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ISSUE BRIEF

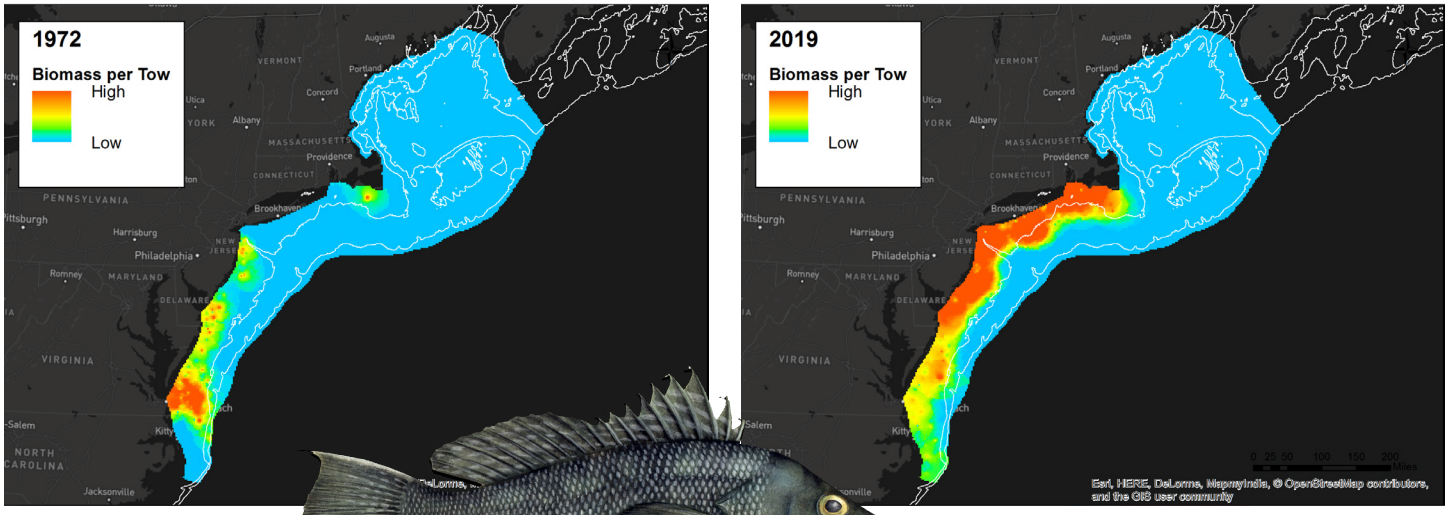
CLIMATE CHANGE AND FISHERIES:

CLIMATE-INDUCED RANGE SHIFT CREATES NEW FISHERY MANAGEMENT PROBLEMS

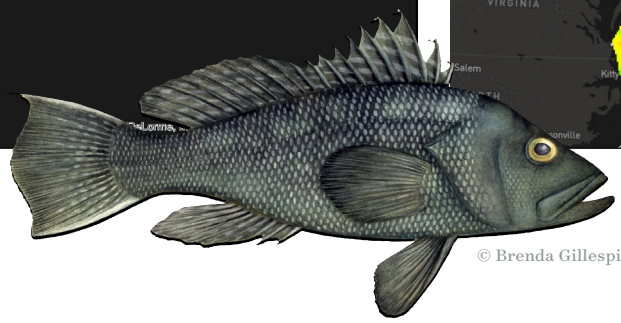
CLIMATE-DRIVEN RANGE SHIFT

Climate change is rapidly altering our oceans: Waters are growing warmer, less oxygenated, and more acidic. In response to these changes, marine species throughout the food web are shifting their geographic ranges to stay within their preferred habitat, tending to move poleward and farther offshore.[1] While water temperature is understood to be the major driver of range shifts, marine species also can respond to changes in oxygen saturation, availability of food and critical habitat, fishing pressure, and other alterations in the marine environment.[2]

The scope of range shift in marine ecosystems is striking. In the United States, two-thirds of fish stocks studied off the Atlantic coast have moved poleward or into deeper water over the past 40 years.[3] The speed of range shift also is noteworthy: In general marine species appear to be altering their geographic ranges an estimated 10 times faster than their land-based counterparts, at an average rate of approximately 45 miles per decade.[4] Scientists believe this rapid rate of migration is due to marine species generally being highly mobile and/or easily dispersed via ocean currents during their larval phase.[5]



The distribution of Black Sea Bass biomass in 1972 and 2019.



For more information, please contact:
Lisa Suatoni
lsuatoni@nrdc.org

Co-authored with Seth Atkinson and Molly Masterton

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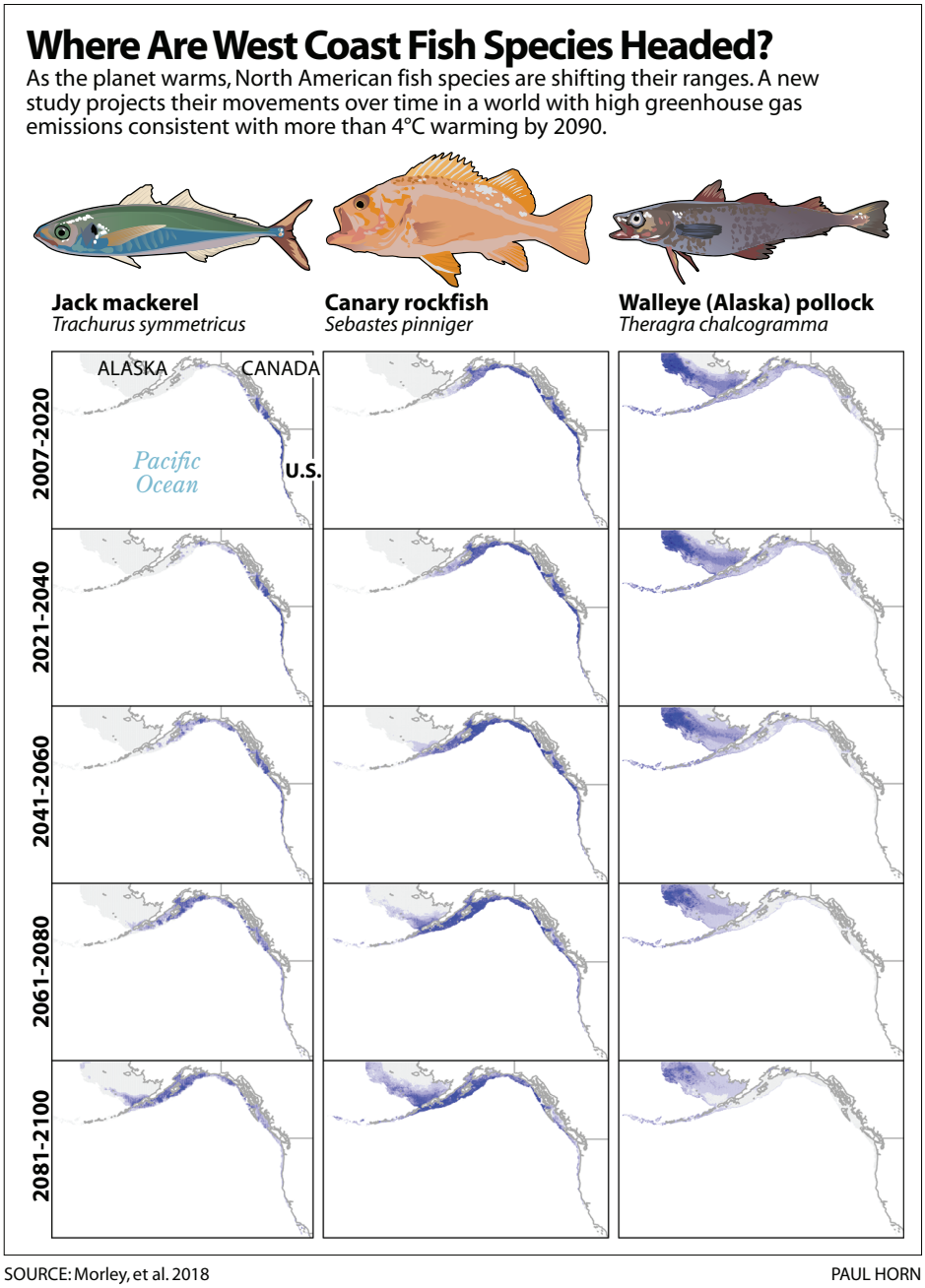
As climate change advances, scientists predict range shift will continue, with currently shifting stocks moving even farther poleward and offshore, and new stocks starting to shift.[6] For example, some models have predicted whole fish assemblages off the U.S. West Coast and Alaska shifting up to 1,500 kilometers (930 miles) by the end of the century.[7] Impacts are expected to be far-ranging and significant, essentially rearranging marine ecosystems at a large scale.[8]

Shifting fish stocks are likely to have a ripple effect throughout the fishery management system, creating a series of novel challenges that threaten the security of our food supply and local fisheries-based economies. If U.S. policymakers can successfully address these challenges, it will move our nation an important step closer to climate-adapted fisheries management and help ensure stability in this important food supply and economic sector.

BASS ON THE MOVE

A prominent example of range shift in U.S. fisheries management is provided by black sea bass (*Centropristis striata*), a commercially and recreationally valuable species with a range spanning most of the East Coast. In the 1970s, the black sea bass population was most abundant off the Chesapeake Bay; by 2008 it had shifted around 200 kilometers up the coast to an area off New Jersey.[9] This change, paired with overall growth in the black sea bass population (peaking in 2014), has dramatically affected fishermen's businesses and livelihoods. Black sea bass now fill charter operators' boats in northern states like Connecticut, and managers have been slow to address the challenging issue of revising state-by-state allocations of the fishery quota.[10]



SOURCE: Morley, et al. 2018

PAUL HORN

SHIFTING FISH POPULATIONS CREATE FISHERIES MANAGEMENT PROBLEMS

Shifting fish populations create significant challenges for fishery managers and policymakers tasked with maintaining healthy fish populations. This issue brief focuses on three specific challenges to the management system posed by shifting stocks: unregulated emerging fisheries, cross-jurisdictional coordination problems, and access or allocation conflicts. While these management challenges are not new—they can result from non-climate factors such as economic changes, habitat alteration, or technological development—they can be expected to increase in severity and frequency due to climate-induced range shift. In essence, climate change is poised to turn what have been infrequent or latent problems into serious stressors for the U.S. fisheries management system.

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I. Unregulated Emerging Fisheries

Climate-induced range shift can lead to a new or "emerging" fishery when a species moves into a new region and fishermen begin targeting it.[11] Emerging fisheries also can occur when a region's historically targeted stocks begin to leave or otherwise decline and fishermen shift their efforts to previously ignored stocks.

Emerging fisheries often lack key regulations to ensure sustainability. This is because most fishery management systems are built around specific existing fisheries. In the U.S. federal management system under the federal fisheries law, the Magnuson–Stevens Fishery Conservation and Management Act, the country's federal marine waters are split into eight separate regions. Within each region, Councils create Fishery Management Plans (FMPs) to cover each fishery—with fisheries being defined as a combination of the gear type used while fishing and the species targeted.[12] Permits and other management measures issued under an FMP govern who can catch, possess, land, or sell the target species in a given region, and how much can be taken.[13]

Most FMPs are limited to regulating the fishery's target species and a few peripheral, or bycatch, species.[14] So in any given region, hundreds of marine finfish and invertebrates usually exist outside any FMP or management framework. When fishermen begin to target a previously untargeted species or a newly arriving one, that fishing activity often is not covered by any existing FMP and is effectively unregulated.

Unregulated emerging fisheries present a problem because managers essentially must play catch-up to provide regulations for a fishery once it has already started. Absent foundational science and initial regulation, exploitation of the new target species can rise quickly and unsustainably, leading to stock depletion or overcapitalization in the fishing fleet.[15] And when regulations finally arrive, they can entail significant cutbacks in harvest, which are often met with widespread resistance.

History shows emerging fisheries tend to develop in a few ways. In some cases, new fishing activity arises from within an existing managed fishery, when individual vessels start "prospecting" on species that co-occur with their normal target species or are easily accessible with permitted gear and in permitted areas in that fishery. A few vessels may start retaining a species that would otherwise be discarded, or even intentionally targeting it, to see if a market can be developed. If so, fishing can intensify, creating a new target species for the fishery. And if the FMP and regulations do not manage the new species already (e.g., as a bycatch species), then fishing efforts can ramp up with little to no restriction.

This form of prospecting occurred with chub mackerel in the Mid-Atlantic region. In the late 2000s, a handful of large pelagic trawlers started to bring in chub mackerel during periods of low shortfin squid availability.[16] Because the Mid-Atlantic FMP for mackerel, squid, and butterfish lacked any limits on expansion to new species and did not regulate chub mackerel as a bycatch species, these vessels were able to land large quantities of chub mackerel with no oversight.[17] In 2013, landings spiked from a previous average of 62,293 pounds to 5.25 million pounds, with no understanding of its impact ecologically.[18] By the mid 2010s, the Mid-Atlantic Council became aware of this fishing activity and passed interim measures to cover chub mackerel.[19] Eventually the species was added to the FMP and fully brought into management, but only after several years of significant unregulated fishing in the early 2010s.[20]

In other cases, new fisheries develop entirely outside any management framework. When new fishing activity is sufficiently different from existing fisheries—in terms of species, gear, and area combinations—that it doesn't fit well under any existing FMP, then managers may have to create a whole new FMP to regulate it. This can be time-consuming and difficult, and by the time managers catch up, the new fishery may have expanded significantly.

Spiny dogfish in the Northeast provide an example of a fishery developing outside any management structure. For years spiny dogfish were encountered in different fisheries on the Atlantic coast and were regarded primarily as a nuisance. In the 1980s and 1990s, however, overseas markets for spiny dogfish developed, and small-boat gillnetters started targeting them in large numbers.[21] The species was not covered by any FMP, so fishing effort was able to ramp up quickly with no oversight. Catch increased dramatically, and by the time managers acted—creating an entirely new FMP—the stock had already crashed and needed rebuilding.[22]

While the emerging fisheries for spiny dogfish and chub mackerel were not driven directly by climate change, similar situations can be expected in the future as climate change reduces the availability of traditional target species or brings new species into a region.

BROADER CHALLENGES

Shifting stocks can create several other challenges beyond those addressed in this issue brief. For example, within a fisheries management system, shifting stocks can dramatically increase the need for permit transfers and procedures for permit holders to enter or exit the fishery, and can accentuate socioeconomic concerns around fishing-dependent communities.[23] Also, in fisheries science, shifting stocks can lead to changing stock structure, altered ecosystem relationships, and changes in productivity, among other things. These changing natural processes in turn can result in elevated scientific uncertainty around stock assessment outputs, and even failed stock assessments in some situations, as well as reduced confidence from stakeholders in the scientific process.[24] Shifting stocks furthermore can lead to breakdowns in the resilience of fish populations themselves, as range shift (and climate change more generally) may reduce the ability of fish populations to bounce back from fishing pressure in some situations.[25] Finally, shifting stocks create international management issues, as fish move across national boundaries and around the high seas.[26] While these topics are beyond the scope of this issue brief, they are important and will need to be addressed for our nation's fisheries to be fully responsive to climate change.

2. Lack of Management Coordination for Cross-Boundary Stocks

When fish stocks cross jurisdictional boundaries, management becomes more complicated. Managers must consider the full range of a stock and ensure complete management coverage, such that all fleets catching the species are subject to effective, coordinated regulation and no part of the stock is exposed to unregulated fishing. In some cases, this includes setting a primary decision maker or establishing procedures between neighboring jurisdictions for regulatory conformity.[27]

Blueline tilefish provide a recent example of what can happen when a cross-boundary stock lacks complete management coverage. The species spans four federal fishery management regions, from the Gulf of Mexico through southern New England.[28] However, on the Atlantic side, the blueline tilefish was understood to be centered in the South Atlantic region and for decades was managed only in that region.[29] Despite regular observations north of Cape Hatteras, the species remained unregulated in the Mid-Atlantic region because it was thought to be too rare to support a significant fishery there.

In 2013, following years of overly high catch levels, a stock assessment found South Atlantic blueline tilefish to be overfished.[30] Regulations restricting catch in the South Atlantic followed.[31] In response, a handful of commercial longline vessels moved north and started targeting blueline tilefish in the Mid-Atlantic region, where the species had been increasingly showing up in recreational catches since the 2000s—possibly as a result of warming waters and a northward shift in the species' distribution.[32]

Without regulations in place, significant numbers of blueline tilefish were landed in New Jersey and Delaware.[33] The National Marine Fisheries Service (NMFS) had to issue an emergency rule limiting catch, and eventually the Mid-Atlantic Council took action to add blueline tilefish to one of its FMPs, expanding management coverage northward for the species.[34]

Had blueline tilefish been managed across its full range to begin with, the unregulated fishing and ensuing management confusion in the Mid-Atlantic would have been avoided. This type of management coverage problem is likely to increase with climate change, as stocks shift outside their historical ranges and managers have to expand regulatory coverage in order to avoid unregulated fishing.

Additionally, cross-boundary stocks can sometimes require neighboring jurisdictions to cooperate, in some cases to set a primary decision maker, or to establish procedures for regulatory conformity across regions. However, this kind of cooperation is not always seamless—or even initiated.

For example, summer flounder, scup, and black sea bass are managed under an FMP issued by the Mid-Atlantic Council.[35] Management coverage includes New England, the Mid-Atlantic, and part of the South Atlantic region, and management measures established under the FMP are finalized by the NMFS as coastwide regulations.[36] Unlike blueline tilefish, the issue with summer flounder, scup, and black sea bass is not management coverage—the FMP applies to the full extent of these species' ranges. Rather, it is how the three covered jurisdictions interact and cooperate with one another.

The Mid-Atlantic Council is the lead federal region for summer flounder, scup, and black sea bass because these species historically had centers of abundance in the Mid-Atlantic region.[37] In recent years, however, summer flounder and black sea bass have notably shifted or expanded northward, leading to increased interest by the

Average Shift in Suitable Habitat by 2100 Under 2 Emission Scenarios

Source: Morley et al., 2018

New England Council.[38] At the urging of states and industry, the New England Council voted at its June 2016 meeting to request joint management authority over these species, explicitly citing climate change as the rationale.[39]

NMFS did not respond formally to the New England request, and the record shows no official resolution of the matter.[40] The Mid-Atlantic Council, for its part, rejected the idea of joint management, though it did made small concessions in its own processes to allow greater New England involvement.[41] There have been no further requests from New England; it is possible that tensions have settled somewhat in recent years or that attention has moved elsewhere. Still, the jurisdictional friction resulting from the request demonstrates the lack of clear structure for dealing with cross-boundary stocks and a reliance on politics, rather than sound policy, to resolve such issues.

The lack of clarity around jurisdictional cooperation originates in the Magnuson–Stevens Act, which provides relatively little structure for dealing with cross-boundary stocks. The legislation does give NMFS authority to delegate a lead council or to require fully joint management between councils, but it lacks any substantive standard or procedure to be used when exercising this authority.[42] The agency has not provided any guidance in this area, nor have regional councils attempted to negotiate ground rules for cooperation. As a result, jurisdictional conflicts—like that over summer flounder, scup, and black sea bass—are resolved in ad hoc ways, without use of the agency's legal authority.[43]

Given the breadth and rapidity of range shift in U.S. waters, fishery managers are likely to encounter challenges with cross-boundary stocks more often, including both management coverage gaps and jurisdictional cooperation difficulties. Stocks that previously did not straddle boundaries may start to, and stocks that already straddle boundaries may change their relative abundances across the boundary lines. New fleets also may start to interact with a stock as a result of changed abundance or distribution or changed fishing patterns, requiring an increased scope of management and active coordination across jurisdictions. At present, the federal management system is largely unprepared for these challenges.

3. Allocation and Access Conflict

Allocation refers to dividing up an amount of allowable catch. Essentially it addresses the question of who gets how much of a finite resource. Allocation decisions are made across jurisdictions (i.e., between federal management regions, or between state and federal management), across sectors (i.e., among commercial, private angler, and charter sectors), and even within sectors. Most allocations in U.S. fisheries management reflect historical records of catch, though there are variations and exceptions to this rule.[44]

Conflicts over catch allocation tend to arise in situations of limited access and high demand, which can occur in many different circumstances and are not always tied to climate change. For example, the long-standing dispute over red snapper in the Gulf of Mexico between recreational and commercial sectors is largely independent of climate change.

In recent years, however, climate-driven range shift has inflamed allocation conflicts. As fish move into new regions, local fishermen may want access to the new resource but may be prevented from getting it by existing permit structures and allocations that favor historical catch.[45] At the same time, the fishermen who do have quota may be from a different region—the stock's historic range—and may find themselves traveling farther and farther to catch their traditional targets.[46] The competing interests of these groups can quickly lead to friction in the management system.

Allocation and access conflict can have a further, complicating dimension when range shift drives a stock across a management boundary. As noted in the previous section, cross-boundary range shift can create a disconnect in management authority—where one region has management control over a stock but the stock now resides largely in a new region. This can exacerbate allocation problems, as the jurisdiction with management authority may favor its own fishermen and be reluctant to reallocate fishing privileges to those in the new region; it also can create an incentive to fish (or manage) unsustainably in the region that is losing the stock.[47] A similar confounding problem for allocations can occur with cross-boundary range shift and incomplete management coverage.[48]

An example of range shift–induced allocation and access conflict can be seen with summer flounder. As part of the poleward march of fisheries along the U.S. East Coast, summer flounder has shifted approximately 120 kilometers (74 miles) north over the past 40 years, yet its allocations have remained relatively static.[49] With highly concentrated allocations in the southern states (North Carolina and Virginia hold nearly 50 percent of the quota across all 11 states) but growing numbers of summer flounder in the north, conflict over summer flounder allocation has steadily increased.

Fairly allocating summer flounder across the Atlantic coast would be a difficult task in itself, but the problem is compounded by the current decision-making structure. Federal management authority for summer flounder is held by the Mid-Atlantic Fishery Management Council. Despite increasing amounts of summer flounder showing up in New England, representation by New England states is limited to a few seats on a Mid-Atlantic advisory body. With only a subset of states making decisions for the whole coast, climate-responsive allocation becomes essentially impossible.

Reflecting the rising level of conflict and discontent around summer flounder allocation, members of Congress from northern states have introduced legislation on the topic in recent years.[50] Some have called for Commerce Department Inspector General investigations of perceived unfair allocations.[51] At least one northern state has launched litigation to challenge summer flounder allocations.[52] And a few fishermen have engaged in regulatory noncompliance.[53]

Summer flounder is only one example; the expansion of black sea bass into northern waters has also sparked debate about its allocation formula, which concentrates quotas in the hands of a few states and is set by largely those same states.[54]

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BURNING DIESEL TO FOLLOW THE FISH

One of the consequences of fishery allocation systems not keeping pace with range shift is that boats can end up traveling farther to catch their allocated quota. As stocks shift northward and farther offshore, fishermen who historically targeted a given stock often retain their longtime catch allocations and have an incentive to follow the fish. This can result in vessels traveling farther and farther and can increase both operational costs and carbon emissions from the fishery.[55] For example, North Carolina commercial fisherman go hundreds of miles north to the Mid-Atlantic region to attain their quota of summer flounder, then travel home to land it—burning substantial amounts of fuel in the process.[56] In a further perverse twist, the market demand for summer flounder is highest in the northern states, so much of the commercially caught fish is then trucked back up the coast for distribution and sale.[57]


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Going forward, allocation problems are expected to increase significantly due to climate-induced range shift. In the Gulf of Maine alone, scientists predict the arrival of numerous species from southern regions in the coming decades, including traditionally important target species like summer flounder, scup, black sea bass, and longfin and shortfin squid.[58] Many of these stocks are currently managed by the Mid-Atlantic Council, and much of the quota is held by fishermen south of Cape Cod. There will be significant political pressure to allow local fishermen to capitalize on these climate-driven fishing opportunities, particularly as traditional New England target species like cod and American lobster move northward and into deeper water.[59]

SOLUTIONS

It is crucial for policymakers and fisheries managers to address the challenges posed by climate-induced range shift. Without proper regulation and management, there are likely to be allocation conflicts, management breakdowns, and potentially significant overfishing on some stocks undergoing range shift. This in turn may lead to a number of harmful biological and ecological consequences for fish populations, like hampered ability to colonize a new region, losses of important genetic diversity, and altered predator–prey relationships. With proper interventions, however, it is possible to avoid bad conservation outcomes, reduce conflict among fishermen and across regions, and maintain the efficacy of fisheries management.

In the sections below, we propose solutions to the three main problems posed by shifting stocks discussed above—emerging fisheries, cross-boundary stocks, and allocation conflict. We then outline how these solutions could be pursued at different levels in the federal system, including through legislation, agency action, and regional council efforts.

I. Address Emerging Fisheries by Drawing a Regulatory Perimeter Around Managed Fisheries and Making a Pathway for New Fishing

In recent years, a consensus has developed that ongoing fishing of a species should not be allowed until sufficient information is gathered and the species is added to a management framework.[60] What this means in practice is that managers should draw a regulatory perimeter around all currently managed fishing activity, prohibit unmanaged fishing outside that perimeter, and then define a pathway for bringing new fishing activity inside the perimeter.

Creating this perimeter requires managers to list all the current fishing activity occurring within their jurisdiction and then create a prohibition on any unlisted fishing. The initial list can be created on a fishery-by-fishery basis, because managers are familiar with thinking about fishing activity in terms of distinct fisheries. It should include details about who manages the fishery (a federal council, a state, an interstate commission, etc.) and what species are caught in that fishery.

Having established a perimeter, the next task is to define specific steps that fishermen can take to bring a new fishery inside the management system. This generally involves experimental fishing, both for scientific data collection and for economic scoping.[61] At the federal level, experimental fishing often takes place through the use of an exempted fishing permit (EFP), a selective type of permit that allows a vessel to conduct fishing activities that would otherwise be prohibited by regulations and promotes fisheries-related research. As such, EFPs should be integrated into the pathway for new fishing.[62] After sufficient data gathering and scoping have taken place through EFP fishing, managers can then decide whether to bring the new species into management and allow fishing on an ongoing basis.

If designed properly, this kind of perimeter-and-pathway system for emerging fisheries will have little to no immediate impact on fishing activity. All currently managed fishing will proceed without disruption; the effect simply is to push future new activity onto the defined pathway for new fishing, starting with EFPs and leading to eventual management.

DEFINING MANAGEMENT UNITS: "FISHERY" VERSUS SPECIES

Using "fishery" as the base unit of measurement when designing a pathway to bring unmanaged fishing activity inside a perimeter solves only one of the two types of emerging fishery problems. Specifically, it solves the kind of situation presented by the emerging spiny dogfish fishery in the 1980s and 1990s, discussed previously, in which unregulated fishing develops outside any management framework. Because the new fishing activity in this type of situation is distinct enough from any current fishing activity, it can be identified as a new "fishery" and is subject to the prohibition on unlisted fishing.

However, an emerging fisheries system that uses "fishery" as the unit of measurement in its perimeter list and prohibition does not solve the prospecting type of situation illustrated by the chub mackerel example. In that situation, unregulated fishing developed within an existing fishery as vessels started to target a new, unmanaged species. For purposes of "fishery" participation, the vessels in the chub mackerel example appeared to be part of the Mid-Atlantic mackerel, squid, and butterfish FMP-managed fishery—but they were landing a new species. To prevent this type of situation, where new fishing develops from within an existing fishery through prospecting behavior, it is necessary to incorporate species into the perimeter list and prohibition.

Using species as the unit of management in the perimeter list creates a much more robust prohibition on unregulated fishing, because only managed *species* can be retained. This can present issues, however, as some fisheries currently land and sell unmanaged bycatch species, which would not be permitted going forward. It also would require policymakers to provide some standards for determining which species are actually managed under each fishery—a complicated question, as a wide range of fisheries are prosecuted in federal waters, with different management bodies, different target and bycatch species (sometimes including large complexes of species), and widely varying forms of management. Finally, in some instances it would require an increase in the granularity of catch reporting and enforcement.

Congress provided an early version of a perimeter around allowable fishing in 1996, when it amended the Magnuson–Stevens Act. Specifically, in the amended Section 305(a) of the act, Congress required NMFS to gather and publish "a list of all fisheries . . . under the authority of each Council and all fishing gear used in such fisheries."[63] Congress then prohibited fishing activity outside the list "without giving 90 days advance written notice to the appropriate Council," and allowed Councils to request emergency regulations to stop any noticed new fishing.[64]

To date, however, use of the List of Fisheries provision in Section 305(a) of the Magnuson–Stevens Act has been hampered by limited implementation from NMFS and the Regional Fishery Management Councils. After the provision was added to the act, the councils developed lists of fisheries in their regions, and NMFS published a compiled national list in the form of a final rule in 1999.[65] Unfortunately, each council included (and NMFS approved) at least one residual category to cover any fishing activity and gear not otherwise listed for the region.[66] What this means is the final list of fisheries published by NMFS in 1999 was all-inclusive—or, phrased differently, the perimeter was drawn so broadly that nothing actually falls outside it. Because nothing was excluded from the list of fisheries, the statutory prohibition and 90-day notice requirement have never had an effect.

Despite its limited effectiveness, the current List of Fisheries requirement does create a useful starting point for action at all three levels of the federal system: as a platform for further amendments by Congress, as authority for more effective implementing action from NFMS, and as support for regulatory revisions by the Regional Fishery Management Councils. These approaches are discussed below.

Legislation: A straightforward approach for Congress to address emerging fisheries would be to build on the existing List of Fisheries provision in Section 305(a) of the Magnuson–Stevens Act. With a few changes, this provision could be turned into an effective perimeter, and an accompanying pathway could be defined for new fishing activity.

The first change to Section 305(a) would be to specify that residual, or catch-all, entries are not permitted on the List of Fisheries. The second change would be to require each entry on the list (i.e., each listed fishery) to state the management body or bodies responsible for the fishery, as well as the species allowed to be caught and landed within that fishery. Then the existing 90-day notice provision in Section 305(a)(3) would be eliminated, resulting in a default prohibition on fishing activity outside the List of Fisheries.[67]

Having established a perimeter, the next step would be to add a pathway for new fishing—specifically, provisions for experimental fishing to gather scientific and economic data, coupled with an eventual determination by the secretary of commerce as to whether the new fishing activity should be brought into regular management. Congress could require that the councils analyze certain topics, using information gathered during experimental fishing, in order to build a factual basis for the secretary's decision. Congress further could provide standards to be used in the secretary's eventual decision, or the agency could be tasked with developing and publishing such standards.

SPECIAL CONSIDERATIONS FOR SHIFTING STOCKS

Decisions on emerging fisheries have an extra layer of complexity when the proposed new target species is undergoing range shift. Researchers believe that fishing pressure can inhibit the ability of a fish stock's leading edge to colonize a new area and can hasten the disappearance of a fish stock at its trailing edge, which in turn can reduce a stock's ability to cope with climate change and stay within its preferred envelope of ocean conditions.[68] There may also be cases in which fishing-induced eradication of trailing edge populations causes a loss of genetic diversity within the population, which could prevent the species from adapting to climate change and foreclose future economic opportunities.[69]

Not all emerging fisheries will involve shifting stocks, but for those that do, special provisions could be warranted. One way to protect shifting stocks would be to set forth—either in an emerging fisheries framework or generally—a broad requirement that the stock's population resilience be maintained, with agency discretion to flesh out exactly what that would involve. Alternatively, Congress could provide specific restrictions, such as reduced fishing at range margins or designated waiting periods before fishing is allowed to commence on an incoming stock.[70]

Other helpful changes to the List of Fisheries section of the act include adding a requirement for regular review and updating of the list, as well as a requirement that all decisions on revisions or additions to the List of Fisheries be published in the Federal Register along with the agency's reasoning. Policymakers also could consider including fishery-independent research incentives for learning about new target species. Fishery-independent research can provide crucial information on proposed new target stocks and can significantly shape the management of new species.[71]

Agency Action: Even without congressional action, NMFS has room under current law to improve and strengthen the List of Fisheries system. At minimum, the agency can and should conduct a rulemaking in which it requires the councils to update and revise their entries on the List of Fisheries, to eliminate inactive entries and refine others as needed. Since the list was initially published in 1999, only the Pacific Council has updated its entries to ensure they are accurate and reflect current fishing activity, and many regions show outdated entries on the list.[72]

NMFS also should, in the same rulemaking, clarify that current law already prohibits councils from including residual, or catch-all entries on the List of Fisheries

(see text box "Residual Entries). Furthermore, NMFS should exercise its interpretive discretion to require councils to include a designation of the management body and managed species for each entry on the List of Fisheries. These changes would turn the list into a robust platform on which to build an emerging fisheries system.[73]

RESIDUAL ENTRIES ON THE LIST OF FISHERIES ARE INCONSISTENT WITH THE MAGNUSON–STEVENS ACT

The text of Section 305(a) of the Magnuson–Stevens Act requires councils to maintain "a list of fisheries," and the term *fishery* is defined in Section 3 of the act as stocks of fish or fishing activity "which can be treated as a unit for purposes of conservation and management."[74] The councils' residual entries on the List of Fisheries are usually phrased as "Commercial Fishery (non-FMP)" or "Recreational Fishery (non-FMP)," indicating fishing activity that falls outside a fishery management plan, accompanied by a recitation of essentially every gear type in existence.[75] These catch-all or residual entries are inconsistent with the plain text of the act because they do not describe fishing activity *that can be treated as a unit*. They are in fact the opposite—open-ended categories with no defined boundaries at all.

The structure of Section 305(a) further makes clear that residual entries are not appropriate on the List of Fisheries. Most crucially, the prohibition and 90-day notice provisions in Section 305(a)(3) become inoperative and superfluous when councils include residual entries on the list because the set of fishing activity outside the List of Fisheries becomes a null set. Other, similar problems are created in Section 305(a) if these all-encompassing residual entries are allowed.[76]

In terms of demarcating a pathway for new fishing activity, NMFS already has the authority to provide guidance on how EFPs will be used to permit experimental fishing for information-gathering purposes.[77] Guidance should include specific steps for issuing EFPs in emerging fishery situations, conditions and criteria for issuing such EFPs, and procedures for how the resulting information should be evaluated. Finally, NMFS should explain how the information gathered through EFPs should be used to establish a factual basis for a council's request to add a new entry to the List of Fisheries.

Council Action: An individual council need not wait for Congress, or even NMFS, to take steps toward addressing emerging fisheries in its region. An easy initial step would be for other councils to follow the Pacific Council's lead in proactively reviewing and revising their entries on the List of Fisheries to ensure accuracy. More important, all eight councils (and NMFS for Atlantic Highly Migratory Species) should remove their residual entries from the List of Fisheries.

Councils also can and should prepare supplemental information for their entries on the List of Fisheries—specifically, the corresponding management body or bodies and the species managed for each fishery. Gathering such information is a critical part of establishing a clear perimeter. Even if it has no immediate regulatory effect, councils can lay the groundwork for subsequent efforts when they compile this information.

In terms of establishing a pathway for new fishing, councils can set their own regional procedures for accepting and evaluating EFP proposals for experimental fishing of unmanaged species. The Pacific Council again provides an example: In the course of prohibiting harvest of certain unmanaged forage species, the council established specific procedures for EFPs involving such species; these procedures include evaluating certain scientific questions around sustainability and considering whether the proposed fishing activity is consistent with the regional fishery ecosystem plan.[78] Such an approach could be taken at a regional level for all unmanaged species—not just forage species—and would be an effective way of setting up a pathway for new fishing.

PROTECTING UNMANAGED FORAGE FISH: A POTENTIAL MODEL

A handful of councils have decided to prohibit fishing of certain designated forage species in order to protect their region's prey base and dependent predators. These prohibitions, such as the Mid-Atlantic Council's Unmanaged Forage Omnibus Amendment and the Pacific Council's Comprehensive Ecosystem-Based Amendment I, essentially are a template of the same perimeter-and-pathway structure proposed here. The difference is that rather than drawing a perimeter around current fishing activity and prohibiting fishing outside that perimeter, these more targeted actions to safeguard unmanaged forage species draw a perimeter around a set of species and prohibit fishing inside that perimeter.[79]

2. Address Cross-Boundary Stocks by Requiring Full Management Coverage and Jurisdictional Coordination

Cross-boundary stocks create problems when there are portions of a stock's range that are unmanaged, and when the rules are not clear as to who has management authority. Fortunately, policy solutions are achievable for both of these problems.

A. Full Management Coverage

Managing a species across its entire range is an established best practice as well as a stated requirement under National Standard 3 of the Magnuson–Stevens Act.[80] This means the scope of management coverage must match the geographic distribution of a species as much as possible. While some boundaries are unavoidable—particularly international borders—the point is to have no coverage gaps in a species' range where unregulated fishing can take place.

An Opah—or moonfish—is a rare find on the Oregon Coast. These fish typically occur in tropical and temperate waters. With climate change, it is becoming more common to see southern fish in northern waters.

Such full management coverage would have addressed the blueline tilefish situation described previously: If the species had been managed across its whole range, it would not have been possible for vessels to avoid South Atlantic harvest quotas by simply crossing into the Mid-Atlantic region.

Full management coverage also can have scientific benefits, as it encourages scientists to consider range-wide population dynamics and discourages artificially dividing out a portion of a species' range for stock assessments.[81]

There are several ways to promote full management coverage in the U.S. federal fisheries management system, from statutory solutions to regional actions that individual councils can take on their own.

THE EMERGING FISHERIES FRAMEWORK CAN HELP AVOID GAPS IN MANAGEMENT COVERAGE

Policymakers should note that if a robust emerging fisheries framework is in place, management coverage can be less of an issue. So long as the emerging fisheries system establishes an effective perimeter around currently managed fishing activity and prohibits unmanaged fishing outside that perimeter, gaps in management coverage for a species do not present opportunities for unregulated fishing—because any portion of a species' distribution that is not managed becomes subject to the emerging fisheries prohibition.

In this way, a well-designed emerging fisheries system can deal with situations like the one facing blueline tilefish, where a species straddles a boundary and is unregulated in the neighboring jurisdiction. Moreover, because of its default prohibition on unmanaged fishing, the emerging fisheries framework creates an incentive for managers to expand the scope of management and achieve full coverage.

Legislation: Congress could encourage managers to consider the scope of management coverage by requiring FMPs to describe the full range and distribution of managed stocks, including any divisions of the species into stocks, as well as describe patterns of fishing effort and harvest across the species' range. Managers should already be familiar with this kind of requirement, as similar language currently is in the advisory National Standard 3 Guidelines in the Code of Federal Regulations.[82] Note that this approach would not directly solve management coverage problems, though, and that the information in FMPs would need to be updated periodically in order to keep them useful as circumstances change.

Another way Congress could promote full management coverage would be to strengthen the requirements around stock designation. This could take the form of amending the definition of "stock of fish" in the Magnuson–Stevens Act, which currently allows stocks to be designated on the basis of essentially any reason.[83] The current National Standard 3 Guidelines in federal regulations already contain language favoring full management coverage.[84] This could serve as a guide in amending the definition of "stock of fish" in the act. An amended definition would give Congress a chance to promote full management coverage and would help to avoid situations in which a council draws a stock boundary based on management convenience and leaves a portion of a species' range unregulated.

Additionally, Congress could strengthen National Standard 3 in the act, which currently encourages councils to manage stocks across their entire range. That National Standard is directly on point, but it requires compliance only "to the extent practicable." Congress could strengthen National Standard 3 easily by replacing "practicable" with "possible." This would increase the rigor of National Standard 3 and promote full management coverage, while still being flexible in its application. Note, however, that for full effectiveness this change should be coupled with the previous one (a refinement of the statutory definition of "stock of fish").[85]

Agency Action: Under current law, NMFS can and should expand its guidance on designation of stocks and the need to provide full management coverage. This could take the form of an agency rulemaking to create more robust National Standard 3 Guidelines, or an addition to the "conservation and management" framework set forth in the general section of the National Standard Guidelines.[86]

NMFS also should initiate a comprehensive review of federally managed stocks, to identify management gaps and recommend corrective action. NMFS is best situated to conduct this analysis, as the agency has a nationwide perspective and can identify gaps in coverage and problems created by regional boundaries that may be less obvious to councils.

Council Action: Councils should scrutinize their own FMPs and determine whether any species should be added to management to avoid further unregulated fishing in situations like the one involving blueline tilefish. Specifically, if a species caught in one region is not managed in a neighboring region, the neighboring council should consider adding it to management—particularly if there are factors suggesting the fishery or the species' distribution could shift into that region. Councils further should consider species undergoing range shift and prepare to add those species to management if they are not managed at present.

B. Jurisdictional Coordination

When stocks straddle boundaries, clear procedures must exist for cooperation across regions. As the impacts of climate change worsen and fish distributions shift, this will become even more important—both because new stocks will start to straddle boundaries as they move and because existing ad-hoc arrangements for coordination, which may have worked in the past, can become unstable with fisheries in flux.

The lack of clear ground rules and the destabilizing effect of climate change can be seen in the previously discussed tensions between the New England and Mid-Atlantic Councils over control of summer flounder, scup, and black sea bass. In that case, climate change rendered existing arrangements around allocations and management authorities unstable, and because the Magnuson–Stevens Act lacks strong procedures to govern cross-regional cooperation, the request for management control from New England was poorly resolved.

To promote cooperation across regions, there must be clear ground rules to determine who has management authority over a stock of fish, and across what spatial area, including provisions for sharing management authority when needed. In the U.S. federal system, these ground rules can be established most effectively through statutory amendment, but action at the agency and council level also can help.

Legislation: Because FMPs form the basis of federal fisheries management, cross-regional cooperation can be structured by setting rules that designate which council has responsibility for drafting and maintaining the relevant FMP. Section 304(f) of the Magnuson–Stevens Act provides a starting point, as that section already gives NMFS the ability to delegate FMP authority for cross-boundary stocks. With a few key changes, Congress could turn Section 304(f) into a robust framework for jurisdictional coordination.[87]

The first change would be to make it mandatory, rather than optional, for NMFS to resolve jurisdictional disputes. When the agency declines to resolve a cross-boundary conflict, as it did with summer flounder, scup, and black sea bass, it frustrates all parties involved and the problem is likely to recur—potentially under worse circumstances—as climate change proceeds.

Another important element is to give councils the opportunity to cooperate before NMFS steps in and makes the decision. This can be structured as a period of time

(a year, for example) within which councils can negotiate and vote on a mutually agreed upon management authority outcome, such as one council being the lead manager for the stock, or both councils coequally managing it. If the councils fail to agree, then responsibility would fall to NMFS to make a decision.

Congress also should require NMFS to set specific criteria for deciding which council has management authority. By setting criteria for a notice-and-comment rulemaking procedure, the agency can provide clarity on how decisions will be made. This would promote transparency (sorely lacking, for example, in the summer flounder, scup, and black sea bass situation) and would help councils negotiate with each other.

The process for adjudicating disputes over management authority also should have a clear start and end. It should be structured so that councils can initiate the process by formal request but should also allow NMFS to initiate the process if, in its judgment, a stock needs jurisdictional coordination. Congress also could provide a waiting period between requests, so councils cannot simply reinitiate the process if they receive an outcome they do not like.

Last, a jurisdictional coordination framework should include provisions for uncoupling management between regions if conditions no longer require it. This could be initiated in the same ways—through council request or NMFS's own determination—and would allow management authority to be consolidated when, for example, a stock has shifted entirely out of a region and is no longer straddling a boundary.

Agency Action: Using existing authority in Section 304(f) of the Magnuson–Stevens Act, NMFS could build out a similar framework to the proposed statutory requirements for jurisdictional cooperation through rulemaking. The same design elements would apply, and from a legal standpoint the agency simply would be fleshing out and explaining how it intends to exercise the discretionary authority provided in Section 304(f), which states that NMFS "may" designate one lead council or require joint management when a stock crosses boundaries. This would be an important and uncontroversial rulemaking, as it would provide neutral ground rules that do not inherently favor one region or dictate any specific outcome. Should the agency undertake this project, it could find helpful examples of policy design in current legislative proposals.[88]

Council Action: Because cross-jurisdictional coordination inherently involves more than one council, the actions that a single council can take on the issue are limited. That said, councils can be proactive in identifying stocks that are undergoing range shift and likely to start straddling boundaries, or stocks that already straddle boundaries and are likely to shift their relative distributions across regions. Councils should flag these stocks for NMFS as likely needing attention and should begin conversations with their neighbors to see if agreement on management authority is possible.

3. Address Allocation Conflict by Removing Structural Biases and Strengthening Allocation Policy

Allocation decisions can be difficult and controversial as they affect fishing privileges for individuals, sectors, or entire regions. These decisions also may involve questions of permit switching, transfers across jurisdictions, or compensation. Because allocation decisions are so dependent on the facts of each particular situation, we do not recommend solutions for specific fisheries here. Rather, the discussion below focuses on concepts and structures that can enable successful allocation decisions.

As an initial matter, the Magnuson–Stevens Act provides relatively little guidance on allocations other than the broad fairness requirements in National Standard 4 (which includes, among other things, a statutory requirement for allocations to be "fair and equitable").[89] NMFS took a step to provide better guidance on allocations in 2017 when it established a Fisheries Allocation Review Policy. Under that policy, the councils are tasked with defining conditions that trigger an allocation review in each of their fisheries, and when triggering conditions are met, NMFS works with the council to conduct the allocation review.[90] Allocation reviews in turn lead to FMP amendments considering reallocations, which are analyzed according to factors specified in the new Fisheries Allocation Review Policy.

While the agency's recent policy is a helpful step, the impacts of climate change will require more guidance. As stocks shift northward and farther offshore, traditional allocations based on historical catch will become increasingly strained. New fisheries may require access to stocks, and in some cases allocation decisions will have to be made across regions as stocks begin to straddle boundaries.

A critical first step for climate-ready fishery allocations is to remove structural biases in allocation decisions. Structural biases are created when, for historical or other reasons, a group is overrepresented in the decision-making process to the point where adaptive allocation becomes very difficult or impossible. In these cases—as with summer flounder—the status quo allocation persists due to inertia.

One way to address structural biases is to ensure that the decision-making body has representation from the full geographic area across which the allocation decision is to be made. For stocks shifting range and newly arriving in neighboring jurisdictions, like summer flounder, it no longer suffices to have the historic jurisdiction alone making allocation decisions for that stock. Fortunately, a robust management coordination framework, discussed in the section above, can help to address the problem. By providing procedures for coupling and uncoupling management of neighboring jurisdictions as stocks move through, a management coordination framework can ensure that all the relevant managers are working together when allocation decisions need to be made across multiple jurisdictions.

A different way of avoiding structural bias in allocation decisions can be to delegate authority to a neutral and independent body. This could be NMFS itself, or it could be a third-party entity constituted specifically for the purpose of making allocation decisions. An example of the latter approach can be found in the military Base Realignment and Closure (BRAC) process, for which Congress created a third-party body to address similarly difficult decisions that heavily impact local livelihoods.[91]

Note that the choice of how to reduce structural bias—use of shared council decision making, direct decision making by NMFS, or enlistment of a neutral independent body—may depend on the degree to which Congress wishes to insulate the decision maker from political and stakeholder pressure. The regional councils are highly exposed to stakeholders (by design), and NMFS is subject to pressure from both stakeholders and elected officials. An independent body could be less vulnerable to these stresses. The BRAC panels, for example, are appointed directly by the president and charged with making decisions in the best interests of the nation as a whole. Similar allocation panels could gather evidence and hear testimony prior to making their decisions, but they would be relatively insulated from direct pressure from stakeholders or political pressure from regional elected officials.

In addition to addressing structural bias in allocation decisions, it is critical to establish a clear set of principles and procedures for making allocation decisions. The specifics will depend on what decision-making structure is used and will involve making policy judgments across a number of complex issues (for example, how much weight to give to fishing history). This task ultimately must be resolved by policymakers working with stakeholders, but at least a few broad observations can be made.

First, any allocation policy will need to provide ample opportunity for public input before substantive allocation decisions are made. Because such decisions are inherently difficult, it is critical to give all participants an opportunity to be heard during the decision-making process and have their viewpoints reflected in the proceedings.

Second, structuring the decision-making process can be helpful. Breaking the decision down into sub-decisions and setting forth specific steps, rules, and procedures can serve to focus all participants as well as potentially reduce conflict. Generally, the more explicit and robust the structure, the easier it is for participants to accept outcomes, as expectations are shaped more strongly in advance.[92]

Third, climate-specific elements should be incorporated to make allocations dynamic and responsive to range shift. This could include mandatory periodic reallocations for shifting stocks, or regular evaluation of data for evidence of catch in new fisheries. To the extent that climate change reconfigures the target and bycatch species in fisheries, an allocation policy needs to be able to adapt and update allocations to reflect evolving realities on the water.

Finally, there is an important class of supportive actions that can and should be taken regardless of whether a specific climate-ready allocation policy is created. Strengthened fishery monitoring and compliance, for example, can be extremely important in avoiding the worst forms of allocation conflict like outright regulatory noncompliance. A stronger mandate to reduce bycatch could help to avoid high mortality in a shifting stock from bycatch, which in turn could reduce pressure and conflict around allocations. Scientific information and tools can play an important role in supporting allocation decisions as well. Regular analysis of and reporting on stock distribution (including future projections) can provide foundational information for allocation decisions, and simulation-based management strategy evaluation can be used to flesh out future scenarios for decision makers.

Legislation: Because range shift–induced allocation conflict tends to involve cross-regional disputes, Congress may be best positioned to address the issue and has the greatest ability to create strong rules and procedures. Legislation also offers potentially the most durable approach.

If Congress were to establish a climate-ready allocation policy, it should place it in an overarching section of the Magnuson–Stevens Act, such as the sections dealing with responsibilities of the secretary of commerce (Sec. 304) or other requirements and authority (Sec. 305), or in a new, freestanding section.[93] If an allocation policy were established through FMP-level requirements (Sec. 303) or council-based procedures (Sec. 302), it could be less effective given the cross-regional nature of range shift–induced allocation issues.

Short of actually establishing a climate-adaptive allocation policy in legislation, members of Congress could request that the National Academy of Sciences conduct a study on the governance structure of fisheries management along the East Coast of the United States as it relates to shifting fish populations and the myriad management challenges. Congress also can play a supportive role by providing adequate funding to NMFS for climate-ready fisheries science. Allocation decisions require information, particularly on the location and likely trajectory of the fish and the catch rates in different fisheries. Adequate support for surveys and fishery observation is critical, and integrating present-day data with future climate and oceanographic projections will provide important perspective for allocation decisions and may help reduce speculation during negotiations. NMFS's recent Climate and Fisheries Initiative, an effort across the National Oceanic and Atmospheric Administration to expand ocean modeling and decision-support tools, is an important step in that direction.[94]

Agency Action: Absent legislative action, NMFS should update its 2017 Fisheries Allocation Review Policy to more explicitly deal with the impacts of climate change and range shift. The agency should identify specific approaches to allocations for shifting stocks, including examples and model procedures. By providing concrete recommendations for councils, rather than just high-level guidance, NMFS can make it easier for councils to actually move forward with actions.

NMFS also can continue to invest in climate-ready fisheries science to support adaptive allocations in key fisheries. Specifically, NMFS should expand and refine its system of fishery-independent trawl surveys and move forward with the Climate and Fisheries Initiative to increase the information and decision-support tools available to managers. Among these tools, NMFS should prioritize simulation-based management strategy evaluations for fisheries experiencing climate-induced range shifts off the Atlantic coast, including an examination of allocation scenarios.

Council Action: Councils should finish implementing the 2017 Fisheries Allocation Review Policy in all their fishery management plans, including establishing trigger conditions and procedures for allocation reviews. In doing so, councils should specifically consider range shift and likely impacts on their managed fisheries and should consider whether co-management with a neighboring council could be productive.

CONCLUSION

As our ocean continues to transform rapidly, shifting marine fish populations will present a key challenge for fishery managers, policymakers, and fishing communities. In addition to keeping in place the Magnuson–Stevens Act's strong foundation for science-based, precautionary management of our fisheries, there is an urgent need to update our fisheries policy to keep pace with climate-induced shifts. To better prepare our fisheries and prevent management breakdowns, policymakers and managers should prioritize creating processes for coordination across jurisdictions, requiring new fisheries to be well managed from their inception and defining tools and mechanisms for revising allocations. These updates can be achieved through a variety of policy pathways, each of which warrants examination to ensure managers are supported with the tools they need to safeguard the sustainability of our fisheries and the fishing communities that rely on them.

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31 "Temporary Rule to Establish Separate Annual Catch Limits and Accountability Measures for Blueline Tilefish in the South Atlantic Region," 79 Fed. Reg. 21,636, April 17, 2014. "Extension of Temporary Rule That Established Separate Annual Catch Limits and Accountability Measures for Blueline Tilefish in the South Atlantic Region," 79 Fed. Reg. 61,262, October 10, 2014.

32 South Atlantic Fishery Management Council, "Decision Document: Management Considerations for Blueline Tilefish," February 23, 2015, 2, 12, https://static1.squarespace.com/static/511cdc7fe4b00307a2628ac6/t/54ed62a0e4b04db4c54bdb02/1424843424970/A9c_BluelineDD_revised022315_1.pdf (noting possible range shift). NOAA Fisheries, "Proactive Approach to Climate Change," December 2016, 2 https://www.st.nmfs.noaa.gov/Assets/ecosystems/climate/documents/ClimateFactsheet_Final.pdf (similar). SEDAR 50, TOR No. 7 Ad Hoc Work Group Report, 2017, 1, http://sedarweb.org/docs/wpapers/S50_DW24_ToR7AdHocWG_1.26.2017update.pdf

33 South Atlantic Fishery Management Council, "Decision Document," at 5 (showing tenfold increase in Mid-Atlantic landings from 2013 to 2014). SEDAR 50, "Stock Assessment Report: Atlantic Blueline Tilefish," October 11, 2017, AR144, https://sedarweb.org/docs/sar/S50_AtlBLT_SAR_10.11.2017_FINALcorrected.pdf.

34 "Fisheries of the Northeastern United States; Blueline Tilefish Fishery; Secretarial Emergency Action," 80 Fed. Reg. 31,864, June 4, 2015. Mid-Atlantic Fishery Management Council, "Amendment 6 to the Tilefish Fishery Management Plan, 2017, https://www.mafmc.org/s/Blueline-Tilefish-Amendment_Final-EA_09-12-2017.pdf. Note that the species remains managed separately by the South Atlantic and Mid-Atlantic Regions, despite no clear genetic evidence for separate stocks. SEDAR 50 Stock ID Work Group, *Recommendations from the SEDAR 50 (Blueline Tilefish) Stock ID Work Group Meeting*, SEDAR 50 Data Workshop Paper 12, August 15, 2016, http://sedarweb.org/docs/wpapers/S50_DW12_S50StockIDWG_Recs_8.15.2016.pdf.

35 Mid-Atlantic Fishery Management Council, "Summer Flounder, Scup, Black Sea Bass," https://www.mafmc.org/sf-s-bsb (accessed June 15, 2020). Note that federal management in this case is conducted in tandem with state-level management via the Atlantic States Marine Fisheries Commission, due to the prevalence of these species in state waters. Note also that scup and black sea bass are managed separately by the South Atlantic Council for presumed separate stocks of those species south of Cape Hatteras.

36 For summer flounder, regulations are coastwide, and for scup and black sea bass, coverage is north of Cape Hatteras. 50 C.F.R. § 648.14(n) (setting forth prohibitions related to summer flounder fishing, with no geographic restrictions). For scup and black sea bass, regulations are promulgated for the area north of Cape Hatteras. 50 C.F.R. § 648.14(o)– (p). 50 C.F.R. § 600.725(v) (listing a summer flounder/scup/black sea bass fishery for both the New England and the South Atlantic Regions, with regulation via the Mid-Atlantic FMP).

37 Mid-Atlantic Fishery Management Council, "Fishery Management Plan for the Summer Flounder Fishery," October 1987, https://www.mafmc.org/s/SFSCBSB___FMP.pdf. Mid-Atlantic Fishery Management Council, "Amendment 8 to the Summer Flounder Fishery Management Plan: Fishery Management Plan and Final Environmental Impact Statement for the Scup Fishery, January 1996), https://www.mafmc.org/s/SFSCBSB_Amend_8.pdf (adding scup). Mid-Atlantic Fishery Management Council, "Amendment 9 to the Summer Flounder Fishery Management Plan: Fishery Management Plan and Final Environmental Impact Statement for the Black Sea Bass Fishery," June 1996, https://www.mafmc.org/s/SFSCBSB_Amend_9.pdf (adding black sea bass).

38 Nye et al., "Changing Spatial Distribution," at 119. Northeast Fisheries Science Center, "66th Northeast Regional Stock Assessment Workshop Assessment Report," April 2019, 67–68, https://repository.library.noaa.gov/view/noaa/22733 (discussing northeastward shift in center of abundance). Charles T. Perretti and James T. Thorson, "Spatio-temporal Dynamics of Summer Flounder (*Paralichthys dentatus*) on the Northeast U.S. Shelf," Fisheries. Research 215 (July 2019): 62–68, https://www.sciencedirect.com/science/article/abs/pii/S0165783619300712.

39 Letter from Thomas A. Nies, executive director, New England Fishery Management Council, to John Bullard, regional administrator, NMFS/NOAA Fisheries, July 5, 2016 (requesting joint management; citing climate change as primary reason). Letter from David E. Pierce, director, Massachusetts Division of Marine Fisheries, to E. F. "Terry" Stockwell, chairman, New England Fishery Management Council, June 10, 2016 (urging New England Council to request joint management, detailing climate change rationale). http://s3.amazonaws.com/nefmc.org/5_160610_MA-DMF-to-NEFMC-re-Joint-Management-SF-Sc-BSB.pdf

40 The agency did respond to members of Congress from New England who cosigned a letter to NMFS echoing the New England Council's request for management control over the summer flounder, scup, and black sea bass fishery. In that response letter, NMFS essentially restated the status quo arrangement and provided no indication that it intended to change management authority for the fishery. Letter from Penny Pritzker, secretary, U.S. Department of Commerce, to Sen. Richard Blumenthal, June 27, 2016.

41 Letter from Christopher M. Moore, executive director, Mid-Atlantic Fishery Management Council, to Tom Nies, executive director, New England Fishery Management Council, August 19, 2016 (stating that the Mid-Atlantic Council "rejected the idea" of joint management but made certain other concessions).

42 16 U.S.C. § 1654(f).

43 A similar example of jurisdictional conflict over cross-boundary stocks occurred in a different request by the New England Council for management authority over the mackerel, squid, and butterfish fishery. 61 Fed. Reg. 64,046, December 3, 1996 (acknowledging receipt of the request from New England Council and requesting public comment on same). As with the summer flounder, scup, and black sea bass instance discussed above, there is no clear resolution of this request evident in the record.

44 Wendy E. Morrison and Tara L. Scott, *Review of Laws, Guidance, Technical Memorandums and Case Studies Related to Fisheries Allocation*, NOAA Technical Memorandum NMFS-F/SPO-148, November 2014, https://media.fisheries.noaa.gov/dam-migration/morrisonscott_nmfs_f_spo_148.pdf. Mark L. Plummer, Wendy Morrison, and Erin Steiner, *Allocation of Fishery Harvests Under the Magnuson–Stevens Fishery Conservation and Management Act: Principles and Practice*, NOAA Technical Memorandum NMFS-NWFSC-115, January 2012, https://repository.library.noaa.gov/view/noaa/4117. George Lapointe, "Marine Fishery Allocation Issues: Findings, Discussion, and Options," December 2012, https://media.fisheries.noaa.gov/dam-migration/lapointe-allocation-report.pdf.

45 Katherine E. Mills et al., "Fisheries Management in a Changing Climate: Lessons From the 2012 Ocean Heat Wave in the Northwest Atlantic," *Oceanography* 26, no. 2 (June 2013) 191, 194, https://tos.org/oceanography/issue/volume-26-issue-02. Malin L. Pinsky and Michael Fogarty, "Lagged Social-Ecological Responses to Climate and Range Shifts in Fisheries," *Climatic Change* 115, no. 3–4 (December 2012): 883, 888–89, https://www.researchgate.net/publication/257548039_Lagged_social-ecological_responses_to_climate_and_range_shifts_in_fisheries. Tanaka et al., "An Ensemble High-Resolution Projection," at 988 (noting that range shift "affects where fish can be caught and who has access to them").

46 Eva A. Papaioannou et al., "Not All Those Who Wander Are Lost: Responses of Fishers' Communities to Shifts in the Distribution and Abundance of Fish, *Front. Marine Sci.* 8 (July 5, 2021): art. 669094, https://www.frontiersin.org/articles/10.3389/fmars.2021.669094/full. Lauren A. Rogers et al., "Shifting Habitats Expose Fishing Communities to Risk Under Climate Change," *Nature Climate Change* 9 (July 2019): 512, 515, https://www.nature.com/articles/s41558-019-0503-z. Kristin M. Kleisner et al., "Marine Species Distribution Shifts on the U.S. Northeast Continental Shelf Under Continued Ocean Warming," *Progress in Oceanography* 153 (April 2017): 24, 34, https://www.sciencedirect.com/science/article/abs/pii/S0079661116301896.

47 Pinsky and Fogarty, "Lagged Social-Ecological Responses," at 890 (noting the perverse incentives that are created when stocks shift across a boundary line).

48 If a stock undergoing range shift is unmanaged in the new part of its range (and no emerging fisheries framework exists), fishermen in the new range may be able to start catching the stock immediately and with no regulation. As fishermen from the historical range pursue the stock into its new range, both groups will be competing for the same fish but under different rules, and no effective total catch limit will exist. This can lead not only to allocation conflict, but also to overfishing.

49 Nye et al., "Changing Spatial Distribution," at 119 (documenting range shift). Mid-Atlantic Fishery Management Council, "Amendment 4 to the Fishery Management Plan for the Summer Flounder Fishery," April 1993, https://www.mafmc.org/s/SFSCBSB_Amend_4.pdf (giving 60 percent of available harvest to the commercial sector and 40 percent to the recreational sector, and setting state-specific allocations within the commercial portion based on state landings during the 1980s). Mid-Atlantic Fishery Management Council, "Amendment 21 to the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan," May 2020, https://www.mafmc.org/s/SF-Commercial-Issues-Amendment-FEIS_FINAL.pdf (maintaining the existing allocation formula except in situations where total available commercial catch exceeds a fairly high threshold, in which case the excess is distributed in a slightly different manner).

50 Fluke Fairness Act of 2021, S. 1747, 117th Cong. (2021). Fluke Fairness Act of 2019, S. 908, 116th Cong. (2019). Transparent Summer Flounder Quotas Act, H.R. 1411, 116th Cong. (2017). Fluke Fairness Act of 2018, S. 3331, 115th Cong (2018).

51 Letter from Sen. Richard Blumenthal et al. to David Smith, acting inspector general, U.S. Department of Commerce, June 13, 2016, https://www.blumenthal.senate.gov/imo/media/doc/2016_06_13%20RB%20et%20al%20Ltr%20to%20Dept.%20of%20Commerce%20IG.pdf.

52 *New York v. Ross*, No 2:19-cv-259 (E.D.N.Y. filed January 14, 2019). Leslie Kaufman, "Climate Change Is Reshaping Atlantic Fisheries and Sending This Fluke Fight to Court," Bloomberg Green, February 18, 2020, https://www.bloomberg.com/news/features/2020-02-18/climate-change-is-reshaping-atlantic-fisheries-and-sending-this-fluke-fight-to-court. Note that the reasons for New York's dissatisfaction with summer flounder allocations are complex, as the state historically underreported its landings and in turn received less when allocations were made on the basis of landings history. This strand of discontent is now interwoven with climate-related arguments around range shift.

53 A flagrant example came to light in late 2015 when a Long Island commercial fisherman was convicted by NMFS's Office of Law Enforcement for criminal violations of the Research Set-Aside program, during which he filed 158 false fishing logs covering 290,000 pounds of summer flounder. NOAA Fisheries, " RSA Scammer Sentenced for 290,000 Pounds of Illegal Summer Flounder," October 9, 2015, https://www.fisheries.noaa.gov/feature-story/rsa-scammer-sentenced-290000-pounds-illegal-summer-flounder.

54 Erica Goode, "*Fish Seek Cooler Waters, Leaving Some Fishermen's Nets Empty,*" *New York Times*, December 30, 2016, https://www.nytimes.com/2016/12/30/science/fish-climate-change-northeast.html

55 Pinsky and Mantua, "Emerging Adaptation Approaches," at 148, 155. Papaioannou et al., "Not All Those Who Wander."

56 Ibid. Bradford A. Dubik et al., "Governing Fisheries in the Face of Change: Social Responses to Long-Term Geographic Shifts in a U.S. Fishery," *Marine Policy* 99 (January 2019): 243, 247–48, https://www.sciencedirect.com/science/article/pii/S0308597X18305463.

57 Moffatt & Nichol, *A Study of the Benefits of Oregon Inlet to the Economy of Dare County and the Surrounding Region*, July 2006, 33, available at https://www.darenc.com/home/showpublisheddocument?id=210 (noting as an example that Wanchese Fish Company trucks "go to Boston, Baltimore, Philadelphia, and New York markets," and that at times as many as 10 to 15 trucks per week go to New York).

58 Bell et al., "Disentangling the Effects." Dubik et al., "Governing Fisheries."

59 Dubik et al., "Governing Fisheries." Morley et al., "Projecting Shifts in Thermal Habitat." Malin L. Pinsky et al., "Preparing Ocean Governance."

60 e.g., California Fish & Game Code § 7090(e), https://codes.findlaw.com/ca/fish-and-game-code/fgc-sect-7090.html (accessed 8/3/21)(providing a three-year evaluation period for emerging fisheries, in which limited fishing and research are conducted to gather essential fishery information). Pinsky and Mantua, "Emerging Adaptation Approaches," at 150–51 (recommending a "temporary moratorium on new fisheries," along with "carefully monitored experimental fishing" and government research). E. Pikitch et al., *Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs*, Lenfest Forage Fish Task Force, April 2012, 89–90, https://www.oceanconservationscience.org/pdf/LEN_Little_Fish_Big_Impact.pdf (recommending, for low-information stocks, that no new fisheries be permitted until adequate information is gathered). "Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks," Art. 6(6), 2167 UNTS 88 (1995) (providing a general obligation of precautionary management measures for exploratory fisheries until sufficient data exists to understand the impacts of the fishery). "Declaration Concerning the Prevention of Unregulated High Seas Fishing in the Central Arctic Ocean," 2015 (providing interim measures to prevent unregulated fishing in the Arctic Ocean while allowing research fishing). "Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean," 2018 (prohibiting directed fisheries in the Arctic for 16 years, to allow time for information gathering), https://www.mofa.go.jp/files/000449233.pdf. "Convention on the Conservation of Antarctic Marine Living Resources," Art. II (providing a precautionary framework for development of new fisheries in the Southern Ocean, in which full-scale fishing is prohibited but experimental fishing is permitted for purposes of gathering information), https://www.ccamlr.org/en/organisation/camlr-convention-text#II. "Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean," Art. 22, 2009 (creating a red-light system for new fisheries that allows fishing only after "cautious preliminary conservation and management measures" are put in place), http://www.sprfmo.int/assets/Basic-Documents/Convention-and-Final-Act/2353205-v2-SPRFMOConvention-textascorrectedApril2010aftersignatureinFebruary2010forcertificationApril2010.pdf.

61 Pinsky and Mantua, "Emerging Adaptation Approaches," at 150–51. Diana L. Stram and Diana C. K. Evans, "Fishery Management Responses to Climate Change in the North Pacific," *ICES Journal of Marine Science* 66, no. 7 (August 2009): 1633, 1635, https://academic.oup.com/icesjms/article/66/7/1633/658823 (noting initial closure coupled with experimental fishing to evaluate sustainability).

62 50 C.F.R. § 600.745 (setting forth procedures for EFPs).

63 16 U.S.C. § 1855(a)(1).

64 Ibid., § 1855(a)(3), (5).

65 "List of Fisheries and Gear, and Notification Guidelines," 64 Fed. Reg. 67,511, December 2, 1999), codified at 50 C.F.R. § 600.725(v).

66 50 C.F.R. § 600.725(v) (listing, for the New England Region, a generic "Commercial Fishery (non-FMP)," composed of "trawl, pot, trap, gillnet, pound net, dredge, seine, handline, longline, hook and line, rod and reel, hand harvest, purse seine, spear, bandit gear, powerhead, dip net, bully net, snare, cast net, barrier net, slurp gun, allowable chemicals," and similarly providing open-ended commercial fishery entries for the other regions, as well as open-ended recreational entries for all regions).

67 A helpful further change to solidify the prohibition on fishing outside the list of authorized fisheries would be to add a corresponding paragraph to Section 307 of the Magnuson–Stevens Act, which enumerates prohibited actions, as well as Section 308, which provides for civil penalties and sanctions. 16 U.S.C. §§ 1857-58.

68 Pinsky and Mantua, "Emerging Adaptation Approaches," at 151 ("Emerging fisheries can reduce net population growth rates at the leading edge of species' ranges, which is precisely where changes to growth rates have the most impact on a species' ability to colonize new territory").

69 Arndt Hampe and Rémy J. Petit, "Conserving Biodiversity Under Climate Change: The Rear Edge Matters," *Ecology Letters* 8, no. 5 (May 2005): 461–67, https://onlinelibrary.wiley.com/doi/10.1111/j.1461-0248.2005.00739.x. Daniel E. Schindler et al., "Population Diversity and the Portfolio Effect in an Exploited Species," *Nature* 465 (June 2010): 609–12, https://www.nature.com/articles/nature09060. Jason P. Sexton et al., "Evolution and Ecology of Species Range Limits," *Annual Review of Ecology, Evolution, and Systematics* 40 (December 2009): 415–36, https://www.annualreviews.org/doi/10.1146/annurev.ecolsys.110308.120317. Eric Sanford and Morgan W. Kelly, "Local Adaptation in Marine Invertebrates," *Annual Review of Marine Science* 3 (January 2011): 509–35, https://www.annualreviews.org/doi/abs/10.1146/annurev-marine-120709-142756. Evan M. Rehm et al., "Losing Your Edge: Climate Change and the Conservation Value of Range-Edge Populations," *Ecology and Evolution* 5, no. 19 (October 2015): 4315–26, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4667833/.

70 Pinsky and Mantua, "Emerging Adaptation Approaches," at 151 ("Delaying the emergence of new fisheries will enable larger, more productive fisheries in the future").

71 Ibid., at 151 (recommending that managers "prioritize research on newly emerging stocks, even though these 'minor' fisheries may seem less important in the short term").

72 50 C.F.R. § 600.725(v) (listing outdated fishery management plans for the Western Pacific Region, among others). The only region to have done a comprehensive update of its entries on the List of Fisheries is the Pacific Region, which did so in 2013–14. 79 Fed. Reg. 76,914 (Dec. 23, 2014).

73 While the 90-day notice provision is written into the statute and can be changed only by Congress, NMFS can strengthen this notice provision into a meaningful perimeter by expressing its intention to issue emergency regulations prohibiting unmanaged fishing activity outside the List of Fisheries and explaining its legal and policy basis for doing so.

74 16 U.S.C. §§ 1802(13), 1855(a).

75 50 C.F.R. § 600.725(v).

76 16 U.S.C. § 1855(a)(2) (requiring the secretary of commerce to draw up guidelines for determining when a new fishery is sufficiently different from a listed fishery as to require 90-day notice, which becomes a logical nullity when residual entries are permitted). 16 U.S.C. § 1855(a)(5) (allowing emergency regulations to prohibit unlisted fishing, which has no use when residual entries are included on the list).

77 The Magnuson–Stevens Act has relatively little direct treatment of EFPs, as these permits historically developed as a matter of regional practice under the various fishery management plans. In 2006, though, Congress did add Section 318(d), which endorses the use of EFPs and instructs NMFS to issue regulations standardizing their use. NMFS promulgated new regulations on EFPs in 2009. Those regulations are located at 50 C.F.R. § 600.745.

78 79 Fed. Reg. 46,214, 46,215, August 7, 2014 (proposed rule noting that the Pacific Council "outlined a process in the [Fishery Ecosystem Plan] Appendix for persons wishing to develop new fisheries to follow so that the Council would receive timely needed scientific information on those potential fisheries," and that the process involves the use of EFPs). 79 Fed. Reg. 76,914, December 23, 2014 (final rule). Pacific Fishery Management Council, "Council Operating Procedure 24: Protocol for Consideration of Exempted Fishing Permits for Shared Ecosystem Component Species," September 11, 2015, https://www.pcouncil.org/documents/2019/09/cop-24.pdf.

79 82 Fed. Reg. 40,721, 40,722, August 28, 2017 (final rule for Mid-Atlantic unmanaged forage action, noting that "the objective of this action is to prevent the development of new, and the expansion of existing, commercial fisheries on certain forage species until the Council has adequate opportunity and information to evaluate the potential impacts of forage fish harvest on existing fisheries, fishing communities, and the marine ecosystem"). 81 Fed. Reg. 19,054, 19,055, April 4, 2016 (similar for Pacific region).

80 16 U.S.C. § 1851(a)(3). 50 C.F.R. § 600.320(b) ("The geographic scope of the fishery, for planning purposes, should cover the entire range of the stocks(s) of fish, and not be overly constrained by political boundaries").

81 Jason S. Link et al., "Guidelines for Incorporating Fish Distribution Shifts Into a Stock Assessment Context," *Fish and Fisheries* 12, no. 4 (December 2011): 461, 466, https://www.researchgate.net/publication/263154777_Guidelines_for_incorporating_fish_distribution_shifts_into_a_fisheries_management_context (noting the importance of regularly reviewing stock structure and reevaluating the unit area for managed stocks).

82 50 C.F.R. § 600.320(e)(1).

83 16 U.S.C. § 1802(42) (defining "stock of fish" as "a species, subspecies, geographical grouping, or other category of fish capable of management as a unit").

84 50 C.F.R. § 600.320(e)(2) (discussing how councils should designate "management units" under FMPs, which is an inquiry similar to [or in some cases the same as] defining a stock).

85 Without a statutory definition of "stock of fish" that favors broad stock designation, changes to National Standard 3 will be less effective because National Standard 3 applies on its own terms to "an individual stock of fish." If stocks can still be designated narrowly, then a stronger National Standard 3 may only result in unified management for what are already narrowly defined stocks of fish.

86 50 C.F.R. § 600.320 (National Standard 3 Guidelines). 50 CFR. § 600.305(c) (conservation and management framework).

87 This is the approach taken by a recent legislative proposal. *Sustaining America's Fisheries for the Future Act of 2021*, H.R. 4690, sec. 105, 117th Congress, July 26, 2021, https://huffman.house.gov/imo/media/doc/Sustaining%20America's%20Fisheries%20for%20the%20Future%20Act_Bill%20Text_7.26.2021.pdf.

88 Ibid.

89 16 U.S.C. § 1851(a)(4) ("Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges").

90 National Marine Fisheries Service Policy No. 01-119, February 23, 2017, https://media.fisheries.noaa.gov/dam-migration/01-119.pdf (overall process memo). National Marine Fisheries Service Procedural Directive No. 01-119-01, July 27, 2016, https://www.pcouncil.org/documents/2019/06/agenda-item-d-4-attachment-1-procedural-directive-01-119-01-criteria-for-initiating-fisheries-allocation-reviews-council-coordinating-committee-allocation-workgroup-guidance-document.pdf/ (Council Coordination Committee document setting forth the categories of public input triggers, time triggers, and indicator-based triggers). National Marine Fisheries Service Procedural Directive No. 01-119-02, July 27, 2016, https://media.fisheries.noaa.gov/dam-migration/01-119-02.pdf (agency practices and factors to consider when reviewing and making allocation decisions).

91 Defense Authorization Amendments and Base Closure and Realignment Act, Pub. L. No. 100-526, 102 Stat. 2623 (1988). Defense Base Realignment and Closure Act of 1990, Pub. L. No. 101-510, 104 Stat. 1485, §§ 2901-11. In this system, the Base Realignment and Closure Commission is periodically convened, and members of the commission are appointed directly by the president. The commission is an independent panel that reviews potential base closures, analyzes the relevant evidence, receives testimony, and produces recommendations for base closures and realignments. Those recommendations go directly to the president for approval, subject to a congressional veto. Note the critical points in the process (panel producing recommendations, president approving recommendations, and full Congress having the option to veto) are all resolved by individuals or entities representing the entire nation; no specific region or subset of representatives is able to control the process.

92 Tim S. Gray, ed., *Participation in Fisheries Governance* (New York: Springer-Verlag, 2005) (reviewing decision-making structures in fisheries management and processes for stakeholder involvement). Brian J. Irwin et al., "Applying Structured Decision Making to Recreational Fisheries Management," *Fisheries* 36, no. 3 (March 2011): 113–22, https://www.researchgate.net/publication/232832009_Applying_Structured_Decision_Making_to_Recreational_Fisheries_Management (describing a highly detailed process for making decisions in the fisheries context). Knut H. Mikalsen and Svein Jentoft, "Limits to Participation? On the History, Structure and Reform of Norwegian Fisheries Management," *Marine Policy* 27, no. 5 (September 2005): 397–407, https://www.researchgate.net/publication/222179631_Limits_to_participation_On_the_history_structure_and_reform_of_Norwegian_fisheries_management (discussing a wide range of considerations with respect to fisheries decision-making processes in a European context).

93 To the extent a climate-ready allocation policy is integrated into a cross-jurisdictional coordination system, the most likely location would be in a built-out Sec. 304(f) of the Magnuson–Stevens Act.

94 NOAA Fisheries, "NOAA Climate and Fisheries Initiative Fact Sheet," https://www.fisheries.noaa.gov/resource/document/noaa-climate-and-fisheries-initiative-fact-sheet (accessed July 23, 2021).