# DO FEDERALLY-MANAGED FISH SPECIES HAVE A BETTER STOCK STATUS THAN STATE-MANAGED SPECIES?

By

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# Executive Summary

The United States is widely considered to have a robust and successful federal fisheries management system. Since the late 1990s, 47 federally-managed fish stocks have been rebuilt. Much is known about federal fisheries management in the United States, but there is a gap in our understanding of state-level fisheries management and whether the states can achieve similarly successful stock status outcomes. This study aims to address that gap. Similar studies, such as Hilborn et al. 2019, have investigated the effect of fisheries management intensity on global stock status outcomes. Hilborn et al. found that regions with more intense fisheries management had, on average, better stock status outcomes than regions with less-developed fisheries management.

In the United States, the Magnuson Stevens Fishery Conservation and Management Act (MSA) is the primary piece of federal-level fisheries legislation. It established 10 National Standards and 8 regional fishery management councils, which are required to abide by the National Standards when developing and implementing fishery management plans (FMPs) for all federally-managed fish stocks within the Exclusive Economic Zone (EEZ, 3 – 200 nautical miles). On the contrary, states implement their own fisheries management rules and regulations for fish stocks located within their territorial waters (0 – 3 nautical miles, with exceptions) based on their own priorities. These priorities have the potential to favor conservation outcomes over economic outcomes, or vice versa, and vary state-to-state.

Due to the generally stricter regulations put in place by the MSA and that any changes made to the MSA are implemented on a much broader scale, as compared to the states where management changes do not have a legislative effect on other states, the hypothesis for this research is as follows: federally-managed fish stocks have better stock status than state-managed fish stocks.

The federal category includes the New England Fishery Management Council, the Mid-Atlantic Fishery Management Council, and the South Atlantic Fishery Management Council. The state category includes the Atlantic States Marine Fisheries Commission, Rhode Island, Maryland, North Carolina, and Florida. Biomass, fishing mortality, and biological reference point data (BRPs, $B_{MSY}$ and $F_{MSY}$) were obtained through stock assessments and FMPs published on the various Council, Commission, and state marine resource agency websites. Statistical analysis and Kobe plots were generated in R Studio (version 2022.12.0).

The findings of this paper suggest that federally managed fish stocks have, on average, better fishing mortality ratios than state-managed fish stocks. It seems this may be because the MSA has stricter and more robust regulations when compared to the selected state fishery management laws. Further analysis is needed to accurately assess the correlation between stock status outcomes and policy and fisheries management structures of federal and state-managed fish stocks in the United States.

This work is part of a larger North Carolina state-funded project led by the University of North Carolina – Chapel Hill Collaboratory that assesses the status of North Carolina fisheries and fisheries management to other management agencies on a federal and state level. These findings will continue to be expanded upon and will support the development of recommendations on how North Carolina may be able to improve the status of its fisheries and fisheries management. A report from the Collaboratory will be ready in the summer of 2025.

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## Introduction

There is widespread concern over the status of fish stocks globally (FAO, 2022; Hilborn et al., 2020; Worm et al., 2009). Many stocks continue to experience declines in biomass due to changes occurring in the climate and increased fishing pressure (FAO, 2022). Understanding the effect that various fishery management strategies have on improving stock statuses is incredibly important when implementing regulations to improve the status of these stocks (FAO, 2022; Hilborn et al., 2020; Sissenwine et al., 2014; Worm et al., 2009). Hilborn et al. (2019) analyzed data from half of the world's reported marine fish catch and compared abundance and fishing pressure trends in regions with varying levels of fisheries management. A clear relationship was found between fishing pressure and management intensity. Regions that did not have highly-developed fisheries management had harvest rates that were three times larger and abundance levels that were only half of those in regions with more intense fisheries management (Hilborn et al., 2020). Although the study showed a significant decrease in fishing pressure along the East Coast of the United States since the 1990s, the assessment lacked data from state-managed species, only using data from federal and inter-jurisdictional sources. Specifically, data from the Atlantic States Marine Fisheries Commission, the Northeast Fisheries Science Center, and Southeast Fishery Science Center were used, with the exception of data from Maryland, which was used for the blue crab stock.

Generally, fisheries management in the United States is considered a success. Enacted in 1976, the Magnuson-Stevens Fishery Conservation and Management Act (MSA or the Act) laid the foundation for federal fisheries management by developing eight regional management bodies that manage fish stocks in federal waters through the development of fishery management plans (FMPs) (Magnuson-Stevens Fishery Conservation and Management Act, 2007). On the

East Coast, the New England Fishery Management Council (NEFMC), the Mid-Atlantic Fishery Management Council (MAFMC), and the South Atlantic Fishery Management Council (SAFMC) are the three federal councils in place to manage fish stocks. The NEFMC manages 29 species, the MAFMC manages 14 species, and the SAFMC manages 75 species (U.S. Regional Fishery Management Councils, 2023).

Over time, federally-managed fisheries eventually became overfished. Too many people were fishing too few fish, causing fishery managers to put a moratorium on fishing certain stocks. Although the status of federal-managed fisheries has improved remarkably in recent years, the MSA has undergone multiple reauthorizations and amendments to correct former fishery management approaches. Since the passing of the 1996 Sustainable Fisheries Act, 47 federally-managed fish stocks have been rebuilt. The National Oceanic and Atmospheric Administration (NOAA) currently manages 460 stocks and has determined the overfishing and overfished status of 322 stocks and 252 stocks, respectively. As of 2021, only 8% of federally-managed fish stocks are subject to overfishing, while 20% are overfished (NOAA Fisheries, 2022).

The regional fishery management councils manage fish stocks from 3 to 200 nautical miles offshore (the exclusive economic zone, or EEZ). The states along the US east coast manage fish stocks located in their territorial waters, 0 to 3 nautical miles offshore (NOAA, 2022). To facilitate the cooperative management of fish species that migrate across the boundaries of US east coast states, an interstate compact created the inter-jurisdictional Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC coordinates managing and conserving 27 nearshore species along the East Coast (ASMFC, n.d.-a). All states along the US East Coast have representatives involved in developing ASMFC FMPs (ASMFC, n.d.-b).

To aid the ASMFC in its mission, the Atlantic Coastal Fisheries Cooperative Management Act states that all states included in an ASMFC FMP must implement the required provisions in the plan. For other fisheries that occur only within the various state boundaries, the states themselves are left to define appropriate fisheries management schemes for that state's priorities. In this paper, four states were selected to assess the stock status of their fisheries: Rhode Island, Maryland, North Carolina, and Florida. All four states have legislation that codifies the development of FMPs for commercially and recreationally significant marine species (*Chapter 379 Section 2401 - 2022 Florida Statutes - The Florida Senate*, n.d.; Maryland Department of Natural Resources, n.d.-b; North Carolina Department of Environmental Quality, n.d.; Rhode Island Freedom to Fish and Marine Conservation Act, n.d.). The frequency of updates and the type of information included in FMPs varies state-to-state. The same can be said regarding fisheries management intensity. For example, Maryland legislation requires ecosystem-based considerations to be included in FMPs, and they are the only state with legislation that explicitly outlines that intervention is required when a stock is found to be overfished (Maryland Department of Natural Resources, n.d.-b, n.d.-a). Although it is essential for each State to have autonomy in managing natural resources, as confirmed by the Supreme Court and the Submerged Lands Act, comprehending the fundamental principles of fisheries management outlined in state laws provides the necessary context to understand the condition of fish stocks.

Given what appears to be stronger legislation and potentially more resources at the federal level, we test the hypothesis that the stock status of federally-managed species is better than the stock status of state-managed species. If we find that federally-managed species have better stock status, then states should consider implementing fishery assessment and management strategies that are similar to the federal system. To address this hypothesis, we will examine the status of fish stocks along the East Coast managed by federal councils (NEFMC, MAFMC, and SAFMC) and the states (ASMFC, Rhode Island, Maryland, North Carolina, and Florida). The paper will explore the foundations of fisheries management at both federal and state levels, including relevant legislation and litigation that has shaped current fisheries management practices. This paper will conclude by reflecting on the differences between fisheries management legislation on a federal and state level and will discuss how the data and analysis will be used in future work.

## Magnuson-Stevens Fishery Conservation and Management Act

The 1976 MSA provided a basis for fisheries management in federal waters (Magnuson-Stevens Fishery Conservation and Management Act, 2007). The MSA created eight regional fishery management councils (New England Fishery Management Council, Mid-Atlantic Fishery Management Council, South Atlantic Fishery Management Council, Caribbean Fishery Management Council, Gulf of Mexico Fishery Management Council, Pacific Fishery Management Council, West Pacific Fishery Management Council, and the North Pacific Fishery Management Council) made up of regional stakeholders, including state representatives and regional federal representatives. These Councils, tasked with developing fishery management plans (FMPs) for stocks within their geographical region, manage fisheries that exist in waters extending from 3 to 200 nautical miles offshore (the exclusive economic zone [EEZ]) (Magnuson-Stevens Fishery Conservation and Management Act, 2007). The MSA establishes a requirement for FMPs to be developed for all federally managed fish stocks. These FMPs must meet a set of standards, which are defined in the Act, and are subject to approval by the Secretary of Commerce (Magnuson-Stevens Fishery Conservation and Management Act, 2007). FMP regulatory measures can include gear type restrictions, seasonal fishing closures, catch quotas, and licensing and permits, among other things (Wallace & Fletcher, n.d.).

The MSA was initially passed to address issues of foreign vessels fishing in United States waters and to promote the increase in size of domestic fishing fleets. The Act has been reauthorized multiple times, with the 1996 Sustainable Fisheries Act (SFA) and the 2007 Magnuson-Stevens Fishery Conservation and Management Reauthorization Act.

Between 1976 and 1996, the United States saw a significant reduction in fish stocks' biomass, or abundance, due to the substantial overcapitalization of the fleets (Campbell, 2019). While this boom in the industry followed the premise of the 1976 MSA, the growth was unsustainable, and changes were needed to address the drastic decline in fish stocks.

In 1996, Congress enacted the SFA (PL 104-294) to address overfishing issues. Managers were prohibited from using any justification that allowed catch targets to exceed the maximum sustainable yield. It was also required that a quantitative definition for “overfishing” (the maximum allowed rate of fishing mortality) and “overfished” (a reduction of biomass below a certain level) be made for all federally managed fish stocks and that if a species were overfished, a rebuilding plan must be put in place that allowed the stock to recover to a specific target level within 10 years. The SFA also established definitions for terms such as "overfished" and "overfishing" (16 USC § 1802 (33)):

> "The terms "overfishing" and "overfished" mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis."

In addition, three national standards that focused on the protection of essential fish habitat and the conservation of fisheries through the reduction of bycatch were added to the 10 National

Standards (see below) (Wallace & Fletcher, n.d.). All FMPs prepared by the Councils, and "any regulation promulgated to implement such plan," follow the 10 National Standards for fishery conservation and management (16 USC 1851 § 301).

Subsequent litigation further clarified necessary management and regulatory practices to implement the National Standards correctly. For example, *Natural Resource Defense Council, Inc. v. Daley* challenged the National Marine Fisheries Service (NMFS) and the MAFMC harvest quota for the 1999 summer flounder season with the plaintiffs claiming that the quota set did not fall in line with the second National Standard (*Natural Resources Defense Council v. Daley*, 2000). The National Resource Defense Council (NRDC) argued that there was not enough proof that the quota would meet the conservation goals of the MSA, stating that it only had an 18% likelihood of meeting those goals. The court ruled that "to achieve the target F [fishing mortality], to "prevent overfishing" … the TAL [total allowable landings] must have at least 50% chance of attaining an F of 0.24," (*Natural Resources Defense Council v. Daley*, 2000).

Litigation can be a very powerful tool when it comes to identifying and implementing changes in management actions that are necessary to achieve the rebuilding of fish stocks and to maintain acceptable stock statuses. *NRDC Inc. v. Daley* set a precedent for how fisheries managers set biomass and fishing mortality targets. Reauthorizations are a time-consuming process that does not allow for all aspects of fisheries management to be adequately addressed. The SFA achieved a lot in pushing the MSA to take a conservation and protective approach to managing U.S. fish stocks. Management plans stopped being developed in ways that promoted industry growth. While the SFA represented a step in the right direction, more changes became necessary for the Act to facilitate the rebuilding of all overfished fish stocks.

In 2007, the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act contained additional mandates that strengthened the rebuilding plan process and increased accountability for Councils that failed to improve the status of overfished stocks (Magnuson-Stevens Fishery Conservation and Management Act, 2007). The 2007 reauthorization added requirements for all FMPs to include conservation mandates and create Annual Catch Limits (ACLs) to prevent overfishing (16 USC § 1853 (a)(15)). Previously, the Councils themselves were tasked with setting quotas. The 2007 reauthorization shifted this responsibility to the Science and Statistical Committee (SSC), which is tasked with providing scientific advice to the Councils for fishery management decisions (U.S. Department of Commerce, 2007). The reauthorization also mandated the inclusion of multiple Accountability Measures (AMs) in FMPs that addressed issues of overharvesting, including identifying operational factors that led to the over-harvest, and creating contingency plans designed to mitigate potential harm to the fish stock (Campbell, 2019).

Since 2000, 47 fish stocks have been rebuilt (NOAA Fisheries, 2022). As of 2021, only 8% of fish stocks are subject to overfishing, while 20% are overfished (NOAA Fisheries, 2022). These numbers reflect significant progress in the nation's ability to manage fish stocks. For the MSA to remain successful, modifications will be needed to adapt to the ongoing changes fish stocks are currently experiencing. Efforts to modernize the MSA by integrating a climate resilience approach to management are underway with Sustaining America's Fisheries for the Future Act (HR 4690), introduced by Representatives Jered Huffman (D-CA) and Ed Case (D-HI) (H.R.4690 - 117th Congress (2021-2022): Sustaining America's Fisheries for the Future Act of 2022, n.d.). This bill proposes amendments to the MSA that would prepare fisheries and fishing communities to be resilient to climate change and improve representation and accountability for fishery managers alongside initiatives to reduce bycatch and rebuild fish stocks by adapting management practices to facilitate an ecosystem-wide understanding of fisheries (H.R.4690 - 117th Congress (2021-2022): Sustaining America's Fisheries for the Future Act of 2022, n.d.).

## State Seaward Jurisdiction and the Submerged Lands Act

Before 1945, there was little argument over which government entity, state or federal, had authority over marine resources and the seabed; states had authority off their coasts? Or feds . In 1947, the United States filed a lawsuit against the state of California, *United States v. California*, to establish ownership of submerged lands within three miles of the coast, and thus ownership of all the resources (oil, fish, minerals, etc.) (*United States v. California*, 1947). The Supreme Court determined that California did not own the seabed but also refrained from declaring ownership to the federal government. Ultimately, the Court reasoned that the federal government should prevail due to federal responsibilities, including maintaining national security through the defense of the seas, that outweighed the interests of the states (*United States v. California*, 1947). The ruling was upheld for two other cases decided in 1950, *United States v. Louisiana* and *United States v. Texas*, with the Supreme Court citing *United States v. California* as precedent (*United States v. Louisiana*, 1950; *United States v. Texas*, 1950).

Despite these case rulings, the Submerged Lands Act (SLA) of 1953 recognized the States' claim to natural resources located within the first three miles of coastal submerged lands (Submerged Lands Act, 1968). Natural resources include oil, gas, other minerals, and fish stocks. However, in 1960 two cases were brought to the Supreme Court, *United States v. Louisiana* and *United States v. Florida*, clarifying the jurisdiction of 3 marine leagues (nine nautical miles) for Florida, Alabama, Mississippi, Louisiana, and Texas (*United States v. Florida*, 1960; *United*

*States v. Louisiana*, 1960). The Court heard the arguments of both cases together but gave two opinions. In *United States v. Florida,* the court opinion ruled that the SLA allows Florida to have jurisdiction over "three marine league belt[s] of land" (*United States v. Florida*, 1960). In *United States v. Louisiana* (1960), the Court granted State jurisdiction of "three leagues seaward" for the Gulf Coasts of Texas and Florida. Still, it ruled that the federal government is entitled to all of the natural resources within the Gulf of Mexico that are 3 nautical miles from the coastlines of Louisiana, Mississippi, and Alabama (*United States v. Louisiana*, 1960).

## Atlantic States Marine Fisheries Commission

The Atlantic States Marine Fisheries Commission (ASMFC) is an interstate compact that was ratified by the states and subsequently approved by Congress in 1942. The ASMFC coordinates the management and conservation of 27 species within state waters (out to three nautical miles). Each of the 15 member states along the East Coast have three representatives on the Commission: the state marine resources agency director, a state legislator, and an individual appointed by the governor representing stakeholder interests (ASMFC, n.d.-a).

Funding for the ASMFC is provided through state dues and state and federal grants. Annual state dues are calculated on a state-by-state basis depending on commercial landings and recreational trips (ASMFC, n.d.-a). NOAA Fisheries provides most of the Commission's funding through the Interjurisdictional Fisheries Act (IFA) of 1986 (PL 99-659) and the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) of 1993 (PL 106-555) (NOAA Fisheries, 2020b, 2020a).

The IFA "promote[s] and encourage[s]" management and research that supports the use of "ecosystems and interspecies approaches" for inter-jurisdictional fishery management and conservation on local, state, and federal levels (NOAA Fisheries, 2020b). Funding from the IRA directly supports the management of fishery resources within waters "under the jurisdiction of one or more states and/or in the Exclusive Economic Zone"; have an interstate FMP; or migrate between two or more state jurisdictions (NOAA Fisheries, 2020b).

The ACFCMA supports the interstate fisheries management and cooperation efforts of the ASMFC for activities such as data collection and management, fisheries research (including stock assessments and biological and economic research), law enforcement, habitat conservation, and fisheries management planning (NOAA Fisheries, 2020a). ASMFC has discretion over how the funds received are used as long as funded projects support one of the activities listed above.

## State Fisheries Management

Though the ASMFC requires states to prepare annual compliance reports for 20 species (including, but not limited to, Atlantic croaker, Atlantic sturgeon, black drum, black sea bass, Spanish mackerel, scup, summer flounder, tautog, and weakfish), many states have their own fisheries management legislation dictating state-specific management schemes as well (e.g., Maryland Department of Natural Resources, n.d.-b). State management of fisheries resources takes many forms, ranging from prioritizing conservation approaches to States declaring that economic opportunities for the State and its people shall be balanced alongside conservation initiatives. Some states don't have marine resource management legislation. This section will explore legislation that supports fisheries management operations in Rhode Island, Maryland, North Carolina, and Florida.

### *Rhode Island*

The Rhode Island Marine Fisheries Council (RIMFC) advises the Director of the Rhode Island Department of Environmental Management (DEM), among other agencies, on planning, management, and regulation aspects of the State's marine fisheries. The RIMFC comprises the DEM Director and eight private citizens, including three commercial representatives, three sport fishing representatives, and two representatives with expertise in the conservation and management of fisheries resources (State of Rhode Island Department of Environmental Management, 2023). The RIMFC ensures that its advice is consistent with the Rhode Island Freedom to Fish and Marine Conservation Act (RIFFMCA), which stipulates that the marine waters of the state shall not be closed unless the closure is necessary to “protect, manage, or restore” marine resources,” or public health and safety. The decision must also be based on the best available scientific information (Rhode Island Freedom to Fish and Marine Conservation Act, n.d.).

The RIFFMCA emphasizes the right of Rhode Island residents to engage in commercial and recreational fishing and mandates the collective management of fishing rights with the protection of marine habitats. The DEM Director is also obligated to create and revise conservation and management plans for the state's fishery resources (State of Rhode Island Department of Environmental Management, 2023). These plans must be developed and updated before or simultaneously with the implementation of any limitations on fishing effort or catch.

### *Maryland*

Under state law (§4-215 (b) (1-24)), the Maryland Department of Natural Resources (DNR) must prepare Fishery Management Plans (FMPs) for 25 species and has the authority to create FMPs for additional species without annual amendments to state law (Maryland Department of Natural Resources, n.d.-a, n.d.-b). Maryland’s fisheries management mission is to balance conservation with an equitable use of fishery resources, ensure that management efforts are balanced with ecosystem needs, continuously assess the status and trends of fisheries resources, and ensure accessible and high-quality opportunities for fishing. Maryland's FMPs include ecosystem-based considerations, such as interactions among species and socioeconomic factors, and DNR must take action when data shows that a fish stock is overfished (Maryland Department of Natural Resources, n.d.-a).

### *North Carolina*

The Division of Marine Fisheries (DMF) is responsible for conducting management, research, statistics, and monitoring programs to provide information for decision-making processes carried out by the Marine Fisheries Commission (MFC), a nine-member board appointed by the Governor of North Carolina. The MFC is responsible for the overall management and protection of marine and estuarine resources by adopting rules and implementing management schemes (North Carolina Department of Environmental Quality, n.d.).

The North Carolina Fisheries Reform Act of 1997 (FRA) mandates that Fishery Management Plans (FMPs) be developed for all commercially and recreationally significant fisheries in the state. FMPs are reviewed annually and include information on the current status of the stock relative to overfishing and overfished status (see more on overfished and overfishing in the methods section) (North Carolina Department of Environmental Quality, n.d.). The FRA does state that FMPs should “ensure the long-term viability” of fish stocks by including conservation and management measures that prevent overfishing while still achieving the optimal yield (FISHERIES REFORM ACT OF 1997, n.d.).

*Florida*

Florida state law (379 § 2401) highlights the importance of protecting and enhancing marine and estuarine environments to provide optimal benefits and use to all based on the best available information. The law mandates the development of FMPs to manage "important marine fishery resources, balancing conservation and management efforts to allow for "reasonable means and quantities of annual harvest" that facilitate the maximum growth of a stock.

The Fish and Wildlife Research Institute collects data through fishery monitoring programs, performs assessments, predicts trends in the fisheries, and compiles other biological information to inform the Division of Marine Fisheries Management (MFM). The MFM uses that data to develop regulatory and management recommendations for the Fish and Wildlife Commission to ensure the long-term conservation of marine resources.

## Stock Assessments

Stock assessments play a critical role in ensuring that fisheries management aligns with national and state-level standards. The MSA requires all federal fish stocks with FMPs to be assessed to determine the status of the stock, whether it is overfished or subject to overfishing, in addition to setting annual catch limits. Stock assessments use modeling tools to provide a comprehensive description of the historical and current status of fish stock and estimate the size of the stock while taking into account critical data regarding the stock's life history, geographical range, habitat preferences, and environmental factors that may influence it (Cooper, n.d.; *Fishery Management Guide — Part 1: Why Fishery Management Is Necessary*, 2021). This section will briefly explore the concept of best available science, the types of data used in stock assessments, will describe various methods that are used in stock assessments, and will define what overfished and overfishing means in terms of stock status.

### *Best Available Science*

National Standard 2 of the MSA requires Councils to use the "best available scientific information" when creating stock assessment models (Magnuson-Stevens Fishery Conservation and Management Act, 2007). The term "best available science" has been debated for some time, and many continue to challenge the perspective that "best" can take. Multiple court cases have attempted to clarify what "best available science" constitutes when allowing a stock assessment and FMP to be implemented. With *NRDC v. Evans* the court ruled that "best available" means that the National Marine Fisheries Service does not fail to comply with the MSA simply because the science is not sufficiently sophisticated (*Natural Resources Defense Council, Inc. V. Evans*, 2003). Another court*, Oceana Inc. V. Evans*, found that if data were absent from an FMP, the use of "limited modeling tool[s] supplemented by data from scientific studies left by that modeling" was sufficient to be used as the best available science (*Oceana, Inc. V. Evans*, 2005). In another case, *Blue Water Fisherman's Association v. NMFS*, the court ruled that data does not have to be perfect to invalidate conclusions brought by the agency, nor that the agency needs to provide "airtight and indisputable" evidence in support of their conclusions (*Blue Water Fishermen's v. Nat'l Marine Fisheries*, 2002). With the courts clarifying how National Standard 2 is implemented, stock assessment models use the data collected to predict how fish stocks will fare under various management scenarios and estimate the stock status (Cooper, n.d.; *Fishery Management Guide — Part 1: Why Fishery Management Is Necessary*, 2021).

### *Stock Assessment Modeling and Data Types*

Two types of data are used in stock assessment models: fishery-dependent and fishery-independent data. Fishery-dependent data consists of information collected through the fishery process such as landing records, recreational portside sampling, observer surveys, and vessel monitoring systems (Cooper, n.d.; *Fishery Management Guide — Part 1: Why Fishery Management Is Necessary*, 2021). Fishery-independent data is typically obtained through federal or state government research surveys that do not involve information from commercial or recreational harvest. Types of fishery-independent research surveys use trawls, seines, video, or acoustic gear (Cooper, n.d.).

Data collected helps inform two aspects of the fish stock: the fishery itself and the biological information about the stock. Information about the fishery includes, but is not limited to, pounds of fish caught, fishing effort, the age structure of fish caught, the male-to-female catch ratio, and how the fish are marketed. Biological information about the fish stock includes the age structure of the stock, the age at which the stock spawns, fecundity, male-to-female ratio, fishing mortality, natural mortality, and an estimate of the total number of fish or biomass of the fish in the stock (Cooper, n.d.; *Fishery Management Guide — Part 1: Why Fishery Management Is Necessary*, 2021).

Once this data is collected, researchers use various techniques to model the fish populations and to predict future outcomes when given certain assumptions. For example, if a researcher wanted to estimate how fish stock abundance or recruitment would fare given two possible management strategies, either closing the next fishing season or reducing the harvest quota for the next season, then the relevant data would be inputted into a model that produces likely the likely outcomes of the two management scenarios. Sock assessment model types include data-limited models, index-based models, aggregate biomass dynamic models, virtual population analysis (VPA), statistical catch at length, or statistical catch at age models (NOAA Fisheries, 2023b). Some of these models can estimate the age composition of a stock, a stock's abundance (biomass), and the stock's vulnerability to fishing gear (fishing mortality) (Cooper, n.d.; *Fishery Management Guide — Part 1: Why Fishery Management Is Necessary*, 2021). All of these estimates are used to inform the overall status of the stock.

### *Overfished and Overfishing*

Stock assessments determine the harvest level (quotas, catch level, etc.) limit that ensures enough adult spawning fish are left to repopulate the stock. The harvest levels are not only listed as a catch level, but as target $F_{MSY}$ and $B_{MSY}$ values as well. $F_{MSY}$ refers to the maximum rate of fishing mortality that results in a population size of $B_{MSY}$, which is the size of a population at the maximum growth rate (PEW Charitable Trusts, 2012). These targets are typically estimated between 20 – 50% of the unfished stock size, the estimated size of the stock should no fishing occur. This target varies due to natural mortality and reproduction rates differing from species to species. If a stock size falls below a certain threshold level, or if there are not enough spawning adults to sustain the population over the long term, the stock is considered overfished (Cooper, n.d.; *Fishery Management Guide — Part 1: Why Fishery Management Is Necessary*, 2021).

Two indicators are used to determine whether a stock is overfished or subject to overfishing: fishing mortality (F) and biomass (B) ratios. Fishing mortality measures the intensity with which a stock is being fished, or the fraction of the fish stock that is expected to be caught at any given time. Biomass is the cumulative weight of the fish stock, although sometimes the weight of the sexually mature individuals that can reproduce (SSB) is used instead. A Kobe Plot is used to visualize the status of a fish stock based on the fishing mortality ratio (F/FMSY) and biomass ratio (B/BMSY). If the fishing mortality ratio is greater than 1.0, the stock is subject to overfishing, meaning that the population size is too small to allow for BMSY. On the other hand, if the biomass ratio is less than 1.0, the stock is considered overfished, which means that the stock does not have a high enough biomass to support continued fishing while allowing for growth. While this paper does not explore this, it should be noted that there are nuances to these definitions, such as the difference between defined target BMSY or FMSY and threshold BMSY or FMSY, which can contribute to assigning a "collapsed" or "rebuilding" definition to a stock.

## Methods

Stock condition data were collected from federal and state sources along the East Coast. Data were collected from three regional fisheries management councils (New England, Mid-Atlantic, and South Atlantic), one inter-jurisdictional state management commission (Atlantic States Marine Fisheries Commission), and four states (Rhode Island, Maryland, North Carolina, and Florida). The Gulf of Mexico Regional Fishery Management Council and the fisheries located on the Gulf of Mexico coast of Florida were excluded.

Stock condition data for the New England Fishery Management Council (NEFMC), Mid-Atlantic Fishery Management Council (MAFMC), and South Atlantic Fishery Management Council (SAFMC) were obtained from the National Oceanic and Atmospheric Administration (NOAA) Fisheries' Stock Status, Management, Assessment, and Resource Trends (SMART) website (NOAA Fisheries, 2023a).

The same data was collated for fish stocks managed by the ASMFC, Rhode Island (RI), Maryland (MD), North Carolina (NC), or Florida (FL), by searching the respective marine resource management commission websites (ASMFC, n.d.-a; Florida Fish and Wildlife

Conservation Commission, n.d.; Maryland Department of Natural Resources, n.d.-b; North Carolina Department of Environmental Quality, n.d.; Rhode Island Department of Environmental Management, 2022).

The collected data recorded in Excel included the terminal year of data used in the stock assessments, biomass or spawning stock biomass data in metric tons or millions of pounds, fishing mortality data, and the maximum sustainable yield (MSY) reference points ($B_{MSY}$ or $SSB_{MSY}$ and $F_{MSY}$). Some fish stocks had overfished/overfishing designations but were not supported with biomass or fishing mortality ratios. Those designations were recorded, but the fish stocks were excluded from statistical analysis. The designation of "depleted" fish stocks is due to their low abundance, though it is unclear whether fishing mortality is the main cause. The fish stock's condition was recorded as unknown if no stock condition data or designation was available. If no stock condition was available and no stock assessment was conducted, the stock was recorded as not having a stock assessment.

Biomass and fishing mortality ratios ($B/B_{MSY}$ or $SSB/SSB_{MSY}$ and $F/F_{MSY}$, respectively) were calculated, and Kobe plots for management bodies that had more than three fish stocks with both the biomass and fishing mortality ratios were generated to visualize the fish stock's condition (R Studio, version 2022.12.0). A biomass ratio threshold of 1.0 determined whether a fish stock was overfished (under 1.0) or underfished (above 1.0). A fishing mortality ratio threshold of 1.0 determined whether a fish stock was subject to overfishing (above 1.0) or under fishing (below 1.0).

A Whitney-Mann U test was performed for federal and state biomass and fishing mortality data to test the hypothesis that federal management will lead to lower numbers of overfished/overfishing stocks compared to state management. These tests were done with all stock status data collected and then only with stock status data from terminal years 2017 – 2021.

## Results

*New England Fishery Management Council*

Biomass and fishing mortality ratio data were collected for 15 fish stocks. The average terminal year of the data is 2020. Eight of the 15 stocks are overfished (53.33%). No fish stocks were reported with $F/F_{MSY}$ ratios above 1.0 (Table 1; Table 9; Figure 1). Overfished fished stocks include Atlantic herring – Northwestern Atlantic Coast ($B/B_{MSY}$ = 0.29), Atlantic wolffish – Gulf of Maine/ Georges Bank ($B/B_{MSY}$ = 0.44), ocean pout – Northwestern Atlantic Coast ($B/B_{MSY}$ = 0.03), white hake – Gulf of Maine/Georges Bank ($B/B_{MSY}$ = 0.50), winter flounder – Georges Bank ($B/B_{MSY}$ = 0.36), winter flounder – Southern New England/Mid-Atlantic ($B/B_{MSY}$ = 0.30), yellowtail flounder – Cape Cod/Gulf of Maine ($B/B_{MSY}$ = 0.62), and yellowtail flounder – Southern New England/Mid-Atlantic ($B/B_{MSY}$ = 0.05; Table 1; Figure 1).

*Mid-Atlantic Fishery Management Council*

Biomass and fishing mortality ratio data were collected for 10 fish stocks. The average terminal year of the data is 2020. Six of the 10 stocks are overfished (60%). One of the 10 fish stocks is subject to overfishing (10%; Table 9). Overfished stocks include Atlantic mackerel – Gulf of Maine/Cape Hatteras ($B/B_{MSY}$ = 0.24), bluefish – Atlantic Coast ($B/B_{MSY}$ = 0.48), butterfish – Gulf of Maine/ Cape Hatteras ($B/B_{MSY}$ = 0.69), spiny dogfish – Atlantic Coast ($B/B_{MSY}$ = 0.67), summer flounder – Mid-Atlantic Coast ($B/B_{MSY}$ = 0.86), and tilefish – Mid-

Atlantic Coast ($B/B_{MSY}$ = 0.96; Table 2; Figure 2). The fish stock subject to overfishing includes Atlantic mackerel – Gulf of Maine/Cape Hatteras ($F/F_{MSY}$ = 2.08; Table 2; Figure 2).

*South Atlantic Fishery Management Council*

Biomass and fishing mortality ratio data were collected for 14 fish stocks. The average terminal year of the data is 2018. Eight of the 14 stocks are overfished (57.14%). Six of the 14 fish stocks are experiencing overfishing (42.86%; Table 9). Overfished stocks include black sea bass – Southern Atlantic Coast ($B/B_{MSY}$ = 0.71), gag – Southern Atlantic Coast ($B/B_{MSY}$ = 0.15), hogfish – Florida Keys/East Florida ($B/B_{MSY}$ = 0.38), red grouper – Southern Atlantic Coast ($B/B_{MSY}$ = 0.29), red porgy – Southern Atlantic Coast ($B/B_{MSY}$ = 0.27), red snapper – Southern Atlantic Coast ($B/B_{MSY}$ = 0.44), snowy grouper – Southern Atlantic Coast ($B/B_{MSY}$ = 0.36), tilefish – Southern Atlantic Coast ($B/B_{MSY}$ = 0.93; Table 3; Figure 3). Fish stocks experiencing overfishing include gag – Southern Atlantic Coast ($F/F_{MSY}$ = 2.15), hogfish – Florida Keys/East Florida ($F/F_{MSY}$ = 1.59), red grouper – Southern Atlantic Coast ($F/F_{MSY}$ = 1.54), red porgy – Southern Atlantic Coast ($F/F_{MSY}$ = 1.73), red snapper – Southern Atlantic Coast ($F/F_{MSY}$ = 2.20), and snowy grouper – Southern Atlantic Coast ($F/F_{MSY}$ = 1.13; Table 3; Figure 3).

*Atlantic States Marine Fisheries Commission*

Biomass ratios and fishing mortality ratios were collected for 22 fish stocks. The average terminal year of the data was 2018. Two of the 9 stocks with biomass ratios are overfished (22.22%). Two of the 12 stocks with fishing mortality ratios are subject to overfishing (16.67%). Eight stocks were listed as depleted (Table 9). Overfished stocks include Atlantic striped bass ($B/B_{MSY}$ = 0.57) and tautog – NJ-NYB ($B/B_{MSY}$ = 0.98). Stocks subject to overfishing include red drum – Northern ($F/F_{MSY}$ = 1.10) and red drum – Southern ($F/F_{MSY}$ = 1.34; Table 4; Figure

4). Stocks listed as depleted include American eel, American shad – Coastwide, American shad – Hudson, American shad – Potomac, Atlantic sturgeon, Northern shrimp, river herring, and weakfish (Table 4; Figure 4).

Overfished/overfishing designations were collected for 31 fish stocks. Four stocks are designated as overfished, six stocks are listed as depleted, and one stock is not depleted (Table 4; Figure 4). The four overfished stocks include Atlantic herring, Atlantic striped bass, Bluefish, and Tautog – New Jersey – New York Bight (Table 4; Figure 4). The depleted stocks include American eel, the coastwide American shad stock, American shad – Hudson, American shad – Potomac, Atlantic sturgeon, Northern shrimp, the coastwide river herring stock, and weakfish (Table 4; Figure 4). The American shad – Albemarle Sound stock is listed as not depleted (Table 4; Figure 4). There are no stocks experiencing overfishing (Table 4; Figure 4). Four stocks have an unknown overfished status, and nine stocks have an unknown overfishing status (Table 4; Figure 4).

### *Rhode Island*

Rhode Island manages 19 fish stocks that are commercially and recreationally important, with four being solely managed by the state. The average terminal year of the data is 2014 (Table 9). The soft-shell clam is the only state-managed stock that is listed as depleted and is experiencing overfishing (Table 5).

*Maryland*

Of the 28 fish stocks that are significant for commercial and recreational purposes, Maryland manages eight of them exclusively. The average terminal year of the data is 2017. No fish stocks have an overfished or overfishing stock status. The Eastern oyster is classified as having a depleted abundance status (Table 6).

*North Carolina*

North Carolina lists 41 fish stocks on the North Carolina Marine Resources Division website. Of those stocks, 12 of them are managed by the state. The average terminal year of the data is 2018. Four of the five stocks with biomass ratios are overfished (80%). Five of the five stocks with fishing mortality ratios are subject to overfishing (100%; Table 9). Overfished stocks include blue crab ($B/B_{MSY} = 0.68$), estuarine striped bass – Albemarle Sound & Roanoke ($B/B_{MSY} = 0.29$), Southern flounder ($B/B_{MSY} = 0.26$), and striped mullet ($B/B_{MSY} = 0.42$; Table 7). Stocks that are subject to overfishing include blue crab ($F/F_{MSY} = 1.21$), estuarine striped bass – Albemarle Sound & Roanoke ($F/F_{MSY} = 1.50$), Southern flounder ($F/F_{MSY} = 1.72$), spotted seatrout ($F/F_{MSY} = 1.25$), and striped mullet ($F/F_{MSY} = 1.14$; Table 7; Figure 5).

*Florida*

Of the 52 fish stocks listed on the website, 23 are managed directly by the state. The average terminal year of the data is 2015. Four of the five stocks with biomass ratios are overfished (80%). Three of the five stocks with fishing mortality ratios are subject to overfishing (60%; Table 9). Overfished stocks include common snook – Atlantic ($B/B_{MSY} = 0.96$), Southern flounder, spotted seatrout – Northeast ($B/B_{MSY} = 0.65$), and spotted seatrout – Southeast ($B/B_{MSY}$

= 0.34). Stocks that are subject to overfishing include Southern flounder, spotted seatrout – Southeast ($F/F_{MSY}$ = 1.05), and stone crab (Table 8; Figure 6).

*Proportional Data for Federally-Managed and State-Managed Stocks*

Of the 40 total federally-managed fish stocks, there are 39 stocks with biomass and fishing mortality ratios. The average terminal year of the data is 2019. 22 of the 39 fish stocks are overfished (56.41%). Seven of the 39 fish stocks are subject to overfishing (17.95%; Table 9; Figure 7).

Of the 69 total state-managed fish stocks, there are 20 stocks with biomass ratios and 25 stocks with fishing mortality ratios. The average terminal year of the data is 2016. Ten of the 20 fish stocks with biomass ratios are overfished (50%). 11 of the 25 fish stocks with fishing mortality ratios are subject to overfishing (44%; Table 9; Figure 7).

*Statistical Analysis*

The Whitney-Mann U test was performed in R Studio to assess differences in the overfished (biomass) and overfishing (fishing mortality) status between federally-managed and state-managed fish stocks. The biomass and fishing mortality ratio distributions did not show significant differences between federally-managed stocks and state-managed stocks; the null hypotheses that the distribution of the biomass and fishing mortality ratios are significantly different are rejected (biomass: $W = 330$, $p = 0.34$; fishing mortality: $W = 335$, $p = 0.07$; Table 10). Further analysis took place with biomass and fishing mortality ratios from 2017 – 2021. No significant differences were found in biomass ratio distribution between federally-managed stocks and state-managed stocks ($W = 241$, $p = 0.77$; Table 10). However, the fishing mortality ratio distribution showed a significant difference between the groups (W = 137.5, p = 0.01113; Table 10), with state-managed stocks exhibiting a higher median ratio than federally-managed stocks. The Hodges-Lehmann estimate suggests that the median fishing mortality ratio for state-managed stocks are 0.34 higher than the median for federally-managed stocks (95% CI: 0.08 to 0.58). Consequently, we reject the null hypothesis that the location of the two management groups is not different and support the alternative hypothesis that the true location shift is not equal to 0.

## Discussion

Though far from perfect, the MSA provides a foundation that aims to support the many conservation, economic, and social aspects important in fisheries management. The process of reauthorizing and improving the MSA is tedious and time-consuming, but it also allows for the law to be flexible and evolve with the needs of the nation. When the states implement fisheries management legislation, they are not bound to the rules of the MSA. States develop their own fisheries management rules for stocks located within their territorial waters.

Indeed, we found that, particularly in recent years, the overfishing ratios were higher (more overfishing) in state-managed fisheries compared to federally-managed fisheries. Although we hypothesized this to be the case, the results are a bit surprising as the four states and the ASMFC have legislative aspects that are similar to the language used in the MSA. For example, all four states required the development of FMPs for commercially or recreationally significant fisheries within their jurisdiction, just as is required for federally-managed stocks. The laws also mention using the “best available science” when developing FMPs, similar to the effect of National Standard 2 of the MSA. National Standard 8 states that management efforts must keep the needs of the fishing communities into account. Legislation from the states emphasizes the need to balance the conservation of marine resources with the economic needs of communities that depend on the resource.

While the FMPs developed by the regional fishery management councils are region-specific, they all follow the same fundamental structure when developing FMPs. State FMP structure can vary state-to-state. Maryland state law requires the inclusion of ecosystem-based considerations within their FMPs while Florida, on the other hand, uses a species-specific approach to their fisheries management. This report does not analyze the reality behind the implementation of the various state fisheries management laws, something that is needed to understand the whole context of the problem. Just because Maryland lists out specific requirements of what is to be included in FMPs does not mean there aren't loopholes in the system. Similarly, there may be a significant lack of resources available to properly abide by those rules. Further information and analyses are needed to assess the implementation of state fisheries management laws and regulations.

While federal fisheries management also makes use of species-specific approaches, current reauthorization efforts seek to include much more language on ecosystem-based fisheries management. Should a reauthorization of the MSA take place soon, these changes would take place across all eight Councils. Reauthorization of the MSA allows for a swath of management changes to be made that span the entire EEZ of the United States. As for the States, should Florida, for example, choose to amend its fisheries management legislation and dictate the use of an ecosystem-based approach for all its fisheries, that change would stop at the Georgia and Alabama borders.

The existence of the inter-jurisdictional ASMFC is crucial to filling in these gaps in fisheries management approaches for stocks that migrate across state boundaries. Although the

ASMFC was grouped in with the state category, it seems that fish stocks managed by North Carolina and Florida drive poor stock status outcomes within that category. Of the nine ASMFC-managed fish stocks with both biomass ratios and fishing mortality ratios, only two of those stocks were designated overfished. However, North Carolina and Florida, each having five fish stocks with biomass and fishing mortality ratios, had four and three of their stocks, respectively, designated as overfished. Additionally, five stocks in North Carolina and one stock in Florida were subject to overfishing. This could be because the ASMFC interacts with, and thus to an extent abides by, federal fisheries management schemes with some of the fish stocks they manage. Another explanation could stem from the funding provided by the IFA (i.e., stipulations on what must be done or included to take advantage of the funding) and the ACFCMA (again, another federal-level piece of legislation that might provide guidance like the MSA). Further analysis of these acts and other areas the ASMFC engages with federal-level management is needed to properly attribute a cause.

It is important to note that this study recorded the stock status of fish stocks that did not have biomass or fishing mortality ratios associated with their status outcomes and that there were many stocks managed by the states and the ASMFC that didn't have a stock assessment, but some did have enough evidence to be listed as depleted. These stocks include commercially important stocks such as red drum, shad, shrimp, and blue crab. This provides additional support for the hypothesis of the paper that federally-managed stocks have a better stock status than state-managed fish stocks.

The statistical analysis performed supports the original hypothesis of the paper. Federal stocks with terminal fishing mortality ratio data within 2017-2021 had, on average, a better overfishing status than state-managed stocks ($p = 0.01113$). While this study did not explicitly analyze the effect fisheries management approaches have on stock status, future research efforts will include this data in those analysis efforts. Analyzing the status of fish stocks throughout time would also facilitate connecting fisheries management actions to previous stock statuses and provide insight into how certain approaches may have influenced stock dynamics.

The North Carolina Collaboratory of the University of North Carolina at Chapel Hill has been commissioned to assess the overall status of coastal and marine fisheries regulated by the state. The study will be conducted by researchers from the University of North Carolina Chapel Hill, East Carolina University, North Carolina State University, and the University of North Carolina at Wilmington and will include two components: (1) assessing the status of North Carolina fisheries and (2) exploring management structures or influences and coastal habitat dynamics correlated with fishery status. The data and findings of this paper will be included in further analysis of fishery status across different jurisdictions (the ASMFC, MAFMC, and SAFMC) and within species managed separately by multiple states. The full report will be completed in the summer of 2025.

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# Appendix

**Table 1.** List of fish stocks managed by the New England Fishery Management Council with recorded $B/B_{MSY}$ and $F/F_{MSY}$ values and terminal year of the most recent stock assessment. Data from NOAA's Fisheries' Stock SMART website (NOAA Fisheries, 2023a).

| Stock Name | Year | B/BMSY | F/FMSY | Overfished | Overfishing |
|---|---|---|---|---|---|
| Acadian redfish - Gulf of Maine / Georges Bank | 2020 | 1.54 | 0.45 | N | N |
| American plaice - Gulf of Maine / Georges Bank | 2019 | 1.16 | 0.35 | N | N |
| Atlantic herring - Northwestern Atlantic Coast | 2020 | 0.29 | 0.47 | Y | N |
| Atlantic wolffish - Gulf of Maine / Georges Bank | 2020 | 0.44 | 0.03 | Y | N |
| Ocean pout - Northwestern Atlantic Coast | 2020 | 0.03 | 0.64 | Y | N |
| Pollock - Gulf of Maine / Georges Bank | 2019 | 1.70 | 0.14 | N | N |
| Sea scallop - Northwestern Atlantic Coast | 2020 | 1.43 | 0.56 | N | N |
| Silver hake - Gulf of Maine / Northern Georges Bank | 2020 | 2.24 | 0.05 | N | N |
| Silver hake - Southern Georges Bank / Mid-Atlantic | 2020 | 1.30 | 0.06 | N | N |
| White hake - Gulf of Maine / Georges Bank | 2019 | 0.50 | 0.77 | Y | N |
| Windowpane - Southern New England / Mid-Atlantic | 2020 | 1.50 | 0.75 | N | N |
| Winter flounder - Georges Bank | 2020 | 0.36 | 0.37 | Y | N |
| Winter flounder - Southern New England / Mid-Atlantic | 2020 | 0.30 | 0.27 | Y | N |
| Yellowtail flounder - Cape Cod / Gulf of Maine | 2019 | 0.62 | 0.29 | Y | N |
| Yellowtail flounder - Southern New England / Mid-Atlantic | 2019 | 0.05 | 0.73 | Y | N |

**Table 2.** List of fish stocks managed by the Mid-Atlantic Fishery Management Council with recorded $B/B_{MSY}$ and $F/F_{MSY}$ values and terminal year of the most recent stock assessment. Data from NOAA's Fisheries' Stock SMART website (NOAA Fisheries, 2023a).

| Stock Name | Year | B/BMSY | F/FMSY | Overfished | Overfishing |
|---|---|---|---|---|---|
| Atlantic mackerel - Gulf of Maine / Cape Hatteras | 2021 | 0.24 | 2.08 | Y | Y |
| Atlantic surfclam - Mid-Atlantic Coast | 2020 | 1.19 | 0.26 | N | N |
| Black sea bass - Mid-Atlantic Coast | 2021 | 2.06 | 0.85 | N | N |
| Bluefish - Atlantic Coast | 2021 | 0.48 | 0.95 | Y | N |
| Butterfish - Gulf of Maine / Cape Hatteras | 2020 | 0.69 | 0.24 | Y | N |
| Ocean quahog - Atlantic Coast | 2020 | 1.08 | 0.26 | N | N |
| Scup - Atlantic Coast | 2021 | 1.96 | 0.68 | N | N |
| Spiny dogfish - Atlantic Coast | 2018 | 0.67 | 0.83 | Y | N |
| Summer flounder - Mid-Atlantic Coast | 2021 | 0.86 | 0.81 | Y | N |
| Tilefish - Mid-Atlantic Coast | 2021 | 0.96 | 0.61 | Y | N |

**Table 3.** List of fish stocks managed by the South Atlantic Fishery Management Council with recorded $B/B_{MSY}$ and $F/F_{MSY}$ values and terminal year of the most recent stock assessment. Data from NOAA's Fisheries' Stock SMART website (NOAA Fisheries, 2023a).

| Stock Name | Year | B/BMSY | F/FMSY | Overfished | Overfishing |
|---|---|---|---|---|---|
| Black sea bass - Southern Atlantic Coast | 2018 | 0.71 | 0.64 | Y | N |
| Blueline tilefish - Southern Atlantic Coast | 2017 | 1.06 | 0.92 | N | N |
| Gag - Southern Atlantic Coast | 2021 | 0.15 | 2.15 | Y | Y |
| Greater amberjack - Southern Atlantic Coast | 2020 | 2.10 | 0.40 | N | N |
| Hogfish - Florida Keys / East Florida | 2014 | 0.38 | 1.59 | Y | Y |
| King mackerel - Southern Atlantic Coast | 2020 | 1.74 | 0.29 | N | N |
| Red grouper - Southern Atlantic Coast | 2017 | 0.29 | 1.54 | Y | Y |
| Red porgy - Southern Atlantic Coast | 2020 | 0.27 | 1.73 | Y | Y |
| Red snapper - Southern Atlantic Coast | 2021 | 0.44 | 2.20 | Y | Y |
| Snowy grouper - Southern Atlantic Coast | 2021 | 0.36 | 1.13 | Y | Y |
| Spanish mackerel - Southern Atlantic Coast | 2013 | 1.49 | 0.52 | N | N |
| Spiny Lobster | 2019 | Unknown | N | | N |
| Tilefish - Southern Atlantic Coast | 2021 | 0.93 | 0.95 | Y | N |
| Vermilion snapper - Southern Atlantic Coast | 2018 | 1.13 | 0.61 | N | N |
| Wreckfish - Southern Atlantic Coast | 2014 | 1.58 | 0.58 | N | N |

**Table 4.** List of fish stocks managed by the Atlantic States Marine Fisheries Commission with the terminal year of the most recent stock assessment, $SSB/SSB_{MSY}$ and $F/F_{MSY}$ values, and overfished and overfishing statuses. Data from the ASMFC website (ASMFC, n.d.-a).

| Stock Name | Year | SSB/SSBMSY | F/FMSY | Overfished | Overfishing |
|---|---|---|---|---|---|
| American eel | 2016 | | | Depleted | Unknown |
| American shad - Albemarle Sound | 2020 | | | Not Depleted | Unknown |
| American shad - Coastwide | 2020 | | | Depleted | Unknown |
| American shad - Hudson | 2020 | | | Depleted | Unknown |
| American shad - Potomac | 2020 | | | Depleted | Unknown |
| Atlantic croaker* | 2017 | | | Unknown | Unknown |
| Atlantic menhaden** | 2021 | 1.28 | 0.85 | N | N |
| Atlantic striped bass | 2021 | 0.57 | 0.82 | Y | N |
| Atlantic sturgeon*** | 2017 | | 0.04 | Depleted | N |
| Black drum | 2012 | 1.92 | 0.96 | N | N |
| Cobia - Atlantic | 2011 | 1.29 | 0.60 | N | N |
| Jonah crab | | | | Unknown | Unknown |
| Northern shrimp | 2021 | | | Depleted | N |
| Red drum - Northern | 2013 | | 1.10 | Unknown | Y |
| Red drum - Southern | 2013 | | 1.34 | Unknown | Y |
| River herring^ | 2015 | Moratorium | | Depleted | Unknown |
| Spot^^ | 2017 | | | Unknown | Unknown |
| Tautog - DelMarVa | 2020 | 1.31 | 0.22 | N | N |
| Tautog - LIS | 2020 | 1.32 | 0.79 | N | N |
| Tautog - MARI | 2020 | 1.97 | 0.47 | N | N |
| Tautog - NJ-NYB | 2020 | 0.98 | 0.87 | Y | N |
| Weakfish^^^ | 2017 | 0.31 | 1.01 | Depleted | N |

*The reported Atlantic croaker stock status is from the 2017 ASMFC Stock Assessment Peer Review.
**The ASMFC uses Ecological Reference Points (ERPs) when determining the status of the Atlantic menhaden stock. Population fecundity (FEC) is used instead of SSB.
***To determine the stock status of Atlantic sturgeon, the ASMFC uses total mortality (Z) estimates. Stock status is from the ASMFC 2017 Atlantic Sturgeon Benchmark Stock Assessment and Peer Review Report.
^The ASMFC established a coastwide moratorium on the commercial and recreational harvest of river herring, except for states that have sustainable fishery management plans approved by the ASMFC (NC Wildlife Resources Commission, 2017).
^^The spot stock status is from the 2017 ASMFC Stock Assessment Peer Review Report. No reference points are available for spot due to conflicting trends and insufficient data (ASMFC, n.d.-c).
^^^The weakfish stock assessment uses total mortality (Z) as the reference point for the stock. The fishing mortality value is below 1.0 (ASMFC, n.d.-d).

**Table 5.** List of fish stocks managed by Rhode Island with recorded $SSB/SSB_{MSY}$ and $F/F_{MSY}$ values, terminal year of the most recent stock assessment, and overfished and overfishing designation. Data from the 2022 Rhode Island Sector Management Plan (Rhode Island Department of Environmental Management, 2022).

| Stock Name | Year | SSB/SSBMSY | F/FMSY | Overfished | Overfishing |
|---|---|---|---|---|---|
| Atlantic rock crab | | No Stock Assessment | | Unknown | Unknown |
| Bay quahaug | | No Stock Assessment | | Unknown | Unknown |
| Soft-shell clam* | 2011, 2016 | | | Depleted | Y |
| Whelk** | 2015 | | 0.94 | N | N |

*The depleted status is from Metzger et al., 2016. The overfishing status uses 2011 terminal year data from Gibson, 2012 (Gibson, 2012; Metzger et al., 2016).
**2016 Whelk Stock Assessment indicated the stock was declining but above the biomass threshold.

**Table 6.** List of fish stocks managed by Maryland with recorded SSB/$SSB_{MSY}$ and F/$F_{MSY}$ values, terminal year of the most recent stock assessment, and overfished and overfishing designation. Data from the Maryland Department of Natural Resources website and the 2017-2019 Fishery Management Plans Report to the Legislative Committees (Ave, n.d.; Maryland Department of Natural Resources, n.d.-b).

| Stock Name | Year | SSB/SSBMSY | F/FMSY | Overfished | Overfishing |
|---|---|---|---|---|---|
| Chesapeake Bay Blue Crab* | 2019 | 2.73 | 0.67 | N | N |
| Maryland Catfish Species | 2019 | | | N | N |
| Maryland Coastal Bays Blue Crab | | No Stock Assessment | | | |
| Maryland Coastal Bays Hard Clam | | No Stock Assessment | | | |
| Eastern Oyster | 2019 | | | Depleted | N |
| Spotted Seatrout** | 2014 | | | N | N |
| White Perch | 2014 | | | N | N |
| Yellow Perch | 2019 | | 0.21 | | N |

*The 2020 Chesapeake Bay Blue Crab Advisory Report uses abundance (millions of crabs) and a female-specific exploitation fraction instead of the SSB and F Ratios, respectively.
**2014 is the year of the completed stock assessment used to determine the stock status The stock status is based on a peer-reviewed stock assessment that was completed for the Virginia stock. In the Chesapeake Bay region, Virginia accounts for most of the harvest (Ave, n.d.).

**Table 7**. List of fish stocks managed by North Carolina with recorded SSB/$SSB_{MSY}$ and F/$F_{MSY}$ values, terminal year of the most recent stock assessment, and overfished and overfishing designation. Data from the North Carolina Department of Environmental Quality website and the

2021 Fishery Management Plan Review (North Carolina Department of Environmental Quality, n.d.).

| Stock Name | Year | SSB/SSBMSY | F/FMSY | Overfished | Overfishing |
|---|---|---|---|---|---|
| Bay scallop | | No Stock Assessment | | | |
| Blue crab* | 2016 | 0.68 | 1.21 | Y | Y |
| Eastern oyster | | No Stock Assessment | | | |
| Estuarine striped bass - A-R | 2017 | 0.29 | 1.50 | Y | Y |
| Estuarine striped Bass - CSMA | 2018 | Moratorium | | Unknown | Unknown |
| Hard clam | | No Stock Assessment | | | |
| Kingfishes | | No Stock Assessment | | | |
| Sheepshead | | No Stock Assessment | | | |
| Shrimp | | No Stock Assessment | | | |
| Southern flounder | 2017 | 0.26 | 1.72 | Y | Y |
| Spotted seatrout | 2019 | 1.98 | 1.25 | N | Y |
| Striped mullet | 2019 | 0.42 | 1.14 | Y | Y |

* NCDMF 2018 Blue Crab Stock Assessment uses spawner abundance at FMSY (SPMSY).

**Table 8**. List of fish stocks managed by Florida with recorded $SSB/SSB_{MSY}$ and $F/F_{MSY}$ values, terminal year of the most recent stock assessment, and overfished and overfishing designation. Data from the Florida Fish and Wildlife Conservation Commission website (Florida Fish and Wildlife Conservation Commission, n.d.-a, n.d.-b).

| Stock Name | Year | SSB/SSBMSY | F/FMSY | Overfished | Overfishing |
|---|---|---|---|---|---|
| Atlantic Thread Herring | | | | Unknown | Unknown |
| Ballyhoo & Balao | 2013 | | | N | N |
| Blue Crab | 2011 | | | N | N |
| Bonefish | | Catch-and-Release | | N | |
| Common Snook - Atlantic | 2019 | 0.96 | 0.85 | Y | N |
| Crevalle Jack | | No Stock Assessment | | Unknown | Unknown |
| Florida Permit | | | | Unknown | Unknown |
| Florida Pompano - East Coast | | | | Unknown | Unknown |
| Grunts | | No Stock Assessment | | Unknown | Unknown |
| Kingfishes | | No Stock Assessment | | Unknown | Unknown |
| Ladyfish | | No Stock Assessment | | Unknown | Unknown |
| Pigfish | | No Stock Assessment | | Unknown | Unknown |
| Pinfish | | No Stock Assessment | | Unknown | Unknown |
| Sheepshead - Atlantic | 2015 | 1.93 | 0.36 | N | N |
| Southern flounder | 2018 | | | Y | Y |
| Spanish sardine | | No Stock Assessment | | | |
| Spotted Seatrout - Northeast* | 2017 | 0.65 | 0.90 | Y | N |
| Spotted Seatrout - Southeast* | 2017 | 0.34 | 1.05 | Y | Y |
| Stone Crab | 2011 | | | | Y |
| Stripped Mullet - East Coast | 2013 | 1.5 | 0.58 | N | N |
| Tarpon | | Catch-and-Release | | | |
| Tripletail | | No Stock Assessment | | | |
| White Mullet | 2012 | | | Unknown | Unknown |

*The spotted seatrout stock assessment uses SSB at SPR35% and FSPR35% as proxies for SSBMSY and FMSY, respectively (Muller & Addis, 2016).

**Table 9.** A summary table that provides the number of managed fish stocks, the average terminal year of the data, the number of stocks with biomass ratios, the number of stocks with fishing mortality ratios, the number of stocks that are designated as overfished, the number of stocks that are designated as subject to overfishing, the number of depleted stocks, the percent (%) of stocks that are overfished, and the percent (%) of stocks that are subject to overfishing for each

management body and grouped into all federally-managed fish stocks and all state-managed fish stocks.

| | Stocks | Average Terminal Year | Stocks w/Biomass Ratios | Stocks w/Fishing Mortality Ratios | Overfished | Overfishing | Depleted | Percent Overfished | Percent Overfishing |
|---|---|---|---|---|---|---|---|---|---|
| **NEFMC** | 15 | 2020 | 15 | 15 | 8 | 0 | 0 | 53.33 | 0.00 |
| **MAFMC** | 10 | 2020 | 10 | 10 | 6 | 1 | 0 | 60.00 | 10.00 |
| **SAFMC** | 15 | 2018 | 14 | 14 | 8 | 6 | 0 | 57.14 | 42.86 |
| **ASMFC** | 22 | 2018 | 9 | 12 | 2 | 2 | 8 | 22.22 | 16.67 |
| **RI** | 4 | 2014 | 0 | 1 | 0 | 1 | 1 | 0.00 | 100.00 |
| **MD** | 8 | 2017 | 1 | 2 | 0 | 0 | 1 | 0.00 | 0.00 |
| **NC** | 12 | 2018 | 5 | 5 | 4 | 5 | 0 | 80.00 | 100.00 |
| **FL** | 23 | 2015 | 5 | 5 | 4 | 3 | 0 | 80.00 | 60.00 |
| **All Federal** | 40 | 2019 | 39 | 39 | 22 | 7 | 0 | 56.41 | 17.95 |
| **All State** | 69 | 2016 | 20 | 25 | 10 | 11 | 10 | 50.00 | 44.00 |

**Table 10.** Whitney-Mann U test results comparing state-managed fish stock overfished (biomass) and overfishing (fishing mortality) statuses to federally-managed fish stock statuses. The W and p-values are shown for four statistical analyses: 1) all compiled state-managed biomass ratios compared to federally-managed biomass ratios, 2) all compiled state-managed fishing mortality ratios compared to federally-managed fishing mortality ratios, 3) state-managed compared to federally-managed biomass ratios from stocks with terminal year data between 2017 – 2021, 4) and state-managed compared to federally-managed fishing mortality ratios from stocks with terminal year data between 2017 – 2021.

| | W | p-value |
|---|---|---|
| **Biomass Ratio** | 330 | 0.34 |
| **Fishing Mortality Ratio** | 335 | 0.07 |
| **Biomass Ratio 2017 - 2021** | 241 | 0.77 |
| **Fishing Mortality Ratio 2017 - 2021** | 137.5 | 0.01113* |

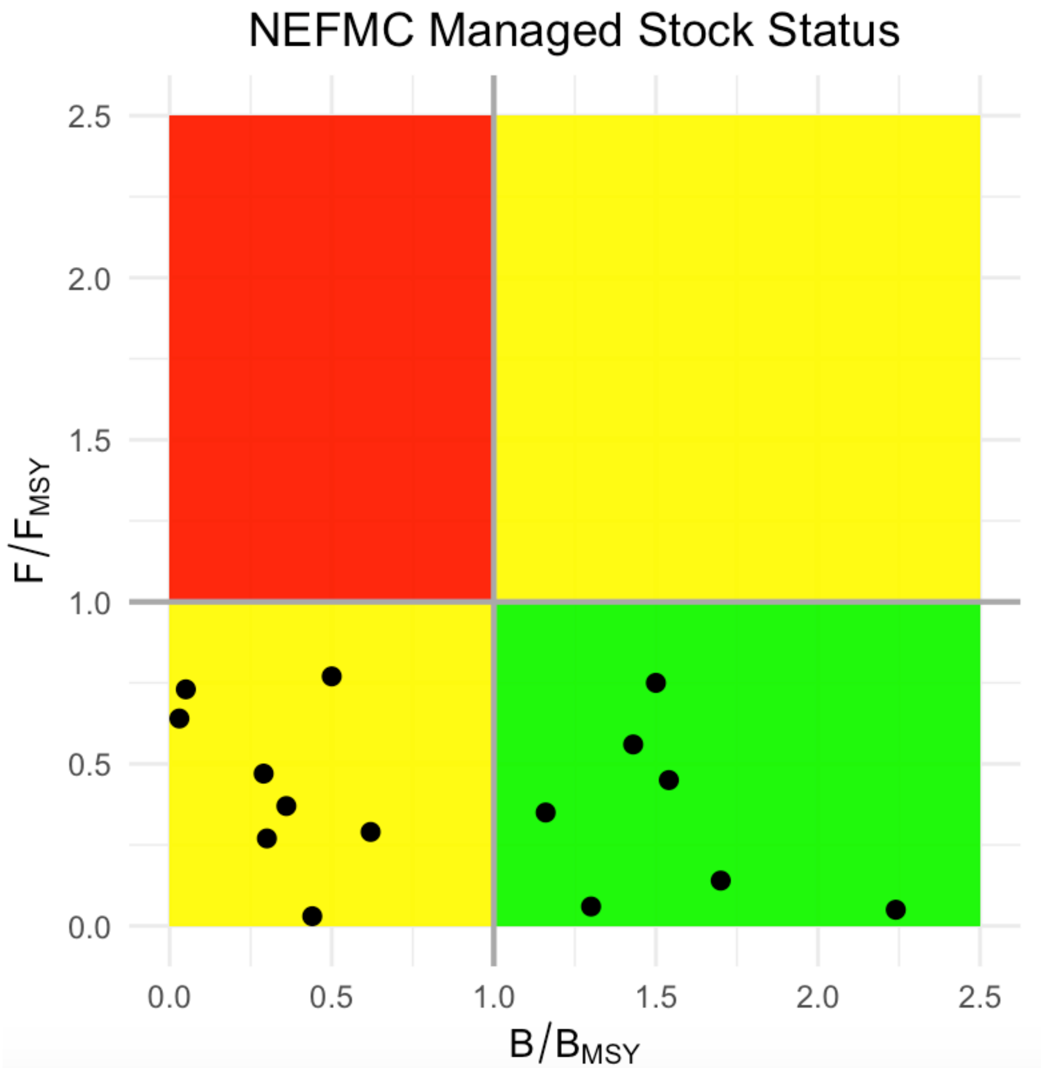


**Figure 1.** Kobe plot showing $B/B_{MSY}$ and $F/F_{MSY}$ values for NEFMC fish stocks. The average terminal year is 2019 (range = 2019 – 2020). Data from NOAA Fisheries' Stock SMART website (NOAA Fisheries, 2023a).

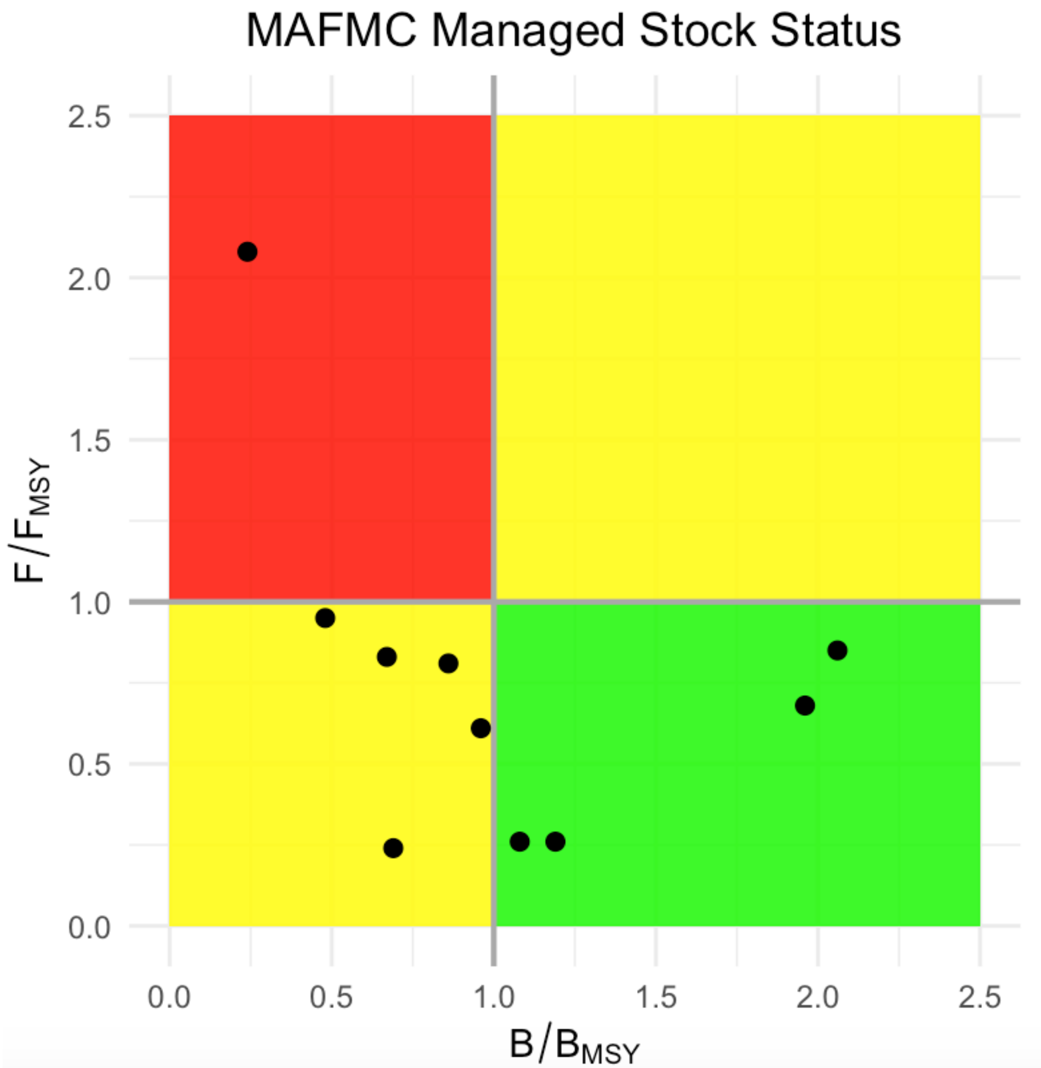


**Figure 2.** Kobe plot showing $B/B_{MSY}$ and $F/F_{MSY}$ values for MAFMC fish stocks. The average terminal year is 2020 (range = 2018 – 2021). Data from NOAA Fisheries' Stock SMART website (NOAA Fisheries, 2023a).

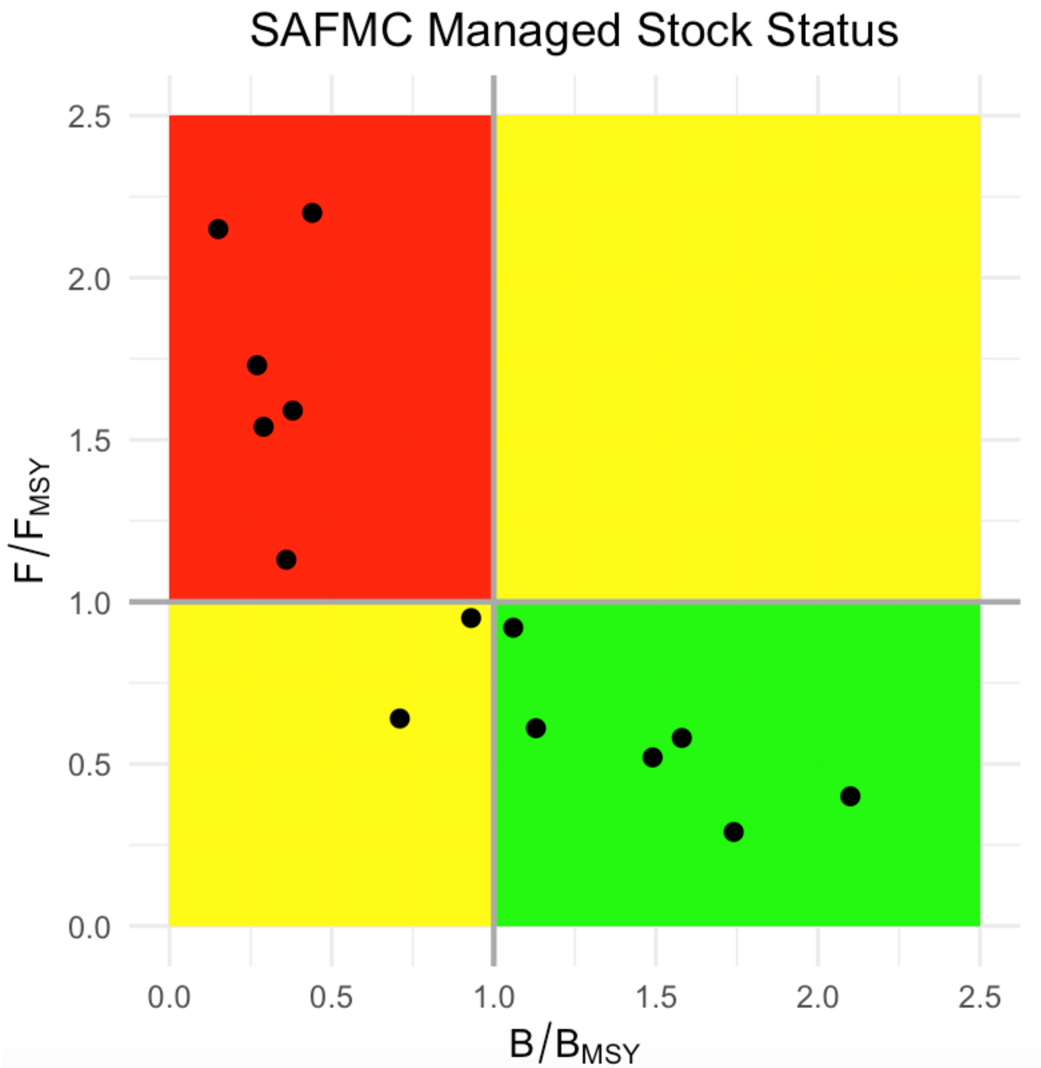


**Figure 3.** Kobe plot showing $B/B_{MSY}$ and $F/F_{MSY}$ values for SAFMC fish stocks. The average terminal year is 2018 (range = 2014 – 2021). Data from NOAA Fisheries' Stock SMART website (NOAA Fisheries, 2023a).

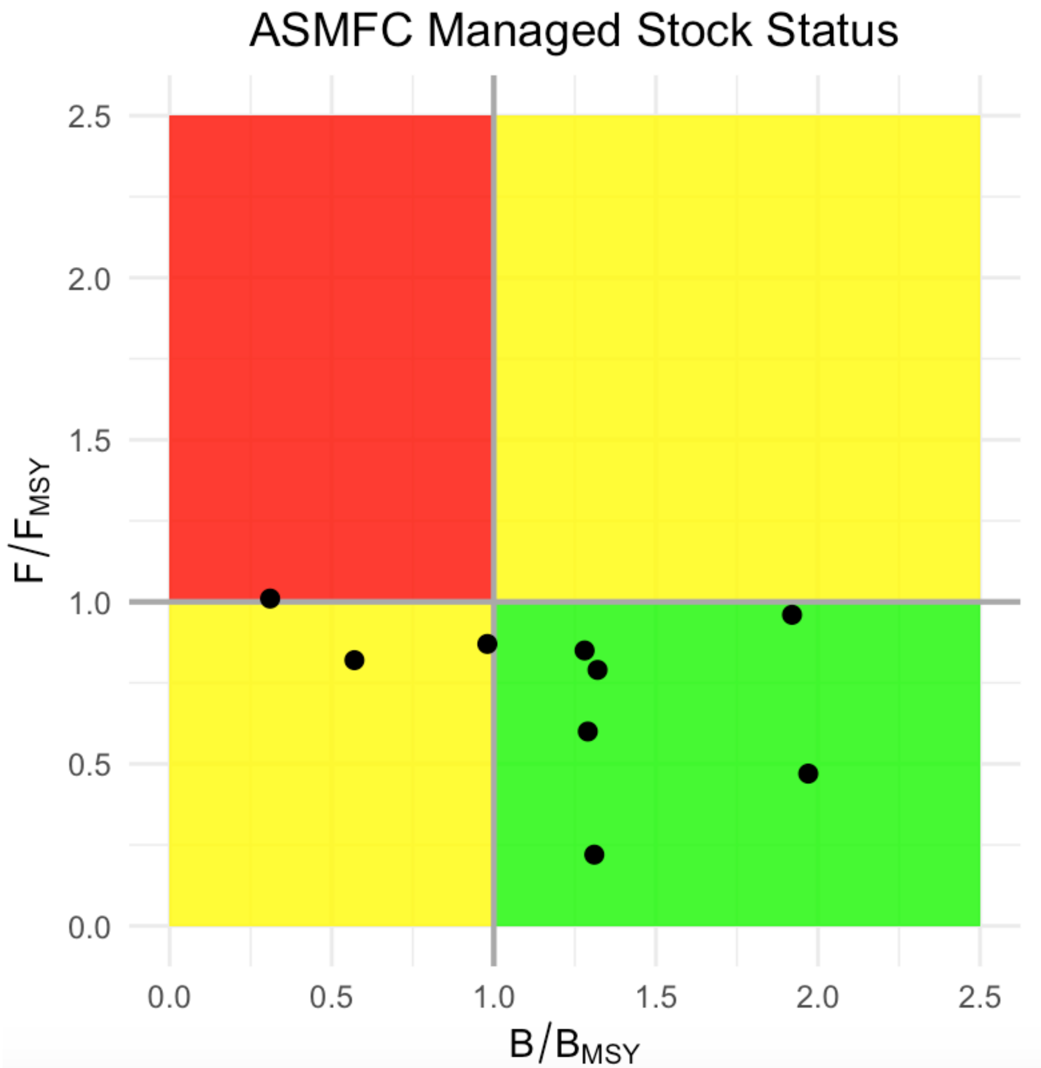


**Figure 4.** ASMFC Kobe Plot. Kobe plot showing $SSB/SSB_{MSY}$ and $F/F_{MSY}$ values for ASMFC fish stocks. The average terminal year is 2018 (range = 2011 – 2020). Data from the ASMFC website (ASMFC, n.d.-a).

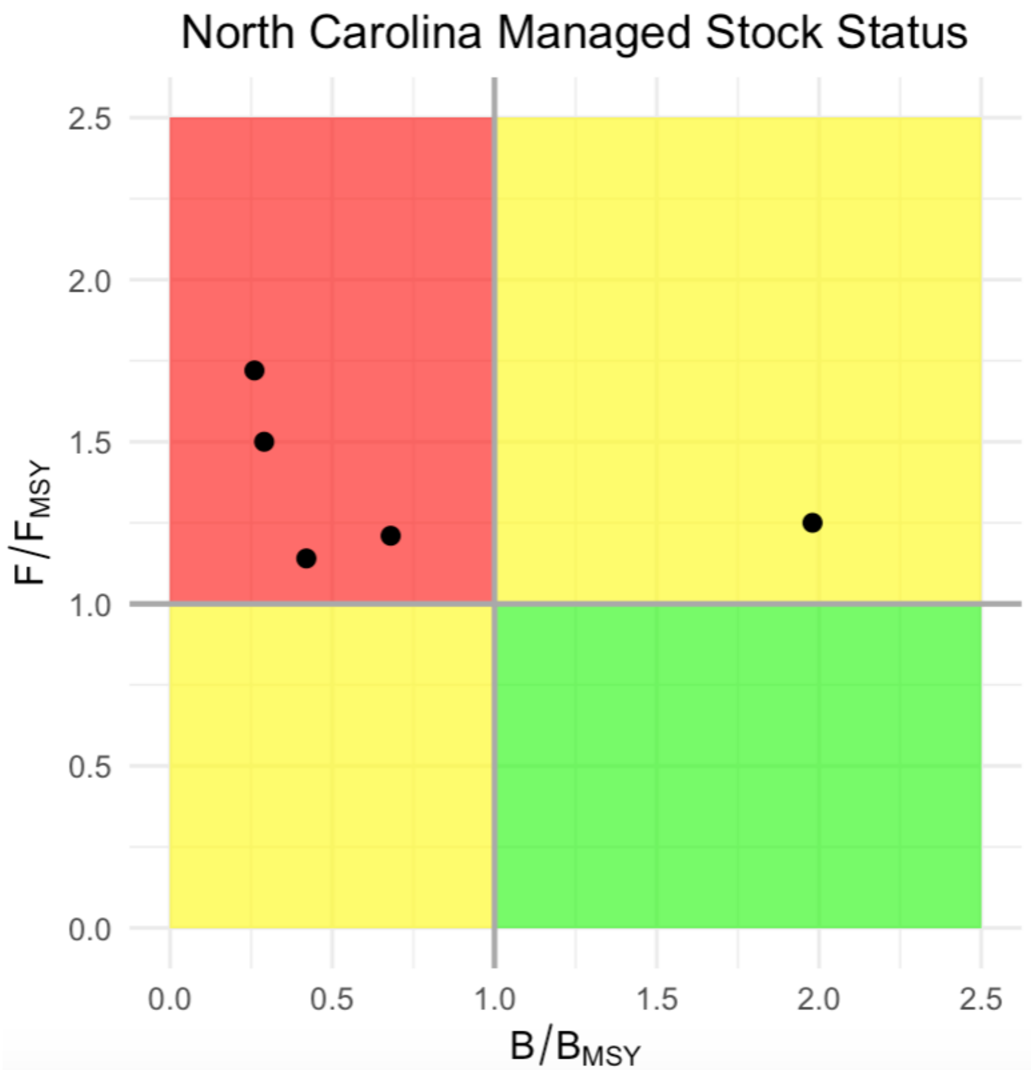


**Figure 5**. Kobe plot showing $B/B_{MSY}$ and $F/F_{MSY}$ values for fish stocks managed by the state of North Carolina. The average terminal year is 2017 (range = 2016 – 2019). Data from the North Carolina Department of Environmental Quality Website (North Carolina Department of Environmental Quality, n.d.).

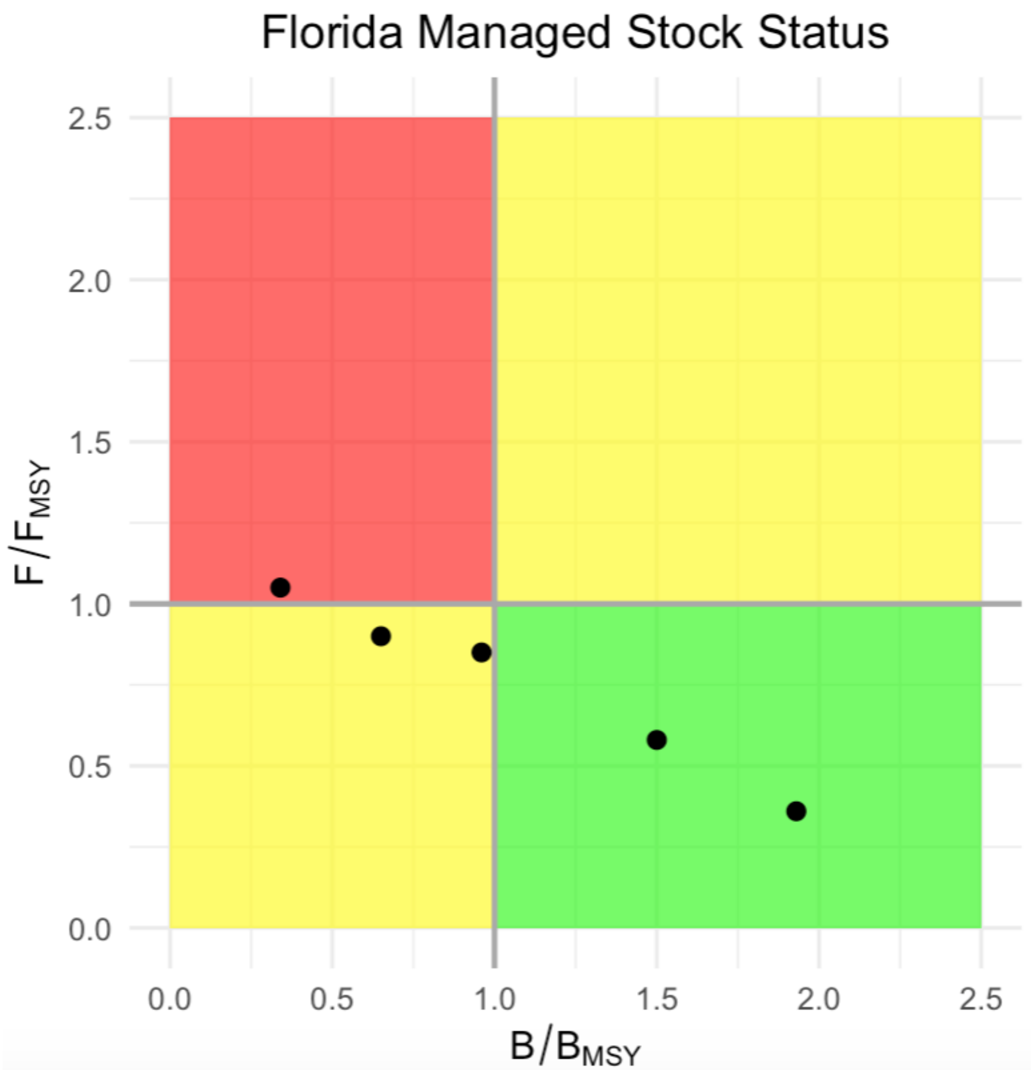


**Figure 6.** Kobe plot showing $B/B_{MSY}$ and $F/F_{MSY}$ values for fish stocks managed by the state of Florida. The average terminal year is 2015 (range = 2011 – 2019). Data from the Florida Fish and Wildlife Conservation Commission Website (Florida Fish and Wildlife Conservation Commission, n.d.-a, n.d.-b).

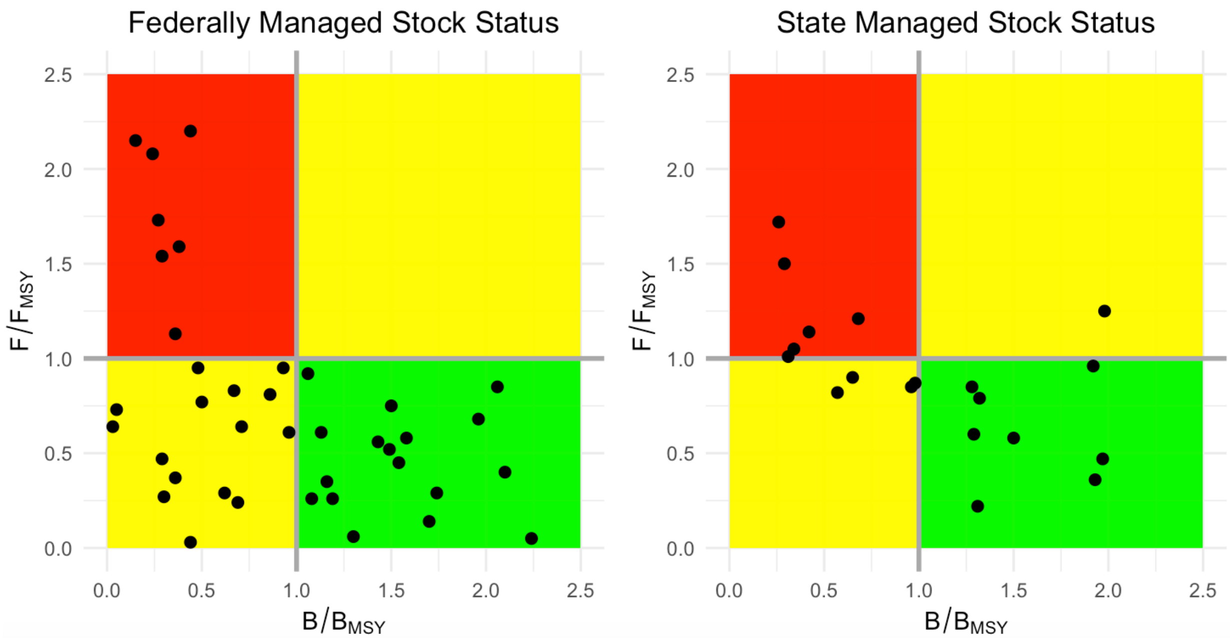


**Figure 7.** Kobe plots showing $B/B_{MSY}$ and $F/F_{MSY}$ values for (A) NEFMC, MAFMC, and SAFMC-managed fish stocks and (B) State-managed fish stocks managed by the ASMFC, MD, NC, and FL with both $B/B_{MSY}$ and $F/F_{MSY}$ values. Data from NOAA Fisheries' Stock SMART Website, ASMFC website, NCDMF website, MD website, and FL website (ASMFC, n.d.-a; Florida Fish and Wildlife Conservation Commission, n.d.-a; Maryland Department of Natural Resources, n.d.-b; North Carolina Department of Environmental Quality, n.d.).