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EDITED BY
Elizabeth Mendenhall,
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United States

REVIEWED BY
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Centre National des Sciences Halieutiques de Boussoura, Guinea
Marza Ihsan Marzuki,
Pertamina University, Indonesia

*CORRESPONDENCE
Dyhia Belhabib
dyhia@ecotrust.ca

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Adjacency and vessel domestication as enablers of fish crimes

Dyhia Belhabib[1,2]* and Philippe Le Billon[3]

[1]Fisheries Program, Ecotrust Canada, Vancouver, BC, Canada, [2]Nautical Crime Investigation Services, Vancouver, BC, Canada, [3]School of Public Policy and Global Affairs, University of British Columbia, Vancouver, BC, Canada

Fishery-related crimes, including illegal fishing, constitute major concerns including for coastal livelihoods and food security. This study examines the importance of adjacency, or legal presence within or in proximity to domestic fishing grounds and fish landing points, with regard to fishery crimes. Distinguishing between five main types of adjacency and examining cases from West Africa, the study finds that adjacency was a characteristic of a third of licensed vessels with reported fishery-related offenses in the region, 60% of which could be categorized as distant water fishing fleets. Fifty-four percent of the vessels authorized to fish in the region were foreign flagged, and 19% were foreign vessels reflagged to the coastal states, bringing up the contribution of foreign vessels to 73% of the fleets authorized to fish in the region. Vessel operators using a legal cover to commit infractions were mostly linked to China and Spain. This study points to the high likelihood of offense occurrence associated with the reflagging or "domestication" of foreign vessels, at least in West Africa, and the need to secure greater transparency and accountability in relation to access, offenses, and ownership.

KEYWORDS

adjacency, distant water fishing, domestication, fishing vessel, fisheries governance, fish crimes, illegal fishing

Introduction

Fisheries are in crisis in many countries around the world. In response, and to exercise their rights under the United Nations Convention on the Law of the Sea (UNCLOS), governments have often instituted rules of access to their waters, including through restrictions favoring domestic fishing vessels against foreign ones (Hanich et al., 2010; Foley and Mather, 2019). Such regulations are motivated in part by the surplus rule as dictated by UNCLOS, and are expected to facilitate stock management as well as support local employment, entrepreneurship, and food security (Mwikya, 2006; Gagern and van den Bergh, 2013). The surplus rule requires coastal states that do "not have the

capacity to harvest the entire allowable catch" to "give other States access to the surplus of the allowable catch" (see UNCLOS, Art. 62.2), which can motivate coastal states to increase their "domestic" capacity through the domestication and the granting of other types of adjacency to foreign vessels (see below). In practice, many supposedly "domestic" or "local" vessels, particularly in low-income countries, are in fact "domesticated" foreign distant water fishing (DWF) vessels fully or partially controlled by foreign interests through legitimate or fraudulent re-registration processes (Gutierrez et al., 2020).[1] Beyond the direct distortions that such practices can introduce, such as very low access fees, access to fish catch quotas and local subsidies, access to domestic landing infrastructures and local fish markets, and lower fines for illegal fishing offenses, a crucial issue is whether such domestication, and other forms of what we call "adjacency"—or legal presence within or in proximity to domestic fishing grounds and fish landing points that creates a context enabling a fishing vessel to operate within or in proximity to domestic waters [i.e., Exclusive Economic Zone (EEZ)]—can facilitate fisheries-related crimes.[2] We suggest that adjacency has two main related effects in terms of illegal fishing: one is that adjacency enables a vessel with no record of previous fishing offenses to fish illegally more easily as a result of adjacency-related conditions of access, control, and rules and regulations (e.g., more lax landing inspections and lower fines), and the other is that granting access to local fishing grounds and landing infrastructure to vessels with a prior record of illegal fishing results in a high risk of re-offense (e.g., through legal presence within the host's EEZ).

A major theory of crime implies that crime is enabled by the opportunity to do so (Felson and Clarke, 1998), such as when the benefits outweigh the costs (including those associated with the risks and costs of being caught). Opportunity factors influencing crime rates not only include geographical proximity, but also the ability of offenders to get institutionally, legally, or personally close to their victims (and even gain their trust to abuse it), as seen in the case of fraudsters (Manning, 2018; Laroche et al., 2019). Within fisheries, "opportunity" for illegal fishing is often due to a lack of monitoring and effective enforcement, the relatively low cost of evasion techniques used to avoid being caught, and delay tactics (e.g., postponing documents delivery, not paying fines), corruption (e.g., bribes to government officials), or diplomatic pressure (e.g., threat to reduce foreign aid) to reduce the likelihood or costs of sanctions (Sumaila et al., 2017; Petrossian, 2019). Such a situational approach guides much of the understanding of and responses to illegal, unreported, and unregulated (IUU) fishing (see Belhabib and Le Billon, 2020; Marteache et al., 2020). Profits derived from illegal fishing are also frequently increased through other fraudulent practices and labor abuses (Sumaila et al., 2006).

If many of the opportunity enablers of crimes within fisheries are well-documented (Miller and Sumaila, 2014; Long et al., 2020), fewer studies have looked at the effects of spatial and/or legal proximity (Marteache et al., 2020), including landing points for illegal catch such as non-compliant ports (Petrossian, 2018) and other spatial criteria for illegal fishing (Weekers et al., 2019), risks of illegal fishing associated with fishing access agreements (Petrossian and Clarke, 2020), proximity to previous illegal fishing spots (Weekers et al., 2020), or the geographic concentration of illegal fishing practices identified as harmful and predatory given their impacts on local food security and revenues (Petrossian and Clarke, 2020). Here, we look into the opportunity enablers associated with "adjacency" providing access for DWF fleets to a coastal state's waters. We hypothesize that such "adjacency" plays a role in enabling illegal fishing and associated crimes, such as human rights abuses (e.g., see EJF, 2021a, EJF, 2021b) or corruption (e.g., see INTERPOL, 2014). Conceptually, we seek to better understand how different vessel legal status and access arrangements may be associated with differing levels of fishing offenses as a result of the adjacency effects on geographical proximity and relations with government officials and local power brokers associated with adjacency (e.g., through joint ventures between a foreign fishing company and a powerful local politician). For this, we distinguish between five main types of adjacency characterizing national (or truly domestic) vessels, domesticated fishing vessels, "neighbor domestic" vessels, "neighbor domesticated" vessels, and foreign flagged vessels with local fishing agreements (see below). Empirically, we focus on how adjacency manifests itself in terms of vessel registration (i.e., "Flag"), fishing license, ownership, and *recorded* fishing offenses in the context of seven countries in West Africa, one of the most targeted fishing areas in the world by DWF fleets, including industrial illegal fishing fleets (Belhabib and Le Billon, 2022).

In this analysis, we look beyond incapacitation of the surveillance system, and address another misunderstood enabler of illegal fishing: adjacency in the form of economic incentives, geographical proximity, and legal access. Here, we posit that adjacency is not only correlated with the occurrence of

1 Domesticated foreign vessels are frequently officially owned or leased through "joint ventures" between domestic companies or individuals and foreign interests.

2 The maritime concept of adjacency was used in the early 1970s to characterize "area beyond the territorial sea applying to the superadjacent waters, the seabed, and the subsoil [and] also impl[ying] a relationship to the land" (Wright, 1971). With the creation of Exclusive Economic Zones through UNCLOS, the term is now mostly used in reference to the rights and duties of coastal states over international waters adjacent to their EEZs (Dunn et al., 2017). The term adjacency is also used in criminology to convey a sense of spatial contiguity, proximity, or being "next to" (Hipp and Williams, 2020).

fisheries-related offenses but is also an enabler, thereby complementing previous studies focusing on the role of flags of convenience (FOC) in facilitating illegal fishing and reflecting economic incentives for vessel operators, private commercial subcontracted to register vessels, and governments offering FOC registration (Miller and Sumaila, 2014; NAFIG, 2018; de Coning, 2020). We suggest that adjacency-related incentives to illegal fishing lay primarily in (i) the *economic attractiveness* of some forms of fishing agreements, licensing, and operational costs that adjacency provides (e.g., lower taxes); (ii) the *geographic proximity* to fishing grounds and landing sites that adjacency brings (e.g., nearby access to prohibited fishing grounds, laundering of illegal fish through local transhipment, multiple landing options, and access to local fish markets); and (iii) the *legal access* that adjacency grants through corporate presence in the form of nominal ownership by nationals (e.g., domestic vessel status and associated fishing licenses). As domestication provides a legitimized and often subsidized presence, as well as reduced sanctions in case of offenses,[3] we examine whether adjacency and associated forms of corporate ownership provide an enabling context for illegal fishing, and if so, how and what options could reduce adjacency-related illegal fishing in the region.

Methods

Study area

Considered among the richest and most sought-after fishing areas in the world, West African waters have diverse yet overexploited fish stocks, and wide continental shelves with seasonal upwelling that enrich the waters in essential nutrients (Belhabib et al., 2019; Okafor-Yarwood and Belhabib, 2020). These waters comprise the Canary Current Large Marine Ecosystem and extend to include the northern part of the Guinea Current Large Marine Ecosystem, renowned for their biodiversity and (previously) rich stocks thanks to coastal upwellings and wide continental shelfs. Over 3,300 industrial vessels (20% foreign flagged) and 54,000 artisanal and subsistence fishing vessels (e.g., canoes and pirogues) operate in the waters of West Africa (comprising the waters of North West Africa and the Gulf of Guinea), catching over 6.4 million tons of fish per year (Belhabib et al., 2012), and generating a landed value of US$10.6 billion (Belhabib et al., 2015), 10% of which are produced within the waters of the countries considered in this present study. Fisheries in West Africa contribute from 2% to 10% of the gross domestic product[4] and employ nearly 1 million people within the region (Belhabib et al., 2015). Considering that for every one fisher there are some dozen fish processors (Belhabib, 2019), mainly women operating on shore (Okafor-Yarwood et al., 2022), the fishing sector is the main gender-balanced sector in the region, which provides safe economic havens for many women and households and a vital source of animal protein intake with a contribution of up to 85% in some coastal communities (Belhabib, 2019).

This major contribution to livelihoods and food security is threatened by unsustainable and often illegal fishing (Doumbouya et al., 2017; Merem et al., 2019; Belhabib et al., 2020), which itself is often tied to other types of criminal activities (UNODC, 2011; Belhabib and Le Billon, 2022). Illegal fishing in West Africa results in a loss to coastal states of US$2.3 billion annually, benefiting more developed nations and their DWF fleets (Doumbouya et al., 2017). The main enablers of these illegal fishing activities were identified as corruption (Standing, 2008); ineffective governance (Merem et al., 2019); weak monitoring, control, and surveillance (MCS); and feeble sanctioning (Doumbouya et al., 2017). In addition, it is worth noting that a combination of factors has contributed to increasing illegal fishing, such as trade policies including extensive subsidies that support fishing effort (Belhabib et al., 2015), and the declaration of EEZs that has limited legal access to coastal states' waters. In short, fisheries in

3 Reduced sanctions can notably result from greater ease of corruption through local contacts and presence, the misrepresentation of the vessel owner (e.g., insolvent national used as the front owner, rather than highly capitalized foreign company that is the actual beneficial owner), or the political influence of nationals involved in domestication joint ventures (Sumaila et al., 2017; EJF, 2018).

4 Ghana: 3%, Gambia: 2.4%, Guinea: 2%, Guinea Bissau: 3.3%, Mauritania: 4%–10%, Senegal: 2.3%, and Sierra Leone: 9.1% (sources: Marti, 2018; https://www.worldfishing.net/news101/regional-focus/senegal#:~:text=Estimated%20annual%20per%20capita%20fish,for%202.3%25%20of%20total%20GDP; https://www.accessgambia.com/information/fisheries-sector.html#:~:text=Present%20Role%20of%20Fisheries%20in,average%20annual%20contribution%20of%202.4%25; http://www.fao.org/fishery/facp/GNB/en#:~:text=The%20fisheries%20sector%20in%20Guinea,12%20to%2015%20million%20USD; http://www.fao.org/fishery/facp/SLE/en#:~:text=Fisheries%20are%20important%20to%20the,are%20from%20inland%20water%20production; https://www.agrilinks.org/sites/default/files/resource/files/ghana_file.pdf).

5 As such, our study does not cover a number of West African coastal countries, including Benin, Côte d'Ivoire, Liberia, Nigeria, and Togo.

6 We note that the lists of licensed vessels obtained from governments in the region may not be complete, as some licenses (notably private licenses with individual companies) may not even be available within the department of fisheries that is supposed to have them. In the case of Sierra Leone, for example, some Italian vessel licenses were only available from the company and not from the Department of Fisheries. It is unclear where and how these licenses were obtained.

West Africa are a vector for food security; however, given the often overexploited status of fish stocks thanks to increasing fishing effort, and illegal fishing, fisheries remain plagued with poverty and fishers' income continues to dwindle (Belhabib et al., 2015).

In this study, we consider seven countries—hereafter "study sample"—for which information on licenses could be retrieved within West Africa anytime between 2016 and 2021: Guinea, Guinea-Bissau, Mauritania, Senegal, Sierra Leone, and The Gambia [all part of the West African Sub Regional Fisheries Commission (SRFC)], as well as Ghana.[5]

Data collection and analysis

In order to analyze possible links between adjacency and illegal fishing, we compared the official lists of registered and licensed fishing vessels (including "domesticated" or "reflagged" with the host jurisdiction)[6] obtained from the governments for the study sample (Table 1) to the data extracted from the Criminal Record of Fishing Vessels (CRFV © Belhabib, 2018) for the region. The CRFV compiles information on vessels and fishing company infractions from media reports, government reports, automatic identification system (AIS) track analysis, and testimonies from witnesses and informants (Belhabib and Le Billon, 2022). Data are gathered on a daily basis since 2016, whenever these reports are made available.[7] CRFV includes information on 7,011 events, each event being usually associated with a specific vessel or a company, and over 1,500 companies during the period 2000–2020 and covers eight languages (Arabic, Chinese, English, French, Spanish, Italian, Indonesian, and Portuguese), thus reducing the spotlight effect created by the "English search bias". While extensive, the CRFV only provides a *partial* record of offenses and our findings are thus inherently limited to a non-comprehensive and possibly biased assessment of illegal activities, with a possible bias in the number of recorded offenses resulting for example from the level of MCS (Ganapathiraju, 2022), as well as the ratio of identified offenses that are publicly reported or otherwise identified and included in the CRFV (Belhabib and Le Billon, 2022).[8] With this caveat in mind, we consider the main categories of offenses for the DWF industrial sector (see Table 1).

We extracted all the incidents for the broader region of West Africa (including countries of the region other than those in the study sample) and then investigated each vessel for ownership ties to foreign entities. This investigation focused on vessels that were flagged domestically, i.e., the coastal states considered in this study, and those flagged to flag of convenience countries. Ownership ties were accessed through the platform Equasis.org and individual company registries whenever available. In addition, we reached out to local contacts to confirm domestic or foreign ownership of a company if a vessel is managed by a local agent. Ultimately, beneficial ownership can be complicated, and all vessels flagged locally for which foreign ownership could not be established as a certainty were considered as "national" (i.e., local)—vessels.

We disaggregated the concept of adjacency into five main categories, according to the link between the vessels and the host jurisdictions (see also Table 2): First, *Type 1* adjacency characterizes national (or truly domestic) vessels licensed to fish within their own coastal states. These vessels are flagged to the

TABLE 1 Categories of offenses.

1. Fishing offenses	2. Fraud and diversion offenses	3. Other personal and property offenses
a. Gear (e.g., use of prohibited gear, such as drift nets)	a. Bribery or corruption	a. Human rights and labor abuse (e.g., slavery at sea)
b. Non-compliance (e.g., infringement of observer regulations)	b. Embezzlement	b. Smuggling (e.g., trafficking of arms, people, drugs, and other illicit goods)
c. Quota related	c. Illegal or fraudulent use of flags/registration of home jurisdiction	c. Violent attack (e.g., physical assaults against other boats and crew, including enforcement agencies)
d. Species and bycatch related	d. Forgery/fraud	d. Waste dumping
e. Transshipment	e. Name or identity masking	
f. Unauthorized	f. Reporting related	
g. Zone/season		
h. Other fishing offense		

7 Privacy concerns over the data take into consideration the prior public release of these data as well as the public interest associated with the reporting of offenses affecting fisheries and marine ecosystems constituting common or public resources. Procedures follow the database ethics guidelines of the second author's institution.

8 We prefer to base our analysis on raw reported offenses, rather than on figures weighted through indicators of MCS effectiveness (e.g., see scoring of the MCS system in Doumbouya et al., 2017) and government openness (e.g., transparency index) as these could add uncertainty.

TABLE 2 Number of registered industrial fishing vessels per country in West Africa.

Country	Year	Total number of unique vessels registered	Licensed vessels with reported offenses	Categories of licensing		Number of sanctioned vessels*
Mauritania	2015–2016	90	29%	Domestic	1	Only 2 cases followed through, 1 remained unsanctioned and 1 where the crew was arrested. In Mauritania, the main sources of information are AIS tracks, and C4ADS reports, and hence, it is unknown whether any of those vessels were prosecuted.
				Domesticated	13	
				"Neighbor domestic"	0	
				"Neighbor domesticated"	0	
				Foreign licensed vessels	76	
Senegal	2019	163	18%	Domestic	76	Of the total number of IF vessels, 18 were sanctioned. This is equivalent to, say, nearly 100% of the vessels caught and arrested were sanctioned (the remaining were detected through AIS tracks).
				Domesticated	47	
				"Neighbor domestic"	0	
				"Neighbor domesticated"	8	
				Foreign licensed vessels	32	
The Gambia	2017–2018	49	14%	Domestic	27	3 transported to port, fined, or awaiting fining, and 1 released for lack of evidence.
				Domesticated	0	
				"Neighbor domestic"	20	
				"Neighbor domesticated"	0	
				Foreign licensed vessels	2	
Guinea Bissau	2019	184	35%	Domestic	4	Of all cases, all the cases that were observed by the authorities (13) were successfully sanctioned, with, however, relatively low fines.
				Domesticated	11	
				"Neighbor domestic"	20	
				"Neighbor domesticated"	15	
				Foreign licensed vessels	134	
Guinea	2019	128	39%	Domestic	8	Of the total cases, 15 were sanctioned (1 unpaid), and 14 have seen their subsidies removed by the government of China, thanks to communications between the 2 countries.
				Domesticated	1	
				"Neighbor domestic"	2	
				"Neighbor domesticated"	8	
				Foreign licensed vessels	109	
Sierra Leone	2019	124	31%	Domestic	7	8 vessels were fined, 1 escaped after detention, and 1 was given a warning.
				Domesticated	11	
				"Neighbor domestic"	3	
				"Neighbor domesticated"	8	

(Continued)

TABLE 2 Continued

Country	Year	Total number of unique vessels registered	Licensed vessels with reported offenses	Categories of licensing		Number of sanctioned vessels*
				Foreign licensed vessels	95	
Ghana	2017	124	41%	Domestic	68	Only 38 were successfully sanctioned. In 2 cases, fines were never paid, and in multiple cases, warning was issued, bonds of good behavior were signed by the captains, and, at times, no sanctions were supplied.
				Domesticated	38	
				"Neighbor domestic"	0	
				"Neighbor domesticated"	0	
				Foreign licensed vessels	18	

*Regardless of licensing, information was not complete. All information on arrests, observed and reported offenses, along with sanctions (whenever applicable) was extracted from the Criminal Record of Fishing Vessels.

coastal state within which they operate, and ownership search does not indicate foreign ownership ties. Of the 862 total vessels licensed in our study sample[9], only 191 were owned by nationals and thus "truly" domestic vessels (22%), as per the type of research described above, found mostly in Senegal with 76 vessels (40%), Ghana with 67 vessels (35%) known with a deep domestication of the fleet (which is difficult to investigate), and 27 vessels (14%) in The Gambia, with the remaining domestic vessels being found in Guinea Bissau, Guinea, and Mauritania.

Second, *Type 2* adjacency characterizes domesticated fishing vessels, with domestication being understood as a process through which a foreign-owned fishing vessel is reflagged to the coastal state yet which has clearly established ties to a beneficial ownership—company or individual—that is not from that coastal state, and not within the region of this study (as defined by the category below). We counted 121 domesticated vessels (14%) in the study sample, once again mostly found in Senegal (47 vessels) and Ghana (38 vessels).

Third, *Type 3* adjacency characterizes "neighbor domestic" vessels, which are domestic vessels flagged and owned by entities within neighboring states (within the sample region of seven countries). An example of this is all the vessels that are of Senegalese origin (ownership and flag) who have a bilateral agreement to fish in Guinea Bissau and The Gambia. The notion of adjacency is here represented by the geographic proximity of these countries to each other. There are 45 vessels (5%) under this category, mostly based in Guinea Bissau (20 vessels) and Gambia (20 vessels).

Fourth, *Type 4* adjacency characterizes "neighbor domesticated" vessels, which are vessels that are flagged to a neighboring state but that have been domesticated as defined per number (2) above. This includes examples of vessels reflagged to Senegal, but owned by South Korean beneficial ownership, which have bilateral and private agreements with Guinea Bissau. There are 39 vessels (5%) that fall under this category, 15 of which operate in Guinea Bissau, 8 in Senegal, 8 in Sierra Leone, and 8 in Guinea.

Fifth, *Type 5* adjacency characterizes foreign flagged vessels that benefit from various forms of access agreements. *Type 5* represents the largest category of adjacency as foreign access agreements are prevalent in the region, with 466 DWF vessels (54% of the fleet) operating in Guinea Bissau with 135 vessels (29%), in Guinea with 107 vessels (23%), in Sierra Leone with 93 vessels (20%), in Mauritania with 75 vessels (16%), in Senegal with 33 vessels (7%), and the remainder in Guinea and Ghana.

We conducted a matching exercise to identify any vessels or companies with a criminal/offense record, and holding a license or a fishing permit to operate in Mauritania, Senegal, Gambia, Guinea Bissau, Guinea, Sierra Leone, and Ghana. We note that the license years vary, depending on the ability to obtain the information. The steps of the matching exercise are presented below and summarized in Figure 1.

First-level analysis consists in searching in the CRFV for vessels authorized to fish in the region, a match meaning that the vessel has a recorded illegal fishing/criminal history. If this match is found, the vessel is labeled as "*high risk*", though again we note that some vessels with a high risk of committing offenses may not be adequately labeled as a result of their prior offenses not having been identified and reported. If no match is found for the vessel in (1), the second-level search is then conducted with the name of the company owning the vessel; if a match is found for the company, the vessel is labeled as "*potential risk*", along with the entire fleet the company owns

9 Vessel licenses imply that sometimes a vessel is licensed in more than one country. In this case, of the 862 vessel licenses, 700 vessels were unique, and 162 vessels had multiple cross-jurisdictional licenses, notably between Senegal, Guinea Bissau, Guinea, and Sierra Leone.

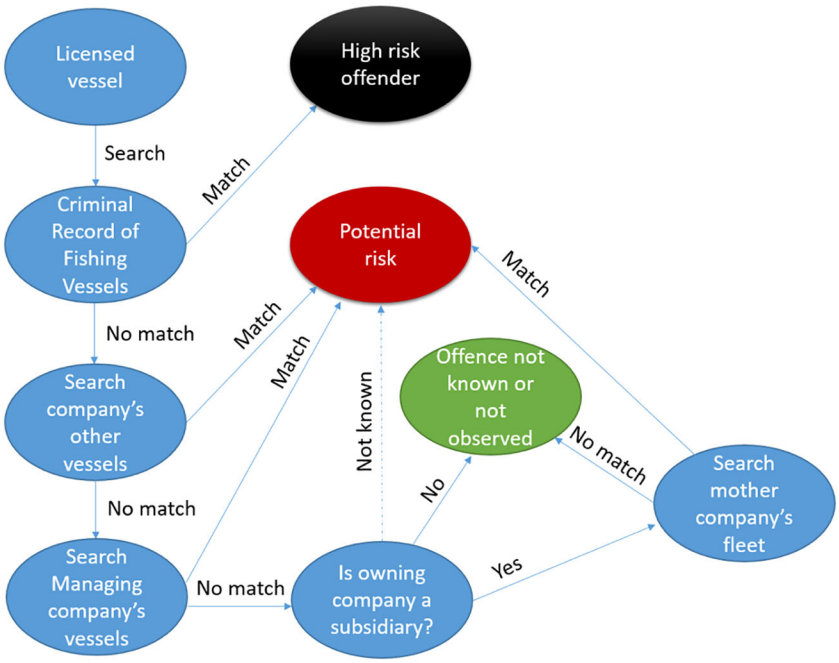

FIGURE 1
Process of identifying high-risk offenders, and potential high risk vessels by matching officially registered and licensed vessels. Information from government license lists and CRFV.

in the region. If no match is returned with company searches in (2), a search with the managing company is conducted; if any of the vessels the managing company handles is involved in illegal activities, then the vessel is labeled as "*potential risk*", along with the entire fleet the company manages.

If no match is found, and in parallel to (3), the following question is asked: Is the company a subsidiary of another company? If the answer is no, then the vessel is labeled with "*offense not known or not existent*". If the search of the mother company is indicative that some of the vessels are on the criminal record of fishing vessels, then the vessel is labeled as "*potential risk*" along with the entire fleet owned by the mother company in the region. Hence, we hypothesize that offenses and criminal behavior are associated with the corporate network and are not necessarily a matter of a singular vessel/captain.

To conduct the overlap analysis, we first gathered licensing data, i.e., vessels licensed in Mauritania (2015–2016), Senegal (2019), Gambia (2017), Guinea Bissau (2019), Guinea (2019), Sierra Leone (2019), and Ghana (2017), and checked every vessel's name against the CRFV.

Results

Our overlap analysis found 700 unique vessels licensed to fish in the waters of West Africa, and 862 licensed vessels (some have licenses in multiple countries considered under this study). Of these, we counted 267 who have engaged at least once in CRFV-reported illegal activities (illegal fishing or other fisheries-related offenses as defined in *Section 1* above). On average, vessels that have a criminal record have engaged in reported illicit activities twice during the 2010–2019 time period within this region.

Criminal record and adjacency type

As shown in Table 1, the ratio of number of reported incidents per number of vessels according to their adjacency type was the highest (1.29) for domesticated vessels (*Type 2*), followed by neighbor domesticated vessels (1.20, *Type 4*), foreign licensed vessels (1.11, *Type 5*), neighbor domestic vessels (0.6, *Type 3*), and domestic vessels (0.59, *Type 1*). In terms of average number of offenses per reported incident (e.g., the number of offenses identified during a vessel inspection by Coast Guard), the highest was neighbor domesticated vessels (5.6), followed by domesticated vessels (2.0), and foreign licensed vessels (1.8) (Table 3).

An analysis by type of adjacency reveals that national licenses, i.e., licenses to domestic and domesticated vessels, were the type associated with the highest number of reported offenses with 31%. We note that adjacency type could not be

TABLE 3 Ratio of incidents to vessels by adjacency type*.

Type	Vessel description	Share of vessels	Share of incidents	Ratio of incidents/vessels	Offenses per incident
1	Domestic	22	13	0.59	1.4
2	Domesticated	14	18	1.29	2.0
3	Neighbor domestic	5	3	1.00	1.5
4	Neighbor domesticated	5	6	0.60	5.6
5	Foreign licensed	54	60	1.11	1.8

* Share of incidents reflects only 65% of the total records due to the lack of identification of access type.
Data for offenses were extracted from the criminal record of fishing vessels. All original references are listed on https://Spyglass.fish.
Data on licenses were obtained from the governments of the countries listed below.

identified for 35% of the offenses. Bilateral agreements (notably with the EU, China, between Senegal and Guinea Bissau, and between Senegal and The Gambia) constituted 27% of all offenses recorded. Vessels[10] under chartering agreements were responsible for 6% of all reported offenses.

Record of incidents by country of license

As shown in Table 4 below, vessels with Bissau-Guinean licenses were the highest reported offenders in the region both in overall number of incidents (65) and number of countries these were reported (all, with the exception of Cote d'Ivoire—a country with no reported incidents except for Ghanaian-licensed vessels) and Namibia (the most distant country), followed by vessels licensed with Ghana (51 incidents) and Guinea (50 incidents).

Vessels from Ghana and Senegal display a high record of offenses in neighboring areas, with eight reported incidents per vessel licensed in Senegal fishing in Guinea Bissau, and five incidents per vessel licensed in Ghana fishing in Cote d'Ivoire. This provides evidence of adjacency *Type 3* (neighbor domestic vessels) and *Type 4* (neighbor domesticated vessels), as defined above, with adjacency *Type 4* being mostly associated with vessels domesticated in Guinea and Guinea Bissau that are conducting illegal operations in neighboring countries (Table 4).

Incidents by EEZ of licensing and offense occurrence

As shown in Table 5, most incidents are reported for practices conducted in the same EEZ where the vessel is licensed. We note that vessels often continue to be licensed despite previous offenses, with 44% of the fleet licensed to Guinea having a reported offense, 41% in Ghana, 37% in Guinea Bissau, 32% in Sierra Leone, 28% in Mauritania, 28% in Senegal, and 14% in The Gambia. Despite Sierra Leone's Fisheries Act prohibiting the issuance of a fishing license to vessels with a record of previous offenses, anywhere in the world, nearly a third of all vessels licensed to fish in Sierra Leone have at least one recorded offense, mostly within Sierra Leone's EEZ. In 2020, one vessel that had committed the same infraction twice within 2 months was fined $30,000 by Sierra Leonean authorities, but its fishing license was maintained (according to records obtained in confidence from the government of Sierra Leone). Overall, there seems to be a tolerance of illegal behavior, with vessels continuing to receive licenses despite having committed offenses, often in the same EEZ for which the license is granted. This tolerance is practiced by coastal states and flag states, whereas, e.g., EU flagged vessels committing acts that are considered illegal under EU laws are not sanctioned by the EU. This calls for a better consideration of the risk associated with vessels with a criminal record.

Criminality record, adjacency type, and vessel ownership

As shown in Figure 2, vessels flagged to China and/or owned by Chinese entities were responsible for 38% of all reported offenses, and 36% of the Chinese fleet licensed to operate in West Africa had at least one reported offense. Vessels flagged to EU countries (mainly Spain) and/or owned by entities in the EU were responsible for 27% of the reported offenses, with 38% of all the vessels that were flagged to EU countries or owned by entities in the EU and that were licensed to fish in West Africa having committed at least one reported offense. FOC-flagged vessels, i.e., vessels that fly the flag of a country listed as a registry of convenience (e.g., Bahamas and Malta), and those vessels owned by entities within FOC countries, i.e., the address of the registered owner is listed within a country defined as an FOC country, and that were licensed to fish in West Africa, were responsible for 10% of all reported infractions, the remaining being distributed between domestically flagged vessels (11%)

10 The use of the word "vessel" as an agent of crime/agreement (e.g., offending vessel) implies "vessel operators" and conceives a vessel as only a shell that is operated by a captain and owned by a company/individual. This is often used in law enforcement to simplify the narrative, and should be construed in this article as such.

TABLE 4 Average number of incidents per vessel.

		Country of license						
	EEZ of offence	Gambia	Ghana	Guinea	Guinea Bissau	Mauritania	Senegal	Sierra Leone
EEZ where offence occured	Angola				1			
	Côte d'Ivoire		5					
	Gabon			3	3			3
	Gambia			2	2		3	
	Ghana		2	1	1			2
	Guinea	1		2	2			1
	Guinea Bissau	1		1	2	3	8	3
	Liberia		1	2	1		2	2
	Mauritania			2	1	1	2	2
	Namibia					1		
	Senegal	1			1	1	2	
	Sierra Leone		2	2	2		2	2

Values represent the average number of incidents reported for individual vessels between 2010 and 2019, based on the average number of times a vessel licensed to fish in a coastal state of West Africa (top row) appeared as incidents on the CRFV in the neighboring country (column). Licenses are assessed for Gambia, Ghana, Guinea, Mauritania, Senegal, and Sierra Leone. Darker shades reflect higher intensity. Data for offenses were extracted from the criminal record of fishing vessels. All original references are listed on https://Spyglass.fish.

TABLE 5 Number of vessels licensed to fish in a coastal state of West Africa, appearing on the criminal record in the neighboring country.

		EEZ of license						
	Row labels	Gambia	Ghana	Guinea	Guinea Bissau	Mauritania	Senegal	Sierra Leone
EEZ where offence occured	Angola				1			
	Côte d'Ivoire		1					
	Gabon			1	1			1
	Gambia			2	3		1	
	Ghana		39	4	2			1
	Guinea	5		21	5			1
	Guinea Bissau	1		6	22	3	14	2
	Liberia		4	3	3		1	3
	Mauritania			3	5	18	4	1
	Namibia					1		
	Senegal	1			7	3	17	1
	Sierra Leone		7	16	19		9	30
	Licensed vessels	49	124	128	184	90	163	124
	% Offender/Licensed	14%	41%	44%	37%	28%	28%	32%

Licenses are assessed for Gambia, Ghana, Guinea, Mauritania, Senegal, and Sierra Leone. Red shade represents countries of overlap (i.e., when the country of license and the EEZ of offense overlap). Data for offenses were extracted from the criminal record of fishing vessels. All original references are listed on https://Spyglass.fish. Data on licenses were obtained from the governments of the countries listed below.

and others such as Russian, South Korean, and Turkish vessels. In this analysis, we grouped FOC-flagged and registered vessels because FOC are often used to hide the true beneficial ownership and group all countries associated with FOC as a single category. The use of FOC is also one of the diversion strategies used by EU vessels to circumvent EU regulations that ban private agreements for EU-flagged vessels with coastal states with which the EU has an active or a dormant fisheries agreement.

Discussion

In this analysis, we explored the notion that adjacency has an enabling effect on illegal fishing. Our results suggest that adjacency is associated with illegality, with adjacency being linked to a third of all illegal fishing and related offenses in West Africa. We note that industrial fishing vessels are highly mobile and that a correlation without causation would imply

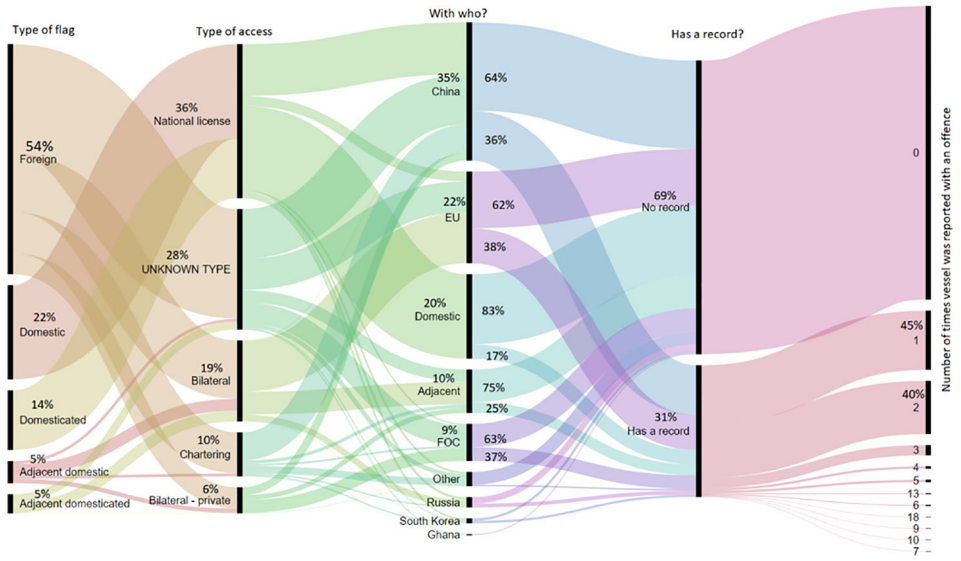

FIGURE 2
Distribution of vessels with a criminal record through nodes of types of flags. The figure reports domestic, domesticated, foreign, neighboring countries or adjacent domestic, or domesticated to the neighboring countries, i.e., domesticated, type of access, whenever known such as a national license, a bilateral agreement, a chartering agreement, or a bilateral and/or private agreement with a company, ownership of flag being typically from, e.g., China, the EU, and South Korea.

that vessels may be engaging in illegal fishing in areas that are not adjacent to the countries within which they have authorizations, or have been domesticated. In this regard, we analyzed the geographic spread of vessel activities and found no evidence of operations in other areas, i.e., areas outside of FAO Area 34 (Eastern Central Atlantic) by industrial vessels analyzed in this report. Furthermore, we observed that adjacency provided opportunities to cross EEZ boundaries, often unnoticed by authorities to fish the same stocks and sub-stocks, and that high-risk vessels, i.e., vessels that have previously committed an offense in a country, will often rename, reflag, and re-license in an adjacent country but go back to their previous fishing grounds. We thus argue that adjacency is part of a complex system that enables but does not necessarily "drive" (i.e., motivate) illegal fishing, alongside weak monitoring, low governance, lax fishing sanctions, and diversion strategies such as reflagging and high mobility. Further study is necessary to understand such a complex system, perhaps using algorithmic analysis methods. We note in particular that domestication (*Type 2* and *Type 4*) seems to enable vessels to more easily engage in illegal fishing, first because they have access to the waters of the country within which they are licensed to, and second because domestication implies (usually) lower fines and sanctions under the laws of the countries considered herein (GRTG, 2007; GRS, 2015). Domestication can be a widespread practice, as seen in Ghana where laws prevent foreign-owned vessels from operating in its waters, incentivizing vessels owners and authorities to reflag foreign vessels to operate within the Ghanaian EEZ; as a result of these practices, the vast majority (90%) of the Ghanaian industrial trawler fleet is owned by Chinese interests (EJF and Hen Mpoano, 2019).

The sanctioning of fishing-related infractions in West Africa is generally infrequent and weak (Doumbouya et al., 2017). Anecdotal evidence points to several processes preventing a more effective sanctioning of fishing vessels. For example, Senegal was subjected to diplomatic pressure by Russia after the arrest of the crew on board the *Oleg Naydenov*, a fishing vessel that operated illegally in Senegalese waters, with Russia going as far as accusing the Senegalese authorities of piracy[11]. In both Senegal and Mauritania, authorities refrained from investigating alleged human rights and labor abuses by one of the most prominent Chinese-owned fishing companies out of fear of economic and diplomatic retaliation by the government of China (senior official in the Senegalese government, personal observation). National authorities can also lack the ability to properly collect and store evidence (Stop Illegal Fishing, 2020). Finally, there is a frequent inability or unwillingness to enforce sanctions, with, for example, a Chinese-owned Ghanaian vessel caught fishing illegally within Ghanaian waters being released without paying a fine after it claimed that the owner, "apparently Ghanaian", could not afford the fine, while the vessel was owned

11 https://www.aljazeera.com/news/2014/01/10/russia-accuses-senegal-of-piracy/?gb=true

by a beneficial owner in China (Godfrey, 2020). The vessel continued to fish and was once again caught for the same offenses[12]. In most West African countries, domestic(ated) vessels pay lower fines than foreign flagged vessels as illustrated in the fisheries laws of Senegal (GRS, 2015) and The Gambia (GRTG, 2007), which constitutes a major motivation for domestication. In addition, domestic vessels typically pay lower access fees, which generate major losses to coastal economies (Virdin et al., 2022); for example, in Senegal alone, a quick analysis of license dues for domestic vessels, license dues for foreign vessels, and the number of domesticated (foreign) trawlers (52) resulted in a calculated loss of US$2.7 million per year to Senegal. Had these vessels not been domesticated, Senegal could have captured US$2.7 million annually in license fees.

There are also bilateral economic or diplomatic challenges when it comes to the agreements themselves. In this study, we find that vessels and companies from two countries contribute the most to reported illegal activities in West Africa: China and Spain (and to a lesser extent other EU member states such as Italy and Portugal). The government of China and other Chinese stakeholders still have much to do to curb illegal fishing and other criminal activities by their fleets, but the government has created its own black list[13] of fishing vessels and has suspended subsidies to some of the vessels reported to have infringed local laws. There can be a blatant *laissez-faire* attitude by the EU towards their own fleets, as with cases of Italian vessels not facing sanctions after being involved in shark finning and shutting down their AIS while operating illegally in Sierra Leone (Philippe, 2020).

Overall, our empirical analysis and discussion of sanctioning suggest that more severe and better enforced sanctions by both local and national authorities and the countries of vessel origin may contribute to reducing illegal fishing by industrial vessels otherwise benefiting from adjacency. We note in this respect that as long as regulations of "domestic(ated)" vessels in local fishing areas are weaker than regulations and enforcement by vessel ownership countries, there will be an incentive for the domestication of DWF vessels and associated illegal practices.

Uncertainty and bias discussion

Several factors of uncertainty and potential biases affect our studies. First, not all countries have a similar level of MCS and post-MCS sanctioning (Doumbouya et al., 2017); the interpretation of the data and the links to adjacency will hence be strongly impacted by the level of illegal fishing caught within the different EEZs considered here. As a result, there may be a reporting bias in terms of number of incidents identified and reported. We note, however, that the sampling method within this region subset is uniform. All AIS analyses were performed equally, and all observed offense data are received from government agencies equally (with the exception of Mauritania), which remove a potential bias linked to the data collection method. Second, the number of arrests and offenses could be a good indicator of the strength of MCS, or its weakness. A high number of (observed) offenses, i.e., those not captured through satellite tracks, may be due to a high surveillance capacity, and on the other hand, it may mean an extremely high intensity of illegal fishing, thus introducing an interpretation bias. We take here that sanctioning, along with the number of observed cases, is a good indicator of a strong MCS system (Doumbouya et al., 2017). Third, this analysis does not differentiate links between offenses related to adjacency and those due to other enablers or drivers such as economic ones (e.g., higher profit and lower sanctions). However, while access and sanctions are intertwined, which suggest marginal differences in the main enablers and drivers listed above, countries with different sanctioning levels perform similarly or worse because of a wider access (e.g., Sierra Leone). This implies that there are other enablers of offenses such as adjacency. We find evidence here that a third of the vessels licensed to fish in the region have committed an infraction within the region (before or after being licensed), and only two vessels committed an infraction outside of the region (i.e., in Italy and Australia). Fourth, different sources of information score differently in terms of uncertainty. Nearly a third of all infractions are sourced back to AIS tracks overlap with artisanal zones (Belhabib et al., 2020), which indicates incursions into prohibited zones (although the vessels resulting from this overlap analysis have not necessarily been caught, the uncertainty level associated with the AIS tracks within the artisanal fishing zone is low).

Conclusions

This study found that adjacency was a characteristic of a third of licensed vessels with reported fishery-related offenses in West Africa, suggesting that adjacency provides an enabling opportunity for fishery-related offenses. Distinguishing between different types of adjacency, according to a vessel's flag, its ownership origin, and its area of operation, we found that all types enable distant water illegal fishing activities in West Africa. Yet, some categories were associated with a higher reported level of incidents and offenses: domesticated vessels (*Type 2* and *Type 4*) had the highest number of offenses per incident, while foreign

12 https://www.seafoodsource.com/news/environment-sustainability/previously-fined-chinese-vessel-given-ghanaian-fishing-permit-despite-lack-of-payment

13 http://www.iuuwatch.eu/2020/01/china-targets-distant-water-criminals-with-new-fisheries-law/

vessels licensed to fish in domestic waters had the highest number of incidents overall, with characteristically varying degrees of re-offense by individual vessels, mainly due to the spotlight effect on some flag countries such as China. We also found that over 40% of all incidents in the region involved vessels licensed to fish within the coastal states of the region. If our study has demonstrated, probably for the first time, that adjacency increases the likelihood of offenses, at least in West Africa, the issue is well recognized in enforcement circles in the region (interviews with fisheries officers in Senegal and in Sierra Leone); yet, awareness still needs to reach more decision-makers to further tighten enforcement and sanctions, and more generally inform debates, policies, and practices around fishing vessel domestication. Several major implications result from our findings.

First, governments should drastically limit and even prohibit adjacent status—and thereby legal access to their fisheries—to vessels, captains, and owners, who have operated illegally within any jurisdiction in the recent past—as established, for example, through Sierra Leone's Fisheries Act. As noted above, this requires that governments have access to a comprehensive list of offending vessels. There are multiple cases linking licensed vessels to criminality in the CRFV. This points to the importance for all organizations to identify offenses and publicly report them in official records, as well as to share precise records to inform authorities considering granting "adjacent" status to foreign vessels. So far, governments have commonly used RMFO IUU lists, but these only currently include about 300 vessels, in contrast, for example, with CRFV/Spyglass, which lists nearly 3,000 individual vessels and over 9,000 offenses. At the moment, only Guinea has official public records of vessels fishing illegally that have been caught and sanctioned, which helps establish the level of risk of re-offense by these vessels when they apply for domestication or licenses. We note that countries such as Senegal, Sierra Leone, and Guinea have established particularly high sanctions for repeat offenders, which is considered a deterrent against illegal fishing. We also note that such information provides a strong signal to countries and regional organizations, such as the EU, to prevent or end support for vessels and companies associated with adjacency-related offenses.

Second, authorization lists of vessels licensed to fish within coastal states (i.e., lists of vessels with "adjacent" status) should be made publicly available by these coastal states to the extent possible, or at least regionally, and both domestic and foreign regulations should be understood in the context of enforcement by all parties concerned, i.e., within the coastal state, by the flag state, and by the subsidizing state, which is often the state of beneficial ownership. In this particular case, we found numerous "EU member state"-owned vessels, listed and operating in countries where the EU holds an active or dormant sustainable fisheries partnership agreement. This constitutes an infringement to EU regulations, but not to coastal state regulations. Hence, knowledge and accountability to these rules may have prevented these vessels to be licensed in the first place.

Third, adjacency-related illegal fishing issues require strong regional and international cooperation. This includes exchanging information, notably on beneficial ownership related to domesticated vessels, their companies, operations, and record of offenses. It also means helping with the verification of the citizenship criteria (e.g., bi-nationals) and for the prosecution of cases. Some adjacency issues, notably related to *Type 3*, require mutually building capacity to properly design and implement crucial policies, such as the Port State Measures Agreement, and to increase enforcement capacity through coordinated patrols and other MCS tools. Currently, the Sub-Regional Fisheries Commission, which includes the area stretching from Mauritania to Sierra Leone, facilitates information sharing, capacity exchange, and joint patrols between countries regionally. These efforts could be further supported to guarantee continuity and high frequency. Current efforts could also be complemented through new technologies and the mobilization of community-level knowledge and stewardship. Innovative approaches include not only IUU hot-spot prediction and monitoring, but also education on the impacts of illegal fishing, positive reinforcement for well-behaved players, such as licensing discounts, and fuel tax rebates offered as fishery stewardship subsidies International Energy Agency (2022).

Fourth, socially just and inclusive conservation and fishing rules approaches should be adopted given the relevance of adjacency issues for small-scale fishers. Empowering local communities as "stewards of the sea" can, in this regard, assist in the MCS of vessels that benefit from and abuse the privileges granted by their "adjacent" status. The Environmental Justice Foundation's program in Sierra Leone, for example, offers lessons about community-level MCS and the use of simple technology such as cellphones and low range drones to alert authorities and collect evidence (Okeke-Ogbuafor et al., 2020; Okeke-Ogbuafor and Gray, 2021; Bennett et al., 2022).

Fifth, there is a need to reduce the number of vessels seeking adjacent status. This notably means eliminating harmful subsidies that enable overcapacity through the building of DWF vessels and overfishing through fuel subsidies and illegal fishing practices (Arthur et al., 2019). We note in this respect that China and EU fleets receive major subsidies (e.g., fuel tax rebates, access agreement fees, and port infrastructure, among others, see Sumaila et al., 2019), and both were found to be key perpetrators of illegal fishing in West Africa. Relatedly, domestic authorities and RFMOs need to report on IUU cases to help implement the new WTO Ministerial Agreement on Fisheries Subsidies.

Sixth, the government of China and the EU should do their due diligence in verifying the activities of their respective fleets and companies, notably, for example, for the EU to obtain the names of the vessels belonging to companies and individuals within EU member states (flagged or owned) that have been found to have committed an offense of any type, and take proper measures and legal action within the EU. In parallel, China has created a blacklist of Chinese-flagged/owned vessels that have

committed offenses (Zhang, 2020). These vessel companies then receive sanctions in the form of subsidy bans and/or removal of DWF license.

Seventh, adjacency has implications in terms of landing and access to fish markets. We suggest that while the "carding system" limits access to the EU market for fish coming from countries with a poor record of IUU enforcement, this system should account for the practices of EU vessels so that vessels from its own member states comply and help redress the situation in countries subject to a warning (e.g., EU member state vessels were found to be an integral part of the problem of illegal fishing in Sierra Leone, which is under a "yellow card" status). The EU should hold its own member states accountable when their fleets commit offenses while under agreement with a third party. A 2021 illegal fishing incident by a Spanish-flagged vessel operating in Senegal under agreement (adjacency *Type 4*), which escaped detention, was granted a license to fish in Las Palmas while still being wanted by Senegalese authorities.

Finally, solutions need to be adapted to local contexts, with a focus on sustainable and realistic enforcement, and inclusive conservation solutions as opposed to targeted time-limited interventions.

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

DB and PB were involved in the conception of the project and the analysis, and drafted the manuscript. DB performed all data collection, quantitative analyses, and figure preparation. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Publisher's note

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