CONTRIBUTION 6.4

Use of a Maritime Domain Awareness Tool for Detecting Fishing Activity in the Waters of Caribbean States

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Abstract

Caribbean Community (CARICOM) Member States are concerned that Illegal, Unreported and Unregulated (IUU) Fishing and associated transnational organized crime in the fishing industry constitute a serious threat to their economies. Collectively, they undermine efforts to improve management and governance of resources, and jeopardize food security and blue economic development of these countries. Recently progress has been made in combating elements of IUU fishing. Monitoring, Control and Surveillance systems are now able to adopt the blended capability of many technologies to provide optimal, bespoke approaches. Maritime domain awareness tools, quickly and automatically detect deceptive movement of vessels which suggests questionable activity by vessels identified as fishing vessels. Using its Maritime Domain Awareness System (MDAS), the CARICOM Implementation Agency for Crime and Security can provide statistics on vessel movement that can be attributed to vessels engaged in fishing related activities, using evolving and frequently updated Artificial Intelligence Algorithms. Using a time series of reports produced by CARICOM IMPACS from its MDAS, we analysed movement of vessels identified as flag state fishing vessels for CARICOM Member States. In 2018, there appeared to be a trend of increasing fishing activity, from January to December, but a subsequent decrease was recorded in 2022. The average number of activity hours (the amount of time spent actively engaged in fishing) increased in 2022 to almost ten times the 2018 average. In 2018 and 2022, there were noticeable reductions in observed fishing activity from July to August. Venezuela showed the highest average annual fishing activity from 2019 to 2022. For fishing activity hours by CARICOM Member State vessels, Belize led the way. Increased fishing activity by "unknown" flags was observed from 2019 through 2022.

There is a wealth of data in MDAS reports that CARICOM Member States may not be utilising optimally. In-country discussions among fisheries administrations/agencies, coast guard agencies, defence force agencies, and maritime administrations regarding collaboration on data analyses can enhance the fight against IUU fishing. States should cooperate to improve understanding and knowledge of the problem, identify countermeasures, and build capacity to prevent, deter and eradicate IUU fishing and associated fisheries crime in the region.

KEYWORDS: IUU fishing, maritime domain awareness, fishing activity, fisheries crime, IMPACS

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1. INTRODUCTION

Caribbean Community (CARICOM) States have expressed concern that Illegal, Unreported and Unregulated (IUU) Fishing and transnational organized crime in the global fishing industry constitute a serious threat to the security and sustainable use of the living marine resources and marine biodiversity. They also undermine regional and national efforts to improve management and governance of the resources, and, therefore, jeopardize the food security and blue economic development of the countries of the region. The Castries (St. Lucia) Declaration on Illegal, Unreported and Unregulated Fishing which was adopted by the Second Special Meeting of the Ministerial Council of the Caribbean Regional Fisheries Mechanism (CRFM) on 28 July 2010, established a regional cooperative framework to prevent, deter and eradicate IUU Fishing in CARICOM Member States.

One of the objectives of the CRFM is "to promote the effective management and sustainable development of the living marine and other aquatic resources within the jurisdiction of Member States" (CRFM, 2002). Relatedly, an objective of the Caribbean Community Common Fisheries Policy (CCCFP), which guides the work of the CRFM, is "to prevent, deter and eliminate illegal, unreported, and unregulated fishing, including the promoting, establishment and maintenance of effective monitoring, control, and surveillance systems" (CRFM, 2020). Pursuant to these policy mandates, the CRFM Secretariat has continued its efforts and collaborations geared towards deterring, disrupting, preventing, and combating illegal, unreported, and unregulated fishing. The CARICOM Implementation Agency for Crime and Security (CARICOM IMPACS) also collaborates closely with the Regional Security System (RSS) and these efforts have been extended to other entities that are not typically included in the security architecture or cluster, including the CRFM (CRFM 2022a).

Even more recently, the CRFM Ministerial Council has opined that illegal, unreported, and unregulated fishing and related transnational organized crime in global fisheries constitute one of the greatest threats to fish stocks and marine ecosystems and continue to have serious and major implications for the conservation and management of ocean resources, as well as the food security and blue economic growth of many States, particularly Small Island Developing States (CRFM, 2022a, 2022b).

Distinct from IUU fishing, "fisheries crime" is an umbrella term used to describe criminal offences anywhere along the fisheries value chain (for example customs and fiscal fraud and money laundering). Such offences may be found in the State's marine living resource act or fisheries regulations but can also be "ordinary" common law offences or offences found in the criminal code and statutes, yet closely linked to the fisheries operation, extending into trade ownership structures and financial services associated with the sector; and may also be related to labour law, economic crime, or organised crime, as well as crime in legislation relating to accounting or health and safety.

Illegal fishing causes economic losses estimated at between US$10 billion and US$23.5 billion annually, and there is a significant correlation between governance and the level of illegal fishing (Agnew et al., 2009). Illegal fishing has also been linked to human rights violations, such as forced labour and human trafficking. Identifying and acting upon illegal fishing activity is extremely challenging. However, recent collective efforts, by governments, seafood buyers, and conservation groups, have resulted in progress being made in combating elements of IUU fishing.

Maritime Domain Awareness (MDA) is the effective understanding of things associated with the maritime environment that could impact the security, safety, economy, or environment. It facilitates detection, classification, identification, monitoring and investigation of vessels in order to understand their activities at sea (Lessing et al., 2006). The concerns of the administrations in charge of the maritime domain awareness are numerous (Gaspar et al., 2016). These include the prevention of accidents, particularly on ships which carry hazardous

material; detection of oil spills and generation of alerts for agencies in charge of oil spill operations ; support for anti-piracy operations; monitoring of maritime borders; monitoring of the fisheries; detection of illegal, unregulated and unreported fishing; the detection of illegal trafficking and smuggling; and supporting authorities in Search and Rescue (SAR) operations.

The use of a Maritime Domain Awareness System (MDAS) can assist administrations in addressing container tracking, illicit trafficking, piracy, irregular migration, pollution, and countering terrorism. It can also help in the strengthening of port security and overall maritime security (Morel et al., 2009). MDAS can also assist authorities in identifying possible IUU fishing activities. Recent efforts driven by the CARICOM IMPACS in collaboration with regional and international partners have resulted in progress made in the identification and addressing of IUU fishing activities in general and to enhance Monitoring, Control and Surveillance activities in the various Member States in particular.

Monitoring, Control and Surveillance (MCS) systems are now able to adopt a blended capability of many technologies to provide optimal, bespoke approaches (Verumar, 2020). Satellite data and wider intelligence can be used to focus patrol operations; patrol vessels can be deployed supported by unmanned aerial vehicles (UAVs), or patrol aircraft can be mobilised; for longer term deployments and deployments in selected operational settings, monitoring and surveillance using fleets of unmanned surface vehicles (USVs) / floating buoys may also be deployed. With flexibility to support a range of strategic and tactical operational enforcement requirements, a robust monitoring and surveillance capability is emerging as available for fisheries authorities' use (*ibid*.).

Presently, relatively few CARICOM Member States' fishing vessels are fitted with vessel monitoring systems (VMS) issued by competent authorities, and concomitantly with an automatic identification system (AIS) required by vessels of Flag States as part of the regulatory systems for ocean-going vessels. Notwithstanding this dearth of AIS operational in CARICOM fishing vessels, it is recognised that AIS is also a key factor when applying MDA technologies, which facilitates detection, classification, identification, monitoring and investigation of vessels in order to understand their activities at sea (Lessing et al, 2006).

The MDA technology primarily used by CARICOM IMPACS, quickly and automatically detects deceptive shipping and IUU fishing practices. It provides a real-time view of the maritime ecosystem, and offers AI-powered behavioural risk assessments of vessels; other information that is critical to the development of risk assessment and intelligence development for the benefit of fisheries administrations and law enforcement. It relies on thousands of real-life case studies and a vast array of parameters including vessel routes, dark activities, and unusual changes in the vessels' behavioural patterns . The system uses artificial intelligence (AI) algorithms that classify suspected fishing operations using pre-determined criteria to classify vessels operating within predefined IUU fishing behavioural 'hot zones', as involved in fishing operations.

Notwithstanding the preset algorithm of the MDAS, the identification of IUU fishing activities must be visibly identified/confirmed. From 2021 through 2022, outputs of the data on fishing activity hours were compiled daily and transmitted to the national security focal point at least twice a week or as specifically requested on a country-basis. CARICOM IMPACS shares monthly reports, emanating out of the MDAS, with the CRFM Secretariat.

2. METHODOLOGY

Using a time series of Excel reports for 2014 to 2022, produced by CARICOM IMPACS from the MDAS, where the behavioural model had identified vessels as conducting "fishing activities", we analysed these vessel activity hours for Member States, vessel of interest (VOI) flags (a.k.a. "flag State") by years and months.

Based on data compiled by vessel activity hours (the amount of time spent actively engaged in fishing) per Member State and vessel activity hours in the waters of Member States by VOI flag ("flag state"), we generated:

- total activity hours over the period 2014 to 2022;
- activity hours a month for 2018 and 2022 averaged across Member States;
- activity hours per month overall per Member State averaged across the years 2018 and 2022;
- activity hours averaged per year per Member State across all years, 2018 to 2022 combined;
- average activity hours per month per year across all Member States, 2018 to 2022;
- total fishing activity hours by all vessels in Member States' waters, 2019 to 2022; and
- total fishing activity hours by nationally flagged vessels in corresponding Member States' waters, 2019 to 2022.

For compiled data on vessel activity hours per VOI flag across Member State we generated total fishing activity hours recorded in Caribbean States' waters by Flag State (non-Member State flags) for 2019 to 2022 and total fishing activity by "unknown" flag States for 2019 to 2022.

Descriptive statistics and figures were produced in Excel (Microsoft 365) and/or Statistix 7.

3. RESULTS

Figure 1 shows an increasing trend in fishing activity observed from 2014 to 2022.

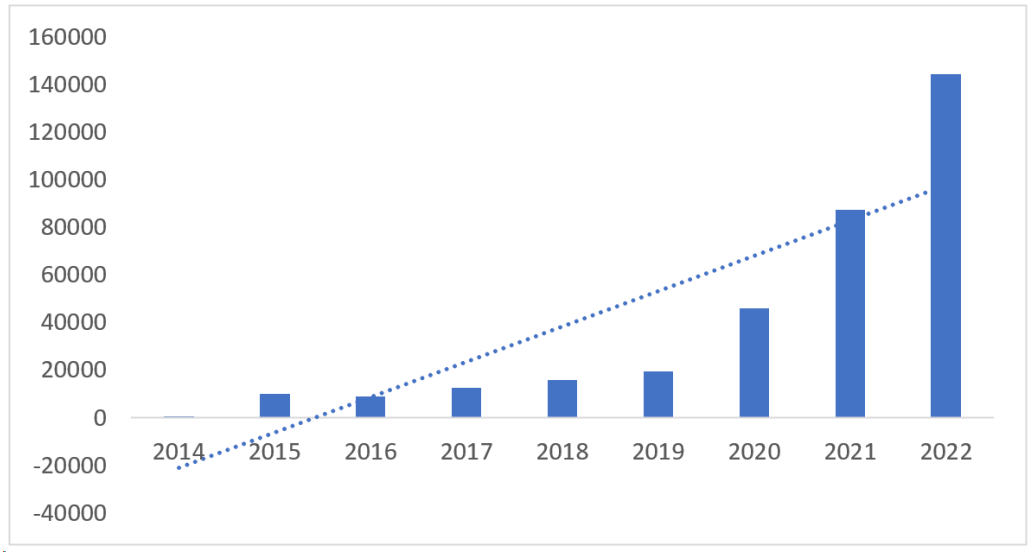

Figure 1. Trend in fishing activity observed via the MDAS 2014-2022

In 2018, as shown in figure 2, there appeared to be a trend towards increasing fishing activity from January to December: with, on average, 1,322 activity hours per month (standard deviation 472.81); Suriname, Trinidad and Tobago and Grenada felt the brunt of this (figure 3).

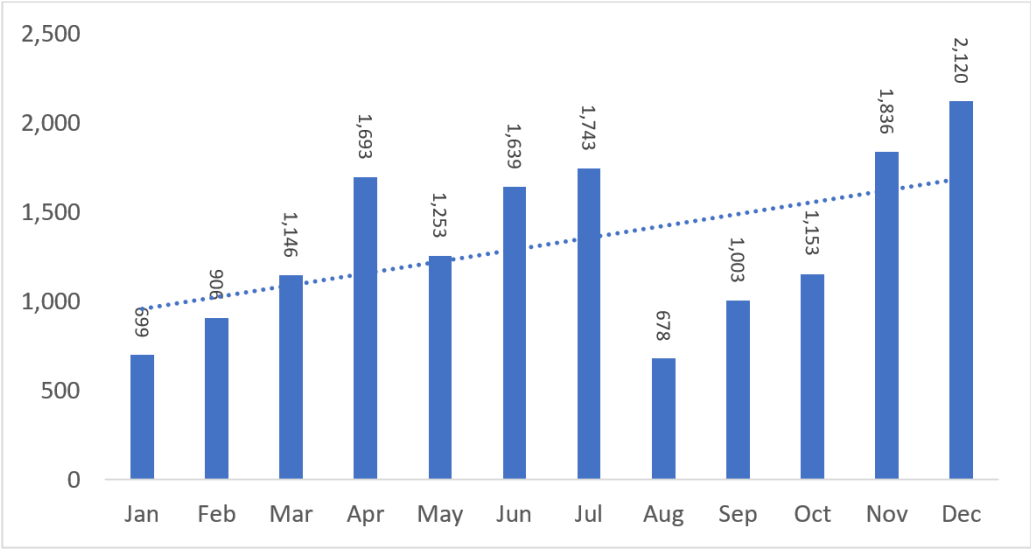

Figure 2. Total fishing activity hours for months across States for 2018 (Monthly average: 1,322; Standard deviation: 472.81)

In both 2018 and 2022 there is a noticeable reduction in observed fishing activity from July to August (61.1% - figure 2 and 34.0% - figure 4 respectively); before the upward trend continues again through to December in 2018 and November in 2022.

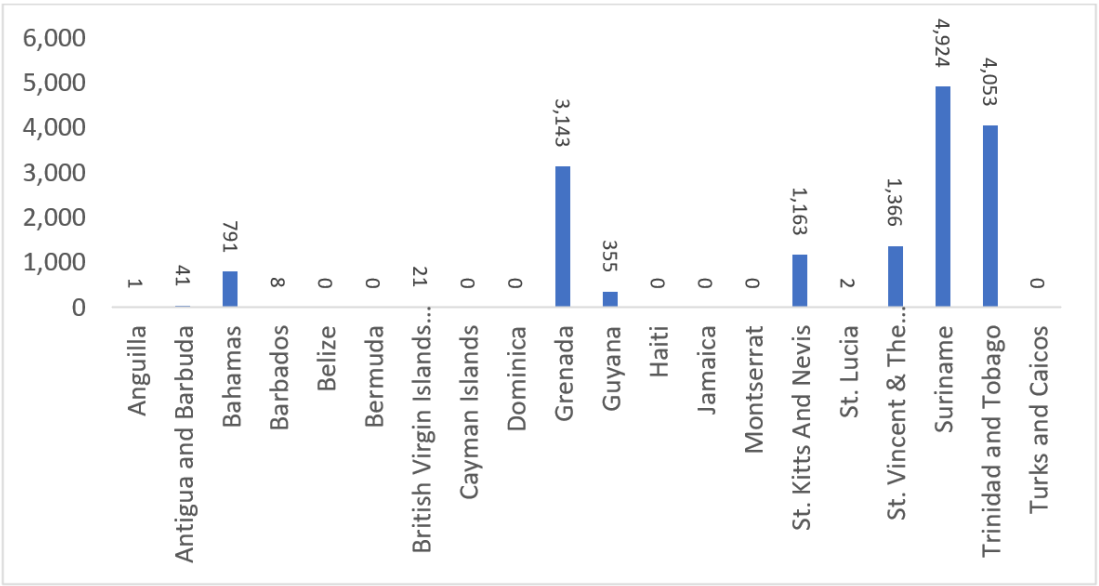

Figure 3. Total Activity hours for State across months for 2018 (State average: 1,511; Standard Deviation: 3,594.32)

In 2022 (figure 4), the trend suggests an overall decline from January to December, however the average number of activity hours increases to almost ten times the 2018 amount: on average 12,028 hours per month (standard deviation 4,223.83), with Suriname, Guyana and Trinidad and Tobago being mostly affected (figure 5).

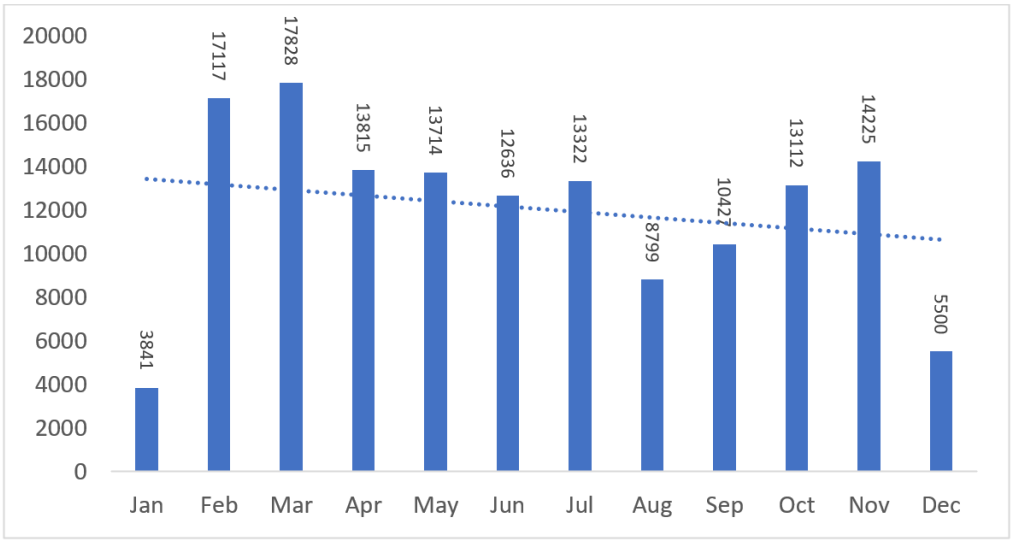

Figure 4. Total fishing activity hours for months across CARICOM Member States for 2022 (Monthly average: 12,028; Standard deviation: 4223.83)

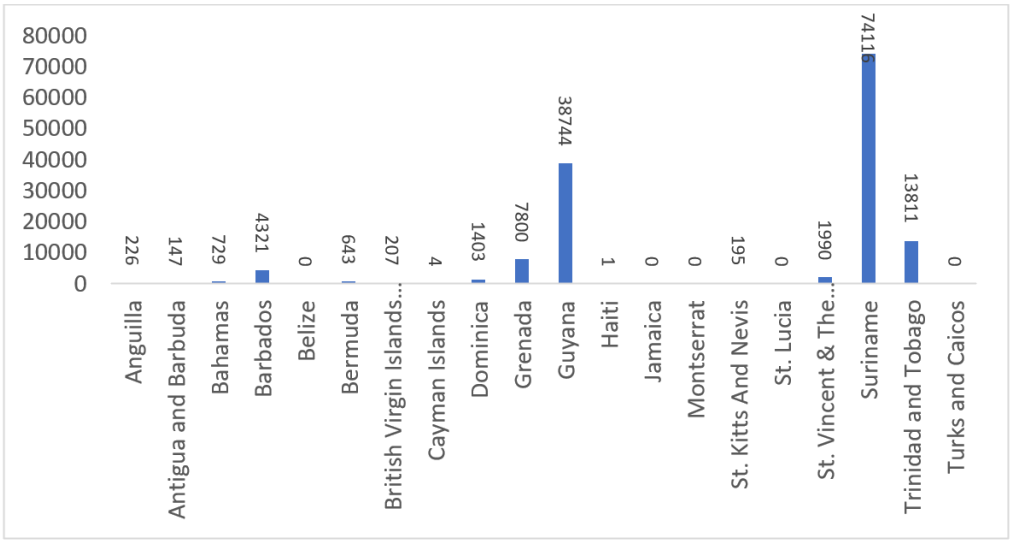

Figure 5. Total Activity hours for State across months for 2022 (State average 7,597; Standard deviation 18,521.84)

Table 1. Monthly comparison of fishing activity hours across all States, for the years 2018 and 2022.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avera	ST.DEV
2018	699	906	1,146	1,693	1,253	1,639	1,743	678	1,003	1,153	1,836	2,12	**1,322**	**472.8**
2022	3,84	17,11	17,82	13,81	13,71	12,63	13,32	8,79	10,42	13,11	14,22	5,50	**12,028**	**4223.8**

Figure 6 shows the total recorded fishing activity hours 2018 to 2022. When fishing activity of vessels of interest (flag state) is considered, vessels broadcasting as Venezuela on their MMSI number shows the highest average annual fishing activity hours (70,041) from 2019 to 2022; Venezuela's MMSI high level of fishing activity detected in CRFM States' waters in 2019 to 2022 is followed by a long margin by the United States (3,786) and China (3,083). Incidentally, the trend of Venezuela having a relatively high broadcast level was also observable in the first 4 months of 2023. The average fishing activity per year across flag States also increases from 2019 through 2022 (figure 7).

Fishing activity by vessels of some CARICOM State vessels are also captured by the MDA System: for 2019 to 2022, Belize led the way with 1837 average activity hours followed by St. Vincent and the Grenadines with 926 and Grenada with 813 activity hours respectively. When these are removed from the estimations, the increasing annual trend remains (figures 7 and 8).

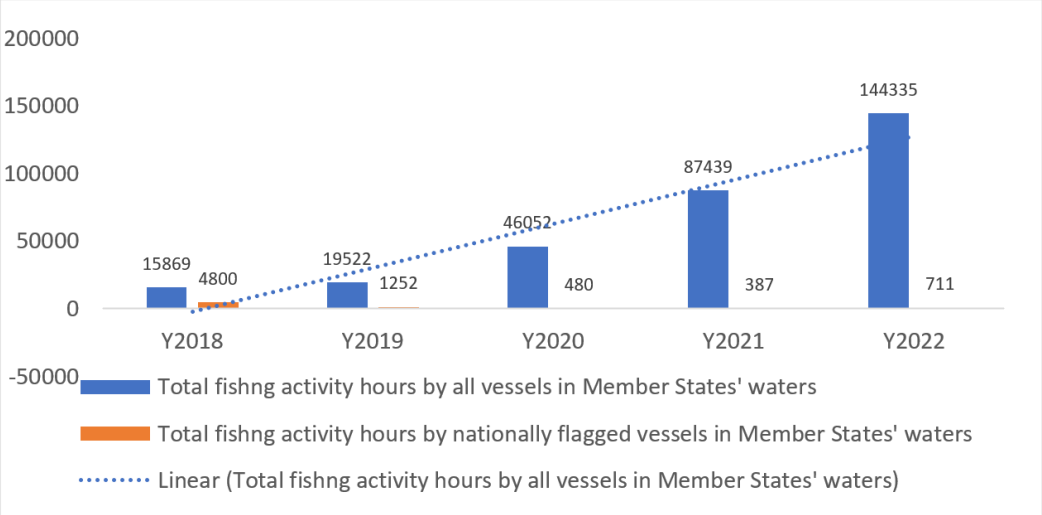

Figure 6. Total recorded fishing activity hours 2018 to 2022

Table 2. Comparison by CARICOM Member State/Territory between 2018 and 2022 of activity hours averaged by months

Year	Anguilla	Antigua and Barbuda	Bahamas	Barbados	Belize	British Virgin Islands	Cayman Islands	Dominica	Grenada	Guyana	
2018	1	41	791	8	0	21	0	0	3,143	355	
2022	226	147	729	4,321	643	207	4	1,403	7,800	38,744	
Year	Haiti	Jamaica	Montserrat	St Kitts and Nevis	Saint Lucia	St. Vincent and the Grenadines	Suriname	Trinidad and Tobago	Turks and Caicos Islands	Average per month	Standard deviation
2018	0	0	0	1,163	2	1,366	4,924	4,053	0	**835**	**1,514.33**
2022	1	0	0	195	0	1,990	74,116	13,811	0	**7,597**	**18,521.84**

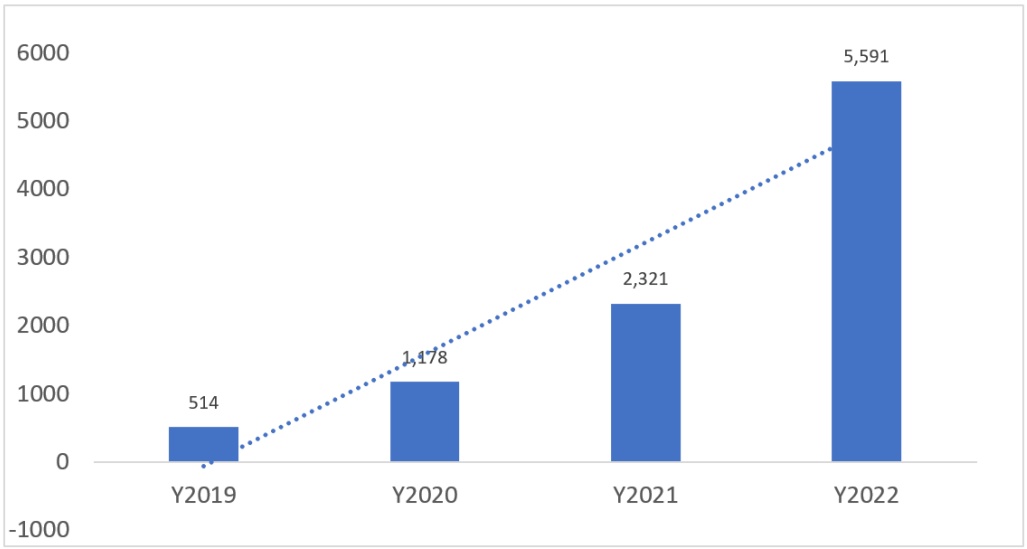

Figure 7. Average annual number of fishing activity hours across flag states for 2019-2022

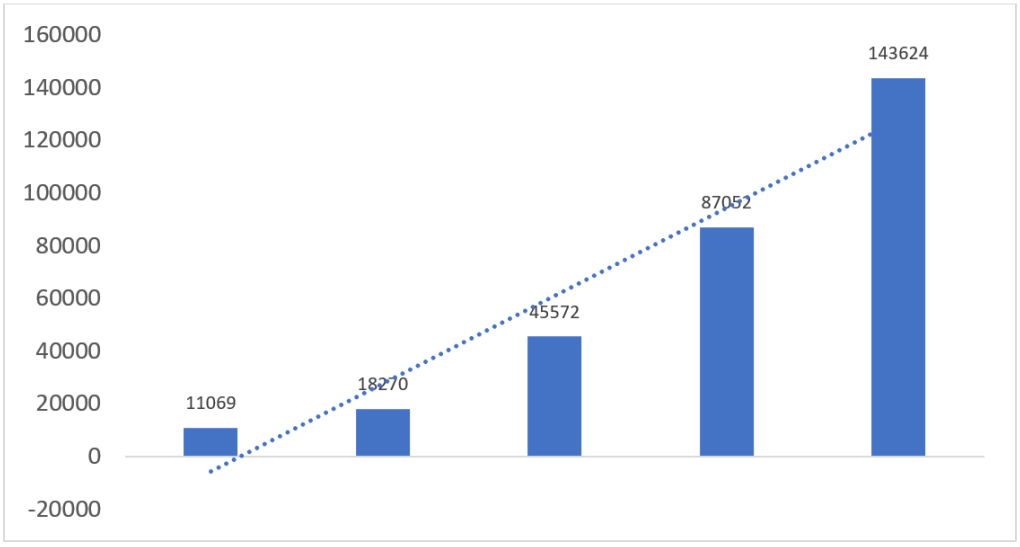

Figure 8. Total fishing activity hours by vessels not flagged by CARICOM States (incl. "unknown"); in CARICOM member States' waters 2018 to 2022

When fishing activity by "unknown" flags is considered, there is an observed increasing trend from 2019 through 2022 (figure 9).

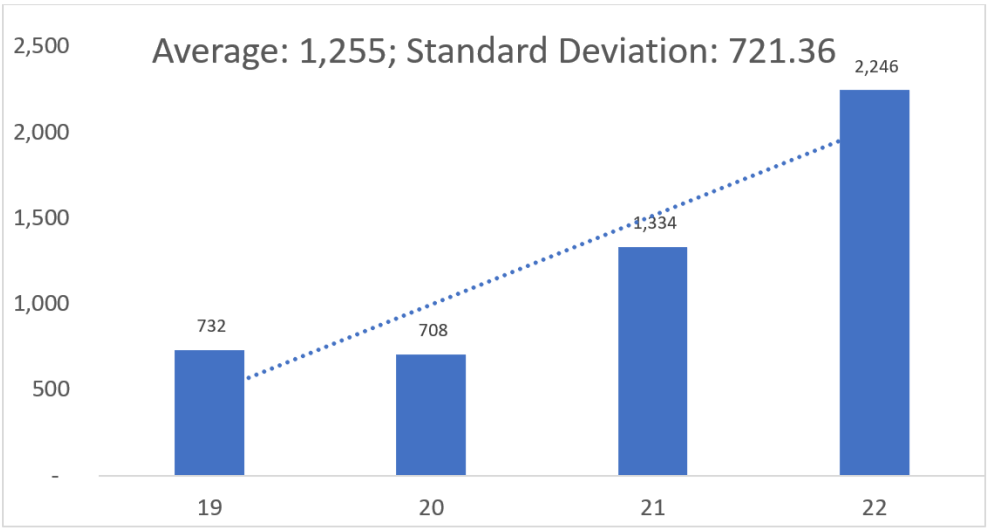

Figure 9. Observations of unknown vessels in CARICOM Member States 2019-2022

4. DISCUSSION AND CONCLUSION

The number of fishing activity hours identified by the CARICOM IMPACS' MDAS, increased from 200 in 2014 to about 16,000 in 2018 and further to 212,000 in 2022. Given that the artificial intelligence algorithm utilised by the MDAS, accurately recognises fishing activity, and that Member States have intimated that they have not granted licences for non-national vessels to fish in their waters and furthermore that few, if any, of their fishing vessels carry AIS, then the fishing activity captured by the MDA platform, is at least illegal and most definitely unreported. Consequently, it can be concluded that there has been a large increase in IUU activity from 2014 to 2022.

The technical team from Windward AI has suggested (Pers. Comm., 14 February 2023) that there is no definitive answer to explain the huge increase in fishing operations in the area. However, they suggest three possibilities:

- captured information from new AIS providers throughout the time; some of them, throughout the mentioned period from 2014 to 2018. As such there was more AIS coverage of vessels
- providers utilised new facilities to track ships, such as more antennas and satellites, which resulted in larger area of coverage.
- a general increase in fishing activities in 2018 (there was an 18% increase in global fishing operations according to FAO 2018); with this increasing trend continuing between 2018 and 2022 (FAO, 2020, 2022).

Given the relatively high variability of these activities across the years and among flag states; as well as in any given year (figure 3 and figure 5) and evidenced by standard deviation in tables 1 and 2, one is tempted to infer that these fishing (read IUU) activities are opportunistic rather than planned/targeted.

What is of concern, however, is the increasing trend in vessels of "unknown" origin carrying out these activities. If one assumes that these vessels' flags are unknown because the system cannot identify the flag states it begs the question that these are in fact "stateless" vessels (i.e., lacking proper registration, having no flag, or having two or more flags: Warner-Kramer and Canty, 2000); making the trend seen in figure 9 even more worrying.

Enforcement of fisheries laws generally lacks full integration as a critical element of national fisheries management cycles, primarily because of a number of factors (Murray and Singh-Renton, 2020). Foremost is an inadequacy of monitoring, control and surveillance units or departments. In addition, outsourced enforcement creates responsibility voids, which has not been helped by the fragmentation of responsibilities for fisheries management, trade, and enforcement across separate government departments and ministries. Also, there is a dearth of fisheries inspectors with adequate powers and mandates. These circumstances are further constrained by the relative paucity of MCS budgets (Singh-Renton and McIvor, 2015, cited in Murray and Singh-Renton, 2020). Quite possibly because of this, one of the biggest challenges faced by States is corroborating the "story" suggested by the MDA system data with information obtained *in situ*. Countries rarely seek to determine the veracity of the observed "fishing" activity, whether by their border control or fisheries agencies. This can also be posited as being mainly due to inadequacy of information sharing when vessel activity reports are received from CARICOM IMPACS, whether daily, bi-weekly, or monthly. Notwithstanding the wealth of data in the reports, States may not be utilising these data optimally.

One example of the utility of the MDA platform occurred when a non-CARICOM Member State fishing vessel was profiled in March of 2021 by CARICOM IMPACS, a Member State's Coast Guard and Fisheries Division in the North Atlantic. This vessel of interest had made its way through several MS EEZ finally entering the Member State's EEZ where it was stopped and boarded by coast guard and escorted to port, where it was searched in conjunction with the Fisheries Division for possible IUU fishing activities. There were also possible violations of ICCAT Recommendations. An analysis by CARICOM IMPACS has shown that the AIS was deliberately turned off and the vessel was engaging in dark activity on nineteen (19) separate occasions; the latest occasion lasted over seven (7) weeks from around the time it was apprehended. Going dark, oftentimes resulting from AIS disabling, near exclusive economic zones and loitering reefers is a risk factor for unauthorized fishing and transshipments (Welch, 2022; see also Ralby, Jones and Shurland, 2020). This vessel followed tracks similar to other vessels flying the same flag and AIS showed that it met with another vessel on several occasions, presumably to obtain fuel and other provisions to sustain its trip without calling to another port.

In another instance, in December of 2021, a suspicious vessel that had recently been in the Caribbean for the first time, broadcasting a false Maritime Mobile Service Identity number (MMSI: a unique 9-digit number that is assigned to a Digital Selective Calling radio or an AIS unit) and no IMO number (IMO ship identification number is a unique ship identifier which identifies a ship and does not change when the ship's owner, country of registry -the flag state or name changes), was picked up on the MDA platform and tracked through the waters of a number of CRFM Member States. A due diligence check on this vessel of interest revealed that there were several entities operating under the same name. These circumstances suggested that this could have been an additional vessel using the same generic identifiers and the same name and was operating in the area (while dark) previously. CRFM Secretariat in collaboration with CARICOM IMPACS monitored this vessel, shared information, and discussed this situation with fisheries, maritime security, and legal agencies. Any agency in the region had the authority, under international law, to board and search the vessel for suspected IUU fishing, or at a minimum, to board to confirm identity given that the vessel was broadcasting a false MMSI number and was not broadcasting an IMO number.

Currently, an evaluation of a fishing vessel's involvement in IUU fishing based on the behaviour exhibited by the vessel, for example dark activities, slow speed activities or meeting with other fishing vessels, is shared with the relevant authorities of Member States and serves to elicit appropriate action by national agencies. While this type of activity engenders suspicion, a definitive judgement cannot be made unless some action is taken at the national level and the vessels are intercepted in the action. Such corroborative action enables the

determination of whether the activity observed is illegal or simply contributing to unreported catches. Similarly, this dilemma occurs when Member States' fishing vessels are observed operating in other Member States' EEZs.

At the wider level, the Regional Security System Headquarters (RSS HQ), which organises/facilitates maritime security exercises between and among its Member States, has not been acting on these data *per se*, as there have been no specific requests from their Member States. The RSS HQ would only schedule maritime patrols (aerial and surface) in accordance with current/ongoing operations or routine missions. However, the RSS Air Wing (RSS AW) has supported, where practical, CARICOM IMPACS and other partners in operations with other law enforcement agencies: for example, when the system has detected vessels of interest, the RSS AW has conducted aerial reconnaissance to ascertain and/or confirm that the target vessels are situated in the location based on information acquired from the MDA system.

The use of an MDA system can enable greater insights into activities in the maritime space of the RSS area of operations, particularly with respect to the vessels using the AIS and their activities in these spaces (CRFM 2022a). Maritime law enforcement (MLE) units, which receive information directly, need to be better organized in utilizing the data, including carrying out trend analyses to improve planning and execution of fisheries patrols in their respective jurisdiction. In all cases, greater capability is required to facilitate routine (including aerial) operations extending to the outer limits of their jurisdictions. In this regard, RSS HQ's strategic direction 2021-26 (RSS, 2020) also provides for the enhancement of the human resource capacity in MCS and other planning activities aimed at strengthening operations. Programmes include (*ibid.*), but are not limited to:

- Increasing the efficiency of MCS with a view of preventing or reducing IUU fishing and improving MDA through a series of public awareness and sensitisation campaigns.
- Increasing the capacity for enforcement of regulations and other laws to effectively manage the living marine resources. This is intended to be achieved through continued work and collaboration with CRFM in the development of officers through various initiatives such as training in fisheries interdiction and prosecution and other related maritime policing duties.

The solutions most often proposed to eliminate IUU fishing are associated with increased governance and the rule of law, increased cooperation between regional management authorities in management and control activities, increased maritime assets to facilitate sustained territorial and EEZ patrols, increased capacity to undertake covert and overt surveillance, enforcement of port state control, and other means of reducing the economic incentives to engage in IUU fishing, such as increased sanctions and trade measures (Agnew, *et al*., 2009). At the national, sub-regional and regional levels, consideration should be given to incorporating the use of the data obtained from MDA systems into both the strategic and operational planning cycles. From these perspectives, we need to consider what these data may mean pertaining to managing security threats (Dr. Ian Ralby, Pers. Comm., 15 May 2023). In this context, there is an urgent need for in-country discussions among fisheries administrations/agencies, coast guard, defence force, maritime administrations (as relevant per country) focused on analyses of the data to determine the extant operating picture and highlight information that can assist the fight against IUU fishing. It has been noted (Widjaja *et al*., 2020) that some enforcement is hampered by the unwillingness of states to enforce the law against their own fishing fleets. Additionally, some states lack the facilities to conduct MCS. Accordingly, it is also critical for CRFM Member States to cooperate with other affected countries to improve understanding and knowledge of the problem, identify countermeasures, and build capacity to prevent, deter and eradicate IUU fishing and any associated fisheries crime.

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