FISH-i Africa

THE POTENTIAL USE OF AIS AS A FISHERIES MONITORING TOOL

FISH-i Africa unites eight East African coastal countries along the Western Indian Ocean, an unprecedented alliance which is showing that regional cooperation, coupled with dedicated analysis and technical expertise can stop illegal catch getting to market, and prevent illegal operators pursuing their lucrative business unhindered.

FISH-i Africa is a Stop Illegal Fishing initiative supported by The Pew Charitable Trusts and a Coordination Team made up of Stop Illegal Fishing, NFDS and Trygg Mat Tracking.

Further information on FISH-i Africa and downloadable FISH-i investigations are available at www.fish-i-africa.org

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The report offers an understanding of the potential and challenges of using automatic identification system (AIS) as part of monitoring, control and surveillance (MCS) operations and provides recommendations for the potential national and regional utilisation of AIS.

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TABLE OF CONTENTS

1	**EXECUTIVE SUMMARY**	**04**
1.1	What is AIS?	04
1.2	Key recommendations	05
2	**INTRODUCTION**	**06**
2.1	Legal mandate	06
2.2	Technology development	08
3	**AIS AS PART OF FISHERIES MCS**	**11**
3.1	The pros and cons of AIS	11
3.2	AIS combined with VMS	13
3.3	AIS combined with operational tools	14
3.4	AIS combined with dockside inspections	14
3.5	AIS combined with diplomatic and mulit-lateral engagement	15
4	**RECOMMENDATIONS**	**16**
4.1	Maximise AIS use by fishing vessels	16
4.2	Ensure access to AIS data	17
4.3	Utilise AIS analysis for MCS	17
5	**ANNEXES**	**18**
5.1	Acronyms and abbreviations	18
5.2	Endnotes	19

1 EXECUTIVE SUMMARY

The FISH-i Africa Task Force was formed in 2012, with the aim to improve cooperation, information and intelligence sharing to take enforcement actions against illegal fishing operators. To date the Task Force members have acted against several notorious illegal fishing operators resulting in over three million dollars collected in fines. The identification of illegal fishing vessels for the FISH-i Africa Task Force has been achieved in part through technical support utilizing the automatic identification system (AIS). To better understand the potential and challenges of using AIS as part of their monitoring, control and surveillance (MCS) operations, the FISH-i Africa Task Force has compiled information on the use, benefits and shortcomings of AIS.

1.1 What is AIS?

AISs are very high frequency (VHF) radio-based tools that support safe navigation and collision avoidance by automatically transferring information about the ship to other ships and coastal authorities. More recently AIS has been identified as a useful tool to contribute to fisheries enforcement efforts. Although fishing vessels are exempted from an International Maritime Organization (IMO) requirement that vessels above 300gt and engaged in international voyages use AIS, some flag and coastal States do mandate the usage of AIS by fishing vessels flying their flag or operating in their waters. In addition, large numbers of fishing vessels use AIS voluntarily as an aid to navigation, and as an operational and safety tool.

AIS receivers have been placed on low-earth orbit satellites since 2008, which has greatly increased coverage and means that AIS signals can be detected from vessels operating beyond the 40nm range of land-based AIS receivers. There are some technological limitations to AIS, however providers are continuously taking steps to improve AIS performance, including the recent launch of more and improved satellites. All of these factors have contributed to increasing the utility of AIS as a fisheries monitoring tool.

Like any other fisheries monitoring tool, AIS has advantages and disadvantages, and is most effective when used in combination with other approaches. AIS is the least expensive vessel monitoring system capable of both near shore and high seas monitoring, and has the benefit of transparency, as data is unencrypted and can be received by anyone with the appropriate equipment. However, software and analytical capacity is required to translate raw AIS data into usable intelligence and is an integral cost of using AIS.

AIS units are more susceptible to tampering than some other types of vessel tracking technology. AIS data is also subject to prosecutorial limitations – it generally cannot be used as the sole piece of

evidence to prosecute acts of illegal fishing, although it has successfully been used in proceedings with less strict evidentiary requirements, such as out of court settlements. However, AIS can be used very effectively in combination with other approaches – for example, to target the deployment of enforcement assets such as coastguard vessels and planes, and to provide intelligence to target and inform dockside inspections.

The strengths and weaknesses of AIS make it a suitable tool to complement the use of VMS (vessel monitoring systems). VMS are mandated by several flag states, coastal states and several regional fisheries management organisations (RFMOs). Whilst VMS units are more difficult to tamper with compared to AIS, they also have limitations, including lack of transparency and less continuous reporting (data is often reported every 1-4 hours). Use of both AIS and VMS transponders can therefore increase transparency and reliability and greatly reduce the likelihood of a vessel going dark due to actual or claimed system malfunction.

1.2 Key recommendations

To maximise the impact of AIS as a tool to reduce illicit fishing activities, coastal, flag and port States are recommended to:

- **Maximise AIS use by fishing vessels** – increase the number of fishing vessels transmitting AIS signals, by requiring AIS use through, where possible, regionally harmonised, coastal, flag and port State measures (including as a licensing and registration requirement) and RFMO conservation and management measures.

- **Ensure access to AIS data** – develop capacity and support to analyse AIS data, combining data from shore-based and satellite receivers supported by expert analysis of the data.

- **Utilise AIS analysis for MCS** – wherever possible support MCS operations and infraction investigations and prosecutions with AIS data and analysis.

2 INTRODUCTION

The Western Indian Ocean (WIO) is home to abundant fish resources that sustain a thriving fishing industry, which in turn supports local economies and provides food and jobs in the region and abroad. These resources also fuel one of the world's illegal fishing hot-spots – destroying the marine environment, robbing national economies, stealing food and livelihoods from local people, and undermining the legitimate industry. In response, eight countries – Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia and Tanzania – have joined forces to tackle this problem through an innovative network known as FISH-i Africa.

The FISH-i Africa Task Force was formed in 2012, with the aim to improve cooperation, and information and intelligence sharing to take enforcement actions against illegal fishing operators. To date the Task Force members have acted against several notorious illegal fishing operators resulting in over three million dollars collected in fines. Licences and port access have also been denied and vessels fishing illegally have been de-flagged. This alliance is demonstrating that regional cooperation, and information and intelligence sharing, coupled with dedicated data analysis, technical advice and strong political motivation, can slowly but surely turn illegal fishing into a high risk/low reward business instead of the low risk/high reward business that it has been for so long.

To date, the identification of illegal fishing vessels for the FISH-i Africa Task Force has been achieved in part through use of AIS information, a technology initially developed as a vessel identification and safety system, but increasingly used as a fisheries monitoring tool.

2.1 Legal mandate

AIS are very high frequency radio-based tools that support safe navigation and collision avoidance by automatically transferring information about the ship to other ships and coastal authorities. This information is formatted in a way that it can easily be displayed on an electronic chart, computer display or compatible radar[1]. AIS use first became widespread after it was mandated in the International Convention for the Safety of Life at Sea (SOLAS) from 31st December 2004 for all vessels 300 gt and greater engaged in international voyages, for all cargo ships of 500 gt and greater irrespective of their voyage type and for all passenger ships irrespective of size[2]. The International Maritime Organization (IMO) is the agency of the United Nations responsible for these standards. An exception to this regulation exists that allows flag States to determine whether this requirement applies to fishing vessels flying their flag, regardless of size or voyage type. Per the Convention, a fishing vessel is defined as 'a vessel

used for catching fish, whales, seals, walrus or other living resources of the sea'[3]. Therefore, while no binding international mandate for AIS carriage on fishing vessels currently exists, fishing support vessels such as reefers and transhipment vessels that meet the Convention's size and voyage type requirements are subject to the requirement for AIS.

The use of AIS has increased extensively since 2004 as flag States have mandated its use by most commercial vessels that fly their flag and coastal States have mandated its expanded use in their coastal waters[4]. In some instances, this has included a mandate for use by fishing vessels. In addition, large numbers of fishing vessels use AIS despite no mandate requiring them to do so. As an example, for major distant water fishing nations with vessels fishing globally the following mandates and usage levels apply:

Table 1: AIS mandate and usage by distant water fishing nations.

Flag State	AIS mandate and use for fishing vessels
Taiwan (Province of China)	No flag State mandates, however a search of a free AIS viewer showed over 2,500 Taiwan-flagged vessels equipped with AIS, 1,427 of which reported being fishing vessels[5].
European Union members	All EU member-country-flagged fishing vessels greater than 15 meters are required to operate AIS[6].
Japan	No flag State mandates, however a search of a free AIS viewer showed over 4,102 Japan-flagged vessels equipped with AIS, 426 of which reported being fishing vessels[7].
Republic of Korea	AIS is required for vessels flagged by South Korea. A search of a free AIS viewer showed over 4,825 Korean Republic-flagged vessels equipped with AIS, 810 of which reported being fishing vessels[8].
People's Republic of China	AIS reported to be required for People's Republic of China-flagged vessels, legal mandate is unclear[9]; a search of a free AIS viewer showed over 60,638 People's Republic of China flagged vessels that reported being fishing vessels are equipped with AIS[10].

There is emerging evidence that as higher risk fishing operations become more aware of the level of monitoring of AIS by countries and organisations interested in combating illegal

fishing, they will turn off or tamper with their signals. This may be linked to the launching of 'public' AIS monitoring platforms, that allow any user to access AIS data from fishing vessels online (although not in real time) [11]. While a comprehensive analysis of whether fishing vessels have been reducing their use of AIS has not been conducted, several high-risk vessels associated with illegal, unreported and unregulated (IUU) fishing activities in the FISH-i Africa region have displayed behaviour such as systematically turning AIS off as they enter fishing grounds, or are now not broadcasting at all[12] . Non-compliance with flag State AIS mandates are generally dealt with administratively and fines, when imposed, are low.

To date no RFMO has required AIS use by fishing vessels authorised to fish in the waters they manage, in part because most have already mandated and invested in VMS. However, the Pacific Islands Forum Fisheries Agency (FFA) maintain a regional vessel register and mandate the use of AIS for any foreign fishing vessel wanting to be licensed to fish in FFA member waters, this is in addition to VMS and requires the vessel to be tracked on VMS and AIS port to port, wherever the vessel goes.

Key points:

- **AIS was originally designed and mandated for use as a navigational safety tool on large commercial vessels.**
- **There is no international legal mandate that requires fishing vessels to use AIS; fishing support and transhipment vessels 300 gt and greater engaged in international voyages, or 500 gt and greater irrespective of their voyage type, are required to carry and use AIS.**
- **There is an expanding number of national-level legal mandates requiring AIS use by fishing vessels, and many thousands of fishing vessels also opt to use AIS voluntarily.**

2.2 Technology development

When AIS was first developed, only a single type of vessel transponder was available, known today as 'Class A' transponders. A lower-cost and slightly less robust version of AIS, called 'Class B' became available in 2006 , a comparison of the capabilities of the two receivers can be found in Table 2.

Table 2: Comparison of Class A and B AIS capabilities

	Class A	Class B
Vessel identity information transmitted	• Maritime mobile service identity (MMSI) number • IMO number when available • Vessel call sign & name • Type of ship • Length and beam • Ship's draught • Hazardous cargo (type) • Safety-related message (free-form)	• Maritime mobile service identity (MMSI) number • Vessel call sign & name • Type of ship • Length and beam

Vessel location/ navigation information transmitted	• Ship's position with accuracy indication and integrity status; • Position time stamp; • Course over ground; • Speed over ground; • Heading; • Navigational status (e.g. at anchor, underway, etc. manual input); • Rate of turn; • Destination and ETA; • Route plan (waypoints)[13].	• Ship's position with accuracy indication and integrity status; • Position time stamp; • Course over ground; • Speed over ground; • Heading.
Antenna Wattage	12 W (minimum)	1-3 W (2 W average)
Average Reporting rate	Every 2 seconds	Every 30 seconds[14]
Likelihood of Detection?	Nearly 100% by vessels and land-based stations, 99% by satellites	83% by vessels and land-based stations[15] [16].. satellite performance known to be less than Class A but exact percentage unknown.
Unit Cost	≥ 2,000 USD	≥ 600 USD

Initially AIS transponders were only visible to coastal authorities by the use of shore based stations that, in ideal conditions could 'see' a maximum of 40 nm from their position, and only within 20 nm consistently.[17]This was directly limited to the limits in range of VHF radio signals. In 2005, the United States Coast Guard began testing the viability of deploying AIS receivers onto existing deep-water off-shore weather buoys, and completed its installation on buoys at key locations by 2007. These 'remote' AIS detection platforms can detect vessels at a maximum range of 40 nm; it should be noted that these buoys are very large with the VHF antenna height above the surface of the water being on average six meters, smaller buoys would have smaller effective ranges of detection[18].

In 2008, satellite detection became possible when both private companies and governments began deploying AIS receivers on low earth orbit satellites. This was previously thought to be impossible before modern advanced big-data processing capabilities were developed, since the satellite receivers can, in high-traffic areas, 'see' and have to process the signals of up to 8,000 vessels at one time. The technology was far from perfect when it was first operationalised; vessel signals would be 'dropped' in areas of high density, vessel information could become garbled and information could be delayed being relayed to operations centres for hours[19]. In addition, Class A transponders are more likely to be detected by S-AIS than Class B because of their higher transmit power, higher frequency of transmissions, and because Class A vessel VHF antennas are typically positioned much higher on the vessel[20]. These issues were serious enough in the technology's infancy that the International Telecommunication Union (ITU) recommended in 2009 that Class B AIS be excluded from Satellite-AIS (S-AIS) altogether to limit the number of vessels being detected at one time[21]. Needless to say this would have posed a significant problem should it have been enacted, as a large proportion of fishing vessels that carry AIS voluntarily have opted to use the less expensive Class B transceivers.

Since that time the two-leading private satellite AIS providers, OrbComm and exactEarth, have both

taken steps to improve S-AIS performance. Both have increased the number of satellites receiving AIS information, the number of base stations downloading the information from these satellites, and the technology used to process the data these satellites receive has improved[22]. These steps have most markedly decreased the incidences of receiving garbled information about vessels, and the delay with which the information is received. In addition, exactEarth has partnered with a Class B AIS transponder company to develop a system specifically developed to guarantee visibility of that specific Class B transponder from S-AIS[23]. This technology has yet to be fully tested in practice, however, nor does it solve the problem that the detection of most Class B AIS transponders in high-vessel-density areas is still unreliable. Therefore, it still should be expected that in these areas a significant number of Class B vessels will not be detected.

In 2017 exactEarth announced the launch of their second generation constellation of satellites, which will offer a continuous, global real-time ship tracking capability[24] and improved vessel detection rates and instantaneous downlinking of AIS information.

Trials are also taking place to test a system specifically developed to guarantee visibility of a Class B transponder from S-AIS[25] in several African coastal States on small-scale fishing vessels, where VMS are impractical. These AIS are promoted to fishers primarily as a safety tool that is also used to monitor vessel movements. However, the detection of most Class B AIS transponders in high-vessel-density areas can still be unreliable, and it should be expected that in these areas a significant number of Class B vessels will not be detected.

Key points:

- There are two types of transceivers that vessels may carry; Class A, which are much more capable but also more expensive and are mandated by the IMO for vessels subject to SOLAS regulations, and Class B which are more accessible and common on smaller commercial vessels including fishing vessels.
- Vessels carrying AIS transponders can be detected by other vessels, shore-based stations and satellites, shore-based stations are limited to a reliable detection range of 20nm.
- Satellite AIS receivers will not consistently detect all Class B AIS-equipped vessels, especially in areas of high congestion.

3 AIS AS PART OF FISHERIES MCS

3.1 The pros and cons of AIS

AIS, as any other tool used in fisheries enforcement has both benefits and shortcomings in its performance. These pros and cons of AIS use are summarised in the table below, and further discussed later in this section.

Table 3: Benefits and shortcoming of AIS use as a fishing vessel monitoring tool.

Pros	Cons
Cost – AIS is the least expensive vessel monitoring system capable of both near shore and high seas monitoring.	**Analysis required** – AIS data requires evaluation to be useful, which adds time and cost to the MCS system.
Transparency – Data is transmitted via unencrypted radio frequencies anyone with the appropriate equipment can receive.	**Susceptible to tampering** – Data transmitted, including vessel identification and location information, can be changed.[26 27 28]
Prevalence – Hundreds of thousands of vessels already carry AIS transponders.	**Prosecutorial limitations** – Generally cannot be used as the sole piece of evidence to prosecute illegal fishing acts.
Complementary – Provides data that complements existing fisheries enforcement tools.	**Industry resistance** – 'Proprietary' and 'sensitive' vessel fishing information can be easily acquired
Existing legal mandates – Many flag and coastal States have mandated its use on fishing vessels.	
Quantity of data – Although transmissions from VMS are received in near real time, the frequency of reporting is in practice usually not more often than every 1-4 hours. AIS reporting from both Class A and B units is much more frequent, and provide better data for analysing vessel movements.	
Coverage – AIS provides the opportunity to identify vessels other than those that are already licensed and most likely transmitting VMS. This includes not only fishing vessels, but other vessels that are engaged in fisheries operations, such as reefers and tankers – which are also of relevance to fisheries authorities	

While AIS is by no means a single all-encompassing solution to illegal fishing, its cons should be analysed with some additional perspective. All vessel tracking systems require some degree of analysis for the data to be made useful for fisheries enforcement purposes. Vessel tracking systems provide the very important information of where a vessel is and when the vessel is in that location; this information must be analysed against vessel licence databases and national and international regulations to turn this positional information into indicators of compliant or non-compliant activity.

AIS' susceptibility to tampering, also known as 'spoofing' is a real challenge. Manipulation of vessels' reported positions is becoming increasingly common and 1-2 % of all ships report fake vessel names and identification numbers on their AIS.[29] [30] Several cases investigated by FISH-i Africa, such as that of the CHI HSIANG NO. 7, show deliberate falsification of AIS and vessel identity. Vessels also attempt to hide their true position by either simply entering false positions into their AIS transponder, or by disconnecting their GPS; however, vessels can also accidentally report incorrect or no positions. Fisheries authorities must be cognisant of the security measures put in place by the data provider that they might choose to use, as incidents have proven that free AIS web viewers are susceptible to hacking.[31]

Analysis of AIS tracks can be used to identify indications of high-risk activity, including:

- Vessels turning off tracking systems such as AIS for significant periods while in national EEZs;
- Reefers stopping and/or moving very slowly at sea for significant periods in a pattern possibly indicative of transhipment activity;
- Vessels being uncooperative when inspections are required;
- and, reports from several sources of reefers and fishing vessels coming together at sea.

Transhipment (the transfer of cargo) from fishing vessels is made to refrigerated cargo vessels, commonly known as reefers. While many fishing vessels do not broadcast AIS, most reefers are required to carry AIS while operating and analysis of their tracks can indicate risk activity for illegal fishing or illegal transhipment.

AIS signals are not uniquely used by vessels and can be associated with other types of objects, including some aircraft and aids to navigation, the increased use of AIS on fishing buoys can significantly increase the number of signals seen from fishing grounds. Whilst some AIS units on buoys are programmed to transmit a name that clearly indicates their status, much of the fishing gear that is observed through AIS does not transmit any information to indicate that it is not a vessel.

To date, there have been no cases in which illegal fishing activity was proven in a court of law using AIS data alone. However, AIS has been successfully used as the sole piece of evidence of illegal fishing activity in proceedings that have less strict evidentiary requirements, such as in out-of-court settlements.[32] Also, given that AIS can be used to prove where a vessel was and at what time, it can provide an essential piece of evidence, in conjunction with other documents (logbook or observer data, for example), to prove illicit activity.

Key points:

- **AIS cannot be used as a standalone tool to detect and prosecute illegal fishing in a court of law, however, it has been successfully used to prove illegal fishing in out-of-court settlements, which have simpler evidentiary requirements.**
- **Shortcomings of AIS can be managed with the use of easily accessible mitigating measures, including complementary fisheries enforcement tools that will be described in the following chapter.**
- **A broad array of vessel transponders and receivers exist, each have their own unique benefits and shortcomings and if transponders are to be required by a State, a detailed analysis of these is required.**
- **The strength of AIS becomes apparent when it is paired with complementary fisheries MCS tools and tactics.**

3.2 AIS combined with VMS

VMS are fisheries management and monitoring tools used in commercial fishing. They were designed specifically for allowing fisheries management organisations to monitor the position, course and speed of fishing vessels and, in some units, to receive frequent catch reporting data. VMS are satellite-based systems, for which transmission occur either at pre-defined intervals, or at both pre-defined intervals and random times allowing fisheries monitoring centers to request information on-demand. [33]

VMS are mandated at both the national and international level. At the national level, the United States and all European Union countries, amongst many others, require the use of VMS by vessels that fish in their coastal waters. To control their vessels, some major flag States, such as the Republic of Korea, also require use of VMS at all times by all fishing vessels that carry their flag. At the international level, nine RFMOs mandate the use of VMS by vessels authorised to fish the waters they manage. The Indian Ocean Tuna Commission (IOTC) is one such RFMO.[34]

Table 4: Status of AIS and VMS provisions in FISH-i Africa national legislation and functionality

FISH-i Africa State	Provision in national legislation for:				AIS operational?	VMS operational?
	national fishing vessels outside of the EEZ to have:		foreign fishing vessels inside the EEZ to have:			
	AIS	VMS	AIS	VMS		
Comoros	No	Yes	No	Yes	No	No
Kenya	No	Yes	No	Yes	Testing Sea Vision with Navy	Yes
Madagascar	No	Yes	Yes	Yes	Yes (CLS)	Yes
Mauritius	Yes*	Yes	No	Yes	Yes	Yes
Mozambique	No	Yes	No	Yes	Marine Traffic occasionally used	Yes
Seychelles	No	Yes	No	Yes	Marine Traffic occasionally used	Yes
Somalia	No	Yes	No	Yes	No	No - New VMS in 2018
Tanzania	No	Yes	No	Yes	Testing Sea Vision with Navy	Yes

* Fisheries and Marine Resources (Automatic Identification System) Regulations 2016. The Regulations require all licensed fishing vessels between 12 and 24 meters to have a Class B AIS transponder and all vessels 24 meters and over to have a Class A AIS transponder.

The inherent weaknesses and strengths of VMS and AIS for fisheries monitoring are generally complementary. For example, AIS signals are totally transparent and unencrypted, while VMS signals are only visible to a narrowly-defined group of members of a national or international organisation. Alternatively, AIS signals can be manipulated to transmit inaccurate information more easily than VMS, for which the most viable tampering approach is faking a unit malfunction by cutting its power supply or blocking its signal. This complementarity provides an opportunity if both AIS and VMS carriage by fishing vessels is mandatory as this increases the transparency of fishing vessel movements with the AIS transponders, and increases the reliability of the vessel position data with the VMS transponders. The chance of both a VMS and AIS unit malfunctioning at the same time are very small and manipulation of both systems to show an identical false vessel position would be extremely difficult.

The Forum Fisheries Agency (FFA) in January 2015, mandated both AIS and VMS use for all vessels licensed to fish in FFA member waters.[35] There is currently no RFMO that mandates AIS, but nine require the use of VMS. Given the low cost but high potential benefit that could be gained, consideration of an AIS mandate by RFMOs such as the IOTC is recommended. [36]

3.3 AIS combined with operational tools

Operational tools including surface patrol vessels and patrol aircraft, either manned or unmanned, are common tools used to detect non-compliance with fisheries regulations. Indeed, some types of regulations that require affirmative action by fishers while fishing (such as release or retention of bycatch, or the use of specific types of fishing equipment) also require an on-scene presence to detect violations. One universal challenge in successfully executing these types of patrols, however, is finding the 'right' fishing vessels to inspect. This is when the information AIS provides can prove to be vital to identifying illegal activity.

Fundamentally, AIS provides proof of a vessel's location at a certain time and can provide strong indications of fishing or transhipment activity at that place and time. The information AIS provides does not have to able to be upheld as incontrovertible proof in a court of law for it to be considered high-quality actionable intelligence. Such strong indicators of on-the-water activity provide excellent intelligence that can then be used to target operational assets in a way that maximises their utility.

For intelligence to be useful for targeting patrol vessels and aircraft, it needs to be recent, reliable and substantive. AIS received by shore-based AIS stations is near-instantaneous, and by satellite is delayed by minutes or at most an hour. Assuming the information can be transmitted to the patrol assets in a timely manner, intelligence derived from AIS data can be easily provided to patrol assets quickly enough to be useful. AIS is, compared to most actionable intelligence, highly reliable. The previous section discussed the emerging problem of AIS tampering, which is a growing concern. However, AIS has proven that it provides substantive information in cases that FISH-i has successfully executed, such as for the F/V PREMIER.

If patrol assets are equipped with AIS, this assists in identifying the 'right' fishing vessel as they often operate in close proximity to each other and they can move from their last reported position quite quickly. Shipboard AIS units have the capability of receiving AIS signals 20nm or more from the vessel, and aircraft can receive signals from even greater distances, greatly decreasing the time it takes to find the target fishing vessel.

3.4 AIS combined with dockside inspections

Dockside inspections are an enforcement tactic used by port authorities to detect illegal activities. However, finding evidence of suspect activity in hundreds of pages of logbooks or other types of documentation can often prove a time-consuming, fruitless task when not focused by intelligence. As AIS is useful for targeting patrol vessels, it can also be useful for targeting dockside examinations. Indications of suspect activity detected using AIS can help port inspectors to choose to inspect vessels that have demonstrated indications of having violated laws. In addition, once onboard the vessel, intelligence gathered from AIS can point inspectors to evaluating specific dates in logbooks. Given that the inspector can know where and when the vessel was operating and likely fishing, discrepancies become rapidly apparent, targeting further investigation and ultimate prosecution.

In addition, with the near-real time receipt capabilities of shoreside AIS, port authorities can have a current picture of fishing vessels entering port. This can allow inspectors to be on-scene for suspect vessel arrivals that might have otherwise gone unnoticed late at night, on public holidays or during busy periods of the day. For dockside inspections, intelligence does not need to be real time as AIS intelligence can be gathered and saved in national or shared suspect vessel watch lists or other databases, to be accessed and used when the opportunity arises.

3.5 AIS combined with diplomatic and multi-lateral engagement

Diplomatic and multi-lateral engagement is an important tool in deterring and prosecuting illegal activity that includes diplomatic approaches to vessel flag States notifying them of illegal activity conducted by a vessel carrying their flag and requesting action, or requesting the listing of a vessel on an RFMO IUU fishing list. For both, having adequate proof of illegal activity is very important. Nearly all fisheries law is in some way location-based; even if a law applies throughout a country's EEZ, it must be proven that a vessel was operating in the EEZ. In one recent example, AIS data proved the location of the transhipment vessel DAMANZAIHAO in the South Pacific RFMO area, which when combined with additional evidence of illegal operations in that area ultimately resulted in the vessel being listed on the IUU fishing vessel list.[37] [38]

Key points:

- A system that combines mandatory AIS and VMS information creates a vessel tracking system that is much more reliable and difficult to tamper with than AIS or VMS alone.
- AIS can provide valuable intelligence that would otherwise not be available on a vessel's position and likely activities, this can be used to target on-the-water or on-the-ground actions, the efficiency of operational assets and the likelihood of positive outcomes are greatly increased.
- The use of AIS to prove vessel location is a key piece of evidence necessary for diplomatic approaches and requesting listing of vessels on IUU lists.

4 RECOMMENDATIONS

The following are recommendations for the application of AIS going forward that will help to maximise its impact on illicit fishing activity.

4.1 Maximize AIS use by fishing vessels

Many fishing vessels already carry and transmit AIS on a voluntarily basis, there are legitimate concerns and evidence that this number could rapidly decrease as awareness of its use as a vessel tracking tool increases. An increase in the number of vessels that are required to carry AIS by coastal, flag and port State regulations, and international conservation and management measures will help to stop this trend. Options to mandate for AIS include:

- Flag States mandate that **all fishing vessels carrying their flag** over a reasonable size carry and operate AIS units. As an example, EU-flagged vessels over 15 meters are required to carry and operate AIS.[39]

- Coastal States mandate that **all fishing vessels permitted to fish in their waters** carry and operate AIS units. As an example, all FFA member nations have already taken this step effective January 2015.

- Port States mandate that **all fishing vessels permitted to enter their ports** carry and operate AIS units. As an example, the port of Phuket, Thailand has required that all foreign vessels, regardless of size or type, have an operational AIS onboard if they pull into port.

- Coastal States **mandate that all vessels operating in their waters carry and operate AIS units**. This has been executed in various ways by many countries; the United States requires all commercial vessels 20 meters and greater operating in their navigable waters to operate AIS.

- Coastal States act in regional cooperation and **mandate AIS carriage requirements as a unified region**. Again, there is precedence for this action in the FFA's recent resolution.

- Coastal States propose the adoption of **AIS carriage requirements for RFMOs**. Combining AIS and VMS into a single vessel tracking monitoring system greatly decreases the opportunity for tampering and increases fisheries authority awareness of on-the-water activity. While there is currently no RFMO that mandates AIS carriage beyond existing IMO requirements, there is documentation of national authorities supporting RFMOs, including the North Pacific Anadromous Fish Commission (NPAFC), using AIS as an enforcement and surveillance tool. [40]

The implementation of any or all the strategies above would be strengthened if harmonised in requirements, timing and action across regions.

4.2 Ensure access to AIS data

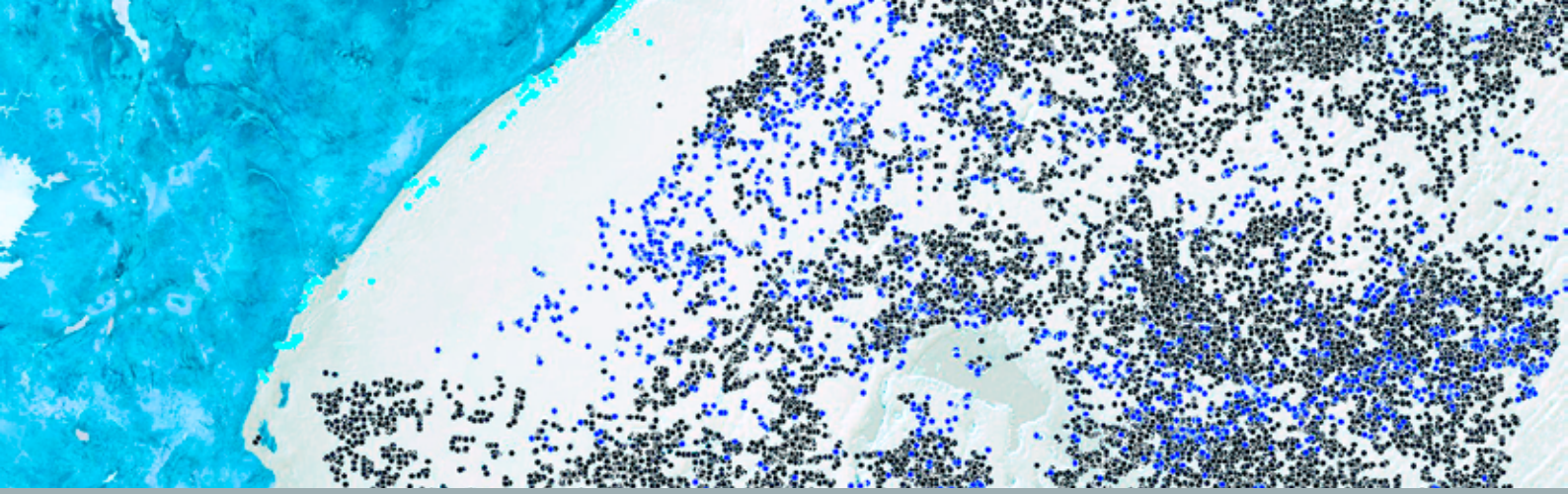
AIS information can be accessed both by shore-based and satellite-based monitoring systems, and to be made useful it must be evaluated for indications of illicit or suspect activity. General recommendations include:

- **Consider a system that combines both shore-based and satellite-based systems**. To monitor vessels operating more than 40nm from shore S-AIS data is required. For closer proximities shore-based systems provide real-time information and do not suffer the same limitations in receiving Class B AIS signals or dropping vessel signals in high density areas.

- **Analysis of AIS data is essential and should be included in cost considerations**. In its rawest form, an AIS data feed will provide the user with hundreds of thousands of data points in a single day. Without human expertise and software tools that can translate this data into usable intelligence, AIS will have minimal utility to MCS operations.

4.3 Utilise AIS analysis for MCS

The use of AIS intelligence data increases the efficiency of operational assets and increases the likelihood that violations will be found by fisheries officers. It also can provide a key piece of evidence when engaging in bilateral or multilateral diplomatic correspondence. The use of AIS intelligence data in these contexts is strongly recommended.



5 ANNEXES

5.1 Acronyms and abbreviations

AIS	Automatic identification system
EEZ	Exclusive economic zone
ETA	Estimated time of arrival
EU	European Union
FFA	Forum Fisheries Agency
gt	Gross tonnage
IMO	International Maritime Organization
IOTC	Indian Ocean Tuna Commission
ITU	International Telecommunication Union
IUU	Illegal, unreported and unregulated (fishing)
MCS	Monitoring, control and surveillance
MMSI	Maritime mobile service identity
NFDS	Nordenfjeldske Development Services
NPAFC	North Pacific Anadromous Fish Commission
RFMO	Regional fisheries management organisation
S-AIS	Satellite automatic identification system
SIF	Stop Illegal Fishing
SOLAS	International Convention for the Safety of Life at Sea
TMT	Trygg Mat Tracking
US	United States
VHF	Very high frequency
VMS	Vessel monitoring system
WIO	Western Indian Ocean

5.2 Endnotes

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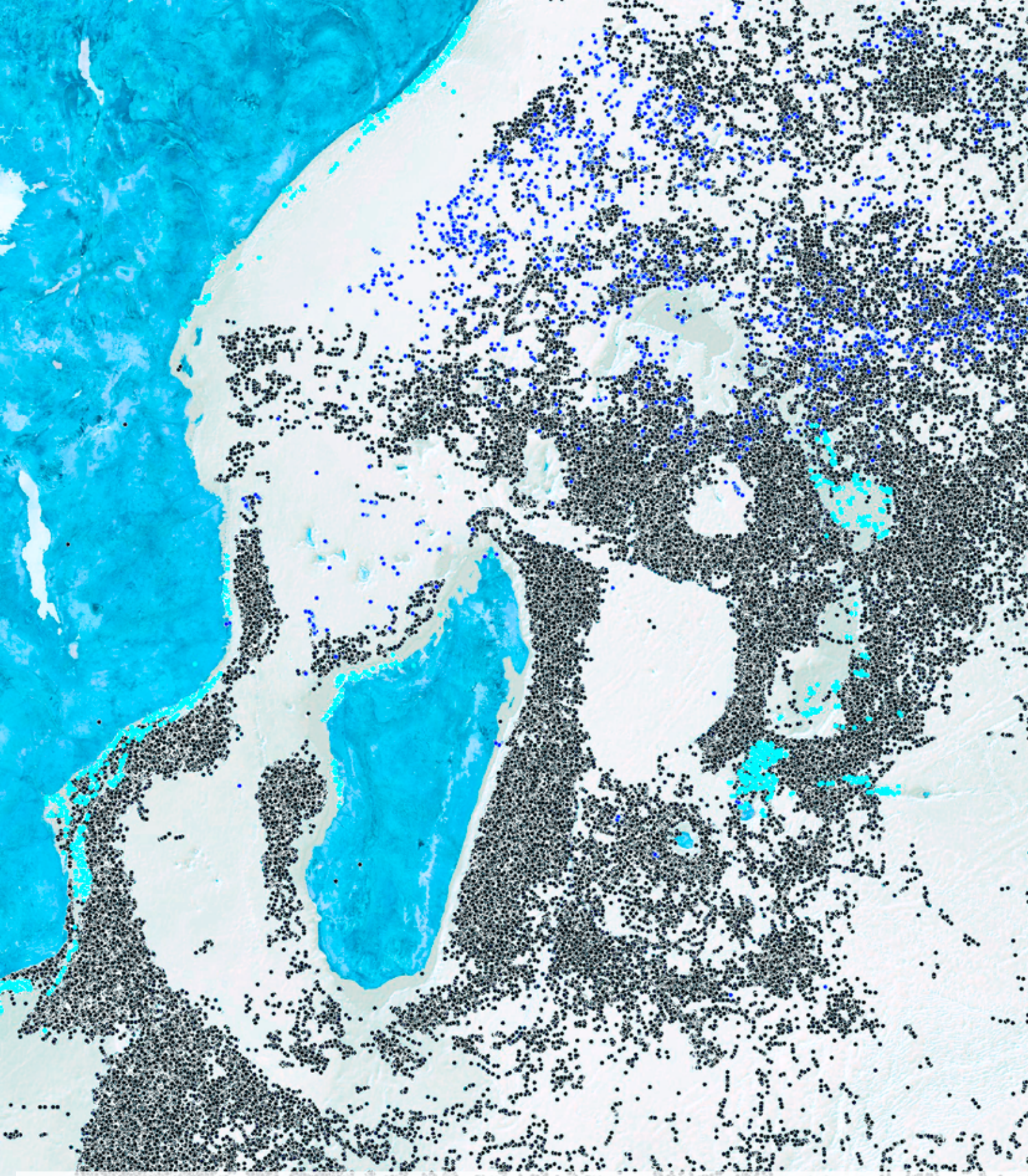

FISH-i Africa is a partnership between Western Indian Ocean countries to stop large-scale illegal fishing in the region. FISH-i Africa is achieving success through strengthened regional coordination and information sharing, which in turn supports targeted enforcement actions against illegal operators.

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The potentil use of 'automtic identification systems - AIS' as a fisheries monitoring tool (2018)