HOW REGULATORS CAN REDUCE FISH MORTALITY FROM RECREATIONAL FISHING

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INTRODUCTION

In order to properly understand the importance of lowering fish mortality from recreational fishing, one must understand the history of overfishing in the United States, and the current state of U.S. fisheries. Since the twentieth century, overfishing has been a reoccurring problem that has been met with continually improving legislation and regulation. Overfishing is the harvesting of fish faster than they can replace themselves.[1] This over-harvest can threaten the survival of species,[2] and destabilize ecosystems so that they become less resilient to change.[3] Overfishing makes it much harder for fishermen to make a living,[4] and when fish are no longer an available product, millions can be denied an important protein source.[5]

A. National History of Overfishing

After World War II, fishing in U.S. waters was virtually a free-for-all, with American and foreign vessels competing for increasingly

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[1] *Overfishing*, NAT'L GEOGRAPHIC, (Apr. 27, 2010), https://www.nationalgeographic.com/environment/oceans/critical-issues-overfishing/.

[2] Marcos Llope, et al., *Overfishing of top predators eroded the resilience of the Black Sea system regardless of the climate and anthropogenic conditions*, 17 GLOB. CHANGE BIOLOGY 1251, 1251 (2011).

[3] *Threats: Overfishing*, WORLD WILDLIFE FUND, (last visited Apr. 18, 2019), https://www.worldwildlife.org/threats/overfishing.

[4] *Effects of Overfishing on Wild Seafood Populations*, MONTEREY BAY AQUARIUM SEAFOOD WATCH, (last visited Apr. 18, 2019), https://www.seafoodwatch.org/ocean-issues/wild-seafood/overfishing.

[5] *Overfishing and Decline in Fish Numbers*, FACTS AND DETAILS, http://factsanddetails.com/world/cat53/sub340/item2196.html.

dwindling resources.[6] At the time, new advances in technology made catching mass quantities of fish much easier than it ever had been before.[7]

Exacerbated by the fact that most states only had jurisdiction extending three miles off of their shorelines, larger and faster foreign vessels were able to decimate swaths of ocean.[8] In 1966, this jurisdiction was expanded to 12 miles offshore.[9] Still, these fleets of large foreign vessels were able to contribute so strongly to overfishing as to seriously damage the economies of coastal fishing regions.[10] It was not until 1977 that the U.S. excluded foreign vessels from fishing within 200 miles of shore.[11] The bill responsible for asserting this jurisdiction was known as the Magnuson-Stevens Act ("MSA") (for its cosponsors, Senator Warren Magnuson (D-WA) and Senator Ted Stevens (R-AK)), and became the principal law governing marine fisheries in the United States.[12]

Unfortunately, the original MSA was not sufficient to prevent drastic overfishing from domestic commercial fleets. After the expulsion of foreign vessels, domestic fishing expanded so much that it created its own national overfishing problem.[13] As a result, fish landings dropped, as some of America's most iconic fisheries became overexploited.[14] Fishermen were forced to travel farther and work

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[6] *The Magnuson-Stevens Act: World's Leading Fisheries Management under threat*, OCEANA, https://usa.oceana.org/magnuson-stevens-act-worlds-leading-fisheries-management-under-threat (last visited Apr. 18, 2019).

[7] *Celebrating the Magnuson Stevens Act (MSA)*, OCEAN CONSERVANCY, https://oceanconservancy.org/sustainable-fisheries/take-deep-dive/celebrating-40-years-magnuson-stevens-act/.

[8] *Id*.

[9] *Id*.

[10] 16 U.S.C. § 1801(a)(3) (1976).

[11] Magnuson Stevens Act of 1976, Pub. L. 94-265 (codified as amended 16 U.S.C. §§ 1801 et seq.).

[12] *Magnuson-Stevens Fishery Conservation and Management Act*, MID-ATL. FISHERY MGMT. COUNCIL, (last visited Apr. 18, 2019), http://www.mafmc.org/magnuson-stevens-act/.

[13] *Managing Fish and Fishing in America's Oceans*, THE PEW CHARITABLE TRUSTS, et al., (last visited April 18, 2019), https://www.pewtrusts.org/-/media/assets/2011/06/07/fact-sheetmsa-101final.pdf.

[14] Steven A. Murawski, *History of the groundfishing industry of New England*, NE. FISHERIES SCIENCE CTR., NAT. OCEANIC & ATMOSPHERIC ADMIN., (last visited Apr. 18, 2019). https://www.nefsc.noaa.gov/history/stories/groundfish/grndfsh2.html. The Red

longer hours to catch fewer fish,[15] all of which made profits less assured.[16] When fish stocks crashed, local economies dependent on those fish were devastated.[17] In response to these crises, congress passed the Sustainable Fisheries Act to amend the MSA in 1996.[18] These new amendments added provisions to address essential fish habitat ("EFH"),[19] as well as to mandate that fishery management councils define overfishing for every fishery in their jurisdiction.[20] Congress made further amendments with the Fishery Conservation and Management Reauthorization Act of 2006, which added requirements to establish ACLs, and Accountability Measures.[21]

B. Current State of Fisheries

The amendments to the MSA, now formally known as Magnuson-Stevens Fishery Conservation and Management Act, have been greatly successful at reducing overfishing. In 2017, the number of overfished stocks in the U.S. reached its lowest point ever, with 15 percent of stocks being overfished.[22] With that, 44 fish stocks have

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Snapper fishery in the Gulf of Mexico and the Atlantic Cod fishery off of New England were two of America's most iconic fisheries, and were overexploited during this time period. *The Law That's Saving America's Fisheries: The Magnuson-Stevens Fishery Conservation and Management Act*, THE PEW CHARITABLE TRUSTS & OCEAN CONSERVANCY, https://oceanconservancy.org/wp-content/uploads/2017/05/ff-msa-report-20131.pdf (last visited April 18 2019).

[15] *Overfishing and Declining Numbers*, *supra* note 5.

[16] Mansel Blackford, *A Tale of Two Fisheries: Fishing and Overfishing in American Waters*, Origins: Current Events in Historical Perspective, OHIO STATE UNIV. & MIAMI UNIV., (Sept. 2008), http://origins.osu.edu/article/tale-two-fisheries-fishing-and-over-fishing-american-waters.

[17] MONTEREY BAY AQUARIUM SEAFOOD WATCH, *supra* note 4.

[18] Brad Sewell, et al., *Bringing Back the Fish: An Evaluation of U.S. Fisheries Rebuilding Under the Magnuson-Stevens Fishery Conservation and Management Act*, NAT. RES. DEF. COUNCIL (2013).

[19] Essential Fish Habitat is defined as "waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." 16 U.S.C. § 1802(10) (2018).

[20] *History and Organization Structure*, NEW ENGLAND FISHERY MGMT. COUNCIL, https://www.nefmc.org/about/history; Pub. L. 104-297, § 108 (1996).

[21] *Magnuson-Stevens Fishery Conservation Management Act*, CONG. SPORTSMEN'S FOUND. (2018), http://congressionalsportsmen.org/policies/state/magnuson-stevens-act.

[22] NAT'L. MARINE FISHERIES SERV., *Status of Stocks 2017: Annual Report to Congress on the Status of U.S. Fisheries* 2 (2018).

now been rebuilt since 2000.[23] What this demonstrates is that more active regulation that emphasizes harvesting a sustainable yield and enforces accountability has been effective in combatting overfishing.

While this trend does highlight the effectiveness of fisheries regulation, it does not paint a dispositive picture of the state of fish populations relative to their historical levels. Since 1970, global fish populations have fallen by approximately 50 percent.[24] Among the most affected populations are commercially important species in the United States, such as Bluefin Tuna (*Thunnus thynnus*) and Atlantic Cod (*Gadus morhua*).[25] What's worse is that the coastlines surrounding the United States are still subject to heavy fishing pressure, which makes it even harder for struggling populations to regrow.[26]

It is also important to note that the MSA measures the fish stocks by maximum sustainable yield, which is defined as the largest long-term average catch that can be taken from a stock under prevailing environmental and fishery conditions. This means that a stock's health is measured relative to the catch that can be taken per year; it is not measured relative to the stock's historical abundance.[27] It follows that the statutory definitions of 'overfishing' and 'overfished' are relative to maximum sustainable yield.[28] Even the definition of a 'rebuilt' stock is in relation to maximum sustainable yield.[29] (This paper will not address the merits of these definitions, but will note that the status of a stock as healthy or rebuilt does not reflect its historical health, which means that there may be a greater need for conservation than what the NMFS indicates in its stock assessments.)

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[23] *Id*.

[24] Alister Doyle, *Ocean Fish Numbers Cut in Half Since 1970*, SCIENTIFIC AM., (Sept. 16, 2015), https://www.scientificamerican.com/article/ocean-fish-numbers-cut-in-half-since-1970/#googDisableSync.

[25] Brad Plumer, *Just how badly are we overfishing the oceans?*, WASH. POST, (Oct. 29, 2013), https://www.washingtonpost.com/news/wonk/wp/2013/10/29/just-how-badly-are-we-overfishing-the-ocean/?utm_term=.824b63c0ef6a.

[26] Maria M.D. Palomares & Daniel Pauly, *Living Planet Report 2018*, WORLD WILDLIFE FUND 60 (2018).

[27] NAT'L. MARINE FISHERIES SERV., *supra* note 22, at 4.

[28] 16 U.S.C.A. § 1802(34) (2018).

[29] A 'Rebuilt' stock is a stock that was previously overfished and that has increased in abundance to the target population size that supports the MSY. NAT'L. MARINE FISHERIES SERV., *supra* note 22, at 4.

The history of depleted fish stocks across the globe, particularly in the United States, demonstrates the imperative to increase fish populations. While the MSA has been effective at reducing overfishing, there is still more room for fish mortality reduction that can further help to regrow fish stocks. This mortality reduction can be driven in large part from the recreational fishing sector.

C. Comparing Recreational and Commercial Fishing

The difference between recreational and commercial fishing is defined by statute. Recreational fishing means fishing for sport or pleasure.[30] Commercial fishing means fishing in which the fish harvested, either in whole or in part, are intended to enter commerce or enter commerce through sale, barter or trade.[31] Businesses guiding recreational fishermen, although commercial in nature, still fall under the umbrella of recreational fishing, given that the customers in such businesses are fishing recreationally.[32]

In 2016, the commercial fishing and the seafood industry supported 1.2 million jobs, and generated $144 billion in sales impacts, contributing $61 billion to the GDP.[33] Recreational saltwater fishing alone supported 472,000 jobs, generating $68 billion in sales impacts and contributing $39 billion to the GDP.[34] Recreational freshwater fishing supported 526,600 jobs, generating more than $82.6 billion in sales impacts, and contributing $41.9 billion to the GDP.[35] Commercial fishing and recreational fishing are two highly productive sectors of the U.S. economy.

A key difference between recreational and commercial fisheries lies in the value of harvest. Commercial fishing is primarily driven by how many fish are brought into the stream of commerce,

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[30] 16 U.S.C.S. § 1802(37) (1976).

[31] *Id.* at § 1802(4).

[32] *Id.* at § 1802(3).

[33] *Economic Impact of U.S. commercial, recreational fishing remains strong*, NAT'L. OCEANIC AND ATMOSPHERIC ADMIN., (Dec. 13, 2018), https://www.noaa.gov/media-release/economic-impact-of-us-commercial-recreational-fishing-remains-strong.

[34] *Id.*

[35] *Sportfishing in America*, AM. SPORTFISHING ASS'N & SPORTFISH RESTORATION, (2018), https://asafishing.org/wp-content/uploads/Sportfishing-in-America-8-2018.pdf.

whereas recreational fishing is more dependent upon the experience and pleasure that comes with catching fish.[36] Commercial fishermen maximize their income by continuing to fish until the costs of catching the fish exceeds the income generated.[37] Recreational fishermen who do not have this financial pressure to harvest fish can take more of a role as stewards of the environment and for the species that they value. There is a recognition throughout the recreational fishing community of the role that recreational fishermen play in conserving species and protecting habitats.[38] This appreciation for the opportunities and enjoyment that recreational fishing affords has led to a strong desire for conservation from recreational fishermen.[39] On the other hand, commercial fishermen often find fishery regulations to be a burden on their lives that extends beyond the reach of any line or net, and are therefore they are more opposed to such mortality-reducing regulation.[40] There are numerous organizations that help to educate interested anglers on how to be better stewards, as well as organizations that lobby for recreational fishermen for conservationist policies.[41] As a result of the lower importance of harvest and the

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[36] Recreational fisheries are not thought to be subject to the same market forces that have driven commercial fisheries to collapse. John R. Post, et al., *Canada's Recreational Fisheries: The Invisible Collapse?*, 27 FISHERIES MAGAZINE 6 (2011).

[37] J. D. Beddington, et al., *Current Problems in the Management of Marine Fisheries*, 316 SCI. 1713, 1713 (2007).

[38] Both President George W. Bush and President Obama have mired over the role that recreational fishermen and hunters have played in conservation efforts throughout the nation's history. Proclamation 7822, 69 FR 59539, (Sept. 24, 2004); Proclamation 8421, 74 FR 49305, (Sept. 22, 2009).

[39] Scott Witty, *It's A Keeper: Preserving Minnesota's Recreational Fishing By Allowing Effective Regulatory Enforcement*, 26 HAMLINE J. PUB. L. & POL'Y 151, 152 (2004).

[40] Commercial fishermen cite more restrictive fisheries regulations as stressors on family dynamics and a contributing factor to high divorce rates. *The Cumulative Social, Cultural, and Economic Effects of Seasonal Closures on Fishing Communities,* ATL. STATES MARINE FISHERIES COMM'N, 6 (June 2005), http://www.asmfc.org/uploads/file/sr85SeasonalClosureImpactsonFishingCommunities.pdf.

[41] *See e.g.* Debbie Hanson, *5 Fishing Conservation Groups for Recreational Anglers*, TAKEMEFISHING.ORG, (Nov. 8, 2015), https://www.takemefishing.org/blog/november-2015/5-fishing-conservation-groups-for-recreational-ang/; MARINE FISH CONSERVATION NETWORK, http://conservefish.org; *Habitat and Clean Water*, THEODORE ROOSEVELT CONSERVATION P'SHIP, http://www.trcp.org/what/habitat-and-clean-water/.

conservationist mindset of many recreational fishermen, regulatory priorities can be more conservation-minded for recreational fishing, since recreational fishing regulations that reduce the number of fish harvested pose less of a threat of economic loss,[42] and are generally more welcomed in the recreational community than they are in the commercial fishing community.

Unfortunately, despite the best intentions of recreational fishermen, recreational fishing can still contribute to degradation of fish populations. While it is true that recreational fishing typically has markedly less of an impact on fisheries than does commercial fishing, recreational fishing has historically been detrimental for many highly valued species.[43] Recreational fishing has even been credited as being responsible for the population collapse of certain species.[44]

Given the economic impact of commercial and recreational fishing in the United States, as well as the harmful environmental impacts that both can have on fish populations, the government has the responsibility to grow and rebuild fish populations while balancing the economic demands of these competing groups.[45] The dichotomy in attitudes towards conservation-based regulation between commercial and recreational fishermen, paired with the lower economic risk of regulation in recreational fisheries, shows that improved regulation in recreational fisheries can be an effective tool in reducing fish mortality in a cost-effective manner.

I. CURRENT STATE OF RECREATIONAL FISHERIES LAW

The most common current forms of regulation surrounding recreational fisheries are the use of size and bag limits, seasonal restrictions, and licensure.[46] Size limits mandate how large a fish must be in order to harvest that fish. Bag limits determine how many fish of

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[42] Ronald J. Salz & David K. Loomis, *Recreation Specialization and Anglers' Attitudes Towards Restricted Fishing Areas*, 10 HUMAN DIMENSIONS OF WILDLIFE 187, 187 (2006).

[43] Robert M. Hughes, *Recreational fisheries in the USA: economics, management strategies, and ecological threats*, 81 FISH SCI. 1, 5 (2015).

[44] Steven J. Cook & Ian G. Cowx, *The Role of Recreational Fishing in Global Fish Crises*, 54 BIOSCI. 857, 858 (2004).

[45] James T. Thorson, et al., *Competing Interests, Economics, and Marine Fisheries Management: An Educational Case Study*, A COLLECTION OF CASE STUDIES 154 (2017).

[46] *See* United States v. Stevens, 559 U.S. 460, 475 (2010).

a certain species may be harvested.[47] Seasonal restrictions restrict the open season in which individuals of a species may be harvested. Licensure requires the holding of a license in order to partake in recreational fishing. There are also protected areas where recreational fishing can be further regulated or prohibited entirely.

A. Size and Bag Limits

Size and bag limits were among the first forms of recreational fishing regulation in America,[48] and have only grown in importance as management techniques.[49] A bag limit is the number of fish that a person or a vessel may harvest per day. Bag limits are a fairly intuitive as a regulatory tool as they protect fish populations from over-exploitation by limiting the amount of fish that a person can take at one time.[50]

Size limits, however, can be more intricate in their use. Minimum size restrictions are meant to protect fish of spawning size until they have a chance to reproduce.[51] For some species, the minimum size limit is meant to ensure that, in theory, every fish will have had at least one chance to reproduce before the individual is harvested.[52] Slot limits are size limits that are meant to protect certain life stages of fish in order to influence the fishery.[53] How regulators use a slot limit is dependent upon the species. For some species, an individual must be outside of a given size range, so harvest is allowed for individuals that are either smaller or larger than the designated size

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[47] Bag limits are synonymous with other terms, such as 'Trip Limits.' *See, e.g.*, 6 NYCRR § 40.1(a)(1) (1993). For the purposes of this paper, 'Bag Limits' will encompass all such terms.

[48] Frank J. Rahel, *Changing Philosophies of Fisheries Management as Illustrated by the History of Fishing Regulations in Wyoming*, 41 FISHERIES 38, 38 (2016).

[49] Maurice I. Muoneke & W. Michael Childress, *Hooking mortality: A review for recreational fisheries*, 2 REV. FISHERIES SCI. 123, 123 (2008).

[50] *Why Do We Have Fishing Regulations?*, N.C. DEP'T ENVTL. QUALITY, http://portal.ncdenr.org/web/mf/edu/fishing-regulations-why.

[51] *Id.*

[52] *Sustainable Fishing pt. 1*, BROOKLYN FISHING CLUB PODCAST (DEC. 18, 2018), https://brooklynfishingclub.libsyn.com/sustainable-fishing.

[53] *Largemouth Bass Facts*, LA. STATE UNIV. AGRIC. CTR. & LA. SEA GRANT, https://www.lsu.edu/seagrantfish/pdfs/factsheets/largemouthbass.pdf.

range.[54] For other species, individuals must be within the 'slot' range in order to be harvested.[55] Minimum size limits are used as opposed to slot limits in the overwhelming majority of fisheries.[56] Unfortunately, an increasing amount of research shows this management technique of ubiquitous use of minimum size limits to be misguided. For either type of size limit, there is also a problem where there are little to no regulation of fishing equipment that helps to ensure that a fish meant to be released will actually be able to survive once it is released.

For some fisheries, in addition to size and bag limits, regulators institute an annual quota for the recreational fishery.[57] These quotas limit the amount of fish that are allowed to be harvested in a given year. While annual quotas are mostly used for commercial fisheries, their use for strained recreational fisheries helps to ensure that the population is not subject to overfishing that year.

B. Open Seasons

Open seasons restrict when fish of a particular species may be harvested. Seasonal restrictions for many species are used to protect aggregations of spawning fish, which prevents fish from being harvested before they have a chance to spawn.[58] Management councils also take into account the need for fishermen to pursue their

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[54] For Largemouth Bass in Kansas, fish under 13 inches in length, or over 18 inches in length, are allowed to be harvested. Largemouth Bass that fall outside those ranges are not allowed to be harvested. *What are slot limits?*, KAN. DEP'T WILDLIFE, PARKS & TOURISM, https://ksoutdoors.com/Fishing/Fishing-FAQ/License-and-Regulation-Questions/What-are-slot-limits.

[55] In Florida, Redfish must be between 18 and 27 inches in order to be harvested. Gary Poyssick & Scott Moore, *Finding Slot Redfish in Schools*, THE ONLINE FISHERMAN, (Jan. 2007), https://www.theonlinefisherman.com/how-to-fish/finding-slot-redfish-in-schools.

[56] Jonathan A.D. Fisher, et al., *Breaking Bergmann's rule: truncation of Northwest Atlantic marine fish body sizes*, 91 ECOLOGY 2499, 2499 (2010).

[57] *See* Etienne René, *A Colossal Bird's Nest: The Backlash Surrounding the Management of the Gulf of Mexico Red Snapper Fishery*, 4 LSU J. OF ENERGY L. & RES. 449, 461 (2016). The Red Snapper fishery in the Gulf of Mexico is subject to an annual quota. After this quota is reached, the harvest of such fish by recreational fishermen is to be prohibited. *Id*.

[58] *Fishery Closures Right Now*, S. ATL. FISHERY MGMT. COUNCIL, (last visited Apr. 18, 2019), http://safmc.net/regulations/fishing-season-calendar-closures/.

livelihood,[59] which can also factor into how open seasons are determined. Additionally, seasonal closures can be triggered if the ACLs for the species has been reached.[60] More restrictive seasons can be put in place in response to reports that a fishery faces overfishing or is being overfished as a means of reducing fishing pressure and mortality for that species.[61]

C. Licensure

The Magnuson-Stevens Fisheries Conservation Management Act requires national registration of recreational fishermen, unless they are registered under satisfactory state programs.[62] Every state requires some sort of recreational fishing license. While some states do not require registration fees for recreational fishing licenses,[63] many do charge such a fee. These fees are directly used for conservation and restoration, including for enforcement of environmental laws.[64] Since 1952, fishing license sales have contributed $8 billion to conservation efforts, with $700 million having been generated in 2015 alone.[65] At present, licenses are used as a self-sustaining means of obtaining funds necessary to carry out needed administrative activity, such as conservation and enforcement, without reaching into state funding.[66] While licensure systems provide states with information about how many people engage in recreational fishing, they do not provide any

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[59] Karol de Zwager Brown, *Symposium on Salmon Recovery: Truce in the Salmon War: Alternatives for the Pacific Salmon Treaty*, 74 WASH. L. REV. 605, 633 (1999).

[60] *See* S. ATL. FISHERY MGMT. COUNCIL, *supra* note 58; Kristin N. Carden, *The Legal Viability of Territorial Use Rights in Fisheries (TURFs) in California*, 38 ECOLOGY L.Q. 121, 123 (2011).

[61] *See, e.g.*, Fred Golofaro, *Know Your New York Blackfish Regulations*, THE FISHERMAN MAGAZINE, (Oct. 1, 2018), https://www.thefisherman.com/index.cfm?fuseaction=feature.display&feature_ID=2179&ParentCat=19.

[62] 16 U.S.C. 1§881(g) (2007).

[63] *See e.g.* N.Y. ENVTL. CONSERV. LAW § 13-0355(4) (McKinney 2009).

[64] *Buying a fishing license*, U.S. FISH AND WILDLIFE SERV., (June 5, 2017), https://www.fws.gov/fishing/FishingLicense.html. Licenses are a critical revenue source to fund enforcement and preservation operations. Witty, *supra* note 39, 189-91.

[65] U.S. FISH AND WILDLIFE SERV., *supra* note 64.

[66] Witty, *supra* note 39, 190-91.

detail about the status of the species that those fishermen are targeting, nor any detail about how many fish are being harvested.

D. Protected Areas

Specially protected areas are set up around the country to help fish populations naturally regrow. These areas are primarily set up as Fish Hatchery Areas governed by the Fish and Wildlife Service in freshwater bodies, Marine Protected Areas governed by the National Oceanic and Atmospheric Administration, and the National Wildlife Refuge System also governed by the Fish and Wildlife service, which covers fresh and marine waters.[67] The reason that National Parks are not on this list is because the primary recreational fishing regulations in National Park waters are the regulations of the state in which the park is located.[68]

1. NATIONAL FISH HATCHERY AREAS

National Fish Hatchery Areas are maintained primarily for propagation and distribution of fish and aquatic wildlife, and for the protection of all wildlife.[69] When it is determined that recreational fishing is not detrimental to the propagation and distribution of fish or other aquatic animal life, it is allowed with special regulation.[70] Currently, there are 72 National Fish Hatcheries, one historic National Fish Hatchery, nine Fish Health Centers, seven Fish Technology Centers, and the Aquatic Animal Drug Approval Partnership Program.[71] The fish hatcheries are spread across 34 states, and support

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[67] Marine Protected Areas began as a type of National Wildlife Refuge, but are managed independently under their own framework. *Meet the National Wildlife Refuge System*, U.S. FISH & WILDLIFE SERV. 12 (Mar. 2015).

[68] 36 CFR § 2.3(a) (1987).

[69] 50 CFR § 70.1 (1980).

[70] 50 CFR § 71.11 (1966).

[71] *National Fish Hatchery System*, U.S. FISH AND WILDLIFE SERV., https://www.fws.gov/fisheries/nfhs/index.html (last visited Apr. 18, 2019).

two million annual visitors.[72] There are also state-operated freshwater hatcheries in both states with and without National Fish Hatcheries.[73]

2. MARINE PROTECTED AREAS

President Bill Clinton began to develop a system of Marine Protected Areas ("MPAs") in 2000.[74] An MPA is any area of the marine environment that has been reserved by federal, state, tribal, or local law or regulations to provide lasting protection for part or all of the natural and cultural resources therein.[75] MPAs are typically established to fulfill specific conservation goals.[76] If recreational fishing is compatible with those goals, it is allowed, which it is across approximately 90 percent of the geographic area that MPAs occupy.[77] MPAs are subject to area-based regulations meant to provide increased protection than such an area would get outside the boundaries of the MPA.[78] In addition to federal MPAs there are also over 100 state and territorial agencies that have jurisdiction to create similar area-based management zones.[79]

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[72] *Visit a National Fish Hatchery*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/fisheries/hatcheries/visit-a-hatchery.html (last visited Apr. 18, 2019).

[73] *See e.g. Fish Hatcheries*, N.Y. DEP'T ENVTL. CONSERVATION, (last visited Apr. 18, 2019), https://www.dec.ny.gov/outdoor/7742.html; *Fish Hatcheries in Illinois*, ILL. DEP'T NAT. RES., (last visited Apr. 18, 2019), https://www.ifishillinois.org/programs/hatchery.html [both New York and Illinois do not have National Fish Hatcheries]; and *Mass Wildlife Trout Stocking Program*, MASS. DIV. OF FISHERIES & WILDLIFE, (last visited Apr. 18, 2019), https://www.mass.gov/masswildlife-trout-stocking-program. (Massachusetts maintains state fish hatcheries and holds multiple National Fish Hatcheries.)

[74] Exec. Order No. 13158, 65 Fed. Reg. 34909 (May 26, 2000).

[75] *Id*.

[76] MARINE PROTECTED AREAS CTR., *Marine Reserves in the United States* 3, (Aug. 2014).

[77] MARINE PROTECTED AREAS CTR., *Marine Protected Areas and Recreational Fishing* 1, (Mar. 2011). The other 10 percent of MPA area is occupied by Marine Reserves, also known as "no-take" zones. In most of these areas, no type of fishing is allowed. *Id*. at 1-2.

[78] MARINE PROTECTED AREAS CTR., *Framework for the National System of Marine Protected Areas of the United States of America* 11, (Mar. 2015).

[79] *States and Territorial Marine Protected Area Programs*, NATIONAL MARINE PROTECTED AREAS CTR., https://marineprotectedareas.noaa.gov/aboutmpas/programs/state/ (last visited April 18, 2019).

3. WILDLIFE REFUGE SYSTEMS

Under the National Wildlife Refuge System Improvement Act of 1997, the mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and restoration of fish, wildlife, and plant resources and their habitats.[80] Wildlife-dependent uses of such refuge areas, including fishing, can be legitimate and appropriate uses.[81] However, Wildlife Refuge Areas may be opened to recreational fishing only after regulators determine that recreational fishing does not interfere with the purpose of the refuge area, and as long as the fishing in that area is well-managed.[82] Each state maintains refuge-specific regulations for hunting and fishing.[83]

II. WHAT'S MISSING FROM CURRENT LAW

The current state regulatory climate has made some progress in addressing issues of overfishing, especially from the commercial sector.[84] However, this does not mean that fish populations in the United States have rebounded relative to their historic levels, which means that there is still a lot to be desired of fishery conservation.[85] Though commercial fishing is often blamed for overfishing issues, recreational fishing can be a significant contributor to fishery declines, and there is room for improvement with regard to fish mortality from recreational fishing.[86] Current recreational fishing regulations do not efficiently protect spawning fish, fail to add protections for fish that are intended to be released, and do not gather sufficient information for accurate reporting on the actual catch rates from recreational fisheries.

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[80] Pub. L. 105-57(4)(2) (1997) – Refuge System Improvement Act of 1997.

[81] *Meet the National Wildlife Refuge System* 16, U.S. FISH & WILDLIFE SERV. (Mar. 2015).

[82] 50 CFR 32.4 (1993).

[83] 50 CFR 32 Subpart B (1993).

[84] NAT'L. MARINE FISHERIES SERV., *supra* note 22.

[85] Doyle, *supra* note 24.

[86] Hughes, *supra* note 43; Cook & Cowx, *supra* note 44.

A. Spawner Protection/Consideration of BOFFFF Hypothesis

Slot limits are only used for certain species, so the majority of fisheries are regulated by minimum size limits. This practice has been based on the historically held notion that smaller fish are the ones that should be released so that they will have a chance to spawn and continue the circle of life.[87] However, more modern investigation has found this to be an extremely limited view, that regulations following this view can alter population dynamics in an unhealthy manner, and that there is a greater conservation value from larger female fish under the BOFFFF principle. The current regulatory framework in most jurisdictions fails to consider population dynamics and the importance of large breeding fish.

1. HARM TO POPULATION DYNAMICS

Regulatory schemes that base fishing regulations on minimum size do not do justice to population dynamics. By mandating release of only smaller fish, minimum size regulations apply selection pressure that may unnaturally favor smaller individuals, which can affect the overall size of the species over time.[88] This artificial pressure also results in truncation of age structure within fish populations, leaving more younger fish and fewer breeders.[89] Populations with a disproportionate number of younger individuals are less resilient to environmental changes.[90] Larger-bodied species have demonstrated a lowered ability to recover and reclaim former ecological roles when the population becomes dominated by early-life-stage individuals.[91]

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[87] James Cave, *Why Big, Old, Fat, Fertile Female Fish Are The Rockstars Of The Ocean*, HUFFINGTON POST, (Oct. 27, 2014), https://www.huffingtonpost.com/2014/10/23/boffffs-big-fat-fish-research_n_6039252.html.

[88] John Matson, *Are Current Fishing Regulations Misguided?*, SCI. AM., (Apr. 27, 2010), https://www.scientificamerican.com/article/fishing-balanced-exploitation/.

[89] John Tiedemann, *The BOFFFF Principle*, THE FISHERMAN MAGAZINE, (Nov. 2018), p. 6G.

[90] John Stewart, *Evidence of age-class truncation in some exploited marine fish populations in New South Wales, Australia*, 108 FISHERIES RESEARCH 209, 209 (2011).

[91] Fisher, et al., *supra* note 56, at 2503.

The homogenization of smaller individuals across a species makes the species more susceptible to breeding failures, further endangering the population.[92] By failing to take these effects into account, regulators leave populations vulnerable by selecting for smaller and younger individuals through minimum size limits.

2. BOFFFF PRINCIPLE

A focus on protecting spawning fish has become less important in the current regulatory framework than it had been in the early days of fishery regulation.[93] The reason that the straying from this focus is misguided is largely due to the Big Old Fat Fecund Female Fish Principle (sometimes also called the Big Old Fat Fertile Female Fish Principle, hereinafter the "BOFFFF Principle"). The BOFFFF Principle is the scientific principle that older and larger female fish play a crucial role in maintaining fish stocks.[94] There is a growing scientific understanding that these fish have been underappreciated in conventional fisheries management.[95]

The reason that these fish are so important is because a female fish's ability to produce and hold eggs grows disproportionately with increased body size[96] because the larger body cavity allows for development of larger ovaries.[97] What's more is that offspring from BOFFFF's typically perform better, with eggs and larvae being larger, growing faster, and being better able to deal with starvation.[98] The size of the oil globule with which larval fish are provisioned at birth is strongly related to maternal age, so the offspring of larger and older fish are more resistant to starvation because they have a larger initial food supply.[99] Because of the increased fitness of BOFFFF offspring,

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[92] *Id.*

[93] Craig Paukert, et al., *Historical Trends in Creel Limits, Length-based Limits, and Season Restrictions for Black Basses in the United States and Canada*, 32 FISHERIES 62, 68 (2007).

[94] Tiedemann, *supra* note 89.

[95] Mark A. Hixon, et al., *BOFFFFs: on the importance of conserving old-growth age structure in fishery populations*, 71 ICES J. MARINE SCI. 2171, 2171 (2010).

[96] Tiedemann, *supra* note 89.

[97] Hixon, et al., *supra* note 95.

[98] *Id.*

[99] Tiedemann, *supra* note 89.

more survive into adulthood to reproduce themselves.[100] Additionally, BOFFFF's are more likely to survive adverse environmental conditions than are younger fish, and can then reproduce feverishly when those conditions improve.[101] In some species, younger fish may skip a spawning season all together.[102] BOFFFF's also have longer spawning seasons, so they can spawn at different times and in different locations than younger fish, which adds an element of stability to annual reproduction cycles.[103]

B. Mortality Reduction in Catch and Release Fishing

One aspect of recreational fishing that can make it a more sustainable use of natural resources is the ability to release fish. At present, there are minimal general regulations that ensure that a fish meant to be released will actually survive.[104] Area-based gear regulations exist for certain protected areas,[105] but these are obviously less effective than would be general regulations that apply federally or state-wide. The success of length-based limits in attaining their intended purposes depends on the survival of released fish.[106] The importance of the survival rates of released fish is especially important given that an estimated 60 percent of all fish captured by recreational fishermen are released.[107] Catch and release fishing in recreational fisheries can be a valuable conservation tool if anglers adopt behaviors that minimize impacts on fish.[108] Unfortunately, broadly-applying regulation that mandates such behaviors is lacking, which reduces the incentive for anglers to undertake these behaviors.

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[100] *Id*.

[101] Cave, *supra* note 87.

[102] Hixon et al., supra note 95.

[103] Tiedemann et al., *supra* note 89.

[104] S. J. Cooke & H. L. Schramm, *Catch-and-release science and its application to conservation and management of recreational fisheries*, 14 FISHERIES MGMT. ECOLOGY 73, 74 (2007).

[105] *See, e.g.*, 56 R.C.N.Y. § 1-05(h). This specifies extra conservation measures mandated for fishing in parks in New York City.

[106] Gene R. Wilde, et al., *Lure-size Restrictions in Recreational Fisheries*, 28 FISHERIES 18, 18 (2008).

[107] Cooke & Schramm, *supra* note 104.

[108] Andy J. Danylchuk, et al., *Keepemwet Fishing—An emerging social brand for disseminating best practices for catch-and-release in recreational fisheries*, 205 FISHERIES RESEARCH 52 (2018).

C. Increased Information Gathering

Despite the fact that the number of recreational fishermen far outnumber the number of commercial fishermen, recreational fishing has poor reporting, with less assessments or surveys completed than are completed in commercial fishing.[109] This under-reporting has led to an overall scarcity of harvest data for recreational fisheries.[110] That scarcity can cause trouble with calculating and trusting fishery data from recreational fisheries.[111] It is believed that management strategies should include localized knowledge, and that broad-scale citizen participation can have a meaningful impact towards achieving these objectives.[112]

At present, reporting requirements are scarce, and information is gathered differently based upon jurisdiction. Some states make no reporting requirement, and do not have infrastructure designed for voluntary reporting.[113] Other states, such as New York and Maryland, maintain electronic portals for voluntary reporting.[114] Some states (i.e. California and Virginia) mandate reporting for certain species, which is included as a license provision for recreational fishermen targeting those species.[115] For federal reporting, NOAA has set up a variety of

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[109] Boris Worm, et al., *Rebuilding Global Fisheries*, 325 SCI. 578, 581-82 (2009).

[110] *Id*.

[111] Felicia C. Coleman, et al., *The Impact of United States Recreational Fisheries on Marine Fish Populations*, 305 SCI. 1958, 1958 (2004).

[112] Ian G. Baird & Mark S. Flaherty, *Mekong River Fish Conservation Zones in Southern Laos: Assessing Effectiveness Using Local Ecological Knowledge*, 36 ENVTL. MGMT. 439, 440 (2005).

[113] *See e.g. Fishing*, CONN. DEP'T ENERGY & ENVTL. CONSERVATION, (Dec. 2018), https://www.ct.gov/deep/cwp/view.asp?a=2696&q=322708&deepNav_GID=1630.

[114] *See e.g. Saltwater Fishing*, N.Y. DEP'T OF ENVTL. CONSERVATION, https://www.dec.ny.gov/outdoor/7755.html (last visited Apr. 19, 2019); *The State of Maryland's Volunteer Angler Surveys*, MD. DEP'T NAT. RES., http://dnr.maryland.gov/fisheries/Pages/survey/index.aspx (last visited Apr. 19, 2019).

[115] *See, e.g., Recreational Reporting FAQ*, VA. MARINE RES. COMM'N, http://www.mrc.virginia.gov/Notices/2017/2017_Recreational-Reporting-FAQ_06-08-17.shtm (last visited Apr. 19, 2019). This program mandates reporting for every trip, even if no fish of the designated species are caught. *See also* CAL. DEP'T FISH & WILDLIFE, *California Freshwater Sport Fishing Regulations 2019-2020* 8-9

survey techniques, including in-person intercepts (interviews with fishermen after a fishing trip), phone surveys, written surveys, and online surveys.[116] These programs can be integrated with state survey programs, but generally do not mandate responses.[117]

III. SOLUTIONS PROPOSED

The short comings of modern recreational fishing regulations can be solved to a large extent with more sophisticated regulatory techniques. The lack of protection for breeding fish and population dynamics can be met with increased use of slot-limits and balanced exploitation. Catch and release fishing can be made less lethal to fish by enforcing certain gear requirements that reduce the likelihood of accidental mortality. The addition of reporting requirements as attachments to fishing licenses can be used to increase information gathering from the recreational fishing sector. The use of fish tagging can also help to increase information gathering from fishermen. Regulators can also use award programs to encourage and further legitimize catch and release fishing. Finally, given the extensive use of protected areas and the benefit that they can produce, steps should be taken to preserve such areas in order to further protect fish populations.

A. Greater Use of Slot Size Limits

The regulatory tool of a minimum size limit that is applied to almost every regulated species can be helpful in protecting young and sexually immature fish. However, minimum size limits are not always the most productive way to regulate fish harvest in recreational fisheries, as a decrease in average individual size is an unavoidable result.[118] Slot limits can be used to protect certain life stages of a

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(Effective Mar. 1, 2019), available at http://www.eregulations.com/california/fishing/supplement/report-card-requirements/.

[116] *How the Marine Recreational Information Program Samples Anglers*, NAT'L. OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/recreational-fishing-data/how-marine-recreational-information-program-samples-anglers (last visited Apr. 19, 2019).

[117] *Id*.

[118] Jeppe Kolding & Paul A.M. van Swieten, *Sustainable Fishing of Inland Waters*, 73 J. LIMNOLOGY 132, 142 (2014).

population, and can be especially protective of larger breeding fish. According to the BOFFF principle, older and larger females produce a disproportionately high amount of eggs with increased body size, and the resulting spawn are better fit to survive.[119] It follows that in order to better conserve populations, slot limits can be used to protect these larger individuals from harvest, which can improve replacement rates. How a slot limit is used will depend on the biology of the fish species and will require scientific study on what life stages require the most protection. These studies ought to be conducted with greater frequency in order to determine how to best manage length limits. Slot size limits are a valuable means of meeting both conservation and recreational fishery objectives, and should be used more ubiquitously by fisheries managers.[120] The use of slot limits can be examined through two case studies: the successful use of a slot limit to revive Red Drum (*Sciaenops ocellatus*), and the need for a slot limit to curb overfishing of Striped Bass (*Morone saxatilis*).

1. RED DRUM: A SLOT LIMIT SUCCESS

The preservation of overfished species due to the implementation of a slot limit is not a novel theory. A slot limit was instituted for Red Drum in 2002 following reports that the species was overfished.[121] The slot limit was set to protect spawning stock, with the harvest only allowed for fish measuring between 18 and 27 inches in length, when individuals generally are first able to spawn when they reach 26 inches in length, thus protecting the vast majority of spawning individuals.[122] As a result of this slot limit, the frequency of larger individuals increased significantly,[123] and the species is no longer

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[119] Hixon et al., *supra* note 95; Tiedemann, *supra* note 89.

[120] Daniel C. Gwinn, et al., *Rethinking length-based fisheries regulations: the value of protecting old and large fish with harvest slots*, 16 FISH AND FISHERIES 259, 259 (2015).

[121] N.C. FISHERIES, CONSIDERATION FOR RELAXING THE CURRENT HARVEST REGULATIONS ON RED DRUM: INFORMATION PAPER (Mar. 4, 2010).

[122] Toby Lapinski, *Playing the Slots*, THE FISHERMAN MAGAZINE, https://www.thefisherman.com/index.cfm?fuseaction=feature.display&feature_ID=2264&ParentCat=2 (last visited Apr. 19, 2019).

[123] Brent L. Winner, et al., *Multidecadal Evidence of Recovery of Nearshore Red Drum Stocks off West-Central Florida and Connectivity with Inshore Nurseries*, 34 N. AM. J. FISHERIES SCI. 780, 780 (2014).

considered overfished, for which the imposition of a slot limit is given credit.[124]

2. STRIPED BASS: SLOT LIMIT NEEDED

Regulators can take a lesson that was the success story of the slot limit for Red Drum. Another species that could greatly benefit from the imposition of a slot limit is Striped Bass. This species has long formed one of the most important recreational and commercial fisheries on the Atlantic coast of the U.S.[125] Striped Bass strongly conform to the BOFFFF Principle, which has led to calls for a slot limit by some recreational fishermen.[126]

At present, the New York State Department of Environmental Conservation uses a slot limit in the Hudson River (a tidal river from which Striped Bass migrate every year) to prohibit the harvest of fish between 28 and 40 inches.[127] This slot limit was created with the intention of protecting most of the spawning biomass while allowing fishermen to harvest trophy-sized fish.[128] However, this fails to account for the disproportionate breeding capabilities of those trophy-sized fish, even if they make up a small percentage of the total population.

New Jersey also has a slot limit for Striped Bass, wherein the first fish harvested must be between 28 and 43 inches in length, and another fish may be harvested that is over 43 inches in length that must be reported to the Division of Fish and Wildlife.[129] This also falls short of protecting breeding fish, as the large breeder females may still be harvested, so long as a smaller fish is harvested as well.

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[124] Summer M. Burdick, et al., *Movement and Selectivity of Red Drum and Survival of Adult Red Drum: An Analysis of 20 Years of Tagging Data*, N.C. DIV. MARINE FISHERIES (Feb. 2007).

[125] *Atlantic Striped Bass*, ATL. STATES MARINE FISHERIES COMM'N, http://www.asmfc.org/species/atlantic-striped-bass (last visited Apr. 19, 2019).

[126] Tiedemann, *supra* note 89.

[127] *Striped Bass Length Distribution and Slot Limit*, N.Y. DEP'T ENVTL. CONSERVATION, https://www.dec.ny.gov/animals/108092.html (last visited Apr. 19, 2019).

[128] *Id*.

[129] *2018 NJ Recreational Minimum Size, Possession Limits, & Seasons*, N.J. DIV. FISH & WILDLIFE, https://www.njfishandwildlife.com/pdf/2018/maregsum18.pdf (last visited Apr. 19, 2019).

Striped Bass are overfished and the stocks are declining.[130] Most of the fishing pressure comes from recreational fishermen who account for 90 percent of all Striped Bass killed.[131] There is a clear need for reduction in fish mortality from the recreational Striped Bass fishery, and a slot limit would have the most meaningful conservation impact. Therefore, state regulators should take the reins and institute slot limits for Striped Bass, or regional management councils or federal regulators should require that states do so.

B. Gear Regulations

If catch and release fishing is to be effective as a conservation tool, the released fish must be able to survive. Length limits – whether slot or minimum size limits – are useless if the protected class of fish does not survive capture. One solution to improve the probability that a released fish will survive is to mandate the use of certain fishing gear that is less likely to mortally wound fish. NOAA has made recommendations for how to best practice catch and release fishing, which include the use of circle or barbless hooks, the use of non-stainless-steel hooks, and guidelines on how to quickly release a fish, including bottom-dwelling fish.[132] The National Park Service also recommends the use of single hooks, as well as the use of artificial lures over bait.[133] Unfortunately, these are just recommendations that do not carry the force of law. Regulators can fix this by adding these provisions to regulations in order to lower mortality rates in catch and release fishing. Chief among the possible areas of regulation are hook regulation, restrictions on the use of bait, and requirements for handling fish that have suffered barotrauma.

1. HOOK REGULATION

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[130] *Striped Bass Overfished, Managers Discuss Options*, ON THE WATER MAGAZINE, (Feb. 14, 2019) https://www.onthewater.com/news/2019/02/14/striped-bass-overfished.

[131] Kevin Blinkoff, *Striped Bass Stock Overview*, ON THE WATER MAGAZINE, (Feb. 15, 2019), https://www.onthewater.com/striped-bass-stock-overview.

[132] *Catch and Release Best Practices*, NAT'L. OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/national/recreational-fishing/catch-and-release-best-practices (last visited Apr. 19, 2019).

[133] *Catch and Release Fishing*, NAT'L. PARK SERV., https://www.nps.gov/subjects/fishing/catch-and-release-fishing.htm (last visited Apr. 19, 2019).

Hooking injury is the primary cause of mortality in catch and release fishing.[134] The type and number of hooks can significantly affect the mortality rates when practicing catch and release fishing. (Attached in Appendix A are images depicting several types of hooks discussed in this section, for reference.) Using fewer hooks – either a lower number of hooks or single hooks instead of treble hooks – reduces physical injury and unhooking times.[135] Barbless hooks reduce injury and unhooking times, but there is little evidence that barbless hooks directly affect mortality rates.[136] A recent New York State Department of Environmental Conservation Study found that hook location was the only variable that significantly affected survival, with individual fish hooked in the gut having a significantly higher likelihood of dying than did those hooked in the lip.[137] Circle and octopus hooks generally reduce injury compared with traditional j-hooks or treble hooks,[138] as these hooks more frequently set in the jaw, and less frequently in the gut than conventional hook types.[139] Additionally, catch rates can remain generally constant between circle hooks and traditional j-hooks.[140]

Given the effectiveness of different hook types and set-ups to decrease mortality rates, regulators should enact limits on the type and quantity of hooks used, especially in designated protected areas. A limit on hook number can improve injury and mortality rates with released fish. Circle hooks are seemingly the most effective way to limit gut-hooking and overall hooking mortality. It should be noted that in some species, circle hooks have minimal conservation

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[134] Jacob W. Brownscombe, et al., *Best practices for catch-and-release recreational fisheries – angling tools and tactics*, 186 FISHERIES RESEARCH 693, 694 (2017).

[135] *Id*.

[136] *Id* at 694-95.

[137] Michael J. Millard, et al., *Best practices for catch-and-release recreational fisheries – angling tools and tactics* (Jan. 2000) [A report to the New York State Department of Environmental Conservation].

[138] Brownscombe, et al., *supra* note 134, at 695.

[139] S.J. Cooke & C.D. Suski, *Are circle hooks an effective tool for conserving marine and freshwater recreational catch-and-release fisheries?*, 14 AQUATIC CONSERVATION: MARINE & FRESHWATER ECOSYSTEMS 299, 299 (2004).

[140] Joseph E. Serafy, *Circle hooks in commercial, recreational, and artisanal fisheries: research status and needs for improved conservation and management*, 88 BULLETIN OF MARINE SCI. 371, 378 (2012).

benefit.[141] Therefore, it may be more useful to tailor mandated circle hook use to targeting certain species. In order to maximize the conservation benefits of circle hooks, management regulations should be as consistent as possible through the entire geographical range of the species for which conservation benefits are being sought,[142] so coordination between different states and regional management jurisdictions would be optimal.

2. RESTRICTING BAIT USE

The use of natural bait (worms, bait fish, crustaceans, etc.) is a common practice in recreational fishing. Unfortunately, the use of natural baits causes increased hooking injury[143] and can lead to increased fish mortality, as fish are more likely to swallow natural baits as opposed to artificial lures.[144] Regulation banning or severely limiting the use of live baits would seem like a simple solution. However, such regulation would have adverse effects on other stakeholders, as the natural bait industry generates millions of dollars per year to state economies,[145] and contribute significantly to locally owned bait and tackle shops, which support over 16,000 jobs.[146] It follows that a more intricate approach would be better suited for minimizing fish mortality from natural bait in order to prevent economic damage to the businesses supported by recreational fishing. Hook type is particularly important for reducing injury and mortality when using natural baits,[147] so one plausible regulation would be to

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[141] Cooke & Suski, *supra* note 139.

[142] Serafy, et al., *supra* note 140, at 384.

[143] Brownscombe, et al., *supra* note 134, at 695.

[144] Aaron Bartholomew & James A. Bohnsack, *A review of catch-and-release angling mortality with implications for no-take reserves*, 15 REV. FISH BIOLOGY and Fisheries 129, 134 (2004).

[145] $50 million is spent annually on bait in Minnesota. *Economic Impact and Social Benefits Study of Coldwater Angling in Minnesota* 7, MINN. DEP'T NAT. RES. (2002). A 6.45 percent increase in total allowable catch for Atlantic Menhaden yielded a 1.5-million-dollar increase in the industry over the course of that year. John C. Whitehead & Jane Harrison, et al., *Socioeconomic Analysis of the Atlantic Menhaden Commercial Bait and Reduction Fishery*, iii (2017) [A Report to the Atlantic States Marine Fisheries Commission].

[146] NAT'L OCEANIC & ATMOSPHERIC ADMIN., *The Economics of Independent Marine Recreational Fishing Bait and Tackle Retail Stores in the United States, 2013* (2013).

[147] Brownscombe, et al., *supra* note 134, at 695.

limit the use of bait to hook types that decrease injury, such as circle hooks. Another answer is to restrict natural bait fishing in designated protected areas in order to minimize the environmental impact from fish mortality in those areas.

3. HANDLING FISH WITH BAROTRAUMA

Barotrauma is trauma caused when a fish is reeled in from deep water, and the fish's swim bladder (which is used to regulate at what depth the fish sits in the water) inflates rapidly, which causes the eyes to bulge out and stomach to be pushed out of the fish's mouth.[148] Amazingly, deep-water fish can survive this trauma if released properly.[149] Three main release tools can be used to help ensure that a fish is properly released: mouth clamps, inverted hooks, and fish elevators.[150] Mouth clamps, often available commercially for purchase, help to hold the fish as it is descended back to a safe depth, and then allows for the fish to easily escape.[151] Inverted hooks work similarly to mouth clamps, but are made with a barbless hook and are inserted through the mouth hole created by the hook used to catch the fish.[152] A fish elevator is an upside down container (often a milk crate or something of similar means) that is attached to a rope and weighted to guide the fish towards the bottom, allowing the fish to swim away at the proper depth once the container begins to be retrieved.[153] It is not advised to attempt to puncture the swim bladder to relieve pressure, as this creates great risk of seriously harming other organs.[154] Regulators should mandate that recreational boats fishing in deep water retain at least one of these three devices on board in order to facilitate safe release of deep-dwelling fish. It also may be helpful to ban the practice of attempting to vent fish (manually deflating the

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[148] *Bring That Rockfish Down*, SEA GRANT & CAL. DEP'T FISH & GAME, https://dornsife.usc.edu/assets/sites/291/docs/pdfs/Publications/BAROTRAUMA-BRO-3-30.pdf (last visited Apr. 22, 2019).

[149] *Id*.

[150] Melissa Crouch, *Ways to help reef fish survive after barotrauma*, FLA. FISH & WILDLIFE CONSERVATION COMM'N, https://myfwc.com/news/all-news/barotrauma/ (last visited Apr. 22, 2019).

[151] *Id*.; SEA GRANT & CAL. DEP'T FISH & GAME, *supra* note 148.

[152] Crouch, *supra* note 150.

[153] *Id*.

[154] SEA GRANT & CAL. DEP'T FISH & GAME, *supra* note 148.

swim bladder by puncturing it), given the potential harm that it can produce.

C. Preservation of Protected Areas

The current network of National Hatchery Areas, Marine Protected Areas, and Wildlife Refuge Systems has established a strong balance between conservation goals and recreational use. There isn't a lot of room for change that would significantly improve this balance. However, regulators can take further steps to ensure that these systems continue to meet their conservation goals. Among the steps that regulators can take are increasing funding for enforcement, preserving the protected areas, and preventing encroachment into these areas by special interests.

1. FUNDING INCREASE

Given that these systems are chronically underfunded, regulators should allocate funding to these areas of increased protection where possible.[155] Funding is especially important for enforcement in areas that are closed to recreational fishing, as these areas provide refuge for overfished stocks, and protect important habitat that can increase ecosystem resilience.[156] Meaningful enforcement of regulations in protected areas is needed, as violations threaten the natural resources.[157]

2. PRESERVING PROTECTION ZONES

To the extent allowed by statute, regulators ought to resist efforts to remove protections for these areas. When there is a proposal to open protected areas to fishing that have previously been free from fishing pressure, the controlling agency should undertake proper study to determine whether to advance such a proposal. For example, in October 2018, the National Marine Fisheries Service proposed to open

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[155] *National Wildlife Refuge System Funding*, NAT'L. WILDLIFE REFUGE ASS'N, https://www.refugeassociation.org/advocacy/funding/refuge-system/ (last visited Apr. 22, 2019).

[156] Worm, et al., *supra* note 108, at 583.

[157] Meaningful enforcement is necessary to preserve the resources important to recreational fishing. Witty, *supra* note 39, at 153-54.

the Block Island Transit Zone to Striped Bass fishing.[158] While the National Oceanic and Atmospheric Administration (which oversees NMFS) was directed to explore opening this area to Striped Bass fishing,[159] it determined that the best course of action would be to delay making a decision until a stock assessment for the species was completed in 2019.[160] Even if the species in question for such proposals are not subject to overfishing (as Striped Bass seemingly are),[161] regulators ought to consider that allowing such pressures can negatively impact replacement rates, which can affect the MSY.

3. PROTECTION FROM SPECIAL INTERESTS

Chief among the special interests threatening protected areas is fossil fuel development. At present, the Trump Administration has ordered review of these areas, including Marine Protected Areas, for fossil fuel development.[162] Offshore oil extraction already contributes millions of gallons of oil into U.S. waters annually, and the addition of offshore drilling in or near MPA's only further increases the threat of contamination.[163] A large part of why MPA's are so effective is that they protect ecosystems from the pressures and contamination resulting from offshore drilling.[164] Protected areas have a demonstrated value as a home for higher densities of fish life than

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[158] Fisheries of the United States: Regulations for Striped Bass Fishing in the Block Island Transit Zone, 83 Fed. Reg. 50061 (proposed Oct. 4, 2018).

[159] 164 Cong. Rec. H2086 (2018).

[160] Dave Monti, *Opening Up Striped Bass Fishing in the EEZ*, MARINE FISH CONSERVATION NETWORK, (Oct. 24, 2018) http://conservefish.org/2018/10/24/opening-up-striped-bass-fishing-in-the-eez/.

[161] *Striped Bass Overfished, Managers Discuss Options*, *supra* note 130.

[162] Sarah Carr, *Trump's proposed offshore drilling plan: What does it mean for US marine protected areas and regional ocean plans?*, MARINE ECOSYSTEMS & MGMT., (Mar. 3, 2018), https://meam.openchannels.org/news/meam/trumps-proposed-offshore-drilling-plan-what-does-it-mean-us-marine-protected-areas-and.

[163] Eleaina Zachos, *Trump's Offshore Drilling Plan—What You Need to Know*, NAT'L. GEOGRAPHIC, (Jan. 4, 2018), https://news.nationalgeographic.com/2018/01/trump-administration-announces-offshore-drilling-plans-spd/.

[164] Sarah Gibbens, *Marine Protected Areas Are Important. But Are They Working?*, NAT'L. GEOGRAPHIC, (June 16, 2018), https://news.nationalgeographic.com/2018/06/marine-protected-areas-ocean-conservation-environment/.

other areas,[165] and deserve protection from outside influences, especially fossil fuel extraction. Failing to protect these zones will ultimately lead to a decline in fish stocks, making them more vulnerable to recreational fishing pressures.

D. License Deposits

There is a scarcity of harvest information from recreational fisheries,[166] which makes it more difficult to assess the impact that recreational fishing has on fish stocks.[167] One potential remedy to this problem would be to add a deposit to recreational fishing licenses that is returned to the fisherman upon receipt of a fishing report. In an ideal system, the governing body (be it state or federal fisheries managers) would have a uniform reporting form for fishermen to fill out. Such a form would request information on where the fishermen fished, what type of fish they caught, how many fish of each species they harvested, whether any fish were killed accidentally, and what type of bait or artificial lure the fishermen used. This would give regulators information on the abundance and location of fish, a baseline for accidental mortality, and what bait species the fish are eating.

Such a license deposit system should work similarly to recycling deposit systems, wherein the opportunity to redeem a cost incurred spurs people into action. The price of the deposit should be high enough to encourage broad-scale participation, as recycling laws have demonstrated that increased economic rewards will create a greater incentive to participate, but not so high as to preclude participation.[168] While angler participation does decrease with rising

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[165] *See, e.g.*, Steven J.D. Martell, et al., *The use of marine protected areas for conservation of lingcod (Ophiodon elongatus)*, 66 BULLETIN MARINE SCI. 729, 729 (2000).

[166] Worm, et al., *supra* note 108.

[167] Coleman, et al, *supra* note 110.

[168] By doubling the deposit on recyclable bottles and cans, Oregon caused recycling rates to increase dramatically in a short period of time. Colin Staub, *Dime deposit drives up Oregon return rate*, RES. RECYCLING NEWS, (January 29, 2019), https://resource-recycling.com/recycling/2019/01/29/dime-deposit-drives-up-oregon-return-rate/. States that have bottle deposits have higher recycling participation rates. W. Kip Viscusi, et al., *Discontinuous Behavioral Responses to Recycling Laws and Plastic Water Bottle Deposits*, 15 AM. LAW & ECON. REV. 110, 110 (2013).

license prices,[169] the fact that anglers can recoup the increased cost should mitigate any participation decrease. It should be noted that license prices have historically been kept low so that those of lower economic means are not excluded based upon economic status,[170] so the deposit prices should not be set so high as to prevent low-income individuals from making the initial license investment. Regulators must balance the risk of excluding fishermen with high cost license deposits while maintaining a price high enough to encourage broad-scale participation in information reporting. If they are able to do this, then they can effectively eliminate the chronic lack of reporting and data from recreational fisheries.

E. Fish Tagging Programs

In addition to gathering information about fish stocks through incentivized reports, regulators can garner biological information on fish through tagging programs. Fish tagging is an accepted method of marking fish so that, upon recapture, growth rates and migration patterns can be studied.[171] With fish species, this most often involves attaching an external tag so that they can be visually identified without the use of special detection equipment.[172] Regulators can create tagging programs that reward recreational fishermen for returning tag data so that agency scientists can analyze growth and migration. North Carolina has had a fish tagging program since 2014 that can be studied as a model program for incentivizing angler participation. The North Carolina Department of Environmental Quality offers cash and merchandise awards for fishermen who report data from a tagged fish.[173] The reward is an essential element of the program, as such

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[169] Stephen G. Sutton, et al., *Understanding Anglers' Willingness to Pay Increased Fishing License Fees*, 6 HUMAN DIMENSIONS OF WILDLIFE 115, 117 (2001).

[170] *Id*. at 116.

[171] *Fish Tagging*, AM. LITTORAL SOC'Y, https://www.littoralsociety.org/fish-tagging.html (last visited April 23, 2019).

[172] Nancy E. Kohler & Patricia A. Turner, *Shark tagging: a review of conventional methods and studies*, 60 ENVTL. BIOLOGY OF FISHES 191, 191 (2001) (explaining how external fish tags work).

[173] *Fish Tagging Program*, N.C. DEP'T ENVTL. QUALITY, http://portal.ncdenr.org/web/mf/fish-tagging-program-r (last visited April 23, 2019). For certain tags, fishermen are offered a $100 reward, while for others they are given $5, a hat, or another unspecified award. *Id*.

programs rely on the cooperation of fishermen, and tag reporting rates are likely to be far lower without the reporting incentive.[174] By spreading awareness of programs and properly incentivizing fishermen to participate, regulators can gain a better understanding of fish migration patterns and biology, which can help in setting size limits, as well as in designating protected areas to allow fish a safer passage to breeding grounds and EFH.

F. C&R Encouragement Programs

In order to further reduce fish mortality from recreational fishing, state regulators should do more to encourage catch and release fishing. State legislatures often task environmental departments with propagating fishing within the state.[175] This allows state departments to conduct programs that encourage catch and release fishing and can influence the behavior of fishermen in the state. Programs such as state records and trophy fish programs can be used to encourage fishermen to practice catch and release fishing. State environmental departments maintain records for the largest fish caught recreationally in the state in 47 out of 50 states (94 percent). Of those 47 states, all maintain records based upon weight that require measurement by a certified scale,[176] but only nine (19.1 percent) maintain catch-and-release records that require that the record fish be released.[177]

Thirty-seven states have awards programs that honor recreational fishermen for catching exceptionally large fish. Of those

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[174] Kenneth H. Pollock, et al., *Tag Reporting Rate Estimation: 1. An Evaluation of the High-Reward Tagging Method*, 21 N. AM. J. FISHERIES MGMT., 521, 529 (2001).

[175] *See, e.g.*, N.Y. ENVTL. CONSERV. LAW § 11-1307 (McKinney 2006).

[176] *See, e.g.*, *Trophy Fish Program and Record Fish Official Entry Form*, N.H. FISH & GAME DEP'T, https://www.wildlife.state.nh.us/fishing/documents/trophy-record-fish-app.pdf (last visited April 23, 2019); *Trophy Fish Program*, NEV. DEP'T WILDLIFE, http://www.ndow.org/uploadedFiles/ndoworg/Content/Fish/Angler_Recognition/2017%20Trophy%20Fish%20Program%20USE.pdf (last visited April 23, 2019).

[177] *See, e.g.*, *Massachusetts freshwater fish records*, MASS. DIV. FISH & WILDLIFE, https://www.mass.gov/service-details/massachusetts-freshwater-fish-records (last visited April 23, 2019); *State Freshwater Records: Catch and Release*, TEX. PARKS & WILDLIFE, https://tpwd.texas.gov/fishboat/fish/action/staterecords.php?env=FW&age_group=all&list=CR&browse=Submit (last visited April 23, 2019).

states, 26 states (70.2 percent) give weight-based awards,[178] 13 states (35.1 percent) give length-based awards that allow the individual to determine whether to keep or release the fish, and 21 states (56.8 percent) give awards that require that the fish be released.[179] Several states offer awards for more than one of the aforementioned categories.[180] Of the weight-based awarding states, only three states (8.1 percent) had only a weight-based category.[181] While such programs can be used simply to promote recreational fishing, they can also be used as a means to promote conservation and catch and release fishing, by rewarding anglers for releasing large fish in the same way that they could be rewarded for harvesting such fish. Colorado's program can work as a model: State regulators maintain records for caught and released fish, as well as for fish that are harvested and weighed, and there are more awards for anglers who release their trophy fish than for those who harvest the fish.[182] Regulators in all states ought to create similar programs that have a focus on catch and release in order to improve recreational fishing conservation efforts. Encouraging the release of larger fish is even more important when considering the BOFFFF Principle, as larger fish have disproportionately higher fecundity compared to smaller fish.

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[178] *See, e.g.*, *Trophy Fish Program Rules*, ALASKA DEP'T FISH & GAME, https://www.adfg.alaska.gov/static/fishing/pdfs/sport/trophyfish/trophyfish_rules.pdf (last visited April 23, 2019); *Rhode Island Game Fish Award Program*, R.I. DEP'T ENVTL. MGMT., http://www.dem.ri.gov/programs/fish-wildlife/records/game-fish-award-program.php (last visited April 23, 2019).

[179] *See, e.g.*, *Master Angler Program*, VT. AGENCY NAT. RES., https://vtfishandwildlife.com/fish/fishing-events-and-programs/master-angler-program (last visited April 23, 2019); *Master Angler*, WYO. GAME & FISH, https://wgfd.wyo.gov/Fishing-and-Boating/Master-Angler#lengths (last visited April 23, 2019).

[180] *See, e.g.*, *2019 Master Angler Entry Form*, MICH. DEP'T NAT. RES., https://www.michigan.gov/documents/dnr/2019-MASTER-ANGLER-FORM_642283_7.pdf (last visited April 23, 2019); *Trophy Fish Award Program*, CONN. DEP'T ENERGY & ENVTL. PROTECTION, https://www.ct.gov/deep/cwp/view.asp?a=2696&q=322722&deepNav_GID=1630 (last visited April 23, 2019).

[181] *See, e.g.*, *Master Angler Program*, ARK. FISH & WILDLIFE COMM'N, https://www.agfc.com/en/get-involved/onthewater/masterangler/ (last visited April 23, 2019); NEV. DEP'T WILDLIFE, *supra* note 176.

[182] *Master Angler Program*, COLO. PARKS & WILDLIFE, https://cpw.state.co.us/learn/Pages/MasterAngler.aspx (last visited April 23, 2019).

CONCLUSION

The weight of evidence shows that the current management focus on protection of juvenile fish is misguided, and that preservation of older, larger, fertile fish has the greater conservation value. Regulators need to incorporate the use of slot limits more frequently, as opposed to minimum size limits, especially with populations subject to overfishing. In order to gather better information about fisheries biology, regulators should enforce a deposit for fishing licenses that is refunded upon the return of a fishing report and should create tagging programs that help to study the long-term biology of individuals. Regulators should promote catch and release fishing however it is feasible, including through the use of length-based trophy fish and state record programs. Catch and release fishing can be improved upon by mandating the use of single and circle hooks with live bait. Live bait should also be prohibited or restricted in designated conservation zones. Regulators have tools available to them to reduce the impacts of recreational fishing on fish populations and can do so without harming fishing-dependent economies.