Georges Bank Haddock

Liz Brooks

Northeast Fisheries Science Center

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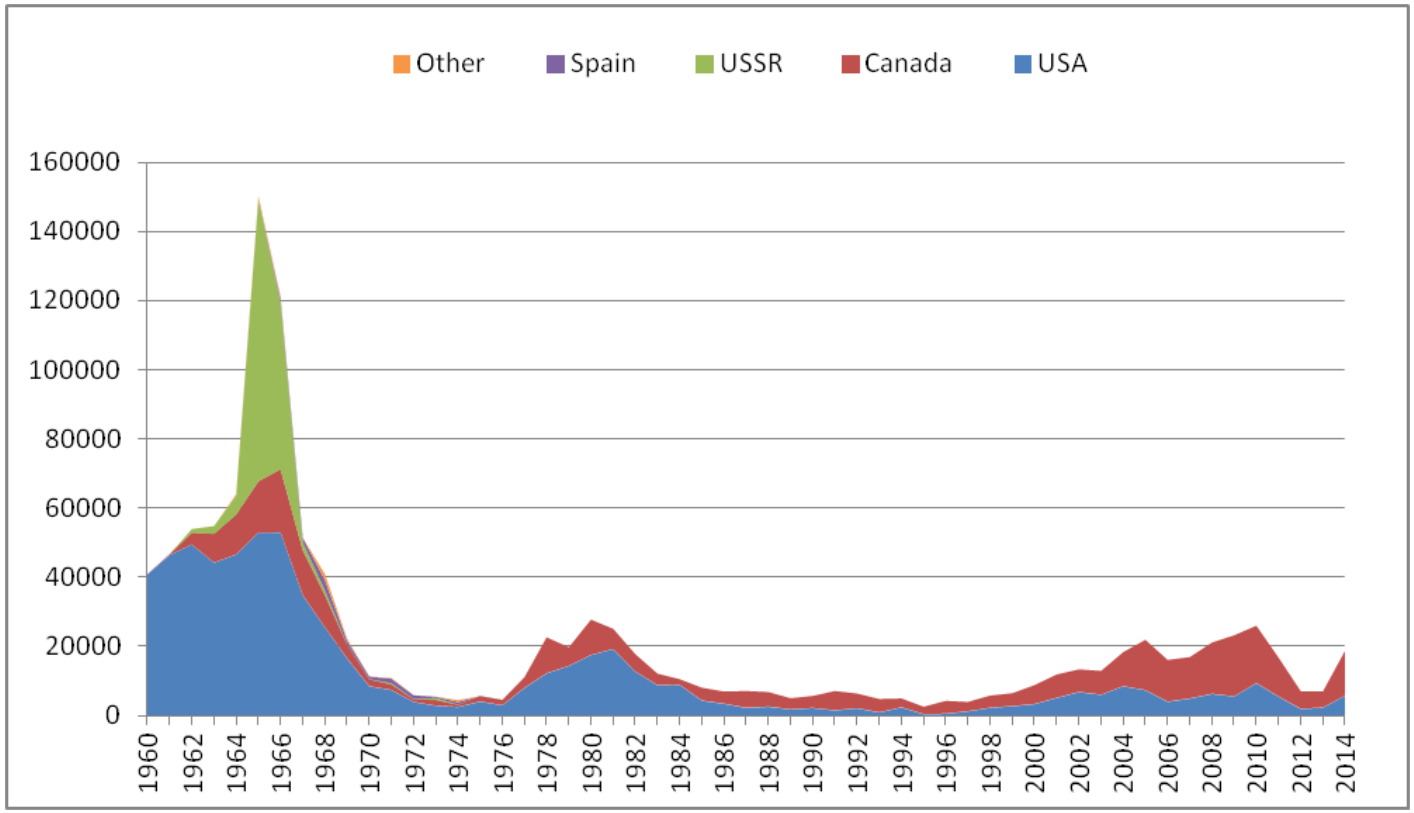
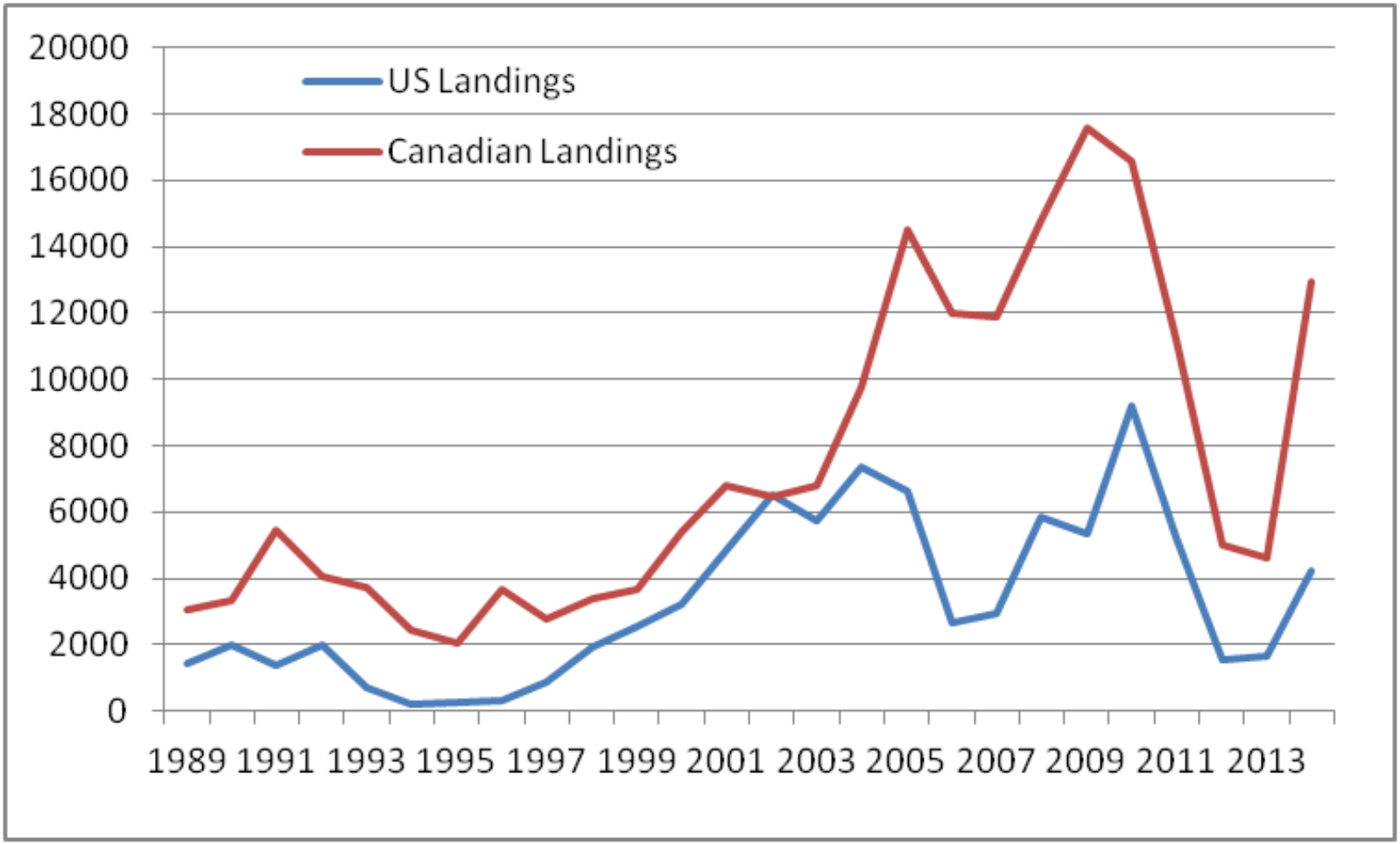
Background

- Assessment model: VPA
- Last assessment: 2012 (update)
- Stock Status (2012)
  - No overfishing ($F/F_{40\%} = 0.46$)
  - Not overfished ($SSB/SSB_{40\%} = 1.34$)

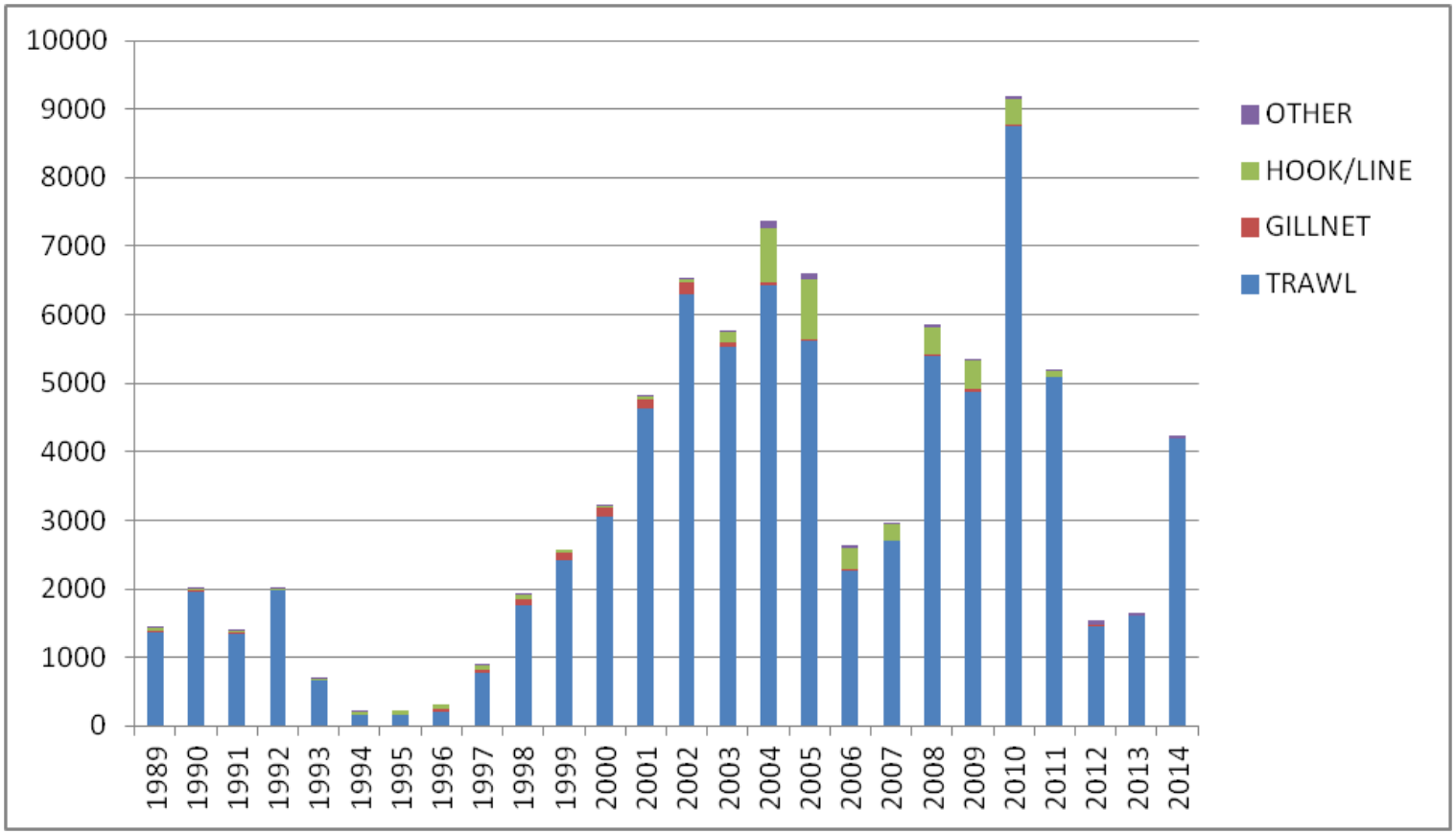
Data: Total catch



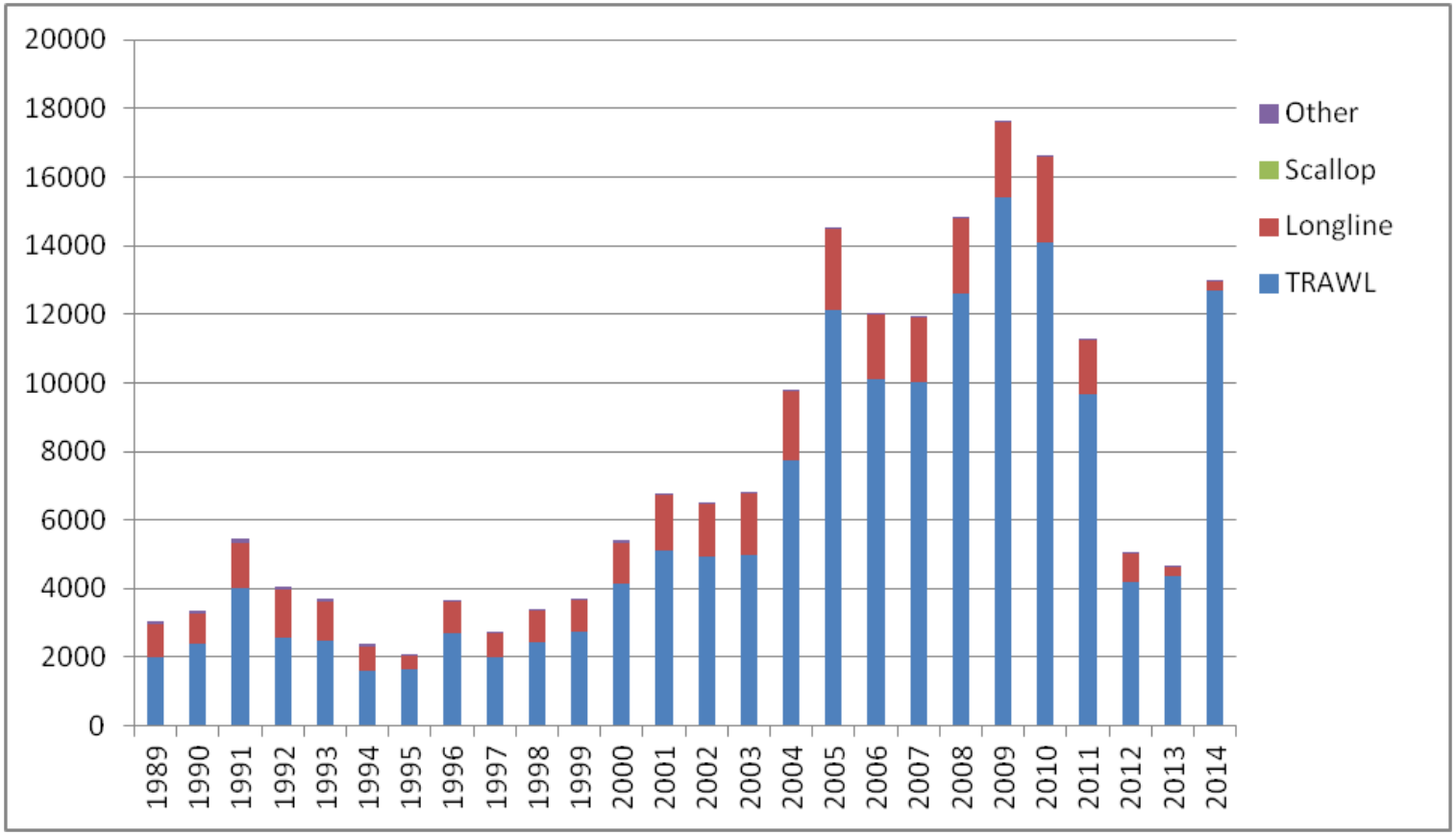
Data – landings (mt)



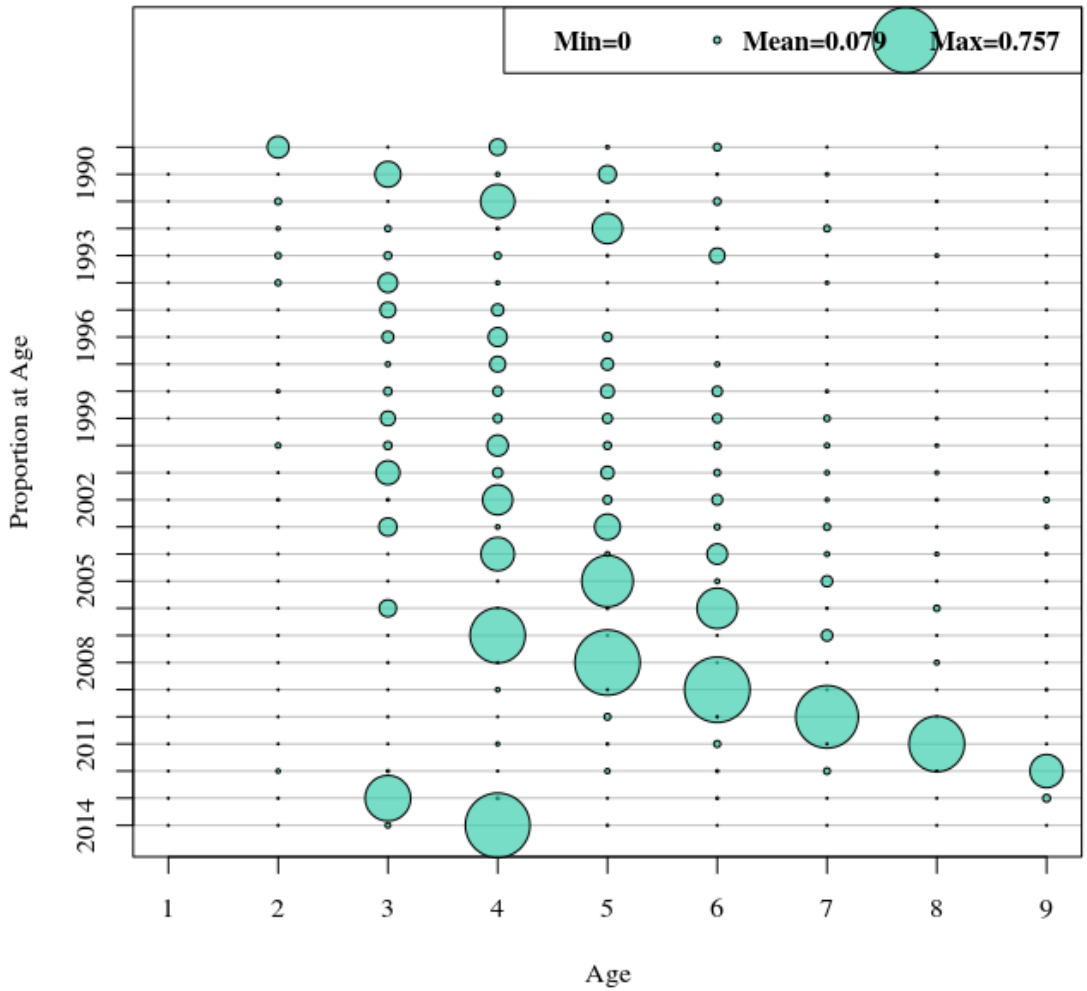
Data – US landings by gear (mt)



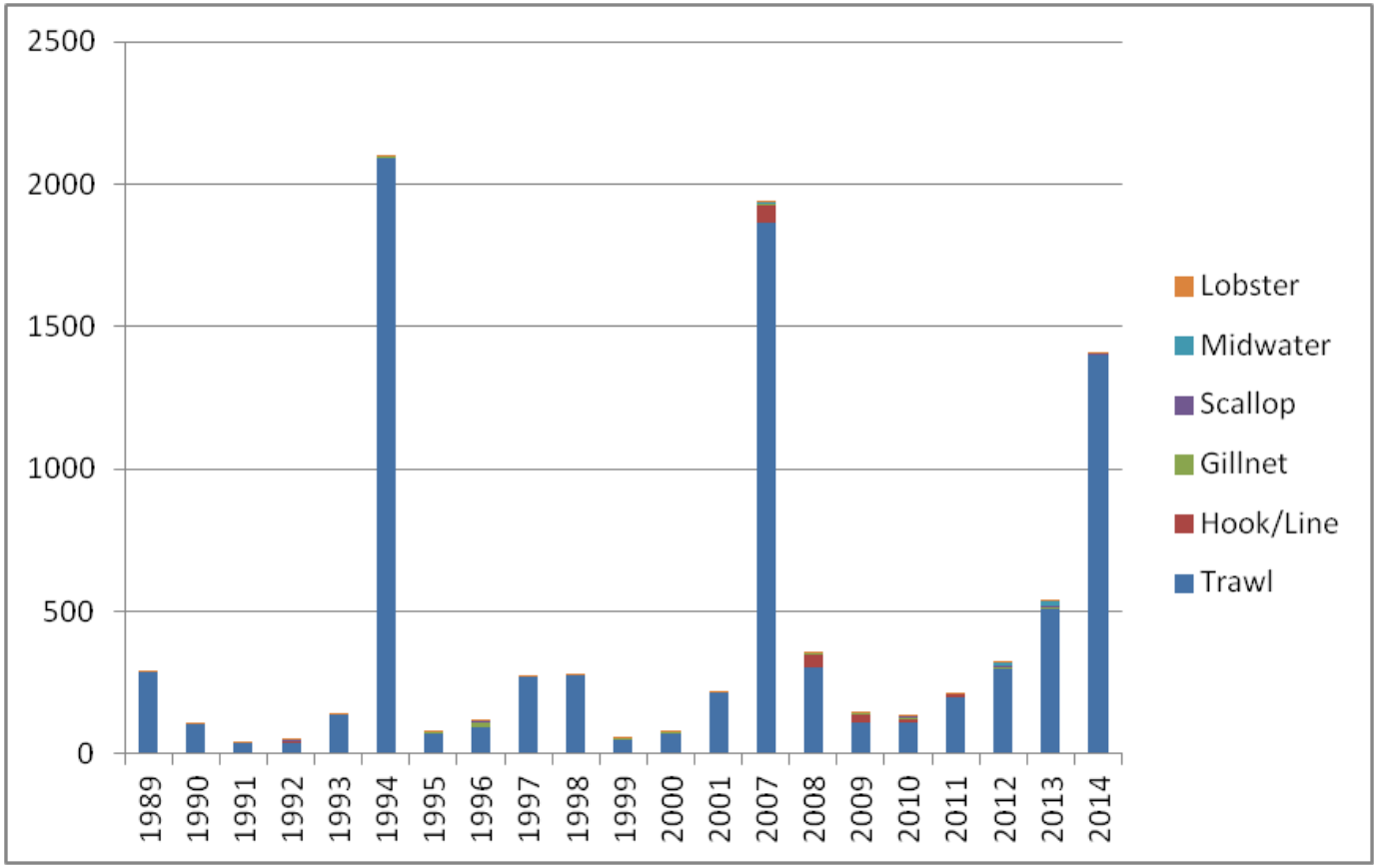
Data – Canadian landings by gear (mt)



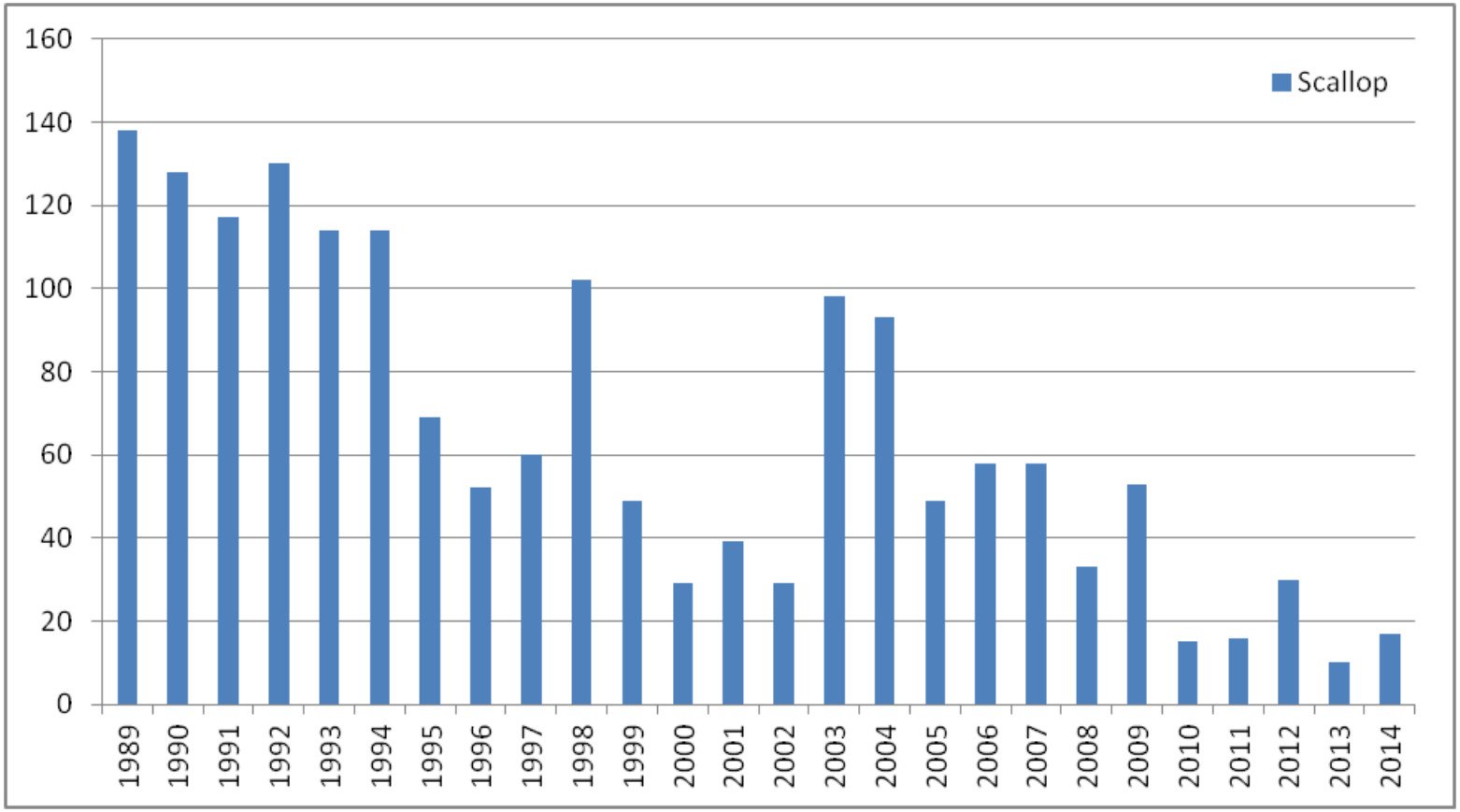
Data – Landings at age (US + Canada)



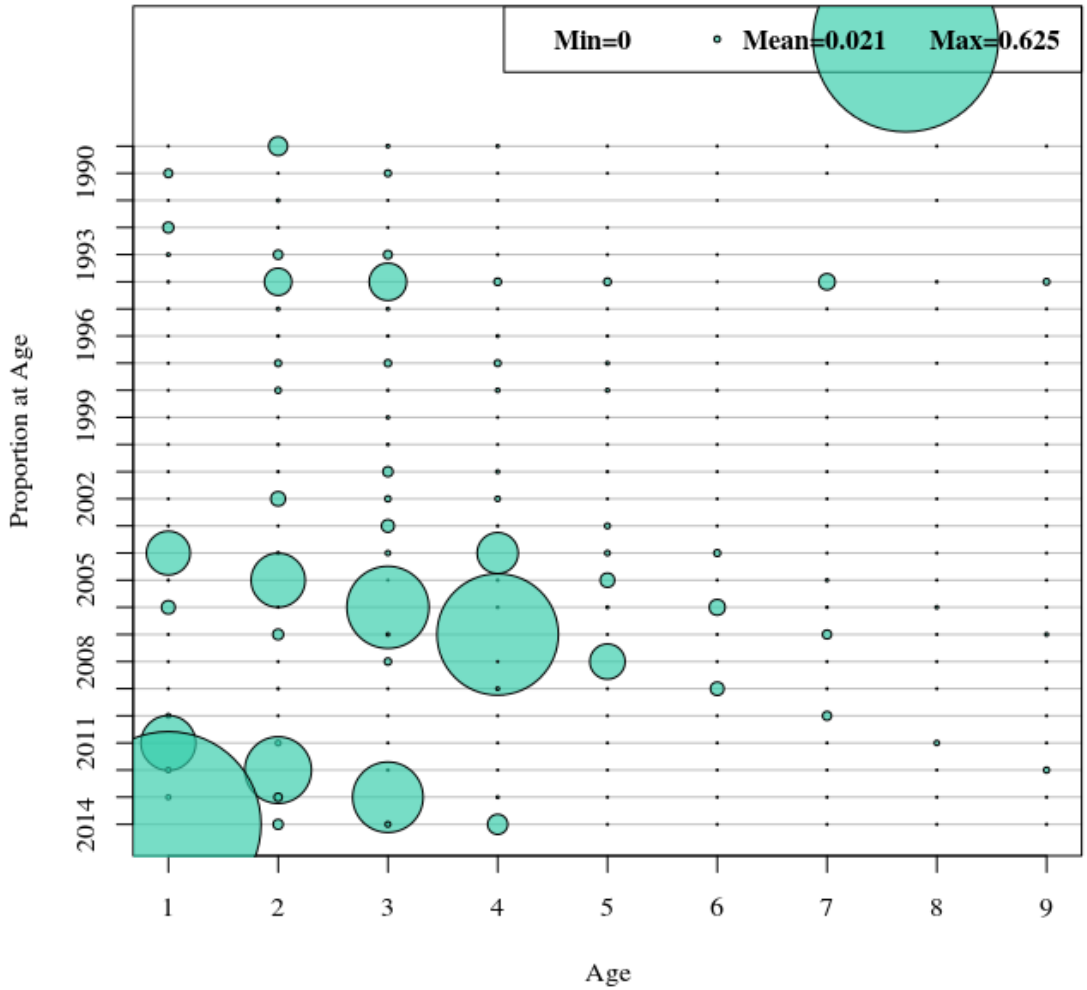
Data: US Discards by gear (mt)



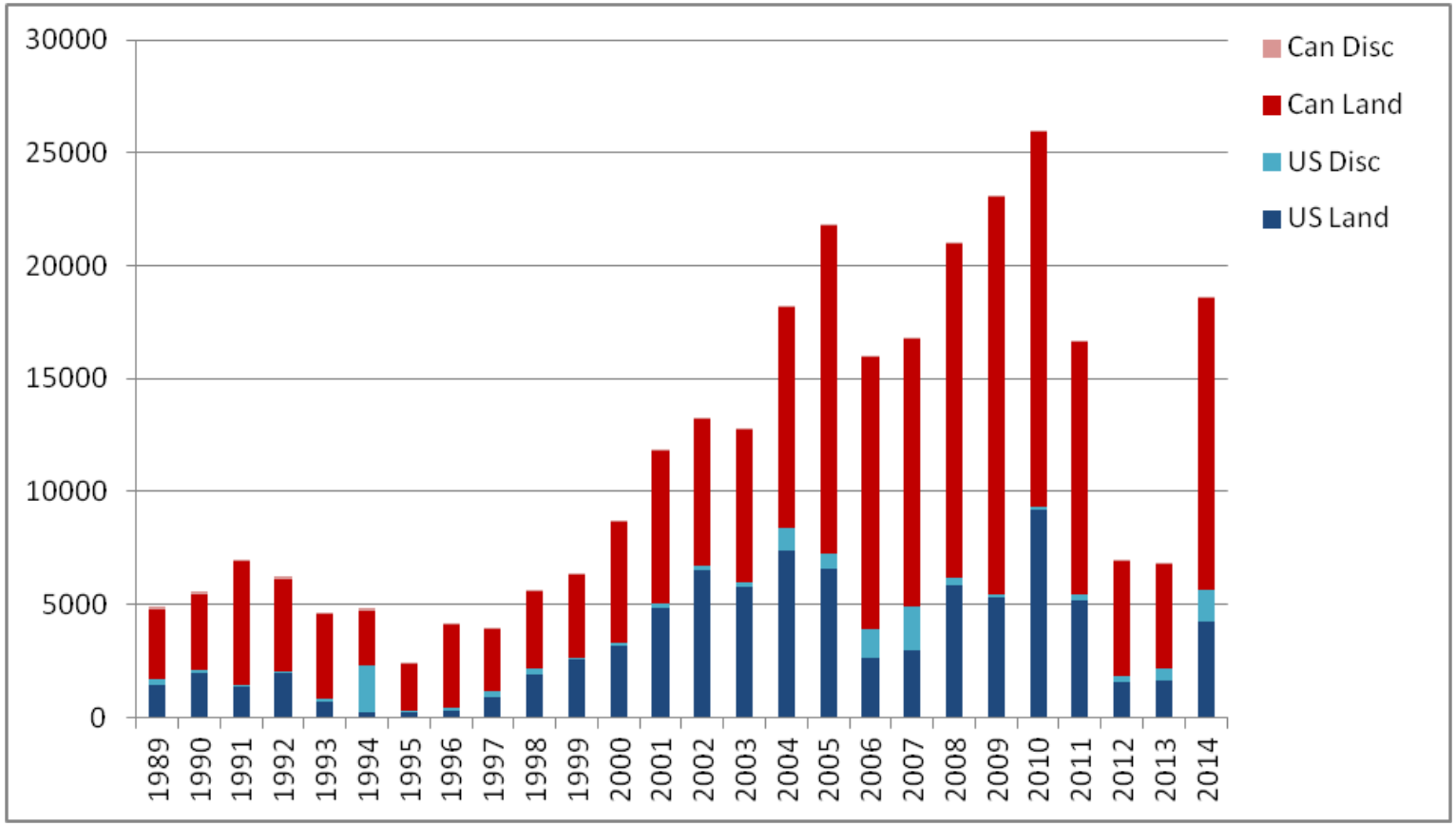
Data: Canada Discards by gear (mt)



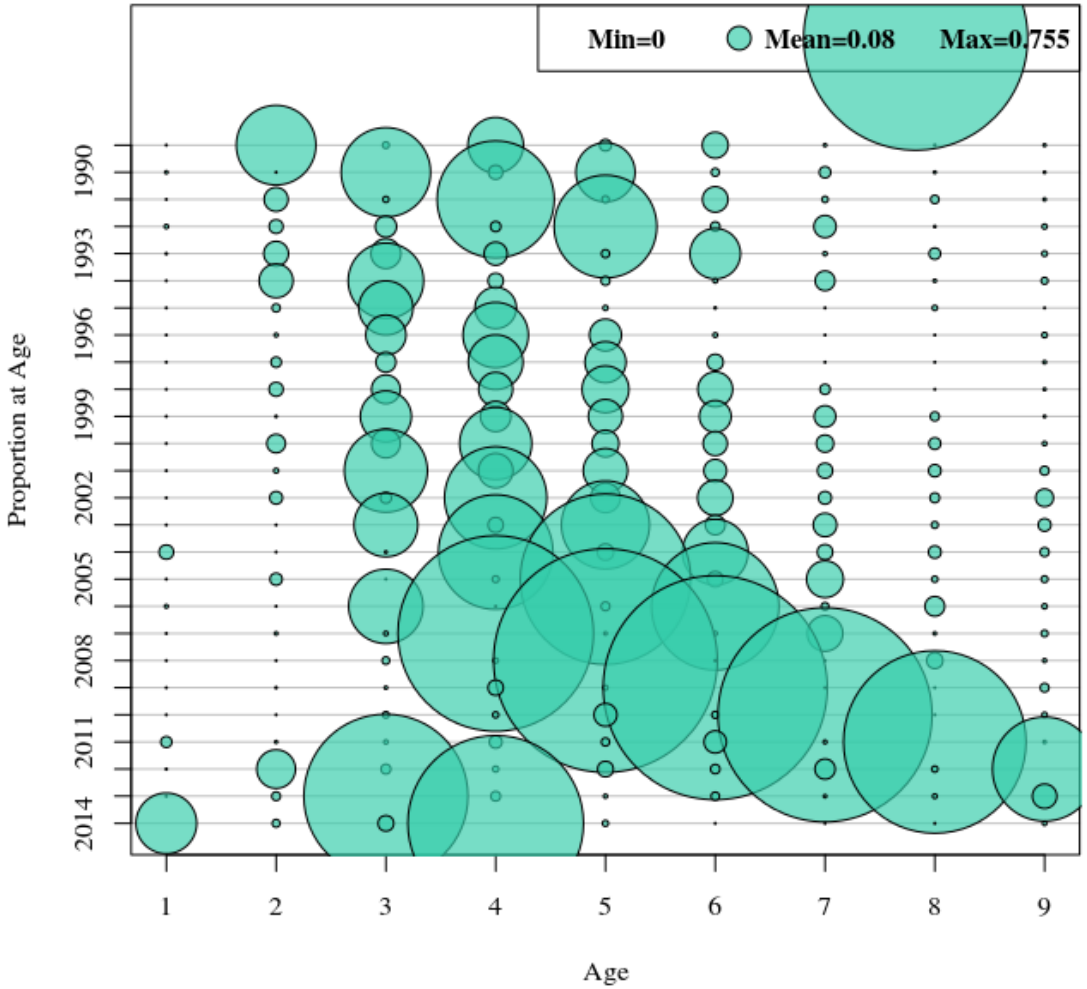
Data – Discards at age (US+Canada)



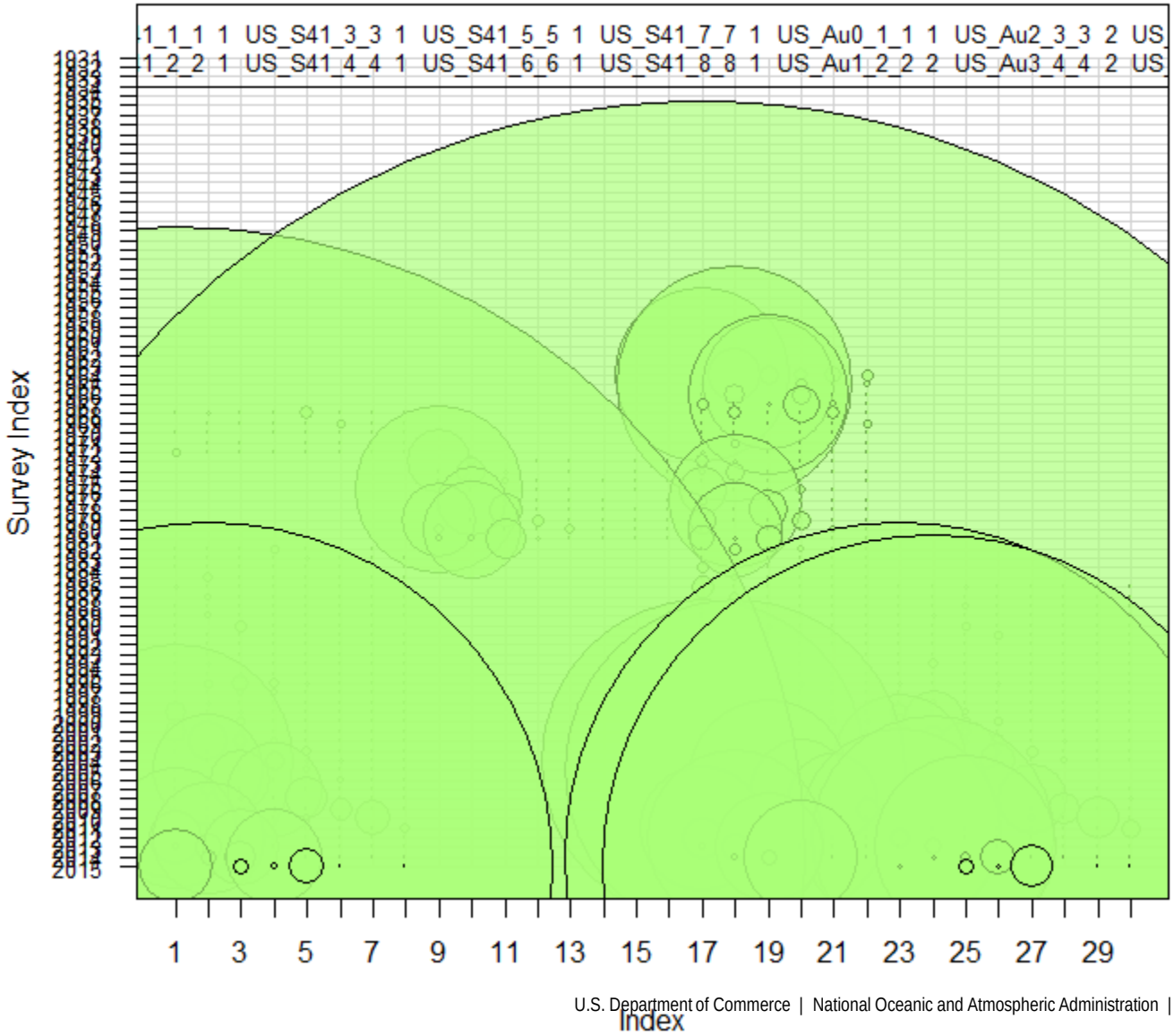
Data – Total Catch (Landings+Discards) mt



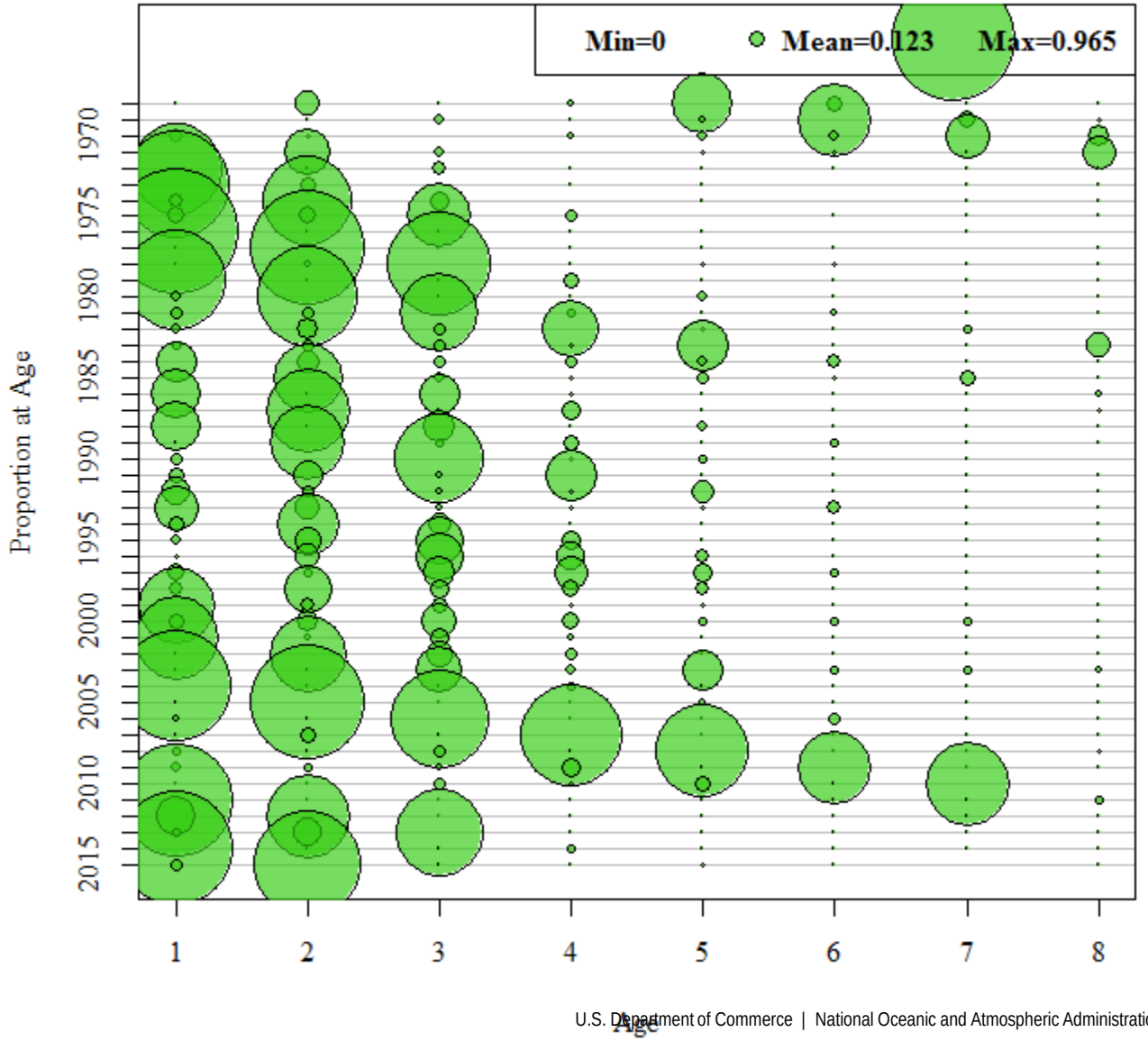
Data – Total Catch at age



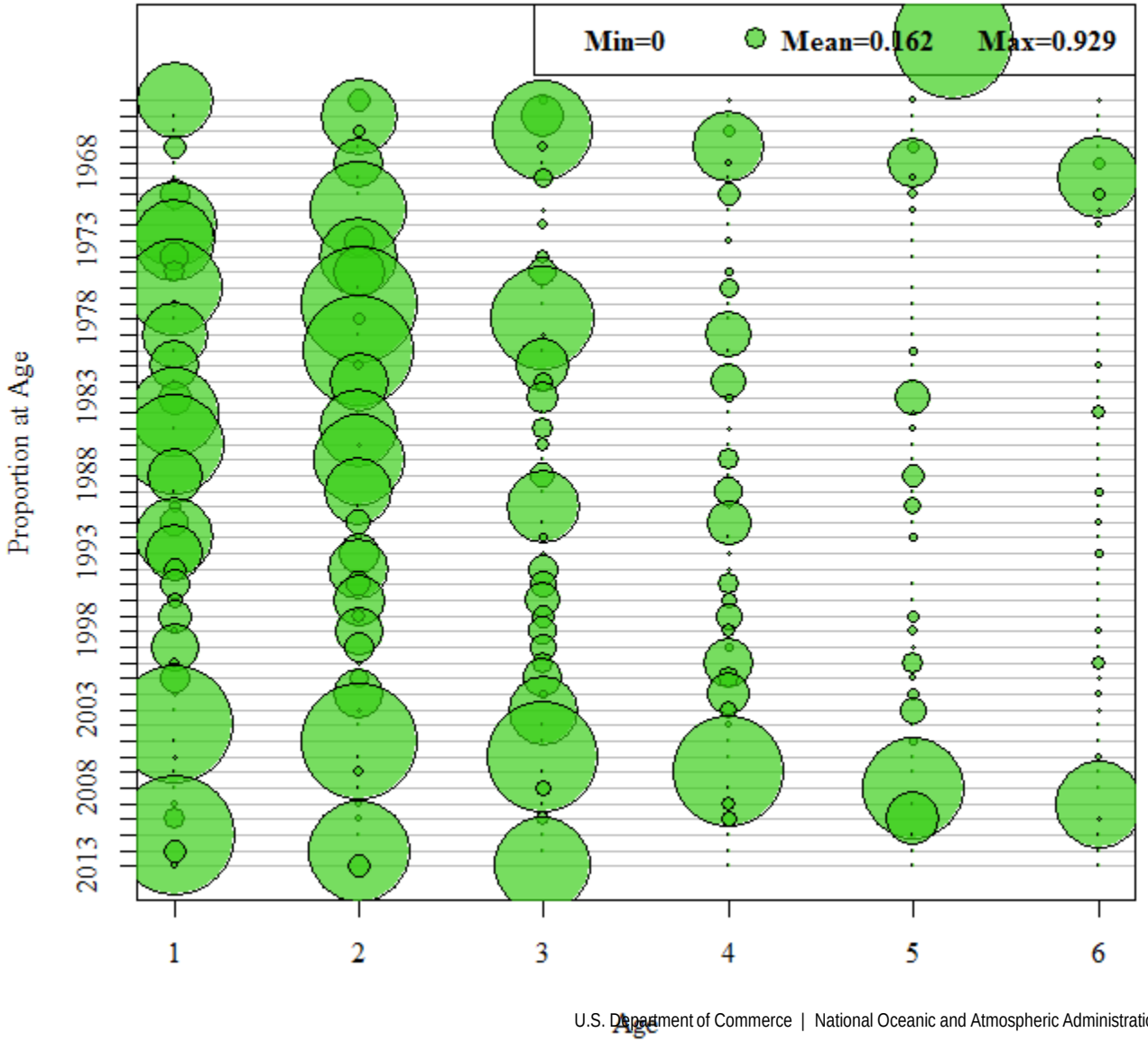
Data: Surveys



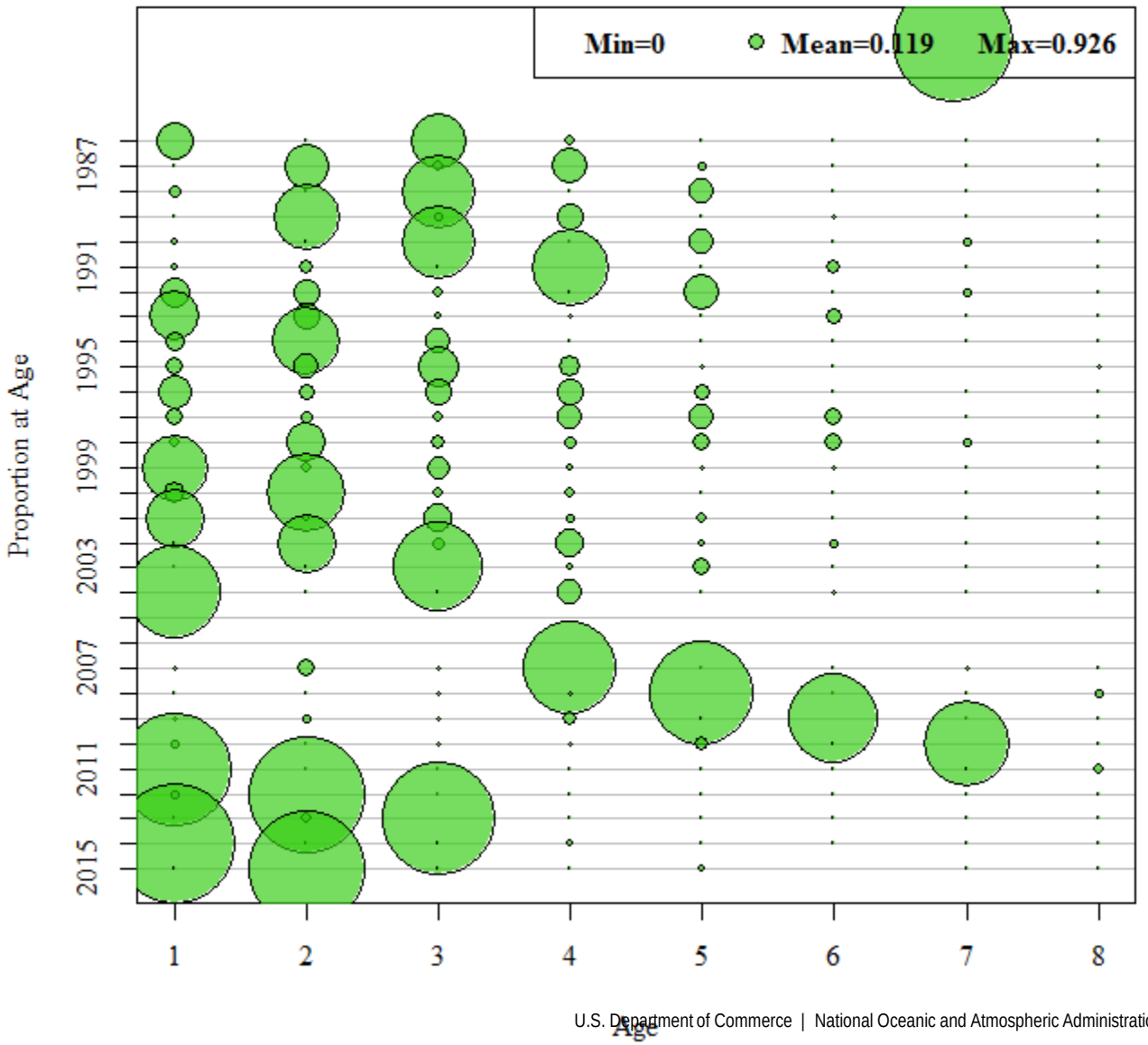
Data: NEFSC Spring Survey



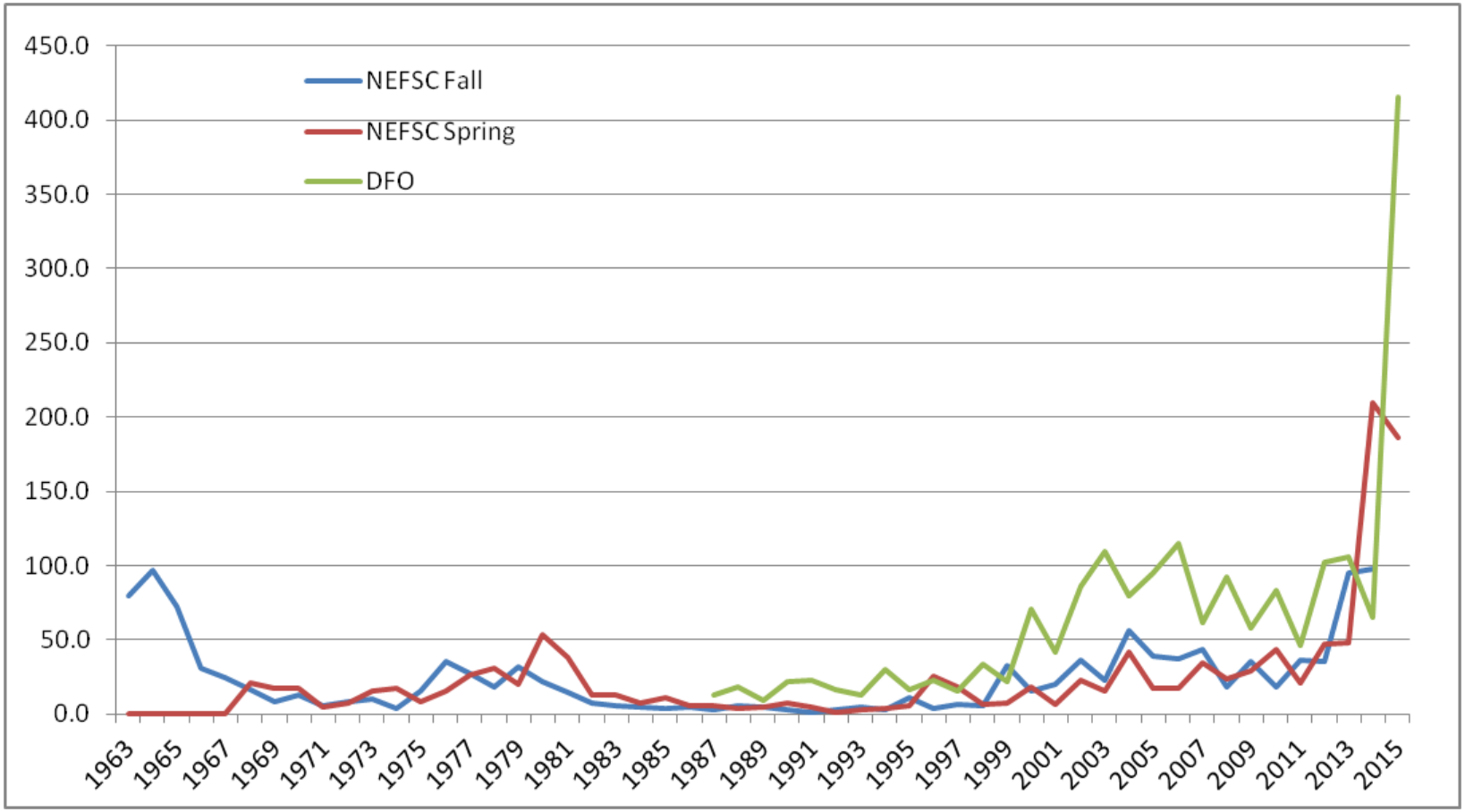
Data: NEFSC Fall Survey



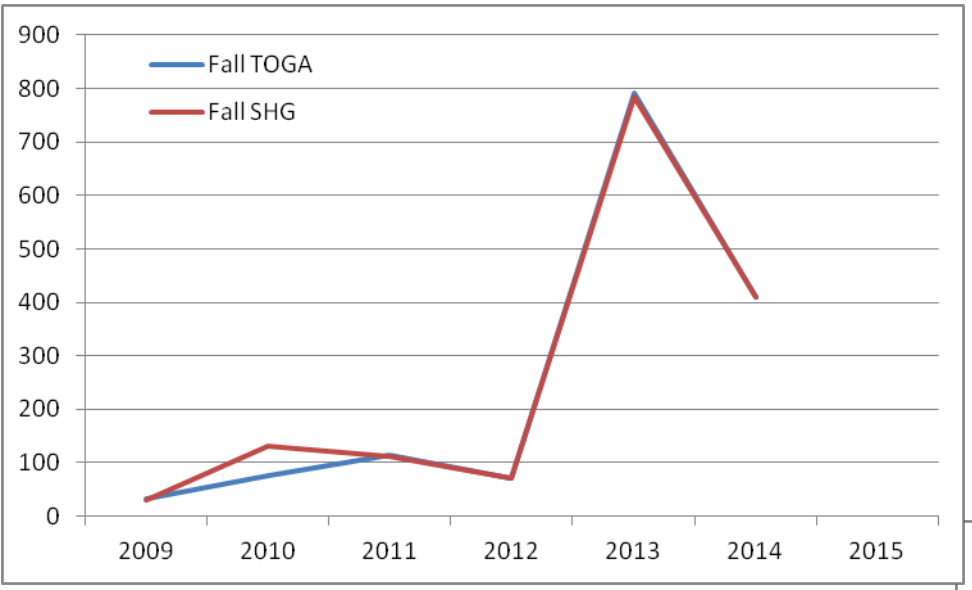
Data: DFO Survey

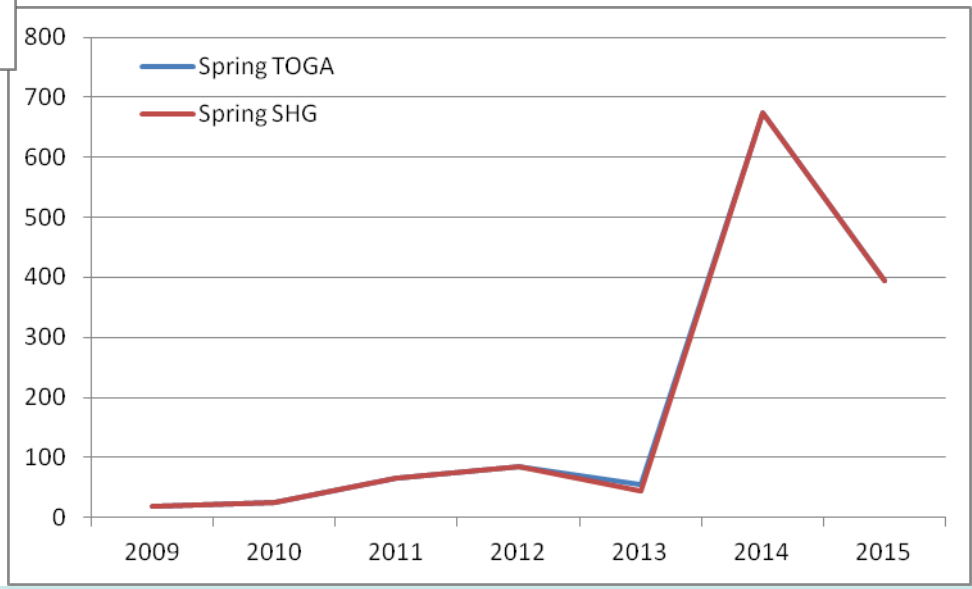


Data: Surveys (Mean Kg/tow)

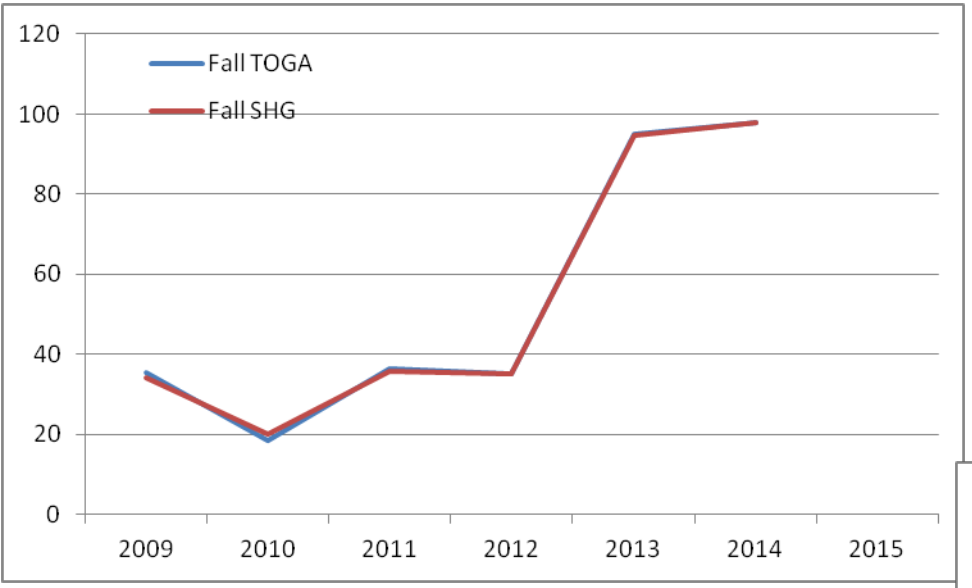


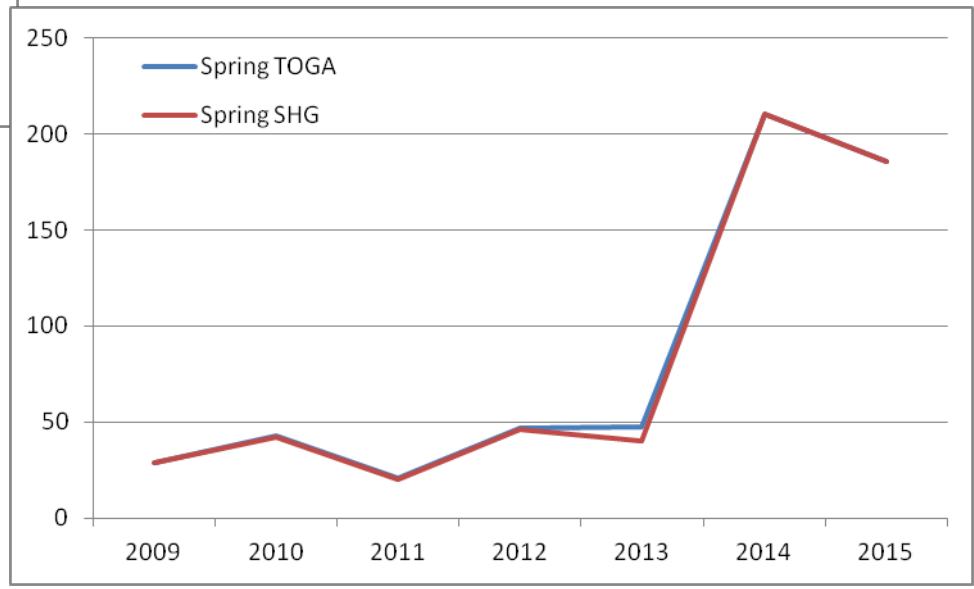
Data: Surveys SHG vs TOGA (Mean Kg/tow)



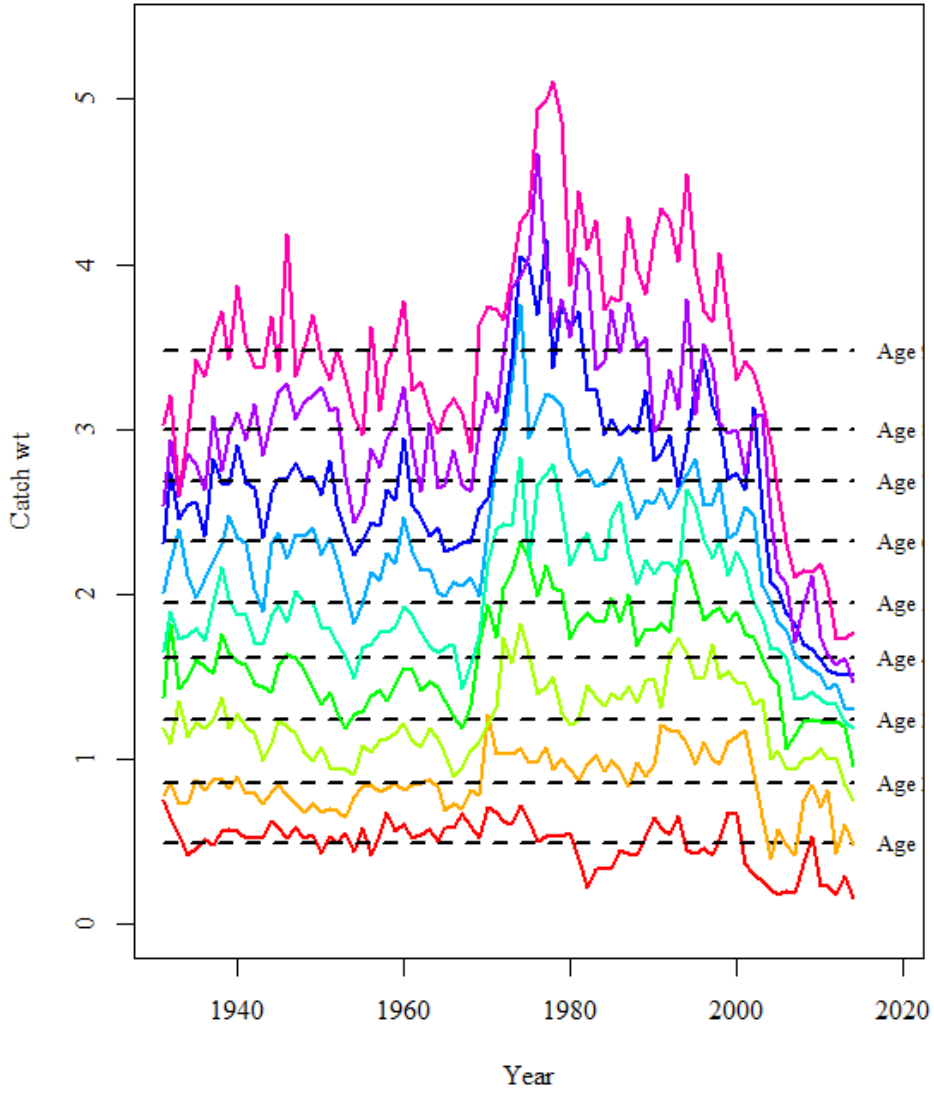


Data: Surveys SHG vs TOGA (Mean N/tow)

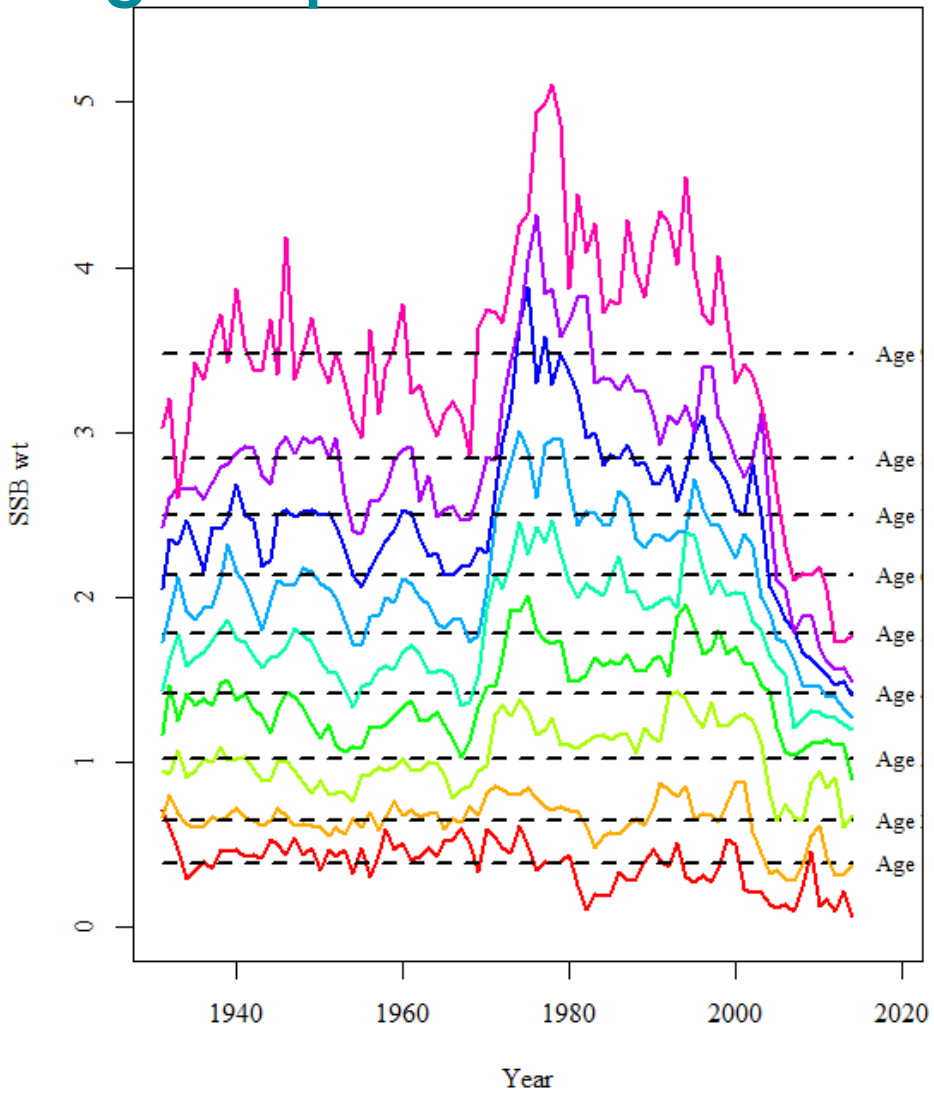




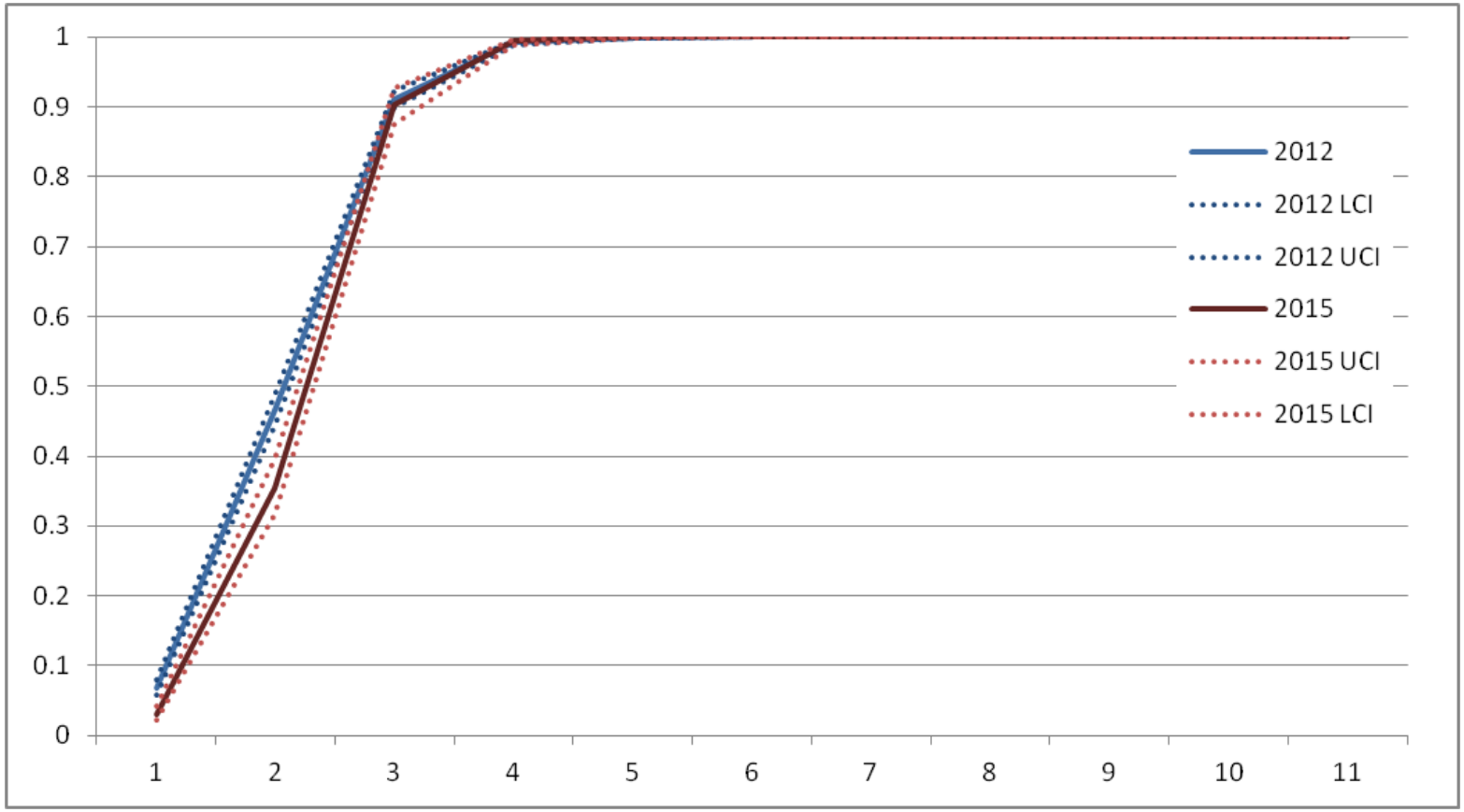
Data: biological parameters – Catch WAA



Data: biological parameters – SSB WAA



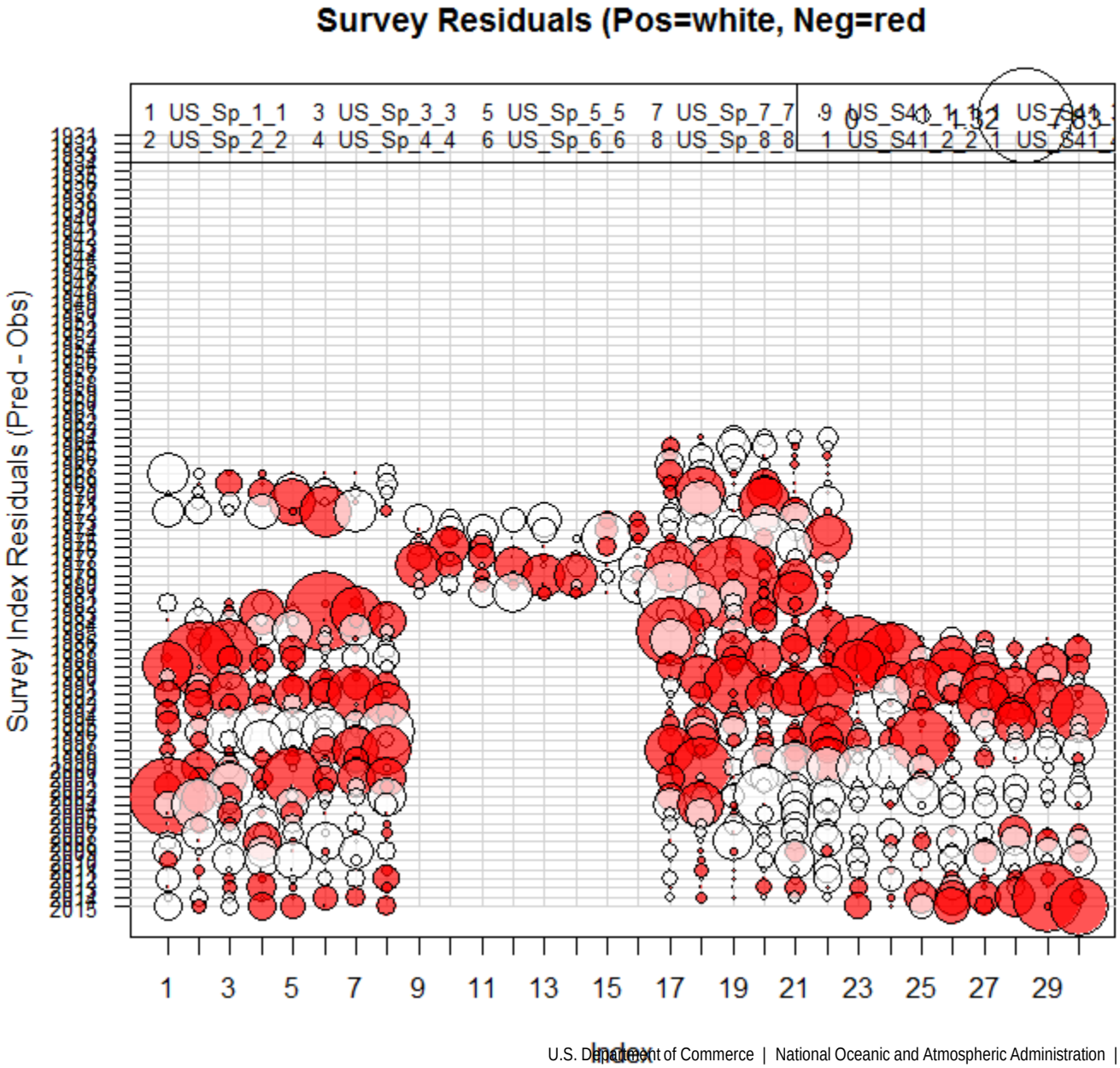
Data: biological parameters – Maturity at age



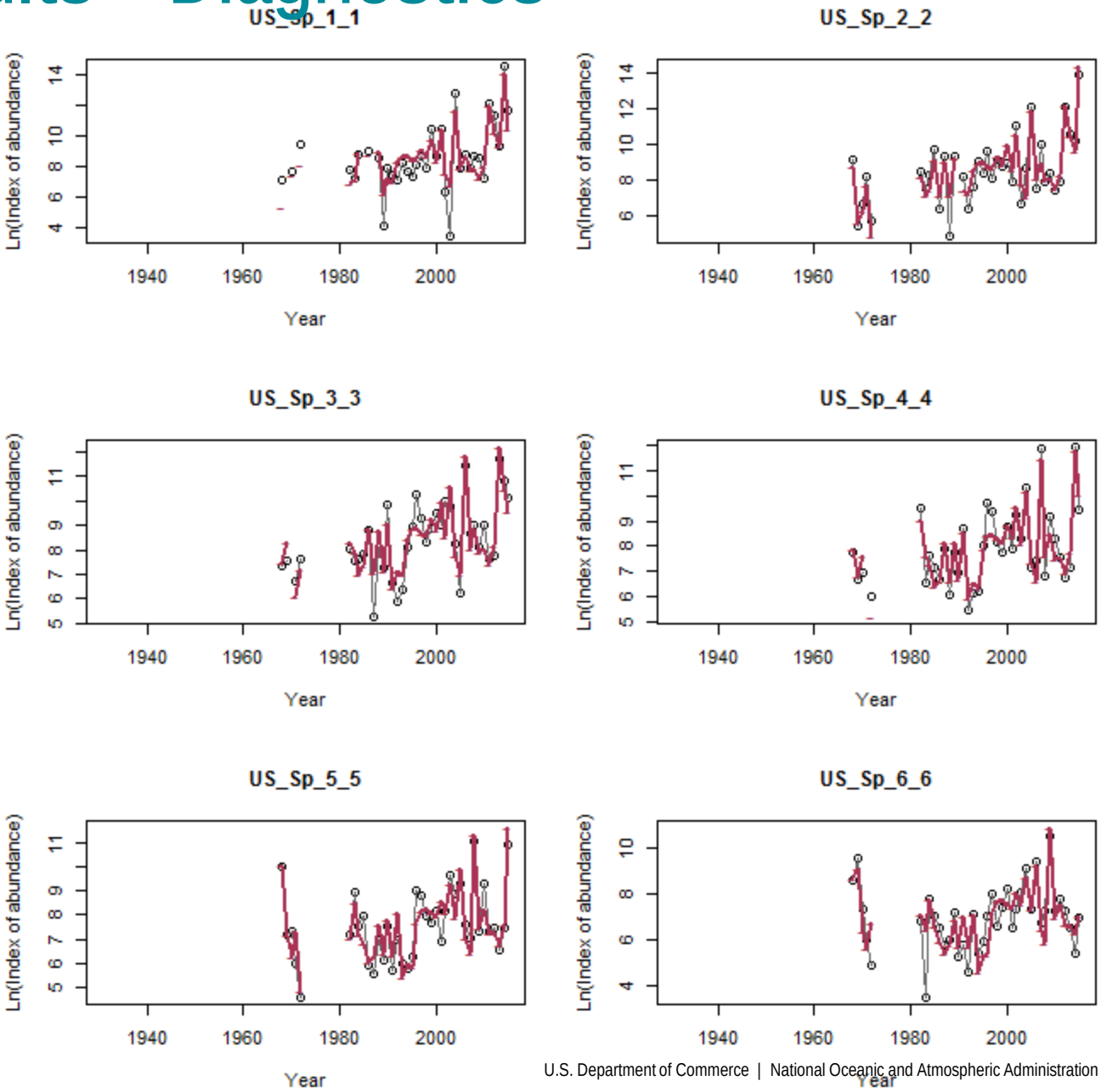
Model configuration

- Ages 1-9+
- Catch at age (1931-2014)
- Surveys
  - NEFSC Spring (ages 1-8) 1968-2015
  - DFO (ages 1-8) 1986-2015
  - NEFSC Fall (ages 0-5, lagged by 1 year → ages 1-6), 1963-2014

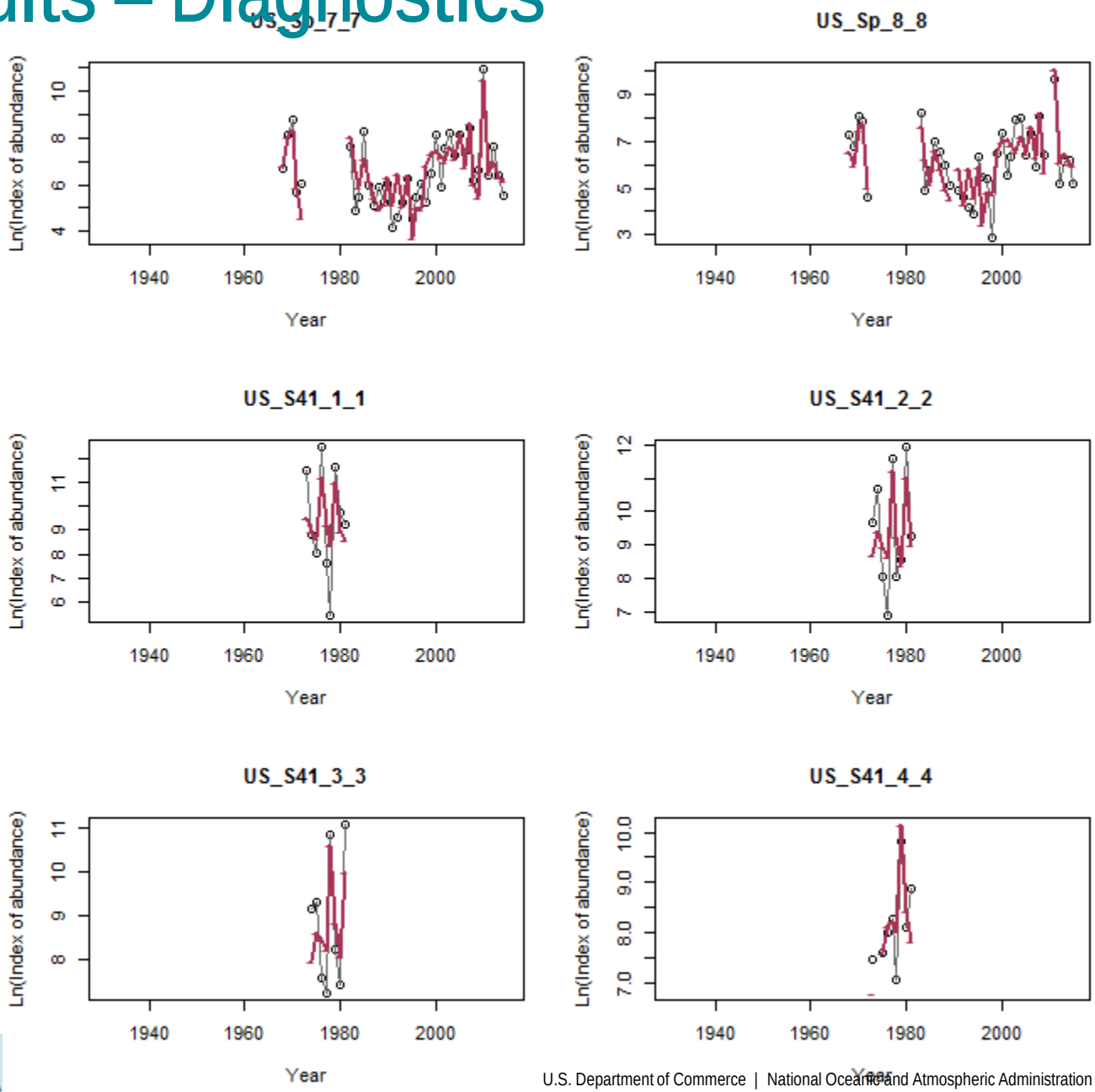
Results – Diagnostics



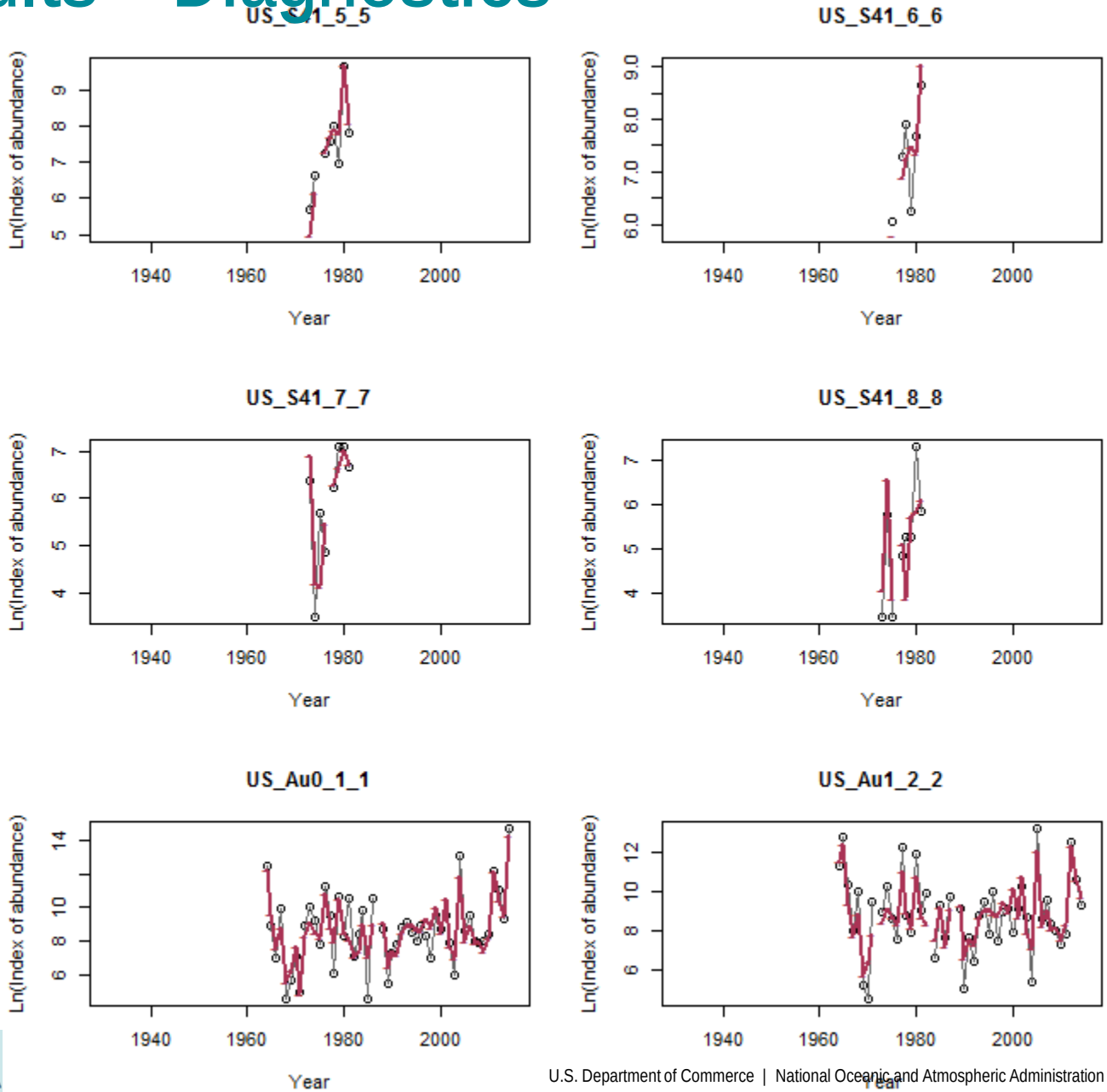
Results – Diagnostics



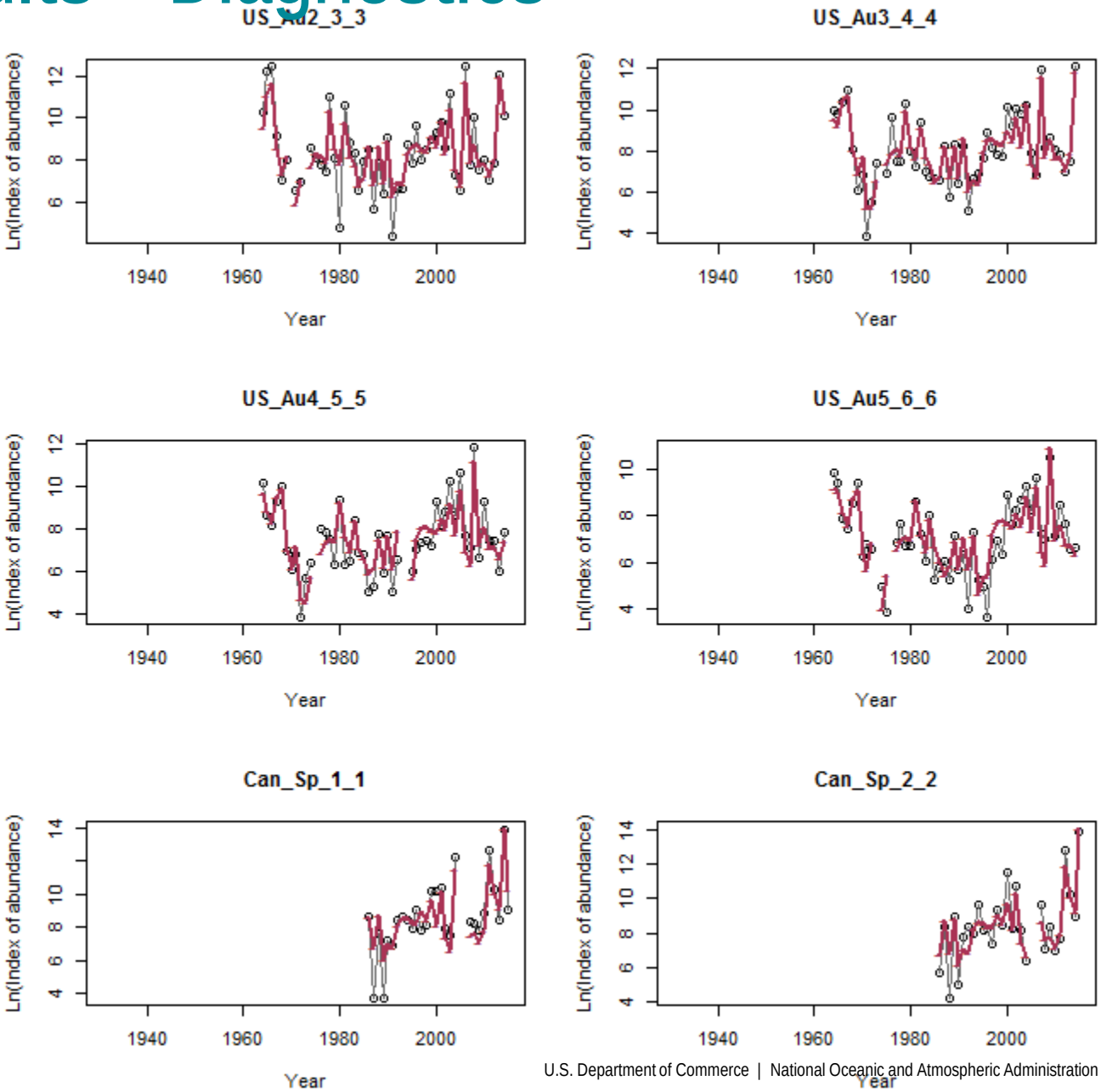
Results – Diagnostics



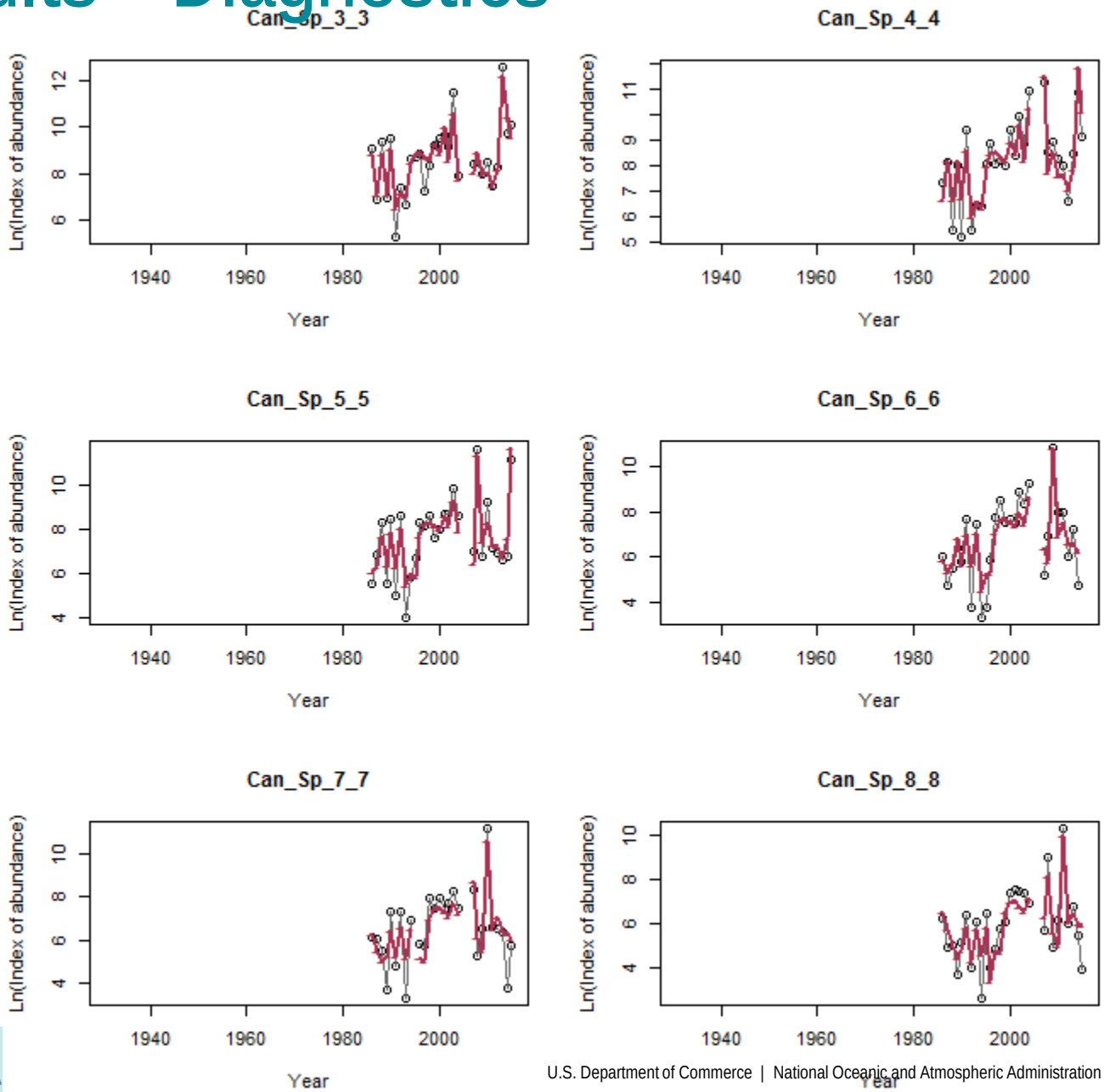
Results – Diagnostics



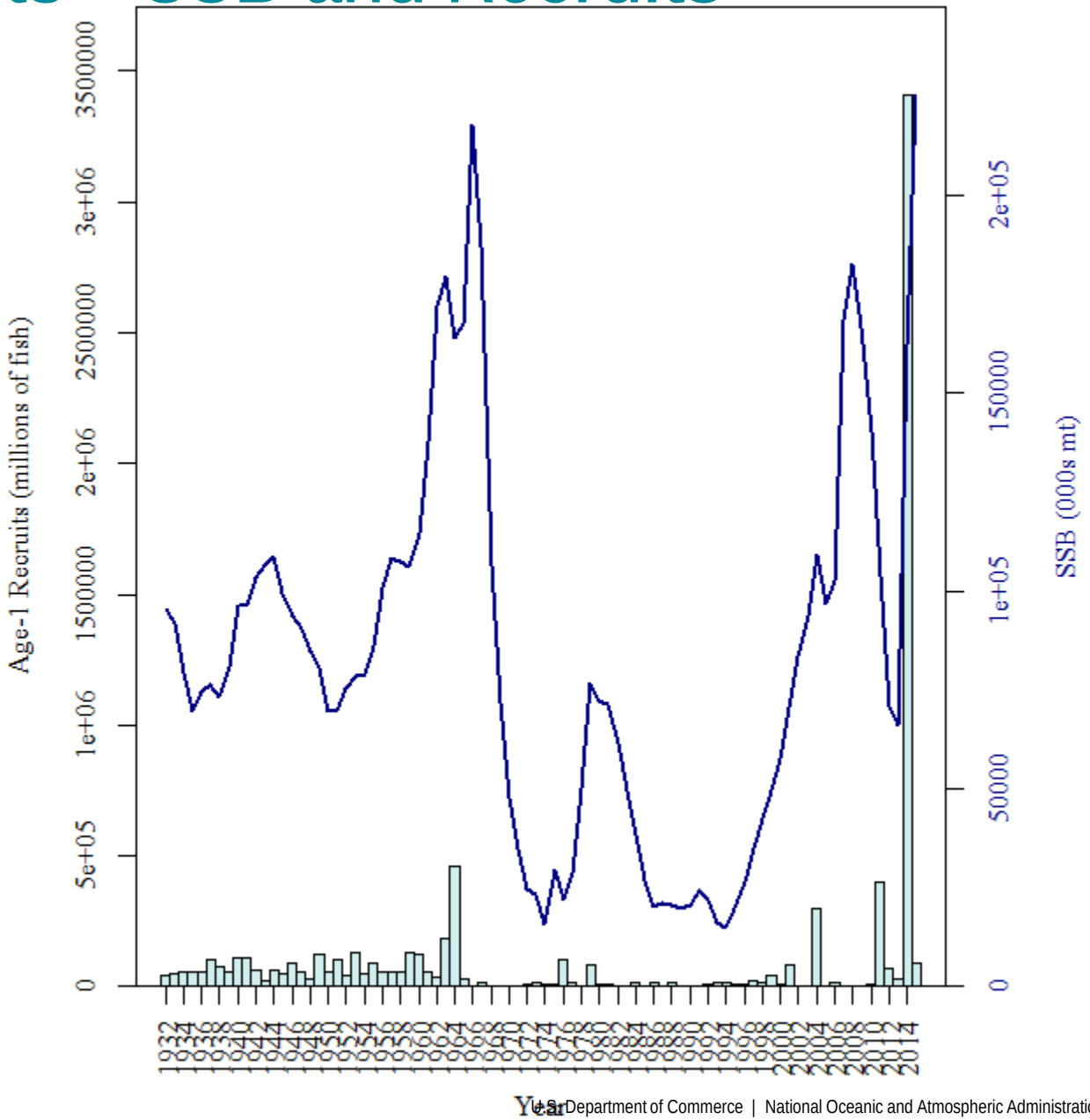
Results – Diagnostics



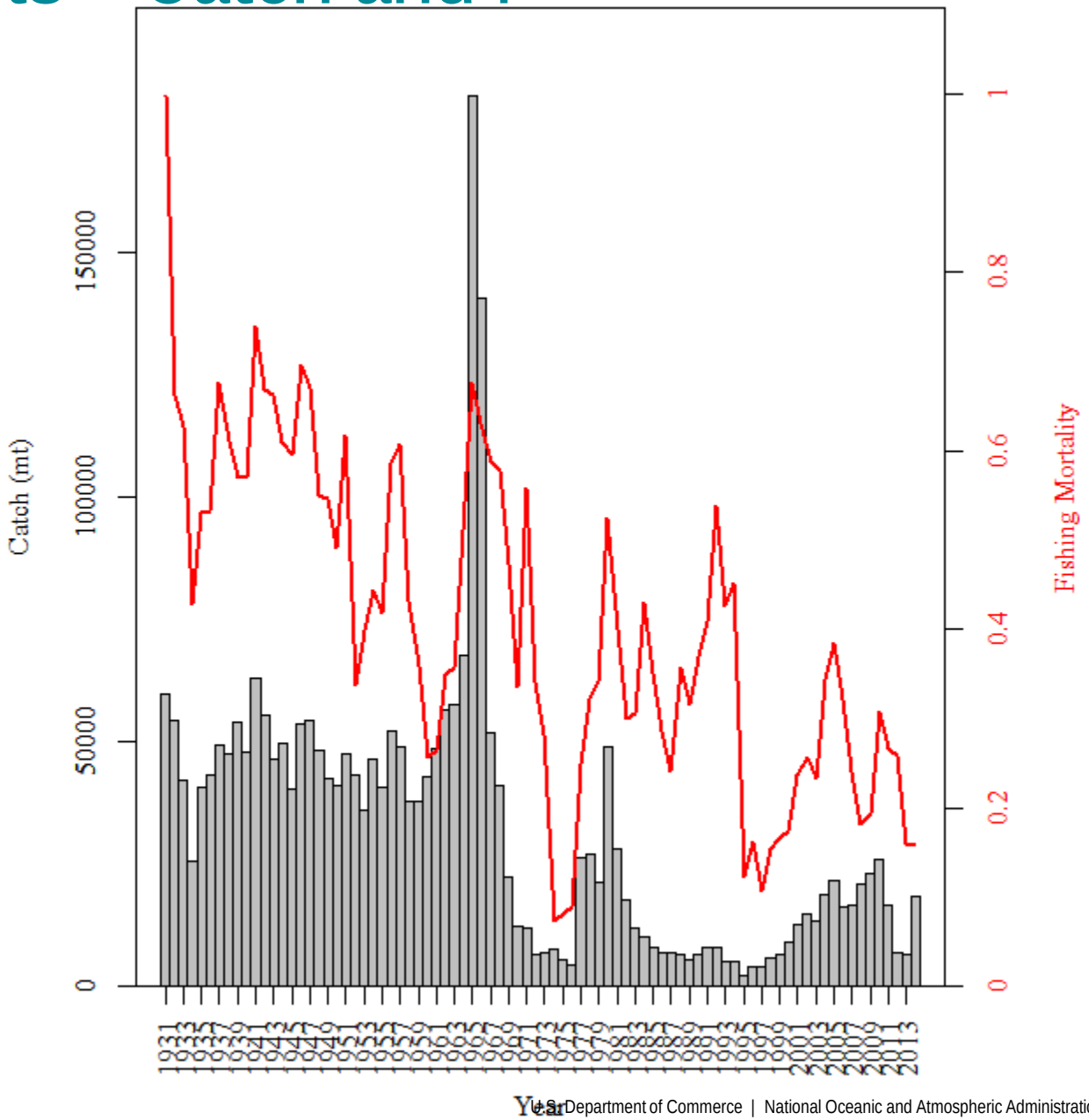
Results – Diagnostics



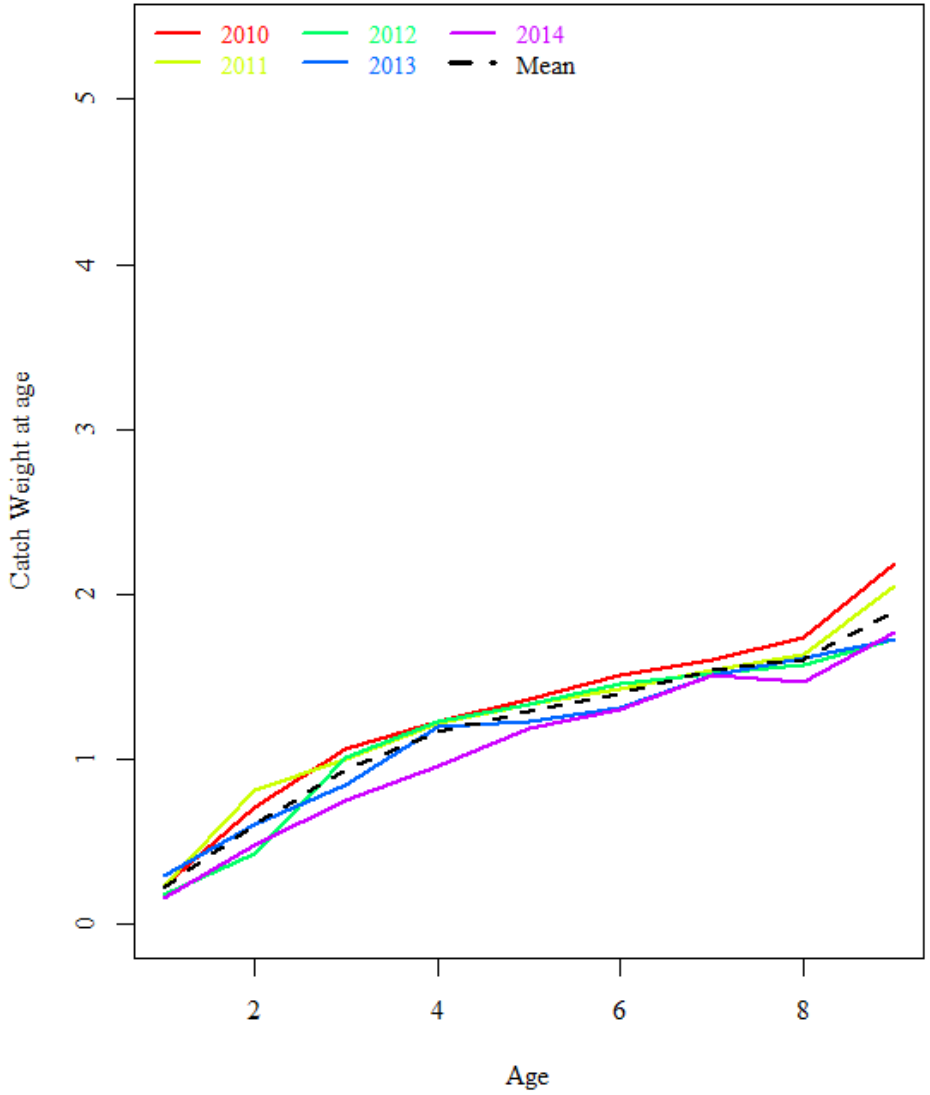
Results – SSB and Recruits



Results – Catch and F



Results – reference point inputs



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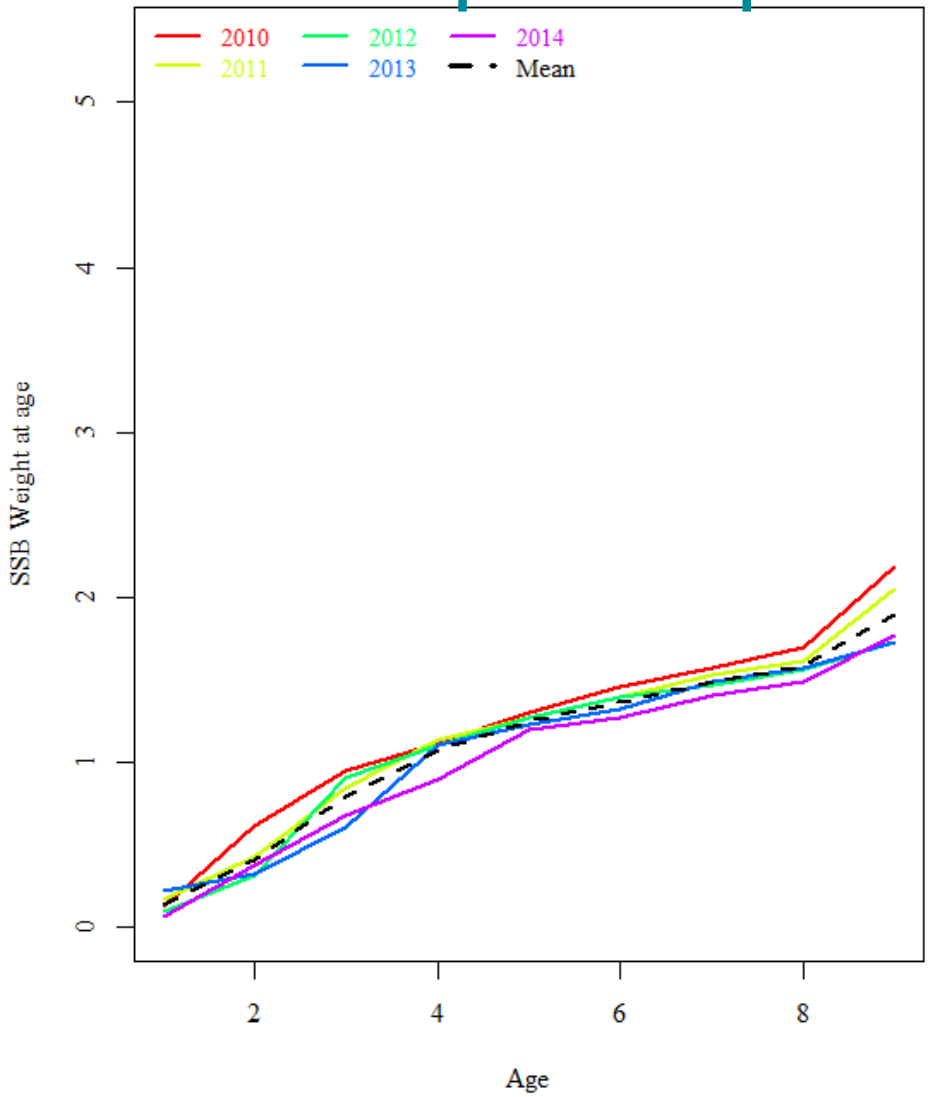
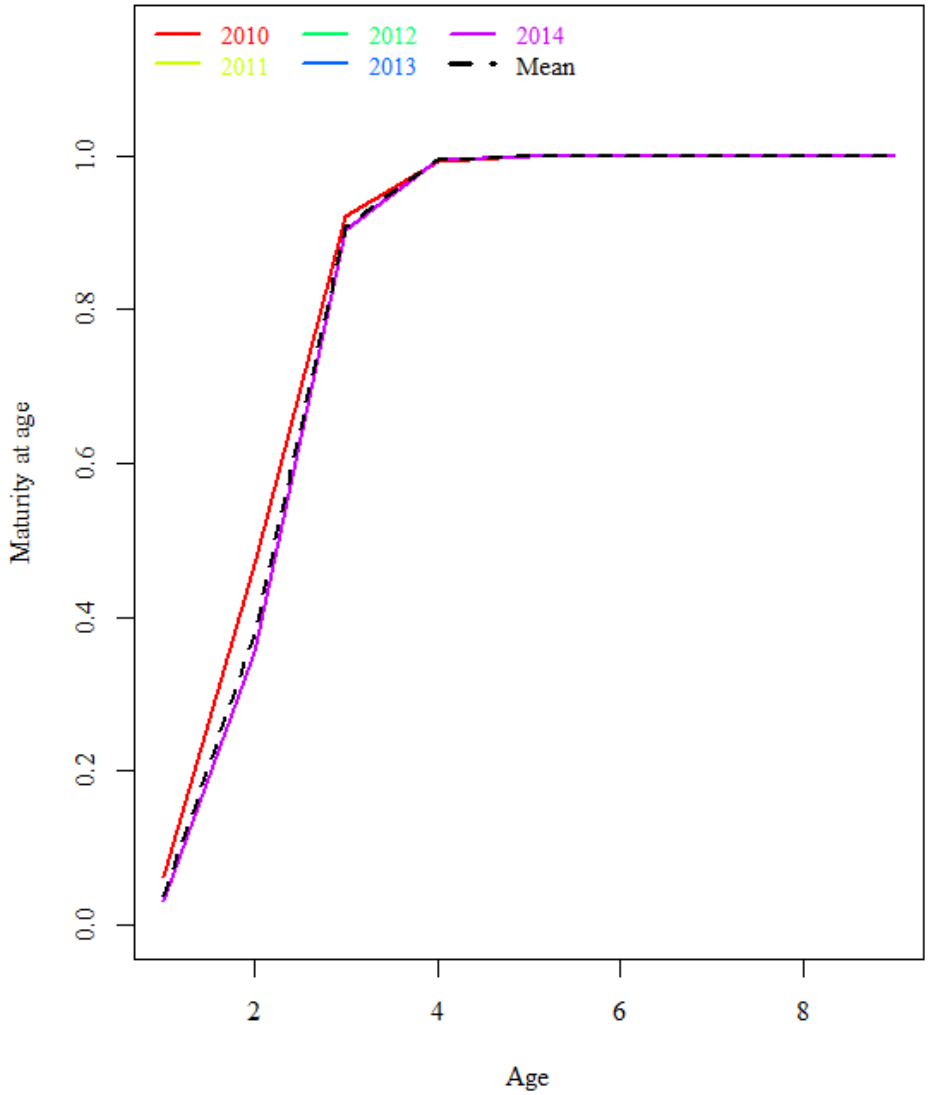
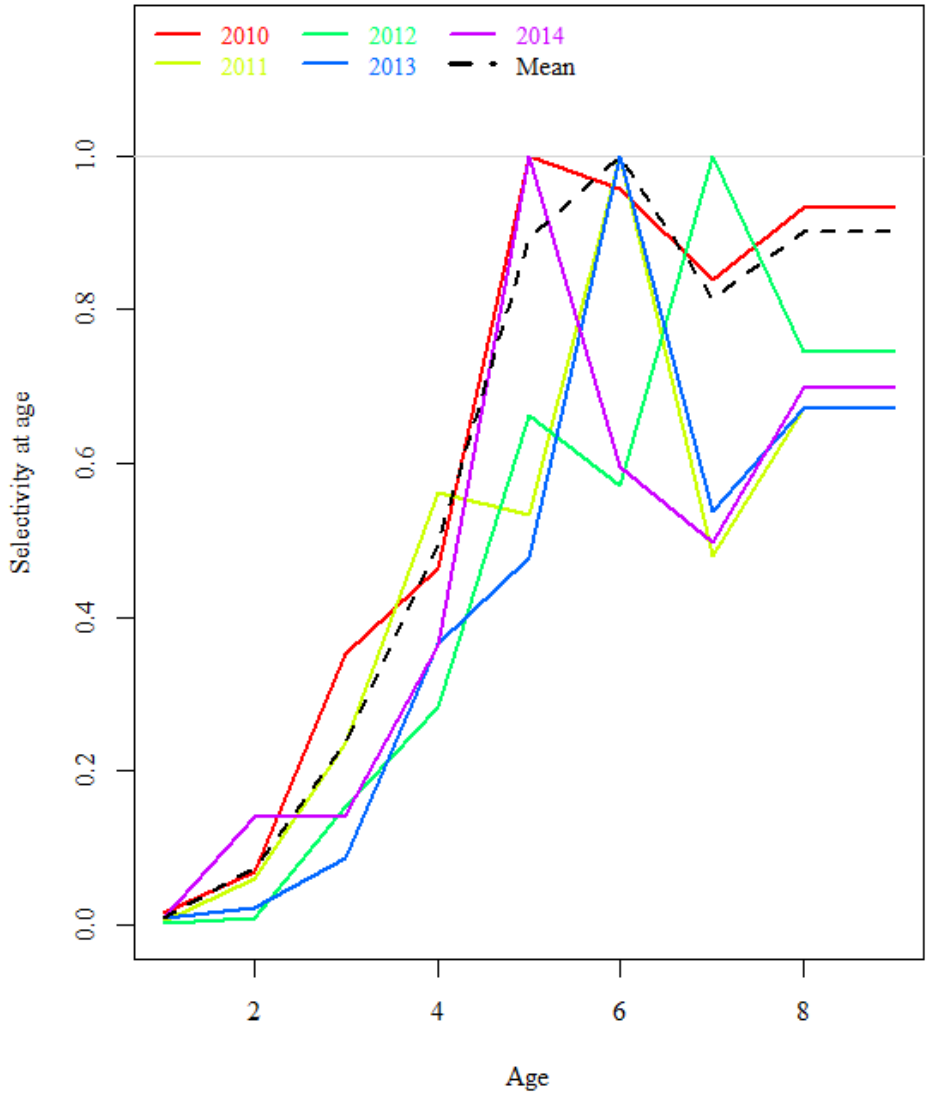


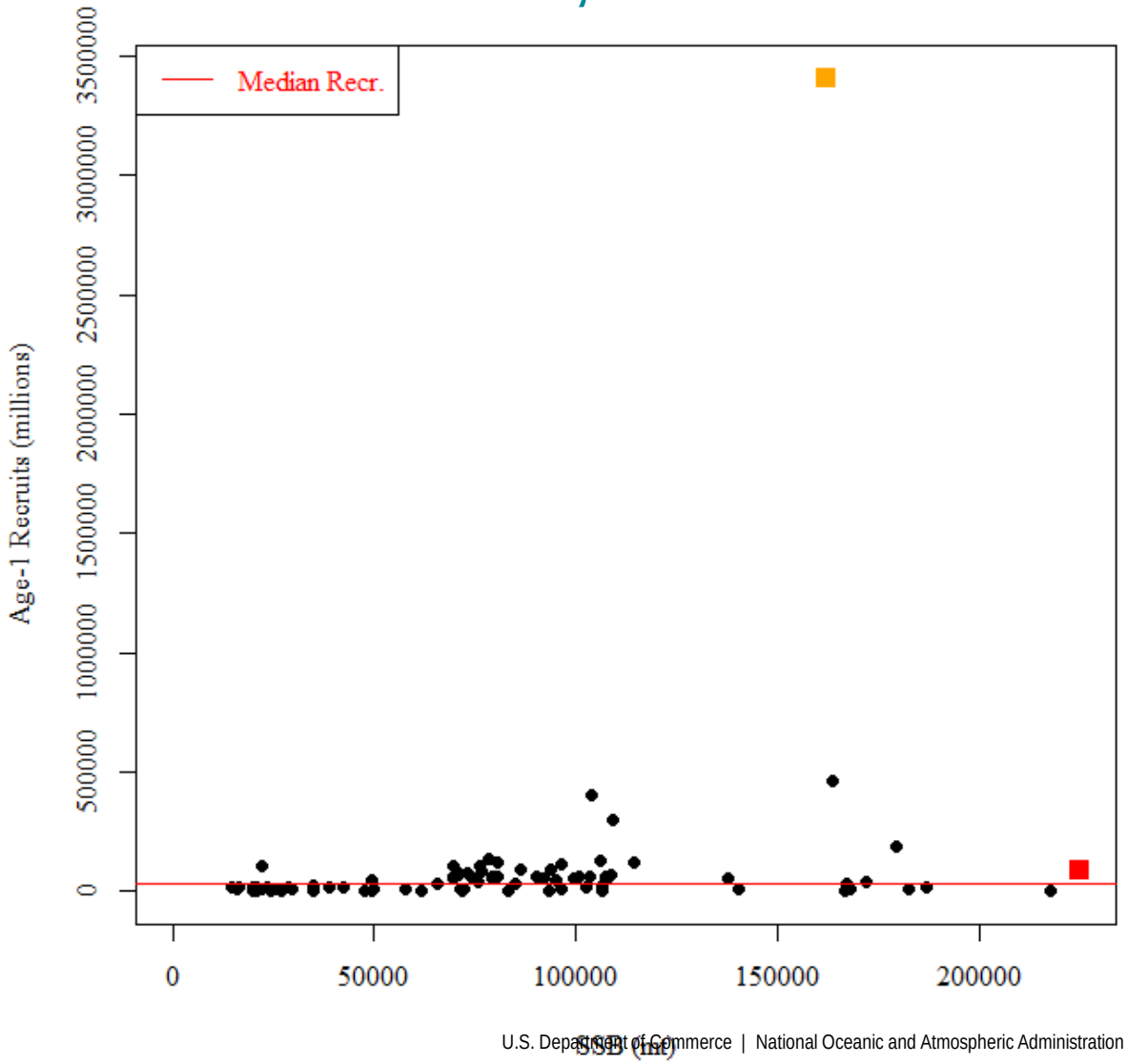
Results – reference point inputs



Results – reference point inputs



Results – reference point inputs
Recruitment when SSB>75,000 mt



Results – reference point (F40%)

- F40% = 0.39, dropping high recruitment (1963,2003,2010)

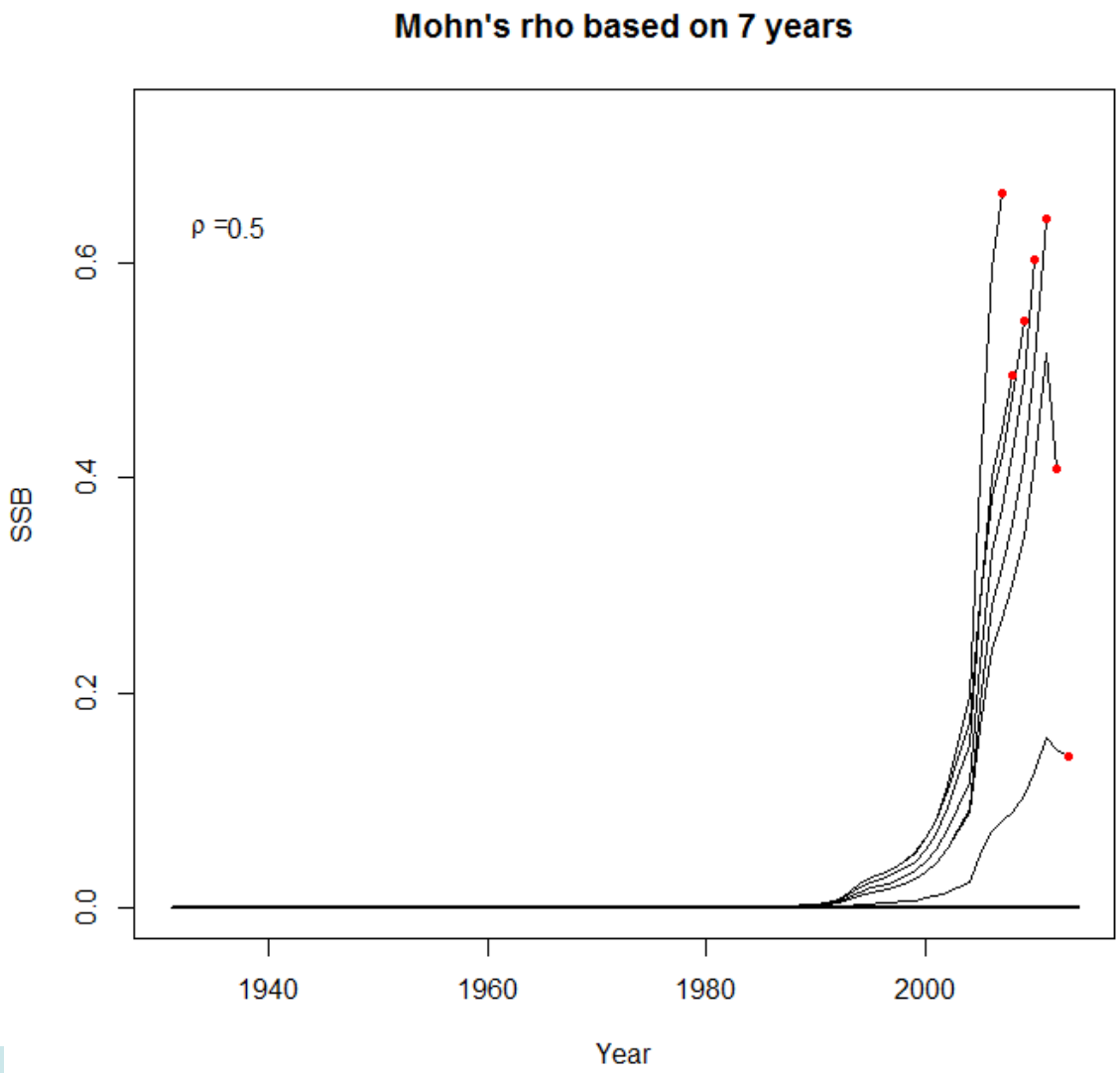
2015 update

	Median	**5th**	**95th**
SSBmsy	108.3	58.2	167.9
MSY	24.9	13.6	38.4
Recruitment	53.4	3.5	130.0

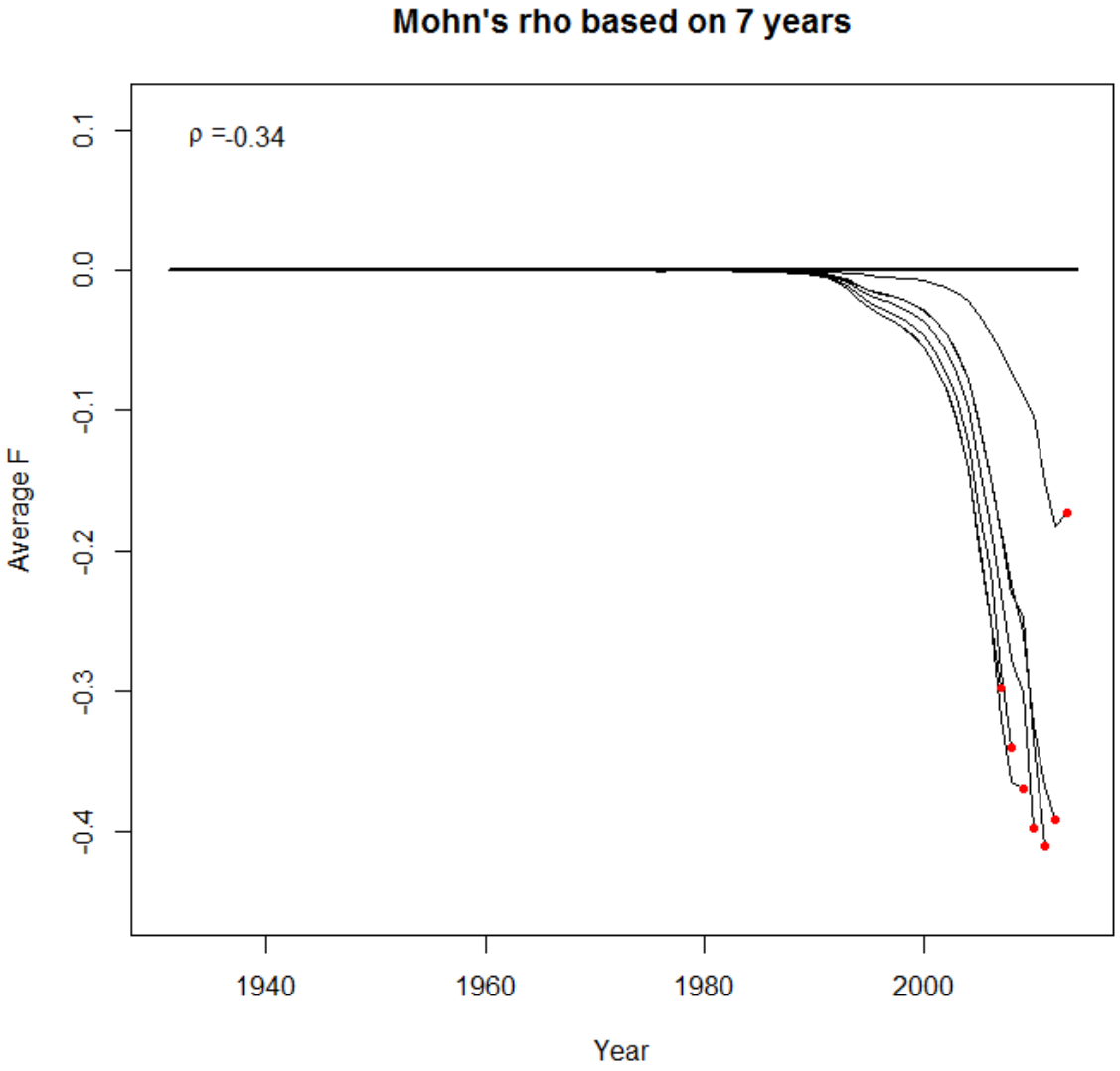
2012 update

	Median	**5th**	**95th**
SSBmsy	124.9	71.8	187.8
MSY	28	16.3	41.9
Recruitment	54.2	4	130

Results – retrospective analysis SSB



Results – retrospective analysis F

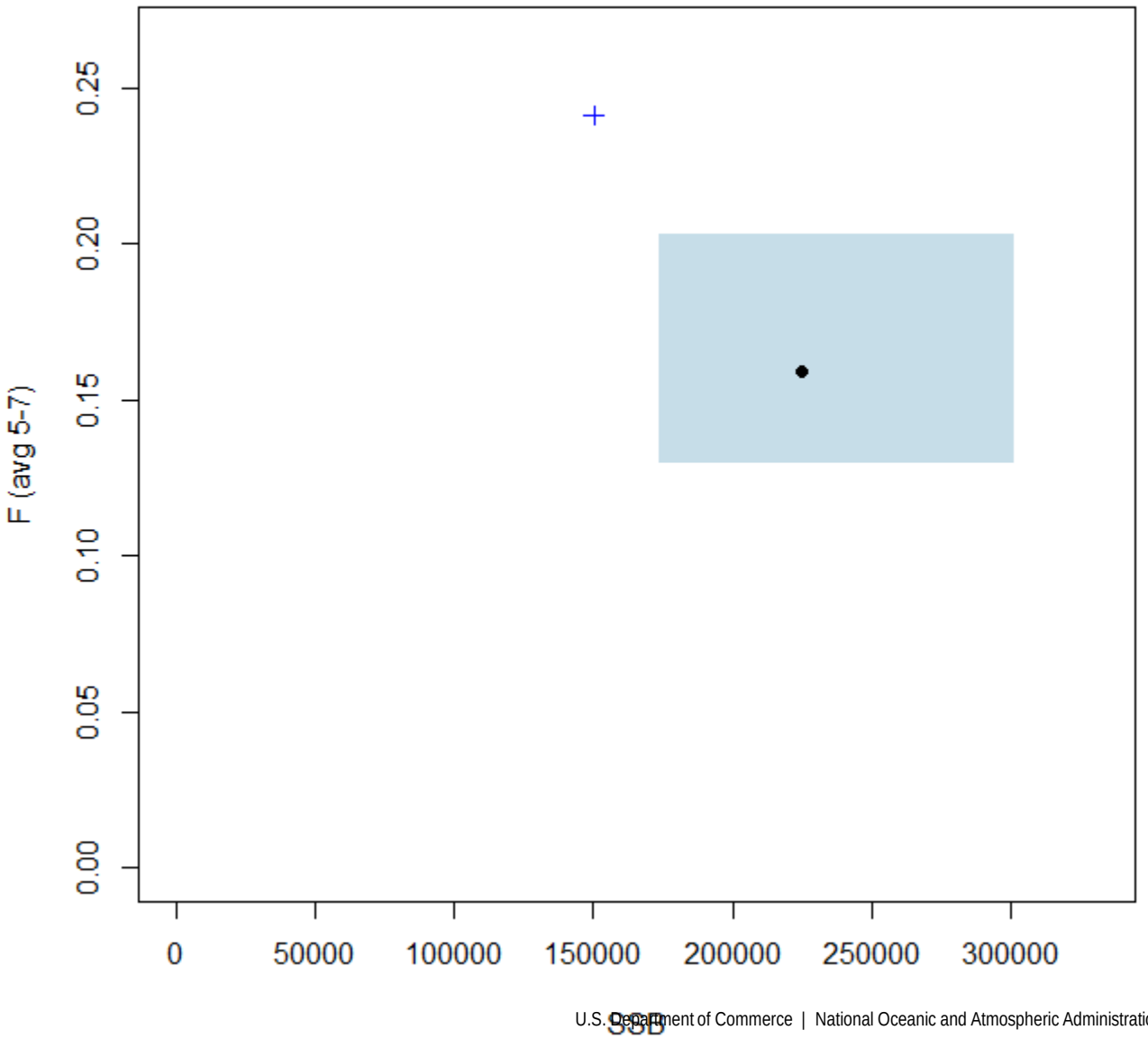


Results – stock status

- SSB_{2014} = 225,080
- F_{2014} = 0.16
- ρ-adjusted SSB_{2014} = 150,053
- ρ-adjusted F_{2014} = 0.24

- F40% = 0.39 → No overfishing
- SSB_{MSY} = 108,300 → Not overfished

Results – stock status (ρ-adjusted vs 90%PI)

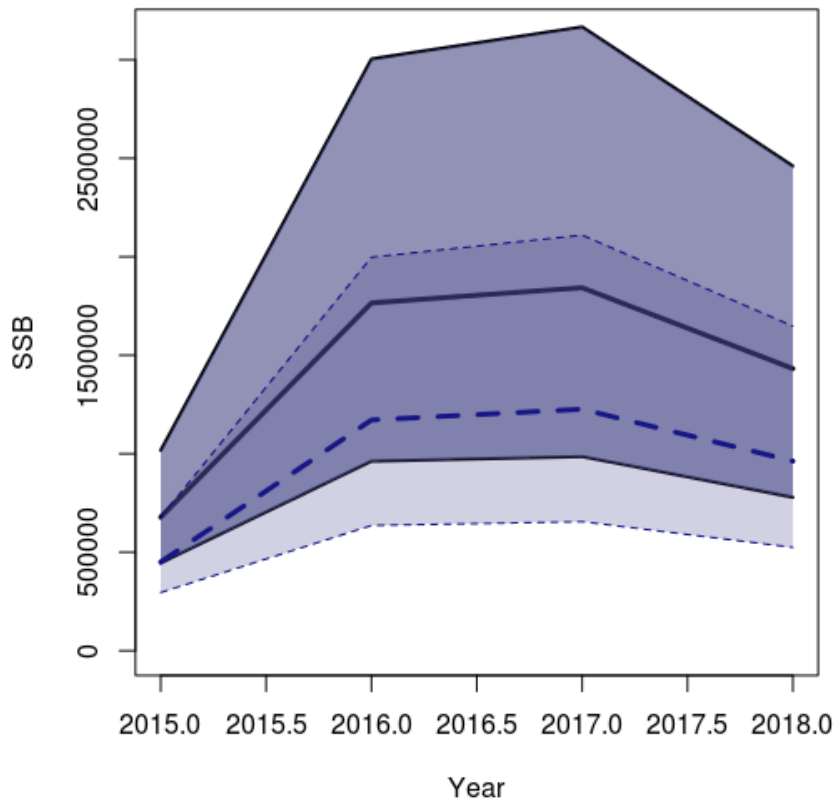


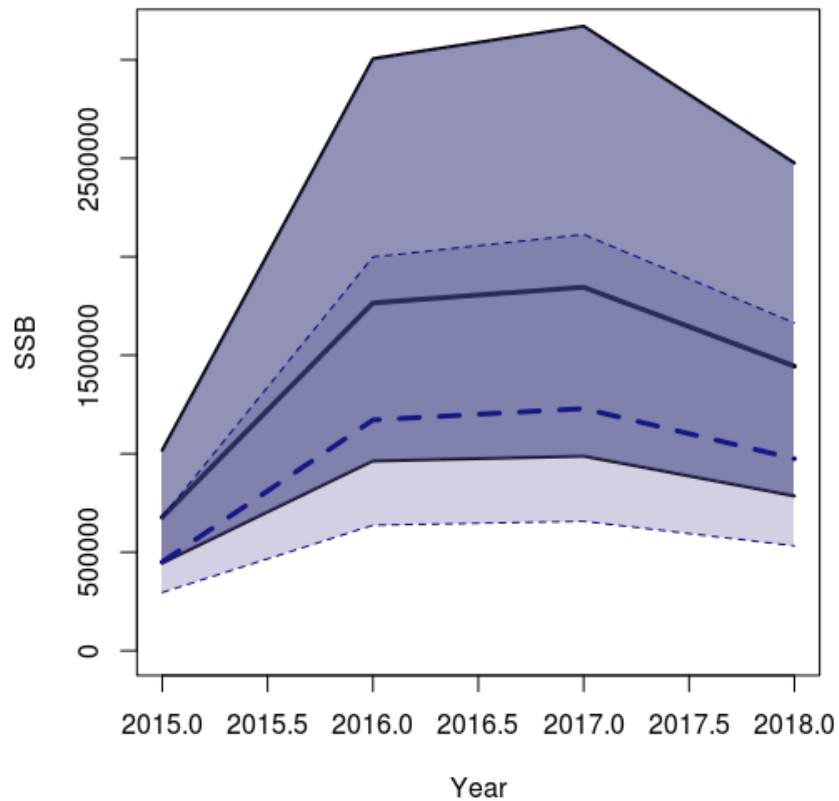
Results - projections

- Catch in 2015 = 20.860 mt, F=0.39 for 2016-2018
- ρ-adjusted or not ρ-adjusted
- Drop or keep high recruitments (1963, 2003, 2010)

Results - projections

- Drop high recr (left) or keep high recr (right)
- ρ-adjusted = light color, dashed lines





Results - projections

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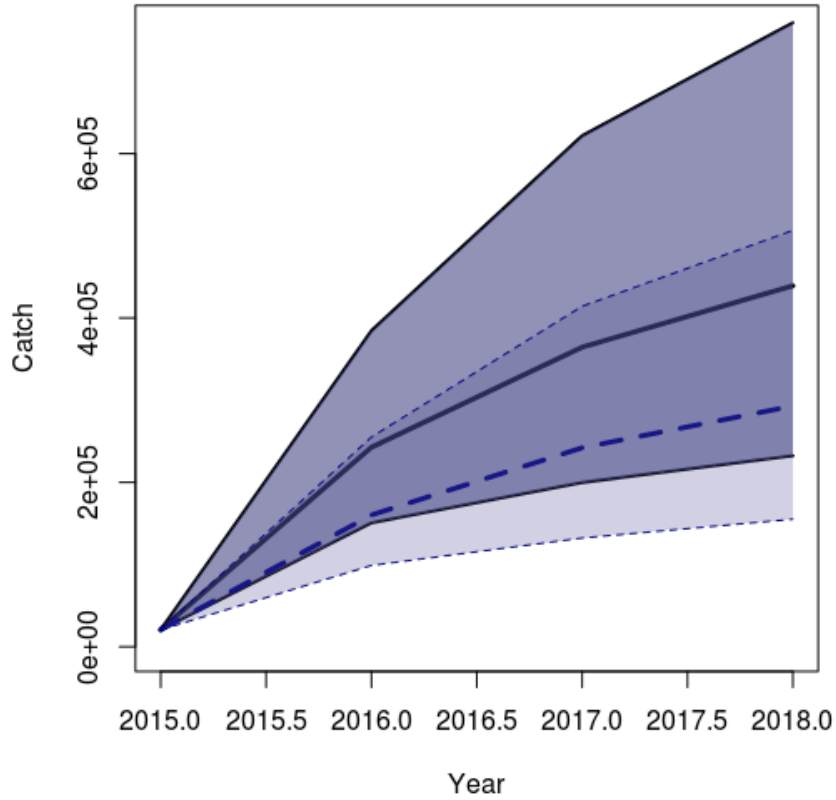
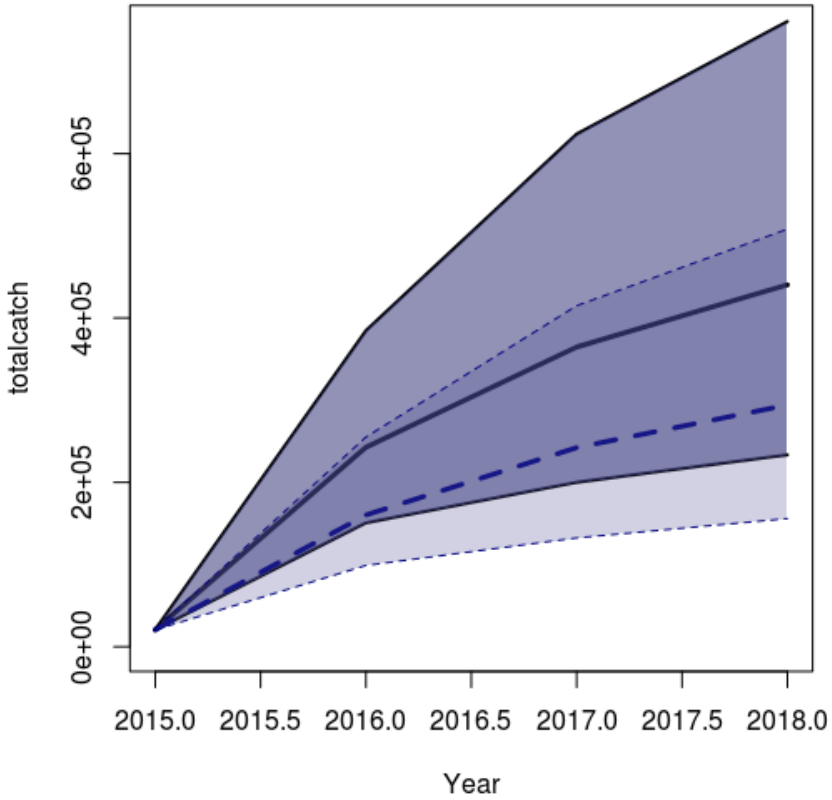
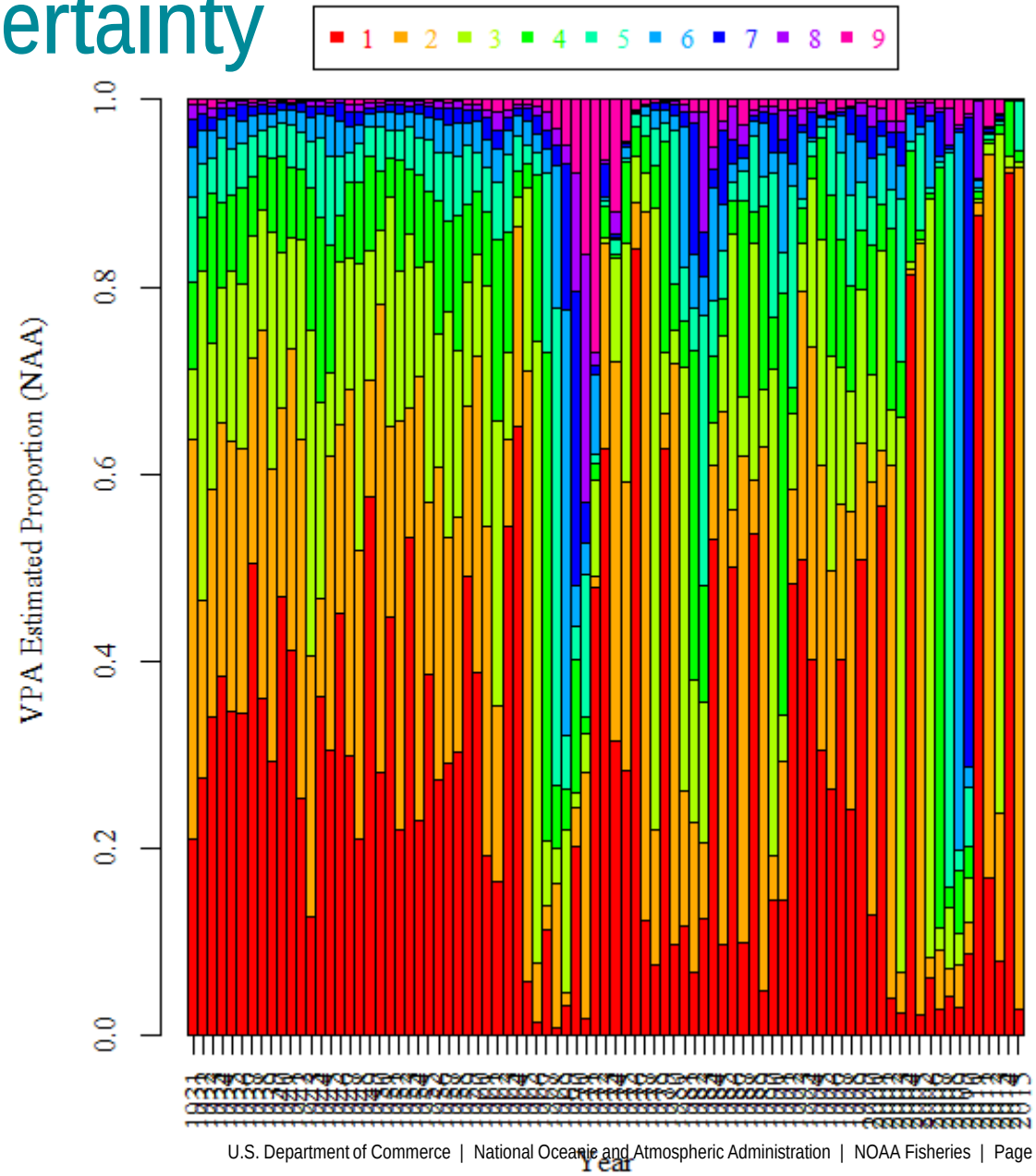


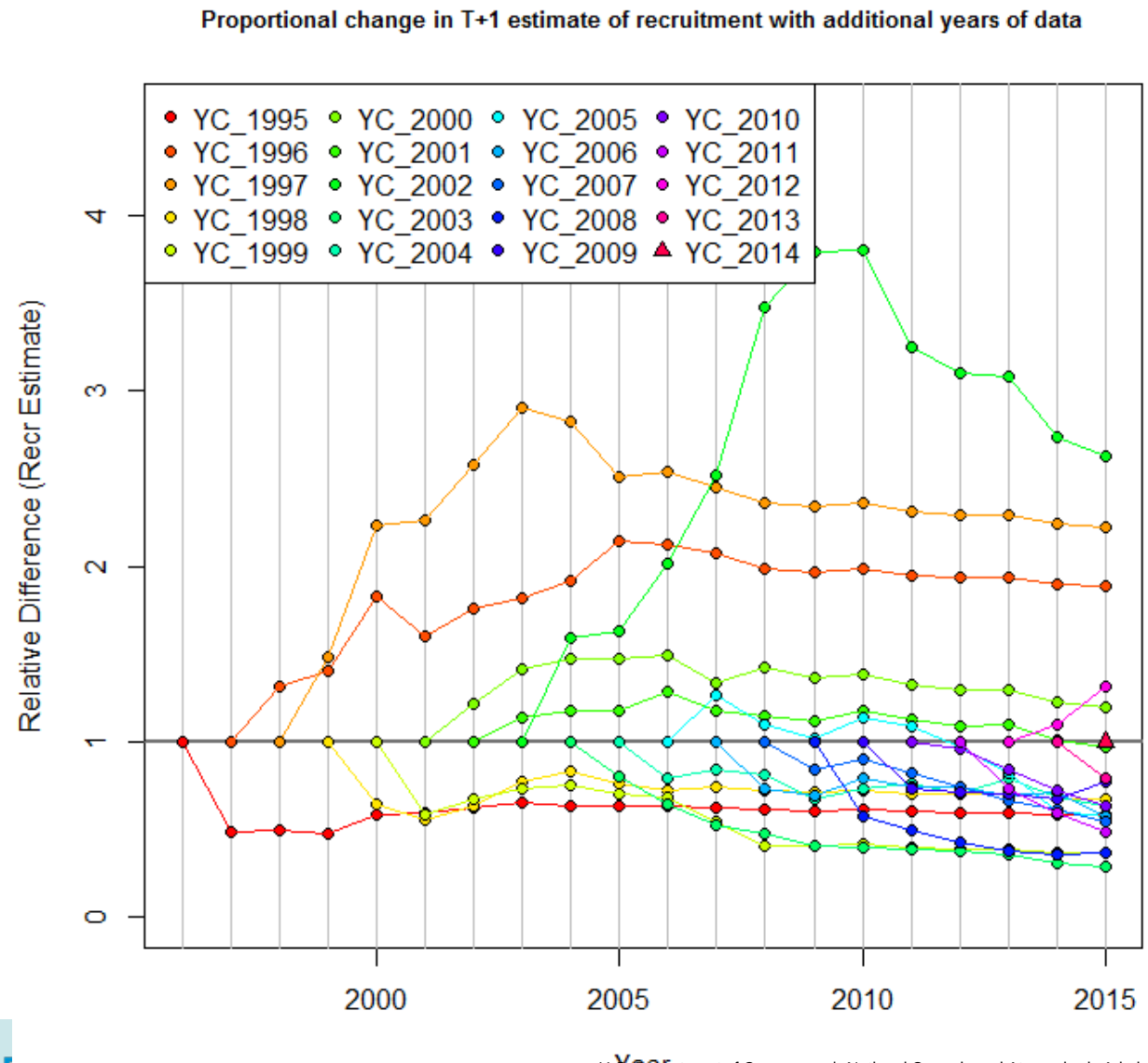


Sources of uncertainty

- Size of 2013 yearclass



Sources of uncertainty – 2013 year class



Sources of uncertainty – 2013 year class

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
1995	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1996	0.49	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1997	0.50	1.31	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1998	0.47	1.40	1.48	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1999	0.58	1.82	2.24	0.65	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2000	0.59	1.60	2.27	0.56	0.58	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	0.62	1.76	2.58	0.63	0.67	1.21	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2002	0.66	1.81	2.90	0.77	0.73	1.41	1.14	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2003	0.63	1.91	2.82	0.83	0.75	1.48	1.18	1.59	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2004	0.64	2.15	2.51	0.76	0.70	1.47	1.18	1.63	0.80	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	0.63	2.12	2.54	0.73	0.69	1.49	1.29	2.02	0.64	0.79	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
2006	0.62	2.07	2.45	0.74	0.54	1.33	1.17	2.52	0.53	0.84	1.26	1	NA	NA	NA	NA	NA	NA	NA	NA
2007	0.61	1.98	2.36	0.72	0.41	1.42	1.15	3.48	0.47	0.81	1.09	0.74	1	NA	NA	NA	NA	NA	NA	NA
2008	0.60	1.97	2.34	0.71	0.41	1.37	1.11	3.79	0.41	0.67	1.02	0.69	0.84	1	NA	NA	NA	NA	NA	NA
2009	0.61	1.98	2.36	0.72	0.41	1.39	1.18	3.80	0.39	0.73	1.14	0.79	0.90	0.58	1	NA	NA	NA	NA	NA
2010	0.60	1.95	2.31	0.71	0.40	1.32	1.12	3.25	0.39	0.76	1.09	0.74	0.82	0.50	0.73	1	NA	NA	NA	NA
2011	0.60	1.94	2.29	0.70	0.39	1.30	1.09	3.10	0.37	0.70	0.96	0.74	0.74	0.43	0.71	0.96	1	NA	NA	NA
2012	0.60	1.93	2.29	0.70	0.39	1.29	1.10	3.08	0.36	0.79	0.82	0.69	0.66	0.38	0.70	0.84	0.73	1	NA	NA
2013	0.59	1.90	2.24	0.68	0.37	1.22	1.01	2.73	0.30	0.69	0.61	0.71	0.61	0.35	0.67	0.72	0.59	1.10	1	NA
2014	0.58	1.88	2.22	0.67	0.36	1.20	0.97	2.62	0.28	0.63	0.58	0.57	0.54	0.36	0.77	0.63	0.48	1.31	0.79	1

Sources of uncertainty

- Size of 2013 yearclass

No rho adjustment, dropping high recruitments

Proportion of CAA

Year	1	2	3	4	5	6	7	8	9
2015	0.00	0.37	0.01	0.06	0.53	0.01	0.00	0.00	0.01
2016	0.00	0.00	0.72	0.01	0.04	0.21	0.00	0.00	0.01
2017	0.00	0.00	0.01	0.88	0.01	0.02	0.07	0.00	0.00
2018	0.00	0.00	0.01	0.02	0.92	0.01	0.01	0.04	0.00

Proportion of SSB

Year	1	2	3	4	5	6	7	8	9
2015	0.01	0.81	0.01	0.03	0.14	0.00	0.00	0.00	0.00
2016	0.00	0.01	0.88	0.01	0.02	0.08	0.00	0.00	0.00
2017	0.00	0.01	0.02	0.90	0.01	0.01	0.05	0.00	0.00
2018	0.00	0.01	0.02	0.03	0.88	0.00	0.01	0.04	0.00

Sources of uncertainty

- Size of 2013 yearclass

Rho adjustment, dropping high Recr

Proportion of CAA

Year	1	2	3	4	5	6	7	8	9
2015	0.00	0.37	0.01	0.06	0.53	0.01	0.00	0.00	0.01
2016	0.00	0.00	0.72	0.01	0.04	0.21	0.00	0.00	0.01
2017	0.00	0.00	0.01	0.88	0.01	0.02	0.07	0.00	0.00
2018	0.00	0.00	0.01	0.02	0.91	0.01	0.01	0.04	0.00

Proportion of SSB

Year	1	2	3	4	5	6	7	8	9
2015	0.01	0.81	0.01	0.03	0.14	0.00	0.00	0.00	0.00
2016	0.01	0.01	0.88	0.01	0.02	0.07	0.00	0.00	0.00
2017	0.01	0.01	0.02	0.89	0.01	0.01	0.05	0.00	0.00
2018	0.01	0.02	0.03	0.03	0.87	0.00	0.01	0.04	0.00

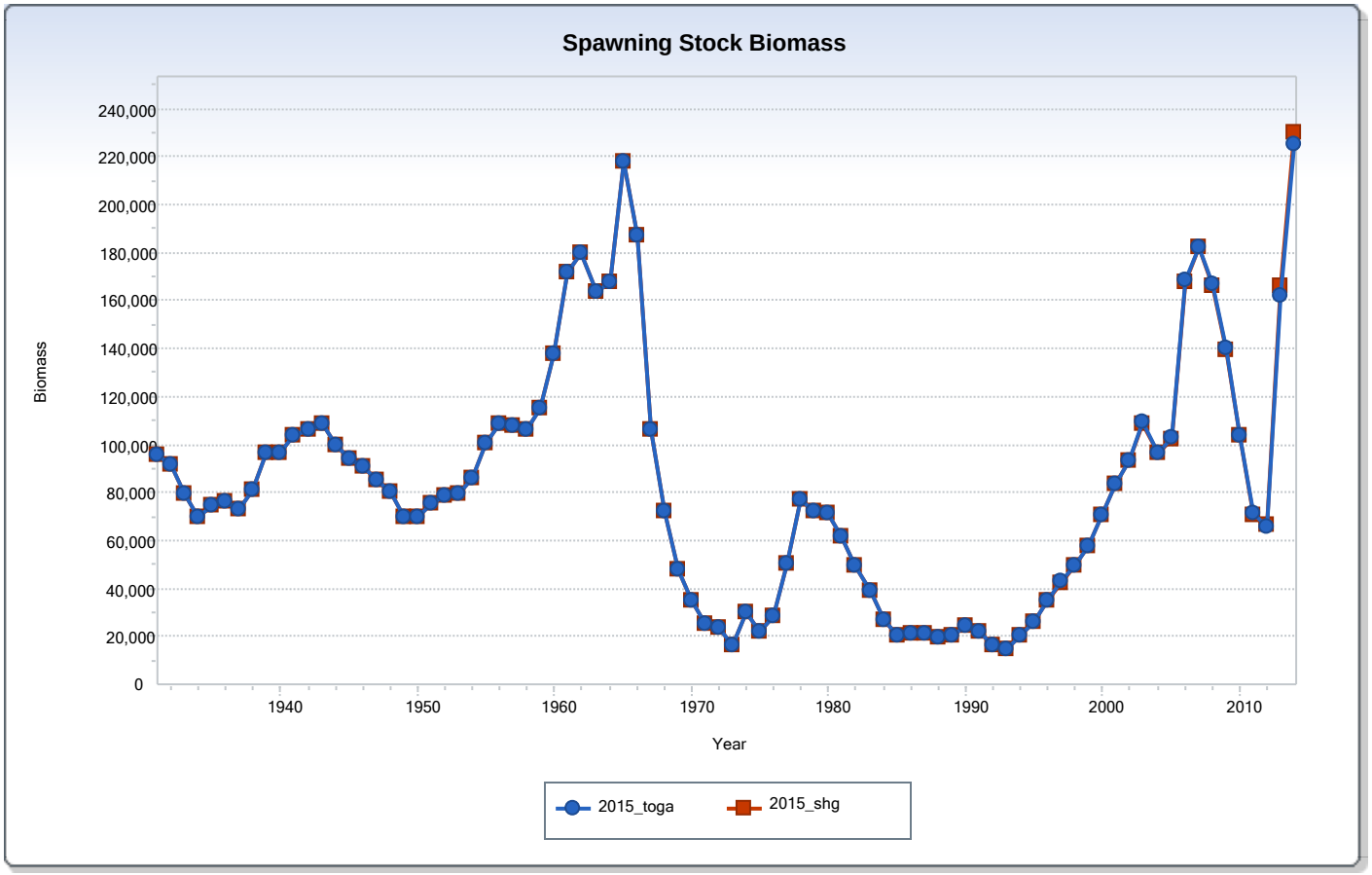
Key research needs

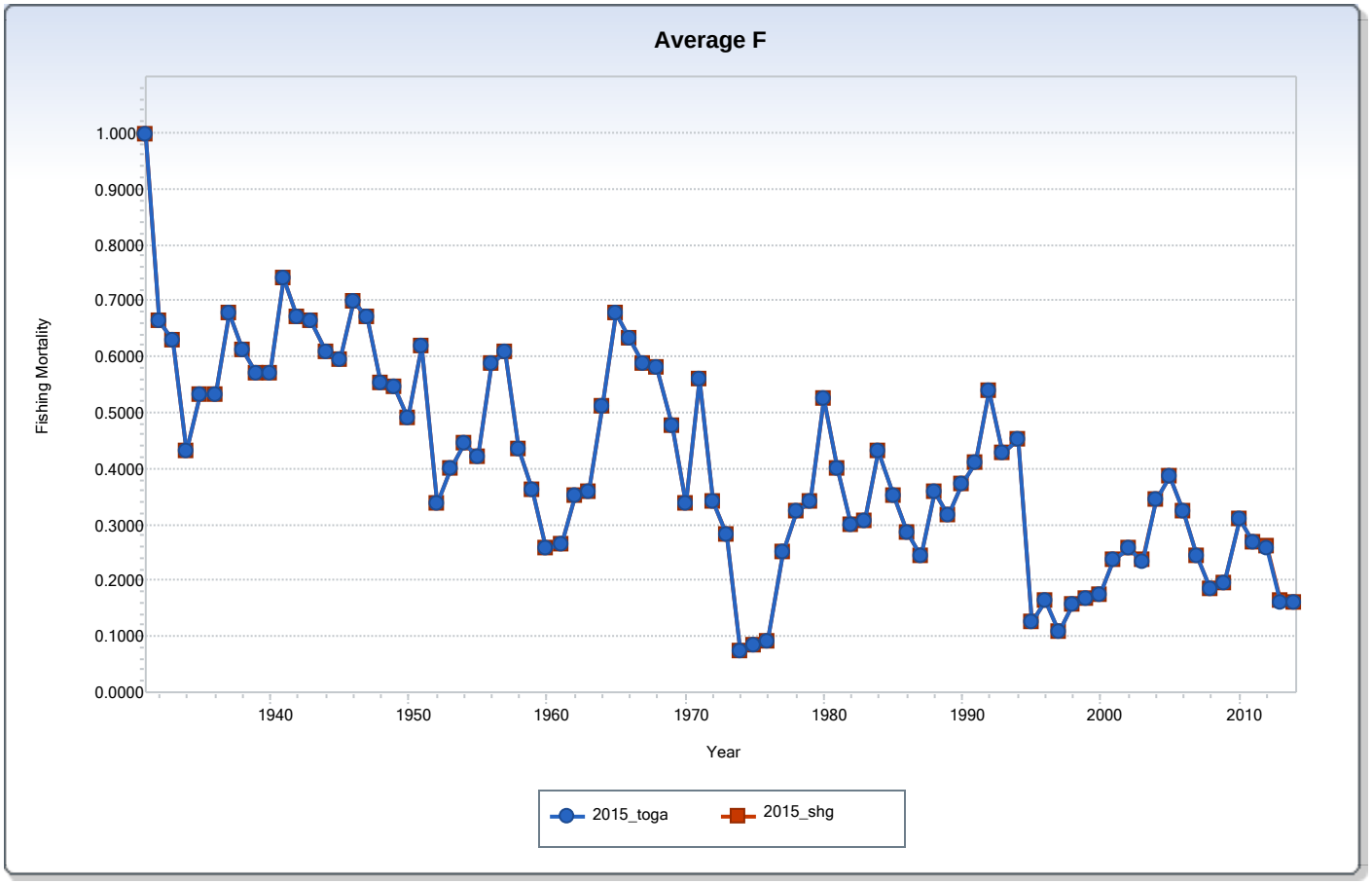
- Forecasting future recruitment, especially in presence of very large year classes

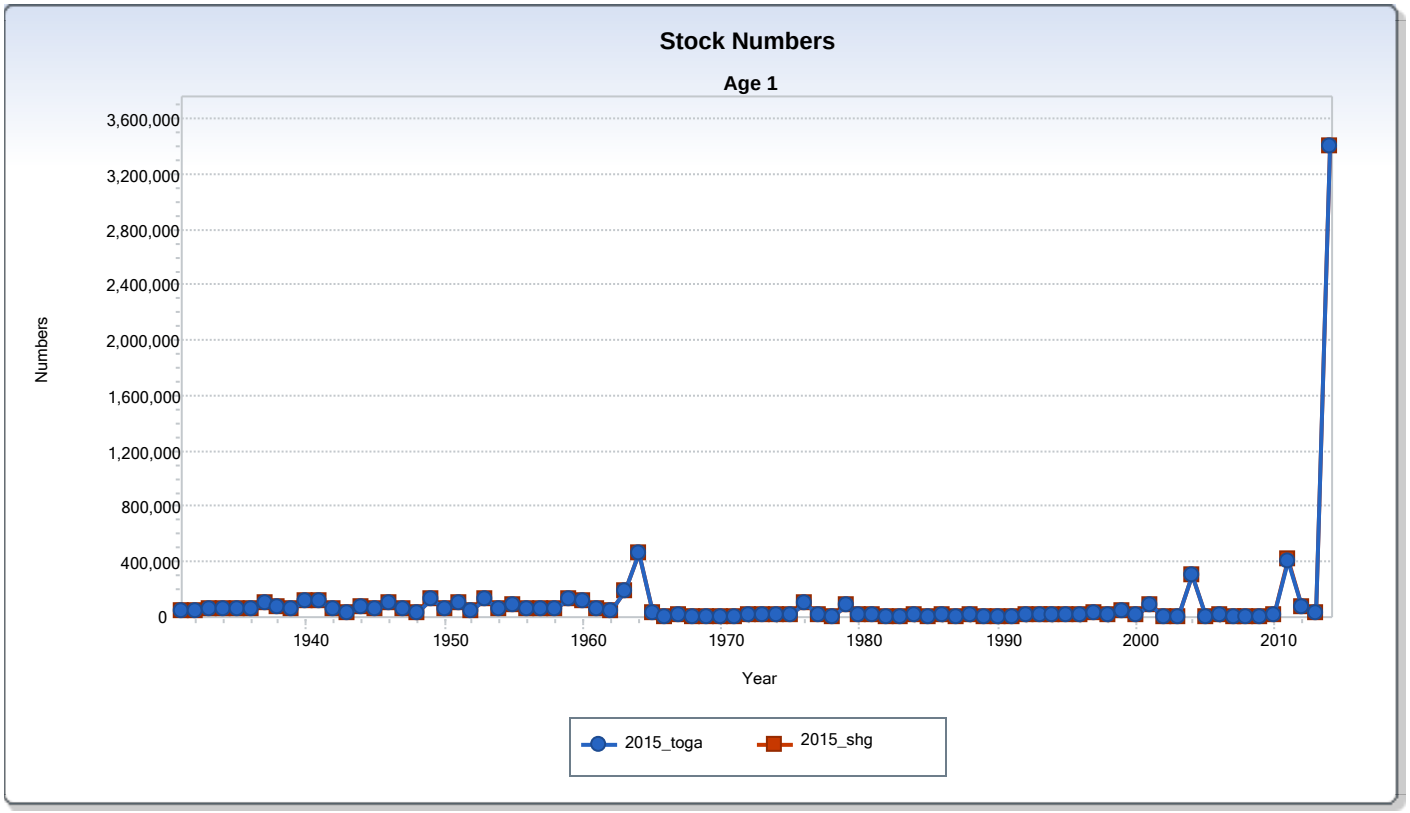
Thank you for your attention.
Questions?

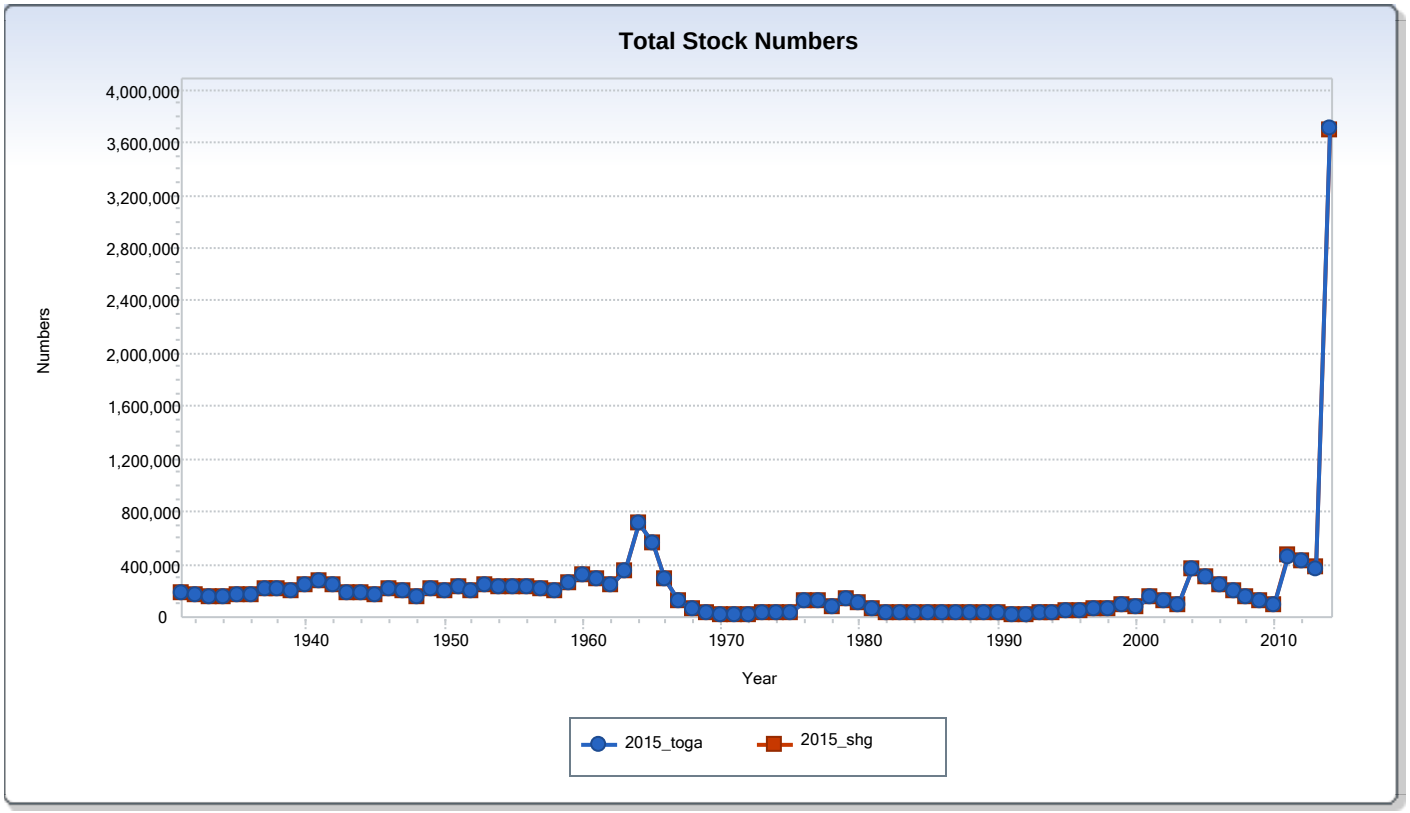
Extra Slides – 2012 Recruitment Est. Updates

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1995	1.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1996	0.49	1.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1997	0.50	1.31	1.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1998	0.47	1.40	1.48	1.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1999	0.58	1.82	2.24	0.65	1.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2000	0.59	1.60	2.27	0.56	0.58	1.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	0.62	1.76	2.58	0.63	0.67	1.21	1.00	NA	NA	NA	NA	NA	NA	NA	NA	NA
2002	0.66	1.81	2.90	0.77	0.73	1.41	1.14	1.00	NA	NA	NA	NA	NA	NA	NA	NA
2003	0.63	1.91	2.82	0.83	0.75	1.48	1.18	1.59	1.00	NA	NA	NA	NA	NA	NA	NA
2004	0.64	2.15	2.51	0.76	0.70	1.47	1.18	1.63	0.80	1.00	NA	NA	NA	NA	NA	NA
2005	0.63	2.12	2.54	0.73	0.69	1.49	1.29	2.02	0.64	0.79	1.00	NA	NA	NA	NA	NA
2006	0.62	2.07	2.45	0.74	0.54	1.33	1.17	2.52	0.53	0.84	1.26	1.00	NA	NA	NA	NA
2007	0.61	1.98	2.36	0.72	0.41	1.42	1.15	3.48	0.47	0.81	1.09	0.74	1.00	NA	NA	NA
2008	0.60	1.97	2.34	0.71	0.41	1.37	1.11	3.85	0.41	0.67	1.01	0.67	0.82	1.00	NA	NA
2009	0.61	1.99	2.36	0.72	0.42	1.39	1.18	3.86	0.40	0.71	1.12	0.76	0.85	0.54	1.00	NA
2010	0.60	1.95	2.32	0.71	0.40	1.33	1.13	3.25	0.39	0.76	1.07	0.70	0.78	0.49	0.82	1.00


Spawning Stock Biomass
Biomass
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1940
1950
1960
1970
1980
1990
2000
2010
Year
2015_toga
2015_shg


Average F
Fishing Mortality
1.000
0.9000
0.8000
0.7000
0.6000
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
1940
1950
1960
1970
1980
1990
2000
2010
Year
2015_toga
2015_shg


Stock Numbers
Age 1
Numbers
3,600,000
3,200,000
2,800,000
2,400,000
2,000,000
1,600,000
1,200,000
800,000
400,000
0
1940
1950
1960
1970
1980
1990
2000
2010
Year
2015_toga
2015_shg


Total Stock Numbers
Numbers
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3,200,000
2,800,000
2,400,000
2,000,000
1,600,000
1,200,000
800,000
400,000
0
1940
1950
1960
1970
1980
1990
2000
2010
Year
2015_toga
2015_shg