Gulf of Alaska SAFE report

Report of the

Gulf of Alaska Groundfish

Plan Team meeting

Nov 18th-22nd, 2015

GOA Plan Team Members

James Ianelli (chair)	AFSC/REFM
Jon Heifetz (co-chair)	AFSC/ABL
James Armstrong	NPFMC
Kristen Green	ADFG
Mark Stichert	ADFG
Jan Rumble	ADFG
Ian Stewart	IPHC
Leslie Slater	USFWS (joint)
Nancy Friday	AFSC/NMML
Mike Dalton	AFSC/REFM
Chris Lunsford	AFSC/ABL
Sandra Lowe	AFSC/REFM
Paul Spencer	AFSC/REFM
Craig Faunce	AFSC/FMA
Obren Davis	AKRO

This information is distributed solely for the purpose of pre-dissemination peer review under applicable information quality guidelines. It has not been formally disseminated by the National Marine Fisheries Service and should not be construed to represent any agency determination or policy.

Overview

Biennial **"on"** year for GOA

12 stocks in Tier 3

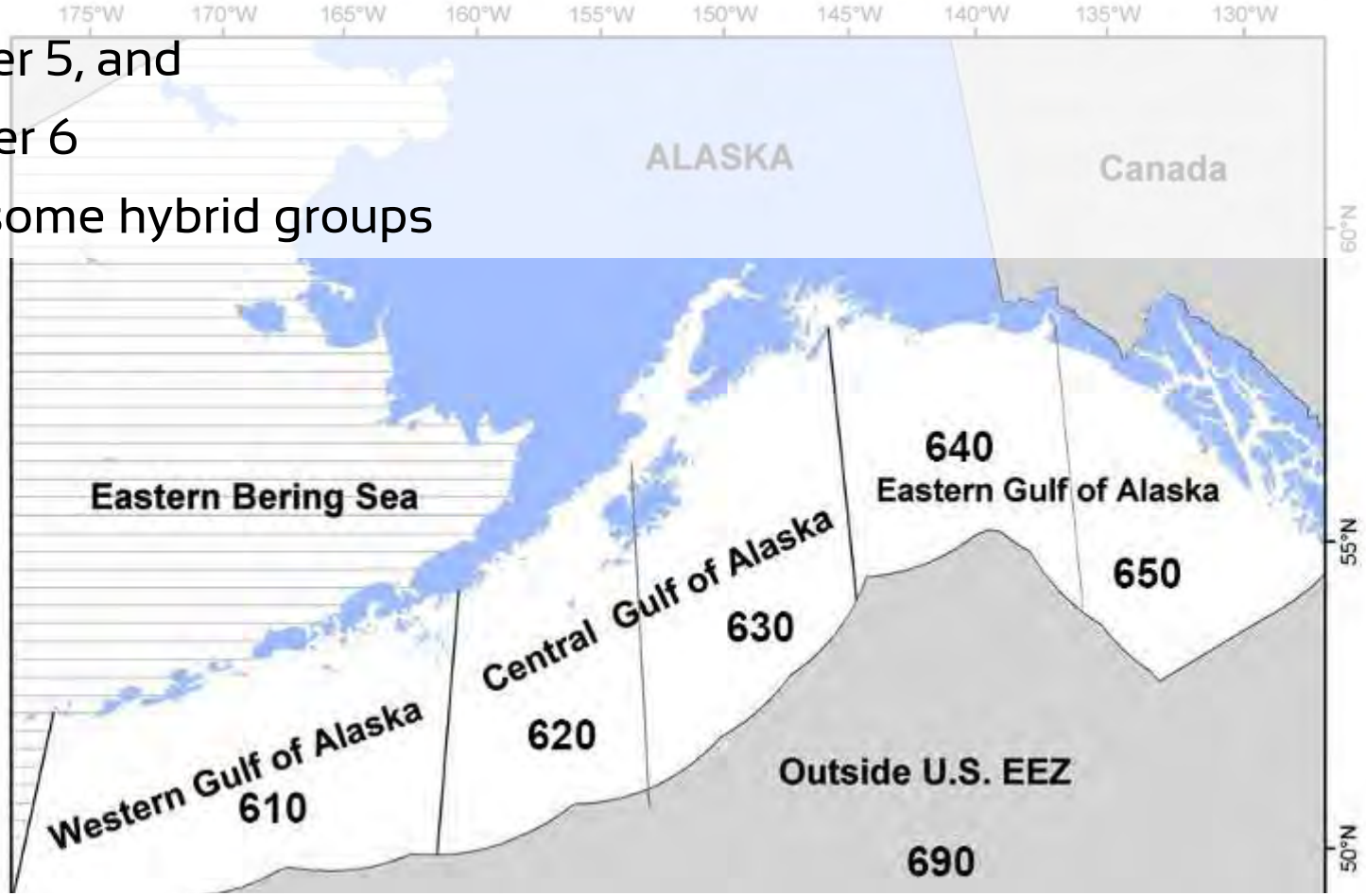
(mostly above $B_{40\%}$)

2 in Tier 4

7 in Tier 5, and

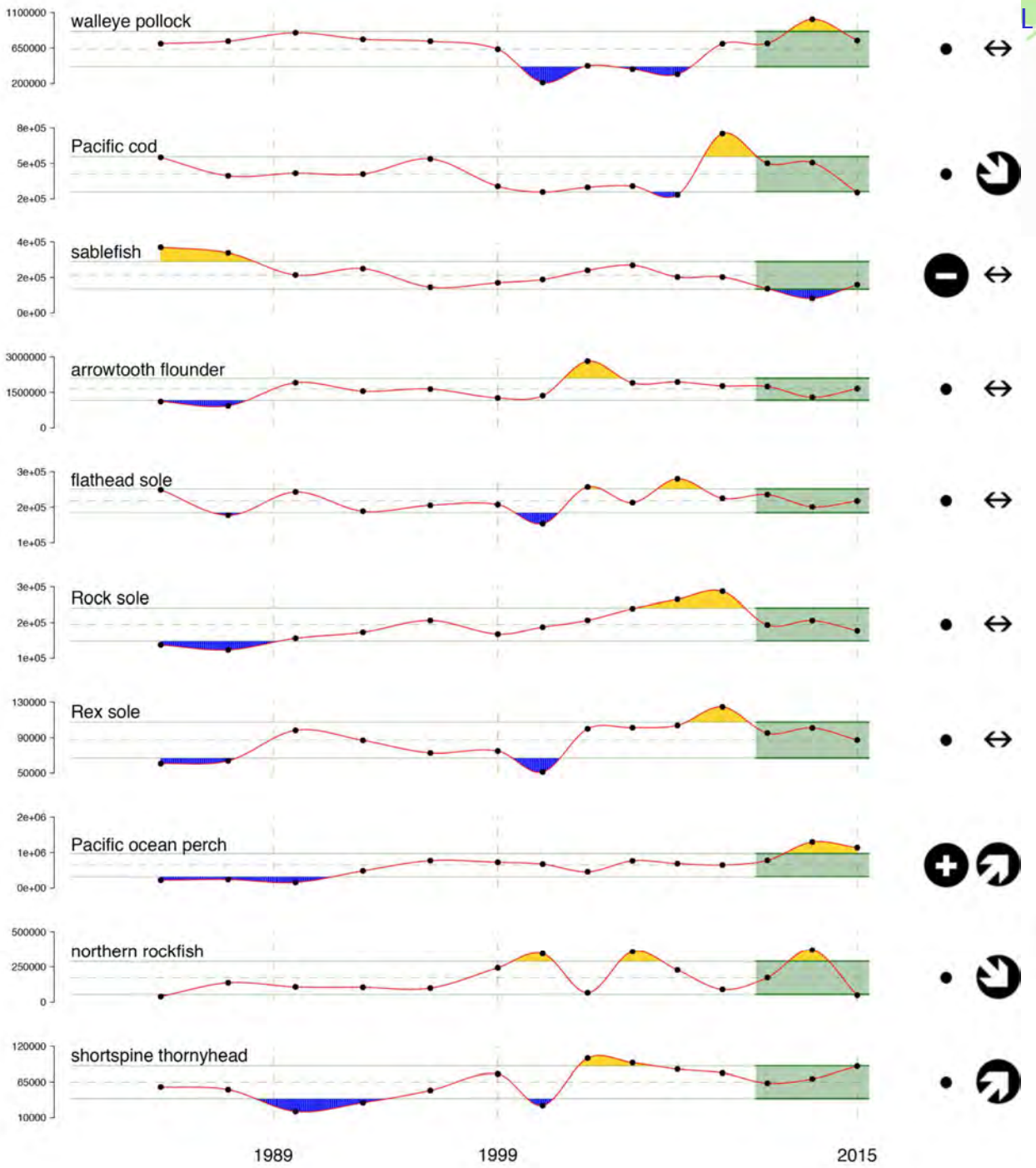
5 in Tier 6

Note some hybrid groups



LF OF ALASKA GROUNDFISH ASSESSMENTS

GOA NMFS Bottom-trawl Survey trends



2011-2015 Trend

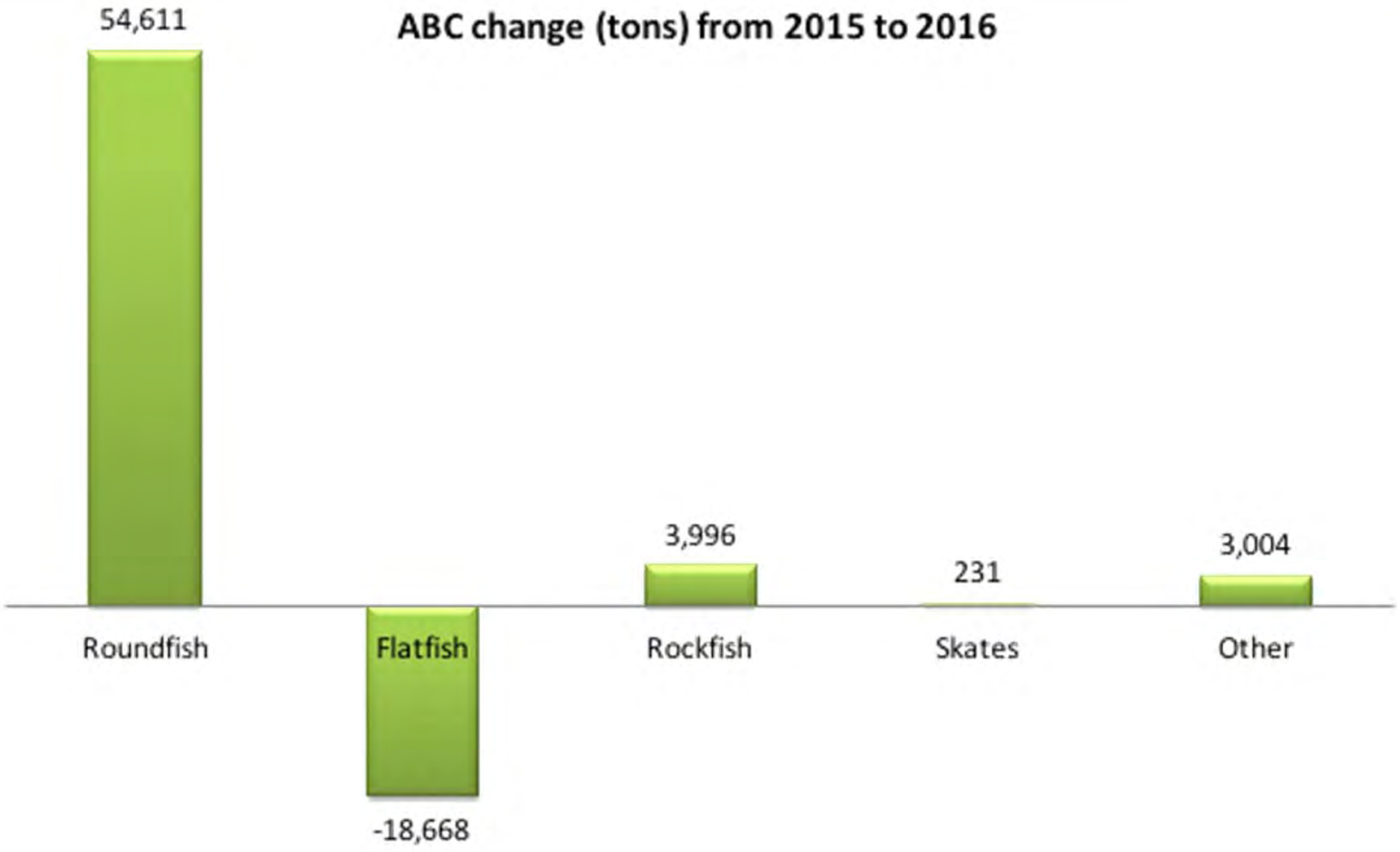
- increase by 1 s.d. over time window
- decrease by 1 s.d. over time window
- ↔ change <1 s.d. over window
- X fewer than 3 data points

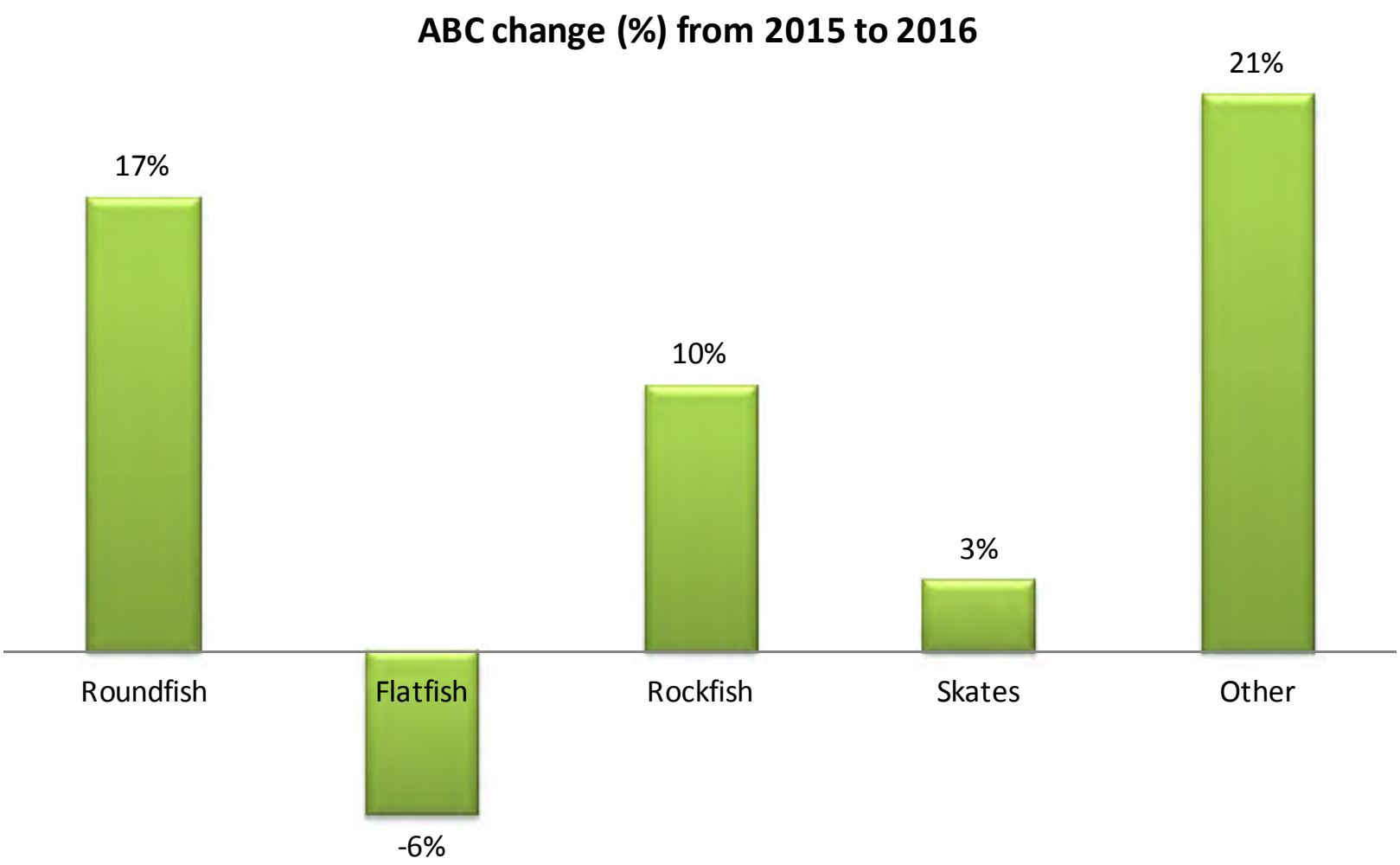
2011-2015 Mean

- 1 s.d. above mean
- 1 s.d. below mean
- within 1 s.d. of mean
- X fewer than 2 data points

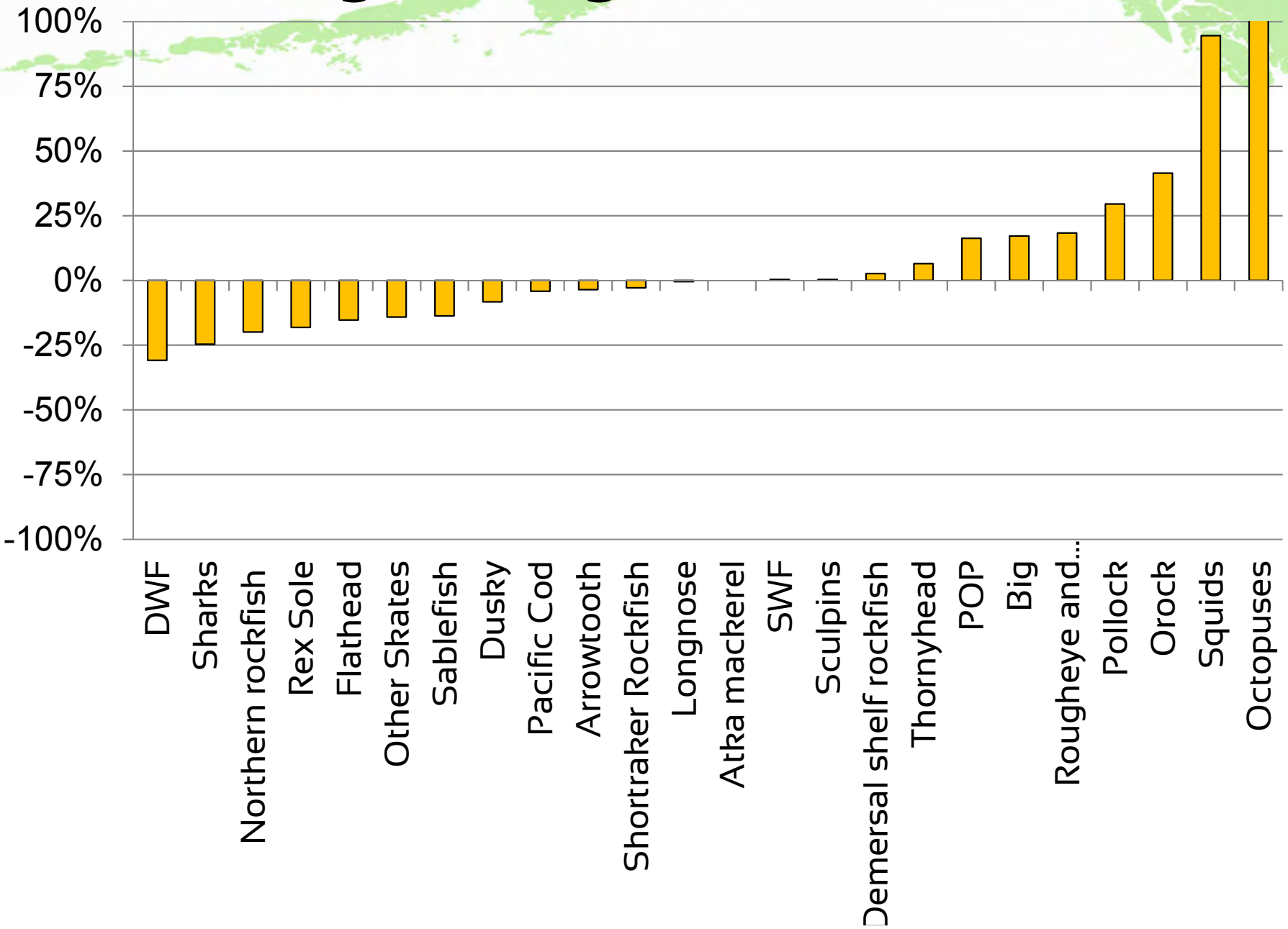
2014-2015 ABC change

2015-2016 ABC change

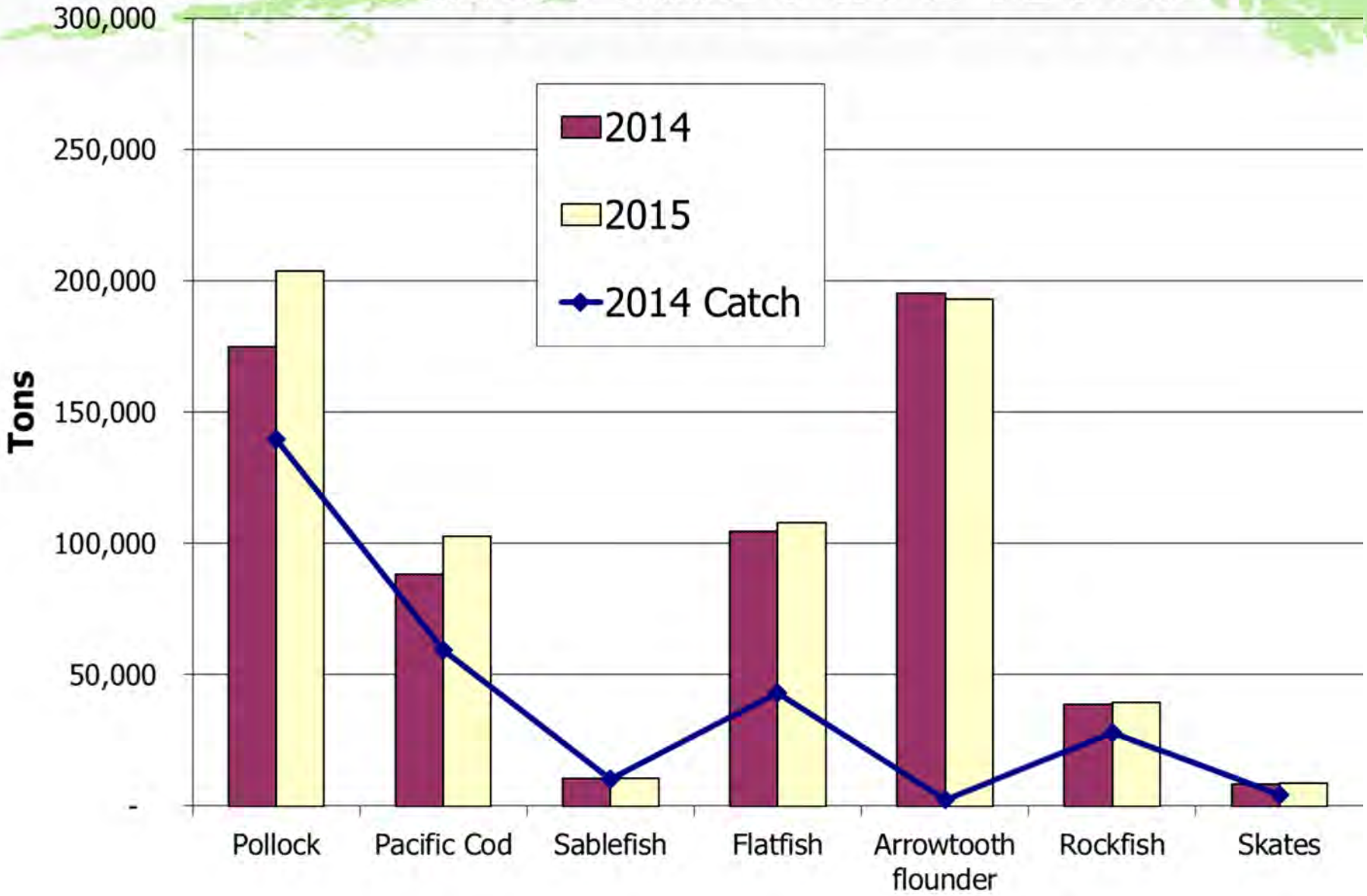



ABC change (%) from 2015 to 2016
17%
-6%
10%
3%
21%
Roundfish
Flatfish
Rockfish
Skates
Other

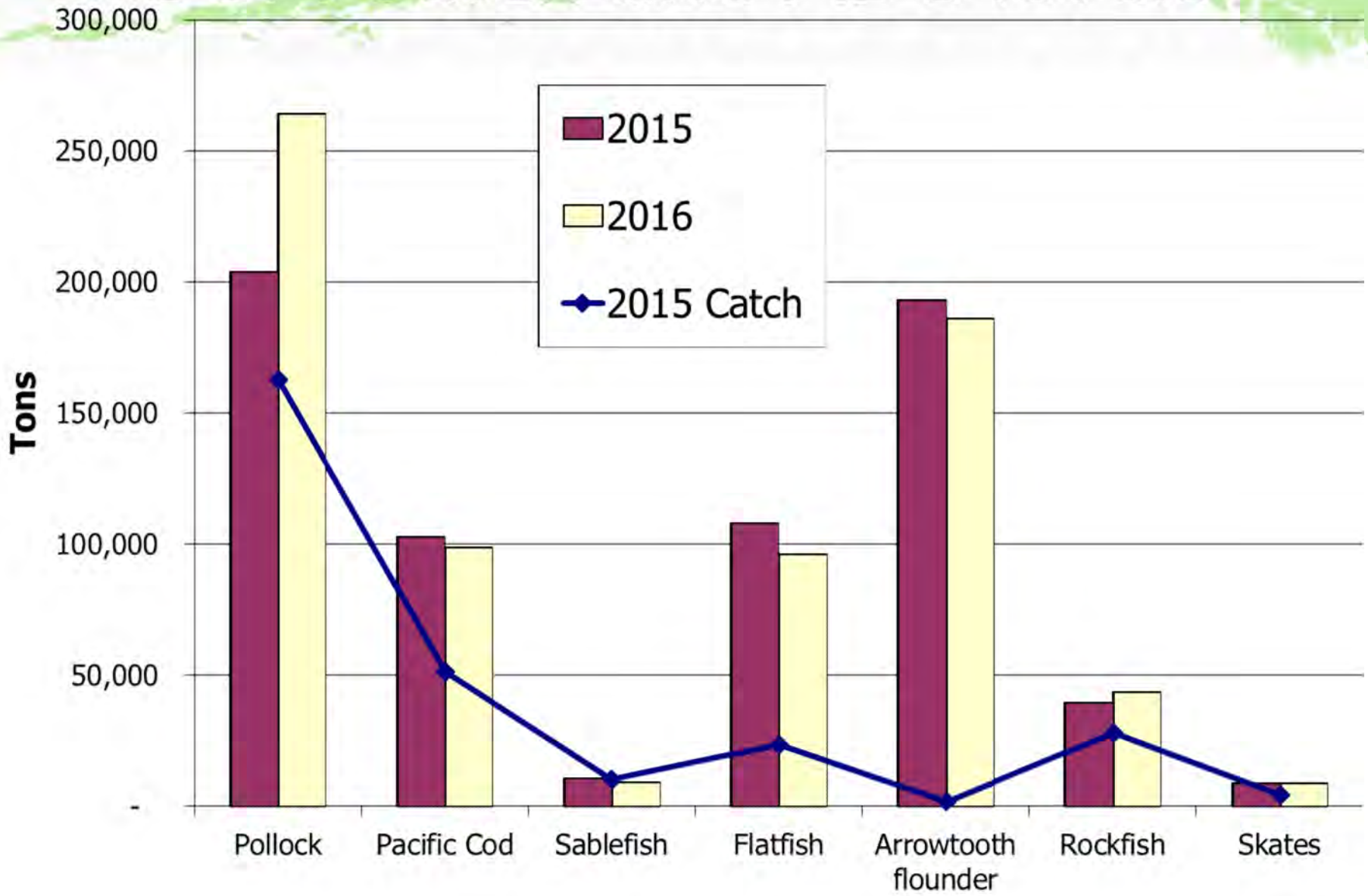
Percentage change in ABC, 2015-2016



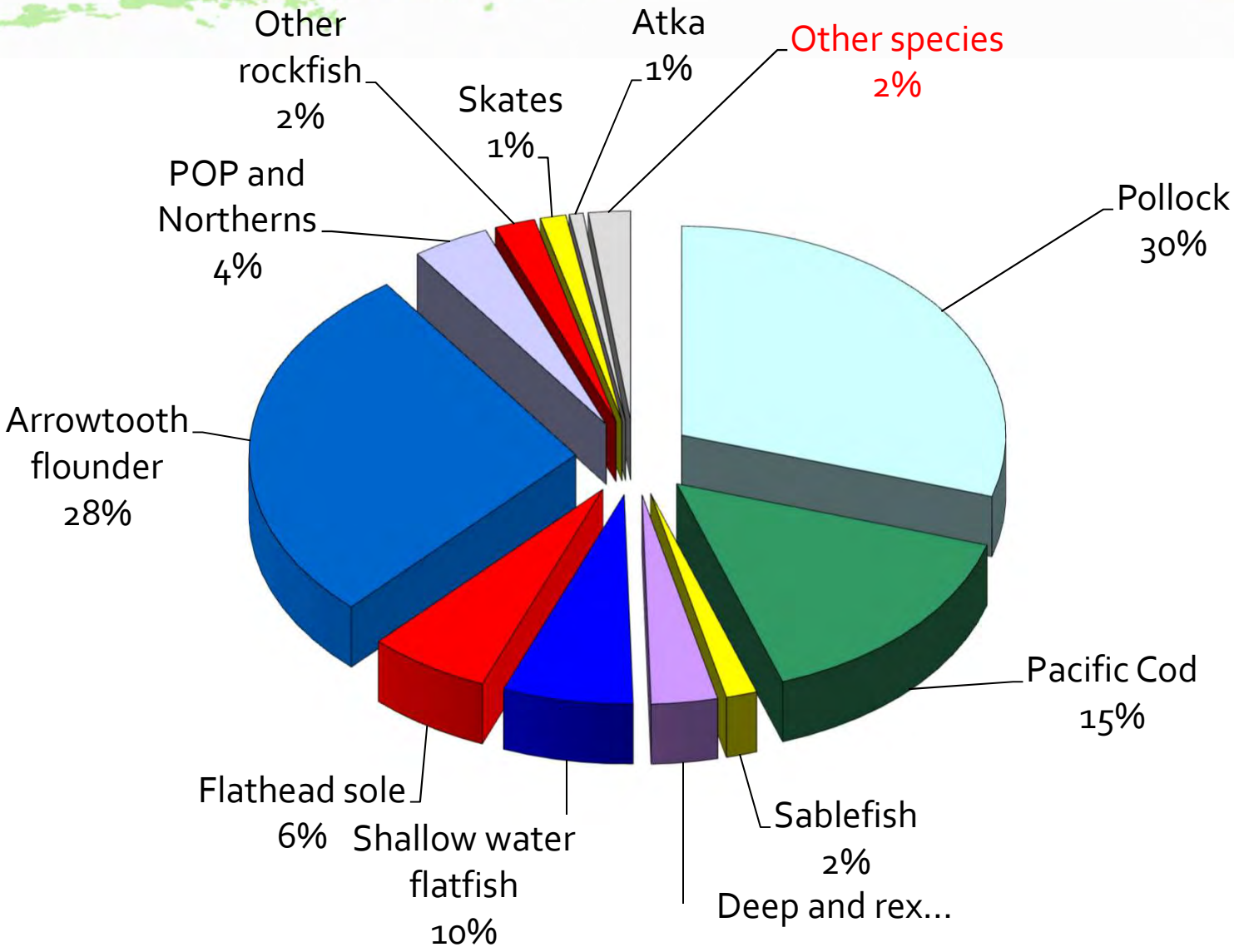
GOA Catch and ABC levels



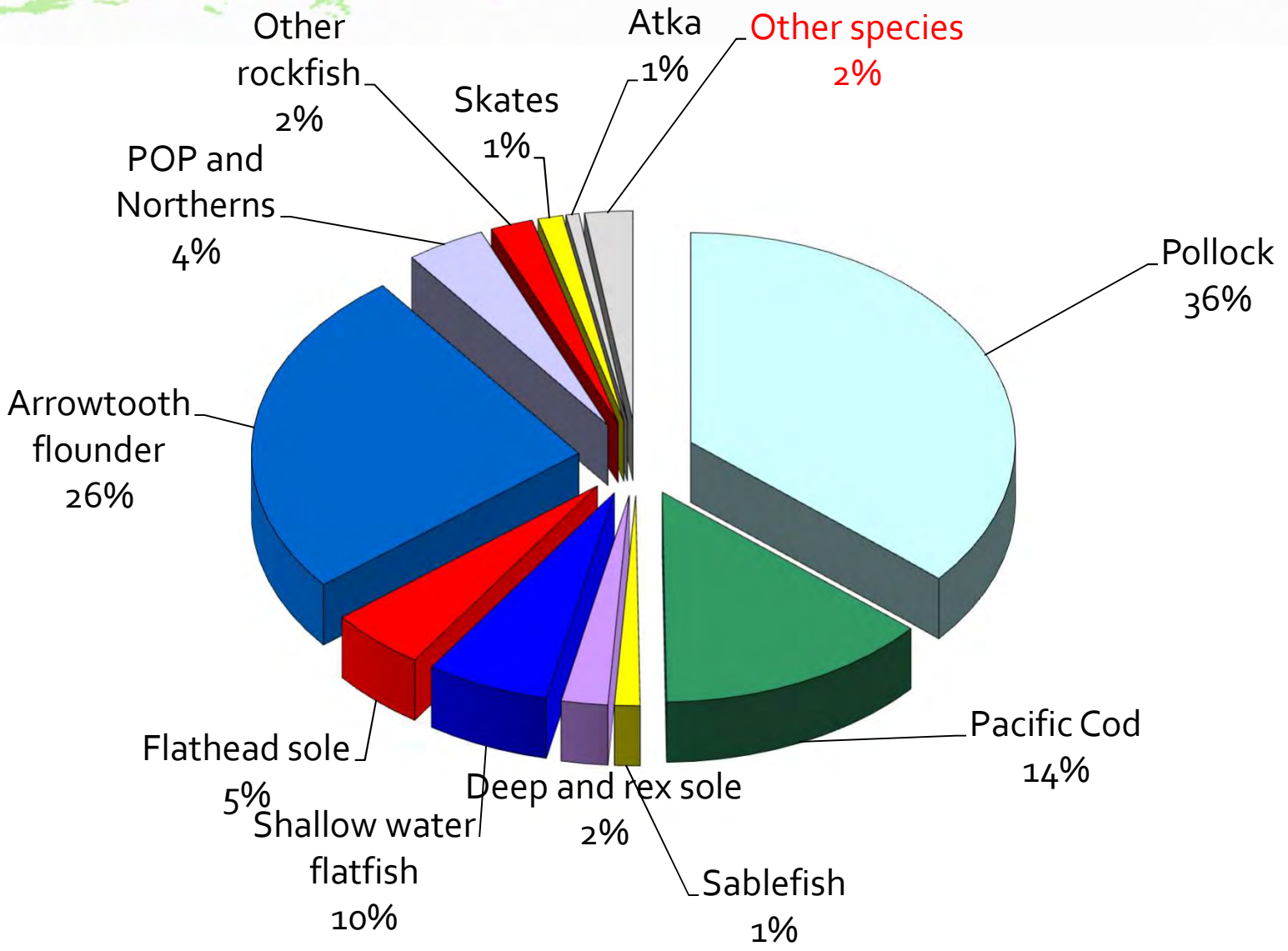
GOA Catch and ABC levels



GOA 2015 ABC's: 685,597 t



GOA 2016 ABC's: 728,770 t

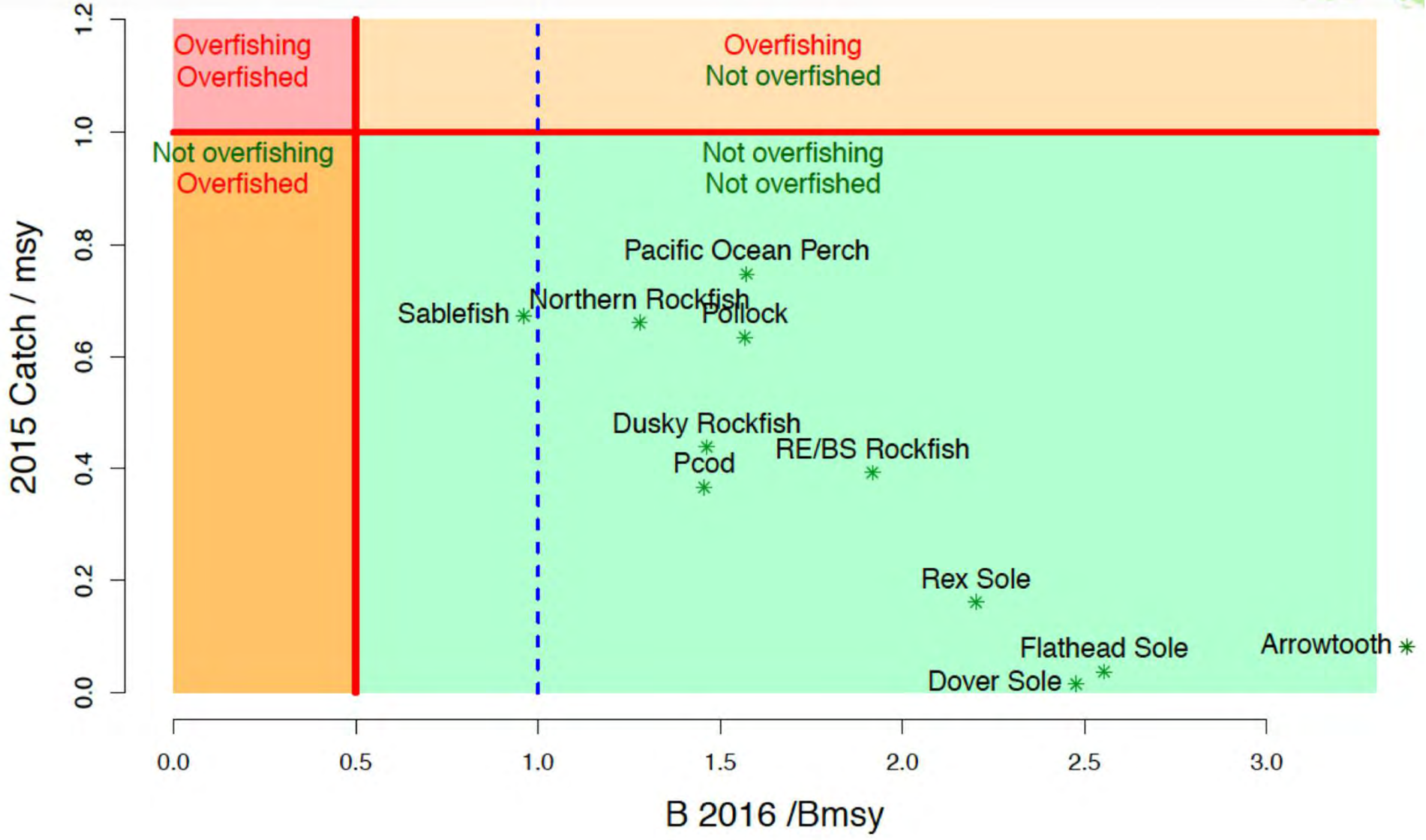


ABC / TAC

Team recommendations where ABC <maximum permissible:

	% of Max Permissible
Pollock	91%
Demersal shelf rockfish	83%

Stock status summary



Some GOA Groundfish assessment issues

The geostatistical approach

- Applied to Dusky rockfish, was considered promising
- **The Team recommends that a workgroup or subset of authors investigate applying the geostatistical approach to selected stocks.**

Multiple indices for apportionment

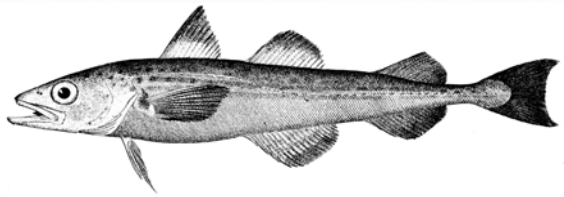
- **The Team recommends an evaluation on how best to tailor the RE model to accommodate multiple indices**.

Area apportionment and RE model

- Specifies a common "process error"

Species overviews

1. 2015 ABC/Catch and recommended changes
2. Highlights
   - New data
   - Analytic approach (changes)
3. Stock status and trend
4. ABC/OFL
   - Tier history and recommendations
   - 2015, 2016 maxABC; recommended ABC



ABC

Species	2015 Catch	ABC 2015	ABC 2016	Change
Pollock	162,700	203,934	264,230	up 60,296 (30%)
Pacific Cod	51,497	102,850	98,600	down 4,250 (4%)
Sablefish	10,206	10,522	9,087	down 1,435 (14%)
Flatfish	25,726	108,038	96,103	down 11,935 (11%)
Arrowtooth flounder	1,907	192,921	186,188	down 6,733 (3%)
Rockfish	28,213	39,710	43,706	up 3,996 (10%)
Atka mackerel	1,191	4,700	4,700	same (0%)
Skates	4,350	8,708	8,939	up 231 (3%)
Other Species	3,564	14,213	17,217	up 3,004 (21%)
Total	287,447	685,596	728,770	up 43,174 (6%)

1. GOA pollock (p. 49)

Fishery: 2014 total catch and catch at age

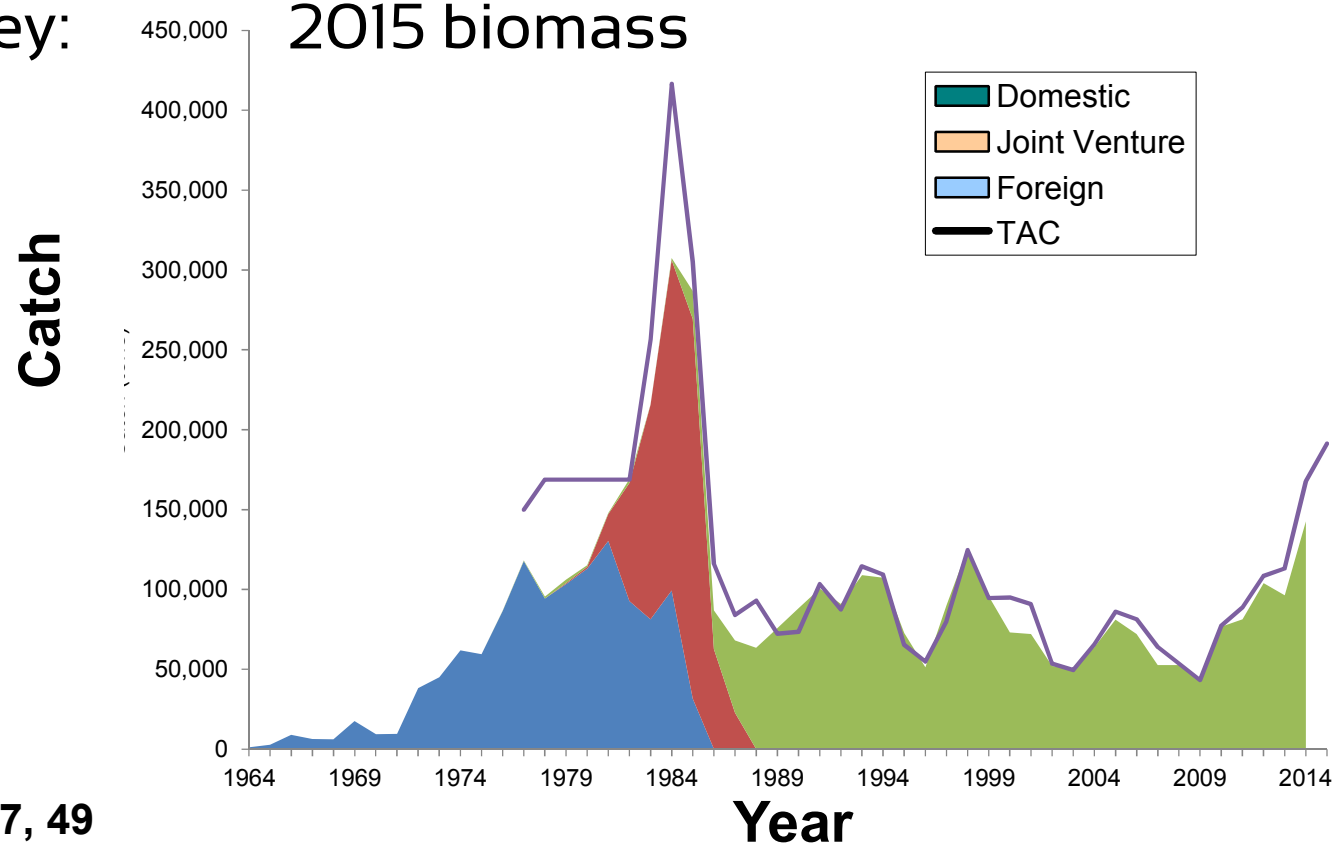
Shelikof EIT survey: 2015 winter biomass and age comp

NMFS **Summer** EIT: 2015 survey estimates (with 2013)

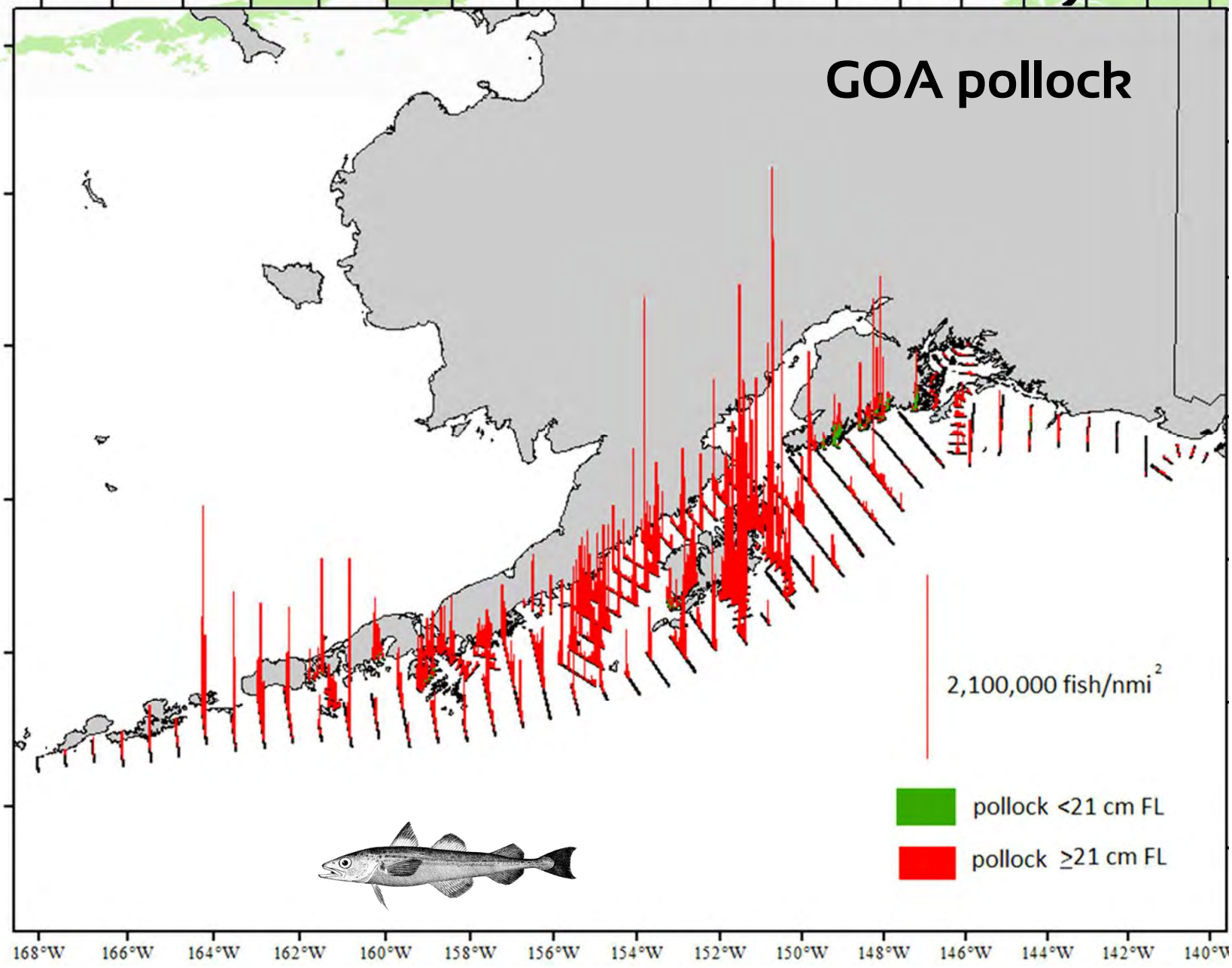
NMFS Summer trawl : 2015 biomass & length comps

ADFG trawl survey: 2015 biomass

Pages 17, 49



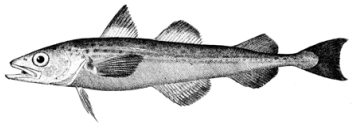
2015 summer acoustic survey

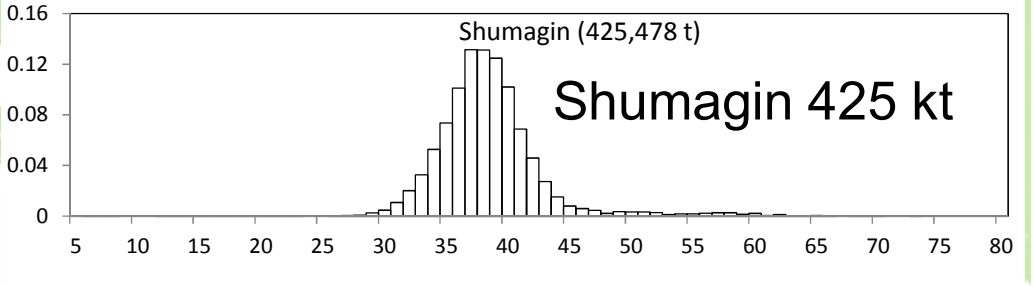


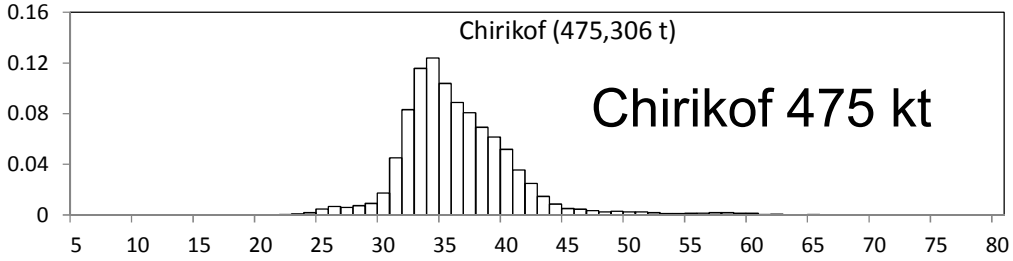
GOA pollock

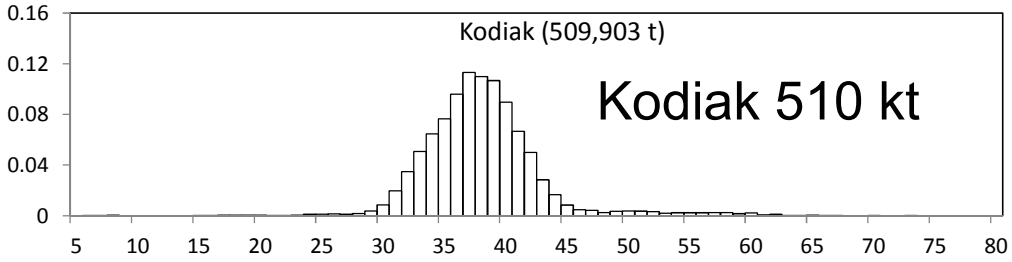
2015 summer acoustic survey size compositions

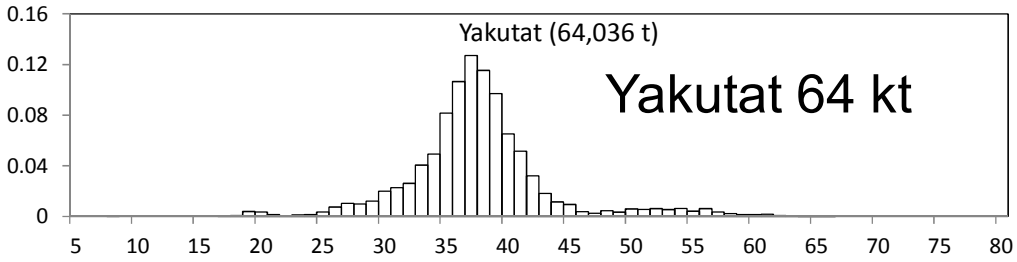
Very different distribution than bottom trawl

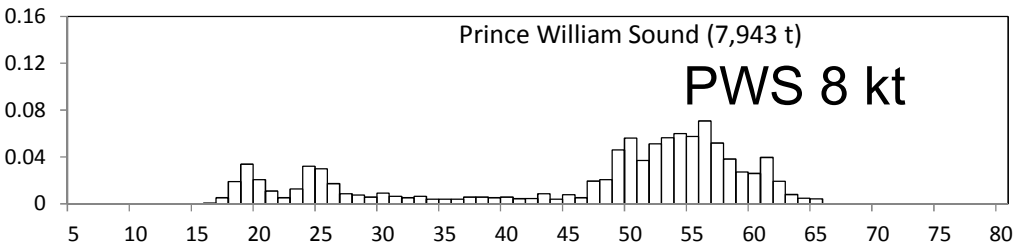






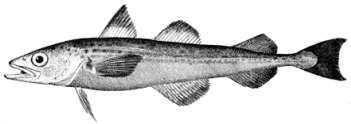


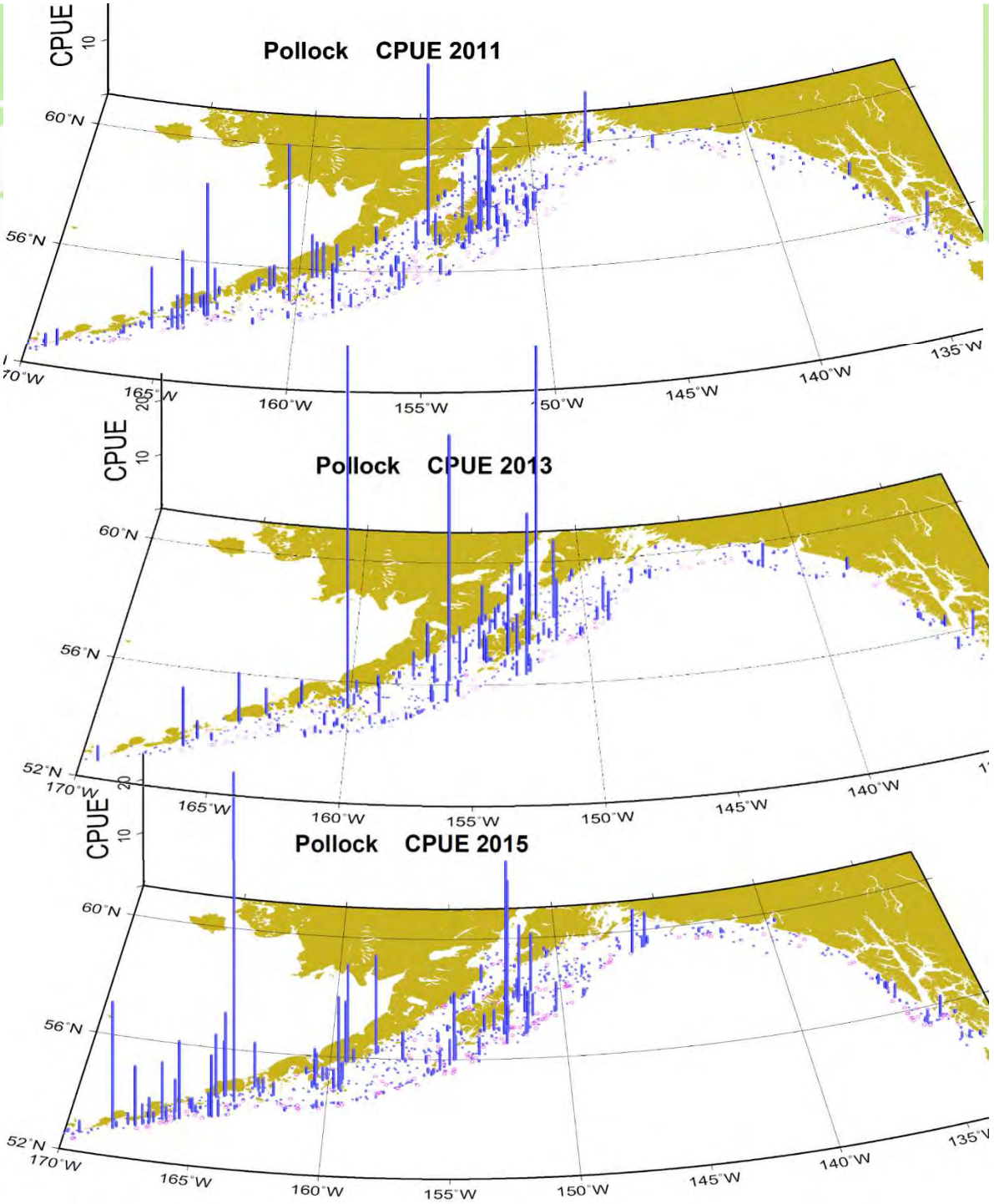




GOA pollock

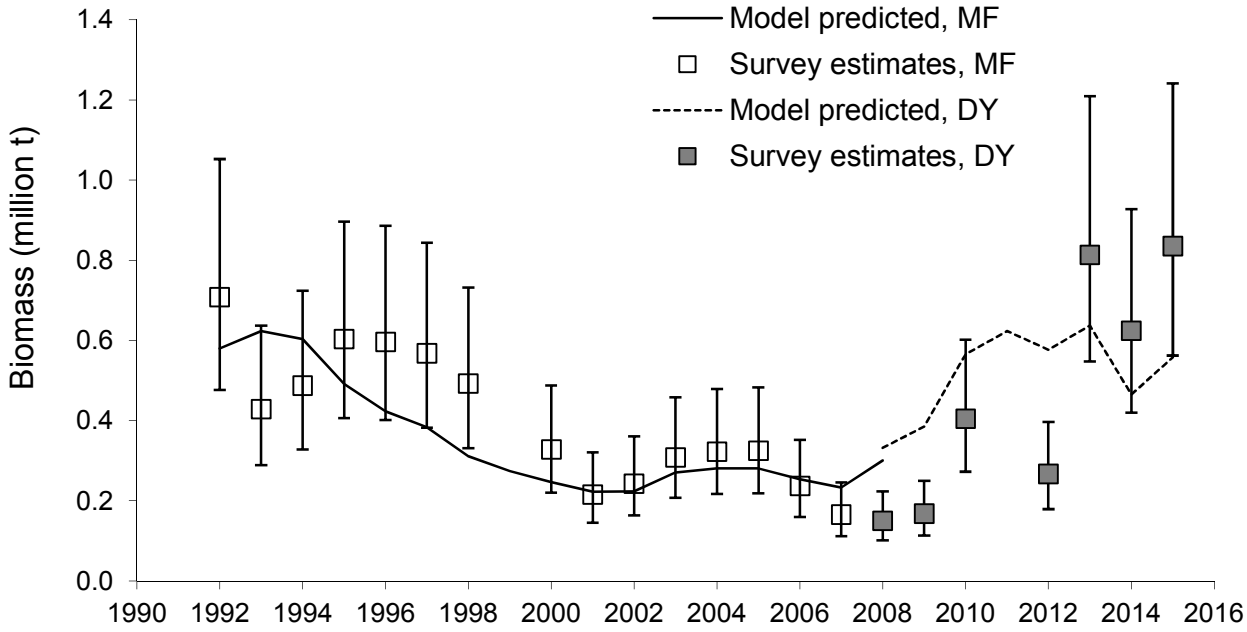
NMFS
Bottom
trawl surveys



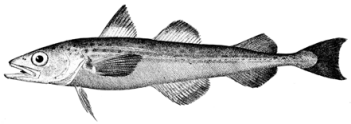


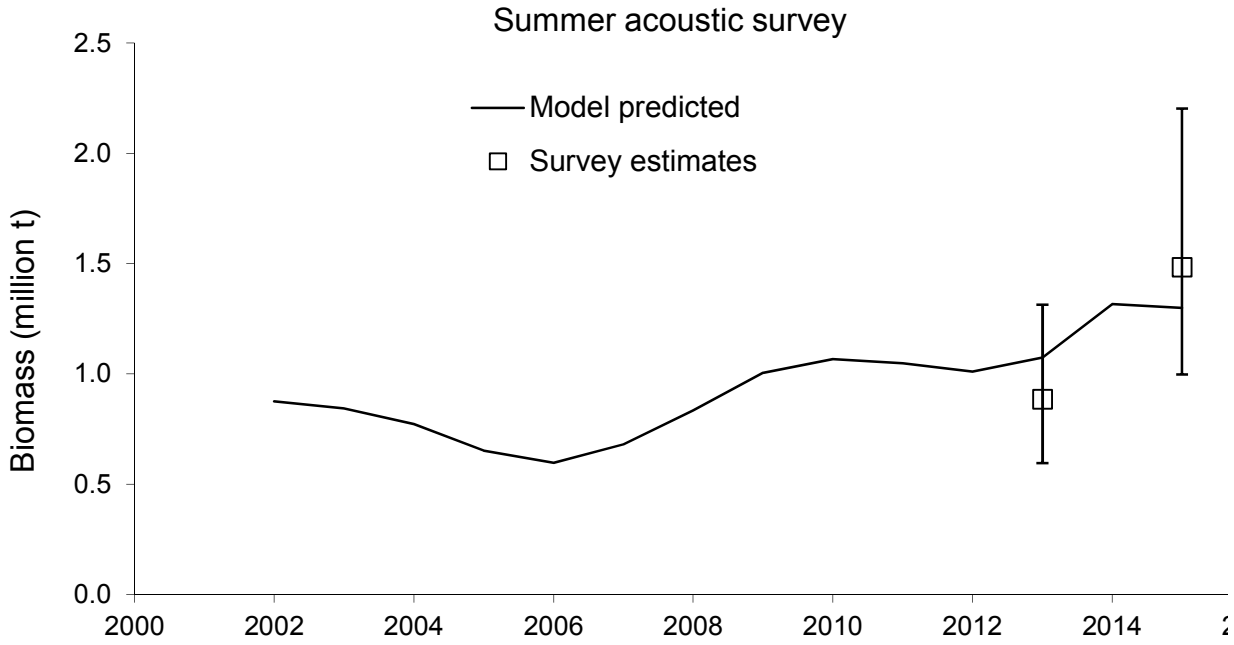
Shelikof Strait EIT survey, 1992-2015

GOA pollock



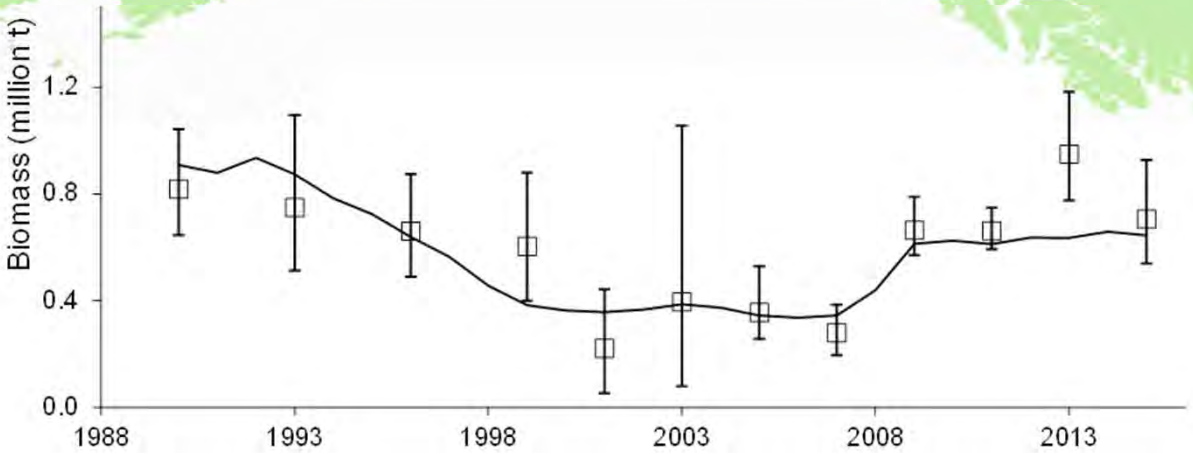
Summer EIT survey 2013, 2015



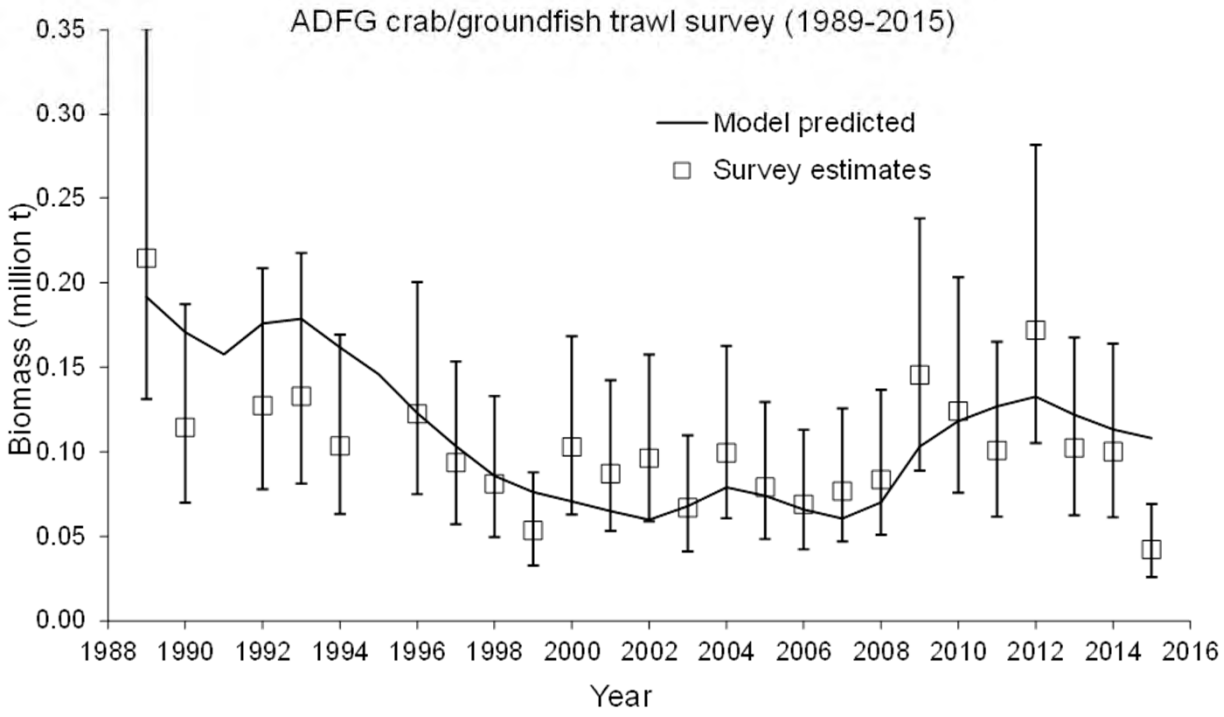


GOA pollock

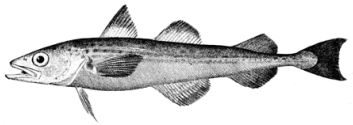
Fit to NMFS bottom trawl survey

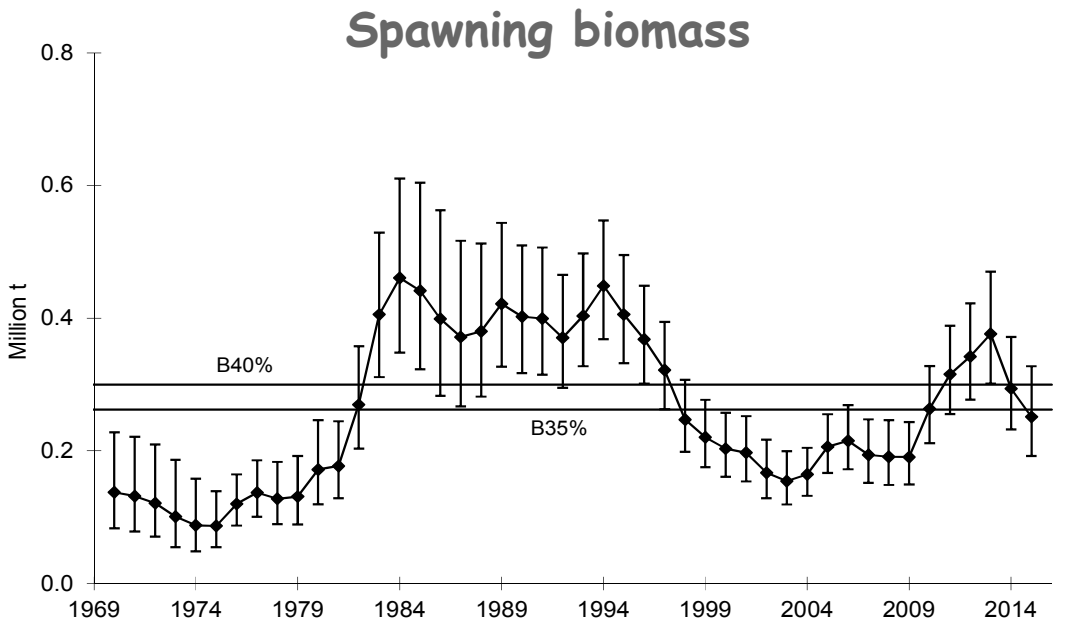


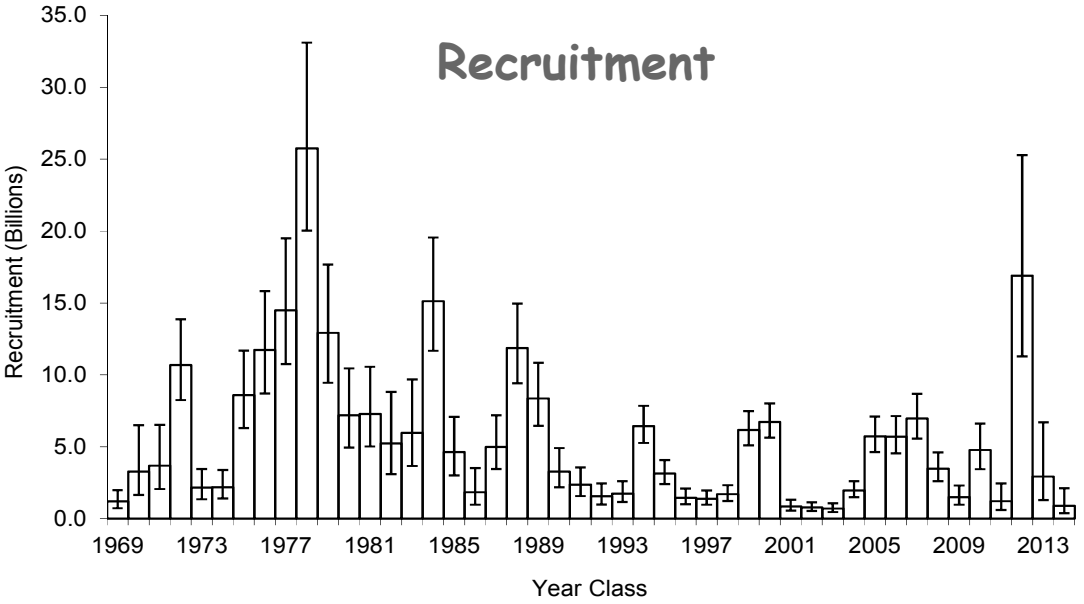
Fit to ADFG survey



GOA pollock model results

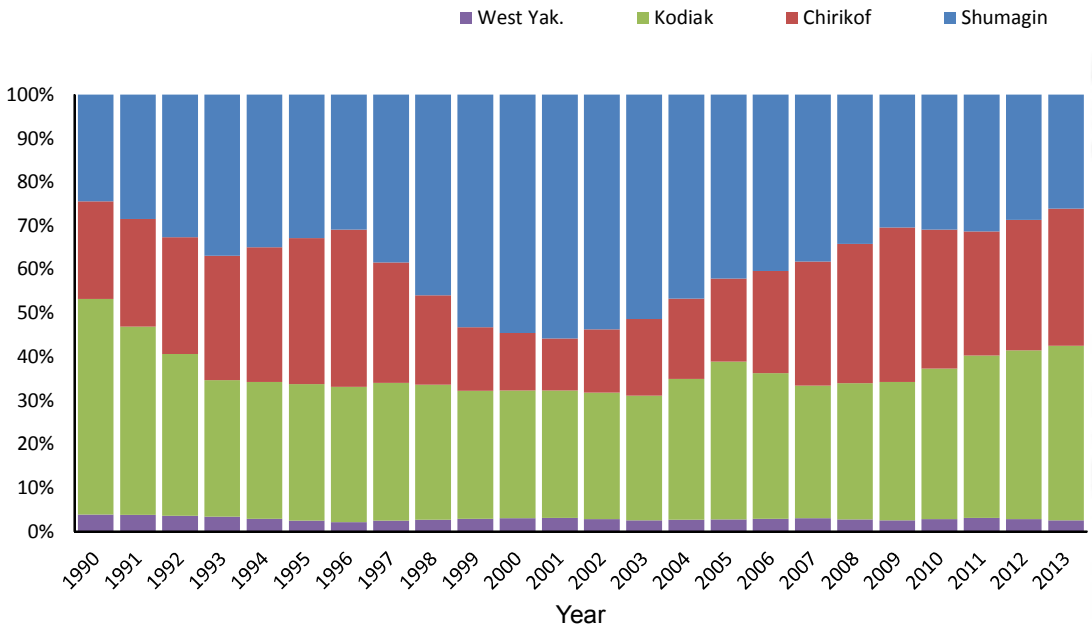


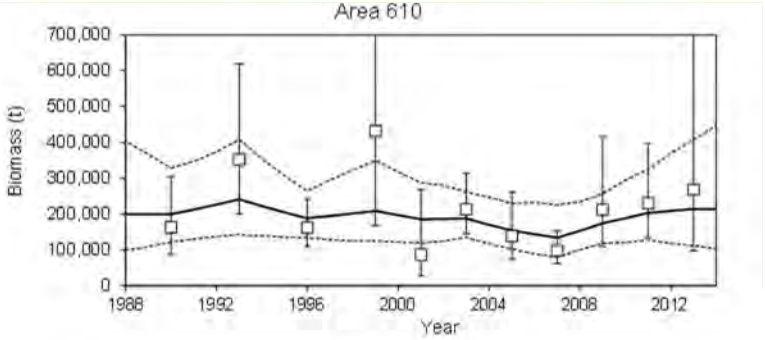


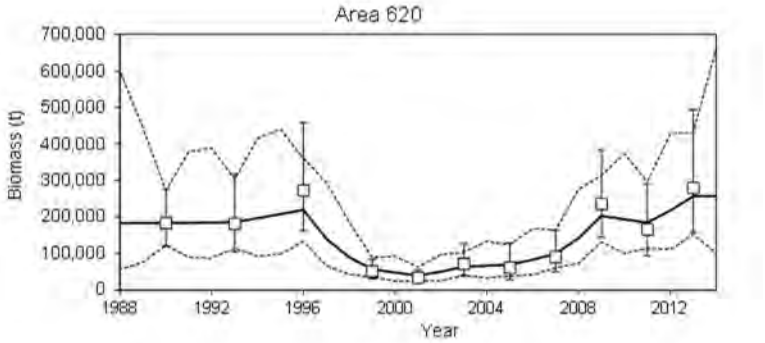


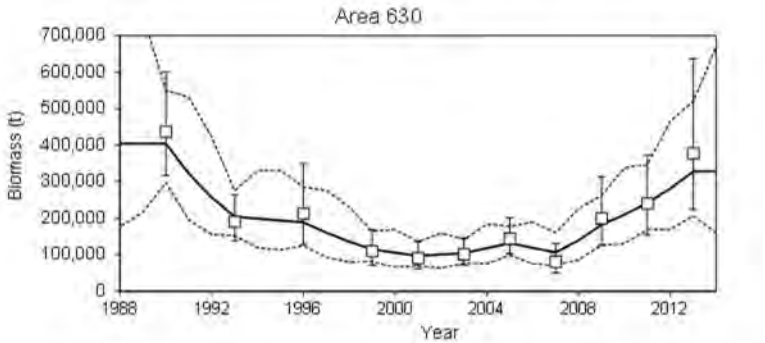
GOA Pollock apportionment

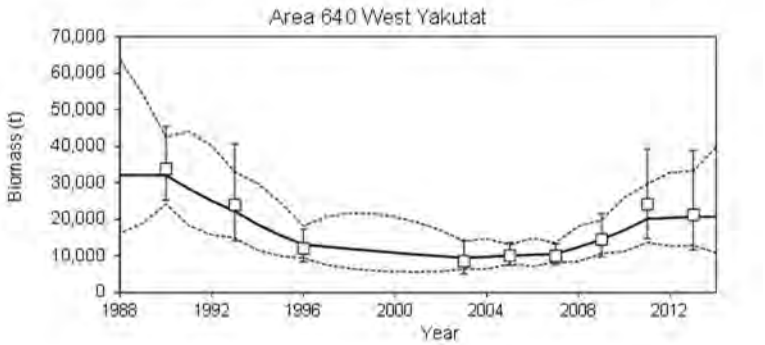
2014 assessment





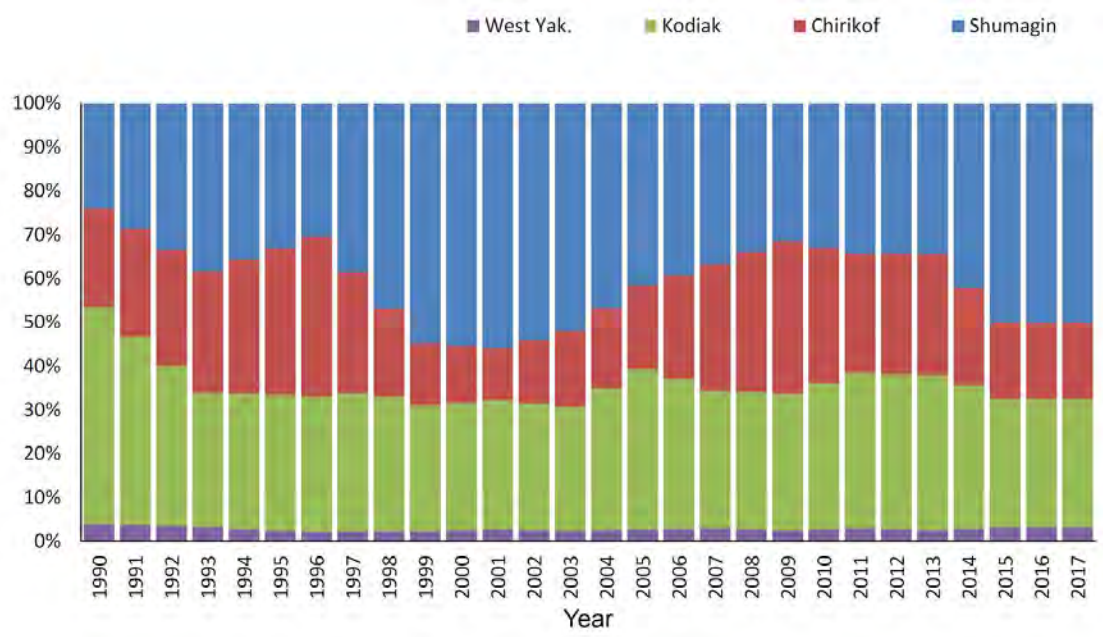


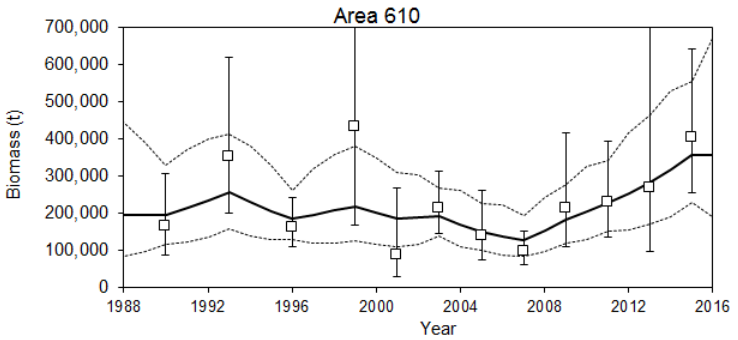


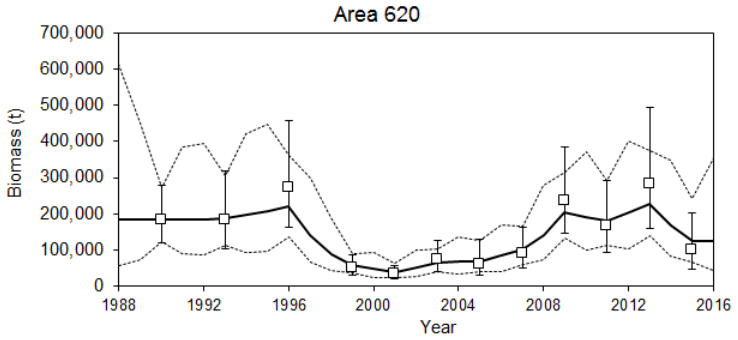


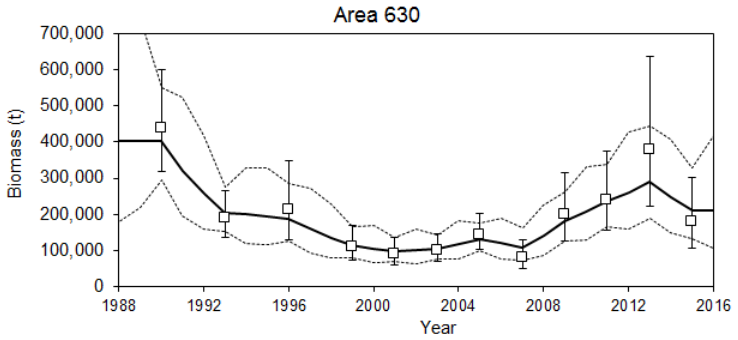
GOA Pollock apportionment

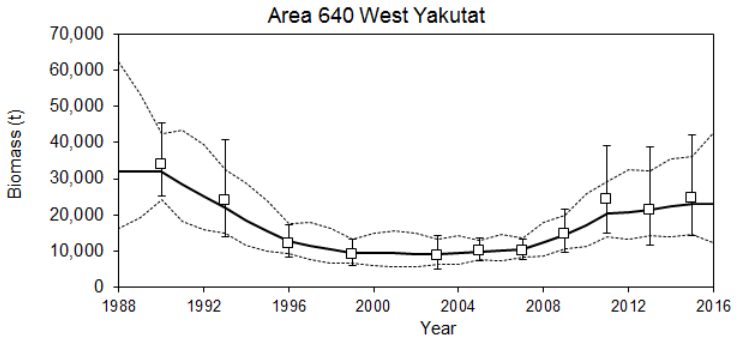
2015 assessment









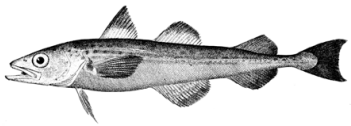


State GHL considerations

As presented in 2014:

Prince William Sound GHL subtracted from W/C GOA **after** ABC presented (similar to Pacific cod);

Set to 2.5% of W/C ABC:
2016 GHL = 0.025 x 254,310 = **6,358 t**



GOA pollock ABC considerations

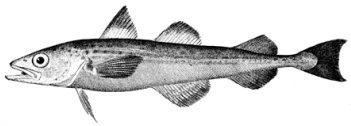
- Harvest rate below maximum permissible F_{ABC}

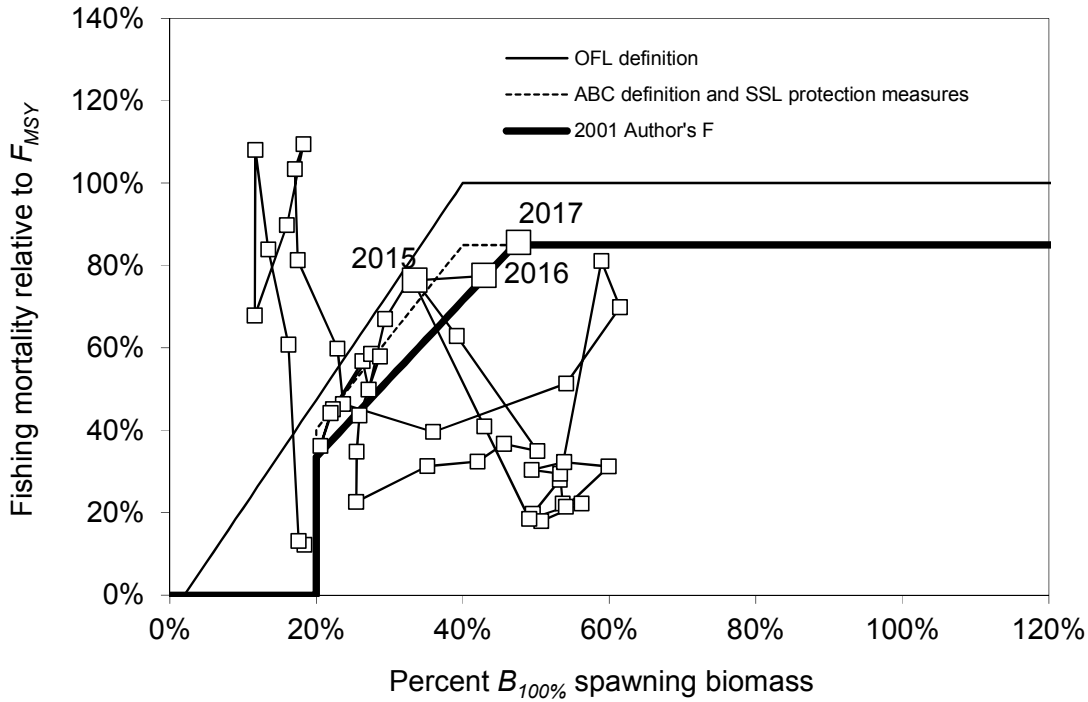
Pollock	Biomass*	OFL**	ABC**
2016	1,937,900	322,858	254,310
2017		289,937	250,544

*Model estimated W/C/WYAK agre 3+ biomass
**Gulfwide

Tier 3a

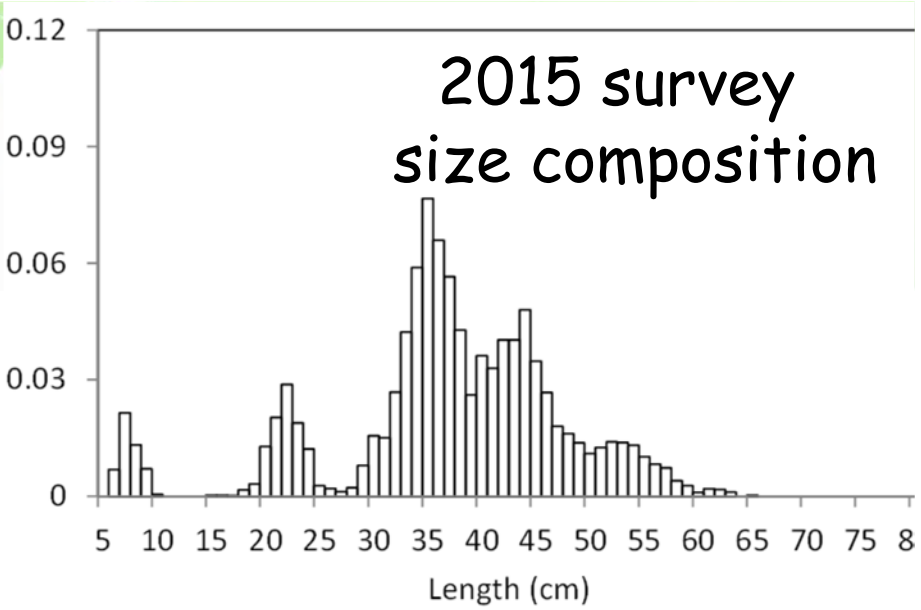
2016 SSB 43% of $B_{100\%}$

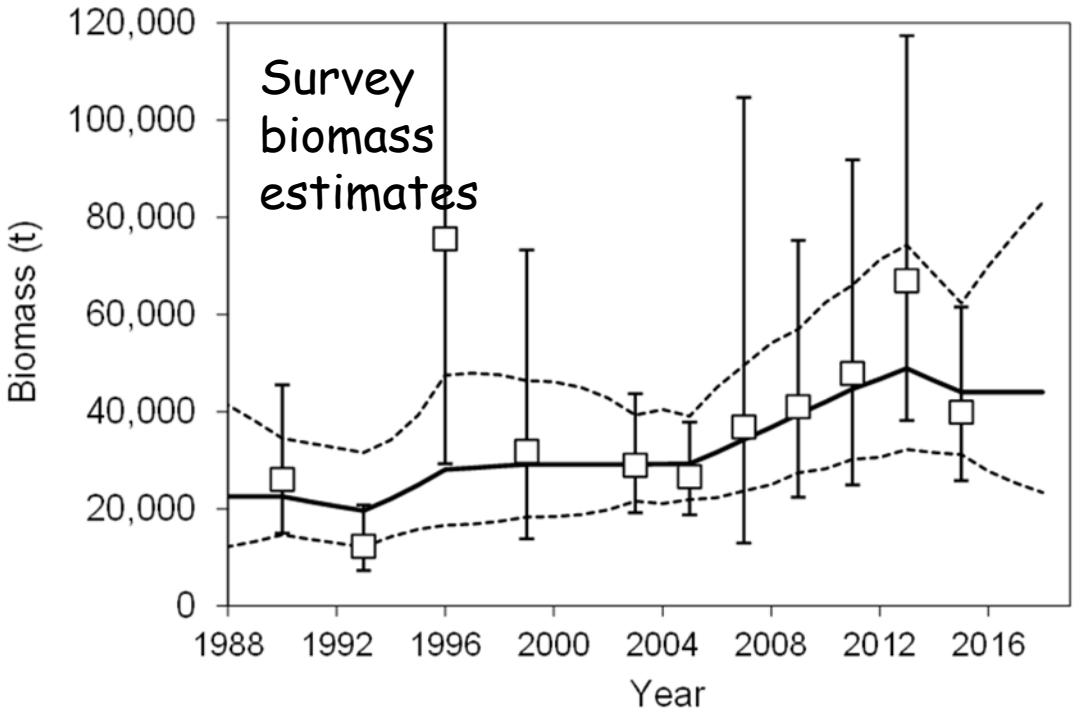




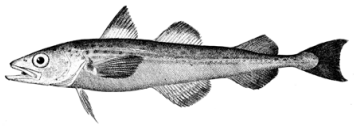
EGOA pollock (Tier 5)

EGOA Pollock	Biomass	OFL	ABC
2016	44,087	13,226	9,920
2017		13,226	9,920





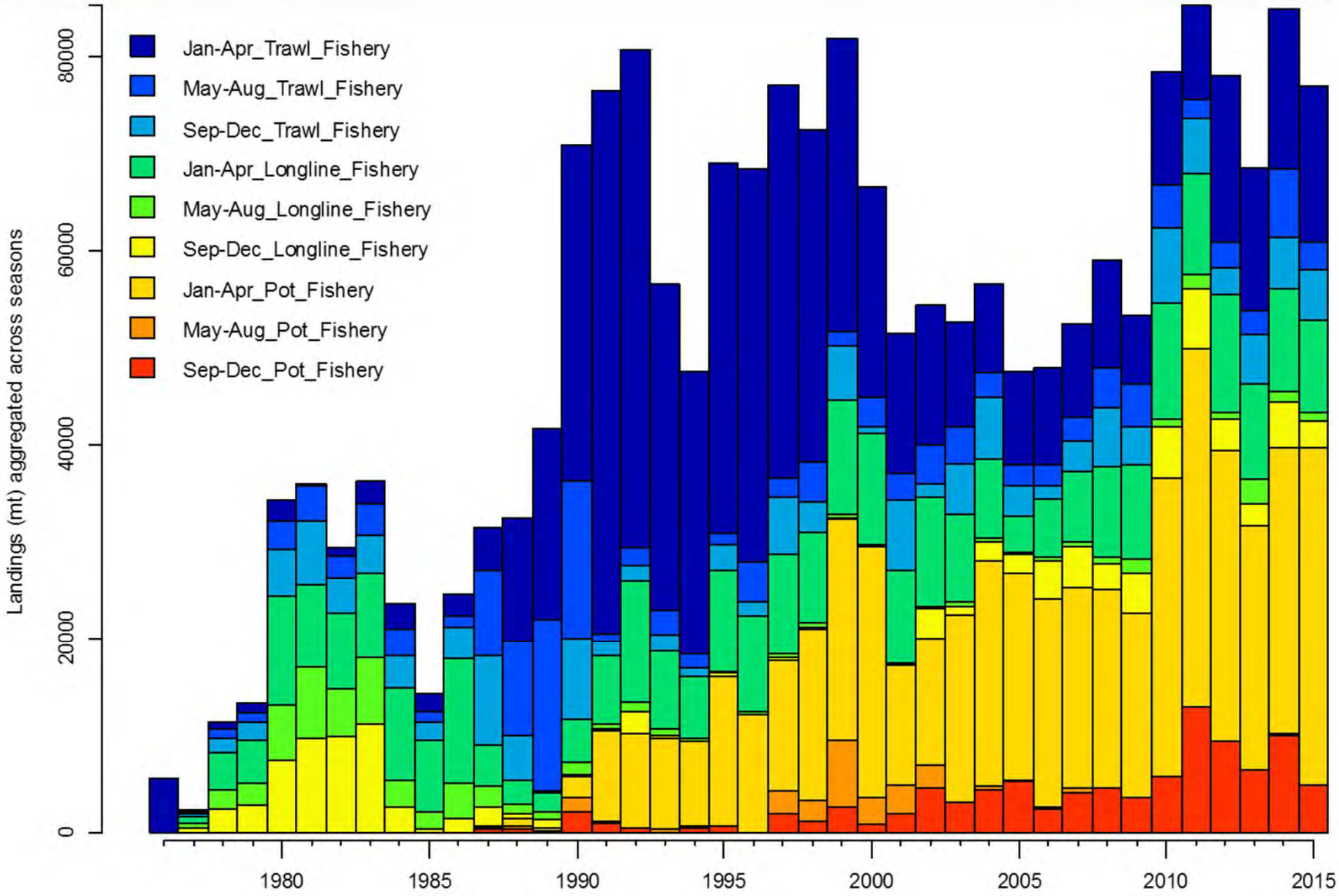
Random effects model



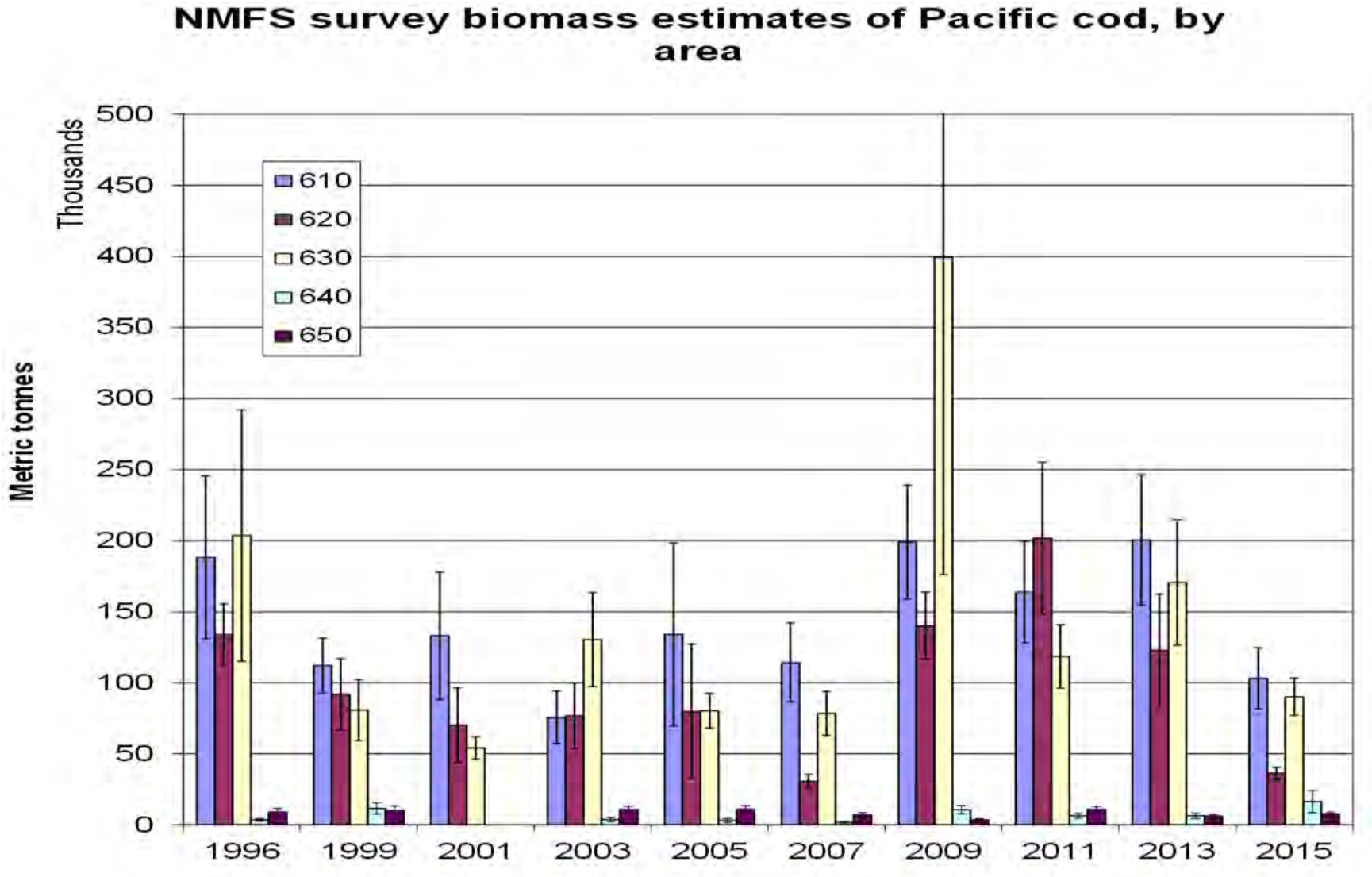
2. GOA Pacific cod (p. 173)

Species	2015 Catch	ABC 2015	ABC 2016	Change
Pollock	162,700	203,934	264,230	up 60,296 (30%)
Pacific Cod	51,497	102,850	98,600	down 4,250 (4%)
Sablefish	10,206	10,522	9,087	down 1,435 (14%)
Flatfish	25,726	108,038	96,103	down 11,935 (11%)
Arrowtooth flounder	1,907	192,921	186,188	down 6,733 (3%)
Rockfish	28,213	39,710	43,706	up 3,996 (10%)
Atka mackerel	1,191	4,700	4,700	same (0%)
Skates	4,350	8,708	8,939	up 231 (3%)
Other Species	3,564	14,213	17,217	up 3,004 (21%)
Total	287,447	685,596	728,770	up 43,174 (6%)

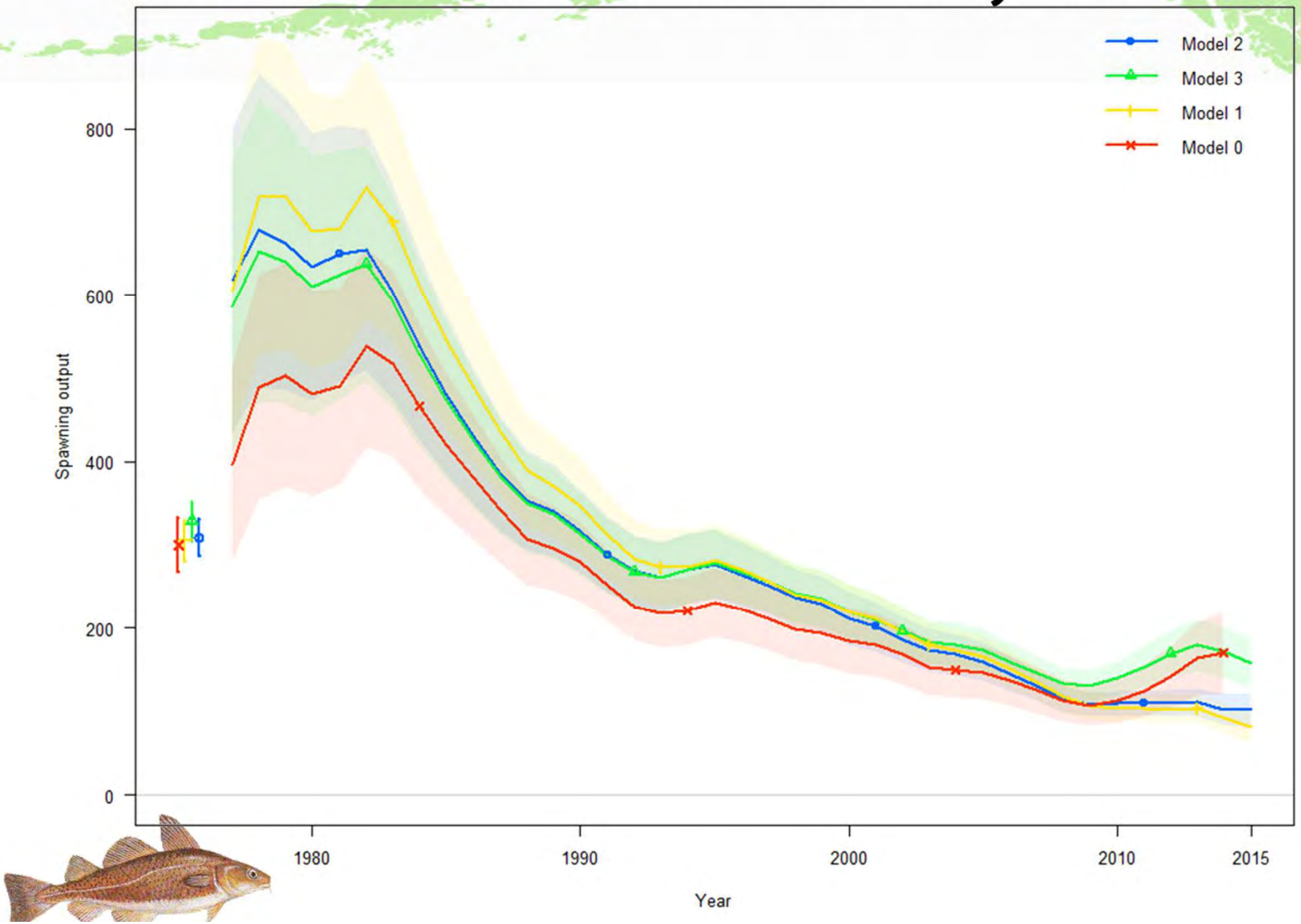
GOA Pacific cod catch by fishery



GOA Pacific cod survey biomass



GOA Pacific cod SSB by model



Pacific cod ABC/TAC

Tier 3a

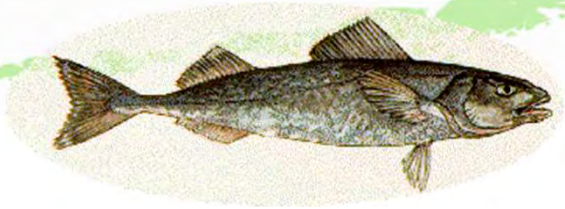
- SSB for 2016 at 51% of $B_{100\%}$

Pacific cod	Biomass	OFL	ABC
2016	518,800	116,700	98,600
2017		100,800	85,200

Area apportionments done using random-effects model

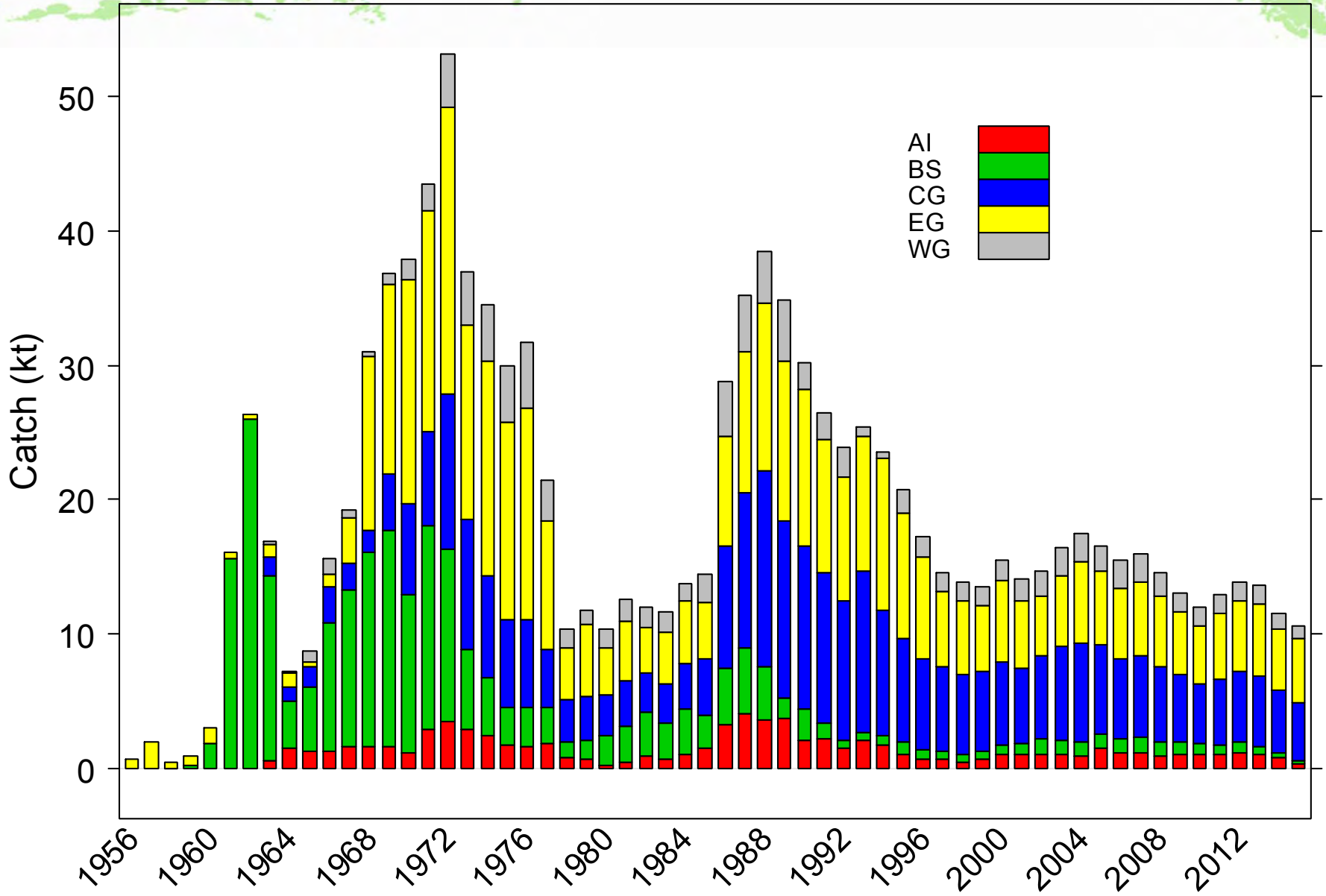
	Western	Central	Eastern	Total
%	41.08	50.01	8.91	100.00
2016	40,503	49,312	8,785	98,600
2017	34,998	42,610	7,592	85,200

3. Sablefish (p. 297)

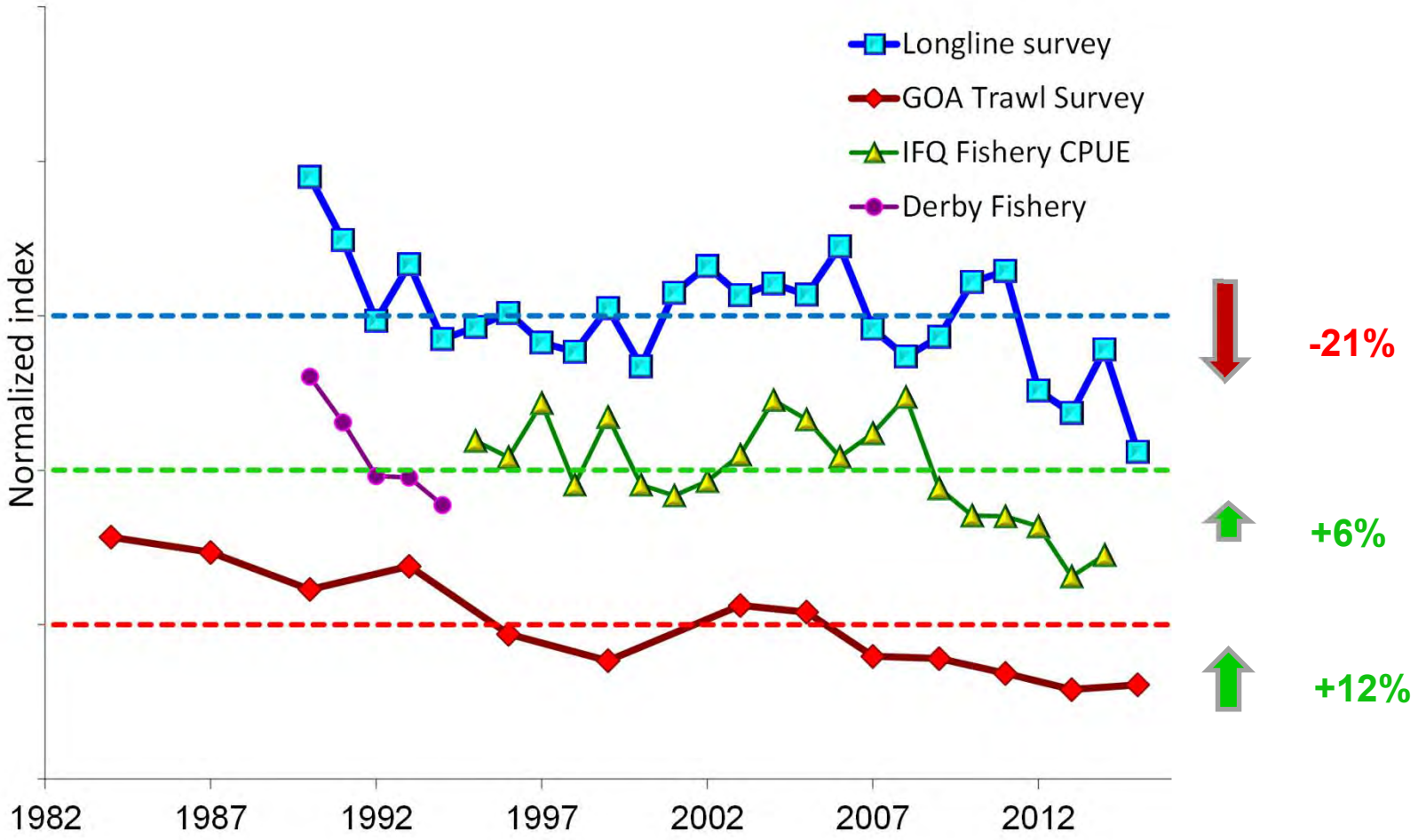


Species	2015 Catch	ABC 2015	ABC 2016	Change
Pollock	162,700	203,934	264,230	up 60,296 (30%)
Pacific Cod	51,497	102,850	98,600	down 4,250 (4%)
Sablefish	10,206	10,522	9,087	down 1,435 (14%)
Flatfish	25,726	108,038	96,103	down 11,935 (11%)
Arrowtooth flounder	1,907	192,921	186,188	down 6,733 (3%)
Rockfish	28,213	39,710	43,706	up 3,996 (10%)
Atka mackerel	1,191	4,700	4,700	same (0%)
Skates	4,350	8,708	8,939	up 231 (3%)
Other Species	3,564	14,213	17,217	up 3,004 (21%)
Total	287,447	685,596	728,770	up 43,174 (6%)

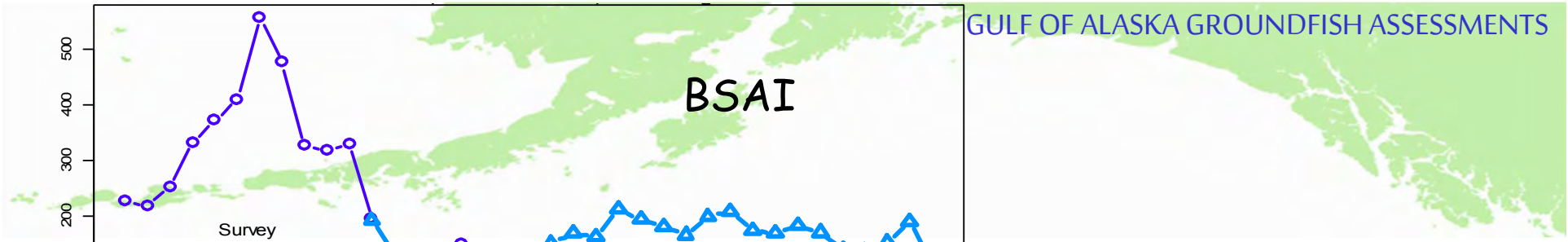
Sablefish Catch by Area

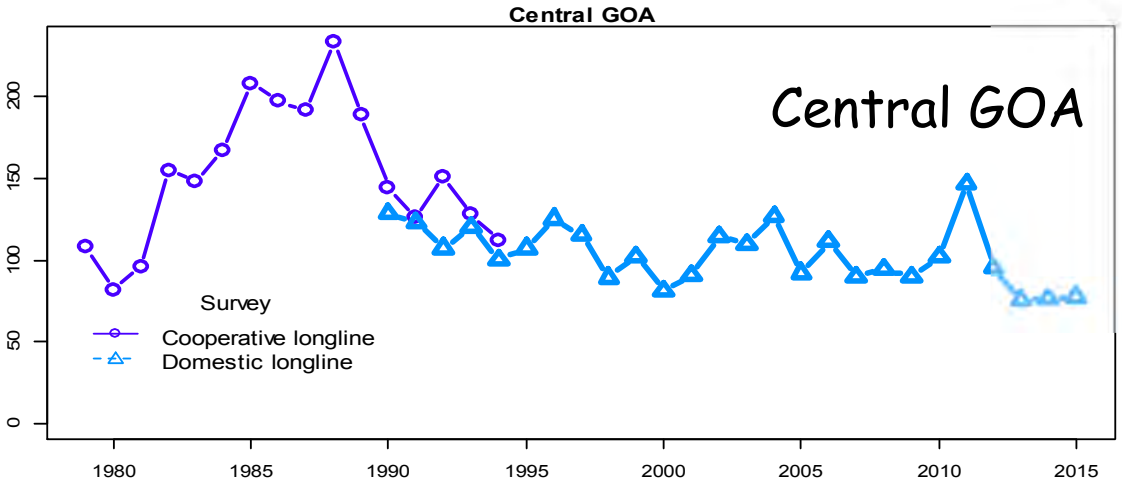


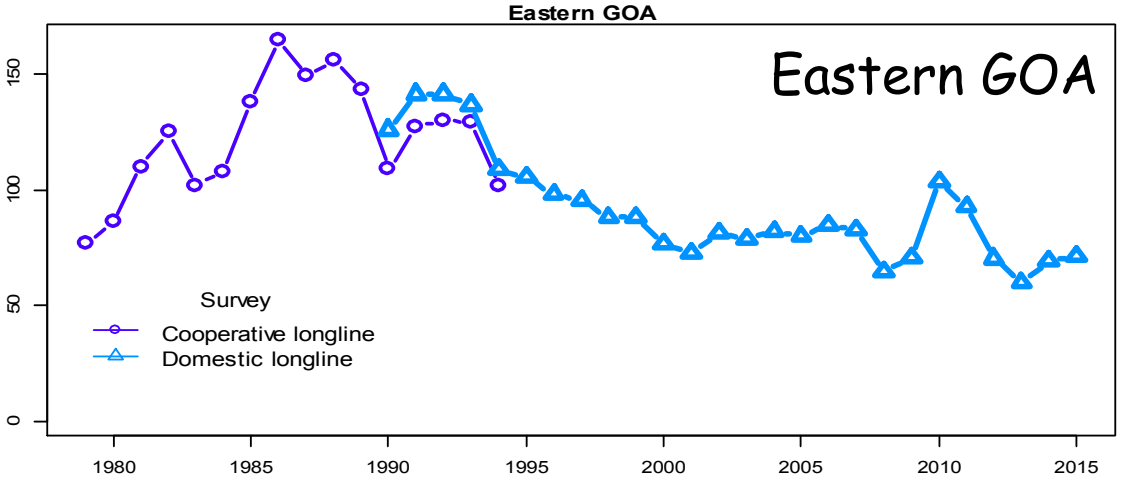
Sablefish abundance indices



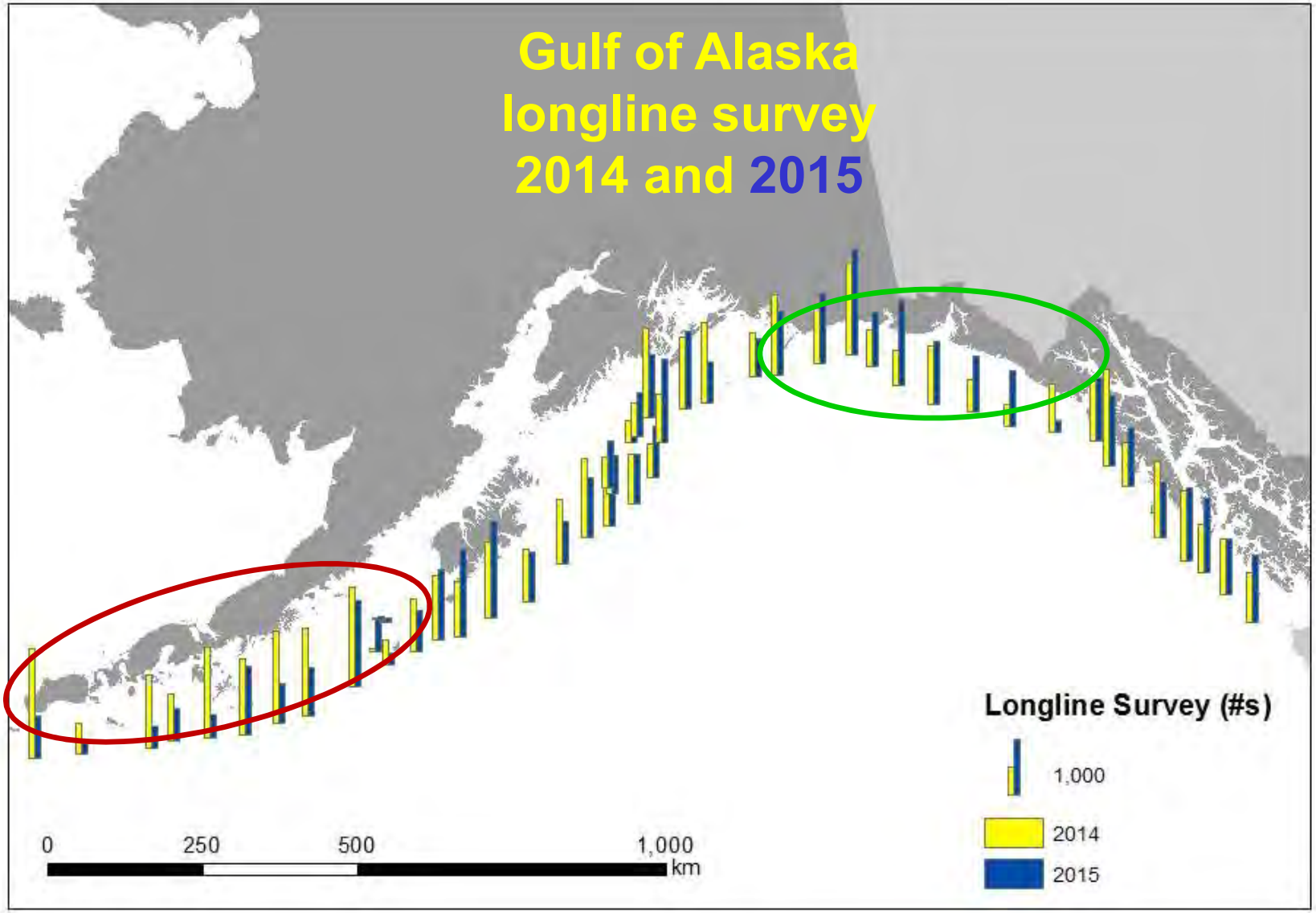
GULF OF ALASKA GROUNDFISH ASSESSMENTS





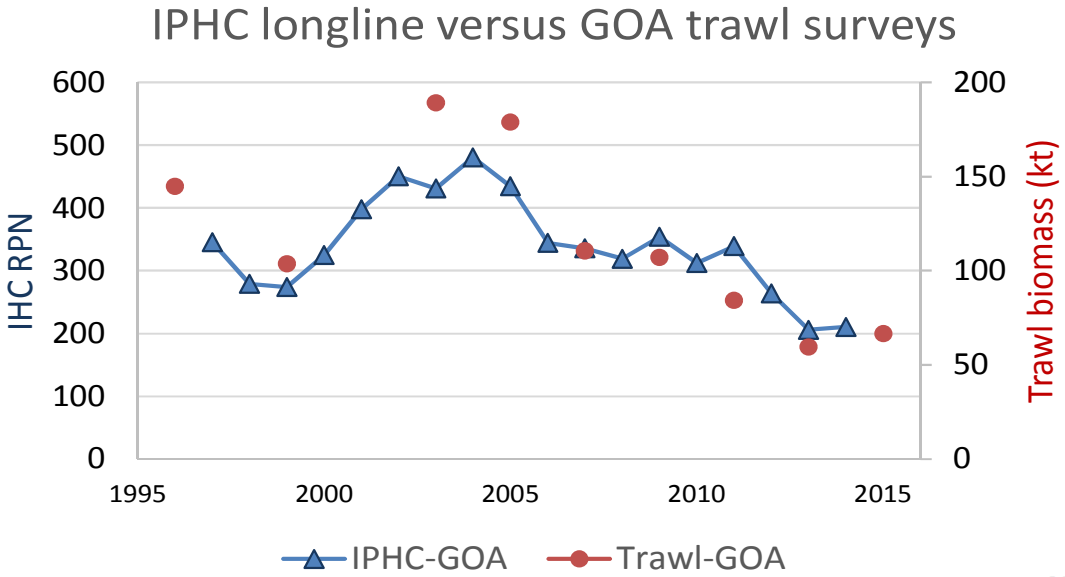


Sablefish longline survey RPN by area…



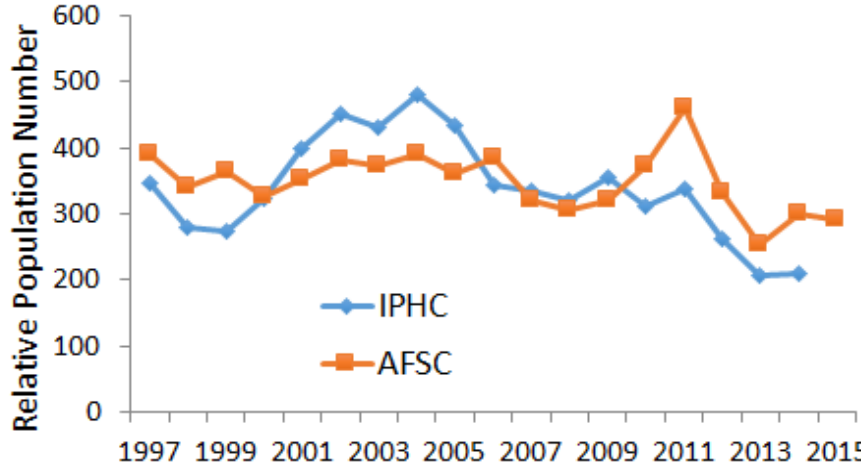
NMFS ABL survey: sablefish

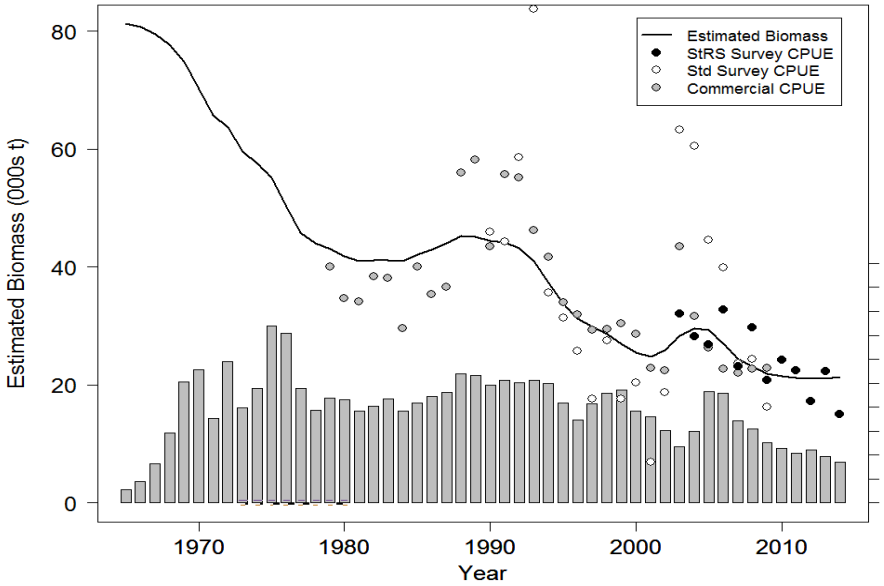
Sablefish other indices



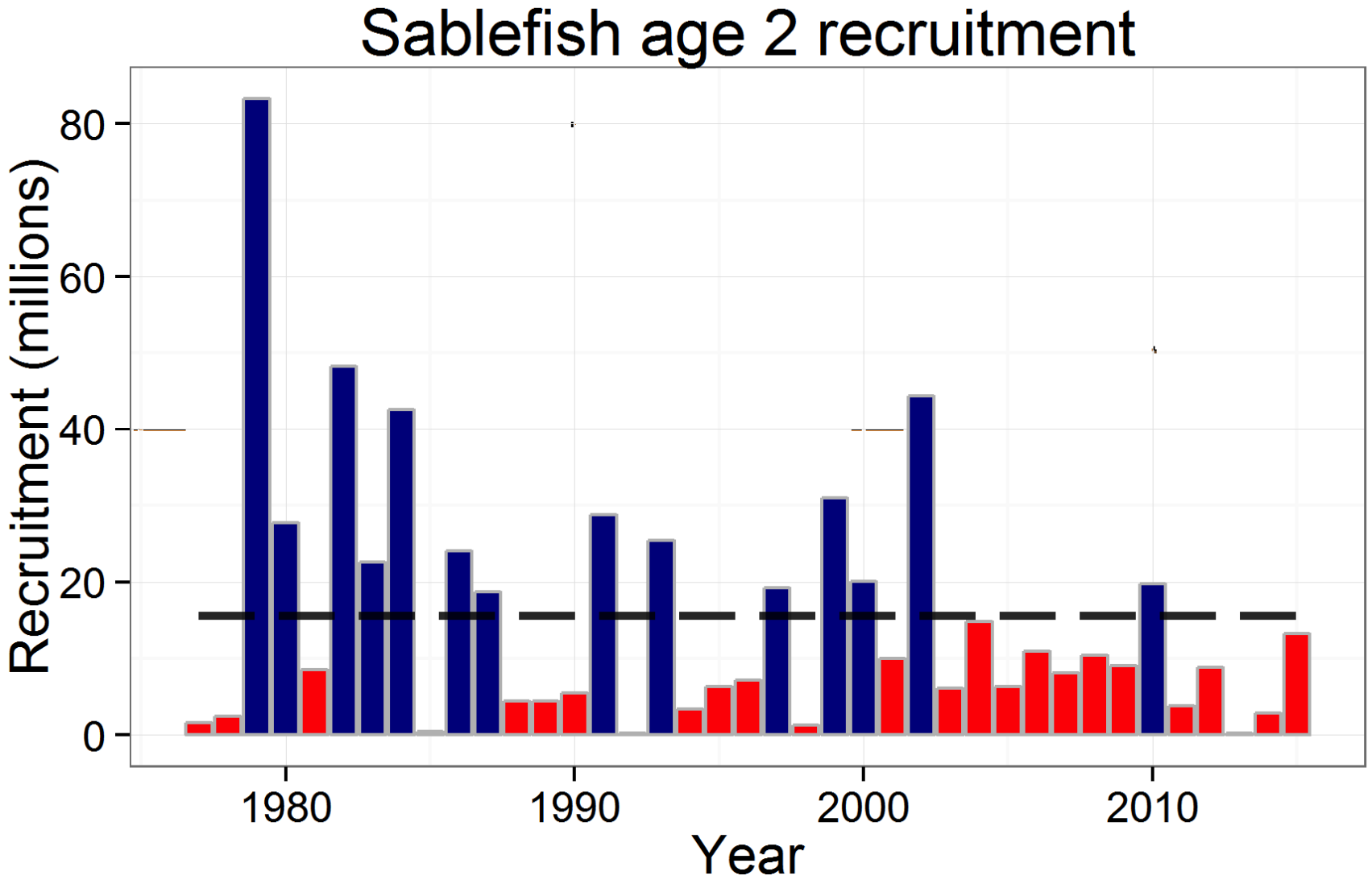
IPHC Survey

- **Stable in 2014**
- **Seems correlated to GOA trawl survey**
- **BC index low**





AK Sablefish model results



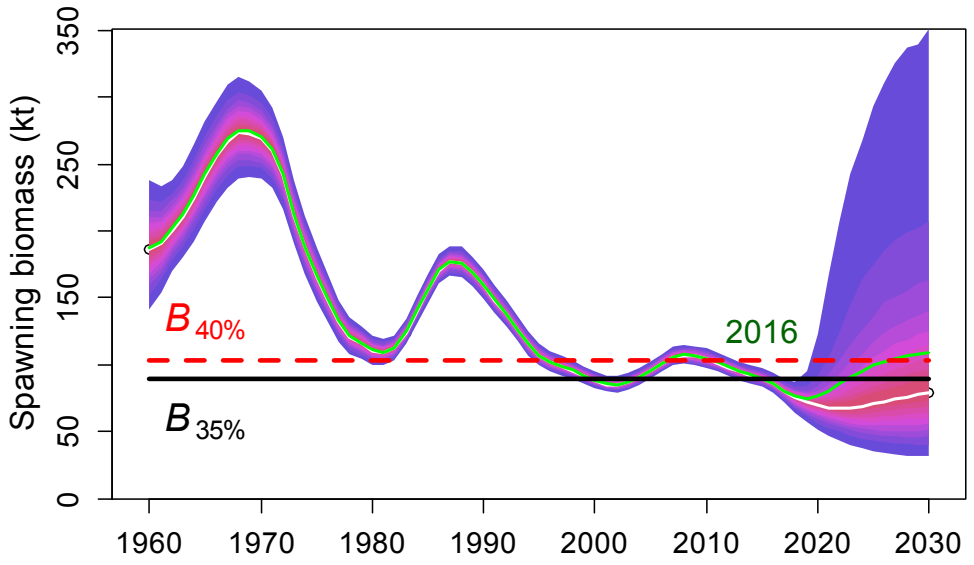
Sablefish ABC/OFL

2016 spawning biomass @ 34% of $B_{100\%}$

Alaska-wide ABC 2016: 13,396 t

GOA specific:

Sablefish	Biomass	OFL	ABC
2016	122,000	10,326	9,087
2017		9,825	8,307



Sablefish apportionment

- Two options presented last year, Team went with Author's recommendation (greater stability)

Area	2015 ABC	Standard apportionment for 2016 ABC	**Recommended fixed apportionment for 2016 ABC***	**Difference from 2015**
Total	13,657	11,795	**11,795**	-13.6%
Bering Sea	1,333	1,816	**1,151**	-13.6%
Aleutians	1,802	1,627	**1,557**	-13.6%
Gulf of Alaska (subtotal)	10,522	8,352	**9,087**	-13.6%
Western	1,473	1,136	**1,272**	-13.6%
Central	4,658	3,451	**4,023**	-13.6%
W. Yakutat**	1,567	1,374	**1,353**	-13.6%
E. Yak. / Southeast**	2,823	2,391	**2,438**	-13.6%

Flatfish ABC Summary

Species	2015 Catch	ABC 2015	ABC 2016	Change
Pollock	162,700	203,934	264,230	up 60,296 (30%)
Pacific Cod	51,497	102,850	98,600	down 4,250 (4%)
Sablefish	10,206	10,522	9,087	down 1,435 (14%)
Flatfish	25,726	108,038	96,103	down 11,935 (11%)
Arrowtooth flounder	1,907	192,921	186,188	down 6,733 (3%)
Rockfish	28,213	39,710	43,706	up 3,996 (10%)
Atka mackerel	1,191	4,700	4,700	same (0%)
Skates	4,350	8,708	8,939	up 231 (3%)
Other Species	3,564	14,213	17,217	up 3,004 (21%)
Total	287,447	685,596	728,770	up 43,174 (6%)

Flatfish ABC's

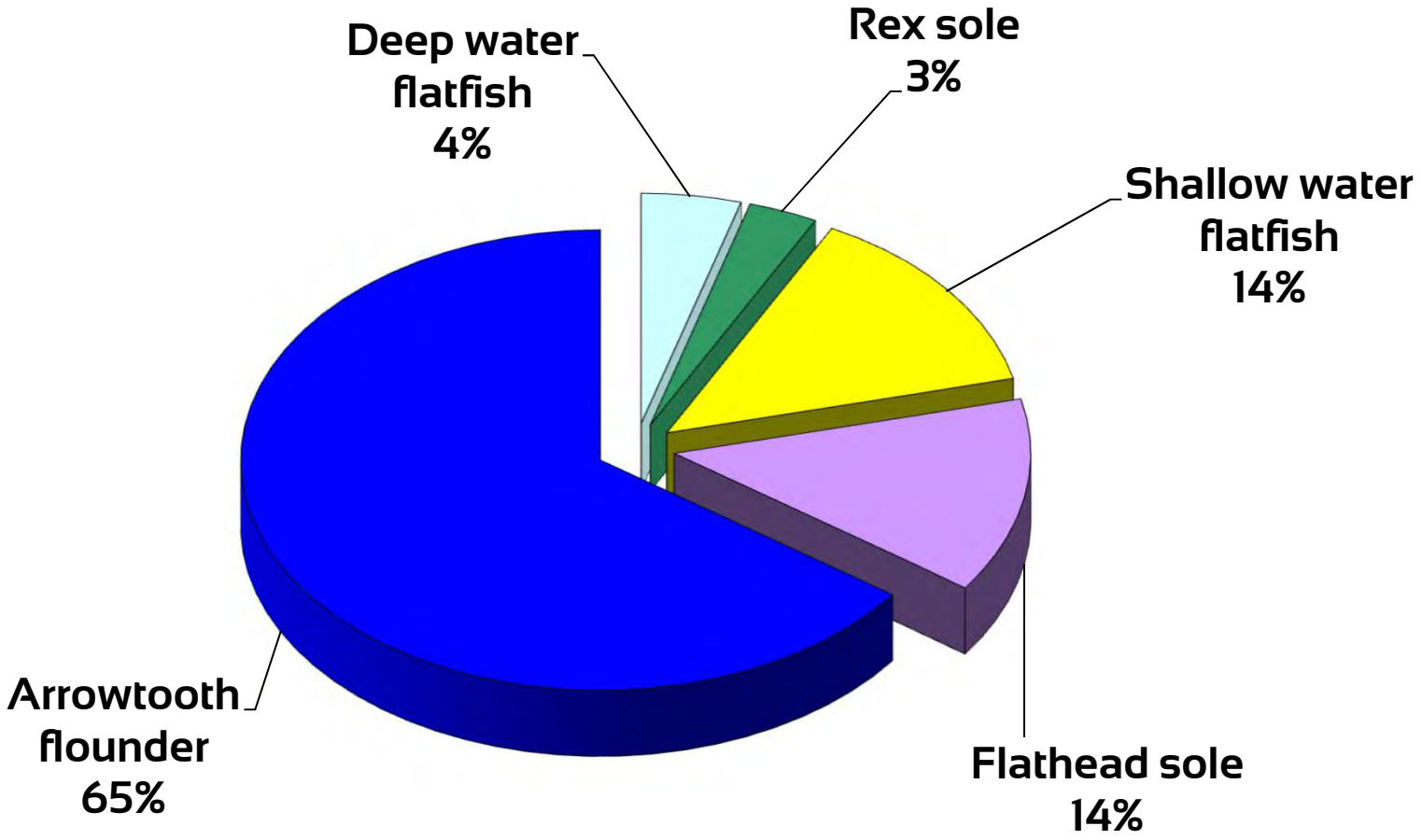
Stock	2015	2016	Change
Shallow water	44,205	44,364	up 159 (0%)
Rex sole	9,150	7,493	down 1,657 (18%)
Deep water	13,334	9,226	down 4,108 (31%)
Flathead sole	41,349	35,020	down 6,329 (15%)
Arrowtooth	192,921	186,188	down 6,733 (3%)
Subtotal	300,959	282,291	down 18,668 (6%)

Deep-water ABC from Dover assessment Tier 3 + others Tier 6

Shallow water flats: N and S rock sole Tier 3, others Tier 5

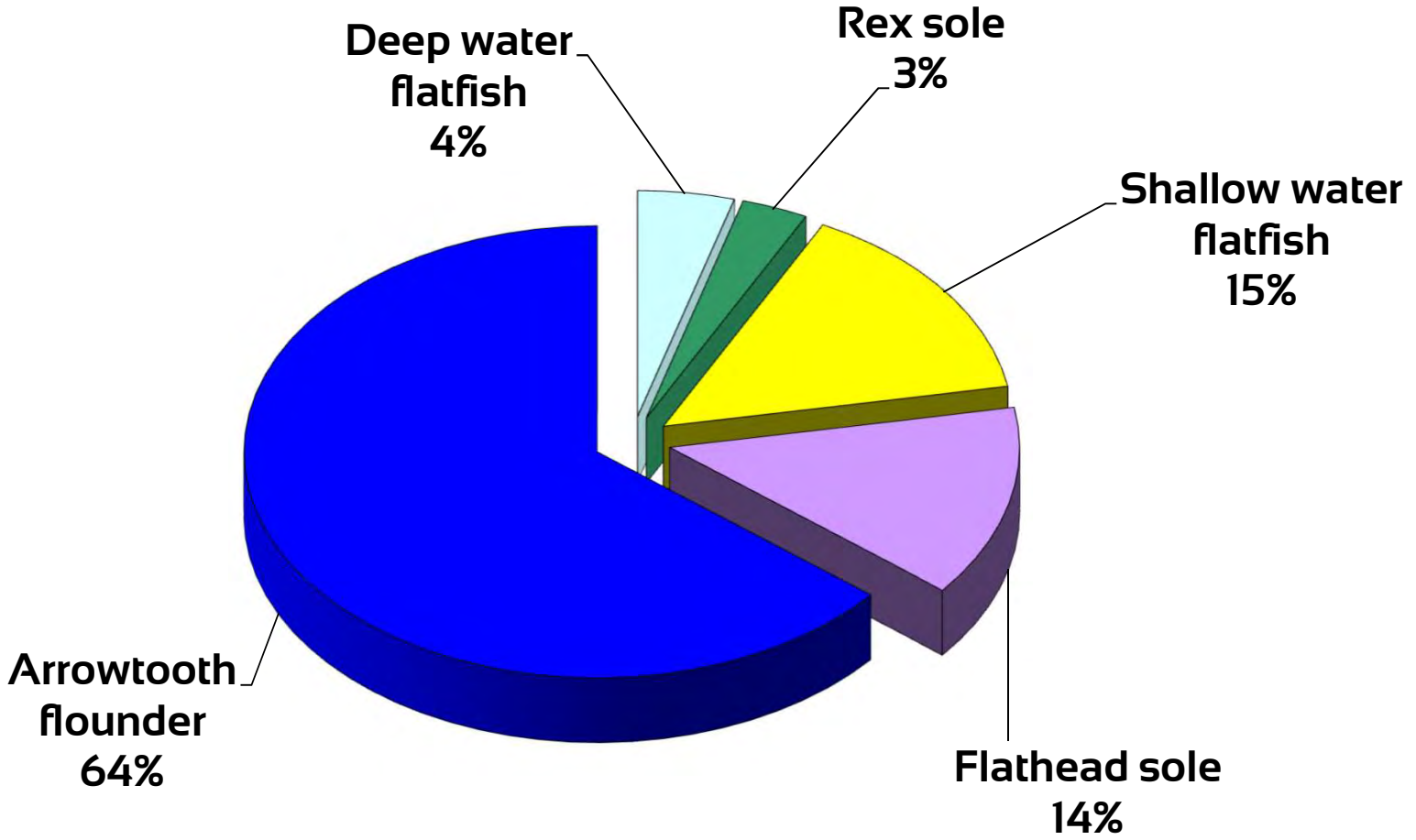
Flatfish 2014 ABC's

300,207 t combined



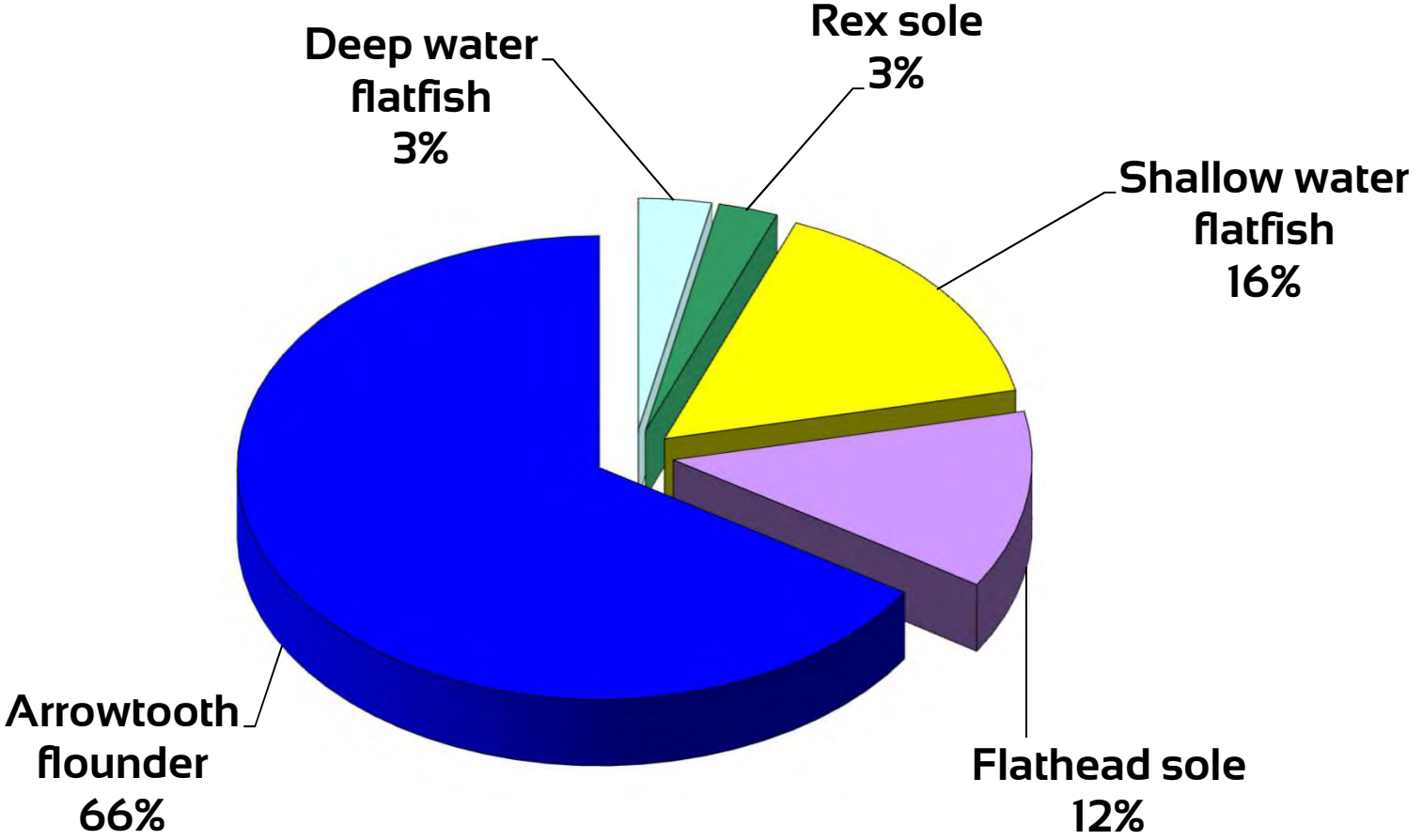
Flatfish 2015 ABC's

300,959 t combined



Flatfish 2016 ABC's

282,291 t combined



General comments on flatfish assessments

- Lightly exploited
- Analytical developments:
  - N & S and "undifferentiated" rock sole models
  - Dover and flathead sole models full in 2015
    - Stock Synthesis modeling platform (SS3) application
    - Models accepted from 2014
  - Rex sole assessment conversion completed to SS3
    - Same Tier 5 approach using model estimated adult biomass

Flatfish ABC's

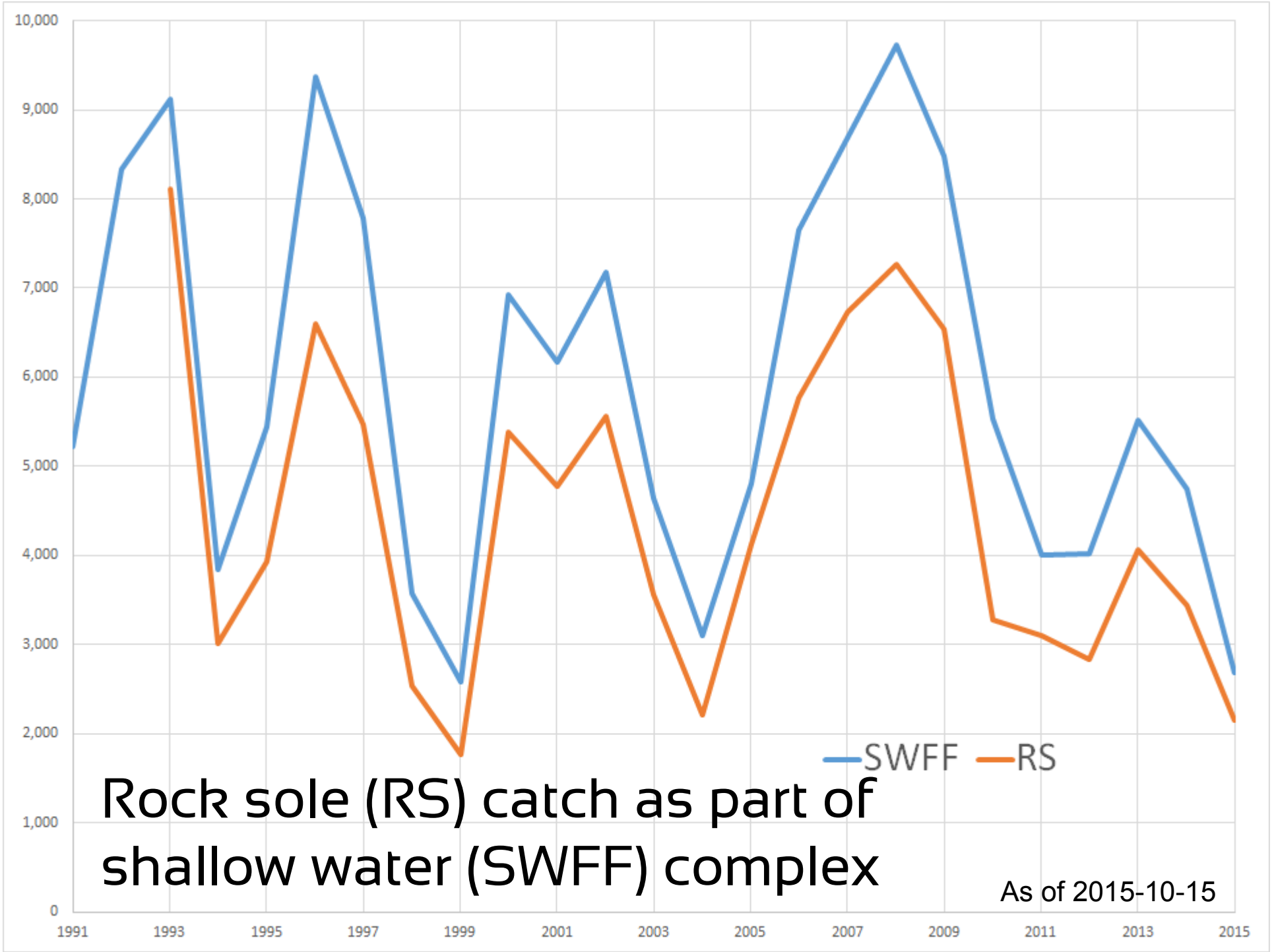
Stock	2015	2016	Change
Shallow water	44,205	44,364	up 159 (0%)
Rex sole	9,150	7,493	down 1,657 (18%)
Deep water	13,334	9,226	down 4,108 (31%)
Flathead sole	41,349	35,020	down 6,329 (15%)
Arrowtooth	192,921	186,188	down 6,733 (3%)
Subtotal	300,959	282,291	down 18,668 (6%)

Shallow water flats: N and S rock sole Tier 3, others Tier 5

4. Shallow water flatfish (p. 415)

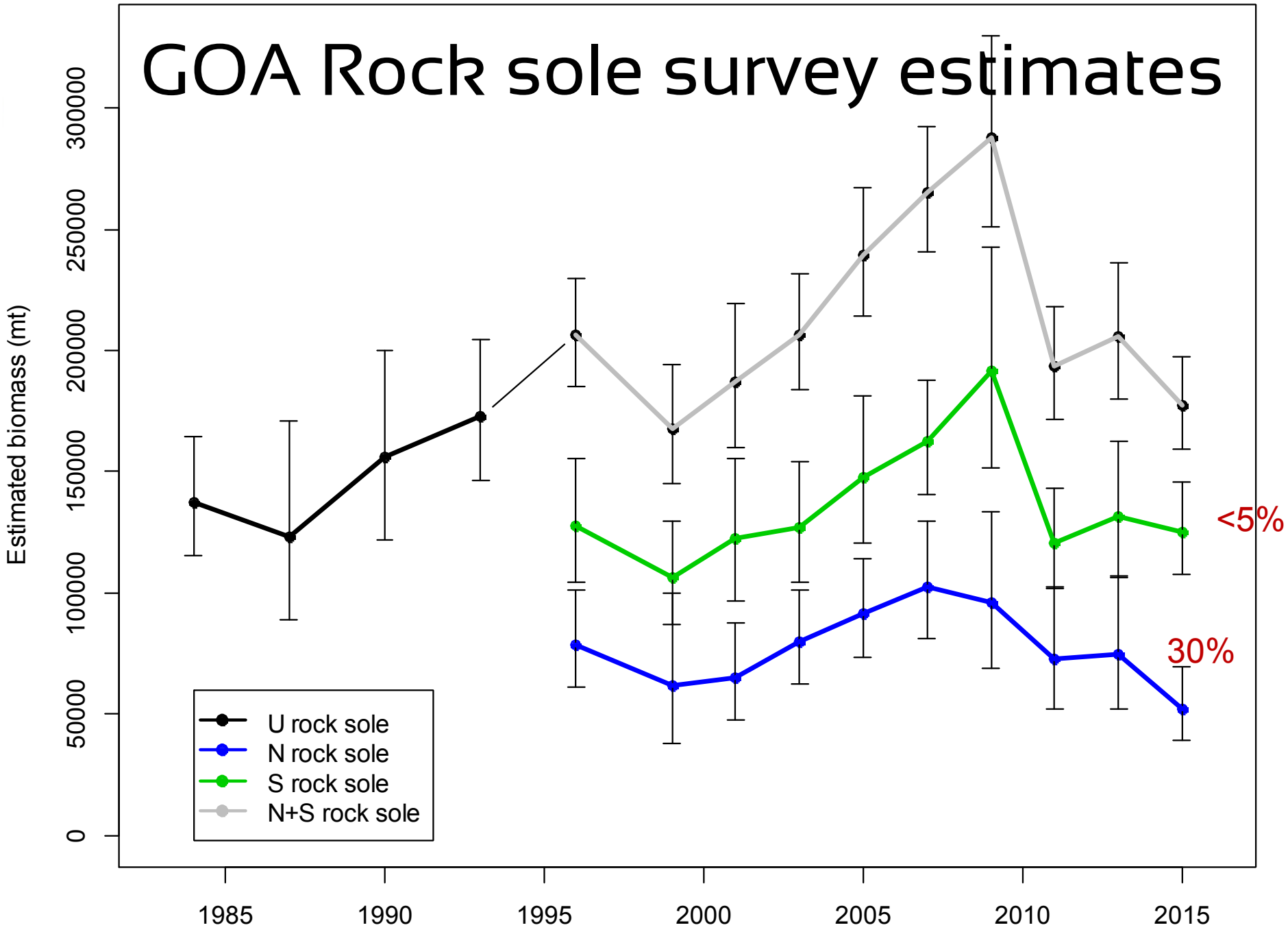
Slight declines over past survey estimates

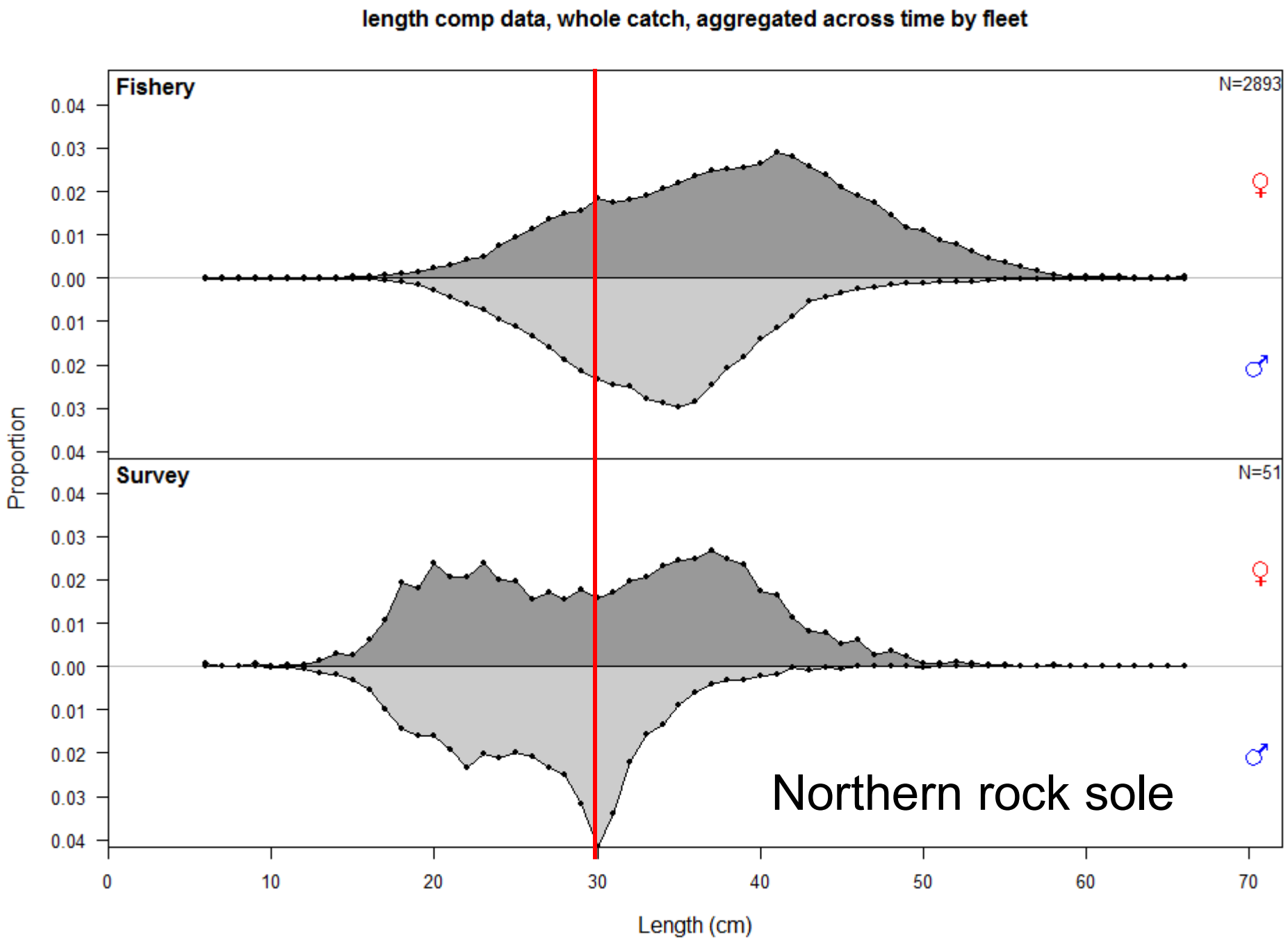
Survey biomass estimates (t)	2011	2013	2015
Northern rock sole	72,875	74,586	52,069
Southern rock sole	120,573	131,441	125,234
Yellowfin sole	46,576	23,016	24,789
Butter sole	19,695	8,122	16,331
Starry flounder	39,757	30,028	23,446
English sole	16,720	18,121	17,498
Sand sole	755	703	301
Alaska plaice	12,266	8,044	5,448
Total	329,217	294,061	267,131

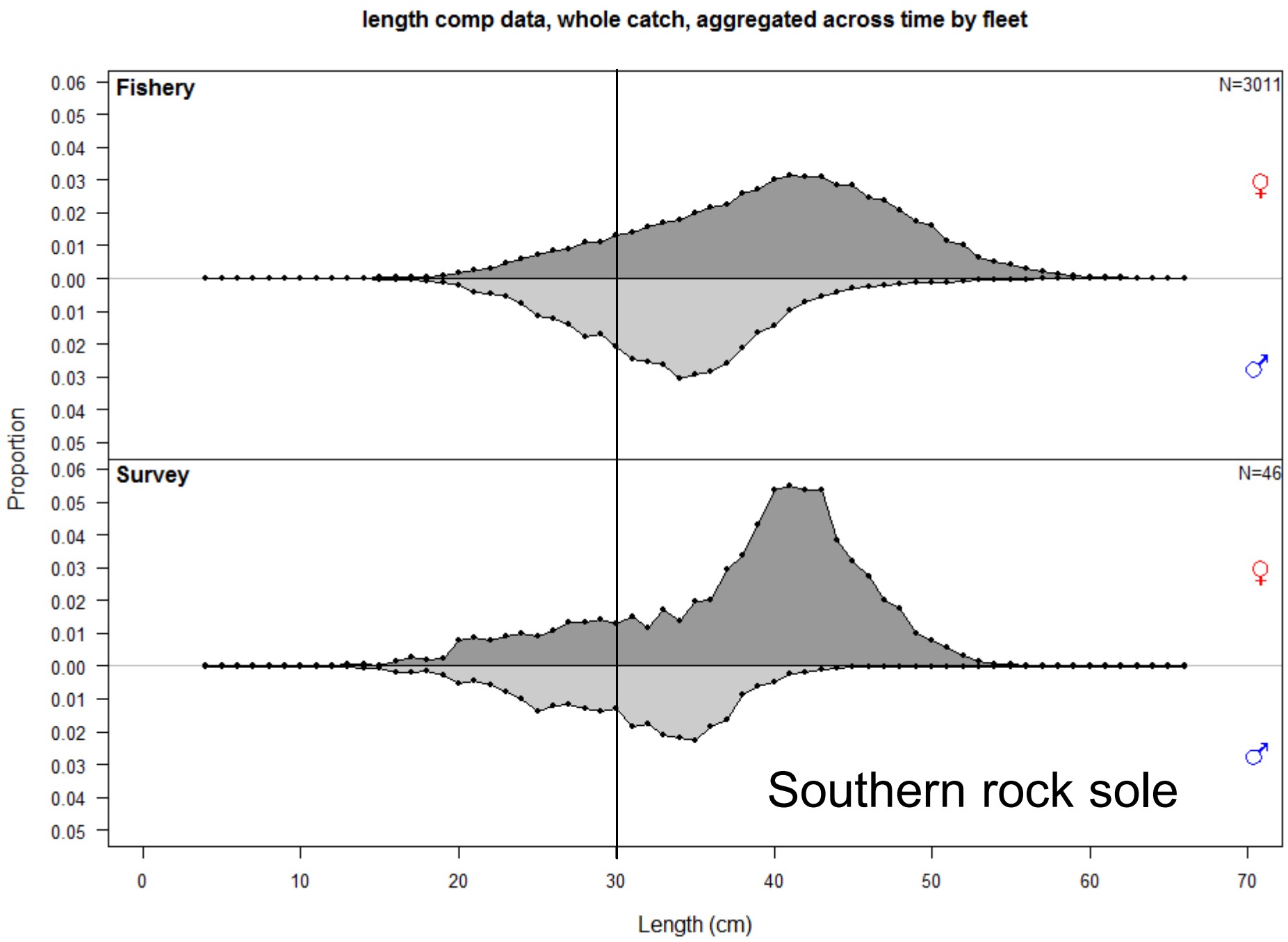


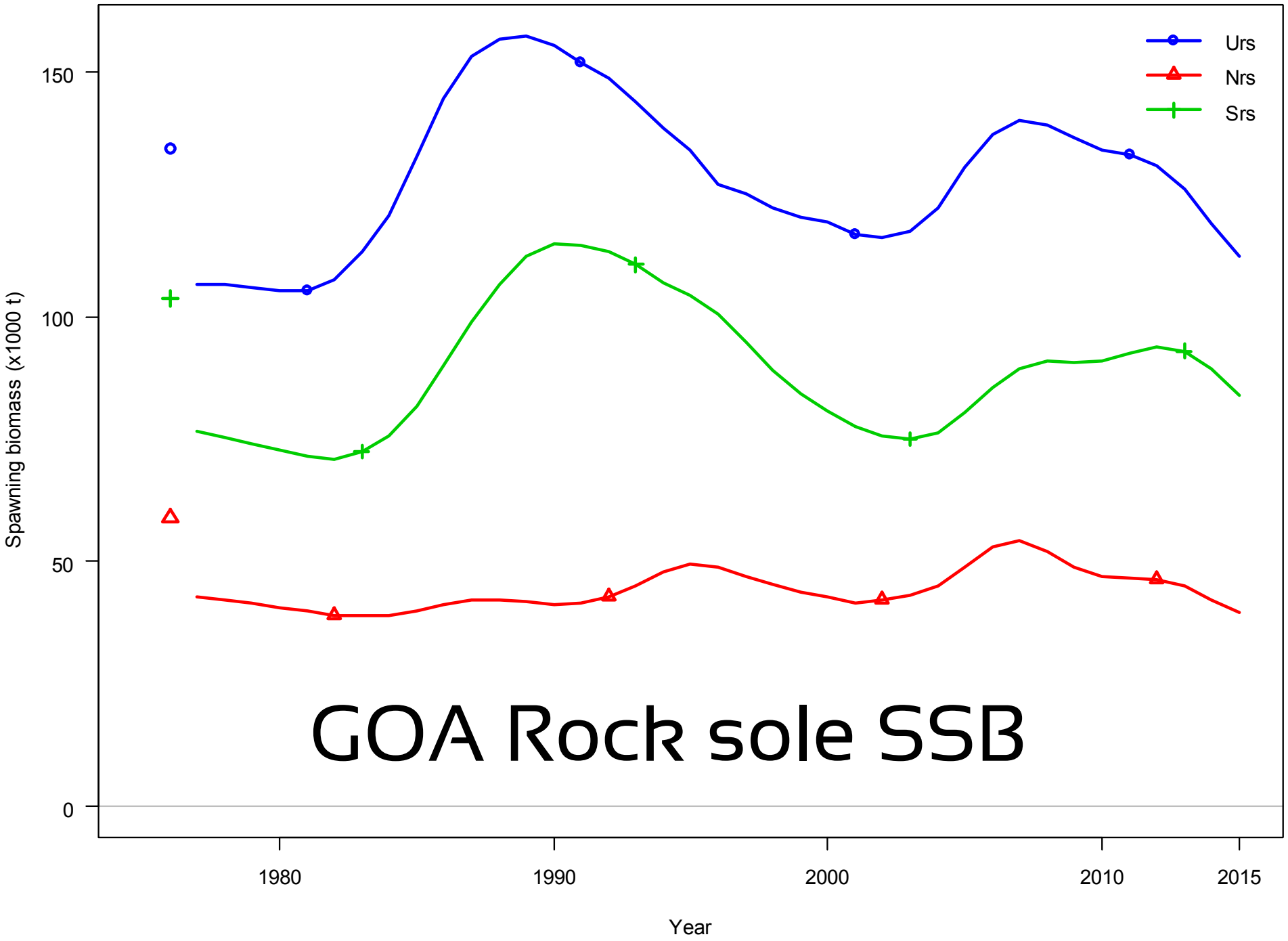
Rock sole (RS) catch as part of shallow water (SWFF) complex

As of 2015-10-15

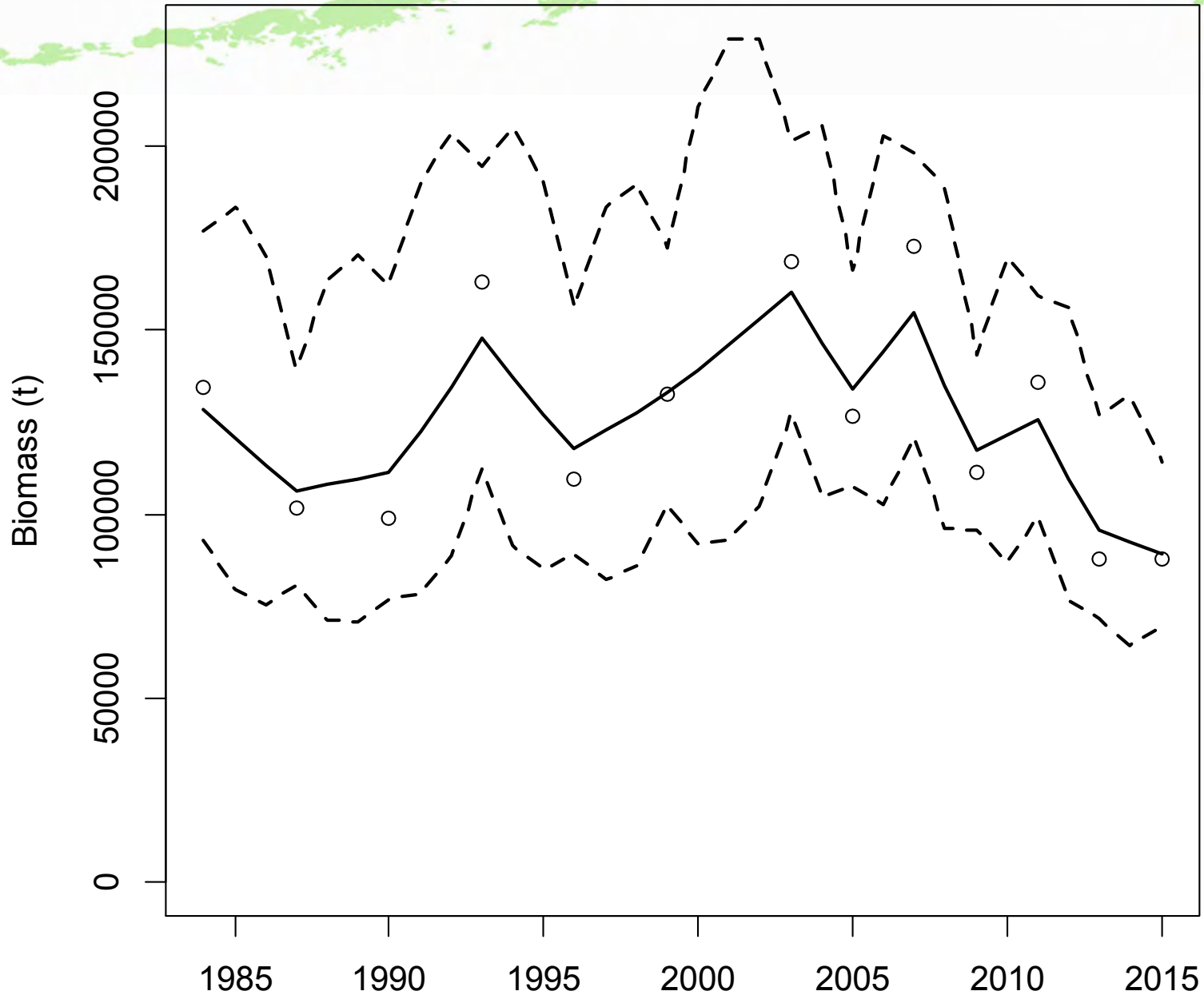

GOA Rock sole survey estimates
Estimated biomass (mt)
0
50000
100000
150000
200000
250000
300000
1985
1990
1995
2000
2005
2010
2015
U rock sole
N rock sole
S rock sole
N+S rock sole
<5%
30%


length comp data, whole catch, aggregated across time by fleet
Fishery
N=2893
Survey
N=51
Proportion
0.04
0.03
0.02
0.01
0.00
0
10
20
30
40
50
60
70
Length (cm)
Northern rock sole


length comp data, whole catch, aggregated across time by fleet
Fishery
N=3011
Survey
N=46
Proportion
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.01
0.02
0.03
0.04
0.05
0
10
20
30
40
50
60
70
Length (cm)
Southern rock sole


Urs
Nrs
Srs
150
100
50
0
Spawning biomass (x1000 t)
1980
1990
2000
2010
2015
Year
GOA Rock sole SSB

Non-rock sole shallow water flat survey averaging



4. Shallow water flatfish summary

	Biomass	OFL	ABC
2016	303,299	54,520	44,364
2017		50,220	40,764

					2016		2017	
Species	Tier	FABC	FOFL	Biomass	ABC	OFL	ABC	OFL
N rock sole	3a	0.248	0.299	75,600	11,800	14,000	10,800	12,800
S rock sole	3a	0.186	0.222	138,600	19,200	22,700	16,600	19,600
Yellowfin sole	5	0.15	0.2	27,664	4,150	5,533	4,150	5,533
Butter sole	5	0.15	0.2	14,221	2,133	2,844	2,133	2,844
Starry flounder	5	0.15	0.2	23,981	3,597	4,796	3,597	4,796
English sole	5	0.15	0.2	16,257	2,438	3,251	2,438	3,251
Sand sole	5	0.15	0.2	643	96	129	96	129
Alaska plaice	5	0.15	0.2	6,333	950	1,267	950	1,267
Total				303,299	44,364	54,520	40,764	50,220

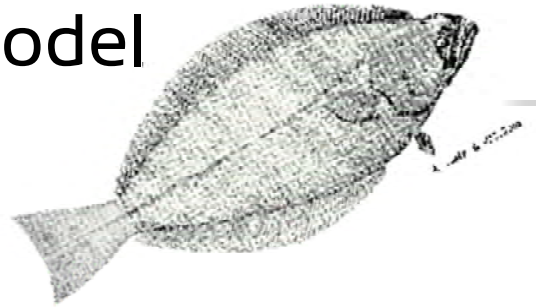
Flatfish ABC's

Stock	2015	2016	Change
Shallow water	44,205	44,364	up 159 (0%)
Rex sole	9,150	7,493	down 1,657 (18%)
Deep water	13,334	9,226	down 4,108 (31%)
Flathead sole	41,349	35,020	down 6,329 (15%)
Arrowtooth	192,921	186,188	down 6,733 (3%)
Subtotal	300,959	282,291	down 18,668 (6%)

Deep-water ABC from Dover assessment Tier 3 + others Tier 6

5. Deepwater flatfish

Dover sole
Deepsea sole
Greenland turbot



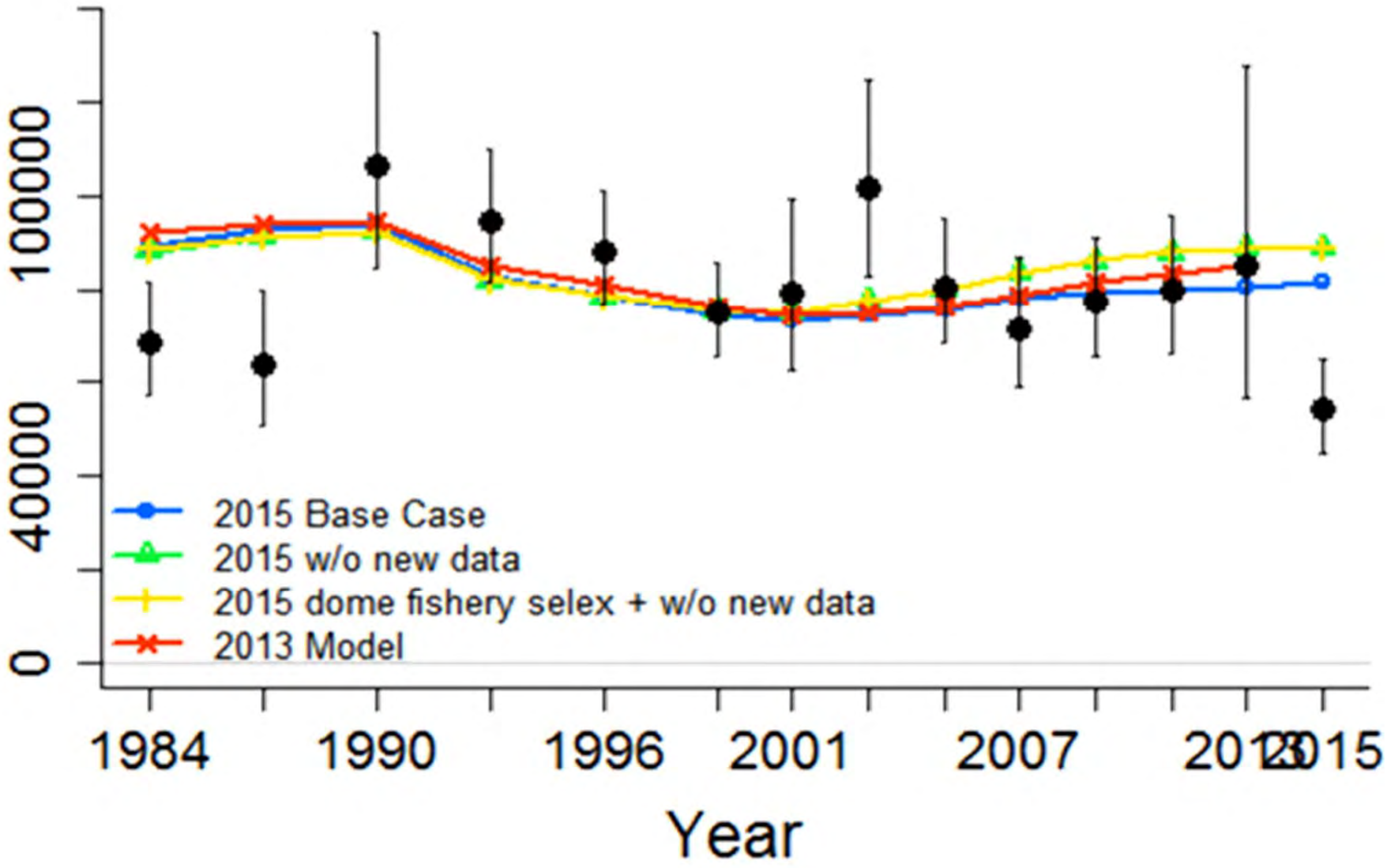
Dover sole: age- and sex-structured model

- M estimated externally
- Survey catchability fixed at 1.0
- Sex-specific fishery and survey selectivity

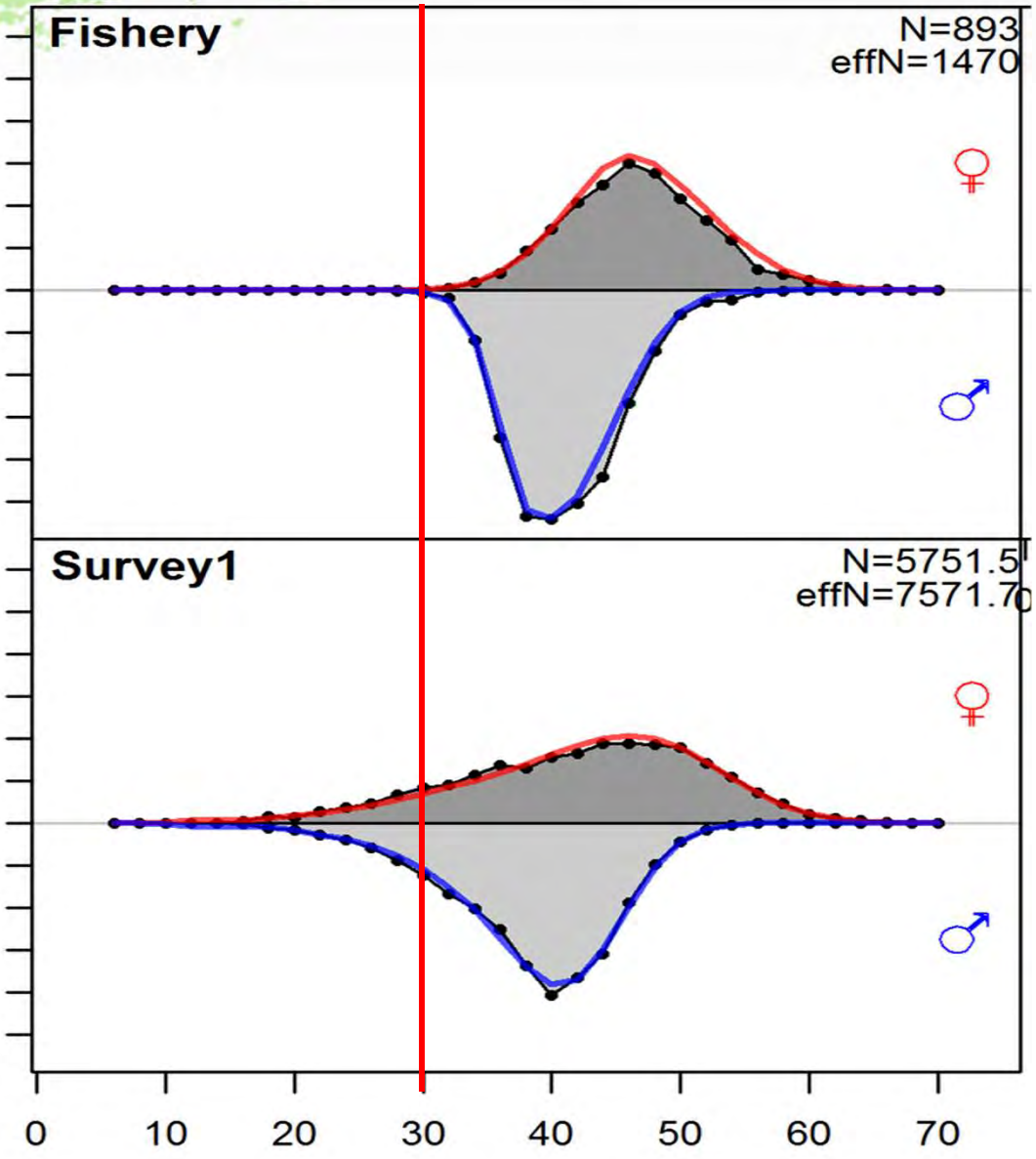
Tuned to

- Catch history, survey biomass
- Length compositions: fishery and survey
- Some survey age compositions

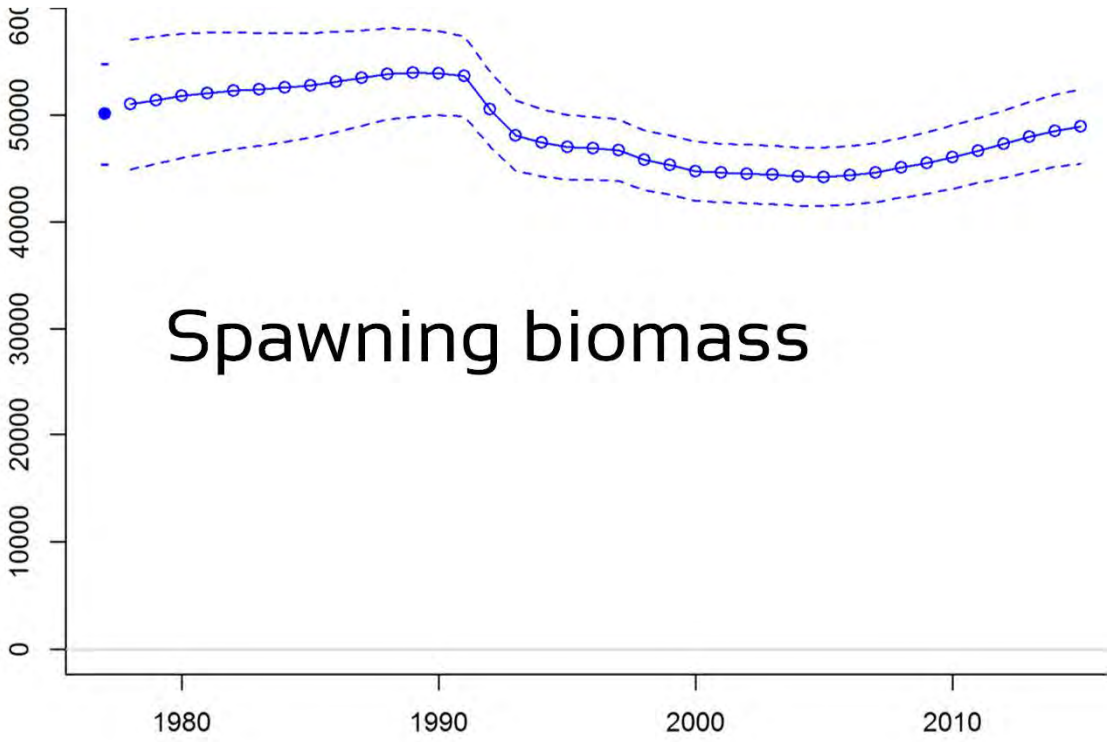
GOA Dover sole (deepwater flatfish)

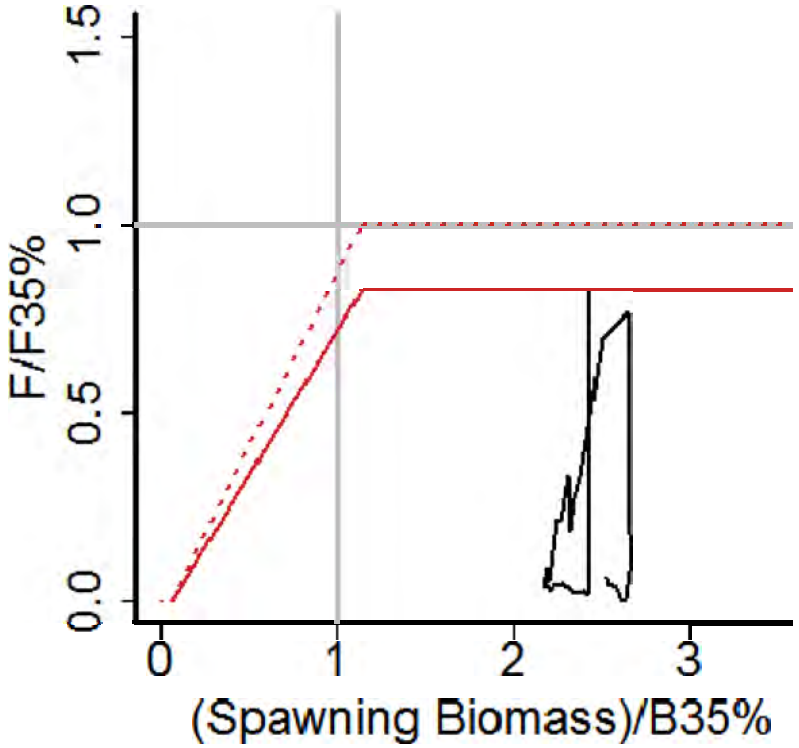


GOA Dover sole (deepwater flatfish)



GOA Dover sole (deepwater flatfish)





5. GOA Deepwater flatfish (p. 451)

	Biomass	OFL	ABC
2016	141,824	11,102	9,226
2017		11,168	9,280

Dover sole
Deepsea sole
Greenland turbot

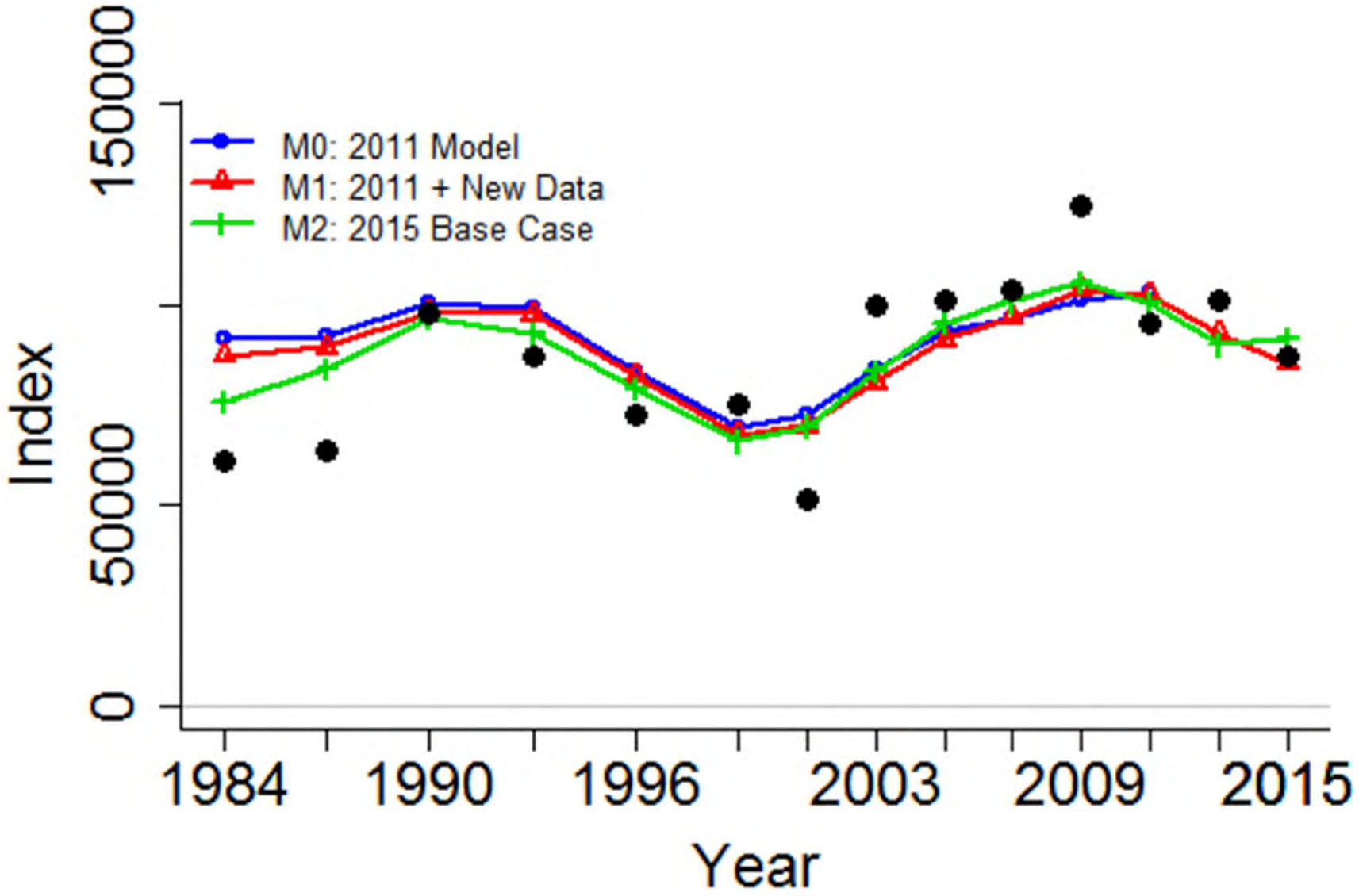
Team discussion on area apportionment: using Dovers to apportion all stocks skewed away from W, modified this to use surveys for other species (still rare)

Year	Western	Central	WYAK	SEO	Total
	2.0%	37.9%	32.5%	27.6%	100.0%
2016	186	3,495	2,997	2,548	9,226
2017	187	3,516	3,015	2,563	9,280

GOA flatfish ABC's

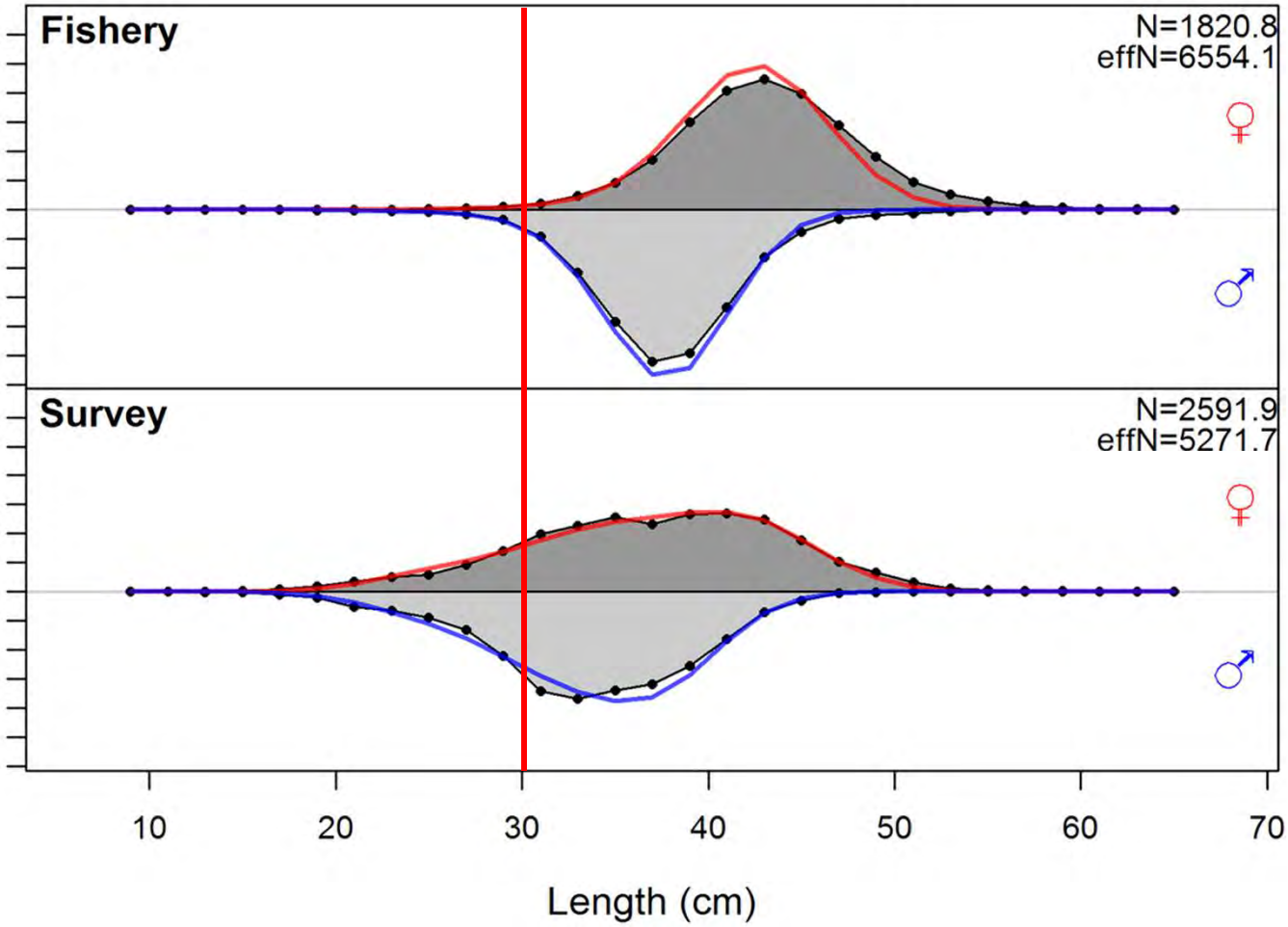
Stock	2015	2016	Change
Shallow water	44,205	44,364	up 159 (0%)
Rex sole	9,150	7,493	down 1,657 (18%)
Deep water	13,334	9,226	down 4,108 (31%)
Flathead sole	41,349	35,020	down 6,329 (15%)
Arrowtooth	192,921	186,188	down 6,733 (3%)
Subtotal	300,959	282,291	down 18,668 (6%)

GOA Rex sole models



6. Rex sole ABC/OFL

	Biomass	OFL	ABC
2016	67,941 t	9,791	7,493
2017		9,810	7,507



Flatfish ABC's

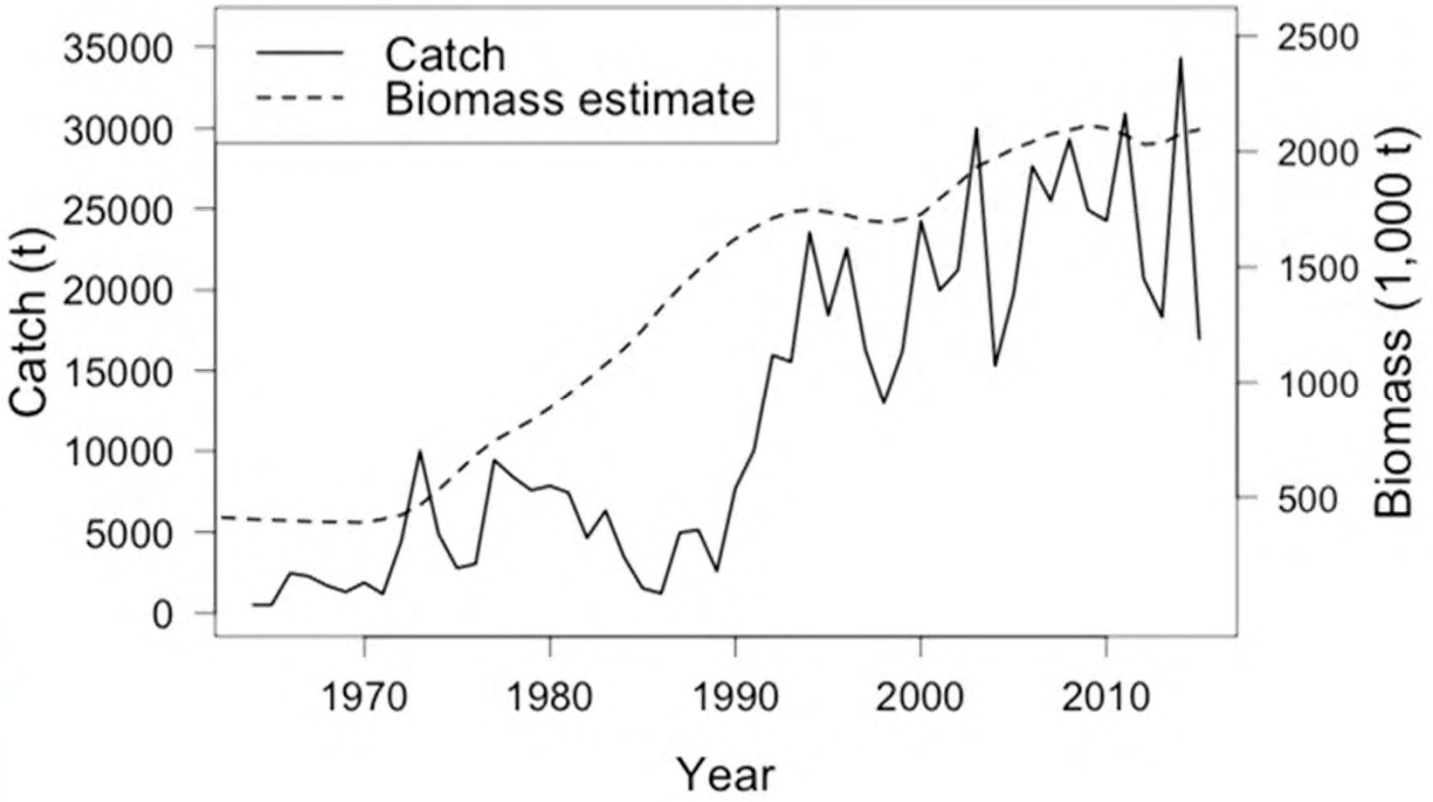
Stock	2015	2016	Change
Shallow water	44,205	44,364	up 159 (0%)
Rex sole	9,150	7,493	down 1,657 (18%)
Deep water	13,334	9,226	down 4,108 (31%)
Flathead sole	41,349	35,020	down 6,329 (15%)
Arrowtooth	192,921	186,188	down 6,733 (3%)
Subtotal	300,959	282,291	down 18,668 (6%)

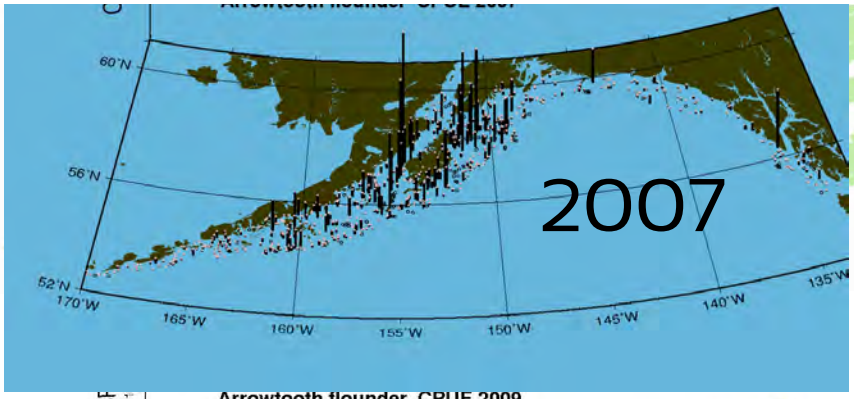
7. GOA Arrowtooth flounder (p. 625)

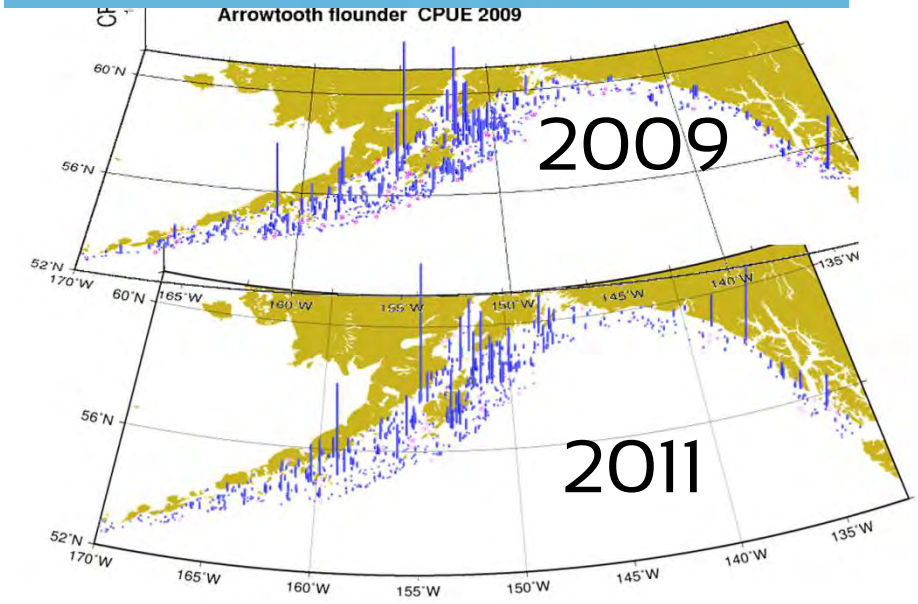
Based on age/sex structured model

Full assessment

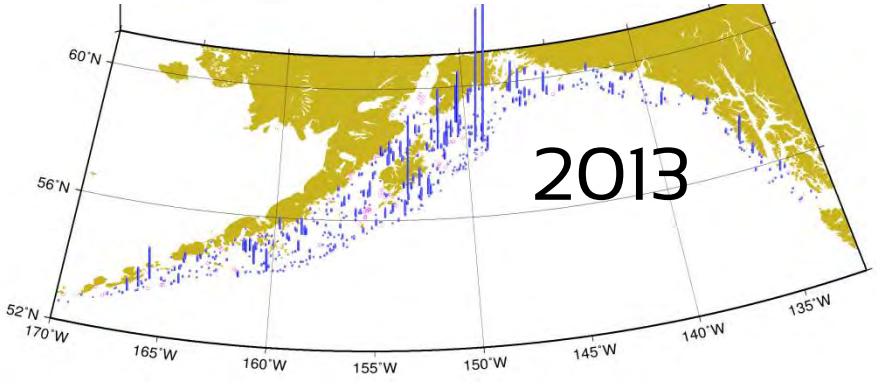
- New model application
- Uses same code for GOA and BSAI

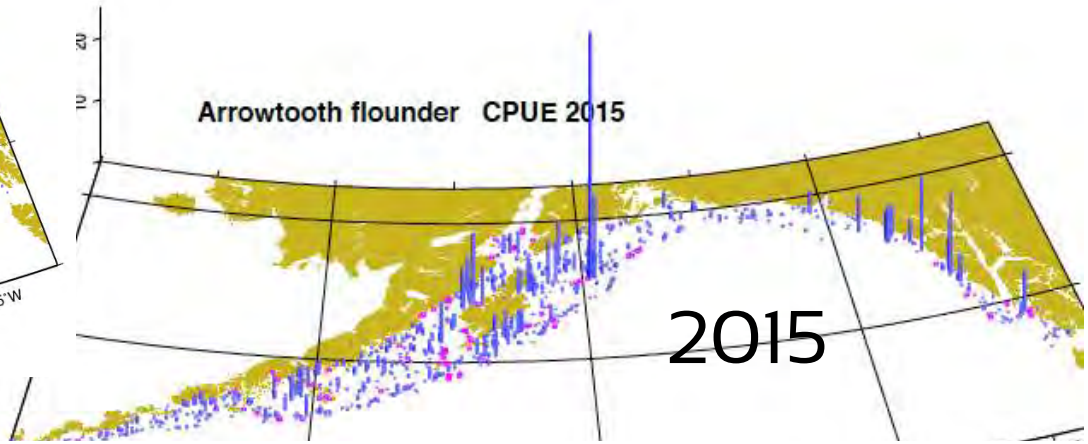




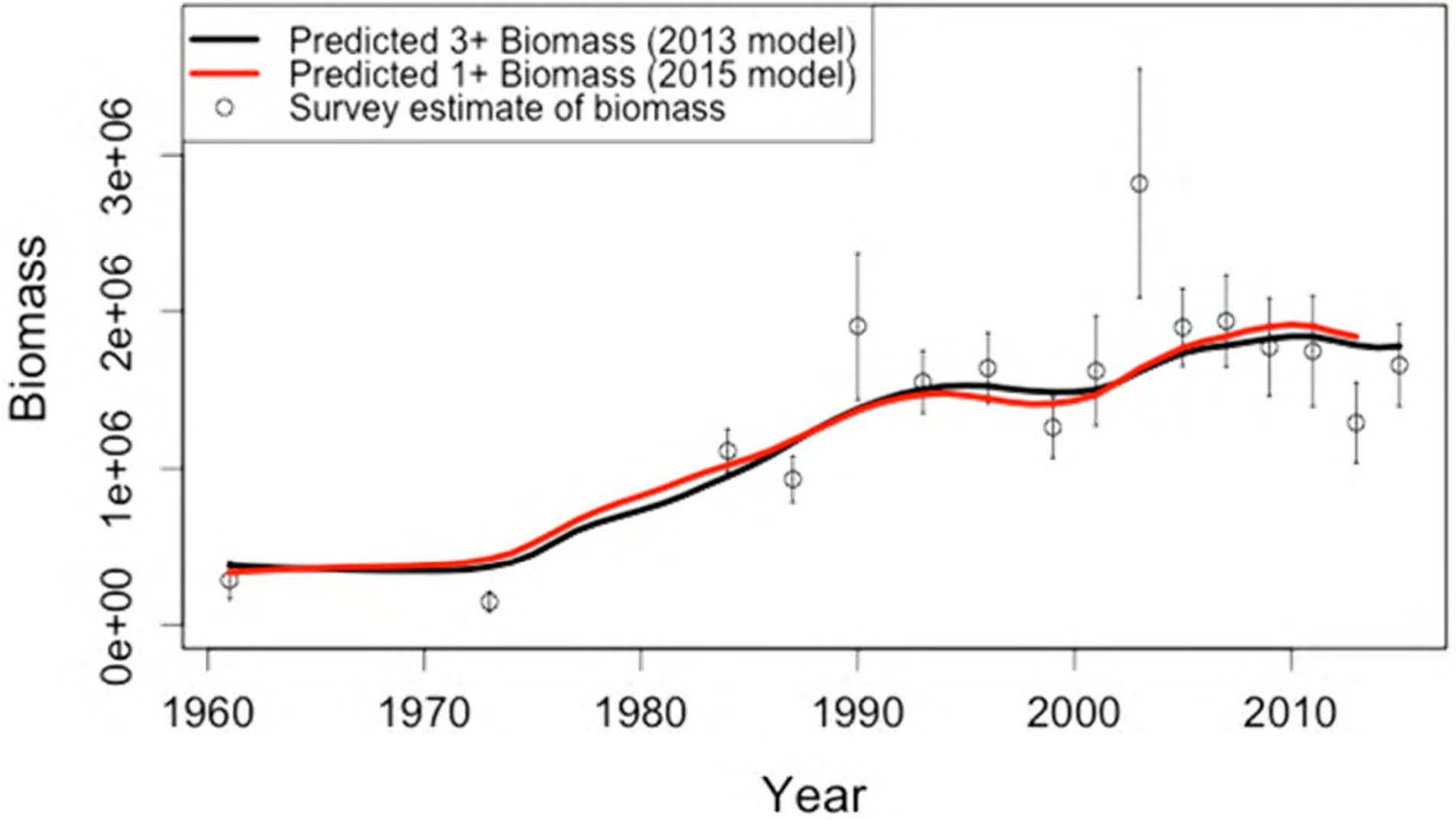


GOA Arrowtooth flounder survey CPUE





GOA Arrowtooth

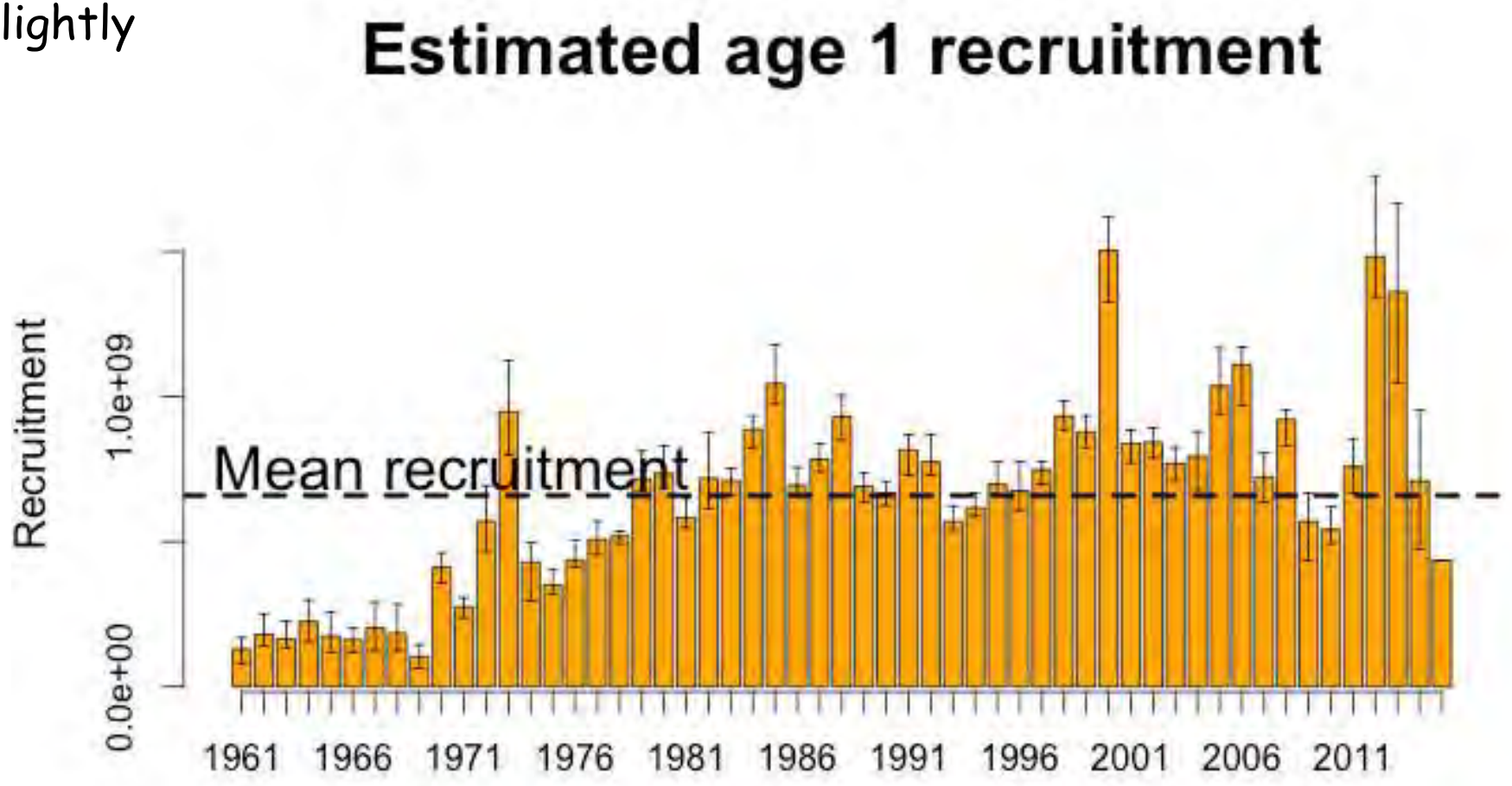


GOA Arrowtooth flounder ABC/OFL

Tier 3a

2015 ABC down slightly

Year	Biomass	OFL	ABC
2016	2,103,860	219,430	186,188
2017		196,714	189,332



GOA flatfish ABC's

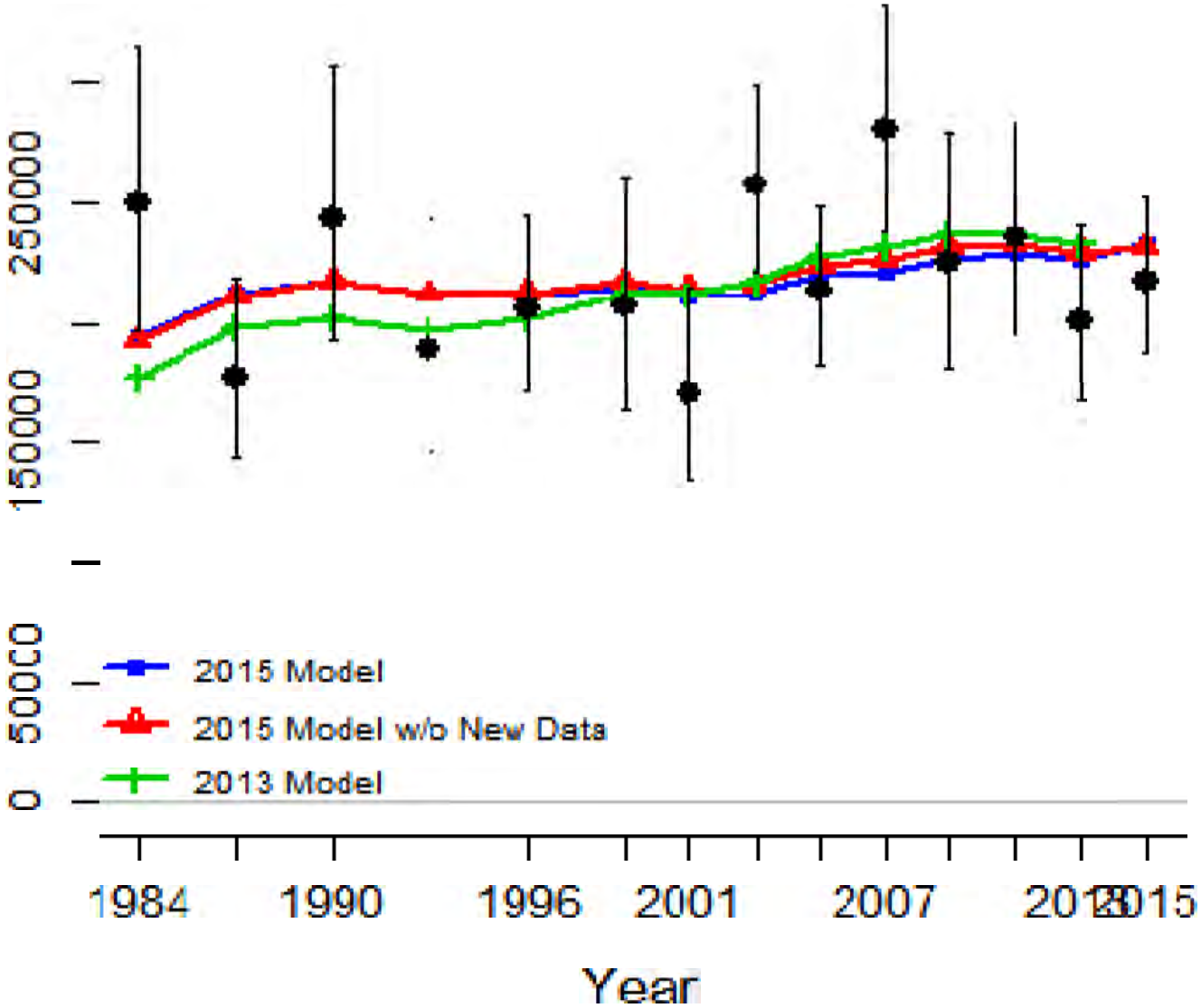
Stock	2015	2016	Change
Shallow water	44,205	44,364	up 159 (0%)
Rex sole	9,150	7,493	down 1,657 (18%)
Deep water	13,334	9,226	down 4,108 (31%)
Flathead sole	41,349	35,020	down 6,329 (15%)
Arrowtooth	192,921	186,188	down 6,733 (3%)
Subtotal	300,959	282,291	down 18,668 (6%)

8. GOA Flathead Sole (p. 675)

Age-structured model

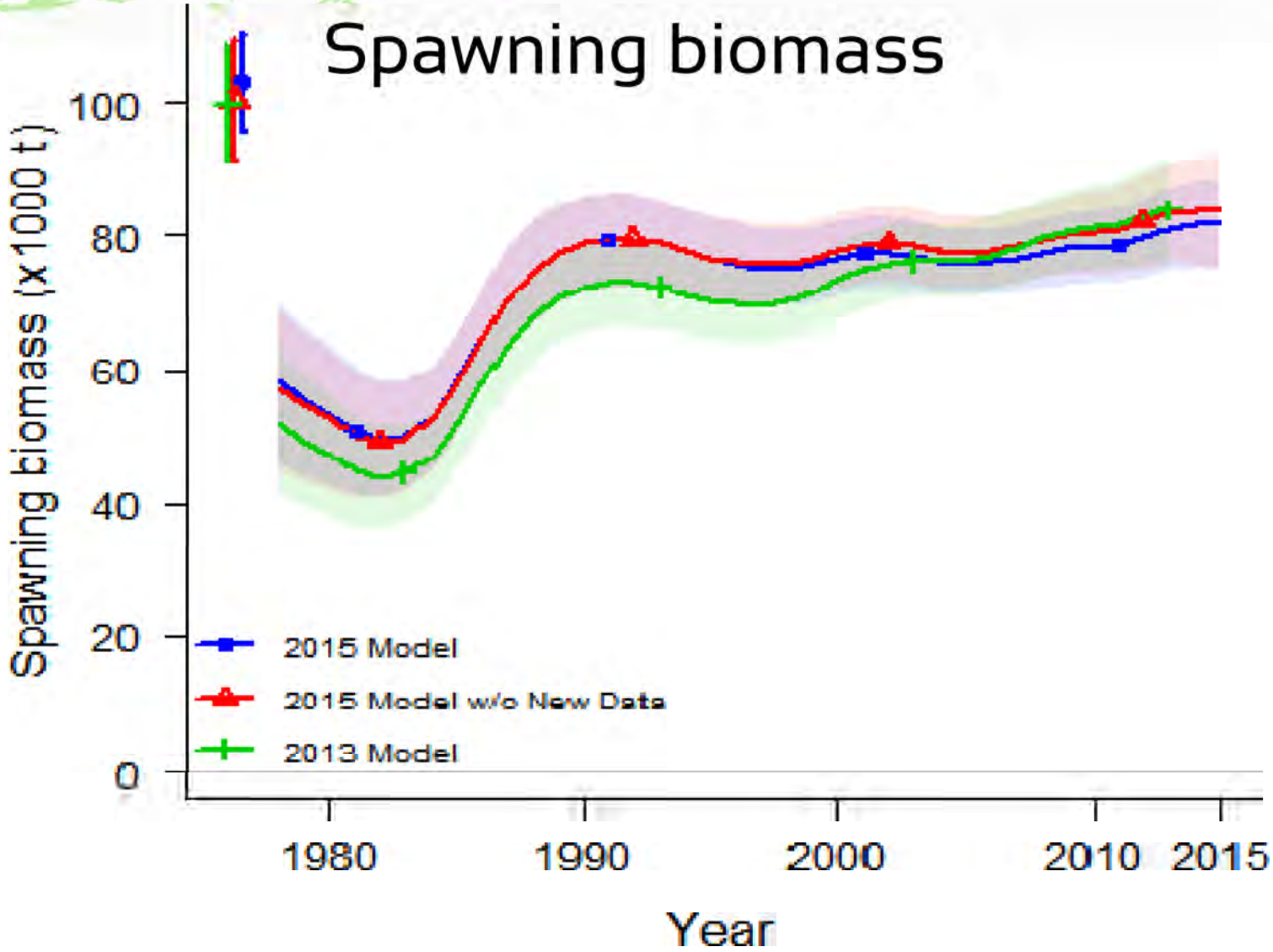
- Extends 2013 development of stock synthesis
- Application

GOA flathead sole survey fit by model



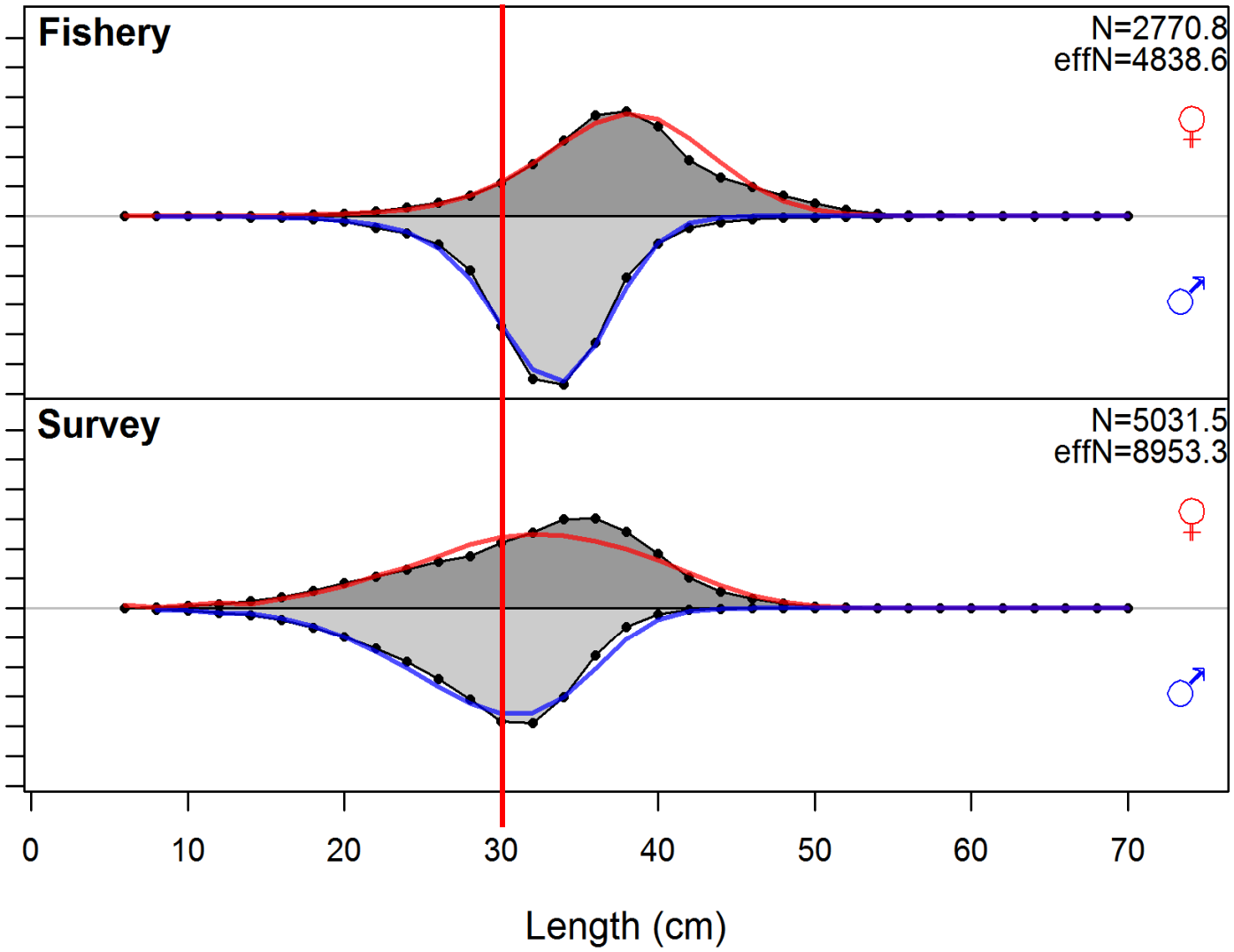
GOA flathead sole

(Flats)



GOA flathead sole

Length composition fit summary

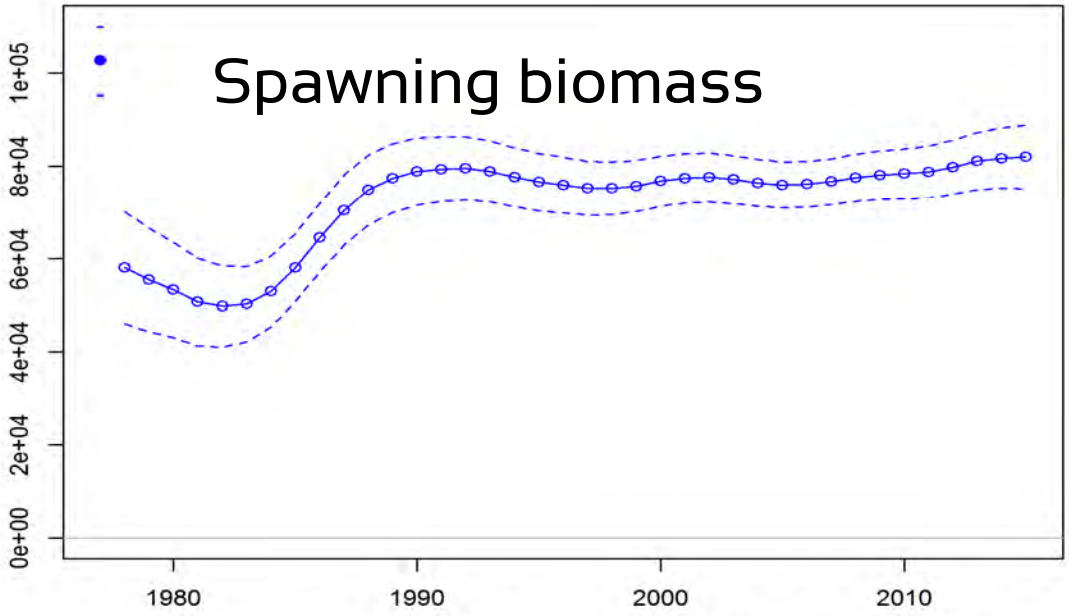


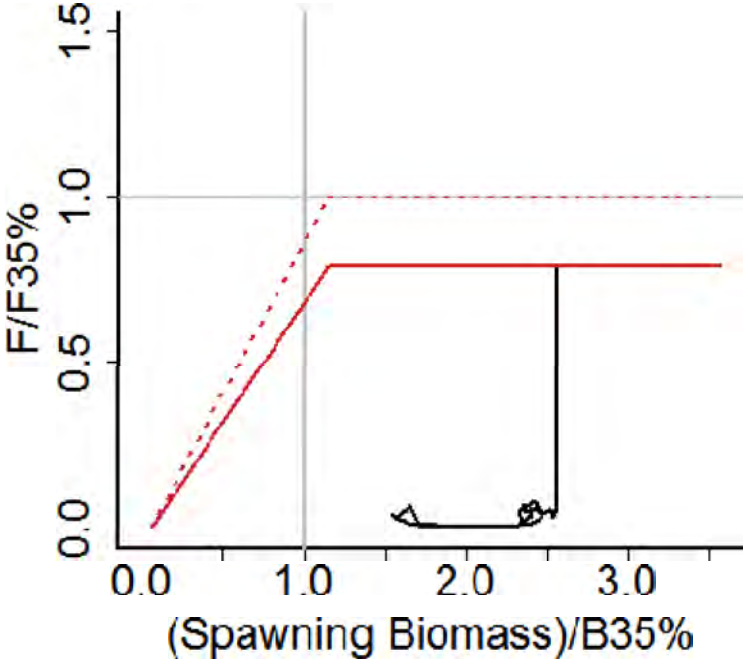
GOA Flathead sole ABC/OFL

	Biomass	OFL	ABC
2016	265,088	42,840	35,020
2017		43,060	35,187

Tier 3a

Discussions limited, low exploitation may warrant less frequent assessments

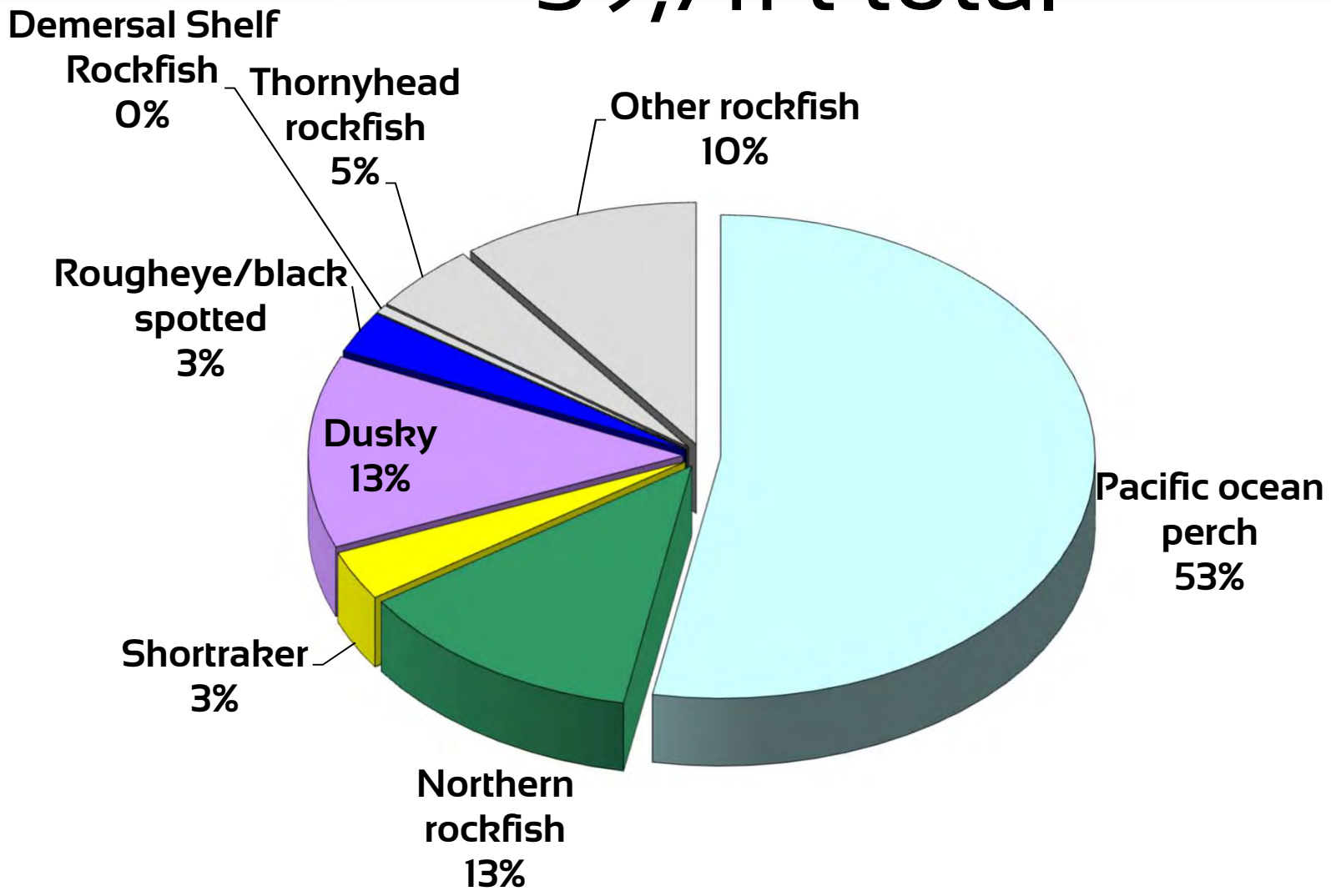




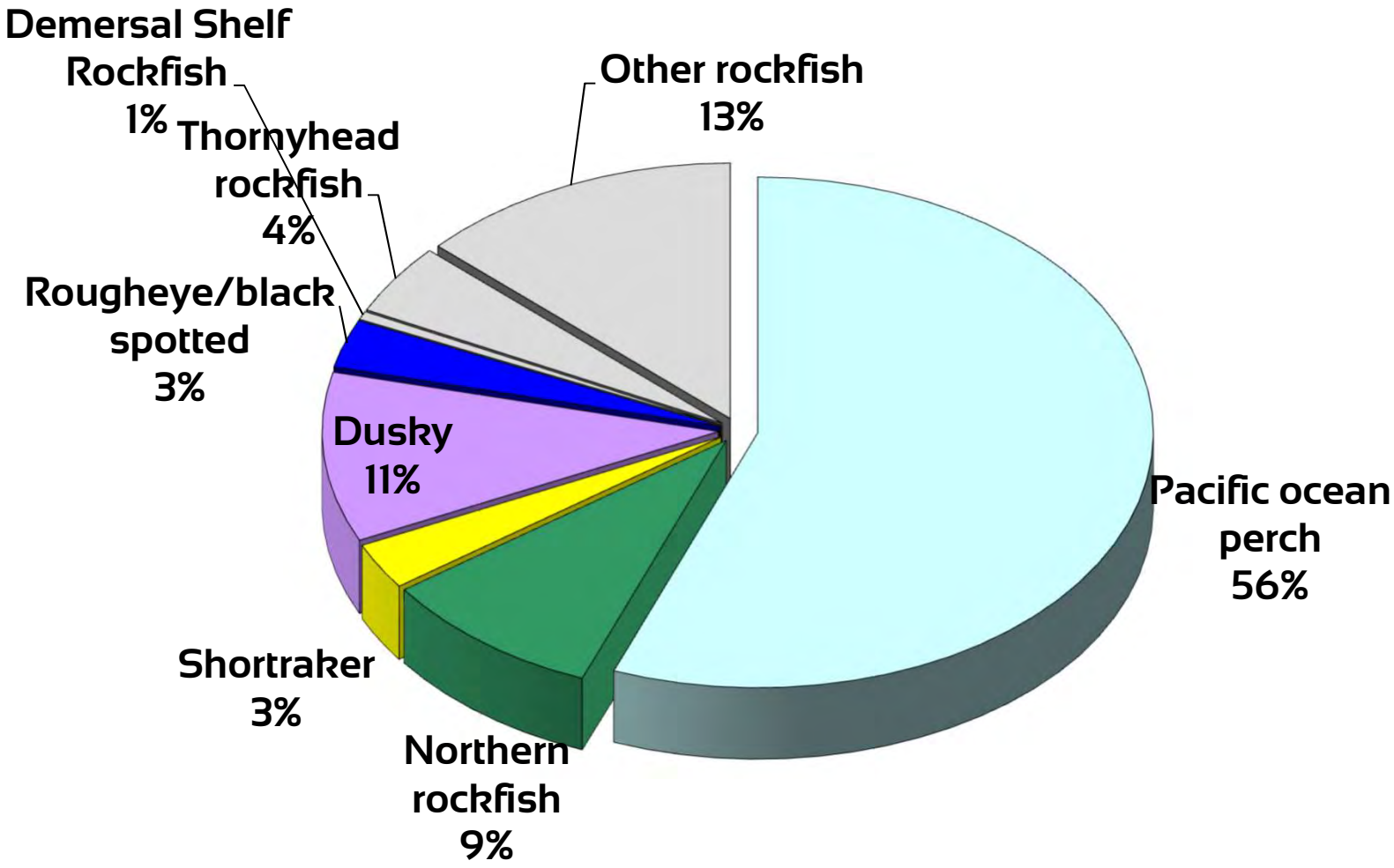
GOA Rockfish

Species	2015 Catch	ABC 2015	ABC 2016	Change
Pollock	162,700	203,934	264,230	up 60,296 (30%)
Pacific Cod	51,497	102,850	98,600	down 4,250 (4%)
Sablefish	10,206	10,522	9,087	down 1,435 (14%)
Flatfish	23,819	108,038	96,103	down 11,935 (11%)
Arrowtooth flounder	1,907	192,921	186,188	down 6,733 (3%)
Rockfish	28,213	39,710	43,706	up 3,996 (10%)
Atka mackerel	1,191	4,700	4,700	same (0%)
Skates	4,350	8,708	8,939	up 231 (3%)
Other Species	3,564	14,213	17,217	up 3,004 (21%)
Total	287,447	685,596	728,770	up 43,174 (6%)

Rockfish 2015 ABC's
39,711 t total



Rockfish 2016 ABC's 43,706 t total



GOA Rockfish assessment recap

2013

- Modified full assessments for POP, northern and dusky rockfish
- Executive summaries for shortraker, rougheye and blackspotted, thornyheads, other rockfish, and demersal shelf rockfish

2014

- Full assessments for POP and rougheye/black spotted; others executive summary

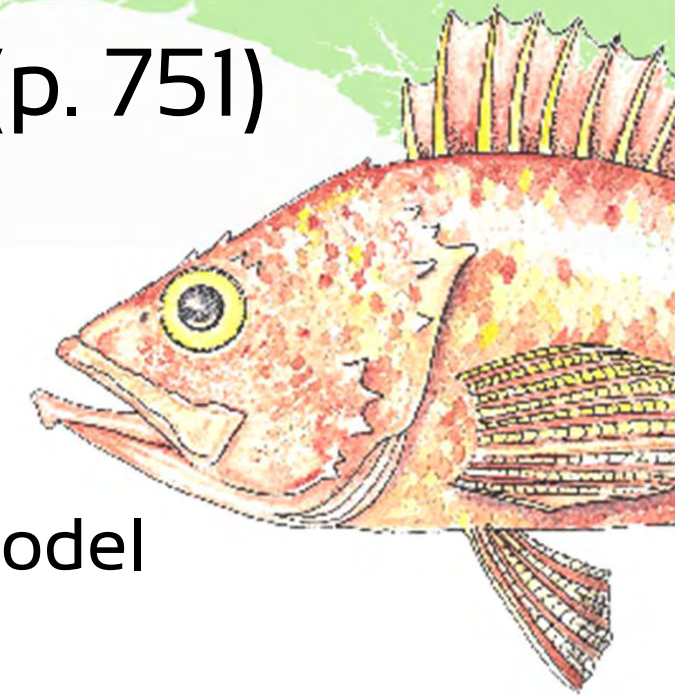
2015

- Full assessments

POP ABC Summary

Species	2015	2016	Change
POP	21,012	24,437	up 3,425 (16%)
northern rockfish	4,998	4,004	down 994 (20%)
Shortraker Rockfish	1,323	1,286	down 37 (3%)
Dusky	5,109	4,686	down 423 (8%)
Rougheye and Blackspotted Rockfish	1,122	1,328	same (0%)
Demersal shelf rockfish	225	231	same (0%)
Thornyhead	1,841	1,961	up 120 (7%)
Other rock	4,080	5,773	up 1,693 (41%)
Sub Total	39,710	43,706	up 3,996 (10%)

9. GOA Pacific ocean perch (p. 751)



Tier 3a, update 2014 assessment model

- Changes in input data:
  - 2015 survey biomass, 2013 survey ages, updated catch 2014, preliminary catch 2015

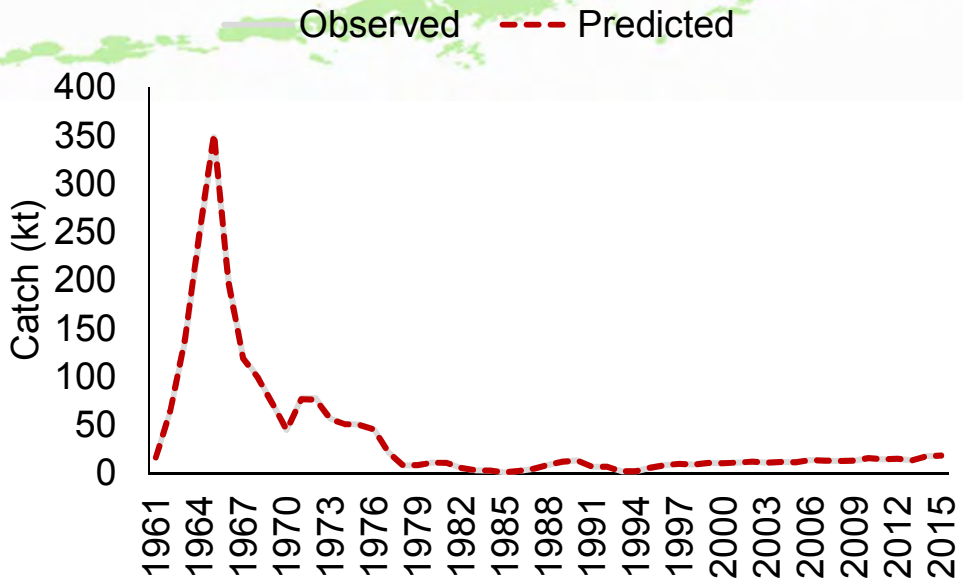
Data trends

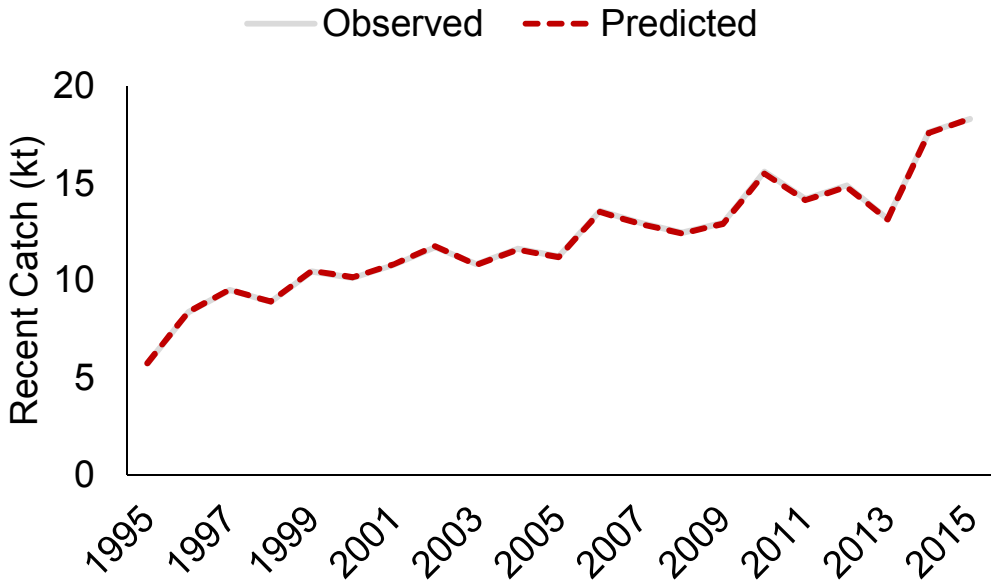
- 2015 survey biomass 2nd largest of time series (CV=15%, smallest of time series)

Model changes:

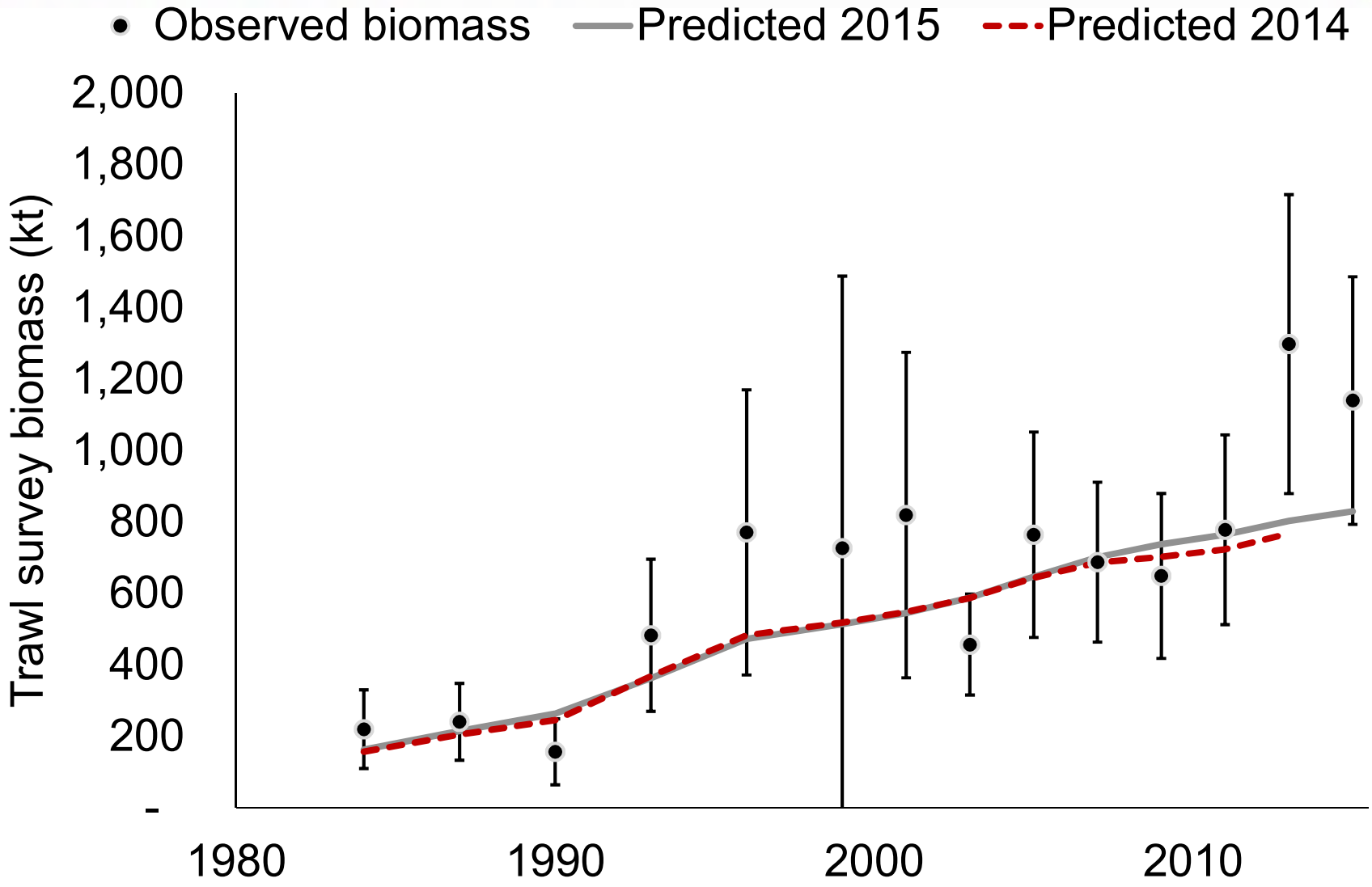
- Length-stratified growth, ageing error extension

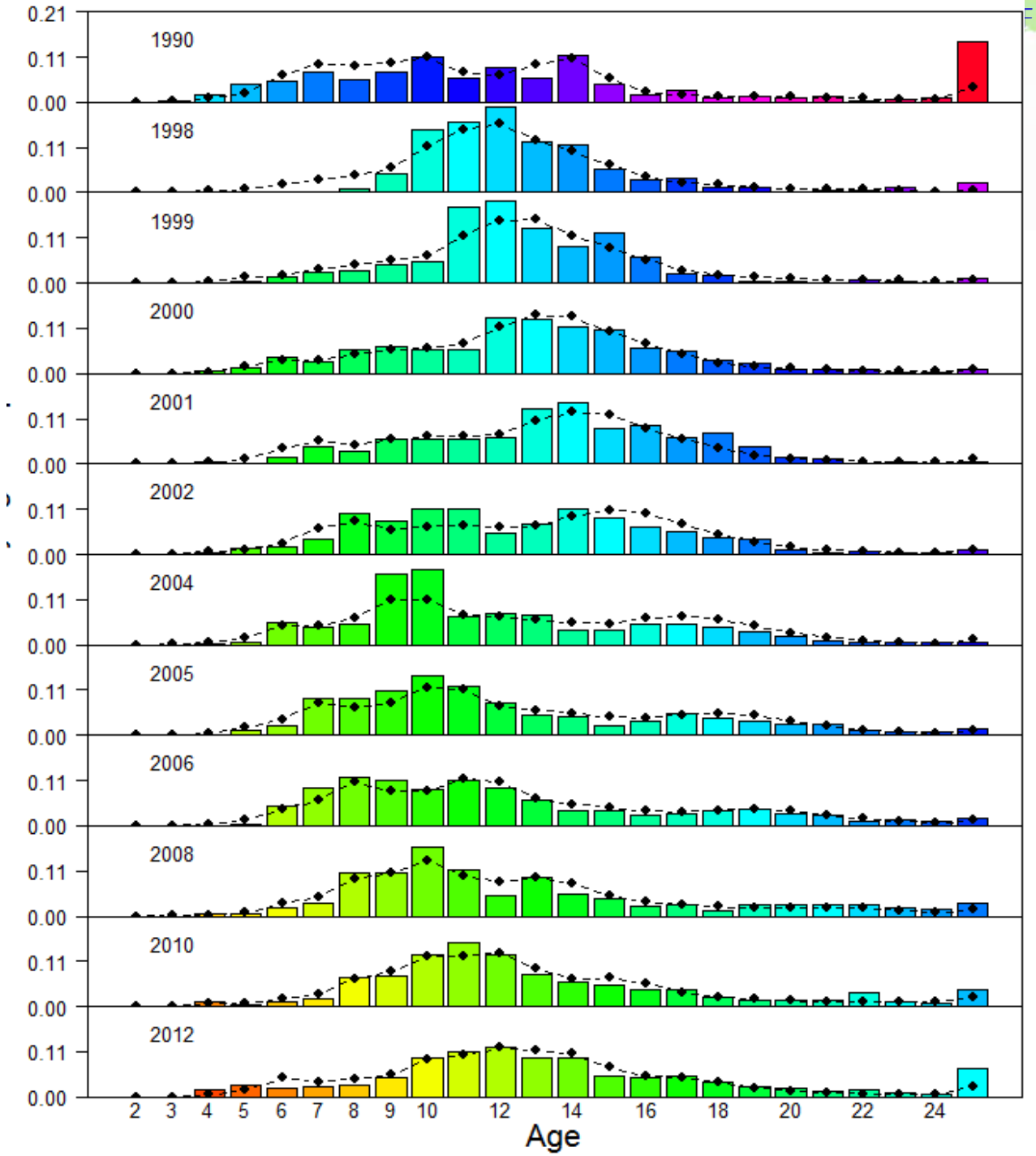
GOA POP – Catch



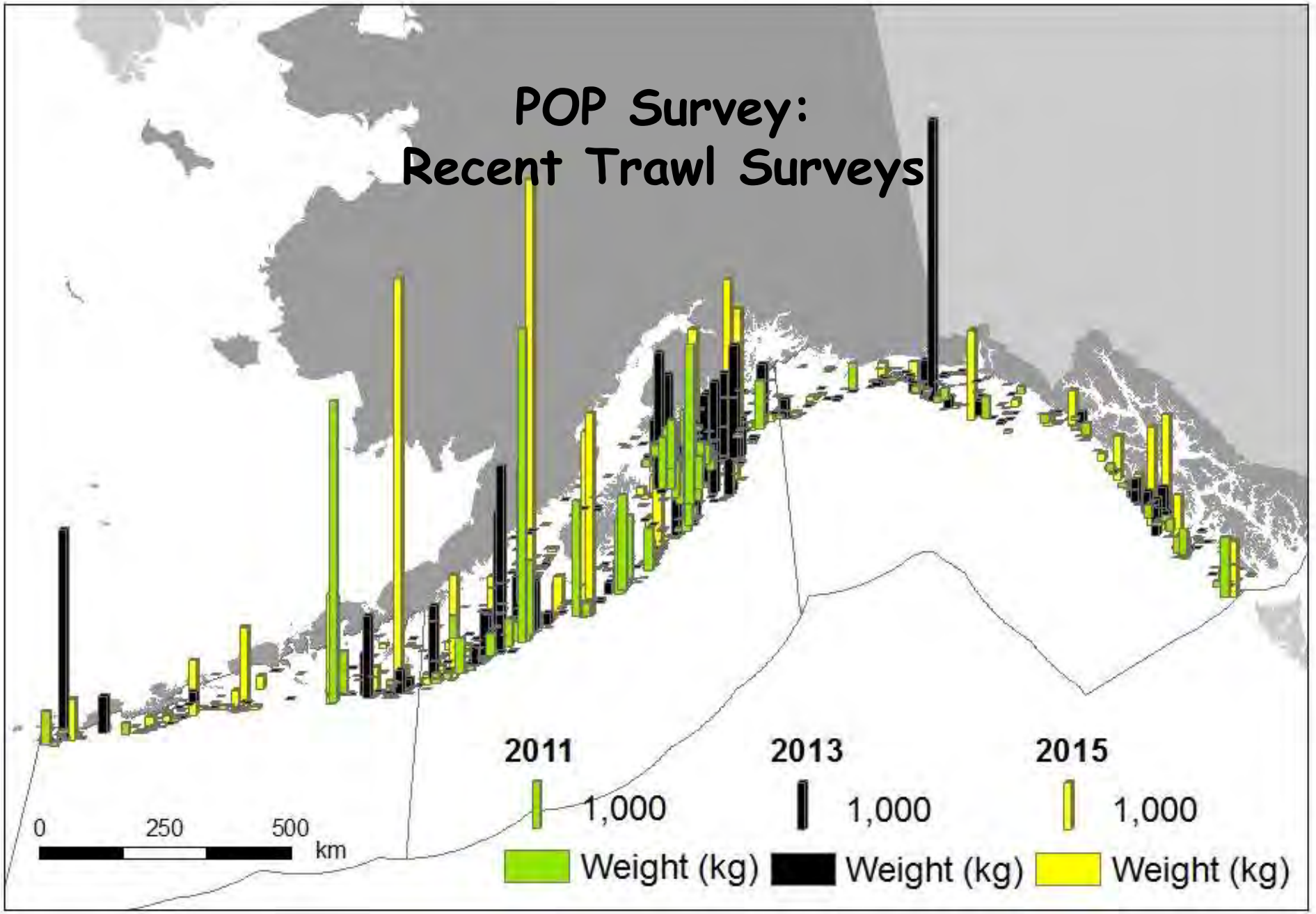


GOA POP – Survey Biomass

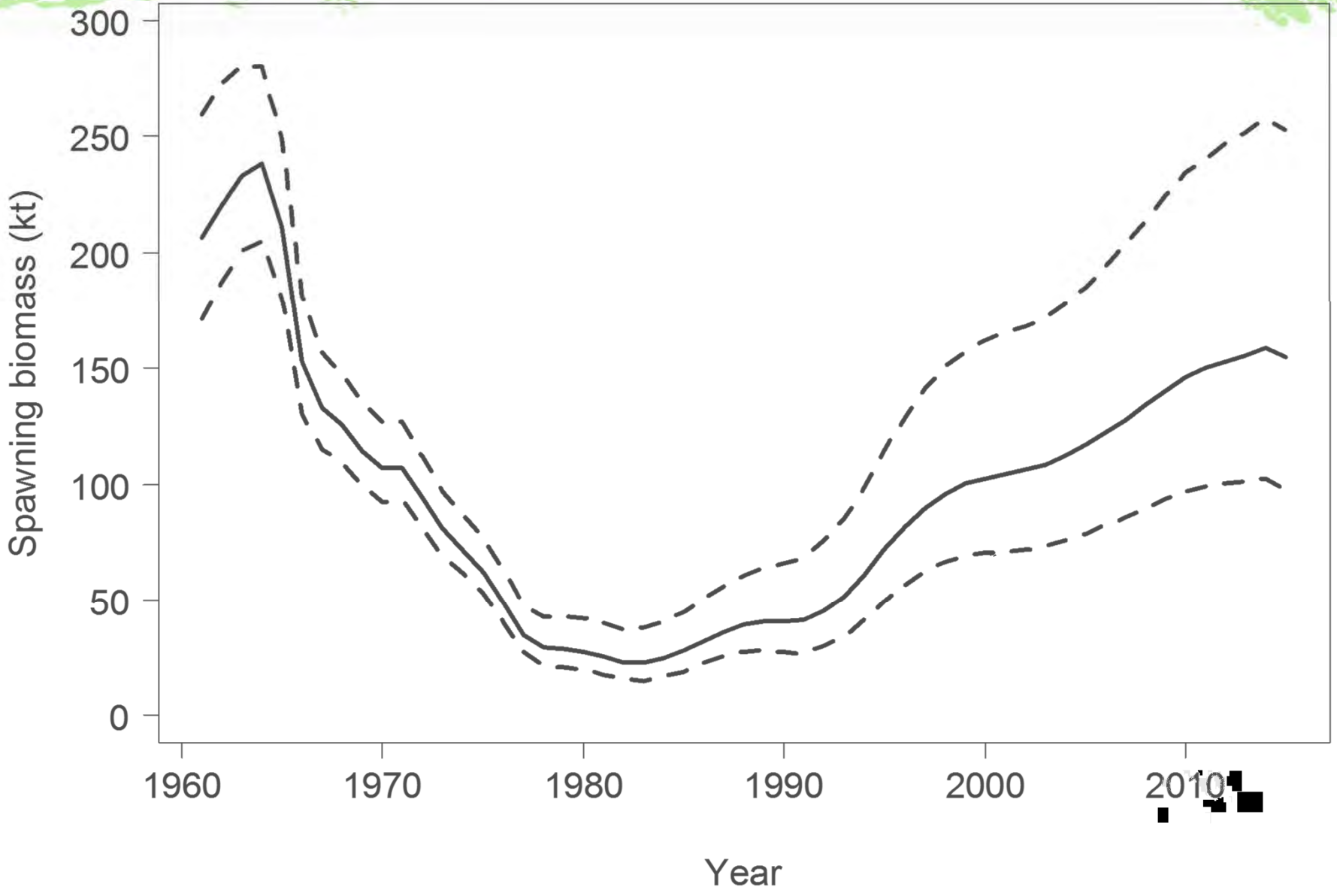




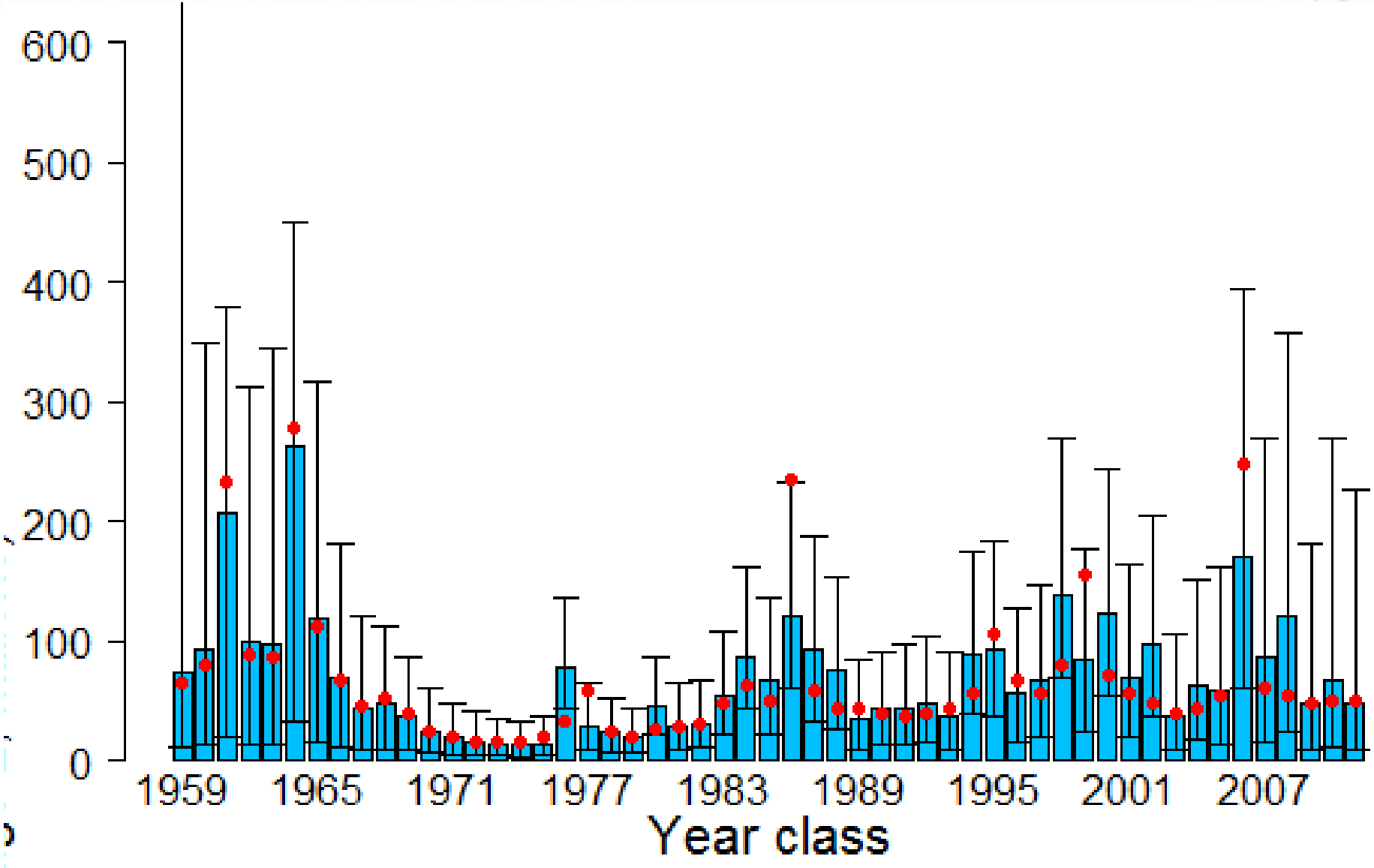
GOA POP Fishery Age data fits


POP Survey:
Recent Trawl Surveys
2011
1,000
Weight (kg)
2013
1,000
Weight (kg)
2015
1,000
Weight (kg)
0
250
500
km

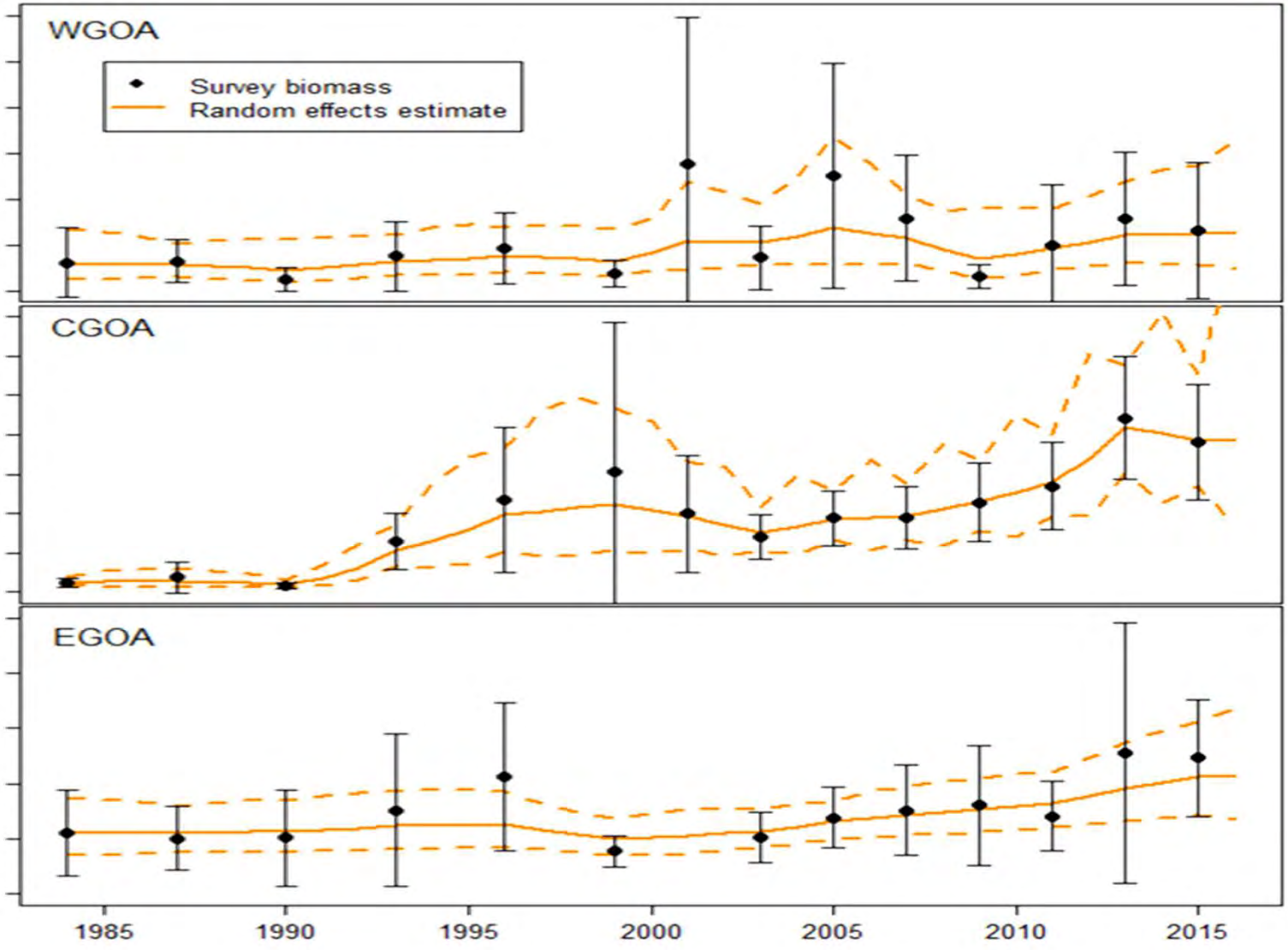
POP – Spawning biomass



POP – Recruitment



GOA POP Apportionment

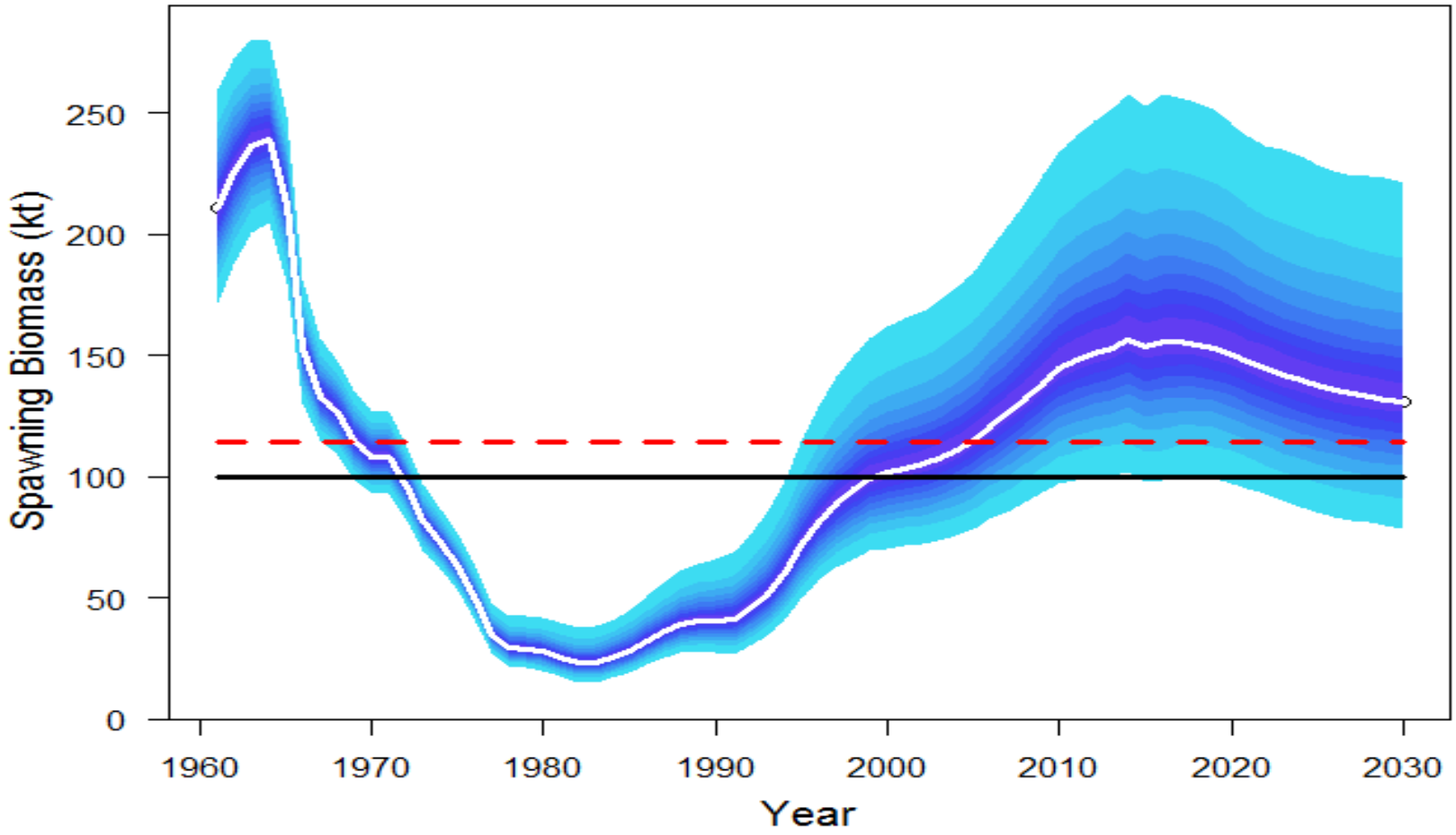


POP – Summary

- Future looks stable
- Projections indicate increasing abundance
- To do for next full assessment specific to POP:
  - Investigate alternative trawl survey index
  - Investigate alternative length bins
  - Input sample sizes for comp data
  - Check out fishery selectivity in relation to average depth fished

GOA Pacific ocean perch

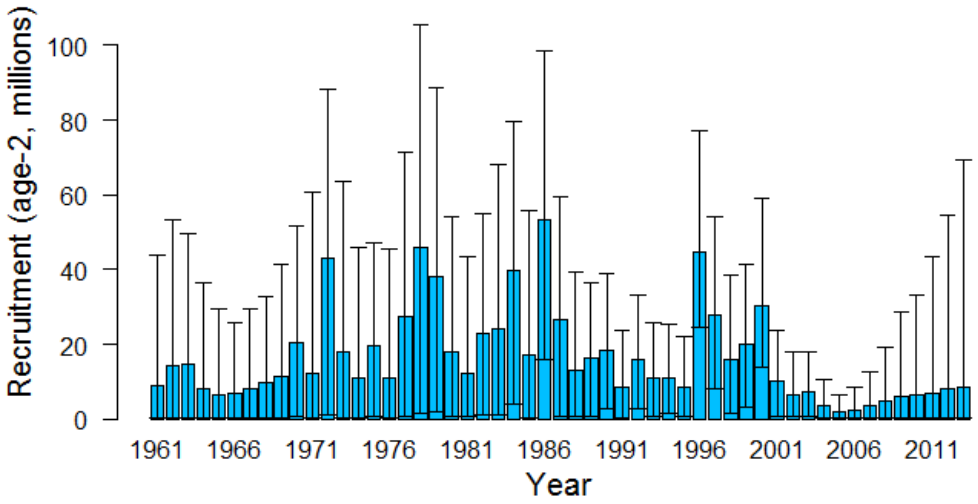
	Biomass	OFL	ABC
2016	457,768	28,431	24,437
2017		28,141	24,189

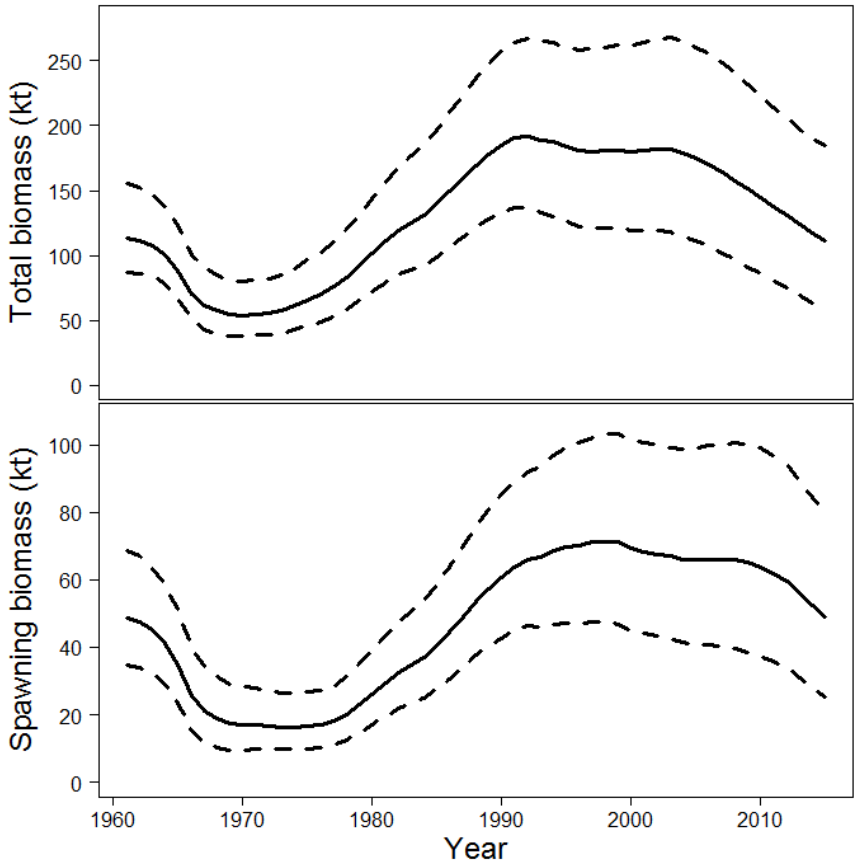


Rockfish Summary

Species	2015	2016	Change
POP	21,012	24,437	up 3,425 (16%)
northern rockfish	4,998	4,004	down 994 (20%)
Shortraker Rockfish	1,323	1,286	down 37 (3%)
Dusky	5,109	4,686	down 423 (8%)
Rougheye and Blackspotted Rockfish	1,122	1,328	same (0%)
Demersal shelf rockfish	225	231	same (0%)
Thornyhead	1,841	1,961	up 120 (7%)
Other rock	4,080	5,773	up 1,693 (41%)
Sub Total	39,710	43,706	up 3,996 (10%)

GOA Northern rockfish

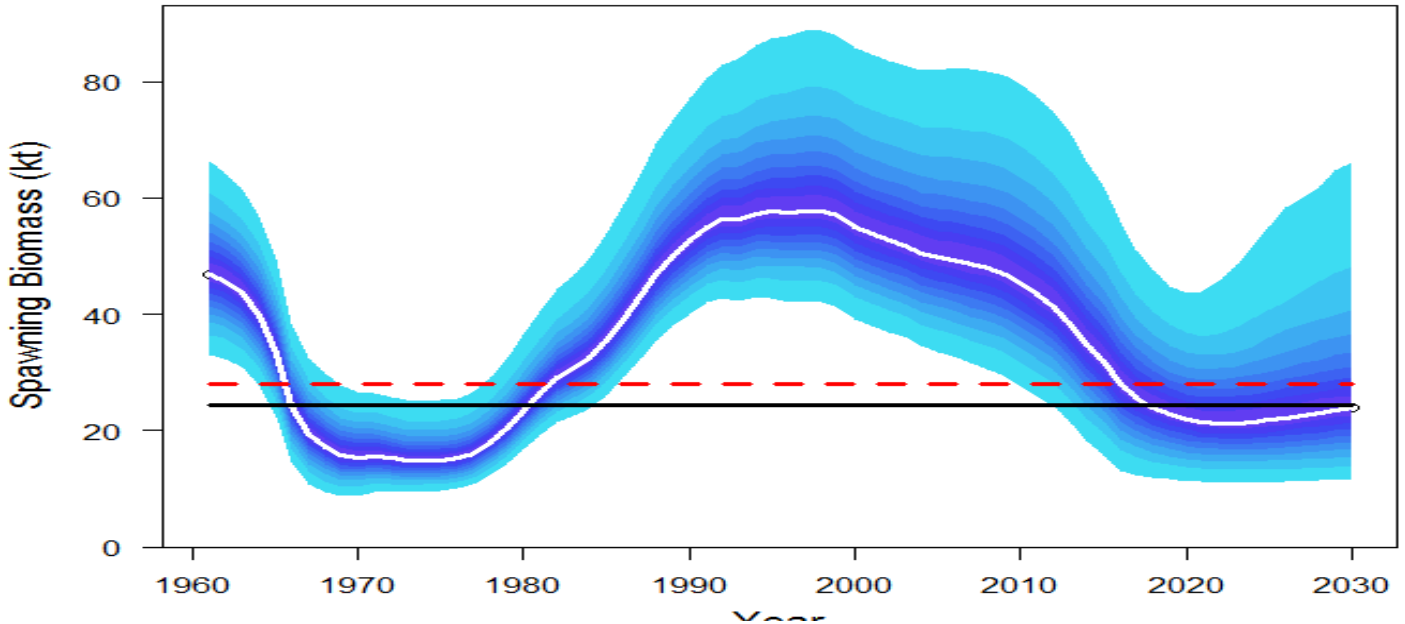




GOA Northern rockfish

	Biomass	OFL	ABC
2016	77,596	4,783	4,004
2017		4,501	3,768

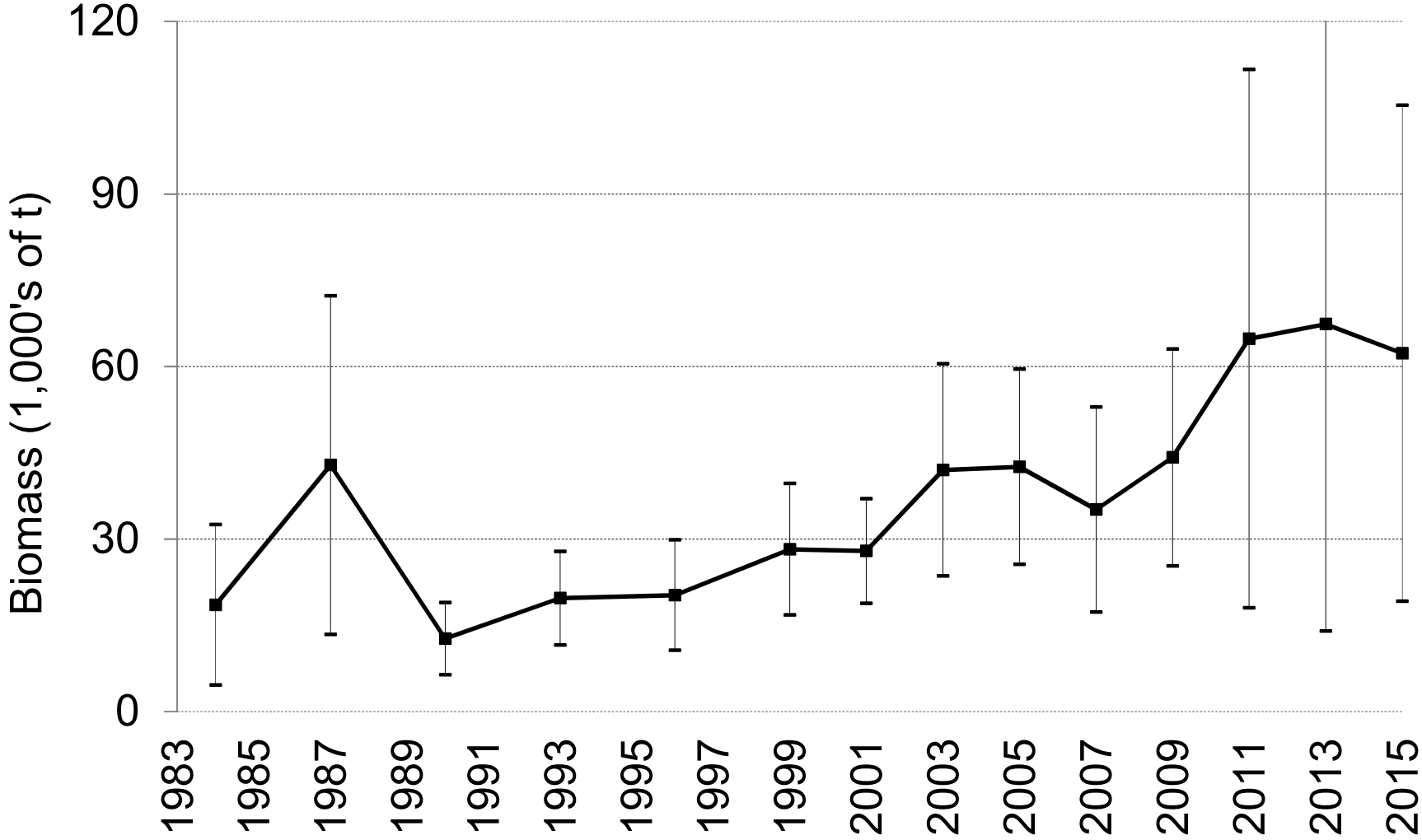
- Future work on alternative index based on geostatistical estimator:
  - Relative weighting with other data
  - Estimate age/length comps accordingly



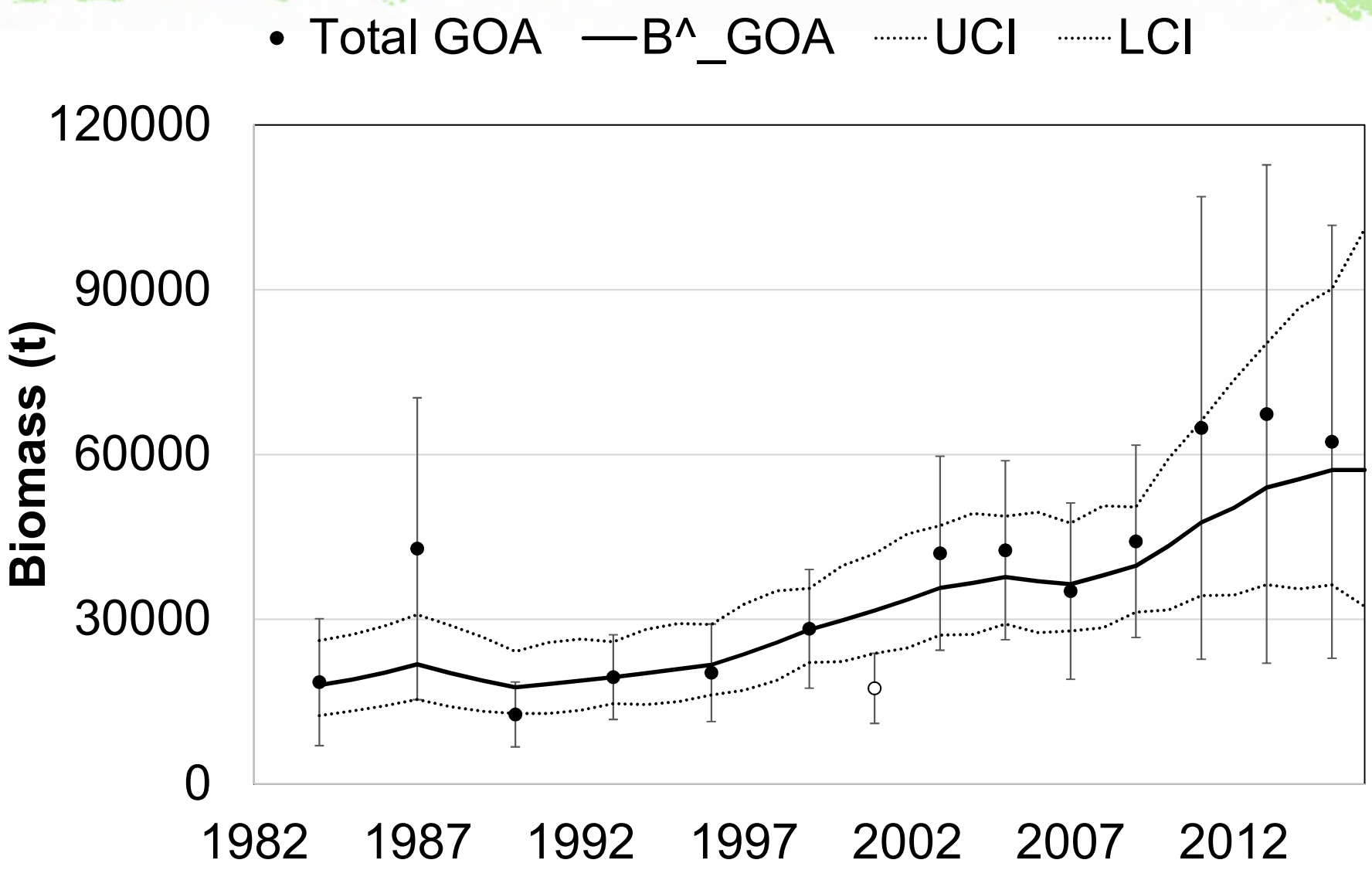
Rockfish Summary

Species	2015	2016	Change
POP	21,012	24,437	up 3,425 (16%)
northern rockfish	4,998	4,004	down 994 (20%)
Shortraker Rockfish	1,323	1,286	down 37 (3%)
Dusky	5,109	4,686	down 423 (8%)
Rougheye and Blackspotted Rockfish	1,122	1,328	same (0%)
Demersal shelf rockfish	225	231	same (0%)
Thornyhead	1,841	1,961	up 120 (7%)
Other rock	4,080	5,773	up 1,693 (41%)
Sub Total	39,710	43,706	up 3,996 (10%)

GOA shortraker rockfish

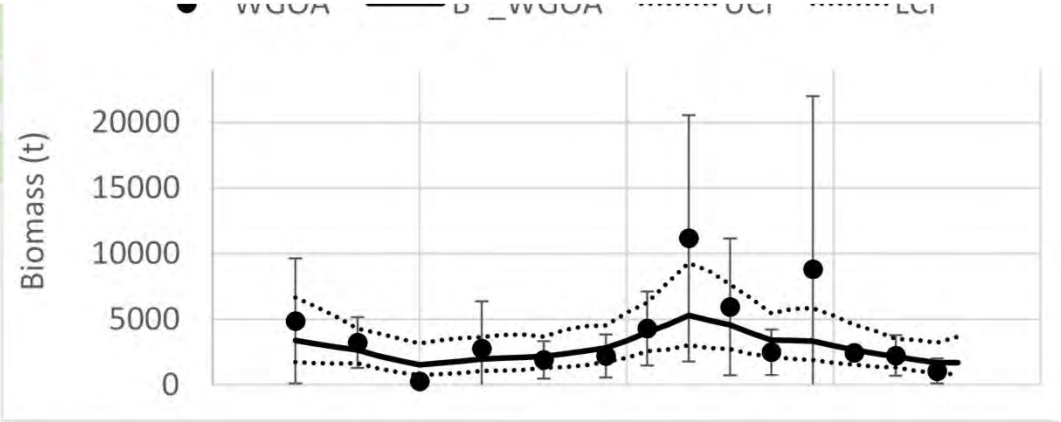


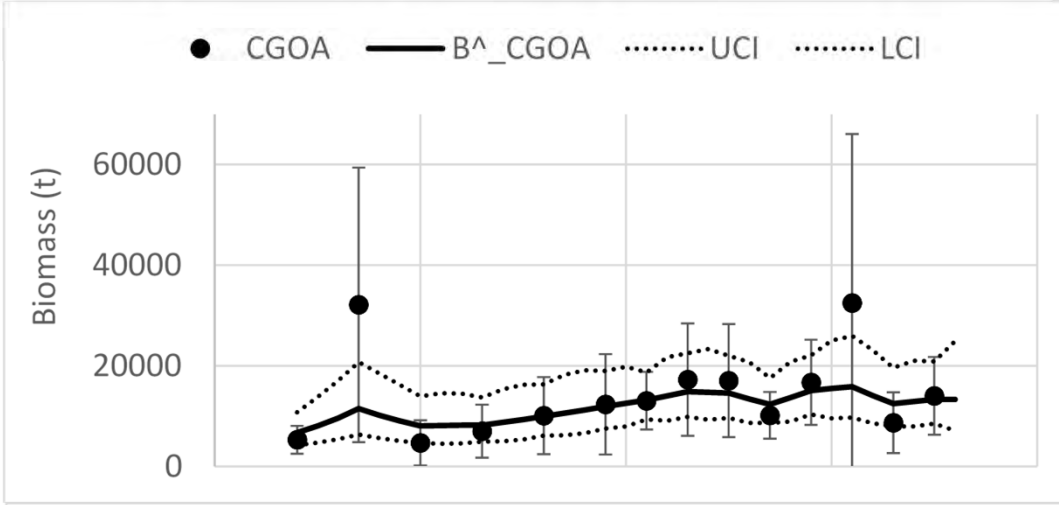
GOA shortraker rockfish

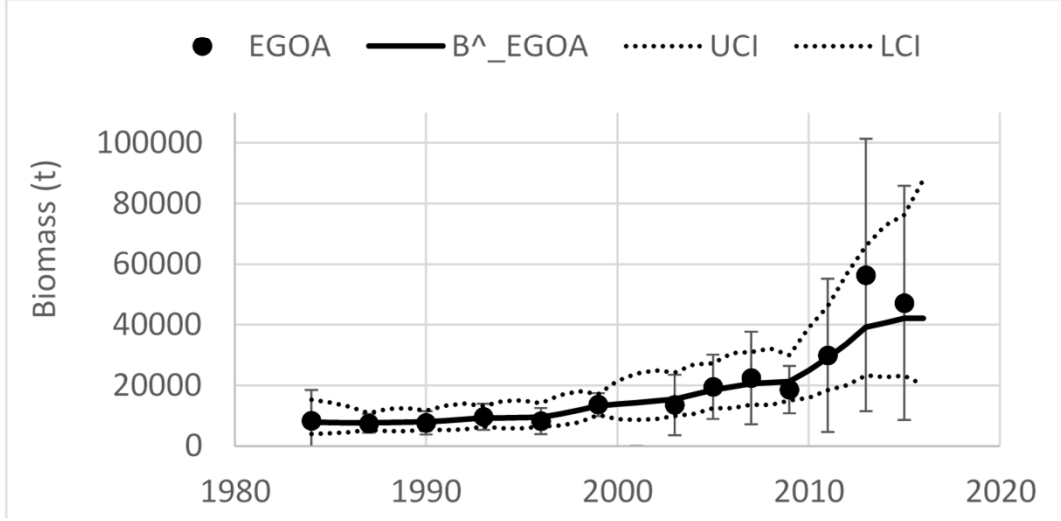


GOA shortraker rockfish

W	C	E	
3%	23%	74%	**Total**
38	301	947	1,286 t



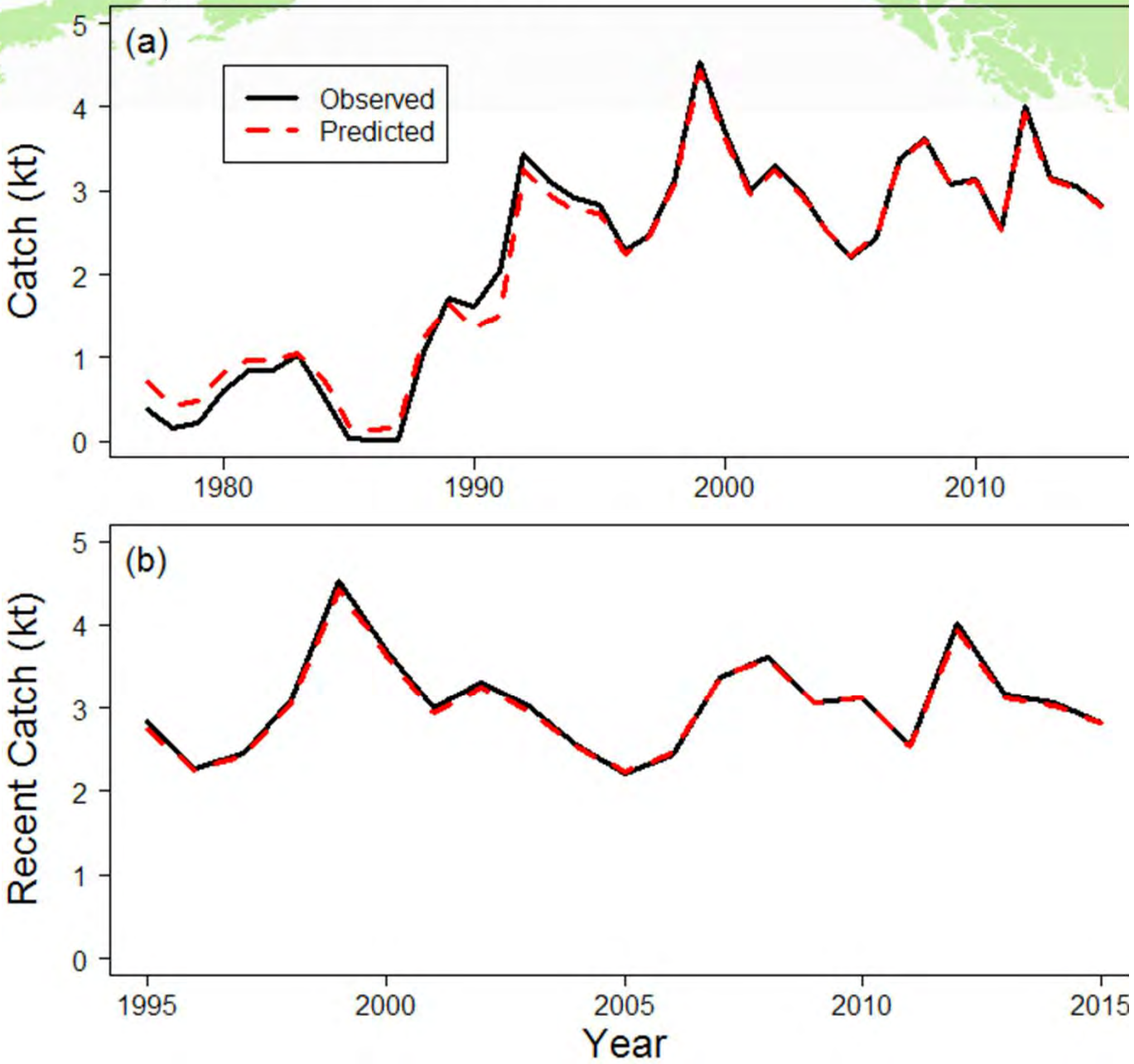




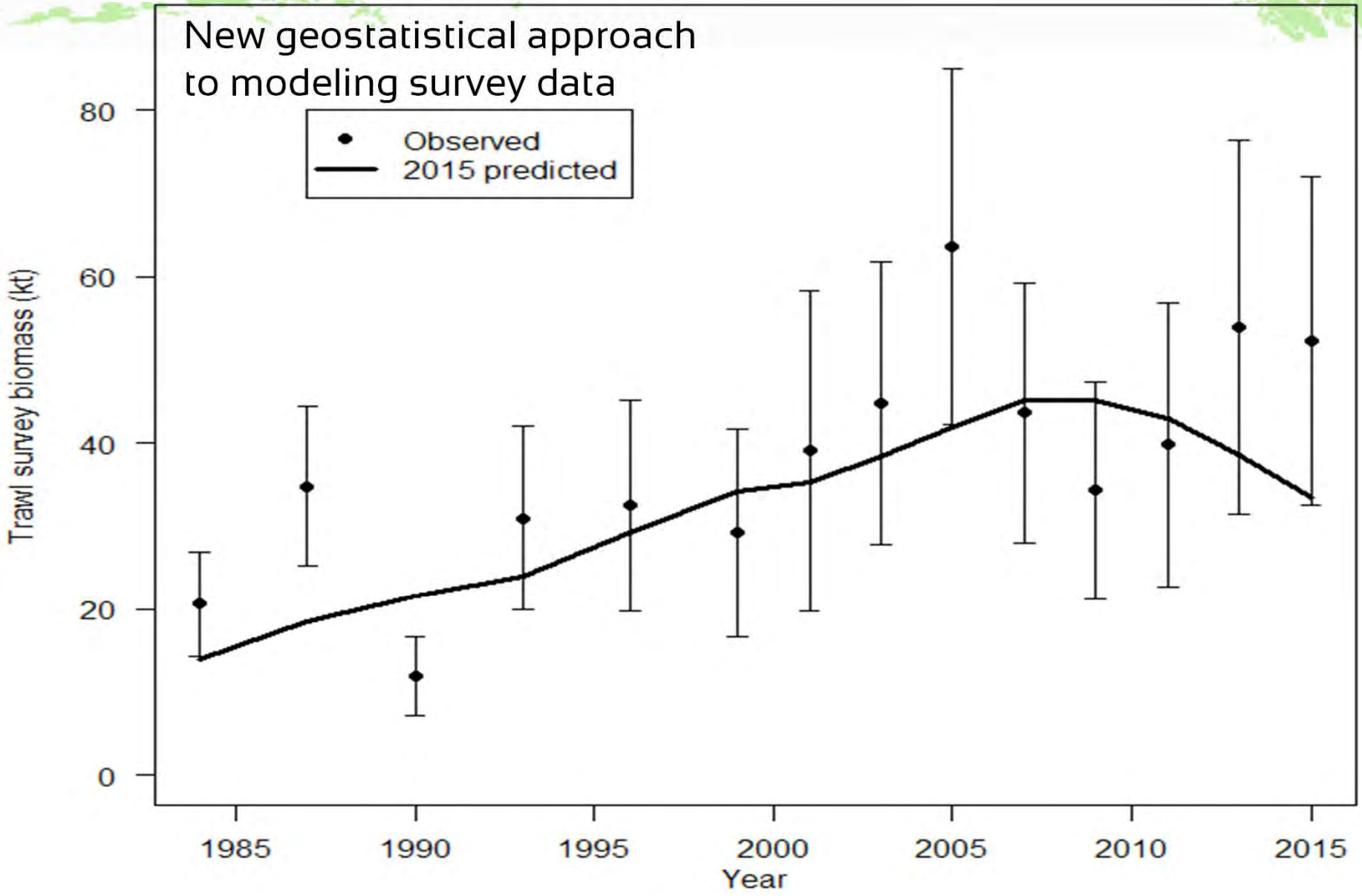
Rockfish Summary

Species	2015	2016	Change
POP	21,012	24,437	up 3,425 (16%)
northern rockfish	4,998	4,004	down 994 (20%)
Shortraker Rockfish	1,323	1,286	down 37 (3%)
Dusky	5,109	4,686	down 423 (8%)
Rougheye and Blackspotted Rockfish	1,122	1,328	same (0%)
Demersal shelf rockfish	225	231	same (0%)
Thornyhead	1,841	1,961	up 120 (7%)
Other rock	4,080	5,773	up 1,693 (41%)
Sub Total	39,710	43,706	up 3,996 (10%)

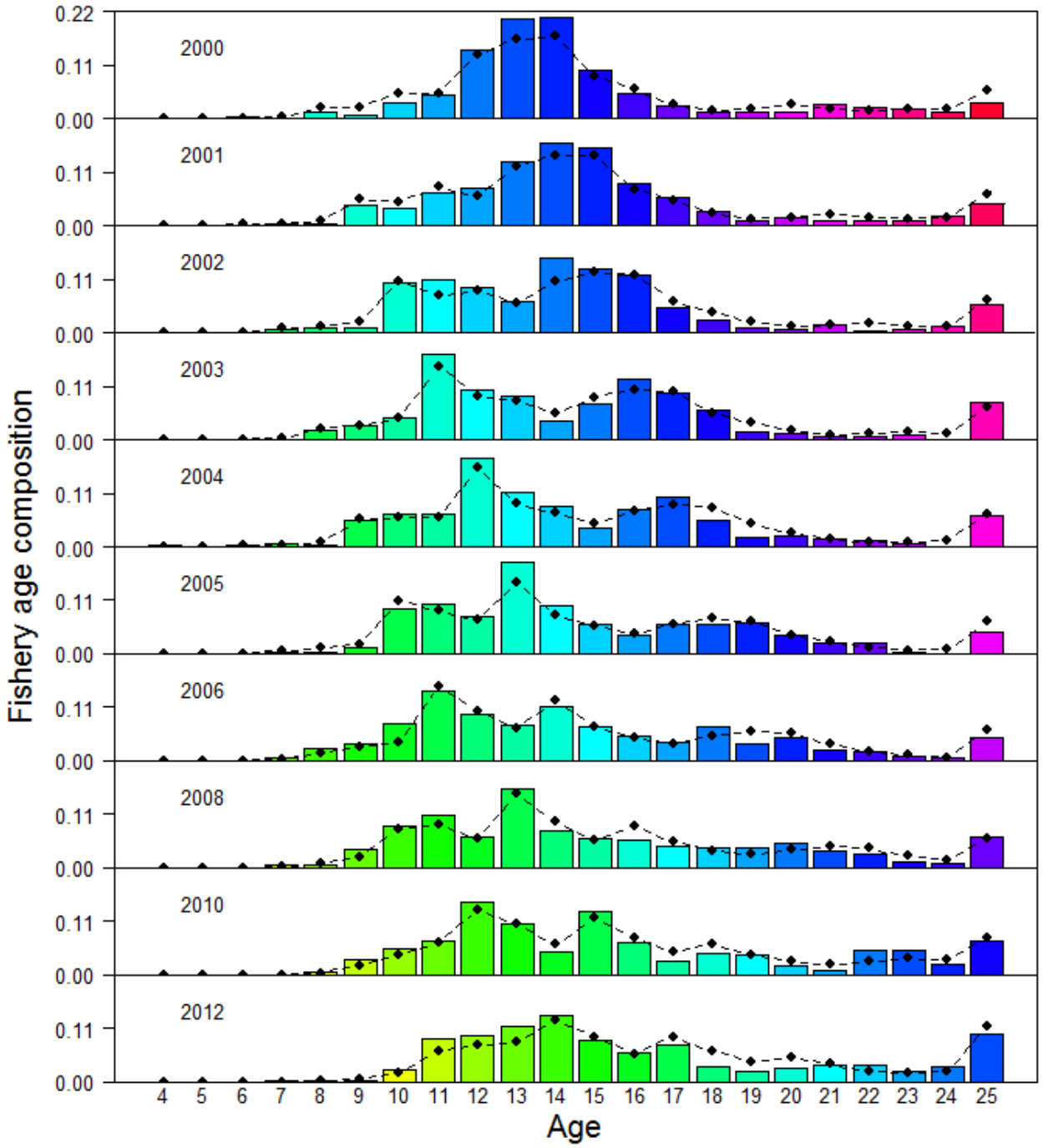
12. GOA Dusky rockfish



12. GOA Dusky rockfish (p. 975)

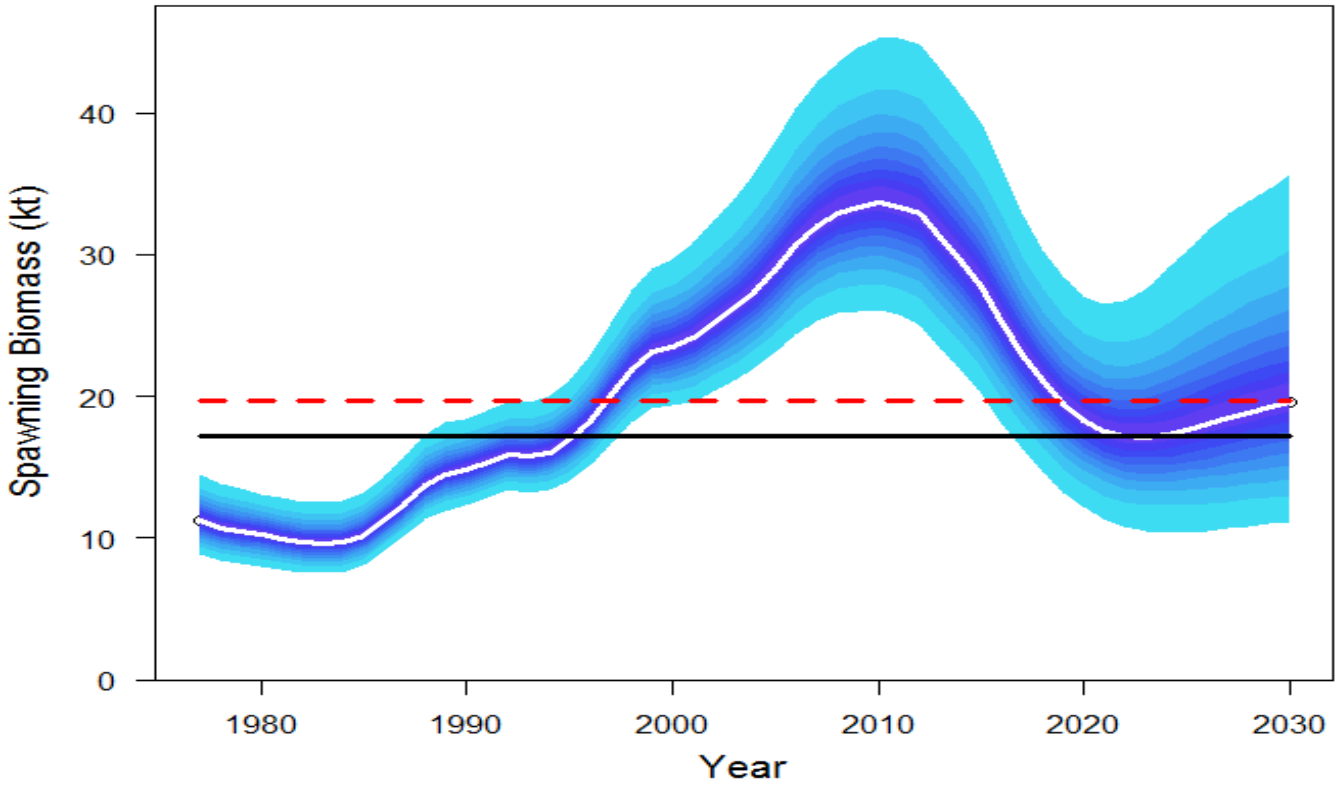


12. GOA Dusky rockfish



12. Dusky rockfish summary

	Biomass	OFL	ABC
2016	60,072	5,733	4,686
2017		5,253	4,284



Dusky rockfish

Rockfish Summary

Species	2015	2016	Change
POP	21,012	24,437	up 3,425 (16%)
northern rockfish	4,998	4,004	down 994 (20%)
Shortraker Rockfish	1,323	1,286	down 37 (3%)
Dusky	5,109	4,686	down 423 (8%)
Rougheye and Blackspotted Rockfish	1,122	1,328	same (0%)
Demersal shelf rockfish	225	231	same (0%)
Thornyhead	1,841	1,961	up 120 (7%)
Other rock	4,080	5,773	up 1,693 (41%)
Sub Total	39,710	43,706	up 3,996 (10%)

RE/BS Genetic Study

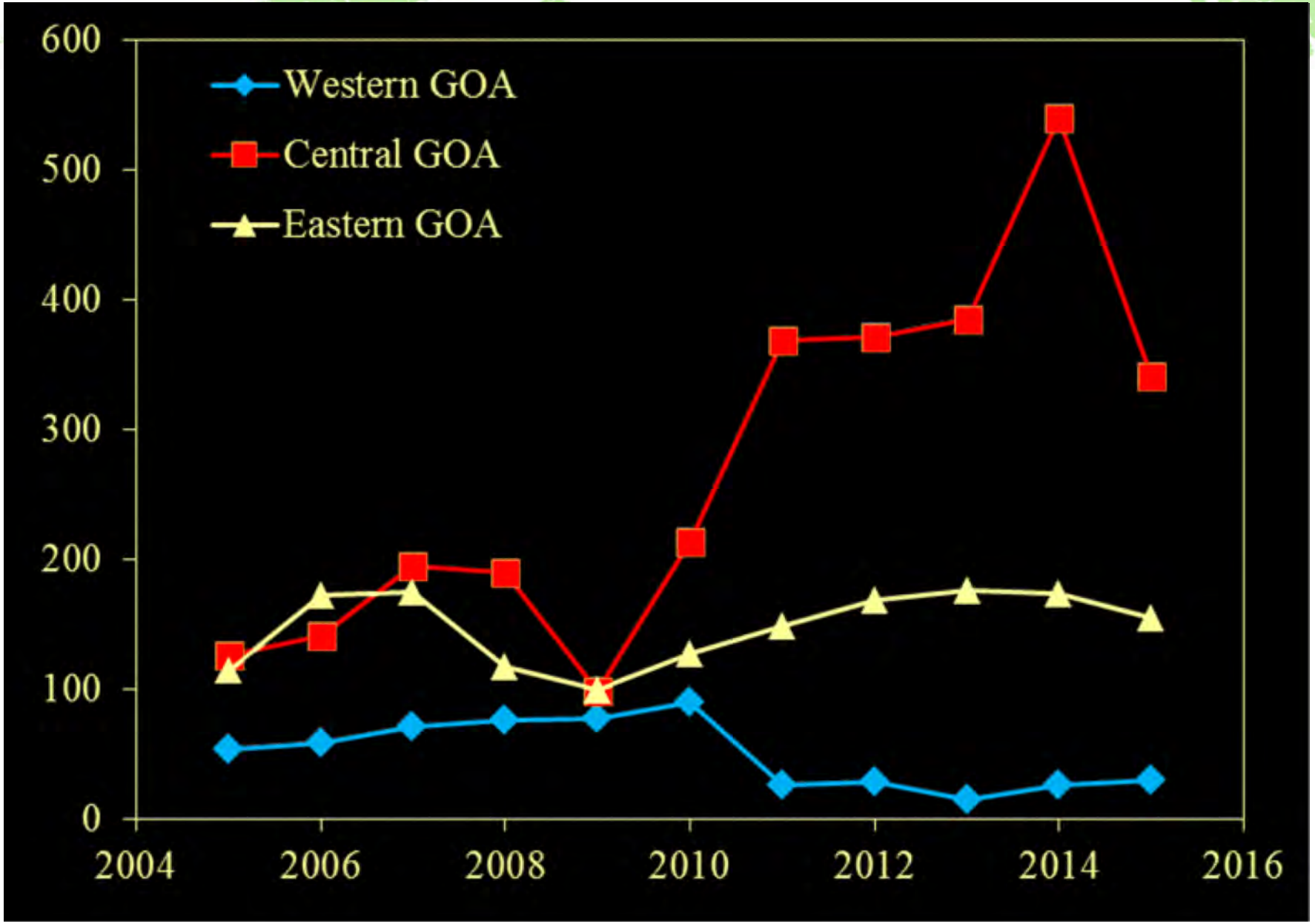
Project during 2009, 2013 and 2015 trawl surveys

- Collected length, weight, muscle tissue or fin clip for most RE/BS samples for otoliths
- Goals to improve at-sea ID, adjust biomass estimates by species, examine species-specific growth

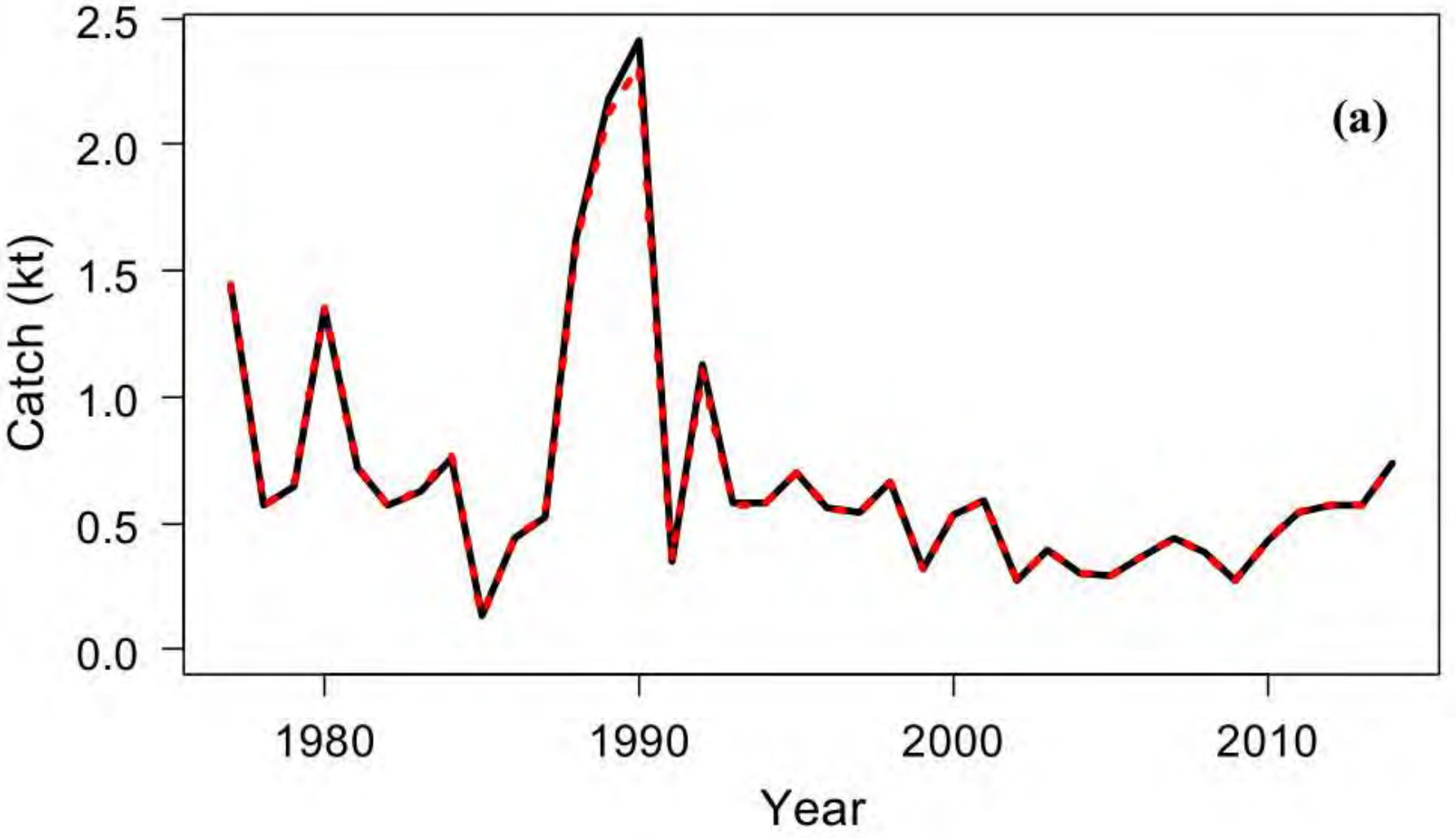
Results

- Samples: 895 in 2009, 1,057 in 2013, 1,053 in 2015
- ID generally improving in field with new field guide
- RE younger on average than BS (15 vs 20 years) and grow faster with greater max size
- Continue with analysis for all three surveys

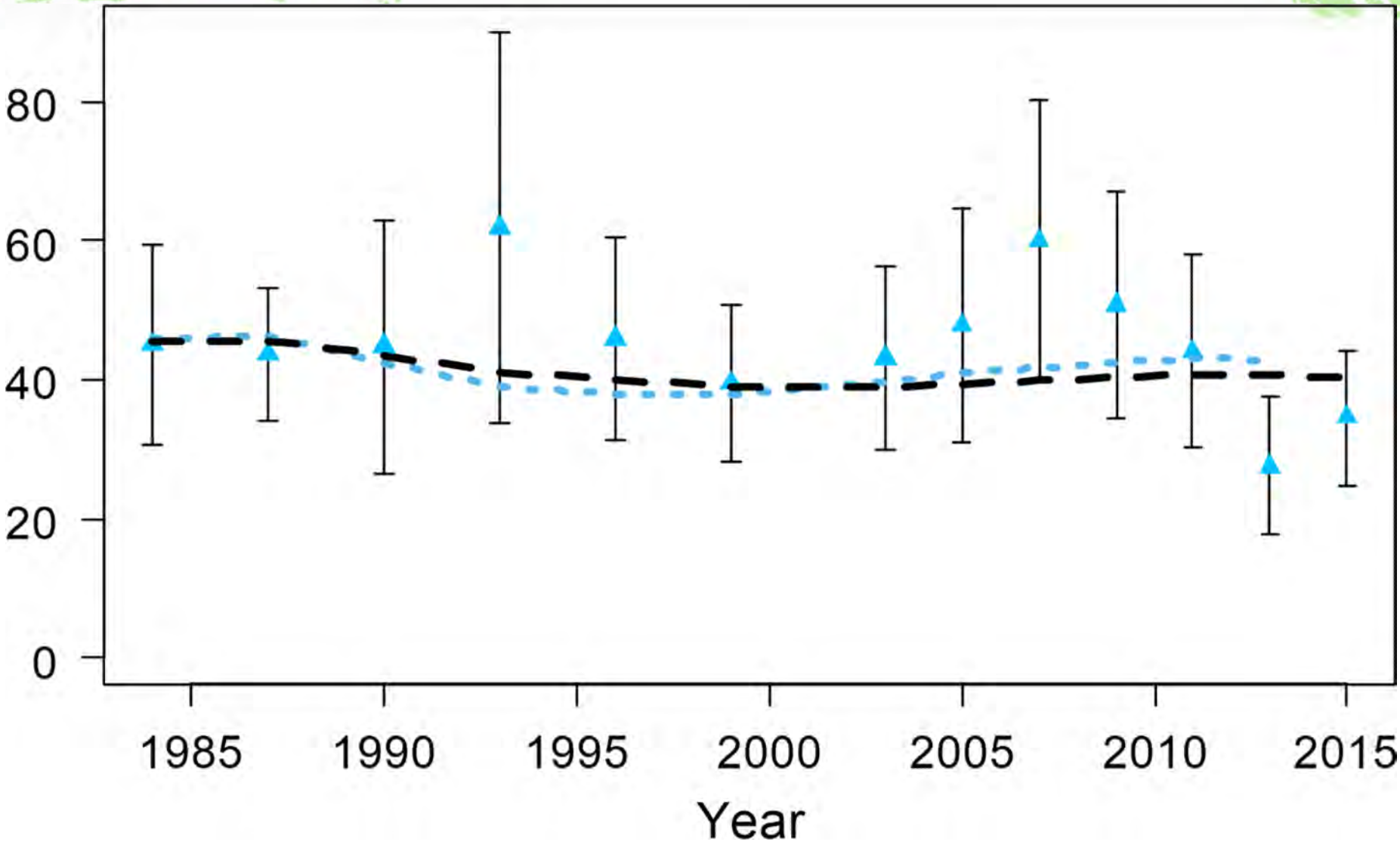
RE/BS Catch by Region



RE/BS Catch

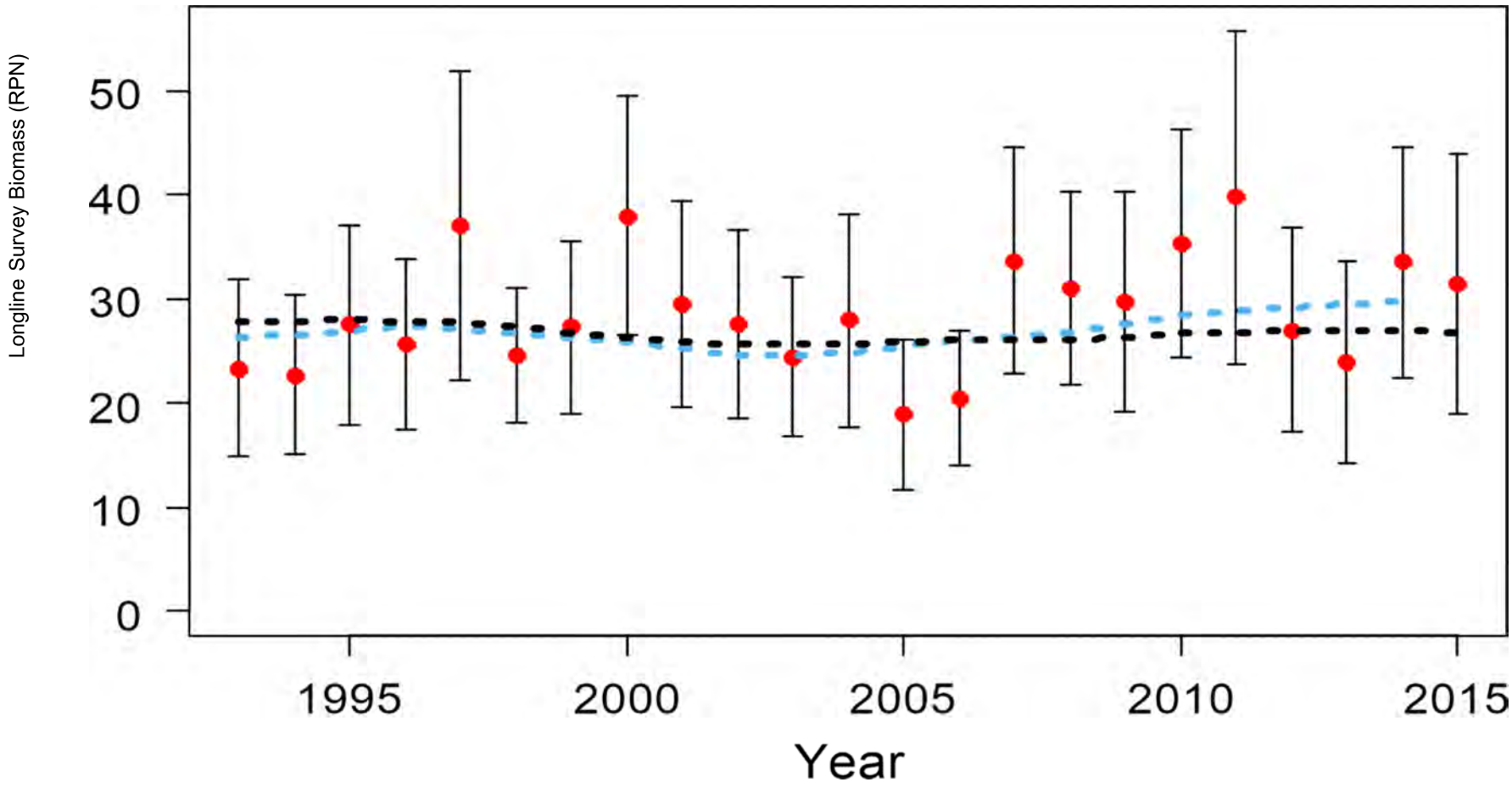


RE/BS Trawl Survey Biomass



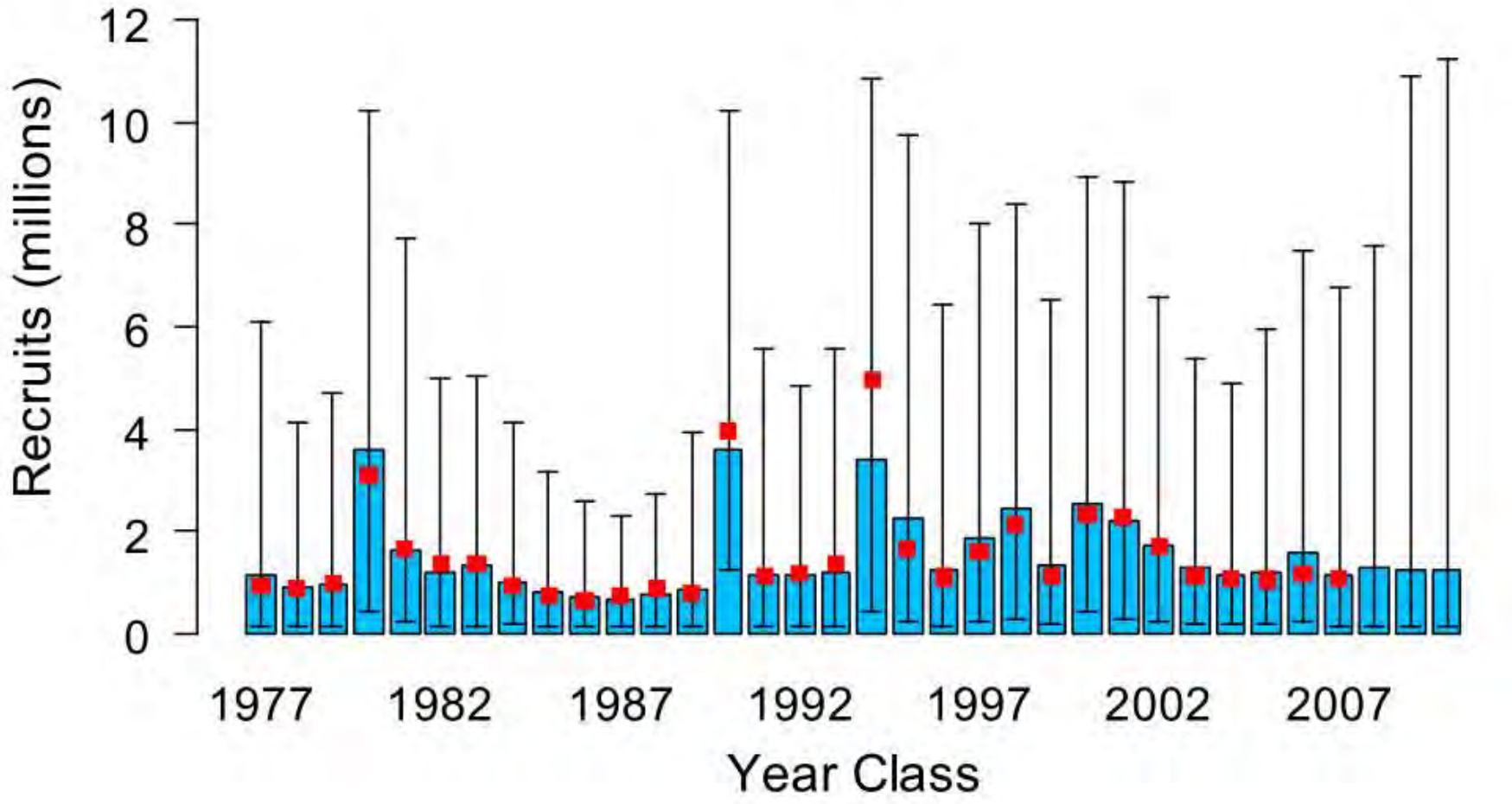
Red line = M0, Blue line = M2

RE/BS LL Survey RPN



Red line = M0 (RPW), Blue line = M2 (RPN)

RE/BS Recruitment



Red square = M0, Blue bar = M2

RE model

WGOA 7.9%

CGOA 53.2%

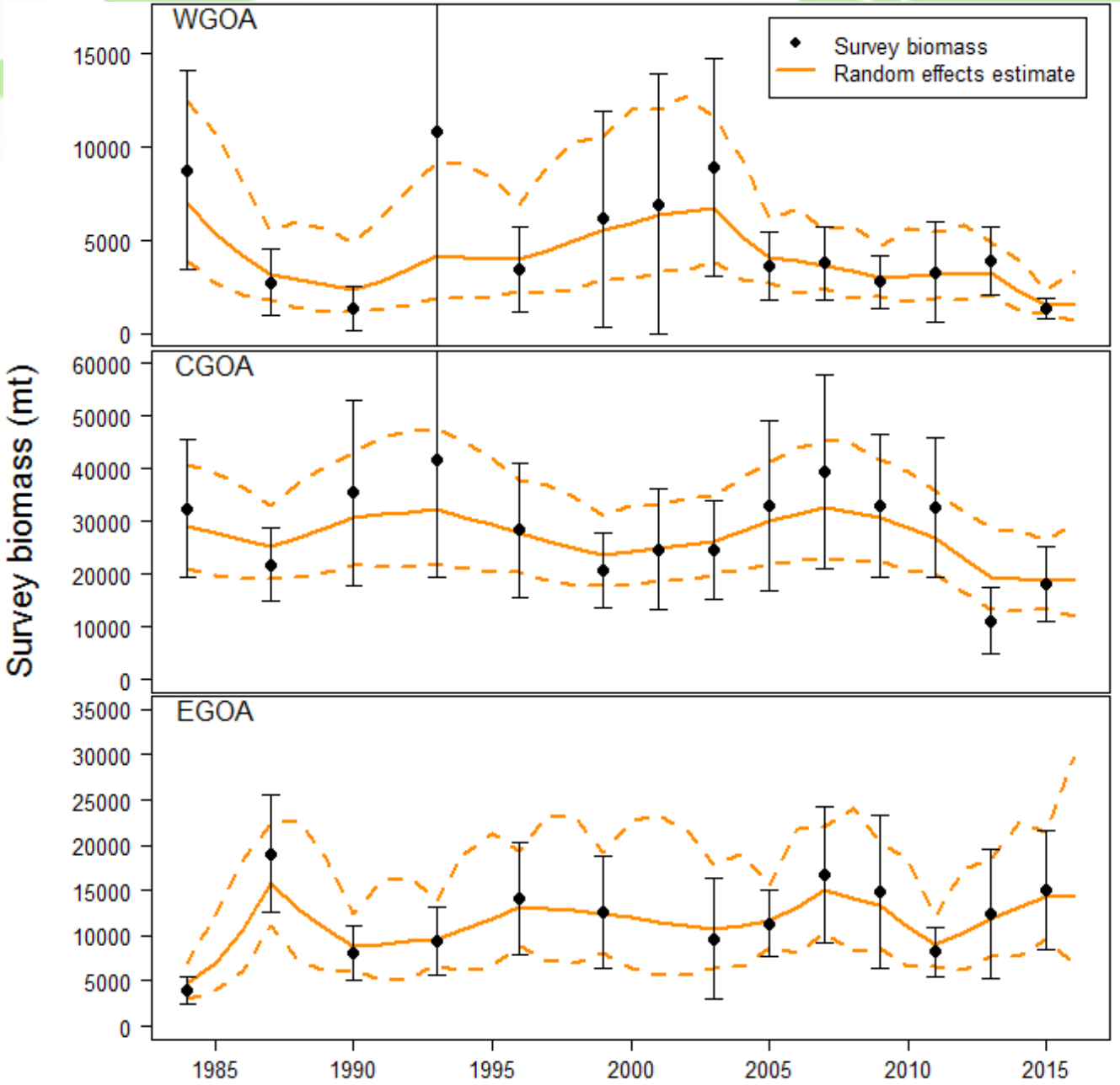
EGOA 38.9%

Survey

WGOA 4.5%

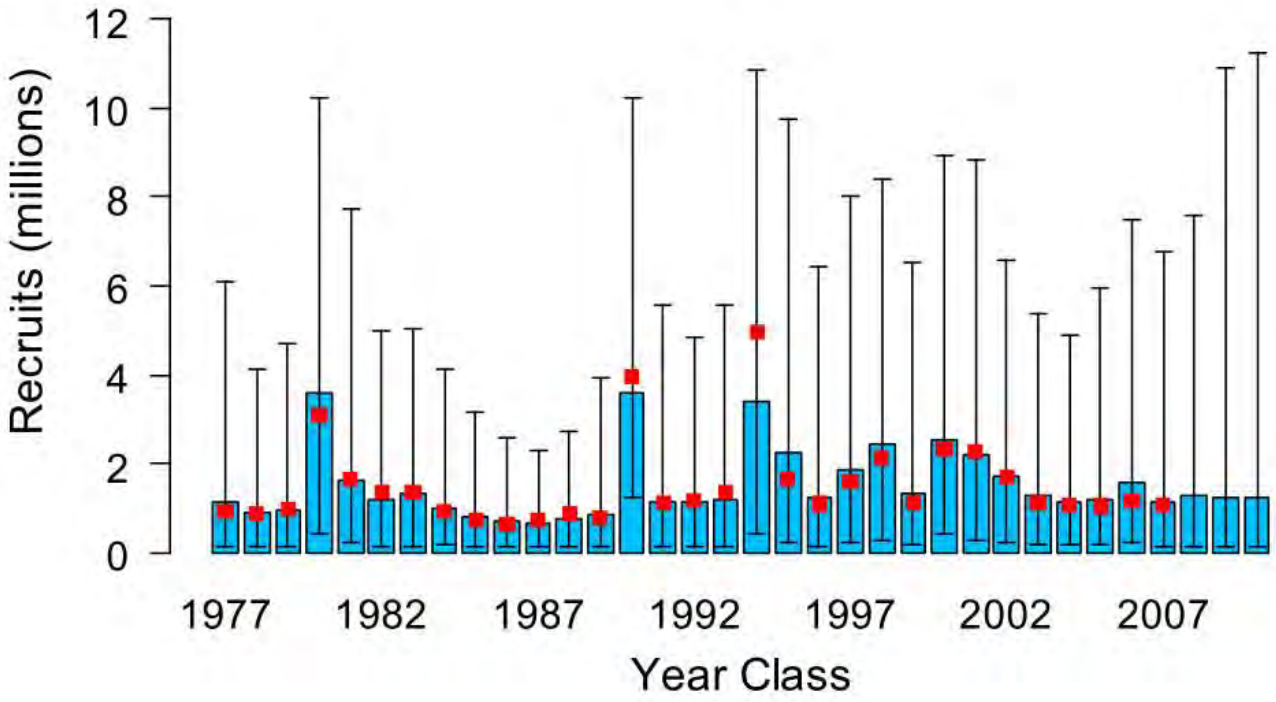
CGOA 54.2%

EGOA 41.3%



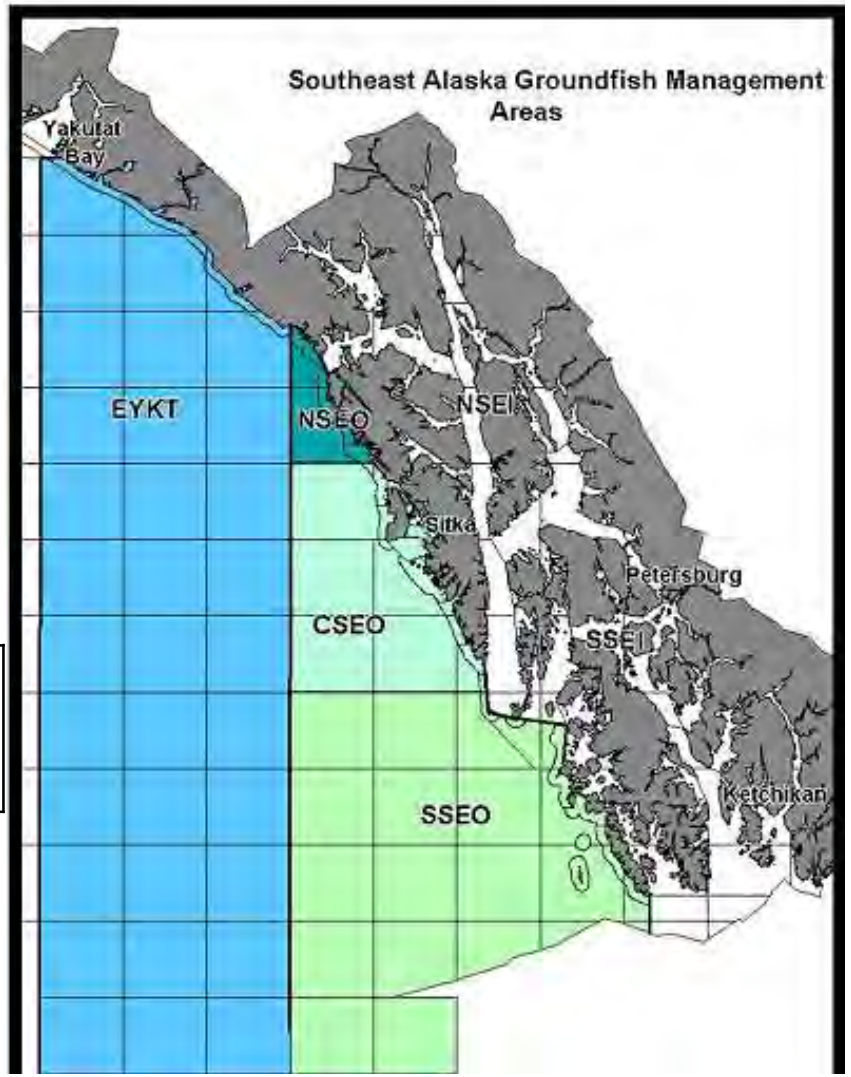
13. Rougheye/blackspotted rockfish summary

Rougheye-BS	Biomass	OFL	ABC
2016	41,864	1,596	1,328
2017		1,592	1,325

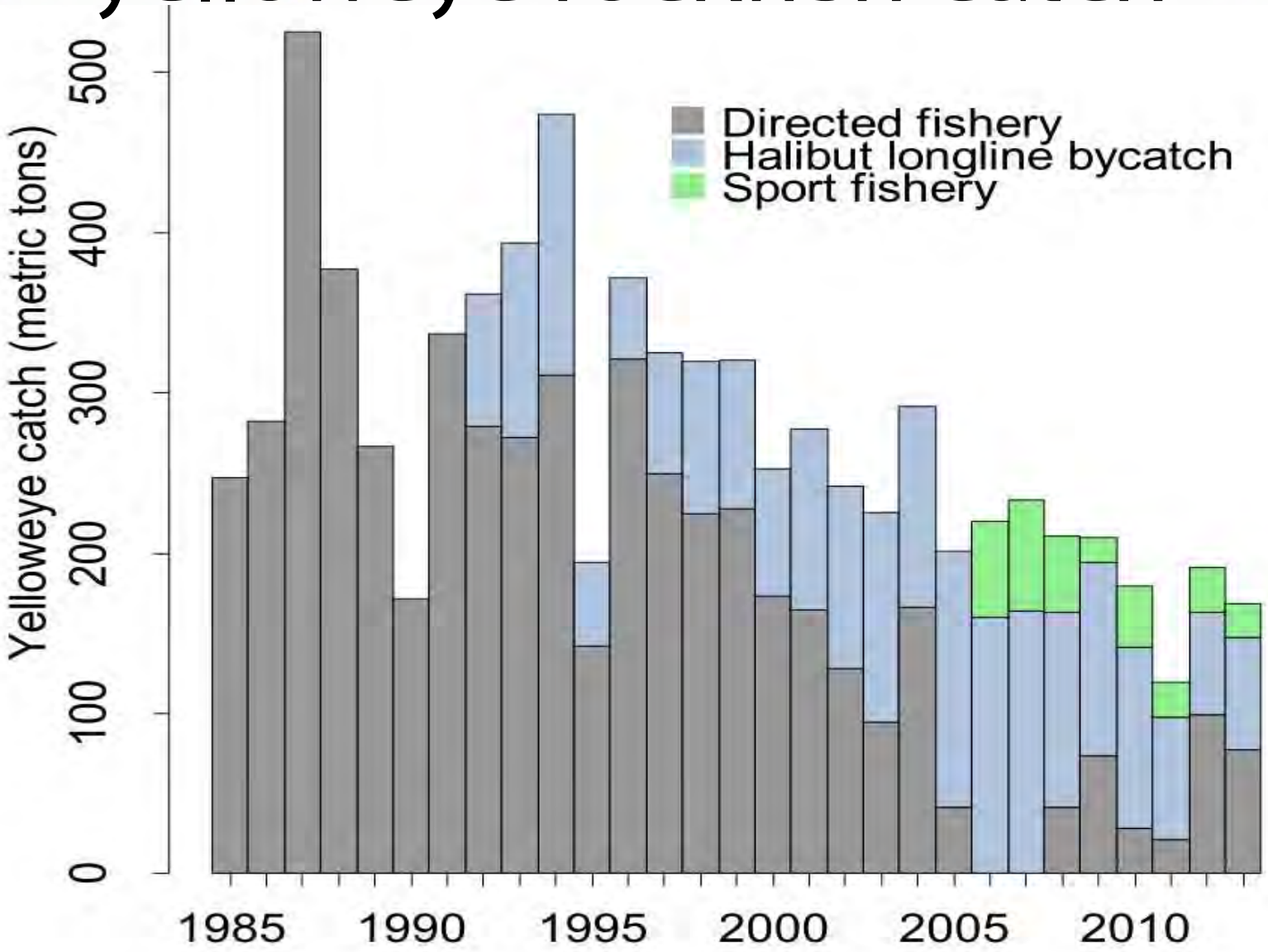


14. Demersal shelf rockfish

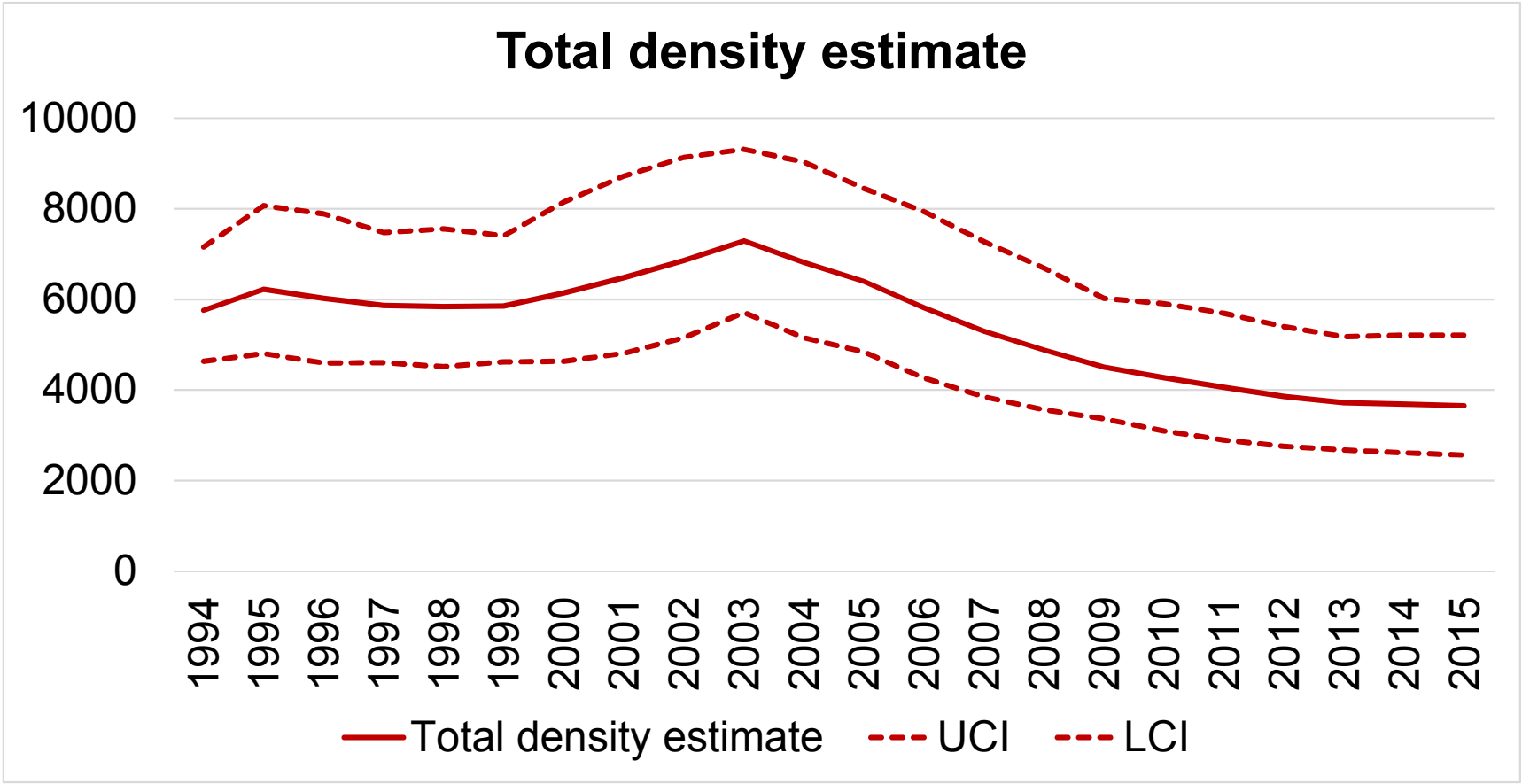
	Biomass	OFL	ABC
2016	10,005	**364**	231
2017		**364**	231



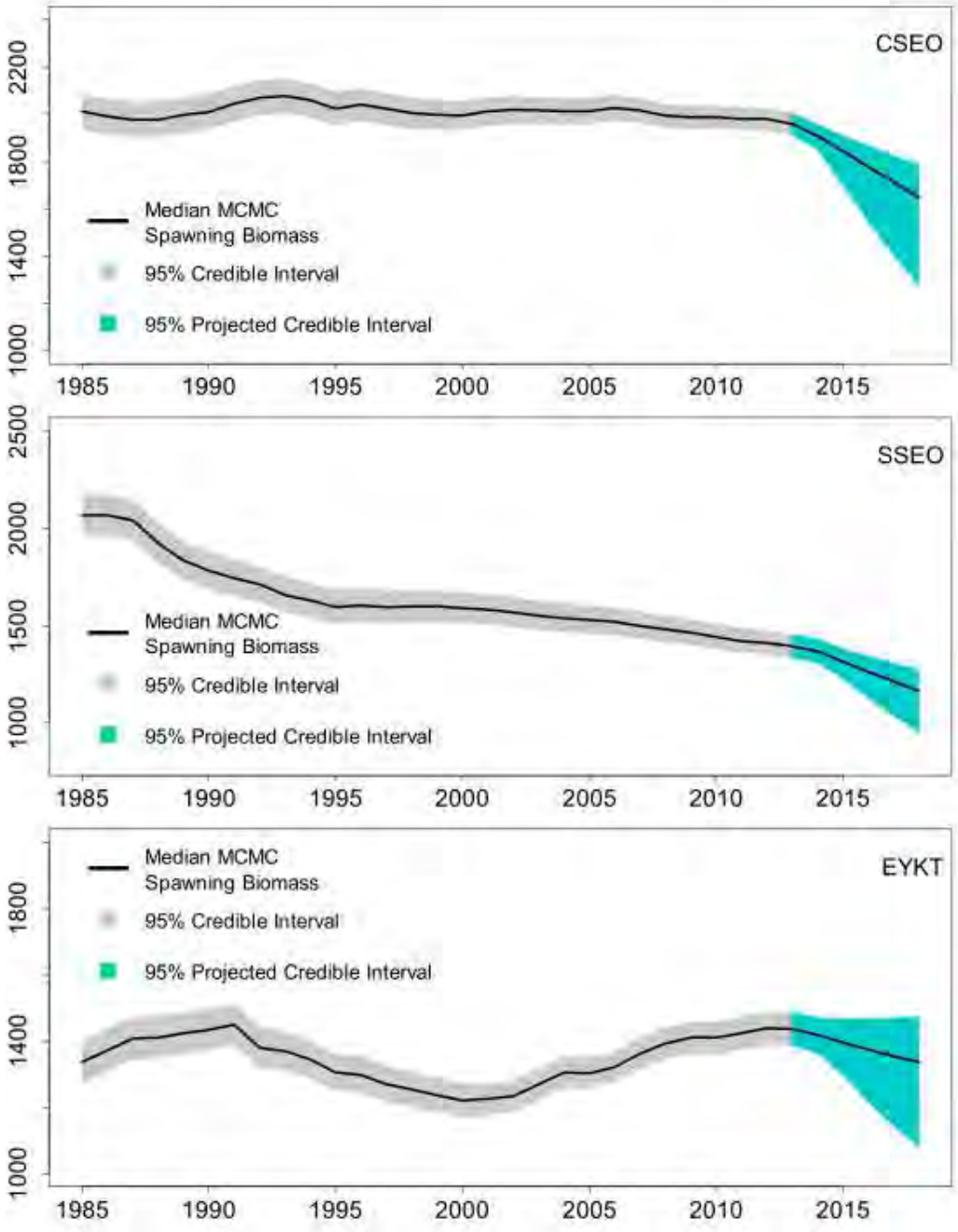
Demersal shelf rockfish yelloweye rockfish catch



14. Demersal shelf rockfish



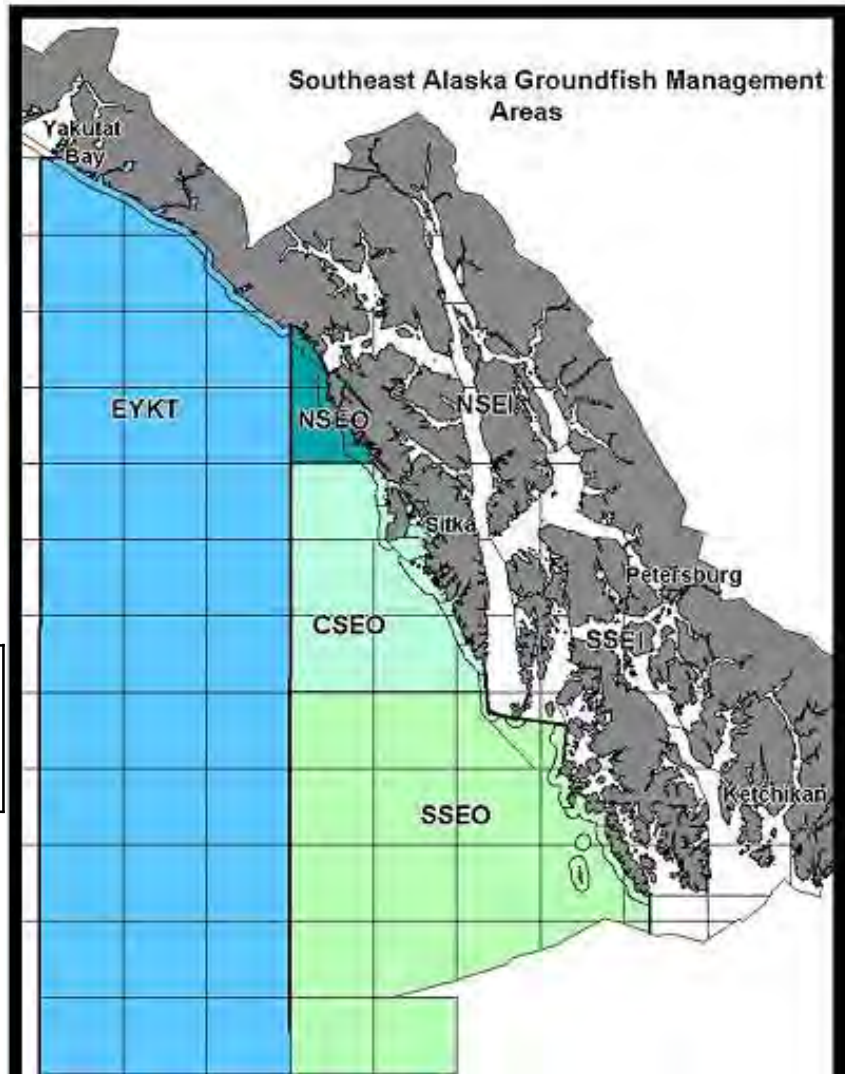
Update on DSR ASA (age structured assessment)



Model discussed, recommend informal working group to continue making improvements

14. Demersal shelf rockfish

	Biomass	OFL	ABC
2016	10,005	**364**	231
2017		**364**	231

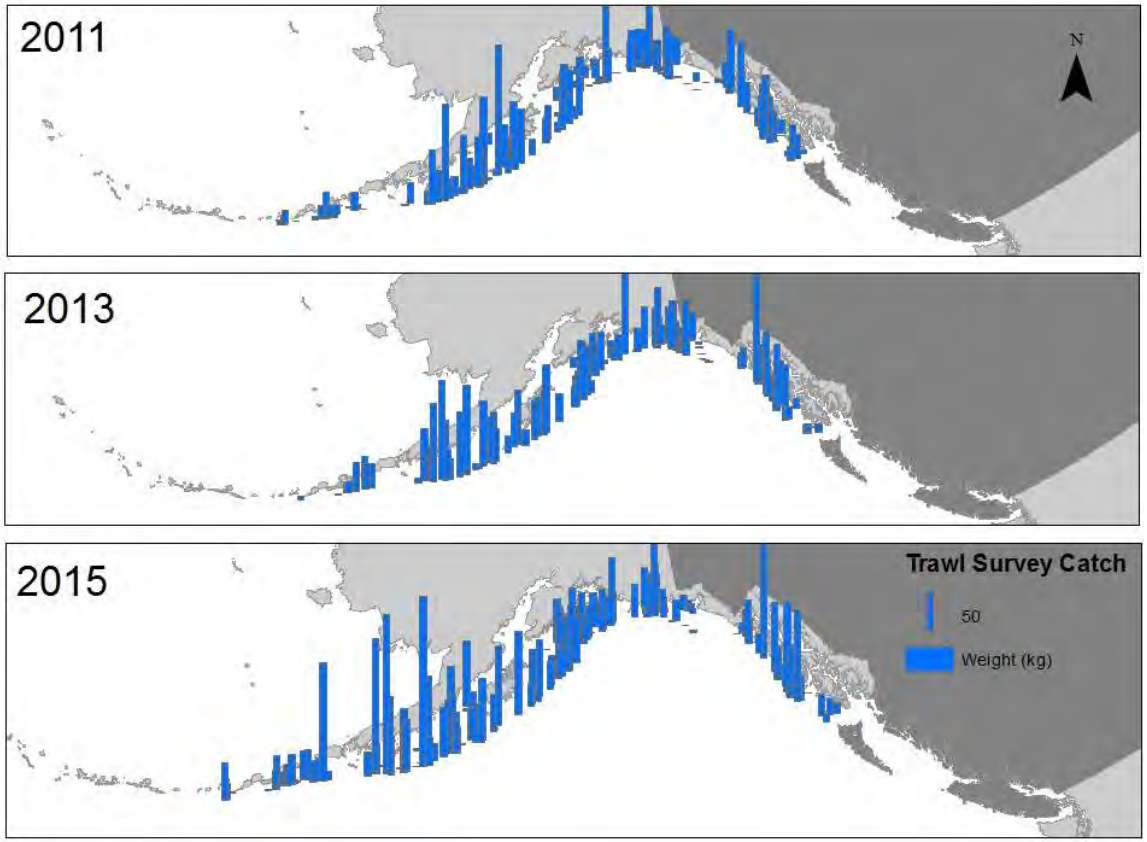


Rockfish Summary

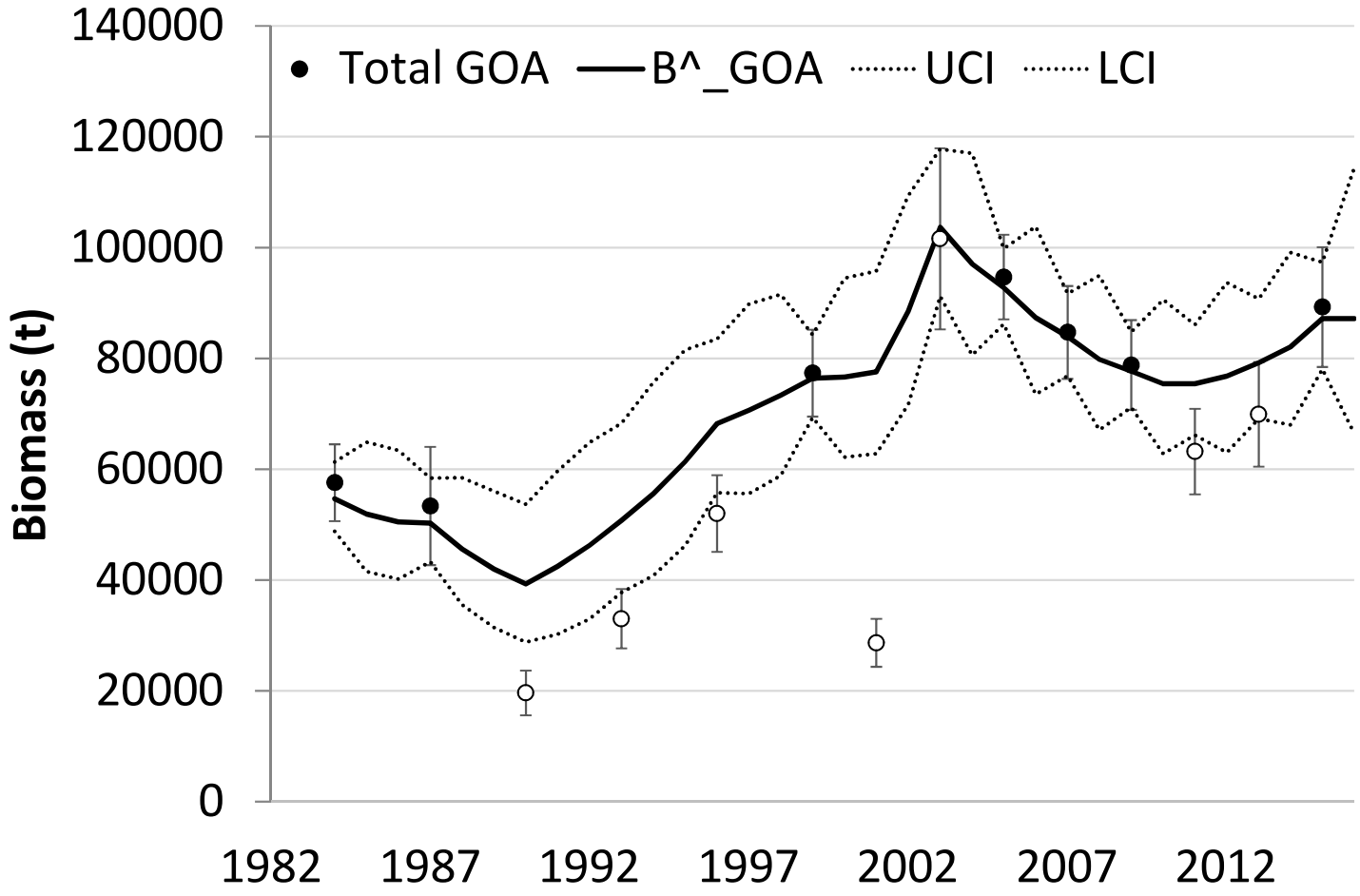
Species	2015	2016	Change
POP	21,012	24,437	up 3,425 (16%)
northern rockfish	4,998	4,004	down 994 (20%)
Shortraker Rockfish	1,323	1,286	down 37 (3%)
Dusky	5,109	4,686	down 423 (8%)
Rougheye and Blackspotted Rockfish	1,122	1,328	same (0%)
Demersal shelf rockfish	225	231	same (0%)
Thornyhead	1,841	1,961	up 120 (7%)
Other rock	4,080	5,773	up 1,693 (41%)
Sub Total	39,710	43,706	up 3,996 (10%)

15. Shortspine thornyheads

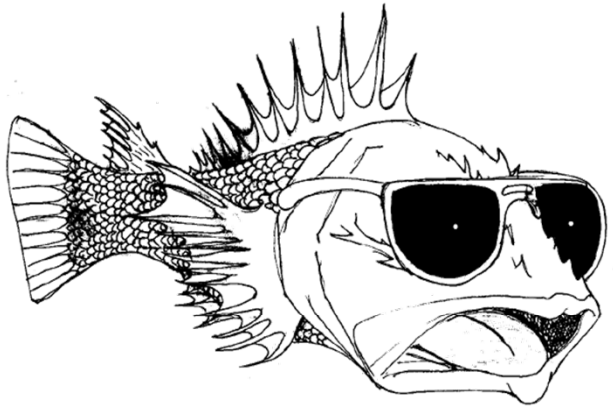
Tier 5

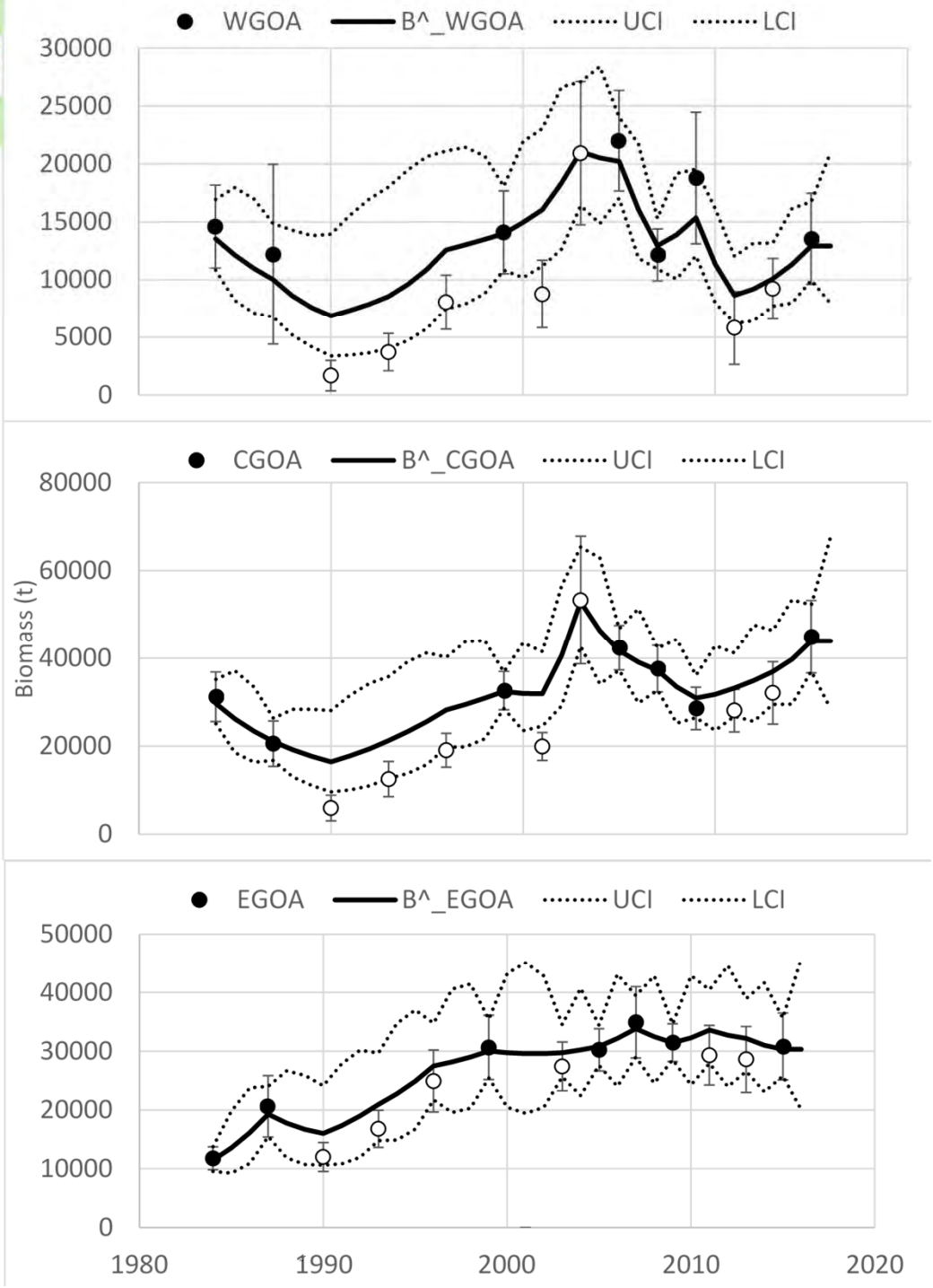


15. Shortspine thornyheads



15. Shortspine thornyheads





15. Shortspine thornyheads

- **The Team requests the authors investigate the reasons for these high discard rates.**
- **Additionally, the Team requests a summary of the thornyhead rockfish tagging data be presented…**

	Biomass	OFL	ABC
2016	87,155	2,615	1,961
2017		2,615	1,961

Rockfish Summary

Species	2015	2016	Change
POP	21,012	24,437	up 3,425 (16%)
northern rockfish	4,998	4,004	down 994 (20%)
Shortraker Rockfish	1,323	1,286	down 37 (3%)
Dusky	5,109	4,686	down 423 (8%)
Rougheye and Blackspotted Rockfish	1,122	1,328	same (0%)
Demersal shelf rockfish	225	231	same (0%)
Thornyhead	1,841	1,961	up 120 (7%)
Other rock	4,080	5,773	up 1,693 (41%)
Sub Total	39,710	43,706	up 3,996 (10%)

16. Other rockfish

Survey Year	Harlequin	Redbanded	Redstripe	Sharpchin	Silvergray	Yelloweye	Minors	OR Total
1984	2,624.9	1,430.3	5,364.0	6,611.9	4,816.7	119.0	1,115.3	22,082.1
1987	72,405.1	1,822.2	26,518.6	80,438.5	5,425.9	422.6	1,078.4	188,111.3
1990	17,664.2	3,285.4	27,063.9	38,333.5	14,148.9	308.9	3,062.3	103,867.1
1993	9,280.6	3,675.1	29,619.3	23,675.9	18,978.9	593.3	5,284.7	91,107.8
1996	20,026.2	4,593.7	14,963.9	64,570.0	24,127.3	522.9	2,691.5	131,495.5
1999	9,876.5	10,941.1	8,225.9	20,840.6	37,641.1	2,280.8	19,399.4	109,205.4
2001[a]	8,364.9	414.6	126.7	1,797.2	63.0	1,549.8	278.3	12,594.5
2003	3,544.6	3,440.6	8,025.3	7,093.6	51,915.4	904.0	1,817.9	76,741.4
2005	33,123.8	5,610.3	21,702.5	21,135.2	41,080.7	1,891.4	2,069.2	126,613.1
2007	4,056.9	7,198.2	11,500.7	19,037.0	29,797.5	980.4	2,910.0	75,480.7
2009	2,686.2	6,442.3	1,591.5	12,492.7	9,851.4	777.0	4,487.5	38,328.6
2011	3,734.5	5,041.8	18,744.8	8,041.0	100,049.1	2,518.0	10,904.2	149,033.4
2013	7,485.3	5,867.9	9,871.1	14,919.7	19,238.5	747.1	4,483.2	62,612.8
2015	2,316.4	5,457.0	16,699.3	45,016.3	44,174.4	872.1	2,268.4	116,803.9

Harvest Recommendations

Seven species are primarily caught in longline fisheries and unreliable biomass estimates:

- Canary, China, copper, quillback, rosethorn, tiger and yelloweye rockfish

Time series for Tier 6 presented

- 1997 – 2007
- 2013 – 2014
- Note no data prior to 1991!

Harvest Recommendations

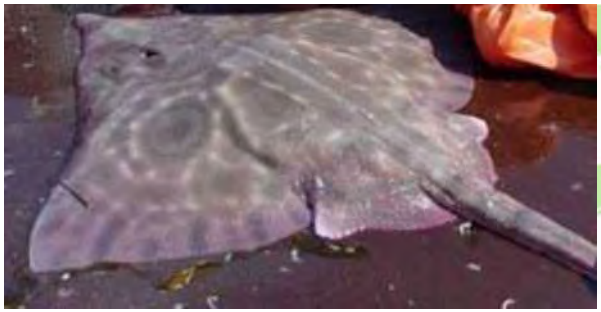
	Alternative 1	Alternative 2	Alternative 3
Tier	4/5	4/5/6	4/5/6
Biomass approach	3 -survey avg	3 - survey avg	random effects
Exploitable Biomass	83,325	81,522	104,826
Tier 4/5 OFL	5,350	5,295	7,254
Tier 4/5 ABC	4,012	3,972	5,642
Tier 6 OFL	na	170	170
Tier 6 ABC	na	127	127
Complex OFL	5,350	5,465	7,424
Complex ABC	4,012	4,099	5,769

GOA Team recommendations
Other rockfish

Other rockfish	Biomass	OFL	ABC
2016	104,826	7,424	5,773
2017		7,424	5,773

GOA Atka mackerel

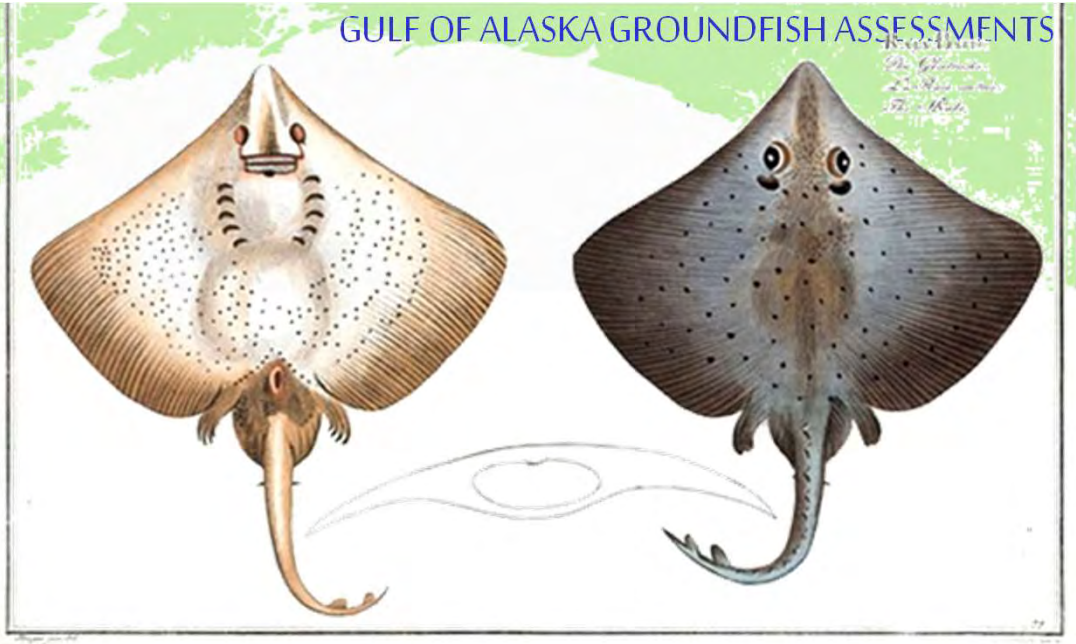
Species	2015 Catch	ABC 2015	ABC 2016	Change
Pollock	162,700	203,934	264,230	up 60,296 (30%)
Pacific Cod	51,497	102,850	98,600	down 4,250 (4%)
Sablefish	10,206	10,522	9,087	down 1,435 (14%)
Flatfish	23,819	108,038	96,103	down 11,935 (11%)
Arrowtooth flounder	1,907	192,921	186,188	down 6,733 (3%)
Rockfish	28,213	39,710	43,706	up 3,996 (10%)
Atka mackerel	1,191	4,700	4,700	same (0%)
Skates	4,350	8,708	8,939	up 231 (3%)
Other Species	3,564	14,213	17,217	up 3,004 (21%)
Total	287,447	685,596	728,770	up 43,174 (6%)



GOA skates

Species	2015 Catch	ABC 2015	ABC 2016	Change
Pollock	162,700	203,934	264,230	up 60,296 (30%)
Pacific Cod	51,497	102,850	98,600	down 4,250 (4%)
Sablefish	10,206	10,522	9,087	down 1,435 (14%)
Flatfish	23,819	108,038	96,103	down 11,935 (11%)
Arrowtooth flounder	1,907	192,921	186,188	down 6,733 (3%)
Rockfish	28,213	39,710	43,706	up 3,996 (10%)
Atka mackerel	1,191	4,700	4,700	same (0%)
Skates	4,350	8,708	8,939	up 231 (3%)
Other Species	3,564	14,213	17,217	up 3,004 (21%)
Total	287,447	685,596	728,770	up 43,174 (6%)

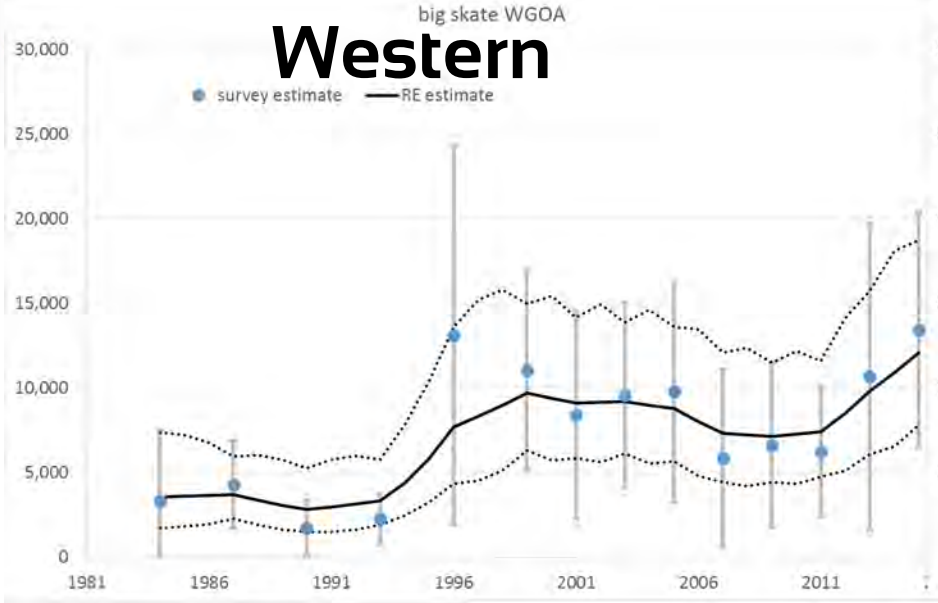
18. GOA skates



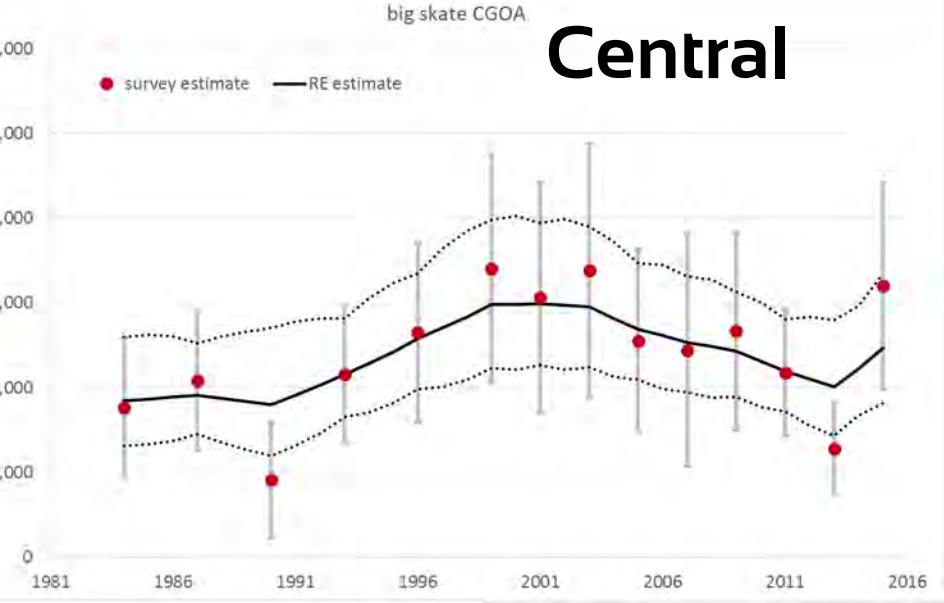
Species	2015 Catch	2015	2016	Change
Big skate	1,410	3,255	3,814	up 559 (17%)
Longnose skate	1,464	3,218	3,206	down 12 (0%)
Other skate	1,476	2,235	1,919	down 316 (14%)
All skates	4,350	8,708	8,939	up 231 (3%)

GOA Big skate biomass

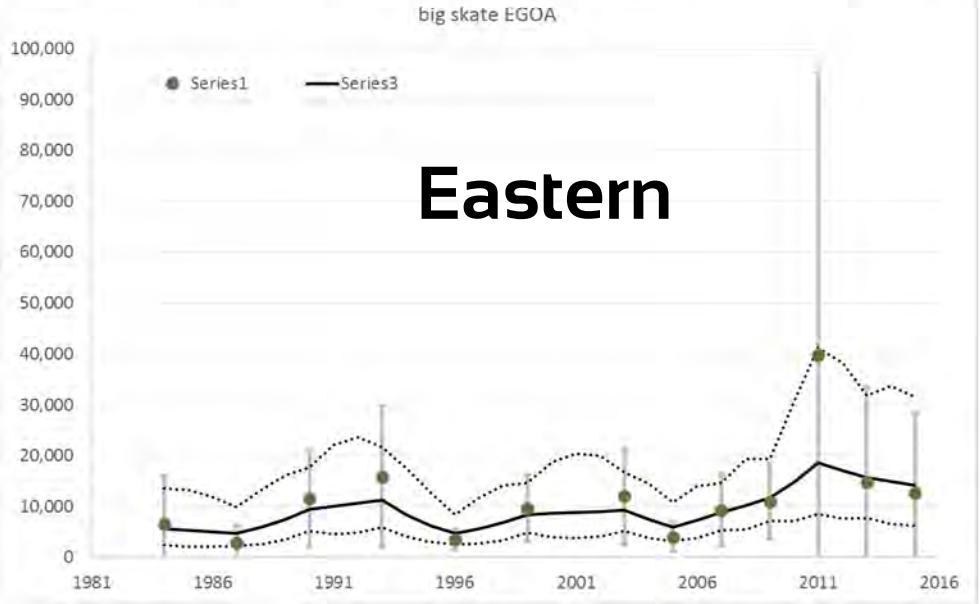
Western



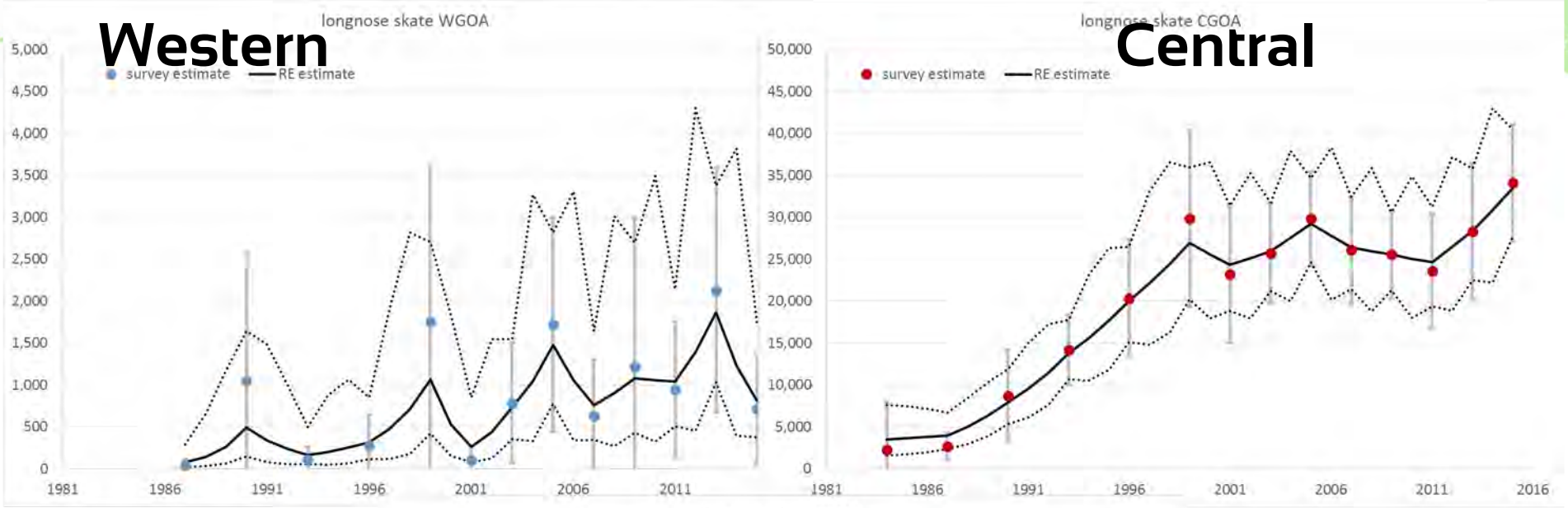
Central



Eastern

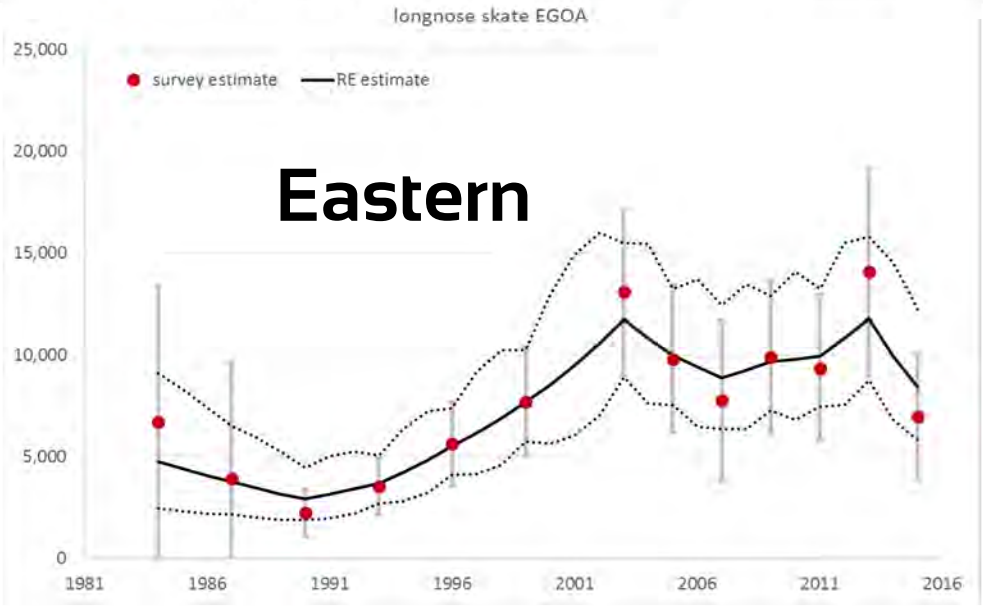


GOA Longnose skate biomass



Western

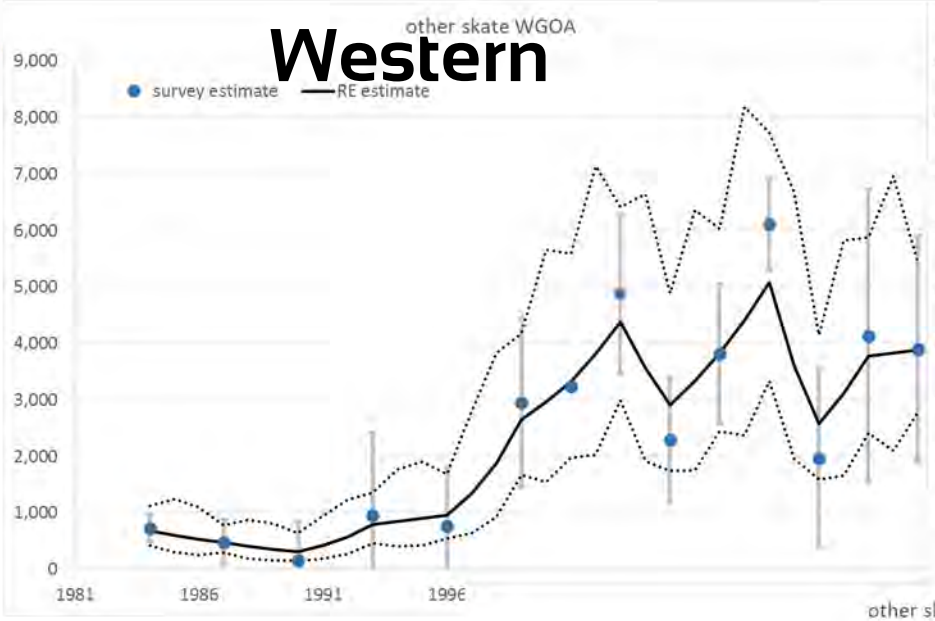
Central



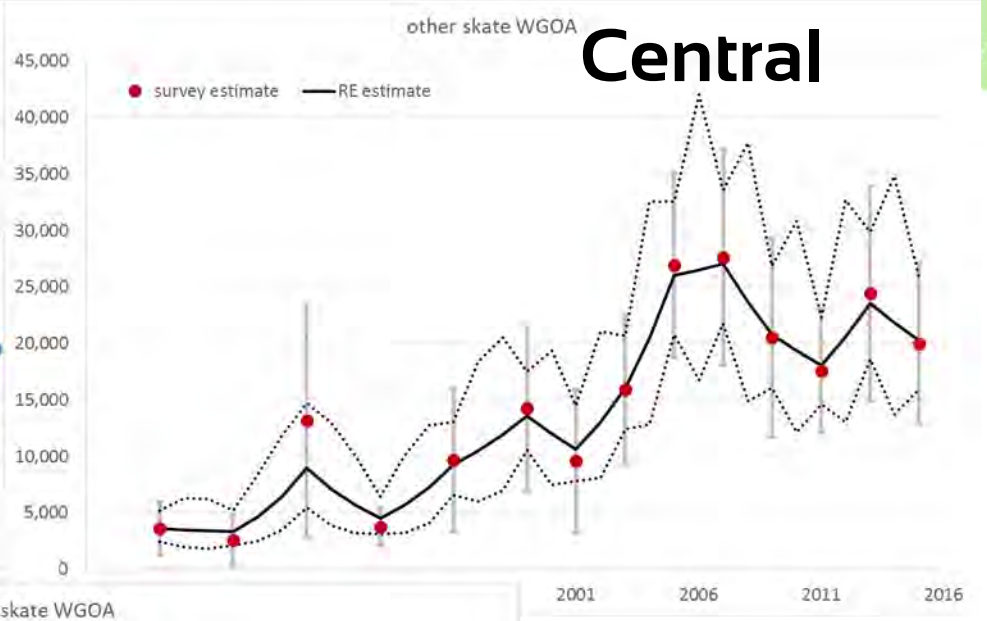
Eastern

GOA "other" skate biomass

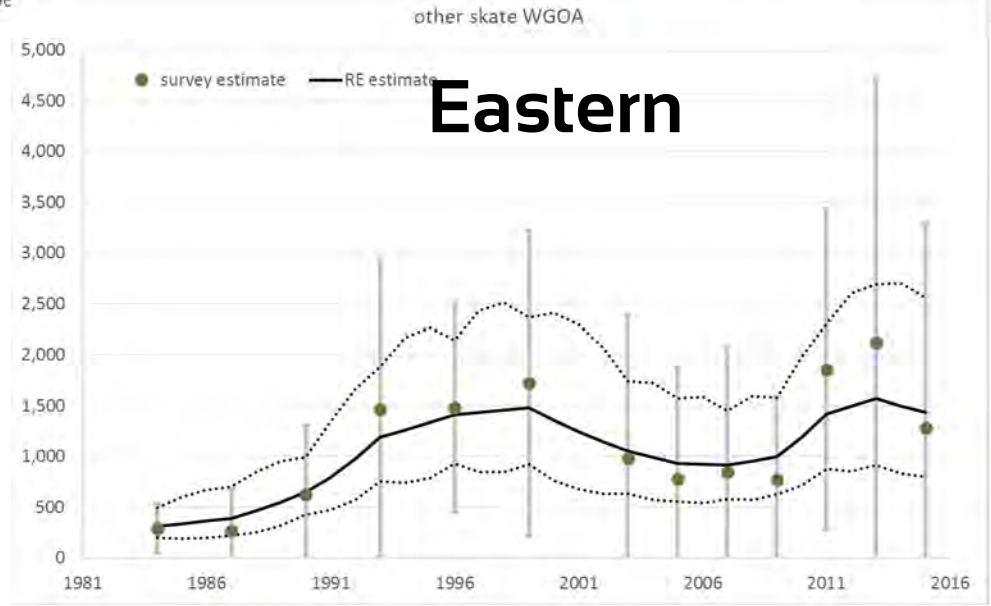
Western



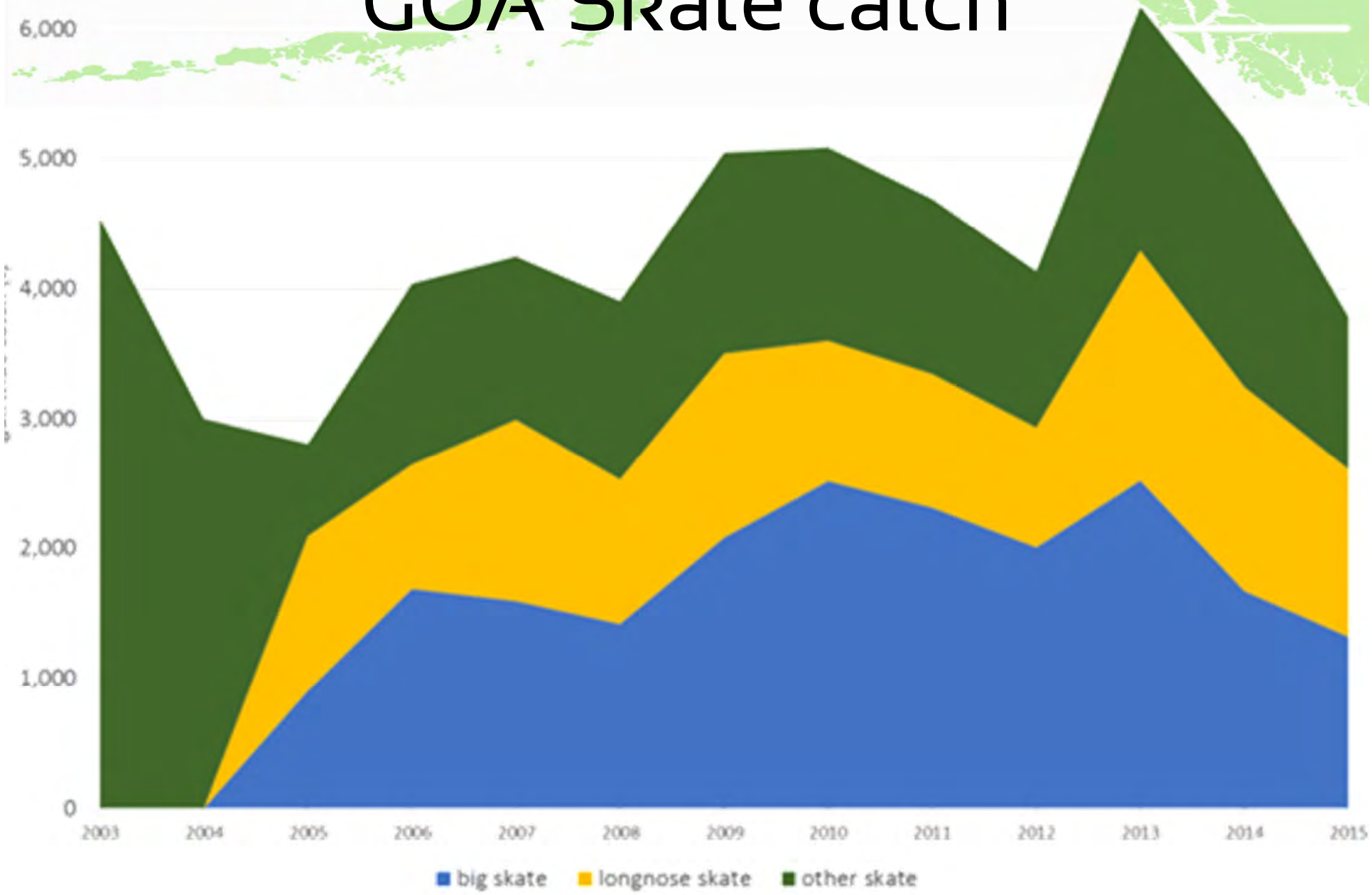
Central



Eastern



GOA Skate catch



Skates ABC/OFL

Tier 5

Big skates		Biomass	OFL	ABC
	2016	50,857	5,086	3,814
	2017		5,086	3,814

Longnose skates

	2016	42,737	4,274	3,206
	2017		4,274	3,206

Other Skates

	2016	25,580	2,558	1,919
	2017		2,558	1,919

GOA other species

Species	2015 Catch	ABC 2015	ABC 2016	Change
Pollock	162,700	203,934	264,230	up 60,296 (30%)
Pacific Cod	51,497	102,850	98,600	down 4,250 (4%)
Sablefish	10,206	10,522	9,087	down 1,435 (14%)
Flatfish	23,819	108,038	96,103	down 11,935 (11%)
Arrowtooth flounder	1,907	192,921	186,188	down 6,733 (3%)
Rockfish	28,213	39,710	43,706	up 3,996 (10%)
Atka mackerel	1,191	4,700	4,700	same (0%)
Skates	4,350	8,708	8,939	up 231 (3%)
Other Species	3,564	14,213	17,217	up 3,004 (21%)
Total	287,447	685,596	728,770	up 43,174 (6%)

GOA Other species

Complex	2015	2016	Change
Sculpins	5,569	5,591	up 22 (0%)
Sharks	5,989	4,514	down 1,475 (25%)
Squid	1,148	2,234	up 1,086 (95%)
Octopus	1,507	4,878	up 3,371 (224%)
Total	14,213	17,217	up 3,004 (21%)

19. GOA Sculpins (p. 1547)

Tier 5 complex

- Random effects model applied to time series of trawl survey biomass
- Species specific F=M to four most abundant species
  - Bigmouth, great, plain, and yellow irish lord
- Average M applied to other species
- Biomass trends differed by species
  - Bigmouth sculpin declined since mid 80's (but "old" survey methods)
- Although largest species in the complex have lowest fecundity
- **Recommendation: examine whether low fecundity and fishing mortality may explain long term trend of bigmouth sculpin**

GOA sculpin assessment based on 4 most abundant species

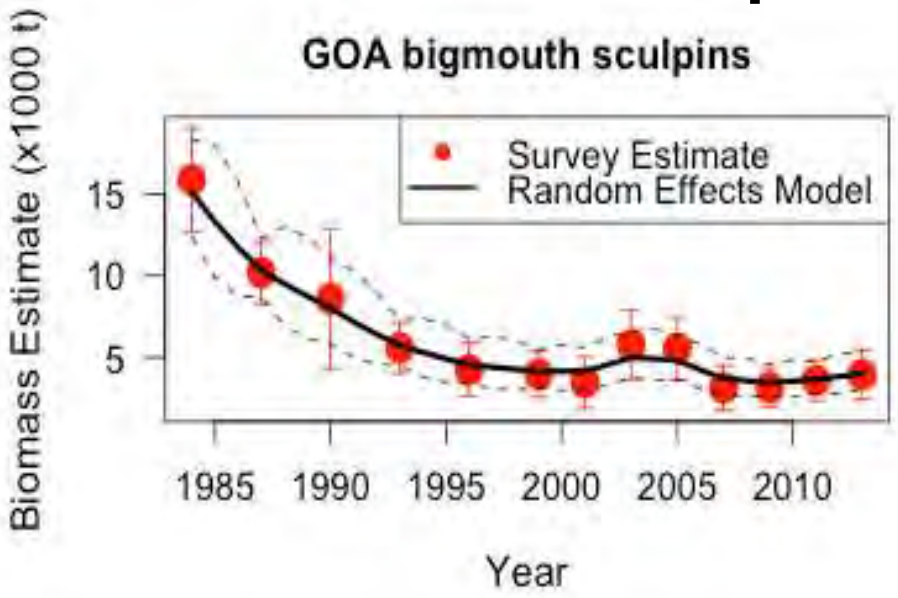
Bigmouth sculpin

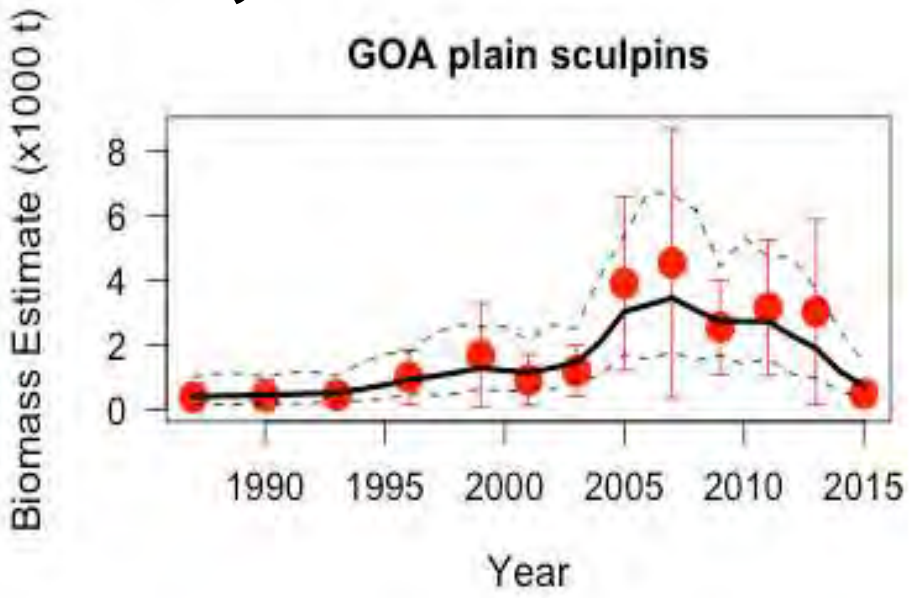
Plain sculpin

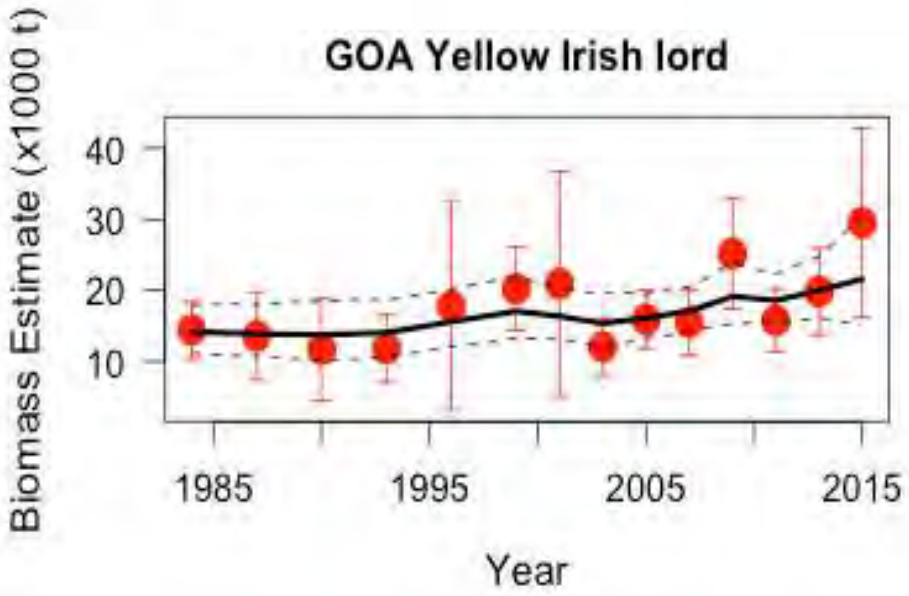
Yellow Irish lord

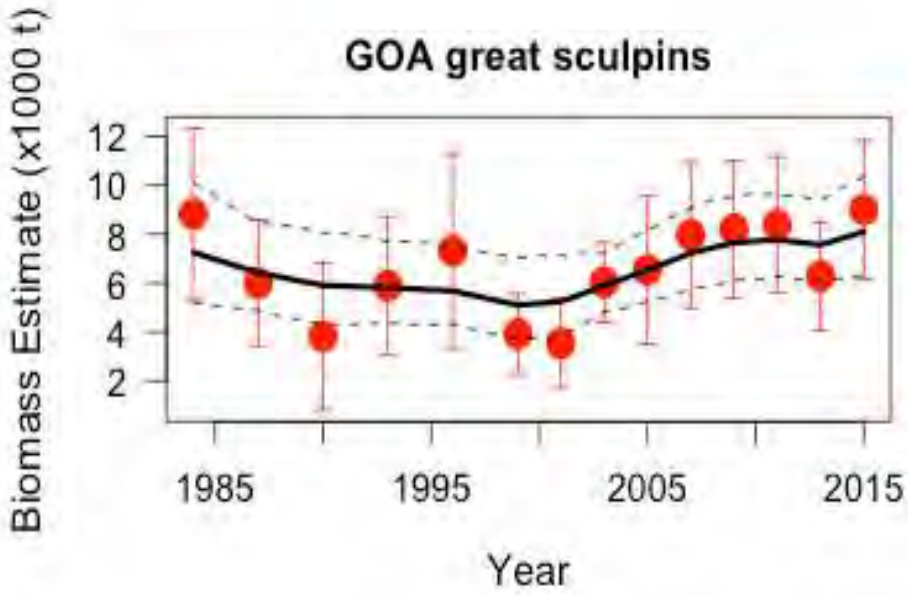
Great sculpin

GOA sculpin survey trends



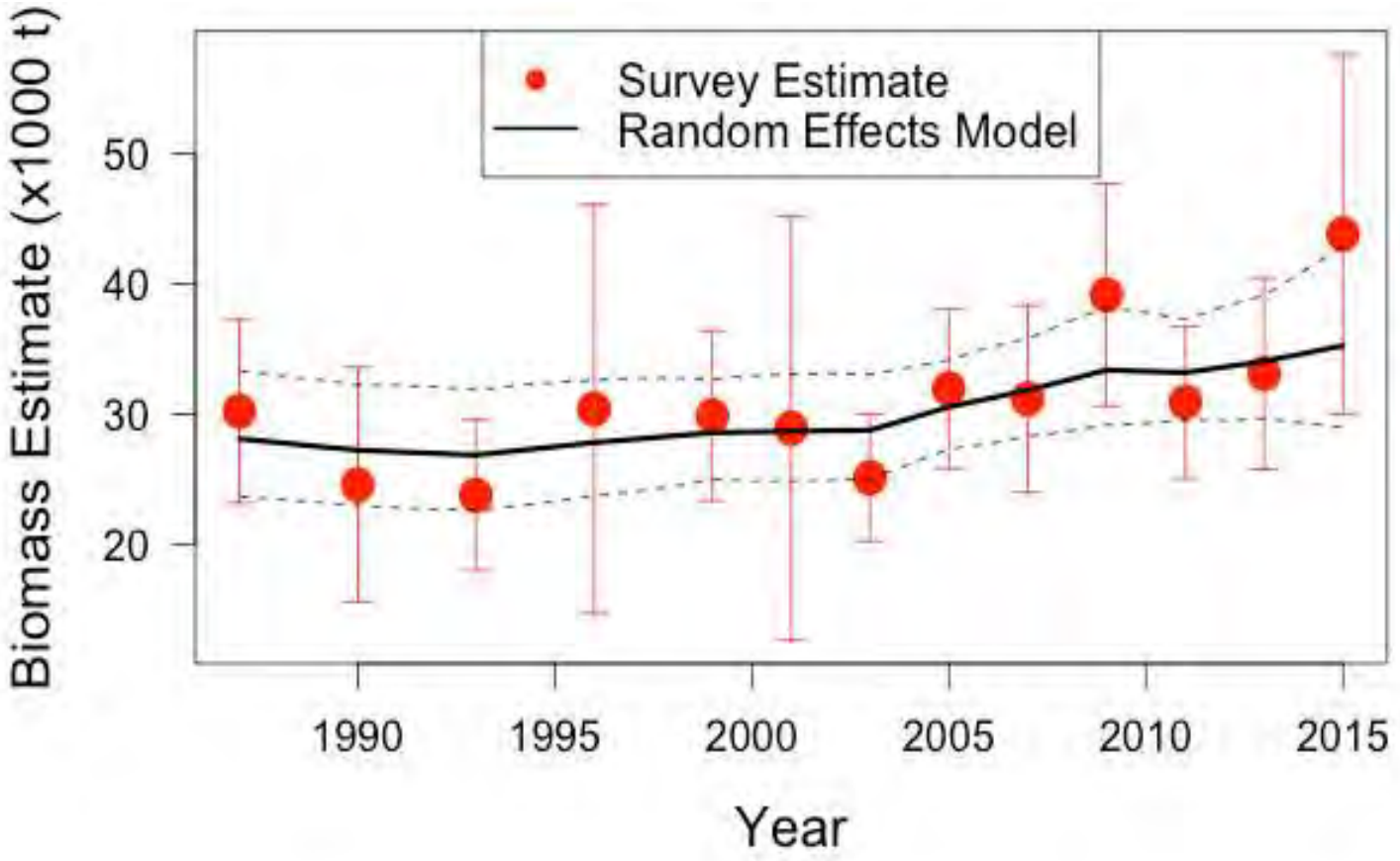






GOA Sculpins

Other rockfish	Biomass	OFL	ABC
2016	34,943	7,338	5,591
2017		7,338	5,591



GOA Other species

Complex	2015	2016	Change
Sculpins	5,569	5,591	up 22 (0%)
Sharks	5,989	4,514	down 1,475 (25%)
Squid	1,148	2,234	up 1,086 (95%)
Octopus	1,507	4,878	up 3,371 (224%)
Total	14,213	17,217	up 3,004 (21%)

20. Sharks (p. 1,569)

- Tier 6
  - Tier 5 calculation used for spiny dogfish (RE model)
  - M=0.097
- Remaining species Tier 6 based on average historical catch 1997-2007
- Future
  - Authors presented F rate for spiny dogfish based on demographic model which results in F=0.04
  - Author and plan team agreed to not implement until trawl survey catchability (q) can be resolved
- Complex ABC about 25% lower than 2015

GOA shark ABC and OFL Calculations

	Biomass	OFL	ABC
2016	56,181	6,020	4,514
2017		6,020	4,514

© Scot Anderson

21. Squid

Tier 6

- Status quo is based on maximum catch 1997-2007
- Alternative Tier 5 approach recommended by Team
  - Interim method while ecosystem component evaluated for squid

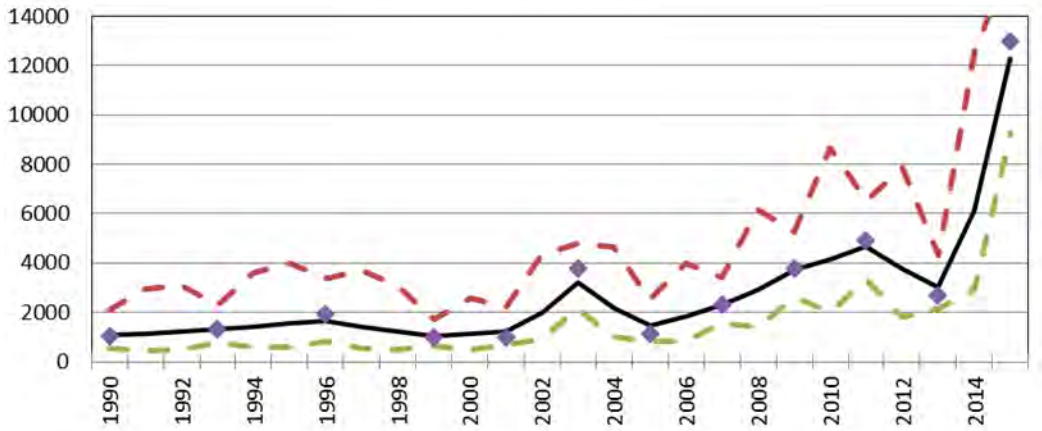
Complex	2015	2016	Change
Sculpins	5,569	5,591	up 22 (0%)
Sharks	5,989	4,514	down 1,475 (25%)
Squid	1,148	2,234	up 1,086 (95%)
Octopus	1,507	4,878	up 3,371 (224%)
Total	14,213	17,217	up 3,004 (21%)

	Biomass	OFL	ABC
2016	6,889	2,978	2,234
2017		2,978	2,234

22. Octopus (p. 1671)

	Biomass	OFL	ABC
2016	12,271	6,504	4,878
2017	-	6,504	4,878

Alternative Tier 6



Complex	2015	2016	Change
Sculpins	5,569	5,591	up 22 (0%)
Sharks	5,989	4,514	down 1,475 (25%)
Squid	1,148	2,234	up 1,086 (95%)
Octopus	1,507	4,878	up 3,371 (224%)
Total	14,213	17,217	up 3,004 (21%)