Estimation of Unaccounted Mortality in the Japanese Fisheries

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Summary

Unaccounted mortality of Pacific bluefin tuna (PBF) in the Japanese fisheries is estimated. As the management measures on PBF are progressively tightened, together with the recovery of the stock, more and more information regarding release of bycaught PBF to comply with catch limit surfaced. It is important to incorporate such unaccounted mortality in the stock assessment. Here, we evaluated available information regarding the release of PBF. In order to reliably estimate the unaccounted mortality, quantitiative information on the amount of bycatch by fishing gear, how they are released, and the survivability of each release method are necessary but it was found that no reliable data is available for any of those. As such, we propose to apply unaccounted mortality of 5% of reported catch for all Japanese fisheries as expert guess for FY 2017 and 2018 when release of PBF considered to have become significant.

Introduction

In a stock assessment it is important to account for all the human induced mortality as precise as possible to reliably model the resource dynamics. This includes the mortality which is often not reported, such as discarded bycatch, mortality of released fish and damaged catch from predation. For valued fish as Pacific bluefin tuna (PBF), such unaccounted mortality has not been considered substantial except for a few special situations. However, as stricter regulations are introduced for PBF fisheries in Japan to recover the stock, more and more information has surfaced regarding the release of PBF in various fisheries in order to comply with allocated catch limit.

When fish is released from fishing gear, some portion will eventually perish due to physical stress it experienced while being harvested (post-release mortality). As the amount of release increases, naturally the mortality related to release would also go up. In case of Japan, the control of PBF fisheries became stricter from 2017 after it substantially overshot its catch limit under WCPFC in 2016. Moreover, in 2018 the stock has formally became a part of TAC system, allocating legally binding quota for each prefecture or fishing industry. As a result, from 2017 we hear many complaints and anecdotal information regarding release of PBF in Japanese fisheries.

Most noticeable fishing gear which likely catch PBF unintentionally or unwillingly in Japan is setnet. Setnet is a type of trap net consisting of large net structure to catch fish and a long leader to direct fish into the main net, all are anchored to the sea floor. This fishery has been deployed throughout the Japanese coastal line from ancient times. As the gear is a passive fishing gear, fishermen cannot choose fish to come into the net. After the introduction of stricter control in 2017, fishermen around Japan is complaining about the difficulty of avoiding and releasing of PBF in setnet fisheries. How fish are released from setnet is not well recorded and would vary

among sites. In some sites, reportedly the net is lowered to free fish including PBF when a large number of PBF is found in the net, in which case post-release mortality would be negligible. In some other cases when small number of PBF is found at the end of hauling, PBF may be scooped by a large hand net to be released. In such cases the PBF may be stressed through hauling process as well as scoop by net and could have substantial level of post-release mortality.

In other fisheries, information is also sparse. Based on the catch record and interview survey, the other major fisheries where release of PBF may occur would be purse seine, longline and trolling. In purse seine fisheries, which can choose species to catch, release may occur when allocation for a particular vessel is reached and the catch of final operation is larger than the remainder of the allocation. In this case, the released fish would probably be all dead. In longline fisheries, the catch of PBF was suspended in the middle of fishing season in FY2017 and 2018 because their catch allocation was almost exhausted. During the suspension period, the vessels are expected to shift fishing ground where species other than PBF is more abundant but bycatch of PBF may still occur and such PBF would be released. As one longline operation takes hours, not always but often times harvested PBF is dead when retrieved to the vessel as we hear. For trolling fisheries, the vessels would change the target once the allocation is exhausted. However, PBF still may be bycaught thereafter, which needs to be released. The fish is alive when brought on board but experience in farming suggests that certain portion of released fish would eventually perish due to the stress from being hooked.

Above are the main sources of assumed unaccounted mortality of PBF in the Japanese fisheries. Then the challenge is how to estimate the amount of such mortality. Mortality should be calculated as the amount of bycaught PBF multiplied by the mortality rate. Firstly, the amount of bycaught PBF in those fisheries is not well recorded, even though we have some information. Secondly, post-release mortality would naturally be different depending on fishing gear and also how a fish is released even in a same gear. Therefore, in order to reliably estimate unaccounted mortality caused by bycatch release, the amount of bycatch by fishing gear, how they are released, and the survivability of each release method need to be estimated. Unfortunately, there is no reliable data for any of those elements. This paper therefore intends to propose a temporary approach on how the 2020 PBF assessment should deal with the unaccounted mortality in the Japanese fisheries. It should be noted that since 2012 the number of PBF caught for farming by trolling vessels in the assessment (Fleet 16) has been doubled from the reported number, which is based on number of fish caged at farming facility, because substantial but unknown level of mortality between harvest and caging is expected (ISC, 2013).

Method

Based on the following approach we estimated unaccounted mortality of PBF in the Japanese fisheries.

Year:

As we hear many information regarding the release of PBF after the introduction of stricter control since 2017, we assume that substantial level of release started in FY 2017. Therefore, it is proposed that unaccounted mortality by the Japanese coastal and offshore fisheries except trolling for farming be estimated for FY 2017 and 2018 for the purpose of the assessment.

Fishing gears:

In principle, release of bycaught PBF can occur in all fishing gears in Japan once allocated catch limit is exhausted for a vessel, a region, a prefecture, or nationally. Therefore, it is proposed that all Japanese fleets, except for troll fishery for farming (Fleet 16) whose unaccounted mortality is already incorporated in the assessment, should be included in the estimation of unaccounted mortality.

How to estimate unaccounted mortality:

As noted above, three elements (the amount of bycatch by fishing gear, how they are released, and the survivability of each release method) are necessary to reliably estimate the unaccounted mortality but no reliable data is available for any of those. In setnet fisheries, it is expected that the larger the amount of PBF bycatch, the more likely that fishermen would lower the net to release fish since scooping thousands of PBF is too burdensome, thus the more the bycatch PBF is, the more likely fish would survive. In case of purse seine, if it happens, release of bycaught PBF, which would be all dead fish, is expected to occur only once at the very end of PBF fishing season and then the vessels would change fishing ground and/or gear thereafter. So, the mortality would be high but release would not be very frequent for this fishery. In case of fisheries using hooks (longline, trolling, and handline), release of bycaught fish, if happens, would happen only for a short period of time when fishing for PBF is restricted AND also PBF is available, with certain level of mortality.

Based on those considerations, we consider that it is not worthwhile to try to come up with specific hypotheses for above three elements for all fisheries at this juncture. Instead, we propose to apply unaccounted mortality of 5% of reported catch for all Japanese fisheries (except for Fleet 16) as expert guess for FY 2017 and 2018. It is also proposed to apply higher CV for the unaccounted mortality in the assessment modeling as it is more uncertain than the reported catch. By doing so,

we hope the model can deal with the data in a proper manner.

In addition, selectivity and timing of catch for the unaccounted mortality need to be specified to be included in the assessment. We propose to assume the unaccounted mortality to occur in the end of Japanese management year as the release of discard is expected to happen towards the end of allocation. Note that Japan applies different management year to different groups of fisheries; for fisheries with national government licenses, calendar year applies and for fisheries with local government licenses, July to next March in 2017 and April to next March in 2018 (Japan, 2019). As to the selectivity, it is not meaningful to try to estimate selectivity precisely for unaccounted mortality as mortality itself is a sort of "guesstimation". Therefore, in order to cover wide range of size of fish, we propose to mirror the selectivity of setnet for all unaccounted mortality.

Results

Based on the above suggestions, we calculated the estimated the unaccounted mortality for PBF in Japanese fisheries in FY 2017 and 2018 (Table 1: those reported in weight and Table 2: those reported in number). We separated Japanese fisheries into national government license and prefecture government license and calculated estimated unaccounted mortality for each based on respective management year.

Conclusions

Here we propose an approach how the 2020 PBF assessment should deal with the unaccounted mortality in the Japanese fisheries given their very data poor situation. The assessment modeling team should consider the proposal and incorporate this into the assessment appropriately.

It should be noted that the unaccounted mortality here is estimated solely for the purpose of 2020 assessment and not intended for catch reporting or compliance monitoring purposes.

Also, we believe it is important for ISC to encourage all PBF harvesting members to strive to improve data collection for unaccounted mortality of PBF.

Reference

ISC, 2012. Report of Pacific Bluefin Tuna Working Group Workshop, Appendix A.

Japan, 2019. Report on CMM 2018-02 (Pacific bluefin tuna). Delegation paper submitted to the WCPFC Northern Committee fifteen regular session, Portland Oregon, U.S.A. 3-6 September 2019. (WCPFC-NC15-2019/DP-05 (Rev.01))

Table 1: Estimation of unaccounted mortality for national government license (grey shaded) and prefecture government license (no shade), which are reported in weight. 5% unaccounted mortality is assumed for each fleet and summed up for the end of respective management year.

Fishing Year	Fishing Season	Calendar Year	Calendar Quarter	National government license			Prefectural government license	National government license	Prefectural government license	National government license		Prefectural government license	National government license	Prefectural government license	National government license	Prefectural government license	Prefectural government license	Prefectural government license	Prefectural government license	Prefectural government license	Prefectural government license	Prefectural government license	Prefectural government license	Prefectural government license	Prefectural government license	Prefectural government license	Prefectural government license	Total	National government license	Prefectural government license
				Fleet 1	Fleet 1	Fleet 1	Fleet 1	Fleet 2	Fleet 2	Fleet 4	Fleet 5	Fleet 6	Fleet 7	Fleet 7	Fleet 7	Fleet 7	Fleet 8	Fleet 8	Fleet 9	Fleet 9	Fleet 10	Fleet 11	Fleet 11	Fleet 11	Fleet 11	Fleet 18	Fleet 18	Fleet 19		Fleet 26	Fleet 26
				Dist & Off LL (NPO)	Dist & Off LL (SPO)	Small Offs LL	Coastal LL w/o TsugaruLL	JP SPPS	SPPS Coastal	JP TPSJS	JP TPSPO	Troll	Offs.PL	Coastal PL	Large meshed drift net	Other Gill net	Setnet w/o HKAM	Unclassified	Setnet w/o HKAM	Unclassified	Setnet HKAM	Handline conv.	Other LL	Trawl	Tsugaru LL	JP SPPS	SPPS coastal	Troll		Discard	Discard
2016	3	2017	1	4.9	0.0	39.7	5.3	72.8	9.7	0.0	0.0	177.8	0.9	0.3	29.2	0.1	478.6	0.4	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	821		
2016	4	2017	2	9.7	0.0	211.7	136.6	116.2	15.1	0.0	1620.4	5.8	27.2	0.0	36.6	0.0	0.0	0.0	366.0	1.6	175.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2722		
2017	1	2017	3	6.7	0.0	6.7	23.6	107.3	4.1	1690.7	0.0	0.0	20.6	0.0	11.0	0.0	259.1	0.3	0.0	0.0	518.1	0.0	0.0	0.0	0.0	0.0	0.0	81.9	2730		
2017	2	2017	4	5.8	0.0	3.1	26.1	0.0	0.0	0.0	0.0	298.9	0.1	0.2	1.0	0.1	107.4	1.4	0.0	0.0	315.9	558.7	39.9	0.0	439.9	356.6	18.2	0.0	2173	218.940463	
2017	3	2018	1	6.0	0.0	37.4	15.6	10.8	0.3	0.0	0.0	81.1	0.0	0.9	29.3	0.2	147.5	0.1	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	330		
2017	4	2018	2	7.6	0.0	135.0	211.6	71.8	9.4	0.0	1571.4	15.0	8.3	0.0	13.1	3.7	0.0	0.0	208.6	0.7	36.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2292		171.260295
2018	1	2018	3	2.1	0.0	0.7	7.9	123.4	0.3	1536.2	0.0	0.0	0.0	0.0	0.3	4.4	98.0	0.0	0.0	0.0	37.4	0.0	0.0	0.0	0.0	0.0	0.0	41.8	1853		
2018	2	2018	4	5.3	0.0	6.4	25.1	0.0	0.0	0.0	0.0	195.8	0.0	0.0	1.8	5.8	109.6	0.9	0.0	0.0	7.1	256.3	19.1	0.0	253.2	94.8	0.2	0.0	981	183.086838	
2018	3	2019	1	11.4	0.0	168.9	14.1	8.3	0.0	0.0	0.0	296.1	0.1	0.0	33.3	1.8	226.3	6.4	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	768		80.4267846
2018	4	2019	2	8.2	0.0	271.1	144.1	151.6	0.9	0.0	1566.6	50.9	0.0	0.0	5.9	3.1	0.0	0.0	232.6	0.0	51.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2487		

Table 2: Estimation of unaccounted mortality for national government license (grey shaded) and prefecture government license (no shade), which are reported in number. 5% and 100% unaccounted mortality are assumed respectively and summed up for the respective fishing season.

Fishing Year	Fishing Season	Calendar Year	Calendar Quarter	Prefectural government license	National government license	National government license	Prefectural government license
				Fleet 16	Fleet 20	Fleet 27	Fleet 27
				J Troll (Penning)	JP SPPS (Penning)	Discard	Discard
1998	1	1998	3	23.5	0.0		23.5
1998	2	1998	4	0.0	0.0		
1998	3	1999	1	0.0	0.0		
1998	4	1999	2	0.0	0.0		
1999	1	1999	3	107.2	0.0		107.2
1999	2	1999	4	0.0	0.0		
1999	3	2000	1	0.0	0.0		
1999	4	2000	2	0.0	0.0		
2000	1	2000	3	190.9	0.0		190.9
2000	2	2000	4	0.0	0.0		
2000	3	2001	1	0.0	0.0		
2000	4	2001	2	0.0	0.0		
2001	1	2001	3	274.6	0.0		274.6
2001	2	2001	4	0.0	0.0		
2001	3	2002	1	0.0	0.0		
2001	4	2002	2	0.0	0.0		
2002	1	2002	3	358.2	0.0		358.2
2002	2	2002	4	0.0	0.0		
2002	3	2003	1	0.0	0.0		
2002	4	2003	2	0.0	0.0		
2003	1	2003	3	441.9	0.0		441.9
2003	2	2003	4	0.0	0.0		
2003	3	2004	1	0.0	0.0		
2003	4	2004	2	0.0	0.0		
2004	1	2004	3	525.6	0.0		525.6
2004	2	2004	4	0.0	0.0		
2004	3	2005	1	0.0	0.0		
2004	4	2005	2	0.0	0.0		
2005	1	2005	3	453.8	0.0		453.8
2005	2	2005	4	0.0	0.0		
2005	3	2006	1	0.0	0.0		
2005	4	2006	2	0.0	0.0		
2006	1	2006	3	632.6	0.0		632.6
2006	2	2006	4	0.0	0.0		
2006	3	2007	1	0.0	0.0		
2006	4	2007	2	0.0	0.0		
2007	1	2007	3	876.4	0.0		876.4
2007	2	2007	4	0.0	0.0		
2007	3	2008	1	0.0	0.0		
2007	4	2008	2	0.0	0.0		
2008	1	2008	3	607.0	0.0		607.0
2008	2	2008	4	0.0	0.0		
2008	3	2009	1	0.0	0.0		
2008	4	2009	2	0.0	0.0		
2009	1	2009	3	255.8	0.0		255.8
2009	2	2009	4	0.0	0.0		
2009	3	2010	1	0.0	0.0		
2009	4	2010	2	0.0	0.0		
2010	1	2010	3	563.4	0.0		563.4
2010	2	2010	4	0.0	0.0		
2010	3	2011	1	0.0	0.0		
2010	4	2011	2	0.0	0.0		
2011	1	2011	3	375.0	0.0		375.0
2011	2	2011	4	0.0	0.0		
2011	3	2012	1	0.0	0.0		
2011	4	2012	2	0.0	0.0		
2012	1	2012	3	180.4	0.0		180.4
2012	2	2012	4	0.0	0.0		
2012	3	2013	1	0.0	0.0		
2012	4	2013	2	0.0	0.0		
2013	1	2013	3	263.9	0.0		263.9
2013	2	2013	4	0.0	0.0		
2013	3	2014	1	0.0	0.0		
2013	4	2014	2	0.0	0.0		
2014	1	2014	3	61.3	0.0		61.3
2014	2	2014	4	0.0	0.0		
2014	3	2015	1	0.0	0.0		
2014	4	2015	2	0.0	121.2		
2015	1	2015	3	242.6	27.4		242.6
2015	2	2015	4	0.0	0.0		
2015	3	2016	1	0.0	0.0		
2015	4	2016	2	0.0	267.4		
2016	1	2016	3	260.5	1.5		260.5
2016	2	2016	4	0.0	0.0		
2016	3	2017	1	0.0	0.0		
2016	4	2017	2	0.0	218.7		
2017	1	2017	3	163.9	0.0		163.9
2017	2	2017	4	0.0	0.0		
2017	3	2018	1	0.0	0.0		
2017	4	2018	2	0.0	245.5	12.3	
2018	1	2018	3	217.8	0.6		217.8
2018	2	2018	4	0.0	0.0		
2018	3	2019	1	0.0	0.0		
2018	4	2019	2	0.0	232.1	11.6	