Agenda Item H.3
Attachment 3
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Status of China rockfish off the U.S. Pacific Coast in 2015

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This assessment reports the status of the China rockfish (*Sebastes nebulosus*) resource in U.S. waters off the coast of the California, Oregon, and Washington using data through 2014. China rockfish are modelled with three independent stock assessments to account for spatial variation in exploitation history as well as regional differences in growth and size composition of the catch. The northern area model is defined as Washington state Marine Catch Areas (MCAs) 1-4. The central area model spans from the Oregon-Washington border to 40°10′ N. latitude. The southern area model spans 40°10′ N. latitude to the U.S.-Mexico border. However, very little catch of China rockfish occurs south of Point Conception, California (34°27′ N. latitude).

Catches

China rockfish are most often caught by hook-and-line (both recreational and commercial fisheries) as well as by traps in the commercial live-fish fishery. Although China rockfish were not a major target species, the commercial rockfish fishery along the U.S. Pacific West Coast developed in the late 1800s and early 1990s. Available estimates of China rockfish catch in California begin in the early 1900s, along with small commercial catches in Oregon until recreational landings began to increase in the early 1970s (Figures a-c). Reconstructed recreational landings of China rockfish in the northern assessment begin in 1967. As of 1995, Washington has prohibited commercial nearshore fixed gear in state waters and does not have a historical reconstruction of China rockfish commercial landings. The majority of commercial removals of China rockfish are now landed by live-fish fisheries in California and southern Oregon. The magnitude of total removals over the last 10 years peaked in 2009 (35.52 mt) and has been decreasing since then. In recent years, California has the largest removals of the three states (dominated by the recreational fleet) with smallest removals coming from the Oregon recreational fleet (Table a).

The nearshore live-fish fishery developed in California in the late 1980s and early 1990s and extended into Oregon by the mid-1990s, driven by the market prices for live fish. Northern Oregon (north of Florence) does not contribute significantly to the live-fish fishery (maximum removal of 0.02 mt) as the market for this sector of the fishery is centered in California. Catches from the live-fish fishery in southern Oregon (south of Florence) has composed the majority of the catch in that state since 1999, and peaked in 2002. In California, the landings of live fish begin exceeding the landings of dead fish south of 40°10′ N. latitude in 1998 and north of 40°10′ N. latitude in 1999; and the pattern continues through 2014.

The historical reconstruction of landings from the recreational fishery for China rockfish in California goes back to 1928, and the fishery began significantly increasing in the late 1940s. The recreational catches in California are significantly higher than the commercial catches, and have decreased in the last five years (Table a). Recreational catches in California peaked in 1987 at 53.29 mt and have declined to roughly 10-20 mt per year over the last 10 years. The trend is opposite in Oregon, with the magnitude of the commercial landings greater than the recreational landings. The historical landings from the recreational fleet in Oregon start in 1973 at 0.86 mt, peak in 1983 at 6.07 mt and again in 1993 at 6.04 mt. The recreational catches over the last 10 years in Oregon have ranged from 1.67 mt in 2014 to 3.66 mt in 2007. Recreational landings in Washington peaked in 1992 (7.98 mt) and have remained between 2-4 mt from 2005-2014.

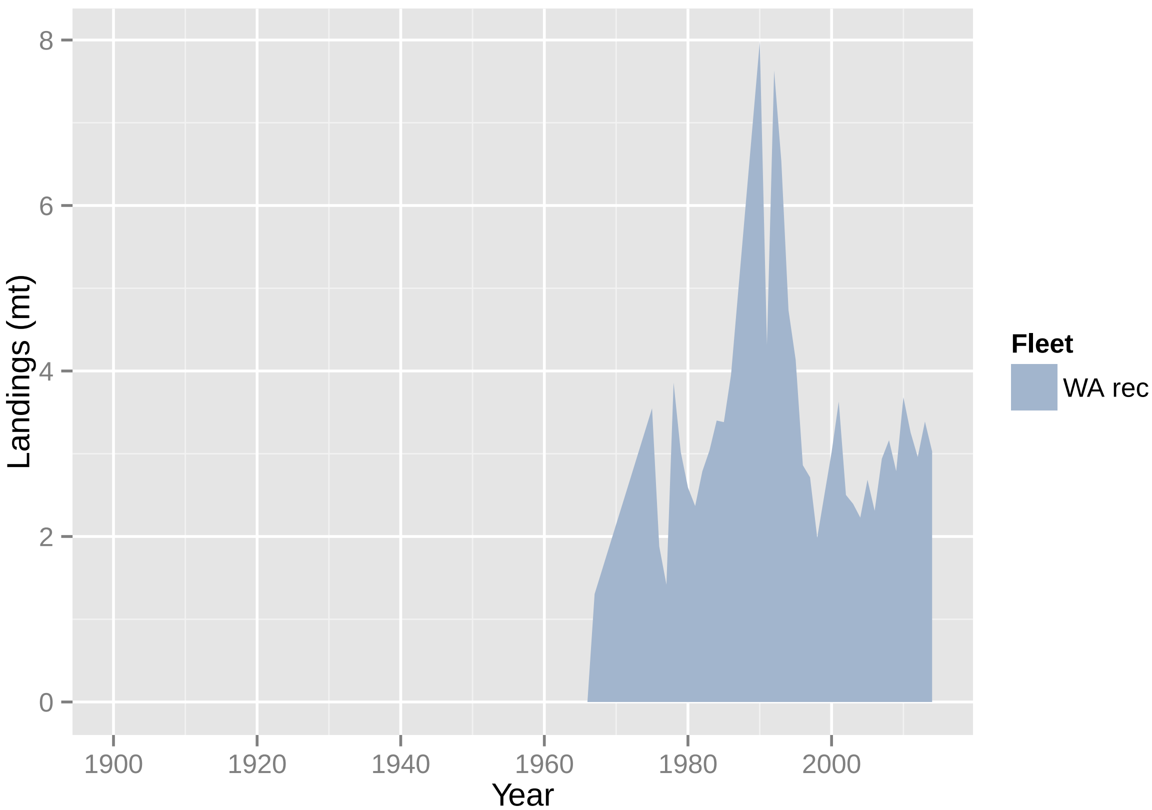

Figure a: China rockfish landings for Washington. Washington has does not have a commercial nearshore fishery.

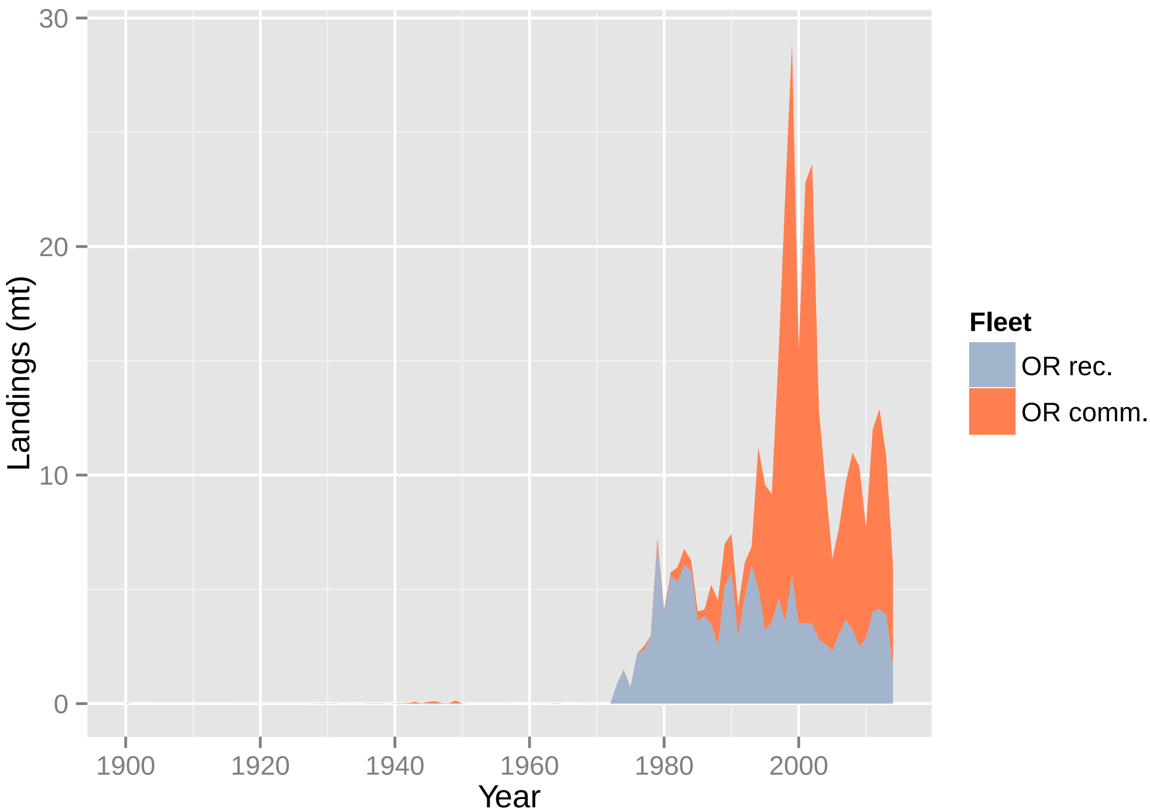

Figure b: Stacked line plot of China rockfish landings history for Oregon by fleet (recreational and commercial).

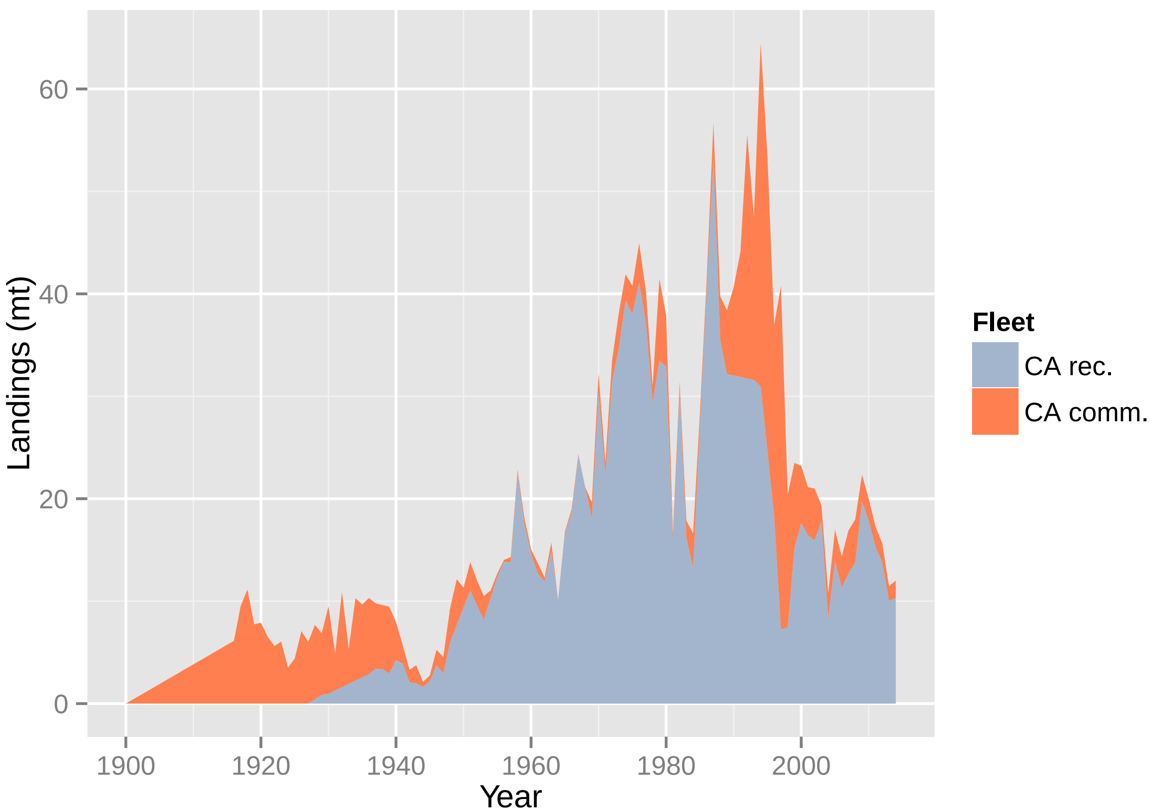

Figure c: Stacked line plot of China rockfish landings history for California by fleet (recreational and commercial).

Table a: Recent China rockfish landings (mt) by fleet.

Year	Washington recreational	Oregon commercial	Oregon recreational	California commercial	California recreational	Total
2005	2.69	4.02	2.31	3.06	13.91	25.98
2006	2.31	4.64	3.07	3.00	11.35	24.37
2007	2.94	6.03	3.66	4.21	12.70	29.54
2008	3.16	7.76	3.22	4.15	13.82	32.12
2009	2.79	7.88	2.50	2.63	19.72	35.52
2010	3.68	4.84	2.85	2.11	17.85	31.34
2011	3.26	7.98	4.02	1.99	15.29	32.54
2012	2.96	8.76	4.14	1.83	13.80	31.49
2013	3.39	6.98	3.85	1.43	10.03	25.68
2014	3.03	4.38	1.67	1.69	10.32	21.08

Data and assessment

China rockfish was assessed as a data moderate stock in 2013 (Cope et al. 2015) using the XDB-SRA modeling framework. This assessment uses the newest version of Stock Synthesis (3.24u). The model begins in 1900, and assumes the stock was at an unfished equilibrium that year.

Data within the central and northern models were stratified as follows: central model north and south of Florence, OR and the northern model groups MCAs 1-2 (southern WA) and MCAs 3-4 (northern WA) (Figure d). Data for the management area south of 40°10′ N. latitude are aggregated, in part because historical removals from the dominant fisheries (recreational charter and private boat modes) prior to 2004 are not available at a finer spatial scale. The data used in the assessments includes commercial and recreational landings, Catch per Unit Effort (CPUE) indices from recreational and commercial fleets, and length and age compositions. Discard data (total discards in mt and size compositions) from the commercial live-fish fishery were modelled south of 40°10′ N. latitude. Where available, age and length compositions for the recreational party/charter (CPFV) and private/rental modes were developed separately.

Stock biomass

Estimated spawning output in the northern area (Washington state) declined between the 1960s and 1990s but has been largely stable during the past two decades (Figure e and Table b). The estimated relative depletion level (spawning output relative to unfished spawning output) of the northern stock in 2015 is 73.4% (~95% asymptotic interval: ± 63.6% - 83.2%) (Figure f).

The central area model for China rockfish estimates that spawning output is just above

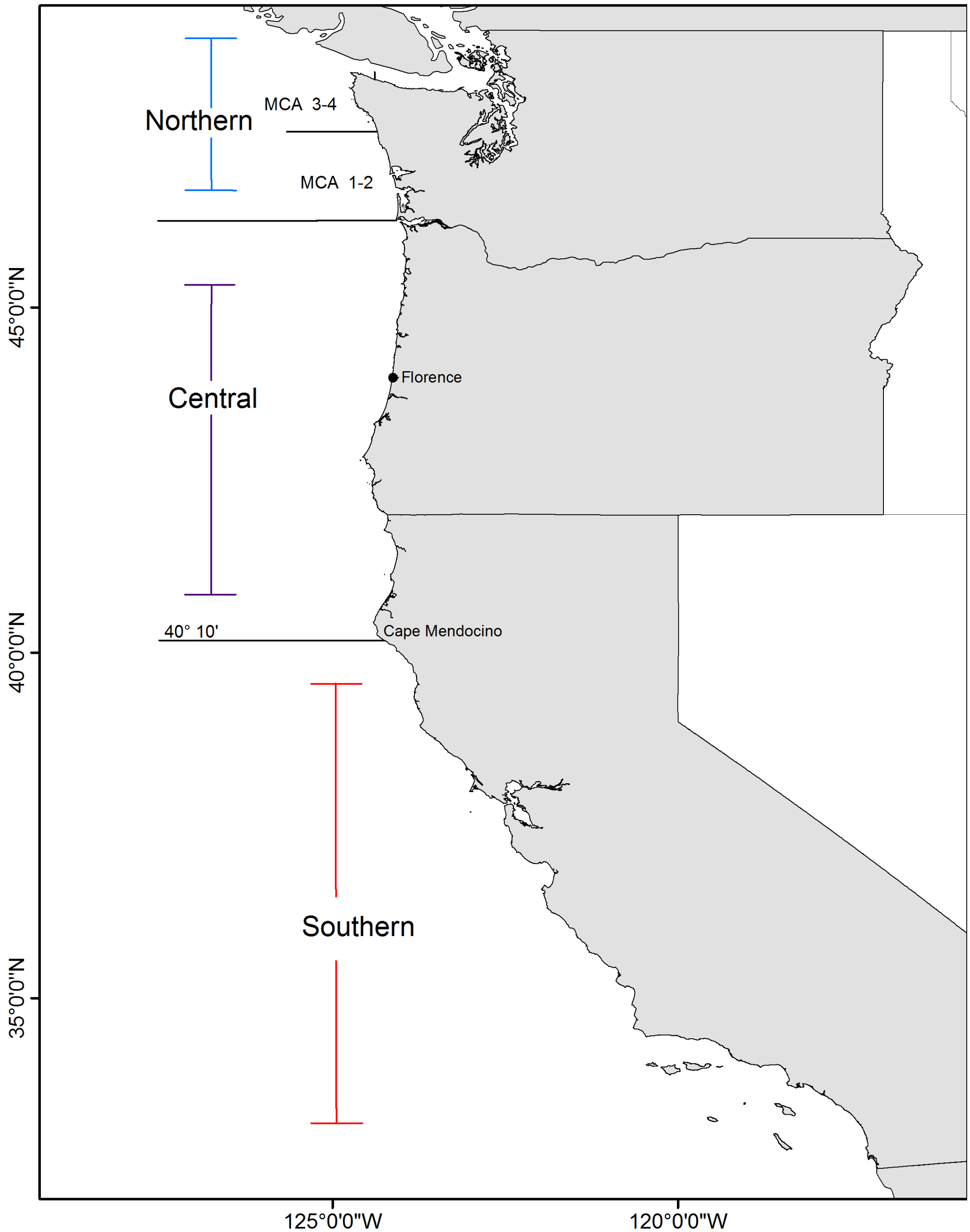

Figure d: Map depicting the boundaries for the three base-case models, Southern model (south of 40°10′ N. latitude), Central model (south of 40°10′ N. latitude to the OR-WA border), and the Northern model (WA state MCAs 1-4).

the biomass target in 2015 (Figure e and Table c). The rate of spawning output decline is estimated to be steepest during the 1980s to 1990s and continued to decline from the early 2000s at a slower rate to an estimated minimum of 39.6% in 2014. The estimated relative depletion level of the central stock in 2015 is 61.5% (~95% asymptotic interval: ± 53.8% - 69.2%) (Figure f).

The assessment for the southern management area suggests that China rockfish were lightly, but steadily exploited since the early 1900s, with more rapid declines in spawning output beginning with development of the recreational fishery in the 1950s (Figure e and Table d). The estimated relative depletion level of the southern stock in 2015 is 29.6% (~95% asymptotic interval: ± 25.0% - 34.3%) (Figure f). Although spawning output in the southern area is more depleted than the central and northern areas, it is the only area with an increasing trend over the past 15 years.

Table b: Recent trend in beginning of the year biomass and depletion for the northern China rockfish model.

Year	Spawning Output (billion eggs)	~ 95% confidence interval	Estimated depletion	~ 95% confidence interval
2006	17.942	(8.86-27.03)	0.734	(0.638-0.83)
2007	18.030	(8.94-27.12)	0.738	(0.642-0.833)
2008	18.044	(8.95-27.14)	0.738	(0.643-0.833)
2009	18.034	(8.93-27.13)	0.738	(0.642-0.833)
2010	18.062	(8.96-27.17)	0.739	(0.644-0.834)
2011	17.993	(8.89-27.1)	0.736	(0.64-0.833)
2012	17.971	(8.86-27.08)	0.735	(0.638-0.832)
2013	17.981	(8.87-27.09)	0.736	(0.639-0.833)
2014	17.944	(8.83-27.06)	0.734	(0.637-0.832)
2015	17.950	(8.83-27.07)	0.734	(0.637-0.832)

Table c: Recent trend in beginning of the year biomass and depletion for the central (north of 40°10′ N. latitude to the OR-WA border) China rockfish model.

Year	Spawning Output (billion eggs)	~ 95% confidence interval	Estimated depletion	~ 95% confidence interval
2006	40.643	(27.6-53.68)	0.624	(0.551-0.697)
2007	40.851	(27.8-53.9)	0.627	(0.555-0.7)
2008	40.630	(27.57-53.69)	0.624	(0.551-0.698)
2009	40.313	(27.25-53.38)	0.619	(0.545-0.694)
2010	40.125	(27.05-53.2)	0.616	(0.541-0.692)
2011	40.380	(27.29-53.47)	0.620	(0.545-0.695)
2012	40.112	(27.01-53.21)	0.616	(0.54-0.692)
2013	39.706	(26.6-52.82)	0.610	(0.533-0.687)
2014	39.573	(26.45-52.7)	0.608	(0.53-0.686)
2015	40.033	(26.88-53.19)	0.615	(0.538-0.692)

Table d: Recent trend in beginning of the year spawning output and depletion for the southern (south of 40°10′ N. latitude) China rockfish model.

Year	Spawning Output (billion eggs)	~ 95% confidence interval	Estimated depletion	~ 95% confidence interval
2006	14.430	(9.47-19.39)	0.217	(0.164-0.27)
2007	15.173	(10.01-20.34)	0.228	(0.174-0.283)
2008	15.819	(10.46-21.18)	0.238	(0.182-0.294)
2009	16.289	(10.77-21.81)	0.245	(0.187-0.303)
2010	16.361	(10.75-21.97)	0.246	(0.186-0.306)
2011	16.444	(10.73-22.16)	0.247	(0.186-0.309)
2012	16.758	(10.91-22.6)	0.252	(0.189-0.315)
2013	17.168	(11.18-23.15)	0.258	(0.193-0.323)
2014	17.899	(11.73-24.07)	0.269	(0.203-0.336)
2015	18.565	(12.23-24.9)	0.279	(0.211-0.347)

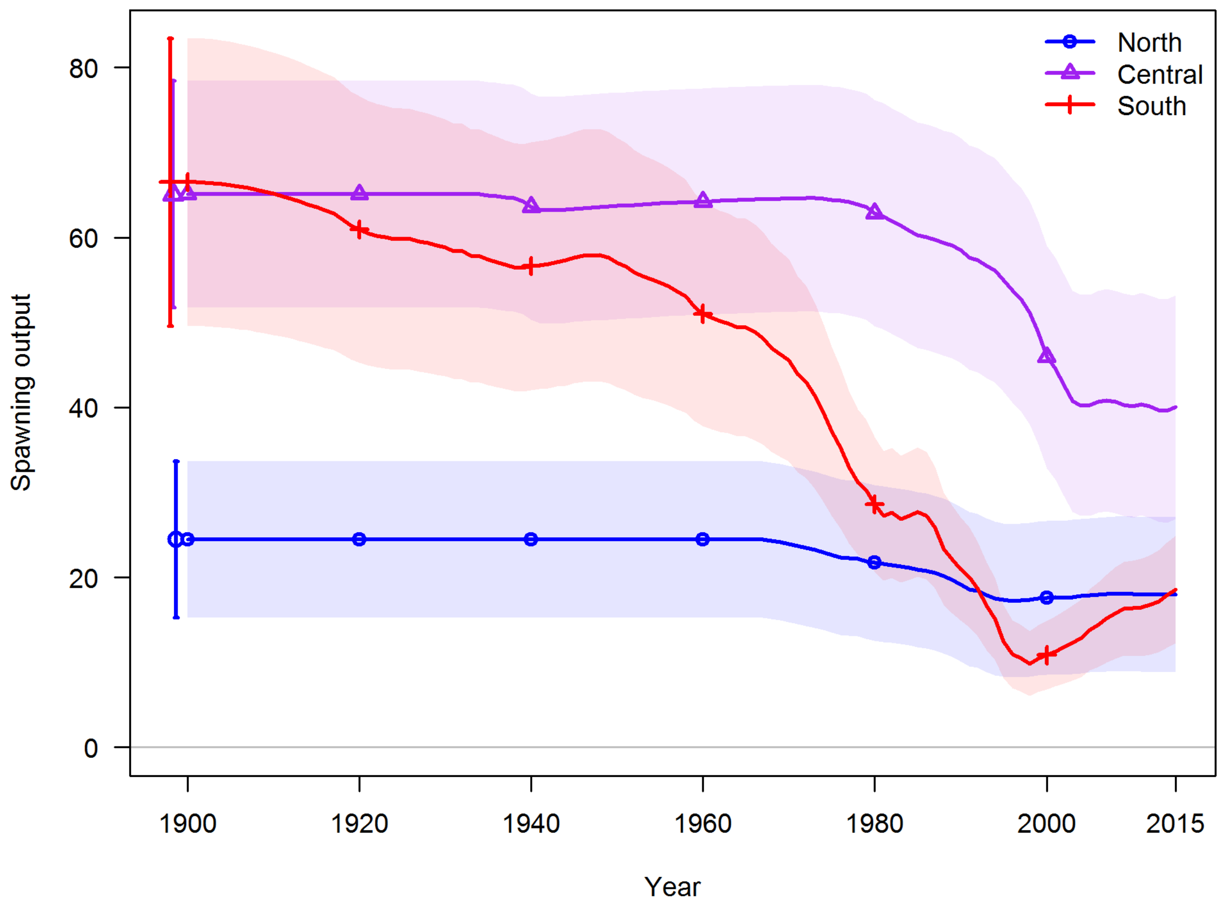

Figure e: Time series of spawning output trajectory (circles and line: median; light broken lines: 95% credibility intervals) for the three models of China rockfish (North=Washington state, Central = 40°10′ N. latitude to the OR/WA border, and South = south of 40°10′ N. latitude).

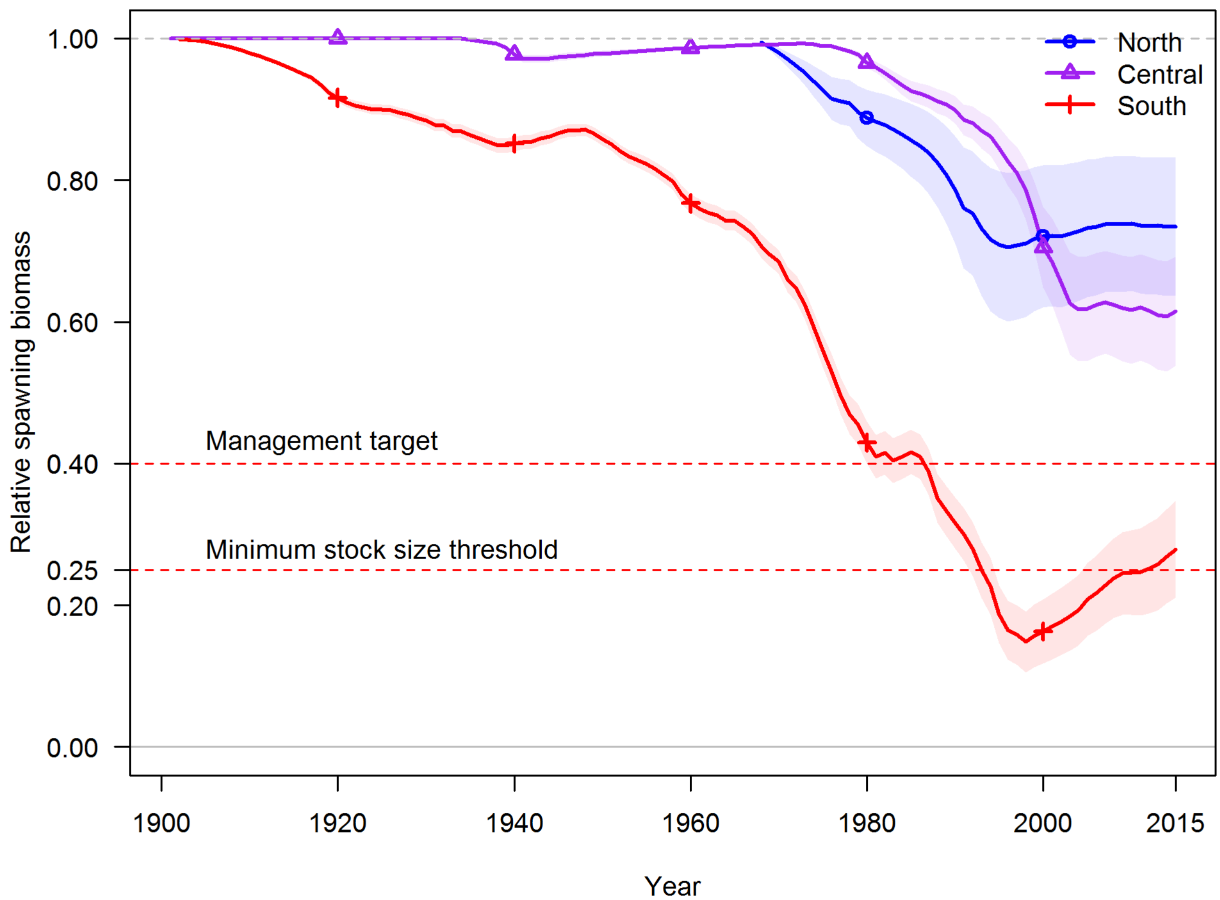

Figure f: Estimated relative depletion with approximate 95% asymptotic confidnce intervals (dashed lines) for the three base case assessment models.

Recruitment

Length and age composition data for China rockfish contain insufficient information to reliably resolve year-class strength. Therefore, all three base models assume that recruitment follows a deterministic Beverton-Holt stock-recruitment relationship, so trends in recruitment reflect trends in estimated spawning output. Given the assumed value of steepness and estimates of current stock status, estimated recruitment has remained fairly constant in the central and northern models, while the estimated biomass in the southern area has declined enough to impact spawning output (Figure g, Tables e, f and g).

Table e: Recent recruitment for the northern model (Washington state MCAs 1-4).

Year	Estimated Recruitment (1,000s)	~ 95% confidence interval
2006	33.29	(21.33 - 45.24)
2007	33.30	(21.35 - 45.25)
2008	33.30	(21.35 - 45.26)
2009	33.30	(21.35 - 45.26)
2010	33.31	(21.35 - 45.26)
2011	33.30	(21.34 - 45.25)
2012	33.29	(21.33 - 45.25)
2013	33.29	(21.33 - 45.25)
2014	33.29	(21.33 - 45.25)
2015	33.29	(21.33 - 45.25)

Table f: Recent recruitment for the central model (40°10′ N. latitude to the OR/WA border).

Year	Estimated Recruitment (1,000s)	~ 95% confidence interval
2006	68.27	(54.59 - 81.94)
2007	68.31	(54.64 - 81.97)
2008	68.26	(54.59 - 81.94)
2009	68.20	(54.51 - 81.9)
2010	68.17	(54.47 - 81.87)
2011	68.22	(54.52 - 81.91)
2012	68.17	(54.46 - 81.87)
2013	68.09	(54.36 - 81.81)
2014	68.06	(54.32 - 81.8)
2015	68.15	(54.43 - 81.87)

Table g: Recent recruitment for the southern model (south of 40°10′ N. latitude).

Year	Estimated Recruitment (1,000s)	~ 95% confidence interval
2006	122.32	(105.92 - 138.73)
2007	123.93	(107.67 - 140.18)
2008	125.23	(109.07 - 141.39)
2009	126.13	(109.98 - 142.28)
2010	126.27	(109.96 - 142.57)
2011	126.42	(109.97 - 142.87)
2012	126.99	(110.52 - 143.46)
2013	127.71	(111.29 - 144.13)
2014	128.94	(112.72 - 145.15)
2015	129.99	(113.95 - 146.03)

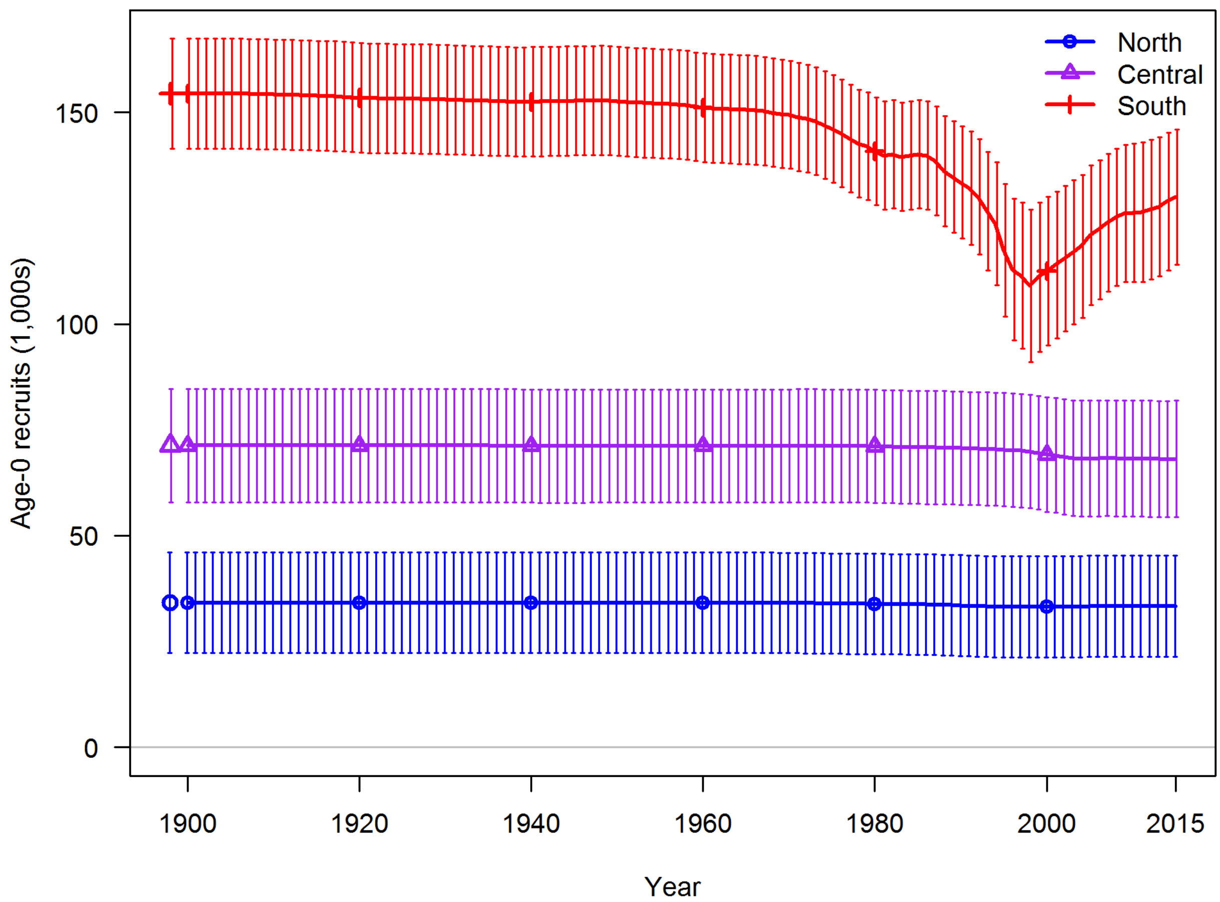

Figure g: Time series of estimated China rockfish recruitments for the three base-case models with 95% confidence or credibility intervals.

Exploitation status

Harvest rates estimated by the northern area model for Washington have never exceeded management target levels (Table h and Figure h). Model results for the central area suggest that harvest rates have briefly exceeded the current proxy MSY value around 2000, but has remained below the management target in the last decade (Table i and Figure h). Historical harvest rates for China rockfish rose steadily in the southern management area until the mid-1990s and exceeded the target SPR harvest rate for several decades, and is just below the target harvest rate as of 2013 (Table j and Figure h). A summary of China rockfish exploitation histories for the northern, central, and southern areas is provided as Figure i.

Table h: Recent trend in spawning potential ratio and exploitation for the northern China rockfish model (Washington state MCAs 1-4). Fishing intensity is (1-SPR) divided by 50% (the SPR target) and exploitation is F divided by F_{SPR}.

Year	Fishing intensity	~ 95% confidence interval	Exploitation rate	~ 95% confidence interval
2005	0.44	(0.27-0.61)	0.32	(0.17-0.47)
2006	0.39	(0.24-0.55)	0.28	(0.15-0.4)
2007	0.47	(0.3-0.65)	0.35	(0.19-0.51)
2008	0.50	(0.32-0.68)	0.38	(0.2-0.55)
2009	0.45	(0.28-0.63)	0.33	(0.18-0.49)
2010	0.56	(0.36-0.76)	0.44	(0.24-0.64)
2011	0.51	(0.32-0.7)	0.39	(0.21-0.57)
2012	0.48	(0.3-0.66)	0.35	(0.19-0.52)
2013	0.53	(0.34-0.72)	0.41	(0.22-0.59)
2014	0.48	(0.3-0.67)	0.36	(0.19-0.53)

Table i: Recent trend in spawning potential ratio and exploitation for the central China rockfish model (40°10′ N. latitude to the OR/WA border). Fishing intensity is (1-SPR) divided by 50% (the SPR target) and exploitation is F divided by F_{SPR}.

Year	Fishing intensity	~ 95% confidence interval	Exploitation rate	~ 95% confidence interval
2005	0.55	(0.42-0.68)	0.40	(0.28-0.52)
2006	0.62	(0.49-0.76)	0.48	(0.34-0.62)
2007	0.78	(0.63-0.93)	0.68	(0.48-0.88)
2008	0.82	(0.66-0.97)	0.73	(0.52-0.95)
2009	0.78	(0.63-0.93)	0.68	(0.48-0.88)
2010	0.61	(0.48-0.75)	0.47	(0.33-0.61)
2011	0.80	(0.65-0.96)	0.72	(0.5-0.93)
2012	0.85	(0.69-1.01)	0.79	(0.55-1.02)
2013	0.77	(0.62-0.93)	0.67	(0.47-0.87)
2014	0.53	(0.4-0.66)	0.39	(0.27-0.5)

Table j: Recent trend in spawning potential ratio and exploitation for the southern China rockfish model (south of 40°10′ N. latitude). Fishing intensity is (1-SPR) divided by 50% (the SPR target) and exploitation is F divided by F_{SPR}.

Year	Fishing intensity	~ 95% confidence interval	Exploitation rate	~ 95% confidence interval
2005	1.30	(1.16-1.45)	1.50	(1.15-1.85)
2006	1.18	(1.03-1.33)	1.19	(0.91-1.47)
2007	1.18	(1.03-1.33)	1.22	(0.93-1.51)
2008	1.23	(1.08-1.37)	1.35	(1.04-1.67)
2009	1.35	(1.21-1.48)	1.76	(1.34-2.17)
2010	1.34	(1.2-1.48)	1.70	(1.29-2.1)
2011	1.25	(1.1-1.4)	1.41	(1.06-1.75)
2012	1.20	(1.05-1.35)	1.27	(0.96-1.58)
2013	1.02	(0.86-1.18)	0.90	(0.68-1.12)
2014	1.04	(0.89-1.2)	0.96	(0.73-1.19)

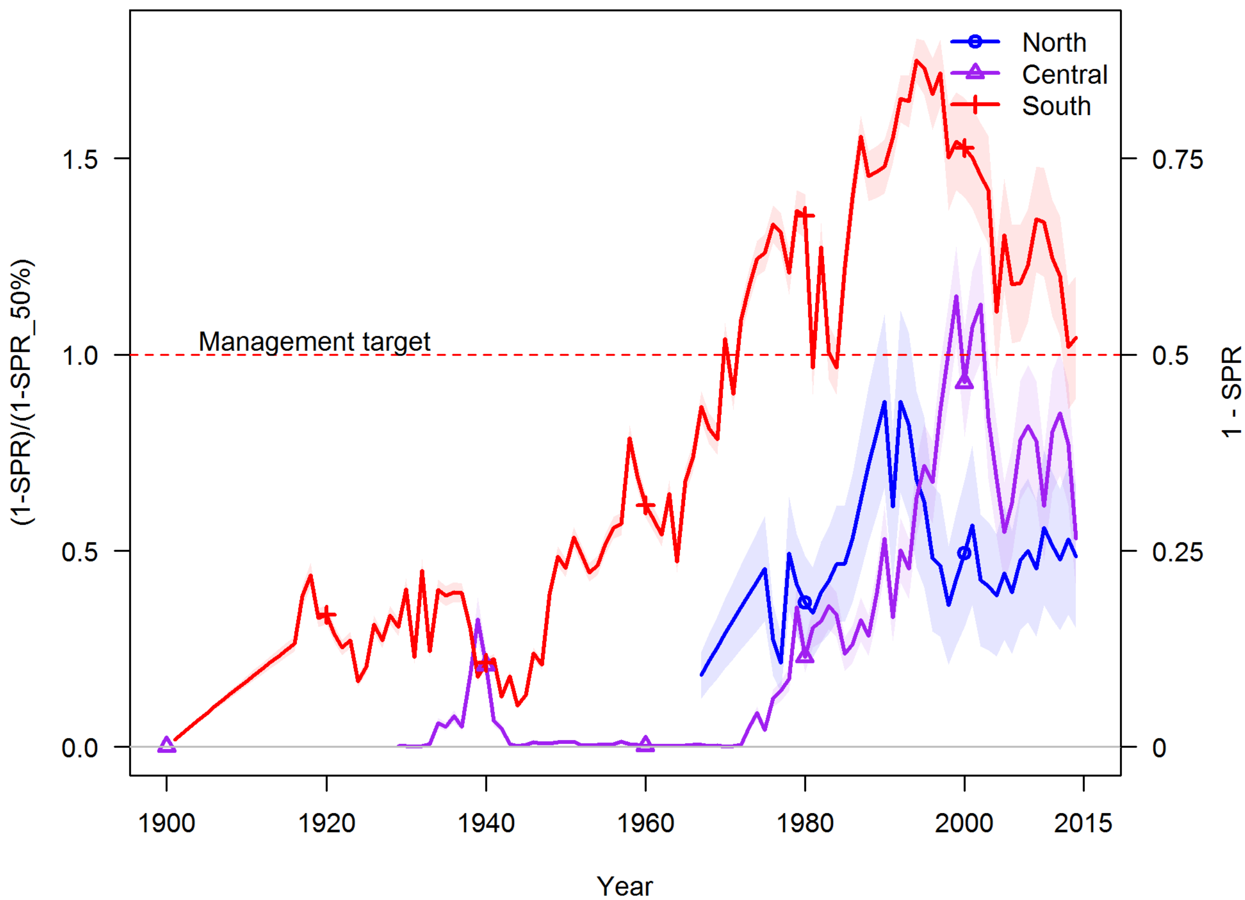

Figure h: Estimated spawning potential ratio (SPR) for the northern, central, and southern base-case models. One minus SPR is plotted so that higher exploitation rates occur on the upper portion of the y-axis. The management target is plotted as a red horizontal line and values above this reflect harvests in excess of the overfishing proxy based on the $SPR_{50\%}$ harvest rate. The last year in the time series is 2014.

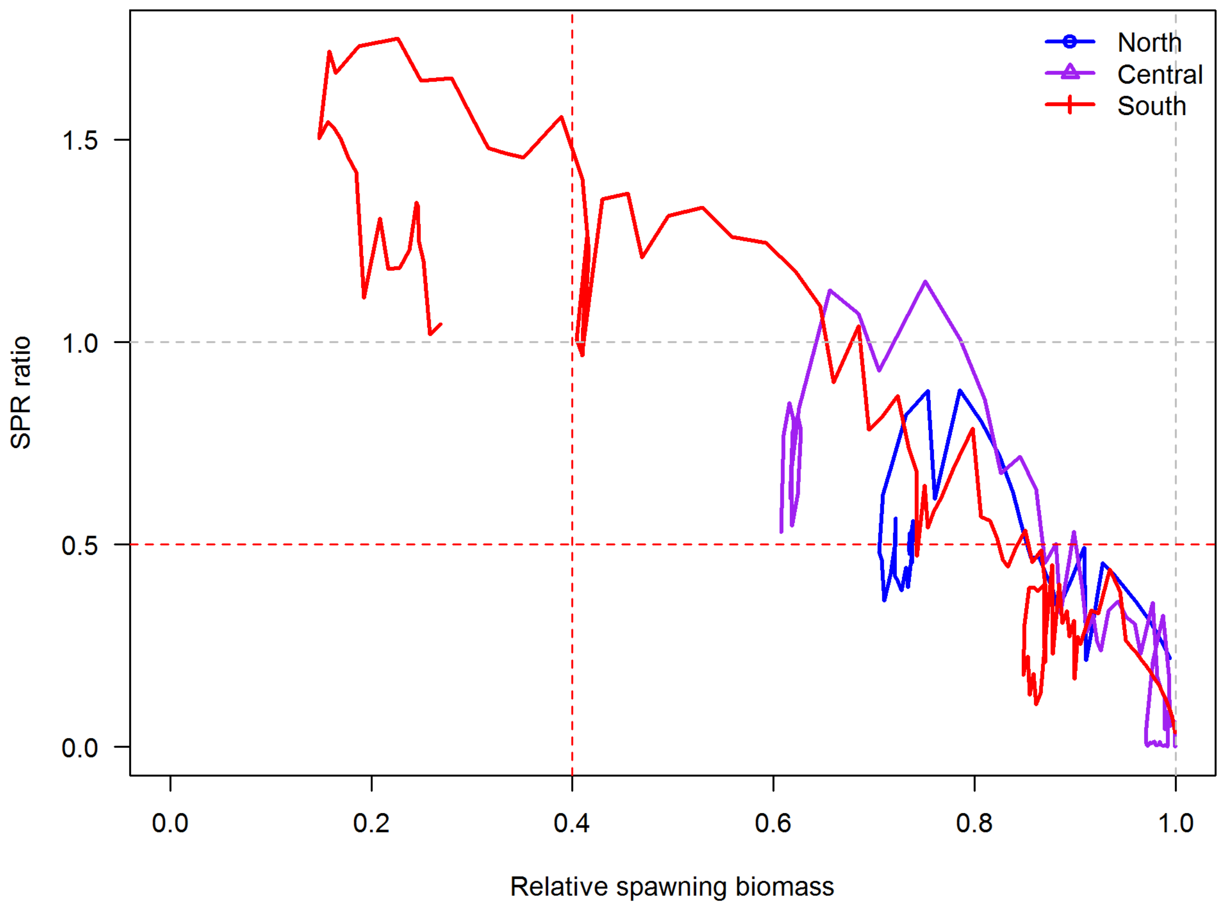

Figure i: Phase plot of estimated relative (1-SPR) vs. relative spawning biomass for the southern, central, and northern base case models. The relative (1-SPR) is (1-SPR) divided by 50% (the SPR target). Relative depletion is the annual spawning biomass divided by the unfished spawning biomass.

Ecosystem considerations

In this assessment, ecosystem considerations were not explicitly included in the analysis. This is primarily due to a lack of relevant data and results of analyses (conducted elsewhere) that could contribute ecosystem-related quantitative information for the assessment.

Recently available habitat information was used to select the data used in the onboard observer indices (see Appendix F, p.9).

Reference points

The management line for China rockfish is at 40°10′ N. latitude, with differing management guidelines north and south. From 2005-2010, the Nearshore Rockfish Complexes north and south of 40°10′ N. latitude were managed by a total catch Optimum Yield (OY). As of the Pacific Fishery Management Council (PFMC) 2011-12 management cycle, China rockfish has a component OFL and ABC within the northern and southern Nearshore Rockfish Complexes, based on the work by Dick and MacCall (2010).

This stock assessment estimates that China rockfish in the north are above the biomass target. The spawning output of the stock declined between the 1960s and 1990s but has largely been stable during the past few decades. The estimated relative depletion level in 2015 is 73.4% (~95% asymptotic interval: ± 63.7% - 83.2%, corresponding to an unfished spawning output of 24.4 billion eggs (~95% asymptotic interval: 15.2 – 33.7 billion eggs) of spawning output in the base model (Table k). Unfished age 5+ biomass was estimated to be 240.8 mt in the base case model. The target spawning output based on the biomass target ($SB_{40\%}$) is 9.8 billion eggs, which gives a catch of 6.3 mt. Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is 5.8 mt.

This stock assessment estimates that central area China rockfish are just above the biomass target. The rate of spawning output decline is estimated to be steepest during the 1980s to 1990s and has continued to decline since the 1990s at a slower rate. The estimated relative depletion level in 2015 is 61.5% (~95% asymptotic interval: ± 53.8% - 69.2%), corresponding to an unfished spawning output of 65.1 billion eggs (~95% asymptotic interval: 51.8 – 78.4 billion eggs) of spawning output in the base model (Table l). Unfished age 5+ biomass was estimated to be 591.5 mt in the base case model. The target spawning output based on the biomass target ($SB_{40\%}$) is 26 billion eggs, which gives a catch of 15.7 mt. Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is 14.5 mt.

This stock assessment estimates that China rockfish south of 40°10′ N. latitude are below the biomass target, but above the minimum stock size threshold, and have been increasing over the last 15 years. The estimated relative depletion level in 2015 is 27.9% (~95% asymptotic interval: ± 21.2% - 34.7%), corresponding to an unfished spawning output of 66.5 billion eggs (~95% asymptotic interval: 49.6 - 83.4 billion eggs) of spawning output in the base model (Table m). Unfished age 5+ biomass was estimated to be 768.6 mt in the base case model.

The target spawning output based on the biomass target ($SB_{40\%}$) is 26.6 billion eggs, which gives a catch of 21.1 mt. Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is 19.5 mt.

Table k: Summary of reference points and management quantities for the northern (Washington state MCAs 1-4) base case model.

Quantity	**Estimate**	**95% Confidence Interval**
Unfished spawning output (billions of eggs)	24.4	(15.2-33.7)
Unfished age 5+ biomass (mt)	240.8	(153-328.7)
Unfished recruitment (R0, thousands)	34.2	(22.3-46)
Spawning output (2015, billions of eggs)	17.9	(8.8-27.1)
Depletion (2015)	0.7344	(0.6369-0.8319)
Reference points based on $\mathbf{SB_{40\%}}$		
Proxy spawning output ($B_{40\%}$)	9.8	(6.1-13.5)
SPR resulting in $B_{40\%}$ ($SPR_{B40\%}$)	0.444	(0.444-0.444)
Exploitation rate resulting in $B_{40\%}$	0.0551	(0.0522-0.058)
Yield with $SPR_{B40\%}$ at $B_{40\%}$ (mt)	6.3	(4-8.5)
Reference points based on SPR proxy for MSY		
Spawning output	11.3	(7-15.5)
SPR_{proxy}	0.5	
Exploitation rate corresponding to SPR_{proxy}	0.0458	(0.0435-0.0482)
Yield with SPR_{proxy} at SB_{SPR} (mt)	5.8	(3.7-7.9)
Reference points based on estimated MSY values		
Spawning output at MSY (SB_{MSY})	5.6	(3.5-7.8)
SPR_{MSY}	0.2875	(0.2823-0.2927)
Exploitation rate at MSY	0.0924	(0.0863-0.0985)
MSY (mt)	7	(4.5-9.4)

Table l: Summary of reference points and management quantities for the central (40°10′ N. latitude to the OR/WA border) base case model.

Quantity	Estimate	95% Confidence Interval
Unfished spawning output (billions of eggs)	65.1	(51.8-78.4)
Unfished age 5+ biomass (mt)	591.5	(473.7-709.3)
Unfished recruitment (R0, thousands)	71.3	(57.9-84.6)
Spawning output (2015, billions of eggs)	40	(26.9-53.2)
Depletion (2015)	0.6149	(0.5381-0.6918)
Reference points based on $\mathbf{SB_{40\%}}$		
Proxy spawning output ($B_{40\%}$)	26	(20.7-31.4)
SPR resulting in $B_{40\%}$ ($SPR_{B40\%}$)	0.444	(0.444-0.444)
Exploitation rate resulting in $B_{40\%}$	0.0584	(0.0567-0.0602)
Yield with $SPR_{B40\%}$ at $B_{40\%}$ (mt)	15.7	(12.6-18.7)
Reference points based on SPR proxy for MSY		
Spawning output	30	(23.8-36.1)
SPR_{proxy}	0.5	
Exploitation rate corresponding to SPR_{proxy}	0.0484	(0.0469-0.0498)
Yield with SPR_{proxy} at SB_{SPR} (mt)	14.5	(11.7-17.3)
Reference points based on estimated MSY values		
Spawning output at MSY (SB_{MSY})	15.4	(12.2-18.6)
SPR_{MSY}	0.2925	(0.29-0.295)
Exploitation rate at MSY	0.098	(0.094-0.1019)
MSY (mt)	17.3	(14-20.7)

Table m: Summary of reference points and management quantities for the southern (south of 40°10′ N. latitude) base case model.

Quantity	**Estimate**	**95% Confidence Interval**
Unfished spawning output (billions of eggs)	66.5	(49.6-83.4)
Unfished age 5+ biomass (mt)	768.6	(660.1-877)
Unfished recruitment (R0, thousands)	154.5	(141.5-167.4)
Spawning output (2015, billions of eggs)	18.6	(12.2-24.9)
Depletion (2015)	0.2791	(0.2113-0.3469)
Reference points based on $\mathbf{SB_{40\%}}$		
Proxy spawning output ($B_{40\%}$)	26.6	(19.8-33.4)
SPR resulting in $B_{40\%}$ ($SPR_{B40\%}$)	0.444	(0.444-0.444)
Exploitation rate resulting in $B_{40\%}$	0.057	(0.0491-0.065)
Yield with $SPR_{B40\%}$ at $B_{40\%}$ (mt)	21.1	(19.9-22.3)
Reference points based on SPR proxy for MSY		
Spawning output	30.6	(22.8-38.4)
SPR_{proxy}	0.5	
Exploitation rate corresponding to SPR_{proxy}	0.0476	(0.041-0.0541)
Yield with SPR_{proxy} at SB_{SPR} (mt)	19.5	(18.4-20.6)
Reference points based on estimated MSY values		
Spawning output at MSY (SB_{MSY})	15.5	(11.2-19.9)
SPR_{MSY}	0.2898	(0.2832-0.2965)
Exploitation rate at MSY	0.0938	(0.0784-0.1092)
MSY (mt)	23.4	(22.1-24.8)

Management performance

China rockfish is managed in the northern and southern Nearshore Rockfish Complex (split at 40°10′ N. latitude. Since the 2011-2012 management cycle, China rockfish has a contribution OFL and ACL within each the northern and southern Nearshore Rockfish Complexes (Table n). The estimated catch of China rockfish north of 40°10′ N. latitude of Nearshore Rockfish Complex has been above both the China rockfish contribution to the northern Nearshore Rockfish Complex OFL and ACL in all years (2011-2014). The estimated catch of China rockfish south of 40°10′ N. latitude of Nearshore Rockfish Complex has been below the China rockfish contribution to the northern Nearshore Rockfish Complex OFL and ACL in all years (2011-2014). A summary of these values as well as other base case summary results can be found in Table s.

Table n: Recent trend in total catch and commercial landings (mt) relative to the management guidelines. Estimated total catch reflect the commercial landings plus the model estimated discarded biomass. Note: 2015 and 2016 ACLs are proposed and not yet in regulations

Year	Management guideline	Nearshore rockfish north	China contrib. north	Estimated catch north	Nearshore rockfish south	China contrib. south	Estimated catch south
2005	**ABC**	na	na	10.10	na	na	16.70
	Total Catch OY	122	na		615	na	
2006	**ABC**	na	na	11.30	na	na	13.60
	Total Catch OY	122	na		615	na	
2007	**ABC**	na	na	15.80	na	na	14.20
	Total Catch OY	142	na		564	na	
2008	**ABC**	na	na	16.90	na	na	16.00
	Total Catch OY	142	na		564	na	
2009	**ABC**	na	na	15.40	na	na	21.00
	Total Catch OY	155	na		650	na	
2010	**ABC**	na	na	12.40	na	na	19.30
	Total Catch OY	155	na		650	na	
2011	**OFL**	116	11.7	16.60	1156	19.8	16.20
	ACL	99	9.8		1001	16.5	
2012	**OFL**	116	11.7	17.50	1145	19.8	14.10
	ACL	99	9.8		990	16.5	
2013	**OFL**	110	9.8	15.60	1164	16.6	10.40
	ACL	94	8.2		1005	13.8	
2014	**OFL**	110	9.8	10.10	1160	16.6	11.80
	ACL	94	8.2		1001	13.8	
2015	**OFL**	88	7.2		1313	55.2	
	ACL	69	6.6		1114	50.4	
2016	**OFL**	88	7.4		1288	52.7	
	ACL	69	6.8		1006	50.4	

Unresolved problems and major uncertainties

As in most/all stock assessments, the appropriate value for stock-recruit steepness remains a major uncertainty for China rockfish. In this assessment a prior value was available from a meta-analysis, allowing bracketing of the uncertainty. Exploration of the southern model during the STAR panel meeting established that the range of uncertainty in current and projected biomass status provided by this bracketing was very similar to the range due to natural mortality, and that natural mortality alone would be used to bracket uncertainty in model results for management advice.

While the northern and the southern area models are able to estimate a plausible value of natural mortality with an apparently good level of precision, this was not possible with the central area model.

The fishery-dependent abundance indices used in the assessment are relatively noisy. There is no fishery-independent index. The assessments assume that trends in CPUE indices are representative of population trends.

Assessment results for the central and the northern area models are dependent on the method used for weighting the conditional age-at-length data. This is an area of active research and there is a lack of consensus on an agreed approach. A workshop is planned for later this year that might provide guidance. For this assessment, the Panel recommended use of harmonic mean method, because it is a well-understood and frequently applied method that provided intermediate results compared to other alternatives.

The current term of reference for stock assessment require development of a single decision table with states of nature ranging along the dominant axis of uncertainty. This presumes that uncertainty is consequential only for a single variable or estimated quantity, such as natural mortality, steepness, or ending biomass. This approach may fail to capture important elements of uncertainty that should be communicated to the Council and its advisory bodies. Additional flexibility in the development of decision tables is needed.

Decision Tables

The forecasts of stock abundance and yield were developed using the final base models. The total catches in 2015 and 2016 are set to the PFMC adopted China rockfish contribution ACLs in the northern and central models (Table n). The southern model total catches in 2015 and 2016 are set to the average annual catch from 2012-2014. The exploitation rate for 2017 and beyond is based upon an SPR harvest rate of 50%. The average of 2010-2014 catch by fleet was used to distribute catches in forecasted years. The forecasted projections of the OFL for each model are presented in Table o.

Uncertainty in the forecasts is based upon the three states of nature agreed upon at the STAR panel and are based on a low value of M, 0.05, and a high value, 0.09. Current medium-term forecasts based on the alternative states of nature project that the stock, under the current control rule as applied to the base model, will decline towards the target stock size Table p. The current control rule under the low state of nature results in a stock decline into the precautionary zone, while the high state of nature maintains the stock at near unfished levels. Removing the catches resulting from the low M state of nature, assuming the base and high values of M both maintain the stock at well above the current target stock size, as does removing the recent average catches under all states of nature. Removing the high M catches under the base model M and high M states of nature results in the population going to extremely low levels during the projection period, spawning biomass and stock depletion values are not reported for years in which the stock goes to these very low levels.

Current medium-term forecasts based on the alternative states of nature for the central model project that the stock, under the current control rule as applied to the base model, will decline towards the target stock size Table q. The current control rule under the low state of nature results in a stock in the precautionary zone, while the high state of nature maintains the stock increasing from 40% to 50% depletion from 2017 - 2026. Removing the catches resulting from the low M state of nature, assuming the base and high values of M both maintain the stock at well above the current target stock size. Removing the high M catches under the base model M and low M states of nature results in the population going to extremely low levels during the projection period. Removing average catches under the base M and high M states of nature result in the stock remaining above the current target stock size, and an ending depletion of 37% in 2026 for the low M state of nature.

Assuming that catches in 2015 and 2016 equal recent average catch, and that catches beginning in 2017 follow the default ACL harvest control rule, projections of expected China spawning output from the southern base model suggest the stock will be at roughly 30% of unfished spawning output in 2017, and increase to 38% by 2026 (Table r). The stock is expected to remain below the target stock size (40% of unfished spawning output) in the base model and "low M" states of nature through 2026, and to exceed target size in the "high M" scenario, assuming stationarity in the stock-recruitment assumptions.

Table o: Projections of potential OFL (mt) for each model, using the base model forecast.

Year	North	Central	South	Total
2017	9.63	20.52	13.31	43.46
2018	9.29	20.05	13.84	43.18
2019	8.98	19.62	14.34	42.93
2020	8.69	19.21	14.80	42.71
2021	8.43	18.84	15.24	42.51
2022	8.20	18.50	15.63	42.33
2023	7.99	18.19	16.00	42.18
2024	7.80	17.91	16.34	42.05
2025	7.64	17.67	16.65	41.95
2026	7.49	17.45	16.93	41.87

Table p: Summary of 10-year projections beginning in 2017 for alternate states of nature based on an axis of uncertainty for the northern model. Columns range over low, mid, and high states of nature, and rows range over different assumptions of catch levels. An entry of '–' indicates that the stock is driven to very low abundance under the particular scenario.

			States of nature					
			Low M 0.05		Base M 0.07		High M 0.09	
	Year	Catch	Spawning Output	Depletion	Spawning Output	Depletion	Spawning Output	Depletion
40-10 Rule, Low M	2017	3.39	10.1	0.541	18.2	0.745	59.30	0.93
	2018	3.37	10.1	0.541	18.1	0.741	59.30	0.93
	2019	3.35	10	0.535	18.1	0.741	59.20	0.92
	2020	3.32	9.9	0.53	18.1	0.741	59.20	0.92
	2021	3.30	9.9	0.53	18	0.736	59.20	0.92
	2022	3.29	9.8	0.525	18	0.736	59.10	0.92
	2023	3.27	9.8	0.525	18	0.736	59.10	0.92
	2024	3.25	9.7	0.519	18	0.736	59.10	0.92
	2025	3.23	9.7	0.519	17.9	0.732	59.10	0.92
	2026	3.22	9.6	0.514	17.9	0.732	59.10	0.92
40-10 Rule	2017	8.82	10.1	0.541	18.2	0.745	59.30	0.93
	2018	8.49	9.5	0.509	17.6	0.72	58.70	0.92
	2019	8.22	8.8	0.471	17	0.696	58.10	0.91
	2020	7.96	8.3	0.444	16.5	0.675	57.70	0.90
	2021	7.72	7.7	0.412	16	0.655	57.20	0.89
	2022	7.51	7.2	0.385	15.6	0.638	56.90	0.89
	2023	7.32	6.8	0.364	15.2	0.622	56.50	0.88
	2024	7.14	6.4	0.343	14.9	0.61	56.20	0.88
	2025	6.99	6	0.321	14.6	0.597	56.00	0.88
	2026	6.85	5.6	0.3	14.3	0.585	55.80	0.87
40-10 Rule, High M	2017	38.81	10.1	0.541	18.2	0.745	59.30	0.93
	2018	36.27	6.2	0.332	14.4	0.589	55.50	0.87
	2019	34.02	-	-	11	0.45	52.30	0.82
	2020	32.06	-	-	8	0.327	49.40	0.77
	2021	30.35	-	-	5.4	0.221	46.90	0.73
	2022	28.87	-	-	3.3	0.135	44.80	0.70
	2023	27.59	-	-	-	-	43.00	0.67
	2024	26.51	-	-	-	-	41.40	0.65
	2025	25.57	-	-	-	-	40.10	0.63
	2026	24.79	-	-	-	-	39.00	0.61
Average Catch	2017	2.45	10	0.535	18.1	0.741	59.20	0.92
	2018	2.45	10.1	0.541	18.1	0.741	59.30	0.93
	2019	2.45	10.1	0.541	18.2	0.745	59.30	0.93
	2020	2.45	10.1	0.541	18.3	0.749	59.40	0.93
	2021	2.45	10.2	0.546	18.3	0.749	59.40	0.93
	2022	2.45	10.2	0.546	18.4	0.753	59.50	0.93
	2023	2.45	10.2	0.546	18.4	0.753	59.50	0.93
	2024	2.45	10.3	0.551	18.5	0.757	59.60	0.93
	2025	2.45	10.3	0.551	18.5	0.757	59.60	0.93
	2026	2.45	10.3	0.551	18.6	0.761	59.70	0.93

Table q: Summary of 10-year projections beginning in 2017 for alternate states of nature based on an axis of uncertainty for the central model. Columns range over low, mid, and high states of nature, and rows range over different assumptions of catch levels. An entry of '–' indicates that the stock is driven to very low abundance under the particular scenario.

			States of nature					
			Low M 0.05		Base M 0.07		High M 0.09	
	Year	Catch	Spawning Output	Depletion	Spawning Output	Depletion	Spawning Output	Depletion
40-10 Rule, Low M	2017	6.70	20.2	0.41	41.40	0.64	109.50	0.85
	2018	6.80	20.5	0.42	41.90	0.64	110.10	0.86
	2019	6.90	20.8	0.42	42.30	0.65	110.50	0.86
	2020	6.90	21	0.43	42.70	0.66	111.00	0.86
	2021	7.00	21.2	0.43	43.00	0.66	111.40	0.87
	2022	7.10	21.4	0.43	43.40	0.67	111.70	0.87
	2023	7.10	21.5	0.44	43.70	0.67	112.10	0.87
	2024	7.20	21.7	0.44	43.90	0.67	112.30	0.87
	2025	7.20	21.8	0.44	44.20	0.68	112.60	0.88
	2026	7.30	22	0.45	44.40	0.68	112.90	0.88
40-10 Rule	2017	18.80	20.2	0.41	41.40	0.64	109.50	0.85
	2018	18.40	19.2	0.39	40.50	0.62	108.70	0.85
	2019	18.00	18.2	0.37	39.70	0.61	107.90	0.84
	2020	17.60	17.2	0.35	38.90	0.6	107.20	0.83
	2021	17.20	16.3	0.33	38.10	0.59	106.60	0.83
	2022	16.90	15.4	0.31	37.50	0.58	106.10	0.83
	2023	16.70	14.6	0.3	36.90	0.57	105.60	0.82
	2024	16.40	13.9	0.28	36.40	0.56	105.20	0.82
	2025	16.20	13.2	0.27	35.90	0.55	104.80	0.82
	2026	16.00	12.6	0.26	35.50	0.55	104.50	0.81
40-10 Rule, High M	2017	64.10	20.2	0.41	41.40	0.64	109.50	0.85
	2018	60.50	14.2	0.29	35.40	0.54	103.60	0.81
	2019	57.30	8.8	0.18	30.00	0.46	98.30	0.76
	2020	54.40	4.1	0.08	25.20	0.39	93.60	0.73
	2021	51.90	0.4	0.01	20.90	0.32	89.60	0.70
	2022	49.80	0	0	17.10	0.26	86.00	0.67
	2023	47.90	0	0	13.80	0.21	83.00	0.65
	2024	46.30	-	-	10.90	0.17	80.40	0.63
	2025	44.92	-	-	8.40	0.13	78.20	0.61
	2026	43.74	-	-	6.30	0.1	76.20	0.59
Average Catch	2017	11.28	20.2	0.41	41.40	63.70%	109.50	0.85
	2018	11.28	20	0.41	41.40	63.50%	109.50	0.85
	2019	11.28	19.8	0.40	41.30	63.40%	109.50	0.85
	2020	11.28	19.5	0.40	41.20	63.30%	109.50	0.85
	2021	11.28	19.3	0.39	41.10	63.10%	109.50	0.85
	2022	11.28	19	0.38	41.00	63.00%	109.50	0.85
	2023	11.28	18.7	0.38	40.90	62.90%	109.40	0.85
	2024	11.28	18.5	0.37	40.80	62.70%	109.40	0.85
	2025	11.28	18.3	0.37	40.80	62.60%	109.40	0.85
	2026	11.28	18	0.37	40.70	62.50%	109.40	0.85

Table r: Summary of 10-year projections beginning in 2017 for alternate states of nature based on an axis of uncertainty for the southern model. Columns range over low, mid, and high states of nature, and rows range over different assumptions of catch levels.

			States of nature					
			Low M 0.05		Base M 0.07		High M 0.09	
	Year	Catch	Spawning Output	Depletion	Spawning Output	Depletion	Spawning Output	Depletion
40-10 Rule, Low M	2017	5.08	14.30	0.21	19.82	0.30	23.16	0.40
	2018	5.73	15.25	0.22	21.05	0.32	24.44	0.42
	2019	6.35	16.17	0.23	22.24	0.33	25.66	0.44
	2020	6.96	17.06	0.25	23.37	0.35	26.80	0.46
	2021	7.54	17.91	0.26	24.44	0.37	27.86	0.48
	2022	8.08	18.71	0.27	25.45	0.38	28.84	0.49
	2023	8.60	19.47	0.28	26.39	0.40	29.74	0.51
	2024	9.08	20.18	0.29	27.27	0.41	30.56	0.52
	2025	9.54	20.85	0.30	28.09	0.42	31.31	0.54
	2026	9.97	21.47	0.31	28.84	0.43	31.99	0.55
40-10 Rule	2017	10.81	14.30	0.21	19.82	0.30	23.16	0.40
	2018	11.46	14.87	0.21	20.63	0.31	24.02	0.41
	2019	12.07	15.40	0.22	21.38	0.32	24.81	0.42
	2020	12.64	15.90	0.23	22.09	0.33	25.53	0.44
	2021	13.17	16.35	0.23	22.74	0.34	26.19	0.45
	2022	13.65	16.76	0.24	23.34	0.35	26.79	0.46
	2023	14.10	17.14	0.25	23.90	0.36	27.33	0.47
	2024	14.51	17.48	0.25	24.40	0.37	27.81	0.47
	2025	14.89	17.79	0.26	24.87	0.37	28.24	0.48
	2026	15.23	18.08	0.26	25.30	0.38	28.63	0.49
40-10 Rule, High M	2017	17.86	14.30	0.21	19.82	0.30	23.16	0.40
	2018	18.18	14.40	0.21	20.10	0.30	23.50	0.40
	2019	18.41	14.48	0.21	20.36	0.31	23.80	0.41
	2020	18.62	14.54	0.21	20.59	0.31	24.07	0.41
	2021	18.81	14.59	0.21	20.80	0.31	24.32	0.41
	2022	18.99	14.62	0.21	20.99	0.32	24.55	0.42
	2023	19.15	14.65	0.21	21.17	0.32	24.76	0.42
	2024	19.30	14.67	0.21	21.34	0.32	24.96	0.43
	2025	19.45	14.68	0.21	21.51	0.32	25.14	0.43
	2026	19.58	14.70	0.21	21.67	0.33	25.32	0.43
Average Catch	2017	13.11	14.30	0.21	19.82	0.30	23.16	0.40
	2018	13.11	14.72	0.21	20.45	0.31	23.85	0.41
	2019	13.11	15.14	0.22	21.09	0.32	24.52	0.42
	2020	13.11	15.56	0.22	21.71	0.33	25.17	0.43
	2021	13.11	15.98	0.23	22.33	0.34	25.80	0.44
	2022	13.11	16.39	0.24	22.94	0.34	26.42	0.45
	2023	13.11	16.81	0.24	23.53	0.35	27.01	0.46
	2024	13.11	17.23	0.25	24.12	0.36	27.58	0.47
	2025	13.11	17.64	0.25	24.70	0.37	28.13	0.48
	2026	13.11	18.06	0.26	25.26	0.38	28.67	0.49

Table s: China rockfish base case results summary.

Region	Quantity	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
North of 40°10′ N	Landings (mt)	11.63	16.14	16.97	15.37	12.58	16.92	17.71	15.67	9.93	
	Total Est. Catch (mt)	11.34	15.79	16.86	15.42	12.44	16.56	17.51	15.65	10.06	
	Nearshore RF ABC/OFL						116	116	110	110	88
	China contrib. ABC/OFL						11.7	11.7	9.8	9.8	7.2
	Nearshore RF OY/ACL	122	142	142	155	155	99	99	94	94	69
	China contrib. OY/ACL						9.8	9.8	8.2	8.2	6.6
South of 40°10′ N	Landings (mt)	12.74	13.39	15.16	20.15	18.75	15.62	13.79	10.01	11.17	
	Total Est. Catch (mt)	13.60	14.22	16.02	20.98	19.32	16.21	14.13	10.44	11.85	
	Nearshore RF ABC/OFL						1,156	1,145	1,164	1,160	1,313
	China contrib. ABC/OFL						19.8	19.8	16.6	16.6	55.2
	Nearshore RF OY/ACL	615	564	564	650	650	1,001	990	1,005	1,001	1,114
	China contrib. OY/ACL						16.5	16.5	13.8	13.8	50.4
Northern model	(1-SPR)(1-$SPR_{50\%}$)	0.44	0.39	0.47	0.50	0.45	0.56	0.51	0.48	0.53	
	Exploitation rate	0.32	0.28	0.35	0.38	0.33	0.44	0.39	0.35	0.41	
	Age 5+ biomass (mt)	182.55	183.26	183.36	183.25	183.49	182.90	182.72	182.82	182.52	182.58
	Spawning Output	17.9	18.0	18.0	18.0	18.1	18.0	18.0	18.0	17.9	17.9
	95% CI	(8.86-27.03)	(8.94-27.12)	(8.95-27.14)	(8.93-27.13)	(8.96-27.17)	(8.89-27.1)	(8.86-27.08)	(8.87-27.09)	(8.83-27.06)	(8.83-27.07)
	Depletion	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	95% CI	(0.638-0.83)	(0.642-0.833)	(0.643-0.833)	(0.642-0.833)	(0.644-0.834)	(0.64-0.833)	(0.638-0.832)	(0.639-0.833)	(0.637-0.832)	(0.637-0.832)
	Recruits	33.29	33.30	33.30	33.30	33.31	33.30	33.29	33.29	33.29	33.29
	95% CI	(21.33 - 45.24)	(21.35 - 45.25)	(21.35 - 45.26)	(21.35 - 45.26)	(21.35 - 45.26)	(21.34 - 45.25)	(21.33 - 45.25)	(21.33 - 45.25)	(21.33 - 45.25)	(21.33 - 45.25)
Central model	(1-SPR)(1-$SPR_{50\%}$)	0.55	0.62	0.78	0.82	0.78	0.61	0.80	0.85	0.77	
	Exploitation rate	0.40	0.48	0.68	0.73	0.68	0.47	0.72	0.79	0.67	
	Age 5+ biomass (mt)	386.73	388.36	386.42	383.69	382.08	384.10	381.88	378.59	377.54	381.29
	Spawning Output	41	41	41	40	40	40	40	40	40	40
	95% CI	(27.6-53.68)	(27.8-53.9)	(27.57-53.69)	(27.25-53.38)	(27.05-53.2)	(27.29-53.47)	(27.01-53.21)	(26.6-52.82)	(26.45-52.7)	(26.88-53.19)
	Depletion	0.62	0.63	0.62	0.62	0.62	0.62	0.62	0.61	0.61	0.61
	95% CI	(0.551-0.697)	(0.555-0.7)	(0.551-0.698)	(0.545-0.694)	(0.541-0.692)	(0.545-0.695)	(0.54-0.692)	(0.533-0.687)	(0.53-0.686)	(0.538-0.692)
	Recruits	68.27	68.31	68.26	68.20	68.17	68.22	68.17	68.09	68.06	68.15
	95% CI	(54.59 - 81.94)	(54.64 - 81.97)	(54.59 - 81.94)	(54.51 - 81.9)	(54.47 - 81.87)	(54.52 - 81.91)	(54.46 - 81.87)	(54.36 - 81.81)	(54.32 - 81.8)	(54.43 - 81.87)
Southern model	(1-SPR)(1-$SPR_{50\%}$)	1.30	1.18	1.18	1.23	1.35	1.34	1.25	1.20	1.02	
	Exploitation rate	1.50	1.19	1.22	1.35	1.76	1.70	1.41	1.27	0.90	
	Age 5+ biomass (mt)	234.08	241.35	247.83	252.61	253.37	254.50	258.52	263.64	272.36	280.18
	Spawning Output	14	15	16	16	16	16	17	17	18	19
	95% CI	(9.47-19.39)	(10.01-20.34)	(10.46-21.18)	(10.77-21.81)	(10.75-21.97)	(10.73-22.16)	(10.91-22.6)	(11.18-23.15)	(11.73-24.07)	(12.23-24.9)
	Depletion	0.22	0.23	0.24	0.24	0.25	0.25	0.25	0.26	0.27	0.28
	95% CI	(0.164-0.27)	(0.174-0.283)	(0.182-0.294)	(0.187-0.303)	(0.186-0.306)	(0.186-0.309)	(0.189-0.315)	(0.193-0.323)	(0.203-0.336)	(0.211-0.347)
	Recruits	122.32	123.93	125.23	126.13	126.27	126.42	126.99	127.71	128.94	129.99
	95% CI	(105.92 - 138.73)	(107.67 - 140.18)	(109.07 - 141.39)	(109.98 - 142.28)	(109.96 - 142.57)	(109.97 - 142.87)	(110.52 - 143.46)	(111.29 - 144.13)	(112.72 - 145.15)	(113.95 - 146.03)

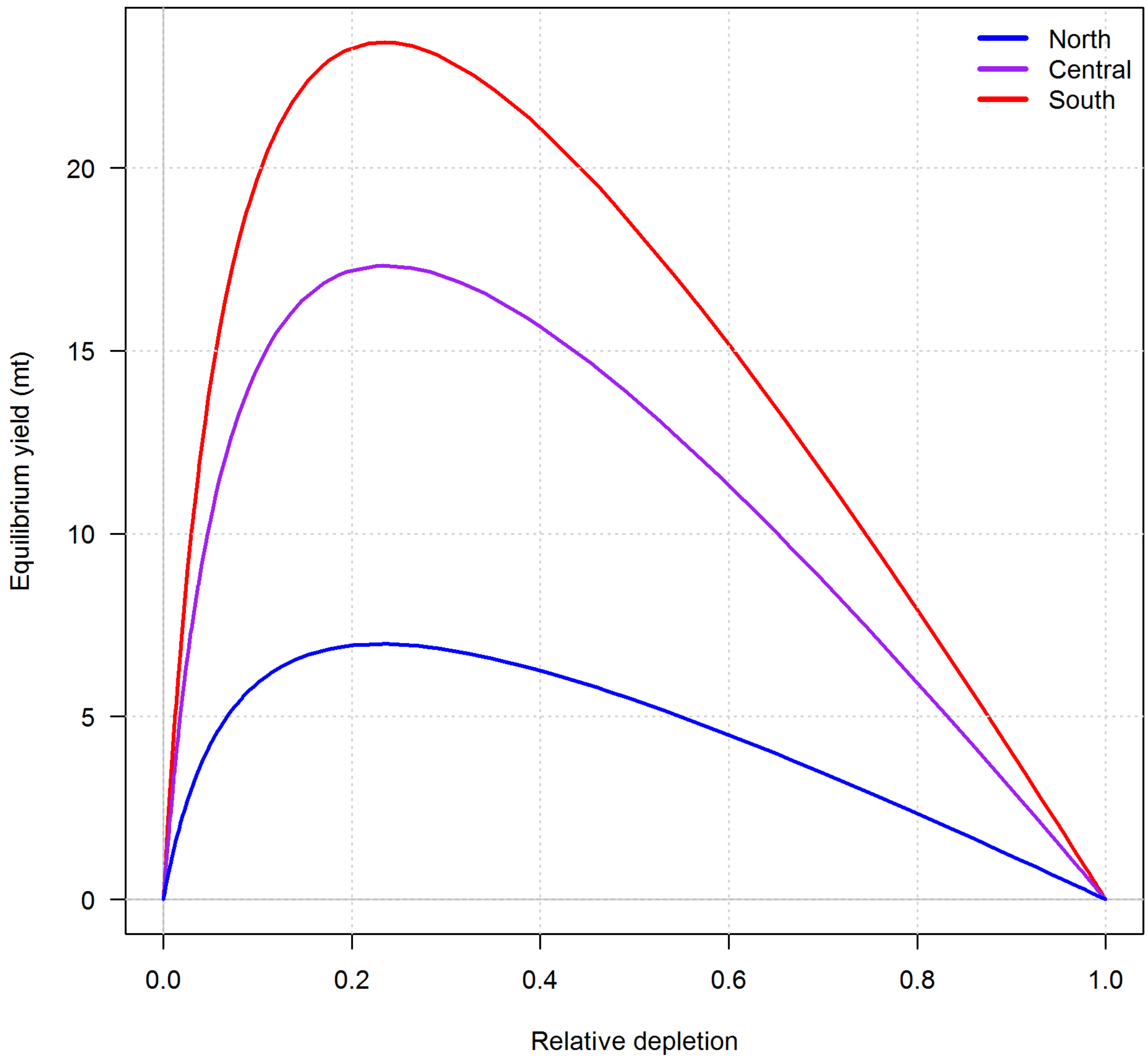

Figure j: Equilibrium yield curve for the base case models. Values are based on the 2014 fishery selectivity and with steepness fixed at 0.773.

Research and data needs

We recommend the following research be conducted before the next assessment:

1. The number of hours fished in Washington should be recorded for each dockside sample (vessel) so that future CPUE can be measured as angler hours rather than just number of anglers per trip. This will allow for a more accurate calculation of effort.

2. The number of hours fished in Oregon should be recorded for each dockside sample (vessel), instead of the start and end times of the entire trip. This will allow for a more accurate calculation of effort.

3. Compare the habitat-based methods used to subset data for the onboard observer indices to Stephens-MacCall and other filtering methods.

4. Explore the sensitivity of Stephens-MacCall when the target species is "rare" or not common encountered in the data samples.

5. A standardized fishery independent survey sampling nearshore rockfish in all three states would provide a more reliable index of abundance than the indices developed from catch rates in recreational and commercial fisheries. However, information value of such surveys would depend on the consistency in methods over time and space and would require many years of sampling before an informative index could be obtained.

6. A coastwide evaluation of genetic structure of China rockfish is a research priority. Genetic samples should be collected at sites spaced regularly along the coast throughout the range of the species to estimate genetic differences at multiple spatial scales (i.e., isolation by distance).

7. Difficulties were encountered when attempting to reconstruct historical recreational catches at smaller spatial scales, and in distinguishing between landings from the private and charter vessels. Improved methods are needed to allocate reconstructed recreational catches to sub-state regions within each fishing mode.

8. There was insufficient time during the STAR Panel review to fully review the abundance indices used in the China rockfish assessments. Consideration should be given to scheduling a data workshop prior to STAR Panel review for review of assessment input data and standardization procedures for indices, potentially for all species scheduled for assessment. The nearshore data workshop, held earlier this year, was a step in this direction, but that meeting did not deal with the modeling part of index development.

9. The Marine Recreational Fisheries Statistics Survey (MRFSS) index in Oregon was excluded from the assessment model because it was learned that multiple intercept interviews were done for a single trip. Evaluate whether database manipulations or some other approach can resolve this issue and allow these data to be used in the assessment.

10. Many of the indices used in the China rockfish assessment model used the Stephens-MacCall (2004) approach to subset the CPUE data. Research is need to evaluate the performance of the method when there are changes in management restrictions and in relative abundance of different species. Examination of the characteristics of trips retained/removed should be a routine part of index standardization, such as an evaluation of whether there are time trends in the proportion of discarded trips.

11. Fishery-dependent CPUE indices are likely to be the only trend information for many nearshore species for the foreseeable future. Indices from a multi-species hook-and-line fishery may be influenced by regulatory changes, such as bag limits, and by interactions with other species (e.g., black rockfish) due to hook competition. It may be possible to address many of these concerns if a multi-species approach is used to develop the indices, allowing potential interactions and common forcing to be evaluated.

12. Consider the development of a fishery-independent survey for nearshore stocks. As the current base model structure has no direct fishery-independent measure of stock trends, any work to commence collection of such a measure for nearshore rockfish, or use of existing data to derive such an index would greatly assist with this assessment.

13. Basic life history research may help to resolve assessment uncertainties regarding appropriate values for natural mortality and steepness.

14. Examine length composition data of discarded fish from recreational onboard observer programs in California and Oregon. Consider modeling discarded catch using selectivity and retention functions in Stock Synthesis rather than combining retained and discarded catch and assuming they have identical size compositions. Another option would be to model discarded recreational catch as a separate fleet, similar to the way commercial discards were treated in the southern model.

15. Ageing data were influential in the China rockfish stock assessments. Collection and ageing of China rockfish otoliths should continue. Samples from younger fish not typically selected by the fishery are needed to better define the growth curve.

16. Consider evaluating depletion estimators of abundance using within season CPUE indices. This approach would require information on total removals on a reef-by-reef basis.

17. The extensive use of habitat information in index development is a strength of the China rockfish assessment. Consideration should be given to how to further incorporate habitat data into the assessment of nearshore species. The most immediate need seems to be to increase the resolution of habitat maps for waters off Oregon and Washington, and standardization of habitat data format among states.

18. Although all the current models for China rockfish estimated implausibly large recruitment deviations when allowed to do so, particularly early in the modeled time period,

further exploration of available options in stock synthesis could produce acceptable results. In addition, this work may provide guidance on any additional options that could be added to stock synthesis to better handle this situation. For example, assuming different levels autocorrelation in the stock-recruit relationship for data-moderate stocks may help curb the tendency to estimate extreme recruitment with sparse datasets.

19. Research is needed on data-weighting methods in stock assessments. In particular, a standard approach for conditional age-at-length data is needed. The Center for the Advancement of Population Assessment Methodology (CAPAM) data weighting workshop, scheduled for later this year, should make important progress on this research need.