



NOAA
FISHERIES

Assessment of Copper Rockfish in California Waters

Biology, Fisheries, Data, and Model Inputs

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Summary of Previous Assessments

- **2013 (Cope et al. 2013)**
 - **Data-moderate (2 areas)**
 - **South of Point Conception**
 - 75% of unfished spawning output
 - **North of Point Conception (including OR/WA)**
 - 48% of unfished spawning output
- **2021(Wetzel et al. 2021 a,b)**
 - **Data-moderate (4 areas)**
 - **California – South of Point Conception**
 - 18.1% of unfished spawning output
 - **California – North of Point Conception**
 - 39.3% of unfished spawning output
 - **Oregon**
 - **Washington**

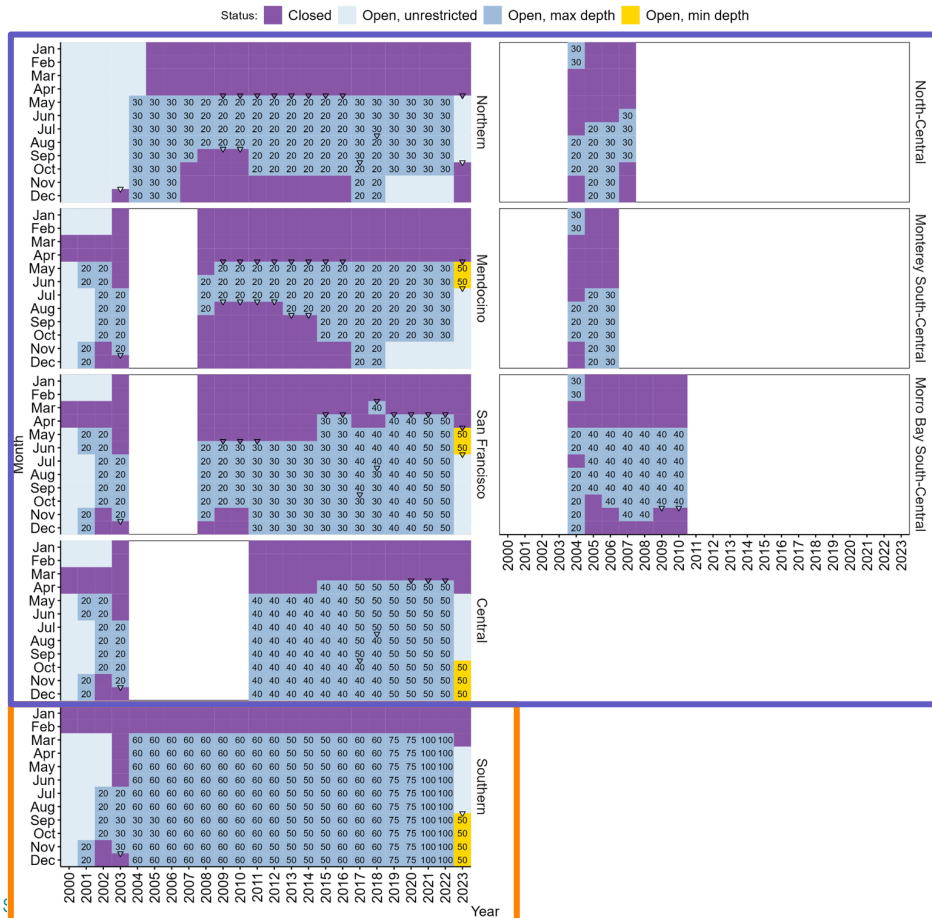
Recreational Management History and Considerations

North of Point Conception

- Latitudinal changes in management boundaries
- Full closures vary, but depth restrictions fairly consistent with latitude
- Most restrict depths in the northern latitudes
- All areas gained access to an additional 10-20 fm starting in 2016
- 2023 regulations differ

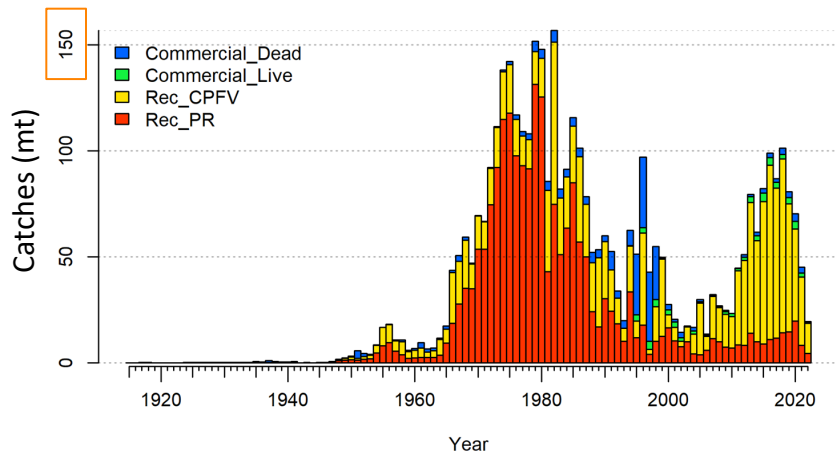
South of Point Conception

- Consistent closure in Jan/Feb since 2000
- Limited to 50 fm from 2013-2015
- Access to deeper depths starting in 2016
- 2023 regulations differ

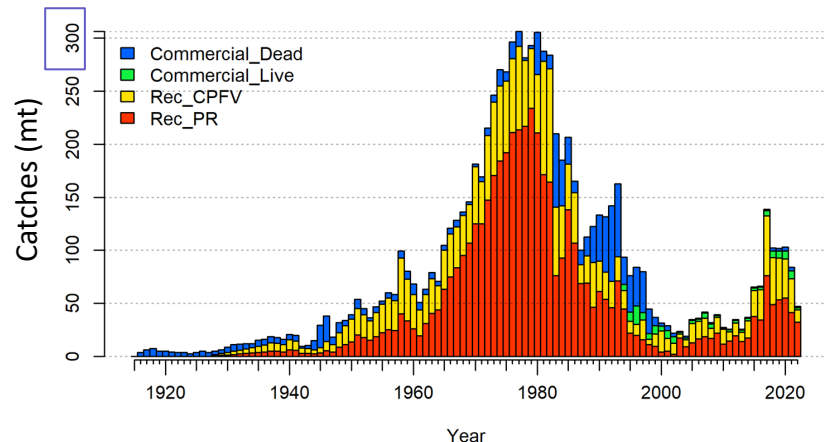


Catches (Landings + Discards)

South of Point Conception



North of Point Conception



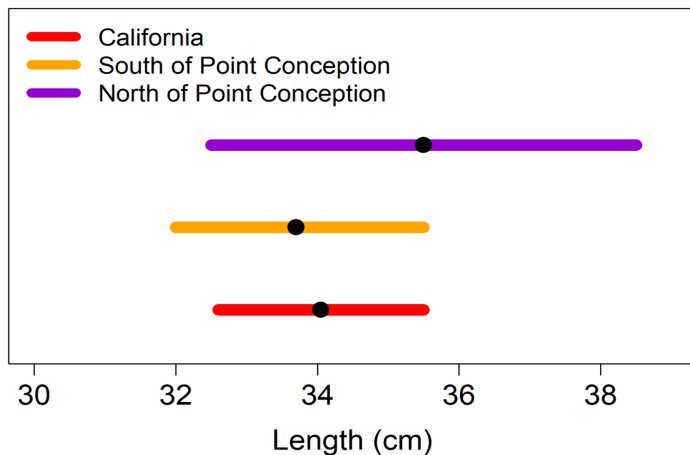
- Magnitude of catches are generally greater north of Point Conception by year (note difference in y-axes)
- In recent years, the CPFV dominates catches south of Point Conception, and it is more equally split between CPFV and PR recreational catches in the north

Maturity and Fecundity

- **Functional maturity**

- Estimated from fishery-independent samples by Melissa Head (NWFSC)
- Samples from September and October
 - 18 samples north of Point Conception
 - 94 samples south of Point Conception
- Pooled California estimate for the north
 - 50% mature at 34.0 cm
- South-specific estimate
 - 50% mature at 33.7 cm

Point Estimates & Confidence Intervals

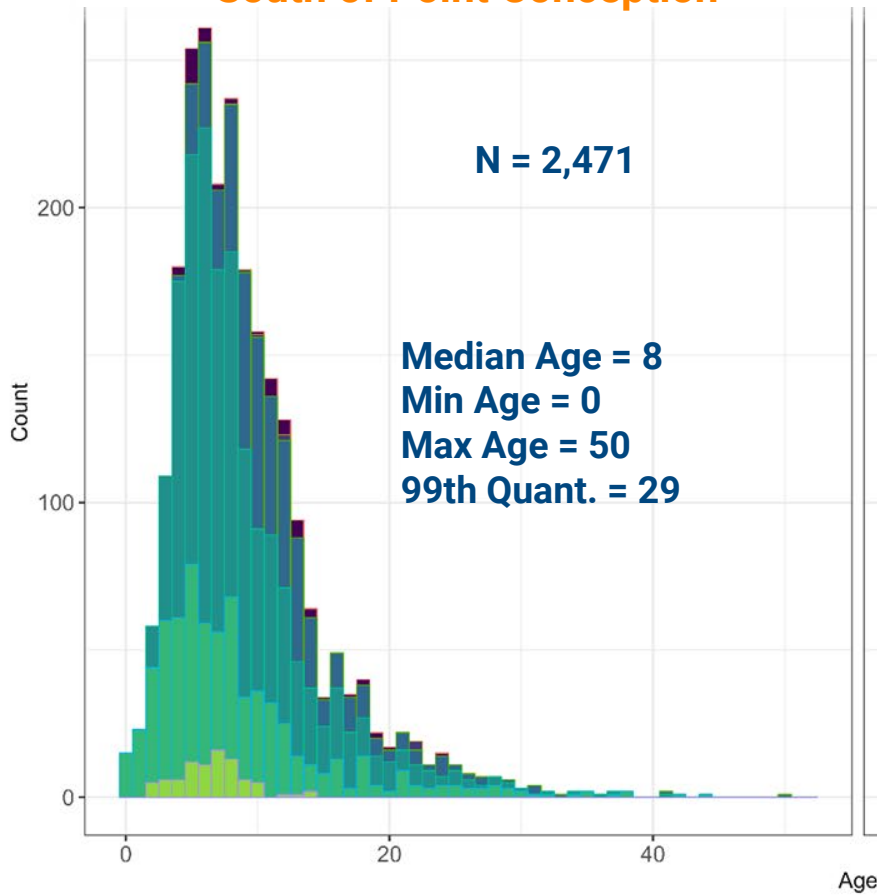


- **Fecundity**

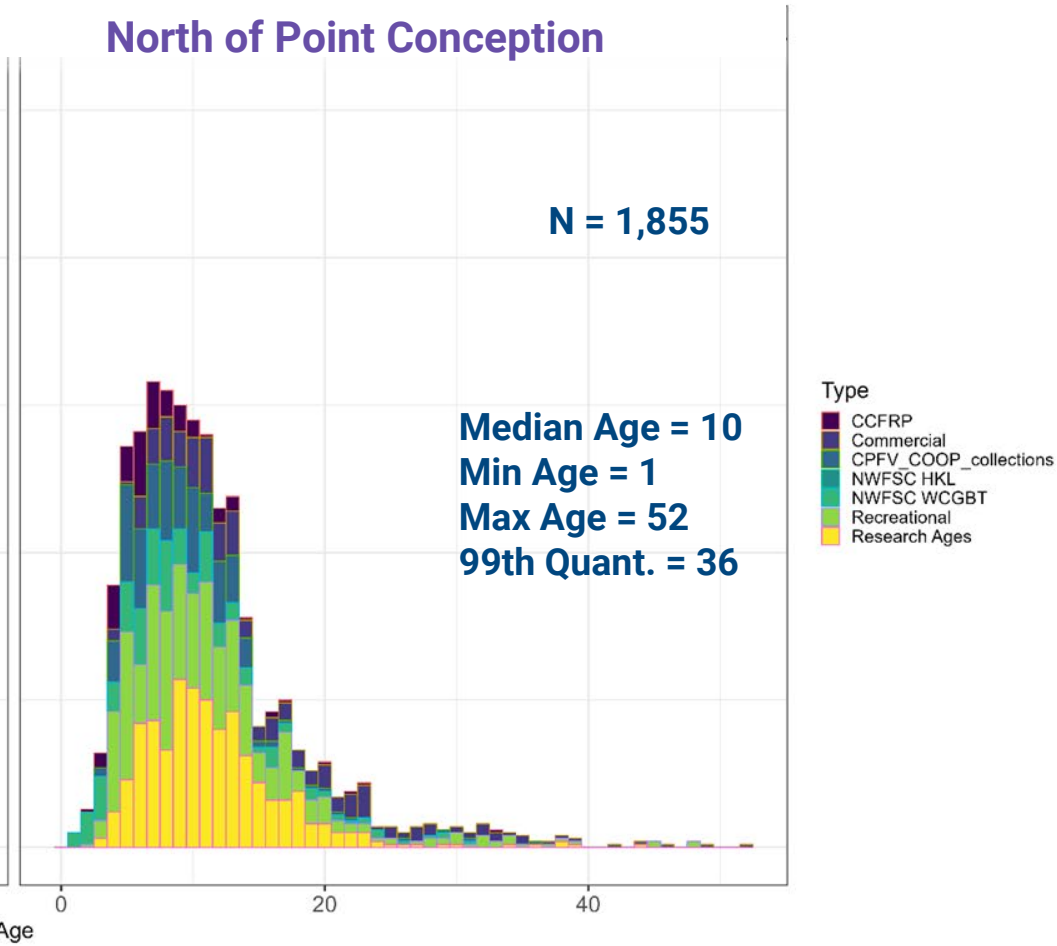
- Based on Dick et al. 2017
- Currently, only 10 samples available from California
- All 2023 winter sampling cancelled due to weather

Summary of All Age Data used Within Each Sub-Area Model

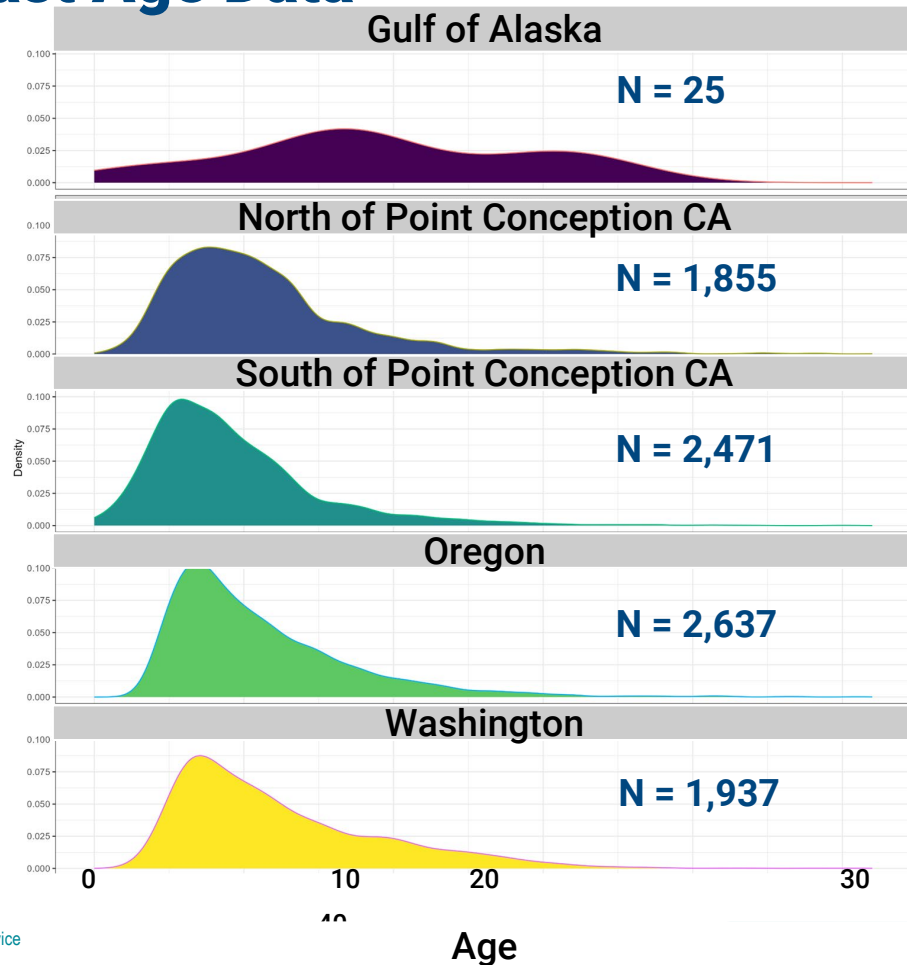
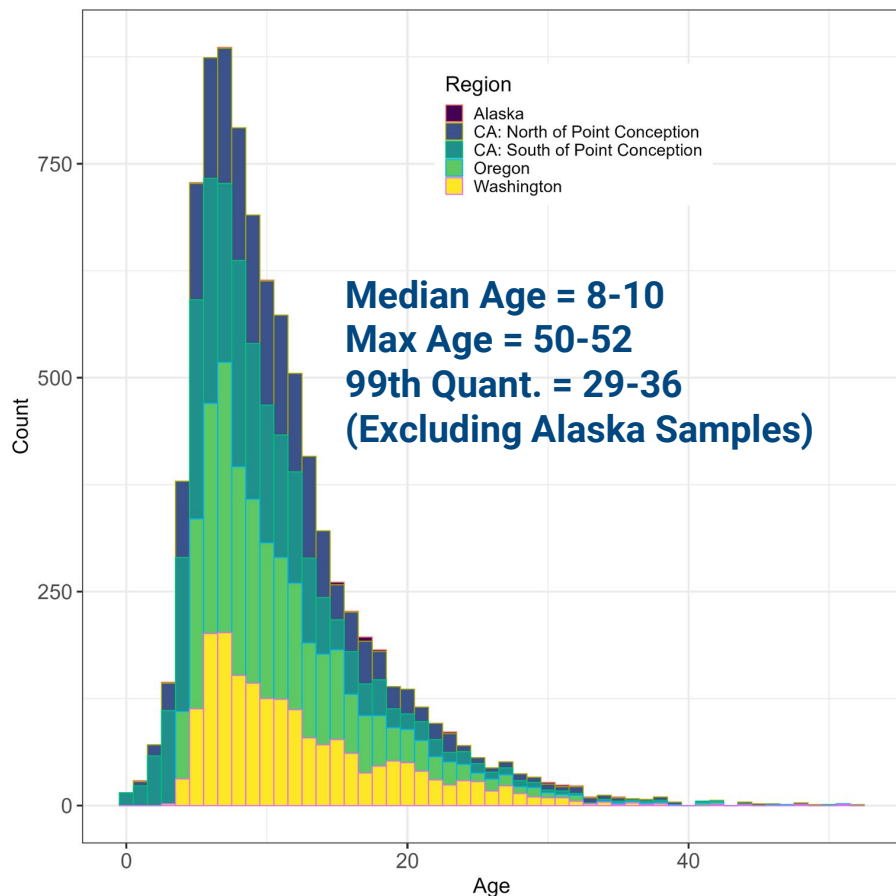
South of Point Conception



North of Point Conception

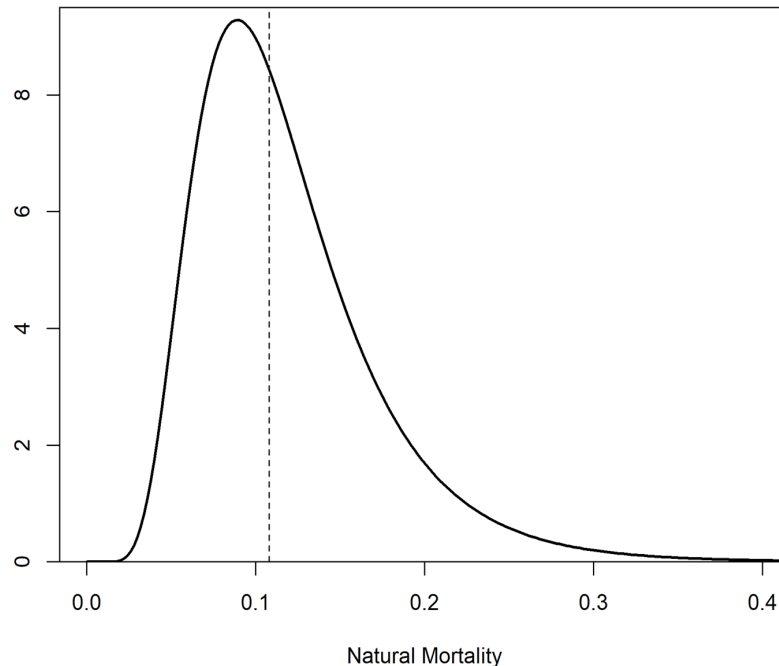


Comparison with All West Coast Age Data



Natural Mortality

- **Assumed a maximum age of 50**
 - Love 1996
 - Maximum observed age of 52 years
 - Total of 31 observations between 40-52 years off the West Coast
 - Same as assumed in the 2021 assessments
- **Hamel-Cope prior:**
 - $M = 0.108 \text{ yr}^{-1}$
 - $SD = 0.31$



Fishery Fleets by Model Area

South of Point Conception

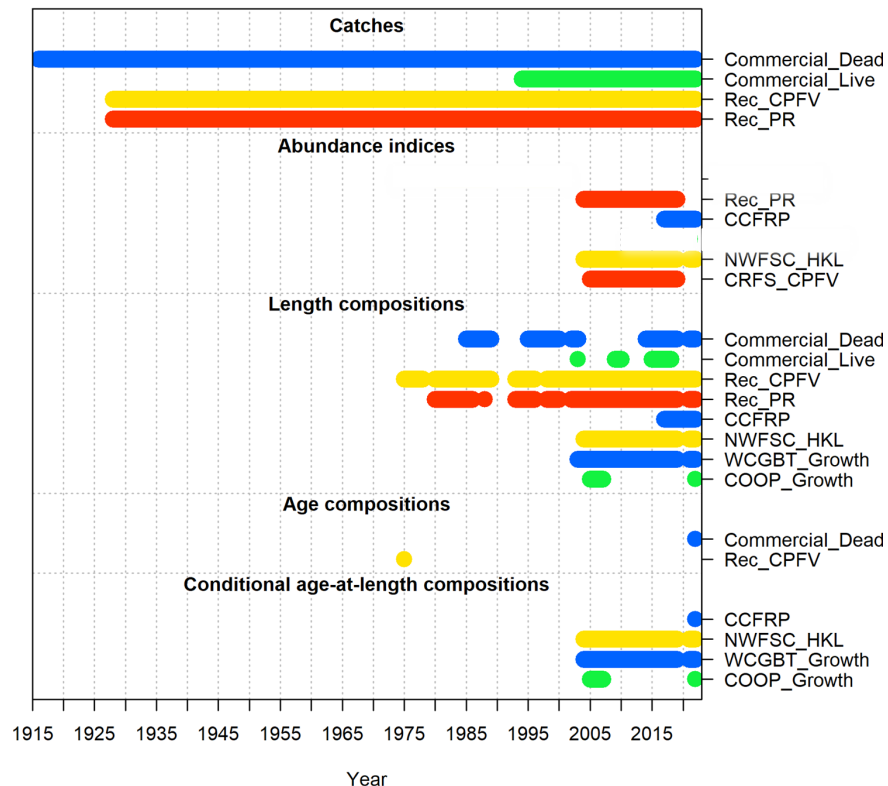
- **Commercial Dead**
 - Lengths and Ages
- **Commercial Live**
 - Lengths
- **Recreational CPFV**
 - Index of Abundance: 2005-2019
 - Lengths and Ages
- **Recreational PR**
 - Index of Abundance: 2005-2019
 - Lengths

North of Point Conception

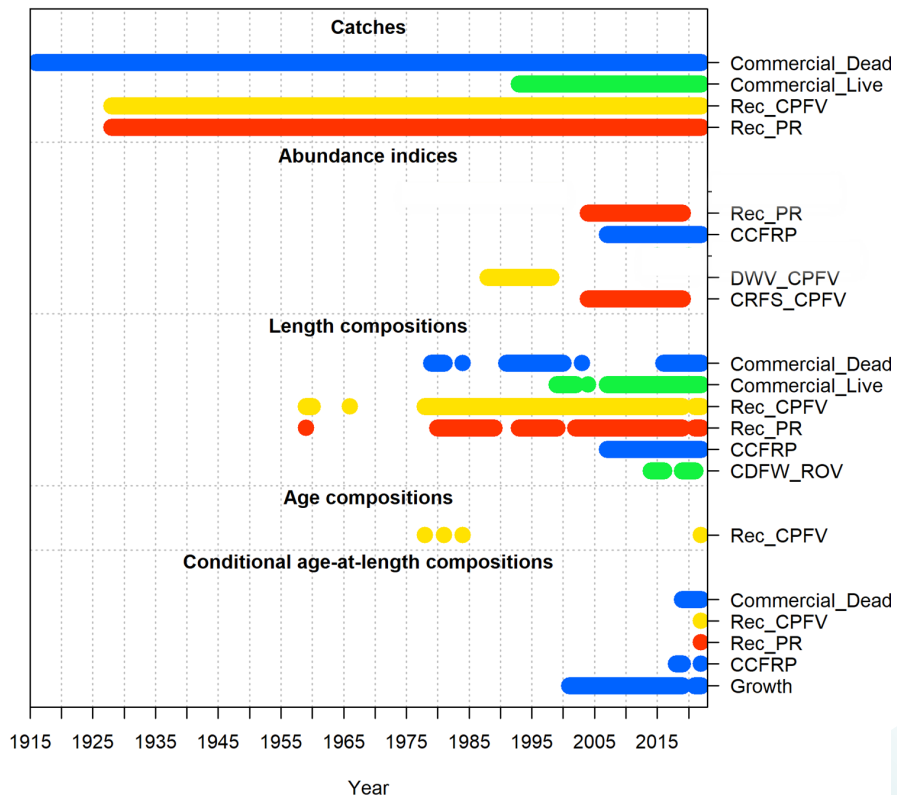
- **Commercial Dead**
 - Lengths and Ages
- **Commercial Live**
 - Lengths
- **Recreational CPFV**
 - Indices of Abundance: 1988-1998 and 2004-2019
 - Lengths and Ages
- **Recreational PR**
 - Index of Abundance: 2005-2019
 - Lengths and Ages

Summary of Data Used in Each Model Area

South of Point Conception



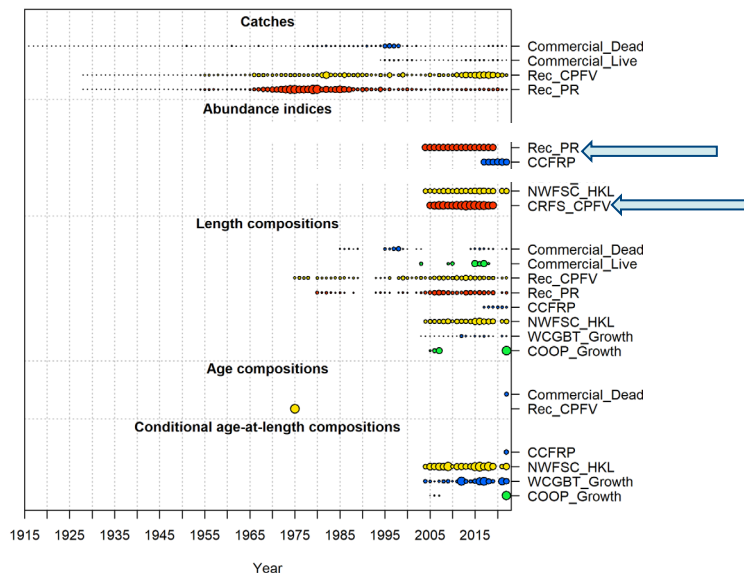
North of Point Conception



Recreational Fishery-Dependent Indices

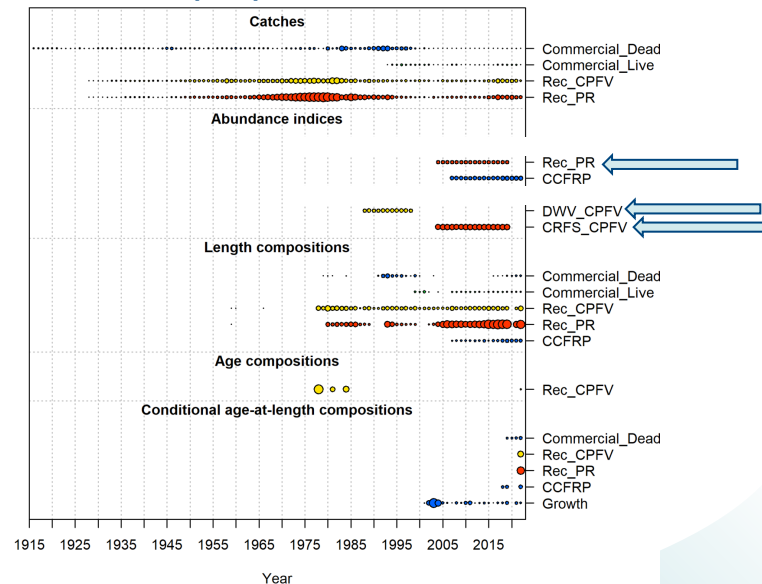
South of Point Conception

- Party/Chater (CPFV) CRFS Onboard
- Private/Rental (PR) CRFS Dockside



North of Point Conception

- Party/Chater (CPFV) Onboard Surveys
 - Deb Wilson-Vandenberg
 - CRFS and Cal Poly Onboard
- Private/Rental (PR) CRFS Dockside



Fishery-Independent Survey Indices & Composition Data

South of Point Conception

- **CCFRP Hook and Line Survey**
 - 2017-2022
 - Paired survey design sampling both MPA and Reference locations
 - Lengths (2017-2022) & Ages (2022)
- **NWFSC Hook and Line Survey**
 - 2004-2019 and 2021-2022
 - Samples a range of rocky reef sites in Southern California
 - Lengths & Ages

North of Point Conception

- **CCFRP Hook and Line Survey**
 - 2004-2022
 - Paired survey design sampling both MPA and Reference locations
 - Lengths (2004-2022) & Ages (2018-2022)

Growth Fleets

South of Point Conception

- **Two separate growth fleets:**
 - **NWFSC West Coast Groundfish Bottom Trawl Survey (N = 626)**
 - **CPFV Cooperative Data Collection (N = 508) and Don Pearson Research (N = 34)**

North of Point Conception

- **Single growth fleet with data from the following sources:**
 - **Abrams Research (N = 77)**
 - **CDFW Special Collections (N = 45)**
 - **NWFSC West Coast Groundfish Bottom Trawl Survey (N = 207)**
 - **Don Pearson Research (N = 430)**

Including age data from research data sources within nearshore assessments is a common practice to support the estimation of growth when ages from fisheries and/or surveys is limited

Data Considered, But Not Used

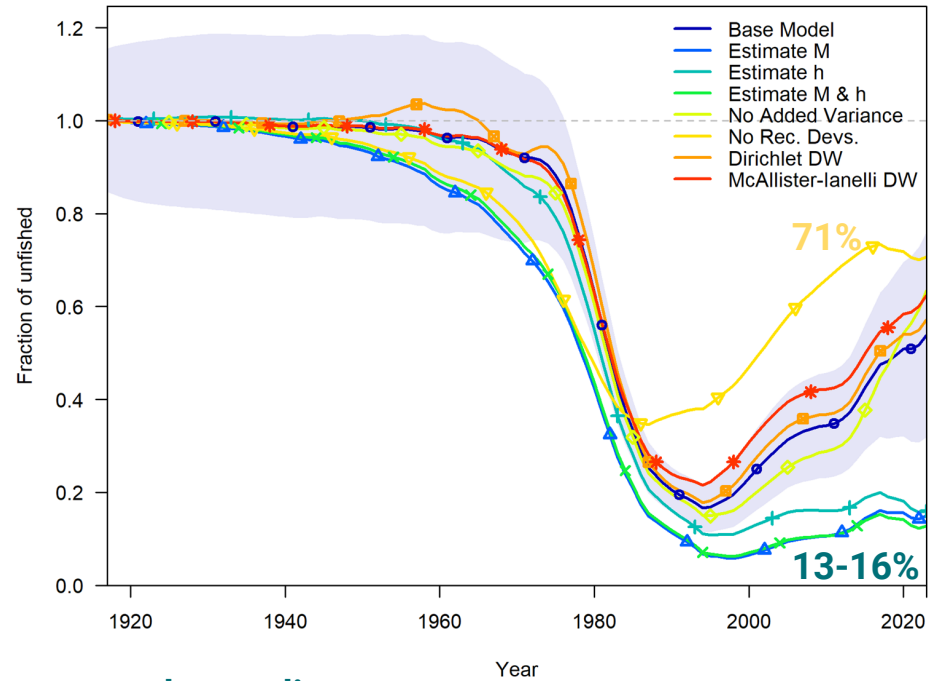
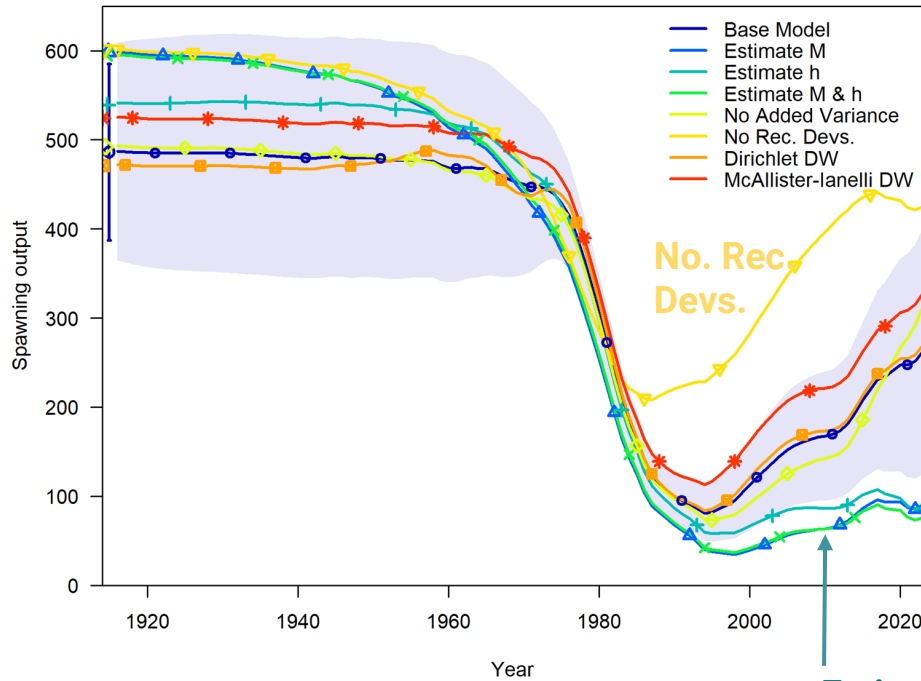
South of Point Conception

- CDFW ROV Survey
- PISCO kelp forest dive survey
- MRFSS dockside CPFV index
- Additional visual surveys
- Southern California Bight Publicly Owned Treatment Works
- CalCOFI
- NWFSC WCGBT survey index of abundance

North of Point Conception

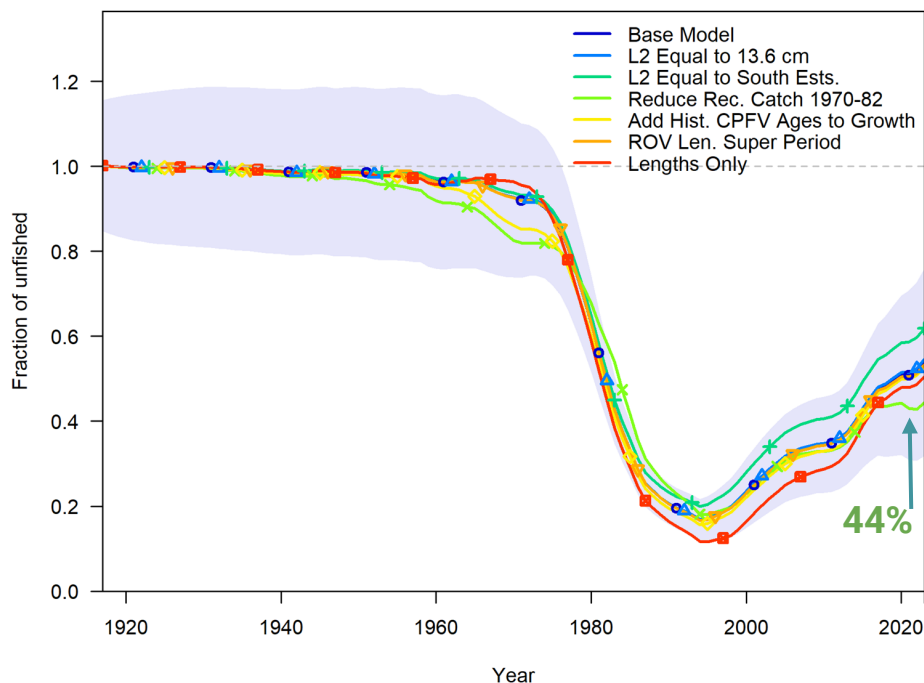
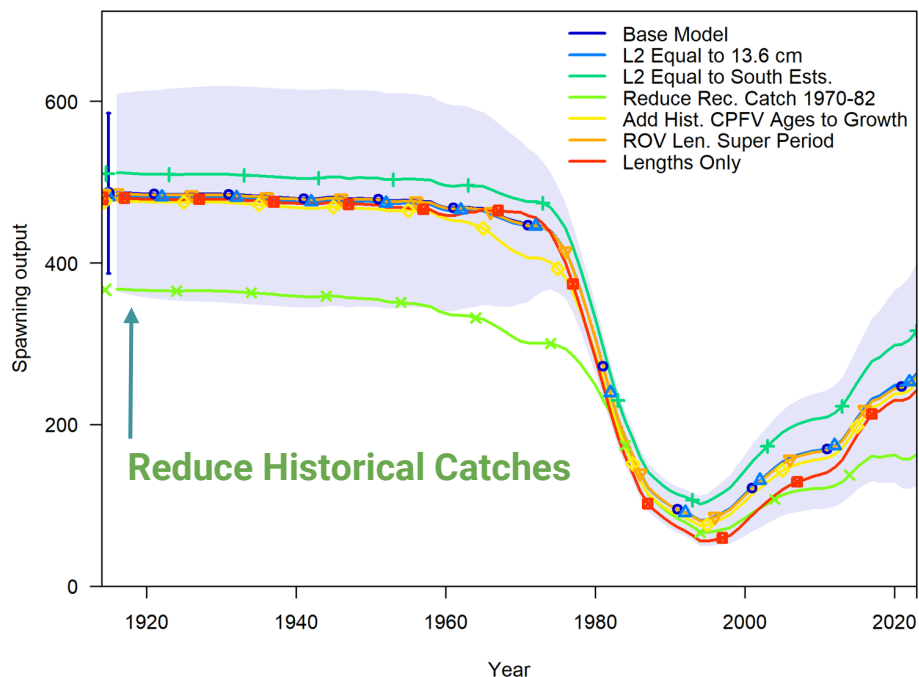
- CDFW ROV Survey
- PISCO kelp forest dive survey
- MRFSS dockside CPFV index
- Additional visual surveys

Sensitivity Analyses: Structural – California North

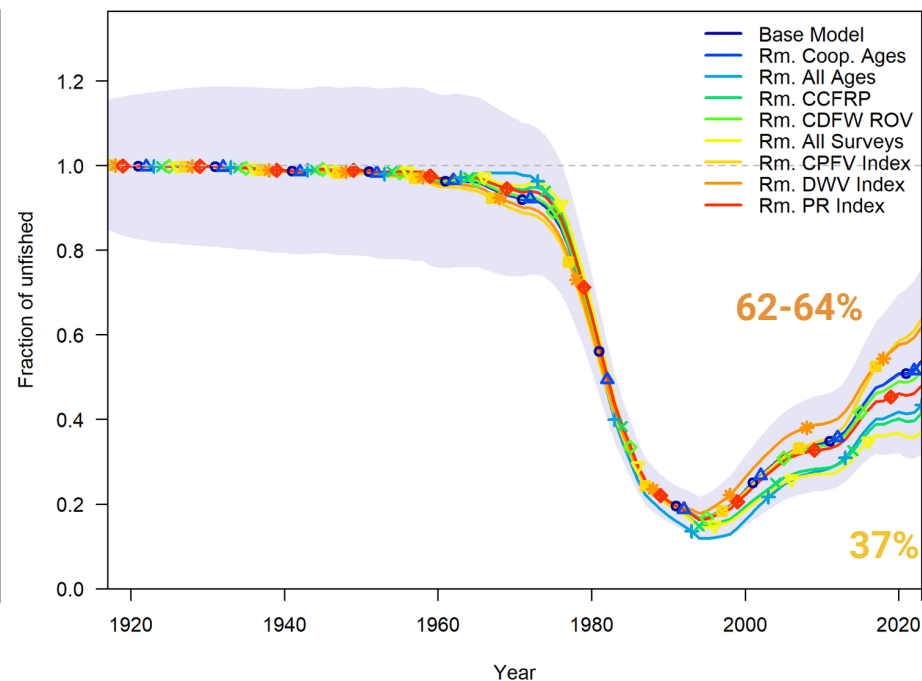
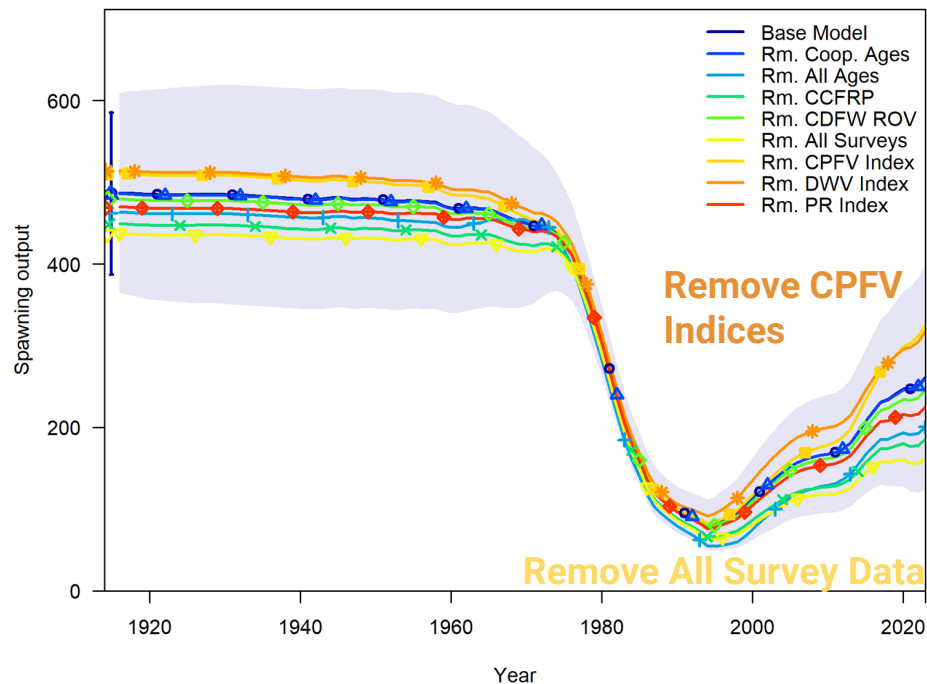


Estimate natural mortality,
steepness, or both

Sensitivity Analyses: Data – California North



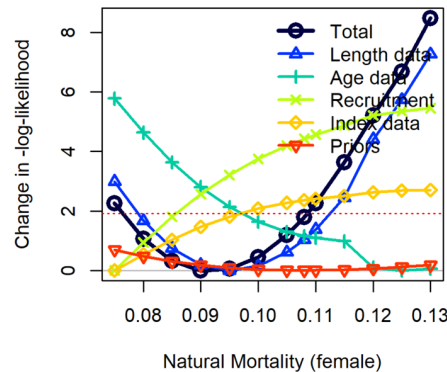
Sensitivity Analyses: Data – California North



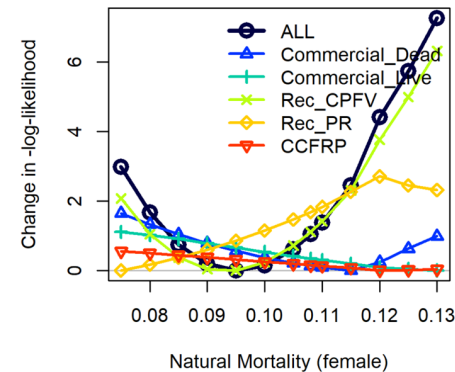
Parameter Profile: Natural Mortality (M)

- The lengths, indices, and recruitment support lower values while ages support a higher value
- The CPFV length data are the most informative
- Signal from age data are consistent from the CPFV and Growth ages
- Opposite signals between the DWV and CRFS CPFV indices

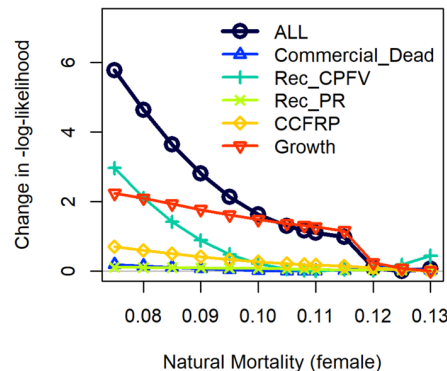
Changes in total likelihood



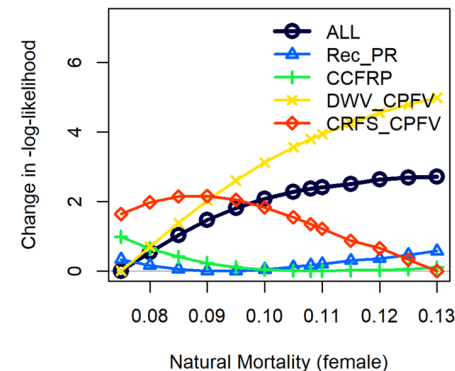
Length-composition likelihoods



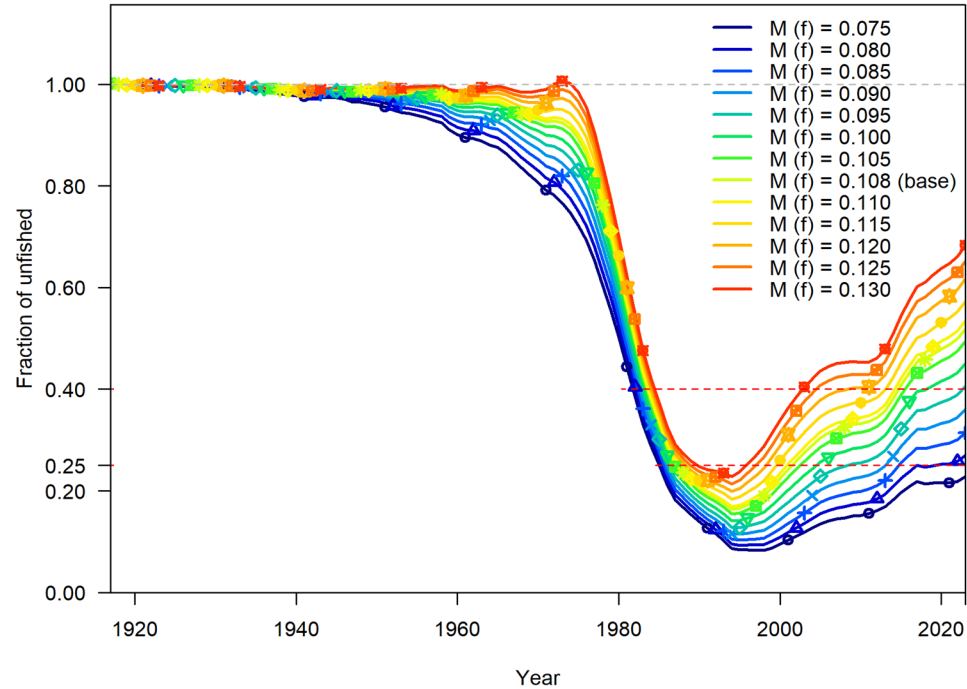
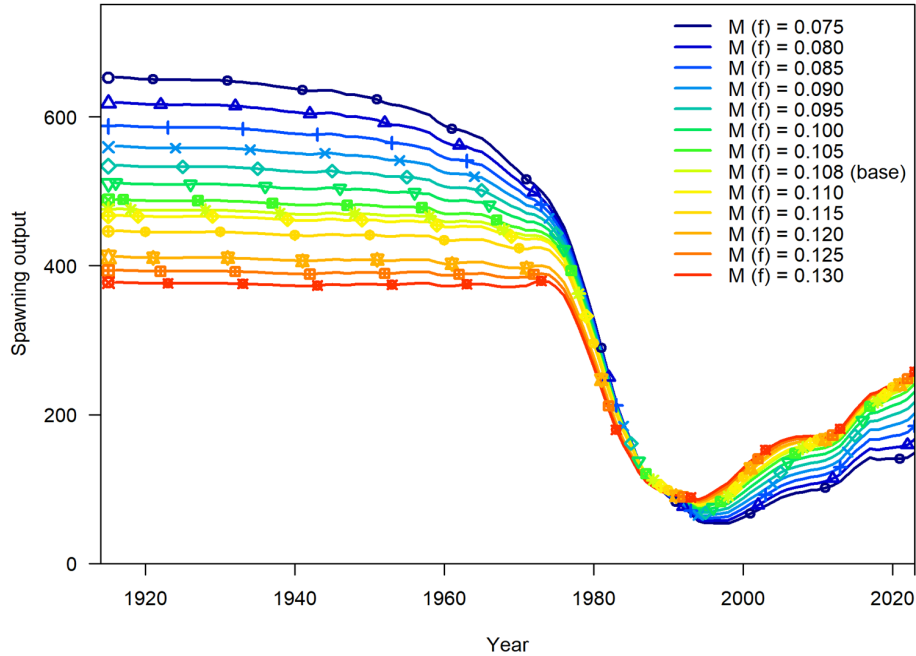
Age-composition likelihoods



Survey likelihoods



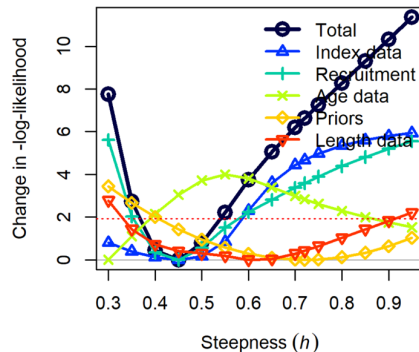
Parameter Profile: Natural Mortality



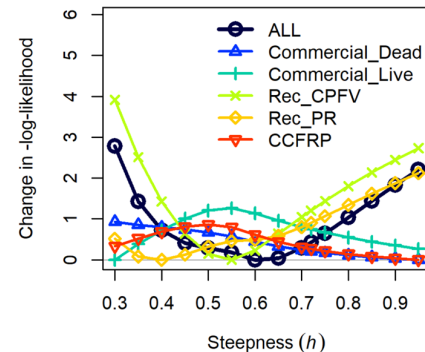
Parameter Profile: Steepness (h)

- The indices and recruitment support lower values while lengths support a higher value closer to the prior
- The CPFV length data are the most informative
- Little signal in the age data
- Opposite signals between the DWV and CRFS CPFV indices versus the CCFRP index

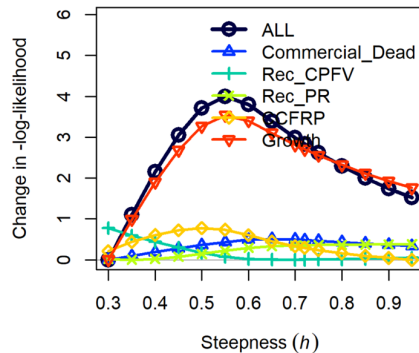
Changes in total likelihood



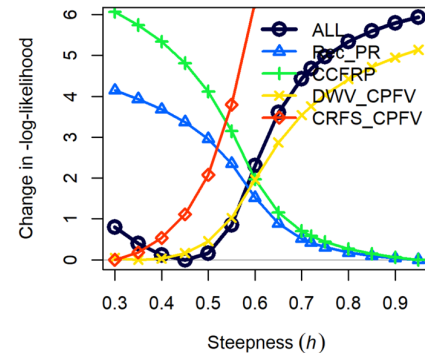
Length-composition likelihoods



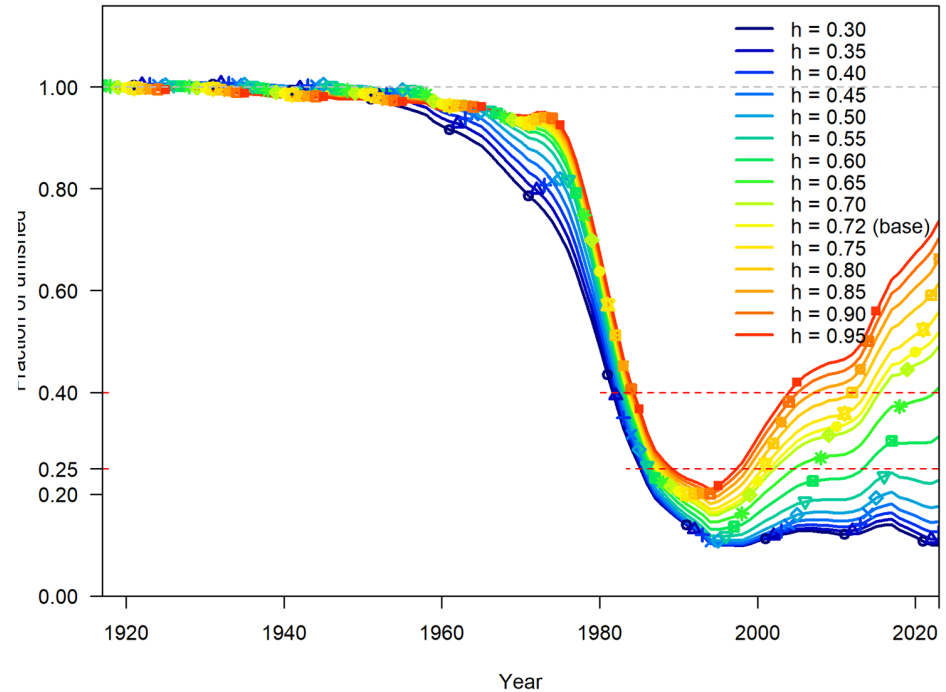
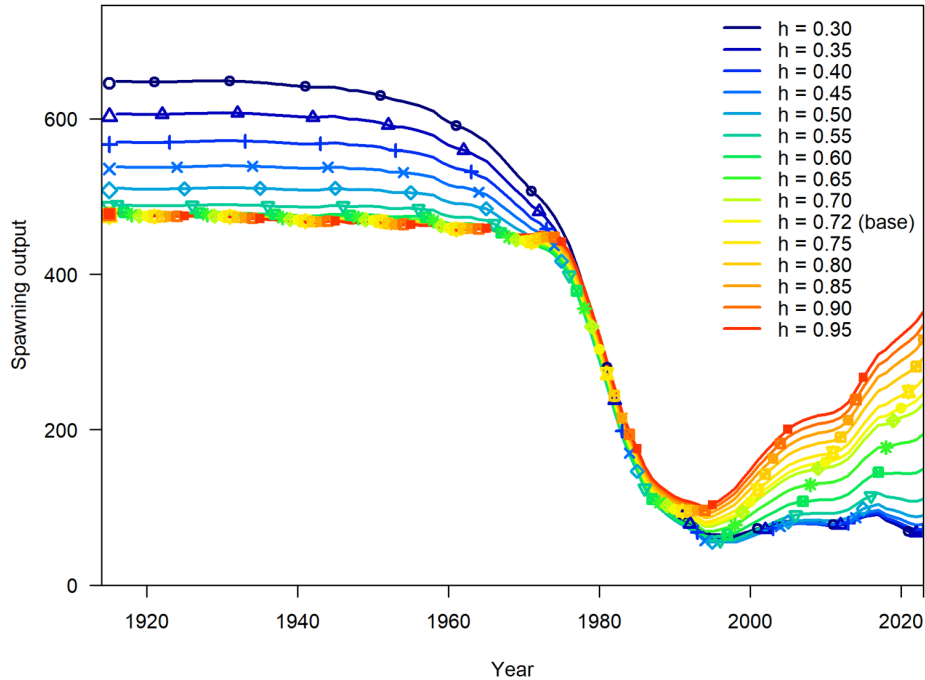
Age-composition likelihoods



Survey likelihoods



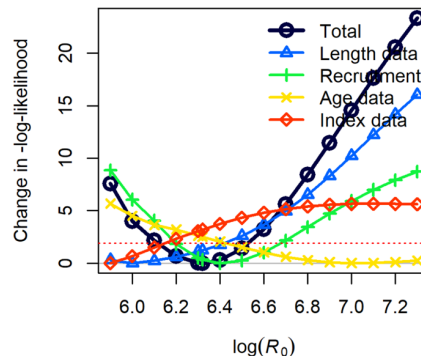
Parameter Profile: Steepness



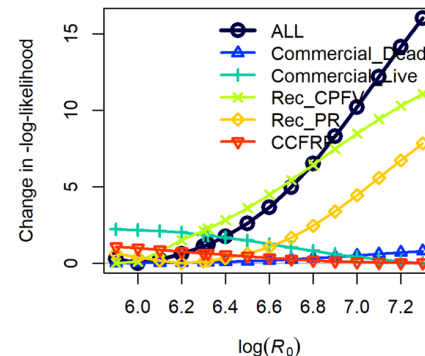
Parameter Profile: Unfished Recruitment (R_0)

- The indices and recruitment support lower values while lengths support a higher value closer to the prior
- The recreational length and age data are the most informative and support lower estimates
- Opposite signals between the CCFRP index and the recreational indices

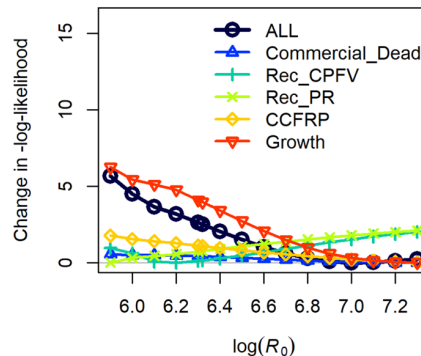
Changes in total likelihood



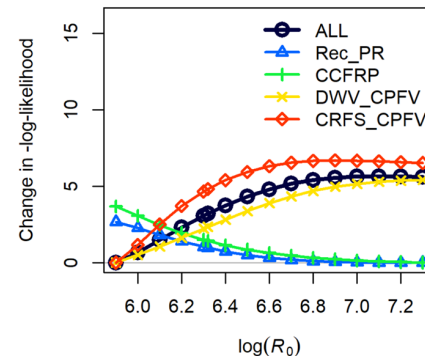
Length-composition likelihoods



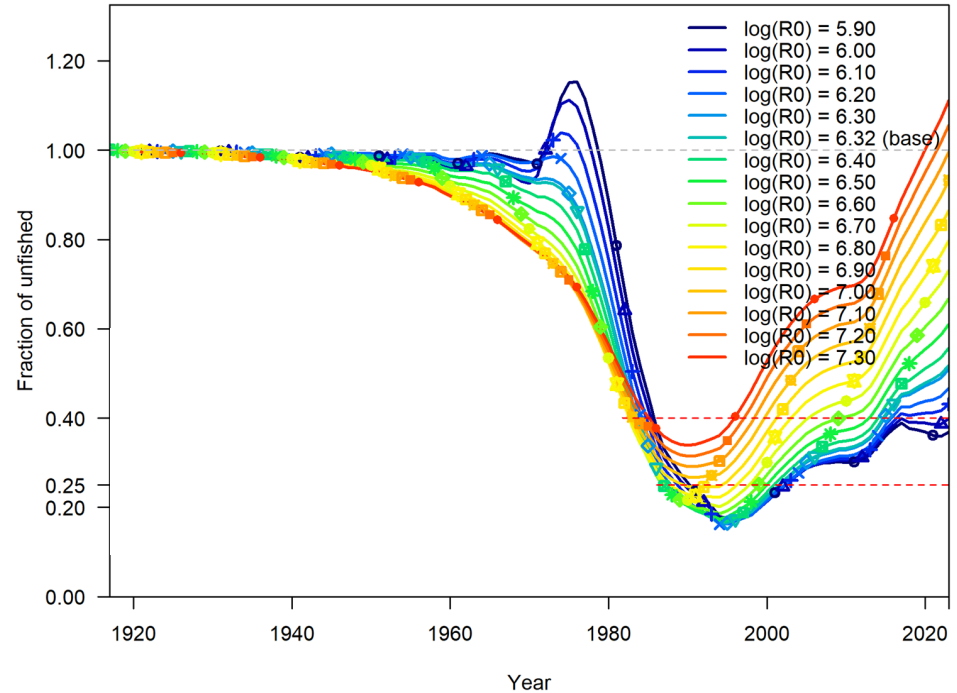
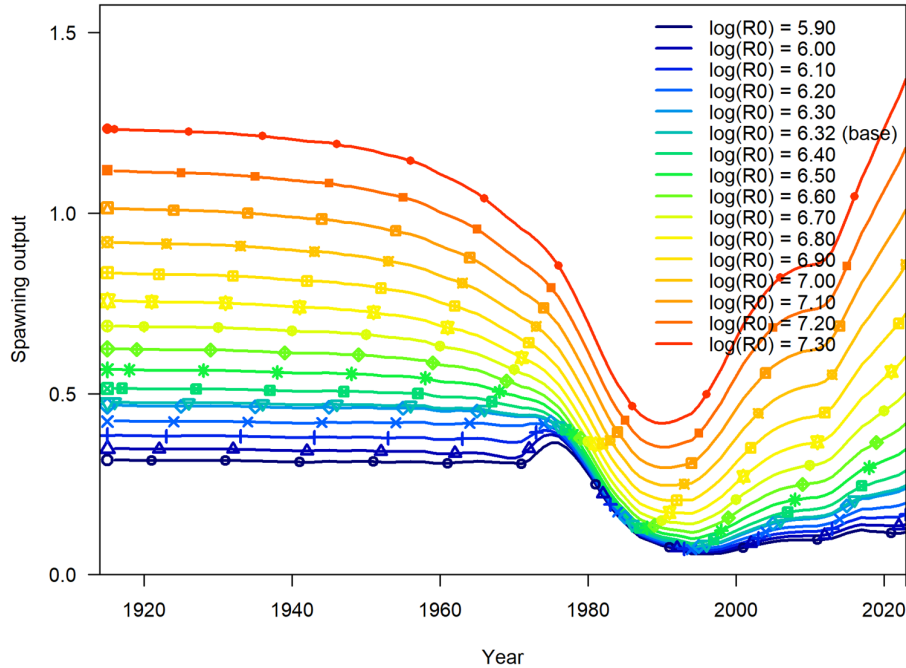
Age-composition likelihoods



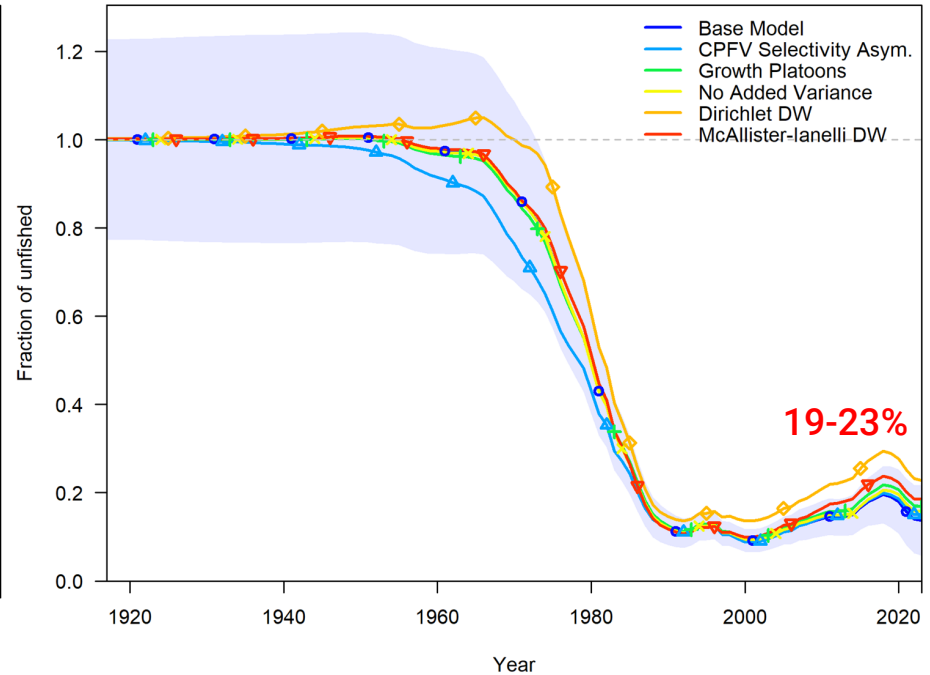
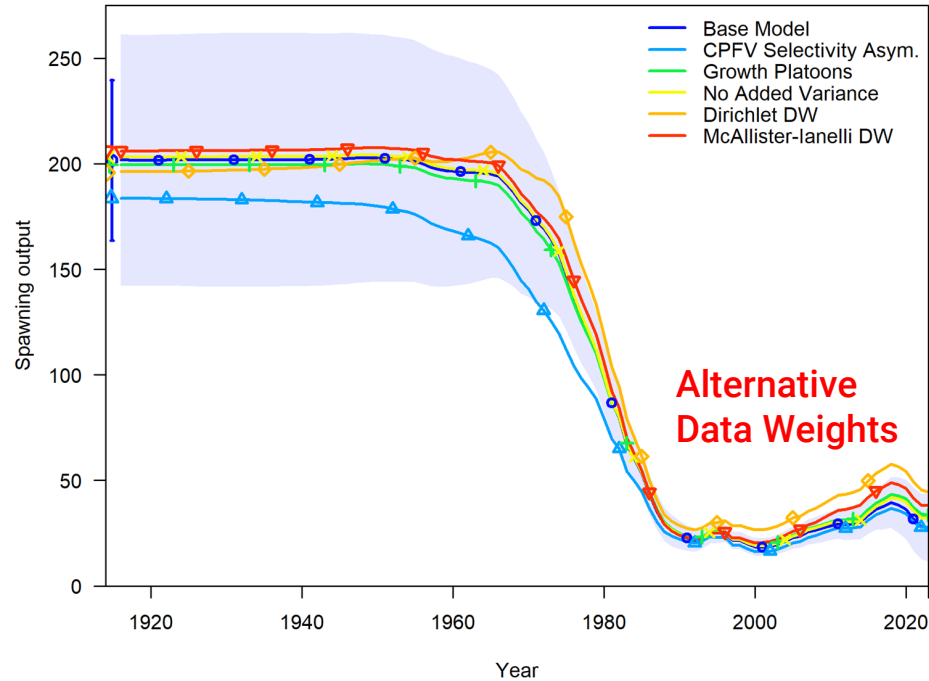
Survey likelihoods



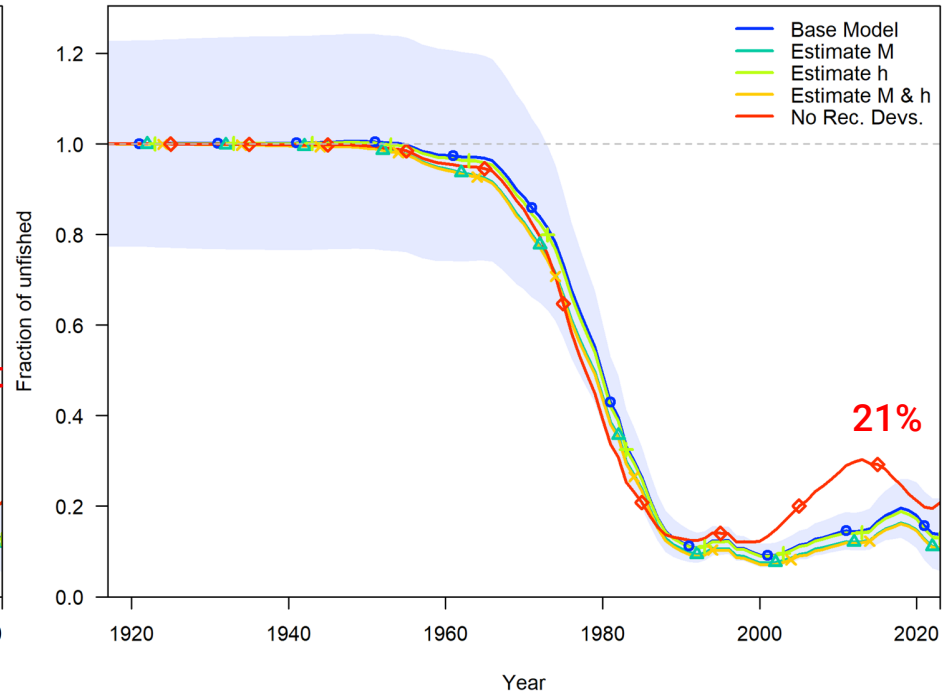
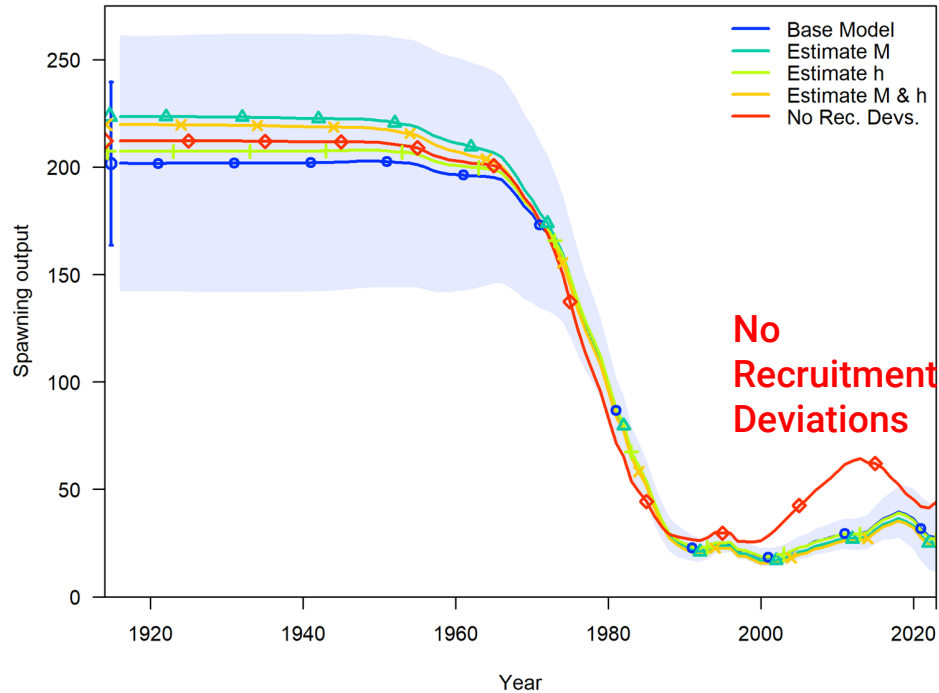
Parameter Profile: R0



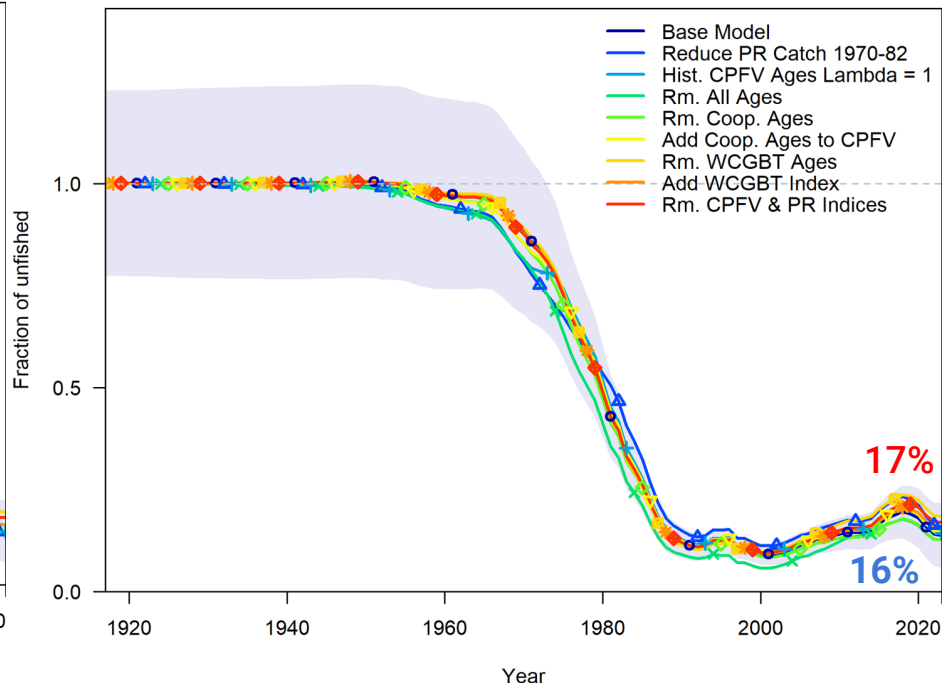
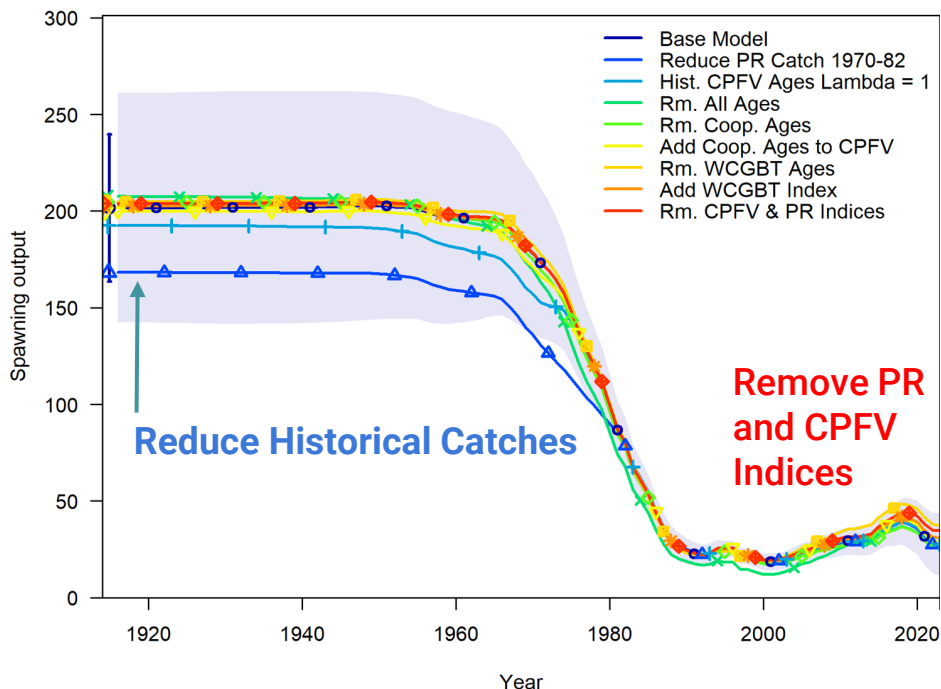
Sensitivity Analyses: Structural – California South



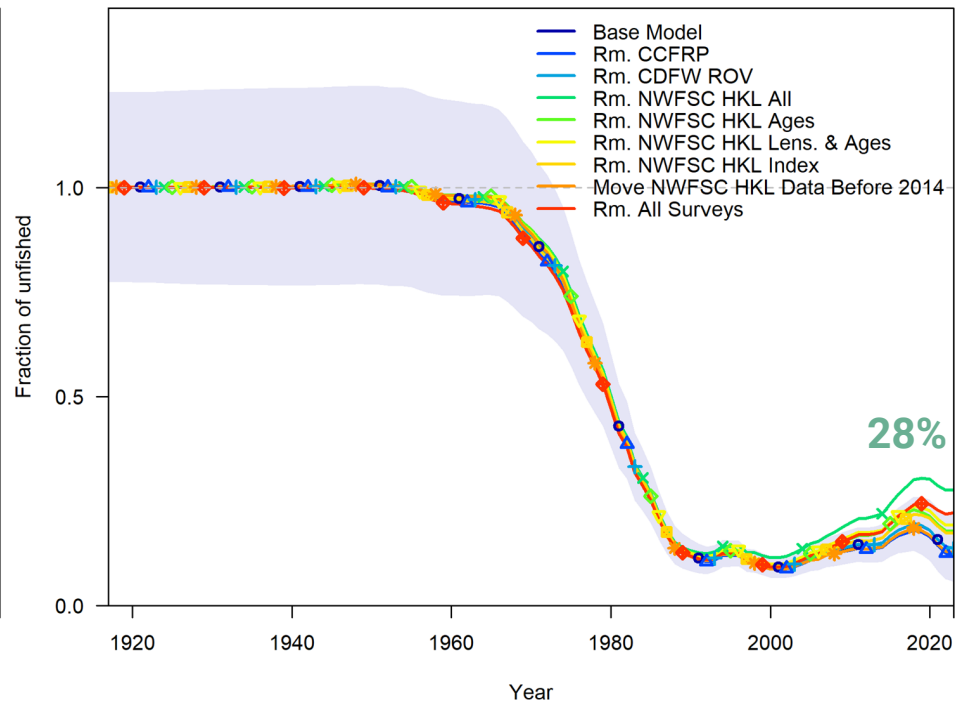
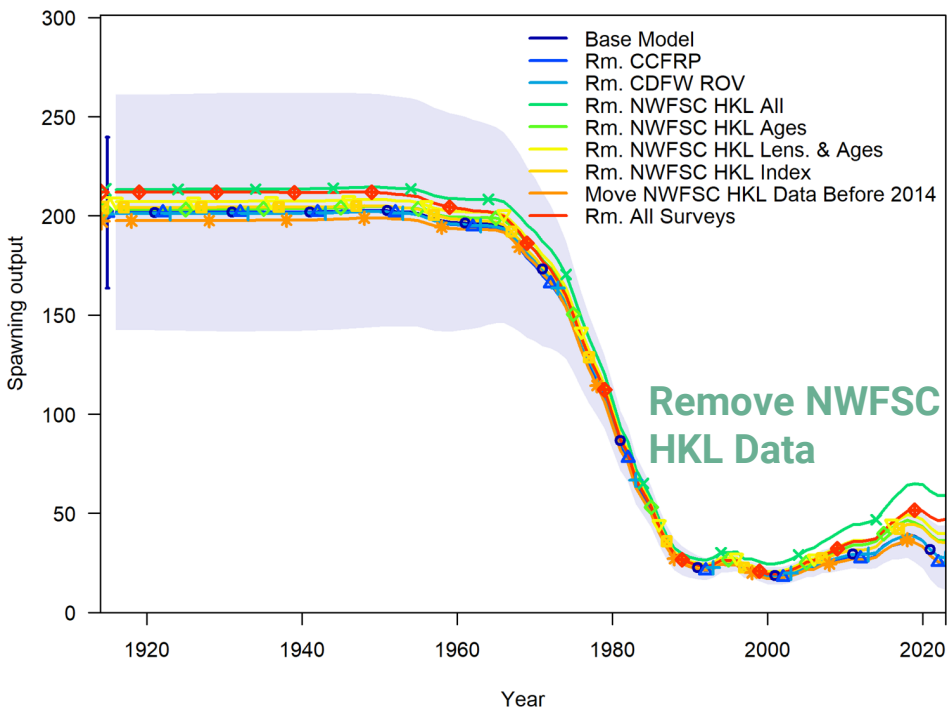
Sensitivity Analyses: Structural – California South



Sensitivity Analyses: Data



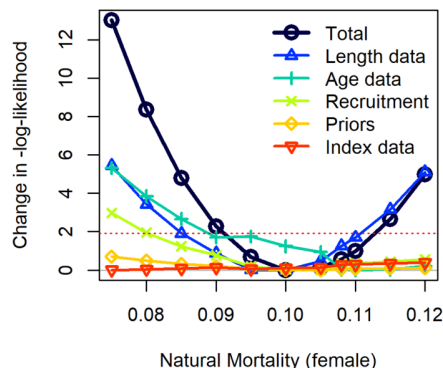
Sensitivity Analyses: Data



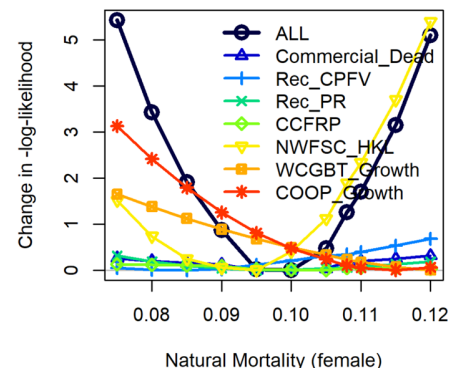
Parameter Profile: Natural Mortality (M)

- The NWFSC Hook and Line lengths support a lower M while the CPFV Coop. Growth lengths support a higher M.
- Limited information in the age data with the NWFSC HKL, NWFSC WCGBT, and CCFRP ages supporting a higher M.

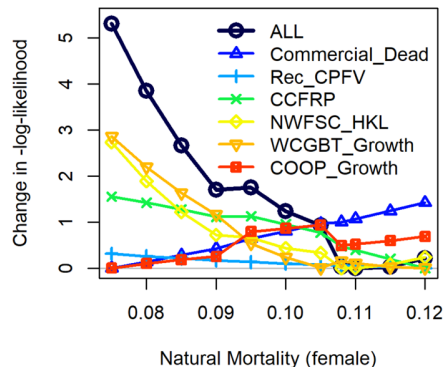
Changes in total likelihood



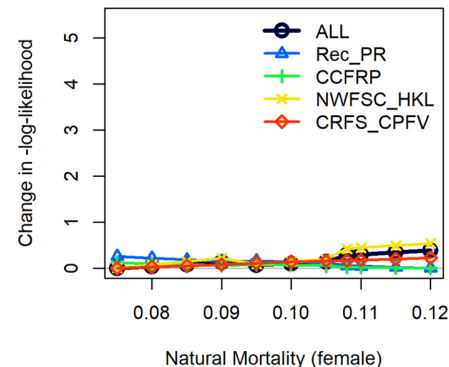
Length-composition likelihoods



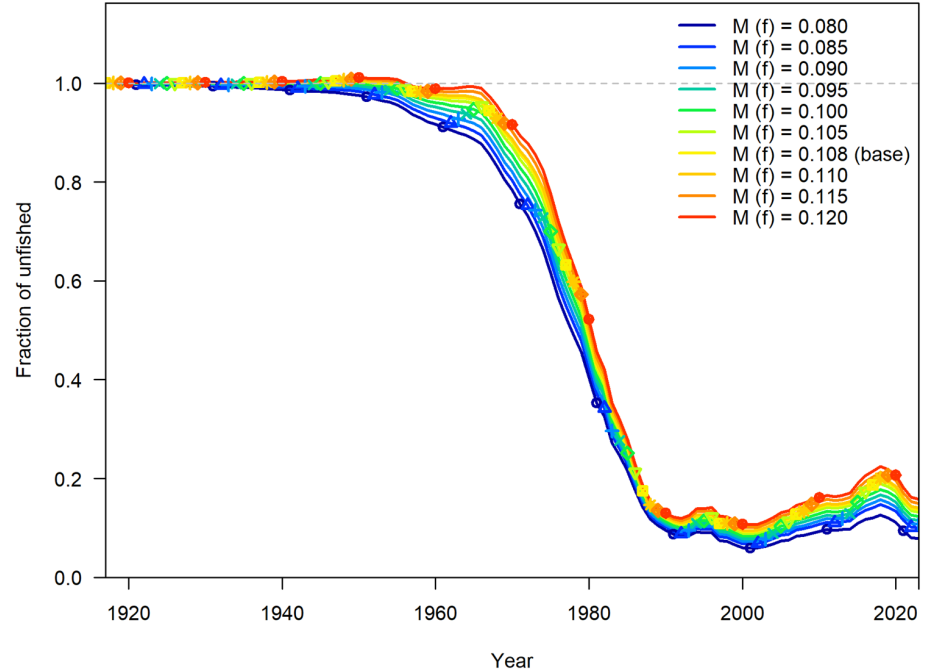
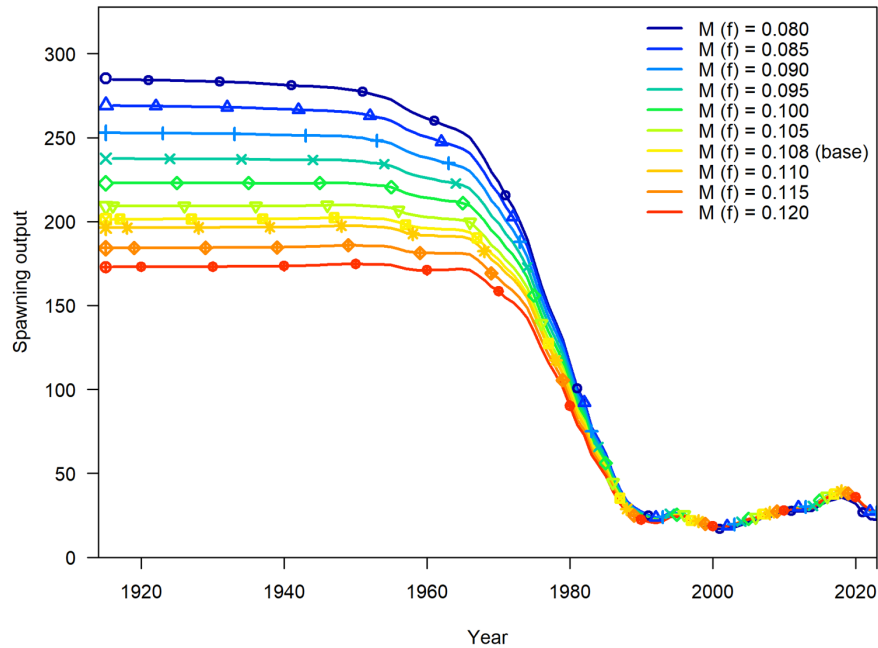
Age-composition likelihoods



Survey likelihoods

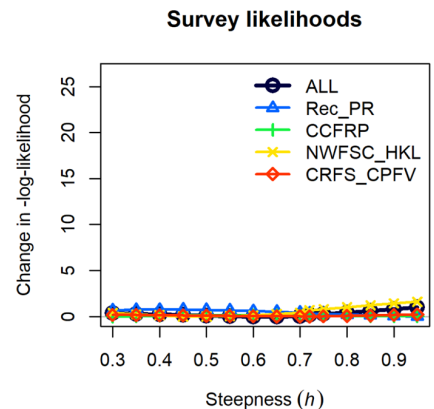
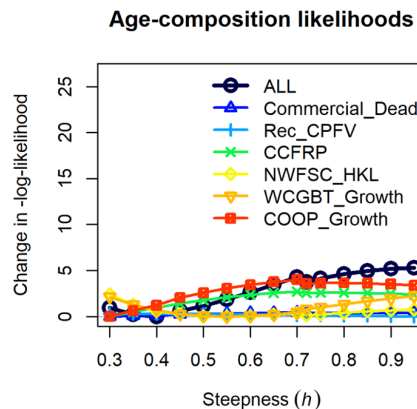
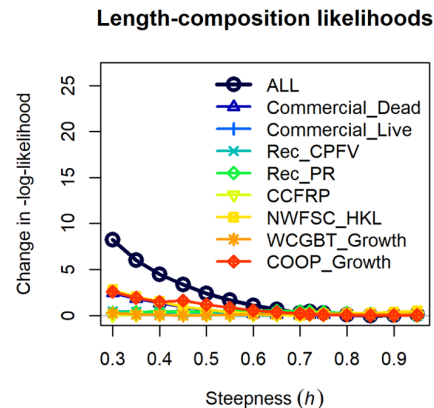
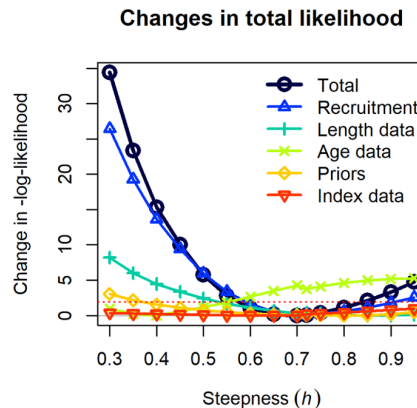


Parameter Profile: Natural Mortality

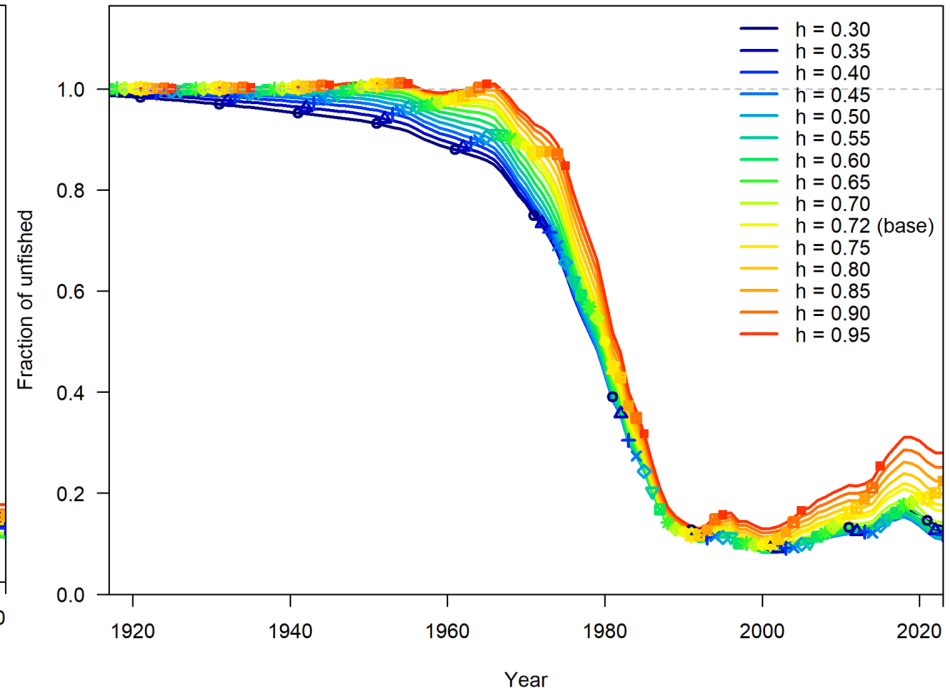
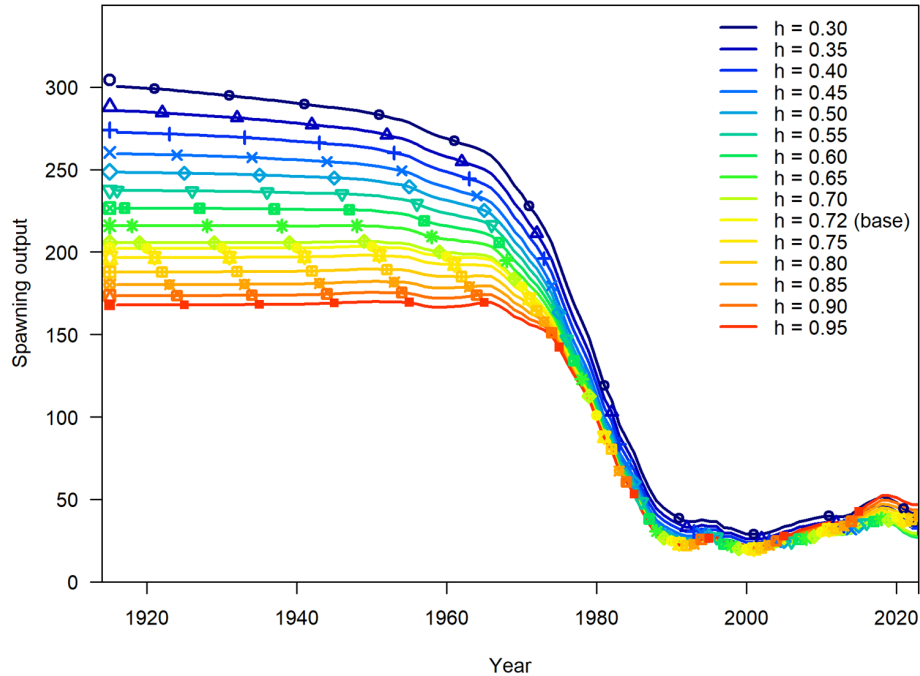


Parameter Profile: Steepness (h)

- Little to no information content about steepness within existing data sources
- Primarily being driven by estimated recruitment
- The limited signal in the lengths and ages are contradictory



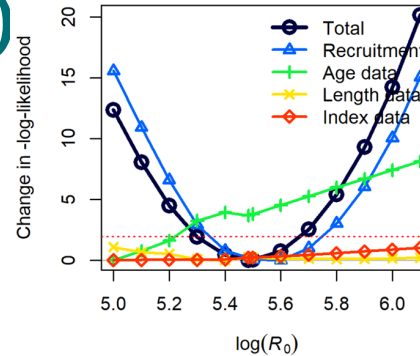
Parameter Profile: Steepness



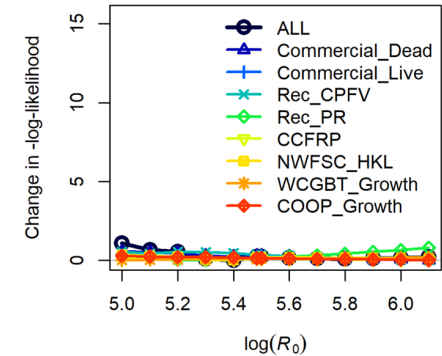
Parameter Profile: Unfished Recruitment (R_0)

- Estimate is largely being driven by estimated recruitment and age data
- Length data across all data sources has little to no information
- Age data supporting lower value with both the NWFS Hook and Line and WCGBT survey data providing similar information

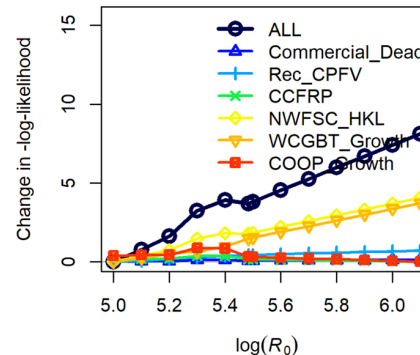
Changes in total likelihood



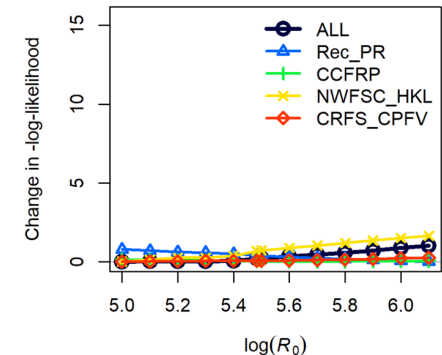
Length-composition likelihoods



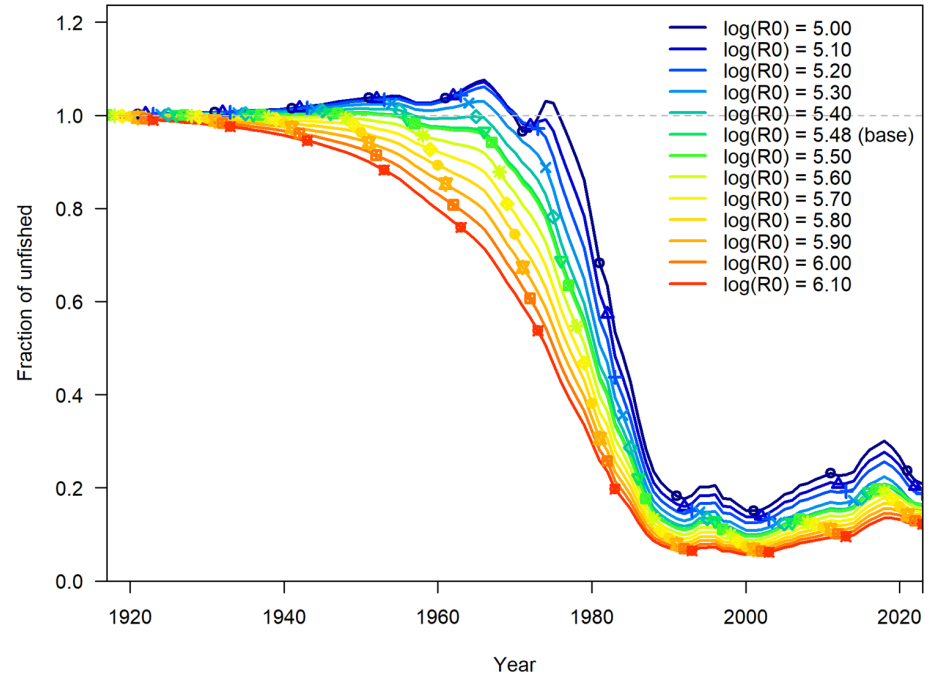
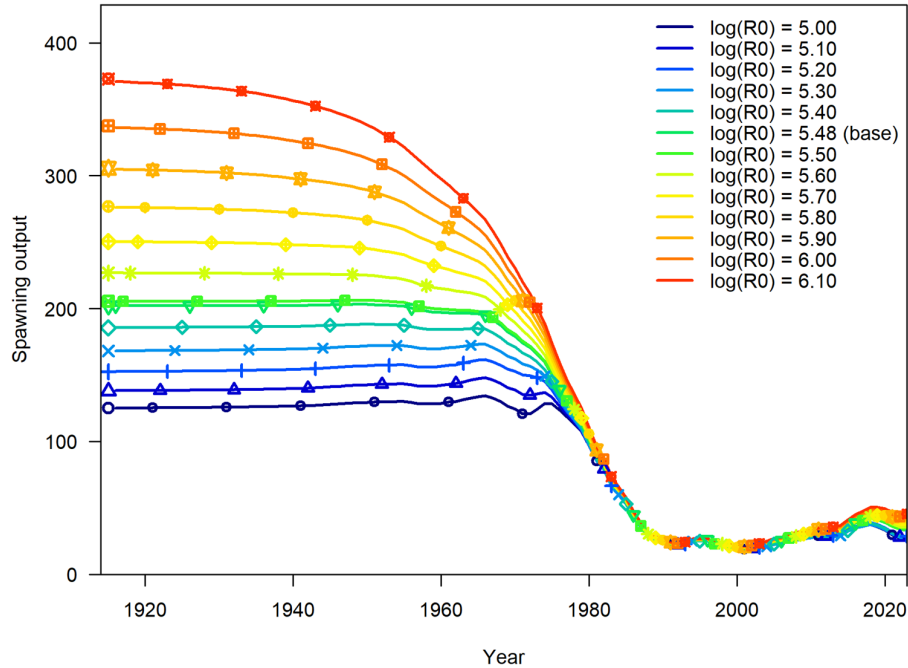
Age-composition likelihoods



Survey likelihoods



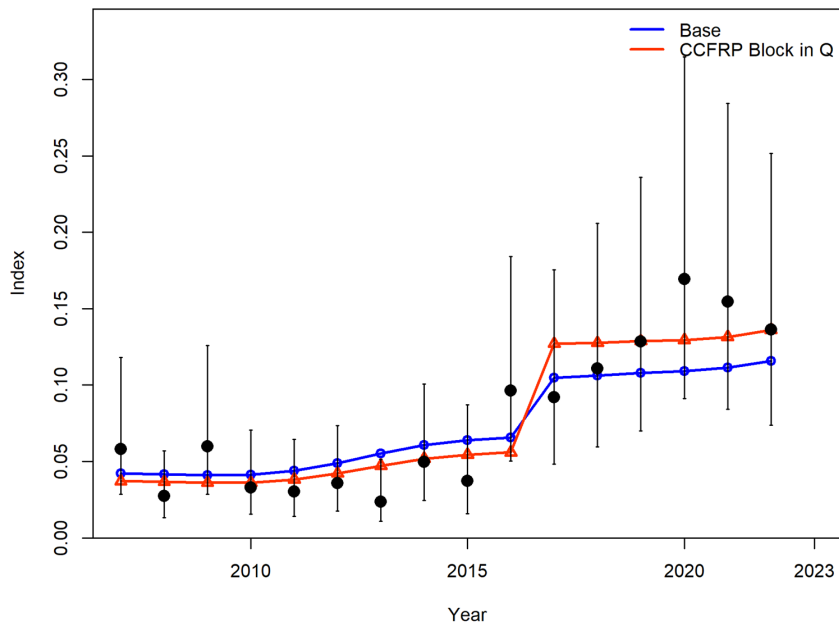
Parameter Profile: R0



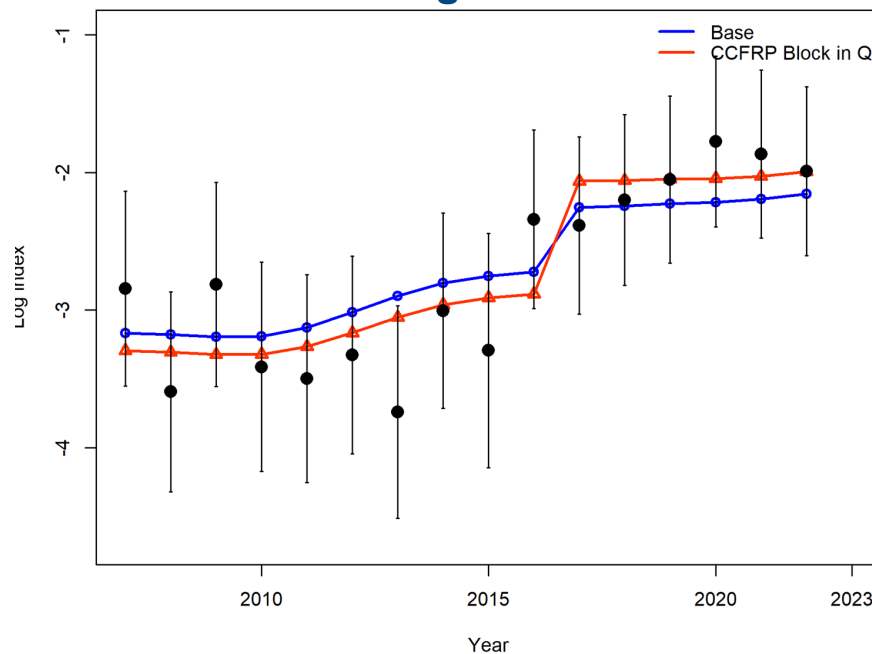
STAR Panel Requests – Time Blocking

North of Point Conception

Index

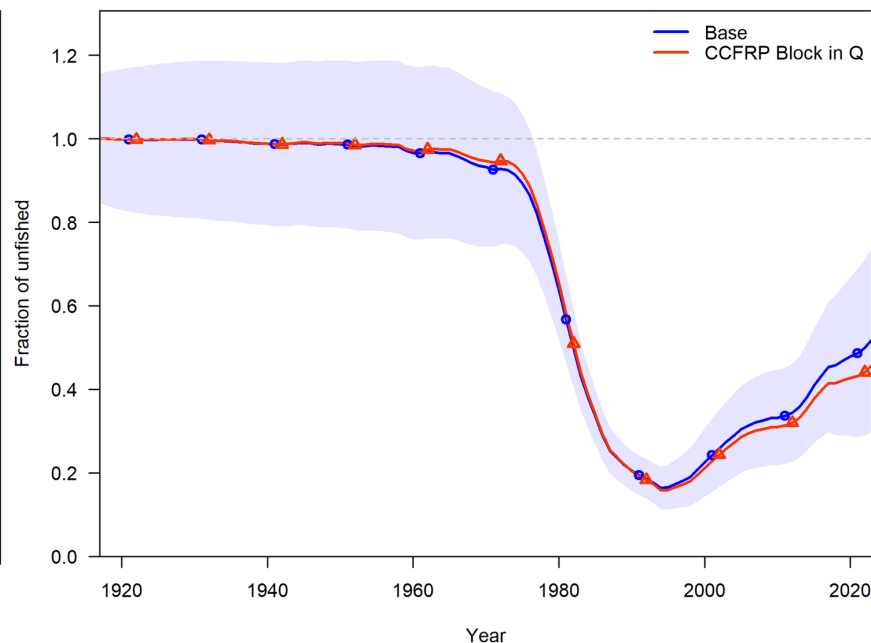
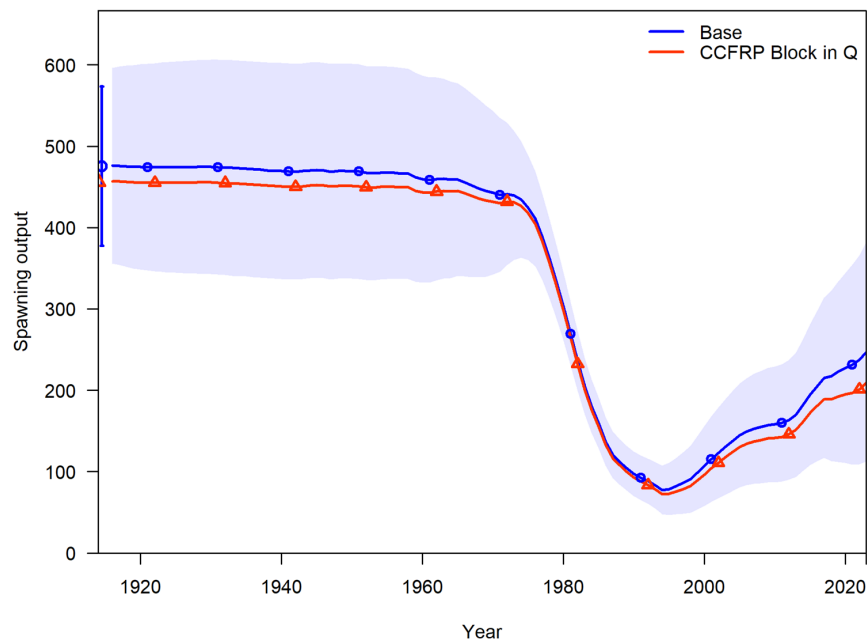


Log Index

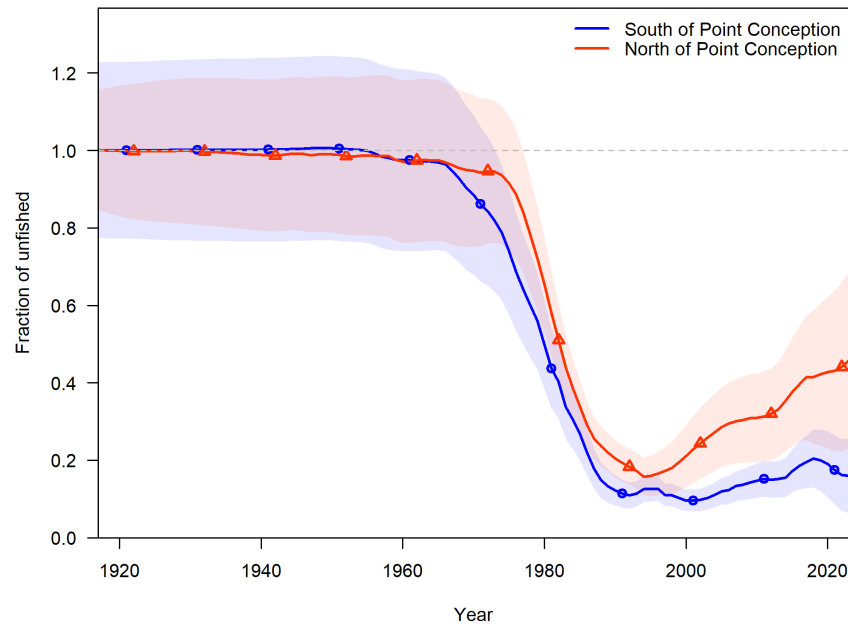
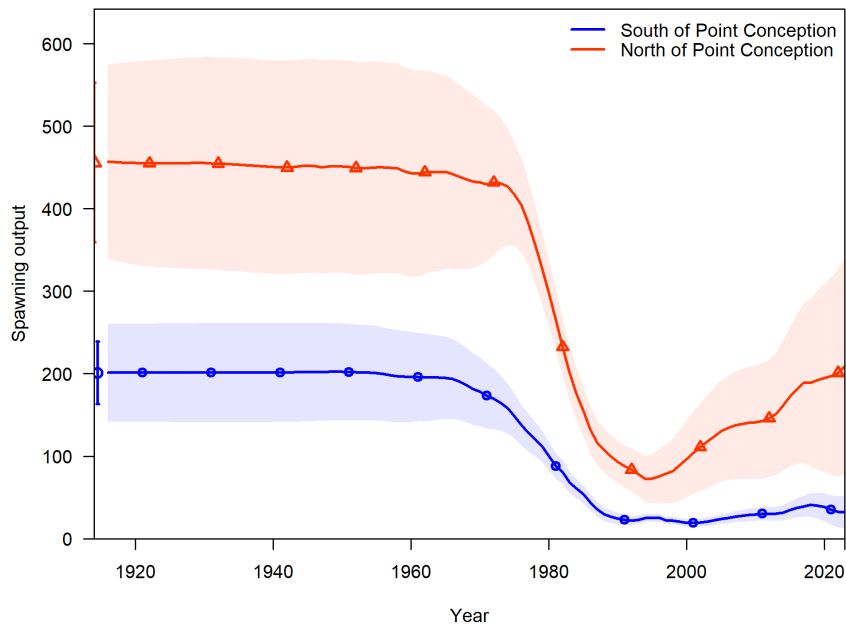


STAR Panel Requests – Time Blocking

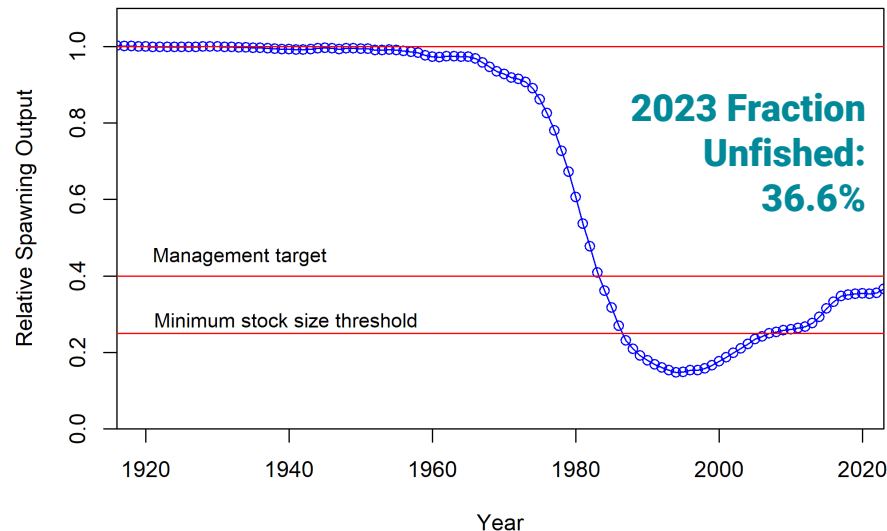
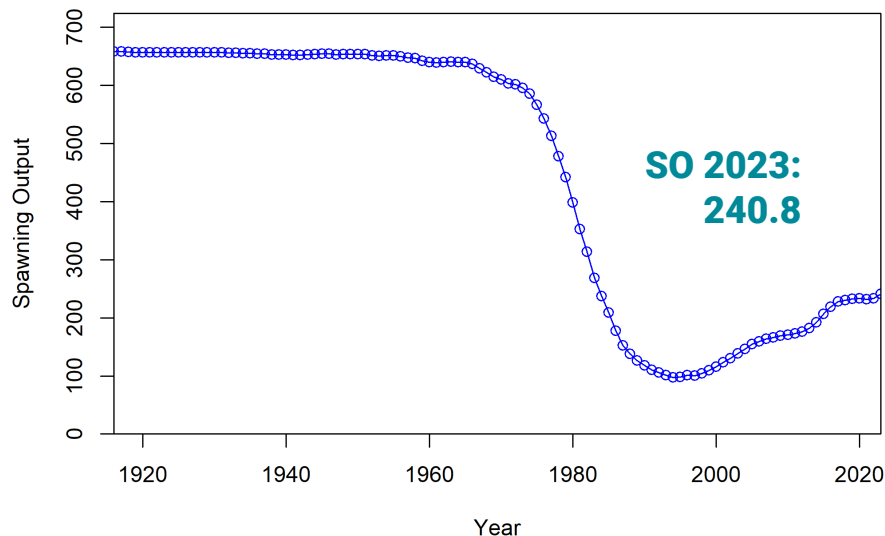
North of Point Conception



Estimated Spawning Output and Fraction Unfished



Estimated Spawning Output and Fraction Unfished



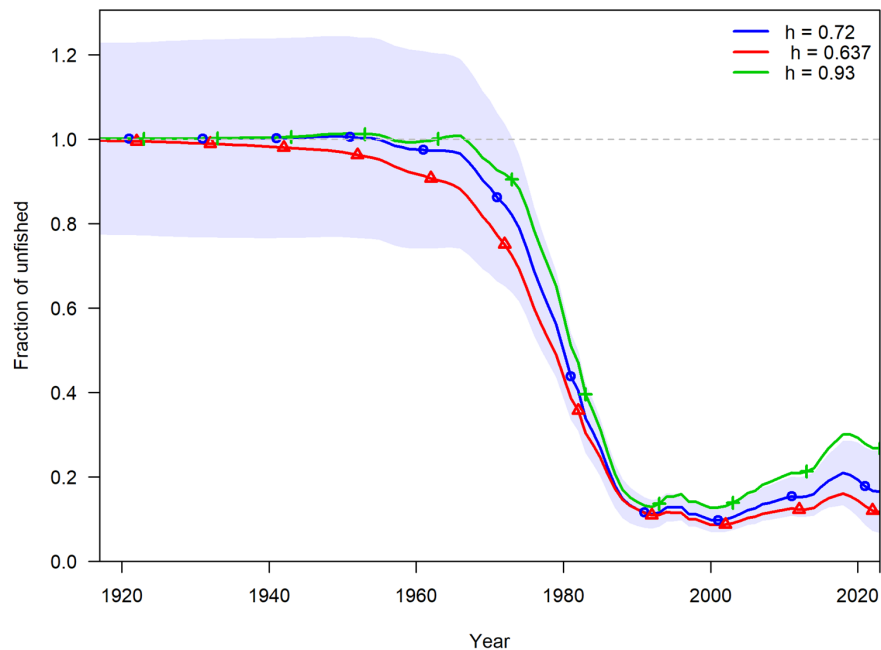
Spawning output and fraction unfished for copper rockfish off of California (state boundary)

Proposed Decision Table

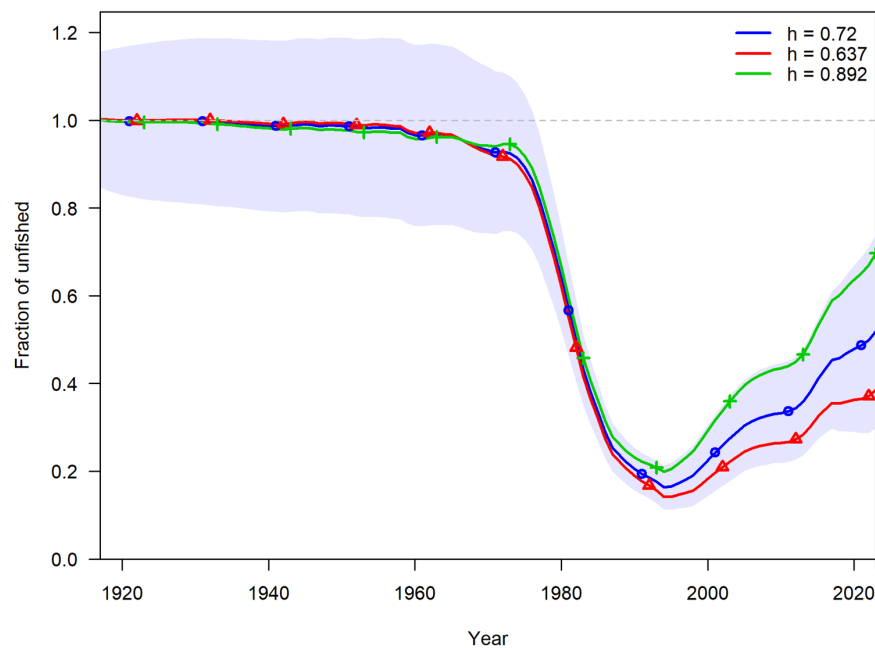
- **Goal:** A single California-wide decision table is needed to inform management decisions
- **Approach**
 - Identify parameter(s) of high uncertainty that can be used to develop a low and high state of nature model.
 - Determine the low and high spawning output that corresponds to the 12.5 and 87.5 quantiles based on uncertainty in the OFL (or spawning output) in 2023
 - **Sub-Area Model North of Point Conception**
 - **Uncertainty in the OFL₂₀₂₃ = 0.262 (SB₂₀₂₃ = 0.273)**
 - **SO_{2023 LOW} = 182.5 and SO_{2023 HIGH} = 333.8**
 - **Low and high states of nature can be created using steepness of 0.637 and 0.892**
 - **Sub-Area Model South of Point Conception**
 - **Uncertainty in the OFL₂₀₂₃ = 0.275 (SB₂₀₂₃ = 0.299)**
 - **SO_{2023 LOW} = 24.3 and SO_{2023 HIGH} = 45.6**
 - **High state of nature can be created using steepness of 0.93**
- **Combine the results from each sub-area model for each state of nature and create a California stock decision table**

Preliminary States of Nature

South of Point Conception



North of Point Conception



Projections: Sigma = 0.50 & P* = 0.45

Year	Assumed Catch (mt)	Low Steepness		Base Steepness		High Steepness	
		Spawning Output	Fraction Unfished	Spawning Output	Fraction Unfished	Spawning Output	Fraction Unfished
2023	91.5	176.2	0.255	240.8	0.366	337.3	0.533
2024	94.7	178.2	0.258	245.9	0.374	345.7	0.546
2025	131.9	180.2	0.261	250.6	0.381	352.9	0.558
2026	133.1	178.9	0.259	251.6	0.383	355.4	0.562
2027	134.5	178.2	0.258	252.9	0.385	357.3	0.564
2028	135.8	178.0	0.258	254.6	0.388	358.9	0.567
2029	136.7	178.3	0.258	256.7	0.391	360.4	0.569
2030	137.7	178.9	0.259	259.1	0.394	361.8	0.572
2031	138.6	179.6	0.260	261.5	0.398	363.1	0.574
2032	139.1	180.4	0.261	264.0	0.402	364.3	0.575
2033	139.5	181.2	0.262	266.5	0.406	365.3	0.577
2034	139.9	182.0	0.264	269.0	0.409	366.2	0.578

Projections: Sigma = 0.50 & P* = 0.40

Year	Assumed Catch (mt)	Low Steepness		Base Steepness		High Steepness	
		Spawning Output	Fraction Unfished	Spawning Output	Fraction Unfished	Spawning Output	Fraction Unfished
2023	91.5	176.2	0.255	240.8	0.366	337.3	0.533
2024	94.7	178.2	0.258	245.9	0.374	345.7	0.546
2025	123.1	180.2	0.261	250.6	0.381	352.9	0.558
2026	124.2	179.7	0.260	252.4	0.384	356.3	0.563
2027	125.4	179.9	0.261	254.6	0.387	359.1	0.567
2028	126.5	180.7	0.262	257.3	0.391	361.6	0.571
2029	127.4	181.9	0.263	260.3	0.396	364.1	0.575
2030	128.1	183.4	0.266	263.6	0.401	366.4	0.579
2031	128.2	184.1	0.268	267.1	0.406	368.7	0.582
2032	128.4	186.9	0.271	270.6	0.411	370.8	0.586
2033	128.4	188.8	0.273	274.1	0.416	372.8	0.589
2034	128.5	190.7	0.276	277.7	0.422	374.7	0.592

Projections: Sigma = 0.50 & P* = 0.35

Year	Assumed Catch (mt)	Low Steepness		Base Steepness		High Steepness	
		Spawning Output	Fraction Unfished	Spawning Output	Fraction Unfished	Spawning Output	Fraction Unfished
2023	91.5	176.2	0.255	240.8	0.366	337.3	0.533
2024	94.7	178.2	0.258	245.9	0.374	345.7	0.546
2025	114.7	180.2	0.261	250.6	0.381	352.9	0.558
2026	115.6	180.5	0.261	253.3	0.385	357.1	0.564
2027	116.7	181.5	0.263	256.3	0.389	360.7	0.570
2028	117.5	183.2	0.265	259.8	0.395	364.2	0.575
2029	118.2	185.3	0.268	263.8	0.401	367.6	0.581
2030	118.1	187.8	0.272	268.1	0.407	370.9	0.586
2031	118.0	190.5	0.276	272.5	0.414	374.1	0.591
2032	117.9	193.4	0.280	277.0	0.421	377.2	0.596
2033	117.6	196.3	0.284	281.5	0.428	380.2	0.601
2034	117.4	199.2	0.289	286.1	0.435	383.1	0.605

Research and data needs

1. The NWFSC Hook and Line survey is the only long-term fishery-independent survey in rocky (untrawlable) habitat in the Southern California Bight. Efforts should continue to explore how best to model hook and line catch data to develop indices of abundance. We also recommend evaluating how to structure the NWFSC Hook and Line survey index, given its expansion into the CCAs and increase in sites within designated MPAs, and independent analysis of information content in NWFSC Hook and Line survey across observed species. Finally, increased spatiotemporal sampling around Point Conception would aid in identifying stock boundaries.
2. The assessment area south of Point Conception appears to have a mixture of observations from areas experiencing variable fishing mortality. In the region there are likely a mixture of areas: open access rocky reefs that are close to port that are heavily fished, open access rocky reefs that are inaccessible via day-trips that are fished but likely at lower levels, and rocky reefs that fall within marine protected areas (MPAs). A spatially-explicit assessment model may be able to capture this complexity but will require data (indices of abundance and composition data) from each of the regions.
3. Future nearshore assessments would greatly benefit from additional CDFW ROV surveys which could increase the power of these data to inform assessments.

Research and data needs

4. There are very limited age data for copper rockfish across California arising from fishery dependent sources. Establishing regular collections of otoliths from the recreational fishery, a large source of mortality, would support future assessments and would improve the understanding of the population structure and life history of copper rockfish.
5. There is limited information for copper rockfish on maturity and fecundity and the variability of these parameters with increasing latitude. The NWFSC WCGBT and Hook and Line surveys provided the only available information on the maturity ogive and the timing of these surveys does not overlap with the expected peak spawning season. The Southwest Fisheries Science Center has egg samples from a total of ten copper rockfish, which is too few to draw conclusions regarding fecundity.
6. Some of the PR mode recreational data that should be available via RecFIN were found to contain information in that database inconsistent with datasheets available from CDFW. There is also a question if length data collected by the Deb Wilson-Vandenberg onboard observer survey is duplicated within RecFIN and attributed to MRFSS dockside samples of the CPFV fleet.

Research and data needs

7. The interpreted substrate data for the areas north of Point Conception within state waters is incomplete. Additional data needs include high resolution interpreted substrate maps for areas outside of state waters. The available interpreted bathymetry data from south of Point Conception is incomplete within state waters around the northern and southern Channel Islands. This poses a challenge for estimating available rocky substrate both by district and also inside and outside closed areas.
8. The genetic stock structure of copper rockfish warrants further investigation to ensure appropriate management of copper rockfish along the West Coast.
9. The Marine Recreational Fisheries Statistics Survey (MRFSS) index was excluded from both California assessment models. The standardized trends in abundance were marked by extreme peaks in the data throughout the time series that the STAT did not think represented the data. Additional investigations of the MRFSS dataset could help resolve some of the issues.
10. Additional research on the effect of the MPA network on copper rockfish and other nearshore rockfish species needs to be conducted. The trend inside the MPAs in northern California exhibited an increasing trend compared to outside the MPAs, similar to what was observed during the 2021 assessment of vermilion rockfish. However, the trends inside MPAs south of Point Conception varied by location with a number of site showing no increase in abundance or declining trends.

Research and data needs

11. Further investigations of other available fishery-independent data such as the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) kelp forest index would benefit future assessments of nearshore species, including copper rockfish.
12. Larval and smaller young-of-the-year copper rockfish can only be identified with certainty genetically. Existing sources of data (CalCOFI and Standard Monitoring Units for the Recruitment of Fishes [SMURFs]) where genetic samples can be analyzed would provide key information to inform spawning output estimates for copper rockfish.
13. Continue to improve historical catch reconstructions, including attempting to quantify uncertainty with these and other historical data.
14. Existing catch estimates within Recreational Fisheries Information Network (RecFIN) that are currently assigned only to "rockfish, general" should be investigated to determine if these removals can be assigned to specific-species.