Chilipepper Rockfish Data Sources and Assessment Planning

Stock Assessment Team ("STAT"):

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January 23, 2025

Overview

Overview

- Previous assessments

- Biology

- Fishery-dependent data

- Fishery-independent data

- Regulatory history
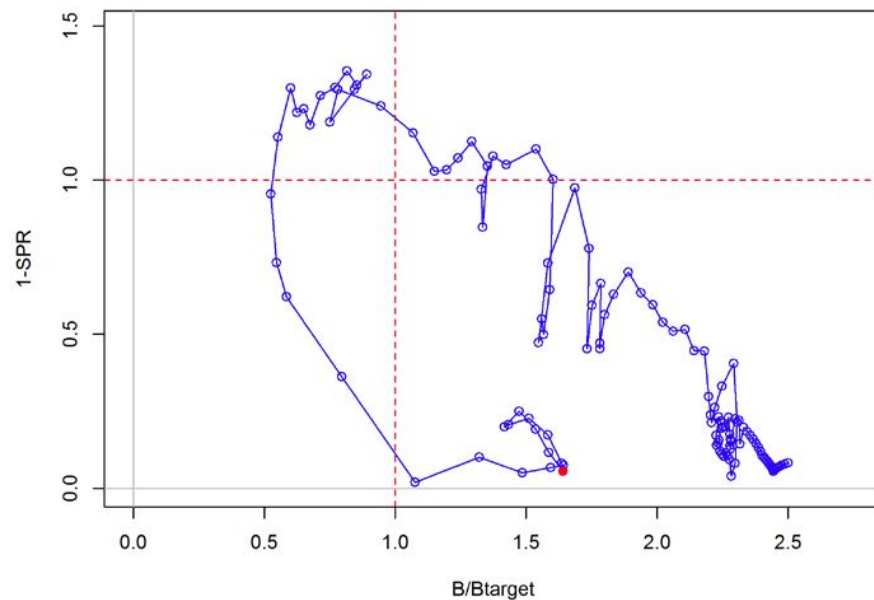
- Early thoughts on modeling

Most Recent **Update** Assessment (Field 2017)

- 2017 spawning output was above target; increases driven by 1999 year class
- 2017 fishing intensity was well below target
- Catch projections updated in 2023 by Dr. Chantel Wetzel (NWFSC)

Spawning Output Relative to Target & Limit
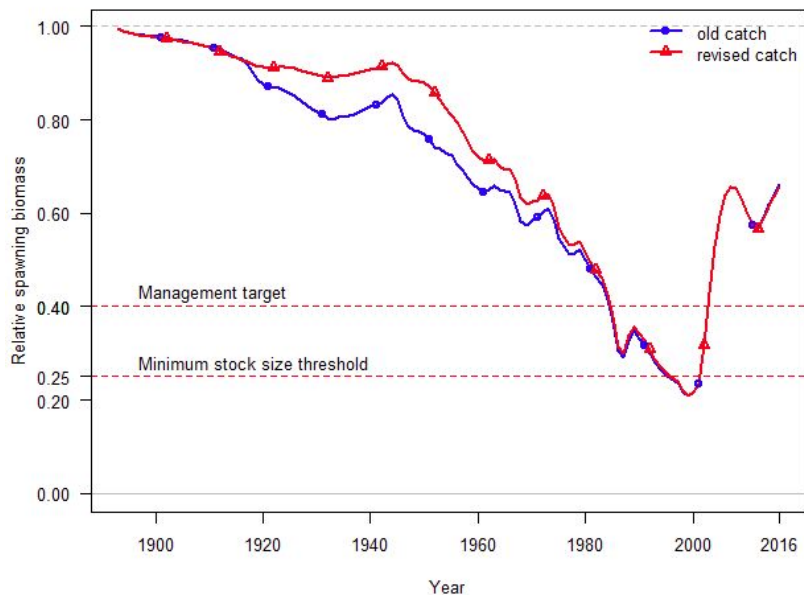
Fishing Intensity Relative to Targets

Most Recent **Benchmark** Assessment (Field 2007)

- Model structure (largely unchanged since 2007)
  - Length-based, age-structured model, with catches from 1892-present
  - Assessed area: US-Mexico border to Columbia River
  - Four fishing fleets (Trawl, hook & line, setnet, and recreational)
  - Two fishery-dependent indices: trawl logbooks and recreational onboard observers
  - Three fishery-independent indices: NWFSC trawl, triennial trawl, age-0 recruitment
  - Length and marginal age compositions
  - Fixed steepness (0.57) and natural mortality (0.16 females, 0.2 males)
  - Time-varying growth
- Formal update in 2015, catch-only update in 2017
  - Updated to recent versions of Stock Synthesis (v3.xx)
  - Extended time series for data listed above
  - The 2017 catch only update corrected historical catches and updated recent catches only
  - Updated maturity and fecundity relationships
  - Selectivity block added for recreational fleet, new ageing error matrix

Research Recommendations

- 2007 STAR Panel Report
  - Replace marginal age compositions with conditional age-at-length compositions
  - Revisit likelihood weighting
  - Reduce lower bound of the smallest length bin
  - Evaluate alternative selectivity configurations for the recreational index
  - Explore possible spatial structuring of data and model
  - Develop a fishery-independent time series using fixed sites and volunteer anglers
  - Need age validation for chilipepper rockfish
- 2015 STAT Recommendations
  - Revisit selectivity functions for all fleets
  - Investigate tension between index and length data (better fit by high steepness), and age data (better fit by low steepness)
  - Re-evaluate time-varying growth using conditional age-at-length compositions
  - Explore spatial differences in growth and other life history characteristics

Biology

Stock Structure

- 1998 assessment: Eureka-Monterey-Conception INPFC Areas
- 2007 assessment and updates: California and Oregon
- Genetic studies are outdated (1980s), but found no evidence of population structure
- Juveniles settle in shallower water, move to deeper depths with age
- Very little data available on adult movement or larval dispersal
- STAT will examine data for spatial differences in
  - Growth
  - Exploitation history
  - Size compositions
- Depending on results, may consider "fleets as areas" model structure

Natural Mortality Rate (M)

- Previous assessment: fixed at M=0.16 for females, M=0.2 for males
- Will update M prior following current best practices
- Possible that use of conditional age-at-length compositions will allow estimation of M.

Maturation

- Updated in 2015
- 50% of females mature at 24.4 cm
- 95% mature at 35.2 cm
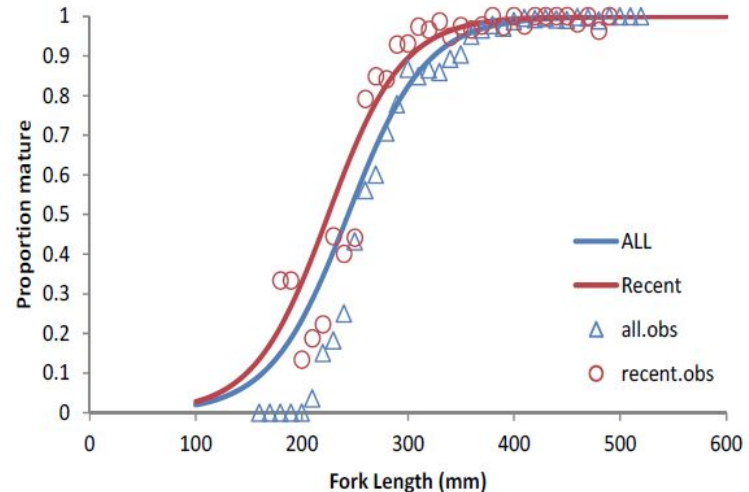
Fecundity

- Number of eggs per gram body weight increases with size
- Evidence of both regional and temporal variation in relative fecundity (Beyer et al. 2014, Beyer et al. 2024)
- Meta-analysis of brood fecundity (Dick et al. 2017)
- Evidence that multiple brooding is size- and area-dependent (Lefebvre et al. 2018)
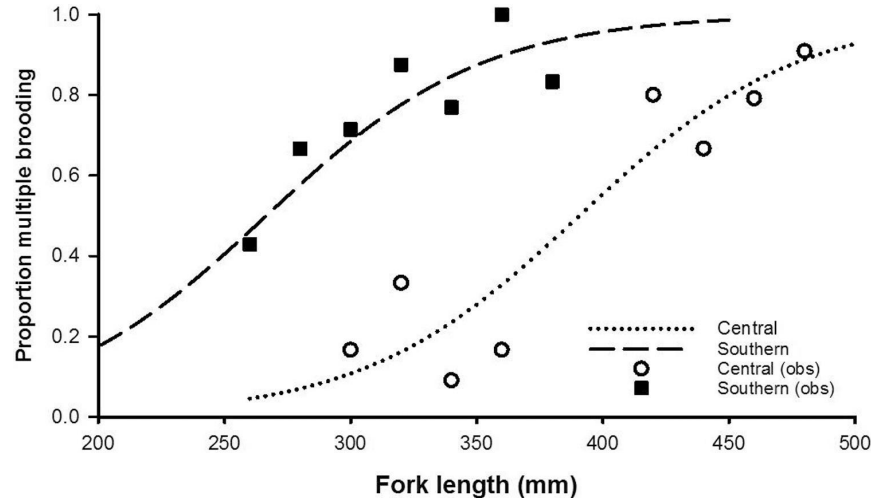
Growth

- Dimorphic growth (females larger than males at a given age)
- 2015 assessment updated time-varying growth model from 2007 benchmark (von Bertalanffy k estimated, other parameters fixed)
- STAT also evaluating alternative hypothesis of time-varying selectivity

Female time-varying growth
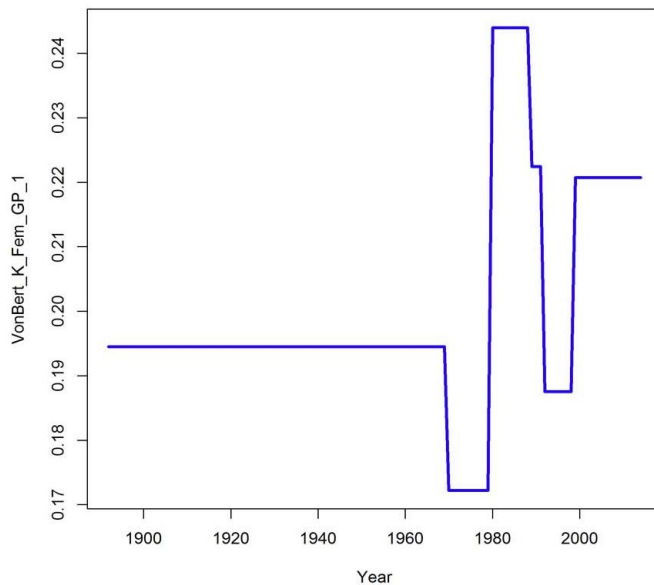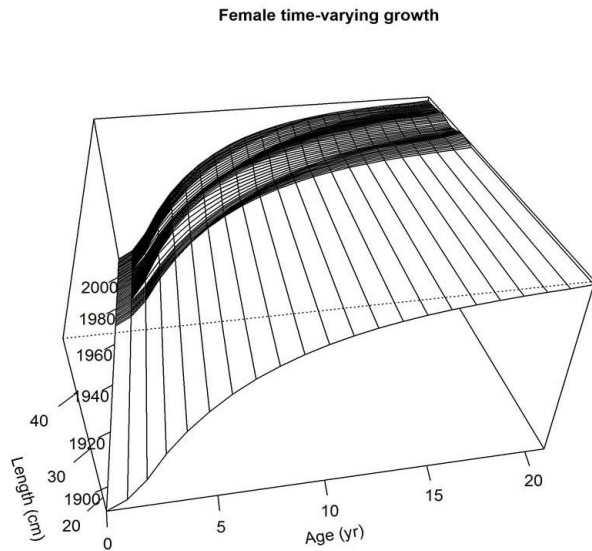
Fishery-Dependent Data

California Historical Landings Overview

- **Commercial landings**
  - "Recent" period (1978-2024) separated by major gear groups: trawl, line, net
  - Ratio estimates; 1969-1977; also by trawl, line, net gears
  - SWFSC California Commercial Catch Reconstruction (Ralston et al. 2010), 1916-1968; trawl, non-trawl gear
  - Sette and Fiedler (1928; FIUS), pre-1916; from last assessment (assumed non-trawl)

- **Recreational landings**
  - Combining all rec modes (account for a small fraction of total removals)
  - RecFIN, 1981-2024; i.e. MRFSS (1981-2003); CRFS (2004-2024)
  - Ralston et al. (2010), 1928-1980; 1980 estimate replacing MRFSS estimate
  - Pre-1928 TBD

Oregon Landings, Foreign Fleets, and Bycatch

- Oregon Landings
  - Commercial landings by year and gear, 1929-present
  - Recreational landings and discard by year (all modes combined), 1979-present

- Foreign Fleets
  - Source: Rogers et al. (2003)
  - Landings by foreign fleets, 1965-1976

- Bycatch
  - Chilipepper caught as bycatch in the at-sea hake fishery
  - Estimates available 1975-present
  - Not included in previous assessments

Recent commercial catch by major gear group, 1916-2022

- Trawl gear has been dominant in California since the 1940s
- Oregon landings are small and sporadic (edge of species' range)
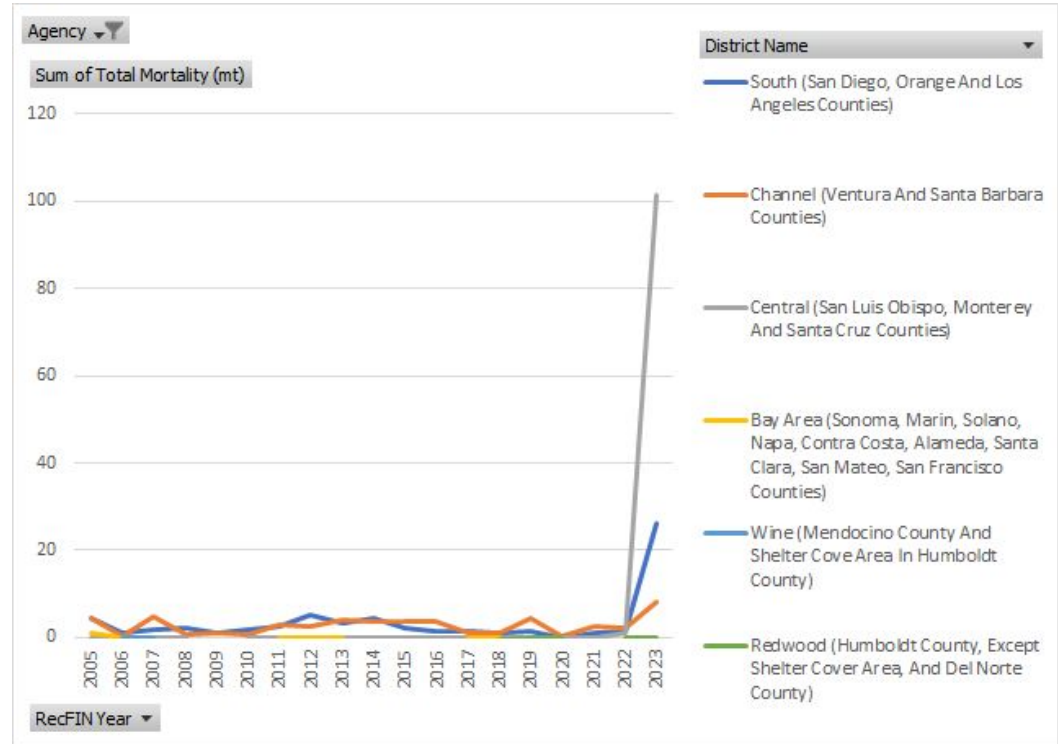

California Chilipepper Landings [mt]

Oregon (all gears combined)
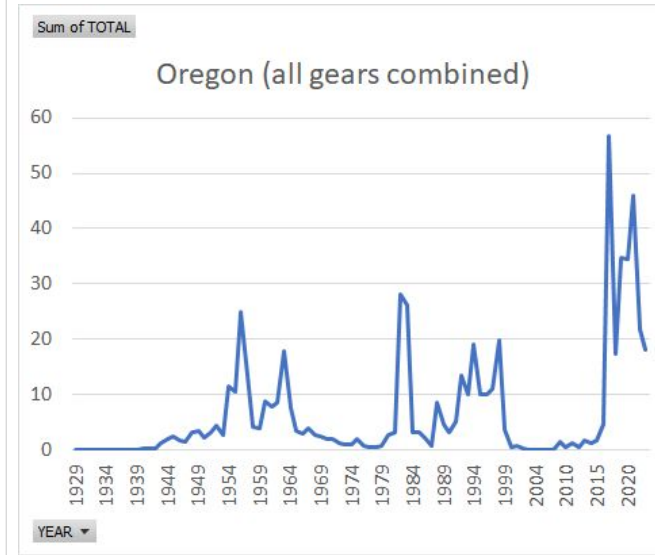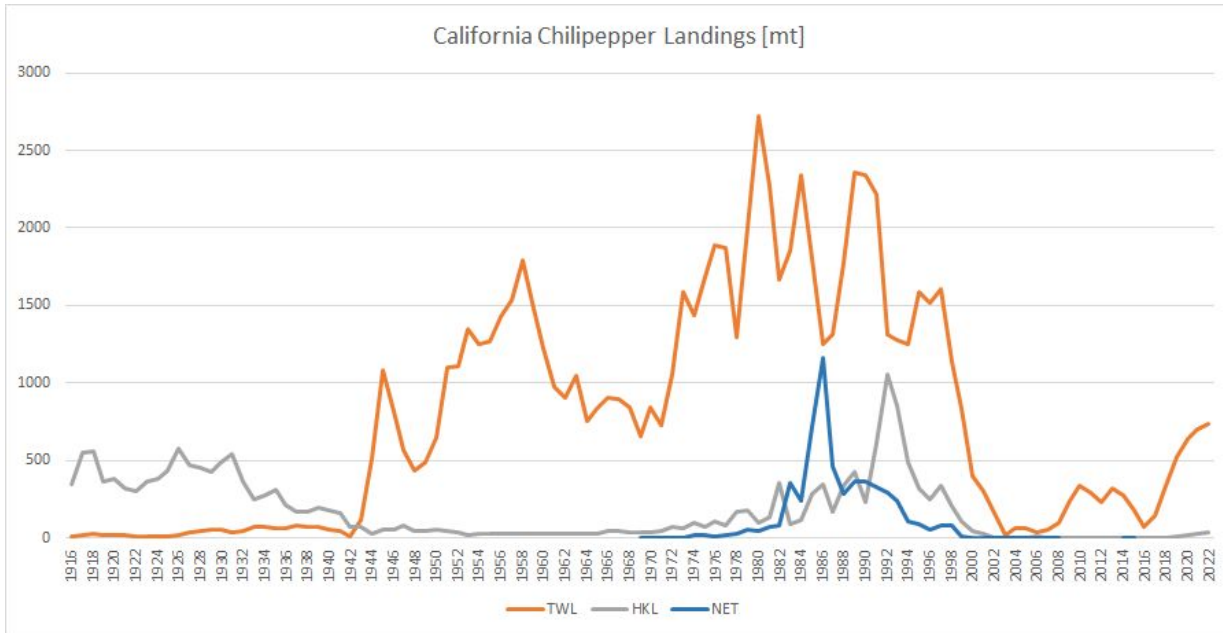
California Recreational Fisheries Survey (CRFS) Districts

Recreational Catch (mt, 2005-2023)

- **Preliminary** Estimates (STAT has <u>not</u> verified these with CDFW)

Commercial mean lengths

- Declines in mean length during 1980s and 1990s observed in 2007 assessment (figure at right shows trawl fishery only)

- Declines slowed or reversed in 2000s

- Females larger than males on average

- STAT will repeat mean length analysis to include recent (2007+) trends, and look for spatial patterns as well

Female Chilipepper mean size at age

Male Chilipepper mean size at age
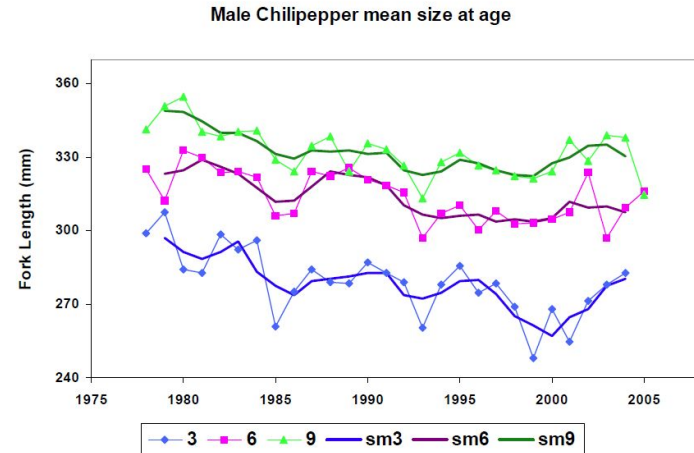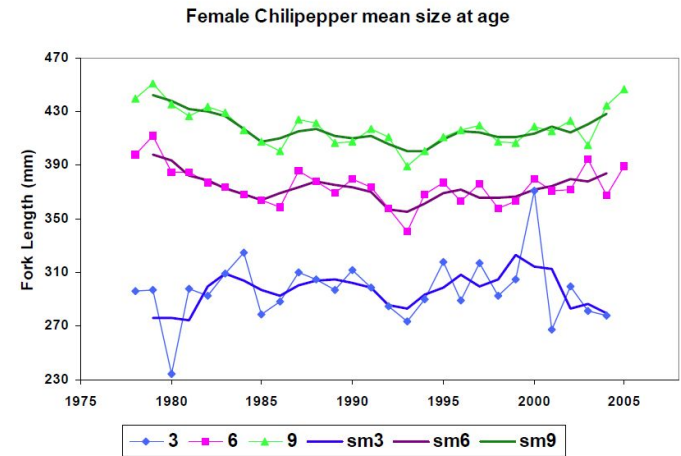
Source: Field 2007

Discard

- Historically, chilipepper discards were a small percentage of landings (<1%)

- Beginning in early 2000s, regulatory discards were a large % of total catch, but total catch was small (not a significant impact to the stock)

- Discard Treatment TBD
  - WCGOP data to inform commercial discards
  - Recreational discards supplied by RecFIN
  - Discards added to landings in previous assessments
  - STAT will likely do the same, but will look at possibility of modeling commercial discards if sufficient data are available

Fishery-Dependent Age Data

- NWFSC ageing laboratory working on new ages for 2025 assessment

- **Insufficient staffing to read all available structures**

- Will allocate samples moving backward in time, likely to ~2017

- Majority of ageing effort will be on California samples, with some Oregon ages to allow for spatial growth comparisons

	California		Oregon	
	Commercial		Commercial	
Year	Unaged otoliths	Ages	Unaged otoliths	Ages
2000	0	1,159		
2001	0	895	18	0
2002	0	1,068		
2003	0	312	15	0
2004	0	949		
2005	0	349	30	0
2006	0	0		
2007	0	511	1	0
2008	0	467		
2009	0	782	224	0
2010	291	305	77	0
2011	1	8	5	0
2012	349	348	46	0
2013	408	408	42	0
2014	374	301	41	0
2015	244	0	162	0
2016	146	0	140	0
2017	153	0	678	0
2018	699	0	438	0
2019	374	0	576	0
2020	868	0	176	0
2021	622	0	301	0
2022	851	0	469	0
2023	396	0	358	0
2024	535	0	*	0

Fishery-Dependent Indices of Abundance

- Commercial Trawl Logbook Index
  - ***Will most likely NOT be included in 2025 assessment***
  - Relied on strong assumptions about the species composition of catch
  - CV of 10% (adjusted upward from 4%) is very informative, and likely overestimates the precision of the index
  - STAT will do sensitivity analyses to evaluate effect of excluding the index or estimating an additive variance parameter

- Onboard Recreational (CPFV) Observer Indices
  - Previous assessments used data from 1987-1998
  - CRFS onboard observer data also available
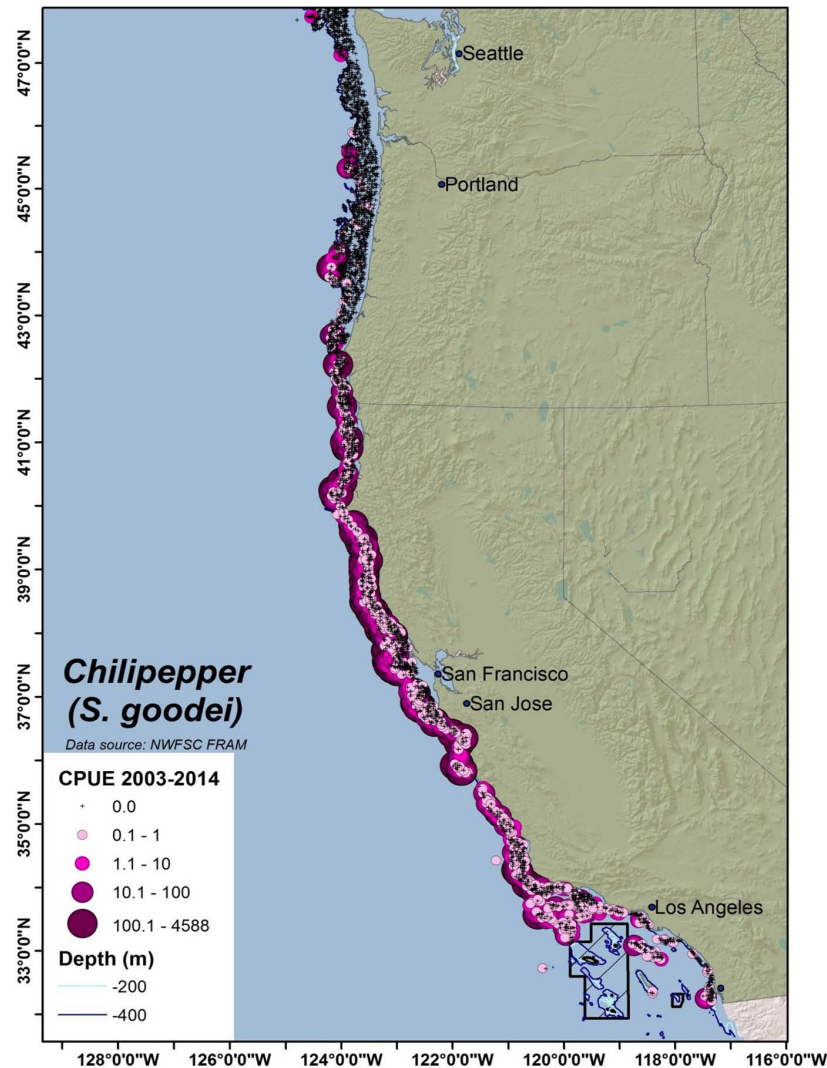 - STAT will examine both time periods using QA/QC'd databases (e.g. Monk et al. 2016)

Fishery-Independent Data

NWFSC Trawl Survey

- Coastwide survey, 2003-2024

- Provides index of abundance, lengths, and ages

	NWFSC WCGBT	
	Unaged otoliths	Ages
2003	17	663
2004	5	743
2005	1	832
2006	0	596
2007	1	590
2008	2	697
2009	0	616
2010	15	806
2011	2	647
2012	0	833
2013	0	683
2014	2	873
2015	0	608
2016	0	720
2017	0	540
2018	530	0
2019	350	0
2020	0	0
2021	770	0
2022	673	0
2023	575	0

Chilipepper (S. goodei)
Data source: NWFSC FRAM

CPUE 2003-2014
- · 0.0
- ○ 0.1 - 1
- ● 1.1 - 10
- ● 10.1 - 100
- ● 100.1 - 4588

Depth (m)
- −200
- −400

SWFSC Rockfish Recruitment and Ecosystem Assessment Survey ("RREAS")

- Index of age-0 pelagic juveniles (recruitment index)
- Coastwide coverage in most years, 2001-2024
- Preliminary results:
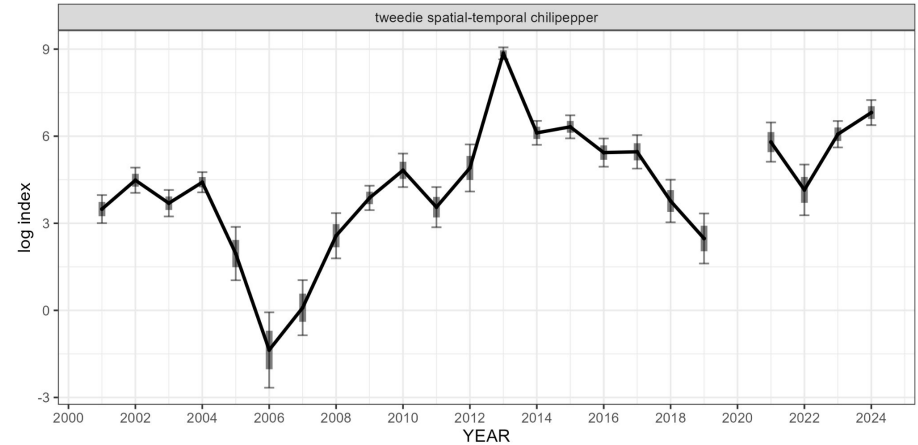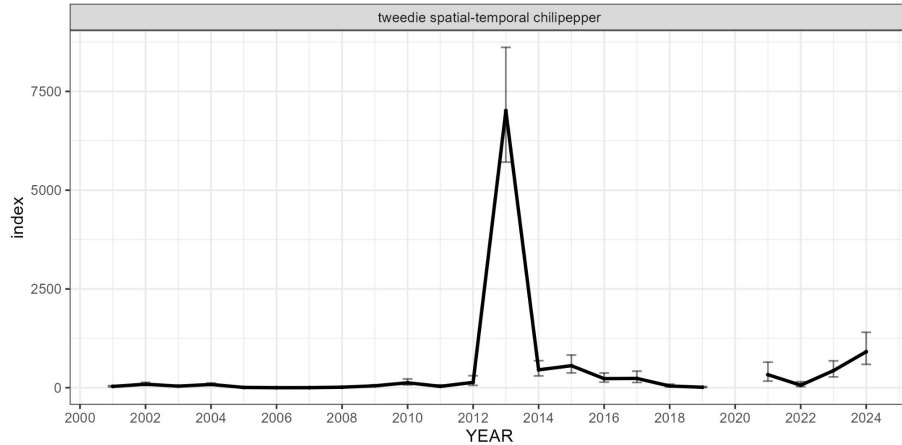
Triennial Trawl Survey

- Survey conducted every three years, 1980-2004
- Provides index and length data (age data lost)
- Shifts in sampled depths have resulted in various treatments over time
- STAT will explore any recommended changes to best practices for index standardization
- Index from 2007 assessment:
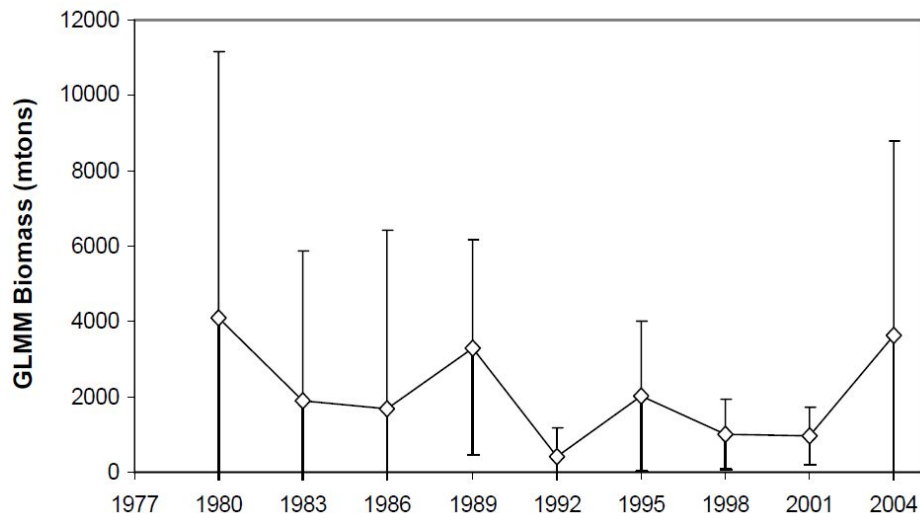
CalCOFI Ichthyoplankton Survey

- Index of spawning output
- Spatial coverage mainly limited to Southern California
- Excluded from previous assessments due to spatial coverage, but STAT will re-evaluate

NWFSC Hook & Line Survey

- Fixed station hook and line survey covering the Southern CA Bight
- 2004-present
- Index of relative abundance, length compositions
- Age data available to assist with analysis of spatial patterns in growth
- STAT is currently evaluating how much ageing effort to allocate to this region; likely a small amount, similar to Oregon (edge of species range)

Regulations

Regulations Overview

- Early 2000s saw steep declines in landings aimed at reducing catch of overfished species, e.g. bocaccio

- Recent catches increasing with restored access to shelf waters

- Moving forward, reliable separation of landings by mid-water and bottom gear types is needed (due to differences in species composition)
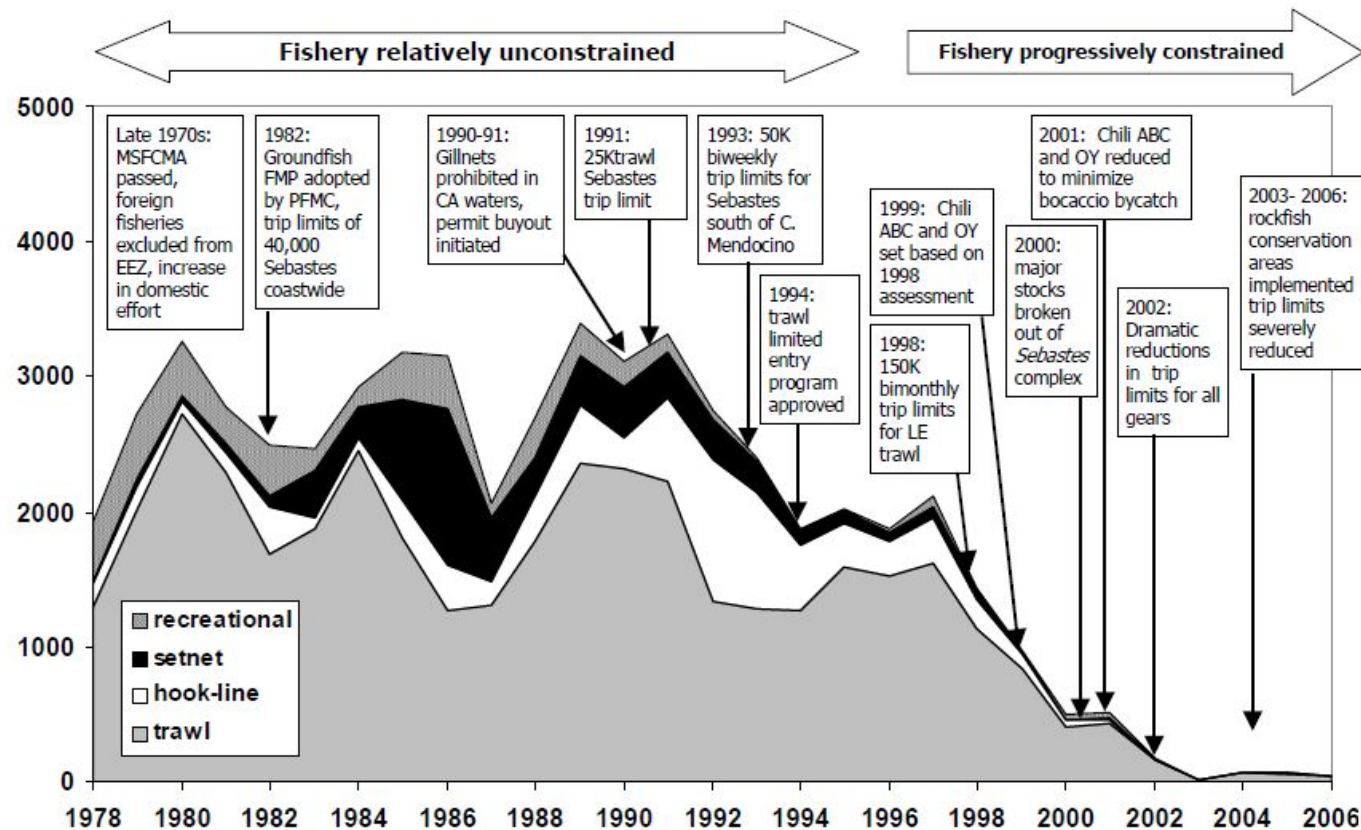
Source: Field 2007

Early thoughts on modeling

Ideas for Model Exploration

- Convert age composition data to conditional age-at-length
  - Avoids using samples twice (length and age from one fish)
  - Could improve growth estimation
  - Could improve natural mortality estimation
  - Could slow the model down to a crawl (might need to use a mixture of CAAL and marginal)
- "Fleets as areas" approach
  - **If** there is evidence of spatial differences in mean length, then individual fleets can be separated by area and allowed to estimate selectivity by area
- Reconsider possibility of time-varying selectivity (Ralston et al. 1998) as an alternative hypothesis to time-varying growth
- Use 1-cm population size bins and 2-cm data bins, change smallest size bin to improve growth estimation
- Attempt to estimate steepness and/or natural mortality using current priors

Parting Thoughts?