

# Protecting the world's fisheries

## Identifying offending operators and their vessels

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## Monitoring, Control and Surveillance Analytics for Illegal, Unregulated and Unreported (IUU) Fishing

As global population increases, food from the ocean will play an increasingly important role for communities, both economically and nutritionally. While this reliance on the ocean is increasing, so too is the rate of illegal, unregulated and unreported fishing, putting stress on an already tenuously balanced economic and food supply chain.

Almost half the world's population relies on food from the ocean as their primary source of protein. This demand is expected to grow as the world's population reaches almost 10 billion by 2050, an increase of around 30%.

Globally, fisheries support the livelihoods of 8% of the world's population. Valued at \$102.1 billion, exports of fish account for one per cent of global merchandise trade. However, there are serious concerns for the state of world fisheries, with more than 80% of global fisheries either at full capacity or overexploited.

Illegal, unregulated and unreported (IUU) fishing not only threatens fisheries

management, but leaves communities at risk of overfishing, leading to the shortage or extinction of species which they rely on for economic and food security. It weighs particularly heavily on developing countries, driven by inadequate resources and weak governance.

IUU, cited as one of the three main causes for poor performance of fisheries management, is estimated to account for 11–19% of catches globally, and costs legal fisheries up to \$23 billion annually. Illegally caught fish are estimated to comprise up to one third of fish for sale in the US.

IUU vessels is a major issue in Indonesia. A recent Global Environment Fund review listed industrial illegal fishing in Indonesia as one of the main drivers of unsustainable fishing in the Arafura Sea, Indonesia's most valuable fishing region. The level of IUU in this region is estimated to be 1.5x that of legal catches. A 2006 estimate calculated the lost revenue to Indonesia to be US\$2 billion; this value has likely increased over time.

Increased enforcement in Indonesia has been identified as a priority action. Since 2014, the Indonesian government has been taking decisive action, particularly against foreign vessels operating illegally in Indonesian waters. However, identifying IUU vessels and fisheries violations remains a significant challenge.

**“ Indonesia's issues are global issues; it is the third largest producer of wild-caught fish globally, with major export markets in Asia and the US**





## International IUU challenges

### 1 Case Study: Domestic transshipment among vessels when VMS is disabled

Transshipment of catch among fishing operators is a key component of fisheries operations, and is an essential strategy for reducing the costs of transporting products from fishing grounds to on-shore processing facilities. However, transshipment is also often used to avoid regulation or taxation, and in some cases allows concealment of illegal catches. We are developing indicators for transshipment events, and using these indicators together to estimate the probability of transshipment events and participants.



### 2 Case Study: Foreign transshipment among vessels, including non-transmitting vessels

Transshipment of catches to foreign vessels is a major issue in facilitating IUU fishing. These activities can involve both smaller scale receiving vessels and large devoted refrigerated cargo ships. Frequently vessels acting as receivers are too small to have tracking systems, such as AIS, while larger vessels may disable their transmitters. Similar to Case Study 1, we're extending our work to foreign vessels, identifying anomalous behaviour which suggests fishing-related activities, and using remote sensing data to identify non-transmitting, or "dark" vessels.

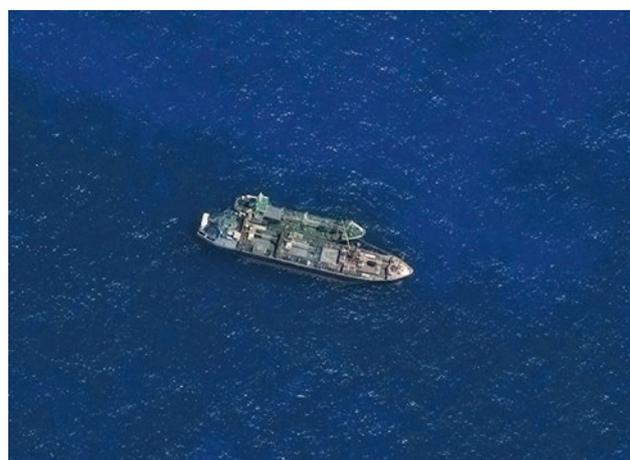


Image: Digital Globe via SkyTruth

### 3 Case Study: Estimating locations, abundance, and use of Fish Aggregating Devices

Fish aggregating devices (FADs) are surface and subsurface structures which are either anchored or drifting in the ocean. Fish congregate under these devices, significantly increasing the efficiency of fishing operators who harvest fish using them. However, FADs can lead to overharvest, and are widely regarded as a major challenge in fisheries management. Case study 3 uses vessel densities and movement patterns inferred from VMS and satellite radar to estimate FAD locations and use.



# New IUU vessel risk report web portal launch

## from CSIRO's Monitoring, Control and Surveillance Analytics team

### The goal of the Vessel Risk Report is to provide a transparent set of indicators to identify high-risk vessels

The IUU risk report uses data categories that fisheries inspectors and maritime surveillance professionals consider key to identify suspicious vessels, including Ownership/crew, history, movement, tampering, rendezvous, cargo, etc.

For instance, the tampering panel (right) uses a statistical model that identifies operators intentionally shutting off their AIS transmitters. The risk pattern (below, right) shows this data over time (blue) and provides a cumulative risk score based on the pattern of AIS shut-offs over time. Similarly, we have a gap summary plot that helps to identify vessels that have intentional shutoffs from those with poorly functioning equipment (points at lower left of the distribution).

Similar to the tampering indicators, the report provides outputs from statistical models of vessel movement to ID vessels moving in abnormal ways, which can indicate suspicious activity. E.g. vessels loitering in areas where vessels typically do not stop, such as near countries' maritime boundaries.

These risk indicators are used to rank a vessel against other vessels, providing a risk score on each indicator against all vessels in a region. For instance, the vessel shown here has varying ranks on a number of indicators. Overall, however, for abnormal behaviour it is ranked in the top 1% vessels, (of 2600 vessels in the region).

## IUU Vessel Risk Report

CSIRO Monitoring, Control and Surveillance Analytics Team

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### Vessel Details:

Vessel name*	xxxxxx
MMSI*	xxxxxxxxxx
IMO*	xxxxxx
Length (m)	56.4
Beam (m)	9.8
Year Built	1982
Craft Type	Fishing Vessel
Flag State*	xxxxxx

Photo: Australian Border Force  
(Photo is used for display purposes only, it is in no way linked to displayed results.)

### Geographic area of interest

### Overall Risk:

Percent ranks are shown for eight indicators and overall rank. For example, '1%' indicates the vessel is ranked in the top 1% of all vessels.

Risk Indicator	Rank (%)
Tampering: AIS transmissions – gaps	1%
Tampering: AIS transmissions – gaps standardised	10%
Tampering: AIS transmissions – skew transmission intervals	5%
Movement: Loitering – time	30%
Movement: Loitering – speed	15%
Movement: Loitering – distance	15%
Movement: Directional statistics – mean	5%
Movement: Directional statistics – standard deviation	5%
<b>Overall Rank</b>	<b>1%</b>

### Movement:

**Loitering** – indicators of loitering activity are time, speed and distance anomalies. Coloured points indicate location of high risk movement anomalies.

**Directional statistics** – (not shown) indicates areas of frequent turning, and areas with more tightly clustered bearings.

### History:

Prior history, movements, ports of call and change in ownership (not shown).

### Rendezvous:

All other vessels within specified time/distance window (not shown).

### Tampering:

**AIS transmission** – behaviour indicative of intentional AIS disabling. Location of low and high risk gaps shown. Grey lines indicate vessel tracks.

**Risk profile for tampering** – light blue circles indicate high risk gaps, dark blue low risk gaps. Red line indicates overall risk profile for anomalous tampering activity – lines close to the diagonal indicate frequent high risk activity.

**FOR FURTHER INFORMATION**  
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# Other products available

The MCS Analytics team is working to produce a range of open source, freely available and low cost tools to help combat IUU fishing.

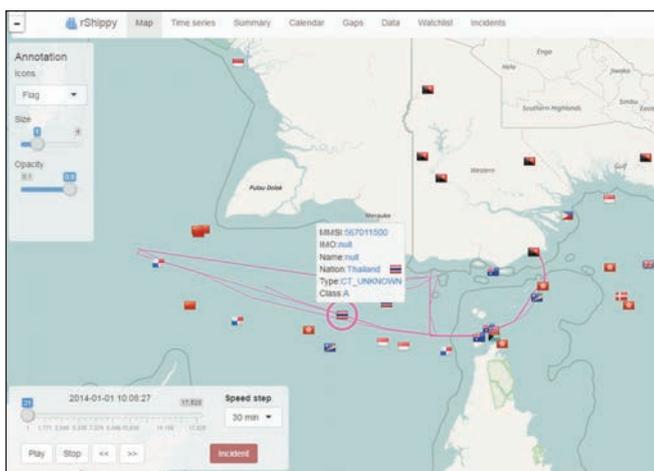
These products will be key for addressing IUU fishing, particularly for professionals in the developing world, where resources are frequently a limiting factor.

The team has developed a web interface called RShippy which allows visualization of vessel tracking data, including the capacity to query individual vessel tracks and characteristics and movements, and

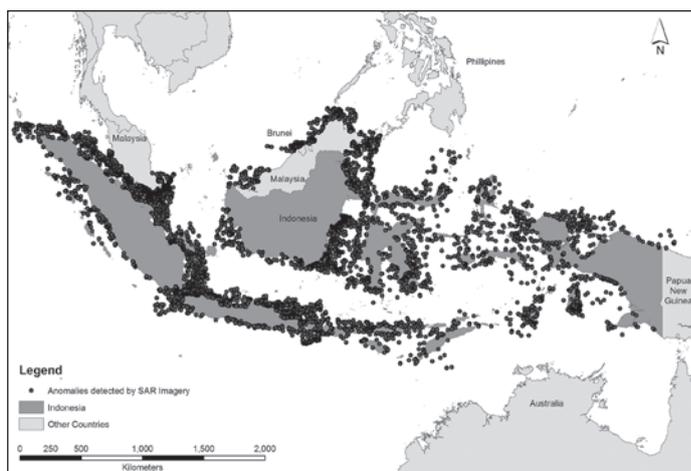
set alerts for behaviours or vessels of interest. The platform is underpinned by detailed statistical analysis that allows high-power data manipulation and advanced analytical tools in a freely available software package.

The team is also identifying and developing low cost data sources that can be used to improve maritime

domain awareness. For instance, the EU Sentinel mission makes low resolution satellite radar data available for a specific region every 6 days. The analytics team has developed a way to rapidly process these satellite data to feed into the visualization tools, including to identify untracked vessels. Below is an example of this data, illustrating a national picture of vessels operating in Indonesian waters.



rShippy highlighting and examining movement/behaviour of an individual vessel.



Vessels detected from satellite radar across Indonesia's waters, based on a mosaic of 146 SAR images from the Sentinel 1A mission, with more than 10,500 potential vessels detected.

Monitoring, Control and Surveillance Analytics for Illegal, Unregulated and Unreported (IUU) Fishing is a collaborative project between the Commonwealth Scientific and Industrial Research Organization (CSIRO) and the Center for Fisheries Research and Development (CFRD) under the Ministry of Marine Affairs and Fisheries of the Republic of Indonesia.

## Funders



## Collaborators



Australian Government  
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### WE DO THE EXTRAORDINARY EVERY DAY

We innovate for tomorrow and help improve today – for our customers, all Australians and the world.

WE IMAGINE  
WE COLLABORATE  
WE INNOVATE

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