THE ECONOMIC CONTRIBUTION OF SPENDING IN THE FLORIDA KEYS NATIONAL MARINE SANCTUARY TO THE FLORIDA ECONOMY

Prepared for the National Marine Sanctuary Foundation

Prepared by:

TBD Economics, LLC
Gaithersburg, MD
July 2019

This page intentionally left blank

I. Table of Contents

II. Executive Summary

The Florida Keys National Marine Sanctuary (NMS) is one of only thirteen nationally-designated marine sanctuaries in the United States. National marine sanctuaries protect unique habitat, conserve rare, threatened, and endangered species, and preserve the Nation's maritime heritage. Florida Keys NMS includes state and federal waters surrounding the Florida Keys, in Monroe County, Florida. It encompasses approximately 2,900 square nautical miles, from Miami to the Tortugas, including around 1,700 islands. The Sanctuary includes North America's only coral barrier reef, 1.4 million acres of seagrass beds, 1,800 miles of mangrove shoreline, and more than 6,000 species of marine life.

Tourists from around the state, the nation, and the world choose the Florida Keys over other locations for the unique experiences it offers. The Florida Keys National Marine Sanctuary is a world-class treasure that invites active participation, evokes awe, possesses a deep cultural identity, creates revenue, and demands careful management and caretaking if it is to be healthy and resilient.

The unmatched ecology of the Florida Keys provides opportunities for many Floridians – for those who work in the recreation economy, but also for those recreating, as about one-third of Keys tourists tend to be from Florida. With a population of just under 75,000 year-round residents, the Florida Keys receive about 3 million overnight tourist visits per year and more than 400,000 day visitors annually. Key West hosts about 750,000 cruise ship visitors each year.

Private-sector wages average more than 10% less in Florida than the U.S. average, but for the Accommodation and Food Services sector, Florida averaged more than 5% over the U.S. average in 2017. That wage income multiplies through the economy. Ocean-dependent economies are generally resilient to economic downturns, with tourism dollars especially important to the Florida Keys, where 54% of jobs and 60% of all spending are associated with tourism. Monroe County was among the top 9 counties in Florida with an increase in employment, through the economic recovery from 2007-2017. Florida tourism relies heavily on healthy subtropical and marine ecosystems, and demand for tourism is sensitive to events that impact the health of the environment, such as disease outbreaks and natural or manmade disasters.

This study describes how spending on tourism and recreation driven by resources within and around Florida Keys NMS provides jobs, wages, and contributions to gross domestic product (GDP) across the state of Florida. The study also presents analysis of a set of alternative scenarios based on the premise that a robust economy relies on the health of the sanctuary. The scenarios estimate the potential economic impacts from intermittent and long-term harmful algal bloom (HAB) events such as the one endured by the West Coast of Florida from October 2017-February 2019.

Contributions to the Florida economy from recreational and tourism spending in Florida Keys NMS, increased each year, from $4.2 billion in 2015 to $4.4 billion in 2017 (these and following

dollar values in this section are in $2015). Expenditures on tourism and recreation in Florida Keys NMS also led to $1.46 billion in labor income across Florida in 2015, and $2.57 billion in value added to the state economy over the cost of business inputs. Employment supported by Florida Keys NMS spending rises for every region, and for the state of Florida from 38,000 jobs in 2015, to 41,000 in 2016, to 42,900 jobs in 2017.

The analysis focuses on 2015 data and impacts. Hurricane Irma significantly affected the Keys economy in 2017, making the most recent year with available data a poor representative year. As a result, 2015 serves as the best and most recent year on which to focus the economic contribution analysis. In 2015, as seen in the table below, Monroe County benefitted with more than 34,500 jobs, over $1.3 billion in employment income, and over $3.8 billion in economic output supported by Florida Keys NMS-related spending.

Florida Keys NMS Contributions to Jobs and GDP ($2015)

	Employment	Labor Income $(000)	Value Added $(000)	Economic Output $(000)
Monroe County	34,583	1,363,502	2,402,471	3,879,632
Southern Urban Adjacent	1,353	74,723	122,649	214,011
Southern West Coast	161	9,912	20,249	41,885
Other Regions Together	249	12,615	24,956	53,928
Total Effect – FLORIDA	**38,111**	**1,460,753**	**2,570,325**	**4,189,456**

Monroe County requires many different goods and services from other regions to support its Florida Keys NMS tourism. These economic links help drive benefits in regions beyond Monroe County. Of the $4.2 billion in statewide economic output in 2015 from Florida Keys NMS spending, $309.8 million accrued outside of Monroe County.

The regions nearer to Monroe County, with high-population urban areas, show high contributions over less urban and farther regions. Miami-Dade, Broward, and Palm Beach Counties comprise the Southern Urban Adjacent region, benefitting from more than 1,300 full-time jobs supported from Florida Keys NMS spending, and $214 million in economic output. Florida Keys NMS spending supported 161 jobs and $42 million in economic output in the Southern West Coast region, from Charlotte County up to Pasco County above Tampa Bay. Among the other six regions analyzed in Florida, no region had fewer than $5.75 million or a total of 28 full-time jobs supported by from Florida Keys NMS recreational spending. Together these six regions could trace just under 250 jobs and $54 million to Florida Keys NMS recreational expenditures in 2015.

The health of Florida Keys NMS is at risk, with the loss of coral, seagrass, and mangrove ecosystems, threats of nutrient pollution and harmful algal blooms, marine debris including lost fishing traps, vessel groundings and anchor injuries to seagrasses and corals, and intense storms and increasing ocean acidification all threatening the environment and the economy that the sanctuary supports. Habitat restoration can reduce these risks. Restoring critical coral, seagrass and mangrove habitats can increase fish populations, recover endangered and threatened

sanctuary resources, and support the local economy. In the U.S. the "restoration economy" contributes approximately $25 billion in direct and indirect economic output and supports about 220,000 jobs annually. In response to requests by the public, shifting environmental conditions and threats in the Florida Keys, better scientific information, and legal requirements, NOAA is proposing changes to the sanctuary's management plan, boundary, marine zoning, and regulations. This Restoration Blueprint, due to be released in August, represents nearly 30 years of science, management experience, and community involvement.

This report demonstrates the need to protect and restore the fragile habitats of the Florida Keys for a healthy economy and to achieve a balance between the popularity of visiting and living in Southern Florida and the Keys with the demands placed on the natural resources that sustain the lives and livelihoods of many Floridians. Protected areas, such as Florida Keys NMS provide much more than just a place to vacation, they provide a source of consistent and extensive economic output, jobs, and wages to a vast array of industries, and the people who depend on them. Understanding their value, and how the resources of Florida Keys NMS supports a strong economy in Florida will help inform management of the sanctuary, and can also inform broader investment and budget decisions that can further impact the health of the environment and the health of the economy.

III. Background

The National Marine Sanctuary System, a network of underwater parks encompassing more than 600,000 square miles of marine and Great Lakes waters. The National Oceanic and Atmospheric Administration's (NOAA) Office of National Marine Sanctuaries and the National Marine Sanctuary Foundation ("Foundation") work with local industries, government, and communities to sustain healthy ecosystems, habitats, and aquatic nurseries in the 13 sanctuaries and two National Marine Monuments that make up the system. Sanctuaries support an environment, rich in biodiversity, that, in turn, supports local coastal and ocean economies. Visitors spend money on sanctuary-supported activities such as fishing, beach visits, boating, snorkeling, diving, research, and education activities,[1] and other tourism-related expenditures such as travel, food, and lodging.

Florida Keys National Marine Sanctuary (Florida Keys NMS) includes state and federal waters surrounding the Florida Keys, in Monroe County, FL. It encompasses 2,900 square nautical miles, from Miami to the Tortugas, including around 1,700 islands and over 1,800 miles of coastline (See Figure 1).

Figure 1. Extent of Florida Keys National Marine Sanctuary

[1] NOAA, Office of National Marine Sanctuaries, 2011. Florida Keys National Marine Sanctuary Condition Report 2011. (Florida Keys NMS Condition Report 2011)

Within the boundaries of the sanctuary lie spectacular, unique, and nationally significant marine resources. It includes North America's only coral barrier reef, 1.4 million acres of seagrass beds, 1,800 miles of mangrove shoreline, and more than 6,000 species of marine life.2 The sanctuary also protects pieces of our nation's history such as shipwrecks and other archeological treasures. Seagrass beds carpet 80% of the sanctuary seafloor and make up part of one of the largest contiguous seagrass beds on earth.

Tourism as a Driver in the Florida Economy

Florida's economy, the fourth largest in the U.S., is largely driven by a handful of industries. Real estate, health care and the life sciences, agriculture, international trade, and financial services all make strong contributions to the Florida economy.[3] However, the industry that most people think of, when they think of Florida, is tourism. Recreation and tourism brought more than $116 million to the state in 2017, providing 1.1 million jobs (of 9.1 million total jobs in Florida), and contributing about $50 billion annually to Florida Gross Domestic Product (GDP).[4]

The central role of the Tourism sector as an economic driver runs deeper than percent of GDP and number of jobs, however. The strength of the Tourism sector helped Florida recover from the Great Recession and still drives growth. From 2010 through 2018, Florida welcomed record numbers of visitors, with "seven consecutive years of record visitation and record spending."[5] From a December 2018 presentation by the Florida Office of Economic and Demographic Research:

- "The drags [on the economy from the Great Recession]—particularly construction—are more persistent than past events, but the strength in tourism is compensating for this."
- "The most recent sales tax forecast relies heavily on strong tourism growth. It assumes no events that have significant repercussions affecting tourism occur during the forecast window."
- "Currently, tourism-related revenue losses pose the greatest potential risk to the economic outlook."[6]

---

[2] NOAA. Restoring for the Future: Florida Keys National Marine Sanctuary. https://nmsfloridakeys.blob.core.windows.net/floridakeys-prod/media/blueprint/florida-keys-national-marine-sanctuary-restoration-blueprint-infographic.pdf. Seagrass bed information from NOAA National Marine Sanctuary 2011 Annual Report – Florida Keys. https://nmsfloridakeys.blob.core.windows.net/floridakeys-prod/media/archive/about/111202Florida Keys NMS-ar.pdf.

[3] Investopedia. Florida's Economy: The 6 Industries Driving GDP Growth, https://www.investopedia.com/articles/investing/011316/floridas-economy-6-industries-driving-gdp-growth.asp; and Office of Economic and Demographic Research (Florida Legislature), "2017 FL state GDP," http://edr.state.fl.us/Content/economy/2017_FL_state_GDP.pdf, (April 11, 2019).

[4] Ibid., Investopedia.

[5] Orlando Weekly, "Florida Breaks Tourism Record with 958 Million Visitors So Far," https://www.orlandoweekly.com/Blogs/archives/2018/11/26/florida-breaks-tourism-record-with-958-million-visitors-so-far-in-2018, (April 10, 2019).

[6] Office of Economic and Demographic Research (Florida Legislature), "Florida: An Economic Overview," http://edr.state.fl.us/content/presentations/economic/FlEconomicOverview_12-26-18.pdf, (May 23, 2019).

Jobs in the Tourism sector are attractive in Florida, with income that multiplies through the economy. U.S. Bureau of Labor Statistics figures by industry and year show that for 2017 private sector wages in Florida averaged 86.3% of the U.S. average. A few industries do better than the U.S. average. Florida wage averages exceed the US average by the highest margin for the state in the Accommodation and Food Services sector, at 105.7%.[7]

Ocean-dependent economies are generally resilient to economic downturns, with tourism dollars especially important to the Florida Keys. Monroe County was among the top 9 counties in FL, in terms of economic recovery, with a 16-36.8% increase in employment from 2007-2017, and was the only such county among the seven southernmost counties, including the urban Palm Beach, Broward, and Miami-Dade Counties.[8]

With a population of just under 75,000[9] year-round residents, the Florida Keys receive about 3 million overnight tourist visits per year and more than 400,000 day trips. Key West hosts about 750,000 cruise ship visitors each year.[10] Tourism contributes billions to the Monroe economy, and 54% of jobs in the Florida Keys are connected to the marine ecosystem.[11] The unique ecology of the Florida Keys provides opportunities for many Floridians – for those who work in the recreation economy, but also for those recreating, as about one-third of Keys tourists tend to be from Florida.[12] The state of Florida relies more than any other state on tourism as an economic driver, and that connection is exemplified by the Monroe County economy.[13]

Florida tourism relies heavily on healthy subtropical and marine ecosystems, and demand for tourism is sensitive to events that impact the health of the environment, such as disease outbreaks and natural or manmade disasters.[14] Together these factors indicate importance to the Florida economy of tourism in general, and maintaining tourism in the Keys in particular.

---

[7] Office of Economic and Demographic Research (Florida Legislature), "Economy: Wages," http://edr.state.fl.us/Content/economy/wages_2017.pdf, (May 23, 2019).

[8] Office of Economic and Demographic Research (Florida Legislature), "Economic Differences: Urban and Rural Areas, for Senate Committee on Commerce and Tourism, November 13, 2017," http://edr.state.fl.us/Content/presentations/economic-development/RuralEconomicChallenges.pdf, (April 10, 2019).

[9] Office of Economic and Demographic Research (Florida Legislature), "Monroe County," http://edr.state.fl.us/content/area-profiles/county/Monroe.pdf, (May 23, 2019).

[10] Monroe County, Florida. Tourism – Florida Keys Visitor Person-Trip Estimates, https://www.monroecounty-fl.gov/DocumentCenter/View/689/Florida-Keys-Visitors?bidId=, (June 13, 2019).

[11] Monroe County, Florida. Tourism Fact Sheet 2018, https://www.monroecounty-fl.gov/DocumentCenter/View/16252/Tourism-Fact-Sheet-2018?bidId=, (May 23, 2019).

[12] TDC Visitor Profile Survey Annual Summaries, various years 2008-2017, from Monroe County Tourism Development Council, averaging between 20 and 25% in recent years, much higher for 2005 and 2006, and in 2017 with assistance, reconstruction, and suspended flight-dependent tourism associated with Hurricane Irma.

[13] NOAA's "The Economics: National Ocean Watch (ENOW)" Explorer calculates that 6% of Florida's economy is ocean dependent, compared to 36% for Monroe County. https://coast.noaa.gov/enowexplorer/#/employment/total/2016/12087.

[14] Office of Economic and Demographic Research (Florida Legislature), "Florida: An Economic Overview," http://edr.state.fl.us/content/presentations/economic/FlEconomicOverview_12-26-18.pdf, (May 23, 2019).

Linking a Healthy Ecosystem to a Healthy Economy

People vacation in Florida because it is special. Tourists from around the state, around the nation, and around the world choose the Florida Keys over other locations for unique experiences. There are other Disney parks throughout the world, but only one Disney World; there are other urban club scenes across the US, but only one Miami; there are other marine parks and reefs, but only one Florida Keys National Marine Sanctuary.

People pay a premium to experience uniqueness, genuineness, and dependable fulfillment of their expectations. The Florida Keys National Marine Sanctuary is a world-class treasure that invites active participation, evokes awe, possesses a deep cultural identity, creates revenue, and demands careful management and caretaking if it is to be healthy and resilient. The sense of place and pride Floridians have in Florida Keys NMS, the Everglades, and dozens of unique places around the state, does not show up in tourist expenditures, tax revenues, or employment figures, but is part of the value of being a Floridian, and a heritage value that Florida protects for the world.

Florida Keys NMS is part of a network of state and federal protected areas that provide a regional approach to resource management from the Everglades and Florida Bay to the reefs. The sanctuary has contiguous boundaries with three national parks (Everglades NP, Biscayne Np and Dry Tortugas NP), four national wildlife refuges (Crocodile Lake NWR, Key Deer NWR, Great White Heron NWR and Key West NWR) and several state parks including the first underwater park designated in the United States, John Pennekamp Coral Reef State Park. Pennekamp is still the most visited state park in the State of Florida.[15] Decades of loss of coral, seagrass, and mangroves, along with coral bleaching, mass die-offs of marine flora and fauna – a host of ecological damage with chronic and cumulative effects[16] – preceded the official designation of Florida Keys NMS in 1990.[17] The tourism-based economy of Monroe County relies on an ecosystem that has been compromised, and continues to face threats from nutrient pollution and harmful algal blooms, disease outbreaks, marine debris including lost fishing traps, vessel groundings and anchor injuries to seagrasses and corals, and intense storms and increasing ocean acidification.

This study describes how spending on tourism and recreation driven by resources within Florida Keys NMS provides jobs, wages, and contributions to GDP across the rest of the state of Florida. Using IMPLAN software and data, the study assesses the economic impact supported by Florida Keys NMS using a Multi-Regional Input-Output (MRIO) approach. MRIO analysis allows for an assessment of the economic trade between different regions. The analysis splits the state of Florida into nine regions. The first comprises Monroe County and serves as the center for the economic activity supported by Florida Keys NMS. The other parts of the state are broken into eight regions based on distance from the sanctuary and similarities in their economic profiles.

---

[15] John Pennekamp Coral Reef Park, http://www.keyshistory.org/pennekamp.html, (July 16, 2019).

[16] National Oceanic and Atmospheric Administration (NOAA), Florida Keys National Marine Sanctuary Revised Management Plan, 2007, 382 pp, https://nmsfloridakeys.blob.core.windows.net/floridakeys-prod/media/archive/mgmtplans/2007_man_plan.pdf, (May 23, 2019).

[17] Florida Keys NMS Condition Report 2011.

The MRIO analysis shows how tourist spending in Monroe County then flows out to other regions in Florida, estimating the jobs, wages, and contributions to GDP that Florida Keys NMS supports across the state.

In a state like Florida, where beaches, sun, and fun are a major driver of economic growth and resiliency, the importance of a healthy environment is paramount. We are only starting to understand the potential long-term impacts of environmental stressors like HABs, climate change, coral disease and bleaching, marine debris, habitat losses, and fishery declines. Understanding the economic contributions that a healthy environment provides to the entire state of Florida can help inform investment and budget decisions that can further impact the health of the environment and the health of the economy.

IV. Methodology

Economic Contribution Analysis for Florida Keys NMS

This study estimates the contribution of economic activity related to recreation and tourism in Florida Keys NMS to the State of Florida. Metrics assessed include jobs, wages, and contribution to statewide GDP. The analysis breaks down the economic contributions into 9 different regions across the state, showing how ocean tourism and recreation in Florida Keys NMS contributes to Monroe County and to other regions in the State. Other studies have estimated how recreation and tourism in Florida Keys NMS directly impacts Monroe County in much greater detail.[18]

Input-output models show how dollars spent in one part of the economy circulate to affect other sectors and the economy as a whole. To do this accurately, the geographic scope of "the economy" in question must be defined, often at the county or state level. This study uses IMPLAN data and software for the economic analysis. IMPLAN is an industry-standard input-output model, and the company updates its algorithms and repeatedly samples actual expenditure relationships between industries across the U.S. IMPLAN is regularly used by industries, NGOs, and the government to analyze the economic impacts or contribution of any specific industry or set of industries over a defined region. It provides standard economic statistics for measuring economic effect, including jobs, wages, output (sales revenue), sales impacts, and value-added.[19] IMPLAN allows users to conduct economic impact analyses, which measure changes to a local economy, and contribution analyses, which measure the contribution to a local economy attributable to a sector or group of sectors at current levels of activity.[20]

Calculation methods differ slightly between economic impact analysis and contribution analysis, but both types of analysis report the impacts of a change or sector to the economy. This analysis reports on three standard economic indicators; contribution to GDP, which is termed economic output; wages, which represent all forms of employment income; and employment, which is the number of full-time jobs. These indicators associate with all effects from an economic change, or with the contribution to the economy of a sector that is comprised of parts of other industries, as is the ocean tourism and recreation sector. "All effects" include direct, indirect, and induced effects. Direct effects occur when money is spent in the local economy on goods and services. Indirect effects measure the impact of local industries buying goods and services from other local industries as a result of the initial expenditure. Induced

[18] Leeworthy, Loomis, Paterson, 2010.

[19] The difference between an industry's or an establishment's total output and the cost of its intermediate inputs. Value-added is a measure of the contribution to GDP made by an individual producer, industry, or sector.

[20] The modeling approach used in this report is IMPLAN contribution analysis, and not economic impact analysis, but "EIA" is accepted "summary slang" for both approaches. "Changes" would include the introduction of or complete loss of an industry to a local economy.

effects occur when employees of businesses involved in direct and indirect effects then spend again through their own household purchases.

Multi-Regional Input-Output Analysis

This study demonstrates the economic contribution that Florida Keys NMS and Monroe County tourism make to the rest of Florida. It is common to use IMPLAN to analyze economic activity in one area only, without including indirect and induced economic impacts beyond that area. This study uses IMPLAN Multi-Regional Input Output (MRIO) analysis, which captures economic trade between economic regions. IMPLAN Multi-Regional Input-Output (MRIO) Analysis accounts for the economic and employment multiplier effects to other economic regions from economic activity in a first region. MRIO uses economic relationships between industries that reside in the first region, and between that first region and other regions. Direct, indirect, and induced economic effects that link to industry sourcing or spending in other parts of Florida do not then drop out of the analysis, but can be captured in effects within another region of Florida. This captures effects from economic activity in the first region on other regions too, while also not double-counting induced effects back to the first region. In this way, we can trace ocean-based tourism and recreation expenditures in Monroe County to economic impacts statewide.

The IMPLAN MRIO model allows us to take the relevant expenditures from activities within Florida Keys NMS (e.g. snorkeling, diving, recreational fishing, land-based activities in Florida Keys NMS, lodging, meals, transportation, etc.), and calculate the economic output, wages, and number of full-time jobs that contribute to the Monroe County economy and across the State. Many of these recreational expenditures will be for materials, resources, services, and gear that originate from other regions in Florida. MRIO will also generate economic output, wages, and employment estimates for each of the other designated regions. Totaling these effects gives the gross output and employment effects across all of Florida from recreational spending supported by Florida Keys NMS.

Setting the first region to Monroe County, and inputting expenditures supported by Florida Keys NMS enables an MRIO model to show economic output, wages, and employment effects in Monroe County and the contribution to other designated regions of Florida. The economic contributions for each region are summed to estimate these metrics for the entire state. The MRIO software also controls against counting induced effects back from the affected economic regions to the first region – a protection against inflating the estimated contribution in dollars and jobs within the first region (Monroe County).

Geographic Regions for Analysis

To better understand how Florida Keys NMS tourism and recreation impacts other regions of the state, this study reviewed the geographic centers across the state for different types of economic activity and examined their potential relationship with expenditures supported by Florida Keys NMS, and then clustered the counties according to those criteria (see Figure 2). Criteria that were considered for developing the regions for analysis included distance from Monroe County, sharing a common feature like being on the coast or being in the same

Metropolitan Statistical Area (MSA),[21] and sharing main economic drivers. For example, top agricultural producing counties are their own region, even when this region is not contiguous – but the top three agricultural counties by sales volume are not included in this broader agricultural region, as they fit better according to the distance and MSA criteria.[22] After the first region, the numbering of the regions is not important, and does not affect modeling or estimates.

1) **Monroe County** – home of Florida Keys NMS, core region where Florida Keys NMS expenditures and most related jobs occur.[23]
2) **Southern Urban Adjacent** – Miami-Dade, Broward, and Palm Beach Counties, close to Monroe, which allows for a ready exchange of workers and recreational day-trippers. Comprises the Miami-Ft. Lauderdale-Pompano Beach MSA.
3) **Everglades Adjacent** – Collier and Lee Counties, home to much of the Everglades, which establishes an ecological and economic connection.
4) **Southern West Coast** – Charlotte, DeSoto, Sarasota, Manatee, Hillsborough, Pinellas, and Pasco Counties, connecting from northern Charlotte Harbor to southern Tampa Bay. Includes Tampa-St. Petersburg-Clearwater and North Port-Sarasota-Bradenton MSAs.
5) **Northern East Coast** – Baker, Clay, Duval, Nassau, Putnam, St. Johns Counties, the Greater Jacksonville area from the Georgia state line down through St. Augustine (Saint John's County). Includes Jacksonville and Palatka MSAs.
6) **Central East Coast** – Volusia, Flagler, Brevard, Indian River, St. Lucie, Martin Counties, from north of Palm Beach to south of St. Augustine (St. Johns), east of Orlando and including Daytona Beach.
7) **Orlando Area** – Lake, Orange, Seminole, Osceola, and Sumter Counties. Comprises the Orlando-Kissimmee and The Villages MSAs.
8) **Top Agriculture Area**[24] (non-contiguous) – Hendry, Glades, Hardee, Highlands, Okeechobee, and Polk Counties (south of Orlando); Levy, Marion, Lafayette, Suwanee, Gilchrist, and Alachua Counties (south and west of Jacksonville), and Jackson County (panhandle on Georgia border, west of Tallahassee).
9) **Northern and Western Counties** (non-contiguous)– from northern Tampa Bay in the south up the west coast, including most of the panhandle of Florida, west of and including Bradford, Union, and Columbia Counties, except for those in the Top Agriculture Area.

---

[21] United States Office of Management and Budget designates Metropolitan Statistical Areas, geographic regions with relatively high population densities at their core and close economic ties throughout the area.

[22] Palm Beach and Miami-Dade Counties in the Southern Urban Adjacent region, and Hillsborough County in the Southern West Coast region.

[23] Monroe County has a mainland component, mostly covered by Everglades National Park that includes about 60 residents, and hosts approximately 12,000 overnight visitors each year. This area was excluded from the IMPLAN analysis as it was not a significant component of use or expenditures. National Park Service Visitor Use Statistics, Everglades (NP), https://irma.nps.gov/Stats/SSRSReports/Park%20Specific%20Reports/Summary%20of%20Visitor%20Use%20By%20Month%20and%20Year%20(1979%20-%20Last%20Calendar%20Year)?Park=EVER, (July 16, 2019).

[24] The Florida Department of Agriculture and Consumer Services lists Florida Agriculture Overview and Statistics, including by value of agricultural sales by county: https://www.freshfromflorida.com/Agriculture-Industry/Florida-Agriculture-Overview-and-Statistics, accessed April, 12, 2019. Agricultural Sales volume is for 2012.

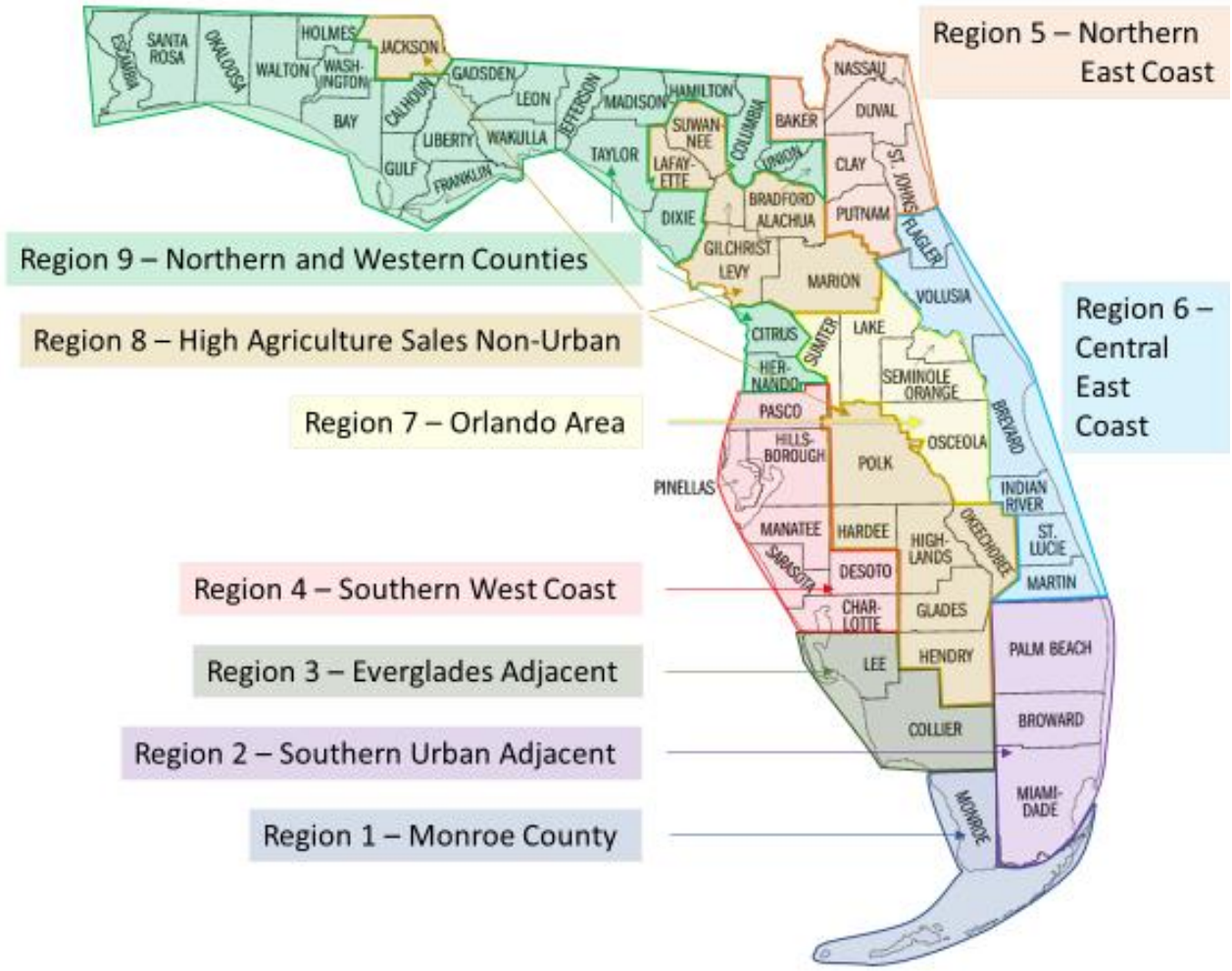


Figure 2. Geographic Regions of Florida for Economic Analysis of Florida Keys NMS Use

Data Sources and IMPLAN Margins of Expenditures

This study used IMPLAN models and data for the state of Florida to calculate jobs, wages, and economic output values resulting from direct, indirect, and induced recreational expenditures associated with Florida Keys NMS in Monroe County.

IMPLAN requires some type of expenditure data as an input for its model. The expenditure data used in this study includes estimates of expenditures for the different types of recreational activities that take place in Florida Keys NMS, and a breakout of expenditures by activity. Monroe County Tourism Development Council (TDC) refers to the D.K. Shifflet company for tourist volume and gross expenditure estimates by trip type, separating overnighting visitors from day trippers, and separating business trips from leisure. D.K. Shifflet's approach to determine visitor use in the Florida Keys is to downscale data from a national longitudinal survey of 50,000 households conducted monthly since 1991. This study assumes that business travelers to Monroe County are not spending money on recreation, and so uses the leisure

visitor estimates from D.K. Shifflet.

Monroe County TDC also conducts an in-depth Visitor Profile Survey for each year for visitors that stay overnight or longer. The Visitor Profile Survey offers many breakouts of visitor characteristics for visitors, including by activity. This breakout of the number of visits by activity type can also be compared to a similar survey from 2007-2008, "Linking the Economy and the Environment of Florida Keys/Key West – Visitor Profiles: Florida Keys/Key West 2007-08."[25] The earlier survey offers a break out of expenditures by activity, for the same activities as in the TDC Survey.

These sources offer the last data piece, matching expenditures by activity type to the industry classification used in IMPLAN. Any questions about how expenditures fit into the 536 industry sectors in IMPLAN can be compared against the National Marine Expenditure Survey, released in 2016 (NMAES 2014), which offers marine expenditures by activity type at a large US regional level, where Florida is one of the "Gulf States." We used the NMAES 2014 to break out food expenditures to different purchase sources, by leisure visitors to Florida Keys NMS.

In IMPLAN, "margins" are used to reflect how retail-level prices paid by visitors to Florida Keys NMS area translate into producer values and economic effects throughout the economy. All the money spent on sun hats for fisherman will come from retail or sporting goods stores, but not all income for these stores comes from hats, and some fishing hats worn in Florida are bought outside of Florida. Retail purchase coefficients (RPCs) reflect how much of a retail good is bought within the core region. IMPLAN MRIO sets default RPC settings across all regions, here, where the regions together comprise Florida. The RPCs for Monroe County are scaled to less than 100% in-county purchase for most goods or services, and any of the rest of the economic inputs from Florida are captured (also at less than 100%) by region – where the expenditure flows to regions then trigger indirect and induced economic effects. Live bait is caught locally, so a 100% RPC exceptionally characterizes live bait purchase.

The U.S.-region-scale NMAES surveys ask respondents the percentage of time a durable purchase is used for a specific activity.[26] This avoids over-counting the use of durable purchases for one activity. For example, if someone buys a pickup truck to go fishing, but reports only using the truck for fishing for 60% of its use, and uses it for other purposes 40% of the time, only 60% of the truck's value is counted as fishing expenditures. Goods used less than 50% of the time for Florida Keys NMS activities were not counted. By design, NMAES expenditures already account for the partial use of durable goods.

[25] Leeworthy, Loomis, Paterson, 2010.

[26] Lovell, S. J., Steinback, S., Hilger, J., & Hunt, C. 2016 (NMAES 2014).

V. Analysis

Economic Contribution Analysis for Florida Keys NMS

We used IMPLAN and expenditures for 2015, 2016, and 2017 to determine how tourism and recreational expenditures in Florida Keys NMS contribute to economic activity across the rest of the state. Figure 3 shows values for labor income, value added[27], and economic output, for the years 2015, 2016, and 2017, all adjusted for inflation and presented in 2015 dollars. Contributions to the Florida economy from recreational and tourism spending in Florida Keys NMS, represented here by economic output, **rose each year, from $4.2 billion in 2015 to $4.4 billion in 2017.** Labor income increased from $1.46 billion in 2015 to $1.56 billion in 2017, and value added increased went from $2.57 billion to $2.66 billion. In any economic analysis, it is important to consider contributing factors. Hurricane Irma hit the Keys on September 9, 2017 causing widespread damage and destruction. Hurricanes and other natural disasters can temporarily deter or limit tourism, however that signal is often masked in an economic analysis such as this one. As responders arrive in the area to assess damages, and provide relief, repair, and construction, they make the same types of expenditures as tourists, filling local hotels and eating at restaurants. While the analysis shows a greater increase in economic contributions from 2016 to 2017 as opposed to the change from 2015 to 2016, approximately $156 million vs. $48 million in labor income, it is not clear how much of that increase is due to increased tourism and recreational expenditures and how much is a result of response and recovery efforts after Irma.

Figure 4 shows the number of jobs across the state of Florida supported by tourism and recreational expenditures in Florida Keys NMS. The increase in employment from 38,111 jobs in 2015, to 42,865 jobs in 2017 represents an increase of about 12%. This percentage increase in employment is larger than the increase in economic output for that same timeframe, 2015-2017, which was about 5%. There is a larger increase in employment from 2015-2016 than there was from 2016-2017, 2,908 jobs versus 1,846 jobs. There are too few years to determine whether the taper in job growth was due to Irma's effect on the economy.

The following analysis focuses on 2015 data and impacts. Hurricane Irma significantly affected the Keys economy in 2017, making the most recent year with available data an anomaly and an inappropriate choice for analysis. There was a lower occurrence of HABs in 2015 than 2016, which, as our analysis on the HAB scenarios show (see Appendix C), can impact recreational expenditures. As a result, 2015 serves as the best and most recent year on which to focus the economic contribution analysis.

[27] Value added is the value that business activities contribute over the cost of business inputs.

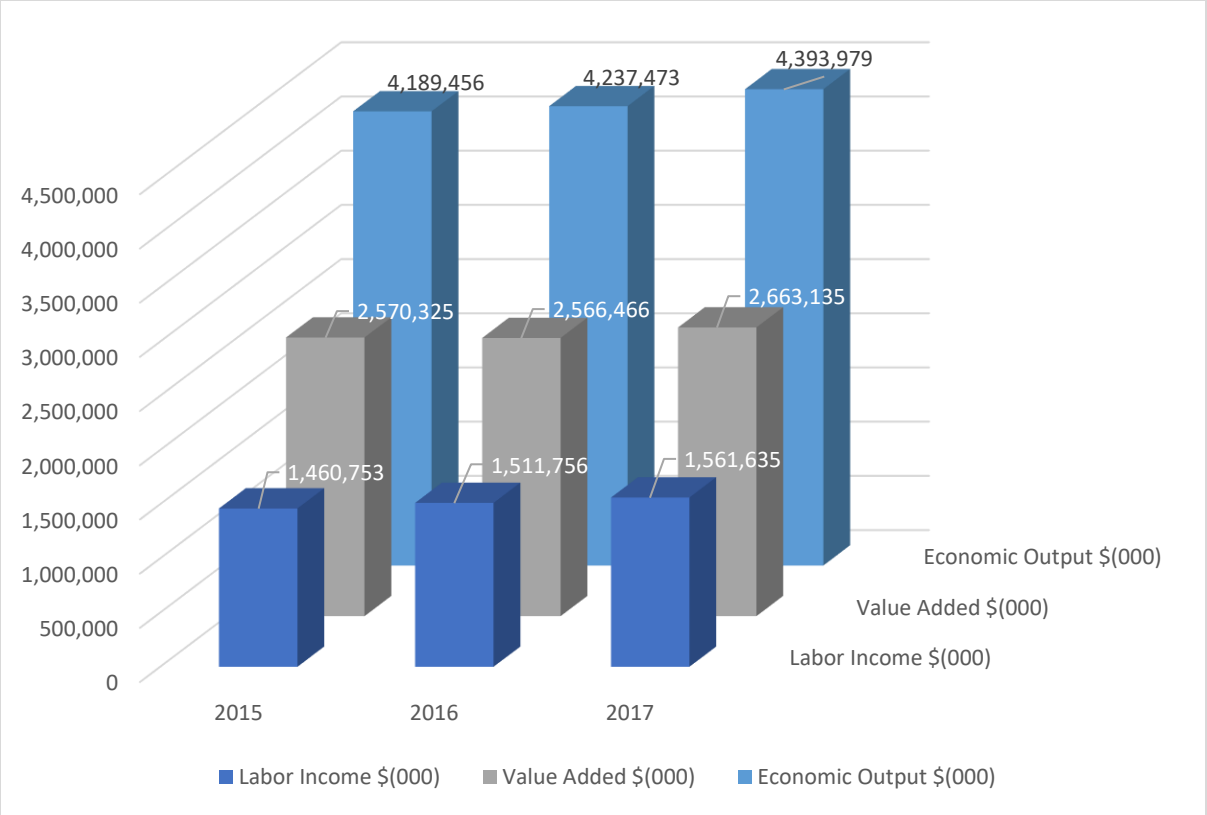


Figure 3. FKNMS Economic Contribution to Florida by Year ($2015)

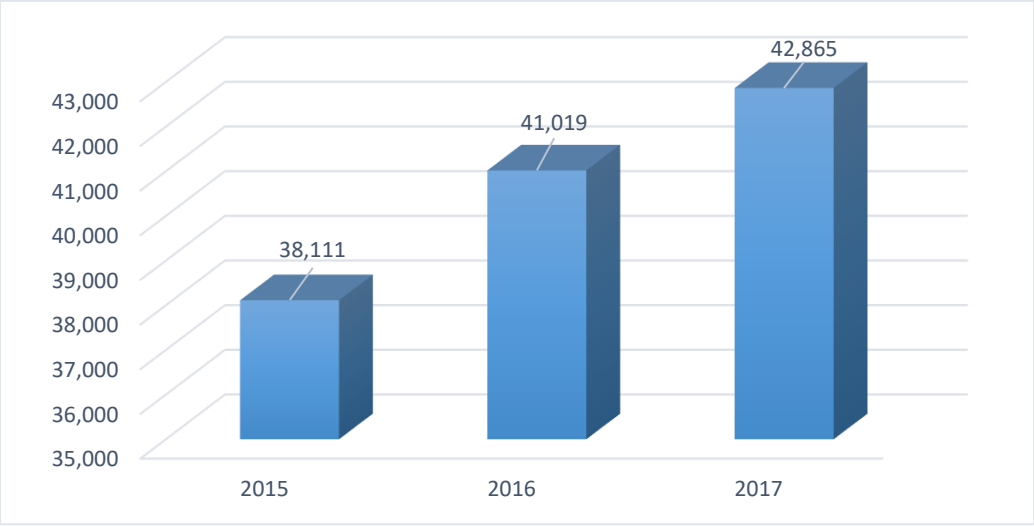


Figure 4. FKNMS Employment Contribution to Florida by Year

Regional and Florida-wide Output and Employment Effects

Results from each year demonstrate that every region of Florida benefits from spending on Florida Keys NMS recreation and tourism. The differences between Region 1 and the others, and then between Regions 2 and 4 and the others, influences presentation of tables and figures here. We present Regions 1, 2, and 4 in more detail, and summarize Regions 3, 5, 6, 7, 8, and 9 together and in less detail. State totals reflect information from all regions.

Table 1 shows that most of the employment, labor income, value added, and economic output contributions to the state economy accrue to Monroe County. Monroe County benefitted with over 34,500 jobs, over $1.3 billion in employment income, more than $2.4 billion in value added to the county economy, and over $3.8 billion in output when accounting for all contributions to the county economy from Florida Keys NMS spending. Monroe County accounts for 95% of the employment, labor income, and value added effects for the state, and 93% of the economic output. The value added total is the value that local labor and capital contribute over the value of goods and services that are purchased from outside of Region 1, largely from other regions in the state of Florida. These economic links help drive benefits in regions beyond Monroe County. More detail on the top industries that benefit from these indirect purchases follows below, after this top line analysis.

Table 1. Florida 2015 and Regions 1, 2, 4, and 3, 5, 6, 7, 8, 9 (combined)

	Employment	Labor Income $(000)	Value Added $(000)	Economic Output $(000)
Region 1 – Monroe County	34,583	1,363,502	2,402,471	3,879,632
Region 2 – So. Urban Adjacent	1,353	74,723	122,649	214,011
Region 4 – So. West Coast	161	9,912	20,249	41,885
Regions 3, 5-9 – Other Regions	249	12,615	24,956	53,928
Total for Florida (2015)	**38,111**	**1,460,753**	**2,570,325**	**4,189,456**

The regions nearer to Region 1, with high-population urban areas, show high contributions over less urban and farther regions. Region 2, *Southern Urban Adjacent*, with Miami-Dade, Broward, and Palm Beach Counties was the next highest by far, with over 1300 full-time jobs supported from Florida Keys NMS spending, and $214 million in economic output. Region 4, *Southern West Coast*, from Charlotte County up to Pasco County above Tampa Bay, stood with Region 2 above other regional numbers. The Southern West Coast supported 161 jobs and $42 million in economic output when accounting for the full statewide effects of Florida Keys NMS spending.

Table 1 shows that together Regions 3, 5, 6, 7, 8, and 9 could trace just under 250 jobs and $54 million to Florida Keys NMS recreational expenditures. In 2015, no region had fewer than $5.75 million or a total of 28 full-time jobs that indirectly derived only from Florida Keys NMS recreational spending and its predictable economic multipliers. Within these six regions, economic output was up to triple that lowest figure, and the largest number of full-time jobs was around twice the minimum number from Regions 3, 5, 6, 7, 8, and 9. The average across the set was 41 ½ jobs and around $9 million per region.

Table 2. Regions 3, 5, 6, 7, 8, 9 Summary

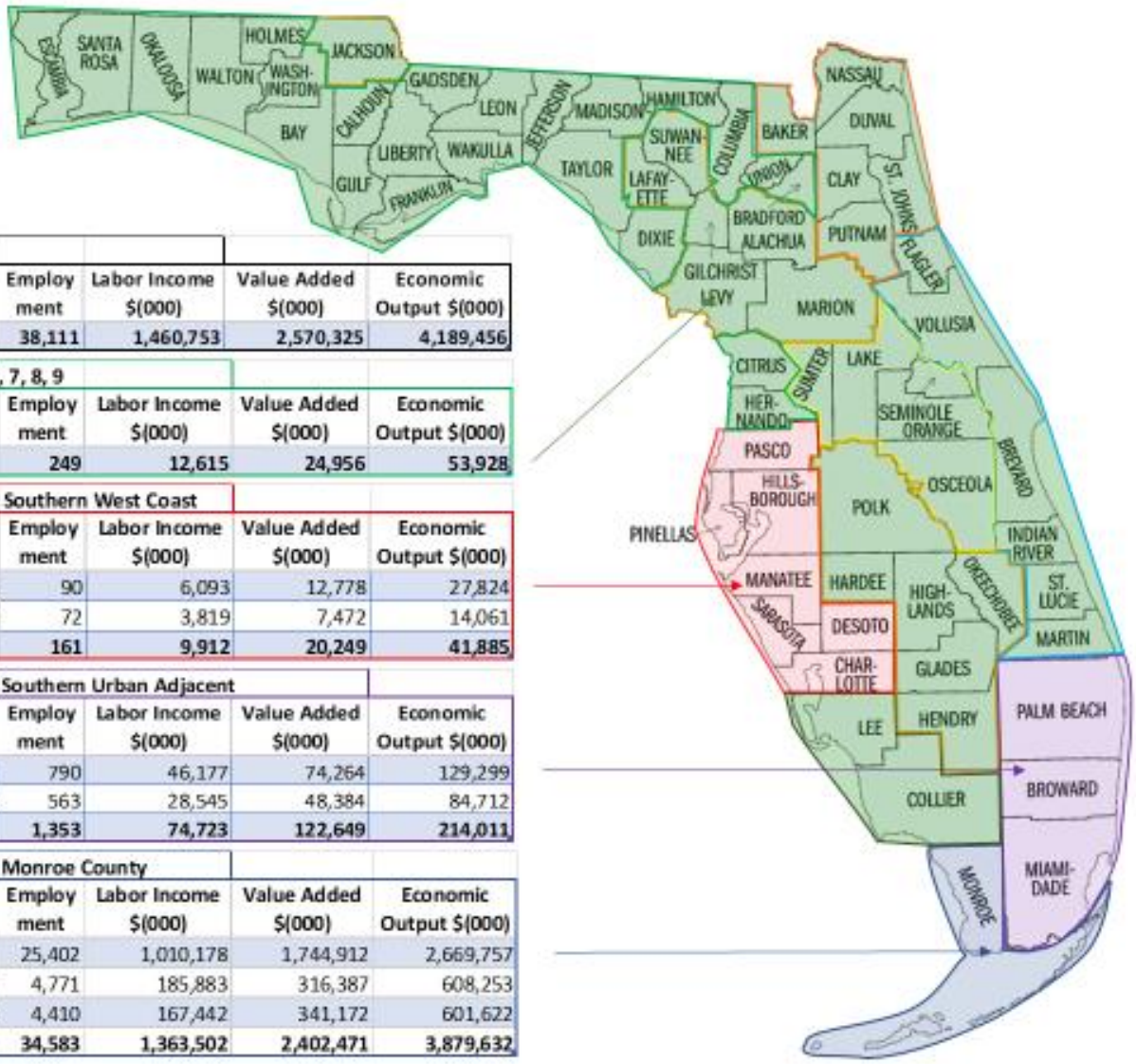
Regions 3, 5-9	Employment	Economic Output $(000)
minimum	27.9	5,750
maximum	54.7	17,703
average	41.5	8,988
Reg 3, 5-9 Totals	**249**	**53,928**

Figure 5 displays a map with employment, labor income, value added, and economic output effects from the MRIO calculations for Florida statewide and the top regions. Statewide totals covering all 9 regions are at the top of the tables on the map. For 2015, the annual contribution to the Florida economy is more than 38,000 jobs and $4.19 billion. The Region 1 table lines up at bottom with Monroe County on the map.

Beyond results in Table 1, the Region tables in Figure 5 show how direct, indirect, and induced economic effects for the highest contribution regions break out. Direct expenditures are consumers spending to businesses in Florida Keys NMS, and have the largest effects. All direct effects from Florida Keys NMS ocean and recreational spending accrue in Region 1. Indirect and induced effects accrue in all other regions and in Region 1.

Indirect effects are businesses buying from businesses back up the supply chain, and have the second largest effects. Induced effects occur when employees paid by businesses in direct or indirect purchases then spend their own money back into the economy. This is an economic multiplier effect. In the Monroe County table in Figure 5, the value added under induced effects is uncharacteristically larger than for indirect effects. This means that the wage multiplier effect in Monroe County is particularly high for the $1.36 billion in labor income from Florida Keys NMS spending. This finding supports the dependency of that economy on tourist spending. All the table values outside of the Region 1 table in Figure 5 demonstrate the contribution of Florida Keys NMS spending to everywhere else in Florida.

In Figure 5, tables for Regions 2 and 4 in the figure show labor income of $75 million and $10 million resulting from Florida Keys NMS spending, with $12.6 million in labor income distributed across the other six regions. Across Florida, direct spending in Florida Keys NMS leads to $1.46 billion in labor income, and $2.57 billion in value added to the state economy.



FLORIDA				
Impact Type	Employment	Labor Income $(000)	Value Added $(000)	Economic Output $(000)
Total Effect	**38,111**	**1,460,753**	**2,570,325**	**4,189,456**

Regions 3, 5, 6, 7, 8, 9				
Impact Type	Employment	Labor Income $(000)	Value Added $(000)	Economic Output $(000)
Total Effect	**249**	**12,615**	**24,956**	**53,928**

Region 4 –	Southern West Coast			
Impact Type	Employment	Labor Income $(000)	Value Added $(000)	Economic Output $(000)
Indirect Effect	90	6,093	12,778	27,824
Induced Effect	72	3,819	7,472	14,061
Total Effect	**161**	**9,912**	**20,249**	**41,885**

Region 2 –	Southern Urban Adjacent			
Impact Type	Employment	Labor Income $(000)	Value Added $(000)	Economic Output $(000)
Indirect Effect	790	46,177	74,264	129,299
Induced Effect	563	28,545	48,384	84,712
Total Effect	**1,353**	**74,723**	**122,649**	**214,011**

Region 1 –	Monroe County			
Impact Type	Employment	Labor Income $(000)	Value Added $(000)	Economic Output $(000)
Direct Effect	25,402	1,010,178	1,744,912	2,669,757
Indirect Effect	4,771	185,883	316,387	608,253
Induced Effect	4,410	167,442	341,172	601,622
Total Effect	**34,583**	**1,363,502**	**2,402,471**	**3,879,632**

Figure 5. MRIO Contribution Analysis Results by Key Regions and for State

Regional Contributions to Industry Sectors from Florida Keys NMS Spending

Examining the various industries across regions that receive the highest contributions from tourism and recreational spending in Florida Keys NMS provides a better understanding of who benefits directly and indirectly from recreational expenditures in Florida Keys NMS. The top ten IMPLAN (industry) sectors by economic output for Region 1 are listed in Table 3. The direct economic effects of Florida Keys NMS expenditures in Monroe County first support high economic output in hotels and lodging at $1.75 B, and food-related sectors (501, 400, 502) at $0.8 B. Indirect and induced effects bear on totals for real estate ($154 M), electric power distribution (49 and 525, $81.7 M), automotive rental and leasing ($79 M), and management companies ($37 M).

Table 3. Top Ten Industry Sectors by Economic Output: Region 1 – Monroe County

IMPLAN Sector	Description	Employment	Labor Income (000)	Value Added (000)	Economic Output (000)
499	Hotels and motels, including casino hotels	13,082	583,625	1,169,521	1,715,017
501	Full-service restaurants	7,263	242,406	260,361	434,921
400	Retail-Food and beverage stores	3,013	111,363	155,369	229,325
440	Real estate	1,092	18,384	93,872	154,210
502	Limited-service restaurants	1,402	36,187	90,355	143,422
441	Owner-occupied dwellings	0	0	70,410	107,642
442	Automotive equipment rental and leasing	354	14,176	46,869	78,794
49	Electric power transmission and distribution	29	4,406	20,609	45,376
461	Management of companies and enterprises	240	11,063	13,196	37,083
525	Local government electric utilities	56	7,799	15,334	36,298

Employment numbers tell a slightly different story. Table 4 shows the top ten industry sectors ranked by employment rather than by output for Monroe County. Employment has the same top three sectors as economic output – Hotels, Full-service restaurants, and Retail food and beverage outlets. The row values for the same industries in Tables 3 and 4 will of course be the same, but there is movement and change in the lower seven sectors of the top ten when looking at economic output versus employment. "Scenic and sightseeing transportation and support activities for transportation" is ranked tenth by employment (Table 4) – but "Scenic and sightseeing…" was not in the top ten ranking by output (Table 3). Jobs in this sector tend to be lower paying but plentiful, providing employment opportunities, even if the economic output is lower than other industrial sectors. Considering the contributions that recreational spending in Florida Keys NMS has on both economic output and employment demonstrates the vital connection between Florida Keys NMS, ocean and recreation expenditures and

contributions to the network of business interests that may not be directly tied to water and nearby activities as specifically as fishing, diving, or nature tours. This pattern is evident enough in other regions by examining the output ranking alone.

Table 4. Top Ten Industry Sectors by *Employment*: Region 1 – Monroe County

IMPLAN Sector	Description	Employment	Labor Income (000)	Value Added (000)	Economic Output (000)
499	Hotels and motels, including casino hotels	13,082	583,625	1,169,521	1,715,017
501	Full-service restaurants	7,263	242,406	260,361	434,921
400	Retail-Food and beverage stores	3,013	111,363	155,369	229,325
502	Limited-service restaurants	1,402	36,187	90,355	143,422
440	Real estate	1,092	18,384	93,872	154,210
468	Services to buildings	488	9,630	10,998	19,240
503	All other food and drinking places	488	17,016	16,530	24,801
402	Retail-Gasoline stores	383	14,595	20,428	32,464
442	Automotive equipment rental and leasing	354	14,176	46,869	78,794
414	Scenic and sightseeing transportation and support activities for transportation	244	11,649	14,979	33,998

After Region 1, the economic contributions from Florida Keys NMS recreational expenditures are the highest in Region 2, at over $200 million in 2015. The top ten industrial sectors that benefit in Region 2 are shown in Table 5, sorted by economic output. Wholesale trade tops the list at around $30.5 million, with business credit facilitators following next at about $14.5 million. Wireless and wired telecommunications enter as top ten sectors, with $15 million in economic output combined, as do professional services like lawyers ($9 million), accountants ($7 million), and insurance agents. At $5.2 million, direct insurance services account for the same economic output as the air transport sector rooted in the Miami and Fort Lauderdale hubs, as it supports Florida Keys NMS tourism and supporting businesses.

Monroe County imports many different goods and services from other regions to support tourism and recreation in Florida Keys NMS. As an example, the top six sectors (by economic output) for Region 1 account for 72% of the total economic impact (See Table 3) for the region. As expected, these sectors all directly relate to recreational activities, including sectors related to lodging and food services. In contrast, for Region 2, the economic contributions of recreational spending in the Keys are more widely distributed across industries not directly related to recreational activity (See Table 5). Here economic output for the top ten sectors only comprises about 48% of the total economic impact. $309.8 million of the statewide $4.2 billion economic output in 2015 accrued outside of Monroe County.

Table 5. Top Ten Industry Sectors by Output: Region 2 – Southern Urban Adjacent

IMPLAN Sector	Description	Employment	Labor Income (000)	Value Added (000)	Economic Output (000)
395	Wholesale trade	131	10,551	20,750	30,630
434	Nondepository credit intermediation and related activities	90	7,013	7,558	14,483
440	Real estate	89	988	6,425	9,586
428	Wireless telecommunications carriers (except satellite)	62	162	2,707	9,338
447	Legal services	57	4,339	6,539	8,989
448	Accounting, tax preparation, bookkeeping, and payroll services	57	4,391	5,899	7,198
441	Owner-occupied dwellings	44	0	3,976	6,079
427	Wired telecommunications carriers	38	1,036	2,581	5,661
408	Air transportation	37	1,357	2,743	5,245
438	Insurance agencies, brokerages, and related activities	29	1,732	2,555	5,244

Table 6. Top Ten Industry Sectors by Output: Region 4 – Southern West Coast

IMPLAN Sector	Description	Employment	Labor Income (000)	Value Added (000)	Economic Output (000)
42	Electric power generation-Fossil fuel	8.6	1,518	6,596	13,390
106	Bottled and canned soft drinks & water	2.0	186	352	1,521
434	Nondepository credit intermediation and related activities	8.7	678	731	1,407
461	Management of companies and enterprises	6.1	601	717	1,319
395	Wholesale trade	4.6	385	754	1,104
441	Owner-occupied dwellings	0.0	0	606	926
440	Real estate	5.2	91	617	904
62	Maintenance and repair construction of nonresidential structures	5.2	270	407	839
154	Printing	5.2	253	355	824
93	Seafood product preparation and packaging	1.6	85	135	645

Table 5 and Table 6 show the top ten industry sectors ranked by output for Region 2 and Region 4, respectively. Comparing Table 6 to Table 5 shows that tourism and recreational expenditures in Florida Keys NMS are lower in Region 4 than in Region 2, but the connections are still apparent. Region 4 is simply farther away from Monroe County by direct overland access than Region 2. While under $23 million of output is represented by the top ten sectors in Region 4, the larger Tampa Bay and Charlotte County area had a total economic output of almost $42

million, with 161 jobs – widely distributed across many industry sectors (See Figure 5). The top two sectors in Region 4 are not among the top ten in Region 2. While Monroe County gets all its electricity from the Turkey Point Nuclear Generating Station, recreational spending in the Keys still supports $13.4 million worth of electric power generation from fossil fuels generated in Region 4, through the production of intermediary goods and services. Purchases of bottled and canned soft drinks and water in the Keys generate $1.5 million for Region 4. Other top sectors not shared by the Region 2 top ten list occupy the 4th, 8th, 9th, and 10th slots, for a total of $3.6 million.

Statewide Contributions to Industry Sectors from Florida Keys NMS Spending

Region 1, consisting of Monroe County, gains the most benefits from all direct effects based on Florida Keys NMS tourism and recreational spending. As tourism and recreational spending in Florida Keys NMS also makes strong contributions to Regions 2 and 4, we have examined them individually in some detail. However, spending in the Keys supports economic activity across the state. Table 7 shows the top industry sectors by output across all regions outside Monroe County. This is a list of the top industry sectors in Florida, excluding Region 1, whose economic output traces to Florida Keys NMS expenditures. Regional economic output is combined in the fourth column according to top industry lists by output for each region, and regions are listed in the last column in descending order of magnitude.

Wholesale trade is the top sector by output in Table 7, with economic contributions from Region 1 to all other regions. Region 2 is the easiest overland route to Region 1 and has the largest contiguous urban hub in the state. Region 2 absorbs 92% of the $33.1 million Wholesale trade contribution from tourism and recreational expenditures made in Region 1.

Spending in the sanctuary supports a total of $25.5 million in economic output for fossil fuel electric power generation industries in Regions 4, 8,9, 6, and 7, through the production of intermediary goods and services. Electric power generation comes from fossil fuel plants in every region not adjacent to Region 1 except Region 5 in the northeast corner of the state. Other power generation fuel sources such as nuclear and solar did enter the top 25 sectors by output.

Regions 2 and 4 supply almost $16 million in “Nondepository credit intermediation and related activities,” which includes services to help businesses attain, use, and maintain credit.

In order, Regions 2, 4, 7, 3, and 8 together receive $11 million in economic output for services related to buying and selling residential, commercial, and industrial real estate. This number includes indirect and induced effects through other sectors from expenditures that begin at Florida Keys NMS and the immediately surrounding area. IMPLAN sector 441, “Owner-occupied dwellings” ranks 7th, and reflects a small portion of value of home ownership, home repair, and maintenance on the homes of Floridians who travel to Florida Keys NMS, especially day trippers. Being the easiest to access by car or boat and return in a day, Region 2 accounts for 75% of the $8 million service that is shared across all eight regions outside of Region 1.

Wireless and wired telecommunications rank 5th and 10th, both in Region 2 as most conveniently located to Region 1, with some wireless output in Region 4. Wireless

telecommunications contributes almost $10 million, and wired telecommunications contributes just over $5 million.

Tourism and recreation in Florida Keys NMS support a wide range of services in Region 2. Legal and accounting services rank 6th and 8th respectively, totaling an economic contribution to the region of more than $16 million in 2015. Region 2's proximity to Region 1 also allows for high economic contributions in Region 2 for business support services (#13), sound recording industries (#14), other financial investment activities (#15), cable and other subscription programming (#17), investigation and security services (#19), electronic and precision equipment repair and maintenance (#20), hospitals (#22), dry-cleaning and laundry services (#23), and advertising, public relations, and related services (#25). As with a number of white-collar services, Region 4 joins Region 2 in insurance agencies and activities (#9), and insurance carriers (#21), for a combined two-sector total of around $8.6 million. Region 2 accounts for just over two-thirds of the $5.5 million for management of companies and enterprises (#11), but is joined by Regions 4, 7, and 8, in that order.

Region 2 also serves as the primary air transportation hub, with tourism and recreation in Florida Keys NMS supporting over $5 million in that sector.

Following the top ten industries, maintenance, and repair construction of nonresidential structures (#16) and extraction of natural gas and crude petroleum (#24) are top-25 industries with totals over five regions, none of which is Region 2.

Table 7. Top 25 Industry Sectors by Output from Top Industry Lists: Regions 2, 3, 4, 5, 6, 7, 8, 9

Rank	IMPLAN Sector	Description	Economic Output (000)	Regions in Order by Output
1	395	Wholesale trade	33,135	2,4,7,5,8,6,3,9
2	42	Electric power generation-Fossil fuel	25,511	4,8,9,6,7
3	434	Nondepository credit intermediation and related activities	15,891	2,4
4	440	Real estate	11,053	2,4,7,3,8
5	428	Wireless telecommunications carriers (except satellite)	9,875	2, 4
6	447	Legal services	8,989	2
7	441	Owner-occupied dwellings	8,083	2,4,8,7,5,6,3,9
8	448	Accounting, tax preparation, bookkeeping, and payroll services	7,198	2
9	438	Insurance agencies, brokerages, and related activities	5,719	2,4
10	427	Wired telecommunications carriers	5,661	2
11	461	Management of companies and enterprises	5,511	2,4,7,8
12	408	Air transportation	5,245	2
13	465	Business support services	4,954	2
14	424	Sound recording industries	4,765	2
15	436	Other financial investment activities	4,693	2
16	62	Maintenance and repair construction of nonresidential structures	3,837	3,4,7,6,8
17	426	Cable and other subscription programming	3,538	2
18	433	Monetary authorities and depository credit intermediation	3,148	2,4
19	467	Investigation and security services	3,010	2
20	506	Electronic and precision equipment repair and maintenance	2,749	2
21	437	Insurance carriers	2,899	2,4
22	482	Hospitals	2,596	2,4
23	511	Dry-cleaning and laundry services	2,385	2
24	20	Extraction of natural gas and crude petroleum	2,234	3,4,8,9,6
25	457	Advertising, public relations, and related services	2,173	2

VI. Limitations and Uncertainties

This study uses quantitative economic measures – in dollars and in jobs – to assess the contribution of ocean and recreational spending supported by Florida Keys NMS to the economy of Florida. The study undertakes a known and reliable method of estimating the actual economic contribution of an industry to an economy using publicly available data. No modeling of economic demand for any commodity was done, nor was any assessment made of the state or health or magnitude of the Florida economy or any region in it.

Any use of the IMPLAN tool relies on a number of assumptions and modeling choices that limit what can be inferred from the results. Misapplication of the IMPLAN tool and inflated projections of economic impact are known problems that this study design and methodology avoid. Misapplication can occur when economic contributions or impacts to industry sectors are applied to the whole sector rather than to an appropriate part. Buying sunhats and lotion from a big box retailer is not the same as supporting every business line that the retailer supports. Not calibrating economic multiplier effects for partial effects, known as setting or using partials, can inflate estimations.

Misapplication of IMPLAN also occurs in part when the IMPLAN model is used to project economic impacts without considering how investments might otherwise be spent (i.e., considering "opportunity costs" of construction or investment). No such projection was done here, only a straight assessment of current economic contribution in the study years, with no change to the industry that is Florida Keys NMS recreation and tourism. The study does not use IMPLAN in the way most commonly criticized when economic impacts are presented using IMPLAN results.[28,29] This study made every attempt to use world-realistic economic multipliers in a coastal recreational economy of carefully defined scope.

The connections and dependencies between industries in an economy that are used to estimate indirect and induced economic effects of production or spending in one industry must be fixed as assumptions of the model during any run of the IMPLAN software. IMPLAN developers gather actual economic data and frequently recalibrate their algorithms based on real-world factors that affect economies within their geographic units of analysis. This method is iterative, but it is still a model. Any changes in the economy or economic shocks not reflected in IMPLAN would upset the confidence of the calculations to some degree, even if it may be slight. For example, if the world steel market is upset, most industry relations between local suppliers and purchasers of many products that use little or no steel will be only minorly affected in Florida. This study carefully restricted the scope of analyzed industries, used "partials/partial effects" to minimize risk of over-counting multiplier effects in the analysis, and did not model an economic shock, such as the loss or introduction of an industry, or make any

[28] Davies, Coleman, and Ramchandani, 2013.

[29] Tyrell and Johnson, 2006.

projections into the future in which technology changes and economic shocks can change the relationships between affected industries.

Despite the best attempts to set reasonable partials, or economic multipliers, supported by known use and available information, there could be a deviation between the economic multipliers used in this modeling, and what a team conducting a more in-depth analysis of the local economies would set. The rigor and investment in updating the analytical precepts and algorithms (the "engine") of the IMPLAN product – a product used by government agencies, universities, non-governmental organizations, and hundreds of consultancies – helps to ensure that IMPLAN's multipliers and algorithms tend to be accurate and reliable. There cannot be perfect confidence in the results, but the method here implies high confidence in the results, and very low risk of having committed mistakes associated with the use of the IMPLAN modeling tool.

Four separate sources provided information useful for breakdowns of recreational and tourism expenditures by amounts and types of activity – DK Shifflet 2018, TDC Annual Surveys, Leeworthy et al. 2010, and NMAES 2014.[30] No single source covered the input needs for the IMPLAN model for the Florida Keys NMS recreation industry. All three sources used survey methods and rigorous methodology to ensure accuracy, but the methods were not identical. Any flaw in the design or implementation of any of the surveys and their related estimations in their results could bias the estimates for expenditures on specific activities up or down. This is a common and unavoidable limitation when working with many types of data. There is similarity across magnitudes of estimated marine and related recreation expenditures by activity across these sources, suggesting either that they each carry validity or that they are all flawed in a similar way.

IMPLAN MRIO modeling uses these expenditures to multiply first for direct economic effect for the number of occurrences of specific activities over a year, such as nights of lodging or recreational fishing trips. Using the DK Shifflet data that the Monroe County TDC uses as its official estimates for number of traveler days by type of traveler per year provided the count by which activity estimates would be multiplied. If any of these quantitative estimates of traveler traffic in Monroe County is significantly off, this would push the IMPLAN estimates for economic output and jobs up or down, and any such effect would multiply through the other regions. This is the nature of this type of input-output modeling. The method here did not ignore or compound the limited uncertainties associated with the data types and modeling.

[30] All four sources are vested in providing accurate estimates. DK Shifflet 2018 and TDC Annual Surveys are commissioned by the county-government Monroe County Tourism Development Council; Leeworthy et al. 2010 was sponsored by federal and academic institutions, and non-profit environmental advocacy groups; and NMAES 2014 is an official publication of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce.

VII. Conclusions

A healthy environment is central to the Floridian way of life. Florida Keys NMS, with its rich, unique, and nationally significant marine resources provides ample opportunities for Floridians and visitors alike to experience the best in coastal-related recreation and tourism that Florida has to offer. In turn that tourism and recreation supports jobs and wages for Floridians and contributes about $4.4 billion in GDP to the State, annually. The 43,000 jobs supported by Florida Keys NMS span across the state and impact a broad range of industries beyond recreation industries, restaurants, and lodging. Substantial benefits accrue to businesses in the wholesale trade, power generation and distribution, transportation, financial services, and real estate sectors as Florida Keys NMS supports over $300 million in economic activity outside of Monroe County annually. The areas in closest proximity benefit the most, such as Miami-Dade, Broward, and Palm Beach counties. However, recreation and tourism in Florida Keys NMS supports regions that are further afield as well. Florida Keys NMS recreation and tourism supports almost $42 million in contributions to GDP and about $10 million in wages annually for the southwest region of Florida, and there are strong economic connections between Monroe County and Orlando, and the agricultural producing regions as well.

The health of Florida Keys NMS is at risk due to the loss of coral, seagrass, and mangrove ecosystems; threats of nutrient pollution and harmful algal blooms; marine debris including lost fishing traps, vessel groundings and anchor injuries to seagrasses and corals; and climate change which is intensifying storms, raising sea levels, warming waters, and acidifying the ocean. These factors all threaten the environment and the economy that the sanctuary supports. If left unchecked, these risks will continue to grow, and Florida may lose additional tourism and recreation expenditures.

Habitat restoration can reduce these risks. Restoring critical coral, seagrass and mangrove habitats can increase fish populations, recover endangered and threatened sanctuary resources, and support the local economy. The act of restoration itself, provides additional economic contributions that are not discussed in this report. In the U.S. the "restoration economy"[31] contributes approximately $25 billion in direct and indirect economic output and supports about 220,000 jobs annually[32]. In response to requests by the public, shifting environmental conditions and threats in the Florida Keys, better scientific information, and legal requirements, NOAA is proposing changes to the sanctuary's management plan, boundary, marine zoning, and regulations. This Restoration Blueprint, due to be released in

[31] The restoration economy comprises economic contributions to industries directly or indirectly resulting from habitat restoration. Industries that benefit from the restoration economy include architectural and engineering services; construction; professional, technical, and scientific services; fishing; real estate; and others.
[32] BenDor et al., 2015.

August, represents nearly 30 years of science, management experience, and community involvement. Public input on the four proposed alternatives is vital for shaping the future of the Florida Keys National Marine Sanctuary.

The diverse and sensitive ecosystem protected by the sanctuary drives the local economy and significantly impacts that health of the state economy. The value of Florida Keys NMS to the State of Florida's economy, job creation, and job retention points to the critical and immediate need to protect and restore this fragile ecosystem. Protected areas, such as Florida Keys NMS, provide much more than just a place to vacation to Florida and to the nation, they provide a source of consistent, and extensive economic output, jobs, and wages to a vast array of industries, and the people who depend on them. Understanding their value, and how Florida Keys NMS supports a strong economy in Florida will help inform investment and budget decisions that can further impact the health of the environment and the health of the economy.

VIII. Appendix A: References

Adams, Aaron and Ross Boucek. Interview with Tracy Rouleau. Personal Interview. Phone Call. May 29, 2019.

BenDor T, Lester TW, Livengood A, Davis A, Yonavjak L. 2015. Estimating the Size and Impact of the Ecological Restoration Economy. PLoS ONE 10(6): e0128339. https://doi.org/10.1371/journal.pone.0128339

Davies, L., Coleman, R., and Girish Ramchandani. 2013. "Evaluating event economic impact: rigour versus reality?", International Journal of Event and Festival Management, Vol. 4 Issue: 1, pp.31-42. https://doi.org/10.1108/17582951311307494.

D.K. Shifflet. 2018. "2017 Monroe County Visitor Volume and Spending," publicly available through the Monroe County Tourism Development Council website, https://www.monroecounty-fl.gov/DocumentCenter/View/14535/2017-Monroe-County-Domestic-Visitor-Count?bidId=, (June 1, 2019).

Florida Department of Agriculture and Consumer Services, "Florida Agriculture Overview and Statistics (2017)." Note: Florida DACS figures are actively updated over time as data are updated by year, https://www.freshfromflorida.com/Agriculture-Industry/Florida-Agriculture-Overview-and-Statistics, (April 12, 2019).

Florida Fish and Wildlife Conservation Commission, "Red Tide Current Status," https://myfwc.com/research/redtide/statewide/, (May 23, 2019).

Investopedia. "Florida's Economy: The 6 Industries Driving GDP Growth," https://www.investopedia.com/articles/investing/011316/floridas-economy-6-industries-driving-gdp-growth.asp, (April 12, 2019).

JDO Insights, Inc., for the Board of County Commissioners of Monroe County, Florida. "2018 TDC Visitor Profile Survey County-wide ANNUAL Summary by Quarter January – December 2017/2018, REVISION II 03202019." Note: older versions of the same report going back five years were also used, provided by the Monroe County Tourism Development Council, Director of Market Research, upon request. https://www.investopedia.com/articles/investing/011316/floridas-economy-6-industries-driving-gdp-growth.asp, (April 12, 2019).

Larkin, S. and C. Adams. 2007. "Harmful Algal Blooms and Coastal Business: Economic Consequences in Florida." *Society and Natural Resources* 20(9): 849-859.

Leeworthy, V.R., Loomis, D., Paterson, S. 2010. "Linking the Economy and the Environment of Florida Keys/Key West – Visitor Profiles: Florida Keys/Key West 2007-08." Office of National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 299 pp, https://www.monroecounty-fl.gov/DocumentCenter/View/756/NOAA-4-reports?bidId= .

Lovell, S. J., Steinback, S., Hilger, J., & Hunt, C. 2016. The Economic Contribution of Marine Angler Expenditures on Durable Goods in the United States, 2014. NOAA Technical Memorandum. National Marine Fisheries Service. (NMAES 2014)

Monroe County, Florida. Tourism Fact Sheet 2018, https://www.monroecounty-fl.gov/DocumentCenter/View/16252/Tourism-Fact-Sheet-2018?bidId=, (May 23, 2019).

Monroe County, Florida. Tourism – Florida Keys Visitor Person-Trip Estimates, https://www.monroecounty-fl.gov/DocumentCenter/View/689/Florida-Keys-Visitors?bidId=, (June 13, 2019).

Morgan, K., S.L. Larkin, and C.M. Adams. 2010. "Red Tides and Participation in Marine-based Activities: Estimating the Response of Southwest Florida Residents." *Harmful Algae* 9(3): 333–341.

Morgan, K.L., S.L. Larkin, and C.M. Adams. 2009. "Firm-level Economic Effects of HABS: A Tool for Business Loss Assessment." *Harmful Algae* Vol. 9.

National Oceanic and Atmospheric Administration (NOAA), Florida Keys National Marine Sanctuary Revised Management Plan, 2007, 382 pp, https://nmsfloridakeys.blob.core.windows.net/floridakeys-prod/media/archive/mgmtplans/2007_man_plan.pdf, (May 23, 2019).

National Park Service Visitor Use Statistics, Everglades (NP), https://irma.nps.gov/Stats/SSRSReports/Park%20Specific%20Reports/Summary%20of%20Visitor%20Use%20By%20Month%20and%20Year%20(1979%20-%20Last%20Calendar%20Year)?Park=EVER, (July 16, 2019).

New York Times. "'The Worst I've Ever Seen It': Lean Stone Crab Season Follows Red Tide in Florida." Dec. 6, 2018. https://www.nytimes.com/2018/12/16/us/stone-crabs-florida-algae-red-tide.html.

New York Times. "The Deadly Toll of the Red Tide." Aug. 31, 2018. https://www.nytimes.com/2018/08/31/us/algae-toxic-florida-dead-animals-red-tide.html

NOAA, National Marine Sanctuaries, 2011 Annual Report – Florida Keys. https://nmsfloridakeys.blob.core.windows.net/floridakeys-prod/media/archive/about/111202Florida Keys NMS-ar.pdf.

NOAA, Office of National Marine Sanctuaries. 2011. Florida Keys National Marine Sanctuary Condition Report 2011. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 105 pp. (Florida Keys NMS Condition Report 2011)

NOAA, Restoring for the Future: Florida Keys National Marine Sanctuary, https://nmsfloridakeys.blob.core.windows.net/floridakeys-prod/media/blueprint/florida-keys-national-marine-sanctuary-restoration-blueprint-infographic.pdf, (May 23, 2019).

NOAA, The Economics: National Ocean Watch (ENOW), https://coast.noaa.gov/enowexplorer/#/employment/total/2016/12087, (May 23, 2019).

Office of Economic and Demographic Research (Florida Legislature), "2017 FL state GDP," http://edr.state.fl.us/Content/economy/2017_FL_state_GDP.pdf, (source citing Bureau of Economic Analysis, US Dept of Commerce, May 4, 2018; April 11, 2019).

Office of Economic and Demographic Research (Florida Legislature), "Economic Differences: Urban and Rural Areas, for Senate Committee on Commerce and Tourism, November 13, 2017," http://edr.state.fl.us/Content/presentations/economic-development/RuralEconomicChallenges.pdf, (April 10, 2019).

Office of Economic and Demographic Research (Florida Legislature), "Economy: Wages," http://edr.state.fl.us/Content/economy/wages_2017.pdf, (May 23, 2019).

Office of Economic and Demographic Research (Florida Legislature), "Florida: An Economic Overview," http://edr.state.fl.us/content/presentations/economic/FlEconomicOverview_12-26-18.pdf, (May 23, 2019).

Office of Economic and Demographic Research (Florida Legislature), "Monroe County," http://edr.state.fl.us/content/area-profiles/county/Monroe.pdf, (May 23, 2019).

Orlando Weekly, "Florida Breaks Tourism Record with 958 Million Visitors So Far," https://www.orlandoweekly.com/Blogs/archives/2018/11/26/florida-breaks-tourism-record-with-958-million-visitors-so-far-in-2018, (April 10, 2019).

Ralston, E.P., H. Kite-Powell, and A. Beet. 2011. "An Estimate of the Cost of Acute Health Effects from Food-and Water-Borne Marine Pathogens and Toxins in the United States." *Journal of Water and Health* 9(4):680-694.

Tyrrell, T., and Johnston, R. 2006. The Economic Impacts of Tourism: A Special Issue. Journal of Travel Research. 45. 3-7. doi.org/10.1177/0047287506288876.

U.S. Bureau of Economic Analysis. 2018. News Release: Real Personal Income for States and Metropolitan Areas, 2017, p8: "Table 1. Real Personal Income and Implicit Regional Price Deflators by State, 2016-2017." Note: U.S. BEA figures are actively updated over time as data and methods are revised, https://www.bea.gov/system/files/2019-05/rpp0519.pdf.

U.S. Bureau of Economic Analysis. 2018. News Release: Real Personal Income for States and Metropolitan Areas, 2016; p8: "Table 1. Real Personal Income and Implicit Regional Price Deflators by State, 2015-2016." Note: U.S. BEA figures are actively updated over time as data and methods are revised, https://www.bea.gov/system/files/2018-05/rpp0518.pdf.

Washington Post. "Florida's unusually long red tide is killing wildlife, tourism and businesses." Aug. 28, 2018. https://www.washingtonpost.com/national/health-science/floridas-unusually-long-red-tide-is-killing-wildlife-tourism-and-businesses/2018/08/28/245fc8da-aad5-11e8-8a0c-70b618c98d3c_story.html?utm_term=.c80d91a50b02.

Wilkinson, Jerry. John Pennekamp Coral Reef Park, http://www.keyshistory.org/pennekamp.html, (July 16, 2019).

IX. Appendix B: Data Tables

Top 25 Industry Sectors by Output: Region 1 – Monroe County

Rank	IMPLAN Sector	Description	Economic Output (000)
1	499	Hotels and motels, including casino hotels	1,715,017
2	501	Full-service restaurants	434,921
3	400	Retail-Food and beverage stores	229,325
4	440	Real estate	154,210
5	502	Limited-service restaurants	143,422
6	441	Owner-occupied dwellings	107,642
7	442	Automotive equipment rental and leasing	78,794
8	49	Electric power transmission and distribution	45,376
9	461	Management of companies and enterprises	37,083
10	525	Local government electric utilities	36,298
11	408	Air transportation	35,418
12	414	Scenic and sightseeing transportation and support activities for transportation	33,998
13	62	Maintenance and repair construction of nonresidential structures	33,250
14	402	Retail-Gasoline stores	32,464
15	526	Other local government enterprises	30,264
16	395	Wholesale trade	29,623
17	482	Hospitals	27,337
18	433	Monetary authorities and depository credit intermediation	26,916
19	436	Other financial investment activities	26,117
20	503	All other food and drinking places	24,801
21	454	Management consulting services	23,040
22	427	Wired telecommunications carriers	19,304
23	468	Services to buildings	19,240
24	396	Retail-Motor vehicle and parts dealers	17,890
25	475	Offices of physicians	16,951
26	457	Advertising, public relations, and related services	16,733

Top Industry Sectors by Output: Region 2 – Southern Urban Adjacent

Rank	IMPLAN Sector	Description	Economic Output (000)
1	395	Wholesale trade	30,630
2	434	Nondepository credit intermediation and related activities	14,483
3	440	Real estate	9,586
4	428	Wireless telecommunications carriers (except satellite)	9,338
5	447	Legal services	8,989
6	448	Accounting, tax preparation, bookkeeping, and payroll services	7,198
7	441	Owner-occupied dwellings	6,079
8	427	Wired telecommunications carriers	5,661
9	408	Air transportation	5,245
10	438	Insurance agencies, brokerages, and related activities	5,244
11	465	Business support services	4,954
12	424	Sound recording industries	4,765
13	436	Other financial investment activities	4,693
14	461	Management of companies and enterprises	3,760
15	426	Cable and other subscription programming	3,538
16	467	Investigation and security services	3,010
17	433	Monetary authorities and depository credit intermediation	2,756
18	506	Electronic and precision equipment repair and maintenance	2,749
19	437	Insurance carriers	2,458
20	511	Dry-cleaning and laundry services	2,385
21	482	Hospitals	2,196
22	457	Advertising, public relations, and related services	2,173

Top Industry Sectors by Output: Region 4 – Southern West Coast

Rank	IMPLAN Sector	Description	Economic Output (000)
1	42	Electric power generation-Fossil fuel	13,390
2	106	Bottled and canned soft drinks & water	1,521
3	434	Nondepository credit intermediation and related activities	1,407
4	461	Management of companies and enterprises	1,319
5	395	Wholesale trade	1,104
6	441	Owner-occupied dwellings	926
7	440	Real estate	904
8	62	Maintenance and repair construction of nonresidential structures	839
9	154	Printing	824
10	93	Seafood product preparation and packaging	645
11	20	Extraction of natural gas and crude petroleum	564
12	428	Wireless telecommunications carriers (except satellite)	537
13	158	Asphalt shingle and coating materials manufacturing	485
14	209	Other concrete product manufacturing	485
15	438	Insurance agencies, brokerages, and related activities	475
16	437	Insurance carriers	441
17	482	Hospitals	400
18	433	Monetary authorities and depository credit intermediation	392
19	427	Wired telecommunications carriers	361
20	94	Bread and bakery product, except frozen, manufacturing	347
21	460	Marketing research and all other miscellaneous professional, scientific, and technical services	335
22	436	Other financial investment activities	334

Top Ten Industry Sectors by Output: Region 3 – Everglades Adjacent

IMPLAN Sector	Description	Employment	Labor Income (000)	Value Added (000)	Economic Output (000)
62	Maintenance and repair construction of nonresidential structures	13	687	1,021	2,076
20	Extraction of natural gas and crude petroleum	6	27	32	623
440	Real estate	2	29	156	251
395	Wholesale trade	1	86	168	251
154	Printing	2	70	96	240
3	Vegetable and melon farming	2	97	144	223
145	All other miscellaneous wood product manufacturing	1	63	71	218
441	Owner-occupied dwellings	0	0	135	206
442	Automotive equipment rental and leasing	1	51	146	191
94	Bread and bakery product, except frozen, manufacturing	2	49	68	189

Top Ten Industry Sectors by Output: Region 5 – Northern East Coast

IMPLAN Sector	Description	Employment	Labor Income (000)	Value Added (000)	Economic Output (000)
151	Stationery product manufacturing	1	84	155	446
106	Bottled and canned soft drinks & water	1	29	55	378
395	Wholesale trade	1	97	199	306
211	Gypsum product manufacturing	0	39	106	277
409	Rail transportation	1	174	162	270
152	Sanitary paper product manufacturing	0	19	81	205
441	Owner-occupied dwellings	0	0	120	183
108	Breweries	0	32	79	179
154	Printing	1	48	67	163
464	Employment services	2	80	118	153

Top Ten Industry Sectors by Output: Region 6 – Central East Coast

IMPLAN Sector	Description	Employment	Labor Income (000)	Value Added (000)	Economic Output (000)
309	Semiconductor and related device manufacturing	1	203	405	876
43	Electric power generation-Nuclear	1	143	478	802
42	Electric power generation-Fossil fuel	0	40	198	408
20	Extraction of natural gas and crude petroleum	3	1	2	299
62	Maintenance and repair construction of nonresidential structures	2	85	129	290
261	Other fabricated metal manufacturing	1	64	88	225
395	Wholesale trade	1	63	126	191
154	Printing	1	50	70	174
449	Architectural, engineering, and related services	1	80	79	157
441	Owner-occupied dwellings	0	0	103	157

Top Ten Industry Sectors by Output: Region 7 – Orlando Area

IMPLAN Sector	Description	Employment	Labor Income (000)	Value Added (000)	Economic Output (000)
494	Amusement parks and arcades	8	317	549	702
62	Maintenance and repair construction of nonresidential structures	2	114	174	346
395	Wholesale trade	1	110	216	313
440	Real estate	1	27	186	255
106	Bottled and canned soft drinks & water	0	16	31	245
461	Management of companies and enterprises	1	110	129	218
42	Electric power generation-Fossil fuel	0	21	102	210
441	Owner-occupied dwellings	0	0	137	209
427	Wired telecommunications carriers	0	36	89	200
154	Printing	1	60	84	199

Top Ten Industry Sectors by Output: Region 8 – High Agriculture Sales Non-Urban

IMPLAN Sector	Description	Employment	Labor Income (000)	Value Added (000)	Economic Output (000)
42	Electric power generation-Fossil fuel	7	1,012	5,000	10,324
20	Extraction of natural gas and crude petroleum	4	6	11	423
62	Maintenance and repair construction of nonresidential structures	2	83	126	285
395	Wholesale trade	1	92	188	285
441	Owner-occupied dwellings	0	0	182	278
44	Electric power generation-Solar	0	41	187	217
461	Management of companies and enterprises	1	85	101	214
48	Electric power generation-All other	0	144	150	162
414	Scenic and sightseeing transportation and support activities for transportation	1	65	78	152
440	Real estate	1	15	92	152

Top Ten Industry Sectors by Output: Region 9 – Northern and Western Counties

IMPLAN Sector	Description	Employment	Labor Income (000)	Value Added (000)	Economic Output (000)
42	Electric power generation-Fossil fuel	1	120	579	1,180
147	Paper mills	0	43	109	362
20	Extraction of natural gas and crude petroleum	3	17	33	325
405	Retail-General merchandise stores	3	83	131	215
93	Seafood product preparation and packaging	1	21	34	206
134	Sawmills	1	37	40	186
395	Wholesale trade	1	41	86	137
523	Other state government enterprises	1	94	79	132
441	Owner-occupied dwellings	0	0	76	116
154	Printing	1	22	32	92

X. Appendix C. Harmful Algal Bloom Scenarios

The study also presents analysis on a set of alternative scenarios based on the premise that the health of the economy relies on the health of the sanctuary. The scenarios estimate the potential economic impacts from intermittent and long-term harmful algal bloom (HAB) events such as the one that impacted the West Coast of Florida from October 2017 – February 2019. Florida is no stranger to red tide events. The Florida Fish and Wildlife Conservation Commission (FWC) tracks the presence and concentrations of Karenia brevis (K. brevis)—the main culprit behind red tides in coastal Florida—in Southwest Florida (including Monroe County, see Figure C1), Northwest Florida, and along the East Coast. However, the recent red tide event was unprecedented in its impacts upon the marine environment of Southwest Florida, and unprecedented in its impacts on tourism.

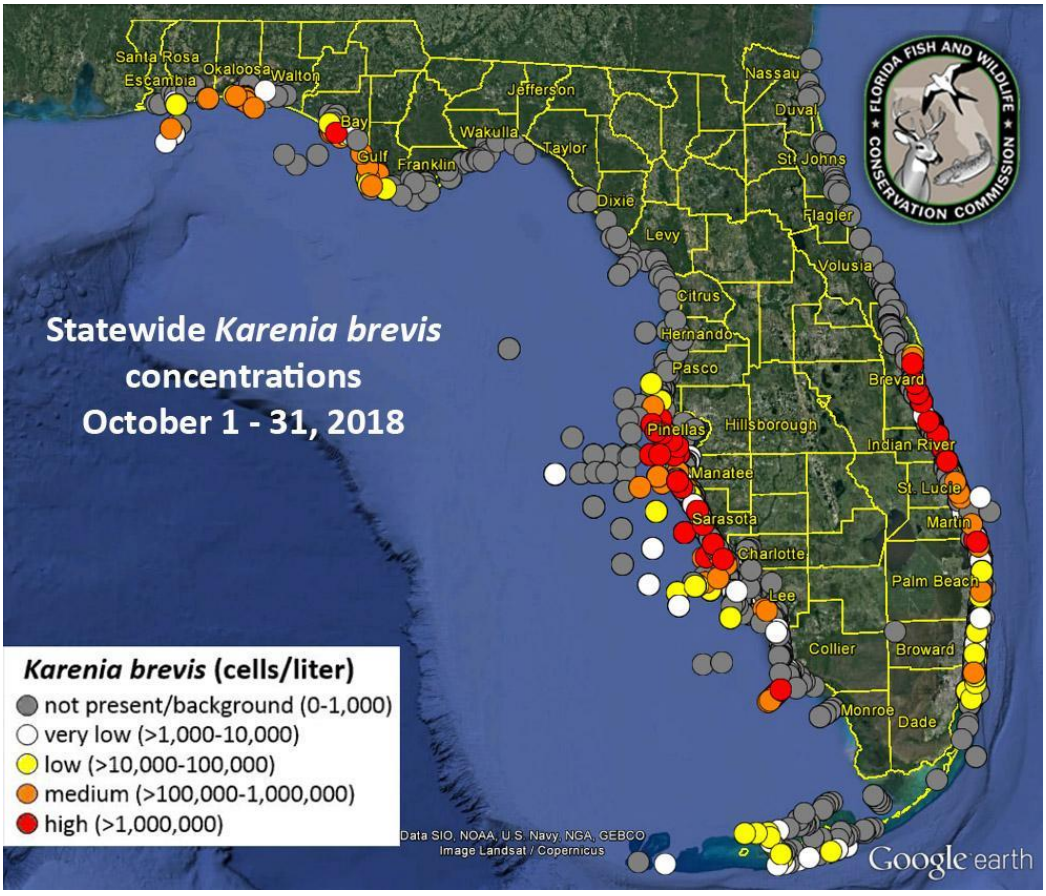


Figure C1. Harmful Algal Bloom Concentrations – October 2018
Source: Florida Fish and Wildlife Conservation Commission, "Red Tide Current Status," https://myfwc.com/research/redtide/statewide/, (May 23, 2019).

Harmful Algal Bloom Scenarios Methodology

The development of scenarios assessing the potential impacts of HAB events started with a comprehensive literature review on the economic impacts of HABs in the state of Florida, and the potential impacts of HABs on recreational and tourism expenditures. Multiple statistical models based on empirical data provided information on reduced revenues at seaside restaurants,[33] health impacts incurred from marine recreation,[34] reduced participation in marine-based activities,[35] and changes in business revenues derived from restaurant and lodging establishments.[36] The authors assessed the timing of HAB events over the study timeframe (2015-2017) using archived Red Tide Status Maps from the Florida Fish and Wildlife Conservation Commission. The framework for the two HAB scenarios was developed using the impacts from the academic literature and the timing of HAB events from 2015-2017.

Two scenarios are premised on *potential HAB events that may occur in the Keys*. One shows the potential impacts of a long-term (persistent) HAB event in Florida Keys NMS, and reflects the impacts across the state. The timing and impacts are intended to be similar to the 2017-2018 HAB event, where businesses have long-term and consistent impacts to their sales, revenues, and wages. The second scenario estimates potential impacts from shorter, but more frequent HAB events that could happen in the Keys. The impacts model ad hoc closures based on average number of beach closures over time, using data from the archived FWC maps. Both scenario analyses used 2015 IMPLAN data – as there were relatively low impacts from HABs that year – and the same baseline tourism and recreation expenditures as were used in the economic contribution analysis. There were much higher incidences of HABs in 2016 and 2018 which would already be implicit in economic data (see Table 1); similarly, the impacts of Hurricane Irma would be reflected in data for 2017. Adjustments to expenditures were determined based on impacts that had been identified in the literature.

For the long-term HAB event scenario, we developed a lower-bound and upper-bound scenario, recognizing that HAB events often vary in duration and impact. For details on the two scenarios, see below:

- **Lower bound:** Reduction of 50% of expenditures for water-based activities, other activities reduced by 15%, which are the minimum reductions found in the literature. This would mimic conditions early in the event, where word of the HAB event hasn't spread beyond the local area yet. The study assumes people are still visiting these areas, but not participating in beach activities. The study assumes that, for the Keys, water-based activities also occur offshore, so there are still some water-related activities that are taking place.

[33] Morgan, K.L., S.L. Larkin, and C.M. Adams. 2009. "Firm-level Economic Effects of HABS: A Tool for Business Loss Assessment". *Harmful Algae* Vol. 9.

[34] Ralston, E.P., H. Kite-Powell, and A. Beet. 2011. "An Estimate of the Cost of Acute Health Effects from Food-and Water-Borne Marine Pathogens and Toxins in the United States." *Journal of Water and Health* 9(4):680-694.

[35] Morgan, K., S.L. Larkin, and C.M. Adams. 2010. "Red Tides and Participation in Marine-based Activities: Estimating the Response of Southwest Florida Residents." *Harmful Algae* 9(3): 333–341.

[36] Larkin, S. and C. Adams. 2007. "Harmful Algal Blooms and Coastal Business: Economic Consequences in Florida." *Society and Natural Resources* 20(9): 849-859.

- **Upper Bound:** Reduction of 70% of water-based expenditures, 35% of lodging expenditures and other industries related to lodging. Reduction of 37% on restaurants, related industries, and all other land-based tourism expenditures. Reductions of 70% and 37% are the highest levels of impact presented in the literature, for water-related activities and restaurant patronage, respectively, and the most recent.[37] They are then appropriate for the upper bound scenario. A reduction of 35% of lodging expenditures was found in multiple analyses in 2006 and is also based on empirical evidence.[38]

Table 1. HAB Impacts for Collier, Monroe and Miami-Dade Counties. 2013-2018

Year	Months Impacted*	Total Number of Months	HAB-impact Ratio (Months impacted/12)
2013	Jan, Feb, Apr, Dec	4	.33
2014	Nov, Dec	2	.16
2015	Dec	1	.08
2016	Feb, Mar, Oct, Nov, Dec	5	.42
2017	Feb	1	.08
2018	Jan, Feb, Mar, Apr, Jun, Jul, Aug, Sep, Oct, Nov, Dec	11	.92
Average		**4**	**.33**

Source: https://www.flickr.com/photos/myfwc/sets/72157635398013168/
*Note: Impact is defined by presence of HAB in Collier, Monroe, or Miami-Dade County >10,000 cells/liter.

For the short-term, but more frequent HAB event scenario, we used FWC archived red tide maps to determine the number of months where HAB events were present in Collier, Monroe, or Miami-Dade counties over a six-year span (2013-2018). Because IMPLAN and expenditure data is only available by year, we then used the number of months to establish a HAB-impact ratio for each year, which is the number of months that HABs were present divided by the total months in a year (12). The HAB-impact ratio, ranged from .08 in 2015 to .92 in 2018 (See Table 1). It was averaged over the six-year span to create a single multiplier (.33) that was applied to the recreation and tourism expenditure data for 2015 so that the impacts from the short-term HAB events described below only impact recreational expenditures for 4 months of the year.

- **Short-term Impacts:** Reduction of 15% on restaurants, related industries and other land-based sources of recreation and tourism. Reduction of 35% on lodging and related industries. Reduction of 50% on water-based activities, as above this assumes that there is offshore recreation that may not be impacted by the HABs, and is a conservative estimate as compared to the 70% reduction in beach related activities identified in the literature.[39]

[37] Morgan, K., S.L. Larkin, and C.M. Adams. 2010.

[38] Larkin, S. and C. Adams. 2007. A multiple regression time-series model was used to measure the impact of a red tide event on the business activity in the study area. Results revealed that the presence of a red tide event resulted in a statistically significant decline in revenues for both restaurants and lodging establishments, by approximately $2.8 million and $3.7 million, respectively.

[39] Morgan, K., S.L. Larkin, and C.M. Adams. 2010.

Potential Economic Impacts of Harmful Algal Blooms

Many studies have assessed the impacts of HABs on the state and local economy, in particular those parts of the economy that support or are supported by recreation and tourism along the coast. Seaside restaurants and hotels are often hit hard, with impacts of up to 29% on restaurant revenues when red tide conditions were present, and as much as 35% losses to the lodging sector.[40] Locals and tourists also spend up to 70% less time at beaches,[41] and U.S. beach goers incur up to $300 million in health care costs due to gastrointestinal illness from beach exposure to HABs annually.[42]

In 2017 and 2018, Florida experienced an unusually persistent HAB event. The economic and ecological impacts of the event were widespread and elevated the problem to the national spotlight. National news outlets covered the story in depth, noting the impacts to local fishermen,[43] tourism,[44] and the health impacts on people and wildlife.[45,46] Local, and world-renown, fly-fishing guide Captain Will Benson likens the impacts to "living next to a war-zone," that can "completely and radically change your life and livelihood." Benson is a flats fisherman in the Florida Keys. The impacts of the HAB event were not as destructive to the Keys as they were to counties along the Southwest coast, however, the environmental and economic impacts were still strong in Monroe County. Benson noted that recreational fishermen and guides from the areas most heavily impacted are moving down to the Keys, which causes conflict between the resident flats fishermen and those that have been displaced from elsewhere, and paces additional pressure on resources.[47] Local scientists from the Bonefish and Tarpon Trust note that the Keys flats fishery is already at over capacity,[48] and that monitoring data is lacking, as the fishery has no commercial component.

[40] Morgan, K., S.L. Larkin, and C.M. Adams. 2010.

[41] Larkin, S. and C. Adams. 2007.

[42] Ralston, E.P., H. Kite-Powell, and A. Beet. 2011.

[43] New York Times. "'The Worst I've Ever Seen It': Lean Stone Crab Season Follows Red Tide in Florida". Dec. 6, 2018. https://www.nytimes.com/2018/12/16/us/stone-crabs-florida-algae-red-tide.html

[44] Washington Post. "Florida's unusually long red tide is killing wildlife, tourism and businesses". Aug. 28, 2018. https://www.washingtonpost.com/national/health-science/floridas-unusually-long-red-tide-is-killing-wildlife-tourism-and-businesses/2018/08/28/245fc8da-aad5-11e8-8a0c-70b618c98d3c_story.html?utm_term=.c80d91a50b02

[45] Ibid.

[46] New York Times. "The Deadly Toll of the Red Tide". Aug. 31, 2018. https://www.nytimes.com/2018/08/31/us/algae-toxic-florida-dead-animals-red-tide.html

[47]

[48] Adams, Aaron and Ross Boucek. Interview with Tracy Rouleau. Personal Interview. Phone Call. May 29, 2019.

"It's like living next to a war zone. The fisheries will recover eventually, but the people won't recover. These events completely and radically change your life and livelihood" ~ Captain Will Benson

This assessment examines the potential economic impacts resulting from lost tourism and recreation revenues across the State of Florida for two different types of HAB events, a long-term, persistent event such as the one experienced in 2017-2018, and shorter term HAB events, such as those that impact the state more regularly. Because the literature shows variation in the potential economic impacts, the upper and lower bounds of the scenario represent the maximum and minimum values derived from the literature. The persistent HAB event shows the potential economic impacts on economic outputs to the State of Florida from a full year HAB event. Potential impacts range from approximately $657 million to over $1.5 billion annually, with regions 1, 2, 4, and 8 experiencing the highest impacts, respectively (See Table C2). Table C3 shows the potential impacts from the more short-term type of HAB events that frequent Florida coastal waters if they were to happen in the Keys, what could be considered as "normal" impacts for any given year. It is based on the average number of months that red tide is present in Florida waters, with impacts on both land-based and water-based recreation and tourism derived from the literature. The analysis shows that in a normal year, the impacts to the state of Florida from HAB events impacting Florida Keys NMS could result in approximately $389 million.

Harmful algal blooms alone threaten nearly $400 million in damages annually, with extreme events, such as the HAB outbreak in 2017-2018 able to cause billions worth of damage. HAB events also impact the health of Floridians and tourists, causing them to spend less time at the beach, and more money on HAB-related illnesses. If left unchecked, these impacts will continue to grow, and Florida risks losing additional tourism and recreation expenditures.

"Normal" economic impacts from HABs are estimated at $389 million annually, an extreme HAB event in the FKNMS could cause up to $1.5 Billion in damages.

Table C2. Potential Impacts on Economic Output in Florida from Persistent HAB Event in the Florida Keys

Regions	Impact from Persistent HAB Event (Upper Bound)	Impact from Persistent HAB Event (Lower Bound)
Region 1	$1,433,742,489	$607,927,608
Region 2	$80,101,997	$34,018,836
Region 3	$3,154,051	$1,343,060
Region 4	$15,475,245	$6,548,447
Region 5	$2,662,900	$1,129,162
Region 6	$2,782,426	$1,187,330
Region 7	$2,886,701	$1,233,318
Region 8	$6,464,688	$2,732,942
Region 9	$2,129,128	$903,803
Totals	**$1,549,399,627**	**$657,024,507**

Table C3. Potential Impacts on Economic Output in Florida from Short-Term HAB Event

Region	Impact from Short-Term HAB Event
Region 1	$360,634,324
Region 2	$19,585,004
Region 3	$784,752
Region 4	$3,812,606
Region 5	$646,089
Region 6	$674,558
Region 7	$725,553
Region 8	$1,644,055
Region 9	$538,316
Totals	**$389,045,257**