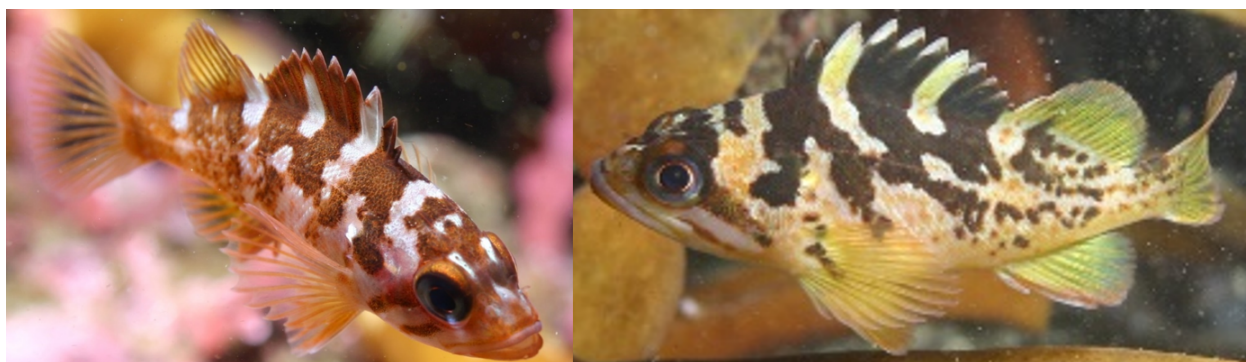


1 Status of Gopher Rockfish (*Sebastes*
2 *carnatus*) and Black-and-Yellow Rockfish
3 (*Sebastes chrysomelas*) Off the California
4 Coast in 2019



7 Gopher rockfish (left) and black-and-yellow rockfish (right). Photos courtesy Steve Lonhart.

8 Melissa H. Monk¹
9 Xi He¹

10 ¹Southwest Fisheries Science Center, U.S. Department of Commerce, National Oceanic and
11 Atmospheric Administration, National Marine Fisheries Service, 110 McAllister Way, Santa Cruz,
12 California 95060

13 DRAFT SAFE

14 Disclaimer: This information is distributed solely for the purpose of pre-dissemination peer review
15 under applicable information quality guidelines. It has not been formally disseminated by NOAA
16 Fisheries. It does not represent and should not be construed to represent any agency
17 determination or policy.

18 2019-05-31

20 Status of Gopher Rockfish (*Sebastes*
21 *carnatus*) and Black-and-Yellow Rockfish
22 (*Sebastes chrysomelas*) Off the California
23 Coast in 2019

24 **Contents**

25	Executive Summary	i
26	Stock	i
27	Catches	i
28	Data and Assessment	vi
29	Stock Biomass	viii
30	Recruitment	xi
31	Exploitation status	xiii
32	Ecosystem Considerations	xv
33	Reference Points	xv
34	Management Performance	xvi
35	Unresolved Problems and Major Uncertainties	xvi
36	Decision Table	xvii
37	Research and Data Needs	xxi

38 **References**

Executive Summary

executive-summary

Stock

stock

This assessment reports the status of the GBY rockfish (*Sebastes carnatus*/*Sebastes chrysomelas*) resource in U.S. waters off the coast of ... using data through 2018.

Catches

catches

Information on historical landings of GBY rockfish are available back to xxxx... (Table [a](#)). Commercial landings were small during the years of World War II, ranging between 4 to 27 metric tons (mt) per year.

(Figures [a-b](#))

(Figure [c](#))

Since 2000, annual total landings of GBY rockfish have ranged between 69-159 mt, with landings in 2018 totaling 93 mt.

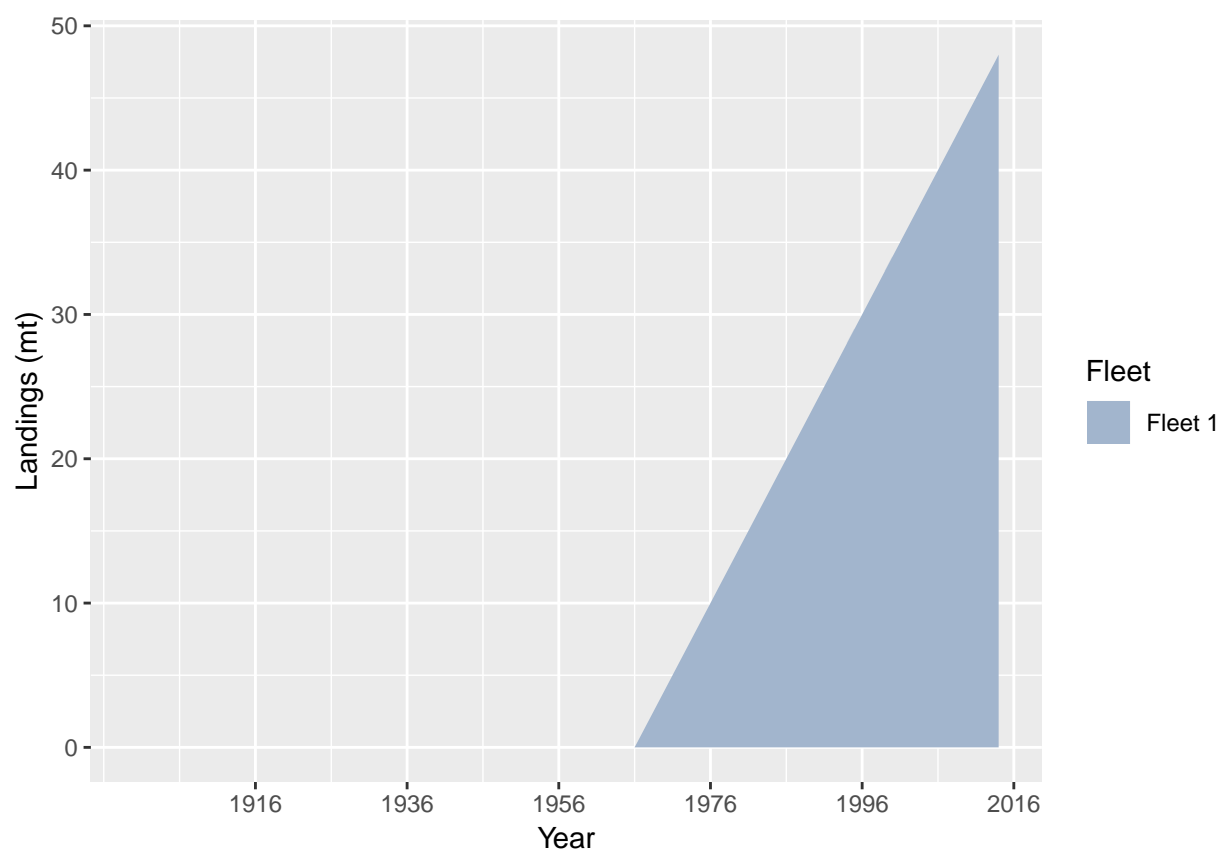


Figure a: GBY rockfish catch history for the recreational fleets. fig:Exec_catch1

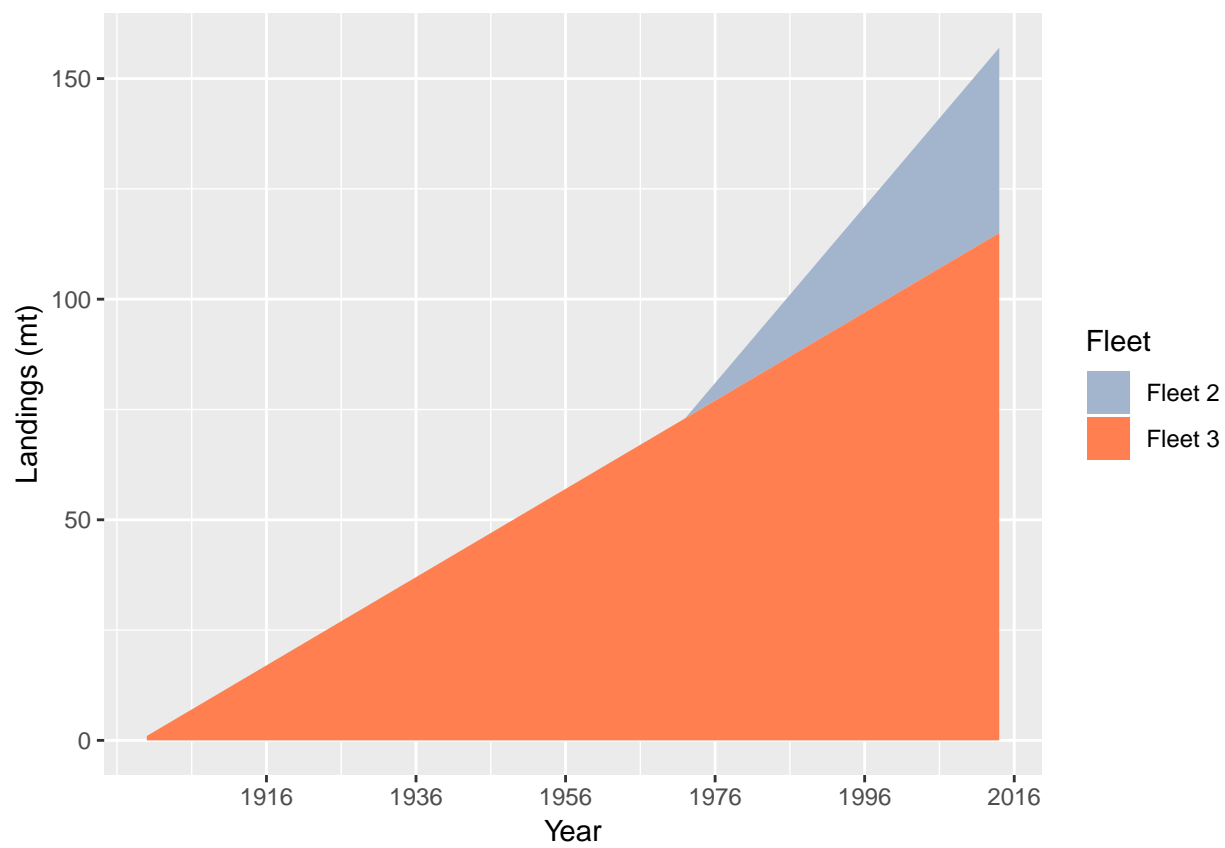


Figure b: Stacked line plot of GBY rockfish catch history for the commercial fleets. fig:Exec_catch2

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

Year	Landings 1	Landings 2	Landings 3	Landings 4	<u>tab:Exec_catch</u>	
					Landings 5	Total
2005	-	-	-	-	-	-
2006	-	-	-	-	-	-
2007	-	-	-	-	-	-
2008	-	-	-	-	-	-
2009	-	-	-	-	-	-
2010	-	-	-	-	-	-
2011	-	-	-	-	-	-
2012	-	-	-	-	-	-
2013	-	-	-	-	-	-
2014	-	-	-	-	-	-

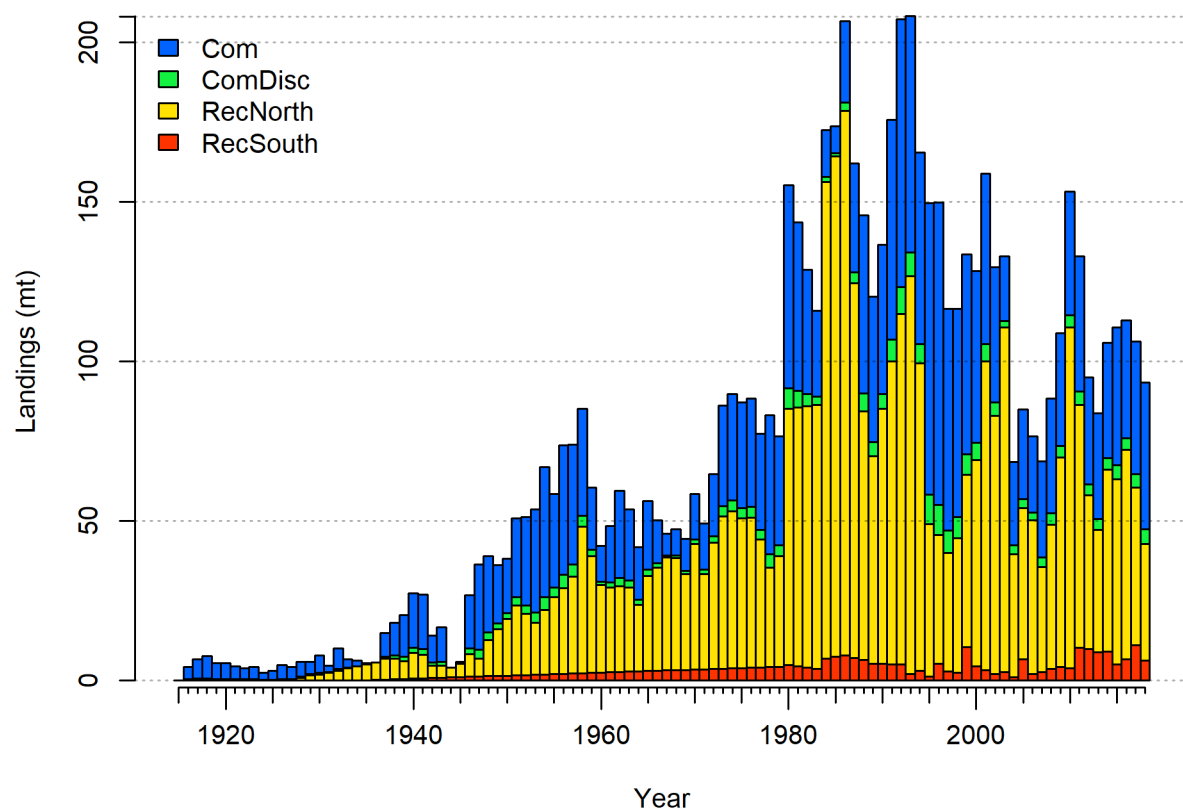


Figure c: Catch history of GBY rockfish in the model. ^{fig:r4ss_catches}

51 **Data and Assessment**

data-and-assessment

52 This a new full assessment for GBY rockfish, which was last assessed in ... using Stock
53 Synthesis Version xx. This assessment uses the newest version of Stock Synthesis (3.30.xx).
54 The model begins in 1916, and assumes the stock was at an unfished equilibrium that year.
55 (Figure [d](#)).

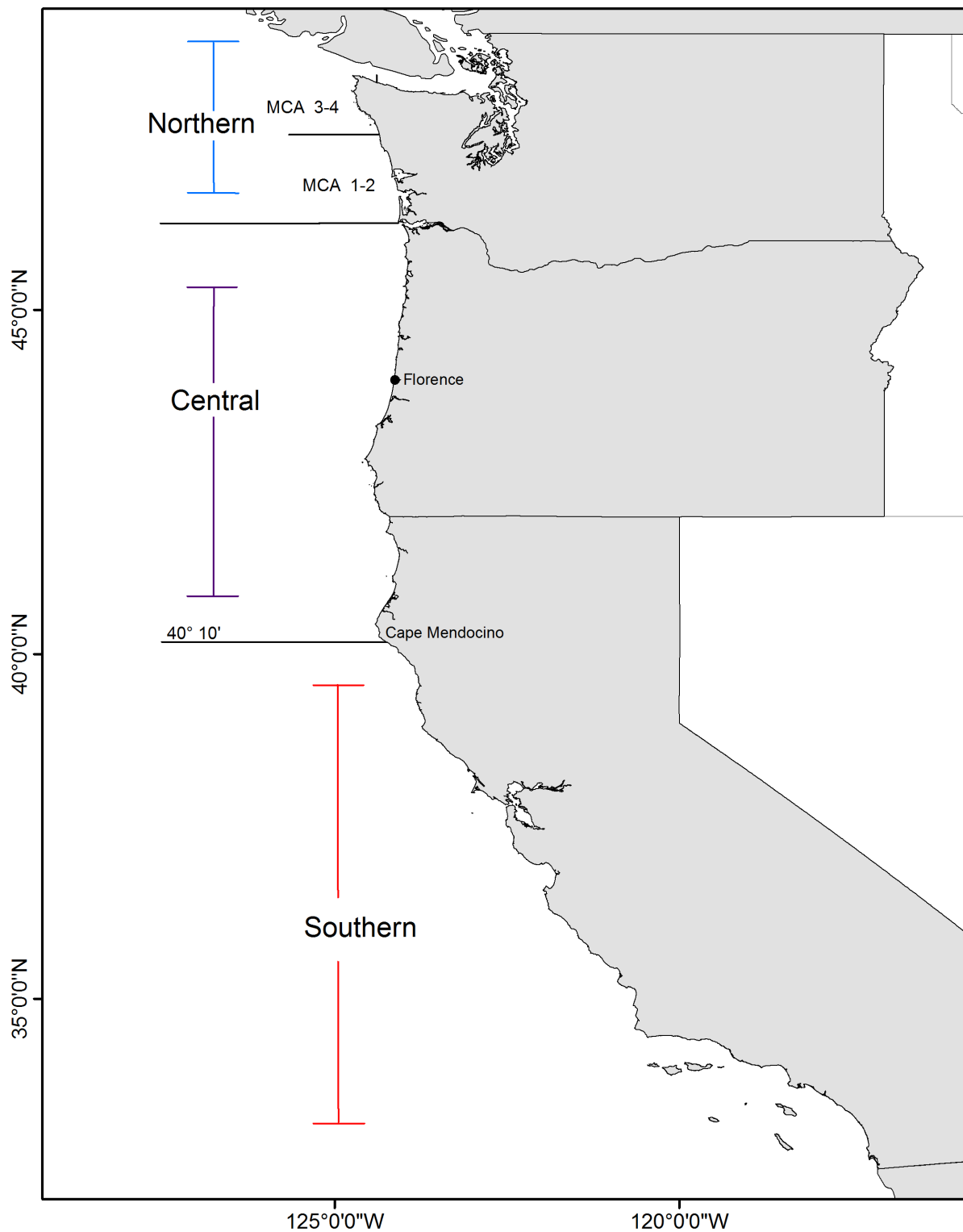


Figure d: Map depicting the distribution of California scorpionfish out to 600 ft. The stock assessment is bounded at Pt. Conception in the north to the U.S./Mexico border in the south.
 fig:assess_region_map

57 (Figure e and Table b).

58 The 2018 estimated spawning biomass relative to unfished equilibrium spawning biomass is
59 above the target of 40% of unfished spawning biomass at 45.1% (95% asymptotic interval: \pm
60 28.9%-61.3%) (Figure f). Approximate confidence intervals based on the asymptotic variance
61 estimates show that the uncertainty in the estimated spawning biomass is high.

Table b: Recent trend in beginning of the year spawning output and depletion for the model for GBY rockfish.

tab:SpawningDeplete_mod1				
Year	Spawning Output (million eggs)	~ 95% confidence interval	Estimated depletion	~ 95% confidence interval
2010	864.575	(604.3-1124.85)	0.650	(0.515-0.786)
2011	795.859	(549.68-1042.04)	0.599	(0.471-0.726)
2012	741.221	(507.57-974.88)	0.558	(0.437-0.678)
2013	711.779	(487.79-935.76)	0.535	(0.421-0.65)
2014	691.107	(474.44-907.77)	0.520	(0.41-0.63)
2015	661.019	(449.78-872.25)	0.497	(0.39-0.604)
2016	634.707	(425.9-843.51)	0.477	(0.371-0.584)
2017	612.729	(404.15-821.3)	0.461	(0.353-0.569)
2018	599.056	(389.03-809.08)	0.451	(0.34-0.561)
2019	599.431	(397.31-801.55)	0.451	(0.289-0.613)

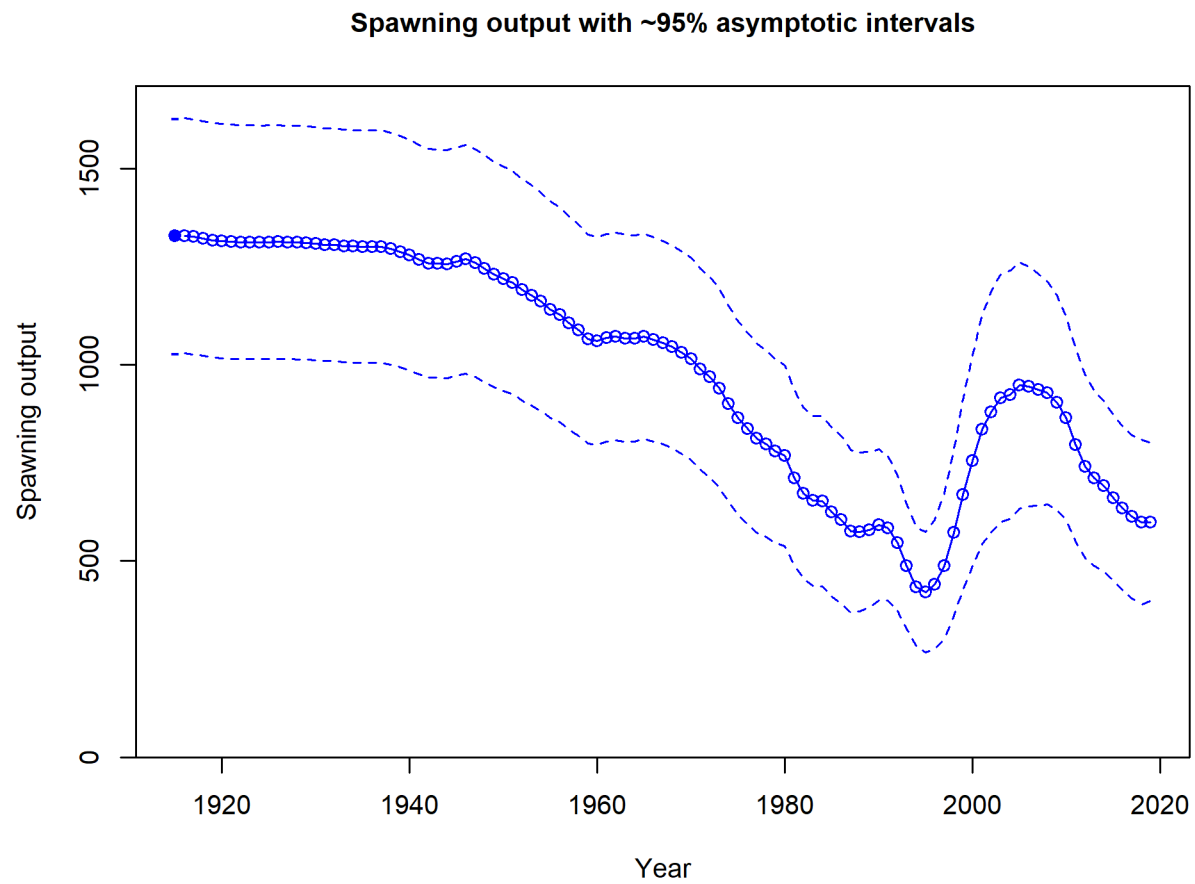


Figure e: Time series of spawning biomass trajectory (circles and line: median; light broken lines: 95% credibility intervals) for the base case assessment model. fig:Spawnbi8_all

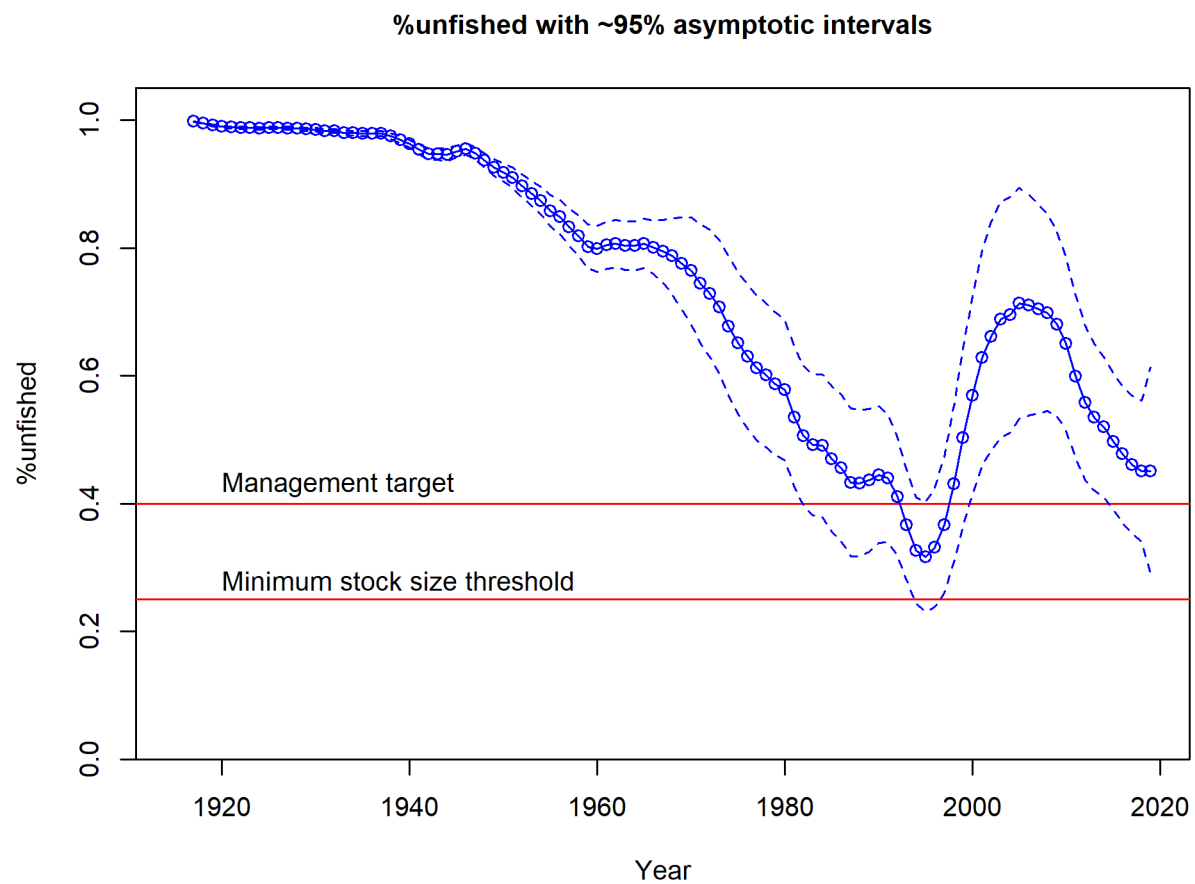


Figure f: Estimated percent depletion with approximate 95% asymptotic confidence intervals (dashed lines) for the base case assessment model. fig:RelDeplete_all

62 **Recruitment**

recruitment

63 Recruitment deviations were estimated from xxxx-xxxx (Figure g and Table c).

Table c: Recent recruitment for the model.

tab:Recruit_mod1		
Year	Estimated Recruitment (1,000s)	~ 95% confidence interval
2010	3218.83	(1410.42 - 7345.97)
2011	2746.99	(1180.57 - 6391.77)
2012	2631.66	(1126.64 - 6147.16)
2013	2767.28	(1179.6 - 6491.88)
2014	3916.77	(1632.26 - 9398.66)
2015	5510.34	(2305.44 - 13170.55)
2016	4079.14	(1645.01 - 10115.07)
2017	3360.32	(1372 - 8230.16)
2018	2968.86	(1262.36 - 6982.25)
2019	3352.25	(1373.02 - 8184.58)

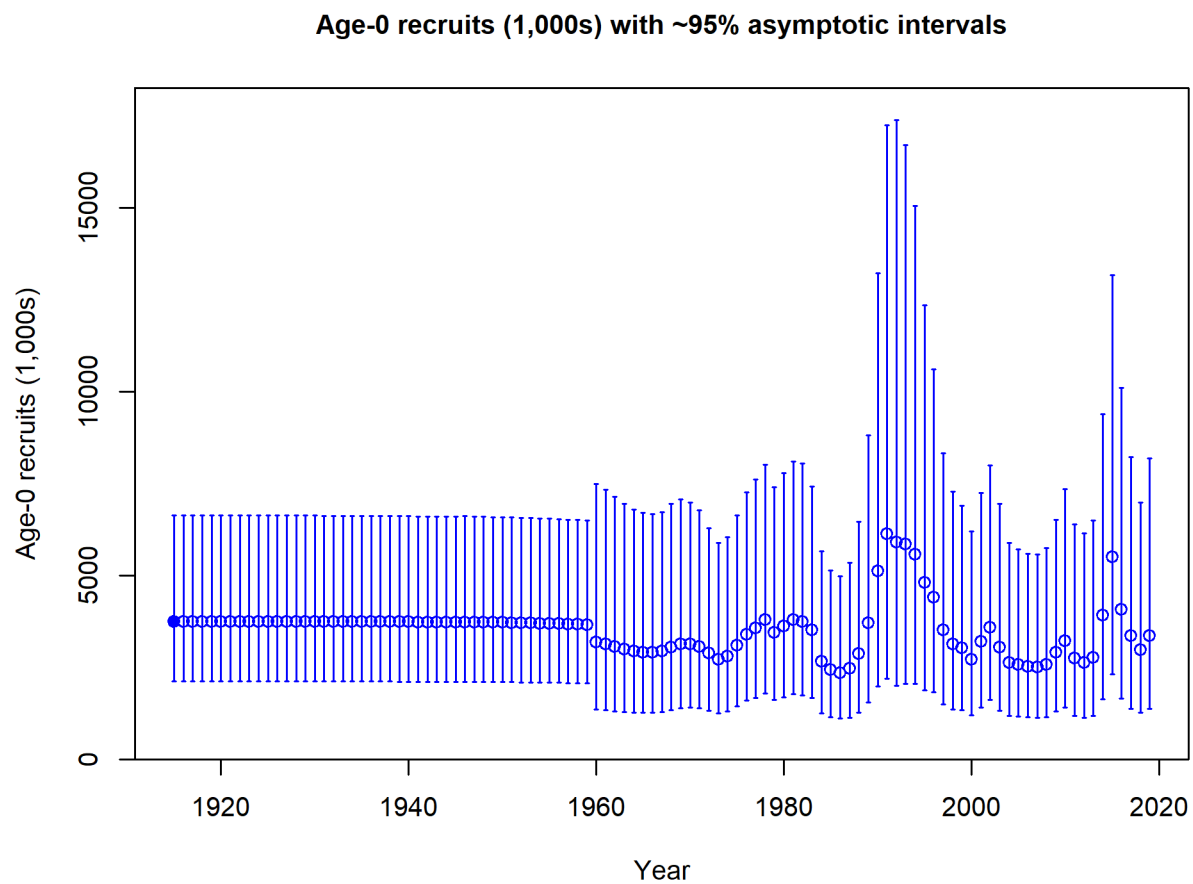


Figure g: Time series of estimated GBY rockfish recruitments for the base-case model with 95% confidence or credibility intervals. `fig:Recruits_all`

64 **Exploitation status**

exploitation-status

65 Harvest rates estimated by the base model management target levels (Table d and
66 Figure h).

Table d: Recent trend in spawning potential ratio and exploitation for GBY rockfish in the model. Fishing intensity is $(1-SPR)$ divided by 50% (the SPR target) and exploitation is F divided by F_{SPR} .

tab:SPR_Exploit_mod1				
Year	Fishing intensity	~ 95% confidence interval	Exploitation rate	~ 95% confidence interval
2009	0.67	(0.49-0.85)	0.08	(0.06-0.1)
2010	0.82	(0.63-1.02)	0.11	(0.08-0.15)
2011	0.81	(0.61-1.01)	0.11	(0.08-0.14)
2012	0.71	(0.52-0.9)	0.08	(0.06-0.1)
2013	0.67	(0.49-0.86)	0.07	(0.05-0.09)
2014	0.78	(0.58-0.97)	0.09	(0.07-0.12)
2015	0.81	(0.61-1.01)	0.10	(0.07-0.13)
2016	0.85	(0.64-1.05)	0.10	(0.07-0.13)
2017	0.85	(0.64-1.06)	0.10	(0.06-0.13)
2018	0.81	(0.6-1.02)	0.08	(0.05-0.11)

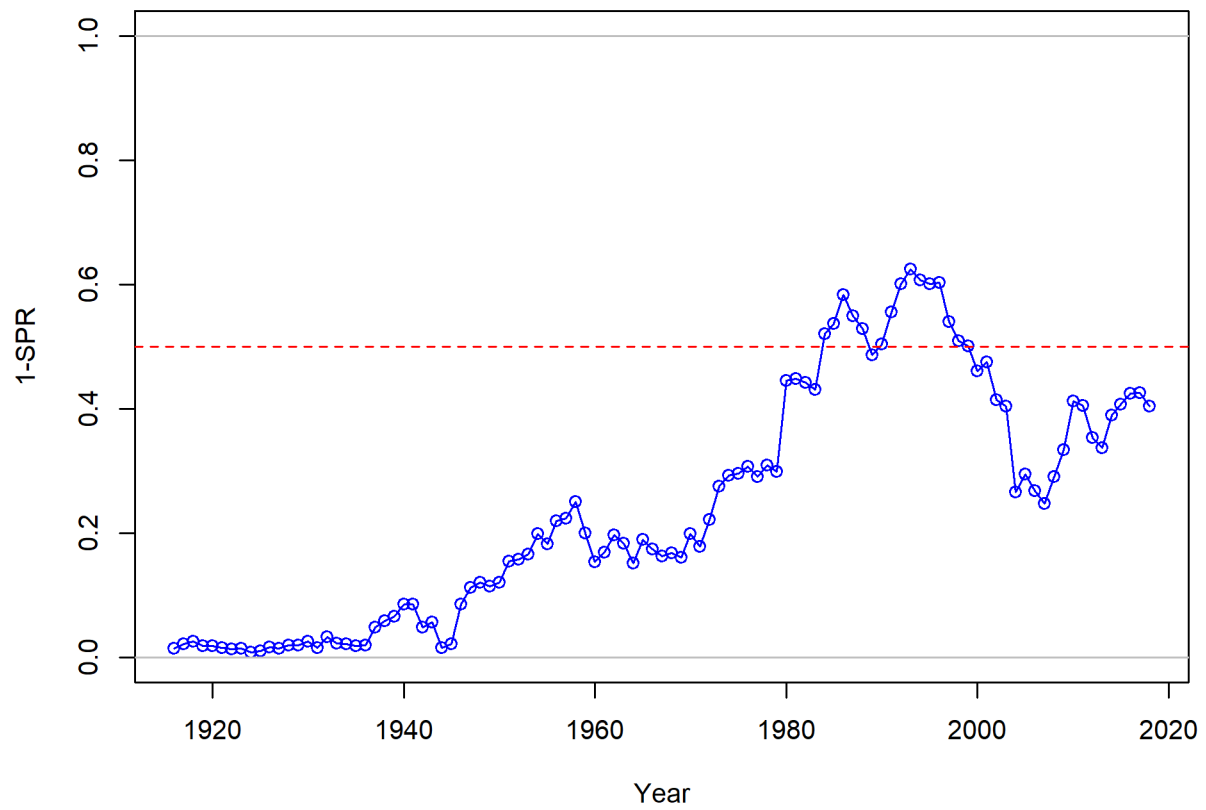


Figure h: Estimated spawning potential ratio (SPR) for the base-case model. One minus SPR is plotted so that higher exploitation rates occur on the upper portion of the y-axis. The management target is plotted as a red horizontal line and values above this reflect harvests in excess of the overfishing proxy based on the $SPR_{50\%}$ harvest rate. The last year in the time series is 2018. fig:SPR_all

Ecosystem Considerations

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.

Reference Points

reference-points

This stock assessment estimates that GBY rockfish in the model is above the biomass target ($SB_{40\%}$), and well above the minimum stock size threshold ($SB_{25\%}$). The estimated relative depletion level for the base model in 2019 is 45.1% (95% asymptotic interval: $\pm 28.9\%$ -61.3%, corresponding to an unfished spawning biomass of 599.431 million eggs (95% asymptotic interval: 397.31-801.55 million eggs) of spawning biomass in the base model (Table e). Unfished age 1+ biomass was estimated to be 1,969 mt in the base case model. The target spawning biomass ($SB_{40\%}$) is 532 million eggs, which corresponds with an equilibrium yield of 145 mt. Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is 136 mt (Figure i).

Table e: Summary of reference points and management quantities for the base case model.

Quantity	Estimate	tab:Ref_pts_mod1	
		Low 2.5% limit	High 2.5% limit
Unfished spawning output (million eggs)	1,329	1,030	1,629
Unfished age 1+ biomass (mt)	1,969	1,642	2,296
Unfished recruitment (R_0)	3,749	1,561	5,937
Spawning output(2018 million eggs)	599	389	809
Depletion (2018)	0.451	0.34	0.561
Reference points based on $SB_{40\%}$			
Proxy spawning output ($B_{40\%}$)	532	456	607
SPR resulting in $B_{40\%}$ ($SPR_{B_{40\%}}$)	0.458	0.458	0.458
Exploitation rate resulting in $B_{40\%}$	0.139	0.107	0.171
Yield with $SPR_{B_{40\%}}$ at $B_{40\%}$ (mt)	145	105	184
Reference points based on SPR proxy for MSY			
Spawning output	593	509	677
SPR_{proxy}	0.5		
Exploitation rate corresponding to SPR_{proxy}	0.121	0.093	0.15
Yield with SPR_{proxy} at SB_{SPR} (mt)	136	99	173
Reference points based on estimated MSY values			
Spawning output at MSY (SB_{MSY})	297	248	346
SPR_{MSY}	0.299	0.288	0.31
Exploitation rate at MSY	0.234	0.171	0.296
Dead Catch MSY (mt)	165	117	212
Retained Catch MSY (mt)	165	117	212

81 Management Performance

management-performance

82 Table [f](#)

83 Unresolved Problems and Major Uncertainties

unresolved-problems-and-major-uncertainties

Table f: 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.

tab:mnmgmt_perform				
Year	OFL (mt; ABC prior to 2011)	ABC (mt)	ACL (mt; OY prior to 2011)	Estimated total catch (mt)
2007	-	-	-	-
2008	-	-	-	-
2009	-	-	-	-
2010	-	-	-	-
2011	-	-	-	-
2012	-	-	-	-
2013	-	-	-	-
2014	-	-	-	-
2015	-	-	-	-
2016	-	-	-	-
2017	-	-	-	-
2018	-	-	-	-

84 Decision Table

decision-table

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

Year	OFL
2019	145.83

tab:OFL_projection

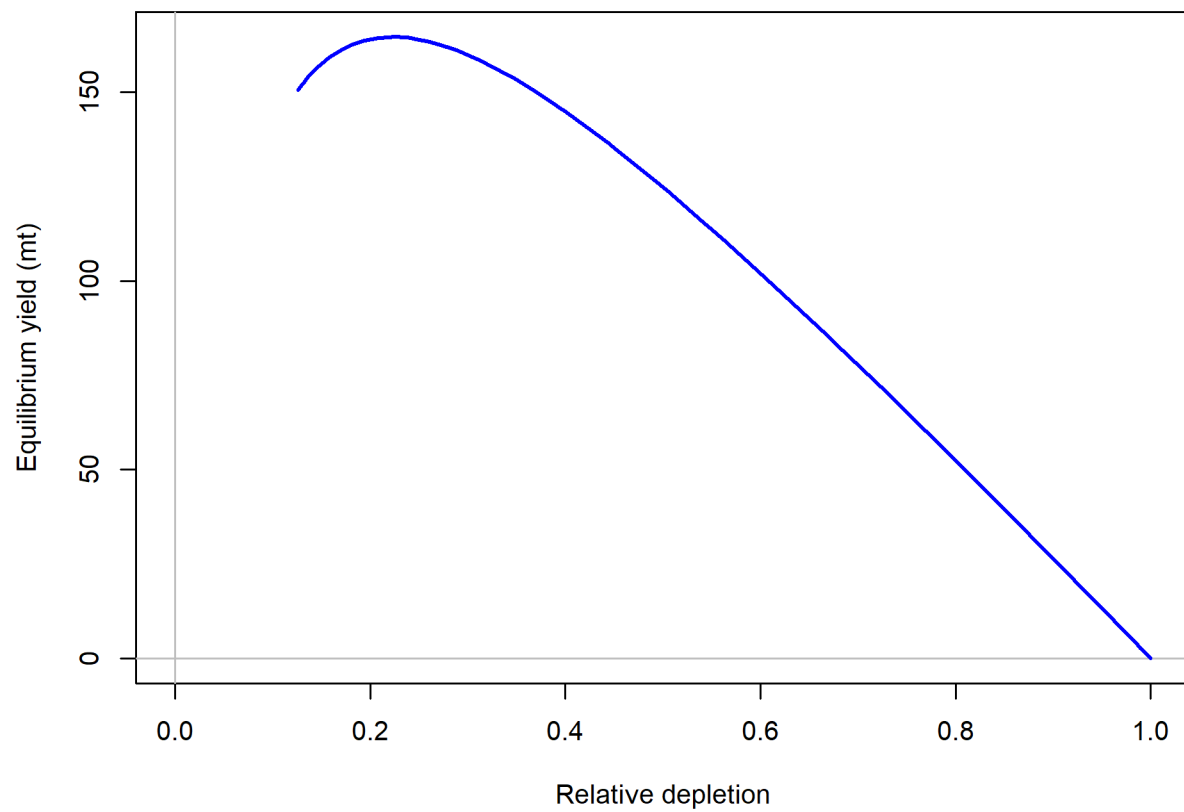


Figure i: Equilibrium yield curve for the base case model. Values are based on the 2018 fishery selectivity and with steepness fixed at 0.718. fig:Yield_all

Table h: Summary of 10-year projections beginning in 2020 for alternate states of nature based on an axis of uncertainty for the 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.

tab:Decision_table_mod1

		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
40-10 Rule, Low M	2019	-	-	-	-	-	-
	2020	-	-	-	-	-	-
	2021	-	-	-	-	-	-
	2022	-	-	-	-	-	-
	2023	-	-	-	-	-	-
	2024	-	-	-	-	-	-
	2025	-	-	-	-	-	-
	2026	-	-	-	-	-	-
	2027	-	-	-	-	-	-
	2028	-	-	-	-	-	-
40-10 Rule	2019	-	-	-	-	-	-
	2020	-	-	-	-	-	-
	2021	-	-	-	-	-	-
	2022	-	-	-	-	-	-
	2023	-	-	-	-	-	-
	2024	-	-	-	-	-	-
	2025	-	-	-	-	-	-
	2026	-	-	-	-	-	-
	2027	-	-	-	-	-	-
	2028	-	-	-	-	-	-
40-10 Rule, High M	2019	-	-	-	-	-	-
	2020	-	-	-	-	-	-
	2021	-	-	-	-	-	-
	2022	-	-	-	-	-	-
	2023	-	-	-	-	-	-
	2024	-	-	-	-	-	-
	2025	-	-	-	-	-	-
	2026	-	-	-	-	-	-
	2027	-	-	-	-	-	-
	2028	-	-	-	-	-	-
Average Catch	2019	-	-	-	-	-	-
	2020	-	-	-	-	-	-
	2021	-	-	-	-	-	-
	2022	-	-	-	-	-	-
	2023	-	-	-	-	-	-
	2024	-	-	-	-	-	-
	2025	-	-	-	-	-	-
	2026	-	-	-	-	-	-
	2027	-	-	-	-	-	-
	2028	-	-	-	-	-	-

Table i: Base case results summary.

Quantity	2010	2011	2012	2013	2014	2015	2016	2017	tab:base summary	
									2018	2019
Landings (mt)										
Total Est. Catch (mt)										
OFL (mt)										
ACL (mt)										
(1-SPR)(1-SPR _{50%})	0.82	0.81	0.71	0.67	0.78	0.81	0.85	0.85	0.81	
Exploitation rate	0.11	0.11	0.08	0.07	0.09	0.10	0.10	0.10	0.08	
Age 1+ biomass (mt)	1391.63	1332.20	1246.97	1184.00	1156.13	1140.65	1116.13	1101.05	1097.89	1118.10
Spawning Output	864.6	795.9	741.2	711.8	691.1	661.0	634.7	612.7	599.1	599.4
95% CI	(604.3-1124.85)	(549.68-1042.04)	(507.57-974.88)	(487.79-935.76)	(474.44-907.77)	(449.78-872.25)	(425.9-843.51)	(404.15-821.3)	(389.03-809.08)	(397.31-801.55)
Depletion	0.7	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
95% CI	(0.515-0.786)	(0.471-0.726)	(0.437-0.678)	(0.421-0.65)	(0.41-0.63)	(0.39-0.604)	(0.371-0.584)	(0.353-0.569)	(0.34-0.561)	(0.289-0.613)
Recruits	3218.83	2746.99	2631.66	2767.28	3916.77	5510.34	4079.14	3360.32	2968.86	3352.25
95% CI	(1410.42 - 7345.97)	(1180.57 - 6391.77)	(1126.64 - 6147.16)	(1179.6 - 6491.88)	(1632.26 - 9398.66)	(2305.44 - 13170.55)	(1645.01 - 10115.07)	(1372 - 8230.16)	(1262.36 - 6982.25)	(1373.02 - 8184.58)

85 **Research and Data Needs**

research-and-data-needs

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

87 1. xxxx:

88 2. xxxx:

89 3. xxxx:

90 4. xxxx:

91 5. xxxx:

