Hurricane Irma Damage Assessment: Provisional results for the Florida commercial and for-hire fisheries and associated businesses

60-Day Interim Report
National Oceanic and Atmospheric Administration (NOAA)

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INTRODUCTION

Hurricanes Irma and Maria struck Florida, Puerto Rico and the U.S. Virgin Islands (USVI) in September 2017. On February 9, 2018, the Secretary of Commerce declared a federal fisheries disaster in Florida, Puerto Rico and the USVI, citing Magnuson–Stevens Fishery Conservation and Management Act (MSA) Section 315 and Interjurisdictional Fisheries Act (IFA) Section 308(d).

This report provides results from a rapid appraisal of impacts to fishing communities in Florida from Hurricane Irma; separate reports are being prepared for Puerto Rico and USVI. This report also serves as NOAA Fisheries (NMFS) 60 day assessment of impacts from these storms, a requirement for disaster declarations filed under MSA 315. More specifically, MSA 315 requires that within two months after a catastrophic regional fishery disaster, the Secretary of Commerce, through NOAA Fisheries, will provide the Governors of affected states (in this case USVI, Puerto Rico and Florida) an economic and socio-economic evaluation of the affected region's fisheries using the best information available. The goals of this evaluation are to assess the impacts of Hurricane Irma in affected communities in Florida that are involved in commercial or for-hire fishing, and characterize the effects of the storm on fishing-related businesses and infrastructure.

Hurricane Irma made landfall near Cudjoe Key in the lower Florida Keys on September 10, 2017 as a Category 4 storm with damaging winds of 130 mph. It was the most intense hurricane to strike the continental US since Hurricane Katrina in 2005. High winds and a storm surge of over 5 feet cut the Keys off from the mainland for days even as Irma churned up Florida's Gulf Coast making a second landfall in the state at Marco Island as a Category 3 storm. The storm continued on a north-northwest track passing east of Tampa on September 11. As it continued its movement through the state, it sustained a large wind field with most of Florida experiencing gale force winds. By the time the hurricane tracked west of Gainesville, Florida on September 11 it had weakened to a tropical storm; however the strongest winds at that time were confined to the northeast coast of Florida and southern Georgia (Cangialosi et al. 2018). Damage estimates for this storm range from $58 billion to $83 billion (Evans 2017).

This report covers impacts on commercial fishermen, for-hire operators, and fishing-related businesses in Florida that largely depend on marine fishing activities for their income. The interviews used for this assessment took place within a period of one to two months after the passing of Irma through the state of Florida (September 10 – 12, 2017). At the time of the interviews, many of those affected were just beginning to recover from the damages of the storm and in many cases had not yet been able to undertake repairs or conduct detailed assessments of their total damages. Individuals were asked to provide their best estimates of the damages to their businesses both in percentage as well as in dollar terms.[1] Nevertheless, the information presented provides the best estimates currently available of the economic and social impacts of Irma on the fishing sector in Florida.

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[1] NOAA plans on conducting a more complete assessment approximately one year after Irma. This assessment will provide a more precise and nuanced account of the total economic and social impacts of Hurricane Irma on fishing businesses in the state of Florida.

FLORIDA FISHERY BACKGROUND

Florida Fishing Industries and Coastal Communities

With one of the longest coastlines in the United States, fishing has long been an integral part of Florida's history and an important economic engine (NOAA 2018). The total annual value added of the commercial seafood industry in Florida is an estimated $5.7 billion (including imports) and domestic production alone accounts for 11,083 jobs some $450 million annually in value added. The recreational sector represents an even more important economic contribution with a value added economic impact estimated at $7 billion annually and accounting for some 96,000 direct and indirect jobs.

Table 1: Economic Impact of Fishing Industry to State of Florida (values are 000s of dollars)

2016	Jobs	Sales	Income impacts	Value added
Commercial Fishing				
With Imports	76,749	16,873,652	3,171,513	5,658,897
Without imports	11,083	1,081,344	284,434	437,467
Recreational Fishing				
Trip Impacts	12,034	1,324,331	465,202	760,445
Durables	84,211	9,587,063	3,650,086	5,817,790
Total State	**96,245**	**10,911,394**	**4,115,288**	**6,578,235**

Community Dependence on Commercial and Recreational Fishing

The coastal towns and communities in Florida depend on fisheries to different degrees. Indicators of commercial and recreational fishing engagement and reliance indicate that Hurricane Irma's direct path crossed areas of Florida that are among the state's most dependent on commercial and recreational fishing.

Commercial and recreational fishing engagement and reliance indicators are derived from federal fisheries datasets that include state landings and provide a measure of sector fishing activity at the county and community levels (Jepson and Colburn 2013). Commercial and recreational fishing engagement indicators are based upon absolute measures of fishing activity.[2] The commercial and recreational reliance indices are relative measures consisting of the same variables related to commercial or recreational fishing activity but divided by the population of the county or community. These variables are placed into a principal component analysis with a single factor solution. The engagement or reliance indicator value for the county or community

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[2] The commercial fishing engagement indicator is based on the number of federal commercial vessels by homeport address, number of federal commercial vessels by owner's address and number of dealers with landings in each county and value of those landings. The recreational fishing engagement indicator is based on the number of recreational vessels by homeport address, number of recreational vessels by owner's address and number of recreational infrastructure (boat ramps) associated with community or county.
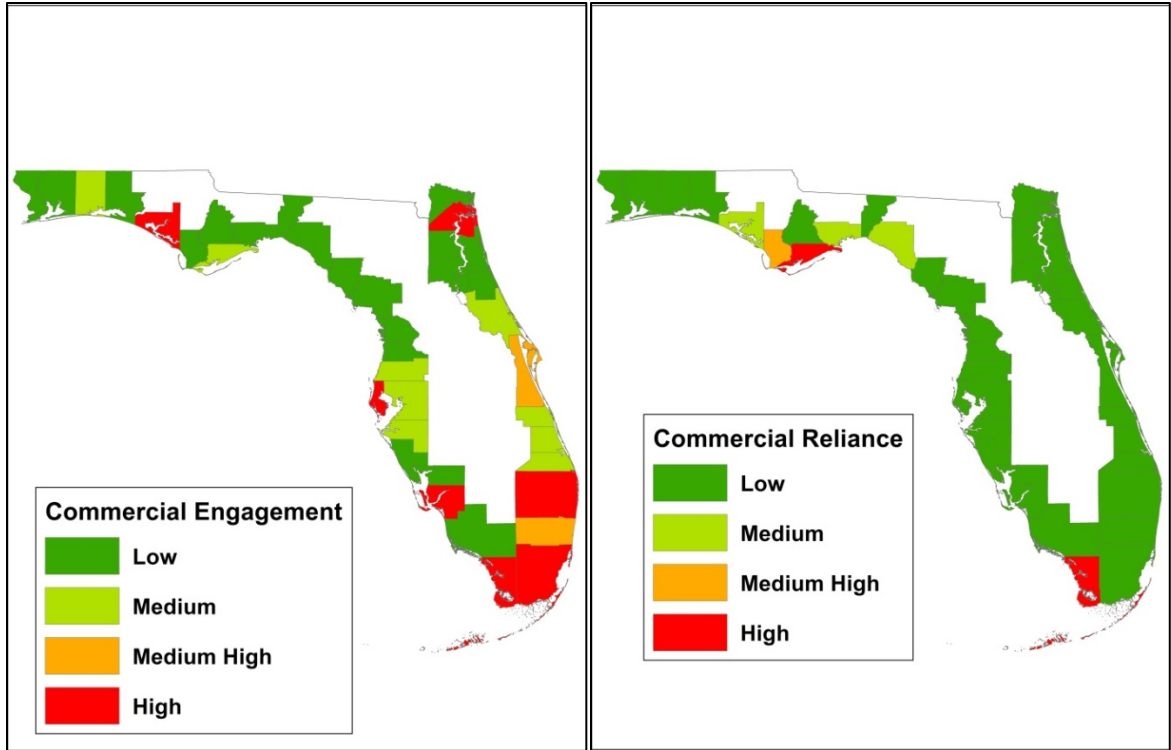
Figure 1. Florida Shoreline Counties Commercial Fisheries Dependence.
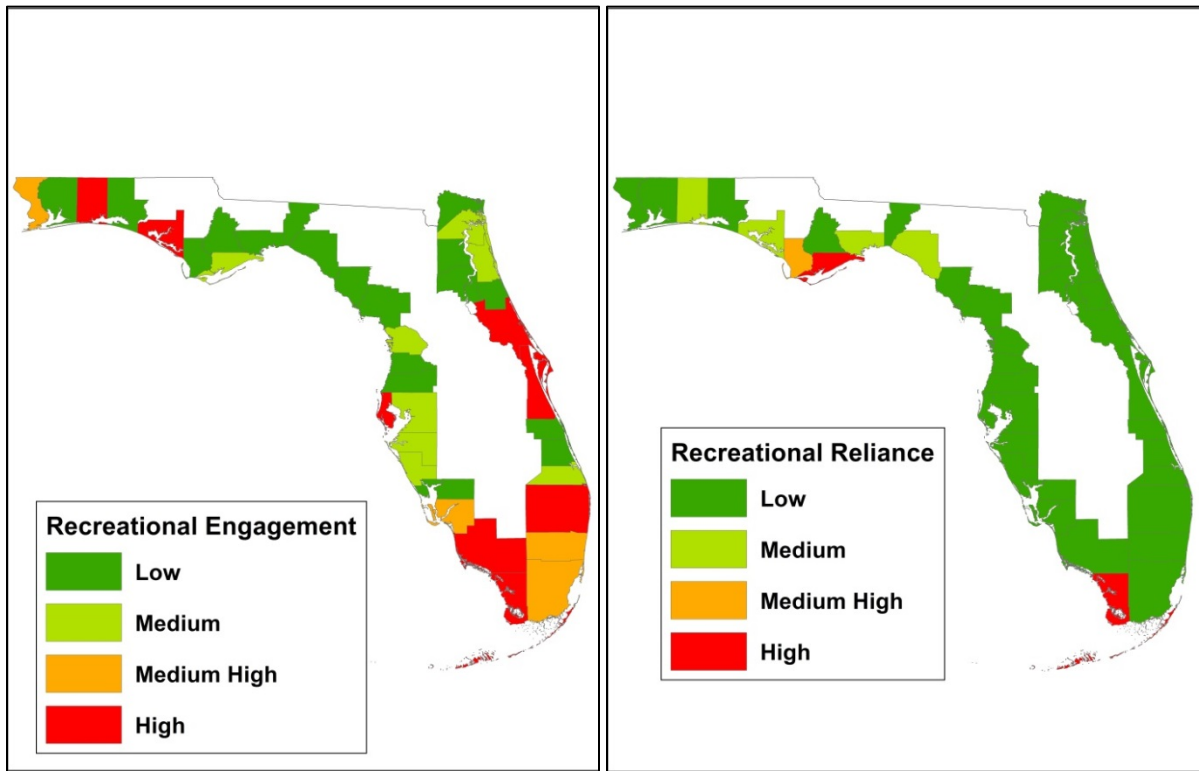Source: SERO CSVIs 2018 (ACS 2014)

Figure 2. Florida Shoreline Counties Recreational Fisheries Dependence
Source: SERO CSVIs 2018 (ACS 2014)

equals the factor score from the respective analysis (these are standardized scores and zero is the mean, they were then categorized by standard deviation: Low = < -0.0 to 0.0; Medium = >0.0 to 0.5; Medium high = >0.5 to 1.0; High = > 1.0, for the county level measure.[3] The measures presented here differ from the national indicators as these indices include only counties or communities within the Southeast Region for analysis and score calculation.

Florida's shoreline counties demonstrate considerable engagement in commercial fishing overall with counties in Southeast Florida exhibiting a concentration of high engagement (see Figure 1). In contrast, overall reliance on commercial fishing is low although Monroe County, which was one of the areas in the state hardest hit by Irma, is one of the two counties in the state with a high reliance on commercial fishing. The other is Franklin County in the northwestern part of the state. In summary, while South Florida shows high commercial engagement, the Panhandle counties demonstrate more reliance.

Recreational fishing engagement is also high in many of Florida's shoreline counties (Figure 2) with South Florida exhibiting a concentration of both high and medium high engagement. Recreational fishing reliance is less common, but Monroe and Franklin Counties again show high reliance on recreational fishing.

Commercial and Recreational Fisheries Landings Data Analyses

Assessments of trends in commercial landed weight in pounds and recreational angler activity can be used to evaluate impacts on fishing-dependent communities. Interviews with fishermen suggest that there was a significant decrease in landings of some species, at least in the period immediately after the storm, especially in the areas that were highly impacted by the storm (especially Monroe and Collier Counties). However, the 2017 Federal and State datasets needed to conduct a quantitative evaluation of the impacts of the storm on commercial landings and revenues are not yet available.

Based on field interviews, the commercial species that would be expected to have experienced the most significant reductions in landings in the immediate period after the storm is spiny lobster, primarily due to the loss of fishing opportunities and gear (lobster traps) in the Florida Keys. Fortunately, the storm passed before the start of the stone crab season, allowing fishermen to focus on recovery of lobster gear and reinvest efforts to start up fishing again.[4] We received fewer reports of disruption related to fishing for finfish, which in the high impact areas is primarily reef fish (grouper-snapper).

Regarding for-hire fishing effort, Irma significantly affected tourism visitation rates especially in the Florida Keys, which, among other factors, significantly reduced angler activity. Of greatest concern for the for-hire sector, especially in Monroe and Collier Counties, was the cancellation of pre-booked fishing trips and loss of potential clientele/tourists due to the storm event and the

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[3] The mean can be 0 because the factor scores go below zero with negative numbers.
[4] Lobster fishermen in the Florida Keys after the storm reported a shift in lobster catches due to the hurricane, with large catches of a size that would normally take place later in the season. They expressed a concern that this shift signaled an earlier than normal movement that would end the season early and they would miss the portion of the season when the catch brought the strongest price from dealers.

subsequent clean-up, repair and redevelopment efforts. Although it is clear that in some areas angler activity was completely stopped for a period after the storm, data is not yet available that would allow us to quantify the overall changes in recreational angler activity in the State as a result of the storm.

RESEARCH METHODS

Survey Logistics

The data used to conduct this impact assessment was gathered specifically to evaluate the economic and social impacts of the storm on the state using three different methods: a field survey, an online survey, and a phone survey. Shortly after the passing of Hurricane Irma in mid-September 2017, NOAA Fisheries met with State of Florida to share information and determine if NMFS could assist them with conducting an appraisal of damages to the fishing industry and its support businesses. To assess the damages, two survey instruments were developed based on damage assessment interviews used by NOAA previously in an assessment of Hurricane Sandy (NOAA 2013; Colburn et al. 2015). One interview was designed for fishermen (both commercial and for-hire) and the other for fishing related businesses.

In late September, preliminary fieldwork started. Sampling frames were created by combining both federal fisheries databases with state databases for fishermen and related businesses and removing duplicates. Business addresses were geocoded and uploaded into mapping software to facilitate easier contact by personnel in the field.

By early October, staff was in the field conducting interviews with affected business owners, commercial and recreational fishermen; fieldwork continued through the first half of November. Interviews were conducted in person and averaged around 20 minutes. During the fieldwork phase an online survey was also developed and placed on the FWC website.

Florida fieldwork covered the Florida Keys, coastal areas of Miami-Dade and south Broward Counties and the southwest coast of Florida from Everglades City to Fort Myers. A fieldwork visit to Jacksonville was also made in late October.

A phone survey was developed once the fieldwork phase was completed and contracted out to a Florida firm to contact vessel owners and other businesses throughout the state that were not captured in earlier fieldwork or through the web interface. Individuals or businesses that had completed surveys through fieldwork or the online form were removed from the phone survey sampling.

Sampling Strategy

The field survey involved attempting to conduct a census of all fisheries-dependent businesses in the areas that the rapid appraisal identified as the most significantly impacted by Hurricane Irma. These businesses included marinas and docks with commercial and charter fishing activity, bait and tackle shops, and seafood processors and dealers. Fieldwork also involved the opportunistic

interviewing of commercial and recreational fishermen. Some 91 businesses and 49 commercial and for-hire fishermen were interviewed in person during the fieldwork phase.

The online survey link was distributed by the FWC to their e-mail address list that included commercial fishing and dealer permit holders, among others. An announcement and link was also posted on the FWC website. The online survey included both English and Spanish versions. A total of 528 responses were received from the online survey including 142 businesses, 226 commercial fishermen and 160 for-hire fishermen.
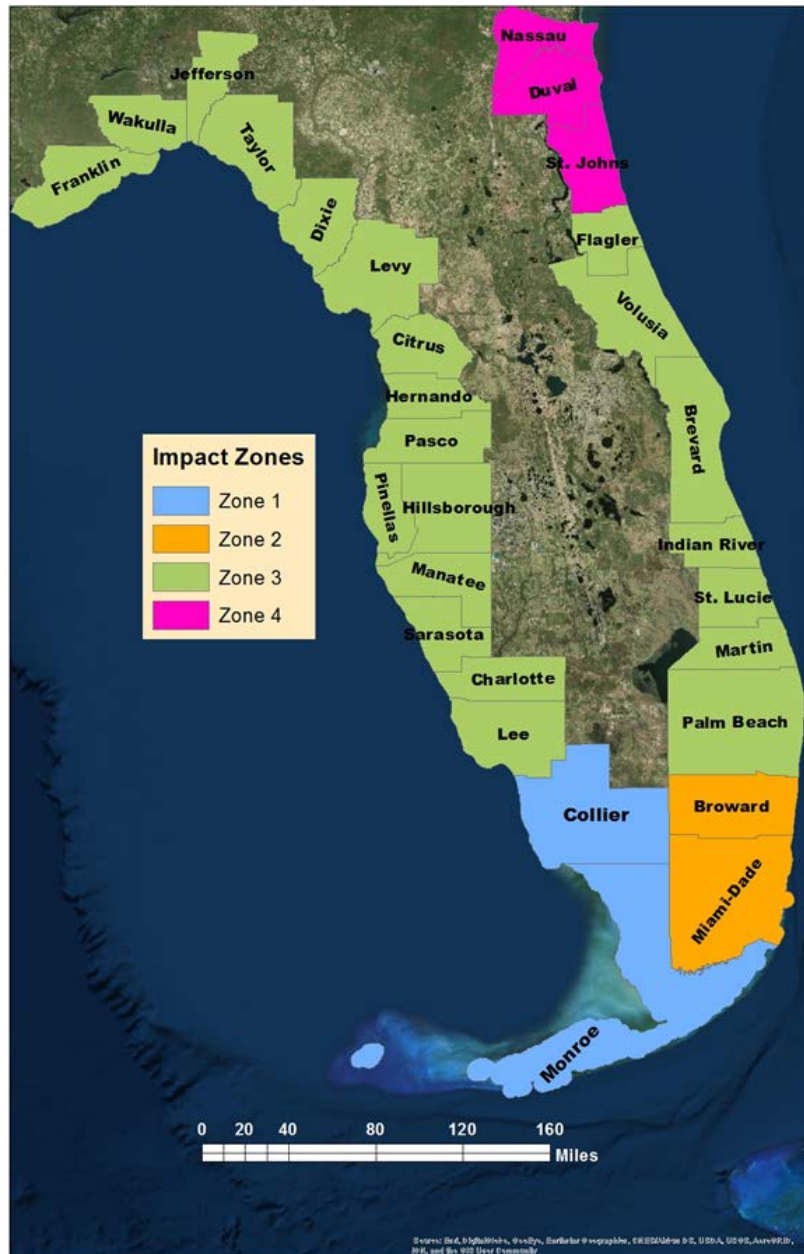

Figure 3: Hurricane Impact Zones used in the Study

The phone survey covered 29 Florida coastal counties extending from the Florida/Georgia border in the east to the Florida Panhandle in the west. The phone survey excluded the six "Emerald Coast" counties in the Panhandle that reports indicated did not suffer any impacts from Hurricane Irma.[5] Individuals or businesses that had completed surveys through fieldwork or the online form were removed from the sample frame. Due to time and cost limitations, sampling was also stratified to ensure adequate coverage of the counties that were most heavily impacted by Irma according to 4 impact zones (see Figure 3). Zone 1 involved the two counties (Monroe and Collier) that received direct hits from the hurricane and that field visits identified as the highest impact areas.[6] These zones were sampled at 100% of the target population for commercial fishermen and for-hire operators and fishing-related business sectors. Zones 2 (Miami-Dade and Broward Counties) and Zone 4 (Duval, Nassau and St. Johns Counties) were medium impact zones with the coasts affected by mostly tropical force winds and coastal flooding due to storm surge. These two zones were sampled at 100% for the fishing sector and 66% for the business sector. Zone 3 included the other 22 coastal counties in the state that in general experienced more moderate impacts from winds (mainly power outages) and some coastal flooding. This zone was sampled at 20% for both the fishing and business sectors.

Table 2: Phone Survey: Frequencies of Potential Frame of Participants (Universe) and Target Sample Size for Each Sector

County/Zone	Commercial and For-Hire		Businesses	
	Frame	Sample	Frame	Sample
Collier/1	146	146	81	0[1]
Monroe/1	832	832	193	0[1]
Miami-Dade/2	362	362	295	191
Broward/2	134	134	162	106
Duval/4	134	134	102	65
Nassau/4	41	41	20	15
St. Johns/4	58	58	47	36
Other Counties/3	2204	441	1187	233
Total	**3911**	**2148**	**1813**	**646**

[1]Since we made every effort to contact 100% of qualified businesses in Collier and Monroe Counties in the field survey, all businesses in these counties were excluded from the phone survey.

[5] Included counties were the following: Levy, Miami-Dade, Citrus, Broward, Hernando, Palm Beach, Pasco, Martin, Pinellas, St. Lucie, Hillsborough, Indian River, Franklin, Manatee, Brevard, Wakulla, Sarasota, Volusia, Jefferson, Charlotte, Flagler, Taylor, Lee, St. Johns, Dixie, Collier, Duval, Monroe, Nassau. The excluded coastal counties were: Escambia, Santa Rosa, Okaloosa, Walton, Bay, Gulf.

[6] In terms of damage to fishing-related businesses and infrastructure, the southern part of Collier County, including Everglades City, Chokoloskee and Goodland, were the most heavily impacted areas. All of the Florida Keys were heavily impacted but the worst damage was concentrated in the middle Keys, including Islamorada, Marathon and Big Pine.

A total of 1045 responses were received in the phone survey, which included 163 businesses and 882 vessel owners. The response rate the phone survey was 29% for businesses and 46% for commercial vessel owners and charter operators.[7]

SURVEY RESULTS

Commercial and For-Hire Fishermen

Approximately 1713 businesses and individual commercial and recreational fishermen participated in the three surveys through November 17, 2017. However, a number of interviews were not included in the final analysis due to the fact that their businesses or activities did not meet the criteria established for the study or response errors that made the records unusable.[8] After cleaning, therefore, a total of 1553 surveys were used for the analysis of both fishermen and businesses.

Table 3: Frequency of Fishermen Interviewed by Fishing Sector

Commercial	Population	Observations	%[1]
Zone 1 (Collier and Monroe Counties)	556	286	51.4
Zone 2 (Miami-Dade and Broward Counties)	409	161	39.4
Zone 3 (Other Counties)	1376	176	12.8
Zone 4 (Duval, Nassau and St. John Counties)	160	73	45.6
Subtotal	2501	696	27.8
For-Hire			
Zone 1 (Collier and Monroe Counties)	465	244	52.4
Zone 2 (Miami-Dade and Broward Counties)	102	49	48
Zone 3 (Other Counties)	875	145	16.6
Zone 4 (Duval, Nassau and St. John Counties)	81	47	58
Subtotal	1523	485	31.8
Total	**4024**	**1181**	**29.3**

[1]Percentage of the total population that responded to the survey. It should not be confused with the response rate.

Table 3 provides a breakdown of the final number of interviews by fishing sector that were included in the final analysis. A total of 1181 fishermen interviews were included in the final dataset of commercial federal and state permit holders and for hire operators. This constituted nearly 30% of the estimated total population of vessel owners and operators from the commercial

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[7] Six attempts were made to contact all individuals in the frame. Refusals accounted for less than 30% of non-responses overall. Most of the non-responses were related to either wrong or nonworking telephone numbers or unanswered calls.

[8] For example, there were a number of businesses and individuals that provided information in the online survey that did not meet the criteria for marine fishery-dependent business or operators. These were removed from the sample for purposes of final analysis.

and for-hire fishing sectors in the 29 coastal counties potentially impacted by Hurricane Irma. However, significantly more than 40% of the total population was interviewed in the Zones 1, 2 and 4 in comparison to Zone 3 in which between 10 – 15% of the total population of commercial and for-hire fishermen was interviewed.

Commercial and for-hire fishermen were also asked what fishery they usually operate in during this time of year. More than 50% of fishermen in Zones 1 and 2 reported targeting lobster during this time of year, whereas for-hire operators and commercial fishermen in the other zones reported that they targeted almost exclusively other species. A more detailed analysis of species targeted and changes in landings in the hurricane's aftermath will be provided in a later report.

Table 4: Species Commercial Fishermen Usually Target during Time of Year of Irma

Species[1]	Zone 1	Zone 2	Zone 3	Zone 4	Overall
Lobster	55%	51%	4%	5%	38%
Stone crab[2]	42%	21%	16%	2%	27%
Other	43%	59%	88%	100%	63%

[1] In the survey, fishermen could choose lobster, stone crab, and other. If they operated in more than one fishery, they could choose more than one category.

[2] Stone crab season in Florida runs from October 15 through May 15 each year. The stone crab season was not open when Hurricane Irma passed in September 2017. However, most of the interviews occurred after the stone crab season had opened on October 15.

Fishing-Related Businesses

A total of 372 fishing-related businesses with facilities and/or licenses to operate in Florida were surveyed. Table 5 provides the distribution of businesses surveyed for each sector by Zone.

Table 5: Frequency of Interviews by Fishing-Related Business Sector

Bait and Tackle Shops	Population	Observations	%
Zone 1 (Collier and Monroe Counties)	33	21	63.6
Zone 2 (Miami-Dade and Broward) Counties)	28	9	32.1
Zone 3 (Other Counties)	134	27	20.1
Zone 4 (Duval, Nassau and St. John) Counties)	25	7	28.0
Subtotal	220	64	29.1
Dealer/Processors[1]			
Zone 1 (Collier and Monroe Counties)	47	27	57.4
Zone 2 (Miami-Dade and Broward Counties)	373	40	10.7
Zone 3 (Other Counties)	633	41	6.5
Zone 4 (Duval, Nassau and St. John) Counties)	80	17	21.3
Subtotal	1133	125	11.0
Marinas & Related			
Zone 1 (Collier and Monroe Counties)	34	62	182.4
Zone 2 (Miami-Dade and Broward) Counties)	25	37	148.4
Zone 3 (Other Counties)	204	32	15.7
Zone 4 (Duval, Nassau and St. John) Counties)	26	8	30.8
Subtotal	289	139	48.1

Seafood Retailer[3]			
Zone 1 (Collier and Monroe Counties)	N/a	5	N/a
Zone 2 (Miami-Dade and Broward Counties)	N/a	13	N/a
Zone 3 (Other Counties)	N/a	7	N/a
Zone 4 (Duval, Nassau and St. John Counties)	N/a	3	N/a
Subtotal	N/a	28	N/a
Sector Unknown[3]			
Zone 1 (Collier and Monroe Counties)	N/a	0	N/a
Zone 2 (Miami-Dade and Broward) Counties)	N/a	8	N/a
Zone 3 (Other Counties)	N/a	3	N/a
Zone 4 (Duval, Nassau and St. John Counties)	N/a	5	N/a
Subtotal	N/a	16	N/a
Totals	**2130**	**372**	**17.5%**

[1] Does not include dealers known to also be vessel owners. However, it still includes many businesses that were not able to be identified as active dealer/processors (see explanation in text).

[2] The discrepancy in these numbers between the population and the sample for Zone 1 and Zone 2 has to do with error in the business frames that we used. In the case where there are more businesses than population, those businesses were added to our overall frame.

[3] We were not able to estimate total populations for these sectors. For the "sector unknown" category, we were not able to place these businesses in one of the four categories although we are confident that they qualify as fishing-dependent businesses.

It should be noted that the business frames were constructed using state registries and commercially available lists. Some of these lists are out of date or contain businesses that do not meet the criteria established for inclusion in the survey. For that reason, the population for each zone is our best estimate of the total population in each zone for each category, after doing our best to clean these lists and match the lists with other records.

Table 6: Distribution of Surveyed Fishing-Related Businesses by Sector

Fishing-Related Business Sector	Responses	Total	%
Marinas and Other Related Businesses[*]	139	289	47.4
Bait & Tackle Shops	64	220	28.2
Seafood Dealers/Processors	125	1133	11.0
Seafood Retailers	28	28[1]	100.0
Sector not available	16	16[1]	100.0
Total	**372**	**2129**	**17.1**

[1] Data not sufficient to estimate total populations for these categories.

One of the largest discrepancies that we found was in the dealer/processor list. Fieldwork showed that this list contained many businesses (e.g., restaurants and grocery stores) that had

applied for a dealer permit in the past but either had never or was not currently operating as a seafood dealer. More importantly, there are many dealer permits registered under the names of individuals on these lists that use P.O. Boxes, private home addresses, or even vehicle information as their business locations. Most of these were determined to be individual commercial fishermen that also had dealer permits. Despite our efforts to clean these lists, we were not able to reliably estimate the total population of seafood dealer/processors potentially affected by Irma. For that reason, as described in more detail below, we therefore took a conservative approach towards estimating total dealer losses in revenues and damages.

The phone survey was used to identify commercial fishermen that are also registered dealers, and interview them about their losses to their seafood dealer business. We were also able to estimate a total vessel-owner dealer population by matching dealer names to names in the vessel license frames and then extracting those from the dealer lists. The results of these efforts to identify and interview vessel owner-dealers are shown in Table 7.

Table 7: Frequency of Interviews of Vessel-owner Dealers

Commercial	Population	Observations	%
Zone 1	106	33	31.1
Zone 2	63	19	30.2
Zone 3	223	14	6.3
Zone 4	52	13	25.0
Subtotal	444	79	17.8

Impacts from Irma

Most of the fishing sector in Florida experienced some level of impact from Hurricane Irma. Of the 1,181 commercial and for-hire fishermen surveyed, 84% reported having to stop fishing as a result of the hurricane. Furthermore, 41% reported having suffered some physical damage to their vessel, gear or buildings, and 76% reported lost revenue as a result of the storm.[9]

Impact percentages were similar for commercial and for-hire sectors with the exception that higher rates of physical damage were reported by the commercial sector (45%) than by the for-hire sector (35%). This can be attributed primarily to higher reported percentages of gear loss in the commercial sector (28%) than in the for-hire sector (13%). As would be expected, the highest levels of impact were reported in Zone 1, with 70% reporting any physical damage and 89% some lost revenue and the lowest levels were Zone 3, with 26% reporting any damage and 70% reporting any revenue losses. Overall, only 2% of commercial fishermen and 6% of recreational fishermen reported that any of their losses were insured.

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[9] Lost revenue is more appropriately described as foregone revenue; that is, revenue that would have been anticipated to have been earned without the disruptions caused by Irma, based on earnings from previous years.

Among fishing-related businesses, 82% of the 372 businesses surveyed across all zones reported having had to close for some period of time as a result of the hurricane.[10] Fully 54% of businesses reported having suffered some physical damage or losses in equipment or merchandize (this included 66% of marinas/marine supply businesses, 50% of bait and tackle shops, and 52% of dealer/processors). As in the case of commercial and for-hire fishermen, the highest level of damage was reported in Zone 1, in which 81% of all businesses reported some physical damage or losses in comparison to Zone 3, in which 39% reported having experienced some damage.

A total of 63% of fishing-related business in all zones also reported suffering some revenue losses as a result of the storm. A very small percentage of businesses (<2%) reported having insurance coverage for their losses, but this low number is likely skewed by the way insurance information was collected in the survey.[11]

Economic impacts

Fishermen and fishing-related businesses were asked to estimate the value of various physical damages/losses to business-related property as a result of the storm. They were also asked to estimate revenue losses (i.e., revenue forgone) due to the storm relative to the previous year (2016). This section describes the average estimated value of physical damages/losses and the average estimated value of losses in revenue. These values are provided first for commercial and for-hire fishermen and then for fishing-related businesses. Then the total values are provided for damages/losses to property and losses in revenue as a result of the storm statewide and by zone. It should be noted that since the surveys were conducted so soon after the storm, few fishermen or fishing-related businesses had received professional estimates of their damages so they mainly based their calculations on personal estimates or repair/replacement costs. However, the Hurricane Sandy one year study did not find any statistically significant difference in the average value of damages between professional estimates and personal estimates/repair or replacement costs (Colburn et. al. 2015).

Average Losses

A higher percentage of commercial fishermen reported experiencing some physical damage/losses to their buildings, vessels or gear than for-hire operators and the average value of damages/losses reported by commercial fishermen was nearly $8,000 greater than the for-hire operator average (see Table 8). For commercial fishermen, average reported losses varied considerably by zone, ranging from an average of $44,589 in Zone 1 to $5,996 in Zone 4. Similarly, average physical damages/losses reported by for-hire fishermen were highest in Zone 1 ($24,702) and lowest in Zone 4 ($1,564).

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[10] Closures ranged from a couple of days to businesses that still had not reopened at the time of the interview.

[11] The survey did not ask business ownersif they had any insurance at all. Rather, it asked them to estimate the percentage and/or the dollar value of their insurance coverage for each category of damage (Business/Facility Damages, Seafood or Bait Losses, Equipment and Other Merchandize Losses, and Pier or Dock Damages). Due to the fact that the interviews were conducted in such a short interval after the storm, it is likely that many of the respondents still could not provide estimates related to their insurance coverage.

Table 8: Fishermen Responses on Average Total Costs for Physical Damages

| Fishing sector | Physical Damages/Losses | | Average Value of Damages/Losses |
	Yes	No	$
Commercial	309 (44.5%)	386 (55.5%)	17,066
For-Hire	170 (35.0%)	316 (65.1%)	9,119
Total	478 (40.6%)	702 (59.4)	14,057

A much higher percentage of commercial and for-hire fishermen reported experiencing revenue losses than the percentage reporting physical damages/losses. Commercial fishermen reported almost $10,000 more in average losses than for-hire fishermen revenue losses than for-hire fishermen (see Table 9). For both fishing sectors, the highest average revenue losses were reported in Zone 1 and the lowest average revenue losses were reported in Zone 3.

Table 9: Responses from Fishermen Interviewed Regarding Occurrence of Changes in Revenue Associated with Storm and Average Value of Revenue Loss

| Fishing Sector | Revenue Losses | | Average Value of Revenue Loss |
	Yes	No	$
Commercial	509 (73.2%)	187 (26.8%)	21,235
For-Hire	385 (79.4%)	100 (20.6%)	11,801
Total	894 (75.7%)	287 (24.3%)	17,663

For the business sectors, the "Marina and Other Related" category included the highest percentage reporting physical damage/losses as well as the highest average value of loss (see Table 10). In contrast, bait and tackle shops (81.8%) and dealer/processors (81.3%) had the highest percentage reporting revenue losses, with dealer/processors reporting the highest average revenue loss overall (see Table 11)

Method for Calculating Total Loss Estimates

In general, total loss estimates by state and zone were calculated by multiplying the total population of each zone/sector by the average loss values derived from the survey samples. However, to avoid overestimations, there were some nuanced differences in the way the total losses were calculated for some sectors.

As previously mentioned, the survey of quantitative hurricane impacts among owners of fishing vessels was conducted using three modes of contact and statistical design: on-location convenience intercept, voluntary online submission, and stratified random sampled telephone survey. For the analysis, the population was stratified into 4 hurricane impact zones and 3 types of vessel operations (commercial fishing, for-hire, or both). Due to their superior statistical properties, the telephone survey responses form the basis of the statistical analysis. In particular,

Table 10: Fishing-Related Business Sector Responses on Average Total Costs for Physical Damages/Losses

Sector	Physical Damages/Losses		Average Value of Damages/Losses[1]
	Yes	No	$
Marina & Related	91 (66.4%)	46 (33.6%)	107,479
Dealer/Processor[2]	64 (51.6%)	60 (48.4%)	41,178
Bait & Tackle	31 (50.0%)	31 (50.0%)	12,710
Seafood Retailer	10 (35.7%)	18 (64.3%)	6,600
Sector not available	2 (13.3%)	13 (86.7%)	5,300
Total[3]	198 (54.1%)	168 (45.9%)	56,975

[1]The average value of losses includes businesses that reported $0 losses.
[2] Does not include vessel owner-dealers that were calculated separately.
[3]Total number of businesses adds to 366 due to 6 missing values in dataset.

Table 11: Responses from Fishing-Related Businesses Interviewed Regarding Estimated Value of Revenue Loss Associated with the Storm

Sector	Revenue Losses		Average Value of Revenue Lost[1]
	Yes	No	$
Bait & Tackle	45 (81.8%)	10 (18.2%)	38,304
Dealer/Processor[2]	87 (81.3%)	20 (18.7%)	80,990
Marinas and Other Related	76 (58.5%)	54 (41.5%)	50,329
Seafood Retailer	20 (76.9%)	6 (23.1%)	56,654
Sector not available	8 (53.3%)	7 (46.7%)	6,667
Total[3]	236 (70.9%)	97 (29.1%)	56,651

[1]The average value includes those businesses that reported $0 in revenue losses.
[2] Does not include vessel owner-dealers that were calculated separately.
[3]Total businesses adds to 333 due to 39 missing values in dataset.

the population totals in each stratum were generated by first extrapolating from the telephone survey responses to the stratum-population less the part of the stratum population that responded in-person or online. In a second step, the in-person and online responses were then added to generate the stratum population totals. In other words, the in-person and online results were included in the final results but not used for extrapolation purposes. This approach is equivalent

to (further) post-stratifying the results by survey mode (telephone or in-person/online); with a census conducted among the in-person/online strata.

Slightly different procedures were used to calculate the fishing-related business sector totals. The data for Zones 1 and 2 were obtained from the field survey and the results were treated as a census of all fishing-related businesses in these zones. Total losses were therefore calculated by simply summing reported losses without applying any extrapolation procedure.

The data for Zones 3 and 4 was obtained from the online and phone surveys and combined into a single dataset. We calculated total population estimates for the "bait and tackle shops" and "marinas and related" categories using state and federal lists and therefore multiplied the sample averages by the total population to obtain total loss estimates. For the "seafood retailers" and "sector unknown" categories, information to estimate total populations was unavailable so only loss values reported by informants in the surveys were included. Similarly, for the "dealer/processor" (non-vessel owner) category, we were also not able to reliably estimate the total population for reasons described above. We therefore only included the sum of losses reported in the surveys without any extrapolation.

However, the "vessel owner-dealer" was treated as a separate sub-sector of the dealer/processor sector for purposes of calculating loss totals. We were able to estimate a total population for this subsector in each zone by matching phone numbers on the vessel permit lists with the dealer lists. To estimate total losses for this subsector by zone, the average losses by zone calculated from the phone survey sample were multiplied by the total estimated zone population.

Total Loss Estimates

Tables 12 – 14 provide estimates of the total value of physical damages/losses and revenue losses for the whole state by sector and by zone. The total estimate of physical damages/losses for all sectors in the State is approximately $95 million. The most significant physical damages/losses were incurred by commercial fishermen, with almost $43 million in physical damages/losses. Although physical damage/losses were included in this estimate for vessel-owner dealers, this still may represent an underestimate of the overall value of physical damages/losses due primarily to the conservative estimate of the total population of seafood dealer/processors in the calculation of the losses.

Similarly, the total estimation of revenue losses incurred as a result of Irma for all fishing dependent sectors was approximately $98 million. Again, commercial fishermen reported the highest revenue losses, estimated at $53 million. Vessel-dealer owners were not included in revenue losses due to the fact that they probably sell their own catch. Therefore, since the vessel-owner dealers were also interviewed as commercial fishermen and asked to report their revenue losses in that survey, we did not calculate their revenue losses as vessel-owner dealers to avoid double counting their losses. Furthermore, this figure probably represents an underestimate of the total value of revenue losses due to the underrepresentation of the total population of the seafood dealer/processor sector in the estimates.

Table 12: Estimation of Total Value of Physical Damages/Losses for All Sectors for the State of Florida

Sector	Average Damage/Loss	Universe	Total Loss Estimate
Commercial Fishermen	$17,066	2501	$42,673,022
For-Hire Fishermen	$9,119	1523	$13,892,172
Dealers/Processors	$41,178	125	$ 5,147,205
Vessel owner-dealers	$25,596	444	$11,364,820
Bait & Tackle Stores	$12,710	220	$ 1,476,624
Marinas & Other Related	$107,479	289	$20,540,600
Seafood Retailers	$6,600	28	$ 184,800
Sector not available	$5,300	15	$ 79,500
Total	--	5144	$95,358,743

Table 13: Estimation of Total Value of Revenue Losses Reported for All Sectors for the State of Florida

Sector	Average Revenue Loss $	Universe	Total Revenue Loss
Commercial Fishermen	$21,235	2501	$53,099,116
For-Hire Fishermen	$11,800	1523	$17,978,110
Bait & Tackle	$38,304	220	$ 5,138,118
Dealer/Processor	$80,990	125	$10,123,798
Marina & Other Related	$50,329	289	$ 9,770,840
Seafood Retailers	$56,654	26	$ 1,473,001
Sector not available	$6,667	15	$ 100,000
Total	---	5142	$97,682,983

Table 14 provides estimates of total losses by zone and for the state. Statewide, total fishing and fishing-related business sectors losses are approximately $193 million. Totals by zone indicate that Zone 1 suffered the most significant losses in value, estimated at approximately $104 million, representing 54% of the total losses for the State. This confirms fieldwork observations that indicated that far and away, the most significant losses from Irma were incurred in the Florida Keys and, especially, in the southern part of Collier County. The second highest losses were incurred in Zone 3, but those represent the cumulative losses of 22 counties covering the majority of the coastal areas of the state of Florida. There were damages reported in all areas, confirming that losses from Irma were distributed unevenly but widely across the whole Florida peninsula.

Table 14: Total Value of Physical Damage/Losses and Revenue Losses by Zone and for the State of Florida

Zone	Total Physical damage/losses	Total Revenue Losses	Total Losses
Zone 1	$9,169,683	$44,747,082	$103,916,765
Zone 2	$13,556,129	$17,942,716	$31,498,845
Zone 3	$16,168,352	$30,032,301	$46,200,652
Zone 4	$6,464,579	$4,960,885	$11,425,463
Totals (State of Florida)	$95,358,743	$97,682,983	$193,041,726

Social Impacts

Job Disruption and Loss

For many throughout the state, shutdowns due to facility damage and the loss of clientele, specifically tourists, meant the loss of jobs either temporarily or permanently. Many of those associated with the tourist industry were negatively impacted by Irma because it took months for people to reopen businesses and encourage tourists back to the area. In the most significantly impacted areas (mainly the Keys), many hotels were closed for repairs or refurbishment, curtailing the availability of accommodations and hampering the flow of tourists. This affected the for-hire industry in the Keys as some charter and party boat businesses were able to restart operations but lacked the clients to make the trips.[12] Sales in bait and tackle shops and local seafood markets and restaurants declined. Commercial fishing activities were also affected as fishermen had to stop fishing to make repairs, search for gear, or repair their homes.

We asked survey respondents how many employees they had pre-storm and post-storm. Using the same extrapolation procedures used for physical damage/losses and revenues, we estimated that 1,677 jobs in the fishing sector were affected by disruptions to fishing operations and fishing-related businesses, resulting in either temporary or permanent job loss. Table 15 provides a breakdown of job loss by fishing sector.

Social Vulnerability

Social vulnerability indices have been developed at the coastal county and community levels for the Southeast region.[13] The three indices reported here are poverty, population composition, and

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[12] For example, some for-hire operations in the Keys reported losing all of their pre-booked charters through the middle of January, 2018.

[13] A suite of Community Social Vulnerability Indices (CSVIs) have been created by NOAA Fisheries to examine the social vulnerability of coastal communities in the U.S. (Colburn and Jepson 2012). Recently, a suite of social vulnerability indices were created using the same methodology for all coastal counties within the Southeast. Using the same variables used at the community level with minor adjustments, a principal component factor analysis was conducted with results meeting the same criteria used previously in creating the CSVIs. The resulting index factor scores for each shoreline county and community are reported here.

Table 15: Immediate Job Losses by Operation/Business Type[1]

Operation/Business Type	Sector	Immediate Job Losses
Commercial & Fishing Businesses	Commercial Fishing Operations	1,169
	Seafood Processors & Dealers	42
	Seafood Retailers	16
For-Hire & Recreational Fishing Businesses	For-hire Businesses	237
	Bait & Tackle Shops	43
	Marinas & Other Related Businesses	170
Total Job Losses		1,677

[1]This table represents jobs affected by disruptions to fishing operations and fishing-related businesses, resulting in either temporary or permanent job loss. Follow-up has not been conducted to determine how many of these jobs have returned.

personal disruptions. The variables included in each of these indices have been identified throughout the literature as being important components that contribute to an individual's or community's vulnerability. Indicators such as increased poverty rates for different groups, more single female-headed households and children under the age of 5, disruptions such as higher separation rates, and unemployment are all signs of vulnerable populations.

Fishing communities are part of the larger county employment and economic sectors that fishermen and their families draw upon in times of need. Understanding the social vulnerability of those places can help determine where the need may be the greatest. Most of Florida's shoreline counties demonstrate low social vulnerability overall with Franklin County scoring medium high for Poverty, Miami-Dade County scoring high for population composition and Taylor and Liberty scoring medium high for personal disruption.
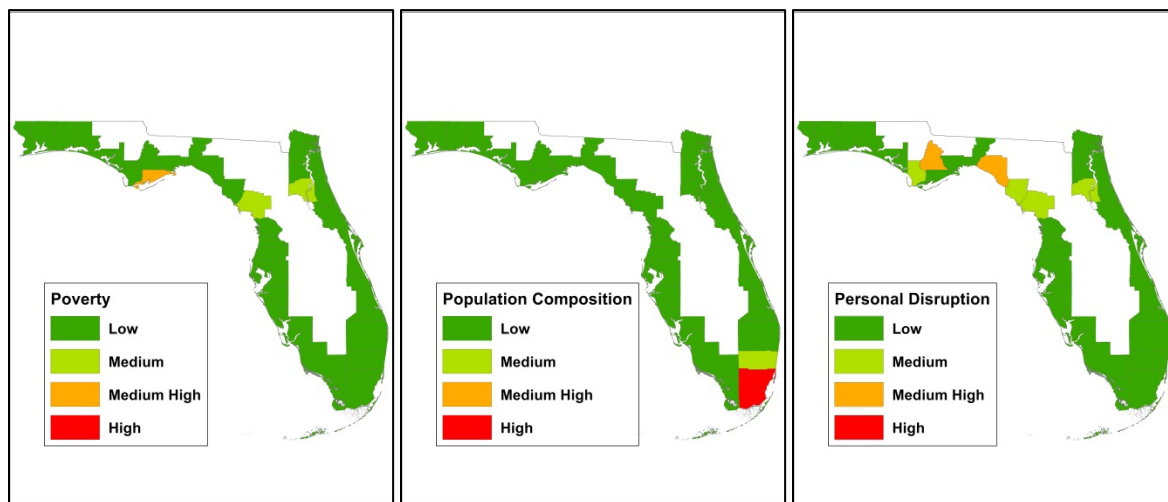
Figure 4 Florida Shoreline County Social Vulnerability Indices
Source: SERO CSVIs 2018 (ACS 2014)

Examining social vulnerabilities at the community level provides a more refined look that presents a different picture in contrast to the county level data. While social vulnerability at the county level does not seem to show many areas of high vulnerability, in Table 16 there are many coastal communities spread throughout the state that score high for poverty, population composition and personal disruption vulnerabilities. These communities seem to be in both rural and urban areas and do not seem to be concentrated in any particular region but are spread throughout the state's coastal counties.

Table 16: Percent of Communities within Impact Zones with High Social Vulnerability by Category (Number of Communities in Zone).

Social vulnerability	Zone 1 (30)	Zone 2 (108)	Zone 3 (493)	Zone 4 (25)
Poverty	23%	22%	18%	4%
Population Composition	13%	64%	9%	0%
Personal Disruption	17%	26%	19%	4%

Source: SERO CSVIs 2018 (ACS 2014)

For that reason, it is important to mention that the impact of Hurricane Irma may not only be unevenly distributed at the state level but also uneven at the county level. Although in this report we were only able to focus on impacts and losses more broadly at the county (zone) level, future data analysis should involve studying losses at the community level and especially examining impacts on vulnerable communities in the areas of high impact.

CONCLUSIONS

This report provides provisional damage estimates for the State of Florida based on a rapid assessment conducted between early October and early December, 2017. Commercial and recreational fishing, and associated businesses, represents a very important economic sector in the state of Florida, providing a significant amount of income and jobs for many communities throughout the state.

In total, we used surveys from 1,181 commercial fishermen and for-hire operators and 372 fishing-dependent businesses in 29 Florida coastal counties. The study showed that significant losses due to Hurricane Irma were incurred across all fishing sectors. The study also found that damages and losses attributed to Irma were widely distributed throughout the Florida peninsula although fishing businesses and operators in the southern part of the state, primarily the Florida Keys and Collier County, suffered much higher levels of damage and loss than other areas. The study estimated that the economic losses amounted to $193 million and that 1,677 jobs were temporarily or permanently lost.

Readers should be cautioned that the estimated economic losses are likely underestimated, primarily because we did not have good estimates of the universe of seafood dealers/processors around the state. Further research will be needed to investigate social impacts of the storm at the

community level, particularly in communities that display high levels of vulnerability, as well as to gauge the resilience of these fishing communities as they work to recover from the storm.

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