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Status of the Chilipepper Rockfish, *Sebastes goodei*, in the California Current for 2015

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EXECUTIVE SUMMARY

Stock

The stock boundary for the 2007 Chilipepper Rockfish assessment, and for this update, is the U.S./Mexico border in the south, to the Columbia River in the north.

Catches

Chilipepper Rockfish have long been one of the most important targets of California commercial rockfish fisheries (including trawl, hook and line and setnet gears), and a fairly important component of recreational fisheries, with total catches ranging from 2500 to 3500 tons from the mid-1970s through the early 1990s. However, since the mid-1990s catches have been greatly reduced as a consequence of trip limit reductions and area closures implemented to reduce catches and rebuild populations of overfished species, particularly Bocaccio and Canary Rockfish, which often co-occur with Chilipepper. Over the past five years, catches have averaged approximately 350 tons per year, primarily from bottom trawl fisheries (Figure E1).

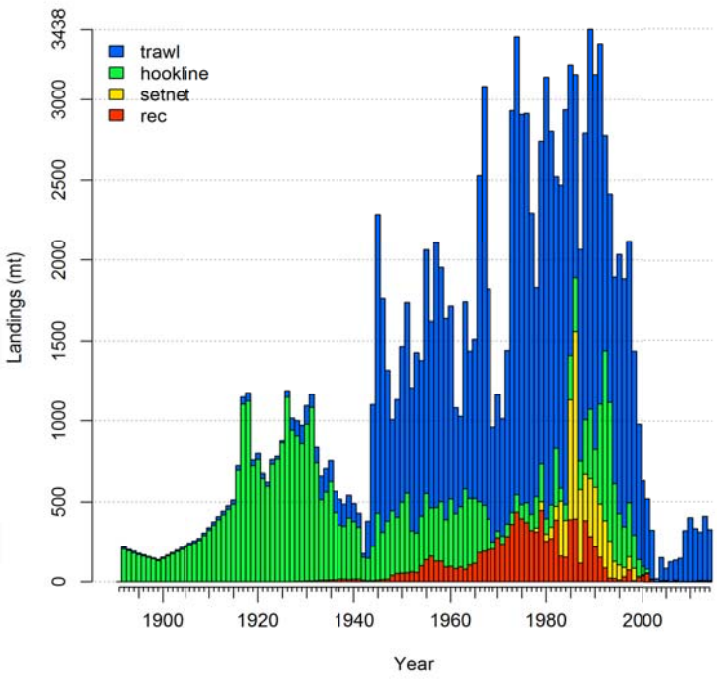

Figure E1: Catches by fishery for Chilipepper rockfish over the past 120 years

Data and Assessment

The 2015 Chilipepper update maintains the same fundamental model structure as the 2007 assessment. New estimates of historical catch data from catch reconstructions were included in the model. Commercial and recreational age and length composition data from 2007-2014, as well as a revised NWFSC bottom trawl survey index, and a revised pelagic juvenile survey abundance index (as an indicator of year class strength) were included in the update. Age

composition data not available in 2007, primarily from bottom trawl surveys, were included. Some refinements to life history data (relative fecundity, maturity relationship) were also made. Most data revisions or additions had some influence on model estimates of stock status, but very few resulted in substantive changes to the model estimate of relative stock status. Steepness remains fixed at the point estimate used in the 2007 stock assessment.

Stock Spawning Output and Depletion

As a result of updating the fecundity relationship, spawning output is now reported in the 1000s of larvae produced, rather than spawning stock biomass. For the executive summary, relative depletion (larvae produced relative to the mean estimated unfished level of larvae produced) is reported. Since the strong 1999 year class, abundance has increased to above target levels.

Table E1: Spawning output, summary biomass and depletion for the base model in 2015

	Spawning Output (millions larvae)	CV Spawning Output	Summary Biomass (age 1+)	Depletion
2005	4177	0.146	53433	0.5931
2006	4484	0.146	53414	0.6367
2007	4621	0.146	51654	0.6561
2008	4601	0.146	50607	0.6534
2009	4459	0.145	51073	0.6331
2010	4259	0.146	50379	0.6048
2011	4041	0.147	48390	0.5738
2012	4000	0.147	48726	0.568
2013	4163	0.148	35349	0.5911
2014	4351	0.151	35168	0.6178
2015	*4502*	0.153	*35039*	*0.6393*

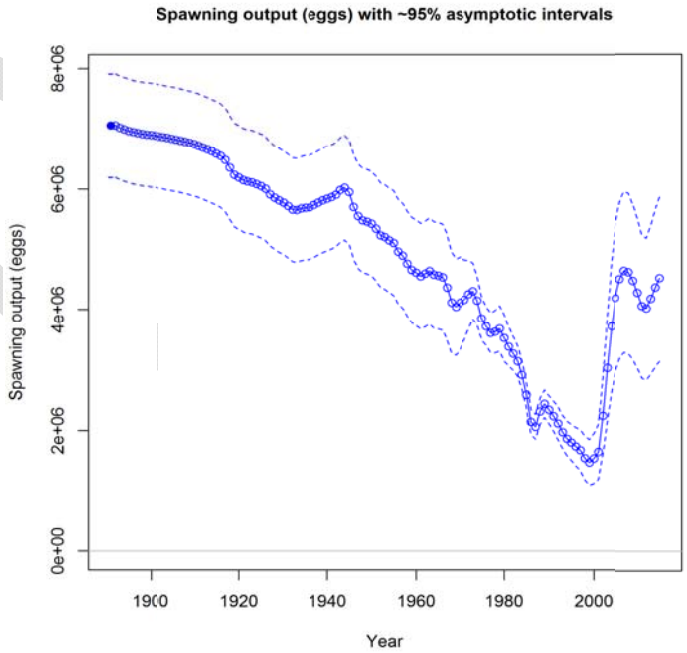

Figure E2: Spawning output (larvae, in 1000s) with approximate 95% confidence intervals

Recruitment

Recruitment for Chilipepper Rockfish is highly variable, with a small number of year classes tending to dominate the catch in any given fishery or region. As age and length data are only available for the late 1970s onward, estimates of year class strength are most informative from the 1970s to the present. The 1984 and 1999 year classes were among the strongest in that time period, however several very strong year classes have been observed in recent years (2009-2010, 2013-2014) and are already leading to a fast rate of increase in abundance and larval production.

Table E2: Recruitment estimates and CV of recruitment estimates for the base model

	Recruitment (1000s)	CV Recruitment
2005	3745	0.37
2006	4566	0.35
2007	14433	0.24
2008	12824	0.27
2009	88159	0.18
2010	61167	0.21
2011	13824	0.32
2012	17857	0.32
2013	47280	0.31
2014	69631	0.77
2015	*37736*	1.00

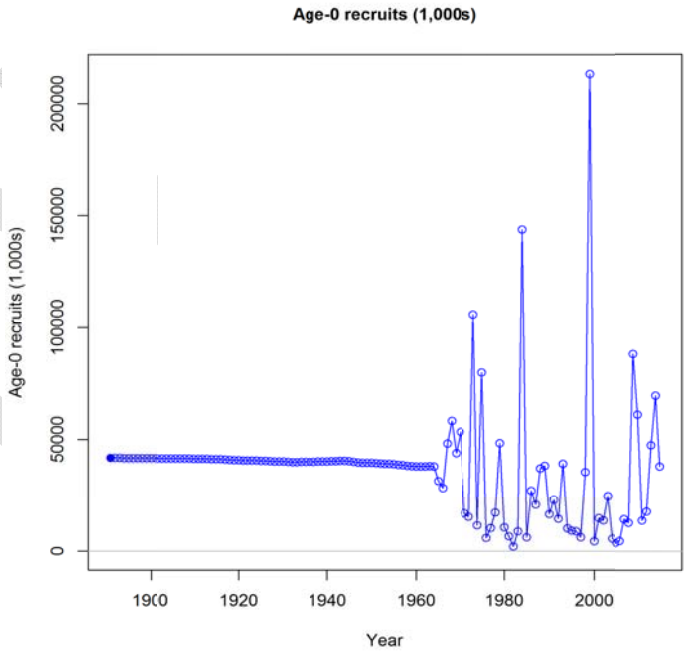

Figure E3: Recruitment estimates for the base model

Reference Points

Reference points, including estiates of yield under target SPR and relative biomass target levels, are reported in Table E3. The model estimated an unfished larval production (spawning biomass) (SSB0) 7.04 billion larvae (labeled as eggs in figures), an unfished summary biomass of 54,491 tons, and a 2015 larval output of 4.5 billion larvae, which results in a relative depletion estimate of 63.9% (of the unfished spawning output). The summary biomass for 2015 was 35,039 tons, corresponding to 69.5% of the estimated unfished summary biomass. Estimates of equilibrium yields in the 2015 base mode, which range from 2113 to 2165 metric tons (depending on whether SPR, SSB or MSY reference was used to estimate) are highly consistent with those from the 2007 assessment (2099 to 2165 metric tons).

Table E3: Reference Points for the 2015 Base Model

	Estimate	St.Dev	Lower ~95% CL	Upper ~95% CL
SSB_Unfished (millions larvae)	7041	436	6605	7477
SmryBio_Unfished	54491	3375	51116	57866
Recr_Unfished	41750	2585	39165	44335

	Yield	Depletion	SSB	SPR	F
Btarget	2133	0.400	2816	0.485	0.082
SPR target	2113	0.420	2958	0.500	0.077
MSY	2165	0.339	2390	0.438	0.095

Exploitation Status and Management Performance

Since 2005, total catches have been well below the established ABC/OY(pre-2011) and ACL/OFL (post 2010) levels, and SPR and exploitation rates have been correspondingly low through this period.

Table E4: Exploitation status and Management Performance, 2005- 2016

	OFL (ABC prior to 2011, south 40 10 only from 2011 onward)	ACL (OY prior 2011) south of 40 10 only from 2011 onward	Chilipepper contribution to minor shelf rock north (OFL), 2011 onward	Total Catch	Catch as % of combined OFL	SPR	Exploitation Rate
2005	2,700	2,000		85	0.03	0.978	0.001
2006	2,700	2,000		126	0.05	0.969	0.002
2007	2,700	2,000		137	0.05	0.966	0.002
2008	2,700	2,000		148	0.05	0.963	0.002
2009	3,037	2885		318	0.10	0.921	0.006
2010	2,576	2,447		397	0.15	0.896	0.007
2011	2,073	1,981	156	331	0.16	0.905	0.006
2012	1,872	1,789	140.9	307	0.16	0.905	0.006
2013	1768	1,690	133.1	405	0.23	0.869	0.011
2014	1722	1,647	129.6	325	0.19	0.888	0.009
2015	1,703	1,628	*129.6*				
2016	1,694	1,619	*129.6*				

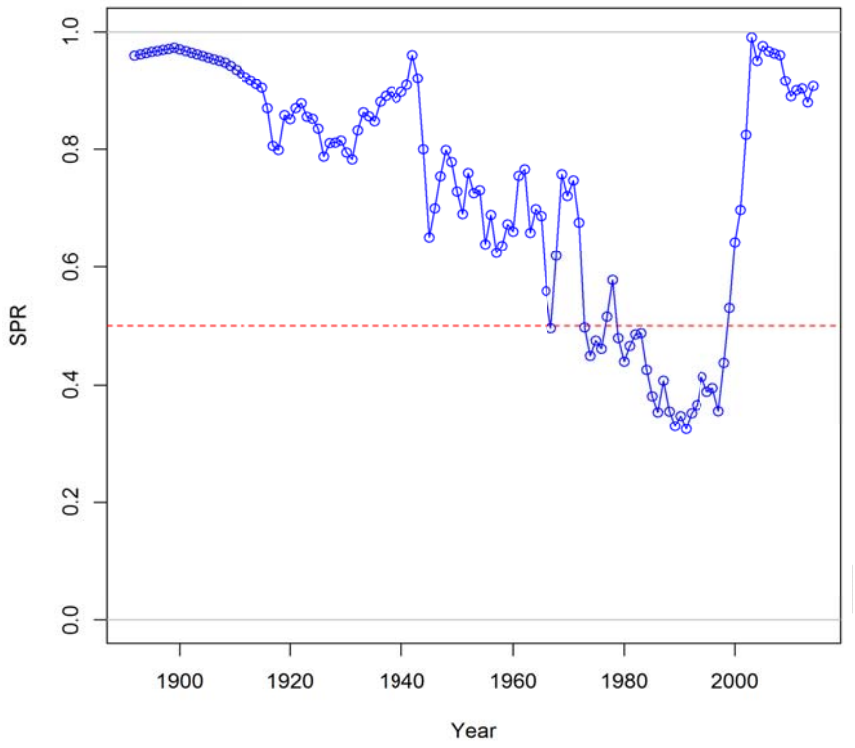

Figure E4: Model estimated Spawning Potential Ratio (SPR)

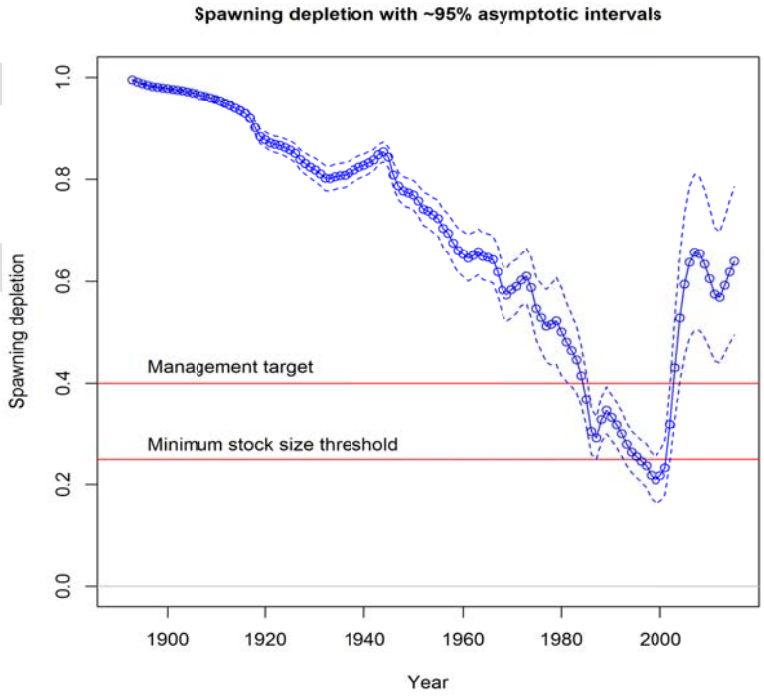

Figure E5: Depletion estimate with reference points and approximate 95% confidence intervals

Forecast

As the current spawning output is above target levels, catches have been below target levels, and several strong year classes are contributing to a forecast for high biomass, the forecast ACL and OFL levels (for 2017 onward, assuming 2015-2016 catches are achieved as adopted for that management cycle) are greater than the equilibrium catch levels reported in Table E5.

Table E5: Base model estimates of 2017-2026 ACL and OFL levels, assuming 2015-16 catches are achieved at set ACL levels

	Base model ACL catches (existing 2015-16)	Base model OFL catches (existing 2015-16)	Depletion (assuming ACL)
2015	*1758*	*1833*	0.64
2016	*1749*	*1824*	0.62
2017	2803	2932	0.62
2018	2707	2820	0.6
2019	2671	2773	0.58
2020	2635	2727	0.57
2021	2583	2666	0.55
2022	2521	2595	0.54
2023	2457	2525	0.52
2024	2397	2458	0.51
2025	2343	2399	0.5
2026	2294	2346	0.49

Unresolved Problems and Major Uncertainties

A number of technical issues discussed in the review of the 2007 model have not yet been resolved in this update (as resolution will require changes to model structure outside of the terms of reference for assessment updates). These include how weightings were assigned for length and age composition data, how the time varying growth is estimated, the length bin structure, and selectivity parameterization issues for both fisheries and fishery independent surveys. Steepness remains a key uncertainty, interestingly when profiled or estimated with a prior, the model has a slightly better fit with lower steepness values (approximately 0.4), in contrast to the results of the 2007 model, which had a better fit with higher steepness values.

Decision Table

The decision table follows the 2007 assessment format, with the two alternative states of nature equating to low (steepness set to 0.34) and high (steepness set to 0.81) productivity assumptions. Catches are based on either the status quo for the "low" catch scenario (average catch over the past 5 years), on the adopted 2015-2016 ACLs and forecast 2017-2026 ACLs for the moderate catch level, and the combined 2015-2016 ACLs and forecast 2017-2026 OFLs for the "high" catch level. As Chilipepper is considered a category 1 stock with a P* = 0.45 in recent years (translating to a 4.4% buffer for the ACL to be set below the OFL), the difference between ACL and OFL catch streams is not terribly large. Recent year average catch seems a good low end

catch stream for the decision table. Under the base and high productivity scenarios, none of these catch streams lead to conservation concerns, however under the low productivity scenario (h=0.34), the stock rebuilds to target levels with status quo catches, but declines below the overfished threshold by 2019 with ACL or OFL catches.

Table E6: Decision Table

Year	Status quo catches	State 1 (h=0.34)	Base (h=0.57)	State 2 (h=0.81)
2015	346	0.32	0.64	0.79
2016	346	0.32	0.65	0.80
2017	346	0.33	0.67	0.83
2018	346	0.33	0.70	0.86
2019	346	0.34	0.73	0.88
2020	346	0.35	0.75	0.90
2021	346	0.36	0.77	0.92
2022	346	0.37	0.79	0.93
2023	346	0.38	0.80	0.93
2024	346	0.39	0.81	0.94
2025	346	0.40	0.82	0.94
2026	346	0.41	0.83	0.94
	ACL catches	State 1	Base	State 2
2015	1758	0.32	0.64	0.79
2016	1749	0.30	0.62	0.77
2017	2803	0.28	0.62	0.76
2018	2707	0.26	0.60	0.74
2019	2671	0.23	0.58	0.72
2020	2635	0.21	0.57	0.7
2021	2583	0.19	0.55	0.68
2022	2521	0.18	0.54	0.65
2023	2457	0.16	0.52	0.63
2024	2397	0.15	0.51	0.61
2025	2343	0.13	0.50	0.59
2026	2294	0.11	0.49	0.58
	OFL catches	State 1	Base	State 2
2015	1758	0.32	0.64	0.79
2016	1749	0.30	0.62	0.77
2017	2932	0.29	0.62	0.76
2018	2820	0.26	0.59	0.74
2019	2773	0.23	0.58	0.71
2020	2727	0.21	0.56	0.69
2021	2666	0.19	0.54	0.66
2022	2595	0.17	0.53	0.64
2023	2525	0.16	0.51	0.62
2024	2458	0.14	0.50	0.60
2025	2399	0.12	0.49	0.58
2026	2346	0.11	0.48	0.56