

# Satellite Applications



## Case Study

# Ending Illegal Fishing

How satellites are helping to tackle illegal, unreported and unregulated (IUU) fishing

We work with  
**Innovate UK**

**CATAPULT**

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## Overview

Illegal, unreported and unregulated (IUU) fishing is estimated to account for up to \$23.5 billion of fish worldwide per year and up to 20 per cent of all the wild marine fish caught globally.<sup>1</sup> Annually, around 10-26 million tonnes of fish are thought to be caught illegally; this not only affects those who rely on wild-caught fish for food but has many other serious consequences as well.



Illegal fishing activity

The Satellite Applications Catapult is transforming the way the world uses satellite technology, enabling new business and improving people's lives.

We are accelerating the growth of the UK space sector by: raising awareness and increasing demand for satellite-enabled services; making space technology more accessible and relevant; and helping businesses, entrepreneurs and innovators to overcome challenges and bring new products and services to market.

Tackling IUU fishing was identified as an ideal application for satellite data soon after the formation of the Catapult in 2013. Since then, we have worked with The Pew Charitable Trusts to establish Project Eyes on the Seas, operating through the Ocean Sustainability Business Unit at the Catapult, which aims to address this global challenge by combining our knowledge of satellites with the sector expertise of our partners and the power of big data. The resulting solution has already had major successes and holds huge potential for the future, including:

- Helping to protect marine reserves and the overall wellbeing of the Earth's oceans.
- Supporting developing countries in protecting fish stocks within their economic exclusion zones.
- Addressing human trafficking associated with illegal fishing.
- Enabling retailers and supply chains to understand their risk in compliance in sourcing fish and marine products.

## The Challenges Posed By Illegal Fishing

It is illegal to fish without permission in regulated waters, such as the national waters of coastal countries, or to disregard protected areas or permitted fishing times and places. The problem is compounded by unreported fishing, where catches are misreported or not reported to the relevant national authority. Added to that, unregulated fishing, which results in overfishing in international waters, or overfishing of highly migratory species, leads to the over-exploitation of certain stocks.

Tackling IUU fishing from ground level is almost impossible due to the sheer number of vessels spread across the Earth's seas and oceans, and it is a major problem in regions where countries cannot afford to adequately control and patrol their own waters. Those engaged in illegal fishing can also damage ocean ecosystems by using banned equipment, catching protected species and fishing in no-take zones, affecting our ability to manage ocean resources. In addition, IUU fishing has been linked to crimes such as human trafficking and slavery.

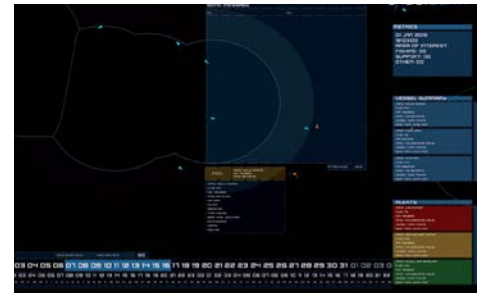
Illegal fishing is also a problem for retailers of marine-based products and those in the supply chain, who face legal requirements – such as the EU's 2008 IUU fishing regulations<sup>2</sup>. Retailers and other players along the supply chain must prove that no slave labour or illegal practices (from a natural resources perspective) have been involved in the harvesting of the products they sell.

Project Eyes on the Seas can provide positions, identities and behavioural information to analyse and provide credible results in real time.

SAR data can monitor large areas of water and it is not affected by cloud cover or time of day.

## Eyes on the Seas

In recognition of the scale of the IUU problem, The Pew Charitable Trusts approached the Catapult in 2013 to help it achieve its aim of establishing a global enforcement system to combat illegal fishing within 10 years, in a venture called Eyes on the Seas. The key was to use anything that could provide positions, identities and behavioural information, and combine them in a single system that analyse them to produce clear, credible results in real time – or as close to real time as possible – on a global scale.



Project Eyes on the Seas can help to identify vessels acting suspiciously

In practice, this meant looking for the best combination of satellite data, terrestrial data and specialist fisheries databases, and applying expert interpretation in order to provide information to governments, retailers or relevant authorities where closer investigation may be warranted.

There have been ship-based position tracking systems in use for some years that can be used to monitor the location of fishing vessels. Firstly, all boats over 300 gross tonnage (or 65 feet) have to broadcast their details and position to other ships as well as to base stations and satellites using an automated information system (AIS), which is effectively a collision avoidance system that supplements marine radar. Fishing boats should also carry a vessel monitoring system (VMS) unit to allow environmental and fisheries regulatory organisations to track and monitor their activities.

Both AIS and VMS can be monitored by satellite, allowing live monitoring of any vessel's movements on a large scale. The challenge, however, is to interpret those movements to determine whether they indicate illegal fishing. In addition, fishing boats can simply switch off their AIS and VMS systems if they want to 'disappear' and fish illegally, while others simply do not have them installed at all.

## Data and Analysis

Eyes on the Seas takes this AIS and VMS data and uses it alongside other satellite data that can map boat locations and movements.

Satellites can spot vessels by using optical, infrared and synthetic aperture radar (SAR) sensors. SAR is particularly powerful for this application as it can monitor large areas of water and it is not affected by cloud cover or time of day. In Eyes on the Seas, the team narrows down the focus to areas of interest and then uses SAR data to spot 'dark targets', allowing them to analyse what vessels are actually in the area compared with what is reporting legitimately.



Solving the challenge with big data

The fisheries analysts can use positional information to identify behavioural patterns that indicate suspicious activities, such as fishing boats moving in a particular way in an oceanographic area that seems likely to hold fish stocks. Analysts can also identify small vessels deliberately encountering large ships, which may indicate that illegally caught stock is being transferred between them – known as 'trans-shipment'. However, speed is of the essence in producing actionable data, in order to allow enforcement teams to act on it.

Eyes on the Seas enables positional and other data to be efficiently synthesized; then machine learning and other algorithms are applied to identify suspicious activities in near real time. This can be done in less than 18 milliseconds, compared with 18 hours or more for analysts to identify problems through manual interpretation of the evidence. This allows limited enforcement resources to focus on a particular vessel or area, saving time and money.

Operation Kurukuru involved the largest intelligence and analysis team to ever participate in a Pacific fisheries operation against IUU.

Both the engine and the fisheries analysts' visual display play vital roles in maximising the use and understanding of all of this data. The solution uses an open source database built on Google's Bigtable technology with multi-level security built in from the ground up to analyse the data. The interface, meanwhile, borrows expertise from the gaming sector. It is based on the high performance Unity 3D games engine for visualisation and uses multiplayer gaming techniques.

## The Future

Eyes on the Seas initially focussed on large, protected marine reserves as these are vital for ensuring the abundance and diversity of marine life, and preserving the overall wellbeing of the oceans and, in turn, the planet. However, it can be difficult to monitor such reserves because of their remote locations. Through our work, we have proved that a satellite-based solution is ideal for such applications.



Global monitoring of vessels will help eradicate IUU fishing

Eyes on the Seas has since expanded, with further work underway, including one for the Metro Group, an international retail group headquartered in Germany, and another in support of the Polynesian Leaders Group, which is a subset of the Pacific Islands Forum Fisheries Agency (see Case Study).

Our Ocean Sustainability Business Unit is now talking to other organisations about potential applications and welcomes interest from any governments, businesses or not-for-profit bodies.

## Case Study

### Operation Kurukuru 2015

In 2015, our Ocean Sustainability Business Unit contributed to the Pacific Islands Forum Fisheries Agency's (FFA) annual initiative to identify and respond to IUU fishing – Operation Kurukuru 2015. This involved the largest intelligence and analysis team to ever participate in a Pacific fisheries surveillance operation against IUU and featured the use of satellite-based surveillance for the first time.



Protecting our Pacific seas

We delivered analysis of satellite observations that provided significant situational awareness over the waters of several countries that are members of the Polynesian Leaders Group (PLG), a subset of the FFA. This helped to identify possible dark targets and vessels of interest that could then be reviewed by the PLG operational teams and FFA's Regional Fisheries Surveillance Center (RFSC).

Following on from Operation Kurukuru, Eyes on the Seas is continuing to support the extensive monitoring, control and surveillance efforts of several PLG member countries, including the use of sensors to identify dark vessels, along with analysis of vessel behaviour and permits to inform the relevant authorities of suspicious or abnormal activity for further investigation.

Electron Building  
Fermi Avenue  
Harwell Oxford  
Didcot  
Oxfordshire  
OX11 0QR

For more information:

T: +44 (0) 1235 567999  
W: sa.catapult.org.uk  
E: info@sa.catapult.org.uk  
@SatAppsCatapult

- 1 Agnew DJ, Pearce J, Pramod G, Peatman T, Watson R, Beddington JR, et al. (2009) Estimating the Worldwide Extent of Illegal Fishing. PLoS ONE 4(2): e4570. doi:10.1371/journal.pone.0004570
- 2 Council Regulation (EC) No 1005/2008 of 29 September 2008 establishing a Community system to prevent, deter and eliminate illegal, unreported and unregulated fishing