

HARVEST PROJECTIONS FOR SELECT WEST COAST GROUND FISH SPECIES USED TO INFORM HARVEST SPECIFICATIONS FOR 2017 AND BEYOND

The following tables provide ten-year harvest projections requested to inform 2017 and 2018 harvest specifications. These requests were made either to update projections from older assessments or rebuilding analyses by assuming actual catches since these projections were first done (e.g., Pacific ocean perch) or were requested alternative specifications decided by the Council in September (e.g., darkblotched rockfish). The following tables are included in this attachment:

- Table 1. Projected harvest specifications, spawning biomass, and depletion for the coastwide model in the 2013 brown rockfish assessment assuming recent year average catch removals in the future.
- Table 2. Projected harvest specifications, spawning biomass, and depletion for canary rockfish assuming half the default annual catch limit is removed in the future.
- Table 3. Projected harvest specifications, spawning biomass, and depletion for canary rockfish assuming half the default annual catch limit is removed in the future and assuming the low state of nature in the 2015 assessment (i.e., $M = 0.025$).
- Table 4. Projected harvest specifications, spawning biomass, and depletion for the three models in the 2015 China rockfish assessment assuming an overfishing limit (P^*) of 0.4.
- Table 5. Projected harvest specifications, spawning biomass, and depletion for the two models in the 2013 copper rockfish assessment assuming recent year average catch removals in the future.
- Table 6. Projected harvest specifications, spawning biomass, exploitation rate, depletion, and probability over the biomass target of cowcod in the Conception area using the 2013 rebuilding analysis assuming actual catches in 2013 (2 mt) and 2014 (1.3 mt) and future ACL removals.
- Table 7. Alternative projected harvest specifications for darkblotched rockfish assuming ACLs = ABCs under $P^* = 0.45$ and 0.25 , respectively.
- Table 8. Projected harvest specifications, spawning biomass, and depletion for the coastwide model in the 2013 English sole assessment assuming future ACL removals.
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- Table 15. Projected harvest specifications, spawning biomass, and depletion for the coastwide model in the 2013 assessment of yellowtail rockfish north of 40°10' N latitude assuming future ACL removals.

Table 1. Projected harvest specifications, spawning biomass, and depletion for the coastwide model in the 2013 brown rockfish assessment assuming recent year average catch removals in the future.

Year	Catch	Spawning Biomass	Depletion	OFL
2013	101.5	727.2	0.417	154.7
2014	101.5	744.2	0.428	159.4
2015	101.5	761.9	0.439	164.1
2016	101.5	779.6	0.449	167.9
2017	101.5	795.6	0.460	172.0
2018	101.5	813.4	0.470	176.0
2019	101.5	829.9	0.481	180.0
2020	101.5	846.5	0.492	184.0
2021	101.5	863.1	0.502	188.3
2022	101.5	879.9	0.512	192.7
2023	101.5	895.1	0.521	196.5
2024	101.5	910.6	0.531	200.0

Table 2. Projected harvest specifications, spawning biomass, and depletion for canary rockfish assuming half the default annual catch limit is removed in the future.

Year	OFL	ACL	Projected Catch (mt)	Spawning biomass (mt)	Depletion
2017	1793	1714	857	4261	56.9%
2018	1735	1526	763	4240	56.6%
2019	1714	1415	707	4219	56.3%
2020	1725	1346	673	4184	55.9%
2021	1751	1297	649	4136	55.2%
2022	1783	1260	630	4087	54.6%
2023	1815	1231	616	4055	54.1%
2024	1847	1210	605	4048	54.0%
2025	1878	1194	597	4067	54.3%
2026	1909	1180	590	4108	54.8%

Table 3. Projected harvest specifications, spawning biomass, and depletion for canary rockfish assuming half the default annual catch limit is removed in the future and assuming the low state of nature in the 2015 assessment (i.e., $M = 0.025$).

Year	OFL	ACL	Projected Catch (mt)	Spawning biomass (mt)	Depletion
2017	793	1714	857	2265	43.3%
2018	741	1526	763	2206	42.2%
2019	716	1415	707	2147	41.0%
2020	711	1346	673	2083	39.8%
2021	716	1297	649	2016	38.5%
2022	725	1260	630	1954	37.4%
2023	735	1231	616	1907	36.5%
2024	745	1210	605	1879	35.9%
2025	755	1194	597	1870	35.8%
2026	763	1180	590	1879	35.9%

Table 4. Projected harvest specifications, spawning biomass, and depletion for the three models in the 2015 China rockfish assessment assuming an overfishing limit (P*) of 0.4.

Southern Model				
Yield with SPR proxy at SB_SPR (mt) = 19.5 mt				
Year	OFL	ACL 40-10	Sbio	Depletion
2017	13.31	9.88	19.82	0.30
2018	13.88	10.53	20.69	0.31
2019	14.43	11.14	21.52	0.32
2020	14.94	11.71	22.30	0.34
2021	15.42	12.24	23.02	0.35
2022	15.86	12.73	23.69	0.36
2023	16.27	13.19	24.31	0.37
2024	16.65	13.61	24.87	0.37
2025	17.00	14.00	25.40	0.38
2026	17.32	14.36	25.88	0.39
Central Model				
Yield with SPR proxy at SB_SPR (mt) = 14.5 mt				
Year	OFL	ACL 40-10	Sbio	Depletion
2017	20.52	17.18	41.44	0.64
2018	20.15	16.87	40.70	0.63
2019	19.79	16.57	40.00	0.61
2020	19.46	16.29	39.36	0.60
2021	19.16	16.04	38.77	0.60
2022	18.88	15.80	38.23	0.59
2023	18.62	15.59	37.73	0.58
2024	18.39	15.39	37.29	0.57
2025	18.18	15.22	36.90	0.57
2026	17.99	15.06	36.54	0.56

Northern Model (WA)				
Yield with SPR proxy at SB_SPR (mt) = 5.8 mt				
Year	OFL	ACL 40-10	Sbio	Depletion
2017	9.63	8.06	18.18	0.74
2018	9.33	7.81	17.63	0.72
2019	9.06	7.58	17.14	0.70
2020	8.81	7.37	16.68	0.68
2021	8.58	7.18	16.27	0.67
2022	8.37	7.01	15.89	0.65
2023	8.19	6.85	15.55	0.64
2024	8.02	6.71	15.25	0.62
2025	7.87	6.58	14.98	0.61
2026	7.73	6.47	14.74	0.60
Sum of Central and Northern Models (N of 40°10' N latitude)				
Year	OFL	ACL 40-10	Sbio	
2017	30.2	25.2	59.6	
2018	29.5	24.7	58.3	
2019	28.9	24.2	57.1	
2020	28.3	23.7	56.0	
2021	27.7	23.2	55.0	
2022	27.2	22.8	54.1	
2023	26.8	22.4	53.3	
2024	26.4	22.1	52.5	
2025	26.0	21.8	51.9	
2026	25.7	21.5	51.3	

Table 5. Projected harvest specifications, spawning biomass, and depletion for the two models in the 2013 copper rockfish assessment assuming recent year average catch removals in the future.

North of 34° 27' N lat.				
Year	Catch	Spawning Biomass	Depletion	OFL
2013	38.3	794.8	0.476	135.1
2014	38.3	821.0	0.492	139.6
2015	38.3	845.6	0.507	144.3
2016	38.3	871.7	0.523	148.7
2017	38.3	897.1	0.540	153.0
2018	38.3	922.6	0.556	157.8
2019	38.3	948.2	0.571	162.2
2020	38.3	973.4	0.586	166.7
2021	38.3	997.6	0.601	171.2
2022	38.3	1022.4	0.616	176.0
2023	38.3	1044.8	0.630	179.8
2024	38.3	1065.2	0.644	184.0
South of 34° 27' N lat.				
Year	Catch	Spawning Biomass	Depletion	OFL
2013	39.6	698.6	0.762	160.3
2014	39.6	705.0	0.772	163.2
2015	39.6	710.0	0.781	165.5
2016	39.6	714.2	0.789	167.4
2017	39.6	717.4	0.797	169.1
2018	39.6	720.5	0.804	170.5
2019	39.6	724.2	0.810	171.8
2020	39.6	728.1	0.814	172.8
2021	39.6	730.9	0.819	173.8
2022	39.6	734.8	0.824	174.6
2023	39.6	738.7	0.828	175.2
2024	39.6	741.6	0.832	175.8

Table 6. Projected harvest specifications, spawning biomass, exploitation rate, depletion, and probability over the biomass target of cowcod in the Conception area using the 2013 rebuilding analysis assuming actual catches in 2013 (2 mt) and 2014 (1.3 mt) and future ACL removals.

Year	Biomass	ACL	Exp. Rate	Depletion	OFL	ABC	Prob. Over Target
2013	1049.0	2	0.0019	0.339	51.6	43.0	0.336
2014	1083.2	1.3	0.0012	0.350	53.3	44.4	0.363
2015	1118.5	7.83	0.0070	0.360	55.0	45.8	0.392
2016	1146.5	8.03	0.0070	0.370	56.4	47.0	0.418
2017	1180.3	8.26	0.0070	0.380	57.9	48.2	0.444
2018	1215.3	8.51	0.0070	0.389	59.4	49.5	0.469
2019	1246.8	8.73	0.0070	0.399	60.9	50.7	0.498
2020	1280.4	8.96	0.0070	0.409	62.4	52.0	0.524
2021	1314.6	9.20	0.0070	0.419	63.9	53.2	0.542
2022	1348.5	9.45	0.0070	0.429	65.6	54.6	0.563
2023	1385.1	9.69	0.0070	0.439	67.3	56.1	0.582
2024	1419.4	9.93	0.0070	0.449	68.8	57.3	0.604
2025	1451.1	10.16	0.0070	0.459	70.5	58.7	0.628
2026	1485.4	10.40	0.0070	0.470	72.2	60.1	0.646

Table 7. Alternative projected harvest specifications for darkblotched rockfish assuming ACLs = ABCs under $P^* = 0.45$ and 0.25 , respectively.

Alt. 1) ACL = ABC ($\sigma = 0.36$, $P^* = 0.45$, ABC buffer = 4.4%)		
Year	OFLs based on SPR50%	ACLs
2015	674	338
2016	675	346
2017	671	642
2018	683	653
2019	739	707
2020	778	744
2021	778	744
2022	759	726
2023	738	706
2024	721	690
2025	708	678
2026	699	669
Alt. 2) ACL = ABC ($\sigma = 0.36$, $P^* = 0.25$, ABC buffer = 21.6%)		
Year	OFLs based on SPR50%	ACLs
2015	674	338
2016	675	346
2017	671	528
2018	688	541
2019	748	589
2020	792	624
2021	797	628
2022	782	616
2023	765	602
2024	750	591
2025	740	583
2026	733	577

Table 8. Projected harvest specifications, spawning biomass, and depletion for the coastwide model in the 2013 English sole assessment assuming future ACL removals.

Year	OFL	ACL	SB	Depletion
2013	10,487	355	25,719	88%
2014	10,623	254	26,019	89%
2015	10,755	300	26,377	90%
2016	10,852	300	26,620	91%
2017	10,914	9,964	26,854	92%
2018	8,255	7,529	19,266	66%
2019	6,697	6,115	14,668	51%
2020	5,799	5,294	12,212	42%
2021	5,301	4,834	10,878	37%
2022	4,994	4,559	10,159	35%
2023	4,793	4,376	9,739	33%
2024	4,642	4,238	9,445	32%
2025	4,529	4,134	9,235	32%
2026	4,452	4,064	9,059	31%

Table 9. Projected harvest specifications, spawning biomass, and depletion for the two models in the 2011 greenspotted rockfish assessment assuming future ACL removals under default harvest control rules.

CA North of 34 27 N lat.				
Year	OFL	ACL 40-10	Sbio	Depletion
2013	42.18	36.23	380.74	0.338
2014	42.30	36.56	386.60	0.343
2015	42.31	36.76	391.66	0.347
2016	42.25	36.88	396.10	0.351
2017	42.16	36.94	400.11	0.355
2018	42.05	36.98	403.83	0.358
2019	41.96	37.02	407.38	0.361
2020	41.90	37.08	410.87	0.364
2021	41.88	37.18	414.35	0.367
2022	41.92	37.33	417.89	0.371
CA South of 34 27 N lat.				
Year	OFL	ACL 40-10	Sbio	Depletion
2013	47.47	43.28	630.18	0.397
2014	47.06	43.03	637.75	0.402
2015	46.69	42.68	644.75	0.406
2016	46.35	42.38	651.28	0.410
2017	46.07	42.12	657.39	0.414
2018	45.83	41.90	663.12	0.418
2019	45.65	41.73	668.51	0.421
2020	45.52	41.61	673.60	0.424
2021	45.43	41.54	678.42	0.427
2022	45.39	41.50	682.99	0.430

Table 10. Historical catches of kelp greenling off Washington used to inform DB-SRA estimates for the Washington kelp greenling stock.

Year	Total catch (mt)	Year	Total catch (mt)	Year	Total catch (mt)
1967	0.72	1984	1.44	2001	2.91
1968	1.52	1985	1.15	2002	3.65
1969	1.69	1986	2.35	2003	3.03
1970	1.85	1987	1.95	2004	4.13
1971	2.02	1988	3.07	2005	4.50
1972	2.18	1989	4.20	2006	3.22
1973	2.35	1990	5.33	2007	2.44
1974	2.52	1991	3.50	2008	2.28
1975	2.68	1992	5.91	2009	2.86
1976	1.27	1993	6.06	2010	4.19
1977	1.37	1994	3.73	2011	3.19
1978	2.51	1995	3.92	2012	3.03
1979	1.55	1996	4.31	2013	3.66
1980	1.93	1997	3.30	2014	3.29
1981	1.17	1998	2.07	2015	3.33
1982	1.42	1999	2.65	2016	3.33
1983	1.28	2000	2.70		

Table 11. Alternative DB-SRA estimates for Washington kelp greenling.

Four alternative delta priors presented here (recall that delta = 1-depletion)						
Parameter	Prior			Notes		
	Distribution	Mean	SD			
M	Lognormal	0.36	0.4	Mean from OR kelp greenling assessment (female M), SD from Dick and MacCall (2011)		
Fmsy/M	Lognormal	0.8	0.1	Values from Dick and MacCall (2011)		
Bmsy/B0	Beta	0.4	0.05	Values from Dick and MacCall (2011)		
Delta 2015 (option 1)	Beta	0.6	0.1	Values from Dick and MacCall (2011)		
Delta 2015 (option 2)	Beta	0.6	0.3	"Uninformative" prior from data-moderate assessment document (Figure 54 in Cope et al. 2015)		
Delta 2015 (option 3)	Beta	0.2	0.1	Mean from OR kelp greenling assessment, SD from Dick and MacCall (2011)		
Delta 2015 (option 4)	Beta	0.35	0.2	"Low Vulnerability" prior from data-moderate assessment document (Figure 54 in Cope et al. 2015)		
DB-SRA Results for Kelp Greenling, WA						
Unfished Biomass, B0 (mt)						
Delta option	Mean	2.50%	25%	50%	75%	97.50%
1	41.3	22.9	32.0	39.1	47.8	73.4
2	77.9	23.4	34.5	44.8	67.9	385.5
3	112.5	34.4	61.1	87.8	135.3	339.6
4	85.2	25.9	41.2	57.1	89.8	327.6
OFL (mt) in 2017						
Delta option	Mean	2.50%	25%	50%	75%	97.50%
1	3.1	1.2	2.3	3.0	3.7	6.0
2	10.2	0.4	1.7	3.7	8.6	69.4
3	17.8	5.0	9.3	13.8	21.2	54.6
4	12.3	1.5	4.2	7.1	13.4	55.7

References

Cope, J., E. Dick, A. MacCall, M. Monk, B. Soper, and C. Wetzel. 2015. Data-moderate stock assessments for brown, China, copper, sharpchin, striptail, and yellowtail rockfishes and English and rex soles in 2013. Pacific Fishery Management Council, Portland, OR, 298 p.

Dick, E. and A. MacCall. 2011. Depletion-based stock reduction analysis: a catch-based method for determining sustainable yields for data-poor fish stocks. Fisheries Research 110: 331–341.

Table 12. Projected harvest specifications, spawning biomass, and depletion for the coastwide model in the 2013 rex sole assessment assuming future ACL removals.

Year	OFL	ACL	SB	Depletion
2013	5,069	560	2,481	78%
2014	5,174	409	2,500	79%
2015	5,313	486	2,539	80%
2016	5,410	486	2,577	81%
2017	5,476	4,999	2,596	82%
2018	4,001	3,639	1,866	59%
2019	3,061	2,786	1,460	47%
2020	2,513	2,291	1,238	39%
2021	2,218	2,019	1,120	36%
2022	2,052	1,858	1,054	34%
2023	1,944	1,772	1,016	33%
2024	1,876	1,708	993	32%
2025	1,830	1,670	974	31%
2026	1,798	1,639	963	31%

Table 13. Projected harvest specifications, spawning biomass, and depletion for the coastwide model in the 2013 sharpchin rockfish assessment assuming future ACL removals.

Year	OFL	ACL	SB	Depletion
2013	436	11	5,708	71%
2014	441	10	5,842	72%
2015	446	11	5,973	74%
2016	450	11	6,101	75%
2017	455	415	6,226	76%
2018	448	409	5,981	75%
2019	441	403	5,885	73%
2020	435	397	5,672	71%
2021	428	391	5,576	69%
2022	422	385	5,368	67%
2023	413	377	5,294	66%
2024	405	370	5,229	64%
2025	398	363	5,169	63%
2026	391	357	5,082	61%

Table 14. Expanded decision table for the 2015 widow rockfish assessment under default and alternative harvest control rules.

				State of nature					
				Low		Base case		High	
Relative probability of ln(SB_2013)				0.25		0.5		0.25	
Management decision	Year	OFL	Catch (mt)	Spawning biomass (mt)	Depletion (%)	Spawning biomass (mt)	Depletion (%)	Spawning biomass (mt)	Depletion (%)
2000K	2015	12,259	2,000	48,360	59%	60,608	75%	69,077	85%
	2016	13,368	2,000	51,094	62%	64,599	80%	74,645	92%
	2017	14,130	2,000	53,178	64%	67,674	84%	79,081	98%
	2018	14,511	2,000	54,831	67%	69,856	87%	82,026	101%
	2019	14,746	2,000	56,417	68%	71,533	89%	83,858	103%
	2020	14,966	2,000	58,025	70%	72,892	90%	84,911	105%
	2021	15,132	2,000	59,510	72%	73,866	92%	85,270	105%
	2022	15,200	2,000	60,750	74%	74,413	92%	85,015	105%
	2023	15,179	2,000	61,745	75%	74,604	92%	84,317	104%
	2024	15,108	2,000	62,549	76%	74,556	92%	83,365	103%
	2025	15,017	2,000	63,222	77%	74,369	92%	82,306	101%
2026	14,924	2,000	63,805	77%	74,110	92%	81,233	100%	
ACL (P* =0.45 and sigma=0.36)	2015	12,259	2000	48,360	59%	60,608	75%	69,077	85%
	2016	13,368	2000	51,094	62%	64,599	80%	74,645	92%
	2017	14,130	13,508	53,178	64%	67,675	84%	79,081	98%
	2018	13,237	12,655	48,794	59%	63,900	79%	76,172	94%
	2019	12,375	11,830	45,047	55%	60,314	75%	72,826	90%
	2020	11,714	11,198	42,188	51%	57,284	71%	69,581	86%
	2021	11,181	10,689	39,951	48%	54,659	68%	66,465	82%
	2022	10,691	10,221	38,060	46%	52,260	65%	63,435	78%
	2023	10,235	9,784	36,431	44%	50,080	62%	60,578	75%
	2024	9,835	9,402	35,056	43%	48,173	60%	58,014	72%
	2025	9,502	9,083	33,908	41%	46,561	58%	55,803	69%
2026	9,232	8,826	32,943	40%	45,225	56%	53,944	67%	
ACL (P* =0.25 and sigma=0.36)	2015	12,259	2,000	48,360	59%	60,608	75%	69,077	85%
	2016	13,368	2,000	51,094	62%	64,599	80%	74,645	92%
	2017	14,130	11,078	53,178	64%	67,675	84%	79,081	98%
	2018	13,506	10,589	50,069	61%	65,158	81%	77,409	95%
	2019	12,855	10,078	47,348	57%	62,584	78%	75,058	93%
	2020	12,345	9,678	45,261	55%	60,313	75%	72,555	89%
	2021	11,918	9,344	43,598	53%	58,241	72%	69,970	86%
	2022	11,502	9,018	42,141	51%	56,241	70%	67,308	83%
	2023	11,096	8,699	40,839	50%	54,339	67%	64,692	80%
	2024	10,726	8,409	39,709	48%	52,615	65%	62,267	77%
	2025	10,409	8,160	38,752	47%	51,113	63%	60,117	74%
2026	10,147	7,955	37,945	46%	49,838	62%	58,267	72%	

Table 15. Projected harvest specifications, spawning biomass, and depletion for the coastwide model in the 2013 assessment of yellowtail rockfish north of 40°10' N latitude assuming future ACL removals.

Year	OFL	ACL	SB	Depletion
2013	17,784	1,476	9,962	91%
2014	17,808	1,449	10,097	91%
2015	17,893	6,590	10,274	91%
2016	16,129	6,344	8,596	78%
2017	15,388	9,296	7,767	72%
2018	14,709	8,510	6,977	68%
2019	14,537	8,197	6,774	67%
2020	14,423	7,984	6,713	67%
2021	14,303	7,788	6,607	66%
2022	14,167	7,562	6,439	66%
2023	14,041	7,313	6,268	65%
2024	13,939	7,094	6,161	64%
2025	13,867	6,928	6,085	63%
2026	13,839	6,851	6,043	63%