Multiple sardine Operating Models and associated risk

SWG-PEL Meeting

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Alternative OMs

- Alternative proportions of south component B^{sp} contributing to west component $effB^{sp}$

  (p=0.0, 0.08, 0.2, 0.6)

  NB: no impact on south recruitment anymore

- Alternative west to south movement

  (MoveR – random informed by parasite data

  MoveD – prop increases as B_{west} increases)

Updated OM

- FISHERIES/2018/SEP/SWG-PEL/27
- Final catches by area and TACs for 2017-8
- New method for simulating future south coast recruitment

Updated CMP ("CMP1")

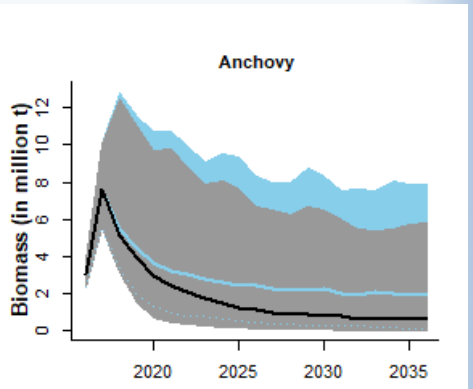
- Same constraints as Interim OMP-18
- "OM1" – Same p=0.08 and MoveR as Interim OMP-18
- $Risk_A$: probability of anchovy B^{sp}_y being below $0.25xB^{sp}_{2006}$ for y={2016,2036}
- Assume $Risk_A$=0.109 from OMP-14 under OM1 is acceptable and tune CMP1 to $Risk_A$<0.109 to get α=1.379 (Interim OMP-18 α=0.914)

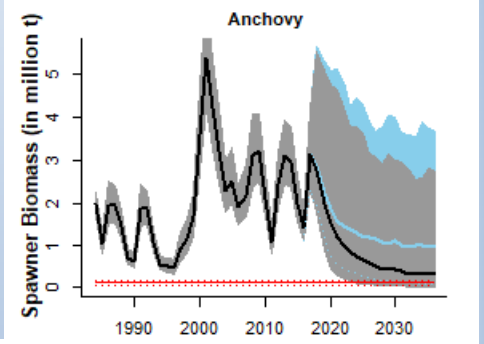
Anchovy CMP1 v Interim OMP-18

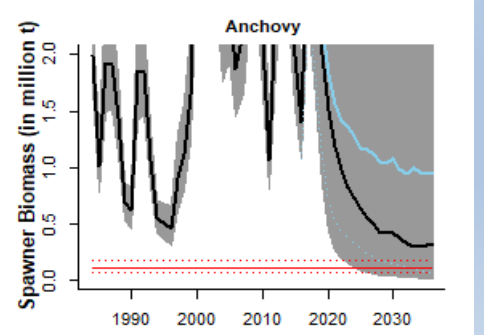
- No change to No Catch
- Higher risk due to fixed catches

(greater impact on poorer projections)

- Higher α; higher catches
- Lower B_{2036}, B_{min}, B_{2036}/B_{2015}
- Higher chance of CB metarule





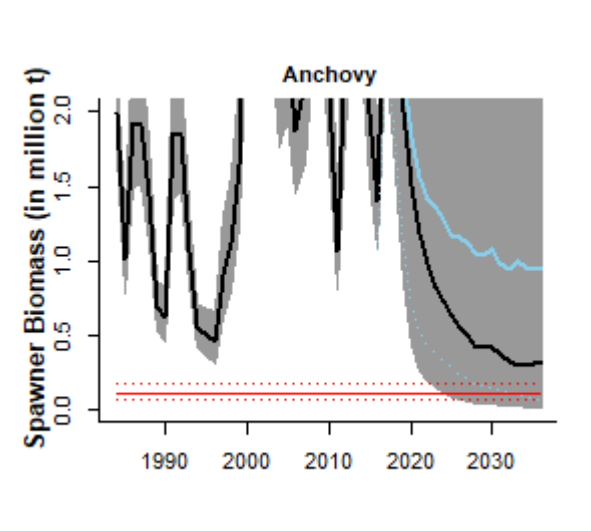


No Catch
CMP1
Risk threshold

Anchovy Discussion Point?

- Is method for choosing $Risk_A$ appropriate?
- Leads to 11% chance of being below a quarter of historical low
- But this only happens after ±5 years
- BH based on all years

- projections more positive if BH based on 2000-15 only?
- How long will current 'regime' last?!



No Catch
CMP1
Risk threshold

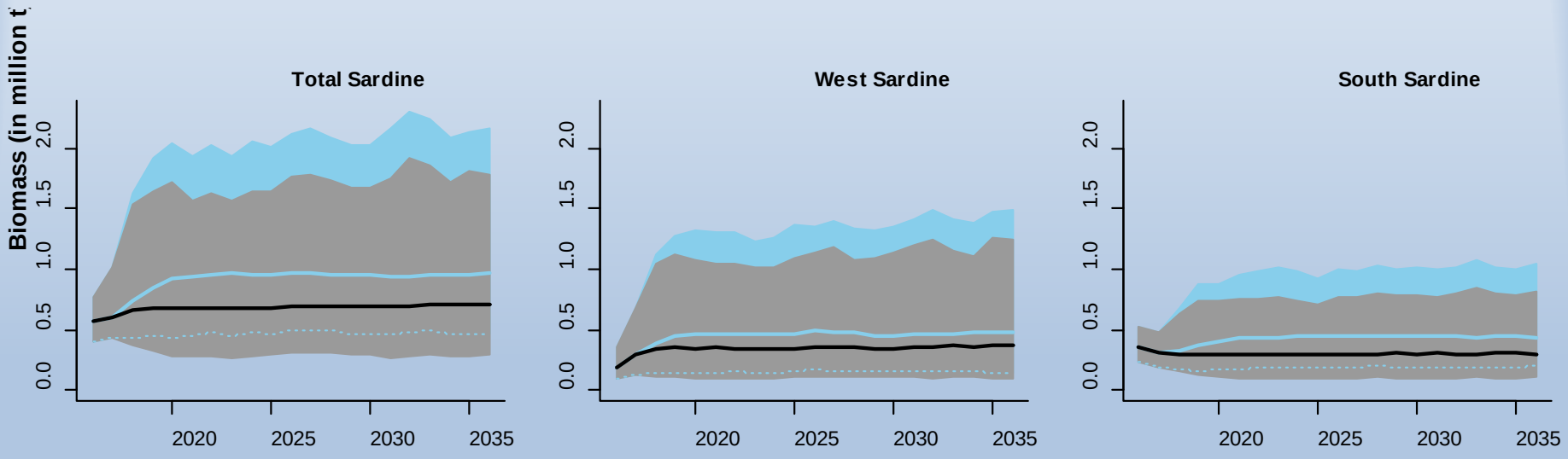
Updated CMP ("CMP1")

- Tune CMP1 to "Leftward Shift" to get β=0.174 (with $Risk_S$=0.20)
  - Lower β due to data updates
  - Higher β due to south component recruitment

				Total		West Component		South Component	
		OMP-08	OMP-14	$\beta = 0.173$	$\beta = 0.174$	$\beta = 0.173$	$\beta = 0.174$	$\beta = 0.173$	$\beta = 0.174$
CMP1 with OM1	10%ile	0.50	0.59	0.64	0.64	0.67	0.67	0.59	0.59
	20%ile	**0.68**	**0.68**	0.69	0.68	0.71	0.71	0.65	0.65
	30%ile	0.72	0.73	0.71	0.71	0.73	0.73	0.68	0.68
	40%ile	0.73	0.76	0.73	0.73	0.76	0.76	0.70	0.70
	50%ile	0.72	0.78	0.74	0.74	0.76	0.76	0.71	0.71

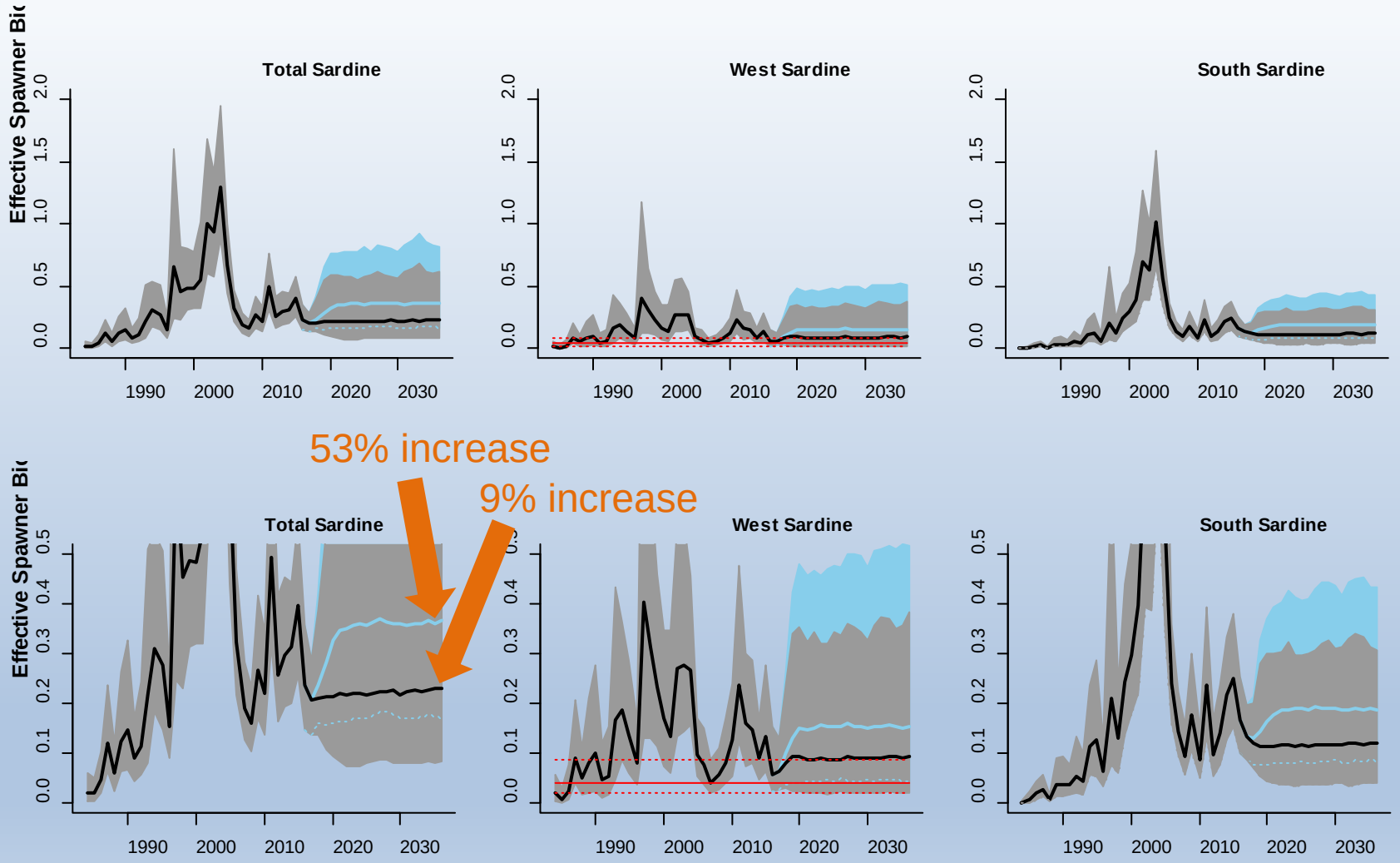
CMP1 v Interim OMP-18

- Higher β; higher catches (more on south coast)
- B^{south}_{2036}, B^{south}_{min}, $B^{south}_{2036}/B^{south}_{2015}$ higher
- B^{west}_{2036}, B^{west}_{min}, $B^{west}_{2036}/B_{west2015}$ lower



No Catch CMP1

CMP1 v No Catch



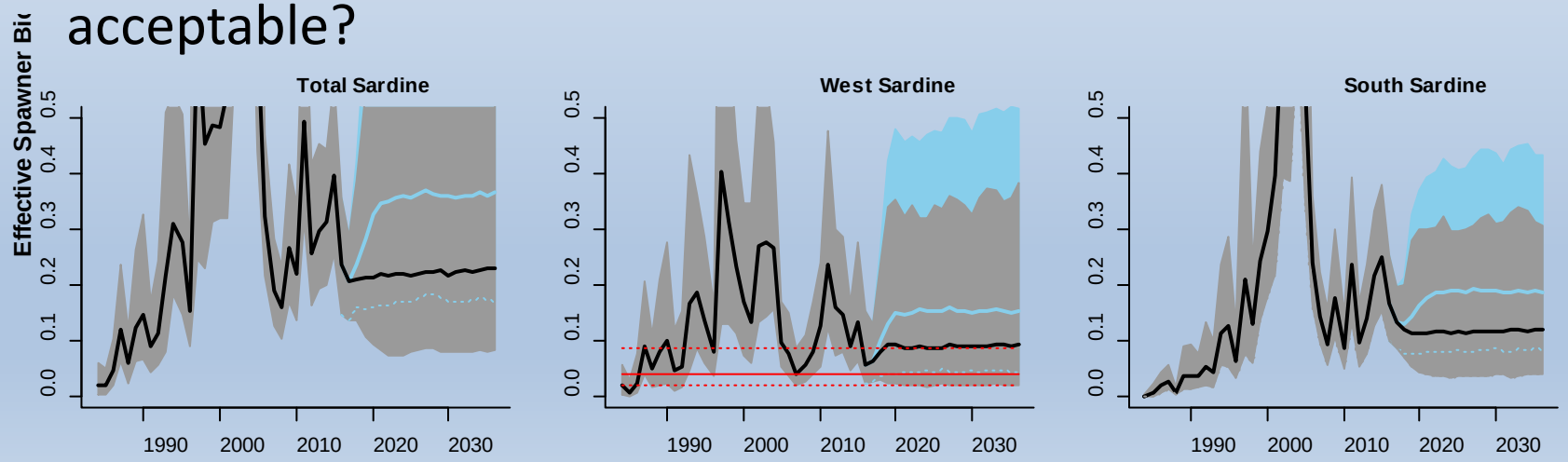
No Catch CMP1 Risk threshold

"Leftward Shift" i.t.o. B^{sp}

				Total	West Component	South Component
		OMP-08	OMP-14	$\beta = 0.174$	$\beta = 0.174$	$\beta = 0.174$
CMP1 with OM1	10%ile	0.50	0.59	0.53	0.53	0.52
	20%ile	**0.68**	**0.68**	0.57	0.57	0.56
	30%ile	0.72	0.73	0.59	0.59	0.59
	40%ile	0.73	0.76	0.61	0.61	0.62
	50%ile	0.72	0.78	0.63	0.63	0.64

Sardine Discussion Point?

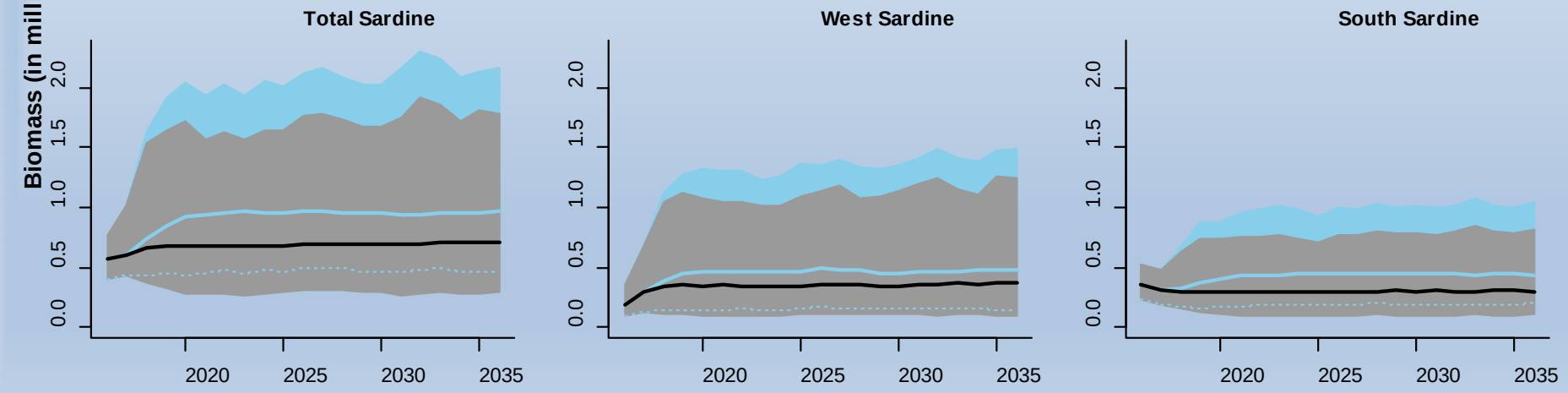
- Tuning CMPs for OMP-18 has been “muddied” by changes in stock structure and risk definition
- “Equivalent” CMPs are tuned based on “Leftward shift” using total biomass
- Our concern for the resource ($Risk_S$) is in terms of west B^{sp}
- Is 20% chance of being below the historically lowest level acceptable?



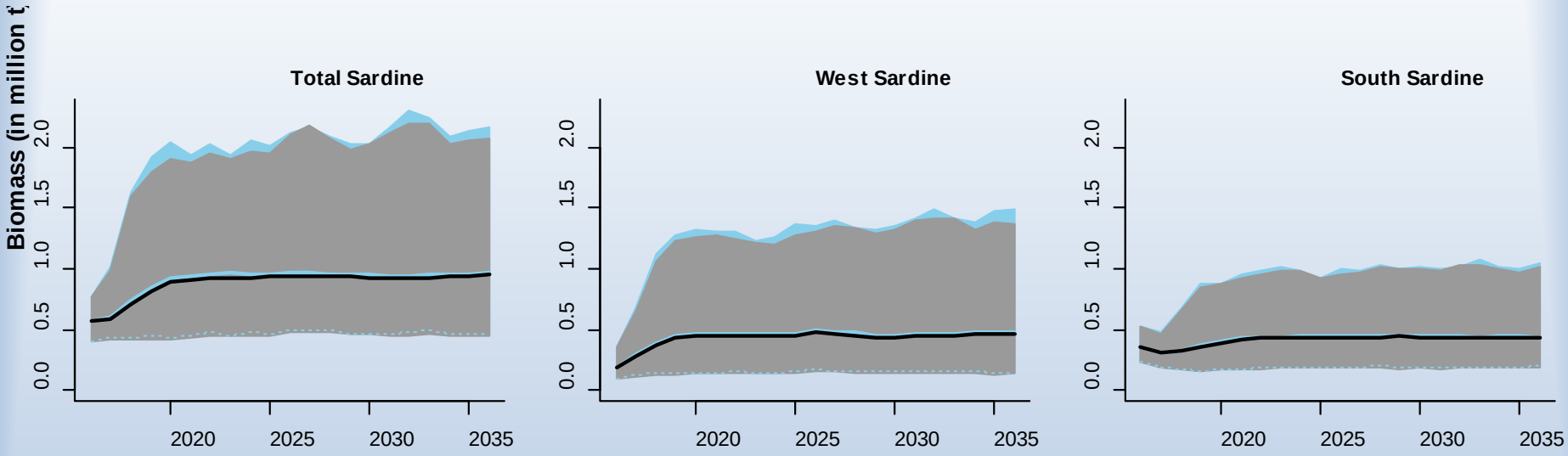
No Catch CMP1 Risk threshold

Sardine Discussion Point?

- Do we overpredict sardine biomass (underestimate natural mortality)?
- B^{obs}_{2016} / k_N ~ 365 [316,426] 000t
- 80% of B_{2016} < 5%ile of 316 00t
- B^{obs}_{2017} / k_N ~473 [409,551] 000t
- B_{2017} mostly > 5%ile of 409, median substantially below 473 000t

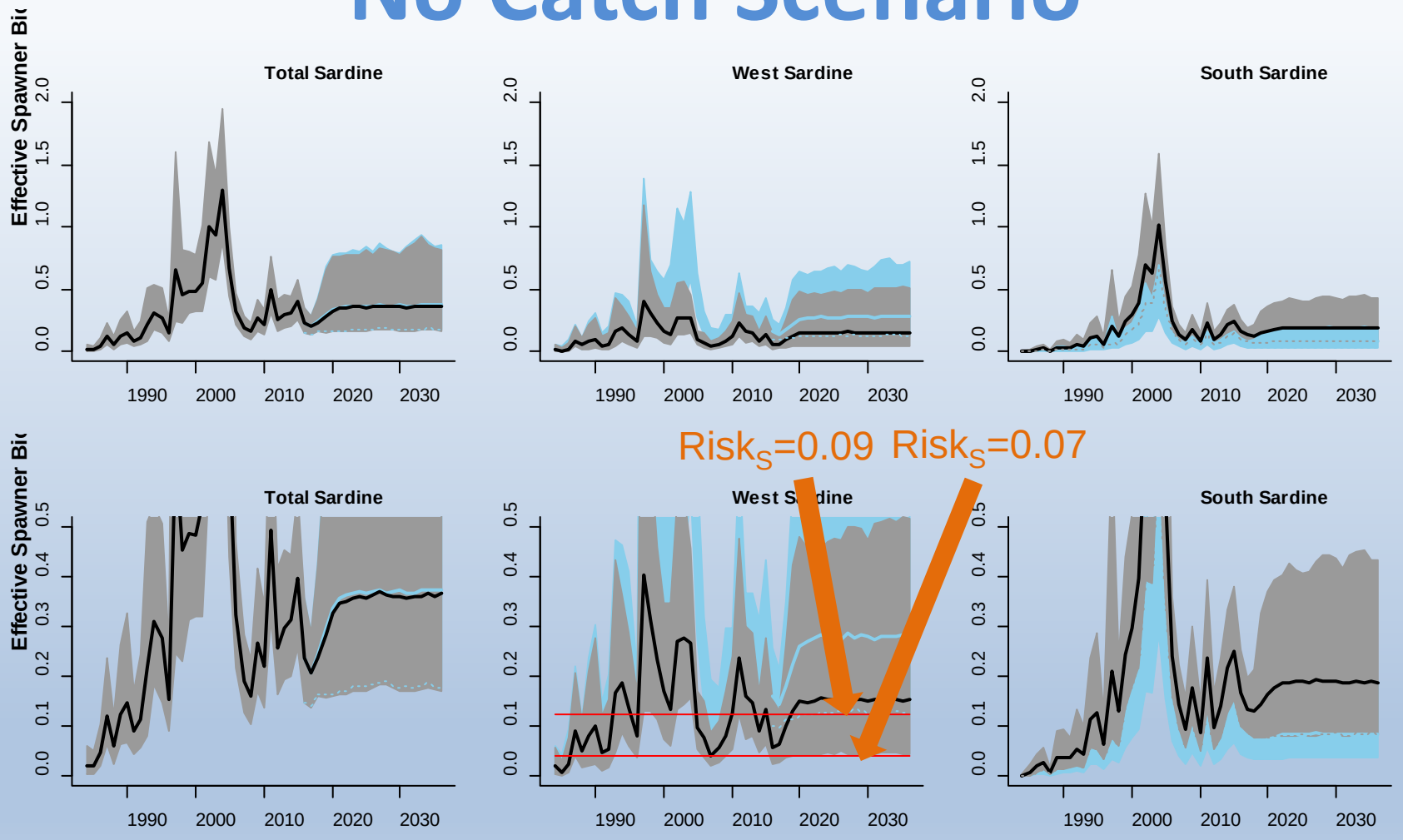


OM1 (p=0.08) v OM2 (p=0.6)
No Catch Scenario



OM1 OM2

OM1 (p=0.08) v OM2 (p=0.6) No Catch Scenario



$Risk_S$=0.09 $Risk_S$=0.07

OM1 OM2 Risk threshold

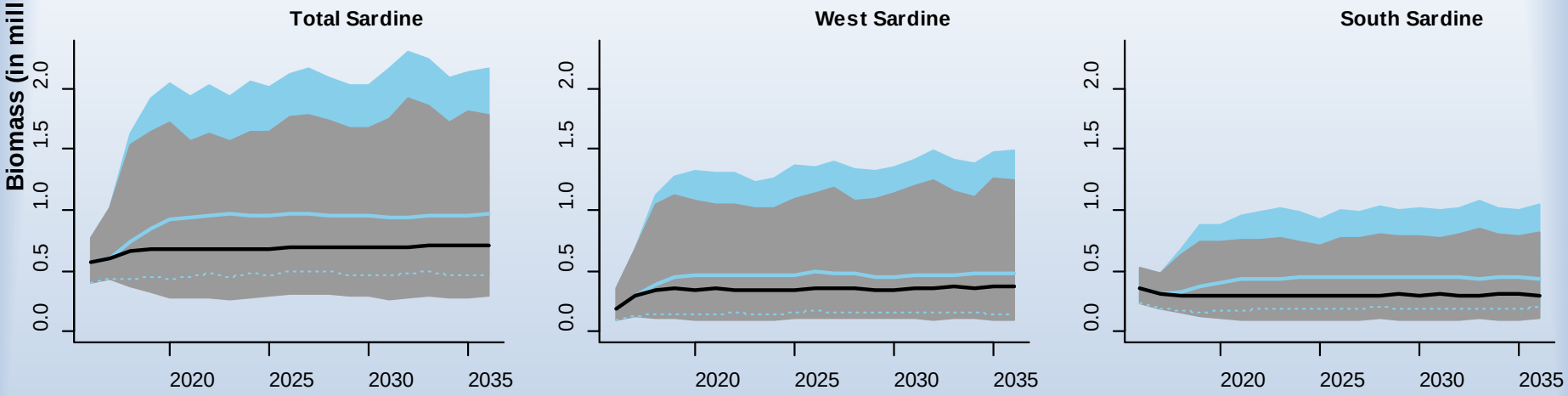
CMP2

- Same constraints as Interim OMP-18
- "OM2" – p=0.6 and MoveR
- $Risk_A$ =0.109
- "Leftward shift" used to select β=0.208

“Leftward Shift” : CMP2 v CMP1

				Total		West Component		South Component	
		OMP-08	OMP-14	$\beta = 0.173$	$\beta = 0.174$	$\beta = 0.173$	$\beta = 0.174$	$\beta = 0.173$	$\beta = 0.174$
CMP1 with OM1	10%ile	0.50	0.59	0.64	0.64	0.67	0.67	0.59	0.59
	20%ile	**0.68**	**0.68**	0.69	0.68	0.71	0.71	0.65	0.65
	30%ile	0.72	0.73	0.71	0.71	0.73	0.73	0.68	0.68
	40%ile	0.73	0.76	0.73	0.73	0.76	0.76	0.70	0.70
	50%ile	0.72	0.78	0.74	0.74	0.76	0.76	0.71	0.71
		OMP-08	OMP-14	$\beta = 0.207$	$\beta = 0.208$	$\beta = 0.207$	$\beta = 0.208$	$\beta = 0.207$	$\beta = 0.208$
CMP2 with OM2	10%ile	0.50	0.59	0.65	0.65	0.72	0.72	0.58	0.58
	20%ile	**0.68**	**0.68**	0.69	0.68	0.73	0.73	0.63	0.63
	30%ile	0.72	0.73	0.71	0.71	0.75	0.75	0.67	0.67
	40%ile	0.73	0.76	0.73	0.73	0.77	0.77	0.68	0.68
	50%ile	0.72	0.78	0.73	0.73	0.77	0.77	0.69	0.69

CMP2 v No Catch (using OM2)



No Catch CMP2

"Leftward Shift" i.t.o. B^{sp}

				Total	West Component	South Component
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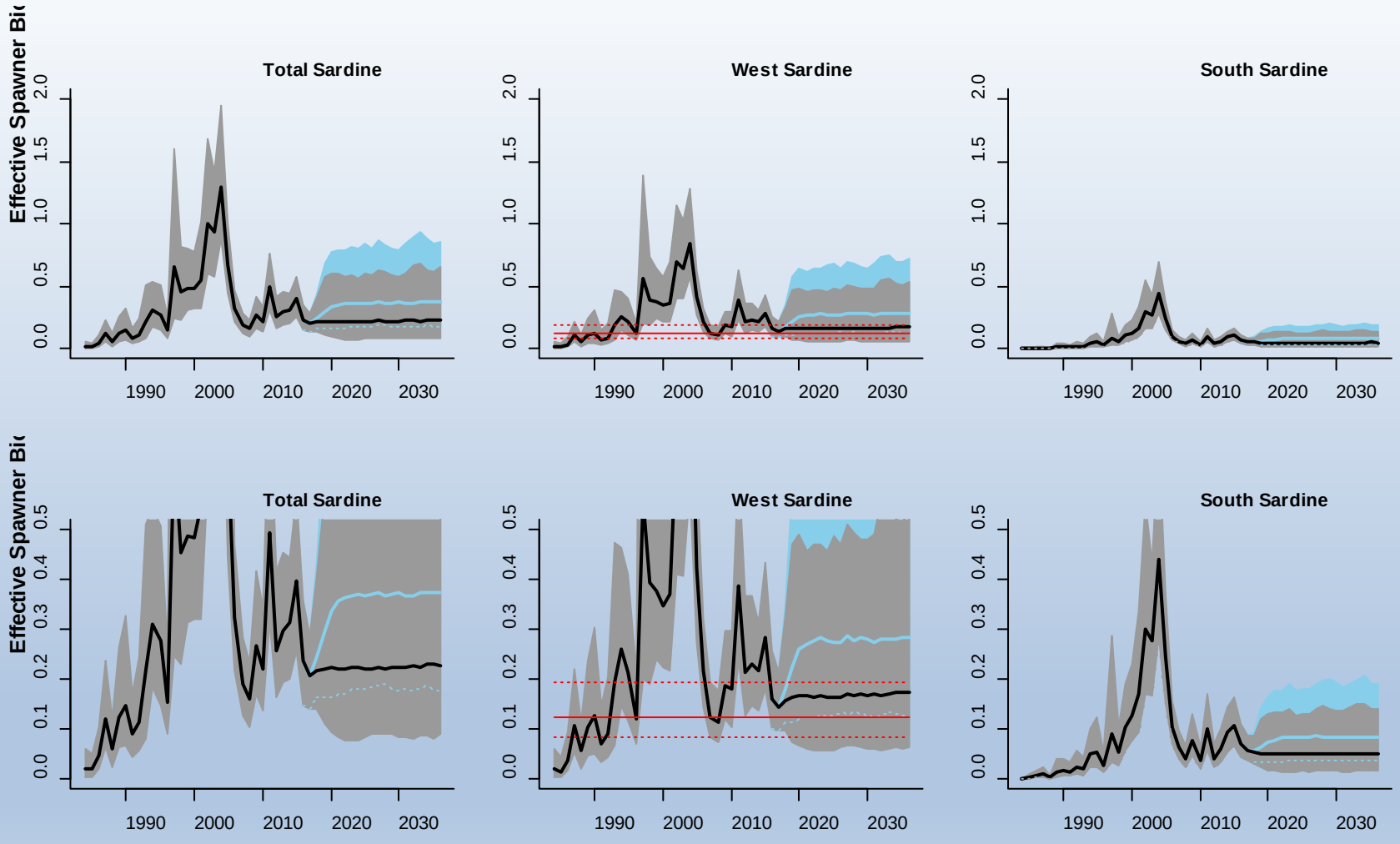
CMP1 with OM1	10%ile	0.50	0.59	0.53	0.53	0.52
	20%ile	**0.68**	**0.68**	0.57	0.57	0.56
	30%ile	0.72	0.73	0.59	0.59	0.59
	40%ile	0.73	0.76	0.61	0.61	0.62
	50%ile	0.72	0.78	0.63	0.63	0.64
		OMP-08	OMP-14	$\beta = 0.208$	$\beta = 0.208$	$\beta = 0.208$
CMP2 with OM2	10%ile	0.50	0.59	0.52	0.54	0.50
	20%ile	**0.68**	**0.68**	0.54	0.55	0.53
	30%ile	0.72	0.73	0.59	0.58	0.57
	40%ile	0.73	0.76	0.60	0.60	0.60
	50%ile	0.72	0.78	0.61	0.62	0.62

CMP2 v No Catch (using OM2)



No Catch CMP2 Risk Threshold

Sardine Risk

- CMP2 : $Risk_S$ =0.32 (OM2 No Catch $Risk_S$ = 0.09)
- CMP1 : $Risk_S$ =0.20 (OM1 No Catch $Risk_S$ = 0.07)

CMP1 & CMP2 on alternative OMs

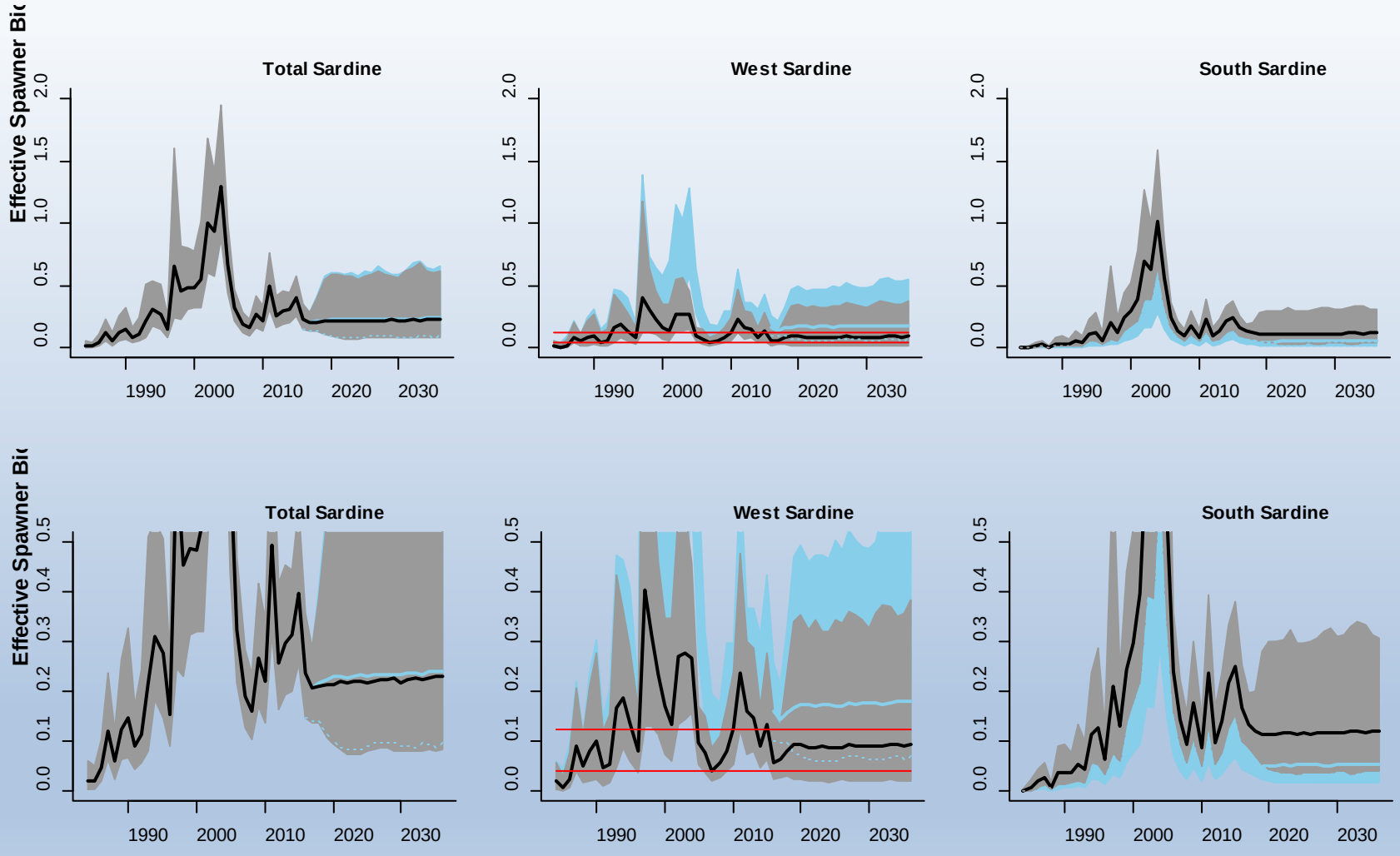
Operating Model		CMP1				CMP2				
		$Risk_S$	C^S_{tot}	C^S_{west}	MAV^S_{tot}	$Risk_S$	C^S_{tot}	C^S_{west}	MAV^S_{tot}	
MoveR	$p = 0.0$	0.199	**101** 90 [26,200]	**66** 57 [14,153]	0.50 [0.25,0.50]	0.204	**110** 100 [27,200]	**69** 60 [14,157]	0.50 [0.23,0.50]	
	$p = 0.08$	0.200	**103** 92 [31,200]	**68** 58 [19,154]	0.50 [0.26,0.50]	0.210	**113** 100 [31,200]	**71** 61 [18,158]	0.50 [0.24,0.50]	OM1
	$p = 0.2$	0.222	**105** 94 [31,200]	**69** 59 [20,156]	0.50 [0.27,0.50]	0.237	**114** 100 [31,200]	**72** 63 [20,159]	0.49 [0.24,0.50]	
	$p = 0.6$	0.296	**107** 97 [31,200]	**71** 61 [22,158]	0.49 [0.26,0.50]	0.320	**116** 103 [31,200]	**74** 64 [22,161]	0.48 [0.23,0.50]	OM2
MoveD	$p = 0.0$	0.174	**102** 91 [31,200]	**68** 58 [16,153]	0.50 [0.26,0.50]	0.179	**111** 100 [31,200]	**71** 62 [16,157]	0.50 [0.25,0.50]	
	$p = 0.08$	0.175	**104** 93 [31,200]	**69** 59 [20,155]	0.49 [0.26,0.50]	0.183	**114** 100 [31,200]	**73** 63 [20,158]	0.50 [0.25,0.50]	
	$p = 0.2$	0.193	**106** 95 [31,200]	**71** 61 [21,156]	0.49 [0.25,0.50]	0.207	**115** 101 [31,200]	**74** 64 [21,160]	0.49 [0.24,0.50]	
	$p = 0.6$	0.276	**107** 97 [31,200]	**72** 62 [23,157]	0.48 [0.25,0.50]	0.296	**117** 104 [31,200]	**75** 66 [23,160]	0.49 [0.24,0.50]	

Catch increases (5-8%) as p increases from 0 to 0.6

$Risk_S$ increases (49-65%) as p increases from 0 to 0.6

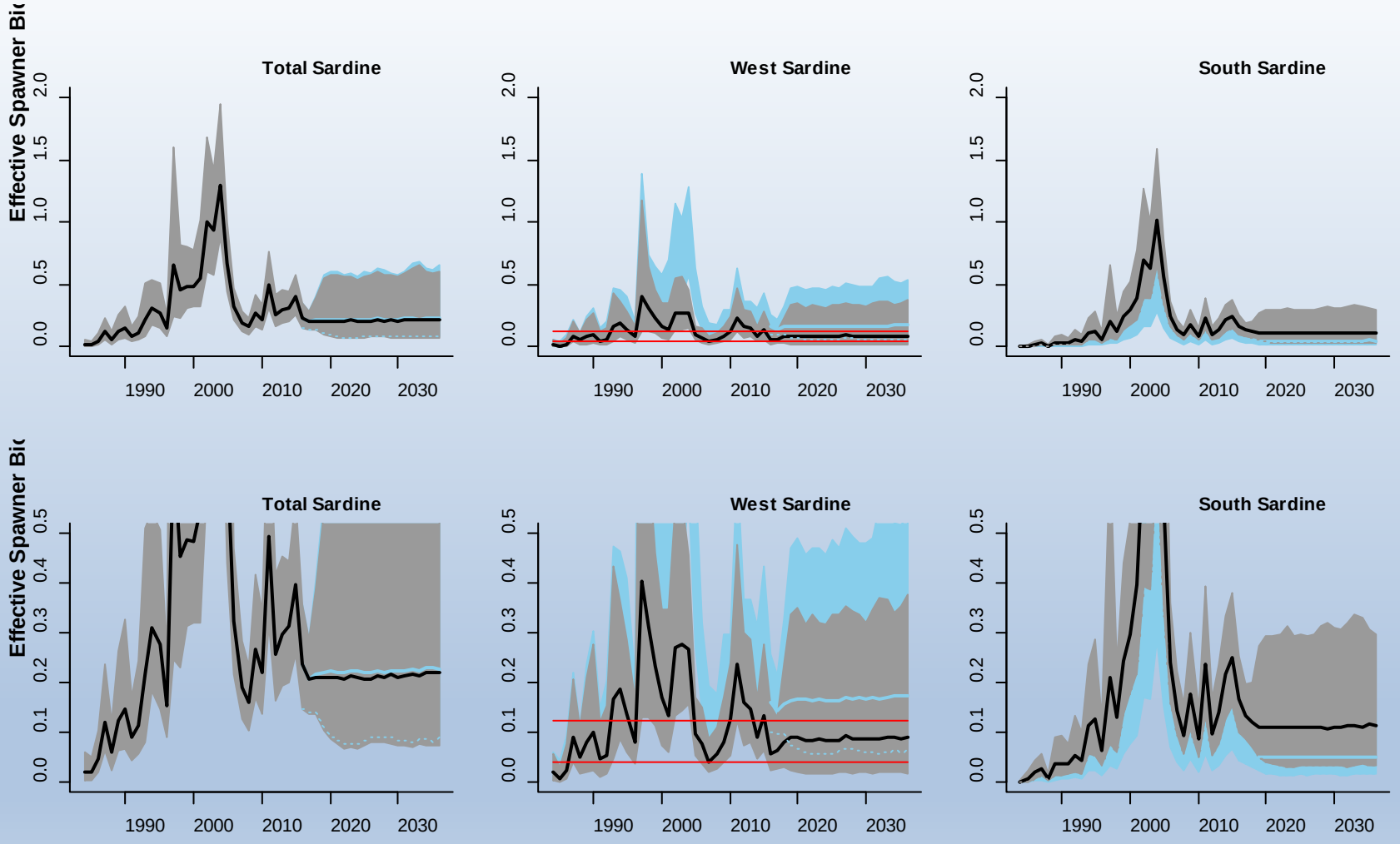
Catches increase slightly; $Risk_S$ decreases as MoveR -> MoveD

CMP1 under OM1 and OM2



CMP1 with OM1 CMP1 with OM2 Risk Threshold

CMP2 under OM1 and OM2



CMP2 with OM1 CMP2 with OM2 Risk Threshold

Example weightings

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
$p = 0.0$	**0.05**	**0.01**	**0.01**	**0.05**	**0.20**
$p = 0.08$	**0.50**	**0.29**	**0.04**	**0.55**	**0.50**
$p = 0.2$	**0.35**	**0.40**	**0.30**	**0.30**	**0.20**
$p = 0.6$	**0.10**	**0.30**	**0.65**	**0.10**	**0.10**
MoveR	0.50	0.25	0.25	0.45	0.40
MoveD	0.50	0.75	0.75	0.55	0.60

Example weightings

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
$p = 0.0$	0.05	0.01	0.01	0.05	0.20
$p = 0.08$	0.50	0.29	0.04	0.55	0.50
$p = 0.2$	0.35	0.40	0.30	0.30	0.20
$p = 0.6$	0.10	0.30	0.65	0.10	0.10
MoveR	**0.50**	**0.25**	**0.25**	**0.45**	**0.40**
MoveD	**0.50**	**0.75**	**0.75**	**0.55**	**0.60**

Weighted performance statistics

		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Mean	Median
MoveR	$p = 0.0$	0.025	0.003	0.003	0.023	0.080		
	$p = 0.08$	0.250	0.073	0.010	0.248	0.200		
	$p = 0.2$	0.175	0.100	0.075	0.135	0.080		
	$p = 0.6$	0.050	0.075	0.163	0.045	0.040		
MoveD	$p = 0.0$	0.025	0.008	0.008	0.028	0.120		
	$p = 0.08$	0.250	0.218	0..030	0.303	0.300		
	$p = 0.2$	0.175	0.300	0.225	0.165	0.120		
	$p = 0.6$	0.05	0.225	0.488	0.055	0.060		
		Sums to 1						

Weighted performance statistics

		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Mean	Median
MoveR	$p = 0.0$	0.025	0.003	0.003	0.023	0.080	0.027	0.025
	$p = 0.08$	0.250	0.073	0.010	0.248	0.200	0.156	0.227
	$p = 0.2$	0.175	0.100	0.075	0.135	0.080	0.113	0.113
	$p = 0.6$	0.050	0.075	0.163	0.045	0.040	0.075	0.057
MoveD	$p = 0.0$	0.025	0.008	0.008	0.028	0.120	0.038	0.028
	$p = 0.08$	0.250	0.218	0..030	0.303	0.300	0.220	0.283
	$p = 0.2$	0.175	0.300	0.225	0.165	0.120	0.197	0.198
	$p = 0.6$	0.05	0.225	0.488	0.055	0.060	0.176	0.068

Weighted performance statistics

		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Mean	Median
MoveR	$p = 0.0$	0.025	0.003	0.003	0.023	0.080	0.027	0.025
	$p = 0.08$	0.250	0.073	0.010	0.248	0.200	0.156	0.227
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MoveD	$p = 0.0$	0.025	0.008	0.008	0.028	0.120	0.038	0.028
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	$p = 0.2$	0.175	0.300	0.225	0.165	0.120	0.197	0.198
	$p = 0.6$	0.05	0.225	0.488	0.055	0.060	0.176	0.068
					CMP1	$Risk_S$	0.215	0.204
						C_{tot}^S	**105** 94	**105** 94
					CMP2	$Risk_S$	0.228	0.216
						C_{tot}^S	**115** 101	**114** 100

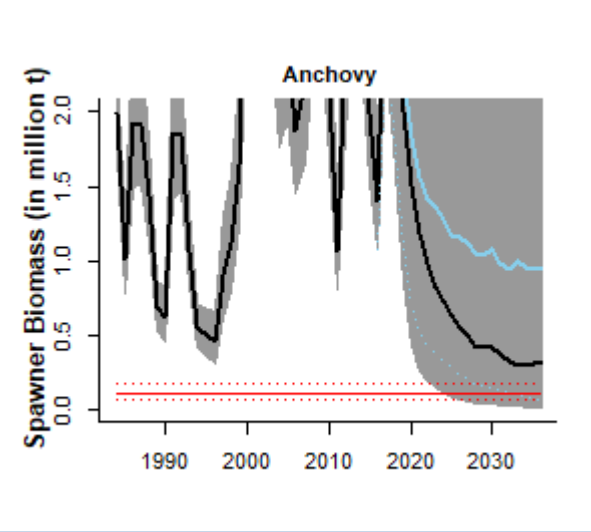
Weighting Discussion Point?

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	+ ?
$p = 0.0$	0.05	0.01	0.01	0.05	0.20	
$p = 0.08$	0.50	0.29	0.04	0.55	0.50	
$p = 0.2$	0.35	0.40	0.30	0.30	0.20	
$p = 0.6$	0.10	0.30	0.65	0.10	0.10	
MoveR	0.50	0.25	0.25	0.45	0.40	
MoveD	0.50	0.75	0.75	0.55	0.60	

Anchovy Discussion Point?

- Is method for choosing $Risk_A$ appropriate?
- Leads to 11% chance of being below a quarter of historical low
- But this only happens after ±5 years
- BH based on all years

- projections more positive if BH based on 2000-15 only?
- How long will current 'regime' last?!



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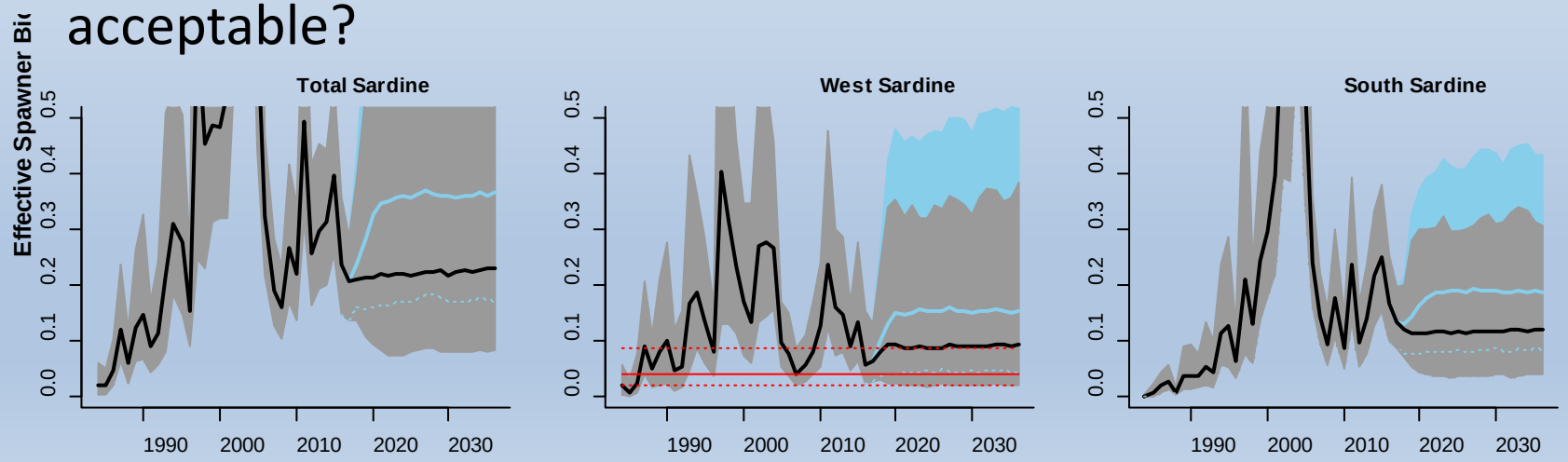
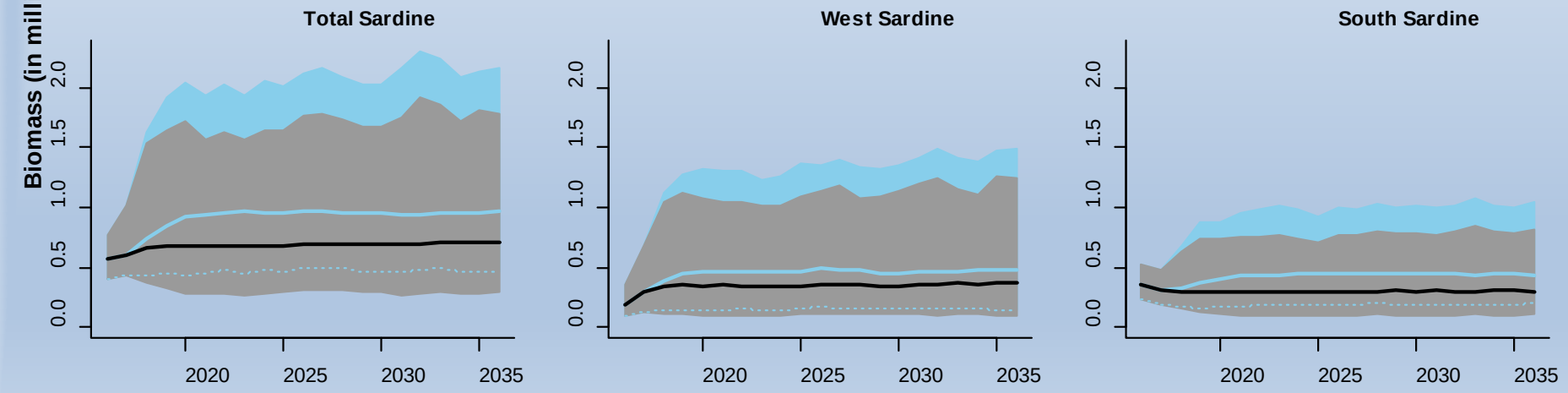


No Catch CMP1 Risk threshold

Sardine Discussion Point?

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- B_{2017} mostly > 5%ile of 409, median substantially below 473 000t