Status of Yellowtail Rockfish (*Sebastes flavidus*) Along the U.S. Pacific Coast in 2017

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Contents

Executive Summary

executive-summary

Stock

stock

This assessment reports the status of the Yellowtail Rockfish (*Sebastes flavidus*) resource in U.S. waters off the coast of the California, Oregon, and Washington using data through 2016.

The Pacific Fishery Management Council (PFMC) manages the U.S. fishery as two stocks separated at Cape Mendocino, California (40° 10'N). This assessment analyzes those two areas as independent stocks, with the southern stock extending southward to the U.S./Mexico border and the northern stock extending northward to the U.S./Canada border.

The previous assessment (Wallace and Lai 2005), following the pattern of prior assessments, included only the Northern stock which it divided into three assessment areas with divisions at Cape Elizabeth (47° 20'N) and Cape Falcon (45° 46'N). However, a more recent genetic analysis (Hess et al. n.d.) found distinct stocks north and south of Cape Mendocino but did not find stock differences within the northern area, with the genetic stock extending northward through British Colombia, Canada to Southeast Alaska. However, Canada and Alaska are not included in this assessment.

Catches

catches

Catches from the Northern stock were divided into four categories: commercial catch, bycatch in the at-sea hake fishery, recreational catch in Oregon and California (north of 40° 10'N), and recreational catch in Washington. The first three of these fleets were entered in metric tons, but the recreational catch from Washington was entered in the model as numbers of fish with the average weight calculated internally in the model.

Catches from the Southern stock were divided into two categories: commercial and recreational catch, both of which were entered as metric tons.

Include: trends and current levels-include table for last ten years and graph with long term data

Catch figures: (Figures a-b)
Catch tables: (Tables a-b)

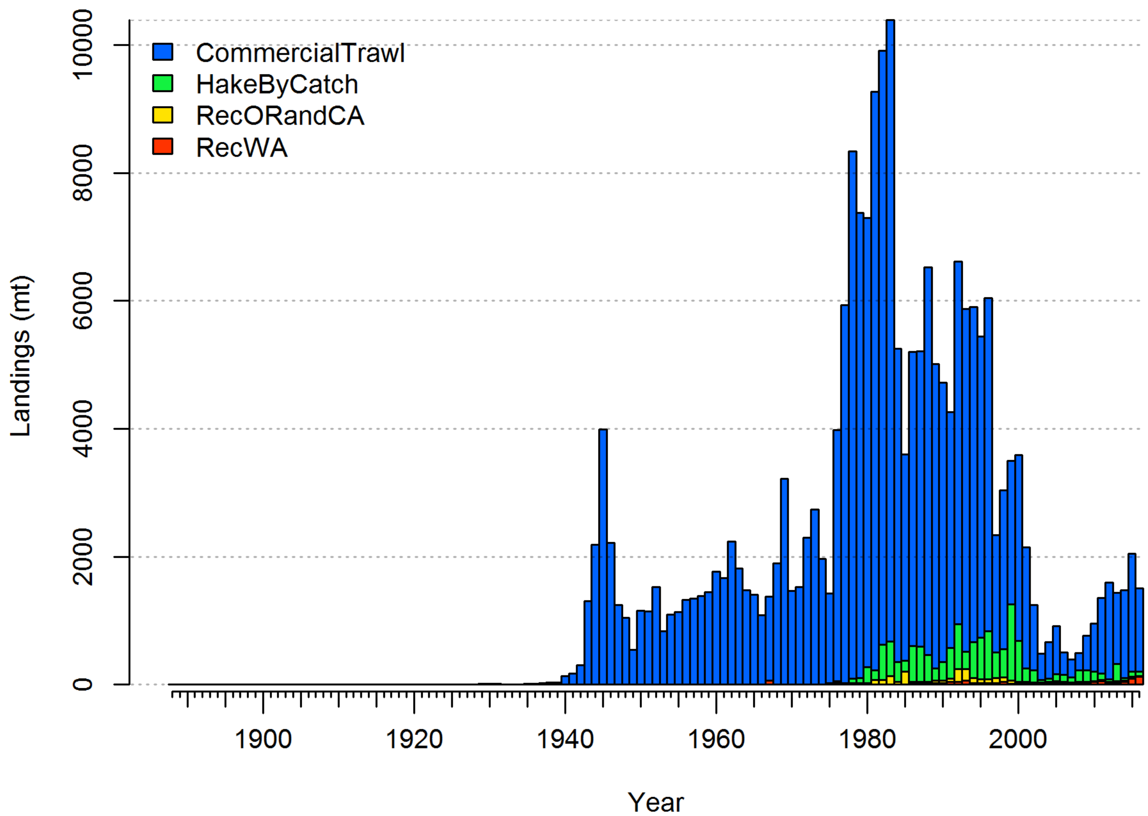


Figure a: Estimated catch history of Yellowtail Rockfish in the Northern model. Recreational catches in Washington are model estimates of total weigth converted from input catch in numbers using model estimates of growth and selectivity. fig:r4ss_catch_N

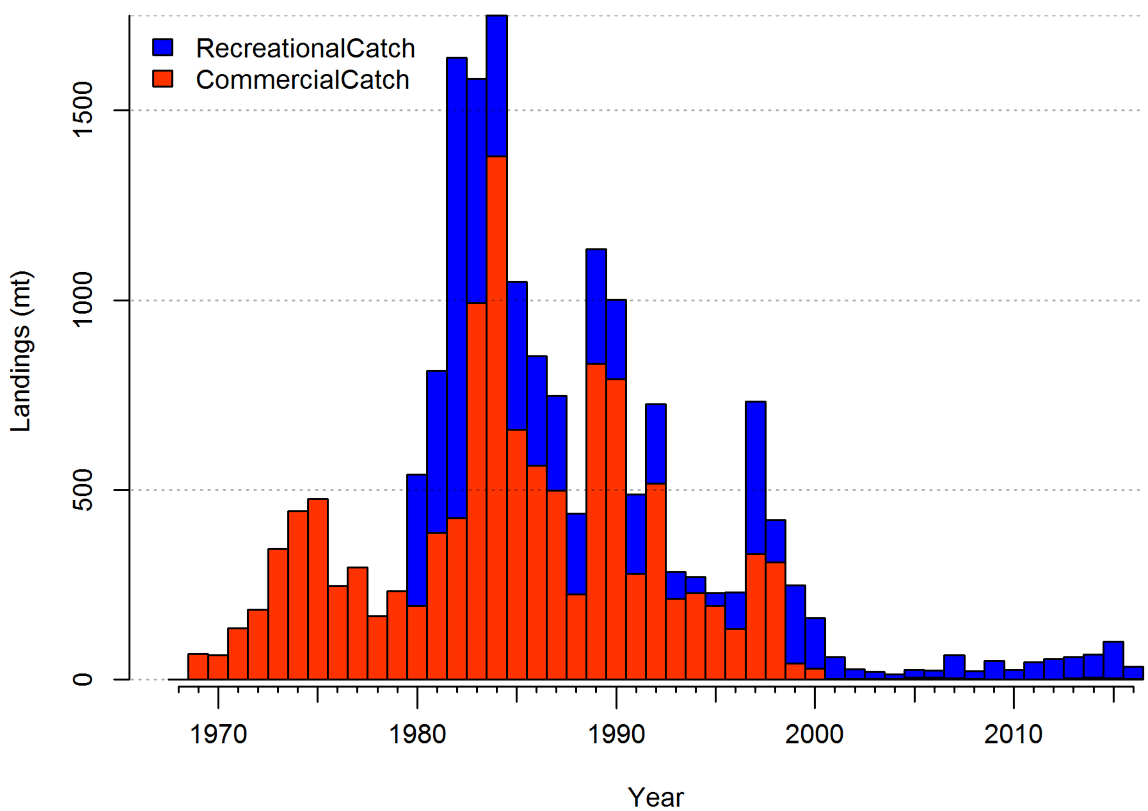


Figure b: Estimated catch history of Yellowtail Rockfish in the Southern model. fig:r4ss_catch_S

Table a: Recent Yellowtail Rockfish catch by fleet for the Northern stock (north of 40° 10'N).
tab:Exec_catch_N

Year	Commercial (t)	At-sea hake bycatch (t)	Recreational OR+CA (t)	Recreational WA (1000s)
2007	-	-	-	-
2008	-	-	-	-
2009	-	-	-	-
2010	-	-	-	-
2011	-	-	-	-
2012	-	-	-	-
2013	-	-	-	-
2014	-	-	-	-
2015	-	-	-	-
2016	-	-	-	-

Table b: Recent Yellowtail Rockfish catch by fleet for the Southern stock (south of 40° 10'N).
tab:Exec_catch_S

Year	Recreational (t)	Commercial (t)
2007	-	-
2008	-	-
2009	-	-
2010	-	-
2011	-	-
2012	-	-
2013	-	-
2014	-	-
2015	-	-
2016	-	-

Data and Assessment

data-and-assessment

Include: date of last assessment, type of assessment model, data available, new information, and information lacking.

Yellowtail Rockfish was assessed.... This assessment uses the newest version of Stock Synthesis (3.xxx). The model begins in 1889, and assumes the stock was at an unfished equilibrium that year.

Map of assessment region: (Figure c).

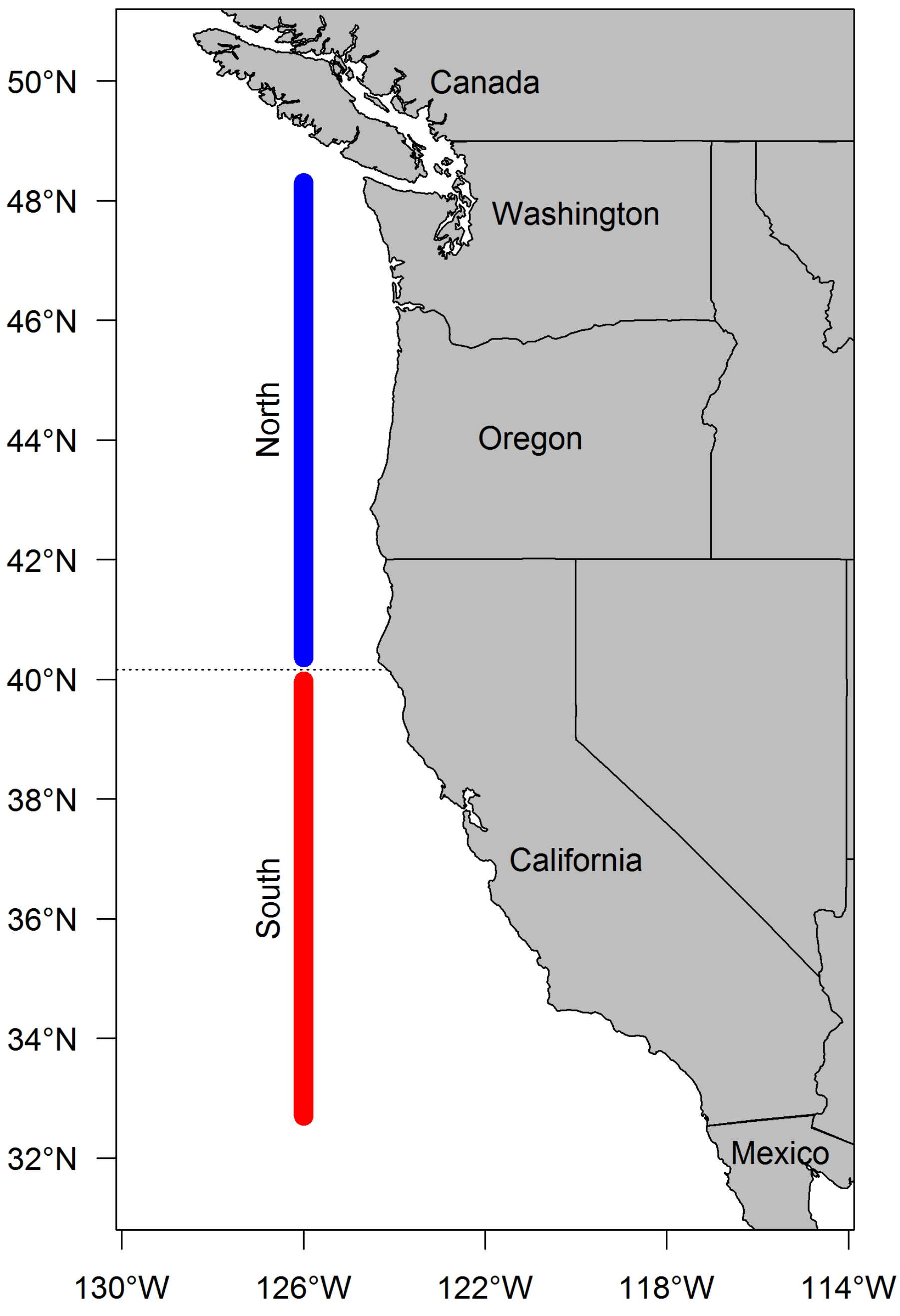


Figure c: Map depicting the boundaries for the base-case model. fig:assess_region_map

Stock Biomass

`stock-biomass`

Include: trends and current levels relative to virgin or historic levels, description of uncertainty-include table for last 10 years and graph with long term estimates.

Spawning output Figure: Figure d
Spawning output Table(s): Table c
Relative depletion Figure: Figure e

Example text (remove Models 2 and 3 if not needed - if using, remove the # in-line comments!!!)
The estimated relative depletion level (spawning output relative to unfished spawning output) of the the base-case model in 2016 is 162% (˜95% asymptotic interval: ± 130%-194%) (Figure e).

The estimated relative depletion level of model 2 in 2016 is 85.6% (˜95% asymptotic interval: ± 71.6%-99.5%) (Figure e).

The estimated relative depletion level of model 3 in 2016 is (˜95% asymptotic interval: ±) (Figure e).

Table c: Recent trend in beginning of the year spawning output and depletion for the Northern model for Yellowtail Rockfish.

tab:SpawningDeplete_mod1

Year	Spawning Output (billion eggs)	~ 95% confidence interval	Estimated depletion	~ 95% confidence interval
2008	28237700.000	(17323385.76-39152014.24)	0.478	(0.367-0.59)
2009	32232200.000	(20121641.34-44342758.66)	0.546	(0.424-0.667)
2010	38164600.000	(24200307.4-52128892.6)	0.646	(0.507-0.785)
2011	46822000.000	(30038338.41-63605661.59)	0.793	(0.626-0.96)
2012	57714100.000	(37282651.44-78145548.56)	0.977	(0.773-1.182)
2013	69517400.000	(45139759.95-93895040.05)	1.177	(0.934-1.421)
2014	80401300.000	(52467893.29-108334706.71)	1.361	(1.087-1.636)
2015	88775000.000	(58110383.48-119439616.52)	1.503	(1.208-1.799)
2016	93687800.000	(61274307.62-126101292.38)	1.586	(1.277-1.896)
2017	95739800.000	(62525662.33-128953937.67)	1.621	(1.305-1.937)

Table d: Recent trend in beginning of the year spawning output and depletion for the Southern model for Yellowtail Rockfish.

tab:SpawningDeplete_mod2

Year	Spawning Output (billion eggs)	~ 95% confidence interval	Estimated depletion	~ 95% confidence interval
2008	7464080.000	(2470993.35-12457166.65)	0.686	(0.561-0.811)
2009	7394450.000	(2481761.07-12307138.93)	0.679	(0.56-0.799)
2010	7341800.000	(2491947.52-12191652.48)	0.674	(0.56-0.789)
2011	7333450.000	(2518465.28-12148434.72)	0.674	(0.563-0.784)
2012	7366260.000	(2554587.62-12177932.38)	0.677	(0.57-0.784)
2013	7469170.000	(2612928.04-12325411.96)	0.686	(0.58-0.792)
2014	7645940.000	(2695188.57-12596691.43)	0.702	(0.596-0.808)
2015	7974640.000	(2828519.36-13120760.64)	0.733	(0.623-0.843)
2016	8506760.000	(3025426.72-13988093.28)	0.781	(0.662-0.901)
2017	9313170.000	(3309545.52-15316794.48)	0.856	(0.716-0.995)

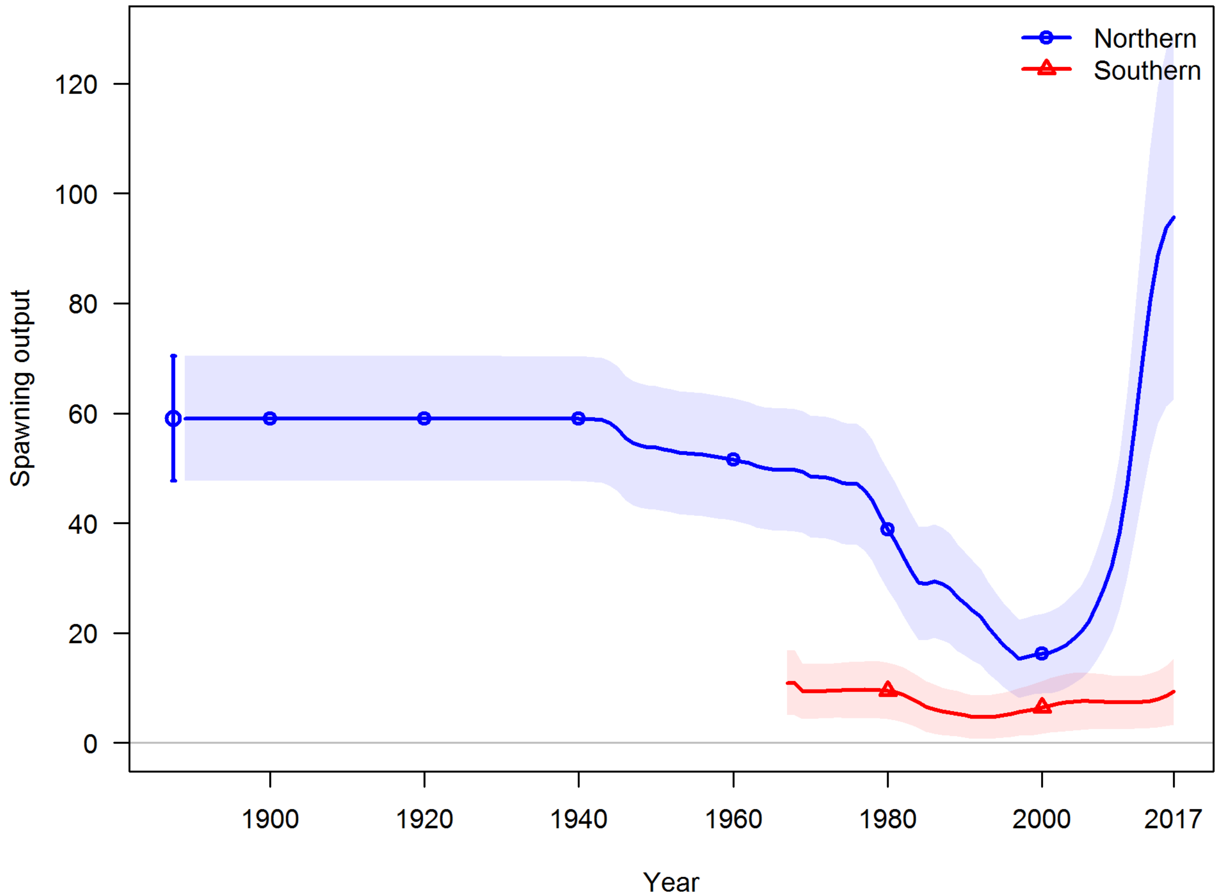


Figure d: Time series of spawning output trajectory (circles and line: median; light broken lines: 95% credibility intervals) for the base case assessment model. fig:Spawnbio_all

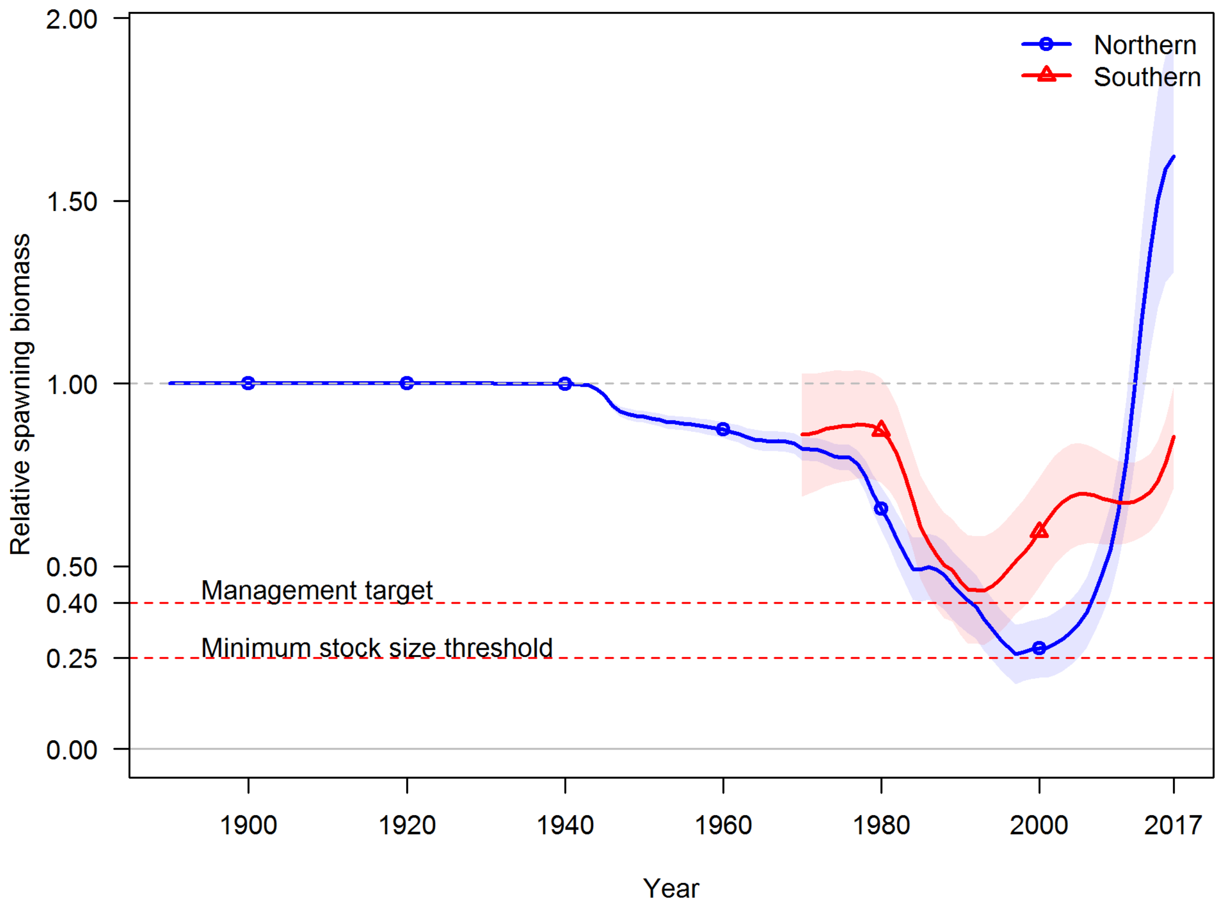


Figure e: Estimated relative depletion with approximate 95% asymptotic confidnce intervals (dashed lines) for the base case assessment model. fig:RelDeplete_all

Recruitment

recruitment

Include: trends and current levels relative to virgin or historic levels-include table for last 10 years and graph with long term estimates.

Recruitment Figure: (Figure f)
Recruitment Tables: (Tables e, f and **??**)

Table e: Recent recruitment for the Northern model.

tab:Recruit_mod1

Year	Estimated Recruitment (millions)	~ 95% confidence interval
2008	10.27	(5.42 - 19.44)
2009	7.45	(3.56 - 15.6)
2010	10.46	(5.46 - 20.01)
2011	6.29	(2.97 - 13.31)
2012	9.25	(3.96 - 21.6)
2013	14.38	(5.33 - 38.74)
2014	21.77	(7.05 - 67.17)
2015	26.68	(7.68 - 92.71)
2016	26.78	(7.71 - 93.11)
2017	26.82	(7.72 - 93.24)

Table f: Recent recruitment for the Southern model.

tab:Recruit_mod2

Year	Estimated Recruitment (millions)	~ 95% confidence interval
2008	61.56	(27.65 - 137.03)
2009	10.32	(2.37 - 44.95)
2010	56.83	(21.85 - 147.83)
2011	15.54	(2.79 - 86.52)
2012	19.71	(4.55 - 85.36)
2013	13.19	(3.22 - 54.03)
2014	9.05	(2.4 - 34.2)
2015	8.17	(2.21 - 30.17)
2016	8.51	(2.29 - 31.6)
2017	8.65	(2.33 - 32.12)

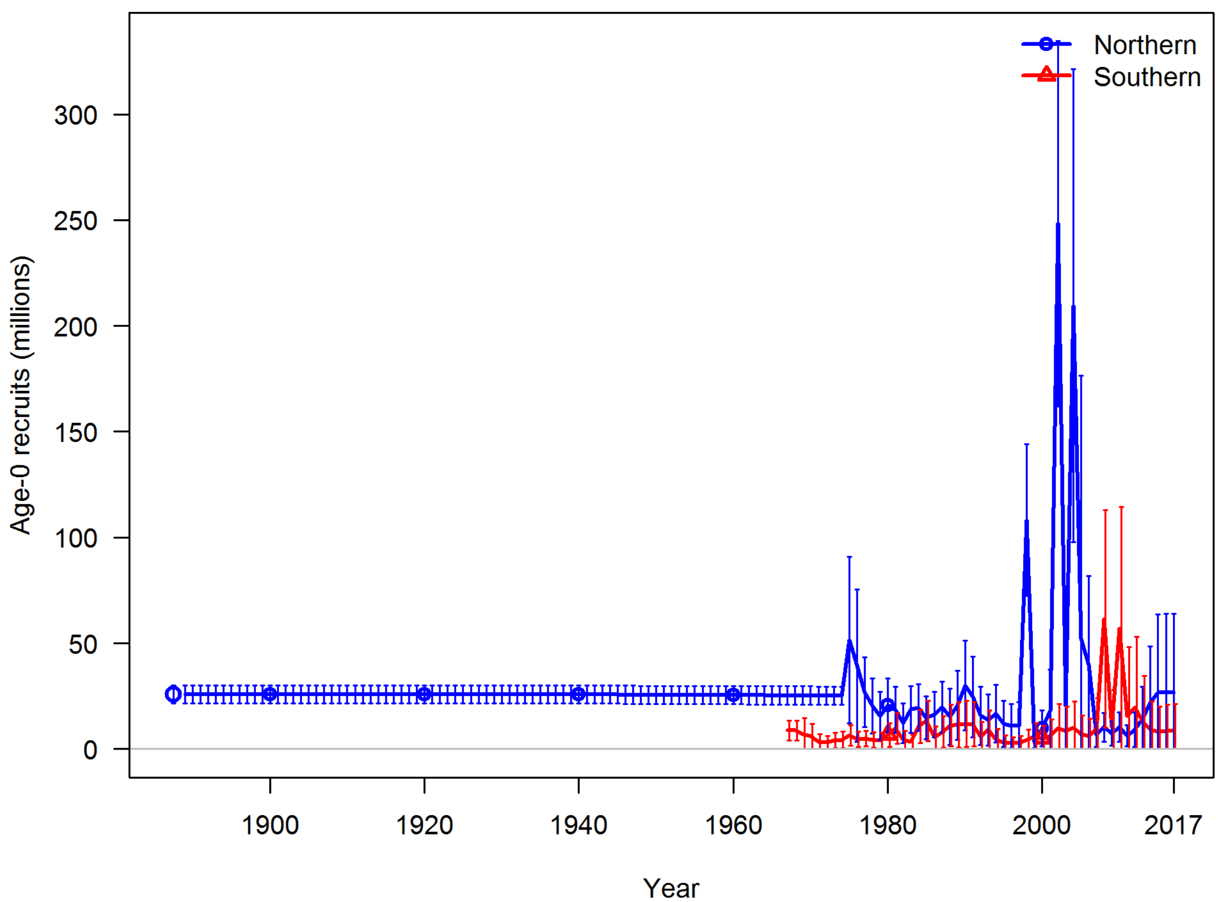


Figure f: Time series of estimated Yellowtail Rockfish recruitments for the base-case model with 95% confidence or credibility intervals. fig:Recruits_all

Exploitation status

exploitation-status

Include: exploitation rates (i.e., total catch divided by exploitable biomass, or the annual SPR harvest rate) include a table with the last 10 years of data and a graph showing the trend in fishing mortality relative to the target (y-axis) plotted against the trend in biomass relative to the target (x-axis).

Exploitation Tables: Table g, Table h, Table **??** Exploitation Figure: Figure g).

A summary of Yellowtail Rockfish exploitation histories for base model is provided as Figure h.

Table g: Recent trend in spawning potential ratio and exploitation for Yellowtail Rockfish in the Northern 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
2007	0.12	(0.08-0.16)	0.00	(0-0)
2008	0.14	(0.09-0.19)	0.00	(0-0)
2009	0.16	(0.11-0.22)	0.00	(0-0)
2010	0.17	(0.11-0.22)	0.00	(0-0.01)
2011	0.19	(0.13-0.25)	0.01	(0-0.01)
2012	0.20	(0.14-0.26)	0.01	(0-0.01)
2013	0.18	(0.12-0.23)	0.01	(0-0.01)
2014	0.17	(0.12-0.23)	0.01	(0-0.01)
2015	0.23	(0.16-0.31)	0.01	(0.01-0.01)
2016	0.18	(0.12-0.24)	0.01	(0-0.01)

Table h: Recent trend in spawning potential ratio and exploitation for Yellowtail Rockfish in the Southern model. Fishing intensity is (1-SPR) divided by 50% (the SPR target) and exploitation is F divided by F_{SPR}.

tab:SPR_Exploit_mod2

Year	Fishing intensity	~ 95% confidence interval	Exploitation rate	~ 95% confidence interval
2007	0.08	(0.03-0.13)	0.00	(0-0)
2008	0.03	(0.01-0.04)	0.00	(0-0)
2009	0.06	(0.02-0.09)	0.00	(0-0)
2010	0.03	(0.01-0.04)	0.00	(0-0)
2011	0.04	(0.02-0.07)	0.00	(0-0)
2012	0.04	(0.02-0.07)	0.00	(0-0)
2013	0.04	(0.02-0.07)	0.00	(0-0)
2014	0.04	(0.02-0.07)	0.00	(0-0)
2015	0.06	(0.02-0.1)	0.00	(0-0)
2016	0.02	(0.01-0.03)	0.00	(0-0)

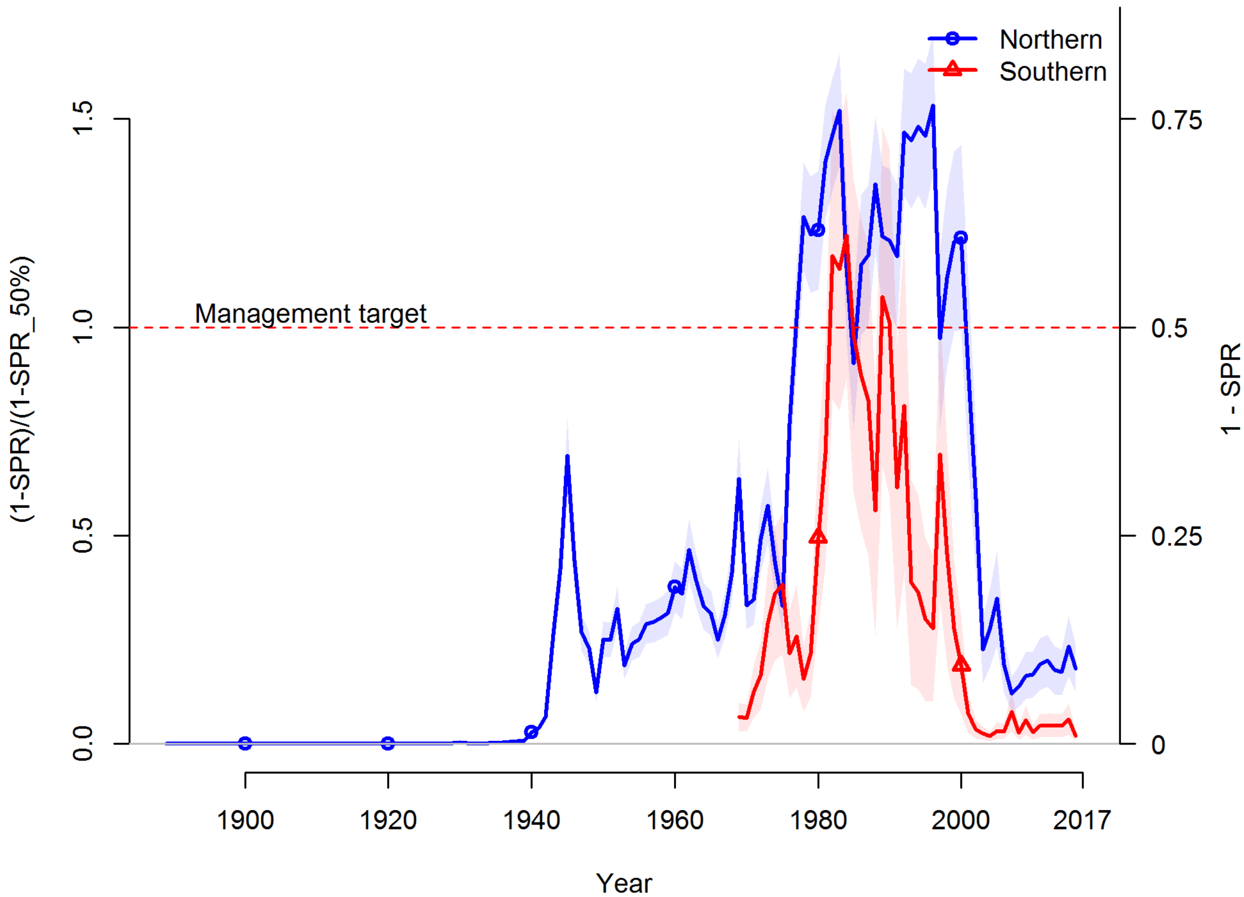


Figure g: Estimated spawning potential ratio (SPR) for the base-case model. One minus SPR is plotted so that higher exploitation rates occur on the upper portion of the y-axis. The management target is plotted as a red horizontal line and values above this reflect harvests in excess of the overfishing proxy based on the $SPR_{50\%}$ harvest rate. The last year in the time series is 2016. fig:SPR_all

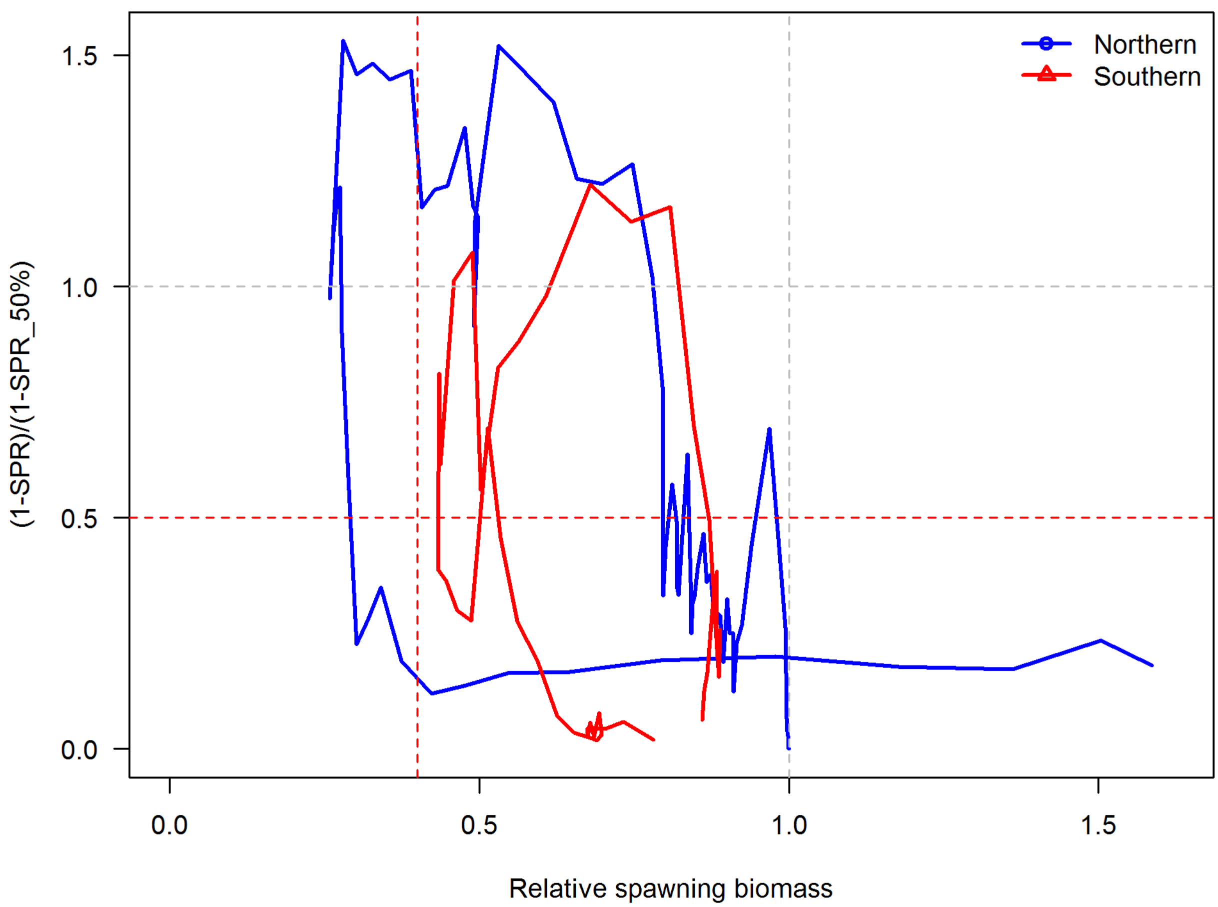


Figure h: Phase plot of estimated relative (1-SPR) vs. relative spawning biomass for the base case model. The relative (1-SPR) is (1-SPR) divided by 50% (the SPR target). Relative depletion is the annual spawning biomass divided by the unfished spawning biomass. fig:Phase_all

Ecosystem Considerations

`ecosystem-considerations`

In this assessment, ecosystem considerations were.....

Reference Points

`reference-points`

Include: management targets and definition of overfishing, including the harvest rate that brings the stock to equilibrium at $B_{40\%}$ (the B_{MSY} proxy) and the equilibrium stock size that results from fishing at the default harvest rate (the F_{MSY} proxy). Include a summary table that compares estimated reference points for SSB, SPR, Exploitation Rate and Yield based on SSBproxy for MSY, SPRproxy for MSY, and estimated MSY values

Write intro paragraph....and remove text for Models 2 and 3 if not needed

This stock assessment estimates that Yellowtail Rockfish in the Northern model are above the biomass target, but above the minimum stock size threshold. Add sentence about spawning output trend. The estimated relative depletion level for Model 1 in 2016 is 162% (˜95% asymptotic interval: ± 130%-194%, corresponding to an unfished spawning output of 95739800 billion eggs (˜95% asymptotic interval: 62525662.33-128953937.67 billion eggs) of spawning output in the base model (Table i). Unfished age 1+ biomass was estimated to be 154796 mt in the base case model. The target spawning output based on the biomass target ($SB_{40\%}$) is 23622100 billion eggs, which gives a catch of 4211.1 mt. Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is 4000.9 mt.

This stock assessment estimates that Yellowtail Rockfish in the Southern model are above the biomass target, but above the minimum stock size threshold. Add sentence about spawning output trend. The estimated relative depletion level for Model 2 in 2016 is 85.6% (˜95% asymptotic interval: ± 71.6%-99.5%), corresponding to an unfished spawning output of 9313170 billion eggs (˜95% asymptotic interval:) of spawning output in the base model (Table j). Unfished age 1+ biomass was estimated to be 45285.2 mt in the base case model. The target spawning output based on the biomass target ($SB_{40\%}$) is 4354300 billion eggs, which gives a catch of mt. Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is 1009 mt.

This stock assessment estimates that Yellowtail Rockfish in the are

the biomass target, but
the minimum stock size threshold. Add sentence about spawning output trend. The estimated relative depletion level or Model 3 in 2016 is (˜95% asymptotic interval: ±), corresponding to an unfished spawning output of (˜95% asymptotic interval:) of spawning output in the base model (Table **??**). Unfished age 1+ biomass was estimated to be mt in the base case model. The target spawning output based on the biomass target ($SB_{40\%}$) is , which gives a catch of mt. Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is mt.

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

tab:Ref_pts_mod1

Quantity	Estimate	95% Confidence Interval
Unfished spawning output (billion eggs)	59055300	(47714340.8-70396259.2)
Unfished age 1+ biomass (mt)	154796	(128640.1-180951.9)
Unfished recruitment (R0, thousands)	25812.6	(21513.7-30111.5)
Spawning output(2016 billion eggs)	93687800	(61274307.6-126101292.4)
Depletion (2016)	1.6	(1.3-1.9)
Reference points based on $\mathbf{SB_{40\%}}$		
Proxy spawning output ($B_{40\%}$)	23622100	(19085724.2-28158475.8)
SPR resulting in $B_{40\%}$ ($SPR_{B40\%}$)	0.4589	(0.4589-0.4589)
Exploitation rate resulting in $B_{40\%}$	0.0512	(0.0503-0.0521)
Yield with $SPR_{B40\%}$ at $B_{40\%}$ (mt)	4211.1	(3511.1-4911)
Reference points based on SPR proxy for MSY		
Spawning output	26312700	(21259618.9-31365781.1)
SPR_{proxy}	0.5	
Exploitation rate corresponding to SPR_{proxy}	0.0453	(0.0445-0.0461)
Yield with SPR_{proxy} at SB_{SPR} (mt)	4000.9	(3334.1-4667.7)
Reference points based on estimated MSY values		
Spawning output at MSY (SB_{MSY})	15163500	(12157013.2-18169986.8)
SPR_{MSY}	0.3297	(0.3267-0.3328)
Exploitation rate at MSY	0.0745	(0.0734-0.0757)
MSY (mt)	4558.5	(3807-5309.9)

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

tab:Ref_pts_mod2

Quantity	**Estimate**	**95% Confidence Interval**
Unfished spawning output (billion eggs)	10885700	(4996557-16774843)
Unfished age 1+ biomass (mt)	45285.2	(21285.6-69284.8)
Unfished recruitment (R0, thousands)	8797.9	(4170.7-13425)
Spawning output(2016 billion eggs)	8506760	(3025426.7-13988093.3)
Depletion (2016)	0.7815	(0.6615-0.9014)
Reference points based on $\mathbf{SB_{40\%}}$		
Proxy spawning output ($B_{40\%}$)	4354300	(1998638.9-6709961.1)
SPR resulting in $B_{40\%}$ ($SPR_{B40\%}$)	0.4589	(0.4589-0.4589)
Exploitation rate resulting in $B_{40\%}$	0.0449	(0.0436-0.0463)
Yield with $SPR_{B40\%}$ at $B_{40\%}$ (mt)	1065	(500.3-1629.7)
Reference points based on SPR proxy for MSY		
Spawning output	4850250	(2226289.4-7474210.6)
SPR_{proxy}	0.5	
Exploitation rate corresponding to SPR_{proxy}	0.0396	(0.0384-0.0408)
Yield with SPR_{proxy} at SB_{SPR} (mt)	1009	(473.9-1544.2)
Reference points based on estimated MSY values		
Spawning output at MSY (SB_{MSY})	2707440	(1237570.9-4177309.1)
SPR_{MSY}	0.3225	(0.3199-0.3251)
Exploitation rate at MSY	0.0677	(0.0659-0.0694)
MSY (mt)	1165.1	(548-1782.2)

Management Performance

management-performance

Include: catches in comparison to OFL, ABC and OY/ACL values for the most recent 10 years (when available), overfishing levels, actual catch and discard. Include OFL(encountered), OFL(retained) and OFL(dead) if different due to discard and discard mortality.

Management performance table: Table k

Table k: 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	-	-	-	-

Unresolved Problems And Major Uncertainties

unresolved-problems-and-major-uncertainties

TBD after STAR panel

Decision Table(s) (groundfish only)

decision-tables-groundfish-only

Include: projected yields (OFL, ABC and ACL), spawning biomass, and stock depletion levels for each year. Not required in draft assessments undergoing review.

OFL projection table: Table l

Decision table(s) Table m, Table n, Table **??**

`Yield curve: Figure \ref{fig:Yield_all}`

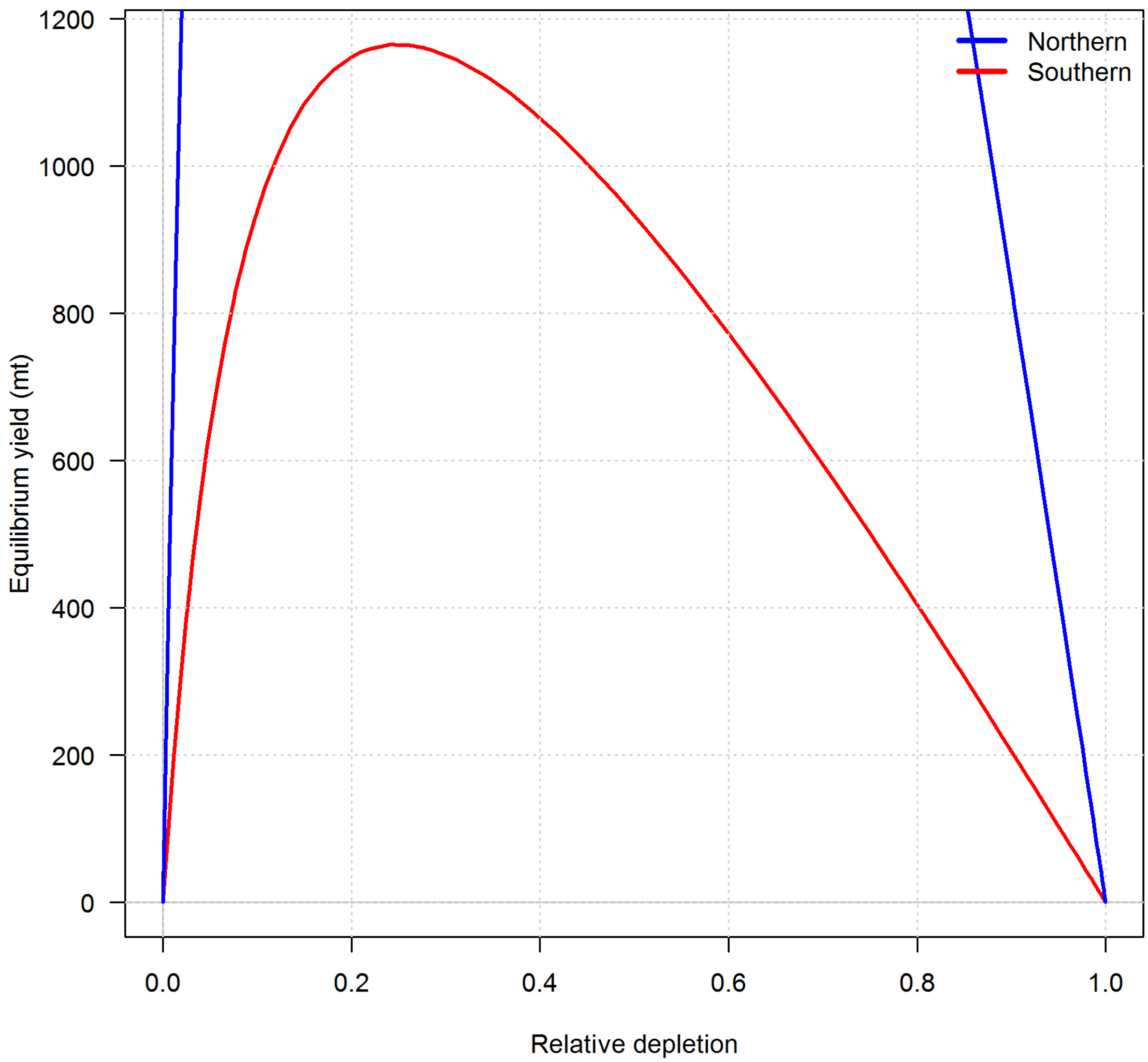


Figure i: Equilibrium yield curve for the base case model. Values are based on the 2016 fishery selectivity and with steepness fixed at... fig:Yield_all

Table 1: Projections of potential OFL (mt) for each model, using the base model forecast.
tab:OFL_projection

Year	Model 1	Model 2	Total
2017	11696.40	2696.90	14393.30
2018	10596.60	2651.58	13248.18
2019	9528.95	2578.95	12107.90
2020	8559.73	2489.08	11048.81
2021	7727.11	2388.74	10115.85
2022	7043.72	2283.32	9327.04
2023	6503.01	2177.15	8680.16
2024	6086.95	2073.53	8160.48
2025	5772.74	1974.78	7747.52
2026	5537.46	1882.41	7419.87
2027	5360.66	1797.28	7157.94
2028	5225.21	1719.72	6944.93

Table m: Summary of 10-year projections beginning in 2018 for alternate states of nature based on an axis of uncertainty for the Northern 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 n: Summary of 10-year projections beginning in 2018 for alternate states of nature based on an axis of uncertainty for the Southern 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_mod2`

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

Table o: Yellowtail Rockfish base case results summary.

tab:base_summary

Model Region	Quantity	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Landings (mt)										
	Total Est. Catch (mt)										
	OFL (mt)										
	ACL (mt)										
Model 1	(1-SPR)(1-$SPR_{50\%}$)	0.14	0.16	0.17	0.19	0.20	0.18	0.17	0.23	0.18	
Base Case	Exploitation rate	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	
	Age 1+ biomass (mt)	156074	184191	209534	228011	240459	246422	247063	243256	236172	226590
	Spawning Output	28237700	32232200	38164600	46822000	57714100	69517400	80401300	88775000	93687800	95739800
	95% CI	(17323385.76-39152014.24)	(20121641.34-44342758.66)	(24200307.4-52128892.6)	(30038338.41-63605661.59)	(37282651.44-78145548.56)	(45139759.95-93895040.05)	(52467893.29-108334706.71)	(58110383.48-119439616.52)	(61274307.62-126101292.38)	(62525662.33-128953937.67)
	Depletion	0.5	0.5	0.6	0.8	1.0	1.2	1.4	1.5	1.6	1.6
	95% CI	(0.367-0.59)	(0.424-0.667)	(0.507-0.785)	(0.626-0.96)	(0.773-1.182)	(0.934-1.421)	(1.087-1.636)	(1.208-1.799)	(1.277-1.896)	(1.305-1.937)
	Recruits	10.27	7.45	10.46	6.29	9.25	14.38	21.77	26.68	26.78	26.82
	95% CI	(5.42 - 19.44)	(3.56 - 15.6)	(5.46 - 20.01)	(2.97 - 13.31)	(3.96 - 21.6)	(5.33 - 38.74)	(7.05 - 67.17)	(7.68 - 92.71)	(7.71 - 93.11)	(7.72 - 93.24)
Model 2	(1-SPR)(1-$SPR_{50\%}$)	0.03	0.06	0.03	0.04	0.04	0.04	0.04	0.06	0.02	
Base Case	Exploitation rate	0	0	0	0	0	0	0	0	0	
	Age 1+ biomass (mt)	30630.3	30995.9	31303.6	31987.0	40129.0	43125.3	52416.3	57334.3	62331.6	65939.3
	Spawning Output	7464080	7394450	7341800	7333450	7366260	7469170	7645940	7974640	8506760	9313170
	95% CI	(2470993.35-12457166.65)	(2481761.07-12307138.93)	(2491947.52-12191652.48)	(2518465.28-12148434.72)	(2554587.62-12177932.38)	(2612928.04-12325411.96)	(2695188.57-12596691.43)	(2828519.36-13120760.64)	(3025426.72-13988093.28)	(3309545.52-15316794.48)
	Depletion	0.69	0.68	0.67	0.67	0.68	0.69	0.70	0.73	0.78	0.86
	95% CI	(0.561-0.811)	(0.56-0.799)	(0.56-0.789)	(0.563-0.784)	(0.57-0.784)	(0.58-0.792)	(0.596-0.808)	(0.623-0.843)	(0.662-0.901)	(0.716-0.995)
	Recruits	61.56	10.32	56.83	15.54	19.71	13.19	9.05	8.17	8.51	8.65
	95% CI	(27.65 - 137.03)	(2.37 - 44.95)	(21.85 - 147.83)	(2.79 - 86.52)	(4.55 - 85.36)	(3.22 - 54.03)	(2.4 - 34.2)	(2.21 - 30.17)	(2.29 - 31.6)	(2.33 - 32.12)

Research And Data Needs

research-and-data-needs

Include: identify information gaps that seriously impede the stock assessment.

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

1. List item No. 1 in the list
2. List item No. 2 in the list, etc.

Rebuilding Projections

rebuilding-projections

Include: reference to the principal results from rebuilding analysis if the stock is overfished. This section should be included in the Final/SAFE version assessment document but is not required for draft assessments undergoing review. See Rebuilding Analysis terms of reference for detailed information on rebuilding analysis requirements.

1 Introduction

introduction

1.1 Basic Information

basic-information

Include: Scientific name, distribution, the basis of the choice of stock structure, including regional differences in life history or other biological characteristics that should form the basis of management units.

1.2 Map

map

A map showing the scope of the assessment and depicting boundaries for fisheries or data collection strata is provided in Figure 1.

1.3 Life History

life-history

Include: Important features of life history that affect management (e.g., migration, sexual dimorphism, bathymetric demography).

1.4 Ecosystem Considerations

ecosystem-considerations-1

Include: Ecosystem considerations (e.g., ecosystem role and trophic relationships of the species, habitat requirements/preferences, relevant data on ecosystem processes that may affect stock or parameters used in the stock assessment, and/or cross-FMP interactions with other fisheries). This section should note if environmental correlations or food web interactions were incorporated into the assessment model. The length and depth of this section would depend on availability of data and reports from the IEA, expertise of the STAT, and whether ecosystem factors are informational to contribute quantitative information to the assessment.

1.5 Fishery Information

fishery-information

Include: Important features of current fishery and relevant history of fishery.

Rockfish example: The rockfish fishery off the U.S. Pacific coast first developed off California in the late 19th century as a hook-and-line fishery (Love et al. 2002).
The rockfish trawl fishery was established in the early 1940s, when the United States became involved in World War II and wartime shortage of red meat created an increased demand for other sources of protein (Harry and Morgan 1961, Alverson et al. 1964). Etc. . . .

1.6 Summary of Management History

summary-of-management-history

Include: Summary of management history (e.g., changes in mesh sizes, trip limits, or other management actions that may have significantly altered selection, catch rates, or discards).

1.7 Management Performance

management-performance-1

Include: Management performance, including a table or tables comparing Overfishing Limit (OFL), Annual Catch Limit (ACL), Harvest Guideline (HG) [CPS only], landings, and catch (i.e., landings plus discard) for each area and year.

Management performance table: (Table k)
A summary of these values as well as other base case summary results can be found in Table o.

1.8 Fisheries off Canada, Alaska, and/or Mexico

fisheries-off-canada-alaska-andor-mexico

Include if necessary.

2 Assessment

assessment

2.1 Data

data

Data used in the Yellowtail Rockfish assessment are summarized in Figure 3.
A description of each data source is below.

2.1.1 Commercial Fishery Landings

commercial-fishery-landings

Washington catch information

WDFW provided historical yellowtail catch for 1889 – 1980 period. WDFW also provided catches for 1981 – 2016 period to include the re-distribution of the "URCK" landings in PacFIN database. This information is currently not available from PacFIN.

Sub-heading 2

Sub-heading 3

2.1.2 Sport Fishery Removals

sport-fishery-removals

Sub-heading 1

Sub-heading 2

Sub-heading 3

2.1.3 Estimated Discards

estimated-discards

Sub-heading 1

Sub-heading 2

Sub-heading 3

2.1.4 Abundance Indices

abundance-indices

Sub-heading 1

Sub-heading 2

2.1.5 Fishery-Independent Data: possible sources

fishery-independent-data-possible-sources

Northwest Fisheries Science Center (NWFSC) slope survey
The NWFSC slope survey was conducted annually from 1999 to 2002.
The depth range of this survey is 100-700 fm.

Northwest Fisheries Science Center (NWFSC) shelf-slope survey
This survey is referred to as the "combo," conducted annually since 2003.
The survey consistently covered depths between 30 and 700 fm.

Alaska Fisheries Science Center (AFSC) shelf survey
The survey, often referred to as the "triennial" survey was conducted every third year between 1977 and (and conducted in 2004 by the NWFSC using the same protocols). The triennial survey trawls in depths of 30 to 275 fm.

Pikitch Study
The Pikitch study was conducted between 1985 and 1987 (Pikitch et al. 1988). The northern

and southern boundaries of the study were $48^{\circ}42'$ N latitude and $42^{\circ}60'$ N. latitude respectively, which is primarily within the Columbia INPFC area (Pikitch et al. 1988 , Rogers and Pikitch 1992). Participation in the study was voluntary and included vessels using bottom, midwater, and shrimp trawl gears.
Observers of normal fishing operations on commercial vessels collected the data, estimated the total weight of the catch by tow and recorded the weight of species retained and discarded in the sample.

Enhanced Data Collection Project (EDCP)
The EDCP was conducted by ODFW to collect information on bycatch and discard groundfish species off the coast of Oregon from late 1995 to early 1999.
EDCP had limited spatial coverage in Oregon waters only.

Partnership For Interdisciplinary Studies of Coastal Oceans (PISCO)
Blurb on species presence in PISCO surveys

2.1.6 Biological Parameters and Data

`biological-parameters-and-data`

Length And Age Compositions

Include: Sample size information for length and age composition data by area, year, gear, market category, etc., including both the number of trips and fish sampled.

Length compositions were provided from the following sources, by region, with brief descriptions below:

Model 1

- Source No. 1 (*ex. research, commerical dead fish, live fish, etc*, date range (ex. 2010-2011)
- Source No. 2 (*ex. research, commerical dead fish, live fish, etc*, date range (ex. 2010-2011)
- etc...
- Begin sublist if desired
  - Sublist source No. 1
  - Sublist source No. 2
  - etc...
- Back to main list, next Source
- Last Source

Can duplicate this list if you have more than one assessment model

Possible sources of age and length data:

Recreational: Washington (WDFW)

Recreational: California MRFSS And CRFS Length Composition Data Individual fish lengths recorded by MRFSS (1980-2003) and CRFS (2004-2011) samplers were downloaded from the RecFIN website (www.recfin.org). CRFS data from 2012-2014 were obtained directly from CDFW.

Recreational: Oregon Recreational Boat Survey (ORBS) Biological data from the ORBS program were provided by ODFW. The ORBS is a dockside sampling program for the both the recreational CPFV and private modes. Length composition samples from north of Florence for the CPFV and private fleets were provided from 1980-2014. Samples from south of Florence spanned 1984-2014

Recreational: Miller and Gotshall (1965)
The Northern California Marine Sport Fish Survey conducted an assessment survey with goals that included estimation of annual fishing effort by all recreational fishing modes, catch by weight, CPUE, and collection of data to analyze length compositions

Commercial: PacFIN (Oregon and California)

Research: NMFS Groundfish Ecology Survey

From 2001-2005, the SWFSC Fisheries Ecology Division conducted longline surveys aboard a chartered commercial longline vessel at various stations between Monterey and Davenport, CA (36° N. latitude to 37.5° N. latitude) (pers. comm. Don Pearson, SWFSC). Longline gear was set in various depths from 10 meters to 700 meters, parallel to the depth contour. Each longline set consisted of 3-5 skates, each with about 250 2/0 circle hooks baited with squid. In nearshore habitats, the gear soaked for roughly 30 minutes.

Research: California Collaborative Fisheries Research Program (CCFRP)

Research: NWFSC shelf-slope survey

Research: NWFSC slope survey

Research: Abrams Thesis

Age Structures

Age structure data were available from the following sources:

Model Region 1

- Source No. 1 (*ex. research, commericla dead fish, live fish, etc*, date range (ex. 2010-2011)

- Source No. 2 (*ex. research, commericla dead fish, live fish, etc*, date range (ex. 2010-2011)
- etc...
- Begin sublist if desired
  - Sublist source No. 1
  - Sublist source No. 2
  - etc...
- Back to main list, next Source
- Last Source

Can duplicate this list if you have more than one assessment model

Length-at-age was initially estimated external to the population dynamics models using the 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

The weight-length relationship is based on the standard power function: $W = \alpha(L^\beta)$ where W is individual weight (kg), L is length (cm), and α and β are coefficients used as constants.

To estimate this relationship, 12,778 samples with both weight and length measurements from the fishery independent surveys were analyzed. These included 6,354 samples from the NWFSC Combo survey, 5,085 from the Triennial survey, and 1,339 from the Hook and Line survey. All Hook and Line survey samples were from the Southern area, along with 910 samples from the other two surveys (Figure 42). A single weight-length relationship was chosen for females and males in both areas after examining various factors that may influence this relationships, including sex, area, year, and season. None of these factors had a strong influence in the overall results. Season was one of the bigger factors, with fish sampled later in the year showing a small increase in weight at a given length (2-6% depending on the other factors considered). However, season was confounded with area because most of the samples from the Southern area were collected from the Hook and Line survey which takes place later in the year (mid-September to mid-November) and the resolution of other data in the model do not support modeling the stock at a scale finer than a annual time step. Males and females did not show strong differences in either area, and the estimated differences were in opposite directions for the two areas, suggesting that this might be a spurious relationship or confounded with differences timing of the sampling relative to spawning.

The estimated coefficients resulting from this analysis were $\alpha = 1.1843e-05$ and $\beta = 3.0672$.

Maturity And Fecundity Maturity was estimated from histological analysis of 141 samples collected in 2016. These include 96 from the NWFSC Combo survey, 25 from mid-water catches in the NWFSC acoustic/trawl survey, 13 from the Hook and Line survey, and 7 from Oregon Department of Fish and Wildlife. The sample sizes were not adequate to estimate differences in maturity by area. Length at 50% maturity was estimated at 42.49cm (Figure **??**) which was consistent with the range 37-45cm cited in the previous assessment (Wallace and Lai 2005).

Natural Mortality

Natural mortality for wild fish populations is extremely difficult to estimate.

Sex ratios

2.1.7 Environmental Or Ecosystem Data Included In The Assessment

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

2.2 History Of Modeling Approaches Used For This Stock

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

2.2.1 Previous Assessments

`previous-assessments`

2.2.2 Previous Assessment Recommendations

`previous-assessment-recommendations`

Include: Response to STAR panel recommendations from the most recent previous assessment.

Recommendation 1: blah blah blah.

STAT response: blah blah blah....

Recommendation 2: blah blah blah.

STAT response: blah blah blah....

Recommendation 3: blah blah blah., etc.

STAT response: Continue recommendations as needed

2.3 Model Description

model-description

2.3.1 Transition To The Current Stock Assessment

transition-to-the-current-stock-assessment

Include: Complete description of any new modeling approaches

Below, we describe the most important changes made since the last full assessment and explain rationale for each change.:

1. Change No. 1. *Rationale*: blah blah blah.
2. Change No. 2. *Rationale*: blah blah blah.
3. Change No. 3. *Rationale*: Continue list as needed.

2.3.2 Definition of Fleets and Areas

definition-of-fleets-and-areas

We generated data sources for each of the models. Fleets by model include:

Model Region 1 or remove this line if only one model

Commercial: The commercial fleets include…

Recreational: The recreational fleets include…

Research: Research derived-data include…

2.3.3 Summary of Data for Fleets and Areas

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

2.3.4 Modeling Software

modeling-software

The STAT team used Stock Synthesis 3 version 3.24u by Dr. Richard Methot at the NWFSC. This most recent version (SS-V3.24u) was used, since it included improvements and corrections to older versions.

2.3.5 Data Weighting

data-weighting

Citation for Francis method (Francis 2011)
Citation for Ianelli-McAllister harmonic mean method (McAllister and Ianelli 1997)

2.3.6 Priors

priors

Citation for Hamel prior on natural mortality (Hamel 2015)

2.3.7 General Model Specifications

general-model-specifications

Citation for posterior predictive fecundity relationship from Dick (2009)
Model data, control, starter, and forecast files can be found in Appendices A-D.

2.3.8 Estimated And Fixed Parameters

estimated-and-fixed-parameters

A full list of all estimated and fixed parameters is provided in Tables.... Estimated and fixed parameters tables currently read in from .csv file, EXAMPLE: Table **??**

2.4 Model Selection and Evaluation

model-selection-and-evaluation

2.4.1 Key Assumptions and Structural Choices

key-assumptions-and-structural-choices

Include: Evidence of search for balance between model realism and parsimony.
Comparison of key model assumptions, include comparisons based on nested models (e.g., asymptotic vs. domed selectivities, constant vs. time-varying selectivities).

2.4.2 Alternate Models Considered

alternate-models-considered

Include: Summary of alternate model configurations that were tried but rejected.

2.4.3 Convergence

convergence

Include: Randomization run results or other evidence of search for global best estimates.

Convergence testing through use of dispersed starting values often requires extreme values to actually explore new areas of the multivariate likelihood surface. Jitter is a SS option that generates random starting values from a normal distribution logistically transformed into each parameter's range (Methot 2015). Table 3 shows the results of running 100 jitters for each pre-STAR base model....

2.5 Response To The Current STAR Panel Requests

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

Request No. 1: Add after STAR panel.

Rationale: Add after STAR panel.

STAT Response: Add after STAR panel.

Request No. 2: Add after STAR panel.

Rationale: Add after STAR panel.

STAT Response: Add after STAR panel.

Request No. 3: Add after STAR panel.

Rationale: Add after STAR panel.

STAT Response: Add after STAR panel.

Request No. 4: Example of a request that may have a list:

- **Item No. 1**
- **Item No. 2**
- **Item No. 3, etc.**

Rationale: Add after STAR panel.

STAT Response: Continue requests as needed.

2.6 Model 1

model-1

2.6.1 Model 1 Base Case Results

model-1-base-case-results

Table **??**

2.6.2 Model 1 Uncertainty and Sensitivity Analyses

model-1-uncertainty-and-sensitivity-analyses

Table 4

2.6.3 Model 1 Retrospective Analysis

`model-1-retrospective-analysis`

2.6.4 Model 1 Likelihood Profiles

`model-1-likelihood-profiles`

2.6.5 Model 1 Harvest Control Rules (CPS only)

`model-1-harvest-control-rules-cps-only`

2.6.6 Model 1 Reference Points (groundfish only)

`model-1-reference-points-groundfish-only`

Intro sentence or two. . . .(Table 5).

Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is 4000.9 mt. Table i shows the full suite of estimated reference points for the northern area model and Figure i shows the equilibrium yield curve.

2.7 Model 2

model-2

2.7.1 Model 2 Base Case Results

model-2-base-case-results

2.7.2 Model 2 Uncertainty and Sensitivity Analyses

model-2-uncertainty-and-sensitivity-analyses

2.7.3 Model 2 Retrospective Analysis

model-2-retrospective-analysis

2.7.4 Model 2 Likelihood Profiles

model-2-likelihood-profiles

2.7.5 Model 2 Harvest Control Rules (CPS only)

model-2-harvest-control-rules-cps-only

2.7.6 Model 2 Reference Points (groundfish only)

model-2-reference-points-groundfish-only

2.8 Model 3

model-3

2.8.1 Model 3 Base Case Results

model-3-base-case-results

2.8.2 Model 3 Uncertainty and Sensitivity Analyses

model-3-uncertainty-and-sensitivity-analyses

2.8.3 Model 3 Retrospective Analysis

model-3-retrospective-analysis

2.8.4 Model 3 Likelihood profiles

model-3-likelihood-profiles

2.8.5 Model 3 Harvest Control Rules (CPS only)

model-3-harvest-control-rules-cps-only

2.8.6 Model 3 Reference Points (groundfish only)

model-3-reference-points-groundfish-only

3 Harvest Projections and Decision Tables

harvest-projections-and-decision-tables

Table k

Model 1 Projections and Decision Table (groundfish only) (Table 6

Table m

Model 2 Projections and Decision Table (groundfish only)

Model 3 Projections and Decision Table (groundfish only)

4 Regional Management Considerations

regional-management-considerations

1. For stocks where current practice is to allocate harvests by management area, a recommended method of allocating harvests based on the distribution of biomass should be provided. The MT advisor should be consulted on the appropriate management areas for each stock.
2. Discuss whether a regional management approach makes sense for the species from a biological perspective.
3. If there are insufficient data to analyze a regional management approach, what are the research and data needs to answer this question?

5 Research Needs

research-needs

1. Research need No. 1
2. Research need No. 2
3. Research need No. 3
4. etc.

6 Acknowledgments

acknowledgments

Include: STAR panel members and affiliations as well as names and affiliations of persons who contributed data, advice or information but were not part of the assessment team. Not required in draft assessment undergoing review.

7 Tables

tables

Table 1: List of parameters used in the base model, including estimated values and standard deviations (SD), bounds (minimum and maximum), estimation phase (negative values indicate not estimated), status (indicates if parameters are near bounds, and prior type information (mean, SD).

No.	Parameter	Value	Phase	Bounds	Status	SD	Prior (Exp.Val, SD)
1	NatM_p_1_Fem_GP_1	0.120	-2	(0.02, 0.25)			None
2	L_at_Amin_Fem_GP_1	1.000	3	(1, 25)	LO	0.000	None
3	L_at_Amax_Fem_GP_1	54.334	2	(35, 70)	OK	0.592	None
4	VonBert_K_Fem_GP_1	0.143	3	(0.1, 0.4)	OK	0.004	None
5	CV_young_Fem_GP_1	0.030	5	(0.03, 0.16)	LO	0.000	None
6	CV_old_Fem_GP_1	0.070	5	(0.03, 0.16)	OK	0.005	None
7	Wtlen_1_Fem	0.000	-50	(0, 3)			None
8	Wtlen_2_Fem	3.067	-50	(2, 4)			None
9	Mat50%_Fem	42.490	-50	(30, 56)			None
10	Mat_slope_Fem	-0.401	-50	(-2, 1)			None
11	Eggs_scalar_Fem	0.000	-50	(0, 6)			None
12	Eggs_exp_len_Fem	4.590	-50	(2, 7)			None
13	NatM_p_1_Mal_GP_1	0.000	-2	(-3, 3)			Normal (0, 99)
14	L_at_Amin_Mal_GP_1	0.000	-2	(-1, 1)			None
15	L_at_Amax_Mal_GP_1	-0.150	2	(-1, 1)	OK	0.013	None
16	VonBert_K_Mal_GP_1	0.294	3	(-1, 1)	OK	0.032	None
17	CV_young_Mal_GP_1	0.000	-5	(-1, 1)			None
18	CV_old_Mal_GP_1	-0.205	5	(-1, 1)	OK	0.100	None
19	Wtlen_1_Mal	0.000	-50	(0, 3)			None
20	Wtlen_2_Mal	3.067	-50	(2, 4)			None
24	CohortGrowDev	1.000	-50	(0, 2)			None
25	FracFemale_GP_1	0.500	-99	(0.001, 0.999)			None
26	SR_LN(R0)	10.159	1	(5, 20)	OK	0.085	None
27	SR_BH_steep	0.718	-6	(0.2, 1)			None
28	SR_sigmaR	0.700	-6	(0.5, 1.2)			None
29	SR_regime	0.000	-50	(-5, 5)			None

Continued on next page

Table 1: List of parameters used in the base model, including estimated values and standard deviations (SD), bounds (minimum and maximum), estimation phase (negative values indicate not estimated), status (indicates if parameters are near bounds, and prior type information (mean, SD).

No.	Parameter	Value	Phase	Bounds	Status	SD	Prior (Exp.Val, SD)
30	SR_autocorr	0.000	-50	(0, 2)			None
140	LnQ_base_CommercialTrawl(1)	-4.893	-1	(-30, 15)			None
141	LnQ_base_HakeByCatch(2)	-10.257	-1	(-30, 15)			None
142	LnQ_base_Triennial(5)	-2.134	-1	(-30, 15)			None
143	LnQ_base_NWFSCcombo(6)	-1.037	-1	(-30, 15)			None
144	SizeSel_P1_CommercialTrawl(1)	55.000	1	(20, 55)	HI	0.000	None
145	SizeSel_P2_CommercialTrawl(1)	6.965	4	(-20, 7)	HI	174.581	None
146	SizeSel_P3_CommercialTrawl(1)	6.200	3	(-5, 20)	OK	0.075	None
147	SizeSel_P4_CommercialTrawl(1)	-2.008	4	(-5, 20)	OK	0.656	None
148	SizeSel_P5_CommercialTrawl(1)	-999.000	-99	(-999, 25)			None
149	SizeSel_P6_CommercialTrawl(1)	-999.000	-99	(-999, 25)			None
150	Retain_P1_CommercialTrawl(1)	29.071	3	(20, 55)	OK	0.127	None
151	Retain_P2_CommercialTrawl(1)	0.100	3	(0.1, 40)	LO	0.000	None
152	Retain_P3_CommercialTrawl(1)	3.945	3	(-10, 20)	OK	0.123	None
153	Retain_P4_CommercialTrawl(1)	0.000	-4	(-3, 3)			None
154	SizeSel_P1_HakeByCatch(2)	51.412	1	(20, 55)	OK	1.623	None
155	SizeSel_P2_HakeByCatch(2)	-10.869	4	(-20, 7)	OK	4702.230	None
156	SizeSel_P3_HakeByCatch(2)	4.036	3	(-5, 20)	OK	0.272	None
157	SizeSel_P4_HakeByCatch(2)	1.795	4	(-5, 20)	OK	1.270	None
158	SizeSel_P5_HakeByCatch(2)	-999.000	-99	(-999, 25)			None
159	SizeSel_P6_HakeByCatch(2)	-999.000	-99	(-999, 25)			None
160	SizeSel_P1_RecORandCA(3)	30.916	1	(20, 55)	OK	2.029	None
161	SizeSel_P2_RecORandCA(3)	-19.799	4	(-20, 7)	LO	1448.070	None
162	SizeSel_P3_RecORandCA(3)	3.145	3	(-5, 20)	OK	0.669	None
163	SizeSel_P4_RecORandCA(3)	5.775	4	(-5, 20)	OK	0.593	None
164	SizeSel_P5_RecORandCA(3)	-999.000	-99	(-999, 25)			None
165	SizeSel_P6_RecORandCA(3)	-999.000	-99	(-999, 25)			None

Continued on next page

Table 1: List of parameters used in the base model, including estimated values and standard deviations (SD), bounds (minimum and maximum), estimation phase (negative values indicate not estimated), status (indicates if parameters are near bounds, and prior type information (mean, SD).

No.	Parameter	Value	Phase	Bounds	Status	SD	Prior (Exp.Val, SD)
166	SizeSel_P1_RecWA(4)	55.000	1	(20, 55)	HI	0.001	None
167	SizeSel_P2_RecWA(4)	2.184	4	(-20, 7)	OK	35683.900	None
168	SizeSel_P3_RecWA(4)	5.477	3	(-5, 20)	OK	0.153	None
169	SizeSel_P4_RecWA(4)	18.917	4	(-5, 20)	OK	4511.330	None
170	SizeSel_P5_RecWA(4)	-999.000	-99	(-999, 25)			None
171	SizeSel_P6_RecWA(4)	-999.000	-99	(-999, 25)			None
172	SizeSel_P1_Triennial(5)	21.418	1	(20, 55)	OK	0.189	None
173	SizeSel_P2_Triennial(5)	1.884	4	(-20, 7)	OK	1.197	None
174	SizeSel_P3_Triennial(5)	-5.000	3	(-5, 20)	LO	0.005	None
175	SizeSel_P4_Triennial(5)	1.581	4	(-5, 20)	OK	4.058	None
176	SizeSel_P5_Triennial(5)	-999.000	-99	(-999, 25)			None
177	SizeSel_P6_Triennial(5)	-999.000	-99	(-999, 25)			None
178	SizeSel_P1_NWFSCcombo(6)	55.000	1	(20, 55)	HI	0.011	None
179	SizeSel_P2_NWFSCcombo(6)	2.193	4	(-20, 7)	OK	28730.500	None
180	SizeSel_P3_NWFSCcombo(6)	5.213	3	(-5, 20)	OK	0.284	None
181	SizeSel_P4_NWFSCcombo(6)	18.469	4	(-5, 20)	OK	11275.500	None
182	SizeSel_P5_NWFSCcombo(6)	-999.000	-99	(-999, 25)			None
183	SizeSel_P6_NWFSCcombo(6)	-999.000	-99	(-999, 25)			None
184	Retain_P3_CommercialTrawl(1)_BLK1repl_2002	5.187	3	(-10, 20)	OK	0.494	None
185	Retain_P3_CommercialTrawl(1)_BLK1repl_2011	19.997	3	(-10, 20)	HI	14.102	None

tab:model_params

Table 2: Summary of the biomass/abundance time series used in the stock assessment.

tab:Index_summary

Region	ID	Fleet	Years	Name	Fishery ind.	Filtering	Method	Endorsed
WA	1	4	1981-2014	Dockside CPUE	No	trip, area, month, Stephens-MacCall	delta-GLM (bin-gamma)	SSC
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Table 3: Results from 100 jitters from each of the three models.

tab:jitter

Status	Model.1	Model.2	Model.3
Returned to base case	-	-	-
Found local minimum	-	-	-
Found better solution	-	-	-
Error in likelihood	-	-	-
Total	100	100	100

Table 5: Time-series of population estimates from the base-case model.

Yr	Total biomass (mt)	Spawning biomass-million (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1889	154794	59	0.00	25813	0	0.00	1.00
1890	154794	59	1.00	25813	0	0.00	1.00
1891	154793	59	1.00	25813	0	0.00	1.00
1892	154768	59	1.00	25813	2	0.00	1.00
1893	154772	59	1.00	25813	2	0.00	1.00
1894	154772	59	1.00	25813	2	0.00	1.00
1895	154789	59	1.00	25812	1	0.00	1.00
1896	154794	59	1.00	25812	0	0.00	1.00
1897	154794	59	1.00	25812	0	0.00	1.00
1898	154795	59	1.00	25812	0	0.00	1.00
1899	154794	59	1.00	25812	0	0.00	1.00
1900	154794	59	1.00	25812	0	0.00	1.00
1901	154793	59	1.00	25812	0	0.00	1.00
1902	154793	59	1.00	25812	0	0.00	1.00
1903	154792	59	1.00	25812	0	0.00	1.00
1904	154788	59	1.00	25812	1	0.00	1.00
1905	154791	59	1.00	25812	0	0.00	1.00
1906	154790	59	1.00	25812	1	0.00	1.00
1907	154790	59	1.00	25812	1	0.00	1.00
1908	154787	59	1.00	25812	1	0.00	1.00
1909	154788	59	1.00	25812	1	0.00	1.00
1910	154788	59	1.00	25812	1	0.00	1.00
1911	154787	59	1.00	25812	1	0.00	1.00
1912	154787	59	1.00	25812	1	0.00	1.00
1913	154786	59	1.00	25812	1	0.00	1.00
1914	154785	59	1.00	25812	1	0.00	1.00
1915	154784	59	1.00	25812	1	0.00	1.00
1916	154783	59	1.00	25812	1	0.00	1.00
1917	154782	59	1.00	25812	1	0.00	1.00
1918	154751	59	1.00	25812	4	0.00	1.00
1919	154771	59	1.00	25812	2	0.00	1.00
1920	154772	59	1.00	25812	2	0.00	1.00
1921	154773	59	1.00	25812	2	0.00	1.00
1922	154776	59	1.00	25812	2	0.00	1.00
1923	154774	59	1.00	25812	2	0.00	1.00
1924	154766	59	1.00	25812	3	0.00	1.00
1925	154762	59	1.00	25812	3	0.00	1.00
1926	154750	59	1.00	25812	4	0.00	1.00
1927	154740	59	1.00	25812	5	0.00	1.00

Table 5: Time-series of population estimates from the base-case model.

Yr	Total biomass (mt)	Spawning biomass-million (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1928	154732	59	1.00	25812	6	0.00	1.00
1929	154664	59	1.00	25812	12	0.00	1.00
1930	154614	59	1.00	25812	16	0.00	1.00
1931	154678	59	1.00	25812	11	0.00	1.00
1932	154761	59	1.00	25811	3	0.00	1.00
1933	154748	59	1.00	25811	4	0.00	1.00
1934	154716	59	1.00	25811	7	0.00	1.00
1935	154684	59	1.00	25811	10	0.00	1.00
1936	154636	59	1.00	25811	14	0.00	1.00
1937	154500	59	1.00	25811	26	0.00	1.00
1938	154466	59	1.00	25811	29	0.00	1.00
1939	154371	59	1.00	25810	38	0.00	1.00
1940	153288	59	1.00	25809	135	0.00	0.99
1941	152792	59	1.00	25807	180	0.00	0.98
1942	151339	59	1.00	25804	313	0.00	0.97
1943	140795	59	0.99	25798	1346	0.01	0.87
1944	132309	58	0.98	25774	2263	0.01	0.79
1945	117355	57	0.97	25731	4127	0.03	0.65
1946	131232	55	0.94	25650	2289	0.02	0.78
1947	140502	55	0.92	25605	1290	0.01	0.87
1948	142587	54	0.92	25583	1082	0.01	0.89
1949	148194	54	0.91	25566	564	0.00	0.94
1950	141392	54	0.91	25563	1194	0.01	0.87
1951	141497	53	0.90	25548	1180	0.01	0.88
1952	137444	53	0.90	25536	1576	0.01	0.84
1953	144821	53	0.89	25516	861	0.01	0.91
1954	141957	53	0.89	25513	1128	0.01	0.88
1955	141434	53	0.89	25506	1176	0.01	0.87
1956	139434	52	0.89	25498	1367	0.01	0.86
1957	139178	52	0.88	25487	1388	0.01	0.85
1958	138722	52	0.88	25476	1428	0.01	0.85
1959	137991	52	0.88	25464	1496	0.01	0.84
1960	134605	52	0.87	25451	1830	0.01	0.81
1961	135545	51	0.87	25431	1724	0.01	0.82
1962	129781	51	0.86	25414	2317	0.02	0.77
1963	133793	50	0.85	25383	1877	0.01	0.80
1964	137182	50	0.85	25363	1532	0.01	0.84
1965	137996	50	0.84	25353	1450	0.01	0.84
1966	141481	50	0.84	25345	1123	0.01	0.88

Table 5: Time-series of population estimates from the base-case model.

Yr	Total biomass (mt)	Spawning biomass-million (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1967	138338	50	0.84	25347	1425	0.01	0.85
1968	132784	50	0.84	25341	1965	0.01	0.79
1969	120420	49	0.84	25324	3328	0.02	0.68
1970	137003	49	0.82	25273	1514	0.01	0.83
1971	136282	48	0.82	25268	1582	0.01	0.83
1972	128391	48	0.82	25262	2376	0.02	0.75
1973	124015	48	0.81	25236	2836	0.02	0.71
1974	131325	47	0.80	25199	2035	0.02	0.78
1975	137137	47	0.80	51598	1471	0.01	0.83
1976	113186	47	0.80	39311	4118	0.03	0.62
1977	98634	46	0.78	26821	6157	0.05	0.49
1978	84061	44	0.75	20440	8695	0.07	0.37
1979	86670	41	0.70	15590	7750	0.06	0.39
1980	86254	39	0.66	20625	7620	0.06	0.38
1981	75548	37	0.62	18688	9622	0.08	0.30
1982	71779	34	0.57	12230	10232	0.09	0.27
1983	67627	31	0.53	18765	10722	0.10	0.24
1984	91933	29	0.49	19560	5429	0.06	0.43
1985	104772	29	0.49	14722	3716	0.04	0.54
1986	91966	29	0.50	16344	5356	0.06	0.43
1987	90524	29	0.49	19641	5383	0.06	0.41
1988	79599	28	0.48	15087	6754	0.08	0.33
1989	87116	26	0.45	20624	5188	0.07	0.39
1990	87911	25	0.43	30079	4889	0.06	0.40
1991	90688	24	0.41	24691	4416	0.06	0.41
1992	71599	23	0.39	15697	6848	0.10	0.27
1993	72352	21	0.36	13652	6144	0.09	0.28
1994	70797	19	0.33	16778	6201	0.09	0.26
1995	72714	18	0.30	11813	5684	0.09	0.27
1996	67797	17	0.28	10942	6265	0.10	0.23
1997	102753	15	0.26	11052	2412	0.04	0.51
1998	94200	16	0.27	108136	3141	0.05	0.44
1999	91169	16	0.27	3367	3586	0.06	0.40
2000	88845	16	0.27	9756	3722	0.06	0.39
2001	106394	16	0.28	18274	2293	0.04	0.55
2002	123881	17	0.29	248297	1348	0.02	0.71
2003	142904	18	0.30	20442	495	0.01	0.89
2004	140221	19	0.32	209478	685	0.01	0.86
2005	136550	20	0.34	52109	985	0.01	0.83

Table 5: Time-series of population estimates from the base-case model.

Yr	Total biomass (mt)	Spawning biomass-million (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
2006	145105	22	0.37	39834	564	0.00	0.91
2007	148707	25	0.42	6831	410	0.00	0.94
2008	147994	28	0.48	10266	519	0.00	0.93
2009	146570	32	0.55	7453	780	0.00	0.92
2010	146317	38	0.65	10455	971	0.00	0.92
2011	144833	47	0.79	6291	1356	0.01	0.90
2012	144229	58	0.98	9250	1600	0.01	0.90
2013	145687	70	1.18	14376	1441	0.01	0.91
2014	145695	80	1.36	21767	1475	0.01	0.91
2015	142409	89	1.50	26680	2051	0.01	0.88
2016	145321	94	1.59	26785			

tab:Timeseries_mod1

Table 4: Sensitivity of the base model to dropping or down-weighting data sources and alternative assumptions about growth.

`tab:Sensitivity_model1`

Label	Base (Francis weights)	Harmonic mean weights	Drop index	Drop ages	Down-weight lengths	Free size Age0	Free CV Amin	External growth
TOTAL_like	-	-	-	-	-	-	-	-
Catch_like	-	-	-	-	-	-	-	-
Equil_catch_like	-	-	-	-	-	-	-	-
Survey_like	-	-	-	-	-	-	-	-
Length_comp_like	-	-	-	-	-	-	-	-
Age_comp_like	-	-	-	-	-	-	-	-
Parm_priors_like	-	-	-	-	-	-	-	-
SSB_Unfished_thousand_mt	-	-	-	-	-	-	-	-
TotBio_Unfished	-	-	-	-	-	-	-	-
SmryBio_Unfished	-	-	-	-	-	-	-	-
Recr_Unfished_billions	-	-	-	-	-	-	-	-
SSB_Btgt_thousand_mt	-	-	-	-	-	-	-	-
SPR_Btgt	-	-	-	-	-	-	-	-
Fstd_Btgt	-	-	-	-	-	-	-	-
TotYield_Btgt_thousand_mt	-	-	-	-	-	-	-	-
SSB_SPRtgt_thousand_mt	-	-	-	-	-	-	-	-
Fstd_SPRtgt	-	-	-	-	-	-	-	-
TotYield_SPRtgt_thousand_mt	-	-	-	-	-	-	-	-
SSB_MSY_thousand_mt	-	-	-	-	-	-	-	-
SPR_MSY	-	-	-	-	-	-	-	-
Fstd_MSY	-	-	-	-	-	-	-	-
TotYield_MSY_thousand_mt	-	-	-	-	-	-	-	-
RetYield_MSY	-	-	-	-	-	-	-	-
Bratio_2015	-	-	-	-	-	-	-	-
F_2015	-	-	-	-	-	-	-	-
SPRratio_2015	-	-	-	-	-	-	-	-
Recr_2015	-	-	-	-	-	-	-	-
Recr_Virgin_billions	-	-	-	-	-	-	-	-
L_at_Amin_Fem_GP_1	-	-	-	-	-	-	-	-
L_at_Amax_Fem_GP_1	-	-	-	-	-	-	-	-
VonBert_K_Fem_GP_1	-	-	-	-	-	-	-	-
CV_young_Fem_GP_1	-	-	-	-	-	-	-	-
CV_old_Fem_GP_1	-	-	-	-	-	-	-	-

Table 6: Projection of potential OFL, spawning biomass, and depletion for the base case model.

tab:Forecast_mod1

Yr	OFL contriubtion (mt)	ACL landings (mt)	Age 5+ biomass (mt)	Spawning Biomass (mt)	Depletion
2017	11696.40	11126.27	216928.00	95739800.00	1.62
2018	10596.60	10056.15	198233.00	90510500.00	1.53
2019	9528.95	9024.93	181713.00	83865500.00	1.42
2020	8559.73	8097.06	167578.00	76617200.00	1.30
2021	7727.11	7301.09	155765.00	69415300.00	1.18
2022	7043.72	6648.11	146058.00	62757800.00	1.06
2023	6503.01	6131.69	138164.00	56959800.00	0.96
2024	6086.95	5734.54	131774.00	52134900.00	0.88
2025	5772.74	5434.85	126593.00	48231800.00	0.82
2026	5537.46	5210.68	122363.00	45117400.00	0.76
2027	5360.66	5042.43	118870.00	42639000.00	0.72
2028	5225.21	4913.69	115944.00	40658500.00	0.69

8 Figures

figures

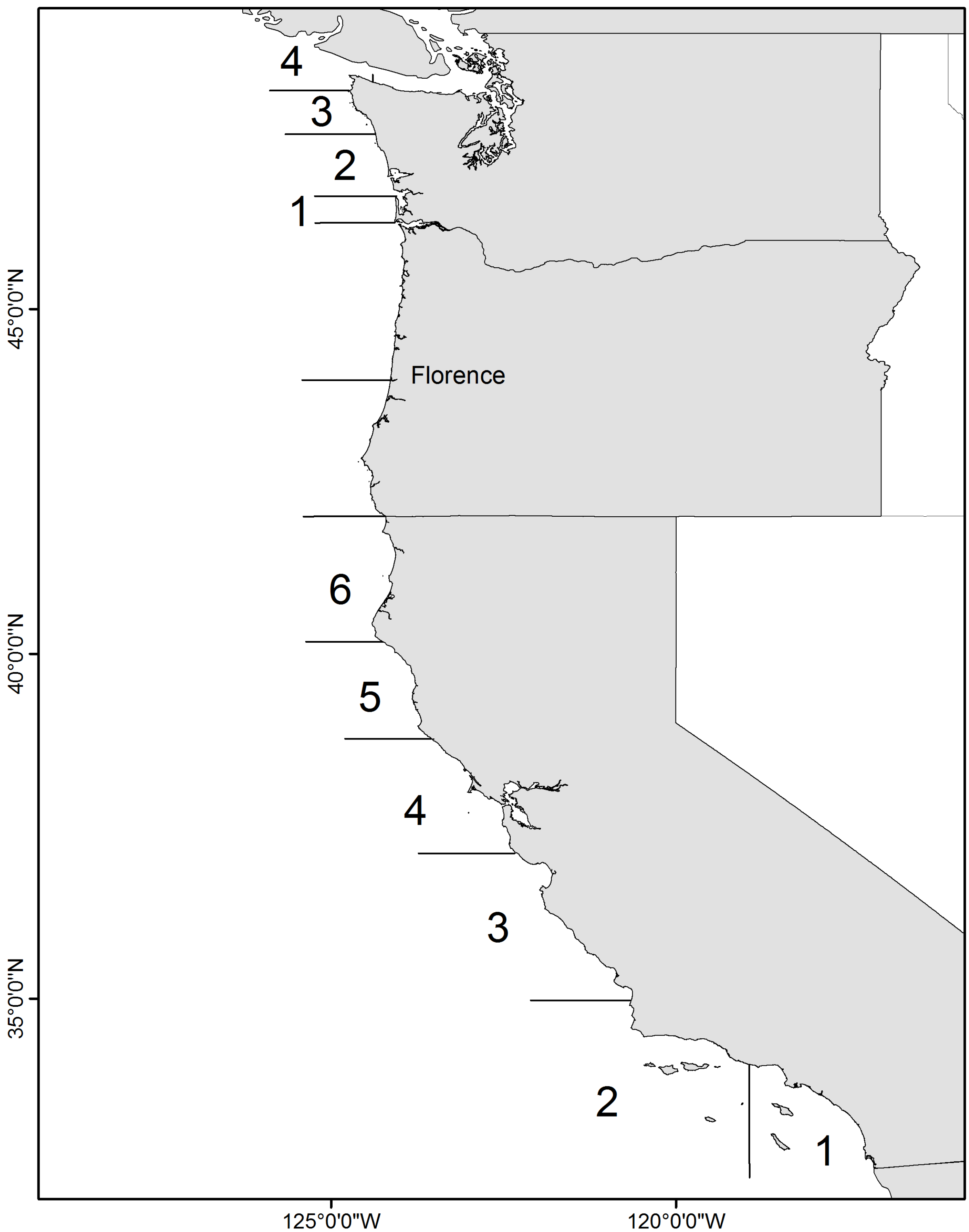


Figure 1: Map showing the state boundary lines for management of the recreational fishing fleets. CRFS Districts 1-6 in California are presented as well as the WDFW Recreational Management Areas in Washington. Florence, OR is shown as a potential location of model stratification. fig:boundary_map

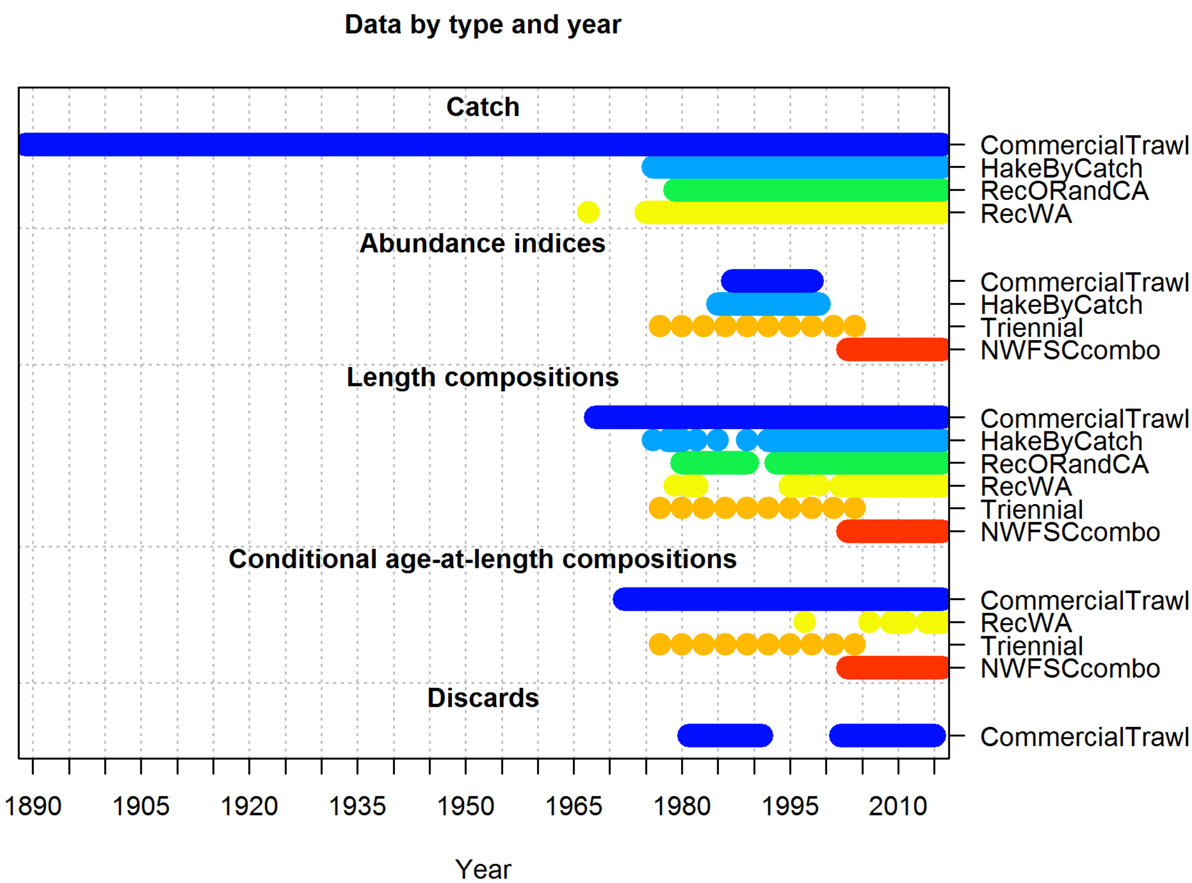


Figure 2: Summary of data sources used in the Northern model. fig:data_plot

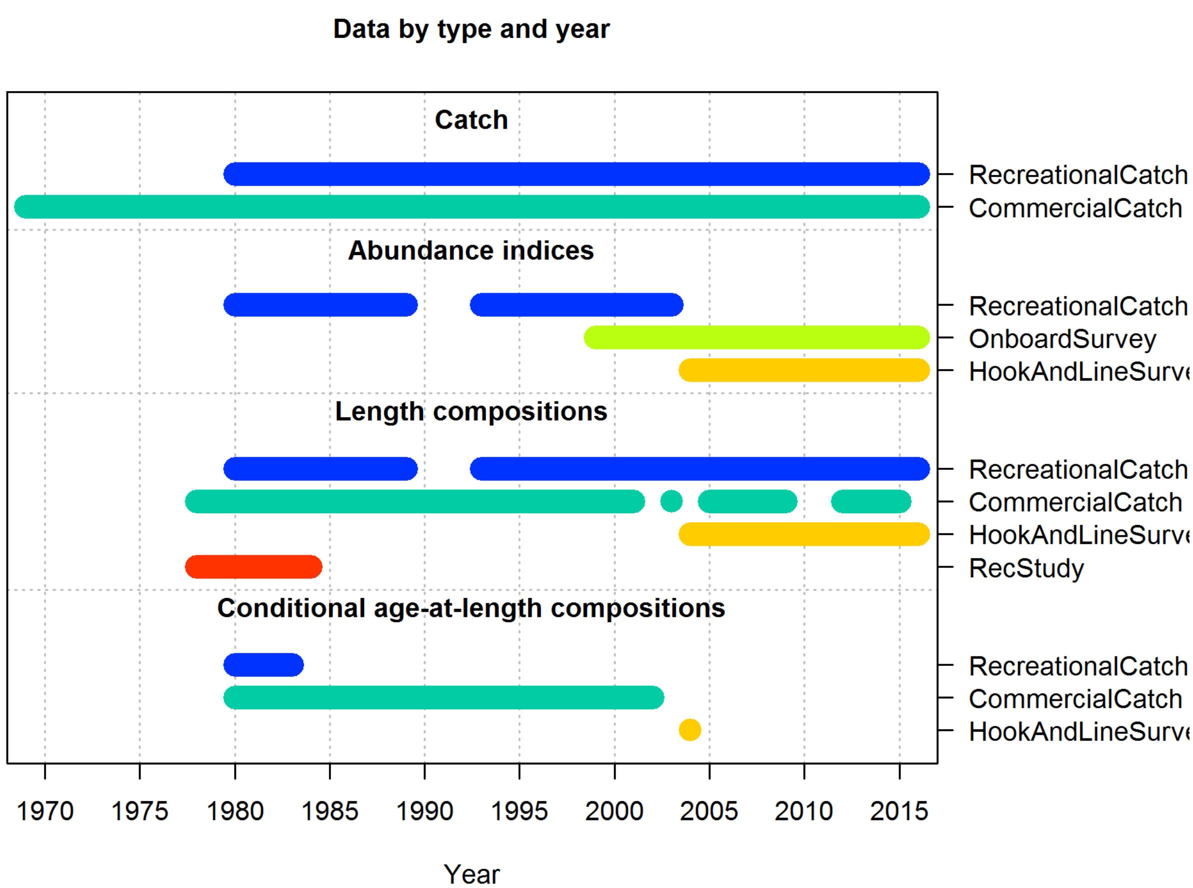


Figure 3: Summary of data sources used in the Southern model. fig:data_plot

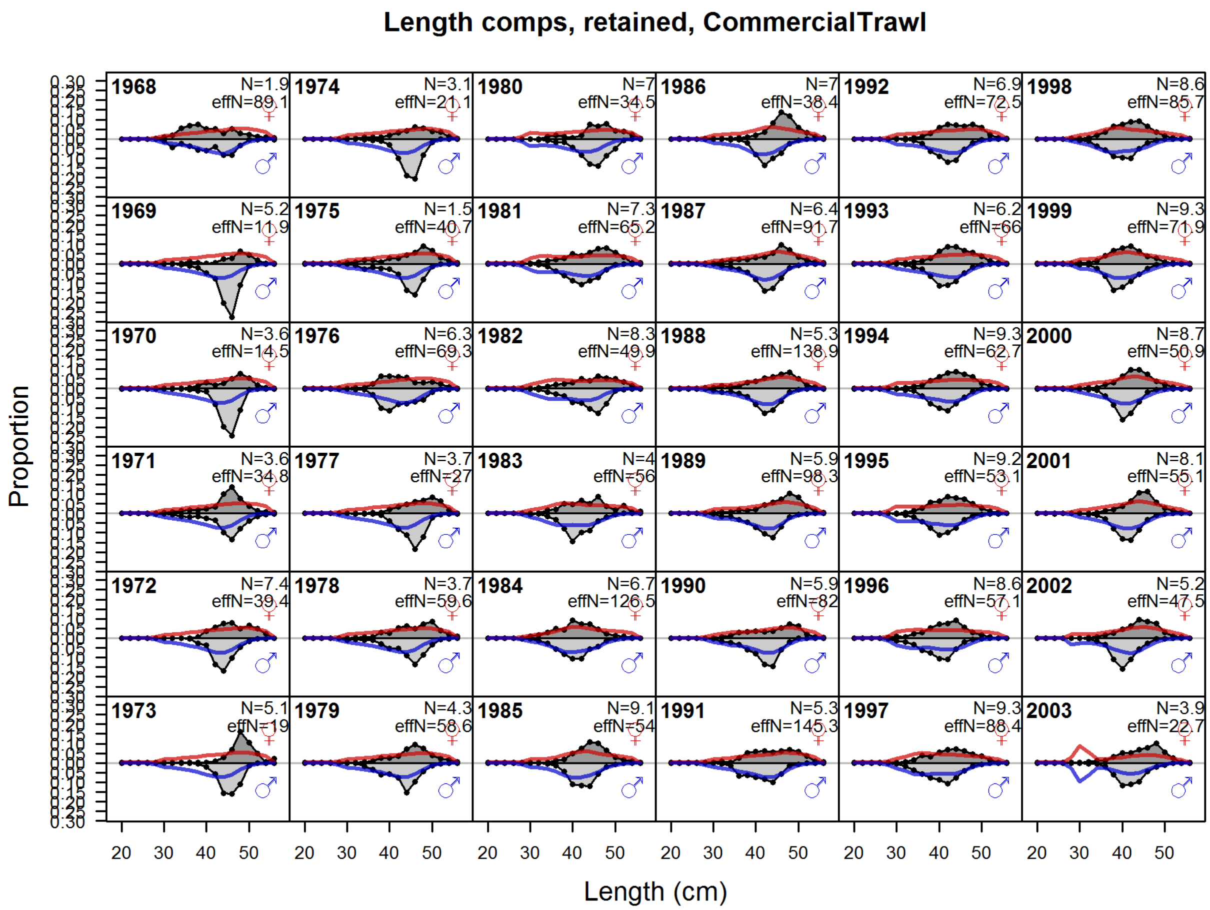
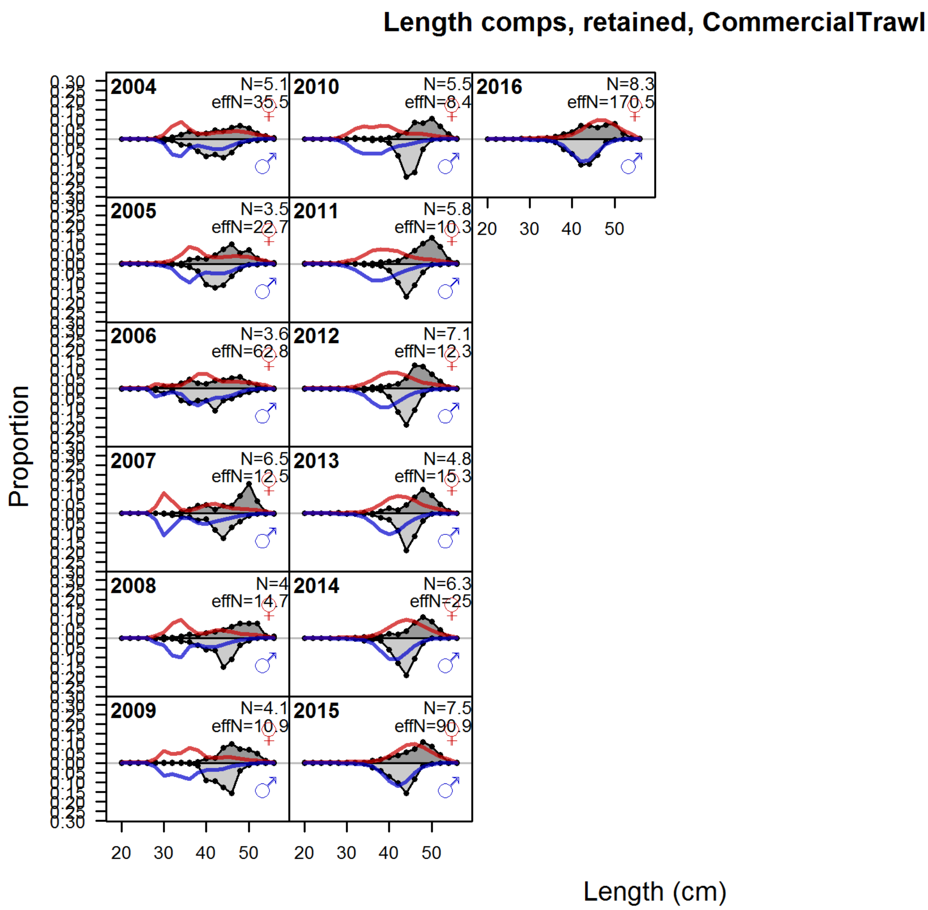


Figure 4: Length comps, retained, CommercialTrawl (plot 1 of 2) fig:mod1_1_comp_lenfit_f



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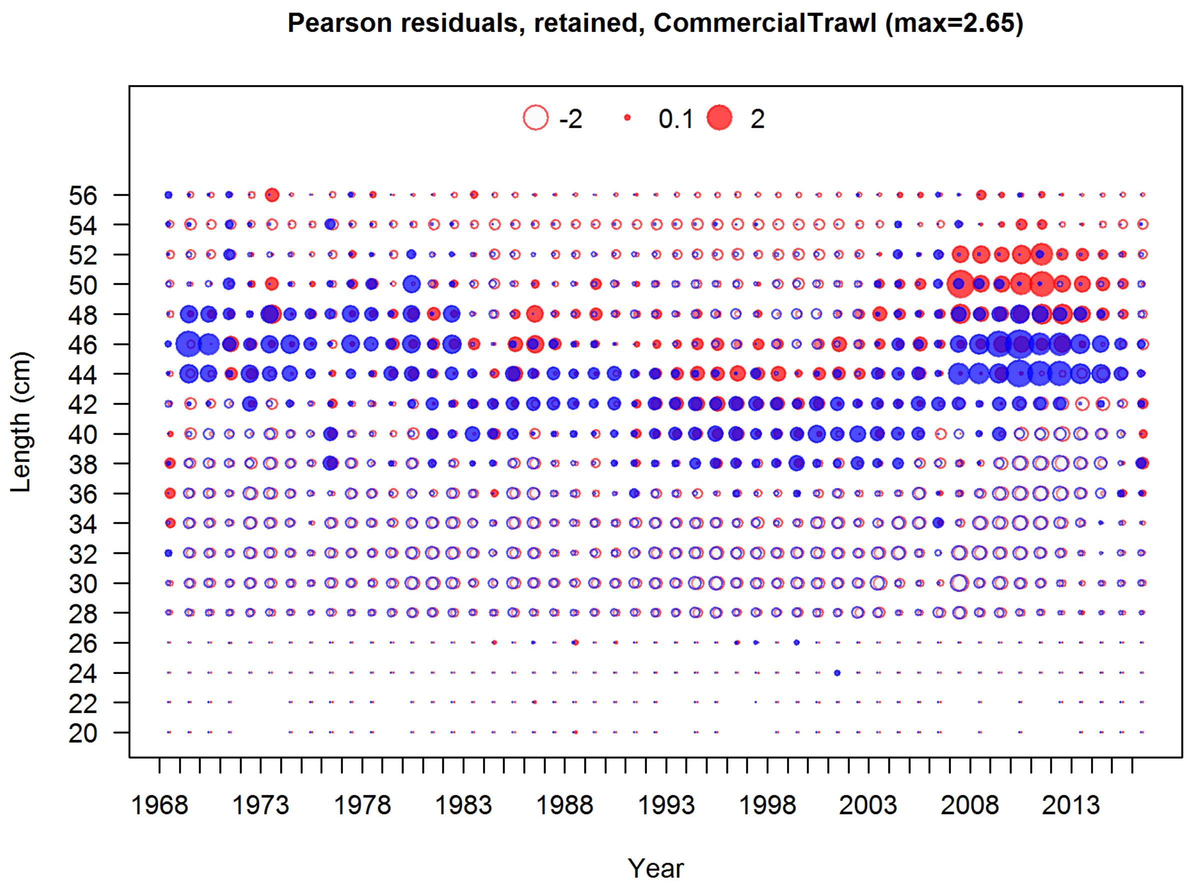

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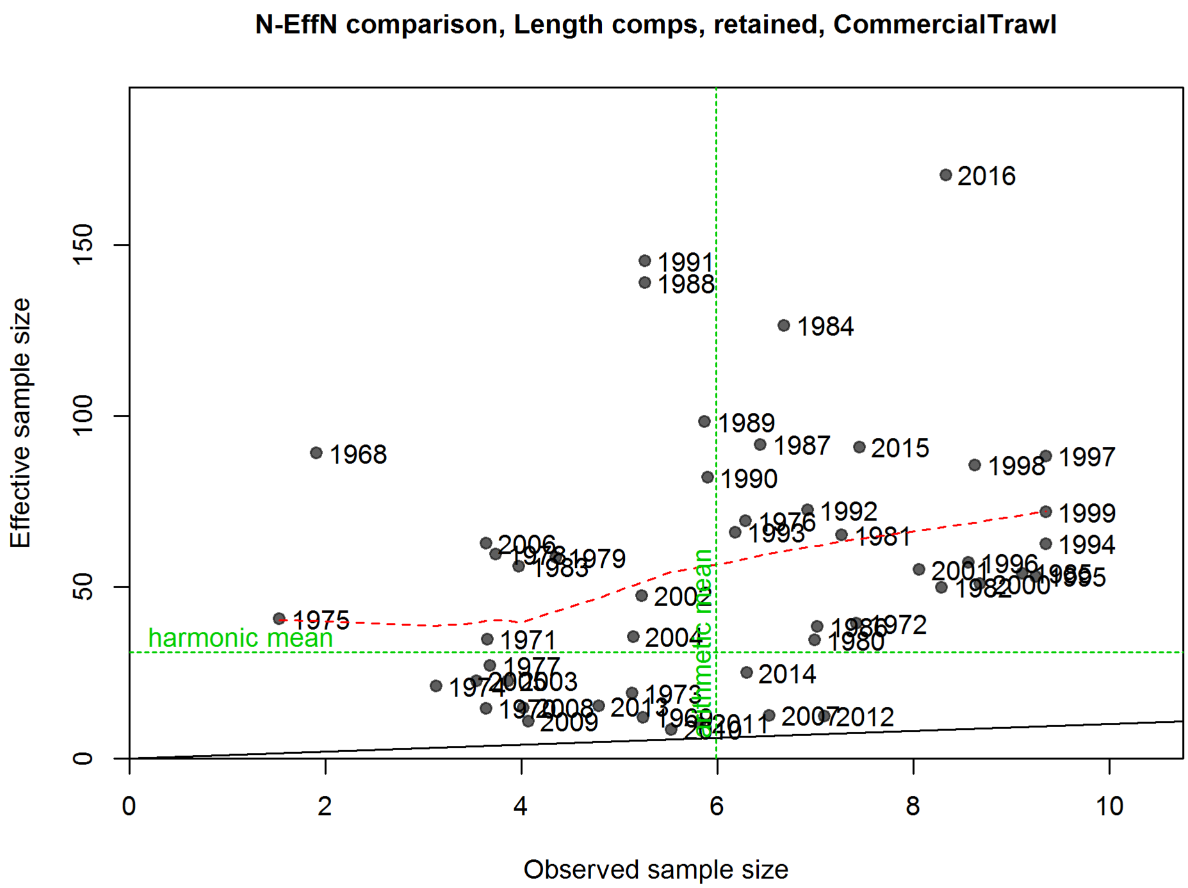

Figure 5: N_EffN comparison, Length comps, retained, CommercialTrawl fig:mod1_4_comp_lenf:

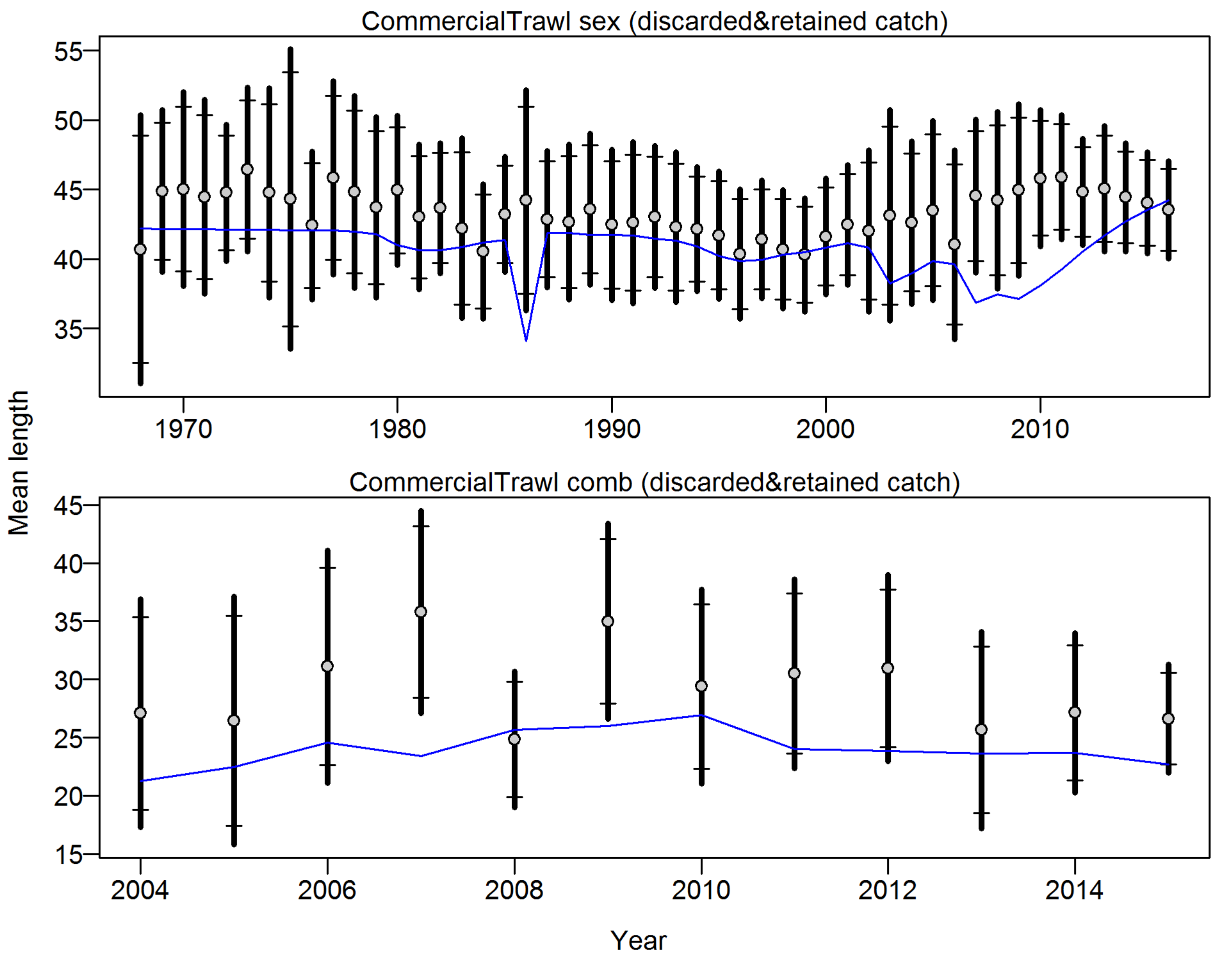

Figure 6: Francis data weighting method TA1.8: CommercialTrawl Suggested sample size adjustment (with 95% interval) for len data from CommercialTrawl: 1.3944 (1.0466_2.2226) For more info, see Francis, R.I.C.C. (2011). Data weighting in statistical fisheries stock assessment models. Can. J. Fish. Aquat. Sci. 68: 1124_1138. fig:mod1_5_comp_lenfit_data_weighting_T

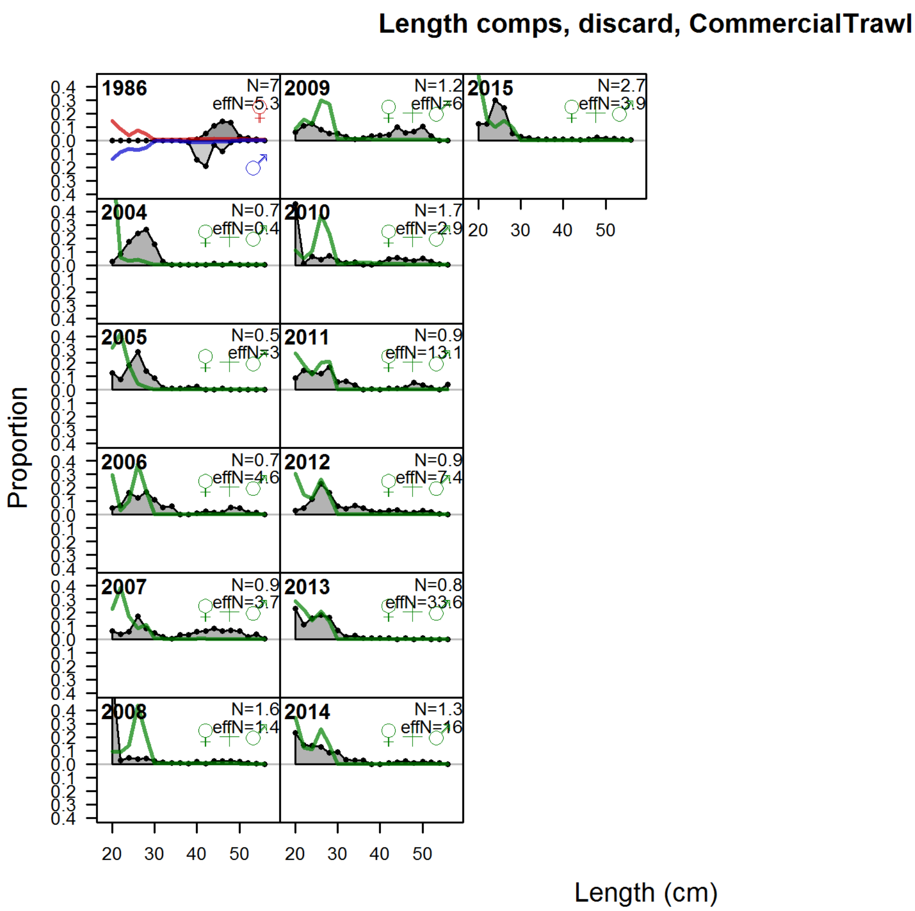

Figure 7: Length comps, discard, CommercialTrawl [fig:mod1_6_comp_lenfit_flt1mkt]

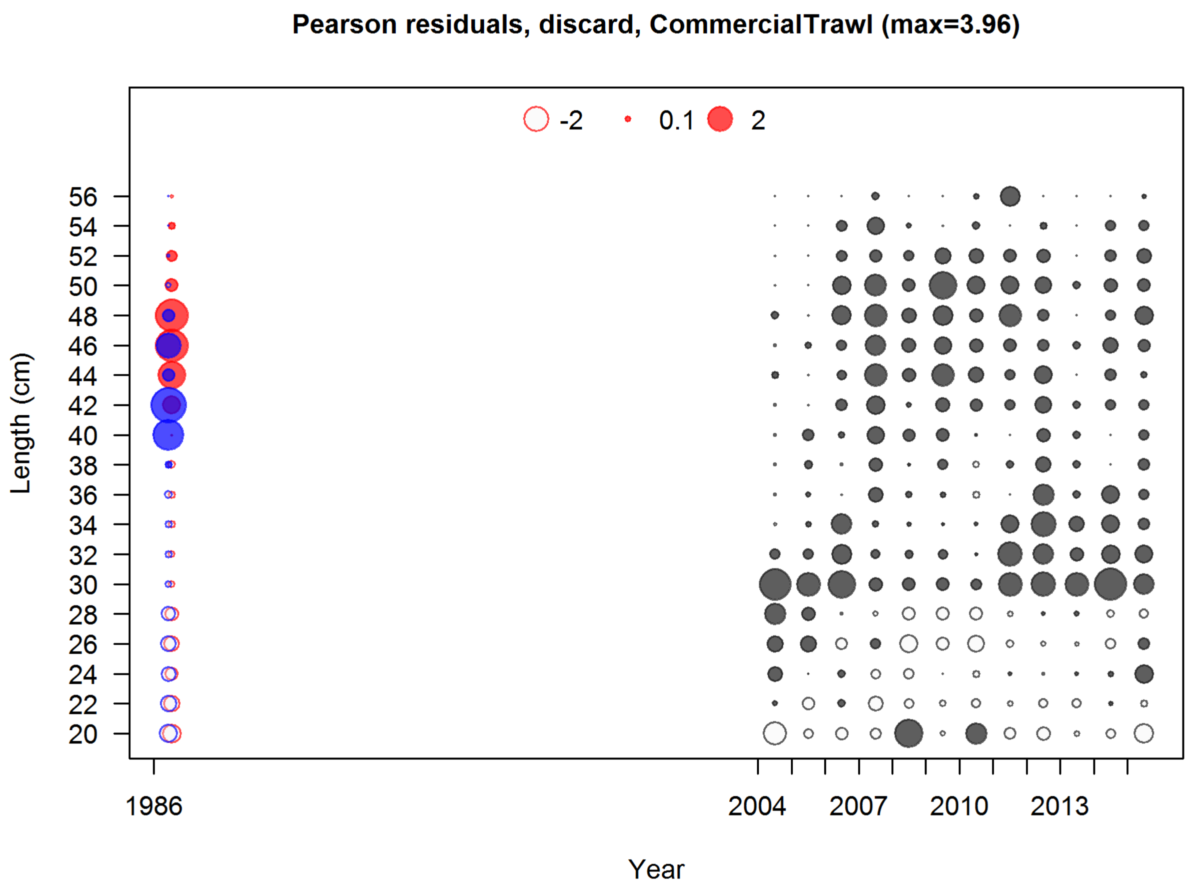

Figure 8: Pearson residuals, discard, CommercialTrawl (max=3.96)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_7_comp_lenfit_residsflt1mkt1

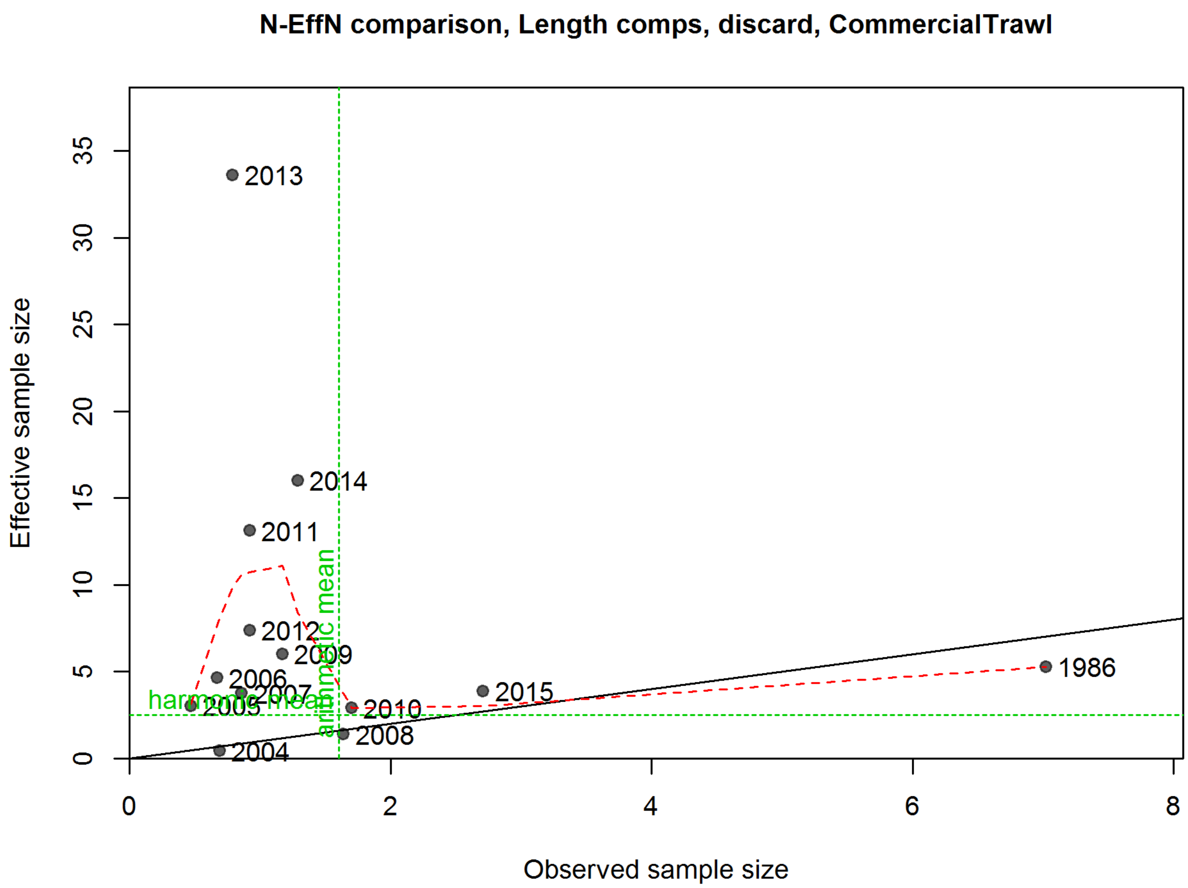

Figure 9: N_EffN comparison, Length comps, discard, CommercialTrawl fig:mod1_8_comp_lenfi

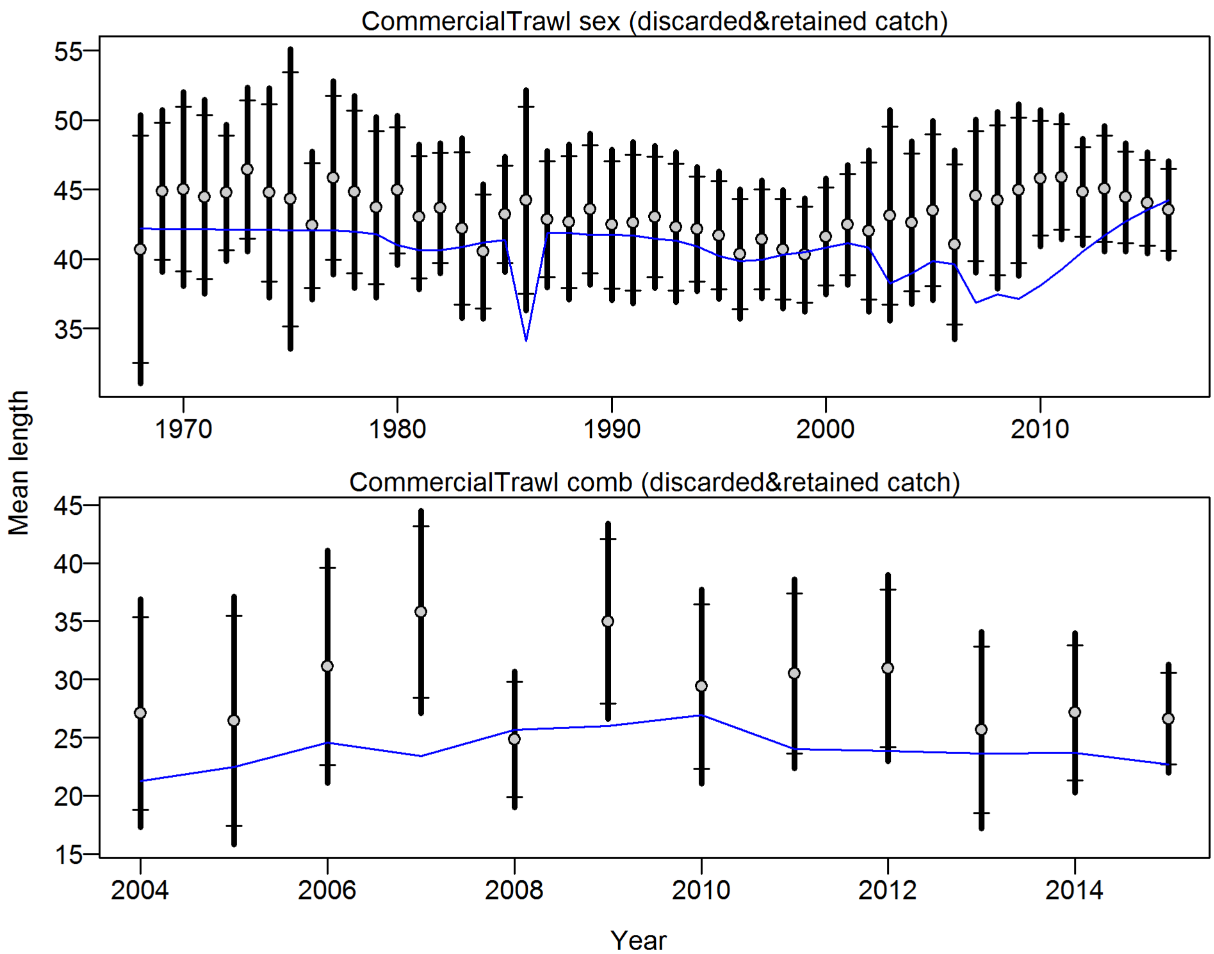

Figure 10: Francis data weighting method TA1.8: CommercialTrawl Suggested sample size adjustment (with 95% interval) for len data from CommercialTrawl: 1.3944 (1.0293_2.2099) For more info, see Francis, R.I.C.C. (2011). Data weighting in statistical fisheries stock assessment models. Can. J. Fish. Aquat. Sci. 68: 1124_1138. fig:mod1_9_comp_lenfit_data_weighting_T

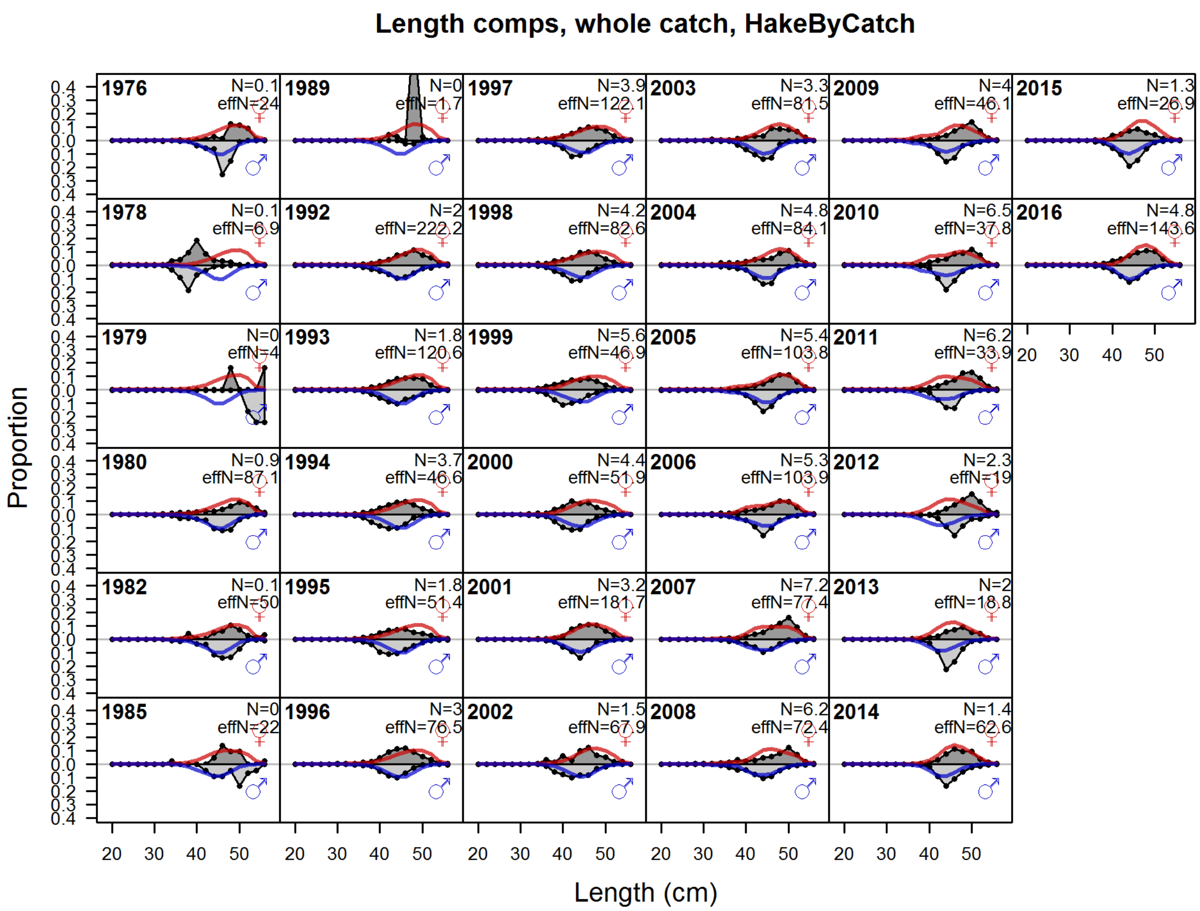

Figure 11: Length comps, whole catch, HakeByCatch fig:mod1_10_comp_lenfit_flt2ml

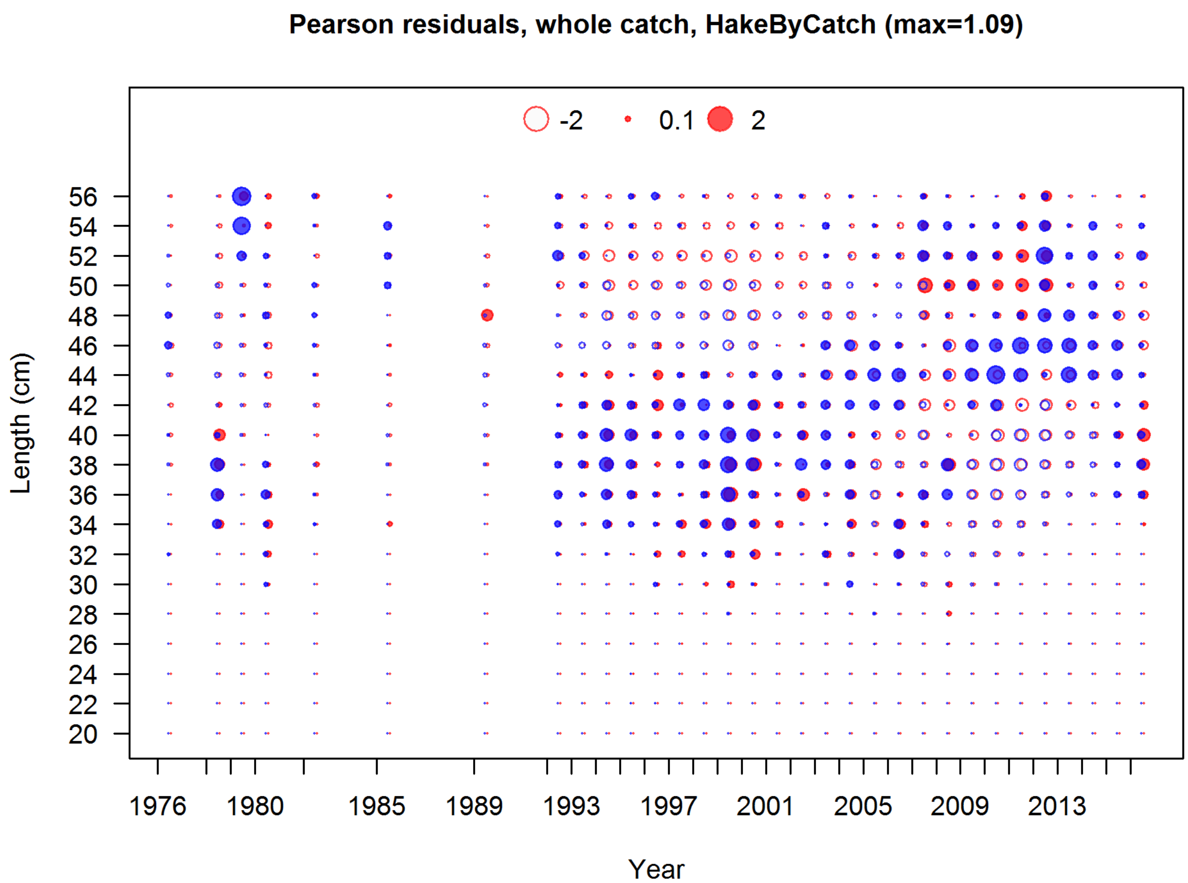

Figure 12: Pearson residuals, whole catch, HakeByCatch (max=1.09)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_11_comp_lenfit_residsflt2mkt0

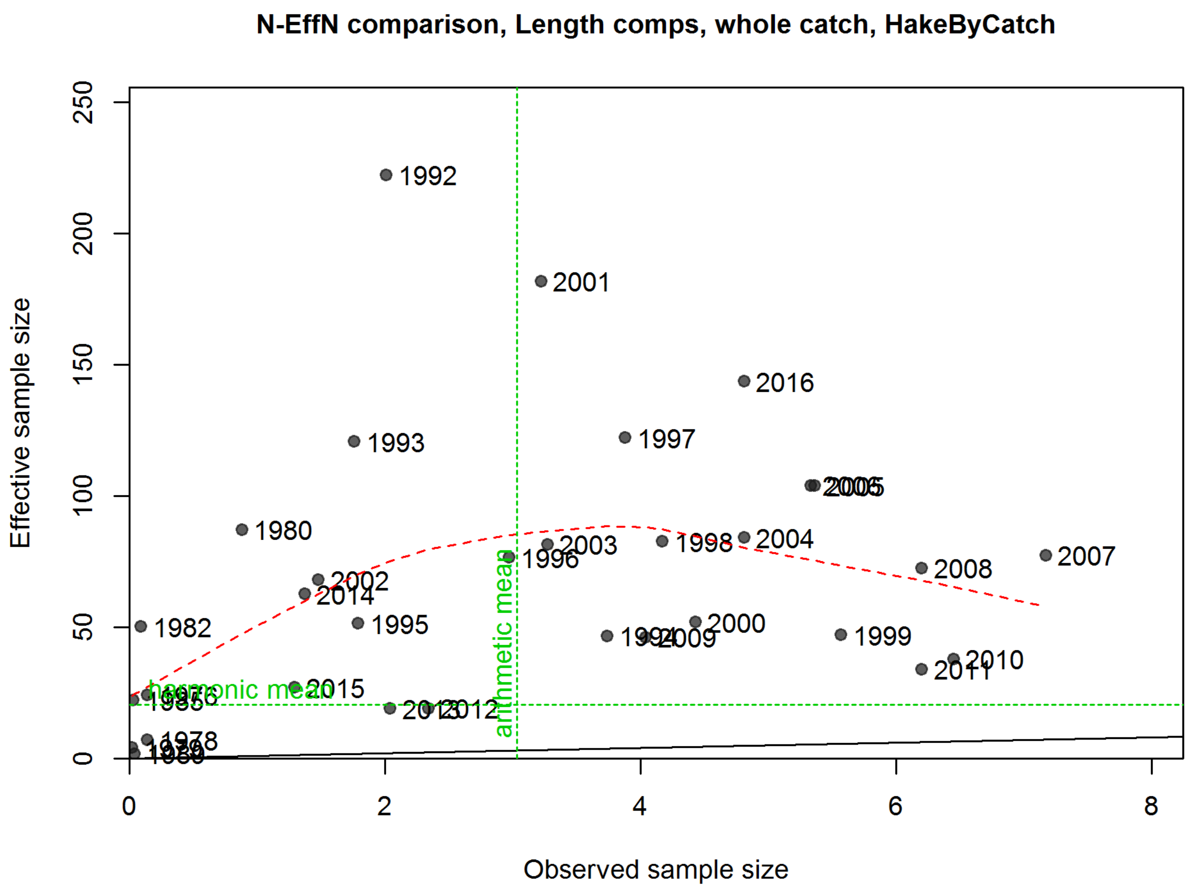

Figure 13: N_EffN comparison, Length comps, whole catch, HakeByCatch fig:mod1_12_comp_len

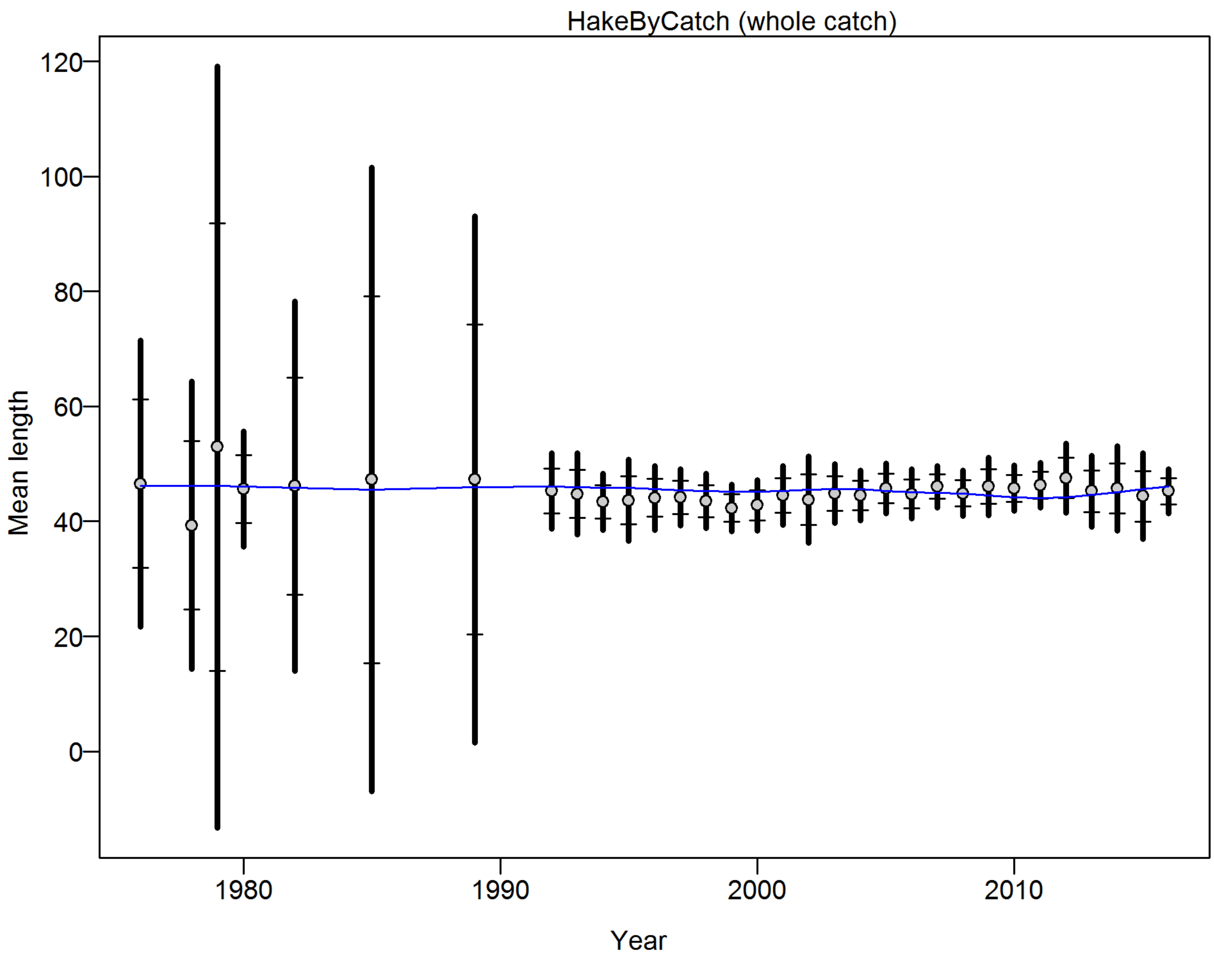

Figure 14: Francis data weighting method TA1.8: HakeByCatch Suggested sample size adjustment (with 95% interval) for len data from HakeByCatch: 2.889 (1.9487_5.4605) For more info, see Francis, R.I.C.C. (2011). Data weighting in statistical fisheries stock assessment models. Can. J. Fish. Aquat. Sci. 68: 1124_1138. fig:mod1_13_comp_lenfit_data_weighting_TA1.8_Hake

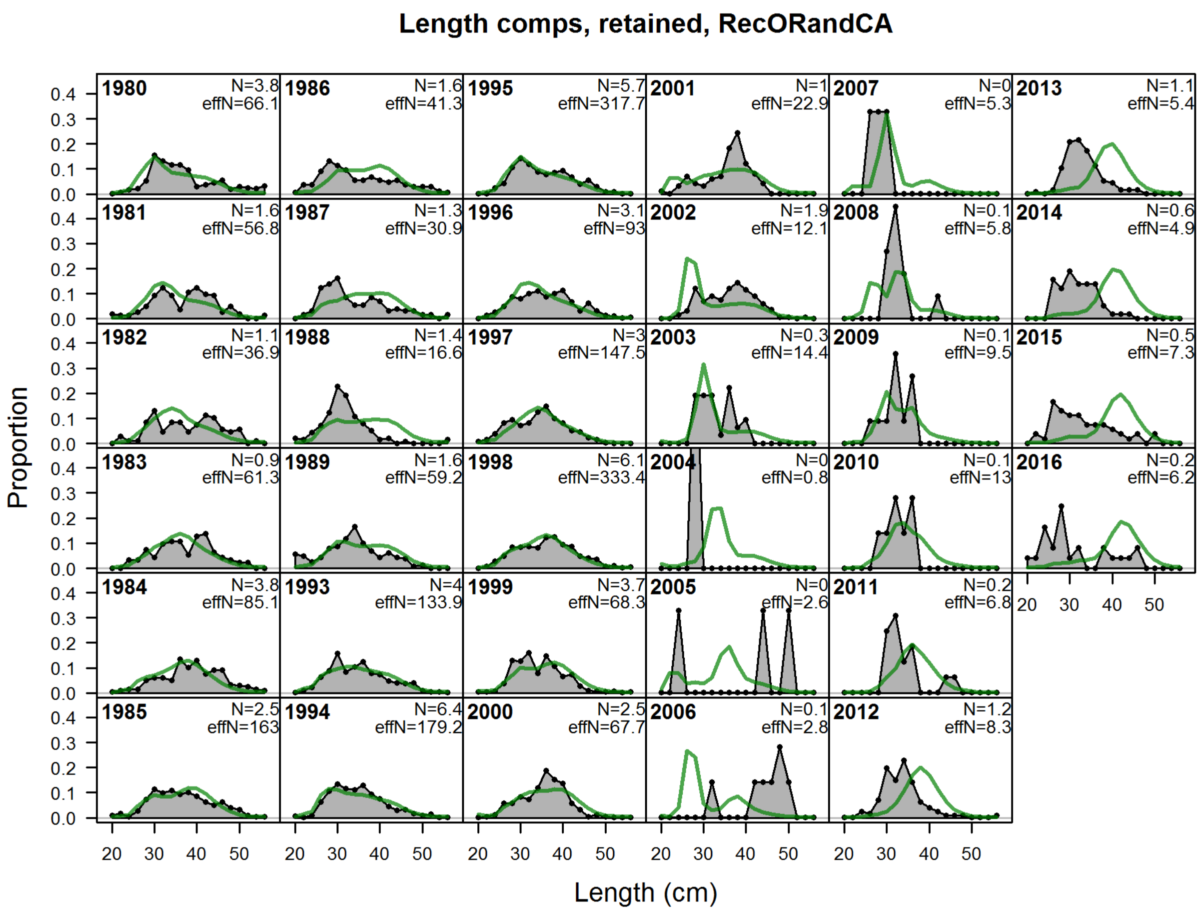

Figure 15: Length comps, retained, RecORandCA [fig:mod1_14_comp_lenfit_flt3mkt

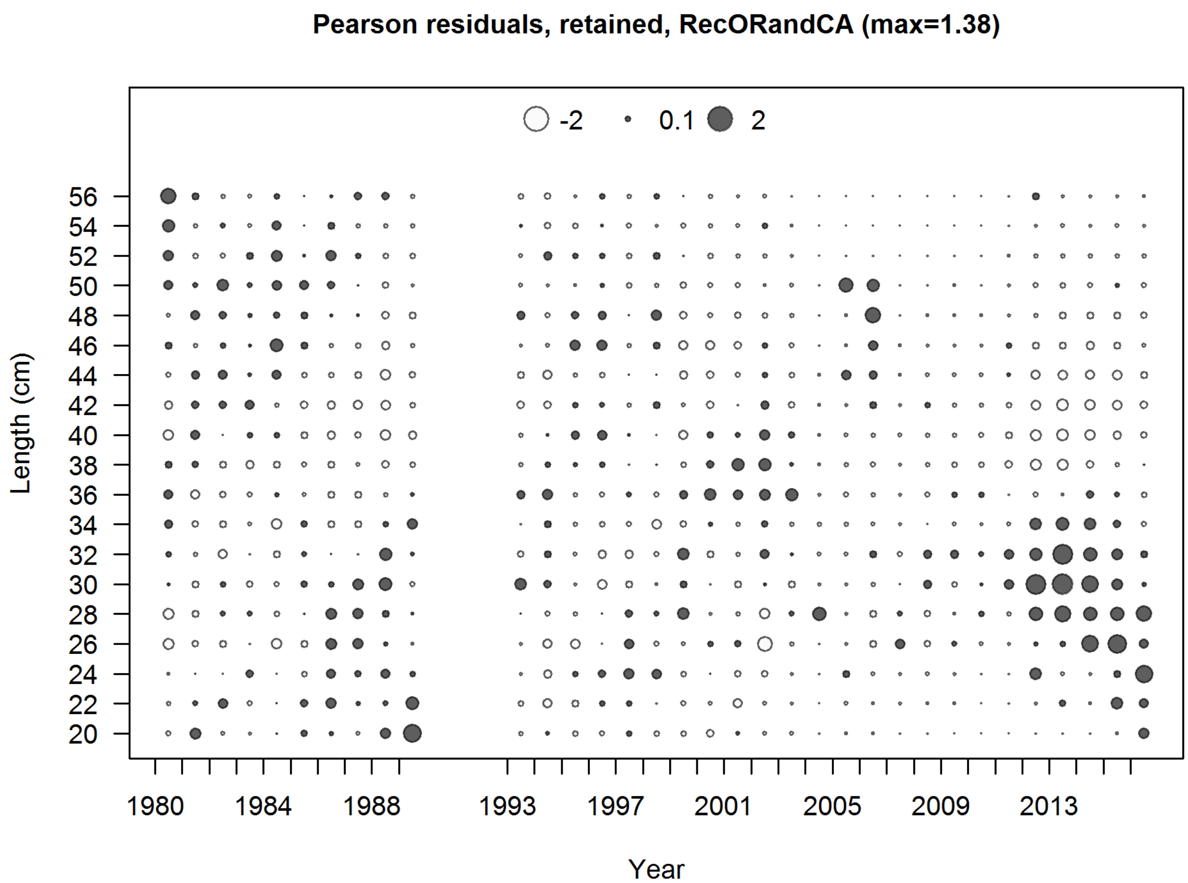

Figure 16: Pearson residuals, retained, RecORandCA (max=1.38)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_15_comp_lenfit_residsflt3mkt2

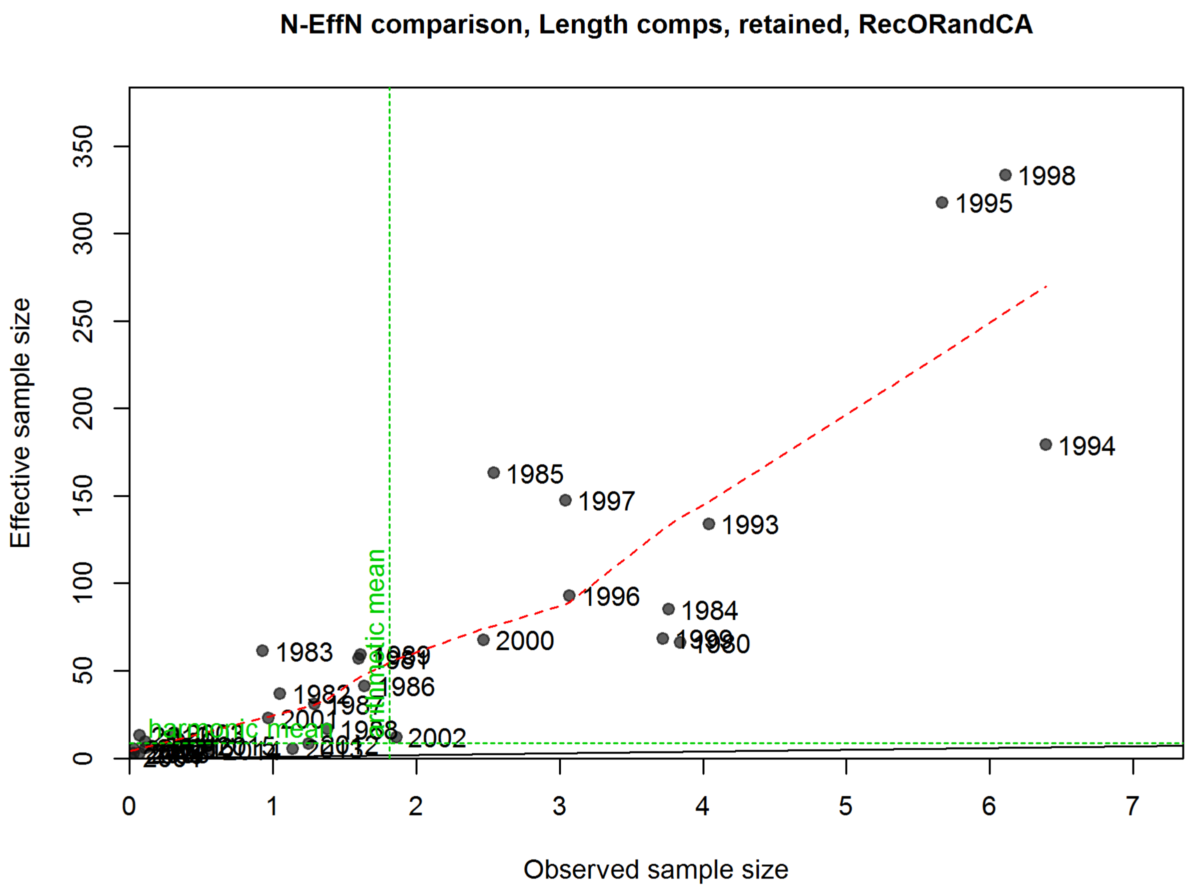

Figure 17: N_EffN comparison, Length comps, retained, RecORandCA fig:mod1_16_comp_lenf:

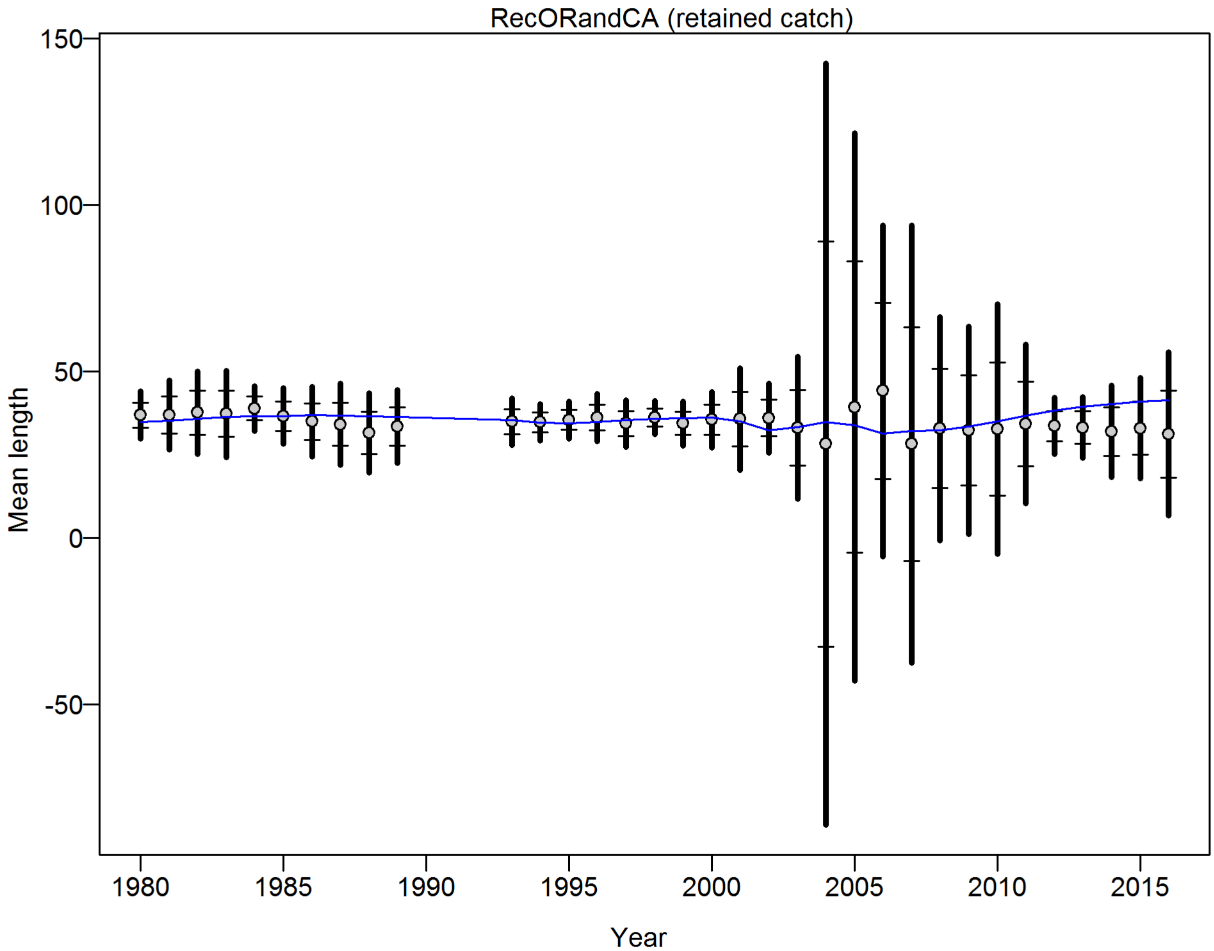

Figure 18: Francis data weighting method TA1.8: RecORandCA Suggested sample size adjustment (with 95% interval) for len data from RecORandCA: 3.5189 (2.5001_6.2626) For more info, see Francis, R.I.C.C. (2011). Data weighting in statistical fisheries stock assessment models. Can. J. Fish. Aquat. Sci. 68: 1124_1138. fig:mod1_17_comp_lenfit_data_weighting_TA1.8_RecO

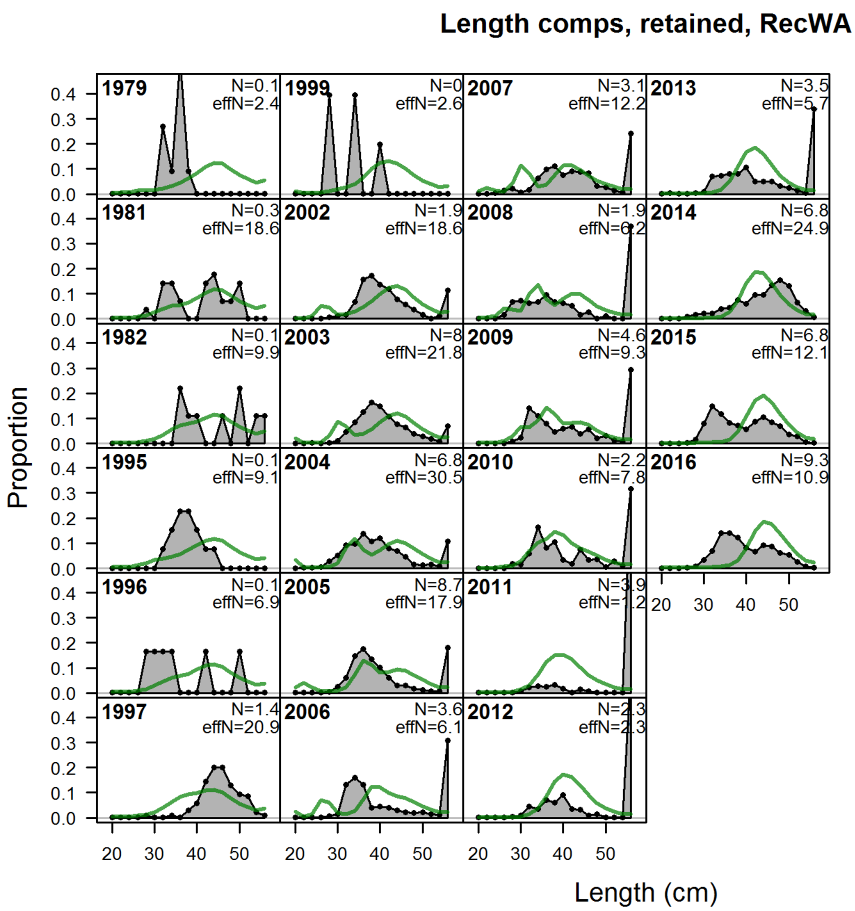

Figure 19: Length comps, retained, RecWA fig:mod1_18_comp_lenfit_flt4mkt2

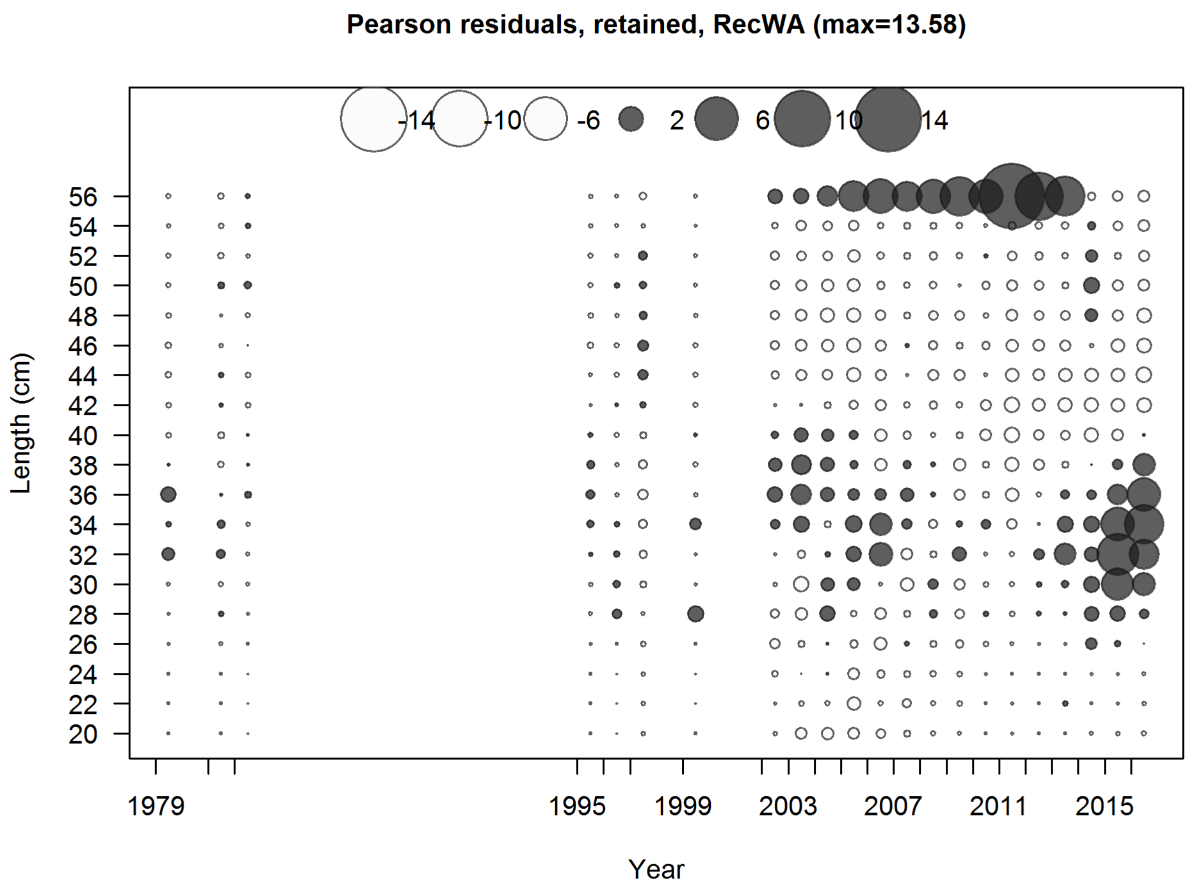

Figure 20: Pearson residuals, retained, RecWA (max=13.58)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_19_comp_lenfit_residsflt4mkt2

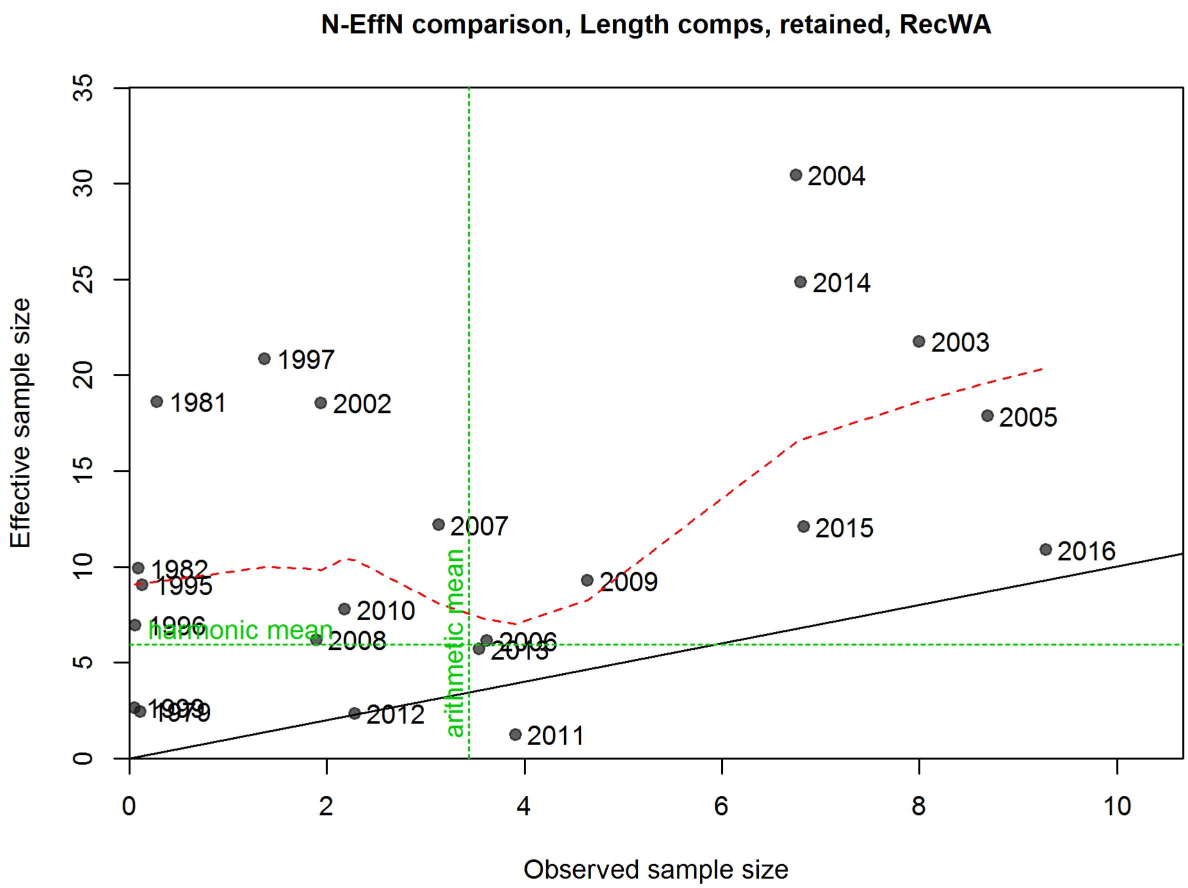

Figure 21: N_EffN comparison, Length comps, retained, RecWA [fig:mod1_20_comp_lenfit_s

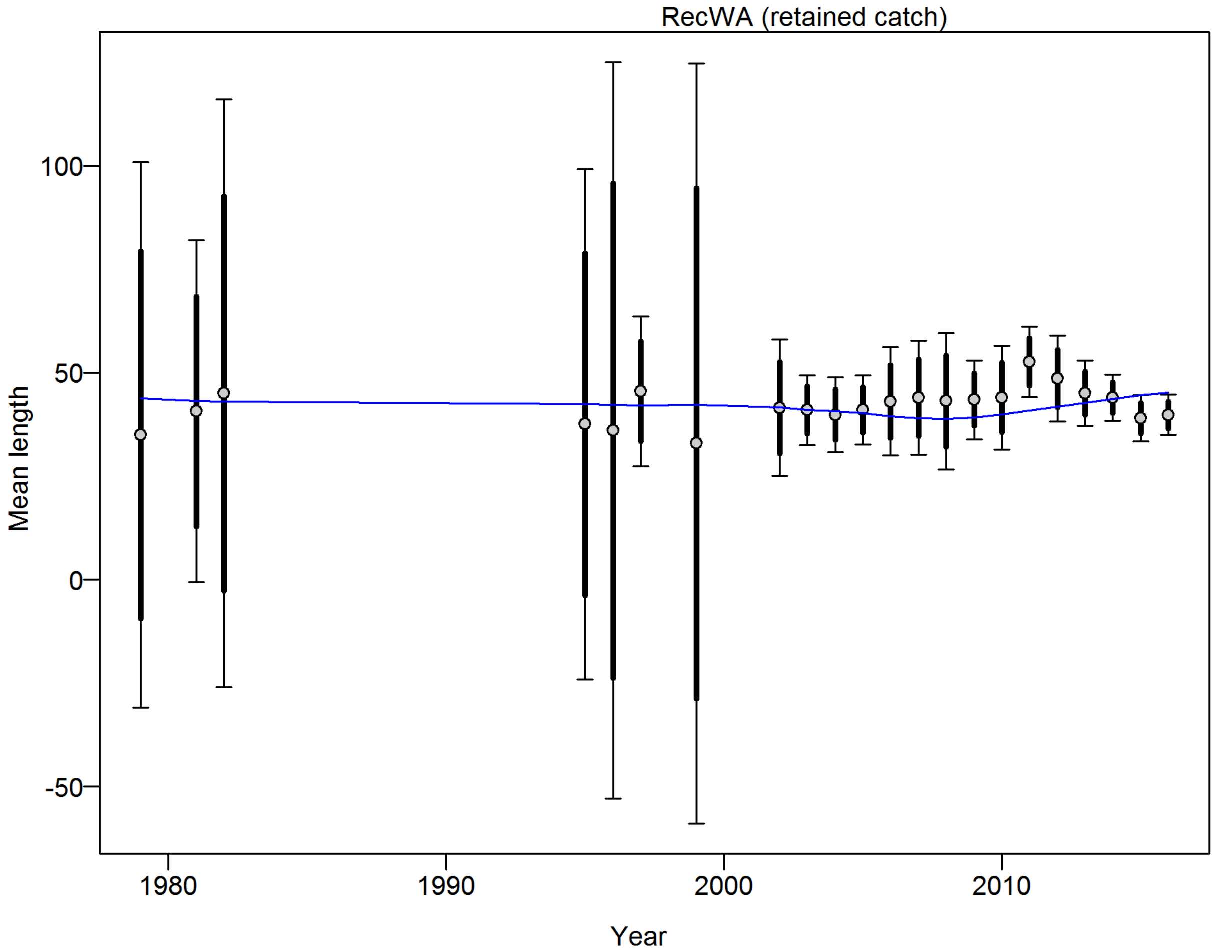

Figure 22: Francis data weighting method TA1.8: RecWA Suggested sample size adjustment (with 95% interval) for len data from RecWA: 0.4521 (0.25_2.3885) For more info, see Francis, R.I.C.C. (2011). Data weighting in statistical fisheries stock assessment models. Can. J. Fish. Aquat. Sci. 68: 1124_1138. fig:mod1_21_comp_lenfit_data_weighting_TA1.8_RecWA

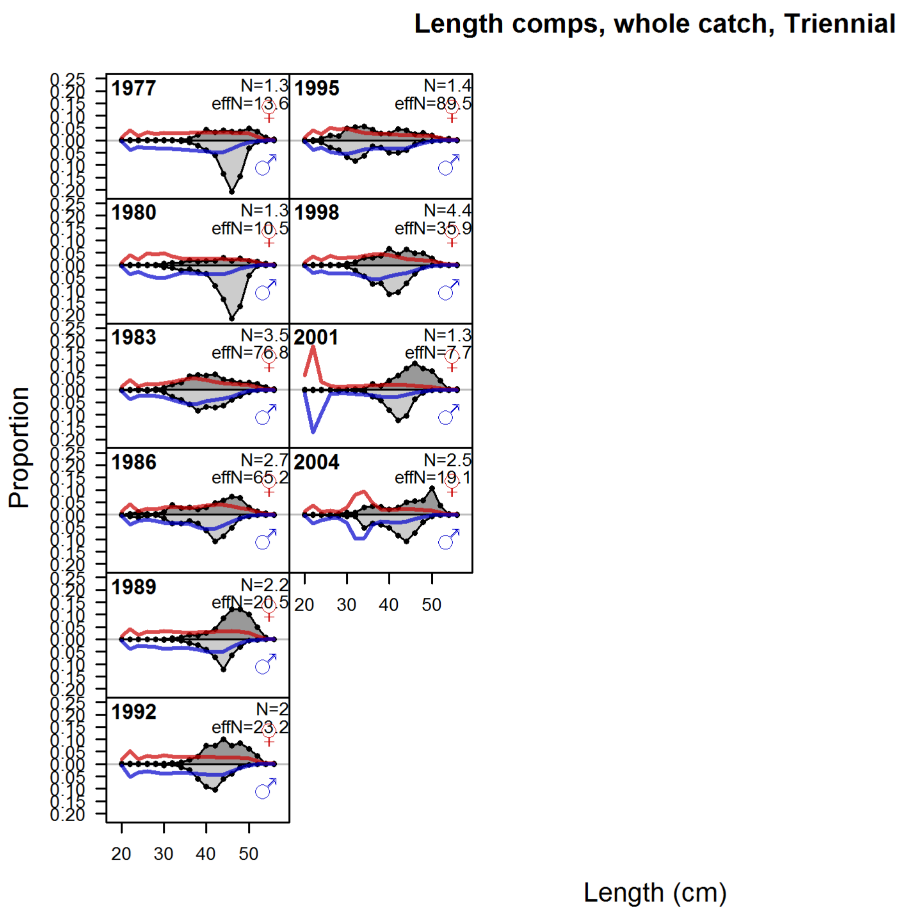

Figure 23: Length comps, whole catch, Triennial fig:mod1_22_comp_lenfit_flt5mkt0

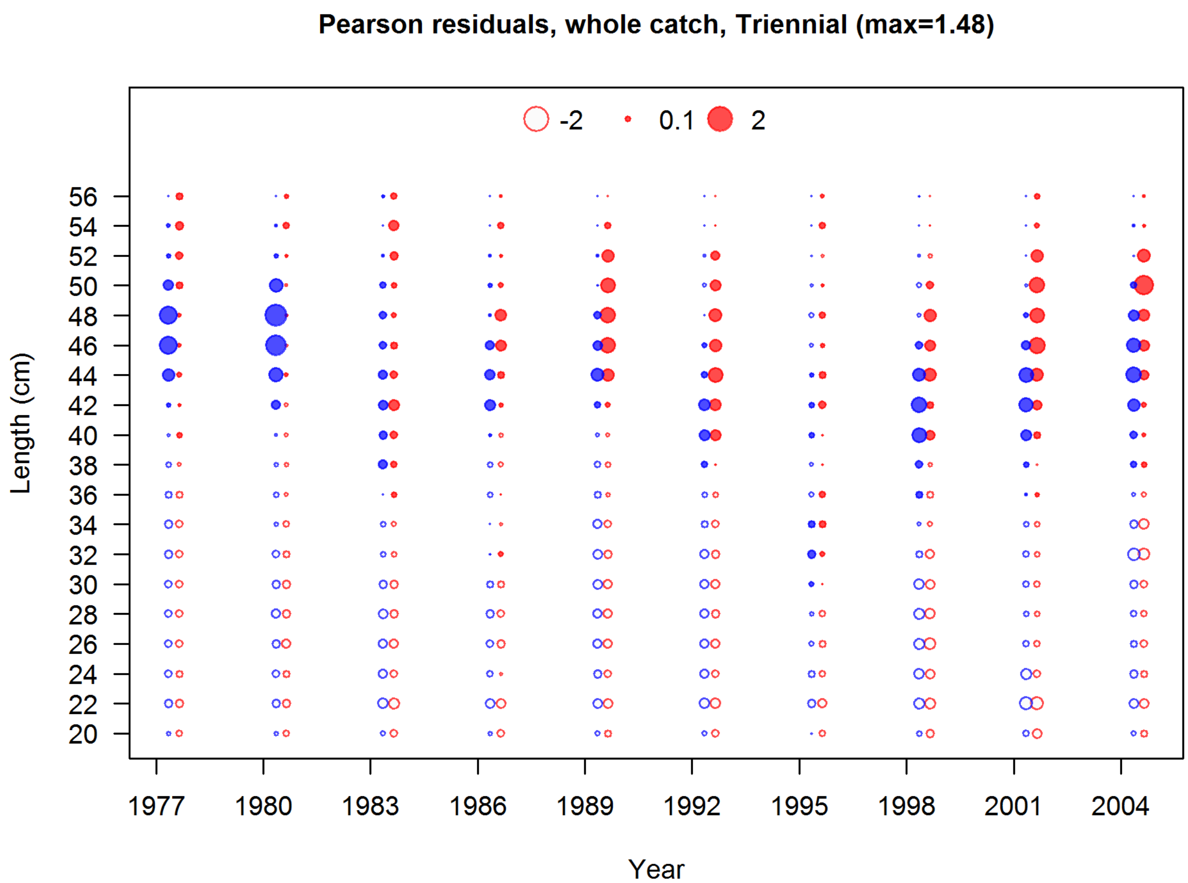

Figure 24: Pearson residuals, whole catch, Triennial (max=1.48)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_23_comp_lenfit_residsflt5mkt0

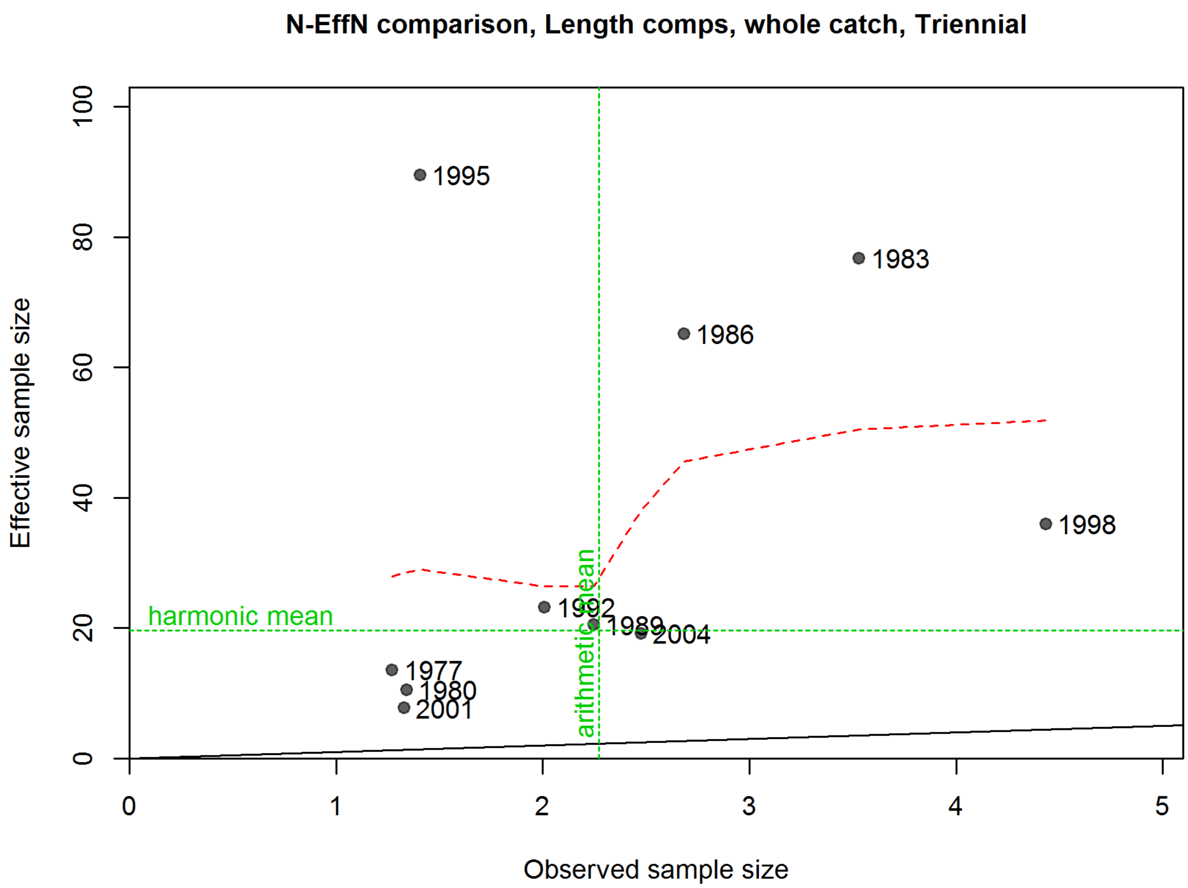

Figure 25: N_EffN comparison, Length comps, whole catch, Triennial fig:mod1_24_comp_lenfi

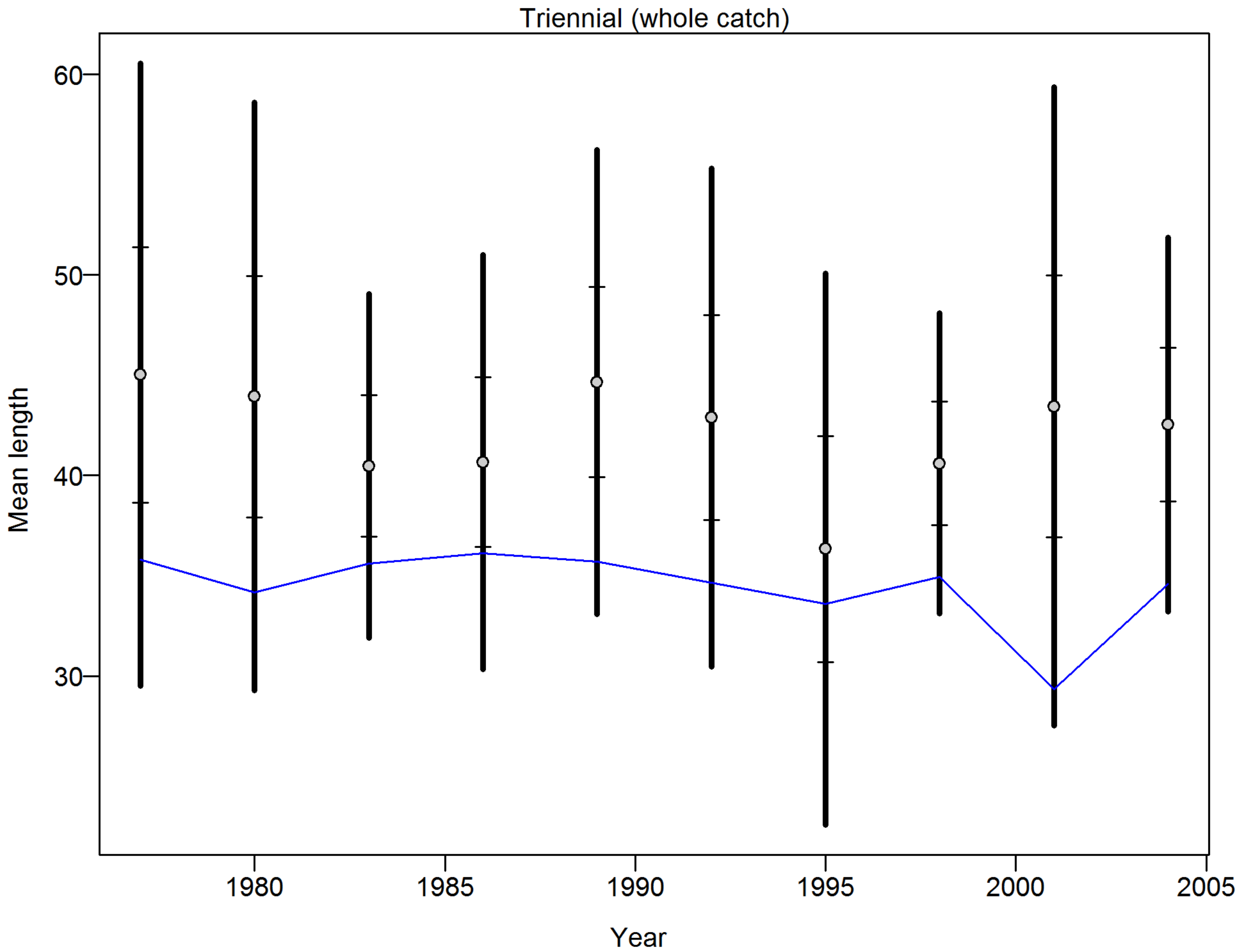

Figure 26: Francis data weighting method TA1.8: Triennial Suggested sample size adjustment (with 95% interval) for len data from Triennial: 5.9358 (3.3554_26.8895) For more info, see Francis, R.I.C.C. (2011). Data weighting in statistical fisheries stock assessment models. Can. J. Fish. Aquat. Sci. 68: 1124_1138. fig:mod1_25_comp_lenfit_data_weighting_TA1.8_Triennial

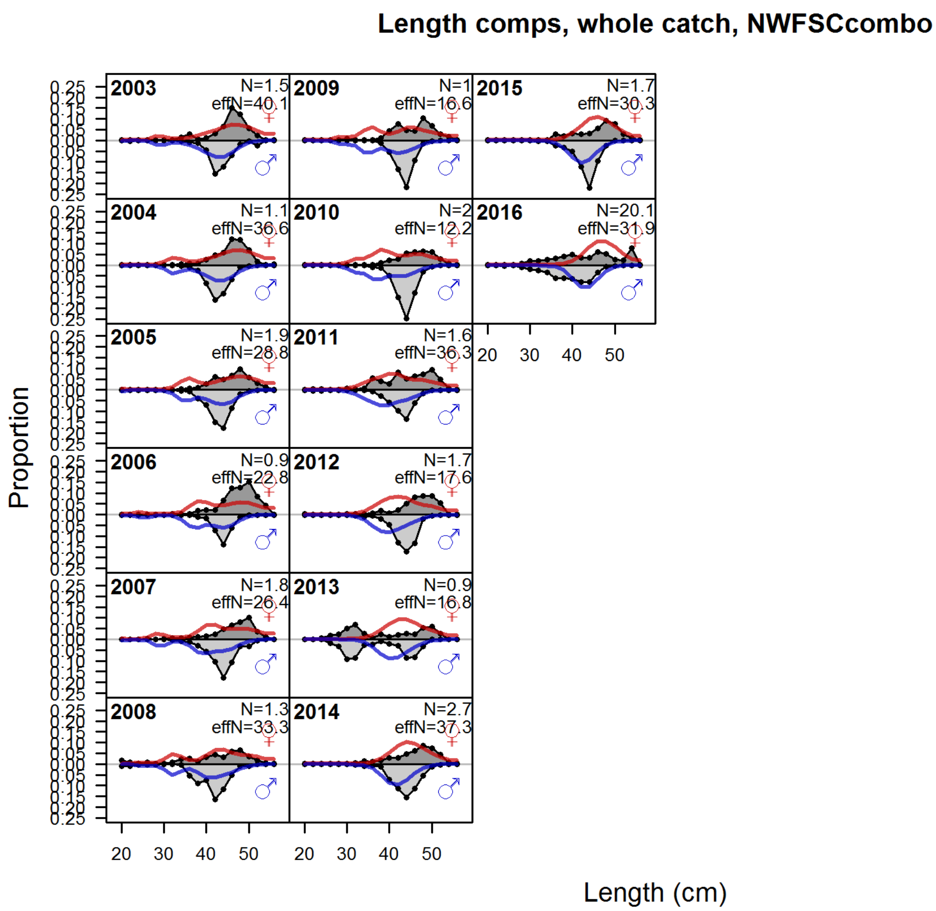

Figure 27: Length comps, whole catch, NWFSCcombo fig:mod1_26_comp_lenfit_flt6m

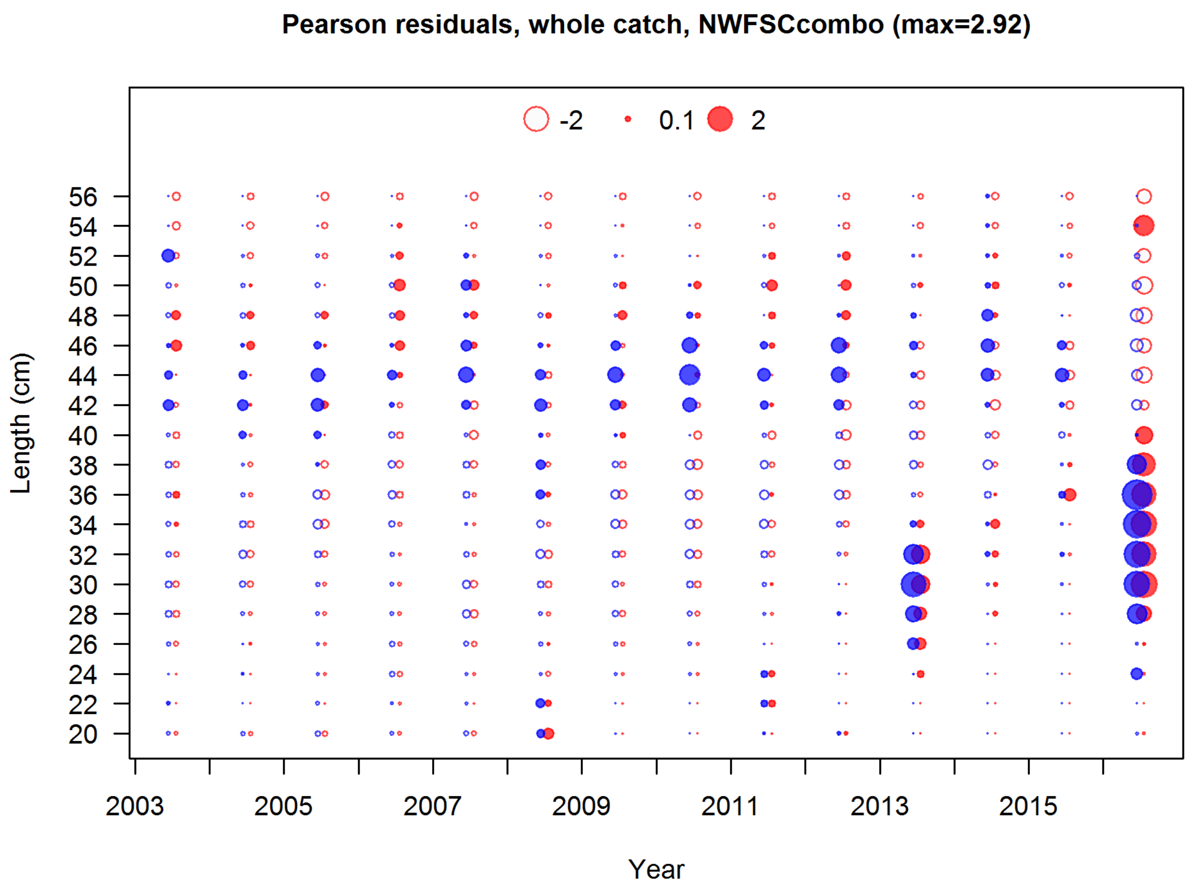

Figure 28: Pearson residuals, whole catch, NWFSCcombo (max=2.92)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_27_comp_lenfit_residsflt6mkt0

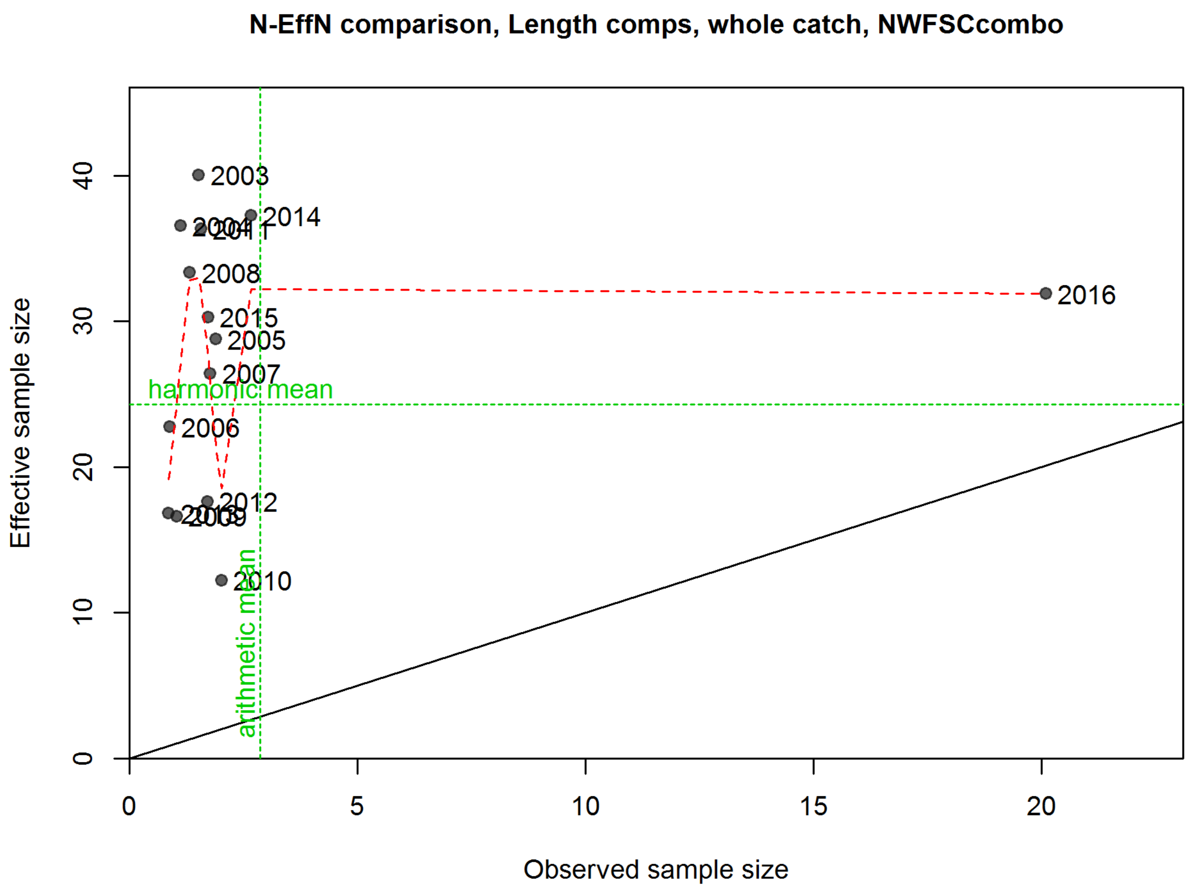

Figure 29: N_EffN comparison, Length comps, whole catch, NWFSCcombo fig:mod1_28_comp_len

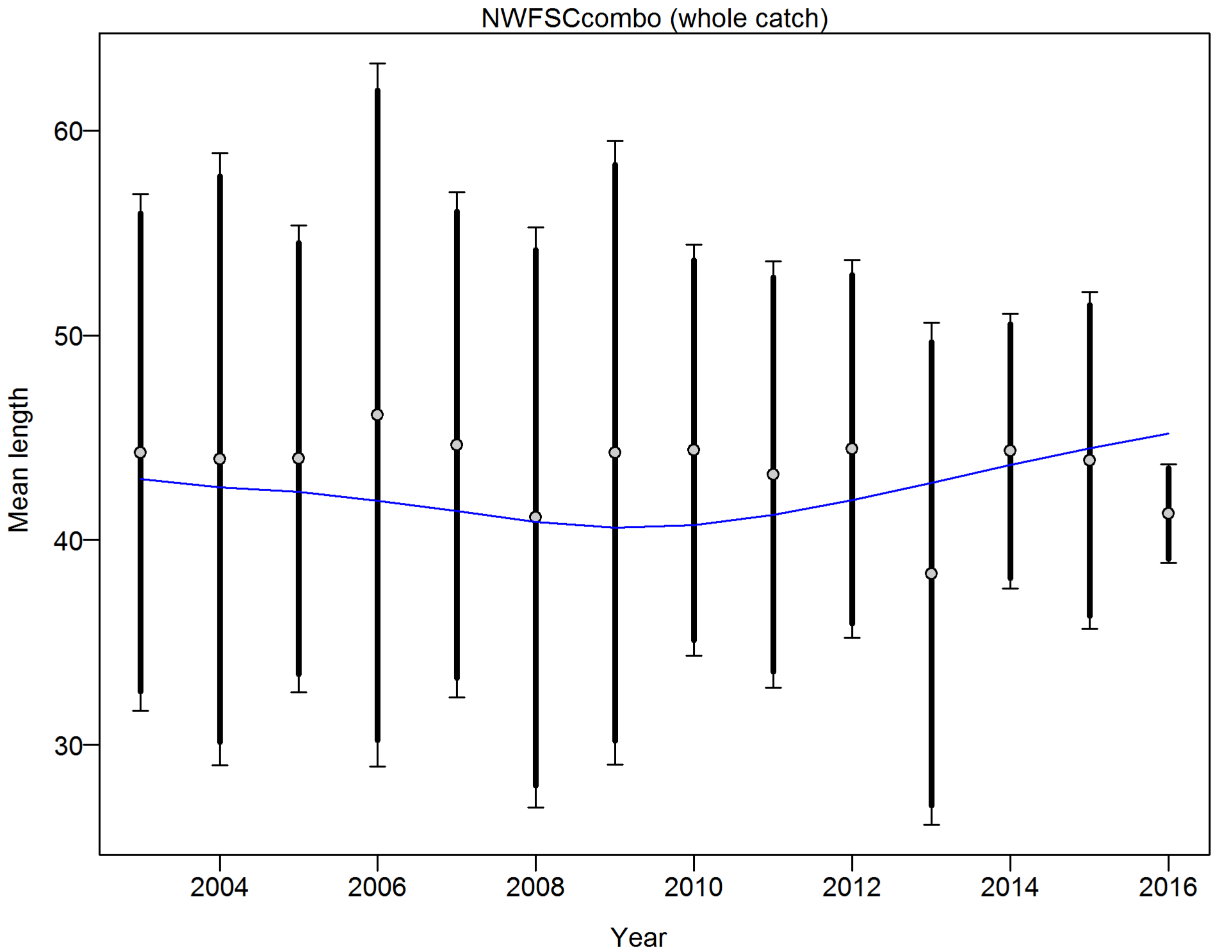

Figure 30: Francis data weighting method TA1.8: NWFSCcombo Suggested sample size adjustment (with 95% interval) for len data from NWFSCcombo: 0.8537 (0.3546_21.6187) For more info, see Francis, R.I.C.C. (2011). Data weighting in statistical fisheries stock assessment models. Can. J. Fish. Aquat. Sci. 68: 1124_1138. fig:mod1_29_comp_lenfit_data_weighting_

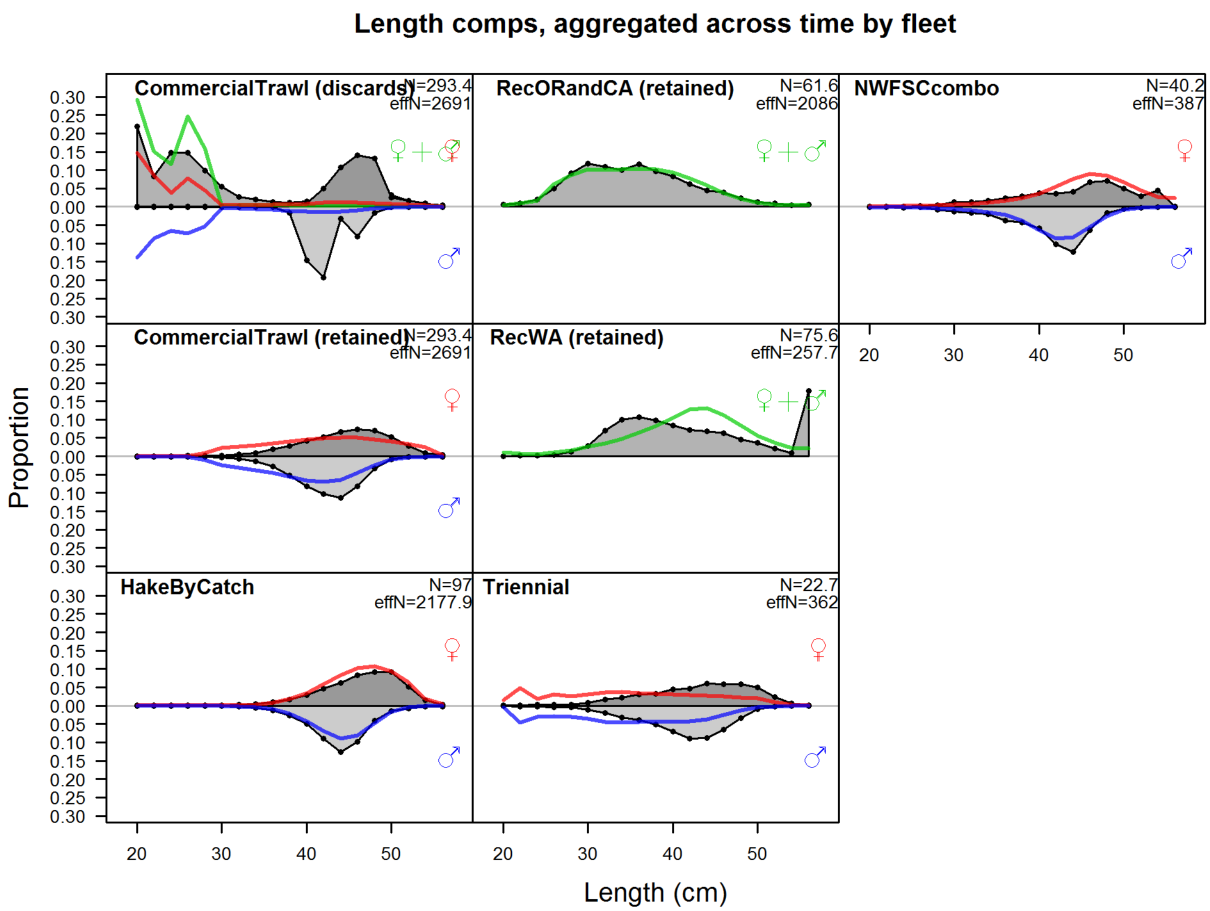

Figure 31: Length comps, aggregated across time by fleet. Labels 'retained' and 'discard' indicate discarded or retained sampled for each fleet. Panels without this designation represent the whole catch. fig:mod1_30_comp_lenfit__aggregated_across_time

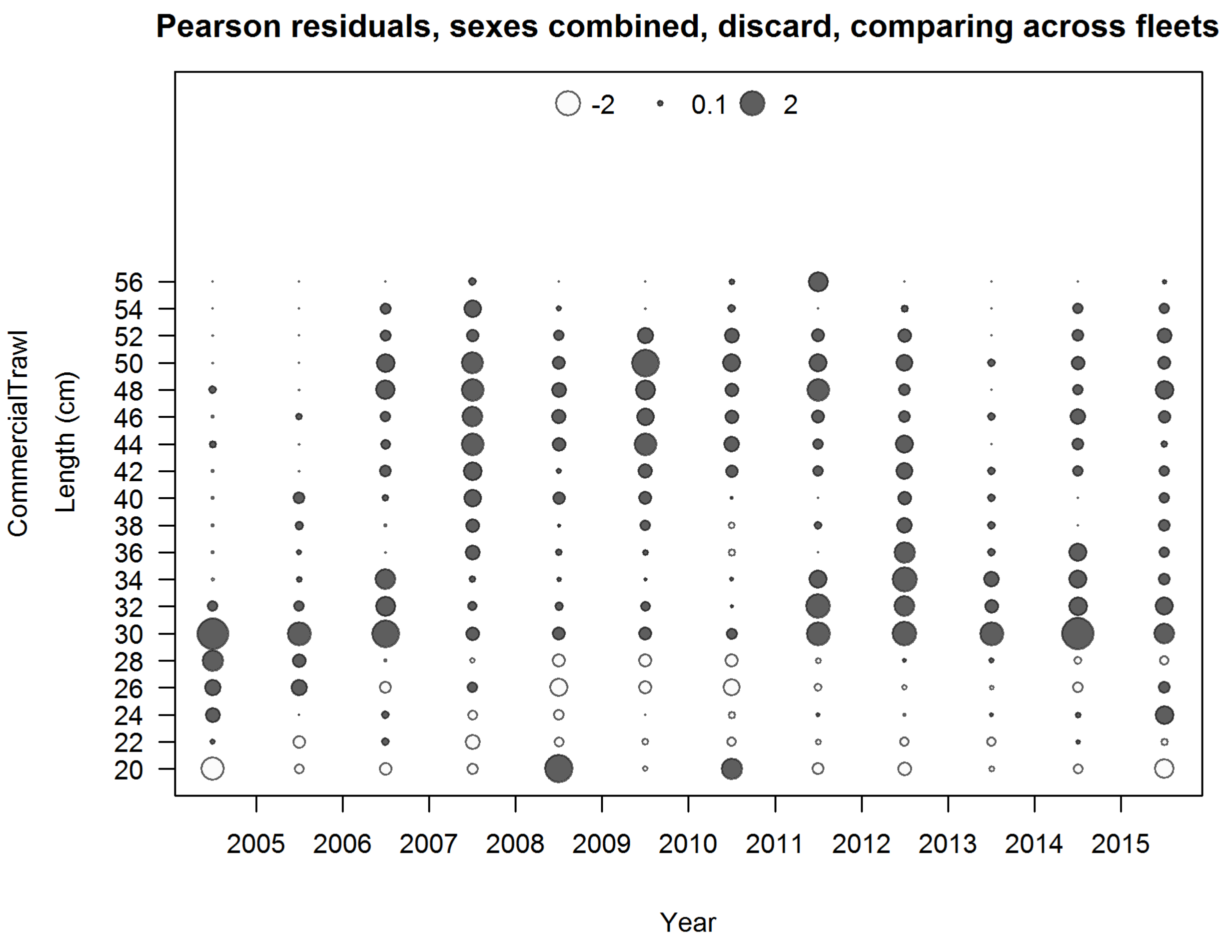

Figure 32: Note: this plot doesn't seem to be working right for some models. Pearson residuals, sexes combined, discard, comparing across fleets
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_31_comp_lenfit_sex1mkt1_multi-fleet_comparison

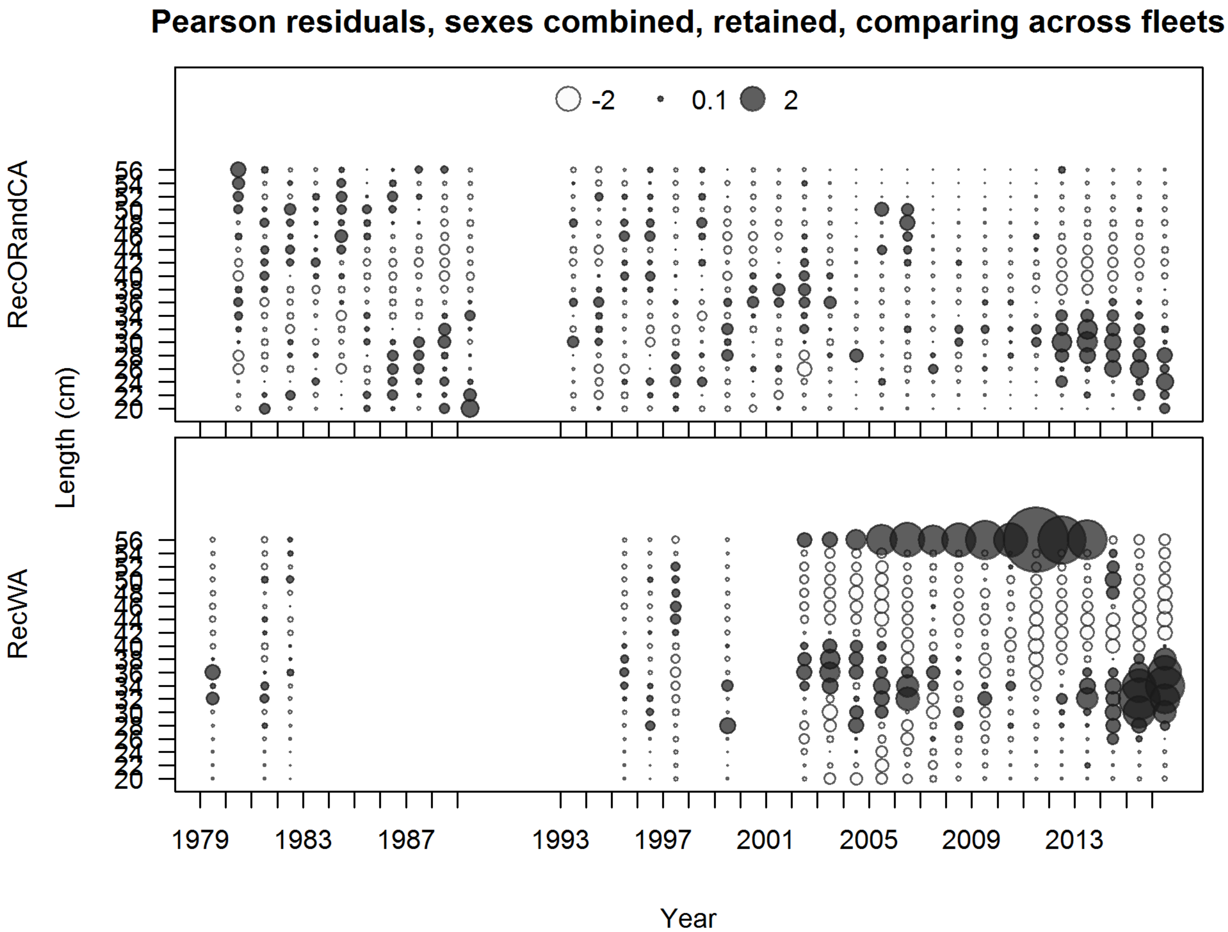

Figure 33: Note: this plot doesn't seem to be working right for some models. Pearson residuals, sexes combined, retained, comparing across fleets
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_32_comp_lenfit_sex1mkt2_multi-fleet_comparison

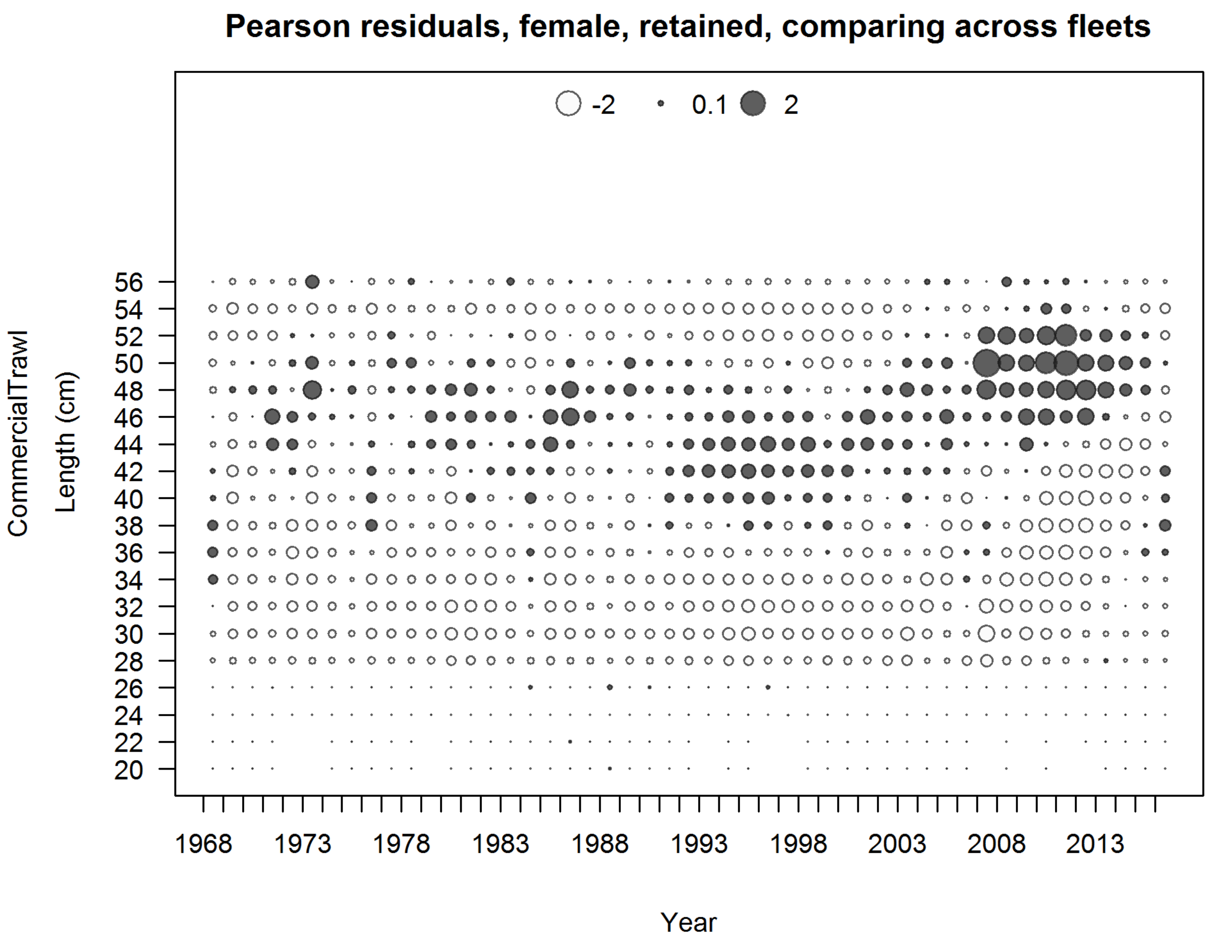

Figure 34: Note: this plot doesn't seem to be working right for some models. Pearson residuals, female, retained, comparing across fleets
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_33_comp_lenfit_sex2mkt2_multi-fleet_comparison

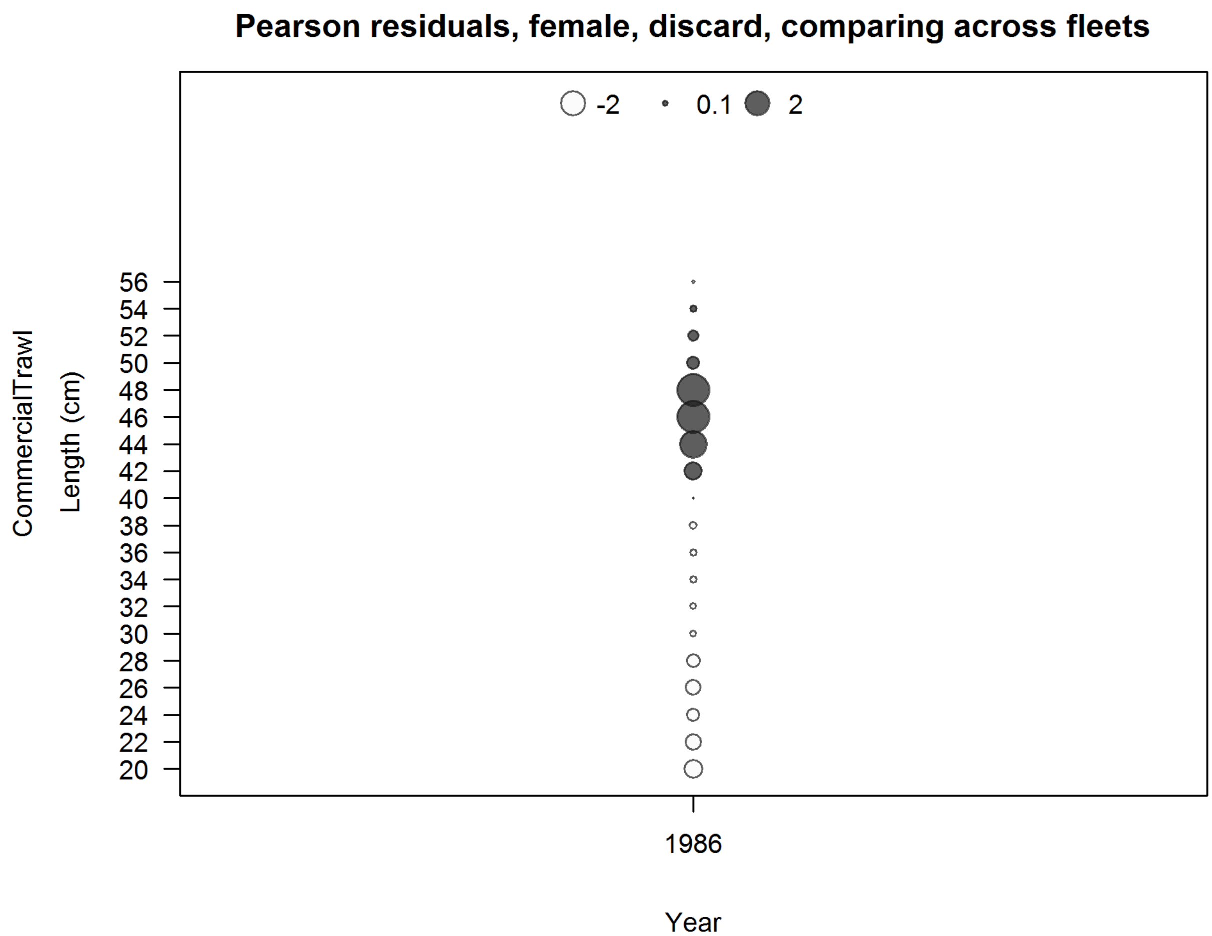

Figure 35: Note: this plot doesn't seem to be working right for some models. Pearson residuals, female, discard, comparing across fleets
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_34_comp_lenfit_sex2mkt1_multi-fleet_comparison

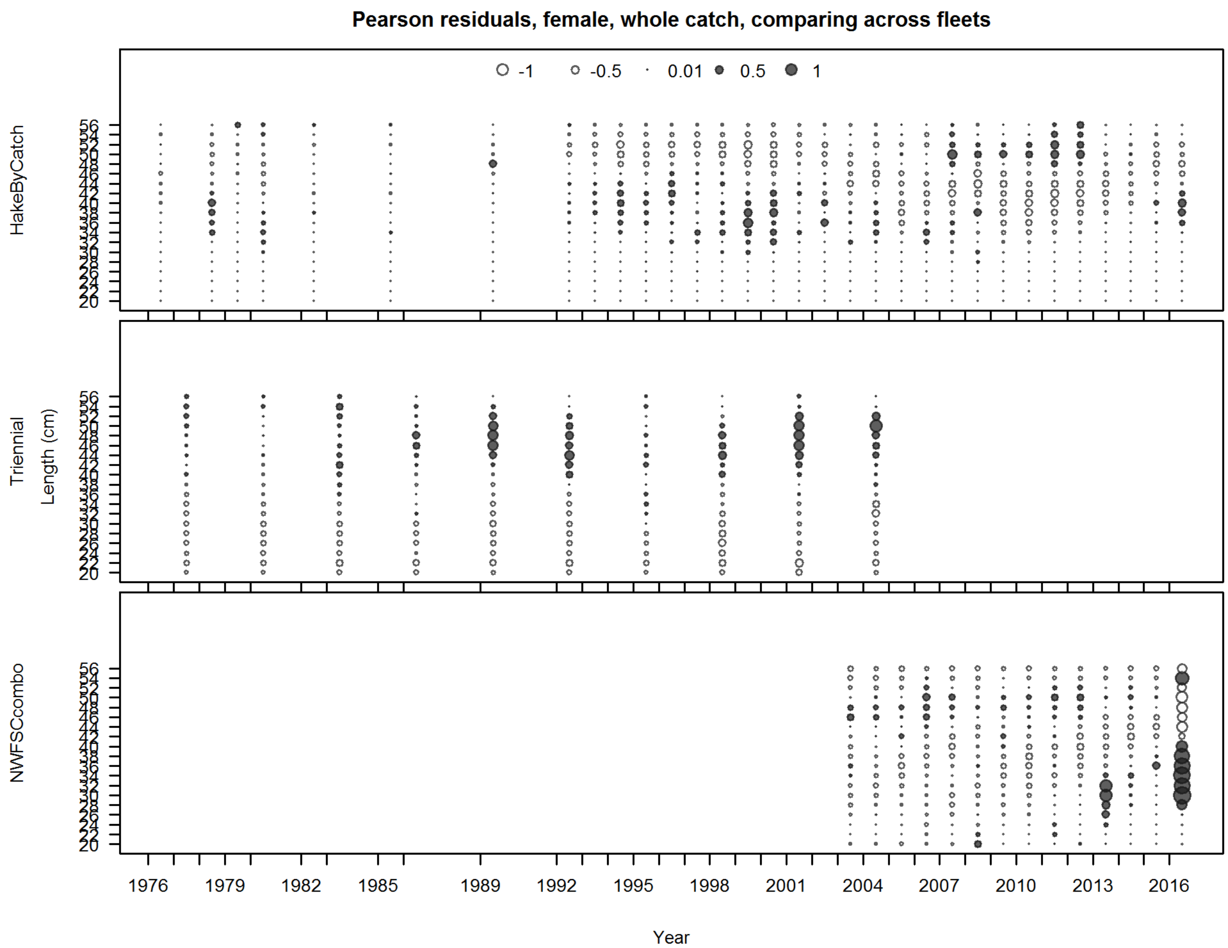

Figure 36: Note: this plot doesn't seem to be working right for some models. Pearson residuals, female, whole catch, comparing across fleets
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_35_comp_lenfit_sex2mkt0_multi-fleet_comparison

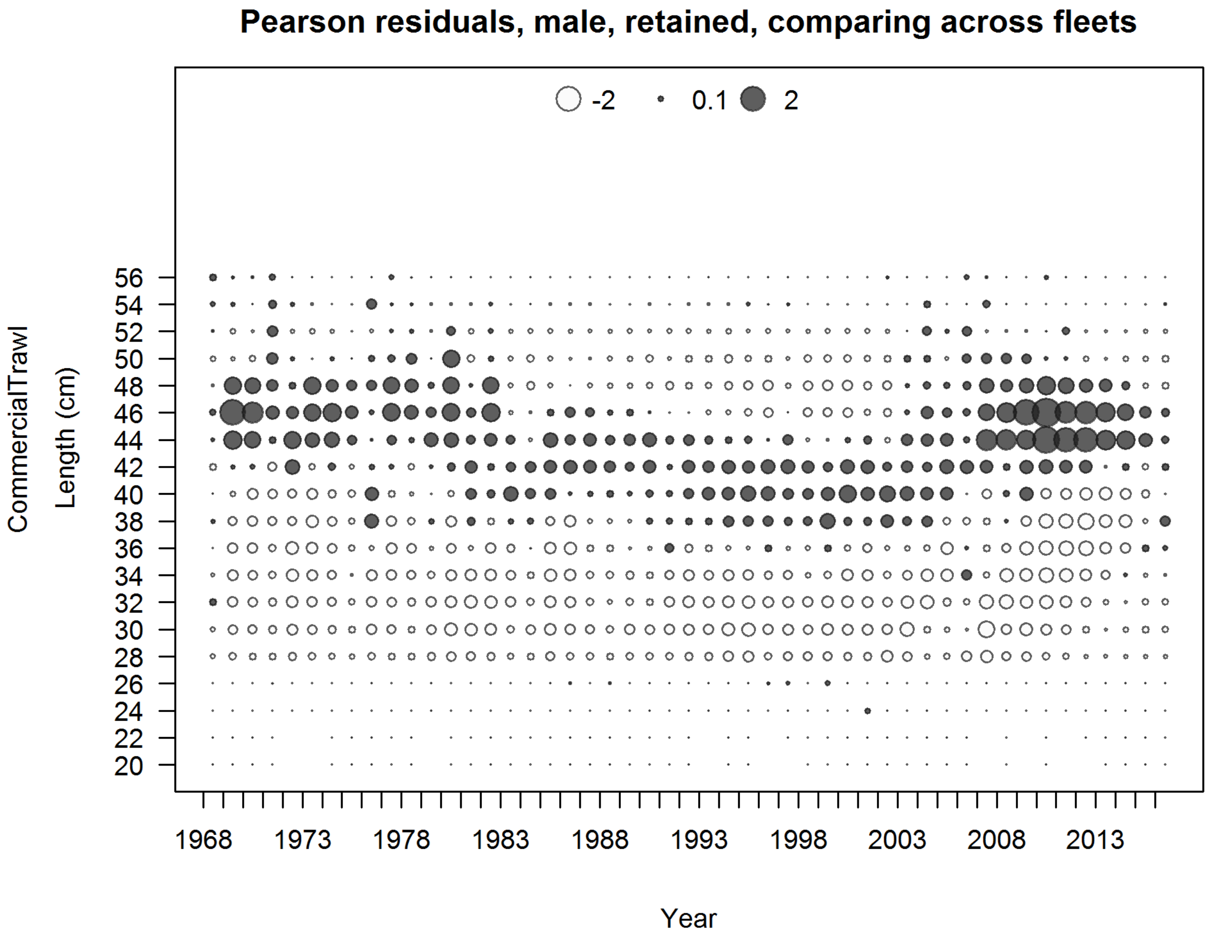

Figure 37: Note: this plot doesn't seem to be working right for some models. Pearson residuals, male, retained, comparing across fleets
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). `fig:mod1_36_comp_lenfit_sex3mkt2_multi-fleet_comparison`

Figure 38: Note: this plot doesn't seem to be working right for some models. Pearson residuals, male, discard, comparing across fleets
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_37_comp_lenfit_sex3mkt1_multi-fleet_comparison

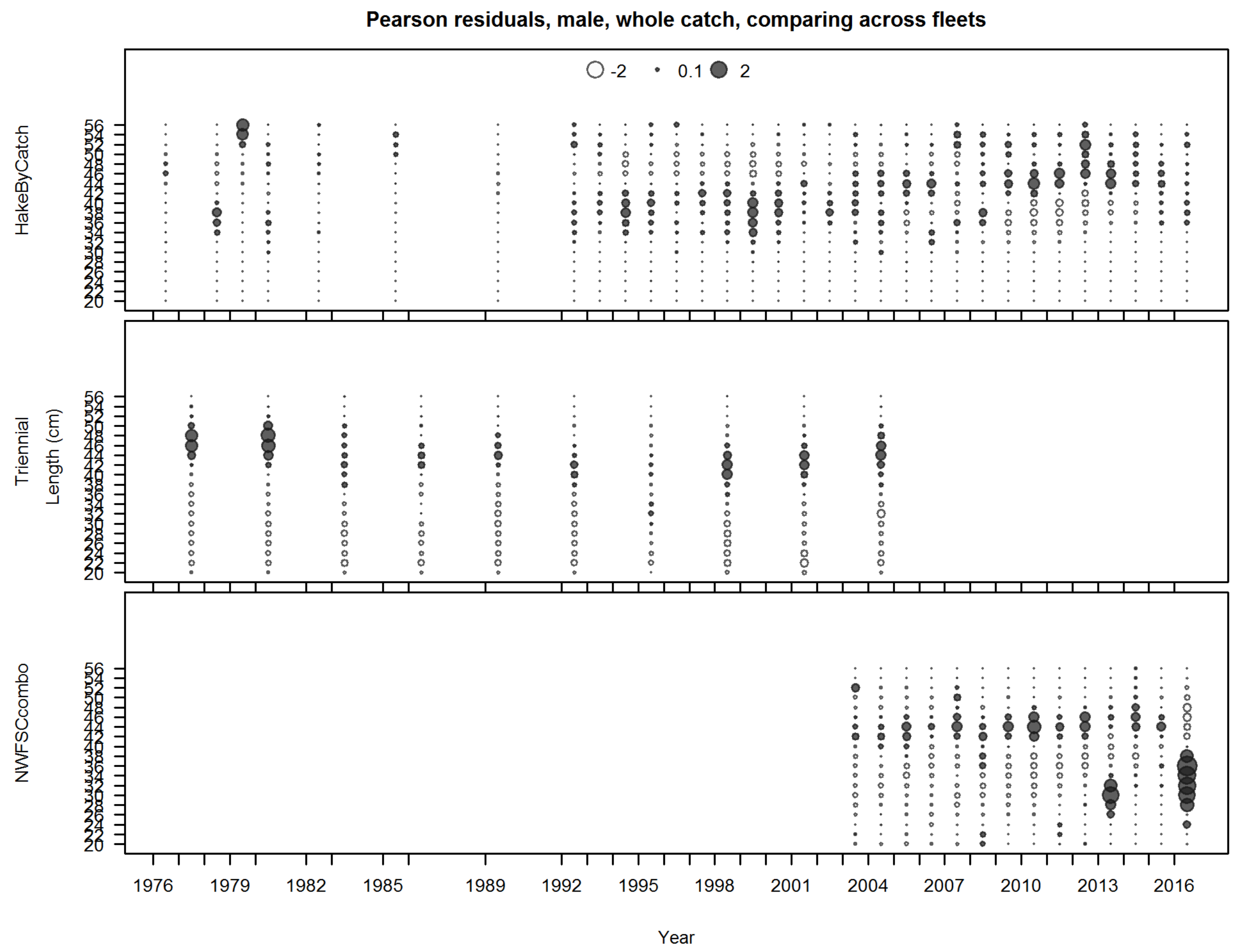

Figure 39: Note: this plot doesn't seem to be working right for some models. Pearson residuals, male, whole catch, comparing across fleets
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_38_comp_lenfit_sex3mkt0_multi-fleet_comparison

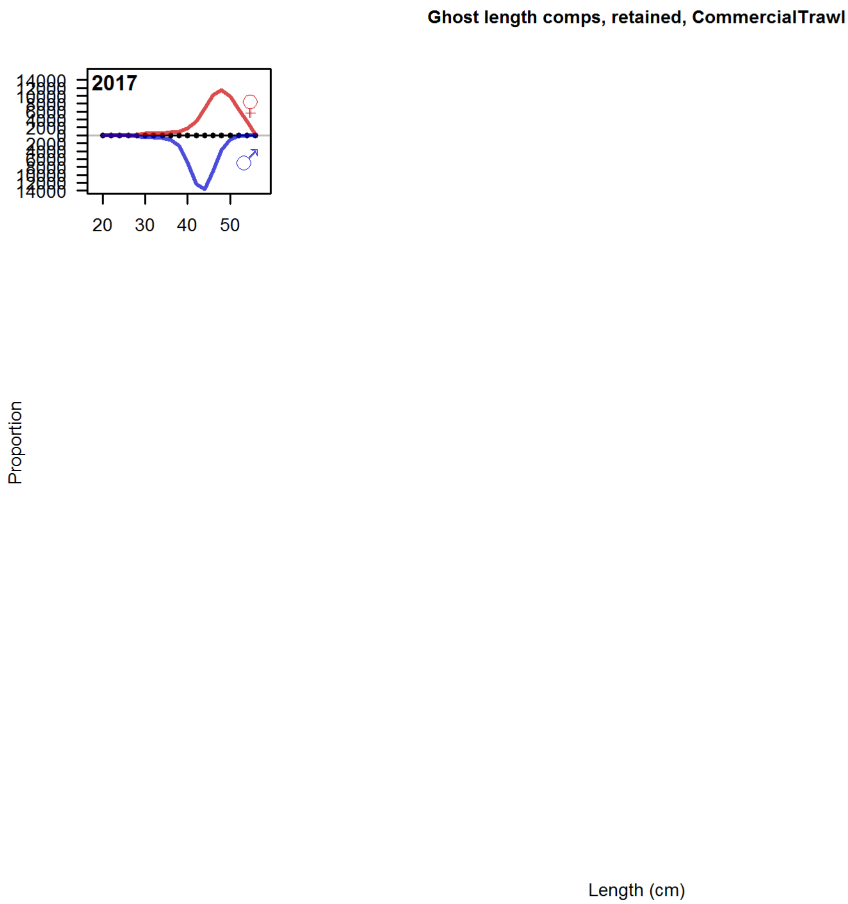

Figure 40: Ghost length comps, retained, CommercialTrawl fig:mod1_39_comp_gstlenfit_

Figure 41: Pearson residuals, retained, CommercialTrawl (max=NA)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). fig:mod1_40_comp_gstlenfit_residsflt1mkt2

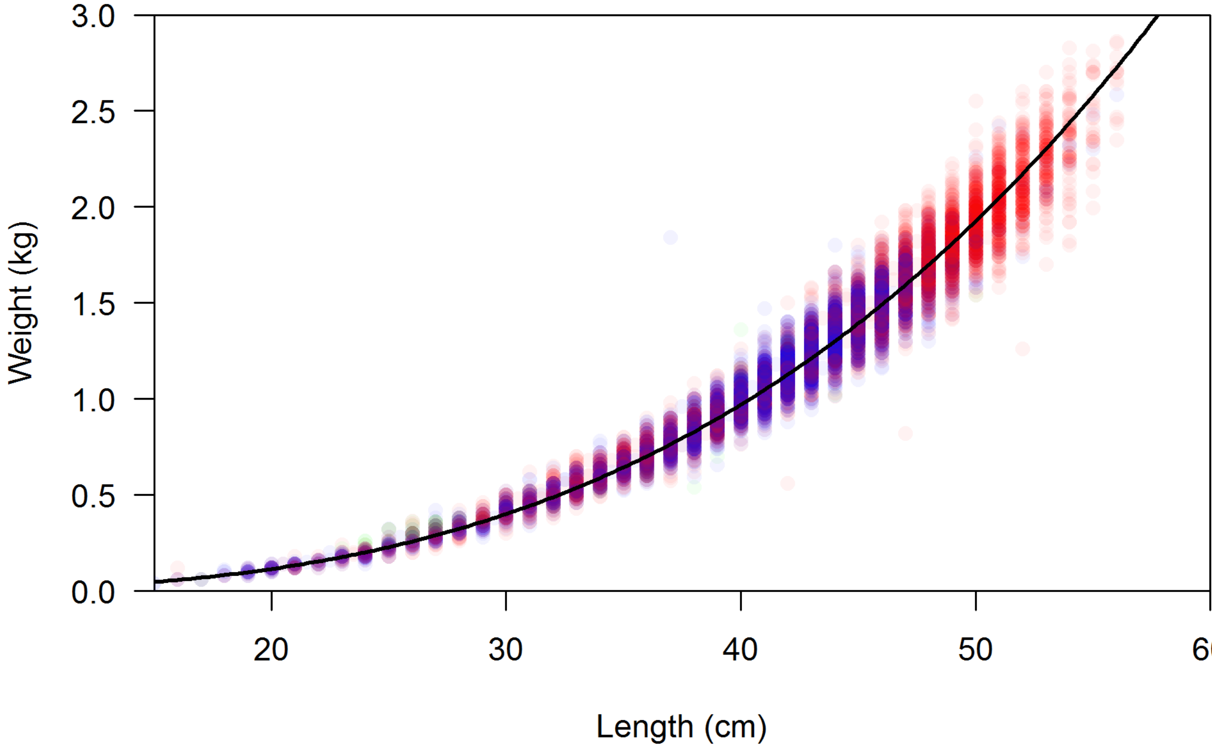

Figure 42: Estimated weight-length relationship for Yellowtail Rockfish used in both models. Colored points show observed values (red for females, blue for males, and green for unsexed). The black line indicates the estimated relationship $W = 0.000011843L^{3.0672}$. fig:weight-length

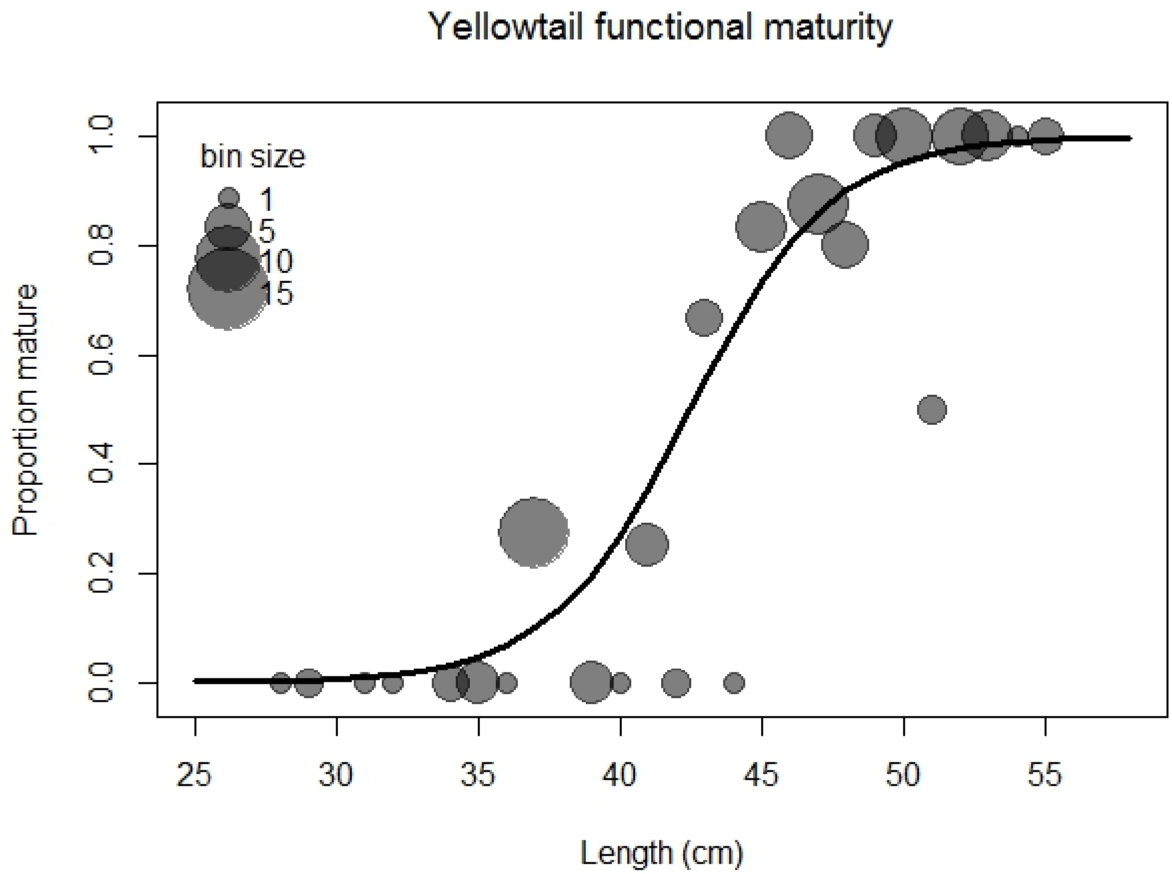

Figure 43: Estimated maturity relationship for Yellowtail Rockfish used in both models. Gray points indicate average observed functional maturity within each length bin with point size proportional to the number of samples. fig:maturity

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