

as hurricanes and earthquakes. These disruptions force people to respond and be resilient (Stoffle and Minnis 2008). They cause people to adapt and sometimes change their behavior to persist and rebuild. Social networks are tasked and put to the test. Perturbations can be short-lived or have long-standing impacts on individuals and communities.

The National Oceanic and Atmospheric Administration Headquarters and Southeast Fisheries Science Center (NOAA and SEFSC, respectively) focused on the effects of hurricanes Irma and Maria that passed over the USVI in September of 2017 causing massive destruction of property and disruption of services. Because the people of these islands are heavily dependent on the local fisheries and fishing, it was essential to examine which fishermen were impacted and their subsequent strategies for recovery and rebuilding in the wake of the disasters.

In September of 2017, the USVI were hit first by hurricane Irma on the 6th, and then by Maria on the 20th. Both passed over the USVI as Category 5 storms with sustained winds of 185 miles per hour (mph) and gusts over 220 mph. There were widespread power outages, infrastructure destruction, and a massive disruption of local life patterns on land and sea (USVI Hurricane Taskforce 2018).

After Irma moved across the USVI and on to Cuba and Florida, St. Croix was used as a recovery center for St. Thomas and St. John. Before the recovery process made much headway, however, Maria followed and further damaged St. Croix. The two storms crippled the social, economic, and environmental resources of all three Islands.

This analysis contributes to the growing academic and technical literature on how increasingly violent weather and sea level rise impact coastal communities and small islands in the Caribbean (Leatherman and Beller-Simms 1997; Schleupner 2007). This is especially relevant for fishing dependent communities (Colburn et al. 2016), which are defined by Magnuson Stevens Fishery Conservation and Management Act, 16 US C. ch. 36, 1801, April 13, 1976. The Act's definition of a fishing-dependent community is

a community which is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such a

Figure 2: Category 5 Maria hitting the USVI



community.

St. Croix and St. Thomas fit this definition and are communities based on their contemporary local dependency on and engagement in fishing and harvesting marine resources and a historic cultural connection between the people of the island and fishing (Stoffle et al. 2009; Stoffle et al. 2011). One key component of meeting this definition is that fact that almost 100% of the marine resources harvested are landed, purchased, and consumed in the USVI.

Extreme weather events include stronger hurricanes, frequent tropical downpours and flooding, and extensive drought (Taylor et al. 2012). While drought may seem a minor event in areas of extreme

Figure 3: Damaged Hillside Homes in St. Thomas, USVI. Source NBCnews.com





Figure 4: Post-Hurricane Maria in St. Croix. ABCnews.com



rainfall, it was historically recognized as a significant issue (Mulcahy 2020) and has become a vital concern for the high island small nations of the Lesser Antilles that have bolstered their economies by selling billions of gallons of freshwater to commercial bottling companies (Pickering 2014, 2015). Sea level rise directly impacts near-shore fisheries and coral reefs, causes shore erosion, and multiplies the effects of storm-related surges and king tides (Darsan, Asmath, and Jehu 2013; Durand, Vernette and Augris 1997). It is common for fishing infrastructure to be vulnerable to the impact of hurricanes, whether in the Caribbean or the continental US. In 2017, Hurricanes Irma and Maria severely impacted fishing infrastructure in both the US and throughout the Caribbean with their high winds and extreme storm surge. In Red Hook, St. Thomas and Salt River, St. Croix both places experienced massive damage to their fishing facilities such as docks and storage facility as well as to the boats that were unable to be hauled out and were left tied off to the docks.

Methods: Storm Impact Data Collection

In 2018 a preliminary impact assessment was conducted by the USVI Hurricane Recovery and Resilience Task Force (USVI Task Force 2018). This initial assessment was derived from a Task Force composed of 21 principal partners and 36 additional contributors. Most were local officials and heads of businesses. They conducted an initial on-site assessment of storm impacts from December 2017 until February 2018 (USVI Task Force 2018). Their findings were presented later in August 2018 and these helped form the foundation of the 2019 NOAA study.

Around the same time, in October and November of 2017, NOAA initiated its 60 day impact assessment relying on local DFW employees to partner in the collection and analysis of NOAA's baseline research (NOAA 2018). Two data collection instruments were used. Implementation of the survey was advertised through several different formats: distributed flyers, social media, radio announcements, and government press conferences. Department of Fish and Wildlife (DFW) staff also spread word of the survey via personal contact with fishers and visits to businesses. No phones were utilized in the process, as phone service

had not yet been restored to the Territory. DFW staff surveyed 92 commercial fishers and 18 charter captains. The latter group includes five charter captains who also commercially fish. For this analysis, respondents who categorized themselves as both charter and commercial fishers were placed into the charter category. Total damages were projected to have been \$7,793,555 and 39 jobs were lost in the short term. An additional \$242,392 in damages were reported by the six tackle and marine supply shops interviewed, with another seven jobs lost and over one million dollars in lost business.

In July 2019, the second NOAA sponsored field-based research effort was designed to provide additional descriptions and assessments of fishing and local life. Like the previous assessment, the primary research goal was to describe the impact of the two storms on the fishing industry and where fishermen were in the recovery process. In addition, the research identified ways in which people utilized their own means for recovery as well as familial and other extended networks. One key aspect of the recovery process was the prevalence of Federal assistance programs and the frequency that fishermen used these programs. The research explored the extent that fishermen were able to access certain types of assistance programs or if they had to rely on other means to rebuild and reengage in fishing.

At this time our research team used Rapid Ethnographic Appraisal Procedures (REAP) to assess the state of the fishery and the fishermen in the USVI. REAP involves a mixed methods approach involving a combination of formal surveys, informal interviews, key informant interviews, and group interviews to triangulate findings and increase confidence levels in the data (Beebe 1995, 2001; Tashakkori and Teddlie 1998). The agreement of both quantitative and qualitative data strengthens the confidence in the findings.

More than 165 people were involved in sharing information for the study, including some tiering from the previous 60-day study. There were 113 surveys, 35 informal interviews, 10 people in a group interview, and 7 key informant in-depth interviews. The formal survey was administered utilizing opportunistic and site-intercept sampling strategies. The site sampling was done at the annual commercial fisheries

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registration on both St. Thomas and St. Croix and has proven to be an effective strategy for sampling a large number of fishermen in a limited time frame (Crosson and Hibbert 2017). A total of 113 surveys were administered, with 58 completed in St. Thomas and 55 in St. Croix. A group interview composed of 10 people was conducted with experts from the business and fishing sectors in St. Croix. Informal interviews (35) were conducted on both islands with local business owners and other community members regarding their experiences with the storms and how they recovered and "got back to normal." Seven key informant in-depth interviews were conducted in both islands with people who were identified as having years of knowledge and experience in the local fisheries.

The Fishery Advisory Committee (FAC) held its monthly meeting on July 10, 2019, where NOAA researchers were invited to present some initial findings. The FAC is comprised of fishermen, scientists, Government officials (from the Head of the Department of Planning and Natural Resources to Enforcement officers), and local business owners (with fishery or marine-related businesses). They meet monthly to discuss issues of local and territorial marine policies.

These meetings usually result in a position statement on a timely issue. Afterward they deliver a policy statement to the local government or the Caribbean Fisheries Management Council. The FAC is a representative group selected to express the interests of those like them professionally and ensure that these perspectives are publicly shared. Their understanding and approval of the NOAA study was critical for its success.

A Description of the USVI Fishery

The USVI commercial fishing industry is relatively small and artisanal compared to some of the larger US continental fleets, such as the surf clam and ocean quahog fleet in the Northeast, Gulf of Mexico Shrimpers in the Southeast, and Alaskan Crabbers of the Northwest. What makes the USVI fishery special are its many local community ties due to it being an important source of sustenance, income, and employment. In contrast with much of the US mainland fisheries, there is neither an export market nor a processing sector, meaning that seafood landed is consumed locally, and revenue generated primarily benefits the local community (Stoffle et al. 2009; Stoffle et al. 2011).

There is a limited fish-dealer network, however, most commercial fishermen choose to harvest their catch on a single day trip and sell it by the roadside either that same day or the next (Stoffle et al. 2009; Stoffle et al. 2011). This eliminates the "middle man" (dealer), thus keeping prices low while retaining a viable profit. This pattern of selling fresh fish provides an opportunity for other family members and friends to sell the fish at specific locations where they can make a little bit of money for themselves. There is a smaller number of fishermen who have connections that allow them to sell directly to restaurants and resorts (Fleming, Armentrout, and Crosson 2017). As noted by a Fisheries Advisory Committee member, the notion of sea-to-door distribution is becoming an increasingly attractive strategy for efficiently harvesting and selling catch.

The commercial and recreational fleets (including for-hire) are primarily located in St. Thomas and St. Croix, with a few fishermen still working from the much less populated St. John. The islands of the USVI are small and, in a sense, entirely consist of coastal communities where the ocean is never more than a short drive away. There are concentrations of commercial and charter fishing fleets on St. Thomas in the Frenchtown neighborhood on the south coast, Hull Bay on the north coast, and the Red Hook community on the east end of the island. The fleet is less concentrated on St. Croix, but there are many boats near the towns of Christiansted on the northeast coast (Gallows Bay) and

Frederiksted on the west coast. It is more common for the fishermen of St. Croix to trailer their boats rather than mooring them as they do in St. Thomas. This is in large part due to the topography of the island.

The number of licensed commercial fishermen declined 32.1% in the USVI since the recent census; surveys commenced in 2004, with the largest decline between 2004 and 2011. The decline was more evident on St. Croix (-36.8%) than on St. Thomas (-25.6%). There has been a moratorium on the issuance of new fishing licenses since 2001. Only transfers to family members or helpers are currently officially permitted. Mean ages for fishermen were 56.9 (St. Croix) and 55.0 (St. Thomas) years. The mean number of years they had fished as licensed fishermen and helpers was 26.7 and 30.8 years, respectively (Kojis et al. 2017).

The average size of fishermen's households is 2.7 people for St. Croix and 2.5 people for St. Thomas (Kojis et al. 2017). St. Thomas and St. Croix differ from one another ethnically, as the majority of the St. Thomas population comes from French descent while the majority of the population in St. Croix is of Hispanic descent (mostly people from Puerto Rico and its neighboring islands of Culebra and Vieques). On both islands, there are people of West Indian heritage and a growing population of people from middle eastern countries. On St. Croix, there is also a sizeable portion of people who have illegally come to the island from the Dominican Republic. These people (called Santos) left the Dominican Republic in search of a better life and opportunity.

Since the first census in 2004 the average age and levels of formal education increased. In 2016, younger fishermen have more years of formal education than older ones. The 2004 census also found that fewer fishermen on St. Thomas (27.5%) derived 100% of their income from fishing compared to St. Croix (38.9%). The concept of occupational multiplicity (Comitas 1964) and environmental multiplicity (Stoffle and Minnis 2008) are common patterns of adaptation found throughout Caribbean communities. It is a strategy used by individuals for creating economic security and stability, and a means of offsetting certain known and unknown crises or hardships (Comitas 1964; Stoffle et al. 2020). This idea focuses on the need to engage in multiple methods for earning money, often straddling both formal and informal economies to ensure that if one method is interrupted or disrupted, the others can either makeup or offset the loss.

The boats used in the USVI are much smaller than those typically used in the larger continental US fisheries. The average size is not much more than 21 feet, and the boats are typically made of fiberglass or fiberglass and wood. Most fishermen have one or two motors that range from 90 to 110 hp. While this makes them more likely to be damaged due to high winds and falling debris, it also means that the fishermen's skill in mechanics and fiberglass allows them to do much of the repairs themselves. The 2016 fishermen's census (Kojis et al. 2017) notes that on average, St. Croix fishermen valued their boat in its present condition (including all on-board gear) and fishing equipment at \$39,000, which is about one-third the value provided by St. Thomas fishermen (\$102,000).

The fisheries of St. Thomas and St. Croix are multi-species, multi-gear fisheries with no exported product (Stoffle et al. 2009; Stoffle et al. 2011). The reef fish fishery continues to be the most important fishery in both St. Thomas and St. Croix. This is largely because it straddles both commercial and recreational fisheries, in addition to being popular in both households and restaurants. Coastal pelagic fish are the second (due to their popularity in restaurants and among recreational fishermen) and spiny lobster the third most important for St. Thomas fishermen. On St. Croix, spiny lobster was the second most important fishery targeted and deep-water pelagic fish (dolphinfish, wahoo) the third.

Kojis et al. (2017) notes that fishing with line fishing gear is the most commonly used gear on both islands. Most fishermen (St. Thomas – 84%, St. Croix – 92%) own handline gear ("yo-yo" gear). Rod and reel ownership was more common on St. Thomas (52% of fishers) than St. Croix (36%), reflecting the more frequent targeting of large pelagic fish on St. Thomas (especially among those who are for-hire fishermen with commercial licenses). Trap gear is more commonly owned by St. Thomas fishermen. Fishermen, particularly those on St. Croix, diversified into other gears such as multi-hook vertical set lines, tuna reel buoy fishing, and vertical set line (single hook for pelagic fish). Also, fishermen on St. Croix more commonly owned scuba gear for spearing fish, hand gathering queen conch, and snaring lobster. Scuba gear was owned by 54% of St. Croix fishermen, but only 14% of St. Thomas fishermen, who primarily used scuba to fish for personal consumption (Kojis et al. 2017).

The USVI fishermen are vulnerable to the loss of both vessel and gear during hurricanes. However, due to their ability to target multiple species utilizing multiple fishing strategies, they can offset the damage and recovery costs. This means they can "get back in the game" more quickly than most because they are not tied to one species or gear type. It provides them with greater flexibility and opportunity to offset various kinds of disruptions in their normal annual round.

Economic data on the USVI is less extensive compared to the economic data available for the mainland United States. As estimated by the Bureau of Economic Analysis (2014), the islands' non-farm employment is approximately 39,000, with the domestic product estimated to be \$3.8 billion in 2013. Commercial fishing is a relatively small contribution, employing a few hundred fishermen and crew between the islands and producing \$5 million worth of landings in the same year. These landings are likely to be low estimates as there has historically been difficulty assessing the total value and size of the annual catch. In addition to the amount landed, sold, and recorded, a significant portion of the catch is given away, shared, and consumed within the fisherman's social networks. The landings generate revenue that stays on the island (Stoffle et al. 2009; Stoffle et al. 2011). Fish

landed is consumed by locals or tourists, and money made tends to be spent locally.

The DFW records listed 104 licensed and currently registered commercial fishermen on St. Thomas and 112 on St. Croix when the hurricanes hit. However, not all of these licensed fishermen were regularly active in commercial fishing. The number of active commercial fishermen was considerably smaller—DFW records indicate that there were 64 active fishers on St. Thomas/St. John and 88 on St. Croix in 2016. We defined "active" as licensed and registered fishers who fished for at least three months out of the year.

The Two-Storms Case Study

The first survey conducted was a 60-day NOAA hurricane impact assessment (2017). This assessment estimated total capital losses of \$3,147,164 and lost revenue of \$485,641, which produces total losses of \$3,632,806 at the time of surveying, for St. Thomas and St. John. An estimated total capital loss of \$1,473,815 combined with an estimate of lost revenue of \$674,850 or total losses of \$2,148,665 by the end of November 2017 was calculated for St. Croix. As the survey indicated in spite of all of the loss insurance (related to fishing) was nearly non-existent and the initial recovery efforts were primarily handled through the fishermen's own ways and means.

Total unemployment in the USVI rose by an estimated 12 percent (4,500 jobs) by November 2017. As of May 2018, only a small portion of those jobs (600) had been recovered (www.libertystreeteconomics.newyorkfed.org 2018). It took months before power was fully restored and transportation could access land and sea destinations. In other economic/industrial sectors, the recovery process was even slower. This was especially evident in the tourism industry, the local commercial businesses and the for-hire fisheries. Employment in the broader leisure and hospitality sector, which includes restaurants and bars that mainly cater to visitors, fell by 2,200 jobs, or 29 percent; in the USVI this represents nearly half of the total job loss experienced across all sectors (www.libertystreeteconomics.newyorkfed.org 2018). The commercial and for-hire fisheries still had not yet fully recovered at the time of this study (2019), al-

Figure 5 : Business Impacts

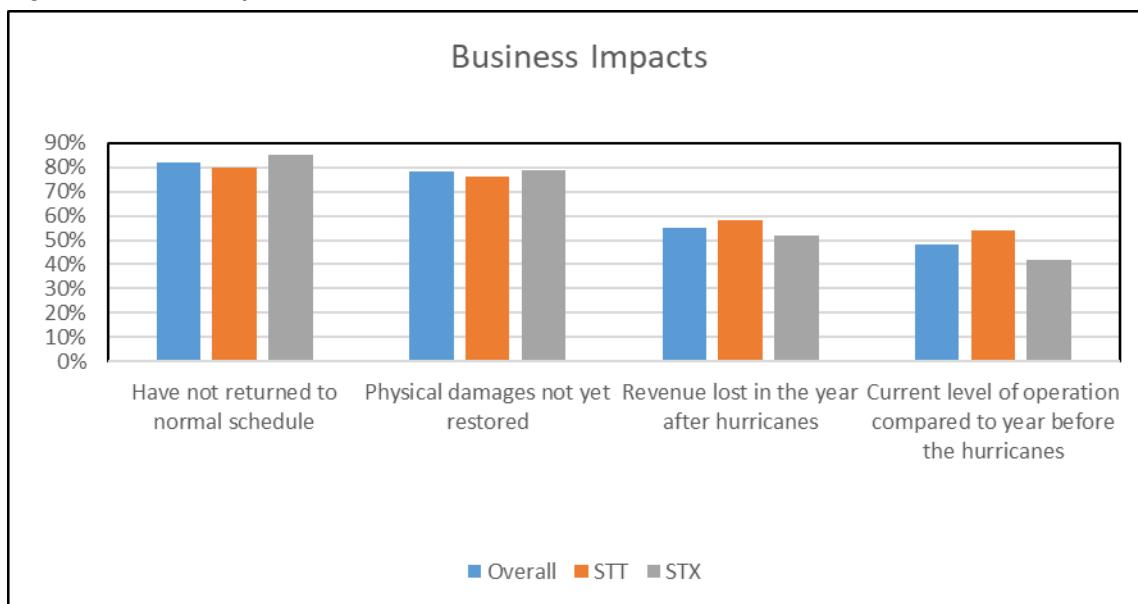
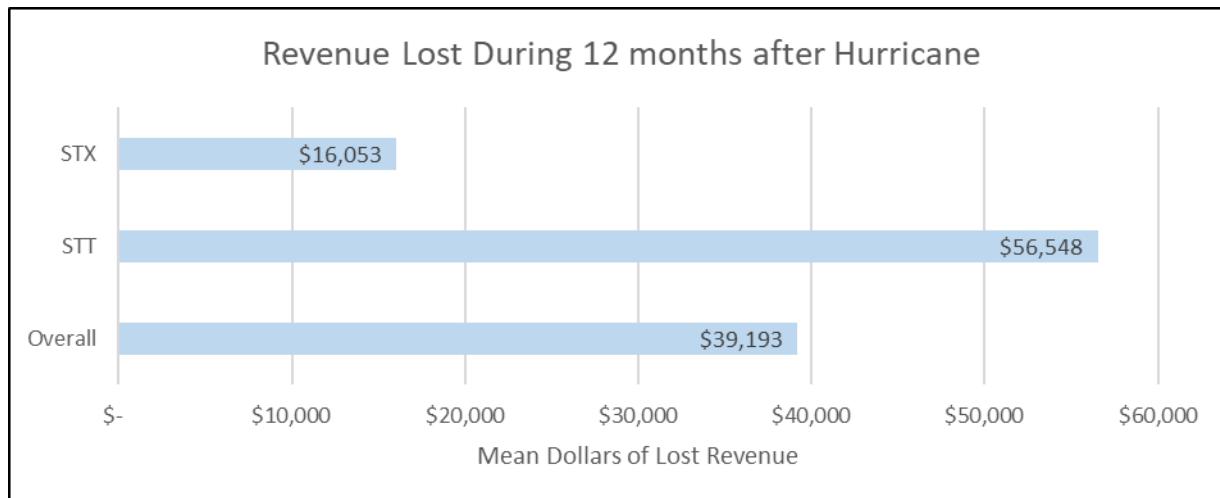


Figure 6: Fishermen's Revenue Loss by Island



most twenty-two months after the impact of the two hurricanes, with some fishermen unable to either rebuild or recover at all.

2019 Research Findings

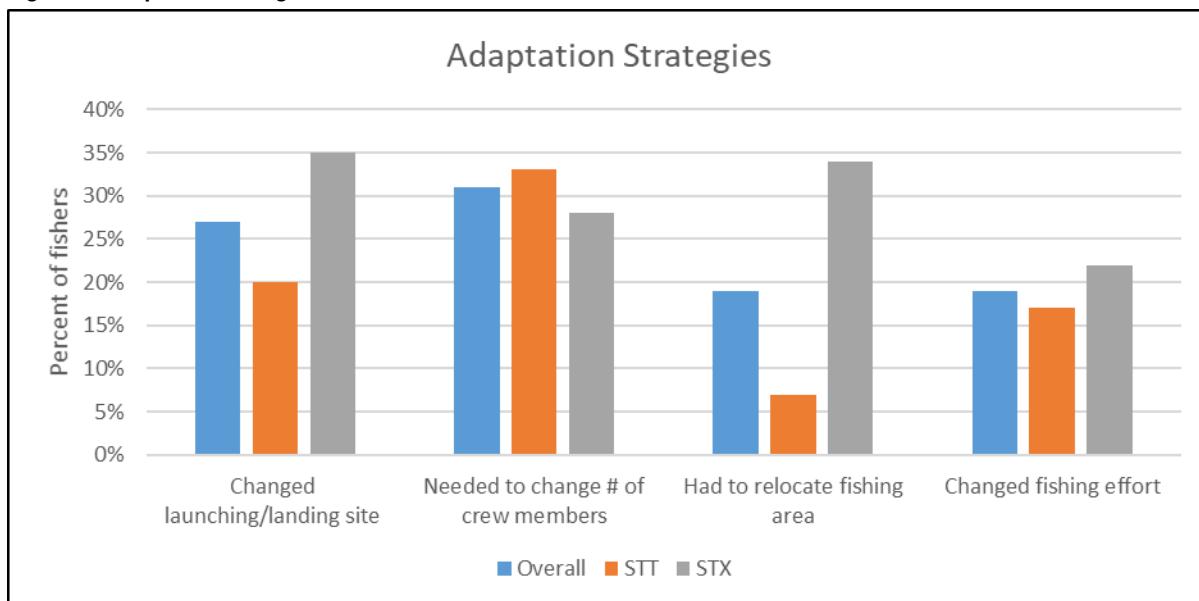
Due to the fact that the 60 day assessments take place in the recent wake of a storm, NOAA typically engages in a second more detailed assessment a year or more after the event when the full extent to the damages can be better understood. For this reason, the July 2019 research developed a more complete assessment of impacts to fishermen 22 months after the storms' passing and how these impacts were manifested in the fishery and the larger community. It was recognized that the initial impact 60 day analysis and the report from the USVI Task Force (2018) were useful for providing a quick assessment of the losses experienced in the fishery and community, this research ad-

dressed the need to more fully document the magnitude of the impacts and the progress and process of recovery over time.

Impacts on Commercial Fishery Permit Holders

Even though there are three culturally distinct islands with distinct fisheries, the fishermen's fishing enterprises were similarly impacted (Figure 5). It should be noted that it is common for members of the for-hire industry to purchase commercial licenses in order to sell their catch and on days when they have no booking are able to commercially fish. By 2019, 80% of the fishermen still had not returned to their normal schedule since before the storms and almost 80% had not yet recovered from the physical damages to their fishing businesses. Because of this, fishermen experienced more than a 50% decrease in revenue from the year before the hurricanes and operated at about 50% of capaci-

Figure 7: Adaptation Strategies





ty compared to the previous year. St. John has a small fishing community and is not directly included in analysis but as a sister island, informal reports indicate that the impacts were generally similar.

For many fishermen what happened on land was what prevented them from getting back to the water. In St. Croix there was so much damage to roadways and homes that people spent months fixing their houses and cleaning their yards and neighborhoods. Massive trees were knocked down all over the island, preventing travel along some of the most commonly used thoroughfares. For the first three months, there was very little fishing on St. Croix and St. Thomas due to the fact that fishermen could not trailer their boats to launching sites and for many even if they could have their boats were in no condition to be fishing. Fishermen experienced terrible damage to their boats even though for many they had taken measures to secure them, some even filling them with water to combat the winds blowing them over. Even in these instances the amount of debris and the strength of the winds caused many boats to be unseaworthy after the two storms passing.

Revenue Loss by Island: For Commercial Licensed Fishermen

The average revenue lost by fishermen in the first year after the two hurricanes highlights a little bit about the differences in the two island fisheries and between the fishing sectors (Figure 6). There are more for-hire fishermen in St. Thomas than St. Croix, which means a higher percentage of larger vessels are directly reliant on the fishery tourism industry. Tourism was shut down for months and then slow to recover. In St. Croix, the fishing boats and amount of fishing are smaller and, thus, better represent the impact on the small-scale commercial fishery.

Anecdotal information from fishermen regarding impacts associated with the loss of tourism industry suggests that the slow recovery of tourism had a tremendous economic impact on each island and fishery. Each island is different in its level of dependence and engagement in tourism. For example, St. Thomas is more dependent on the cruise ship industry than St. Croix. In a "normal" year, the total number of visitors that come by cruise ships to St. Thomas can be over 1,750,000; this in comparison to a total of 2.5 million visitors from all types of travel in total to all of USVI (www.usviber.org/wp-content/uploads/2016/11/Tourism-Indicator-Annual-2016-December-9-6-17.pdf). Cruise ship tourists are likely to frequent high-end restaurants during their day-long stay on the island and increase demand for fresh high-end pelagic species, lobsters and conch. The cruise ship tourists are also commonly engaging in half and full-day charter trips as a part of their vacation experience.

The east coast businesses of St. Thomas (especially Red Hook) tend to cater to weekly and longer-term condo rentals with individuals and families who tend to purchase higher valued fish species, including snappers and pelagic species, along with lobsters. There are also high-end hotels and resorts on the island that purchase large amounts of high-end species for their fresh catch menu items for their clientele. Specific fishermen cater to these markets, and because of damage to boats and equipment in conjunction with the loss of the tourism-related markets, these fishermen experienced a most significant reduction in revenue from the two-storms.

An example of the relationship between tourism and fishing industries is highlighted in the story of a St. Thomas fisherman. This fisherman has one of the larger lobster enterprises in St. Thomas, which has a special relationship with some of the larger hotels and resorts on the island. The hurricanes had a tremendous impact on his fishing business, initially with the loss of one of his two main lobster boats, and then in effect a closure of the tourism industry because of the time needed to rebuild and recover. For this fisherman, not only was the loss of the

boat a tremendous impact that changed his fishing business but so too was the loss of the high-end tourism industry where he specifically marketed his catch. This is a clear example of how these types of natural perturbations cause negative impacts throughout the fishing industry. People at the economic top end of the commercial fishery were as impacted as those on the industry's lower economic level.

Adaptation Strategies

Many fishermen have a social responsibility that is as important as the economic opportunity to fish in the aftermath of hurricanes (Figure 7). These fishermen often changed where they fish, the method that they use, and the fish they target in order to get back out on the water as soon as they are able to provide for families in their social networks.

A Cruzan fisherman said,

Gas was available, my trailer and truck were OK and the boat and motor could run. It seemed to me that I could do the things I need to do on shore in the afternoons and after curfew. During the early morning I could go out and try and catch some fish to eat. It is so much better than the other options. Fresh fish is always better.

It makes sense that more than a third of the St. Croix fishermen changed their launching and landing sites. This was both to offset the loss of fishing infrastructure and the damage to essential fish habitat preferred by local fishermen. On land, certain areas were severely impacted by the storms forcing some to alter where they launched, landed, and marketed their catch. In many cases, this was temporary but for some it became a permanent change. In the ocean there were fishing areas said to be impacted by the storms due to run-off and destruction to the inshore reefs. Wind, rain, and wave activity during these massive storms was said to have caused a great deal of pollution with various types of land-based materials carried out to sea and deposited on fishing grounds. For St. Croix, this caused over 30% of the fishermen to relocate where they fish. And this may also be a factor as to why over 20% of the St. Croix fishermen changed their fishing effort, either based on new locations, targeting different species, or utilizing different gear strategies. For trap fishermen, whether on land or at sea, they experienced trap loss and destruction, equating to a time and labor cost to rebuild.

For St. Thomas, one of the hardest-hit areas was Red Hook and its marina. Many of the docks where commercial fishermen stayed were completely destroyed, forcing them to relocate if possible. In that area, there are many commercial, for hire and recreational boats. These tend to be on the higher end of the fisheries, ones that target pelagic species and big game fish.

There was little change in terms of boat crew. Overall, fishermen kept the same crew they had prior to the storms. In other cases, fishermen had not returned to fishing activities and thus had not rehired crew. This explains why over 25% responded that there was a change in crew. There were a number of reasons, both positive and negative, that explain the loss of crew. One positive example is that the captain or owner also engaged in shore-based employment or labor. Certain types of jobs such as mechanic, landscaper, and construction worker led to enough land-based opportunities to create a situation where there was no immediate need or even perhaps time to return to fishing. This meant that they either did not fix up their broken gear and vessel or the gear and vessel were operational but the fishermen did not have time to reengage in fishing. This means employment opportunities for crew as well, where they may engage in a variety of other land-based employment opportunities, potentially even more lucrative than fishing.

In other cases, some fishing crews have been temporarily or permanently eliminated from the fishery due to a lack of resources to re-

Table 1: Identified Resources Used for Rebuilding After Storms by Island

Resources	St. Thomas	St. Croix	Totals
Personal Savings	36	75%	26
Personal Savings and Loans from Family/Friends	8	16%	7
Personal Savings and SBA/FEMA	4	9%	1
Totals	48	100%	34
			100%

build and restart. Usually, these are the small-scale fishers who operated with one or no crew members. Because there is a moratorium on new licenses, there is the hope that one day these commercial licenses will equate to currency in that they can be sold to another individual who wishes to enter the fishery. For that reason people will continue to sign up for their commercial license even if there is no desire or opportunity to fish. There are examples of individuals who desire to engage in fishing but are waiting until they retire from their land-based employment to transition to fishing. Their perspective is that they will keep the license up until that time and utilize it in retirement to provide additional money to the household through fishing.

Adaptations to Rebuild

There are similarities between the rebuilding patterns of the fishermen of St. Croix and St. Thomas (Table 1). Most of them relied on their savings as the primary means of recovery (St. Thomas 75% and St. Croix 76%). The second most common adaptation was to use their own savings and borrow from friends and family (St. Thomas 16% and St. Croix 21%). A small number of fishermen used local bank loans and unemployment benefits. Many people did not respond to the question (St. Thomas 14% and St. Croix 35%). When these non-responding fishermen were asked, most replied that (1) they were not actively fishing before the hurricanes, (2) they may have stopped fishing in the interim, and (3) they may have been in the midst of rebuilding process at the time of the survey.

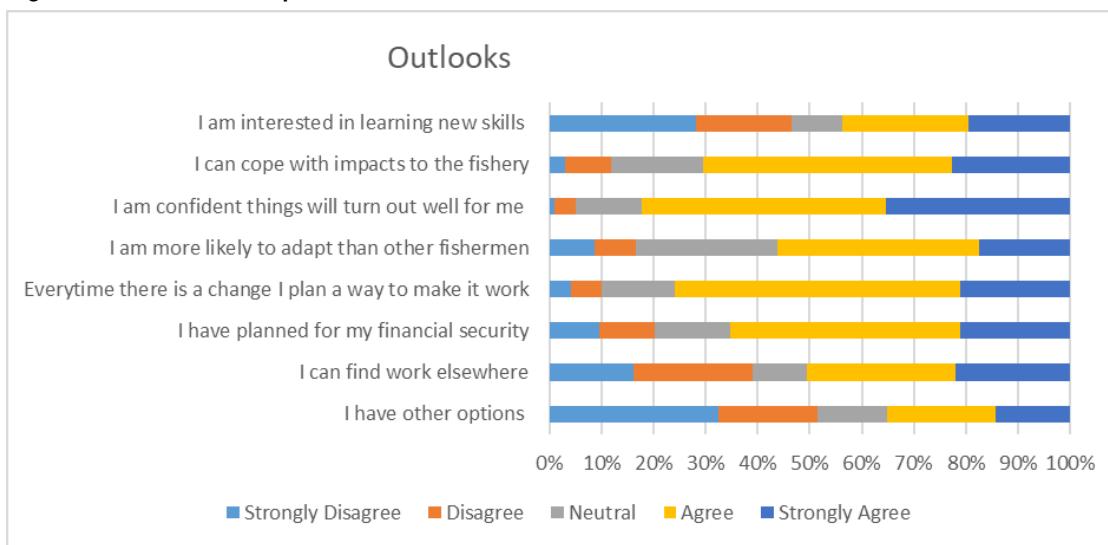
The majority of fishermen chose not to use the FEMA or Small Business Loans made available to them. The few that did tended to be larger enterprises that experienced greater financial loss.

When one St. Croix commercial fisherman was asked why he did not take advantage of these loans, his response was:

The problem with using loans and borrowing money from banks is that you have to have collateral and go through a lot of time and search into your life; showing you have collateral and that you will be able to pay it back. We can't predict the future. We have just suffered massive losses and borrowing money to fix things only puts me in a bad spot. You see if we put up our trucks and our house as collateral what happens if we can't pay the loan back. It is better to just do it on our own. So you make sure you have some money put away for the boat. Then do your own repairs or have someone you know help you. If you have to borrow money do it from someone close who knows that you can pay them back but may need a little more time. Sometimes you can also do something for them to pay them back like help them fix something or go fishing and make sure that they have fish for their family.

In 2018, the USVI government requested that a fisheries disaster be declared, resulting in the declaration of a catastrophic regional fishery disaster by the Secretary of Congress, ultimately resulting in approximately 10 million dollars for disaster relief. By the time this study was conducted in July 2019, the disaster relief money for the USVI fisheries had been approved but had not been distributed to USVI fishermen. As of July 2020, the distribution of relief money was still in process with fishermen having to come into the government office to apply for funds (2020 Personal Communications with local fishermen and Government officials).

It is important to note that Federal Fishery Disaster Relief money is tied to a specific natural disaster. Still, the process of getting "relief" is difficult to understand because the process from (1) disaster, to (2) declaration, to (3) determining funding level, and eventually to (4) disbursement can be long and arduous. These relief steps involve multiple levels of assessment by multiple government actors including the US Federal and Territorial Governments, the US Congress, the USVI Department of Planning and Natural Resource, and the USVI Division of Fish and Wildlife. Therefore, almost three years elapsed from when the two storms occurred in September 2017, money has not been distributed to local fishermen.

Figure 8: Fishermen's Perception of Future Outlook




Future Outlook

Fishermen were asked a series of questions to determine their vision for the future and their ability to cope with current and future impacts of hurricanes. Their answers were coded using the Likert scale method for analysis (Figure 8). These questions were adapted from Marshall & Marshall 2007 and they were first used as adapted in Seara et al. 2016 (see <https://www.ecologyandsociety.org/vol12/iss1/art1/> and <https://www.sciencedirect.com/science/article/abs/pii/S0959378016300085?via%3Dhub> for more on this).

When fishermen were asked if they were willing to learn new skills, there was an almost even split between those that would and would not. A reason for this is the fact that for many of the fishermen that would not be willing to learn a new skill relates to their perception that their life is in fishing and that there is no need to learn a new skill. When asked about their ability to cope with impacts on the fishery and their confidence that all will be well, fishermen's responses indicate that they are secure regarding their future in fishing. For many the idea is to rebuild and start anew. Fishing as an occupation or as a source of retirement is seen as a viable economic option, even in the face of having to deal with disruptions from hurricanes.

Fishermen's responses suggest they are confident in their ability to adapt that they can find a way to cope with changes. This may be based on their belief in their work ethic and their ability to overcome problems. It also may relate to the fact that more than 60% of the fishermen perceive that they have planned for their financial security. They have their own measures for recovery and responding to impacts that may allow them even on the face of a major crisis the ability to overcome.

As a local Cruzan fisherman stated,

I don't need to learn new skills like car mechanic or something. I already know the things I need to run and fix my boat and motor when things break. So when the Hurricanes hit us, and they hit us hard, I knew that I would soon be back up fishing and going because the things that needed to be fixed were things that I could handle.

The previous questions focused on perceptions of what would happen to fishermen in the future. Even though some of their responses express concern about remaining in the fishery and their ability to cope with another crisis such as this, overall fishermen are positive about recovery from the two storms and their future in fishing. However, it should not be overlooked that there are those that will not be able to return to fishing be it an issue of age, ability or desire. For some the idea of fishing any longer may be too much for them to conceive. And, this is easily understood for not everyone is at the same station in life as the fleet seems to be on average getting older.

Discussion

There are five Key Findings from the NOAA 2019 research. Some may have policy implications and others highlight how USVI fishermen respond to natural disasters.

Reduction in Effort: Some fishermen are not able or willing to remain fishermen in either the short term or at all. Thus fishing effort may decline in the wake of the storms. This can be related to a lack of financial resources or the fact that for some they are reaching a point that it is not a viable activity. This does not take away from the notion that fishermen are resilient but it address a smaller portion of the fishing population that aged out or in the interim went to other activities to rebuild and reengage at a later date.

Fishery Impacts: Fishermen reported significant losses in revenue and damage to boats and equipment. Coupled with the loss

of tourism and infrastructure, USVI fishermen on average reported a 55% loss with 17 individual USVI fishermen experiencing a 100% loss in revenue. This was especially apparent in the for hire/charter fisheries who carry commercial licenses with numbers potentially being even higher if the non-licensed for-hire fishermen were included.

Aid and Assistance: Fishermen chose to rely on their savings and social networks for immediate recovery rather than Federal Assistance Programs, such as Small Business Loans and FEMA loans. In addition, it is clear that Disaster Relief funding is not intended to be used in the immediate aftermath of storms. This money is to offset costs incurred in the rebuilding process. Because of this fishermen strategically rebuild and reengage in fishing, sometimes sharing vessels, gear and labor until the time comes that they can return to a fully operational status. This may take some time but by working together they assist one another in the recovery process.

Network Food Security: Fishermen take responsibility to provide food for their own families, friends, and neighbors. Fishermen are among the most important individuals at a local level for providing food within their social networks. By providing support it strengthens bonds between individuals and assists in the process of immediate recovery. Their ability to provide food for island residents is a primary reason for the Governor to call the essential workers when the majority of the island was closed. There is the continued perception that fishing and being a fisherman is an integral part of their identity.

Future Projection: Most fishermen maintain a positive outlook for their future in fishing. The for-hire sector experienced major impacts due to the loss of tourism as did those commercial fishermen providing high-end species to hotels and restaurants. Many found ways to offset losses by switching to selling to local residents and changing the species they normally targeted. Even so the revenue they generated was a small percentage of their normal yearly income. They did this in order to continue to operate until the time they could return to their style of fishing and market to a certain population that called for specific high end species.

The USVI fisheries are not yet back to where they were before the 2017 hurricanes Irma and Maria. Most are still in some part of the recovery process. There is little doubt that recovery is tied to the tourism industry, especially in the for-hire sector. Other fishermen are doing well because there was less fishing effort after the two storms. Fish stocks are perceived as more plentiful because of fewer active fishermen. Recovery is still in process and essentially is a function of the fisherman's personal savings and ability to fix the damage incurred to key parts of their fishing enterprise. While the future is uncertain, fishermen feel their place is a certainty.

Conclusion

The NOAA 2019 study documented the pattern of mutual self-help, as illustrated by fishermen's post storm behavior. While the data suggests that some fishermen have left fishing as an occupation, future studies are likely to show many of them getting back into fishing, which is both a component of their Occupational Multiplicity and their commitment to preparing for the next crisis event. One St Croix fisherman expressed his commitment to providing fish in a crisis:

Listen, all the stores were closed and people were living on canned food and hurricane food brought on island. This is not the way to live. Lucky we could get

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gas and we didn't have too much damage to one of the boats. We were able to find a spot to put in and went out to dive and handle a bit. The traps were all over the water so we tried to mark those for people to come get later. We had to go all over the place to find good fishing. There was trash everywhere and the reefs were mashed up. We could fish a bit, but it was dangerous. Each day got a little better and we were able to bring fish home for our family and friends. It was a total effort. We got fish and people who stayed on land helped do what they could. It was bad but we have been through this before.

Clearly, the two storms damaged the people and infrastructure of three islands in the USVI, but the storms and the reconstruction aftermath reaffirm an adaptive pattern that has served these and many other peoples of the Caribbean and West Indies for hundreds of years.

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