

# AI for Earth Grantee Profile

OceanMind

Curbing illegal fishing with satellite data and AI

## Summary

Illegal, unreported, and unregulated fishing have significant detrimental impacts on biodiversity and exacerbate ocean impacts of climate change. Healthy and productive ocean ecosystems are necessary for human food security, livelihoods, and health, and for helping the planet be more resilient in the face of climate change. OceanMind is working to increase the sustainability of fishing by analyzing vessel movements and identifying their behavior and regulatory compliance. This helps governments enforce existing laws more effectively and helps seafood buyers make more responsible choices. Through a Microsoft AI for Earth grant, OceanMind moved its data analytics to the Microsoft Azure cloud, allowing it to analyze more data in real time, faster and more accurately. That greatly improves OceanMind's ability to help in the fight against illegal fishing.

## Curbing illegal fishing with satellite data and AI

Fish are a crucial global resource, providing the primary source of protein in the diets of as many as 3 billion people worldwide. And as much as 12 percent of the world's population relies in some fashion upon fishing and the seafood industry for their livelihood. But this resource is seriously threatened. As reported by the [UN Food and Agriculture Organization](#), consumption of fish as food by humans has grown on average about 1.5 percent per year since 1961. Fully a third of all fish stocks are now overfished, no longer biologically sustainable, and about 60 percent are maximally sustainably fished; as little as 7 percent remains underfished.

**One-third of all fishing stocks are now overfished and about 60 percent are maximally sustainably fished.**

These problems are worsened by illegal, unreported, and unregulated (IUU) fishing. A [seminal study in 2009](#) estimated that illegal and unreported fishing catches between 11 million and 26 million metric tons annually, costing the industry as much as \$24 billion. But by definition the extent of IUU fishing is not fully known, which means the depletion of fish stocks could be even worse. And the weight of this problem tends to fall on the poorest nations with the least ability to manage their fish stocks, causing additional suffering. Illegal fishing

also sometimes uses slave labor, with the unpaid crews forced to stay working on vessels for years at a time in horrifying conditions.

Worldwide, fishing fleets collectively include more than 4 million vessels—a huge number in the even more vast environment of the oceans, where physical borders are rarely obvious. These fleets operate in a variety of jurisdictions. National governments patrol their own coastal waters, and usually form treaties to jointly manage nearby areas in between. Regional fisheries management organizations also govern some areas of international waters, while other large areas of the oceans are unregulated. With this complicated situation, it's challenging to catch IUU fishing—especially because it generally looks no different than normal legal fishing. The distinction comes in whether a vessel was licensed to catch the species it caught, with the gear used, in the amounts it caught, at the time and location where it was fishing.

### Identifying fishing activities with AI

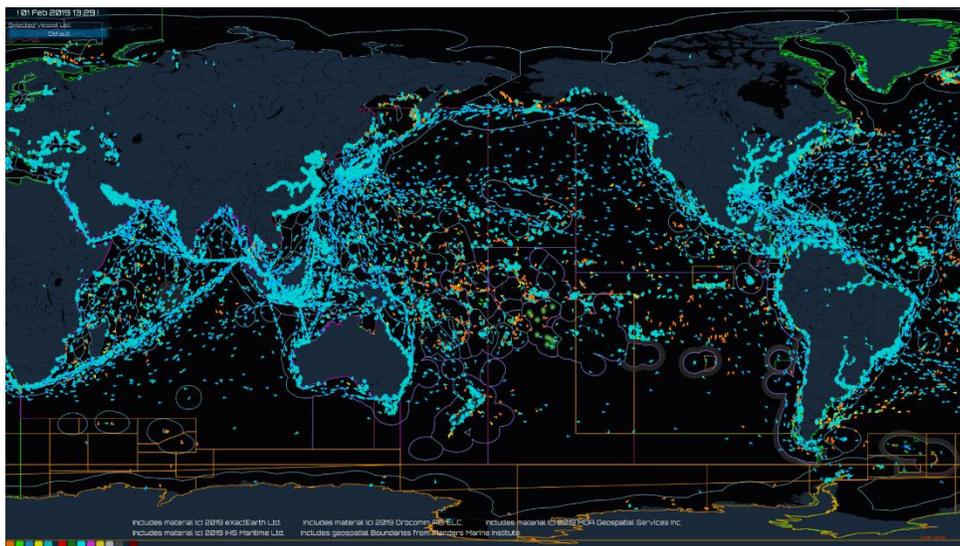
[OceanMind](#) was founded specifically to help address this problem. Its mission is to help governments be more effective at enforcement and to help the seafood industry be more responsible with compliance, thereby improving the sustainability of fishing. The non-profit organization began as a project of the [Satellite Applications Catapult](#), a UK government-funded research and development organization designed to help grow the UK economy through the application of satellite technologies. The Catapult, together with Pew Charitable Trusts, invested in developing a system to gather satellite data for analyzing the behavior of fishing vessels, to help curb illegal fishing.

**Data on a vessel's movement can determine the type of fishing it's doing, and the time and positioning helps indicate whether it should be investigated.**

Different types of commercial fishing—such as long-lining, purse seining, and trawling—have observable characteristic movements based upon their methods, and factors such as location, duration, and time of day can all indicate what's likely being caught. Data from satellites, from photo images to radar, automated tracking signals, and even ship lights can be used to determine a vessel's movement behavior. Where vessel tracking data such as Automatic Identification System (AIS) is available, OceanMind is able to detect fishing to a very high degree of accuracy, even to the point of recognizing different phases of fishing, such as the deploying of gear, soaking gear to catch fish, and the recovery of gear. Running that data through an artificial intelligence algorithm then determines the type of fishing, and the time and positioning helps indicate whether it should be considered for investigation. Once fishing activities have been identified, the data is cross-referenced with vessel registries and licensing information to establish compliance, which can help pick out “dark targets”,

vessels lacking transponders that aren't readily identifiable and may be worth checking by sending out a patrol vessel. When fishing activities have been identified, they can be compared with marine mammal movements to determine the risk of by-catch and entanglement.

Satellite imagery and movement behavior data can also identify when a fishing vessel meets up with a cargo carrier to transfer its catch, allowing the fishing vessel to continue working while the catch is brought in to market. This practice, called transshipment, is both legal and efficient for the industry, but does also provide an opportunity for illegal fishers to launder their catch. The carrier vessels are also sometimes involved in using slave labor, another reason they are targets of interest for monitoring and enforcement checks.



*The OceanMind system visualizing vessel tracking data*

OceanMind doesn't make legality determinations itself or engage in enforcement activities. Rather, through its data analysis work, it produces insights and reports that it provides to fishing authorities who have the expertise and responsibility to enforce the law. The authorities can use that information to determine what needs investigation. OceanMind also works with seafood buyers, helping them to make more responsible buying decisions by understanding the risks of illegal catches and the benefits of buying from the fishers following the regulations. That in turn creates economic incentives for fishers to operate within the law.

## **Processing satellite data on ocean vessels in the cloud**

OceanMind's work would be impossible without modern computing resources, including AI and machine learning. With hundreds of thousands of vessels involved in any one type of fishing, across wide areas involving many different jurisdictions and thousands of regulations, monitoring couldn't be managed by humans alone. They'd never have enough time and informed analysts to manage at this scale.

Issues of scale and time also apply to the computing resources. Previously, OceanMind used an on-premises system for data analytics, but that was limited in the scope and scale of data it could process. Running an analysis for a particular location required an overnight batch process, and the system could never handle all the data for fishing fleets worldwide all at once. To reach for real-time global monitoring, OceanMind moved its database and data analytics to Microsoft Azure cloud computing, thanks to a Microsoft AI for Earth grant.

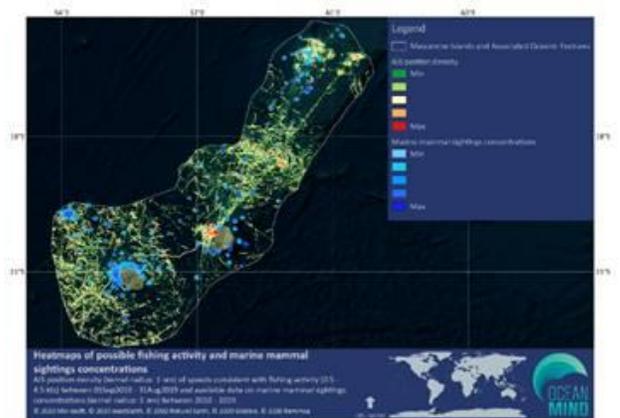
As part of this migration, OceanMind redesigned its solution to take full advantage of the machine learning capabilities in Azure. This redesign enables OceanMind to analyze more data in real time, faster and more accurately—as well as cost-effectively. The goal is to deliver insights to any government anywhere, in real time, telling them of potentially illegal fishing in their waters. And that will clearly make a big difference to fighting illegal fishing.

### Protecting whales and wildlife habitats in the Mascarene Islands

OceanMind conducted an analysis of [115 Important Marine Mammal Areas](#) (IMMAs), in which they looked at fishing vessel activity to assess by-catch risks and looked at shipping lanes for ship strikes, where vessels hit a mammal resulting in a fatality. They then provided case studies to highlight risk areas and suggestions on how to preserve endangered and charismatic animals.

The three islands comprising the Mascarene Islands IMMA represent one of the most important breeding and feeding habitats for sperm whales in the southwestern Indian Ocean. The area also hosts calving, nursing, and mating humpback whales and is an important habitat for three different dolphin species. This IMMA has very high vessel transit, creating a higher probability of ship strikes. While there is some data around the occurrence of marine mammals, the region is still understudied, which was one reason why OceanMind focused on this particular area. With the support of the [WWF](#) and [Globice](#) (Groupe Local d'Observation et d'Identification des Cétacés), OceanMind identified risk areas where ship strikes and by-catch of mammals by fishing vessels were more likely to occur.

OceanMind highlighted marine mammal aggregation points (shown in blue to the right) and possible pathways between those in comparison to vessel activity. This could help to improve shipping lanes to reduce ship strikes and allow fishing vessels to operate without the risk of catching smaller marine mammals, such as dolphins.





## Press

"Can conservation save our ocean?" *Ocean*, season 2 episode 1. The Economist. March 7, 2018.  
<https://www.youtube.com/watch?v=BFtrZ0aqqtM> (segment on OceanMind begins around 19:30)

"Is China's fishing fleet taking all of West Africa's fish?" BBC News. March 25, 2019.  
<https://www.bbc.co.uk/news/av/world-africa-47698314/is-china-s-fishing-fleet-taking-all-of-west-africa-s-fish>

"The dramatic hunt for the fish pirates" BBC Future. February 18, 2019.  
<http://www.bbc.com/future/story/20190213-the-dramatic-hunt-for-the-fish-pirates-exploiting-our-seas>

## Documentation

*The State of the World Fisheries and Aquaculture 2018*. Food and Agriculture Organization (FAO) of the United Nations. 2018. <http://www.fao.org/state-of-fisheries-aquaculture/en/>

Agnew DJ, Pearce J, Pramod G, Peatman T, Watson R, et al. (2009) *Estimating the Worldwide Extent of Illegal Fishing*. PLoS ONE 4(2): e4570. doi:10.1371/journal.pone.0004570.  
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