California Scorpionfish 2017 Stock Assessment

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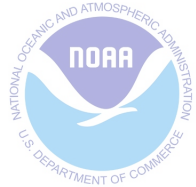
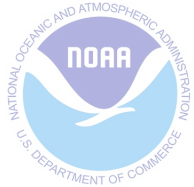
SSC Groundfish subcommittee August 28, 2017



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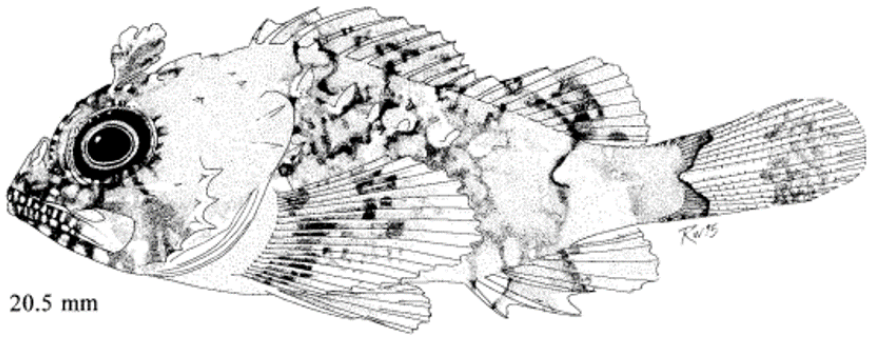
California scorpionfish (*Scorpaena guttata*)

- Most common species of *Scorpaena* on the U.S. West Coast, more species in Mexico
- Venomous dorsal, anal and pelvic spines
- Demersal, found over both hard and soft bottom (anectodtal evidence sugggests they prefer *new* structure)
- Exhibit aggregating behavior (spawning and non-spawning aggregations)

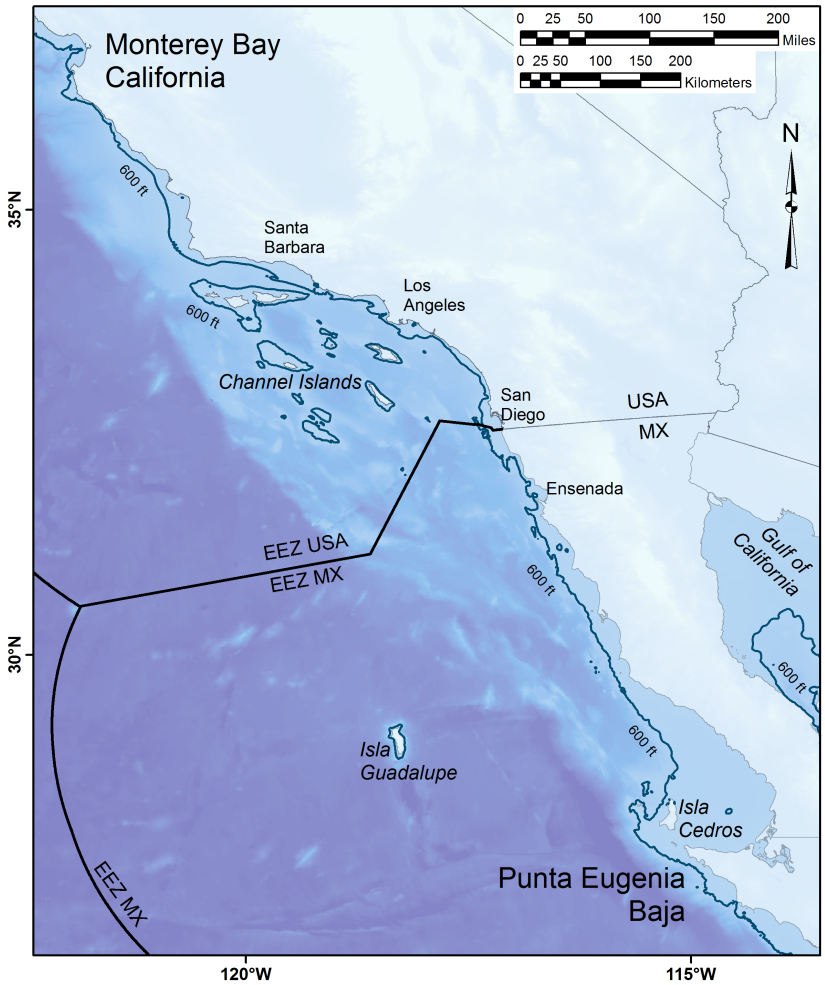
Early Life History

- Migration to spawning grounds, exhibit explosive breeding behavior just before dawn
- External fertilization, females produce hollow gelatenous single-layer floating egg matrix
- Eggs hatch after about 5 days
- Juveniles settle at less than 2 cm



[0]Line drawning from CalCOFI Atlas 33, pg. 789 Figure 26

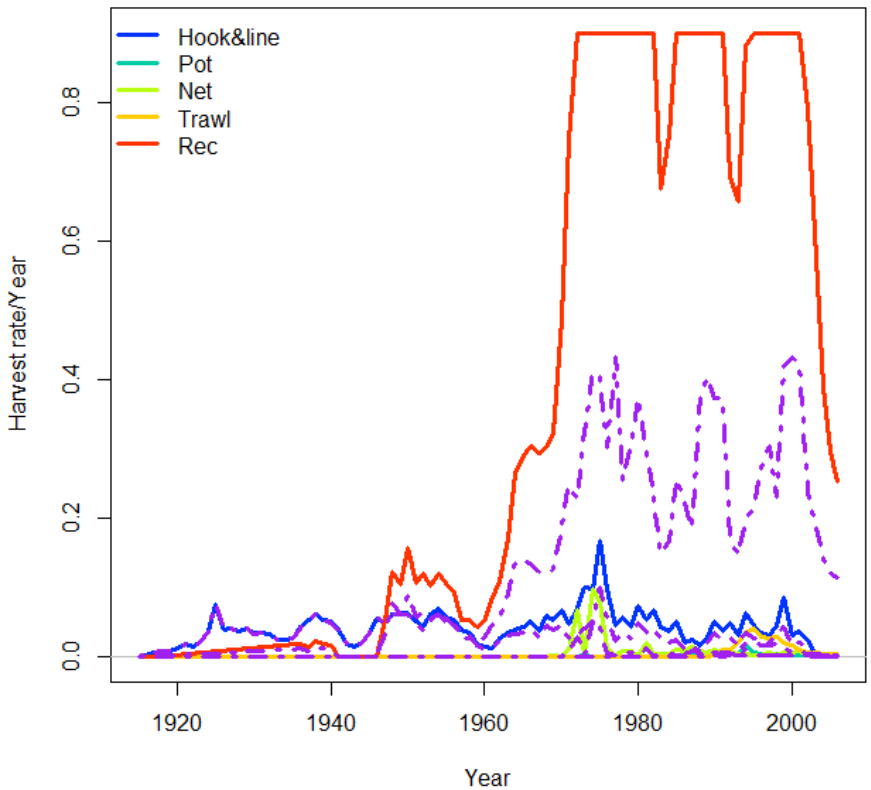
Distribution and Stock Assessment Boundary

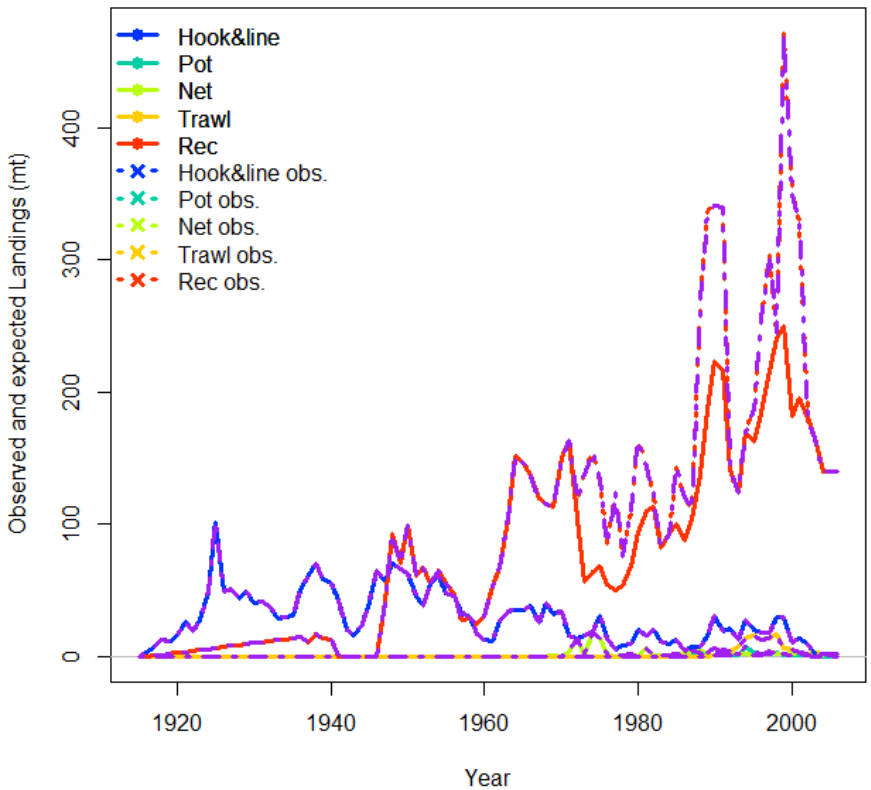


- Distributed from central California to Punta Eugenia, Baja California Sur, Mexico
- Assessment south of Pt. Conception to U.S/Mexico border
- Observed from the intertidal to 600 ft, prefer depths of 20-450 ft
- Proportion of the stock in Mexican waters unknown

2005 Stock Assessment

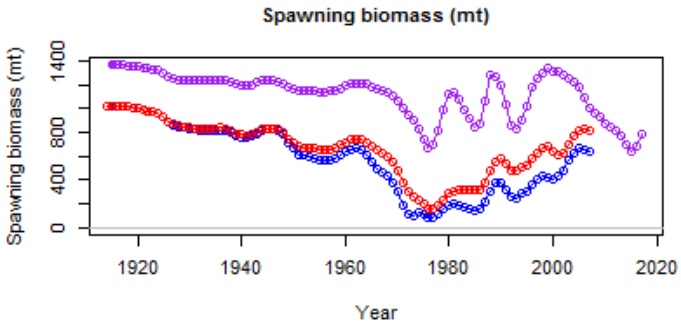
- Transitioning from the 2005 assessment, an error was found
- Harvest rate hit the bounds for the recreational fleet
- Not all of the recreational catch was removed in the model
- Input vs. estimated catch was not standard output in SS v.1.8

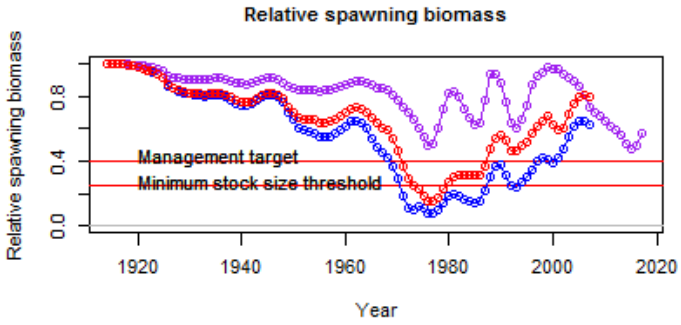


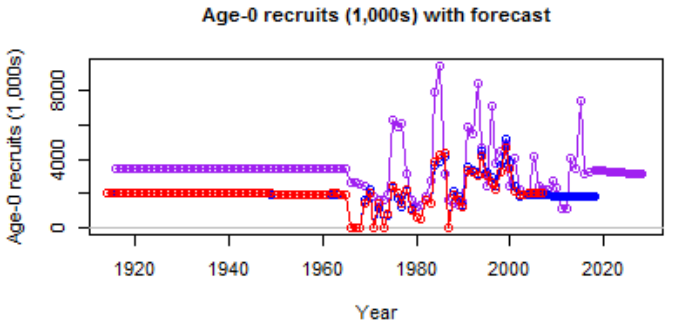


2005 Stock Assessment

- 2005 assessment, SS v.1.8
- 2005 model in SS3.24z
- 2017 pre-STAR base model, SS3.30.0.05
- The two assessments have very similar trends over time, with B_0 higher for the 2017 assessment that includes all removals





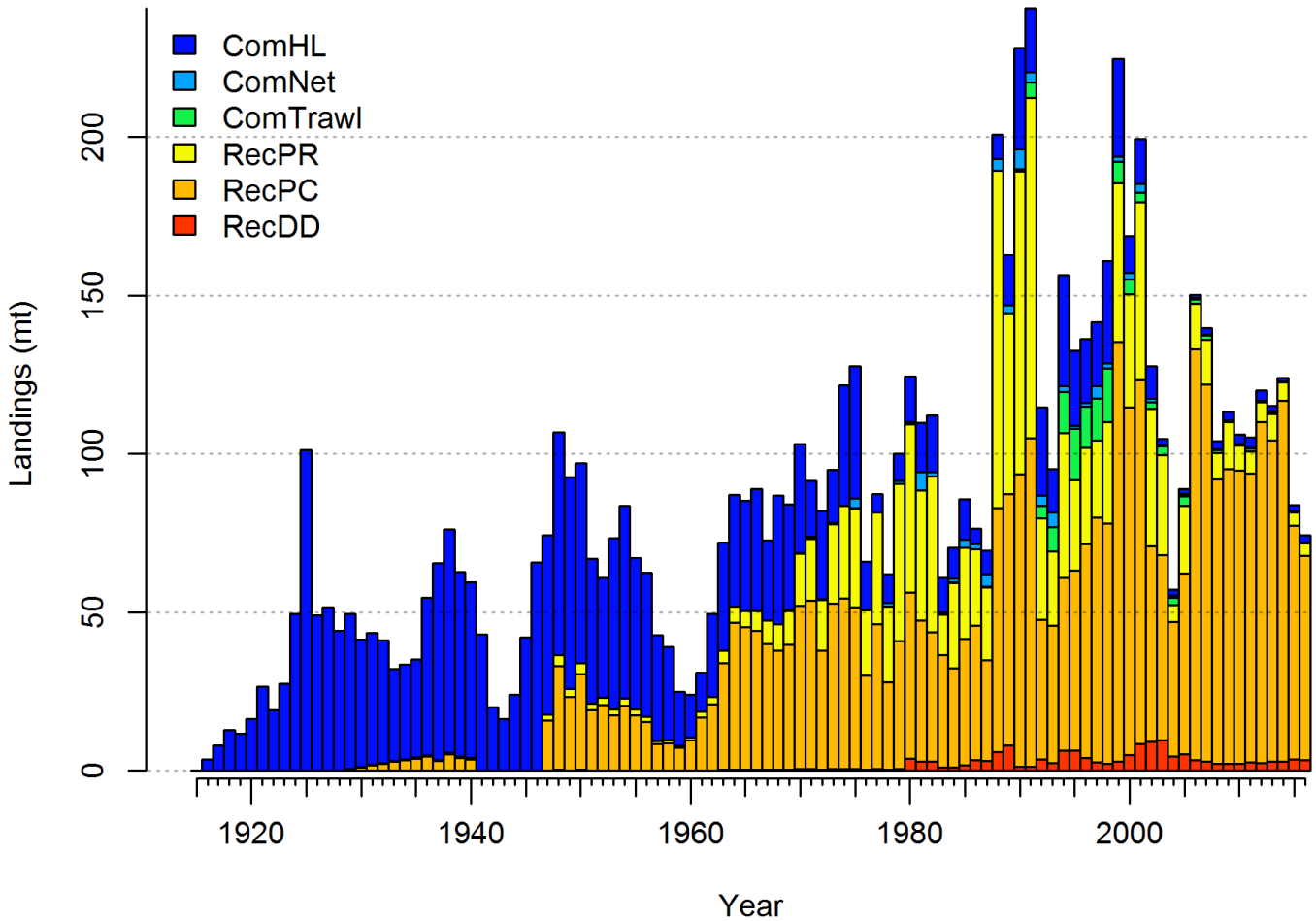


2017 Stock Assessment

Pre-STAR Base Model

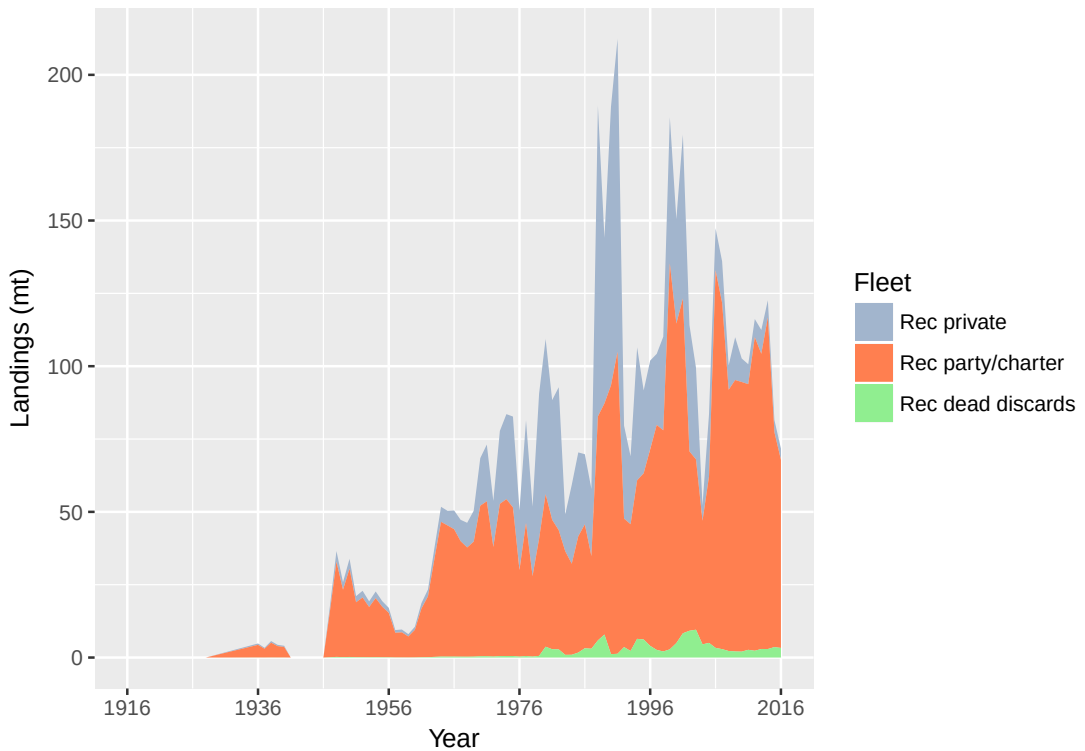
- One area south of Pt. Conception
  - Catches from Mexican waters excluded as in 2005
- Steepness fixed at 0.718
- Sex-specific M fixed for females, male M estimated as offset
- Re-evaluated fleet definitions
- Ages now available from the NWFSC trawl survey
- New indices and length compositions available
- Newest version of SS allows specification of the minimmum sample size

Catches by Fleet



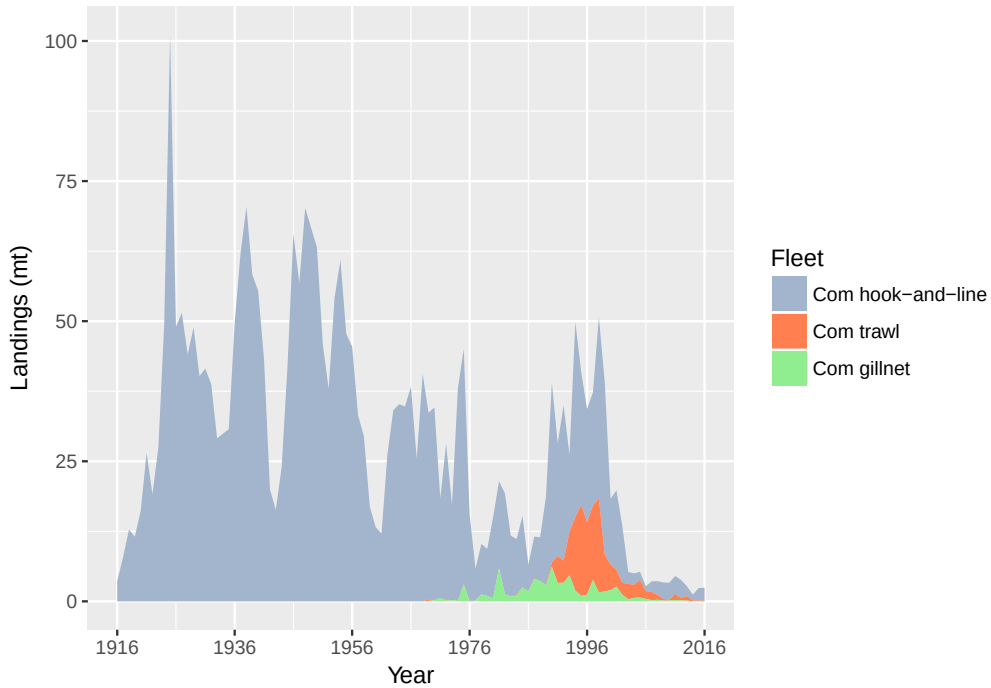
Recreational Catch

- 2005 assessment used number of fish for recreational catches
- 2017 assessment includes one recreational discard fleet
  - Discard mortality rate of 7%
  - Discard biomass accounts for <3% of recreational mortality

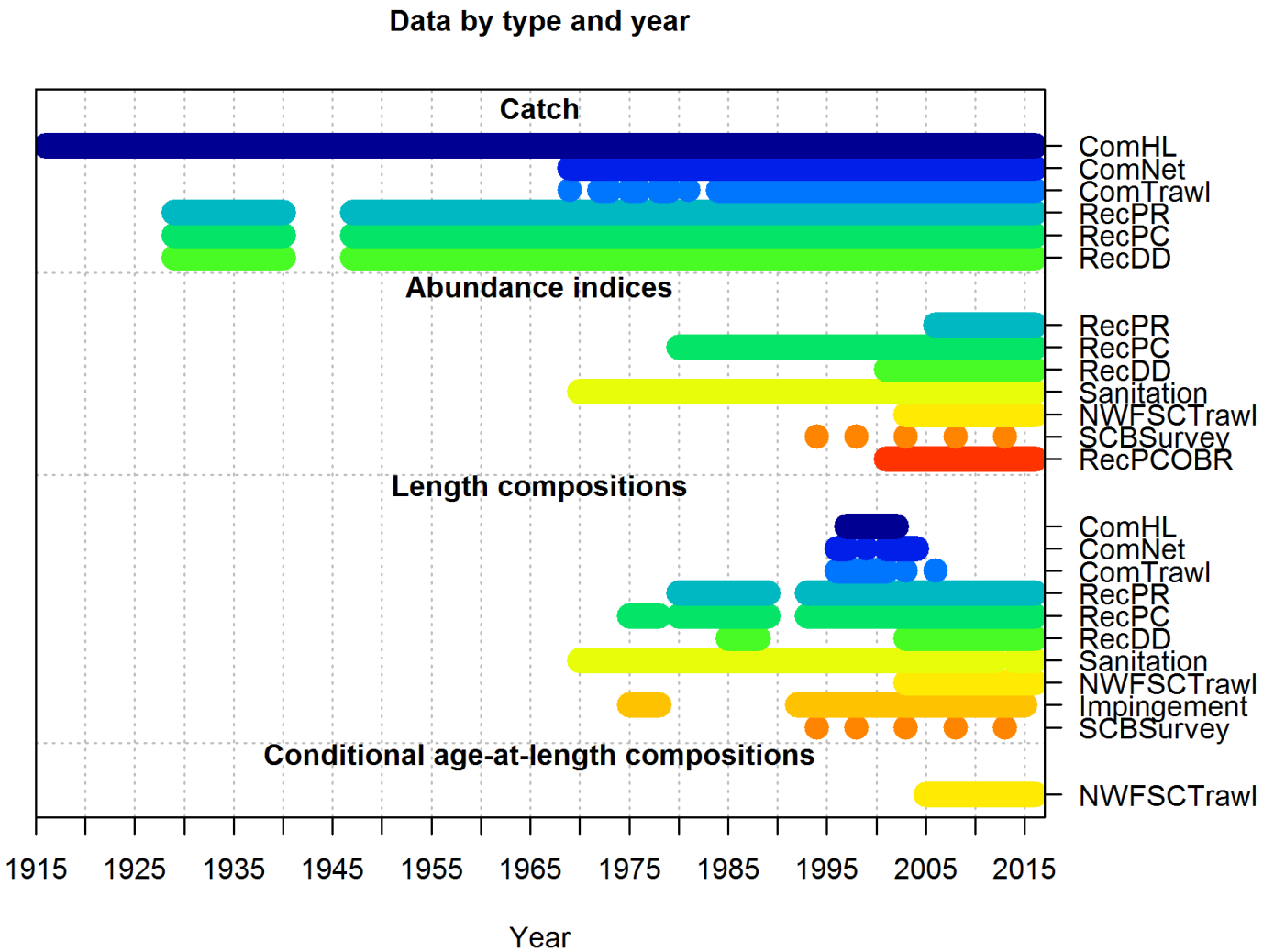


Commercial Catch

- Historical catches same as the 2005 assessment
- California Fisheries Information System (CFIS) landings data used to update catches from 2005-2016
- Discards assumed neglible



Indices of Abundance



Indices of Abundance

All of the methods used to standardize indices have been endorsed by the SSC

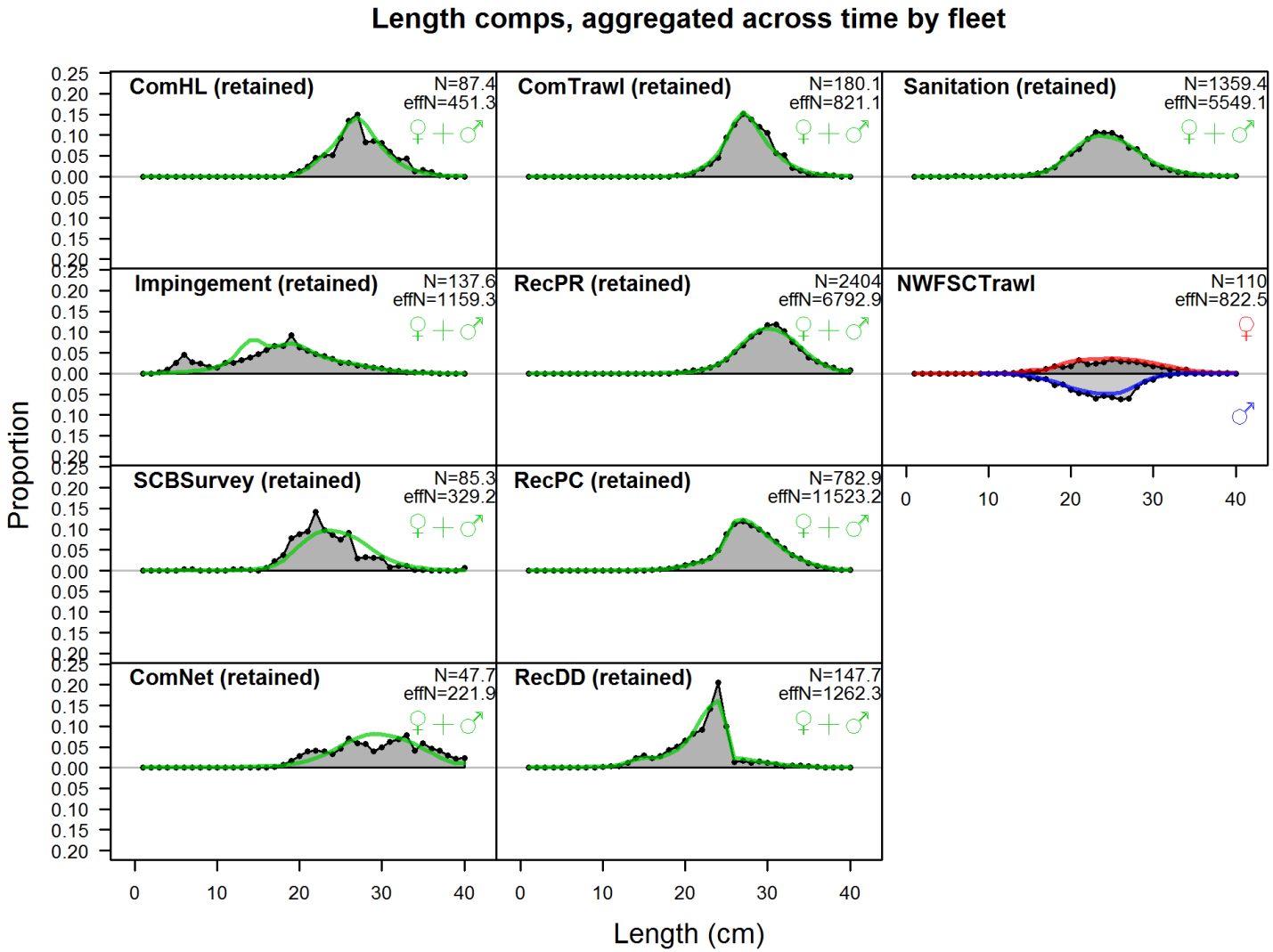
Name	Years	Fishery ind.	Method
Recreational PR dockside CPUE	2004-2016	No	delta-GLM (bin-lognormal)
CPFV logbook CPUE	1980-2016	No	negative binomial
Onboard observer discard catch CPUE	2002-2016	No	delta-GLM (bin-lognormal)
Sanitation district CPUE	1970-2016	Yes	delta-GLM (bin-lognormal)
NWFSC trawl survey CPUE	2003-2016	Yes	VAST
CSUN/VRG Gillnet survey CPUE	1995-2008	Yes	delta-GLM (bin-lognormal)
Southern California Bight trawl survey CPUE	'94, '98, '03, '08, '13	Yes	delta-GLM (bin-lognormal)
Onboard observer retained catch CPUE	2002-2016	No	delta-GLM (bin-lognormal)

Indices of Abundance

Length compositions were provided from the following sources:

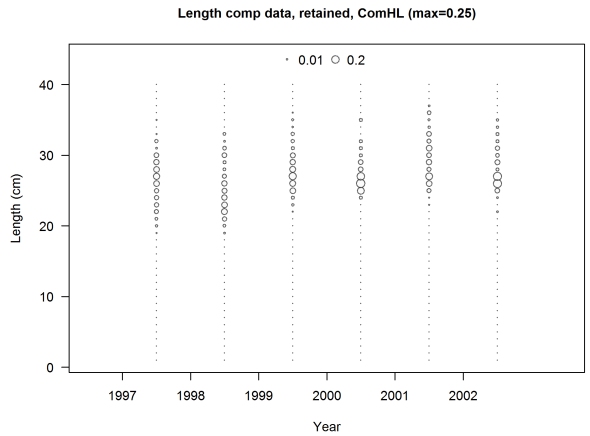
- CDFW market category study (*commercial dead fish*, 1996-2003)
- CALCOM (*commercial dead fish*, 2013-2016)
- CDFW onboard observer (*recreational charter discards*, 2003-2016)
- Collins and Crooke onboard observer surveys (1975-1978)
- Ally onboard observer study (*recreational charter kept/discards*, 1984-1989)
- MRFSS (1980-2003) and CRFS (2004-2014) (*private and party/charter, kept*)
- POTW trawl surveys (*research*, 1970-2016)
- CSUN/VRG gillnet survey (*research*, 1995-2008)
- Power plant impingement surveys (*research*, 1974-2016)
- Southern California Bight trawl survey (*research*, 1994, 1998, 2003, 2008, 2013)

Aggregate length composition

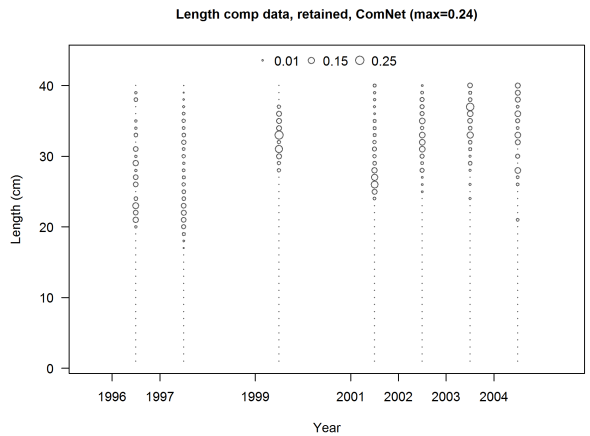


Commercial fishery length composition

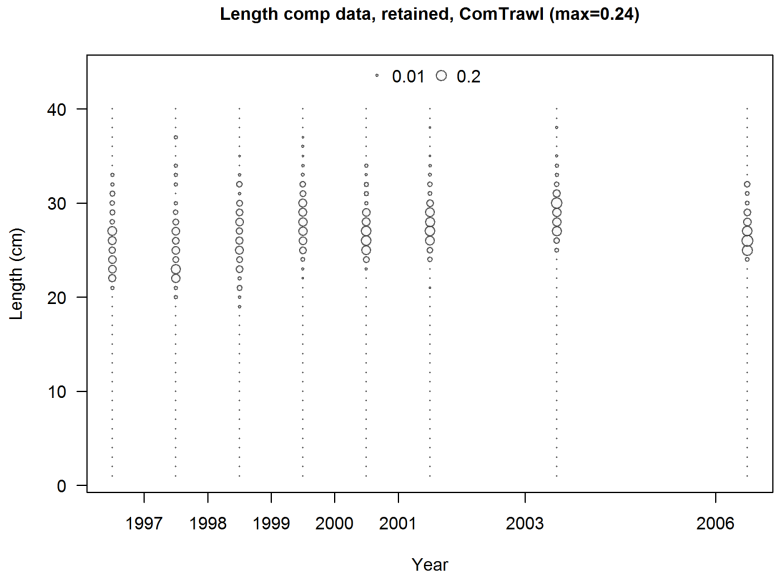
Commercial hook-and-line



Commercial gillnet

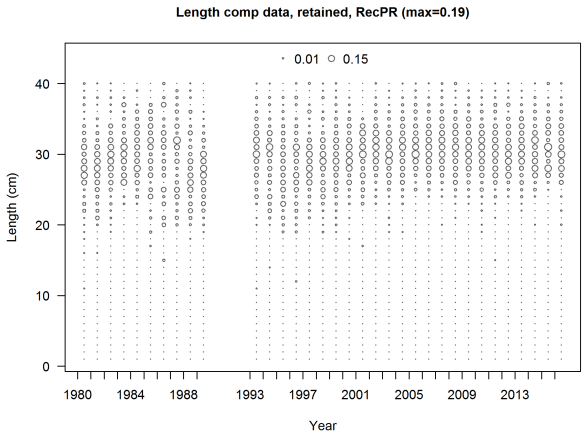


Commercial trawl

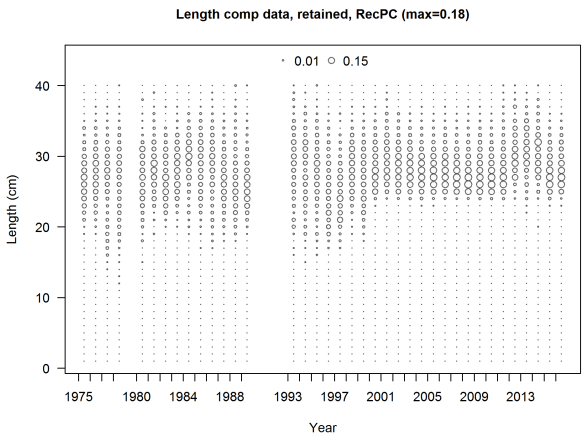


Recreational fishery Length Composition

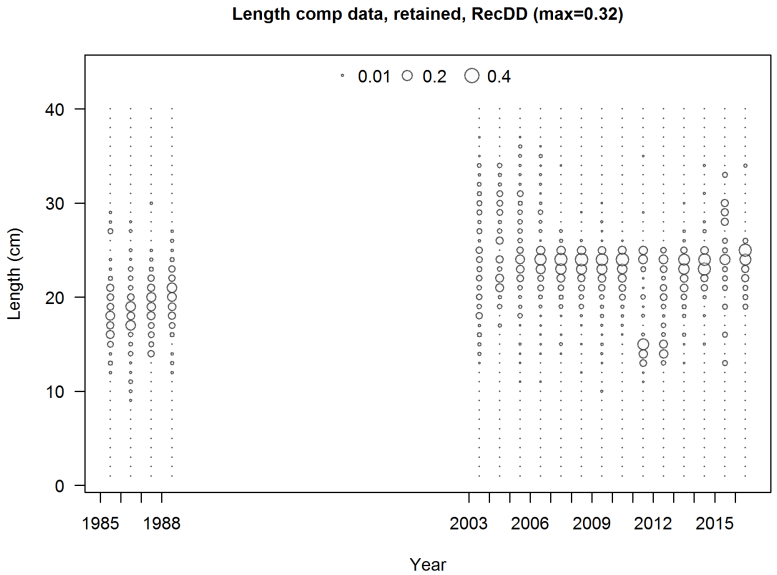
Recreational private fleet



Recreational party/charter fleet

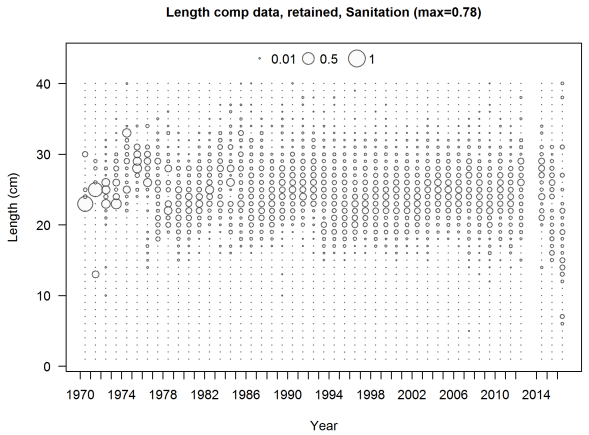


Recreational dead discards

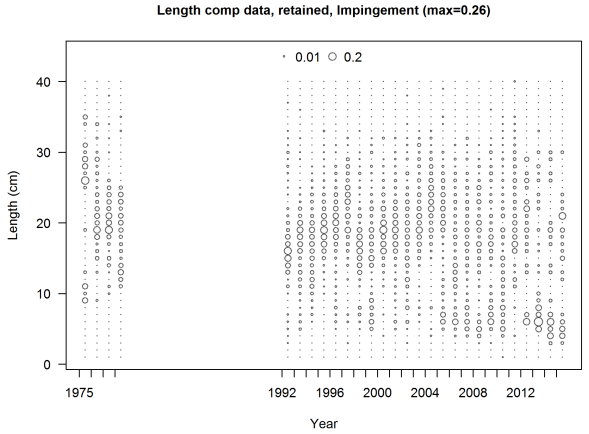


Research Length Composition

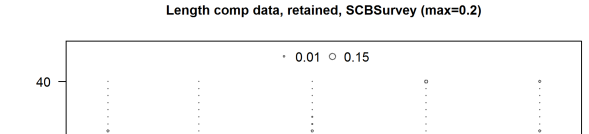
POTW survey



Impingement survey

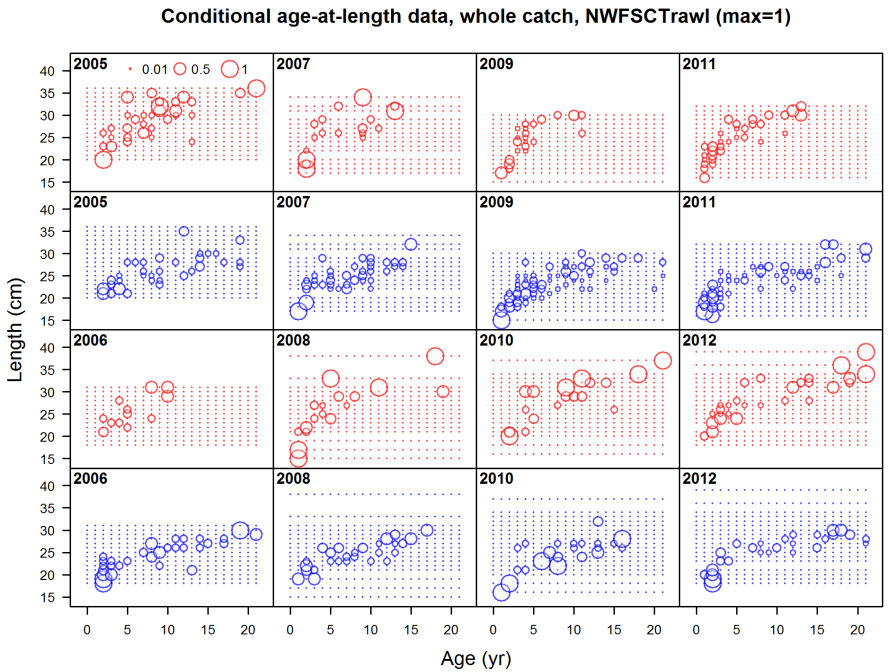


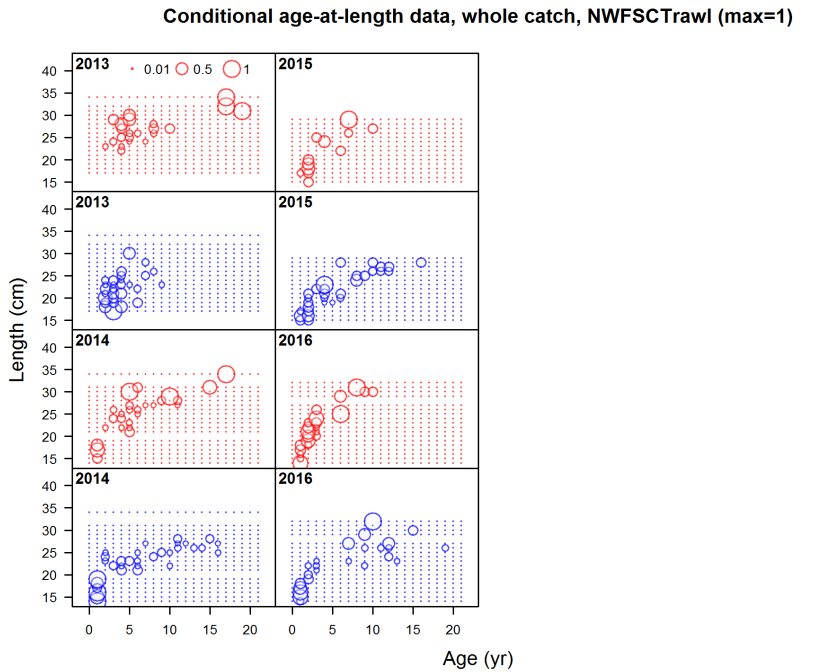
Bight trawl survey



NWFSC Length and Age Composition

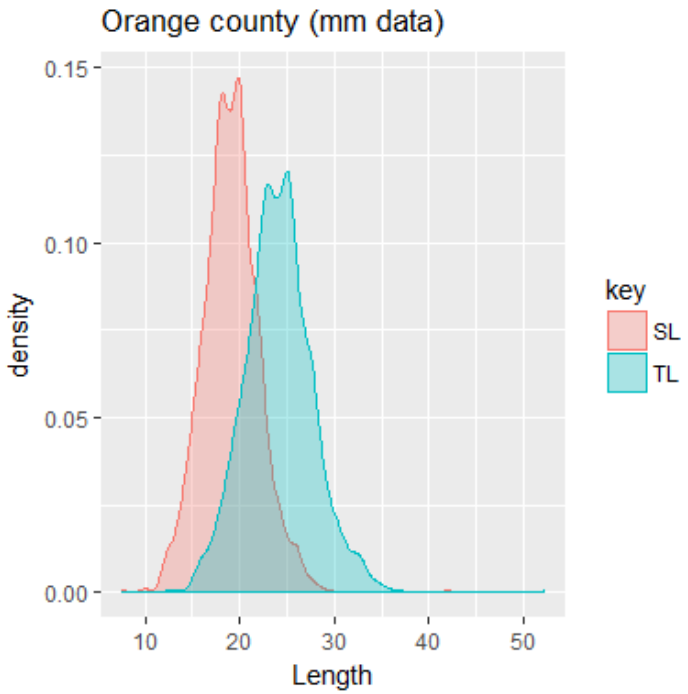
Note: females in red and males in blue

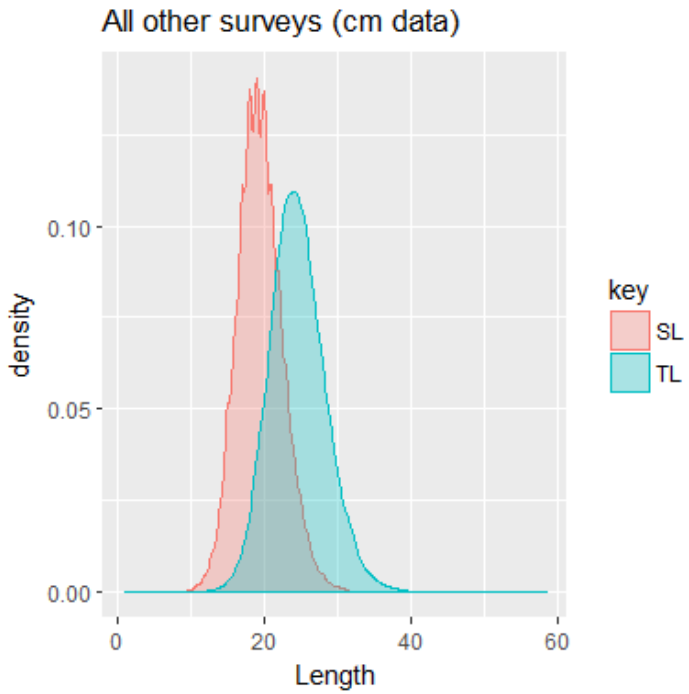




Length data

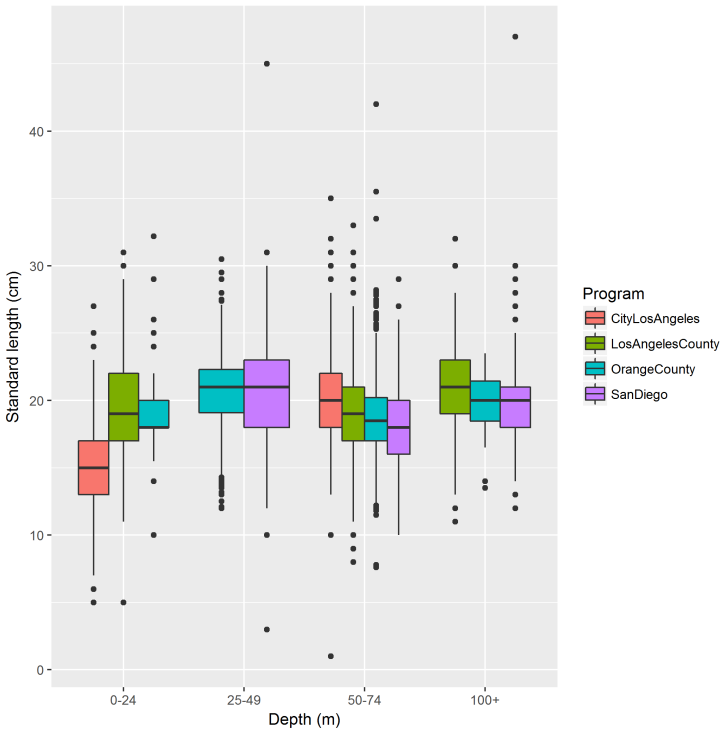
- 2005 assessment used standard length
- Impingement, POTW, and Bight surveys measure standard length
- 2017 assessment uses total length (conversion based on a CDFW halibut trawl study; measured both SL and TL)
- To avoid gaps in TL length bins, TL = SL - 0.5 + U[0,1]

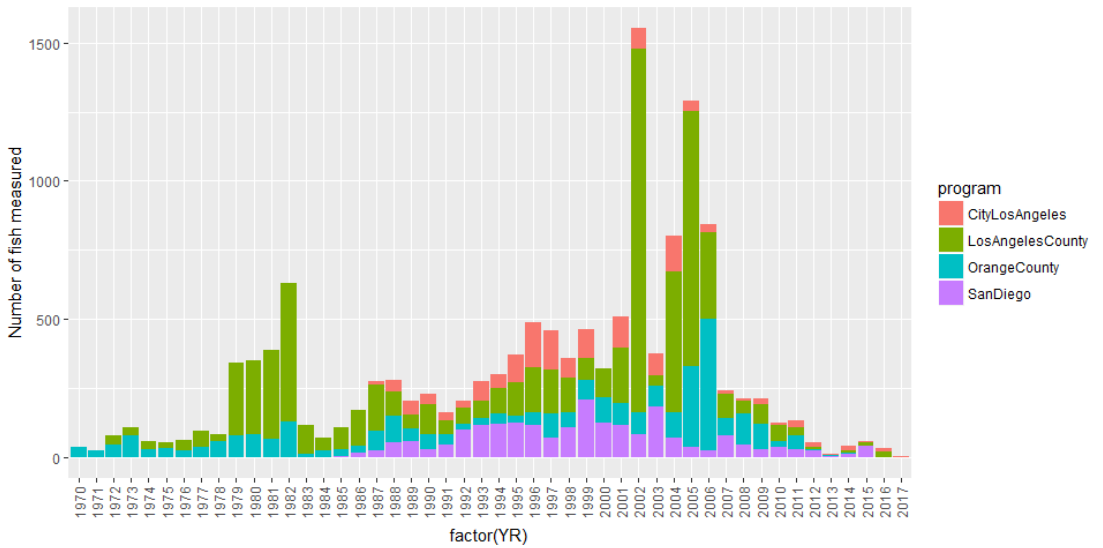




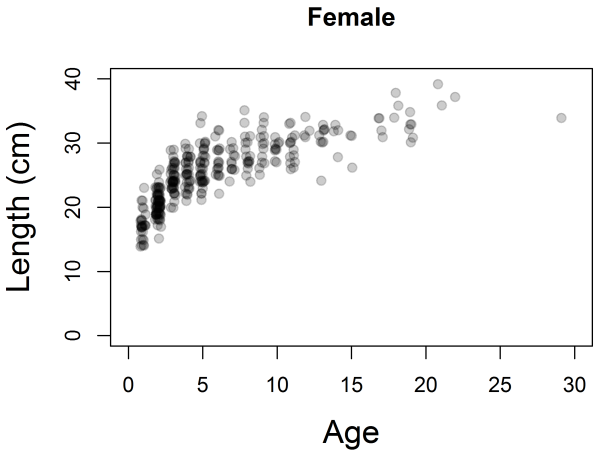
Length data

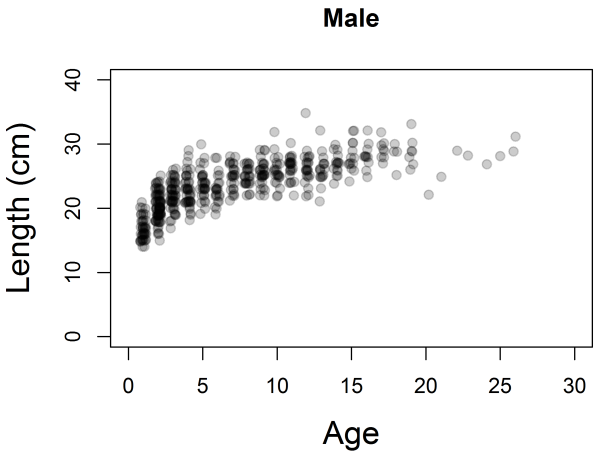
POTW lengths

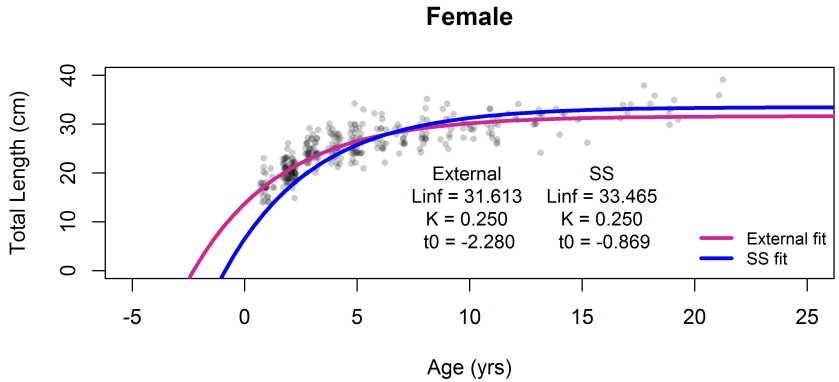


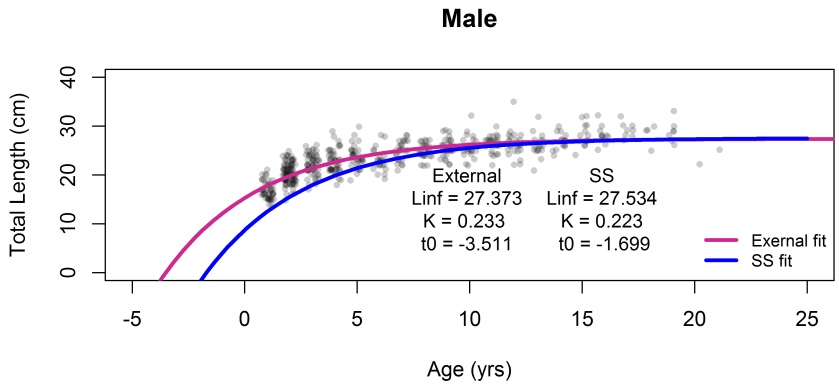


Length-at-Age

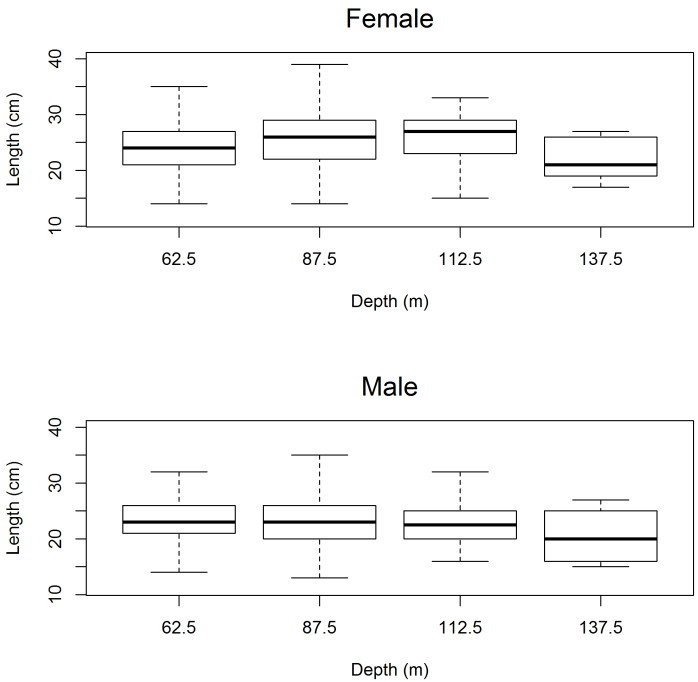


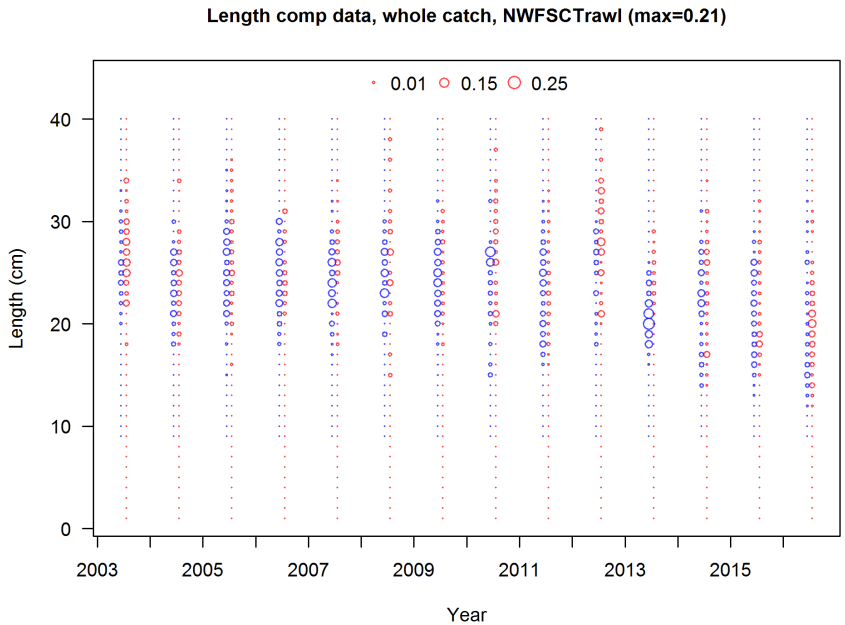






Length-at-Age





Model Specifications

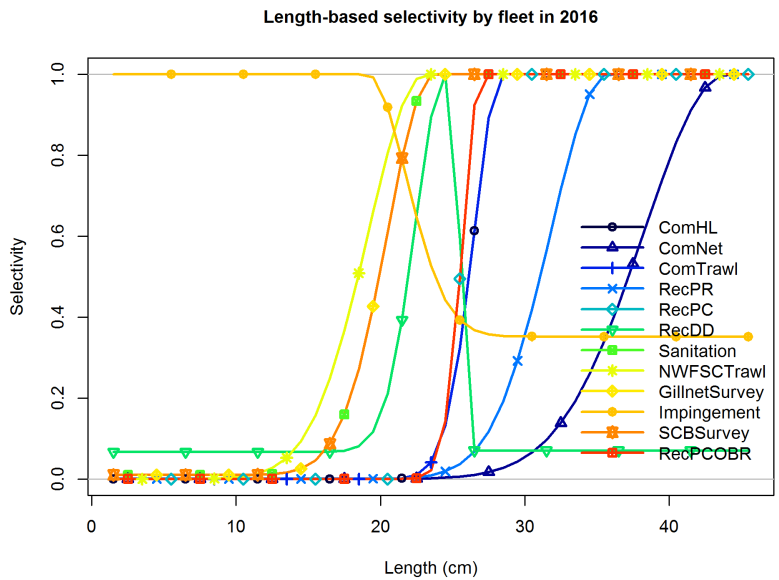
- Stock Synthesis version 3.30.05.04
- Model starts in 1916, unfished equilibrium catch prior to that
- Sex-specific growth and mortality with female M fixed at 0.2571 (prior) and male M offset is estimated at -0.2134 (male $M = 0.2077$)
  - M fixed at 0.25 for both sexes in 2005 assessment
- Steepness fixed at 0.718 (from meta-analysis)
  - h fixed at 0.7 in 2005 assessment
- Maximum age of 21
- One cm length bins
- Recruitment deviations estimated

Selectivity

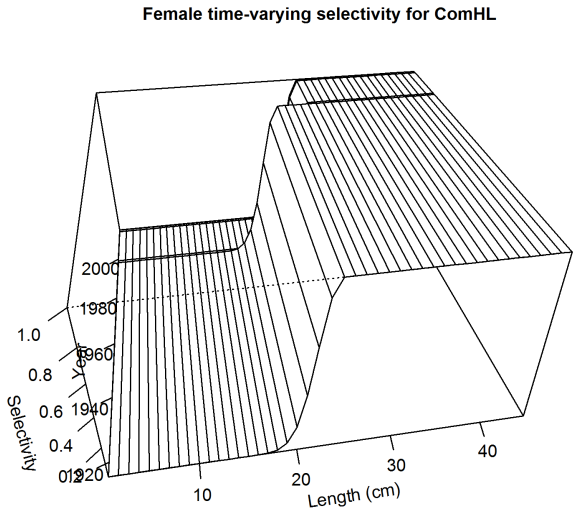
- Time blocks
  - Commercial fleet: 1916-1999 and 2000-2016 (10-in. minimum size limit as of 2000)
  - Recreational fleets: 1916-2000 (few regulations), 2001-2005 (fishery closures), 2006-2016 (consistent regulations)
- Double normal except for the impingement survey (Selectivity = 1.0 for all ages)
- Fisheries selectivity parameters estimated for commercial hook-and-line, receational private, recreational party/charter, and recreational discard fleets

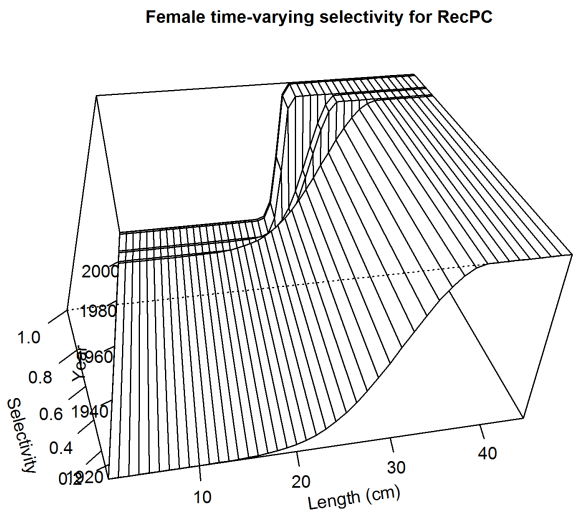
Selectivity

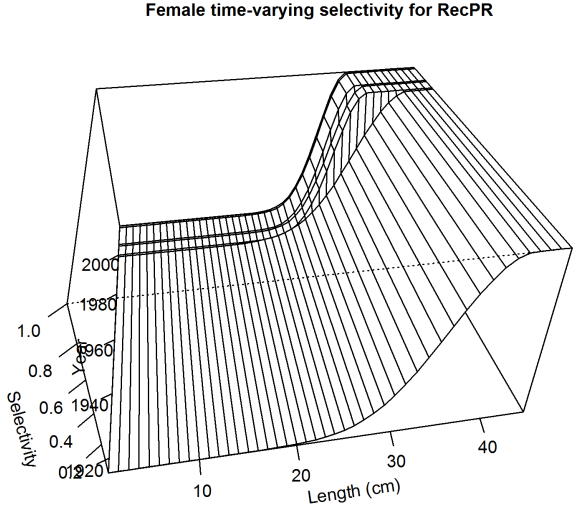
- Commercial gillnet and trawl fleets mirrored to the commercial hook-and-line fleet
- Recreational CPFV onboard observer retained catch mirrored to the recreational party/charter fleet selectivity (same boats)
- Survey selectivity parameters estimated for the POTW and NWFSC trawl surveys
- The gillnet survey and Bight trawl survey mirrored to the POTW selectivity

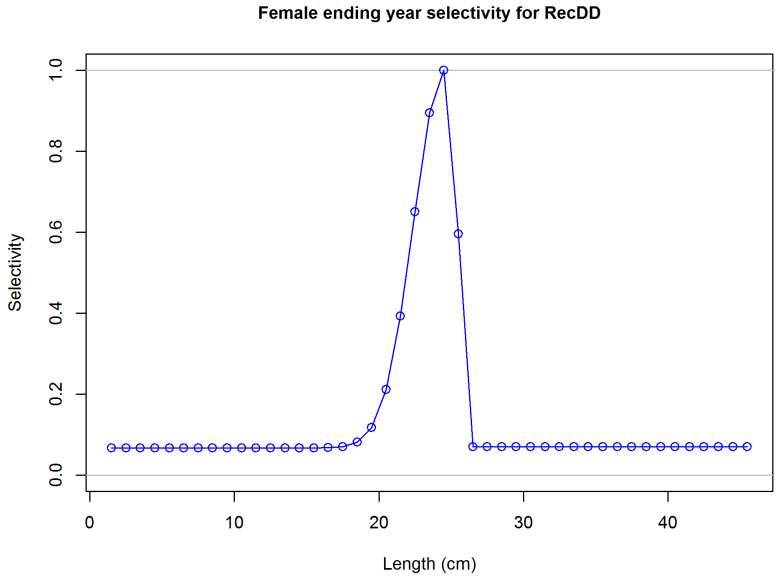


Selectivity

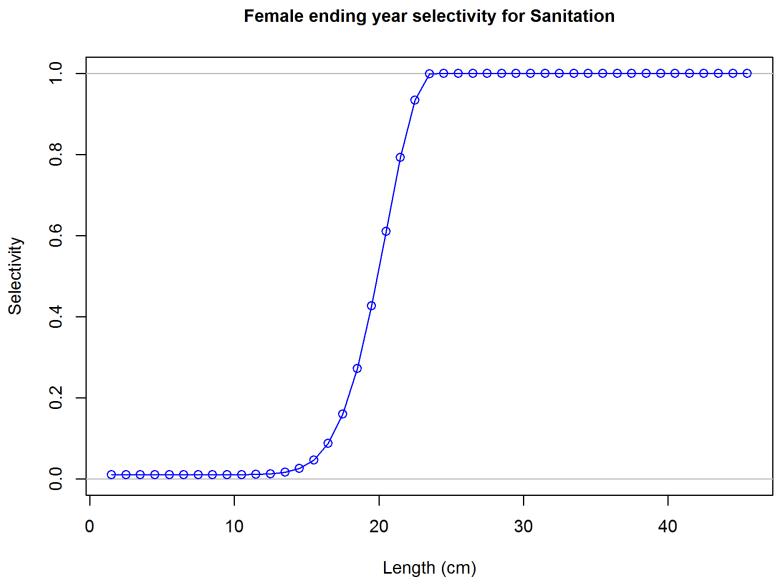


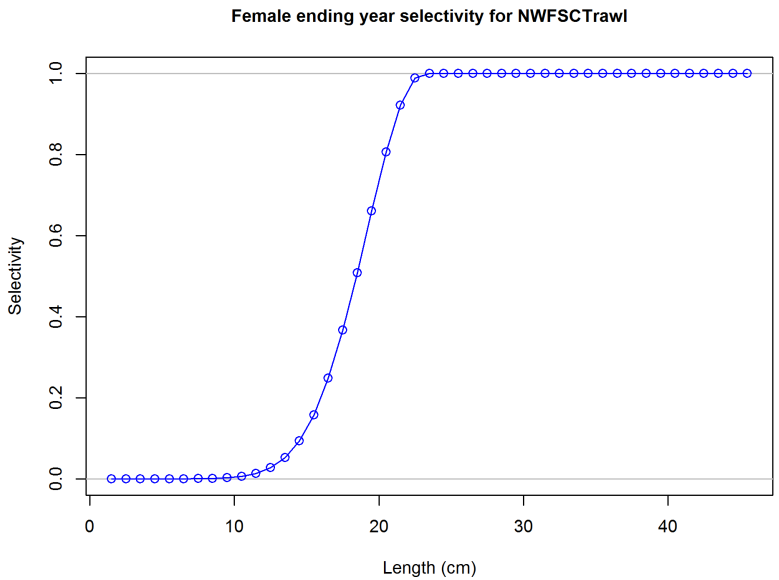






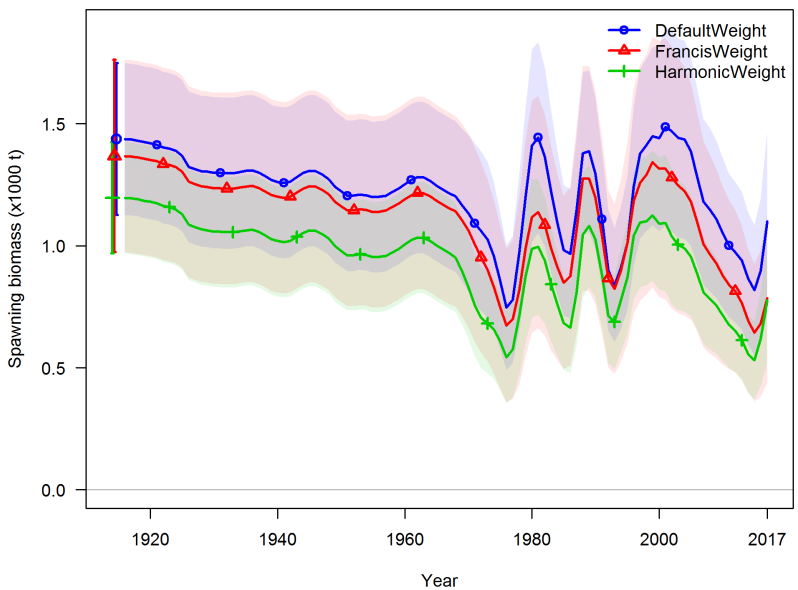
Gear Selectivity

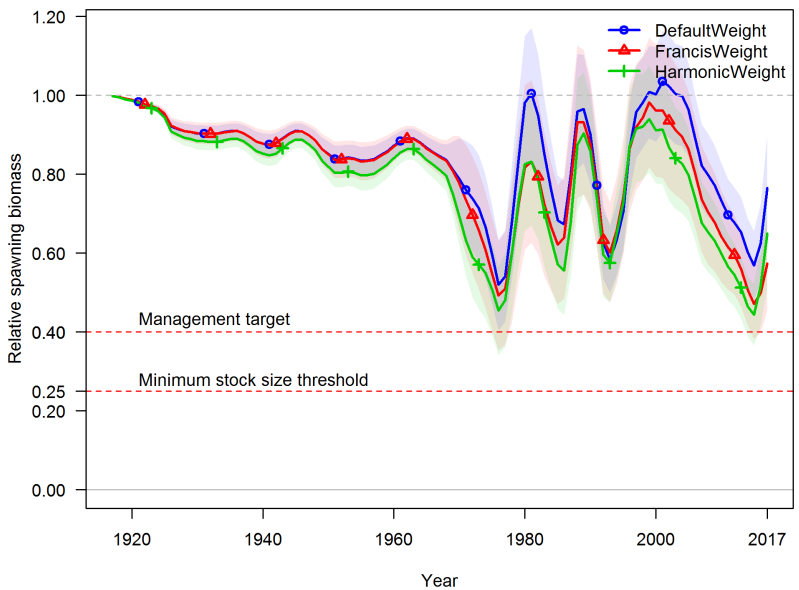




Data Weighting

- Extra SD estimated for indices
- Francis weighting applied to length and age data
- Conducted sensitivities to no weighting and harmonic means



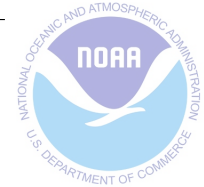


Base Model Output (page 1)

Parameter	Value	Phase	Bounds	Status	SD	Prior (Exp.Val, SD)
NatM_p_1_Fem_GP_1	0.235	-3	(0.01, 1)			Log_Norm (-1.3581, 0.438438)
L_at_Amin_Fem_GP_1	11.925	2	(2, 30)	OK	0.675	None
L_at_Amax_Fem_GP_1	31.886	2	(30, 50)	OK	0.680	None
VonBert_K_Fem_GP_1	0.292	2	(0.05, 0.5)	OK	0.030	None
CV_young_Fem_GP_1	0.088	3	(0.02, 0.5)	OK	0.020	None
CV_old_Fem_GP_1	0.119	3	(0.02, 0.75)	OK	0.007	None
Wtlen_1_Fem	0.000	-3	(-3, 3)			None
Wtlen_2_Fem	3.058	-3	(2, 4)			None
Mat50%_Fem	18.000	-3	(10, 30)			None
Mat_slope_Fem	-1.200	-3	(-3, 3)			None
Eggs/kg_inter_Fem	1.000	-3	(-3, 3)			None
Eggs/kg_slope_wt_Fem	0.000	-3	(-3, 3)			None
NatM_p_1_Mal_GP_1	0.000	-2	(-1, 1)			Normal (0, 99)
L_at_Amin_Mal_GP_1	0.000	-2	(-3, 3)			None
L_at_Amax_Mal_GP_1	-0.143	2	(-3, 3)	OK	0.024	None
VonBert_K_Mal_GP_1	-0.080	2	(-3, 3)	OK	0.144	None
CV_young_Mal_GP_1	1.318	3	(-3, 3)	OK	0.229	None
CV_old_Mal_GP_1	-0.495	3	(-3, 3)	OK	0.121	None
Wtlen_1_Mal	0.000	-5	(0, 1)			None
Wtlen_2_Mal	2.981	-5	(2, 4)			None
CohortGrowDev	1.000	-1	(1, 1)			None
FracFemale_GP_1	0.500	-4	(0.000001, 0.999999)			None
SR_LN(R0)	8.194	1	(0, 31)	OK	0.155	None
SR_BH_steep	0.718	-2	(0.21, 0.99)			Full_Beta (0.718, 0.158)

Pre-STAR Base Model Output (page 2)

Parameter	Value	Phase	Bounds	Status	SD	Prior (Exp.Val, SD)
SR_sigmaR	0.600	-2	(0, 2)			None
SR_regime	0.000	-4	(-5, 5)			None
SR_autocorr	0.000	-3	(0, 0.5)			None
LnQ_base_RecPR(4)	-6.847	-1	(-15, 15)			None
Q_extraSD_RecPR(4)	0.012	4	(0.0001, 1)	OK	0.022	None
LnQ_base_RecPC(5)	-11.255	-1	(-15, 15)			None
Q_extraSD_RecPC(5)	0.258	4	(0.0001, 1)	OK	0.047	None
LnQ_base_RecDD(6)	-10.578	-1	(-15, 15)			None
Q_extraSD_RecDD(6)	0.067	4	(0.0001, 1)	OK	0.043	None
LnQ_base_Sanitation(7)	-10.614	-1	(-15, 15)			None
Q_extraSD_Sanitation(7)	0.217	4	(0.0001, 1)	OK	0.047	None
LnQ_base_NWFSCTrawl(8)	-1.086	-1	(-15, 15)			None
Q_extraSD_NWFSCTrawl(8)	0.253	4	(0.0001, 1)	OK	0.145	None
LnQ_base_SCBSurvey(11)	-11.143	-1	(-15, 15)			None
Q_extraSD_SCBSurvey(11)	0.159	4	(0.0001, 1)	OK	0.139	None
LnQ_base_RecPCOBR(12)	-10.209	-1	(-15, 15)			None
Q_extraSD_RecPCOBR(12)	0.136	4	(0.0001, 1)	OK	0.046	None
SizeSel_P1_ComHL(1)	24.436	5	(13, 44)	OK	1.166	None
SizeSel_P2_ComHL(1)	15.000	-3	(-10, 16)			None
SizeSel_P3_ComHL(1)	2.119	5	(-1, 10)	OK	0.619	None
SizeSel_P4_ComHL(1)	15.000	-3	(-1, 16)			None
SizeSel_P5_ComHL(1)	-15.537	5	(-25, -1)	OK	128.790	None
SizeSel_P6_ComHL(1)	10.000	-3	(-5, 11)			None
SizeSel_P1_ComNet(2)	44.000	-5	(13, 44)			None
SizeSel_P2_ComNet(2)	15.000	-3	(-10, 16)			None
SizeSel_P3_ComNet(2)	5.146	5	(-1, 10)	OK	0.234	None



Pre-STAR Base Model Output (page 3)

Parameter	Value	Phase	Bounds	Status	SD	Prior (Exp.Val, SD)
SizeSel_P4_ComNet(2)	15.000	-3	(-1, 16)			None
SizeSel_P5_ComNet(2)	-16.400	5	(-25, -1)	OK	119.734	None
SizeSel_P6_ComNet(2)	10.000	-3	(-5, 11)			None
SizeSel_P1_ComTrawl(3)	1.000	-2	(1, 45)			None
SizeSel_P2_ComTrawl(3)	45.000	-3	(1, 45)			None
SizeSel_P1_RecPR(4)	42.043	5	(13, 44)	OK	2.423	None
SizeSel_P2_RecPR(4)	15.000	-3	(-10, 16)			None
SizeSel_P3_RecPR(4)	4.572	5	(-1, 10)	OK	0.181	None
SizeSel_P4_RecPR(4)	15.000	-3	(-1, 16)			None
SizeSel_P5_RecPR(4)	-8.075	5	(-25, -1)	OK	0.792	None
SizeSel_P6_RecPR(4)	10.000	-3	(-5, 11)			None
SizeSel_P1_RecPC(5)	37.769	5	(13, 44)	OK	1.567	None
SizeSel_P2_RecPC(5)	15.000	-3	(-10, 16)			None
SizeSel_P3_RecPC(5)	4.609	5	(-1, 10)	OK	0.168	None
SizeSel_P4_RecPC(5)	15.000	-3	(-1, 16)			None
SizeSel_P5_RecPC(5)	-8.370	5	(-25, -1)	OK	2.026	None
SizeSel_P6_RecPC(5)	10.000	-3	(-5, 11)			None
SizeSel_P1_RecDD(6)	22.469	5	(13, 44)	OK	0.091	None
SizeSel_P2_RecDD(6)	-11.207	4	(-15, 16)	OK	57.911	None
SizeSel_P3_RecDD(6)	3.684	4	(-1, 10)	OK	0.490	None
SizeSel_P4_RecDD(6)	-10.915	4	(-20, 5)	OK	48.055	None
SizeSel_P5_RecDD(6)	-2.632	5	(-25, 3)	OK	0.390	None
SizeSel_P6_RecDD(6)	-2.583	4	(-5, 11)	OK	0.405	None
SizeSel_P1_Sanitation(7)	23.678	4	(13, 44)	OK	0.487	None
SizeSel_P2_Sanitation(7)	15.000	-3	(-10, 16)			None

Pre-STAR Base Model Output (page 4)

Parameter	Value	Phase	Bounds	Status	SD	Prior (Exp.Val, SD)
SizeSel_P2_Sanitation(7)	15.000	-3	(-10, 16)			None
SizeSel_P3_Sanitation(7)	3.005	4	(-1, 10)	OK	0.158	None
SizeSel_P4_Sanitation(7)	15.000	-3	(-1, 16)			None
SizeSel_P5_Sanitation(7)	-4.582	4	(-25, 5)	OK	0.606	None
SizeSel_P6_Sanitation(7)	10.000	-3	(-5, 11)			None
SizeSel_P1_NWFSCTrawl(8)	23.098	4	(13, 44)	OK	2.213	None
SizeSel_P2_NWFSCTrawl(8)	15.000	-3	(-10, 16)			None
SizeSel_P3_NWFSCTrawl(8)	3.443	4	(-1, 10)	OK	0.616	None
SizeSel_P4_NWFSCTrawl(8)	15.000	-3	(-1, 16)			None
SizeSel_P5_NWFSCTrawl(8)	-12.730	4	(-25, 5)	OK	169.330	None
SizeSel_P6_NWFSCTrawl(8)	10.000	-3	(-5, 11)			None
SizeSel_P1_GillnetSurvey(9)	1.000	-2	(1, 45)			None
SizeSel_P2_GillnetSurvey(9)	45.000	-3	(1, 45)			None
SizeSel_P1_Impingement(10)	18.012	-3	(13, 44)			None
SizeSel_P2_Impingement(10)	-5.928	4	(-15, 16)	OK	27.411	None
SizeSel_P3_Impingement(10)	2.137	-4	(-1, 10)			None
SizeSel_P4_Impingement(10)	2.701	4	(-20, 5)	OK	1.173	None
SizeSel_P5_Impingement(10)	8.275	-3	(-25, 10)			None
SizeSel_P6_Impingement(10)	-0.611	4	(-5, 11)	OK	0.476	None
SizeSel_P1_SCBSurvey(11)	1.000	-2	(1, 45)			None
SizeSel_P2_SCBSurvey(11)	45.000	-3	(1, 45)			None
SizeSel_P1_RecPCOBR(12)	1.000	-2	(1, 45)			None
SizeSel_P2_RecPCOBR(12)	45.000	-3	(1, 45)			None
SizeSel_P1_ComHL(1)_BLK1repl_1999	28.427	6	(13, 44)	OK	0.583	None
SizeSel_P3_ComHL(1)_BLK1repl_1999	2.029	6	(-1, 10)	OK	0.301	None
SizeSel_P1_ComNet(2)_BLK1repl_1999	44.000	-6	(13, 44)			None

Base Model Output

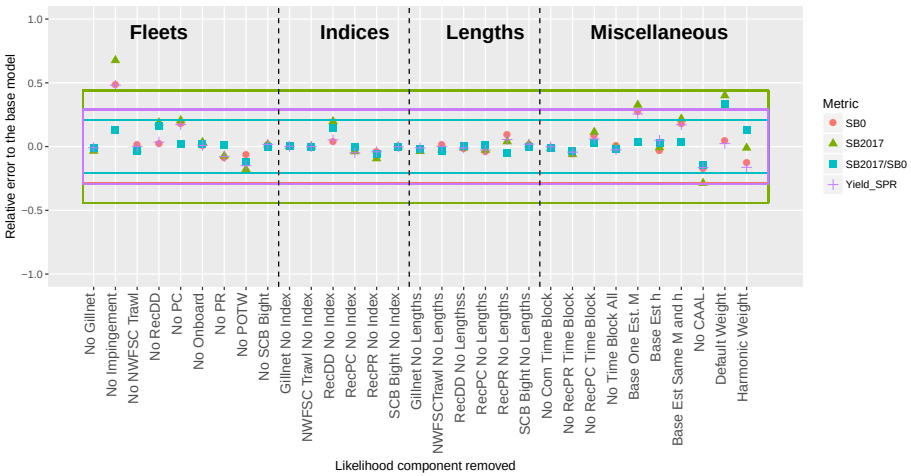
Year	Spawning biomass (mt)	95% confidence interval	Estimated depletion	95% confidence interval
2008	1144.50	(654.46-1634.54)	0.70	(0.573-0.836)
2009	1090.48	(629.78-1551.18)	0.67	(0.55-0.793)
2010	1029.33	(597.2-1461.46)	0.63	(0.521-0.746)
2011	980.13	(571.79-1388.47)	0.60	(0.5-0.707)
2012	943.55	(553.81-1333.3)	0.58	(0.485-0.677)
2013	890.08	(518.85-1261.32)	0.55	(0.456-0.64)
2014	810.22	(462.86-1157.59)	0.50	(0.41-0.587)
2015	746.23	(412.08-1080.38)	0.46	(0.371-0.548)
2016	774.81	(426.28-1123.35)	0.48	(0.381-0.572)
2017	882.46	(484.21-1280.71)	0.54	(0.43-0.657)

Base Model Output

Year	OFL	ABC	ACL	ACT	Total Catch
2007	219		175		139.583
2008	219		175		103.887
2009	175		175		113.318
2010	155		155		105.968
2011	141	135	135		105.215
2012	132	126	126		120.008
2013	126	120	120		115.142
2014	122	117	117		123.822
2015	119	114	114		83.8908
2016	117	111	111		74.1613
2017	289	264	150	110	-
2018	278	254	150	110	-

Sensitivities

Sensitivities to Likelihood Components and Model Specification



Remove fleets, only one index, or length composition only

Sensitivity relative to the base model

Boxes are the 95% CI from the base model

Metrics

- SB_0 Population scale
- SB_{2017} Population scale
- SB_{2017}/SB_0 Depletion/Population status
- $MSY_{SPR50\%}$ Yield/Productivity/scale

Sensitivities - All