Evaluation of the potential impact of catch underreporting on yellowfin stock assessment using exploratory scenarios of catch history

Gorka Merino[1], Dan Fu[2], James Geehan[2], Agurtzane Urtizberea[1], Josu Santiago[3], Hilario Murua[4]

[1]AZTI, Herrera Kaia - Portualdea,z/g, E-20110 Pasaia – Gipuzkoa, Spain

[2]IOTC Secretariat,

[3]AZTI, Txatxarramendi uhartea, E-48395 Sukarrieta – Bizkaia, Spain

[4]ISSF, International Seafood Sustainability Foundation, Washington DC (USA)

Emails:

gmerino@azti.es

Dan.Fu@fao.org

James.Geehan@fao.org

aurtizberea@azti.es

jsantiago@azti.es

hmurua@iss-foundation.org

Abstract

In 2018, a new stock assessment was carried out for yellowfin in the IOTC area. The uncertainty on nominal catches among others, recommended to avoid catch limits recommendation and the development of a workplan to address these uncertainties. One of the objectives of the workplan is to address the potential impact of the uncertainty on catches by exploring alternative scenarios of catch histories for yellowfin. In this study, we carried out a relatively simple exploratory analysis of the potential impact of underreporting of artisanal fisheries. We generated three scenarios of underreporting and re-run the stock assessment model. Our results suggest that the uncertainty in the catch information used in the stock assessment does not produce a noticeable impact on the estimates of stock status. Our results do suggest that changes in catch scenarios produce changes in the estimated productivity of the stock.

Introduction

In 2018, a new stock assessment was carried out for yellowfin in the IOTC area using Stock Synthesis III (SS3), a fully integrated model that is used for the three tropical tuna stocks in the IOTC (bigeye, yellowfin and skipjack). In 2018, the results of 24 scenarios were used to advice

IOTC Commission on yellowfin stock status, which was considered overfished and subject to overfishing. However, the lack of understanding of stock dynamics due to various uncertainties, including uncertainty on nominal catches, led the IOTC's Scientific Committee (SC) to avoid providing catch limits advice and to develop a workplan to address these uncertainties in 2019 (IOTC, 2018b). One of the items of this workplan is to explore scenarios of alternative time series/catch histories for yellowfin.

Nominal catches are the total annual retained catches (in live weight and number), estimated per fleet, IOTC area, gear and year for a large area. Catch data is submitted by IOTC's Contracting and Cooperating Non-Contracting Party (CPC) to the IOTC Secretariat. If these data are not reported adequately, the Secretariat estimates a total catch from a range of sources (including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; and data reported by parties on the activity of vessels under their flag (IOTC Resolution 10/08; IOTC Resolution 12/05) or other flags (IOTC Resolution 14/05; IOTC Resolution 05/03); data on imports of bigeye tuna from vessels under the flag concerned (IOTC Resolution 01/06); and data on imports of tropical tunas from canning factories collaborating with the International Seafood Sustainability Foundation (IOTC, 2018c). Therefore, the catch data that is used in stock assessments in certain proportions is estimated by the Secretariat.

In the case of yellowfin, in recent years catches have been evenly split between industrial and artisanal fisheries. Purse seiners (free and associated schools) and longline fisheries still account for around 50% of total catches, while catches from artisanal gears – namely handline, gillnet, and pole-and-line – have steadily increased since the 1980s. Contrary to other oceans, the artisanal fishery component of yellowfin catches in the Indian Ocean are substantial, accounting for catches of over 200,000 t per annum since 2012. Moreover, the proportion of yellowfin catches from artisanal fisheries has increased from around 30% in 2000 to nearly 50% in recent years (IOTC, 2018c).

Overall, the IOTC Secretariat considers that nominal catches are generally well known for the major industrial fisheries catching yellowfin (European and Asian purse seine and longline fleets), with the proportion of catches estimated, or adjusted, by the IOTC Secretariat relatively low. However, for the case of artisanal fleets the story is very different (IOTC, 2018c). For example, many coastal fisheries catches are very uncertain (IOTC, 2018c). The IOTC has identified the amount of the nominal catch data that is *poor* or *very poor* (Figure 1).

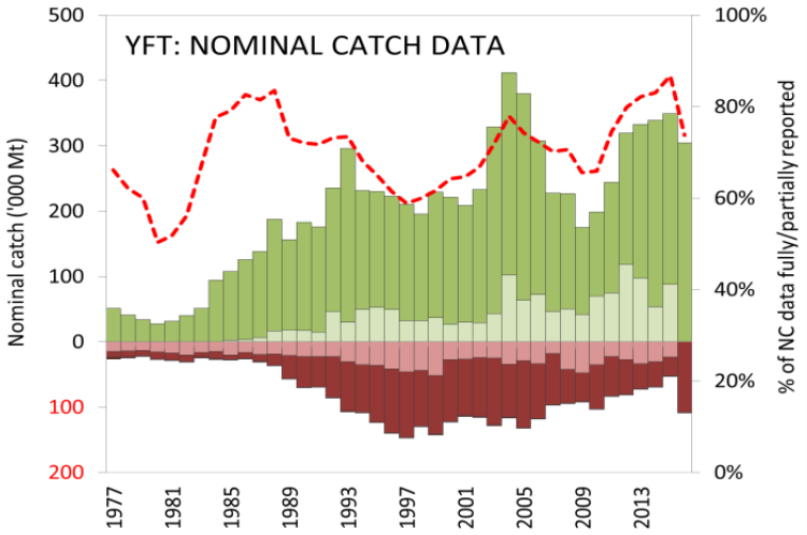


Figure 1. Amount of good (green), fair (light green), poor (light brown) or very poor (brown) data in the total yellowfin nominal catch in the period 1977-2018. Red dashed line is the percentage of fully to partially reported nominal catch data.

In yellowfin (and other stocks), nominal catch data are used as input for stock assessment models and they are generally used as if they were perfectly reported and known. This means that the potential uncertainties in these data are not explored and therefore, the impact of potential misreporting is ignored. Today, there is a large uncertainty in some countries yellowfin catch and this can propagate into stock assessment (Sharma, 2018). Issues of uncertainty in unreported catches is problematic and alternative catch series could be examined to explore their potential impact (Sharma, 2018).

Material and methods

We carried out a relatively simple exploratory analysis of the potential impact of underreporting of artisanal fisheries. We used a range of exploratory values for inflating the catch that is considered *poor* and *very poor* to all artisanal gears. We created three scenarios of catch by increasing the catch considered *poor* and *very poor* across the nominal catch series used in the stock assessment of yellowfin. We do this to create exploratory scenarios for evaluating the potential impact of misreporting on the Reference Case of the 2018 assessment of yellowfin.

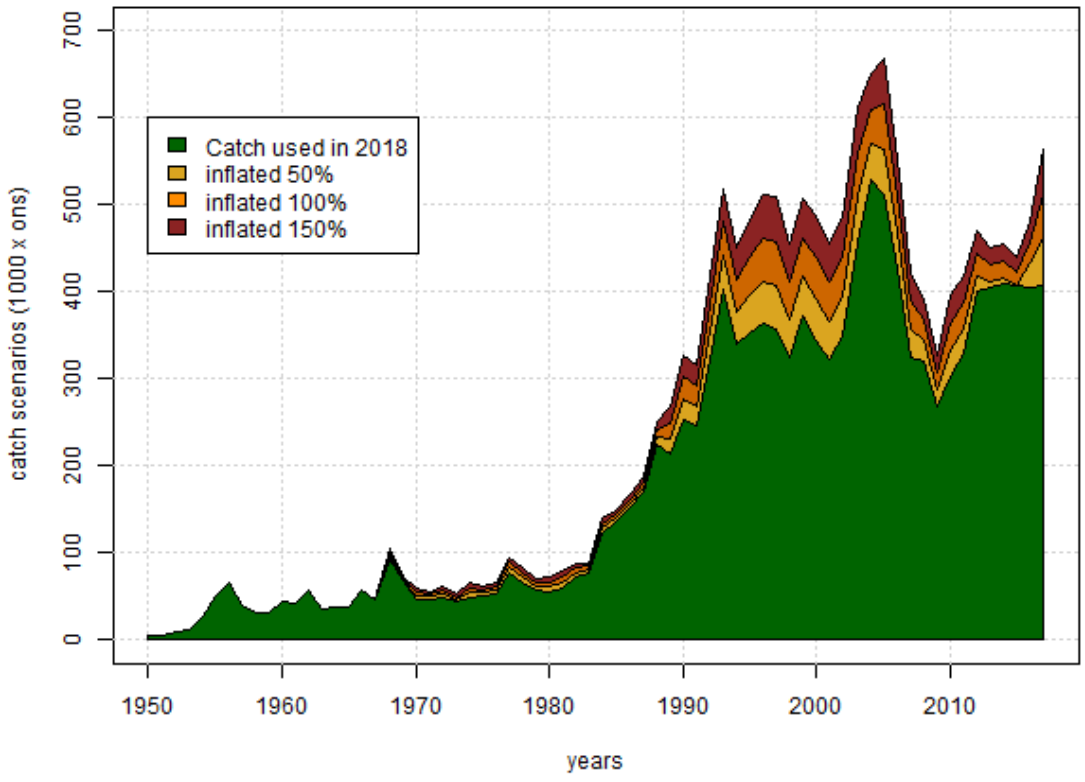


Figure 2. Catch scenarios including total catch used in 2018, and poor and very poor nominal catch inflated at different levels (50%, 100% and 150%).

Details of the Reference Case of the 2018 assessment can be found in the report of the 20th Working Party of Tropical Tunas (IOTC, 2018a). The 2018 stock assessment was carried out using SS3 which uses catch data, length frequency data, abundance indices and tagging information. In order to generate catch reporting scenarios, one of the SS3 input files (*data.ss*) was modified. This file contains (among other information), one catch record with a date field per fishery (Methot Jr, 2013). These catch records were increased for artisanal fleets (gears other than longline and purse seine) to account for the potentially unreported catch. The stock assessment model was run with the new input files and outputs compared with special attention to estimated time series and stock productivity (estimated Maximum Sustainable Yield (MSY)).

Results

Figure 3 shows the estimated trajectories of biomass and fishing mortality relative to their MSY coordinates (B_{MSY} and F_{MSY}). This Figure suggests that the different catch scenarios generated do not have a notable impact on the result of the stock assessment in relation to current stock status.

Figure 3. Estimated trends for total biomass and fishing mortality relative to MSY.

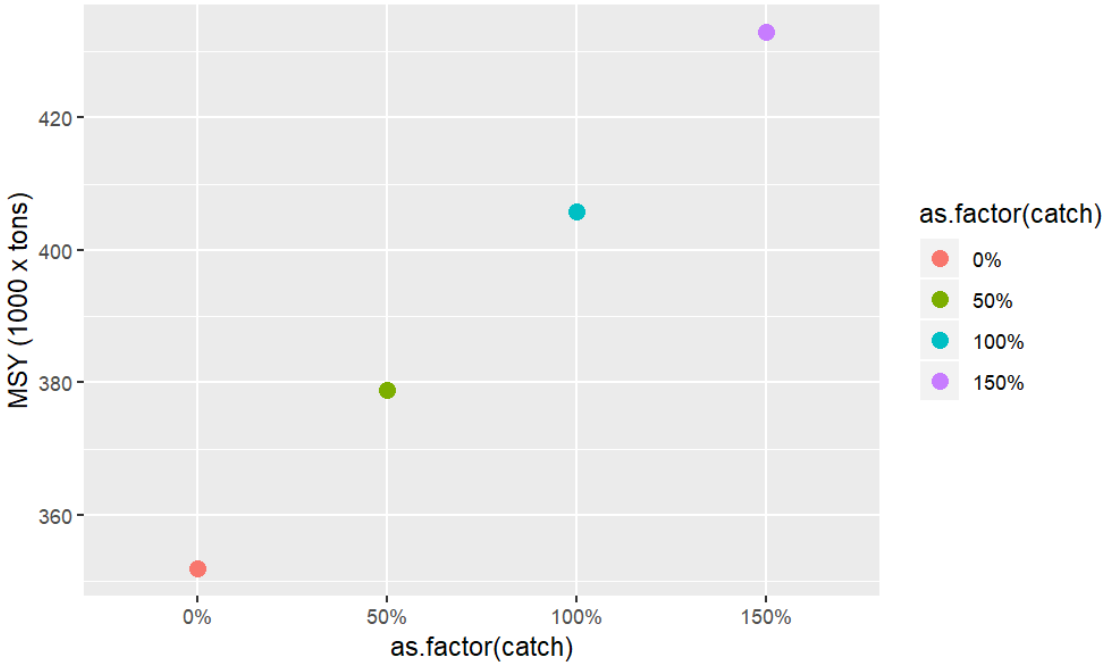
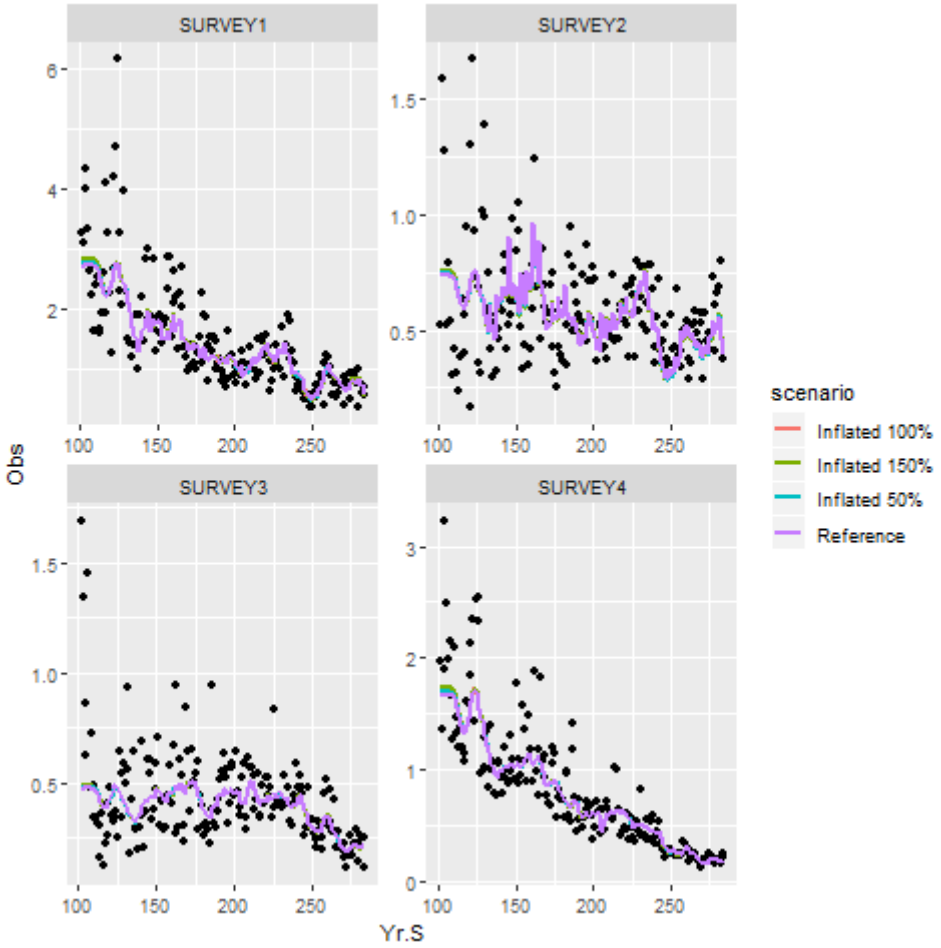


Figure 4 shows the values of the estimated MSY for Indian Ocean yellowfin for each of the underreporting scenarios. This figure shows how underreporting can produce a notable impact on reference points.

Figure 5 shows the fits to the Joint longline index used in the four regions of the stock assessment model. This figure suggests that the catch scenarios do not produce any appreciable impact in the fits to the indices.



Discussion

This study is a first attempt to explore the potential impact of underreporting of nominal catch on the results of stock assessments and in the scientific advice is provided to IOTC. Our results are very preliminary but suggest that, at least with the range explored here, the uncertainty in the catch information used in the stock assessment does not produce a noticeable impact on the estimates of stock status. The 2018 stock assessment estimated that yellowfin was overfished and subject to overfishing and this conclusion holds for the four scenarios produced here. The model fits to the available cpue indices are almost exactly the same for the four scenarios and therefore, our results suggest that it is more important to explore the uncertainty on abundance indices in the stock assessment rather than that on the nominal catch information.

If the catch scenarios had been built using homogeneous catch inflations across the time series, it would be expected that trends were exactly the same. However, here we have created new catch data that is not homogeneously inflated in all the years of the time series. We have

assigned uncertainty to the catch information considered poor and very poor by the IOTC Secretariat, and this is not even across the time series.

Our results show that changes in catch scenarios produce changes in the estimated productivity of the stock and this is how the model accommodates the differences in catch series rather than producing different relative stock trajectories.

Future exercises should review the catch of artisanal fisheries during the 80s and 90s where less effort in data collection/revision were available and therefore, catch could not be catalogued as *poor* and *very poor (IOTC, 2017).*

IOTC (2017). Report of the Working Party on Tropical Tunas. Seychelles, October 2017.

IOTC (2018a). Report of the 20th Session of the IOTC Working Party on Tropical Tunas, Seychelles, 29 October - 3 November. . *IOTC-2018-WPTT20*.

IOTC (2018b). Report of the 21st Session of the IOTC Scientific Committee. Seychelles, 3-7 December.

IOTC (2018c). Review of the statistical data and fishery trends for tropical tunas. *Working Party of Tropical Tunas, Seychelles, October 2018. IOTC–2018–WPTT20–08.*

Methot Jr, R.D. (2013). User manual for Stock Synthesis.

Sharma, R. (2018). Review of IOTC YFT in 2018. *IOTC Scientific Committee, Seychelles, December 2018. IOTC-2018-SC21-INF02.*