The Combined Status of Gopher (*Sebastes carnatus*) and Black-and-Yellow Rockfishes (*Sebastes chrysomelas*) in U.S. Waters Off California in 2019

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

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The Combined Status of Gopher (*Sebastes carnatus*) and Black-and-Yellow Rockfishes (*Sebastes chrysomelas*) in U.S. Waters Off California in 2019

Contents

Executive Summary

executive-summary

Stock

stock

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

Catches

catches

Information on historical landings of GBYR are available back to xxxx... (Table a). Commercial landings were small during the years of World War II, ranging between 4 to 28 metric tons (mt) per year.

(Figures a-b)
(Figure c)

Since 2000, annual total landings of GBYR have ranged between 70-168 mt, with landings in 2018 totaling 91 mt.

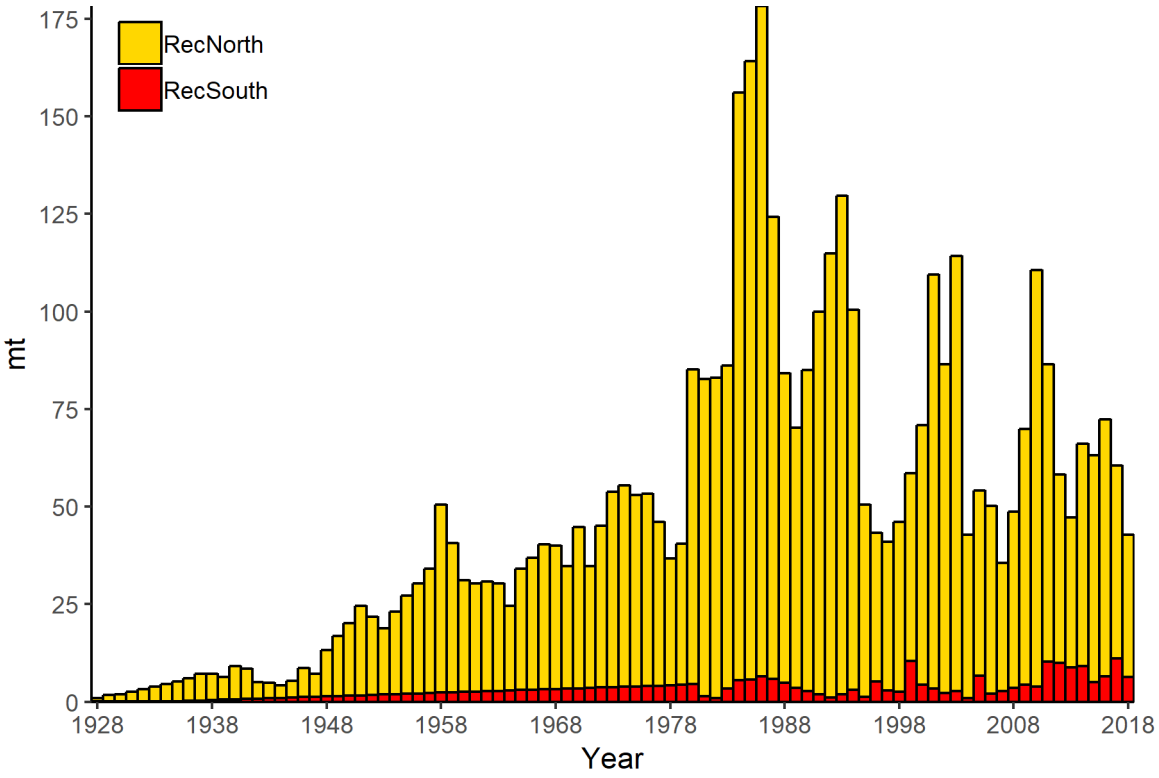

Figure a: Catch history of GBYR for the recreational fleet. `fig:Exec_catch1`

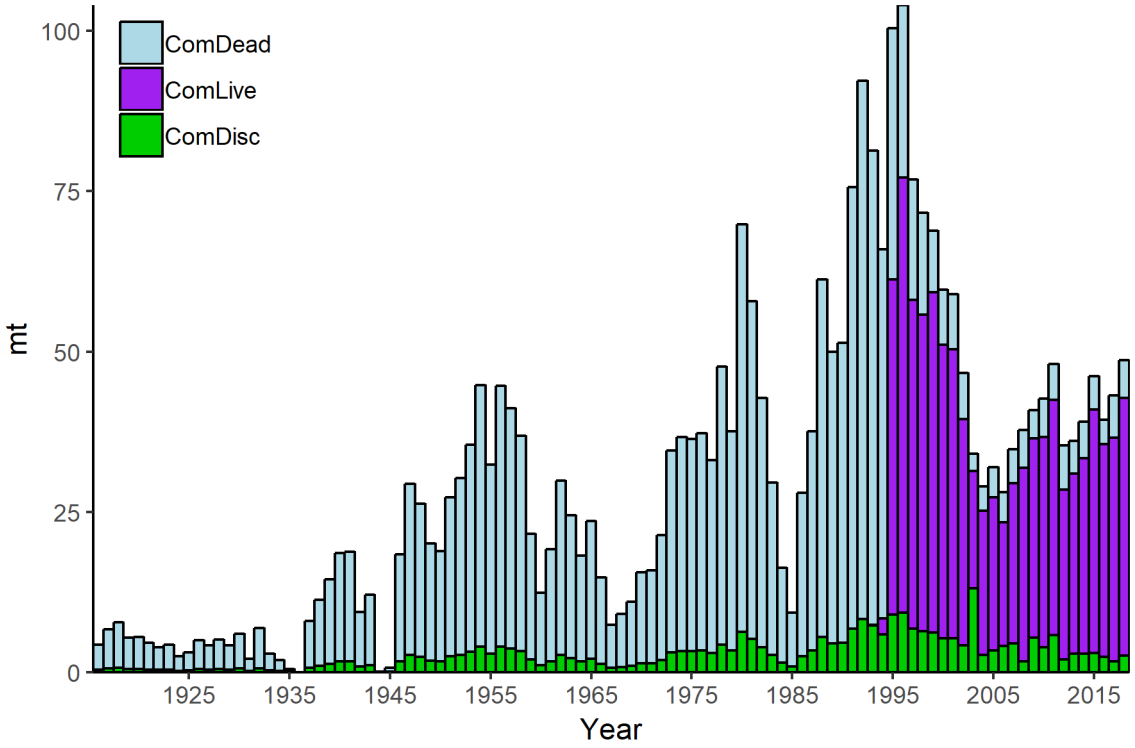

Figure b: Catch history of GBYR for the commercial fleet by dead and live landings, and discards. Catches in 1936 and 1946 were minimal. ⌜fig:Exec_catch2

Table a: Recent GBYR landings (mt) by fleet.

tab:Exec_catch

Year	Commercial Retained	Commercial Discard	Recreational North	Recreational South	Total
2009	35.42	5.38	65.64	4.30	110.73
2010	38.65	3.92	106.76	3.90	153.23
2011	42.28	5.72	76.16	10.24	134.41
2012	33.46	1.93	48.25	9.89	93.53
2013	33.17	2.85	38.43	8.86	83.30
2014	36.15	2.85	56.96	9.06	105.02
2015	43.18	2.93	58.09	5.00	109.20
2016	36.84	2.42	65.72	6.57	111.55
2017	41.51	1.65	49.36	11.15	103.66
2018	46.08	2.54	36.48	6.30	91.40

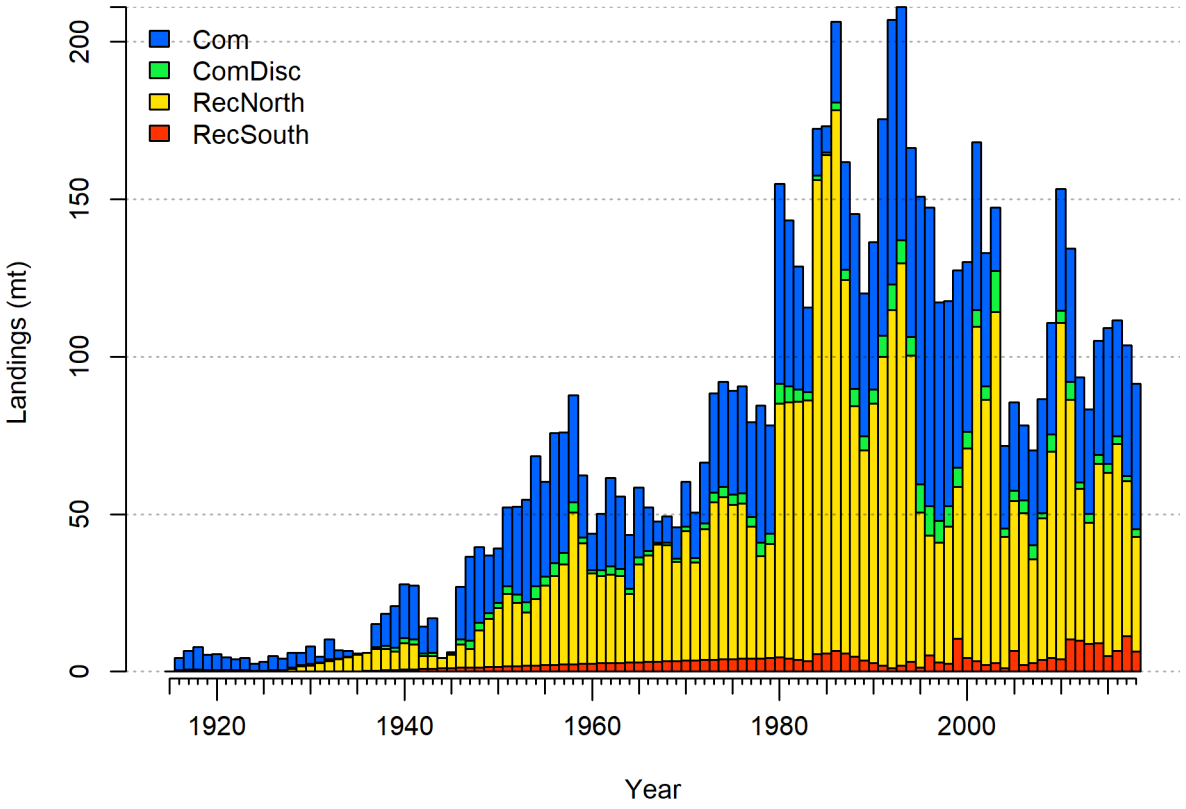

Figure c: Catch history of GBYR in the model. [fig:r4ss_catches

Data and Assessment

data-and-assessment

This a new full assessment for GBYR, which was last assessed in ... using Stock Synthesis Version xx. This assessment uses the newest version of Stock Synthesis (3.30.xx). The model begins in 1916, and assumes the stock was at an unfished equilibrium that year.

(Figure d).

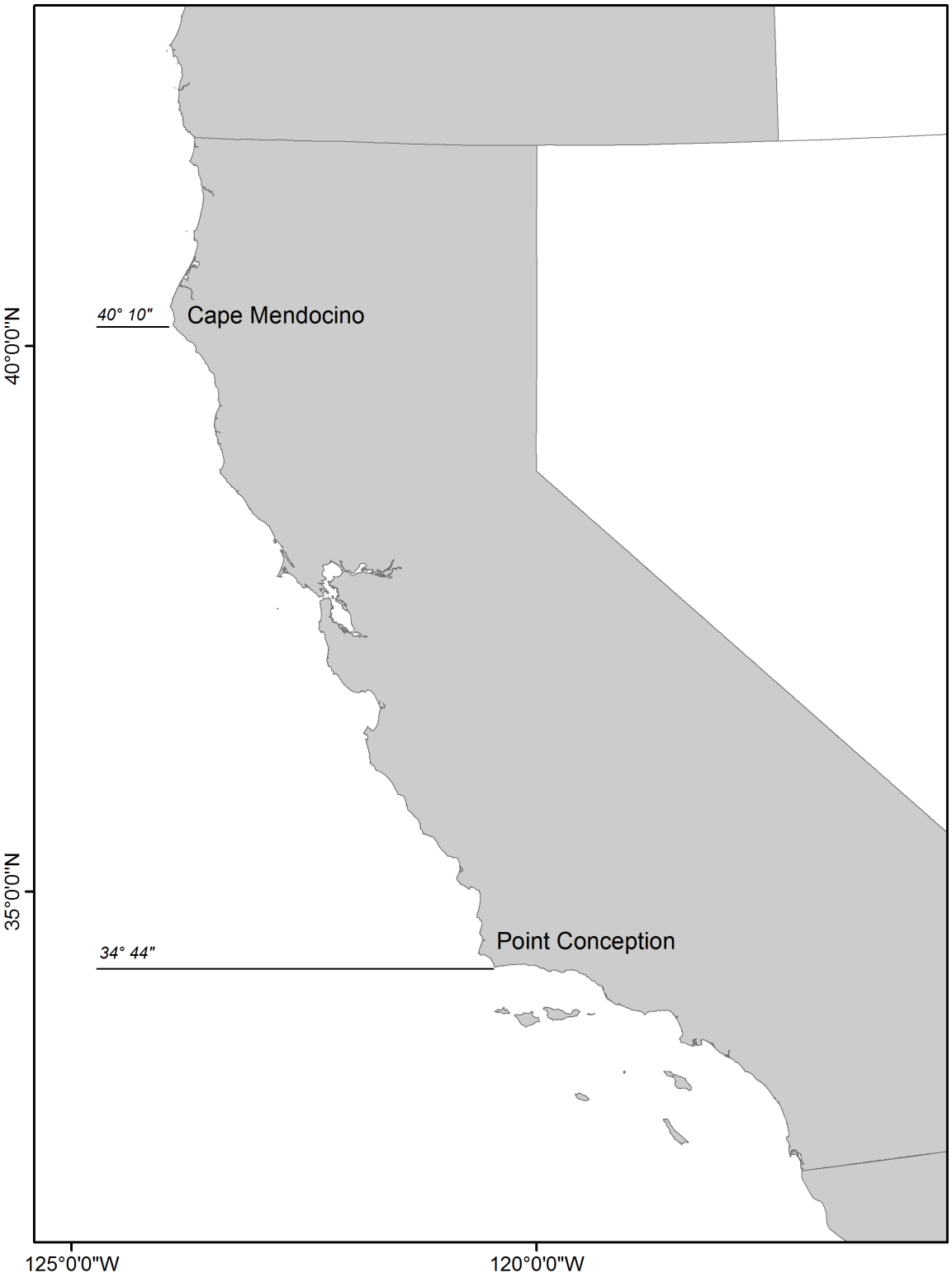

Figure d: Map depicting the core distribution of gopher and black-and-yellow rockfishes. The stock assessment is bounded at Cape Mendocino in the north to the U.S./Mexico border in the south. `fig:assess_region_map`

Stock Biomass

stock-biomass

(Figure e and Table b).

The 2018 estimated spawning biomass relative to unfished equilibrium spawning biomass is above the target of 40% of unfished spawning biomass at 45.2% (95% asymptotic interval: ± 23.4% - 67.0%) (Figure f). Approximate confidence intervals based on the asymptotic variance 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 GBYR.

tab:SpawningDeplete_mod1

Year	Spawning Output (million eggs)	~ 95% confidence interval	Estimated depletion	~ 95% confidence interval
2010	877	550 - 1205	0.6	0.456671416787653 - 0.809834583212347
2011	805	497 - 1113	0.6	0.416425186606963 - 0.744970813393037
2012	745	454 - 1036	0.5	0.383877756091065 - 0.691252243908935
2013	712	434 - 990	0.5	0.369011511248305 - 0.658444488751695
2014	688	420 - 957	0.5	0.358835044888064 - 0.634514955111936
2015	658	395 - 921	0.5	0.340845995576311 - 0.608982004423689
2016	634	372 - 895	0.5	0.323721662100644 - 0.590826337899356
2017	616	351 - 880	0.4	0.308299755523342 - 0.580348244476658
2018	611	338 - 884	0.4	0.299338718623481 - 0.582173281376518
2019	626	332 - 919	0.5	0.233512088592723 - 0.669807911407277

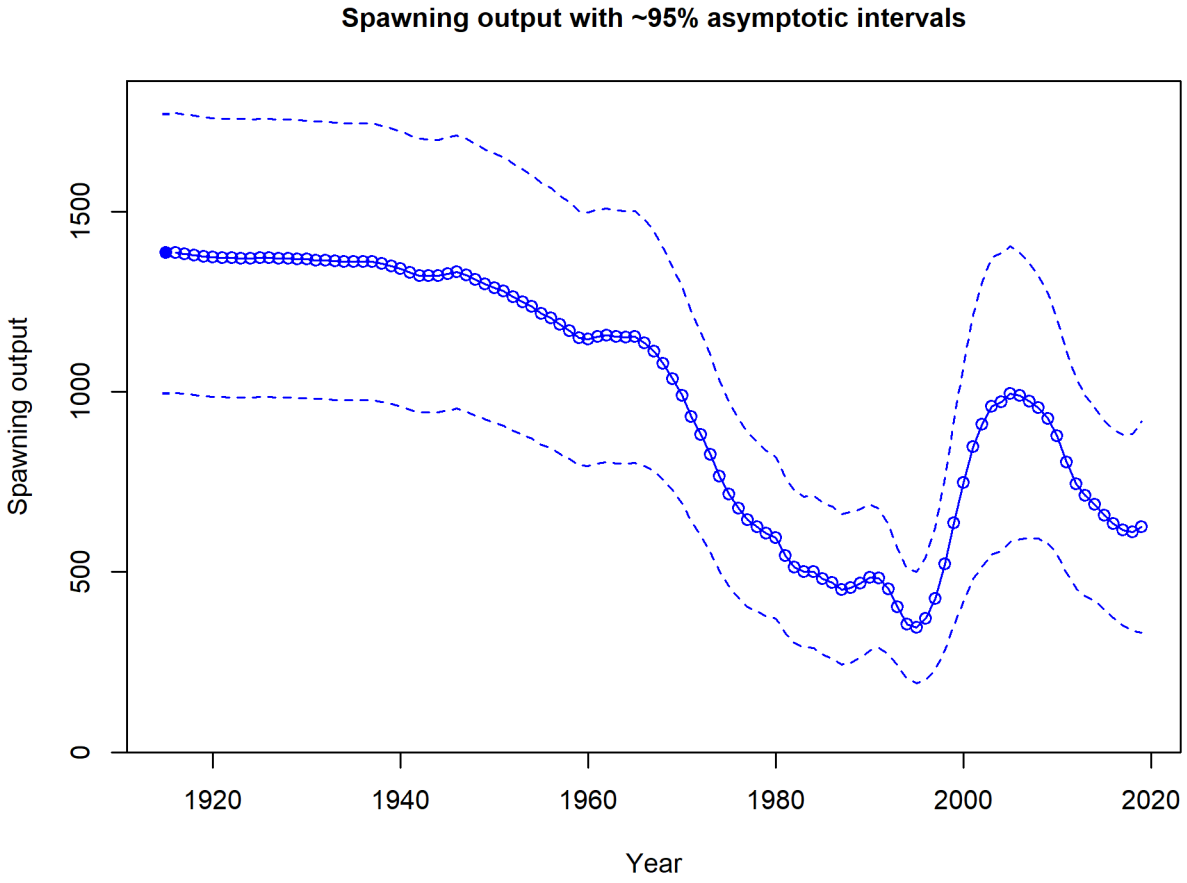

Figure e: Time series of spawning biomass trajectory (circles and line: median; light broken lines: 95% credibility intervals) for the base case assessment model. `fig:Spawnbio_all`

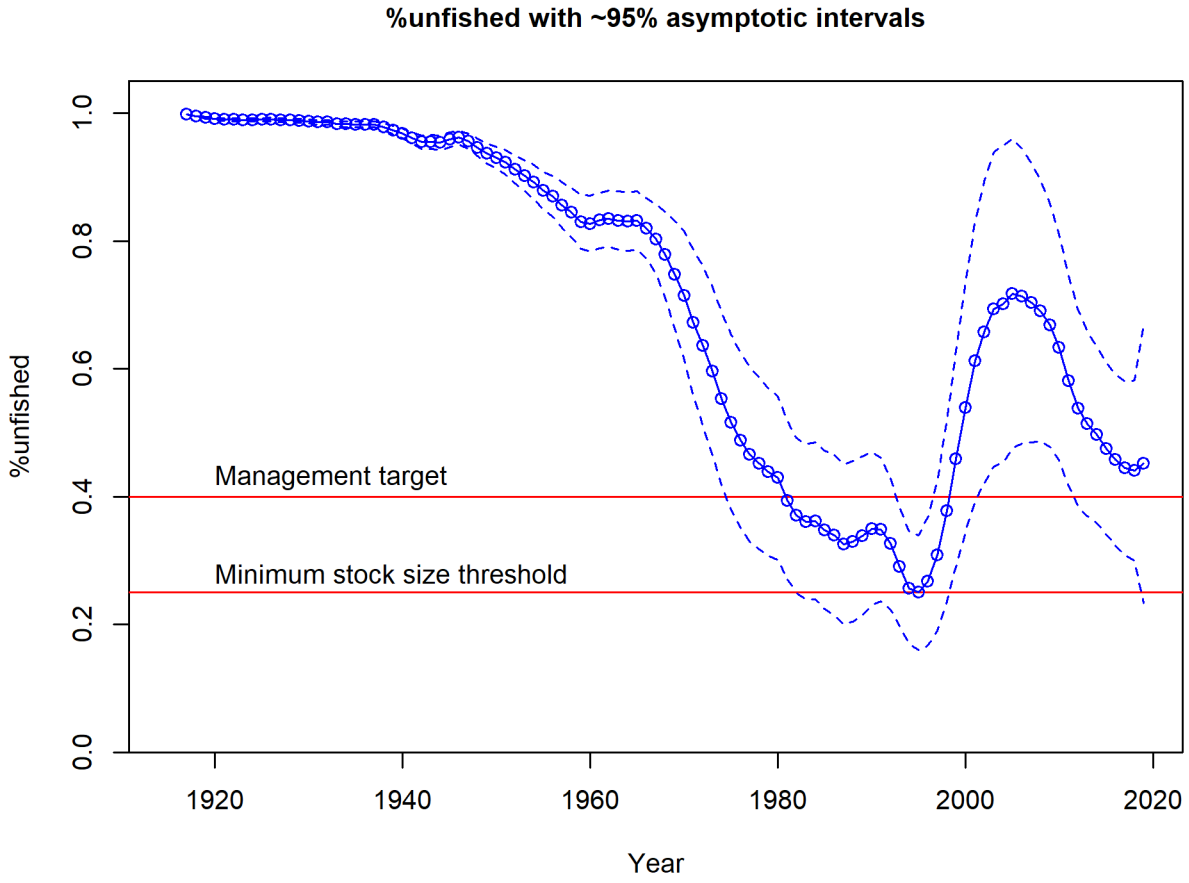

Figure f: Estimated percent depletion with approximate 95% asymptotic confidence intervals (dashed lines) for the base case assessment model. ⌜fig:RelDeplete_all

Recruitment

recruitment

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

Table c: Recent recruitment for the GBYR assessment.

tab:Recruit_mod1

Year	Estimated Recruitment (1,000s)	~ 95% confidence interval
2010	3817	1496 - 9738
2011	3564	1358 - 9354
2012	3610	1346 - 9679
2013	4355	1619 - 11711
2014	6351	2368 - 17032
2015	8323	3082 - 22476
2016	7554	2745 - 20791
2017	5963	2111 - 16842
2018	4790	1661 - 13814
2019	4789	1610 - 14244

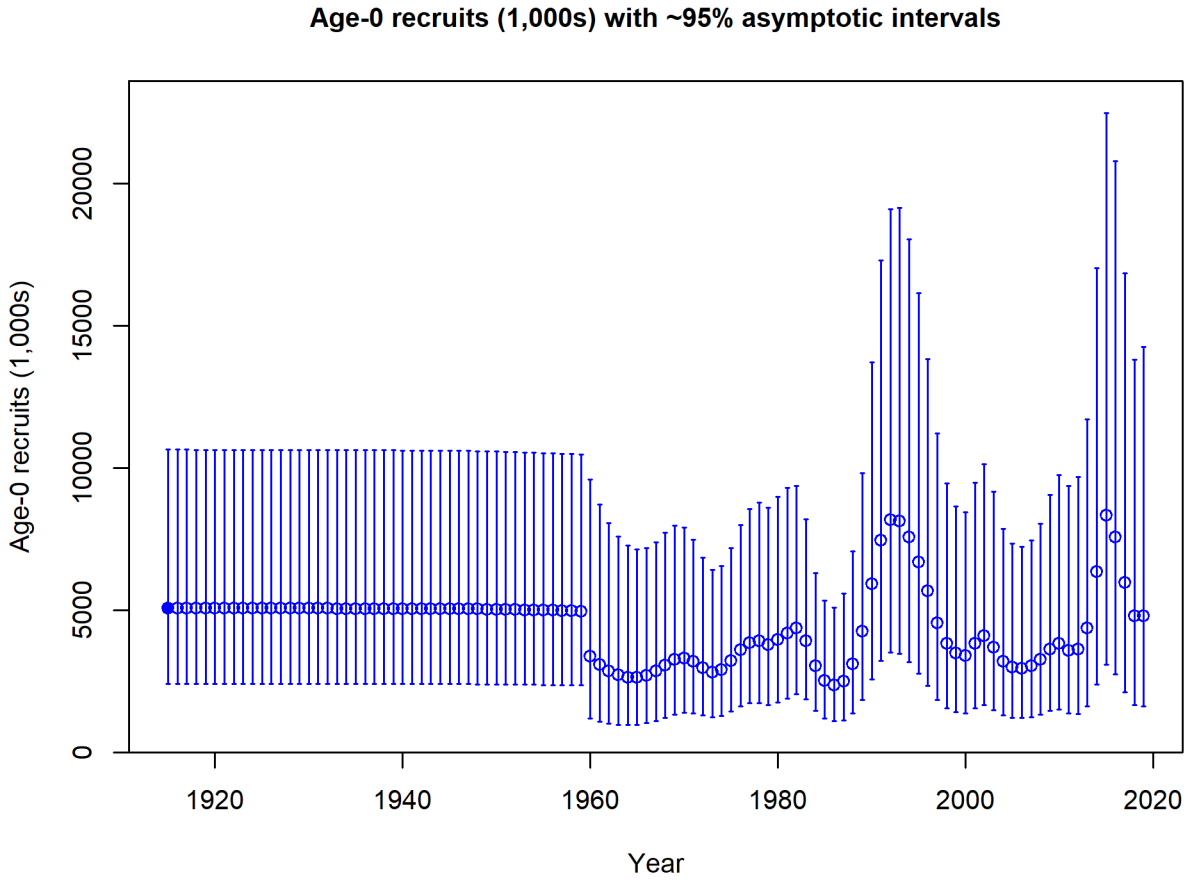

Figure g: Time series of estimated GBYR recruitments for the base-case model with 95% confidence or credibility intervals. ⌜fig:Recruits_all

Exploitation status

exploitation-status

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

Table d: Recent trend in spawning potential ratio and exploitation for GBYR 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	0.60	0.37 - 0.82	0.07	0.05 - 0.1
2010	0.74	0.49 - 0.98	0.11	0.07 - 0.15
2011	0.73	0.48 - 0.98	0.10	0.06 - 0.14
2012	0.62	0.39 - 0.86	0.07	0.05 - 0.1
2013	0.60	0.37 - 0.83	0.07	0.04 - 0.09
2014	0.70	0.45 - 0.95	0.09	0.05 - 0.12
2015	0.73	0.48 - 0.99	0.09	0.05 - 0.13
2016	0.77	0.5 - 1.03	0.09	0.05 - 0.13
2017	0.76	0.49 - 1.03	0.08	0.04 - 0.12
2018	0.72	0.45 - 0.98	0.07	0.03 - 0.1

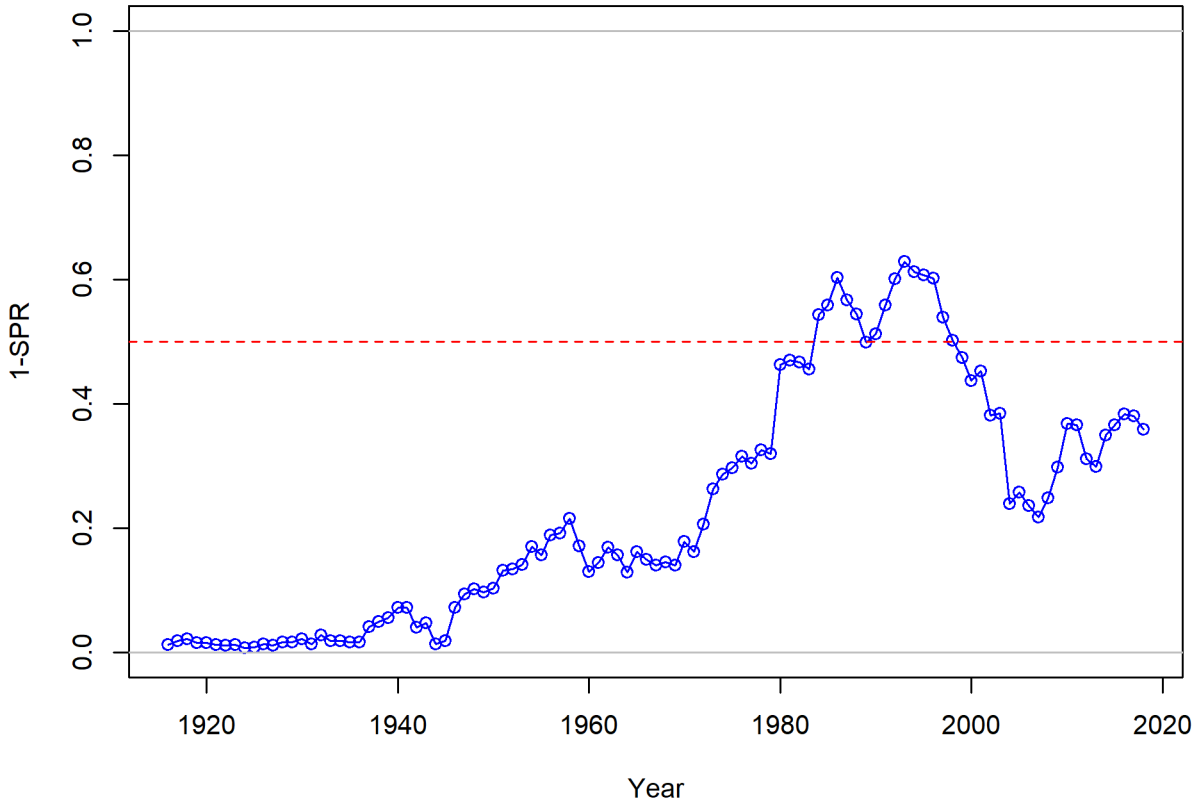

Figure h: Estimated spawning potential ratio (SPR) for the base-case model. One minus SPR is plotted so that higher exploitation rates occur on the upper portion of the y-axis. The management target is plotted as a red horizontal line and values above this reflect harvests in excess of the overfishing 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 GBYR 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 45.2% (95% asymptotic interval: ± 23.4% - 67.0%, corresponding to an unfished spawning biomass of 626 million eggs (95% asymptotic interval: 332 - 919 million eggs) of spawning biomass in the base model (Table e). Unfished age 1+ biomass was estimated to be 2,206 mt in the base case model. The target spawning biomass ($SB_{40\%}$) is 554 million eggs, which corresponds with an equilibrium yield of 181 mt. Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is 169 mt (Figure i).

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

tab:Ref_pts_mod1

Quantity	Estimate	Low 2.5% limit	High 2.5% limit
Unfished spawning output (million eggs)	1,386	997	1,774
Unfished age 1+ biomass (mt)	2,206	1,701	2,710
Unfished recruitment (R_0)	5,057	1,156	8,958
Spawning output(2018 million eggs)	611	338	884
Depletion (2018)	0.441	0.299	0.582
Reference points based on SB$_{40\%}$			
Proxy spawning output ($B_{40\%}$)	554	449	659
SPR resulting in $B_{40\%}$ ($SPR_{B40\%}$)	0.458	0.458	0.458
Exploitation rate resulting in $B_{40\%}$	0.151	0.109	0.194
Yield with $SPR_{B40\%}$ at $B_{40\%}$ (mt)	181	110	252
Reference points based on SPR proxy for MSY			
Spawning output	618	501	735
SPR_{proxy}	0.5		
Exploitation rate corresponding to SPR_{proxy}	0.132	0.095	0.169
Yield with SPR_{proxy} at SB_{SPR} (mt)	169	104	235
Reference points based on estimated MSY values			
Spawning output at MSY (SB_{MSY})	298	239	357
SPR_{MSY}	0.291	0.282	0.3
Exploitation rate at MSY	0.262	0.18	0.344
Dead Catch MSY (mt)	209	123	296
Retained Catch MSY (mt)	209	123	296

Management Performance

management-performance

Table f

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:mnmgt_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	-	-	-	-

137 # Decision Table

decision-table

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

tab:OFL_projection

Year	OFL
2019	182.79

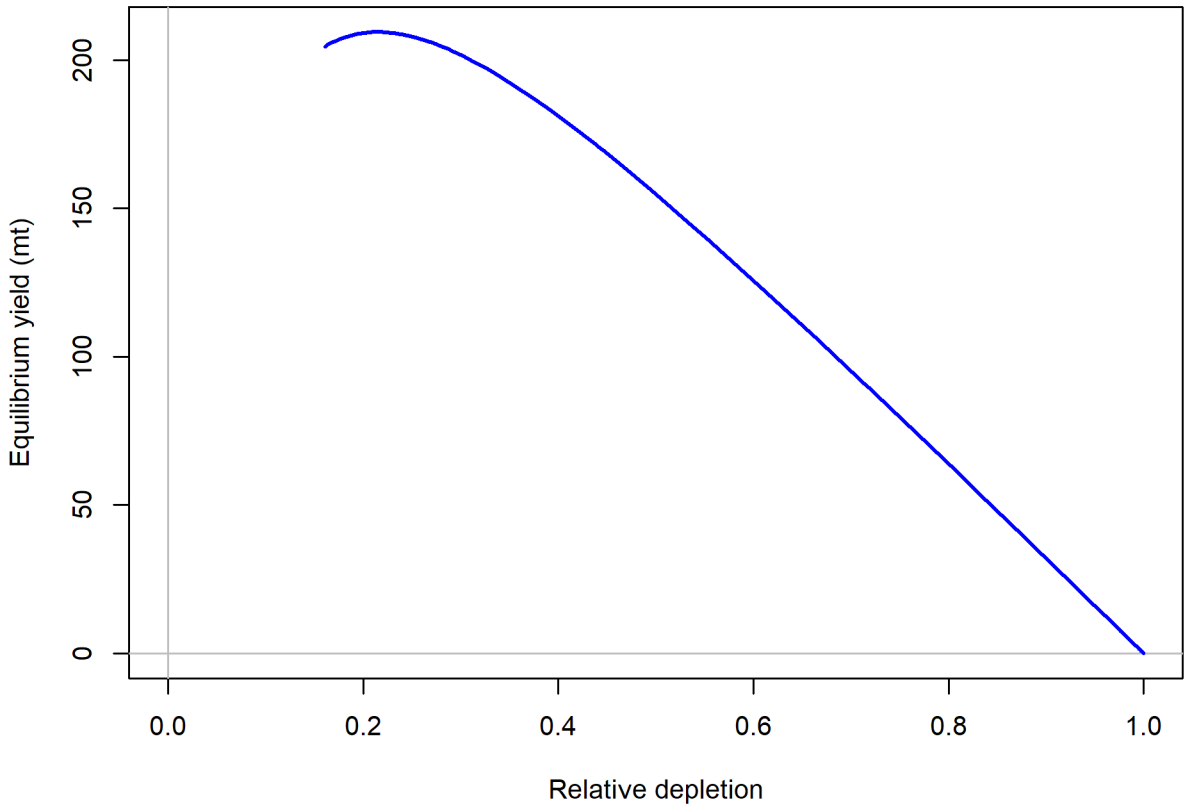

Figure i: Equilibrium yield curve for the base case model. Values are based on the 2018 fishery selectivity and with steepness fixed at 0.718. ⌜fig:Yield_all

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	Depletion
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.

tab:base_summary

Quantity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Landings (mt)										
Total Est. Catch (mt)										
OFL (mt)										
ACL (mt)										
(1-SPR)(1-$SPR_{50\%}$)	0.74	0.73	0.62	0.60	0.70	0.73	0.77	0.76	0.72	
Exploitation rate	0.11	0.10	0.07	0.07	0.09	0.09	0.09	0.08	0.07	
Age 1+ biomass (mt)	1483.34	1412.40	1322.19	1255.68	1227.62	1215.60	1203.97	1213.90	1250.81	1322.40
Spawning Output	877	805	745	712	688	658	634	616	611	626
95% CI	550 - 1205	497 - 1113	454 - 1036	434 - 990	420 - 957	395 - 921	372 - 895	351 - 880	338 - 884	332 - 919
Depletion	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.5
95% CI	0.456671416787653 - 0.809834583212347	0.416425186606963 - 0.744970813393037	0.383877756091065 - 0.691252243908935	0.369011511248305 - 0.658444488751695	0.358835044888064 - 0.634514955111936	0.340845995576310 - 0.608982004423680	0.323721662100640 - 0.590826337899359	0.308299755523342 - 0.580348244476658	0.299338718623480 - 0.582173281376519	0.233512088592723 - 0.669807911407277
Recruits	3817	3564	3610	4355	6351	8323	7554	5963	4790	4789
95% CI	1496 - 9738	1358 - 9354	1346 - 9679	1619 - 11711	2368 - 17032	3082 - 22476	2745 - 20791	2111 - 16842	1661 - 13814	1610 - 14244

Research and Data Needs

research-and-data-needs

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

1. **xxxx**:
2. **xxxx**:
3. **xxxx**:
4. **xxxx**:
5. **xxxx**:

1 Introduction

introduction

1.1 Basic Information and Life History

basic-information-and-life-history

1.2 Early Life History

early-life-history

1.3 Map

map

A map showing the scope of the assessment and depicting boundary at Pt. Conception for the recreational fishing fleet (Figure d).

1.4 Ecosystem Considerations

ecosystem-considerations-1

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.

1.5 Fishery Information

fishery-information

1.6 Summary of Management History

summary-of-management-history

1.7 Management Performance

management-performance-1

Table f

1.8 Fisheries Off Mexico or Canada

fisheries-off-mexico-or-canada

2 Assessment

assessment

2.1 Data

data

Data used in the GBYR assessment are summarized in Figure 2. Descriptions of the data sources are in the following sections.

2.1.1 Commercial Fishery Landings

`commercial-fishery-landings`

Overview of gopher and black-and-yellow catch history

Commercial fishery landings for gopher and black-and-yellow rockfishes have not been reported consistently by species throughout the available catch history (Figure 3). The period from 1916-1935 indicates that only black-and-yellow rockfish were landed in the commercial fishery, which then switched to predominately gopher rockfish from 1937-1984. From 1985-1988 the landings data suggest that only black-and-yellow rockfish were landed and not until 1995 are both speices well-represented in the catches. There is not way to tease apart the historical catches by species and even across north and south of Pt. Conception prior to about 1995. This precludes the ability to model the catch histories for eiether species accurately. Given these constraints, all commercial dats were combined to represent one one commercial flee in the assessment.

The stock assessment of gopher rockfish in 2005 did not include black-and-yellow rockfish landings. A comparison of recreational and commercial landings from the 2005 assessment to those used in this assessment suggest the 2005 assessment may have included some black-and-yellow rockfish landings (Figure 4). The 2005 assessment estimated recreational landings from 1969-1980 based on a ratio of commercial to recreational landings, where as this assessment makes use of the California Catch Reconstruction landings estimates (Ralston et al. 2010).

Commercial Landings Data Sources

Commercial landings in California are based on two primary data sources: a cooperative port sampling program (California Cooperative Groundfish Survey, CALCOM) that collects information including species composition data (i.e. the proportion of species landed in a sampling stratum), and landing receipts (sometimes called "fish tickets") that are a record of pounds landed in a given stratum. Strata in California are defined by market category, year, quarter, gear group, port complex, and disposition (live or dead). Although many market categories are named after actual species, catch in a given market category can consist of several species. All landings used in this assessment are "expanded" landings, i.e., species composition data collected by port samplers were used to allocate pounds recorded on landing receipts to species. Use of the "Gopher Rockfish" or the "Black-and-Yellow Rockfish" categories alone to represent actual landings of GBY would not be accurate. See Pearson et al. Appendix C (2008) for a simple example of the expansion calculations. Data from the California Cooperative Groundfish Survey, species compositions, and expanded landings estimates are stored in the CALCOM database at the Pacific States Marine Fisheries Commission, a central repository of commercial landings data for the U.S. West Coast.

Commercial catches of black-and-yellow rockfish from 1916-1968 and for gopher rockfish from 1937-1968 were queried (4 April 2019) from the California Catch Reconstruction (Ralston et al. 2010). Landings in this database are divided into trawl and 'non-trawl.' Since the

majority of GBYR are caught in the commercial fixed gear fisheries, only estimated catch in the 'non-trawl' was used. A total of 0.154 mt (3.18%) were removed from Eureka commercial landings (based on current proportions of commercial catch from north of Cape Mendocino in Eureka) since the assessment represents the GBYR stock south of Cape Mendocino.

Commercial landings from 1969-2018 were queried for a final time from the CALCOM database on 4 April 2019 (Table **??**. Commercial landings were also queried from PacFIN (Pacific Fisheries Information Network) for a final time on 3 June 2019 for comparison to CALCOM landings. There are very small differences in commercial landings between CALCOM and PacFIN from 1981-2018 (Figure **??**fig:Calcom_vs_Pacfin}). Landings estimates from CALCOM were used in the assessment. Landings were stratified by year, quarter, live/dead, market category, gear group, port complex, and source of species composition data (actual port samples, borrowed samples, or assumed nominal market category). Data from individual quarters were aggregated at the year level. Fish landed live or dead were combined, due to changes over time in the reliability of condition information (D. Pearson, pers. comm.). From 1916-1968, on average, 74% of GBYR were landed north of Point Conception, which rose to 97% from 1978-2018. Given the smaller landings south of Point Conception and the similar length composition of GBYR north and south of Pt. Conception, no spatial separation was considered for the commercial fleet.

2.1.2 Commercial Discards

`commercial-discards`

The West Coast Groundfish Observer Program (WCGOP) provides observer data on discarding across fishery sectors back to 2003. Gopher and black-and-yellow rockfishes have different depth-stratified commercial fishery discard mortality rates (Pacific Fishery Management Council 2018). In consultation with WCGOP staff, the STAT used estimates of total discard mortality from WCGOP's Groundfish Expanded Mortality Multiyear (GEMM) report. WCGOP observes between 1-5% of nearshore fixed gear landings annually south of $40°10'$ N. latitude (coverage rates available here). The expanded estimates of total discard weight by species is calculated as the ratio of the observed discard weight of the individual species divided by the observed landed weight
from PacFIN landing receipts. WCGOP discard estimates for the nearshore fixed gear fishery take into account the depth distribution of landings in order to appropriately apply the depth-stratified discard mortality rates by species (Somers, K.A., J. Jannot, V. Tuttle, K. Richerson and McVeigh 2018). The discard mortality for 2018 was estimated as an average of the discard mortality from 2013-2017. Discard mortality was estimated from the period prior to WCGOP discard estimates (1916-2002) based on the average discard mortality rate from 2003-2016 (2017 was excluded because 2017 discard mortality was disproportionately higher than all other years) (Table 1).

2.1.3 Commercial Fishery Length and Age Data

commercial-fishery-length-and-age-data

Biological data from the commercial fisheries that caught GBYR were extracted from CALCOM on 9 May 2019. The CALCOM length composition data were catch-weighted to "expanded" length the raw lenght composition data (Table 2). The 2005 assessment used commercial length composition informtion from CALCOM, but did not include black-and-yellow rockfish and is not directly comparable. The 2005 assessment used 2 cm length bins from 16-40 cm, where this assessment uses 1 cm length bins from 4-40 cm. Sex was not available for the majority (99.5%) of the commercial length, and the assessment did not find sexual dimorphism in growth for either species. We aggregated the commercial length composition among all gears and regions south of Cape Mendocino.

Discard length compositions from WCGOP (2003-2017) were expanded based on the the discard estimates and were aggregated for all regions south of Cape Mendocino and across all fixed gear fisheries.

A total of 46 ages were available for gopher rockfish from the commercial fisheries 2009-2011, 2016, and 2018. Though sparse, the data were included as conditional age-at-length for the commercial fleet.

The input sample sizes for commercial length composition data were calculated via the Stewart Method for fisheries (Ian Stewart, personal communication, IPHC):

$$\text{Input effN} = N_{\text{trips}} + 0.138 * N_{\text{fish}} \text{ if } N_{\text{fish}}/N_{\text{trips}} \text{ is } < 44$$

$$\text{Input effN} = 7.06 * N_{\text{trips}} \text{ if } N_{\text{fish}}/N_{\text{trips}} \text{ is } \geq 44$$

2.1.4 Recreational Fishery Removals and Discards

recreational-fishery-removals-and-discards

Historical recreational landings and discard, 1928-1980

Ralston et al. (2010) reconstructed estimates of recreational rockfish catch and discard in California, 1928-1980. Reported landings of total rockfish were allocated to species based on several sources of species composition data. Estimates of GBYR landings and discard (combined) from 1928-1979 are available from the SWFSC. For this assessment, historical recreational catch was stratified by year and area (north and south of Point Conception). The catches of GBYR reported in Ralston et al. (2010) are higher than expected given the more recent catches of GBYR south of Pt. Conception and the species' ranges (Figure 6). The California Catch Reconstruction used a linear ramp from from 1928-1936 that was not altered in this assessment. From 1937-1979 linear ramp to the average recreational landing from 1980 and 1983 (1981-1982 catches interpolated as described in the next section) of 4.3 mt. The recreational catches north of Pt. Conception were not altered from the original

catch reconstruction. The resulting alternate recreational catch streams are in (Table 3 and Figure 7).

Marine Recreational Fisheries Statistics Survey (MRFSS), 1980-2003

From 1980-2003, the Marine Recreational Fisheries Statistics Survey (MRFSS) executed a dockside (angler intercept) sampling program in Washington, Oregon, and California. Data from this survey are available from the Recreational Fisheries Information Network RecFIN. RecFIN serves as a repository for recreational fishery data for California, Oregon, and Washington. Catch estimates for years 1980-2003 were downloaded on 23 March 2019 (), and are consistent with the previous assessment [Key2005]. - need to check again)

MRFSS-era recreational removals for California were estimated for two regions: north and south of Point Conception. No finer-scale estimates of landings are available for this period. Catches were downloaded in numbers and weight. Catch in weight is sometimes missing from the database due to missing average weight estimates. We estimated average weights based on adjacent strata as needed, although the effect was relatively minor (7.4 mt over all years for gopher rockfish and 0.6 mt for black-and-yellow rockfish). Data were not available for the CPFVs in Northern California from 1980-1982, and we used the average value from this mode and region from 1983-1987 for these three years. MRFSS sampling was temporarily suspended from 1990-1992, and we used linear interpolation to fill the missing years. Sampling of CPFVs in Northern California was further delayed, and the linear interpolation spans the period 1990-1995 for this boat mode and region. Landings data for the shore-based modes (beach/bank, man-made/jetty and shore) were sparse throughout the MRFSS sampling. All three shore-based modes were combined by region and linear interpolations were applied missing data in 1981 for the Northern California and 1995, 1996-2001, and 2004 in Southern California.

Catches from north of Cape Mendocino were removed based on a CRFS-era average of fraction of recreational landings north of Cape Mendocino by mode (3.3% of shore-based, 0.1% of CPFV, and 0.2% of private/rental were removed). From 1980-1989, San Luis Obispo County was sampled as part of Southern California (personal observation from MRFSS Type 3 sampler examined catch where county is available for 1980-2004). This assessment separates the recreational fleet at Pt. Conception. Recreational landings were re-allocated from southern California from 1980-1992 by fleet based on the average proportion of recreational landings in northern California from 1996-2004 (after sampling of the CPFV fleet in northern California resumed). The average proportion re-allocated from southern to northern California for the CPFV mode was 85%, 97% for the private/rental mode, and 81% for the shore-based modes. Data were pooled over all years and modes to estimate the landings re-allocation for the shore-based modes. Total recreational landings for 1981 and 1982 were 18.8 mt and 18.6 mt, respectively. These landings were >60 mt lower than any of the neighboring years. Landings from 1981-1982 were interpolated from the 1980 and 1983 landings.

California Recreational Fisheries Survey (CRFS), 2004-2016

MRFSS was replaced with the California Recreational Fisheries Survey (CRFS) beginning January 1, 2004. Among other improvements to MRFSS, CRFS provides higher sampling intensity, finer spatial resolution (6 districts vs. 2 regions), and onboard CPFV sampling. Estimates of catch from 2004-2018 were downloaded from the RecFIN database a final time on 4 June 2019, We queried and aggregated CRFS data to match the structure of the MRFSS data, by year, and region (Table 3. Catches in the shore-based modes are small compared to the CPFV and private rental modes. All modes are combined, but separated at Point Conception for two recreational fleets in this assessment, just as was done for the California Catch Recontruction and MRFSS time series.

Recreational Discard

Recreational discards were only added to the California Catch Reconstruction landings, as Ralston et al. (2010) did not address discards for the recreational recontruction. Recreational removals from the California Department of Fish and Wildlife MRFSS era (1980-2003) includes catch type A + B1. Catch type A refers to estimates of catch based on sampler-examined catch. Catch type B1 includes mainly angler-reported discard, but also angler-reported retained fish that were unavailable to the sampler during the interview (e.g., fillets). (2004-2018) databases. The CRFS era removals account for depth-stratified discard mortality rate and the catch time series includes both retained and discarded catch (toal mortality). We calculated the ratio of dead discards to total mortality from the CRFS era by region and mode. The region average across modes was applied to the California Catch Reconstruction as a constant. The result added 4.68% annually to recreational removals north of Pt. Conception and 4.05% annutally to the removals South of Pt. Conception). The final time series of landings and discard mortality are in Table 3.

2.1.5 Recreational Fishery Length and Age Data

`recreational-fishery-length-and-age-data`

Recreational length composition samples for California were obtained from several sources, depending on the time period and boat mode (Table 2). This assessment makes use of a much longer time series of length composition data, relative to the previous assessment, as described below. Input sample sizes for recreational length composition data were based on the number of observed trips, when available. Other proxies that were used to estimate the number of trips are described below.

There were no standardized coastwide surveys measure retained or discarded fish from the recreational fleet prior to 1980.

CPFV length composition data, 1959-1978

The earliest available length data for this assessment were described by Karpov et al. (1995), who assembled a time series (1959-1972) of available California CPFV length data (made available courtesy of W. Van Buskirk). For GBYR, data from 1959-1961 and 1966 were

available north of Pt. Conception and from 1959-1961 from south of Pt Conception. A total of 716 (680 north of Pt. Conception) unsexed measurement of retained fish (no discards,) were included in the assessment (Table). Sampling of these length data did not follow consistent protocol over time and areas (data are unweighted), and therefore may not be representative of total catch. Since the number of trips sampled was not reported by Karpov et al. (1995), we assume the number of sampled trips is proportional to the number of measured fish in each year, and estimated the number of trips using the ratio of fish measured per trip in the MRFSS data (roughly 10 fish per trip).

Collins and Crooke (n.d.) conducted an onboard observer survey of the CPFV fleet in southern California from 1975-1978. A total of 1,308 GBYR lengths were available from the study and were assumed to all be from retained fish. Ally et al. (**???**) conducted an onboard observer program of thee CPFV fleet from 1985-1987 in southern California. Becuase MRFSS data were available for this time period as well and represents multiple recreational modes, the Ally et al. (**???**) length data were not used in the assessment.

MRFSS Recreational Length Data, 1980-1989 and 1993-2003

Unsexed length data of retained fish were collected by MRFSS dockside samplers and downloaded from the RecFIN website. We identified a subset of lengths that were converted from weight measurements, and these were excluded from the final data set (Table **??**). The length measurements from Collins and Crooke (n.d.) from 1975-1978 are assumed to all be from retained fish. As of 2003, the CDFW Onboard Observer program has taken length measurements for discarded fish. The retained catch is measured during the dockside (angler intercept) surveys.

The number of trips used as initial sample sizes for the MRFSS was based on....

During the recent restructiong of the CRFS data on RecFIN, a "trip" identifier was not carried over for all modes, and trip-level sample sizes could not be extracted from the biological detail table on RecFIN. A proxy for initial sample sizes for 2004-2018 were developed using the 2015 data for which I had access to raw data files by mode from CDFW.
In more recent years, sampling of the shore-based modes has declined and were not sampled at all in 2018. Samples sizes were calculated by mode as the number of port-days (or site-days for shore-based modes) during bi-weekly intervals (e.g., Jan 1-15, Jan 16-31, etc). The number of port-days sampled in the bi-weekly intervals was used as the initial sample size for number of trips to calculate initial input sample sizes using Ian Stewart's method (described above). All lenght data were re-weighted in the assessment model.

2.1.6 Fishery-Dependent Indices of Abundance

`fishery-dependent-indices-of-abundance`

Data Source 1

Data Source 1 Index Standardization

Table 6)

(Table **??**) *Data Source 1 Length Composition*

Data Source 2

Data Source 3

2.1.7 Fishery-Independent Data Sources

`fishery-independent-data-sources`

Data Source 1

Data Source 1 Index Standardization

Data Source 1 Length Composition

Data Source 2

2.1.8 Biological Parameters and Data

`biological-parameters-and-data`

Length and Age Compositions

Length compositions were provided from the following sources:

- Source 1 (*type, e.g., commercial dead fish, research, recreational*, yyyy-yyyy)
- Source 2 (*type*, yyyy-yyyy)
- Source 3 (*research*, yyyy, yyyy, yyyy, yyyy)

The length composition of all fisheries aggregated across time by fleet is in Figure **??**. Descriptions and details of the length composition data are in the above section for each fleet or survey.

Age Structures

von Bertalanffy growth curve (Bertalanffy 1938), $L_i = L_\infty e^{(-k[t-t_0])}$, where L_i is the length (cm) at age i, t is age in years, k is rate of increase in growth, t_0 is the intercept, and L_∞ is the asymptotic length.

Aging Precision and Bias

Weight-Length

Sex Ratio, Maturity, and Fecundity

Natural Mortality

2.1.9 Environmental or Ecosystem Data Included in the Assessment

environmental-or-ecosystem-data-included-in-the-assessment

In this assessment, neither environmental nor ecosystem considerations were 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.

2.2 Previous Assessments

previous-assessments

2.2.1 History of Modeling Approaches Used for this Stock

history-of-modeling-approaches-used-for-this-stock

2.2.2 yyyy Assessment Recommendations

yyyy-assessment-recommendations

Recommendation 1:

STAT response: xxxxx

Recommendation 2:

STAT response: xxxxx

Recommendation 3:

STAT response: xxxx

2.3 Model Description

model-description

2.3.1 Transition to the Current Stock Assessment

transition-to-the-current-stock-assessment

2.3.2 Summary of Data for Fleets and Areas

summary-of-data-for-fleets-and-areas

There are xxx fleets in the base model. They include:

Commercial: The commercial fleets include ...

Recreational: The recreational fleets include ...

Research: There are xx sources of fishery-independent data available ...

2.3.3 Other Specifications

other-specifications

2.3.4 Modeling Software

modeling-software

The STAT team used Stock Synthesis 3 version 3.30.05.03 by Dr. Richard Methot at the NWFSC. This most recent version was used, since it included improvements and corrections to older versions. The r4SS package (GitHub release number v1.27.0) was used to post-processing output data from Stock Synthesis.

2.3.5 Data Weighting

data-weighting

2.3.6 Priors

priors

The log-normal prior for female natural mortality were based on a meta-analysis completed by Hamel (2015), as described under "Natural Mortality." Female natural mortality was fixed at the median of the prior, 0.xxx for an assumed maximum age of xx. An uninformative prior was used for the male offset natural mortality, which was estimated.

The prior for steepness (h) assumes a beta distribution with parameters based on an update for the Thorson-Dorn rockfish prior (Dorn, M. and Thorson, J., pers. comm.), which was endorsed by the Science and Statistical Committee in 2018. The prior is a beta distribution with mu=0.xxx and $sigma$=0.xxx. Steepness is fixed in the base model at the mean of the prior. The priors were applied in sensitivity analyses where these parameters were estimated.

2.3.7 Estimated and Fixed Parameters

estimated-and-fixed-parameters

A full list of all estimated and fixed parameters is provided in Tables **??**.

The base model has a total of xxx estimated parameters in the following categories:

- xxx,
- xxx
- xxx, and
- xxx selectivity parameters

The estimated parameters are described in greater detail below and a full list of all estimated and parameters is provided in Table **??**.

Growth.

Natural Mortality.

Selectivity.

Other Estimated Parameters.

Other Fixed Parameters.

2.4 Model Selection and Evaluation

model-selection-and-evaluation

2.4.1 Key Assumptions and Structural Choices

key-assumptions-and-structural-choices

2.4.2 Alternate Models Considered

alternate-models-considered

2.4.3 Convergence

convergence

2.5 Response to the Current STAR Panel Requests

response-to-the-current-star-panel-requests

Request No. 1:

Rationale: xxx

STAT Response: xxx

Request No. 2:

Rationale: xxx

STAT Response: xxx

Request No. 3:

Rationale: x.

STAT Response: xxx

Request No. 4:

Rationale: xxx

STAT Response: xxx

Request No. 5:

Rationale: xxx

STAT Response: xxx

2.6 Base Case Model Results

`base-case-model-results`

The following description of the model results reflects a base model that incorporates all of the changes made during the STAR panel (see previous section). The base model parameter estimates and their approximate asymptotic standard errors are shown in Table **??** and the likelihood components are in Table **??**. Estimates of derived reference points and approximate 95% asymptotic confidence intervals are shown in Table e. Time-series of estimated stock size over time are shown in Table **??**.

2.6.1 Parameter Estimates

`parameter-estimates`

The additional survey variability (process error added directly to each year's input variability) for all surveys was estimated within the model.

(Figure **??**).

The stock-recruit curve ... Figure **??** with estimated recruitments also shown.

2.6.2 Fits to the Data

fits-to-the-data

Model fits to the indices of abundance, fishery length composition, survey length composition, and conditional age-at-length observations are all discussed below.

2.6.3 Uncertainty and Sensitivity Analyses

uncertainty-and-sensitivity-analyses

A number of sensitivity analyses were conducted, including:

1. Sensitivity 1
2. Sensitivity 2
3. Sensitivity 3
4. Sensitivity 4
5. Sensitivity 5, etc/

2.6.4 Retrospective Analysis

retrospective-analysis

2.6.5 Likelihood Profiles

likelihood-profiles

2.6.6 Reference Points

reference-points-1

Reference points were calculated using the estimated selectivities and catch distribution among fleets in the most recent year of the model, (2017). Sustainable total yield (landings plus discards) were 169 mt when using an $SPR_{50\%}$ reference harvest rate and with a 95% confidence interval of 104 mt based on estimates of uncertainty. The spawning biomass equivalent to 40% of the unfished level ($SB_{40\%}$) was 554 mt.

(Figure **??**

The 2018 spawning biomass relative to unfished equilibrium spawning biomass is above/below the target of 40% of unfished levels (Figure **??**). The relative fishing intensity, $(1 - SPR)/(1 - SPR_{50\%})$, has been xxx the management target for the entire time series of the model.

Table e shows the full suite of estimated reference points for the base model and Figure **??** shows the equilibrium curve based on a steepness value xxx.

3 Harvest Projections and Decision Tables

harvest-projections-and-decision-tables

The forecasts of stock abundance and yield were developed using the final base model, with the forecasted projections of the OFL presented in Table g.

The forecasted projections of the OFL for each model are presented in Table h.

4 Regional Management Considerations

regional-management-considerations

5 Research Needs

research-needs

There are a number of areas of research that could improve the stock assessment for GBYR. Below are issues identified by the STAT team and the STAR panel:

1. **xxxx**:
2. **xxxx**:
3. **xxxx**:
4. **xxxx**:
5. **xxxx**:

6 Acknowledgments

acknowledgments

7 Tables

tables

Table 1: Commercial landings and discards (mt) from the commercial fisheries. Data sources are the California Catch Reconstruction, CALCOM, and WCGOP GEMM report.

Year	Landings	Discards	Total Commercial Removals	Source
1916	3.88	0.38	4.27	Catch Reconstruction
1917	6.03	0.59	6.63	Catch Reconstruction
1918	7.06	0.69	7.75	Catch Reconstruction
1919	4.91	0.48	5.39	Catch Reconstruction
1920	5.01	0.49	5.50	Catch Reconstruction
1921	4.13	0.41	4.54	Catch Reconstruction
1922	3.56	0.35	3.90	Catch Reconstruction
1923	3.84	0.38	4.22	Catch Reconstruction
1924	2.22	0.22	2.44	Catch Reconstruction
1925	2.78	0.27	3.05	Catch Reconstruction
1926	4.48	0.44	4.92	Catch Reconstruction
1927	3.81	0.37	4.18	Catch Reconstruction
1928	4.60	0.45	5.06	Catch Reconstruction
1929	3.81	0.37	4.18	Catch Reconstruction
1930	5.40	0.53	5.93	Catch Reconstruction
1931	1.93	0.19	2.11	Catch Reconstruction
1932	6.24	0.61	6.85	Catch Reconstruction
1933	2.58	0.25	2.84	Catch Reconstruction
1934	1.75	0.17	1.92	Catch Reconstruction
1935	0.43	0.04	0.47	Catch Reconstruction
1936	0.01	0.00	0.01	Catch Reconstruction
1937	7.27	0.71	7.98	Catch Reconstruction
1938	10.29	1.01	11.30	Catch Reconstruction
1939	13.13	1.29	14.42	Catch Reconstruction
1940	16.90	1.66	18.56	Catch Reconstruction
1941	17.06	1.67	18.73	Catch Reconstruction
1942	8.55	0.84	9.38	Catch Reconstruction
1943	11.00	1.08	12.08	Catch Reconstruction
1944	0.05	0.00	0.05	Catch Reconstruction
1945	0.59	0.06	0.65	Catch Reconstruction
1946	16.71	1.64	18.35	Catch Reconstruction
1947	26.71	2.62	29.33	Catch Reconstruction
1948	23.95	2.35	26.30	Catch Reconstruction
1949	18.29	1.79	20.09	Catch Reconstruction
1950	17.15	1.68	18.83	Catch Reconstruction
1951	24.83	2.44	27.26	Catch Reconstruction

Continues next page

tab:CommCatches

Table 1: Commercial landings and discards (mt) from the commercial fisheries. Data sources are the California Catch Reconstruction, CALCOM, and WCGOP GEMM report.

Year	Landings	Discards	Total Commercial Removals	Source
1952	27.59	2.71	30.29	Catch Reconstruction
1953	32.30	3.17	35.47	Catch Reconstruction
1954	40.75	4.00	44.74	Catch Reconstruction
1955	29.49	2.89	32.38	Catch Reconstruction
1956	40.66	3.99	44.65	Catch Reconstruction
1957	37.52	3.68	41.20	Catch Reconstruction
1958	33.56	3.29	36.86	Catch Reconstruction
1959	19.62	1.92	21.54	Catch Reconstruction
1960	11.30	1.11	12.41	Catch Reconstruction
1961	17.49	1.72	19.20	Catch Reconstruction
1962	27.18	2.67	29.85	Catch Reconstruction
1963	22.29	2.19	24.48	Catch Reconstruction
1964	16.55	1.62	18.17	Catch Reconstruction
1965	21.50	2.11	23.61	Catch Reconstruction
1966	13.44	1.32	14.76	Catch Reconstruction
1967	6.70	0.66	7.36	Catch Reconstruction
1968	8.29	0.81	9.10	Catch Reconstruction
1969	9.99	0.98	10.97	CALCOM
1970	14.21	1.39	15.60	CALCOM
1971	14.41	1.41	15.83	CALCOM
1972	19.42	1.91	21.33	CALCOM
1973	31.43	3.08	34.51	CALCOM
1974	33.41	3.28	36.69	CALCOM
1975	33.08	3.25	36.33	CALCOM
1976	33.90	3.33	37.23	CALCOM
1977	30.13	2.96	33.09	CALCOM
1978	43.41	4.26	47.67	CALCOM
1979	34.24	3.36	37.60	CALCOM
1980	63.65	6.24	69.89	CALCOM
1981	52.67	5.17	57.84	CALCOM
1982	38.96	3.82	42.78	CALCOM
1983	26.89	2.64	29.52	CALCOM
1984	14.82	1.45	16.27	CALCOM
1985	8.42	0.83	9.25	CALCOM
1986	25.49	2.50	27.99	CALCOM
1987	34.21	3.36	37.57	CALCOM
1988	55.73	5.47	61.20	CALCOM
1989	45.48	4.46	49.94	CALCOM

Continues next page

tab:CommCatches

Table 1: Commercial landings and discards (mt) from the commercial fisheries. Data sources are the California Catch Reconstruction, CALCOM, and WCGOP GEMM report.

Year	Landings	Discards	Total Commercial Removals	Source
1990	46.77	4.59	51.36	CALCOM
1991	68.85	6.75	75.60	CALCOM
1992	83.99	8.24	92.23	CALCOM
1993	74.09	7.27	81.35	CALCOM
1994	60.06	5.89	65.95	CALCOM
1995	91.42	8.97	100.39	CALCOM
1996	94.71	9.29	104.00	CALCOM
1997	69.37	6.81	76.18	CALCOM
1998	65.28	6.40	71.68	CALCOM
1999	62.70	6.15	68.85	CALCOM
2000	53.91	5.29	59.20	CALCOM
2001	53.41	5.24	58.65	CALCOM
2002	42.28	4.15	46.42	CALCOM
2003	20.18	13.04	33.22	CALCOM & WCGOP
2004	26.27	2.66	28.93	CALCOM & WCGOP
2005	28.09	3.33	31.42	CALCOM & WCGOP
2006	23.87	4.10	27.96	CALCOM & WCGOP
2007	30.14	4.50	34.64	CALCOM & WCGOP
2008	36.06	1.63	37.69	CALCOM & WCGOP
2009	35.42	5.38	40.80	CALCOM & WCGOP
2010	38.65	3.92	42.57	CALCOM & WCGOP
2011	42.28	5.72	48.01	CALCOM & WCGOP
2012	33.46	1.93	35.39	CALCOM & WCGOP
2013	33.17	2.85	36.02	CALCOM & WCGOP
2014	36.15	2.85	39.00	CALCOM & WCGOP
2015	43.18	2.93	46.11	CALCOM & WCGOP
2016	36.84	2.42	39.26	CALCOM & WCGOP
2017	41.51	1.65	43.15	CALCOM & WCGOP
2018	46.08	2.54	48.62	CALCOM & WCGOP

Table 2: Length composition sample sizes for fishery dependent data. Continuous years begin in 1975. Recreational north samples include Karpov et al., MRFSS, and CRFS data. Recreational south samples include Karpov et al., Collins and Crooke unpub., Ally et al. 1991, MRFSS, and CRFS data.

tab:length_samples_fishery

	CALCOM		WCGOP		Rec North		Rec South		Deb VW	
Year	Trips	Lengths	Trips	Lengths	Trips	Lengths	Trips	Lengths	Trips	Lengths
1959					27	271	2.10	21		
1960					39	394	1.40	14		
1961					1	8	0.10	1		
1966					1	7				
1975							50.00	159		
1976							73.00	224		
1977							96.00	392		
1978							91.00	533		
1979										
1980					4	164	21.00	53		
1981					1	19	30.00	100		
1982					1	50	17.00	58		
1983					6	323	60.00	170		
1984					14	849	42.00	150		
1985					35	1027	34.00	180		
1986					36	826	28.00	86		
1987	2	82			28	392	5.00	7	14	73
1988					30	303	10.00	30	54	664
1989					19	303	7.00	11	70	727
1990									17	109
1991									38	722
1992	56	671							55	838
1993	148	1648			14	1094	8.00	24	75	614
1994	170	1379			12	608	1.00	15	86	735
1995	174	1523							90	1171
1996	256	3270			74	607	14.00	32	100	1364
1997	140	1319			95	1424	7.00	23	107	1415
1998	206	2549			89	614	19.00	66	83	1048
1999	251	3283			49	1112	33.00	301		
2000	384	4918			21	695	12.00	58		
2001	142	2179			46	929	14.00	35		
2002	59	870			58	1656	22.00	65		
2003	55	625			72	1690	15.00	100		
2004	63	770	72	572	19	2023	3.00	42		
2005	72	700	42	260	30	3217	8.00	93		
2006	31	478	42	266	35	3737	9.00	106		
2007	80	1165	37	268	30	3200	10.00	126		
2008	46	503	12	46	39	4165	11.00	132		
2009	73	854	22	263	43	4612	15.00	184		
2010	75	925	37	344	47	4992	16.00	192		
2011	61	858	68	366	44	4692	22.00	270		
2012	57	709	69	302	46	4904	89.00	1081		
2013	48	581	56	348	40	4339	77.00	930		
2014	15	184	62	388	44	4746	49.00	595		
2015	48	578	93	521	54	5789	36.00	436		
2016	77	928	56	317	58	6265	37.00	444		
2017	67	1581	49	226	44	4691	39.00	478		
2018	67	1210			33	3563	26.00	317		

Table 3: Recreational removals (mt) of GBYR. Data sources are the California Catch Reconstruction (modified for south of Pt. Conception), MRFSS (modified for 1981-1982), and CRFS.

Year	North of Pt. Conception	South of Pt. Conception	Total Recreational Removals	Source
1928	0.84	0.02	0.85	Catch Reconstruction
1929	1.67	0.03	1.70	Catch Reconstruction
1930	1.92	0.05	1.97	Catch Reconstruction
1931	2.56	0.06	2.62	Catch Reconstruction
1932	3.20	0.08	3.28	Catch Reconstruction
1933	3.84	0.09	3.93	Catch Reconstruction
1934	4.48	0.11	4.59	Catch Reconstruction
1935	5.12	0.12	5.24	Catch Reconstruction
1936	5.76	0.22	5.98	Catch Reconstruction
1937	6.82	0.31	7.14	Catch Reconstruction
1938	6.71	0.41	7.12	Catch Reconstruction
1939	5.87	0.50	6.37	Catch Reconstruction
1940	8.45	0.60	9.05	Catch Reconstruction
1941	7.81	0.69	8.51	Catch Reconstruction
1942	4.15	0.79	4.94	Catch Reconstruction
1943	3.97	0.88	4.85	Catch Reconstruction
1944	3.26	0.98	4.24	Catch Reconstruction
1945	4.35	1.07	5.42	Catch Reconstruction
1946	7.48	1.17	8.65	Catch Reconstruction
1947	5.92	1.26	7.18	Catch Reconstruction
1948	11.81	1.36	13.17	Catch Reconstruction
1949	15.30	1.45	16.76	Catch Reconstruction
1950	18.65	1.55	20.20	Catch Reconstruction
1951	22.97	1.64	24.61	Catch Reconstruction
1952	19.99	1.74	21.73	Catch Reconstruction
1953	17.02	1.83	18.85	Catch Reconstruction
1954	21.16	1.93	23.09	Catch Reconstruction
1955	25.23	2.02	27.25	Catch Reconstruction
1956	28.17	2.12	30.28	Catch Reconstruction
1957	31.80	2.21	34.01	Catch Reconstruction
1958	48.15	2.31	50.46	Catch Reconstruction
1959	38.25	2.40	40.65	Catch Reconstruction
1960	28.66	2.50	31.15	Catch Reconstruction
1961	27.74	2.59	30.33	Catch Reconstruction
1962	28.04	2.69	30.73	Catch Reconstruction
1963	27.53	2.78	30.32	Catch Reconstruction
1964	21.73	2.88	24.61	Catch Reconstruction

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tab:Rec_removal

Table 3: Recreational removals (mt) of GBYR. Data sources are the California Catch Reconstruction (modified for south of Pt. Conception), MRFSS (modified for 1981-1982), and CRFS.

Year	North of Pt. Conception	South of Pt. Conception	Total Recreational Removals	Source
1965	31.10	2.97	34.07	Catch Reconstruction
1966	33.85	3.07	36.91	Catch Reconstruction
1967	37.08	3.16	40.25	Catch Reconstruction
1968	36.78	3.26	40.03	Catch Reconstruction
1969	31.46	3.35	34.81	Catch Reconstruction
1970	41.25	3.45	44.70	Catch Reconstruction
1971	31.18	3.54	34.72	Catch Reconstruction
1972	41.50	3.64	45.13	Catch Reconstruction
1973	50.02	3.73	53.75	Catch Reconstruction
1974	51.60	3.83	55.43	Catch Reconstruction
1975	49.01	3.92	52.93	Catch Reconstruction
1976	49.30	4.02	53.32	Catch Reconstruction
1977	41.99	4.11	46.10	Catch Reconstruction
1978	32.57	4.21	36.77	Catch Reconstruction
1979	36.23	4.30	40.53	Catch Reconstruction
1980	80.56	4.54	85.10	MRFSS
1981	81.32	1.42	82.74	Estimated
1982	82.08	0.90	82.99	Estimated
1983	82.85	3.29	86.14	MRFSS
1984	150.47	5.58	156.05	MRFSS
1985	158.34	5.74	164.08	MRFSS
1986	171.81	6.52	178.33	MRFSS
1987	118.51	5.78	124.29	MRFSS
1988	79.43	4.80	84.23	MRFSS
1989	66.61	3.57	70.19	MRFSS
1990	82.33	2.73	85.06	MRFSS
1991	98.04	1.89	99.93	MRFSS
1992	113.76	1.04	114.80	MRFSS
1993	127.71	1.97	129.68	MRFSS
1994	97.39	3.03	100.42	MRFSS
1995	49.25	1.19	50.44	MRFSS
1996	38.06	5.23	43.28	MRFSS
1997	38.15	2.84	40.99	MRFSS
1998	43.55	2.52	46.07	MRFSS
1999	48.17	10.45	58.61	MRFSS
2000	66.53	4.39	70.92	MRFSS
2001	106.23	3.29	109.53	MRFSS

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tab:Rec_removal

Table 3: Recreational removals (mt) of GBYR. Data sources are the California Catch Reconstruction (modified for south of Pt. Conception), MRFSS (modified for 1981-1982), and CRFS.

Year	North of Pt. Conception	South of Pt. Conception	Total Recreational Removals	Source
2002	84.28	2.15	86.43	MRFSS
2003	111.50	2.70	114.20	MRFSS
2004	41.75	0.98	42.73	CRFS
2005	47.51	6.59	54.10	CRFS
2006	48.10	2.13	50.22	CRFS
2007	32.88	2.70	35.58	CRFS
2008	45.14	3.61	48.74	CRFS
2009	65.64	4.30	69.94	CRFS
2010	106.76	3.90	110.67	CRFS
2011	76.16	10.24	86.40	CRFS
2012	48.25	9.89	58.14	CRFS
2013	38.43	8.86	47.28	CRFS
2014	56.96	9.06	66.02	CRFS
2015	58.09	5.00	63.09	CRFS
2016	65.72	6.57	72.29	CRFS
2017	49.36	11.15	60.51	CRFS
2018	36.48	6.30	42.78	CRFS

Table 4: Length composition sample sizes for survey data.

tab:length_samples_survey

	CCFRP		PISCO	
Year	Trips	Lengths	Trips	Lengths
2001			55	222
2002			56	438
2003			64	473
2004			64	312
2005			65	241
2006			68	220
2007	35	2147	68	156
2008	52	3143	67	198
2009	35	1579	68	154
2010	32	2201	58	144
2011	32	1727	68	260
2012	32	1820	40	183
2013	32	685	61	258
2014	32	1655	61	313
2015	18	1121	64	622
2016	32	2015	56	346
2017	58	2402	58	317
2018	29	1975	60	264

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Table 5: Summary of indices used in this assessment.

tab:Index_summary

Fleet	Years	Name	Type	Area	Method	Endorsed
5	1988-1998	Deb Wilson-Vandenberg's Onboard Observer Survey	Fishery-dependent	Central California	Delta lognormal	SSC
6	2001-2018	CRFS CPFV Onboard Observer Survey	Fishery-dependent	North of Pt. Conception	Delta lognormal	SSC
7	2001-2018	CRFS CPFV Onboard Observer Survey	Fishery-dependent	South of Pt. Conception	Delta lognormal	SSC
8	2001-2018	PISCO Dive Survey	Fishery-independent	North of Pt. Conception	Negative Binomial	First use in stock assessment
9	2007-2018	CCFRP Hook-and-Line Survey	Fishery-independent	Central California	Negative Binomial	First use in stock assessment
10	1984-1999	MRFSS Dockside Survey	Fishery-dependent	North of Pt. Conception	Negative Binomial	SSC
11	1980-1999	MRFSS Dockside Survey	Fishery-dependent	South of Pt. Conception	Negative Binomial	SSC

Table 6: Index inpus.

tab:Indices

	Deb WV		MRFSS N		MRFSS S		Onboard N		Onboard S		CCFRP		PISCO	
Year	Obs	se_log	Obs	se_log	Obs	se_log	Obs	se_log	Obs	se_log	Obs	se_log	Obs	se_log
1980					0.08	0.21								
1981					0.05	0.24								
1982					0.07	0.25								
1983					0.13	0.13								
1984			0.04	0.60	0.09	0.17								
1985			0.03	0.55	0.09	0.21								
1986			0.09	0.58	0.03	0.19								
1987			0.02	0.66										
1988	0.22	0.17	0.03	0.61										
1989	0.34	0.15	0.02	0.66										
1990														
1991														
1992	0.30	0.17												
1993	0.20	0.14												
1994	0.23	0.12												
1995	0.25	0.10	0.04	0.64										
1996	0.28	0.10	0.04	0.52	0.04	0.28								
1997	0.21	0.09												
1998	0.24	0.11			0.05	0.26								
1999			0.03	0.53	0.05	0.22								
2000														
2001							0.32	0.12	0.01	0.52			1.66	0.23
2002							0.19	0.14	0.01	0.37			2.05	0.21
2003							0.28	0.07	0.03	0.33			2.53	0.19
2004							0.27	0.06	0.01	0.37			1.29	0.22
2005							0.26	0.08	0.02	0.24			0.91	0.24
2006							0.34	0.08	0.04	0.21			0.87	0.23
2007							0.33	0.08	0.08	0.16	1.20	0.15	0.69	0.24
2008							0.33	0.08	0.06	0.16	1.14	0.16	0.92	0.22
2009							0.27	0.08	0.07	0.16	1.13	0.16	0.59	0.22
2010							0.26	0.07	0.08	0.15	1.32	0.16	0.67	0.21
2011							0.24	0.07	0.15	0.11	0.97	0.16	1.24	0.19
2012							0.18	0.08	0.09	0.11	1.00	0.15	1.34	0.23
2013							0.09	0.09	0.07	0.12	0.38	0.16	1.45	0.22
2014							0.10	0.10	0.09	0.13	0.81	0.15	1.43	0.23
2015							0.17	0.10	0.06	0.17	1.03	0.16	2.55	0.22
2016							0.18	0.08	0.09	0.14	0.96	0.16	2.17	0.22
2017							0.15	0.12	0.08	0.17	1.18	0.16	1.80	0.23
2018							0.30	0.10	0.08	0.18	1.33	0.16	1.24	0.19

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Table 7: Data filtering steps for Deb Wilson-Vandenberg's CPFV onboard observer index of abundance

tab:Fleet5_Filter

Filter	Drifts	Positive Drifts
Remove errors, missing data	6691	1470
Remove 1987 (sampled only MNT), 1990-1991 low sample sizes	4283	1372
Remove reefs that never encountered GBY	4022	1372
Remove lower and upper 2.5% of time fished	3762	1300
Remove depth less than 9 m and greater than 69 m	3515	1279
Remove reefs with low sample rates	2411	1096

Table 8: Model selection for Deb Wilson-Vandenberg's CPFV onboard observer index of abundance. Bold values indicate the model selected.

tab:Fleet5_AIC

Model	Lognormal	Binomial
Year	2834	3330
Year + Depth	2781	2906
Year + Reef	2716	2880
Year + Month	2839	3286
Year + Depth + Reef	**2625**	**2488**
Year + Month+ Reef	2725	2844
Year + Depth + Month	2780	2902
Year+ Depth+Month+Reef	2632	2479

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8 Figures

figures

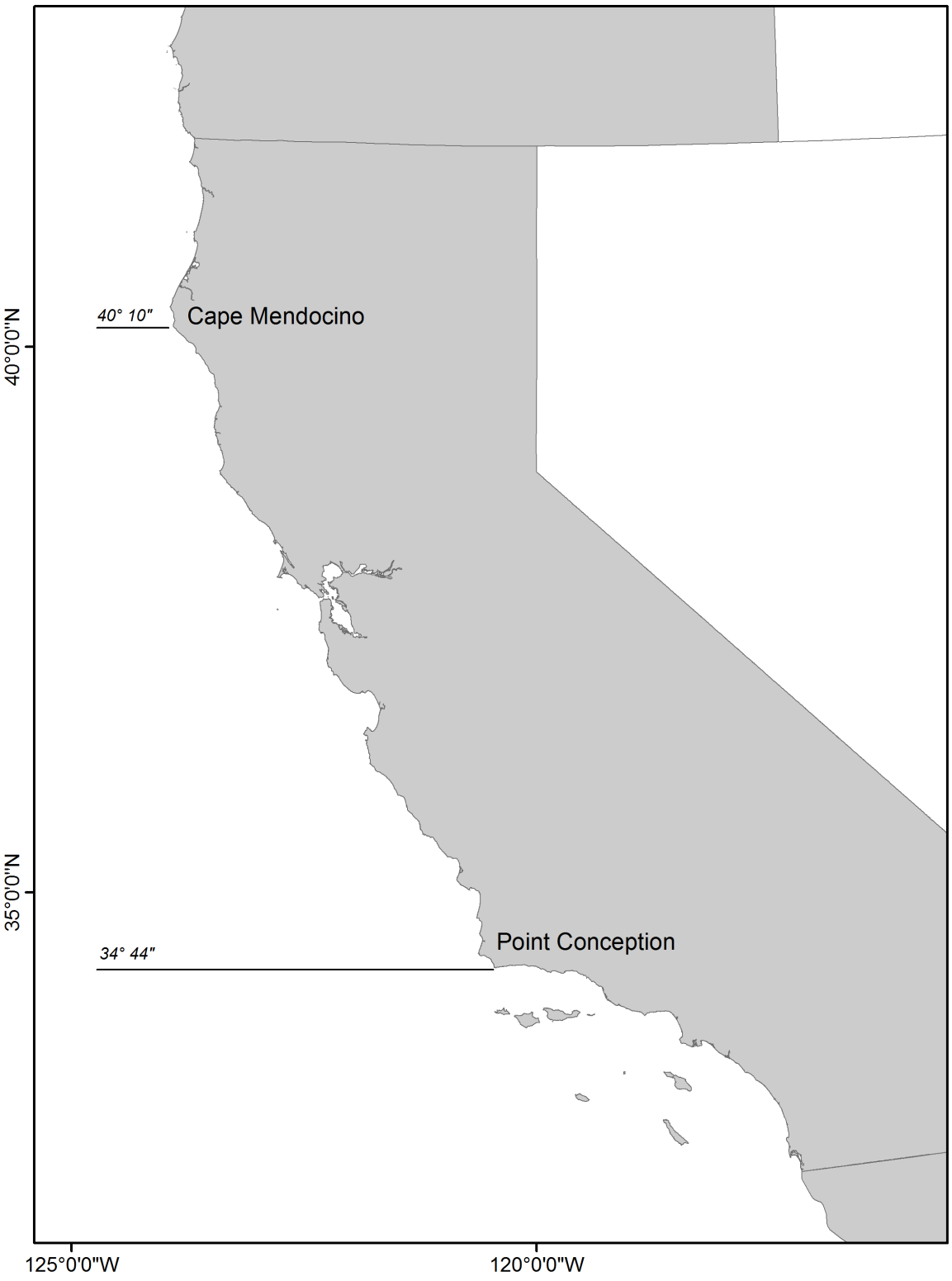

Figure 1: Map showing the management area for gopher and black-and-yellow rockfish from Cape Mendocino to the U.S. Mexico border.{fig:assess_reagion_map}

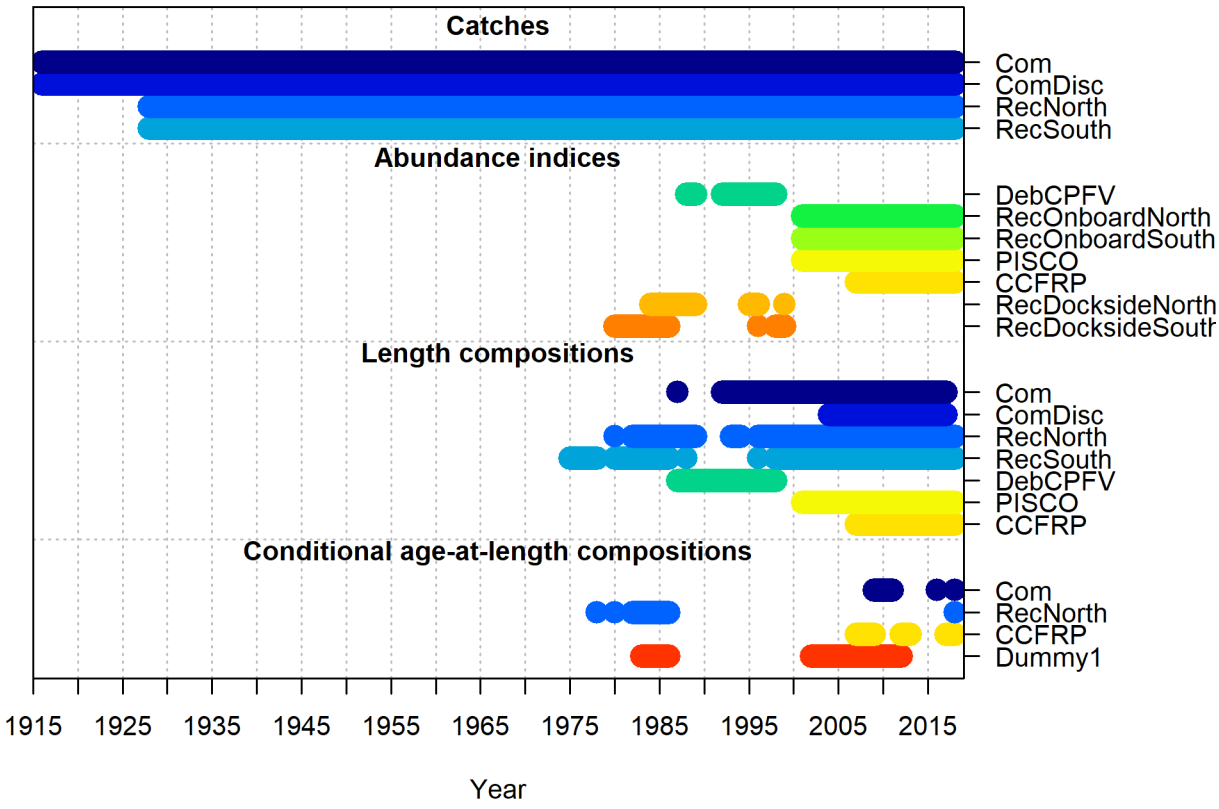

Figure 2: Summary of data sources used in the model. `fig:data_plot`

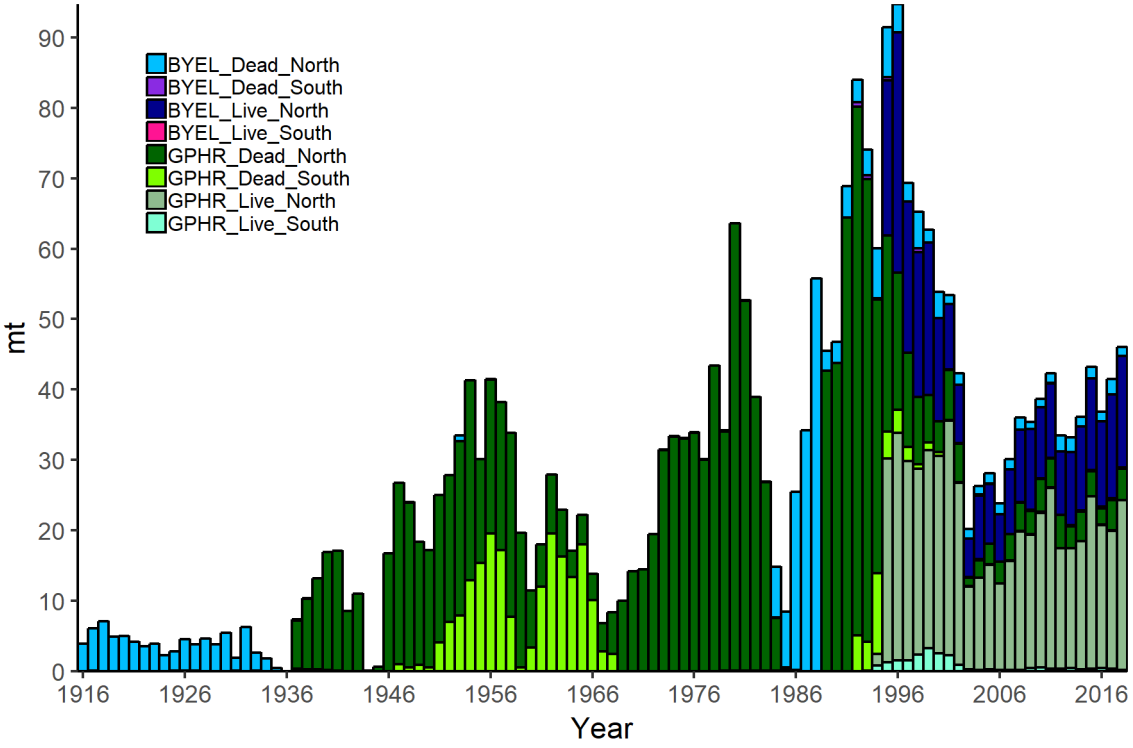

Figure 3: Commercial landings for gopher (GPHR) and black-and-yellow (BYEL) rockfishes landed live and dead north and south of Pt. Conception. All catch time series were combined for the assessment into one commercial fleet. `fig:Catches_livedeadNS_gby`

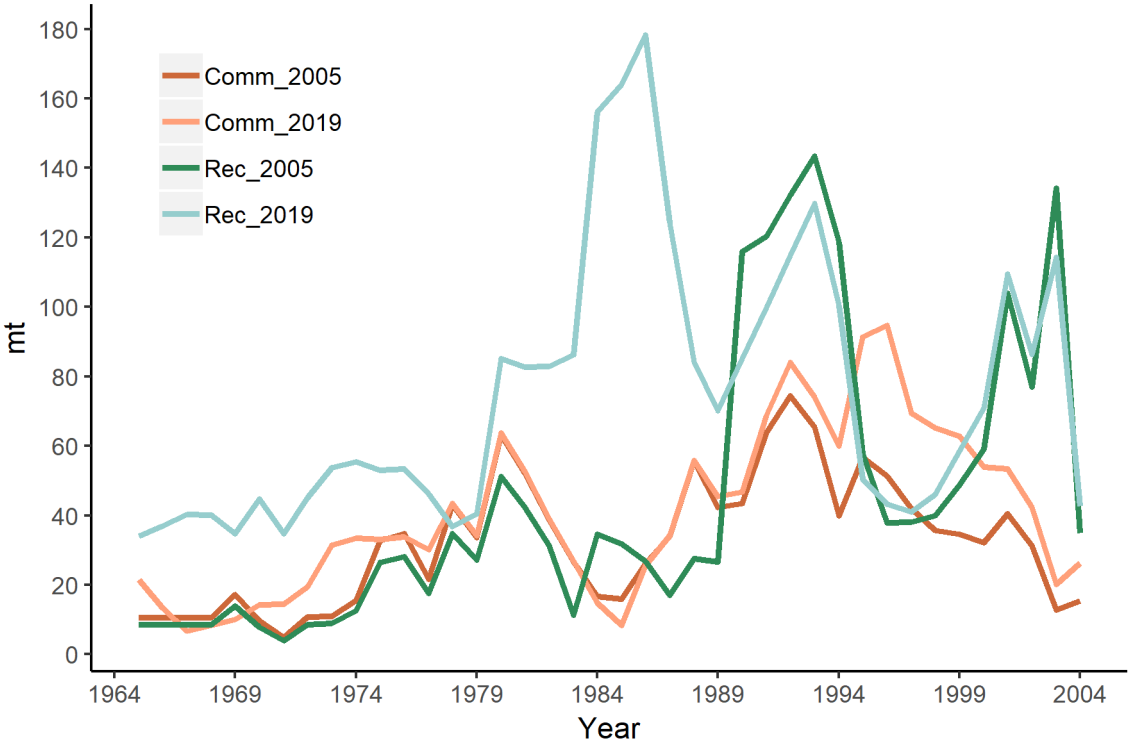

Figure 4: Comparison of the recreational and commercial fishery landings from the 2005 assessment to this 2019 assessment. Note that the 2019 assessment includes both gopher and black-and-yellow rockfish where the 2005 assessment represents gopher rockfish only. The 2005 assessment also did not include landings from south of Pt. Conception. fig:Assessment_compar

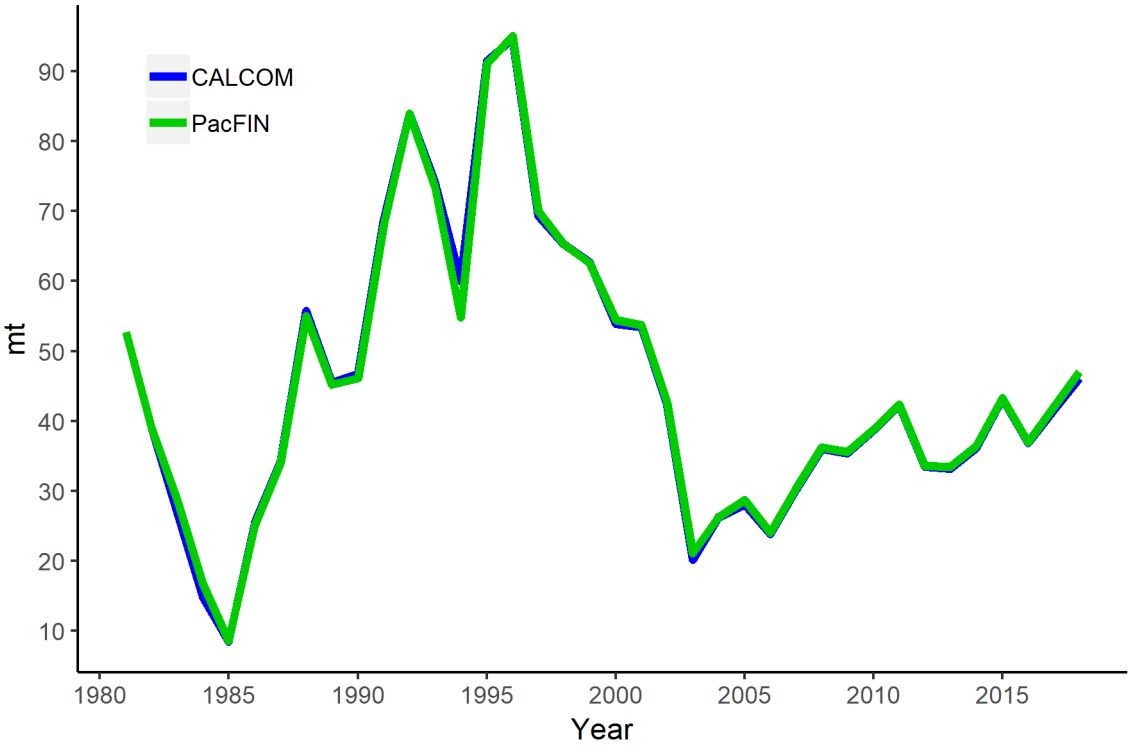

Figure 5: Commercial landings estimates from CALCOM add PacFIN. `fig:Calcom_vs_Pacfin`

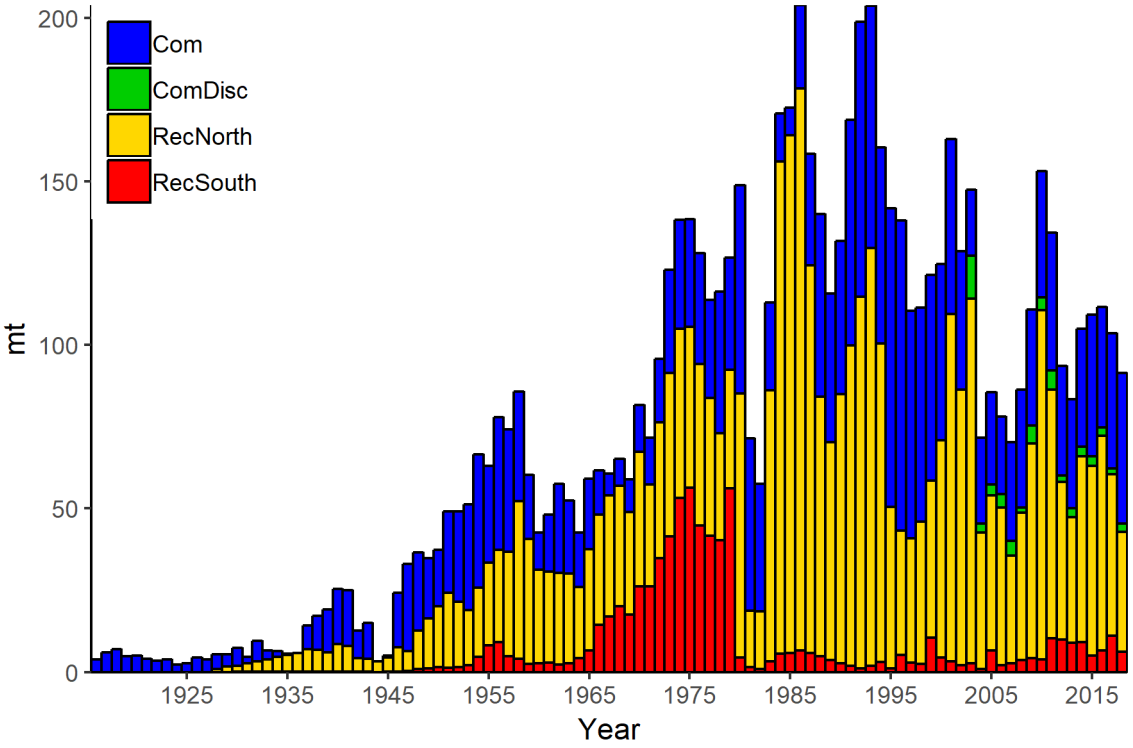

Figure 6: Commercial and recreational landings estimates prior to any data modification or interpolation to the recreational catches or hindcasting of commercial discards. `fig:Catches_original`

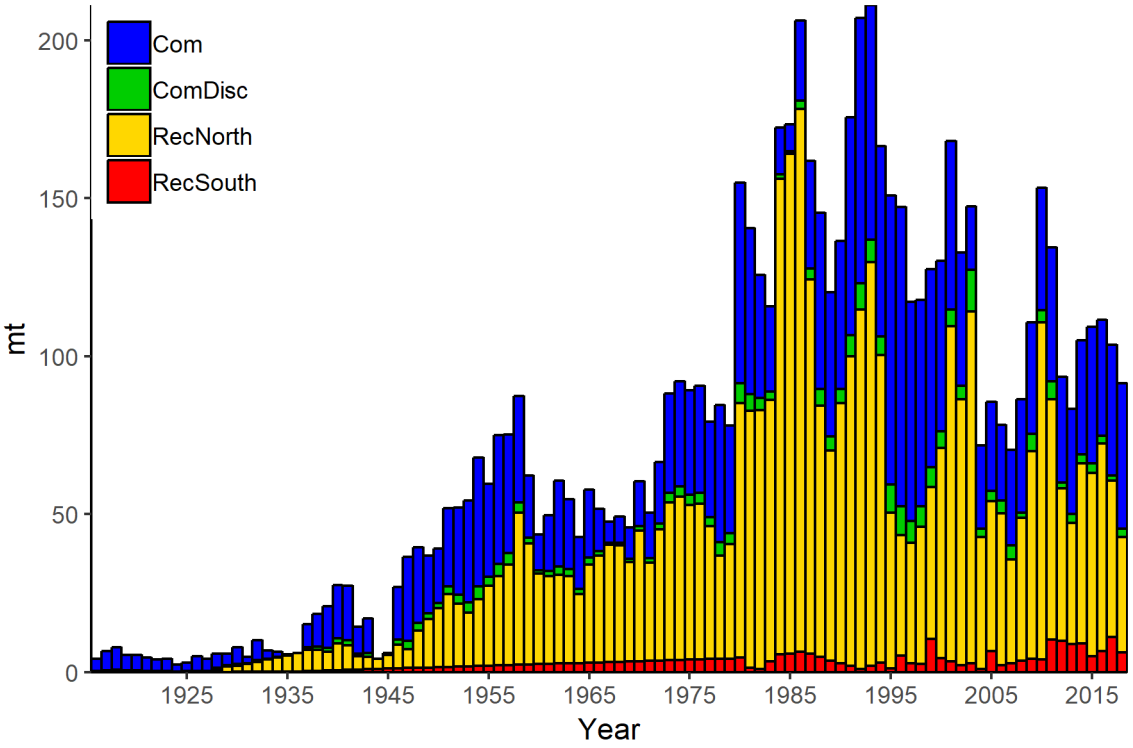

Figure 7: Commercial and recreational landings estimates after data modification and interpolations were made to the recreational catches and commercial discards. ⌜fig:Catches_alternate

544 ¡!– ********** –¿

References

references

Bertalanffy, L. von. 1938. A quantitative theory of organic growth. Human Biology **10**: 181–213.

Collins, R., and Crooke, S. (n.d.). An evaluation of the commercial passenger fishing vessel record system and the results of sampling the Southern California catch for species and size composition, 1975-1978. Unpublished report.

Hamel, O. 2015. A method for calculating a meta-analytical prior for the natural mortality rate using multiple life history correlates. ICES Journal of Marine Science **72**: 62–69.

Karpov, K.A., Albin, D.P., and Van Buskirk, W. 1995. The marine recreational fishery in northern California and central California: a historical comparison (1958–86), status of stocks (1980–1986), and effects of changes in the California Current. California Department of Fish Game Fish Bulletin **176**.

Pacific Fishery Managment Council. 2018. Status of the Pacific Coast Groundfish Fishery: Stock Assessment and Fishery Evaluation.

Pearson, D.E., Erwin, B., and Key, M. 2008. Reliability of California's groundfish landings estimates from 1969-2006. NOAA Technical Memorandum NMFS **NOAA-TM-NM**.

Ralston, S., Pearson, D., Field, J., and Key, M. 2010. Documentation of California catch reconstruction project. NOAA-TM-NMFS-SWFSC-461.

Somers, K.A., J. Jannot, V. Tuttle, K. Richerson, N.R., and McVeigh, J. 2018. Estimated discard and catch of groundfish species in the 2017 US west coast fisheries.. NOAA Fisheries, NWFSC Observer Program, 2725 Montlake Blvd E., Seattle, WA 98112.