SCRS/2014/192 Collect. Vol. Sci. Pap. ICCAT, 71(1): 592-596 (2015)

T3+: A TOOL FOR PROCESSING AND MANAGING GHANAIAN INDUSTRIAL TUNA FISHERIES DATA

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SUMMARY

This document present a work plan to improve the monitoring of Ghanaian fisheries through the development of specific software to: (i) facilitate the description of fisheries data collected by MFRD through easy extraction and visualisation of raw data, including size samples, (ii) extend the criteria used for the post-stratification of size-frequency samples, and (iii) develop an export tool that facilitates the provision of Task I and II processed data to the ICCAT secretariat. This work plan is included in the overall plan for improving the Ghanaian Task II statistics adopted by the SCRS in 2011.

RÉSUMÉ

Ce document présente un plan de travail pour améliorer la surveillance des pêcheries ghanéennes à travers le développement d'un logiciel spécifique pour: (i) faciliter la description des données des pêcheries recueillies par MFRD grâce à la simple extraction et visualisation des données brutes, y compris les échantillons de taille, (ii) élargir les critères utilisés pour la stratification a posteriori des échantillons de fréquence des tailles et (iii) élaborer un outil d'exportation qui facilite la transmission au Secrétariat de l'ICCAT des données traitées de la Tâche I et de la Tâche II. Ce plan de travail est inclus dans le plan d'ensemble visant à améliorer les statistiques ghanéennes de la Tâche II adoptées par le SCRS en 2011.

RESUMEN

Este documento presenta un plan de trabajo para mejorar el seguimiento de las pesquerías de Ghana mediante el desarrollo de un software específico para: (i) facilitar la descripción de los datos pesqueros recopilados por el MFRD mediante una fácil extracción y visualización de los datos brutos, incluidas las muestras de talla, (ii) ampliar los criterios utilizados para la estratificación posterior de las muestras de frecuencias de tallas y (iii) desarrollar una herramienta de exportación que facilite la presentación de los datos procesados de Tarea I y Tarea II a la Secretaría de ICCAT. Este plan de trabajo se incluye en el plan global para mejorar las estadísticas de Ghana de Tarea II adoptado por el SCRS en 2011.

KEYWORDS

Baitboat, Purse seining, FAD, Bigeye, Skipjack, Yellowfin

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1. Introduction

The estimation of the total catch (Task I) and monthly spatially-aggregated catch, effort, and size data (Task II) for the Ghana baitboat (BB) and purse seine (PS) tuna fisheries has been difficult since the early 1990s because of the general lack of information available on fishing activities and some issues in sampling of landings at port (Kebe 2011, Palma *et al.* 2012). Until very recently, only information on total monthly landings was available for some major segments of the Ghana PS fleet which prevented the reallocation of catch and effort in space (Chassot *et al.* 2013a). In addition, the general absence of plans of the brine-freezing tanks, which describe where the catch is stored within a vessel, prevents to know the characteristics of origin (date, location, fishing mode, set weight and composition) of the size-frequency samples collected in Tema (Ghana) and Abidjan (Ivory Coast). Finally, the frequent collaboration between Ghanaian BB and PS vessels that results in the sharing of the catch at sea was until very recently not entered in the MFRD database. This adds some complexity to the data collection and processing as it blurs the relationship between catch and landings at the scale of the vessel trip and it can affect the linkage between the samples collected at port and their set(s) of origin.

The current collection and processing of European PS and BB fisheries data is based on tools and softwares that aim to control and manage the datasets collected from different sources so as to estimate the Tasks I and II required by ICCAT. Here, we describe the main specificities and current limitations of the Ghanaian tuna industrial fisheries data that call for some adaptation of the tools used for processing and managing PS and BB data. To improve the monitoring of Ghanaian fisheries, we propose some computer developments that have 3 main objectives: (i) facilitating the description of fisheries data collected by MFRD through easy extraction and visualisation of raw data, including size samples, (ii) extending the criteria used for the post-stratification of size-frequency samples, and (iii) developing an export tool that facilitates the provision of Task I and II processed data to the ICCAT Secretariat.

2. Key features of Ghanaian tuna fisheries data

2.1 Collection and management of 'raw' fisheries data

The collection and management of raw data for the Ghanaian PS and BB fisheries is currently based on the AVDTH ('Acquisition et Validation des Données de Pêche au Thon Tropical') software that was developed by IRD in the mid-1990s (Lechauve 1999). AVDTH is maintained by the team of the 'Observatoire Thonier' of IRD and recent developments include the extension of the logbooks to activities related to fish aggregating devices (FADs) and GPS buoys (e.g. buoy transfer, FAD deployment, etc.) as well as a specific module dedicated to the collection of landings destined to the local markets.

AVDTH is currently in use for the monitoring of the EU PS and BB fisheries coordinated by the IRD and IEO (Instituto Español de Oceanografia), the Senegalese BB fishery by the CRODT (Centre de Recherches Océanographiques de Dakar-Thiaroye), the CRO of Côte d'Ivoire (Centre de Recherches Océanologiques), the Seychelles PS fishery by the SFA (Seychelles Fishing Authority), the Malagasy Unité Statistiques Thonières d'Antsiranana (USTA) and the Mauritian PS fishery by AFRC (Albion Fisheries Research Centre). AVDTH is a standalone application which connects to an MS Access database. The database contains at first the reference data, and is filled with the data of interest thanks to the application. The datasets are composed of (i) daily fishing activities and catches as recorded in logbooks, (ii) landing reports recorded on a trip basis at unloading or transhipment of the principal market tunas by commercial category(iii) the size-frequency histograms collected at unloading, and (iv) landings destined to the local markets on a trip basis. The software has been used by MFRD since the mid-2000s and the AVDTH database includes data for the period 2006-2013, with very few data available in 2007 (Chassot *et al.* 2013a). The database reference tables have been recently extended to include activities of collaboration at sea between BB and PS and the reference table for the vessels is now common and shared between IRD and MFRD (Chassot *et al.* 2013b). Finally, data collected at Abidjan by IRD/IEO/CRO team on the landings of tuna to canneries or on the local market of Abidjan by Ghanaian vessels are now provided to MFRD on a regular basis.

2.2 Specificities of the Ghanaian fisheries data

The major issue with Ghanaian industrial tuna fisheries data results in the level of data availability and quality that is highly variable between years and fishing companies (Fonteneau *et al.* 2013, Chassot *et al.* 2013a). Data collected in the past were characterized by incomplete logbooks and landing reports, including transhipments at sea and landings on local markets that can be important for some vessels or fishing trips and are generally difficult to monitor. Improvements in the information available to MFRD have been recently noticed, in particular for the PANOFI fleet that has been better monitored since 2012. The second issue concerns the active collaboration between BB and PS that results in the sharing of catch at-sea, with varying proportions of the share (Chassot *et al.* 2013b). The reporting of such catch sharing in the database is critical to distinguish between BB and PS catches and landings as well as to identify the gear of origin of the catch when samples are conducted at port. Processing schemes proposed for the Ghanaian industrial fisheries data currently rely on samples collected from PS fisheries on FADs (Chassot *et al.* 2013a, Chassot *et al.* 2014) while the species and size composition of the catch might significantly differ between PS and BB as observed in Senegalese waters. In particular, information on the fishing mode recorded in logbooks has improved over time and recent data indicate that a substantial part of Ghanaian BB fishing sets is made on free-swimming schools. Finally, the general absence or poor quality of the plans of brine-freezing tanks available for Ghanaian BB and PS vessels currently prevents establishing the linkage between the size and species composition estimated from fish collected in the tanks and their sets of origin. Such information is however crucial to know the characteristics of the schools of origin of the fish, i.e. location, date, fishing mode, and set biomass that is used for weighing the different samples.

3. Processing Ghanaian fisheries data

T3+ is a PostgreSQL/PostGIS database coupled with SQL/JAVA codes that is currently in development (Cauquil 2012a) and aims to replace the suite of Fortran algorithms used to process BB and PS fisheries data since the late 1990s (Pallarés and Hallier 1997). A strong advantage of T3+ is to combine both raw and processed data in a same database, which facilitates the comparison of input and output data and intermediate results obtained through the successive processing steps. Another interest of the tool is to ensure that historical assumptions and methods used to process the data are stored in the database through specific configurations so that the processing is transparent and repeatable. It is also useful to assess the sensitivity of the results to some parameters such as length-weight relationships or some sample selection criteria. T3+ enables to mutualise size-samples collected from different fisheries of the Atlantic that can be anonymised (i.e. vessel codes and names removed) for confidentiality reasons. In addition to local version(s) installed at MFRD, a version of T3+ could be deployed on an ICCAT server so as to maintain a centralised database with controlled access.

The following sections describe some computer developments that would add several features to T3+ so as to facilitate the description, processing, and extraction of both the raw and processed data and eventually improve the overall monitoring of PS and BB fisheries.

3.1 Fishery activity and sampling data description and visualization

After data importation from AVDTH, a list of indicators and different metrics describing the fishing fleet capacity, activities and fisheries production could be defined in collaboration with MFRD and the ICCAT Secretariat. For instance, synthetic tables describing the active vessels, trips and fishing sets according to temporal (month, quarter, year), spatial (spatial layers), and technical factors (gear, fishing mode, fleet, vessel size) could be displayed. Similarly, graphical displays giving the cumulated catch and landings by species, landings by commercial category, nominal effort in days-at-sea and fishing days could be accessible through an interface. Also, different statistics and graphics could be defined to provide the main characteristics and attributes of the size samples available in the database (e.g. number of samples, average size by species in the sample, number of fish measured by species, average species composition, etc.).

In order to compare and reconcile the different data sources available, some metrics such as the ratio between catches and landings could be computed on a trip basis and graphs could be plotted to compare the different vessels or a specific vessel in time so as to identify possible outliers. Raising factors between catches and landing data on local market could be computed to assess the quality of the data while threshold values could be set so as to indicate values that are potentially not consistent.

Because Ghanaian fishing fleets or companies can typically characterize a certain level of data quality and availability, the definition of a group of vessels could be defined through boat codes or names. This would enable to compute the indicators for each vessel group and potentially conduct a specific data processing procedure according to the group (e.g. PANOFI).

Overall, all associated SQL queries and R codes used to compute the indicators would be available to the user while output tables could be retrieved in .csv and .xls formats so that they can be post-processed and included in any publications and report.

3.2 Post-stratification of size-samples and ancillary data

The selection of samples could be done through an interface that would propose the technical factors describing the samples (gear, fleet, vessel group, fishing mode), a time frame, and a list of spatial layers (e..g. current sampling strata used for the EU PS fishery). In addition, it would be possible to construct its own spatial strata (e.g. Geoserver and Openlayers). Summary statistics tables and graphics of the output of the processing (e.g. average species composition on each stratum, etc.) would enable assessing the main results obtained through the processing and assess the sensitivity of the results to a change in stratification.

3.3 Provision of data to ICCAT

All results from data processing could be extracted from the T3 database through an export module that would enable to format the data outputs (i.e. tasks I and II) following the data format of the ICCAT database. On one side, .csv or .xls files could be available to the user for easy management and inclusion into reports. On the other side, outputs could follow XML formats that could be built through close collaboration with the ICCAT secretariat. This would strongly facilitate the provision of data to ICCAT and their inclusion into the ICCAT information system.

Development plan and budget

The WP1 - Fishery activity and sampling data description and visualization - will be developed as an R software. It will perform as independent software, as well as integrated to the t3+ main interface. This task is estimated to 2 months for an R developer.

The WP2 - Post-stratification of size-samples and ancillary data - consists of improvements in the existing software and that will be performed by the company which developed it. This task is estimated to 2 months.

The WP3 - Provision of data to ICCAT, can be integrated to the existing software or developed as an R independent module. This task is estimated to 1 month.

Work package	*Contribution type*	*Details*	*Budget (€)*
WP1 - Fishery activity and sampling data description and visualization	R developer managed by IRD	2 months	8.000
WP2 - Post-stratification of size-samples and ancillary data	Software development company	2 months	18.000
WP3 - Provision of data to ICCAT	R developer managed by IRD	1 month	4.000
Missions and hardware		1 mission from IRD to Ghana, 1 mission from Ghanaian to IRD, 1 computer	5.000
IRD management fees		10% of total	3.500
Total			38.500

Acknowledgments

This paper is a contribution to the ICCAT-MFRD-IRD project aimed at strengthening the Ghanaian industrial purse seine fishery monitoring in the Gulf of Guinea (Bannerman *et al.*, 2012).

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