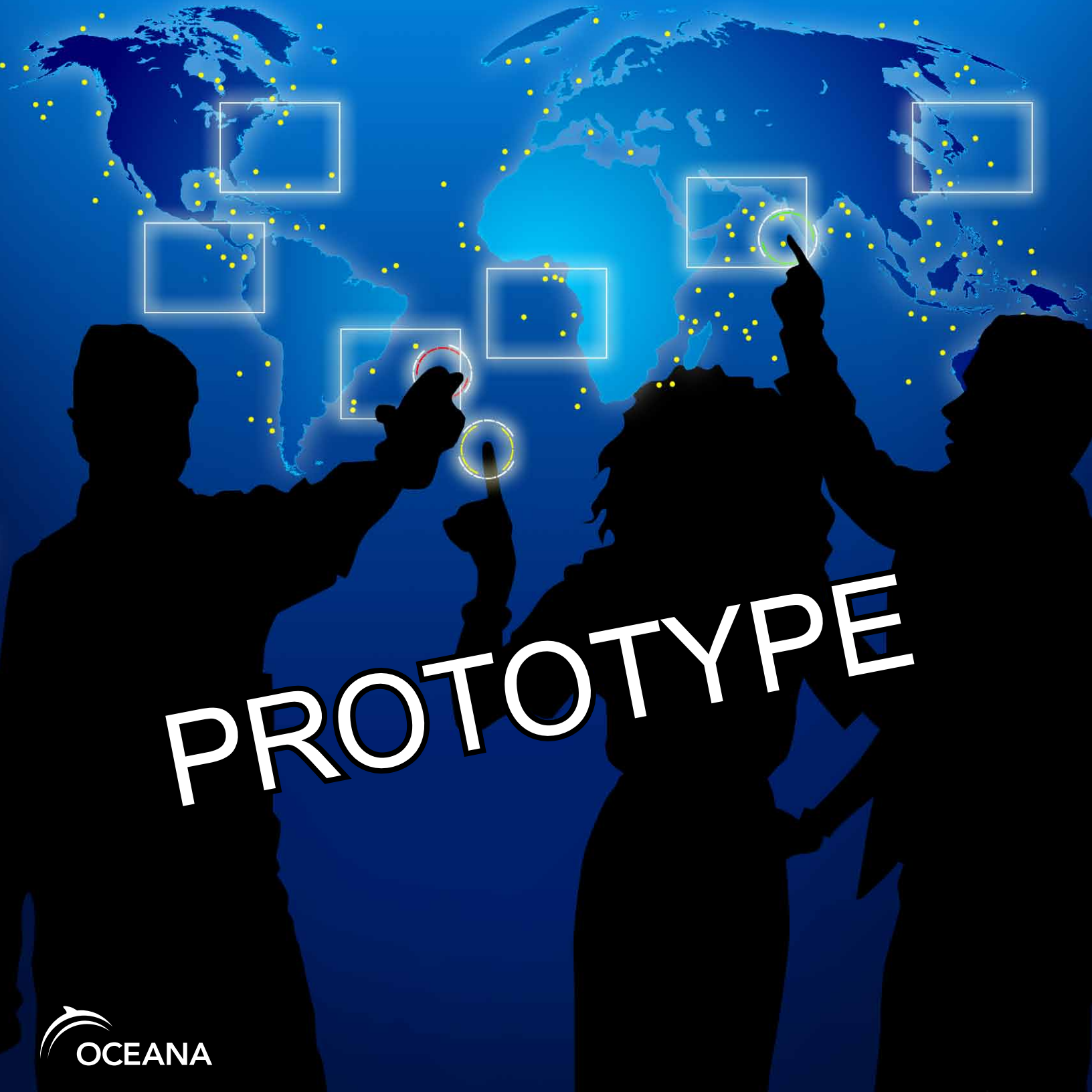



# GLOBAL FISHING WATCH

FREE WORLDWIDE INFORMATION FOR CITIZENS SEEKING EFFECTIVE ENFORCEMENT OF OCEAN CONSERVATION LAWS



# PROTOTYPE





ILLEGAL, UNREPORTED  
AND UNREGULATED  
(IUU) FISHING AROUND  
THE WORLD HAS  
**ESCALATED RAPIDLY**  
AS THE CHANCE FOR  
PROFIT OUTWEIGHS  
CONCERNS ABOUT  
THE HEALTH AND  
SUSTAINABILITY OF  
OUR OCEANS

## CONTENTS

- 3** What is *Global Fishing Watch*?
- 4** Why is *Global Fishing Watch* Needed?
- 5** Why is Illegal Fishing a Concern?
- 6** How does *Global Fishing Watch* Work?
- 7** How Will Technological Improvements Strengthen *Global Fishing Watch*?
- 8** What Can *Global Fishing Watch* Do?
  - 8** Can it track a fishing vessel anywhere on the globe?
  - 10** Can it identify suspicious activity in No-Take Marine Protected Areas?
  - 12** Can *Global Fishing Watch* track “blacklisted” vessels?
  - 14** Can *Global Fishing Watch* identify vessels that may be fishing without proper registration?
  - 16** Can *Global Fishing Watch* identify vessels that may be cheating on AIS rules?
- 18** Recommendations
- 19** Frequently Asked Questions



### Acknowledgements

The authors Daniel Hess and Jacqueline Savitz wish to acknowledge the following people who provided input and advice on this report: Rebecca Moore and Brian Sullivan of Google, John Amos and Paul Woods of Skytruth, and Andrew Sharpless, James Simon, Michael Hirshfield, Dustin Cranor and Elizabeth Pincumbe of Oceana.

THE LONG-TERM  
SUSTAINABILITY  
OF OUR OCEANS  
DEPENDS ON ACTION  
BY GOVERNMENTS,  
FISHERY MANAGEMENT  
ORGANIZATIONS, CITIZENS  
AND THE FISHING  
INDUSTRY ITSELF

# WHAT IS *GLOBAL FISHING WATCH*?

***Global Fishing Watch* is the result of a collaboration among Google, Oceana and SkyTruth to map and measure fishing activity worldwide. *Global Fishing Watch* is made possible by the availability of data from the Automatic Identification System (AIS), used by more than 100,000 vessels worldwide. *Global Fishing Watch* analyzes these data to identify behavior consistent with fishing, and gives citizens everywhere in the world the information they need to examine that behavior in the context of global fishery management rules and ensure that the government agencies responsible for managing commercial fishing fleets are accountable for delivering a healthy, diverse and maximally productive ocean.**

The *Global Fishing Watch* prototype demonstrates a system unlike any existing AIS fishery tracking service because it will be:

- Free
- Global in scale
- Easy to use, and
- Available to anyone in the world with an internet connection

The long-term health of our oceans depends on action by governments, fishery management organizations, citizens and the fishing industry itself. Governments must set and enforce scientifically based limits, and set policies to protect the ecosystems on which fishing depends. Fishing companies must follow those rules, and citizens must hold government and the industry accountable. *Global Fishing Watch* is designed to empower all stakeholders so that together they may work to restore fishery abundance.

*Global Fishing Watch* offers citizens, governments, organizations and other players in the fishing industry a new way to understand the magnitude and extent of global fishing activity. Importantly, it will subject fishery enforcement to a participatory process by giving any citizen anywhere in the world with internet access information on commercial ocean fishing activity that they can use to pressure their governments to strengthen fisheries management and enforce fishing laws. The system is based on openness, from the original data itself to the final web portal, which will be free to the public and available to anyone who wishes to use it.

Besides providing a nearly real-time window on the worldwide activities of the world's commercial fishing fleets, *Global Fishing Watch* will also empower citizens to help identify illegal fishing vessels. Doing so will help to keep illegally caught fish out of the market and level the playing field to benefit those fishing legally. By helping deter illegal fishing, *Global Fishing Watch* will allow honest fishermen to benefit from increased catch, better pricing and fair competition at sea.

While citizens wishing to hold their governments accountable are the primary intended users of *Global Fishing Watch*, this tool could also be used by Regional Fishery Management Organizations and businesses throughout the fishery supply chain, from fishing companies to distributors, processors, restaurateurs, buyers and certification agencies. All of these can play an important role in preventing illegal and unsustainably caught fish from entering the market, and thus help to put an end to illegal fishing.

*Global Fishing Watch* could also be used as a supplementary tool that allows governments, especially those with limited resources, to monitor the extent and nature of fishing in their national or

local waters. They will be able to enforce fishing restrictions such as trawling bans and no-take zones or use *Global Fishing Watch* to assess the character of the vessels to help enforce areas set aside for small-scale or local fishermen. In addition, it will allow governments requiring AIS to track and assess the behavior of vessels registered in their countries. *Global Fishing Watch* could enhance the ability of countries to block imports of fish from vessels flagged in countries that fail to enforce fishery laws.

By helping to manage fisheries more sustainably, *Global Fishing Watch* will help bring back fishery abundance, protecting and enhancing the livelihoods of the hundreds of millions of people around the world who depend on ocean fisheries for food and income.

## *GLOBAL FISHING WATCH* WILL BE USED BY:

- **Citizens** who want to hold their government fishery agencies accountable for managing an abundant ocean,
- **Regional Fishery Management Organizations** who want to identify which fishing vessels are engaged in suspicious activity,
- **Independent Fishery Certification Organizations** who want help in validating claims by commercial fishing fleets that they are complying with fishing rules or certification standards,
- **Scientists** who want to monitor and track changes in fishing pressure, both globally and in areas of special biological or commercial interest or vulnerability,
- **Advocacy Organizations** seeking to determine whether changes in fishery laws and/or rules are necessary to assure responsible and sustainable fishing by the world's commercial ocean fishing fleets,
- **Sustainable Seafood Distributors and Retailers** seeking to assure that their suppliers are indeed conducting themselves honestly and in compliance with promises to fish responsibly,
- **Governments** wanting help in identifying potentially illegal fishing activity by specific vessels, and
- **Fishery Agencies** seeking to identify areas of the world's oceans that are good candidates for increased protection.

# WHY IS *GLOBAL FISHING WATCH* NEEDED?

**Illegal, unreported and unregulated fishing is one of the greatest threats to the long-term economic and environmental sustainability of global ocean fisheries. Activities like fishing in restricted areas, ignoring quotas, catching prohibited species or failing to accurately report catches now account for an estimated 11-26 million tons of fish caught each year and \$10-23 billion in economic losses for countries and local communities.<sup>1</sup>**

To address the increasing demand for food as the global population grows, we need to bring back abundant wild ocean fisheries. This requires meaningful and scientifically-based fishery management policies – catch limits, habitat protection and bycatch limits – and they need to be enforced.

History shows that citizens cannot rely on governments to set and enforce fishery laws on their own. Public demand for sound policies and enforcement is a necessary component of effective fishery management. In a growing number of places where science-based ocean policy advocates like Oceana engage the public, leaders have created sound policies, but this is not yet true everywhere. And even in places where the policies are sound, lack of effective enforcement is sometimes a major problem.

A free, global tool that allows any citizen of any country to access vessel specific information showing activity suggestive of illegal fishing in their home country's ocean, or indeed anywhere in the world, would empower the public to demand meaningful enforcement, which is essential to rebuilding diminished fish populations. It would also be useful for governments and regional fishery management organizations that are charged with formulating and enforcing fishing policies, as well as certification organizations and businesses that make up the seafood supply chain, including fishermen, distributors, processors, importers and sellers. All of these players can benefit from knowing that their fish are legally caught.

Google, SkyTruth and Oceana have built the prototype of a system that is intended to provide information on activities of many of the world's largest fishing vessels to the public at no cost. This report describes *Global Fishing Watch* and provides a glimpse into the power this tool wields for revealing big commercial ocean fishing vessel operations around the world, including those that are suggestive of illegal, unreported and unregulated fishing. Full development of *Global Fishing Watch* will allow public crowd-sourcing to help identify illegal fishing and pressure governments to enact and enforce important fishery rules.

For example, a fisherman in Belize, where trawl fishing is illegal, could use *Global Fishing Watch* to alert authorities when foreign trawling vessels using AIS enter the Belizean Exclusive Economic Zone (EEZ) to fish under the cloak of darkness. And because the vessel tracking data is openly and freely available to the public and the Belizean media, the Government of Belize cannot easily choose to ignore or dismiss it. As a result, information provided by *Global Fishing Watch* could empower that fisherman and others to win decisive and effective Belizean enforcement actions. In the

Philippines, a mayor could use *Global Fishing Watch* to take action to protect the fishing rights exclusively provided to municipal fishermen, when large industrial vessels enter areas where all fishing is strictly restricted by law to smaller artisanal boats. In Chile, conservation leaders could use *Global Fishing Watch* to identify areas, like the Desventuradas Islands, that are not yet destroyed by bottom trawling, in time to win their protection.

The potential applications of *Global Fishing Watch* are too numerous to list comprehensively. Some examples include:

- identifying vessels that may be fishing illegally or fishing without a license,
- identifying vessels that may be fishing in ways that involve under-reporting or false reporting of catches,
- measuring and tracking apparent fishing activity,
- identifying places where large numbers of vessels gather and may be breaking the rules, therefore indicating ocean areas where increased coast guard and other enforcement patrolling are needed, and
- monitoring the current activities of “blacklisted” vessels previously identified by governments or NGOs as engaged in illegal or suspicious fishing activity.

This report debuts the *Global Fishing Watch* prototype and answers many important questions about the capabilities of the tool, including:

- **Can it track a fishing vessel anywhere on the globe?**
- **Can it identify suspicious activity in no-take Marine Protected Areas on a global basis?**
- **Can it track vessels that are named on fishing “blacklists?”**
- **Can it identify unregistered vessels that may be fishing in areas managed by a Regional Fishery Management Organization?**
- **Can it identify vessels that may be cheating on AIS rules?**

The report shows that even the prototype can answer many of these questions. The public release version of this tool will be even more powerful, drawing on ever-improving satellite data and additional algorithms to assess fishing behavior around the globe. A free, global tool driven by extremely large data sets that can galvanize the public and dramatically strengthen ocean fishery management is clearly in reach. Here we present a glimpse of its potential.

# WHY IS ILLEGAL FISHING A CONCERN?

**Global overfishing is destroying ocean ecosystems. Nearly one-third (29 percent) of assessed marine fish stocks worldwide have been overfished, and 90 percent were either fully fished or overfished in 2011, according to the United Nations Food and Agriculture Organization.<sup>2</sup> In comparison, only 10 percent of fish stocks were overfished in 1974.<sup>3</sup>**

As a result, fish catches have declined. From 1996 to 2012, the annual global wild marine catch decreased from 86.4 million tons to 79.7 million tons.<sup>4</sup> This declining catch trend is not the result of decreased fishing, it is a consequence of overfishing. Some ocean fisheries have even entirely collapsed as a result of a continuous and excessive increase in fishing effort.<sup>5</sup>

To ensure the long-term sustainability of ocean fish stocks at abundant levels, countries must set scientifically based limits, limit bycatch and protect important spawning, breeding, feeding and other habitats. Where this has occurred, fisheries have recovered.<sup>6</sup> Some nations already have placed restrictions on fishing in their territorial waters (which are the source of more than 90 percent of the world's wild fish catch by weight), and many nations have come together and made agreements about how to manage and conserve rare and threatened international fish stocks.<sup>7</sup> However, illegal fishing continues to be a problem.

Illegal, unreported and unregulated fishing, taken together as "IUU" fishing, is a serious threat to the long-term economic and environmental sustainability of our oceans. This global problem has escalated rapidly as the commercially motivated race for big catches outweighs concerns about the health and sustainability of our oceans.<sup>8</sup> IUU fishing, including fishing in a restricted area, ignoring quotas, catching prohibited species, or failing to report

catches accurately, accounts for an estimated 11-26 million tons of fish caught each year and \$10-23 billion in economic losses for countries and local communities.<sup>9</sup> In the United States alone, imports from IUU fishing are valued at \$1.3-2.1 billion each year.<sup>10</sup>

Illegal fishing can occur in all types and sizes of fisheries. It can occur in national waters and on the high seas, and at all stages along the supply chain from catch to market. In some cases, it is even associated with organized crime.<sup>11</sup> IUU fishing frequently occurs in and through nations with corrupt or weak leadership, especially in countries that lack the capacity or resources to monitor or enforce fisheries management laws, and it often results in continued overfishing (despite formal protections) and damage to sensitive marine habitats. It also takes a toll on honest fishers, as they are put at an unfair disadvantage in competing with vessels that do not observe the rules.<sup>12</sup>

With hundreds of millions of people around the world depending on our oceans for their livelihoods, and many more people relying on the oceans for food, ending overfishing, stopping illegal fishing, and ensuring the long-term sustainability of our oceans are all critical global needs. There is an urgent need for a tool that harnesses the power of citizen engagement to allow people to hold their leaders accountable for enacting and enforcing fishery laws and for delivering an abundant ocean.



## HOW DOES GLOBAL FISHING WATCH WORK?

The International Maritime Organization (IMO) requires all ships of 300 gross tonnage and above engaged on international voyages, cargo ships of 500 gross tonnage and above not engaged on international voyages, and all passenger ships, to use an Automatic Identification System (AIS).<sup>13</sup> This navigation and safety aid uses a VHF-frequency to automatically broadcast a vessel's identity, type, location, course, speed and other safety-related information to other ships, coastal authorities, radio towers and satellites around the world. Depending on the type of AIS system in use, it automatically broadcasts this information every 2-20 seconds while a vessel is in transit and every 3-6 minutes while at anchor. The IMO requires vessels fitted with AIS to use it at all times except where international agreements, rules or standards provide for the protection of navigational information. It is illegal for a vessel to turn it off or use a false identity.<sup>14</sup>

*Global Fishing Watch* analyzes AIS data to create a complete and continuous track of a vessel's movements including speed, accelerations and decelerations, changes in direction, and proximities to other vessels and landmarks like ports and boundaries of marine protected areas. Using an early stage machine-learning algorithm, *Global Fishing Watch* assesses the data to identify the characteristic motions that indicate fishing activity and assigns a probability of fishing score value from zero to one for every point in time where there is position data. These score values are weighted and normalized so values above 0.5 are "likely" fishing and values greater than 0.6 are "highly likely" fishing. The *Global Fishing Watch* prototype identified 20,000 vessels that had a possibility of fishing behavior in 2013 out of 140,000 total vessels using AIS worldwide. Of these, 2,800 were independently verified as fishing vessels. *Global Fishing Watch* also overlays boundaries of national Exclusive Economic Zones, protected areas and regional fishery management areas. Users can compare this information with lists of vessels known or suspected to be fishing illegally, vessel registration information or other data to create a clearer picture of commercial ocean fishing activity worldwide.

This *Global Fishing Watch* prototype is just a start. It demonstrates that the tool can be useful in empowering citizens to pressure governments to better manage the world's ocean fishing fleets, even though

there are challenges, including:

**Incomplete Coverage:** Many smaller fishing vessels are not included in *Global Fishing Watch*. Vessels below 300 gross tonnage are not currently required to operate AIS in many areas. The scope of the AIS vessel requirement is being considered by many countries and by the International Maritime Organization. The release of *Global Fishing Watch* will show the value and importance of expanding the AIS requirement to smaller vessels.

**Failure to Operate AIS as Required:** Some vessels that are required to operate AIS may illegally switch it off while fishing. However, users of *Global Fishing Watch* will be able to identify behavior suggestive of AIS avoidance. Since this information will be available to all its users, it will help generate public pressure on authorities to crack down on violators. This will result in more reliable vessel AIS operation, and over time, strengthen the comprehensiveness of *Global Fishing Watch*.

**Use of Bogus Identification Numbers:** Vessels may try to "spoof" the AIS system by entering a bogus vessel identification number, preventing authorities from identifying the vessel. However, *Global Fishing Watch* users will be able to recognize potential "spoofing," and with appropriate public pressure, persuade authorities to crack down on these illegal activities as well. This creates another "virtuous cycle" as increasing use of bona fide identification numbers itself enhances the effectiveness of *Global Fishing Watch*.

While *Global Fishing Watch* will not fully cover the world's commercial ocean fishing activities for the reasons described above, even in prototype, it can be used to identify many instances of activities that are highly suggestive of illegal fishing. When made broadly available to the public, it will serve as a tool for improving compliance with AIS requirements, thereby further enhancing its ability to monitor commercial fishing activity and help identify illegal fishing on a global basis.

The prototype successfully validates the feasibility and utility of the *Global Fishing Watch* concept.





# HOW WILL TECHNOLOGICAL IMPROVEMENTS STRENGTHEN GLOBAL FISHING WATCH?

While the prototype provides useful information, the future public release version of *Global Fishing Watch* will be more effective. The full public release will benefit from a series of technological improvements including near-real-time tracking, increasing satellite coverage and better terrestrial coverage to improve near-shore detection.

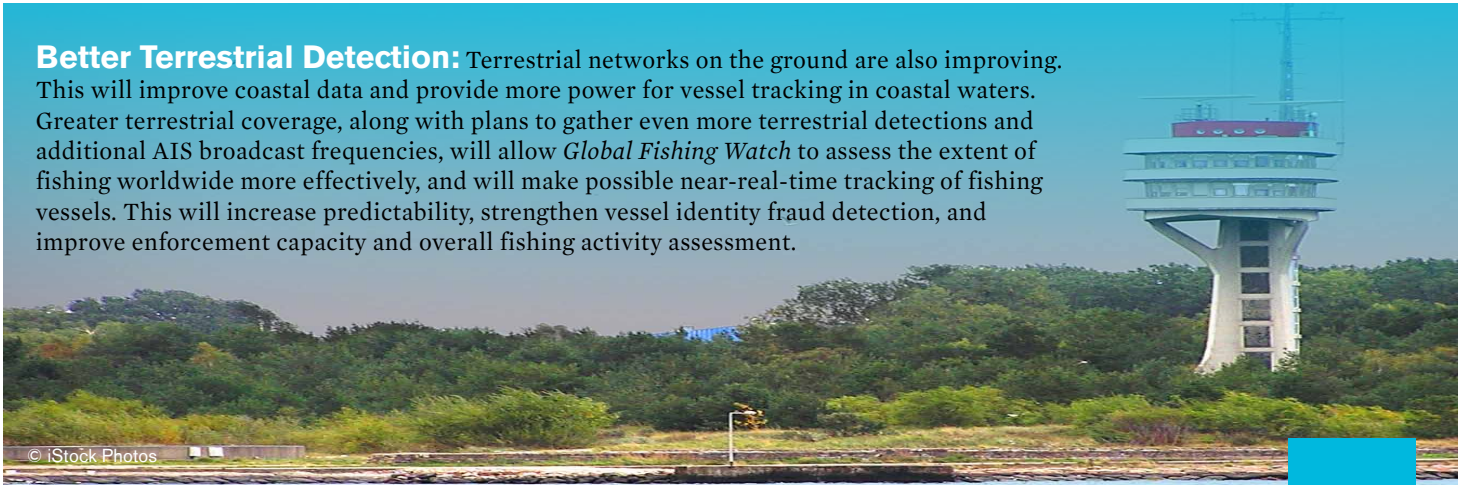
**Near-Real-Time Tracking:** While the prototype relies on historical data, compiled for 2012 and 2013, the public release version will offer “near-real-time” tracking of fishing vessels to increase predictability and actionable enforcement capacity.



**Increasing Satellite Coverage:** In 2012, only two satellites captured AIS data for public use. By the end of 2013, that had already almost quadrupled to seven, and 14 will be in space by the end of 2014 with many more planned to go into operation by the end of 2015.<sup>15</sup> This expansion of satellite coverage is already vastly improving the power of this tool. While vessels broadcast their position as frequently as 30 times every minute, in 2013, the limited number of satellites passing overhead meant a vessel's position was only detected roughly once every six hours. By 2014, that time had already been cut to once every two hours, and there should be no gaps in coverage at all by the end of 2016.



**Better Terrestrial Detection:** Terrestrial networks on the ground are also improving. This will improve coastal data and provide more power for vessel tracking in coastal waters. Greater terrestrial coverage, along with plans to gather even more terrestrial detections and additional AIS broadcast frequencies, will allow *Global Fishing Watch* to assess the extent of fishing worldwide more effectively, and will make possible near-real-time tracking of fishing vessels. This will increase predictability, strengthen vessel identity fraud detection, and improve enforcement capacity and overall fishing activity assessment.



# WHAT CAN *GLOBAL FISHING WATCH* DO?

To hold government agencies accountable for setting and enforcing necessary fishery management policies, citizens need to answer some very specific questions. Here we provide some examples of the type of information citizens might seek. These include the ability to determine whether fishing enforcement agencies in local waters are ignoring the presence of suspicious vessels or activities, allowing fishing in “no-take” zones, or even permitting fishing by unlicensed vessels. It also includes the ability for users of the model to identify vessels that may be cheating on the AIS requirements, either by shutting down their AIS or entering a fictitious identification number.



© OCEANA | Juan Cuetos

## CAN IT TRACK A FISHING VESSEL ANYWHERE ON THE GLOBE?

***Global Fishing Watch* can be used to track any vessel that is using AIS anywhere it goes and over a long time period. The prototype tracks vessel movements through 2013, and the public release version will provide near real-time vessel movements to within days, and possibly hours of the present time.**

An example of this vessel tracking ability is the Wakashio Maru No. 118. The Wakashio Maru No. 118 is a Japanese longliner that often fishes for tuna in the Pacific Ocean. This vessel provides a useful example of the capacity of *Global Fishing Watch* to track a vessel worldwide. The Wakashio Maru No. 118 exhibited possible fishing behavior mostly on the high seas across much of the Pacific Ocean, but it also went through the exclusive economic zones of Australia, Fiji, Japan, Micronesia, New Caledonia, Papua New Guinea and the Solomon Islands along its voyage.

The map on the next page shows the track of the Wakashio Maru No. 118 during 2013. The marks on the map indicate the speed the vessel was traveling at that point in time. Green marks indicate it was moving quickly, brown marks indicate it was moving at a more moderate pace, and red marks indicate times where the vessel was moving slowly. These colors range from pure green when a vessel travels at or faster than 20 knots, to brown when a vessel travels at 8-10 knots, to pure red when a

vessel is not in motion. During some of the times shown in red, the model predicts that the vessel may have been fishing. Yellow lines on a map mark gaps in time ranging from one to two days between detections, while red lines mark gaps in time of two days or more between detections. Exclusive Economic Zone (EEZ) boundaries of maritime countries, as well as boundaries of marine protected areas, are shown in white.

The Wakashio Maru No. 118 began 2013 off the western boundary of the Papahānaumokuākea Marine National Monument around the Hawaiian Islands. It exhibited possible fishing behavior in that area until early February and then moved slightly west and appeared to fish a little more before heading back to Japan, arriving around the end of February. The Wakashio Maru No. 118 left Japan around the beginning of April and headed south, traveled around the Marianas Trench Marine National Monument, between Papua New Guinea and the Solomon Islands, and arrived in the Tasman Sea and began exhibiting possible fishing behavior there from the end of April

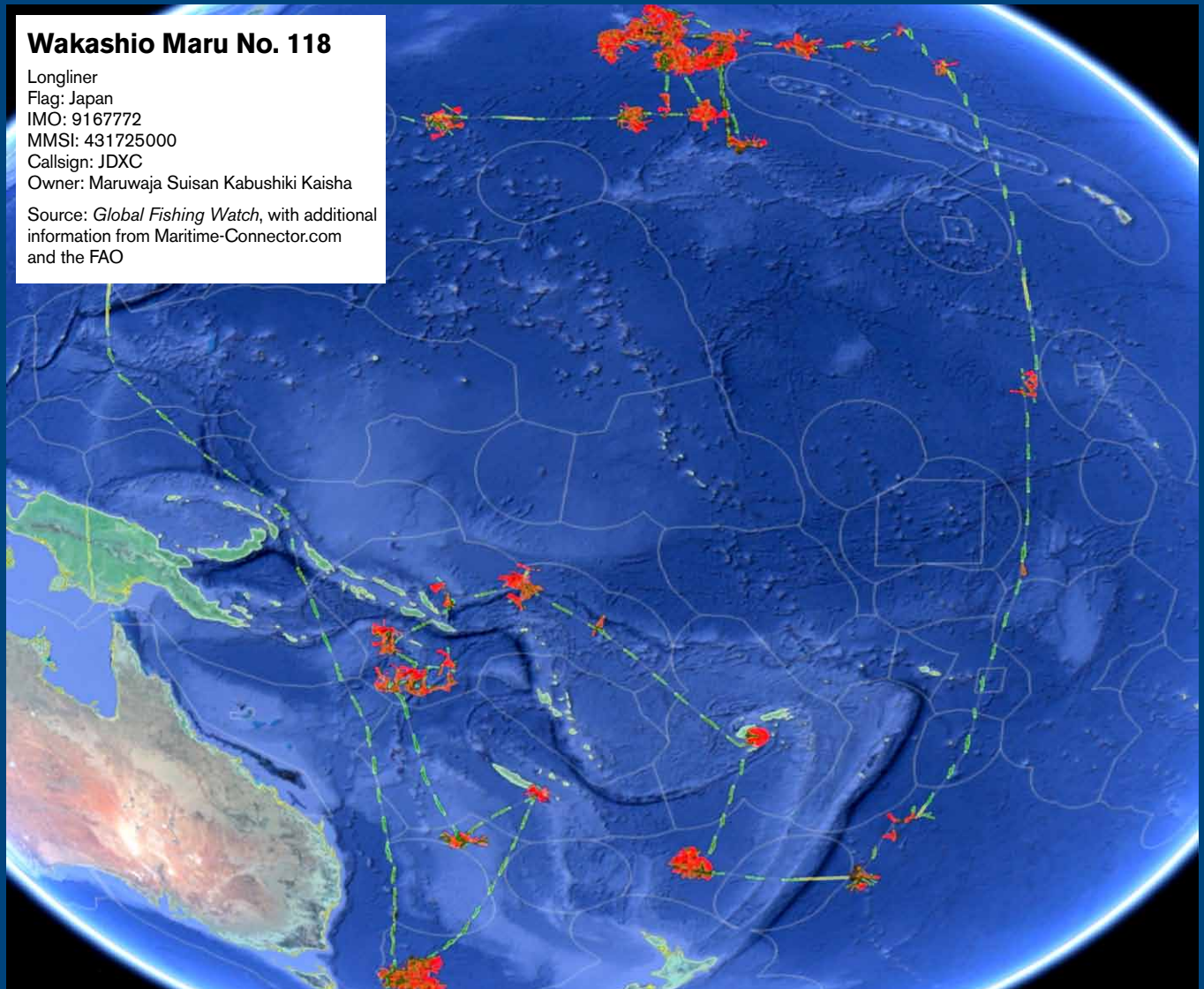
through the beginning of June. It then moved north, stopping in Noumea, New Caledonia between June 10-13 before heading southwest for what appears to be more fishing, and then north to the Solomon Islands EEZ. There the Wakashio Maru No. 118 appeared to have been fishing again for about a month. It then made a stop in Suva, Fiji on its way south to engage in apparent

fishing in the open sea north of New Zealand. Around the middle of August, the Wakashio Maru No. 118 moved west and appeared to be fishing in the open sea before heading north of the Hawaiian Islands where it exhibited fishing behavior in the middle of September. This apparent fishing behavior continued in the Hawaiian Islands for the remainder of 2013.

## WAKASHIO MARU No. 118

### Wakashio Maru No. 118

Longliner  
 Flag: Japan  
 IMO: 9167772  
 MMSI: 431725000  
 Callsign: JDXC  
 Owner: Maruwaja Suisan Kabushiki Kaisha  
 Source: *Global Fishing Watch*, with additional information from *Maritime-Connector.com* and the *FAO*



**KEY**

- Vessel traveling at 20+ knots
- Vessel traveling at 8-10 knots
- Vessel moving slowly or not in motion
- 1-2 day gap in AIS detection
- 2+ day gap in AIS detection

*Track of the Wakashio Maru No. 118 during 2013, demonstrating that Global Fishing Watch can track a fishing vessel anywhere on the globe.*



© Stephane Barbedienne

# CAN IT IDENTIFY SUSPICIOUS ACTIVITY IN NO-TAKE MARINE PROTECTED AREAS?

**There are currently 6,600 marine protected areas (MPAs) covering about 2 percent of the world’s oceans. An even smaller area of the global oceans, about 1 percent, has been protected with a “No Take” designation where all fishing is prohibited.**

MPAs play a valuable role in safeguarding some of our oceans’ greatest treasures by preserving habitats necessary for diverse and vibrant marine life. Protecting deep sea corals, canyons, sea mounts and grass beds provides safe havens for fish to breed, spawn, migrate, feed and find shelter. From the Great Barrier Reef to the recently expanded Pacific Remote Islands Marine National Monument, MPAs provide a way to manage and preserve sensitive marine habitats and promote biodiversity by restricting human activities within their borders.

The *Global Fishing Watch* prototype identified many unique vessels exhibiting behavior suggestive of fishing in no-take marine protected areas. One example occurred in the Dzhugdzhursky State Nature Reserve in Russia.

Founded in 1990 and situated on the eastern coast of Russia along the bank of the Sea of Okhotsk, the Dzhugdzhursky State Nature Reserve includes the central part of the Dhugdzhur Mountain Range, the southern part of the Pribrezhny Ridge, and 537km<sup>2</sup> of the Okhotsk Sea, including the Malminskye islands.<sup>15</sup> Many different types of salmon and other species live in the area.<sup>16</sup>

The nature reserve is an International Union for Conservation of Nature (IUCN) category 1a protected area, meaning it has the highest, and strictest, protection level possible.<sup>17</sup> However, at least five vessels, all registered in Russia, entered the Nature Reserve and exhibited behavior suggestive of fishing in 2013.

Vessel Name	IMO ID Number	MMSI Number	Flag	Vessel Type
Baykal	8728426	273828800	Russia	Fishing Vessel
Kalmar	8826412	273827800	Russia	Fishing Vessel
Kit	8898362	273452330	Russia	Trawler
Komarovo	8723098	273863100	Russia	Trawler
Vasan	8862088	273452210	Russia	Trawler

Source: Compiled by *Global Fishing Watch*, with additional information from MarineTraffic.com



© US Coast Guard

## DZHUGDZHURSKY STATE NATURE RESERVE

The Komarovo, a trawler registered in Russia, exhibited behavior that appears to be fishing five times inside the Dzhugdzhursky State Nature Reserve in September 2013. This vessel entered the Reserve and appeared to be fishing on at

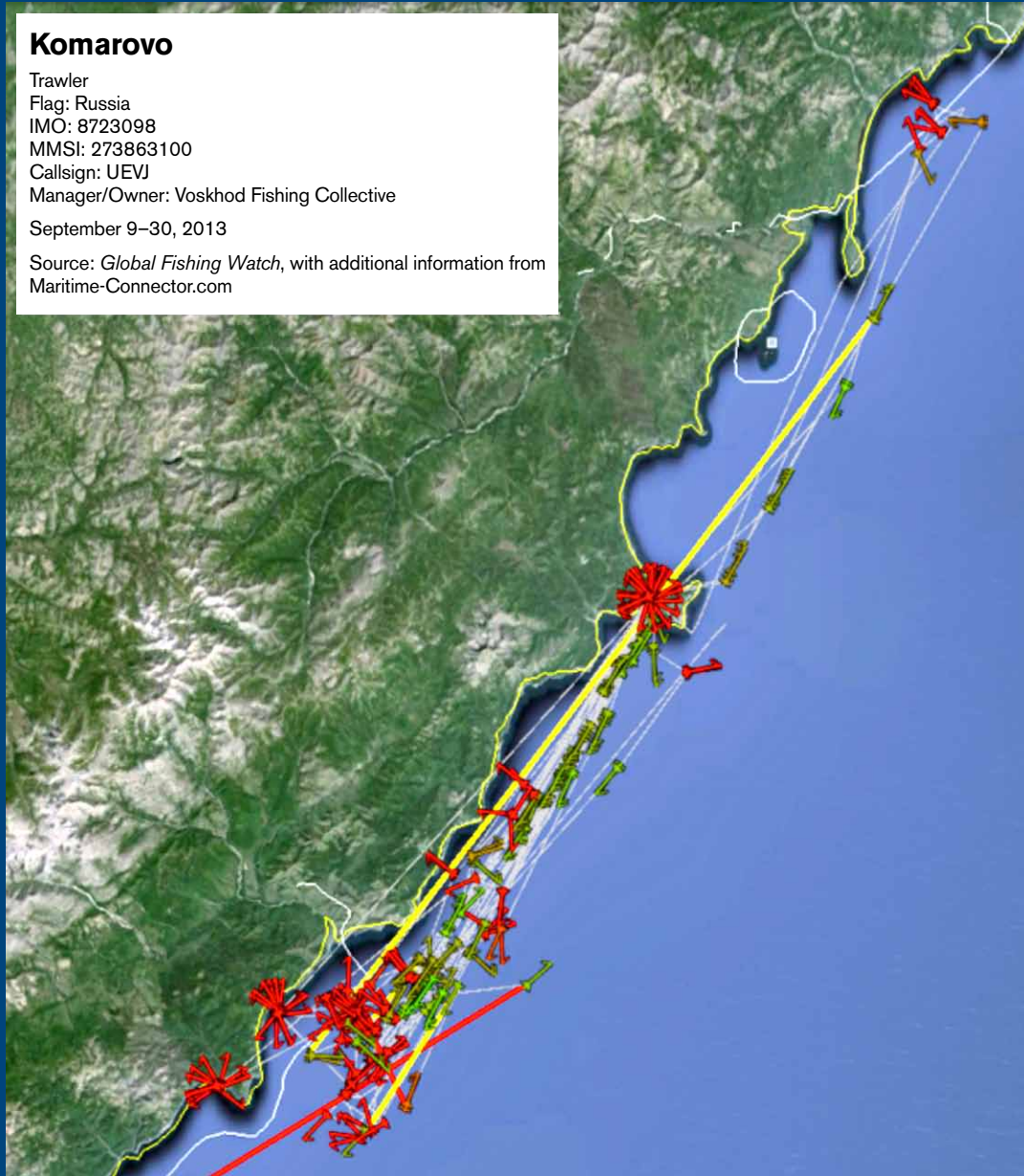
least 13 days in 2013. The manager and owner of the Komarovo is Voskhod Fishing Collective, and according to a Russian Business Database, the company is an industrial fishery for crabs and salmon.<sup>18</sup>

### Komarovo

Trawler  
Flag: Russia  
IMO: 8723098  
MMSI: 273863100  
Callsign: UEVJ  
Manager/Owner: Voskhod Fishing Collective

September 9–30, 2013

Source: *Global Fishing Watch*, with additional information from *Maritime-Connector.com*



### KEY

- Vessel traveling at 20+ knots
- Vessel traveling at 8-10 knots
- Vessel moving slowly or not in motion
- 1-2 day gap in AIS detection
- 2+ day gap in AIS detection

*Track of the Komarovo from September 9–30, 2013, demonstrating that Global Fishing Watch can identify suspicious activity in no-take Marine Protected Areas.*

# CAN GLOBAL FISHING WATCH TRACK “BLACKLISTED” VESSELS?

**Some fishing vessels are known for frequently fishing illegally. Sometimes known as “pirate fishers,” they are listed on both official and unofficial IUU fishing vessel blacklists. More than 80 fishing vessels are currently on official blacklists. In addition, there are blacklists published by the European Union, Norway and Japan, as well as organizations like Greenpeace and The Pew Charitable Trusts.**

Currently, there are about 300 vessels on both official and unofficial blacklists. *Global Fishing Watch* can be used to monitor the activities of these vessels to help confirm whether or not they are fishing illegally.

The story of the *Marta Lucia R* shows that users of *Global Fishing Watch* can track a vessel to determine whether it may be fishing in places where it is not registered, or from which it is otherwise prohibited.

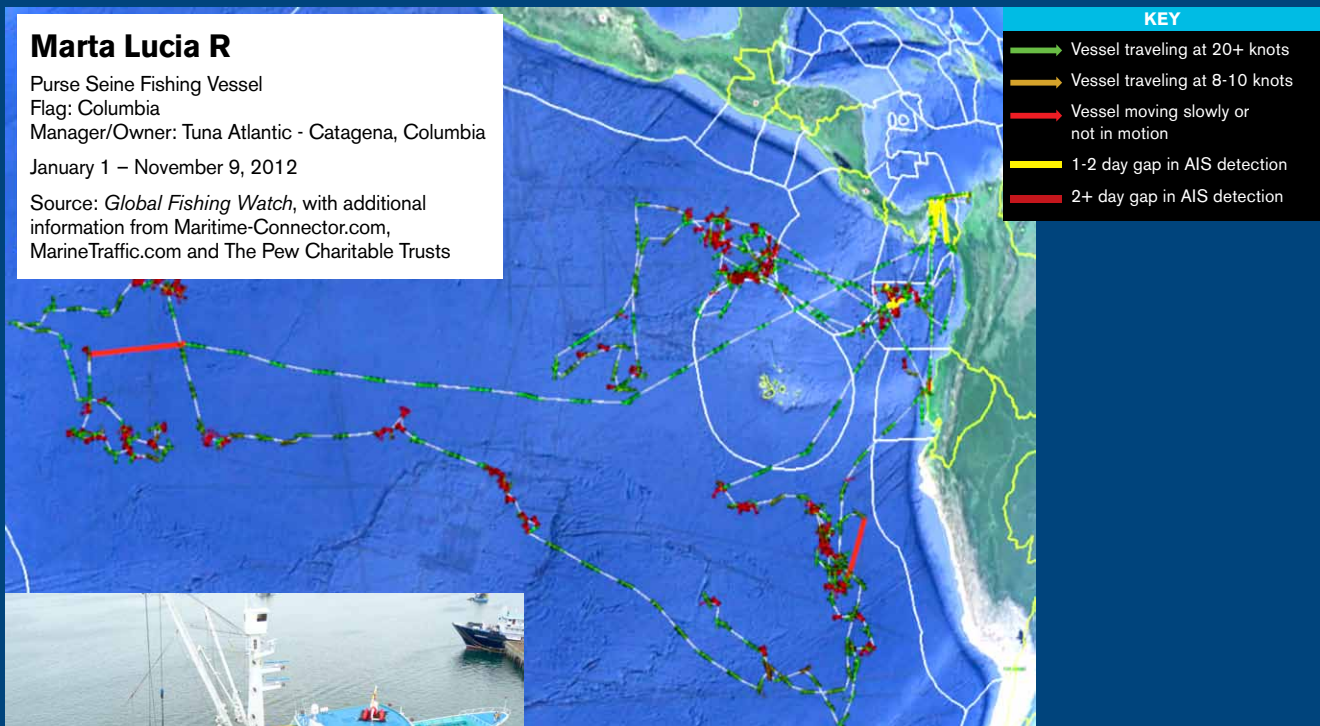
The *Marta Lucia R* is a purse seine fishing vessel registered in Colombia. It was added to the Inter-American Tropical Tuna Commission (IATTC) IUU vessel blacklist in 2006<sup>19</sup> because it was fishing in IATTC waters during a closed season. Despite repeated requests from Colombia to remove the vessel from the IUU list, the *Marta Lucia R* remained on the list and also continued fishing illegally. She made 12 trips into IATTC waters from 2006-2009,<sup>20</sup> including four times in 2009 and 2010.<sup>21</sup>

## MARTA LUCIA R

### Marta Lucia R

Purse Seine Fishing Vessel  
Flag: Columbia  
Manager/Owner: Tuna Atlantic - Catagena, Columbia  
January 1 – November 9, 2012

Source: *Global Fishing Watch*, with additional information from Maritime-Connector.com, MarineTraffic.com and The Pew Charitable Trusts



© Wil Weijsters

Track of the *Marta Lucia R* from January 1 – November 9, 2012, demonstrating that *Global Fishing Watch* can track “blacklisted” vessels. This shows all available track information for *Marta Lucia R* in 2012.

## MARTA LUCIA R

### Marta Lucia R

Purse Seine Fishing Vessel  
 Flag: Columbia  
 Manager/Owner: Tuna Atlantic - Catagena, Columbia  
 July 30, 2012 – April 24, 2013

Source: *Global Fishing Watch*, with additional information from Maritime-Connector.com, MarineTraffic.com and The Pew Charitable Trusts



According to NOAA, the Marta Lucia also “allegedly fished in the Eastern Pacific Ocean (EPO) in 2011 without being on the Regional Vessel Register.”<sup>22</sup> The European Union included the vessel in its IUU blacklist in 2010, and the International Commission for the Conservation of Atlantic Tunas (ICCAT) added the Marta Lucia R to its IUU vessel blacklist in 2011.<sup>23</sup>

The *Global Fishing Watch* prototype can track the whereabouts of this vessel over time. In 2012, while it was listed on three official IUU vessel lists, the Marta Lucia R ventured once again into the Pacific Ocean and exhibited possible fishing behavior from January through July. During 2012 she passed through the Panama Canal at least three times and visited the Ecuadorian city of Manta at least twice.

In June of 2013, Colombia again requested that the IATTC remove the Marta Lucia R from its IUU blacklist, reaffirming “its total willingness to comply with the provisions of the IATTC, and...that the vessel Marta Lucia R has not operated for a year.”<sup>24</sup> Another document describing the actions Colombia had taken regarding the Marta Lucia R and another vessel

involved in IUU fishing gives a much more specific date, saying, “The vessels have been in port for the off season and have not fished since July 29, 2012.”<sup>25</sup>

However, AIS data suggests that the Marta Lucia R was not in port for the season and was in fact over 130 miles away from Cartagena around 7:00 pm on July 30. *Global Fishing Watch* also shows the vessel going back through the Panama Canal between August 3-5, 2012 and traveling south to Manta before its AIS signal suddenly disappeared on August 6. The Marta Lucia R AIS signal then resurfaces on August 15, September 4, November 1 and November 9, in each case in Ecuadorian waters around Manta. The AIS data suggest that the vessel stayed in Manta until April 17, 2013 and returned to Cartagena about a week later. On June 14, 2013, the IATTC removed the Marta Lucia R from its blacklist.<sup>27</sup>

This example also demonstrates the ability of *Global Fishing Watch* to identify vessels for which there is a gap in AIS detection, which could be due to the vessel switching off the AIS, and could suggest an intent to avoid detection. This is described in more detail later in the report.

# CAN GLOBAL FISHING WATCH IDENTIFY VESSELS THAT MAY BE FISHING WITHOUT PROPER REGISTRATION?

**Countries form regional fishery management organizations (RFMOs) to govern fishing activity in areas outside of Exclusive Economic Zones and to manage fish stocks in international waters. The focus of these international organizations varies widely. Some RFMOs manage all the fish stocks in a particular area of international waters, others manage all the living marine resources within a region, and several have been established to manage only highly migratory species, like tuna.**

*Global Fishing Watch* can be used to identify unregistered vessels exhibiting possible fishing behavior in a given RFMO's ocean territory. An example can be seen by looking at a RFMO known as the Pacific Islands Forum Fisheries Agency.

The Pacific Islands Forum Fisheries Agency (FFA) is a RFMO established to help 17 South Pacific island nations sustainably manage, control and develop the tuna fisheries in their Exclusive Economic Zones (EEZs). FFA's members include Australia, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu.

Recognizing that many of these countries had large exclusive economic zones, and often limited means of monitoring illegal fishing, the FFA established a Regional Register of Foreign Fishing Vessels to ensure foreign fishing vessels complied with the RFMO's rules and regulations. Every foreign vessel must be on the Western and Central Pacific Fisheries Commission (WCPFC) registry before applying for a license, and must receive a license authorizing it to fish in any FFA member country's EEZ before any fishing is permitted.<sup>26</sup> Any foreign vessel fishing in the EEZ of a FFA member country in 2013 and not on this Register during that time would presumptively be fishing illegally.



© Wolcott Henry | 2005 Marine Photobank



## THE PACIFIC ISLANDS FORUM FISHERIES AGENCY (FFA)

The Ugulan, a bottom longliner which was not on the registry of the Forum Fisheries Agency or the WCPFC, exhibited possible fishing behavior multiple times within the Fiji EEZ. It first exhibited potential fishing behavior from February 10-13, 2013 on its way to Suva, Fiji where it stayed until March 1. On March 2, the Ugulan traveled back south to an area just east of where it had exhibited possible fishing behavior in February, and it

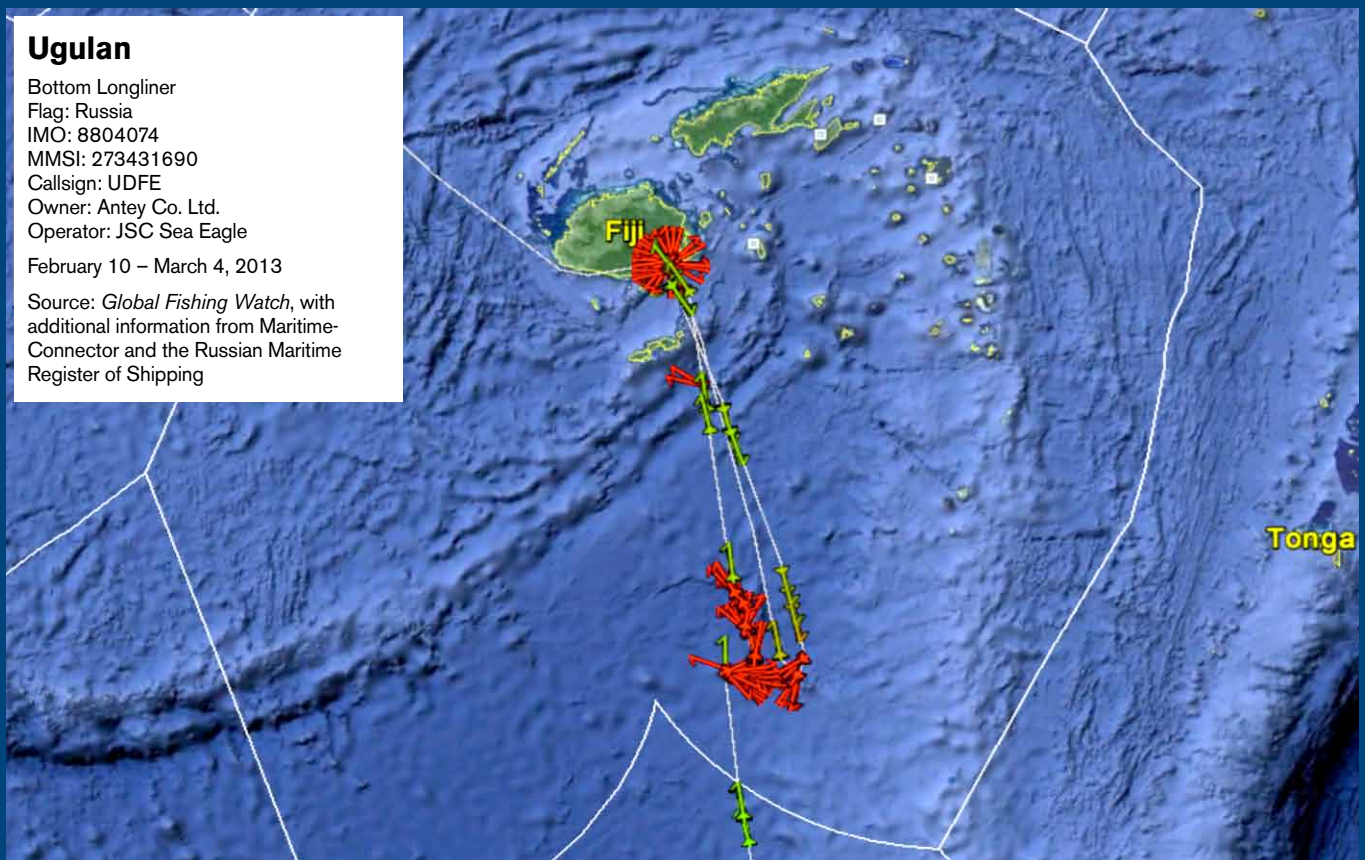
appeared to fish again for another day and a half before traveling back to Suva on March 5 where it stayed until it left Fiji on March 15.

It is likely that if the FFA were prompted by a message from an active citizen who used *Global Fishing Watch* to uncover the activities of the Ugulan, it would consider taking action to enforce its fishing licensing rules.

### Ugulan

Bottom Longliner  
 Flag: Russia  
 IMO: 8804074  
 MMSI: 273431690  
 Callsign: UDFE  
 Owner: Antey Co. Ltd.  
 Operator: JSC Sea Eagle  
 February 10 – March 4, 2013

Source: *Global Fishing Watch*, with additional information from Maritime-Connector and the Russian Maritime Register of Shipping



#### KEY

- Vessel traveling at 20+ knots
- Vessel traveling at 8-10 knots
- Vessel moving slowly or not in motion

*Track of the Ugulan from February 10 – March 4, 2013, demonstrating Global Fishing Watch can identify and track vessels that may not be registered to fish in a given RFMO.*



© CCAMLR

# CAN GLOBAL FISHING WATCH IDENTIFY VESSELS THAT MAY BE CHEATING ON AIS RULES?

## AIS Avoidance

*Global Fishing Watch* can be used to identify vessels for which AIS data are intermittently received. One possible reason for this is that it was intentionally switched off, possibly to avoid detection. While the *Marta Lucia R*, the longliner described earlier, may have a good reason for its intermittent use of AIS, it provides an example of *Global Fishing Watch's* ability to detect suspicious AIS activity.

After receiving assurances from Colombia about its efforts to crack down on illegal fishing as described earlier in this report, the IATTC removed the *Marta Lucia R* from its blacklist on June 14, 2013.<sup>28</sup> Shortly after that, on July 9, the *Marta Lucia R* appears to have left Cartagena and passed through the Panama Canal before traveling along the Colombia coast. On July 15, upon passing south of the Malpelo Island Fauna and Flora Sanctuary, on a course appearing to head toward the Galapagos Islands and the open sea, the *Marta Lucia R's* AIS signal suddenly stops. This event is documented by *Global Fishing Watch* and shown in the Google map below.

For the next four months, the AIS signal from the purse seine fishing vessel was not detected by the AIS satellites. It is possible

that it went into port, and it's also possible that it began to fish on the high seas, escaping detection by AIS satellites. However, it is clear that the vessel's AIS was not in use, raising questions about the Colombian government's assurances on behalf of the vessel.

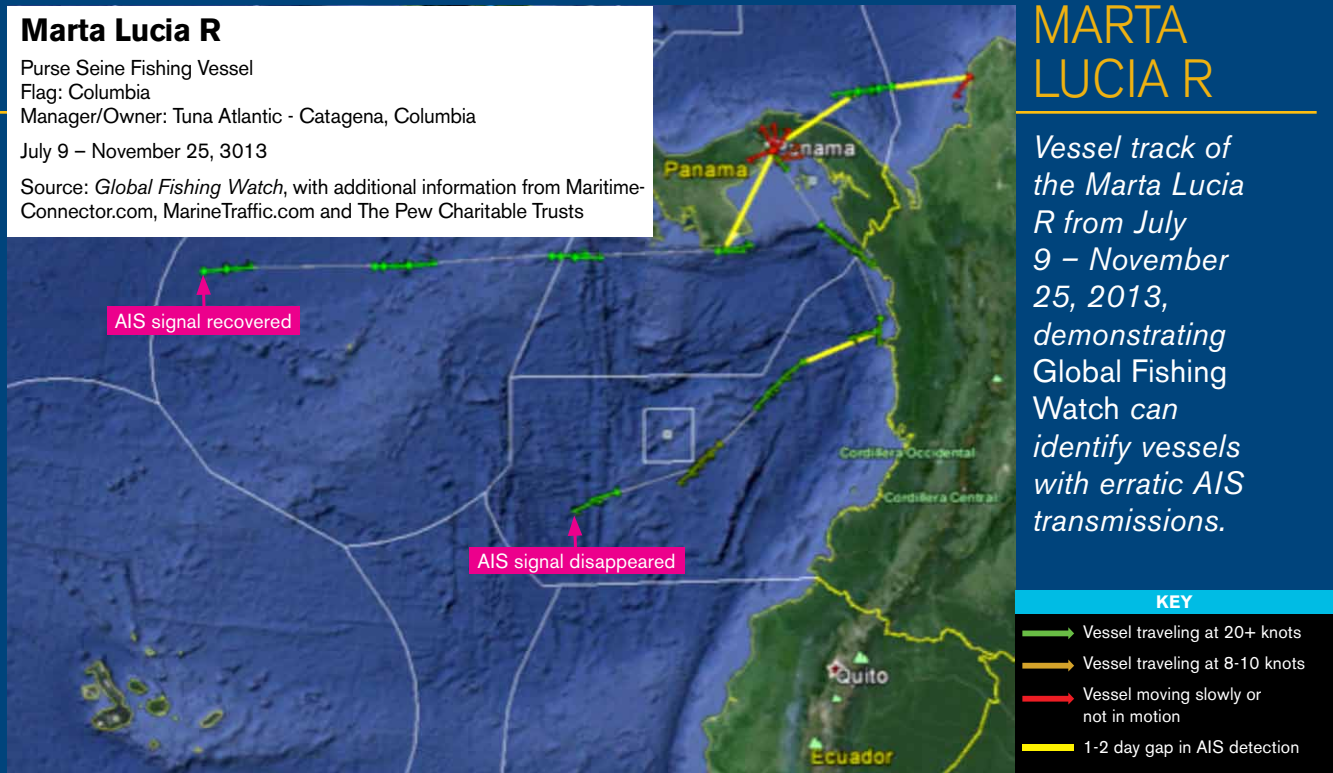
On November 17, the *Marta Lucia R* reappeared in Costa Rica's Exclusive Economic Zone when its AIS signal suddenly began operation again. It then appears to have traveled back to Panama Canal and appears to cross around November 25. It is next detected in Cartagena on December 6.

The Colombian government urged ICCAT and the EU to follow IATTC's example and remove the *Marta Lucia R* from their IUU blacklists. They did so on August 20, 2013.<sup>29</sup> Ironically, this occurred during the period when the *Marta Lucia R* had disappeared from AIS detection. *Global Fishing Watch* can be used to demonstrate situations in which AIS is not received and therefore further investigation may be warranted. Near real-time data in the public release version would allow citizens to demand prompt investigation of fishing vessels with erratic AIS signals.

### Marta Lucia R

Purse Seine Fishing Vessel  
 Flag: Columbia  
 Manager/Owner: Tuna Atlantic - Catagena, Columbia  
 July 9 – November 25, 3013

Source: *Global Fishing Watch*, with additional information from Maritime-Connector.com, MarineTraffic.com and The Pew Charitable Trusts



## Spoofing

Many fishing vessels receive a unique nine digit Maritime Mobile Service Identity (MMSI) number when they register in a flag state. This number is attached to data broadcast by the vessel, allowing anyone to see what vessel it is and where it is located.

Vessel operators enter their broadcast information manually, creating an opportunity for a vessel to hide its identity.

Whether done intentionally or accidentally, *Global Fishing Watch* revealed many vessels using invalid MMSI numbers during 2012 and 2013. These invalid MMSI numbers took many forms. In some cases the MMSI number did not have the necessary nine digits. In others, the first three MMSI numbers did not, as required, correspond to the appropriate flag state.

While the identity of these vessels, and often where they are from, may never be known, *Global Fishing Watch* can nonetheless be

used to establish where and when these vessels traveled since their AIS continued to capture their location. With real-time data that is currently available, governments could find these vessels and take enforcement action against them where appropriate. Currently, these enforcement actions occur too infrequently. *Global Fishing Watch* will enable citizens to hold governments accountable for vigorously enforcing the AIS identification requirement.

*Global Fishing Watch* showed what appear to be three vessels using the same MMSI number on January 25, 2012. This number may be invalid, but even if it is valid, at least two of these vessels have entered an incorrect number. Two of these vessels are located in Brazil, Rio de Janeiro and São Luís, and the third is located in Buenos Aires, Argentina. On January 25, 2012, it appears two of these vessels are engaged in fishing activities, while the third is stationary in port.

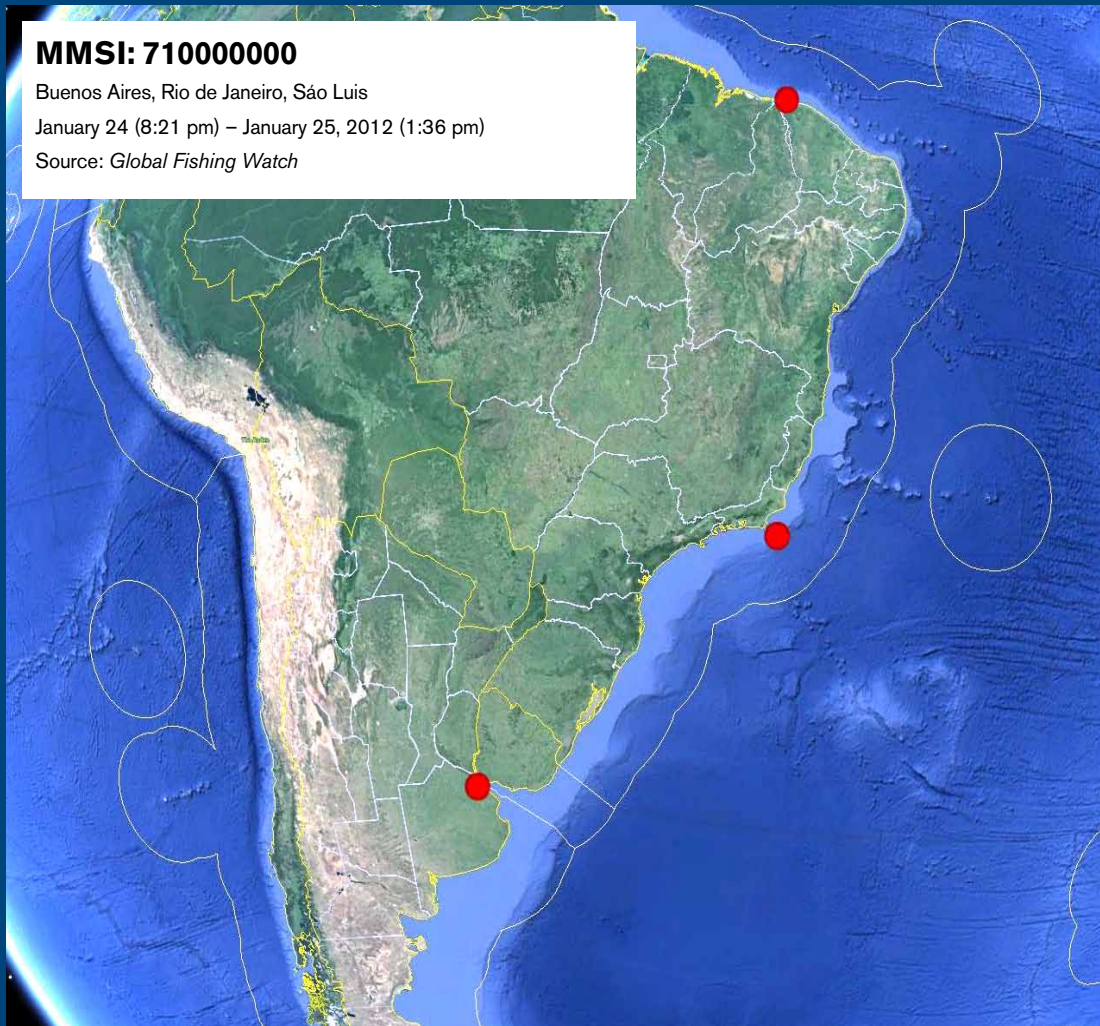
## MMSI: 710000000

### MMSI: 710000000

Buenos Aires, Rio de Janeiro, São Luis

January 24 (8:21 pm) – January 25, 2012 (1:36 pm)

Source: *Global Fishing Watch*



Three vessels detected using the same MMSI number on January 24 – January 25, 2012, demonstrating *Global Fishing Watch* can identify vessels using invalid MMSI numbers.

#### KEY

● Detection of vessel with MMSI 710000000

## RECOMMENDATIONS

---

Based on the development and use of the *Global Fishing Watch* prototype, Oceana makes the following recommendations to empower citizens to hold their governments accountable for setting and enforcing fishing policies that allow fish populations to recover and thrive. These recommendations will also allow responsible fishing companies, seafood suppliers and retailers to better assess the integrity of their partners.

- 1.** Governments should require AIS use for all commercial ocean fishing vessels operating in their exclusive economic zones.
- 2.** The IMO should reduce the minimum gross tonnage requirements for AIS use, and increase penalties for commercial ocean fishing vessels that do not comply.
- 3.** Erratic use of AIS should result in blacklisting of a commercial fishing vessel.
- 4.** All RFMOs should require AIS usage by any commercial vessel operating in their territory.
- 5.** Resources should be provided so that the *Global Fishing Watch* prototype can be developed for public release and provided as a free global ocean information source to everyone in the world with an internet connection.

**Q:** *Is this prototype going to be made available to the public? If so, when?*

**A:** Yes, we are going to create a free web portal to be made available to the public at no cost. We anticipate that it will be launched in 2015 or 2016, depending on the availability of funding for the production of the public release version.

**Q:** *Will Global Fishing Watch be free?*

**A:** Yes it will be free and can be used by anyone with an internet connection.

**Q:** *Will Global Fishing Watch provide real-time information?*

**A:** *Global Fishing Watch* will be capable of “near real-time” processing of vessel movement data within hours of the present moment. We anticipate that the public data will be no more than 72 hours old by the time it is available to the public and will depend on the data license we are able to negotiate. Project partners will have access to more timely and detailed information, and we anticipate that data on a vessel’s activity at sea will routinely be available by the time that vessel arrives in port.

**Q:** *What questions will Global Fishing Watch be able to help answer?*

- A:**
- When and where commercial fishing appears to be happening.
  - All of the places and times a vessel was likely to be fishing since it was last in port.
  - The whereabouts of a specific fishing vessel, including one that is on a “blacklist.”
  - Vessels that appear to be fishing in a given country’s EEZ.
  - Vessels that appear to be fishing in a no-take marine protected area (MPA).
  - The relative magnitude of fishing that appears to be happening in a given MPA in a given period of time.
  - Vessels with sporadic AIS detection and that may be turning off their AIS.

**Q:** *How reliable is this information?*

**A:** Automatic Identification System (AIS) use is required by law for most cargo vessels, tankers, research vessels and passenger ships, and is increasingly being required for fishing vessels. The vessel position and identity data that we use comes from a well established vessel safety and collision avoidance system called AIS. This system has been used by the shipping industry for decades and can locate a vessel using onboard GPS very accurately and consistently. Satellite and terrestrial capture and collection of AIS signals is also a highly reliable and well established process with multiple commercial providers competing to provide a high quality data stream. One challenge with AIS is the fact that the AIS broadcasting device installed on a vessel is under the vessel operator’s control and is potentially subject to tampering. This can result in the device broadcasting false information. However, the fact that broadcasting false information can also be a safety hazard limits this sort of behavior, and AIS when used properly is a very reliable vessel tracking technology. This algorithm used by *Global Fishing Watch* is in development, and will improve over time.

While this information is fairly reliable, enforcement agencies may need to supplement it prior to taking action as there are ways for vessels to game the system, by entering bogus identification numbers, for example. In addition, the model that predicts fishing behavior is not exact and should be viewed as one piece of information to support additional evidence in making a case when illegal fishing is suspected. That said, the information generated by *Global Fishing Watch* will provide enforcement authorities with some powerful initial evidence to focus their efforts and speed their responses.

**Q:** *Why hasn’t this been done before?*

**A:** The analytics engine used by *Global Fishing Watch* requires massive data storage and analytical capacity that has never before been readily available. To deliver all fishing activity over the entire world over a three-year span free to the public requires massive web hosting capabilities and cutting edge visualization. It also requires ubiquitous and low cost satellite AIS detection capabilities which have only recently become commercially available. When fully operational, the system will contain billions of vessel positions and process hundreds of millions of positions per day as it filters through the movements of a few hundred thousand trackable vessels to find the ones that are engaged in fishing activity. Google’s participation has allowed a much faster and more effective analysis of this incredibly large amount of data.

In order to do all these things, you need the expertise and

vision to conceive it, the right technology partners to build and run it, and the right outreach partners to make sure that it gets used to its maximum potential to change the world. In early 2014, those partners came together to make this first-of-its-kind tool possible.

### **Q:** Which fishing vessels are in and which are not, and how will that change going forward?

**A:** The system detects commercial fishing vessels that are using AIS. Generally speaking this includes larger commercial vessels and does not include sport fishing or artisanal fishing vessels. In addition, many smaller commercial fishing vessels have been exempt from AIS broadcasting requirements in the past, though this is changing through increasingly inclusive AIS broadcast requirements set by fisheries management organizations and national regulators.

The *Global Fishing Watch* prototype identified 20,000 vessels that had a possibility of fishing behavior in 2013 out of 140,000 total vessels using AIS worldwide. Of these, 2,800 were independently verified as fishing vessels due to self-identification by the vessel or through public records from fishing regulatory bodies. The public release version will close the gap, verifying additional fishing vessels and detecting a larger percentage of them due to the availability of better satellite and terrestrial monitoring data and an increasing number of fishing vessels required to use AIS. As our confidence in the behavioral algorithm improves, we will add vessels that are behaving like fishing vessels, despite how they identify themselves. While the *Global Fishing Watch* prototype is far from 100 percent inclusive, it can identify many instances of illegal fishing and will serve as a tool for improving compliance with AIS requirements, further empowering its ability to identify illegal fishing.

### **Q:** How is this different from other tools we've heard about?

**A:** This tool is different because it's global, free to the public and focused exclusively on fishing. *Global Fishing Watch* is unique in that it is primarily designed to engage the public and civil society to allow them to hold agencies accountable for sustainably managing fisheries and effectively enforcing fishing rules. Other tools exist that allow the public to view the current locations of some vessels, and provide more detail via paid subscription. However these tools do not perform analytics to predict the likelihood of fishing, so a viewer would have to do that analysis manually, vessel by vessel. Enforcement agencies and other security-focused entities currently have a range of commercial tools available, and more in development, that their analysts can use to track individual vessels in real time and combine other non-public data sources to support direct enforcement actions. However these tools

generally do not make their data freely available, leaving the public powerless to evaluate how well the enforcement and management agencies are doing their jobs.

Other products being developed, including the one being developed by The Pew Charitable Trusts are useful tools designed to target specific locations and to enable enforcement authorities to act. *Global Fishing Watch* will also be available to all stakeholders, including fishermen, seafood buyers and seafood dealers, who might wish to document or verify the source of their products, to demonstrate that the seafood they sell is legally obtained.

### **Q:** How can you use this to tell if a vessel is fishing illegally?

**A:** *Global Fishing Watch* will provide reliable data on who is fishing, when and where, that can be used by the public, NGOs, and management and enforcement agencies to make that legal determination. In some specific instances, such as fishing activity identified in a no-take marine protected area, that determination may be obvious. But elsewhere, further research is usually required.

### **Q:** Won't the fishermen just turn off their AIS so they can't be tracked?

**A:** Some probably will. But increasingly, AIS use is being required, so operating without it will compromise a vessel's ability to get permits allowing them to fish, and will likely result in increased scrutiny whenever those "dark fleet" vessels appear in port. In addition to the safety considerations that favor AIS use in our increasingly busy ocean, we hope *Global Fishing Watch* will encourage fishers to make themselves trackable even where it's not yet required, as an easy way to publicly demonstrate that they are "the good guys" who are sticking to the rules.

- 1 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
- 2 Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations, *The State of World Fisheries and Aquaculture 2014* (Rome: United Nations, 2014), available from <http://www.fao.org/3/d1eaa9a1-5a71-4e42-86c0-f2111f07de16/i3720e.pdf>
- 3 *The State of World Fisheries and Aquaculture 2014*.
- 4 *The State of World Fisheries and Aquaculture 2014*.
- 5 Botsford, Castilla, and Peterson. 1997. The Management of Fisheries and Marine Ecosystems. *Science*: 277 (5325), 509-515. [DOI:10.1126/science.277.5325.509]
- 6 Worm, B., Hilborn, R., Baum, J., et al. 2009. Rebuilding Global Fisheries. *Science* 325(5940): 578-585; and Hilborn, R. 2007. Moving to Sustainability by Learning from Successful Fisheries. *Journal of the Human Environment* 36(4): 296-303
- 7 Srinivasan T, Watson R and Sumaila UR. 2012. Global fisheries losses at the exclusive economic zone level, 1950 to present. *Marine Policy* 36(2): 544-549
- 8 *The State of World Fisheries and Aquaculture 2014*.
- 9 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
- 10 Pramoda, Nakamurab, Pitchera, and Delagranc. 2014. Estimates of illegal and unreported fish in seafood imports to the United States. *Marine Policy*: Vol. 48, 102-113. [DOI: 10.1016/j.marpol.2014.03.019]
- 11 *The State of World Fisheries and Aquaculture 2014*.
- 12 *The State of World Fisheries and Aquaculture 2014*.
- 13 <http://www.imo.org/OurWork/Safety/Navigation/Pages/AIS.aspx>
- 14 <http://www.imo.org/OurWork/Safety/Navigation/Pages/AIS.aspx>
- 15 Carson-Jackson, J. 2012. Satellite AIS – Developing Technology or Existing Capability? *Journal of Navigation*, 65: 303-321
- 16 <http://www.rusnature.info/zap/116.htm>
- 17 [http://gov.khabkrai.ru/invest2.nsf/pages/sights/dzhug\\_en.htm](http://gov.khabkrai.ru/invest2.nsf/pages/sights/dzhug_en.htm)
- 18 [http://www.protectedplanet.net/sites/Dzhugdzhursky\\_Zapovednik](http://www.protectedplanet.net/sites/Dzhugdzhursky_Zapovednik)
- 19 <http://rus.bizdirlib.com/node/103498>
- 20 <https://www.iattc.org/PDFFiles2/IATTC-74-MinutesREV2.pdf>
- 21 <http://www.iattc.org/PDFFiles2/JWG-8-Jun-2009-MinutesREV.pdf>
- 22 [http://www.nmfs.noaa.gov/ia/iuu/msra\\_page/2013\\_biennial\\_report\\_to\\_congress\\_jan\\_11\\_2013\\_final.pdf](http://www.nmfs.noaa.gov/ia/iuu/msra_page/2013_biennial_report_to_congress_jan_11_2013_final.pdf)
- 23 [http://www.nmfs.noaa.gov/ia/iuu/msra\\_page/2013\\_biennial\\_report\\_to\\_congress\\_jan\\_11\\_2013\\_final.pdf](http://www.nmfs.noaa.gov/ia/iuu/msra_page/2013_biennial_report_to_congress_jan_11_2013_final.pdf)
- 24 [https://www.iccat.int/Documents/BienRep/REP\\_EN\\_12-13\\_I.1.pdf](https://www.iccat.int/Documents/BienRep/REP_EN_12-13_I.1.pdf)
- 25 <http://www.iattc.org/Meetings/Meetings2013/June/pdfs/IATTC-85-Minutes.pdf>
- 26 [http://www.nmfs.noaa.gov/ia/iuu/msra\\_page/2013\\_biennial\\_report\\_to\\_congress\\_jan\\_11\\_2013\\_final.pdf](http://www.nmfs.noaa.gov/ia/iuu/msra_page/2013_biennial_report_to_congress_jan_11_2013_final.pdf)
- 27 Western and Central Pacific Fisheries Commission. WWF Emerging Technologies Initial Cost Benefit Analysis. September 9, 2014, available from <https://www.wcpfc.int/system/files/WCPFC-TCC10-2014-OP03%20WWF%20Emerging%20technologies%20initial%20cost%20benefit%20analysis%20study.pdf>
- 28 <https://www.iattc.org/Meetings/Meetings2013/June/pdfs/IATTC-85-Minutes.pdf>
- 29 <http://faolex.fao.org/docs/pdf/eur131170.pdf>



1350 Connecticut Ave. NW, 5th Floor  
Washington, DC 20036  
phone: +1.202.833.3900  
toll-free: 1.877.7.OCEANA

Global | Washington, DC Europe | Brussels | Madrid | Copenhagen North America | Boston | Ft. Lauderdale | Juneau | Monterey | New York | Portland Central America | Belize City South America | Santiago



**OCEANA** is the largest international conservation group working solely to protect the world's oceans. Oceana wins policy victories for the oceans using science-based campaigns. Since 2001, we have protected over 1.2 million square miles of ocean and innumerable sea turtles, sharks, dolphins and other sea creatures. More than 600,000 supporters have already joined Oceana. Global in scope, Oceana has offices in North, South and Central America and Europe. **To learn more, please visit [www.oceana.org](http://www.oceana.org).**