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Production model analysis of the north Pacific striped marlin using currently available data set in the ISC marlin working group[1]

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Introduction

ISC marlin working group held a stock assessment workshop of the north Pacific striped marlin in Nov. 2005. The group could not finalize the assessment during the workshop mainly due to the insufficient data for the annual catch data by country (ISC, 2006). The group estimated missing parts of the catch data during the workshop using available information such as data in the albacore database as well as IATTC database. This document describes the production model analysis on this stock using catch and abundance index created by the working group during the last workshop as well as the revised data sets.

Materials and methods

Two data sets were used in this study. Dataset 1 was created by the working group during the last workshop. Annual catch weight of countries other than Japan, United States, Mexico and Costa Rica were estimated using information from the ISC data base and national fishery statistics published by the governments of ISC member countries. During the last workshop, the group created quarterly abundance index by area by standardizing the CPUE of Japanese offshore and distant-water longliner for the input of the integrated assessment models. The annual abundance index in Dataset 1 was created from this quarterly abundance index by area using the same method described in Clarke and McAllister (2006).

Annual catch weight of Dataset 2 was same data as Dataset 1 except for historical Japanese catch data. Because a way to estimate the catch of Japanese coastal fishery in Dataset 1 was incorrect, catch of these fisheries were revised in Dataset 2. The annual abundance index in Dataset 2 was same index shown in Figure 7 in the report of the last workshop.

The annual abundance index in Dataset 1 was started in 1962. This is because fishing activities by the Japanese longliner did not extent into the Eastern Pacific Ocean until after that time. The annual abundance index in Dataset 2 was obtained by the revised method in Yokawa and Clarke (2005) which was descried in the report of the last workshop (ISC, 2006).

For the production model analysis, ASPIC software ver.5 (Prager, 2004) was used. Though the ASPIC demands biomass index and catch weight as input, the abundance index was used in this study based on the conclusion by Prager and Goodyear (2001) that the impact of using abundance index in not serious.

Results

Figure 1 shows trends of annual catch weights and abundance indices of Dataset 1 and 2. Trends of abundance indices were almost same between Dataset 1 and 2 for the period of 1962 – 2003, while the trends of catch were different between two data sets. Generally, the amount of catch in Dataset 2 was smaller than Dataset 1.

The logistic and FOX model were fitted to the catch and CPUE data sets. Figure 2 shows the results of the logistic model fitting. In both Datasets, ASPIC optimization process were converged without fixing estimating parameters (B1/K, MSY, K, and q). The result by the Dataset 1 was more pessimistic than the Dataset 2. Results of FOX model were quite similar to the one by the logistic model, though their results tend to be slightly pessimistic than those by the logistic model.

Tables 1 – 4 show major quantities of interest obtained by the estimated parameters by ASPIC and their bias-corrected confidence intervals by the bootstrapping analysis. In all cases, values of B1/K (ratio of biomass in starting year to the initial biomass) were 0.5 or smaller.

Discussions

ASPIC fitting procedure was successfully converged for the analysis using both the original and the revised data sets and for the Logistic and FOX model. The relative biases of major quantities of interest estimated by bootstrapping analysis were lower in the results of revised data set and FOX model (Table 5). This would suggest that results by the revised data set and FOX model is closer to the actual stock situation.

Results of this study indicates that the current stock status of the north Pacific striped marlin is over fished, but this results should be taken with great care because the abundance index used in this study was underestimate the current stock level and the reliability of catch data used in this study is rather low (ISC, 2006). The relatively lower values of B1/K (>= 0.5, Tables 1-4) obtained in this study would be attributed to the fact that the trend of annual abundance index used in this study did not reflect the historical change of the stock size of the north Pacific striped marlin.

The report of the last workshop indicated that the GLM model used in the CPUE standardization of Japanese offshore and distant-water longliners could not fully adjusted the effect of the high striped marlin CPUE recorded by the striped marlin directed sets occurred in the northeast Pacific during the 1960's – the 1980's because there is no code to identify the target species in the data of Japanese longliners in the period before 1975 (ISC, 2006).

During the 1950's, the data of Japanese offshore and distant-water longliners only covered in the area west of 140W in the north Pacific (Fig. 10 in the report of the last workshop (ISC, 2006)). When the operation area of Japanese longliners extended to the northeast Pacific, they started to target striped marlin (Yokawa, 2005). These to fact would cause the large contrast in the level of the catch and abundance index between the 1950's and the 1960's, and that would affect on the estimates of B1/K values in this study.

The discussions written in above three paragraphs would support the following conclusion of ISC marlin working group at the stock assessment workshop of the north Pacific striped marlin in Nov. 2005;

"The GLM results show that the relative level of the stock in the 1950's is roughly the same as in the 1960's, while the results from statHBS with the priors of the absolute depth and ambient temperature hypotheses show the relative level of the stock in the 1950's is roughly the same as the one in the 1970's and there after. The GLM and statHBS based on relative temperature indicate the stock is currently heavily exploited. The statHBS results based on absolute depth would also indicate the stock is currently heavily exploited if the relatively lower level of the abundance indices in the 1950's were attributed to the developing stage of the fishery. However, if the level of the abundance indices in the 1950's was not representative of the unexploited stage, then this trend indicates the stock is currently not seriously exploited. (2nd paragraph in 3.10 in the report of the workshop (ISC, 2006))".

Further study on the CPUE standardization of Japanese longliners and availability of catch data of courtiers which have not been submitted the Category I data is necessary to obtain more clear and reliable results of stock assessment.

References

ISC (2006): Report of the striped marlin stock assessment workshop, Marlin Working Group, ISC. 23p.

Prager, M.H. (2004): Manual for ASPIC, A stock-production model incorporating covariates (ver. 5) and auxiliary programs. NMSF Beaufort Laboratory Document BL-2004-01. 27p.

Prager, M. H. and C. P. Goodyear (2001): Fitting a surplus-production model with numbers- vs. weight-based indices of abundance together with removals data in weight: an evaluation on simulated fisheries similar to blue marlin in the Atlantic Ocean. Col. Vol. Sci. Pap. ICCAT, 53: 164-179.

Clarke, S. and M. McAllister (2006): Application of a Bayesian surplus production model to striped marlin (Tetrapturus audax) in the North Pacific. Document submitted to this meeting. 14p.

Yokawa, K. (2005): Operation patterns of Japanese offshore and distant-water longliners in the North Pacific, with emphasis on the billfishes. ISC/05/MAR&SWO-WGs/16. 19pp.

Yokawa, K. and S. Clarke (2005): Standardizations of CPUE of striped marlin caught by Japanese offshore and distant water longliners in the North Pacific. 9pp. ISC/05/MAR-WG/03.

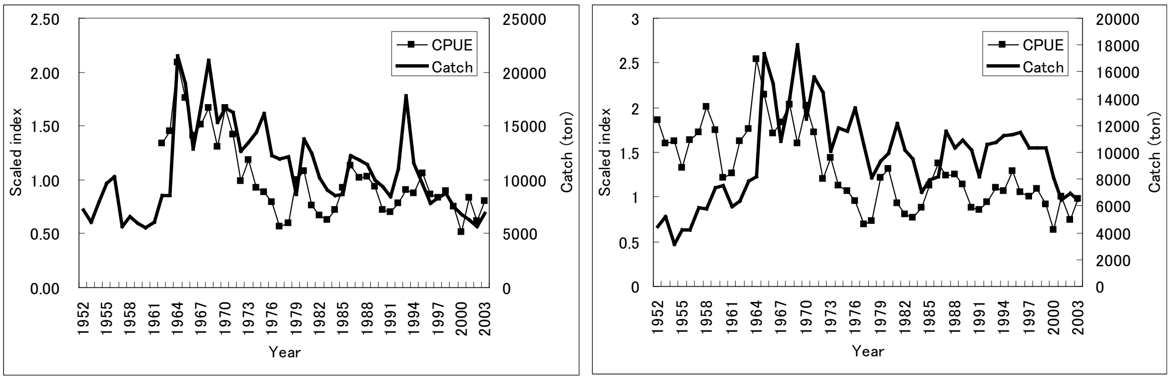

Fig. 1. Input data to ASPIC. Left panel shows the trend of the annual catch weight and abundance index of Dataset 1 and Right panel shows those of Dataset 2.

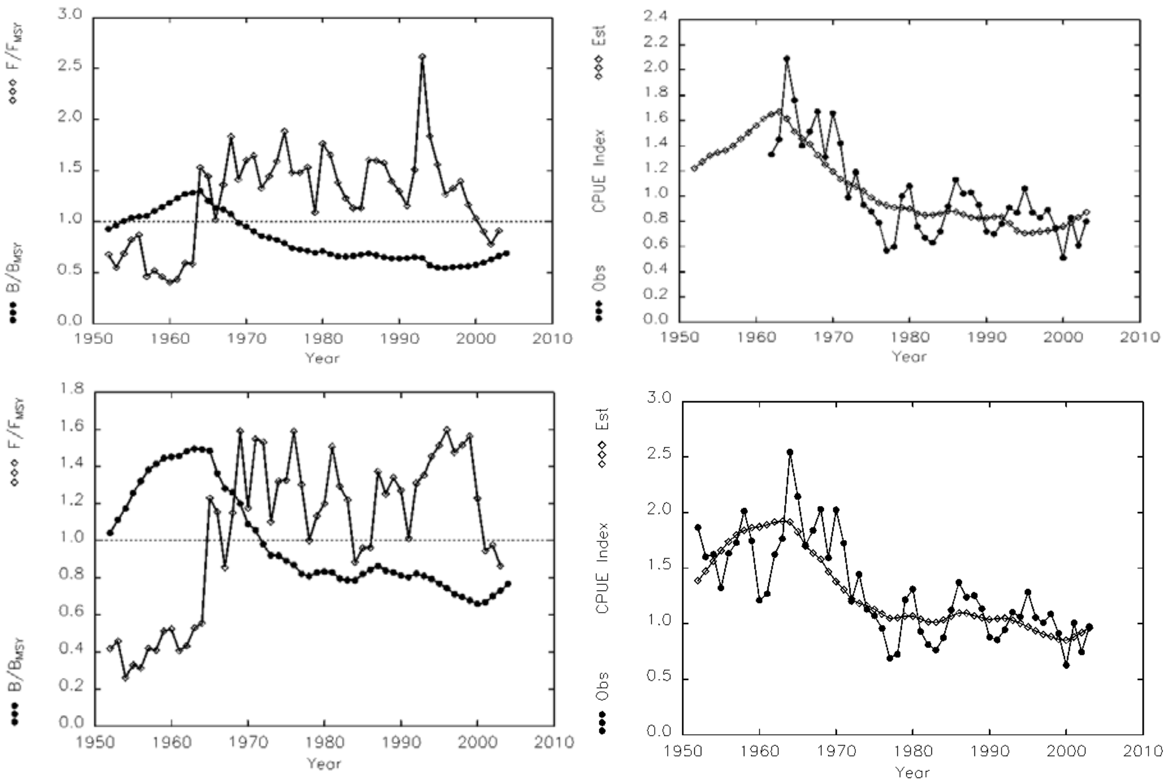

Fig. 2. Results of the logistic model. Top two panels show the trend of B/B_{MSY} and F/F_{MSY} (left) and the trend of observed and estimated CPUE (right) by Dataset 1. Bottom two panels show those by Dataset 2.

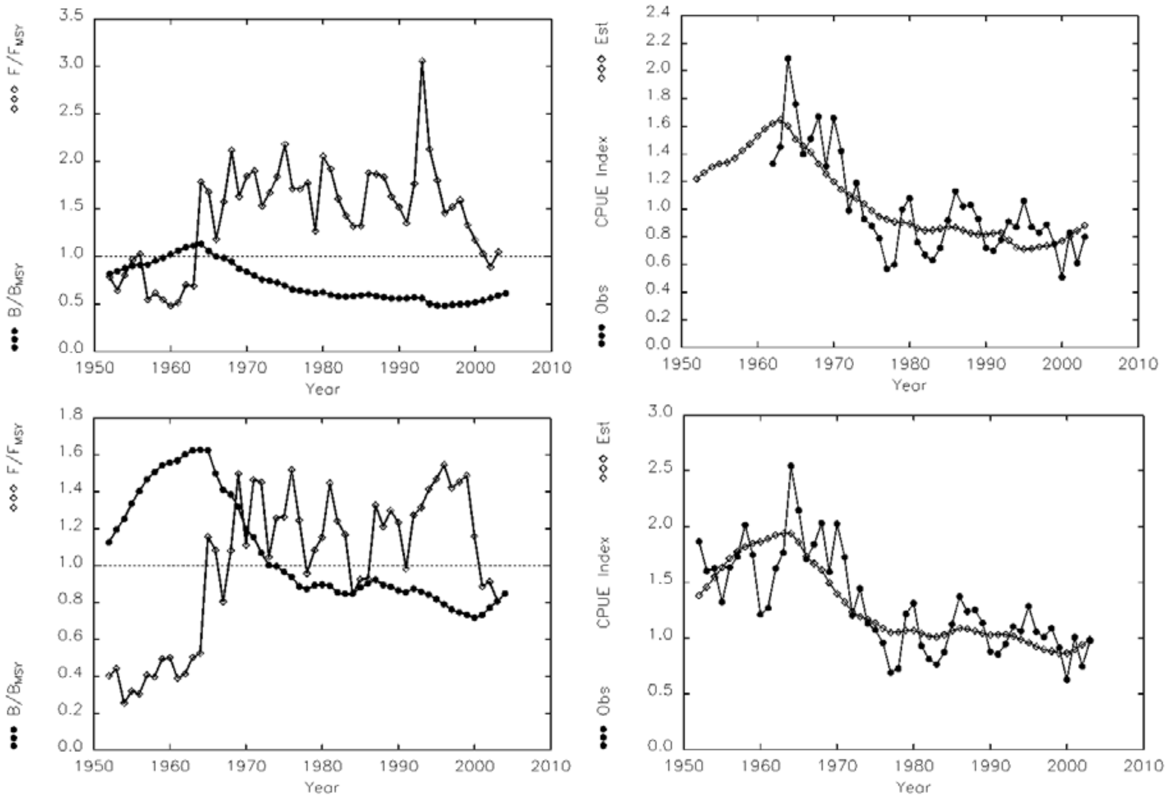

Fig. 3. Results of the FOX model. Top two panels show the trend of B/B_{MSY} and F/F_{MSY} (left) and the trend of observed and estimated CPUE (right) by Dataset 1. Bottom two panels show those by Dataset 2.

Table 1. Results of bootstrapped analysis of the logistic model by Dataset 1.

Param	Point	Estimated	Estimated	Bias-cor	rected appro:	imate confide	nce limits	Inter-	Relative
name	estimate	bias in pt estimate	relative bias	80% lower	80% upper	50% lower	50% upper	quartile range	IQ range
B1/K	4.09E-01	2.20E+00	536.98%	2.10E-01	6.06E+01	3.52E-01	8.54E+00	8.18E+00	20.016
K	2.32E+05	3.98E+04	17.19%	1.82E+05	6.92E+05	2.10E+05	3.66E+05	1.56E+05	0.673
q(1)	1.17E-05	3.59E-06	30.71%	8.12E-06	1.46E-05	8.37E-06	1.18E-05	3.42E-06	0.293
MSY	1.16E+04	3.49E+03	30.20%	9.67E+03	1.36E+04	1.00E+04	1.18E+04	1.81E+03	0.156
Ye(2004)	1.02E+04	5.43E+02	5.31%	7.96E+03	1.10E+04	8.78E+03	1.04E+04	1.63E+03	0.16
Y.@Fmsy	7.63E+03	2.97E+02	3.89%	5.42E+03	9.31E+03	6.23E+03	8.35E+03	2.13E+03	0.279
Bmsy	1.16E+05	1.99E+04	17.19%	9.11E+04	3.46E+05	1.05E+05	1.83E+05	7.80E+04	0.673
Fmsy	9.97E-02	2.53E-02	25.37%	5.85E-02	1.20E-01	6.54E-02	1.00E-01	3.46E-02	0.347
fmsy(1)	8.52E+03	-2.30E+02	-2.70%	7.51E+03	1.07E+04	8.16E+03	9.88E+03	1.73E+03	0.203
B./Bmsy	6.60E-01	-5.56E-02	-8.42%	4.32E-01	9.84E-01	5.69E-01	8.57E-01	2.88E-01	0.436
F./Fmsy	9.26E-01	1.18E-02	1.27%	7.51E-01	1.27E+00	8.31E-01	1.11E+00	2.74E-01	0.296
Ye./MSY	8.85E-01	-8.70E-02	-9.84%	6.77E-01	9.97E-01	8.15E-01	9.80E-01	1.65E-01	0.187

Table 2. Results of bootstrapped analysis of the logistic model Dataset 2..

				Bias−cor	rected appr	imate confic	nce limits		
Param name	Point estimate	Estimated bias in pt estimate	Estimated relative bias	80% lower	80% upper	50% lower	50% upper	Inter−quartile range	Relative IQ range
B1/K	5.21E−01	1.58E−02	3.04%	3.95E−01	6.64E−01	4.53E−01	5.92E−01	1.40E−01	0.268
K	1.52E+05	1.09E+04	7.21%	1.19E+05	2.03E+05	1.32E+05	1.77E+05	4.52E+04	0.298
q(1)	1.70E−05	−1.01E−07	−0.60%	1.22E−05	2.34E−05	1.46E−05	2.05E−05	5.81E−06	0.342
MSY	9.94E+03	−6.27E+01	−0.63%	9.30E+03	1.04E+04	9.63E+03	1.02E+04	5.50E+02	0.055
Ye(2004)	9.40E+03	−1.59E+02	−1.69%	8.58E+03	1.02E+04	9.01E+03	9.87E+03	8.56E+02	0.091
Y.@Fmsy	7.62E+03	−5.11E+01	−0.67%	6.39E+03	9.24E+03	7.03E+03	8.46E+03	1.43E+03	0.188
Bmsy	7.59E+04	5.47E+03	7.21%	5.96E+04	1.02E+05	6.59E+04	8.85E+04	2.26E+04	0.298
Fmsy	1.31E−01	−1.16E−03	−0.88%	9.20E−02	1.74E−01	1.10E−01	1.55E−01	4.51E−02	0.345
fmsy(1)	7.72E+03	−1.23E+01	−0.16%	7.19E+03	8.38E+03	7.44E+03	8.10E+03	6.51E+02	0.084
B./Bmsy	7.67E−01	−5.02E−04	−0.07%	6.40E−01	9.05E−01	7.03E−01	8.37E−01	1.34E−01	0.175
F./Fmsy	8.62E−01	2.21E−02	2.57%	7.16E−01	1.03E+00	7.78E−01	9.34E−01	1.56E−01	0.181
Ye./MSY	9.46E−01	−1.02E−02	−1.07%	8.70E−01	9.91E−01	9.12E−01	9.73E−01	6.19E−02	0.065

Table 5. Results of bootstrapped analysis of the FOX model by Dataset 1.

Param name	Point estimate	Estimated bias in pt estimate	Estimated relative bias	Bias-corrected approximate confidence limits				Inter-quartile range	Relative IQ range
				80% lower	80% upper	50% lower	50% upper		
B1/K	3.01E-01	7.39E-02	24.54%	1.26E-01	1.02E+00	2.16E-01	6.39E-01	4.23E-01	1.406
K	3.79E+05	-4.15E+04	-10.94%	2.99E+05	4.91E+05	3.57E+05	4.79E+05	1.21E+05	0.32
q(1)	1.05E-05	3.28E-06	31.15%	8.10E-06	1.23E-05	8.14E-06	1.04E-05	2.28E-06	0.216
MSY	1.10E+04	1.20E+03	10.93%	9.70E+03	1.34E+04	1.01E+04	1.16E+04	1.55E+03	0.14
Ye(2004)	1.01E+04	5.79E+02	5.76%	8.82E+03	1.07E+04	9.17E+03	1.01E+04	9.45E+02	0.094
Y.@Fmsy	6.75E+03	8.08E+02	11.96%	4.90E+03	8.73E+03	5.65E+03	7.55E+03	1.89E+03	0.281
Bmsy	1.40E+05	-1.53E+04	-10.94%	1.10E+05	1.81E+05	1.31E+05	1.76E+05	4.47E+04	0.32
Fmsy	7.90E-02	2.31E-02	29.19%	5.95E-02	8.22E-02	5.95E-02	7.16E-02	1.22E-02	0.154
fmsy(1)	7.51E+03	2.78E+02	3.70%	5.74E+03	1.11E+04	6.48E+03	9.17E+03	2.70E+03	0.359
B./Bmsy	6.13E-01	3.81E-02	6.22%	3.74E-01	1.03E+00	4.81E-01	8.02E-01	3.21E-01	0.525
F./Fmsy	1.04E+00	-4.27E-02	-4.09%	7.90E-01	1.42E+00	9.28E-01	1.26E+00	3.27E-01	0.313
Ye./MSY	9.13E-01	-2.69E-02	-2.95%	7.47E-01	9.95E-01	8.35E-01	9.75E-01	1.40E-01	0.153

Table 4. Results of bootstrapped analysis of the FOX model by Dataset 2.

Param name	Point estimate	Estimated bias in pt estimate	Estimated relative bias	Bias-cor	rected appr	imate confic	nce limits	Inter-quartile range	Relative IQ range
				80% lower	80% upper	50% lower	50% upper		
B1/K	4.14E-01	5.78E-03	1.40%	3.20E-01	5.56E-01	3.65E-01	4.86E-01	1.21E-01	0.293
K	1.97E+05	5.99E+03	3.04%	1.59E+05	2.81E+05	1.74E+05	2.39E+05	6.49E+04	0.33
q(1)	1.65E-05	4.89E-07	2.96%	1.09E-05	2.09E-05	1.32E-05	1.88E-05	5.59E-06	0.339
MSY	9.61E+03	2.78E+01	0.29%	8.91E+03	9.89E+03	9.20E+03	9.74E+03	5.42E+02	0.056
Ye(2004)	9.50E+03	-5.89E+01	-0.62%	8.73E+03	9.90E+03	9.12E+03	9.75E+03	6.27E+02	0.066
Y.@Fmsy	8.15E+03	1.16E+02	1.42%	6.53E+03	9.81E+03	7.24E+03	9.09E+03	1.85E+03	0.227
Bmsy	7.23E+04	2.20E+03	3.04%	5.84E+04	1.04E+05	6.38E+04	8.77E+04	2.39E+04	0.33
Fmsy	1.33E-01	3.62E-03	2.73%	8.52E-02	1.68E-01	1.02E-01	1.48E-01	4.61E-02	0.347
fmsy(1)	8.06E+03	2.39E+01	0.30%	7.08E+03	9.29E+03	7.53E+03	8.63E+03	1.10E+03	0.136
B./Bmsy	8.48E-01	8.68E-03	1.02%	6.79E-01	1.01E+00	7.55E-01	9.30E-01	1.76E-01	0.207
F./Fmsy	8.07E-01	1.24E-02	1.54%	6.69E-01	1.00E+00	7.27E-01	9.07E-01	1.81E-01	0.224
Ye./MSY	9.88E-01	-9.06E-03	-0.92%	9.46E-01	9.99E-01	9.68E-01	9.97E-01	2.83E-02	0.029