CPUE comparison for Japanese longline vessels in the RTMP with and without observers

科学オブザーバ乗船時と非乗船時での報告 CPUE の比較

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Summary

RTMP Japanese longline data are compared to investigate the impact of observer presence, so as to provide some qualitative insight into the extent to which market anomaly overcatches might reflect underestimation of CPUE for commercial operations. There was seldom any difference between the CPUE value reported by the scientific observer and that reported by the vessel during the RTMP over 1992-2004. When RTMP CPUEs with and without an observer present are standardized by GLM to allow comparison, there is an indication that CPUE when an observer is present is a somewhat higher in the late 1990s, but no clear general trend overall. Time has been insufficient to allow the statistical significance of this to be checked fully, further analysis is required.

Introduction

The Real Time Monitoring Program (RTMP) was introduced in the Japanese Southern Bluefin Tuna (SBT) target longline fishery in 1991. This program was expanded to all Japanese vessels taking SBT after 1995. The vessels that participate in the RTMP must report the fishing information (position, catch, efforts, etc.) every-day during the fishing season. Since 1992, a scientific observer has conducted research on board the vessel for several trips by RTMP vessels every year. The scientific observer reports on the fishing operation independently of the fishermen, and collects scientific samples.

In this document, we compared the CPUE for the operations in the RTMP between with and without scientific observers. The scientific observer did not monitor all the times hauling of lines was taking place (e.g. observation time was about 80% of all operation time in 2003 (Itoh and Miyauchi 2004)). Therefore, we did not compare the data from the scientific observer directly with those reported by the vessel, but made adjustments at two levels, as described below.

1) In order to examine whether the observer data agrees with that for the identical operation reported by the vessel for the RTMP, we adjusted the number of fish caught as recorded in the scientific observer data by the proportion of the time that the observer watched the operation.
2) In order to examine whether the data of operations with scientific observers on board is representative of RTMP data without observers present, CPUE information was first standardized by GLM to remove the effects of other explanatory variables to attempt to exclude sources of potential bias before making comparisons.

Method

[Comparison of CPUE for the same RMTP operation as reported by vessels and as observed by the scientific observers]

The data used for these analyses were taken from the scientific observer reports and the corresponding RTMP reports submitted by the vessel concerned over the period 1992-2004 throughout areas 1-10. From both data series, we extracted the fishing information (numbers of hooks and of fish caught) for all operations which were reported in both, and aggregated every 5° x 5° square monthly. Catch per unit effort (CPUE) was calculated as the number of SBT caught per 1000 hooks.

In correcting CPUE for the proportion of time that hauls were not recorded by the observer, the mean value for the other observed hauls on the same trip was assumed to apply. Where there was no record of the observation time of any of the hauls during the trip, adjustments were made by use of the mean value for operations during other trips in the same year.

[Comparison of CPUE between RTMP vessels with and without scientific observers]

The data used for these analyses were taken from RTMP reports over 1995-2005 and in the areas 4, 7, 8, and 9 only (in close correspondence with the procedure used to develop CPUE indices for assessments). We divided the data according to whether or not a scientific observer was on board, and first compared the corresponding CPUEs (nominal CPUEs). Then to allow for the effect of possible explanatory variables, CPUE standardization was carried out using CPUE model with Log-Nomral error structure through a generalized linear model (GLM). Main effects and two-way interactions of Year, Area, Month, Observer (i.e. on board or not) and HPB (hooks per basket) were initially included into the model. This CPUE standardization excluded data for 1995 and 1996, because SBT of <25 kg were released in both these years by vessels without a scientific observer on board (Itoh 1996) and also excluded data for months 4, 8, and 12 because the number of observations is small. At first, we assumed the following formula as a full model:

-Full model-

log(CPUE+0.1) = Intercept + Year + Area + Month + Observer + HPB + (Year*Area) + (Year*Month) + (Year*Observer) + (Area*Observer) + (Month*Observer) + (Year*HPB) + (Area*HPB) + (Month*HBP) + (Observer*HPB) + (Error), where Error$\sim N(0, \sigma^2)$

As a result of variable selection process based on the statistical stepwise F test with a one percent level of significance, the following model was finally selected.

(Note: All explanatory variables except for HPB were incorporated into the model as non-ordered categorical variables and HPB were included as a continuous variable because there seems to be linear relationship between CPUE and HPB in this case.)

-Finally selected model-

log(CPUE+0.1) = Intercept + Year + Area + Month + Observer + HPB + (Year*Area) + (Year*Observer) +

(Area*Observer) + (Year*HPB) + (Month*HBP) + (Error),

where Error～N(0, σ^2) (See Table 3)

Results

[Comparison of CPUE for the same RMTP operation as reported by vessels and as observed by the scientific observers]

A total of 7433 operations were considered in the comparison (Table 1). The mean observation time of the scientific observers per operation was about 82%. The year-to-year values of CPUE for both data were virtually identical (Fig 1).

[Comparison of CPUE between RTMP vessels with and without scientific observers]

For the areas 4, 7, 8, and 9 and times considered, the number of operations when a scientific observer was on board was 6405, and the number without such an observer was 152383 (Table 2). The annual observer coverage proportion for the RTMP vessels ranged over 4.74-9.25% (Table 2). Over 1995-2005, there was little difference between nominal mean CPUEs with and without observers (see Fig. 2), except for the first two years where the difference arises from different procedures for dealing with small fish as described above.

Figure 3 and 4 show the point estimates and 95% confidence intervals (including the point estimates) for the year trends of the standardized CPUE with observer and without observer, respectively. While there is some indication of higher CPUEs with an observer present in the earlier years, there is no clear trend overall. The histogram of the standard residuals, shown in Figure 5, seems to be approximately normal distributed.

As regards implications for possible bias in existing Japanese longline commercial CPUE given the market anomalies, these analyses suggest that catch underreporting in the data from longline vessels upon which the existing CPUE estimates are based is not large if it exists. However, it is important to appreciate the initial and limited scope of these analyses.

References

Itoh, T. 1996. Japanese SBT fisheries in 1995 and 1996. CCSBT/SC/96/1 21p

Itoh, T., T. Nishida, and S. Tsuji. 1997. Southern Bluefin Tuna catch by Japan. CCSBT/SC/97/11 29p

Table 1. Number of longline operations reported by the scientific observers (adjusted as described in the text) and by the fishermen in the area 1-10 for the RTMP

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Operation number	789	467	544	804	553	607	397	446	503	585	468	656	614

Table 2. Number of vessels and of operation reported during the RTMP, and the prortional coverage by obdservers, in the areas 4,7,8 and 9.

Year	Vessel number				Total operation number	
	RTMP vessels...(A)	Operated with observer...(B)	Operated without observer	Coverage rate ...(B)/(A)	With observer	Without observer
1995	185	12	182	6.49%	813	9120
1996	210	15	210	7.14%	562	12754
1997	207	14	206	6.76%	597	16009
1998	211	10	210	4.74%	415	15965
1999	185	14	183	7.57%	443	14011
2000	167	12	165	7.19%	538	14834
2001	187	15	187	8.02%	623	15326
2002	173	16	172	9.25%	480	12568
2003	163	14	161	8.59%	650	12638
2004	169	13	167	7.69%	621	14511
2005	161	14	157	8.70%	663	14647

Table 3 ANOVA table for the finally selected model.

Source	DF	Type III SS	Mean Square	F Value	Pr > F
observer	1	3.64509612	3.64509612	7.87	0.0051
year	8	14.52978238	1.81622280	3.92	0.0001
area	3	16.11997915	5.37332638	11.61	<.0001
month	5	8.55648935	1.71129787	3.70	0.0025
year*area	24	37.68093403	1.57003892	3.39	<.0001
year*month	40	58.78985696	1.46974642	3.18	<.0001
observer*year	8	14.25067015	1.78133377	3.85	0.0002
observer*area	3	5.65852899	1.88617633	4.07	0.0068
HPB	1	4.41762203	4.41762203	9.54	0.0020
HPB*year	8	15.09894131	1.88736766	4.08	<.0001
HPB*month	5	9.63086211	1.92617242	4.16	0.0009

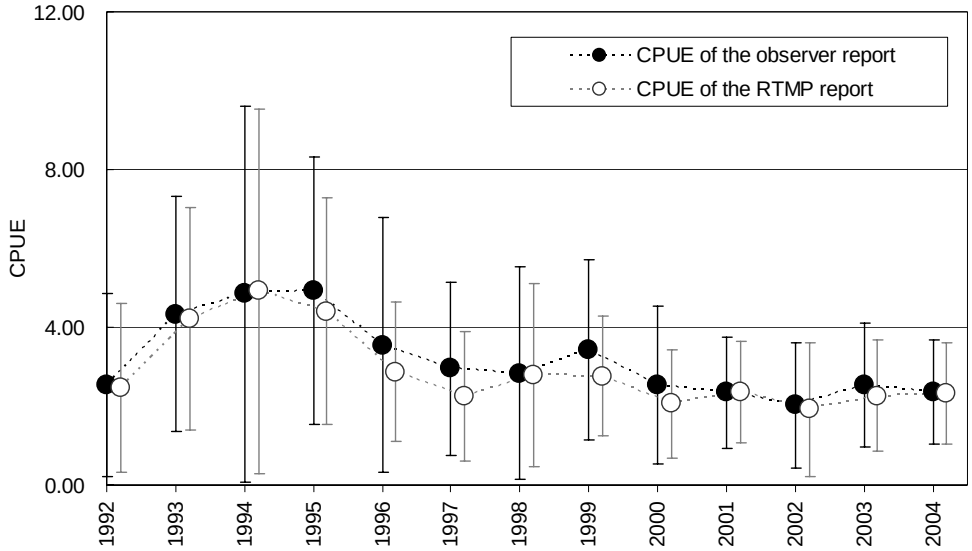

Fig. 1. Mean CPUE (Catch number/ 1000 Hooks) from the RTMP report and from the scientific observer reports over 1992-2004 in areas 1-10 (error bar is ± 1 S. D.)

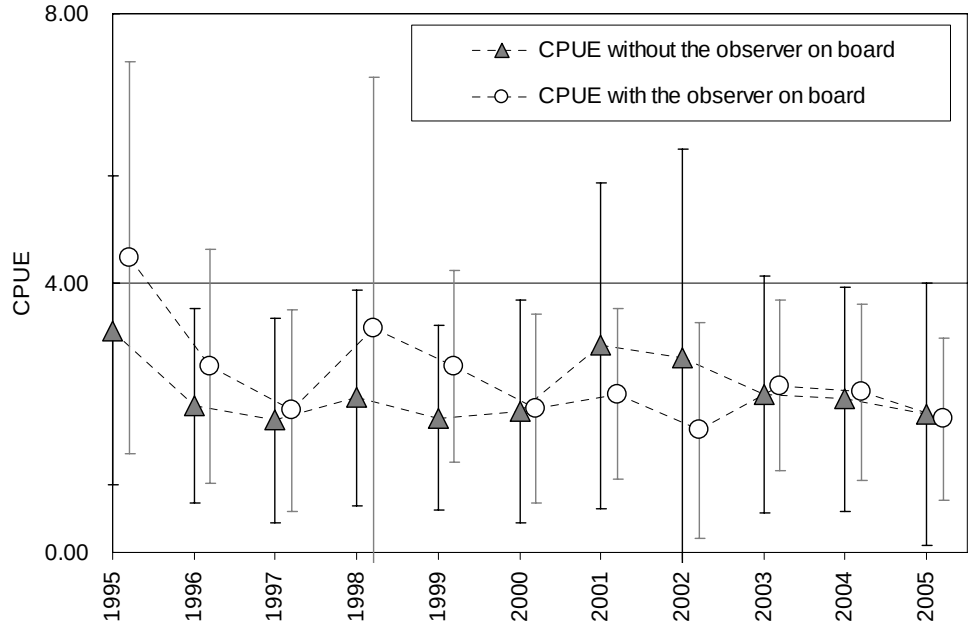

Fig. 2. Mean (nominal) CPUE (Catch number/ 1000 Hooks) from the RTMP reports both with and without a scientific observer on board over1995-2005 in area 4, 7, 8, 9 (error bars are ± 1 S. D.)

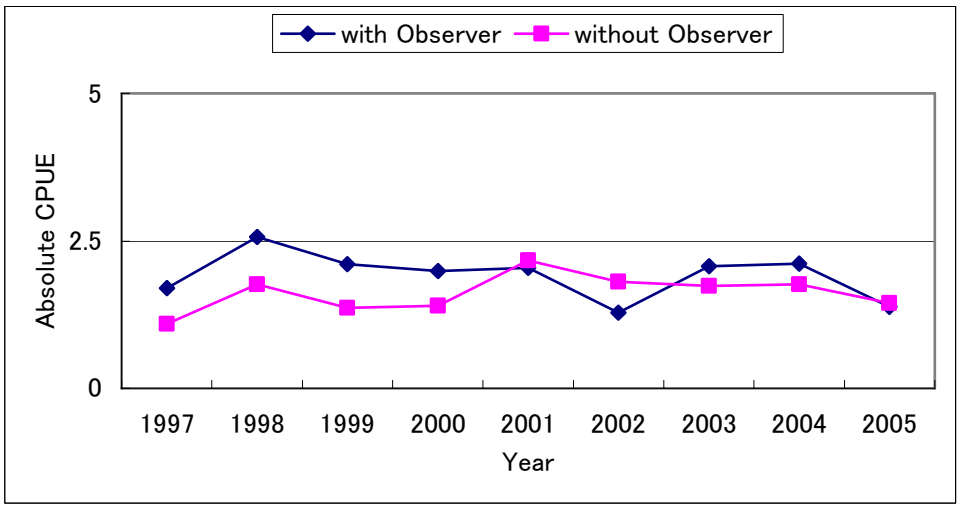

Figure 3 Point estimates of the year trends of standardized CPUE with and without scientific observers.

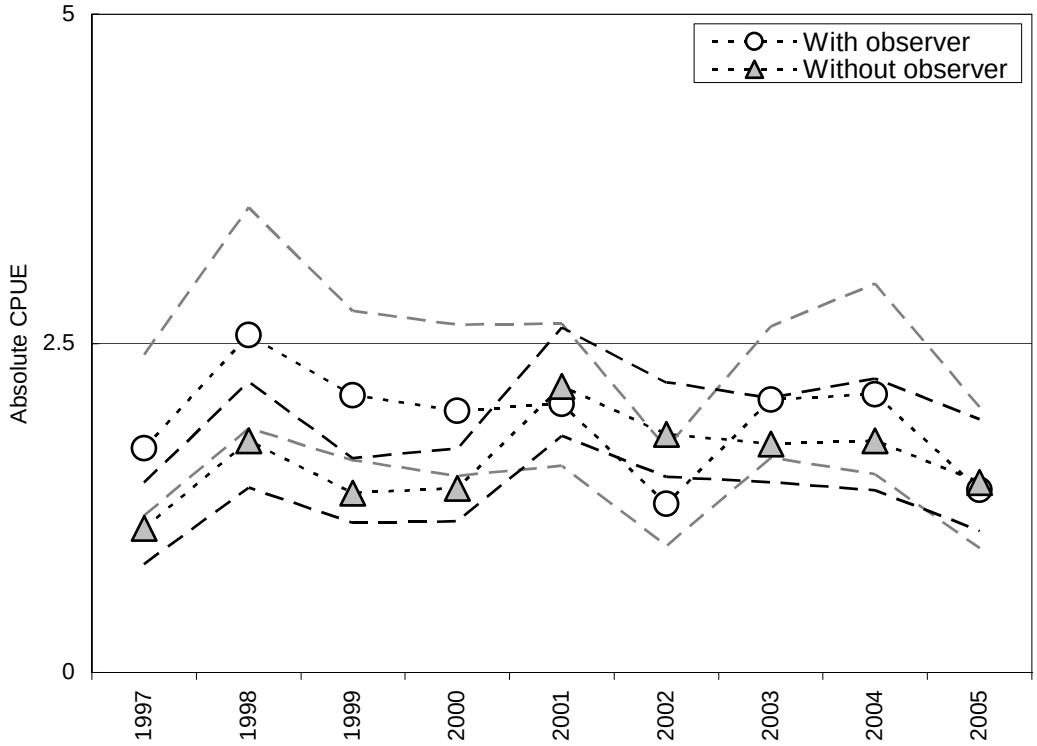

Figure 4 Point estimates and the 95% confidence intervals of the year trends of standardized CPUE with and without scientific observers.

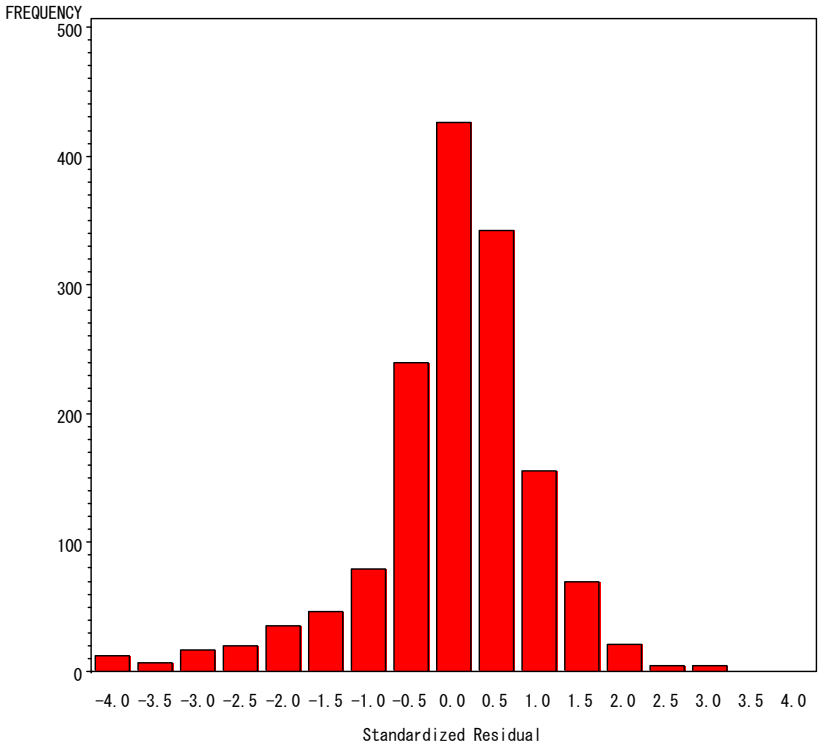

Figure 5 Histgram of standardized residuals for the finally selected model.