



# Who Gets the Catch? How Conventional Catch Attribution Frameworks Undermine Equity in Transboundary Fisheries

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The focus on flag States for the purpose of attributing fisheries catch is inconsistent with the assignment of sovereign rights to coastal States under international law and undermines equity in contemporary quota allocation negotiations. We propose modernizing reporting frameworks to include zone-based reporting of fish catches to more equitably present data, ensure consistency with the Law of the Sea, and better support the realization by developing coastal States of their development aspirations consistent with SDG 14, Life Below Water. States are already required to collect the data necessary to support this change, and many regional fisheries management authorities already do so. Reforms to data collection and reporting mechanisms should support zone-based catch attribution as a central feature of negotiations around access to future fishing opportunities on shared resources. Doing so will ensure that the sovereign rights of developing coastal States are properly accounted for and implemented.

**Keywords:** fisheries data, fisheries negotiations, quota allocation, shared resource, shared resource allocation, zone-based reporting, zone based allocation

## INTRODUCTION

Global fish catches have traditionally been attributed to States based upon the flag (nationality) of the fishing vessel taking the catch rather than the location of fishing activity. This practice predates the adoption of the 1982 United Nation Convention on the Law of the Sea (LOSC) and its recognition of coastal States' sovereign rights over their Exclusive Economic Zones (EEZs). Decisions from the 1950s, prioritizing consistency and ease of statistical reporting, have continued into the 21st century, with little reflection of the changes wrought by the adoption of the LOSC. This approach has ensured that flag State attribution of catch continues to be the default position, underpinning important and useful datasets including the benchmark United Nations Food and Agriculture Organization (FAO) biennial State of World Fisheries and Aquaculture (SOFIA) report. However, there are other characteristics of fish catches upon which data is frequently collected and

reported, including the maritime jurisdiction where the fish were caught, which could also form a basis for national catch attribution. The question of how catches are attributed is not an idle one. How fisheries data is reported, and how catches are thereby attributed, can have significant practical impacts on how that data can be used. Catch reporting and attribution also shape the framing of important discussions around conservation and management of fish stocks. These impacts are relevant to contemporary negotiations that are taking place in a number of subregional and regional fisheries management fora around the allocation of fishing opportunities, where historical fishing catches are a key consideration in the determination of future fishing rights.

Recognizing the sovereign rights of coastal States is especially important as the vast majority of fish catches come from areas within national jurisdiction. Schiller et al. (2018) estimate that between 2009 and 2014, nearly 96% of global marine catch by volume came from fishing in EEZs. Of the estimated 84.4 million tonnes of marine fish caught in 2018, the top seven producers accounted for nearly 50% of the catch, with China alone accounting for 15% and Indonesia (8%), Peru (8%), the Russian Federation (6%), United States of America (6%), India (4%), and Vietnam (4%) rounding out the list (FAO, 2020). The catches of these major producers can be sourced not only from their own EEZs and from international waters, but also from the EEZs of other States. However, it is difficult to determine the proportion of one State's catch which is linked to the sovereign rights of another State. Many of the developing coastal States of the Indian and Pacific Oceans, including numerous small island developing States (SIDS), license distant water fishing nations (DWFN) to fish in their EEZs. Conventional reporting and attribution frameworks are not particularly helpful in understanding the extent and value of catches in their national waters and the contribution of these catches to global fish production. For example, the SOFIA report table listing the Regional Contribution to World Fisheries and Aquaculture Production shows the contribution of "Oceania" as being dwarfed by each of the other regions and the Indian Ocean region is not separately identified (FAO, 2020). While careful reading of the SOFIA report may render it possible to determine that the tuna fisheries of the Pacific are the largest and most valuable in the world (PEW Charitable Trusts, 2020), it seems nearly impossible to disentangle the contribution of the various SIDS' national waters. The generation and publication of data on not just which States are catching fish, but where they are catching them, would provide a more balanced view of fishing activity and would acknowledge the contribution of developing coastal States, and in particular SIDS, to world fish supply.

This paper seeks to change the discourse around national attribution of fish catches by demonstrating the need to expand current flag-based reporting of global fisheries statistics to include zonal attribution of catches. The reasons for this are twofold. First, we argue that concentrating on flag States for the national attribution of catches, without giving equal prominence to the geographical origin of those catches, undermines the sovereign rights of coastal States over fisheries resources within their EEZs. Second, we demonstrate that a flag-based attribution framework

is inconsistent with internationally agreed obligations under the 1982 LOSC and the United Nations Sustainable Development Goals (SDGs). We do not argue that geographic reporting should replace reporting by flag State, as both have merit, but that both are necessary to accurately implement the LOSC and SDGs. Catch attribution is an important and timely issue for developing coastal States in both the Indian and Pacific oceans, where ongoing negotiations regarding access to future fishing opportunities are heavily influenced by historical reporting. We show how attributing catch data can impact on important negotiations regarding future fishing rights and thereby diminish the benefit that coastal States may derive from their fisheries. To correct historical inequities, we highlight the need to collect geographic data and to establish a reporting and attribution framework that supports the development aspirations of SIDS and other coastal States.

Here we outline relevant internationally agreed obligations and principles to demonstrate how these either require, or are advanced by, a catch reporting system with coastal State attribution. The LOSC, SDGs and declarations on the development rights and aspirations of SIDS are all important in this regard. We then examine the history and structure of current fisheries data reporting according to FAO guidelines, to demonstrate that there is a compelling argument to modernize the attribution framework. We briefly introduce the equity context of catch attribution, and survey current data collection and reporting practices by regional fisheries bodies to determine what data is currently collected and consider how zonal attribution might be advanced within the current reporting framework. Finally, we highlight some of the practical implications for flag-based and zone-based attribution of catches, before recommending next steps. Throughout the paper we use the term "catch" to reflect the harvesting of fish, and note that catch data should also include appropriate fishing effort data so as to enable management and science.

## INTERNATIONAL LAW AND POLICY FRAMEWORK

### Law of the Sea and International Fisheries Law

Important international law obligations require the collection of data to support the management by coastal States of fisheries under sovereign rights, and the equitable distribution of the burden of conserving highly migratory species and straddling stocks. The 1982 United Nations Convention on the Law of the Sea (LOSC) provides the legal framework for all marine activities, including fishing, and allocates rights and responsibilities between coastal States and others. Following its adoption in 1982, approximately 36% of the world's ocean surface, more than a third of its seabed, and 90% of its fisheries resources were assigned to the national jurisdiction of coastal States (Friedheim, 1999; Alcock, 2011; Seto and Campbell, 2019). This includes the internal waters, territorial sea and archipelagic waters over which coastal States have sovereignty (LOSC Articles

2, 49), and the 200 nm EEZ over which the coastal States have sovereign rights with respect to fish stocks (LOSC Article 56; Hey, 1999).

The benefits of an EEZ are not conferred without cost; the coastal State holds significant obligations to ensure that fish stocks in its EEZ are managed sustainably, including obligations to collect and share data (LOSC, Article 61). Nationals of other States who fish in the coastal State's EEZ must comply with the coastal State's conservation measures, including those regulating catch limits and data collection (LOSC Article 62). Through these various provisions, the LOSC indicates a clear intention both that coastal States control and benefit from the fisheries within their EEZ, and that data necessary to sustainably manage those fisheries be collected and shared. Reporting fisheries data in a manner that allows coastal States to identify the scope and value of their endowment, i.e., by ensuring that catches from within an area under sovereign rights are identified as such, is critical for sound conservation and management decisions and for supporting the development aspirations of coastal States.

Complexities arise where the relevant fish stocks do not confine themselves to the EEZ of a single coastal State. In this case, States with an interest in those stocks either as coastal States (where the stocks straddle two or more EEZs) or as coastal or fishing States (for stocks which move between EEZ and high seas) are obliged to cooperate in the development of appropriate conservation and management measures (LOSC Articles 63 and 64). The 1995 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 (the UN Fish Stocks Agreement, or "UNFSA") (United Nations, 1995) gives substance to the duty to cooperate under the LOSC, including the timely collection and sharing of "complete and accurate data concerning fishing activities on, *inter alia*, vessel position, catch of target and non-target species and fishing effort . . ." [UNFSA Article 5(j)].

The UNFSA anticipates that regional or subregional fisheries management organizations (collectively, "RFMOs") will be the primary mechanism through which fishing and coastal States cooperate (UNFSA Article 8), and gives detailed guidance on requirements for data collection and sharing in relation to straddling and highly migratory fish stocks [UNFSA Article 3(1) and Annex 1]. The UNFSA obligations to collect data fall largely upon the flag State, which is reasonable given that most of the basic information will come from the vessels themselves. This does not, however, require that catch data only be attributed according to the nationality of the fishing vessel. To only present the data in this way obscures the value of fisheries resources granted to coastal States under the LOSC.

The UNFSA also requires that developing States be given special assistance to ensure their effective participation in the conservation, management and sustainable use of these straddling and highly migratory fish stocks (UNFSA, Article 24). In particular, when developing conservation and management measures in furtherance of their duty to cooperate, States are required to "ensure that such measures do not result in transferring, directly or indirectly, a disproportionate burden

of conservation action onto developing States" [UNFSA Article 24(2)(c)]. This obligation is central to the equitable implementation by RFMOs of measures to allocate future fishing rights, and the way in which historical catch data are presented will have an important influence upon allocation negotiations within these organizations.

## The Sustainable Development Goal Framework and the Small Island Developing States Accelerated Modalities of Action Pathway

A reporting framework that facilitates the attribution of catches by geographic origin is also important for advancing key aspects of the United Nations Sustainable Development Goals (SDGs). The SDGs explicitly recognize the importance of maritime zones, particularly the EEZ, to the development aspirations of SIDS. Target 14.7 of SDG 14, Life Below Water, seeks to "increase the economic benefits to SIDS and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism" (United Nations, 2020). While SDG 14 is the focus of targets relating to marine capture fisheries, the 17 goals are strongly interconnected and many seek to advance the development aspirations of SIDS. These goals sit alongside the internationally agreed program of action for the sustainable development of SIDS—the SIDS Accelerated Modalities of Action [SAMOA] Pathway (UNGA, 2014)—which recognizes that sustainable fisheries and aquaculture are "among the main building blocks of a sustainable ocean-based economy in small island developing States" (SAMOA Pathway, 53). Enhancing the capacity of SIDS to maximize benefits from the sustainable use of their fisheries resources, and also ensuring that SIDS do not bear a disproportionate share of the burden of sustainably conserving and managing ocean resources, are key components of this program of action [SAMOA Pathway, 58(l)]. In so doing, the SAMOA Pathway emphasizes the shared nature of responsibilities under RFMOs and urges the international community to cooperate to enable SIDS to sustainably manage and benefit from those arrangements [SAMOA Pathway, 58(l)].

The collection and attribution of catch data by geographic origin is important for all of these internationally agreed-upon obligations and goals. Knowing the origin of the catch provides essential information to support the sustainable management of national and shared fish stocks. A standardized, globally accepted system of reporting catch based upon the zone of origin would provide a reliable and comparable representation of the value and extent of coastal State sovereign rights, and support decision-making for maximizing the benefits of those resources to developing coastal States. Moreover, a zone-based reporting and attribution framework would benefit the development aspirations of developing coastal States as it would start to identify and address historical inequities. The paper will briefly address this fundamental question of equity, before examining the history and rationale of the current global fisheries catch reporting framework.

## THE EQUITY CONTEXT OF FLAG STATE ATTRIBUTION

Fair and equitable allocation of resources is one of the most important aspects of natural resource governance (Ostrom, 1990). Despite an early emphasis on biological sustainability, environmental governance regimes have increasingly acknowledged that resource allocation may provide a pathway toward resource equity, redistributing some of the resource wealth accumulated through colonization and globalization (Pitt et al., 2012; Gupta and Lebel, 2020; Seto et al., 2020). Modern colonialism has its basis in the extraction of “tribute, goods, and wealth,” creating a flow of human and natural resources to colonial powers (Loomba, 2015.) As such, colonialism is largely attributed with creating our current world of differential development (e.g., colonizer/colonized, developing/developed, etc.). Current natural resource (UNEP, 1989; Bruhacs, 1993; Soltau, 2009) and sustainable development (United Nations, 1992) regimes have explicitly or implicitly sought to counteract those differences by recognizing the unique positions and prioritizing the needs and interests of developing or highly resource-dependent States (van der Brugt, 2012; Hanich, 2016).

Despite the general consensus that natural resource regimes should promote equity principles, the growing awareness of development aspirations of SIDS, and the legal framework provided by the LOSC, colonial attitudes still shape fisheries policies that result in an inequitable *status quo* (Richmond, 2011). This is acutely illustrated in the context of international negotiations over quota allocation. In international fisheries management, the allocation of catch quota has largely been based on historical catch, as defined by flag State attribution and unrelated to the catch location (Gupta and Lebel, 2010; Pitt et al., 2012; Abolhassani, 2018; Andriamahefazafy et al., 2020; Seto et al., 2020).

The practice of attributing fish production to the States that have historically fished the resource—rather than the States from which the resource came—acts to grant historical claim of the resource to States with historically developed fishing capacity, and undermines the development aspirations of developing States (Sinan and Bailey, 2020). Historical fishing States are most often those with relatively greater development status, and often former colonial powers. The fact that allocation of current and future rights to access the fishery is then, in turn, dependent on this historical attribution of fish production, acts to reinforce the interests of those that have historically benefited most (FAO, 2002). This is fundamentally opposed to principles of equity, which by definition emphasize the rights of marginalized actors and seek to counteract the concentration of benefits to the historical “winners.”

## CURRENT FISHERIES DATA REPORTING STRUCTURE AND HISTORY

The FAO is formally tasked with the collection and analysis of information relating to nutrition, food and agriculture, including fisheries (FAO, 2017). Critically, it is the key source of global

fisheries data and statistics. The FAO has worked extensively over many years to strengthen and support fisheries data collection and analysis at both the national and international level. In particular, the FAO has worked through the Coordinating Working Party on Fisheries Statistics (CWP), established in 1960, on standardizing key concepts and methods of collecting and collating fisheries statistics. One of the key standards adopted by the CWP and FAO has been to assign nationality to catch data based upon the “flag of the vessel performing the essential part of the operation catching the fish” (CWP, 2021).

This assumption dates back to a 1954 decision of the United Nations Statistical Commission based upon a request by some members for fish landings to be included in trade and production statistics. Noting that national practice varied, the Statistical Commission recommended that, “wherever the magnitude of landings is of importance and wherever it is possible to do so, countries should include in their import statistics fish landed on their shores directly from foreign fishing vessels and include in their export statistics fish landed abroad by domestic fishing vessels.” (UN Doc E/CN.3/L.33, par 13) Importantly, the Commission report then notes, “It was the opinion of the Commission that the attribution of provenance by flag of fishing vessel would usually produce useful figures” (see also Edeson, 1999, 2012). The CWP adopted this practice and flag-based attribution continues to be a central feature of the FAO’s fisheries reporting, including in its “flagship” SOFIA reports. In addressing criticisms of the approach, the CWP notes in its Handbook of Fishery Statistics that, having been used since 1954, “any change in this concept would have serious adverse effects on the continuity of catch data” (CWP, 2021).

Fisheries data and statistics play a central role in modern fisheries management; however, data needs depend upon the policy context and the types of decisions that need to be supported. Decision-making about how to sustainably manage a particular stock, the food security requirements of a national population, the socio-economic conditions of fishers, or the contribution of the fishing sector to a national economy all rely upon basic data about the amount of fish caught, how it was caught, who catches them, and where they go after landing. However, the manner in which that data is processed and presented is critical to its role in decision-making and its ability to serve important policy goals. In this context, it is important to consider just how well a reporting convention that was originally thought to “usually produce useful figures” for historical trade and production statistics serves current challenges in sustainable fisheries management. In particular, we argue that spatialized catch data is critical for equitable decision-making in current negotiations concerning the allocation of shared resources.

The FAO’s SOFIA report makes some effort to report catches geographically based upon designated “Major Fishing Areas for Statistical Purposes,” however, these areas do not reflect national maritime boundaries and are insufficient for modern post-LOSC needs. The FAO designates 19 major marine fishing areas, the boundaries of which are acknowledged to be “arbitrary,” although they were originally determined taking into account a number of factors including geography, and noting that “the areas should, as far as possible, coincide with the areas of

competence of other fishery commissions when existing” (CWP, 2021). The boundaries have been refined over time; for example in 2001 the boundary between areas 57 (Indian Ocean, Eastern) and 71 (Pacific, Western Central) was shifted to match the areas of competence of the Indian Ocean Tuna Commission (IOTC) and Western and Central Pacific Fisheries Commission (WCPFC). Many of the major fishing areas are further divided into statistical sub-areas, divisions, and sub-divisions to allow for greater geographical precision and more detailed analysis. However, if the statistical divisions do not consistently reflect zonal boundaries, they are unable to be used to distinguish catches made in an EEZ from those made on the high seas.

Some progress has been made in this regard. In 2007, in FAO Major Fishing Area 47 (Atlantic, Southeast), the FAO and the South East Atlantic Fisheries Organization (SEAFO) endorsed a proposal to rearrange the statistical divisions within the Area to allow for catches taken within the EEZs of SEAFO member States to be distinguished from catches taken elsewhere (SEAFO, 2007). Some of the statistical divisions for Major Fishing Area 87 (Pacific, Southeast) are also defined in terms of territorial waters [for example, Division 87.1.3 – Galapagos, and Division 87.2.5 Pascua (Rapa Nui)]; however, the boundaries are not consistently defined across the area and the vast majority of FAO reporting areas do not reflect national maritime jurisdiction.

## WHAT DATA IS CURRENTLY COLLECTED? IS IT FEASIBLE TO CONSIDER ZONAL REPORTING?

This section examines current RFMO practice and considers the potential for zone-based catch attribution to be more widely implemented. RFMOs and regional marine organizations (RMOs) manage international fisheries and collect catch data to provide scientific advice on stock status and total allowable catch (TAC). Although some RFMOs only have jurisdiction over the high seas, many have a mandate for stocks that also straddle or migrate to and from EEZs. An analysis of the reporting requirements of RFMOs and RMOs showed that many of these organizations are already collecting spatialized catch data from both the high seas and EEZs (Figure 1).

For the purposes of spatially attributing catch, the resolution at which catch data is reported is critical. Catch data aggregated at the level of  $5 \times 5$  degree may be suitable for scientific purposes, but it is unlikely to be sufficiently fine scale to permit attribution at the margins of maritime zones. Catches reported against maritime spaces that do not correspond to maritime jurisdictions (EEZs and high seas areas) are also of little use for spatial attribution. Catch data transmitted from a vessel to its flag State (that is, operational data) may be of sufficiently high resolution to enable the attribution of that catch to either an EEZ or a high seas area. However, the flag State, as a member of an RFMO or RMO, may only be required to provide aggregated data to that organization. To permit spatial attribution, the RFMO/RMO will require either high resolution, disaggregated data or data aggregated by maritime jurisdiction provided by the member State.

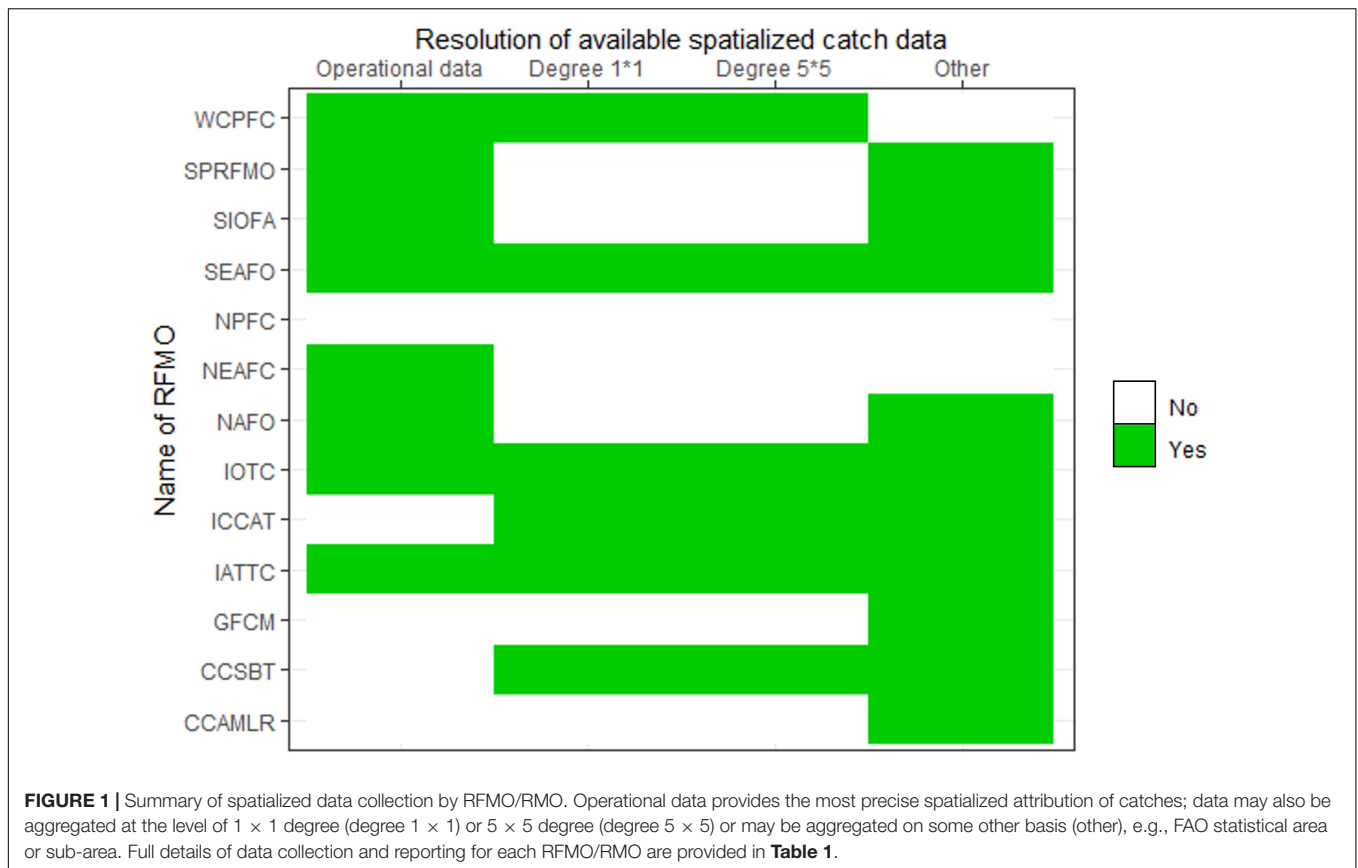
The case of the WCPFC demonstrates that RFMOs can in fact require members to provide data suitable for spatial attribution. WCPFC members have agreed to do so. This process typically requires that vessels authorized to fly the member’s flag, or vessels authorized to fish in its waters, must supply operational level data to that member, who then forward the data to the WCPFC Secretariat. When data is provided by vessels for catches in an EEZ, this dual reporting channel allows both sets of data to be compared to each other and to Vessel Monitoring System (VMS) data for verification purposes. That the WCPFC has been able to establish a requirement for reporting of operational data suggests that there is no fundamental barrier to other RFMOs doing so. Furthermore, those members that have committed to providing operational data in one RFMO, should reasonably support initiatives to do so in other RFMOs of which they are also members, in their capacity as both a coastal State and a flag State, as appropriate. RFMOs that require only aggregated data to be provided by their members should at the very least require aggregation by maritime jurisdiction (the particular EEZ or high seas area) rather than by “subareas” or FAO areas that bear no relation to maritime jurisdictions.

## WHAT IMPACT WOULD ZONAL REPORTING HAVE? HOW DOES THE PICTURE CHANGE?

The switch to zonal based attribution presents a very different picture of the value of fisheries resources and to which States they are credited. This is particularly true for fishing activity in regions traditionally dominated by distant water fishing. As shown in Figure 2, there are large discrepancies in the proportions of catch caught at home versus abroad among nations reporting to WCPFC. For example, the ratio of total reported catch compared to catch in their own national waters is large for Japan ( $8\times$ ), the United States ( $22\times$ ), Taiwan (Chinese Taipei;  $29\times$ ), and particularly South Korea ( $>9,000\times$ ) and China ( $>210,000\times$ ). Conversely, fleets flagged to Nauru, Palau, Tonga, Cook Islands, Tuvalu, and Tokelau reported much smaller ratios of reported catch ( $0\text{--}1/5\times$ ) compared to the total caught in their own waters.

While presenting fisheries catches based upon the production of flag States rather than place of capture may seem like a minor issue, this attribution approach contributes to a discourse focused on colonial perspectives and negatively influences equity concerns. This influence is apparent in current negotiations in both Pacific and Indian Ocean RFMOs around allocation of future fishing rights. The WCPFC has been considering allocation issues since the early years of its establishment (see for example, MRAG, 2006 and Seto et al., 2020), with debate on attribution acting as a central feature. As in the WCPFC, similar and quite contentious debates continue today in the IOTC’s Technical Committee on Allocation Criteria (TCAC) (IOTC, 2021).

Generally, allocation practices (i.e., the actual material allocation of national opportunities to participate in a fishery) are most strongly shaped by the existing data and information. As noted above, while there are various ways to allocate

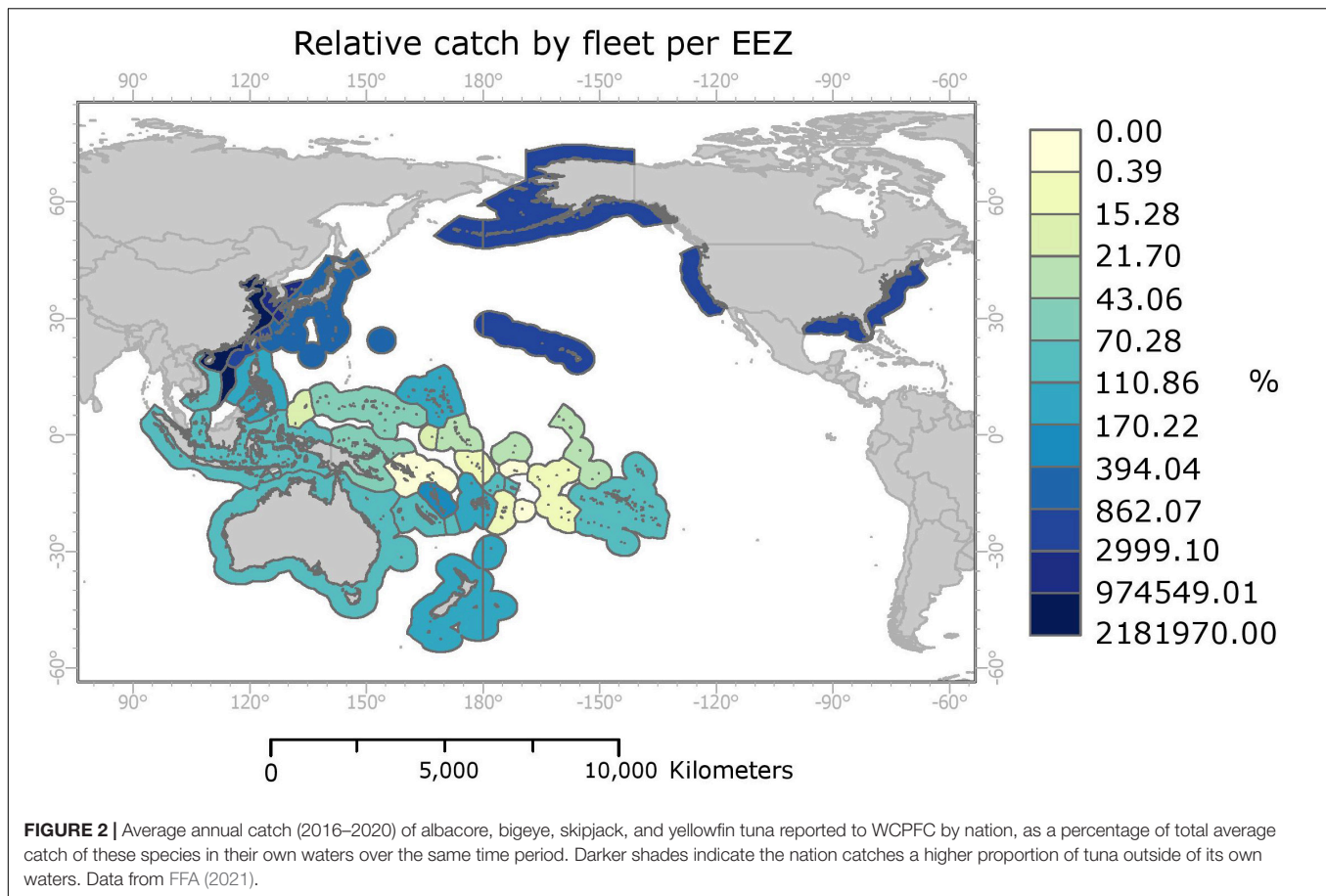


future fishing opportunities amongst member States, basing that allocation on catch history is one of the most common mechanisms (Lynham, 2014). Discussions around allocations and historical catch are closely linked to catch attribution, as flag States point to large historical catches attributed to them without duly acknowledging the source of that catch in the EEZs of coastal States. Attributing catch in this way is inequitable as it prioritizes the rights of those who have previously benefited most from the resource. For example, in the IOTC, the dominant DWFN (European Union) argues that only 10% of the historical catches taken within an EEZ should be allocated to the coastal State and 90% of those catches should be allocated to the flag State of the fishing vessel (Sinan and Bailey, 2020). Such a proposal favors developed countries and countries with greater historical production, ignores the sovereign rights of coastal States, and entrenches and increases the existing inequity among the member States.

In the Pacific, the tuna fisheries are one of the main sources of economic revenue for coastal States (Gillett, 2016). Most of the catch in the Western and Central Pacific has been caught in the EEZs of SIDS by distant water fishing fleets (Azmi and Hanich, 2021). In the context of allocation, if these catches were attributed to flag States (i.e., mainly distant water States), rather than coastal States, the sovereign rights of those SIDS would be seriously undermined. The interests of the Pacific SIDS in WCPFC tuna are complex, however, and the particular equity impact upon each

State will depend upon the balance of their interests as coastal and flag State. The WCPFC recognizes contracting parties, participating (non-sovereign) territories and cooperating non-members collectively as CCMs. **Figure 3** illustrates one aspect of the diversity of interests in the WCPFC – the balance of each CCM's interests in fishing by its national fleet in its own waters compared to fishing by its national fleet in distant waters and to fishing by foreign vessels in its waters (Azmi and Hanich, 2021). The balance between each of these three interests reveals the possible impacts of attributing catches to flag States for the purposes of determining allocations.

Some States (for example, France in relation to the three overseas French territories, as well as Indonesia, Philippines, Vietnam, and Australia) rely solely on domestic fleets taking catches in their EEZs. For these States, attribution would not matter in the present circumstances as they would receive the allocation regardless of how catch history was attributed. However, these coastal States may in the future wish to allow foreign vessels into their EEZ to generate further revenue from the sale of access rights. They may also wish to develop a distant water fleet. Several SIDS and territories rely heavily on access to their EEZs by foreign fleets. Pre-emptively allocating catches to flag States removes the opportunity for coastal States, many of which are SIDS, to sell access to the highest bidder, potentially forgoing substantial returns. It also removes the option for the coastal State to develop its own fleet to fish its own EEZ in the



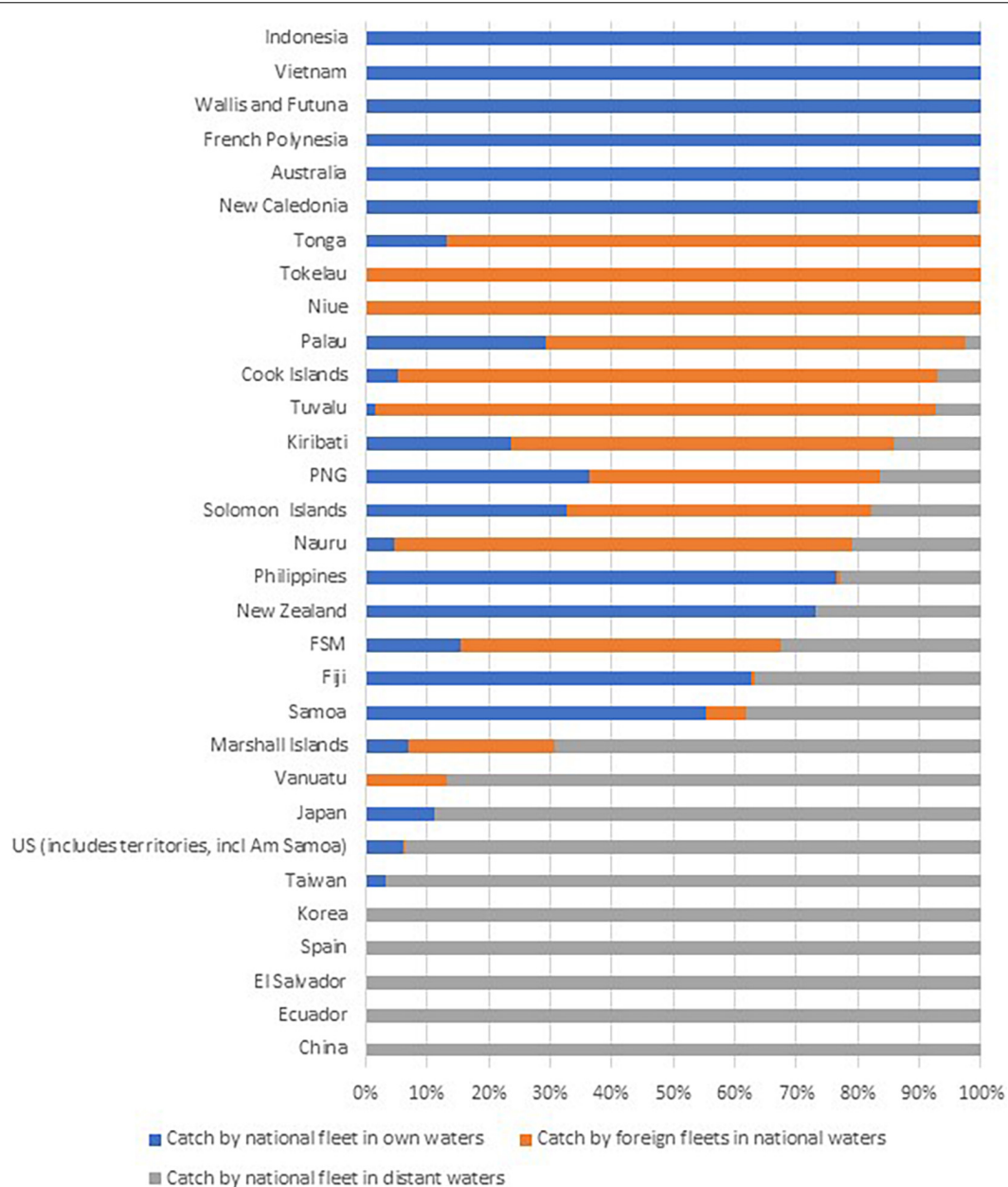
future. Some States have purely distant water fishing interests in the Western and Central Pacific Ocean, yet would receive allocations based on their status as a flag State without having any waters in the region (e.g., Spain). Others, such as Kiribati, Papua New Guinea, and Solomon Islands, have a mix of all three interests.

The attribution of catches to States by flag or by maritime zone will affect each State differently depending on its interests. Attribution to flag States would undermine the coastal State interests of the Pacific SIDS by ignoring their sovereign rights to determine who may fish in their EEZs and by removing the opportunity to develop their domestic fleets. Attribution by zone – to EEZs and to the high seas – is more likely to provide SIDS with the opportunity to maximize the benefits obtained from the fisheries resources within their EEZs, while leaving open the opportunity to develop their domestic and distant water fleets. While it may be appropriate to attribute catches to flag States for the high seas, establishing allocations on this basis would perpetuate the disadvantage that SIDS have faced in developing distant water fleets. This suggests that a more equitable approach would be first, to allocate a portion of a TAC or total allowable effort (TAE) to the high seas, and then to design a process to allocate that limit that allows the possibility of States without a catch history to acquire an allocation in the future.

## NEXT STEPS

The LOSC and UNFSA together recognize the sovereign rights of coastal States over the fisheries resources within their EEZ, and require the collection of data to allow fish catches to be attributed to the EEZ of origin. Despite this legal framework, and the significance of EEZ fisheries to sustainable development, catch attribution practices continue to prioritize “catch by flag State” rather than “catch by geographic origin.” This approach fails to recognize the fundamental sovereign rights of coastal States over fisheries in waters under their jurisdiction. By removing this important perspective from discussions around fisheries management, in particular when those discussions concern catch allocations across developing coastal States and developed fishing States, this reporting bias undermines equity and perpetuates colonial legacies.

As the current catch attribution framework is inconsistent with the LOSC and SDGs, we propose that responsible institutions, such as RFMOs and the FAO, modernize their reporting mechanisms to better recognize the sovereign rights of coastal States. Spatialized reporting of catch data, allowing for zonal attribution of catches, acknowledges the sovereign rights of coastal States consistent with international law, and would make an important contribution toward achieving SDG 14. The experiences of allocation negotiations in the IOTC and WCPFC,



**FIGURE 3 |** Balance of interests in fishing by the national fleet in their own waters (orange), fishing in national waters by foreign vessels (gray), and distant water fishing (blue) in the Western and Central Pacific Ocean: catch volumes for albacore, bigeye, skipjack, yellowfin, all gear types for the three years from 2018 to 2020. CCMs are listed in order of relative reliance on catches in their national waters by both domestic fleets and foreign fleets. Data from FFA (2021). This chart updates Chart 4 in Azmi and Hanich (2021).

however, suggest that reforms to data collection and reporting mechanisms are only a first step. Zonal based catch attribution must be a central feature of negotiations around access to future fishing opportunities on shared resources if the sovereign rights of coastal States are to be properly accounted for.

Some RFMOs already have mechanisms in place for zonal based catch reporting. For example, the WCPFC collects data on fishing activity to monitor compliance with effort limits for the tropical purse seine fishery that have been set for each

EEZ in the WCPFC convention area and for the high seas. While access to some other WCPFC fisheries, such as longline catches of bigeye tuna, continues to be allocated and reported on the basis of the flag State, geographical catch data is still collected (Seto et al., 2020). These examples may provide useful starting points for consideration of how zonal reporting could be implemented more broadly.

Parties who are in favor of the flag-based reporting approach could argue that there is insufficient data to provide the



**TABLE 1** | Catch data collection for each of the RFMOs and the FAO.\*

Acronym	Organization	Jurisdiction	Data collection methods	Information on catch for associated/adjacent EEZs or EEZs within jurisdiction is available	What information is provided	Catch reports publicly available
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources	High seas	By flag State	Yes	Vessel information (vessel IMO number; vessel flag; vessel name; vessel call sign; email address of person responsible for submitting the data) Vessel category Reporting details (reporting period; start date; start period code; type of fishing; target species; subarea or division; SSRU/research block/other management area) Fishing effort (number of days fished; type of fishing gear; number of sets deployed; longlines and pots only: number of hooks/pots set/retrieved and lost; intention for the next reporting period) Catch-report all target species and bycatch caught IMAF species interactions Vulnerable marine ecosystems [total volume that fit in a 10-L container; total weight (kg) that do not fit into a 10-L container; VME-indicator units]	Yes
GFCM	General Fisheries Commission for the Mediterranean	High seas and EEZ <sup>1</sup>	By flag State	NA	Flag State, species, annual catch, subarea/division	Yes
NAFO	Northwest Atlantic Fisheries Organization	High seas and EEZ	By flag State	No	Flag Fishing effort (number of days fished; number of days on ground) Nominal catches (live weight equivalent of the landings, in metric tonnes) Fishing gear/method Vessel type and size Species; intended target of multispecies fishery <sup>2</sup> FAO major fishing area NAFO division or subdivision Vessel details: Entry and exit – quantities on board by species/stocks upon entry to and exit the regulatory area, by vessel Daily catch reports – catch, retained, and rejected, by species/stocks, by vessels Electronic logbooks – gear specifications, catch by species/stock, including VME species, on haul-by-haul basis (i.e., operational data)	Yes
NEAFC	Northeast Atlantic Fisheries Commission	High seas and EEZ	By contracting party	Yes	Catch report by fishing vessels (catch on entry, catch report, catch on exit, transshipment report, port of landing report. See here: <a href="https://www.neafc.org/scheme/Annex8:\penalty-\@M">https://www.neafc.org/scheme/Annex8:\penalty-\@M</a> Vessel identity [radio call sign, vessel name, contracting party internal reference number, vessel external registration number (the side number of the vessel or IMO number in the absence of a side number)]; Catch on entry: information on the quantities on board when entering the regulatory area Catch report: daily catches (except EU – weekly catches), cumulative catch by species retained on board, either since commencement of fishing in the regulatory area or last catch report, in pairs as needed (fishing location, time, and catch) (i.e., operational data) Daily information (date, fishing area, and daily catch) Information on transshipments Information on exit from the regulatory area Monthly catch reporting: provisional monthly statistics of catches from stocks in accordance with recommendation 2:2011, as amended. The reporting elements are: contracting party; year/month; stock; fishing grounds either international waters or EEZs; monthly catch (quantity in metric tonnes of catch landed or transshipped in the relevant month. No decimals, rounded up) and; cumulative catch (quantity in metric tonnes of cumulative catch up to and including the relevant month. No decimals, rounded up)	No

(Continued)

TABLE 1 | (Continued)

Acronym	Organization	Jurisdiction	Data collection methods	Information on catch for associated/adjacent EEZs or EEZs within jurisdiction is available	What information is provided	Catch reports publicly available
NPFC	North Pacific Fisheries Commission	High seas	By flag State	Yes	Total catch and effort Member States submit catches for the HS as well as their EEZ to secretariat. Only Pacific saury requires 1 × 1 resolution for stock assessment purpose	Yes
SEAFO	Southeast Atlantic Fisheries Commission	High seas	By flag State	No	Information on vessel (vessel IMO number; vessel flag; vessel name; vessel call sign) Haul identification (target species, type of fishing, subarea; 1 × 1 degree; 5 × 5 degree) Gear specific information Set and haul details (i.e., operational data) Catch information Information on incidental catch Quantity of VME-indicator organisms	No
SIOFA	Southern Indian Ocean Fisheries Agreement	High seas	By flag State	No	Information on vessel (vessel IMO number; vessel flag; vessel name; vessel call sign) Haul information [target species, gear details, type of fishing, set and haul details, catch, etc. (i.e., operational data)] Information on incidental catch and benthos organisms for all details refer to SIOFA CMM 2021/02	No <sup>3</sup>
SPRFMO	South Pacific Regional Fisheries Management Organization	High seas	By member	Yes	Vessel information (vessel IMO number; vessel flag; vessel name; vessel call sign; vessel type, characteristics and authorization details) Annual catches by flag, FAO area, HS versus EEZ, method, species Monthly catch estimates for major fisheries (including area and number of vessels) Fishing activity data (22 fields, event by event including catch, effort, time, location, species, discards, incidental captures) (i.e., operational data) Observed, landed and transshipped catches (highly detailed) VME encounters (vessel id, gear, event datetime and location, taxa encountered by weight)	Yes
CCSBT	Commission for the Conservation of Southern Bluefin Tuna	High seas and EEZ	By flag State	Yes	For southern bluefin tuna: total annual catch by fleet (via both Member reporting and CDS data); final yearly catch by vessel; vessel IMO number; vessel flag; vessel name; vessel call sign Aggregated catch and effort data (country, year, month, gear, 1 × 1 degree <sup>4</sup> , 5 × 5 degree, CCSBT statistical areas) plus standardized CPUE indices from specific operation level catch and effort data; non-retained catch; raised total catch at size data (same stratification as for catch/effort data) CDS data (vessel/farm, catch, transshipment, export, import, re-export, domestic landing, individual measurements of all whole fish); other trade information; fishery independent annual direct juvenile abundance estimates (via a gene tagging monitoring program); fishery independent direct reproductive output estimates (via a Close-Kin Mark-Recapture monitoring program), direct aging (otolith) data. For ecologically related species: observer data on number of interactions including the fate (retained, discarded, released, other) by species/species group, country, year, quarter, gear, 1 × 1 degree, 5 × 5 degree, effort, CCSBT statistical areas) with the type of seabird mitigation used	Partly
IATTC	Inter-American Tropical Tuna Commission	High seas and EEZ	By flag State	No	Annual total catch and effort estimate by flag, gear, set-type. Reported catch and effort of primary species by flag, year, month and grouped position. For fishing trips without an observer, the IATTC collects vessel logbook data. So operational level data is collected for purse seine gear. Industrial longliners operating in the EPO are required to submit operational level observer data for 5% of the trips. EPO longline catch and effort data is also required, aggregated by country, year, month and 5 × 5 degree. Some countries submit the data at 1 × 1 degree resolution.	Yes

(Continued)

TABLE 1 | (Continued)

Acronym	Organization	Jurisdiction	Data collection methods	Information on catch for associated/adjacent EEZs or EEZs within jurisdiction is available	What information is provided	Catch reports publicly available
ICCAT	International Commission for the Conservation of Atlantic Tuna	High seas and EEZ	By flag State	Yes	Nominal catch data (landings and dead discards) by species, year, flag, gear, stock/management unit, sampling area, fishing zone (EEZ and/or High seas) in live weight equivalent (biomass). Collection of data by ICCAT statistical areas and 1 × 1 degree for purse seiners and 5 × 5 degree for long liners.	Yes
IOTC	Indian Ocean Tuna Commission	High seas and EEZ	By flag State	Yes	Total catch data (estimates of the total annual catch by species, flag, gear and IO major area) for IOTC and bycatch species; Data on interactions with cetaceans, seabirds, and marine turtles; Monthly georeferenced catch and effort data by flag, gear, species and grid (for surface fisheries; longline fisheries; coastal fisheries); Monthly size data by flag, gear, species and grid; Regional observer scheme data (at trip level); Information on transshipments (ROP) and exports (bigeye tuna StatDoc); Information on catches onboard (PSM); Operational data: exact coordinates of setting/hauling operations. These are aggregated to 1 × 1 or 5 × 5 degrees grids when publicly disseminated Individual EEZs: implicitly derived from nominal catch data reported by artisanal fisheries from coastal States; also reported in the catch-and-effort data for some artisanal fisheries 1 × 1 degree: catch-and-effort data for surface fisheries 5 × 5 degree: catch-and-effort data for longline fishery; size-frequency data for all fisheries FAO sub-areas: nominal catch data (F51 – Western IO and F57 – Eastern IO) for all fisheries	Yes
WCPCF	Western and Central Pacific Fisheries Commission	High seas and EEZ	By flag State <sup>5</sup>	Yes	Annual catch and effort by primary species and gear; Number of vessels by gear type and size Fishing patterns (catch by time/area) Estimated total catches of non-target, associated, and dependent species; Vessel category (GRT); catch of species in MT; Distribution of catch; Discard in MT	Yes
FAO	Food and Agriculture Organization	NA	By member State	No – catch is reported according to the FAO major areas	State; species; area code; unit (i.e., indicates the quantity or value unit of the data reported); quantity (in live weight equivalent without discards) Fleet information	Yes

While some RFMOs have only the mandate to operate in the high seas, members can expressly consent to include their EEZ and adjacent waters into the convention area. \*This table is based upon information found on the public websites of each organization, supplemented by clarifications and comments from RFMO/RMO secretariats. Not all secretariats provided feedback.

<sup>1</sup>Most of the Mediterranean States have not claimed an EEZ due to difficulties in delimitation and the desire to have fisheries access to all Mediterranean basins (Chevalier, 2005).

<sup>2</sup>Excluding tuna and other highly migratory species.

<sup>3</sup>Public catch records can be available if in accordance with the SIOFA rules on the confidentiality of catch data (ref. CMM 2016/03).

<sup>4</sup>For purse seine gear.

<sup>5</sup>Scientific data might be also collected, and which has not been reflected there.

requested information. While this might be true for small-scale and artisanal fisheries, the UNFSA provides explicit management obligations for straddling and migratory fish stocks, requiring States “to collect and share, complete and accurate data concerning fishing activities” such as vessel position [UNFSA Article 5(j)]. It also requires that assistance be provided to developing States to support the collection of such data (UNFSA Article 25). The increasing sophistication of monitoring, control and surveillance technologies, such as electronic monitoring, and the increasing use of VMSs are overcoming many of the practical objections to location-based

catch reporting (van Helmond et al., 2019). Bradley et al. (2019) survey recent developments in technology that could support the modernization and expansion of fisheries data systems including for the provision of more detailed spatial data. At the same time, investigations into the integration of VMS and logbook or landings data to permit more finer-scale spatial analysis (Gerritsen and Lordan, 2011; Russo et al., 2018) and sophisticated catch reconstruction approaches (Pauly and Zeller, 2016; SPC [Pacific Community], 2021) permit analysis of historical catch data at increasing levels of spatial disaggregation. Bradley et al. (2019) point to a number of factors that currently

inhibit the uptake of more technologically advanced data systems, including cost, institutional and legal barriers, and a lack of cooperation and trust in the relationship between fishers and managers. Despite this, significant progress in removing institutional barriers to zonal reporting of fish catches can be seen in the contemporary practice of RFMOs. Examples include the development of E-reporting standards by the WCPFC (2017), support for electronic monitoring (WCPFC, 2021) and the rearrangement of statistical divisions within the area of competence of SEAFO to allow catches taken within national waters of member States to be distinguished from those taken elsewhere (see section “Current Fisheries Data Reporting Structure and History,” above).

## CONCLUSION

Here we highlight the flag State-focused discourse around catch attribution and its potential ramifications for the development aspirations of SIDS and coastal developing States. Focusing on flag States rather than on coastal States is inconsistent with the LOSC assignment of sovereign rights and undermines and contradicts SDG 14. Moreover, this discourse influences international management discussions of fisheries resources, especially on the allocation of future fishing rights. Since quota allocations are primarily based on historical catch, attributing catches to flag States favors States that have historically had the capacity to invest in and develop their fishing fleets, and undermines the development aspirations of SIDS and coastal developing States. Therefore, we propose modernizing reporting frameworks to include zone-based reporting of fish catches. This will provide a more equitable presentation of the data, ensure

consistency with the LOSC, and better support the goals of SDG 14. Attributing catches to geographical origin is an essential first step in understanding and accounting for the true value of these fisheries resources, and ensuring the equitable distribution of their value into the future.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## AUTHOR CONTRIBUTIONS

RD, QH, BH, and KA contributed to conception and design of the study. BH, AC-M, KA and PG-E performed the data analysis and visualization. RD wrote the first draft of the manuscript with contributions from all authors.

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