Improving data in artisanal IOTC fisheries using electronic monitoring tools

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Summary

The parlous data situation for artisanal tuna fisheries in the IOTC is due in part to reliance on technology that is literally thousands of years old - handwriting on paper - to record data. Fisheries management bodies (business, national and inter-governmental, including in IOTC) are transitioning to electronic fisheries information systems. However, the IOTC data holdings and management are reliant on actions taken by Parties to the Commission (CPCs). Primary data recording for logbooks, monitoring or catch documentation schemes remains overwhelmingly paper-based. Information on paper must be captured into an electronic system by CPCs before it can be shared or used for national reporting purposes. This is a cumbersome, expensive and error-strewn process. Furthermore, paper-based systems are highly scale-dependent, meaning that as the scale of the data requirements grows (more fishing operations, more volumes and types of information), so too does the effort to meet those requirements. Few coastal CPCs consistently meet their data submission and reporting obligations to the IOTC. ABALOBI is a social enterprise working with artisanal fisheries, and has developed a suite of electronic tools for fishing data recording, including for monitors recording catch information at landing. Its systems are fully digital, but are designed to work with paper information sheets if needed, and can be configured to work without an internet connection, making this the ideal electronic system for the vast numbers of widely dispersed and often remote artisanal fishing communities that catch tuna in the Indian Ocean. While ABALOBI's e-logbook and other apps are also available, we believe that the ABALOBI MONITOR platform, constituted by a smartphone application feeding a secure, cloud-based data warehouse, together with the suite of analysis, visualisation and access-management tools, can provide multiple benefits to artisanal fishers, substantially strengthen governments' capabilities to detect and address illegal activities and transform the provision of data from artisanal fisheries to the IOTC - with obvious benefits for a wide range of activities, most pertinently stock assessment and scientific advice. ABALOBI invites any interested party to explore a joint program of work, and proposes to collaborate closely with the IOTC Secretariat to develop heuristics and Standards for electronic systems in artisanal fisheries.

Introduction

The transition from analogue to digital information systems has happened to varying degrees in most major economic sectors, with the move being virtually complete in finance. Fisheries have been exceptionally slow to adopt electronic systems. Electronic information systems, once adopted and integrated, can be dramatically cheaper, more reliable and more efficient than paper-based systems. The timeous provision of accurate and reliable catch and effort data remains an enormous challenge for bodies such as the Indian Ocean Tuna Commission (IOTC). The lack of, delayed, incomplete and/or unreliable catch and effort data makes scientific analyses and recommendations for stock and bycatch management exceptionally challenging. Parties to the IOTC (hereafter CPCs) are bound by Res 15/02 to report specific aspects of their fleets' fishing activity, behaviour and outcomes. Additionally, CPCs have a binding obligation under the United Nations Convention on the Law of the Sea to prevent vessels carrying their flag to engage in Illegal, Unreported and Unregulated (IUU) fishing activities.

The IOTC categorises fishing vessels as industrial or artisanal, the latter defined as <24 m in total length, and which do not operate on the High Seas. All other fishing vessels are classified as industrial. Artisanal IOTC fisheries make up close to half the estimated tonnage caught under the ambit of the IOTC (IOTC 2020b). Annually, the Scientific Committee reports on the parlous state of data from artisanal fisheries under its purview (e.g. IOTC 2020b). Annually there is little tangible improvement in data provision from most coastal CPCs, despite considerable effort from the Secretariat and others to improve CPCs' data collection and management capacity (IOTC 2020a).

Challenges with paper-based systems

Logbooks and verification at landing are primary IOTC-codified Monitoring, Control and Surveillance (MCS) mechanisms that CPCs must use to gather and provide minimum types and amounts of data. The work required to adequately manage catch and effort documentation (logbooks, landing declarations, etc.) and inspection schemes are, unlike in the financial sector, by-and-large reliant on first-mile/pedigree data being captured on paper. Physical data sheets and books must be stored temporarily or submitted to an office, batched and stored again, then transferred to a data capture centre where humans spend inordinate hours, at great expense to the national fiscus, to convert analogue data into digital data. While the drawbacks for paper-based systems are manifold, the time-lag and inherent process errors from manual recording and data capture are arguably the most problematic. Consequently, these compounding issues erode the reliability and relevance of the data. Events from too long in the past and with often appreciable legal uncertainty are unlikely to be taken forward from a compliance process. Last, but not least, tuna are typically caught, landed, moved, sold and consumed in timeframes that seldom match those for the arrival of data. Trade and food-quality imperatives cannot halt commerce while paper-based systems take weeks or months to confirm the provenance and legality of products, meaning that tuna may be traded without official verification of its traceability.

Currently, traceability in many tuna supply chains begins with generating catch and effort data at landing - contrary to Best Practice where fishing events are recorded by the fisher, daily, usually onboard. A second challenge is the availability of supporting documentation; responsible buyers must proactively secure copies of permits, Authorisations to Fish, etc. in an attempt to demonstrate the traceability and legality of the products. Typically these actions (generating data and accessing documents) are the domain of well-resourced, industrial corporations trading in large volumes of tuna. Furthermore, industry-generated landing data are seldom if ever shared with authorities. Thus data from the same event are often generated multiple times - creating inefficiencies and potential discrepancies. Artisanal fishers usually lack the coordination, resources and market pressure to collect, manage and share landing data. Limited market access severely constrains many artisanal fishers' livelihoods and resilience. For the purposes of this paper, these challenges are termed 'market barriers'. For those governments that have not completed the adoption of electronic information systems, the costs are substantial. It is functionally impossible for paper-based systems operating at the scale of many artisanal IOTC fisheries to provide traceability data and documents *timeously*. Without robust traceability data, tuna cannot be legally exported to most international markets because those markets require increasingly robust traceability data. The impacts on the earning potential for fishers is obvious. However, this also negatively impacts the national economy, specifically the balance of trade and foreign currency earnings.

A CPC that wishes to meet its data submission and reporting obligations from artisanal fisheries to IOTC requires both logbooks and MCS data to be robust. Logbook data, because it is self-reported with minimal verification systems, becomes less trustworthy when MCS effort is weak or inadequate. An electronic system for monitoring data (which collects much of the same data that are collected in logbooks) can become a powerful tool for CPCs to meet IOTC requirements while strengthening national logbook systems.

Digital Monitor data

The digital revolution, and especially smartphone applications (apps) with cloud-based storage and processing capacity, can overcome some of the market barriers, even for very small operations. Electronic Fisheries Information Systems (eFIS) allow CPCs to increase dramatically the scope, quantity and quality of fisheries data collection. The many benefits of electronic solutions extend to the realm of Monitoring, Compliance and Surveillance (MCS).

This paper presents a privately developed, smartphone app-based system for artisanal fisheries data recording, management, analysis and sharing. ABALOBI (which means "fisher" in the isiXhosa language) is a South African-registered public benefit organisation and social enterprise working with artisanal fishers. ABALOBI's suite of electronic tools includes the the FISHER app which collects e-logbook-type data and the MARKETPLACE app, which connects fishers with buyers by utilising the FISHER app data. The MONITOR app is of most relevance for the IOTC's artisanal fisheries. It is intended for use by compliance officers and/or fisheries inspectors recording data typical of shore- or port-based MCS schemes. While our vision is for a modern, paperless, fully integrated, electronic fisheries information system, our platform allows for physical paper forms to be maintained, as de facto physical backup, for as long as needed. Pilots of ABALOBI MONITOR conducted in non-tuna fisheries demonstrated proof of concept successfully.

Overview of the ABALOBI MONITOR platform

The ABALOBI MONITOR platform incorporates data collection, storage, analysis and real-time data visualisations as a complete end-to-end electronic catch reporting system. The app populates a secure data warehouse, while user management and data visualisation interfaces are accessed through ABALOBI's admin console. App functionality and development are considerably more complex than using typical data forms utilised in many mainstream operations reliant on off-the-shelf products. For situations where the app isn't suited or available ABALOBI makes use of electronic forms built in the Open Development Kit (ODK) standard, to which ABALOBI has contributed open-source code in the past. All data and administration tools rely on cloud storage, while data can be collected offline - i.e. both ABALOBI MONITOR and mobile forms can be configured to function without an internet connection (batching and storing data on the local device and uploading when an internet connection is established). Further, they are designed to function on Android and Apple smartphones from entry-level devices up. ABALOBI MONITOR was co-designed with fishers and monitors specifically to ensure intuitive, easy-to-use interfaces requiring minimal training to achieve proficiency, and with field types defined to minimise incorrect data entry. Our systems are built with response-dependent logic to ensure only relevant data fields are presented to users.

The platform incorporates gear- or fishery-specific catch reporting using scientifically robust, standardised approaches and definitions whenever possible. The platform follows the alignment standards of the industry-led Global Dialogue on Seafood Traceability (GDST) and ensures the collection of GDST-defined Key Data Elements (KDE). This ensures interoperability between ABALOBI MONITOR and other platforms, allowing data exports to other databases. This is particularly valuable for meeting CPCs reporting obligations to the IOTC.
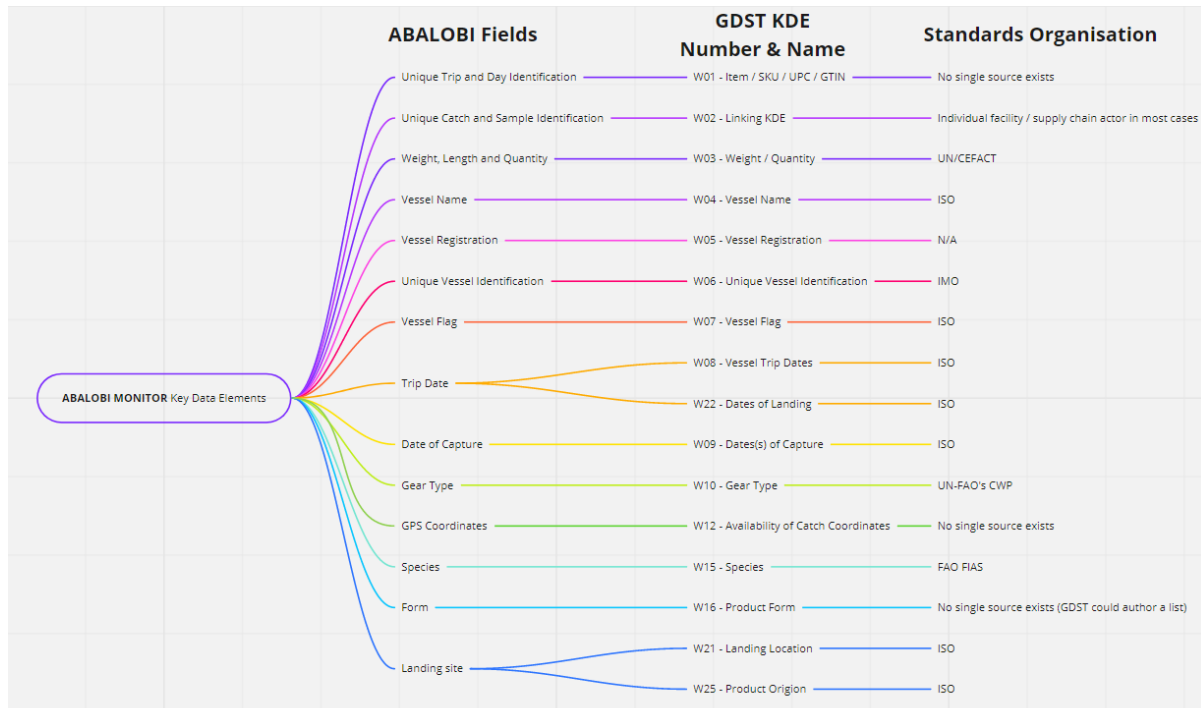
Figure 1. Comparison of ABALOBIdata fields with the Key Data Elements defined by the Global Dialogue on Seafood Traceability. [this is currently a screengrab, but useful placeholder since this is what I'd like included in the paper in a polished form]

Analytics and data visualisations include multiple, dynamic dashboards, per monitor, gear, species or by landing site. Standard tables or visualisations include metrics for catch per unit effort, gear type, community catches, target species, mapping capabilities (if spatial management of fishing effort is of interest) and many more. An essential component of the platform is accessibility, through managed user accounts that provide varying levels of access, including data export. As part of the user management component, partners can easily and flexibly upload and update lookup fields (fisher names, monitor names, species, gear types, communities etc.) that surface in the app interface - subject to controls and verification protocols. ABALOBI follows strict, secure and standardised data protocols and data warehouse management. This includes the registration and verification of users, compliance with privacy laws, and best practice security protocols and encryption for apps and servers.

The platform incorporates the following fishery-specific catch reporting and data visualisations using mobile, web- and cloud-based technology:

1. **Catch reporting** - Standardised and scientific methodology implemented for catch monitoring at landing sites or along the shore - rendering a robust and efficient service for analysis and reporting. Meeting the required level of coverage can be achieved if the requisite human resources are in place - the platform is not a limiting factor.
2. **Analytics and data visualisations** - Dynamic dashboards allow users to summarise data by fisher or landing site, and to tabulate and analyse CPUE metrics, length frequency, gear type and community breakdowns, species-specific metrics, spatial effort and more.
3. **Data export** - Manual and automated downloads of data tables (in csv and other formats), APIs to push or pull data between databases.
4. **Alignment** - with GDST's KDEs.

5. **Admin console** - User (fisher & monitor) management, data management (species & gear types), access to data analytics and visualisations. Easy and flexible upload/update of fisher, monitor, gear type and species look-ups.
6. Standardised and secure data protocols and data warehouse management.
7. Online/offline use and capability.

Proposal

We propose to pilot the implementation of the ABALOBI MONITOR platform for artisanal tuna landings. ABALOBI's experience has shown that customising ABALOBI MONITOR is necessary to ensure reliable data recording and efficient reporting. Co-configuration with the IOTC Secretariat and one or more coastal CPCs should be a simple and efficient process, since most of the fields in use are standard. The proposed pilot(s) could evaluate the cost:benefit of adopting digital tools and also develop lessons and principles that would allow IOTC to develop Standard Operating Procedures , or minimum standards, for digital data systems. A standards-based approach encourages innovation and cost-effectiveness by facilitating new entrants to the sector to provide new tools and services to under-served artisanal tuna fishers.

Benefits from adopting electronic information systems

There are multiple benefits from eFIS, of which some of the biggest are listed below (in no particular order).

1) The *timeous* provision of large volumes of reliable data, including length-frequencies and other fundamental data for stock assessments (if CPCs mandate those data to be collected)
2) Related to 1) is more robust and efficient stock assessments (and thus management advice). Electronic data can
   a. obviate much of the current, periodic revisiting of stock assessment models to update with historical data
   b. allow assessments to be conducted with better *a priori* model selection and parameterisation
3) Establishing a robust pathway for artisanal fisheries to achieve ecolabel certification
4) Real-time, integrated eFIS allows new approaches to address IUU, including building novel compliance tools around digital monitoring data
5) A single, reliable source of shareable digital monitoring data will create substantial efficiencies across the supply chain. ABALOBI specifically allows multiple users to access the information it curates. Thus tuna traders obtain data required for onward sales of tuna directly, unlike the current situation where they must either create their own catch and provenance data (e.g. requiring a Captain's Declaration or similar) or attempt to trade without them.

The sustainability of tuna fisheries is of interest to many parties besides the IOTC and its CPCs. In particular, developed markets are increasingly attuned to environmental impacts and sustainability of seafood products. As a result, it is widespread practice in developed markets to procure tuna exclusively or preferentially from fisheries that are publicly listed by [Fishery Progress](#) as being in a credible Fisheries Improvement Project (FIP), or with Marine Stewardship Council (MSC) certification. Adoption of Abalobi's electronic tools could be catalytic in moving groups or communities of artisanal tuna fishers into FIPs and thus on a well-trodden and supported path towards sustainability.

Recommendations

The full benefits of electronic approaches are only experienced when the conversion from paper is complete – partial solutions are ineffective against IUU, don't reduce effort or costs substantially and

cannot consistently deliver timeous and reliable data. ABALOBI's experience suggests that the management and sustainability of many artisanal IOTC fisheries will not improve until the transition from paper-based to electronic data collection occurs. Electronic systems such as those developed by ABALOBI have clear potential in transforming important aspects of IOTC's data environment.

ABALOBI agrees with the findings of the Second Performance Review (PRIOTC02) regarding the need to improve data collecting systems for IOTC fisheries, including electronic systems (IOTC 2017). The first topic in the WPDCS' DRAFT Program of Work (2021-2025) refers to supporting "... the implementation of data collection and sampling activities of coastal fisheries …" (IOTC 2020a). To give more tangible effect to a specific recommendation from the Second Performance Review regarding electronic data systems ("innovative and/or alternative means of data collection [systems]... and [to] move towards electronic data collection and reporting for all fleets" (IOTC 2017)), ABALOBI recommends that the WPDCS consider including supporting a pilot(s) of ABALOBI MONITOR under the WPDCS Work Plan. In addition, such an action would substantively address the eighth recommendation in PRIOTC02: "... continue efforts to adopt adequate fisheries management arrangements and to assist developing coastal States…" (IOTC 2017, p. 15)

We are cognisant that great caution is needed when replacing data collection and management systems. However, given the challenges with the status quo, we believe that piloting ABALOBI MONITOR will not cause bigger problems than currently experienced. Further, such a pilot will burnish a CPC's environmental and sustainability credentials, directly address IUU, facilitate development of additional compliance-related tools, and create the potential for artisanal fishers to start accessing premium markets

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