NORTHERN COMMITTEE
THIRTEENTH REGULAR SESSION

Busan, Republic of Korea
28 August – 1 September 2017

ISC17 – Annex 11
SUMMARY OF ADDITIONAL PBF PROJECTIONS

WCPFC-NC13-2017/IP-04

ISC[1]

[1] International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean

Annex 11

SUMMARY OF ADDITIONAL PBF PROJECTIONS

International Scientific Committee for Tuna and Tuna-like Species
In the North Pacific Ocean

INTERNATIONAL PBF STAKEHOLDERS MEETING
25-27 April 2017
Mita Kaigisho, Japan

1. BACKGROUND

At the first meeting of the IATTC-WCPFC-NC Joint Working Group on Pacific Bluefin Tuna in September 2016 the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) was requested to evaluate the expected performance of various harvest scenarios under a range of assumptions regarding future recruitment, and to present the results at the ISC Pacific Bluefin Tuna Stakeholders Meeting in April 2017 (Table 1, Scenarios 1-10; Appendix A). ISC was further requested to conduct additional harvest scenarios at the 13th Meeting of the WCPFC (WCPFC13) in December 2016 (Table 1, Scenarios 11-12; Appendix B), and to ensure a robust suite of harvest scenarios useful for stakeholders, the ISC added additional harvest scenarios (Table 1, Scenarios 13-15; Appendix C). The scenarios are intended to provide requisite information for developing future effective conservation and management measures (CMMs).

2. METHOD

Stochastic harvest scenarios were evaluated using the same projection methodology utilized in the 2016 ISC Pacific Bluefin tuna stock assessment (ISC/16/PBFWG-1/05). Using the terminal year of the 2016 benchmark stock assessment as the starting point (2014), trajectories of spawning stock biomass and total yield were projected forward annually from 2015 to 2034 by accounting for removals (catch and natural mortality) and additions depending on the assumed recruitment condition (e.g., low recruitment). For scenarios assuming a catch limit, once the limit was reached future catches did not increase. Projections assuming historical average recruitment conditions were conducted by resampling recruitment annually from the entire series of estimated recruitment in the 2016 stock assessment (1952-2014). Projections assuming low recruitment conditions were conducted by resampling estimated annually from the low recruitment period (1980-1989). A detailed explanation of the projection methodology can be found in Akita et al. (2017)

(ISC/17/PBFWG-1/06).

The expected performance of each harvest scenario was assessed as the probability of achieving a suite of candidate rebuilding targets including (a) the initial rebuilding target of $SSB_{MED1952-2014}$ equal to 41,000t by 2024, (b) 150% of $SSB_{MED1952-2014}$, or 61,500mt by 2030, (c) 200% of $SSB_{MED1952-2014}$, or 82,000mt by 2030, (d) 20% of the current SSB without fishing ($SSB_{CURRENT, F=0}$), equal to 141,454mt, by 2030, (e) 20% of the unfished SSB ($20\%SSB_0$), equal to 128,893t, by 2034, and (f) $20\%SSB_{0, \text{LOW RECRUITMENT}}$ equal to 77,247t by 2034 (Table 2)[1]. Scenarios were considered successful if there was at least a 60% probability of achieving the candidate rebuilding targets. For illustrative purposes the influence of recruitment condition on SSB trajectories is depicted in Figures 1 and 2.

Scenarios 11 and 12 assess the impact of transferring quota of small fish (< 30 kg) to quota for large fish (> 30 kg) on SSB and catch trajectories. It should be noted that these scenarios do not fully account for expected removals of fish by Korean fleets. Historically, Korean fleets did not catch large fish and developing representative fishing mortality estimates could not be accurately determined. This information will be available in the 2018 PBF update stock assessment, at which point these scenarios can be re-evaluated. For illustrative purposes the influence of transfers on SSB trajectories is depicted in Figure 3.

Additional performance measures provided for each harvest scenario included the expected annual yield during the projection period by fishery, the probability of SSB falling below the historical lowest at any time during the projection period, and the probability of catch falling below the historical lowest at any time during the projection period, as well as the stock falling below the median SSB in 2024.

3. RESULTS

Projection results are presented in Table 3 and Figures 4 – 7, and can be summarized as follows:

- Different recruitment scenarios forecast entirely different levels of SSB in the future.
- Under average recruitment conditions, all harvest scenarios achieve the initial rebuilding target of $SSB_{MED1952-2014}$ by 2024.
- Under all recruitment conditions with zero removals (no fishing), SSB trajectories achieved all rebuilding targets by approximately 2020 and the initial rebuilding target,

[1] There are several definitions of SSB0 in the projection results (Table 2), so the reader might want to be careful. (1) SSBcurrent F=0 as requested by the Joint Meeting which uses recruitment information 2004-2013. It is used for target-d. (2) SSB0 as currently used by ISC which uses the historical recruitment information (1952-2014). It is used for target-e. (3) SSB0 based on low recruitment scenario (1980-1989). It is used for target-f.

$SSB_{MED1952-2014}$, within 2-3 years. These scenarios point to the potential productivity of the current population under varying recruitment conditions (scenario 13).

- Achieving 20%SSB_0 during the projection period is difficult in most of the low recruitment scenarios.
- The probability of SSB falling below the historical lowest at any time during the projection period is low (< 2%) in all projections.
- Scenarios that do not have catch limits for large fish in the EPO and WPO (scenarios 4 and 7), or has a higher catch limit for large fish in WPO (scenario 11), do not achieve the initial rebuilding target, $SSB_{MED1952-2014}$, by 2024 under low recruitment conditions.
- Reducing the catch of small fish results in positive impacts on SSB trajectories, even with increases in the catch of large fish in WPO (scenarios 5, 8, and 12). It was reported that Japan was considering to transfer 200-300 tons of catch limit of small fish to large fish. For example, if 250 t of small fish caught by purse seines targeting small fish in the WPO is transferred to purse seines targeting large fish, the probability of achieving the initial rebuilding target ($SSB_{MED1952-2014}$) would improve from 62% to 73%.

4. DISCUSSION

Achieving the initial rebuilding target of $SSB_{MED1952-2014}$ by 2024 increases the current SSB to 7%, and efforts should be made to increase SSB as fast as practical. Fastest recovery of the stock occurs when there is no fishing and by 2020 the stock would exceed all SSB targets. While this scenario may be implausible, it points to the resiliency of the stock, and what could be achieved. All other scenarios modulate the potential productivity of the stock, extending the number of years to achieve the SSB target based on size-specific removals and recruitment condition. Given that the recruitment time series exhibits high variability with no apparent trend and current recruitment is at historically low levels, choosing future rebuilding targets based on scenarios assuming low recruitment conditions would be more precautionary; in the short term this could lead to faster rebuilding of the population. If rebuilding to 20%SSB levels is the goal (Targets d-f), scenarios 2, 10d, and 12 have a greater chance of achieving that goal under low recruitment conditions by 2034. Likewise, if rebuilding to a specified proportion above the initial rebuilding target is the goal, then scenarios 2, 6, 8, 9, 10b-e, and 12 have a greater chance of achieving the goal under low recruitment conditions by 2034. Regardless of which harvest scenario is chosen, the identification of future rebuilding targets is a longer term objective and should be evaluated assuming plausible recruitment conditions.

While the choice of a rebuilding target involves biological, social, and economic factors, and is clearly a management decision, results suggest that the tested rebuilding targets fall into three

categories based on future gains relative to the initial target of 41,000mt or 7% SSB. Target-b represents the lowest gain in SSB by 2034, at most a 50% increase. Targets-c and -f represent modest gains, at most a doubling of SSB by 2034. While targets-d and -e represent substantial gains in SSB by 2034.

5. REFERENCES

Akita, Tetsuya, H. Fukuda, and S. Nakatsuka. 2017. Preliminary analysis of additional future projections for Pacific bluefin tuna requested by WCPFC NC and IATTC. ISC/17/PBFWG-1/06. 17p.

ISC. 2016. Stock Assessment of Bluefin Tuna in the Pacific Ocean in 2016.

Figure 1. Trajectories of SSB under three recruitment scenarios. Solid lines are the median, shaded areas 90% confidence intervals. Target refers to the rebuilding target.

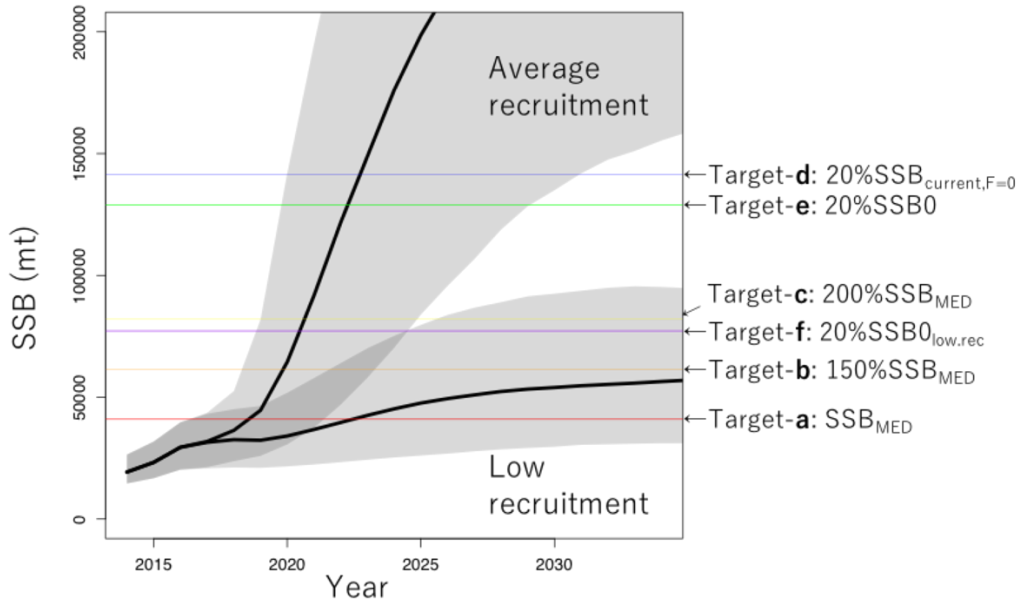

Figure 2. Trajectories of SSB under the current measures with low and average recruitment, illustrated for the explanatory purpose of SSB targets. The bold line refers to the median; and the gray shaded area refers to 90% confidence interval. Horizontal lines show the level of SSB targets, as noted in Table 2.

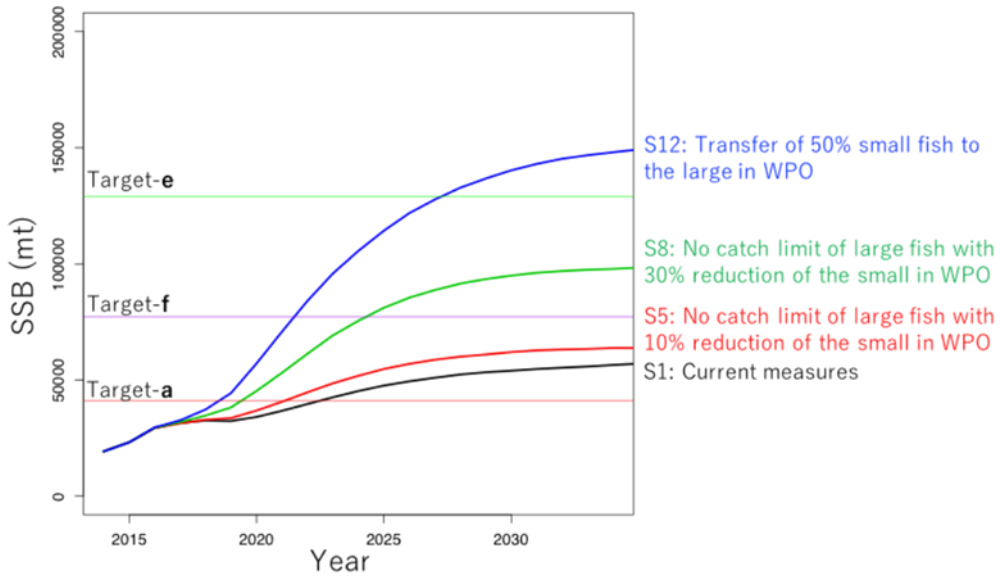

Figure 3. Trajectories of SSB for three harvest scenarios with varying size-at-catch and transfer characteristics relative to the current management measure trajectory. All projections assume a low recruitment conditions. Solid lines are the median values and target refers to the rebuilding target.

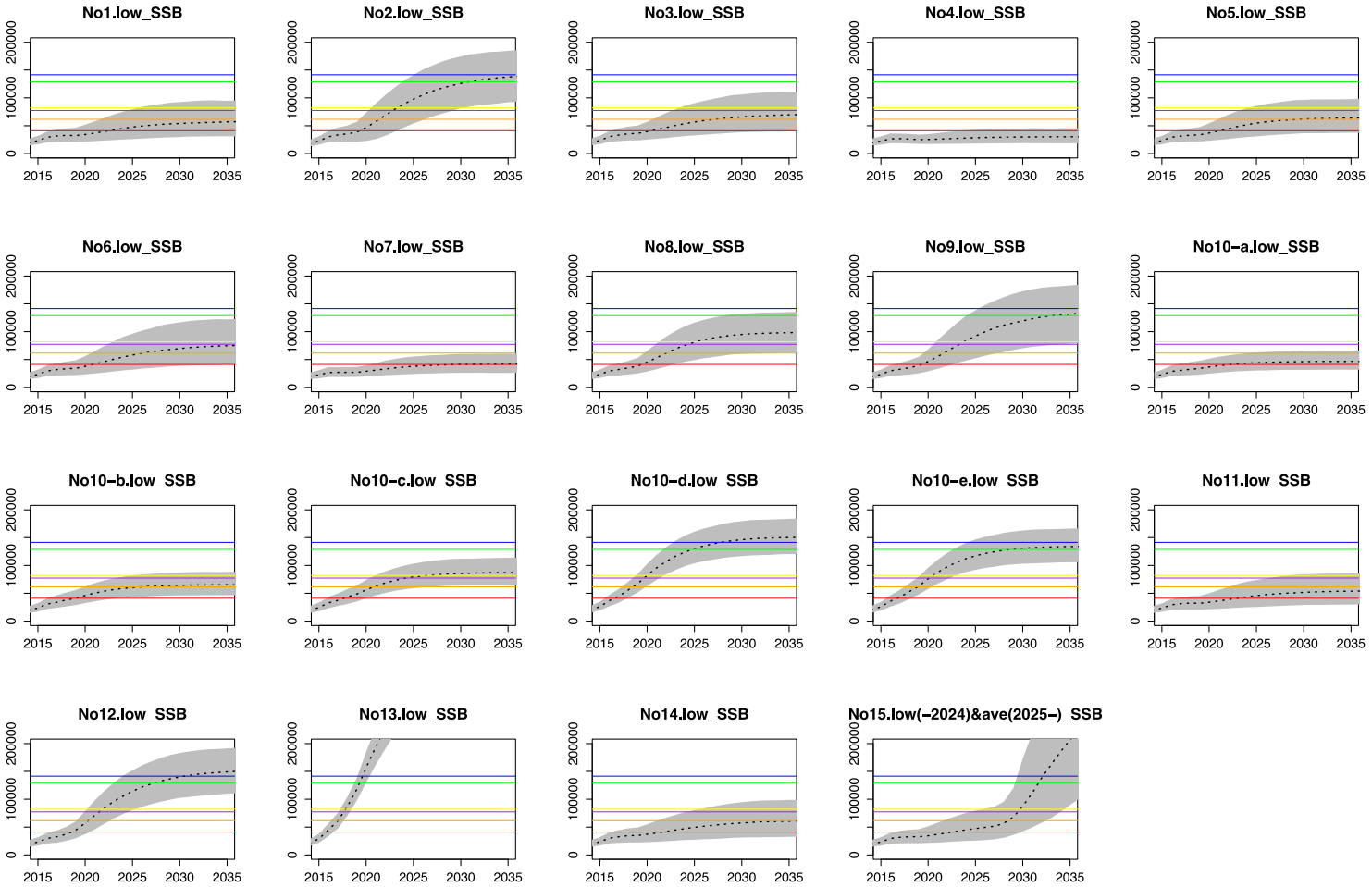

Figure 4. Trajectories of SSB under low recruitment scenarios, including average recruitment ten years after (scenario 15). The dotted line refers to the median; and the gray shaded area refers to 90% confidence interval. Horizontal lines in (a) show the level of SSB targets (red: 41,000 t; orange: 61,500; purple: 77,247 t; yellow: 82,000 t; green: 128,893 t; blue: 141,454 t).

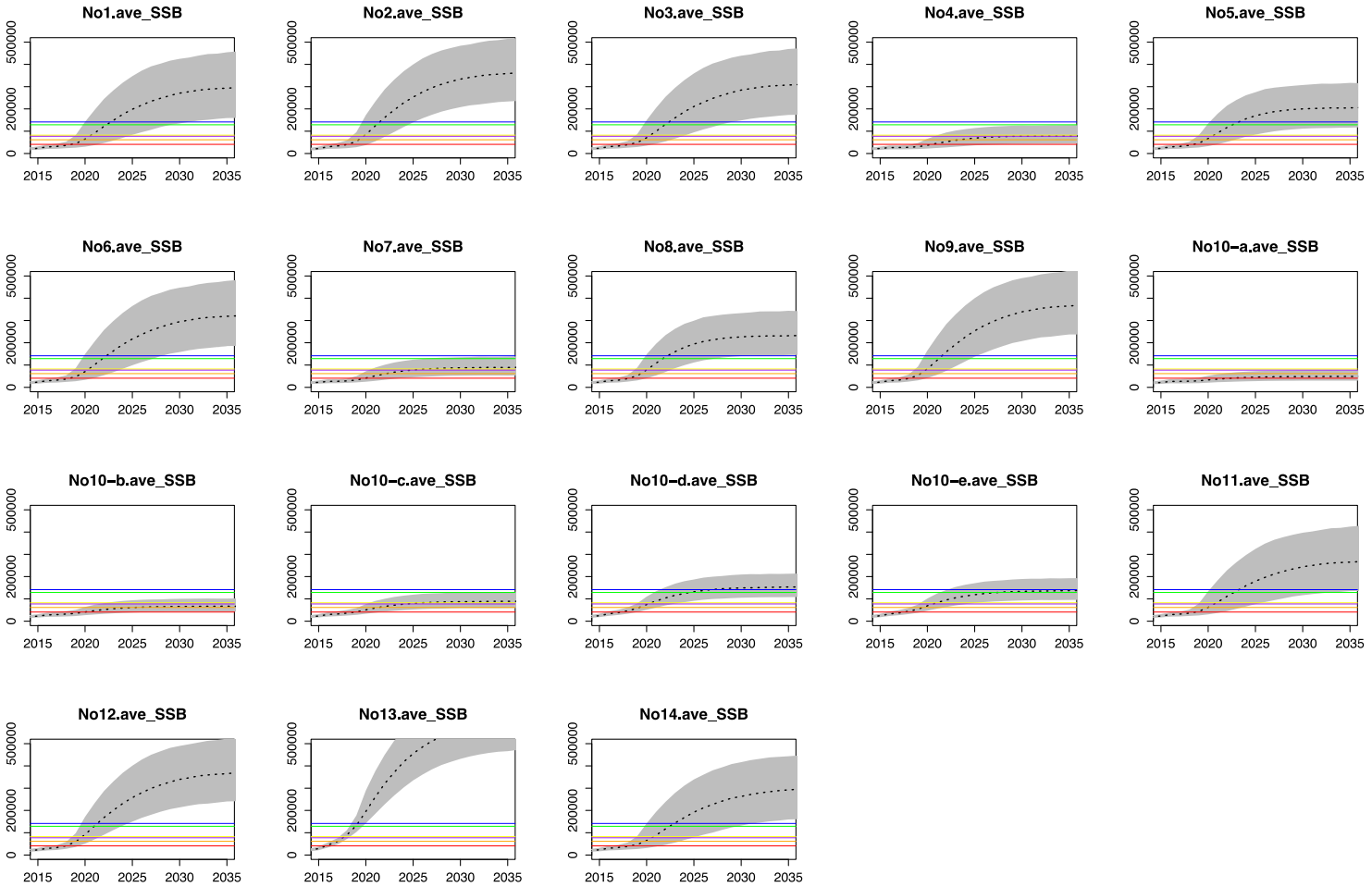

Figure 5. Trajectories of SSB under average recruitment scenarios. The details are the same in Figure 4, except that the scale of y-axis is changed.

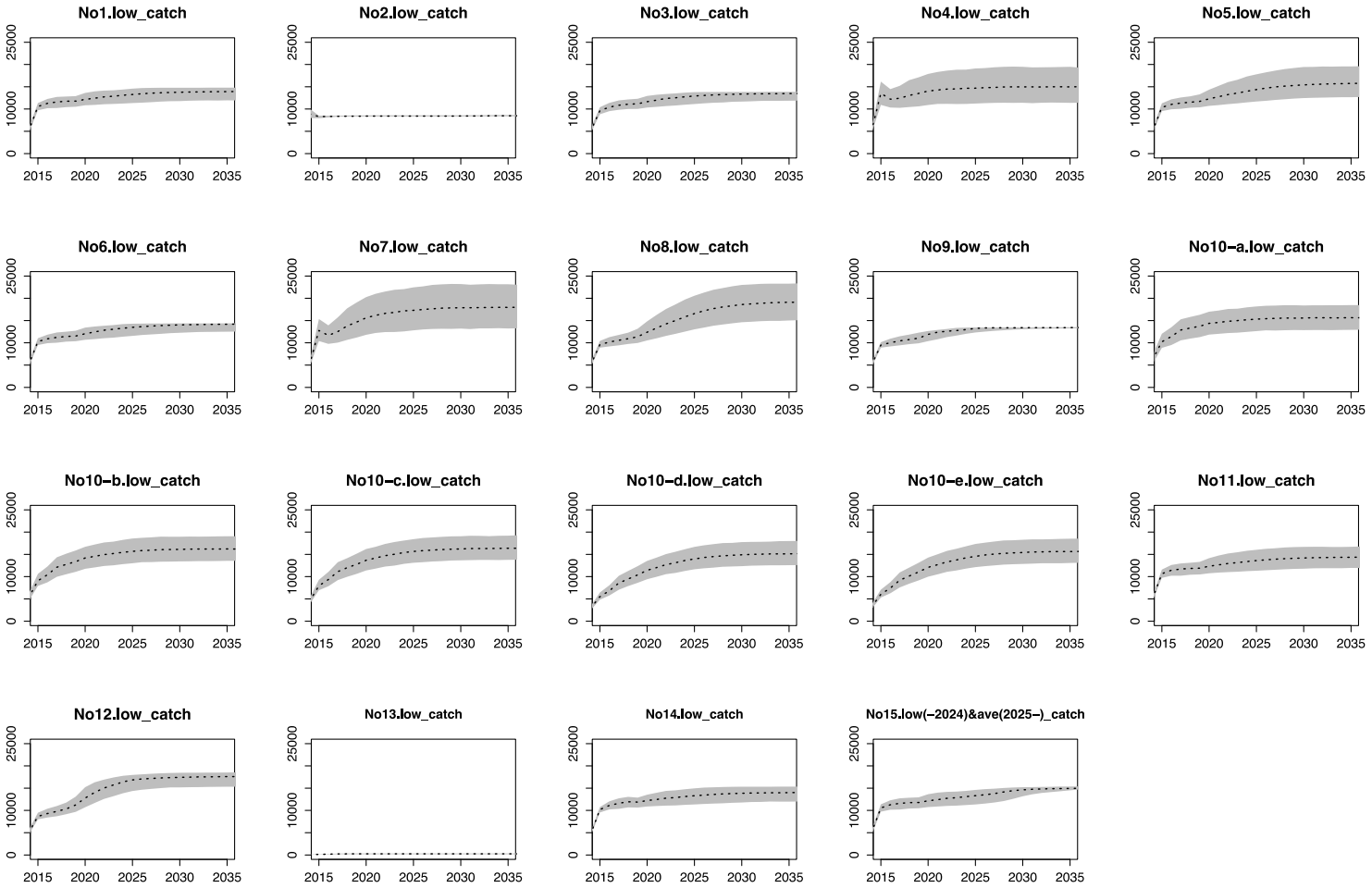

Figure 6. Trajectories of total yield under low recruitment scenarios, including average recruitment ten years after (scenario 15). The dotted line refers to the median; and the gray shaded area refers to 90% confidence interval.

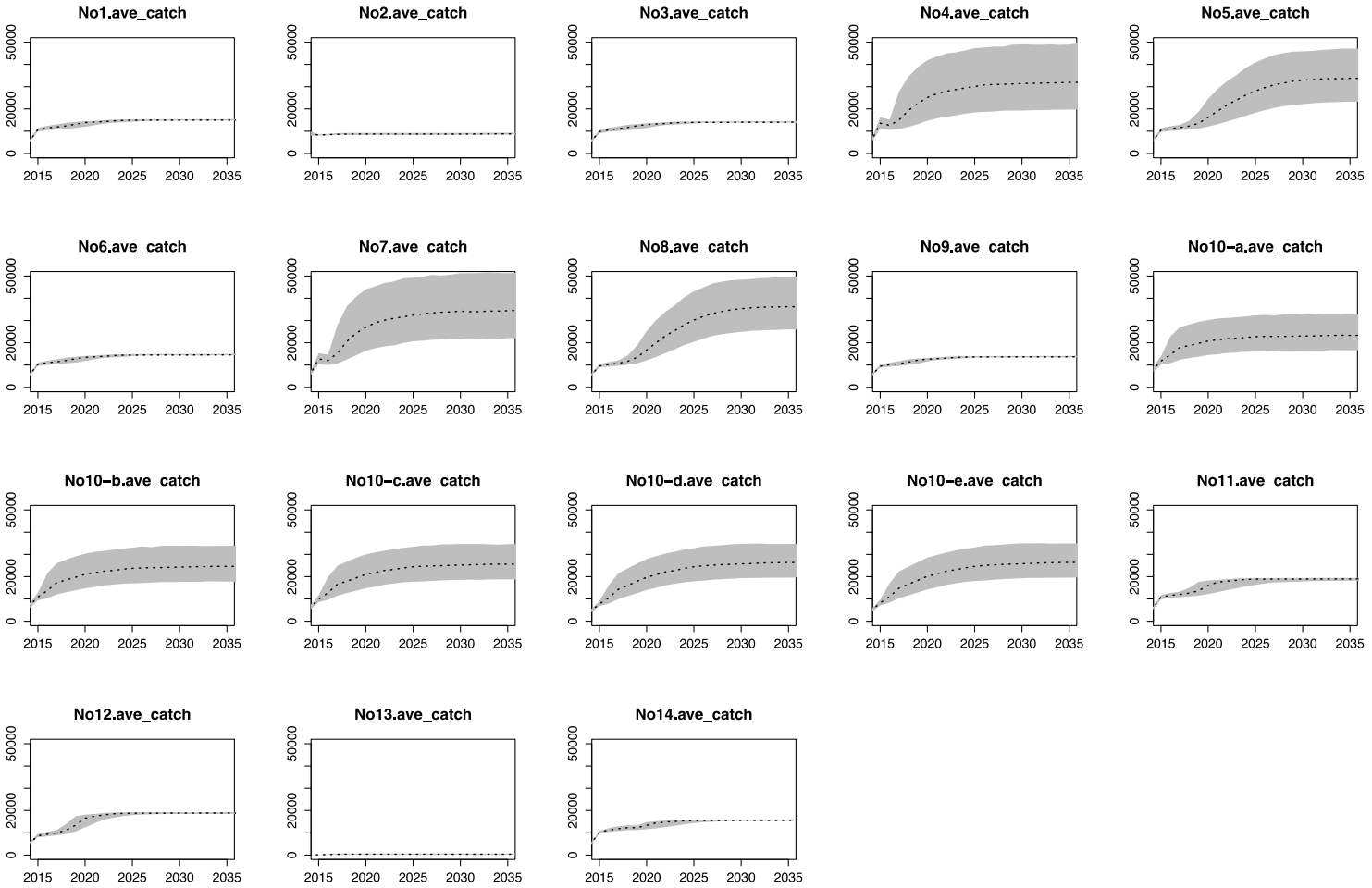

Figure 7. Trajectories of total yield under average recruitment scenarios. The details are the same in Figure 3, except that the scale of y-axis is changed.

Table 1. Fishing mortality and catch limit for each scenario.

Harvesting Scenario #	Fishing mortality in WPO	Catch limit in WPO		Fishing mortality in EPO	Catch limit in EPO	Threshold of small/large fish	Catch limit by country (mt)							
							Japan		Korea		Taiwan		EPO commercial	EPO sports
		Small	Large				Small	Large	Small	Large	Small	Large		
1	F2002-2004	50% 2002-2004	Average 2002-04	F2002-2004	3,300 mt comm.		4,007	4,882	718		0	1,700	3,300	-
2	Enough high value to fullfill its catch limit (multiply F2010-2012 by two)	50% 2010-2012	50% 2010-12	F2002-2004	50% 2010-12		3,192	1,393	553		0	155	2,884	-
3	F2002-2004	50% 2002-2004	Average 2002-04	F2002-2004	50% 2002-04		4,007	4,882	718		0	1,700	2,329	-
4	F2002-2004	45% 2002-2004	No catch limit	F2010-2012 (multiply F2002-2004 by 1.3451)	No catch limit		3,606	-	646	-	0	-	-	-
5	F2002-2004	45% 2002-2004	No catch limit	F2002-2004	3,300 mt comm.		3,606	-	646	-	0	-	3,300	-
6	F2002-2004	45% 2002-2004	Average 2002-04	F2002-2004	3,300 mt comm.		3,606	4,882	646		0	1,700	3,300	-
7	F2002-2004	35% 2002-2004	No catch limit	F2010-2012 (multiply F2002-2004 by 1.3451)	No catch limit		2,805	-	503	-	0	-	-	-
8	F2002-2004	35% 2002-2004	No catch limit	F2002-2004	3,300 mt comm.	30 kg	2,805	-	503	-	0	-	3,300	-
9	F2002-2004	35% 2002-2004	Average 2002-04	F2002-2004	3,300 mt comm.		2,805	4,882	503		0	1,700	3,300	-
10	Fullfill a target with 60%	No catch limit		Fullfill a target with 60%	No catch limit		-	-	-	-	0	-	-	-
11	F2002-2004	50% 2002-2004	"Average 2002-04 catches in WPO (all sizes)" minus "50% 2002-04 catches in WPO (<30 kg)"	F2002-2004	3,300 mt comm.		4,007	8,889	718	718	0	1,700	3,300	-
12	F2002-2004	25% 2002-2004	"Average 2002-04 catches in WPO (all sizes)" minus "25% 2002-04 catches in WPO (<30 kg)"	F2002-2004	3,300 mt comm.		2,003	10,893	359	1,077	0	1,700	3,300	-
13	No fishing						0	0	0	0	0	0	0	0
14	F2002-2004	50% 2002-2004	Average 2002-04	F2002-2004	3,300 mt comm.	85 kg	4590*	3718*	718		0	1,700	3,300	-
15	F2002-2004	50% 2002-2004	Average 2002-04	F2002-2004	3,300 mt comm.	30 kg	4,007	4,882	718		0	1,700	3,300	-

*These catch limits are provisional and should be revised if this measure to be implemented.

Table 2. List of performance indices

Target-a:	41,000 t,	Initial rebuilding target ($SSB_{MED1952-2014}$) by 2024;
Target-b:	61,500 t,	150% of initial rebuilding target by 2030;
Target-c:	82,000 t,	200% of initial rebuilding target by 2030;
Target-d:	141,454 t,	20%$SSB_{CURRENT, F=0}$ by 2030;
Target-e:	128,893 t,	20%SSB_0 by 2034.
Target-f:	77,247 t,	20%$SSB_{0, LOW\ RECRUITMENT}$ by 2034

Table 3: Performance measures for each scenario. Cells under rebuilding targets a-f are color-coded relative to whether the scenario has at least a 60% probability of achieving the candidate rebuilding target. In scenarios 11 and 12, Korean vessels cannot realize its allocated catch limit for large fish under the current scenario setting because the fleet does not have historical fishing mortality in the specified period.

Harvesting Scenario #		Fishing mortality in the WPO	Catch limit in WPO		Fishing mortality in EPO	Catch limit in EPO	Multiplier to F2011-2013	Threshold of small/large fish	Recruitment scenario	Probability of achieving each of the candidate rebuilding targets						The time expected to achieve each of the candidate rebuilding target SSB levels with 60% probability from 2014						Probability of the stock is below the median of 2014 at 2024	Probability of SSB falling below the historical lowest at any time during the projection period	Probability of Catch falling below the historical lowest at any time during the projection period	Median SSB at 2034	Expected annual yield in 2024, by area and size category					Expected annual yield in 2030, by area and size category					Expected annual yield in 2034, by area and size category				
																										Japan					Japan					Japan				
			Small	Large						41,000 t @2024	61,500 t @2030	82,000 t @2030	141,454 t @2030	128,893 t @2034	77,247 t @2034											Small	Large	Korea	Taiwan	EPO	Small	Large	Korea	Taiwan	EPO	Small	Large	Korea	Taiwan	EPO
										a	b	c	d	e	f	a	b	c	d	e	f																			
Scenario1 (the current measures)		F2002-2004	50% 2002-2004	Average 2002-2004	F2002-2004	3,300 mt comm.	-	30 kg	Low	61.5%	35.2%	10.5%	0.1%	0.5%	16.7%	10	-	-	-	-	-	0.8%	0.0%	0.7%	56466	3969	3915	719	989	3396	3966	4154	719	1362	3400	3964	4190	719	1439	3395
									Average	99.4%	99.9%	99.4%	94.0%	98.0%	99.8%	6	7	8	10	9	7	0.0%	0.0%	0.3%	291478	4027	4884	720	1504	3620	4025	4909	720	1722	3624	4026	4912	720	1728	3626
Scenario2		Enough high value to fullfill its catch limit (multiply F2010-2012 by two)	50% 2010-2012	50% 2010-12	F2002-2004	50% 2010-12	-		Low	96.8%	98.9%	94.6%	29.1%	60.0%	98.2%	6	8	10	-	20	10	0.4%	1.4%	100.0%	136132	3205	1404	554	159	3089	3205	1404	554	158	3092	3205	1404	554	158	3093
									Average	100.0%	100.0%	100.0%	99.8%	100.0%	100.0%	5	6	7	8	8	7	0.0%	1.0%	100.0%	355928	3244	1416	556	157	3373	3245	1415	556	158	3377	3246	1415	556	158	3380
Scenario3		F2002-2004	50% 2002-2004	Average 2002-2004	F2002-2004	50% 2002-04	-		Low	81.4%	58.9%	23.0%	0.5%	1.3%	34.6%	8	17	-	-	-	-	0.4%	0.0%	2.1%	69186	3977	4283	719	1141	2449	3975	4473	719	1524	2449	3975	4484	719	1585	2449
									Average	99.8%	100.0%	99.8%	96.1%	99.1%	99.9%	5	6	7	10	9	7	0.0%	0.0%	1.3%	305244	4026	4896	721	1568	2657	4025	4912	720	1724	2661	4026	4913	721	1729	2662
Scenario4		F2002-2004	45% 2002-2004	No catch limit	F2010-2012 (multiply F2002-2004 by 1.3)	No catch limit	-		Low	6.0%	0.2%	0.0%	0.0%	0.0%	0.0%	-	-	-	-	-	-	8.3%	1.0%	0.7%	30192	3594	2912	647	691	6919	3592	3098	647	793	6987	3592	3099	647	821	6970
									Average	88.8%	75.2%	42.8%	1.7%	4.3%	51.9%	7	11	-	-	-	-	0.2%	0.0%	0.1%	78608	3624	7254	648	988	17911	3624	8160	648	2011	17954	3624	8236	648	2171	18094
Scenario5		F2002-2004	45% 2002-2004	No catch limit	F2002-2004	3,300 mt comm.	-		Low	77.7%	51.3%	14.9%	0.0%	0.4%	23.4%	8	-	-	-	-	-	0.5%	0.0%	0.8%	63808	3609	5453	647	1021	3425	3609	6315	647	1620	3426	3608	6382	647	1770	3427
									Average	99.7%	99.9%	99.1%	84.7%	91.5%	99.6%	5	7	8	11	10	7	0.0%	0.0%	0.5%	203902	3628	16982	649	1855	3641	3628	20203	649	5207	3643	3629	20461	649	5778	3645
Scenario6		F2002-2004	45% 2002-2004	Average 2002-2004	F2002-2004	3,300 mt comm.	-		Low	80.6%	65.5%	30.6%	1.2%	3.3%	44.7%	8	15	-	-	-	-	0.4%	0.0%	0.7%	74204	3609	4310	647	1082	3425	3609	4532	647	1530	3426	3608	4547	647	1599	3427
									Average	99.8%	100.0%	99.9%	97.2%	99.3%	100.0%	5	7	7	9	9	7	0.0%	0.0%	0.5%	316301	3628	4902	649	1550	3642	3627	4916	649	1725	3646	3628	4916	649	1730	3647
Scenario7		F2002-2004	35% 2002-2004	no catch limit	F2010-2012 (multiply F2002-2004 by 1.3)	No catch limit	-		Low	30.9%	3.8%	0.1%	0.0%	0.0%	0.2%	-	-	-	-	-	-	1.3%	0.1%	1.2%	41645	2810	3865	504	770	9267	2810	4238	504	1061	9373	2810	4253	504	1123	9351
									Average	95.5%	88.0%	58.8%	3.2%	8.0%	68.9%	7	9	18	-	-	13	0.0%	0.0%	0.7%	88936	2829	8216	505	1086	20076	2829	9176	505	2274	20222	2830	9249	505	2443	20186
Scenario8		F2002-2004	35% 2002-2004	No catch limit	F2002-2004	3,300 mt comm.	-		Low	97.4%	94.1%	72.3%	2.3%	7.9%	82.6%	6	9	13	-	-	12	0.0%	0.0%	2.1%	97792	2813	7946	504	1226	3470	2813	9479	504	2404	3471	2813	9603	504	2676	3471
									Average	100.0%	100.0%	99.9%	94.8%	97.7%	100.0%	5	6	7	9	9	7	0.0%	0.0%	1.9%	230687	2832	19516	506	2121	3681	2833	22844	506	5954	3682	2833	23100	506	6548	3683
Scenario9		F2002-2004	35% 2002-2004	Average 2002-2004	F2002-2004	3,300 mt comm.	-		Low	97.9%	97.7%	89.0%	24.8%	51.2%	95.1%	6	9	11	-	-	10	0.0%	0.0%	2.2%	130078	2813	4802	504	1311	3470	2813	4872	504	1691	3471	2813	4876	504	1707	3471
									Average	100.0%	100.0%	100.0%	99.7%	99.9%	100.0%	5	6	7	8	8	7	0.0%	0.0%	1.9%	363095	2832	4923	506	1629	3684	2833	4924	506	1729	3687	2833	4924	506	1732	3689
Scenario10	a	Constant F to achive "target a" with 60% of its probability.	No catch limit		Constant F to achive "target a" with 60% of its probability.	No catch limit	0.798		Low	60.4%	8.7%	0.2%	0.0%	0.0%	0.7%	10	-	-	-	-	-	0.0%	0.0%	3.0%	46453	3822	4849	682	724	5110	3813	5050	679	898	5146	3813	5057	679	922	5148
							0.965		Average	60.3%	19.0%	2.9%	0.0%	0.0%	4.7%	10	-	-	-	-	-	0.1%	0.0%	0.2%	48950	6672	6417	1259	740	7911	6664	6719	1255	1058	7958	6687	6770	1261	1095	8001
	b	Constant F to achive "target b" with 60% of its probability.	No catch limit		Constant F to achive "target b" with 60% of its probability.	No catch limit	0.666		Low	96.1%	60.6%	9.7%	0.0%	0.0%	17.8%	6	16	-	-	-	-	0.0%	0.0%	28.9%	65149	3516	5399	598	810	5166	3508	5710	595	1104	5216	3508	5730	595	1145	5219
							0.841		Average	90.5%	60.1%	19.3%	0.1%	0.4%	28.6%	7	16	-	-	-	-	0.0%	0.0%	1.2%	66924	6339	7315	1148	851	8204	6333	7757	1144	1320	8267	6354	7826	1149	1380	8313
	c	Constant F to achive "target c" with 60% of its probability.	No catch limit		Constant F to achive "target c" with 60% of its probability.	No catch limit	0.554		Low	100.0%	96.9%	60.6%	0.1%	0.7%	76.0%	5	8	16	-	-	12	0.0%	0.0%	82.1%	87110	3190	5755	518	866	5098	3188	6144	518	1280	5142	3178	6195	517	1338	5131
							0.729		Average	99.1%	92.1%	60.3%	2.1%	5.6%	71.2%	6	8	16	-	-	13	0.0%	0.0%	6.7%	88965	5960	8094	1036	951	8351	5954	8690	1034	1586	8433	5975	8780	1038	1673	8482
	d	Constant F to achive "target d" with 60% of its probability.	No catch limit		Constant F to achive "target d" with 60% of its probability.	No catch limit	0.347		Low	100.0%	100.0%	100.0%	60.4%	87.0%	100.0%	3	5	7	16	12	6	0.0%	0.0%	100.0%	149949	2360	5705	352	874	4366	2355	6294	350	1485	4452	2356	6363	350	1591	4459
							0.519		Average	100.0%	100.0%	99.8%	60.2%	78.5%	100.0%	4	6	7	16	12	7	0.0%	0.0%	87.4%	152558	4982	9149	798	1100	8112	4979	10080	796	2097	8236	4997	10221	800	2257	8287
	e	Constant F to achive "target e" with 60% of its probability.	No catch limit		Constant F to achive "target e" with 60% of its probability.	No catch limit	0.390		Low	100.0%	100.0%	100.0%	27.7%	60.6%	100.0%	3	6	7	-	19	7	0.0%	0.0%	100.0%	133800	2559	5824	389	889	4589	2554	6386	387	1467	4672	2555	6447	387	1564	4679
							0.562		Average	100.0%	100.0%	98.6%	39.4%	60.2%	99.5%	4	6	8	-	20	7	0.0%	0.0%	69.6%	136490	5216	9008	850	1077	8234	5212	9869	848	1999	8350	5231	9999	852	2142	8400
Scenario11		F2002-2004	50% 2002-2004	"Average 2002-2004 catches in WPO (all sizes) " minus "50% 2002-2004 catches in WPO (<30 kg)"	F2002-2004	3,300 mt comm.	-		Low	57.8%	29.0%	6.1%	0.0%	0.2%	10.0%	11	-	-	-	-	-	1.1%	0.0%	0.6%	53683	3967	4389	719*	955	3395	3965	4816	719*	1308	3398	3965	4841	719*	1387	3399
									Average	99.3%	99.8%	99.0%	89.1%	95.6%	99.7%	6	7	8	11	10	8	0.0%	0.0%	0.3%	263027	4027	8493	720*	1461	3619	4025	8781	720*	1717	3622	4026	8811	720*	1725	3624
Scenario12		F2002-2004	25% 2002-2004	"Average 2002-2004 catches in WPO (all sizes) " minus "25% 2002-2004 catches in WPO (<30 kg)"	F2002-2004	3,300 mt comm.	-		Low	99.9%	100.0%	99.5%	48.0%	79.4%	99.8%	5	7	9	20	15	8	0.0%	0.0%	49.7%	148029	2014	8803	361*	1475	3507	2014	9579	361*	1709	3508	2014	9691	361*	1713	3508
									Average	100.0%	100.0%	100.0%	99.9%	100.0%	100.0%	5	6	6	8	8	6	0.0%	0.0%	49.4%	362590	2035	10808	362*	1663	3721	2035	10961	362*	1728	3724	2035	10973	362*	1731	3726
Scenario13		No fishing							Low	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	2	4	4	6	6	4	0.0%	0.0%	100.0%	375685	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
									Average	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	2	4	4	6	6	4	0.0%	0.0%	100.0%	593325	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario14		F2002-2004	50% 2002-2004	Average 2002-2004	F2002-2004	3,300 mt comm.	-	85 kg	Low	66.7%	40.9%	12.2%	0.2%	0.6%	20.6%	9	-	-	-	-	-	0.8%	0.0%	0.3%	60317	3884	4005	719	1048	3403	3863	4370	719	1382	3408	3865	4409	719	1465	3409
									Average	99.4%	99.8%	99.3%	93.6%	98.1%	99.9%	5	7	8	10	10	8	0.0%	0.0%	0.2%	289143	3947	5421	720	1499	3617	3939	5544	720	1719	3621	3947	5549	720	1727	3627
Scenario15		F2002-2004	50% 2002-2004	Average 2002-2004	F2002-2004	3,300 mt comm.	-	30 kg	Low(-2024), Ave(2025-2034)	61.3%	78.2%	55.4%	13.5%	77.4%	95.1%	10	15	17	19	19	16	1.0%	0.0%	0.6%	185286	3967	3911	719	993	3395	4023	4731	720	1371	3605	4025	4889	720	1643	3620

Appendix A: NC12 Summary Report Attachment D, Annex 2

Attachment D, Annex 2

Formulation of a Pacific Bluefin Tuna Rebuilding Strategy

1. The ISC is requested to evaluate the expected performance of each of the following harvest scenarios, and to make the results available to the Northern Committee and IATTC by April 2017.

Harvest scenarios (see summary table attached)**:** The following scenarios should be evaluated under an appropriate range of assumptions regarding future recruitment (e.g., the "low" and "average" recruitment assumptions used in the ISC's previous set of projections).[2]

1. 2002-04 fishing effort in all WCPO PBF-directed fisheries; 50% of 2002-04 catches of <30kg PBF in all WCPO fisheries; 2002-04 catches of ≥30kg PBF in all WCPO fisheries; and 3,300 mt/yr in EPO commercial PBF fisheries (i.e., current management measures in WCPO and EPO).
2. 50% of 2010-2012 catches (all fish sizes) in all EPO and WCPO fisheries.
3. 2002-04 fishing effort in all WCPO PBF-directed fisheries; 50% of 2002-2004 catches of <30kg PBF in all WCPO fisheries; 2002-04 catches of ≥30kg PBF in all WCPO fisheries; and 50% of 2002-04 catches in all EPO fisheries.
4. 2002-04 fishing effort in all WCPO PBF-directed fisheries; 45% of 2002-04 catches of <30kg PBF in all WCPO fisheries; F of ≥30kg PBF at 2002-04 average level in all WCPO fisheries; and F of PBF in EPO PBF fisheries at 2010-12 average level.
5. 2002-04 fishing effort in all WCPO PBF-directed fisheries; 45% of 2002-04 catches of <30kg PBF in all WCPO fisheries; F of ≥30kg PBF at 2002-04 average level in all WCPO fisheries; and 3,300 mt/yr in EPO commercial fisheries.
6. 2002-04 fishing effort in all WCPO PBF-directed fisheries; 45% of 2002-04 catches of <30kg PBF in all WCPO fisheries; 2002-04 catches of ≥30kg PBF in all WCPO fisheries; and 3,300 mt/yr in EPO commercial fisheries.
7. 2002-04 fishing effort in all WCPO PBF-directed fisheries; 35% of 2002-04 catches of <30kg PBF in all WCPO fisheries; F of ≥30kg PBF at 2002-04 average level in all WCPO fisheries; and F of PBF in EPO PBF fisheries at 2010-12 average level.
8. 2002-04 fishing effort in all WCPO PBF-directed fisheries; 35% of 2002-04 catches of <30kg PBF in all WCPO fisheries; F of ≥30kg PBF at 2002-04 average level in all WCPO fisheries; and 3,300 mt/yr in EPO commercial fisheries.
9. 2002-04 fishing effort in all WCPO PBF-directed fisheries; 35% of 2002-04 catches of <30kg PBF in all WCPO fisheries; 2002-04 catches of ≥30kg PBF in all WCPO fisheries; and 3,300 mt/yr in EPO commercial fisheries.
10. Constant F in all PBF fisheries, set at the level at which, for a given candidate rebuilding target, the target is achieved at the end of the rebuilding period with 60% probability (relative F among fisheries assumed to be unchanged from the most recent 3-year average).

[2] For the fisheries in which *F* is not explicitly limited under a given scenario, the projections should be run such that F in the fishery is not allowed to exceed ten times the 2010-2012 average level in that fishery.

Performance measures:

1. Probability of achieving each of the following candidate rebuilding targets:
    a. initial rebuilding target ($SSB_{MED1952-2014}$) by 2024
    b. 150% of initial rebuilding target by 2030
    c. 200% of initial rebuilding target by 2030
    d. $20\%SSB_{current,F=0}$[3] by 2030
2. For all scenarios except 6, the time expected to achieve each of the SSB levels listed above, with 60% probability.
3. Expected annual yield during projection period, by fishery (defined in terms of flag, gear, and area).
4. Probability of SSB falling below the historical lowest at any time during the projection period.
5. Probability of catch falling below the historical lowest at any time during the projection period.

2. Taking into account the objectives of the two Conventions, the results of the evaluations described above, any advice from the IATTC scientific staff and/or Scientific Advisory Committee, and the desire to maintain or enhance fishing opportunities in, and benefits from, PBF-directed fisheries to the extent compatible with the need to rebuild the stock, the WCPFC and IATTC will:

    1. In 2017, agree on a second rebuilding target to be reached by 2030 (not necessarily the ultimate rebuilding target).
    2. Revise their respective management measures as needed to achieve the initial WCPFC rebuilding target by 2024, as appropriate given progress of rebuilding the stock.
    3. Revise or adopt conservation and management measures to achieve the second rebuilding target that would become effective after the initial target is met.

Summary of harvest scenarios

	WCPO			**EPO**	
	F	**Catch**		**F**	**Catch**
		<30kg	**≥30kg**		
1	2002-04	50% 2002-04	2002-04	unlimited	3,300 mt comm.
2	unlimited	50% 2010-12		unlimited	50% 2010-12
3	2002-04	50% 2002-04	2002-04	unlimited	50% 2002-04
4	2002-04	45% 2002-04	unlimited	2010-12	unlimited
5	2002-04	45% 2002-04	unlimited	unlimited	3,300 mt comm.
6	2002-04	45% 2002-04	2002-04	unlimited	3,300 mt comm.
7	2002-04	35% 2002-04	unlimited	2010-12	unlimited
8	2002-04	35% 2002-04	unlimited	unlimited	3,300 mt comm.
9	2002-04	35% 2002-04	2002-04	unlimited	3,300 mt comm.
10	constant – depend on	unlimited		constant – depend on	unlimited

[3] The time period to be used for 20%SSBcurrent,F=0 shall have a length of 10 years and be based on the years t1=ylast-10 to t2=ylast-1 where ylast is the last year used in the assessment; and the approach used for calculating the unfished biomass levels shall be based on scaled estimates of recruitment according to the stock recruitment relationship.

	target		target	

Appendix B: WCPFC13 draft Summary Report Attachment P

WCPFC13 draft Summary Report Attachment P

Outcomes of extraordinary meeting of NC

1. At its 2017 meeting, NC will develop additional measures to further expedite the recovery of PBF stock.

2. In 2017, NC members will take the following voluntary measures to expedite the recovery of the Pacific Bluefin Tuna Stock in 2017.

(1) Japan
Japan will transfer a part of its catch limit for Pacific Bluefin tuna (PBF) smaller than 30kg (4,007 metric tons) to its catch limit of PBF 30 kg or larger in accordance with a new measure stipulated in paragraph 4 of the draft CMM (Attachment E of the NC Summary Report) if the recommendation from the Northern Committee is endorsed by the Commission. The amount to be used is currently under consideration.

(2) Korea
Korea will make a voluntary payback for its overharvest of PBF 30 kg or larger in accordance with its multi-year plan (see the attached Circular No. 2016/71 dated on December 2, 2016) from its annual catch limit of 718 tons of PBF smaller than 30kg.

3. NC will strengthen cooperation with IATTC to bear shared responsibilities to expedite the recovery of PBF stock.

4. NC requests that the ISC evaluate the following scenarios—in addition to the other ten scenarios already requested—prior to the anticipated ISC sponsored stakeholder meeting in 2017:

Scenario 11: 2002-04 fishing effort in all WCPO PBF-directed fisheries; 2002-04 catches of PBF (of all sizes) in all WCPO fisheries, within which catches of <30kg PBF are 50% of 2002-04 level; and 3,300 mt/yr in EPO commercial fisheries.

Scenario 12: 2002-04 fishing effort in all WCPO PBF-directed fisheries; 2002-04 catches of PBF (of all sizes) in all WCPO fisheries, within which catches of <30kg PBF are 25% of 2002-04 level; and 3,300 mt/yr in EPO commercial fisheries.

Appendix C: Summary of ISC Scenario Requests

(i) Runs with zero catch for both recruitment scenarios. (Scenario 13)

(ii) Change the threshold of small/large fish to 85kg in Scenario 1. (Scenario 14)

(iii) Scenario 1 using a recruitment scenario of 10 years of low recruitment and average recruitment thereafter. (Scenario 15).