The Nature Conservancy

Benefits of Electronic Monitoring

Electronic Monitoring (EM) refers to the use of cameras onboard fishing vessels, integrated with a geolocation device (GPS) and sensors that detect specific vessel actions, such as setting or hauling of fishing gear that trigger video recording.

EM is a closed system, meaning the camera, GPS, and sensor data is tamper-evident, with any manipulation of the data evident to authorities. The data collected by the EM system is recorded on either external hard drives or stored in the cloud and transmitted to the relevant fishery authority and/or an approved third-party for review.

What information does EM collect?

EM records all fishing activities onboard the vessel in the camera's field of view and in the water close to the vessel for example recording endangered, threatened and protected (ETP) species interactions and best handling practices. The specific objectives of the EM program determine the number and placement of the cameras, and therefore the activities that are in the camera's field of view and that are recorded. The EM records are first collected as video footage files that are, once reviewed, converted into EM data files (e.g., species, numbers, etc.), often the same as logbook files, and stored in databases.

Typically, the video footage review protocols dictate how the footage is reviewed, what data is collected during the video review stage, and how this data is compared with the daily catch and effort logbook data for example. Importantly, the flag state authority may set predetermined tolerances for any discrepancies between the data reported by fishers in their daily catch and effort logbook and the data collected by the EM system.

How does the information support fisheries management?

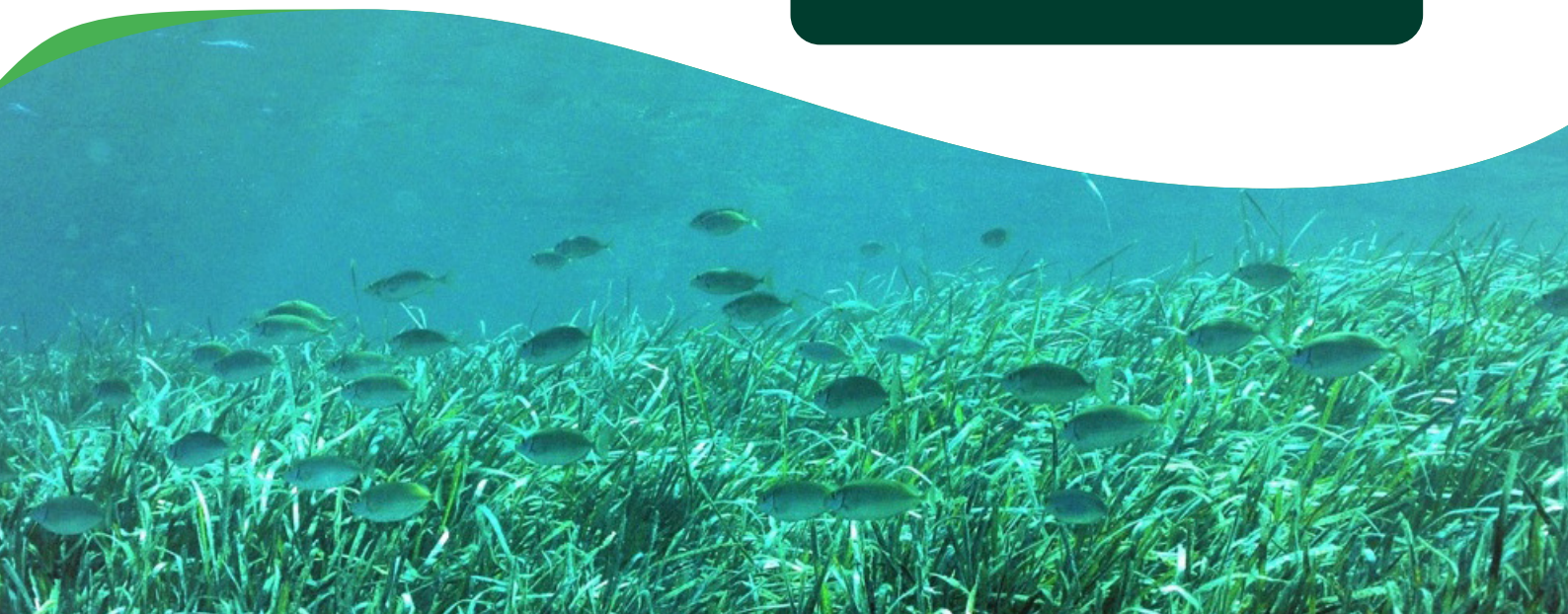
Fisheries management needs to be modernised, collecting reliable data on fishing operations at sea to unlock the economic potential of fisheries worldwide. Implementing more efficient and effective management measures requires reliable data on the activities of fishing fleets on the water, but regulators lack accurate information about what is being caught, where, and how. Most fisheries are missing granular level data about activities at-sea, which is the cornerstone of effective management. EM has a critical role to play in realising this future.

Due to lack of visibility of at-sea activities, managers rely on coarse management measures (e.g., days at sea, gear and size limits) with large buffers to account for high uncertainty and to constrain effort and catch to conserve fish stocks and ETP species populations. This approach can erode the economic performance of the fishery and may increase the incentives for industry to ignore regulations.

EM provides reliable, independent data at sea, enabling more effective, sustainable, and economically efficient fisheries management.

The overarching objective of fisheries monitoring is to provide independent verification of activities at sea to provide assurance that fishing is taking place within sustainable levels . EM is one key tool to achieve this, offering independently verified data on fishing effort, compliance, catch composition, and ensuring the use of best handling and practices are being employed, enabling fisheries managers to:

1. Improve the accuracy of statistical data that is used to conduct stock assessments, determine the status of the target species population, and support the development and refinement of management procedures or harvest strategies.
2. Monitoring fishers' implementation of, and compliance with, fisheries regulations, rules, and policies enabling management measures to be refined and implemented to address the real risks of fishing.
3. Enhance the detail and precision of data collection from the fishery, particularly at fine spatial and temporal scales, which are critical for adaptive management.
4. Build stakeholder and consumer trust in the fisheries management and support third-party accreditation of the fishery with greater transparency and efficiency of activities at-sea.



EM is used to monitor activities at sea and provides managers with independently verified data on catch, effort, location, fishing duration, and interactions with protected species, which is collected by fishers in their daily catch and effort logbooks. Collecting independently verified data enables fisheries managers and scientists to understand and assess the reliability of the statistical data, that is, the daily catch and effort data collected in logbooks, by removing inaccuracies due to human error or biases. This data is used to:

- Conduct stock assessments
- Determine the status of the target species population
- Support the development and refinement of management procedures or harvest strategies.
- Verify compliance with fisheries laws and regulations
- Provide supply chains with verified catch documentation
- Drive continual improvement on bycatch handling and safe release practicess.

The use of at-sea monitoring is also critical in assessing a fisher's compliance with the regulations, rules, and policies. By understanding the level of compliance with the management arrangements, fisheries managers are better equipped to refine or implement new management measures to address the real risks in the fishery. EM also enables the detection of unscrupulous operators and their illegal, unreported, or unregulated (IUU) catch.

Data collection is fundamental to effective fisheries management. As this data is gathered at increasingly finer scales, it will also enable adaptive fisheries management under future climate conditions. EM has been proven to provide robust scientific data about activities at-sea enabling more real-time and vessellevel management that helps provide a level playing field for all. Available evidence shows that EM can typically improve monitoring coverage, data quality, and compliance relative to human observers for the most important at-sea data needs (e.g., catch volumes, fishing effort and interactions with protected species). Along with fisheries specific data, EM has also been shown to provide verification of social and labour conditions onboard vessels. EM can also be used as a complementary tool to human observers, who may still be critical for sampling biological data that cameras cannot capture.

> *EM delivers verified, high-quality at-sea data that improves stock assessments, ensures compliance, and supports adaptive, sciencebased fisheries management.*

What are the benefits of EM?

EM enables more granular management measures.

EM can increase at-sea monitoring coverage, improving compliance with mandatory catch and effort reporting which builds data confidence, robustness, and accountability in daily catch and effort logbooks. EM can provide more granular information (e.g., species composition, catch per unit effort (CPUE), size distribution, seasonality, ETP interactions and use of best handling and practices, near-real-time information on Endangered, Threatened and Protected species hotspots) needed to enable dynamic, adaptive management of fisheries.

Greater data accountability and granularity allow regulators to reduce uncertainty and adopt more targeted and efficient management measures that address the 'real' risks, rather than the perceived risks, in the fishery. Improved scientific data and confidence in compliance on the water allows managers to convert EM data streams into timely, science-based management decisions and to employ tools such as individual quotas rather than effort limits to increase the economic performance of the fishery (e.g., when to close a season, when to close a bycatch hotspot, which boats to target). This adaptive capacity is increasingly important in the context of climate change, with shifting stocks and changing ocean conditions.

EM improves fisheries management through better data, accountability, and adaptive decision-making.

The power of EM to monitor quota fisheries can be seen in examples from Denmark and the UK. Between 2010-2012 in Denmark and between 2012-2015 in the UK, EM systems were tested to determine if they could accurately monitor catch data versus what was being landed at shore. In both trials, vessels equipped with EM were found to land a significantly higher share of the smallest size cod grade than vessels that did not have EM, clearly demonstrating that the fleet had been high-grading their quota species by discarding the smaller individuals and undermining the effectiveness of the management regime.

EM builds scientific accuracy and confidence in data.

Numerous studies have compared EM data with data from self-reported logbooks and at-sea observers. EM programs have demonstrated effectiveness at monitoring for discards, catch enumeration, endangered, threatened, or protected species (ETP) interactions (e.g., turtles, seabirds, and sharks), catch handling processes, protected areas, and use of bycatch mitigation measures.

EM has provided fundamental data for research applications, for example, stock assessments, assessing the efficacy of harvest strategies, protected species hotspots and data for ecosystem models. EM has also been used for monitoring transshipments, catch estimation for purse seine fisheries, labour standard compliance, and waste management procedures.

Critically, EM has been found to be more efficient, and reliable on longline vessels, and can be scaled more cost-effectively than human observers. This is particularly evident on longline vessels where there is low human observer coverage rates and/or where vessels are not so conducive to placement of observers. In these instances EM provides critical opportunities for at-sea observation on smaller vessels and/or vessels that conduct lengthy annual trips. EM footage review can easily be increased to 100 percent of fishing activity, thereby providing the exact number for specific activities (e.g., interactions with protected species).

Along with improving compliance with the mandatory reporting, EM is less susceptible to bias and can overcome challenges such as observer and deployment effects; non-random selection of vessels and trips to observe (deployment effects), limited pools of skilled observers; low observer coverage rates; bribery, intimidation, or "friendly" observer reports, corruption; and basic human limitations (e.g., need to eat, sleep).

EM enhances monitoring coverage, data accuracy, and compliance, enabling adaptive, science-based fisheries management that is more efficient, transparent, and scalable than traditional observer programs.

Issues with traditional at-sea monitoring programs

For a long time, human observer programs continue to be integral component of fisheries management and provide valuable information about at-sea activities.

The limitations of human observer programs have always been known and have become more pronounced in recent years.

Human observers cover a tiny fraction of fishing effort. Michelin and Zimring (2020) suggest that is it likely much less than 1 percent of total fishing activity. Additionally, it is very difficult to scale at-sea observer programs on a greater proportion of the fishing effort. This is primarily due to the costs of the programs, but also related to the challenges of finding and placing observers in some of the harshest working environments in the world and on often smaller vessels that don't return to port for months at a time.

Traditional human observer programs are limited by low coverage, high costs, safety risks, and data reliability issues due to bias, intimidation, and logistical challenges.

The data collected from human observers, although excellent, can sometimes face be inaccurate due to observer and deployment effects, biased reporting, intimidation and bribery, and the basic human limitations of trying to keep track of all fishing operations in difficult ocean environments. Observer effects result when fishing activity on observed trips deviates from activity on unobserved trips. If fishermen are worried about issues such as catching choke species or ETP interactions, they may change the location, method, or duration of a trip to minimize these challenges while being observed. In a 2010 survey of fishermen in the Gulf of Mexico and Northeast US, 68 percent of fishermen agreed that the presence of observers affected their fishery practices in ways that reduce violations.64 The end result is that data collected by observers is not truly representative of the entire fishery.

Observer obstruction can also be significant. A survey of NOAA observers in the US found that 7 percent of observers had been pressured to change data, 15 percent experienced interference or biasing of samples, and 13 percent had faced tampering or destruction of their equipment or records. Similarly, an exposé in the EU in 2012 found that many EU observers had experienced harassment while fulfilling their oversight duties.

EM supports compliance.

In some instances, fisheries management rules can inadvertently create incentives to misreport or discard catch. For example, fisheries managed with quotas, and particularly those creating choke stocks, fisheries with strong restrictions on discards, and fisheries with penalties associated with bycatch and wildlife interactions, have all been known to create perverse incentives for industry to discard, high-grade, and/or misreport their catch and effort. This can create a further intractable situation where, even if fishers would like to abide by the regulations, the fact or even perception that others are ignoring the rules may encourage them to break the rules to maintain an economically level playing field.

Improving at-sea monitoring is the helps to override incentives to ignore regulations, and EM, placed on all vessels and reviewed randomly, provides the mechanism to achieve this. Review studies in multiple EM pilots and programs demonstrate that the adoption of EM resulted in significant changes in behaviour and reporting. For example, reported discards in Australia's longline fisheries more than doubled after the installation of EM in 2015, while overall reported catch remained the same.

In the EU, fisheries are managed with a combination of quotas, effort restrictions, and landing obligations but there is limited monitoring at sea, creating a strong incentive for fishers to discard fish where they have limited quota or smaller fish with lower market value.

EM can benefit Industry.

Captains have reported benefits from the multiple camera views available to them at the helm, which enable rapid assessment and monitoring of what is occurring across their vessel and fine-tune their operations. From a safety perspective, being able to monitor all parts of the vessel from the helm is also a huge benefit for captains. Captains and fishers who install EM often appreciate not bearing the responsibility of having observers on board, in terms of being responsible for the safety of another person onboard.

Importantly, fisheries are starting to demonstrate other ancillary benefits of EM. EM can improve onboard operations, validate market claims around sustainability and labour standards, reduce business risk, and empower industry by corroborating their on-the-water observations in regulatory and scientific dialogues.

There are also possible future opportunities for industry from EM. EM data (e.g., catch, vessel, location, CPUE) could be used to underpin business analytics to increase fishery value by processing and aggregating EM data to provide valuable information to industry. There may also be scope for EM to help reduce marine insurance costs by facilitating rapid accident investigations, improving claims processes, and reducing liability, possibly supporting industry to demonstrate lower insurance risk.

EM offers operational, safety, and business benefits to fishers, while also supporting sustainability, transparency, and potential cost savings.

EM builds trust and accountability among stakeholders.

EM systems have been shown to help build trust between industry and regulators in the data used to inform fisheries management. Mistrust is common between industry and management where there is limited at-sea monitoring: managers don't necessarily trust what industry reports in their logbooks, and industry do not necessarily trust the science delivered by managers.

There is also significant value in the information that EM can provide for all fisheries stakeholders, including industry, regulators, and non-governmental organizations (NGOs). EM can pull stakeholders out of their respective corners by transforming what is often considered anecdotal fisheries knowledge into trusted data. The video doesn't lie.

An example of the value of full accountability to deliver increased flexibility to fishers is in the USA West Coast groundfish fishery, where, under output controls, the fishery has doubled net revenues, seen fishers take advantage of the flexibility of the new management system, and dramatically reduced the catch of overfished species.

> *EM builds trust and accountability by providing verifiable data that supports fair, flexible management.*

EM supports traceability claims.

EM has the promise to improve traceability, sustainability and social responsibility claims that can provide premium market access, while providing new data for business analytics. EM can help seafood supply chains mitigate risks by providing transparency from catch to dock. EM can help stamp out illegal, unreported, and unregulated (IUU) fishing.

What are the downsides of EM?

There are several major barriers to the wide-scale adoption of EM: cost, regulator concerns, fisher and seafood industry concerns, and technological limitations. While these are valid concerns, many can be addressed with appropriate investments and policy support.

The imitations of EM must be considered in a fishery-by-fishery context. There are many fisheries where EM can cost-effectively meet critical data needs.
To obtain accurate information from EM, there may be a need to modify the behaviour of the crew. For example, if the crew follow appropriate catch handling procedures, EM has been shown to be capable of discard estimation in multispecies trawl fisheries. Cameras need to be regularly cleaned to ensure video imagery is clear.

There may also be issues where the EM data may show more variation compared to observer reported data, particularly for non-target species. This may be due to smaller sample sizes, difficulty in identifying non-target species from the video footage, and/or the need for more procedural support from industry on-board the vessel. Similarly, EM has been shown to provide accurate data on ETP interactions, but it can be challenged by interactions that occur outside the field of view or for species released without bringing them on board (e.g., cutting a branch line).

Finally, EM cannot undertake biological sampling and, as such it still needs to be integrated thoughtfully within a broader scientific data collection program and monitoring, control, and surveillance program with complementary tools and onshore capacity.

> *"Electronic monitoring offers valuable data but faces practical, technological, and fishery-specific challenges."*

The information above is a summary from Michelin, M., Elliott, M., Bucher, M., Zimring, M., and Sweeney, M. (2018). *Catalysing the growth of electronic monitoring in fisheries*. CEA and The Nature Conservancy, available at this link and Michelin, M.; Zimring, M. (2020). *Catalysing the growth of electronic monitoring in fisheries: progress update August 2020*. CEA and The Nature Conservancy, available at this link.

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