External Expert

Preliminary Report

Review of Oman's data collection system and statistics

Muscat, 10th October 2024

1. Purpose of the document

In the last meeting of the 26th Session of the Working Party on Tropical Tunas Data Preparatory Meeting, Oman reported that "*is internally reviewing its sampling protocol, with adjustments to data from 2014 where catches may have been underestimated"*, in particular, in relation to yellowfin catches, as was included in the Minutes of the Meeting.

During the last months and until now, the Department of Fisheries Statistics and Information of the Ministry of Agriculture, Fisheries and Water Resources, Directorate General of Fisheries Research, (hereinafter, the **"MAFWR"**), has been working on this task with a view to present a full report to the WP of Data Collection and Statistics to take place in Cape Tome by the end of November 2024.

In this respect, an Omani Delegation of the MAFWR travelled to the IOTC headquarters at end of July 2024 and held working sessions with the IOTC Data Officers.

As a next step MAFWR hired the services of an external data expert, Dr Constantine Stamatopoulos, a senior fisheries consultant in fisheries data and statistics (hereinafter, the **"External Expert"**), whose CV is attached. His first terms of reference were to prepare and present a Preliminary Report during the 26th Session of the WPTT to take place in Seychelles (28 October – 2 November 2024).

This document has been prepared by the External Expert with the support of the MAFWR, with a view of presenting **the preliminary results of the on-going review** (which started in August 2024) of Oman's fisheries statistical programme and, in particular, on artisanal fisheries. The review is evaluating the current data collection system to verify its compliance with regional and international standards. It has already evaluated the related Oracle database and the statistical reports resulting from the collected information and data. Based on these findings a catch/effort analysis has been conducted and a retrospective revision of catch/effort figures for 2014-2022 is currently in progress.

2. Background

With an extensive coastline stretching for 3,165 kilometers, Oman is uniquely positioned to capitalize on its marine resources. The fisheries sector stands out as a cornerstone of the Omani economy, not only as an important source of income but also as a cultural mainstay. For many individuals fishing is more than just a livelihood; it represents a way of life and sustains a rich maritime heritage. Consequently, Omani authorities have always shown great interest in sustaining and conserving this activity.

Statistical fisheries data collection in Oman began in 1984, as part of a joint Omani-American committee established during that period to foster cooperation between the two countries. These early statistics laid the foundation for the methodologies **based on a sampling approach** to estimate total fish production by month, region, and fish species, with specific focus on artisanal and coastal fisheries This development involved financial resources, human capabilities, and technical systems for data collection, storage and analysis. Fisheries statistics personnel received specialized training both within Oman and abroad.

Over time, the fisheries statistical monitoring programme underwent multiple stages of development and improvement. At present the programme relies on a **robust infrastructure involving human resources for data collection, processing, and analysis, advanced data collection systems, and well-structured databases**. Additionally, **statistical tools and techniques** have been introduced to assess the current statistical and computational practices and verify statistical results through parallel methodologies. **Automatic diagnostic procedures** have been introduced to provide regular indicators related to data consistency and reliability.

Intensive training programmes have also been implemented, focusing on practical marine statistics to address current needs for accuracy, inspection, and changes. Several of these programs were executed: Athens in July-August 2010, University of Reading in England from May 28 to June 6, 2013, and in the Netherlands.

Oman is witnessing the rise of an emerging industry within the fishing sector. This includes the development of processing and canning factories, which add value to the raw marine products harvested from the sea, and aquaculture projects, which aim to cultivate fish and seafood in a controlled environment, contributing to food security and diversification of marine resources.

In line with these developments, Omani fishermen have become increasingly professional, adopting more sophisticated fishing techniques and practices. There is a concurrent push to modernize the fishing fleet to meet the demands of a growing market and enhance the efficiency of operations. However, Oman is committed to balancing modernization with sustainability. The principle of sustainable fishing activity is paramount, ensuring that marine ecosystems are preserved for future generations while allowing the current population to benefit from the ocean's bounty.

In this transformative period, Oman's approach is to harness the potential of its fisheries sector in a way that is both environmentally responsible and economically viable, aiming to create a legacy that supports both the nation's prosperity and the conservation of its natural resources.

3. Present state of the data collection system

Most of the fleet comprises artisanal vessels (98%), some smaller coastal (1%) and commercial (0.8%) vessels (as per 2015 fleet census). The artisanal vessels are made up of approximately 13,000 skiffs undertaking day trips, and about 600 dhows (9-24m length) undertaking longer trips of 1-10 days.

To date, onboard observer and logbook schemes are in the early stage of implementation. Plans have been made for a stepwise implementation of logbooks for certain fleet segments. At present data collection on artisanal and coastal fisheries is entirely based on sampling. Data for the industrial fleet concerns a few longliners and 3 industrial purse seiners. This information is based on real data from VMS and log-books, including e-logbooks on board the purse seiners.

The port-based sampling system involves **42 data collectors who cover over 156 landing sites**. Data collection records fish species and weights as they are landed and includes first-sale prices, as well as average weight of individuals. An electronic data recording device is used that has an inbuilt catalogue of species to be used for species identification; **this practice is reported to have improved in recent years the detail of information reported**.

Data collection on fishing effort is performed independently by recording the fishing activities of fishermen on the previous day (1 if fished or 0 if otherwise). Occasionally the effort query refers to the total days worked during the reference month.

Sampling operations are conducted according to **well-prepared guidelines and protocols and are supervised effectively.** The quality of landings data submitted to the database is generally good. An important point concerns the trip duration which is missing in some places, on the assumption that it will automatically be set to 1 by the system. This practice can impede the occasional use of trip durations that are shorter than one day.

With regards to effort samples, the quality of data submitted to the database, is also good. However, there is an occasional mix of monthly effort with boat proportions. Such a mix is not arithmetically wrong, but it affects the calculation of accuracy for effort samples.

Given the significant increase in production over the period 2017–2022, as reported to the IOTC, and the high importance of strategic species such as tuna and Indian oil sardine, the Ministry may consider conducting limited census-based data collection for such fisheries. For the other fisheries, it would simplify the effort scheme by generalizing the monthly effort approach; an action that would increase sampling accuracy and decrease data collection costs.

4. The Oracle database

The structure and contents of the database are of good quality. There are some minor problems with the system referentials (tables) where some descriptions are misspelled; in other cases, different codes correspond to the same description (duplication of names). Data integrity and data security are issues that should be paid particular attention; additional backup functions performed locally would reduce the database dependence on the data security services provided by the server team.

With respect to the reliability of effort and catch samples, it is recalled that the Statistics Directorate **has been aiming at a sampling accuracy level of 95%,** This has proved to be a little too ambitious for the size and frequency of sampling operations; nevertheless, the achieved accuracy level of 90% over the period 2017-2022 is quite acceptable and conforms to regional and international standards.

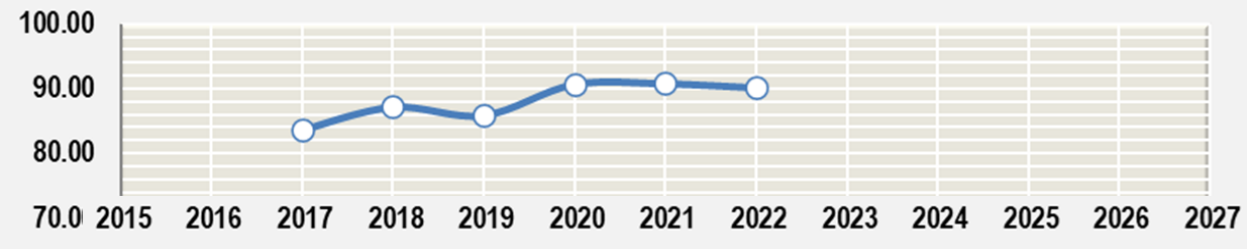

Figure 1. Overall sampling accuracy for 2017-2022.

In examining the Oracle script which estimates fishing effort and catch, the review observed that the estimator uses **an unrestricted extrapolating approach for fishing effort, an approach in which most days of reduced or zero fishing activities, such as weekends, bad weather, holidays, market days, etc., are not excluded from the extrapolation**. With the current effort data scheme in use such an assumption tends to over-estimate fishing effort (and hence production), particularly for fisheries with high catch rates, such as the small pelagic net and beach seine.

To be noted however that the above consideration **only concerns the absolute size of total catch and effort and not the relative differences between the peak years 2020-2021 and the rest**. A more detailed analysis is given in the coming sections.

5. Verification process

The objective of the verification process that is being undertaken by this External Expert is to confirm the compliance of the Oracle estimator with recognized generic approaches for estimating fishing effort and catch. For this purpose, the review made use of the standard FAO utility ArtWeb and of a programmed Excel workbook prepared specifically for the verification exercise. Both tools were parametrized to operate under the same conditions and assumptions built into the Oracle estimator. Verification is still in progress.

The verification exercise was conducted by means of three parallel applications on the same datasets for 2017-2022. As shown in Figure 2 the resulting estimates are almost identical. This fact permitted the utilization of FAO ArtWeb as a versatile instrument for the revision of effort and catch figures, thus facilitating the review process.

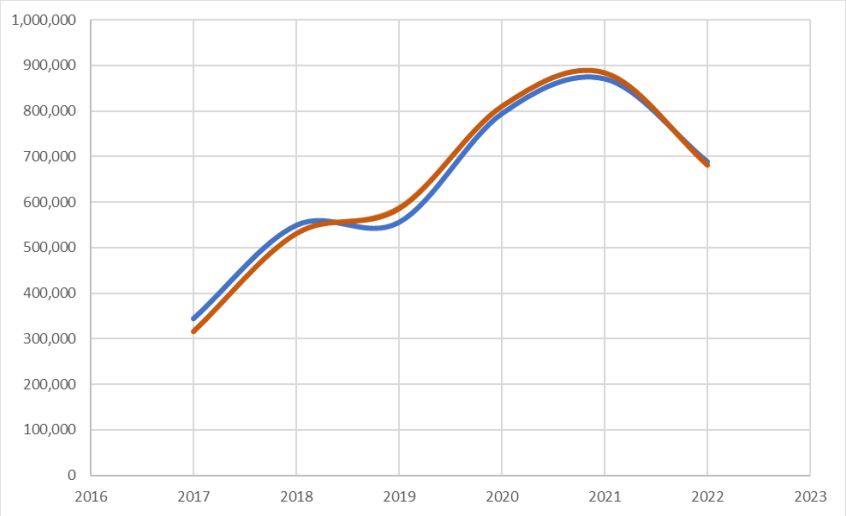

Figure 2. Results of the verification process for 2017-2022. The blue line represents total catch estimates resulting from the Oracle database. The red line represents the results of FAO ArtWeb and Excel.

6. Review of catch/effort estimates for 2017-2022

Total production amounted to around 348,000 Tons in 2017 with an increase of approximately 24% compared to 2016. In 2020 production reached record levels of over 840,000 tons (Figure 2 – blue line), representing a significant 45% increase compared to reported catches of the previous year and continuing a rising trend observed since 2017. These figures were obtained by the original Oracle estimator and verified against the verification utilities FAO ArtWeb and Excel.

Detailed within the overall production are the species catches. Small pelagic such as Indian oil sardine escalated from 82,654 tons in 2015 to 430,243 tons in 2020, with a pronounced 56% increase from 2019. Similarly, yellowfin catches surged from 14,957 tons to 68,815 tons in the same timeframe, marking an 86% jump from the preceding year.

There is a clear increase in the production figures for 2020 and 2021 which raises the following two basic questions:

(a) Whether the relative differences between 2020-201 and the rest of annual productions are indeed real and could be explained statistically.
(b) Whether the absolute figures for 2017-2022 could be revised and still maintain the relative differences mentioned above.

Concerning point (a) the review only made use of factors that stem from the statistical system itself and do not constitute assumptions. In other words, the review did not consider other possible factors affecting production, such as increased abundance, new markets, decreased fishing pressure in neighbouring waters, etc.

The first statistical factor related to point (a) concerns intensified fishing activities, i.e. more boats out fishing, while the number of boats is unaltered. This is shown in Figure 3.

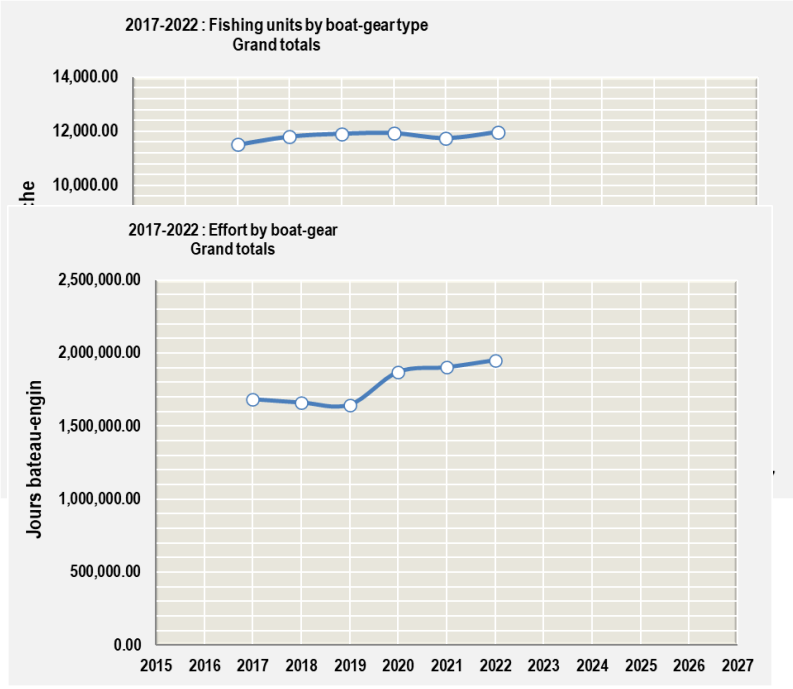

Figure 3. The upper plot shows the mobilization of fishing vessels during 2017-2022, which is about constant. The lower plot clearly highlights the intensification of fishing activities over 2020-2022.

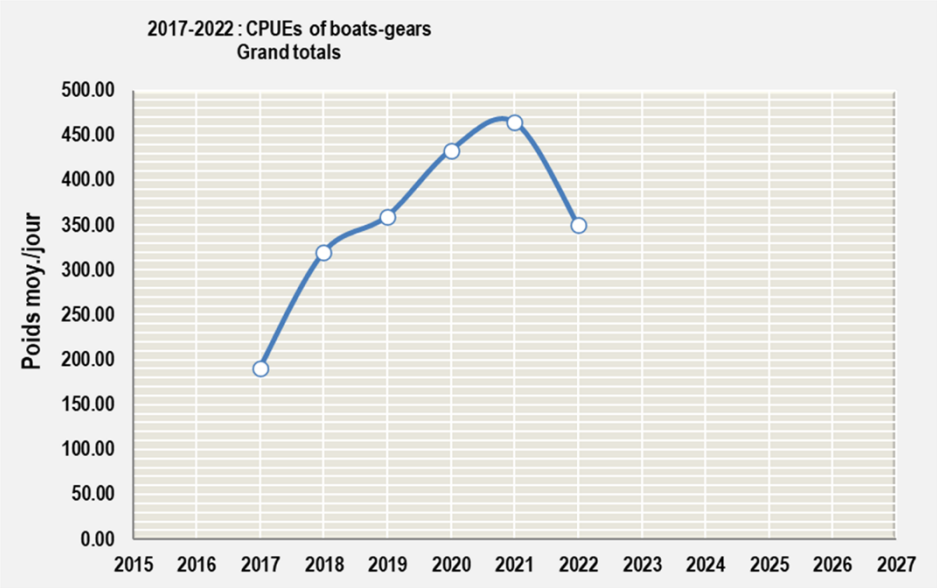

Figure 4. Overall catch rates (all boats-gears and species) for 2017-2022. The plot shows a clear increase over 2020-2021.

The second factor related to point (a) concerns higher catch rates. Field agents have reported that during the peak years daily trips lasted longer, thus increasing the daily yields. Figure 4 illustrates this fact. To be sure there may exist other external factors that have contributed to the higher catch rates in 2020 and 2021. One example is the period of the COVID crisis during which the government allowed the fishery sector to continue operating while other sectors were totally closed (such as construction). This action brought more fishermen at sea.

With regards to point (b) that concerns the absolute figures for 2017-2022 it should be recalled that the Oracle system uses an estimation approach for fishing effort in which little importance is given to days of reduced or zero fishing activities, such as weekends, bad weather, holidays, etc. With the effort data collection scheme currently in use (in which only two days of zero activity are accounted for), this unrestricted approach generally over-estimates fishing effort and hence production.

A more conservative approach is to estimate fishing effort on the basis of empirical knowledge regarding days of reduced or zero fishing activity. The on-going review suggests a more realistic effort estimation that reduces extrapolation not by two but but by ten days. Fishing effort and catch for all regions, boat-gear types and species would thus show lower results, as shown schematically in Figure 5 (right part of the plot).

For the years before 2017 a retrospective revision would follow a mixed pattern.

The first (negative) pattern corresponds to the conservative effort estimation described earlier.

But here there are also two positive (upward) factors to consider.

The first concerns hindsight knowledge regarding the fishing fleet. A first adjustment would increase the number of fishing units, thus revising positively fishing effort and production.

The second factor (also positive) is due to statistical gaps that existed in the early operational steps of the present system, **when certain regions and/or boats-gears were not covered appropriately**.

This mixed approach, in which the prevailing factor is positive (green arrow), is shown schematically in Figure 5 (left part of the plot).

Figures for 2017 are expected to be unaltered.

More details will be provided in the Final Report to be presented to the forthcoming session of the WPDCS to take place next month in Cape Town, South Africa.

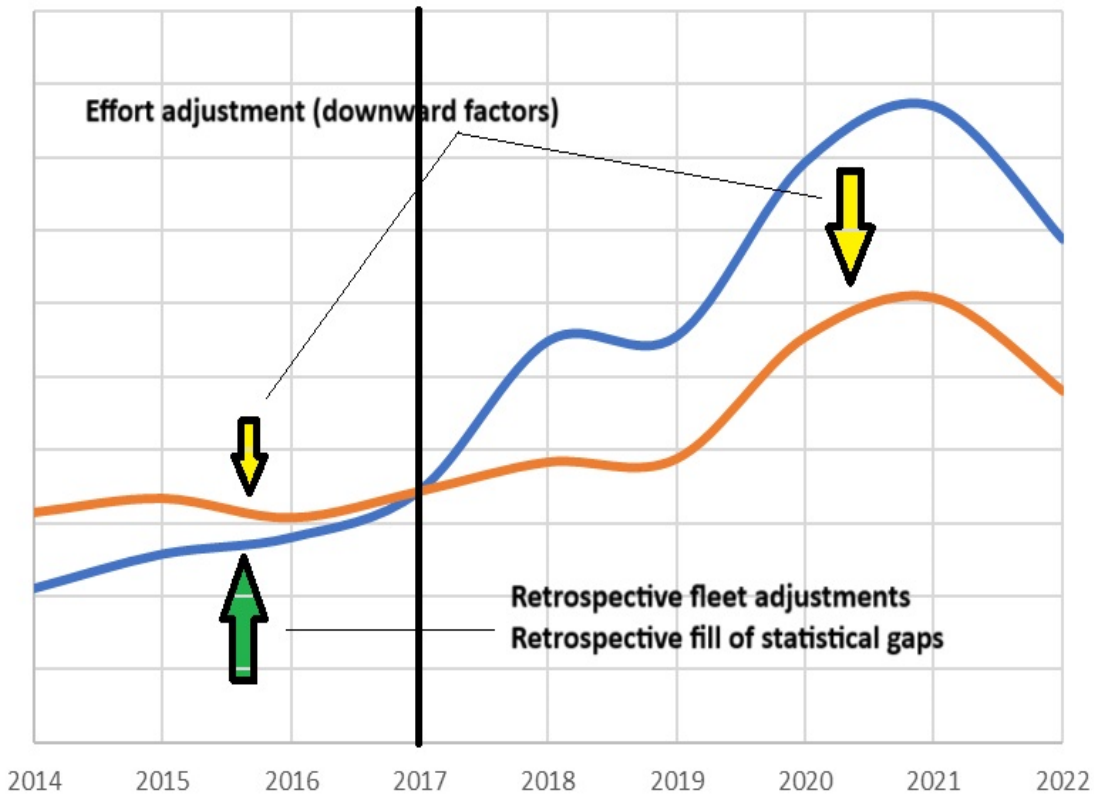

Figure 5. Retrospective revision of production figures using different adjustment factors.

Explaining the peak years 2019-2021 requires caution. At this time, it is not certain that the atypical high figures are indeed part of a trend or are circumstantial and not likely to be repeated. Estimates

for 2022 and early monthly figures for 2023 suggest, in fact, a return to more moderate trends in effort and production.

This Preliminary Report relates specifically to data collection and statistics on the artisanal and coastal system in Oman. In addition to re-estimated total catches of these fisheries, the Final Report will also include real catches declared by the industrial fleet in recent years that are based on log-book declarations.

7. Some facts from figures

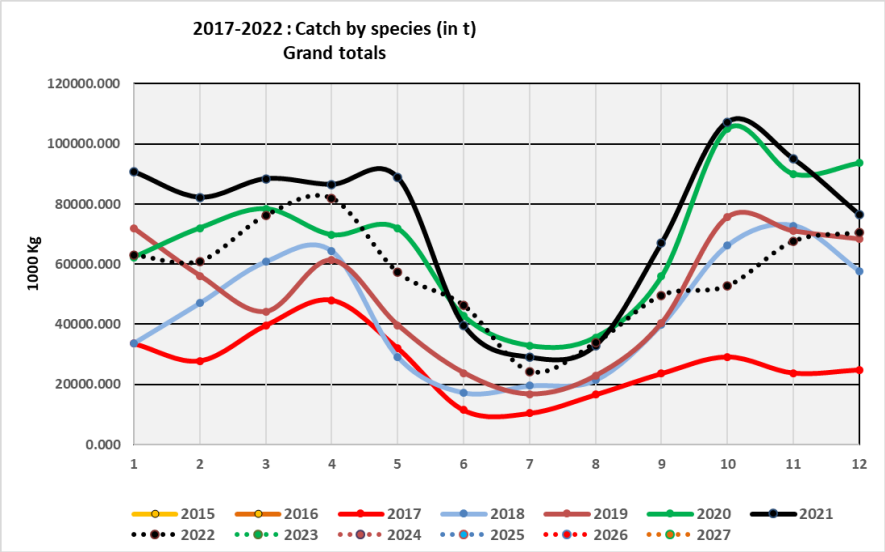

Figure 6. Monthly fluctuations are U-shaped with low values in June-July and high values in January-May and October-December.

2017-2022 Totals over all years : Ranking and cumulative percentages			
FG(Small Pelagic Net)	1,197,845	31.4 %	**31.4 %**
FG(HL+TL)	867,744	22.7 %	**54.1 %**
FG(NET)	848,428	22.2 %	**76.3 %**
Beach Seine	309,578	8.1 %	**84.4 %**
Launch(Net)	237,487	6.2 %	**90.6 %**
FG(FT)	155,258	4.1 %	**94.7 %**
FG(CN)	121,983	3.2 %	**97.8 %**
FG(CuttleFish+Squid)	49,146	1.3 %	**99.1 %**
Launch(HL+TL)	13,253	0.3 %	**99.5 %**
Launch(FT)	7,018	0.2 %	**99.7 %**
FG(Shrimps-Trowler)	5,652	0.1 %	**99.8 %**
FG(Lobster)	4,485	0.1 %	**99.9 %**
Launch(Beach Seine)	2,641	0.1 %	**100.0 %**

Figure 7. Predominant fishing unit is the small pelagic net (31.4% of total production). Four boat-gear types account for about 85% of the production: Small pelagic net, handline and trawl, nets and, beach seine.

2017-2022 Totals over all years : Ranking and cumulative percentages			
Al-Wusta Governorate	1,962,950	51.4 %	**51.4 %**
Al Sharqiyah South Governorate	706,830	18.5 %	**69.9 %**
Al Batinah North & South Governorate	430,993	11.3 %	**81.2 %**
Dhofar Governorate	410,329	10.7 %	**91.9 %**
Musandam Governorate	207,552	5.4 %	**97.3 %**
Muscat Governorate	101,863	2.7 %	**100.0 %**

Figure 8. Al Wusta is by far the most productive region. It alone accounts for more than 50% of the national production.

Muscat, 10th October 2024