Image: Tung Yang No. 188, a vessel suspected of illegal drift-netting in the Pacific. Credit: WFOA/USCG
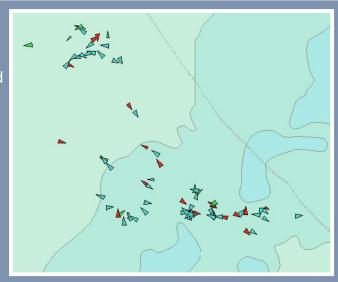
Illegal, Unregulated and Unreported (IUU) fishing is a growing social, economic, and environmental issue, and has been designated a crime of global significance by INTERPOL, the International Criminal Police Organization. Over-fishing, economic instability in developing countries, piracy, and other crimes can all be linked to illegal industrial extraction of fish from sovereign waters and marine protected areas, evading the laws designed to conserve fisheries and protect ocean biodiversity. According to the U.S. National Oceanic and Atmospheric Administration, 1 in 5 fish on the global market has likely been caught illegally by one of many shape-shifting vessels who operate in the shadows and outside the law.
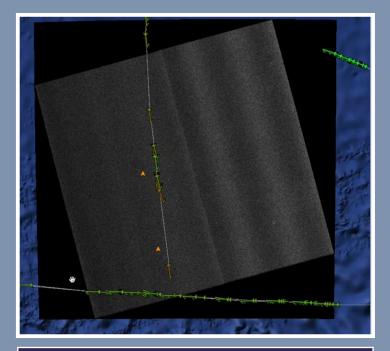
Remote sensing plays a pivotal role in tackling this global problem.

Automatic Identification System (AIS): To avoid collisions, many ships use a system known as AIS to broadcast their location, speed, and heading to surrounding vessels. These transmissions are also picked up by satellites, giving us a real-time view of maritime activity around the world. By analyzing AIS data, we can tell the difference between a freighter rushing straight through the sovereign waters of another country, and a fishing vessel laying out miles of long-line to catch swordfish in a marine protected area.

However, AIS use is still voluntary for most vessels in most places, so we can't rely on this technology alone. In the future, keeping a clean AIS record may factor into market-based initiatives, but to complement AIS, we utilize another tool to investigate what happens "in the dark" when there are no AIS transmissions.

Above: Satellite AIS detections of fishing vessels and support craft operating in the South Pacific off the coast of Chile.
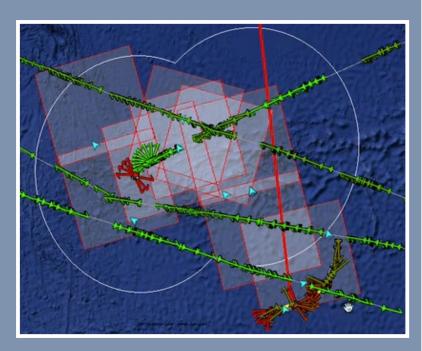
Synthetic Aperture Radar (SAR): Though illicit operators can attempt to evade detection by turning off their AIS transmitter, a different satellite technology allows us to directly detect the presence of vessels anywhere on the ocean. Radar satellites operate day and night, illuminating the sea with a beam of energy that penetrates clouds and haze. Image processing creates a picture of the ocean surface by measuring the strength and characteristics of the radar signal that returns to the satellite. The open ocean appears gray on radar satellite imagery, while unnatural objects like ships reflect much more radar energy and show up as bright white spots. Expert analysts can use advanced software to extract more information from the images, estimating a vessel's size, heading, and in some cases it's speed.

SAR image with vessel detections (orange) overlaid with AIS tracks (green).

Together, AIS and radar satellite imagery reveals vessel locations and behavior around Easter Island.

An Integrated Approach: Together these technologies allow us to watch the behavior of broadcasting vessels and search for ships that are operating in stealth. We are working to the solve the complex data-management challenges posed by monitoring global vessel traffic in real-time, so that we can not only spot IUU fishing as it happens, but also detect suspicious behavior such as silencing AIS transmissions or rendezvousing with vessels to "transship" fish or other illicit goods.

SkyTruth is developing this innovative approach in partnership with the Global Ocean Legacy and Stop Illegal Fishing campaigns of the Pew Charitable Trusts. In January 2013 we launched a 12-month program to monitor 700,000 square

kilometers of Chile's territorial waters spanning the Easter Island Province, over 2,000 miles from the Chilean mainland. As of September 2013 we detected more than 40 unidentified vessels operating in the Province's waters that are likely non-Chilean commercial fishing vessels. This is a major concern for the residents and artisanal fishermen of Rapa Nui (Easter Island), who blame declining catches of swordfish and tuna on illegal fishing incursions by commercial vessels from other nations. SkyTruth and Pew are sharing information with the Chilean government to help mitigate this problem and pave the way for establishing one of the world's largest protected areas in these waters.

LEARN MORE ABOUT OUR WORK AT: SKYTRUTH.ORG/ISSUES/OCEANS

SkyTruth is a 501(c)(3) nonprofit organization using satellite images, digital mapping and data analysis to investigate and illuminate global environmental issues.