

Pacific Ocean Perch 2017 Assessment

Biology and Data

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STAR Panel
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Outline

Model Summary

- Landings

- Estimated Stock Size and Status

- Uncertainties

Biology

Removals

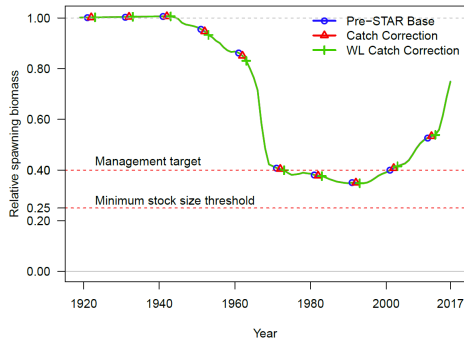
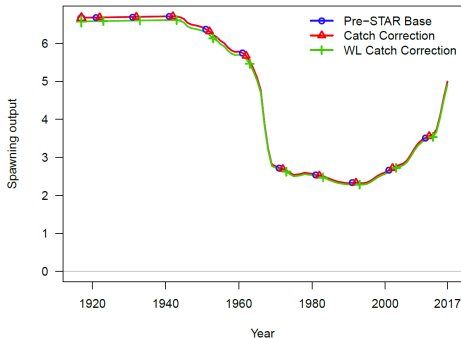
Index Data

Composition Data

Correction for the Post-STAR Model

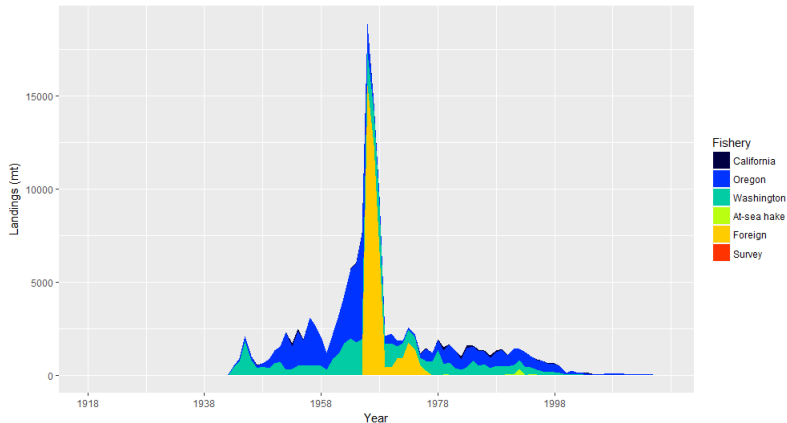
- Addition to California historical landings
 - 1948-1968 corrections totaling 10 mt
- Survey catch removal correction
 - Stock Synthesis was not removing catches for survey fleets
- Weight-at-length
 - Small correction to the weight-at-length values for females and males

Comparison between STAR model and Corrected Model

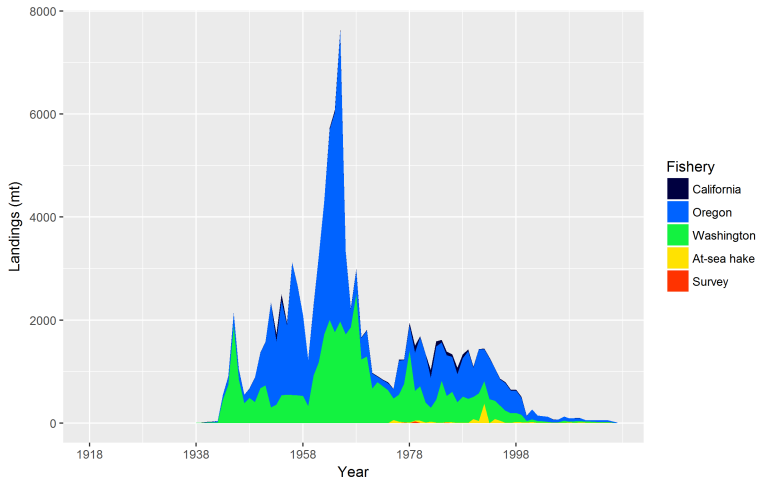


*All results shown come from the Pre-STAR base model as included in the document.

Landings



Landings without the Foreign Catches



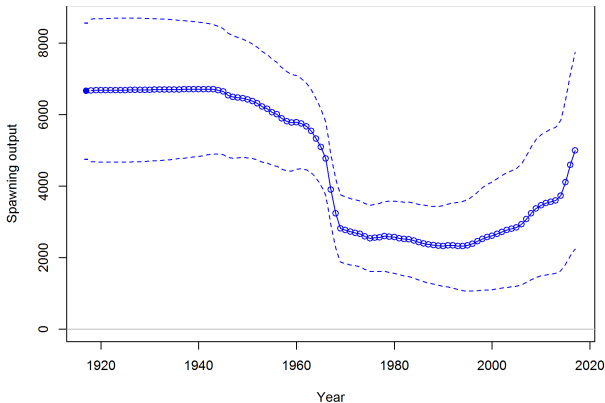
Landings Over the Last 10-Years

Year	CA	OR	WA	At-sea hake	Survey	Total Landings
2007	0.15	83.65	45.12	4.05	0.58	133.55
2008	0.39	58.64	16.61	15.93	0.80	92.36
2009	0.92	58.74	33.22	1.56	2.72	97.17
2010	0.14	58.00	22.29	16.87	1.68	98.98
2011	0.12	30.26	19.66	9.17	1.94	61.14
2012	0.18	30.41	21.79	4.52	1.62	58.51
2013	0.08	34.86	14.83	5.41	1.71	56.89
2014	0.18	33.91	15.82	3.92	0.57	54.40
2015	0.12	38.05	11.41	8.71	1.59	59.88
2016	0.23	40.81	13.12	10.30	3.10	67.56

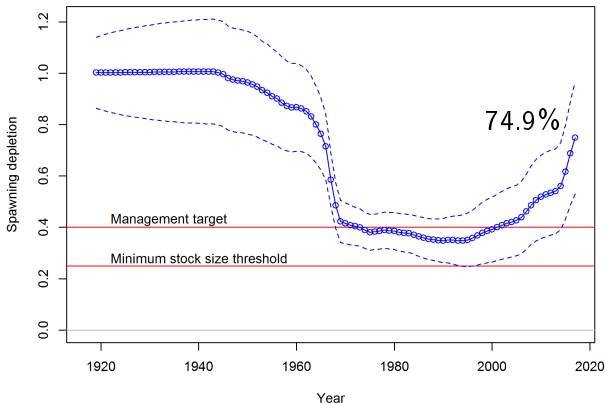
Approximately 70% of the landings are from Oregon in the recent years.
Vast majority of landings are from bottom-trawl gear.



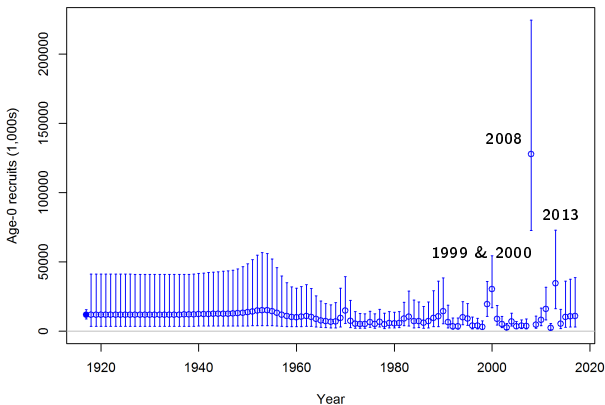
Spawning Output



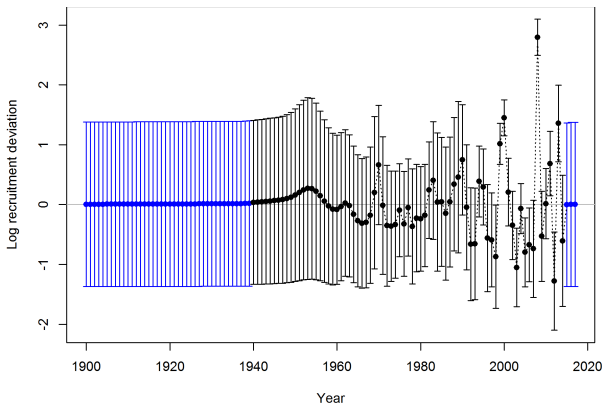
Relative Depletion



Estimated Annual Recruitment



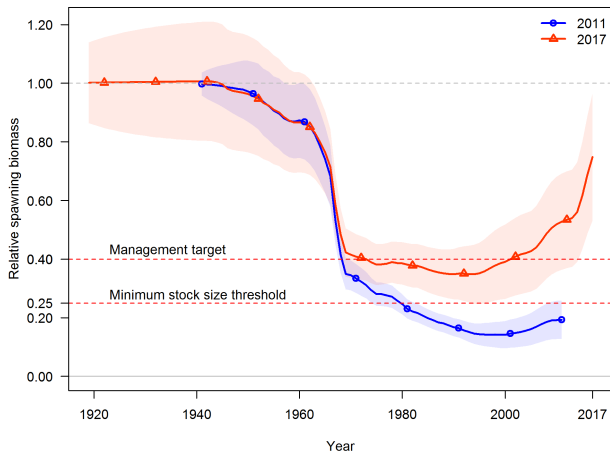
Estimated Annual Recruitment Deviations



History of Assessments for West Coast Pacific Ocean Perch

- Evaluation conducted in the 1980s determined the stock was in poor shape in need of rebuilding.
- Assessments in the 1990s determined the stock was well below target levels but with early signs of population growth by 1995.
- The stock was declared overfished in 1999 based the assessment which determined the stock was likely below 50% of the target stock size.
- A formal rebuilding plan was adopted in 2001 for West Coast Pacific ocean perch.
- The stock has been re-evaluated periodically between 2003-2011 determining that the stock was still well below target levels.

Comparison between 2011 and 2017

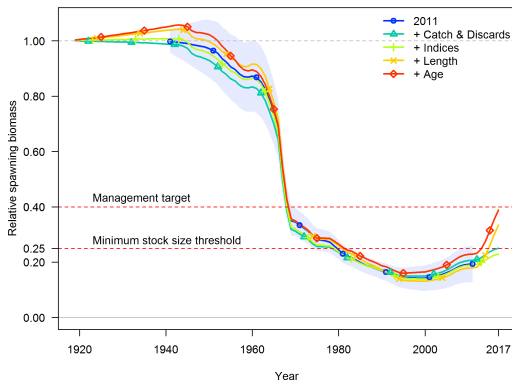


Major Changes Between the Previous and Current Assessment

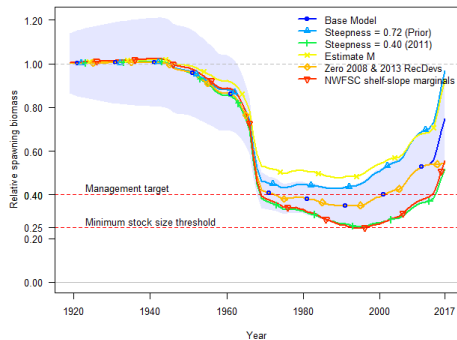
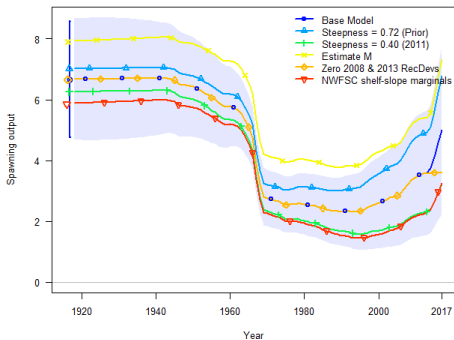
- Steepness
 - The 2011 assessment fixed $h = 0.40$
 - The current assessment fixed $h = 0.50$
- Natural Mortality
 - The 2011 assessment fixed $M = 0.05$ for females, males estimated $M = 0.051$
 - The current assessment fixed $M = 0.054$ for both sexes
- Landings History
- Maturity and Fecundity
- Fleet and Survey Selectivities

2011 Model Data "Update"

- Added layers of new data cumulatively while retaining 2011 modeling assumptions



2017 Base Model Sensitivities



Key Sources of Uncertainty

- Steepness
 - Fixed at 0.50 within the base model. Likelihood profile over steepness indicates no information in data concerning steepness. Fixing the value at the steepness prior value of 0.72 results in stock status 97% of unfished.
- Natural Mortality
 - Fixed at 0.054 for males and females, the mean of the prior when maximum age is 100. Likelihood profile relatively flat around the prior.
- Recruitment
 - Estimated large recruitments in 2008 and 2013.
 - Setting these recruitments equal to the stock-recruitment curve results in a decline in stock status to 54%.
- NWFSC shelf-slope age data
 - Treating these data as either conditional age-at-length or as marginals results in differing estimates of R_0 and final stock status.

Outline

Model Summary

Biology

Overview

Maturity

Fecundity


Growth

Removals

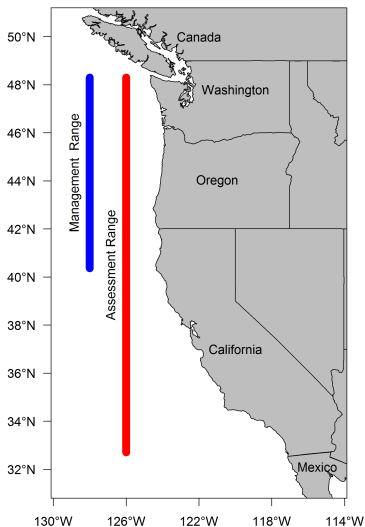
Index Data

Composition Data

Pacific ocean perch (*Sebastes alutus*)

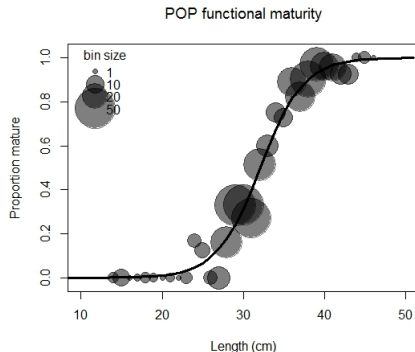
- Distributed from Alaska Aleutian Islands to Northern California
 - Typically distributed between 200 - 400 meters during summer months
 - Semi-demersal and can be pelagic
 - Both sexes move to deeper water with age
- 
- Females move to deeper waters post-spawning during winter months and return inshore in spring.

Management and Assessment Range for Pacific Ocean Perch



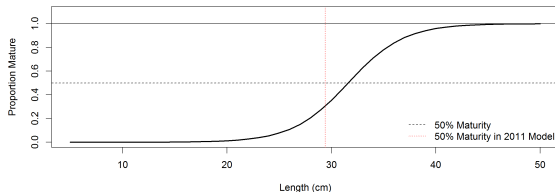
Functional Maturity-at-Length

- Categorized mature and immature fish based on the proportion of vitellogenin in the cytoplasm and atretic cells
- 50% maturity is at larger lengths vs. biological maturity
- functional 50% = 32.1 cm vs. biological 50% = 30.1 cm

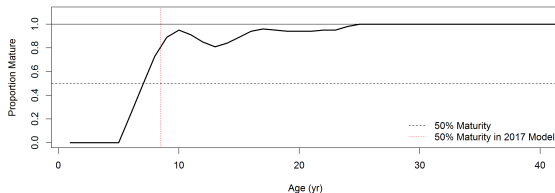


Maturity Comparison

Functional Maturity by Length (2017 Assessment)

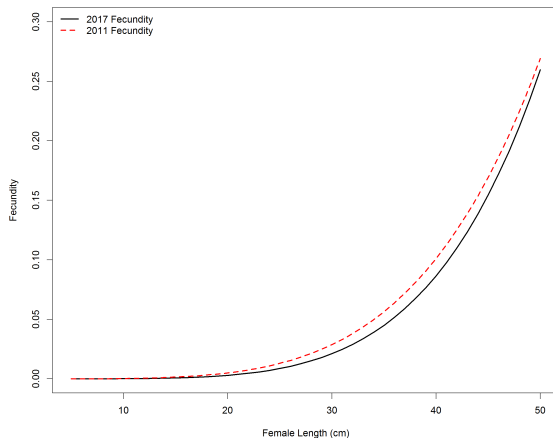


Maturity by Age (2011 Assessment)



*Sensitivity to assumed maturity shown to not have a large impact on results

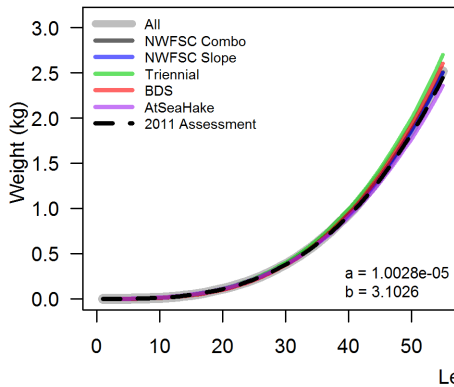
Fecundity



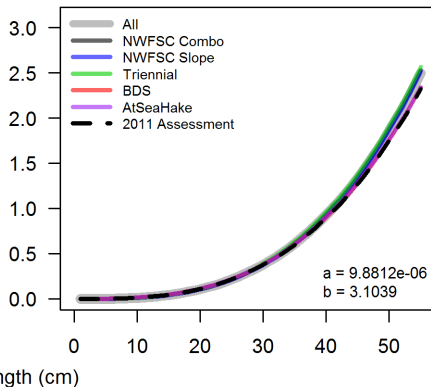
*Sensitivity to assumed fecundity shown to not have a large impact on results

Weight-at-Length

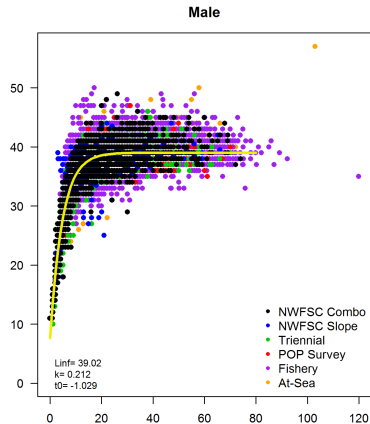
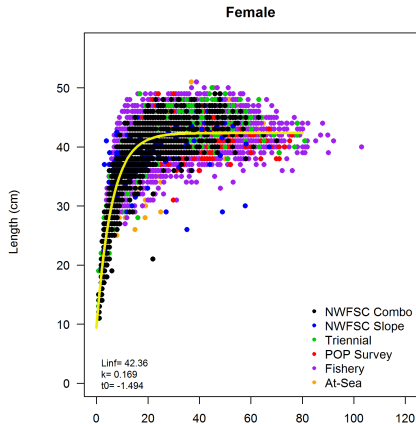
Female



Male



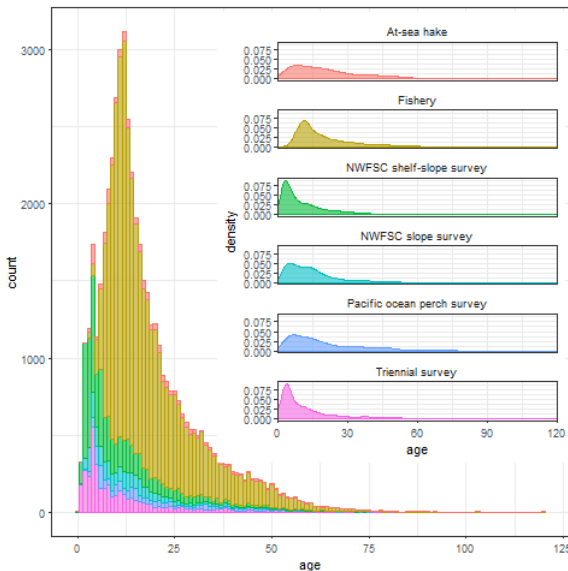
Length-at-Age



Age

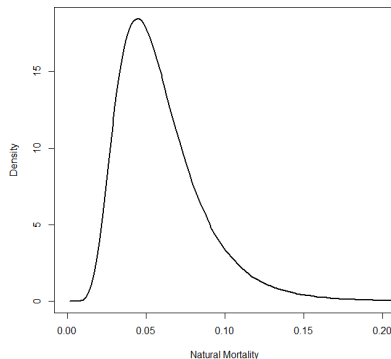
Observed Ages

- Oldest age: 120 by the fishery (2007)
- Next oldest fish range from 90-103 collected by the fishery or the at-sea hake fishery between 1981-2010
- Love et al. (2002) - maximum age of 100



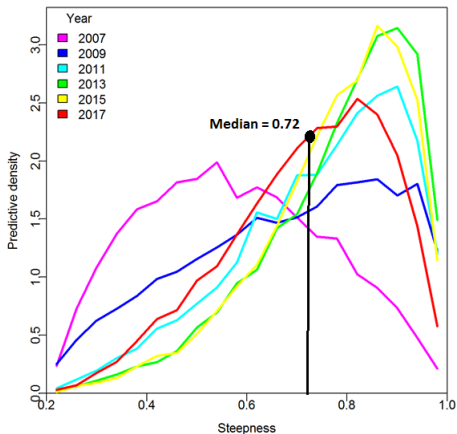
Natural Mortality

- Prior based on maximum age of 100
- Lognormal distribution with a median of 0.054
- Value fixed in the base model for both sexes



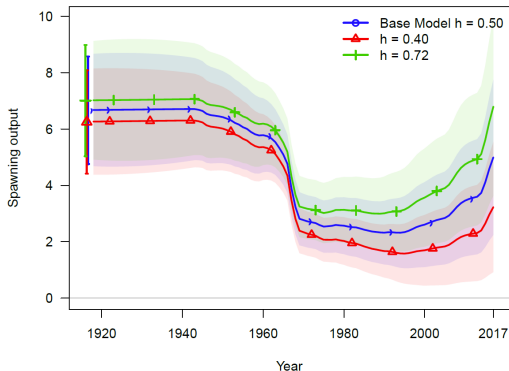
Steepness: Density-Dependent Recruitment Compensation

- Predictive distribution for Pacific rockfish meta-analysis
- Prior median in 2017 for steepness (h) = 0.72

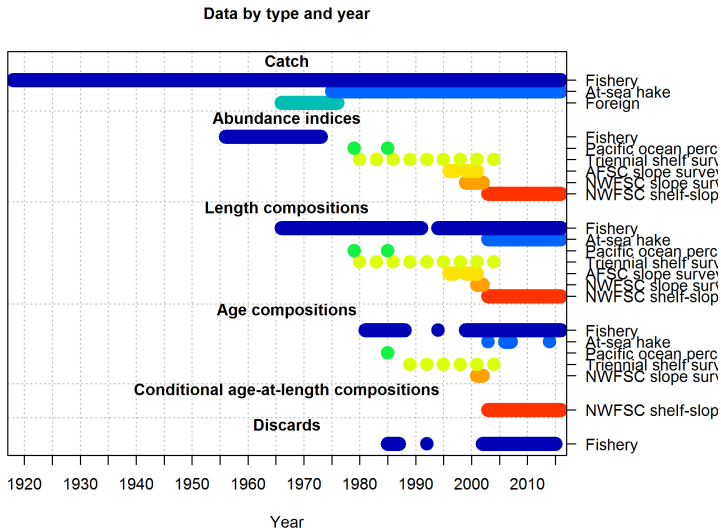


Steepness

- Using the prior in the base model resulted in estimated depletion = 96.8%
- Base model set $h = 0.50$



Data Summary Used in the 2017 Assessment



Outline

Model Summary

Biology

Removals

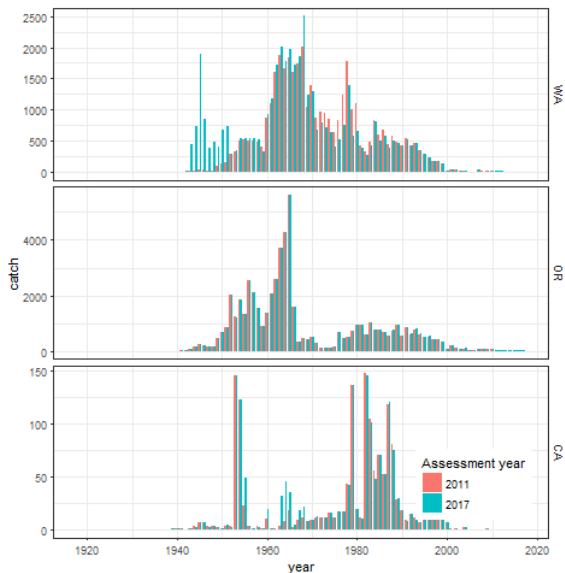
- Landings History by State
- Discarding practices

Index Data

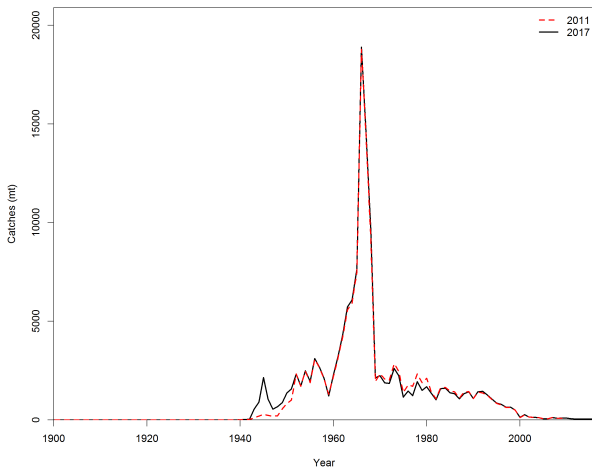
Composition Data



Landings Data: 2017 vs. 2011

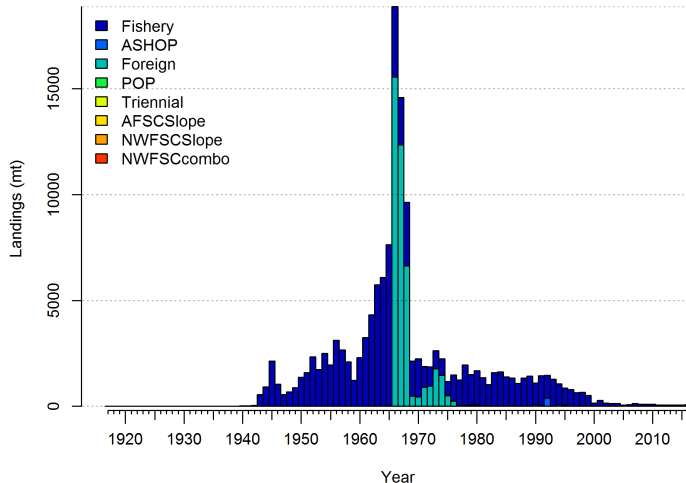


Cumulative Catch Difference

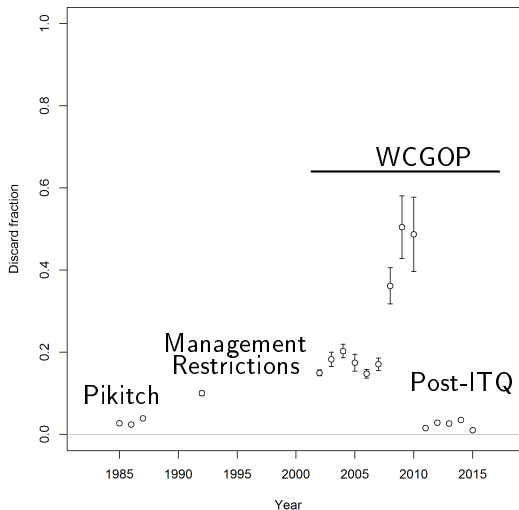


*Resulted in $< 1\%$ change in $R0$

Landings by Fleet and Survey



Fishery Discard Data



* Sensitivities done on the 1992 data point (high vs. low) results $\pm 0.5\%$ in status.

Outline

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Removals

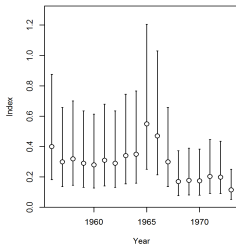
Index Data

CPUE and Survey Indices

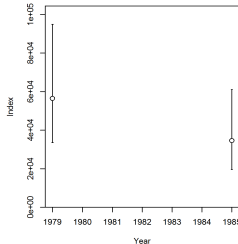
Composition Data

Fishery and Survey Indices

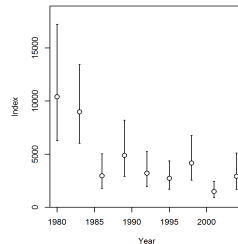
Fishery CPUE



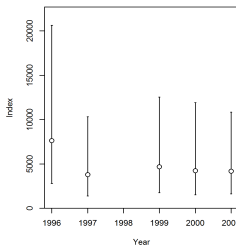
POP Survey



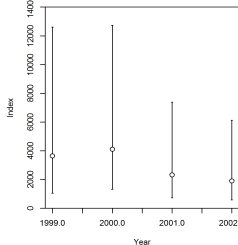
Triennial Survey



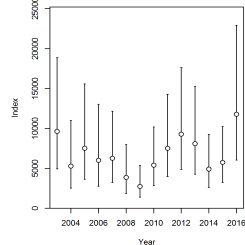
AFSC Slope Survey



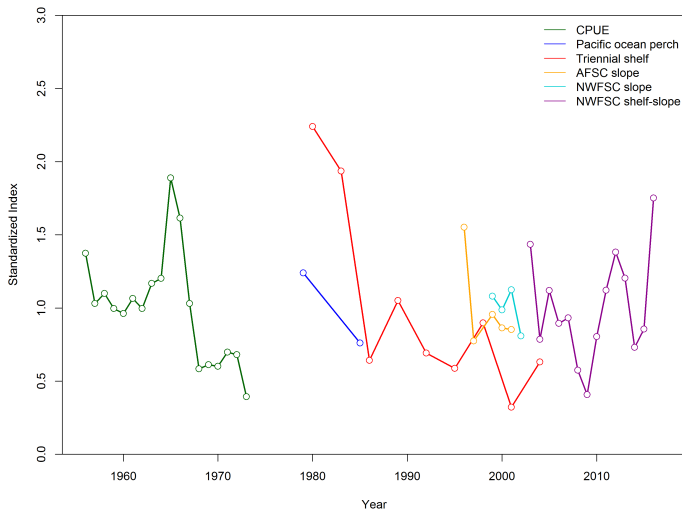
NWFS Slope Survey



NWFS Shelf-Slope Survey



All: Standardized



Outline

Model Summary

Biology

Removals

Index Data

Composition Data

Fishery Data

Survey Length and Age Data

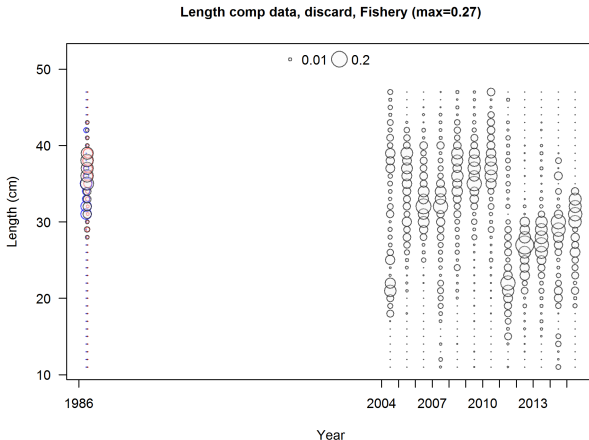
Ageing Error

Fishery Length and Age Data

Fishery length data used in the 2017 assessment:

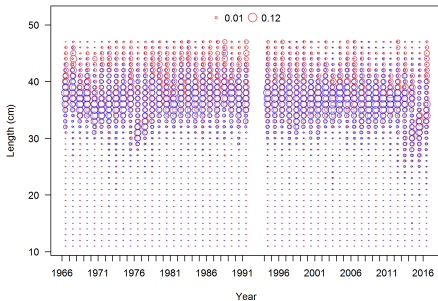
- Fishery: bottom trawl, mid-water trawl, fixed gear
 - Retained Lengths: 1966-2016
 - Discarded Lengths: 1986 (Pikitch), 2004-2015
 - Ages: 1981-1988, 1994, 1999-2016
- At-sea hake fishery
 - All (Retained and Discarded) Lengths: 2003-2016
 - Ages: 2003, 2006, 2007, 2014

Fishery Lengths: Discarded

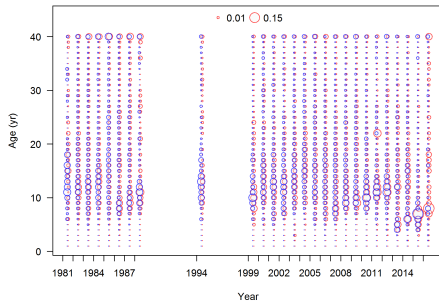


Fishery Lengths and Ages: Retained

Length comp data, retained, Fishery (max=0.13)

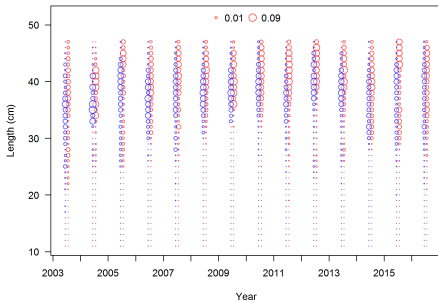


Age comp data, retained, Fishery (max=0.17)

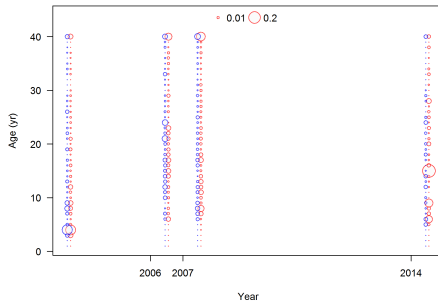


At-sea hake

Length comp data, whole catch, At-sea hake (max=0.08)



Age comp data, whole catch, At-sea hake (max=0.24)



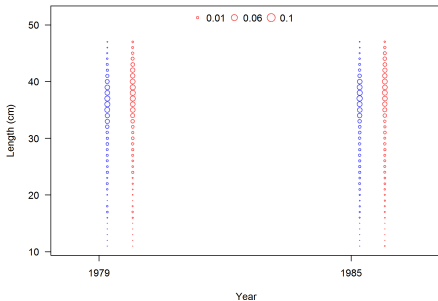
Survey Length Data

Survey length data used in the 2017 assessment:

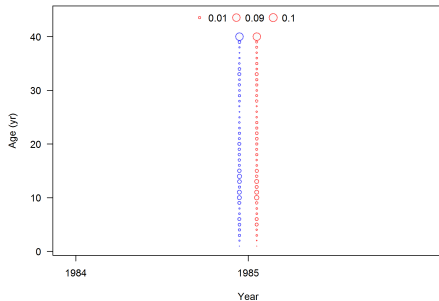
- Pacific ocean perch survey
 - Lengths: 1979 and 1985
 - Ages: 1985
- Triennial shelf survey
 - Lengths: 1980, 1983, 1986, 1989, 1992, 1995, 1998, 2001, 2004
 - Ages: 1989, 1992, 1995, 1998, 2001, 2004
- AFSC slope survey
 - Lengths: 1996, 1997, 1999-2001
- NWFSC slope survey
 - Lengths: 2001 and 2002
 - Ages: 2001 and 2002
- NWFSC shelf-slope survey
 - Lengths: 2003-2016
 - Ages: 2003-2016

Pacific ocean perch survey lengths

Length comp data, whole catch, Pacific ocean perch survey (max=0.05)

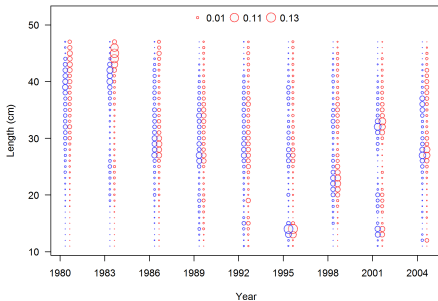


Age comp data, whole catch, Pacific ocean perch survey (max=0.09)

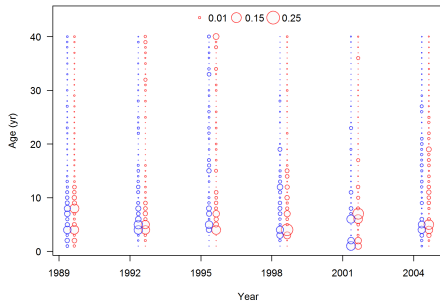


Triennial shelf survey

Length comp data, whole catch, Triennial shelf survey (max=0.13)

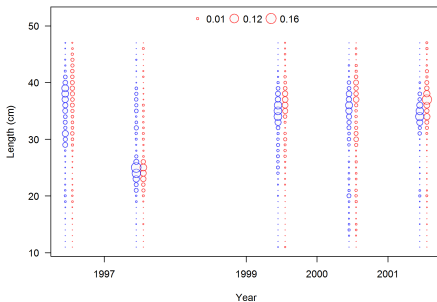


Age comp data, whole catch, Triennial shelf survey (max=0.2)



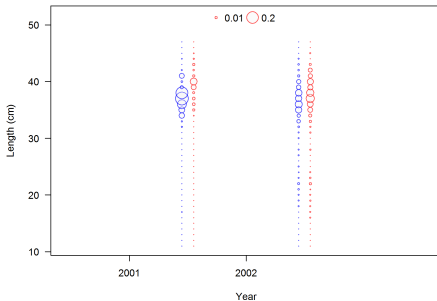
AFSC slope survey

Length comp data, whole catch, AFSC slope survey (max=0.14)

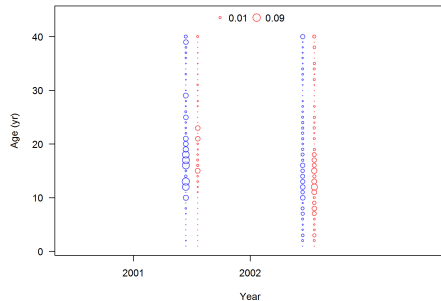


NWFSC slope survey

Length comp data, whole catch, NWFSC slope survey (max=0.25)

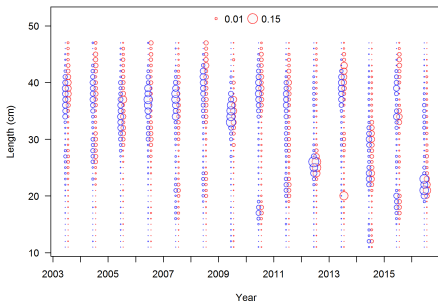


Age comp data, whole catch, NWFSC slope survey (max=0.08)

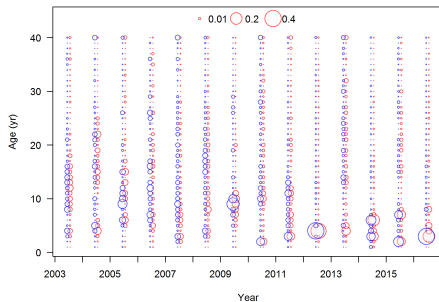


NWFSC shelf-slope survey

Length comp data, whole catch, NWFSC shelf-slope survey (max=0.16)

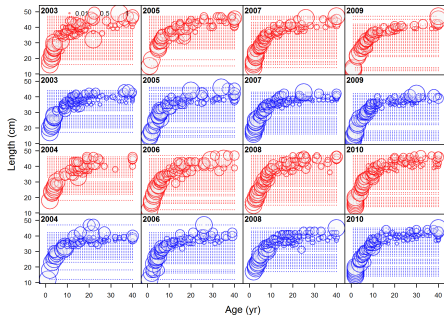


Ghost age comp data, whole catch, NWFSC shelf-slope survey (max=0.4)

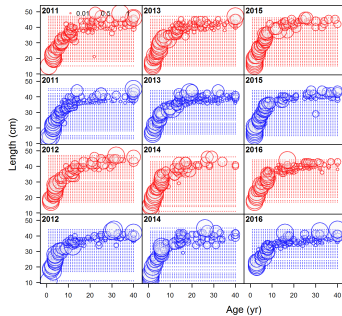


NWFSC shelf-slope conditional age-at-length

Conditional age-at-length data, whole catch, NWFSC shelf-slope survey (max=0.96)

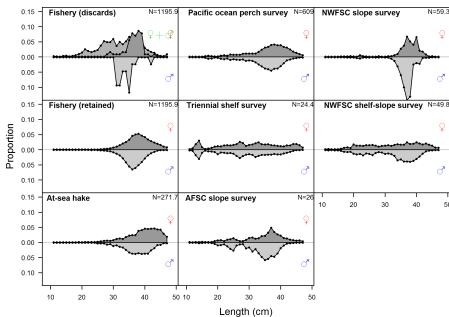


Conditional age-at-length data, whole catch, NWFSC shelf-slope survey (max=0.96)

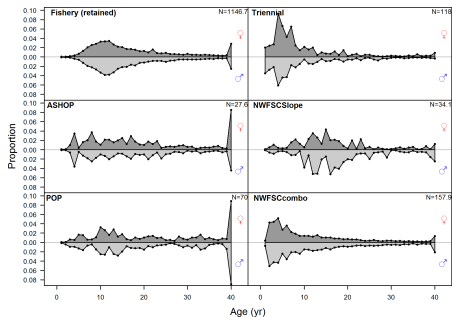


Aggregated data by source

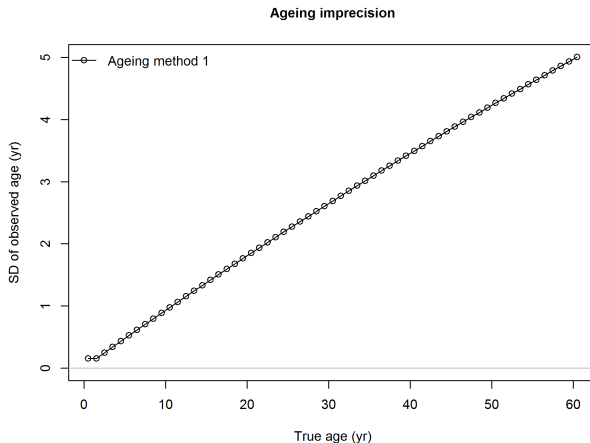
Length comp data, aggregated across time by fleet



Age comp data, aggregated across time by fleet



Estimated Ageing Error: Curvilinear without bias



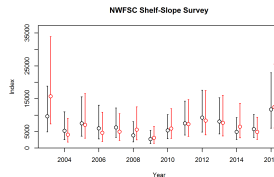
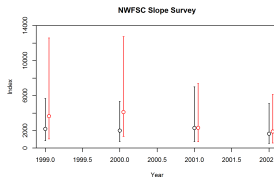
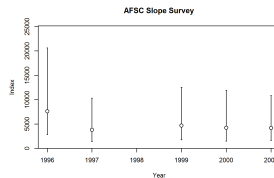
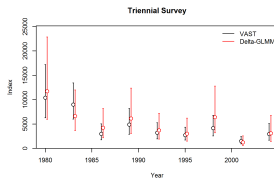
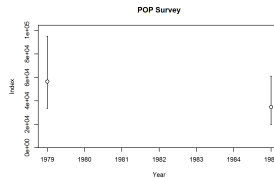
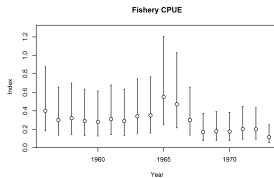
Conclusion of Biology & Data

Additional data slides

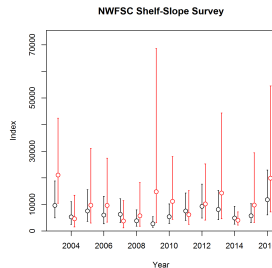
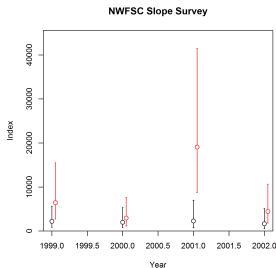
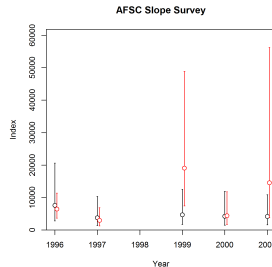
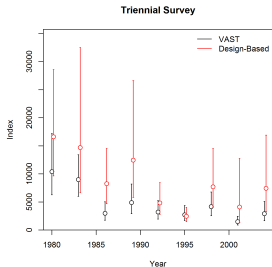
Survey Stratification and Model Selection

Survey	Depth (m)	Latitude	Model	Error
Pacific ocean perch	155-500	44-48.5	VAST	Lognormal
Triennial shelf	55-366	40.5-49	VAST	Lognormal
AFSC slope	183-549	42-49	VAST	Lognormal
NWFSC slope	183-549	42-49	Bayesian delta glmm	Gamma
NWFSC shelf-slope	55-549	42-49	VAST	Lognormal

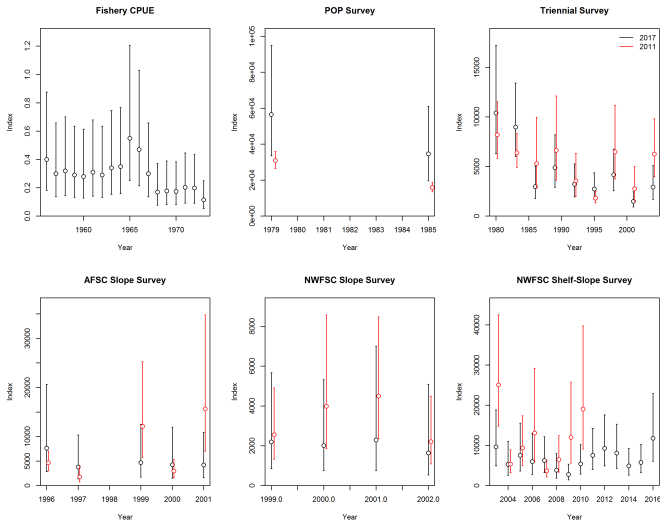
VAST vs. Bayesian Delta-GLMM Indices



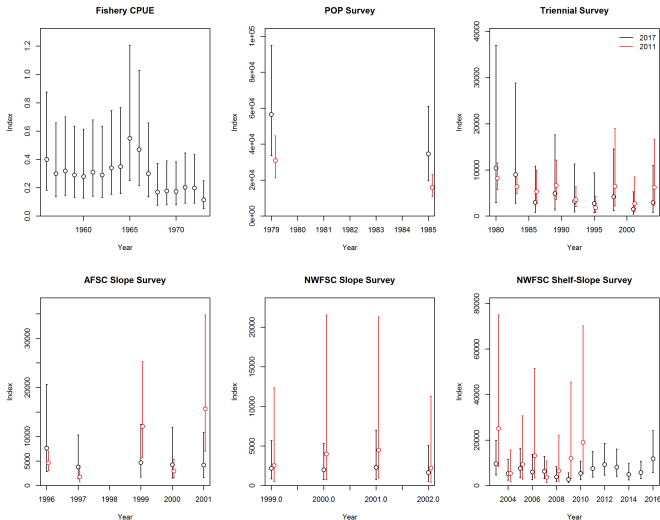
Designed Based vs. VAST Indices



Pre-Model 2011 Indices vs. 2017 Indices



Post Model 2011 Indices vs. 2017 Indices



Catchability Comparison

Index	2011	2017
Fishery CPUE	5.25E-06	4.48E-06
Pacific ocean perch survey	0.8126	0.8741
Triennial shelf survey (early)	0.2423	0.161
Triennial shelf survey (late)	0.1793	-
AFSC slope survey	0.2708	0.0822
NWFSC slope survey	0.1717	0.0571
NWFSC shelf-slope survey	0.4797	0.0728