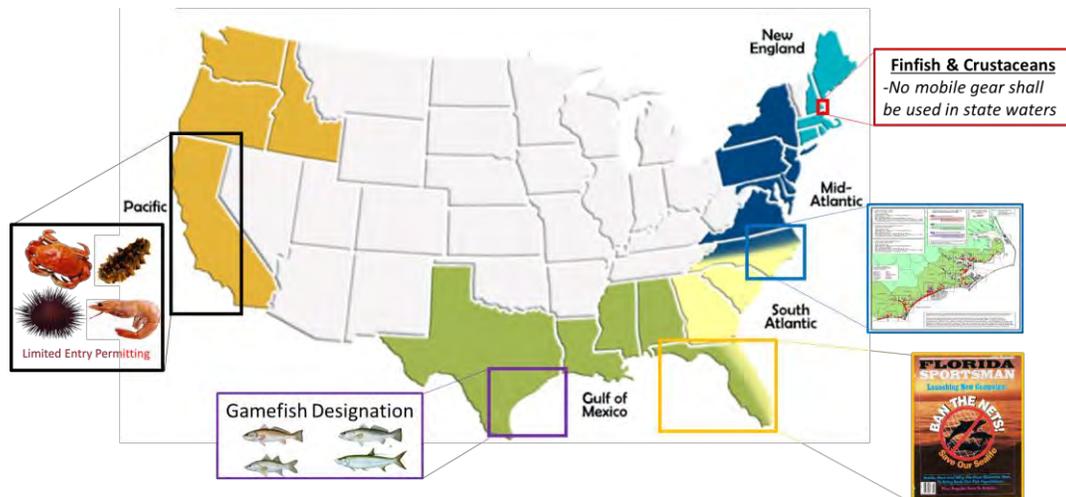

Coastal Fisheries Management: A State-By- State Synthesis of Fisheries Resource Allocation, Habitat Management, and Administrative Frameworks

Report to the North Carolina Marine and Estuarine
Foundation



Prepared by: Drs. Christopher Baillie & Joel Fodrie

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Foreword

In 2020, the North Carolina Marine and Estuary Foundation commissioned a synthesis of coastal fisheries management practices, with particular focus on how fisheries resources are allocated, how estuarine and coastal habitats are managed, and the administrative frameworks used by coastal states to manage fisheries under state or joint state-federal jurisdiction. Within each of these three broad themes, two to four more specific foci were identified as practices, approaches, or frameworks for which synthesis of their employment would be of value. For example, the use of limited entry licensing, commercial fishing gear prohibitions, and gamefish designation, as well as frameworks used to allocate mixed-use fisheries' resources, were identified as the four foci within the resource allocation theme of this study.

For each of our eight focal areas, documentation and reports published by relevant agencies within each of 23 coastal states in the United States were searched to identify the practices, approaches, frameworks used by each state in their management of coastal fisheries and habitat. When searches of available documentation failed to yield the desired information, the relevant agency was contacted for information. For each focal area (e.g. commercial gear prohibitions, gamefish designation), the information gathered was collated into a separate table or tables containing largely categorical entries. Each table represents, to the best of our knowledge, nationwide information on each topic had been synthesized and describe a diverse landscape of alternative practices, approaches, and frameworks employed by coastal U.S. states.

The synthesis component of this research represents the first step in beginning to identify what might constitute “best” management practices given the fact that identifying what is “best” necessitates a comprehensive inventory of the alternatives. Valuable for categorical comparison of practices, approaches, and frameworks between and among coastal states, it was understood that their value could be dramatically increased with insight into the factors precipitating actions, the perceived or documented outcome of management approaches, and the benefits and shortcomings of various frameworks. Peer-reviewed and, to a lesser extent, gray literature was searched to identify studies that might provide insight relevant to each area of focus. For most of the topics in question, published research on the topic was limited. Fortunately, from the inception of this project it was acknowledged that the greatest resource for meaningful insight lay with senior coastal fisheries administrators and requests were made to conduct interviews with high ranking marine fisheries managers from each coastal state.

The responses to requests for interviews were overwhelmingly positive and we were able to conduct interviews ranging in length from 45 to 90 minutes with senior marine fisheries or natural resource administrators from 20 of 23 coastal states. In some cases, we were granted interviews with multiple persons from a given state. In total, we interviewed seven chiefs or deputy chiefs, 12 directors, one assistant director, two commissioners, one assistant secretary, and five additional senior administrators with varying, state-specific titles. Eight questions (Supplement Information 1) were used to guide the discussion and the interviews were conducted abiding to a modified version of Chatham House Rule. Specifically, information conveyed by the interviewee could be used freely to inform our discussion, but the information would be suitably anonymized so that comments or thoughts could not be directly linked to any one interviewee. The purpose of this approach was to increase openness of the discussion about

topics that are often highly controversial. Insights from these interviews, supplemented with information gleaned from independent research, were synthesized into discussions that typically detailed the background or origination of given actions, policies, or frameworks, perceived strengths and weaknesses of different alternatives, and, where suitable, recommended considerations for coastal states that may be considering adopting new or changing existing practices within the scope of those covered in this report.

Coastal Fisheries Synthesis Key Takeaways

Access to Commercial Fisheries: Limited Entry Licensing

- Limited entry licensing is an approach used by the majority of coastal states to manage a portion, or in some cases all, of their commercial fisheries. Limited entry can regulate who can enter the profession of commercial fishing, who has rights to harvest a particular species, or who can use a certain gear type. The most consistently reported benefits of limited entry were professionalization and increased accountability of the fishery to which restricted access was applied. Conditions set on the limited entry license (e.g. eligibility, transferability, active use requirements) were reported to dramatically impact long-term outcomes of these management actions. Limited entry, alone, has not proven to be a guarantee of sustainable fisheries management but appears to be a useful tool in combination with other management actions.

Commercial Gear Prohibitions

- Numerous coastal US states have enacted outright prohibitions on specific commercial fishing gear types. There are numerous reasons for the enactment of these outright bans, which include minimizing spatial conflict, reducing fishing pressure, preventing the establishment of industrial scale fisheries, pressure from environmental groups, and compliance with the Endangered Species Act. All of the commercial fishing gear bans within state jurisdictional marine waters in the US were enacted at the legislative level or by constitutional amendment, and not via stock assessment amendments *per se*.
- The social, economic, and ecological impacts of outright prohibitions on commercial marine fishing gears are, unsurprisingly, context-dependent. Studies on the effects of outright commercial fishing gear bans in coastal waters are limited, but there is evidence to suggest that the banning of a gear type may have positive impacts on the populations of species that are most vulnerable to the gear in question; however, these benefits may come at the cost of increased pressure on other fisheries species and detrimental socio-economic impacts to former fishers of the prohibited gear. Further research evaluating the context-dependent ecological, economic, and social impacts of outright gear bans in coastal waters would facilitate informed discussions weighing the costs and benefits of such measures.

Prohibition on Commercial Sale of Marine Fishes (e.g. Gamefish Designation)

- The vast majority of coastal US states have enacted prohibitions on the commercial harvest and sale (henceforth, gamefish designation) of at least one marine finfish species. Where commercial harvest of the species was minimal prior to a finfish species' designation as a gamefish, designations were often enacted to minimize regulatory burden. In the case of mixed-used species for which there was considerable recreational and commercial harvest prior to designation, designations were largely the result of lobbying by recreational fishing interest groups. There are anecdotal reports of gamefish designation benefitting the population of a designated species; however, most managers were unable to say whether they believed the action had an effect on the designated

population(s) – a position corroborated by a dearth of peer-reviewed analyses on this topic. Also, numerous managers reported the need for additional recreational restrictions subsequent to a species designation, potentially as a result of increased recreational effort and efficiency as well as environmental influences. Evaluating the population-level impacts of gamefish designations is often confounded by concurrent changes to recreational regulations and temporally proximate initiation of stocking programs. As such, studies parsing the effects of gamefish designation, concurrent management actions, and environmental fluctuations are needed to parse the population impacts attributable to prohibiting commercial sale and harvest of a coastal finfish species.

Allocation in Mixed-Use Coastal Fisheries

- The allocation of total allowable catch (TAC) or quota to commercial and recreational sectors in mixed-used coastal fisheries by coastal US states has and continues to be almost entirely based upon historical catch composition. While multiple states have begun incorporating ecosystem-based models into select fishery management plans, managers reported that, while doing so may have decreased overall TAC, it has not influenced how TAC is divided among sectors. Socio-economic consideration have not been explicitly incorporated into allocation decisions by coastal US states, largely due to insufficient data, absence of an established framework for quantifying economic and social values placed on the fishery by sectors, and lack of inhouse social scientists and natural resource economists at the state agencies responsible for marine fisheries management. Therefore, the “status quo approach” of allocation based on historical catch composition has generally represented the least contentious way forward and, without considerable research to evaluate whether biological, economic, and/or social benefits could be maximized by other allocation frameworks, appears unlikely to change in the near future.

Coastal Habitat Protection Schemes

- Seven of the twenty-three coastal states in the U.S. delineate and afford some level of protection to areas that serve as high-quality, inshore habitat for juvenile fishes (i.e. nursery areas). While the other sixteen states do not have protections based predominantly on an area’s nursery value, they all have broader coastal habitat protection approaches that often serve to protect many of the habitats typically considered important nurseries for marine fishes. Approaches for identifying these areas and the level of protection afforded varied considerably among states, but there was consensus among fisheries managers that transparency and communication was essential to building support for coastal habitat protection. Research comparing the outcomes of coastal habitat protection approaches among states with similar biophysical characteristics would be critical for identifying the most efficacious approaches.

Integrating Mariculture

- Identifying suitable sites for mariculture is critical to providing seafood to the world’s growing population. There are myriad sources of potential conflict between mariculture and other public trust uses that managers must identify suitable approaches to ameliorate

to facilitate continued responsible and sustainable growth of the mariculture industry. Synthesis of coastal state's statutory language authorizing and regulating mariculture leases revealed dramatic differences in the proscriptiveness of siting requirements, the discretion afford to managers to balance public trust uses, and the considerations that must explicitly be addressed to mitigate social, economic, and ecological externalities. These differences could provide valable, comparative lessons on how to optimize leasing siting processes.

Rule-Making Frameworks

- The majority of coastal U.S. states' marine fisheries regulations are made by a council, board, or commission whose membership is appointed by the state's governor. The remaining states convey this authority to the highest-ranking official at the agency responsible marine fisheries management. Despite the range of approaches, senior fisheries managers reported general satisfaction with the process within their jurisdiction; however, most states defined by limited proclamation power reported that as an impediment to adaptive and responsive management. Public engagement was universally reported as critical to effective and constituent-supported fisheries management. Novel approaches to increase public participation and to solicit input from a more diverse sample of resource users was widely lauded.

Resource Allocation

Access to Commercial Fisheries: Limited Entry Licensing

Background

The Submerged Lands Act of 1953 provided coastal states with jurisdiction over a region extending 3 nautical miles from the high tide line, with the exception of Florida and Texas, both of which were granted jurisdiction extending 9 nautical miles into the Gulf of Mexico. Under this authority, states began requiring commercial fishers to register and pay licensing fees to the state. Initially, an open access licensing approach, in which the number of licenses was not capped and there weren't requisite qualifications a person must meet to be eligible for a license, was used nearly universally by coastal states. Around the same time, natural resource economists were beginning to publish work predicting the potential for unlimited entry to result in overcapitalization and depletion of fisheries resources (Gordon 1954).

Since then, economists have generated a wealth of literature on the relative advantages and disadvantages of open versus limited-entry fisheries, also called restricted access licensing. Many of these analyses and commentaries have suggested that limited entry approaches are valuable, if not necessary, to overcoming the economic incentive to overfish and integral tool for effective fisheries management (Crutchfield 1961, Sinclair 1961). In 1973, Alaska was the first U.S. state to embrace limited entry licensing as a tool to address over-exploitation of fisheries. The use of limited entry to regulate coastal fisheries has since been widely adopted by coastal states throughout the U.S. (Table 1). Unsurprisingly, limited entry has not been the panacea predicted by some.

Interviews with senior fisheries managers from coastal states (henceforth coastal fisheries managers) provide valuable insights into beneficial outcomes of limited entry, inadequacies resulting from faulty design, and pervasive shortcomings for which there appear to be no readily identifiable remedies. Our references to limited entry herein refer to a system in which licenses are granted through some requirement, those without licenses cannot access the resource, and rights are not clearly delineated among those holding licenses. More specifically, our focus is access rights (i.e. limits on those who can participate in a fishery) as opposed to harvest share rights (i.e. how a fishery resource is divided among those with access rights).

Consistently Reported Benefits

A majority of senior fisheries managers responded that implementation of limited entry programs has been successful for increased accountability within, and professionalization of, a fishery. Many, if not the majority, agree that as a concept, limited entry licensing represents an effective way in which to allocate a scarce resource; however, below we detail some key factors that interviewees highlighted as shortcomings of their states limited entry licensing approach.

Shortcomings

Capital stuffing

Fishing effort is not merely dictated by the number of participants in the fishery but also by the size and power of the vessel, attributes of fishing gear, and utilization of technology. Reduction

or stabilization of the number of vessels or participants in a fishery is not guaranteed to reduce effort without restrictions on the other factors that contribute to effort. As such, limited entry without the additional measure of allocating individual quota can result in an arms race to acquire larger and/or, if tonnage limits are in place, faster boats, more efficient gear, and novel technologies to locate and capture fishes/shellfishes. The challenges of foreseeing and regulating all of the aspects that influence effort may limit the efficacy of limited entry licensing.

A Net Cast Too Wide

Numerous coastal fisheries managers discussed the fact that, in order to minimize the number of aggrieved parties, legislatures intentionally set a low eligibility bar for being grandfathered into the fishery at the inception limited entry licensing. While politically expedient in the short term, the decision to prioritize inclusivity often resulted in deleterious economic impacts to all those issued licenses when, as is sometimes the case, the productivity of the fishery declines after the enactment of limited entry. As declining productivity mandates reductions in total allowable catch (TAC) became necessary, a static pool of eligible participants must then compete for pieces of a shrinking pie. While those who are unable to turn a profit that justified continued participation in the fishery may let their licenses go latent, without active-use requirements, the pool of potential fishers that could enter the fishery remains unchanged and fisheries managers are forced to regulate with the uncertainty around having a pool of latent license holders who could re-enter at any time.

Transferability and Active-Use Requirements

While the ability to transfer (i.e. sell) a limited entry license provides an incentive for the least profitable fishers to leave the fishery, monetization of limited entry licenses effectively amounts to a state's government bestowing a valuable commodity to a select few citizens in addition to granting them the right to harvest and sell a public trust resource. This can become particularly problematic when transferable licenses are not accompanied by an active-use requirement.

Without active-use requirements, latent license holders hoping to sell their licenses may hold out for prices that are cost prohibitive to potential entrants to the fishery. Further, without a mechanism to retire inactive licenses, if there is a desire by the state to reduce participation, buybacks are the sole mechanism through which the state can reduce the number of transferable, limited-entry licenses. Where these buybacks have the stated objective of reducing fishing effort, holders of latent transferable licenses can significantly increase the cost of buybacks as latent license holders are frequently the most willing to sell their licenses back through competitive bidding. In cases where a considerable portion of existing licenses are latent, a large portion of buyback funds end up going to latent license holders before funds can go towards purchasing licenses from willing, active participants. Numerous coastal fisheries managers described limited entry fisheries in their state with 50% or more of licenses were latent. With only 50% of licenses being actively used and the other 50% being latent, assuming latent license holders were always willing to sell their licenses for less than active participants in a competitive bidding buyback, achieving a 20% reduction in effort (using participants as a proxy) would require the state to buy back 60% of all licenses issues (50% latent and another 10% that are active). The question becomes: Who pays for this? Using taxpayer funds to repurchase a state issued commodity granting the right to harvest and sell a public trust resource is not an easy pill for many constituent groups to swallow.

One senior fishery manager detailed a program to fund buybacks via a fee assessed to holders of limited entry licenses. Approval for such a program is, however, likely correlated with the degree to which buyback funds are likely to go towards repurchasing licenses from active participants or latent license holders. If the former is the case, paying into such a fund could be seen as being in one's self-interest to reduce competition. Conversely, if the funds largely go towards purchasing latent licenses, license holders could understandably be less enthusiastic about paying a fee to fund buybacks, the impacts of which are likely to be heavily diluted as funds are allocated to individuals not participating in the fishery.

Reduced Adaptive Capacity

Transferable limited entry licenses without active use clauses not only make it challenging to decrease the number of participants but can also make fisheries management less nimble in their ability to respond to changing fishery dynamics. Transferable licenses are often highly sought after, with new entrants paying considerable sums of money (e.g. tens to hundreds of thousands of dollars) to acquire a license from its current owner. As such, for a state to issue additional licenses at a fraction of the going market value would be highly unpopular among those wishing to sell their license and unfair by entrants who had paid market price to transfer a license in accordance with the transferability framework established by the state.

Why might a state want to issue additional permits? Fish populations may increase in response to effective fisheries management, as a result of natural environmental fluctuations, or due to range shifts associated with climate change. In states with large coastlines, appreciable shifts in the location of the most productive fishing grounds can result in spatial mismatch between the ports in which limited entry licenses are aggregated and the ports from which exploiting those grounds would be most economical. More than one coastal fisheries manager reported the emergence of productive fishing grounds located too far from the port(s) in which existing licenses were aggregated for their exploitation by existing license holders to be economical. Thus, the issuance of additional licenses to establish a novel, small-scale fishery presented an opportunity to sustainably increase exploitation of the fishery resource and, with it, resulting economic benefits to the state. However, as alluded to previously, the issuance of any new licenses would likely have been vehemently opposed by those holding licenses they want to sell to supplement their retirement or those who have paid handsomely for a license transfer.

Considerations for States Implementing New or Restructuring Existing Programs

A clear majority of senior coastal fisheries managers we interviewed expressed a belief that limited entry licensing has successfully increased the accountability and professionalism of the fishery to which it was applied. There was a general consensus that active-use requirements, provided they include clauses exempting license holders in the event of illness or disability are necessary and valuable to avoid commoditization of licenses by those who are not committed to their productive use. Senior fisheries managers largely had much less or no objection to the commoditization of licenses when the license holder had made productive use of it prior to its sale.

While limited entry licenses in the majority of coastal fisheries in which they are used are treated as real property, numerous states have indeed broken that convention and embraced non-

transferrable licenses. Non-transferrable permit requiring active use provide considerably greater opportunity for the state to manage participation. Absence of markets for commercial licenses will reduce or eliminate speculative appropriation of limited-entry licenses. If the state deems it beneficial to reduce participation, adaptive entry/exit ratios offer an avenue to reduce participation through attrition. Conversely, if fisheries managers observe an opportunity to increase participation sustainably through the issuance of additional license, non-transferability of licenses will have addressed opposition on the grounds of interfering with external markets.

An alternative approach to limited entry licensing that was raised by more than one senior fisheries manager was to administer licenses similarly to how timber rights are allocated. Specifically, newly issued licenses could be allocated through competitive bidding and grant holders the rights to fish for a period deemed long enough for the holder to effectively profit from their participation (e.g. 10 years). When the license expires, it would again become available for competitive bidding. Provided the individual whose license had just expired had made productive use of it and made appropriate financial (e.g. gear) and time (e.g. building a business) investments, that individual should have the greatest incentive to be the highest bidder and, in doing so, retain the license. Conversely, had the license holder failed to make productive use of the license, potential entrants who believed they could make better use of this scarce resource could outbid the previous owner. The upshot would be licenses being held by those with a financial stake to make best use of the privilege of harvesting a public trust resource and the state receiving licensing fees commensurate with the productivity of the fisheries they manage. As a stand-alone measure, limited entry licensing holds little promise to address the challenges faced by fisheries managers. It can be a useful tool if the systems is set up to be adaptive and supplemented with additional measures to factors that contribute to effort outside of the number of vessels or participants.

Table 1. Use of limited or open entry licensing by coastal U.S. states for commercial marine fisheries under state or joint state-federal jurisdiction for the top three finfish and crustacean species by cumulative poundage landed annually (lbs yr⁻¹), cumulative dockside value (\$ yr⁻¹), and price per pound (2019 NOAA Commercial Fisheries Landings data). The use of some form of limited entry for a given fishery is indicated by Y. Fisheries for which there is no limit on entry (e.g. permits or licenses are typically required but there are not pre-requisites for acquiring one) are indicated by N. Cells without a Y or N indicated either fewer than three state or joint-state federal jurisdiction fisheries to consider or ranking challenges associated with data confidentiality. A subset of limited entry approaches are identified by multicolored boxes with the corresponding limited entry approach explained within a box of the same color located to the right of the table.

Region	State	Pounds Landed						Dockside Value						Price Per Pound					
		Finfish			Crustacean			Finfish			Crustacean			Finfish			Crustacean		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
New England	ME	N	-	-	Y	Y	Y	N	-	-	Y	Y	N	N	-	-	N	N	N
	NH	-	-	-	Y	N	-	-	-	-	Y	N	-	-	-	-	-	Y	N
	MA	Y	N	Y	Y	Y	N	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y
	RI	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	CT	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N
Mid-Atlantic	NY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	NJ	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	N	N	Y	Y	Y
	DE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
	MD	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	VA	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
South East	NC	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	SC	Y	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N
	GA	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	N	N	N
Gulf of Mexico	FL	Y	N	N	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y	N
	AL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	MS	N	N	Y	N	Y	-	N	N	N	N	Y	-	N	N	N	N	Y	N
	LA	N	N	N	N	N	-	N	N	N	N	N	-	N	N	N	N	N	-
	TX	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pacific	CA	N	N	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
	OR	N	Y	-	Y	Y	Y	N	Y	-	Y	Y	Y	N	-	Y	Y	Y	Y
	WA	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y
North Pacific	AK	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Western Pacific	HI	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Commercial Fishing License Qualification:
Minimum 40 RI trip in past 24 months

Species-Specific Gear Allocation: Pot allocation based on previous year's allocation

Species Specific: Individual transferable quota

Commercial Fisherman Qualification: Decided by eligibility board

Species Specific: Capped at 100 license. Lottery for surplus licenses made available via attrition

Species Specific: 20%+ of taxable income from spotted seatrout

Finfish License: Renewal allowed only if license was held in previous year. Buyback program

Species Specific: Renewal allowed only if license was held in previous year.

Species Specific: Previous participation and tiered gear allowance (200, 300, 500 pots)

Commercial Gear Prohibitions

Background

Commercial fishers use a wide variety of gear types and methods to harvest their catch. These gears vary in their potential to deleteriously impact habitats, induce bycatch mortality, and cause in spatial conflict (Chuenpagdee et al. 2003), the occurrence and severity of which are all context dependent. Parametric management measures, which describes the management of how, when, and where fishing occurs, can modify the severity of these impacts (Depestele et al. 2014). Some studies have shown that fishers are more supportive of restrictions on specific types of fishing gears as opposed to outright closure of fishing grounds (McClanahan et al. 2005); however, jurisdiction-wide, outright prohibitions on entire categories of commercial fishing gear are often highly controversial, particularly when they result from political considerations rather than from a strong basis in science (Loring 2017). Our interviews with senior marine fisheries managers from coastal U.S. states supports this assertion.

Origination of Outright Commercial Gear Prohibitions

All coastal states in which outright bans on commercial fishing gears have been enacted reported that these prohibitions were enacted through legislation (e.g. by the state legislature) or a constitutional amendment. None of the coastal fisheries managers we spoke with reported an outright gear prohibition originating from within their agency. Senior coastal fisheries managers from multiple states reported that outright prohibitions on mobile gears (e.g. trawls, seines) in all or vast swaths (e.g. all tidal waters, sounds, bays) of state waters were enacted as a preventative measure aimed at safeguarding against the establishment of industrial scale fisheries and the encroachment of out-of-state fleets. Outright bans on gill nets or the restriction of their use to a single species (e.g. strike netting) were largely reported as a measure to address ESA considerations or as a political response to lobbying of legislators by environmental groups. In the case of states with short coastlines, outright gear prohibitions were enacted to mitigate or safeguard against seemingly inevitable, intense spatial conflicts.

Perception of Outright Commercial Gear Prohibitions

When asked whether they believed that the enactment of any additional commercial gear prohibitions would have ecological, economic, and/or social benefits that outweigh the costs, the vast majority responded in the negative, while a few proposed a couple highly caveated situations that fell short of the prohibition of broad categories of gear we considered here. The overwhelming sentiment reflected by the managers that were interviewed was that that spatial and temporal closures were sufficient to protect vulnerable habitats, prevent overexploitation of aggregations, and to minimize gear/user conflicts. Further, gear modifications (e.g. excluder devices) or conditions on specific gear use (e.g. identifying marking and tending of gear) were frequently referenced as additional safeguards against deleterious impacts.

In a handful of instances, coastal states' senior fisheries managers said they have seen anecdotal evidence that outright bans on a commercial fishing gear within a major subset or all state waters had contributed to the rebuilding of one or multiple fishery stocks. However, most were quick to acknowledge that the bans occurred concurrently with other management actions, such as stricter restriction on water degradation, changes to recreational bag/size limits, etc., that confound their ability to draw a straight line between the gear ban and the stock recovery. Research on the

effects of outright gear prohibitions on fishery stocks is limited and available research suggests that impacts are, unsurprisingly, often highly context-dependent (Pipitone et al. 2000, Bergman et al. 2015, Tao et al. 2018, Tao et al. 2020).

The most uniformly realized benefit of gear bans was their success in stopping the establishment or proliferation of industrial scale operations. Where bans impacted only a subset of a given species' habitat, as was the case in states where a fish gear was banned from all tidal or estuarine waters, numerous managers reported that a considerable proportion of fishers were supportive of limiting fishing to a subset of potential fishing grounds (e.g. outside the estuary) in order to minimize impacts on spawning aggregations, nursery habitats critical, etc., critical to the sustainability of the fishery. Fisheries managers reported variable social outcomes of gear prohibitions, ranging from considerable attrition from commercial fishing to widescale adaptability.

While Florida's gillnet ban is not the only outright restriction on commercial fishing gear, as the archetype, it dominates the case study literature on outright prohibitions of commercial fishing gear in the U.S. Studies have documented attrition from the profession of commercial fishing, deleterious economic implications, and negative mental health outcomes stemming from the ban (Salz 1998, Adams et al. 2001, Smith et al. 2003, Loring 2017). Further, legislative action resulting in outright gear bans can also result in additional burden on coastal resource management agencies that are already stretched thin, whom, because they are charged with enforcing regulations originating from the legislature or a constitutional amendment, are often a defendant named in lawsuits challenging the legality of gear bans (Anderson 2002).

Importantly, improvement of several fish stocks subsequent, and at least partially attributed, to the ban (e.g. spanish mackerel, mullet) have been documented (Adams et al. 2001). This is not particularly surprising given that commercial landings dropped from over 50 million pounds in a two year period preceding the ban (1992-1994) to less than 20 million pounds in a two year period after the ban (1996-1998; Adams et al. 2001). However, other species appear to have been negatively impacted by the ban as a result of effort reallocation by gillnet fishers that did not exit the profession entirely. For example, the number of active stone crab traps doubled in the decades following the net ban and, while the the harvest has not increased notably, stock assessments in 2011 indicated an overfished stock with overfishing occurring (Commission 2011).

Considerations for States Implementing New Gear Prohibitions

There is evidence that outright bans may benefit species targetted by the gear, but also of the potential for unintended impacts on species to which displaced effort is redirected. Studies of economic and social impacts remain limited and those that do have only focussed on the implications for commercial fishers. Thus, the only recommendation that seems appropriate is for states considering enacting outright gear bans to provide state agencies with the resources to conduct the biological, social, and economic research needed to develop a holistic understanding of the implications of an outright gear ban.

Table 2. State-by-state synthesis of coastal U.S. state’s implementation of outright prohibition on commercial gear types in all state jurisdictional waters *or* all sounds, bays, or estuarine waters.

Region	State	State Water Commercial Gear Ban (Y/N)								
		Stationary				Mobile				
		Fixed Gill Net	Trammel Net	Pots/Traps	Hook and Line	Purse Seine	Drag Seine	Beam/Pair/Otter Trawl	Drift Gill Net	Shellfish Dredge
New England	ME	N	N	N	N	N	N	N	N	N
	NH	N	N	N	N	Y	Y	Y	Y	N
	MA	N	N	N	N	N	N	N	N	N
	RI	N	N	N	N	N	N	N	N	N
	CT	N	N	N	N	Y	N	N	N	N
Mid-Atlantic	NY	N	N	N	N	N	N	N	N	N
	NJ	N	N	N	N	N	N	N	N	N
	DE	N	N	N	N	Y*	Y*	Y^	N	N
	MD	N	Y*	N	N	Y*	Y*	Y*	N	N
	VA	N	N	N	N	N	N	Y	N	Y*
South East	NC	N	N	N	N	N	N	N	N	N
	SC	N	N	N	N	Y	N	N	N	N
	GA	Y ¹	N	N	Y- Longlines	N	N	N [%]	N	N
Gulf of Mexico	FL	Y	Y	N	Y- Longlines	N	N	N	Y	N
	AL	N	N	N	N	N	N	N	Y	N
	MS	N	N	N	N	N	N	N	Y	N
	LA	Y ^{&}	Y ^{&}	N	N	N	Y	N	Y	N
	TX	Y	Y	N	N	N	Y	N	Y	N
Pacific	CA	N [§]	N [§]	N	N	N	N	N	N [#]	N
	OR	N	N	N	N	N	N	N	Y	Y
	WA	N	N	N	N	N	N	N	Y	Y
North Pacific	AK	N	N	Y-Fish Traps	N	N	N	Y	N	N
Western Pacific	HI	N	N	N	Y- Longlines	N	N	Y^	Y	Y

[^] Bottom Trawling Prohibited
^{*} Prohibited within tidal water (e.g. ocean allowed)
¹ Shad only
[%] See gear restriction text for caveat
[&] Only strike netting of mullet and pompano
[#] Phase out occurring and prohibited after 2023
[§] Banned in Central and Southern California State Waters

Prohibition on Commercial Sale of Marine Fishes (e.g. Gamefish Designation)

Background

There is considerable variability in the use of gamefish designation (Table 3) and, indeed, how the terminology is used, among coastal U.S. states. In Texas, the designation of a species as a gamefish prohibits harvest of that species with gears other than rod and reel by either commercial or recreational fishers. However, in the majority of coastal U.S. states, the designation of a fish species as a gamefish prohibits commercial harvest and sale of the species while maintaining the recreational fishery. For the sake of consistency, references herein to gamefish status or designation will conform to the more broadly used definition that stipulates prohibition on the sale of a finfish species.

For mixed-use fisheries with considerable commercial and recreational participation, a state's decision to designate a coastal species as a gamefish generally results from longstanding conflict between user groups (Matlock 1982). Alternatively, in cases where recreational anglers have historically comprised the vast majority of a species' total harvest and few if any commercial fishers are dependent on the fishery, a state may elect to end commercial harvest to reduce the burden of managing an additional commercial fishery with very low participation.

When the designation of a coastal fish species as a gamefish impacts an existing, profitable commercial fishery, fisheries managers reflected on the fact that the move has been met with considerable opposition from the commercial sector. Similar to outright gear restrictions, the designation of coastal fishes as gamefish has consistently been a legislative action rather than an agency decision. Gamefish designation was universally reported by senior fisheries managers to be the result of political pressure on state legislatures by environmental or recreational fishing interest groups.

Considerations for States Considering Additional Gamefish Designations

Managing a commercial fishery is considerably more resource intensive than managing a recreational fishery, as the management of a commercial fisheries requires much more intensive tracking of harvest, permitting and monitoring of fish houses, etc., while recreational fisheries management largely entails setting a size and bag limit and, sometimes, a season. As such, eliminating a commercial fishery while preserving recreational harvest can dramatically reduce the administrative burden on the agency responsible for regulating a given coastal fisheries. Decreasing regulatory burden appears to have been a contributing factor in multiple states' legislatures decisions to designate species for which there has been little commercial interest or for which commercial allocation has been set perennially low by a regional council as gamefish species. In such cases, gamefish designation may arguably be a relatively simple decision with the outcome of reducing the administrative burden of managing an additional commercial fishery at the cost of eliminating only a very small portion of commercial landings value.

Cases in which there was little to no commercial harvest of a species prior to its designation as a gamefish are, however, the exception. Designating a mixed-use coastal fish species as a gamefish is more typically an action fraught with conflict over the merits of economic and social arguments from both sides around optimal resource allocation. Interviewees typically reported that commercial fishers view gamefish designation as another erosion of their livelihood and

heritage, while recreational anglers often rely on arguments based on economic efficiency or conservation objectives.

Regarding the ecological impacts of gamefish designation, senior fisheries managers from a few coastal states said anecdotally that they believed that a species' designation as a gamefish had a beneficial impact on the species' population. A handful of additional fisheries managers expressed a belief that the elimination of commercial harvest had benefitted the quality of the recreational fishery for the species granted gamefish designation. Importantly, assessing the population-level impacts of gamefish designation is often highly confounded by the frequency of concurrent changes to recreational regulations and the initiation of programs to stock hatchery reared individual in close temporal proximity to the species' designation as a gamefish (Table 4). There has been research to assess the contribution of these stocking programs to fishery stocks (Jenkins et al. 2004, Smith et al. 2004, Denson et al. 2012); however, we were unable to locate any studies evaluating the effects of gamefish designations on fishery stocks, let along the interactive effects of gamefish designation, stocking programs, concurrent management actions, or environmental fluctuations (but see Brown 2016).

Importantly, none of the managers with whom we spoke thought that the designation of a species as a gamefish was a panacea for a fisheries sustainability. Senior fisheries managers largely acknowledged that in many cases recreational fisheries were a major, and in some cases the dominant, contributor to harvest and mortality of a species prior to its designation of a species as a gamefish. This aligns with research documenting a 71% increase in the relative magnitude of recreational harvest compared to commercial harvest (Ihde et al. 2011). Further, results from a 2004 study found that, while recreational harvest accounted for only 4% of all finfish landings, this number jumps to 23% when focusing on population of concern across all U.S. landings and as high as 65% for populations of concern in the Gulf of Mexico (Coleman et al. 2004). The majority of senior fisheries managers from states in the Gulf of Mexico, southeast Atlantic, and Mid-Atlantic regions of the U.S. reported considerable increases in recreational fishing effort in recent decades. Interestingly, a many of the interviewees prefaced this belief with a statement expressing their lack of confidence in Marine Recreational Information Program (MRIP) data and asserted that their assessment of recreational effort was based on person or agency observations (see approach to supplement MRIP surveys below).

Citing, increase recreational effort concurrent to dramatic improvements in electronics, wider use of boats (e.g. bay boats) that allow recreational fishers to access areas that may have previously been inaccessible, and trolling motors that allow fishers to sit above productive areas that were previously unfishable because the area was not conducive to anchoring, interviewees expressed the belief that the efficiency of recreational anglers has increase dramatically. Numerous managers reported that subsequent to a species designation as a gamefish, increased recreational pressure and efficiency, to say nothing of environmental factors, have necessitated reduced bag limits and/or increased minimum sizes to sustain the fishery, a surprise to some recreational fishers who believed that gamefish designation would results in more liberal bag limits over time.

The resounding sentiment among the majority of coastal resource managers with whom we spoke was that gamefish laws represent just one tool at a state's disposal to influence fisheries,

but one largely based in politics rather than science. The coastal fisheries managers we spoke to reflected on the fact that reallocating a mixed-use fishery resource entirely to the recreational sector is generally a third rail issue and that while outside groups frequently come to them with analyses they have commissioned on the potential economic implications and impassioned arguments, agencies lack to the inhouse staff (economists, social scientists) to generate their own assessments. Thus, agencies rarely seek to become involved in these legislative decisions.

**MRIP Supplement

Louisiana Creel Program: Louisiana's Department of Wildlife and Fisheries developed LA Creel as a supplement to MRIP data. The program uses emails and calls to conduct relatively short surveys about recreational fishing effort. These short surveys, which provides spatial and temporal information on fishing effort (weekly/basin scale) and gear type used, enable the collection of sample sizes with considerably reduced error relative to MRIP data. Further, the spatial resolution of the data allows for basin-level management.

See: https://www.lafisheriesforward.org/wp-content/uploads/2018/03/LFF_FastFacts_LeCREEL_12-2017.pdf

Table 3. Synthesis of coastal U.S. states' use of legislation prohibiting the commercial harvest and sale of select coastal finfish species (i.e. gamefish designation). The species selected are largely those that comprise significant recreational fisheries in coastal U.S. states primarily along the Atlantic and Gulf of Mexico coasts and for which an appreciable portion of their catches occur within estuarine or state jurisdictional waters. As such, billfishes, are a notable exclusion. NAs indicate that the state is outside of a species' geographic range according to species distribution data obtained from Fishbase.org.

Region	State	Species							
		Red Drum	Spotted Seatrout	Snook	Bonefish	Tarpon	Cobia	Striped Bass	Steelhead Trout
New England	ME	NA	NA	NA	NA	N	NA	Y	NA
	NH	NA	NA	NA	NA	N	NA	Y	NA
	MA	N	NA	NA	NA	N	N	N	NA
	RI	N	NA	NA	NA	N	N	N	NA
	CT	N	NA	NA	NA	N	N	Y	NA
Mid-Atlantic	NY	N	N	NA	NA	N	N	N	NA
	NJ	N	N	NA	NA	N	N	Y	NA
	DE	N	N	NA	NA	N	N	N	NA
	MD	N	N	NA	NA	N	N	N	NA
	VA	N	N	NA	NA	C/R	N	N	NA
South East	NC	N	N	NA	NA	N	N	N	NA
	SC	Y	Y	NA	NA	Y	Y	Y	NA
	GA	Y	R	NA	NA	Y	N	Y	NA
Gulf of Mexico	FL	Y	N	Y	C/R	C/R	N	N	NA
	AL	Y	Y	N	NA	Y	N	Y	NA
	MS	N	N	N	NA	Y	Y	Y	NA
	LA	Y	N	N	NA	N	N	Y	NA
	TX	Y	Y	Y	NA	Y	N	Y	NA
Pacific	CA	NA	NA	NA	NA	NA	NA	NA	Y
	OR	NA	NA	NA	NA	NA	NA	NA	Y
	WA	NA	NA	NA	NA	NA	NA	NA	Y
North Pacific	AK	NA	NA	NA	NA	NA	NA	NA	N
Western Pacific	HI	NA	NA	NA	NA	NA	NA	NA	NA
		Y: Commercial Harvest and Sale Prohibited N: Commercial Harvest Permitted _____ C/R: Catch and Release Only R: Commercial Harvest Limited to Recreational Bag Limit							

Table 4. State-by-state synthesis identifying whether coastal states have engaged in stocking of hatchery-reared juveniles of coastal finfish species from the same pool of species considered in Table 3. Species for which stocking has occurred or is occurring are indicated by a Y. Species for which stocking has never occurred are indicated by a N. NAs indicate that the state is outside of a species' geographic range according to species distribution data obtained from Fishbase.org.

Region	State	Species							
		Red Drum	Spotted Seatrout	Snook	Bonefish	Tarpon	Cobia	Striped Bass	Steelhead Trout
New England	ME	NA	NA	NA	NA	N	NA	Y	NA
	NH	NA	NA	NA	NA	N	NA	Y	NA
	MA	N	NA	NA	NA	N	N	Y	NA
	RI	N	NA	NA	NA	N	N	Y	NA
	CT	N	NA	NA	NA	N	N	Y	NA
Mid-Atlantic	NY	N	N	NA	NA	N	N	Y	NA
	NJ	N	N	NA	NA	N	N	Y*	NA
	DE	N	N	NA	NA	N	N	Y*	NA
	MD	N	N	NA	NA	N	N	Y	NA
	VA	N	N	NA	NA	N	Y^	Y	NA
South East	NC	N	N	NA	NA	N	N	Y	NA
	SC	Y	Y	NA	NA	N	Y	Y	NA
Gulf of Mexico	GA	Y	N	NA	NA	N	N	Y	NA
	FL	Y	N	Y	N	N	N	Y	NA
	AL	Y	Y	N	NA	N	Y	Y	NA
	MS	Y	Y	N	NA	N	N	Y	NA
	LA	N	N	N	NA	N	N	Y*	NA
	TX	Y	Y	N	NA	N	N	Y	NA
Pacific	CA	NA	NA	NA	NA	NA	NA	NA	Y
	OR	NA	NA	NA	NA	NA	NA	NA	Y
	WA	NA	NA	NA	NA	NA	NA	NA	Y
North Pacific	AK	NA	NA	NA	NA	NA	NA	NA	Y
Western Pacific	HI	NA	NA	NA	NA	NA	NA	NA	NA
		* Hybrid striped bass							
		^Small scale, experimental stocking							

Allocation in Mixed-Use Coastal Fisheries

Background

Recreational fishing effort has grown dramatically in recent decades and in some cases equals or even exceeds commercial fishery harvest (Ihde et al. 2011). Despite the high levels of uncertainty associated with recreational harvest estimates, increased recreational effort has required fisheries managers to begin incorporating recreational harvest estimates into analyses that determine total allowable catch or quota for commercial fisheries (Eero et al. 2015). However, in doing so, the allocation of a resource between recreational and commercial fisheries becomes explicit, an outcome that can generate or exacerbate conflict between the two sectors (Cooke and Cowx 2004, Borch 2010). Even as recreational harvest estimates have been more explicitly incorporated into fisheries management, most recreational marine fisheries continue to operate under status-quo management regimes of open access, low or no license fees, size and bag limits, and seasons. Hence, their contribution to harvest, recreational fisheries have largely remained below the radar as commercial fisheries policies have transformed dramatically (e.g. limited entry; quota-based management, Table 5). While there is evidence that extension of rights-based approaches to recreational fisheries management may increase fisheries sustainability and angler welfare, efforts to do so may be challenged by inavailability and inconsistency of data pertaining to recreational fisheries (Abbott et al. 2018).

At the federal level, the most recent reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) included a Comprehensive Annual Catch Limit Amendment requiring the establishment of sector allocations for species managed by regional fishery management councils (Hawkes Jr 2011, Islands and Assessment 2011). These efforts seek to move beyond reliance solely on historical landing and to incorporate species interactions and socio-economic considerations. Based on guidance from the Government Accountability Office (GAO), the councils are working to develop allocation decision support tools (e.g. decision trees) based on landing and catch trends, stock assessment results, economic analyses, social indicator analyses, and ecosystem models. As these efforts by federal councils begin in earnest, we wanted to explore whether any coastal U.S. states have successfully incorporated, or are working to incorporate, socio-economic analyses or ecosystem-based management into their allocation frameworks for state-managed coastal finfish or crustaceans.

Challenges

Socio-economics

Economists and social scientists have developed generalized frameworks for incorporating socio-economic considerations into the allocation of a fishery resource between commercial and recreational fisheries (Easley and Prochaska 1987, Edwards 1990, 1991, Green 1994, Brown 2016, Voyer et al. 2017). However, these frameworks typically requires the expertise of scientists and management practitioners well-versed in natural resources economics and social science to generate the data necessary to inform models within the framework as well as to adapt the generalized frameworks to the unique attributes of a given fishery. The vast majority of senior fisheries managers with whom we spoke, including one whose agency employs hundreds of research staff, reported having either no dedicated natural resource economists or social scientists on staff. As such, lack of inhouse expertise represents a major bottleneck in the implementation of the aforementioned idealized approaches. Further, senior fisheries managers

routinely asked the questions: How does one define optimal economic efficiency? Economically efficient to whom and at what spatial scale (local, regional, state)? How do we quantify and prioritize the myriad social values derived from the fishery by its diverse participants? They also pointed to the fact that economic activity generated by recreational and commercial sectors often stimulate different parts of the economy and vary appreciably in the scale at which their impact is realized (e.g. local vs. state). Further, interviewees expressed that economic impact is calculated differently between sector (e.g. excess of value vs expenditures for commercial and recreational sectors, respectively), and the cumulative value ultimately depends on how far you follow each dollar or fishery product through the economy or market. Further, fishing is not the only use of natural resources that generates economic activity while inducing fish mortality. For example, hydroelectric power, natural resource extraction, and land use practices that degrade environmental quality all have the potential to impact fishery populations.

Biological

In contrast to socio-economic expertise, the staff of the state agencies responsible for marine fisheries management are typically well versed in biology and fisheries science. Senior fisheries managers from a number of coastal states reported state or joint state-federal efforts to move towards a more ecosystem based management approach, while a number of others expressed staffing and resource shortcomings that challenged their ability to adequately conduct single species management. Among the states in which ecosystem based management (EBM) approaches had been embraced, managers almost universally perceived considerable value to a multi-species and ecosystem approach. They expressed that moving beyond an engineering approach towards an approach that incorporates species interactions and stock diversity has been important in their state's resilience to periods of low fishery productivity and anthropogenic disturbances. Typically, it was reported that incorporation of EBM approaches influencing escapement goals (the number of fish that should be allowed to escape the fishery to reproduce and achieve maximum sustainable yield) in order to account for their importance as forage for other species. However, doing so had little influence on allocation between sectors. In a small number of states, EBM has been mandated by legislation (e.g. California's Marine Life Management Act) requiring science-based management that shifts the burden of proof towards demonstrating that fisheries and other activities are sustainable.

Future Directions

While some states have enacted statutes that specify equitable sharing of fisheries resources between user groups and preclude decisions driven largely by economic or social considerations, other states appear to have considered inclusion of these factors; however, these efforts appear to have largely stalled due to lack of staff resources and expertise. Additionally, numerous senior fisheries managers expressed that allocation based on historical catch benefits from being the simplest approach to explain to stakeholders and, therefore, the one for which they are most likely to garner constituent support. Even as EBM models and socio-economic analyses improve, explaining to constituents that resource allocation is informed by delta models that have been ranked by a panel of experts as the most suitable is challenging and has the potential to erode stakeholder confidence due to a perceived lack of transparency. Ultimately, divying up allocation is a zero-sum game, so until there are suitable models informed by sufficient data and improved ways to communicate how these models work to constituents, numerous senior fisheries

managers expressed that it was best to use the status quo of relying on historical catch as the most parsimonious and defensible approach.

Table 5. Use of quota management for select mixed-use fishery species of commercial and recreational importance in coastal Atlantic and Gulf of Mexico states of the U.S. GF indicated prohibition of commercial harvest and sale (i.e. gamefish designation). N indicates the absence of quota management. Numerical values are the annual commercial quota in a given coastal state. NAs indicate that the state falls outside of a given species' range based on geographic distribution information obtained from Fishbase.org.

Region	State	Red Drum		Spotted Seatrout		Southern Flounder		Striped Bass	
		Commercial (lb/yr)	Recreational (lb/yr)	Commercial (lb/yr)	Recreational (lb/yr)	Commercial (lb/yr)	Recreational (lb/yr)	Commercial (lb/yr)	Recreational (lb/yr)
New England	ME	NA		NA		NA		GF	
	NH	NA		NA		NA		GF	
	MA	N	N	NA		NA		869,813 ^{CQ}	N
	RI	N	N	NA		NA		181,572 ^{CQ}	N
	CT	N	N	NA		NA		GF	
Mid-Atlantic	NY	N	N	N	N	NA		795,795 ^{IQ}	N
	NJ	N	N	N	N	NA		GF	
	DE	N	N	N	N	NA		135,142 ^{IQ}	N
	MD	N	N	N	N	NA		1,562,615 ^{ITQ}	N
	VA	N	N	51,104 ^{CQ}	N	NA		1,203,637 ^{ITQ}	N
South East	NC	250,000 ^{CQ}	N	N	N	N	N	360,360 ^{CQ}	N
	SC	GF		GF		N	N	GF	
	GA	GF		N	N	N	N	GF	
Gulf of Mexico	FL	GF		N	N	N	N	N	N
	AL	GF		GF		N	N	GF	
	MS	60,000 ^{CQ}	N	50,000 ^{CQ}	N	74,000 ^{CQ}	N	GF	
	LA	GF		1,000,000* ^{CQ}	N	N	N	GF	
	TX	GF		GF		N	N	GF	
Pacific	CA	NA		NA		NA		NA	
	OR	NA		NA		NA		NA	
	WA	NA		NA		NA		NA	
North Pacific	AK	NA		NA		NA		NA	
Western Pacific	HI	NA		NA		NA		NA	

CQ: Communal Quota; IQ: Individual Quota; ITQ: Individual Transferable Quota
 * Commercial Rod and Reel Only

Habitat Management

Coastal Habitat Protection Schemes

Background

Research on federal authority to establish marine protected areas has largely eclipsed interest in the protection of marine areas and habitats that occurs under state authority (but see Mengerink and Austin 2015). This is unfortunate, as the considerable latitude afforded to states to enact protections over and above federal regulations provides an interesting landscape of approaches from which to assess potentially beneficial management practices. Some states designate habitats with the expressed purpose of benefitting the productivity of their fisheries (e.g. nursery habitat, critical habitat areas, significant fish and wildlife habitat areas, fisheries sanctuaries), while other coastal states embrace approaches that, while not solely focussed on their fisheries benefits, protect a subsets of the same habitats (e.g. environmentally sensitive areas, outstanding resource waters, SAV protections). Among these designated areas, there is considerable breadth in the types and extent of protection afforded to them. Among protection schemes aimed specifically at conserving and enhancing fisheries, the level of protections range from, at the least prescriptive in statute, having no protection proscribed and bestowing the authority authority to enact restrictions (e.g. seasonal or year-round closures) to regulatory body to, at the most prescriptive end of statutory language, enhanced permitting requirements and prohibitions on certain types of fishing gear or activities within the entirety of the designated area (Tables 6 & 7, Figs. 1-5). Broader protection schemes (Table 8) focused on protecting marine flora and fauna without explicit focus on fisheries benefits have an even greater breadth of restrictions, ranging from none at all to prohibition of particular extractive activities (e.g., National Estuarine Research Reserves) and, in the most extreme cases, prohibiting access entirely (e.g. portions of the Wakulla River, FL).

Successes

Generally, senior fisheries managers thought that their coastal habitat protection schemes worked fairly well to protect habitats of importance for the sustainability of their fisheries. Senior fisheries managers from numerous states highlighted the importance of public participation in the process of delineating areas that will limit use to enhance constituent buy-in. Another attribute that seemed to bolster support for the establishment of areas that limit activities was a commitment to evaluate whether the protections afforded to the designated area had the intended outcome and a willingness to open the areas back up if anticipated outcomes were not realized. For example, a manager provided the example an area that the state had closed to bottom gear with the hope of re-establishing submerged aquatic vegetation (SAV) beds. Within a few years, it became apparent that the biophysical environment had changed to an extent that the area was no longer capable of supporting seagrass. As such, after sufficient time had elapsed determine that recolonization was not likely to occur, the area was reopened. Another state's senior fisheries managers reflected on the establishment of marine protected areas, an undertaking supported by an appropriation from the legislature which included funding to conduct a before-after-control-impact (BACI) study assessing the impact of the protections. The ten year study is ongoing, but at the end of the experiment, the state will be able to assess whether the designation had the

intended benefits. If the results of the BACI experiment show significant benefits, they will serve as science-based evidence in support of sustaining, and potentially expanding, protections on the area. If the results don't support the hypothesis that the protection will increase species abundance and diversity (e.g. it becomes a predator sink, etc), the state will remove the protections on the area. Either way, the director expressed that a commitment to transparency and willingness to acknowledge that a management action did not achieve its intended outcome increased constituent trust in the process and willingness to support future experimental management actions.

Shortcomings

Few senior fisheries managers spoke of any major disadvantages of habitat protection programs. One director spoke to the fact that when you enact stringent restrictions on the uses in an area, it can lose value to the user group that proscriptions exclude and, as a result, the areas may lose some of its best advocates for the continued protection of that area. We know that fishers and hunters are often the major contributors to habitat protection and management through licence fees and advocacy. There is likely some threshold for the extent and stringency of spatial restrictions above which user groups may start to devalue the area unless there is really effective communication of how these restrictions benefit their interests. Further, displaced effort from areal closures has demonstrated potential to increase the intensity of fishing and its impacts in areas outside permanent closures or within temporality closed areas during the portion of the year that they are open (Murawski et al. 2005, Kellner et al. 2007).

Future Directions

Stakeholder involvement appears to be key to building a coalition of support for the enactment of protected marine areas. Communication and a transparent, science-drive approach was universally reported as imperative to continued support for limitations on approved uses of marine areas.

Table 6. Use of marine finfish and crustacean nursery habitat designation as a fishery management approach by coastal U.S. states. Where used, the table describes the terminology used, protections afforded to designated areas, and the approach used to identify and designate nursery areas.

Region	State	Nursery-Habitat Designation (Y/N)	Terminology Used	Protection Afforded (Y/N)	Description of Protections Afforded	Identification/ Designation Methodology
New England	ME	N	N/A	N/A	N/A	N/A
	NH	N	N/A	N/A	N/A	N/A
	MA	N	N/A	N/A	N/A	N/A
	RI	N	N/A	N/A	N/A	N/A
	CT	N	N/A	N/A	N/A	N/A
Mid-Atlantic	NY	N	N/A	N/A	N/A	N/A
	NJ	N	N/A	N/A	N/A	N/A
	DE	Y	Migratory Fish Spawning and Nursery Designated Use: Outstanding Resource Waters (ORW)	Y	Antidegradation policy to maintain existing water quality	Proposal and DEQ Board review of exceptional aquatic community
	MD	Y	Migratory Fish Spawning and Nursery Designated Use: ORW	Y	Antidegradation policy to maintain existing water quality	Proposal and DEQ Board review of exceptional aquatic community
	VA	Y	Migratory Fish Spawning and Nursery Designated Use: ORW; Anadromous Use Zone	Y	Antidegradation policy to maintain existing water quality	Proposal and DEQ Board review of exceptional aquatic community

Table 6 (continued).

Region	State	Nursery-Habitat Designation (Y/N)	Terminology Used	Protection Afforded (Y/N)	Description of Protections Afforded	Identification/ Designation Methodology
Mid-Atlantic South East GOM	NC	Y	Primary, Secondary, and special Secondary Nursery Areas: 15A NCAC §§ 03N.0101-0106, 03R.0103 (1991)	Y	PNAs: Once designated, it is unlawful to use trawl nets, long haul seines, swipe nets, dredges, or mechanical methods for clam or oyster harvest. Further, if an area is recognized as an AEC, development activities may be further restricted. ⁵³ Finally, the law prohibits activities such as mechanically assisted fish harvesting and any unpublicized residential development within PNAs.	Proposed based on inshore trawl surveys and areas with similar biophysical properties.
	SC	N	N/A	N/A	N/A	N/A
	GA	N	N/A	N/A	N/A	N/A
	FL	N	N/A	N/A	N/A	N/A

Table 6 (continued).

Region	State	Nursery-Habitat Designation (Y/N)	Terminology Used	Protection Afforded (Y/N)	Description of Protections Afforded	Identification/ Designation Methodology
Gulf of Mexico	AL	Y	Nursery Areas	Y	No taking or attempting to take shrimp by trawl, seine, cast net or any other means. See: AL 220-3-.01. Closure of all inshore waters to shrimping between May 1 and June 1 annually. 220-3-.04	Biophysical characteristics
	MS	Y	Nursery Habitats	Y	Gear restrictions and area/seasonal closures: Unlawful to engage in commercial harvesting of crabs, oysters, shrimp, bait shrimp or saltwater fish in certain marine waters; exceptions; department to set limits on all catches for noncommercial use; penalties. § 49-15-321. Commission authorized to establish sanctuaries and nursery grounds; unlawful to engage in prohibited activity in designated sanctuary or nursery area	The statute states that the Department must establish nursery grounds in estuaries and bays for the same purpose. The Gulf Coast Research Laboratory must complete studies and may recommend creating nursery grounds if deemed necessary to protect the resources.
	LA	N	N/A	N/A	N/A	N/A

Table 6 (continued).

Region	State	Nursery-Habitat Designation (Y/N)	Terminology Used	Protection Afforded (Y/N)	Description of Protections Afforded	Identification/ Designation Methodology
Gulf of Mexico	TX	Y	Nursery Areas	Y	No Shrimping Allowed.	Those coastal waters not specifically named as Major Bays or Bait Bays are considered Nursery Areas. Includes tributary bays, bayous, inlets, lakes and rivers that serve as significant growth and development environments for postlarval and juvenile shrimp. Does not include outside waters, major bays or bait bays.
Pacific	CA	N	N/A	N/A	N/A	N/A
	OR	N	N/A	N/A	N/A	N/A
	WA	N	N/A	N/A	N/A	N/A
North Pacific	AK	N	N/A	N/A	N/A	N/A
Western Pacific	HI	N	N/A	N/A	N/A	N/A

Table 7. Acreage of estuarine or inshore waters designated as nursery, or another functionally similarly classification aimed at protection of juvenile fish habitat, areas by coastal U.S. states.

Region	State	Nursery-Habitat Designation (Y/N)	Terminology Used	Acreage
New England	ME	N	N/A	N/A
	NH	N	N/A	N/A
	MA	N	N/A	N/A
	RI	N	N/A	N/A
	CT	N	N/A	N/A
Mid-Atlantic	NY	N	N/A	N/A
	NJ	N	N/A	N/A
	DE	Y	Migratory Fish Spawning and Nursery Designated Use: Outstanding Resource Waters	780
	MD	Y	Migratory Fish Spawning and Nursery Designated Use: Outstanding Resource Waters	517,013
	VA	Y	Migratory Fish Spawning and Nursery Designated Use: Outstanding Resource Waters	153,941
South East	NC	Y	Primary, Secondary, and special Secondary Nursery Areas	76,927 primary; 82,000 secondary
	SC	N	N/A	N/A
	GA	N	N/A	N/A
Gulf of Mexico	FL	N	N/A	N/A
	AL	Y	Shrimp Nursery Areas	79,178
	MS	Y	Nursery Habitats	101,454
	LA	N	N/A	N/A
Pacific	TX	Y	Shrimp Nursery Areas	294,878
	CA	N	N/A	N/A
	OR	N	N/A	N/A
North Pacific	WA	N	N/A	N/A
Western Pacific	AK	N	N/A	N/A
	HI	N	N/A	N/A

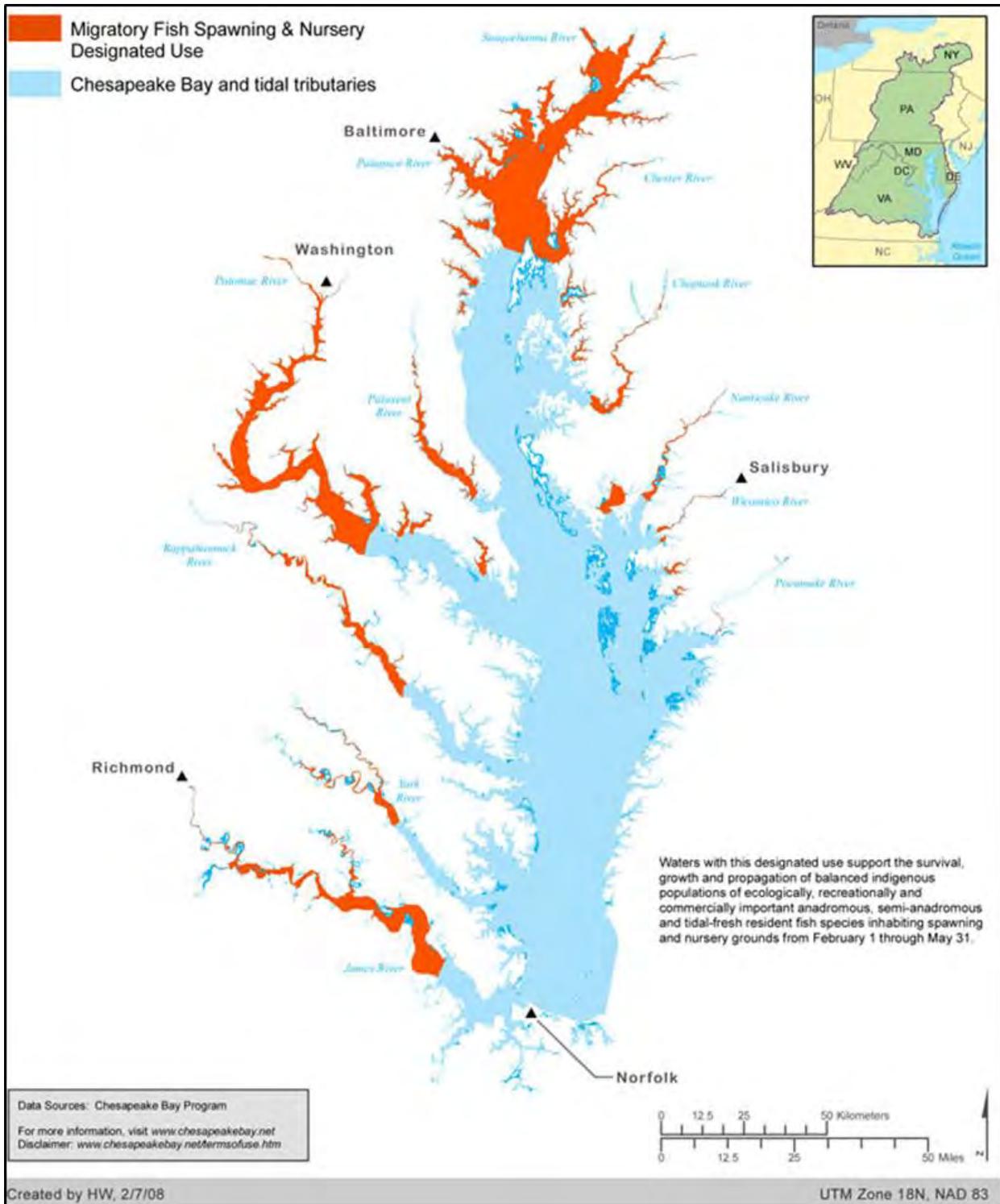


Figure 1. Areas within the Chesapeake Bay (encompassing DC, DE, MD, and VA jurisdictional waters) designated as migratory fish spawning and nursery designated use. Map Source: The Chesapeake Bay Foundation.

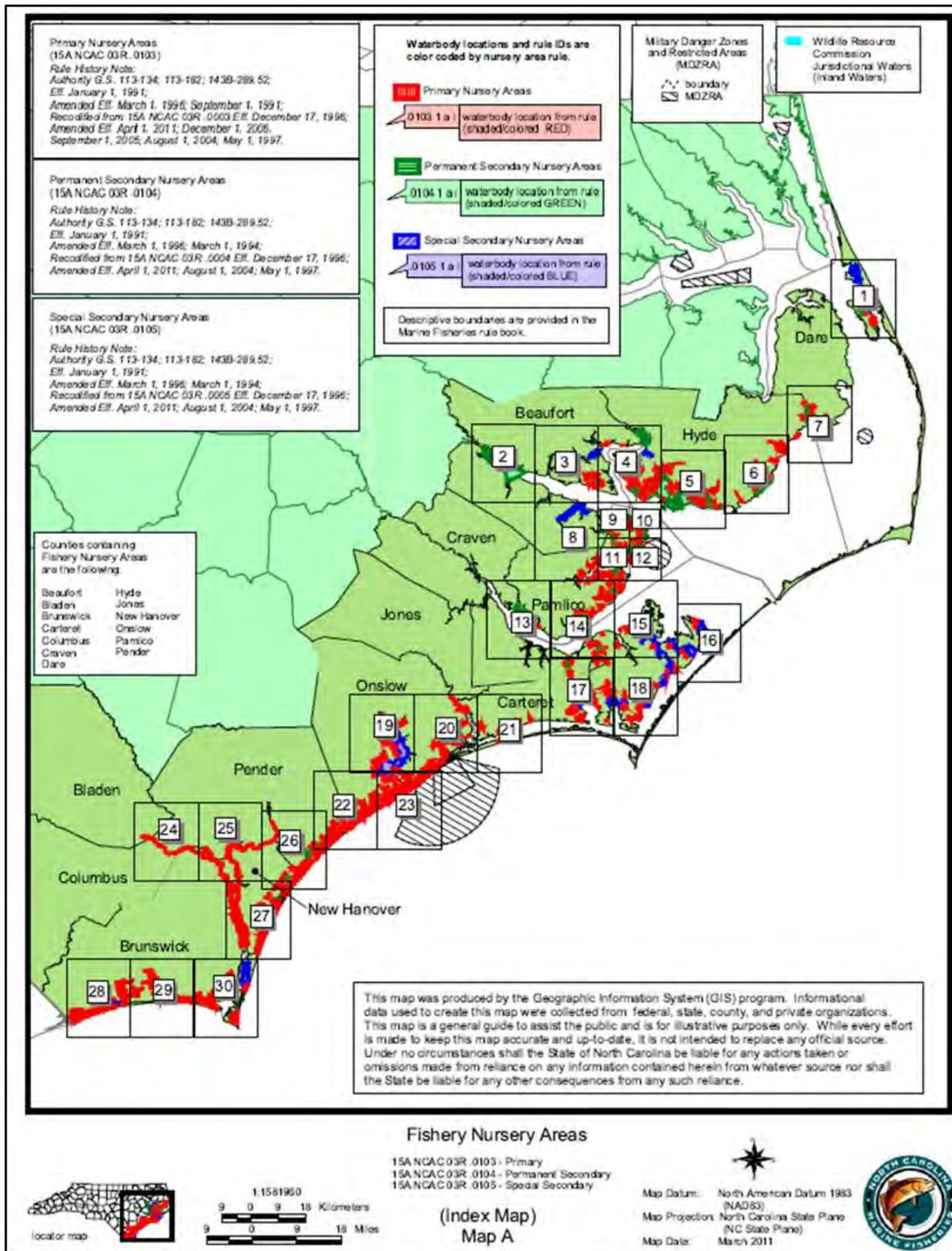


Figure 2. Location of primary, secondary, and special secondary nursery water in North Carolina. Map Source: The North Carolina Coastal Habitat Protection Plan.

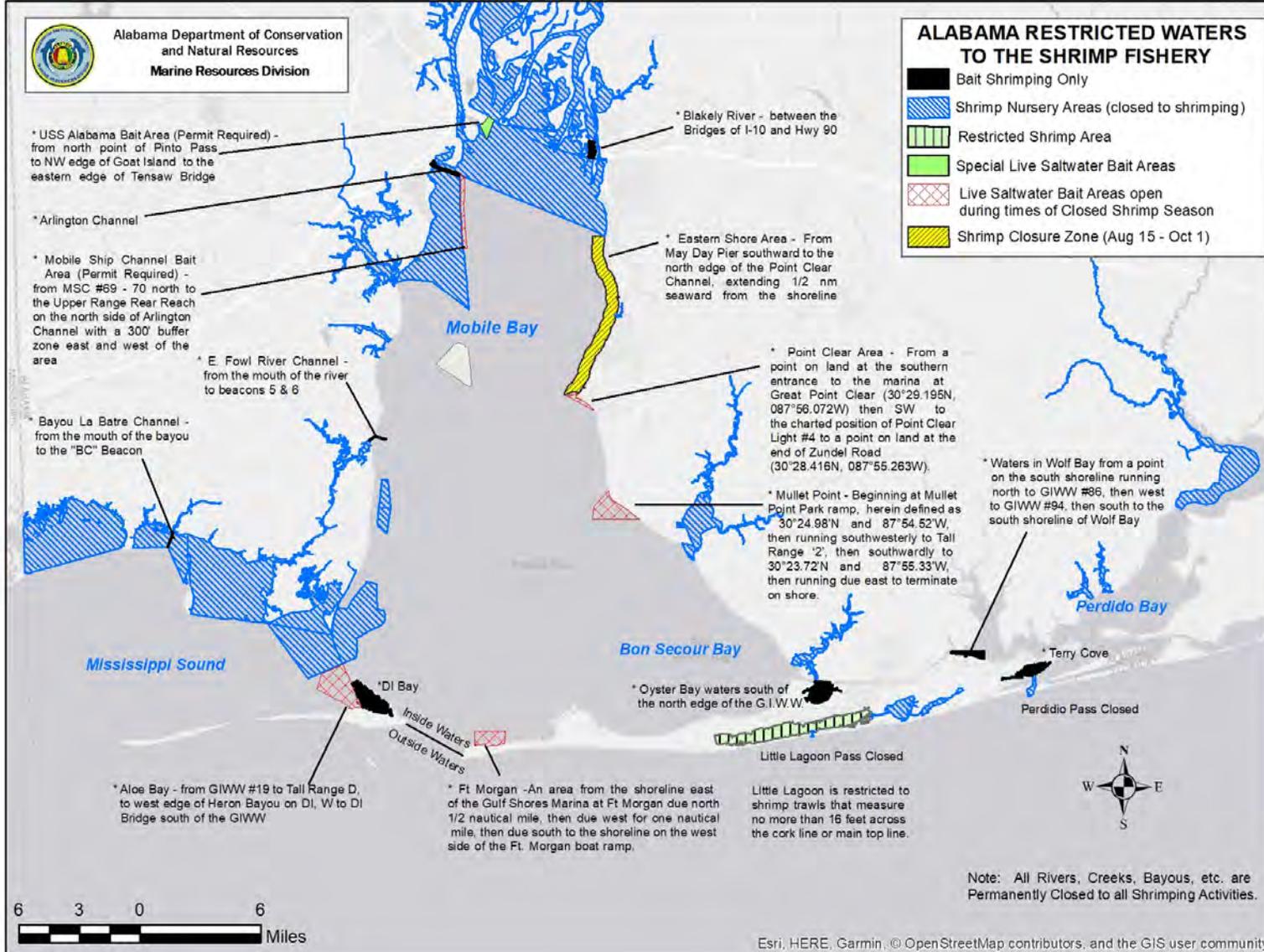


Figure 3. Alabama coastal waters designated as shrimp nursery areas. Map Source: Alabama Department of Conservation and Natural Resources, Marine Resources Division.

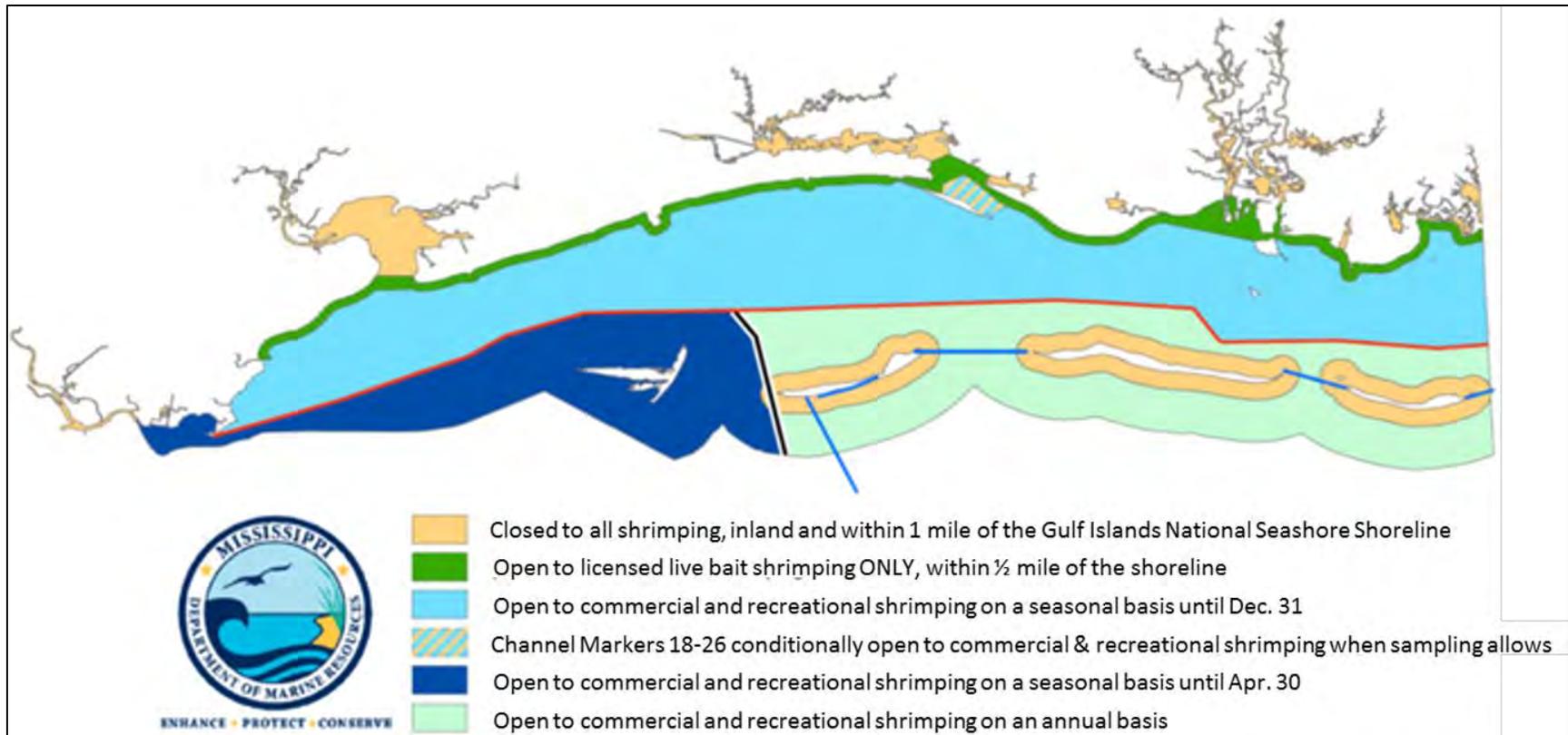


Figure 4. Areas within Mississippi's jurisdictional waters designated as nursery habitat (light orange). Map Source: Mississippi Department of Marine Resources.

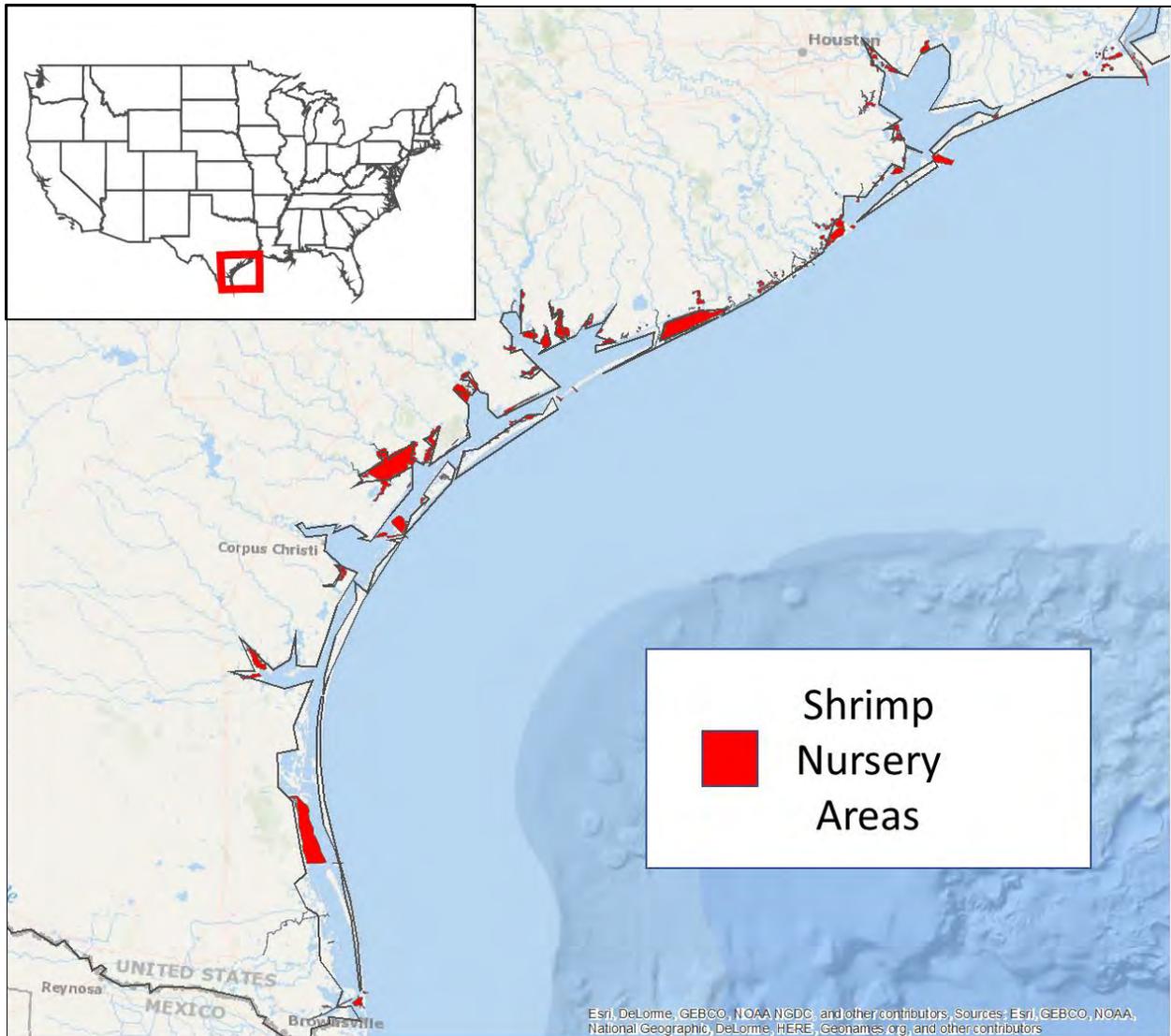


Figure 5. Areas designated as shrimp nursery areas within Texas' jurisdictional waters. Data source: Emma Clarkson, Habitat Assessment Team, Texas Parks and Wildlife Department's Coastal Fisheries Division.

Table 8. Broader coastal habitat protection areas/designations with the potential to encompass habitats typically considered valuable fish nurseries but not specifically designed for that purpose are listed for each coastal state.

Region	State	Broader Protection Approaches That Protects Habitats Serving as Nurseries
New England	ME	1. Maine’s Mandatory Shoreland Zoning Act; 2. Areas of Ecological Importance
	NH	1. Eelgrass protection; 2. NH Wildlife Action Plan: Species of Greatest Conservation Need
	MA	1. The Massachusetts Oceans Act of 2008; 2. Areas of Critical Environmental Concern
	RI	1. Section 300.18 Submerged Aquatic Vegetation and Aquatic Habitats of Particular Concern
	CT	1. Significance of submerged aquatic vegetation (SAV); 2. Natural Area Preserves
Mid-Atlantic	NY	1. Significant Coastal Fish and Wildlife Habitats
	NJ	1. Shellfish habitat; 2. Prime fishing areas; 3. Finfish migratory pathways; 4. Submerged vegetation habitats
	DE	1. The Natural Areas Preservation System (NAPS); 2. DNREC Wildlife Area (SWAs)
	MD	1. Anadromous Fish Propagation Waters; 2. SAV Protection
	VA	1. Fisheries Protected Areas; 2. SAV Protection

Table 8 (continued).

Region	State	Broader Protection Scheme That Protects Habitats Serving as Nurseries
Mid-Atl	NC	Strategic Habitat Areas
	SC	Outstanding Resource Waters Class SA&SB
South East	GA	1. Outstanding National Resource Waters Tier 3; 2. Trawling prohibition in estuaries
	FL	1. Outstanding Florida Waters; 2. Aquatic Preserves
Gulf of Mexico	AL	Areas of Particular Concern
	MS	Coastal Wetlands Protection Act
	LA	Fisheries Sanctuaries and Closures
	TX	1. Wildlife management areas; 2. Fish Sanctuaries; 3. Coastal Preserves
Pacific	CA	1. Environmentally Sensitive Habitat Areas (CAPRC § 30000 (1976)); 2. California State Seashores Provision CAPRC § 5001.6 (1974)
	OR	1. Marine reserves; 2. Areas of Critical State Concern; 3. Marine Gardens and Research Reserves
	WA	1. Aquatic Reserves; 2. Conservation Areas/Marine Preserves; 3. Natural Area Preserves
North Pacific	AK	1. Fish and Game Critical Areas; 2. Marine Parks
Western Pacific	HI	1. Fisheries Reserve and Protected Areas; 2. Natural Reserve System; 3. Marine Life Conservation District

Integrating Mariculture

Background

Aquaculture has surpassed wild fisheries as the largest supplier of fish for human consumption and we are living through an era of rapid expansion of farming of the marine environment (Da Silva 2016). In the U.S., one-third to one-half of current seafood production is now produced via aquaculture (NOAA Fisheries Data 2017); however, identification of appropriate areas to site aquaculture is critical to supporting the sustainable development of the industry. To avoid spatial conflict that stifles development and erodes public support for the industry and to ensure appropriate mitigation of potentially deleterious ecological/environmental outcomes, siting must consider conflicting uses of this public trust resource, social carrying capacity, and environmental externalities (Kaiser et al. 1998, McKindsey et al. 2006, Douvere 2008).

Of the five perceived negative risks associated with mariculture identified by Schlag (2010), which include environmental impacts, human health, animal welfare, organizational, and social issues, the first three listed are primarily perceived as issues associated with finfish aquaculture (Schlag 2010). Indeed, social issues can be a major source of opposition to the conveyance of public trust bottom. Studies have shown appreciable potential for conflict between mariculturists and wild harvest fishers commercial and recreational fishers when leases are located within productive fishing grounds or impede navigation channels to those fishing grounds (Neikirk 1990, Roberts 2018). In Table 9, we review the statutory language used by coastal state to address: 1) potential conflict between mariculture and wild fisheries; and 2) shellfish mariculture becoming an impediment to navigation. Further, we evaluate whether coastal state's statutes pertaining to shellfish mariculture: 1) specify restrictions to minimize impact on wild flora and fauna (Table 10); and 2) specify the need to consider factors impacting social carrying capacity are explicitly included as factors to consider in siting additional factors that, while they may not be protected under public trust laws or riparian rights (e.g. viewscape, light pollution), influence public perception of the industry (Table 11).

Table 9. A synthesis of statutory language used by coastal states to mitigate conflict between mariculture and commercial/recreational fisheries as well as minimize the potential for leases to impede navigation.

Region	State	Statutory Language Addressing Commercial/Recreation Fishing and Mariculture Conflict	Navigation
New England	ME	The Commissioner shall examine whether the lease activities would unreasonably interfere with commercial or recreational fishing or other water-related uses of the area. This examination shall consider such factors as the number of individuals that participate in recreational or commercial fishing, the amount and type of fishing gear utilized, the number of actual fishing days, and the amount of fisheries resources harvested from the area. Report required from marine patrol or harbormaster.	No unreasonable interference with navigation. Structure or work that extending closer to the horizontal limits of a Federal Navigation Project than 3x the authorized depth shall be subject to removal at the owner's expense prior to any Corps dredging or performance of any hydrographic surveys.
	NH	The executive director shall review all of the information to determine that the proposed aquaculture operation would not pose any unacceptable risk as specified in Fis 807.02(g), does not conflict with or negatively impact any recreational, commercial or other use currently being conducted in the area in and around the proposed project area, or does not adversely impact the value or use of private property in and around the projected area before issuing a license.	No unreasonable interference with navigation. Structure or work that extending closer to the horizontal limits of a Federal Navigation Project than 3x the authorized depth shall be subject to removal at the owner's expense prior to any Corps dredging or performance of any hydrographic surveys.
	MA	Applications for open-water aquaculture permits will be reviewed by the Division and cooperating agencies to determine if adverse impacts are likely to occur at the proposed site as a result of the operation of the permit. Topics for evaluation include, but are not limited to, the following: Wild fisheries.	No unreasonable interference with navigation.

Table 9 (continued).

Region	State	Statutory Language Addressing Commercial/Recreation Fishing and Mariculture Conflict	Navigation
New England	CT	Regulatory agencies may place conditions on proposed projects in order to minimize adverse impacts to other water-dependent uses or to adjacent property owners	No unreasonable interference with navigation. Structure or work that extending closer to the horizontal limits of a Federal Navigation Project than 3x the authorized depth shall be subject to removal at the owner's expense prior to any Corps dredging or performance of any hydrographic surveys. 200' setback from Federal Navigation Projects.
	Mid-Atlantic	NY	Before leasing or using the lands hereby ceded to it, the county of Suffolk shall cause an accurate survey to be made of such lands, and a map or maps to be prepared therefrom. Underwater lands where the leasing will result in a significant reduction of established commercial finfish or crustacean fisheries shall not be included in a shellfish cultivation zone.
		NJ	None

Table 9 (continued).

Region	State	Statutory Language Addressing Commercial/Recreation Fishing and Mariculture Conflict	Navigation
Mid-Atlantic	MD	<p>The Tidal Wetlands License application review involves issues of conflicting uses of the waterway, as they relate to activities in navigable waters and land-based operations. Among the many effects of aquaculture that are reviewed for potential conflicts are: established areas of recreational and commercial boating or fishing; water quality impacts; protection of submerged aquatic vegetation; and boating safety issues. These considerations are important due to the understanding that water column aquaculture will affect public rights and traditional uses of the waters, at least to some degree.</p>	<p>150' setback from Federal Navigation Channel. Corps Regional Conditions states that no work may extend into anchorage areas; customary boating channels; navigation fairways; marked, lighted, or charted channels; or State or Federal Navigation Channels. Permittee must provide location of the approved aquaculture activity to U.S. Coast Guard and ensure that it is published in the U.S. Coast Guard's "Local Notice to Mariners".</p>
	VA	<p>No explicit language apart from requiring "a detailed description of the temporary protective enclosures proposed to be deployed, the species to be cultured, a general description of the area within 500 feet of the lease boundary, including existing marine resources (SAV, shellfish beds, fixed fishing devices, traditional fishing and shellfish areas), locations of public and private piers and docks, water depths at mean low water, tidal range, the minimum vertical clearance, at mean low water, over the enclosures, the estimated date of placement of the structures, and any other information the Commissioner deems necessary to evaluate the proposal." The commission shall consider the project's effect on marine and fisheries resources of the commonwealth.</p>	<p>No unreasonable interference with navigation.</p>
South East	NC	<p>The marine aquaculture operation in the leased area will not unreasonably interfere with lawful utilization by the public of other marine and estuarine resources. Other public uses which may be considered include, but are not limited to, navigation, fishing, and recreation. The leased area must not be within an area traditionally used and available for significant levels of fishing or hunting activities incompatible with the activities proposed by the leaseholder, such as trawling or seining.</p>	<p>No unreasonable interference with navigation.</p>

Table 9 (continued).

Region	State	Statutory Language Addressing Commercial/Recreation Fishing and Mariculture Conflict	Navigation
South East	SC	In reviewing applications for Shellfish Culture Permits and Shellfish Mariculture Permits, the department must: guarantee of public rights of access and nonconflicting uses of permitted areas.	No unreasonable interference with navigation.
	GA	Prior to offering a subtidal water bottoms lease, the department shall consider compatibility with other public uses of the marine and estuarine resources in proximity of the lease area that include, but are not limited to, navigation, fishing, swimming, and other forms of recreation.	No unreasonable interference with navigation.
GOM	FL	All sovereignty lands shall be considered single use lands and shall be managed primarily for the maintenance of essentially natural conditions, propagation of fish and wildlife, and traditional recreational uses such as fishing, boating, and swimming. Compatible secondary purposes and uses which will not detract from or interfere with the primary purpose may be allowed. Activities which would result in significant adverse impacts to sovereignty lands and associated resources shall not be approved unless there is no reasonable alternative and adequate mitigation is proposed.	100' setback from Federal Navigation Channel.

Table 9 (continued).

Region	State	Statutory Language Addressing Commercial/Recreation Fishing and Mariculture Conflict	Navigation
Gulf of Mexico	AL	Leasing shall be conducted in a manner that considers potential conflicts presented by other uses of the coastal waters, including navigation, recreation, and commercial fishing. The easement parcel shall not significantly restrict public access for boating, swimming, and fishing.	State riparian easement will not be issued if lease is 100' from a marked navigation channel.
	MS	Leased area must provide reasonable public access for boating, swimming and fishing, unless it will interfere with the cultivation.	Must be greater than 0.5 mile of centerline of Federal Navigation Channel.
	LA	None specified-at LDWF discretion.	No unreasonable interference with navigation.
	TX	Lease will not be issues for an area that has been fished as a public reef within eight years of the lease application.	No unreasonable interference with navigation.

Table 9 (continued).

Region	State	Statutory Language Addressing Commercial/Recreation Fishing and Mariculture Conflict	Navigation
Pacific	CA	<p>If the final programmatic environmental impact report is prepared pursuant to subdivision (a) for coastal marine finfish aquaculture projects and approved by the commission under the California Environmental Quality Act set forth in Division 13 (commencing with Section 21000) of the Public Resources Code, the report shall provide a framework for managing marine finfish aquaculture in an environmentally sustainable manner that, at a minimum, adequately considers all of the following factors: (1) Appropriate areas for siting marine finfish aquaculture operations to avoid adverse impacts, and minimize any unavoidable impacts, on user groups, public trust values, and the marine environment. (3) The effects on marine ecosystems, commercial and recreational fishing, and other important ocean uses. Lessees under a state water bottom lease may not unreasonably impede public access to state waters for purpose of fishing, navigation, commerce, or recreation. The lessee may, however, limit public access to the extent necessary to avoid damage to the leasehold and the aquatic life culture therein. The commission may prohibit any recreational activity in any aquaculture area subject to a state water bottom lease if it determines that the activity is detrimental to the enhancement of the resource.</p>	<p>No unreasonable interference with navigation.</p>
	OR	<p>In determining if an area is suitable for cultivation of oysters, clams or mussels, the department shall consider the following: Compatibility with existing commercial fishing and shellfish operations including crabbing, shrimping and clamming.</p>	<p>No unreasonable interference with navigation.</p>

Table 9 (continued).

Region	State	Statutory Language Addressing Commercial/Recreation Fishing and Mariculture Conflict	Navigation
Pacific	WA	The management of state-owned aquatic lands shall preserve and enhance water-dependent uses. Water-dependent uses shall be favored over other uses in state-owned aquatic land planning and in resolving conflicts between competing lease applications. In cases of conflict between water-dependent uses, priority shall be given to uses which enhance renewable resources, waterborne commerce, and the navigational and biological capacity of the waters, and to statewide interests as distinguished from local interests.	No unreasonable interference with navigation.
North Pacific	AK	The following criteria are within the scope of the department's review: whether aquatic farming conflicts with existing uses, or with pending uses, as that term is defined in 11 AAC 63.900, of the site and of nearby land, whether or not the nearby land is in state ownership; under this paragraph, the finding must consider (B) traditional and existing uses of the site, including commercial fishing, sport fishing, subsistence activities, use as an anchorage, navigation, seaplane landing area, recreation, sightseeing, and tourism; consideration of this criterion will, in the commissioner's discretion, be combined with a traditional use finding if such a finding is required by AS 38.05.830.	Evaluated on an individual permit application basis.
Western Pacific	HI	Any person desiring to lease state marine waters shall submit to the board an application for specific activities in any specific area or areas. Applications made pursuant to this chapter shall contain: A statement on the extent to which the proposed activities will interfere with the use of the state marine waters for the purposes of navigation, fishing, and public recreation.	No unreasonable interference with navigation.

Table 10. Coastal state’s policies to address interaction between mariculture leases and essential fish habitat, submerged aquatic vegetation (SAV), and protected resources and critical habitat designations. Additionally, appraisal of whether (Y) or not (N) coastal state’s rules and regulations pertaining to mariculture siting consider introduction of pathogens, interference with public facilities, light pollution, noise, visual impact, and riparian user rights.

Region	State	Environmental/Ecological Consideration and Proscriptions			
		Essential Fish Habitat	SAV	Protected Resources and Critical Habitat Designations	Pathogens/ Invasive Species
New England	ME	Federal requirements. List of salmon habitats for special consideration.	Avoidance and minimum setback of 25'.	>1,500' from Critical Habitat Designation.	Y
	NH	Federal requirements. List of salmon habitats for special consideration.	No bottom culture shall be allowed where eel grass (<i>Zostera marina</i>) occurs in contiguous beds of 1/20 of an acre. Bottom culture must be separated from seagrass beds by 10m buffer.	N	Y
	MA	N/A	25' buffer required. Buffer zone increases if dredging activities occurring.	Floating gear removal when whales present. Max. of 10% of total acreage may be covered with floating gear.	N
	RI	Federal requirements.	Prohibition on areas with SAV.	N	Y
	CT	Federal requirements	Minimum 25' buffer.	Special review for areas of critical habitat designations.	Y
	NY	NYDEC permit required prior to submitting pre-construction notification to Army Corps for activities within EFH.	Not permitted if SAV is within Essential Fish Habitat.	Additional information required in application if impacting protected resource.	N
Mid-Atlantic	NJ	Federal requirements	Leases prohibited if SAV is observed.	Additional information required in application if impacting protected resource.	N
	DE	Federal requirements	N	Additional information required in application if impacting protected resource.	N
	MD	Higher scrutiny for summer flounder habitat in MD coastal bays.	State prohibits lease if SAV present	Buffers implemented if listed species are present.	Y
	VA	Federal requirements	State prohibits lease if SAV present.	N	Y

Table 10 (continued).

Region	State	Consideration and Proscriptions for Siting Mariculture Leases			
		Essential Fish Habitat	SAV	Protected Resources and Critical Habitat Designations	Pathogens/ Invasive Species
Mid-Atlantic	NC	Information source regarding EFH required to be included in application	State lease standard requires: 15% or less of samples contain SAV, SAV density is very sparse (10% of less), no SAV for past 10 years during growing season.	N	N
	SC			Federal requirements	N
South East	GA	Federal requirements	N	N	Y
	FL	Federal requirements	N	Modified permit if listed species observed.	Y
Gulf of Mexico	AL	Federal requirements	N	N/A	Y
	MS	Federal requirements	N	Leases prohibited within 1 mile of habitats of special significance (e.g. ESA listed species, public oyster reefs, nesting bird areas, sea turtle nesting areas).	Y
	LA	Federal requirements	N	N/A	Y
	TX	Federal requirements	N	N/A	N
	CA	Federal requirements	Habitat assessment required and compensatory mitigation required if deemed necessary.	N/A	Y
Pacific	OR	Federal requirements	Mitigation plan may be required if project impacts eelgrass.	N/A	N
	WA	Federal requirements	10' buffer from seagrass for expansion of existing lease. 5m buffer around native eelgrass for new leases.	N/A	Y
North Pacific	AK	Evaluated on an individual permit application basis.	Evaluated on an individual permit application basis.	Evaluated on an individual permit application basis.	Y
Western Pacific	HI	Federal requirements.	N/A	Shall not occur within marine life conservation districts or shoreline fisheries management area programs, or natural areas reserve programs if activities will results in adverse impacts.	N

Table 11. Coastal state’s policies to address interaction between mariculture leases and essential fish habitat, submerged aquatic vegetation (SAV), and protected resources and critical habitat designations. Additionally, appraisal of whether (Y) or not (N) coastal state’s rules and regulations pertaining to mariculture siting consider introduction of pathogens, interference with public facilities, light pollution, noise, visual impact, and riparian user rights.

Region	State	Social-Environmental Considerations and Proscriptions				
		Interference with Public Facilities	Light Pollution	Noise	Visual Impact	Riparian User Rights
New England	ME	Y	Y	Y	Y	Y
			Indirectly- Value or use of private property nearby	Indirectly- Value or use of private property nearby	Indirectly- Value or use of private property nearby	
	NH	Y				Y
	MA	Y	N	N	N	N
	RI	N	N	N	N	N
	CT	Y	Y	Y	Y	Y
Mid-Atlantic						Y-1000ft setback from high water mark
	NY	N	N	N	N	
	NJ	N	N	N	N	N
	DE	Y	N	N	N	N
	MD	Y	N, but within state's BMP guidance.	N, but within state's BMP guidance.	N, but within state's BMP guidance.	Y
	VA	Y	N	N	N	Y
South East	NC	Y	N	N	N	Y
	SC	Y	N	N	N	N
	GA	Y	N	N	N	Y
	FL	Y	N	N	Y	Y
	AL	Y	N	N	N	Y
Gulf of Mexico	MS	Y	Y	N	N	Y
	LA	Y	N	N	N	N
	TX	Y	N	N	N	Y
Pacific	CA	Y	N	N	N	N
	OR	Y	N	N	N	N
	WA	N	N	N	N	N
North Pacific	AK	Y	N	N	N	Y
Western Pacific	HI	Y	N	N	N	N

Coastal Fisheries Administration

Rule-Making Framework

Overview

The majority of coastal state's marine fisheries enact regulations through commission, boards, or councils, the memberships of which are governor appointed (Table 12). Among coastal states whose marine fisheries rules are made by a commission, board, or council, some of these bodies are dedicated exclusively to regulating marine fisheries, while other are responsible for all of the states fish and game, and those with the broadest scope have rule making authority over all conservation, natural resources, and even energy-related issues. Other states convey this power to the most senior official (i.e. director or commissioner) at the agency responsible for marine fisheries management.

These different approaches are all considered to work fairly well by the managers we interviewed. Typically, the entities responsible for rule making are advised by agency staff and, with one exception, standing or ad-hoc advisory committees that range in number from one to upwards of 50. A recurring issue that was raised was the length of time that it can take to enact rules in states where everything has to be done by either a commission or legislatively (e.g. no proclamation authority). There is a gradient in the amount of proclamation authority afforded to the heads of marine fisheries management agencies among states. North Carolina has among the widest latitude for the use of proclamations, while South Carolina has among the least. Lack of proclamation authority seems to be particularly difficult in the case of rules that are necessary and non-negotiable to remain in compliance with regional council or commission directives. When legislative or commission processes drag on for months to years, numerous interviewees responded that it hinders reactive management needed to address these non-negotiable actions. Indeed, a number of interviewees expressed that coastal fisheries management would be more efficient with the type of proclamation authority afforded to North Carolina's Director of the Division of Marine Fisheries. Uniformly, this did not reflect a desire to circumvent traditional rule making processes that managers acknowledged were integral to stakeholder trust, rather to minimize resources allocated devoted to actions for which there are no alternatives and redirect those effort towards better serving their stakeholders.

Asked about public participation, interviewees universally highlighted the importance of public engagement. In fact, numerous interviewees cited efforts to build meaningful relationships with their constituents and increase engagement as top actions that have benefitted the efficacy of coastal fisheries management in their state and, thus, the sustainability of their coastal fisheries. An interesting insight reported by a number of interviewees was that fact that opinions voiced at venues for public comment are largely dominated by organizations speaking to the interests of their membership. Indeed, some pioneering states have actually conducted random mail and phone surveys of anglers and hunters and found that the opinions of the vocal organizations the frequently dominate the conversation at public forums don't reflect, and in some cases are diametrically opposed to, the views of the average fisher and/or hunter (see: Responsive Management: <https://responsivemanagement.com/articles-and-publications/articles/>). States that have identified innovative ways to increase participation by, and representation of, a more

diverse group of sector participants report that the majority of users often favor regulations that are more streamlined than those advocated for by the most vocal participants at meetings. To the benefit of managers, these streamlined regulations (e.g. consistent limits, sizes, and gear proscriptions), as opposed to more complex management approaches (e.g. variable regulations by water body) that special-interest groups may advocate for, typically correlate with lower regulatory burden to enforce.

Speaking in generalities, interviewee responses indicate that effective and efficient rule-making can be achieved through a number of different frameworks. Proclamation authority, the scope of which is well-considered and well-defined, was viewed as valuable to efficient regulation of coastal fisheries by most interviewees. Stakeholder involvement was highlighted repeatedly as integral to identifying workable solutions and ensuring buy-in from resource user groups.

Table 12. Summary of coastal state’s rule making frameworks, which includes the entity ultimately responsible for marine fisheries rule making and who appoints the individual or individuals responsible for rule making. Additionally, if the rule making entity is comprised of multiple members (e.g. a commission or board), any compositional prescription set out in law and a list of advisory bodies to the state’s marine fisheries rule making entity.

Region	State	Marine Fisheries Rule Making Entity	Appointer of Rule Making Entity	Membership (#) & Composition of Rule Making Body	List of Advisory Bodies to the Rule Making Entity
New England	ME	Commissioner of Department of Marine Resources	Governor	NA	Aquaculture Advisory Council, DMR Advisory Council, Lobster Advisory Council, Scallop Advisory Council, Seaweed Fisheries Advisory Council, Shellfish Advisory Council
	NH	Fish and Game Commission	Governor	11 members: Each member shall be a resident of a different county and not more than 6 commissioners shall be members of the same political party. (a) Well informed on the subject of fish and wildlife conservation and restoration; (b) Dedicated to the conservation and protection of the state's fish and wildlife resources and of an environment conducive to the welfare of the same; (c) Committed to a fish and game program providing reasonable balance between research, habitat management and law enforcement; (d) An active outdoorsman holding a resident fishing, hunting, or trapping license in at least 5 of the 10 years preceding the appointment; (e) A personal record free of convictions of violation of fish and game laws and regulations of this state or any other jurisdiction within 5 years, preceding his appointment; and (f) At least 5 years' experience in one or a combination of the following fields: (1) Forestry (2) Agriculture (3) Management of wild lands (4) Soils conservation (5) Conservation of water resources (6) Fish and game management or propagation (7) Conservation engineering (8) Conservation law (9) Wildlife education(10) Active membership in a conservation or sportsmen's organization in this state. In the case of the coastal commission member, a general knowledge of all crustaceans and bivalves in coastal waters and salt water fishing in general.	Public Water Access Advisory Board; Advisory Committee on Marine Fisheries
	MA	Director of the Division of Marine Fisheries	Commissioner of the Department of Fish and Game with the approval of the Marine Fisheries Advisory Commission	NA	Marine Fisheries Advisory Commission, Marine Recreational Fisheries Development Panel, Shellfish Advisory Panel, Seafood Marketing Steering Committee
	RI	Director of the Department of Environmental Management	Governor, with consent of the Senate	NA	Rhode Island Marine Fisheries Council; Industry Advisory Panel, Shellfish Advisory Panel
	CT	Commissioner of Energy and Environmental Protection	Governor, with consent of the Senate	NA	Fisheries Advisory Council; Conservation Advisory Council

Table 12 (continued).

Region	State	Marine Fisheries Rule Making Entity	Appointer of Rule Making Entity	Membership (#) & Composition of Rule Making Body	List of Advisory Bodies to the Rule Making Entity
Mid-Atlantic	NY	Commissioner of the Department of Environmental Conservation	Governor	NA	Marine Resource Advisory Council
	NJ	Marine Fisheries Council	Governor, with consent of the Senate	10 members: The makeup of the council is set by statute and is composed of four sports fishermen, two active commercial fin fishermen, one active fish processor, two members of the general public, and the chairman of the two sections of the Shellfisheries Council.	Shellfisheries Council, Endangered and Nongame Species Advisory Council
	DE	Director of Division of Fish and Wildlife	Governor	NA	Advisory Council on Tidal Finfisheries, Council on Recreational Fishing Funding, Council on Shell Fisheries
	MD	Department of Natural Resources' Director of Fisheries	Governor	NA	Sport Fisheries Advisory Commission, Tidal Fisheries Advisory Commission, Oyster Advisory Commission, Blue Crab Advisory Committee, Commercial Striped Bass Advisory Committee, Maryland Artificial Reef Committee
	VA	Marine Resources Commission	Governor	9 members: Shall be representative of all areas of interested in VA's marine resources, including commercial, recreational, and environmental interests. At least one shall have earned their livelihood for at least 5 yrs from working on VA waters.	Aquaculture Management Advisory Committee, Finfish Advisory Committee, Crab Management Advisory Committee, Commercial Fishing Advisory Board, Seaside Eastern Shore Oyster Replishment Committee, Habitat Management Advisory Committee, Recreational Fishing Advisory Committee, Shellfish Management Advisory Committee, Saltwater Fishing Tournament Advisory Committee
	NC	North Carolina Marine Fisheries Commission	Governor	9 members: 3 recreational, 3 commercial, 2 at large, 1 scientist	Regional: North, South; Standing: Finfish, Habitat and Water Quality, Shellfish/Crustacean
South East					

Table 12 (continued).

Region	State	Marine Fisheries Rule Making Entity	Appointer of Rule Making Entity	Membership (#) & Composition of Rule Making Body	List of Advisory Bodies to the Rule Making Entity	
South East	SC	Director of Department of Natural Resources (Very limited capacity, almost all done legislatively).	Department of Natural Resources' Board of Directors	NA	Marine Advisory Committee, Saltwater Recreational Fisheries Advisory Committee	
	GA	Board of Natural Resources	Governor, with consent of the Senate	19 members: One member from each congressional distribe of the state, plus an additional member from one of six coastal counties, plus at large members.	Marine Fisheries Advisory Council, Coastal Advisory Council, Blue Crab Advisory Panel, Finfish Advisory Panel, Shellfish & Mariculture Advisory Panel, Shrimp Advisory Panel	
Gulf of Mexico	FL	Fish and Wildlife Conservation Commission	Governor, with consent of the Senate	7 members: typically, from different geographic regions, but no prescribed composition.	Technical assistance groups as needed.	
	AL	Conservation Advisory Board	Governor	10 members: The appointed members of the board shall be selected with special reference to training and experience along one or more of the principal lines of activity vested in the Department of Conservation and Natural Resources. Three ex-officio members in the Governor, Commissioner of Agriculture and Industries, and the Director of the Alabama Cooperative Extension System.	N/A	
	MS	Executive Director of Department of Marine Resources	Governor	NA	Advisory Commission on Marine Resources	
	LA	Wildlife and Fisheries Commission	Governor, with consent of the Senate	7 members: three from coastal parishes, representing fishing and fur industries. The other four, from the state at large, represent interests other than commercial fishing and fur industries.	Crab Task Force, Finfish Task Force, Oyster Task Force, Shrimp Task Force, Artificial Reef Council	
	TX	Parks and Wildlife Commission	Governor, with consent of the Senate	9 members: In making appointments under this section, the governor shall attempt to include persons with expertise in diverse fields, including fields such as historic preservation, conservation, and outdoor recreation. For exclusionary characteristics: https://statutes.capitol.texas.gov/Docs/PW/htm/PW.11.htm#11.0121	Coastal Resource Advisory Committee	
	Pacific					Marine Resource Committee (commission subgroup), Advisory Committee on Salmon and Steelhead, Regional Fish and Game Advisory Commissions, Aquaculture Development Committee, Bay-Delta Sport Fish Enhancement Stamp Fund Advisory Committee, Fish Barrier Removal Advisory Group
		CA	Fish and Game Commission	Governor, with consent of the Senate	5 members: Appointees should demonstrate background in natural resource management, public policy decision making, natural resource science.	

Table 12 (continued).

Region	State	Marine Fisheries Rule Making Entity	Appointer of Rule Making Entity	Membership (#) & Composition of Rule Making Body	List of Advisory Bodies to the Rule Making Entity
Pacific	OR	Fish and Wildlife Commission	Governor	7 members: one from each congressional district, one from east of the Cascades and one from the west of the Cascades. Must have a general knowledge of fish and wildlife issues and an understanding of the operation and functions of public policy boards and commissions. Governor shall consider those with backgrounds in commercial fishing, recreational fishing, hunting, agriculture, forestry, and conservation.	Conservation & Recreation Advisory Committee, Salmon and Trout Enhancement Advisory Committee
	WA	Fish and Wildlife Commission	Governor	9 members: three members from west of the Cascade Mountains, three members from east of the Cascade Mountains and three "at-large" members who may reside anywhere in the state. No two Commission members may reside in the same county	Budget and Policy Advisory Group, ADA Advisory Committee, Ad-Hoc Coastal Recreational Bottomfish Advisory Group, Ad-Hoc Puget Sound Steelhead Advisory Group, Ad-Hoc Recreational Pacific Halibut Advisory Group, Coastal Dungeness Crab Advisory Group, Columbia River Alternative Gear Advisory Board, Columbia River Commercial Fishing Advisory Group, Columbia River Recreational Fishing Advisory Group, Columbia River Salmon and Steelhead Recreational Anglers Board, Cowlitz River Advisory Group, Fishing Guide Advisory Group, Grays Harbor Salmon Advisory Group, Puget Sound Recreational Crab and Shrimp Advisory Committee, Puget Sound Recreational Fisheries Enhancement Fund Oversight Committee, Puget Sound Sport Fishing Advisory Group, Washington Shellfish Import Advisory Committee, Willapa Bay Salmon Advisory Group, Brian Abbott Fish Barrier Removal Board, Hydraulic Code Implementation Citizen Advisory Group, Skagit Wildlife Area Island Unit Advisory Group

Table 12 (continued).

Region	State	Marine Fisheries Rule Making Entity	Appointer of Rule Making Entity	Membership (#) & Composition of Rule Making Body	List of Advisory Bodies to the Rule Making Entity
North Pacific	AK	Board of Fisheries	Governor, with consent of the legislature	7 members: shall be appointed on the basis of interest in public affairs, good judgment, knowledge, and ability in the field of action of the board, and with a view to providing diversity of interest and points of view in the membership. The appointed members shall be residents of the state and shall be appointed without regard to political affiliation or geographical location of residence.	84 regional advisory committees throughout 6 regions of the state (5 coastal, 1 interior)
Western Pacific	HI	Board of Land and Natural Resources	Governor, with consent of the Senate	7 members: one from each land district and three at large. At least one member of the board shall have a background in conservation and natural resources, as provided in section 171-4. At least one member, other than the member with a background in conservation and natural resources, shall have demonstrated expertise in native Hawaiian traditional and customary practices, as provided in section 171-4, to ensure assistance to the board to better administer the public lands and resources with respect to native Hawaiian issues and concerns, the public land trust obligations, and the recognition of native Hawaiian cultural values that are intrinsically tied to the aina.	Natural Area Reserves System Commission

Table 13. Summary of the entities responsible for the regulation of marine fisheries and promotion of marine fisheries derived products (e.g. wild caught seafood) in coastal U.S. states and whether regulatory and promotional responsibilities are within the purview of a single or separate entities.

Region	State	Regulatory Agency	Promotional Agency	Regulatory and Promotional Arms Within Same Agency (Y/N)
New England	ME	Department of Marine Resources	Coastal Enterprises, Inc.	N
	NH	Fish and Game Department	Sea Grant/Community Seafood	N
	MA	Division of Marine Fisheries	Division of Marine Fisheries Seafood Marketing Program	Y
	RI	Division of Marine Fisheries	Rhode Island Seafood Marketing Collaborative, DEM Dept of Agriculture	N
	CT	Connecticut Department of Energy and Environmental Protection	Department of Agriculture, Seafood Advisory Council	N
Mid-Atlantic	NY	Department of Environmental Conservation	New York Seafood Marketing Task Force, Independent body directed by State Department of Agriculture and Markets, the State Department of Environmental Conservation, the Department of Economic Development, and the State Department of State	Regulatory agency involvement in multi-agency cooperative
	NJ	Department of Environmental Protection's Bureau of Marine Fisheries	Department of Agriculture, Jersey Seafood	N
	DE	Delaware Division of Fish & Wildlife	Delaware Sea Grant	N
	MD	Department of Natural Resources	Department of Agriculture	N
	VA	Marine Resources Commission	Department of Agriculture and Consumer Services	N
	NC	Division of Marine Fisheries	Department of Agriculture and Consumer Services	N
South East	SC	Department of Natural Resources Division	Certified SC Seafood program, a cooperative effort among the SC Department of Natural Resources, the SC Seafood Alliance, and the SC Department of Agriculture	Regulatory agency involvement in multi-agency cooperative
	GA	Department of Natural Resources	Department of Agriculture	N
Gulf of Mexico	FL	Fish and Wildlife Conservation Commission, Division of Marine Fisheries	Department of Agriculture and Consumer Services	N
	AL	Marine Resources Division of the Alabama Department of Conservation and Natural Resources	Alabama Seafood Marketing Commission, led by the director of the Alabama Marine Resources Division of the Alabama Department of Conservation and Natural Resources	Y
	MS	Department of Marine Resources	Department of Marine Resources	Y
	LA	Department of Wildlife and Fisheries	Seafood Promotion & Marketing Board	N
	TX	Coastal Fisheries Division of the Texas Parks and Wildlife Department	Department of Agriculture	N
Pacific	CA	Department of Fish and Game	Fisheries and Seafood Institute	N
	OR	Department of Fish and Wildlife Marine Resources Program	Oregon Department of Agriculture in conjunction with Oregon Sea Grant	N
	WA	Department of Fish and Wildlife	Washington Sea Grant	N
North Pacific	AK	Department of Fish and Game	Alaska Seafood Marketing Institute	N
Western Pacific	HI	Board of Land and Natural Resources	Hawaii Seafood	N

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Supplemental Material

Interview Questions

Eight (8) questions that were asked of each senior fisheries manager we interviewed.

Successes:

1. What management action taken by your agency do you believe to have had the greatest benefit to the sustainability of your state's fisheries (within the last 2-3 decades)?

Gear restrictions:

2. If your state has enacted outright bans on any commercial gear (e.g. gillnets, trawls, shellfish dredges), do you believe the intended outcome was realized?
3. Are there any (or any additional) commercial or recreational gear restrictions for which you believe the social/economic/ecological benefits outweigh the social/economic/ecological costs?

Limited Entry:

4. If your state has used limited entry permitting as a fisheries management strategy, do you believe it has been effective in reducing overcapacity, reducing latent licenses, stabilizing catches, and/or increasing income of eligible fishers within the fishery to which it was applied? Have you observed reduced diversification or increased attrition of fishers resulting from your state's limited entry approach?

Quota allocation:

5. For the most important/valuable mixed-use (commercial and recreational) fisheries in your state, do you believe there is sufficient credible data to incorporate economic efficiency, social benefits, and ecological externalities (e.g. bycatch, gear impacts to habitats) into the process of allocating Total Allowable Catch between the two sectors? Note: Our synthesis is largely focused on coastal species managed by the state or jointly by the state and a regional commission. If your state's mixed use fisheries occur almost exclusively outside the of state-jurisdictional waters, we would still appreciate your perspective on whether you believe the regional management council responsible for their management has adequate data to progress beyond quotas allocation based on historical harvest data.

Gamefish Species:

6. Do you believe there would be a benefit to the designation of any, or any additional, saltwater fishes as gamefish species (recreational harvest only)? If your state has designated any saltwater fishes as gamefish, how has that worked out in your state?

Incorporation of Habitat into Fisheries Management:

7. How does your state integrate coastal and marine habitats into marine fisheries management? Can you identify strengths or shortcomings of your state's approach?

Public Engagement:

8. Do you believe the regulatory structure, process for outside expertise (e.g. advisory committees), and public input is effective? Do you see any way it could be improved?

Supplemental Table 2. Categorical summary of whether habitat-ecosystem considerations, the maximization or social, ecological, and economic benefits, and approaches to increase participation and inclusiveness are explicitly mentioned within the mission statement, vision statement, or enduring principles of the agency responsible for the management of each coastal U.S. state's marine fisheries management.

State	Habitat-Ecosystem Considerations				Maximizing Benefits			Increasing Participation	
	Habitat	Ecosystem	Habitat Protection	Habitat Enhancement /Restoration	Economic	Ecological	Social	Increasing Access	Improving Infrastructure
ME	N	N	N	N	Y	N	N	Y	N
NH	Y	N	Y	Y	N	N	N	N	N
MA	N	Y	Y	Y	Y	Y	Y	Y	N
RI	N	N	Y	Y	Y	N	Y	N	Y
CT	Rely on Interstate Fisheries Management Council.								
NY	No mission statement specific to marine fisheries.								
NJ	Y	N	Y	N	Y	N	N	N	N
DE	N	N	Y	Y	N	N	N	Y	N
MD	N	Y	N	N	N	N	N	Y	N
VA	N	N	N	Y	N	N	N	N	N
NC	Y	N	N	N	N	N	N	N	N
SC	N	N	N	N	N	N	Y	Y	N
GA	N	N	N	N	N	N	N	N	N
FL	N	N	N	N	Y	N	Y	N	N
AL	N	N	N	N	N	N	N	N	N
MS	Y	N	N	Y	N	N	N	N	N
LA	Y	N	N	N	Y	N	N	Y	N
TX	Y	N	Y	Y	N	N	N	N	N
CA	Y	Y	Y	Y	N	Y	Y	N	N
OR	Y	N	Y	Y	Y	N	Y	Y	N
WA	N	Y	Y	N	N	N	N	N	N
AK	Y	N	Y	Y	Y	N	Y	Y	N
HI	Y	Y	Y	Y	N	N	N	N	N