Article Id
AL04538

DARK FISHING FLEETS AND SATELLITE TRACKING: USING AIS DATA TO EXPOSE ILLEGAL FISHING

S.Vishnupriya

Email
vishnupriyashanmugam16@gmail.com

Department of Aquatic Environment Management, Kerala University of Fisheries and Ocean Studies, Panangad P.O, kochi, Kerala, India

Illegal, unreported, and unregulated (IUU) fishing pulls in a huge chunk of the world's catch. It messes with fisheries management, drains fish stocks, and robs coastal countries especially in the developing world of billions of dollars every year. The ships doing this are practically invisible. Plenty run as "dark fleets," switching off or messing with their AIS transponders on purpose just to avoid getting caught. But things are starting to change. Thanks to new satellite technology blending AIS data with synthetic aperture radar, optical satellite images, and even night time light detection, all crunched by machine learning the world is finally starting to see what's really going on out at sea. Turns out, most of the world's industrial fishing vessels just aren't tracked publicly most of the time. This article digs into how these dark fleets actually work and why they manage to keep operating. It looks at the cutting edge satellite and AI tools that are helping uncover their activities and what this means for enforcing protected marine areas, running fair fisheries, and protecting people's rights at sea. Case studies from Global Fishing Watch and other research show both how massive this problem really is and how open satellite data is finally making it a lot harder for illegal fishing to go unnoticed.

The ocean has always been tough to keep an eye on. On land, it's easy you can spot roads, buildings, and other infrastructure from satellites. But out at sea, figuring out who's fishing where, and whether they're following the rules, has usually depended on patchy reports from the people fishing, random chance encounters with patrol boats, and port inspections that only happen after a boat comes back. So, illegal, unreported, and unregulated (IUU) fishing takes advantage of that gap. Some estimates say IUU fishing makes up over 20% of the global catch, which throws off stock assessments, hurts legal fishers, and robs coastal countries often ones that really need the income and food supply of important resources. Then came the Automatic Identification System, or AIS. This tech was originally meant to stop ships from crashing into each other, but it turned out to be a game-changer for tracking where vessels go

and figuring out where fishing happens, all across the globe. AIS wasn't built for keeping tabs on bad actors. Any vessel can just turn off its transponder whenever it wants. That's created a "dark" fleet of ships boats that disappear from the usual public tracking systems, making their activity nearly impossible to monitor. This article takes a closer look at how these dark fleets manage to operate in the shadows, how new satellite tools are starting to bring them out into the open, and what this new wave of transparency could mean for the future of managing our oceans.

What Are Dark Fleets, and Why Do They Persist?

Dark fleets are ships that don't share their locations through AIS. Sometimes they aren't required to carry a transponder, sometimes they turn it off on purpose, or they're just in places where satellite AIS signals can't reach. Global Fishing Watch found that most of the world's big fishing vessels aren't trackable at any given moment. This issue really stands out in Asia, where rules about AIS are all over the place and enforcement is pretty weak. There's a lot driving ships to go dark, and it's not just about illegal fishing. They go silent to hide while fishing inside marine protected areas, or when they drift into another country's exclusive waters without permission. Sometimes, they want to keep transhipment under wraps that's when they pass off their catch at sea, which is a sneaky way to launder illegal fish into the market. There's also the ugly reality of human trafficking and forced labour; most vessels flagged for forced labour don't use AIS at all, making it easier for them to stay off the radar and avoid scrutiny. Of course, not every "dark" ship is hiding something. Reception is a problem, too. Inshore and coastal areas, especially around Southeast Asia and Africa, have terrible satellite coverage. And in some countries, the government even blocks access to AIS data from their waters, so people can't see what's going on, even if the ships are trying to broadcast. It's not just fishing, either. Dark fleets pop up in all kinds of maritime activities. Satellite data has caught ships going dark to dodge international sanctions, like doing ship to ship transfers in violation of trade bans. The same tools used to uncover illegal fishing now help track wider security risks out at sea.

Satellite and AI Technologies Illuminating Dark Fleets

The Automatic Identification System, or AIS, is still the go to data source for tracking global fishing. Ships constantly send out updates on their position, speed, and heading, and when researchers combine billions of these messages, they can map fishing activity all over the world. It's a huge leap from those older, catch only estimates the detail is just on another level. Turns out, industrial fishing touches most of the world's oceans. Then you have synthetic

aperture radar, or SAR. Unlike AIS, SAR satellites actually shoot radar down to the sea and pick up reflections so they can spot ships whether the crew wants to be seen or not.

Even if a vessel turns off its AIS, SAR can still find it. That makes SAR essential for catching "dark vessels" that would otherwise slip under the radar. Daytime optical imagery has its place, too. It helps confirm what radar picks up and gives a better look at what the vessels are doing. At night, some satellites can spot artificial lights on the ocean ideal for finding ships like squid jiggers or purse seiners that use bright lights to lure fish. These glowing signatures stand out, even if a ship isn't broadcasting AIS.

It's how scientists now pull all these streams together AIS, SAR, optical, and night time imagery and feed them into deep learning models. These models are trained not just to tell fishing vessels apart from other ships, but also to guess what kind of fishing is happening, even in parts of the ocean where AIS signals are sparse or missing. With this, researchers crunch through vast amounts of data petabytes, actually and produce near real time global maps of vessel activity. That just wasn't possible before. And here's the big shift, platforms like Global Fishing Watch now put much of this data out there for anyone to use. This open access was intentional, breaking down the old barriers where only governments or industry giants had this kind of insight. Now, journalists, researchers, and regular folks can dig into the same data, shining a light on potential illegal fishing anywhere in the world.

Implications for Governance and Enforcement

Satellite monitoring has started to shine a light on "dark vessels" sneaking into fully protected marine reserves. We're talking about places like the Galápagos Marine Reserve or the Great Barrier Reef Marine Park spots you'd hope are off limits for everyone, but some boats just keep crossing the line anyway. Even so, when you compare different marine protected areas, the ones with strict industrial fishing bans are mostly keeping poachers out. Satellite tech can catch people breaking the rules, and it proves that strong enforcement actually works. There's a whole other layer to this with transhipment at sea. This is when one vessel transfers its catch to a giant refrigerated cargo ship, far from any inspectors. It's perfect for mixing illegal fish in with the legal haul tough to trace once it reaches port. Now, satellites are helping track weird rendezvous patterns, tipping off authorities to suspicious transfers that need a closer look.

The human story is pretty bleak, too. A lot of vessels dodging AIS tracking (the system ships use to broadcast their location) are also linked to labour abuses, like forced work at sea. Researchers now pair satellite data with human rights know how to zero in on boats where crews are most at risk, so the benefits of watching these "dark fleets" stretch way beyond just policing fishing quotas. This kind of vessel tracking gives a solid backbone to international agreements, too. Countries finally have independent evidence for things like port inspections, regional fishery rules, or deals between coastal nations and far away fishing fleets. With this kind of proof, there's a real push to switch IUU (illegal, unreported, and unregulated) fishing enforcement from playing catch up with patrol boats to catching lawbreakers in real time with hard data. Still, spotting bad actors from space is just the first step. Catching them is a whole different struggle especially for small or developing coastal nations that just don't have enough ships or resources. Even after a satellite flags a vessel, some governments can't actually haul them in. And if the violation happens in international waters or someone else's territory, the legal and diplomatic headaches are far from over.

Policy and Future Directions

To make global fisheries more transparent, we need stronger rules. Industrial fishing vessels should be required to always carry and use AIS (Automatic Identification Systems), with real penalties if they mess with the equipment or don't follow the rules. On top of that, investing more in satellite radar especially ar0ound places like Southeast Asia where untracked "dark fleets" operate is crucial, since these regions remain blind spots. Sharing data also matters. When coastal countries can use satellite information about ships in their exclusive zones even if they don't have much monitoring tech of their own they stand a far better chance at stopping illegal activity. This kind of international data sharing deal can make small or under resourced countries much tougher enforcers. Open access platforms and better machine learning models play a big role too. The smarter and better trained these detection systems are, the easier it is to spot illegal fleets. So, public investment here shouldn't slow down. we need to make sure the evidence from satellites actually counts. That means regional fisheries groups and port authorities should start relying on satellite data as a formal part of their enforcement process. Without that step, all this new visibility won't translate into real accountability on the water.

Conclusion

When you bring together AIS data, synthetic aperture radar, optical and night time satellite imagery, and machine learning, you end up with a totally new window into what people are actually doing at sea. Suddenly, we know that most of the world's industrial fishing vessels are running outside the scope of public tracking right now, all the time. This sharper visibility is already making waves. It's transforming how marine protected areas get enforced, it's outing connections between illegal fishing, transhipment laundering, and even forced labour, and it's giving international fisheries rules more solid evidence to lean on. But spotting these vessels isn't the same as holding people accountable. Turning these streams of satellite data into real action is tough especially for coastal states that have limited resources and find themselves going up against huge, well-funded distant-water fleets. The technology keeps getting better, though. Its real potential isn't just to shine a light on hidden fleets. It's about using that new transparency to push for a fairer, more open, and more sustainable way of governing the world's oceans.

Reference

Bergman, B., & Miller, N. A. (2019). Detection of malicious AIS position spoofing by exploiting radar information. In Proceedings of the 16th International Conference on Information Fusion (pp. 1196–1203). IEEE.

Global Fishing Watch. (n.d.). Dark vessels. Retrieved July 8, 2026.

Global Fishing Watch. (n.d.). Technology for ocean action. Retrieved July 8, 2026.

Kroodsma, D. A., Mayorga, J., Hochberg, T., Miller, N. A., Boerder, K., Ferretti, F., Wilson, A., Bergman, B., White, T. D., Block, B. A., Woods, P., Sullivan, B., Costello, C., & Worm, B. (2018). Tracking the global footprint of fisheries. *Science*, 359(6378), 904–908.

Kroodsma, D. A., et al. (2024). Satellite mapping reveals extensive industrial activity at sea. *Nature,* 625, 85–91.

McCauley, D. J., Jablonicky, C., Allison, E. H., Golden, C. D., Joyce, F. H., Mayorga, J., & Kroodsma, D. (2018). Wealthy countries dominate industrial fishing. *Science Advances*, 4(8), Article eaau2161.

McDonald, G. G., Costello, C., Bone, J., Cabral, R. B., Farabee, V., Hochberg, T., Kroodsma, D., Mangin, T., Meng, K. C., & Zahn, O. (2021). Satellites can reveal global extent of forced labor in the world's fishing fleet. Proceedings of the National Academy of Sciences, 118(3), Article e2016238117.

Park, J., Lee, J., Seto, K., Hochberg, T., Wong, B. A., Miller, N. A., Takasaki, K., Kubota, H., Oozeki, Y., Doshi, S., Midzik, M., Hanich, Q., Sullivan, B., Woods, P., & Kroodsma, D. A. (2020). Illuminating dark fishing fleets in North Korea. *Science Advances*, 6(30), Article eabb1197.

Paolo, F. S., Kroodsma, D., Raynor, J., Hochberg, T., Davis, P., Cleary, J., Marsaglia, L., Orofino, S., Thomas, C., & Halpin, P. (2024). Satellite mapping reveals extensive industrial activity at sea. *Nature*, 625(7993), 85–91.

Poloczanska, E. S. (2018). A clearer picture of global fishing. *Science*, 359(6378), 864.

Selig, E. R., Nakayama, S., Wabnitz, C. C. C., Golden, C. D., Pinsky, M. L., Spijkers, J., Cheung, W. W. L., & Fulton, C. J. (2022). Mismatches between fishmeal production and reduction fisheries transparency and accountability. *Fish and Fisheries*, 23(6), 1249–1261.

Sumaila, U. R., Zeller, D., Hood, L., Palomares, M. L. D., Li, Y., & Pauly, D. (2020). Illicit trade in marine fish catch and its effects on ecosystems and people worldwide. *Science Advances*, 6(9), Article eaaz3801.

Welch, H., Clavelle, T., White, T. D., Cimino, M. A., Van Osdel, J., Hochberg, T., Kroodsma, D., & Hazen, E. L. (2022). Hot spots of unseen fishing vessels. *Science Advances*, 8(44), Article eabq2109.

White, T. D., Ferretti, F., Kroodsma, D. A., Hazen, E. L., Carlisle, A. B., Scales, K. L., Bograd, S. J., & Block, B. A. (2017). Predicted hotspots of overlap between highly migratory fishes and industrial fishing fleets in the northeastern Pacific. *Science Advances*, 3(9), Article e1701051.

Xu, J., Yao, R., Sun, Y., et al. (2022). xView3-SAR: Detecting dark fishing activity using synthetic aperture radar imagery. In Advances in Neural Information Processing Systems 35 (NeurIPS 2022) Datasets and Benchmarks Track.