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Information paper 2

E-reporting/E-monitoring AI

Franck Magron, Emmanuel Schneiter, Malo Hosken

ER/EM needs - introduction

1. Electronic reporting using mobile electronic devices improves the timeliness of data acquisition and transmission, removing the tedious process of using paper forms. The recent application of electronic monitoring where video recording technology is used presents the capability to address long standing data gaps in the longline fishery and can potentially be used in other areas such as transhipment monitoring. Streamlining the use of different electronic reporting applications and protocols developed in the region and particularly for electronic monitoring the high cost of implementation, enlisting cooperation of industry partners and the ongoing development of EM systems and software are current issues faced in the region.

2. As data collection effort increases, especially for coastal fisheries, up-to-date technology including Artificial Intelligence can assist data collection and analysis of images & videos for easier data entry and improved data quality. Tasks such as species identification, reading fish fork length on a measuring board or weight from scale can be pre-processed from pictures and validated by an operator.

Responses to these growing needs

3. Five mobile applications have been developed by FAME in recent years for fisheries reporting and monitoring, such as OnBoard for longline e-reporting, Ollo for longline observers, OnShore for port sampling, Tails for artisanal tuna, and Ikasavea for coastal fisheries associated data.

   These freely downloadable applications are now commonly used all around the SPC member countries and allow an increase of efficiency and availability of data.
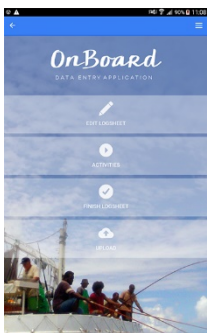
   a. **OnBoard**

   OnBoard app is one of the SPC-developed E-Reporting tools suite. It is available on Android and Windows 10 operating systems. It is available in English, French, Chinese Traditional and Chinese Simplified. It is used to collect logsheet data onboard longline vessels fishing in the Western and Central Pacific Ocean. Electronic logsheet data consist of listing the daily activities undertaken by the vessel, including the position and start time of each activity. For fishing set activities, the vessel captain can enter from an exhaustive species list, each fish caught each day (retained and discarded) as well as information on the fishing effort (number of hooks used and hooks between floats).

   As with the rest of the app suite, OnBoard can then remotely send data to the master cloud-based system TUFMAN2. Once in the system, the data can be viewed and/or edited by fisheries officers from Pacific Island countries, in near real-time.

b. Ollo

OLLO (Offline LongLine Observer) is an android app developed by SPC for observers monitoring longline vessels operating in the southern albacore fisheries of WCPFC area. It is used on ruggedised tablets and allows observers to record all the data fields required in the SPC/FFA Longline Regional Observer Workbook. It is used offline by observers onboard the vessels and their data is uploaded to the regional fisheries database Tufman2 when observers return to port. It incorporates Data Quality Checks tools which ensures quality data is recorded and transmitted.

OLLO was extensively trialled with the New Caledonia observer program and is now in production and used in 5 member countries. SPC provides training and support to observer programs willing to trial and implement OLLO. It is regularly updated based on observers' feedback and ongoing data collection requirements.
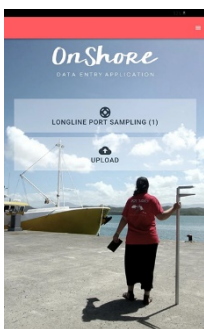
c. OnShore

OnShore is one of the tablet applications of the SPC-developed suite of e-Reporting tools. It is used to **collect port sampling** data from commercial vessels fishing in the Western and Central Pacific Ocean.

In some countries, when a vessel comes into port to offload its catch, a sampling* of the individual unloaded fish is made by port officers on shore. SPC has designed OnShore as an efficient solution to replace port sampling paper forms.

d. Tails

Tails is a smartphone and tablet application that allows coastal fisheries staff to easily collect tuna and reef fish catch information from small-scale fishers in remote locations and send it instantly back to the main office for analysis, even when internet connectivity is limited. This technology eliminates the need for costly and time-consuming delays in sending paper-based data from outer islands to the central fisheries office to help pacific countries monitor and manage their artisanal tuna catch with today's data, not last year's data.

e. Ikasavea

Ikasavea is the flagship mobile application of Coastal Fisheries and Aquaculture Programme for offline data collection and it synchronises with the **coastal fisheries** application portal. At the moment, market, landing and socio-economic surveys have been implemented on Ikasavea and additional web modules will also be proposed on Ikasavea in the future for coastal Monitoring, Control and Surveillance activities, underwater surveys and other resource surveys data entry.

4. To complement e-data collection and traditional in-situ catch identification and measurements by surveyors, several approaches have been tested to improve data quality

and reduce the time spent measuring the catch using pictures processed at the office at later time, either of individual fish or invertebrate on a measurement board or multiple specimens on a mat. Pictures allow for check of species ID and measurements when outliers are detected in analysis, and they can be automatically analysed to reduce data entry time.

5. AI assistance: Pictures of coastal fishes on a standard measuring board and scale are now processed automatically to extract species ID, fork length and weight of market species (33,000 pictures processed), and simply validated by the operator. Pictures of invertebrates on board and specimens on a mat are calibrated to allow for direct measurement from picture and further automation is under work as more pictures of invertebrates on board (1,400) and fishes on mat (900) become available.

Future work

Study of the possibility of building an annotated image database for electronic monitoring of pelagic species

6. In 2023 there could be well over a hundred electronic monitoring (EM) systems installed on longline tuna fishing vessels operating in PICTs. EM systems record the activities of fishing vessels through imagery (video/photo) and sensor data (position, speed, time) collection. These EM records are then transferred to a Review Centre where EM data is produced by EM analysts. EM is a recent technology part of a suit of other monitoring tools and standards used by PICTs to manage their pelagic fisheries.

7. One of the key developments in e-monitoring is the assisted analysis of EM records using Artificial Intelligence (AI) and Machine Learning (ML) tools. While human analysts will remain central to producing EM data, AI and ML tools can be used by EM analysts to focus on the key events of a trip (catch events in particular) for efficiency gains in the analysis of a fishing trip.

8. For AI and ML tools to work well, you need a skilled EM analyst, a powerful computer, a good AI ML code and importantly, a reliable database of annotated images. Annotated images are digital images where key visual elements are described in a code. Such images are used to develop and refine the accuracy of AI and ML tools.

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        </bndbox>
    </object>
</annotation>
```

9. The above image of a yellowfin tuna during a biological sampling operation has the corresponding data describing the image properties, that the species is indeed a yellowfin tuna and providing bounding boxes dimensions (an invisible rectangle around the edges of the tuna in the image).

10. While there are existing databases of annotated images for AI ML work in longline EM (e.g. fishnet.ai; several EM technology providers have also developed their own databases), we invite SPC members to consider the potential for developing a regional database of annotated images for pelagic species, managed, and owned by the membership and made available in the public domain.

    Key benefits would include:

    a. Ownership and Intellectual Property remain in the membership. EM service providers needing to develop and refine their AI ML tools will need annotated images. Member countries becomes leaders in the annotation of images for EM therefore being well informed on AI ML development work to ensure it meets their needs.

    b. Employment opportunities for people in PICTs (including for women). There are skilled observers without many opportunities to work in-situ since the pandemic. Observers and other skilled people could be trained in image annotation techniques and earn wages for doing this work.

    We encourage SPC members to consider this approach and provide feedback to FAME. An online seminar for discussing this approach in more details can also be envisaged.

11. As sea cucumber species are added to the CITES appendix II, the export of these species requires countries to conduct non-detrimental findings studies and monitor exported specimens. CFAP is conducting experiments using remotely operated underwater vehicles (ROV) for deep transects and videos are analysed with the assistance of computer vision and artificial intelligence. Trials are also conducted for the identification and measurement of dry sea cucumber products from pictures at the processing plant for export monitoring.

12. Artificial intelligence requires big amounts of validated data to train models, especially for picture analysis and data remains scarce for invertebrates and infrequent coastal fish species. Through partnership and joint projects with other organisations, we work on improving models with additional data and expertise provided by partners for the benefit of the Pacific region.
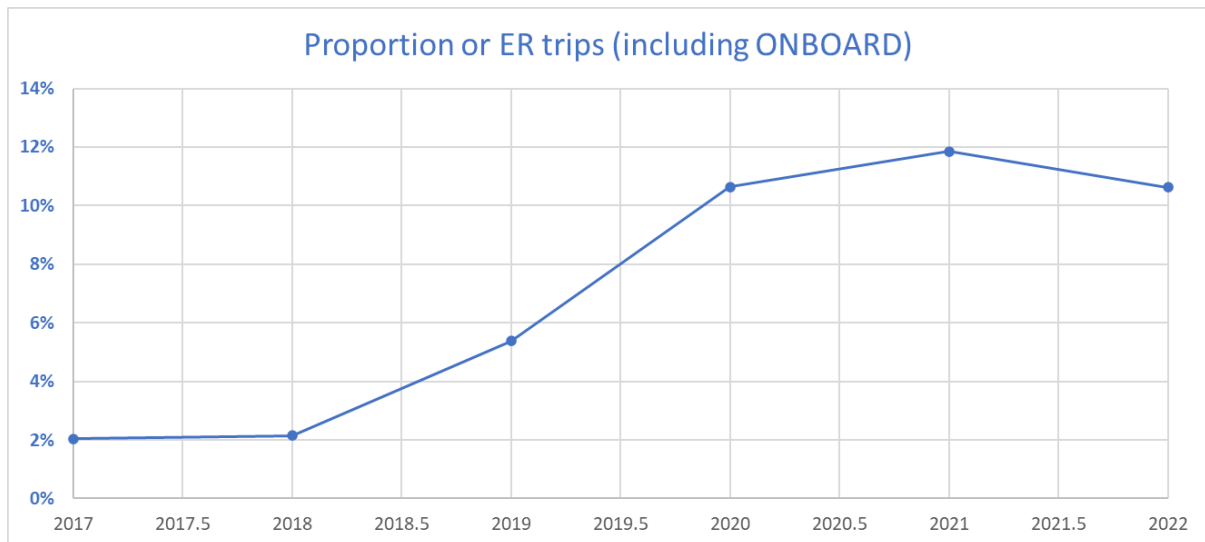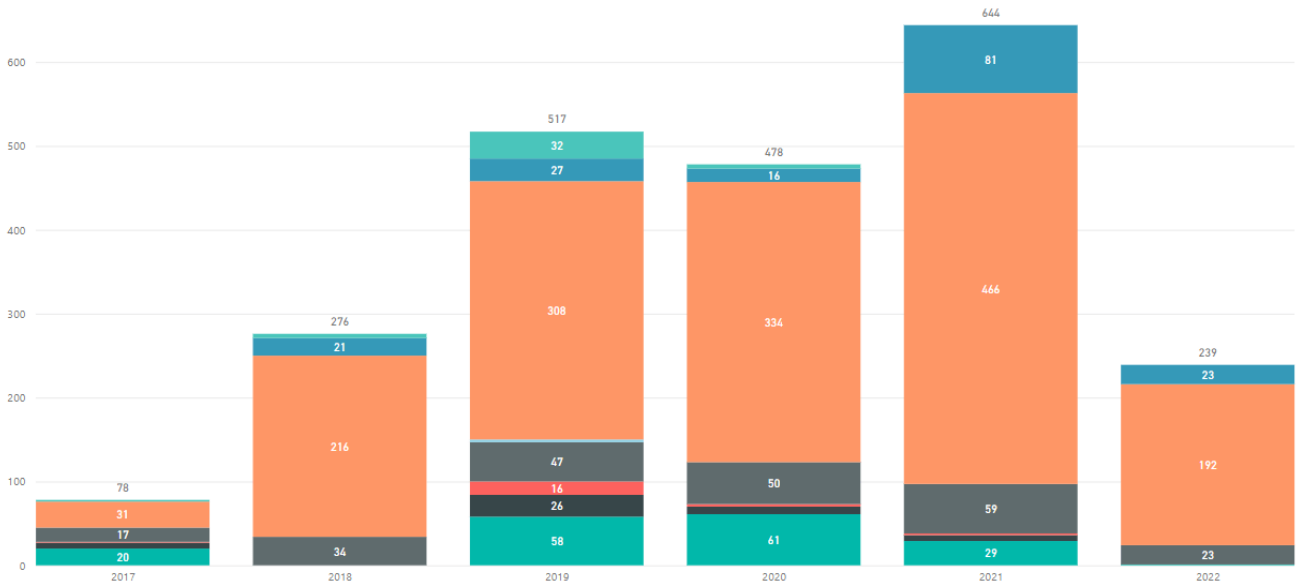
Appendices

SPC/OFP ER data flow
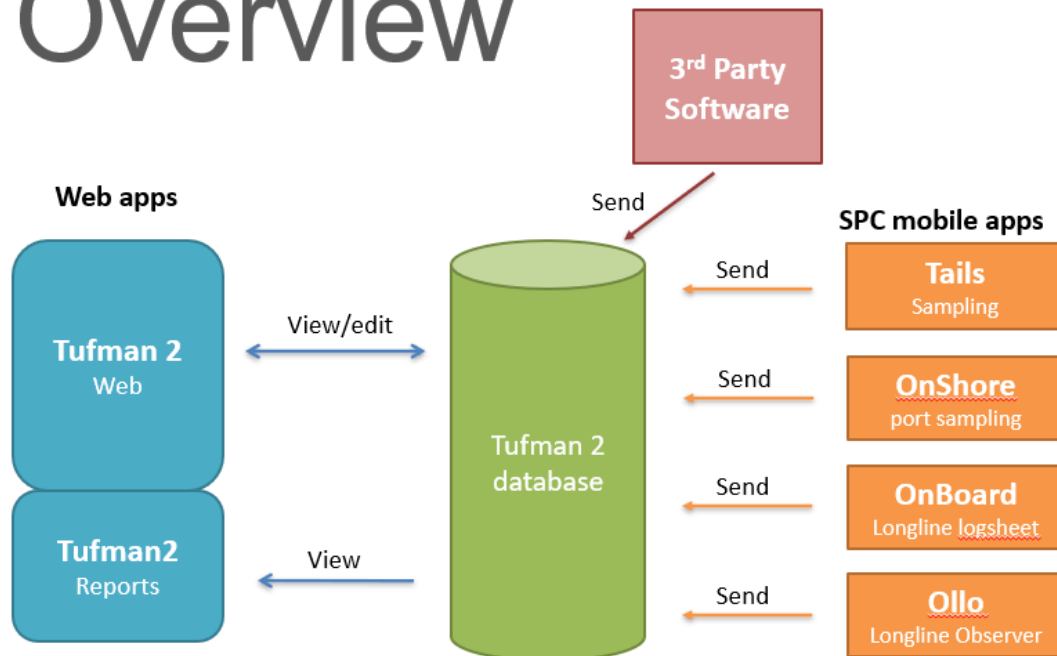
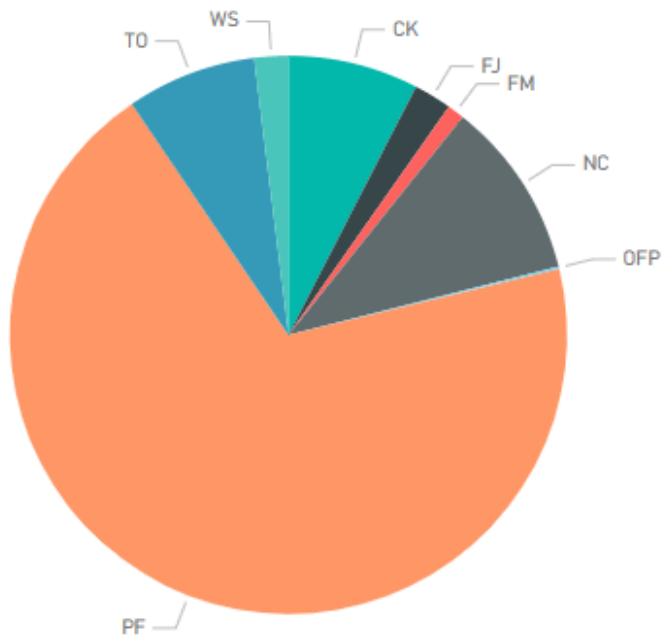*Summary of ONBOARD usage – Longline logsheet trips*

Number of longline ONBOARD trips - by Year and Instance Source
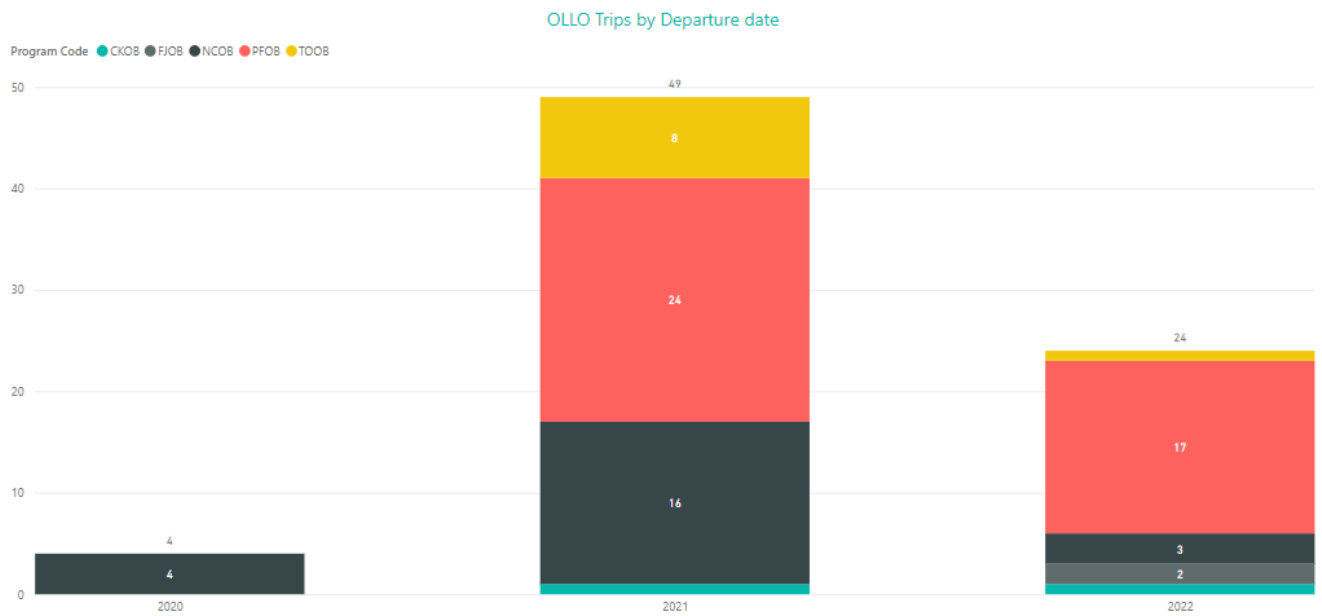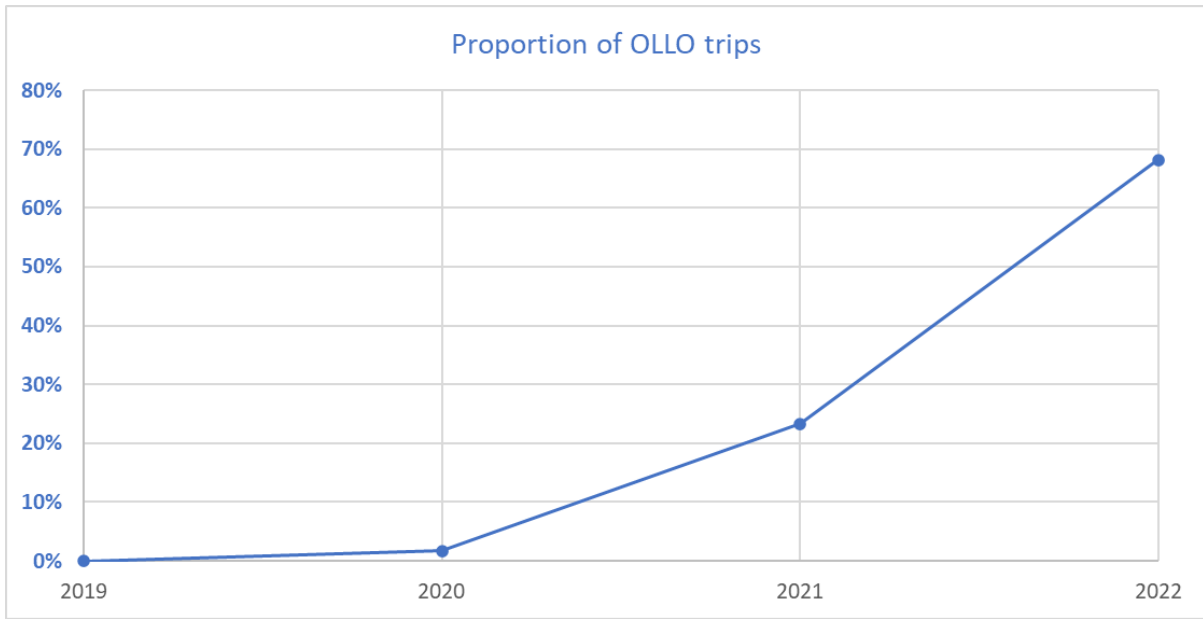
Instance Source ● CK ● FJ ● FM ● NC ● OFP ● PF ● TO ● WS
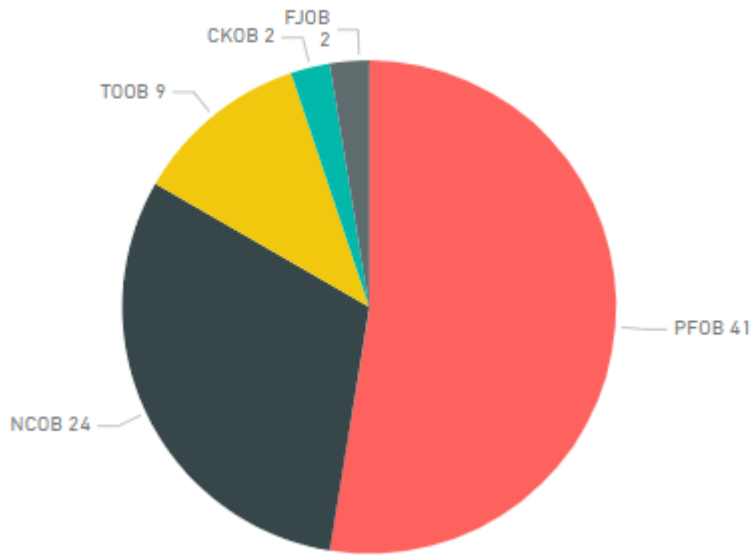

ONBOARD trips proportion - by Instance Source
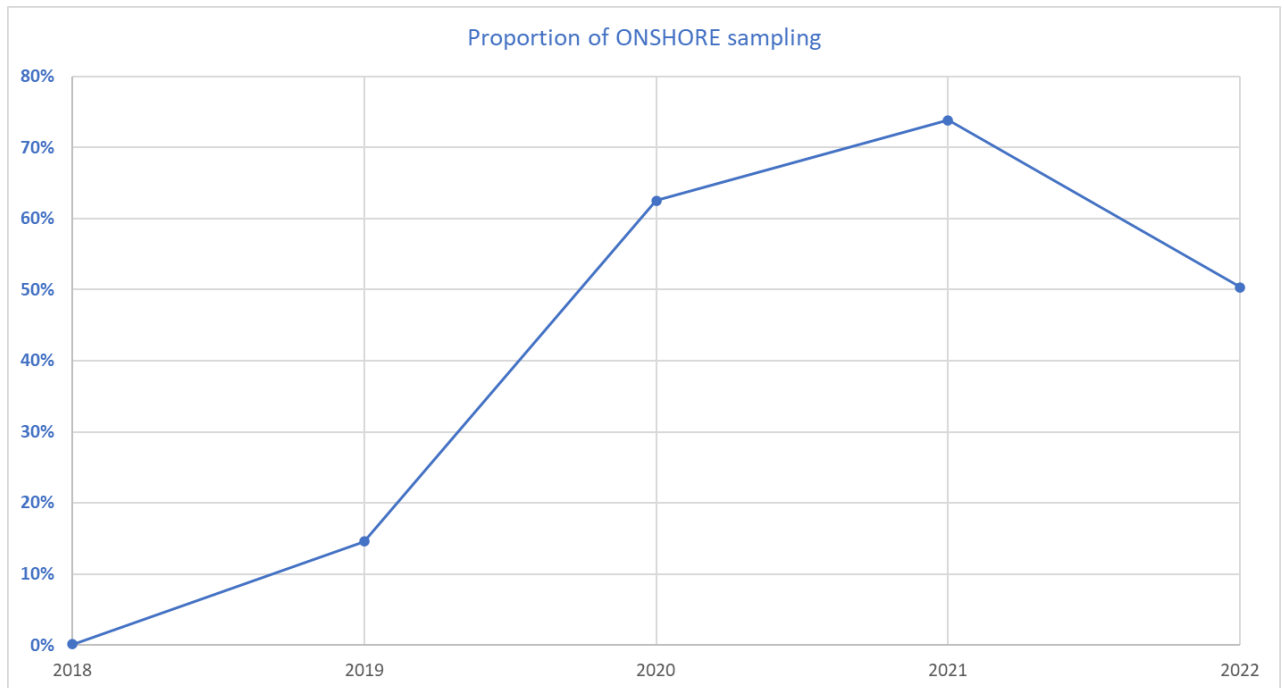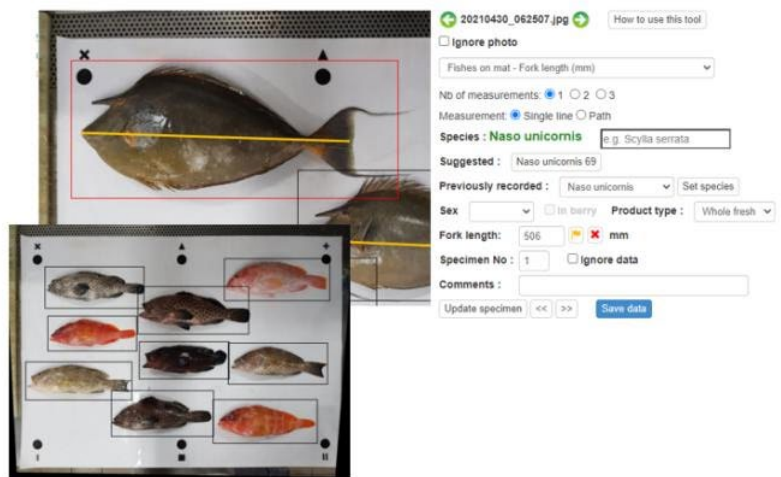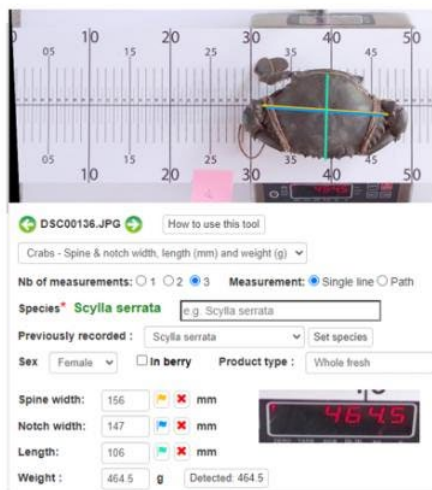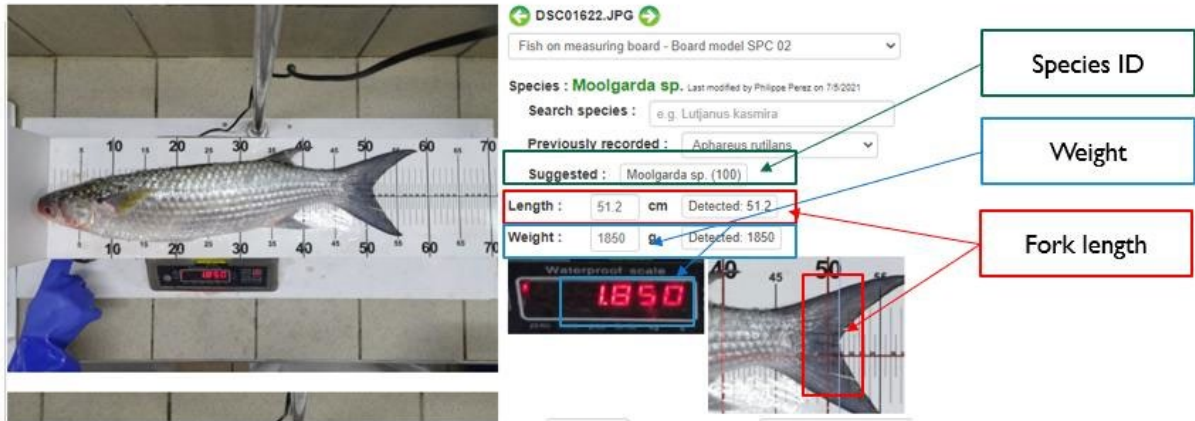
Summary of OLLO usage – Longline observer trips

Proportion of OLLO trips

OLLO Trips by Departure date

OLLO Trips by Programs

Summary of ONSHORE usage – Fish sampling

Proportion of ONSHORE sampling

AI assistance for coastal fisheries catch on measuring board/mat and calibration of pictures

Computer vision/AI is also used to calibrate pictures of measuring board and mat for direct measurements on the picture.