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 Responsibility

# One ocean: Data drives effective fisheries management

8 September 2021

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## Science-based management requires reliable information, yet many fisheries lack capacity and compliance tools



Comparing fisheries of varying scales requires context, but when it comes to effective fisheries management, only one tool levels the field: data. Shutterstock image.

In global fisheries, there are both clear and subtle differences between small-scale, artisanal, semi-industrial, and industrial fisheries. The United Nations' [Atlas of the Oceans](http://www.oceansatlas.org/subtopic/en/c/1421/) (<http://www.oceansatlas.org/subtopic/en/c/1421/>), suggests that the best test is to graphically combine both the vessel size and degree of technology. Of course, regions with varying socioeconomic characteristics will produce different pictures in such an exercise. "Relativity" is a key word in comparing fisheries; however, when it comes to effective fisheries management, there is one powerful tool that puts all at the starting line together: data.

Naturally, there are challenges. According to a [2018 report](https://www.nature.org/content/dam/tnc/nature/en/documents/Catalyzing_Growth_of_Electronic_Monitoring_in_Fisheries_9-10-2018.pdf) ([https://www.nature.org/content/dam/tnc/nature/en/documents/Catalyzing\\_Growth\\_of\\_Electronic\\_Monitoring\\_in\\_Fisheries\\_9-10-2018.pdf](https://www.nature.org/content/dam/tnc/nature/en/documents/Catalyzing_Growth_of_Electronic_Monitoring_in_Fisheries_9-10-2018.pdf)), by California Environmental Associates (CEA) and The Nature Conservancy (TNC), many fisheries "lack reliable data about what happens on the water to inform and implement science-based management." Many others also "lack the political will, management and legal frameworks, capacity, and compliance tools necessary for enforcement." A 2018 report by the [Environmental Defense Fund](https://www.edf.org/sites/default/files/oceans/Technologies_for_Improving_Fisheries_Monitoring.pdf) ([https://www.edf.org/sites/default/files/oceans/Technologies\\_for\\_Improving\\_Fisheries\\_Monitoring.pdf](https://www.edf.org/sites/default/files/oceans/Technologies_for_Improving_Fisheries_Monitoring.pdf)), (EDF) states that there are at least 10,000 fisheries in the world, and the catch is monitored to some degree in about 7,000 of them; however, the approximate number of fisheries that are scientifically assessed and managed is only about 600. That leaves an enormous gap.



(<https://www.globalseafood.org/goal/>).

There's a price attached to that disparity. The World Bank estimates that ineffective fisheries management results in a (U.S.) \$80 billion reduction in annual net benefits compared to if fisheries were managed sustainably (CEA/TNC report).

Improved data collection and the ability to enforce regulations are important factors in addressing these losses. Managing fisheries to reach their potential contributes to achieving many of the United Nations' **Sustainable Development Goals** (<https://sdgs.un.org/goals>), including ending poverty and hunger, improving health, creating sustainable livelihoods, and protecting ocean ecosystems. To sum up: equal access to data matters.

**"One ocean: At the intersection of green energy and a blue economy" (<https://www.aquaculturealliance.org/advocate/one-ocean-at-the-intersection-of-green-energy-and-a-blue-economy/?hstc=236403678.24c2da4641244a61b0e15134d4122679.1680630499117.1680630499117.1680630499117.1&hssc=236403678.1.1680630499117&h>)**

## Reason for optimism

Despite the hurdles, good news is on the horizon. As the EDF report states, a wide range of fisheries is increasingly turning to technology to improve fisheries monitoring. Moreover, not all technologies require a significant start-up cost or infrastructure investment, making these vital tools more accessible for a wide range of fisheries.

Case in point: Conventional electronic monitoring (EM) systems used in industrialized fisheries can provide full accountability for fishing activities; however, due to various constraints, including cost and lack of infrastructure, less than 1 percent of the world's fishing vessels are subject to EM (CEA/TNC report).

But as the EDF report indicates, the landscape is changing. Other types of monitoring technologies are emerging that can be especially useful in fisheries without ample infrastructure, revenue, or capacity for conventional EM systems. The table below summarizes fishery enforcement challenges or needs, types of technological solutions, and specific technologies.

## Ocean data, Table 1

Table 1. Fishery enforcement challenges that can be addressed with existing or soon-to-be available technology. Table reposted with permission from EDF.

Challenge/need	Technological solutions	Specifics
IUU fishing of highly migratory species and transboundary stocks	Satellite imagery; VMS data; AIS data	Global Fishing Watch, Eyes on the Sea, Camio, Data Science for Social Good
Catch limit compliance - self reported	Electronic logbooks on tablets Smartphone apps	TNC e-Catch, DeckHand Apps: Abalobi, mFish, FACTS, FishBrain, iSnapper, FishAngler
Catch limit compliance - monitored	Low-cost cameras with data loggers	Flywire, ShellCatch
Effort limit compliance	Electronic logbooks on tablets; Smartphone apps; GPS trackers; Low-cost VMS	TNC e-Catch, DeckHand Apps: Abalobi, mFish, FACTS, FishBrain, iSnapper, FishAngler PDS trackers, Remora trackers, SatLink artisanal VMS
Compliance with spatial restrictions (MPAs, TURFs, SPAG closures, etc)	GPS trackers; Low-cost VMS	PDS trackers, SatLink artisanal VMS, Data Science for Social Good tracking and alert software, Camio tracking and alert software
Compliance with seasonal restrictions	GPS trackers VMS	PDS trackers, Remora trackers, SatLink; artisanal VMS
Reducing bycatch of ocean wildlife	Cameras; Satellite imagery; AI for detecting wildlife in images; Acoustic monitoring of marine mammals	Flywire, ShellCatch, GoPro Planet Images, CVision SA Instrumentation
Illegal access to fishery	Radar; GPS trackers; VMS	Marine Monitor (M2) radar; PDS trackers; Remora trackers; SatLink; artisanal VMS
Seafood fraud	DNA scanning; Blockchain ledgers	Conservation X DNA scanner, FishCoin
Fisher ID and vessel registry	Electronic registries	FINNS, FishTrax (web-based)
Compliance with size limits	Cameras; AI software for image processing; Web-based length quantification	Flywire, Shellcatch, TNC system, CVision, Poseidon
Data management	Hardware to integrate data from multiple sensors; Databases with user friendly interfaces	Nautilus, Olrac Akvo, Hydroswarm
Predicting illegal activity	Machine learning	Google TensorFlow
Incentivizing data collection and sharing	Blockchain ledger	FishCoin

Inevitably, there are barriers to adopting new technologies – insufficient drivers for monitoring and enforcement, high perceived cost, resistance to change, privacy concerns, accountability, infrastructure and lack of governance are all on the list. High levels of stakeholder buy-in are critical to success, especially in situations where enforcement is ineffective. One way to achieve stakeholder buy-in is to demonstrate and otherwise communicate the benefits of monitoring for fishers, often in the form of higher market prices, increased catches and increased sustainability.

## Beating IUU fishing helps all fisheries

In the effort to combat illegal, unreported and unregulated (IUU) fishing, data-gathering and visualization techniques are helping improve transparency on the ocean. Given that IUU fishing occurs in all types of fisheries and is a threat to the food security, economic security, national security and environmental security of countries around the world, it's a global problem that calls for a coordinated approach.

Technology is playing a role in tackling IUU fishing. For example, the remote-sensing tools developed by [Global Fishing Watch](http://globalfishingwatch.org/) (GFW) are helping address this issue. The GFW data platform detects illegal fishing independent of fishery-specific monitoring efforts by collecting and integrating a tremendous amount of information about fishing activity from vessel monitoring system (VMS) and automatic identification system (AIS) data.

For fisheries that are unwilling or unable to carry any monitoring equipment beyond VMS or AIS, this is a huge advantage. AIS was designed as a collision avoidance tool, and for vessels over a certain size, it is required by international law. For some smaller vessels, it is required by national regulation. VMS is a fisheries management system regulated at the national and regional levels. VMS data have traditionally been proprietary, but more governments are sharing these data for greater fisheries transparency. Greater transparency certainly helps, but more detective work is required to "see" vessels that do not have VMS or AIS, as well as those that go "dark", or turn off their AIS signals to hide their locations. GFW's work provides a more complete picture by combining the VMS and AIS data with numerous satellite imagery sources.

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Currently, most information is collected from large commercial fishing vessels. However, these data can benefit small-scale fisheries by enabling governments to detect illegal fishing, interdict illegal vessels, and deter illegal fishing in areas set aside for artisanal or small-scale fisheries, or in protected areas. As the EDF report details, GFW has partnered with Pelagic Data Systems to integrate more small-scale fishing into its data.

GFW and the U.S. Department of Defense (DOD) also recently announced a partnership in the form of an [AI contest](https://www.maritime-executive.com/article/the-pentagon-wants-programmers-help-to-spot-iuu-fishing) for software developers. The challenge is to detect IUU vessels that go dark. The DOD has global satellite surveillance capabilities and a particular type of remote-sensing technology that allows radar-reflective objects – like steel decks and topsides – to show up bright and clear against the backdrop of the sea. Creating an algorithm to look for IUU fishing patterns in the scores of DOD images comes with a prize of \$150,000. The best-performing algorithms will then be shared as open-source and can be applied to a global, free data set – an exciting prospect for increased monitoring and fisheries management.

## A step forward

Most people engaged in fishing reside in developing countries, and the majority are small-scale or artisanal fishers. As the EDF report states, while small-scale fisheries are perhaps the least monitored fisheries in the world, there is great potential for them to improve monitoring by taking advantage of the power of technology to create high-quality data. Collecting data is only the first step, but the increasing accessibility of technologies for fisheries monitoring programs is a foot forward in the right direction – toward nourished people, healthier fisheries and a healthier ocean.

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