The first stage trial of performance statistics of initial candidate management procedure for southern bluefin tuna of CCSBT

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Abstract

In this report, the evaluation of the performance statistics of the initial candidate management procedure was conducted to finish the first stage trial of projection code of management procedure. The control file for the projection trial is set for considering the influence of uncertainty from observation and process errors and the different setting values of the parameters in nine initial candidate models specified in SAG3. Three types of performance statistics, maximization catch, resource safe regarding, and the catch stability, to meet the objectives of management procedure were outputs form the SBT projection program. Different initial candidate models seem to account more variation than that of different hierarchy. Model hestmcmc is the best for the catch stability. Model h6M05 is the best for maximizing catch. Model h9M15 is the best for safe regarding the resource. Models of h3 are not preferred for the decreasing trend of projected biomass and catch series and the lowest biomass ratios.

Introduction

The workshop of management strategy of CCSBT was held in 2000 to set up the management procedure (MP) for southern bluefin tuna (SBT). And then

implemented in the following three workshops, MPI in 2002, MP2 in 2003, and MP3 in 2004. The workshop in 2000 was focused on the objectives, performance measurement and decision rule of the management strategy. The recommended objects can be summarized in three aspects, catch maximization, safe regarding of the resource, and catch stability. The performance measurement includes the performance statistics, observational inputs, and monitoring statistics. The initial set of operating models identification and the performance indicator used to evaluate the candidate MP have mainly been implemented in MP1 in 2002. This year in MP2, the main tasks are evaluation of performance statistics of initial candidate MP during the first-year trials and the final specification of operating models to be used for the second-year evaluations of MP, including estimation procedures for conditioning on past data, projection models and models used to simulate data. This report is mainly focused on the first task of MP2 to facilitate the improvement of MP by comparing the results among the national scientist trials.

Materials and Methods

The projection program code, sbtprojV103 which distributed on CCSBT website, and the file of getquota1.exe was kindly provided by Norio Takahashi for lack of ad model builder are used for the initial trials. The outputs of the projection program are conditioned on the controlled file. The control file is option selected for the

consideration of uncertainty includes the observation error and process error (Hierarchy option) and different sets of model parameter value (9 initial candidate model selections). The option of hierarch 1 regards the model as a deterministic one without the consideration of observation and process errors. Hierarchy 2 considers the model with observation error. Hierarchy 3 considers both the observation and process errors. Nine initial candidate models that are the combination of the default values of two parameters, steepness (h), the relationship between the spawner and the recruit, and natural mortality (M) at age 10 are optional selected in the control file. To test the influence of the uncertainty from observation and process error and the different set of parameter values, the control files is optional selected for 3 hierarchies conditioned on one of the initial candidate model (h6M15d1) and optional selected for 9 initial candidate models conditioned on hierarchy 3 for comparing the influence on the performance statistics by two types of uncertainty. And the other options of the control files are set as the followings. The maximum posterior density (MPD) fit is set on 1 for all the three hierarchies. The number of historical replicates is 1 that is the number of parameter sets sampled from the joint posterior distribution that will be selected for the simulation. The number of projection replicates per historical replicates is 10. The number of years for forward projection is 20.

Results and Discussion

The figures are mainly based on the output files of *.sum. They are compared based on the influence on the three types of performance statistics, i.e. catch stability, maximizing catch, and safe regarding the resource, by two kinds of uncertainty, observation and process error and different set of model parameter values. Fig. 1-8 show three types of performance statistics in terms of inter-annual change d[i] and variation in catches AAV, five and twenty years average catch, and biomass ratios to the specific years influenced by the uncertainty of observation error and process error. The outputs of the performance statistics are in distribution except hierarch 1. The medians of the performance statistics differ not much among the three hierarchies. From the point of catch stability, the preferred hierarchy is 2 and 1 in d[i] and AAV with the lowest median, respectively (Fig. 1-2). From the point of maximizing catch, the preferred hierarchy is 2 and 3 of five years and twenty years average catch with the largest median, respectively (Fig. 3-4). From the point of safe regarding the resource, the preferred hierarchy is 1 of biomass ratio with five years later to the first projection year and 3 in the other biomass ratios with the largest median (Fig. 5-8). The biomass ratios are all greater than 1 for the three hierarchies. It means that no matter which hierarchy is the projected resource under the specified model do recover to the resource level of the first projected year except to the year of 1980. But the

biomass ratios are still near the resource level in 1980 (Fig. 7). Fig. 11-18 show the performance statistics of three types in terms of inter-annual change d[i] and variation in catches AAV, five and twenty years average catch, and biomass ratios to the specific years influence by the uncertainty of 9 different parameters set of the initial candidate model. The performance statistics are all in distribution for the projection are based on hierarchy 3 that considers both the observation and process error. The medians of the performance statistics of the different parameters sets of the initial candidate model varied larger than those among different hierarchies. From the point of catch stability, the preferred model is hestmcmc in d[i] and in AAV with the lowest median. Models of h3M10 and h3M15 are not preferred for the projected biomass and catch series are in the decreasing trends (Fig. 9-10). The medians of the performance statistics decrease with the increasing M in the same h. It means that the lower the natural mortality the more stable catch under the default h (Fig. 11-12). From the point of maximizing catch, the preferred model is h6M05 in five years and twenty years average catch with the largest median. The medians of the performance statistics also decrease with the increasing M in the same h. It means that the lower the natural mortality the more maximum catch under the default h (Fig. 13-14). From the point of safe regarding the resource, the preferred model is h9M15 in all biomass ratios except h6M15 in the biomass ratio of NB(2022)/NB(2002) with

the largest median (Fig. 15-18). While the biomass of the 5th projected year could not reach to the level of the first projected year for four models (h3M10, h3M15, h6M05, and hestmcmc) (Fig. 15). The biomass of the 20th projected year could not reach to the level of the first projected year for three models (h3M10, h3M15, and h6M05) (Fig. 16). The projected biomass in 2020 could not reach to the level in 1980 for five models (h3M10, h3M15, h6M05, h6M10 and hestmcmc) (Fig. 17). The non-spawning biomass of the 20th projected year could not reach to the level of the first projected year for two models (h3M10 and h3M15) (Fig. 18). The projected biomass of other models recovered well.

As for maximization the catch, the simulate catch and exploitation rate (ER) were divided into four fishery components in the file of *.s2. The exploitation rate is the catch of the specific fishery component divided by the exploitable biomass of specific fishery component. Does it mean that the estimated total allowable catch will be divided into 4 fishery components. It is worth to notice about the partition rules for the different components. The performance statistic of hierarchy 1 in figure 1 is in distribution is unreasonable for the deterministic model. It needs further investigation.

References

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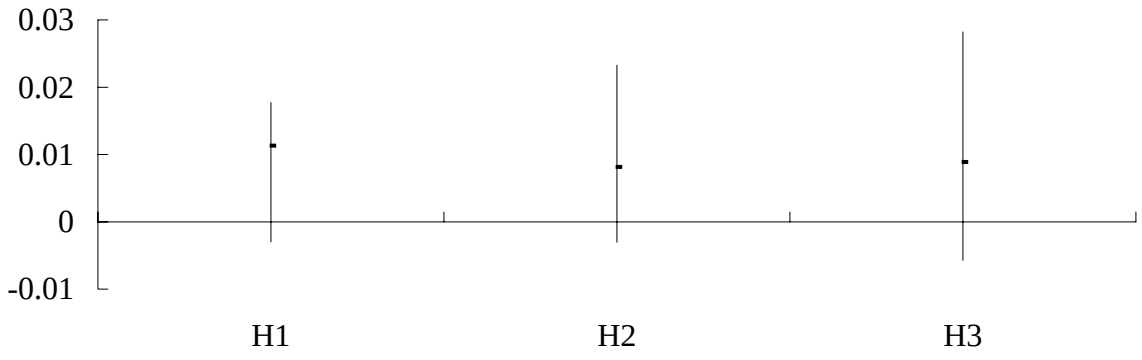

Fig.1 The 10%, 50% and 90% quantiles of inter-annual change (d[i]) of model h6M15d1 of 3 Hierarchies.

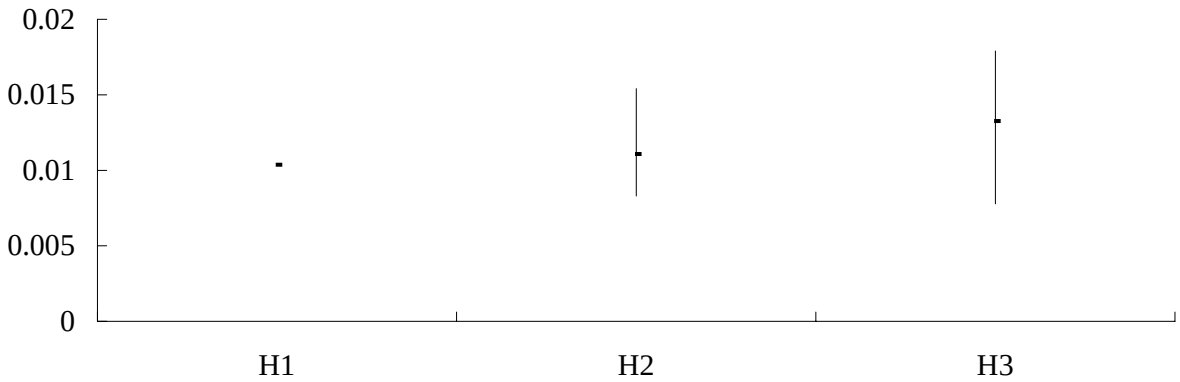

Fig.2 The 10%, 50% and 90% quantiles of inter-annual variations in catces (AAV) of model h6M15d1 of 3 Hierarchies.

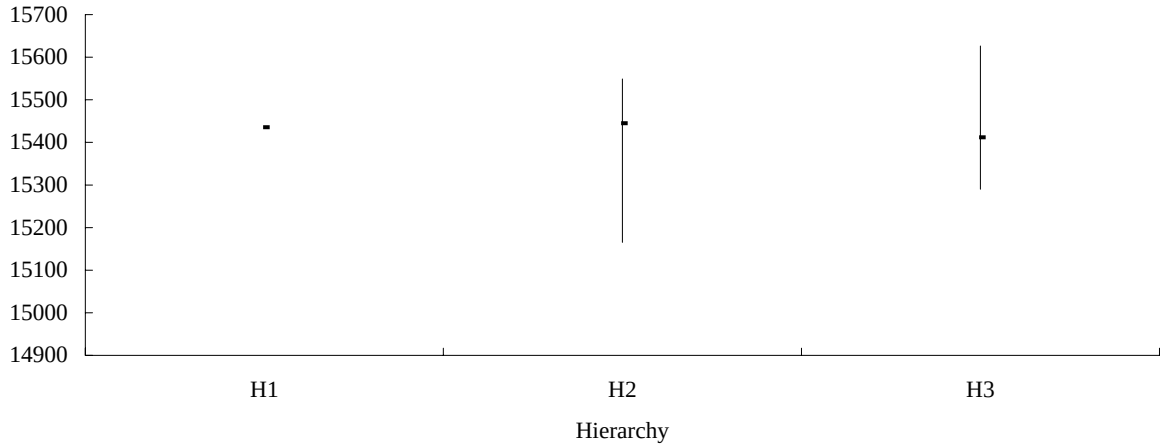

Fig.3 The 10%, 50% and 90% quantiles of 5 years average catch of model h6M15d1 of 3 Hierarchies.

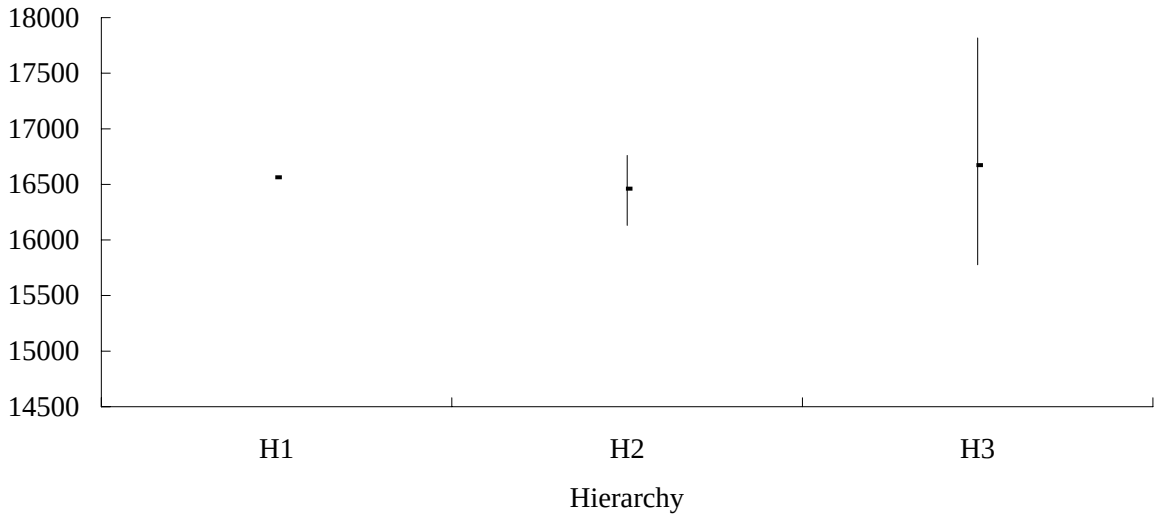

Fig.4 The 10%, 50% and 90% quantiles of 20 years average catch of model h6M15d1 of 3 Hierarchies.

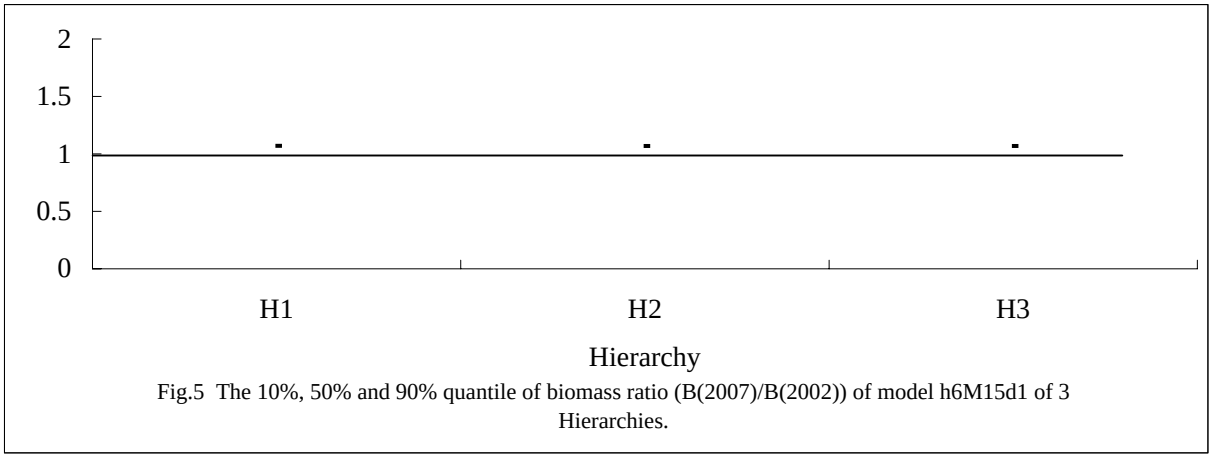

Fig.5 The 10%, 50% and 90% quantile of biomass ratio (B(2007)/B(2002)) of model h6M15d1 of 3 Hierarchies.

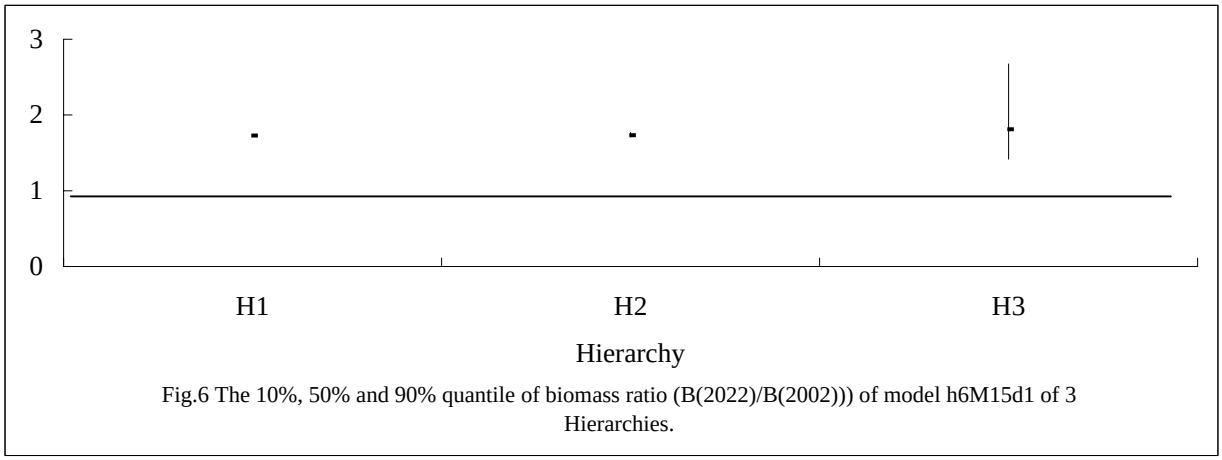

Fig.6 The 10%, 50% and 90% quantile of biomass ratio (B(2022)/B(2002))) of model h6M15d1 of 3 Hierarchies.

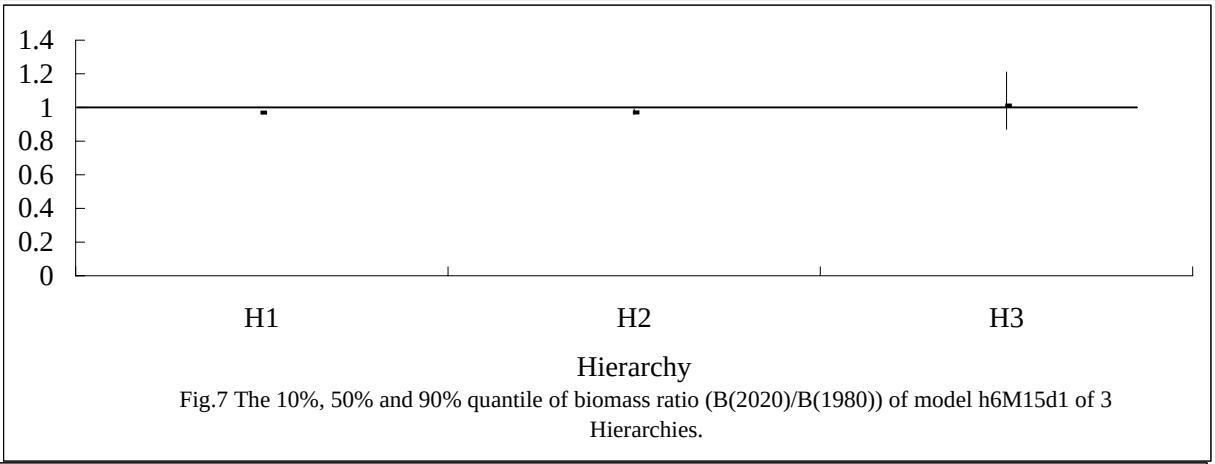

Fig.7 The 10%, 50% and 90% quantile of biomass ratio (B(2020)/B(1980)) of model h6M15d1 of 3 Hierarchies.

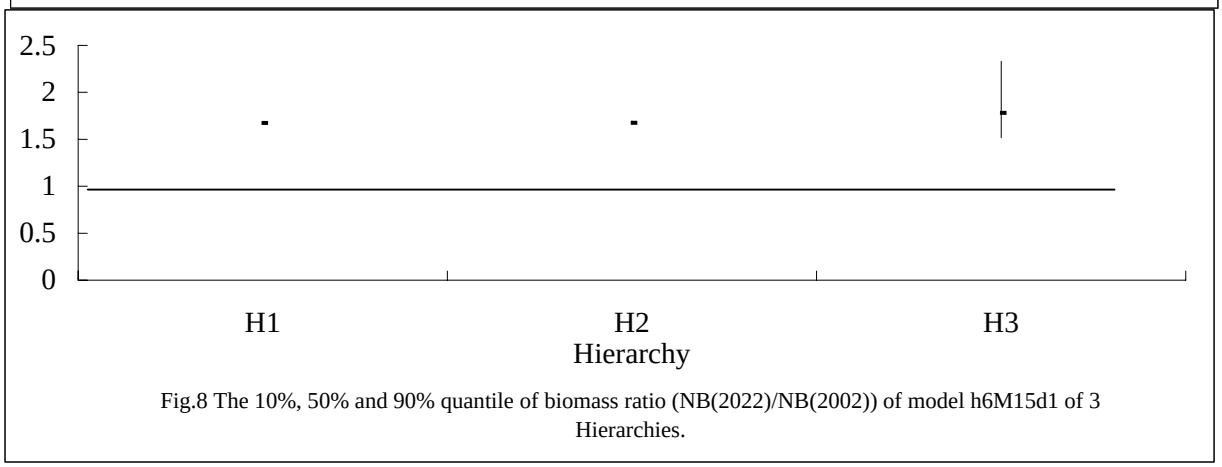

Fig.8 The 10%, 50% and 90% quantile of biomass ratio (NB(2022)/NB(2002)) of model h6M15d1 of 3 Hierarchies.

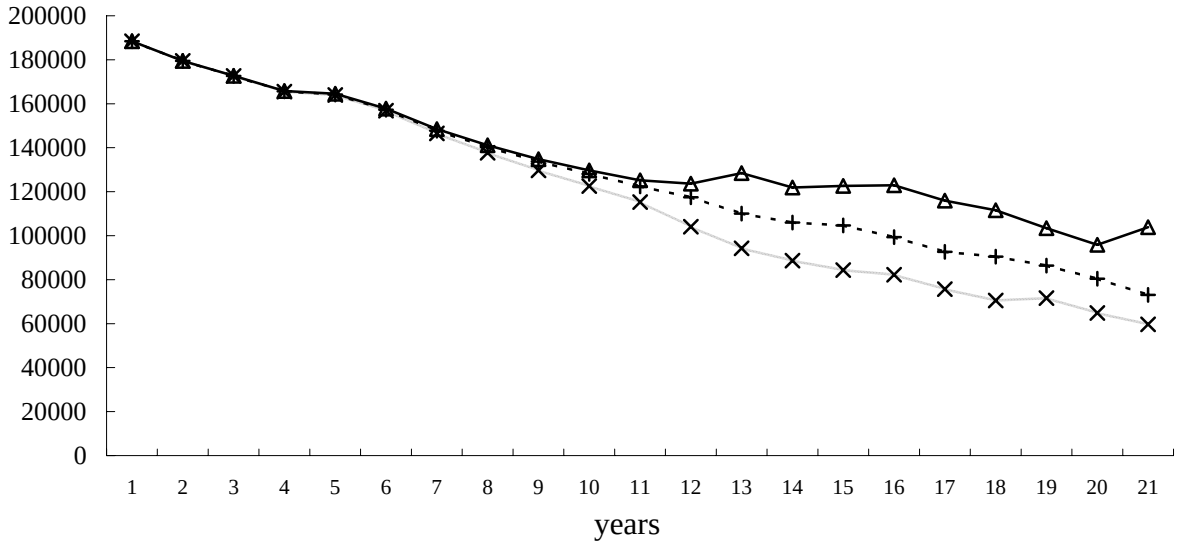

Fig.9 The 10%, 50% and 90% quantiles of biomass series of model h3M10.

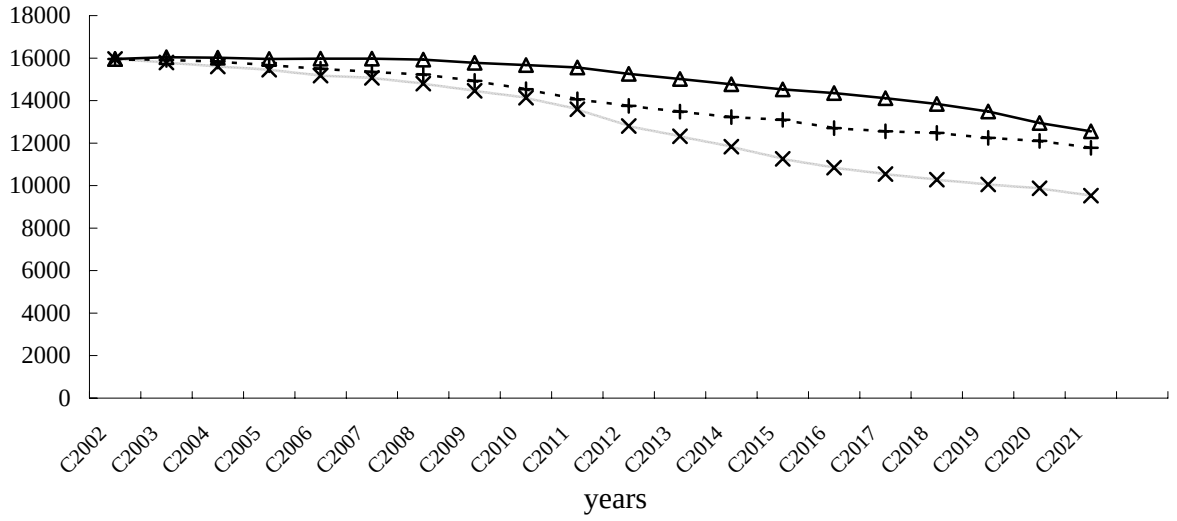

Fig.10 The 10%, 50% and 90% quantiles of catch series of model h3M10.

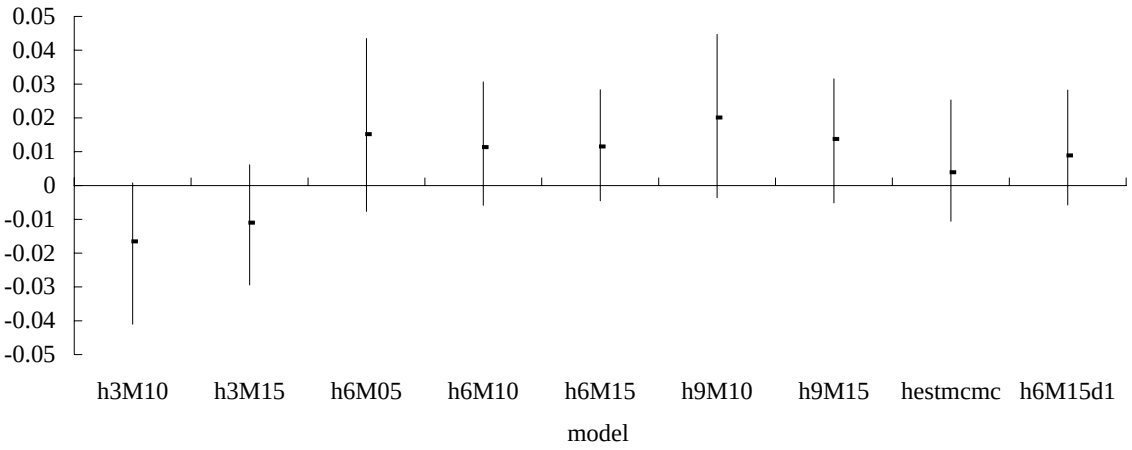

Fig.11 The 10%, 50% and 90% quantiles of inter-annual change (d[i]) of 9 models.

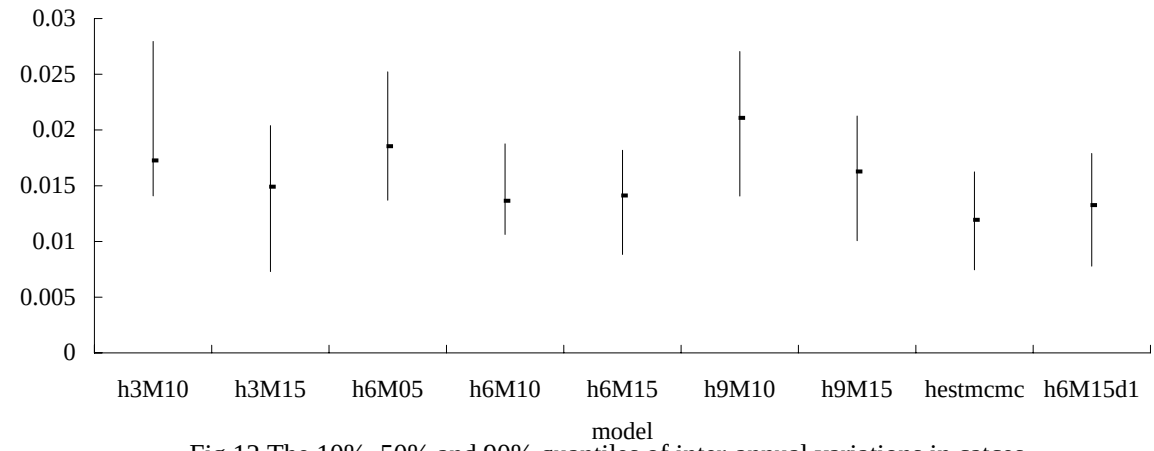

Fig.12 The 10%, 50% and 90% quantiles of inter-annual variations in catces (AAV) of 9 models.

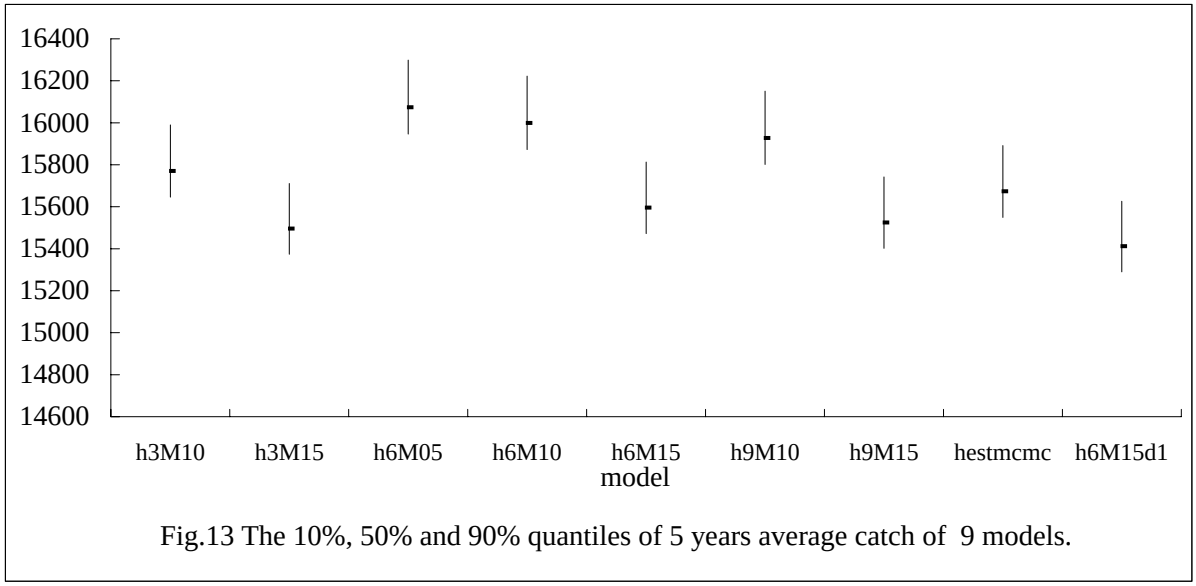

Fig.13 The 10%, 50% and 90% quantiles of 5 years average catch of 9 models.

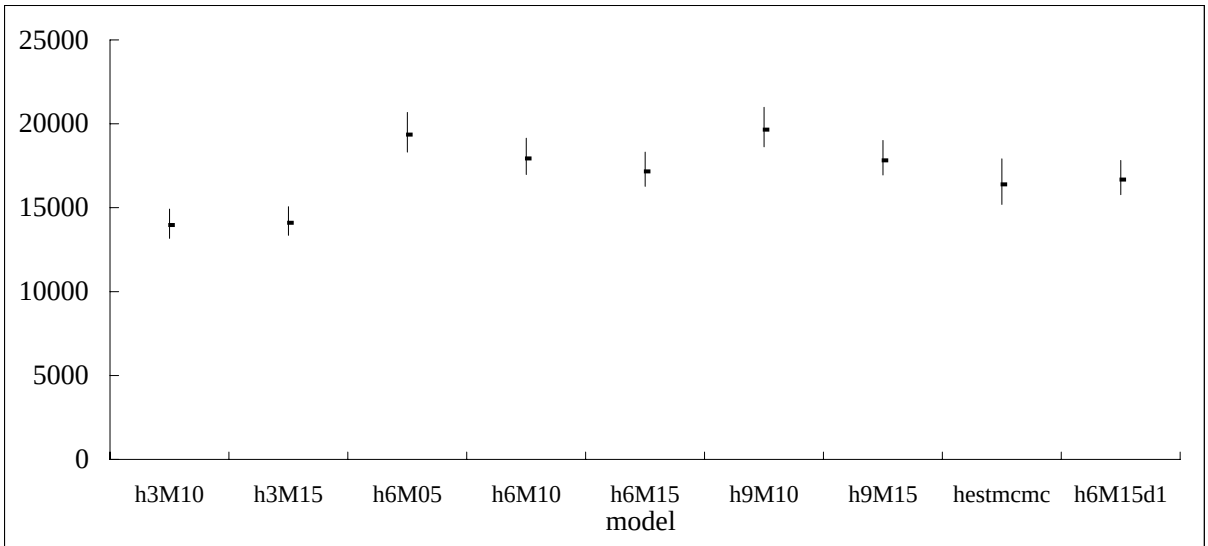

Fig.14 The 10%, 50% and 90% quantile of 20 years average catch of 9 models.

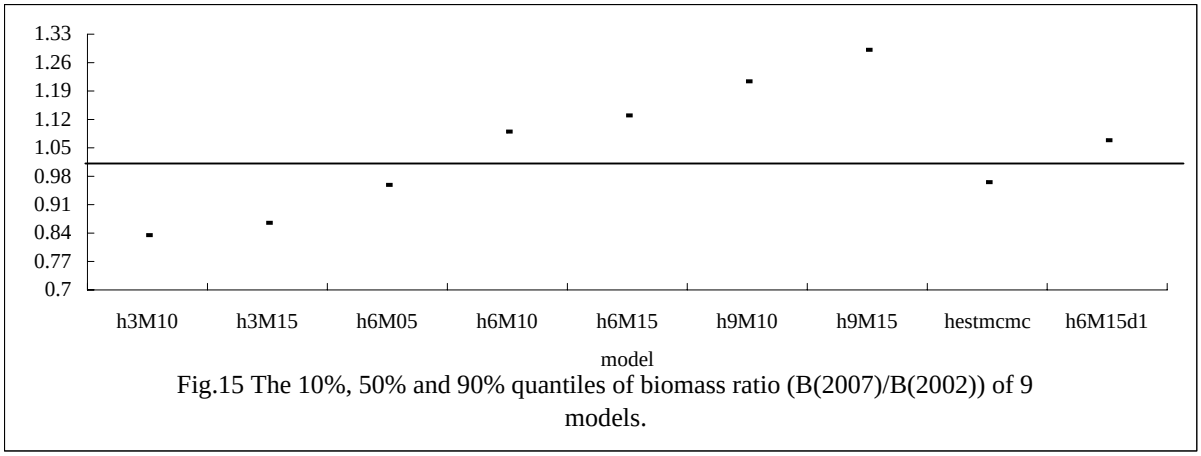

Fig.15 The 10%, 50% and 90% quantiles of biomass ratio (B(2007)/B(2002)) of 9 models.

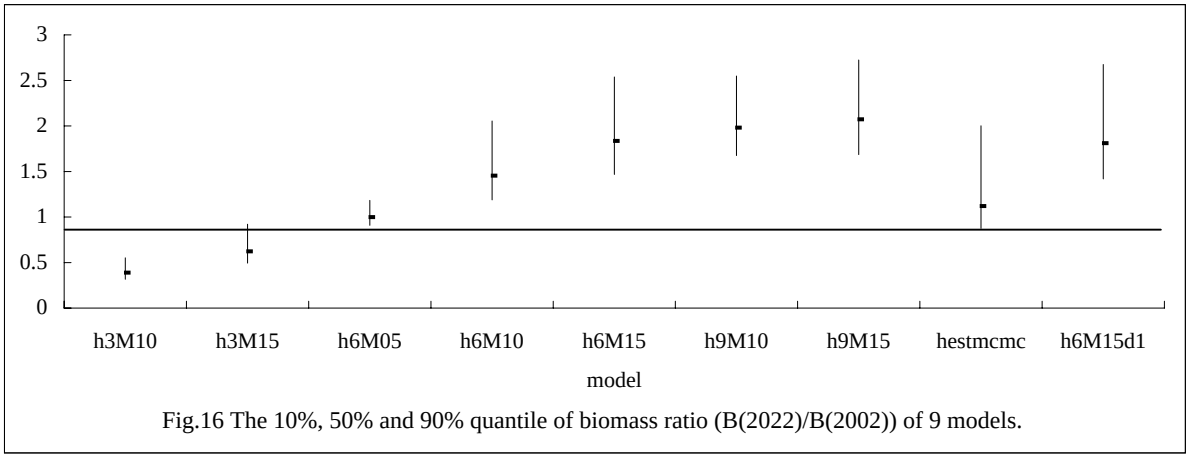

Fig.16 The 10%, 50% and 90% quantile of biomass ratio (B(2022)/B(2002)) of 9 models.

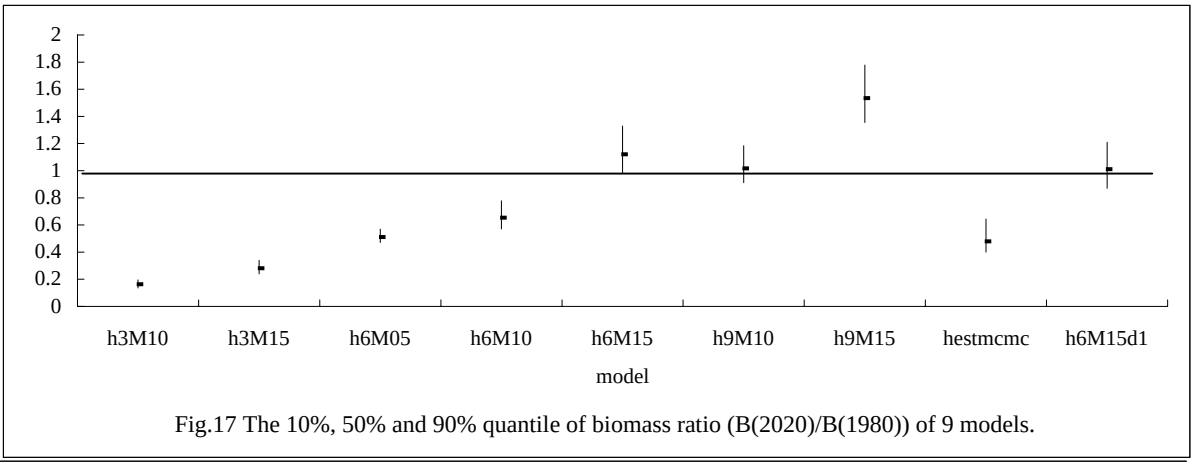

Fig.17 The 10%, 50% and 90% quantile of biomass ratio (B(2020)/B(1980)) of 9 models.

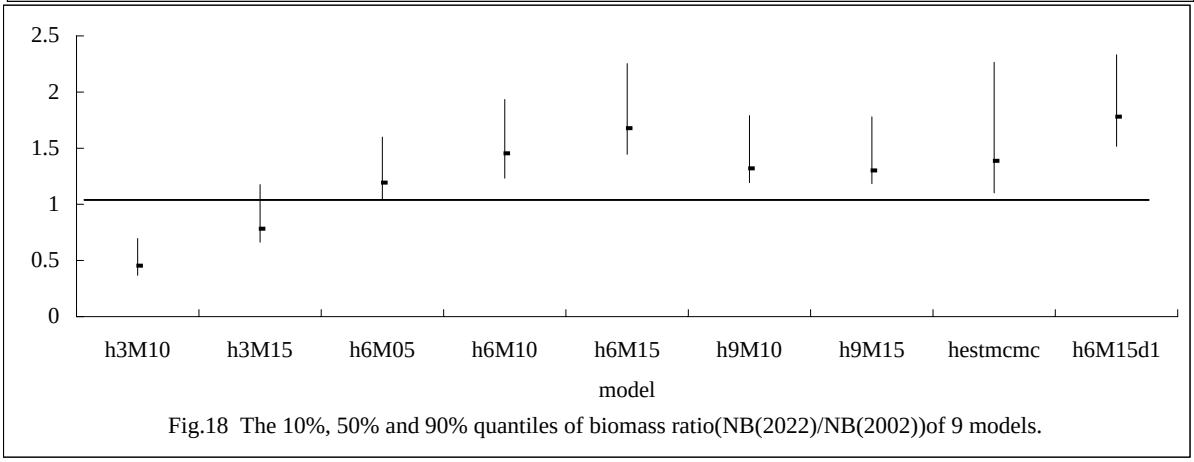

Fig.18 The 10%, 50% and 90% quantiles of biomass ratio(NB(2022)/NB(2002))of 9 models.