Summary of reference point for North Pacific albacore tuna stock assessment [1]

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Abstract

We summarized the calculation method and unit of F-based reference points for North Pacific albacore stocks. Based on this result, we proposed the options on the calculation method of F based reference point to be used for the stock assessment in 2017.

Introduction

Western and Central Pacific Fisheries Commission of Northern Committee (WCPFC NC) agreed to use $20\%SSB_{F=0}$ for the biological limit reference point (RPs) of North Pacific albacore (WCPFC NC10 2014). On the other hand, there was no agreement on the F-based reference point. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) carried out North Pacific albacore (NPALB) stock assessment considering two sex age-structured population dynamics using the stock synthesis 3 (SS3) (ISC 2014). To verify the different life history by two genders for the RPs, Akita & Ijima (2016) calculated the F-based RPs using the previous NPALB stock assessment result. However, this result was different from the last assessment result. ALBWG requested to report the reason of this differences (ALBWG 2016). Here, in this paper, we summarized the calculation method of F-based RPs used in NPALB stock assessment, it also compiled the notation method. Furthermore, based on this result, we proposed some options on the calculation method of F-based RPS to be used in this stock assessment.

Here, we estimated catch at length data for Japanese longline and pole and line fishery and summarize historical or seasonal change of catch at length data and we suggest fishery definition for stock synthesis 3.

Methods

Regarding the F-based RPs utilized by NPALB stock assessment, $F_{ssbathl}$, F_{msy}, $F0.1$, F_{med} and $Fx\%$ were calculated in the previous stock assessment. In this stock assessment, F_{msy}, $F0.1$, and $Fx\%$ will be used (ref). Thus, in this paper, we summarized calculation methods and their units for F_{msy}, $F0.1$, $Fx\%$.

Result and discussion

The F-based RPs of NPALB can be calculated by the following four calculation methods.

1. Using SS3 result 1 (SS_1): Calculated from time_series of Report.sso.
2. Using SS3 result 2 (SS_2): Need to set Forecast file.
3. Using SS3 result 3 (SS_3): Calculated from SPR/YPR_PROFILE of Report.sso.
4. Calculation outside of SS3 (Outside): Using SS3 output, RPs were calculated by F at age.

In the previous stock assessment, F-based RPs were calculated using various methods (Table 1). There are some difficulties to understand this table. In particular, as the units differ for each RPs for the F ratio, it is impossible to compare the RPs (Table 1). Also, in the SS 3, SPR is an abbreviation for Spawner Potential Rate, which is different from general Spawning Per Recruitment analysis which also means SPR. Akita & Ijima's (2016) calculated SPR using Spawning Per Recruitment analysis. The reason why Akita & Ijima's result differs from the result of previous stock assessment result is that the notation unit is different and the calculation method (especially SPR) is also different (Table 2).

In the stock assessment, calculation of the candidate F-based RPs is one of the most important results. For easy of understanding, it is desirable to unify calculation methods and units. Therefore, we propose the following three options on how to calculate and compile F-based RPs.

Option 1: Follow the method and unit in last stock assessment.

Option 2: All calculations will be done externally.

Option 3: All calculations will be done using SS3.

The result of option 1 is consistency with the previous assessment can be maintained. However, it is very difficult to understand because calculation methods and units were mixed (Table 1). For the option 2, calculation method and unit are unified (Table 3). Furthermore, there is a little confusion about the word of SPR because option 2 is performing Spawner Per Recruitment analysis. The option 3 can be obtained from SPR/YPR_PROFIL of Report.sso. Thus it is possible to calculate all F-based RPs from SS3 in a unified method. Also, if all units are SPR* based, it is possible to compare all RPs (Table 4). The methodology of option 3 is highly transparent because option 3 is relatively easy to perform from the SS3 output. However, SS3 can't calculate total biomass that corresponding to equilibrium yield.

References

Western and Central Pacific Fisheries Commission. 2014, Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean Summary report.
ISC Albacore tuna working group. 2014, Stock assessment of Albacore tuna in the North Pacific Ocean in 2014.
Akita, Tetsuya and Ijima, Hirotaka. 2016 Reference points under the hypothesis of a sex-specific life-history. ISC/16ALBWG-02
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Table 1: Calculation method of RPs in 2014 assessment. SS_1: Using the output of Report.sso (time_series). SS_2: Need to set forecast file. SPR*: Spawning Potential Ratio equal to SSB_{fished}/SSB_{zero}.

	F_{1012}/F_{rps}		SSB	Yield
RPs	Method	Unit	Method	Method
F_{MSY}	SS_2	$Fstd/Fstd_{MSY}$	SS_2	SS_2
$F0.1$	Outside	$1/Fmult$	Outside	Outside
$F10\%$	SS_1	(1-SPR*)/(1-0.1)	SS_2	SS_2
$F20\%$	SS_1	(1-SPR*)/(1-0.2)	SS_2	SS_2
$F30\%$	SS_1	(1-SPR*)/(1-0.3)	SS_2	SS_2
$F40\%$	SS_1	(1-SPR*)/(1-0.4)	SS_2	SS_2
$F50\%$	SS_1	(1-SPR*)/(1-0.5)	SS_2	SS_2

Table 2: Comparison ISC 2014 and Akita & Ijima (2016). SS_1: Using the output of Report.sso (time_series). SS_2: Need to set forecast file. SPR*: Spawning Potential Ratio equal to SSB_{fished}/SSB_{zero}. SPR: Spawner Per Recruitment analysis.

	ISC 2014			Akita & Ijima (2016)		
RPs	F_{1012}/F_{RP}	Method	Unit	F_{1012}/F_{RP}	Method	Unit
F_{MSY}	0.52	SS_2	$Fstd/Fstd_{MSY}$	0.46	Outside (MSY)	$1/Fmult$
$F0.1$	0.51	Outside (YPR)	$1/Fmult$	0.53	Outside (YPR)	$1/Fmult$
$F10\%$	0.63	SS_1	(1-SPR*)/(1-0.1)	0.32	Outside (SPR)	$1/Fmult$
$F20\%$	0.71	SS_1	(1-SPR*)/(1-0.2)	0.48	Outside (SPR)	$1/Fmult$
$F30\%$	0.81	SS_1	(1-SPR*)/(1-0.3)	0.66	Outside (SPR)	$1/Fmult$
$F40\%$	0.94	SS_1	(1-SPR*)/(1-0.4)	0.89	Outside (SPR)	$1/Fmult$
$F50\%$	1.13	SS_1	(1-SPR*)/(1-0.5)	1.21	Outside (SPR)	$1/Fmult$

Table 3: The calculation method of Akita & Ijima (2016). SPR means Spawner Per Recruitment analysis.

	F_{1012}/F_{RP}		SSB	Yield
RPs	Method	Unit	Method	Method
F_{MSY}	Outside (MSY)	$1/Fmult$	Outside (MSY)	Outside (MSY)
$F0.1$	Outside (MSY)	$1/Fmult$	Outside (MSY)	Outside (MSY)
$F10\%$	Outside (MSY)	$1/Fmult$	Outside (MSY)	Outside (MSY)
$F20\%$	Outside (MSY)	$1/Fmult$	Outside (MSY)	Outside (MSY)
$F30\%$	Outside (MSY)	$1/Fmult$	Outside (MSY)	Outside (MSY)
$F40\%$	Outside (MSY)	$1/Fmult$	Outside (MSY)	Outside (MSY)
$F50\%$	Outside (MSY)	$1/Fmult$	Outside (MSY)	Outside (MSY)

Table 4: The alternative calculation method using the SS3 output. SS_1: Use the output of Report.sso(time_series). SS_3: Use SPR/YPR_PROFILE. SPR^* means Spawning Potential Ratio (SPB_{fished}/SPB_{zero}).

	F_{1012}/F_{RP}		SSB	Yield
RPs	Method	Unit	Method	Method
F_{MSY}	SS_1	(1-SPR^*)/(1-SPR^*F_{msy})	SS_3	SS_3
$F0.1$	SS_1	(1-SPR^*)/(1-$SPR^*F0.1$)	SS_3	SS_3
$F10\%$	SS_1	(1-SPR^*)/(1-0.1)	SS_3	SS_3
$F20\%$	SS_1	(1-SPR^*)/(1-0.2)	SS_3	SS_3
$F30\%$	SS_1	(1-SPR^*)/(1-0.3)	SS_3	SS_3
$F40\%$	SS_1	(1-SPR^*)/(1-0.4)	SS_3	SS_3
$F50\%$	SS_1	(1-SPR^*)/(1-0.5)	SS_3	SS_3