GOA CEATTLE

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Model development

- Developed from ADMB CEATTLE
- Built in Template Model Builder
- Major changes:
  - Fit multiple surveys/fisheries flexibly
  - Added multiple bias corrections
  - Time varying catchability/selectivity
  - Two sex model
  - Estimate predator/prey suitability
  - Includes aging error
- Used to fit 3 different ms-models

GOA model Specifications

- Years: 1977 to 2018
- Species
  - Walleye Pollock – sexes combined
  - Pacific Cod – sexes combined
  - Arrowtooth Flounder – 2 sex
- Fit to the same data-sets as SAFE models

Likelihood components

#	Data	Distribution
1	Survey biomass	Lognormal
2	Survey composition	Multinomial
3	Survey selectivity (Non-par & Deviates)	Ianelli & Normal
4	Survey selectivity normalization	Normal on avg
5	Survey catchability	Lognormal
6	Total catch	Lognormal
7	Fishery composition	Multinomial
8	Fishery selectivity (Non-par & Deviates)	Ianelli & Normal
9	Fishery selectivity normalization	Normal on avg
10	Initial abundance/recruitment deviates	Lognormal
11	Fishing mortality deviates	Lognormal

Data used

Pollock Data – 10 ages

#	Data	Years	Selectivity	Catchability	Weight
1	Summer acoustic	2013-2017	Non-parametric		Summer
2	Shelikof Acoustic Age 3+	1992-2018	Logistic	Time-varying Dev ~ N(0, 0.05)	EK500
3	Shelikof Acoustic Age 1 and 2	1990-2017	Set to 1	Q * N ^ Q_pow	
4	AFSC Bottom Trawl	1990-2017	Non-parametric	Time-varying Dev ~ N(0, 0.01)	BT
5	ADFG Survey	1988-2018	Logistic	Time-varying Dev ~ N(0, 0.05)	BT
5	Total Catch	1977-2018	Time-varying double logistic		Fishery

Cod Data – 12 ages

#	Data	Years	Selectivity	Catchability	Weight
1	AFSC Bottom Trawl	1990-2017	Non-parametric	Analytical	VBGF
2	Longline Survey	1988-2018	Logistic	Analytical	VBGF
3	Trawl	1977-2018	Blocked logistic 1977-1995, 1996-2004, 2005-2006, 2007-2016, 2017-2018		VBGF
4	Longline	1977-2018	Blocked logistic 1977-1995, 1996-2004, 2005-2006, 2007-2016, 2017-2018		VBGF
5	Pot	1977-2018	Blocked logistic 1977-2012, 2013-2018		VBGF

ATF Data – 21 ages

#	Data	Years	Selectivity	Catchability	Weight
1	AFSC Bottom Trawl	1990-2017	Logistic	Analytical	VBGF
2	Total	1977-2018	Non-parametric		VBGF

Maturity

Spp	1	2	3	4	5	6	7	8	9	10	11	12	13
Pollock	0.00	0.00	0.02	0.29	0.60	0.84	0.93	0.97	0.99	0.99			
Cod	0.00	0.00	0.13	0.73	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	
ATF	0.00	0.00	0.00	0.02	0.06	0.21	0.51	0.81	0.94	0.99	1.00	1.00	1.00

PropF – Female proportion

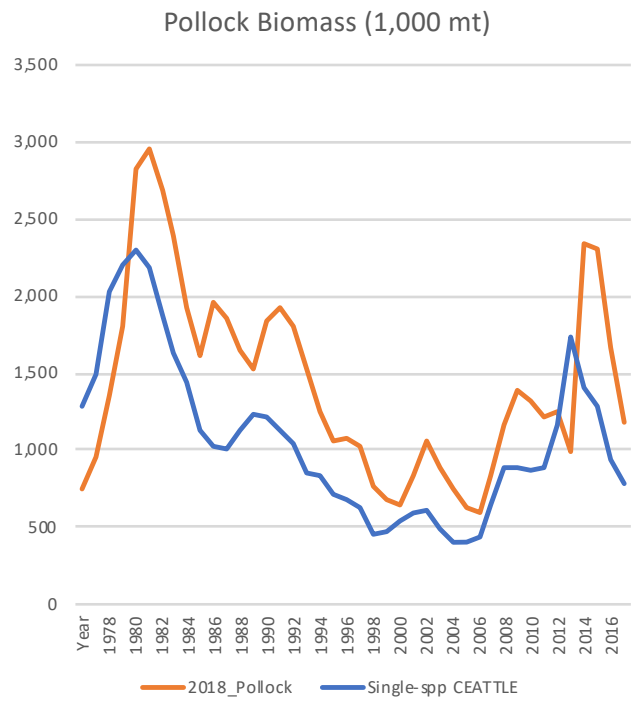
Spp	1	2	3	4	5	6	7	8	9	10	11	12	13
Pollock	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50			
Cod	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
ATF	Estimated												

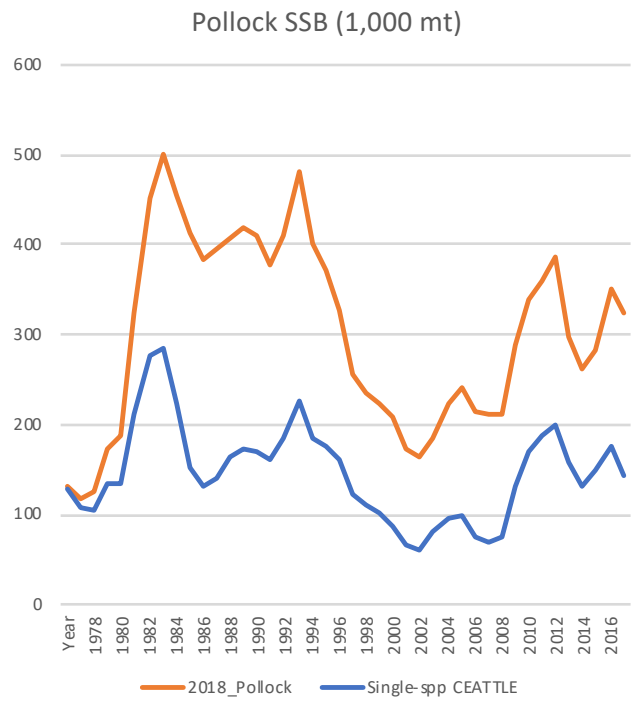
M1 – Natural Mortality

Spp	1	2	3	4	5	6	7	8	9	10	11	12	13
Pollock	1.39	0.69	0.48	0.37	0.34	0.30	0.30	0.29	0.28	0.29			
Cod	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	
ATF Female	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
ATF Males	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35

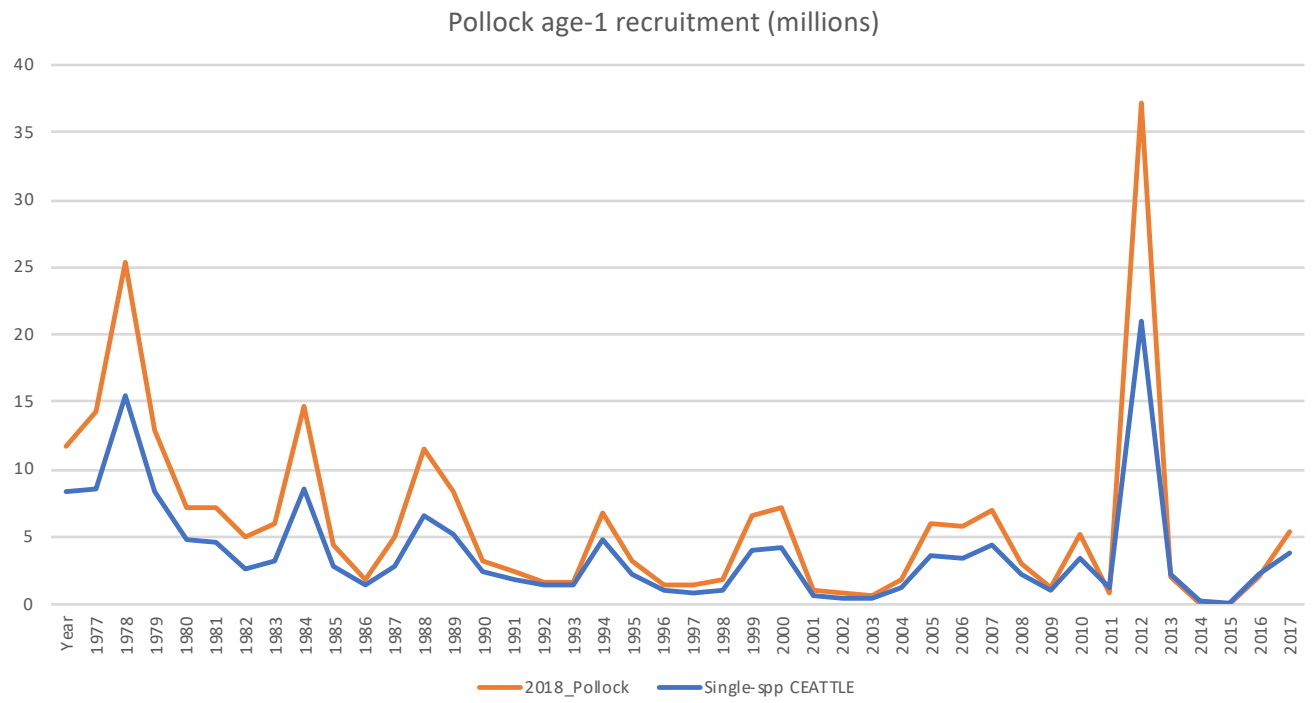
Comparison with previous assessments

Pollock

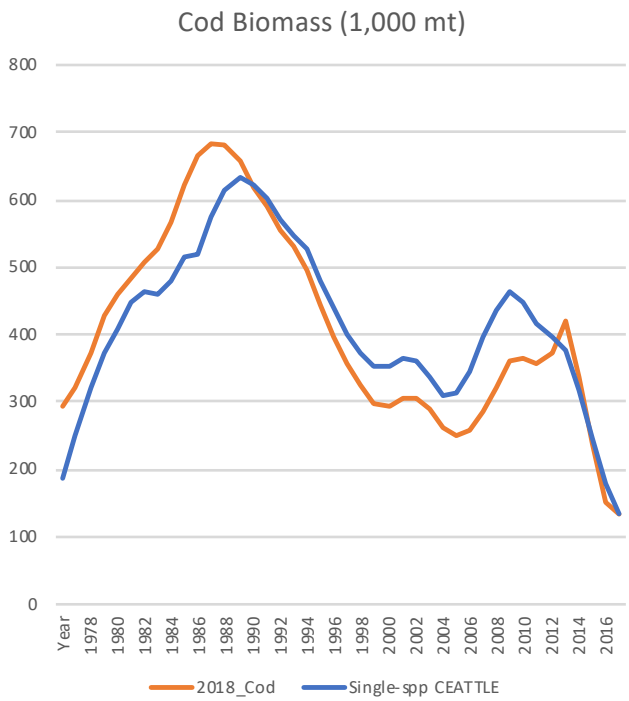

Pollock Biomass (1,000 mt)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Year
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018_Pollock
Single-spp CEATTLE

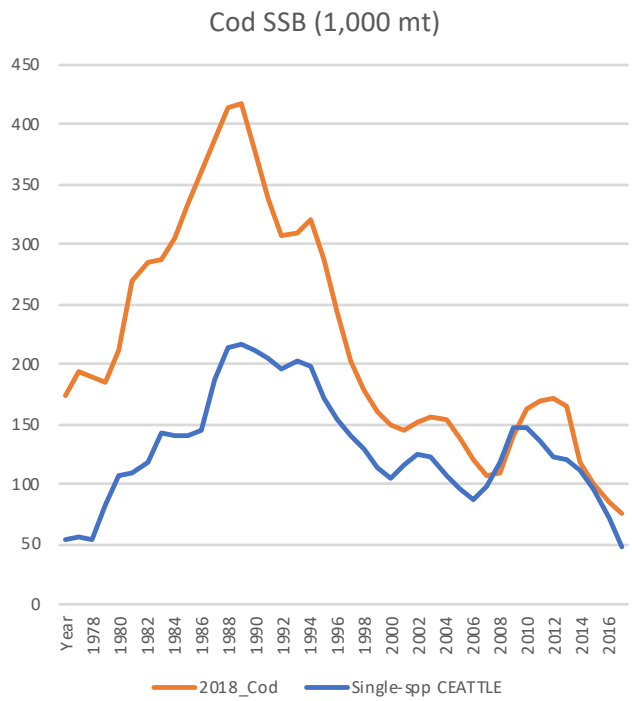

Pollock SSB (1,000 mt)
600
500
400
300
200
100
0
Year
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018_Pollock
Single-spp CEATTLE

Pollock recruitment

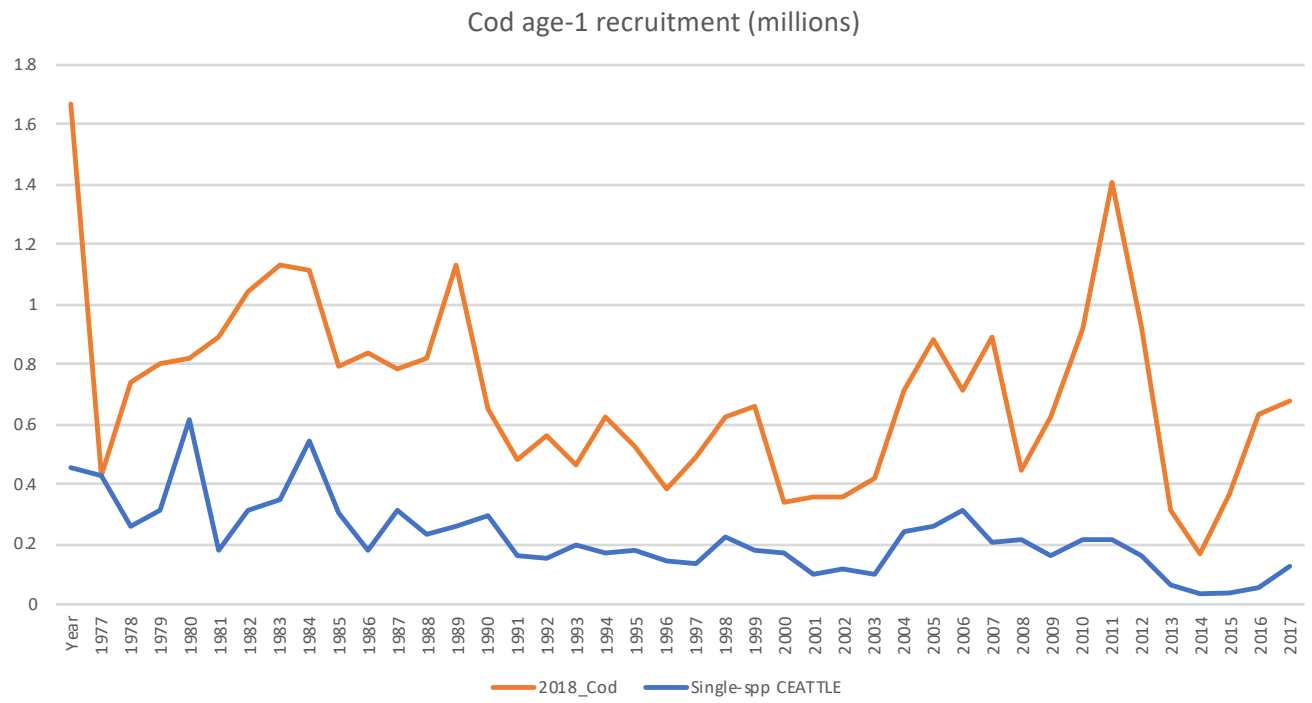


Cod

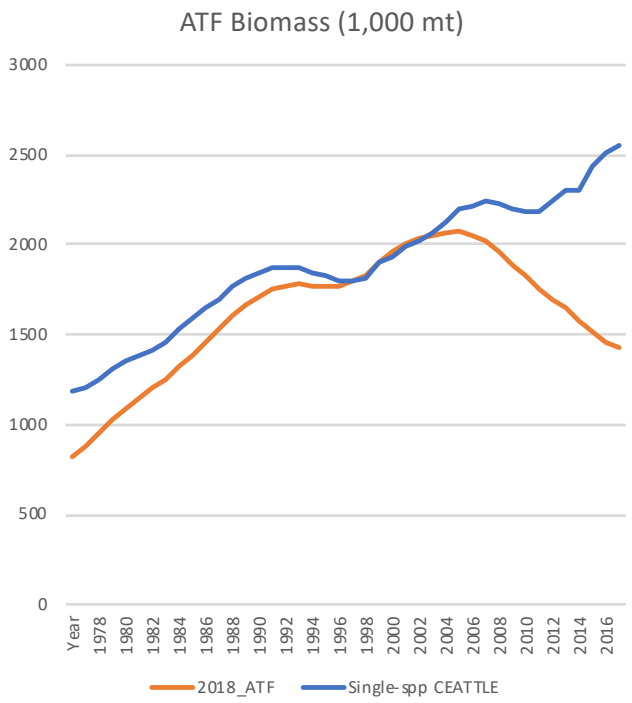

Cod Biomass (1,000 mt)
800
700
600
500
400
300
200
100
0
Year
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018_Cod
Single-spp CEATTLE

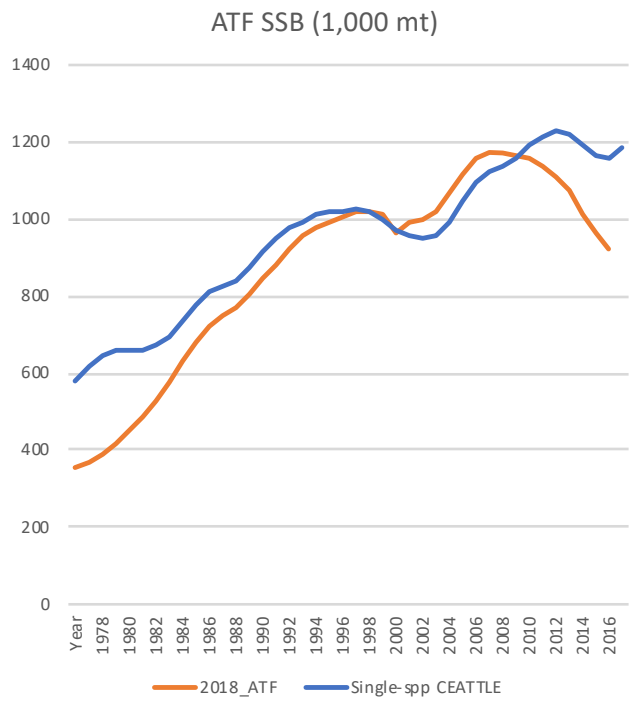

Cod SSB (1,000 mt)
450
400
350
300
250
200
150
100
50
0
Year
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018_Cod
Single-spp CEATTLE

Cod recruitment

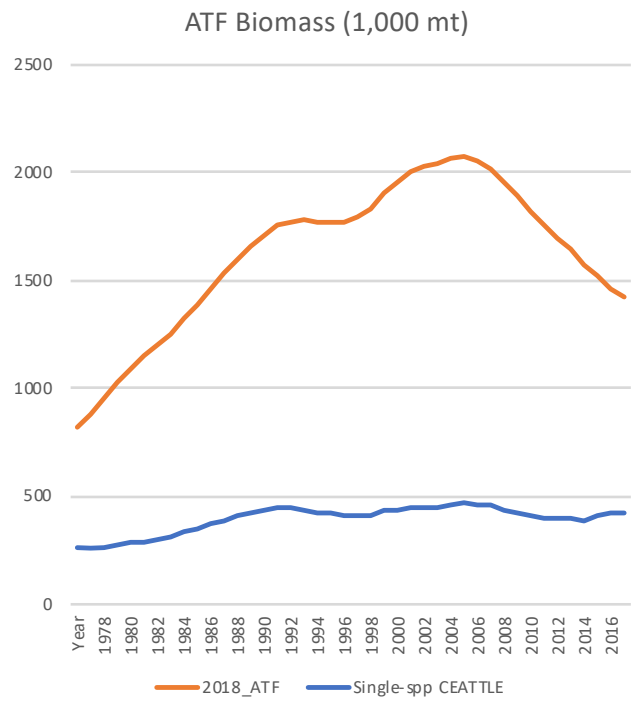


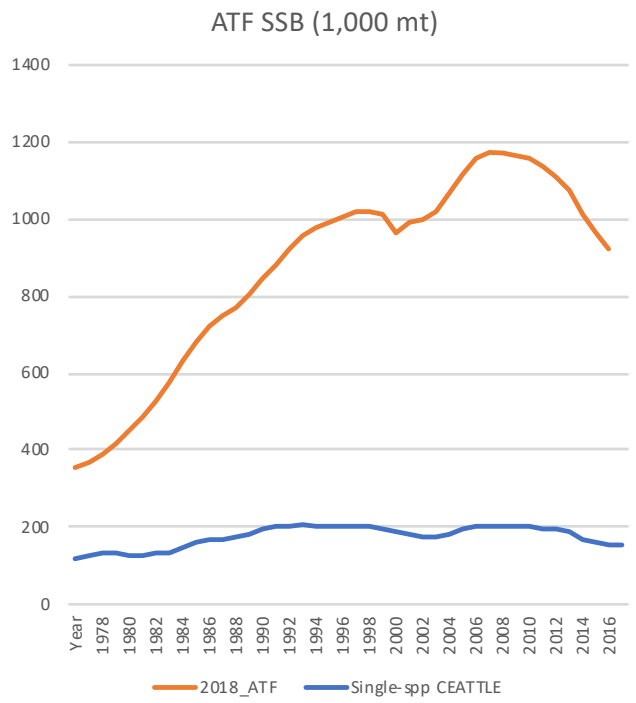
ATF


ATF Biomass (1,000 mt)
3000
2500
2000
1500
1000
500
0
Year
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018_ATF
Single-spp CEATTLE


ATF SSB (1,000 mt)
1400
1200
1000
800
600
400
200
0
Year
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018_ATF
Single-spp CEATTLE

ATF – estimate q (too much ATF)





Key differences from assessments

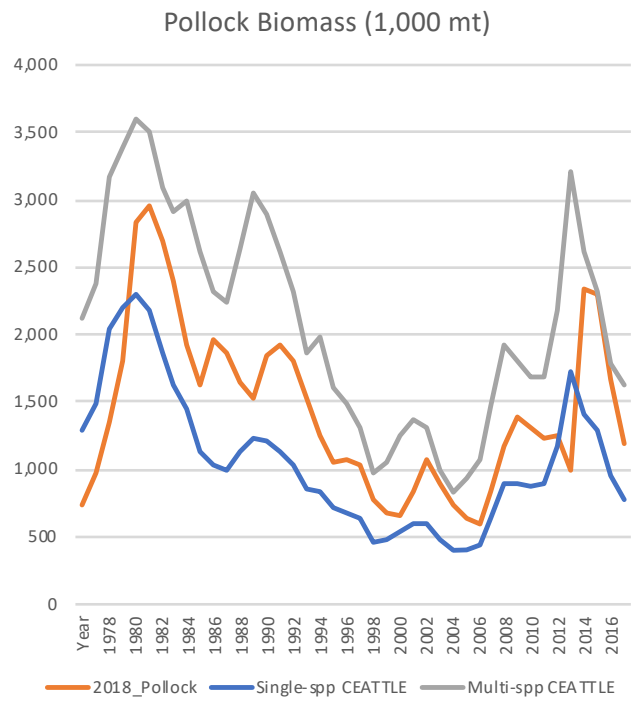
- Selectivity (double logistic) for Pollock
  - Difficult to converge
- Selectivity (time-varying double normal) for Cod
  - Not yet implemented
- Time-varying catchability for Cod
- Time-varying mortality for Cod
- Conditional age-at-length for Cod
- Fitting to observed sex ratio for ATF
- Estimate catchability for bottom trawl ATF

Adding in predation

Sex/size specific diet composition

Bioenergetics for GOA (Holsman and Aydin 2015)

Pollock


Pollock Biomass (1,000 mt)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Year
1978
1980
1982
1984
1986
1988
1990
1992
1994
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2006
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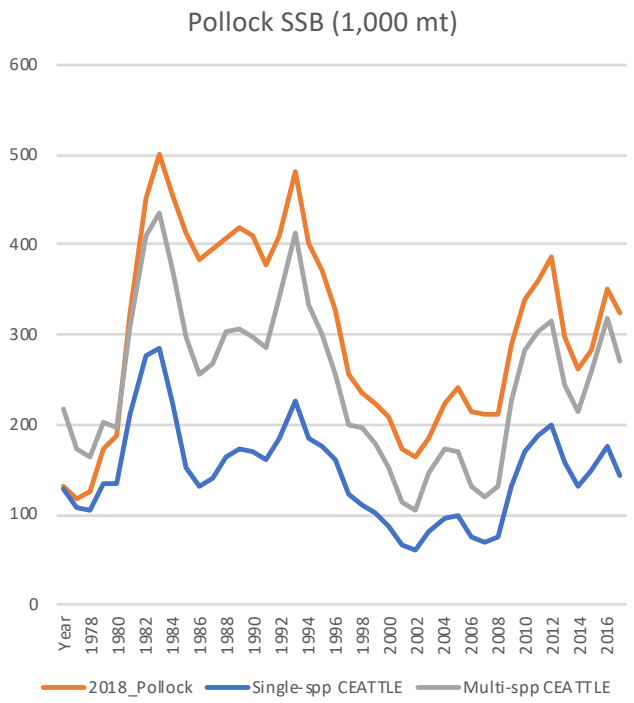
2012
2014
2016
2018_Pollock
Single-spp CEATTLE
Multi-spp CEATTLE


Pollock SSB (1,000 mt)
600
500
400
300
200
100
0
Year
1978
1980
1982
1984
1986
1988
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1992
1994
1996
1998
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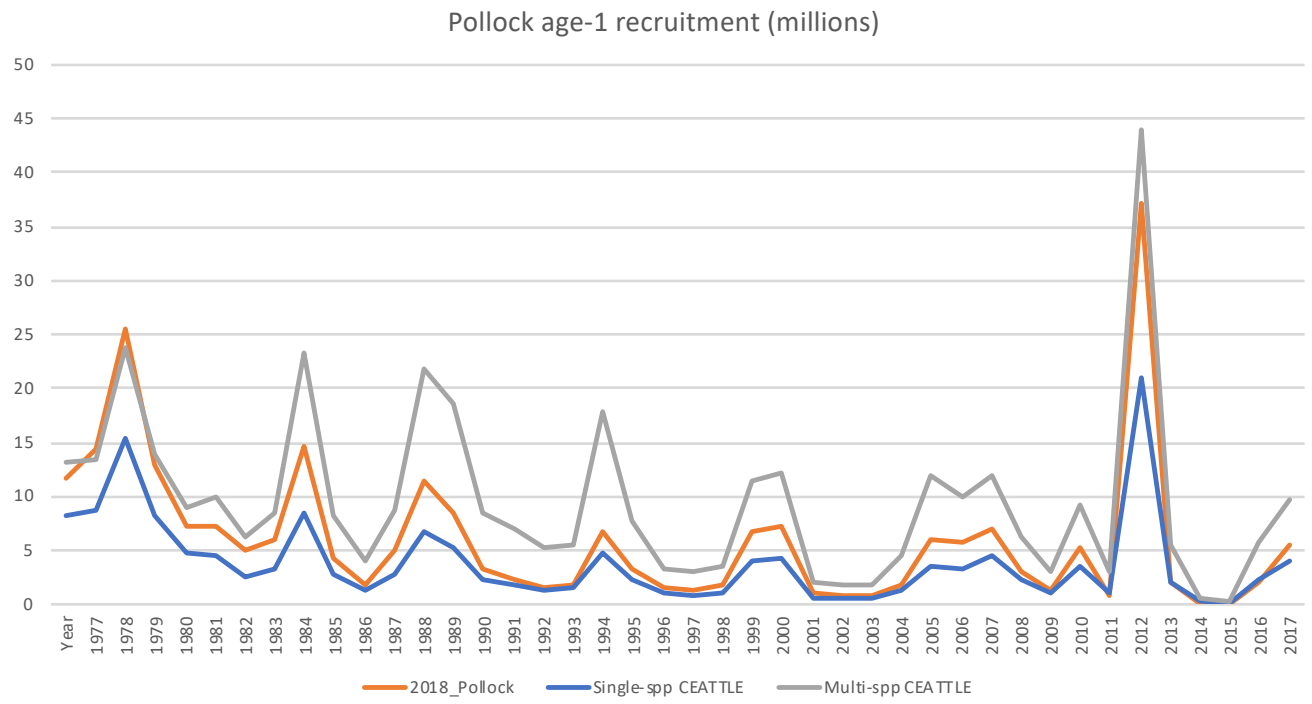
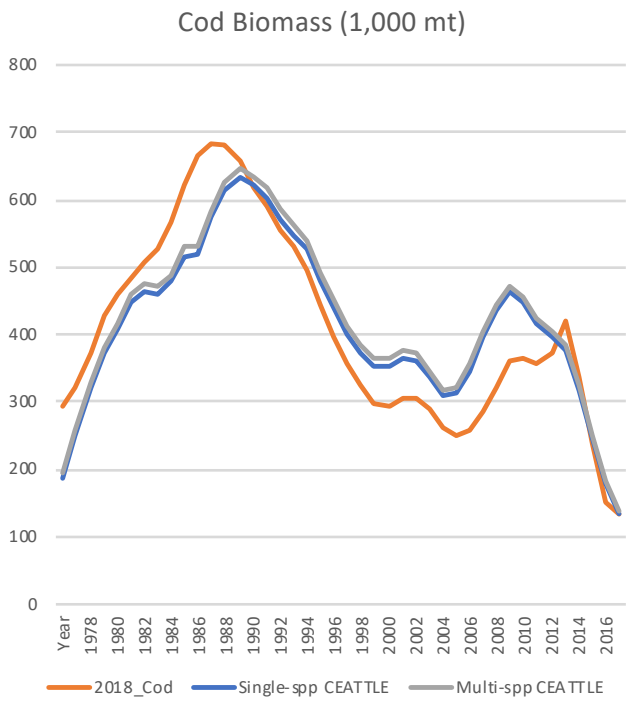
2010
2012
2014
2016
2018_Pollock
Single-spp CEATTLE
Multi-spp CEATTLE

Pollock recruitment



Cod


Cod Biomass (1,000 mt)
800
700
600
500
400
300
200
100
0
Year
1978
1980
1982
1984
1986
1988
1990
1992
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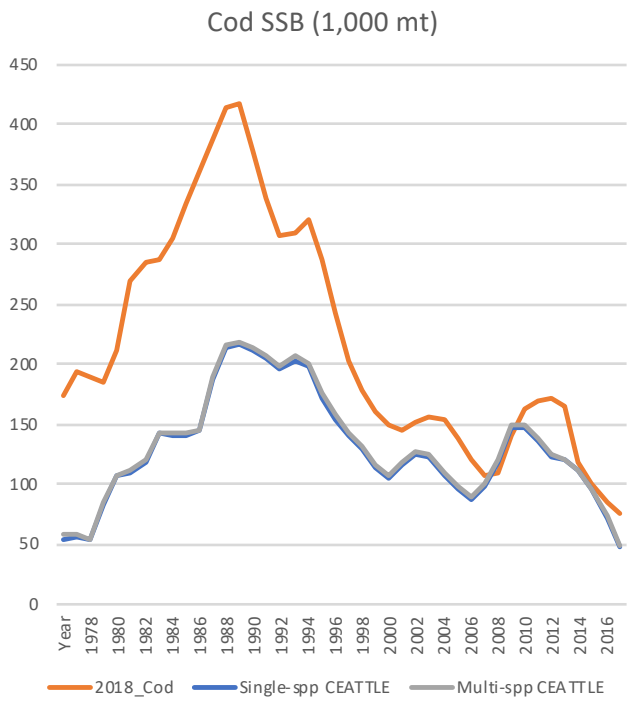
2012
2014
2016
2018_Cod
Single-spp CEATTLE
Multi-spp CEATTLE


Cod SSB (1,000 mt)
450
400
350
300
250
200
150
100
50
0
Year
1978
1980
1982
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1986
1988
1990
1992
1994
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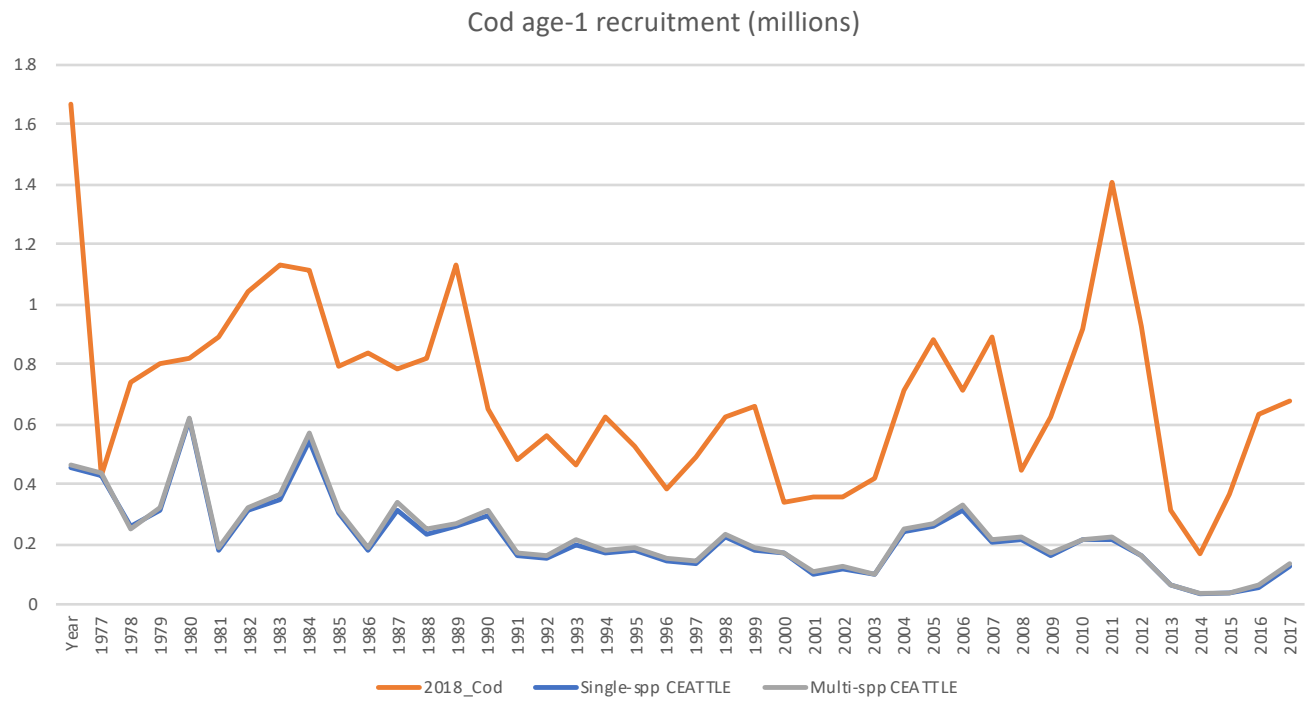
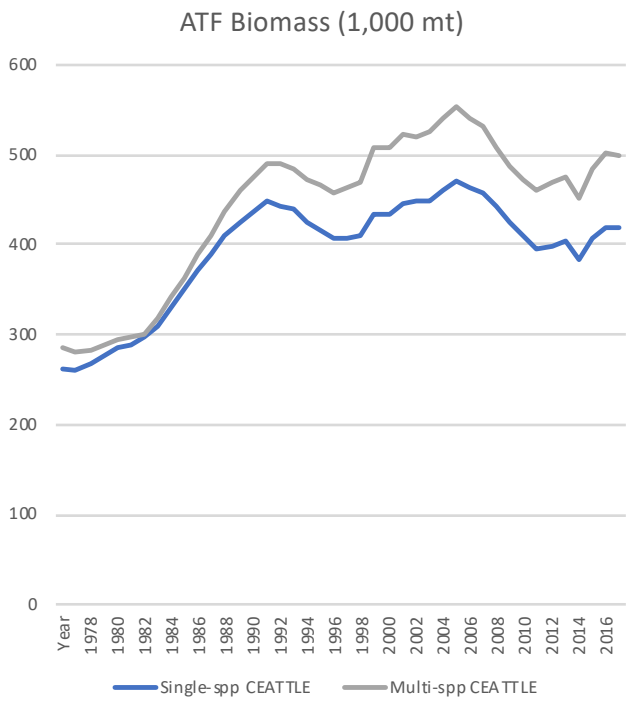
2012
2014
2016
2018_Cod
Single-spp CEATTLE
Multi-spp CEATTLE

Cod recruitment



ATF


ATF Biomass (1,000 mt)
600
500
400
300
200
100
0
Year
1978
1980
1982
1984
1986
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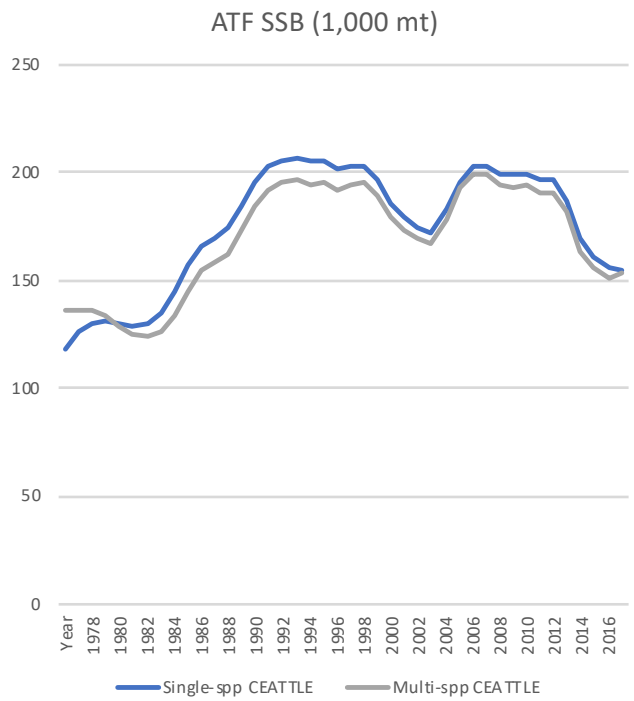
2016
Single-spp CEATTLE
Multi-spp CEATTLE


ATF SSB (1,000 mt)
250
200
150
100
50
0
Year
1978
1980
1982
1984
1986
1988
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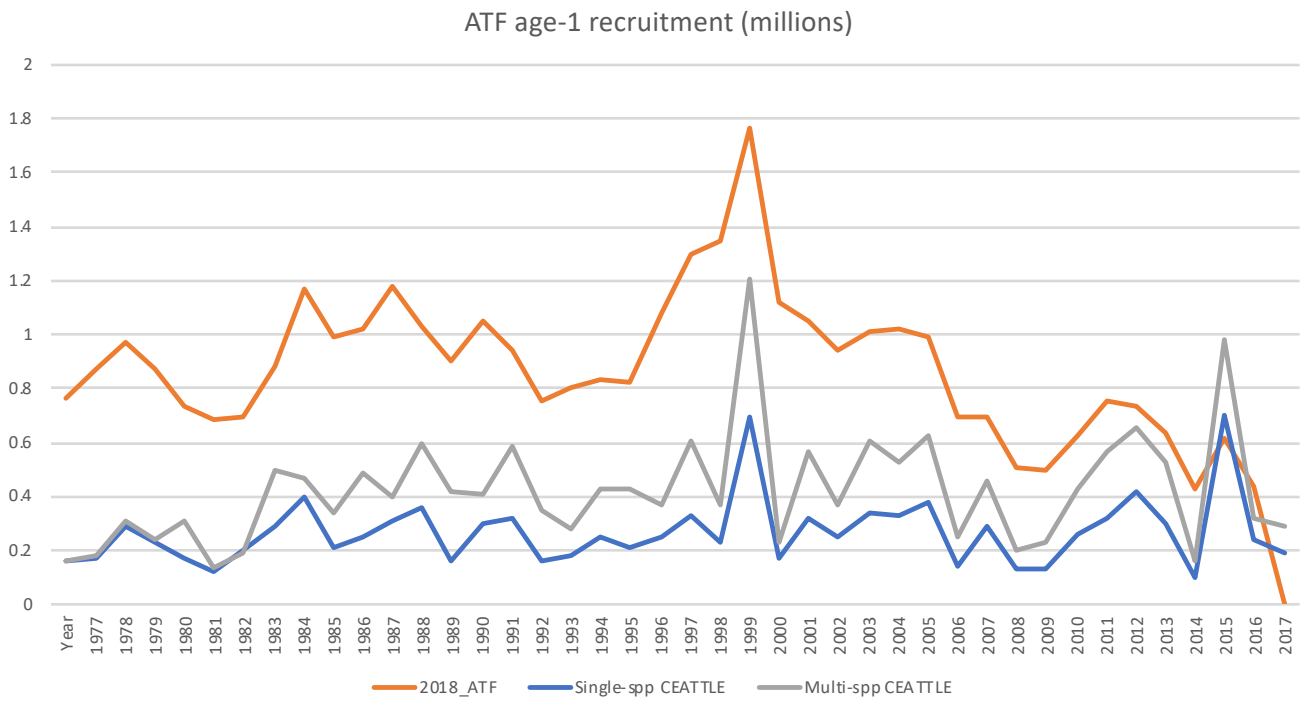
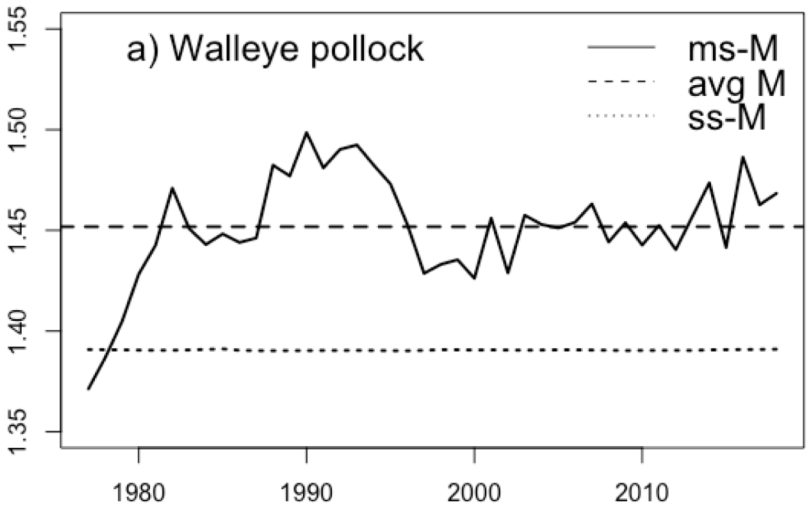
2012
2014
2016
Single-spp CEATTLE
Multi-spp CEATTLE

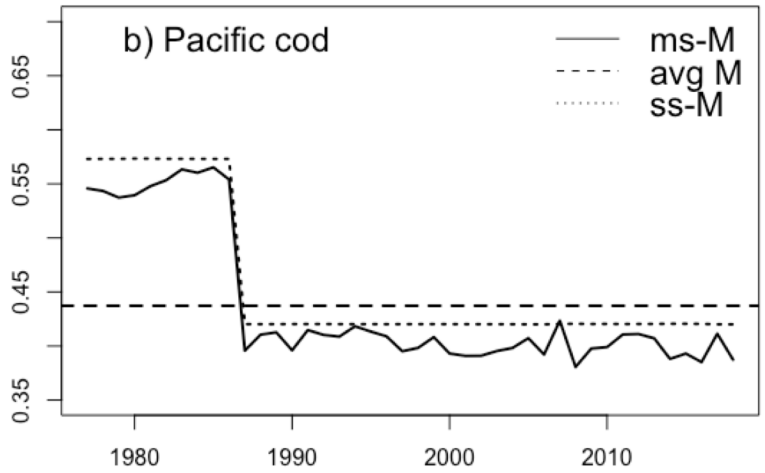
ATF recruitment



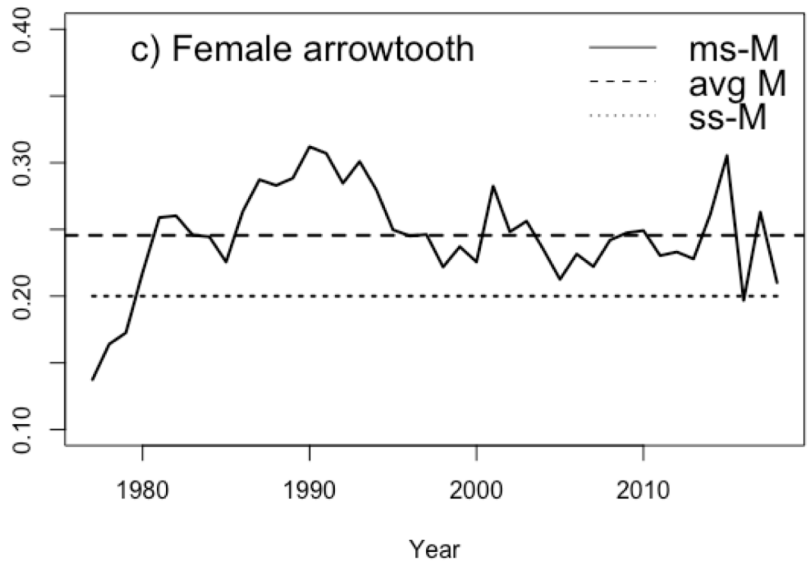
Predation components

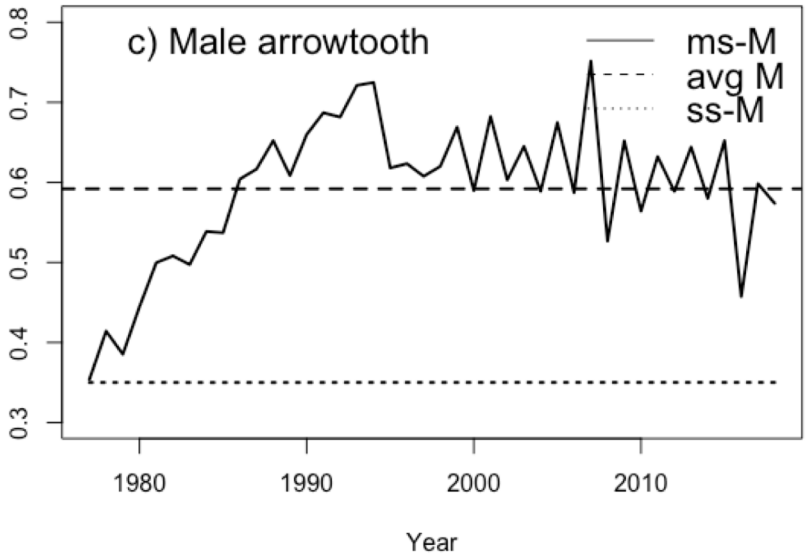
Age-1 total mortality



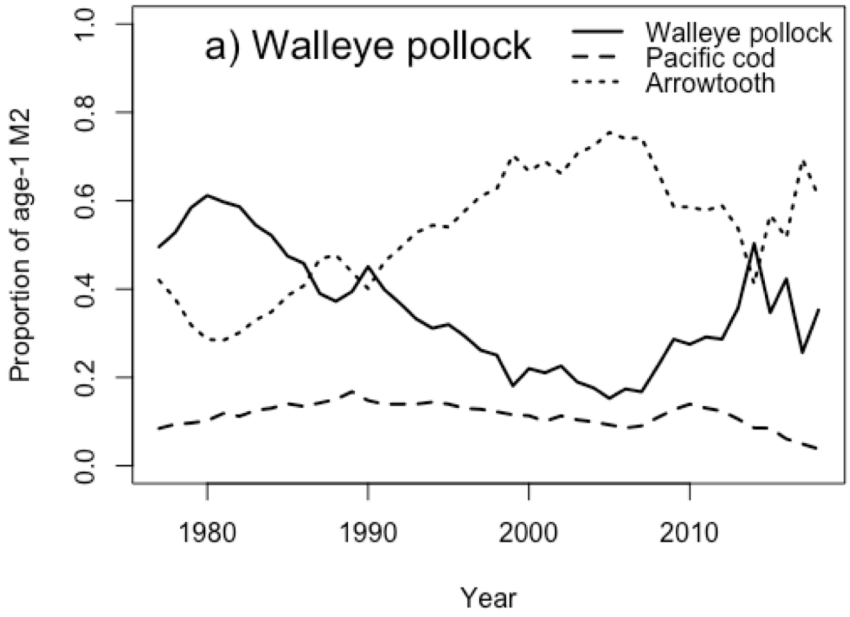


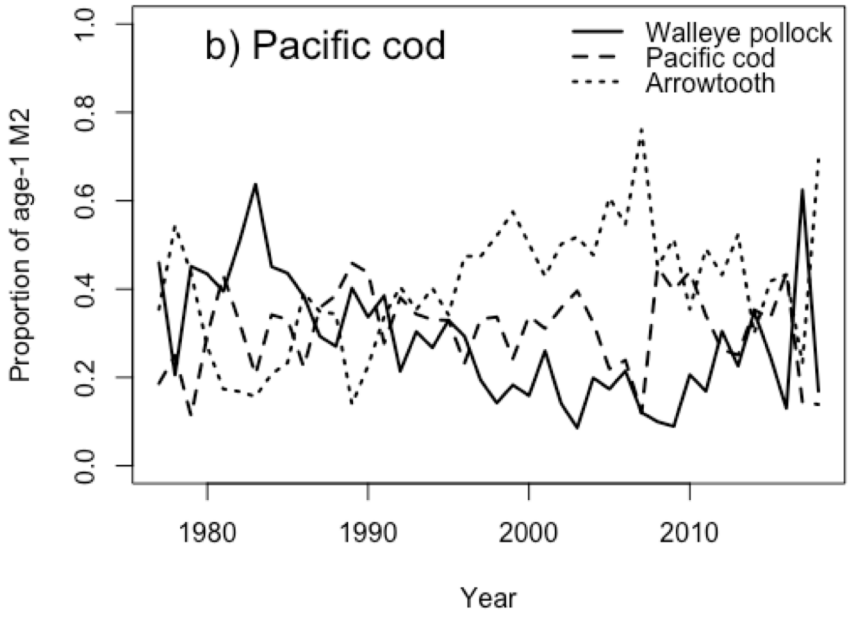
Age-1 total mortality

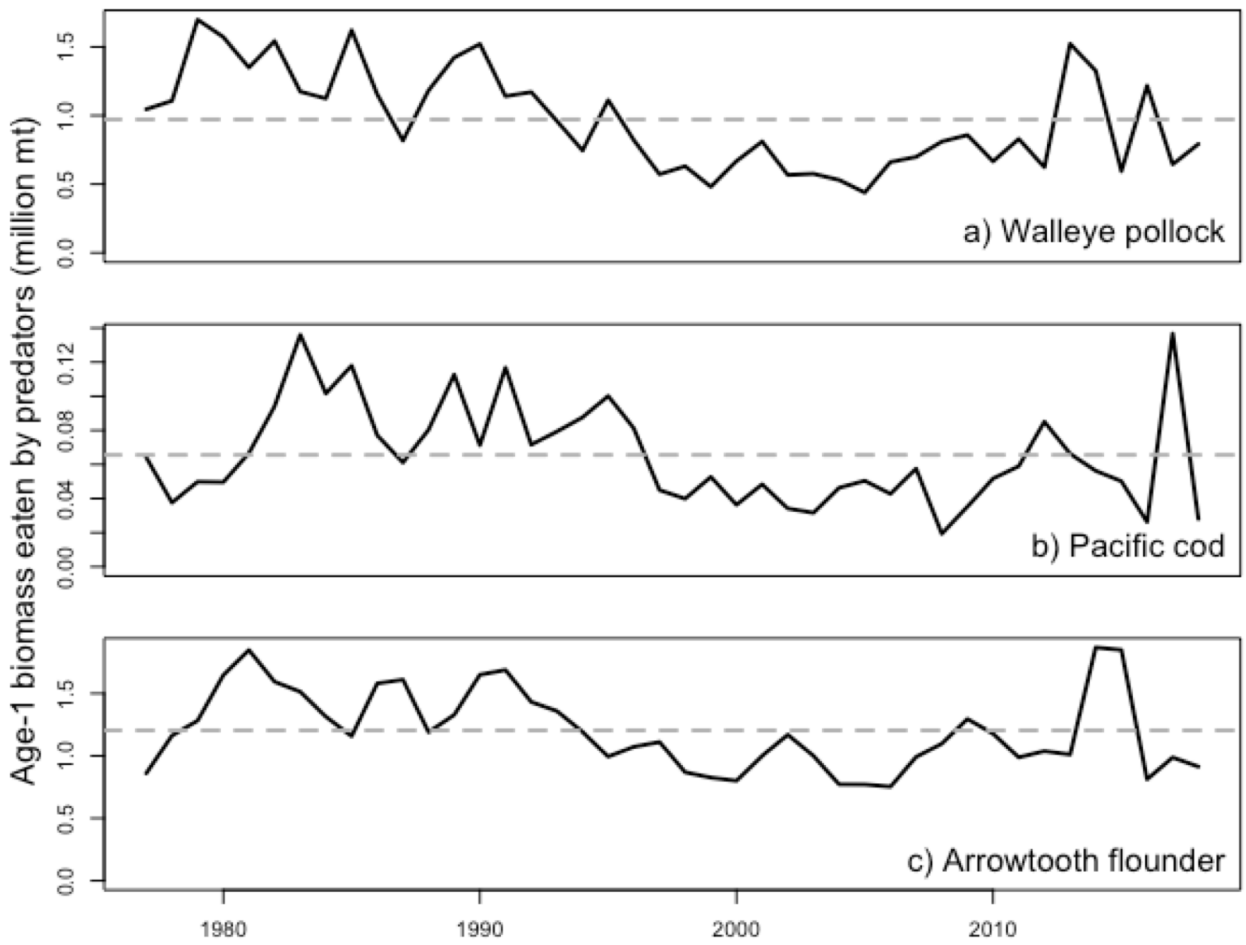




Age-1 predation mortality source






Age-1 biomass eaten by predators (million mt)
0.0
0.5
1.0
1.5
a) Walleye pollock
0.00
0.04
0.08
0.12
b) Pacific cod
0.0
0.5
1.0
1.5
c) Arrowtooth flounder
1980
1990
2000
2010

Next steps

Next steps

- Include Pacific Halibut as a predator
- Simulation test model
  - Random effects
  - Diet uncertainty/suitability formulation
- MSE of if predation matters
- Evaluate alternative forecasting
- Improve similarity with assessment models?
- How best to bring results into management process?

Questions