Theme Session H Report

Can technology-based monitoring deliver timely, cost-effective and high quality fishery-dependent data?

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INTRODUCTION

Fisheries continue to develop and implement electronic technologies (ETs) to improve the timeliness, quality, cost effectiveness, and accessibility of fisheries-dependent data. Electronic monitoring (EM; cameras, gear sensors, and GPS), electronic reporting (ER), and other ETs, together with advancements in computer vision and machine learning, will provide innovative and integrated data collection to address increasing scientific and management information needs. As technology advances, it is important to review what is available, share lessons learned, and be sure that programmes are selecting the ETs that fit their data collection needs. The process of incorporating ETs into a monitoring approach has significant challenges, including modernizing back-end data infrastructure, validation, optimizing for automation and integration, adapting to emerging needs, and providing data at a scale that will support future needs. This session sought to share the progress made on technology-based, at-sea fishery monitoring, practicalities and challenges of implementation, opportunities for further integration of data collection, extensions of data applications, and analytical approaches and innovation.

SUMMARY OF PAPER CONTRIBUTIONS

The scientific focus of the presentations were quite diverse, but there were some commonalities in the drivers behind the ET programs being developed. Amos Barkai and Lauren Clayton both addressed particularly novel applications to address areas of key public interest and consumer-led campaigns. Amos has developed a supply chain traceability method and mobile application for tracing shark products through the seafood supply chain, while addressing increased focus on the conservation of sharks. Lauren demonstrates how EM systems deployed in the Scottish demersal trawl fishery could also be utilised for observing littering by fishers at sea, with insights informing more effective future regional marine litter plans.

Several contributions promote the use of data collected from ETs in stock assessment frameworks. Andrew Jones focuses on encouraging stock assessment scientists to utilise a 15-year time series of self-reported ER data for stock assessments, to inform stock boundary discussions, and in marine spatial planning. In contrast, Julia Wouters focuses on the importance of examining EM data for biases related to errors in collecting length measurements and species identification. In addition Amos Barkai's poster demonstrated that stock assessment metrics such as catch per unit effort (CPUE) can also be utilised by fishers to minimise bycatch of choke species and maximise the length of the fishing season.

Cost-effectiveness of EM was a cross cutting theme; Maria Sokolova and Xabier Lekunberri presented on innovative applications of deep-learning models (AI) to reduce tedious and costly processes within fisheries monitoring, control and surveillance (MCS). Their research ranges from automated detection and counting of catches within demersal *Nephrops* trawls to deep-learning classification and measurement of tuna species in purse seiner catches.

Several contributions are pursuing ETs to fill specific knowledge and data gaps or to offer a first look at how best to monitor and manage a particular fishery. Bjorn Bos described how both the automatic identification system (AIS) and satellite assessments of visible infrared imaging radiometer suite (VIIRS) night-time lights can be used to estimate fishing effort and identify non-compliance with spatial closures in the Chinese EEZ. Chris Cusack presented on using shore-based cameras and ML to provide fishery managers with near real-time estimates of recreational and small-scale fishing effort which typically lack these types of data due to their spatial dispersion and low per-vessel catch values. On the same thread, Chris McGuire demonstrated the first EM project in a for-hire fishery to address the gap in data quality between commercial and recreational/charter fisheries, sharing lessons learned on validating self-reported catches of for-hire captains.

The last category of presentations covered data integration of new and varied data types collected by ETs, how the data streams are managed and integrated with existing programs. Jordan Watson focuses on the back-end data infrastructure so that end-users can focus on scientific output, instead of being a data janitor. Jordan demonstrated a suite of automated data digesting and integration procedures to link and make available multiple data sources in near real-time to improve accessibility, consistency and reproducible for end users. In a similar vein, Cian Kelly described how the 'FishGuider' project aims to develop methodologies and tools to integrate and more accurately couple species abundance and oceanographic models to catch data to support decision making tools for fishers, in turn decreasing time and fuel spent on locating suitable catches.

SUMMARY OF PANEL DISCUSSION

We assembled a diverse group of panellists on a range of topics, including how to apply AI and machine learning (ML) to imagery collected from EM systems, how to integrate EM data into stock assessment, building relationships with the fishing industry, and how to integrate data from different types of technology.

Applying AI/ML to imagery from EM programs

Algorithims are heavily reliant upon the quality of the data, and it can be very challenging to collect large volumes of high-quality imagery from EM systems. To date, a lot of progress has been made on single use cases, limited numbers of applications, but more focus and resources should be placed on applications that are more widely available to all fisheries. For example, AI/ML tools that identify when fishing crew are on deck would allow any EM program to priorize data review, such as focusing on when fishery catch is on deck and presumably de-prioritize data review when transiting is occuring. This would potentially reduce the amount of data being collected and transmitted. There are limited cases of data standards across fishery governances and very few fish image datasets publicly available, but creating

standards and making data more publicly available could help spur on growth of AI/ML tools for EM programs.

Using of EM in stock assessments and outreach with industry

EM data tends to be of lower quality when compared with fishery observer data; length, weight, and species identification is less precise, and EM systems are not able to collect age information. Some stock assessments may be improved by having more (but slightly less precise) monitoring data, but overall, a shift towards EM data could lead to a bias in a stock assessment. It is important moving forward to balance data quality vs. quantity.

It is important to consider stock assessment scientists as collaborators when building an EM program, not only for how to design the data collection, but to determine how EM data can fill a niche for improving an assessment. More over, many assessments build an index of abundance from survey data, rather than fishery-dependent sources. It is also important to curate and manage EM data in a way that makes access easier, such as developing a web-based application programming interface (API) to promote efficiency and creating a repeatable process. If it is difficult for stock assessment scientists to access and examine EM data, it is far less likely they will consider it for use. It is important moving forward for studies that compare EM data with other sources of data to be published in order to build a peer-review record over time. Lastly, if EM programs expect to get industry participation and engagement, programs must be affordable and add value to fishermen and their businesses. Programs that are hyper-focused on enforcement and compliance with regulations will likely struggle to get industry particiation.

Data integration from different technologies

Data managers and analysts in many instituions and organizations are classicly-trained fishery biologists, often lacking the specific expertise and skills for properly building and mainting databases that are required for successfully integrating data from various sources. It is extremely important to identify specifc needs, and get help from (or hire) experts in database design in order to create standardized processes with checks and balances, adequate metadata, and reproducibility of results. The same holds true for other types of data collection, being able to leverage social scientists and behavioral economists to assist with challenges in EM programs, such as specificying how much video review is necessary to dissuade non-compliance while being able to cost-effectively collect monitoring data.

SUMMARY OF POLL QUESTIONS AND NEXT STEPS FOR WGTIFD

The theme session included poll questions to create a more dynamic flow, but also to gather participant's opinions regarding several topics pf interest to WGTIFD; these are summarised below.

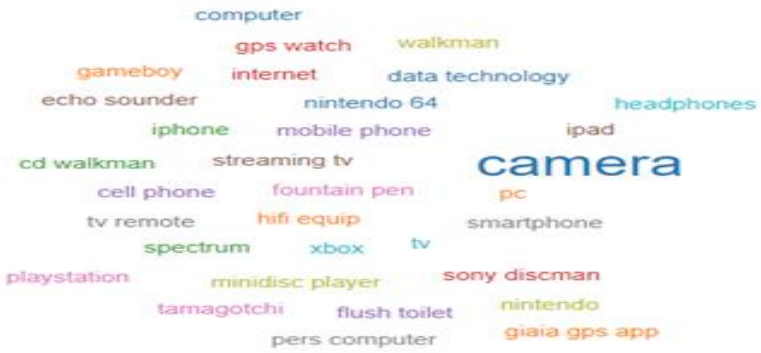

Figure 1 – Cloud of answers to the ice breaker: "what is your favourite technology developed (ex. cassette player, game console, spectrum computer, etc)?"
We asked attendees, "what is something being collected by EM systems, but isn't being examined or analysed yet by scientists or managers?" The top answers included: fishing gear conflicts, marine litter, endangered/threatened/protected species encounters, weather/environmental data, fishers behaviour, crew safety and engine emissions.

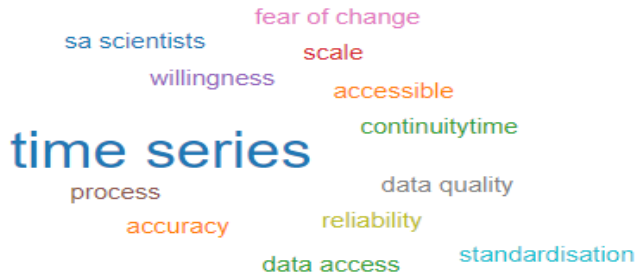

Figure 2 - Cloud of answers to "what are the challenges with bringing new data into fishery stock assessments?"

The fourth poll question, "what is the biggest barrier to more effective data integration?" Data confidentiality and access (50% of replies) was followed by operationalization (29%), technology (14%), and vision (7%).

Finally, the group had a discussion on the next steps for the WGTIFD. TIFD will have its last meeting of its first 3-year cycle in 2021, scheduled as a virtual meeting (29 November – 3 December). There was also a discussion on the possibility to extend TIFD for another 3-year cycle, and in this context a poll was created to sense participants opinion on "what should WGTIFD prioritize in the next set of ToRs (2022 – 2024)?". The answers identified integration of EM data into stock assessment and advice as the main issue (58% of replies), followed by standardizing elements of EM programs (e.g., data, service acquisition) and developing recommendations for implementing ETs in data-poor/small-scale fisheries (both with 16%), while somewhat surprisingly data sharing and privacy policies (e.g., General Data Protection Regulation) and best practices and recommendations for ET tool selection for different types of fisheries received both only 5% of answers. It was agreed that a more in-depth discussion of the ToRs will take place at the next WGTIFD meeting, where the ToRs will be drafted and agreed.