A method to recommend the final anchovy TAC for 2020 based on short-term projections of the anchovy resource

SWG-PEL Meeting

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Carryn de Moor

Marine Resource Assessment and Management Group (MARAM)
Department of Mathematics and Applied Mathematics
University of Cape Town

Back in March…

Rec	Catch	Deterministic								Recruitment and Initial variability							
		$R=SSB_{2020}:SSB_{2019}$			$R^{Catch}:R^{NoCatch}$					$R=SSB_{2020}:SSB_{2019}$			$R^{Catch}:R^{NoCatch}$				
		5%	20%	50%	5%	20%	50%	R^{Isk}_{20}	R^{Isk}_{all}	5%	20%	50%	5%	20%	50%	R^{Isk}_{20}	R^{Isk}_{all}
100%	0	1.61	1.61	1.61	1.00	1.00	1.00	0.00	0.00	0.86	1.12	1.63	1.00	1.00	1.00	0.00	0.00
	50	1.59	1.59	1.59	0.98	0.98	0.98	0.00	0.00	0.84	1.10	1.60	0.97	0.98	0.99	0.00	0.00
	100	1.56	1.56	1.56	0.97	0.97	0.97	0.00	0.00	0.81	1.07	1.58	0.95	0.96	0.97	0.00	0.00
	150	1.53	1.53	1.53	0.95	0.95	0.95	0.00	0.00	0.79	1.05	1.55	0.92	0.94	0.95	0.00	0.00
	200	1.51	1.51	1.51	0.94	0.94	0.94	0.00	0.00	0.77	1.03	1.53	0.89	0.92	0.94	0.00	0.00
	250	1.48	1.48	1.48	0.92	0.92	0.92	0.00	0.00	0.74	1.01	1.50	0.86	0.89	0.92	0.00	0.00
	300	1.46	1.46	1.46	0.91	0.91	0.91	0.00	0.00	0.72	0.98	1.48	0.83	0.87	0.91	0.00	0.00
75%	0	1.32	1.32	1.32	1.00	1.00	1.00	0.00	0.00	0.76	0.96	1.34	1.00	1.00	1.00	0.00	0.00
	50	1.30	1.30	1.30	0.98	0.98	0.98	0.00	0.00	0.74	0.93	1.31	0.97	0.97	0.98	0.00	0.00
	100	1.27	1.27	1.27	0.96	0.96	0.96	0.00	0.00	0.71	0.91	1.29	0.94	0.95	0.96	0.00	0.00
	150	1.25	1.25	1.25	0.94	0.94	0.94	0.00	0.00	0.69	0.89	1.26	0.91	0.93	0.94	0.00	0.00
	200	1.22	1.22	1.22	0.92	0.92	0.92	0.00	0.00	0.67	0.86	1.24	0.88	0.90	0.93	0.00	0.00
	250	1.20	1.20	1.20	0.91	0.91	0.91	0.00	0.00	0.64	0.84	1.21	0.84	0.88	0.91	0.00	0.00
	300	1.17	1.17	1.17	0.89	0.89	0.89	0.00	0.00	0.61	0.82	1.19	0.80	0.85	0.89	0.00	0.00
50%	0	1.03	1.03	1.03	1.00	1.00	1.00	0.00	0.00	0.66	0.79	1.04	1.00	1.00	1.00	0.00	0.00
	50	1.01	1.01	1.01	0.98	0.98	0.98	0.00	0.00	0.64	0.77	1.02	0.97	0.97	0.98	0.00	0.00
	100	0.98	0.98	0.98	0.95	0.95	0.95	0.00	0.00	0.61	0.75	0.99	0.93	0.94	0.95	0.00	0.01
	150	0.96	0.96	0.96	0.93	0.93	0.93	0.00	0.00	0.59	0.72	0.97	0.89	0.91	0.93	0.00	0.02
	200	0.94	0.94	0.94	0.90	0.90	0.90	0.00	0.00	0.56	0.70	0.94	0.85	0.88	0.91	0.00	0.03
	250	0.91	0.91	0.91	0.88	0.88	0.88	0.00	0.00	0.53	0.67	0.92	0.81	0.85	0.88	0.00	0.04
	300	0.89	0.89	0.89	0.86	0.86	0.86	0.00	0.00	0.51	0.65	0.89	0.77	0.82	0.86	0.01	0.06
40%	0	0.92	0.92	0.92	1.00	1.00	1.00	0.00	0.00	0.62	0.72	0.93	1.00	1.00	1.00	0.00	0.01
	50	0.89	0.89	0.89	0.97	0.97	0.97	0.00	0.00	0.60	0.70	0.90	0.96	0.97	0.97	0.00	0.02
	100	0.87	0.87	0.87	0.95	0.95	0.95	0.00	0.00	0.57	0.68	0.88	0.93	0.94	0.95	0.00	0.04
	150	0.84	0.84	0.84	0.92	0.92	0.92	0.00	0.00	0.54	0.65	0.85	0.88	0.90	0.92	0.00	0.06
	200	0.82	0.82	0.82	0.89	0.89	0.89	0.00	0.00	0.52	0.63	0.83	0.84	0.87	0.89	0.01	0.08
	250	0.80	0.80	0.80	0.87	0.87	0.87	0.00	0.00	0.49	0.60	0.80	0.80	0.83	0.87	0.01	0.11
	300	0.77	0.77	0.77	0.84	0.84	0.84	0.00	0.00	0.47	0.58	0.78	0.76	0.80	0.84	0.02	0.14
30%	0	0.80	0.80	0.80	1.00	1.00	1.00	0.00	0.00	0.58	0.66	0.81	1.00	1.00	1.00	0.00	0.06
	50	0.78	0.78	0.78	0.97	0.97	0.97	0.00	0.00	0.55	0.63	0.78	0.96	0.97	0.97	0.00	0.09
	100	0.75	0.75	0.75	0.94	0.94	0.94	0.00	0.00	0.53	0.61	0.76	0.92	0.93	0.94	0.00	0.13
	150	0.73	0.73	0.73	0.91	0.91	0.91	0.00	0.00	0.50	0.59	0.74	0.87	0.89	0.91	0.01	0.18
	200	0.71	0.71	0.71	0.88	0.88	0.88	0.00	0.00	0.48	0.56	0.71	0.83	0.85	0.88	0.02	0.23
	250	0.68	0.68	0.68	0.85	0.85	0.85	0.00	0.00	0.45	0.54	0.69	0.78	0.82	0.85	0.03	0.28
	300	0.66	0.66	0.66	0.82	0.82	0.82	0.00	0.64	0.43	0.51	0.66	0.75	0.78	0.82	0.04	0.33
20%	0	0.69	0.69	0.69	1.00	1.00	1.00	0.00	0.00	0.54	0.59	0.69	1.00	1.00	1.00	0.00	0.25
	50	0.66	0.66	0.66	0.97	0.97	0.97	0.00	0.64	0.51	0.57	0.67	0.96	0.96	0.97	0.00	0.32
	100	0.64	0.64	0.64	0.93	0.93	0.93	0.00	0.73	0.49	0.54	0.64	0.91	0.92	0.93	0.01	0.40
	150	0.61	0.61	0.61	0.89	0.89	0.89	0.00	0.73	0.46	0.52	0.62	0.86	0.88	0.89	0.02	0.47
	200	0.59	0.59	0.59	0.86	0.86	0.86	0.00	0.82	0.44	0.50	0.59	0.81	0.84	0.86	0.04	0.52
	250	0.57	0.57	0.57	0.82	0.82	0.82	0.00	0.82	0.42	0.47	0.57	0.78	0.80	0.82	0.05	0.57
	300	0.54	0.54	0.54	0.79	0.79	0.79	0.00	0.82	0.41	0.44	0.54	0.77	0.75	0.79	0.08	0.61

Primarily a recruit fishery, assumptions about incoming recruitment are important

Same Method, New Information

What's new?

- Anchovy assessment ∴ updated projections (Doc #52)
- Information on recruitment at the time of the 2020 survey (Doc #56)

→ Information on recruitment in November 2019 (can we narrow down % of historical recruitment)

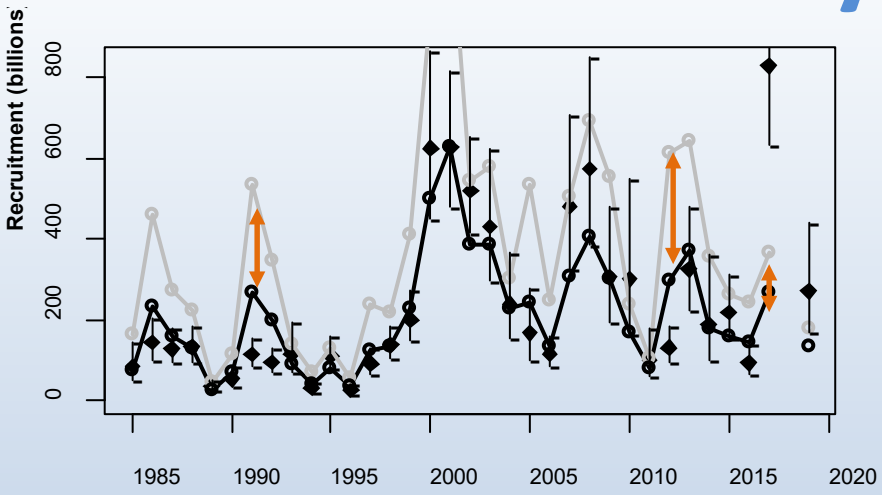
Back-projection of recruitment

- Given 'true' recruitment at the time of the survey, we can back-project taking natural and fishing mortality into account to 1 November 2019.
- BUT: Missing LFs mean we can't separate out recruit catch from 1+ year olds during end March – mid June 2020
- Best Approximation: Use Commercial LFs from April – mid-June of 2014 & 2015 to represent commercial LFs from April – mid-June 2020.
- + Two Sensitivities

	April – June Length frequency		
	Best approximation	2018 Commercial LF	2020 Survey LF
$C^{A}_{2020,1,0}$	0.003	0.003	0.003
$C^{A}_{2020,2,0}$	4.09	1.17	11.16
$C^{A}_{2020,0bs}$	2.65	1.43	11.09

- (See Fig 1 for LFs)

What is ‘true’ recruitment at the time of the survey?



1) Survey bias: Difference between ‘true’ recruitment and bias corrected recruitment which is taken to represent the survey index (k_r^A)

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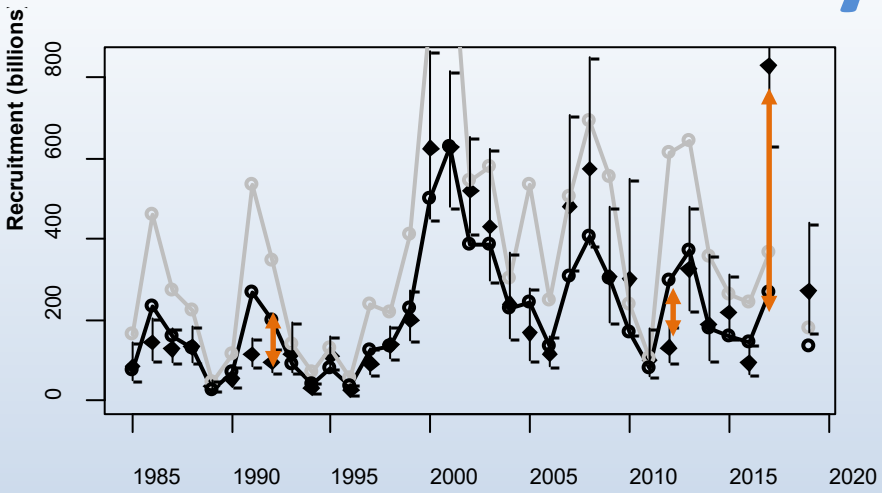
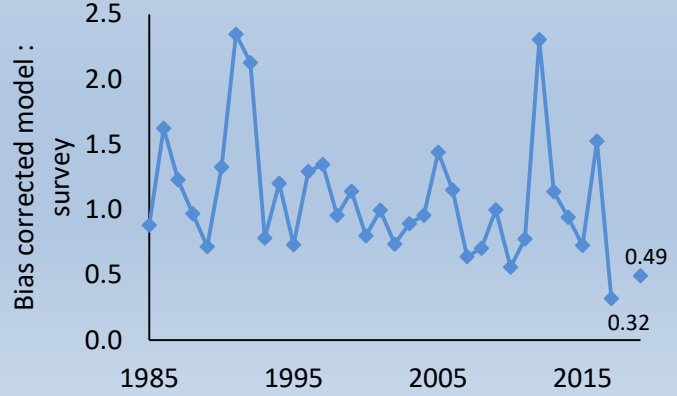
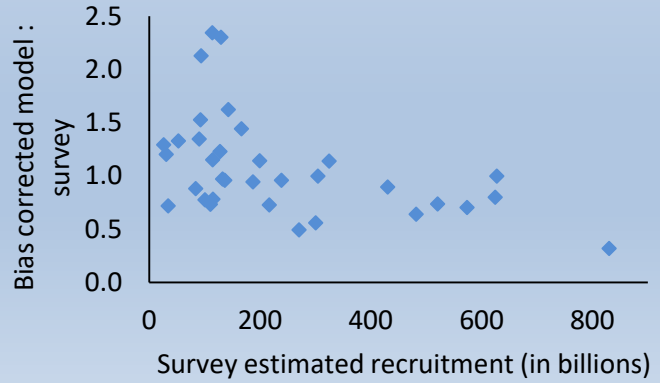


1) Survey bias: Difference between ‘true’ recruitment and bias corrected recruitment which is taken to represent the survey index (k_r^A)
2) Survey and additional variance:





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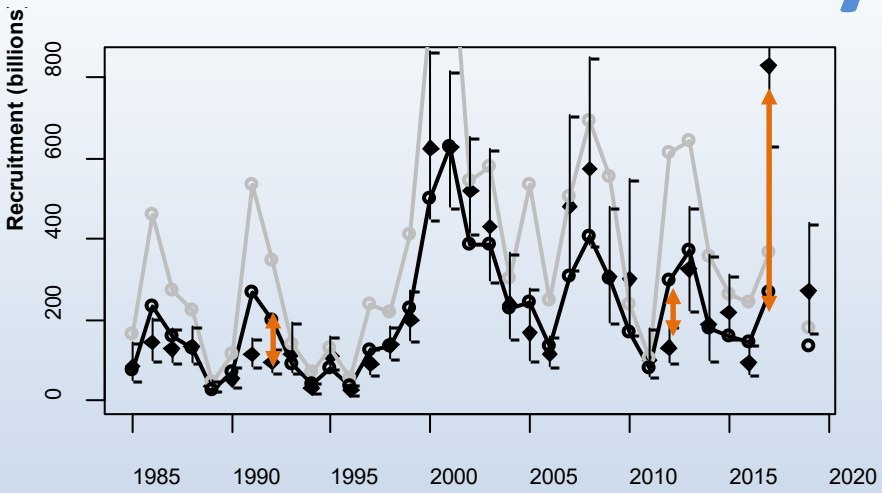


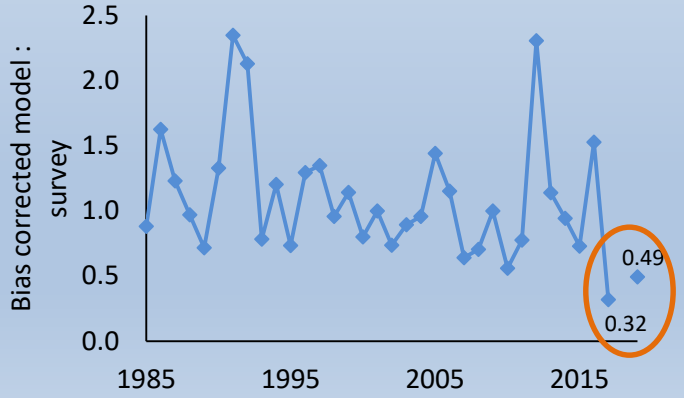
1) Survey bias: Difference between ‘true’ recruitment and bias corrected recruitment which is taken to represent the survey index (k_r^A)

2) Survey and additional variance:

i) No uncertainty : $k_r^A N_{2020,r}^A = N_{2020,r}^{obs}$

ii) One SE difference : $k_r^A N_{2020,r}^A = (1 - 0.20) N_{2020,r}^{obs}$

iii) Recent difference : $k_r^A N_{2020,r}^A = 0.5 N_{2020,r}^{obs}$



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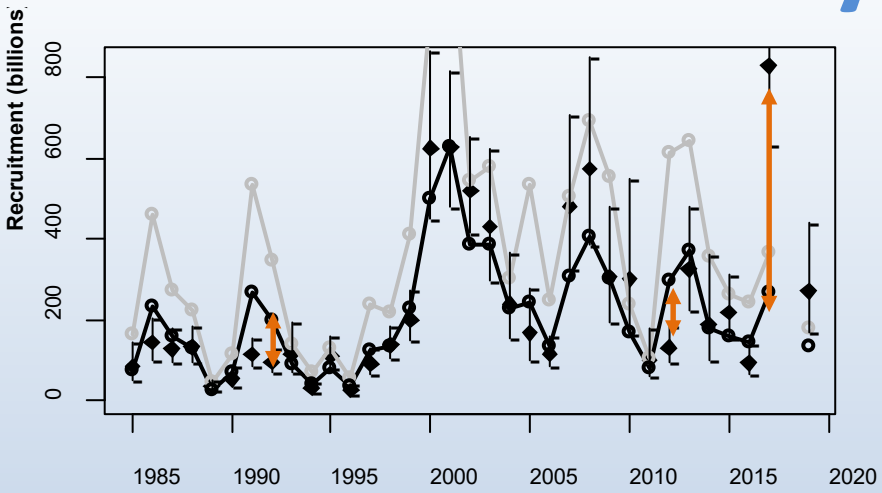

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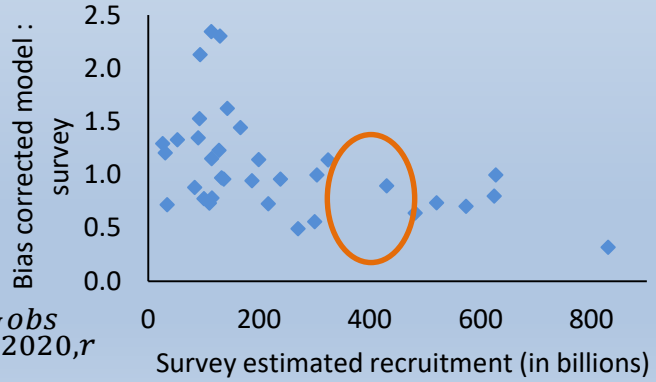
iii) Recent difference : $k_r^A N_{2020,r}^A = 0.5 N_{2020,r}^{obs}$

iv) Difference corresponding to 400+ billion: $k_r^A N_{2020,r}^A = 0.9 N_{2020,r}^{obs}$



Back-projected November 2019 Recruitment

	April – June Length frequency		
	Best approximation	2018 Commercial LF	2020 Survey LF
$C^{A}_{2020,1,0}$	0.003	0.003	0.003
$C^{A}_{2020,2,0}$	4.09	1.17	11.16
$C^{A}_{2020,0bs}$	2.65	1.43	11.09
$N^{obs}_{2020,r}$	1095	1088	1122
$(1-0.20)N^{obs}_{2020,r}$	878	871	906
$0.5N^{obs}_{2020,r}$	553	546	581
$0.9N^{obs}_{2020,r}$	986	979	1014

198%

96%

98%

193%

Impact of 2020 catch on the resource

- Statistics given for 5%ile, 20%ile and 50%ile
- Given the availability of the June 2020 survey estimate, it is likely defensible to primarily consider the 20%ile

20%ile of SSB_{2020}:SSB_{2019}

Catch (in thousand tons)	Proportion of historical average recruitment							
	10%	30%	50%	70%	90%	110%	130%	150%
0	0.47	0.59	0.72	0.84	0.97	1.09	1.22	1.34
150	0.39	0.52	0.64	0.76	0.89	1.01	1.13	1.26
200	0.37	0.49	0.62	0.74	0.86	0.99	1.11	1.23
210	0.36	0.48	0.61	0.73	0.86	0.98	1.10	1.23
220	0.36	0.48	0.60	0.73	0.85	0.97	1.10	1.22
230	0.35	0.47	0.60	0.72	0.85	0.97	1.09	1.22
240	0.35	0.47	0.59	0.72	0.84	0.96	1.09	1.21
250	0.34	0.46	0.59	0.71	0.84	0.96	1.08	1.21
260	0.34	0.46	0.58	0.71	0.83	0.95	1.08	1.20
270	0.33	0.45	0.58	0.70	0.83	0.95	1.07	1.19
280	0.33	0.45	0.57	0.70	0.82	0.94	1.07	1.19
290	0.32	0.44	0.57	0.69	0.81	0.94	1.06	1.18
300	0.31	0.44	0.56	0.69	0.81	0.93	1.06	1.18
310	0.31	0.43	0.55	0.68	0.80	0.93	1.05	1.17
320	0.31	0.42	0.55	0.67	0.80	0.92	1.05	1.17
330	0.30	0.42	0.54	0.67	0.79	0.92	1.04	1.16
340	0.30	0.41	0.54	0.66	0.79	0.91	1.04	1.16
350	0.29	0.41	0.53	0.66	0.78	0.91	1.03	1.15

Increase in SSB

Table 2b of Doc #52

20%ile of $(SSB_{2020}:SSB_{2019})^{C}:(SSB_{2020}:SSB_{2019})^{NoC}$

Proportion of historical average recruitment

Catch (in thousand tons)	10%	30%	50%	70%	90%	110%	130%	150%
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
150	0.84	0.87	0.89	0.91	0.92	0.93	0.93	0.94
200	0.78	0.82	0.86	0.88	0.89	0.90	0.91	0.92
210	0.77	0.82	0.85	0.87	0.89	0.90	0.91	0.92
220	0.76	0.81	0.84	0.86	0.88	0.89	0.90	0.91
230	0.75	0.80	0.83	0.86	0.88	0.89	0.90	0.91
240	0.74	0.79	0.83	0.85	0.87	0.88	0.89	0.90
250	0.73	0.78	0.82	0.84	0.87	0.88	0.89	0.90
260	0.72	0.77	0.81	0.84	0.86	0.87	0.89	0.90
270	0.71	0.76	0.81	0.83	0.85	0.87	0.88	0.89
280	0.69	0.75	0.80	0.83	0.85	0.87	0.88	0.89
290	0.68	0.75	0.79	0.82	0.84	0.86	0.87	0.88
300	0.67	0.74	0.78	0.81	0.84	0.86	0.87	0.88
310	0.66	0.73	0.77	0.81	0.83	0.85	0.86	0.88
320	0.65	0.72	0.76	0.80	0.82	0.85	0.86	0.87
330	0.64	0.71	0.76	0.79	0.82	0.84	0.86	0.87
340	0.63	0.70	0.75	0.79	0.82	0.84	0.85	0.86
350	0.62	0.68	0.74	0.78	0.81	0.83	0.85	0.86

Table 3b of Doc #52

20%ile of SSB_{2020}:$SSBO_{2019}$

Catch (in thousand tons)	Proportion of historical average recruitment							
	10%	30%	50%	70%	90%	110%	130%	150%
0	0.31	0.40	0.48	0.56	0.65	0.73	0.81	0.90
150	0.26	0.35	0.43	0.51	0.59	0.68	0.76	0.84
200	0.25	0.33	0.41	0.49	0.58	0.66	0.74	0.82
210	0.24	0.32	0.41	0.49	0.57	0.66	0.74	0.82
220	0.24	0.32	0.40	0.49	0.57	0.65	0.73	0.82
230	0.24	0.32	0.40	0.48	0.57	0.65	0.73	0.81
240	0.23	0.31	0.40	0.48	0.56	0.65	0.73	0.81
250	0.23	0.31	0.39	0.48	0.56	0.64	0.72	0.81
260	0.23	0.31	0.39	0.47	0.56	0.64	0.72	0.80
270	0.22	0.30	0.39	0.47	0.55	0.64	0.72	0.80
280	0.22	0.30	0.38	0.47	0.55	0.63	0.71	0.80
290	0.21	0.30	0.38	0.46	0.54	0.63	0.71	0.79
300	0.21	0.29	0.37	0.46	0.54	0.63	0.71	0.79
310	0.21	0.29	0.37	0.46	0.54	0.62	0.70	0.79
320	0.20	0.28	0.37	0.45	0.53	0.62	0.70	0.78
330	0.20	0.28	0.36	0.45	0.53	0.61	0.70	0.78
340	0.20	0.28	0.36	0.44	0.53	0.61	0.69	0.78
350	0.19	0.27	0.36	0.44	0.52	0.61	0.69	0.77

Table 4b of Doc #52

20%ile of SSB_{2020}:$SSBO_{2020}$

Catch (in thousand tons)	Proportion of historical average recruitment							
	10%	30%	50%	70%	90%	110%	130%	150%
0	0.71	0.75	0.79	0.81	0.83	0.85	0.86	0.87
150	0.59	0.65	0.70	0.73	0.76	0.79	0.80	0.82
200	0.55	0.62	0.67	0.71	0.74	0.76	0.78	0.80
210	0.54	0.61	0.66	0.70	0.73	0.76	0.78	0.80
220	0.53	0.60	0.65	0.70	0.73	0.75	0.78	0.79
230	0.53	0.60	0.65	0.69	0.72	0.75	0.77	0.79
240	0.52	0.59	0.64	0.69	0.72	0.75	0.77	0.79
250	0.51	0.58	0.64	0.68	0.72	0.74	0.76	0.78
260	0.50	0.58	0.63	0.67	0.71	0.74	0.76	0.78
270	0.49	0.57	0.62	0.67	0.70	0.73	0.76	0.78
280	0.49	0.56	0.62	0.66	0.70	0.73	0.75	0.77
290	0.48	0.56	0.61	0.66	0.69	0.72	0.75	0.77
300	0.47	0.55	0.61	0.65	0.69	0.72	0.74	0.77
310	0.46	0.54	0.60	0.65	0.68	0.72	0.74	0.76
320	0.46	0.54	0.60	0.64	0.68	0.71	0.74	0.76
330	0.45	0.53	0.59	0.64	0.67	0.71	0.73	0.75
340	0.44	0.52	0.58	0.63	0.67	0.70	0.73	0.75
350	0.43	0.52	0.58	0.62	0.66	0.70	0.72	0.75

Table 5b of Doc #52

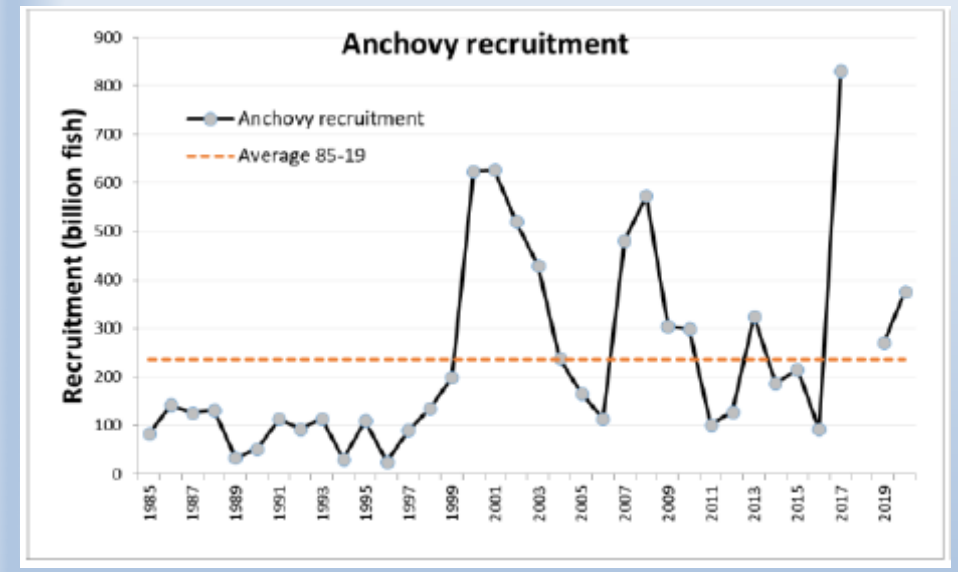
20%ile of SSB_{2029}:$SSBO_{2029}$

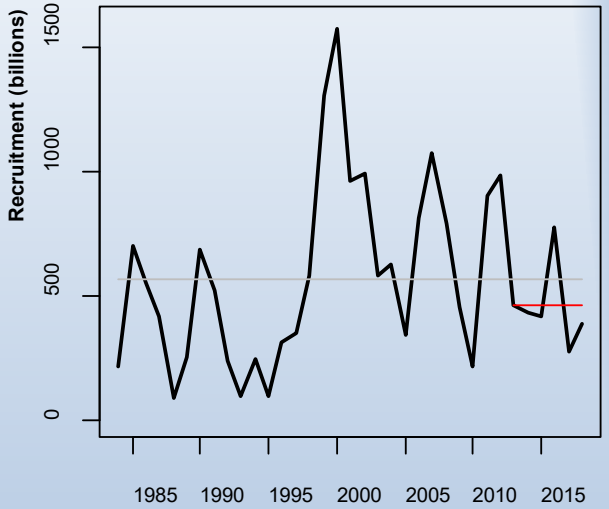
Catch (in thousand tons)	Proportion of historical average recruitment							
	10%	30%	50%	70%	90%	110%	130%	150%
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
150	0.01	0.68	0.81	0.87	0.90	0.91	0.93	0.94
200	0.00	0.57	0.74	0.82	0.86	0.89	0.90	0.92
210	0.00	0.54	0.73	0.81	0.85	0.88	0.90	0.91
220	0.00	0.52	0.72	0.80	0.85	0.87	0.89	0.91
230	0.00	0.50	0.70	0.79	0.84	0.87	0.89	0.90
240	0.00	0.48	0.69	0.78	0.83	0.86	0.88	0.90
250	0.00	0.45	0.68	0.77	0.82	0.86	0.88	0.90
260	0.00	0.43	0.66	0.76	0.82	0.85	0.87	0.89
270	0.00	0.41	0.65	0.75	0.81	0.85	0.87	0.89
280	0.00	0.39	0.64	0.74	0.80	0.84	0.86	0.88
290	0.00	0.36	0.62	0.73	0.80	0.83	0.86	0.88
300	0.00	0.34	0.61	0.73	0.79	0.83	0.85	0.87
310	0.00	0.31	0.60	0.72	0.78	0.82	0.85	0.87
320	0.00	0.29	0.58	0.71	0.77	0.82	0.84	0.87
330	0.00	0.26	0.57	0.70	0.77	0.81	0.84	0.86
340	0.00	0.24	0.56	0.69	0.76	0.80	0.83	0.86
350	0.00	0.21	0.54	0.68	0.75	0.80	0.83	0.85

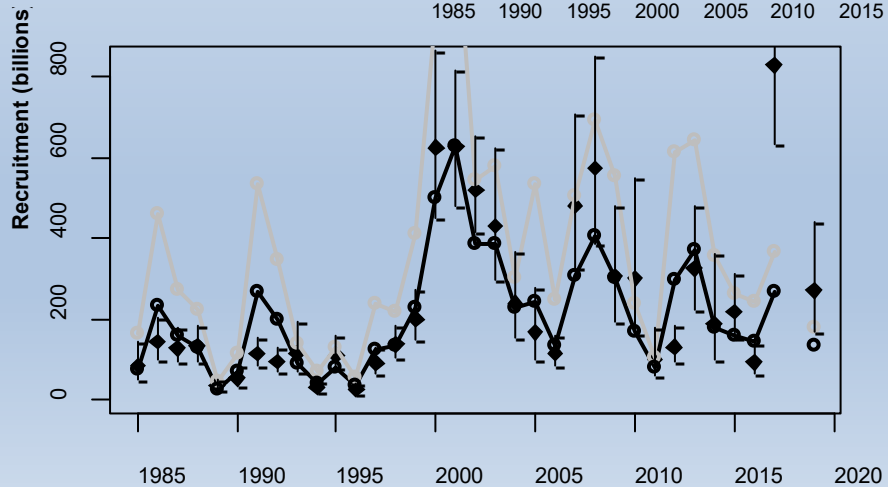
Table 6b of Doc #52

Impact of 2020 catch on the resource

- "Worst" case, but not unlikely, scenario is 90% of historical recruitment:







Impact of 2020 catch on the resource

- Worst case scenario is most likely 90% of historical recruitment:
- @350 000t, SSB_{2020} will be 78% of SSB_{2019}, which is 81% of that which could be achieved if there were no catch during 2020
- @350 000t, “depletion” will be 66%, lower than could be argued to be ideal for this resource, but no catastrophic

A method to recommend the final anchovy TAC for 2020 based on short-term projections of the anchovy resource

Thank you!