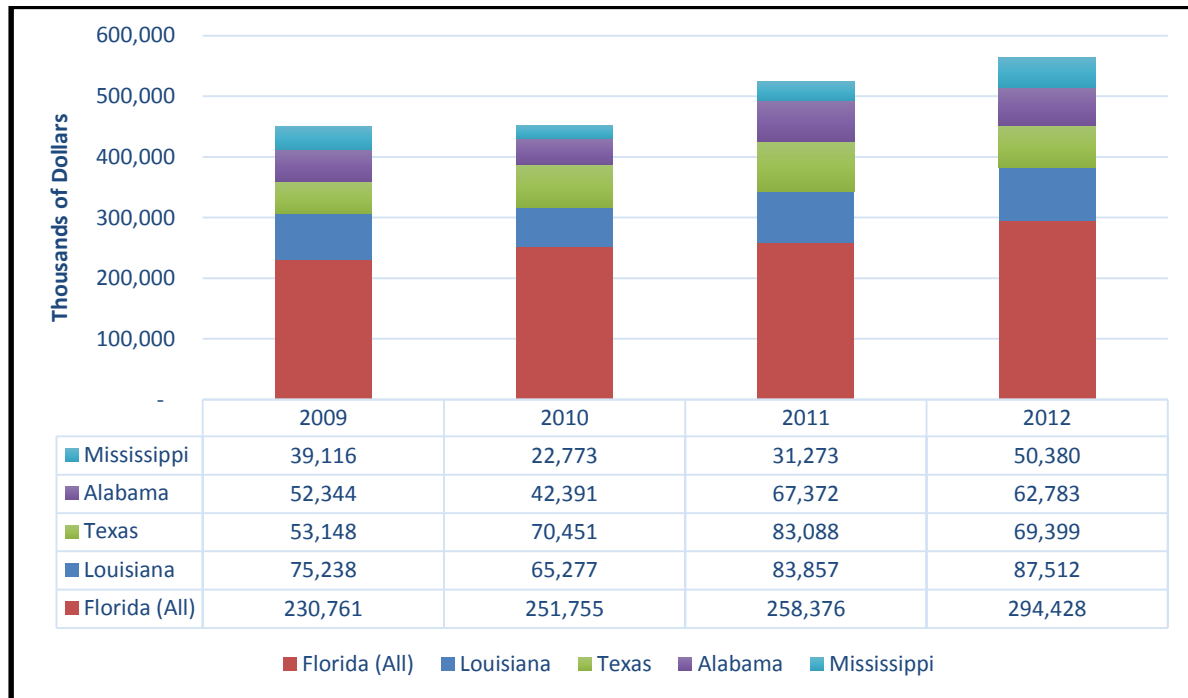


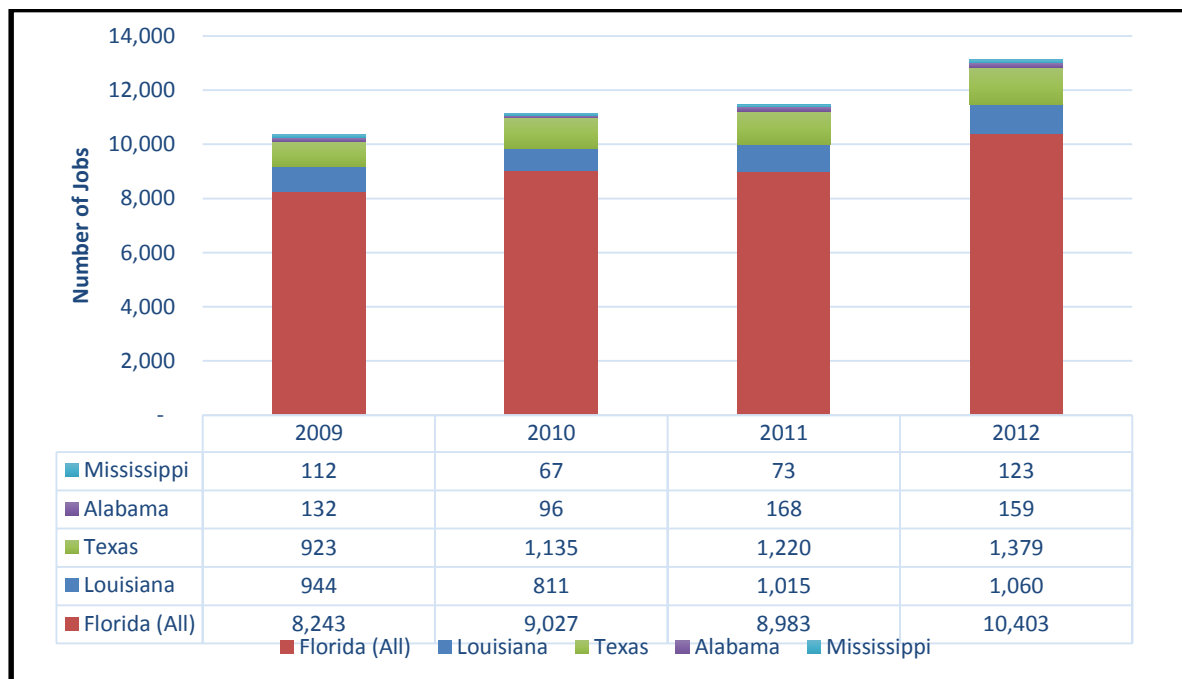
Figure 10. Value-Added Impacts of Seafood Processing by State



Seafood Wholesaling and Retailing

The last pieces of the Gulf of Mexico seafood industry are the wholesaling and retailing sectors both of which generate significant economic impacts on the region. Seafood wholesalers in the region are responsible for moving seafood from the processors to restaurants, grocers, and specialty seafood markets. In 2011 the Gulf Region was home to 469 seafood wholesale establishments that generated 11,459 jobs, \$1.3 billion in output impacts, and \$639 million in value-added impacts (NMFS 2012). Figures 11, 12, and 13 present the economic impacts of the Gulf Region seafood wholesaling industry for the years 2009 to 2012 (NMFS 2013)⁴. Similar to the processing industry, Florida has by far the largest wholesale industry and accounts for approximately 80% of all Gulf Region economic impacts from seafood wholesaling.

Figure 11. Employment Impacts of the Seafood Wholesale Industry by State



⁴ Seafood wholesale industry economic impacts for the State of Florida are not Gulf specific and include impacts associated with the Atlantic Coast. 2012 data is the most recent available on these economic impacts.

Figure 12. Output Impacts of the Seafood Wholesale Industry by State

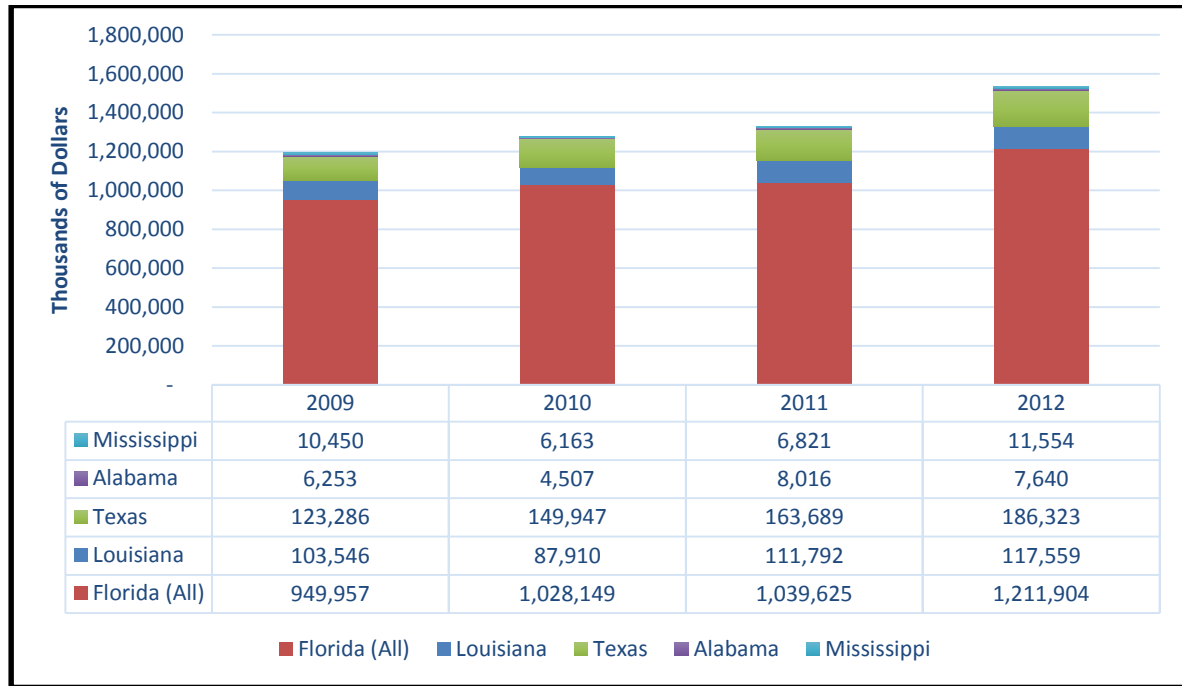
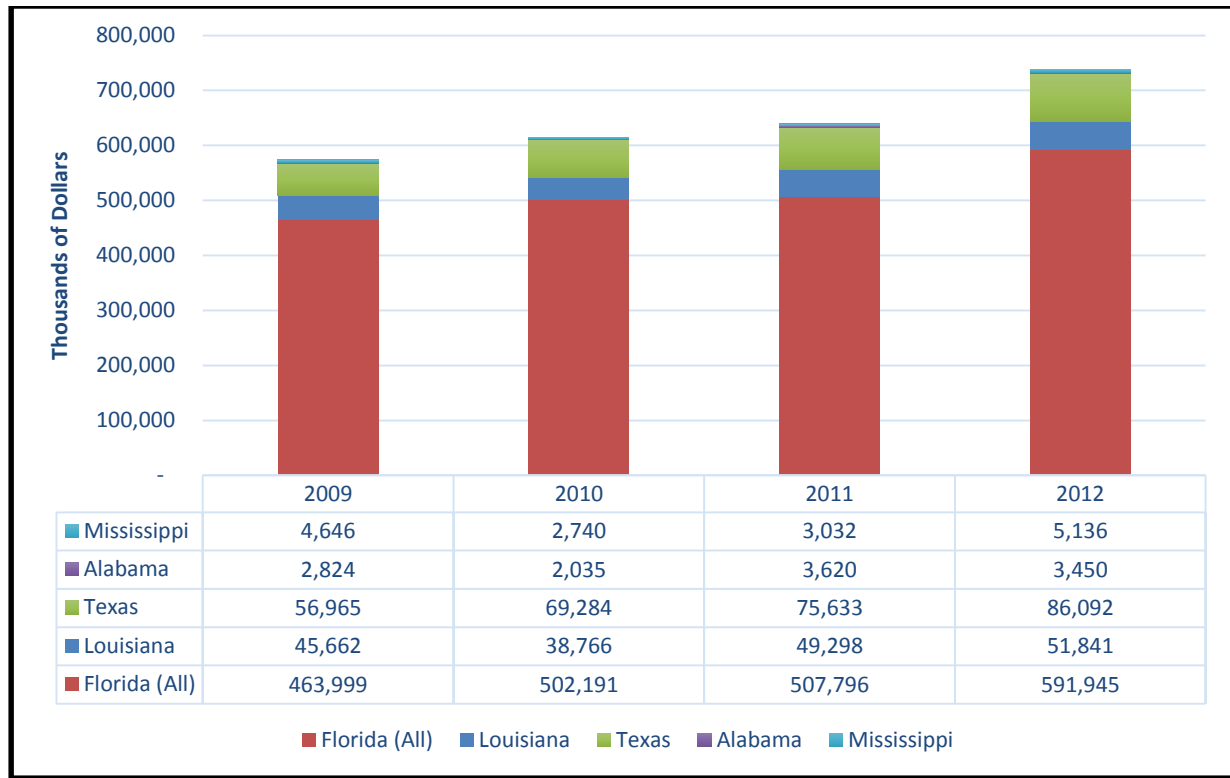
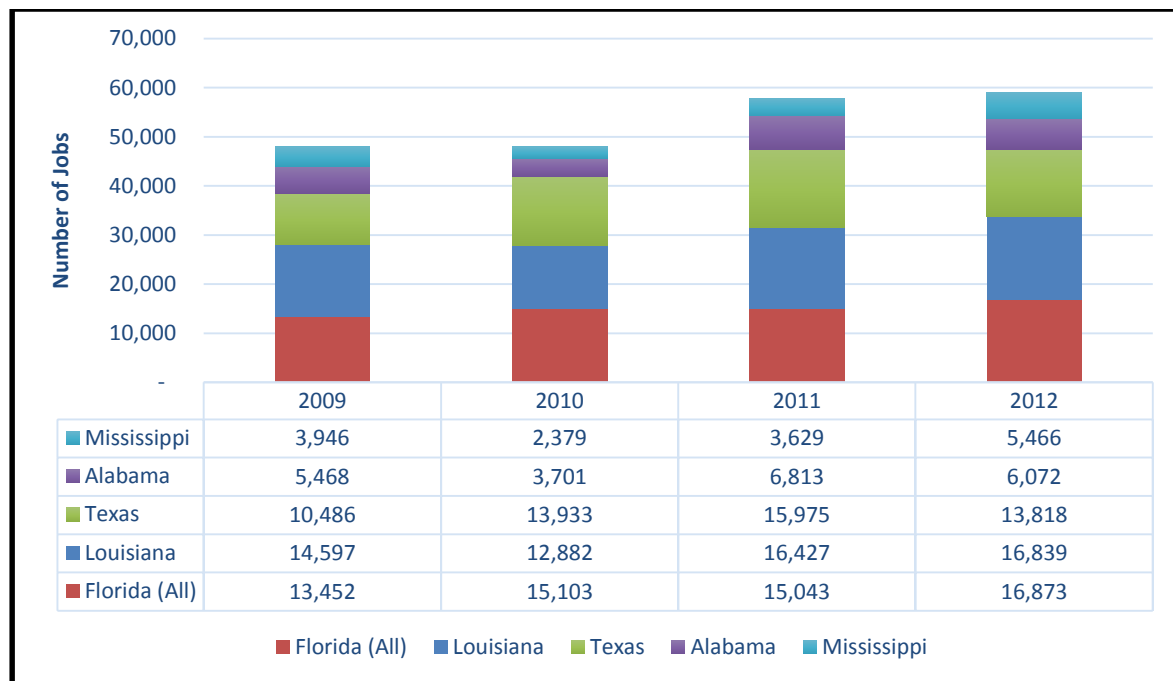


Figure 13. Value-Added Impacts of the Seafood Wholesale Industry by State



The Gulf States seafood retail industry includes both seafood restaurants and fish and seafood markets. In 2012, the seafood retail industry included over 1,100 firms and generated 59,098 jobs, \$3.7 billion in output impacts, and \$1.7 billion in value-added impacts (NMFS 2013) in the Gulf States. The seafood retail industry has the largest economic impacts of any of the Gulf States seafood industries (harvesting, processing, wholesaling, and retailing). Florida had the largest economic impacts followed by Texas and Louisiana. Figures 14, 15, and 16 present the economic impacts of the Gulf Region seafood wholesaling industry for the years 2009 to 2012 (NMFS 2013)⁵.

Figure 14. Employment Impacts of the Seafood Retail Industry by State



⁵ Seafood retail industry economic impacts for the State of Florida are not Gulf specific and include impacts associated with the Atlantic Coast. 2012 data is the most recent available on these economic impacts.

Figure 15. Output Impacts of the Seafood Retail Industry by State

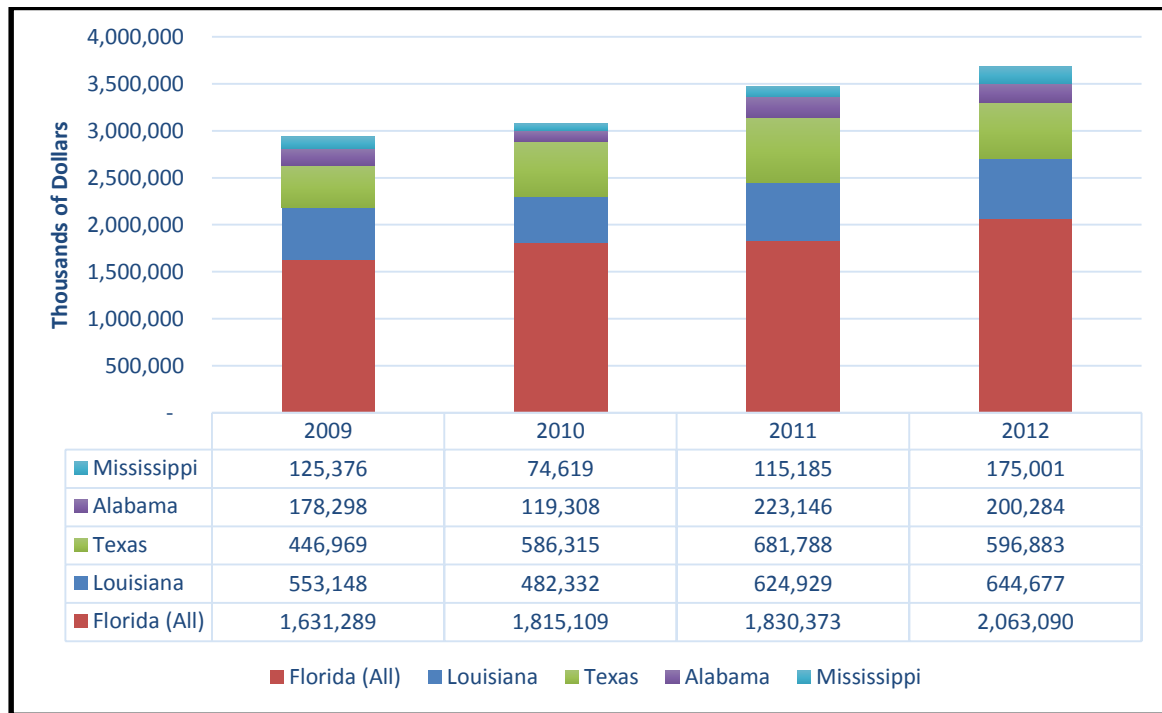
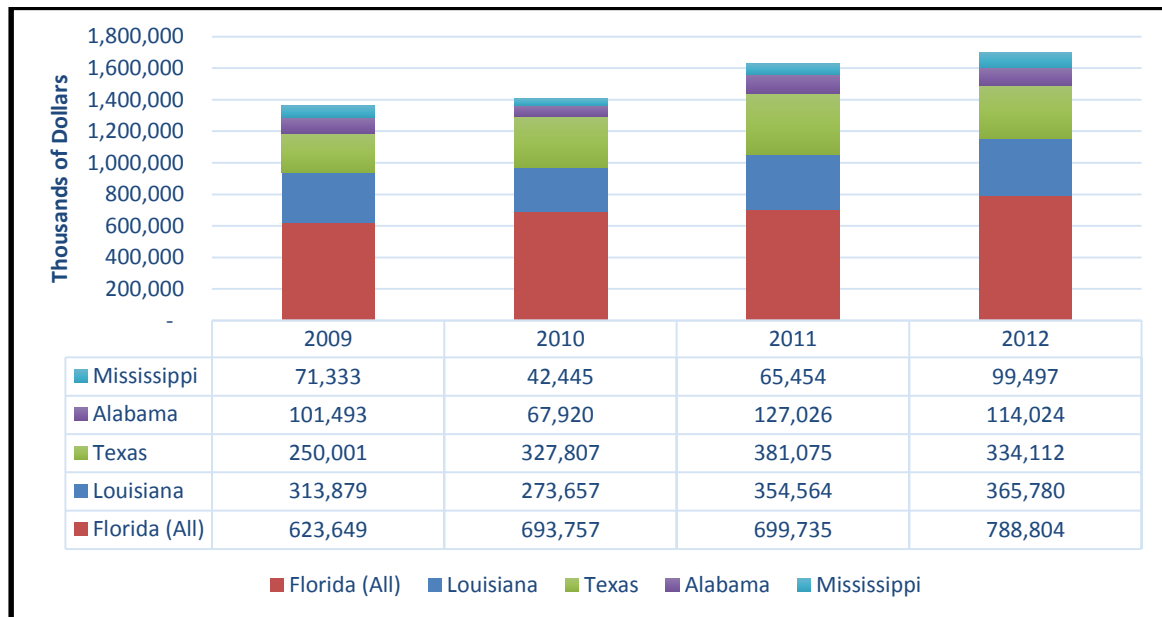


Figure 16. Value-Added Impacts of the Seafood Retail Industry by State



Recreational Fishing

Marine recreational fishing is a popular pastime and a major industry in the Gulf States. In 2011, 5.2 million recreational anglers took 22 million Gulf of Mexico fishing trips (Lovell et al. 2013). Those fishers spent approximately \$1.5 billion on those fishing trips in 2011 (NMFS 2012). Although the economic impacts associated with fishing trip expenditures (ice, bait, fuel, charter fees, etc.) are substantial, those impacts are dwarfed by the economic impacts generated by recreational fishers spending on durable equipment including items such as fishing tackle, boat expenses, vehicle expenses, and other equipment. In 2011, marine recreational anglers in the Gulf States spent \$9.7 billion on durable equipment expenditures (NMFS 2012).

Gulf wide economic impacts of recreational fishing are provided in figures 17, 18, and 19. The data presented was calculated by the National Marine Fisheries Service and includes direct, indirect, and induced impacts (NMFS 2013). Durable goods spending by recreational fishers was the major driver of all three types of economic impacts accounting for 80% of jobs created, 81% of output impacts, and 79% of value-added impacts. Among trip expenditure categories private boat fishing had the largest economic impacts accounting for 9% of impacts across all three impact categories (employment, output, and value-added).

Figure 17. Employment Impacts of Recreational Fishing by Fishing/Spending Type

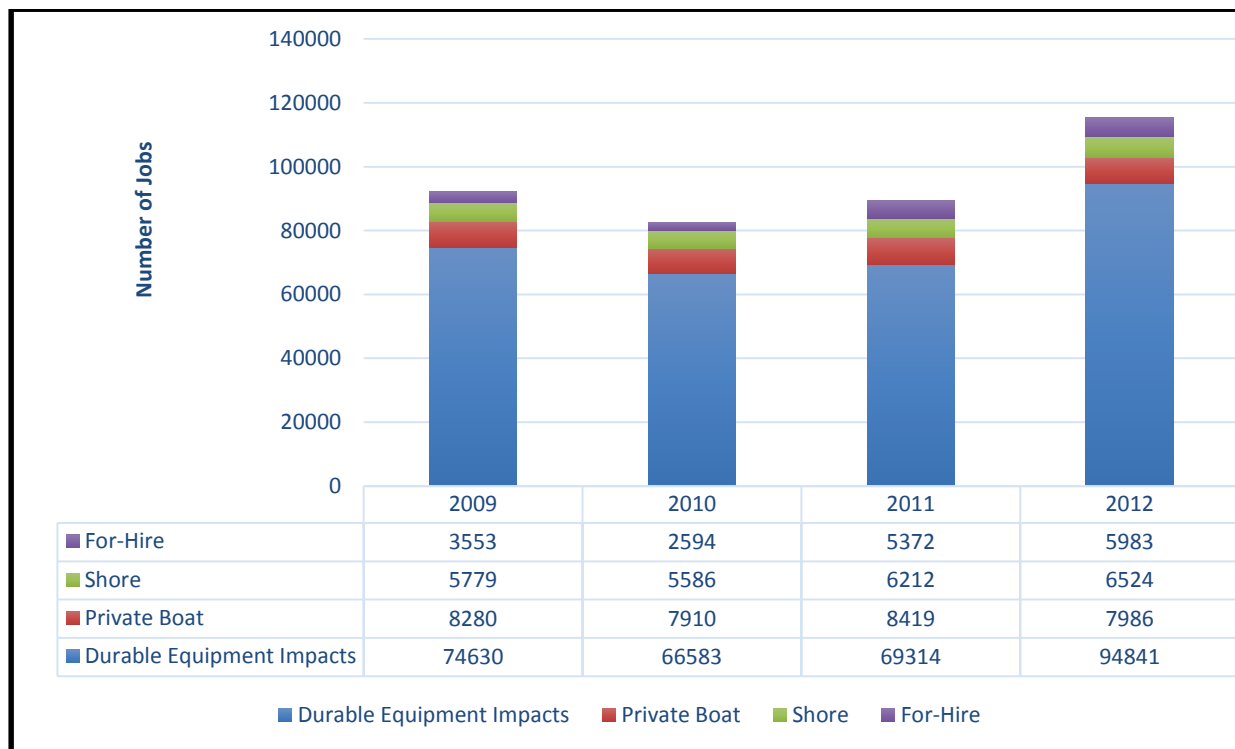


Figure 18. Output Impacts of Recreational Fishing by Fishing/Spending Type

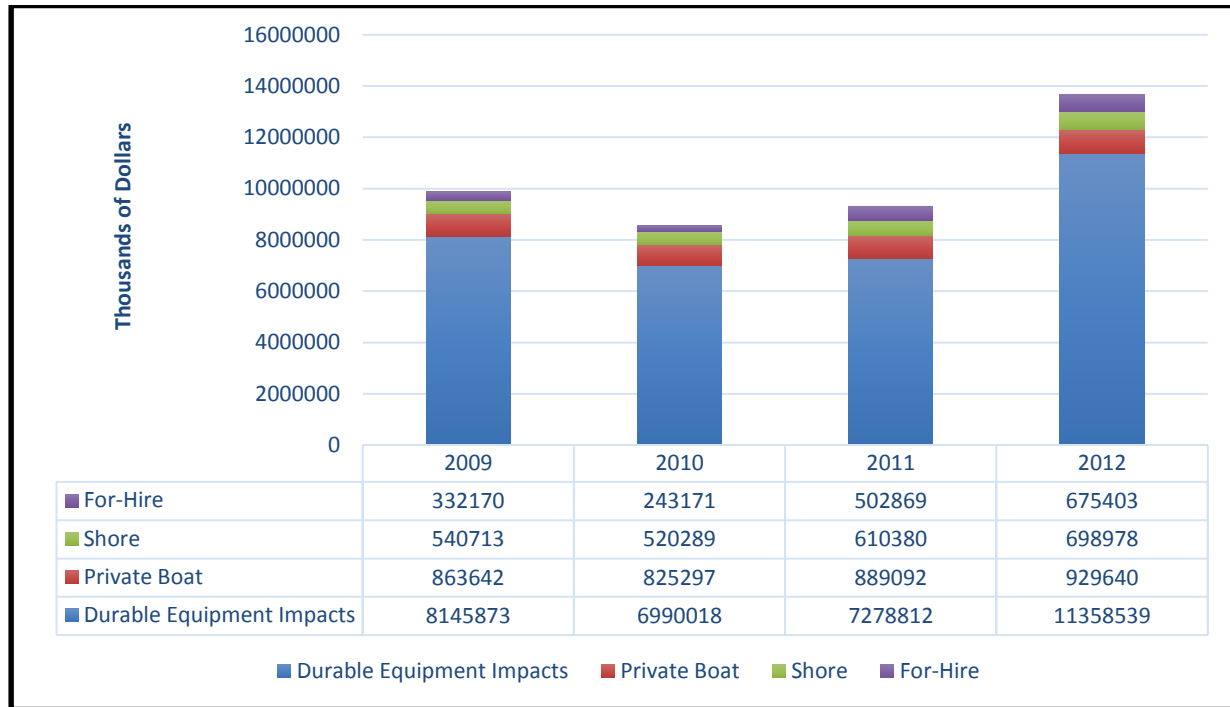
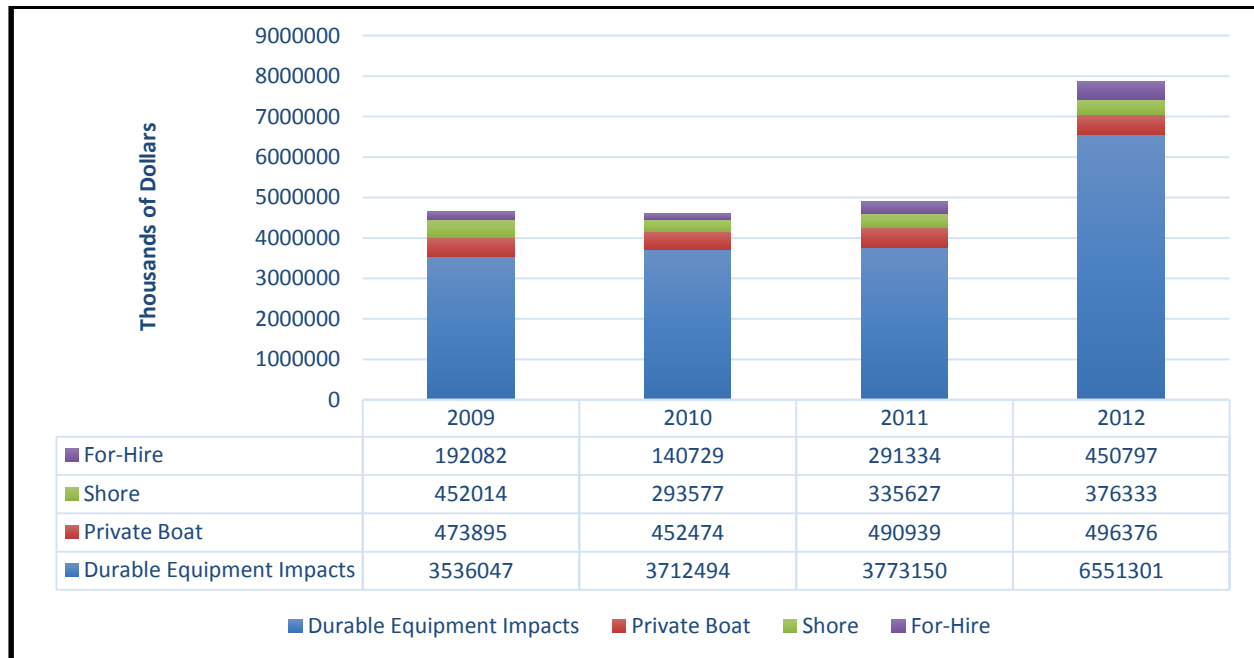


Figure 19. Value-Added Impacts of Recreational Fishing by Fishing/Spending Type



At the state level, recreational fishing impacts are largest in Florida followed by Texas and Louisiana. In 2012, Florida Gulf recreational fishing impacts accounted for 67% of all output and value-added impacts, and 65% of all employment impacts in the Gulf States. Figures 20, 21, and 22 provide the recreational fishing impacts at the state level.

Figure 20. Employment Impacts of Recreational Fishing by State

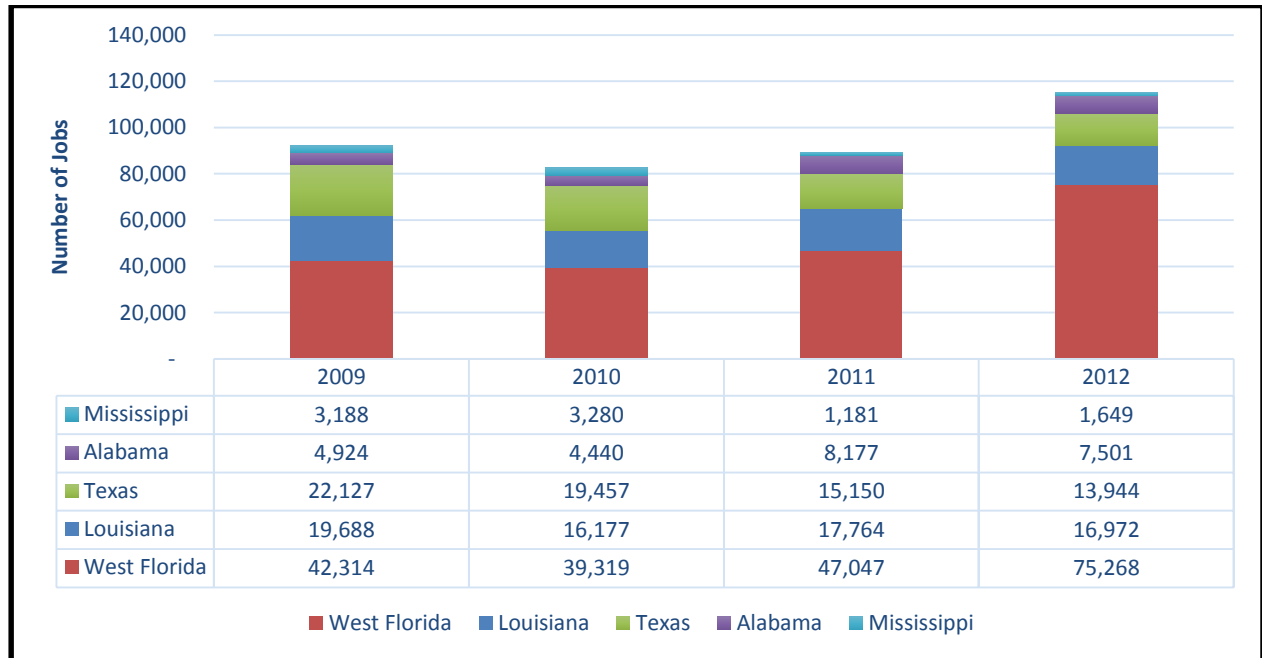


Figure 21. Output Impacts of Recreational Fishing by State

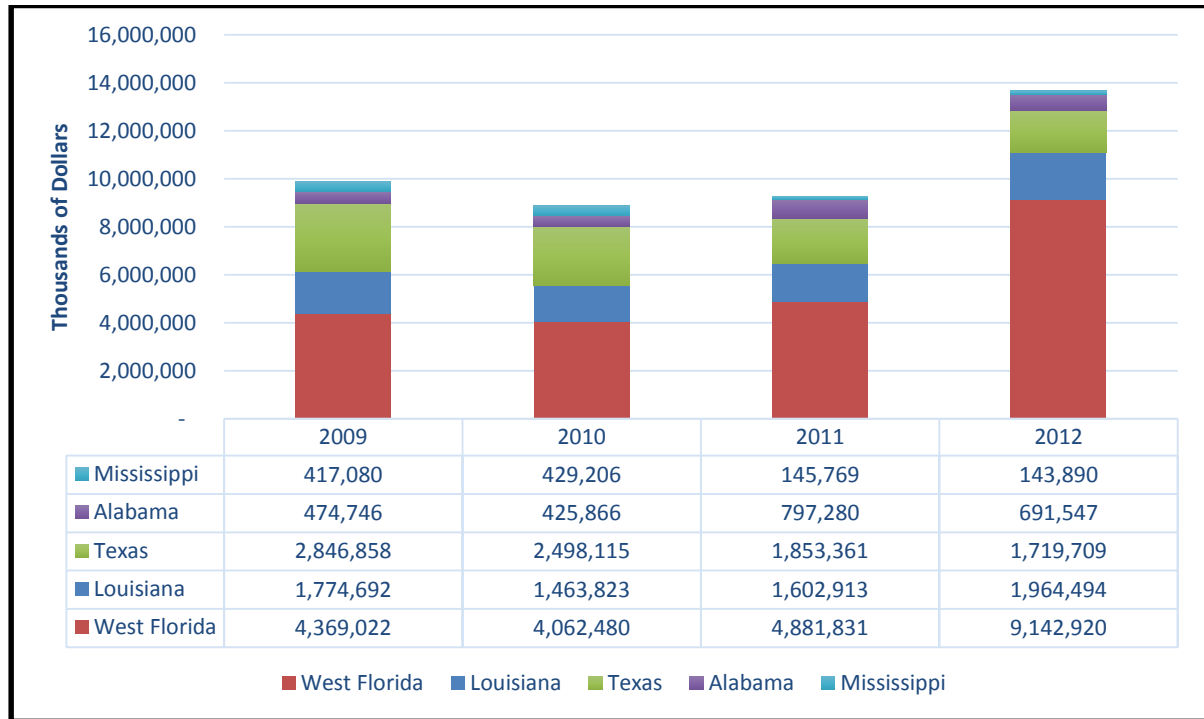
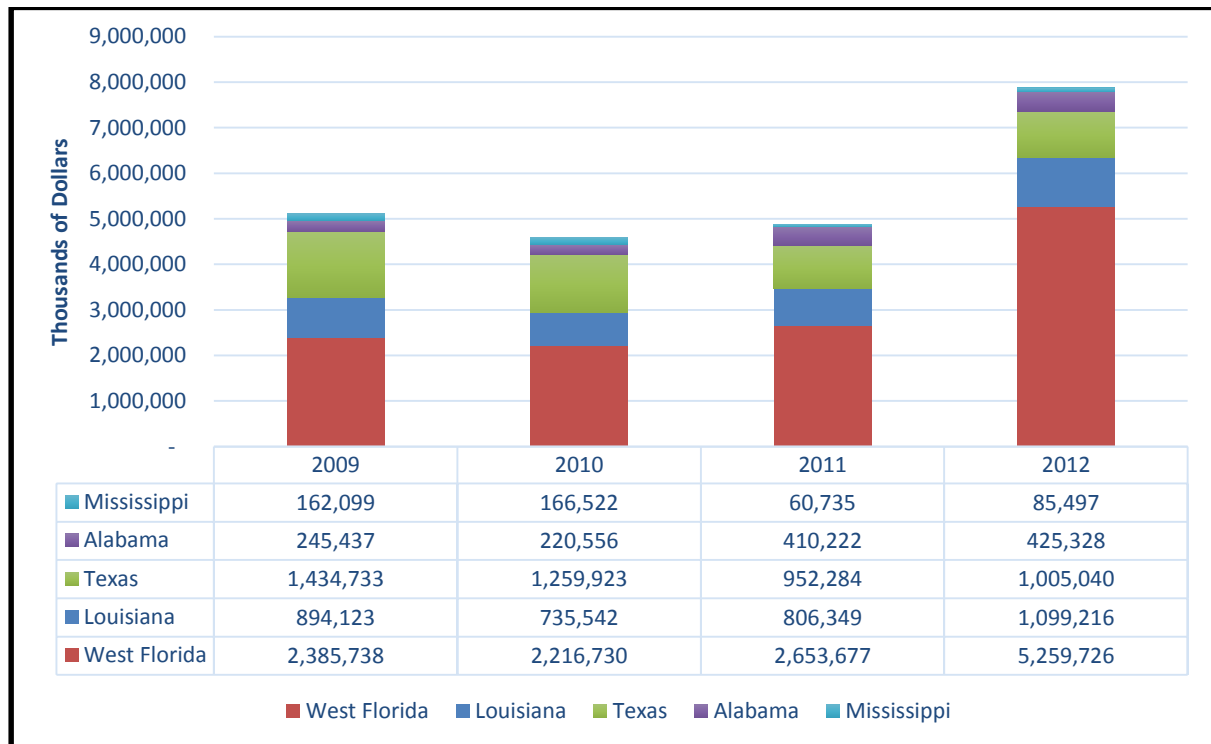


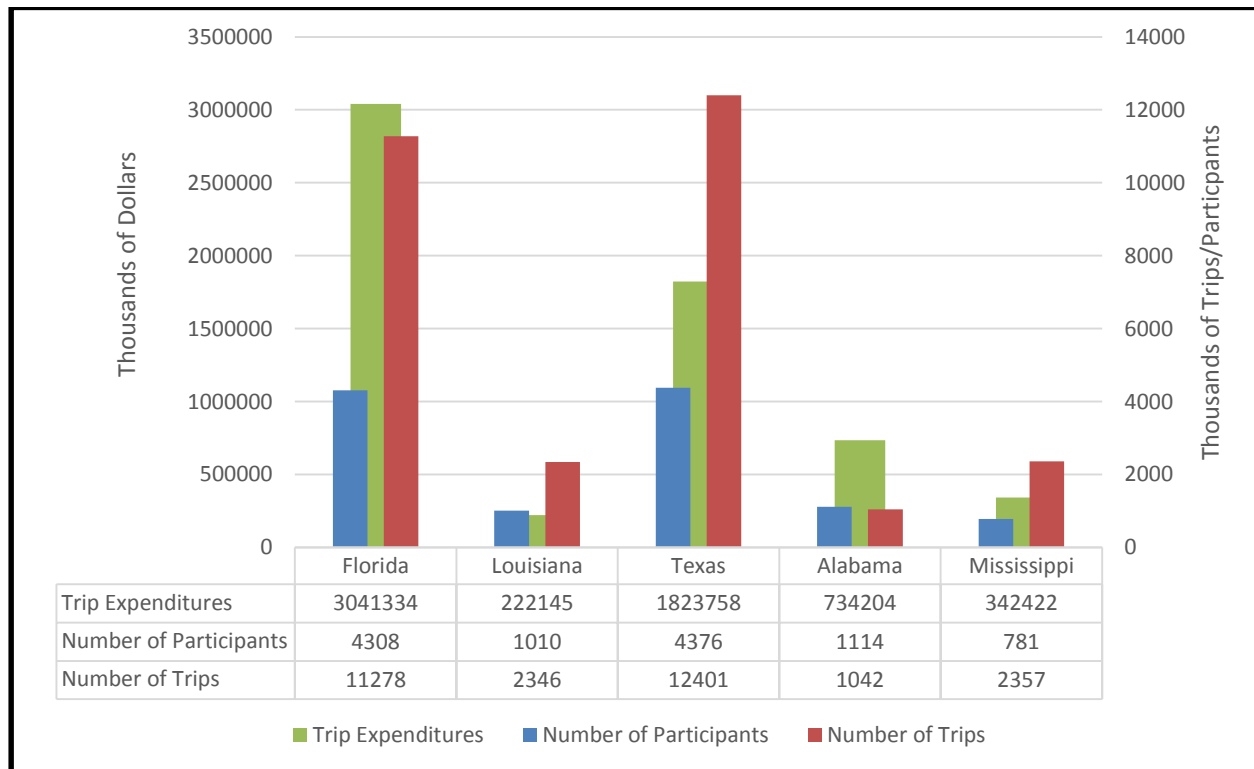
Figure 22. Value-Added Impacts of Recreational Fishing by State



Marine Environmental Recreation and Tourism

Marine dependent recreational activities common to the Gulf States include birding, sea turtle watching, dolphin cruises, hiking, recreational boating, and hunting. Wildlife watching in the Gulf States draws more participants than any other wildlife related activity (USFWS 2012). Wildlife tourism (excluding recreational fishing) accounts for approximately \$11 billion in annual spending in the Gulf States; in addition, the 53 Gulf of Mexico coastal counties are home to 1,100 recreational guide businesses, 6,400 dining establishments, and 4,900 lodging businesses (Stokes and Lowe 2013). In all, tourism provides approximately 455,000 jobs in the 53 Gulf of Mexico coastal counties (BLS 2010). Figure 23 presents US Fish and Wildlife Service estimates of the number of participants, trips, and trip expenditures for wildlife watching in the Gulf States for 2011⁶.

Figure 23. Participants, Trips, and Expenditures for Gulf States Wildlife Watching, 2011



⁶ Values shown are for the entire state and not just the coastal region.

Selected Impacts of Gulf States Sea Grant Programming

The previous section outlined the economic importance of some of the major Gulf of Mexico marine dependent industries that Sea Grant works with. In this section we highlight a number of Sea Grant programmatic activities that have positively impacted those targeted industries. A discussion of these activities is provided through a series of descriptive vignettes. Each vignette includes a discussion of the relevance, response, results, reality and recommendations associated with each activity. The *relevance* section outlines the issue, or problem, that Sea Grant programming was designed to address. The *response* gives a brief synopsis of what actions Sea Grant took, along with partners, to address the problem. The *results* section provides information on the outcome of the program. The *reality* section attempts to highlight thorny issues related to the programming in question, such as attribution (which impacts are due to Sea Grant and which impacts are due to other partners) and what economic analysis techniques are appropriate (does the programming example lend itself to the use of techniques such as benefits transfer in a defensible manner). Lastly, the *recommendation* section provides advice on how to report the results of each program examined in an economically defensible manner. In some cases the *recommendation* is to present qualitative impacts of Sea Grant programming (due to the difficulty inherent in calculating and attributing quantitative impacts for the example) along with quantitative analysis of the importance of the industry benefiting from Sea Grant programming. The examples provided in the section are designed to help provide guidance on future economic impact analyses and reporting associated with Sea Grant programming.

Rapid and Credible Economic Assessment of Hurricane Impacts

Relevance

Seafood harvesters, dealers, and processors of the Northern Gulf of Mexico (GoM) are highly vulnerable to coastal storms. In the past decade alone, 14 hurricanes of category 1 or greater intensity have made landfall in the region. In the wake of these storms, state and federal agencies have relied on Sea Grant economists for rapid and credible assessments of storm impacts to coastal fishing sectors. But developing such estimates is confounded by a number of factors.

In the immediate aftermath of a hurricane, damaged fishing infrastructure often becomes the iconic focus of public attention. Government officials are invariably pressured for sector-specific estimates of fisheries infrastructure damages and projected revenue losses. For most storms, such estimates begin emerging in the media as early as one or two days following landfall. This demand for preliminary numbers is fueled by more than public curiosity; it is driven by political processes governing the acquisition of federal recovery aid. The U.S. Department of Commerce requires specific economic thresholds be met for designation of a “Federal Fisheries Disaster”. Such a declaration can open the door for Congress to appropriate hundreds of millions of dollars in emergency aid, but there is typically a short window of political attention for making such claims. As a result, fisheries impacts assessments have derived from a wide variety of methods and assumptions, some of which are inconsistent with established economic procedures. Complicating this process is the fact that major hurricanes can cause destruction and diasporas that preclude the use of traditional assessment methods (e.g. accessing court house records or surveying affected populations).

In the days and weeks following Hurricanes Katrina and Rita in 2005, a wide range of economic impact estimates were emerging from public and private sources. Lack of standardization was limiting the relative comparisons needed to fully examine impacts within and between states. NOAA Fisheries commissioned resource economists in GoM Sea Grant programs to develop independent assessments of impact to specific fishing sectors. The objective was to develop unbiased estimates for use in the emergency aid appropriations process. In Louisiana, marine economists with Louisiana Sea Grant (LSG) and the LSU AgCenter (LAC) partnered with the Louisiana Department of Wildlife and Fisheries (LDWF) and the LSU Hurricane Center to develop a new and improved technique for estimating the economic impacts of hurricanes on coastal fisheries revenue and infrastructure.

Response

A method was developed that allows for rapid and spatially-precise damage estimates of a hurricane’s impact on fisheries. The process begins by first valuing commercial fisheries infrastructure within the storm-affected region using revenue-based and market-based appraisal methods. These values are then integrated via GIS along with hind-cased, dynamic simulation data on maximum wind speed and storm surge heights (i.e. ADCIRC model output). Physical damage functions developed for fisheries harvesters, dealers, and processors are then applied to generate economic estimates of infrastructure and revenue losses. This approach was used to document fisheries infrastructure damages following Hurricanes Katrina and Rita in 2005, and Hurricanes Gustav and Ike in 2008. The specificity of the estimates, in most cases to the firm level, has been a welcome addition to the state and federal agencies tasked with the development

of rapid and objective methods for post-storm damage assessment and recovery funding allocation.

Results

Since 2005, four separate applications of this approach have been used to document slightly more than \$700 million in infrastructure damages and revenue losses to Louisiana fishing sectors. These objective assessments have provided the economic justification for more than \$250 million in fisheries recovery funds for Louisiana. State and federal agencies have also relied on these assessments to coordinate the equitable distribution of loan and grant programs targeting more than 2000 commercial and recreational fishing businesses. As indication of this success, in 2010 LSG entered into a memorandum of understanding with LDWF that provides immediate access to confidential fisheries trip ticket data in the event of a major hurricane landfall.

Reality

Although the method described above constitutes a more credible approach to rapid impact assessment than previously used in Louisiana, its use is limited by several conditions that dictate its application and interpretation. First and foremost, it relies on access to highly sophisticated hydrodynamic models and confidential commercial trip-ticket data; neither of which is universally available throughout in GoM region. Moreover, the approach does not project damages and revenue losses beyond the firm and dockside level. As a result, the preliminary estimates generated by this process appear disproportionately smaller than estimates derived from methods that capture a larger suite of economic activity. Not surprisingly, this sophisticated but conservative approach is not always highly valued by stakeholders seeking federal recovery aid.

For extreme storm events, it is likely that large amounts of federal aid would be forthcoming - even without the commissioning of objective impact assessments. Indeed, billions in agricultural and fisheries disaster aid has been allocated over the years based solely on the claims of commodity associations and closely aligned public agencies. In an era of increasing fiscal scrutiny; however, the political influence on federal disaster aid appropriations is declining. In the future, obtaining large allocations of federal disaster aid will likely be increasingly reliant on rigorous economic justifications.

Regardless of the impact assessment method used, documenting Sea Grant's contribution in this process is perhaps the bigger challenge. Numerous questions surround the credit that Sea Grant might claim for their role in this process: *What is the value of independently-derived, objective impact assessments? What, if any, financial metrics can Sea Grant claim in regards to their contribution to the disaster aid process? Is it appropriate to assume that federal aid allocations would be absent or lower in the absence of Sea Grant's help? Who really benefits from the improved rigor introduced by Sea Grant economist in the impacts assessment process?*

Recommendations

While the actions of NOAA in 2005 were a step in the right direction, there is a need to standardize the methodology used in post-disaster damage calculations. Ideally, the processes involved in estimating fisheries infrastructure damage and projecting revenue loss should be

commonly agreed upon by Sea Grant programs in GoM states. Such standardization would improve intra- and interstate comparisons of impact and help direct federal aid to the most heavily affected area and sectors. In the specific case of economic impact calculations, multiplier ceilings should be set within accepted economic BEA practices. Such ceilings would protect individual Sea Grant economists from post-storm political pressure and reduce the programmatic “arms race” that often emerges from the impact reporting required OMB.

1. To the extent possible, the credit that individual Sea Grant programs claim from economic impact assessments should also be standardized. Semantics will be a crucial part of this standardization. Individual economists are typically careful to use qualifiers that characterize specific contributions of their work. For example, the assessment method described above was credited as “...*provid(ing) the economic justification* for more than \$250 million in fisheries recovery funds for Louisiana” which is an accurate and credible description of the method’s use and highlights/quantifies its importance to constituents.

Attribution of Recreational Amenity Benefits – Florida’s Artificial Reef Programs

Relevance

The use of artificial marine habitats to provide fishing and diving access for boaters has a long history in Florida. Florida has the largest number of individually permitted reef sites in the Gulf and South Atlantic region. These sites provide a location for anglers and divers to have greater access to finfish and shellfish species within near-shore and offshore waters. The debate regarding production versus aggregation of biomass due to artificial reefs continues. However, the success of artificial reefs in providing angling and diving access, and the resulting economic contribution of such activities to local economies, is not debatable. A recent Florida Sea Grant study suggests that artificial reef activities within the SW Florida region generate \$250 million dollars annually in economic impact. Additional studies have been conducted for other regions of the state that suggest positive economic impacts to local economies due to artificial reef programs. The associated economic activity contributes to the overall economy through the sales of angling and diving related products, incomes, employment support, and taxes. And though the environmental contribution of artificial reefs is not known, in terms of biomass creation, the economic contribution has been measured. Florida Sea Grant has provided assistance to state and county artificial reef programs through periodic applied research funding on ecosystem-related topics, focused reef-related extension and outreach activities, annual county reef coordinator workshops, quadrennial major conferences addressing topics ranging from reef technology to economic contribution, select publications on artificial reef issues, and other activities.

The applied research and extension programming conducted with respect to artificial reefs has been done within a partnership of state, county, private, and academic agencies and programs. The Florida Sea Grant Marine Extension Agents have collaborated with the County Artificial Reef coordinators within the respective counties. In addition, a close working relationship exists between Florida Sea Grant and the Florida Artificial Reef Program within the Florida Wildlife Conservation Commission. Applied research efforts, which generate the information needed to develop extension programming, have been conducted by several academic departments at the University of Florida, including the Food and Resource Economics Department and Fisheries and Aquatic Sciences. In addition, some private firms who are developing artificial reef technology have also played a role in the overall effort. Thus, partnering of private firms, county and state agencies, and academic institutions have necessarily merged to ensure the development and delivery of effective and timely applied research and extension programming concerning artificial reefs in Florida.

Response

Florida Sea Grant has recognized the need to provide assistance to stakeholders in a number of ways with regard to artificial reef programs at the county and state level. County Sea Grant marine agents have provided assistance with a variety of issues, ranging from assistance with permitting to providing support for ongoing research efforts. This information has been transferred to the various stakeholders via annual workshops and periodic statewide conferences. Current information regarding permitting and technical innovation have been key topics. The workshop forums allow stakeholders to become aware of efforts throughout the state, better

ensuring that artificial reef programs operate at the cutting edge of technology and are implemented in an efficient and cost effective manner. Academic research has helped address a wide range of ecosystem issues related to artificial reefs, such as species assemblage, impact on recruitment, contribution to habitat, etc. A major research effort is being conducted off the Big Bend region of Florida in an effort to better understand the role that artificial reef habitat can play in ensuring the sustainability of reef fish stocks within the region.

Results

Florida Sea Grant involvement with local and statewide artificial reef programs has contributed to the sustained viability of such programs, in terms of the number of reef deployments, economic contribution, and a better understanding of the ecosystem role of artificial reefs. A large number of partners and collaborators has characterized the “team” effort that is the hallmark of the statewide artificial reef program. Additional funding has been directed toward applied research that will allow a better understanding of the existing and potential ecosystem role being played by artificial reef deployments. In addition, the visibility of the local and statewide artificial reef programs has been enhanced through the outreach and applied research efforts conducted by Florida Sea Grant. In particular, the periodic Artificial Reef Summit events are very well attended and provide clientele groups, the media, and local/state agencies to better understand other ongoing artificial reef efforts throughout Florida and the Gulf and South Atlantic region. Further, participation by Florida Sea Grant program representatives in international conferences (International Conference on Artificial Reefs and Associated Habitats) has created an international dimension to the visibility of the overall program.

Reality

The Florida Sea Grant artificial reef program has been shown to be effective in providing technical guidance, applied research direction, outreach, and networking for the various clientele groups involved in artificial reef deployment in Florida. This effort by the Florida Sea Grant program has benefited the overall artificial reef program at the statewide, regional, and local level. Recent studies have shown that artificial reef deployments in the near-shore waters of Florida results in positive economic activity, which supports local businesses, creates jobs, generates tax revenues, and contributes to the habitat available for reef fish and other species. However, Florida Sea Grant cannot claim the economic impact measured by recent studies. Florida Sea Grant can claim to have played a major role in providing key information requested by the various artificial reef clientele groups. Placing a monetized value on the contribution by Florida Sea Grant would only be a guess. Aside from monetary benefits, the Florida Sea Grant program has likely raised awareness of artificial reefs amongst anglers and divers, as well as the general public. In addition, the technical guidance provided has likely increased the awareness and efficiency of local and statewide artificial reef programs. These impacts may be quantified by data obtained from pre and post extension event surveys, which is a legitimate claim for Florida Sea Grant.

Recommendations

1. Sea Grant should not claim the full value associated with the use of artificial reefs in Florida. The current studies primarily focus upon the annual economic impact which is derived from an inventory of reefs placed over an extended period of time. Florida Sea Grant cannot claim

to be solely responsible for the funding, placing and management of these reef sites, but has certainly played a role in assuring those reefs were deployed in a manner consistent with state policy and regulations, in a cost efficient manner, utilized the best technology available, and were visible to the clientele groups who make use of the reefs. Thus, Florida Sea Grant can claim to have played a role in the generation of the resulting economic impact, but cannot claim the full value of the estimated impacts.

2. Although Sea Grant should not claim sole responsibility for the economic impacts associated with Florida's artificial reef program, highlighting the economic importance of the program while discussing Sea Grants contribution to the program is reasonable. It would be reasonable to state "Sea Grant has played an integral role in the development and expansion of Florida's artificial reefs which generate \$250 million of economic impacts annually for the State of Florida."

Measuring and Applying Ecosystem Services (Louisiana Wetlands Restoration)

Relevance

More than 1.2 million acres of coastal wetlands have been lost in Louisiana in the past century due primarily to hydrologic modification. Protecting and restoring the ecosystem services associated with these wetlands is the goal of state and federal restoration programs that have spent more than \$2 billion on this crisis to date. Despite these expenditures, scientists and managers widely regard the scale of the crisis as beyond the budget available for restoration. Given this financial constraint, the need for efficiency is paramount when allocating limited funding amongst competing project needs.

Response

Louisiana Sea Grant funded economists in the LSU Center for Natural Resource Economics & Policy (CNREP) are using primary and secondary data to develop original, monetized estimates of ecosystems service values (ESV). Moreover, they have developed a method for comparing the aggregate flow of these values over time from alternative coastal restoration methods. This decision support tool utilizes an ESV trajectory economics simulation technique (ESV-TEST) based on a cost-benefit analysis framework. Data for validating the ESV-TEST cost and benefit sub-models were obtained from project managers with the Louisiana Office of Coastal Protection and Restoration (LaOCPR). In November of 2012, the draft tool was completed and presented to LaOCPR following a two year developmental period.

Results

Preliminary applications of ESV-TEST compared two primary methods of coastal restoration in SE Louisiana: freshwater/sediment diversions (DIV) and dredge-based marsh creation (MC) projects. Results indicate that when time and risk are accounted for, the flow of ecosystem services (and the benefit-to-cost ratio) from MC projects exceed that of DIV projects over the typical 50 year restoration horizon. This finding counters prevailing management that regards the efficiency and sustainability of DIV projects to be relatively greater than MC projects. Based on these findings, Sea Grant economists have made preliminary recommendations to LaOCPR regarding optimal combinations of these methods. Future refinement of ESV-TEST will involve a recalibration of sub-models towards the large-scale projects called for in the Louisiana 2012 Coastal Master Plan. Given the ambitious budget for that plan (\$50 billion), this decision tool will ultimately help to improve the efficiency through which millions of dollars in coastal restoration funding is allocated.

Reality

What is the economic worth of nature? How does one value the non-market value of fisheries habitat, storm surge protection, or coastal water quality? Such questions are the heart of a growing number of studies centered on the development of ecosystem services values (ESV). Monetized ESVs are increasingly cited in the scientific and programmatic literature of environmental research and outreach programs, but their use is typically limited to justification purposes – *e.g. to protect a resource, to prevent development, to justify restoration*. Impartial use of ESV; however, requires that such estimates be viewed more than just strategic outputs, but neutral inputs to the decision-making process. Incorporated into traditional decision-support

models, ESVs offer insight on programmatic efficiency and help inform economic trade-offs within and between restoration options.

Development of ESV-TEST provides one example of how a Sea Grant-funded research project developed and applied such values in an effort to improve restoration spending. But how should such an improvement be reported? What is the additive value of more efficient project selection? In regards to claiming Sea Grant impacts, can we go beyond the qualitative claims such as “*the process was made more efficient*” and actually claim specific percentages or dollars saved? What about the values themselves – can we claim any portion of an ESV calculation developed with Sea Grant funding? Moreover, can previously developed ESV be used to extrapolate the non-market impacts of our various programs and projects?

Recommendations

1. Monetized ESVs are most useful when they are used to reflect societal preferences in policy trade-offs involving non-market resources. Overreaching is a risk when ESVs are utilized to examine programmatic impacts. Efficiency claims should be limited to qualitative claims only.
2. Original ESVs developed from Sea Grant funded research should not be claimed as a monetary contributions or impacts. Once again, only qualitative claims can be made about the contribution of Sea Grant derived ESV estimates.
3. Sea Grant programs should be very careful in applying benefit transfer techniques (estimating ESVs from previous studies already completed in another location or context). Like most other types of values, ESVs are context-dependent, and extrapolation can be challenging, if not impossible, to do to in an economically justifiable manner. Human preferences change over time and location, thus ESVs are moving targets and applying study results across space and time can be problematic.

Evaluating Sea Grant's Role in the Southeastern U.S. Shrimp Trawl Fishery TAA Program

Relevance

Shrimp is the most valuable commercial species harvested in the Gulf and South Atlantic regions as measured by total dockside revenue (NMFS 2013). In a 2013 report, the National Marine Fisheries Service estimated that the combined Gulf and South Atlantic seafood industry created approximately 184,000 jobs, \$24.6 billion in sales, and \$5.4 billion in income for the two regions; shrimp as the major fishery in the industry accounted for a substantial amount of these impacts. Historically, shrimping in the Gulf and South Atlantic has been a low profit margin business. An analysis of the Texas offshore shrimp fleet using 11 years of data (1987-1997) found that on average fishers only earned \$0.05 of profit for every \$1.00 of shrimp harvested (Haby et al. 2000). These low profit margins leave shrimp producer incomes extremely vulnerable to both decreases in the price they are paid for shrimp and increases in fishing costs. Unfortunately since 2001, the industry has faced both decreasing dockside prices due to increased imports of farmed shrimp and higher fuel costs.

The increased level of shrimp imports was due to a number of factors including: technological advances that increased the productivity and profitability of shrimp aquaculture around the world, decreased shrimp demand in Japan, the implementation and enforcement of more strict food standards in the E.U. regarding imported farmed shrimp (Keithly et al. 2008), and a strong U.S. dollar which made selling into the U.S. market easier for foreign producers. From 2001 to 2008 shrimp imports increased 38% (NOAA 2009). The increased supply of imported shrimp led to average dockside prices for wild caught Gulf shrimp falling 30% during the same period (NOAA 2002, NOAA 2009). At the same time the industry was hit by increasing fuel costs, as the cost of diesel increased 55%. An analysis of Texas shrimp producers performed between 1987 and 1997 found that, on average, 1.15 gallons of fuel (diesel) was required to harvest 1 pound of shrimp (Haby et al. 2000). Given the fuel intensive nature of shrimp trawling the increased fuel costs led to a sharp decline in producer profitability.

Response

Sea Grant staff around the Gulf of Mexico region along with the Southern Shrimp prepared a petition for certification to participate in the 2010 Trade Adjustment Assistance (TAA) for Farmers Program offered by the U.S. Department of Agriculture on behalf of Gulf and South Atlantic shrimp producers (those operating in Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Texas). Implementation of the training program required of TAA recipients was done in conjunction with other Sea Grant programs in the region and the shrimp producers included in the petition. The successful petition allowed Gulf and South Atlantic shrimpers that could demonstrate lower price, revenue, or production levels due to increased imports to apply for TAA. Each shrimper that applied for TAA was eligible to receive up to \$12,000 of assistance upon completion of training designed to make their operations more competitive with farmed imports.

Gulf region Sea Grant staff also took an active role in designing and implementing the training program required of shrimpers to receive TAA. The training program developed was designed to

make Gulf and South Atlantic shrimp producers more competitive in the U.S. shrimp market. Sea Grant staff created education programming on: new trawling technologies that lowered fuel use, on-vessel best handling practices to ensure that shrimpers get the best possible price for their catch, the correct installation of Turtle Excluder Devices (TEDs), and how to develop a business plan (a requirement of the TAA program). The trainings were made available on-line in English, Spanish, and Vietnamese so all eligible applicants could complete the training. Along with on-line training, Sea Grant specialists and agents held in-person training sessions around the region to accommodate as many shrimp producers as possible.

Results

Approximately 4,300 Gulf and South Atlantic shrimp producers received \$46 million in TAA payments in 2010 and 2011. In addition to the cash payments shrimp producers received, they also received valuable training on becoming more competitive with foreign shrimp producers by: decreasing their operating costs by reducing fuel usage, increasing the value of their product dockside through improved on-vessel shrimp handling and storage techniques, improving the sustainability and image of their industry by limiting turtle bycatch, and implementing a business plan to prepare their business for the future. While the cash payments to shrimp producers are easily quantifiable and were extremely beneficial to fishers in the Gulf and South Atlantic shrimp fishery, the training participants received should allow these shrimp producers to harvest their catch more efficiently and maximize the value they receive for their product making their operations more competitive with foreign shrimp suppliers.

Reality

While the Sea Grant programs in the GoM region were pivotal in the development and delivery of the TAA technical assistance program, the primary contribution of Sea Grant efforts in this program was non-monetary. Claiming any part of TAA pass-through dollars is problematic, and likely constitutes an overreach in terms of economic impact. The primary contribution of Sea Grant's role was educational. Sea Grant specialists and agents were uniquely qualified to provide the primary source of subject matter expertise on a wide range of topics (e.g. gear & fuel efficiency, product quality assurance, regulations and permitting, and marketing and economics). The value of this expertise is difficult to quantify beyond hours of instruction or the number of FTEs. Yet, intangible benefits were invariably generated from many of the 4,300 participants who developed or refined personal business plans. Perhaps most importantly, the networking provided by thousands of TAA interactions likely contributed to Sea Grant's good will in this harvesting community.

Recommendations

1. For federal pass-through dollars, impact statements should focus more on the facilitation, support, and instructional roles that Sea Grant provides in the delivery of financial aid and economic recovery programs. While quantification of the TAA programs benefits and Sea Grants role in generating those benefits is reasonable, semantics in how Sea Grant highlights those benefits is crucial. It would be reasonable to say "Sea Grant staffers helped craft a successful TAA petition and provided necessary training opportunities for Gulf and South Atlantic fishers which helped those fishers earn \$46 million in TAA payments in 2010 and 2011."

2. To the extent possible, metrics of educational effort (FTEs and CE credit hours) should be used to capture the capacity and effort of Sea Grant contributions.
3. Intangible benefits, though more difficult to quantify, might ultimately be the most important contribution of Sea Grant led technical assistance. To the extent feasible, participant surveys should be used to capture changes in knowledge and practice of target audiences.

Measuring Sea Grant's Role in the Development and Growth of the Florida Commercial Hard Clam Culture Industry

Relevance

The commercial hard clam industry in Florida is the most successful sector of the marine aquaculture industry in Florida. Though the commercial aquaculture industry in Florida is very diverse, hard clams are the only marine species cultured for human food that has realized consistent success. Other marine species are cultured for food, such as penaeid shrimp and a very few marine finfish, but hard clams are the marine aquaculture success story for Florida. *Annual sales* by Florida's 400 growers are typically about **\$15-20 million**, with an *annual economic impact* on the Florida economy from wholesale sales of the 60 dealers of approximately **\$50 million**. However, given that record of success, the industry is continuing to require the services of Cooperative Extension, Florida Sea Grant, university academic research units, and state resource management agencies. In particular, research and extension needs of the industry fall within the following topic areas: marketing, culture site substrate characteristics and impact on yield, developing genetic strategies to create hybrid vigor, production recordkeeping, water quality monitoring, crop insurance participation, alternative product development, identifying additional culture candidate species, shellfish quality, and other topics. The Cooperative Extension Service and Florida Sea Grant have been very involved over the past 20 years with the industry as research needs and extension informational demands have been met via numerous funded projects and extension programs.

Response

The hard clam culture industry in Florida has a history that traces back to the late 1980's. This was the time when the natural spat set in the Indian River Lagoon began to decline, resulting in significant reductions in wild clam harvests. Cultured clams were seen as a strategy to fill the excess demand for clams, which existed due to a strong market with an insufficient supply of wild clams. *In response*, Florida Sea Grant became involved in developing the first document to address the technological, economic, and market potential for cultured clams. Providing a Molluscan Shellfish specialist position (Cooperative Extension) on the Gulf coast was the response that helped jumpstart training efforts immediately preceding and following the elimination of near-shore gill-netting, and thereby creating a potential workforce of displaced commercial fisherman looking for alternative sources of incomes. The new Shellfish specialist provided leadership in culture training, while the existing Marine Economics specialist provided training in financial management, marketing strategies, and other topics. Many training programs were developed, such as Project OCEAN, Project CLAM, and others that trained prospective clam growers and fundamentally supported the development of the new clam culture industry. The Florida Sea Grant program has provided extension backstopping, financial support, applied research support via multi-year funding, and other assistance to the growing clam culture industry. Each of these examples of support provided key assistance to the growing industry and even now provides marginal contributions to the existing clam culture industry across a wide range of topics, as mentioned in the Problem statement above.

The applied research and extension programming needs manifested by the commercial hard clam culture have been met by a partnership of agencies and programs. Ongoing monitoring of water quality within growing regions is provided by the State of Florida, as mandated via the NSSP

and ISSC. Marketing assistance has often been provided by the Florida Bureau of Seafood Marketing. Crop insurance assistance has been provided by USDA. However, the primary source of assistance regarding those issues pertaining to production technology, lease site management, marketing strategy development, financial management, alternative species assessment, and other topics has been Cooperative Extension and Florida Sea Grant. In addition, the industry has organized, with Extension assistance, an Industry Task Force and Clam Growers Association that provides a means by which industry can stay connected with these many partners who provided assistance to their growing industry. Again, this effort is in large part supported by Cooperative Extension and Florida Sea Grant, programs that continue to respond to the needs of the industry.

Results

The response to the informational requests and training needs of the industry have played a large role in the establishment and steady growth of the cultured hard clam industry in Florida. Providing industry with the business training needs of individual farmers, the informational needs for lease site holders, the wet storage and tempering technology required by the market, the access to water quality information by growers, and many other types of information vital to effective business management of the clam culture, processing and wholesaling activities represent the input that has helped the industry continue to grow and remain viable as competitive markets have expanded, domestic economic conditions changed, and local water quality conditions fluxed in the face of variable local weather and regional climatic conditions. The results are that the commercial hard clam culture industry in Florida has grown from zero production in 1990 to an industry located in three major regions in Florida with hundreds of producers, dozens of seed hatcheries, many businesses related to the culture process (nursery/growout bag producers, culture equipment sales, etc.), many dozens of wholesale dealers, and a strong clientele of food service, restaurant, grocery, and final consumers of culture clams.

Reality

The efforts historically directed by Florida Sea Grant toward the commercial hard clam industry in Florida have most certainly provided a direct benefit to the industry. These efforts have helped the industry grow from a collection of interested “investors”, many of whom were commercial fishermen displaced from their industry but looking for a career that would “keep them on the water”. The training program developed by Cooperative Extension and Florida Sea Grant provided that initial training, some of which was required for potential growers to acquire leases from the state. However, these extension and applied research efforts were not the ONLY reason the industry developed as it has for the past 20-plus years ... nor are these efforts the ONLY reason the commercial hard clam culture industry in Florida will continue to exist as a viable and sustainable industry into the future. However, the Florida Sea Grant program can certainly claim a major role in the development and maintenance of this industry, which has grown to be the single largest producer of marine, aquacultured food products in Florida. What is the marginal benefit of Florida Sea Grant’s role in the development of this industry? That is intractable. Would hard clams culture industry in Florida exist as it currently does without the support of Florida Sea Grant? Likely not. The current \$50 million annual economic impact of the hard clam culture industry cannot be fully claimed by either the Cooperative Extension Service or Florida Sea Grant. But likewise, the industry cannot claim credit for that benefit to the state of Florida ... without giving credit to Florida Sea Grant.

Recommendations

1. While Sea Grant has played an instrumental role in the development and continued growth of the Florida hard clam culture industry it would be incorrect for Sea Grant to try to claim the economic benefits of the industry as a program impact. As the Response section indicated the industry is reliant on a number of entities (State of Florida, Florida Bureau of Seafood Marketing, USDA, and assorted industry groups), this makes benefit/impact attribution impossible in an economically justifiable manner.
2. This is another case where Sea Grant, while not able to directly claim the industries economic impact as due to Sea Grant programming, can highlight the economic importance of the industry (quantitatively) while providing a qualitative description of Sea Grant's impact on the industry. For instance, the following could be said, "Florida Sea Grant has been an important contributor to the hard clam culture industry which contributes \$50 million to the state economy."

Applying Benefits Transfer to Ecosystem Services Valuation Issues – Texas Wetlands Restoration

Relevance

Historically, approximately a quarter of the Coastal Prairie Ecosystem in the Galveston Bay/Houston area consisted of freshwater prairie wetlands. These wetlands provide a number of valuable ecosystem services including: flood attenuation, improved water quality, carbon sequestration, ground water maintenance, and wildlife habitat. Unfortunately, the majority of the regions freshwater prairie wetlands were leveled for farming and the ecosystem service benefits provided by these wetlands were lost. As the Houston-Galveston metropolitan area has continued to grow the Galveston Bay ecosystem has been strained by pollution and flood control problems caused by rapid urban and industrial growth. In the face of this strain, area leaders have looked to the conservation of current wetlands and restoration of damaged or destroyed wetlands to increase the health of the Galveston Bay estuary. However, restoration of freshwater prairie wetlands has proved challenging due to the fact that agricultural use of these lands buried the natural wetland basins and provided little evidence regarding the nature and shape of the original wetlands. The difficulties presented by this situation called for new techniques and tools to be used in the restoration of freshwater prairie wetlands in the Houston-Galveston area.

Response

The Sheldon Lake area in a Houston was a prime example of the problems associated with renovating former freshwater prairie wetlands to their natural state. Sheldon Lake was once coastal prairie interspersed in pine/oak savannah. Between rice farming and the construction of the Sheldon Reservoir (1942) most of the original wetlands were destroyed in the first half of the twentieth century. Sheldon Reservoir came under the control of TPW in 1952 and was designated as Wildlife Management Area. In 1984, the entire Sheldon Park area became a state park. In 2003, Texas Sea Grant, along with their numerous partners on this endeavor, began the process of restoring approximately 135 acres of filled wetlands by re-excavating the original basins.

This was the first wetland restoration project in Texas designed to reclaim filled wetlands by excavating the original basins. The technique used, referred to as the “Sheldon-Sipocz” method (named after TPW biologist Andy Sipocz), relied on historical topographical maps to determine the shapes and contours of the original wetlands; then precision equipment was used to remove any added soils to an area until the original wetland prairie soil was exposed. Once the original contours of the wetlands were re-created native plants had to be added to finish the restoration. Fifty different varieties of native wetland plants were used in the replanting process. All of the plant material used in the project was collected from within 50 miles of the restoration site. With the help of numerous volunteers, 123,000 plants were transplanted into the newly restored wetlands.

Texas Sea Grant partnered with a number of different groups on the Sheldon Lake State Park Wetland Restoration Project. Project partners included Texas Parks and Wildlife (TPW), Texas AgriLife Extension, U.S. Fish and Wildlife Service, and the Texas State Soil and Water Conservation Board. In addition to these organizations, volunteers from the Texas Master

Naturalists Program, Friends of Sheldon Lake State Park, and local students provided approximately 10,500 hours of volunteer labor planting about 123,000 native wetland plants.

Results

As of late 2014 three stages of the Sheldon Lake Prairie Wetland Restoration Project have been completed and 135 acres of freshwater prairie wetlands have been restored to their original state. In addition, to the already restored wetlands an additional 50 acres is planned to be planted and restored by 2016. The ecosystem services provided by these wetlands include: water and waste regulation, recreational and aesthetic values, habitat for wildlife, a freshwater source, and carbon sequestration. While no research estimates exist to calculate the values of these ecosystem services specifically for Sheldon Lake Prairie, estimates have been calculated for other freshwater wetlands around the United States which are available through the Harte Research Institute's Ecosystem Services Valuation Database (<http://www.gecoserv.org/>). Using the median value of each of the ecosystem services noted above from past studies of other freshwater wetlands around the United States the estimated value of ecosystem services from this restoration project is \$10,461/acre/year. Assuming that these services will be continued in perpetuity and applying a discount rate of 10% to ecosystem services in future years the value of this project is \$104,610/acre or \$19,352,850 for the entire project area.

Reality

Although the ecosystem services provided by the Sheldon Lake Prairie have quantifiable values associated with them, the use of benefits transfer techniques to apply estimates of ecosystem services values provided by another study of different freshwater wetlands is problematic. There are three major problems with using ecosystem services valuation data not specific to both the ecosystem (freshwater prairie wetlands) and area (Houston/Galveston Bay) being evaluated. The first problem is that different ecosystems will provide different levels of ecosystem services. For example, if wetland "A" has numerous recreational activities possible (birding, boating, fishing, etc.,) and wetland "B" does not, it is likely that wetland "A" would provide higher recreational use values. The second problem with this approach is that ecosystem services provided in different locales will have different values. For instance, the value of freshwater wetlands as a water source will be proportional to water scarcity in the area around the wetlands.

These problems can be displayed by using the lowest ecosystem services values, as opposed to the median values, from the Harte Research Institute's Ecosystem Services Valuation Database to calculate the value of the Sheldon Lake Prairie restoration project. Using the lowest values in the database the value of the project falls from \$19,352,850 to \$1,045,250.

Recommendation

1. The application of ecosystem services values to restoration projects should only be attempted when either: a) calculation of ecosystem services specific to the restoration project being evaluated were done as part of the restoration project, or, b) credible recent-past research has led to ecosystem services valuations related to the same type of ecosystem in the same geographic region (freshwater prairie wetlands in the Houston/Galveston area for this example) as the restoration project in question.

2. For restoration projects where no reliable ecosystem services values have been calculated, Sea Grant should note the types of ecosystem services benefits the project provides but refrain from trying to value them.

Estimating the Impact of Direct Seafood Marketing in Louisiana

Relevance

Louisiana Sea Grant's strategic plan calls for development of practices, technologies, and systems designed for enhanced, more efficient operation of seafood culture facilities with minimal impact on coastal and oceanic environments and habitats, on natural fisheries, and on the people who depend on natural fisheries. In this capacity, our program has invested a substantial amount of time and effort in the establishment of direct marketing channels for locally-sourced seafood. While the logistics and policy of this "Louisiana Direct" programming effort continue to expand, comparatively little in the way of economic guidance has been made available for potential investors seeking specific costs and returns for this alternative, direct marketing (DM) strategy.

Response

During 2013, more than 250 respondents (shrimp fishermen and shrimp consumers) provided supply- and demand-based surveys for development of a Louisiana Seafood Direct Budget Generator. In collaboration with one graduate assistant, two field agents, and a dozen commercial operators, a partial budget generator was developed in 2013 and refined in 2014. Operational parameters were refined through simulations conducted as part of the MS thesis: *Direct Marketing Louisiana Shrimp: A Costs Earning Analysis* completed by Ms. Jill Christoferson in November 2014.

Results

Results indicate that for LA inshore shrimpers engaging in this practice, average Net Income From Operations with direct marketing (NIFO_{dm}) would increase by \$5,213, \$15,156, \$30,548, and \$44,402 for harvesters dedicating an additional 5%, 15%, 30%, and 50%, respectively, of their catch towards DM. These increases are compared to an average base NIFO of - \$220 for the Louisiana inshore shrimp fleet for the year 2013 (Miller and Isaacs 2014). A conservative extrapolation of this NIFO_{dm} estimate can be applied only to those vessels who Louisiana Sea Grant worked with directly through this program. Thus, of the 1773 fresh product license holders, only 243 reported shrimp landings in 2013 to the states trip ticket data base, and of these, only 55 were enrolled in the LA Direct program. Based on this lower bound population (and the average fraction of DM sales to the public determined to be 30% via survey), it is estimated that this practice yielded an additional \$1,680,140 in NIFO_{dm} for the 55 operators in this program.

Reality

The trend towards "local foods", "slow foods", and "direct marketing" (in both agriculture and fisheries) is often driven by assumptions and claims of increased profitability, sustainability, and product quality. While such claims may ultimately prove true for some applications, the reality is that many, if not most, of these efforts are driven more by ideology than efficiency. In the case of seafood, for example, there is certainly some perceived, if not actual, benefit associated with access to higher quality, locally-procured marine products. Moreover, the promotion of direct seafood marketing as a business strategy promises the capture of price margins typically retained by intermediate players in the market chain (dealers, wholesalers, processors, retailers).

Initial claims associated with the Louisiana Direct seafood marketing program were limited to the additional revenue obtained from the price premiums afforded by this method, some as high as 3x the dockside price. Those initial calculations were submitted as programmatic “economic impacts” in 2012. Yet, the problem with this type of reporting is that it’s based on gross revenue estimates only, and tells us very little about the true profitability of this strategy (i.e. marginal DM revenue minus marginal DM costs) . Moreover it fails to account for the opportunity costs of bulk, commodity-based dockside sales of shrimp. Such opportunity costs can be substantial if dockside prices increase dramatically in a short period – a phenomena that occurred in 2013 due to a global reduction in shrimp supply. Such costs can also be very high, socially, for harvesters who receive pressure from their dockside market for engaging in the practice. Thus, reporting from Louisiana Sea Grant on DM in shrimp was scaled back from the initial, gross revenue-based impacts claimed in 2012. For 2013, reporting was changed to a DM-based “accomplishment” report and the focus shifted to the development of an economic decision tool that has been through two years of tedious development and refinement.

Preliminary analysis with the new template during 2014 has identified what appears to be an optimal combination of operator characteristics related to location, technology, vessel size and product form. These findings will be further developed in 2015 through marine extensions programs in which the tool is disseminated and tested with additional operators. The extrapolation above; however, can only be partially credited to the LA Direct Seafood marketing program (i.e. ...*it is estimated that this practice yielded an additional \$1,68,0140 in NIFO_{dm} for the 55 operators in this program.*). In reality, many of those 55 vessels were already involved in some form of direct marketing before enrolling in the program. Indeed, the “ice chest” market has been around in the LA inshore shrimp sector for decades.

Thus we must be careful not to take complete credit for the entire \$1.6 million. So how much can we claim – *a quarter? a third? half?* Determining this number would require estimating the number of harvesters (amongst this group of 55) who were not previously engaged in DM, and were led to this practice specifically because of outreach and guidance provided through the *LA Direct Seafood Marketing* program. Perhaps more valid than this number is the decision tool that resulted from this Sea Grant supported program. This tool is currently an “accomplishment” – and the extent to which it can be used to ultimately determine “economic impact” depends on its use and application in coming years.

Recommendations

1. Sea Grant programs should avoid making gross-revenue based claims of any increased sales derived from vessels participating in sea grant coordinated direct marketing programs. It is the NIFO_{dm} that should be estimated, and not for the entire fleet, but only those operators for which a program can validly claim they guided to, and trained for, this practice.
2. Sea Grant programs should be careful to not to make blanket claims about the feasibility of DM, rather they should point out that that the feasibility of this practice is dependent on a number of characteristics related to target species, time of year, location, technology, vessel size and product form. Moreover, the local, political environment should be carefully considered when engaging in DM-based extension programing. While the practice of DM is

allowed in some locations, it can be illegal or extremely unpopular in specific states and/or ports.

3. Sea Grant programs should focus more on the education aspect of direct marketing, versus the economic impact side. While the former may result in a less exciting metric for the national office, the latter metric (economic impact) comes with a number of semantic caveats and qualifications – many of which are lost in the arms race created by the current performance report system.

Working with Industry to Implement Technology Change – Improving Fuel Efficiency in the Texas Shrimp Fishery

Relevance

Shrimp fishermen have always been concerned about fuel use because trawling is a fuel-intensive enterprise. In a Standardized Performance Analysis (SPA) of the offshore Texas shrimp fleet using producer information from the twelve-year interval 1986 through 1997, the average quantity of diesel used by cooperating producers was 66,101 gallons a year (Haby et al, 2000). The journey of investigating various upgrades to improve the operational efficiency of shrimp trawling continues to this day, but with a much greater sense of urgency. This sense of urgency exists because since 2001, operators have encountered sharp reductions in dockside prices for their shrimp and a simultaneous, rapid escalation in diesel prices that began in 2002. Specifically, between 1994 and 2001 annual diesel prices averaged \$0.74 per gallon. Over the next eleven years (2002 – 2012) the average price tripled to \$2.22 per gallon. This rapid escalation in diesel prices hit shrimp fishermen extremely hard. By 2006, the cost of 66,101 gallons – the average quantity used each year by SPA cooperators – amounted to \$140,399 and was, by far, the largest input expense. Therefore, it should come as no surprise that roughly 40% of the 2,666 federally-permitted offshore trawlers remained idle that year because of record-high fuel prices coupled with historically-low shrimp prices. Today, identifying and reducing avoidable costs is critical to the fundamental business goal of surviving and thriving over time.

Response

Texas Sea Grant, working with Western Seafood, a fleet operator, began looking at ways to make shrimp trawling more fuel efficient. The work included analyzing two technologies new to the fishery: 1) cambered steel trawl doors, and 2) using advanced webbing material for nets (Sapphire[®] webbing). Both technologies presented the opportunity to reduce drag and fuel usage while trawling. A proof-of-concept cruise demonstrated the possibility for success with cambered doors, but much more work was required before this new design could become a legitimate option to the flat, rectangular doors used for decades.

Texas A&M AgriLife/Sea Grant faculty secured two separate funding sources for cooperative research efforts. Investigators developed a four-step research protocol for fisher cooperators (those willing to try the new gear) which (a) benchmarked fuel use with their traditional gear, (b) measured the proportional contribution to fuel savings made by braided Sapphire[®] nets opened with traditional flat doors, (c) documented identical shrimp production during simultaneous trawling with their traditional rig and the new gear, and (d) measured fuel use while fishing with the new gear.

To examine what this fuel-saving gear could mean to a hypothetical operator, a net present value analysis compared those cash production costs that would be impacted by gear type (fuel use and cost, frequency of engine overhauls, plus door/net acquisition and maintenance). This analysis demonstrated that higher-priced, longer-lived trawl gear that could save 10% of historic fuel used (the least amount saved in the cooperative research project) was, by far, the better investment choice since the NPV across all seven discount rates represented lower operational costs. Given that all cooperating fishermen verified identical catches between their traditional trawl complement (i.e., flat, wooden doors and nylon nets) and the cambered doors and Sapphire[®]

nets, investing in the new gear and saving at least 10% on fuel consumption would improve an operator's bottom line other things being equal.

Generating greater earned operating income can add to retained earnings. More equity in the business can help the firm weather short-term economic shocks like spiking fuel prices or lower dockside shrimp prices. Increased income from fuel savings and a longer useful life also allows management to consider uses for these additional funds. Examples could include (a) "catching up" on deferred maintenance, (b) investing in subsequent efficiency projects like recent improvements in propellers and nozzles, (c) increasing the size of immersion brine freezing systems, and (d) periodically withdrawing a portion of retained earnings to fund a personal retirement program.

Results

By adhering to the four-step research protocol, cooperating Gulf and South Atlantic shrimp fishermen documented that braided Sapphire[®] nets accounted for 20% of total fuel savings while the cambered doors accounted for 80% of total fuel saved. Reduced fuel consumption ranged from 10% to 39% when using fuel-saving gear. Cooperators also verified that catches remained identical to those produced with traditional trawl gear when both gear types were simultaneously fished. Early adopters of the fuel-saving gear also noted that doors and nets had a much longer useful life than traditional equipment (7-8 years for cambered, steel doors vs. 2 years for traditional wooden doors and 4-6 years for braided, Sapphire[®] nets vs. 2 years for nylon nets).

The adoption rates for cambered doors and Sapphire[®] webbing were highest in the Brownsville and Port Isabel shrimp fleets in Cameron County. After two local operators' success with the fuel saving technologies became public most of the Cameron County shrimp fleet adopted the cambered doors and Sapphire[®] webbing. In the following seven years (2008 through 2014), using the average, annual fuel use value of 66,101 gallons and the median fuel-savings values from the analysis (4.8% for Sapphire[®] webbing, 19.2% for cambered doors, and 24% for the application of both), the Cameron County fleet is estimated to have saved some 14.86 million gallons of diesel valued at \$41.19 million while harvesting the same quantity of shrimp! In the words of one of the fleet managers in Cameron County who committed early to the cambered gear, "*Were it not for these doors, I wouldn't be here.*"

Reality

Never has a more systematic approach been used in the Southeastern U.S. shrimp-trawl fishery both to prove the gear across various operating conditions as well as to enable its adoption. Proving the modified cambered doors worked in the offshore shrimp-trawl fishery involved a cadre of fishermen, each with a different mix of operating conditions and targeted shrimp species who implemented the same four-step research protocol. When highlighting the impacts of this extension work Sea Grant is justified in highlighting the fuel savings recognized by adopters of this technology as being due in large part to Texas Sea Grant (while noting the important roles played by Western Seafood and those shrimpers that took part in testing the new gear, the Ocean Conservancy, and the Walton Foundation⁷). Texas Sea Grant should not attempt to claim the

⁷ The Ocean Conservancy and the Walton Foundation worked together to partially fund and partially finance the purchase of cambered doors by trawlers that needed help with the purchase of the doors.

funding from the Ocean Conservancy and the Walton Foundation used to subsidize the initial gear purchases as an economic impact of this work.

Recommendations

1. Given Sea Grant's lead role in this endeavor it is reasonable for Sea Grant to estimate and report the fuel and cost savings associated with adoption of this fuel efficient gear as an economic impact/benefit generated by Sea Grant programming (14.86 million gallons of diesel and \$41.19 million); however it is important to note that this work also relied heavily on participation by industry (Western Seafood), a philanthropic organization (Walton Foundation), and a conservation group (Ocean Conservancy) and these groups should be named in any document highlighting the benefits of this program. The correct measure for highlighting this impact is to measure fuel and money saved.
2. Although it is reasonable to assume that this program led to both businesses sustained and jobs sustained (as stated by one fleet manager: "Were it not for these doors, I wouldn't be here."), measuring those values is extremely difficult. Most economic impacts are calculated using input-output analysis; however that is not possible in this case due to the fact that this program is actually causing trawlers to use less of an input (fuel). While the adoption of more fuel efficient gear decreased fuel consumption and allowed fishers to continue fishing it also led to decreased fuel purchases which an input-output model would see as a negative impact! In addition, actually measuring the counterfactual of how many jobs and businesses would have been lost without the more efficient gear is nearly impossible⁸. Given this reality it is best that the benefits of this programming be measured in fuel and money saved.

⁸ To measure the number of jobs created and sustained by adoption of the new trawl gear would require an experiment involving all shrimp trawlers in the Brownsville/Port Isabel fleet. Fishers would be randomly assigned to either a control group (not given the option of adopting the new gear) or a treatment group (those that were allowed to, and did, adopt the new gear) and differences in the number of jobs and businesses sustained would be measured. While such an experiment would provide an indication of how many business and jobs were sustained it would not fit Sea Grant's mission of extension and outreach.

Conclusions

The Sea Grant program has a strong reputation as being an honest broker of good science. That reputation is essential if Sea Grant is to be considered a source of solid science-based information that can be used to guide the wise and sustainable use of our nation's finite marine resources. Any deviation from that role will jeopardize the reputation that Sea Grant has maintained for many decades. Likewise, the accurate and defensible reporting of the marginal benefits associated with the science-based applied research and outreach programs conducted by Sea Grant is also essential to maintaining an irrefutable reputation of objectivity. Exaggerated and erroneous claims of programmatic benefits would likely taint the reputation for objectivity and honesty of any public and/or private institution. Sea Grant takes great care in attempting to measure and report the benefits associated with the applied research and extension programming activities conducted throughout the nation. Reports of accomplishment via the Sea Grant OARS (Online Activity Reporting System) and PIER (Planning, Implementing, and Evaluation Resource) strive to offer information that describes the tangible benefits that are derived from Sea Grant activities. Such statements of "impact" are extremely useful not only in justifying the existence of such institutions to the general public, but also for the process of competing for scarce public dollars being allocated among competing public institutions. The Sea Grant program has recently produced documents that help guide that reporting process, to better ensure that the reported benefits are accurate and defensible. This Final Report hopefully provides further guidance toward that end. Utilizing a set of descriptive "vignettes" as case examples to offer suggestions on benefit reporting is the key contribution of this effort. The authors hope this approach is useful.

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