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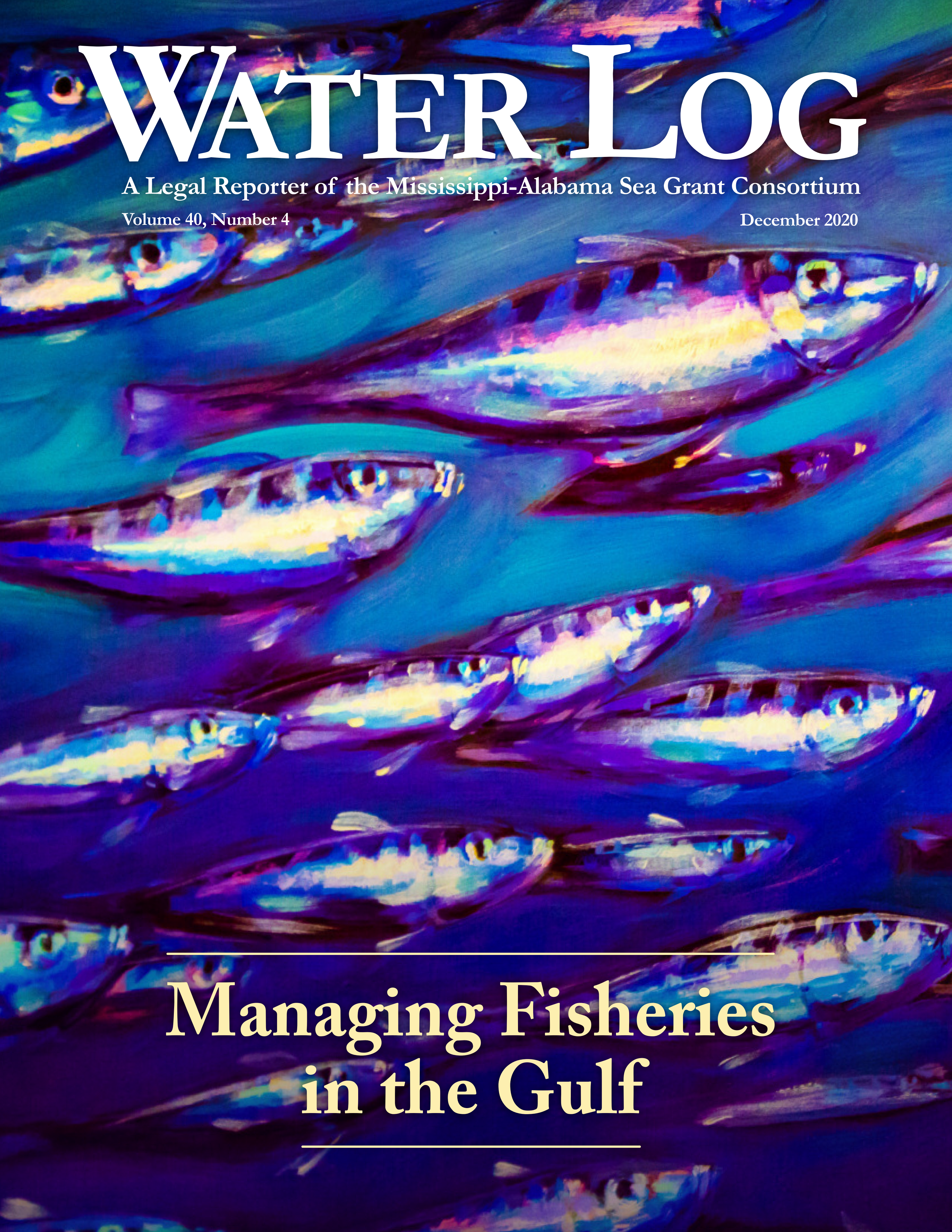

Managing Fisheries in the Gulf

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Cover photograph: Painting of a school of fish
Credit: Thomas Hawk

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Credit: Dan Barbus

• UPCOMING EVENTS •

2020 Bays & Bayous Symposium

Dec. 1 – 3, 2020

Virtual Event

https://bbs20.baysandbayous.org

Clean Water Act 2020: Law and Regulation

Dec. 3 – 4, 2020

Virtual Event

https://bit.ly/cwa2020ve

Mississippi-Alabama American Planning Association Annual Conference

Dec. 7 – 11, 2020

Virtual Event

https://bit.ly/maapaac

Federal Fishery Management

Kristina Alexander

It's one thing to manage livestock – to a certain degree you know how many there are, where they are, and how to protect them until harvest. But managing fish is another school of practice. The federal Magnuson-Stevens Fishery Conservation and Management Act (known as the MSA, or Magnuson-Stevens Act) is the primary authority for how the federal government manages fish in U.S. waters.[1] The National Oceanic and Atmospheric Administration (NOAA) oversees most MSA activities, although enforcement is shared with the Coast Guard. The Magnuson-Stevens Act's goals are both ecologic and economic, with the idea that the better fish management is ecologically, the higher the economic benefits are over the long term of the fishery.

Implementing the MSA

The MSA has been in place since 1976, and subsequent amendments have refined rather than revised how the law functions. At the heart of the Magnuson-Stevens Act is the development of Fishery Management Plans. A plan is developed by the Regional Fishery Management Councils (Councils or FMC) based on the fish stock in their geographical regions. There are eight Councils. Fish that travel beyond the boundaries of a single region are subject to plans developed by more than one regional council or in some cases by one of the three commissions authorized to manage such stock. Those commissions are: the Atlantic States Marine Fisheries Commission; the Gulf States Marine Fisheries Commission; and the Pacific Marine Fisheries Commission. Finally, not all fish in the sea are managed under the MSA, or maybe at all (think of sea slugs and starfish).

In the Gulf of Mexico, there are two main entities for fish management: the Gulf of Mexico Fishery Management Council and the Gulf States Marine Fisheries Commission. The Gulf States Marine Fisheries Commission (GSMFC) predates the MSA by almost 30 years. Among other responsibilities, it manages menhaden in the Gulf – an example of a fish not managed under the MSA as it is managed under the Interjurisdictional Fisheries Act.

The Gulf of Mexico Fishery Management Council is the primary management body for fishery management plans in the Gulf. It has implemented plans for coral, reef fish (such as red snapper, grouper, greater amberjack, and gray triggerfish), red drum, coastal migratory pelagics (such as king mackerel, Spanish mackerel, and cobia), shrimp, spiny lobster, and stone crab. As shown by that list, a fishery is not the same as a species of fish. Generally, a fishery will address similar species in the same region for which a specific type of gear is used. The Gulf Council also prepared a plan for aquaculture, but a court found that to be outside of its authority under the Magnuson-Stevens Act (see article by Jacob Hamm for more on that). Additionally, a plan may provide that no fishing is allowed. For example, in the Gulf, no red drum or Nassau grouper may be caught in federal waters.

Fishery Management Councils are independent bodies created by Congress. Because they are independent, NOAA cannot force a Council to do something. However, final actions by the Councils must be approved by NOAA.[2] Roughly speaking, it is a relationship where NOAA does not make the plans but has veto authority over them. NOAA also is responsible for issuing regulations to implement plans.

Contents of a Fishery Management Plan

A Fishery Management Plan (FMP) will consider types of fishing gear, catch by species (either by weight or by numbers of fish), location of fishing areas, fishing seasons, the number of vessels with permits for the stock, costs of management, revenues from the fishery, recreational interests, and any "Indian treaty fishing rights."[3] A plan must balance conservation with the economic interests of the fishing community, which includes not just vessels but fishing processors, for example. The statute requires the best scientific information available. This information comes from experts and members of the public.

Ten National Standards within the MSA set the goals for FMPs. As summarized, the National Standards require FMPs to establish Conservation and Management Measures that shall:

1. Prevent overfishing while achieving optimum yield on a continuing basis.
2. Be based upon the best scientific information available.
3. To the extent practicable, manage individual stocks or interrelated stocks of fish as a unit throughout its range.
4. Not discriminate between residents of different states, making allocations (a) fair and equitable to all such fishermen; (b) reasonably calculated to promote conservation; and (c) giving no individual or entity an excessive share.
5. Where practicable, consider efficiency, but shall not have economic allocation as its sole purpose.
6. Consider variations among, and contingencies in, fisheries, fishery resources, and catches.
7. Where practicable, minimize costs and avoid unnecessary duplication.
8. Take into account the importance of fishery resources to fishing communities by using economic and social data when addressing overfishing and rebuilding, in order to minimize adverse economic impacts to these communities to the extent practicable.
9. To the extent practicable, (a) minimize bycatch and (b) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.
10. To the extent practicable, promote the safety of human life at sea.

The plans must address each of these ten standards. Additionally, within a plan, a Council will describe in detail the fishery that will be managed, including a discussion of what is known about the fish and fishing practices. Reaching this level of detail requires input from a Council's committees and panels. Councils have committees and panels of experts to advise on different issues. For example, Councils are advised by the Scientific and Statistical Committee which consists of economists, biologists, sociologists, and natural resource attorneys who all are knowledgeable about the technical aspects of fisheries, and Advisory Panels with specialized knowledge about certain stocks. A Stock Assessment Panel with biologists trained in population dynamics will assess the available biological data and advise the Councils on the status of stocks and level of acceptable biological catch. Surveys of fishers are conducted regularly to estimate stocks and learn about fisheries.

Additionally, no FMP may be adopted without public input. This may occur when a Council hosts a public meeting, takes written and oral statements from attendees, or requests comments from the public (which includes individuals and entities) when a draft plan is published in the *Federal Register*, a publicly-available online publication for federal agencies' work. When a plan is amended or significantly changed, a Council must seek public comment on the changes.

Age and Population of Fish

Knowing the age and lifespan of fish is key information in developing an FMP. Take for example the red snapper. Gulf red snapper reach full maturity in 6-8 years. A 2-year old red snapper produces 350,000 eggs a year, but an older, larger red snapper produces 120 million eggs a year. This information can influence size limits in a plan. An FMP that is trying to rebuild the stock might not succeed by only imposing a minimum size limit on harvests. Some advocate putting both a minimum and a maximum fish size on harvests to allow the large fish to continue producing massive quantities of eggs.

However, setting a minimum size for catches is a common management practice. For example, the minimum size for cobia was changed in 2020 by the Gulf Council as a tool to cut harvests. The minimum size for that fish was increased from 33-inch forklength to 36 inches, which the Council estimated would cut commercial harvests by 10 percent.

Other tools to manage fish are limits on the quantity (by weight or number) that may be harvested, the seasons, or the number of vessels that are permitted to catch the fish. All of these practices are used to manage Gulf red snapper commercial and recreational harvests.

Restrictions in FMPs may change based on new data. The Great Red Snapper Count, funded by the Mississippi-Alabama Sea Grant Consortium, found in 2020 that the red snapper population in the Gulf was greater than believed, in part because the assessment covered more of the Gulf. This could influence the existing reef fish FMP by providing the Council with justification to support changing catch limits, or the Council could create geographical sectors to set catch limits based in part on geography to balance harvest levels across the entire red snapper fishery.

While it is important to understand the biology of the stock to develop a meaningful FMP, a Council must also know the equipment used, such as the number of vessels and what technology is on those vessels. This information helps a Council or its committee understand the catch-per-unit effort, i.e. how much work it take to catch a certain amount of that fish. If it takes a much longer time for a vessel to catch a certain quantity of fish than in previous years, that could indicate that the fishery is overfished, making fishing unprofitable.

Overfishing and Rebuilding

When overfishing occurs, a Council must develop a plan to rebuild the stock. After all, National Standard 1 requires optimum yield on a continuing basis. The MSA defines optimum yield as "the amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems."[4] It also includes managing to attain maximum sustainable yield while taking into account relevant social, environmental, and economic factors.

Under the MSA, when a fishery is overfished, an FMP should develop a rebuilding plan that will restore fish to sustainable populations in as short a time period as possible, but not taking more than 10 years.[5] This does not mean the plan must rebuild as quickly as possible. The fastest way to rebuild a fishery is to stop all fishing, but that would destroy the fishing economy, and National Standard 8 requires evaluating a plan's economic impacts on the fishing community.

Notably, courts have held that a plan does not need to guarantee success to be acceptable, but the odds of success should be even. In the case of red snapper in the Gulf, a court rejected a 2005 plan to rebuild within 27 years, in part because the plan had less than a 50 percent chance of success.[6] A different court allowed a Council to choose a rebuilding plan that would make almost no gains to the fishery for two to five years, because the plan that would achieve a quicker recovery was more harmful economically.[7]

While red snapper are no longer considered overfished, some Gulf stocks are undergoing overfishing. For example, NOAA announced on April 8, 2020 that in the Gulf of Mexico both greater amberjack and gray triggerfish are subject to overfishing. On the other hand, a few months later, NOAA found that gray snapper were no longer overfished.[8]

In addition to long-term plans to rebuild a stock, a FMP must plan for how to react to seasonal fluctuations – such as reaching harvest limits before the season is over. The MSA requires FMPs to include Accountability Measures (AMs).[9] Under the regulations that apply to the Gulf of Mexico fisheries, an AM is defined as "a management control implemented such that overfishing is prevented, where possible, and mitigated if it occurs."

One recent example is the accountability measure applied to recreational private anglers for red snapper in the Gulf. Recreational private fishing of red snapper (as opposed to recreational fishing on headboats or charter boats) is managed in part by states. States can dictate the seasons for fishing, but not the annual catch limits (ACL), which are set by the Council in the FMP. In 2020, NOAA found that both Texas and Louisiana private anglers had exceeded catch limits during 2019. The accountability measure for exceeding the ACL is to reduce the next year's harvest by that amount. However, the finding that both Louisiana and Texas exceeded their catch limits in 2019 came well into the 2020 season. In fact Texas, which had exceeded the 2019 limit by 110,526 lbs., had closed its season 20 days before the AM took effect.[10] Louisiana's season was scheduled to end when the ACL was met. But when it was discovered it had exceeded its private angler component by 31,901 lbs. in 2019, its 2020 season was closed September 25, 2020.[11]

Another example of where new information changed fish harvests is in the case of gray triggerfish. In May 2020, the Gulf Council closed the recreational season early, anticipating that the ACL would be reached. But in September, based on more current harvest information, the Council reopened the season using a temporary rule.[12]

Conclusion

Federal fishery management, like so many things, is only as good as the information it is based on. Because it requires balancing multiple interests – both ecologic and economic – the Councils rely on expert data on the stock they are managing. A strong fishery management plan uses that data continually, and builds a document with flexibility to allow changes so that optimum yield is attained on a continuing basis.

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Endnotes

1. Federal waters are those at least 3 nautical miles from shore. The waters closer in are managed by the states. In the case of reef fish in the Gulf of Mexico, states are authorized to manage to at least nine miles from shore.
2. Anglers Conservation Network v. Ross, 387 F. Supp. 3d 87 (D.D.C. 2019).
3. 16 U.S.C. § 1853(a).
4. 16 U.S.C. § 1802(33).
5. 16 U.S.C. § 1854(e)(4).
6. Coastal Conservation Ass'n v. Gutierrez, 512 F. Supp. 2d 896, 900 (S.D. Texas 2007).
7. Oceana, Inc. v. Evans, 2005 WL 555416 (D.D.C. March 9, 2005).
8. 85 Fed. Reg. 40181 (July 6, 2020).
9. 16 U.S.C. § 1853(a)(15).
10. 85 Fed. Reg. 52055 (Aug. 24, 2020).
11. 85 Fed. Reg. 60386 (Sept. 25, 2020).
12. 85 Fed. Reg. 54513 (Sept. 2, 2020).

In Sum.

A Summation of the Facts and Figures of Interest in this Edition

★ *Number of eggs per year from a 2-yr old red snapper*	350,000
★ *Number of eggs per year from a 20-yr old red snapper*	120,000,000
★ *Number of Gulf states that exceeded private recreational red snapper limits in 2019*	2
★ *Amount Texas exceeded its limit, in pounds*	110,526
★ *Amount Louisiana exceeded its limit, in pounds*	31,901

The Life History of Fishes: Age, Growth, Reproduction, and Mortality[1]

Amanda E. Jefferson and J. Marcus Drymon

Let's start with a question. Imagine a fish (Species A) that lives to be 5 years old, grows quickly, reaches maturity at a young age, and produces many offspring that have low survival. Now imagine a second fish (Species B) that lives to be 50 years old, grows slowly, reaches maturity at an older age, and produces few offspring that have high survival. Which species can withstand an intense amount of fishing? To answer this question, we need to learn how these biological traits are calculated and what they mean to fisheries managers.

In the fisheries science world, to age a fish means to determine how old it is (typically in years). Age data are integral to fisheries management because they serve as the foundation for age-based stock assessments. Once enough fish of a given stock have been aged, we can look at the stock's age structure – a graphical depiction of the number of fish of each age. We can learn a considerable amount of information from the age structure, including the proportions of young, middle-aged, and old fish, the longevity of the fish, and – where applicable – the age at which the fish begin to be harvested by a fishery.

Since growth – defined as increasing length and weight with time – varies between species and among individuals within species, we cannot age a fish simply by looking at it. For example, imagine trying to guess someone's age simply based on his or her height and weight. Impossible. Instead, we examine a hardened structure from the fish's body, as described in the following four steps.

Step 1: Select a Structure

We choose a structure in which material accretes, or accumulates, over a fish's lifespan. This process creates annual rings inside the structure, like in a tree trunk. Those structures in fish include scales, otoliths, fin spines, and vertebrae.

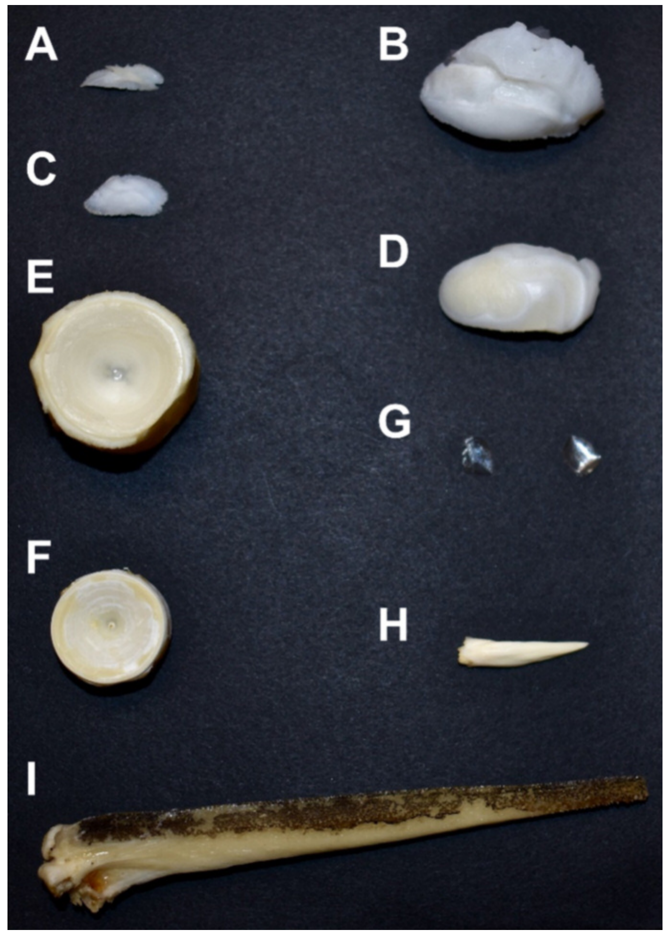

Figure 1. An assortment of aging structures: otoliths from (A) crevalle jack, (B) red snapper, (C) tripletail and (D) red drum; vertebrae from (E) great hammerhead and (F) blacktip shark; (G) scales from Gulf menhaden, and first dorsal spines from (H) tripletail and (I) gray triggerfish. Photo courtesy of Amanda Jefferson.

Scales have been used for aging fishes since the late 1800s. We can easily pull scales from a fish's body without sacrificing the animal. However, the rings inside the scales are difficult to interpret. Moreover, early rings can disappear, which can cause us to underestimate age. Therefore, we primarily use scales to age short-lived species, like Gulf menhaden.

Otoliths (from the Greek, "oto" = ear, and "lithos" = stone) are ear stones. Otoliths exist in pairs (one in each ear) in the inner ears of most vertebrates, and their size and shape vary by species. Unfortunately, we must sacrifice a fish to extract its otoliths. Sometimes otoliths might be difficult to access, extract, or age. Despite these downsides, otoliths work well for aging many fishes (e.g., snappers, groupers, drums). In fact, they represent the most popular structure used in aging studies today (Figure 1).

Fin spines and fin rays provide structural support to the fins. Spines are rigid and pointy, whereas rays are flexible. It isn't necessary to sacrifice a fish to extract a spine or ray. However, these structures often have one of the drawbacks of scales: disappearing early rings. Additionally, spines and rays sometimes contain false rings or sets of multiple rings stacked closely together. For these reasons, spines and rays are typically only used for aging when otoliths are unfit. Examples of fishes aged using spines include tunas, swordfishes, and triggerfishes.

Vertebrae – the bony or cartilaginous parts that protect the spinal cord – are useful for aging elasmobranchs (sharks, skates, and rays), which lack typical scales or otoliths. Elasmobranch vertebrae usually contain mineralized calcium phosphate, which provides a structure for aging. Unfortunately, we must sacrifice the animal to extract its vertebrae. Examples of species aged using vertebrae include finetooth shark, blacktip shark, and southern stingray.

Step 2: Extract the Structure

We use specific tools and methods to extract the various structures.

- To extract scales, we simply pull them from the fish's body using forceps, taking them from the same place on every fish for consistency.
- To extract an otolith, we generally use one of two methods. For the first method, we lift the operculum (bony gill cover), move the gills away from the otic capsule, use a sharp chisel to open the capsule, and pull the otolith out using forceps (Figure 2). For the second method, we saw through the skull with a serrated knife or butcher saw and then pull the otoliths out of the skull with forceps.
- To extract fin spines or rays, we use a sharp knife to cut the structure out of its anchor point at the base of the fin (where the fin meets the body).
- To extract vertebrae, we use a sharp knife to cut several consecutive vertebrae from the vertebral column (the backbone).

Figure 2. A fisheries scientist extracts an otolith from a large red snapper. Photo courtesy of David Hay Jones.

Step 3: Prepare the Structure

This is the most exciting part of the process because it reveals the rings within the structures.

- To prepare scales, we either flatten them (since they curl as they dry) or make impressions of them.
- To prepare otoliths, occasionally we leave them whole if they are small, thin, and relatively transparent. However, we usually cross-section them, by cutting through each otolith to obtain several thin slices (Figure 3).
- To prepare fin spines, fin rays, and vertebrae, we cross-section all of these structures.

Figure 3. A low-speed saw is outfitted with four consecutive blades to produce three sections from a tripletail otolith. Photo courtesy of Amanda Jefferson.

Step 4: Age the Structure

Once we've selected, extracted, and prepared the structures, we can age them. First, we place each structure under a microscope and examine it using light that passes upward through the structure. Next, we search for alternating translucent and opaque rings (Figure 4). This varying opacity results from differences in the rate and extent of growth throughout the year. One translucent ring plus its adjacent opaque ring usually represents one year of growth; we count these ring pairs to assign an age.

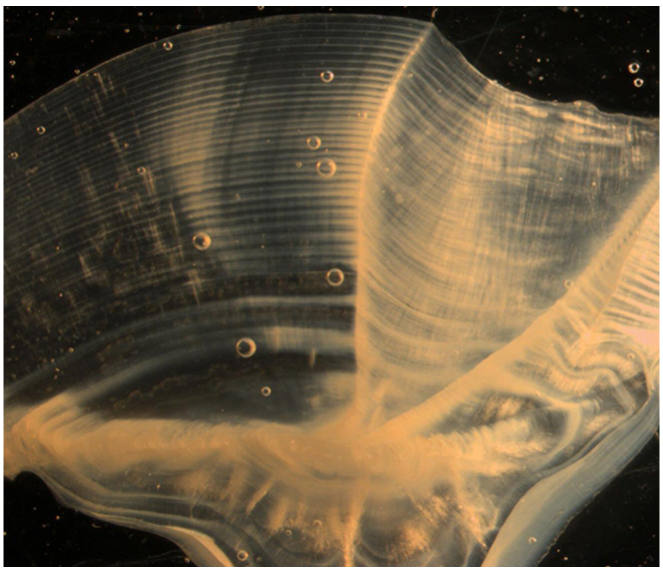

Figure 4. A red drum otolith section, as seen through a microscope. Scientists assigned an age of 33 years to this specimen. Photo courtesy of the Dauphin Island Sea Lab Fisheries Ecology Lab.

We frequently pair age data with other kinds of data to learn more about the stock. Most often we pair age data with length data to learn about individual growth. Specifically, we can fit mathematical growth models to the age and length data to estimate the growth rate and maximum size of the fish in a given stock. These patterns can show the effectiveness of past management strategies and predict future management needs.

Fecundity

Like age and growth, fecundity is an important component of stock assessment models. The fecundity, or reproductive potential, of fishes varies between species and among individuals within species. However, it is well-known that fecundity generally increases with length and weight (and age, since larger fishes are usually older).[2] In other words, the largest and likely oldest fishes tend to produce the most eggs and sperm. The focus is on female fecundity as eggs are the limiting factor in spawning events. Because eggs take more energy to produce and occupy more space inside a female's body, they are produced in lower quantities than sperm. We affectionately refer to the largest, most fecund female fishes as BOFFFs – big, old, fat, fertile females. It is important that a stock contains enough BOFFFs because they are responsible for producing lots of young fish. The current and future status of a stock largely depends on a healthy presence of BOFFFs.

Let's take a look at some of the female fecundity estimates used in the latest Gulf of Mexico red snapper assessment.[3] At age 2, when they are newly mature, female Gulf red snapper produce about 350,000 eggs per year. By age 5, this number increases to about 20 million eggs. By the time these fish grow to be 20-year-old BOFFFs, they are capable of producing more than 120 million eggs per year!

A key point about the relationship between fishing pressure and fish reproduction is that enough fish must survive the fishing pressure to spawn and replenish the stock. For each managed stock, stock assessment scientists determine the amount of fishing pressure that yields this balance using a metric called spawning potential ratio (SPR). The SPR compares the spawning ability of a fish where fishing occurs to its hypothetical spawning ability if it were completely unfished. This ratio is defined as the number of eggs that could be produced by an average fish over its lifetime in a fished stock divided by the number of eggs that could be produced by an average fish in its lifetime in an unfished stock. This results in a fraction between zero and one. Generally speaking, SPR should be at least 0.2-0.3 (20-30%), if not higher, to prevent stock declines.[4] Once scientists have calculated the SPR for a stock, they can advise how to ensure that fishing pressure does not exceed the threshold of maintaining a healthy SPR, and thus, a healthy stock.

Mortality

Mortality is the scientific measurement of the death rate of fishes. We use age structure to determine the mortality rate of the fish in the stock. This is usually expressed as the annual mortality rate (the proportion of fish that die each year). However, age structure only tells us about the total mortality occurring in the stock due to all possible causes. Total mortality combines two main types of mortality: natural and fishing.

- Natural mortality is defined as the death of fishes from all causes except fishing, such as predation, aging, and disease. We can estimate natural mortality based on life history parameters, such as growth rate, maximum age, and maximum length.
- Fishing mortality is defined as the proportion of the fishable stock that is caught in a year, or the rate of removal from a population by fishing. We can estimate fishing mortality by conducting tagging studies.

Figure 5. A SeaQualizer is used to return a captured red snapper to depth. Photo courtesy of SeaQualizer.

By definition, fishing mortality technically only involves fishes that are kept by fishers – in other words, the fishes that are brought home and baked, fried, pan-seared, or grilled. Yet, there is another, more cryptic type of mortality that results from fishing activities: discard mortality. Often, anglers must discard fishes to comply with management regulations – such as when fish are too small. Not all discarded fishes survive, however. Research shows that discarded fish can die from the trauma related to fishing events (for example, gut-hooking and barotrauma). For example, the most recent red snapper stock assessment models incorporated a discard mortality of 12-16% – about one in every seven red snapper that is caught and released dies.[5]

Discards that die are a waste. Therefore, it is important that we take earnest steps to mitigate discard mortality. Using non-stainless steel circle hooks instead of J-hooks reduces gut-hooking. This is already required when using natural baits to fish for reef fishes in federal waters.[6] To help with barotrauma recovery, we can either vent a fish by releasing air from its swim bladder using a hollow needle inserted behind the pectoral fin or use a descending device (such as a SeaQualizer, Figure 5) to return the fish to depth safely and quickly.

Conclusion

Now that we've learned about the life history of fishes, let's answer our initial question: Which species can withstand higher fishing pressure? The answer is Species A because fishes with short lifespans and the ability to produce lots of offspring are more resilient to fishing pressure. Even if many individuals of Species A are removed via fishing, there will still be plenty of young individuals left in the population. These youth will mature quickly and produce many offspring themselves. In contrast, if many individuals of Species B are removed, sufficient numbers of offspring may not be produced and the stock's sustainability may be placed in jeopardy.

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Endnotes

1. This article is excerpted from J.M Drymon, et al., *FISHES: Fishermen Invested in Science, Healthy Ecosystems and Sustainability* (In Press). Sections of the article relied in part on Wallace and Fletcher, *Understanding Fisheries Management: A Manual for Understanding the Federal Fisheries Management Process, Including Analysis of the 1996 Sustainable Fisheries Act*, Mississippi-Alabama Sea Grant Legal Program (2d ed. 2005) for background. The authors recommend that source for those seeking more in-depth discussion of these issues. The Third Edition of *Understanding Fisheries Management* will be available in 2021 from the Mississippi-Alabama Sea Grant Legal Program.
2. *NOAA Fisheries Glossary* (2006 ed.).
3. Southeast Data Assessment and Review, *SEDAR 52 Gulf of Mexico Red Snapper Final Stock Assessment Report* (April 2018).
4. *NOAA Fisheries Glossary.*
5. *SEDAR 52 Gulf of Mexico Red Snapper Final Stock Assessment Report.*
6. Gulf of Mexico Fishery Management Council, *Recreational Fishing Regulations for Gulf of Mexico Federal Waters for Species Managed by the Gulf of Mexico Fishery Management Council*. Other FMPs in the Gulf require circle hooks, which limit bycatch of sea turtles and dolphins.

Aquaculture Regulation for the Gulf Coast Yields Salty Responses from Courts

Jacob D. Hamm

This past August, the Fifth Circuit Court of Appeals upheld a lower court ruling that found the National Oceanic and Atmospheric Administration (NOAA) lacked jurisdiction to implement an FMP developed by the Gulf of Mexico Fishery Management Council for aquaculture. The case forced the court to navigate the murky waters of the Magnuson-Stevens Fishery Conservation and Management Act, the purpose and powers of Fishery Management Councils, the implicit meaning of statutes, the definition of "harvesting," and the ever-blurry distinctions between "aquaculture" and "fisheries." With such an array of complex issues, it is essential to start with the basics and understand the roots of where this situation started.

Congress, Conservation, and Councils

Congress enacted the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act or MSA) in 1976 as a means of ensuring the conservation and efficient management of the United States' coastal fishery resources.[1] The Magnuson-Stevens Act tasks eight regional Fishery Management Councils with creating and implementing Fishery Management Plans (FMP) for their respective regions. Each FMP has to list and describe the fishery it applies to, as well as detail the conservation and management measures the Council will take to ensure the long term health and stability of the fishery, according to 16 U.S.C. § 1853(a). It is important to note that when the MSA was passed, it did not mention aquaculture (raising fish/shellfish under physical controls) or fish farming.[2] This means, arguably, that the Magnuson-Stevens Act gave the Councils authority to create plans only for wild-capture fisheries in their respective regions.

Gulf Aquaculture Plan

The Gulf of Mexico Fishery Management Council (the Council) manages the fisheries in the federal waters of the Gulf of Mexico. In 2009, the Council created an FMP entitled "Plan for Regulating Offshore Marine Aquaculture in the Gulf of Mexico" (the Plan) that attempted to regulate aquaculture in that region.[3] Under the Plan, the Council sought to approve 5 to 20 permits for aquaculture operations in the Gulf of Mexico over a 10-year period. The permits would be conditioned on compliance with biological, environmental, recordkeeping, and reporting conditions.

The National Marine Fisheries Service (NMFS), which is part of NOAA, published a rule (the Rule) in 2016 to implement the Plan, which, "establishes a comprehensive regulatory program for managing the development of an environmentally sound and economically sustainable aquaculture fishery in Federal waters of the Gulf."[4] The Rule stated that its purpose is to, "increase the yield of Federal fisheries in the Gulf by supplementing the harvest of wild caught species with cultured product."[5] In order to achieve this goal, and implement the Plan, the Rule requires aquaculture facilities to obtain permits from NMFS. Each aquaculture facility would be required to adhere to relevant regulatory standards enacted by NMFS and other federal agencies. This rule was the first attempt by NMFS or any regional council to regulate aquaculture under the Magnuson-Stevens Act, according to the court.[6]

The regulation of all aquaculture in the Gulf of Mexico is no small feat. The Rule allowed for a maximum annual production of 64 million pounds of seafood in the Gulf of Mexico. To put that number into perspective, the previous average annual yield for all marine species in the Gulf between 2000 and 2006, except menhaden and shrimp, was roughly 64 million pounds.[7] These numbers sound staggering, but on a global stage, 64 million pounds is nothing. China's aquaculture facilities produced 49 million tons (98 billion pounds) of seafood in 2016.[8]

It should also be noted that the United States currently imports more than 80 percent of its seafood.[9] Opening the door for aquaculture in the Gulf could mean more jobs and potentially decrease the country's annual seafood imports. However, some believe that aquaculture could adversely affect existing fisheries. Thus, a coalition of fishing and conservation organizations (Plaintiffs) sued NMFS in federal court.

The Lawsuit

The Plaintiffs alleged that NMFS's rule was invalid since the Magnuson-Stevens Act gave NMFS the authority to regulate only fisheries, not aquaculture. When reviewing an agency's interpretation of a statute, a court will first examine whether Congress's intent is clear from the language of the statute, and if not, the court will defer to the judgment of the agency.[10] The trial court, in this case, decided that the MSA plainly stated that the Council's power was limited solely to fisheries, and ruled in favor of the Plaintiffs. NMFS appealed.

In reviewing the case, the appellate court considered the differences between "fishery" and "aquaculture." The court applied the MSA's definitions of "fishery" and "fishing," which state that "fishery" refers to the management and fishing of stocks of fish, with "fishing" defined as the act or attempted act of "catching, taking, or harvesting of fish." The court found "aquaculture," however, to be synonymous to "fish farming," which is, "the cultivation of aquatic organisms (such as fish or shellfish), especially for food." From there, the concern shifted to whether or not NMFS should have been granted deference to its interpretation of the statute to include "aquaculture."

NMFS argued that the MSA did not "unambiguously express Congress's intent to prohibit the regulation of Aquaculture." The court, however, shot down the agency's argument, noting that if agencies were able to claim any power that was not expressly prohibited in legislation, they would enjoy nearly limitless power. The court interpreted the powers of agencies to be limited solely to what the statutes expressly delegate to them, stating: "In order for there to be an ambiguous grant of power, there has to be a grant of power in the first place."[11]

NMFS also argued that the Magnuson-Stevens Act allowed the agency leeway to regulate aquaculture instead of only fisheries. It argued that the word "harvesting" is a loose enough term to include aquaculture, since harvesting sometimes means the gathering or reaping of a crop. Since aquaculture is a type of farming, where the "crop" harvested is fish, NMFS argued the definition of fishing could be interpreted to include aquaculture. The court, however, disagreed, and pointed out that harvesting, under the MSA, is best read to mean the catching and taking of fish, rather than the agrarian meaning relating to the gathering of crops. Considering the overall meaning of the Magnuson-Stevens Act and what it was created to do, the court stated that NMFS's argument that the word harvesting in the definition of fishing meant that NMFS has authority to regulate aquaculture operations, "does not hold water."[12] The court ruled that NMFS's attempt to regulate aquaculture in the Gulf of Mexico exceeded the agency's statutory authority, rendering the Plan null.

Where does this leave us?

So, who governs offshore aquaculture in the Gulf now that the 2016 Rule has been struck down by the Fifth Circuit? Two federal agencies have authority to issue permits for aquaculture operations in federal waters. Under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403), the Corps may issue permits for obstructions to "the navigable capacity of any of the waters of the United States." If the aquaculture operation will grow finfish, permits are required under the Clean Waters Act from the EPA for the discharge of pollutants.[13]

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Using Spatial Analysis in the Study of Mississippi and Alabama Fisheries

Stephen Deal

The profession of urban planning would not be possible without spatial analysis and comprehensive mapping. Maps allow planners to recognize statistically important patterns and relationships that occur within a city. Individuals who compile information from the content of a map by either finding patterns, assessing trends, or making decisions are engaged in the process of spatial analysis.[1] Spatial analysis can be used to determine the redevelopment potential of a land parcel or to determine the size of a watershed.

Coastal communities that engage in spatial analysis can ascertain sites that have close proximity to an abundant array of marine life. They can also utilize numerous decision support tools that can enhance a city's spatial analysis capabilities and improve coastal policymaking with respect to fisheries. By utilizing the full capabilities of GIS software, coupled with decision support tools from governmental partners and NGOs, coastal communities can attain a better understanding of their local fisheries.

An Examination of the GIS Mapping Approach

The evolution from simple navigation charts to the full digital displays made by Geographic Information System (GIS) software is a fascinating history. One innovation that is key to the development of modern GIS is the use of overlays. The practice of creating map overlays gained increasing acceptance in the early and mid-20th century. For example, Sanborn Fire Insurance Maps would create paste-on correction slips.[2] When significant change occurred within a city, such as a new building, a correction slip would be layered onto an existing map and then annotated in a correction record. These slips would effectively keep the map's coverage current. Such a development also signified a move away from perceiving a map as a single, static document towards an interactive tool for documenting change within a complex system like a city.

By the 1950's the concept of map overlays was further expanded with the adoption of transparent map overlays. In the 1967 book *Design with Nature*, Landscape Architect Ian McHarg described how transparent map overlays could be a critical tool for urban and environmental planning. The idea was that different transparent plastic sheets, each containing a unique layer of map information for the same geographic area, could be layered on top of each other to allow cartographers to view several unique maps at the same time.

With the advent of computers, transparent plastic sheets soon gave way to distinct digital layers, which represented individual map themes.[3] By using digital layers, many aspects of the mapmaking process could be easily automated. For example, the Coastal Alabama Restoration Tool collates several different layers of habitat and water quality data into one single online portal.[4] The layers can be viewed online without the need for GIS software, and many of the layers include information on water quality and land coverage. Website users can use the tool to compare past locations of oyster reefs with more modern data on oyster reef distribution. An understanding of GIS map layers, coupled with knowledge on marine ecosystems, can greatly enhance knowledge of local fisheries.

Developing a Suitability Analysis for Coastal Applications

Though land suitability studies have gained increasing acceptance in local planning departments with the rise of GIS, land suitability analysis has been an important component of the planning practice since it was first popularized by Mr. McHarg in the 1960's.[5] A suitability analysis is an approach commonly used by planners, real estate officials, and other land development professionals to determine the ability of a piece of land to support a specific type of land use.[6] There are multiple approaches one can take to developing a suitability analysis, but one approach that is prized for its flexibility and mathematical simplicity is the rules of combination approach.

The rules of combination approach is a model that most closely emulates the land suitability methods used by Mr. McHarg. In this approach a planner assigns each factor high, moderate, and low suitability ratings. Rather than adding the rankings together, under the rules of combination approach, "the planner decides to establish rules for combining different rankings for each factor to determine level of land use suitability".[7] Consider, for example, a community that needs to analyze the suitability of land to support a new manufacturing operation. A piece of land that has high proximity both to highway and to water/sewer lines could be assigned a high suitability rating. A moderate suitability rating could be assigned to land that has high proximity either to highway or to water/sewer lines. Finally, a low suitability rating could be assigned to a piece of land that does not have high proximity to highways or to water/sewer lines. This method gives communities the option to weigh the importance of specific suitability factors. It also avoids the political pitfalls of more mathematically complex suitability models because it openly acknowledges that the suitability factors are a value judgment made by planners.

In Ohio's Lake Erie region, a comprehensive suitability analysis was used to guide watershed planning efforts. Confronted with water pollution problems coming from non-point sources, the Ohio Lake Erie Commission produced Watershed Balanced Growth Plans. These advisory plans identified priority development areas and priority conservation areas within the Lake Erie region. One watershed in particular, Chippewa Creek, worked with the Commission to develop a methodological framework for implementing balanced growth plans. The framework chosen was a land suitability analysis that employed the rule of combination approach. In total, three separate suitability analyses were devised for the watershed region for: development, conservation, and agriculture. Different suitability factors were utilized for each analysis. For example, the conservation suitability analysis looked at wetlands, FEMA floodplain data, riparian corridors and infiltrative capacity of land. After all these factors were aggregated, a GIS map was produced showing five different land suitability rankings, ranging from very low to very high. Coupled together with the two other land suitability studies, communities in the watershed can use the suitability analyses to guide zoning and land development.

A major hurdle with watershed planning is that watersheds often span multiple jurisdictions. This means that land use decision-making is often split between multiple cities with different zoning rules and regulations. By pursuing a suitability analysis for a major watershed, communities can consult a common tool for guiding zoning maps and districts. Also, because the suitability analysis allows for the inclusion of multiple suitability factors, coastal communities can choose to include factors that are unique to coastal regions. For example, a coastal suitability study might designate proximity to marinas as a high suitability factor in determining where urban development is prioritized.

A suitability analysis can also be used to inform shoreline restoration practices within a coastal region. In North Carolina, a suitability analysis was conducted in the New River Estuary to ascertain which stretches of shoreline would be conducive to the installation of living shorelines.[8] For this study, a shoreline shape file was converted to points 50 meters apart. Each point was evaluated according to its wave energy input from wind waves and boat wakes, along with its distance to the nearest natural shoreline, assigning wave energy scores of 0, 5, or 10. Each point on the shoreline was assigned either a score of 0 or 10 for proximity to natural marsh shoreline. After scores for each attribute were collected, cumulative scores were tallied for each point. Shoreline points with a score of 0-5 were not recommended for living shorelines, while sites that scored 10, 15, or 20 were considered suitable for hybrid living shorelines, and scores of 25 or 30 indicated points where marsh vegetation alone or marsh with oyster was recommended.

In Louisiana, suitability analysis has even been used in evaluating existing and future habitat conditions of key marine species in coastal Louisiana. As part of Louisiana's Comprehensive Ecosystem Restoration Plan, 12 habitat suitability studies were developed for critical marine species such as brown shrimp, American oyster, and Gulf menhaden.[9] These studies provide insight into how comprehensive restoration decisions undertaken by the state of Louisiana may affect commercially important marine species going into the future.

Decision Support Tools for Local Fisheries

Over the years, there have been numerous decision support tools and applications developed by coastal scientists, planning bodies and NGOs that can take a lot of guesswork out of mapping marine assets and coastal attributes. One application that is of considerable value for Alabama and Mississippi coastal communities is Gulf TREE, because it provides a summary snapshot of the different digital support tools that exist for coastal resilience.[10] The application was developed through a collaborative partnership between the Northern Gulf of Mexico Sentinel Site Cooperative and the Gulf of Mexico Alliance in order to assist local stakeholders in finding climate support tools. A quick, filtered search in Gulf TREE of Mississippi and Alabama for free decision support tools yields 65 results and is indicative of the wide range of technical support and assistance that exists for coastal jurisdictions.

One tool that can be applied to an in-depth analysis of seafood harvesting is the collection of community snapshots compiled by NOAA Fisheries.[11] This digital tool catalogs the qualities and characteristics of major fisheries from across the nation. For example, a summary snapshot of Bayou La Batre, Alabama indicates the general size of commercial boats within the fishery and lists the top species landed by commercial fishermen. The snapshot tool can also provide insight into the how a local fishery compares to other nearby fishery communities. Such information would serve as a good foundation for any comprehensive mapping exercises a city undertakes to understand its local seafood economy.

Spatial analysis of local fisheries should consider the vulnerability of infrastructure. Fortunately there are support tools that can assist coastal communities in assessing infrastructure vulnerability. One of these tools is the Flood Vulnerability Assessment Map developed by the U.S. Energy Information Administration. By utilizing the flood vulnerability assessment map, coastal communities can determine what properties are within a FEMA designated flood zone.[12] The flood vulnerability map also notes the location of offshore oil platforms, which are areas of critical concern for fisheries in the northern Gulf of Mexico.

Another vulnerability factor coastal communities must contend with is sea level rise and one tool that can aid spatial analysis in this area of concern is NOAA's sea level rise viewer. By accessing the sea level rise viewer, coastal communities can analyze various sea level rise scenarios and how they may affect critical infrastructure going into the future.[13] Visitors to the sea level rise viewer are given the option of viewing sea level rise impacts under different scenarios ranging from as low as one foot to as high as 10 feet of sea level rise. Although the viewer is not accurate enough at the parcel level to inform planning regulations and zoning, its ease of use and different ranges for sea level rise make it an effective public outreach tool for getting a handle on coastal vulnerability.

Conclusion

Valuable data on the size of commercial fishing craft and the vulnerability of local infrastructure to coastal hazards can serve as a good starting point for a comprehensive planning report on local fisheries. By deploying decision support tools in the spatial analysis process for local fisheries, coastal communities can improve their knowledge and understanding of the marine ecosystem and apply policy solutions that are appropriate to the needs of local fishers.

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