A proposal to adjust natural mortality to obtain SY:B relationships consistent with Smith et al (2011)

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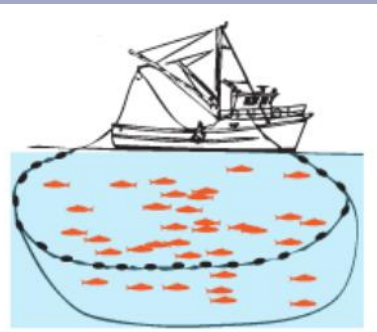


Smith et al (2011), Figure 4

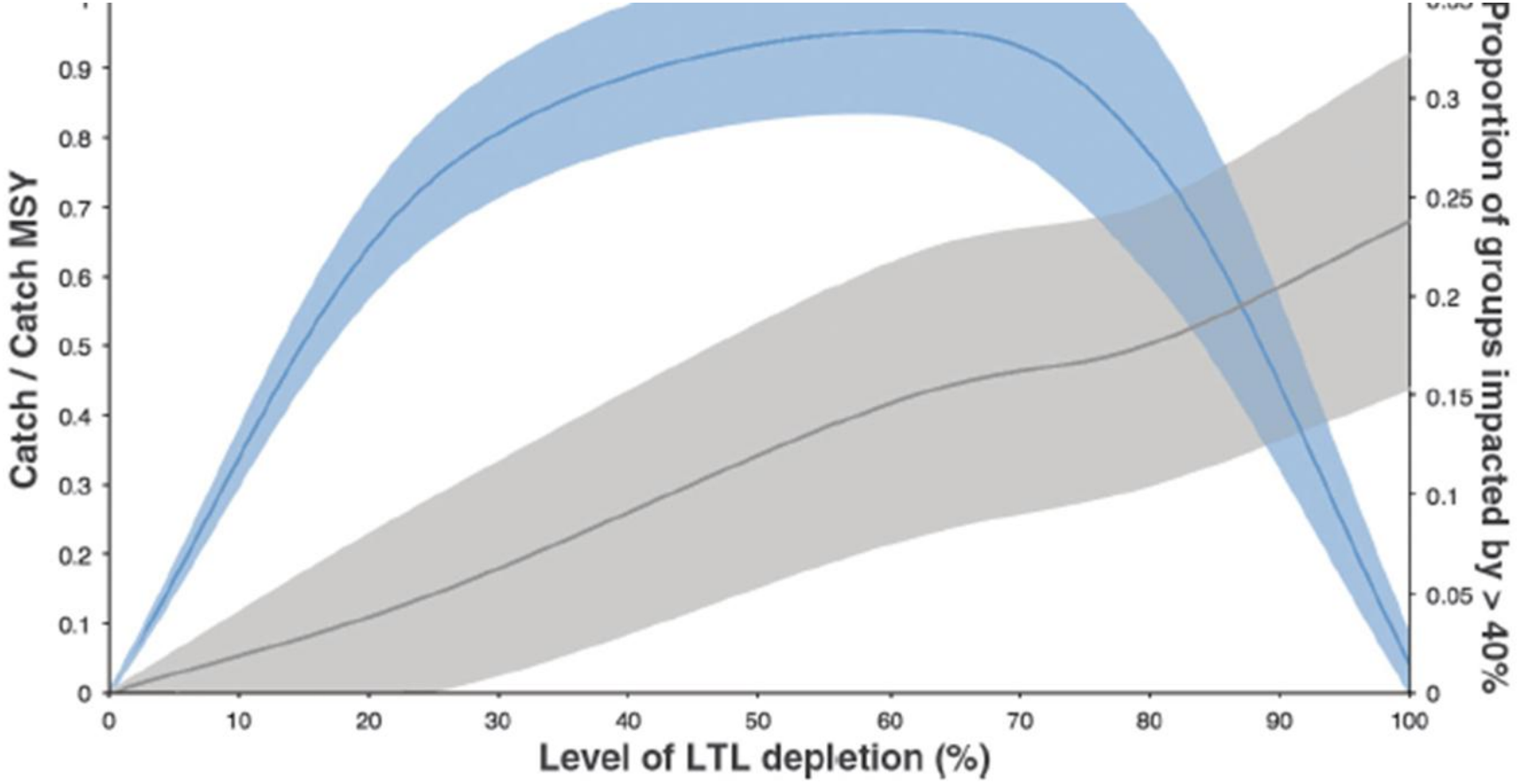
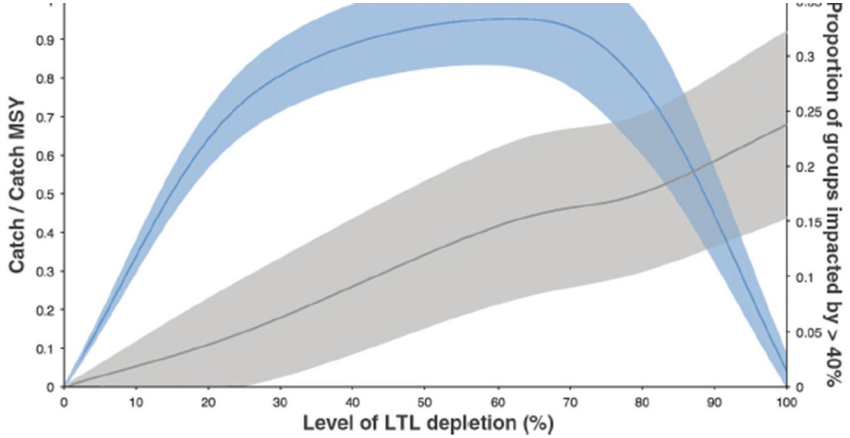


Figure 1. Figure 4 from Smith et al (2011). In this plot the term 'Level of LTL depletion (%)' is 1-B/B0.

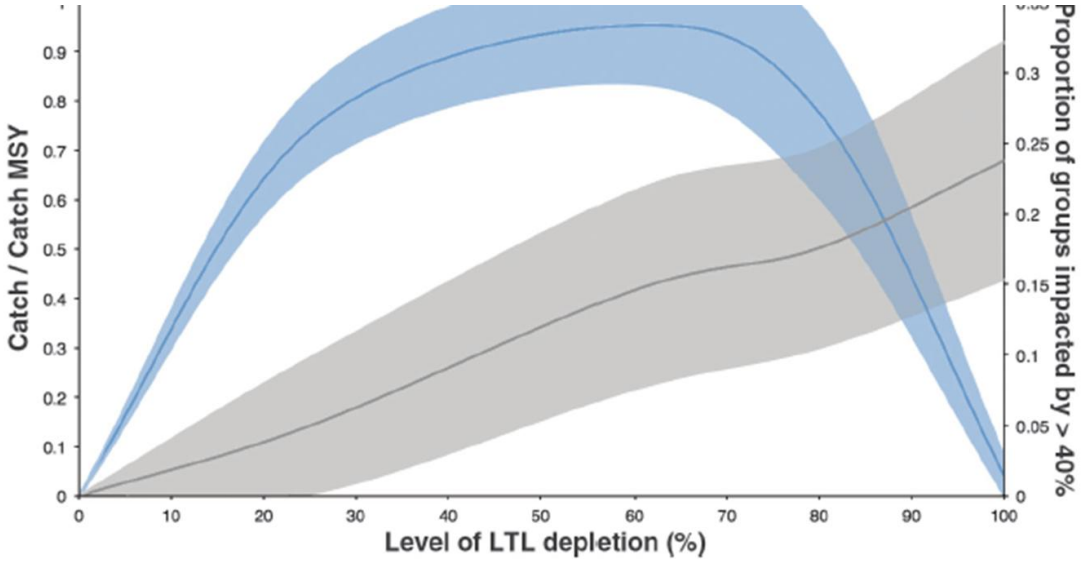
Adjusting for uncertainty in Smith et al (2011), Figure 4, and results for additional h values



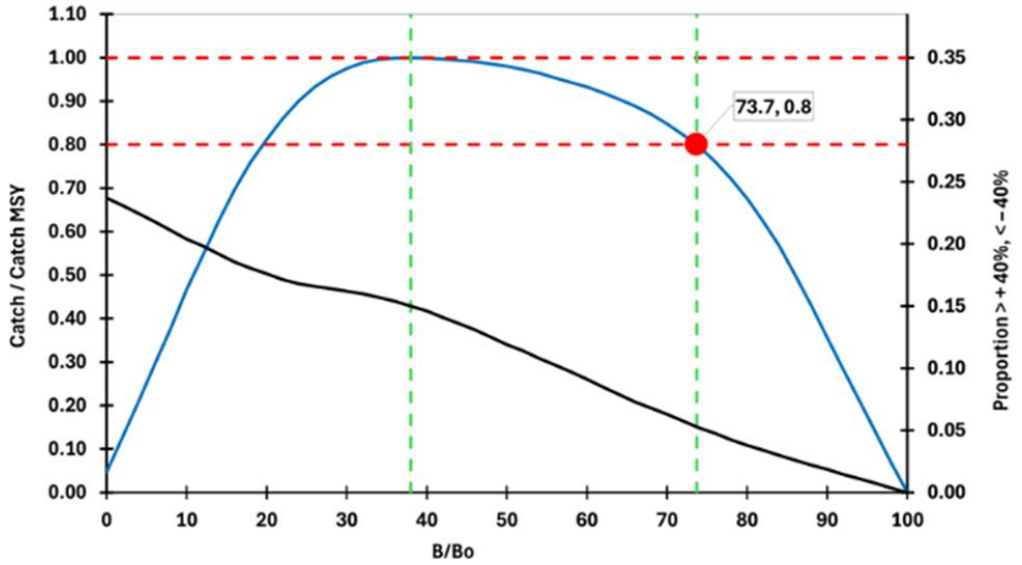
Smith et al (2011) concludes that at B/B0=0.75 the loss of yield relative to MSY is about 20%, and suggests that this may be a favorable trade-off.

The B/B0 target of 0.75 is now the basis for the MSC standard for LTL stocks.

Need to flip Figure 4 of Smith et al horizontally



1-B/B0



B/B0

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Figure 4 of Smith et al flipped horizontally

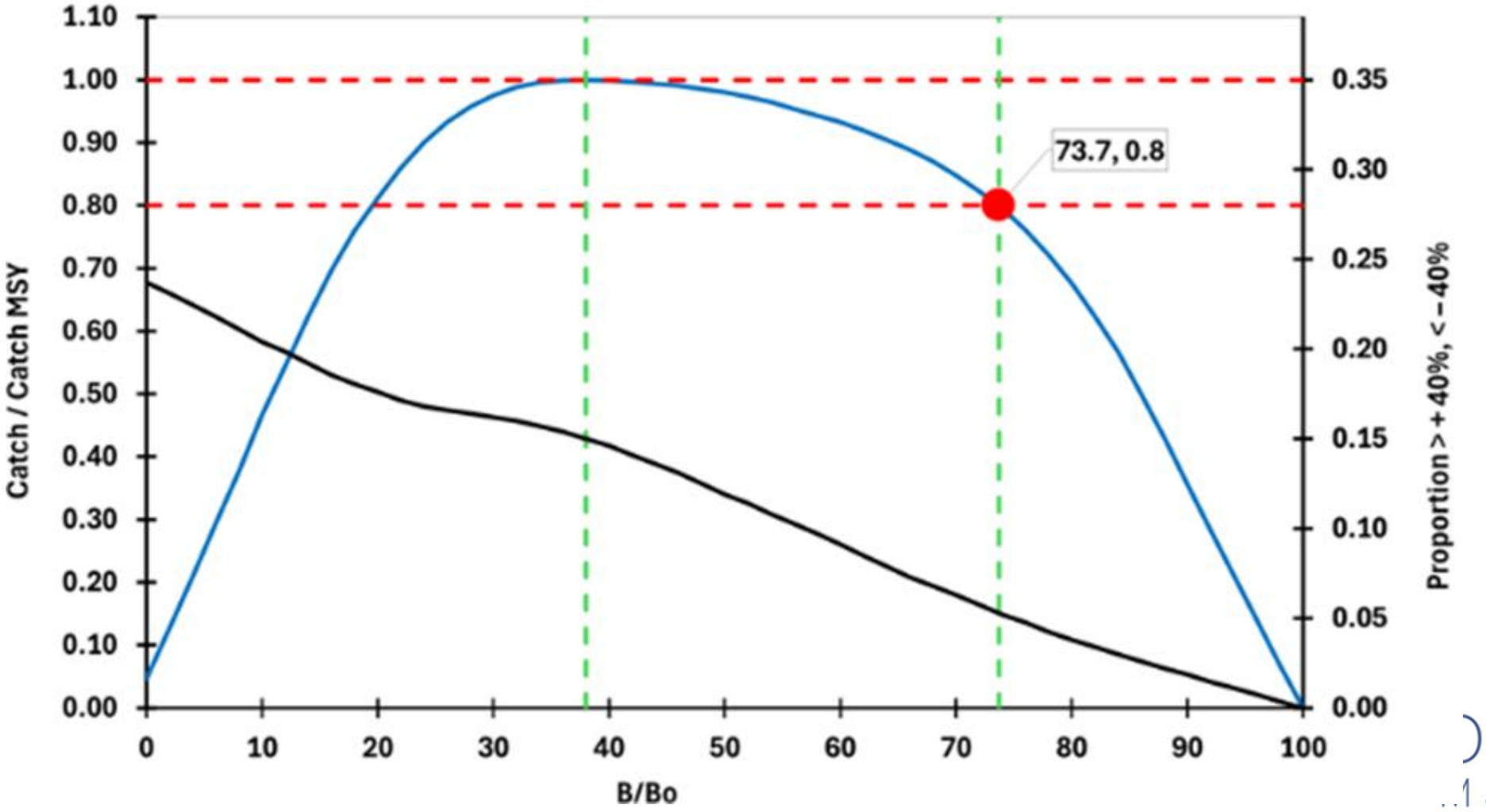
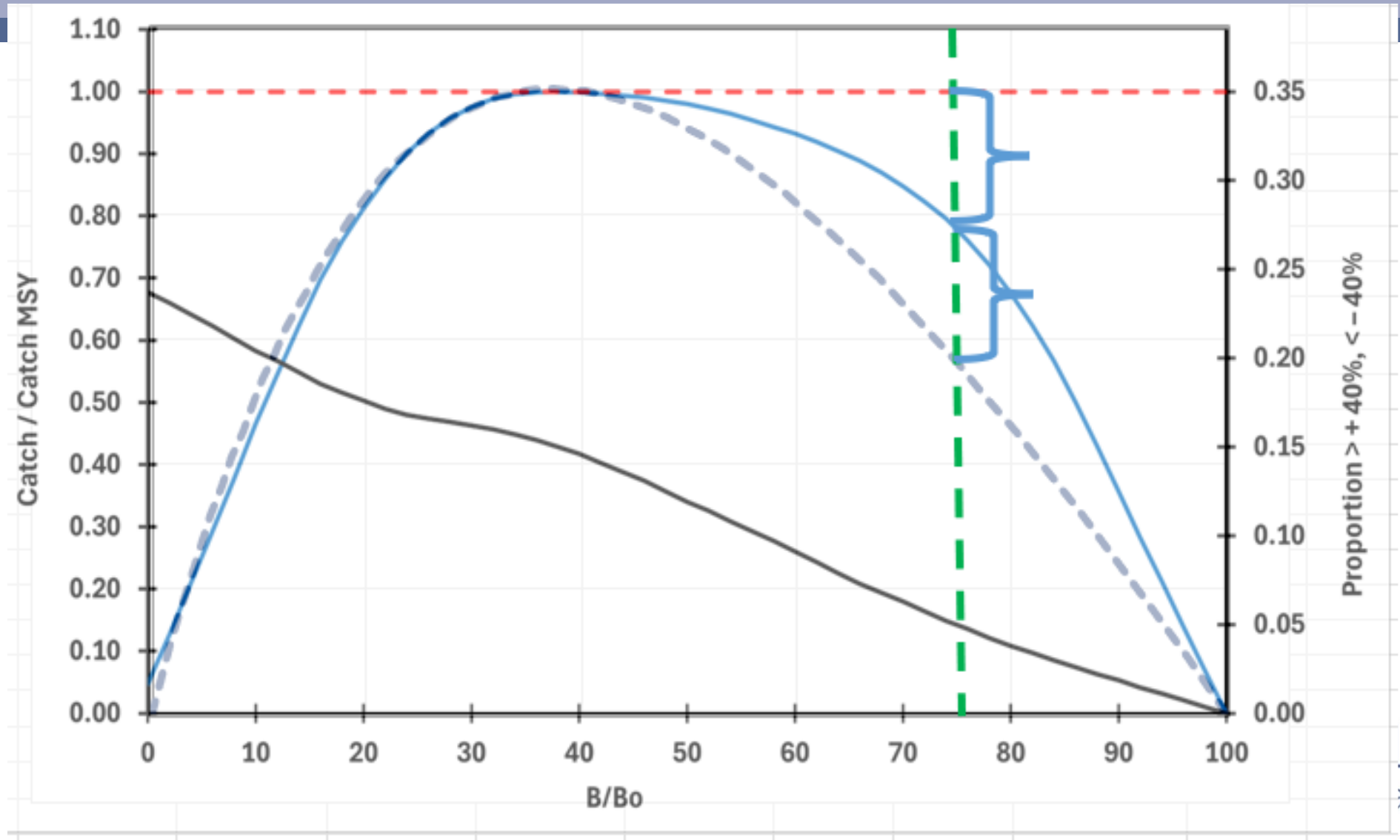


Figure 4 of Smith et al vs a conventional sardine model (h=0.9)



How to proceed?

The trade-off suggested as being favorable by Smith et al (2011) must therefore either

(a) be revisited in the context of a conventional sardine population model,

or

(b) the conventional sardine model needs to be revised to conform to Smith et al (2011).

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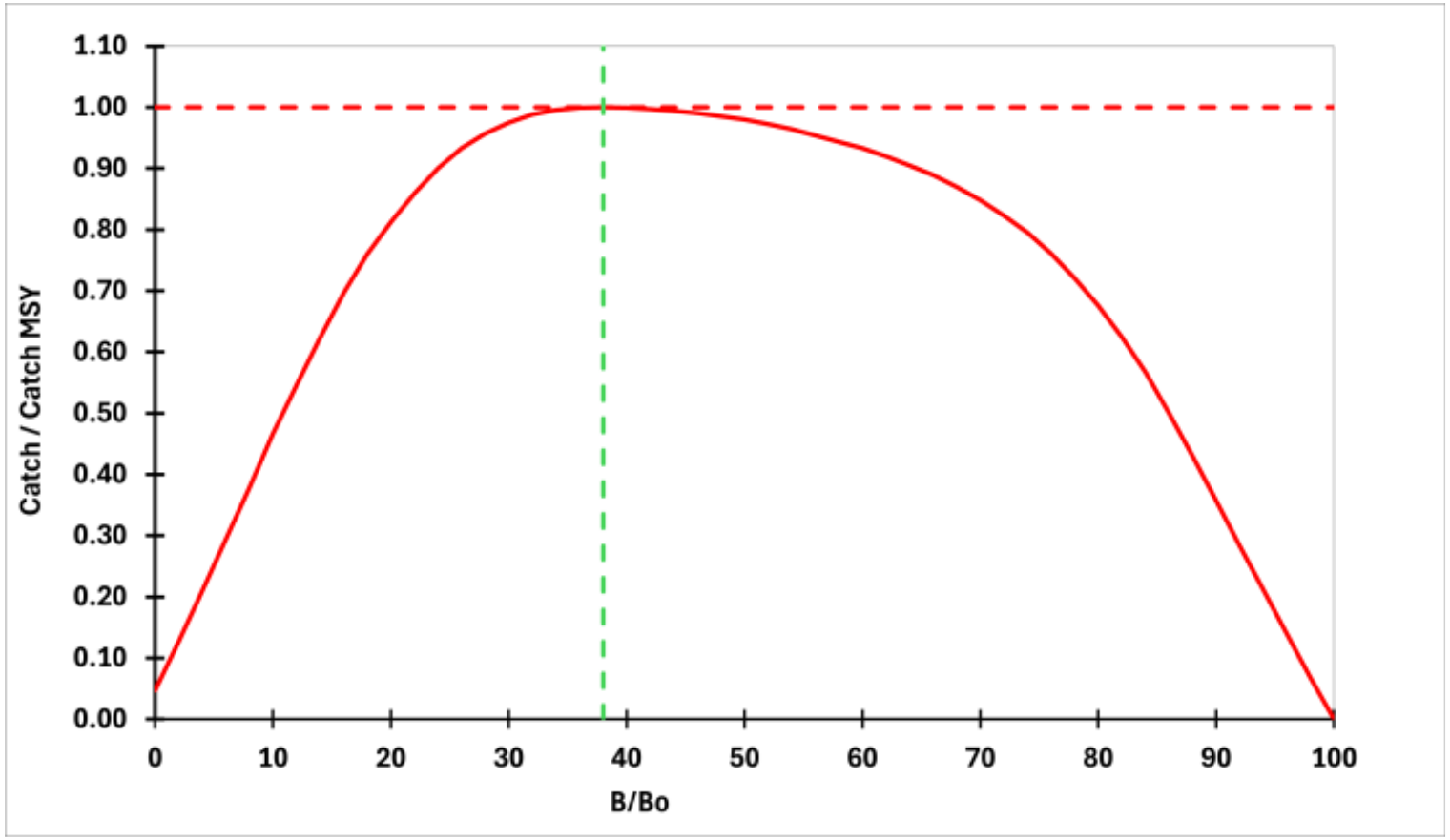
Proposed method for adjusting a conventional population model so that it conforms to the SY:B relationship in Figure 4 of Smith et al (2011)



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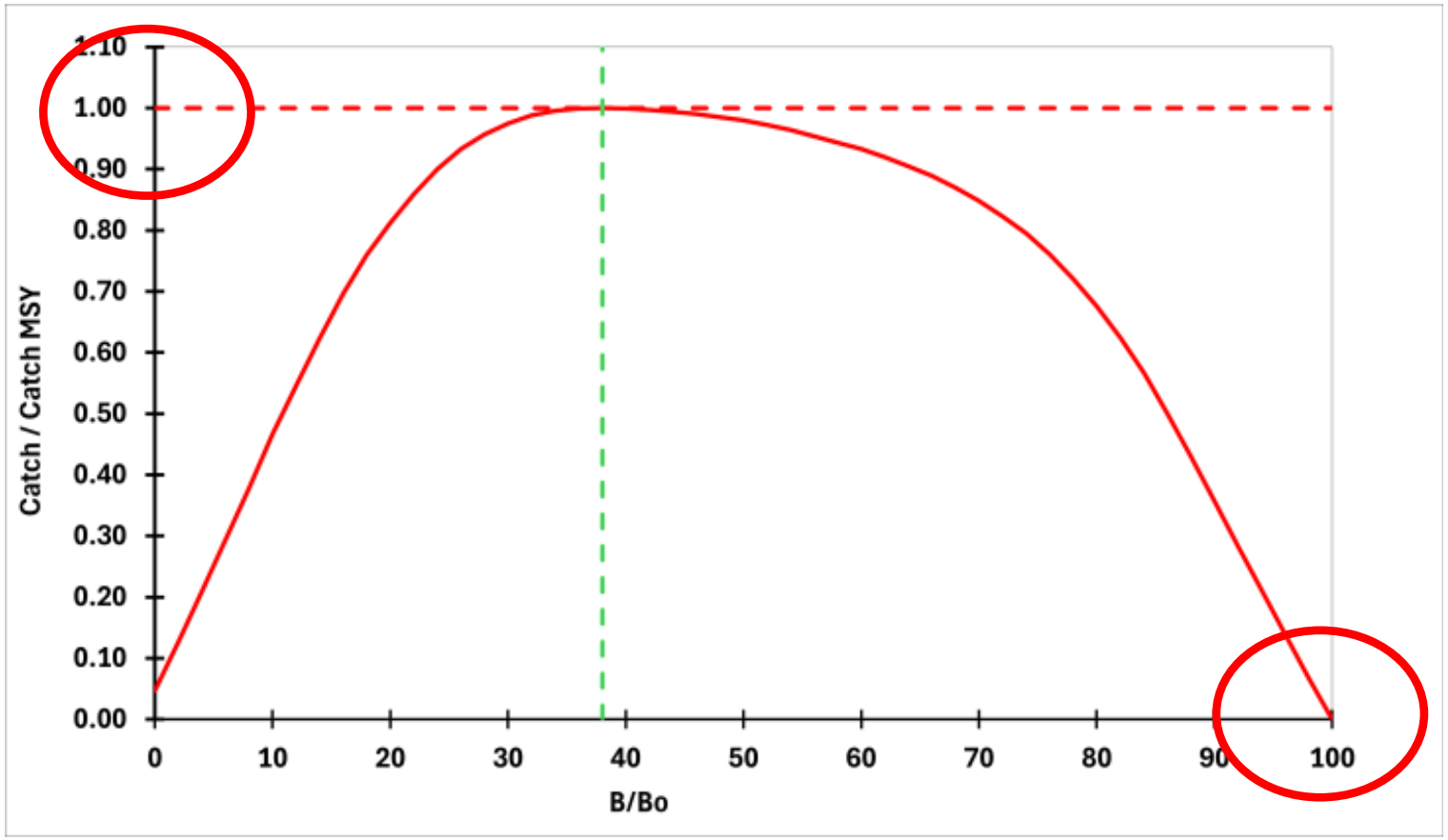
x and y axis scaling factors, MSY and B0, from the unadjusted population model



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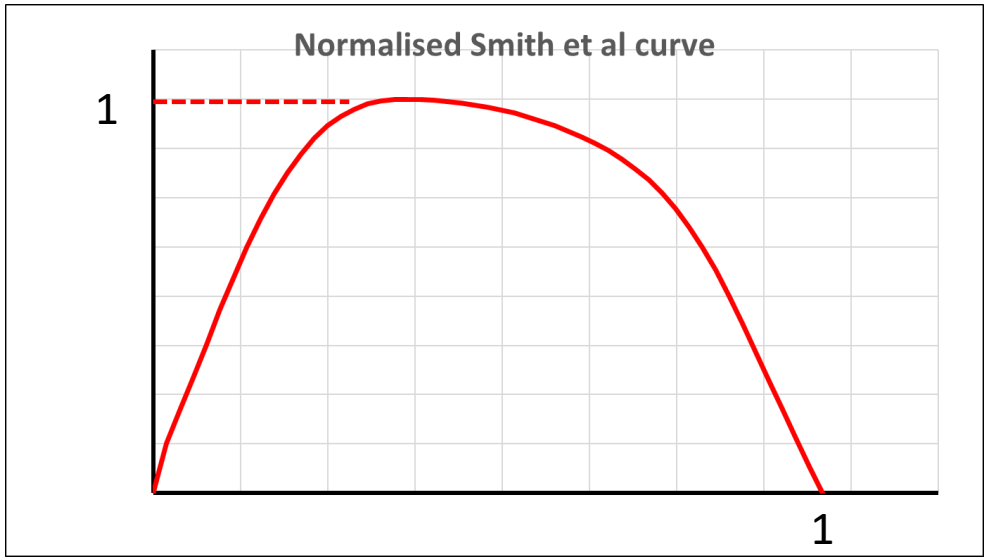
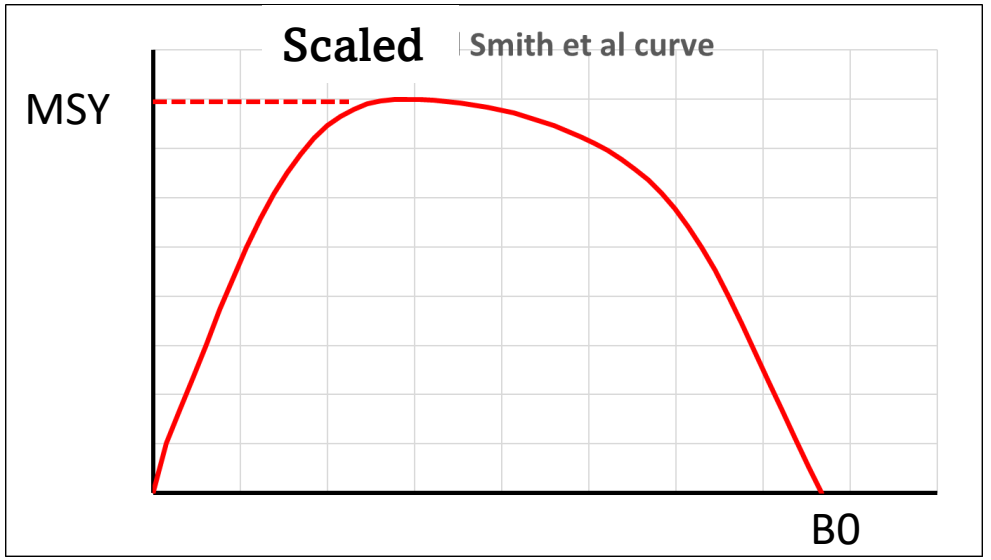
Adjusting the single species model to reflect the Smith et al effect: Scaling the normalised Smith et al curve





MSY and B0 from the single species model.

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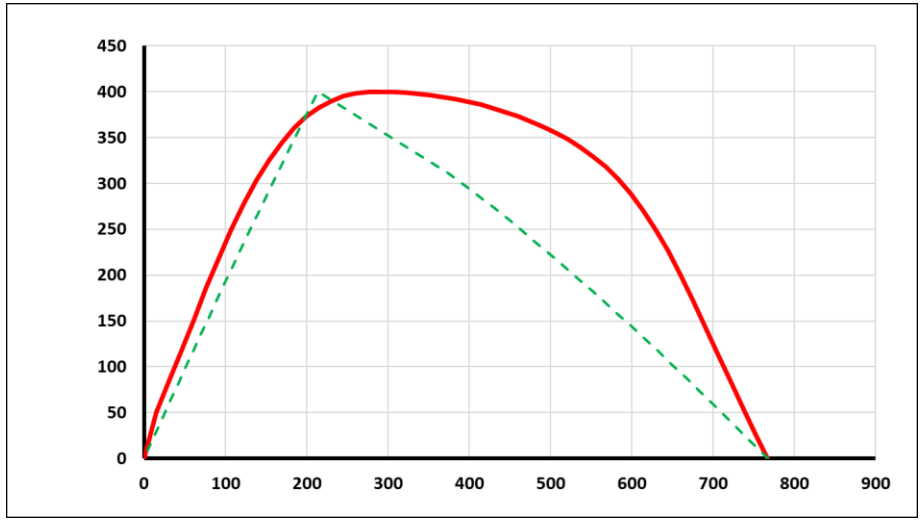
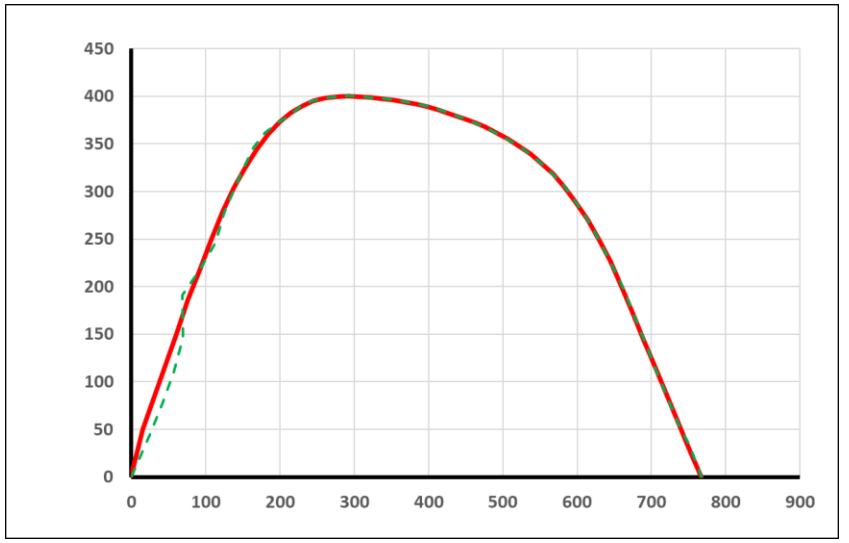
Adjusting the single species model to reflect the Smith et al effect: Scaling the normalised Smith et al curve

j	B/B_0	SY/MSY	j	B/B_0	SY/MSY
1	**1.000**	**0.000**	26	**0.500**	**0.980**
2	0.980	0.068	27	0.480	0.985
3	0.960	0.139	28	0.460	0.991
4	0.940	0.212	29	0.440	0.994
5	0.920	0.283	30	0.420	0.997
6	0.900	0.356	31	0.400	0.999
7	**0.880**	**0.430**	32	0.380	1.000
8	0.860	0.500	33	0.360	0.999
9	0.840	0.567	34	0.340	0.996
10	0.820	0.624	35	0.320	0.988
11	**0.800**	**0.676**	36	0.300	0.975
12	0.780	0.721	37	0.280	0.957
13	0.760	0.761	38	0.260	0.933
14	**0.740**	**0.796**	39	0.240	0.900
15	0.720	0.823	40	0.220	0.860
16	0.700	0.848	41	0.200	0.812
17	0.680	0.870	42	0.180	0.760
18	0.660	0.889	43	**0.160**	**0.697**
19	0.640	0.905	44	0.140	0.624
20	0.620	0.919	45	0.120	0.545
21	0.600	0.933	46	0.100	0.466
22	0.580	0.943	47	**0.080**	**0.377**
23	0.560	0.954	48	0.060	0.294
24	0.540	0.964	49	0.040	0.210
25	0.520	0.973	50	0.020	0.127
			51	**0.000**	**0.000**

j	B	SY	j	B	SY
1	611	0	26	306	148
2	599	10	27	293	149
3	587	21	28	281	150
4	574	32	29	269	150
5	562	43	30	257	151
6	550	54	31	244	151
7	538	65	32	232	151
8	526	76	33	220	151
9	513	86	34	208	151
10	501	94	35	196	149
11	489	102	36	183	147
12	477	109	37	171	145
13	464	115	38	159	141
14	452	120	39	147	136
15	440	124	40	134	130
16	428	128	41	122	123
17	416	131	42	110	115
18	403	134	43	98	105
19	391	137	44	86	94
20	379	139	45	73	82
21	367	141	46	61	71
22	354	143	47	49	57
23	342	144	48	37	44
24	330	146	49	24	32
25	318	147	50	12	19
			51	0	0

Adjusting the single species model to reflect the Smith et al effect:





Find the value of F and k (multiplier for M) for each point on the red curve where the 'adjusted conventional model' has the same SY and B value.

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Rationale

Smith et al (2011) results are based on predator-prey models.

These models are assumed to contain prey natural mortality levels that depend on the prey stock depletion level.

Therefore M is not constant.

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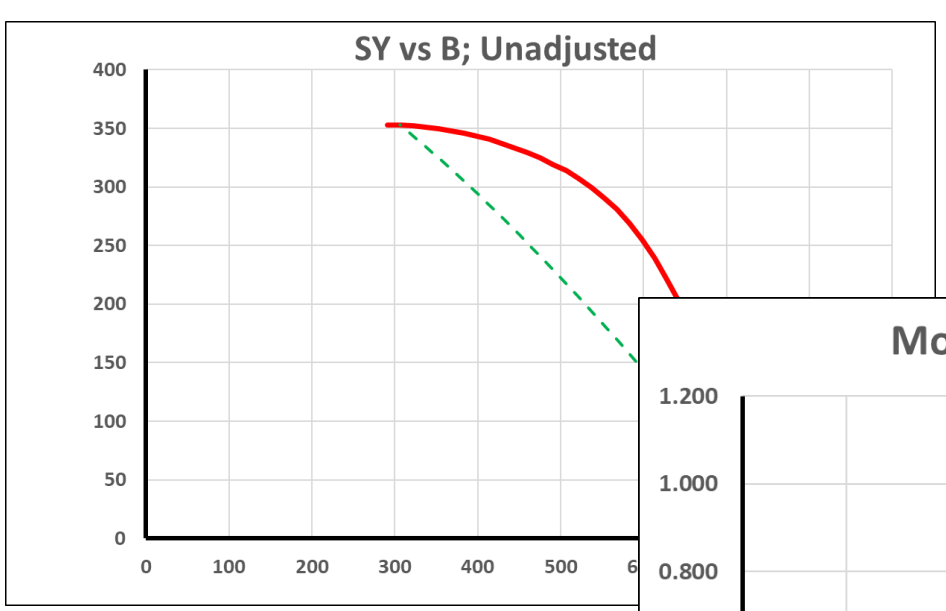
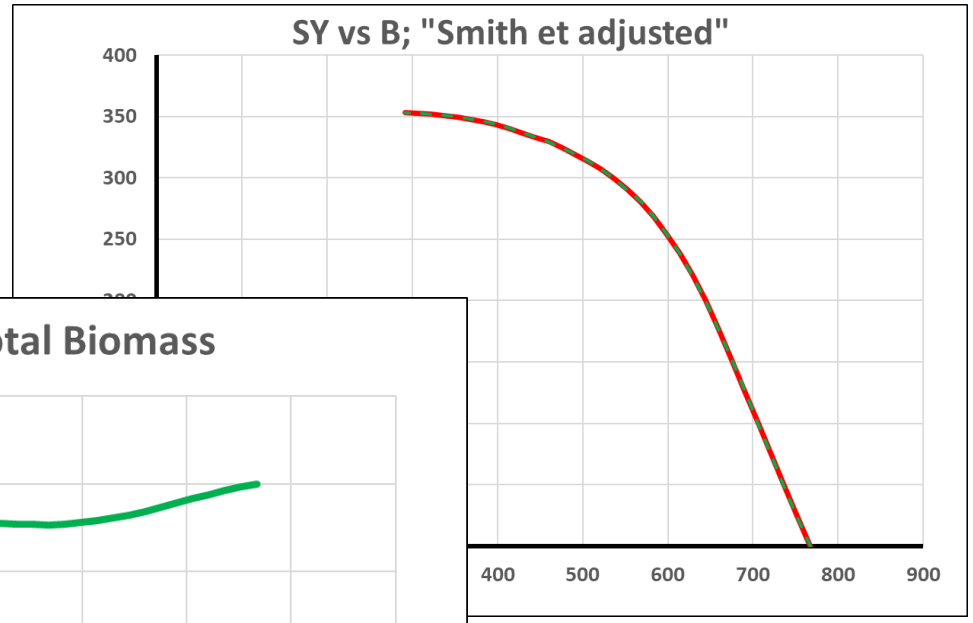
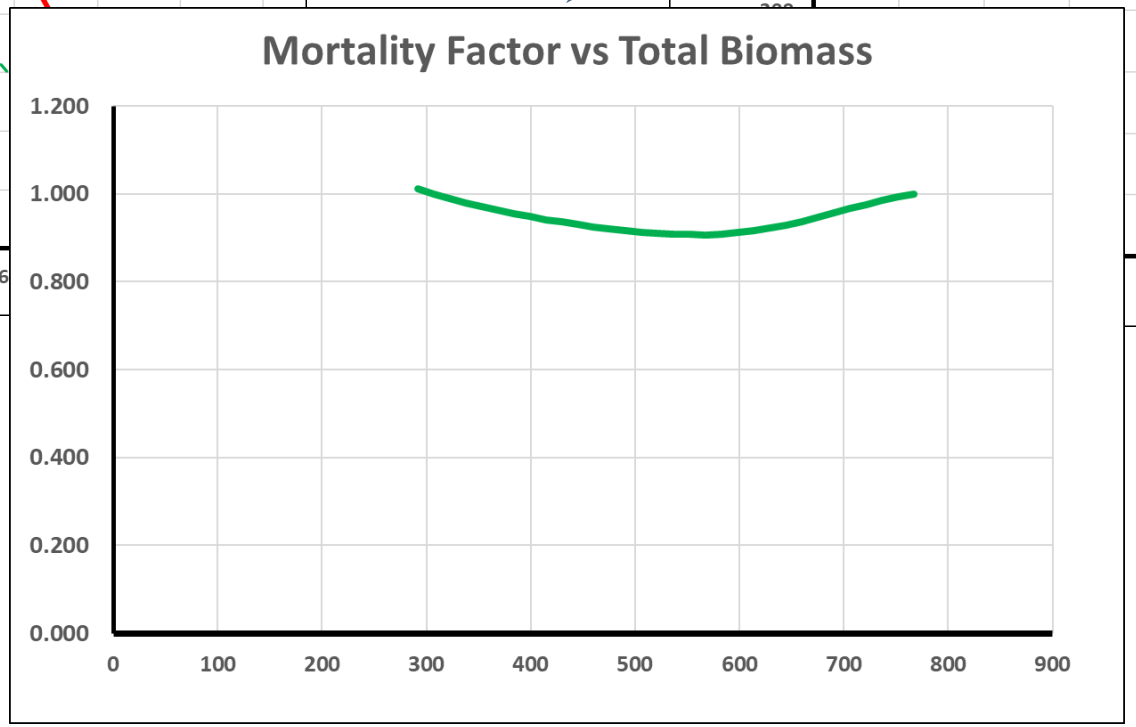
Simplification; only for B>MSYL







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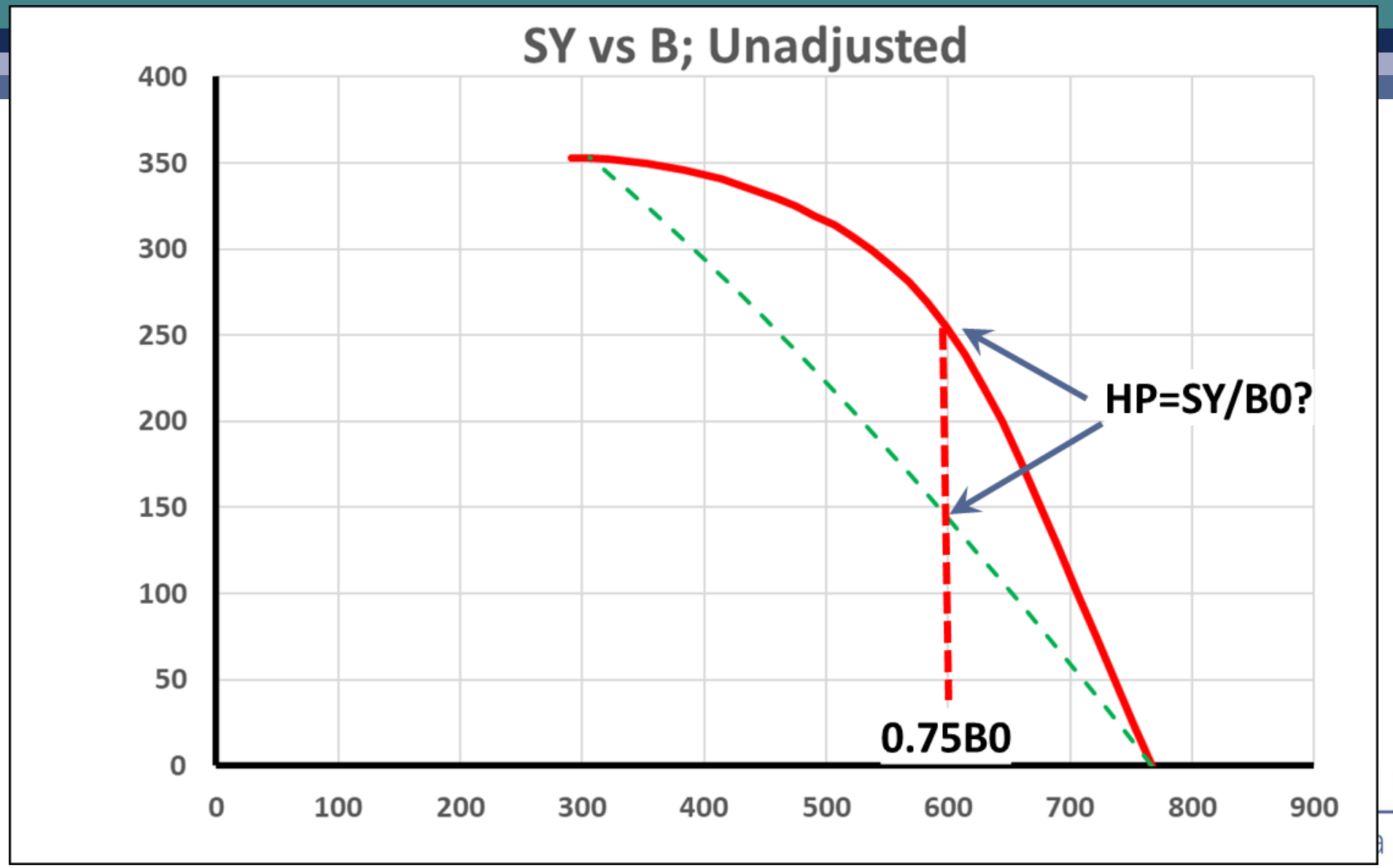
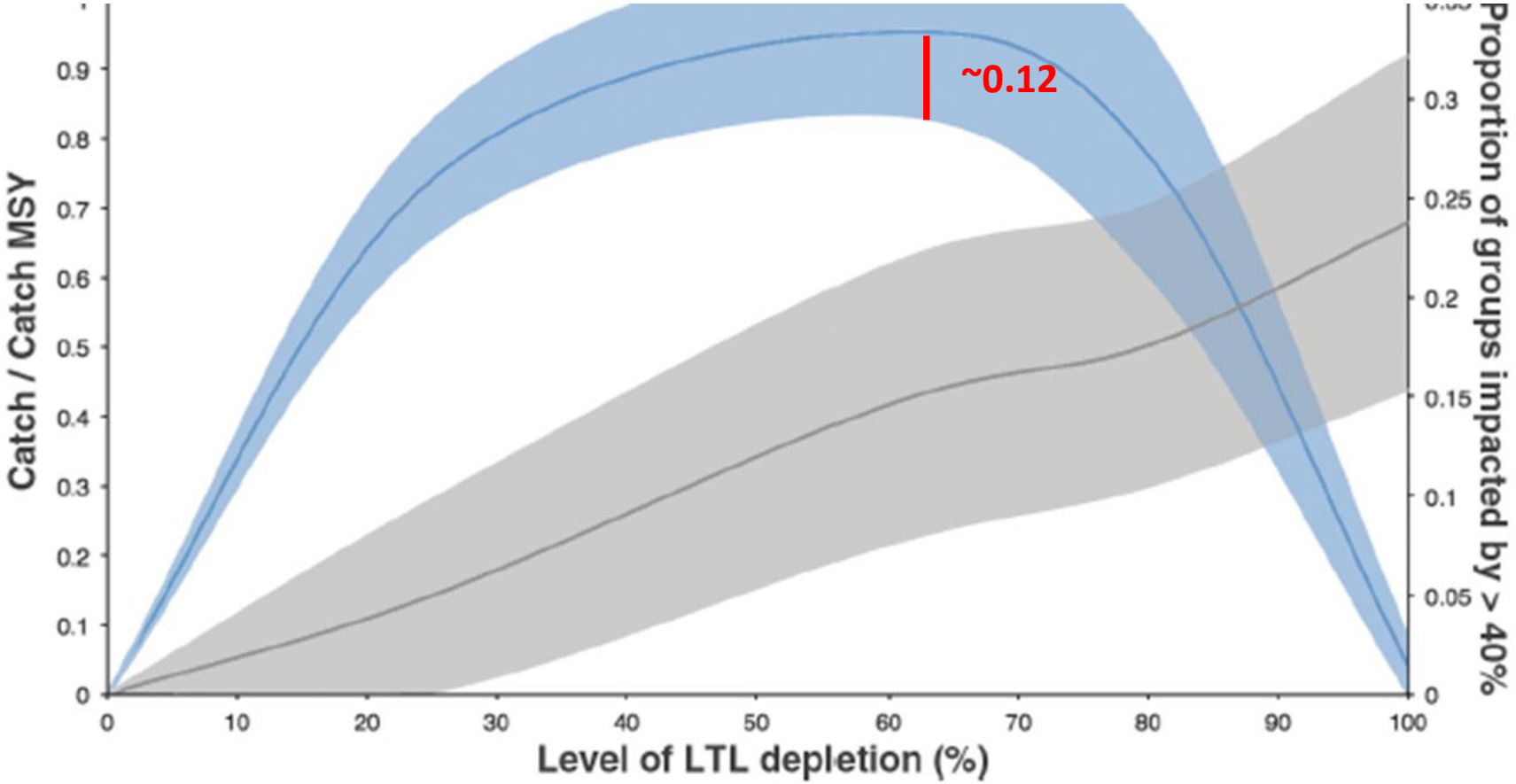
What harvest proportion results in B/B0=0.75?



Adjusting for uncertainty in Smith et al (2011), Figure 4, and results for additional h values



Adjustment factor =1-0.12/1.96 ~0.94

Applied to single species yield to get multispecies yield

Some CTS Results (deterministic)

bR	CTS aR	C/B single species	C/B "multi-species"	{C/B "multi-species"}/ {C/B single species}	C/B "multi-species" - 1 SD
50	13.87	0.220	0.395	1.795	0.375
100	15.47	0.220	0.350	1.591	0.330
200	18.06	0.220	0.260	1.182	0.250
h=0.548	n/a	0.160	0.200	1.250	0.190
h=0.3	n/a	0.070	0.078	1.114	0.073
h=0.5	n/a	0.140	0.182	1.300	0.170
h=0.7	n/a	0.180	0.260	1.444	0.245

bR	CTS aR	C/Bexp single species	C/Bexp "multi-species"	{C/Bexp "multi-species"}/ {C/Bexp single species}	C/Bexp "multi-species" - 1 SD
50	13.87	0.170	0.288	1.694	0.273
100	15.47	0.170	0.250	1.471	0.246
200	18.06	0.170	0.205	1.206	0.191
h=0.548	n/a	0.126	0.160	1.270	0.152
h=0.3	n/a	0.061	0.065	1.066	0.062
h=0.5	n/a	0.110	0.145	1.318	0.138
h=0.7	n/a	0.150	0.200	1.333	0.191

Some WTS Results (deterministic)

b_R	WTS a_R	C/B single species	C/B "multi-species"	{C/B "multi-species"}/ {C/B single species}	C/B "multi-species" - 1 SD
50	40.76	0.28	0.48	1.71	0.450
75	44.16	0.28	0.48	1.71	0.450
125	44.6	0.28	0.48	1.71	0.450
h=0.3					
h=0.5	n/a	0.18	0.229	1.27	0.215
h=0.7					

b_R	WTS a_R	C/Bexp single species	C/Bexp "multi-species"	{C/Bexp "multi-species"}/ {C/Bexp single species}	C/Bexp "multi-species" - 1 SD
50	40.76	0.195	0.31	1.59	0.293
75	44.16	0.195	0.31	1.59	0.293
125	44.6	0.194	0.31	1.60	0.293
h=0.3					
h=0.5	n/a	0.13	0.165	1.27	0.156
h=0.7					