Memo

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Date: **19 June 2015**

Subject: **Satellite monitoring and data collection in our oceans. Current projects and initiatives**

Introduction

The continuous advance of technology has paved the way for a range of initiatives utilising satellite monitoring and other types of data collection and intelligence sharing in our oceans. Many of these can to some extent be used to detect and progressively combat illegal, unreported and unregulated (IUU) fishing, both within the Exclusive Economic Zones (EEZ) of coastal states and on the high seas. The data currently collected in diverse projects serve different purposes and thus differ in scope and accessibility.

This document provides an overview of current and planned projects in this field, outlining their key characteristics and features. It has no intention to be exhaustive in terms of MCS projects and initiatives, but rather seeks to give an idea of the most prominent and relevant activities in this field, with an emphasis on those that explicitly address IUU fishing and are either global in scope or pursue a potentially more widely applicable approach. Comparing these projects against each other will allow drawing conclusions on similarities in methods and approaches but also limitations and gaps to filter into a strategy discussion.

Background Information

Possible ways of application of satellite monitoring and data collection methods

- Satellite monitoring can be used to **track fishing vessels and specifically target and identify illegal operations**.
- Satellite monitoring can also provide **evidence for the lawful behaviour of compliant vessels**.
- Some methods involve crosschecking of data from several sources to **identify** and account for potential **satellite data manipulations**.
- **Machine-learning algorithms can identify relevant patterns** such as fishing activity or transhipments and submit automatic alerts in case of suspicious operations such as fishing in restricted areas or seasons, by unlicensed or unregistered vessels, or involving AIS inconsistencies.
- **Transparency and enforcement** can be enhanced by intelligence sharing of satellite monitoring data and other information between fisheries authorities, or by even making them publicly available.

Relevant satellite monitoring and data collection methods

Satellite technology used to track vessels includes the Automatic Identification System (AIS), the Vessel Monitoring System (VMS) and different forms of satellite imagery.

Automatic Identification System (AIS)

In 2000, the International Maritime Organization (IMO) made the **on-board installation** of AIS **mandatory** for all vessels over 300 gross tonnage in international voyages, cargo ships of 500 tonnes or more in local waters and all passenger ships irrespective of size, mainly for the purpose of avoiding collisions and promoting maritime safety. This relatively inexpensive method broadcasts information on vessel identity, position, course and speed to nearby vessels, coastal tracking stations and low-orbiting commercial satellites.

Limitations

- The **manipulation of AIS** has already been identified as an indicator for illegal fishing operations, including for example simply turning off of AIS ('going dark') or using bogus identification numbers entered manually by the vessel operator. Similarly, the AIS can be spoofed to create 'ghost' vessels that do not actually exist, and GPS coordinates (and thereby the overall track and destination) can be manipulated as well. Hence, the reliance on AIS data in the **absence of adequate data vetting mechanisms to account for potential AIS manipulation** can lead to false assumptions about the legality of the observed fishing operations.
- Also, decoding AIS data gets more difficult in high density traffic areas.

Vessel Monitoring System (VMS)

Via VMS information on vessel identity, position, course and speed is transmitted to fisheries management authorities, which several coastal States and Regional Fisheries Management Organizations (RFMOs) use to monitor their fleet's fishing activities.[1] The obligation for an on-board installation usually depends on the vessel size or tonnage, as laid out in the respective rules of the responsible State or RFMO.[2]

Limitations

- The installation of VMS is **not mandatory for all vessels**, i.e. excluding smaller or uncooperative ones. Therefore vessel coverage is one of the main disadvantages associated with the usage of VMS.
- Also, as we understand, VMS is more expensive than AIS which further limits the feasibility of this approach.

Earth observation satellites (EO satellites)

Earth Observation satellites are used to monitor the Earth from orbit, usually for purposes such as environmental monitoring, meteorology and map making. The data they provide depends crucially on the type of orbit they are in, the payload they carry, and, from the point of view of

1 Examples include several RFMOs like CCAMLR (Commission for the Conservation of Antarctic Living Marine Resources), FFA (Forum Fisheries Agency), NAFO (Northwest Atlantic Fisheries Organization) and NEAFC (North East Atlantic Fisheries Commission) and several countries like Australia and the USA, see [online] http://www.fao.org/fishery/topic/18072/en.

2 The use of VMS in the EU for example is mandatory for all vessels above 12 m length, see [online] http://ec.europa.eu/fisheries/cfp/control/technologies/index_en.htm.

imaging instruments, the spatial resolution, spectral characteristics and swath width of the sensors.

Limitations

- For applications requiring high resolution imaging of a very specific area, a high resolution sensor is needed that would generally have a narrow swath and be on a satellite at Low Earth Orbit. In such an orbit it is **not possible to continuously monitor the same area**, because of the relative movement of the satellite with respect to the Earth. Images can only be acquired over a given area when the satellite passes over it.[3]

Satellite imagery

Both AIS and VMS can be complemented with **satellite imagery**, including Synthetic Aperture Radar (SAR) and optical satellite images (OSI). Satellites with SAR sensors continuously produce images around the globe, whereas optical satellite imagery with a higher resolution can target smaller ocean areas.

Limitations

- The main disadvantage of SAR imagery is usually the low commercial resolution.
- The spatial coverage of optical satellite imagery is limited to smaller areas.

Other methods

Recently, the usage of **unmanned drones** has been discussed for the purpose of monitoring and mapping terrestrial and aquatic ecosystems, as well as supporting the enforcement of protected areas. Low-cost drones are able to collect high quality aerial images and video footage.[4]

Other Monitoring, Control and Surveillance (MCS) methods include the use of **coastal radar systems** and the installation of **video surveillance systems** on board of vessels and in ports. The method employed also depends on the local circumstances. For example, the Environmental Justice Foundation (EJF) – supported by the National Geographic Ocean Initiative's Ocean Innovations grant program, launched a project in West Africa equipping fishermen with cell phones and **GPS-enabled cameras** to fight pirate fishing by taking a picture of the vessel, collecting the geospatial coordinates and then sending all data to the EJF[5].

Possible limitations of the application of satellite monitoring

- Many types of illegal fishing operations or suspicious behaviour **cannot be detected by one** of the above-mentioned satellite monitoring and data collection **method**s **alone**.
- Methods not specifically designed to combat illegal fishing may use no or only **inadequate algorithms** to identify fishing activity, necessitating a lengthy manual analysis of satellite data.
- Moreover, they may **not** be **able to identify and issue automatic alerts** for suspicious fishing operations or at-sea transhipments.

Other possible limitations refer to:

- Spatial coverage (limited target area, fragmented satellite coverage)

3 See [online] http://www.esa.int/SPECIALS/Eduspace_EN/SEM7YN6SXIG_0.html.
4 See [online] http://conservationdrones.org/our-story/.
5

- Data latency between occurrence of relevant event and transmission or detection, hampering real-time tracking and immediate enforcement measures in response to illegal activities
- Limitation of access to data for relevant bodies or the public due to issues of cooperation, confidentiality or data commercialisation.

Overview of projects and initiatives

Name	**Project Eyes on the Seas**	**Global Fishing Watch**	**MarineTraffic**	**Copernicus**	**TransparentSea Service**	**Transparent Seas Project**	**Project Sea Quest**
Category	Transparency Project	Transparency Project	Transparency Project	Transparency Project	Transparency Project	Transparency Project	Transparency Project
Status	Ongoing	Ongoing (pilot phase)	Ongoing	Ongoing (fully operative since 4/2015)	Ongoing	Ongoing	Ongoing (pilot phase)
Executing organisation(s) or participants	• Pew Charitable Trusts • Satellite Applications Catapult	• Google (Earth Outreach team) • SkyTruth • Oceana • Analyze Corp • SpaceQuest	• MarineTraffic	• European Commission • European Environment Agency • European Space Agency • Member States	• LuxSpace • navama GmbH • WWF • ESA (Artes Application)	• WWF • Oceans 5 funders collaborative • Norwegian Agency for Development Cooperation (Norad)	• WWF • Sea Quest Fiji Ltd.
Geographical Scope	Regional	Global	Global (but depending on participation)	Global	Global (but depending on participation)	Regional	Regional
Purpose	IUU fishing	Fisheries law enforcement	collecting and presenting data which are exploited in research areas	Sustainable fisheries management compliant with the CFP Planned: extend scope of project (data) for the purpose of fighting IUU fishing	good fisheries management, including sustainble fishing and fighting IUU fishing; voluntary monitoring for increased transparency	Traceability and transparency for fisheries and seafood supply chain	Voluntarily demonstrate transparency and compliance in fishing operations
Method						?	
Satellite monitoring	AIS, VMS	AIS	AIS	EO satellites	AIS, VMS		AIS
Satellite imagery	SAR, OSI						
other	• Automated algorithm-based analyses • Offline data	• Machine-learning algorithm-based analyses		• Sea and Land Surface Temperature Radiometer (SLSTR • Ocean and Land Colour Instrument • Synthetic Aperture Radar Altimeter	• Other location based data		
Data accessibility						?	
Open access	🚫	✓	✓	✓ (but registration needed)			✓
Restricted					✓		
Data availability					?	?	
Real-time	✓		✓	✓			✓
Near-real-time		✓ (planned)		✓			
Pre-recorded		✓ (currently)					

Project Name	Project Scale	International MCS Network	West Africa Regional Fisheries Program (WARFP)	FISH-i Africa	Galapagos Marine Reserve	IMAS-Fish	i-Fish North Sea	FishSAT
Category	Enforcement Project	Enforcement Project	Enforcement Project	Enforcement Project	Enforcement Project	Research Project	Research (feasibility study)	Research (feasibility study)
Status	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Completed	Completed	Completed
Executing organisation(s)	• INTERPOL • Pew Charitable Trusts • Norwegian Ministry of Foreign Affairs • Norwegian Agency for Development Cooperation (NORAD) • United States Department of State	• Voluntary participants	• World Bank International Development Association (IDA) • World Bank Group (WBG) • Global Environment Facility (GEF) • Ministries of Fisheries in Cape Verde, Guinea-Bissau, Liberia, Senegal, Sierra Leone, Gambia, Ghana, Guinea and Mauritania • Joint Maritime Commission	• Seven Southeast African countries: Seychelles, Comoros, Kenya, Madagascar, Mauritius, Mozambique, United Republic of Tanzania • Pew Charitable Trusts (US) • New Partnership for Africa's Development (NEPAD) • Fisheries Analytical Capacity Tank AS (FACT) • Nordenfjeldske Development Services (NFDS) • Trygg Mat Foundation; International Ocean Tuna Commission (IOTC) • Indian Ocean Commission's (IOC) SmartFish Programme	• WWF • Direction of the National Park Gapalagos (DPNG) • Sea Shepard Conservation Society • WildAid • Conservation International	• Hellenic Centre of Marine Reserach (HCMR) • University of Aegean • University of Thessaly • Quality & Reliability • INFOMAP • LAMANS	• Avanti communications Group plc • OLSPS Intl • ESA (ARTES Application)	• Flyby • PXL • SATOC • ESA (Artes Application)
Geographical Scope	Global	Global	Regional	Regional	Regional	Regional	Regional	Global (but only fisheries where coastal fishing is conducted)
Purpose	coordinate operations to target fisheries crimes, disrupt trafficking routes and harmonize national and regional enforcement efforts	platform for fisheries law enforcement professionals to share information and experiences	to support countries to sustainably increase the net economic benefits generated by their marine fish resources (including reduction of illegal fishing)	IUU fishing	Monitoring of all vessel activities in Galapagos Marine Reserve	Enable sustainble fisheries management compliant with the CFP	Sustainable fisheries management	Enforcement of catch quota
Method								
Satellite monitoring			VMS (country-dependent)	AIS, VMS	AIS	AIS, VMS	AIS, VMS	AIS, EO satellites
Satellite imagery						Photosynthetically Active Radiation		
other	• Intelligence sharing • Support institutionalized cooperation and facilitate regional and international operations	• Intelligence sharing	• Different methods depending on country (aerial and surface patrol, radar) • Intelligence sharing	• Offline data	• Radar and port video surveillance systems	• Offline data	• SatCom-enabled information interchange • Global Navigation Satellite system (GNSS)	• Global Navigation Satellite system (GNSS)
Data accessibility	n/a	n/a						
Open access								
Restricted			✓	✓	✓	✓	✓	✓
Data availability	n/a	n/a	?					?
Real-time				✓	✓	✓		
Near-real-time							✓	
Pre-recorded								

Project Name	**Windward Mind**	**Spire**	**ArgoNet**	**MRAG**	**CLS America**
Category	Commercial Service	Commercial Service	Commercial Service	Commercial service	Commercial service
Status	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Executing organisation(s)	Windward (IL)	Spire	Argos	MRAG	CLS America
Geographical Scope	Global	Global	Global	Global	Regional
Purpose	IUU fishing, however mainly security and tracability of marine traffic		tracking and location service for meeting VMS requirements	promoting sustainable utilization of natural resources through sound integrated management policies and practices	good fisheries management, including sustainble fishing and IUU fishing
Method					
Satellite monitoring	AIS	AIS	VMS	VMS	AIS, VMS
Satellite imagery					
other	• Machine-learning algorithm-based analyses • Offline data	• GPS Radio Occultation • Algorithm-based analyses			• Shore-based radar systems
Data accessibility					
Open access					
Restricted	✓	✓	✓	✓	✓
Data availability		?		?	?
Real-time	✓				
Near-real-time			✓		
Pre-recorded					

Analysis of current projects and initiatives

Given the plethora of MCS-related efforts, we decided to focus on projects for which concrete information on most relevant characteristics (involved organisations or countries, methods, advantages, limitations, data access and availability) was readily available.

The analysis groups the presented projects and initiatives into transparency, enforcement and research projects[6], based on their respective primary goals. Additionally, we included a number of commercial services which have already been involved in attempts to utilise satellite technology and other data collection methods to combat IUU fishing, or could contribute relevant expertise in this area,

Transparency projects

Transparency Project: Project Eyes on the Seas[7]

Overview and context

'Project Eyes on the Seas', which is part of the 'Ending Illegal Fishing' initiative[8] of Pew Charitable Trusts, is a **fisheries monitoring and enforcement tool to combat illegal fishing**. It has been developed in collaboration between Pew Charitable Trusts and the UK-based technology company Satellite Applications Catapult. The project is potentially global in scope, but has an **initial focus on the Easter Islands (Chile), Palau and Polynesia** where pilot studies have been launched in January and March 2015. A five-year support for the newly established Pitcairn Islands MPA has also been agreed on.

Methods

The project utilises a **combination of AIS vessel tracking and satellite imagery (SAR and optical)**, supplemented with databases of vessel ownership history and registration information. An automated algorithm analyses the data and alerts analysts in a 'Virtual Watch Room' about suspicious vessel behaviour such as transhipments, fishing in a restricted area or irregularities of AIS transmission. The analysts then review a synthesized record of the vessel's history to determine if the activities were unlawful and notify the responsible authorities where necessary. These can subsequently proceed with enforcement measures, seek help from the vessel's flag state or ask a relevant RFMO to add it to an illegal fishing blacklist.[9]

Data accessibility and availability

Due to the use of a low-cost open access model, the data should be available for the bodies dealing with regulating IUU fishing. While primarily targeted at government and enforcement authorities, the data should be made available for the public. The methods used provide **real-time data**.

Results

6 The Strategic Working Group on Fisheries and Aquaculture of the Standing Committee on Agricultural Research,'**SCAR-Fish**', was set up to advise Member States of the European Union and the Commission on how to make research policies and research themes instrumental in the delivery of the new European fisheries policy. In its 2013 report, it provides an overview of the most relevant overarching science projects for the purpose of supporting the Common Fisheries Policy (CFP). However, we understand that SCAR-Fish functions as an advisory body rather than an actual initiative involving MCS methods of its own, and therefore did not include any further details about this in the present document.

7 If not indicated otherwise, information presented in this section is based on [online] http://www.pewtrusts.org/en/multimedia/video/2015/project-eyes-on-the-seas and The Pew Charitable Trusts (2015). 'Project Eyes on the Seas ' [online] http://www.pewtrusts.org/~/media/Assets/2015/03/Eyes-on-the-Seas-Brief_WEB.pdf.

8 For more information on the initiative, see The Pew Charitable Trusts (2013). 'How to End Illegal Fishing' [online] http://www.pewtrusts.org/en/research-and-analysis/reports/2013/12/10/how-to-end-illegal-fishing.

9 See [online] http://www.pewtrusts.org/en/about/news-room/press-releases/2015/01/21/pew-unveils-pioneering-technology-to-help-end-illegal-fishing.

According to the website, the system has already helped identify suspicious vessels in Palau's waters. Further information on results is scarce since the project has only been running for a few months.

Advantages

'Project Eyes on the Seas' is a potentially global, comprehensive system that enables the identification and real-time tracking of illegal fishing vessels, facilitating immediate enforcement actions. The synthesis of information from different sources increases reliability and coverage, and allows for the incorporation of other supplementary information such as GPS-tagged photos, electronic signals, radio broadcasts, reports or other intelligence shared by fisheries agencies.

Limitations

- The **lack of an obligation** for smaller fishing vessels (below 300 gross tonnage) **to utilise AIS** represents a loophole for uncooperative vessels, although this **may be partially covered by satellite imagery**. This method however may not be able to unambiguously identify vessels at all times and the **spatial coverage of optical satellite sensors is small**. The project is initially **limited to** the **focus areas** although it aims at a progressive widening of the scope to a global scale.
- Potential AIS manipulation other than temporary deactivation may mask some illegal operations. Like other satellite monitoring-based methods this tool cannot detect illegal fishing of endangered or over-quota fish without **additional control and enforcement measures**. The overall success of the project also depends on the effectiveness of enforcement following alerts about suspicious operations.

Transparency Project: Global Fishing Watch[10]

Overview and context

'Global Fishing Watch' was initiated by Google, SkyTruth and Oceana, with contributions from Analyze Corp and SpaceQuest. Google provides expertise in handling large amounts of data and SpaceQuest collects satellite data, whereas SkyTruth and Analyze Corp developed algorithms for the identification of fishing activity and Oceana is using the tool internally to track some blacklisted illegal fishing vessels. The current version is a **prototype** based on data from 2012 and 2013, but the **full public release version anticipated to be launched in 2015 or 2016** aims to increase transparency of fisheries worldwide by involving the public in near-real-time-monitoring of fishing vessels.

Methods

The project uses a **combination of AIS satellite tracking and machine-learning algorithms** that automatically identify fishing activity. Fishing effort can be displayed as hours spent fishing for each vessel and suspicious behaviour like deactivation of AIS and potential fishing activity in restricted areas or by unlicensed vessels can be flagged.

Data accessibility and availability

The full public release version of 'Global Fishing Watch' will be **inherently open access and free of charge**, with faster (near-real-time) access for project partners, depending on the **data license**.

Results

10 If not indicated otherwise, information presented in this section is based on [online] http://globalfishingwatch.org/.

According to the website, previous results are based on the prototype, which utilizes data from 2012 and 2013. Examples of successful application include tracking of particular vessels around the globe and the detection of likely fishing activity by unlicensed vessels and in MPAs. Moreover, some cases of AIS spoofing were observed in 2012, as well as an incident of AIS avoidance in 2013.

Advantages

- The machine-learning algorithm allows for an automatic identification of likely fishing activity, thereby rendering time-consuming manual analyses unnecessary.
- The full public release version will allow for near-real-time-tracking of vessels around the globe.
- The prototype has been successfully applied to detect likely fishing activities in restricted areas and cases of AIS avoidance and spoofing.
- It is publicly available and free of charge and therefore helps to make fishing activities more transparent by allowing the public to hold fisheries agencies and RFMOs accountable for the enforcement of fishing rules in the areas under their mandate.
- The system also enables compliant fishermen to provide evidence for lawful behaviour.

Limitations

- **Vessels** that are **not equipped with AIS** (including all fishing vessels with less than 300 gross tonnage) cannot be detected with this tool.
- The AIS tracking technology only works reliably for cooperative vessels as there is **no vetting mechanism** to adequately account for AIS manipulation other than temporary deactivation. The use of fake identification numbers may be detectable, but the determination of the actual vessel identity requires further enforcement actions.
- The 2014 satellite coverage (14 satellites) allowed for the detection of individual vessels at **two-hour intervals**, which may be too long for continuous tracking and the detection of shorter incidents such as suspicious transhipments. According to *Oceana*[11] **data** should be **available** to the public **within 'less than 72 h**', **hampering immediate enforcement** actions in response to suspicious vessel behaviour.

Transparency Project: Marine Traffic[12]

Overview and context

The projects is dedicated to the collection and presentation of data which are exploited in different areas of research ranging from meteorology, environmental protection, technological science, etc. These data are provided by collaborating partners in order to inform the public, about ship movements and ports, mainly across the coast-lines of many countries around the world.

Methods

MarineTraffic uses **AIS** to collect data which are presented in a central database by means of a **web service**. Information that is transmitted covers dynamic information, such as vessel's position, speed, current status, course and rate of turn, static information, such as vessel' name, IMO (International Maritime Organization) number, MMSI (Maritime Mobile Service Identity) number, dimensions and voyage-specific information, such as destination, ETA (estimated time of arrival) and draught.

11 See Oceana (2014). 'Global Fishing Watch' [online] http://globalfishingwatch.org/oceana-global-fishing-watch-report.pdf.
12 If not indicated otherwise, information presented in this section is based on [online] https://www.marinetraffic.com/.

Data accessibility and availability

Marine Traffic is an open, community-based project that provides primarily **free, real-time data** that partners share with the project, although some services such as AIS satellite coverage for mid-ocean vessel tracking are subject to a monthly subscription fee.[13]

Limitations

- The MarineTraffic system does not cover all the seas of the world, but **only specific coastal areas** where a land-based AIS receiver is installed, although a new subscription plan allows for mid-ocean vessel AIS tracking subject to a 6 to 12 hour delay.[14]
- The data presented are provided by project partners, hence the project **relies on voluntary cooperation**. Although having a global geographical scope, data are far from complete.
- **Data** are only processed for technical purposes, i.e. for transmission, but **not analysed** as for their contents.

Transparency Project: Copernicus - marine environment monitoring service[15]

Overview and context

Copernicus as a whole is a **European system for monitoring the Earth**. In the marine sector, the application aims to contribute to **marine safety and the protection and sustainable management of living marine resources** in particular for aquaculture, fishery research or regional fishery organisations providing information on the state of the physical oceans and regional seas.

A Delegation Agreement with Mercator Océan for the implementation of the service was signed in November 2014. According to the website (no date), the marine service of Copernicus is currently delivered in a pre-operational mode while the service should have been fully operational from April 2015.

According to the project leaflet,[16] the **next steps** of the project include to **widen the area of surveillance and control** of marine resources in Member State Exclusive Economic Zones for enhanced fisheries protection and **detection of Illegal, Unreported, and Unregulated (IUU) Fishing** and supporting activity.

Methods

Copernicus collects data from **earth observation (EO) satellites and *in situ* sensors** such as ground stations, airborne and sea-borne sensors.

Data accessibility and availability

The products delivered by the Copernicus marine environment monitoring service today are provided **free of charge to registered users** who have signed a license agreement through an Interactive Catalogue available on the marine.copernicus.eu web portal.

13 See [online] http://www.marinetraffic.com/en/p/plans
14 See [online] http://www.marinetraffic.com/en/p/satellite-ais
15 If not indicated otherwise, information presented in this section is based on [online] http://copernicus.eu/main/.
16 ESA, Copernicus (2013). 'Satellites supporting sustainable fishing' [online] http://www.copernicus.eu/sites/default/files/documents/Copernicus_Briefs/Copernicus_Brief_Issue34_FishMonitoring_Sep2013.pdf.

The ***in situ* sensors** provide **near-real-time data** while the **satellites** are supposed to provide **real-time data**. The product description is unclear on how exactly satellite data are made available.

Limitations

- Currently, the marine service of Copernicus only provides reference information on the state of the physical oceans and regional seas. However, it is planned to widen the project scope and also look into options of how to fight IUU fishing.

WWF initiatives

WWF is involved in a wide range of initiatives, projects and partnerships aimed at fighting IUU fishing and making fisheries worldwide more sustainable. These cover different approaches including the use of satellite technology to improve monitoring and transparency of fishing operations, and efforts to drive the market demand for sustainable seafood, largely via cooperation with relevant players throughout the supply chain (fishers, processors, buyers and retailers).

WWF's fisheries-related work is spearheaded by its '**Smart Fishing Initiative**' (SFI), which pursues the overarching goal of making fisheries and markets for seafood more sustainable. Many of WWF's activities in this regard are directly linked to or have emerged as side-branches of SFI. The most relevant of these projects and initiatives are presented below:

Transparency Project: TransparentSea Service[17]

Overview and context

In 2014, LuxSpace, navama and WWF were awarded an **ESA development contract** for the design of an **innovative fishery monitoring system** (ARTES programme[18]). The system seeks to make fishing operations more transparent by allowing **cooperating fisheries to voluntarily share their vessel tracking information**, with an **emphasis on certified sustainable fisheries**.[19] The activities related to the requirement engineering for the system could be successfully concluded in December 2014.

Methods

The TransparentSea Service uses satellite technology for the surveillance of fishing activities carried out by cooperating fisheries that can voluntarily provide their 24/7 **AIS, VMS or other location-based information** via an **online data sharing platform**. Targeted at certified sustainable fisheries, the new system retraces **the routes and activities of fishing vessels and assesses the conformity of fishing operations with sustainability standards and rules**. Users can notice if boundaries of marine protected areas or fish nursery areas are being respected. Following **evaluation by experts** and approval of the cooperating fishery, the data are intended to be made publicly available via a **smartpone app**.

In the pre-project phase,[20] WWF stated on its website that it was aware of the limitations of AIS and therefore 'sees huge potential in the use of AIS, **in combination with other verification methods** (such as cloud-penetrating satellite imagery), to dramatically increase the visibility of fishing activities.'[21]

Data accessibility and availability

Data are now accessible via 'a web based fishery track analysis **platform for experts**' called 'seeOcean explorer'. [22] The web-based platform enables registered independent experts from navama, WWF, other NGOs, governments and science to evaluate the submitted data. Information on global AIS coverage, individual shared fishery tracks, MPAs, wind, waves, track patterns, ports and economic data is then visualized and **ultimately** made available to **seafood customers** via a smartphone app with the consent of the collaborating fisheries. Hence we understand that data is intended to be accessible publicly.

As for data availability, no information is provided.

Advantages

- Routes of fishing vessels can be visualized and certain fishing activities are automatically recognised, on a potentially global scale depending on participation of fishing operators.

17 If not indicated otherwise, information presented in this section is based on [online] https://artes-apps.esa.int/projects/transparentsea.
18 ARTES is ESA's 'Advanced Research in Telecommunications Systems' programme which aims to transforms research and development investment into successful commercial products in order to help securing the futures of Europe and Canada in the worldwide satcom market.
19 See [online] http://wwf.panda.org/what_we_do/footprint/smart_fishing/latest_fishing_news/?230896/LuxSpace-navama-and-WWF-awarded-new-contract-European-Space-Agency-ESA-to-design-fishery-monitoring-system.
20 In 2012, WWF and navama GmbH launched a project under the 'Smart Fishing Initiative' with the aim of making fishing activities more transparent via AIS vessel tracking. The development of a feasible methodology set the groundwork for the following projects in this field, such as the TransparentSea Service. WWF claims to have 'obtained good results with fisheries and RFMOs' using the AIS system, but more detailed information was not available on the website, see [online] http://wwf.panda.org/what_we_do/footprint/smart_fishing/how_we_do_this/good_governance2/transparent_seas_/satellite_tracking_via_ais_/.
21 WWF (2014). 'Technology Helps Fight Illegal Fishing' [online] https://www.worldwildlife.org/stories/technology-helps-fight-illegal-fishing.
22 Navama (2015). 'TransparentSea.org' [online] http://transparentsea.org/?page_id=69&lang=en.

- The project promotes sustainable fishing practices and supports certified fisheries by enabling cooperative fisheries to make their operations more transparent, thereby demonstrating their commitment to legal and responsible fishing.
- The open communication of this to seafood consumers adds credibility to claims of sustainable fishing practices and eco-certification schemes and could ultimately drive market demand for legally harvested seafood.
- The Service also helps maintain high certification standards by providing an additional control mechanism.

Limitations

- The project is currently **only targeted at certified sustainable fisheries** in order to ensure compliance with the standards and rules in the field.
- The project relies on **data** that are **provided voluntarily** by cooperating vessels.
- **AIS** is **only legally requires for certain vessels**, which is why a mandatory installation of AIS on every commercial fishing vessel, regardless of size, is needed to make the AIS approach a powerful tool in the battle for sustainable fishing.
- The potential issue of AIS manipulation has not been addressed.

Transparency Project: Transparent Seas Project (TSP)[23]

Overview and context

The 'Transparent Seas Project' (TSP) was launched in 2012 as part of WWF's Smart Fishing Initiative whose core budget it is funded by, with further support from Oceans 5 funder collaborative and the Norwegian Agency for Development Cooperation (Norad). It focuses on the **collaboration with market and producer countries within the seafood supply chain to improve fisheries transparency**.

Methods

The project website does not contain specific information about the methods used, but supported initiatives include promoting laws and policies to limit market access for illegally caught seafood and working with the industry for improved seafood traceability. In this context, the project seeks to **help fishermen, the industry and governments to adopt tracking systems for monitoring and documenting catches, and to educate consumers about sustainably caught seafood**.

23 If not indicated otherwise, information presented in this section is based on [online] http://wwf.panda.org/what_we_do/footprint/smart_fishing/how_we_do_this/good_governance2/transparent_seas_/.

Data accessibility and availability

Concrete information about results and data availability or access was not available on the project website

Limitations

Potential advantages and limitations of the approach are difficult to evaluate due to lack of specific information about the methods applied.

Transparency Project: Project SeaQuest[24]

Overview and context

The 'Sea Quest project' is WWF's **pilot project** in collaboration with the tuna fishing and processing company Sea Quest Fiji Ltd., which enables the latter to **voluntarily demonstrate transparency and compliance** in its fishing operations. It was launched in 2013 and is **currently limited to Sea Quest's fishing vessels**, but is aimed at becoming a global example of transparent fisheries, with an associated potential extension of its scope to other fisheries.

Methods

The project is a joint initiative of WWF and Sea Quest, which agreed to have **AIS transmitters** installed on all of its six albacore tuna fishing vessels to show full transparency of its operations.

Data accessibility and availability

According to the website, the **vessels are tracked 24/7** using AIS transmitters, constantly sending signals to the WWF database and thereby allowing for the retracing of all routes and activities of the involved vessels. Hence we understand that the project provides **real-time data**.

No information on data availability could be found at this stage, but the information obtained throughout the project should at least eventually be made available to the public as the concept of the project is to demonstrate full transparency.

Advantages

- The Sea Quest project helps to ensure that all of Sea Quest's fishing operations are fully monitored and legal, enabling the company to demonstrate transparency and compliance with fishing rules.
- The positive resonance from Sea Quest both in terms of the strong transparency statement and improved safety at sea provides for a possible extension of the concept to other fishing companies seeking to demonstrate compliance, or may even incentivise authorities to make AIS use mandatory for fishing operations under their jurisdiction.[25]

24 If not indicated otherwise, information presented in this section is based on [online] http://wwf.panda.org/what_we_do/footprint/smart_fishing/latest_fishing_news/?212551/WWF-calls-satellite-technology-commercial-vessels-increase-transparency-fishing-activities.

25 See [online] http://wwf.panda.org/what_we_do/footprint/smart_fishing/latest_fishing_news/smart_fishing_interviews_/?231571/Transparency-matters-interview-with-Sea-Quest-Fiji-Ltd.

Limitations

- The project is **currently limited to six vessels** belonging to one cooperative fishing company and therefore has no power to tackle IUU fishing operations executed by other fishing operators.
- **AIS manipulations** may occur in theory, but should be relatively easily detected as only six known vessels are involved which are monitored 24/7.

Further WWF involvement

In addition to the above-described initiatives, WWF is involved in a range of other ongoing activities promoting sustainable fisheries and aiming at combating IUU fishing, which do not appear to be treated as individual projects, or did not provide sufficiently detailed information for individual inclusion in the project profiles of this document. These include

- Seafood partnerships between WWF, the Marine Stewardship Council (MSC), companies throughout the seafood supply chain (such as retailers), and private sector fisheries partners including the International Seafood Sustainability Foundation (ISSF) and the Common Fisheries Reform Alliance, in order to drive market demand for sustainable seafood[26]
- Collaboration between WWF and TRAFFIC on a guide on fisheries data to 'help governments and other stakeholders conduct trade data analyses to identify IUU hotspots and target trade in IUU products'[27]
- Involvement of WWF with eleven different RFMOs for the purpose of improving fisheries management towards sustainability, with an emphasis on tuna fisheries[28]
- A joint statement with other private and public leaders issued by the World Economic Forum's Global Agenda Council on Oceans in January 2013 calling for enhanced traceability of seafood products[29]

26 See [online] http://wwf.panda.org/what_we_do/footprint/smart_fishing/how_we_do_this/sustainable_markets__new/wwf_seafood_partnerships_/.
27 See [online] http://wwf.panda.org/what_we_do/footprint/smart_fishing/how_we_do_this/good_governance2/transparent_seas_/about_the_tsp_22/monitoring_tracking_fisheries_/.
28 See [online] http://wwf.panda.org/what_we_do/footprint/smart_fishing/how_we_do_this/good_governance2/getting_the_right_management_in_place_/rfmos/.
29 See [online] http://wwf.panda.org/about_our_earth/blue_planet/news/?207339/WWF-joins-call-for-seafood-traceability-to-fight-illegal-fishing.

Enforcement projects

Enforcement Project: Project Scale[30]

Overview and context

In 2013, Interpol launched Project Scale which is supported by the Government of Norway, the Pew Charitable Trusts and the United States Department of State. It aims at **supporting member countries in identifying, deterring and disrupting transnational fisheries crime**. For the purpose of the project, fisheries crime is defined as 'all types of illegality and criminality which facilitate or accompany illegal fishing activities but **reach beyond the traditional definition of illegal fishing**', including fraud, avoidance of taxes and handling of stolen goods, corruption, money laundering, document falsification, drug trafficking and human trafficking.

Methods

Interpol's project focuses on **intelligence and capacity building** through activities. These include the development of the Fisheries Crime Working Group and supporting its two projects on intelligence and on capacity building and advocacy, supporting member countries in issuing international notices and alerts, and facilitating region- or commodity-specific operations tailored to the needs of member countries.

Data accessibility and availability

n/a

Limitations

n/a

Enforcement Project: International MCS Network[31]

Overview and context

The International Monitoring, Control, and Surveillance (IMCS) Network was established in 2000 to provide a **mechanism for fisheries law enforcement professionals to share information and experiences**. Its role is focused on improving the efficiency and effectiveness of fisheries-related MCS activities through enhanced cooperation, coordination, information collection and exchange among national organisations and relevant institutions.

The IMCS Network is a voluntary organisation, which operates informally. **Membership is open to national government organisations/agencies responsible for fisheries MCS as well as regional fisheries management organisations**.

30 If not indicated otherwise, information presented in this section is based on [online] http://www.interpol.int/Crime-areas/Environmental-crime/Projects/Project-Scale.
31 If not indicated otherwise, information presented in this section is based on [online] http://www.imcsnet.org/.

Methods

The IMCS Network hosts a wide array of fisheries law enforcement information through it website, organises meetings, implements trainings, and serves as a liaison among MCS professionals.

Data accessibility and availability

No information is available on data accessibility and availability. Given the nature of the project, we assume that **information is only shared between the members**.

Limitations

Due to lack of information, the limitations of the project cannot be assessed.

Enforcement Project: West Africa Regional Fisheries Program (WARFP)[32]

Overview and context

The Program under participation of the ministries of fisheries of **Cape Verde, Guinea-Bissau, Liberia, Senegal, and Sierra Leone** was launched in 2009 with the aim to **support countries to sustainably increase the net economic benefits generated by their marine fish resources**, and the portion of these benefits captured within the region. The approach includes activities to (1) strengthen governance of the fisheries, (2) **reduce illegal fishing** and (3) increase local value added from the fisheries.

Component 2 of this programme includes enhanced MCS systems through the **introduction of surveillance patrols, coastal surveillance stations and satellite-based monitoring of fisheries**. Since the project's inception, four additional countries (Gambia, Ghana, Guinea and Mauritania) have been included in WARFP, which is due to be completed by the end of 2015.[33]

Methods

As for component 2 of the programme, the participating countries seem to introduce their **monitoring system individually** rather than implementing a common monitoring system. Methods include **aerial and surface patrol, radar and satellite monitoring, including AIS and VMS**, depending on the different countries' capacities. According to the World Bank, VMS has been in place and functioning since at least January 2015, although it is not specified if this applies to all participating countries and their vessels. Both Liberia and Sierra Leone for example had introduced a VMS by 2011.[34]

Data accessibility and availability

No information is available on data accessibility and availability. Given the nature of the project, we assume that **information is only shared between the responsible participating bodies**.

32 If not indicated otherwise, information presented in this section is based on [online] http://www.worldbank.org/en/results/2013/03/28/protecting-west-african-fisheries.
33 See [online] http://www.worldbank.org/projects/P106063/west-africa-regional-fisheries-program?lang=en.
34

Advantages

- The WARFP has already considerably improved fisheries management in several participating countries[35], such as reduced illegal fishing and a 100% registration rate for the artisanal fleet, leading the World Bank to classify progress as 'moderately satisfactory' in February 2015.

- Overall, the MCS efforts have contributed to enhanced fisheries surveillance, i.a. thanks to the implementation of VMS in participating countries.

Limitations

Due to lack of information, the limitations of the project cannot be assessed.

Enforcement Project: FISH-i Africa[36]

Overview and context

'FISH-i Africa' is a **joint project of seven Southeast African countries** (Seychelles, Comoros, Kenya, Madagascar, Mauritius, Mozambique, United Republic of Tanzania) with financial and coordinative support from Pew Charitable Trusts' 'Stop illegal Fishing' (SIF) project and the New Partnership for Africa's Development (NEPAD). Technical, analytical and intelligence capacity is provided by Fisheries Analytical Capacity Tank AS (FACT), Nordenfjeldske Development Services (NFDS) and the Trygg Mat Foundation, whereas the International Ocean Tuna Commission (IOTC) and the Indian Ocean Commission' (IOC) SmartFish Programme contribute further advice, resources and information.

The project consists of a Task Force (comprising representatives from the participating countries) and a Technical Team of international technical experts. It **focuses on the seven States' EEZ and aims to identify and track down illegal fishing operators through enhanced collaboration and intelligence sharing** to make illegal fishing ultimately unprofitable. The project was initiated in December 2012 as a one-year pilot project, extended when Madagascar and Mauritius joined in mid-2013, and fully established in May 2014. The FISH-i Africa Task Force recently partnered with the Southern African Development Unit (SADC) IUU Task Force to establish the SADC Regional MCS Coordination Centre in Mozambique. The project scope can potentially be extended to further regional countries in the future.

Methods

The project systematically compiles information on vessel licensing, movements, catches and landings from flag and port States, trade data and suspected illegal fishing incidents. This intelligence is then shared between the participating countries via an online communications platform. The utilisation, analysis and sharing of **real-time vessel data from satellite tracking** allows for immediate collective enforcement actions across all participating countries, making the market access for illegal catches more difficult. Enforcement measures include port measures (such as denial of fishing licenses or port access to vessels that were previously engaged in illegal fishing activities), document checks, de-registration of illegally operating fishing vessels, vessel ID checks and fines. We understand that the vessel tracking information is **individually** provided by the participating countries using **satellite monitoring (AIS, VMS)** rather than a joint initiative covering the entire focus area, taking into account the different respective MCS capacities.

35 See [online] http://www.undercurrentnews.com/2015/03/19/world-bank-gives-22m-to-boost-fisheries-in-mauritania-guinea/
36 If not indicated otherwise, information presented in this section is based on [online] http://www.fish-i-africa.org/.

Data accessibility and availability

While intelligence sharing between the participating countries constitutes the main principle of this project, the level of public access to relevant data is unclear. However, most likely at least part of it is sensitive and must therefore remain confidential. The project uses **real-time** vessel data from satellite tracking.

Results

According to the website, 'FISH-i Africa' has identified several commonly encountered types of illegal fishing activities, including vessel identity issues, forged documents, whitewashing of illegal fish through unauthorized transhipments and an overall avoidance of regulatory systems. The project has already produced 'impressive' results in the form of actions taken against several notorious illegal fishing operators, including for instance the collection of almost 3 million USD of fines (as of March 2015) and various other above-mentioned measures. Overall, this has lead to improved compliance with fisheries laws.[37]

Advantages

- The main strength of 'FISH-i Africa' lies in the strong collaboration between countries in the form of intelligence sharing, which facilitates immediate enforcement actions.
- Moreover, it is a very cost-effective method and can exert regional and global pressure towards effective enforcement and subsequent enhanced compliance in previously illegally operating fishing vessels.

Limitations

- Currently, the focus area is **limited to the EEZs** of the participating Southeast African coastal States, i.e. excludes the high seas.
- In lack of detailed information about the satellite technology used for vessel tracking limitations in this regard cannot be evaluated at this stage, but most likely include the usual difficulties of **detecting and accounting for AIS manipulation**. The lack of unique vessel identification numbers on industrial vessels and insufficient coordinated police effort to investigate international corruption and fraud issues represent additional hurdles.

Enforcement Project: Galapagos Marine Reserve[38]

Overview and context

WWF has been supporting several AIS projects with the Directorate of the Galapagos National Park (DPNG) since 2009 **as part of the Galapagos Marine Reserve (GMR) Management Plan** to support the DPNG's and the National Direction of Aquatic Spaces' monitoring and control efforts within the reserve.

In addition, AIS tracking was initiated in 2011 in cooperation with the Sea Shepherd Conservation Society, and further measures including radar and port video surveillance systems were installed in 2013 in cooperation with WWF, WildAid and Conservation International. The overarching goal of these monitoring efforts is to ensure the **correct use of visitor sites and monitor fisheries within the Galapagos Marine Reserve**.

Methods

37 See [online] http://www.huffingtonpost.com/wallace-cosgrow/fish-i-africa-is-proving-that-coastal-countries_b_7472548.html.
38 If not indicated otherwise, information presented in this section is based on [online] http://www.galapagospark.org/nophprg.php?page=reserva_marina_control_vigilancia.

The primary monitoring method is **AIS vessel tracking**, covering all Ecuadorian-flagged vessels transiting within the Galapagos Marine Reserve. These efforts are coordinated by the Monitoring Center in the Galapagos National Park and complemented by advanced radar and port video surveillance systems.

Information on ships is integrated between the Dirección Nacional de Espacios Acuáticos (DIRNEA) and the DNPG, granting the Galapagos National Park Service (GNPS) direct access to the **DIRNEA database**, for purposes of mutual consultation of all national vessels'.

Data accessibility and availability

We are not aware of any concrete information on data accessibility and availability other than the sharing of collected information between DIRNEA and the GNPS. Hence we understand that **access is restricted** to the involved stakeholders. The method used should however allow for **real-time data** transmission.

Advantages

- The data collected throughout all monitoring efforts within the reserve can be used for various purposes, including surveillance of fisheries and an appropriate use of visitor sites.
- The implementation of AIS tracking for all Ecuadorian-flagged vessels, including those with less than 20 gross tonnage, makes the Galapagos Marine Reserve the 'first marine protected area in the world to apply satellite monitoring technology to 100% of their ships'.[39]
- Cooperation between DIRNEA and DPNG allows the relevant bodies to fully access the required monitoring information.

Limitations

- The project is **limited in its scope** to the Galapagos Marine Reserve and – though including all Ecuadorian-flagged vessels – presumably does not cover vessels from other countries which may also enter the reserve.
- The usual **AIS manipulation** issues may apply and information on enforcement – such as ensuring that vessels without AIS do not enter the marine reserve – was not available on the project website.

39 Directorate of the Galapagos National Park (2009). 'Control and Monitoring of the Galapagos Marine Reserve'. [online] http://www.galapagospark.org/nophprg.php?page=reserva_marina_control_vigilancia.

Research projects

Research Project: IMAS-Fish[40]

Overview and context

The project IMAS (Integrated Management System) was launched in the context of implementing the CFP and its **sustainable approach to fisheries management in Greece**. The IMAS aims to support the integrative ecosystem approach in the new CFP by **connecting all available fisheries-related data** to a GIS component, to provide statistical analyses linked to statistical packages and ultimately to **serve as a decision-making tool for fisheries managers**.

The project under cooperation of the Hellenic Centre of Marine Research (HCMR), University of Aegean, University of Thessaly, Quality & Reliability, INFOMAP and LAMANS was completed in 2006.

Methods

IMAS uses a combination of different methods, including **satellite imagery data** (sea surface semperature, photosynthetically active radiation) and **VMS** data and several **offline data** sources like fisheries statistics and legislation.

Data accessibility and availability

IMAS is available via an online web tool, however access is limited to **authorised users**. The technology is able to execute user requests and present data in **real-time**.

Limitations

- The installation of VMS is **not mandatory for all vessels**, i.e. excluding smaller or uncooperative ones. Therefore vessel coverage is the main limitation associated with the usage of VMS.
- In its scope, the research project was **designed for Greek fisheries**. However, according to the article the method can be made applicable for other geographical regions.

Research Project: i-Fish North Sea[41]

Overview and context

In May 2012, the ESA (ARTES programme) cooperated with Avanti Communications Group plc and OLSPS Intl in order to **identify the shortcomings and challenges in current operational processes** and to specify an integrated solution and associated services that will enhance **sustainability of fisheries resources**. The project is designed to identify users and other stakeholders who are keen to engage in the development of an operational service in a follow-on phase as part of a demonstration project to enable market access and promotion of the solution.

40 If not indicated otherwise, information presented in this section is based on *Kadavas, Damalas, Georgakarakos, Maravelias, Tserpes, Papaconstinantinou, Bazigos* (2013) 'IMAS-Fish: Integrated Management System to support the sustainability of Greek Fisheries resources. A multidisciplinary web-based database management system: implementation, capabilities, utilization and future prospects for fisheries stakeholder' [online] http://www.medit-mar-sc.net/index.php/marine/article/view/324/386.
41 If not indicated otherwise, information presented in this section is based on [online] https://artes-apps.esa.int/projects/ifish-north-sea.

According to the website (no date), a **phase II demonstration project** that will exploit the capabilities of space assets to **develop a sustainable service to support an integrated fisheries management system across the North Sea region**.

Methods

The system will use a **combination of satellite communications and satellite navigation**. More detailed information is not available. The satellite technology enables **near-real-time** data availability.

Data accessibility and availability

According to the website, '**selected data**' are supposed to be made available '**for various stakeholders** such as fisheries authorities and compliance agencies (compliance reports), vessel agents (vessel arrival and departure times), auction houses, wholesalers and fish markets (stock availability and market demand information), fishermen (event data, vessel position, catch, fishing operation, changes, area closures).' This indicates that data accessibility is restricted to certain stakeholder groups

Advantages

The study was completed in May 2013, its main achievements according to the project website are:

- Successful demonstration of the technical viability of a seafood commercialisation platform via a Proof of Concept system that constitutes web-based on-board and onshore applications,
- Development of a business plan to demonstrate economic viability of the system,
- User and stakeholder engagement to ensure industry support towards development of the system into an operational service.

Limitations

Due to lack of information, the limitations of the project cannot be assessed at this stage.

Research Project: FishSAT[42]

Overview and context

The project under the ESA's ARTES programme is designed as a **feasibility study** to assess the needs of fisheries and sea authorities (enforcement) in the areas of monitoring catches and better enforcement of quotas. It aims at designing, developing and validating a **first basic prototype of a distributed system** (onboard & onshore) that provides information services for more efficient, more compliant and more sustainable fishing.

The study is focused on fisheries where coastal fishing with small-size boats is conducted.

Methods

42 If not indicated otherwise, information presented in this section is based on [online] http://www.esa.int/Our_Activities/Preparing_for_the_Future/Space_for_Earth/Oceans/Sustainable_fishing_by_satellite.

In the study, a combination of methods is used: **Earth observation (EO) satellite data** will be used to estimate several sea parameters and to derive meteorological information in support to conventional forecasts. Such data will support the identification of most productive regions, thus allowing a more effective catches strategy. **AIS** will be used to complement terrestrial wireless technology in offshore areas, where the latter is not effective. Data from the Global Navigation Satellite System **(GNSS)** is used to track vessels and to collect the geo-references for catch traceability.[43]

Data accessibility and availability

According to the website, the project is intended to provide Sea Authorities with a more effective law enforcing capability, while providing fisheries with a tool and service that ease their activities, reduce costs and allow for more profitable sales. Hence, we understand that data accessibility is restricted to certain stakeholders. No information is provided for timeliness data availability.

Limitations

- The research project was designed to cover fisheries where **coastal fishing with small-size boats** is conducted. It is unclear, whether the methods applied can potentially be used to cover other areas as well.
- **AIS is not mandatory for all vessels**. The lack of adequate **vetting mechanisms** to identify and account for AIS manipulation can be an important limitation. However, it appears that by employing different methods and **cross-checking** the data acquired this disadvantage can be reduced.
- **EO satellites** only allow for images of a given area when the satellite passes over it, **not** for **continuously monitoring the same area**.

Commercial services

Commercial service: Windward Mind[44]

Overview and context

Windward is a maritime data and analytics company with an **emphasis on marine traffic** that looks both at individual vessel tracking and global trade patterns. Through the maritime data platform 'Windward Mind' it seeks to enable its customers to find out about the real identity and destination of vessels by counteracting the issue of fragmented and often intentionally manipulated data. It was originally founded to tackle illegal fishing but quickly spread its focus to other areas involving **trade and security**, as the illegal fishing market was not sufficiently funded to support the company. Windward's tools can be customised for the different purposes of government agencies it has primarily been working with.

Methods

The 'Windward Mind' applies a 'trust-no-one'-approach by synthesizing and cross-checking AIS and other data sources to create a coherent and reliable global database of vessel movements. Commercially available **satellite data** are sourced for example from the satellite technology company Spire and other data partnerships. These are complemented with information from port agents and logistics brokers. Shipping expertise helps to shape **machine-learning algorithms** (using Apache Hadoop™ and Apache Spark™), which integrate and analyse the different types

43 ESA (2014). 'FISHSAT - Integrated Satellite Services for Fishing Support and Safety' [online] https://artes-apps.esa.int/projects/fishsat.
44 If not indicated otherwise, information presented in this section is based on [online] http://www.windward.eu/#/solutions.

of data and correct manipulation attempts. The result is a unique history of the activities of each target vessel that can then be fed into MARINT (Maritime Intelligence), an activity-based intelligence product that can issue real-time alerts in case of suspicious vessel behaviour.

Data accessibility and availability

Windward's services are **commercially available**. It is unclear if customers have direct access to the utilised data or if this is limited to the final analytical products. Windward provides **real-time** information as well as alerts, which can be customized to support a range of different end-users.

Results

According to the website, the 'Windward Mind' is widely used by governmental security, intelligence and law enforcement agencies. Its applicability in the context of illegal fishing has recently been outlined in the lead-up to the G7 summit on 7-8 June 2015 in Germany.[45]

Advantages

The main advantage lies in the sophisticated mechanisms for vetting AIS data to detect and correct potential manipulation. According to Windward it is the only platform that 'aggregates, analyses and vets all maritime data, globally 24/7'. The use of algorithms is less time-consuming than other approaches that require a manual evaluation by analysts.

Limitations

- The approach is presumably **limited to vessels equipped with AIS**, which excludes smaller fishing vessels with less than 300 gross tonnage.
- Despite its acknowledged applicability to illegal fishing, no concrete initiative seems to have been implemented yet in this field. The ability to automatically identify fishing activity – though most likely feasible with the utilized technology – has not explicitly been mentioned either.

45 Ami, D. (2015) 'Oceans 2.0: The Key to Unlocking a Sustainable Maritime Future' [online] http://cloud.digipage.net/go/g7climate-change2015/#110 (15 June 2015).

Commercial service: Spire[46]

Overview and context

Spire claims to be on its way to building the most powerful remote sensing platform in the world. Covering the ¾ of Earth neglected by traditional remote sensing, Spire offers faster revisit times with more data than any other system. It contributes satellite data to the 'Windward Mind'.

According to the website, the data that is provided through their services **augments detection of illegal fishing and helps promote fairer seas for everyone**. However, it is unclear how exactly their service translates into this are of action.

Methods

Spire employs satellites operating in Low Earth Orbit (**EO satellites**) which they claim avoids transmission blockage by the curvature of the Earth and 'provides The Ultimate High Ground to capture and relay critical information from every ship' that is equipped with an AIS transponder.

Algorithms allow the satellites to measure **GPS radio signals** when those pass through the Earth's atmosphere, allowing the satellites to extract quite accurate data profiles for temperature, pressure and humidity at the point of the bend.

Data accessibility and availability

No information is available on data accessibility and availability. Given the commercial nature of the service, we assume that information is only **shared between the contracting parties**.

Limitations

- **AIS is not mandatory for all vessels**. The lack of adequate **vetting mechanisms** to identify and account for AIS manipulation can be an important limitation. However, it appears that by employing different methods and **cross-checking** the data acquired this disadvantage can be reduced.
- **EO satellites** only allow for images of a given area when the satellite passes over it, **not** for **continuously monitoring the same area**.

Commercial service: ArgoNet[47]

Overview and context

ArgoNet is a commercial service co-developed (in cooperation with Eumetsat, and NOAA) and operated by CLS, a subsidiary of the French Space Agency (Cnes). According to the website, Argonet 'meets the mandatory requirements and performance standards of most VMS regulations worldwide and is endorsed by Fisheries Administrations around the world'.

46 If not indicated otherwise, information presented in this section is based on [online] http://www.spire.com/products/.
47 If not indicated otherwise, information presented in this section is based on [online] http://www.argonet-vms.com/web/en/44-aboutargonet.php.

Methods

ArgoNet uses a **VMS transmitter** with an integrated Argos transceiver and **GPS receiver** to allow tracking vessel's fishing activities.

Next to VMS compliance, the system also allows for optimising fleet management which includes ensuring that good fishing practices are being respected. For these purposes, messages about the latest catch reports and warning messages when a vessel enters or leaves a fishing zone can be transmitted.

Data accessibility and availability

As the system is a commercial service, **data is only available to customers**. Only authorized individuals have access to data. The system allows for **near-real-time data** and transmission of messages.

Limitations

- The installation of VMS is **not mandatory for all vessels**, i.e. excluding smaller or uncooperative ones. Therefore vessel coverage is the main disadvantage associated with the usage of VMS.

Commercial service: MRAG[48]

Overview and context

MRAG is a consulting firm designing and implementing integrated resource management systems in marine, estuarine, riverine and floodplain environments. The Fisheries Monitoring, Control and Surveillance work stream includes the management of vessel monitoring systems, analysis and assessment of VMS data and advice relating to setting up, commissioning or developing VMS functionality. The IUU work stream however has mainly focused on development of risk assessment methodologies, analysis of the performance and applicability of whitelists (authorised) and blacklists by regional fisheries management authorities and port state measures.

Methods

MRAG uses VMS as part of its toolkit, having developed in-house capacity for the analysis and assessment of VMS data. This has been used for **environmental and vulnerable marine ecosystem impact assessments** where the VMS tracks are interpolated and a technique applied to generate a **vessel "footprint"** of where impacts will have occurred. Similarly, this sort of analysis has been used as part of licensing operations where VMS data are submitted by vessels to prove that they have not been engaging in illegal activity. Analyses are performed on the data and any outliers outside normal fishing behaviour will be raised, checked and verified before licences are issued.

Data accessibility and availability

No information is available on data accessibility and availability. Given the commercial nature of the service, we assume that information is **only shared between the contracting parties**.

Limitations

48 If not indicated otherwise, information presented in this section is based on [online] http://www.mrag.co.uk/.

Due to lack of information, the limitations of the project cannot be assessed.

Commercial service: CLS America[49]

Overview and context

CLS uses twenty years of close collaboration with the government authorities in the US and Canada responsible for the fishing industry in order to provide a total **solution**, adaptable to all fishery policies, **with the aim of preserving fish stocks and managing them in an economically sustainable manner**.

In addition to monitoring applications, CLS America also supplies a service to **estimate catch effort on the basis of VMS data**.

Methods

CLS uses **VMS** to monitor fishing activities. By superimposing VMS data on **satellite radar images**, it is possible to detect vessels fishing illegally.

Also, **shore-based radar systems** using operating principle, together with an **AIS** solution for managing in-shore activity are used. CLS America has also developed receiver systems enabling patrol vessels and reconnaissance aircraft to access VMS data transmitted by fishing vessels directly. This solution, together with the oceanographic data used to define patrol areas, increases the effectiveness of control operations at sea and reduces their cost.

Data accessibility and availability

According to the website, the data is to be used for carefully planned, sustainable and responsible fisheries management program, and the technology shall provide governments with statistics that are both dynamic and reliable. This suggests that data access is limited to stakeholders responsible for fisheries management. Information on availability is not provided.

Limitations

- The installation of VMS is **not mandatory for all vessels**, i.e. excluding smaller or uncooperative ones. Therefore vessel coverage is the main disadvantage associated with the usage of VMS.

Synthesis and Conclusion

The present document provides an overview of current and planned initiatives utilising satellite monitoring and other data collection methods as well as intelligence sharing which can be or are already used to combat IUU fishing in our oceans.

In terms of satellite technology, both **AIS and VMS** seem to be the **most commonly used MCS methods**. However, looking at the current projects and initiatives we observe a clear tendency to **employ more than one method**, often in combination with coordinative efforts aimed at intelligence sharing of the collected data to allow for subsequent enforcement actions**.**

49 If not indicated otherwise, information presented in this section is based on [online] http://www.clsamerica.com/#!sustainable-marine-resources/c4ng.

We understand that this is primarily linked to the widely acknowledged limitations of individual satellite monitoring methods in terms of vessel coverage and the potential for manipulation of the transmitted data: the on-board installation and utilisation of AIS and VMS devices usually excludes smaller fishing vessels as it is not mandatory for all vessels, and many of the presented projects do not have appropriate vetting mechanisms in order to identify and account for data manipulation. Therefore, the reliability of the transmitted data largely depends on the cooperation of the targeted vessels, which represents a considerable loophole for those involved in IUU fishing.

In addition to this, it is important to note that satellite signals alone usually only provide information on the vessel's identity, location, direction and speed, again subject to cooperation of the vessel operator. In the context of IUU fishing, this might be helpful to identify ships that venture into restricted areas or operate throughout closed seasons, but it cannot unambiguously identify all types of illegal activities *per se*. As Spire correctly states, **more data points allow to see a trajectory, and to map patterns that may otherwise be missed**.[50]

The logical strategy used by many of the presented projects is therefore to **employ more than one method and cross-reference data**, for example with registers of vessel and fishing licenses and blacklists of vessels previously involved in IUU fishing, so as to increase reliability and coverage through this synthesis of information from different sources. This also allows for the **incorporation of other supplementary information** such as GPS-tagged photos, electronic signals, radio broadcasts, reports or other intelligence shared by fisheries agencies.[51]

Overall, it appears that the current (ongoing) project **Eyes on the Seas** is the most in advanced in terms of overcoming the above-described limitations. Similarly, the data vetting mechanisms employed by Windward's in its **Windward Mind** project appears to be the most elaborated method to account for satellite data manipulations.

50 See [online] http://www.spire.com/insights/news/noaa-will-curb-illegal-fishing/.
51 See The Pew Charitable Trusts (2015). 'Project Eyes on the Seas ' [online] http://www.pewtrusts.org/~/media/Assets/2015/03/Eyes-on-the-Seas-Brief_WEB.pdf.