Status of Lingcod (*Ophiodon elongatus*) Along the U.S. Pacific Coast in 2017

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Contents

Executive Summary

executive-summary

Stock

stock

Include: species/area, including an evaluation of any potential biological basis for regional management.

This assessment reports the status of the Lingcod (*Ophiodon elongatus*) resource in U.S. waters off the coast of the California, Oregon, and Washington using data through 2013. Etc. . .

Catches

catches

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

Catch figure(s) with fleets: (Figures a-c)
Catch table: (Table a)

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

tab:Exec_catch

Year	Landings 1	Landings 2	Landings 3	Landings 4	Landings 5	Total
2005	-	-	-	-	-	-
2006	-	-	-	-	-	-
2007	-	-	-	-	-	-
2008	-	-	-	-	-	-
2009	-	-	-	-	-	-
2010	-	-	-	-	-	-
2011	-	-	-	-	-	-
2012	-	-	-	-	-	-
2013	-	-	-	-	-	-
2014	-	-	-	-	-	-

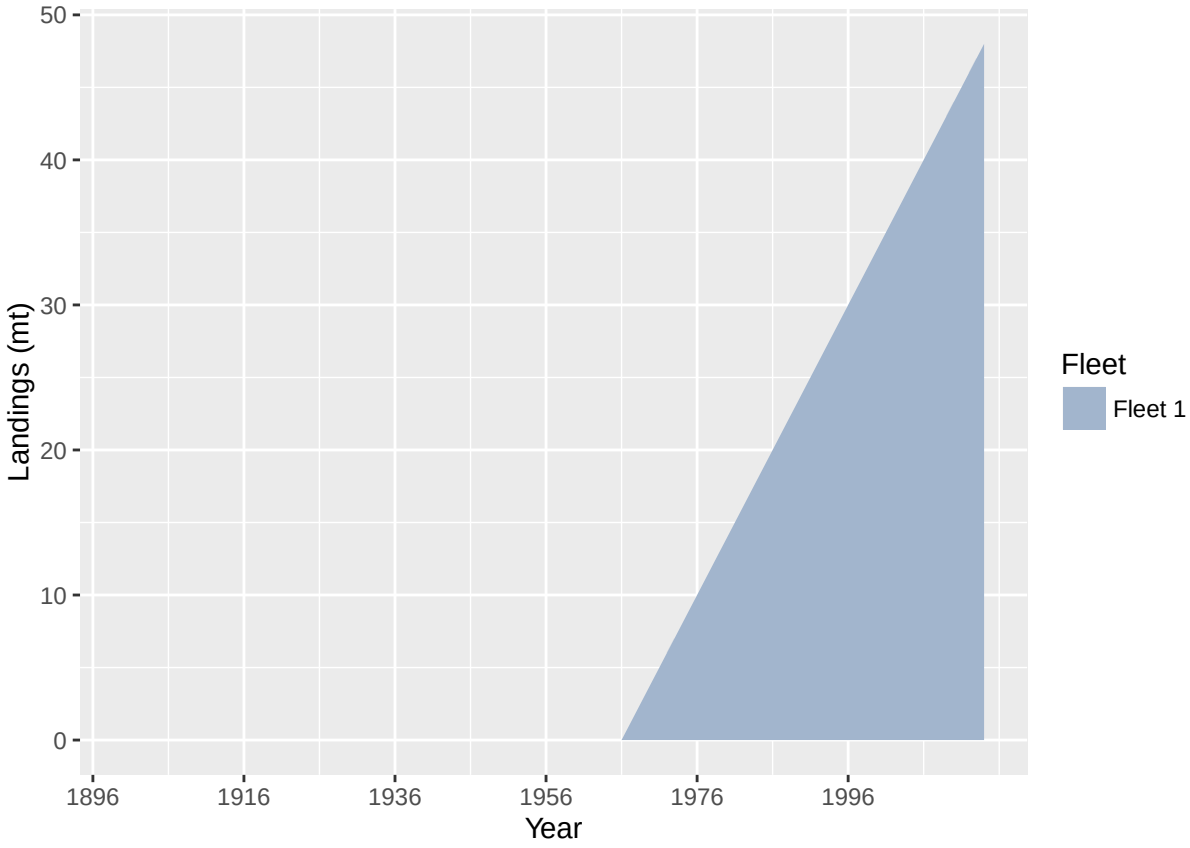

Figure a: Lingcod landings in ..... `fig:Exec_catch1`

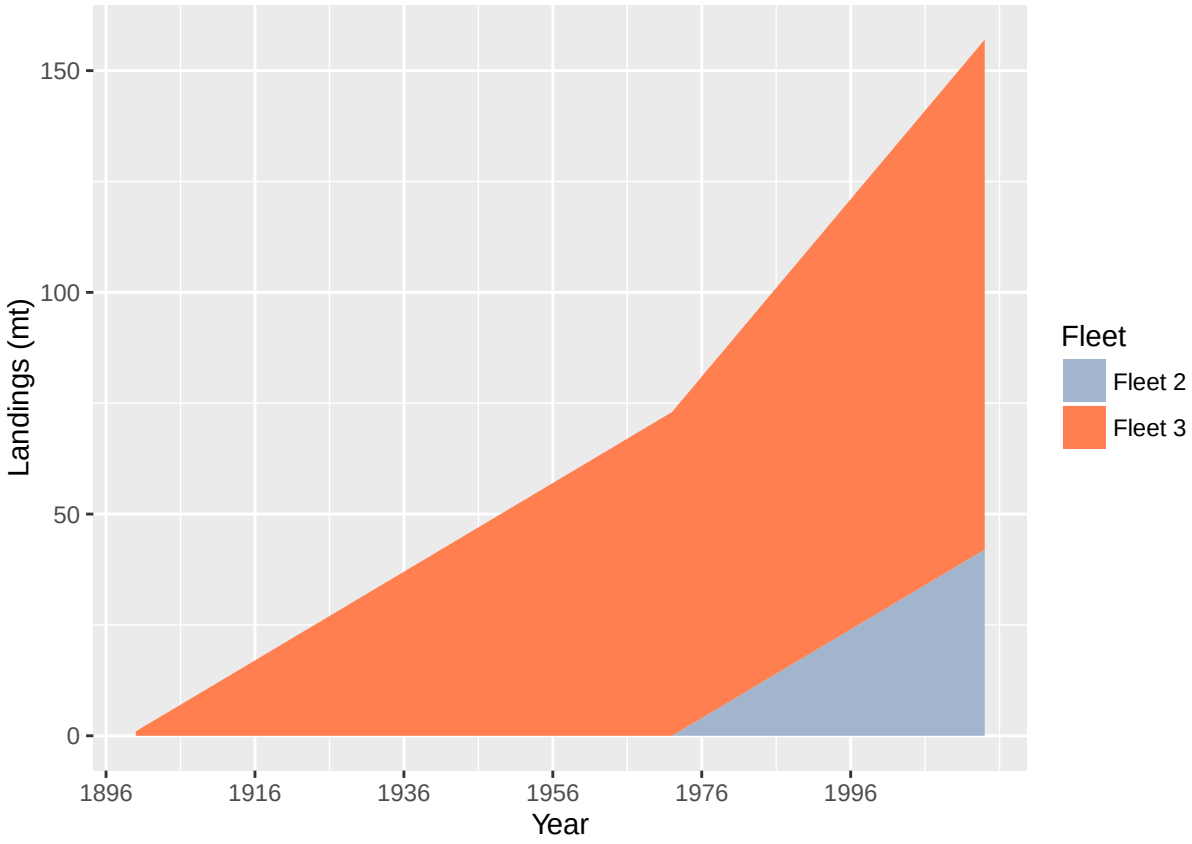

Figure b: Stacked line plot of Lingcod landings history for Oregon by fleet (recreational and commercial). 「fig:Exec_catch2

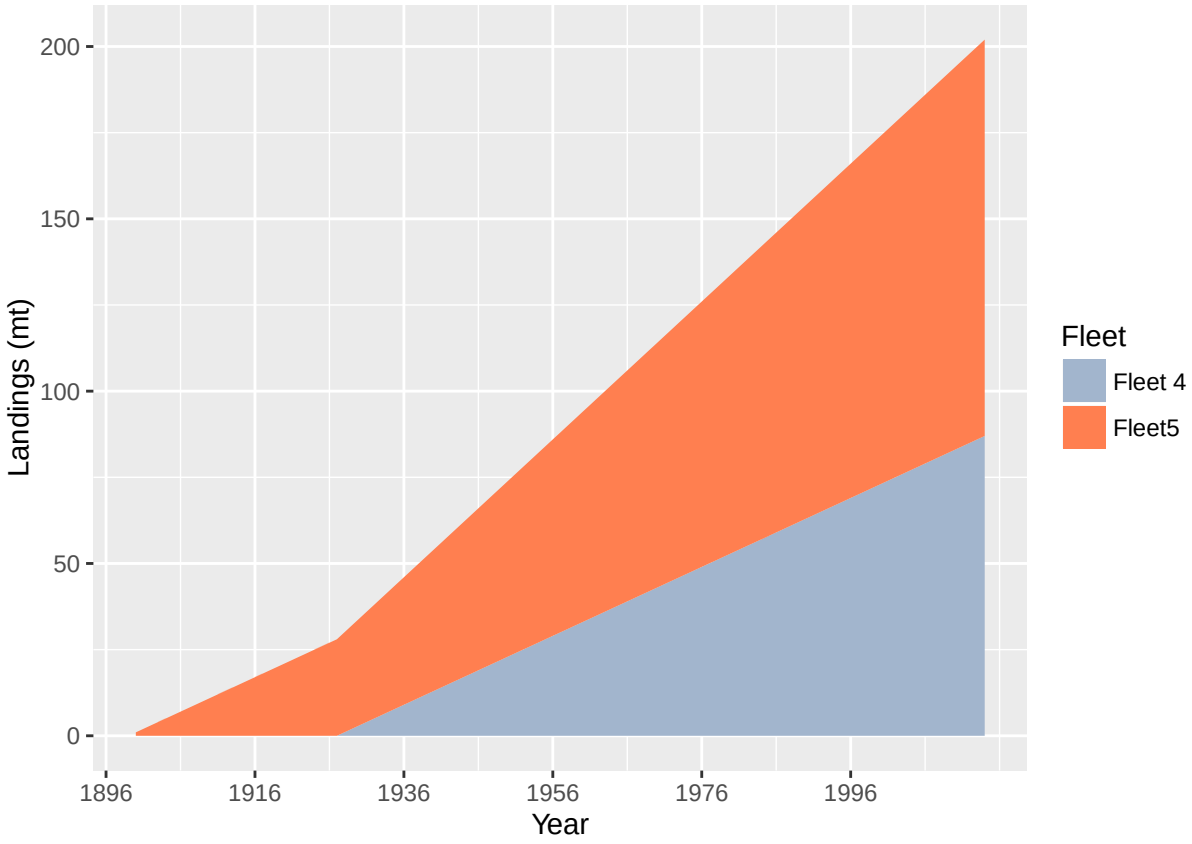

Figure c: Stacked line plot of Lingcod landings history for California by fleet (recreational and commercial). 「fig:Exec_catch3

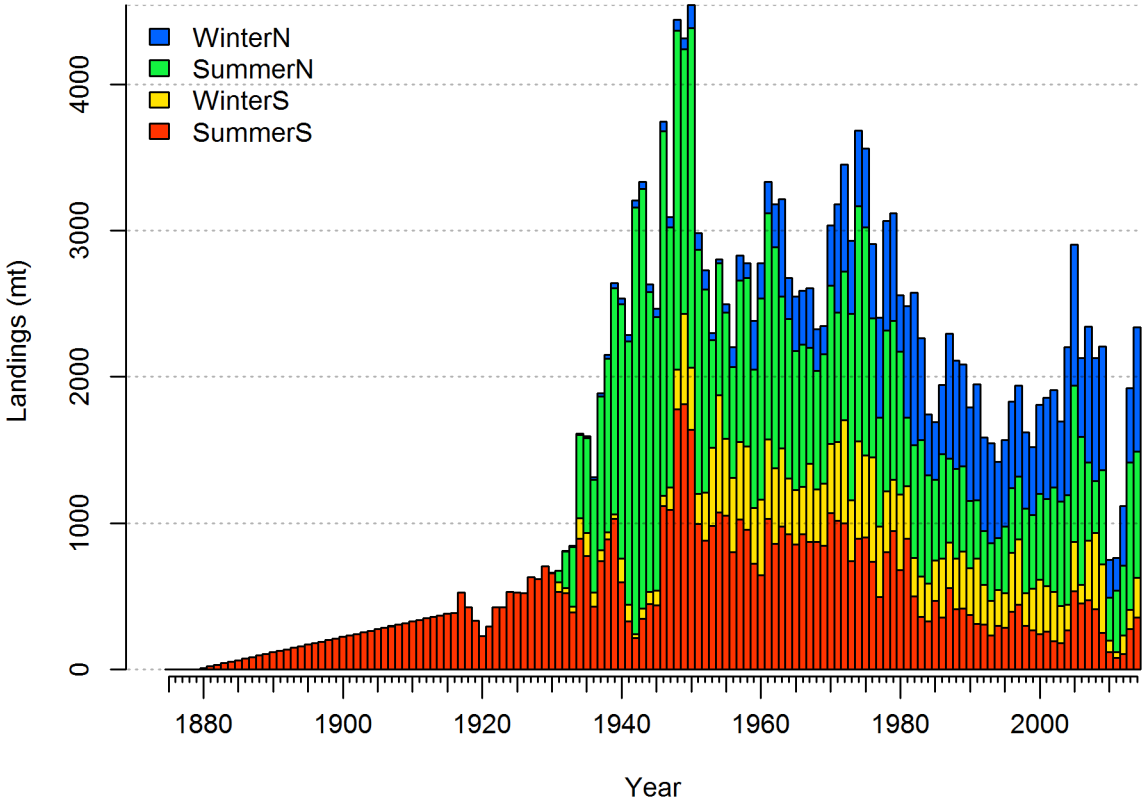

Figure d: Landings history of Lingcod. ⌈fig:r4ss_catches

Data and Assessment

data-and-assessment

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

Lingcod was assessed.... This assessment uses the newest version of Stock Synthesis (3.24u). The model begins in 1876, and assumes the stock was at an unfished equilibrium that year.

Map of assessment region: (Figure e).

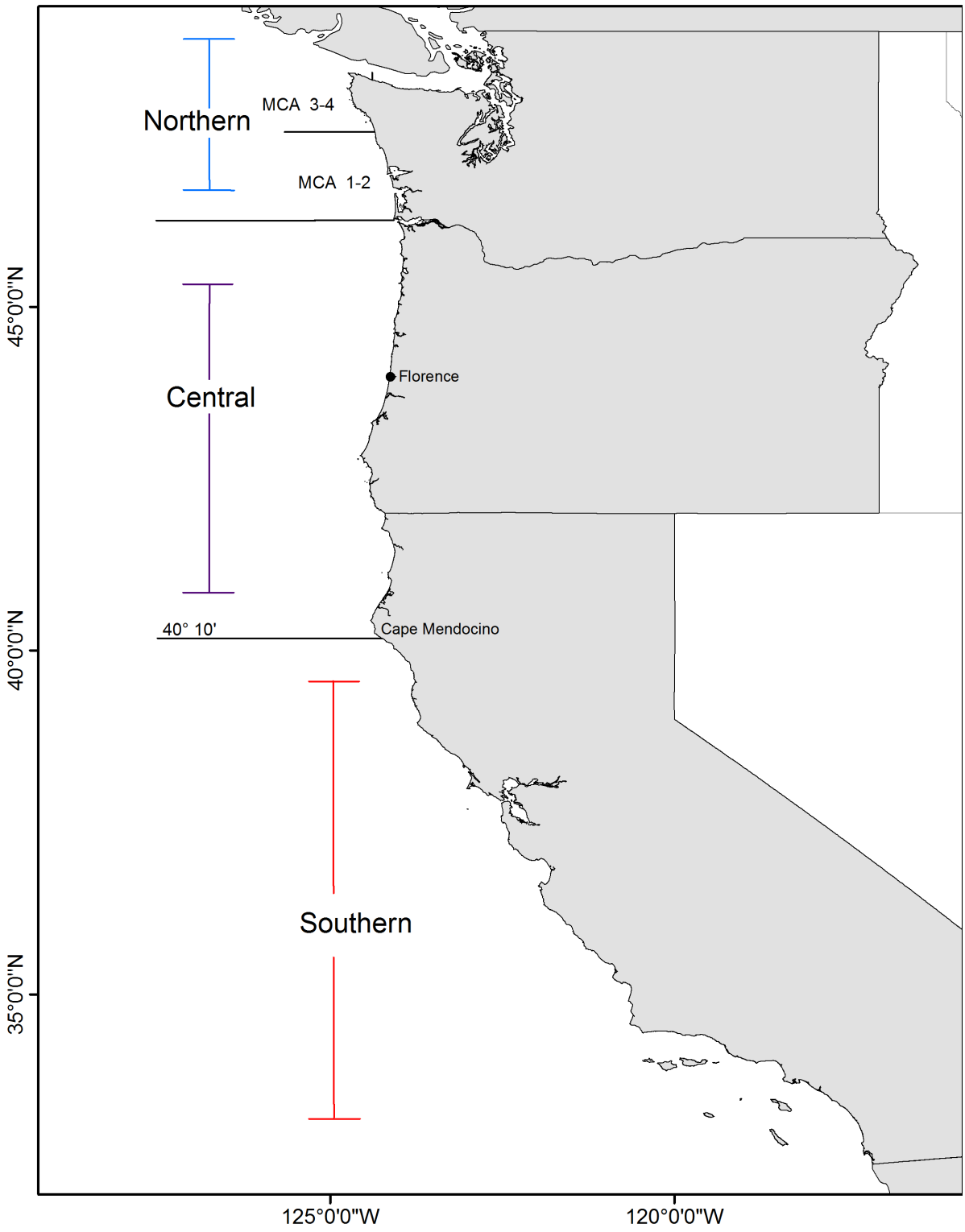

Figure e: Map depicting the boundaries for the base-case model. `fig:assess_region_map`

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 f
Spawning output Table(s): Table b
Relative depletion Figure: Figure g

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 2014 is 27.3% (~95% asymptotic interval: ± 19.9%-34.8%) (Figure g).

The estimated relative depletion level of model 2 in 2014 is (~95% asymptotic interval: ±) (Figure g).

The estimated relative depletion level of model 3 in 2014 is (~95% asymptotic interval: ±) (Figure g).

Table b: Recent trend in beginning of the year spawning output and depletion for the base model for Lingcod.

tab:SpawningDeplete_mod1

Year	Spawning Output (billion eggs)	~ 95% confidence interval	Estimated depletion	~ 95% confidence interval
2005	4251.380	(3877.19-4625.57)	0.123	(0.093-0.152)
2006	4028.730	(3645.6-4411.86)	0.116	(0.088-0.145)
2007	3952.010	(3558.37-4345.65)	0.114	(0.086-0.142)
2008	3654.820	(3241.54-4068.1)	0.106	(0.079-0.132)
2009	3465.390	(3008.41-3922.37)	0.100	(0.074-0.127)
2010	3310.760	(2770.45-3851.07)	0.096	(0.068-0.123)
2011	4198.090	(3514.81-4881.37)	0.121	(0.087-0.156)
2012	5712.870	(4803.76-6621.98)	0.165	(0.119-0.211)
2013	7691.440	(6465.54-8917.34)	0.222	(0.161-0.283)
2014	9466.580	(7890.42-11042.74)	0.273	(0.199-0.348)

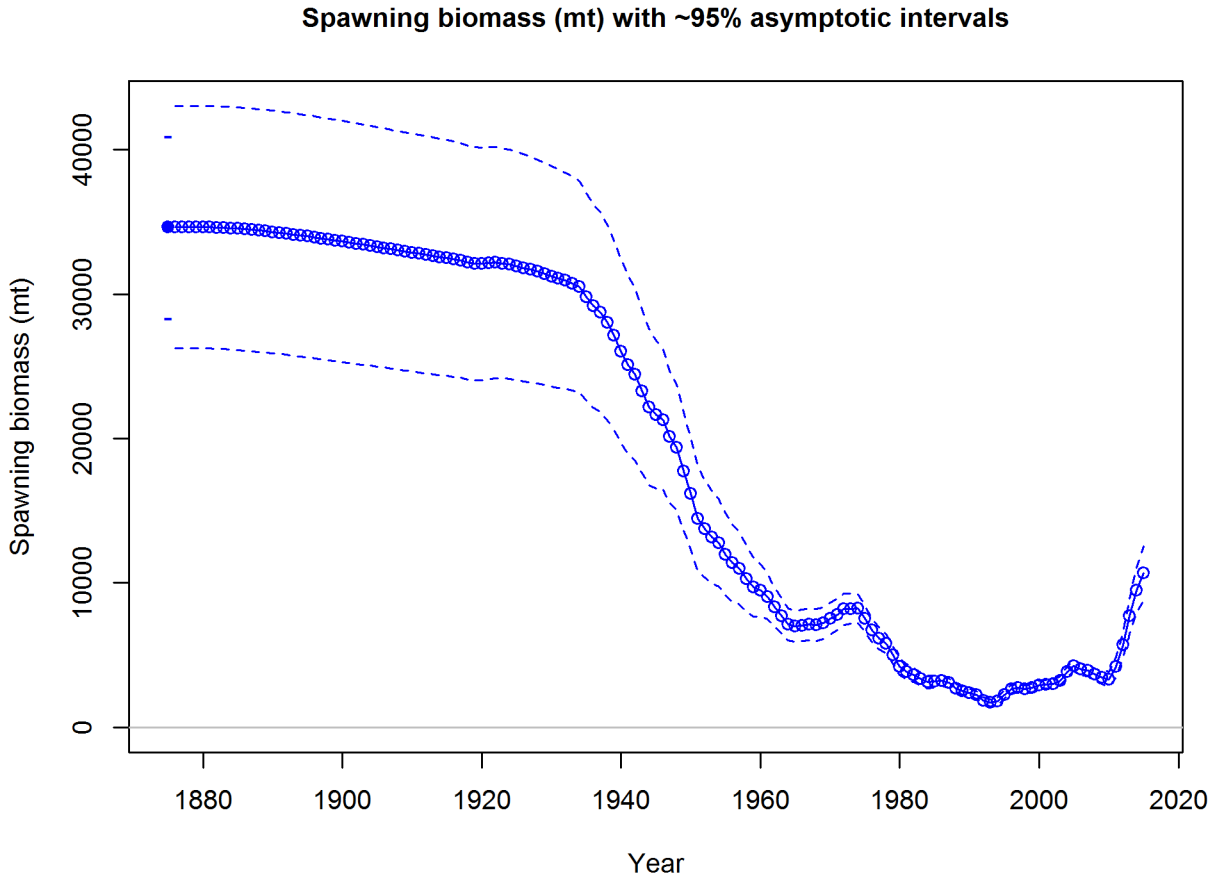

Figure f: Time series of spawning output trajectory (circles and line: median; light broken lines: 95% credibility intervals) for the base case assessment model. `fig:Spawnbio_all`

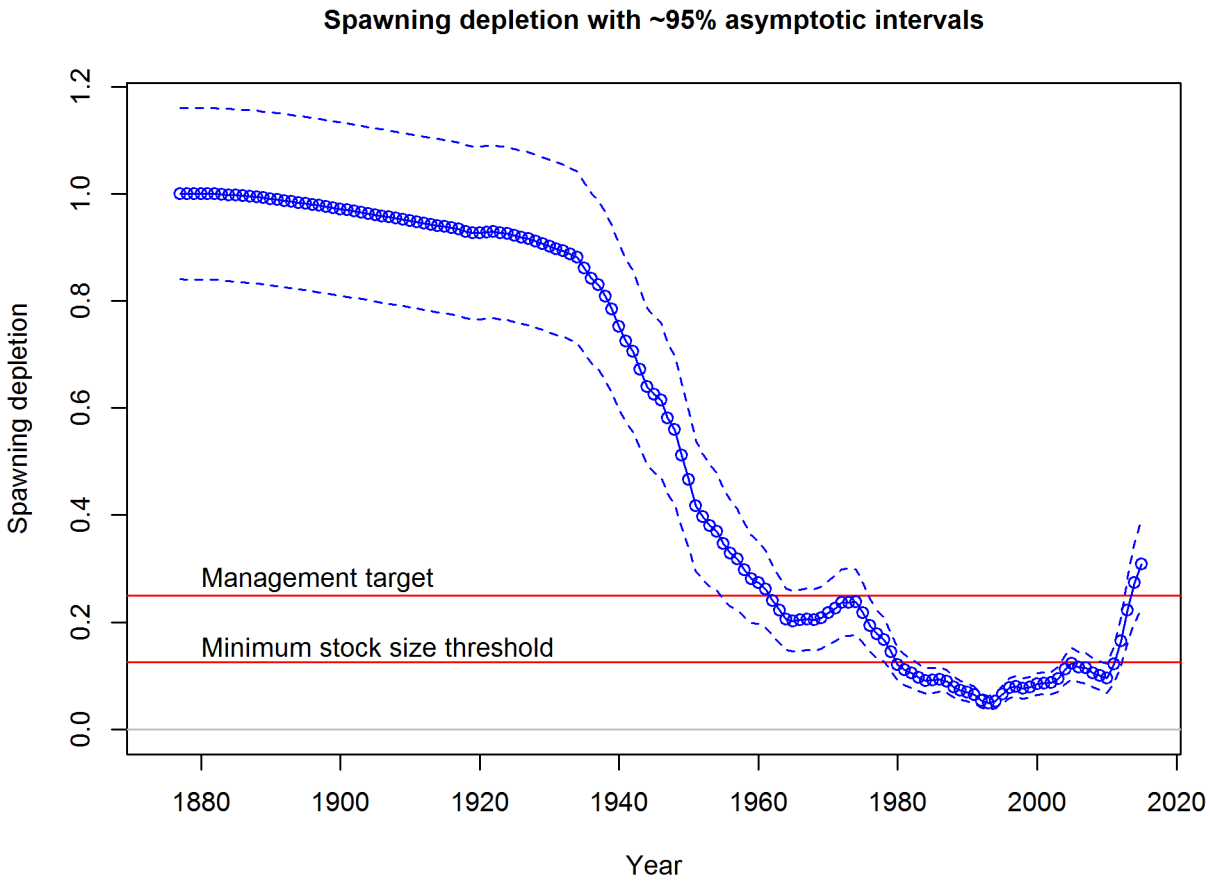

Figure g: Estimated relative depletion with approximate 95% asymptotic confidnce intervals (dashed lines) for the base case assessment model. `fig:RelDeplete_all`

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 h)
Recruitment Tables: (Tables c, **??** and **??**)

Table c: Recent recruitment for the base model.

tab:Recruit_mod1

Year	Estimated Recruitment (1,000s)	~ 95% confidence interval
2005	9501.26	(6008.78 - 12993.74)
2006	16408.30	(10661.04 - 22155.56)
2007	22866.50	(14879.47 - 30853.53)
2008	31400.20	(20649.99 - 42150.41)
2009	13034.00	(7530.52 - 18537.48)
2010	10207.10	(5442.37 - 14971.83)
2011	10285.90	(4750.84 - 15820.96)
2012	14683.10	(5478.95 - 23887.25)
2013	12421.30	(2404.51 - 22438.09)
2014	13495.70	(1954.82 - 25036.58)

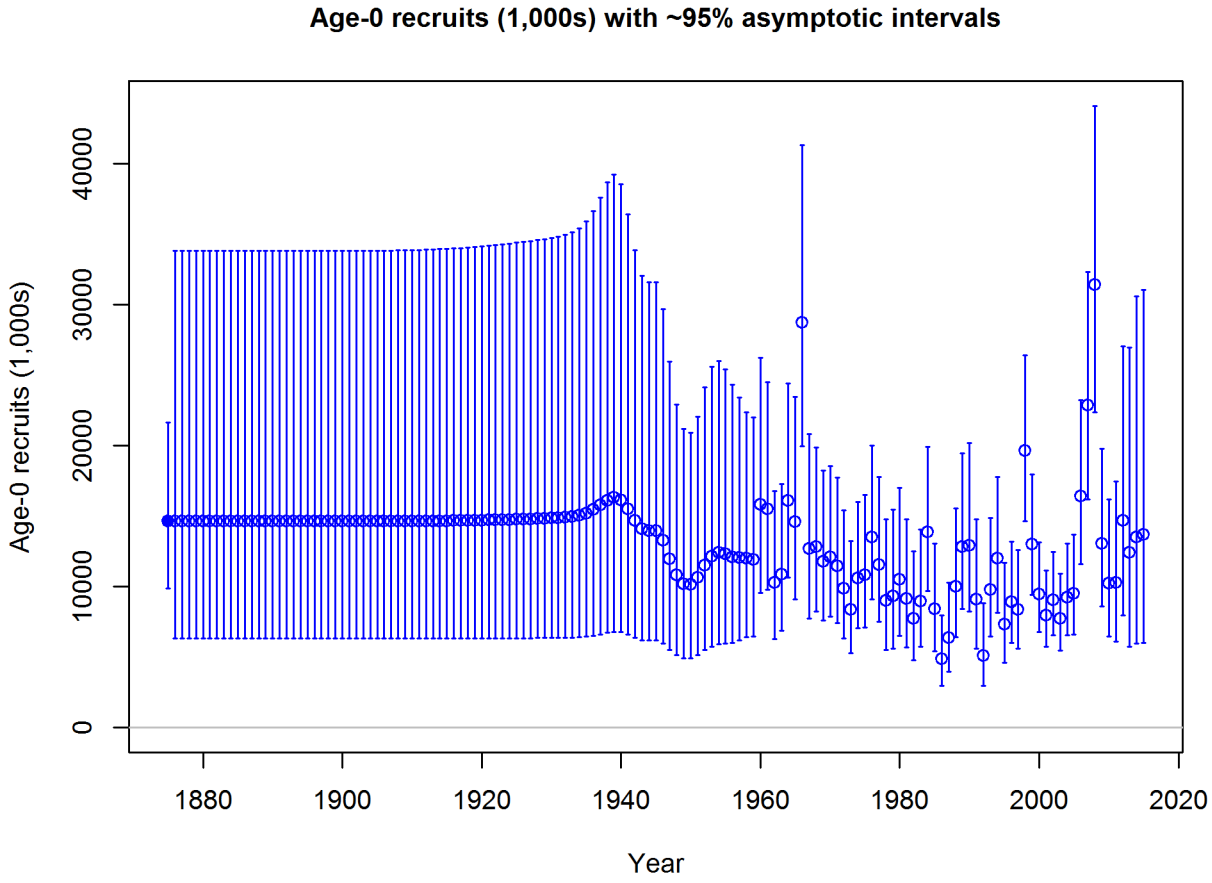

Figure h: Time series of estimated Lingcod recruitments for the base-case model with 95% confidence or credibility intervals. `fig:Recruits_all`

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 d, Table **??**, Table **??** Exploitation Figure: Figure i).

A summary of Lingcod exploitation histories for base model is provided as Figure j.

Table d: Recent trend in spawning potential ratio and exploitation for Lingcod in the base 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
2004	0.84	(0.79-0.89)	0.25	(0.23-0.27)
2005	0.87	(0.82-0.91)	0.33	(0.3-0.36)
2006	0.84	(0.78-0.89)	0.26	(0.24-0.29)
2007	0.85	(0.8-0.9)	0.29	(0.26-0.33)
2008	0.84	(0.79-0.9)	0.28	(0.24-0.31)
2009	0.86	(0.81-0.91)	0.29	(0.24-0.33)
2010	0.69	(0.6-0.78)	0.10	(0.08-0.12)
2011	0.60	(0.5-0.69)	0.06	(0.05-0.08)
2012	0.61	(0.52-0.7)	0.07	(0.06-0.09)
2013	0.67	(0.59-0.75)	0.11	(0.09-0.13)

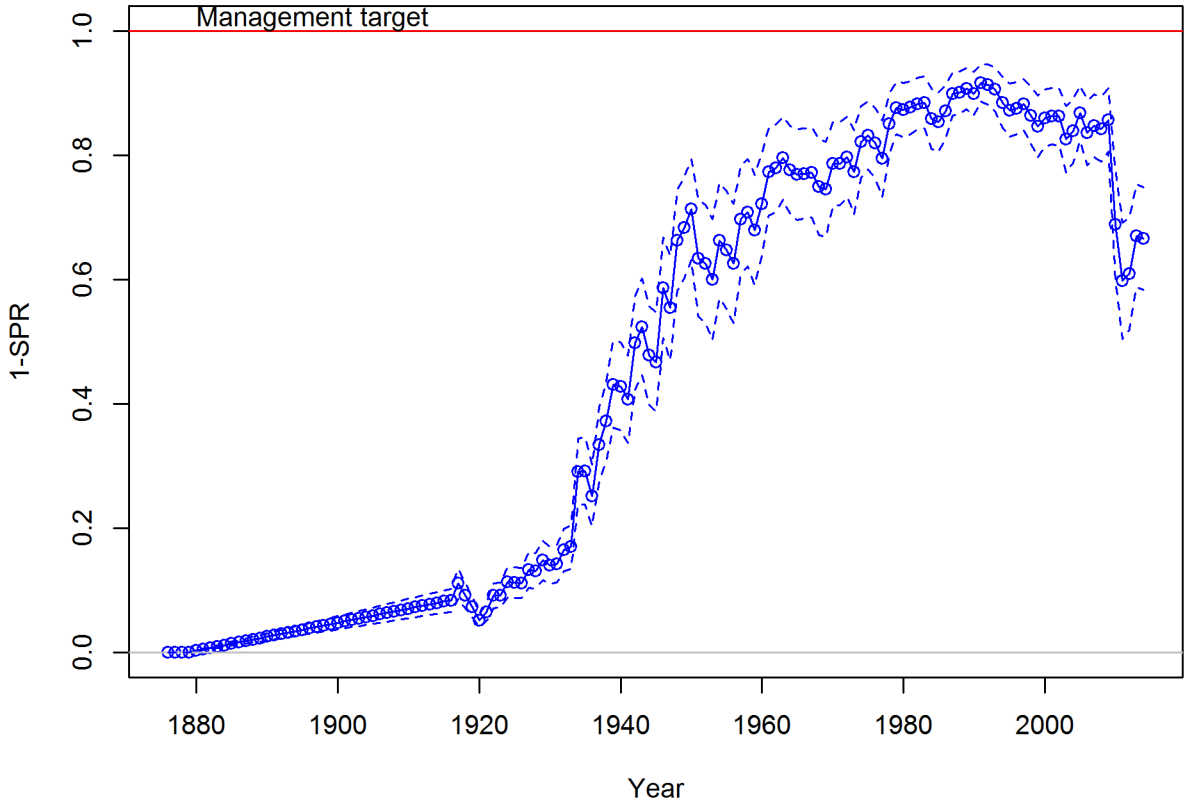

Figure i: Estimated spawning potential ratio (SPR) for the base-case model. One minus SPR is plotted so that higher exploitation rates occur on the upper portion of the y-axis. The management target is plotted as a red horizontal line and values above this reflect harvests in excess of the overfishing proxy based on the $SPR_{50\%}$ harvest rate. The last year in the time series is 2014. fig:SPR_all

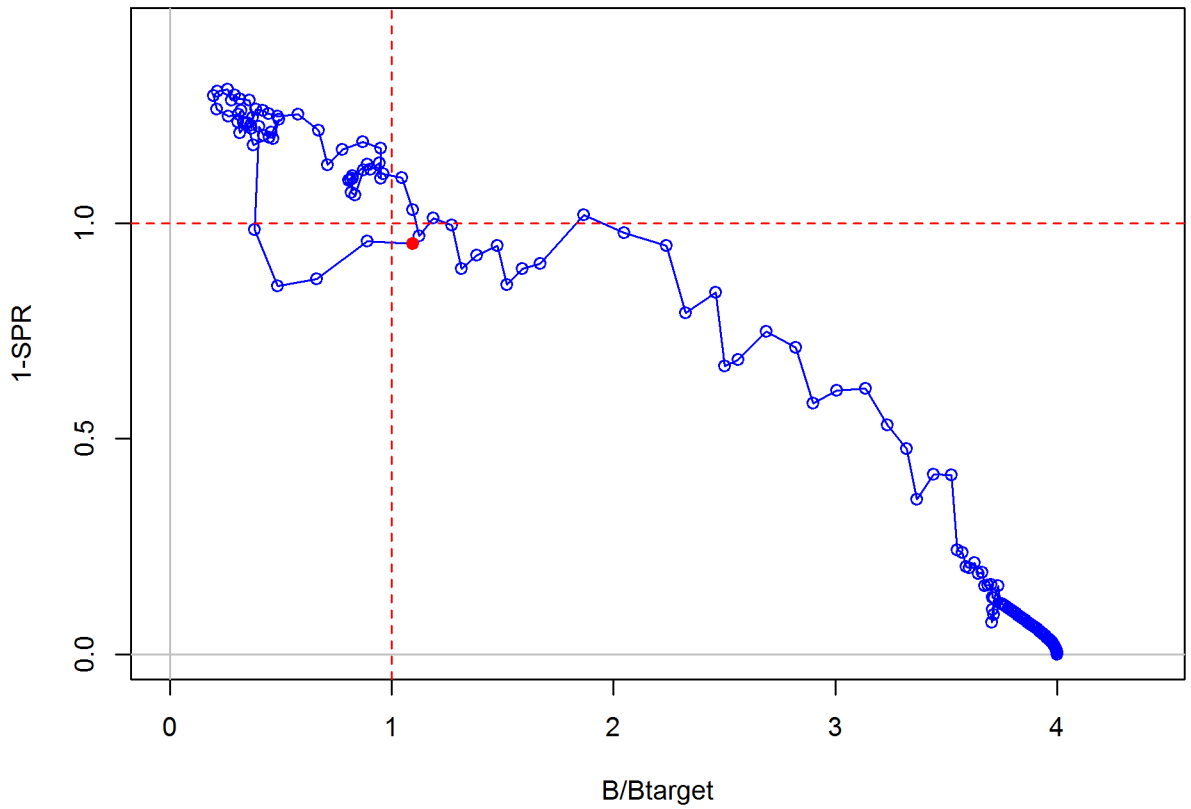

Figure j: Phase plot of estimated relative (1-SPR) vs. relative spawning biomass for the base case model. The relative (1-SPR) is (1-SPR) divided by 50% (the SPR target). Relative depletion is the annual spawning biomass divided by the unfished spawning biomass. 「fig:Phase_all

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 Lingcod in the base model are below 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 2014 is 27.3% (˜95% asymptotic interval: ± 19.9%-34.8%, corresponding to an unfished spawning output of 9466.58 billion eggs (˜95% asymptotic interval: 7890.42-11042.74 billion eggs) of spawning output in the base model (Table e). Unfished age 1+ biomass was estimated to be 53804.3 mt in the base case model. The target spawning output based on the biomass target ($SB_{40\%}$) is 8659.2 billion eggs, which gives a catch of 2780.5 mt. Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is 2748.3 mt.

This stock assessment estimates that Lingcod in the are

the biomass target, but
the minimum stock size threshold. Add sentence about spawning output trend. The estimated relative depletion level for Model 2 in 2014 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.

This stock assessment estimates that Lingcod 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 2014 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 e: Summary of reference points and management quantities for the base case base model.

tab:Ref_pts_mod1

Quantity	**Estimate**	**95% Confidence Interval**
Unfished spawning output (billion eggs)	34637	(28339-40935)
Unfished age 1+ biomass (mt)	53804.3	(45613-61995.6)
Unfished recruitment (R0, thousands)	14619	(8827-20411)
Spawning output(2014 billion eggs)	9466.6	(7890.4-11042.7)
Depletion (2014)	0.2733	(0.1989-0.3477)
Reference points based on $SB_{40\%}$		
Proxy spawning output ($B_{40\%}$)	8659.2	(7084.8-10233.7)
SPR resulting in $B_{40\%}$ ($SPR_{B40\%}$)	0.2735	(0.2504-0.2966)
Exploitation rate resulting in $B_{40\%}$	0.1673	(0.1503-0.1843)
Yield with $SPR_{B40\%}$ at $B_{40\%}$ (mt)	2780.5	(2558.3-3002.8)
Reference points based on SPR proxy for MSY		
Spawning output	9607.6	(7519.2-11695.9)
SPR_{proxy}	0.5	
Exploitation rate corresponding to SPR_{proxy}	0.1522	(0.1273-0.177)
Yield with SPR_{proxy} at SB_{SPR} (mt)	2748.3	(2487.6-3009)
Reference points based on estimated MSY values		
Spawning output at MSY (SB_{MSY})	7291.5	(5492-9091.1)
SPR_{MSY}	0.2352	(0.172-0.2985)
Exploitation rate at MSY	0.193	(0.1637-0.2222)
MSY (mt)	2799.7	(2603.5-2996)

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 f

Unresolved Problems And Major Uncertainties

unresolved-problems-and-major-uncertainties

TBD after STAR panel

Table f: Recent trend in total catch and commercial landings (mt) relative to the management guidelines. Estimated total catch reflect the commercial landings plus the model estimated discarded biomass.

tab:mnmgt_perform

Year	OFL (mt; ABC prior to 2011)	ABC (mt)	ACL (mt; OY prior to 2011)	Estimated total catch (mt)
2007	-	-	-	-
2008	-	-	-	-
2009	-	-	-	-
2010	-	-	-	-
2011	-	-	-	-
2012	-	-	-	-
2013	-	-	-	-
2014	-	-	-	-
2015	-	-	-	-
2016	-	-	-	-

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 g

Decision table(s) Table h, Table **??**, Table **??**

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

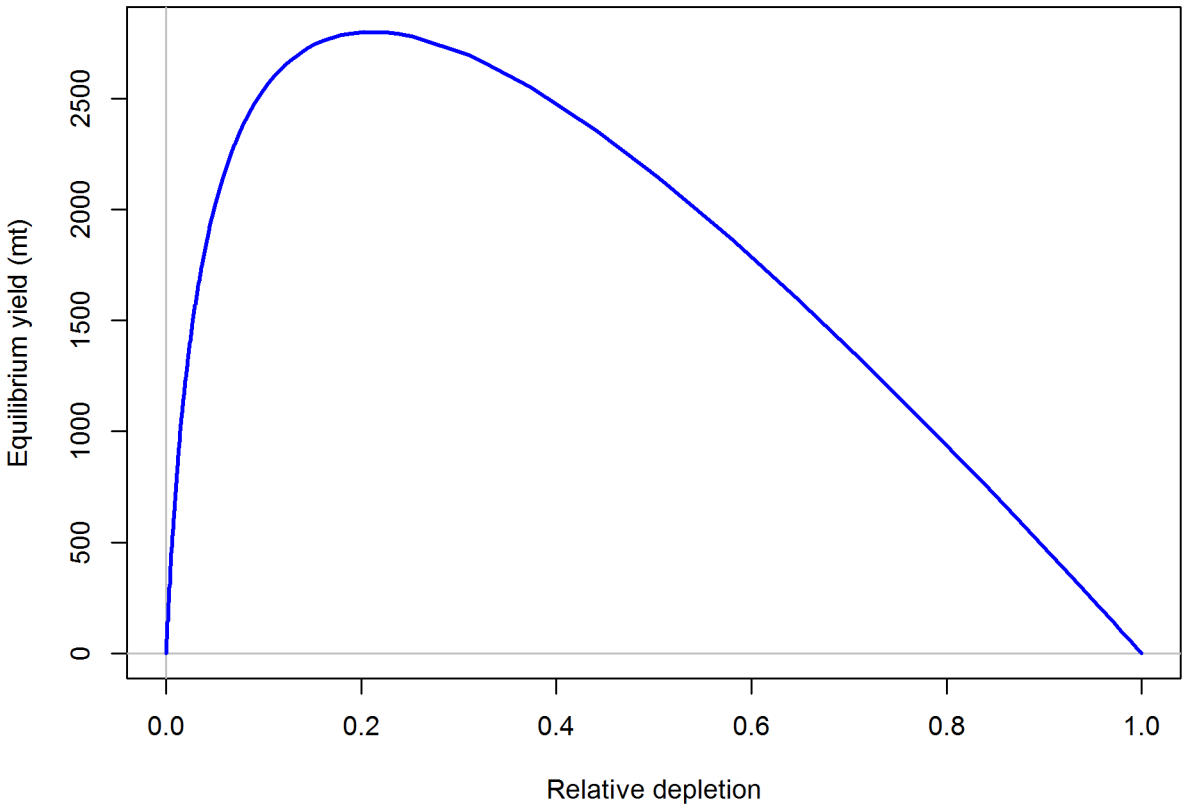

Figure k: Equilibrium yield curve for the base case model. Values are based on the 2014 fishery selectivity and with steepness fixed at... `fig:Yield_all`

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

Year	OFL
2015	3072.90
2016	3207.71
2017	3219.65
2018	3138.42
2019	3050.82
2020	2981.68
2021	2935.68
2022	2908.07
2023	2892.39
2024	2883.38
2025	2877.63
2026	2873.28

Table h: Summary of 10-year projections beginning in 2016 for alternate states of nature based on an axis of uncertainty for the base model. Columns range over low, mid, and high states of nature, and rows range over different assumptions of catch levels. An entry of "–" indicates that the stock is driven to very low abundance under the particular scenario.

tab:Decision_table_mod1

			States of nature					
			Low M 0.05		Base M 0.07		High M 0.09	
	Year	Catch	Spawning Output	Depletion	Spawning Output	Depletion	Spawning Output	Depletion
40-10 Rule, Low M	2019	-	-	-	-	-	-	-
	2020	-	-	-	-	-	-	-
	2021	-	-	-	-	-	-	-
	2022	-	-	-	-	-	-	-
	2023	-	-	-	-	-	-	-
	2024	-	-	-	-	-	-	-
	2025	-	-	-	-	-	-	-
	2026	-	-	-	-	-	-	-
	2027	-	-	-	-	-	-	-
	2028	-	-	-	-	-	-	-
40-10 Rule	2019	-	-	-	-	-	-	-
	2020	-	-	-	-	-	-	-
	2021	-	-	-	-	-	-	-
	2022	-	-	-	-	-	-	-
	2023	-	-	-	-	-	-	-
	2024	-	-	-	-	-	-	-
	2025	-	-	-	-	-	-	-
	2026	-	-	-	-	-	-	-
	2027	-	-	-	-	-	-	-
	2028	-	-	-	-	-	-	-
40-10 Rule, High M	2019	-	-	-	-	-	-	-
	2020	-	-	-	-	-	-	-
	2021	-	-	-	-	-	-	-
	2022	-	-	-	-	-	-	-
	2023	-	-	-	-	-	-	-
	2024	-	-	-	-	-	-	-
	2025	-	-	-	-	-	-	-
	2026	-	-	-	-	-	-	-
	2027	-	-	-	-	-	-	-
	2028	-	-	-	-	-	-	-
Average Catch	2019	-	-	-	-	-	-	-
	2020	-	-	-	-	-	-	-
	2021	-	-	-	-	-	-	-
	2022	-	-	-	-	-	-	-
	2023	-	-	-	-	-	-	-
	2024	-	-	-	-	-	-	-
	2025	-	-	-	-	-	-	-
	2026	-	-	-	-	-	-	-
	2027	-	-	-	-	-	-	-
	2028	-	-	-	-	-	-	-

Table i: Base case results summary.

tab:base_summary

Quantity	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Landings (mt)										
Total Est. Catch (mt)										
OFL (mt)										
ACL (mt)										
(1-SPR)(1-$SPR_{50\%}$)		0.84	0.87	0.84	0.85	0.84	0.86	0.69	0.60	0.61
Exploitation rate		0.25	0.33	0.26	0.29	0.28	0.29	0.10	0.06	0.07
Age 1+ biomass (mt)	19086.90	9063.19	8271.63	8091.58	7714.19	7975.75	8843.39	12052.40	15084.80	17610.00
Spawning Output	9466.6	4251.4	4028.7	3952.0	3654.8	3465.4	3310.8	4198.1	5712.9	7691.4
95% CI	(7890.42-11042.74)	(3877.19-4625.57)	(3645.6-4411.86)	(3558.37-4345.65)	(3241.54-4068.1)	(3008.41-3922.37)	(2770.45-3851.07)	(3514.81-4881.37)	(4803.76-6621.98)	(6465.54-8917.34)
Depletion	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
95% CI	(0.199-0.348)	(0.093-0.152)	(0.088-0.145)	(0.086-0.142)	(0.079-0.132)	(0.074-0.127)	(0.068-0.123)	(0.087-0.156)	(0.119-0.211)	(0.161-0.283)
Recruits	13495.70	9501.26	16408.30	22866.50	31400.20	13034.00	10207.10	10285.90	14683.10	12421.30
95% CI	(1954.82 - 25036.58)	(6008.78 - 12993.74)	(10661.04 - 22155.56)	(14879.47 - 30853.53)	(20649.99 - 42150.41)	(7530.52 - 18537.48)	(5442.37 - 14971.83)	(4750.84 - 15820.96)	(5478.95 - 23887.25)	(2404.51 - 22438.09)

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 f)
A summary of these values as well as other base case summary results can be found in Table i.

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 Lingcod assessment are summarized in Figure 2.
A description of each data source is below.

2.1.1 Commercial Fishery Landings

commercial-fishery-landings

Sub-heading 1

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°42′ N latitude and 42°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.

Maturity And Fecundity

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 2748.3 mt. Table e shows the full suite of estimated reference points for the northern area model and Figure k 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 f

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

Table h

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	SD	Bounds	Phase	Status	Prior
1	NatM_p_1_Fem_GP_1	0.14	0.02	(0.005, 0.5)	6	OK	Log_Norm (-1.888, 0.333)
2	L_at_Amin_Fem_GP_1	15.66	0.45	(10, 45)	2	OK	None
3	L_at_Amax_Fem_GP_1	54.45	0.41	(35, 80)	3	OK	None
4	VonBert_K_Fem_GP_1	0.13	0.01	(0.04, 0.5)	2	OK	None
5	CV_young_Fem_GP_1	0.19	0.01	(0.01, 1)	3	OK	None
6	CV_old_Fem_GP_1	0.03	0.01	(0.01, 1)	4	OK	None
7	NatM_p_1_Mal_GP_1	0.15	0.02	(0.005, 0.6)	6	OK	Log_Norm (-1.58, 0.333)
8	L_at_Amin_Mal_GP_1	16.33	0.33	(10, 45)	2	OK	None
9	L_at_Amax_Mal_GP_1	43.26	0.41	(35, 80)	3	OK	None
10	VonBert_K_Mal_GP_1	0.20	0.01	(0.04, 0.5)	2	OK	None
11	CV_young_Mal_GP_1	0.14	0.01	(0.01, 1)	3	OK	None
12	CV_old_Mal_GP_1	0.05	0.01	(0.01, 1)	4	OK	None
13	Wtlen_1_Fem	0.00		(-3, 3)	-3		Normal (0, 0.8)
14	Wtlen_2_Fem	3.47		(1, 5)	-3		Normal (3.474, 0.8)
15	Mat50%_Fem	33.10		(10, 50)	-3		Normal (33.1, 0.8)
16	Mat_slope_Fem	-0.74		(-3, 3)	-3		Normal (-0.743, 0.8)
17	Eggs/kg_inter_Fem	1.00		(-3, 3)	-3		Normal (1, 1)
18	Eggs/kg_slope_wt_Fem	0.00		(-3, 3)	-3		Normal (0, 1)
19	Wtlen_1_Mal	0.00		(-3, 3)	-3		Normal (0, 0.8)
20	Wtlen_2_Mal	3.36		(-3, 5)	-3		Normal (3.361, 0.8)
24	CohortGrowDev	1.00		(0, 1)	-4		None
25	SR_LN(R0)	9.59	0.20	(5, 20)	1	OK	None
26	SR_BH_steep	0.89	0.05	(0.2, 1)	5	OK	Normal (0.8, 0.09)
27	SR_sigmaR	0.40		(0, 2)	-99		Normal (0.9, 5)
28	SR_envlink	0.00		(-5, 5)	-99		Normal (0, 1)
29	SR_R1_offset	0.00		(-5, 5)	-2		Normal (0, 0.2)

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No.	Parameter	Value	SD	Bounds	Phase	Status	Prior
30	SR_autocorr	0.00		(0, 0)	-99		None
31	Early_InitAge_31	0.00	0.40	(NA, NA)		act	dev (NA, NA)
32	Early_InitAge_30	0.00	0.40	(NA, NA)		act	dev (NA, NA)
33	Early_InitAge_29	0.00	0.40	(NA, NA)		act	dev (NA, NA)
34	Early_InitAge_28	0.00	0.40	(NA, NA)		act	dev (NA, NA)
35	Early_InitAge_27	0.00	0.40	(NA, NA)		act	dev (NA, NA)
36	Early_InitAge_26	0.00	0.40	(NA, NA)		act	dev (NA, NA)
37	Early_InitAge_25	0.00	0.40	(NA, NA)		act	dev (NA, NA)
38	Early_InitAge_24	0.00	0.40	(NA, NA)		act	dev (NA, NA)
39	Early_InitAge_23	0.00	0.40	(NA, NA)		act	dev (NA, NA)
40	Early_InitAge_22	0.00	0.40	(NA, NA)		act	dev (NA, NA)
41	Early_InitAge_21	0.00	0.40	(NA, NA)		act	dev (NA, NA)
42	Early_InitAge_20	0.00	0.40	(NA, NA)		act	dev (NA, NA)
43	Early_InitAge_19	0.00	0.40	(NA, NA)		act	dev (NA, NA)
44	Early_InitAge_18	0.00	0.40	(NA, NA)		act	dev (NA, NA)
45	Early_InitAge_17	0.00	0.40	(NA, NA)		act	dev (NA, NA)
46	Early_InitAge_16	0.00	0.40	(NA, NA)		act	dev (NA, NA)
47	Early_InitAge_15	0.00	0.40	(NA, NA)		act	dev (NA, NA)
48	Early_InitAge_14	0.00	0.40	(NA, NA)		act	dev (NA, NA)
49	Early_InitAge_13	0.00	0.40	(NA, NA)		act	dev (NA, NA)
50	Early_InitAge_12	0.00	0.40	(NA, NA)		act	dev (NA, NA)
51	Early_InitAge_11	0.00	0.40	(NA, NA)		act	dev (NA, NA)
52	Early_InitAge_10	0.00	0.40	(NA, NA)		act	dev (NA, NA)
53	Early_InitAge_9	0.00	0.40	(NA, NA)		act	dev (NA, NA)
54	Early_InitAge_8	0.00	0.40	(NA, NA)		act	dev (NA, NA)
55	Early_InitAge_7	0.00	0.40	(NA, NA)		act	dev (NA, NA)
56	Early_InitAge_6	0.00	0.40	(NA, NA)		act	dev (NA, NA)

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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	SD	Bounds	Phase	Status	Prior
57	Early_InitAge_5	0.00	0.40	(NA, NA)		act	dev (NA, NA)
58	Early_InitAge_4	0.00	0.40	(NA, NA)		act	dev (NA, NA)
59	Early_InitAge_3	0.00	0.40	(NA, NA)		act	dev (NA, NA)
60	Early_InitAge_2	0.00	0.40	(NA, NA)		act	dev (NA, NA)
61	Early_InitAge_1	0.00	0.40	(NA, NA)		act	dev (NA, NA)
225	InitF_1WinterN	0.00		(0, 1)	-1		Normal (0, 99)
226	InitF_2SummerN	0.00		(0, 1)	-1		Normal (0, 99)
227	InitF_3WinterS	0.00		(0, 1)	-1		Normal (0, 99)
228	InitF_4SummerS	0.00		(0, 1)	-1		Normal (0, 99)
229	Q_power_1_WinterN	-0.14	0.35	(-5, 5)	3	OK	None
230	Q_power_3_WinterS	-1.00	0.31	(-5, 5)	3	OK	None
231	Q_extraSD_5_TriEarly	0.18	0.11	(0.001, 2)	5	OK	None
232	Q_extraSD_6_TriLate	0.19	0.12	(0.001, 2)	4	OK	None
233	LnQ_base_1_WinterN	-7.07	2.75	(-20, 5)	1	OK	None
234	Q_walk_1y_1988	0.00		(-20, 5)	-1		None
235	Q_walk_1y_1989	0.00		(-20, 5)	-1		None
236	Q_walk_1y_1990	0.00		(-20, 5)	-1		None
237	Q_walk_1y_1991	0.00		(-20, 5)	-1		None
238	Q_walk_1y_1992	0.00		(-20, 5)	-1		None
239	Q_walk_1y_1993	0.00		(-20, 5)	-1		None
240	Q_walk_1y_1994	0.00		(-20, 5)	-1		None
241	Q_walk_1y_1995	0.00		(-20, 5)	-1		None
242	Q_walk_1y_1996	0.00		(-20, 5)	-1		None
243	Q_walk_1y_1997	0.00		(-20, 5)	-1		None
244	Q_walk_1y_1998	0.00		(-20, 5)	-1		None
245	Q_walk_1y_1999	0.00		(-20, 5)	-1		None
246	Q_walk_1y_2000	0.00		(-20, 5)	-1		None

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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	SD	Bounds	Phase	Status	Prior
247	Q_walk_1y_2001	0.00		(-20, 5)	-1		None
248	Q_walk_1y_2002	0.00		(-20, 5)	-1		None
249	Q_walk_1y_2003	0.00		(-20, 5)	-1		None
250	Q_walk_1y_2004	0.59	0.18	(-20, 5)	7	OK	None
251	Q_walk_1y_2005	0.00		(-20, 5)	-7		None
252	Q_walk_1y_2006	0.00		(-20, 5)	-7		None
253	Q_walk_1y_2007	0.00		(-20, 5)	-7		None
254	Q_walk_1y_2008	0.00		(-20, 5)	-7		None
255	Q_walk_1y_2009	0.00		(-20, 5)	-7		None
256	LnQ_base_3_WinterS	-0.20	2.53	(-20, 5)	1	OK	None
257	Q_walk_3y_1988	0.00		(-20, 5)	-1		None
258	Q_walk_3y_1989	0.00		(-20, 5)	-1		None
259	Q_walk_3y_1990	0.00		(-20, 5)	-1		None
260	Q_walk_3y_1991	0.00		(-20, 5)	-1		None
261	Q_walk_3y_1992	0.00		(-20, 5)	-1		None
262	Q_walk_3y_1993	0.00		(-20, 5)	-1		None
263	Q_walk_3y_1994	0.00		(-20, 5)	-1		None
264	Q_walk_3y_1995	0.00		(-20, 5)	-1		None
265	Q_walk_3y_1996	0.00		(-20, 5)	-1		None
266	Q_walk_3y_1997	0.00		(-20, 5)	-1		None
267	Q_walk_3y_1998	0.00		(-20, 5)	-1		None
268	Q_walk_3y_1999	0.00		(-20, 5)	-1		None
269	Q_walk_3y_2000	0.00		(-20, 5)	-1		None
270	Q_walk_3y_2001	0.00		(-20, 5)	-1		None
271	Q_walk_3y_2002	0.00		(-20, 5)	-1		None
272	Q_walk_3y_2003	0.00		(-20, 5)	-1		None
273	Q_walk_3y_2004	0.77	0.24	(-20, 5)	7	OK	None

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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	SD	Bounds	Phase	Status	Prior
274	Q_walk_3y_2005	0.00		(-20, 5)	-7		None
275	Q_walk_3y_2006	0.00		(-20, 5)	-7		None
276	Q_walk_3y_2007	0.00		(-20, 5)	-7		None
277	Q_walk_3y_2008	0.00		(-20, 5)	-7		None
278	Q_walk_3y_2009	0.00		(-20, 5)	-7		None
279	SizeSel_1P_1_WinterN	47.08	0.87	(15, 75)	1	OK	None
280	SizeSel_1P_2_WinterN	3.00		(-5, 3)	-3		None
281	SizeSel_1P_3_WinterN	3.98	0.14	(-4, 12)	2	OK	None
282	SizeSel_1P_4_WinterN	14.00		(-2, 15)	-3		None
283	SizeSel_1P_5_WinterN	-999.00		(-15, 5)	-4		None
284	SizeSel_1P_6_WinterN	-999.00		(-5, 5)	-4		None
285	Retain_1P_1_WinterN	27.48	2.66	(10, 40)	1	OK	None
286	Retain_1P_2_WinterN	2.53	1.12	(0.1, 10)	2	OK	None
287	Retain_1P_3_WinterN	1.00	0.00	(0.001, 1)	4	HI	None
288	Retain_1P_4_WinterN	0.00		(-10, 10)	-2		None
289	SzSel_1Male_Peak_WinterN	-9.40	0.74	(-15, 15)	3	OK	None
290	SzSel_1Male_Ascend_WinterN	-1.22	0.21	(-15, 15)	4	OK	None
291	SzSel_1Male_Descend_WinterN	0.00		(-15, 15)	-4		None
292	SzSel_1Male_Final_WinterN	0.00		(-15, 15)	-4		None
293	SzSel_1Male_Scale_WinterN	1.00		(-15, 15)	-4		None
294	SizeSel_2P_1_SummerN	51.67	1.13	(15, 75)	1	OK	None
295	SizeSel_2P_2_SummerN	3.00		(-5, 3)	-3		None
296	SizeSel_2P_3_SummerN	5.10	0.10	(-4, 12)	2	OK	None
297	SizeSel_2P_4_SummerN	14.00		(-2, 15)	-3		None
298	SizeSel_2P_5_SummerN	-999.00		(-15, 5)	-4		None
299	SizeSel_2P_6_SummerN	-999.00		(-5, 5)	-4		None
300	Retain_2P_1_SummerN	30.77	0.51	(10, 40)	1	OK	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	SD	Bounds	Phase	Status	Prior
301	Retain_2P_2_SummerN	1.64	0.38	(0.1, 10)	2	OK	None
302	Retain_2P_3_SummerN	1.00	0.00	(0.001, 1)	4	HI	None
303	Retain_2P_4_SummerN	0.00		(-10, 10)	-2		None
304	SzSel_2Male_Peak_SummerN	-12.23	0.91	(-20, 15)	3	OK	None
305	SzSel_2Male_Ascend_SummerN	-1.82	0.17	(-15, 15)	4	OK	None
306	SzSel_2Male_Descend_SummerN	0.00		(-15, 15)	-4		None
307	SzSel_2Male_Final_SummerN	0.00		(-15, 15)	-4		None
308	SzSel_2Male_Scale_SummerN	1.00		(-15, 15)	-4		None
309	SizeSel_3P_1_WinterS	41.53	1.65	(15, 75)	1	OK	None
310	SizeSel_3P_2_WinterS	3.00		(-5, 3)	-3		None
311	SizeSel_3P_3_WinterS	4.53	0.24	(-4, 12)	2	OK	None
312	SizeSel_3P_4_WinterS	14.00		(-2, 15)	-3		None
313	SizeSel_3P_5_WinterS	-999.00		(-15, 5)	-4		None
314	SizeSel_3P_6_WinterS	-999.00		(-5, 5)	-4		None
315	Retain_3P_1_WinterS	29.46	0.52	(10, 40)	1	OK	None
316	Retain_3P_2_WinterS	1.20	0.36	(0.1, 10)	2	OK	None
317	Retain_3P_3_WinterS	0.98	0.04	(0.001, 1)	4	OK	None
318	Retain_3P_4_WinterS	0.00		(-10, 10)	-2		None
319	SzSel_3Male_Peak_WinterS	-13.92	1.62	(-15, 15)	3	OK	None
320	SzSel_3Male_Ascend_WinterS	-2.58	0.47	(-15, 15)	4	OK	None
321	SzSel_3Male_Descend_WinterS	0.00		(-15, 15)	-4		None
322	SzSel_3Male_Final_WinterS	0.00		(-15, 15)	-4		None
323	SzSel_3Male_Scale_WinterS	1.00		(-15, 15)	-4		None
324	SizeSel_4P_1_SummerS	41.20	1.34	(15, 75)	1	OK	None
325	SizeSel_4P_2_SummerS	3.00		(-5, 3)	-3		None
326	SizeSel_4P_3_SummerS	4.38	0.24	(-4, 12)	2	OK	None
327	SizeSel_4P_4_SummerS	14.00		(-2, 15)	-3		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	SD	Bounds	Phase	Status	Prior
328	SizeSel_4P_5_SummerS	-999.00		(-15, 5)	-4		None
329	SizeSel_4P_6_SummerS	-999.00		(-5, 5)	-4		None
330	Retain_4P_1_SummerS	28.99	0.42	(10, 40)	1	OK	None
331	Retain_4P_2_SummerS	1.21	0.25	(0.1, 10)	2	OK	None
332	Retain_4P_3_SummerS	1.00	0.00	(0.001, 1)	4	HI	None
333	Retain_4P_4_SummerS	0.00		(-10, 10)	-2		None
334	SzSel_4Male_Peak_SummerS	-8.24	1.19	(-15, 15)	3	OK	None
335	SzSel_4Male_Ascend_SummerS	-1.37	0.31	(-15, 15)	4	OK	None
336	SzSel_4Male_Descend_SummerS	0.00		(-15, 15)	-4		None
337	SzSel_4Male_Final_SummerS	0.00		(-15, 15)	-4		None
338	SzSel_4Male_Scale_SummerS	1.00		(-15, 15)	-4		None
339	SizeSel_5P_1_TriEarly	35.85	1.23	(15, 61)	1	OK	None
340	SizeSel_5P_2_TriEarly	3.00		(-5, 3)	-2		None
341	SizeSel_5P_3_TriEarly	4.30	0.19	(-4, 12)	1	OK	None
342	SizeSel_5P_4_TriEarly	14.00		(-2, 15)	-2		None
343	SizeSel_5P_5_TriEarly	-999.00		(-15, 5)	-4		None
344	SizeSel_5P_6_TriEarly	-999.00		(-5, 5)	-4		None
345	SzSel_5Male_Peak_TriEarly	-3.87	1.11	(-15, 15)	2	OK	None
346	SzSel_5Male_Ascend_TriEarly	-0.54	0.22	(-15, 15)	2	OK	None
347	SzSel_5Male_Descend_TriEarly	0.00		(-15, 15)	-3		None
348	SzSel_5Male_Final_TriEarly	0.00		(-15, 15)	-3		None
349	SzSel_5Male_Scale_TriEarly	1.00		(-15, 15)	-4		None
350	SizeSel_6P_1_TriLate	36.99	0.88	(15, 61)	1	OK	None
351	SizeSel_6P_2_TriLate	3.00		(-5, 3)	-2		None
352	SizeSel_6P_3_TriLate	4.68	0.11	(-4, 12)	1	OK	None
353	SizeSel_6P_4_TriLate	14.00		(-2, 15)	-2		None
354	SizeSel_6P_5_TriLate	-999.00		(-15, 5)	-4		None

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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	SD	Bounds	Phase	Status	Prior
355	SizeSel_6P_6_TriLate	-999.00		(-5, 5)	-4		None
356	SzSel_6Male_Peak_TriLate	-3.05	0.92	(-15, 15)	2	OK	None
357	SzSel_6Male_Ascend_TriLate	-0.15	0.14	(-15, 15)	2	OK	None
358	SzSel_6Male_Descend_TriLate	0.00		(-15, 15)	-3		None
359	SzSel_6Male_Final_TriLate	0.00		(-15, 15)	-3		None
360	SzSel_6Male_Scale_TriLate	1.00		(-15, 15)	-4		None
361	SizeSel_7P_1_NWFSC	43.84	0.93	(15, 61)	1	OK	None
362	SizeSel_7P_2_NWFSC	3.00		(-5, 3)	-2		None
363	SizeSel_7P_3_NWFSC	5.21	0.08	(-4, 12)	1	OK	None
364	SizeSel_7P_4_NWFSC	14.00		(-2, 15)	-2		None
365	SizeSel_7P_5_NWFSC	-999.00		(-15, 5)	-4		None
366	SizeSel_7P_6_NWFSC	-999.00		(-5, 5)	-4		None
367	SzSel_7Male_Peak_NWFSC	-6.14	0.78	(-15, 15)	2	OK	None
368	SzSel_7Male_Ascend_NWFSC	-0.50	0.09	(-15, 15)	2	OK	None
369	SzSel_7Male_Descend_NWFSC	0.00		(-15, 15)	-3		None
370	SzSel_7Male_Final_NWFSC	0.00		(-15, 15)	-3		None
371	SzSel_7Male_Scale_NWFSC	1.00		(-15, 15)	-4		None
372	SizeSel_1P_1_WinterN_BLK1add_1973	-0.03	0.03	(-3, 2)	4	OK	None
373	SizeSel_1P_1_WinterN_BLK1add_1983	-0.08	0.02	(-3, 2)	4	OK	None
374	SizeSel_1P_1_WinterN_BLK1add_1993	-0.07	0.02	(-3, 2)	4	OK	None
375	SizeSel_1P_1_WinterN_BLK1add_2003	-0.02	0.02	(-3, 2)	4	OK	None
376	SizeSel_1P_1_WinterN_BLK1add_2011	-0.03	0.02	(-3, 2)	4	OK	None
377	Retain_1P_1_WinterN_BLK2add_2003	-0.66	1.88	(-3, 2)	4	OK	None
378	Retain_1P_1_WinterN_BLK2add_2010	0.33	0.42	(-3, 2)	4	OK	None
379	Retain_1P_1_WinterN_BLK2add_2011	-0.10	0.20	(-3, 2)	4	OK	None
380	Retain_1P_2_WinterN_BLK2add_2003	-0.15	0.33	(-3, 2)	4	OK	None
381	Retain_1P_2_WinterN_BLK2add_2010	0.95	0.72	(-3, 2)	4	OK	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	SD	Bounds	Phase	Status	Prior
382	Retain_1P_2_WinterN_BLK2add_2011	-0.68	0.32	(-3, 2)	4	OK	None
383	Retain_1P_3_WinterN_BLK2add_2003	-1.09	21.54	(-3, 2)	4	OK	None
384	Retain_1P_3_WinterN_BLK2add_2010	-0.29	47.07	(-3, 2)	4	OK	None
385	Retain_1P_3_WinterN_BLK2add_2011	-1.61	21.11	(-3, 2)	4	OK	None
386	SizeSel_2P_1_SummerN_BLK1add_1973	-0.06	0.02	(-3, 2)	4	OK	None
387	SizeSel_2P_1_SummerN_BLK1add_1983	-0.16	0.03	(-3, 2)	4	OK	None
388	SizeSel_2P_1_SummerN_BLK1add_1993	-0.15	0.03	(-3, 2)	4	OK	None
389	SizeSel_2P_1_SummerN_BLK1add_2003	-0.10	0.02	(-3, 2)	4	OK	None
390	SizeSel_2P_1_SummerN_BLK1add_2011	-0.06	0.02	(-3, 2)	4	OK	None
391	Retain_2P_1_SummerN_BLK3add_2003	-0.05	0.06	(-3, 2)	4	OK	None
392	Retain_2P_1_SummerN_BLK3add_2009	0.02	0.07	(-3, 2)	4	OK	None
393	Retain_2P_1_SummerN_BLK3add_2011	-0.23	0.06	(-3, 2)	4	OK	None
394	Retain_2P_2_SummerN_BLK3add_2003	-0.13	0.17	(-3, 2)	4	OK	None
395	Retain_2P_2_SummerN_BLK3add_2009	0.00	0.17	(-3, 2)	4	OK	None
396	Retain_2P_2_SummerN_BLK3add_2011	0.01	0.16	(-3, 2)	4	OK	None
397	Retain_2P_3_SummerN_BLK3add_2003	-2.06	12.67	(-3, 2)	4	OK	None
398	Retain_2P_3_SummerN_BLK3add_2009	-1.94	12.69	(-3, 2)	4	OK	None
399	Retain_2P_3_SummerN_BLK3add_2011	-0.48	12.78	(-3, 2)	4	OK	None
400	SizeSel_3P_1_WinterS_BLK1add_1973	-0.05	0.06	(-3, 2)	4	OK	None
401	SizeSel_3P_1_WinterS_BLK1add_1983	0.07	0.05	(-3, 2)	4	OK	None
402	SizeSel_3P_1_WinterS_BLK1add_1993	0.20	0.06	(-3, 2)	4	OK	None
403	SizeSel_3P_1_WinterS_BLK1add_2003	0.12	0.05	(-3, 2)	4	OK	None
404	SizeSel_3P_1_WinterS_BLK1add_2011	0.15	0.05	(-3, 2)	4	OK	None
405	Retain_3P_1_WinterS_BLK2add_2003	-0.40	0.19	(-3, 2)	4	OK	None
406	Retain_3P_1_WinterS_BLK2add_2010	0.31	0.18	(-3, 2)	4	OK	None
407	Retain_3P_1_WinterS_BLK2add_2011	-0.22	0.16	(-3, 2)	4	OK	None
408	Retain_3P_2_WinterS_BLK2add_2003	0.44	0.24	(-3, 2)	4	OK	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	SD	Bounds	Phase	Status	Prior
409	Retain_3P_2_WinterS_BLK2add_2010	0.38	0.46	(-3, 2)	4	OK	None
410	Retain_3P_2_WinterS_BLK2add_2011	-0.51	0.84	(-3, 2)	4	OK	None
411	Retain_3P_3_WinterS_BLK2add_2003	3.44	11.91	(-3, 4)	4	OK	None
412	Retain_3P_3_WinterS_BLK2add_2010	-0.57	1.44	(-3, 2)	4	OK	None
413	Retain_3P_3_WinterS_BLK2add_2011	0.93	1.15	(-3, 2)	4	OK	None
414	SizeSel_4P_1_SummerS_BLK1add_1973	-0.08	0.03	(-3, 2)	4	OK	None
415	SizeSel_4P_1_SummerS_BLK1add_1983	-0.14	0.04	(-3, 2)	4	OK	None
416	SizeSel_4P_1_SummerS_BLK1add_1993	-0.04	0.05	(-3, 2)	4	OK	None
417	SizeSel_4P_1_SummerS_BLK1add_2003	0.07	0.03	(-3, 2)	4	OK	None
418	SizeSel_4P_1_SummerS_BLK1add_2011	0.03	0.03	(-3, 2)	4	OK	None
419	Retain_4P_1_SummerS_BLK3add_2003	-0.23	0.13	(-3, 2)	4	OK	None
420	Retain_4P_1_SummerS_BLK3add_2009	-0.25	0.18	(-3, 2)	4	OK	None
421	Retain_4P_1_SummerS_BLK3add_2011	-0.09	0.10	(-3, 2)	4	OK	None
422	Retain_4P_2_SummerS_BLK3add_2003	0.27	0.15	(-3, 2)	4	OK	None
423	Retain_4P_2_SummerS_BLK3add_2009	0.21	0.17	(-3, 2)	4	OK	None
424	Retain_4P_2_SummerS_BLK3add_2011	0.16	0.16	(-3, 2)	4	OK	None
425	Retain_4P_3_SummerS_BLK3add_2003	-0.22	44.04	(-3, 2)	4	OK	None
426	Retain_4P_3_SummerS_BLK3add_2009	-0.38	49.86	(-3, 2)	4	OK	None
427	Retain_4P_3_SummerS_BLK3add_2011	-0.31	47.32	(-3, 2)	4	OK	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	Rank	Endorsed
WA	1	4	1981-2014	Dockside CPUE	No	trip, area, month, Stephens-MacCall	delta-GLM (bin-gamma)	1	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.

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1876	53794.2	3.46e+04	0	14619.6	1.0091	0	1
1877	53794.2	3.46e+04	1	14619.7	1.0091	0	1
1878	53794.2	3.46e+04	1	14619.8	1.0091	0	1
1879	53794.2	3.46e+04	1	14619.9	1.0091	0	1
1880	53687.9	3.46e+04	1	14620	11.6551	0	1
1881	53581.9	3.46e+04	1	14620	22.3011	0	1
1882	53476.2	3.46e+04	1	14620	32.9473	0	0.99
1883	53370.7	3.46e+04	1	14619.9	43.5935	0	0.99
1884	53265.3	3.46e+04	1	14619.8	54.24	0	0.99
1885	53160	3.45e+04	1	14619.6	64.8866	0	0.99
1886	53054.8	3.45e+04	1	14619.3	75.5335	0	0.98
1887	52949.7	3.45e+04	0.99	14619	86.1808	0	0.98
1888	52844.5	3.44e+04	0.99	14618.7	96.8283	0	0.98
1889	52739.3	3.44e+04	0.99	14618.4	107.476	0	0.98
1890	52634.1	3.43e+04	0.99	14618.1	118.124	0	0.97
1891	52528.8	3.42e+04	0.99	14617.8	128.773	0	0.97
1892	52423.5	3.42e+04	0.99	14617.5	139.422	0	0.97
1893	52318	3.41e+04	0.99	14617.2	150.081	0	0.97
1894	52212.5	3.41e+04	0.98	14617	160.731	0	0.97
1895	52107	3.40e+04	0.98	14616.9	171.381	0	0.96

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

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1896	51999.2	3.39e+04	0.98	14616.7	182.275	0	0.96
1897	51893.8	3.39e+04	0.98	14616.7	192.882	0	0.96
1898	51788.4	3.38e+04	0.98	14616.8	203.489	0	0.96
1899	51682.4	3.37e+04	0.97	14616.9	214.137	0	0.95
1900	51576.4	3.36e+04	0.97	14617.2	224.785	0	0.95
1901	51470.3	3.36e+04	0.97	14617.6	235.434	0	0.95
1902	51364.1	3.35e+04	0.97	14618.2	246.083	0	0.95
1903	51257.7	3.34e+04	0.97	14619	256.732	0	0.95
1904	51151.3	3.33e+04	0.96	14620	267.382	0.01	0.94
1905	51044.8	3.33e+04	0.96	14621.3	278.033	0.01	0.94
1906	50938.2	3.32e+04	0.96	14622.8	288.684	0.01	0.94
1907	50831.5	3.31e+04	0.96	14624.7	299.335	0.01	0.94
1908	50724.7	3.30e+04	0.95	14626.8	309.987	0.01	0.93
1909	50617.8	3.30e+04	0.95	14629.4	320.639	0.01	0.93
1910	50510.8	3.29e+04	0.95	14632.4	331.292	0.01	0.93
1911	50403.8	3.28e+04	0.95	14635.9	341.946	0.01	0.93
1912	50296.7	3.27e+04	0.94	14639.9	352.6	0.01	0.93
1913	50189.5	3.27e+04	0.94	14644.5	363.255	0.01	0.92
1914	50082.3	3.26e+04	0.94	14649.7	373.91	0.01	0.92
1915	49975	3.25e+04	0.94	14655.5	384.565	0.01	0.92

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

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1916	49914.3	3.24e+04	0.94	14662	390.234	0.01	0.92
1917	48612.5	3.23e+04	0.93	14669.2	531.588	0.01	0.89
1918	49536.5	3.22e+04	0.93	14675.9	428.045	0.01	0.91
1919	50390	3.21e+04	0.93	14684.6	336.759	0.01	0.93
1920	51403.4	3.21e+04	0.93	14695.2	232.803	0	0.95
1921	50782.5	3.22e+04	0.93	14707.8	296.684	0.01	0.94
1922	49530.5	3.22e+04	0.93	14720.7	428.979	0.01	0.91
1923	49499.3	3.21e+04	0.93	14733	431.586	0.01	0.91
1924	48518.4	3.21e+04	0.93	14746.3	538.126	0.01	0.89
1925	48540.6	3.19e+04	0.92	14759.4	533.708	0.01	0.89
1926	48586.9	3.18e+04	0.92	14773.6	526.856	0.01	0.89
1927	47577.3	3.17e+04	0.92	14789	638.339	0.01	0.87
1928	47656.9	3.16e+04	0.91	14804.6	626.266	0.01	0.87
1929	46861.8	3.14e+04	0.91	14822.2	714.661	0.01	0.85
1930	47246.1	3.12e+04	0.9	14842	666.697	0.01	0.86
1931	47122.7	3.11e+04	0.9	14868.6	684.609	0.01	0.86
1932	46106.5	3.09e+04	0.89	14905.2	817.803	0.02	0.84
1933	45903.6	3.07e+04	0.89	14956.2	853.545	0.02	0.83
1934	40127.9	3.05e+04	0.88	15046.2	1633.3	0.03	0.71
1935	40073.6	2.98e+04	0.86	15196.6	1616.59	0.03	0.71

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

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1936	42039.9	2.92e+04	0.84	15431.6	1327.27	0.03	0.75
1937	38151.7	2.88e+04	0.83	15755.5	1905.95	0.04	0.67
1938	36334.5	2.80e+04	0.81	16110.2	2173.3	0.05	0.63
1939	33513	2.72e+04	0.78	16325.4	2664.84	0.06	0.57
1940	33666.9	2.60e+04	0.75	16137	2563.76	0.06	0.57
1941	34710.1	2.51e+04	0.72	15494.8	2311.13	0.06	0.59
1942	30442.4	2.44e+04	0.71	14682.4	3234.43	0.08	0.5
1943	29140.7	2.33e+04	0.67	14086.1	3369.66	0.09	0.48
1944	31331.8	2.22e+04	0.64	13949.8	2666.16	0.07	0.52
1945	31821.8	2.17e+04	0.63	13949.6	2498	0.07	0.53
1946	25979.6	2.13e+04	0.61	13276	3789.81	0.11	0.41
1947	27517.7	2.01e+04	0.58	11954.9	3136.71	0.09	0.45
1948	22075.3	1.94e+04	0.56	10832.2	4506.31	0.14	0.34
1949	20892	1.77e+04	0.51	10184.2	4401.04	0.15	0.32
1950	19506.3	1.62e+04	0.47	10125.9	4622.33	0.17	0.29
1951	23556.9	1.45e+04	0.42	10638.7	3035.25	0.12	0.37
1952	23887.1	1.38e+04	0.4	11508.1	2782.03	0.12	0.37
1953	24979.9	1.32e+04	0.38	12115.7	2356.17	0.11	0.4
1954	21743	1.28e+04	0.37	12385.5	2883.06	0.13	0.34
1955	22642.4	1.20e+04	0.35	12311	2561.16	0.13	0.35

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

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1956	23712.9	1.14e+04	0.33	12100.6	2267.69	0.12	0.37
1957	20192.5	1.10e+04	0.32	12040.9	2906.64	0.15	0.3
1958	19596.6	1.03e+04	0.3	11989.1	2862.58	0.16	0.29
1959	21117.2	9.72e+03	0.28	11925.6	2448.1	0.14	0.32
1960	18967.4	9.48e+03	0.27	15801.3	2864.23	0.17	0.28
1961	16285.4	9.05e+03	0.26	15477.3	3438.48	0.21	0.23
1962	16000.8	8.32e+03	0.24	10247.6	3284.74	0.21	0.22
1963	15074.7	7.70e+03	0.22	10871.9	3328.04	0.22	0.2
1964	16153.8	7.12e+03	0.21	16095.1	2782.78	0.19	0.22
1965	16544.5	6.98e+03	0.2	14608.1	2649.77	0.19	0.23
1966	16486.7	7.06e+03	0.2	28734.1	2679.65	0.19	0.23
1967	16244.1	7.12e+03	0.21	12701.5	2716.07	0.19	0.23
1968	17536.5	7.08e+03	0.2	12796.3	2421.5	0.17	0.25
1969	17700.2	7.21e+03	0.21	11761.9	2464.66	0.16	0.25
1970	15614.8	7.54e+03	0.22	12071.1	3189.59	0.19	0.21
1971	15543.3	7.81e+03	0.23	11465.8	3323.2	0.2	0.21
1972	14957.7	8.18e+03	0.24	9848.12	3590.89	0.22	0.2
1973	16143.2	8.22e+03	0.24	8348.23	3066.02	0.19	0.23
1974	13497.4	8.23e+03	0.24	10593.9	3863.97	0.25	0.18
1975	12976.2	7.53e+03	0.22	10808.6	3727.16	0.26	0.17

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

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1976	13504	6.71e+03	0.19	13497.5	3061.68	0.24	0.18
1977	14904	6.16e+03	0.18	11556.4	2519.07	0.22	0.21
1978	11980.9	5.80e+03	0.17	9010.88	3216.99	0.29	0.15
1979	10595.3	4.99e+03	0.14	9297.14	3305.3	0.33	0.12
1980	10676.7	4.20e+03	0.12	10483.9	2771.44	0.3	0.13
1981	10445.3	3.85e+03	0.11	9141.87	2670.92	0.31	0.12
1982	10265	3.63e+03	0.1	7726.22	2730.6	0.34	0.12
1983	9969.04	3.34e+03	0.1	8950.99	2461.01	0.33	0.11
1984	11395.6	3.14e+03	0.09	13862.3	1908.04	0.27	0.14
1985	11651.2	3.18e+03	0.09	8384.3	1845.18	0.27	0.15
1986	10674.8	3.23e+03	0.09	4859.73	2114.93	0.3	0.13
1987	9128.47	3.09e+03	0.09	6378.76	2497.91	0.36	0.1
1988	9024.12	2.72e+03	0.08	9991.92	2331.07	0.36	0.1
1989	8671.37	2.53e+03	0.07	12805.1	2291.18	0.39	0.09
1990	9109.31	2.39e+03	0.07	12899.5	1941.89	0.37	0.1
1991	8099.78	2.24e+03	0.06	9064.76	2116.22	0.43	0.08
1992	8304.53	1.85e+03	0.05	5096.46	1777.38	0.37	0.09
1993	8931.68	1.70e+03	0.05	9782.47	1696.15	0.33	0.09
1994	10106.8	1.83e+03	0.05	12013.4	1559.87	0.28	0.12
1995	10790.1	2.27e+03	0.07	7312.89	1695.98	0.29	0.13

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

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1996	10590.6	2.67e+03	0.08	8885.02	1945.14	0.32	0.12
1997	10241.4	2.76e+03	0.08	8375.1	2059.99	0.32	0.12
1998	11252.9	2.64e+03	0.08	19640.6	1742.13	0.28	0.14
1999	12200.6	2.72e+03	0.08	12993.3	1627.28	0.25	0.15
2000	11450.8	2.94e+03	0.08	9440.98	1924.76	0.29	0.14
2001	11330.8	2.98e+03	0.09	7963.34	1982.13	0.27	0.14
2002	11348.3	3.01e+03	0.09	9028.43	2068.53	0.26	0.14
2003	13461.3	3.24e+03	0.09	7705.18	1754.24	0.21	0.17
2004	12835.1	3.87e+03	0.11	9219.13	2254.33	0.25	0.16
2005	11228.4	4.25e+03	0.12	9501.26	2964.19	0.33	0.13
2006	12995.9	4.03e+03	0.12	16408.3	2178.84	0.26	0.16
2007	12305.4	3.95e+03	0.11	22866.5	2378.12	0.29	0.15
2008	12488.8	3.65e+03	0.11	31400.2	2156.58	0.28	0.16
2009	11738.8	3.47e+03	0.1	13034	2274.03	0.29	0.14
2010	20576.3	3.31e+03	0.1	10207.1	884.326	0.1	0.31
2011	25253.6	4.20e+03	0.12	10285.9	774.815	0.06	0.4
2012	24637.6	5.71e+03	0.16	14683.1	1129.34	0.07	0.39
2013	21618.1	7.69e+03	0.22	12421.3	1945.94	0.11	0.33
2014	21762.8	9.47e+03	0.27	13495.7			

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

Year	OFL contriubtion (mt)	ACL landings (mt)	Age 5+ biomass (mt)	Spawning Biomass (mt)	Depletion
2015	3072.90	2800.78	20046.80	10669.20	0.31
2016	3207.71	2895.41	20214.50	11076.70	0.32
2017	3219.65	3076.71	20119.00	11074.80	0.32
2018	3138.42	2998.73	19749.60	10821.80	0.31
2019	3050.82	2914.44	19417.60	10571.10	0.31
2020	2981.68	2847.86	19168.80	10373.40	0.30
2021	2935.68	2803.56	19000.20	10239.00	0.30
2022	2908.07	2777.00	18891.60	10156.00	0.29
2023	2892.39	2761.92	18821.40	10106.30	0.29
2024	2883.38	2753.28	18773.80	10075.50	0.29
2025	2877.63	2747.78	18738.80	10054.40	0.29
2026	2873.28	2743.61	18710.90	10038.00	0.29

8 Figures

figures

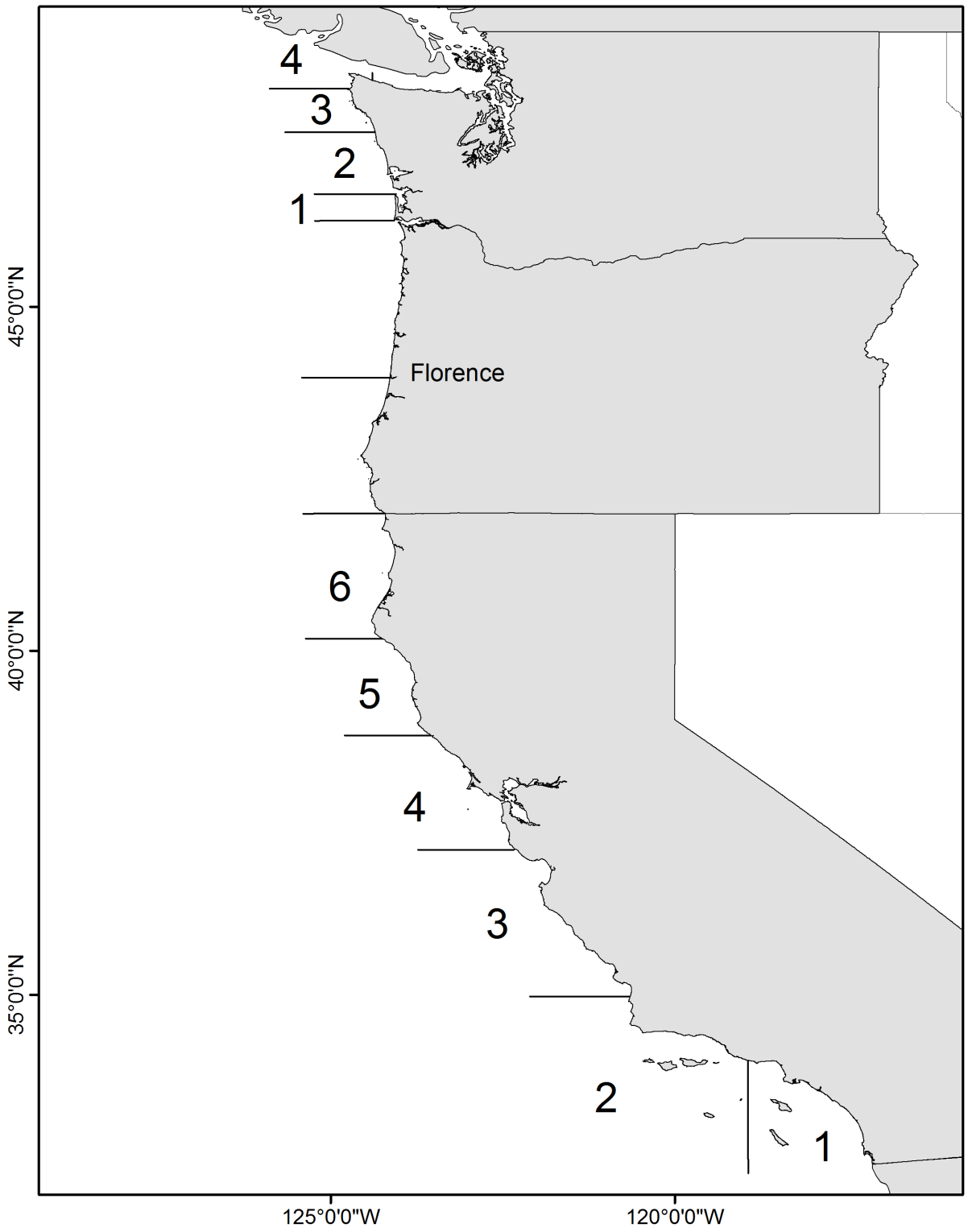


Figure 1: Map showing the state boundary lines for management of the recreational fishing fleets. CRFS Districts 1-6 in California are presented as well as the WDFW Recreational Management Areas in Washington. Florence, OR is shown as a potential location of model stratification. `fig:boundary_map`

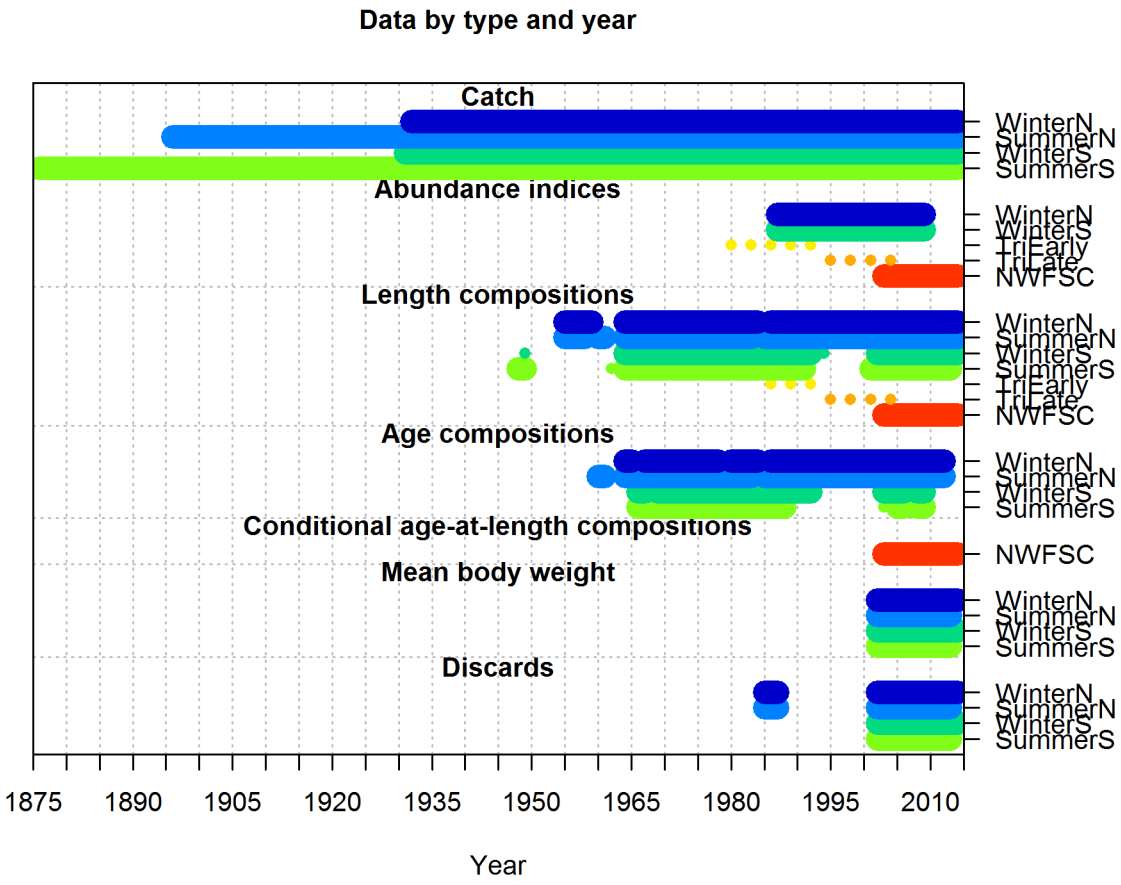


Figure 2: Summary of data sources used in the northern assessment. `fig:data_plot`

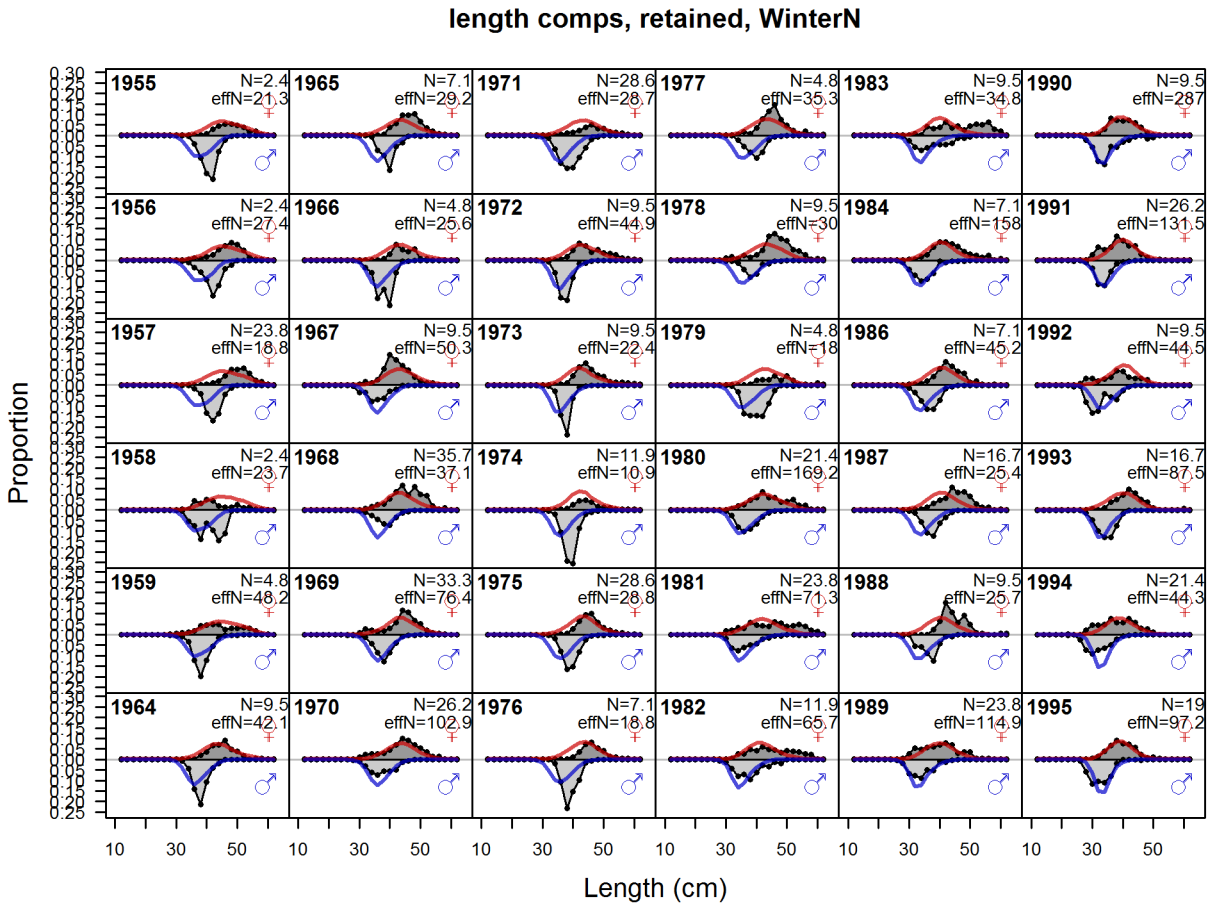
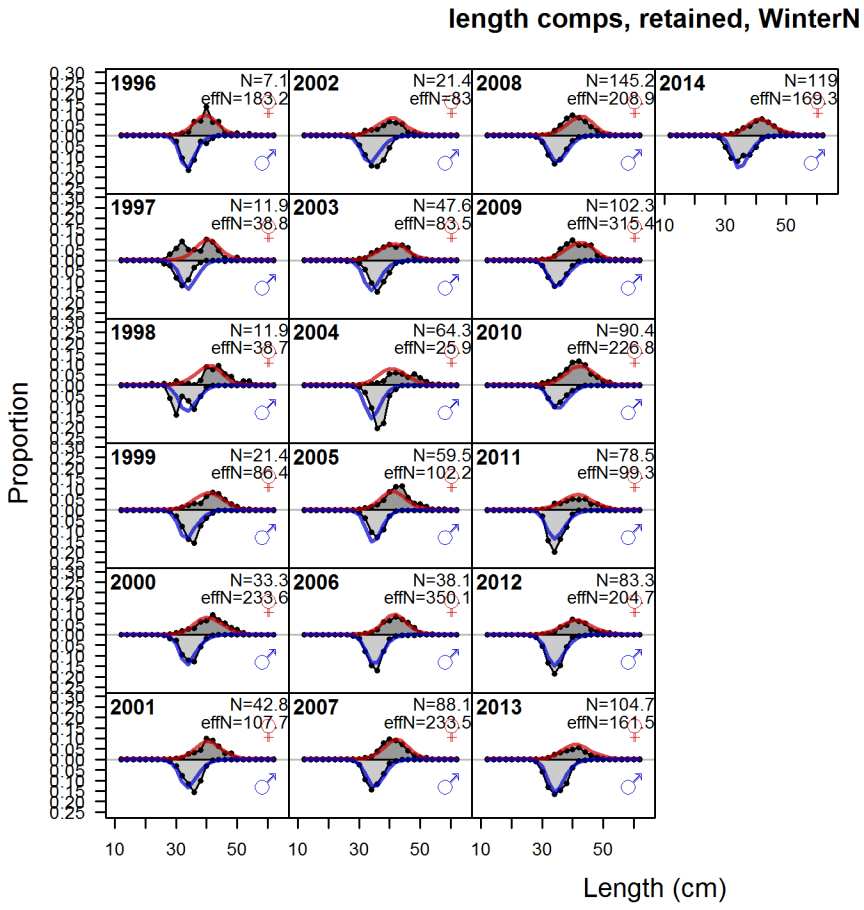


Figure 3: length comps, retained, WinterN (plot 1 of 2) [fig:mod1_1_comp_lenfit_flt1m



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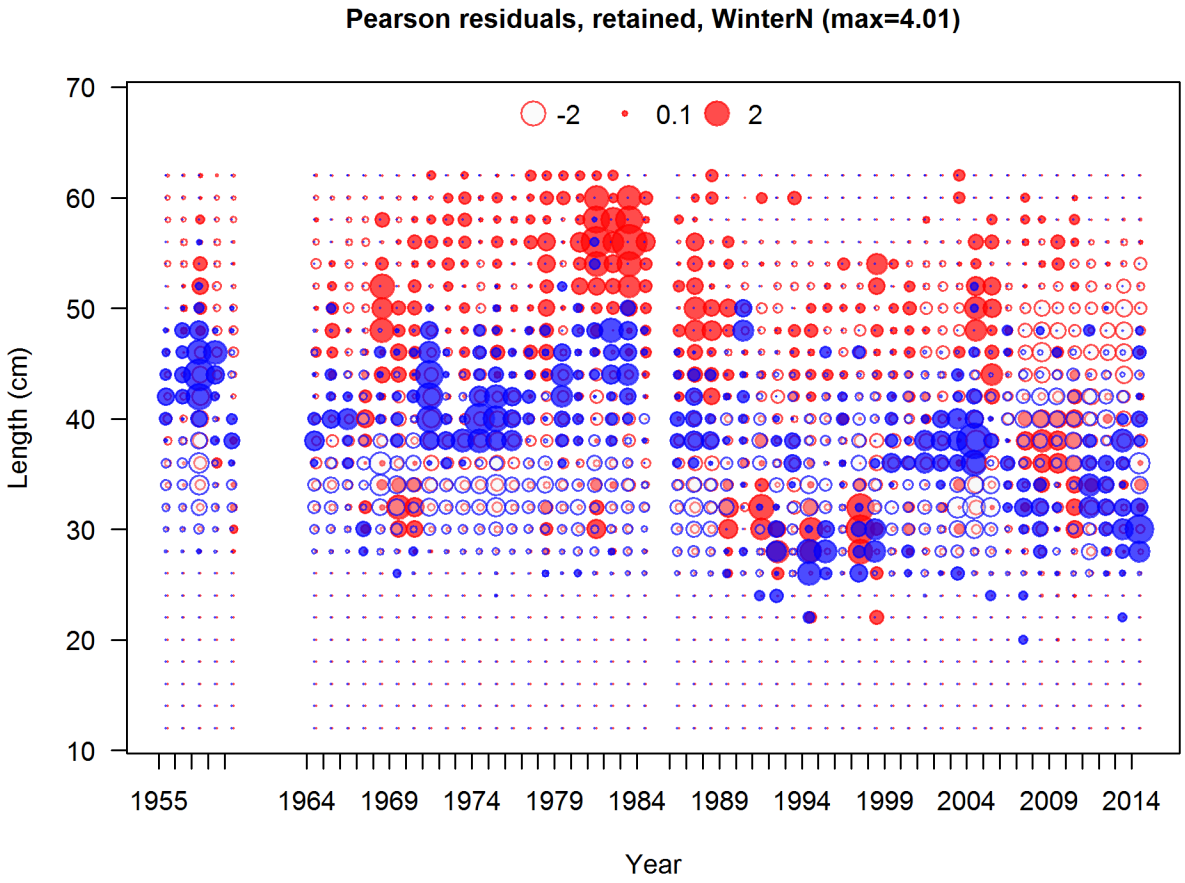

490

491 Figure continued from previous page

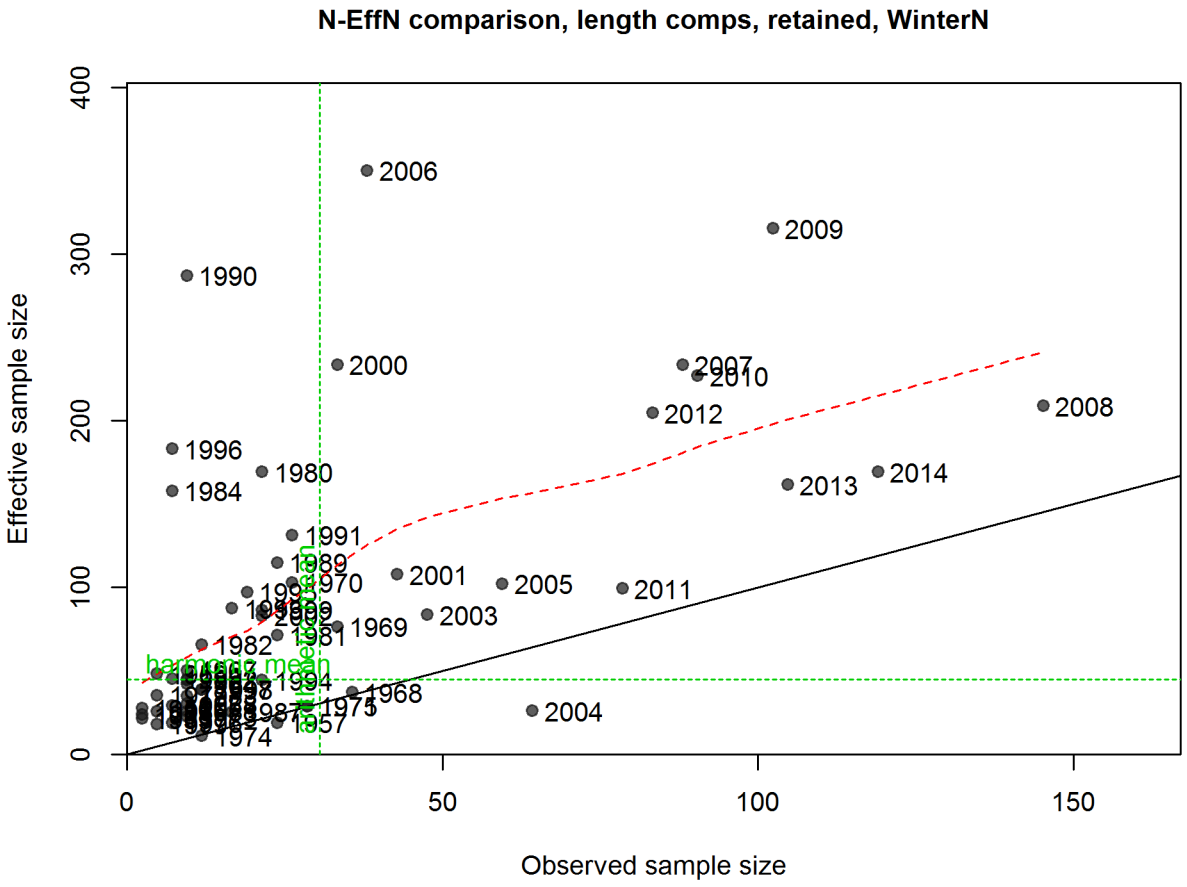

Figure 4: N_EffN comparison, length comps, retained, WinterN [fig:mod1_4_comp_lenfit_sa

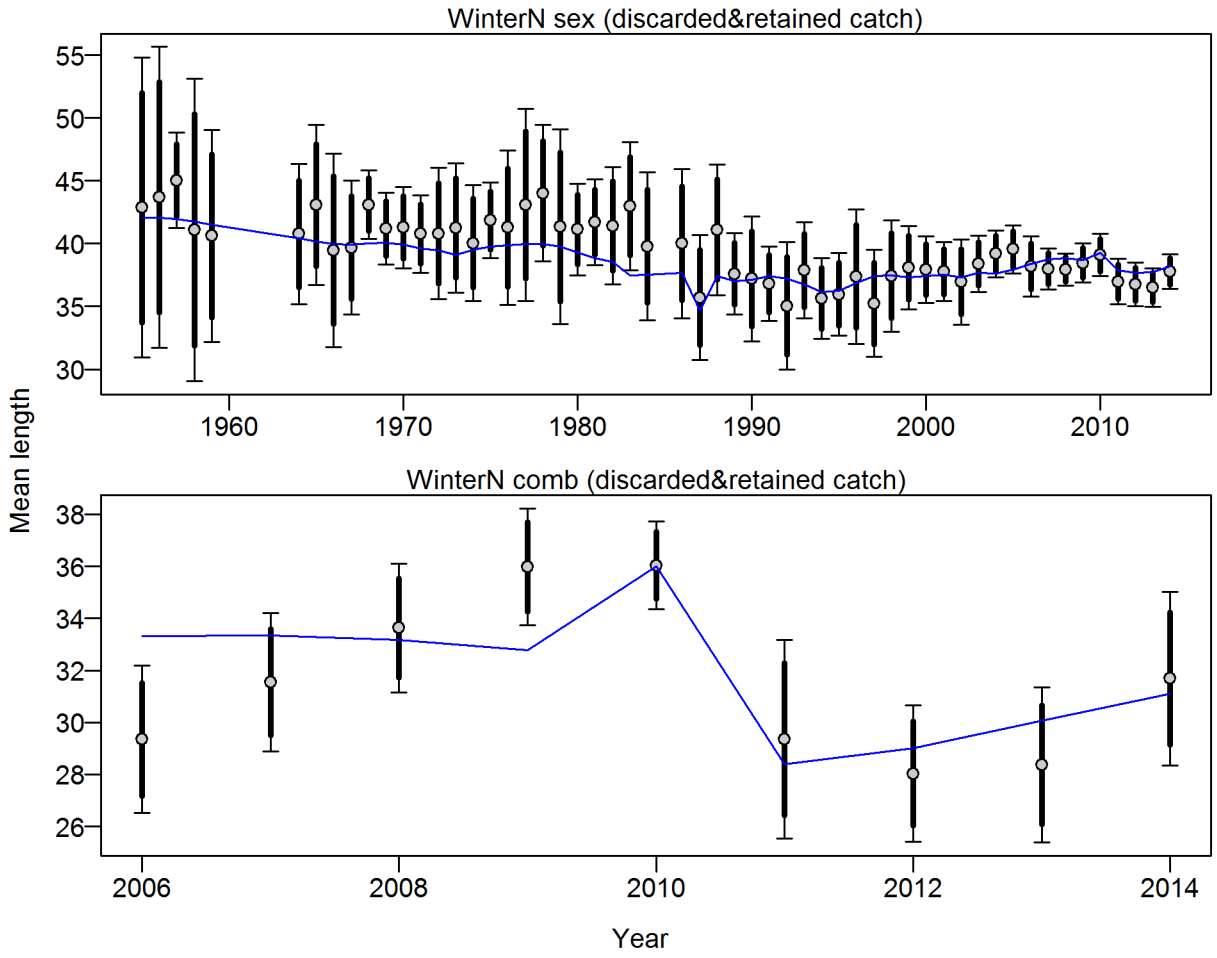

Figure 5: Francis data weighting method TA1.8 WinterN Suggested sample size adjustment (with 95% interval) for len data from WinterN: 0.5881 (0.4129_0.9119) | fig:mod1_5_comp_lenfit_data_wei

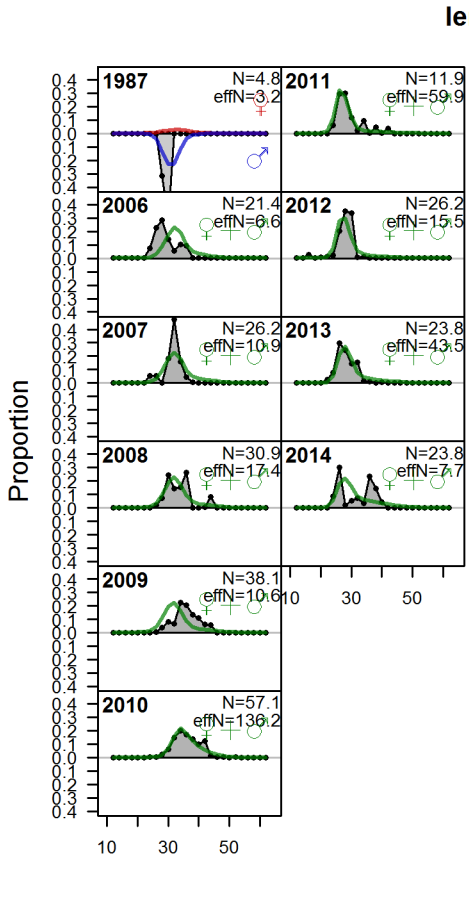

Figure 6: length comps, discard, WinterN ⌈ `fig:mod1_6_comp_lenfit_flt1mkt1`

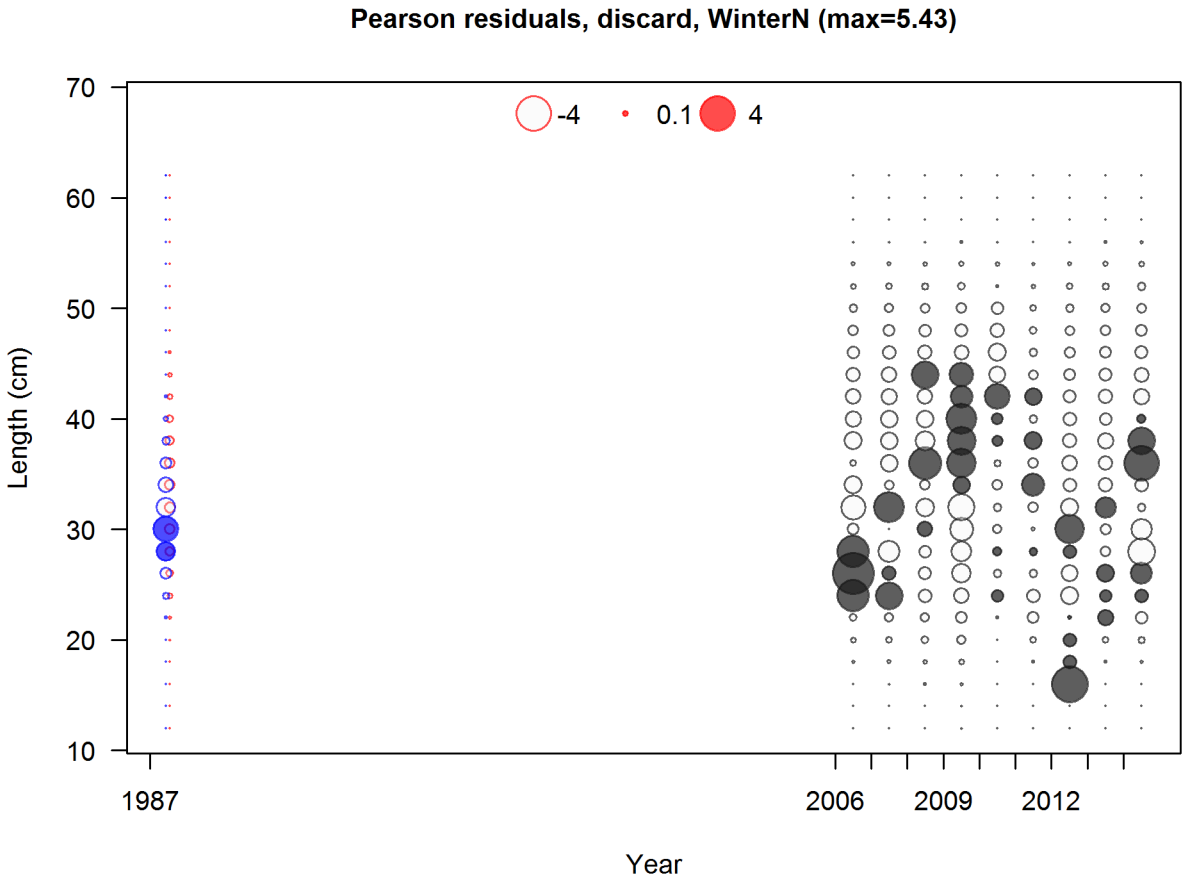

Figure 7: Pearson residuals, discard, WinterN (max=5.43)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). `fig:mod1_7_comp_lenfit_residsflt1mkt1`

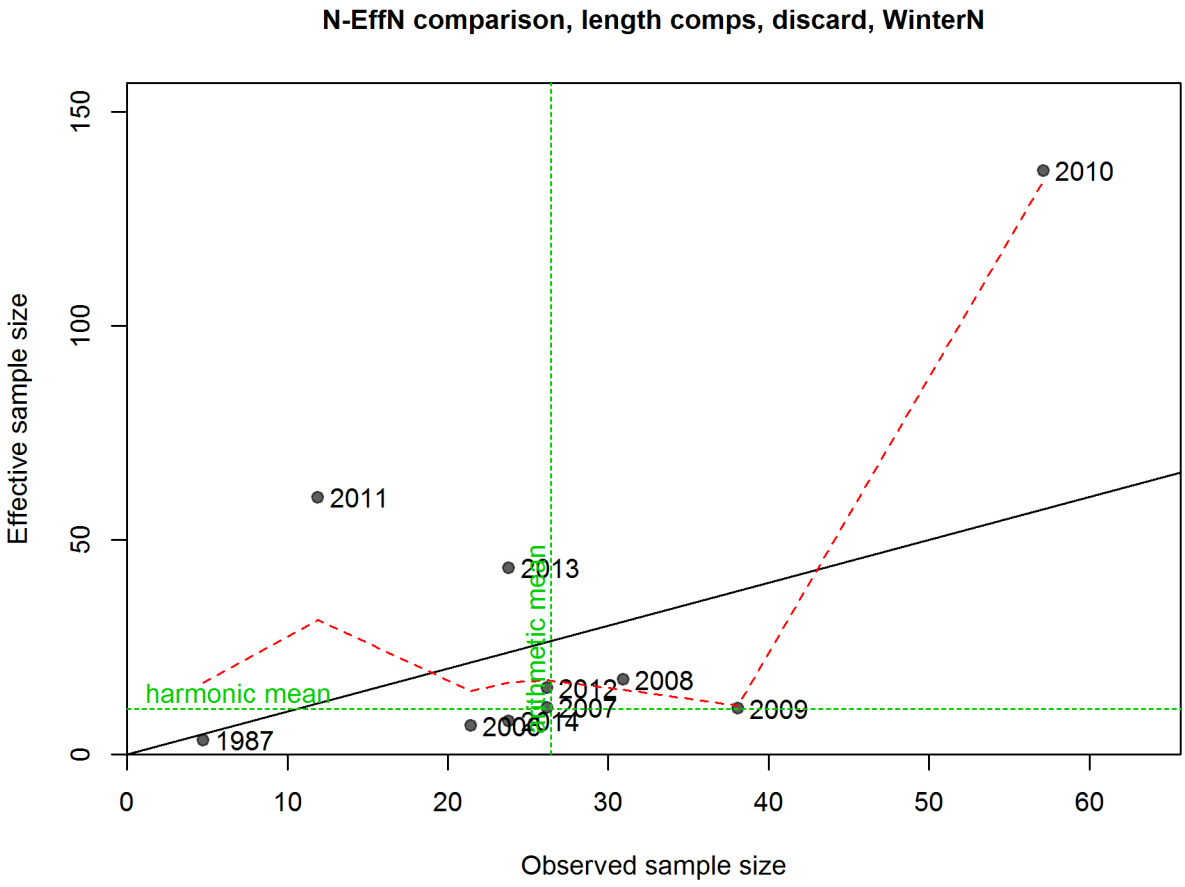

Figure 8: N_EffN comparison, length comps, discard, WinterN [fig:mod1_8_comp_lenfit_sa

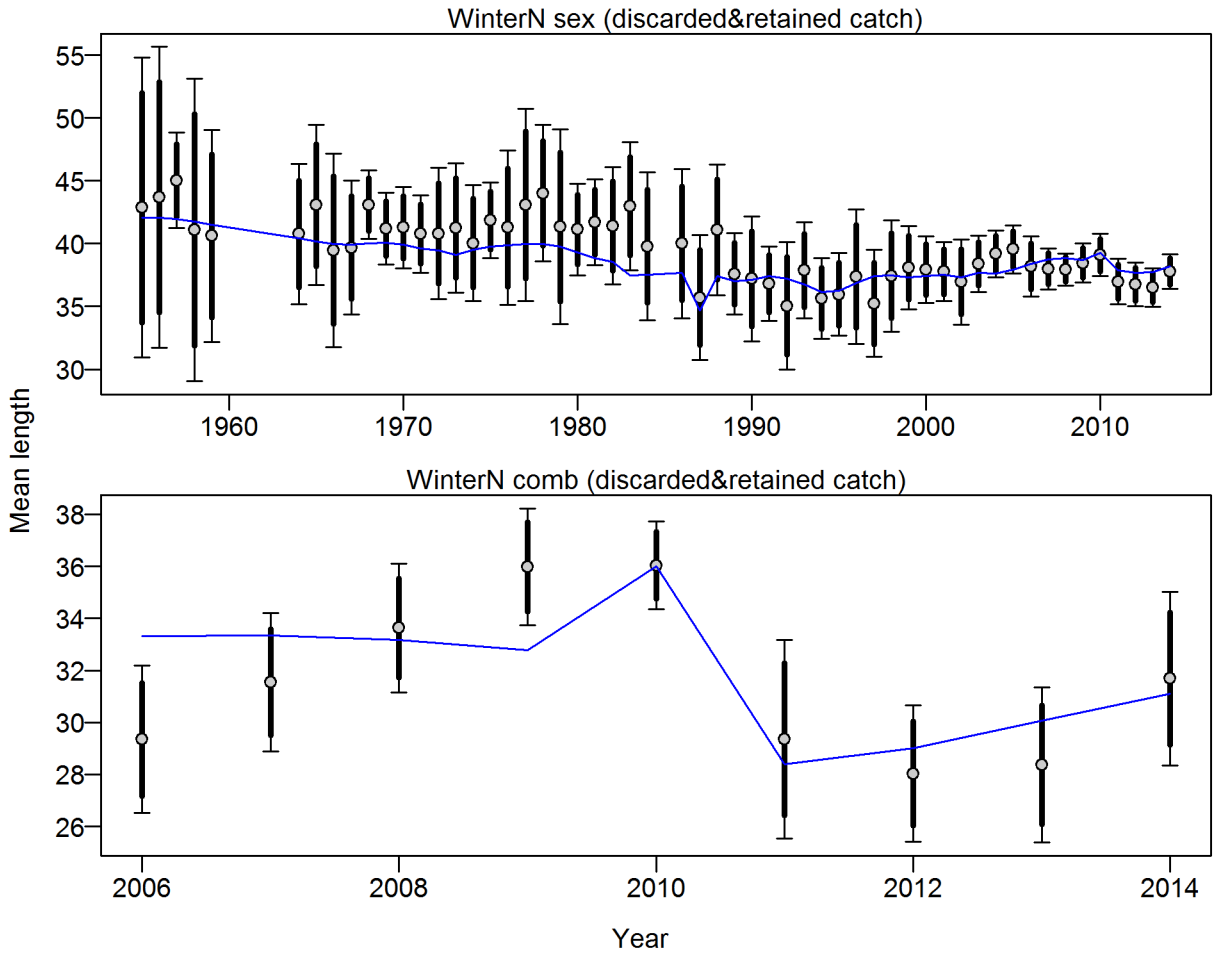

Figure 9: Francis data weighting method TA1.8 WinterN Suggested sample size adjustment (with 95% interval) for len data from WinterN: 0.5881 (0.4122_0.9265) | fig:mod1_9_comp_lenfit_data_wei

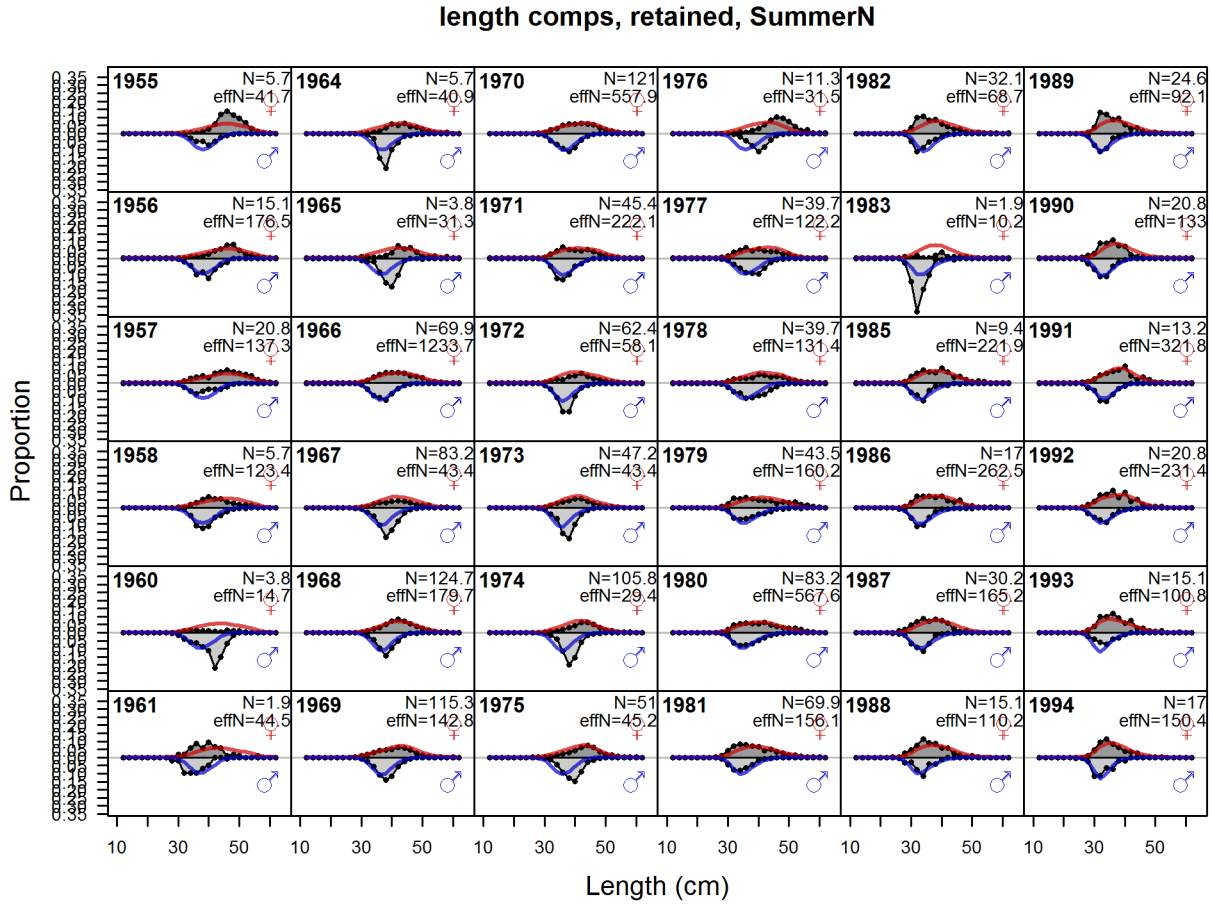

Figure 10: length comps, retained, SummerN (plot 1 of 2) [fig:mod1_10_comp_lenfit_flt

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