RE-VISITING BENCHMARK ESTIMATES FROM THE CATCH-FREE MODEL APPLICATIONS TO BLUE SHARK AND SHORTFIN MAKO SHARK

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SUMMARY

The assessment of blue shark (Prionace glauca) and Shortfin Mako shark (Isurus oxyrinchus) conducted in Tokyo, Japan (14-18 June 2004) relied on a suite of stock assessment models, including a "catch-free" model (SCRS/2004/110). Results from runs of the catch-free model produced implausible MSY benchmarks, thus, only estimates of SSB relative to virgin conditions were included in the final report of the shark stock assessment. It was suggested that the unreliable MSY benchmarks were the result of the particular suite of biological inputs, which suggested that the population was able to support very little, if any, exploitation. Further exploration of the catch-free model runs, which occurred after the meeting, revealed a minor coding bug that was responsible for the unreliable estimates. This document presents an update of the catch-free model runs, including MSY benchmarks.

RÉSUMÉ

L'évaluation du requin peau bleue (Prionace glauca) et du requin taupe bleue (Isurus oxyrinchus) réalisée à Tokyo, Japon (14-18 juin 2004), est basée sur une suite de modèles d'évaluation de stocks, y compris un modèle « sans capture » (SCRS/2004/110). Les résultats des passages du modèle sans capture ont produit des paramètres de PME peu vraisemblables ; ainsi, seules des estimations de SSB par rapport aux conditions vierges ont été incluses dans le rapport final de l'évaluation du stock de requins. Il a été suggéré que les paramètres peu fiables de la PME résultaient de la disposition particulière des entrées biologiques, ce qui suggérait que la population était capable de supporter très peu, voire aucune exploitation. De nouvelles explorations des passages du modèle sans capture, qui ont eu lieu après la réunion, ont révélé un bogue de codage mineur qui était responsable du manque de fiabilité des estimations. Le présent document fournit une actualisation des passages du modèle sans capture, y compris les paramètres de PME.

RESUMEN

La evaluación de tintorera (Prionace glauca) y marrajo dientuso (Isurus oxyrinchus) que se realizó en Tokio, Japón (del 14 al 18 de junio de 2004) se basó en un conjunto de modelos de evaluación de stock, entre los que se incluía el modelo sin capturas (SCRS/2004/110). Los resultados de los ensayos del modelo sin capturas produjeron elementos de comprobación inverosímiles, por tanto, en el informe final de la evaluación del stock de tiburones se incluyeron sólo las estimaciones de SSB en condiciones sin explotar. Se sugirió que los elementos de comprobación del RMS no fidedignos habían sido el resultado de la disposición específica de valores de entrada biológicos, lo que sugería que la población sólo podría soportar un nivel muy bajo de explotación o ninguna explotación. Una exploración posterior de los ensayos del modelo sin capturas, que se realizó tras la reunión, reveló un fallo menor en la codificación que fue el responsable de las estimaciones no fidedignas. Este documento presenta una actualización de los ensayos del modelo sin captura, incluidos los elementos de comprobación del RMS.

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1. Introduction

The catch-free model applied at the shark stock assessment parameterizes the stock-recruit function in terms of the maximum reproductive rate, α. This parameter has a lower bound of 1.0. An earlier implementation of the catch-free model required input in terms of (α-1), however, the current version as applied to blue and shortfin mako shark requires the term α. All but one set of model calculations were revised to reflect the use α instead of (α-1) – the exception being the calculation for equilibrium spawning stock biomass (SSB). At the stock assessment conducted 14-18 June 2004 in Tokyo, Japan, model runs for both blue shark and shortfin mako shark showed implausible values for benchmarks related to equilibrium statistics. At the time, it was suggested that the demographic parameters, as determined by the group during the meeting to be the best available information, portrayed a stock unable to support much fishing pressure. This document presents results from all of the catch-free models reported in SCRS/04/014, with the corrected equilibrium calculations.

2. Results and discussion

The results from re-running the catch-free models for shortfin mako are very similar to those from the assessment in Tokyo (**Table 1).** Model estimates of α range from 1.01 to 1.26. This range of α explains why any calculation using (α-1), which is undefined, would produce unusual results. It also supports the suggestion made during the meeting that some combinations of the demographic inputs suggest a stock that cannot be fished sustainably. For all models, the estimates of SPR_{MSY} for shortfin mako range from 0.89-0.996. Although the group proceeded with these values for demographic inputs, the paucity of information warrants further consideration of what ranges might be plausible.

The results for blue shark were nearly identical to the previous model runs. Model estimates for α were consistently around 2.46 (**Table 2**). While using (α-1) did not lead to an undefined condition, the value of α is still low enough as to not support substantial fishing pressure. SPR_{MSY} is estimated at 0.66, which is greater than the range of SPR reference values examined during the meeting and explains why an examination of fishing rates based on SPR values of say 20-30% would lead to questionable results.

Overall, the conclusions to be drawn from the model applications are the same as those made during the assessment meeting, namely that blue shark do not appear to be overfished nor undergoing underfishing. Mako shark, on the other hand, could be overfished, however this conclusion is dependent on, and sensitive to, the suite of demographic parameters used, which are more uncertain than for blue sharks.

Table 1. Mako shark catch-free model estimates (standard deviation). F_{modern} refers to the average estimated fishing mortality in the period 1971-2003, from which annual deviations were estimated; F_{hist} refers to the average estimated fishing mortality in the period 1956-1971.

Model	*Obj Fn*	SSB_{curr}	SSB_{curr} / SSB_{MSY}	F_{curr}	F_{curr} / F_{MSY}	F_{modern}	F_{hist}	F_{MSY}	SPR_{MSY}	*M*	*Pup Survival*
Combined Index; 13% depletion in 1971	-36.00	0.31 (0.22)	0.65 (1.60)	0.046 (0.0038)	5.13 (4.40)	0.046 (0.03)	0.0148 (0.042)	0.009 (0.0008)	0.90	0.18 (0.033)	0.55 (0.047)
JLL North Index; 13% depletion in 1971	-35.68	0.33 (0.24)	0.70 (1.59)	0.039 (0.035)	4.39 (4.00)	0.039 (0.028)	0.014 (0.038)	0.0089 (0.00079)	0.89	0.18 (0.033)	0.55 (0.047)
US LL logbook Index; logistic selectivity; 48% depletion in 1971	-24.40	0.25 (0.15)	0.51 (2.67)	0.068 (0.054)	14.7 (11.7)	0.068 (0.042)	0.033 (0.02)	0.0046 **(N/A)**	0.96	0.19 (0.035)	0.55 (0.047)
US LL logbook Index; domed selectivity; 48% depletion in 1971	-24.15	0.35 (0.159)	0.029 (0.024)	0.068 (0.054)	102.41 (83.0)	0.075 (0.046)	0.058 (0.038)	0.0029 (1.53E-5)	0.996	0.195 (0.036)	0.55 (0.047)
Combined Index; virgin conditions in 1971	-34.13	0.36 (0.21)	0.76 (2.0)	0.045 (0.037)	5.31 (4.52)	0.045 (0.029)	0 (FIXED)	0.0084 (0.00079)	0.91	0.18 (0.033)	0.55 (0.047)

Table 2. Blue shark catch-free model estimates (standard deviation). F_{modern} refers to the average estimated fishing mortality in the period 1971-2003, from which annual deviations were estimated; F_{hist} refers to the average estimated fishing mortality in the period 1956-1971.

Model	*Obj Fn*	SSB_{curr}	SSB_{curr} / SSB_{MSY}	F_{curr}	F_{curr}/F_{MSY}	F_{modern}	F_{hist}	F_{MSY}	SPR_{MSY}	*M*	*alphal*
North Stock; 20% depletion in 1971	-43.07	0.77 (0.15)	1.81 (0.51)	0.019 (0.016)	0.34 (0.29)	0.019 (0.014)	0.019 (0.047)	0.057 **(N/A)**	0.66	0.15 (0.044)	2.46 (0.39)
North Stock; 10% depletion in 1971	-43.09	0.76 (0.15)	1.78 (0.49)	0.20 (0.016)	0.35 (0.29)	0.20 (0.014)	0.03 (0.048)	0.057 **(N/A)**	0.66	0.15 (0.044)	2.46 (0.39)
North Stock; Virgin conditions in 1971	-43.40	0.80 (0.14)	1.87 (0.52)	0.019 (0.015)	0.33 (0.27)	0.019 (0.014)	0 (FIXED)	0.057 **(N/A)**	0.66	0.15 (0.044)	2.46 (0.39)
South Stock; 20% depletion in 1971; combined selectivity	-47.31	0.81 (0.12)	1.90 (0.53)	0.20 (0.016)	0.24 (0.19)	0.20 (0.014)	0.036 (0.055)	0.081 **(N/A)**	0.66	0.15 (0.044)	2.46 (0.39)
South Stock; 20% depletion in 1971; Japanese selectivity	-47.30	0.78 (0.14)	1.81 (0.47)	0.017 (0.014)	0.31 (0.24)	0.02 (0.014)	0.038 (0.058)	0.057 **(N/A)**	0.66	0.15 (0.044)	2.46 (0.39)
South Stock; Virgin conditions in 1971; combined selectivity	-41.11	0.85 (0.11)	1.98 (0.57)	0.019 (0.015)	0.23 (0.19)	0.019 (0.014)	0 (FIXED)	0.081 **(N/A)**	0.66	0.15 (0.044)	2.46 (0.39)