Status of Pacific ocean perch (*Sebastes alutus*) along the U.S. west coast in 2017

Chantel R. Wetzel[1]
Kelli Johnson[2]
Lee Cronin-Fine[3]

[1]Northwest Fisheries Science Center, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, 2725 Montlake Boulevard East, Seattle, Washington 98112

[2]Northwest Fisheries Science Center, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, 2725 Montlake Boulevard East, Seattle, Washington 98112

[3]University of Washington, School of Aquatic and Fishery Sciences

Status of Pacific ocean perch (*Sebastes alutus*) along the U.S. west coast in 2017

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 Pacific ocean perch (*Sebastes alutus*) resource in U.S. waters off the coast of the California, Oregon, and Washington using data through 2011. 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-**??**)
Catch table: (Table a)

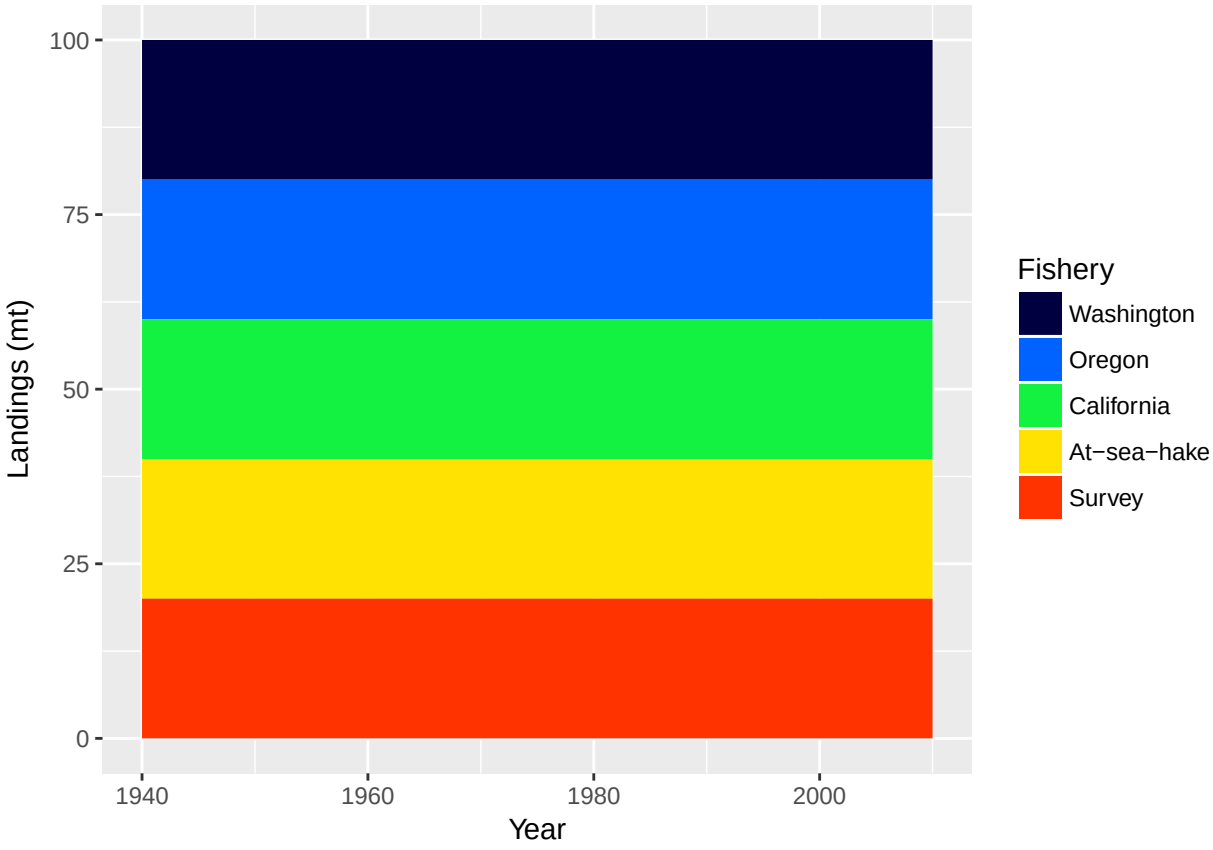

Figure a: Pacific ocean perch landings in ..... `fig:Exec_catch1`

Table a: Recent Pacific ocean perch landings (mt) by fleet.

tab:Exec_catch

Year	Washington	Oregon	California	At-sea-hake	Survey	Total Catch	Total Dead
2001	20	20	20	20	20	264	264
2002	20	20	20	20	20	150	150
2003	20	20	20	20	20	134	134
2004	20	20	20	20	20	122	122
2005	20	20	20	20	20	64	64
2006	20	20	20	20	20	72	72
2007	20	20	20	20	20	132	132
2008	20	20	20	20	20	86	86
2009	20	20	20	20	20	95	95
2010	20	20	20	20	20	91	91

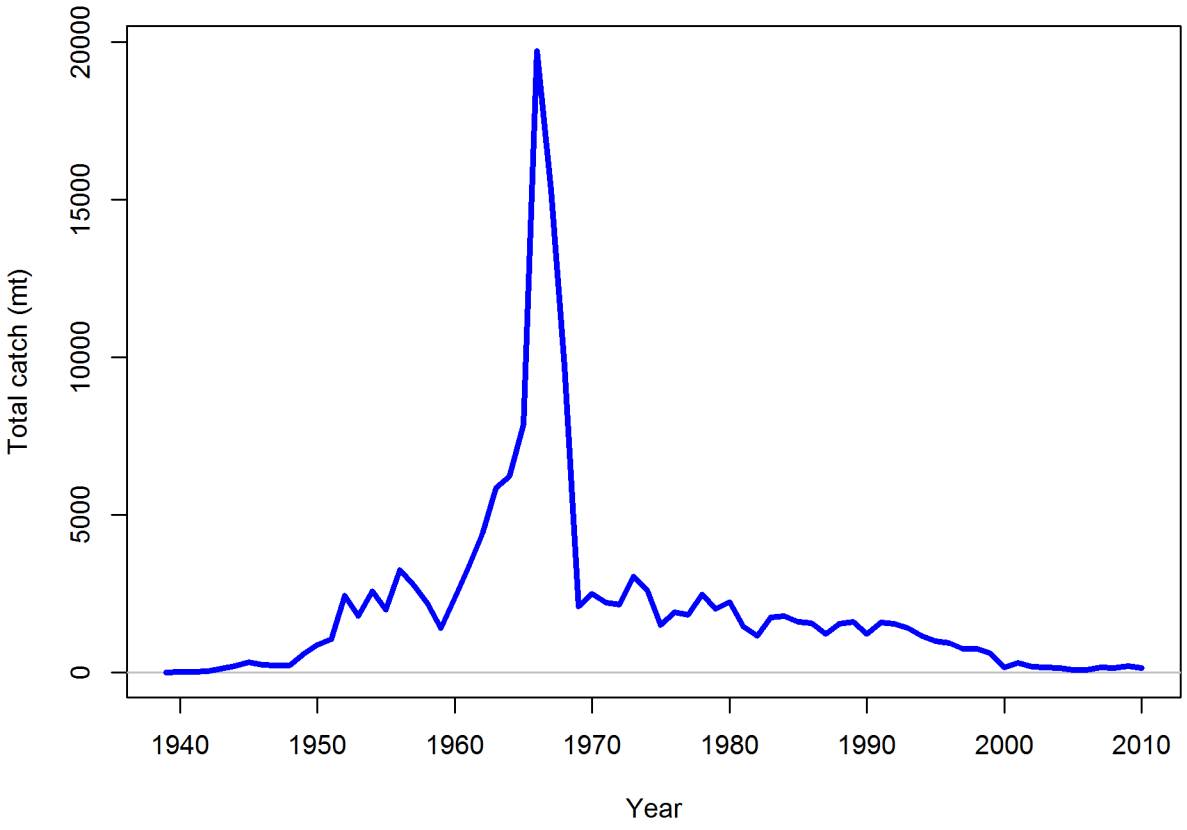

Figure b: Landings history of Pacific ocean perch in the Base model. [fig:r4ss_catches]

Data and Assessment

data-and-assessment

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

Pacific ocean perch was assessed.... This assessment uses the newest version of Stock Synthesis (3.30). The model begins in 1940, and assumes the stock was at an unfished equilibrium that year.

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

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 2011 is 19.5% (~95% asymptotic interval: ± 12.9%-26%) (Figure d).

The estimated relative depletion level of model 2 in 2011 is (~95% asymptotic interval: ±) (Figure d).

The estimated relative depletion level of model 3 in 2011 is (~95% asymptotic interval: ±) (Figure d).

Table b: Recent trend in beginning of the year spawning output and depletion for the Base model for Pacific ocean perch.

tab:SpawningDeplete_mod1

Year	Spawning Output (billion eggs)	~ 95% confidence interval	Estimated depletion	~ 95% confidence interval
2002	9812.00	5399 - 14225	0.15	0.099 - 0.198
2003	10044.00	5500 - 14588	0.15	0.101 - 0.203
2004	10330.00	5634 - 15025	0.16	0.104 - 0.209
2005	10706.00	5825 - 15587	0.16	0.107 - 0.217
2006	11220.00	6110 - 16330	0.17	0.113 - 0.227
2007	11802.00	6431 - 17173	0.18	0.119 - 0.239
2008	12291.00	6684 - 17897	0.19	0.124 - 0.249
2009	12632.00	6862 - 18403	0.19	0.127 - 0.256
2010	12769.00	6913 - 18624	0.19	0.128 - 0.258
2011	12852.00	6954 - 18751	0.20	0.129 - 0.260

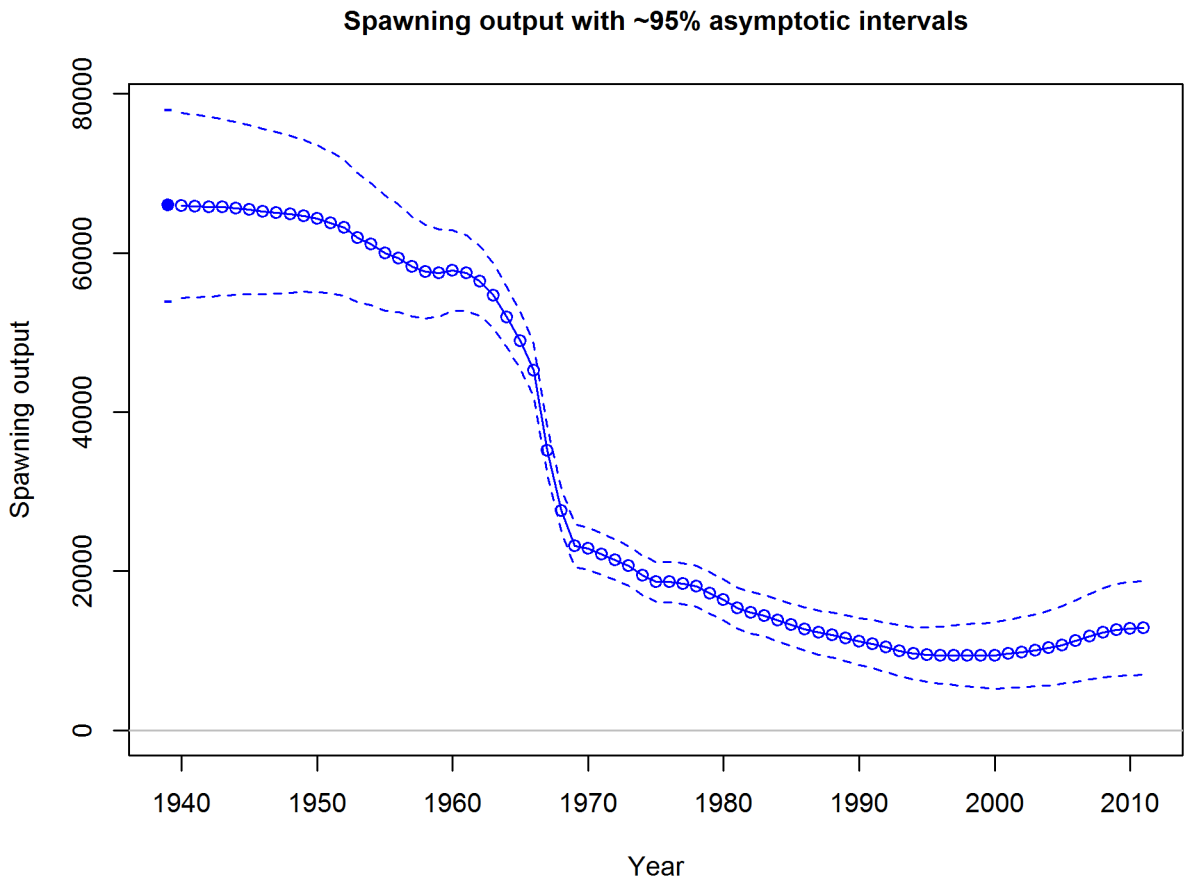

Figure c: Time series of spawning output trajectory (circles and line: median; light broken lines: 95% credibility intervals) for the base case assessment model. fig:Spawnbio_all

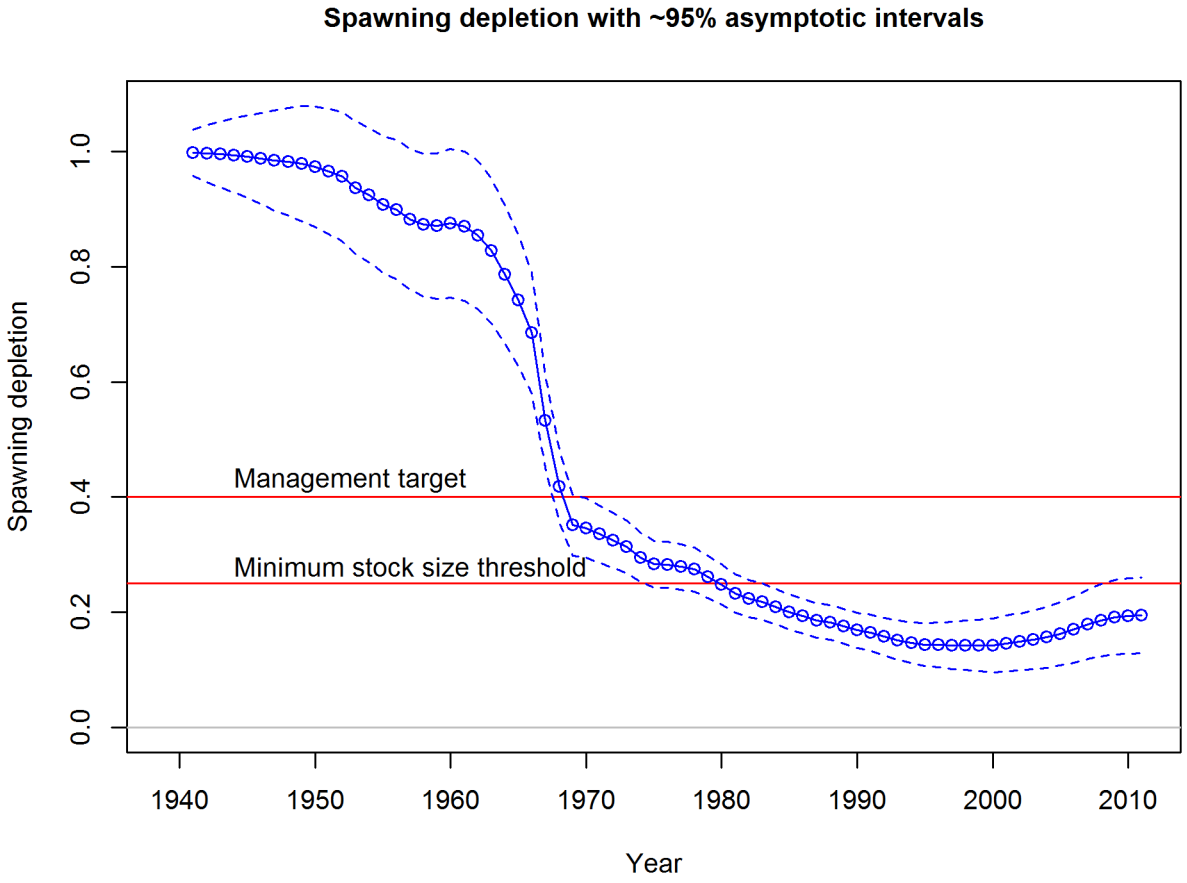

Figure d: Estimated relative depletion with approximate 95% asymptotic confidnce intervals (dashed lines) for the base case assessment model. 「fig:RelDeplete_all

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

Table c: Recent recruitment for the Base model.

tab:Recruit_mod1

Year	Estimated Recruitment (1,000s)	~ 95% confidence interval
2002	2030.00	1104 - 3733
2003	820.00	374 - 1799
2004	2983.00	1663 - 5348
2005	2055.00	1029 - 4102
2006	1270.00	558 - 2887
2007	1210.00	485 - 3016
2008	10906.00	5555 - 21412
2009	2753.00	871 - 8700
2010	3664.00	1023 - 13130
2011	3683.00	1384 - 9798

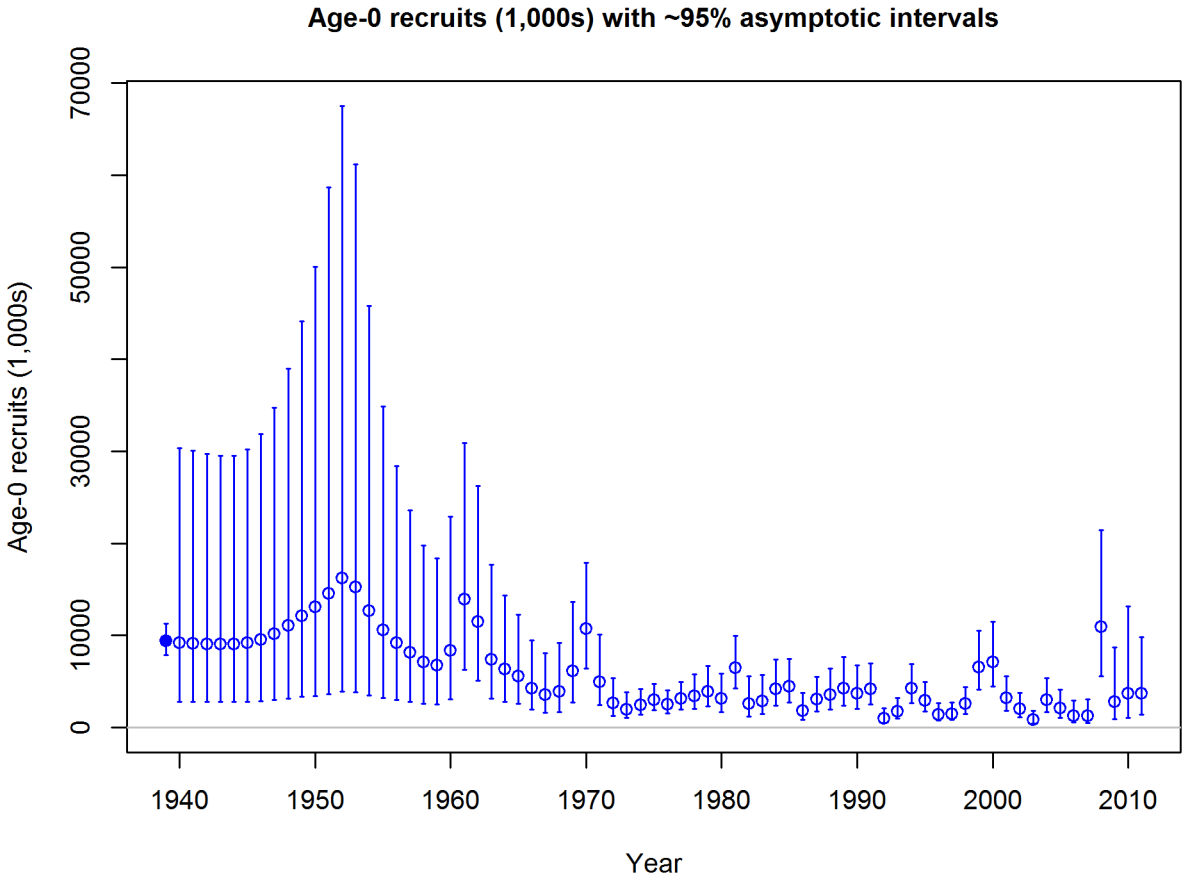

Figure e: Time series of estimated Pacific ocean perch recruitments for the base-case model with 95% confidence or credibility intervals. ⌜fig:Recruits_all

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 f).

A summary of Pacific ocean perch exploitation histories for base model is provided as Figure g.

Table d: Recent trend in spawning potential ratio and exploitation for Pacific ocean perch 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
2001	0.616	0.416 - 0.816	0.016	0.009 - 0.023
2002	0.388	0.243 - 0.533	0.009	0.005 - 0.013
2003	0.347	0.214 - 0.481	0.007	0.004 - 0.011
2004	0.315	0.192 - 0.439	0.006	0.004 - 0.009
2005	0.172	0.100 - 0.243	0.003	0.002 - 0.005
2006	0.183	0.107 - 0.259	0.004	0.002 - 0.005
2007	0.300	0.182 - 0.419	0.006	0.004 - 0.009
2008	0.254	0.149 - 0.358	0.005	0.003 - 0.008
2009	0.354	0.208 - 0.500	0.008	0.004 - 0.012
2010	0.255	0.150 - 0.360	0.006	0.003 - 0.008

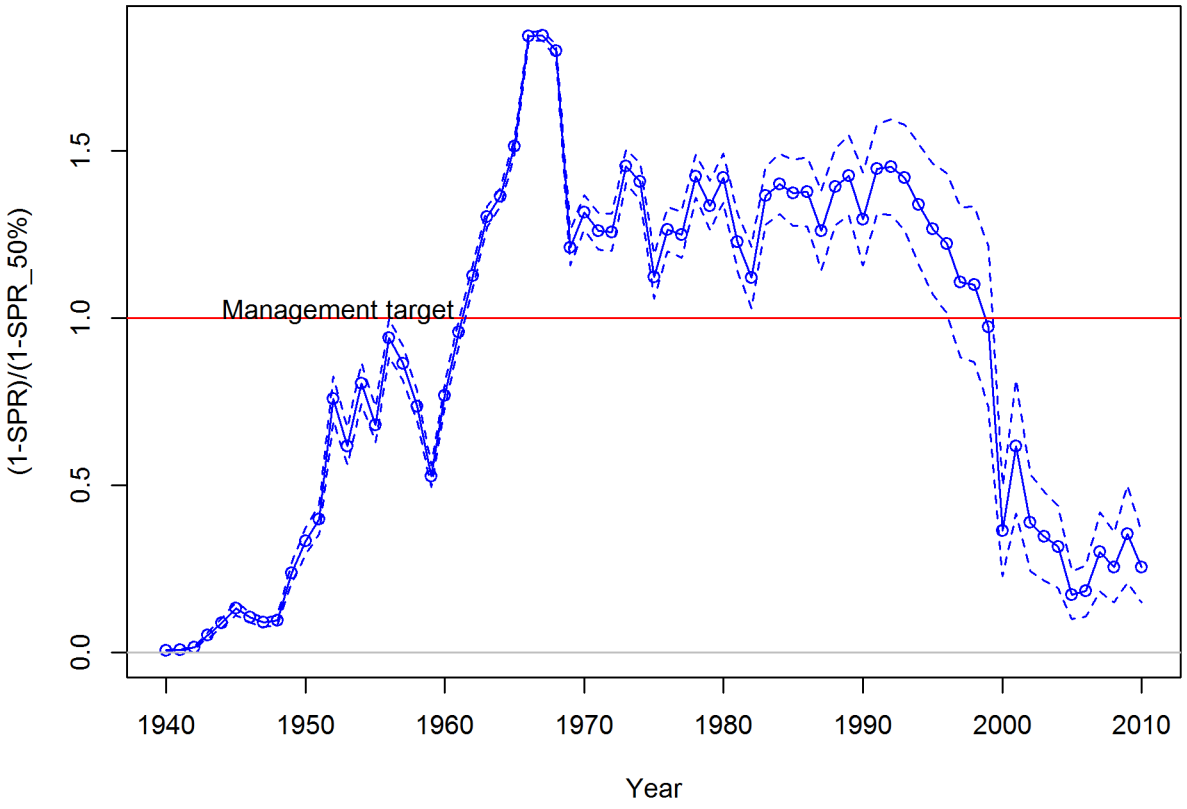

Figure f: Estimated spawning potential ratio (SPR) for the base-case model. One minus SPR is plotted so that higher exploitation rates occur on the upper portion of the y-axis. The management target is plotted as a red horizontal line and values above this reflect harvests in excess of the overfishing proxy based on the $SPR_{50\%}$ harvest rate. The last year in the time series is 2010. `fig:SPR_all`

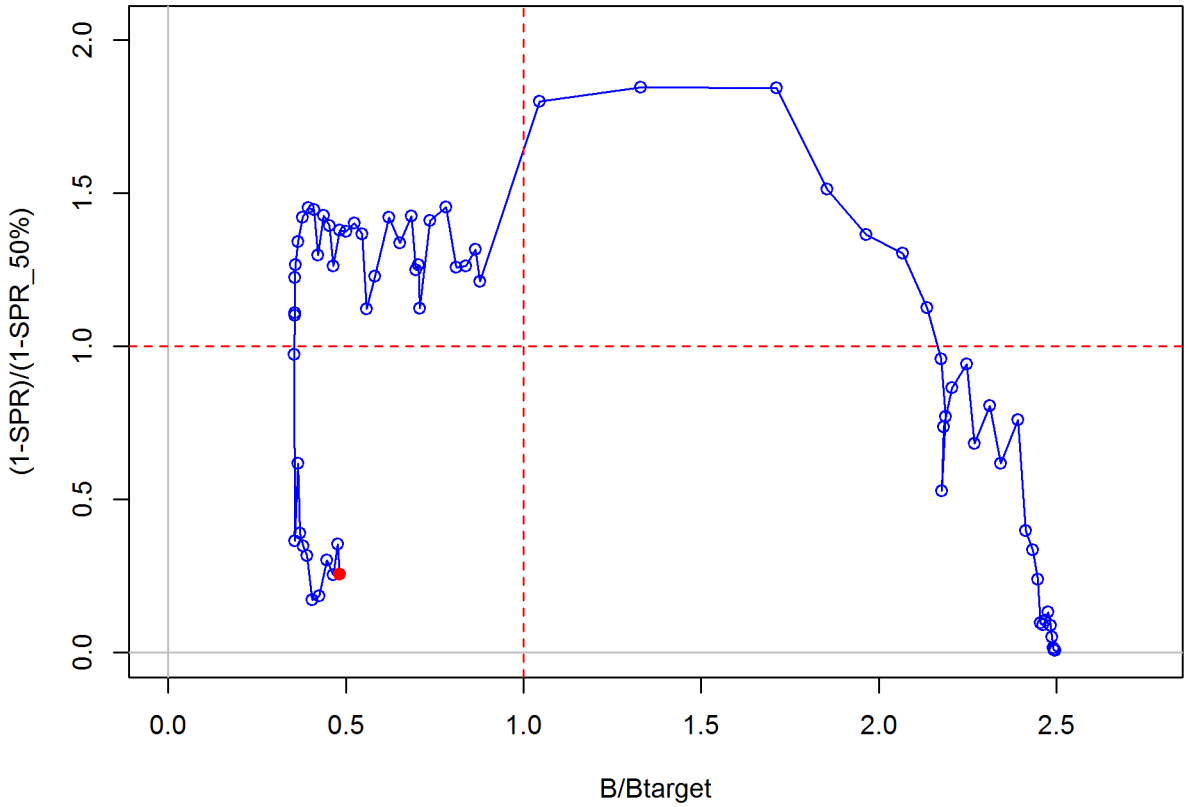

Figure g: Phase plot of estimated relative (1-SPR) vs. relative spawning biomass for the base case model. The relative (1-SPR) is (1-SPR) divided by 50% (the SPR target). Relative depletion is the annual spawning biomass divided by the unfished spawning biomass. `fig:Phase_all`

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 Pacific ocean perch in the Base model are below the biomass target, but below the minimum stock size threshold. Add sentence about spawning output trend. The estimated relative depletion level for Model 1 in 2011 is 19.5% (˜95% asymptotic interval: ± 12.9%-26%, corresponding to an unfished spawning output of 12852 billion eggs (˜95% asymptotic interval: 6953.7119917681-18751.0880082319 billion eggs) of spawning output in the base model (Table e). Unfished age 3+ biomass was estimated to be 121380 mt in the base case model. The target spawning output based on the biomass target ($SB_{40\%}$) is 26418.6 billion eggs, which gives a catch of 1064.7 mt. Equilibrium yield at the proxy F_{MSY} harvest rate corresponding to $SPR_{50\%}$ is 869.6 mt.

This stock assessment estimates that Pacific ocean perch 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 2011 is (˜95% asymptotic interval: ±), corresponding to an unfished spawning output of (˜95% asymptotic interval:) of spawning output in the base model (Table **??**). Unfished age 3+ 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 Pacific ocean perch 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 2011 is (˜95% asymptotic interval: ±), corresponding to an unfished spawning output of (˜95% asymptotic interval:) of spawning output in the base model (Table **??**). Unfished age 3+ 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)	66046.4	54008 - 78084.8
Unfished age 3+ biomass (mt)	121380	99829.6 - 142930.4
Unfished recruitment (R0, thousands)	9398.2	7835.3 - 11272.9
Spawning output(2011 billion eggs)	12852.4	6953.7 - 18751.1
Depletion (2011)	0.195	0.129 - 0.26
Reference points based on SB$_{40\%}$		
Proxy spawning output ($B_{40\%}$)	26418.6	21603.2 - 31234
SPR resulting in $B_{40\%}$ ($SPR_{B40\%}$)	0.625	0.625 - 0.625
Exploitation rate resulting in $B_{40\%}$	0.021	0.02 - 0.021
Yield with $SPR_{B40\%}$ at $B_{40\%}$ (mt)	1064.7	875.1 - 1254.2
Reference points based on SPR proxy for MSY		
Spawning output	13209.3	10801.6 - 15617
SPR_{proxy}	0.5	
Exploitation rate corresponding to SPR_{proxy}	0.032	0.032 - 0.032
Yield with SPR_{proxy} at SB_{SPR} (mt)	869.6	714.5 - 1024.6
Reference points based on estimated MSY values		
Spawning output at MSY (SB_{MSY})	25790.9	21104.1 - 30477.7
SPR_{MSY}	0.619	0.618 - 0.62
Exploitation rate at MSY	0.021	0.021 - 0.021
MSY (mt)	1065.1	875.4 - 1254.7

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}`

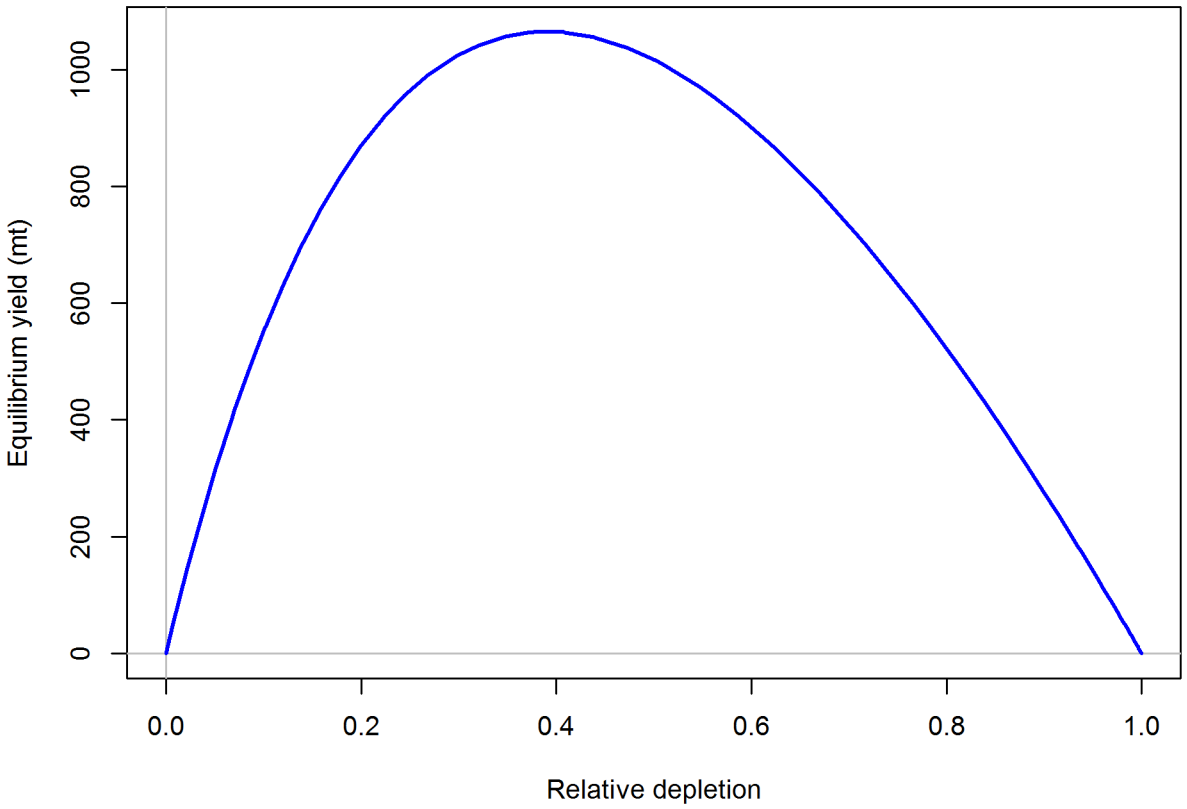

Figure h: Equilibrium yield curve for the base case model. Values are based on the 2010 fishery selectivity and with steepness fixed at... 「fig:Yield_all

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

tab:OFL_projection

Year	OFL	ACL
2011	857.65	180.00
2012	859.55	183.00
2013	865.17	577.91
2014	868.10	588.62
2015	881.24	608.91
2016	897.89	629.76
2017	912.69	646.89
2018	923.94	657.16
2019	932.33	663.60
2020	939.09	669.01
2021	945.15	677.76
2022	950.93	688.08

Table h: Summary of 10-year projections beginning in 2013 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	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Landings (mt)										
Total Est. Catch (mt)										
OFL (mt)										
ACL (mt)										
(1-SPR)(1-$SPR_{50\%}$)		0.39	0.35	0.32	0.17	0.18	0.30	0.25	0.35	0.26
Exploitation rate		0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01
Age 3+ biomass (mt)	26104.0	20233.4	21304.4	22166.0	22909.4	23497.1	24161.9	24600.9	24881.0	24963.3
Spawning Output	12852	9812	10044	10330	10706	11220	11802	12291	12632	12769
95% CI	6954 - 18751	5399 - 14225	5500 - 14588	5634 - 15025	5825 - 15587	6110 - 16330	6431 - 17173	6684 - 17897	6862 - 18403	6913 - 18624
Depletion	0.195	0.149	0.152	0.156	0.162	0.170	0.179	0.186	0.191	0.193
95% CI	0.129 - 0.260	0.099 - 0.198	0.101 - 0.203	0.104 - 0.209	0.107 - 0.217	0.113 - 0.227	0.119 - 0.239	0.124 - 0.249	0.127 - 0.256	0.128 - 0.258
Recruits	3683	2030	820	2983	2055	1270	1210	10906	2753	3664
95% CI	1384 - 9798	1104 - 3733	374 - 1799	1663 - 5348	1029 - 4102	558 - 2887	485 - 3016	5555 - 21412	871 - 8700	1023 - 13130

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 Pacific ocean perch 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 869.6 mt. Table e shows the full suite of estimated reference points for the northern area model and Figure h 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	Phase	Bounds	Status	SD	Prior (Exp.Val, SD)
1	NatM_p_1_Fem_GP_1	0.050	-2	(0.02, 0.1)			None
2	L_at_Amin_Fem_GP_1	21.211	-3	(15, 25)			None
3	L_at_Amax_Fem_GP_1	41.983	-2	(35, 45)			None
4	VonBert_K_Fem_GP_1	0.159	-3	(0.1, 0.4)			None
5	CV_young_Fem_GP_1	0.072	-5	(0.03, 0.16)			None
6	CV_old_Fem_GP_1	0.064	-5	(0.03, 0.16)			None
7	Wtlen_1_Fem	0.000	-50	(0, 3)			None
8	Wtlen_2_Fem	3.080	-50	(2, 4)			None
9	Mat50%_Fem	8.000	-50	(2, 12)			None
10	Mat_slope_Fem	-2.000	-50	(-2, 4)			None
11	Eggs_scalar_Fem	1.086	-50	(0, 6)			None
12	Eggs_exp_wt_Fem	1.440	-50	(-3, 3)			None
13	NatM_p_1_Mal_GP_1	0.028	2	(-1, 1)	OK	0.020	Normal (0.05, 0.1)
14	L_at_Amin_Mal_GP_1	0.000	-2	(-1, 1)			None
15	L_at_Amax_Mal_GP_1	-0.059	-2	(-1, 1)			None
16	VonBert_K_Mal_GP_1	0.195	-2	(-1, 1)			None
17	CV_young_Mal_GP_1	0.049	-2	(-1, 1)			None
18	CV_old_Mal_GP_1	-0.189	-2	(-1, 1)			None
19	Wtlen_1_Mal	0.000	-50	(0, 3)			None
20	Wtlen_2_Mal	3.000	-50	(2, 4)			None
24	CohortGrowDev	1.000	-50	(0, 2)			None
25	FracFemale_GP_1	0.500	-99	(0.000001, 0.999999)			None
26	SR_LN(R0)	9.148	1	(5, 20)	OK	0.093	None
27	SR_BH_steep	0.400	-3	(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
31	Early_InitAge_8	-0.041	3	(-6, 6)	act	0.684	dev (NA, NA)
32	Early_InitAge_7	-0.043	3	(-6, 6)	act	0.683	dev (NA, NA)
33	Early_InitAge_6	-0.043	3	(-6, 6)	act	0.683	dev (NA, NA)
34	Early_InitAge_5	-0.042	3	(-6, 6)	act	0.683	dev (NA, NA)
35	Early_InitAge_4	-0.038	3	(-6, 6)	act	0.684	dev (NA, NA)
36	Early_InitAge_3	-0.033	3	(-6, 6)	act	0.685	dev (NA, NA)
37	Early_InitAge_2	-0.027	3	(-6, 6)	act	0.685	dev (NA, NA)
38	Early_InitAge_1	-0.025	3	(-6, 6)	act	0.685	dev (NA, NA)
134	LnQ_base_Fishery(1)	-12.158	-1	(-15, 15)			None
135	LnQ_base_POP(2)	-0.218	-1	(-15, 15)			None
136	LnQ_base_EarlyTriennial(3)	-1.427	-1	(-15, 15)			None
137	LnQ_base_LateTriennial(4)	-1.714	-1	(-15, 15)			None
138	LnQ_base_AFSCSlope(5)	-1.329	-1	(-15, 15)			None
139	LnQ_base_NWFSCSlope(6)	-1.787	-1	(-15, 15)			None
140	LnQ_base_NWFSCcombo(7)	-0.749	-1	(-15, 15)			None
141	SizeSel_P1_Fishery(1)	36.604	2	(20, 45)	OK	0.319	None
142	SizeSel_P2_Fishery(1)	-5.000	-2	(-6, 4)			None
143	SizeSel_P3_Fishery(1)	3.256	3	(-1, 9)	OK	0.147	None
144	SizeSel_P4_Fishery(1)	0.644	3	(-1, 9)	OK	0.714	None
145	SizeSel_P5_Fishery(1)	-2.734	4	(-5, 9)	OK	0.244	None
146	SizeSel_P6_Fishery(1)	0.993	2	(-5, 9)	OK	0.169	None
147	Retain_P1_Fishery(1)	30.937	1	(15, 45)	OK	0.285	None
148	Retain_P2_Fishery(1)	1.876	1	(0.1, 10)	OK	0.217	None
149	Retain_P3_Fishery(1)	0.681	1	(0.001, 1)	OK	0.030	None
150	Retain_P4_Fishery(1)	0.000	-3	(0, 0)			None
151	SizeSel_P1_POP(2)	22.997	2	(20, 70)	OK	1.018	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)
152	SizeSel_P2_POP(2)	9.304	3	(0.001, 50)	OK	1.805	None
153	SizeSel_P1_EarlyTriennial(3)	20.332	2	(18, 70)	OK	0.666	None
154	SizeSel_P2_EarlyTriennial(3)	5.424	3	(0.001, 50)	OK	1.438	None
155	SizeSel_P1_NWFSCcombo(7)	25.783	2	(20, 70)	OK	2.693	None
156	SizeSel_P2_NWFSCcombo(7)	17.243	3	(0.001, 50)	OK	4.202	None
157	Retain_P3_Fishery(1)_BLK1repl_1940	0.999	-1	(0.001, 1)			Normal (0.9, 99)
158	Retain_P3_Fishery(1)_BLK1repl_1982	0.980	-1	(0.001, 1)			Normal (0.9, 99)
159	Retain_P3_Fishery(1)_BLK1repl_1989	0.964	1	(0.001, 1)	OK	0.034	Normal (0.88, 99)
160	Retain_P3_Fishery(1)_BLK1repl_1995	0.906	1	(0.001, 1)	OK	0.011	Normal (0.82, 99)
161	Retain_P3_Fishery(1)_BLK1repl_2009	0.497	1	(0.001, 1)	OK	0.041	Normal (0.65, 99)

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.

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	Relative exploitation rate	SPR
1940	121094	65941	0.00	9163	13	0.00	1.00
1941	120951	65876	1.00	9117	19	0.00	1.00
1942	120618	65804	1.00	9048	33	0.00	0.99
1943	118701	65728	1.00	9002	119	0.00	0.97
1944	116740	65610	0.99	9020	208	0.00	0.96
1945	114457	65444	0.99	9177	316	0.00	0.93
1946	115838	65217	0.99	9526	249	0.00	0.95
1947	116629	65026	0.98	10139	212	0.00	0.96
1948	116301	64853	0.98	11035	226	0.00	0.95
1949	108799	64671	0.98	12065	594	0.01	0.88
1950	103740	64288	0.97	13081	865	0.01	0.83
1951	100348	63770	0.97	14517	1056	0.01	0.80
1952	81069	63184	0.96	16205	2441	0.02	0.62
1953	88712	61895	0.94	15215	1786	0.02	0.69
1954	78636	61083	0.92	12637	2583	0.02	0.60
1955	85279	59968	0.91	10551	1995	0.02	0.66
1956	71270	59359	0.90	9200	3248	0.03	0.53
1957	75500	58272	0.88	8109	2784	0.02	0.57
1958	82301	57652	0.87	7088	2182	0.02	0.63
1959	93523	57502	0.87	6761	1390	0.01	0.74
1960	80561	57804	0.88	8371	2364	0.02	0.62
1961	70426	57475	0.87	13917	3338	0.03	0.52
1962	61240	56439	0.85	11506	4416	0.04	0.44
1963	51452	54635	0.83	7380	5851	0.06	0.35
1964	48022	51925	0.79	6306	6212	0.06	0.32
1965	39475	48976	0.74	5558	7851	0.08	0.24
1966	18667	45228	0.68	4247	19711	0.23	0.08
1967	18585	35149	0.53	3542	15293	0.22	0.08
1968	21824	27621	0.42	3910	9720	0.18	0.10
1969	56543	23201	0.35	6089	2083	0.05	0.39
1970	50739	22869	0.35	10718	2502	0.06	0.34
1971	53819	22157	0.34	4937	2218	0.05	0.37
1972	54015	21441	0.32	2601	2155	0.05	0.37
1973	42863	20678	0.31	1949	3034	0.07	0.27
1974	45463	19489	0.30	2415	2617	0.07	0.30
1975	61399	18691	0.28	2984	1490	0.04	0.44
1976	53541	18635	0.28	2470	1903	0.05	0.37
1977	54439	18405	0.28	3102	1823	0.05	0.38
1978	44605	18101	0.27	3377	2479	0.07	0.29
1979	49568	17228	0.26	3914	1998	0.06	0.33

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
1980	44855	16404	0.25	3145	2232	0.07	0.29
1981	55641	15362	0.23	6489	1467	0.05	0.39
1982	61546	14760	0.22	2561	1164	0.04	0.44
1983	47884	14420	0.22	2867	1751	0.06	0.32
1984	45929	13832	0.21	4153	1774	0.07	0.30
1985	47427	13236	0.20	4454	1605	0.06	0.31
1986	47243	12744	0.19	1785	1555	0.06	0.31
1987	53771	12276	0.19	3058	1219	0.05	0.37
1988	46397	12010	0.18	3522	1535	0.06	0.30
1989	44471	11584	0.18	4262	1596	0.07	0.29
1990	51835	11136	0.17	3654	1210	0.05	0.35
1991	43358	10874	0.16	4168	1584	0.07	0.28
1992	43023	10425	0.16	959	1546	0.07	0.27
1993	44868	10005	0.15	1724	1396	0.07	0.29
1994	49351	9684	0.15	4242	1164	0.06	0.33
1995	53484	9494	0.14	2936	1002	0.05	0.37
1996	55873	9436	0.14	1409	925	0.05	0.39
1997	62237	9410	0.14	1471	757	0.04	0.45
1998	62623	9425	0.14	2536	750	0.04	0.45
1999	69541	9390	0.14	6552	599	0.03	0.51
2000	102150	9407	0.14	7108	156	0.01	0.82
2001	88741	9641	0.15	3168	310	0.02	0.69
2002	100848	9812	0.15	2030	176	0.01	0.81
2003	103009	10044	0.15	820	157	0.01	0.83
2004	104707	10330	0.16	2983	144	0.01	0.84
2005	112320	10706	0.16	2055	76	0.00	0.91
2006	111721	11220	0.17	1270	86	0.00	0.91
2007	105501	11802	0.18	1210	156	0.01	0.85
2008	107972	12291	0.19	10906	134	0.01	0.87
2009	102652	12632	0.19	2753	202	0.01	0.82
2010	107903	12769	0.19	3664	141	0.01	0.87
2011	104764	12852	0.19	3683			

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
2011	857.65	116.44	26104.00	12852.40	0.19
2012	859.55	118.36	26677.40	12943.50	0.20
2013	865.17	372.19	27334.20	13234.70	0.20
2014	868.10	376.93	27609.90	13438.40	0.20
2015	881.24	388.84	27882.80	13708.40	0.21
2016	897.89	402.20	28141.40	13934.10	0.21
2017	912.69	413.65	28380.20	14099.20	0.21
2018	923.94	420.72	28603.10	14155.60	0.21
2019	932.33	425.19	28817.30	14167.00	0.21
2020	939.09	428.86	29026.90	14181.50	0.21
2021	945.15	434.57	29231.90	14289.40	0.22
2022	950.93	441.23	29427.80	14441.60	0.22

8 Figures

figures

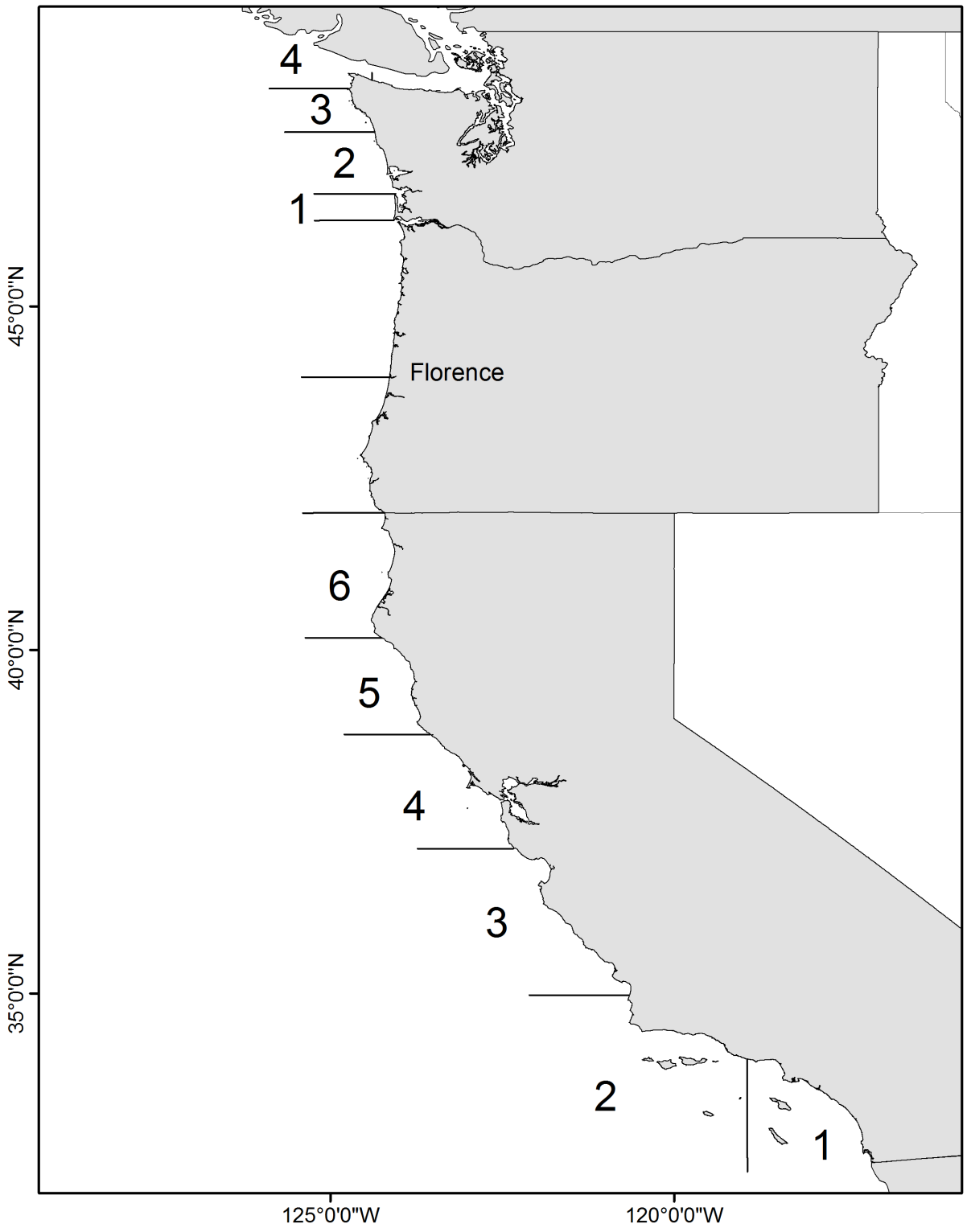

Figure 1: Map showing the state boundary lines for management of the recreational fishing fleets. CRFS Districts 1-6 in California are presented as well as the WDFW Recreational Management Areas in Washington. Florence, OR is shown as a potential location of model stratification. `fig:boundary_map`

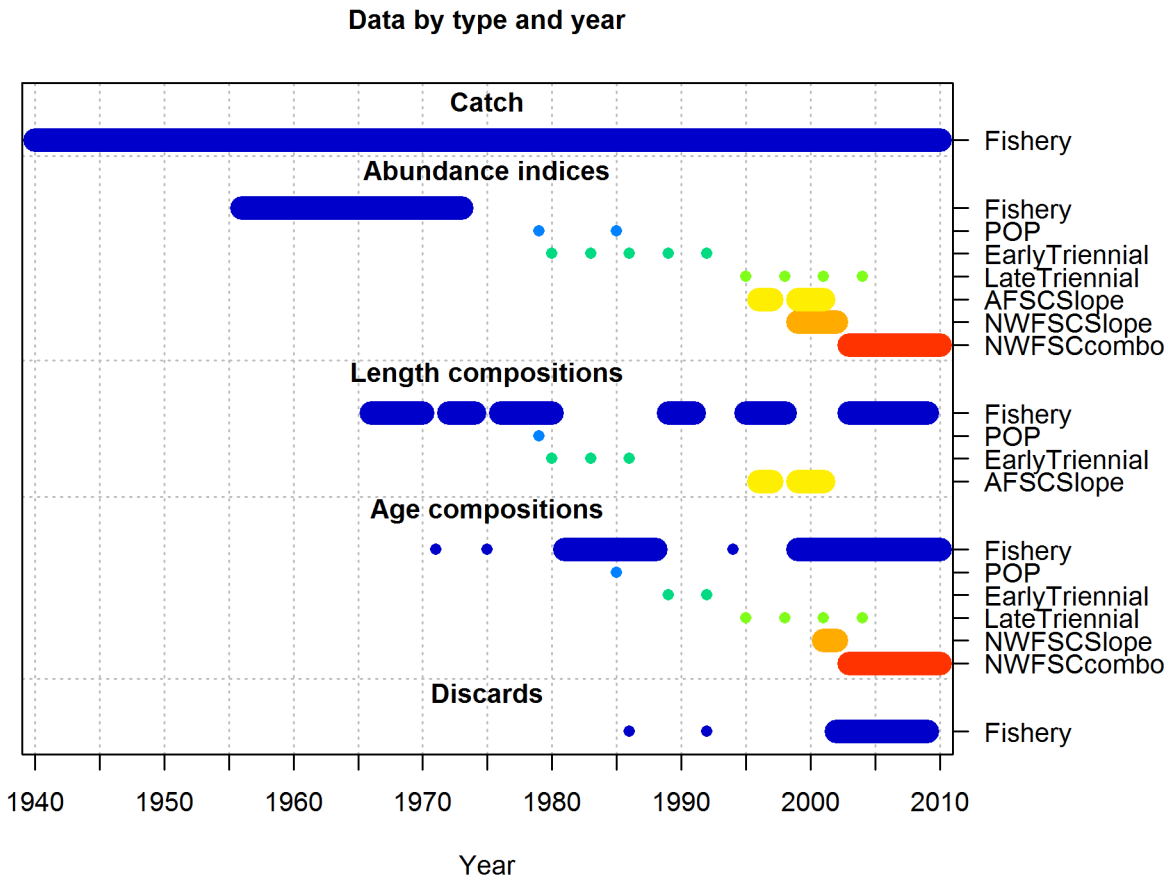

Figure 2: Summary of data sources used in the Base model. `fig:data_plot`

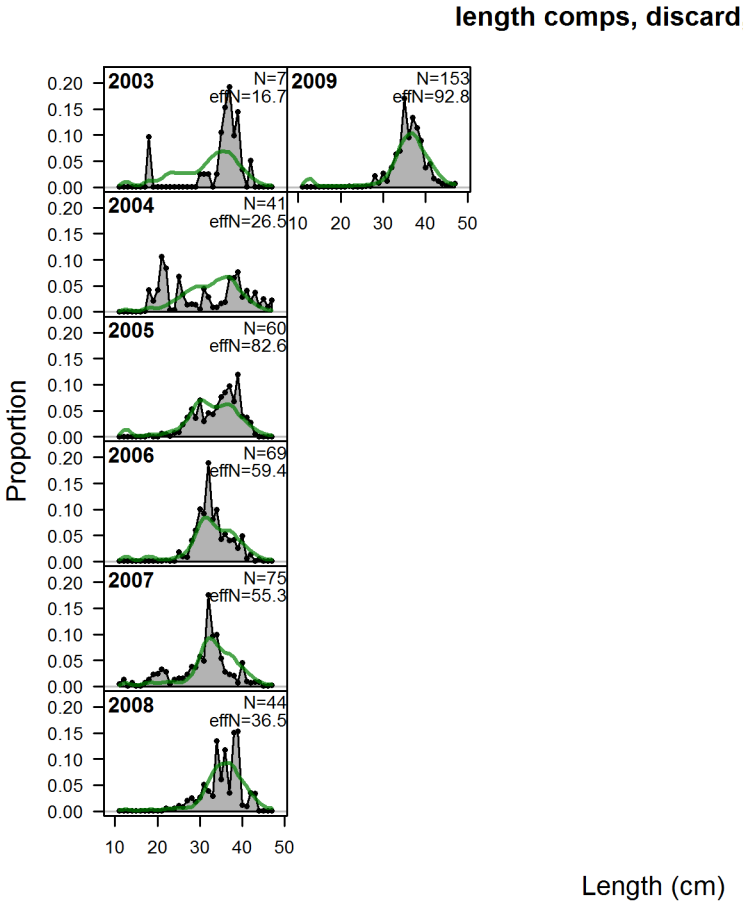

Figure 3: length comps, discard, Fishery [fig:mod1_1_comp_lenfit_flt1mkt1

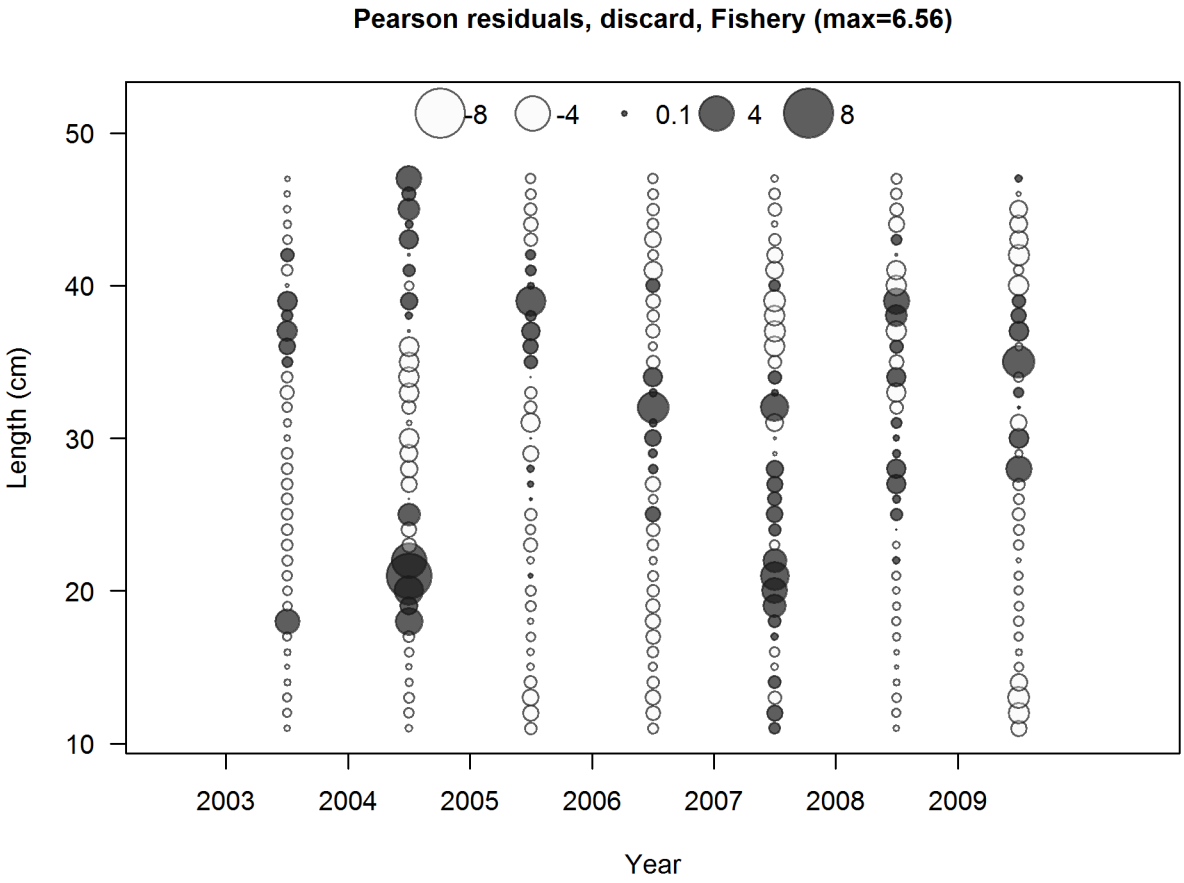

Figure 4: Pearson residuals, discard, Fishery (max=6.56)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). `fig:mod1_2_comp_lenfit_residsflt1mkt1`

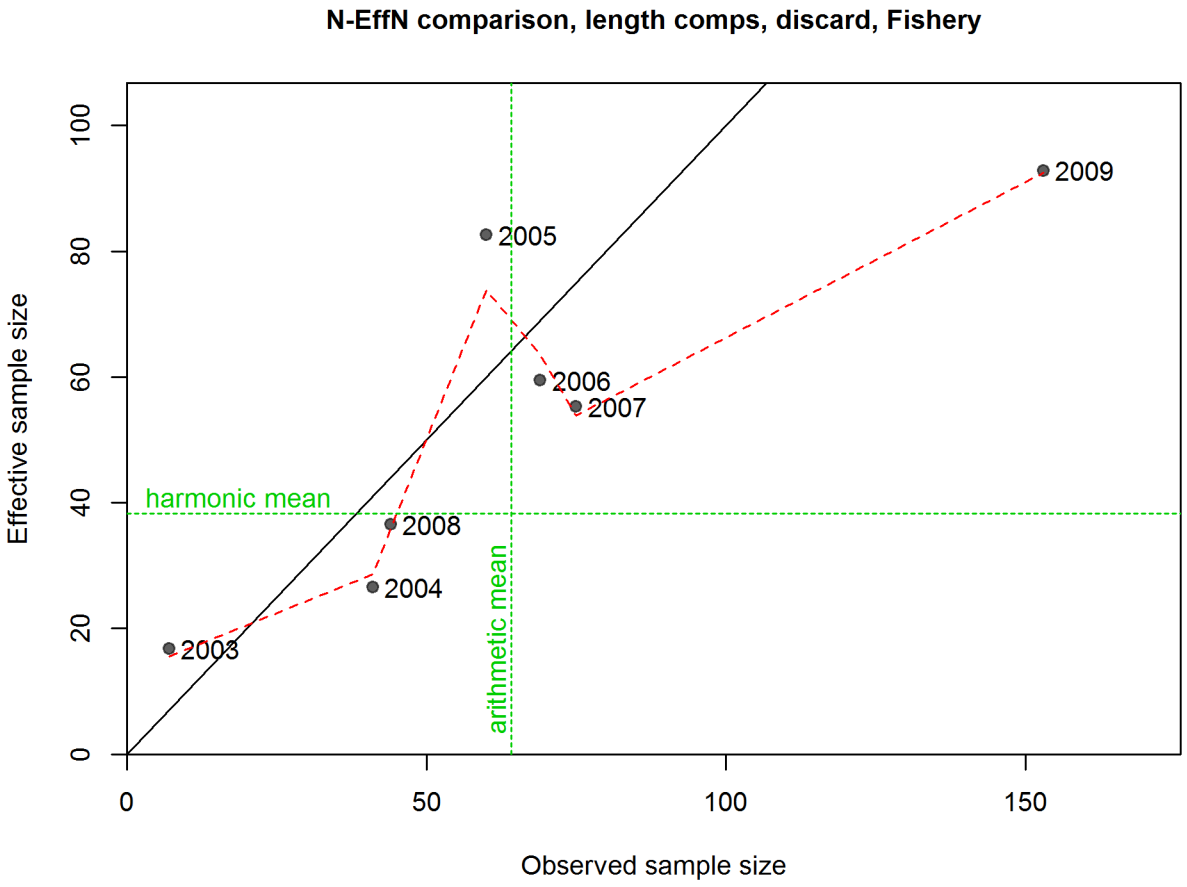

Figure 5: N_EffN comparison, length comps, discard, Fishery [fig:mod1_3_comp_lenfit_sam

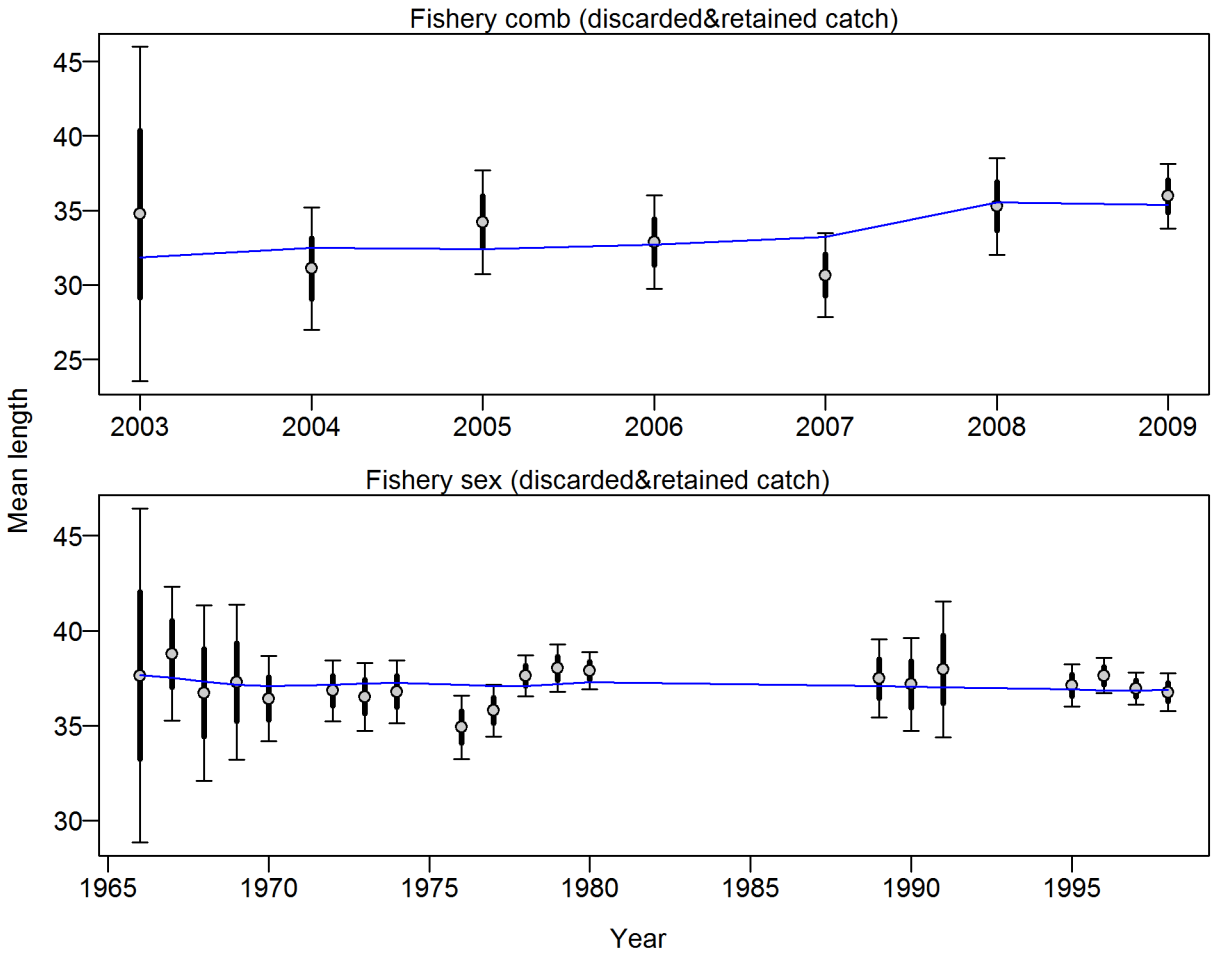

Figure 6: Francis data weighting method TA1.8 Fishery Suggested sample size adjustment (with 95% interval) for len data from Fishery: 0.2505 (0.1591_0.5781) fig:mod1_4_comp_lenfit_data_weig

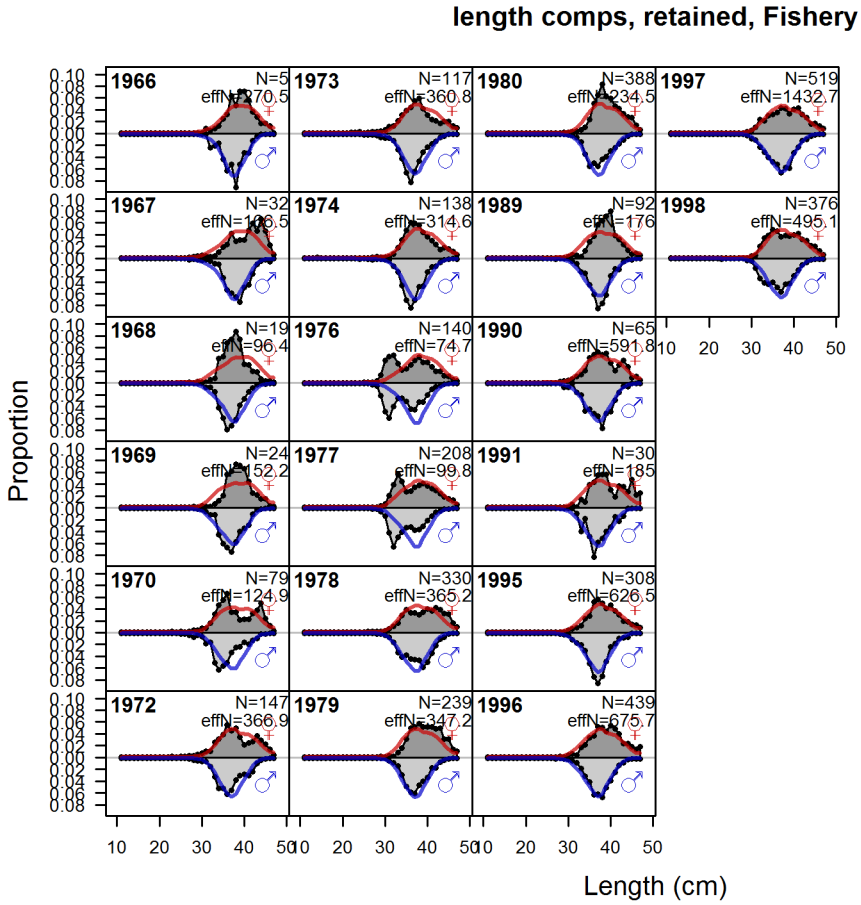

Figure 7: length comps, retained, Fishery | `fig:mod1_5_comp_lenfit_flt1mkt2`

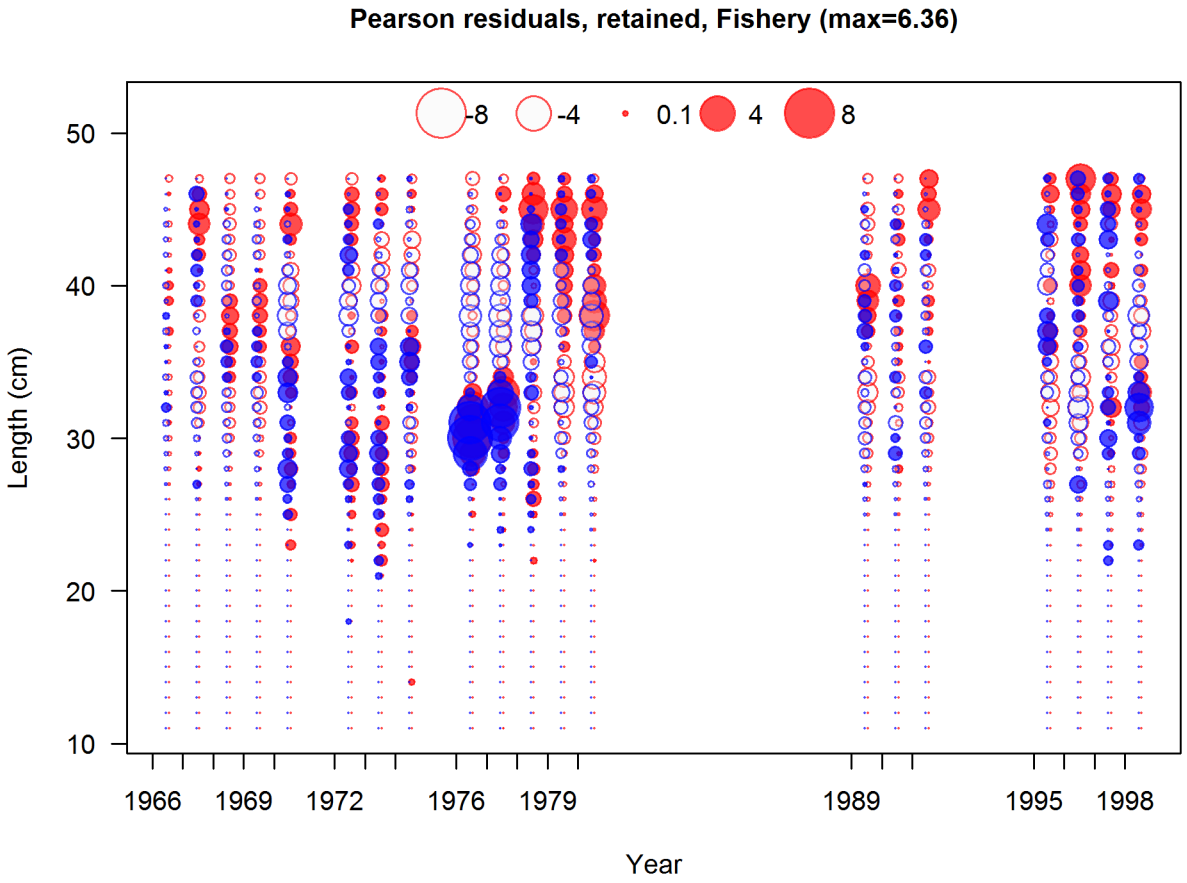

Figure 8: Pearson residuals, retained, Fishery (max=6.36)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). `fig:mod1_6_comp_lenfit_residsflt1mkt2`

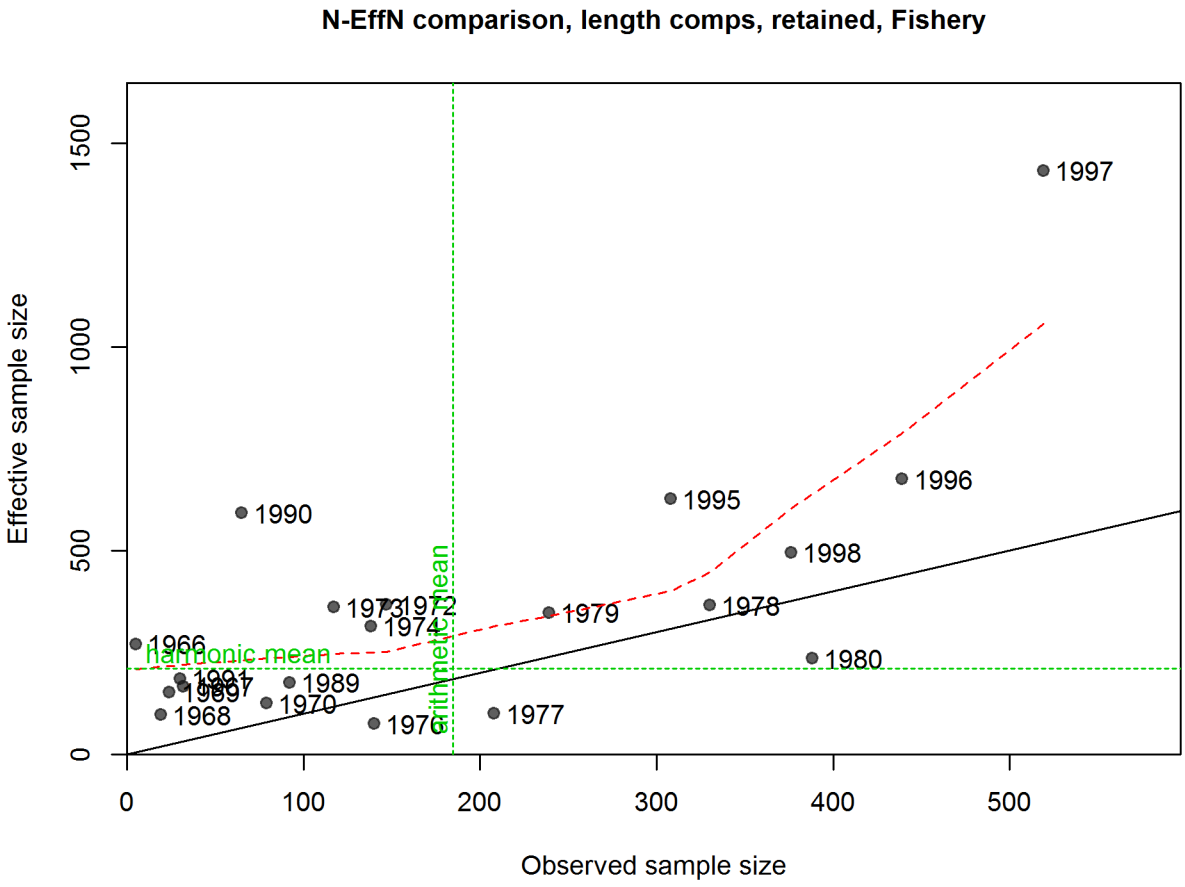

Figure 9: N_EffN comparison, length comps, retained, Fishery [fig:mod1_7_comp_lenfit_sa

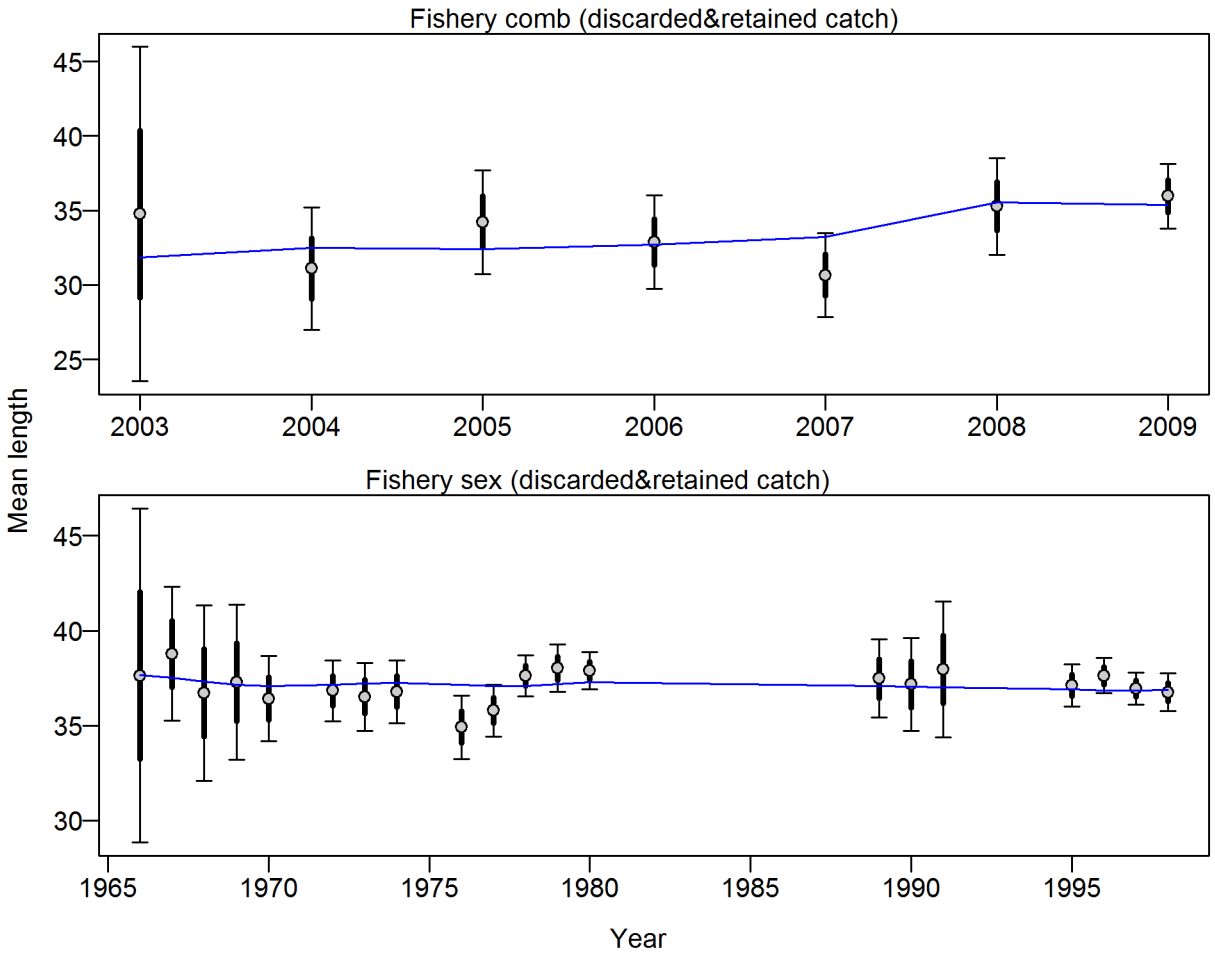

Figure 10: Francis data weighting method TA1.8 Fishery Suggested sample size adjustment (with 95% interval) for len data from Fishery: 0.2505 (0.1568_0.6379) fig:mod1_8_comp_lenfit_data_weig

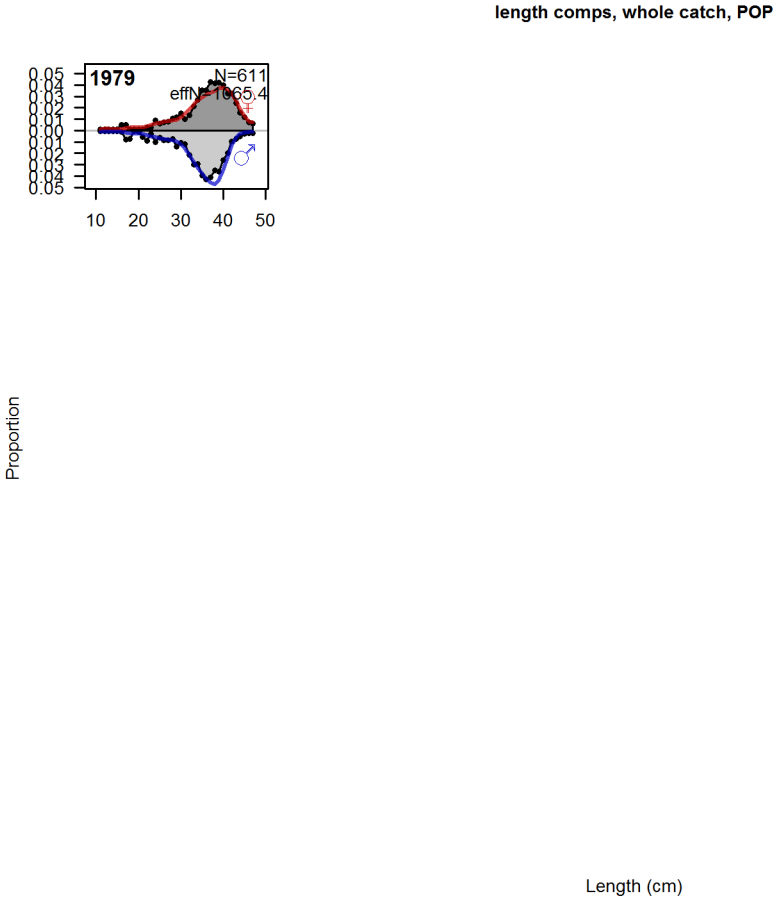

Figure 11: length comps, whole catch, POP ⌈fig:mod1_9_comp_lenfit_flt2mkt0

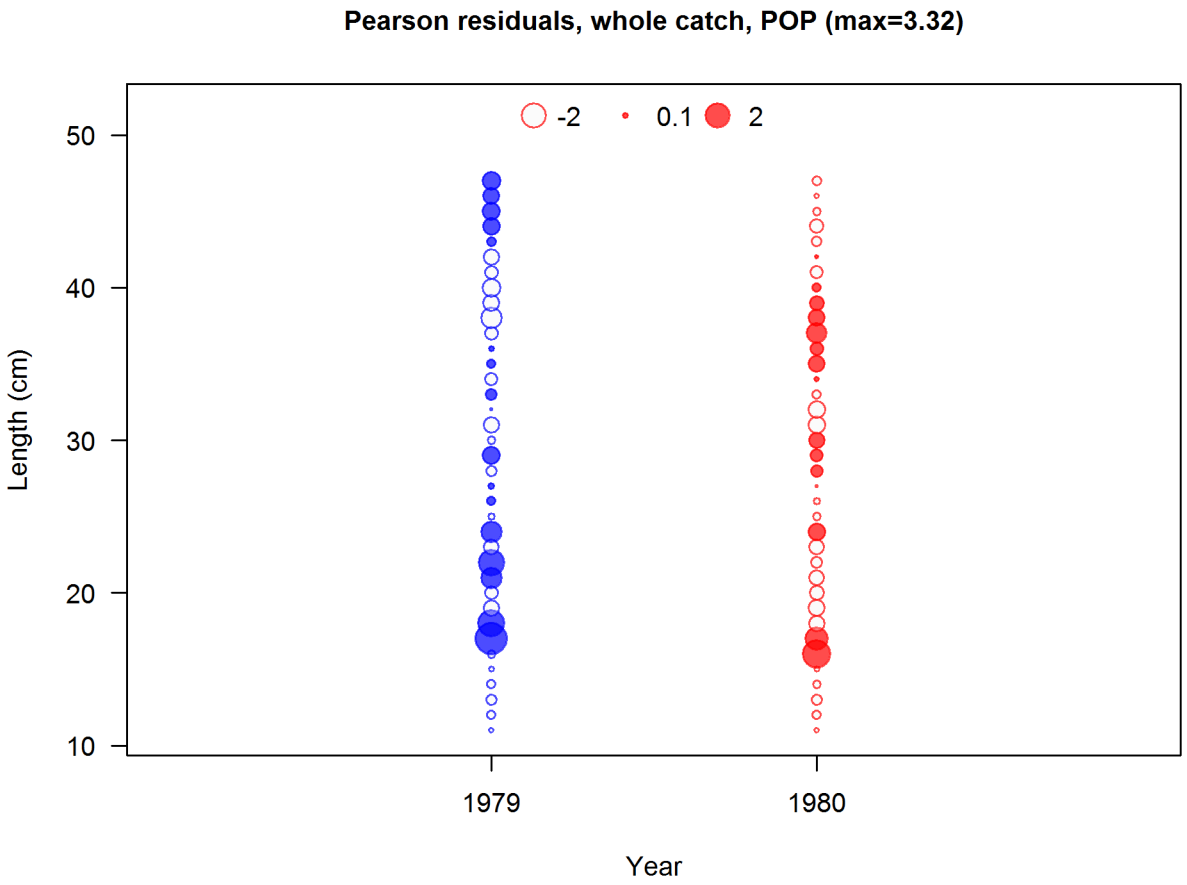

Figure 12: Pearson residuals, whole catch, POP (max=3.32)
Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected). [fig:mod1_10_comp_lenfit_residsflt2mkt0]

¡!– **********MODEL 2 REFERENCE POINTS FIGURES – IF NEEDED **********
–¿

References

references

Alverson, D.L., Pruter, a T., and Ronholt, L.L. 1964. A Study of Demersal Fishes and Fisheries of the Northeastern Pacific Ocean. Institute of Fisheries, University of British Columbia.

Bertalanffy, L. von. 1938. A quantitative theory of organic growth. Human Biology **10**: 181–213.

Dick, E. 2009. Modeling the reproductive potential of rockfishes (*Sebastes* spp.). PhD Dissertation, University of California Santa Cruz.

Francis, R. 2011. Data weighting in statistical fisheries stock assessment models. Canadian Journal of Fisheries and Aquatic Sciencies **68**: 1124–1138.

Hamel, O. 2015. A method for calculating a meta-analytical prior for the natural mortality rate using multiple life history correlates. ICES Journal of Marine Science **72**: 62–69.

Harry, G., and Morgan, A. 1961. History of the trawl fishery, 1884-1961. Oregon Fish Commission Research Briefs **19**: 5–26.

Love, M., Yoklavich, M., and Thorsteinson, L. 2002. The rockfishes of the northeast Pacific. University of California Press, Berkeley, CA, USA.

McAllister, M.K., and Ianelli, J.N. 1997. Bayesian stock assessment using catch-age data and the sampling - importance resampling algorithm. Canadian Journal of Fisheries and Aquatic Sciences **54**(2): 284–300.

Methot, R.D. 2015. User manual for Stock Synthesis model version 3.24s. NOAA Fisheries, US Department of Commerce.

Miller, D., and Gotshall, D. 1965. Ocean sportfish catch and effort from Oregon to Point Arguello, California July 1, 1957-June 30, 1961. State of California, The Resources Agency Department of Fish and Game, Fish Bulletin **130**.

Pikitch, E., Erickson, D., and Wallace, J. 1988. An evaluation of the effectiveness of trip limits as a management tool. Northwest and Alaska Fisheries Center, National Marine Fisheries Service, US Department of Commerce.

Rogers, J., and Pikitch, E. 1992. Numerical definition of groundfish assemblages caught off the coasts of Oregon and Washington using commercial fishing strategies. Canadian Journal of Fisheries and and Aquatic Sciences **49**: 2648–2656.