Standardized CPUE for Management Procedure in 2011

2011 年の管理方式のための標準化 CPUE

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Abstract

This paper summarize standardized CPUE of longline fishery for southern bluefin tuna which used for Management Procedure for discussion in the 16th Extended Scientific Committee in 2011. It describes data preparation, CPUE standardization using GLM and area weighting.

要旨

本文書は、2011 年の第 16 回拡大科学委員会での議論のため、管理方式に用いられるミナミマグロ延縄漁業の標準化 CPUE についてまとめたものである。データ準備、GLM を用いた CPUE 標準化、エリア重み付けについて記述する。

Introduction

CPUE index of longline fishery mostly on Japanese will be used as one of the major input data for Management Procedure. This paper describe procedure of making the CPUE index based on the agreed method in CCSBT (Attachment 7 of 15th Scientific Committee of CCSBT).

Data preparation

The dataset used was made from shot-by-shot records of Japanese longline from Japan (1986-2010), from Australia (RTMP data; 1989-2005) and from New Zealand (Joint venture; 1990-2010). Data from Japan are based on logbook data, but RTMP data were used for the most recent years if logbook data were not yet available and RTMP data of the vessel were available. Note that logbook data will be available after one or two years later so that data of operations especially for non-SBT targeting will be added later years.

Dataset was limited within CCSBT statistical areas between Area 4 and Area 9 and months between 4 and 9. CPUE was defined as that for SBT more than equal age 4. Proportion of age 4+ by 5x5 degree square and month was calculated from the CCSBT catch-at-age database, adding catch-at-age data made by Japan for 2009 and 2010. Number of age 4+ catch in Australian data was revised by Australia corresponding to change of length-at-age in 2011.

Core vessels which caught many SBT were selected with x (top rank of SBT catch in a year) = 56 and y (number of years in the top ranks) = 3. X was 52 last year, but increased as 56 because missing of data occurred in year/area strata. A sub-dataset from vessels with a total records of 150,343 was made.

Following corrections were further carried out before CPUE standardization. Delete records operated south of 50 degree South, combined Area 5 and Area 6 into Area 56, and delete operations with extremely high CPUE (>120). The shot-by-shot data were aggregated into 5x5 degree and month. Aggregated data with little effort (< 10,000 hooks) were deleted.

CPUE standardization

CPUE were standardized with GLM using SAS (version 9.2). Small constant of 0.2 was added into CPUE age 4+ before log transform.

Base series:

*log(CPUE+0.2) = Intercept + Year + Month + Area + Lat5 + BET_CPUE + YFT_CPUE + (Month*Area) + (Year*Lat5) + (Year*Area) + Error,*

Two additional CPUE series are made for monitoring purpose of the status of the stock and MP implementation.

Monitoring series 1 (Reduced base model):

*log(CPUE+0.2) = Intercept + Year + Month + Area + Lat5 + (Month*Area) + Error,*

Monitoring series 2: Same procedure as in Base series, but the data used are shot-by-shot daily level rather than the aggregated 5x5 month level.

Standardized CPUE and QQ plots of residual are shown in Fig.1 and Fig. 2.

AIC and BIC were calculated for the base model and the reduced base model which are nested models each other. The base model is appropriate model in terms of AIC, but not in BIC.

Area weighted standardized CPUE

With the estimated parameters obtained from CPUE standardization by GLM, the CS and VS abundance indices were computed by the following equations:

$$CS_{4+,y}=\sum_m \sum_a \sum_l (AI_{CS})_{(1969\text{-}present)}[\exp(Intercept + Year + Month + Area + Lat5 + BET\_CPUE + YFT\_CPUE + (Month*Area) + (Year*Lat5) + (Year*Area) + \sigma^2/2) - 0.2]$$

$$VS_{4+,y}=\sum_m \sum_a \sum_l (AI_{VS})_{ymal}[\exp(Intercept + Year + Month + Area + Lat5 + BET\_CPUE + YFT\_CPUE + (Month*Area) + (Year*Lat5) + (Year*Area) + \sigma^2/2) - 0.2]$$

where

$CS_{4+,y}$	is the CS abundance index for age 4+ and y-th year,
$VS_{4+,y}$	is the VS abundance index for age 4+ and y-th year,
$(AI_{CS})_{(1969\text{-}present)}$	is the area index of the CS model for the period 1969-present,
$(AI_{VS})_{ymal}$	is the area index of the VS model for y-th year, m-th month, a-th SBT statistical area, and l-th latitude,
σ	is the mean square error in the GLM analyses,

Then, w0.5 and w0.8 (B-ratio and geostat proxies) were calculated using the equation below.

$$I_{y,a} = wCS_{y,a} + (1-w)VS_{y,a}$$

The area weighted CPUE value in the most recent year (2010), which was mainly from RTMP and targeting on SBT, was corrected with the constant of 0.889, the average in three years (0.987 in 2007, 0.947 in 2008 and 0.733 in 2009 of ratio Logbook based CPUE / RTMP based CPUE in the core vessel dataset).

The area weighted CPUE series between 1986 and 2010 were calibrated to the historical time series since 1969 based on the agreed method (SAG9 Report in 2008, attachment 5) derived from GLM model using data from all vessels described in Nishida and Tsuji (1998). At the 3rd OMMP Technical meeting held in Seattle in 2010, it was agreed that the pre-1986 series used in MP implementation will be fixed at the values estimated based on data to 2008 only. Calibration would thus in future always be based upon the 1986-2008 points of this series."

Calculated area weighted standardized CPUE are shown in Table 1 and Fig. 3.

Reference

Nishida, T., and S. Tsuji. 1998. Estimation of abundance indices of southern bluefin tuna (*Thunnusmaccoyii*) based on the coarse scale Japanese longline fisheries data (1969-97). Paper submitted to the Commission for the Conservation of Southern Bluefin Tuna, Scientific Meeting. CCSBT/SC/9807/13. 27 pp.

Table 1. Number of records in the dataset used.

Vessels	All Japan	All Australia	All New Zealand	All Total	Core vessel Total
1986	27,043			27,043	3,961
1987	26,821			26,821	4,716
1988	24,418			24,418	5,283
1989	24,312	1,156		25,468	6,649
1990	19,899	504	475	20,878	6,480
1991	18,316	1,204	460	19,980	6,988
1992	17,233	1,717	499	19,449	6,718
1993	14,794	2,001	486	17,281	6,472
1994	12,610	1,394	268	14,272	5,782
1995	12,804	800	373	13,977	5,884
1996	14,854			14,854	6,588
1997	16,322		379	16,701	7,430
1998	16,310		310	16,620	7,782
1999	14,414		306	14,720	7,220
2000	11,745		265	12,010	6,648
2001	14,075		198	14,273	7,280
2002	10,693		228	10,921	5,783
2003	11,563		294	11,857	6,146
2004	13,101		349	13,450	7,737
2005	13,848		198	14,046	7,871
2006	9,124		183	9,307	5,902
2007	5,540		387	5,927	4,134
2008	6,841		167	7,008	4,672
2009	5,217		231	5,448	3,585
2010	3,813		144	3,957	2,632
Total	364,471	8,776	6,200	379,447	150,343

Data are from Area 4-9 and month 4-9.

Table 2. AIC and BIC of Base case model and reduced base case

Model	AIC	BIC
Base	5,928	7,265
Reduced Base	6,088	6,435

Table 3. Area weighted standardized CPUE

	Base	Base	Reduced Base	Reduced Base	Base with SxS	Base with SxS
Year	w08	w05	w08	w05	w08	w05
1969	2.2841	2.4934	2.2841	2.4934	2.2841	2.4934
1970	2.2268	2.4169	2.2268	2.4169	2.2268	2.4169
1971	2.0654	2.2054	2.0654	2.2054	2.0654	2.2054
1972	2.1669	2.2273	2.1669	2.2273	2.1669	2.2273
1973	1.8263	1.9271	1.8263	1.9271	1.8263	1.9271
1974	1.8989	1.9710	1.8989	1.9710	1.8989	1.9710
1975	1.4556	1.4974	1.4556	1.4974	1.4556	1.4974
1976	1.8715	1.9279	1.8715	1.9279	1.8715	1.9279
1977	1.6556	1.6850	1.6556	1.6850	1.6556	1.6850
1978	1.4300	1.3820	1.4300	1.3820	1.4300	1.3820
1979	1.1472	1.2558	1.1472	1.2558	1.1472	1.2558
1980	1.3862	1.3852	1.3862	1.3852	1.3862	1.3852
1981	1.3103	1.2917	1.3103	1.2917	1.3103	1.2917
1982	1.0285	1.0220	1.0285	1.0220	1.0285	1.0220
1983	1.0103	1.0228	1.0103	1.0228	1.0103	1.0228
1984	1.0261	1.0603	1.0261	1.0603	1.0261	1.0603
1985	0.8578	0.8861	0.8578	0.8861	0.8578	0.8861
1986	0.6451	0.6779	0.6717	0.7062	0.6625	0.6919
1987	0.6437	0.6694	0.6904	0.7101	0.6517	0.6733
1988	0.5464	0.5584	0.5208	0.5226	0.5897	0.5933
1989	0.5341	0.5544	0.5294	0.5504	0.5481	0.5616
1990	0.5536	0.5403	0.5941	0.5759	0.4913	0.4809
1991	0.4689	0.4700	0.5222	0.5178	0.4640	0.4701
1992	0.5791	0.5624	0.6263	0.6012	0.5629	0.5494
1993	0.7120	0.6505	0.6837	0.6195	0.6909	0.6490
1994	0.7448	0.6160	0.5735	0.4823	0.7787	0.6437
1995	0.7411	0.6508	0.6996	0.6237	0.8777	0.7451
1996	0.5807	0.5321	0.5541	0.5158	0.5936	0.5523
1997	0.5380	0.4876	0.5709	0.5190	0.5172	0.4741
1998	0.5072	0.5019	0.5331	0.5126	0.4918	0.4823
1999	0.4483	0.4476	0.4699	0.4511	0.4513	0.4507
2000	0.5360	0.4771	0.5221	0.4669	0.5339	0.4822
2001	0.6232	0.5726	0.6129	0.5646	0.6022	0.5561
2002	0.9168	0.7550	0.8278	0.6889	0.8545	0.7086
2003	0.6822	0.5723	0.7103	0.5895	0.6618	0.5608
2004	0.5946	0.5501	0.6526	0.5842	0.5474	0.5078
2005	0.4918	0.4675	0.5390	0.4913	0.4942	0.4677
2006	0.3810	0.3328	0.3775	0.3406	0.4043	0.3471
2007	0.2936	0.2473	0.3510	0.2859	0.3204	0.2705
2008	0.5902	0.4486	0.5195	0.4225	0.5621	0.4240
2009	0.7515	0.5741	0.6637	0.5184	0.7029	0.5223
2010	0.8794	0.6243	0.5708	0.4214	0.8453	0.5883

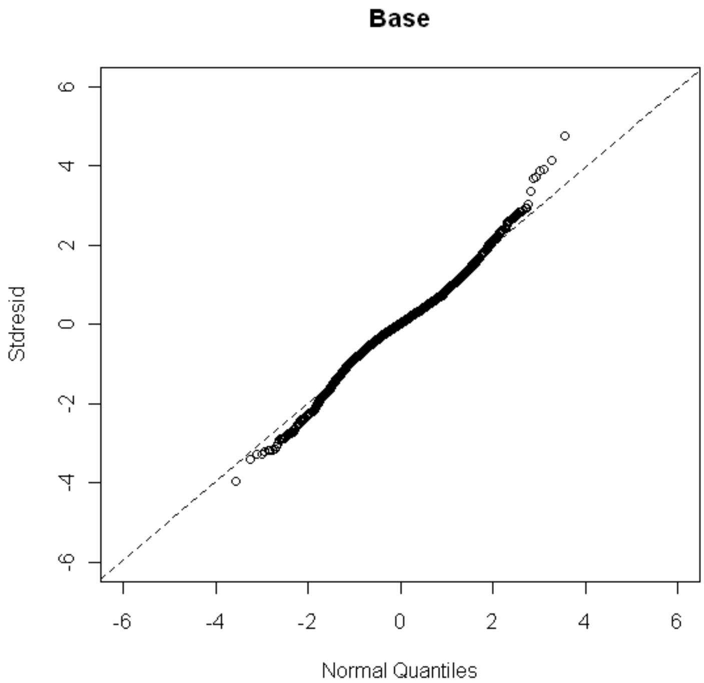


Fig 1. Standardized CPUE (mean with 95% confidence interval) of core vessel data (upper panel) and its QQ plot of residual (lower panel) for Base case.

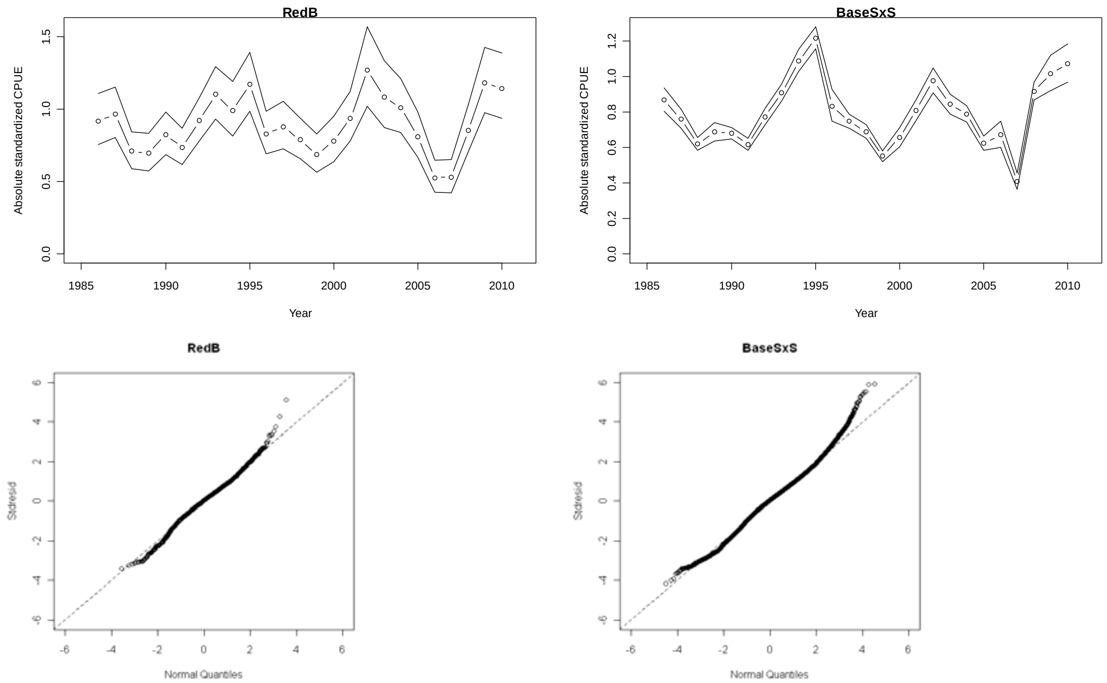
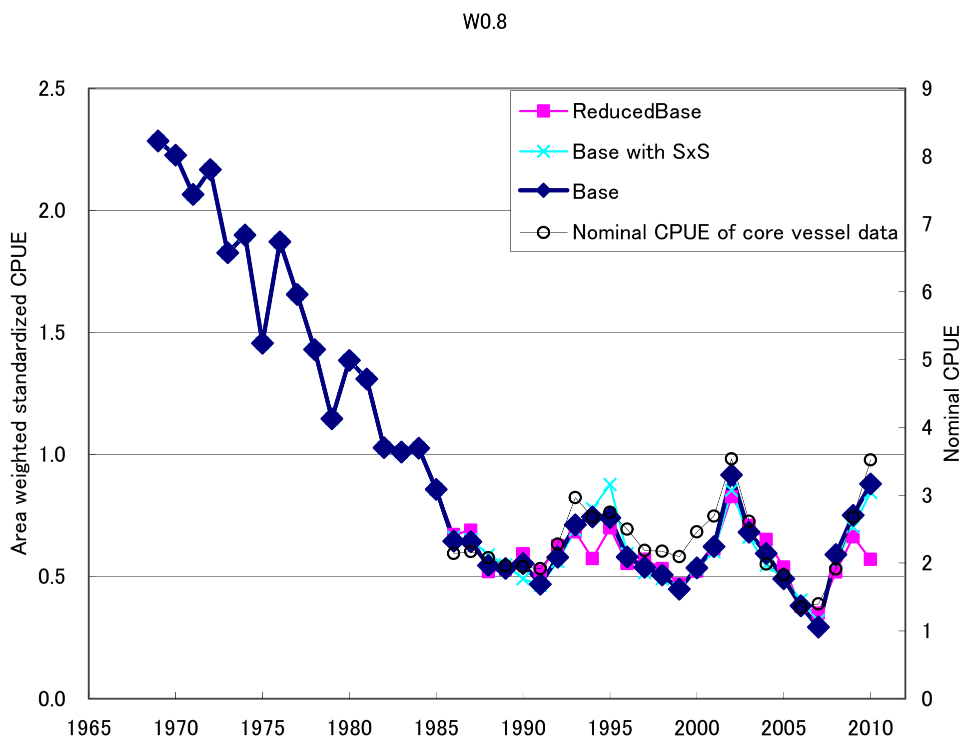


Fig 2. Standardized CPUE (mean with 95% confidence interval) of core vessel data (upper panel) and its QQ plot of residual (lower panel) for monitoring series. Left panels for reduced base case and right panels for shot-by-shot data with base case GLM model.



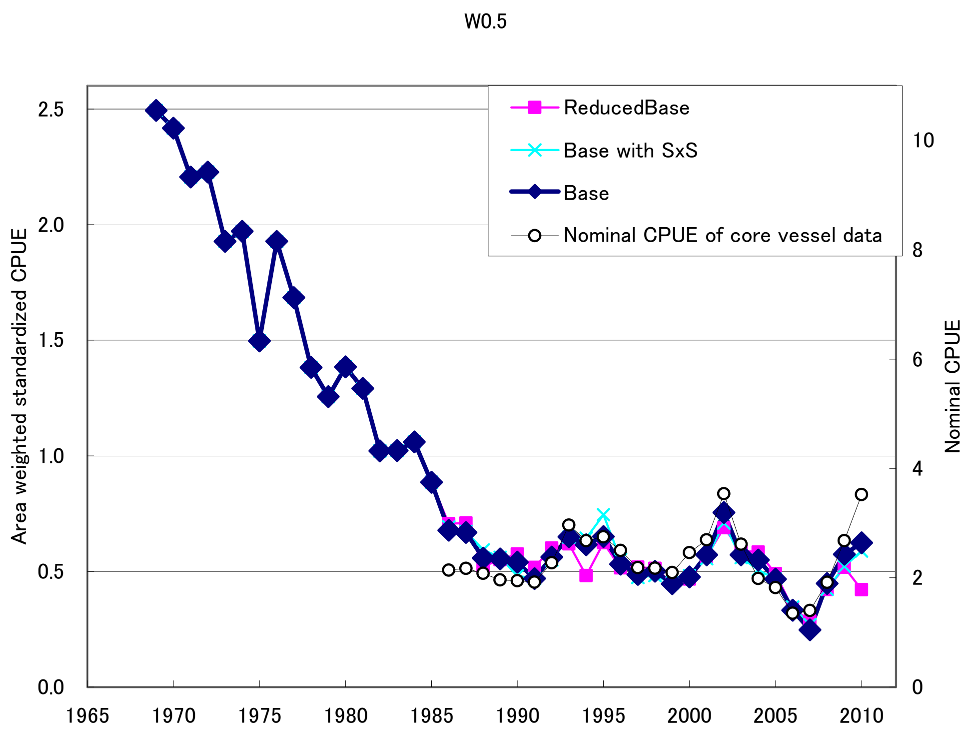


Fig 3. Area weighed standardized CPUEs. Nominal CPUE of the core vessels are also shown.