

PROJECTIONS FROM THE 2015 KELP GREENLING ASSESSMENT IN OREGON WATERS USING
ALTERNATIVE SIGMA AND P* VALUES

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Alternative sets of projections are shown below for two possible sigma values for the 2015 Kelp Greenling stock assessment in Oregon waters. In addition, five alternative P* values (and associated buffer levels) were explored for each sigma value. This resulted in 10 total scenarios (2 sigmas * 5 P* values). For each scenario, fleet specific catches during the first two years (2015 – 2016) were set to their average over the most recent three years (2012 – 2014; i.e., status quo levels). Thereafter (2017 – 2026), OFLs were determined by the 40:10 harvest control rule, with ABCs determined by using the calculated OFL/ABC buffer from the specified P* and sigma value.

The first sigma value used was calculated using the standard PFMC set of rules for defining the sigma value. The sigma was set to the minimum sigma of 0.36 for a category 1 stock (the sigma for the estimated spawning biomass in 2015 was 0.322). Five alternative P* values (0.25, 0.30, 0.35, 0.40, and 0.45) were evaluated and used to calculate the OFL/ABC buffer. This set of 5 projection scenarios are shown in Table 1.

The second sigma value used applied an alternative approach for setting this value that was discussed at the SSC meeting in Sacramento, CA (September 11, 2015). This approach was meant to directly take into account the uncertainty associated with Kelp Greenling (male and female) natural mortality and the resulting influence these parameters had on overall population scale. Here, sigma was calculated by taking the log of the ratio of the base model spawning biomass in 2015 to the assumed low values for natural mortality model spawning biomass in 2015 and dividing by 1.15 (the z-score equivalent to a probability of 0.125; see equation 1). This calculation resulted in a sigma of 0.441. Again, five alternative P* values (0.25, 0.30, 0.35, 0.40, and 0.45) were evaluated for this sigma and used to calculate the OFL/ABC buffer. This set of 5 projection scenarios are shown in Table 2.

$$\sigma = \frac{\ln \left[\frac{\text{base model}_{SB2015}}{\text{low M model}_{SB2015}} \right]}{1.15} \quad \text{Eq. 1}$$

The values for natural mortality (M) in the base model were 0.36 for females and 0.318 for males. The values for M in the 'low M' model were 0.318 for females and 0.285 for males. Please refer to the 2015 Kelp Greenling assessment document for further details about natural mortality.

Table 1. Projections following the default PFMC guidelines for setting sigma for each of five alternative P* values (and hence buffers between the OFL and the ABC).

Sigma = 0.360

P*	Buffer (%)	Year	OFL Catch (mt)	ABC=ACL Catch (mt)	Age 1+ Biomass (mt)	Spawning Biomass (mt)	Depletion
0.25	21.6	2015	38.7	38.7	1,131	316	0.80
		2016	38.7	38.7	1,141	300	0.76
		2017	239.1	192.3	1,156	299	0.75
		2018	210.1	168.7	1,045	260	0.65
		2019	191.5	153.8	972	235	0.59
		2020	179.3	143.9	924	218	0.55
		2021	171.1	137.2	890	208	0.52
		2022	165.4	132.7	867	200	0.50
		2023	161.5	129.5	851	195	0.49
		2024	158.7	127.2	839	191	0.48
		2025	156.7	125.6	830	189	0.48
2026	155.3	124.5	824	187	0.47		
0.30	17.2	2015	38.7	38.7	1,131	316	0.80
		2016	38.7	38.7	1,141	300	0.76
		2017	239.1	202.0	1,156	299	0.75
		2018	208.2	175.7	1,037	257	0.65
		2019	188.6	159.1	960	230	0.58
		2020	175.7	148.2	908	213	0.54
		2021	167.1	140.9	873	202	0.51
		2022	161.2	135.9	849	194	0.49
		2023	157.1	132.4	832	189	0.48
		2024	154.2	130.0	819	185	0.47
		2025	152.2	128.2	811	182	0.46
2026	150.7	127.0	804	181	0.46		
0.35	13.0	2015	38.7	38.7	1,131	316	0.80
		2016	38.7	38.7	1,141	300	0.76
		2017	239.1	211.2	1,156	299	0.75
		2018	206.4	182.2	1,030	254	0.64
		2019	185.8	163.9	948	226	0.57
		2020	172.4	152.0	894	208	0.53
		2021	163.4	144.1	857	197	0.50
		2022	157.3	138.7	832	189	0.48
		2023	153.1	135.0	814	183	0.46
		2024	150.2	132.4	801	179	0.45
		2025	148.1	130.5	792	177	0.45
2026	146.5	129.2	786	175	0.44		

Table 1 cont.

0.40	8.7	2015	38.7	38.7	1,131	316	0.80
		2016	38.7	38.7	1,141	300	0.76
		2017	239.1	220.5	1,156	299	0.75
		2018	204.6	188.6	1,022	252	0.63
		2019	183.0	168.7	936	222	0.56
		2020	169.0	155.7	879	204	0.51
		2021	159.7	147.2	841	191	0.48
		2022	153.5	141.4	815	183	0.46
		2023	149.2	137.4	797	178	0.45
		2024	146.2	134.6	784	174	0.44
		2025	144.0	132.6	774	171	0.43
2026	142.5	131.2	767	169	0.43		
0.45	4.4	2015	38.7	38.7	1,131	316	0.80
		2016	38.7	38.7	1,141	300	0.76
		2017	239.1	229.8	1,156	299	0.75
		2018	202.8	194.9	1,014	249	0.63
		2019	180.3	173.2	924	218	0.55
		2020	165.8	159.2	865	199	0.50
		2021	156.2	150.0	826	186	0.47
		2022	149.8	143.8	799	178	0.45
		2023	145.4	139.6	780	172	0.43
		2024	142.3	136.6	766	168	0.42
		2025	140.1	134.5	757	165	0.42
2026	138.5	133.0	750	163	0.41		

Table 2. Projections following an alternative approach discussed at the SSC meeting in Sacramento, CA for setting the sigma for each of five alternative P* values (and hence buffers between the OFL and the ABC).

Sigma = 0.441

P*	Buffer (%)	Year	OFL Catch (mt)	ABC=ACL Catch (mt)	Age 1+ Biomass (mt)	Spawning Biomass (mt)	Depletion
0.25	25.7	2015	38.7	38.7	1,131	316	0.80
		2016	38.7	38.7	1,141	300	0.76
		2017	239.1	183.1	1,156	299	0.75
		2018	211.8	162.0	1,053	262	0.66
		2019	194.4	148.6	985	239	0.60
		2020	182.8	139.6	938	223	0.56
		2021	174.9	133.6	907	213	0.54
		2022	169.5	129.4	885	206	0.52
		2023	165.7	126.5	869	201	0.51
		2024	163.0	124.4	858	198	0.50
		2025	161.1	122.9	850	195	0.49
		2026	159.7	121.9	844	193	0.49
0.30	20.6	2015	38.7	38.7	1,131	316	0.80
		2016	38.7	38.7	1,141	300	0.76
		2017	239.1	194.5	1,156	299	0.75
		2018	209.6	170.4	1,043	259	0.65
		2019	190.9	155.0	970	234	0.59
		2020	178.5	144.9	920	217	0.55
		2021	170.2	138.1	886	206	0.52
		2022	164.4	133.4	863	199	0.50
		2023	160.5	130.2	846	194	0.49
		2024	157.7	127.9	834	190	0.48
		2025	155.7	126.2	826	187	0.47
		2026	154.2	125.1	820	185	0.47
0.35	15.6	2015	38.7	38.7	1,131	316	0.80
		2016	38.7	38.7	1,141	300	0.76
		2017	239.1	205.5	1,156	299	0.75
		2018	207.5	178.2	1,034	256	0.64
		2019	187.5	161.0	955	229	0.58
		2020	174.4	149.7	903	211	0.53
		2021	165.7	142.1	867	200	0.50
		2022	159.7	137.0	842	192	0.48
		2023	155.6	133.4	825	187	0.47
		2024	152.7	130.9	812	183	0.46
		2025	150.6	129.1	804	180	0.45
		2026	149.1	127.9	797	178	0.45

Table 2 cont.

0.40	10.6	2015	38.7	38.7	1,131	316	0.80
		2016	38.7	38.7	1,141	300	0.76
		2017	239.1	216.4	1,156	299	0.75
		2018	205.4	185.8	1,025	253	0.64
		2019	184.2	166.6	941	224	0.56
		2020	170.5	154.1	886	206	0.52
		2021	161.3	145.8	848	194	0.49
		2022	155.2	140.2	822	186	0.47
		2023	150.9	136.4	804	180	0.45
		2024	147.9	133.7	791	176	0.44
		2025	145.8	131.7	782	173	0.44
2026	144.2	130.3	775	171	0.43		
0.45	5.4	2015	38.7	38.7	1,131	316	0.80
		2016	38.7	38.7	1,141	300	0.76
		2017	239.1	227.6	1,156	299	0.75
		2018	203.2	193.4	1,016	250	0.63
		2019	180.9	172.1	927	219	0.55
		2020	166.5	158.4	868	200	0.50
		2021	157.0	149.4	829	188	0.47
		2022	150.6	143.3	802	179	0.45
		2023	146.3	139.1	784	174	0.44
		2024	143.2	136.2	770	170	0.43
		2025	141.0	134.1	761	167	0.42
2026	139.4	132.6	754	165	0.42		