

Pacific Ocean Perch 2017 Assessment

Biology and Data

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STAR Panel
June 26-30, 2017

Outline

Model Summary

Overview

Landings

Estimated Stock Size and Status

Uncertainties

Biology

Removals

Index Data

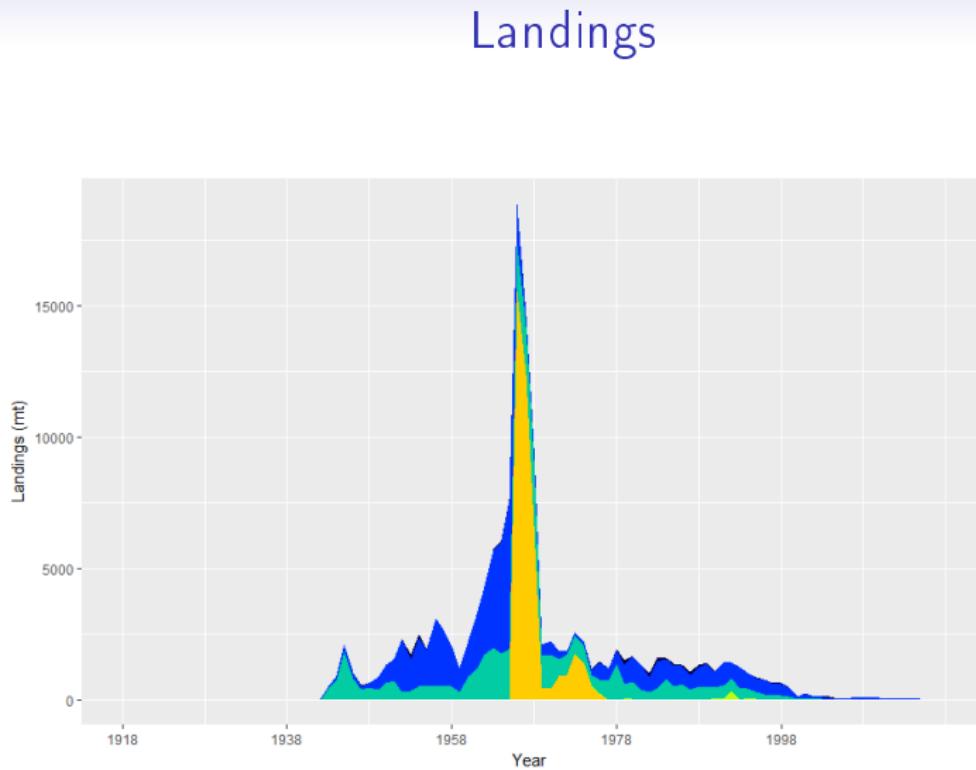
Composition Data

Pacific ocean perch (*Sebastodes alutus*)

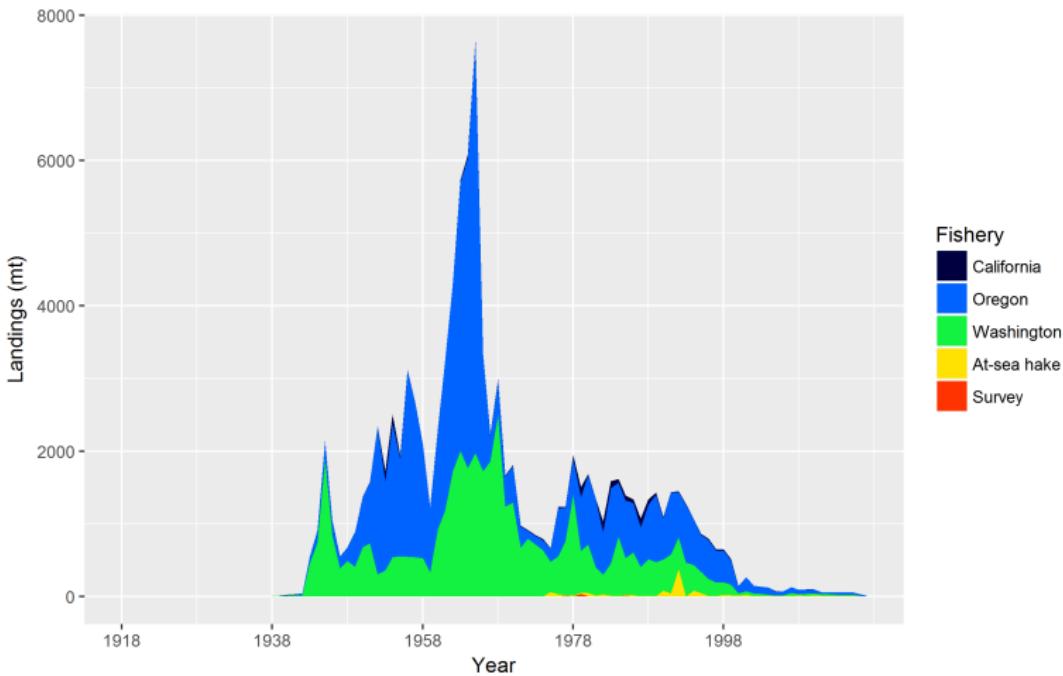
- Distributed from Alaska Aleutian Islands to Northern California
- Typically distributed between 200 - 400 meters during summer months
- Semi-demersal and can be pelagic
- Both sexes move to deeper water with age
- Currently, no evidence for genetic differences in the assessment area



- Females move to deeper waters post-spawning during winter months and return inshore in spring.



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

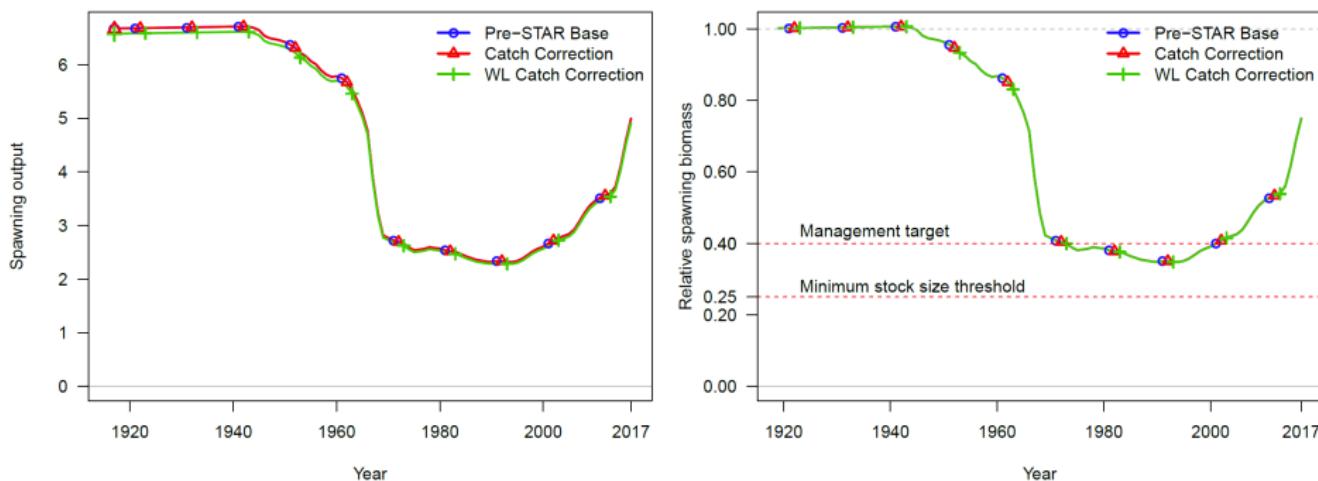
Approximately 70% of the landings are from Oregon in the recent years.
 Vast majority of landings are from bottom-trawl gear.



Correction for the Post-STAR Model

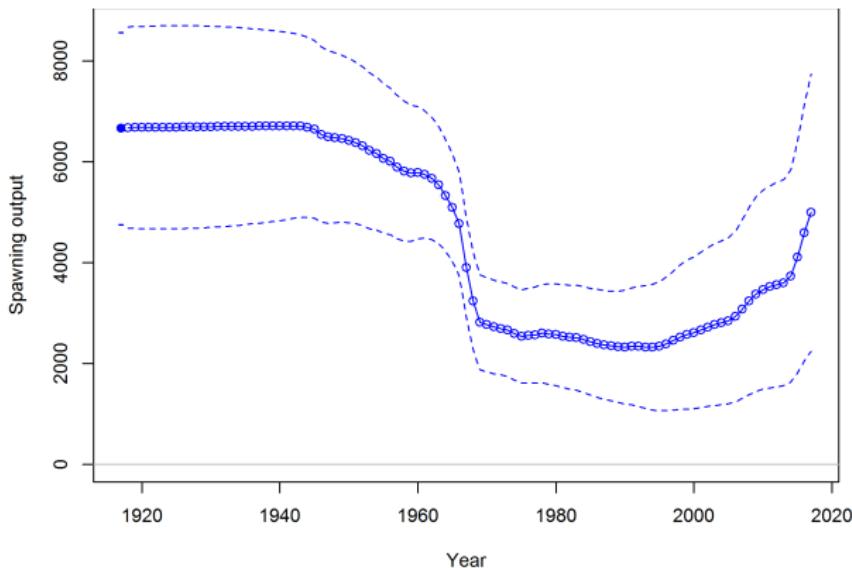
- Addition to California historical landings
 - 1948-1968 corrections totaling 10 mt
- Survey catch removal correction
 - Stock Synthesis was not removing catches for survey fleets
- Weight-at-length
 - Small correction to the weight-at-length values for females and males

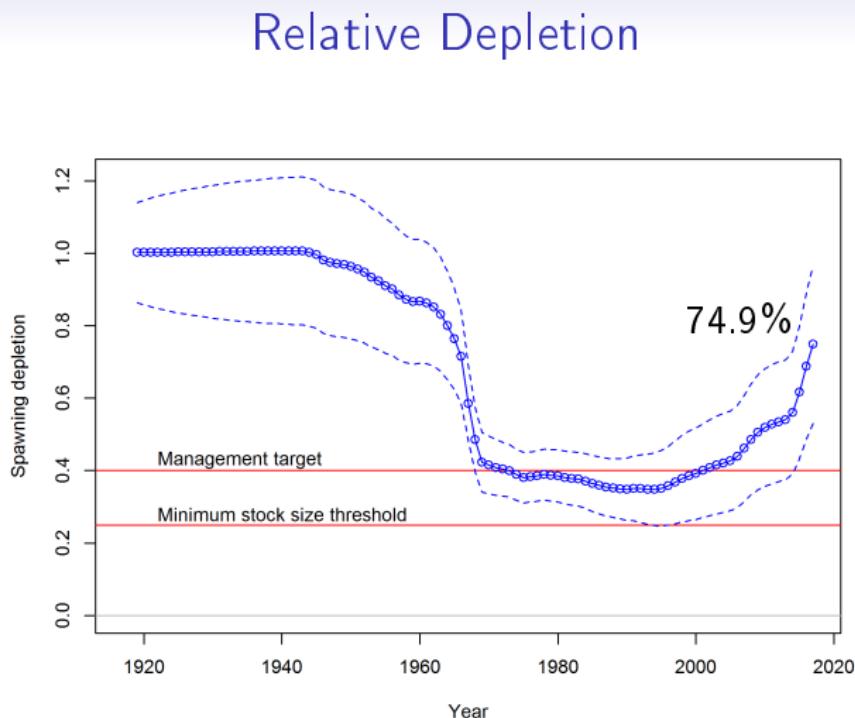
Comparison between STAR model and Corrected Model



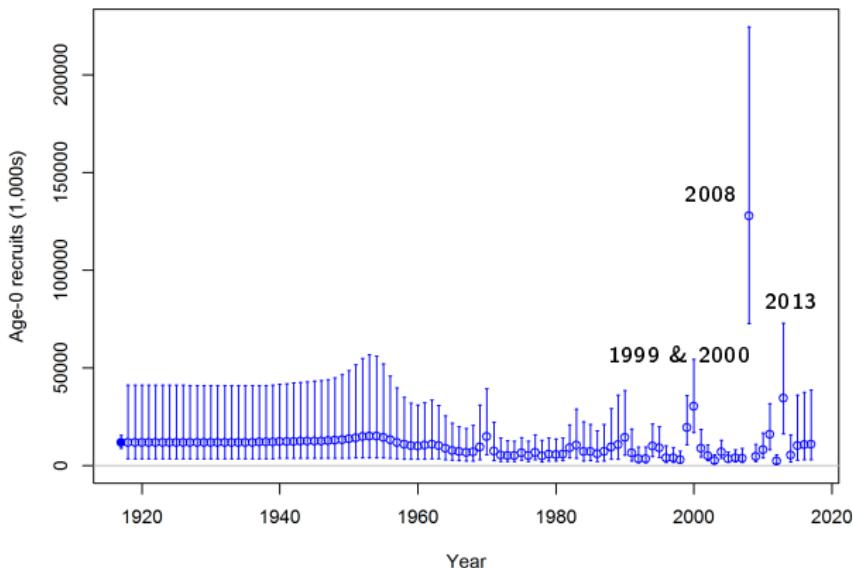
*All results shown come from the Pre-STAR base model as included in the document.

Spawning Output

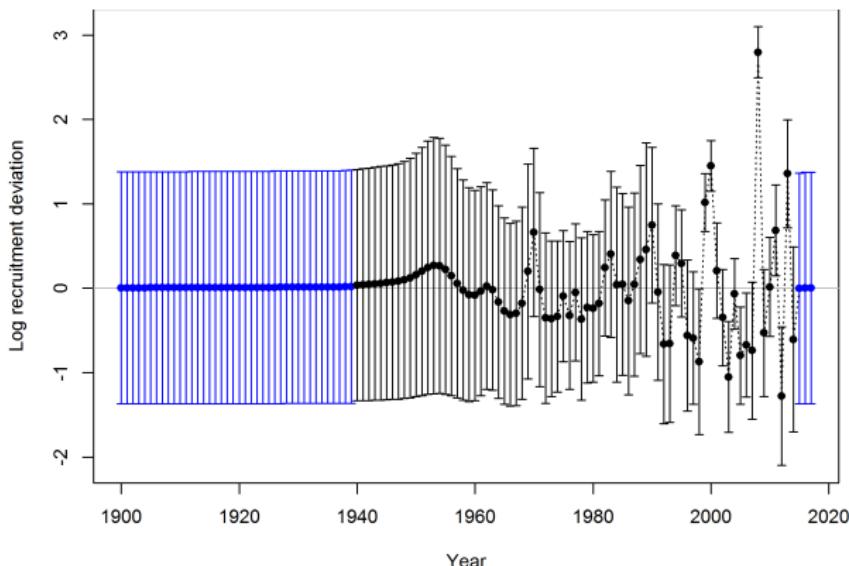




Estimated Annual Recruitment



Estimated Annual Recruitment Deviations

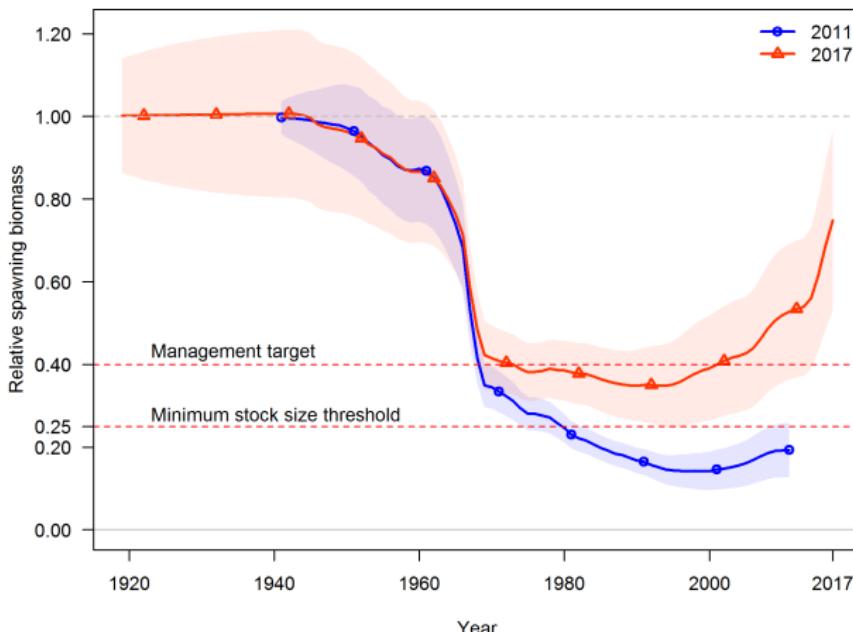


History of Assessments for West Coast Pacific Ocean Perch

- 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

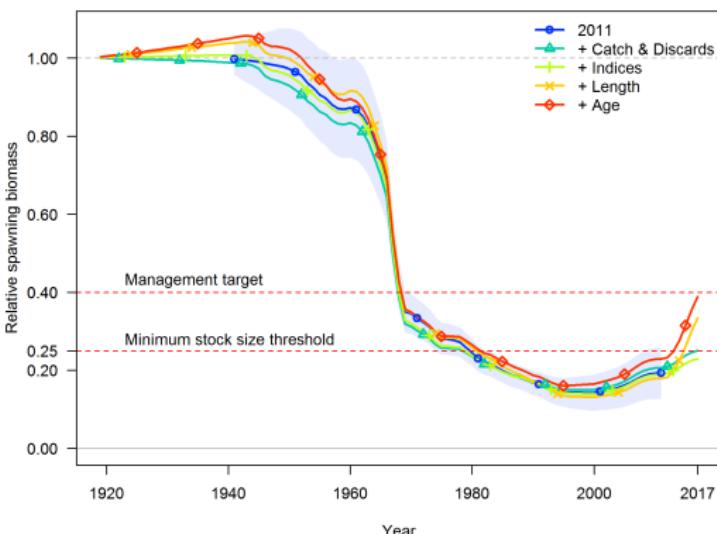


Major Changes Between the Previous and Current Assessment

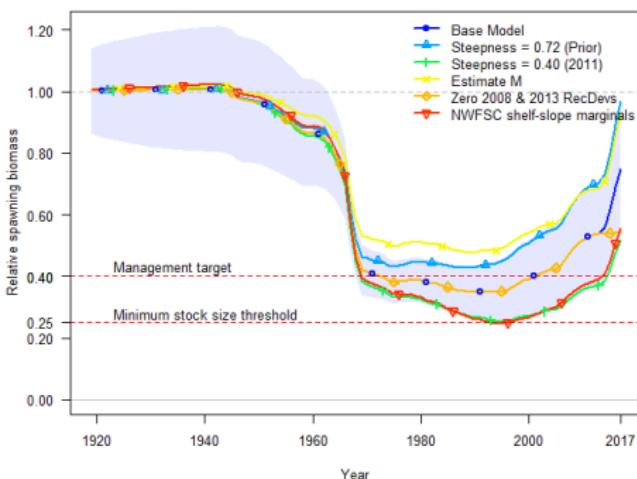
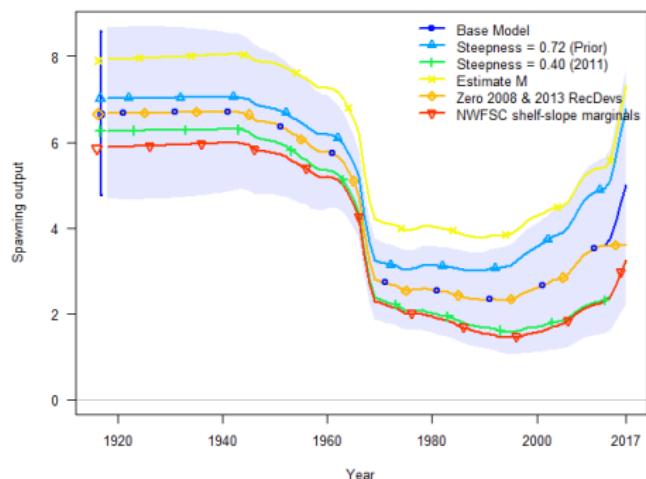
- Steepness
 - The 2011 assessment fixed $h = 0.40$
 - The current assessment fixed $h = 0.50$
- Natural Mortality
 - The 2011 assessment fixed $M = 0.05$ for females, males estimated $M = 0.051$
 - The current assessment fixed $M = 0.054$ for both sexes
- Landings History
- Maturity and Fecundity
-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

Maturity

Fecundity

Growth

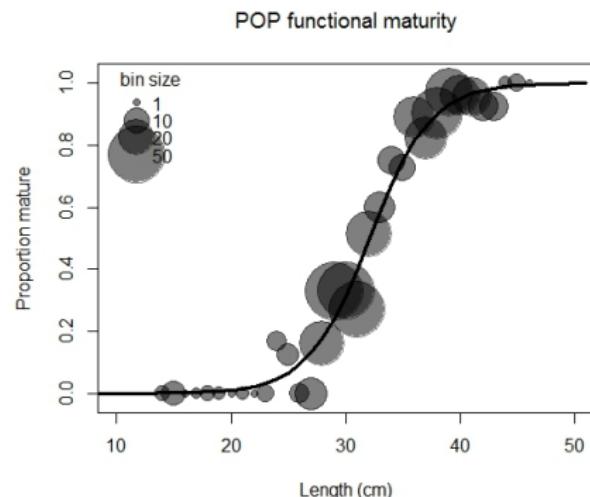
Removals

Index Data

Composition Data

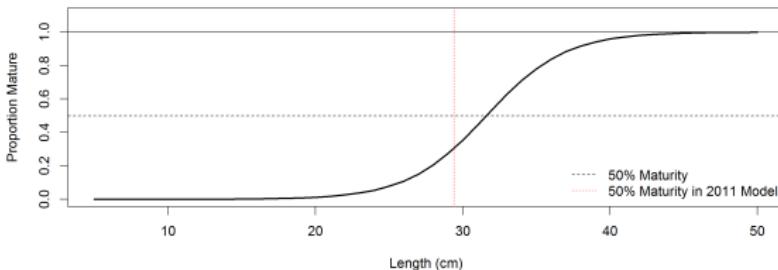
Functional Maturity-at-Length

- 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

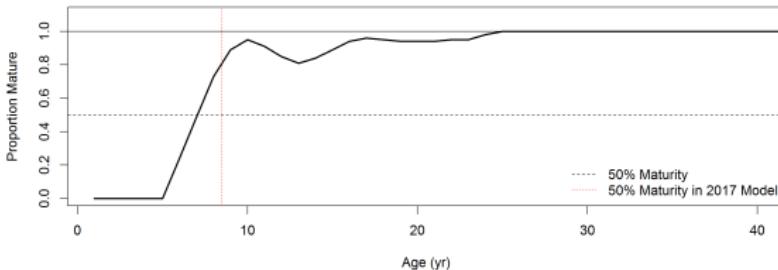


Maturity Comparison

Functional Maturity by Length (2017 Assessment)

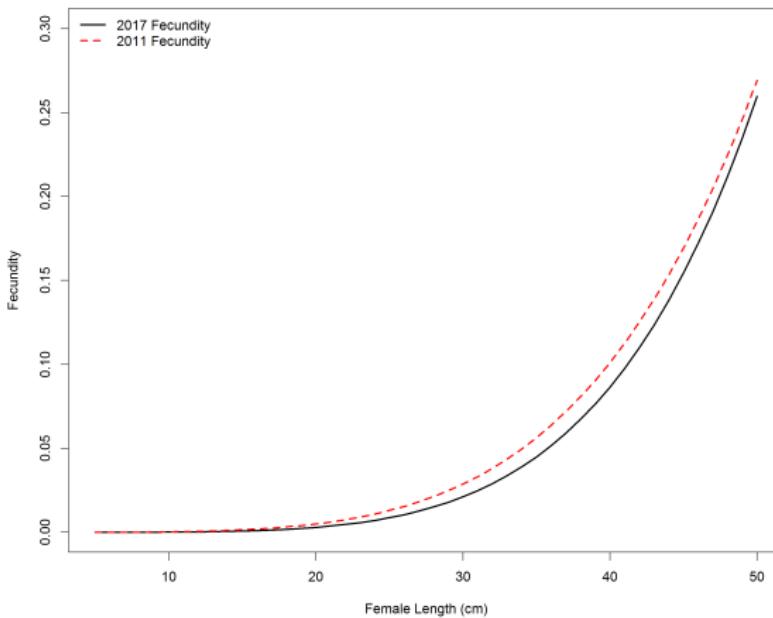


Maturity by Age (2011 Assessment)



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

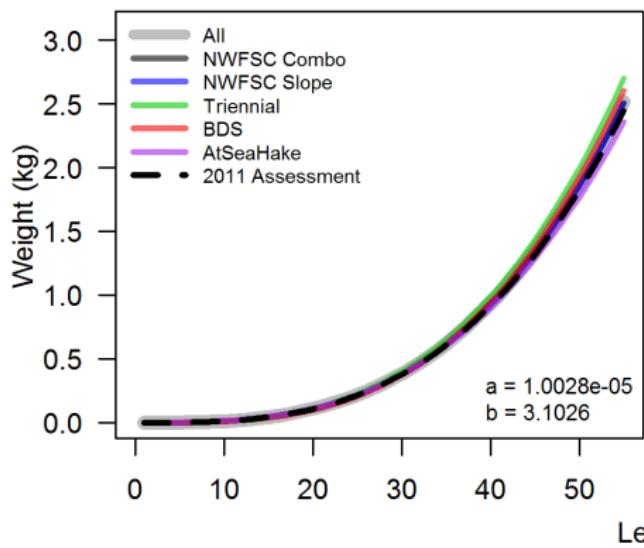
Fecundity



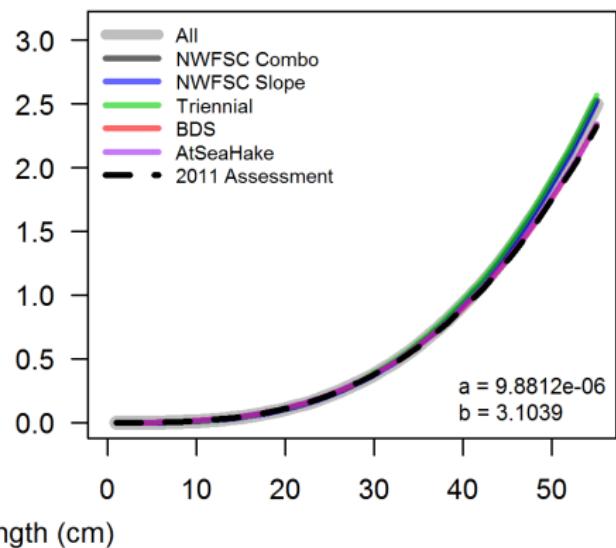
*Sensitivity to assumed fecundity shown to not have a large impact on results

Weight-at-Length

Female

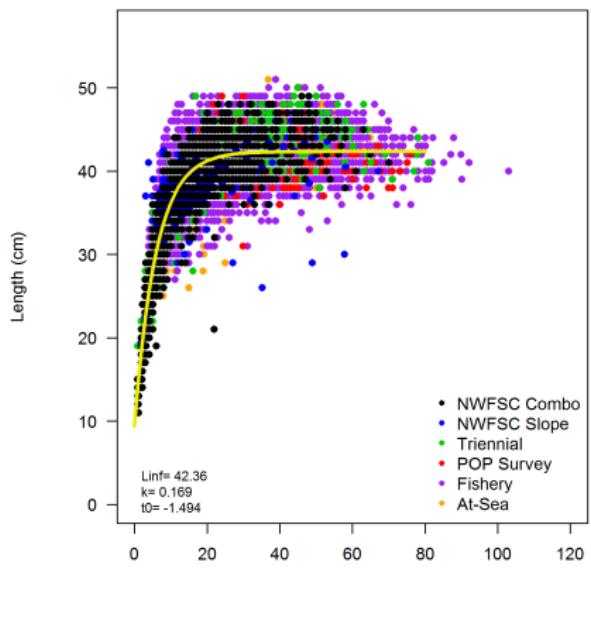


Male

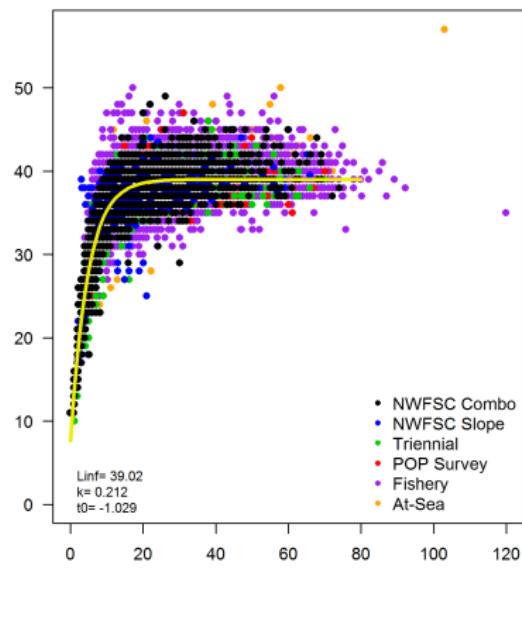


Length-at-Age

Female

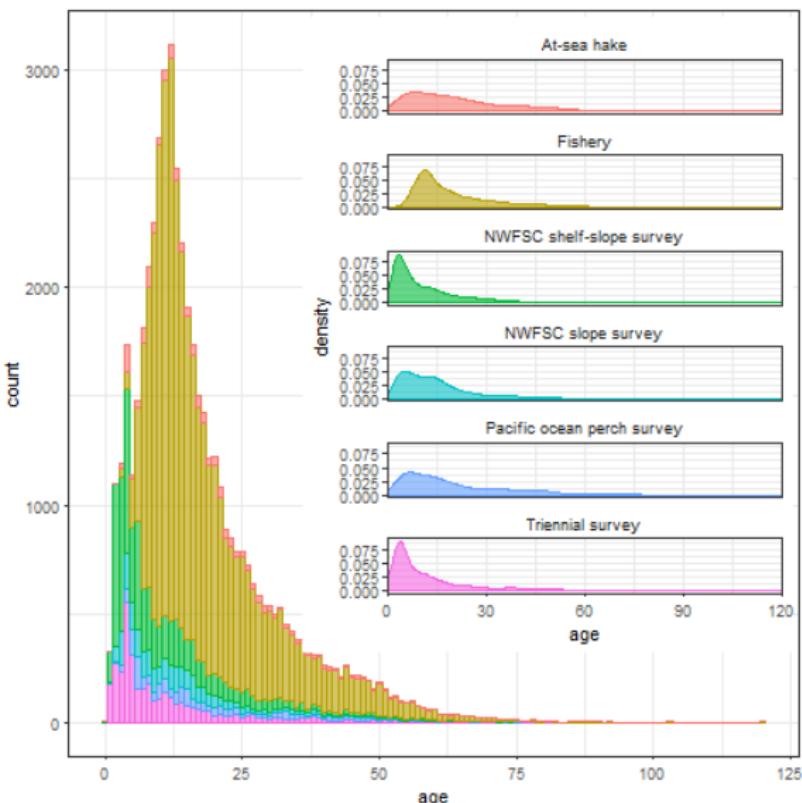


Male



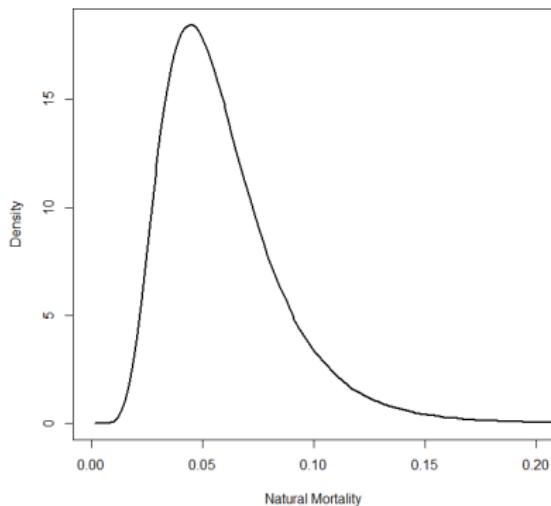
Observed Ages

- 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



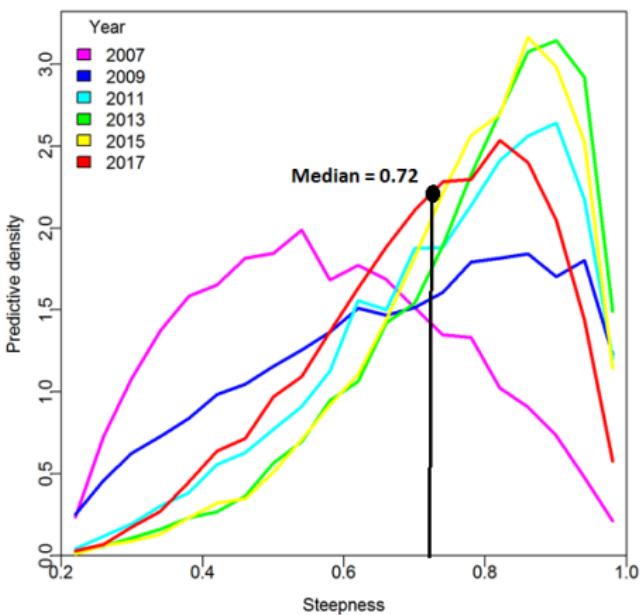
Natural Mortality

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



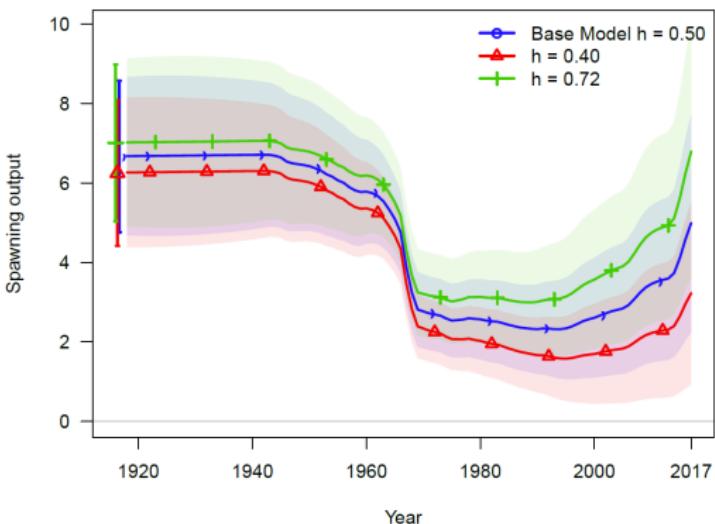
Steepness: Density-Dependent Recruitment Compensation

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



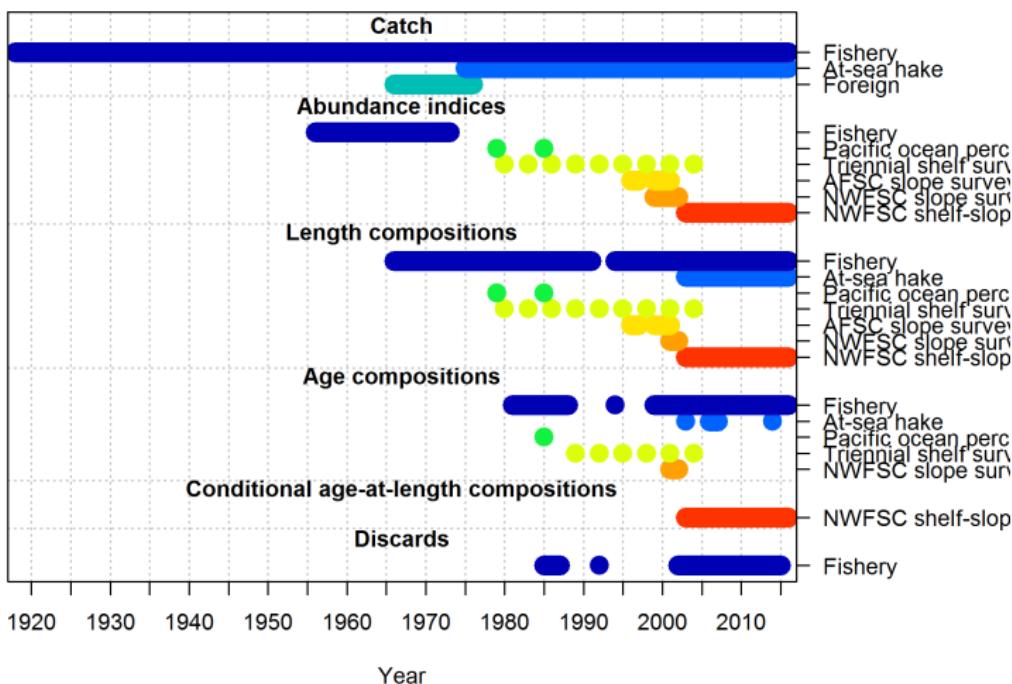
Steepness

- 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

Data by type and year



Outline

Model Summary

Biology

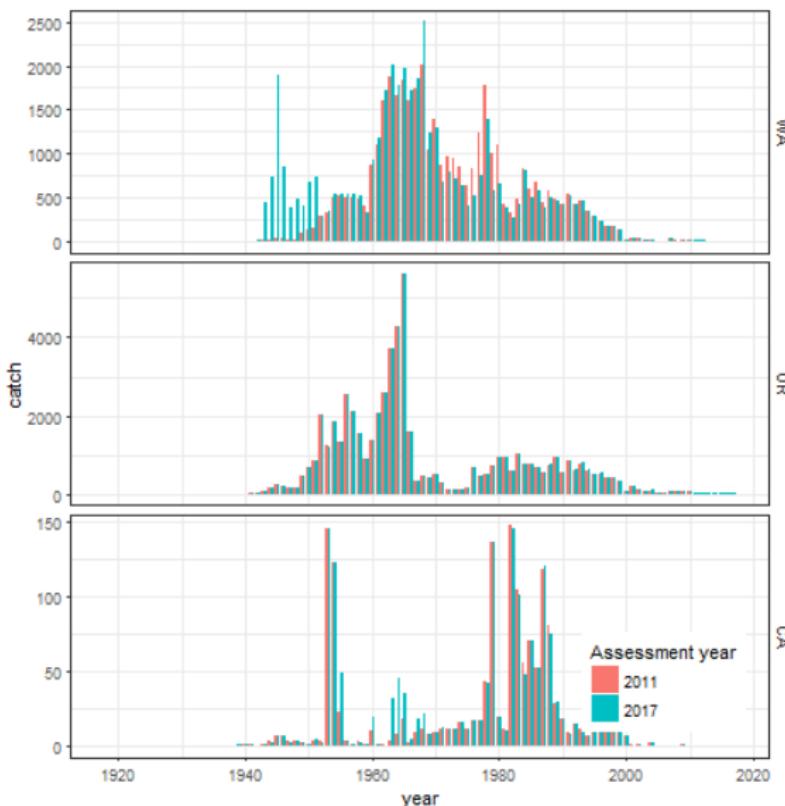
Removals

Landings History by State
Discarding practices

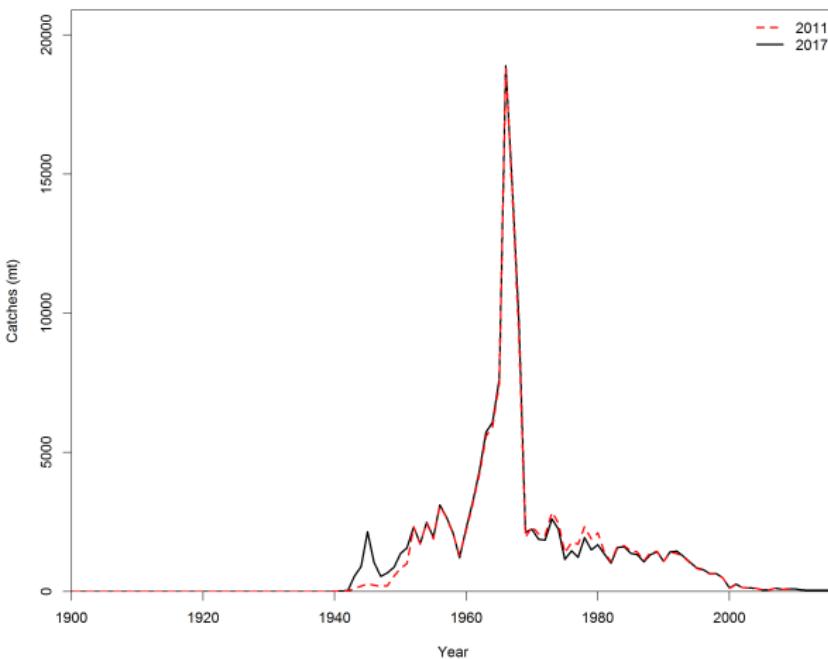
Index Data

Composition Data

Landings Data: 2017 vs. 2011

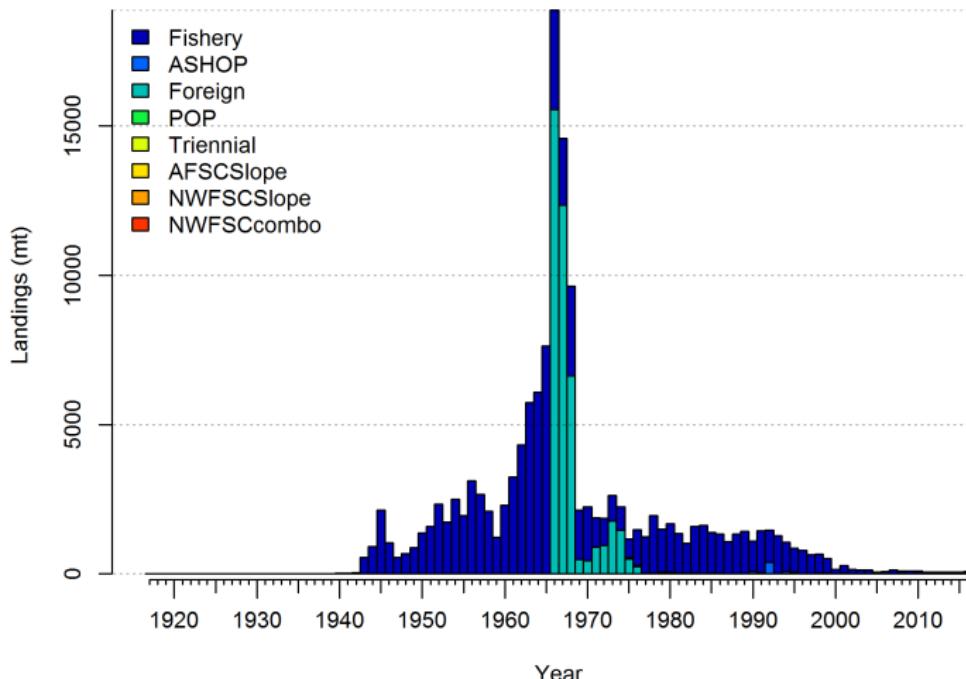


Cumulative Catch Difference

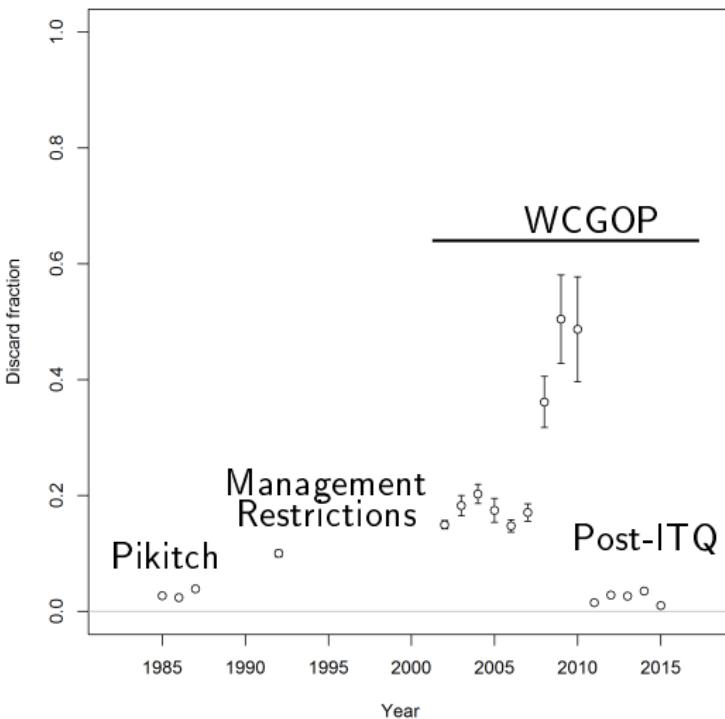


*Resulted in < 1% change in R_0

Landings by Fleet and Survey



Fishery Discard Data



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

Model Summary
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Biology
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Removals
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Composition Data
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Appendix

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Model Summary

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CPUE and Survey Indices

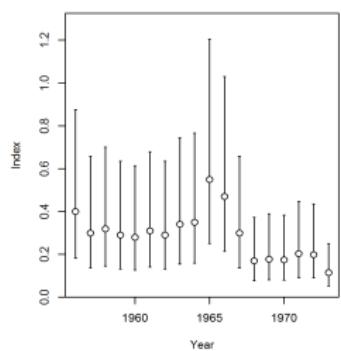
Composition Data

Survey Stratification and Model Selection

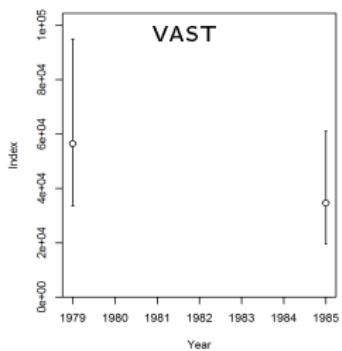
Survey	Depth (m)	Latitude	Model	Error
Pacific ocean perch	155-500	44-48.5	VAST	Lognormal
Triennial shelf	55-366	40.5-49	VAST	Lognormal
AFSC slope	183-549	42-49	VAST	Lognormal
NWFSC slope	183-549	42-49	Bayesian delta glmm	Gamma
NWFSC shelf-slope	55-549	42-49	VAST	Lognormal

Fishery and Survey Indices

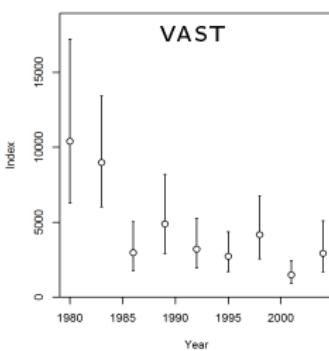
Fishery CPUE



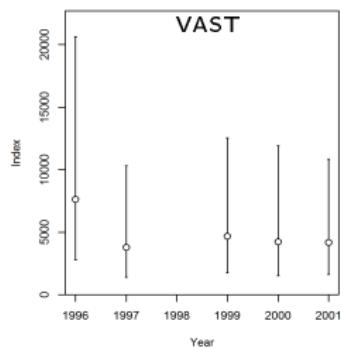
POP Survey



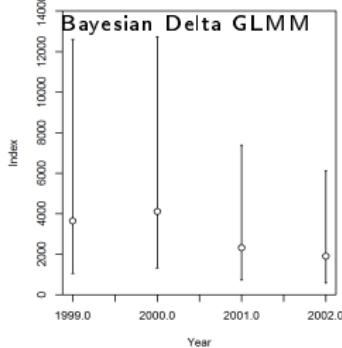
Triennial Survey



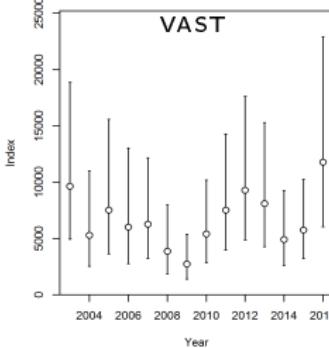
AFSC Slope Survey



NWFSC Slope Survey

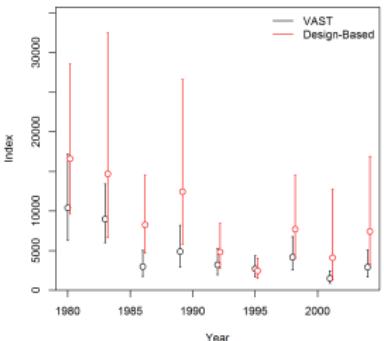


NWFSC Shelf-Slope Survey

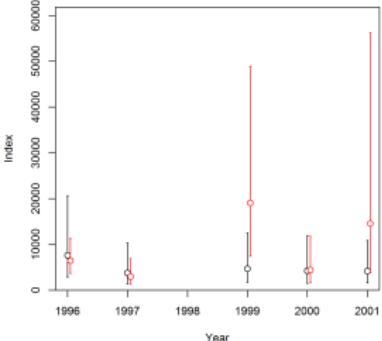


Designed Based vs. Model Indices

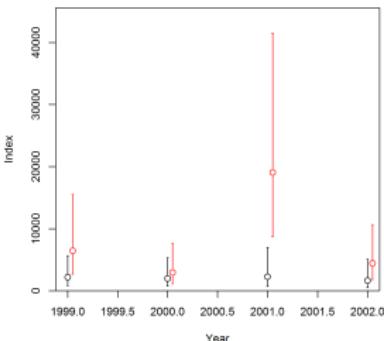
Triennial Survey



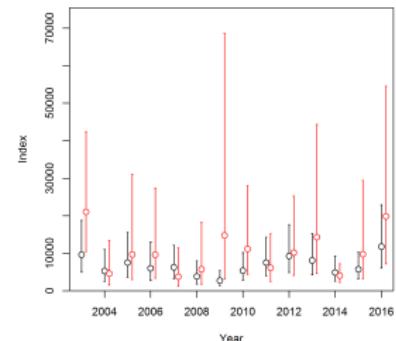
AFSC Slope Survey



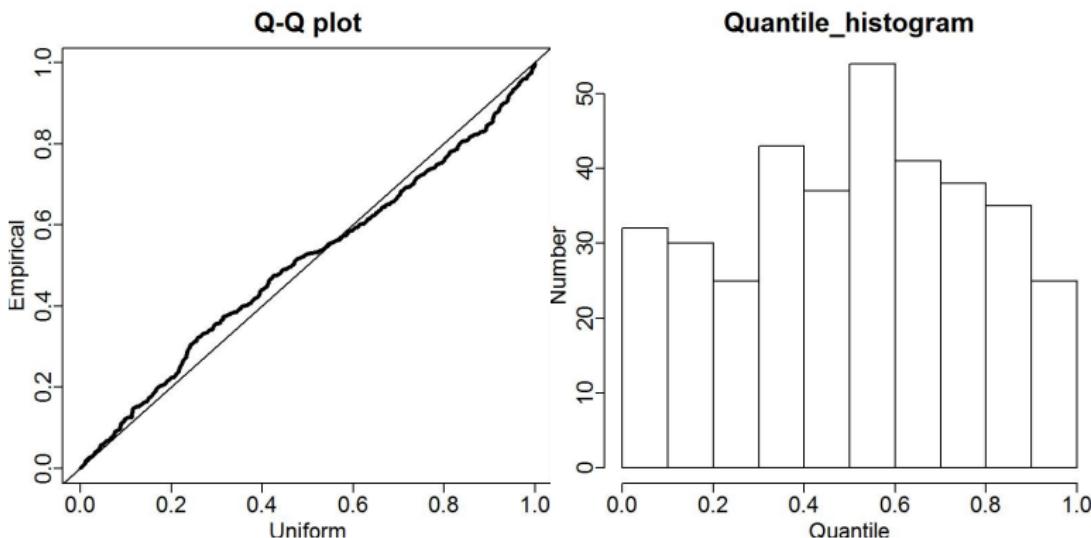
NWFSC Slope Survey



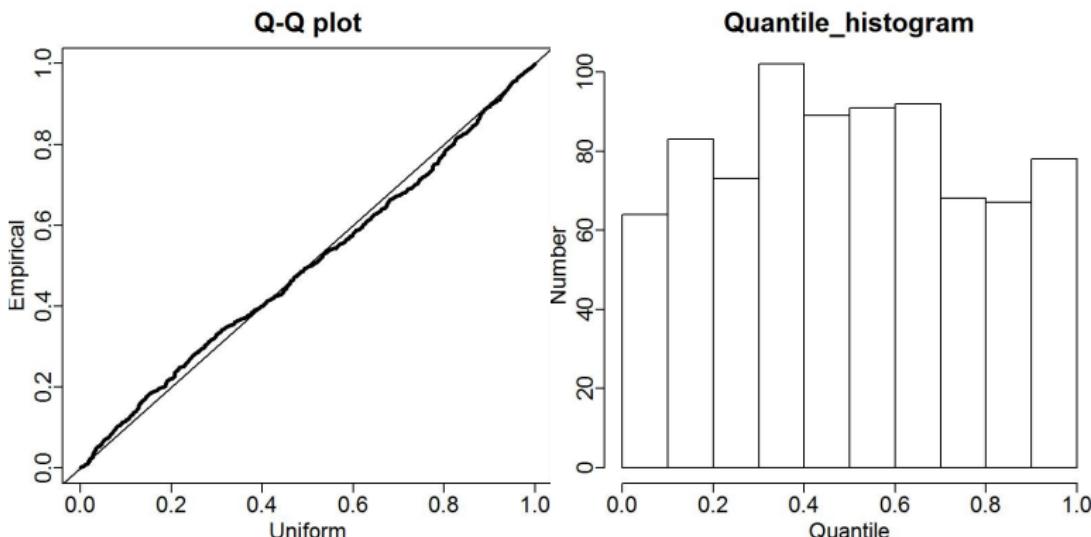
NWFSC Shelf-Slope Survey



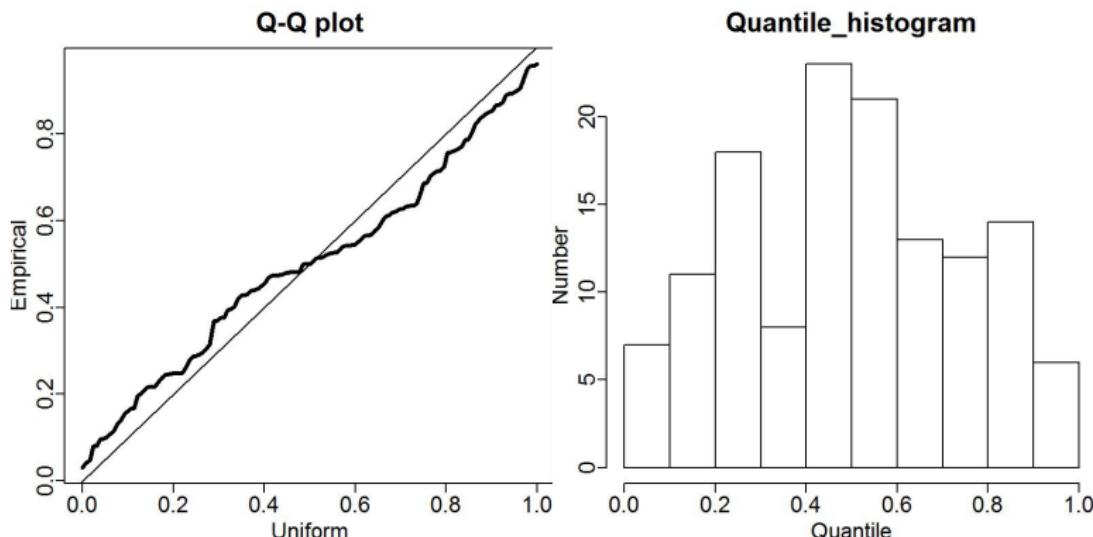
Pacific Ocean Perch Survey Diagnostics



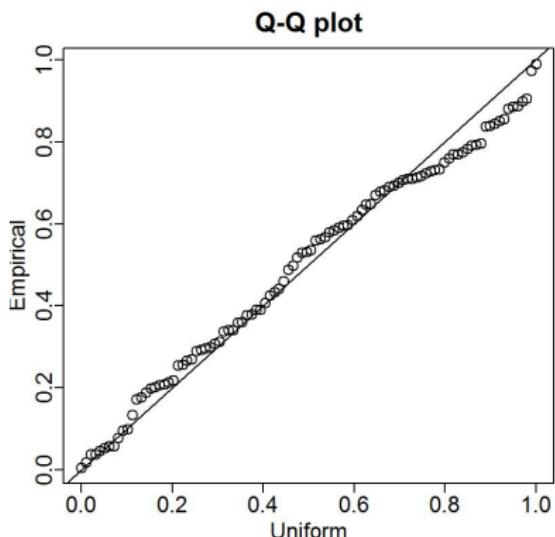
Triennial Shelf Survey Diagnostics



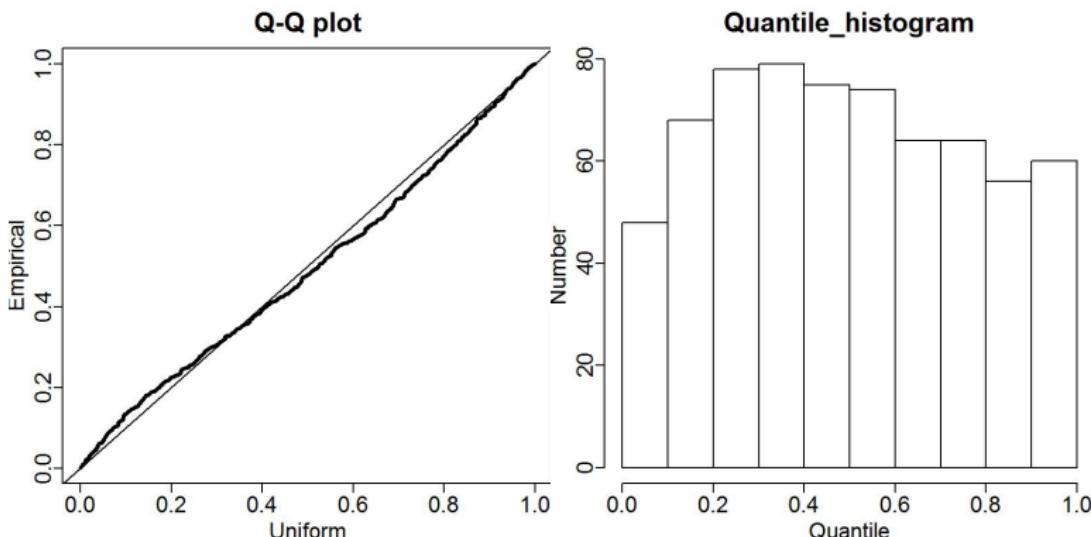
AFSC Slope Survey Diagnostics



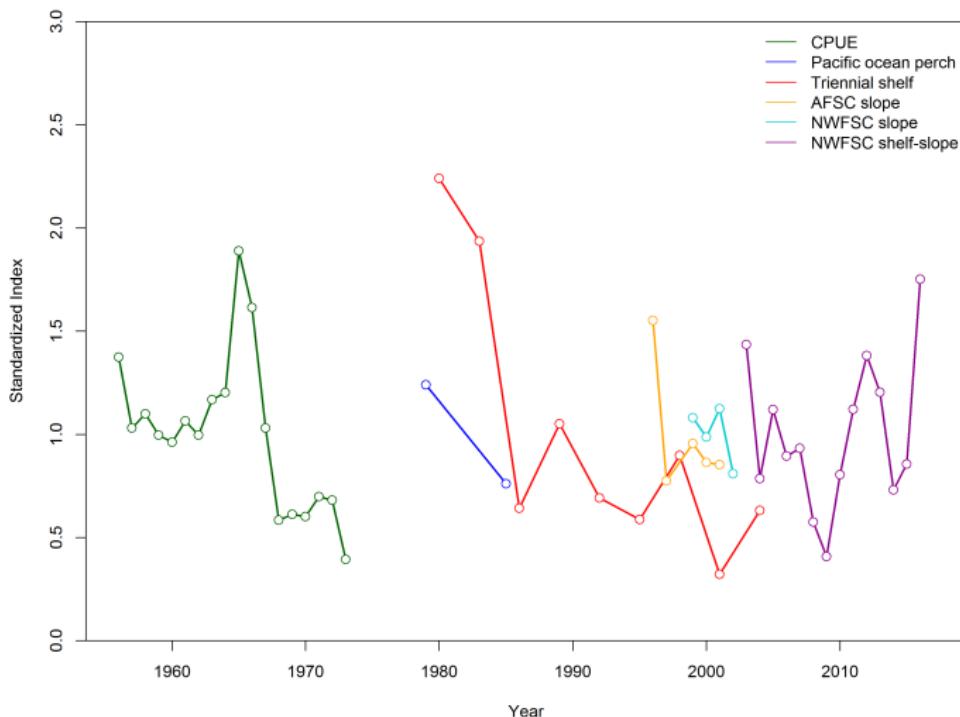
NWFSC Slope Survey Diagnostics



NWFSC Shelf-Slope Survey Diagnostics



All: Standardized



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Composition Data

Fishery Data

Survey Length and Age Data

Ageing Error

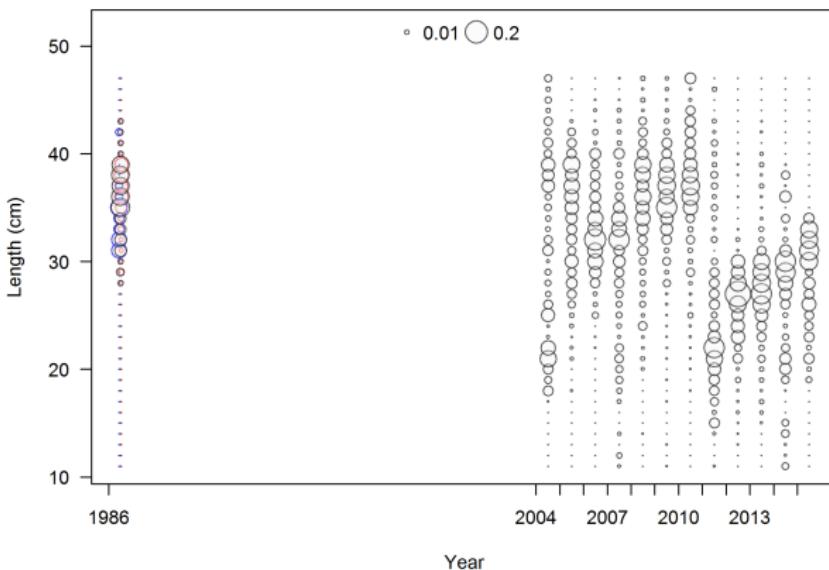
Fishery Length and Age Data

Fishery length data used in the 2017 assessment:

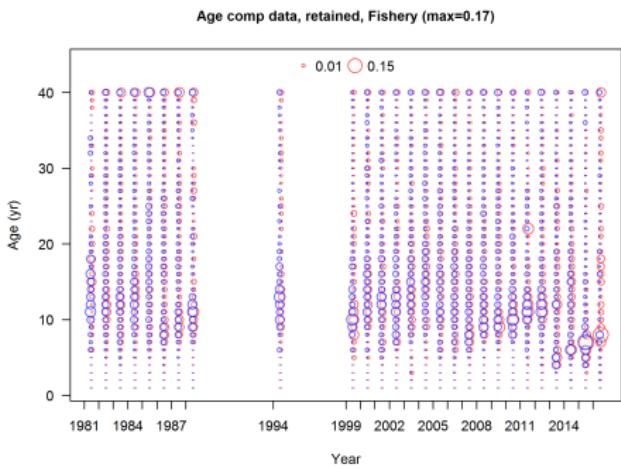
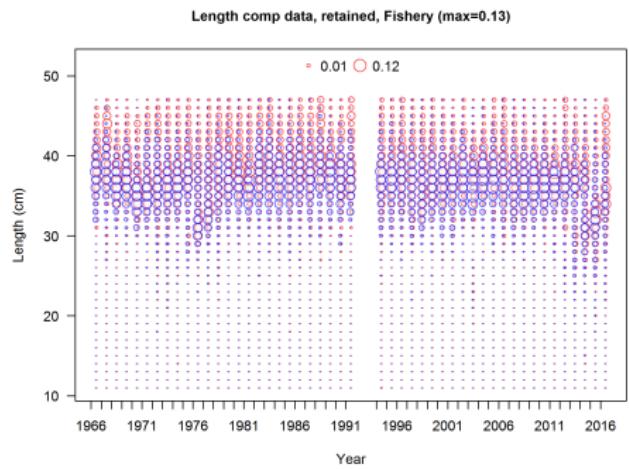
- Fishery: bottom trawl, mid-water trawl, fixed gear
 - Retained Lengths: 1966-2016
 - Discarded Lengths: 1986 (Pikitch), 2004-2015
 - Ages: 1981-1988, 1994, 1999-2016
- At-sea hake fishery
 - All (Retained and Discarded) Lengths: 2003-2016
 - Ages: 2003, 2006, 2007, 2014

Fishery Lengths: Discarded

Length comp data, discard, Fishery (max=0.27)

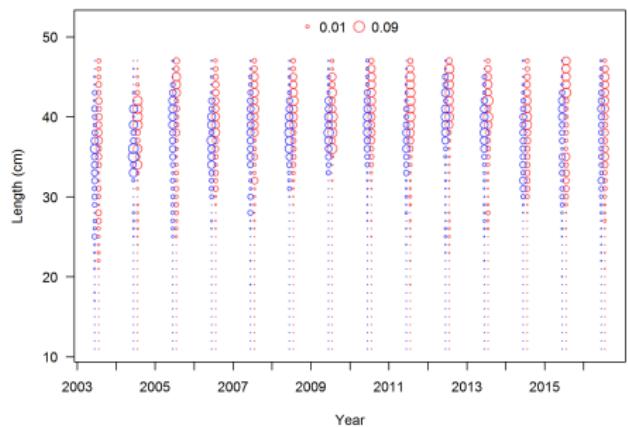


Fishery Lengths and Ages: Retained

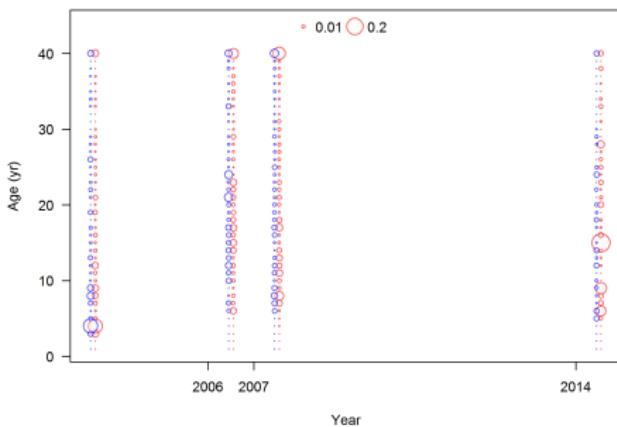


At-sea hake

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



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



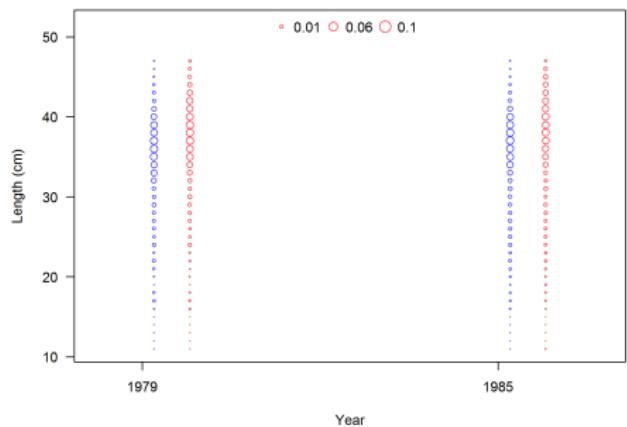
Survey Length Data

Survey length data used in the 2017 assessment:

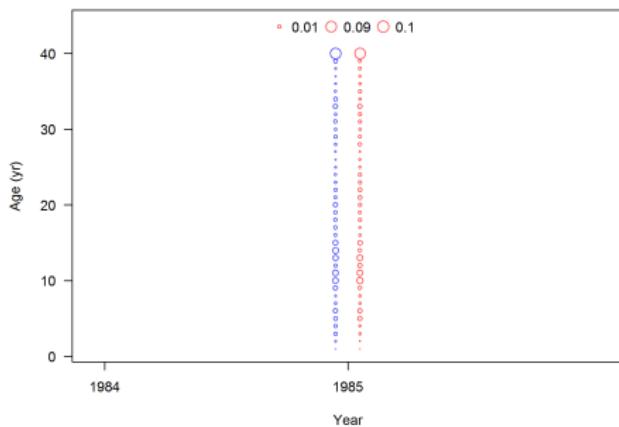
- Pacific ocean perch survey
 - Lengths: 1979 and 1985
 - Ages: 1985
- Triennial shelf survey
 - Lengths: 1980, 1983, 1986, 1989, 1992, 1995, 1998, 2001, 2004
 - Ages: 1989, 1992, 1995, 1998, 2001, 2004
- AFSC slope survey
 - Lengths: 1996, 1997, 1999-2001
- NWFSC slope survey
 - Lengths: 2001 and 2002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

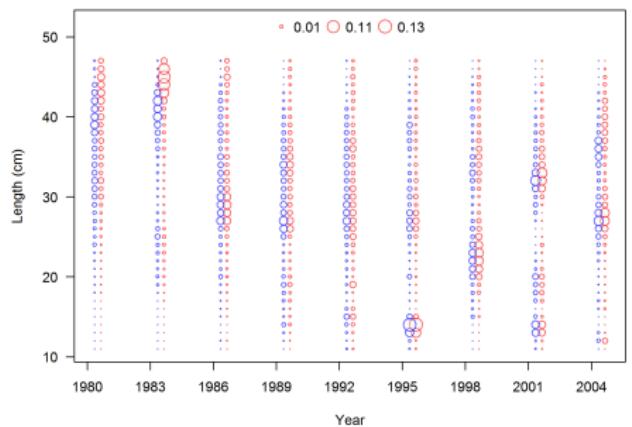


Age comp data, whole catch, Pacific ocean perch survey (max=0.09)

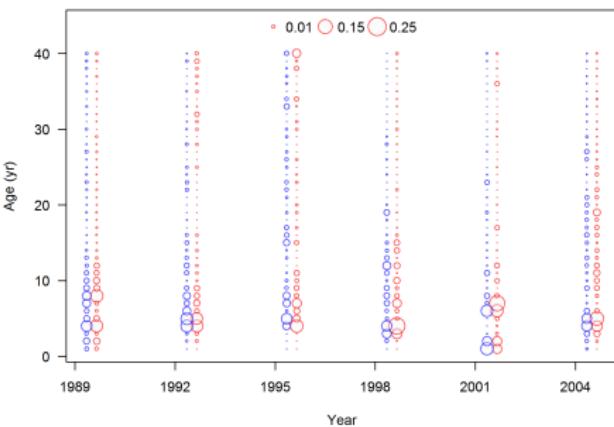


Triennial shelf survey

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

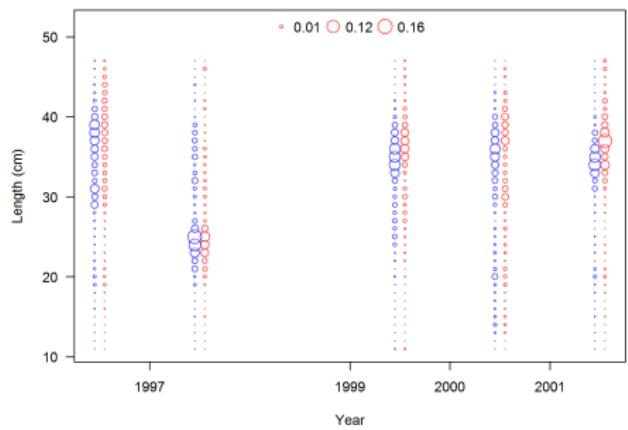


Age comp data, whole catch, Triennial shelf survey (max=0.2)



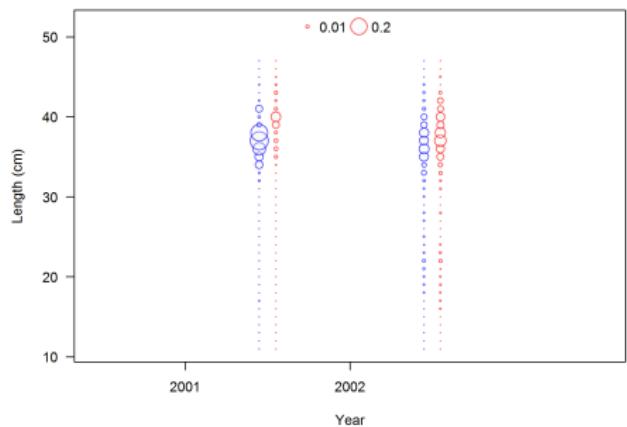
AFSC slope survey

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

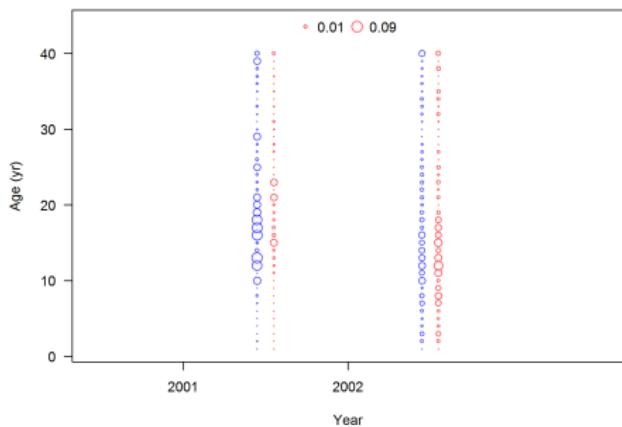


NWFSC slope survey

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

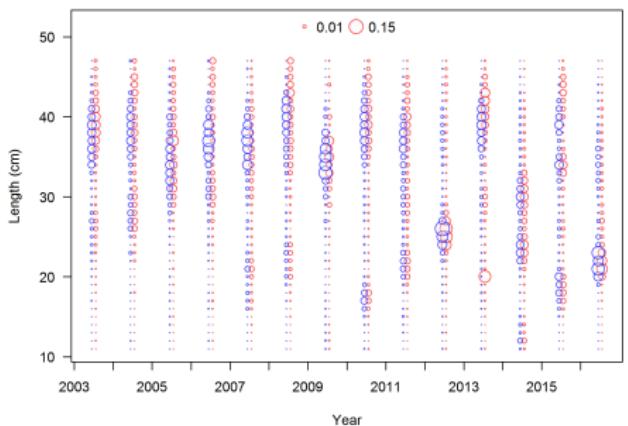


Age comp data, whole catch, NWFSC slope survey (max=0.08)

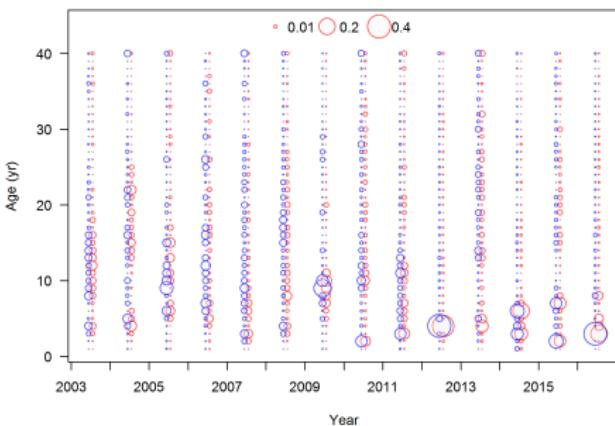


NWFSC shelf-slope survey

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

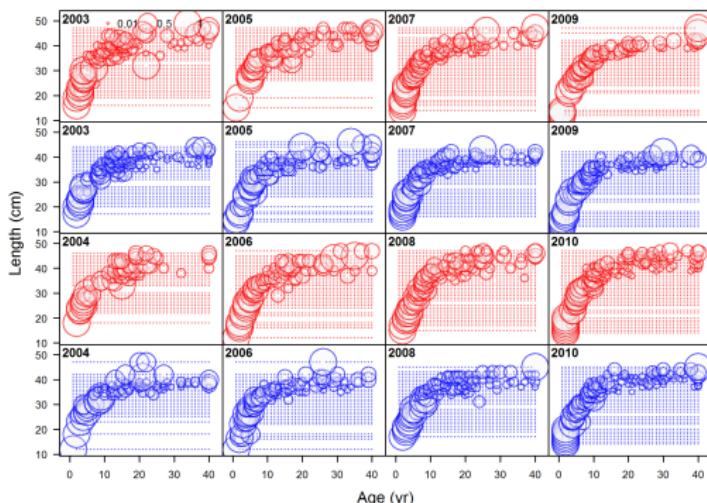


Ghost age comp data, whole catch, NWFSC shelf-slope survey (max=0.4)

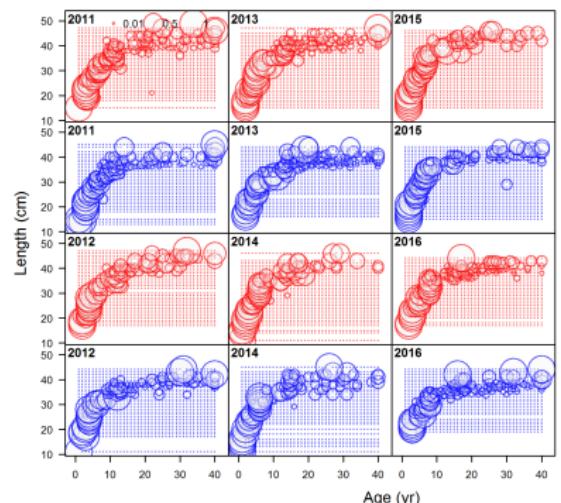


NWFSC shelf-slope conditional age-at-length

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

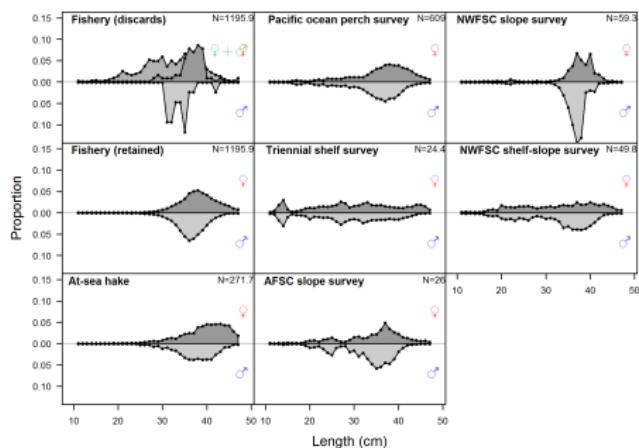


Conditional age-at-length data, whole catch, NWFSC shelf-slope survey

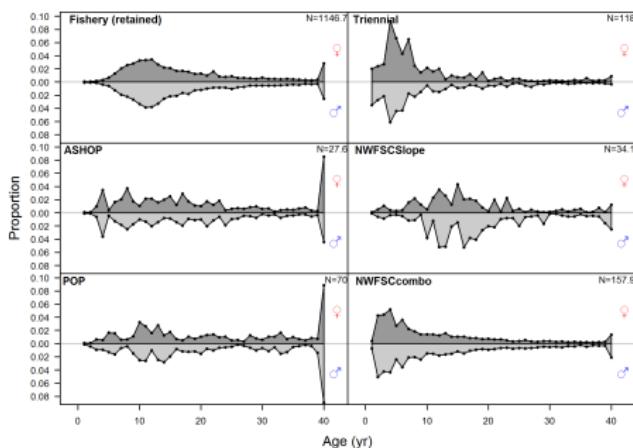


Aggregated data by source

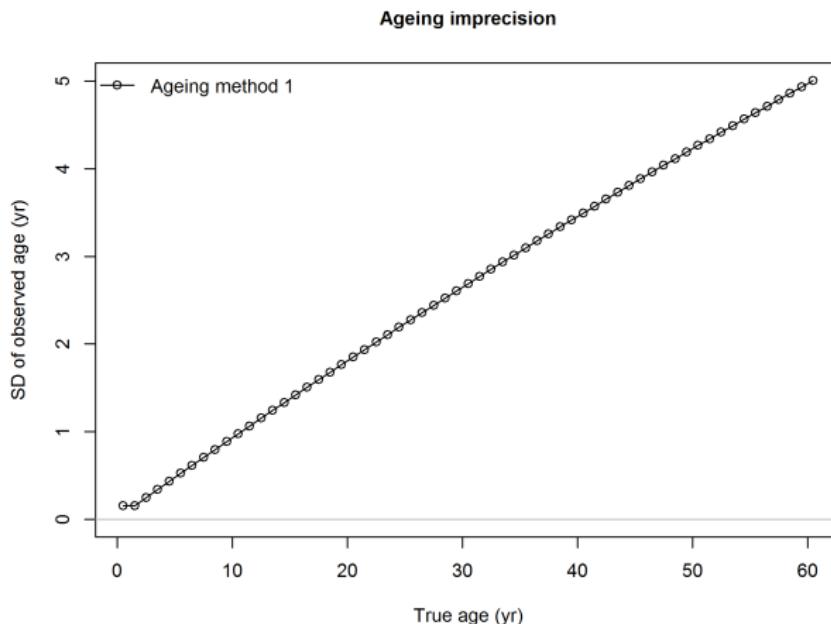
Length comp data, aggregated across time by fleet



Age comp data, aggregated across time by fleet



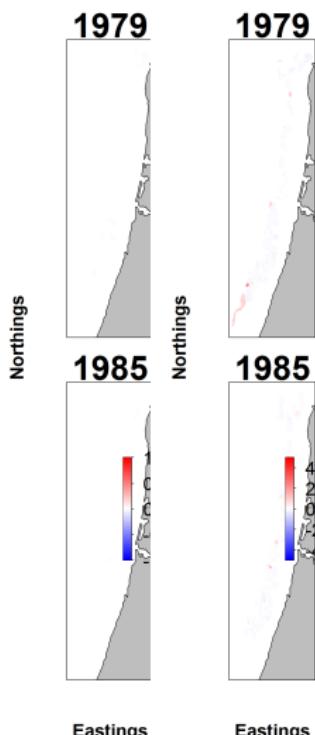
Estimated Ageing Error: Curvilinear without bias



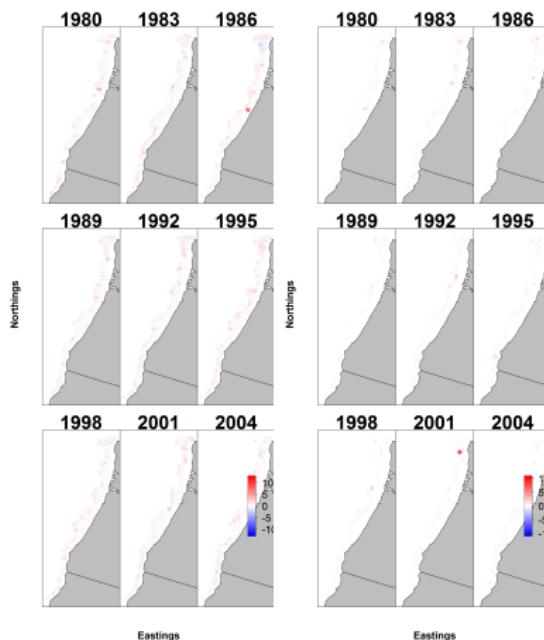
Conclusion of Biology & Data

Additional data slides

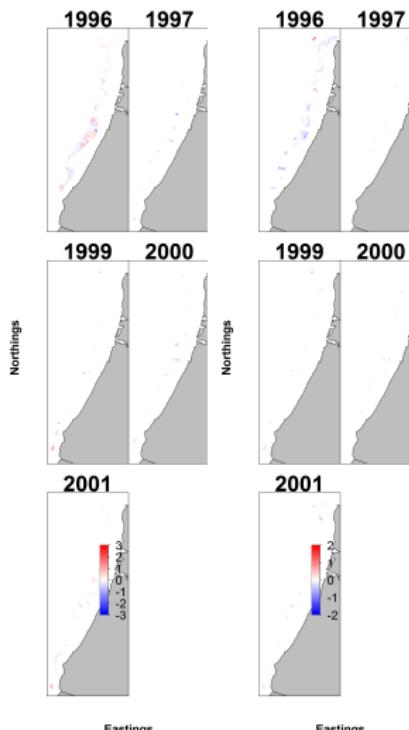
Pacific Ocean Perch Survey Diagnostics: Encounter (left) and Catch Rate (right) Pearson Residuals



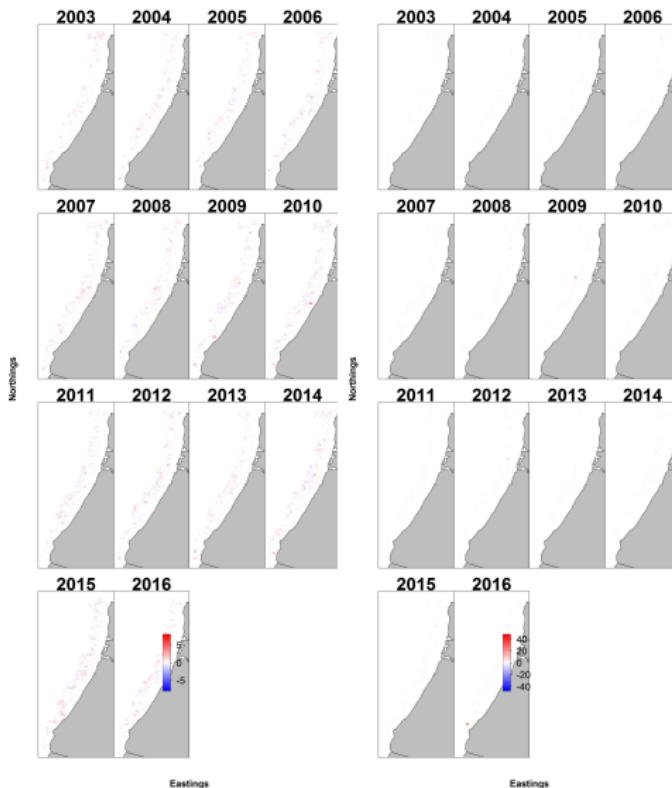
Triennial Shelf Survey Diagnostics: Encounter (left) and Catch Rate (right) Pearson Residuals



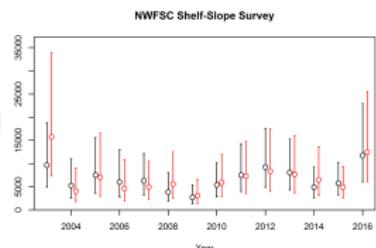
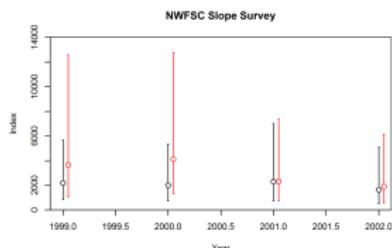
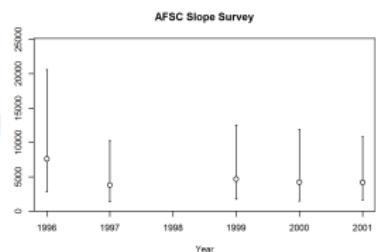
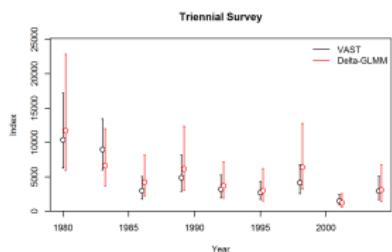
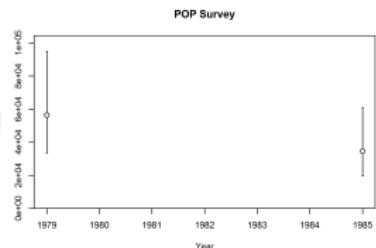
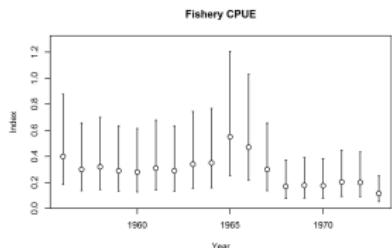
AFSC Slope Survey Diagnostics: Encounter (left) and Catch Rate (right) Pearson Residuals



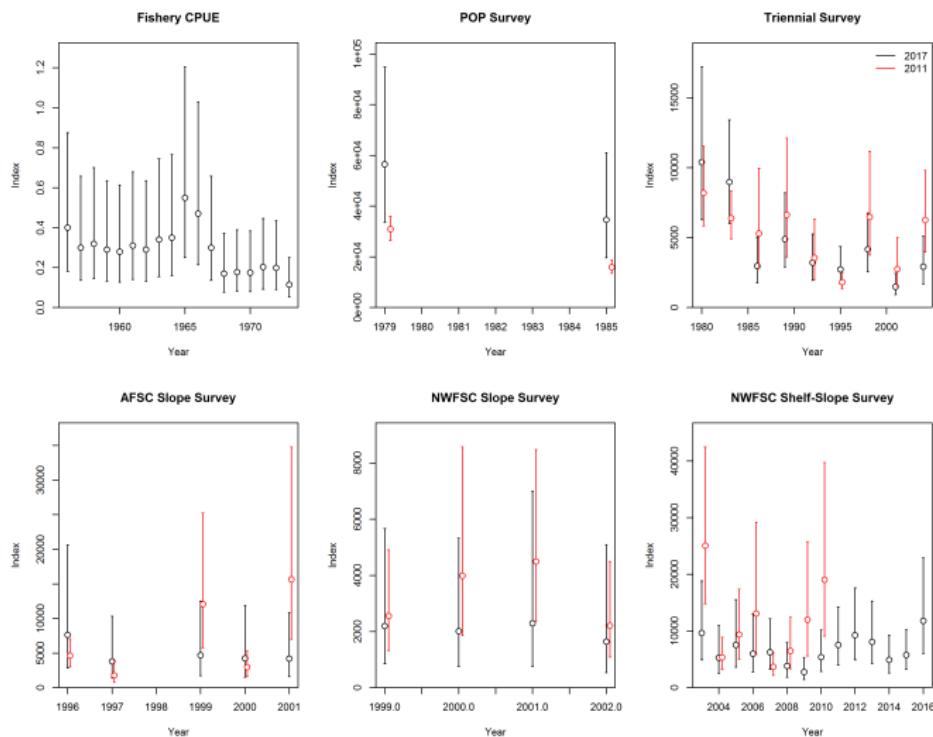
NWFSC Shelf-Slope Survey Diagnostics: Encounter (left) and Catch Rate (right) Pearson Residuals



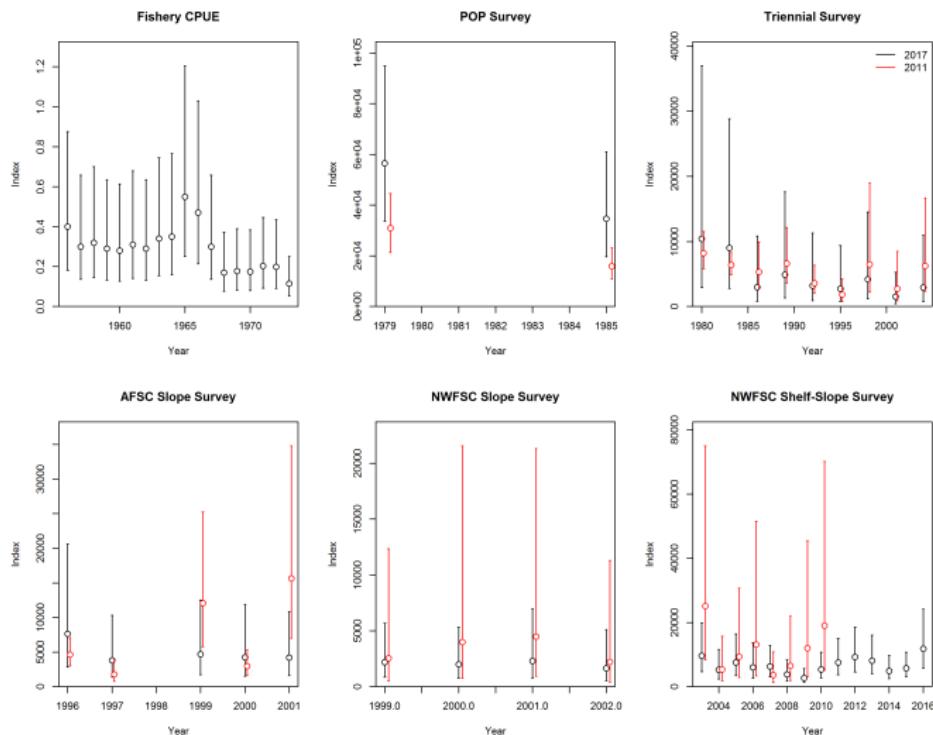
VAST vs. Bayesian Delta-GLMM Indices



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

Length-at-Age by Area

