INTERNATIONAL PACIFIC HALIBUT COMMISSION

The stock status of Pacific halibut (2018), harvest decision table, and preliminary mortality projections

IPHC-2018-IM094-08/09 Rev_1

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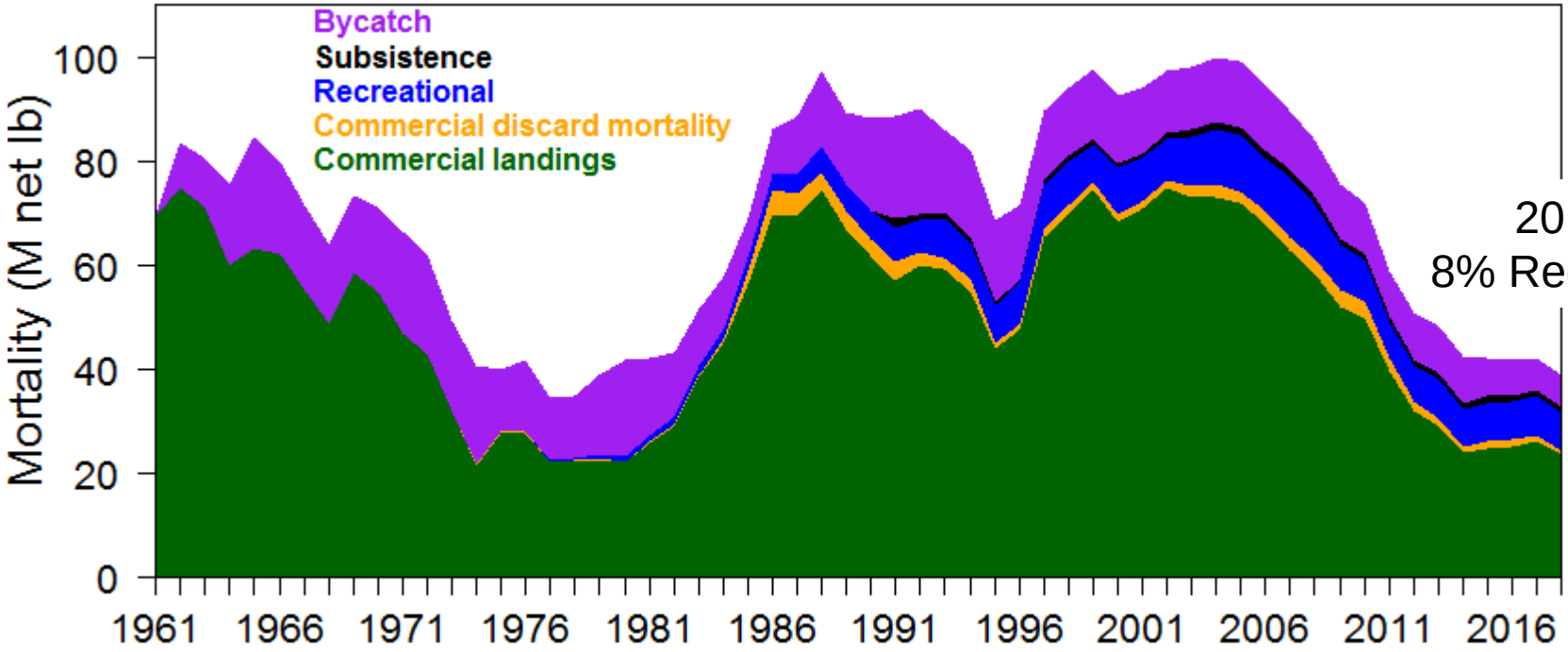
Summary

- Fishery and modelled survey trends down coastwide
- Setline survey expansion data increased coastwide biomass estimates
- Setline survey observations of the 2011 and 2012 cohorts reduced recent fishing intensity estimates
- Spawning biomass still estimated to be decreasing and projected to decrease for TCEYs >20 Mlb, with greater uncertainty in this year’s results

Outline

- Coastwide stock assessment
  - Data sources
  - Modelling and results
  - Projections and Decision table
- 2019 Mortality projection tool

Sources of mortality



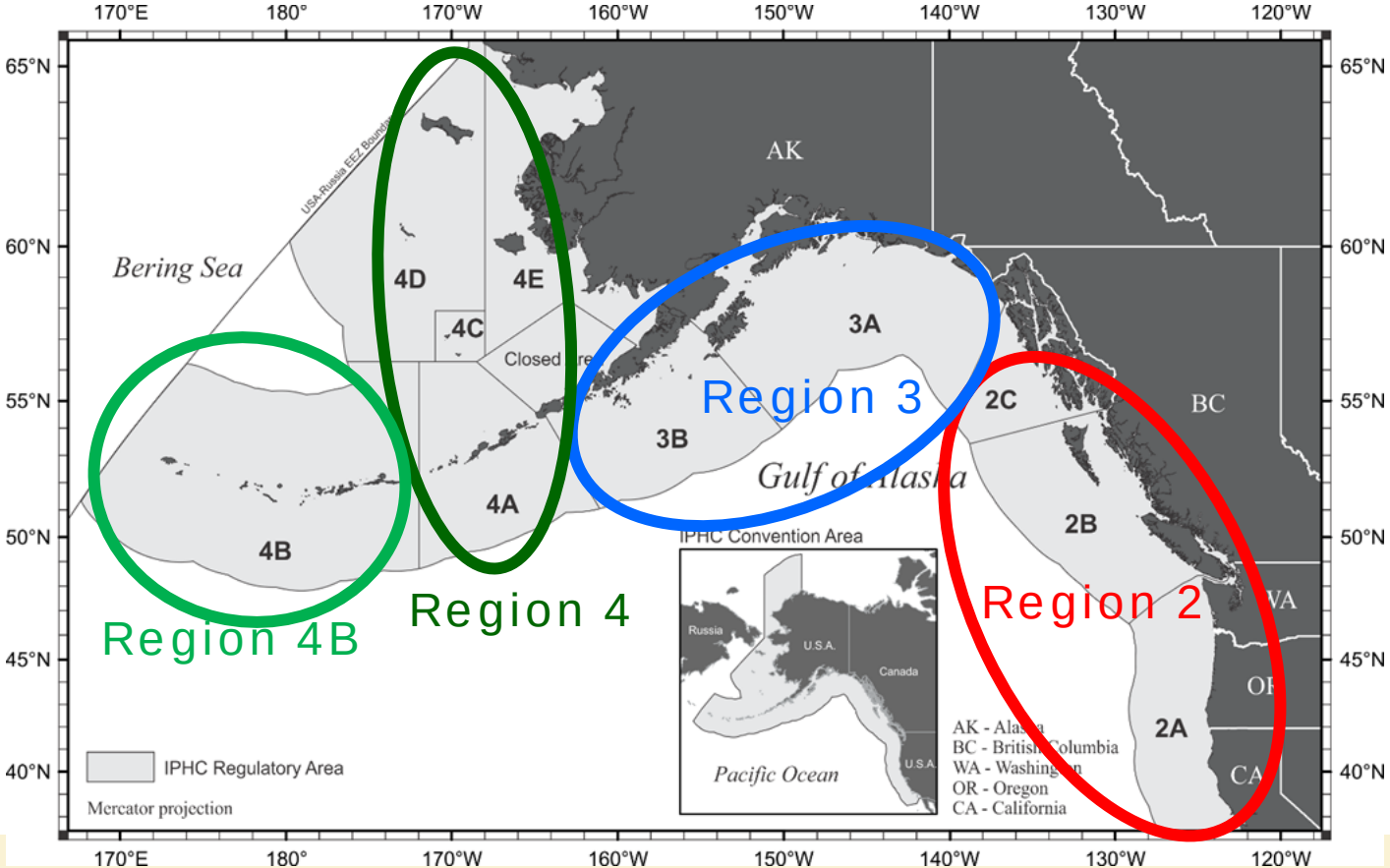
2018:
8% Reduction

Recent mortality (weight)

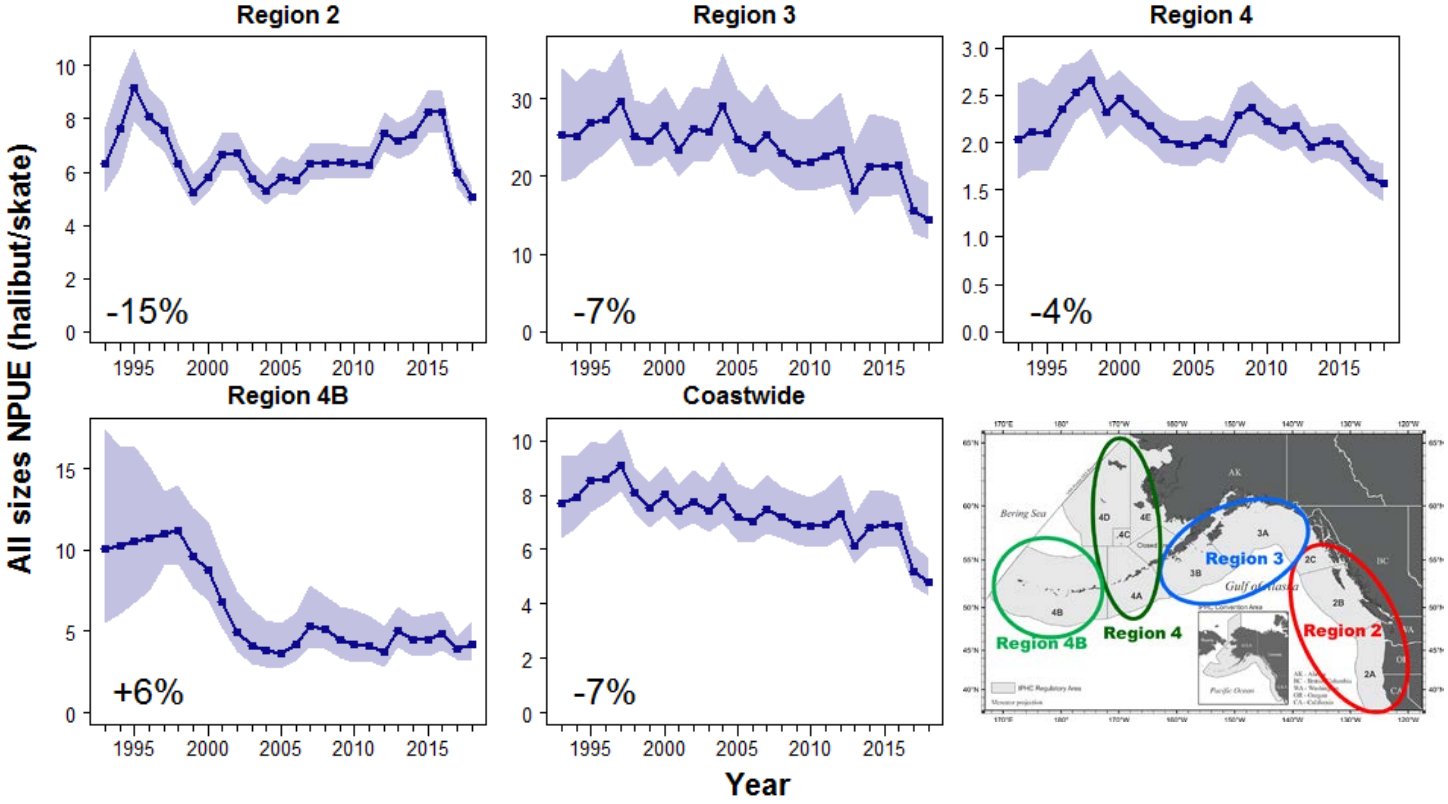
Year	Commercial Landings	Discard mortality	Recreational	Subsistence	Bycatch	Total
2014	23.70	1.30	7.18	1.20	8.93	42.31
2015	24.67	1.29	7.46	1.20	7.47	42.10
2016	25.05	1.18	7.38	1.17	7.02	41.79
2017	26.17	0.99	7.60	1.17	6.07	41.99
2018	23.50	0.83	7.19	1.17	6.06	38.74

(Bycatch estimates to be updated in early January)

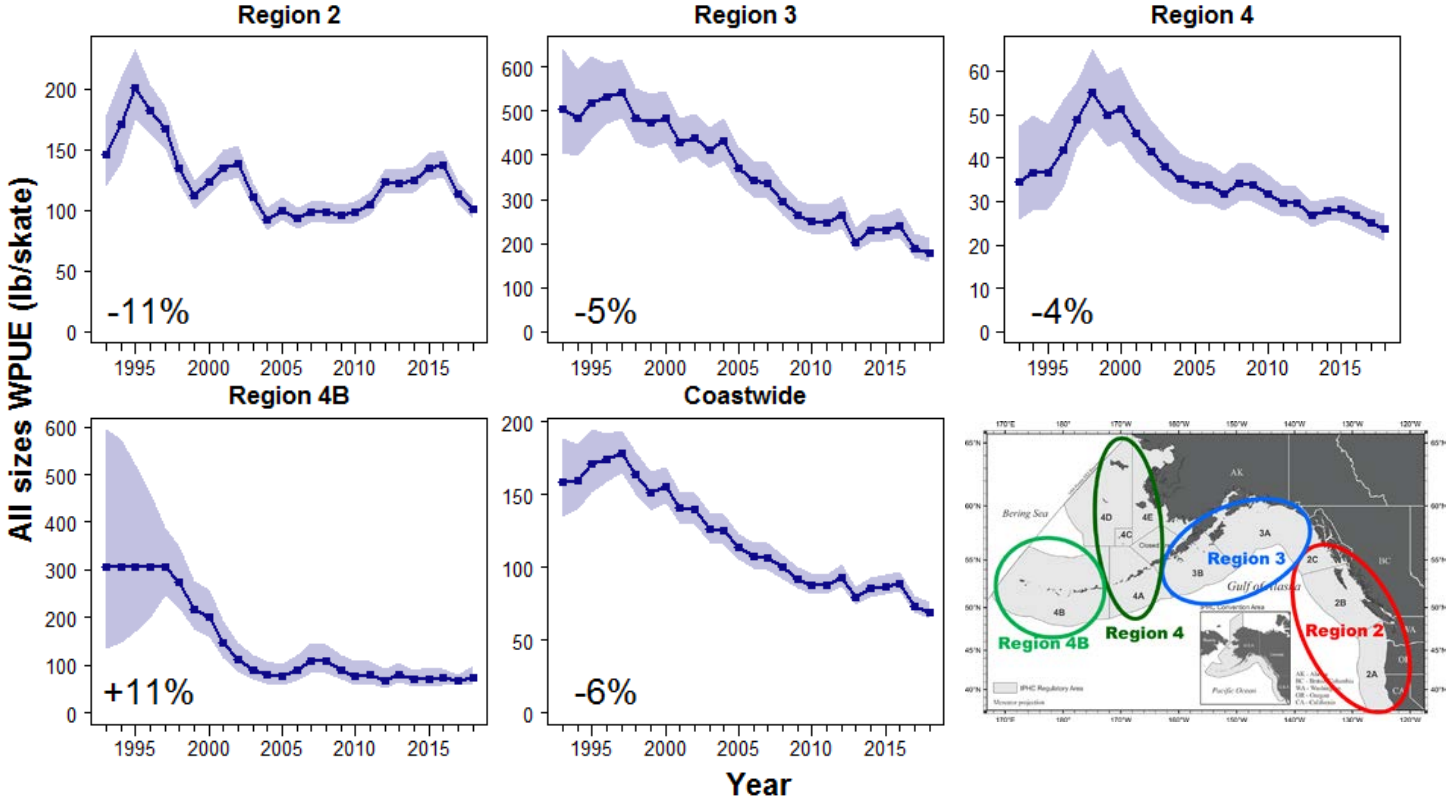
Biological regions



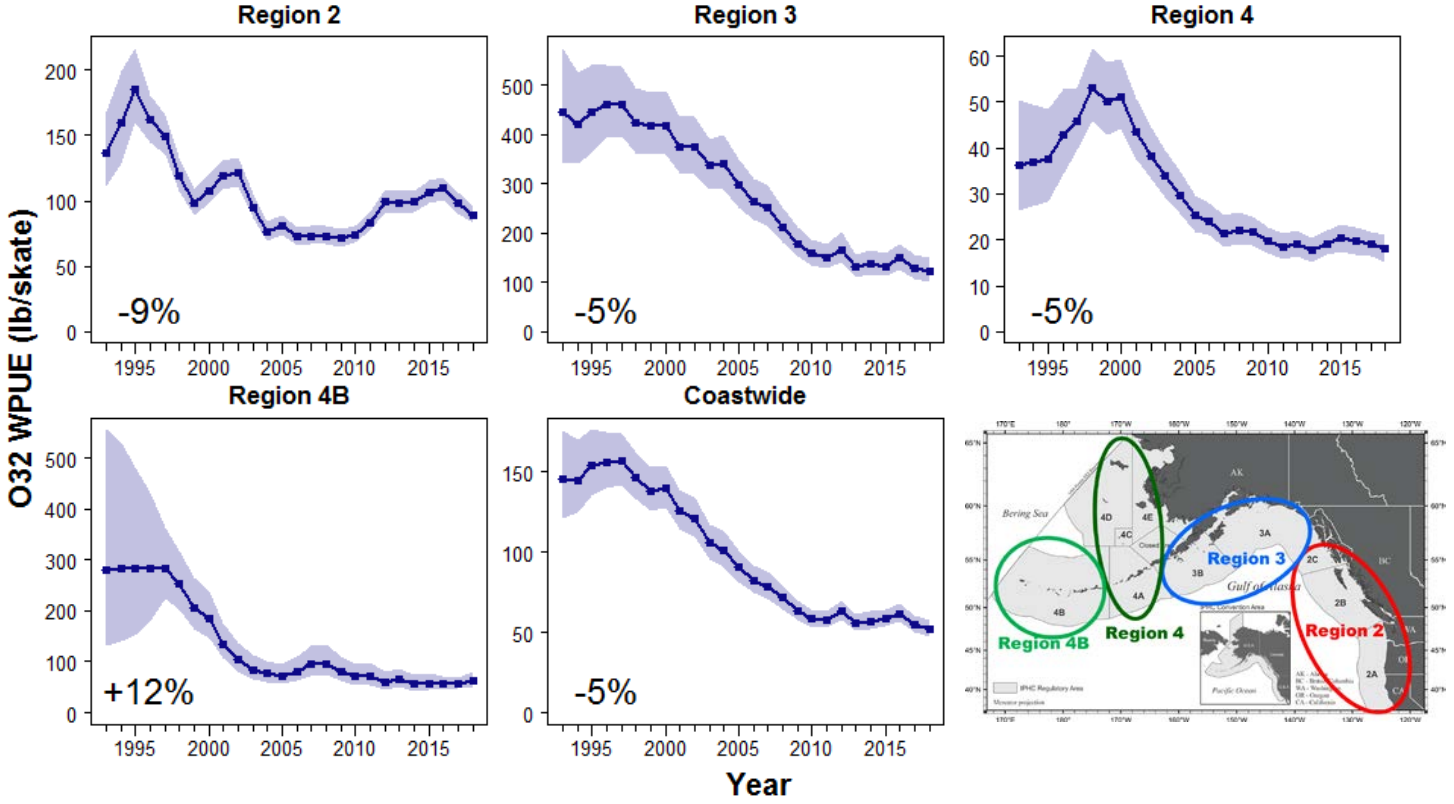
Modelled survey trend (Numbers)



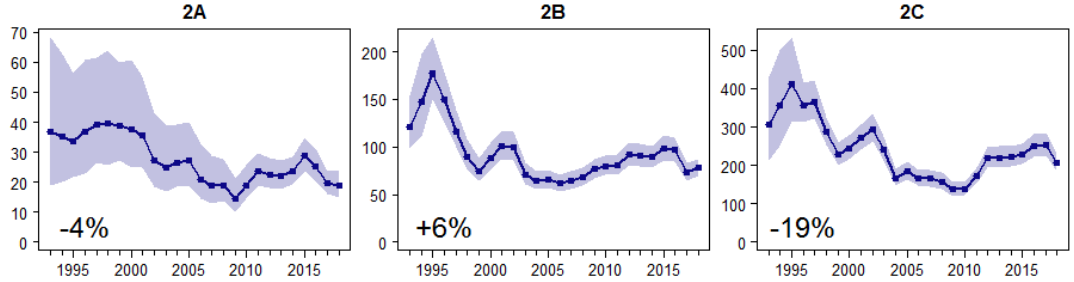
Modelled survey trend (All sizes WPUE)



Modelled survey trend (O32 WPUE)



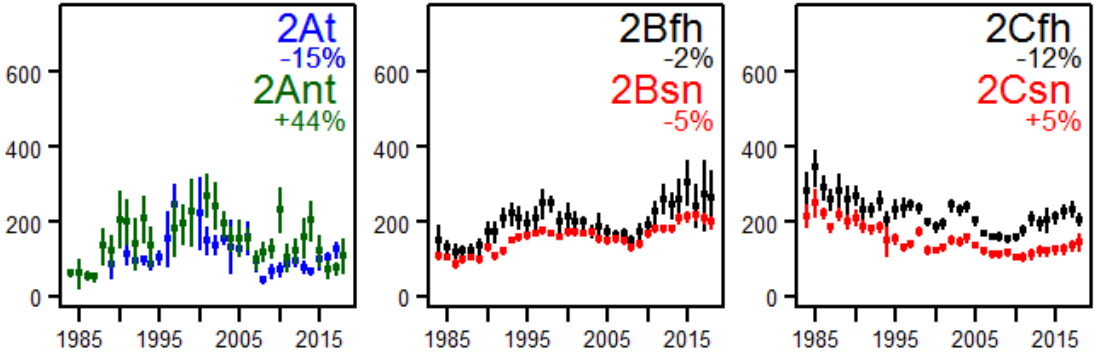
Modelled survey trend (O32 WPUE): Region 2



Fishery trend: Region 2

Tribal

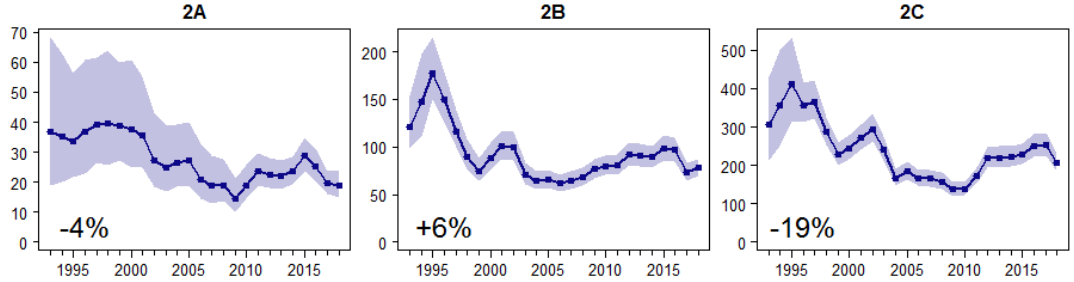
Non-tribal



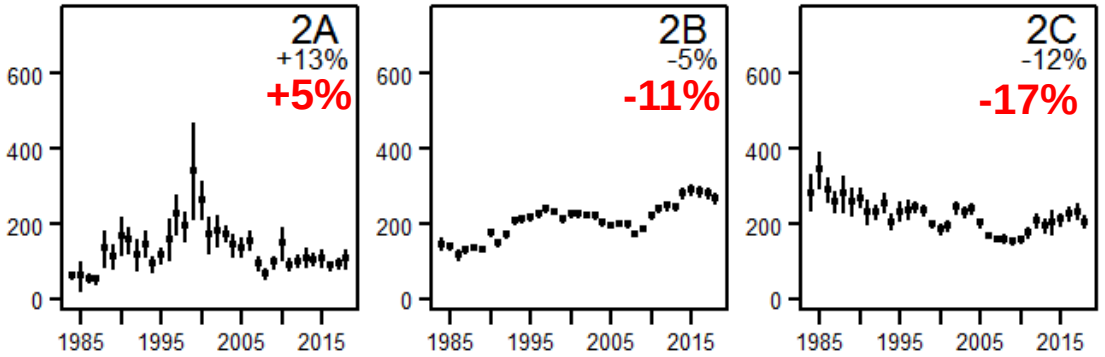
Fixed-hook

Snap

Modelled survey trend (O32 WPUE): Region 2

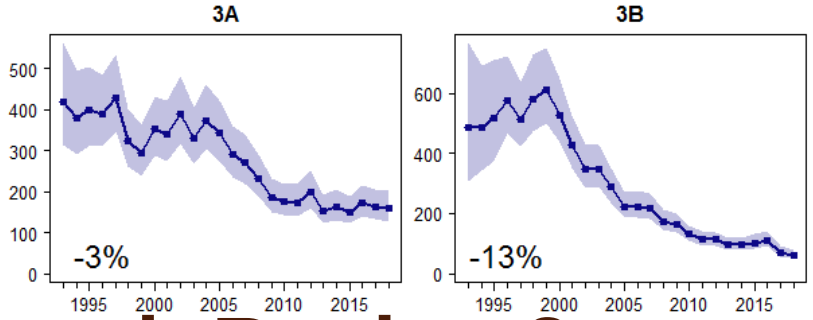


Fishery trend: Region 2

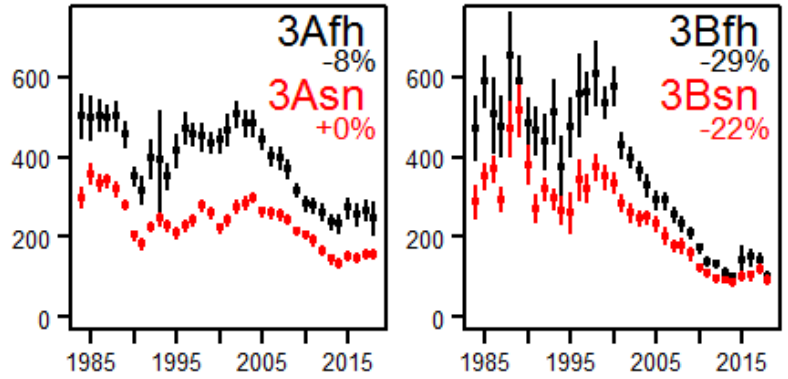


Bias corrected for incomplete data

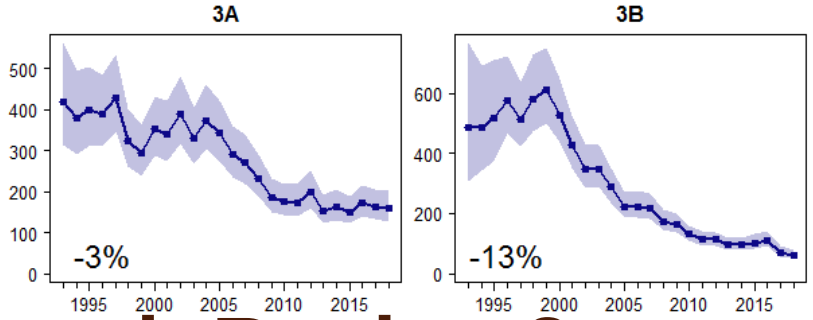
Modelled survey trend (O32 WPUE): Region 3



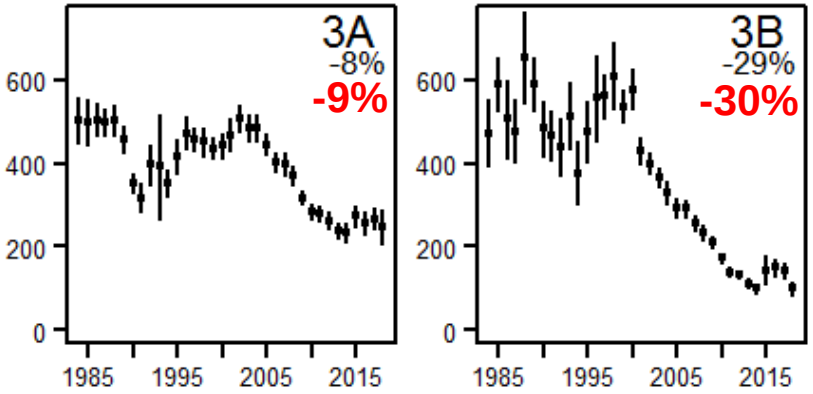
Fishery trend: Region 3



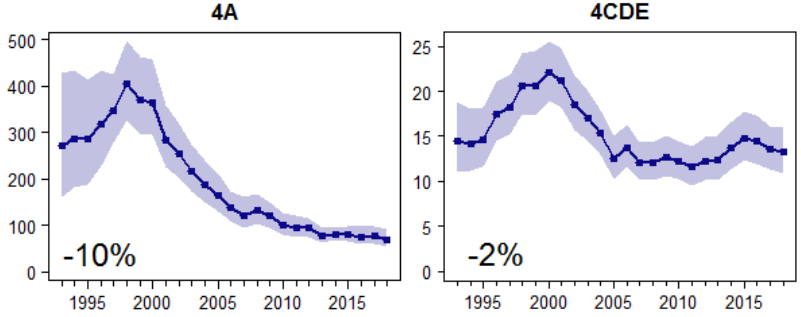
Modelled survey trend (O32 WPUE): Region 3



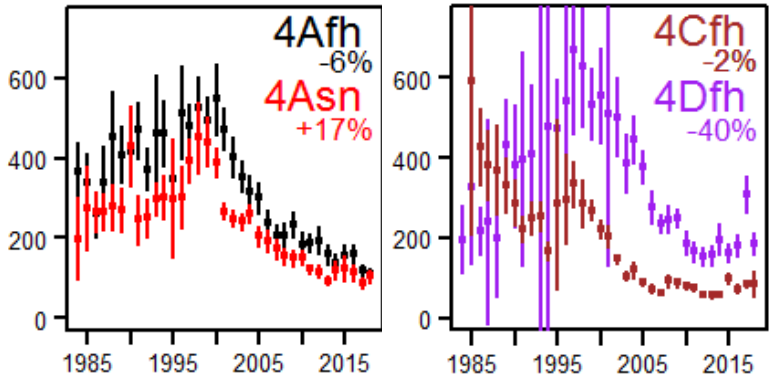
Fishery trend: Region 3



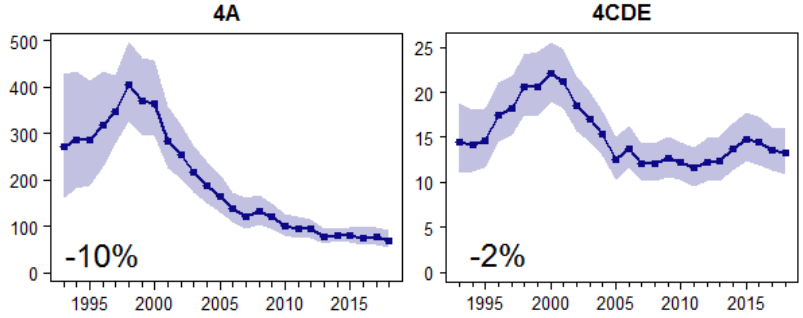
Modelled survey trend (O32 WPUE): Region 4



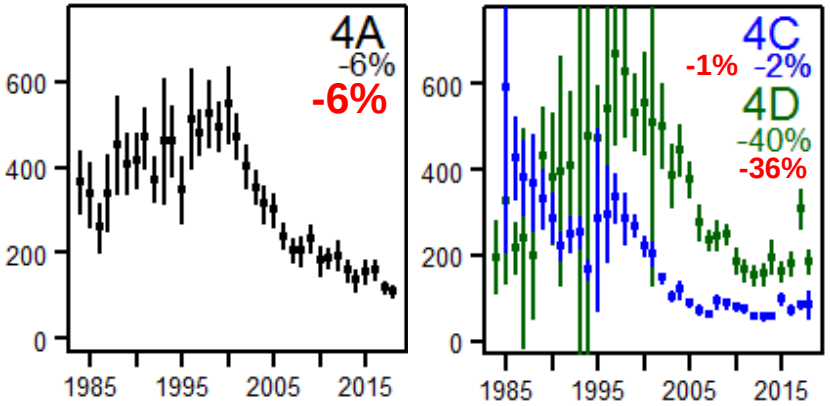
Fishery trend: Region 4



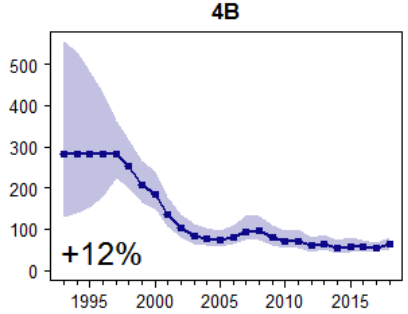
Modelled survey trend (O32 WPUE): Region 4



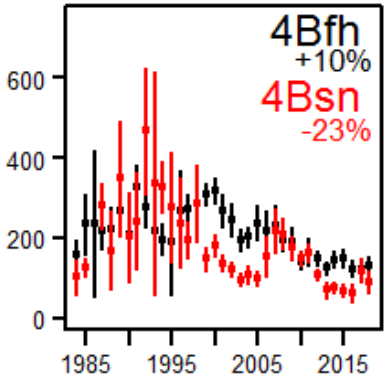
Fishery trend: Region 4



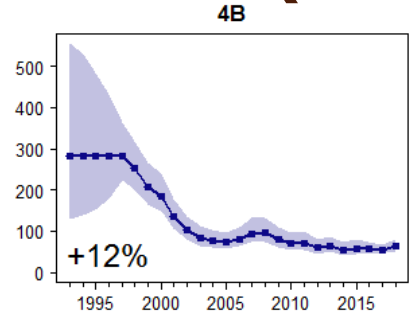
Modelled survey trend (O32 WPUE): Region 4B



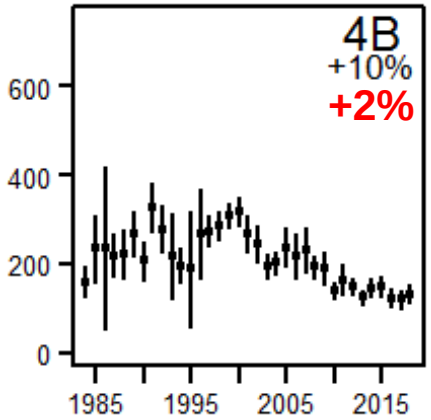
Fishery trend: Region 4B



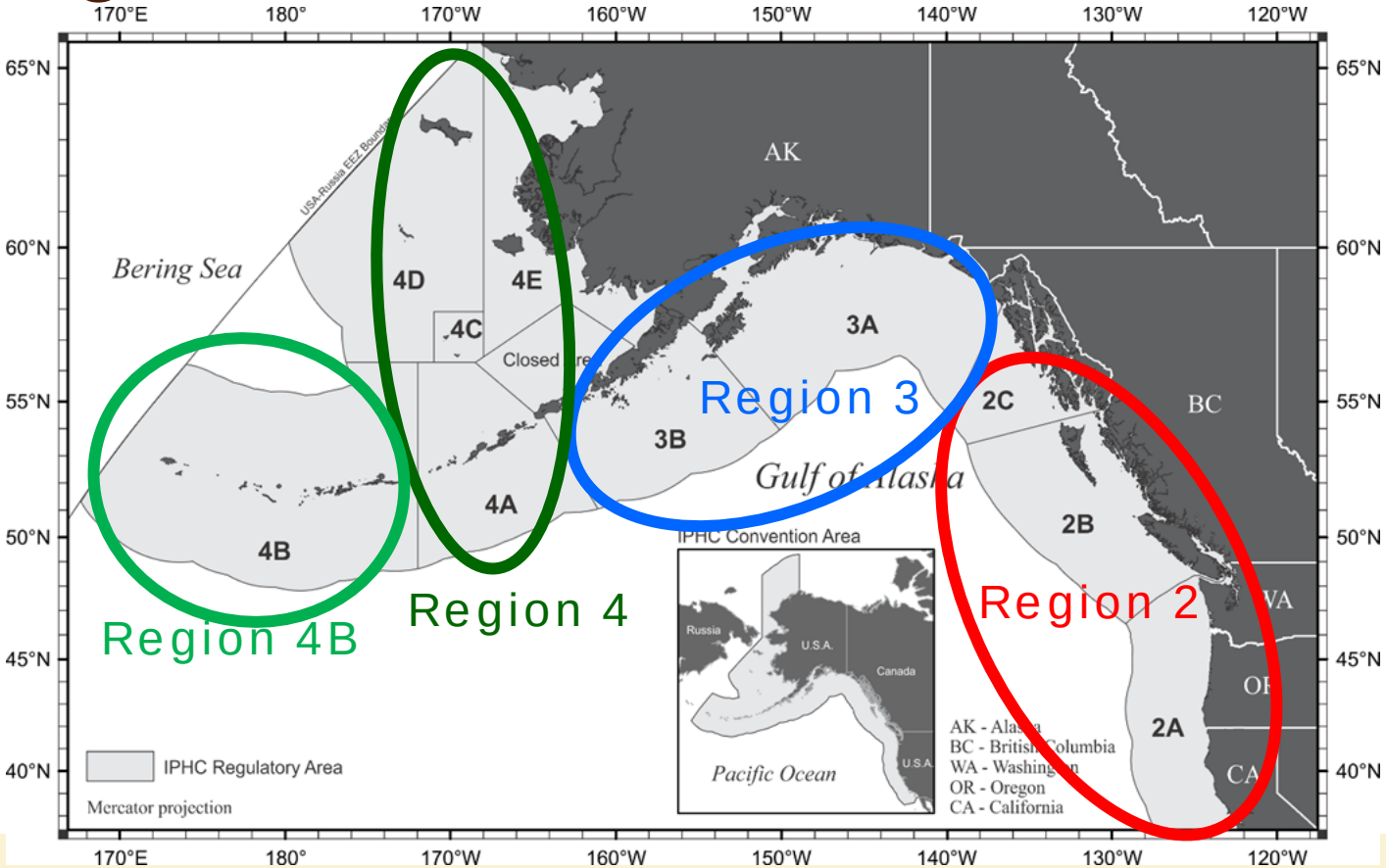
Modelled survey trend (O32 WPUE): Region 4B



Fishery trend: Region 4B



Biological stock distribution



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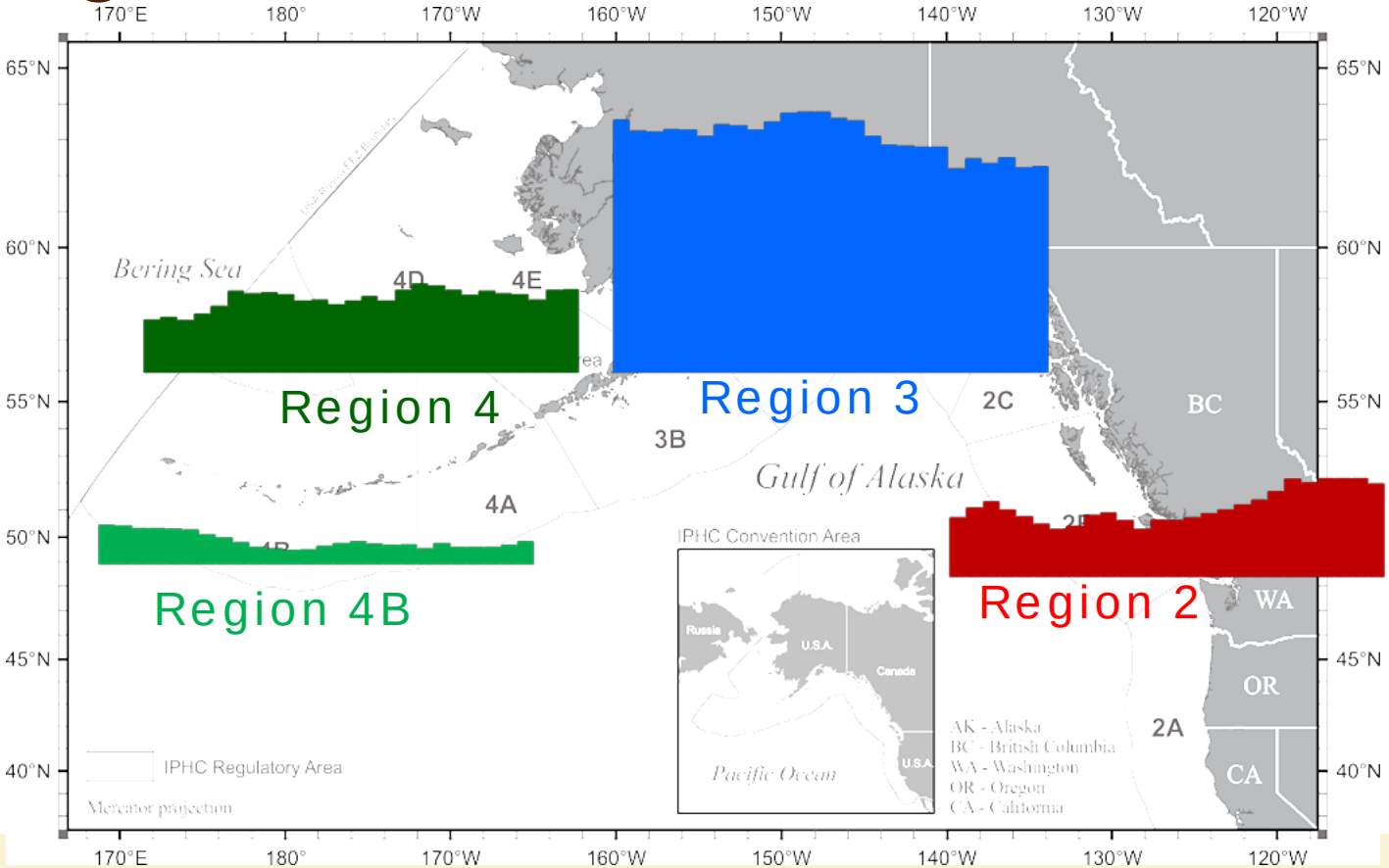
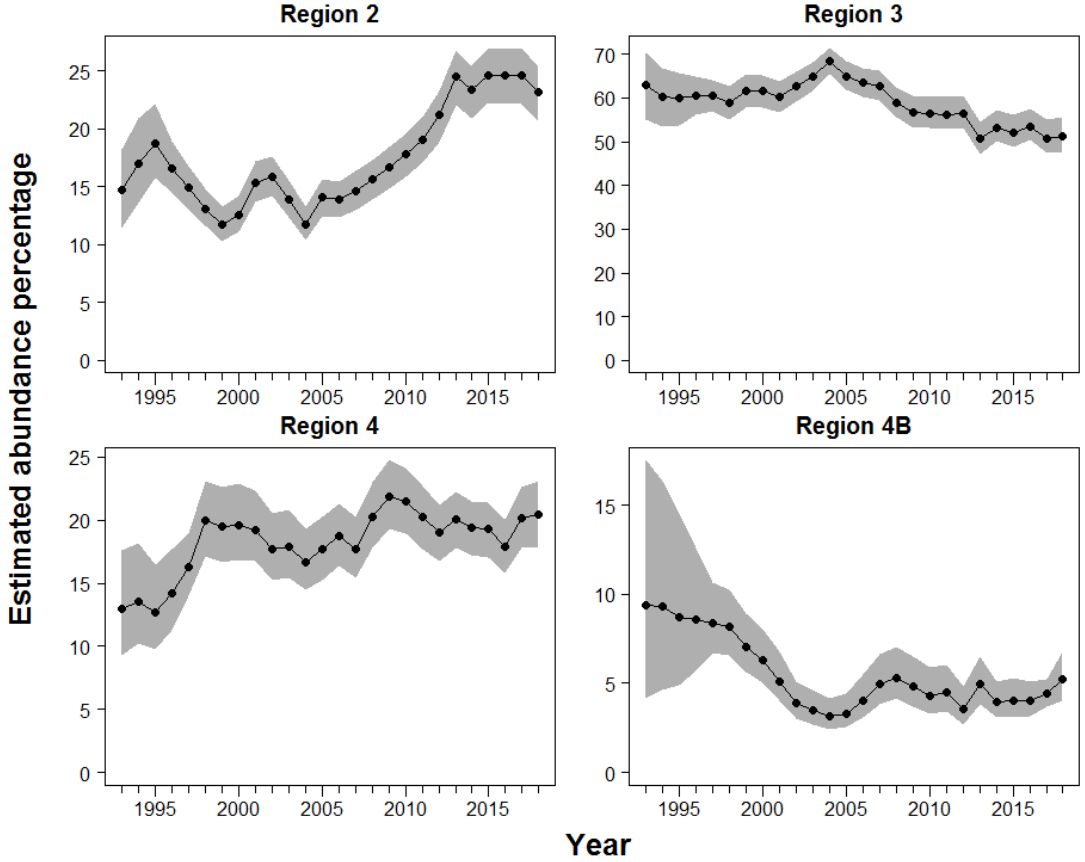


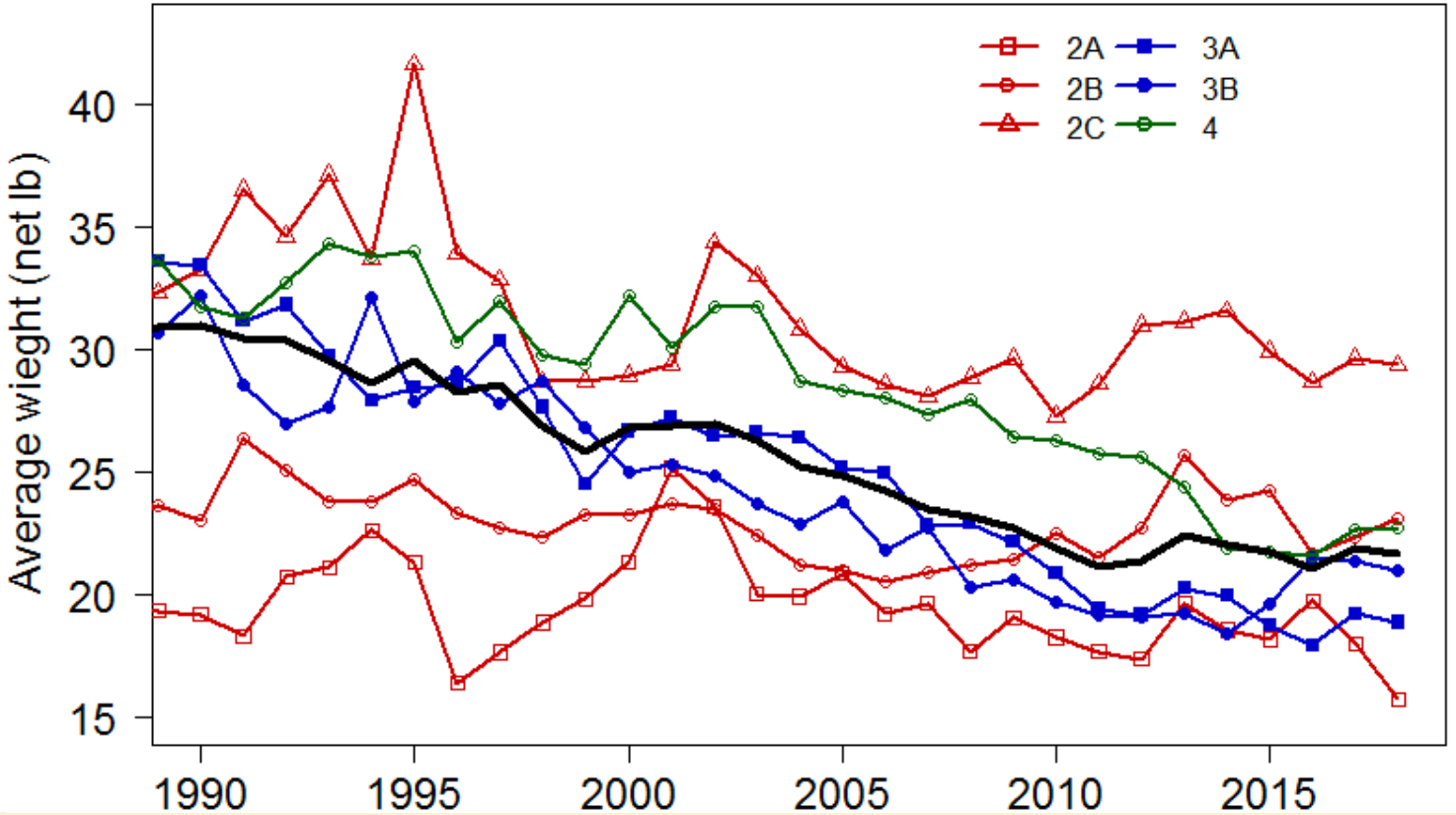
Biological stock distribution



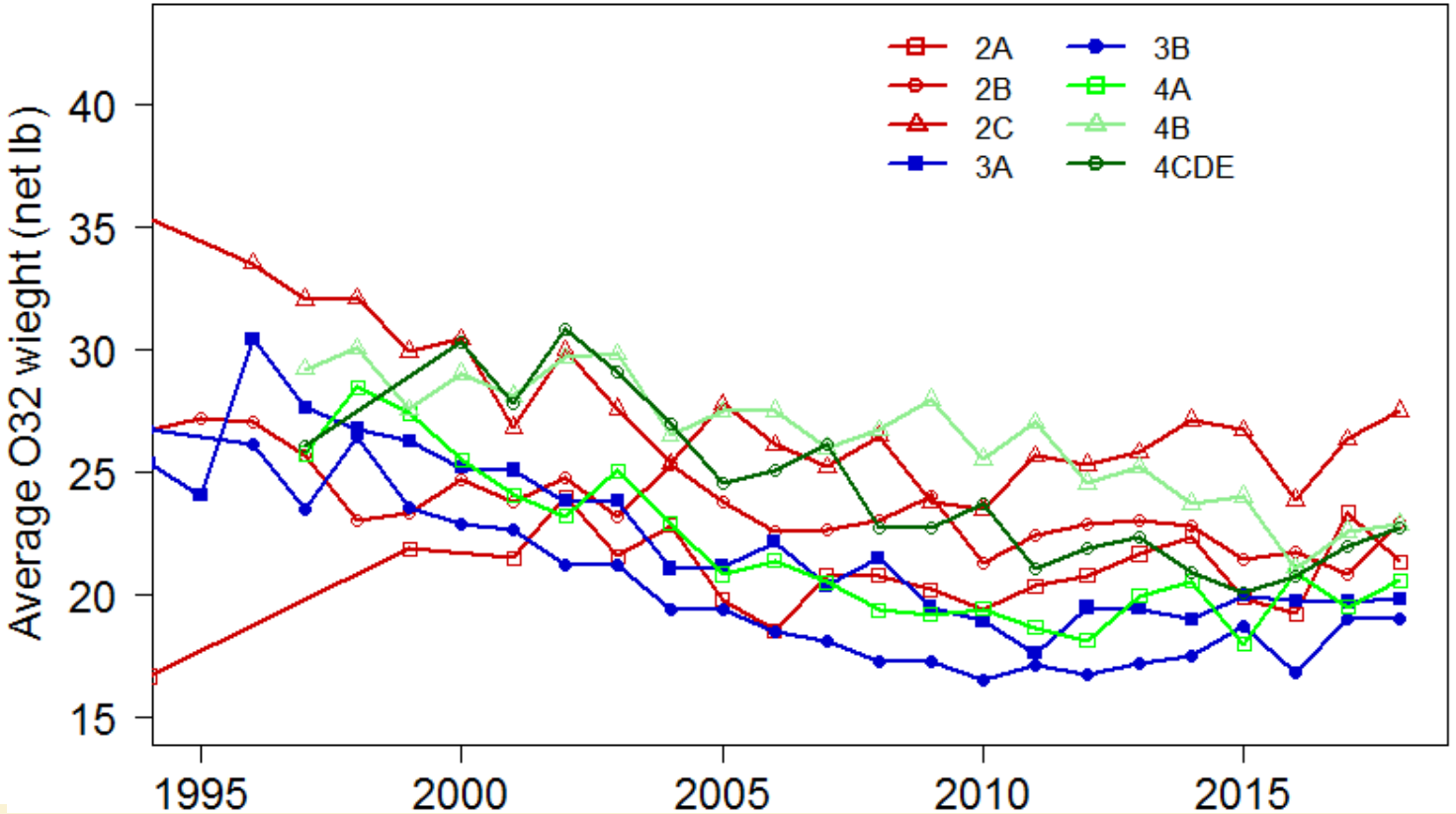
Biological stock distribution

Year	Region 2 (2A, 2B, 2C)	Region 3 (3A, 3B)	Region 4 (4A, 4CDE)	Region 4B
2014	23.4%	53.3%	19.4%	4.0%
2015	24.6%	52.1%	19.3%	4.0%
2016	24.6%	53.5%	17.9%	4.0%
2017	24.6%	50.8%	20.2%	4.4%
2018	23.1%	51.2%	20.4%	5.2%

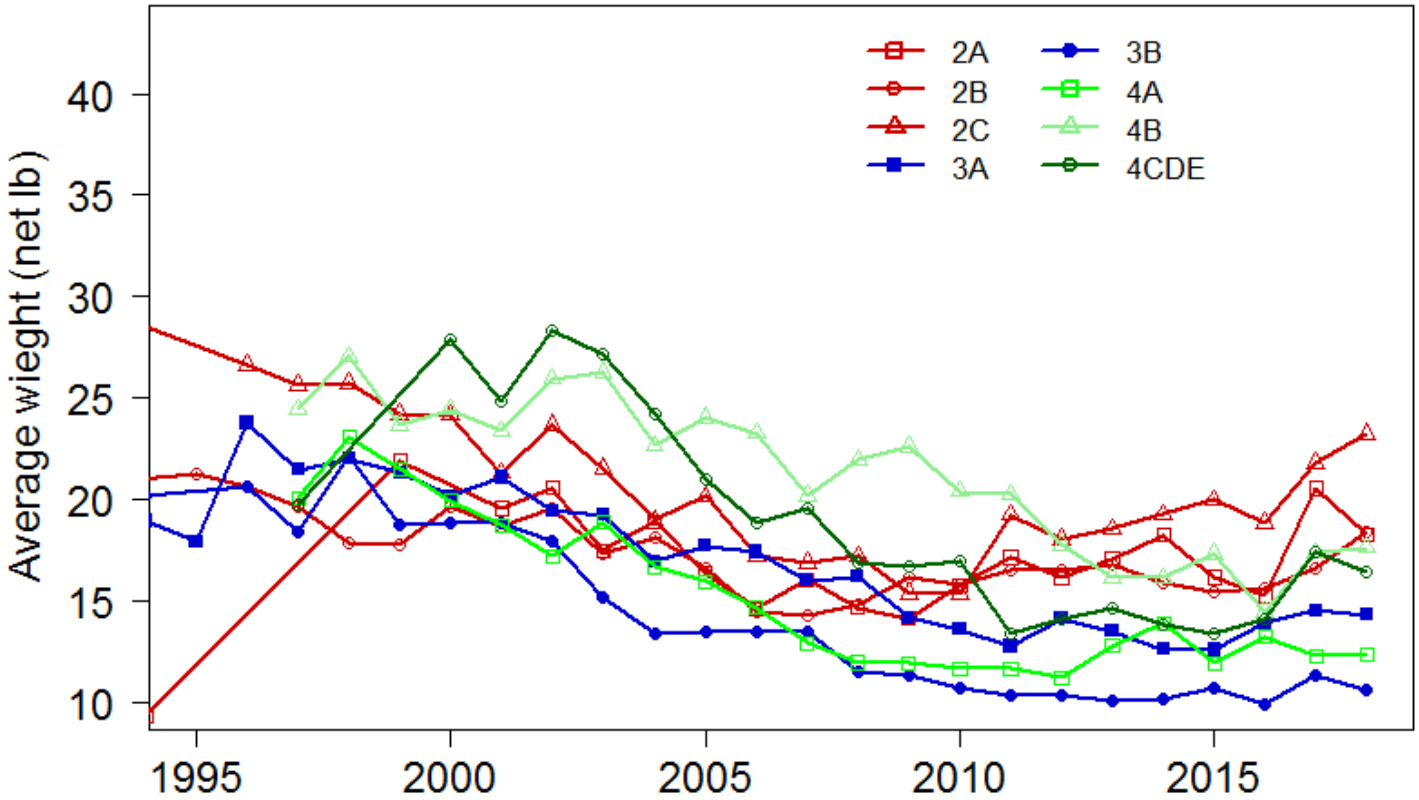
Fishery average fish weight



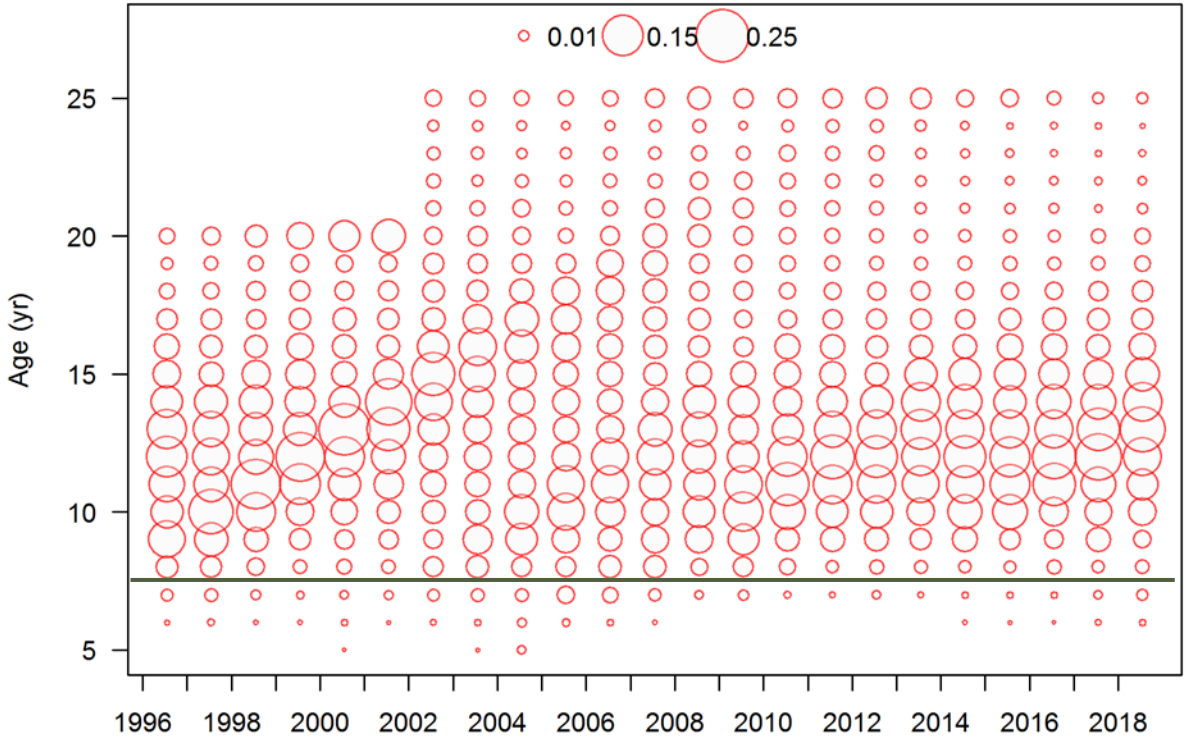
Setline survey average O32 fish weight



Setline survey average fish weight

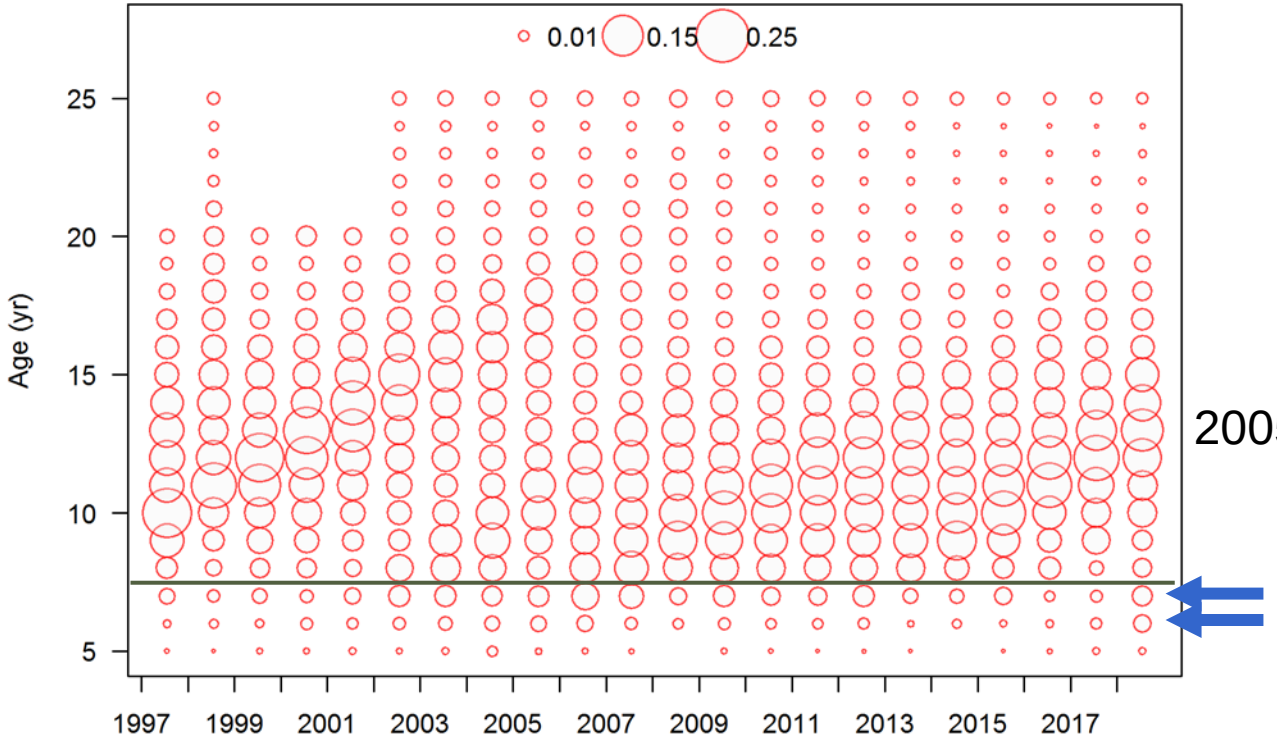


Fishery ages (sexes combined)



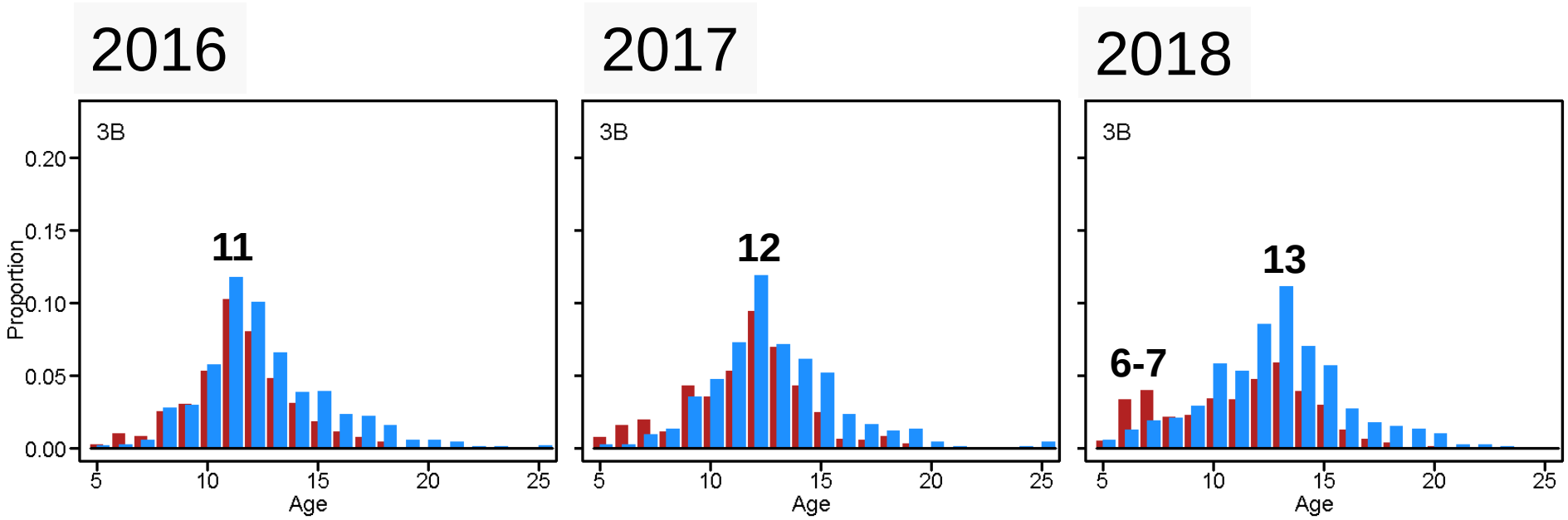
2005 year class

Setline survey ages (sexes combined)



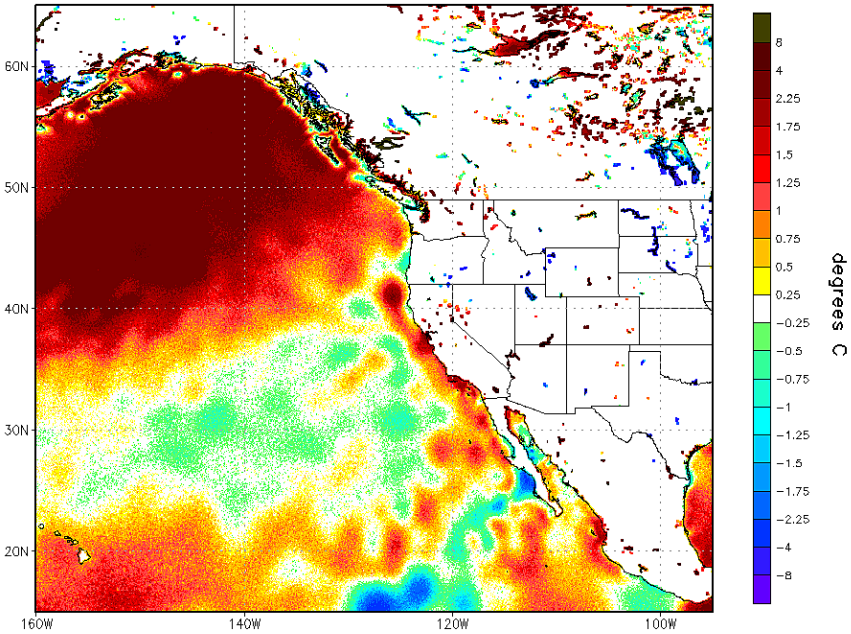
2005 year class

Setline survey age composition data: 3B



Ecosystem conditions

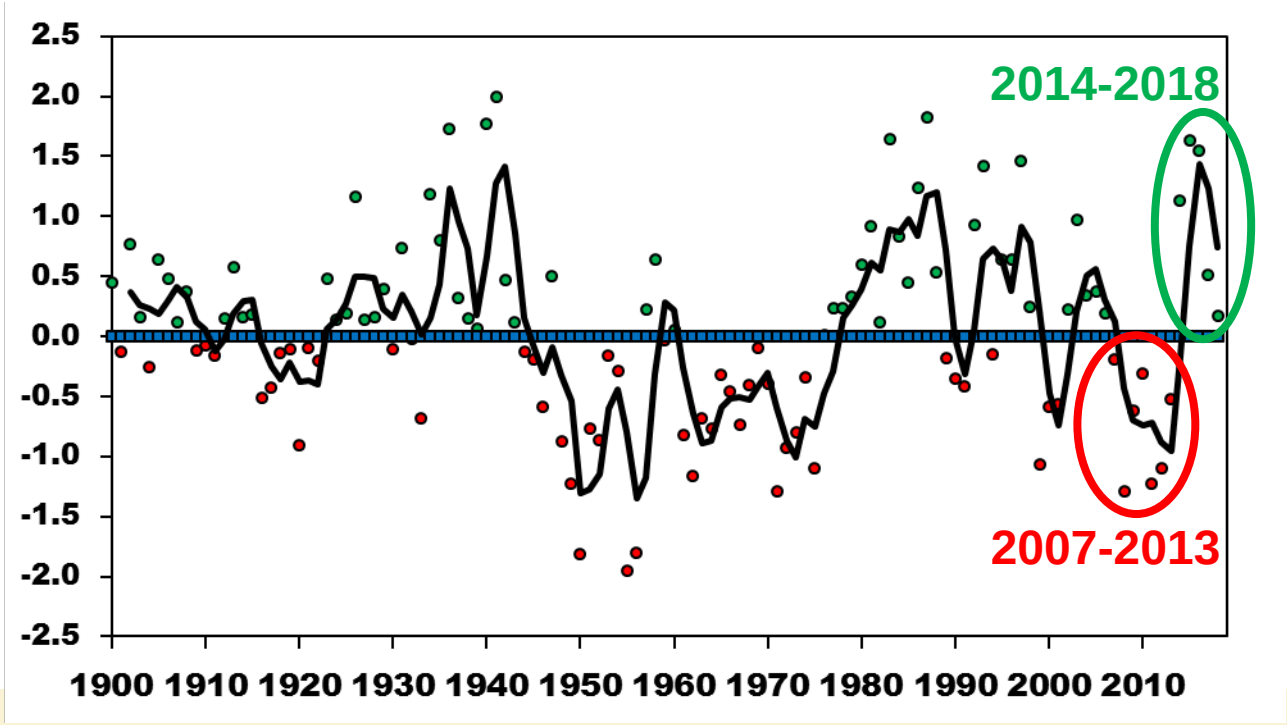
- More warm water in the fall of 2018
- No cold pool in Bering Sea
  - Northerly shift in cod and pollock distributions
  - Bird mortality



Temperature anomalies from October

Ecosystem conditions

- Weakly positive Pacific Decadal Oscillation in 2018



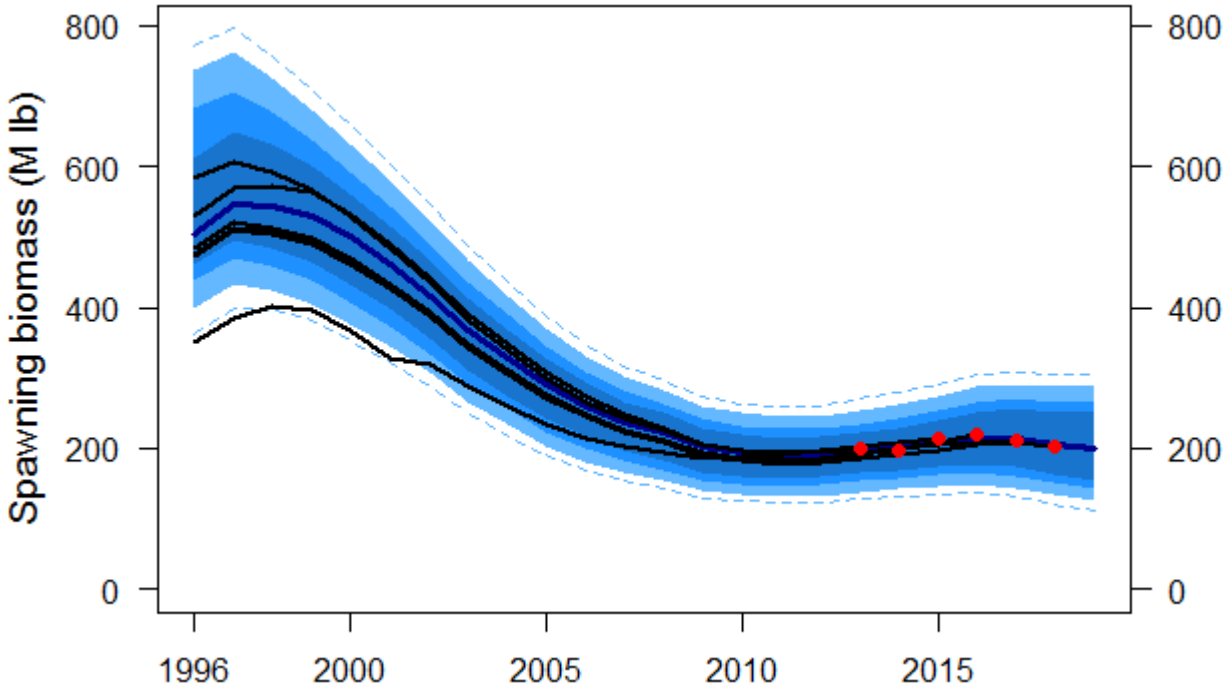
Outline

- Coastwide stock assessment
  - Data sources
  - Modelling and results
  - Projections and Decision table
- 2019 Mortality projection tool

Modelling for 2018

- Updated assessment using the same ensemble methodology (4 models) from 2016-17, based on the independent scientific review in 2015
- Full analysis and review scheduled: June 2019
- New information:
  - 2018 fishery and modelled survey trend, biological data (ages, lengths, and weights)
    - Setline survey expansion in Region 2 (updated the full modelled survey time-series)

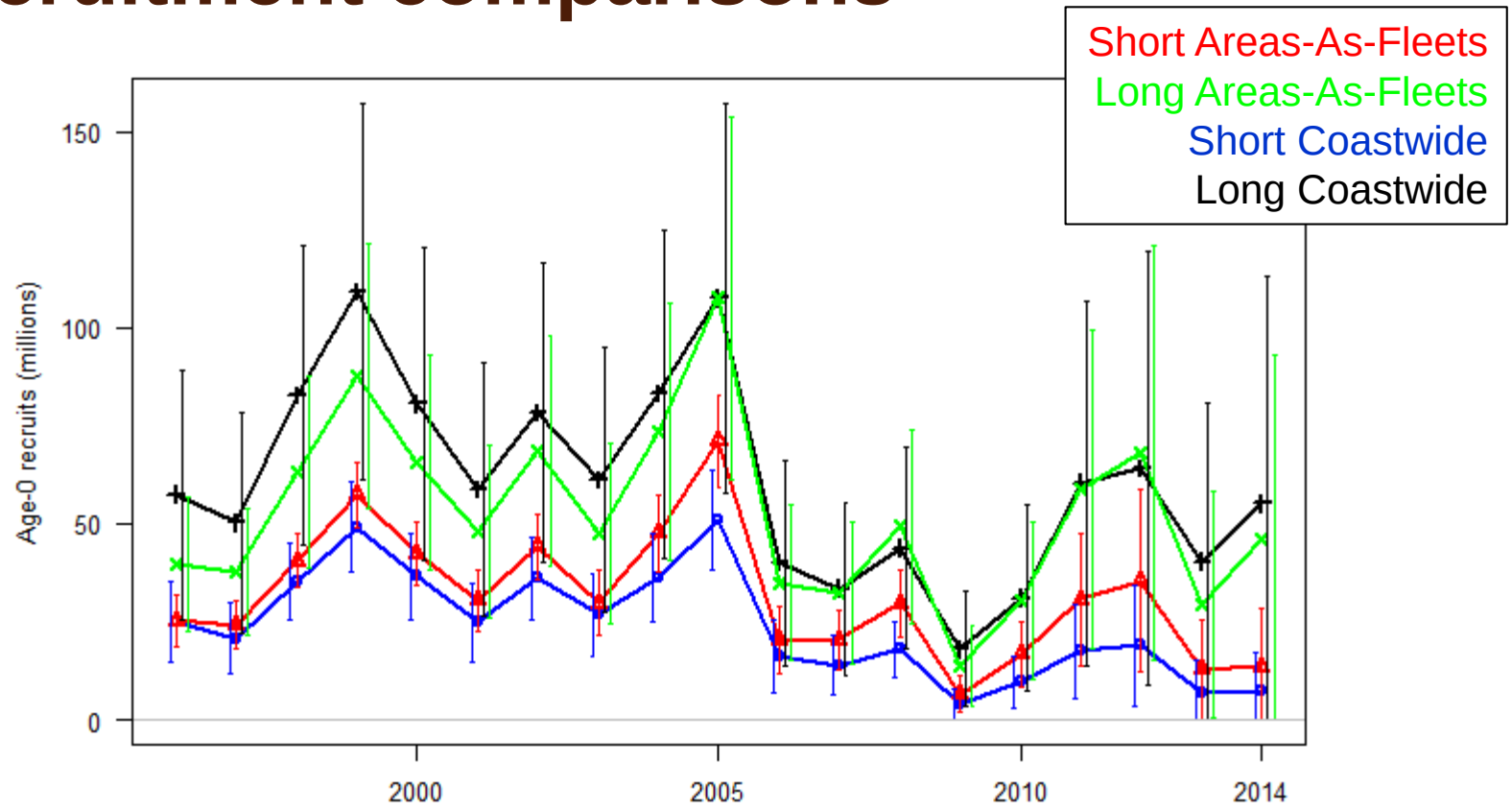
Comparison to previous years



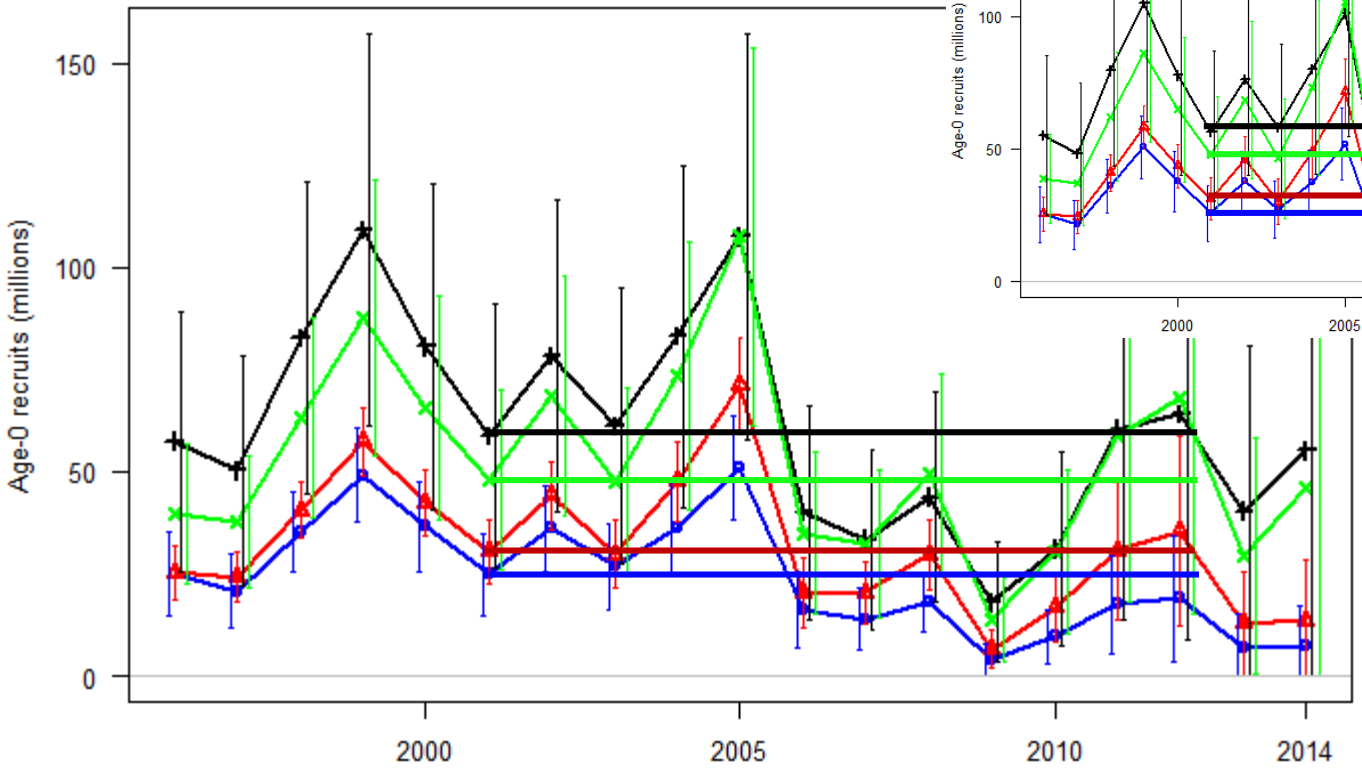
Change in individual model estimates (compared to last year)

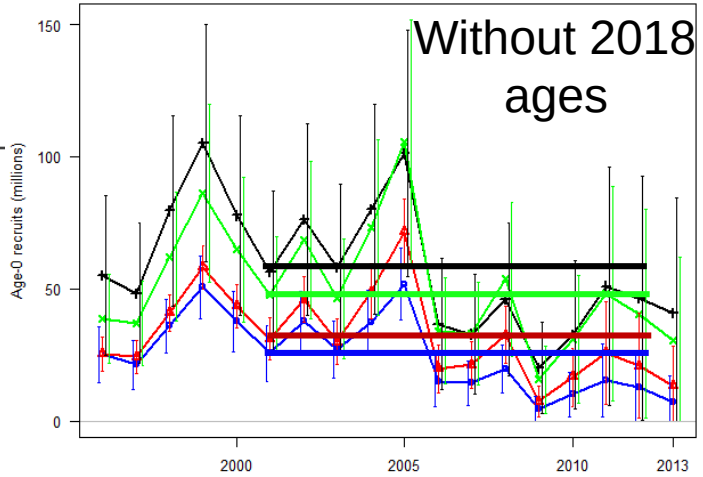
- 2018 Survey observed more of the 2011 and 2012 cohorts than in 2017 → increased estimated recruitment

Recruitment comparisons

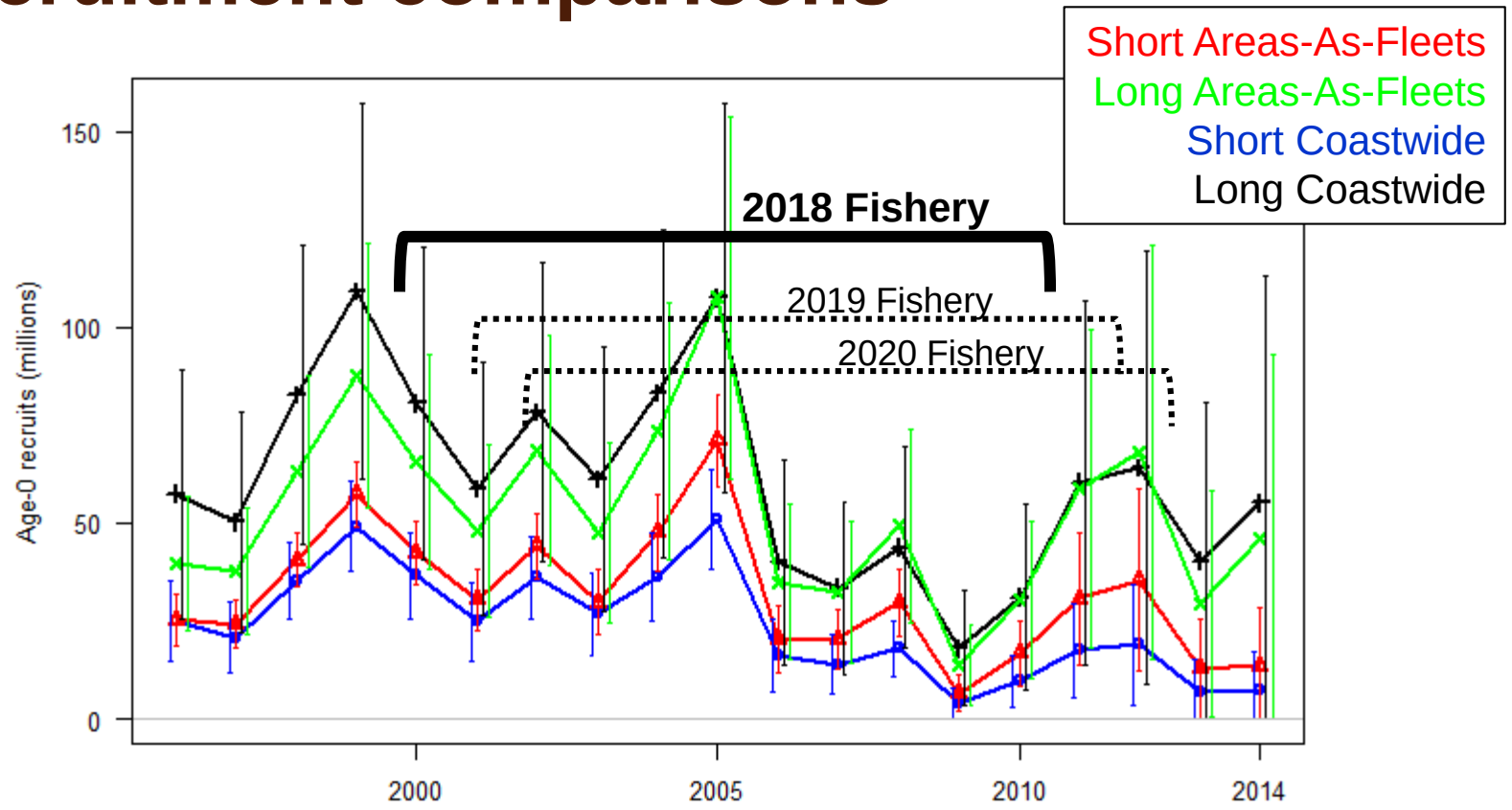


Recruitment comparisons





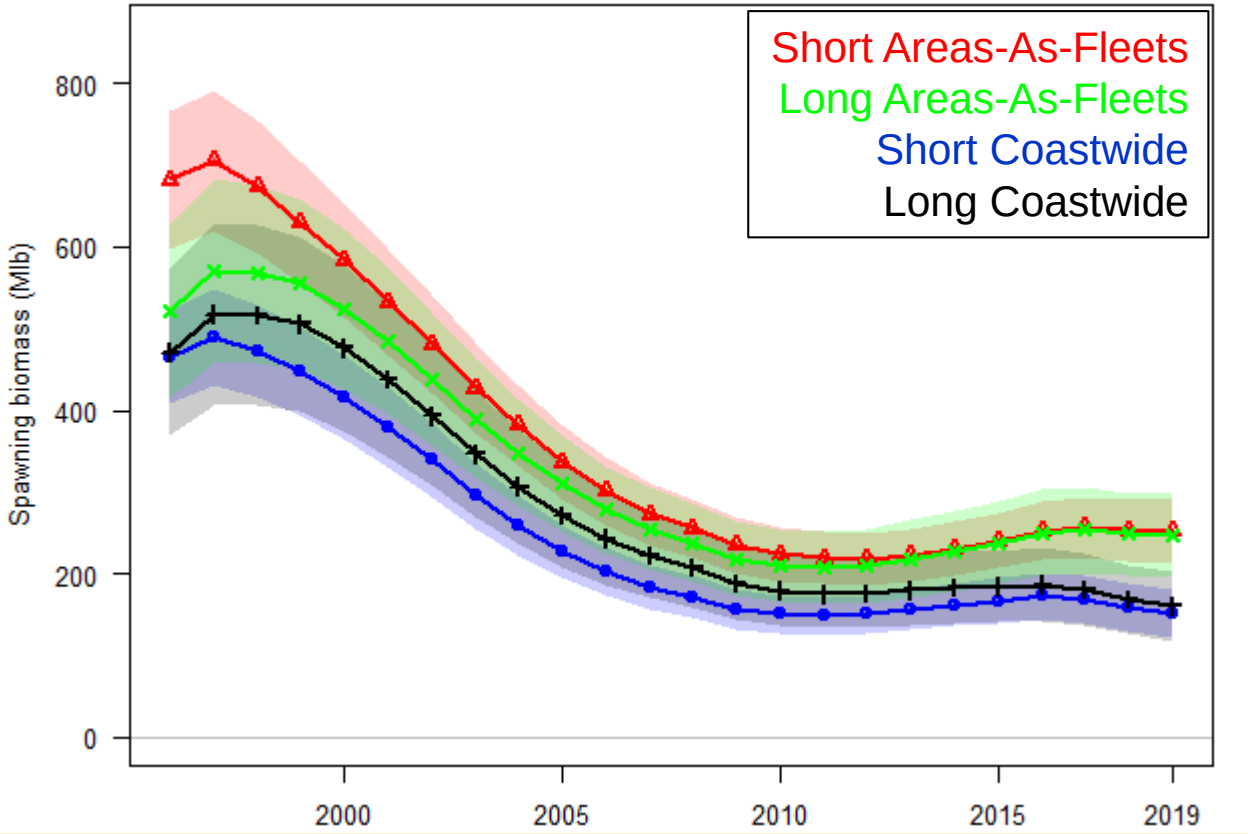
Recruitment comparisons



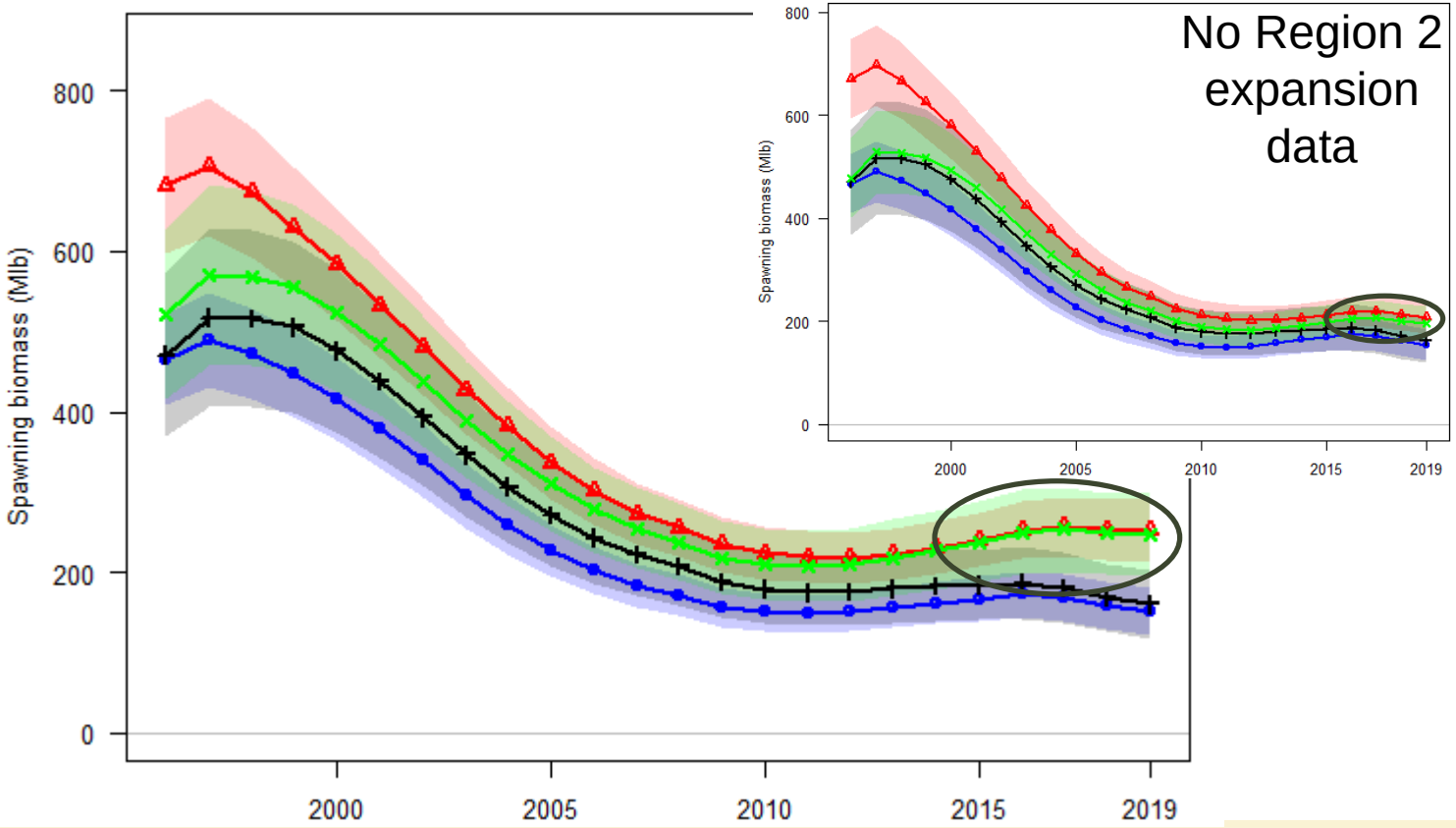
Change in individual model estimates (compared to last year)

- 2018 Survey observed more of the 2011 and 2012 cohorts than in 2017 → increased estimated recruitment
- 2018 Expansion data (Region 2) produced more precision (throughout the time series) and a flatter trend

Spawning biomass



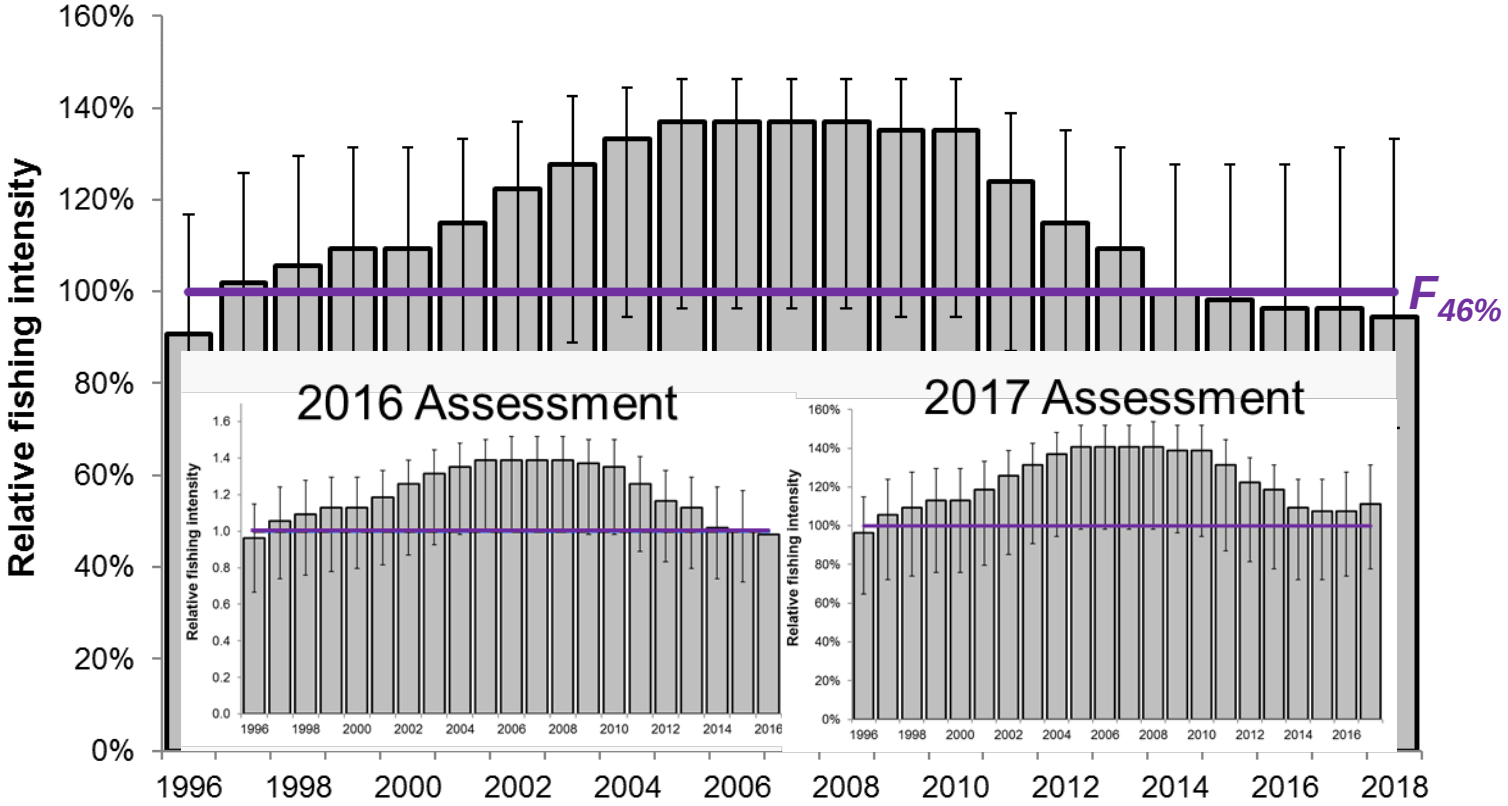
Spawning biomass comparison



Change in estimates from last year

- Increased uncertainty:
  - Fish aged 6-7 are poorly sampled (0-7% of annual survey catch), another year's data will improve the certainty of the incoming year-classes
  - The completion of the expansion data (Region 3) will be collected in 2019

Relative coastwide harvest rate



Assessment summary table

Indicators	Values	Trends	Status
Total mortality 2018: Retained catch 2018: Average removals 2014–18:	38.74 Mlbs, 17,572 t 31.81 Mlbs, 14,427 t 41.39 Mlbs, 18,772 t	Mortality decreased from 2017 to 2018	2018 mortality near 100-year Low
SPR_{2018}: P(SPR<46%): P(SPR<limit):	49% (28-62%) 34% Limit not specified	Fishing intensity decreased from 2017 to 2018	Fishing intensity below reference level
SB_{2019} (Mlb): SB_{2019}/SB_0: $P(SB_{2019}<SB_{30})$: $P(SB_{2019}<SB_{20})$:	199 Mlbs (125–287) 43% (27-63%) 11% <1%	SB decreased from 2017 to 2018	Not overfished
Biological stock distribution:	See Tables and Figures	Distribution stable 2014-18	Region 2 above, Region 3 below Historical values

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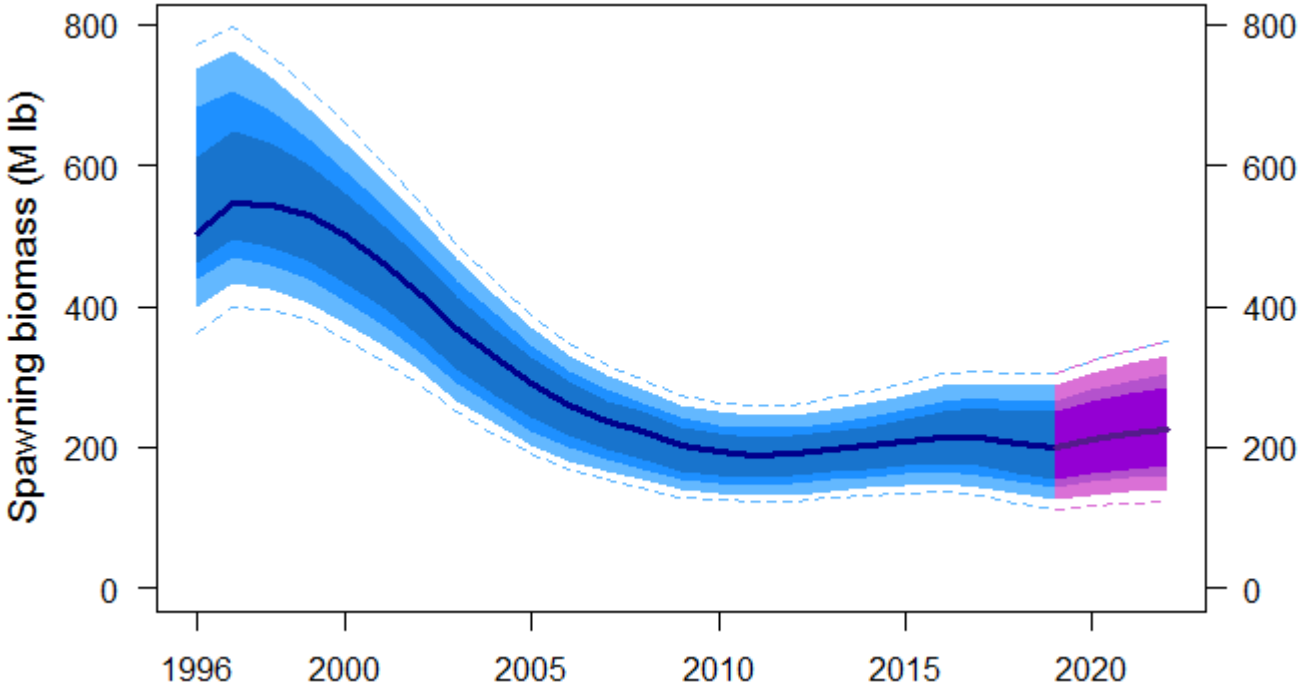
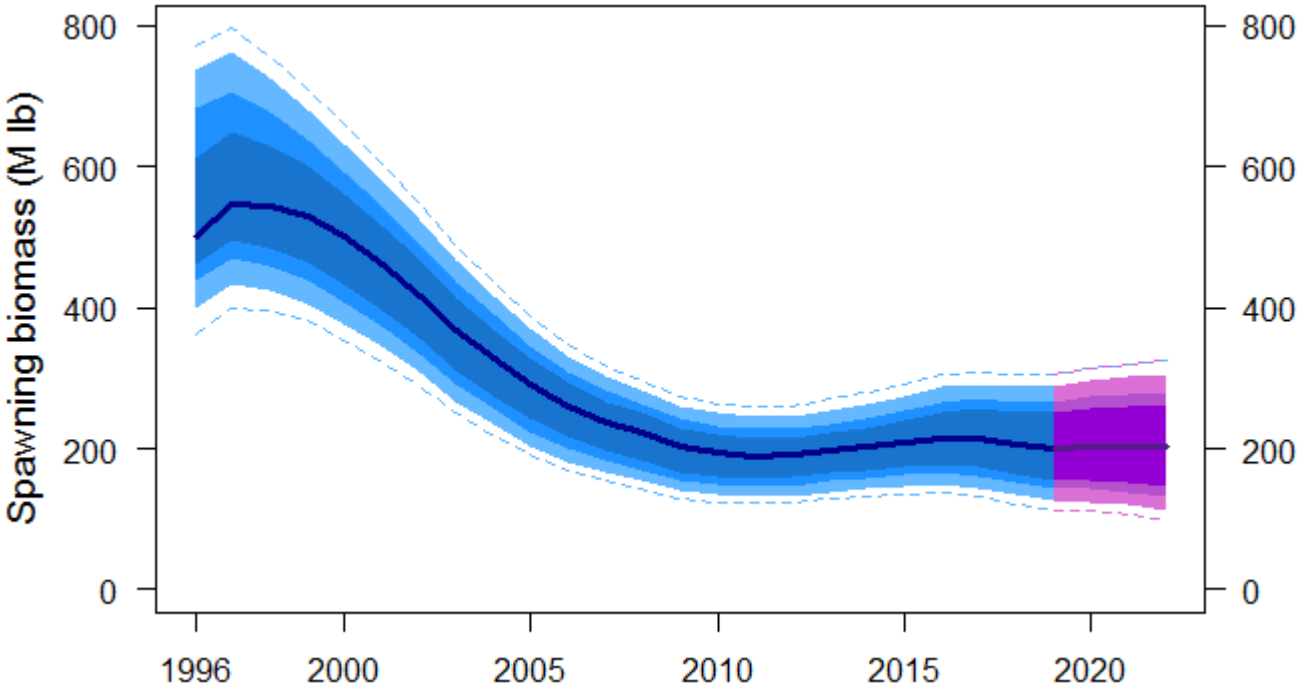
Projections under constant mortality

2019 Alternative	No fishing mortality					Status quo		*Reference SPR=46%*							
Total mortality (M lb)	0.0	11.7	21.8	31.8	37.6	39.0	40.4	41.8	43.1	44.3	45.5	46.8	48.3	49.9	61.8
TCEY (M lb)	0.0	10.0	20.0	30.0	35.8	37.2	38.6	40.0	41.3	42.5	43.7	45.0	46.5	48.1	60.0
2019 Fishing intensity	$F_{100\%}$	$F_{78\%}$	$F_{64\%}$	$F_{54\%}$	$F_{49\%}$	$F_{48\%}$	$F_{47\%}$	$F_{46\%}$	$F_{45\%}$	$F_{44\%}$	$F_{43\%}$	$F_{42\%}$	$F_{41\%}$	$F_{40\%}$	$F_{34\%}$
Fishing intensity interval	--	56-87%	41-76%	31-67%	27-63%	26-62%	25-61%	25-60%	24-59%	23-59%	23-58%	22-57%	22-56%	21-55%	17-49%

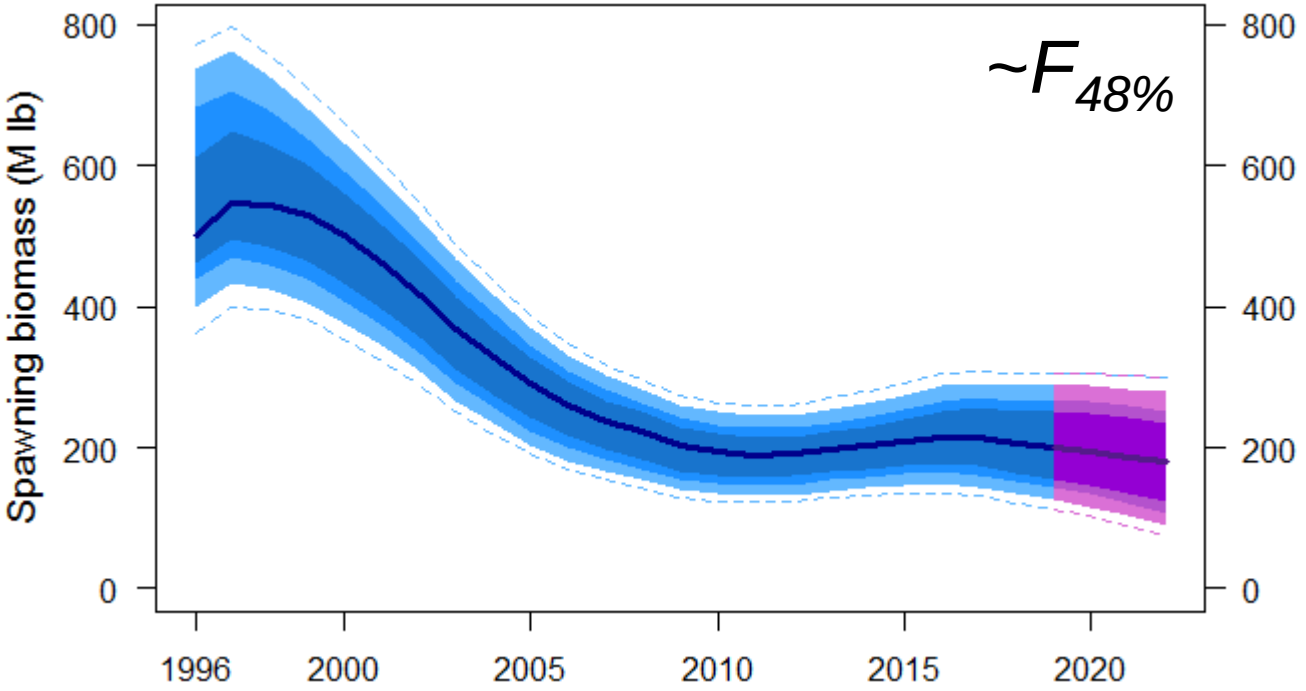
Projections – no fishing



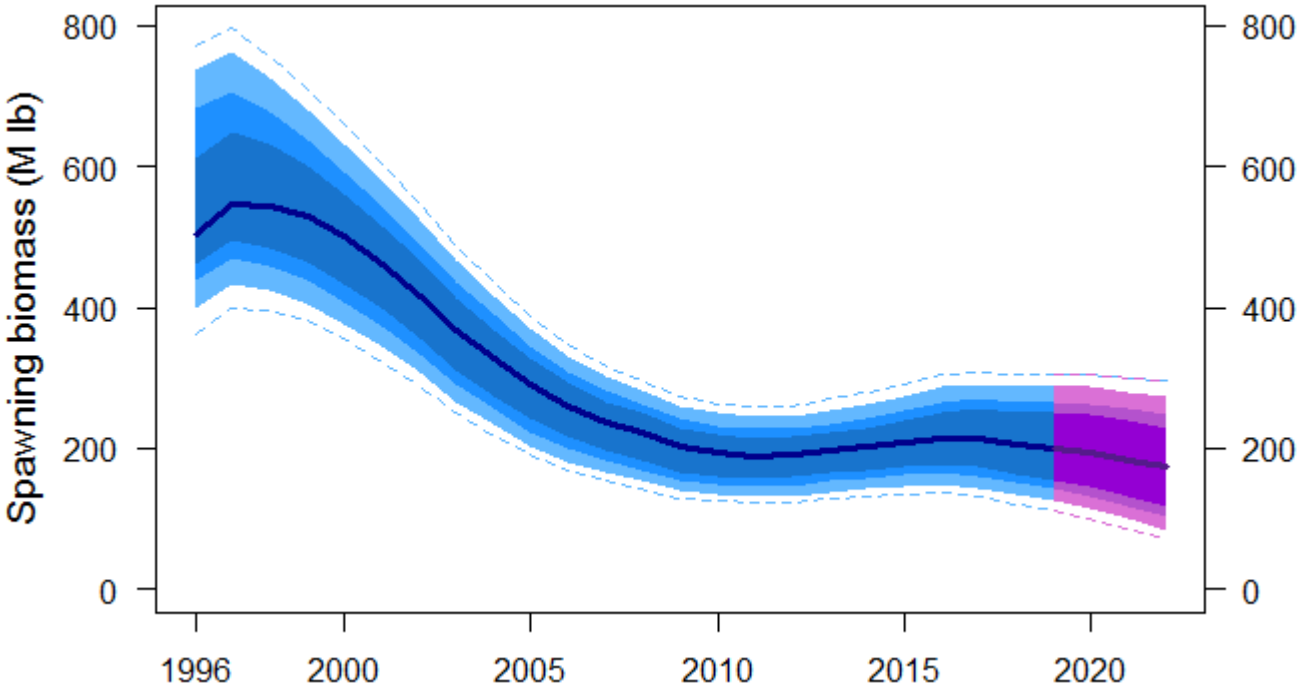
Projections – 20 Mlb TCEY



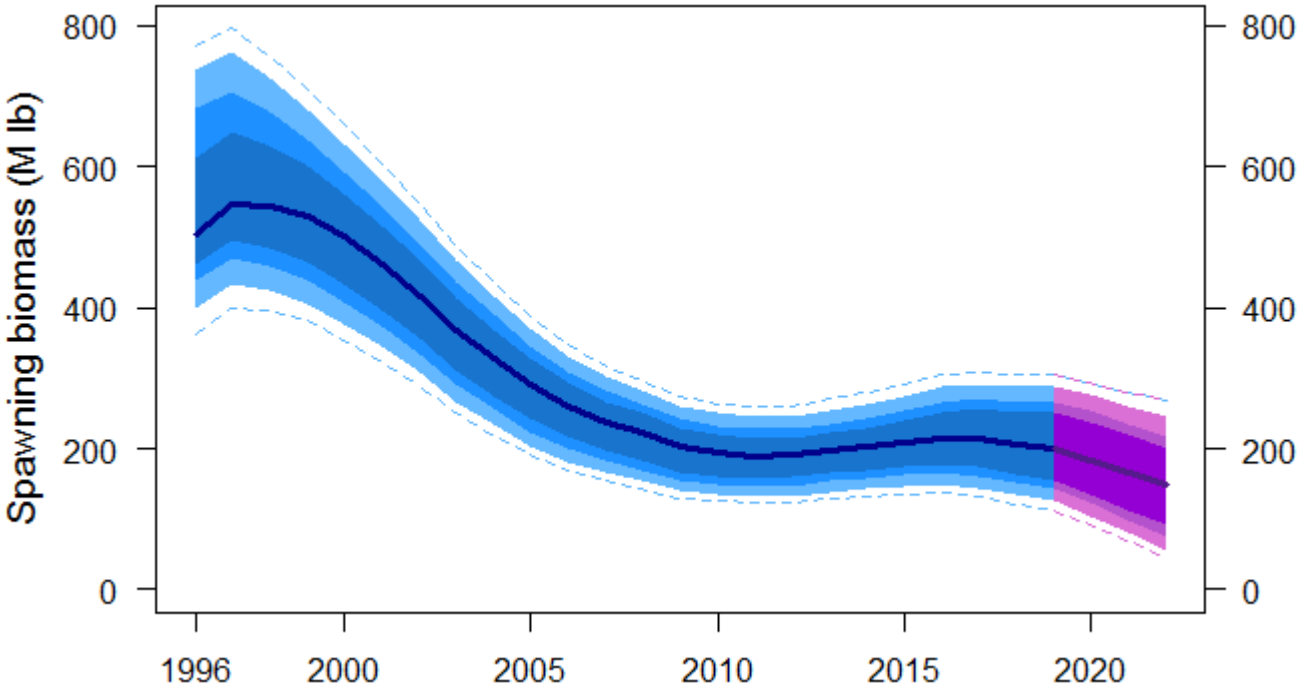
Projections – *status quo* (37.2 Mlb TCEY)



Projections – Reference ($F_{46\%}$, 40 Mlb TCEY)



Projections – 60 Mlb TCEY



2019 Decision table

2019 Alternative

Total mortality (M lb)

TCEY (M lb)

2019 Fishing intensity

Fishing intensity interval

2019 Decision table

2019 Alternative			No fishing mortality						Status quo		*Reference SPR=46%*								
Total mortality (M lb)			0.0	11.7	21.8	31.8	37.6	39.0	40.4	41.8	43.1	44.3	45.5	46.8	48.3	49.9	61.8		
TCEY (M lb)			0.0	10.0	20.0	30.0	35.8	37.2	38.6	40.0	41.3	42.5	43.7	45.0	46.5	48.1	60.0		
2019 Fishing intensity			$F_{100\%}$	$F_{78\%}$	$F_{64\%}$	$F_{54\%}$	$F_{49\%}$	$F_{48\%}$	$F_{47\%}$	$F_{46\%}$	$F_{45\%}$	$F_{44\%}$	$F_{43\%}$	$F_{42\%}$	$F_{41\%}$	$F_{40\%}$	$F_{34\%}$		
Fishing intensity interval			--	56-87%	41-76%	31-67%	27-63%	26-62%	25-61%	25-60%	24-59%	23-59%	23-58%	22-57%	22-56%	21-55%	17-49%		
Stock Trend (spawning biomass)	in 2020	is less than 2019	1	3	26	60	77	81	84	87	90	92	93	95	96	97	>99	a	
		is 5% less than 2019	<1	<1	1	10	26	30	34	37	39	41	43	45	48	50	78	b	
	in 2021	is less than 2019	1	7	41	75	90	93	94	96	97	98	98	99	99	99	>99	c	
		is 5% less than 2019	<1	1	11	42	57	61	65	69	73	77	80	83	87	90	99	d	
	in 2022	is less than 2019	1	12	51	82	93	94	96	97	98	98	99	99	99	>99	>99	e	
		is 5% less than 2019	<1	3	28	58	76	79	83	86	88	90	92	93	95	96	>99	f	

High probability of stock decline over all TCEYs larger than 20 Mlb

Decision table from last year

2018 Alternative		No removals						*Reference: SPR=46%*					*Suggested*		*Status quo*
Total removals (M lb)		0.0	11.8	21.8	28.8	29.8	30.8	31.8	32.8	33.8	34.8	35.8	37.3	39.0	41.8	42.6
TCEY (M lb)		0.0	10.0	20.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.5	37.2	40.0	40.8
Fishing intensity		$F_{100\%}$	$F_{73\%}$	$F_{58\%}$	$F_{50\%}$	$F_{49\%}$	$F_{48\%}$	$F_{47\%}$	$F_{46\%}$	$F_{45\%}$	$F_{44\%}$	$F_{43\%}$	$F_{42\%}$	$F_{41\%}$	$F_{39\%}$	$F_{38\%}$
Fishing intensity interval		--	61-84%	45-73%	37-67%	36-66%	36-65%	35-65%	34-64%	33-63%	32-63%	32-62%	31-61%	30-60%	28-58%	27-57%
Stock Trend (spawning biomass)	in 2019	is less than 2018	1	3	24	59	64	69	74	78	81	85	87	91	93	98	>99
		is 5% less than 2018	<1	<1	<1	2	2	3	4	5	7	9	11	14	19	29	34
	in 2020	is less than 2018	<1	1	14	46	52	57	62	67	71	76	80	85	88	95	98
		is 5% less than 2018	<1	<1	1	9	11	14	18	21	25	29	34	41	48	61	68
	in 2021	is less than 2018	<1	2	23	59	63	68	72	76	79	83	86	90	92	97	99
		is 5% less than 2018	<1	<1	5	27	32	36	41	46	50	55	59	66	72	83	89

High probability of stock decrease: *Now estimated to have decreased*

‘Surplus production’ for 2018-2021 was ~25.25 Mlb:

Estimated to be ~20 Mlb for 2019-2022

2019 Decision table

2019 Alternative			No fishing mortality						Status quo		*Reference SPR=46%*							
Total mortality (M lb)			0.0	11.7	21.8	31.8	37.6	39.0	40.4	41.8	43.1	44.3	45.5	46.8	48.3	49.9	61.8	
TCEY (M lb)			0.0	10.0	20.0	30.0	35.8	37.2	38.6	40.0	41.3	42.5	43.7	45.0	46.5	48.1	60.0	
2019 Fishing intensity			$F_{100\%}$	$F_{78\%}$	$F_{64\%}$	$F_{54\%}$	$F_{49\%}$	$F_{48\%}$	$F_{47\%}$	$F_{46\%}$	$F_{45\%}$	$F_{44\%}$	$F_{43\%}$	$F_{42\%}$	$F_{41\%}$	$F_{40\%}$	$F_{34\%}$	
Fishing intensity interval			--	56-87%	41-76%	31-67%	27-63%	26-62%	25-61%	25-60%	24-59%	23-59%	23-58%	22-57%	22-56%	21-55%	17-49%	
Stock Status (Spawning biomass)	in 2020	is less than 30%	5	7	11	14	17	17	18	18	19	19	20	20	21	21	25	g
		is less than 20%	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	h
	in 2021	is less than 30%	3	7	13	20	24	25	25	26	27	27	27	28	29	29	33	i
		is less than 20%	<1	<1	<1	<1	1	1	1	1	2	2	2	3	3	4	10	j
	in 2022	is less than 30%	2	8	17	25	28	29	29	30	30	31	31	32	33	33	41	k
		is less than 20%	<1	<1	<1	2	4	5	6	7	8	9	10	12	13	15	24	l

Increasing, but low probability of dropping below $SB_{30\%}$,$SB_{20\%}$.

2019 Decision table

2019 Alternative			No fishing mortality						Status quo		*Reference SPR=46%*								
Total mortality (M lb)			0.0	11.7	21.8	31.8	37.6	39.0	40.4	41.8	43.1	44.3	45.5	46.8	48.3	49.9	61.8	
TCEY (M lb)			0.0	10.0	20.0	30.0	35.8	37.2	38.6	40.0	41.3	42.5	43.7	45.0	46.5	48.1	60.0	
2019 Fishing intensity			$F_{100\%}$	$F_{78\%}$	$F_{64\%}$	$F_{54\%}$	$F_{49\%}$	$F_{48\%}$	$F_{47\%}$	$F_{46\%}$	$F_{45\%}$	$F_{44\%}$	$F_{43\%}$	$F_{42\%}$	$F_{41\%}$	$F_{40\%}$	$F_{34\%}$	
Fishing intensity interval			--	56-87%	41-76%	31-67%	27-63%	26-62%	25-61%	25-60%	24-59%	23-59%	23-58%	22-57%	22-56%	21-55%	17-49%	
Fishery Trend (TCEY)	in 2020	is less than 2019	0	<1	18	26	40	45	51	56	60	63	66	69	73	77	95	m
		is 10% less than 2019	0	<1	12	25	29	33	37	42	47	51	54	58	62	66	95	n
	in 2021	is less than 2019	0	<1	20	28	46	51	56	60	64	67	70	73	77	81	97	o
		is 10% less than 2019	0	<1	16	26	35	39	44	49	53	56	59	63	66	71	97	p
	in 2022	is less than 2019	0	<1	22	32	50	54	58	62	66	69	72	76	79	83	98	q
		is 10% less than 2019	0	<1	19	28	40	45	49	53	56	60	62	66	69	73	98	r
Fishery Status (Fishing intensity)	in 2019	is above $F_{46\%}$	0	<1	16	25	35	40	46	50	56	59	62	65	69	72	92	s

Probabilities of decreased fishery yield (on returning to an $F_{46\%}$) exceed 50/100 between 36 and 43 Mlb TCEY

Uncertainty in SPR is large: 25/100 chance of exceeding $F_{46\%}$ even at "$F_{54\%}$"

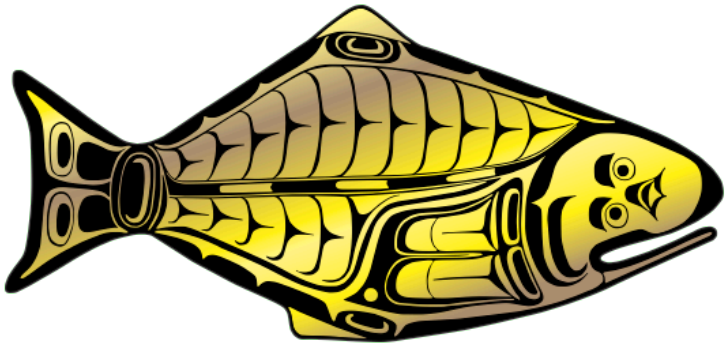
Full decision table

2019 Alternative			No fishing mortality						Status quo		*Reference SPR=46%*								
Total mortality (M lb)			0.0	11.7	21.8	31.8	37.6	39.0	40.4	41.8	43.1	44.3	45.5	46.8	48.3	49.9	61.8	
TCEY (M lb)			0.0	10.0	20.0	30.0	35.8	37.2	38.6	40.0	41.3	42.5	43.7	45.0	46.5	48.1	60.0	
2019 Fishing intensity			$F_{100\%}$	$F_{78\%}$	$F_{64\%}$	$F_{54\%}$	$F_{49\%}$	$F_{48\%}$	$F_{47\%}$	$F_{46\%}$	$F_{45\%}$	$F_{44\%}$	$F_{43\%}$	$F_{42\%}$	$F_{41\%}$	$F_{40\%}$	$F_{34\%}$	
Fishing intensity interval			--	56-87%	41-76%	31-67%	27-63%	26-62%	25-61%	25-60%	24-59%	23-59%	23-58%	22-57%	22-56%	21-55%	17-49%	
Stock Trend (spawning biomass)	in 2020	is less than 2019	1	3	26	60	77	81	84	87	90	92	93	95	96	97	>99	a
		is 5% less than 2019	<1	<1	1	10	26	30	34	37	39	41	43	45	48	50	78	b
	in 2021	is less than 2019	1	7	41	75	90	93	94	96	97	98	98	99	99	99	>99	c
		is 5% less than 2019	<1	1	11	42	57	61	65	69	73	77	80	83	87	90	99	d
	in 2022	is less than 2019	1	12	51	82	93	94	96	97	98	98	99	99	99	>99	>99	e
		is 5% less than 2019	<1	3	28	58	76	79	83	86	88	90	92	93	95	96	>99	f
Stock Status (Spawning biomass)	in 2020	is less than 30%	5	7	11	14	17	17	18	18	19	19	20	20	21	21	25	g
		is less than 20%	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	h
	in 2021	is less than 30%	3	7	13	20	24	25	25	26	27	27	27	28	29	29	33	i
		is less than 20%	<1	<1	<1	<1	1	1	1	1	2	2	2	3	3	4	10	j
	in 2022	is less than 30%	2	8	17	25	28	29	29	30	30	31	31	32	33	33	41	k
		is less than 20%	<1	<1	<1	2	4	5	6	7	8	9	10	12	13	15	24	l
Fishery Trend (TCEY)	in 2020	is less than 2019	0	<1	18	26	40	45	51	56	60	63	66	69	73	77	95	m
		is 10% less than 2019	0	<1	12	25	29	33	37	42	47	51	54	58	62	66	95	n
	in 2021	is less than 2019	0	<1	20	28	46	51	56	60	64	67	70	73	77	81	97	o
		is 10% less than 2019	0	<1	16	26	35	39	44	49	53	56	59	63	66	71	97	p
	in 2022	is less than 2019	0	<1	22	32	50	54	58	62	66	69	72	76	79	83	98	q
		is 10% less than 2019	0	<1	19	28	40	45	49	53	56	60	62	66	69	73	98	r
Fishery Status (Fishing intensity)	in 2019	is above $F_{46\%}$	0	<1	16	25	35	40	46	50	56	59	62	65	69	72	92	s

Projection summary

- New data suggest slightly lower recent fishing intensity (but not significantly different given uncertainty)
- Stock declines estimated for last few years and projected to continue under TCEYs greater than 20 Mlbs
- 2019 data should refine estimates of uncertain 2011-2012 year-classes

INTERNATIONAL PACIFIC



HALIBUT COMMISSION

Outline

- Coastwide stock assessment
  - Data sources
  - Modelling and results
  - Projections and Decision table
- 2019 Mortality projection tool

Mortality projection tool

- Inputs (yellow cells, everything else locked):
  - Distributed mortality limit (TCEY)
  - % of TCEY in each Regulatory Area
  - Bycatch option (previous year's estimates or full regulatory limits)
  - Unit of measure (Mlb, metric tons)

https://iphc.int/data/projection-tool

Mortality projection tool

- Outputs:
  - Estimated SPR
  - TCEY and total mortality by Regulatory Area
  - Modelled stock and TCEY distribution with relative harvest rate by Biological Region
  - Detailed mortality tables (by Regulatory Area and sector)
    - Applying the Catch agreements in each Area

https://iphc.int/data/projection-tool

Mortality projection tool

- Graphics:
  - Spawning biomass projection
  - Coastwide relative fishing intensity
  - Relative harvest rate by Biological Region
  - Mortality by source and Regulatory Area (% and absolute)

https://iphc.int/data/projection-tool

Example: ‘Interim management procedure’

- **Scale** from:
  - Reference SPR = 46%
- **Distribution** from:
  - Modelled O32 survey distribution by Regulatory Area
  - Relative harvest rates by Regulatory Area:

    1.0 in 2A-3A, 0.75 in 3B-4CDE

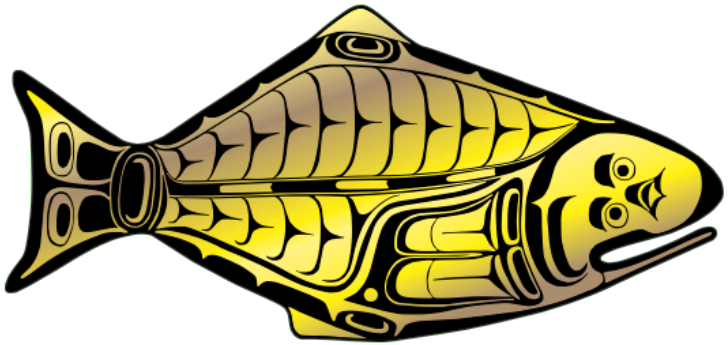
https://iphc.int/data/projection-tool

Mortality projection tool

- Will be updated with end-of-year bycatch estimates in early January for use during AM095

https://iphc.int/data/projection-tool

INTERNATIONAL PACIFIC



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