Tenfold increase in public vessel tracking supports science, management and policy

David Kroodsma, Luke Bantock, Jaeyoon Park, Krizia Matthews, Anna Hughes, Bjorn Berman, Amanda Lohmann, Lisa Tossey, Geoff McGhee, Tim Hochberg

ONE OCEAN SCIENCE CONGRESS
NICE FRANCE 3-6 June 2025

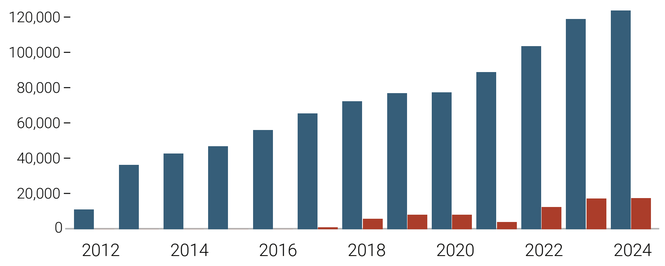
Until the past decade, it was not possible to map fishing activity at scale.

AIS and **VMS** both broadcast GPS positions of vessels over radio. VMS generally send encrypted messages that are only received by satellites, while AIS broadcasts are unencrypted and can be recorded by satellites, shore based antenna, or other ships at sea.

Since 2012, the number of vessels that share their GPS positions publicly through AIS or public VMS has exploded, driving science, improved ocean management and policy.

Increased adoption of tracking technology

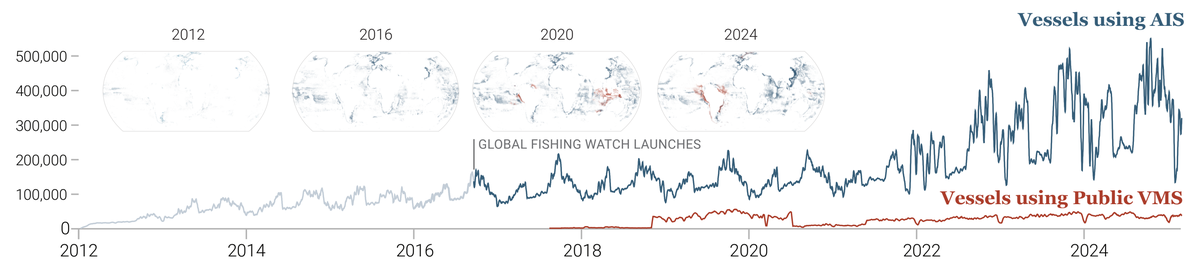
VESSEL ACTIVITY BY YEAR: AIS AND PUBLIC VMS



Only vessels that are active at least one week annually or that fish for more than 24 hours are included.

Increase in apparent fishing activity by vessels with public tracking

7-DAY AVERAGE OF DAILY FISHING HOURS, 2012-2024



Drawing on the algorithms developed in Kroodsma et al 2018,[1] we estimate the hours of apparent fishing activity based on a neural net algorithm that estimates when and where vessels are engaging in fishing activity. As technologies have advanced and the number of vessels with tracking devices has increased, the amount of activity that can be mapped has grown dramatically. The large map below shows all apparent fishing activity by vessels using AIS and public VMS across 2012-2024, while the smaller maps above show four different years. The time series graph shows a weekly rolling average of fishing hours per day. The drop in VMS fishing in 2020 is due to Indonesia ending sharing of its VMS data. The large jump in AIS fishing effort in 2022 is due to improved reception technology that allowed better tracking of vessels in congested areas, especially in East and Southeast Asia.

Worldwide AIS and public VMS apparent fishing activity

2012-2024

AIS for tracking vessels

The automatic identification system (AIS) is maritime safety technology that transmits a vessel's identity, location, speed and course via satellite and radio signals. Developed for ship-to-ship communication to avoid collisions, AIS messages can also be received by satellites, coastal stations, and nearby vessels, and are stored in global databases to track vessel activity over time.

AIS fishing hours per km²
10^{-1} 10^{0} 10^{1} 10^{2}

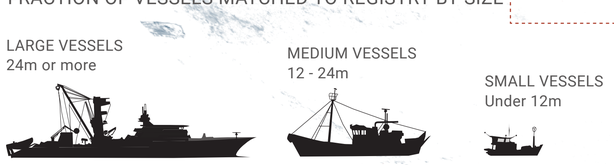
Public VMS

Vessel monitoring systems (VMS) are tracking tools used by governments to monitor the location and movement of licensed fishing vessels and fishing related activities. Data is transmitted at regular intervals to fisheries authorities, supporting enforcement, scientific research and fleet management. While VMS data has traditionally been kept private, an increasing number of countries are now making it publicly available.

VMS fishing hours per km²
10^{-1} 10^{0} 10^{1} 10^{2}

Larger vessels are much more likely to have AIS

FRACTION OF VESSELS MATCHED TO REGISTRY BY SIZE



63.5% MATCHED TO AIS

33.2%

9.1%

Global Fishing Watch matches more than 50 public registries to AIS data for over 100 countries (methods from Park et al. 2023[3]). From these registries, about two-thirds (~18,000 in total) of vessels over 24 meters in length can be found on AIS, just over one-third (~13,000 in total) between 12 and 24 meters long have AIS, and a smaller fraction of those smaller than 12 meters are broadcasting. The vessels not matched to AIS could be inactive, broadcasting incorrect identity information, or operating without AIS. Note that these are vessels on public registries, and represent only a small fraction of total fishing vessels.

Tracking drives scientific discovery...

Public vessel data has transformed ocean science, **enabling over 1,000 peer-reviewed studies annually**.

RESEARCH PAPERS MENTIONING "FISHING" AND AIS, VMS OR BOTH

Based on dimensions.ai analysis.

Examples include:

Marine protected areas and spatial management: AIS data has been used to identify best locations for marine protected areas (MPAs)[3], study fishing within them[4] and estimate how fishing effort redistributes once they are created. [5] [6]

Fisheries economics: By modeling costs at the vessel level, AIS has helped estimate economics of high seas fisheries[7], and shown how wealthy nations dominate industrial fishing.[8]

Catch, bycatch and biodiversity: Catch can sometimes be estimated by vessel[9] and it is possible to identify where species overlap with specific fishing activities, identifying potential bycatch or target species.[10] [11] [12]

Human rights and Illegal, unreported, and unregulated (IUU) fishing: IUU risk can be identified[13] by examining the ports that vessels visit and vessel behavior such as transshipments[14] at sea. It is also found that vessels engaging in forced labor may have distinctive patterns.[15] [16]

... improves ocean management ...

Public vessel tracking improves ocean management by making the movements of industrial fleets transparent. Benefits include:

Marine spatial planning: AIS data can help identify areas for protection,[17] assess ecosystem impacts, and manage fishing, tourism and shipping. It has also supported MPA negotiations: National Geographic's Pristine Seas used Global Fishing Watch data to help create seven marine protected areas with a combined area larger than Egypt.[18]

Monitoring, control, and surveillance: Public tracking data enables governments and NGOs to detect illegal activity, verify compliance and improve licensing and subsidy oversight.[19] [20] In the past year, Global Fishing Watch alone helped patrol over 40 million km². Public data builds trust and boosts enforcement in areas like MPAs and the high seas.

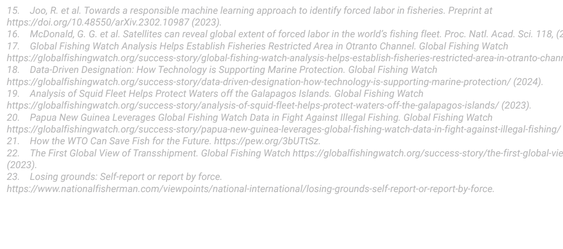
Policy and governance: AIS-based research has shaped global trade talks, including World Trade Organization negotiations on fisheries subsidies.[21] Public access also levels the playing field, empowering developing states and civil society.

Sustainability and supply chains: Public tracking supports certification, traceability and corporate accountability, helping buyers assess risk and consumers trust products.[22]

... and reveals policy options.

Support AIS requirements: Individual flag States regulate AIS use by fishing fleets and fishing -related vessels. While many vessels adopted AIS voluntarily, much of the growth stems from new regulations. The figure below highlights how AIS use surged in the Republic of Korea and Indonesia following mandates.

NUMBER OF VESSELS PER DAY



Tackle AIS misuse: Some vessels–about 1 percent of the fleet–spoof identities or share MMSIs, complicating monitoring. Others disable AIS to avoid detection. While disabling beyond 50 nautical miles has declined overall, it's rising for some flag States and gear types. Another tiny fraction of vessels (less than 0.01 percent) intentionally broadcast incorrect GPS positions. Authorities should enforce identity integrity and consistent AIS use.

Address privacy concerns: Though satellite visibility has made secret fishing grounds less tenable, with some arguing that the "era of secret fishing spots is over," [23] competitive concerns persist. These can often be eased by releasing data with a time delay, or making exceptions for areas with piracy or political instability.

Support VMS sharing: When shared with a temporal delay, VMS data can build trust in fisheries, enable stronger science and informed decision-making, and enable fair and effective enforcement.

Access references and additional content here at
globalfishingwatch.org

1. Kroodsma, D. A. et al. Tracking the global footprint of fisheries. Science 359, 904–908 (2018).
2. Park, J. et al. Tracking elusive and shifting identities of the global fishing fleet. Sci. Adv. 9, eabp8200 (2023).
3. Sala, E. et al. Protecting the global ocean for biodiversity, food and climate. Nature 592, 397–402 (2021).
4. Dureuil, M., Boerder, K., Burnett, K. A., Froese, R. & Worm, B. Elevated trawling inside protected areas undermines conservation outcomes in a global fishing hot spot. Science 362, 1403–1407 (2018).
5. McDonald, G., Bone, J., Costello, C., Englander, G. & Raynor, J. Global expansion of marine protected areas and the redistribution of fishing effort. Proc. Natl. Acad. Sci. 121, e2400592121 (2024).
6. White, T. D. et al. Tracking the response of industrial fishing fleets to large marine protected areas in the Pacific Ocean. Conserv. Biol. 34, 1571–1578 (2020).
7. Sala, E. et al. The economics of fishing the high seas. Sci. Adv. (2018).
8. McCauley, D. J. et al. Wealthy countries dominate industrial fishing. Sci. Adv. 4, eaau2161 (2018).
9. Cappa, P. et al. Estimating fisheries catch from space: Comparing catch estimates derived from AIS fishing effort with reported catches for Indian Ocean industrial fisheries. Reg. Stud. Mar. Sci. 77, 103632 (2024).
10. White, T. D. et al. Predicted hotspots of overlap between highly migratory fishes and industrial fishing fleets in the northeast Pacific. Sci. Adv. 5, eaau3761 (2019).
11. Frawley, T. H. et al. Clustering of disaggregated fisheries data reveals functional longline fleets across the Pacific. One Earth 5, 1002–1018 (2022).
12. Kroodsma, D. et al. Global prevalence of setting longlines at dawn highlights bycatch risk for threatened albatross. Biol. Conserv. 283, 110026 (2023).
13. Selig, E. R. et al. Revealing global risks of labor abuse and illegal, unreported, and unregulated fishing. Nat. Commun. 13, 1612 (2022).
14. Miller, N. A., Roan, A., Hochberg, T., Amos, J. & Kroodsma, D. A. Identifying Global Patterns of Transshipment Behavior. Front. Mar. Sci. 5, (2018).
15. Joo, R. et al. Towards a responsible machine learning approach to identify forced labor in fisheries. Preprint at https://doi.org/10.48550/arXiv.2302.10987 (2023).
16. McDonald, G. G. et al. Satellites can reveal global extent of forced labor in the world's fishing fleet. Proc. Natl. Acad. Sci. 118, (2021).
17. Global Fishing Watch Analysis Helps Establish Fisheries Restricted Area in Otranto Channel. Global Fishing Watch https://globalfishingwatch.org/success-story/global-fishing-watch-analysis-helps-establish-fisheries-restricted-area-in-otranto-channel/ (2024).
18. Data-Driven Designation: How Technology is Supporting Marine Protection. Global Fishing Watch https://globalfishingwatch.org/success-story/data-driven-designation-how-technology-is-supporting-marine-protection/ (2024).
19. Analysis of Squid Fleet Helps Protect Waters off the Galapagos Islands. Global Fishing Watch https://globalfishingwatch.org/success-story/analysis-of-squid-fleet-helps-protect-waters-off-the-galapagos-islands/ (2023).
20. Papua New Guinea Leverages Global Fishing Watch Data in Fight Against Illegal Fishing. Global Fishing Watch https://globalfishingwatch.org/success-story/papua-new-guinea-leverages-global-fishing-watch-data-in-fight-against-illegal-fishing/ (2024).
21. How the WTO Can Save Fish for the Future. https://pew.org/3bUTtSz.
22. The First Global View of Transshipment. Global Fishing Watch https://globalfishingwatch.org/success-story/the-first-global-view-of-transshipment/ (2023).
23. Losing grounds: Self-report or report by force. https://www.nationalfisherman.com/viewpoints/national-international/losing-grounds-self-report-or-report-by-force.