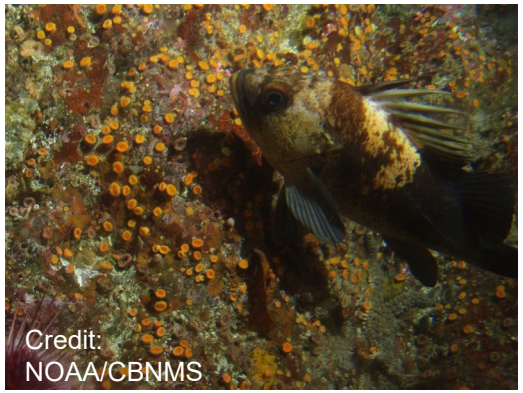
2023 California Quillback Rockfish Rebuilding Analysis

Mop Up Panel
September 26, 2023


Credit:
NOAA/CBNMS

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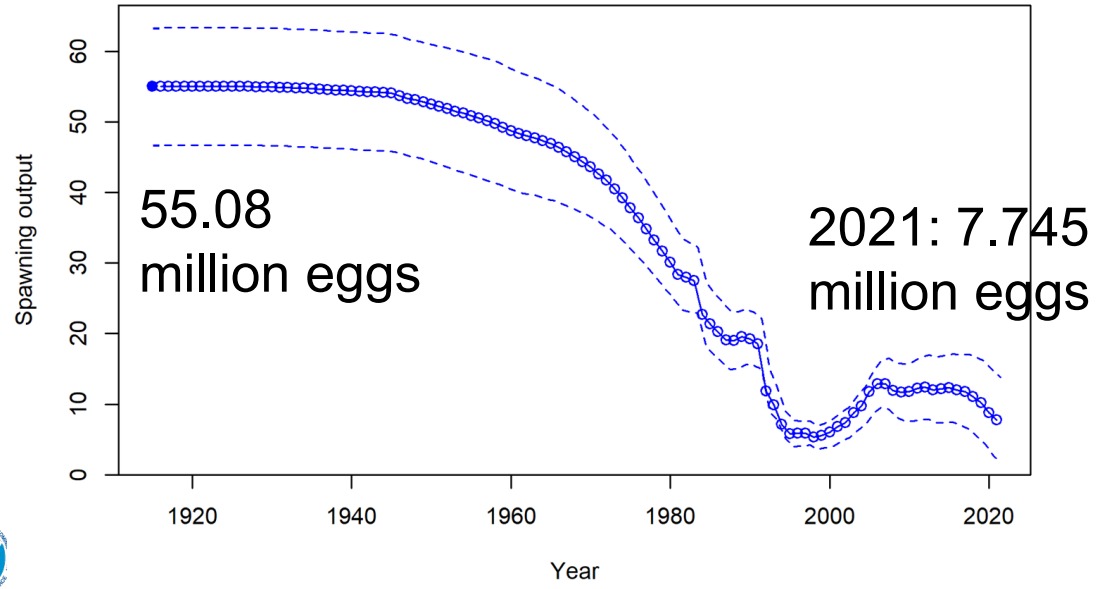
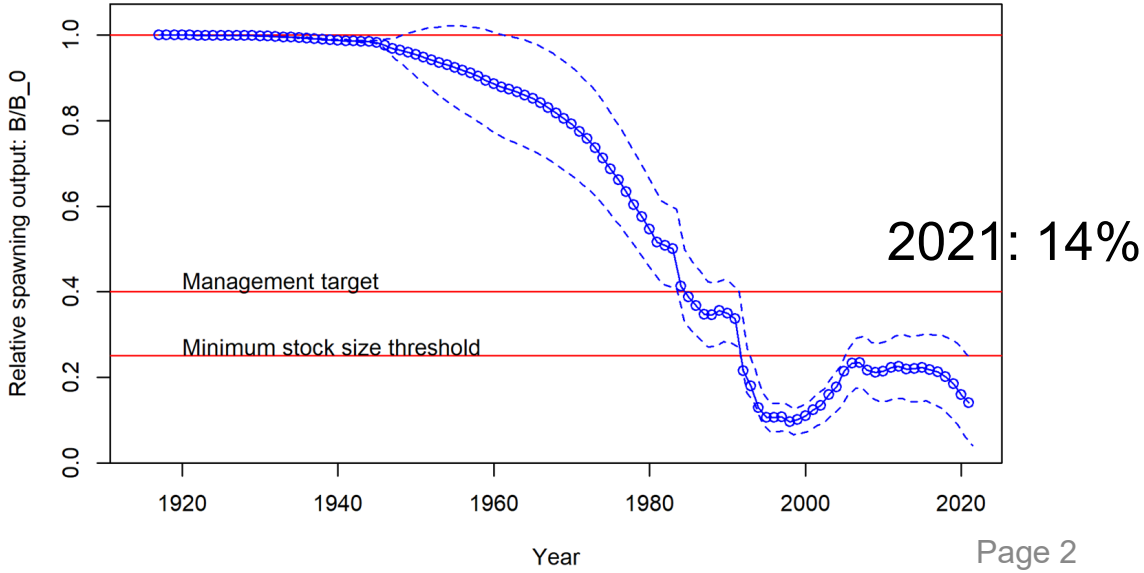
NOAA Fisheries
Northwest Fisheries Science Center

Overview of 2021 CA quillback rockfish stock assessment

- Stock Synthesis model with two fishing fleets (comm, rec)
- Catch + discard, length composition, and biological data
- Estimated stock to be below MSST (14% in 2021)
- Axis of uncertainty based on natural mortality





Rebuilding specifications

- Based on approved 2021 CA base model
- Rebuilding software version 3.12j (December 2021)
- 2021-2024 removals based on GMT provided values or Council requested alternative 2024 value

GMT (**or CDFW**) Provided Values

Year	Commercial (mt)	Recreational (mt)	Total (mt)
2021	5.03	10.55	15.58
2022	8.87	9.24	18.11
2023	7.67	3.45	11.12
2024	7.37	3.25	10.62
2024 alt	**3.82**	**2.50**	**6.32**

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Input changes from 2021 rebuilding analysis

- Harvest strategies start in 2025 instead of in 2023
  - Two additional years of buffers
- Two additional years of fixed removals (2023-2024)
  - Updated removals in 2021-2022 with new values

Assumed Removals in 2021 analysis

Year	Com*	Rec*	Total (mt)
2021	3.32	10.18	**13.50**
2022	2.87	9.02	**11.90**

*Com/Rec values not provided. Total was split by fleet based on the relative Fs averaged over 2017-2019

Assumed Removals in 2023 analysis

Year	Commercial	Recreational	Total (mt)
2021	5.03	10.55	**15.58**
2022	8.87	9.24	**18.11**
2023	7.67	3.45	**11.12**
2024	7.37	3.25	**10.62**
2024 alt	3.82	2.50	**6.32**

Total was split to approximate fleet-specific values as provided

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Rebuilding strategies

Dark text = Specified in the TOR Light text = Additional strategies

1) Eliminate all harvest beginning in the next management cycle (i.e. estimate $T_{F=0}$). Equivalent to setting SPR = 1.0
2) Apply the harvest rate that would generate the ACL contributions specified for the current year (i.e. latest year specified in regulations)
3) Apply the SPR or relevant harvest control rule in the current rebuilding plan
4) Apply the harvest rate that is estimated to lead to a 50% probability of recovery by alternative target years
   a) by the current T_{TARGET}
   b) by T_{MAX} from the previous cycle
   c) by T_{MAX} from the current cycle
   d) by T_{MID} from the current cycle
5) Apply the 40-10 harvest policy based on category 2 σ = 1.0 and P* = 0.45
6) Apply the ABC harvest rate based on category 2 σ = 1.0 and P* = 0.45
7) Apply a range of SPR values (0.5, 0.55, 0.6, 0.65, 0.7, 0.8, 0.9)

Some rebuilding strategies require existing rebuilding plan

Dark text = Specified in the TOR Light text = Additional strategies

1) Eliminate all harvest beginning in the next management cycle (i.e. estimate $T_{F=0}$). Equivalent to setting SPR = 1.0
2) Apply the harvest rate that would generate the ACL contributions specified for the current year (i.e. latest year specified in regulations)
3) ~~Apply the SPR or relevant harvest control rule in the current rebuilding plan~~
4) Apply the harvest rate that is estimated to lead to a 50% probability of recovery by alternative target years
   a) ~~by the current T_{TARGET}~~
   b) ~~by T_{MAX} from the previous cycle~~
   c) by T_{MAX} from the current cycle
   d) by T_{MID} from the current cycle
5) Apply the 40-10 harvest policy based on category 2 σ = 1.0 and P* = 0.45
6) Apply the ABC harvest rate based on category 2 σ = 1.0 and P* = 0.45
7) Apply a range of SPR values (0.5, 0.55, 0.6, 0.65, 0.7, 0.8, 0.9)

No existing rebuilding plan

No existing rebuilding plan that set T_{TARGET} or T_{MAX}

Some rebuilding strategies not possible or are very similar

Dark text = Specified in the TOR Light text = Additional strategies

1) Eliminate all harvest beginning in the next management cycle (i.e. estimate $T_{F=0}$). Equivalent to setting SPR = 1.0
2) ~~Apply the harvest rate that would generate the ACL contributions specified for the current year (i.e. latest year specified in regulations)~~ **Would require SPR < 0.5**
3) ~~Apply the SPR or relevant harvest control rule in the current rebuilding plan~~
4) Apply the harvest rate that is estimated to lead to a 50% probability of recovery by alternative target years
   a) ~~by the current T_{TARGET}~~
   b) ~~by T_{MAX} from the previous cycle~~
   c) ~~by T_{MAX} from the current cycle~~ ← **Nearly identical to SPR = 0.5 strategy so results not shown**
   d) by T_{MID} from the current cycle
5) Apply the 40-10 harvest policy based on category 2 σ = 1.0 and P* = 0.45
6) Apply the ABC harvest rate based on category 2 σ = 1.0 and P* = 0.45
7) Apply a range of SPR values (0.5, 0.55, 0.6, 0.65, 0.7, 0.8, 0.9)

Rebuilding strategies in report

Dark text = Specified in the TOR Light text = Additional strategies

1) Eliminate all harvest beginning in the next management cycle (i.e. estimate $T_{F=0}$). Equivalent to setting SPR = 1.0
2) ~~Apply the harvest rate that would generate the ACL contributions specified for the current year (i.e. latest year specified in regulations)~~
3) ~~Apply the SPR or relevant harvest control rule in the current rebuilding plan~~
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   a) ~~by the current T_{TARGET}~~
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7) Apply a range of SPR values (0.5, 0.55, 0.6, 0.65, 0.7, 0.8, 0.9)

Including uncertainty within analysis

- All runs assume full attainment of the estimated catch corresponding to the specified harvest rate
- Each run incorporates random future recruitment strength
- Runs include uncertainty in starting values based on M states of nature from 2021 assessment
  - 25% of simulations from low state (M = 0.0464)
  - 50% of simulations from base (M = 0.057)
  - 25% of simulations from high state (M = 0.0744)

Rebuilding reference points

Table 1: Summary of the rebuilding reference points.

Quantity	2021 Assessment Values
SB_0 (millions of eggs)	55.08
$SB_{40\%}$ (millions of eggs)	22.03
SB_{2021} (millions of eggs)	7.75
Year rebuilding begins	2025
Current year	2021
T_{MIN}	2045
Mean generation time (years)	26
T_{MAX}	2071
T_{MID}	2058
$T_{F=0}$	2045
T_{TARGET}	TBD
SPR_{TARGET}	TBD
Current SPR (2021)	0.1

Rebuilding strategies

Table 2: Results of rebuilding strategies based on alternative SPR targets for 50 percent probability of recovery based on the assumed removals for 2021–2024. SPR for the ABC and 40-10 strategies is provided as a dash (-) because these strategies do not have a constant SPR value.

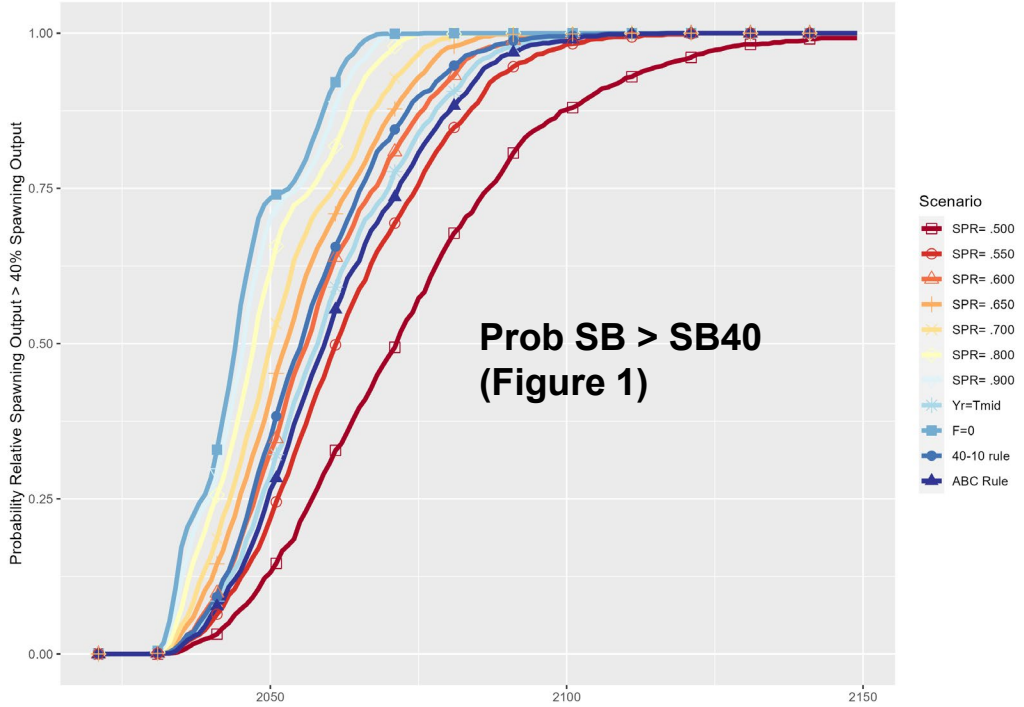
Decreasing fishing pressure →

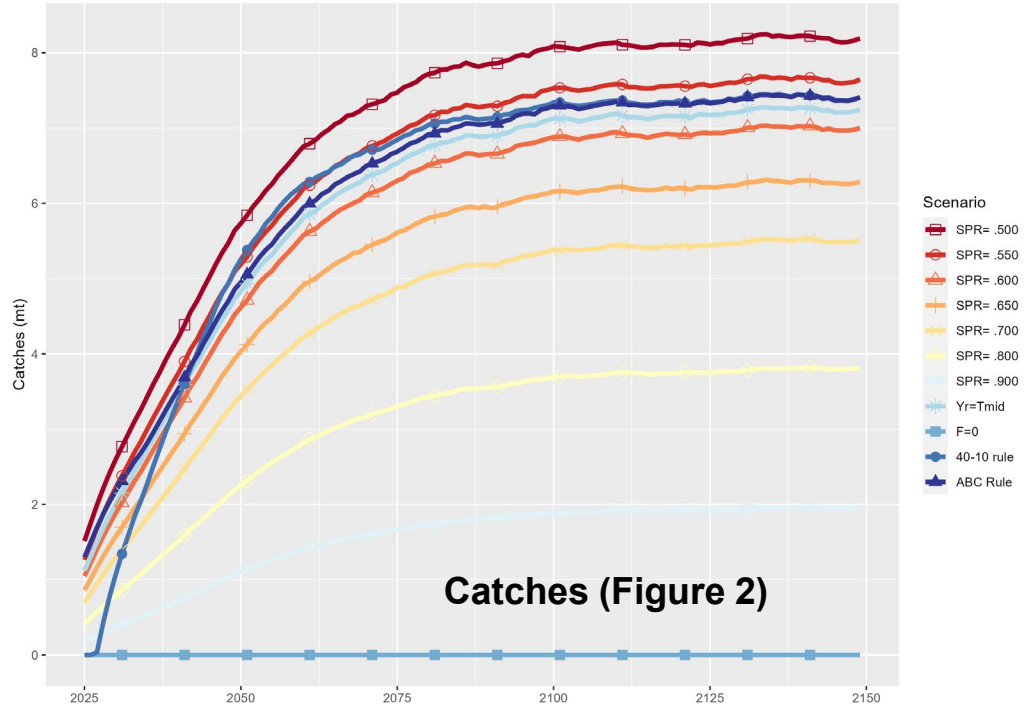
No fishing ↓

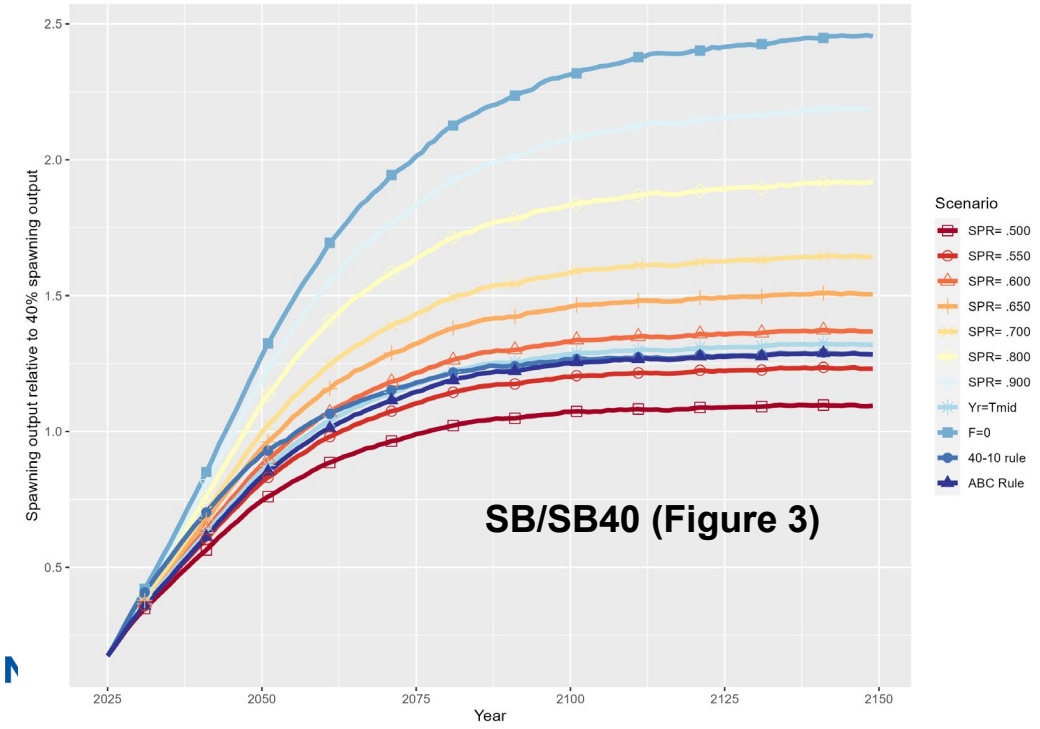
Quantity	SPR= .500	SPR= .550	SPR= .600	SPR= .650	SPR= .700	SPR= .800	SPR= .900	Yr= T_{MID}	F=0	40-10 rule	ABC Rule
2021 Assumed Removals (mt)	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58
2022 Assumed Removals (mt)	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11
2023 Assumed Removals (mt)	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12
2024 Assumed Removals (mt)	10.62	10.62	10.62	10.62	10.62	10.62	10.62	10.62	10.62	10.62	10.62
2025 ACL (mt)	1.51	1.26	1.05	0.86	0.69	0.41	0.19	1.12	0	0	1.3
2026 ACL (mt)	1.76	1.47	1.23	1.01	0.82	0.49	0.22	1.31	0	0	1.5
SPR	0.5	0.55	0.6	0.65	0.7	0.8	0.9	0.58	1	-	-
T_{TARGET}	2072	2062	2057	2053	2051	2048	2046	2058	2045	2056	2060
T_{MAX}	2071	2071	2071	2071	2071	2071	2071	2071	2071	2071	2071
Probability of recovery by T_{MAX}	0.494	0.694	0.809	0.878	0.928	0.979	0.999	0.777	0.999	0.845	0.736

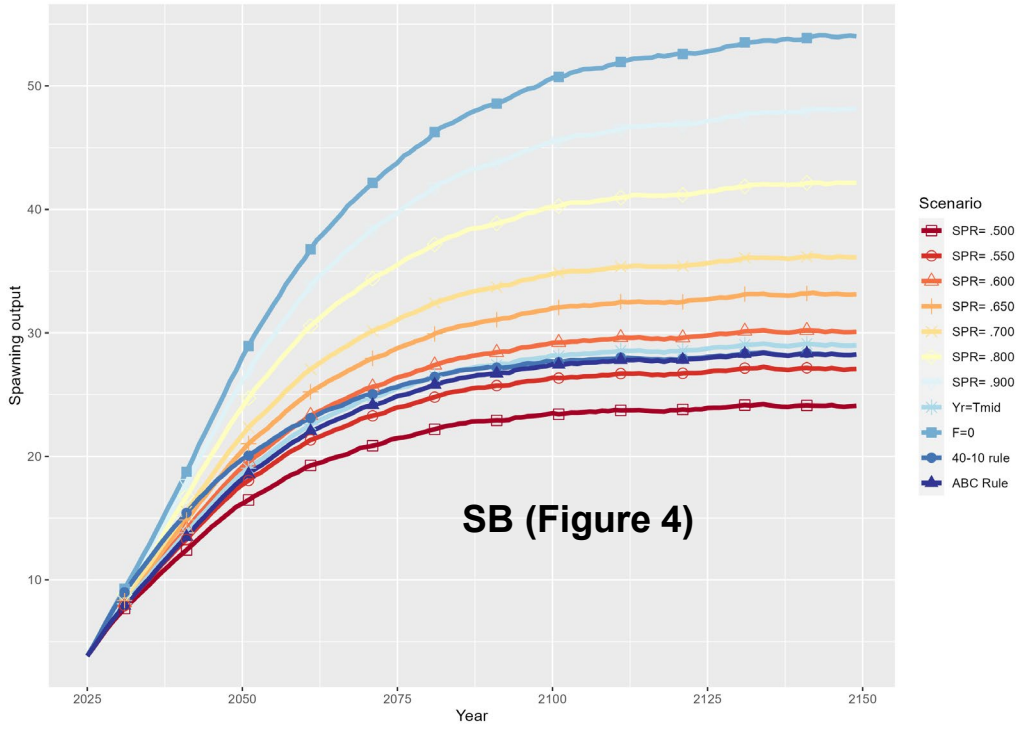
Fixed removals

- Time series of quantities in Table 3-6, Figures 1-4


Probability Relative Spawning Output > 40% Spawning Output
1.00
0.75
0.50
0.25
0.00
2050
2100
2150
Prob SB > SB40
(Figure 1)
Scenario
SPR= .500
SPR= .550
SPR= .600
SPR= .650
SPR= .700
SPR= .800
SPR= .900
Yr=Tmid
F=0
40-10 rule
ABC Rule


Catches (mt)
8
6
4
2
0
2025
2050
2075
2100
2125
2150
Catches (Figure 2)
Scenario
SPR= .500
SPR= .550
SPR= .600
SPR= .650
SPR= .700
SPR= .800
SPR= .900
Yr=Tmid
F=0
40-10 rule
ABC Rule


Spawning output relative to 40% spawning output
2.5
2.0
1.5
1.0
0.5
2025
2050
2075
2100
2125
2150
Year
SB/SB40 (Figure 3)
Scenario
SPR= .500
SPR= .550
SPR= .600
SPR= .650
SPR= .700
SPR= .800
SPR= .900
Yr=Tmid
F=0
40-10 rule
ABC Rule


Spawning output
50
40
30
20
10
2025
2050
2075
2100
2125
2150
Year
SB (Figure 4)
Scenario
SPR= .500
SPR= .550
SPR= .600
SPR= .650
SPR= .700
SPR= .800
SPR= .900
Yr=Tmid
F=0
40-10 rule
ABC Rule

Comparison To Alternative Analysis With Different 2024 Removals

Council request: Analysis using alternative value for 2024 total removals

- Repeat rebuilding analysis making single change to 2024 total removal value (6.32 mt) from original value (10.62 mt)

- Results are similar to those using original value
  - T_{MIN} and T_{MAX} occur 1 year sooner
  - 2025 and 2026 estimated catches at most 0.17 mt greater

Reference points comparison

Original 2024 Value (10.62 mt)

Quantity	2021 Assessment Values
SB_0 (millions of eggs)	55.08
$SB_{40\%}$ (millions of eggs)	22.03
SB_{2021} (millions of eggs)	7.75
Year rebuilding begins	2025
Current year	2021
T_{MIN}	2045
Mean generation time (years)	26
T_{MAX}	2071
T_{MID}	2058
$T_{F=0}$	2045
T_{TARGET}	TBD
SPR_{TARGET}	TBD
Current SPR (2021)	0.1

1 year differences

Alternative 2024 Value (6.32 mt)

Quantity	2021 Assessment Values
SB_0 (millions of eggs)	55.08
$SB_{40\%}$ (millions of eggs)	22.03
SB_{2021} (millions of eggs)	7.75
Year rebuilding begins	2025
Current year	2021
T_{MIN}	2044
Mean generation time (years)	26
T_{MAX}	2070
T_{MID}	2057
$T_{F=0}$	2044
T_{TARGET}	TBD
SPR_{TARGET}	TBD
Current SPR (2021)	0.1

Rebuilding strategies comparison

Original

	SPR= .500	SPR= .550	SPR= .600	SPR= .650	SPR= .700	SPR= .800	SPR= .900	Yr= T_{MID}	F=0	40-10 rule	ABC Rule
2021 Assumed Removals (mt)	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58
2022 Assumed Removals (mt)	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11
2023 Assumed Removals (mt)	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12
2024 Assumed Removals (mt)	10.62	10.62	10.62	10.62	10.62	10.62	10.62	10.62	10.62	10.62	10.62
2025 ACL (mt)	1.51	1.26	1.05	0.86	0.69	0.41	0.19	1.12	0	0	1.3
2026 ACL (mt)	1.76	1.47	1.23	1.01	0.82	0.49	0.22	1.31	0	0	1.5
SPR	0.5	0.55	0.6	0.65	0.7	0.8	0.9	0.58	1	-	-
T_{TARGET}	2072	2062	2057	2053	2051	2048	2046	2058	2045	2056	2060
T_{MAX}	2071	2071	2071	2071	2071	2071	2071	2071	2071	2071	2071
Probability of recovery by T_{MAX}	0.494	0.694	0.809	0.878	0.928	0.979	0.999	0.777	0.999	0.845	0.736

Alternative

	SPR= .500	SPR= .550	SPR= .600	SPR= .650	SPR= .700	SPR= .800	SPR= .900	Yr= T_{MID}	F=0	40-10 rule	ABC Rule
2021 Assumed Removals (mt)	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58
2022 Assumed Removals (mt)	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11	18.11
2023 Assumed Removals (mt)	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12
2024 Assumed Removals (mt)	6.32	6.32	6.32	6.32	6.32	6.32	6.32	6.32	6.32	6.32	6.32
2025 ACL (mt)	1.68	1.4	1.16	0.95	0.77	0.46	0.21	1.24	0	0	1.44
2026 ACL (mt)	1.92	1.61	1.34	1.11	0.9	0.54	0.25	1.43	0	0	1.64
SPR	0.5	0.55	0.6	0.65	0.7	0.8	0.9	0.58	1	-	-
T_{TARGET}	2070	2061	2056	2052	2050	2047	2045	2057	2044	2055	2059
T_{MAX}	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070	2070
Probability of recovery by T_{MAX}	0.5	0.709	0.827	0.894	0.943	0.991	0.999	0.8	0.999	0.857	0.766

Future ACL contributions and probabilities are higher for alternative due to lower 2024 removal (Difference in ACL contributions of no more than 0.17 mt Difference in probability of no more than 3%)

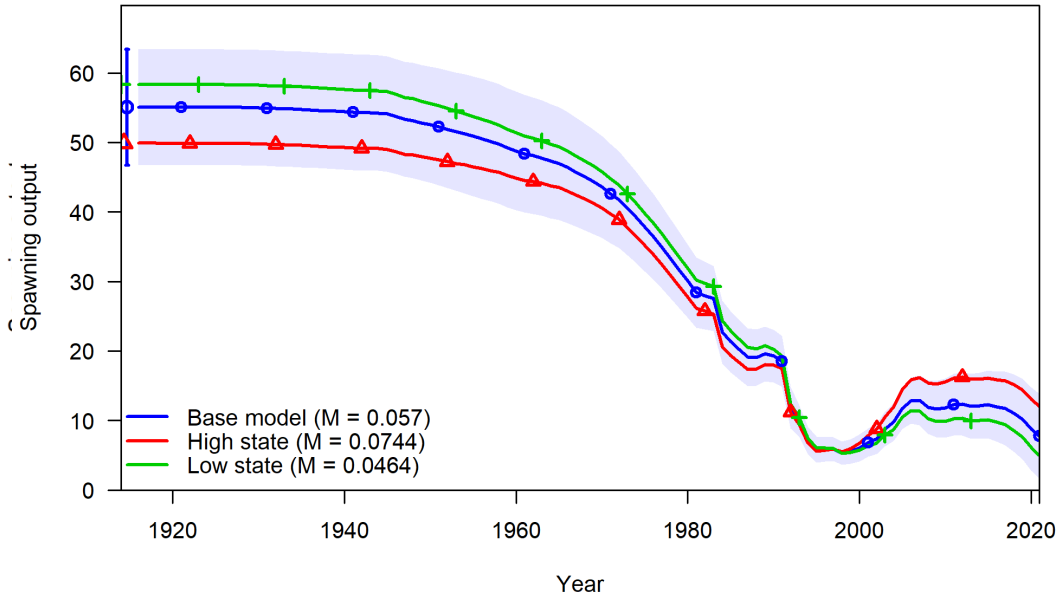
T_{TARGET} is 1-2 years earlier

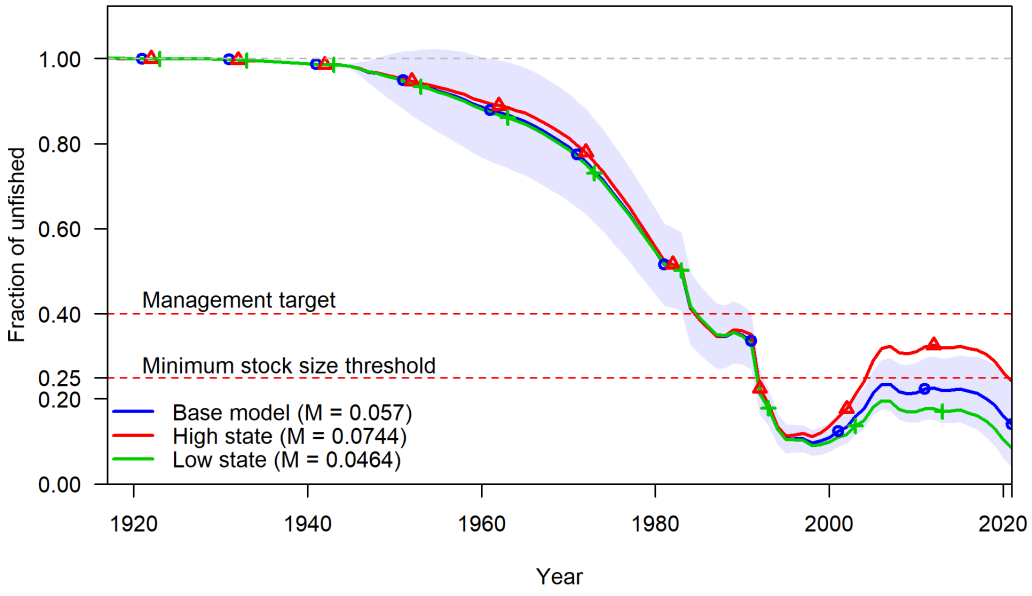
Questions/Comments?

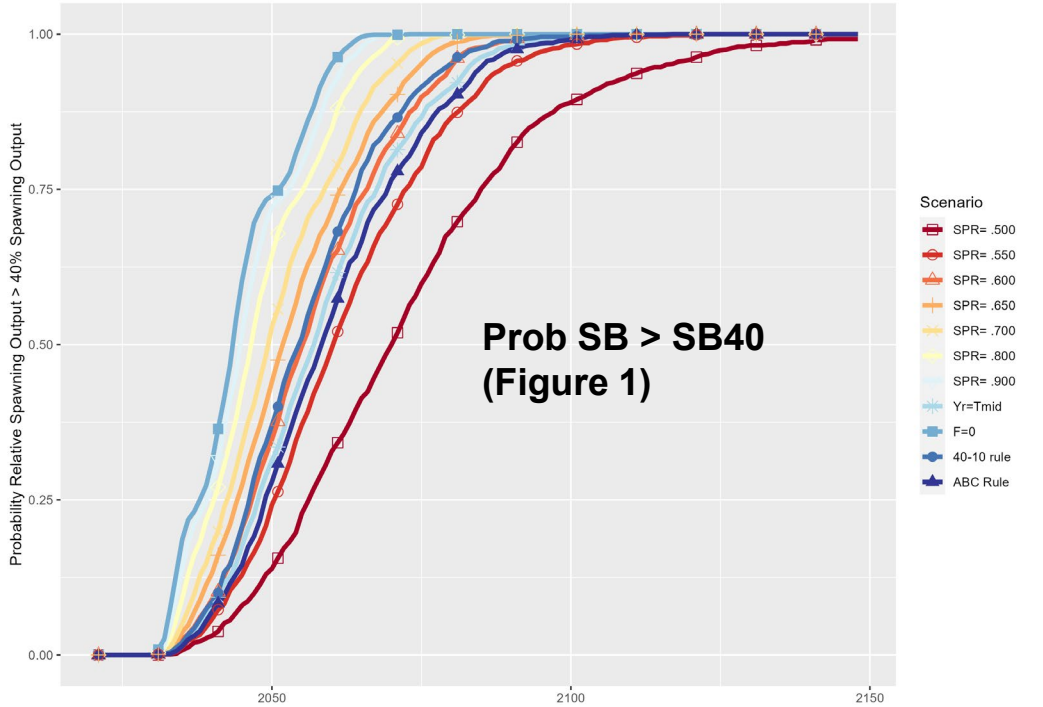
Extra slides

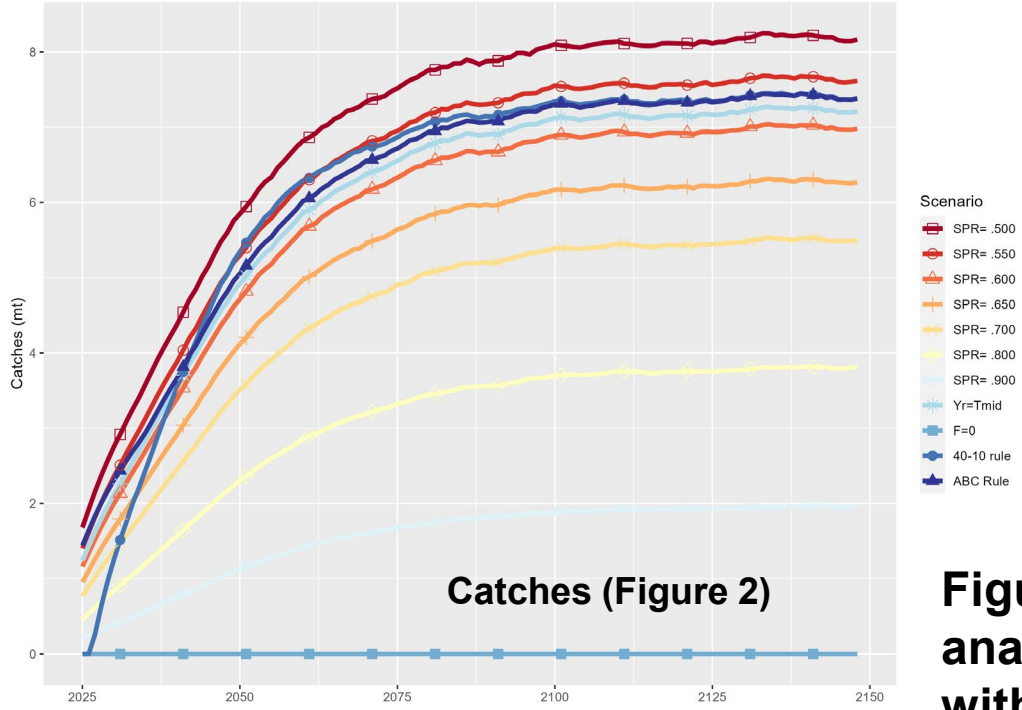
Overview of 2021 CA quillback rockfish stock assessment

- Single-sex Stock Synthesis model with two fishing fleets
- Use catch, discard, length composition, and biological data
- Estimate stock to be below MSST (14% in 2021)
- Axis of uncertainty based on natural mortality









Figures for analysis with alternative 2024 value (6.32 mt)