2022 Atlantic Striped Bass Stock Assessment Update Appendices

Appendix 1: Model structure and detailed results for the base model run.

Table 1. Model structure, equation, and data inputs used in this assessment.

General Definitions	Symbol	Description/Definition
Year Index	y	y = {1982,..,2021} for catch. y = {1970,..,2021} for indices.
Age Index	a	a = {1,..,15+}
Fleet Index	f	f = {1: Chesapeake Bay, 2: Coast }
Indices Index:	t	t = {1,..,14}
Input Data	**Symbol**	**Description/Definition**
Observed Fleet Catch	$C_{f,y}$	Reported number of striped bass killed each year (y) by fleet (f)
Coefficient of Variation for Fleets	$CV_{f,y}$	Calculated from MRIP harvest and releases estimates with associated proportional standard errors (commercial harvest from census – no error)
Observed Fleet Age Compositions	$P_{f,y,a}$	Proportion-at-age (a) for each year (y) and fleet (f)
Observed Total Indices of Relative Abundance	$I_{t,y}$	Reported by various states. YOY and Age 1 Indices: 6 Indices with Age Composition: 8 (one fisheries-dependent, 7 fishery-independent)
Coefficient of Variation for Indices	$CV_{t,y}$	Calculated from indices and associated standard errors
Observed Age Compositions of Indices of Relative Abundance	$P_{t,y,a}$	Proportion-at-age (a) for each year (y) and index (t)
Effective Sample Size	$\hat{\bar{n}}$	<u>Starting Values from 2018 Benchmark</u> Fleets: Bay – 68.4, Ocean – 71 Indices: NYOHS – 21.4, NJ Trawl – 5.2, MDSSN – 16.8, DESSN – 19.7, MRIP – 35.6, CTLIST – 12.4, DE30FT – 7.3, ChesMap – 10.7 The multiplier from equation 1.8 method of Francis (2011) is used to adjust the starting values.

Table 1 (cont.)

Population Model	Symbol	Equation
Age-1 numbers	$\hat{N}_{y,1}$	$\widehat{N}_{y,1} = \overline{N}_1 e^{\hat{\varepsilon}_y - 0.5\sigma_R^2}$ $\hat{\sigma}_R = \sqrt{\frac{\sum_y(\hat{\varepsilon}_y - \bar{\hat{\varepsilon}})^2}{n-1}}$ where ε_y are independent and identically distributed normal random variables with zero mean and constant variance and are constrained to sum to zero over all years
Abundance-at-Age	$\hat{N}_{y,a}$	First year (ages 2-A in 1970): $\hat{N}_{y,a} = \hat{N}_{y,a-1} \exp^{-\hat{F}_{1982,a-1} - M_{1982,a-1}}$ Rest of years (ages 2-15): $\hat{N}_{y,a} = \hat{N}_{y-1,a-1} \exp^{-\hat{F}_{y-1,a-1} - M_{y-1,a-1}}$
Plus-group abundance-at-age	$\hat{N}_{y,A}$	$\hat{N}_{y,A} = \hat{N}_{y-1,A-1} \exp^{-\hat{F}_{y-1,A-1} - M_{y-1,A-1}} + \hat{N}_{y-1,A} \exp^{-\hat{F}_{y-1,A} - M_{y-1,A}}$
Fishing Mortality	$\hat{F}_{f,y,a}$	$\hat{F}_{f,y,a} = \hat{F}_{f,y} \cdot \hat{s}_{f,a}$ where $F_{f,y}$ and $s_{f,a}$ are estimated parameters
Total Mortality	$\hat{Z}_{y,a}$	$Z_{y,a} = F_{y,a} + M_{y,a}$
Fleet Selectivity Time Blocks and Selectivity Equations	$\hat{s}_{f,a}$	Fleet 1 (Chespeake Bay): 1982-1984, 1985-1989, 1990-1995, 1996-2019, 2020-2021 $\hat{s}_a = \frac{1}{1-\hat{\gamma}} \cdot \left(\frac{1-\hat{\gamma}}{\hat{\gamma}}\right)^{\hat{\gamma}} \frac{\exp^{\hat{\alpha}\hat{\gamma}(\hat{\beta}-a)}}{1+\exp^{\hat{\alpha}(\hat{\beta}-a)}}$ Fleet 2 (Ocean): 1982-1984, 1985-1989,1990-1996,1997-2019, 2020-2021 $\hat{s}_a = \exp^{(-\exp^{-\hat{\beta}(a-\hat{\alpha})})}$
Predicted Catch-At-Age	$\hat{C}_{f,y,a}$	$\hat{C}_{f,y,a} = \frac{\hat{F}_{f,y,a}}{\hat{F}_{f,y,a} + M_{y,a}} \cdot (1 - \exp^{-\hat{F}_{y,a} - M_{y,a}}) \cdot \hat{N}_{y,a}$

Table 1 (cont.)

Population Model	Symbol	Equation
Predicted Total Catch	$\hat{C}_{f,y}$	$\hat{C}_{f,y} = \sum_a \hat{C}_{f,y,a}$
Predicted Proportions of Catch-At-Age	$\hat{P}_{f,y,a}$	$\hat{P}_{f,y,a} = \frac{\hat{C}_{f,y,a}}{\sum_a \hat{C}_{f,y,a}}$
Predicted Aggregated Indices of Relative Abundance	$\hat{I}_{t,y,\sum a}$	$\hat{I}_{t,y,\Sigma a} = \hat{q}_t \cdot \sum_a \hat{N}_{y,a} \cdot \exp^{-p_t \cdot Z_{y,a}}$ where q_t is the estimated catchability coefficient of index t and p_t is the fraction of the year when the survey takes place.
Predicted Age-Specific Indices of Relative Abundance	$\hat{I}_{t,y,a}$	$\hat{I}_{t,y,a} = \hat{q}_t \cdot \hat{s}_{t,a} \cdot \hat{N}_{y,a} \cdot exp^{-p_t \hat{Z}_{y,a}}$ where $\hat{s}_{t,a}$ is the selectivity-at-age a for index t
Predicted Total Indices of Relative Abundance with Age Composition Data	$\hat{I}_{t,y}$	$\hat{I}_{t,y} = \hat{q}_t \sum_a \hat{s}_{t,a} \cdot \hat{N}_{y,a} \cdot \exp^{-p_t \cdot \hat{Z}_{y,a}}$
Predicted Age Composition of Survey	$\hat{U}_{t,y,a}$	$\hat{U}_{t,y,a} = \frac{\hat{I}_{t,y,a}}{\sum_a \hat{I}_{t,y,a}}$
Female Spawning Stock Biomass (metric tons)	SSB_y	$SSB_y = \sum_{a=1}^{A} N_{y,a} \cdot sr_a \cdot m_a \cdot w_{y,a}/1000$ where sr_a is the female sex ratio at age a and m_a is female maturity at age a.

Table 1 (cont.)

Likelihood	Symbol	Equation
Concentrated Lognormal Likelihood for Fleet Catch (F) and Indices of Relative Abundance (T)	$-L_F$; $-L_T$	$-L_F = 0.5 * \sum_f n_f * ln\left(\frac{\sum_f RSS_f}{\sum_f n_f}\right)$ $-L_T = 0.5 * \sum_t n_t * ln\left(\frac{\sum_t RSS_t}{\sum_t n_t}\right)$ where $RSS_f = \lambda_f \sum_y \left(\frac{ln(C_{f,y} + 0.00001) - ln(\hat{C}_{f,y} + 0.00001)}{\delta_f \cdot CV_{f,y}}\right)^2$ $RSS_t = \lambda_t \sum_y \left(\frac{ln(I_{t,y} + 0.00001) - ln(\hat{I}_{t,y} + 0.00001)}{\delta_t \cdot CV_{t,y}}\right)^2$ *ln* is the natural log. $CV_{f,y}$ and $CV_{t,y}$ are the annual coefficient of variation for the observed total catch (f) and index (t) in year *y*, δ_f and δ_t is the CV weights for total catch *f* and index *t* , and λ_t and λ_f are relative weights.
Multinomial fleet catch (FC) and index (TC) age compositions	$-L_{FC}$; $-L_{TC}$	$-L_{FC} = \lambda_f \sum_y -n_{f,y} \sum_a P_{f,y,a} \cdot ln(\hat{P}_{f,y,a} + 0.0000001)$ $-L_{TC} = \lambda_t \sum_y -n_{t,y} \sum_a U_{t,y,a} \cdot ln(\hat{U}_{t,y,a} + 0.0000001)$ where λ_f and λ_t are a user-defined weighting factors and n_y are the effective sample sizes.
Constraints Added To Total Likelihood	P_{n1}, P_{rdev}, P_{fadd}	$P_{n1} = \lambda_{n1}(\hat{N}_{y,1} - N^e_{y,1})^2$ - forces $N_{1,1}$ to follow S-R curve $P_{rdev} = \lambda_R \sum_y log_e(\hat{\sigma}_R) + \frac{\hat{\varepsilon}_y^2}{2\hat{\sigma}_R^2}$ - for bias correction to constrain deviations $P_{f_{add}} = \begin{cases} \text{phase} < 3, & 10 \cdot \sum_y (F_{f,y} - 0.15)^2 \\ \text{phase} \geq 3, & 0.000001 \cdot \sum_y (F_{f,y} - 0.15)^2 \end{cases}$ - avoid small F values at start

Table 1 (cont.)

Diagnostics	Symbol	Equation
Standardized residuals (lognormal – catch and surveys)	$r_{f,y}$ or $r_{t,y}$	$r_{t,y} = \frac{ln\, I_{t,y} - \widehat{ln\, I_{t,y}}}{\sqrt{ln(\,(\delta_t CV_{t,y})^2 + 1)}}$ $r_{f,y} = \frac{ln\, C_{f,y} - \widehat{ln\, C_{f,y}}}{\sqrt{ln(\,CV_{f,y}^2 + 1)}}$
Standardized residuals (age compositions – catch and surveys)	$ra_{f,y,a}$ or $ra_{t,y,a}$	$ra_{f,y,a} = \frac{P_{f,y,a} - \hat{P}_{f,y,a}}{\sqrt{\frac{\hat{P}_{f,y,a}(1-\hat{P}_{f,y,a})}{\hat{\tilde{n}}_f}}}$ $ra_{t,y,a} = \frac{P_{t,y,a} - \hat{P}_{t,y,a}}{\sqrt{\frac{\hat{P}_{t,y,a}(1-\hat{P}_{t,y,a})}{\hat{\tilde{n}}_t}}}$
Root mean square error	*RMSE*	Total catch $RMSE_f = \sqrt{\frac{\sum_y r_{f,y}^2}{n_f}}$ Index $RMSE_t = \sqrt{\frac{\sum_y r_{t,y}^2}{n_t}}$

Table 2. Comparison of RMSE, CV weights and effective sample sizes from the 2018 benchmark and 2022 update assessments.

2018 Benchmark				
Index	n	RMSE	CV Weight	Effective Sample Size
NYYOY	32	0.99623	3.03	
NJYOY	35	0.989621	1.75	
MDYOY	12	1.04199	2.10	
compos	36	1.01178	0.98	
NYAge1	33	1.01612	3.13	
MDAge1	48	1.03659	3.32	
NYOHS	20	1.0349	2.38	21.48
NJTRAWL	28	1.01072	24.00	5.20
MDSSN	33	1.02561	2.40	16.79
DESSN	21	1.00789	0.95	19.70
MRIP	36	0.98235	0.97	35.58
CTLIST	31	0.987111	1.60	12.41
DE30FT	17	0.994321	0.91	7.33
ChesMP	16	1.00057	2.85	10.76

2022 Update Assessment				
Index	n	RMSE	CV Weight	Effective Sample Size
NYYOY	36	0.990985	2.97	
NJYOY	38	1.00901	1.73	
MDYOY	12	1.00507	2.11	
compos	40	1.00575	0.96	
NYAge1	37	1.00193	1.19	
MDAge1	52	0.998121	3.25	
NYOHS	20	0.996071	2.65	21.80
NJTRAWL	29	1.00117	2.95	5.66
MDSSN	37	0.998646	2.50	14.95
DESSN	24	1.00934	1.17	18.55
MRIP	40	1.00898	2.27	29.64
CTLIST	34	0.996705	3.00	12.93
DE30FT	21	1.00132	0.85	5.81
ChesMP	17	1.00111	2.45	15.10

Table 3. Summary of likelihood component values.

	Likelihood Weight	RSS
Fleet 1 Total Catch:	2	0.198243
Fleet 2 Total Catch:	2	1.63939
Aggregate Abundance Indices		
NYYOY	1	28.0077
NJYOY	1	30.684
MDYOY	1	10.3223
Compos	1	38.5644
NYAge1	1	32.3038
MDAge1	1	24.3656
Age Comp Abundance Indices		
NYOHS	1	18.801
NJTRAWL	1	20.5932
MDSSN	1	31.1497
DESSN	1	22.2464
MRIP	1	36.0733
CTLIST	1	27.1241
DE30FT	1	17.3121
ChesMap	1	14.7808
Total RSS		354.166
No. of Obs		517
Conc. Likel.		-97.7846
Age Composition Data	Likelihood	
Fleet 1 Age Comp:	1	5244.92
Fleet 2 Age Comp:	1	7223.16
NYOHS	1	726.071
NJTRAWL	1	308.944
MDSSN	1	1130.86
DESSN	1	1024.38
MRIP	1	2537.37
CTLIST	1	816.295
DE30FT	1	230.031
ChesMap	1	397.76
Recr Devs :	1	42.5514
Total Likelihood :		19515
AIC :		39412.1

Table 4. Estimates of Bay and Ocean fully-recruited fishing mortality and total fully-recruited fishing mortality with associated standard errors.

	Bay			Ocean			Total		
	Fully-recruited			Fully-recruited			Fully-recruited		
Year	F	SD	CV	F	SD	CV	F	SD	CV
1982	0.054	0.013	0.244	0.173	0.003	0.017	0.175	0.028	0.161
1983	0.060	0.028	0.466	0.141	0.013	0.089	0.142	0.039	0.272
1984	0.062	0.008	0.122	0.059	0.004	0.060	0.075	0.015	0.194
1985	0.002	0.038	16.224	0.186	0.013	0.069	0.187	0.068	0.364
1986	0.004	0.014	3.251	0.050	0.004	0.076	0.050	0.013	0.250
1987	0.002	0.011	6.511	0.029	0.017	0.576	0.030	0.006	0.200
1988	0.004	0.000	0.090	0.035	0.004	0.113	0.036	0.007	0.200
1989	0.003	0.068	25.687	0.046	0.016	0.351	0.046	0.008	0.178
1990	0.041	0.001	0.035	0.065	0.005	0.072	0.067	0.011	0.168
1991	0.045	0.013	0.278	0.093	0.018	0.197	0.094	0.015	0.164
1992	0.050	0.000	0.009	0.112	0.004	0.034	0.113	0.018	0.161
1993	0.043	0.006	0.139	0.088	0.014	0.157	0.089	0.013	0.148
1994	0.055	0.001	0.017	0.115	0.003	0.026	0.117	0.016	0.140
1995	0.081	0.007	0.087	0.209	0.015	0.073	0.212	0.032	0.149
1996	0.056	0.001	0.011	0.241	0.004	0.017	0.275	0.036	0.130
1997	0.061	0.008	0.135	0.177	0.013	0.075	0.215	0.015	0.069
1998	0.052	0.006	0.109	0.191	0.007	0.035	0.224	0.016	0.070
1999	0.054	0.011	0.205	0.175	0.016	0.093	0.208	0.015	0.070
2000	0.057	0.007	0.128	0.171	0.005	0.027	0.207	0.014	0.068
2001	0.046	0.015	0.334	0.177	0.017	0.094	0.205	0.013	0.065
2002	0.050	0.005	0.107	0.189	0.007	0.035	0.220	0.014	0.063
2003	0.065	0.018	0.276	0.195	0.017	0.088	0.236	0.015	0.063
2004	0.063	0.004	0.065	0.223	0.006	0.026	0.262	0.018	0.070
2005	0.056	0.013	0.235	0.224	0.026	0.115	0.258	0.017	0.067
2006	0.076	0.005	0.064	0.258	0.009	0.034	0.305	0.020	0.066
2007	0.057	0.016	0.282	0.190	0.021	0.111	0.226	0.015	0.068
2008	0.050	0.007	0.136	0.209	0.006	0.031	0.239	0.017	0.070
2009	0.067	0.031	0.465	0.190	0.019	0.102	0.233	0.015	0.065
2010	0.071	0.004	0.053	0.230	0.010	0.042	0.274	0.018	0.067
2011	0.070	0.034	0.493	0.238	0.023	0.095	0.281	0.018	0.066
2012	0.081	0.004	0.043	0.230	0.007	0.032	0.281	0.020	0.070
2013	0.090	0.013	0.143	0.335	0.029	0.088	0.391	0.028	0.072
2014	0.104	0.003	0.029	0.243	0.006	0.024	0.309	0.024	0.078
2015	0.086	0.014	0.167	0.215	0.022	0.103	0.270	0.022	0.082
2016	0.117	0.003	0.025	0.238	0.004	0.019	0.314	0.027	0.086
2017	0.082	0.013	0.160	0.303	0.020	0.067	0.354	0.032	0.092
2018	0.068	0.003	0.050	0.216	0.007	0.033	0.259	0.025	0.096
2019	0.054	0.012	0.230	0.194	0.016	0.084	0.228	0.023	0.099
2020	0.062	0.002	0.039	0.091	0.007	0.072	0.138	0.015	0.109
2021	0.053	0.012	0.231	0.100	0.017	0.172	0.136	0.014	0.103

Table 4 cont.

Year	Recruitment	SD	CV
1982	36,189,600	3,415,330	0.094
1983	70,145,300	5,542,010	0.079
1984	60,501,600	4,742,270	0.078
1985	66,752,800	4,951,110	0.074
1986	64,466,700	4,809,840	0.075
1987	71,185,100	5,141,690	0.072
1988	92,479,400	6,290,120	0.068
1989	104,639,000	7,046,020	0.067
1990	128,332,000	8,206,210	0.064
1991	100,577,000	7,316,250	0.073
1992	105,956,000	7,799,400	0.074
1993	131,057,000	8,985,700	0.069
1994	285,603,000	14,309,000	0.050
1995	184,270,000	11,209,300	0.061
1996	232,110,000	12,916,600	0.056
1997	261,208,000	13,616,500	0.052
1998	147,107,000	9,796,390	0.067
1999	152,132,000	9,786,470	0.064
2000	121,379,000	8,726,180	0.072
2001	192,224,000	10,957,900	0.057
2002	228,677,000	11,909,800	0.052
2003	118,255,000	8,247,380	0.070
2004	323,301,000	13,987,900	0.043
2005	156,979,000	9,376,400	0.060
2006	138,701,000	8,611,040	0.062
2007	81,206,600	6,223,450	0.077
2008	131,795,000	8,033,860	0.061
2009	70,564,800	5,605,470	0.079
2010	92,287,300	6,652,580	0.072
2011	118,345,000	7,876,950	0.067
2012	208,585,000	11,831,700	0.057
2013	63,645,900	5,833,940	0.092
2014	76,900,600	6,625,860	0.086
2015	152,439,000	11,679,900	0.077
2016	238,696,000	18,299,700	0.077
2017	101,690,000	10,165,500	0.100
2018	130,745,000	13,613,800	0.104
2019	159,592,000	18,174,900	0.114
2020	109,463,000	15,540,500	0.142
2021	116,007,000	24,287,000	0.209

Catch Selectivity Parameters

Bay	Estimate	SD	CV
1982-1984			
α	-5.448	0.215	0.04
β	2.541	0.046	0.02
ϒ	0.829	0.022	0.03
1985-1989			
α	-4.103	0.442	0.11
β	2.155	0.073	0.03
ϒ	0.964	0.012	0.01
1990-1995			
α	-2.062	0.110	0.05
β	4.456	0.203	0.05
ϒ	0.819	0.035	0.04
1996-2019			
α	-1.820	0.072	0.04
β	3.597	0.094	0.03
ϒ	0.968	0.010	0.01
2020-2021			
α	-1.689	0.159	0.09
β	4.735	0.140	0.03
ϒ	0.761	0.073	0.10

Ocean	Estimate	SD	CV
1982-1984			
α	3.484	0.194	0.06
β	0.820	0.086	0.10
1985-1989			
α	4.713	0.383	0.08
β	0.473	0.051	0.11
1990-1996			
α	6.186	0.508	0.08
β	0.345	0.034	0.10
1997-2019			
α	4.932	0.170	0.03
β	0.450	0.022	0.05
2020-2021			
α	3.358	0.384	0.11
β	0.682	0.127	0.19

Survey Selectivity Parameters

NYOHS	Estimate	SD	CV
α	-3.03	0.51	0.17
β	2.62	0.15	0.06
ϒ	0.92	0.03	0.03
NJ Trawl			
α	1.63	0.55	0.34
β	0.26	0.12	0.45
MDSSN			
s_2	0.13	0.02	0.16
DE SSN			
α	3.96	0.28	0.07
β	0.59	0.08	0.14
MRIP			
α	2.56	0.07	0.03
β	1.08	0.06	0.06
CTLIST			
α	-2.83	0.29	0.10
β	2.16	0.12	0.05
ϒ	0.96	0.01	0.01
DE30FT			
α	-1.246	0.983	0.79
β	1.290	0.813	0.63
ϒ	0.938	0.102	0.11
ChesMap			
α	-2.56	0.42	0.16
β	1.77	0.20	0.11
ϒ	0.91	0.03	0.03

Catchability Coefficients

Survey	Estimate	SD	CV
NYYOY	1.24E-07	1.29E-08	0.10
NJYOY	8.37E-09	5.61E-10	0.07
MDYOY	1.35E-07	2.27E-08	0.17
compos	1.05E-06	4.75E-08	0.05
NYAge1	2.55E-08	1.95E-09	0.08
MDAge1	9.00E-09	1.58E-09	0.18
NYOHS	8.97E-08	8.47E-09	0.09
NJTRAWL	1.02E-07	1.68E-08	0.16
MDSSN	7.94E-08	7.16E-09	0.09
DESSN	4.90E-08	6.41E-09	0.13
MRIP	4.31E-08	2.96E-09	0.07
CTLIST	7.98E-09	6.76E-10	0.08
DE30FT	2.76E-08	5.01E-09	0.18
ChesMap	7.69E-07	9.90E-08	0.13

Table 5. Bay Fishing Mortality-At-Age, 1982-2021.

	Age														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1982	0.0001	0.0075	0.0542	0.0231	0.0091	0.0036	0.0014	0.0006	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0011
1983	0.0001	0.0082	0.0600	0.0255	0.0100	0.0040	0.0016	0.0006	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0012
1984	0.0001	0.0085	0.0616	0.0262	0.0103	0.0041	0.0016	0.0006	0.0003	0.0001	0.0000	0.0000	0.0000	0.0000	0.0013
1985	0.0000	0.0010	0.0024	0.0021	0.0018	0.0016	0.0014	0.0012	0.0010	0.0009	0.0008	0.0007	0.0006	0.0005	0.0004
1986	0.0001	0.0018	0.0043	0.0038	0.0033	0.0029	0.0025	0.0021	0.0019	0.0016	0.0014	0.0012	0.0010	0.0009	0.0008
1987	0.0000	0.0007	0.0017	0.0016	0.0013	0.0012	0.0010	0.0009	0.0007	0.0006	0.0006	0.0005	0.0004	0.0004	0.0003
1988	0.0001	0.0018	0.0044	0.0039	0.0034	0.0029	0.0025	0.0022	0.0019	0.0016	0.0014	0.0012	0.0011	0.0009	0.0008
1989	0.0000	0.0011	0.0027	0.0024	0.0020	0.0018	0.0015	0.0013	0.0011	0.0010	0.0008	0.0007	0.0006	0.0005	0.0005
1990	0.0002	0.0011	0.0055	0.0224	0.0415	0.0364	0.0260	0.0180	0.0124	0.0085	0.0059	0.0040	0.0028	0.0019	0.0013
1991	0.0002	0.0012	0.0060	0.0243	0.0450	0.0395	0.0282	0.0195	0.0134	0.0093	0.0064	0.0044	0.0030	0.0021	0.0014
1992	0.0002	0.0013	0.0066	0.0270	0.0500	0.0438	0.0313	0.0216	0.0149	0.0103	0.0071	0.0049	0.0034	0.0023	0.0016
1993	0.0002	0.0011	0.0056	0.0230	0.0425	0.0373	0.0266	0.0184	0.0127	0.0087	0.0060	0.0042	0.0029	0.0020	0.0014
1994	0.0003	0.0014	0.0073	0.0300	0.0555	0.0487	0.0347	0.0240	0.0166	0.0114	0.0079	0.0054	0.0037	0.0026	0.0018
1995	0.0004	0.0021	0.0107	0.0437	0.0809	0.0710	0.0506	0.0350	0.0242	0.0166	0.0115	0.0079	0.0054	0.0037	0.0026
1996	0.0007	0.0037	0.0170	0.0430	0.0557	0.0560	0.0533	0.0504	0.0475	0.0448	0.0423	0.0399	0.0376	0.0355	0.0335
1997	0.0007	0.0040	0.0185	0.0466	0.0604	0.0606	0.0578	0.0546	0.0515	0.0486	0.0458	0.0432	0.0408	0.0384	0.0363
1998	0.0006	0.0035	0.0160	0.0404	0.0523	0.0525	0.0500	0.0473	0.0446	0.0421	0.0397	0.0374	0.0353	0.0333	0.0314
1999	0.0006	0.0036	0.0164	0.0414	0.0536	0.0539	0.0513	0.0485	0.0457	0.0432	0.0407	0.0384	0.0362	0.0341	0.0322
2000	0.0007	0.0038	0.0175	0.0442	0.0572	0.0575	0.0548	0.0517	0.0488	0.0460	0.0434	0.0410	0.0386	0.0364	0.0344
2001	0.0006	0.0030	0.0139	0.0352	0.0455	0.0457	0.0436	0.0412	0.0388	0.0366	0.0345	0.0326	0.0307	0.0290	0.0273
2002	0.0006	0.0033	0.0153	0.0385	0.0499	0.0501	0.0477	0.0451	0.0425	0.0401	0.0378	0.0357	0.0337	0.0317	0.0299
2003	0.0008	0.0043	0.0199	0.0502	0.0651	0.0653	0.0623	0.0588	0.0555	0.0523	0.0494	0.0466	0.0439	0.0414	0.0391
2004	0.0008	0.0042	0.0193	0.0488	0.0632	0.0635	0.0605	0.0572	0.0539	0.0509	0.0480	0.0453	0.0427	0.0403	0.0380
2005	0.0007	0.0037	0.0170	0.0429	0.0556	0.0558	0.0532	0.0502	0.0474	0.0447	0.0422	0.0398	0.0375	0.0354	0.0334
2006	0.0009	0.0050	0.0231	0.0584	0.0757	0.0760	0.0724	0.0684	0.0645	0.0609	0.0574	0.0541	0.0511	0.0482	0.0454
2007	0.0007	0.0038	0.0175	0.0441	0.0571	0.0573	0.0546	0.0516	0.0487	0.0459	0.0433	0.0408	0.0385	0.0363	0.0343
2008	0.0006	0.0033	0.0153	0.0385	0.0499	0.0501	0.0477	0.0451	0.0425	0.0401	0.0378	0.0357	0.0337	0.0317	0.0299
2009	0.0008	0.0045	0.0205	0.0518	0.0671	0.0674	0.0642	0.0607	0.0572	0.0540	0.0509	0.0480	0.0453	0.0427	0.0403
2010	0.0009	0.0047	0.0217	0.0548	0.0710	0.0713	0.0679	0.0642	0.0605	0.0571	0.0539	0.0508	0.0479	0.0452	0.0426
2011	0.0008	0.0046	0.0213	0.0538	0.0696	0.0699	0.0666	0.0629	0.0594	0.0560	0.0528	0.0498	0.0470	0.0443	0.0418
2012	0.0010	0.0054	0.0248	0.0625	0.0809	0.0813	0.0775	0.0732	0.0690	0.0651	0.0614	0.0579	0.0546	0.0515	0.0486
2013	0.0011	0.0060	0.0274	0.0692	0.0896	0.0899	0.0857	0.0810	0.0764	0.0720	0.0679	0.0641	0.0604	0.0570	0.0538
2014	0.0012	0.0069	0.0316	0.0798	0.1034	0.1038	0.0989	0.0934	0.0882	0.0832	0.0784	0.0740	0.0698	0.0658	0.0621
2015	0.0010	0.0057	0.0262	0.0662	0.0857	0.0860	0.0820	0.0775	0.0731	0.0689	0.0650	0.0613	0.0578	0.0546	0.0515
2016	0.0014	0.0077	0.0355	0.0896	0.1161	0.1165	0.1110	0.1049	0.0990	0.0934	0.0880	0.0830	0.0783	0.0739	0.0697
2017	0.0010	0.0054	0.0249	0.0630	0.0815	0.0818	0.0780	0.0737	0.0695	0.0656	0.0619	0.0583	0.0550	0.0519	0.0489
2018	0.0008	0.0045	0.0207	0.0523	0.0678	0.0680	0.0648	0.0613	0.0578	0.0545	0.0514	0.0485	0.0457	0.0431	0.0407
2019	0.0006	0.0036	0.0165	0.0416	0.0538	0.0540	0.0515	0.0486	0.0459	0.0433	0.0408	0.0385	0.0363	0.0343	0.0323
2020	0.0009	0.0034	0.0116	0.0344	0.0625	0.0612	0.0447	0.0304	0.0203	0.0136	0.0091	0.0061	0.0040	0.0027	0.0018
2021	0.0008	0.0028	0.0098	0.0289	0.0525	0.0514	0.0376	0.0255	0.0171	0.0114	0.0076	0.0051	0.0034	0.0023	0.0015

Table 6. Ocean Fishing Mortality-At-Age, 1982-2021.

	Age														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1982	0.0001	0.0059	0.0392	0.0901	0.1300	0.1527	0.1640	0.1692	0.1715	0.1726	0.1730	0.1732	0.1733	0.1734	0.1734
1983	0.0001	0.0048	0.0318	0.0732	0.1055	0.1240	0.1331	0.1374	0.1393	0.1401	0.1405	0.1407	0.1407	0.1408	0.1408
1984	0.0000	0.0020	0.0134	0.0307	0.0443	0.0520	0.0559	0.0577	0.0585	0.0588	0.0590	0.0590	0.0591	0.0591	0.0591
1985	0.0006	0.0051	0.0199	0.0463	0.0785	0.1090	0.1338	0.1521	0.1647	0.1731	0.1785	0.1820	0.1842	0.1856	0.1864
1986	0.0002	0.0014	0.0053	0.0123	0.0209	0.0290	0.0356	0.0405	0.0438	0.0461	0.0475	0.0484	0.0490	0.0494	0.0496
1987	0.0001	0.0008	0.0031	0.0073	0.0124	0.0172	0.0211	0.0240	0.0260	0.0273	0.0282	0.0287	0.0291	0.0293	0.0294
1988	0.0001	0.0010	0.0037	0.0086	0.0146	0.0203	0.0249	0.0283	0.0307	0.0322	0.0332	0.0339	0.0343	0.0346	0.0347
1989	0.0001	0.0013	0.0049	0.0113	0.0192	0.0267	0.0328	0.0372	0.0403	0.0424	0.0437	0.0446	0.0451	0.0455	0.0457
1990	0.0002	0.0010	0.0034	0.0082	0.0152	0.0236	0.0322	0.0402	0.0470	0.0525	0.0567	0.0600	0.0624	0.0641	0.0654
1991	0.0003	0.0014	0.0048	0.0116	0.0216	0.0335	0.0457	0.0570	0.0666	0.0744	0.0805	0.0851	0.0885	0.0910	0.0928
1992	0.0003	0.0017	0.0058	0.0140	0.0260	0.0404	0.0551	0.0687	0.0803	0.0897	0.0970	0.1025	0.1066	0.1096	0.1118
1993	0.0002	0.0013	0.0046	0.0110	0.0205	0.0318	0.0434	0.0541	0.0632	0.0706	0.0764	0.0807	0.0839	0.0863	0.0880
1994	0.0003	0.0018	0.0060	0.0144	0.0268	0.0416	0.0568	0.0707	0.0827	0.0924	0.0999	0.1056	0.1098	0.1129	0.1151
1995	0.0006	0.0032	0.0109	0.0262	0.0488	0.0756	0.1032	0.1287	0.1504	0.1680	0.1817	0.1920	0.1997	0.2053	0.2094
1996	0.0006	0.0037	0.0126	0.0302	0.0562	0.0871	0.1189	0.1483	0.1733	0.1935	0.2093	0.2212	0.2301	0.2366	0.2413
1997	0.0005	0.0042	0.0164	0.0390	0.0677	0.0963	0.1205	0.1390	0.1522	0.1613	0.1674	0.1714	0.1740	0.1757	0.1767
1998	0.0005	0.0046	0.0178	0.0422	0.0733	0.1042	0.1304	0.1505	0.1648	0.1747	0.1812	0.1856	0.1884	0.1902	0.1913
1999	0.0005	0.0042	0.0162	0.0386	0.0670	0.0953	0.1192	0.1375	0.1507	0.1597	0.1657	0.1696	0.1722	0.1739	0.1749
2000	0.0005	0.0041	0.0159	0.0377	0.0655	0.0930	0.1164	0.1343	0.1471	0.1559	0.1618	0.1656	0.1681	0.1698	0.1708
2001	0.0005	0.0042	0.0164	0.0390	0.0677	0.0962	0.1203	0.1388	0.1521	0.1611	0.1672	0.1712	0.1738	0.1755	0.1765
2002	0.0005	0.0045	0.0176	0.0418	0.0725	0.1031	0.1290	0.1489	0.1630	0.1728	0.1793	0.1836	0.1864	0.1882	0.1893
2003	0.0006	0.0047	0.0181	0.0430	0.0747	0.1062	0.1329	0.1533	0.1679	0.1779	0.1847	0.1891	0.1919	0.1938	0.1950
2004	0.0006	0.0053	0.0207	0.0492	0.0855	0.1216	0.1521	0.1755	0.1922	0.2037	0.2114	0.2164	0.2197	0.2218	0.2232
2005	0.0006	0.0054	0.0208	0.0495	0.0859	0.1221	0.1528	0.1762	0.1930	0.2046	0.2123	0.2173	0.2206	0.2227	0.2241
2006	0.0007	0.0062	0.0239	0.0569	0.0988	0.1405	0.1758	0.2028	0.2221	0.2354	0.2442	0.2501	0.2539	0.2563	0.2579
2007	0.0005	0.0045	0.0177	0.0420	0.0730	0.1037	0.1298	0.1497	0.1640	0.1738	0.1804	0.1847	0.1875	0.1893	0.1904
2008	0.0006	0.0050	0.0194	0.0460	0.0800	0.1137	0.1422	0.1641	0.1797	0.1904	0.1976	0.2023	0.2054	0.2074	0.2086
2009	0.0005	0.0045	0.0177	0.0420	0.0729	0.1036	0.1297	0.1496	0.1639	0.1737	0.1802	0.1845	0.1873	0.1891	0.1903
2010	0.0007	0.0055	0.0213	0.0506	0.0879	0.1250	0.1564	0.1805	0.1977	0.2095	0.2174	0.2226	0.2259	0.2281	0.2295
2011	0.0007	0.0057	0.0221	0.0524	0.0911	0.1294	0.1620	0.1868	0.2046	0.2169	0.2251	0.2304	0.2339	0.2362	0.2376
2012	0.0007	0.0055	0.0214	0.0508	0.0882	0.1253	0.1568	0.1809	0.1982	0.2100	0.2179	0.2231	0.2265	0.2287	0.2301
2013	0.0010	0.0080	0.0311	0.0740	0.1285	0.1827	0.2286	0.2637	0.2888	0.3061	0.3176	0.3252	0.3301	0.3333	0.3353
2014	0.0007	0.0058	0.0225	0.0535	0.0929	0.1321	0.1653	0.1907	0.2089	0.2214	0.2297	0.2352	0.2387	0.2410	0.2425
2015	0.0006	0.0051	0.0199	0.0474	0.0823	0.1170	0.1464	0.1689	0.1850	0.1961	0.2035	0.2083	0.2115	0.2135	0.2148
2016	0.0007	0.0057	0.0221	0.0525	0.0911	0.1295	0.1620	0.1869	0.2047	0.2169	0.2251	0.2305	0.2340	0.2362	0.2377
2017	0.0009	0.0072	0.0282	0.0669	0.1162	0.1652	0.2067	0.2385	0.2612	0.2769	0.2873	0.2941	0.2986	0.3015	0.3033
2018	0.0006	0.0052	0.0201	0.0477	0.0829	0.1178	0.1474	0.1700	0.1862	0.1974	0.2048	0.2097	0.2129	0.2149	0.2162
2019	0.0006	0.0046	0.0180	0.0429	0.0745	0.1058	0.1324	0.1528	0.1673	0.1773	0.1840	0.1884	0.1913	0.1931	0.1943
2020	0.0006	0.0073	0.0254	0.0477	0.0657	0.0772	0.0837	0.0873	0.0891	0.0901	0.0905	0.0908	0.0909	0.0910	0.0910
2021	0.0007	0.0080	0.0279	0.0525	0.0722	0.0848	0.0921	0.0959	0.0980	0.0990	0.0995	0.0998	0.0999	0.1000	0.1000

Table 7. Total Fishing Mortality-At-Age, 1982-2021.

	Age														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1982	0.0002	0.0134	0.0934	0.1132	0.1390	0.1563	0.1654	0.1697	0.1718	0.1727	0.1731	0.1733	0.1733	0.1734	0.1745
1983	0.0002	0.0130	0.0918	0.0987	0.1156	0.1280	0.1347	0.1380	0.1395	0.1402	0.1405	0.1407	0.1408	0.1408	0.1420
1984	0.0001	0.0105	0.0750	0.0569	0.0546	0.0561	0.0575	0.0583	0.0587	0.0589	0.0590	0.0591	0.0591	0.0591	0.0604
1985	0.0006	0.0061	0.0222	0.0484	0.0803	0.1106	0.1352	0.1532	0.1657	0.1739	0.1793	0.1826	0.1847	0.1861	0.1869
1986	0.0002	0.0031	0.0096	0.0162	0.0242	0.0319	0.0381	0.0426	0.0457	0.0477	0.0489	0.0496	0.0501	0.0503	0.0504
1987	0.0001	0.0015	0.0049	0.0089	0.0137	0.0184	0.0221	0.0249	0.0267	0.0280	0.0287	0.0292	0.0295	0.0297	0.0297
1988	0.0002	0.0028	0.0081	0.0126	0.0180	0.0232	0.0275	0.0305	0.0326	0.0339	0.0347	0.0351	0.0354	0.0355	0.0355
1989	0.0002	0.0023	0.0075	0.0137	0.0213	0.0285	0.0343	0.0386	0.0415	0.0434	0.0446	0.0453	0.0457	0.0460	0.0461
1990	0.0004	0.0021	0.0089	0.0306	0.0567	0.0600	0.0582	0.0582	0.0594	0.0610	0.0626	0.0640	0.0652	0.0661	0.0667
1991	0.0005	0.0026	0.0108	0.0360	0.0666	0.0730	0.0739	0.0765	0.0801	0.0837	0.0868	0.0894	0.0915	0.0930	0.0942
1992	0.0005	0.0030	0.0124	0.0410	0.0760	0.0842	0.0864	0.0903	0.0952	0.0999	0.1040	0.1074	0.1099	0.1119	0.1134
1993	0.0004	0.0024	0.0102	0.0340	0.0630	0.0691	0.0700	0.0725	0.0759	0.0794	0.0824	0.0849	0.0868	0.0883	0.0894
1994	0.0006	0.0032	0.0133	0.0444	0.0823	0.0902	0.0915	0.0948	0.0992	0.1038	0.1077	0.1110	0.1135	0.1155	0.1169
1995	0.0009	0.0052	0.0216	0.0700	0.1297	0.1466	0.1539	0.1637	0.1745	0.1846	0.1931	0.1999	0.2051	0.2091	0.2120
1996	0.0013	0.0074	0.0296	0.0733	0.1119	0.1431	0.1723	0.1986	0.2208	0.2384	0.2516	0.2611	0.2677	0.2721	0.2748
1997	0.0012	0.0082	0.0349	0.0856	0.1281	0.1569	0.1782	0.1935	0.2037	0.2099	0.2132	0.2146	0.2147	0.2141	0.2130
1998	0.0012	0.0081	0.0338	0.0826	0.1256	0.1567	0.1805	0.1977	0.2094	0.2167	0.2209	0.2230	0.2237	0.2235	0.2227
1999	0.0011	0.0078	0.0326	0.0800	0.1207	0.1491	0.1706	0.1860	0.1964	0.2028	0.2064	0.2080	0.2084	0.2080	0.2071
2000	0.0012	0.0079	0.0334	0.0819	0.1227	0.1505	0.1712	0.1860	0.1959	0.2019	0.2052	0.2066	0.2068	0.2062	0.2052
2001	0.0011	0.0073	0.0303	0.0741	0.1132	0.1419	0.1639	0.1800	0.1909	0.1978	0.2018	0.2038	0.2045	0.2044	0.2039
2002	0.0011	0.0078	0.0328	0.0803	0.1224	0.1532	0.1767	0.1939	0.2056	0.2129	0.2171	0.2193	0.2200	0.2199	0.2192
2003	0.0013	0.0090	0.0380	0.0933	0.1398	0.1715	0.1951	0.2121	0.2234	0.2303	0.2340	0.2356	0.2358	0.2352	0.2340
2004	0.0014	0.0095	0.0401	0.0981	0.1488	0.1850	0.2126	0.2326	0.2461	0.2546	0.2593	0.2617	0.2624	0.2620	0.2611
2005	0.0013	0.0091	0.0378	0.0924	0.1415	0.1779	0.2059	0.2265	0.2404	0.2493	0.2544	0.2571	0.2581	0.2581	0.2575
2006	0.0016	0.0112	0.0471	0.1153	0.1745	0.2164	0.2482	0.2712	0.2866	0.2962	0.3016	0.3042	0.3049	0.3045	0.3033
2007	0.0012	0.0084	0.0351	0.0861	0.1301	0.1610	0.1844	0.2013	0.2127	0.2197	0.2237	0.2255	0.2260	0.2256	0.2247
2008	0.0012	0.0083	0.0346	0.0845	0.1298	0.1637	0.1899	0.2091	0.2222	0.2305	0.2354	0.2380	0.2390	0.2391	0.2386
2009	0.0013	0.0090	0.0382	0.0938	0.1400	0.1710	0.1939	0.2103	0.2211	0.2276	0.2311	0.2325	0.2326	0.2318	0.2305
2010	0.0015	0.0102	0.0430	0.1055	0.1589	0.1963	0.2243	0.2446	0.2582	0.2666	0.2712	0.2734	0.2738	0.2733	0.2721
2011	0.0015	0.0103	0.0434	0.1062	0.1607	0.1993	0.2286	0.2498	0.2640	0.2729	0.2779	0.2802	0.2809	0.2805	0.2794
2012	0.0016	0.0109	0.0461	0.1133	0.1691	0.2066	0.2343	0.2541	0.2672	0.2751	0.2794	0.2811	0.2812	0.2802	0.2787
2013	0.0020	0.0140	0.0585	0.1431	0.2180	0.2726	0.3142	0.3446	0.3652	0.3781	0.3855	0.3893	0.3905	0.3903	0.3891
2014	0.0019	0.0127	0.0541	0.1333	0.1963	0.2359	0.2642	0.2841	0.2970	0.3045	0.3081	0.3091	0.3085	0.3068	0.3046
2015	0.0016	0.0108	0.0462	0.1136	0.1680	0.2031	0.2284	0.2464	0.2581	0.2650	0.2685	0.2696	0.2693	0.2681	0.2663
2016	0.0021	0.0134	0.0576	0.1421	0.2071	0.2460	0.2730	0.2918	0.3037	0.3103	0.3132	0.3135	0.3123	0.3101	0.3074
2017	0.0018	0.0127	0.0531	0.1299	0.1978	0.2471	0.2848	0.3122	0.3308	0.3424	0.3491	0.3525	0.3536	0.3534	0.3523
2018	0.0014	0.0097	0.0408	0.1001	0.1506	0.1858	0.2122	0.2313	0.2440	0.2519	0.2562	0.2582	0.2586	0.2581	0.2569
2019	0.0012	0.0082	0.0345	0.0844	0.1283	0.1599	0.1839	0.2014	0.2132	0.2206	0.2248	0.2269	0.2276	0.2273	0.2266
2020	0.0016	0.0107	0.0370	0.0821	0.1282	0.1383	0.1284	0.1176	0.1094	0.1036	0.0996	0.0968	0.0949	0.0937	0.0928
2021	0.0015	0.0108	0.0377	0.0814	0.1247	0.1363	0.1296	0.1215	0.1151	0.1104	0.1072	0.1049	0.1033	0.1023	0.1016

Table 8. Estimates of age-specific population abundance, 1982-2021.

	Age																
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total	8+
1982	36,189,600	8,980,640	3,381,790	2,540,120	1,011,400	406,282	323,876	204,485	180,341	276,008	188,655	301,291	156,225	113,064	295,270	54,549,047	1,715,339
1983	70,145,300	11,688,500	4,489,350	1,963,990	1,630,780	685,430	287,364	236,271	148,525	130,725	199,890	136,571	218,071	113,064	295,270	92,369,101	1,478,387
1984	60,501,600	22,655,600	5,844,880	2,611,450	1,279,310	1,131,440	498,741	216,168	177,150	111,189	97,795	149,490	102,121	163,052	305,029	95,845,015	1,321,994
1985	66,752,800	19,541,600	11,358,100	3,457,730	1,773,590	943,389	884,612	405,297	175,524	143,782	90,227	79,351	121,290	82,855	379,454	106,189,601	1,477,780
1986	64,466,700	21,550,300	9,840,040	7,083,080	2,368,390	1,274,720	698,466	665,117	299,279	128,007	103,997	64,915	56,897	86,785	330,142	109,016,835	1,735,139
1987	71,185,100	20,820,600	10,883,500	6,214,350	5,010,570	1,800,400	1,021,060	578,704	548,589	246,090	105,049	85,240	53,168	46,581	341,226	118,940,227	2,004,647
1988	92,479,400	22,992,600	10,532,000	6,905,910	4,428,270	3,849,050	1,461,770	859,604	485,861	459,715	205,970	87,855	71,255	44,432	324,010	145,187,702	2,538,702
1989	104,639,000	29,869,100	11,616,100	6,661,230	4,902,890	3,387,190	3,109,900	1,224,080	717,638	404,789	382,507	171,243	73,009	59,200	306,062	167,523,938	3,338,528
1990	128,332,000	33,795,900	15,096,800	7,351,370	4,723,790	3,738,090	2,722,480	2,586,480	1,013,730	592,589	333,620	314,878	140,862	60,030	300,217	201,102,836	5,342,406
1991	100,577,000	41,440,300	17,086,600	9,540,890	5,125,770	3,476,090	2,911,240	2,210,780	2,100,440	822,243	479,865	269,721	254,210	113,592	290,082	186,698,823	6,540,933
1992	105,956,000	32,474,900	20,940,800	10,777,900	6,616,980	3,734,680	2,672,270	2,327,250	1,762,730	1,668,790	650,916	378,672	212,289	199,673	316,316	190,690,166	7,516,636
1993	131,057,000	34,209,300	16,403,600	13,187,400	7,437,180	4,776,140	2,839,040	2,109,730	1,830,110	1,379,440	1,299,750	504,897	292,750	163,696	396,743	217,886,776	7,977,116
1994	285,603,000	42,317,400	17,289,200	10,353,100	9,163,740	5,438,300	3,686,010	2,278,370	1,688,870	1,460,040	1,096,730	1,030,240	399,213	231,023	441,270	382,476,506	8,625,756
1995	184,270,000	92,207,000	21,371,100	10,878,000	7,119,850	6,572,990	4,109,230	2,895,270	1,783,720	1,316,300	1,132,820	847,560	793,599	306,733	515,063	336,119,235	9,591,065
1996	232,110,000	59,469,700	46,469,700	13,335,300	7,292,030	4,870,560	4,694,430	3,032,470	2,115,680	1,289,380	941,967	803,808	597,325	556,375	572,827	378,151,552	9,909,832
1997	261,208,000	74,881,500	29,907,100	28,765,200	8,909,970	5,077,830	3,490,770	3,401,170	2,139,880	1,460,180	874,407	630,420	532,853	393,370	739,399	422,412,049	10,171,679
1998	147,107,000	84,275,700	37,624,900	18,416,100	18,983,100	6,104,780	3,589,470	2,514,050	2,412,300	1,502,370	1,018,860	608,107	437,817	370,007	787,656	325,752,217	9,651,167
1999	152,132,000	47,465,000	42,353,100	23,194,400	12,190,100	13,038,900	4,316,110	2,579,400	1,775,670	1,684,030	1,041,160	703,131	418,796	301,313	797,271	303,990,381	9,300,771
2000	121,379,000	49,087,900	23,860,900	26,138,200	15,392,700	8,414,510	9,288,820	3,132,430	1,843,250	1,255,810	1,183,390	729,039	491,536	292,653	768,483	263,258,621	9,696,591
2001	192,224,000	39,163,700	24,673,300	14,715,200	17,313,900	10,603,700	5,986,220	6,737,100	2,238,420	1,304,230	883,242	829,603	510,372	344,044	743,712	318,270,743	13,590,723
2002	228,677,000	62,029,900	19,697,700	15,262,600	9,823,400	12,041,200	7,609,030	4,373,520	4,843,600	1,591,840	921,138	621,321	582,407	358,032	763,427	369,196,115	14,055,285
2003	118,255,000	73,786,600	31,180,000	12,154,200	10,126,200	6,769,040	8,543,360	5,488,150	3,100,730	3,394,270	1,107,370	638,088	429,485	402,284	775,057	276,149,834	15,335,434
2004	323,301,000	38,149,600	37,047,000	19,140,000	7,959,900	6,857,590	4,715,460	6,049,750	3,820,880	2,134,520	2,320,550	754,257	433,921	292,001	801,592	453,778,021	16,607,471
2005	156,979,000	104,292,000	19,143,700	22,694,700	12,474,700	5,342,360	4,712,970	3,281,300	4,126,330	2,571,160	1,424,320	1,541,060	499,737	287,294	724,775	340,095,406	14,455,976
2006	138,701,000	50,643,700	52,359,900	11,753,700	14,876,200	8,433,790	3,698,010	3,301,530	2,251,910	2,792,590	1,724,770	950,527	1,025,700	332,272	673,235	293,518,834	13,052,534
2007	81,206,600	44,731,600	25,371,300	31,850,800	7,529,640	9,730,730	5,617,200	2,483,440	2,166,770	1,455,240	1,787,380	1,097,970	603,545	650,813	638,794	216,921,822	10,883,952
2008	131,795,000	26,200,400	22,473,400	15,618,900	21,009,400	5,148,980	6,850,080	4,020,570	1,747,730	1,507,650	1,005,460	1,230,090	754,240	414,402	886,201	240,662,503	11,566,343
2009	70,564,800	42,523,600	13,163,800	13,842,100	10,318,600	14,370,300	3,615,030	4,876,120	2,807,530	1,204,550	1,030,470	683,868	834,507	511,156	881,696	181,228,127	12,829,897
2010	92,287,300	22,764,200	21,349,900	8,079,120	9,060,350	6,986,110	10,015,700	2,563,070	3,401,060	1,937,140	825,694	703,915	466,496	569,216	951,562	181,960,833	11,418,153
2011	118,345,000	29,767,200	11,415,600	13,040,100	5,226,960	6,019,360	4,747,670	6,888,190	1,727,350	2,261,190	1,277,160	541,857	460,959	305,338	996,678	203,020,612	14,458,722
2012	208,585,000	38,172,000	14,925,900	6,970,100	8,430,340	3,466,540	4,078,220	3,251,400	4,618,370	1,141,760	1,481,440	832,577	352,400	299,590	847,266	297,452,903	12,824,803
2013	63,645,900	67,270,700	19,129,200	9,088,220	4,474,310	5,544,020	2,331,610	2,777,010	2,170,560	3,042,960	746,344	964,313	541,024	228,976	746,716	182,701,863	11,217,903
2014	76,900,600	20,518,200	33,607,700	11,504,000	5,662,340	2,801,930	3,490,930	1,465,690	1,693,450	1,296,690	1,794,520	436,879	562,374	315,114	568,950	162,619,367	8,133,667
2015	152,439,000	24,793,700	10,263,900	20,300,100	7,238,160	3,623,860	1,830,230	2,307,050	949,515	1,083,010	823,097	1,134,990	276,032	355,552	560,684	227,978,880	7,489,930
2016	238,696,000	49,162,600	12,425,500	6,249,390	13,027,300	4,765,250	2,446,100	1,253,600	1,552,070	631,344	715,149	541,636	746,012	181,492	603,844	332,997,287	6,225,147
2017	101,690,000	76,947,900	24,574,900	7,479,710	3,897,850	8,247,590	3,081,390	1,602,320	805,921	986,013	398,441	450,037	340,722	469,863	496,770	231,469,427	5,550,087
2018	130,745,000	32,789,000	38,492,300	14,859,400	4,722,360	2,490,960	5,327,360	1,994,980	1,009,300	498,309	602,592	241,876	272,286	205,913	584,657	234,836,293	5,409,913
2019	159,592,000	42,174,900	16,451,500	23,562,500	9,665,710	3,163,480	1,710,600	3,708,470	1,362,530	680,598	333,396	401,421	160,811	180,953	526,121	263,674,990	7,354,300
2020	109,463,000	51,492,000	21,191,600	10,134,300	15,568,200	6,621,540	2,229,610	1,225,000	2,609,650	947,550	469,826	229,178	275,368	110,240	485,102	223,052,164	6,351,914
2021	116,007,000	35,305,300	25,810,300	13,021,100	6,711,400	10,666,200	4,768,280	1,687,760	937,358	2,013,300	735,274	366,046	179,050	215,544	466,930	218,890,842	6,601,262

Table 9. Estimates of female spawning stock biomass, 1982-2021.

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
1982	0.0	0.0	0.0	145.8	375.5	411.5	874.9	791.2	861.0	2,012.0	1,828.1	2,987.7	1,925.8	1,557.2	4,727.7	18,498.3
1983	0.0	0.0	0.0	105.6	576.1	566.4	623.0	834.9	730.4	855.1	1,664.3	1,304.2	2,466.3	1,476.8	4,410.6	15,613.7
1984	0.0	0.0	0.0	154.1	482.9	958.1	1,316.9	752.9	940.9	704.6	732.3	1,618.5	1,183.5	2,171.0	4,766.9	15,782.6
1985	0.0	0.0	0.0	240.8	600.2	854.5	2,279.5	1,467.7	935.6	899.6	694.9	724.1	1,375.3	1,034.5	5,345.0	16,451.8
1986	0.0	0.0	0.0	582.1	879.4	996.9	1,566.1	2,278.6	1,358.6	697.5	718.0	543.8	538.8	917.0	3,760.8	14,837.5
1987	0.0	0.0	0.0	484.3	2,079.7	1,374.8	2,069.5	1,793.7	2,473.7	1,334.3	692.4	724.0	507.6	494.2	4,218.9	18,246.9
1988	0.0	0.0	0.0	526.5	2,100.6	3,766.1	3,364.1	2,587.0	2,072.7	2,244.4	1,484.9	781.4	699.5	481.5	4,016.0	24,124.8
1989	0.0	0.0	0.0	521.8	2,255.2	3,829.2	9,034.4	4,772.5	3,395.4	2,700.0	2,740.7	1,484.9	758.9	664.3	3,902.6	36,059.9
1990	0.0	0.0	0.0	553.9	1,829.8	3,696.3	7,601.1	10,244.5	4,918.8	3,087.7	2,317.8	2,612.4	1,281.2	606.9	3,266.7	42,017.0
1991	0.0	0.0	0.0	737.1	2,107.3	2,788.6	7,662.7	8,200.3	11,048.6	4,355.3	3,626.5	1,993.0	2,361.2	1,151.3	3,344.7	49,376.5
1992	0.0	0.0	0.0	786.2	2,905.4	3,432.2	6,794.3	8,746.7	9,656.4	11,124.4	5,086.9	4,017.6	2,387.5	2,596.7	5,128.4	62,662.5
1993	0.0	0.0	0.0	988.8	3,141.4	4,391.0	7,384.7	8,308.7	10,187.1	9,266.7	10,681.2	4,854.3	3,390.3	2,107.4	5,688.2	70,389.6
1994	0.0	0.0	0.0	838.9	3,976.9	4,887.8	9,715.3	9,005.2	9,271.8	9,364.5	9,091.6	9,770.2	4,364.5	2,828.5	6,097.5	79,212.5
1995	0.0	0.0	0.0	927.4	3,090.2	6,105.5	11,410.0	11,391.3	10,256.1	9,382.7	7,594.9	7,462.4	8,059.3	3,441.9	6,334.8	85,456.6
1996	0.0	0.0	0.0	1,125.8	3,545.7	5,275.1	14,959.1	13,525.2	12,756.4	9,561.9	7,636.7	6,793.6	6,255.0	6,430.1	7,515.6	95,380.3
1997	0.0	0.0	0.0	2,589.0	3,957.4	4,851.6	9,030.3	12,295.1	11,981.3	11,028.6	7,545.1	5,695.7	5,808.0	4,871.0	10,574.0	90,227.3
1998	0.0	0.0	0.0	1,147.3	7,244.0	4,811.8	9,056.4	9,043.2	12,528.9	8,951.1	7,290.2	5,428.2	4,348.4	4,183.0	9,830.9	83,863.2
1999	0.0	0.0	0.0	1,328.7	3,707.8	8,619.1	8,053.8	8,585.9	9,219.3	10,950.4	7,599.5	5,859.1	4,368.6	3,553.6	11,177.9	83,023.7
2000	0.0	0.0	0.0	1,475.8	4,634.1	5,779.0	18,578.5	9,678.4	9,870.9	7,713.8	9,643.6	6,696.5	5,442.3	3,758.7	11,829.7	95,101.2
2001	0.0	0.0	0.0	955.3	5,718.9	8,225.6	12,844.4	21,382.1	11,063.9	8,524.7	6,503.9	6,470.0	4,991.8	3,814.9	8,925.5	99,420.8
2002	0.0	0.0	0.0	890.5	3,363.1	9,436.4	17,154.9	15,017.4	22,889.7	9,878.7	7,127.4	5,309.8	5,756.9	4,112.0	10,391.9	111,329.0
2003	0.0	0.0	0.0	660.0	3,358.4	5,314.4	18,798.0	18,161.3	15,081.3	20,003.9	8,073.3	5,363.0	4,243.5	4,534.2	9,915.0	113,506.0
2004	0.0	0.0	0.0	1,023.8	2,788.6	5,274.8	10,457.6	19,784.5	18,232.7	12,480.4	16,197.7	6,033.2	4,123.3	3,144.5	9,795.6	109,337.0
2005	0.0	0.0	0.0	1,309.4	4,086.8	4,337.2	10,459.9	11,489.4	20,421.9	15,165.0	10,217.6	13,186.1	4,951.8	3,238.3	9,552.5	108,416.0
2006	0.0	0.0	0.0	631.1	4,602.7	5,990.7	7,741.9	11,088.6	11,761.6	16,943.4	12,429.6	7,804.7	10,370.5	3,808.1	8,932.1	102,105.0
2007	0.0	0.0	0.0	1,530.8	2,347.3	7,218.8	12,452.7	8,188.5	11,489.8	9,395.9	13,985.6	9,623.4	6,402.9	7,956.4	9,237.5	99,829.6
2008	0.0	0.0	0.0	837.0	6,580.6	4,259.0	17,490.6	13,998.0	9,043.9	10,182.8	7,842.1	10,767.7	7,943.4	4,991.0	12,138.7	106,075.0
2009	0.0	0.0	0.0	752.1	3,048.2	11,466.6	8,710.9	18,210.7	14,952.5	7,686.3	7,892.3	5,797.5	8,493.9	5,943.9	11,643.9	104,599.0
2010	0.0	0.0	0.0	437.4	2,734.5	5,473.2	22,864.5	8,614.0	17,024.1	12,298.7	6,279.2	5,731.0	4,605.2	6,428.1	12,258.8	104,749.0
2011	0.0	0.0	0.0	772.2	1,583.2	4,476.3	10,548.3	22,585.5	8,575.3	13,871.4	9,050.7	4,726.5	4,584.4	3,499.6	13,282.7	97,556.0
2012	0.0	0.0	0.0	429.1	2,901.2	2,685.3	9,420.5	11,685.3	23,258.0	7,574.1	11,261.8	7,328.8	3,764.8	3,620.9	12,005.9	95,935.6
2013	0.0	0.0	0.0	482.6	1,545.8	4,549.9	5,138.5	9,333.4	11,353.0	18,707.6	5,851.7	8,625.3	5,777.6	2,796.8	10,588.0	84,750.1
2014	0.0	0.0	0.0	564.2	1,797.8	2,140.3	8,005.4	4,870.1	8,980.2	8,762.6	13,742.2	4,373.2	6,569.9	4,249.3	9,291.3	73,346.4
2015	0.0	0.0	0.0	1,158.5	2,523.1	3,183.3	4,312.2	8,183.3	5,044.0	6,933.9	6,387.7	10,382.0	3,055.2	4,442.4	7,809.4	63,414.9
2016	0.0	0.0	0.0	299.4	4,302.8	4,021.6	6,219.4	4,708.9	8,435.1	4,494.3	5,881.4	5,141.7	8,693.8	2,410.2	9,618.8	64,227.4
2017	0.0	0.0	0.0	412.4	1,345.3	6,539.0	7,283.8	5,502.5	4,111.2	6,811.4	3,324.9	4,255.1	3,936.4	6,249.7	7,334.6	57,106.2
2018	0.0	0.0	0.0	797.7	1,530.5	2,196.1	11,389.4	6,741.0	5,675.1	3,501.8	5,337.6	2,623.8	3,178.1	2,626.2	9,522.9	55,120.3
2019	0.0	0.0	0.0	1,242.3	3,052.0	2,428.7	3,927.0	13,810.6	7,732.0	4,899.2	2,927.5	4,177.4	2,108.0	2,409.5	7,920.0	56,634.1
2020	0.0	0.0	0.0	620.1	4,863.5	4,698.5	5,194.9	4,773.2	14,328.6	6,921.7	4,249.9	2,446.1	3,366.4	1,441.1	7,076.1	59,980.3
2021	0.0	0.0	0.0	747.6	2,368.8	7,218.7	10,002.4	5,738.2	4,475.4	13,863.5	4,495.5	3,637.8	2,252.2	2,830.6	7,174.6	64,805.3

Table 10. Estimate of total female spawning stock biomass with associated standard errors and coefficients of variation.

Year	Total	SE	CV
1982	18,498.3	2,503.5	0.135
1983	15,613.7	2,222.4	0.142
1984	15,782.6	2,227.6	0.141
1985	16,451.8	2,168.2	0.132
1986	14,837.5	1,853.5	0.125
1987	18,246.9	2,045.6	0.112
1988	24,124.8	2,308.8	0.096
1989	36,059.9	2,987.1	0.083
1990	42,017.0	3,143.0	0.075
1991	49,376.5	3,516.2	0.071
1992	62,662.5	4,466.7	0.071
1993	70,389.6	4,811.8	0.068
1994	79,212.5	5,098.9	0.064
1995	85,456.6	5,224.7	0.061
1996	95,380.3	5,924.5	0.062
1997	90,227.3	5,980.4	0.066
1998	83,863.2	5,138.6	0.061
1999	83,023.7	5,080.4	0.061
2000	95,101.2	5,484.7	0.058
2001	99,420.8	5,210.0	0.052
2002	111,329.0	5,770.6	0.052
2003	113,506.0	5,879.3	0.052
2004	109,337.0	5,831.2	0.053
2005	108,416.0	6,006.0	0.055
2006	102,105.0	5,861.8	0.057
2007	99,829.6	5,908.9	0.059
2008	106,075.0	5,872.6	0.055
2009	104,599.0	5,640.0	0.054
2010	104,749.0	5,512.3	0.053
2011	97,556.0	5,396.3	0.055
2012	95,935.6	5,634.8	0.059
2013	84,750.1	5,475.6	0.065
2014	73,346.4	5,526.5	0.075
2015	63,414.9	5,051.1	0.080
2016	64,227.4	5,429.4	0.085
2017	57,106.2	5,230.7	0.092
2018	55,120.3	5,571.5	0.101
2019	56,634.1	5,917.2	0.104
2020	59,980.3	6,369.9	0.106
2021	64,805.3	6,945.1	0.107

Table 11. Estimates of exploitable biomass, 1982-2021.

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
1982	2,287.3	4,742.6	3,288.0	3,153.3	2,099.2	1,519.5	1,485.0	1,162.1	978.2	2,281.6	2,077.3	3,213.5	2,030.9	1,611.7	5,055.0	36,985.1
1983	8,099.7	3,125.5	3,482.1	2,400.0	3,115.5	1,934.1	1,080.5	1,202.2	876.2	926.4	1,821.8	1,446.7	2,564.7	1,552.4	4,700.7	38,328.3
1984	9,107.9	7,848.1	5,635.1	3,222.6	2,446.8	3,207.0	2,036.9	997.7	1,066.3	759.3	807.2	1,644.8	1,184.1	2,197.0	5,039.1	47,199.9
1985	1,299.5	7,477.1	9,100.7	5,791.5	3,340.7	2,920.8	3,609.1	2,132.4	1,085.6	1,020.4	754.0	752.4	1,492.5	1,095.5	5,722.2	47,594.1
1986	3,848.4	3,985.4	8,660.9	11,350.6	4,766.5	3,332.1	2,630.2	3,312.0	1,631.1	821.9	790.2	589.4	581.8	991.3	3,971.6	51,263.3
1987	6,674.4	6,836.0	9,757.0	10,172.8	12,273.3	4,797.5	3,426.8	2,504.1	2,896.4	1,462.2	722.6	742.1	518.4	498.1	4,446.2	67,727.9
1988	17,520.6	9,809.0	9,692.9	11,538.9	11,361.9	12,202.2	5,218.7	3,540.8	2,421.4	2,560.5	1,537.0	789.8	723.8	491.7	4,234.8	93,643.9
1989	7,098.7	15,151.0	12,239.5	10,432.9	12,068.3	12,734.0	14,449.3	6,394.3	3,823.6	2,730.0	2,711.3	1,565.4	786.9	674.6	4,119.6	106,979.4
1990	3,027.5	12,753.2	14,685.1	11,625.9	10,813.8	12,797.0	12,839.7	14,632.5	6,040.9	3,558.4	2,681.0	2,837.0	1,360.7	651.4	3,455.5	113,759.5
1991	11,652.1	11,242.5	18,308.2	15,006.2	11,879.2	9,487.6	12,495.4	11,633.9	13,033.2	4,903.8	3,606.2	2,119.5	2,436.8	1,175.1	3,547.7	132,527.4
1992	3,843.5	12,361.8	22,989.2	17,006.3	16,339.7	11,580.8	10,531.9	12,281.6	11,044.1	12,108.7	5,082.4	4,107.9	2,246.3	2,487.0	5,450.1	149,461.3
1993	2,368.7	9,430.8	15,595.5	21,292.3	17,196.0	15,148.6	11,915.8	11,543.7	11,676.0	10,299.7	11,454.8	5,176.7	3,609.5	2,225.4	6,030.5	154,964.0
1994	40,135.7	11,472.6	19,594.0	17,615.8	21,823.4	16,933.1	15,501.1	12,429.1	10,886.1	10,622.8	9,682.1	10,398.6	4,521.2	2,944.1	6,482.3	211,041.9
1995	26,643.9	37,793.6	25,444.2	20,879.5	17,616.0	21,199.8	17,831.4	15,971.4	11,975.4	10,217.0	8,552.8	8,246.8	8,590.0	3,680.7	6,798.8	241,441.3
1996	15,441.5	32,245.5	47,138.7	23,600.1	19,349.9	17,234.1	22,671.5	18,755.2	14,674.6	10,544.9	8,555.1	7,028.5	6,422.1	6,648.8	8,117.0	258,427.5
1997	13,952.6	22,061.5	33,289.7	54,700.9	22,749.6	17,411.2	15,760.8	19,359.0	14,802.4	12,357.1	8,361.8	6,155.4	5,936.7	5,036.7	11,349.8	263,285.2
1998	37,766.7	26,663.6	32,453.5	25,462.2	44,660.7	17,576.6	14,830.9	12,702.0	14,184.9	10,333.9	8,594.7	6,023.3	4,608.5	4,512.1	10,562.5	270,936.0
1999	100,144.0	28,120.7	39,155.5	30,489.8	21,442.8	30,986.3	13,588.6	12,528.2	10,819.9	12,321.9	8,137.8	6,119.2	4,494.7	3,618.7	11,991.0	333,959.0
2000	44,315.5	28,665.0	23,741.3	33,160.5	25,859.7	19,424.4	29,025.0	12,954.2	11,023.1	8,731.9	10,326.4	7,030.0	5,468.1	3,814.8	12,687.7	276,227.6
2001	22,095.7	14,685.1	19,365.0	20,416.5	30,993.9	26,762.6	20,295.7	29,771.4	12,735.9	9,706.4	7,052.2	7,439.3	5,389.1	4,179.7	9,571.6	240,460.0
2002	12,272.1	13,814.7	12,501.5	19,848.5	19,187.1	31,870.9	28,078.7	20,781.2	26,648.9	11,038.0	7,751.3	5,705.9	5,694.0	4,175.0	11,161.3	230,529.2
2003	6,509.7	19,799.0	17,360.3	14,806.2	18,456.4	17,878.5	30,800.0	25,617.4	17,927.5	22,365.1	8,877.0	5,898.3	4,435.7	4,796.5	10,664.8	226,192.4
2004	50,432.9	6,930.2	26,300.8	22,646.7	14,681.6	17,937.6	17,163.2	27,853.2	21,466.4	14,067.1	17,808.8	6,608.0	4,321.2	3,324.7	10,565.0	262,107.4
2005	11,936.2	35,367.1	11,741.8	26,637.0	21,992.3	14,967.1	16,992.7	15,855.7	23,698.4	17,009.5	11,086.9	13,937.9	5,048.1	3,330.7	10,299.1	239,900.5
2006	15,617.4	11,256.1	33,321.7	14,581.3	26,671.1	21,027.0	13,023.7	15,612.8	13,842.9	19,201.1	13,565.7	8,501.5	10,898.5	3,997.7	9,674.4	230,792.8
2007	3,828.1	12,871.5	15,163.5	32,684.0	12,678.0	23,869.5	19,513.6	11,224.7	13,155.2	10,547.0	14,909.3	10,231.1	6,452.7	8,129.4	9,926.9	205,184.4
2008	16,107.6	5,557.9	15,544.1	18,108.5	35,042.2	13,899.4	26,971.8	19,593.1	10,426.6	11,373.6	8,534.5	11,812.0	8,231.7	5,258.2	13,062.6	219,523.8
2009	11,181.5	15,343.9	8,962.0	16,762.1	17,097.7	38,130.3	14,269.2	26,252.8	17,273.4	8,662.2	8,790.5	6,379.8	8,810.2	6,264.2	12,520.1	216,699.8
2010	8,190.7	9,711.5	17,711.4	9,736.3	15,176.8	17,691.3	37,539.8	12,396.6	20,403.4	14,043.3	6,875.5	6,320.0	4,780.7	6,777.3	13,236.2	200,590.8
2011	15,278.3	8,586.2	9,740.1	17,104.4	8,777.6	14,902.3	17,568.9	32,238.7	9,982.2	15,547.3	10,115.4	5,126.8	4,695.5	3,645.0	14,352.2	187,660.9
2012	6,742.5	11,827.2	10,816.9	9,185.7	15,917.5	8,838.0	15,081.3	15,964.3	26,812.1	8,333.0	12,237.5	7,692.3	3,875.7	3,732.8	12,971.6	170,028.5
2013	7,107.5	13,318.9	12,985.3	10,768.3	8,711.6	15,457.8	8,552.6	13,471.2	13,613.6	21,431.5	6,547.0	9,373.3	6,077.1	2,959.1	11,566.6	161,941.4
2014	48,980.7	6,632.8	22,193.8	12,702.5	9,788.6	7,396.7	13,277.7	6,865.6	10,307.4	9,737.9	14,931.6	4,588.0	6,676.4	4,326.0	10,064.7	188,470.4
2015	13,505.2	9,346.3	7,301.1	24,148.6	12,897.3	10,289.8	6,847.9	11,385.1	5,771.1	7,940.2	7,149.5	11,158.3	3,294.4	4,796.4	8,427.1	144,258.3
2016	24,148.9	12,485.7	5,909.6	6,701.7	24,198.2	13,893.0	10,323.7	6,584.5	9,837.2	4,978.1	6,280.7	5,430.1	8,872.4	2,455.9	10,422.4	152,522.2
2017	12,740.3	21,980.7	16,591.3	8,329.7	6,876.7	22,003.6	11,999.2	8,047.2	5,007.0	7,669.7	3,721.5	4,686.1	4,126.3	6,633.0	7,983.1	148,395.4
2018	20,361.3	11,541.5	26,400.2	17,971.9	8,629.1	7,437.2	19,078.2	9,653.5	6,369.4	3,767.6	5,743.4	2,720.0	3,257.5	2,783.3	10,266.6	155,980.7
2019	19,247.5	15,599.0	13,492.2	27,401.4	16,532.6	8,123.4	6,601.4	18,288.5	8,600.9	5,507.2	3,199.7	4,500.9	2,201.9	2,523.6	8,512.6	160,332.9
2020	28,307.1	17,078.0	16,079.1	13,686.9	26,439.4	16,161.4	8,287.5	6,320.8	16,934.5	7,713.1	4,521.7	2,564.4	3,466.2	1,551.5	7,504.5	176,616.2
2021	4,218.7	13,980.2	18,754.7	16,186.5	12,986.2	25,101.9	15,926.1	8,104.1	5,596.6	15,173.4	5,452.9	3,949.1	2,318.8	2,962.5	7,615.6	158,327.3

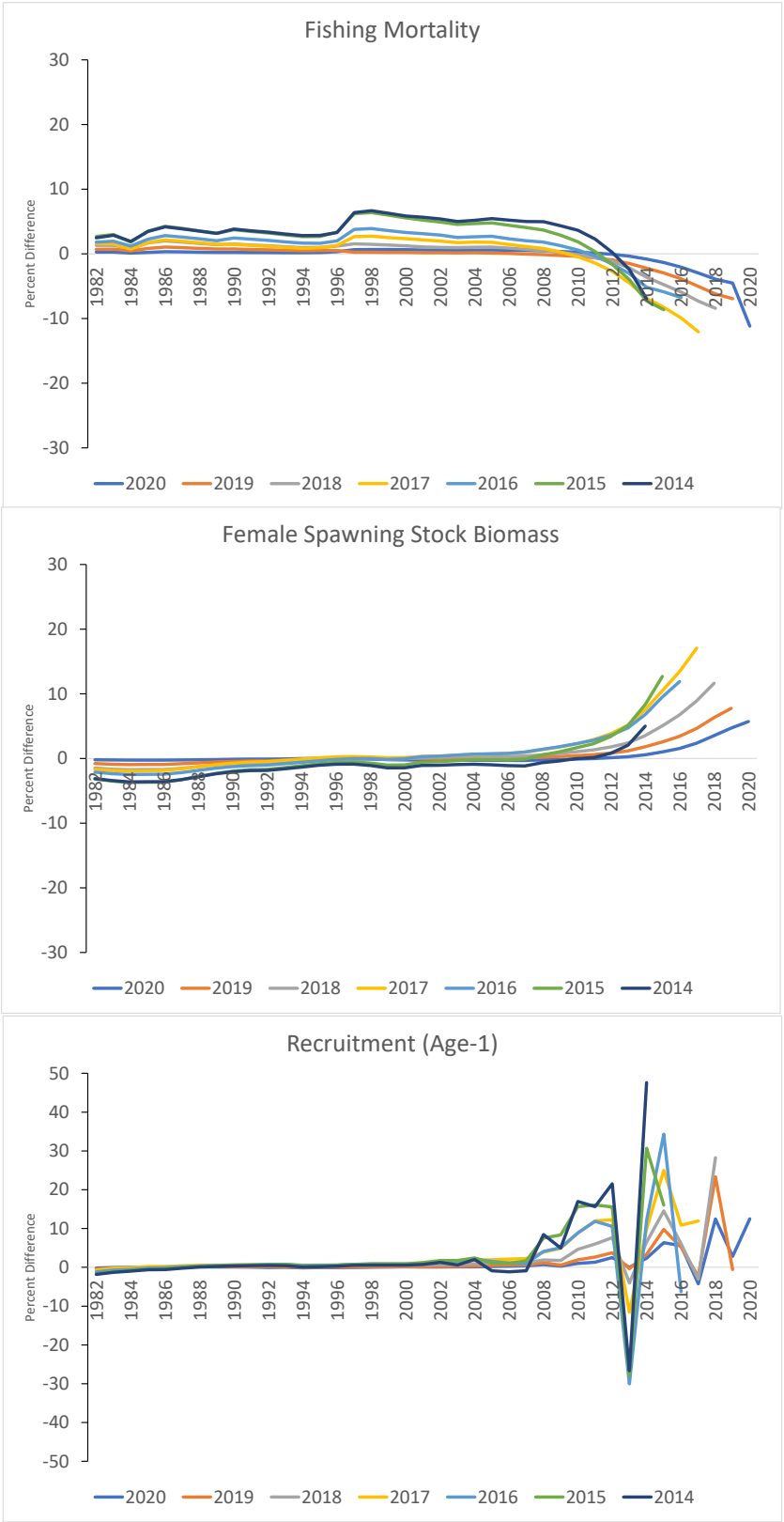
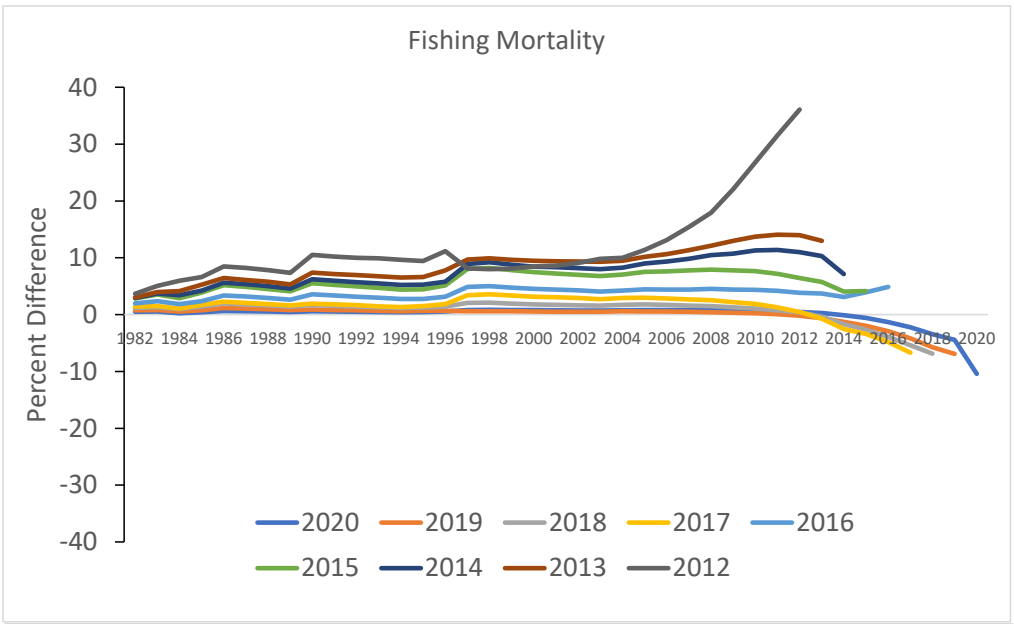


Figure 1. Base model retrospective plots of seven-year peels for fishing mortality, female spawning stock biomass and recruitment.



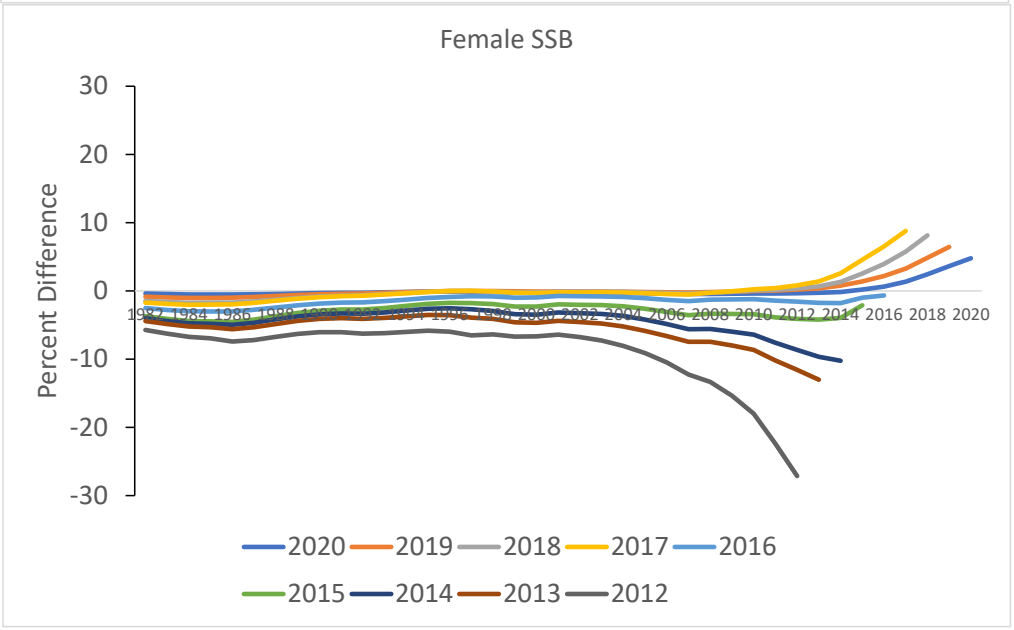
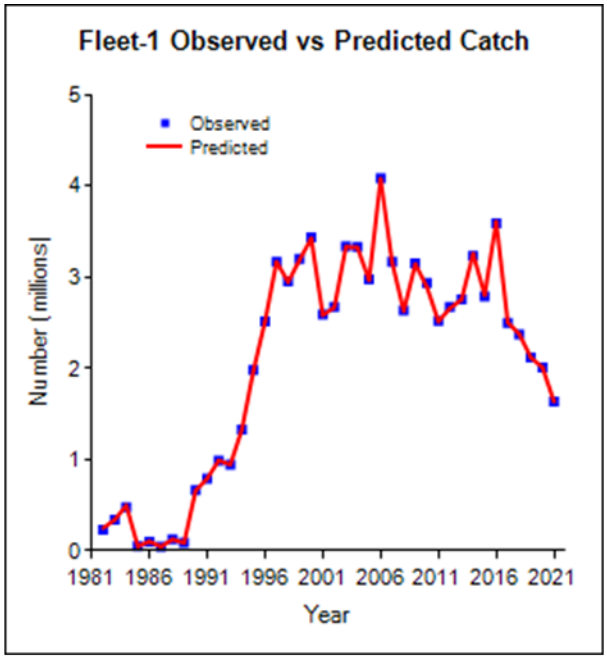
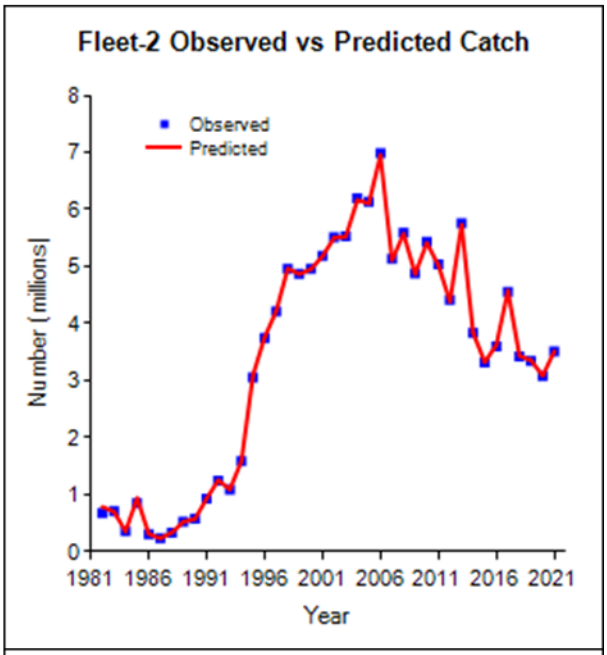
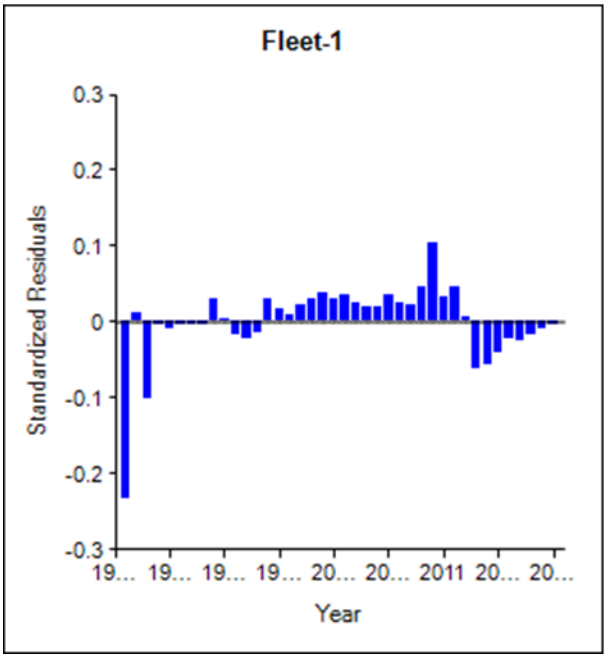


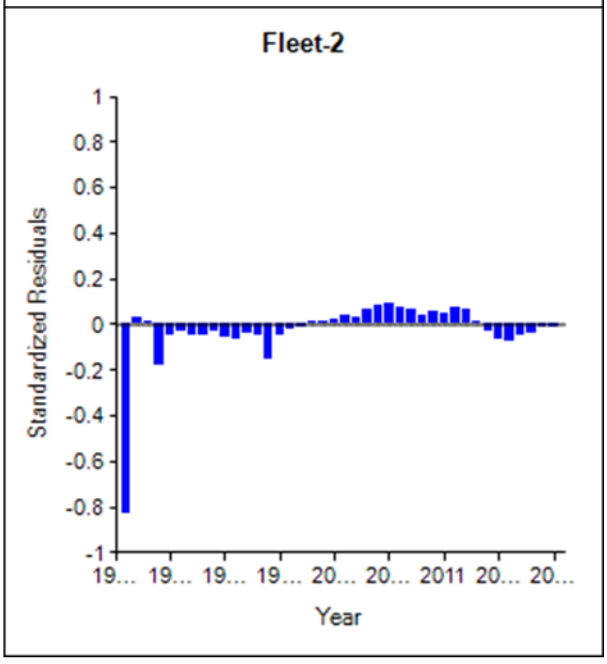
Figure 2. Plots showing changes in the retrospective pattern when the index CV weights from the 2018 benchmark are used in the current assessment.

Appendix 2. Diagnostic plots for the base model in which new 2020-2021 selectivity blocks were added for the Bay and Ocean regions.

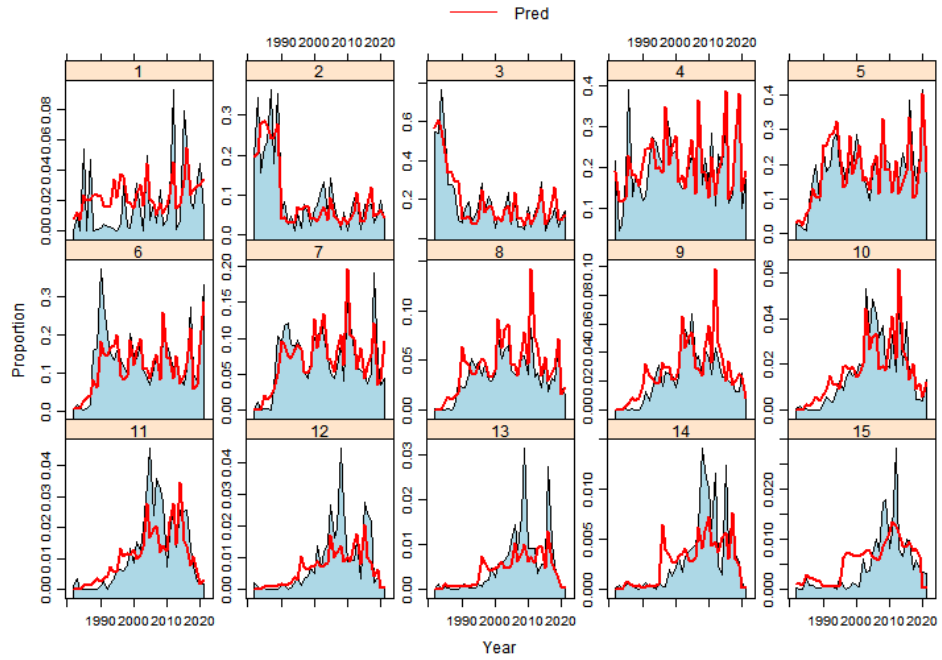




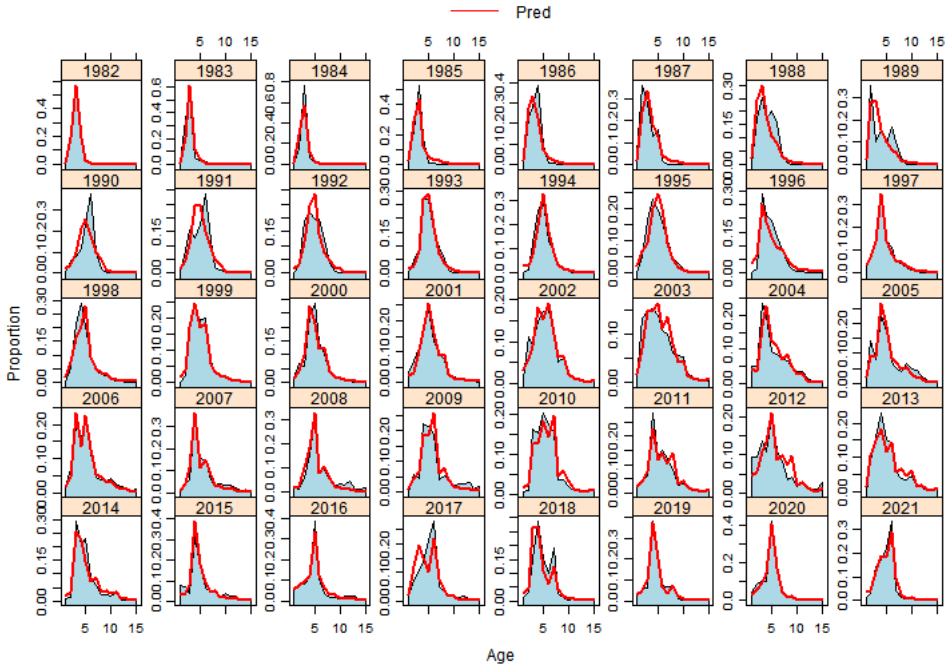


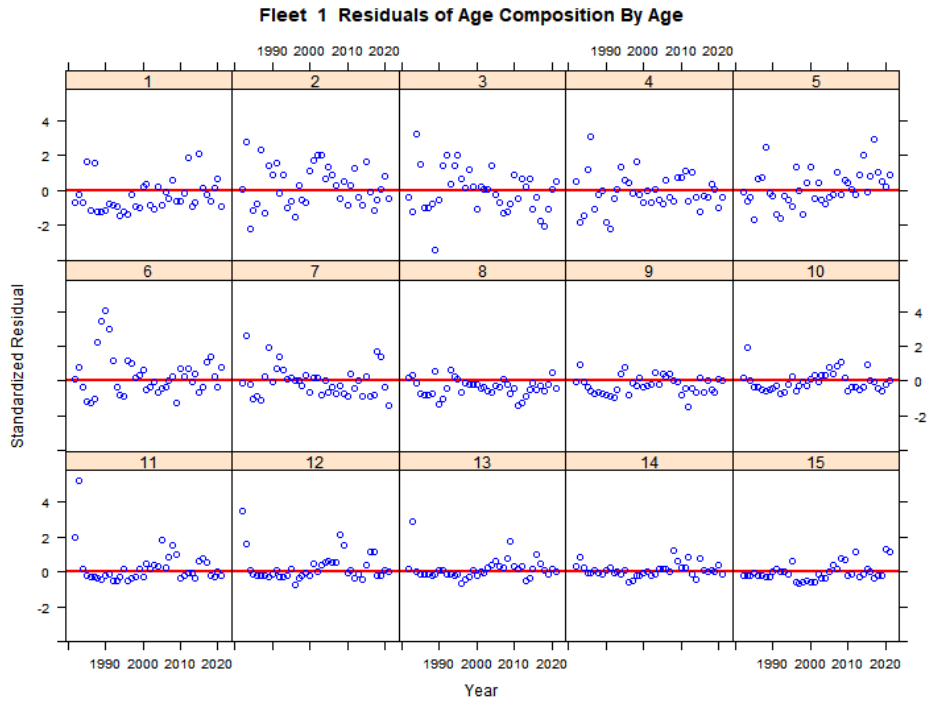


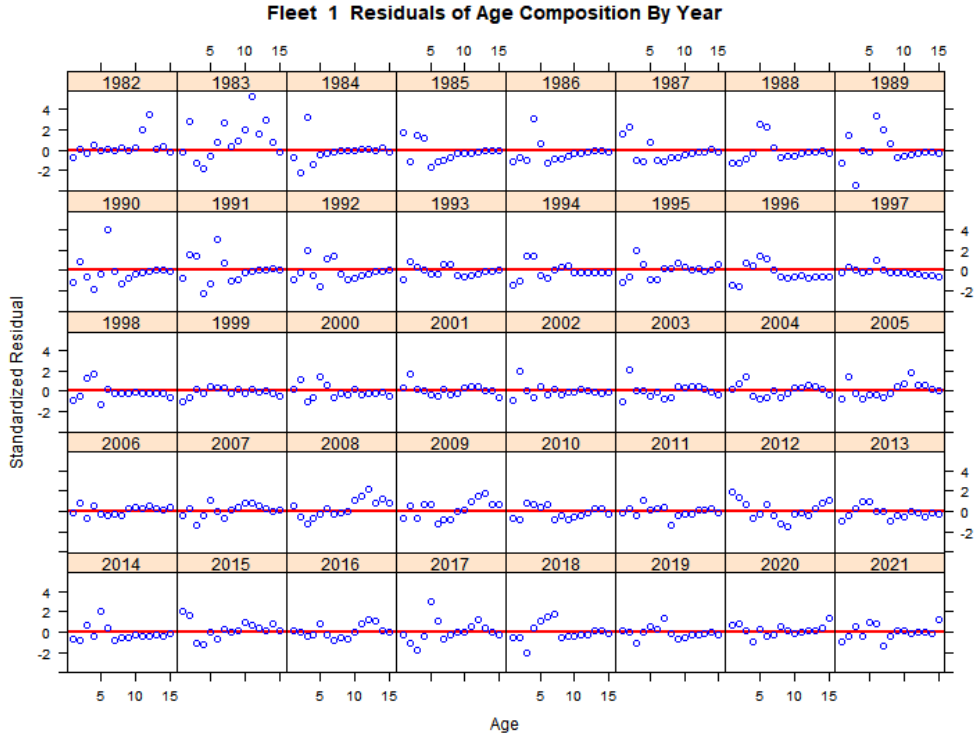
Fleet 1 Catch Age Composition By Age

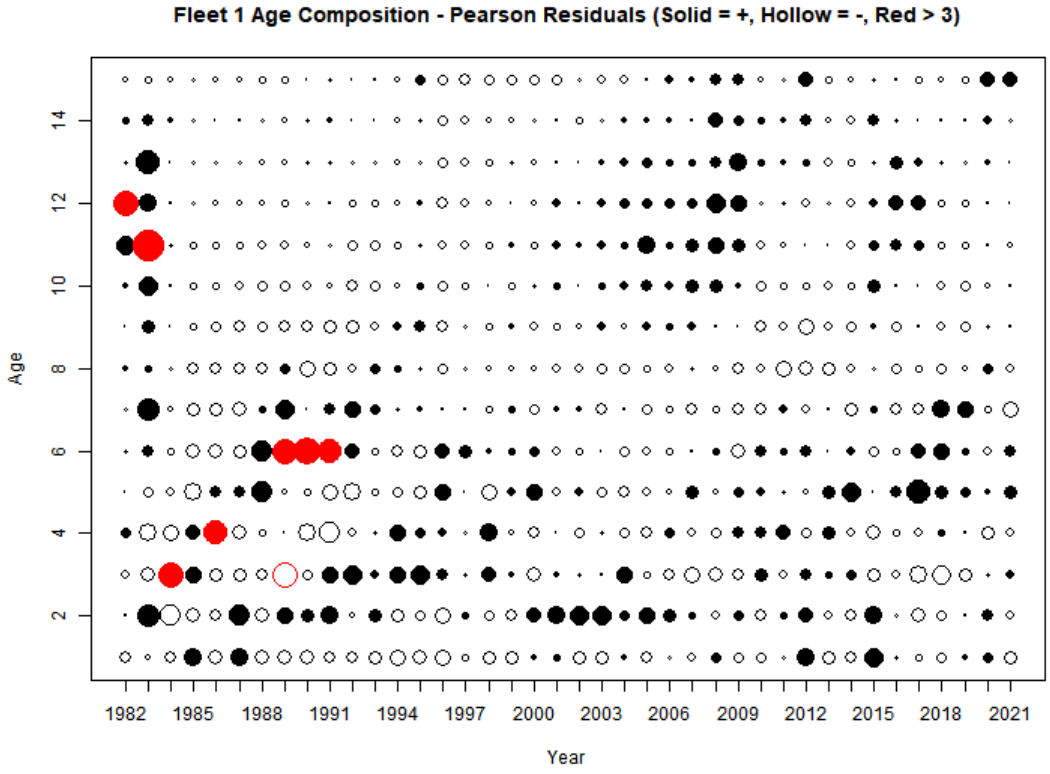


Fleet 1 Catch Age Composition By Year

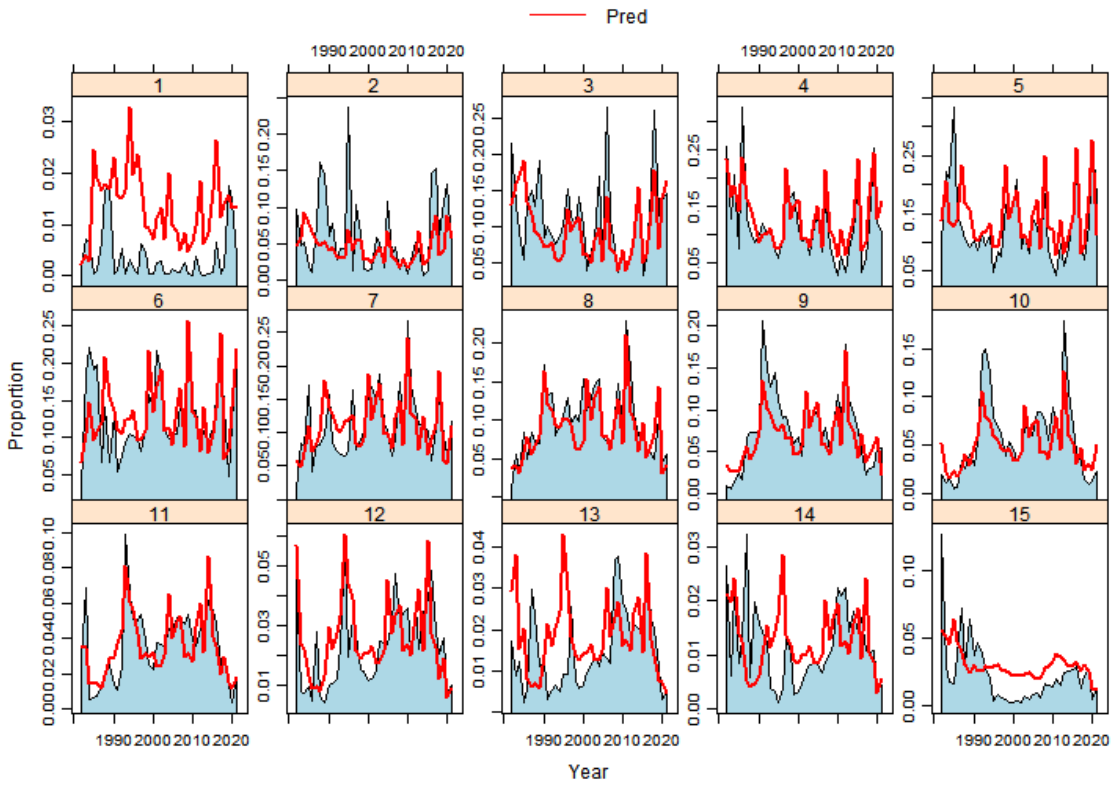



Fleet 1 Residuals of Age Composition By Age
1 2 3 4 5
6 7 8 9 10
11 12 13 14 15
Standardized Residual
Year

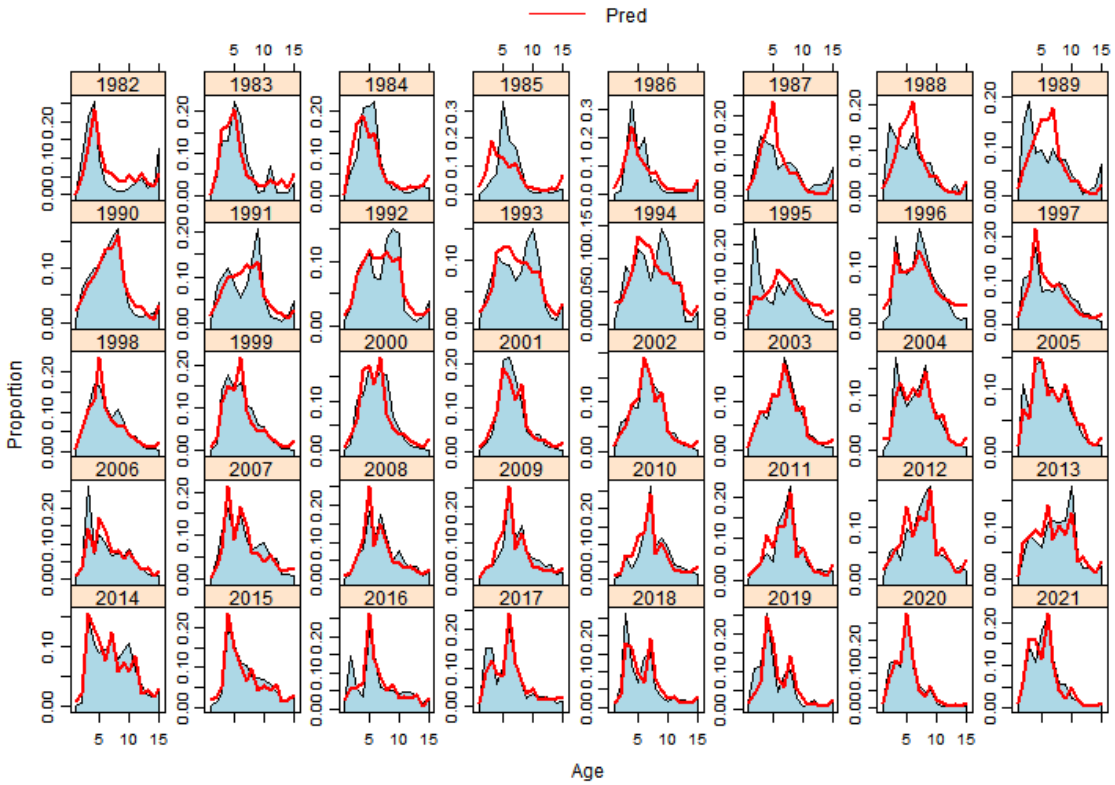

Fleet 1 Residuals of Age Composition By Year
1982 1983 1984 1985 1986 1987 1988 1989
1990 1991 1992 1993 1994 1995 1996 1997
1998 1999 2000 2001 2002 2003 2004 2005
2006 2007 2008 2009 2010 2011 2012 2013
2014 2015 2016 2017 2018 2019 2020 2021
Standardized Residual
Age


Fleet 1 Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
2021
Year

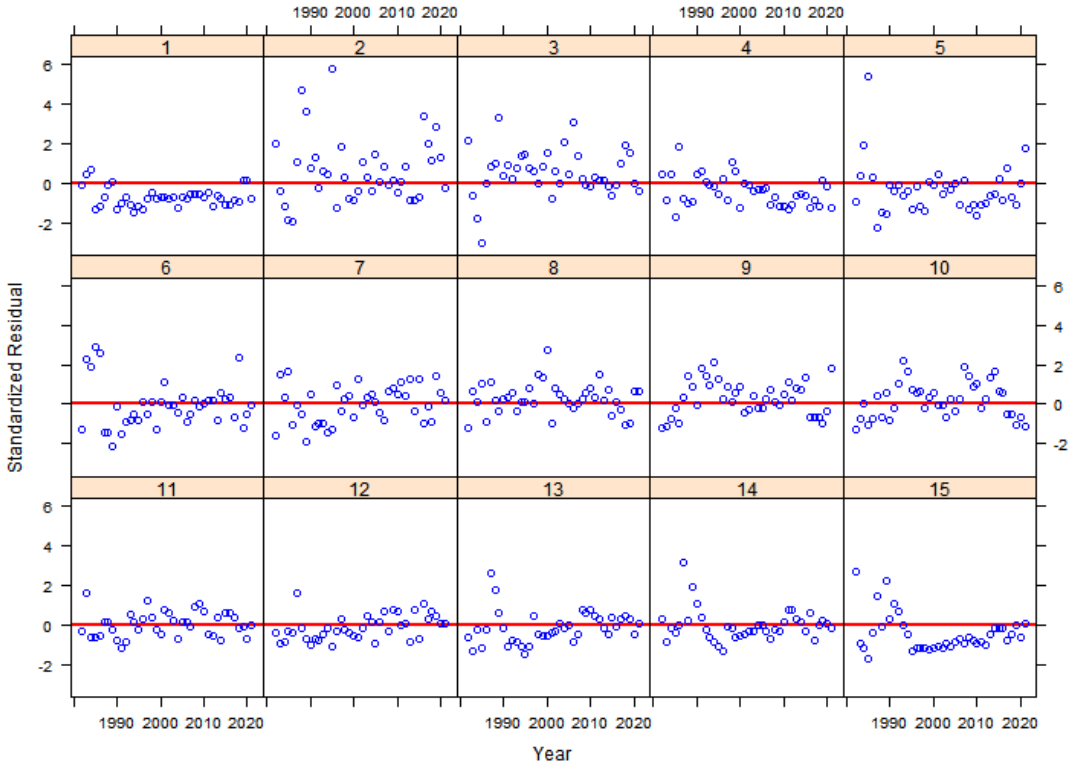
Fleet 2 Catch Age Composition By Age



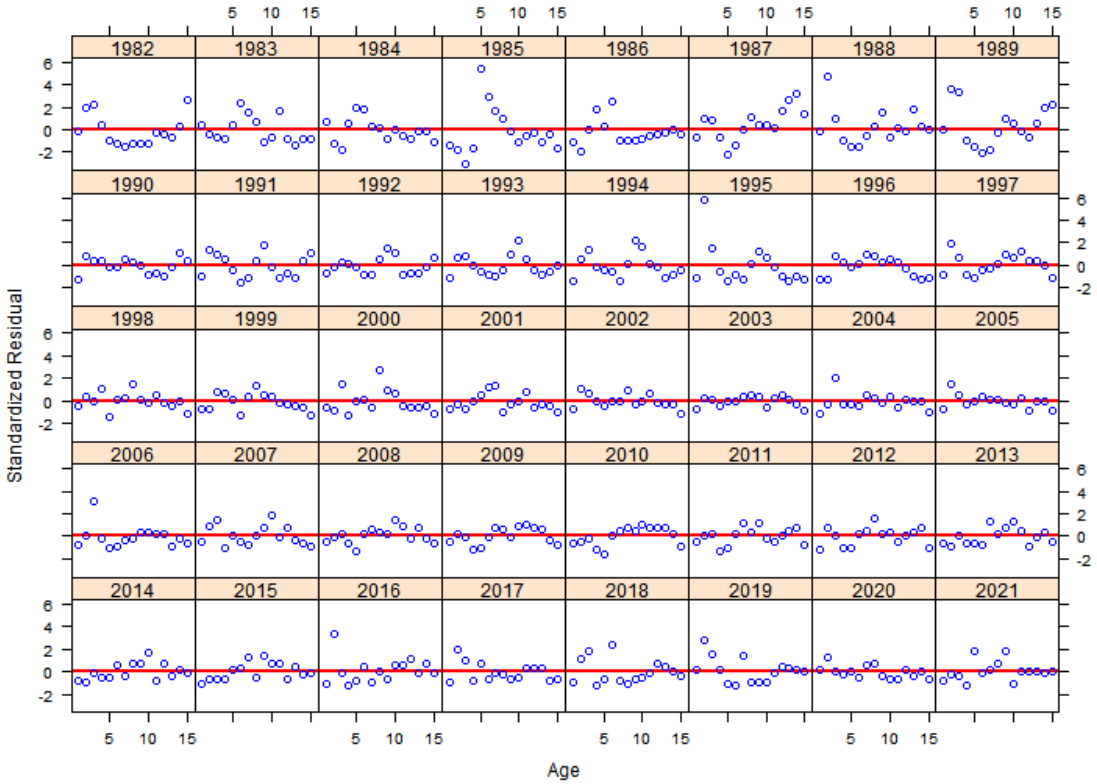
Fleet 2 Catch Age Composition By Year

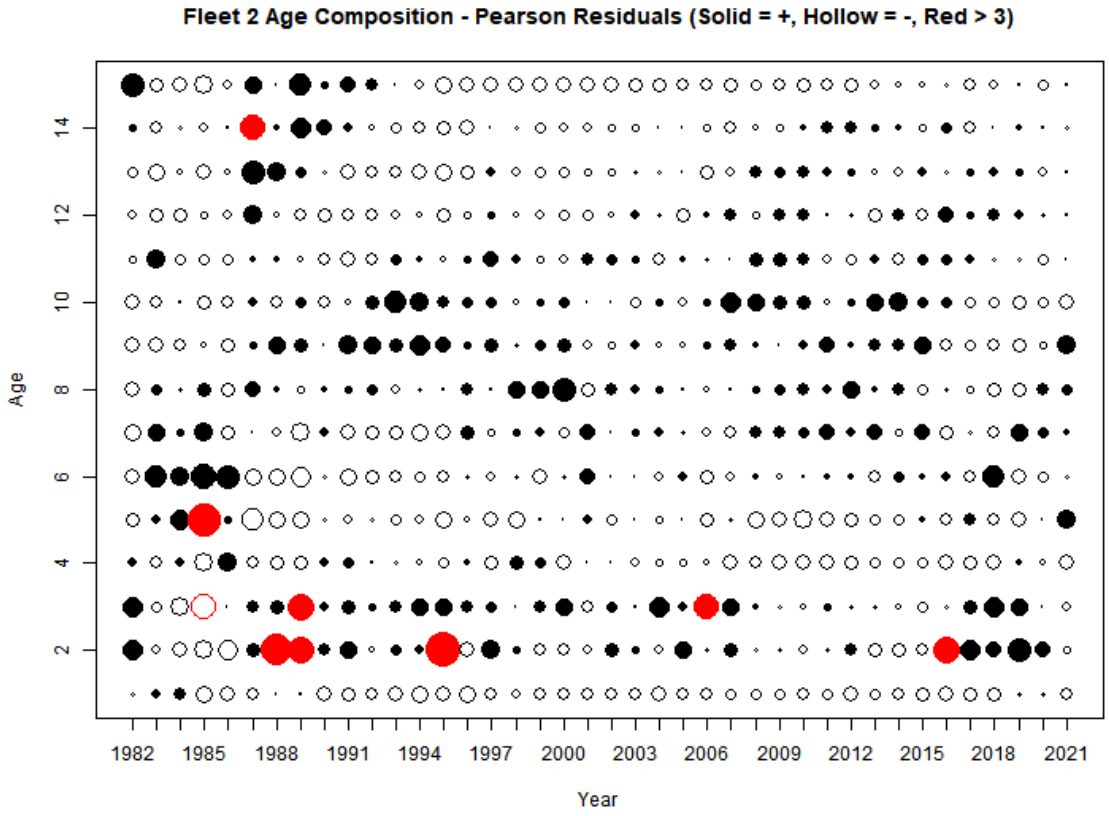


Fleet 2 Residuals of Age Composition By Age



Fleet 2 Residuals of Age Composition By Year




Fleet 2 Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
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1982
1985
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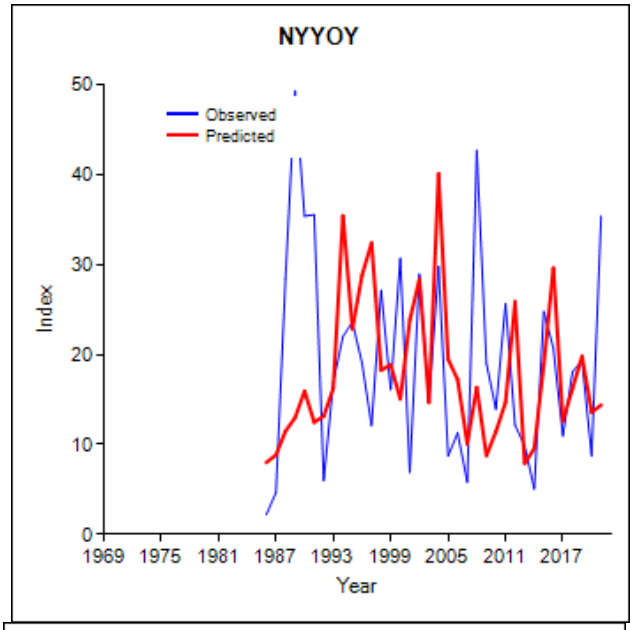
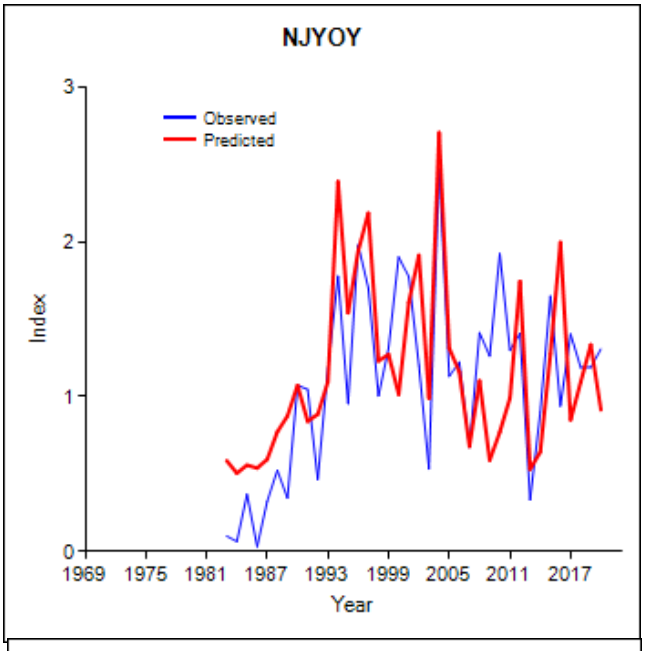
2018
2021
Year


NYYOY
Observed
Predicted
Index
Year
0
10
20
30
40
50
1969
1975
1981
1987
1993
1999
2005
2011
2017


NJYOY
Observed
Predicted
Index
Year
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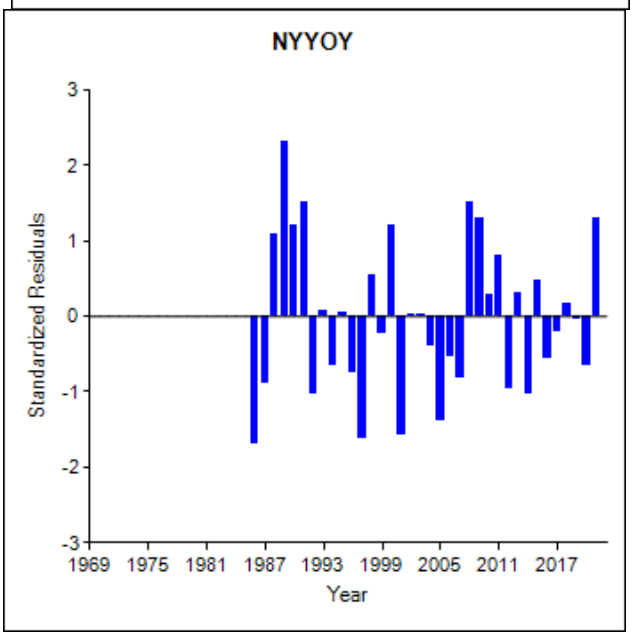
2017


NYYOY
Standardized Residuals
Year
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1969
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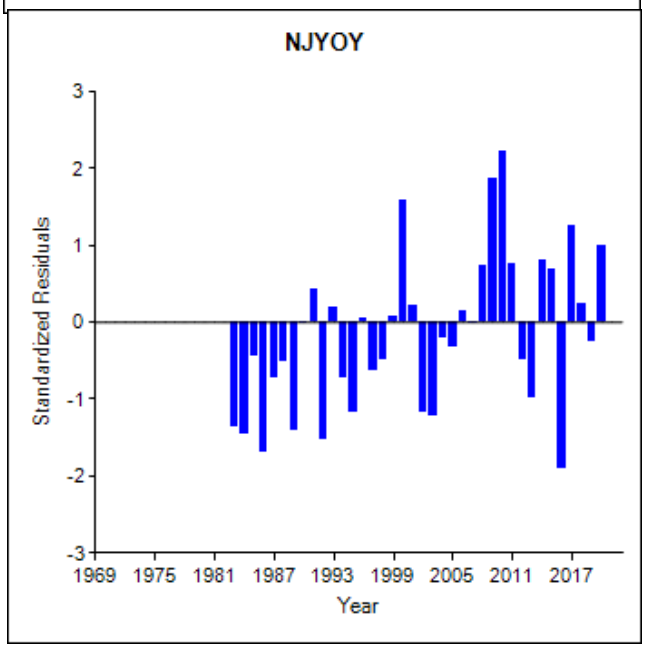
NJYOY
Standardized Residuals
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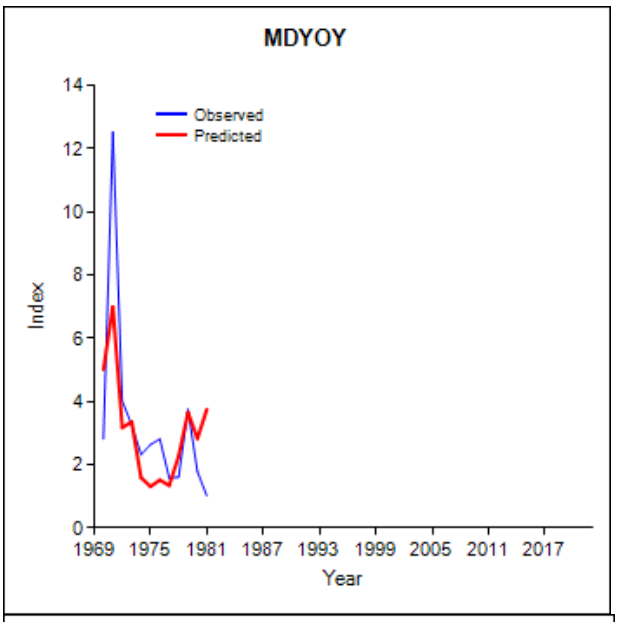
MDYOY
Observed
Predicted
Index
Year
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1975
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2005
2011
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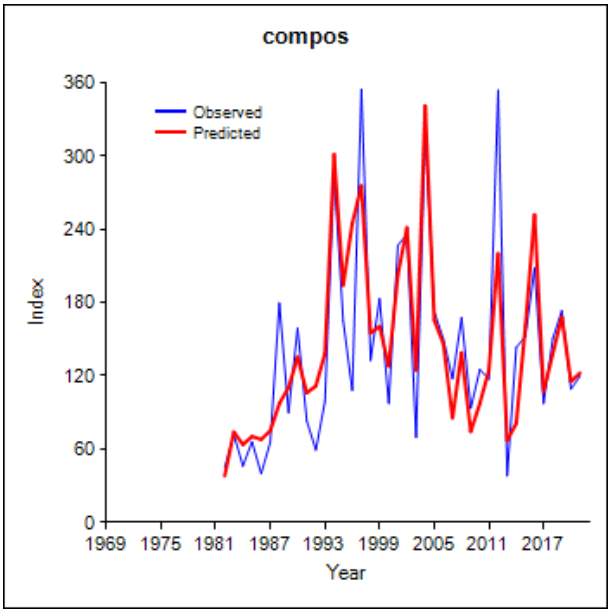
compos
Observed
Predicted
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240
300
360
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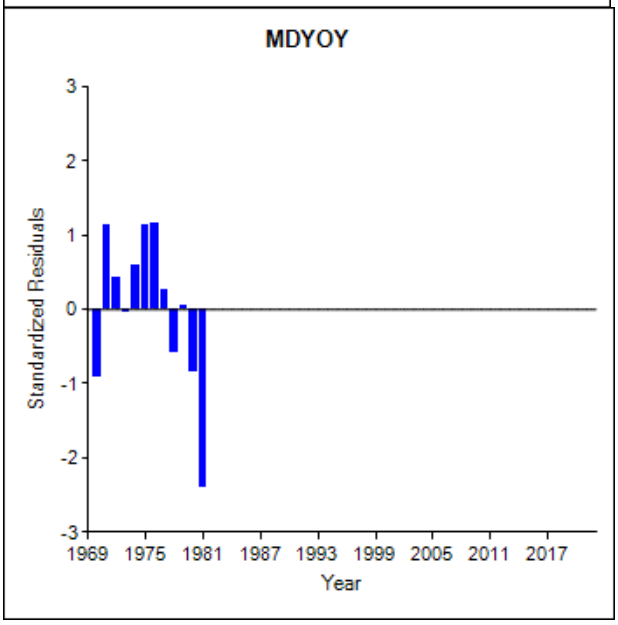
MDYOY
Standardized Residuals
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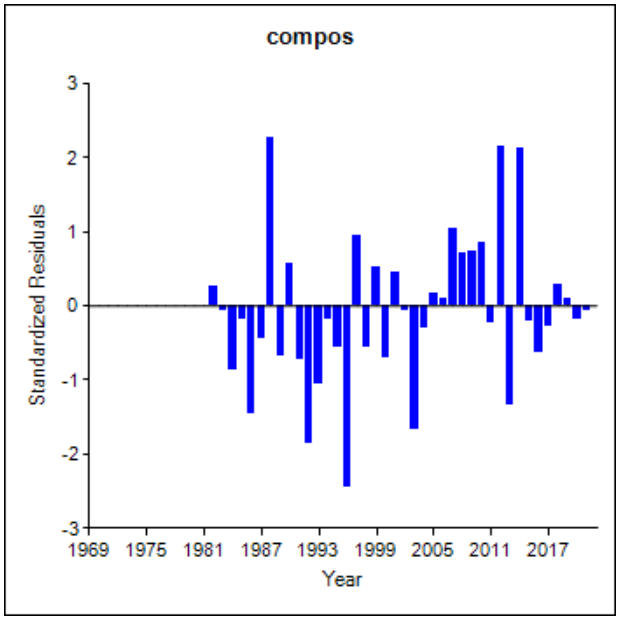
2011
2017


compos
Standardized Residuals
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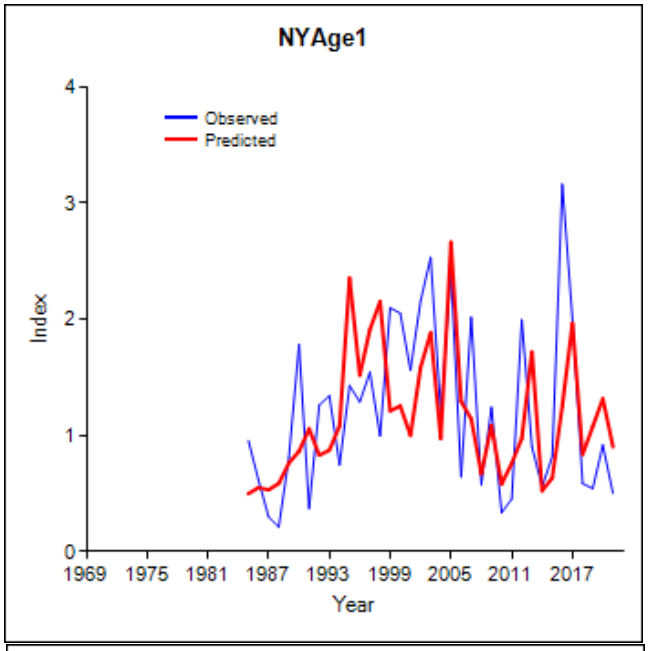
NYAge1
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Predicted
Index
Year
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1
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4
1969
1975
1981
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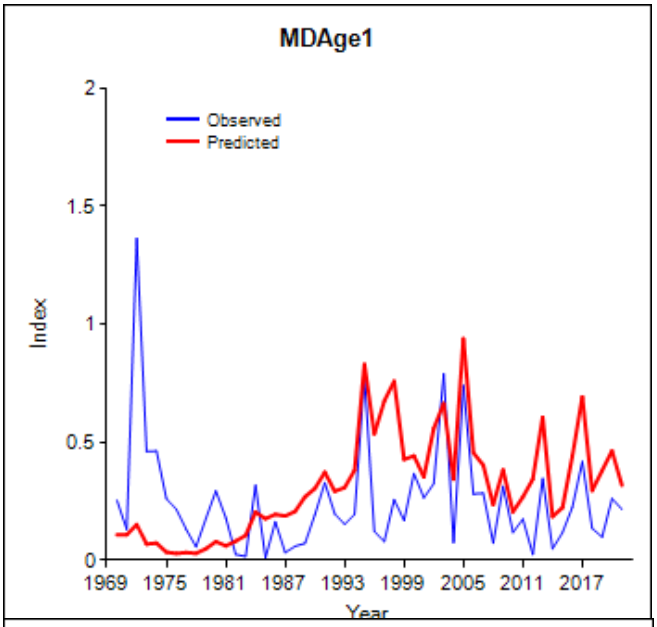
1993
1999
2005
2011
2017


MDAge1
Observed
Predicted
Index
Year
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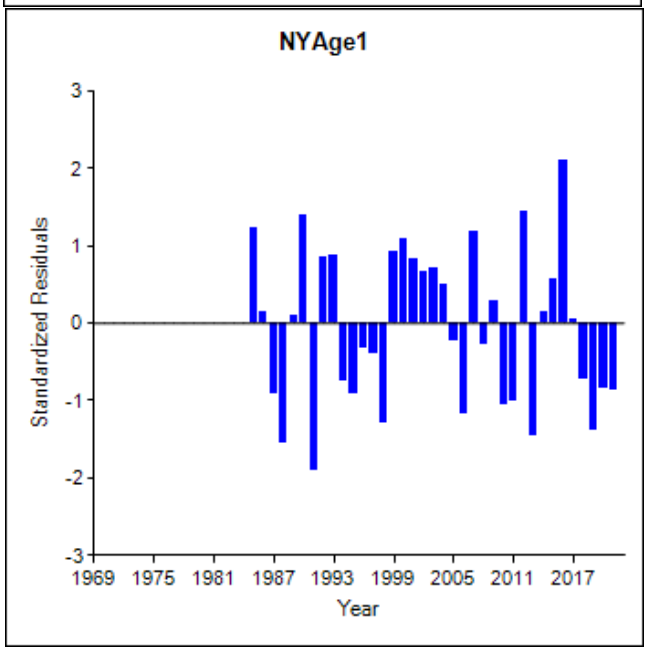
1.5
2
1969
1975
1981
1987
1993
1999
2005
2011
2017


NYAge1
Standardized Residuals
Year
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-1
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1
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3
1969
1975
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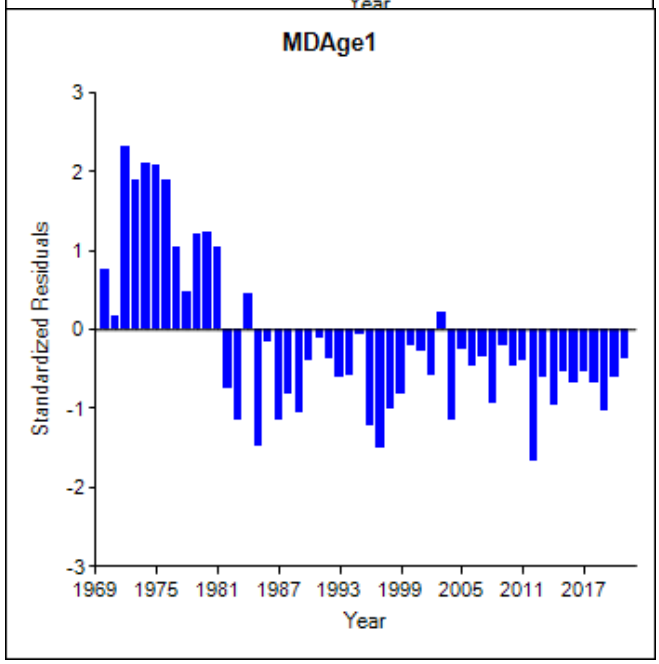
MDAge1
Standardized Residuals
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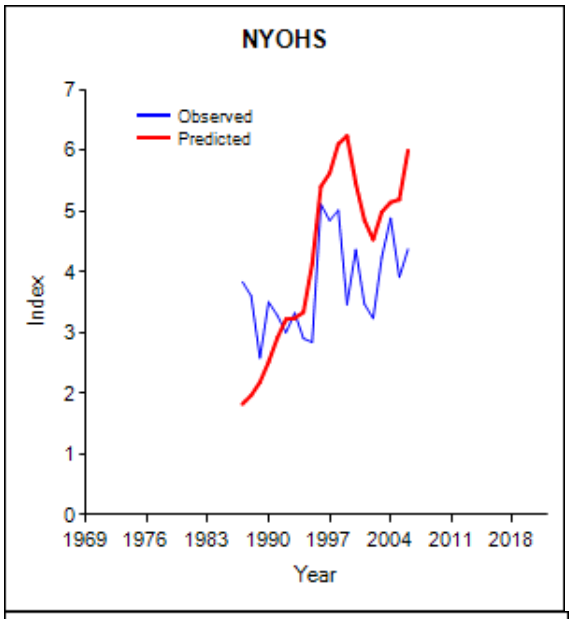
NYOHS
Observed
Predicted
Index
Year
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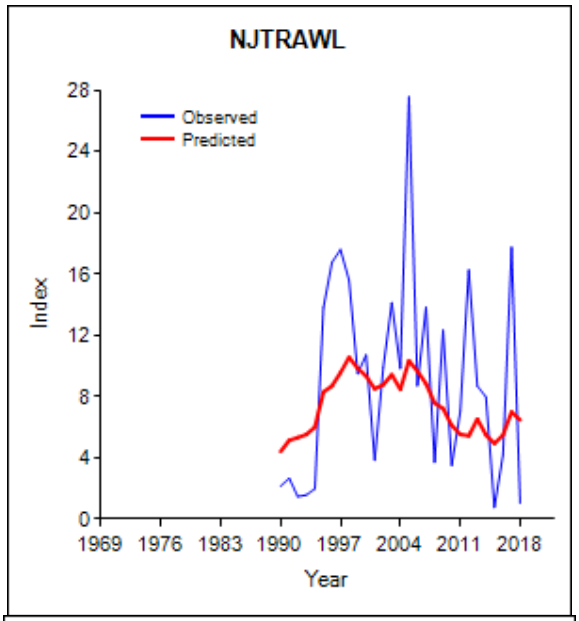
1
2
3
4
5
6
7
1969
1976
1983
1990
1997
2004
2011
2018


NJTRAWL
Observed
Predicted
Index
Year
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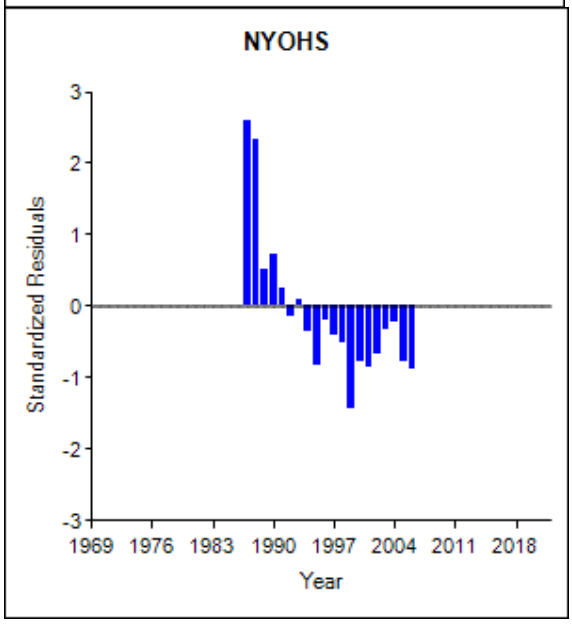
4
8
12
16
20
24
28
1969
1976
1983
1990
1997
2004
2011
2018


NYOHS
Standardized Residuals
Year
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-2
-1
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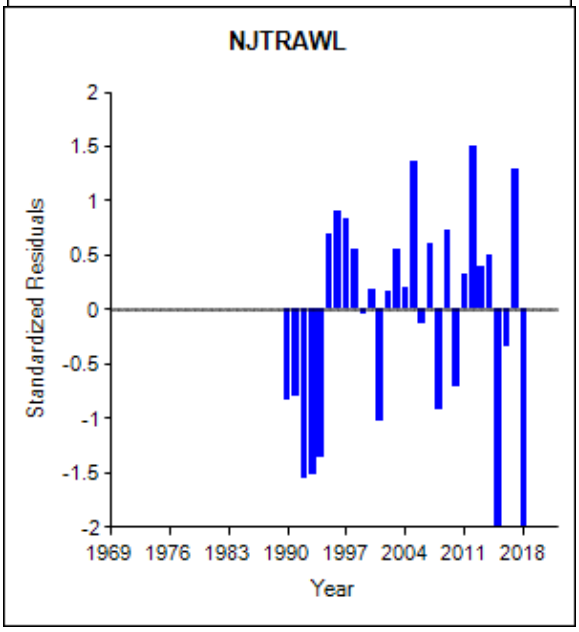
1
2
3
1969
1976
1983
1990
1997
2004
2011
2018


NJTRAWL
Standardized Residuals
Year
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-1
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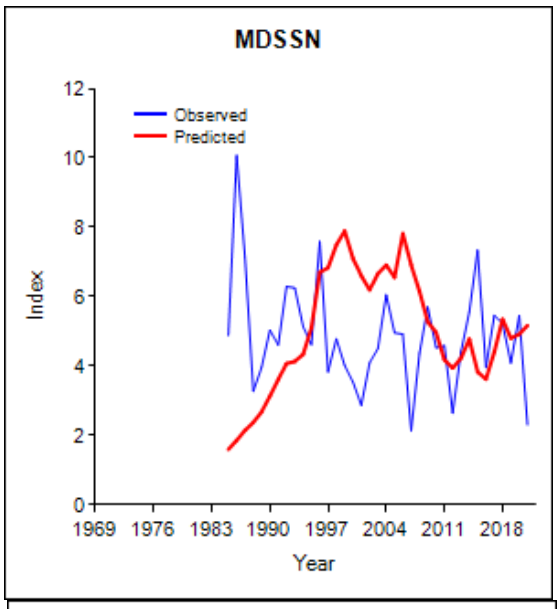
0.5
1
1.5
2
1969
1976
1983
1990
1997
2004
2011
2018


MDSSN
Observed
Predicted
Index
Year
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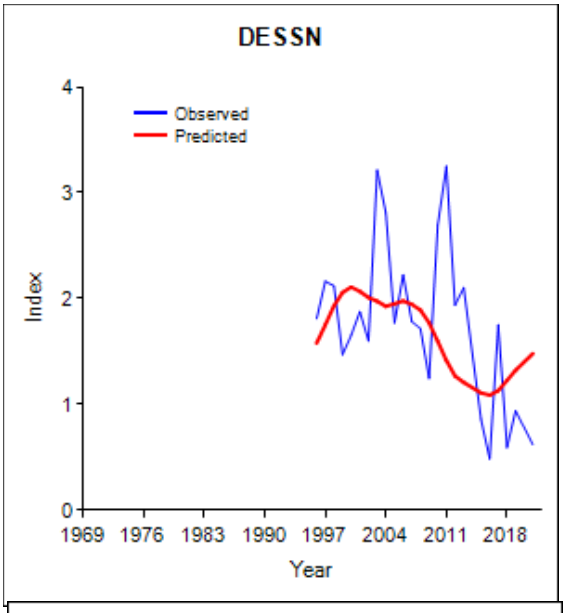
2
4
6
8
10
12
1969
1976
1983
1990
1997
2004
2011
2018


DESSN
Observed
Predicted
Index
Year
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4
1969
1976
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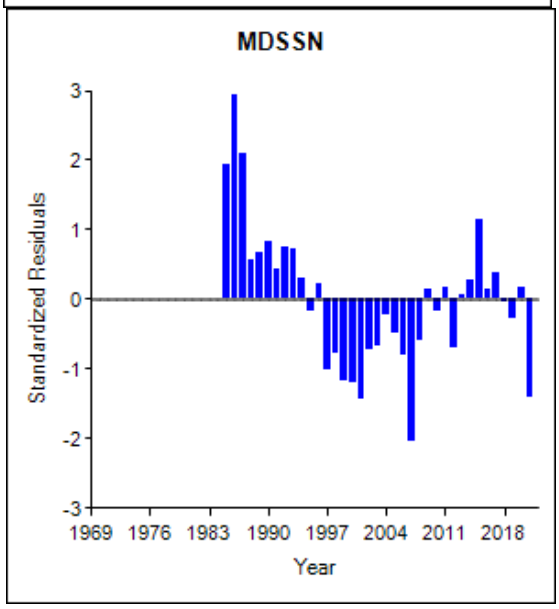
1990
1997
2004
2011
2018


MDSSN
Standardized Residuals
Year
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-2
-1
0
1
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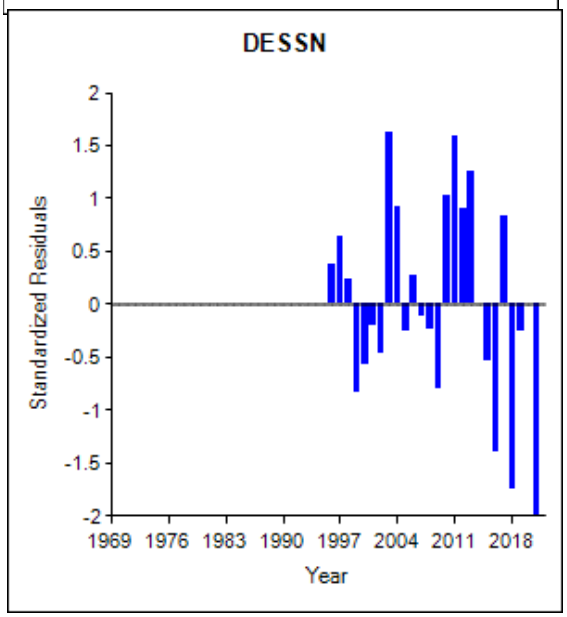
3
1969
1976
1983
1990
1997
2004
2011
2018


DESSN
Standardized Residuals
Year
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-1
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0
0.5
1
1.5
2
1969
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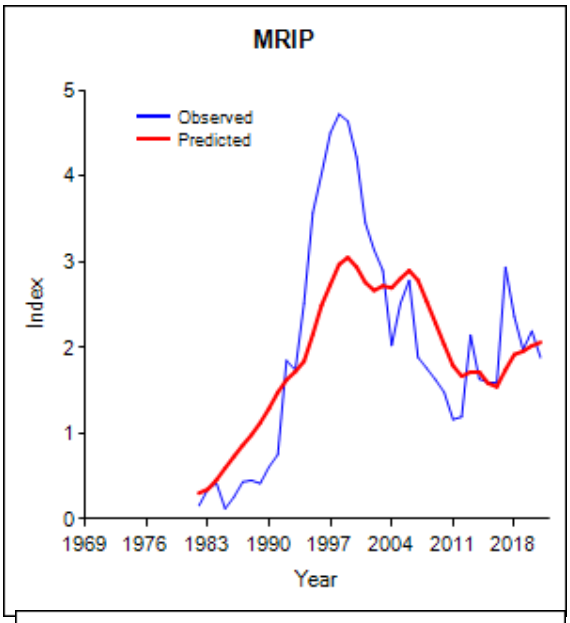
1997
2004
2011
2018


MRIP
Observed
Predicted
Index
Year
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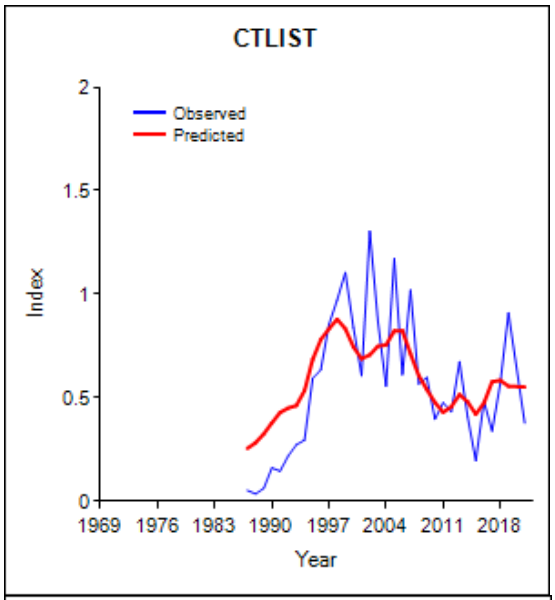
2
3
4
5
1969
1976
1983
1990
1997
2004
2011
2018


CTLIST
Observed
Predicted
Index
Year
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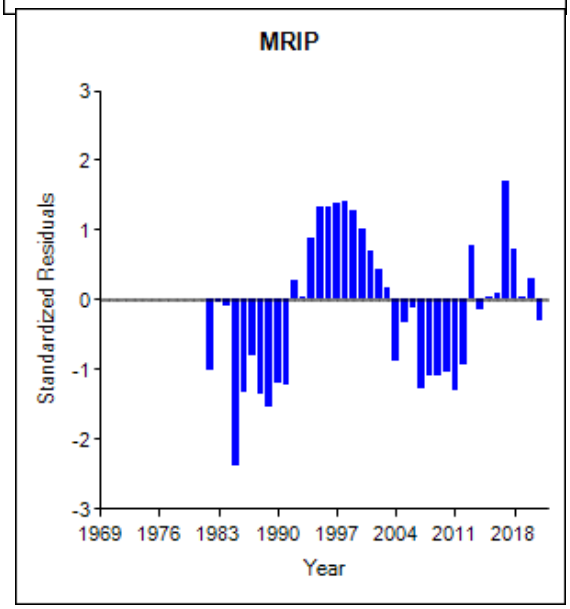
1
1.5
2
1969
1976
1983
1990
1997
2004
2011
2018


MRIP
Standardized Residuals
Year
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-2
-1
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2
3
1969
1976
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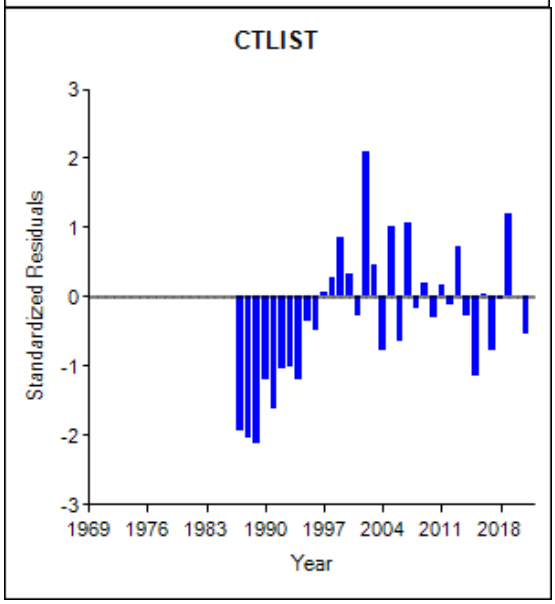
1997
2004
2011
2018


CTLIST
Standardized Residuals
Year
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3
1969
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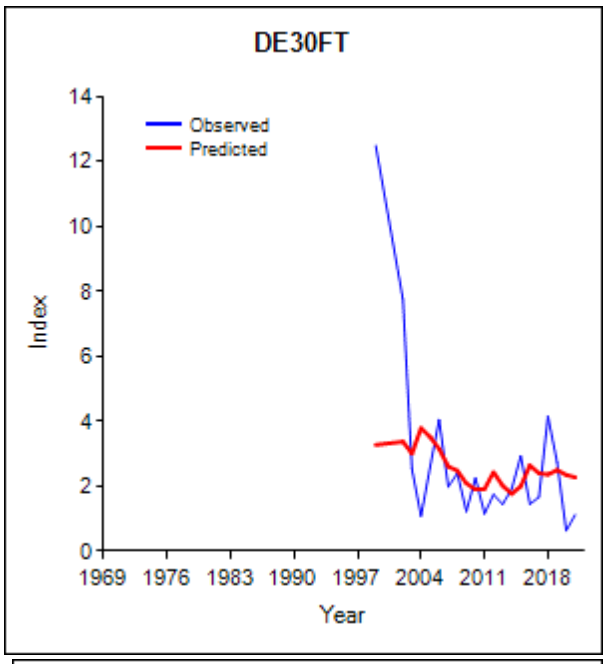
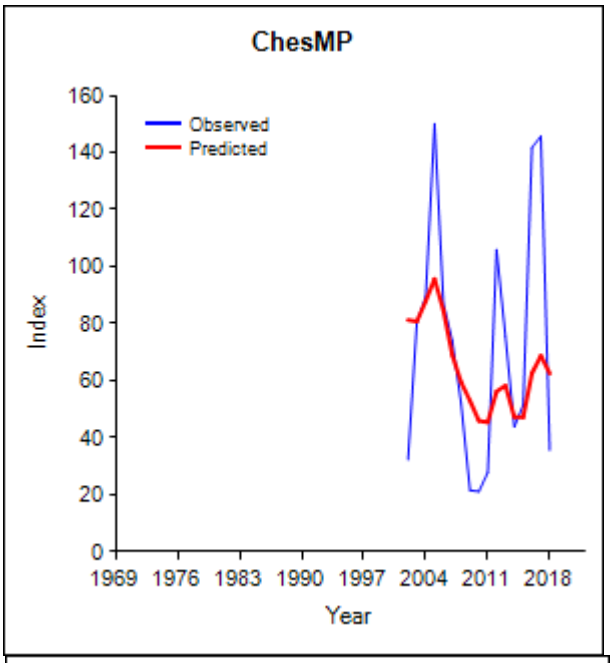
1990
1997
2004
2011
2018


DE30FT
Observed
Predicted
Index
Year
14
12
10
8
6
4
2
0
1969 1976 1983 1990 1997 2004 2011 2018


ChesMP
Observed
Predicted
Index
Year
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120
100
80
60
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20
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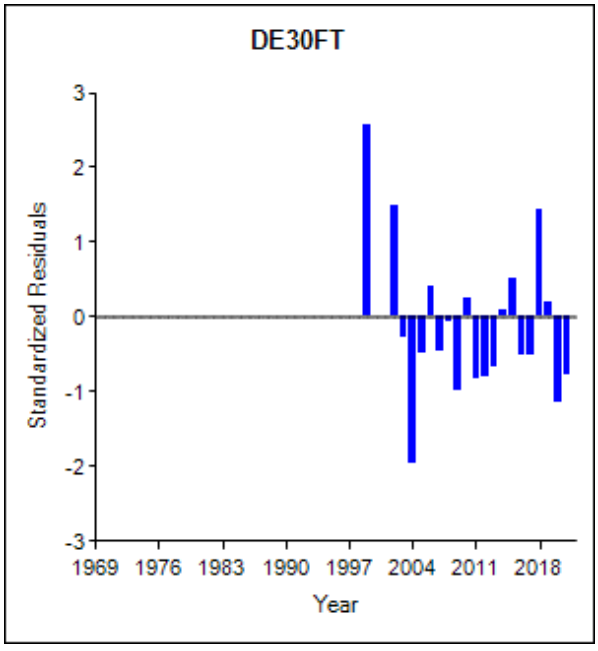
DE30FT
Standardized Residuals
Year
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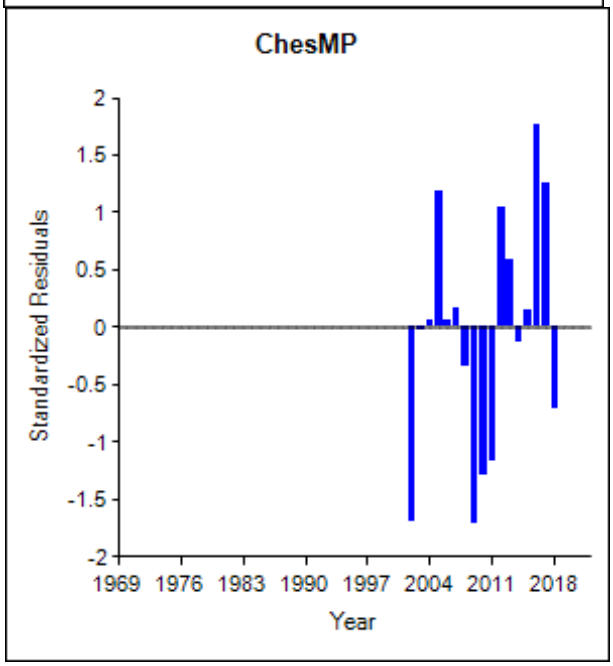
-1
-2
-3
1969 1976 1983 1990 1997 2004 2011 2018


ChesMP
Standardized Residuals
Year
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-1
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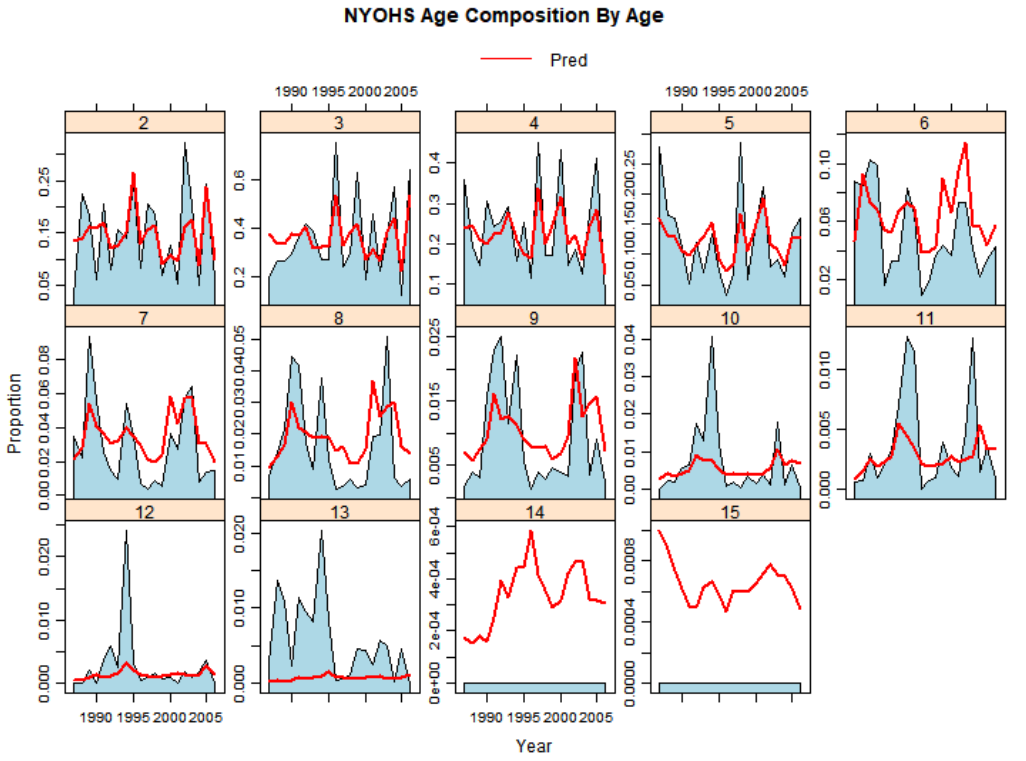
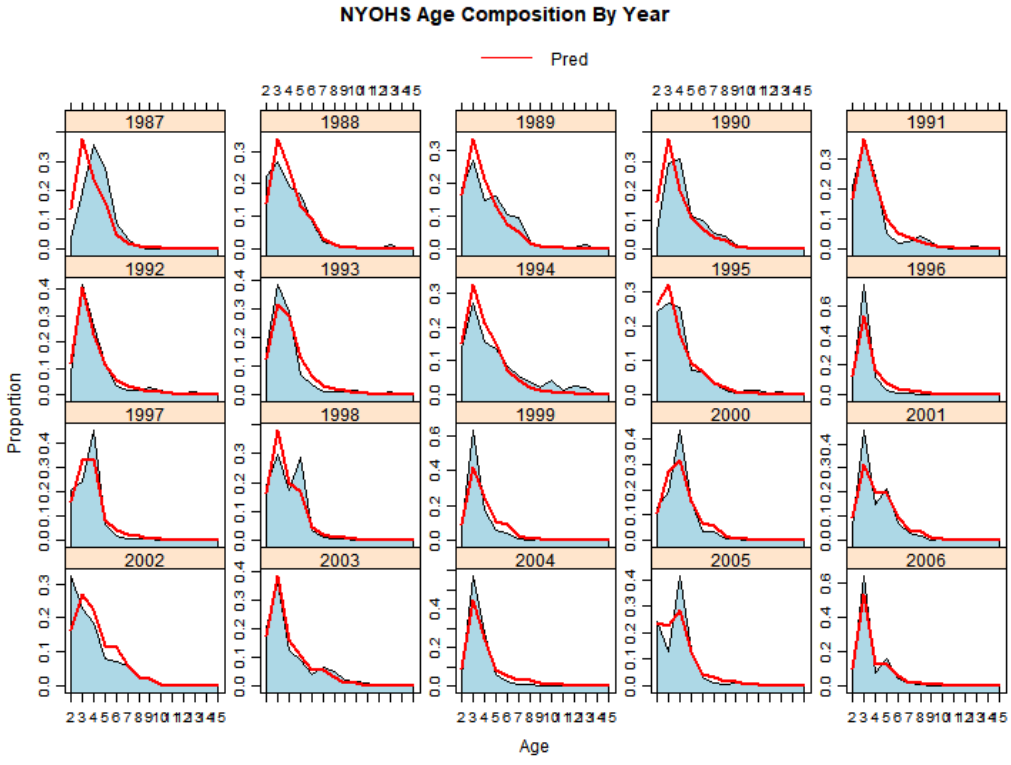
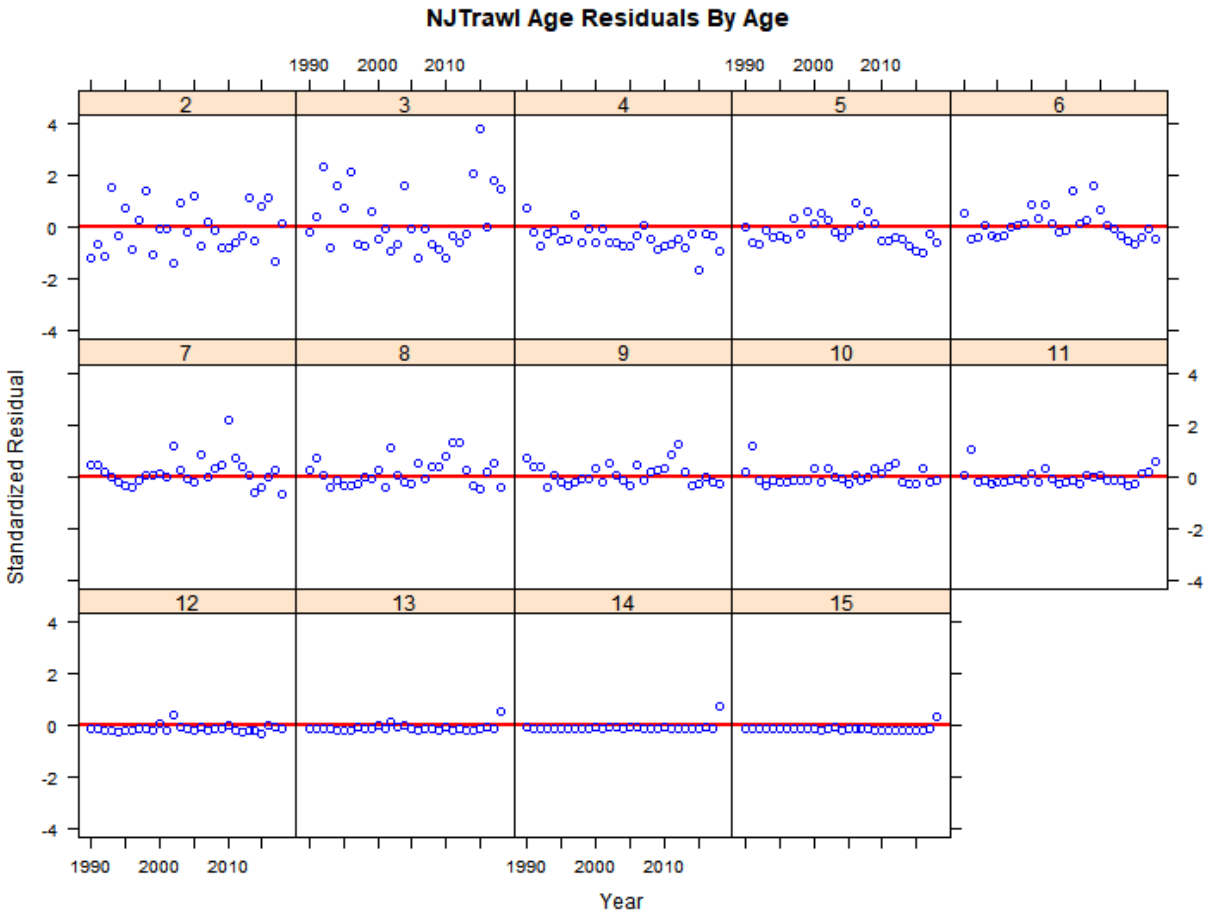
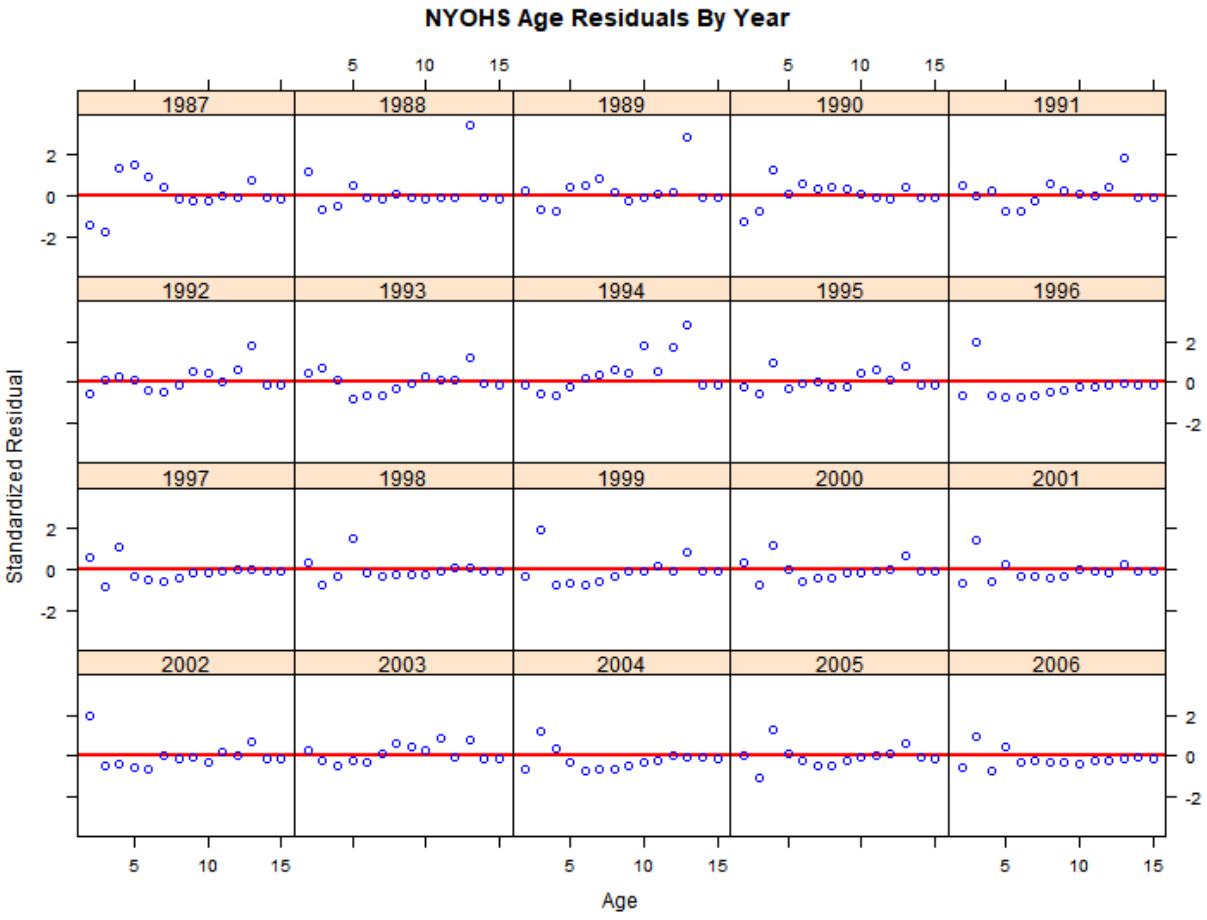
1969 1976 1983 1990 1997 2004 2011 2018


NYOHS Age Composition By Age
Pred
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year


NYOHS Age Composition By Year
Pred
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Proportion
Age


NJTrawl Age Residuals By Age
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1990
2000
2010
Standardized Residual
Year


NYOHS Age Residuals By Year
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
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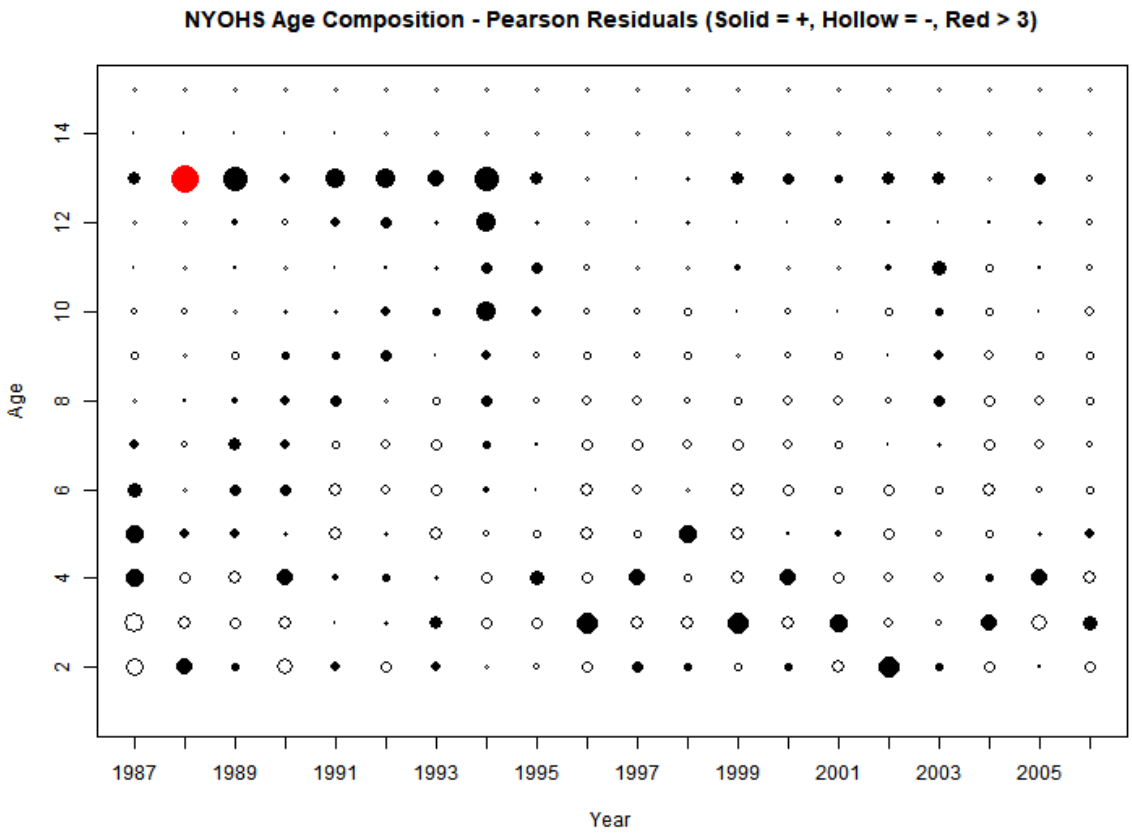
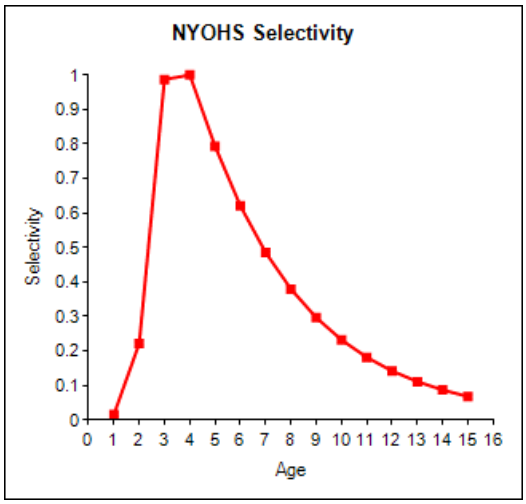
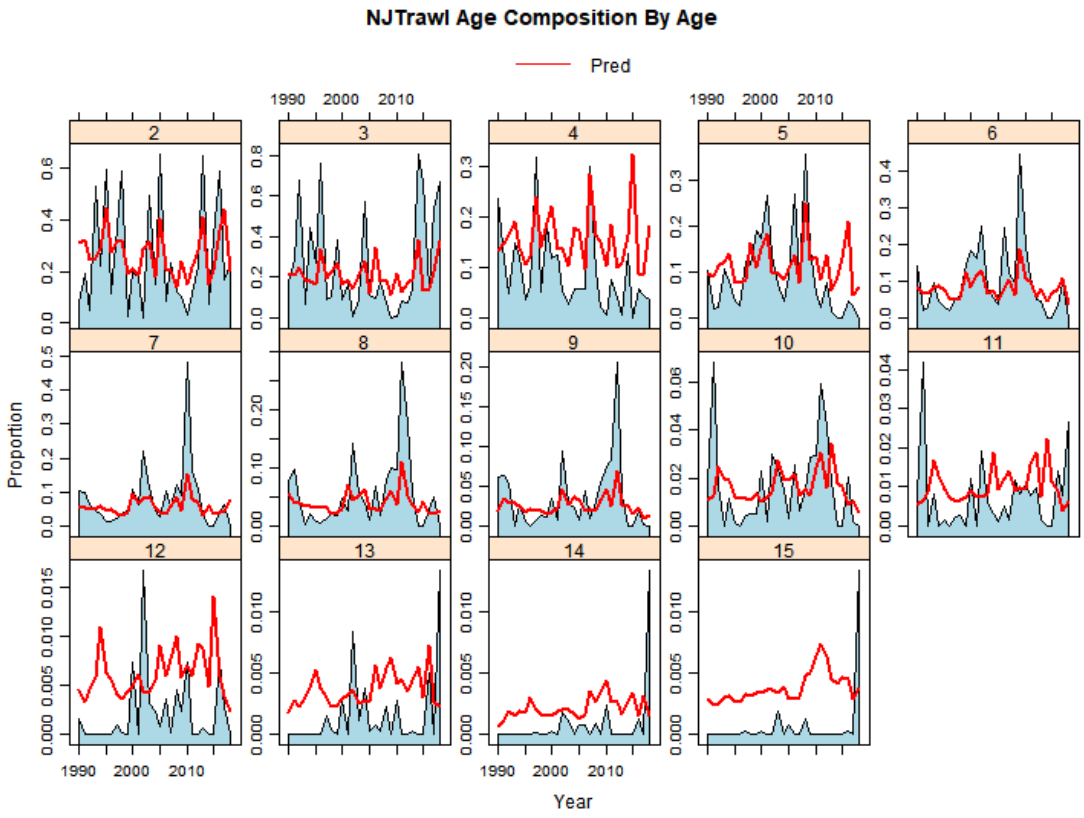
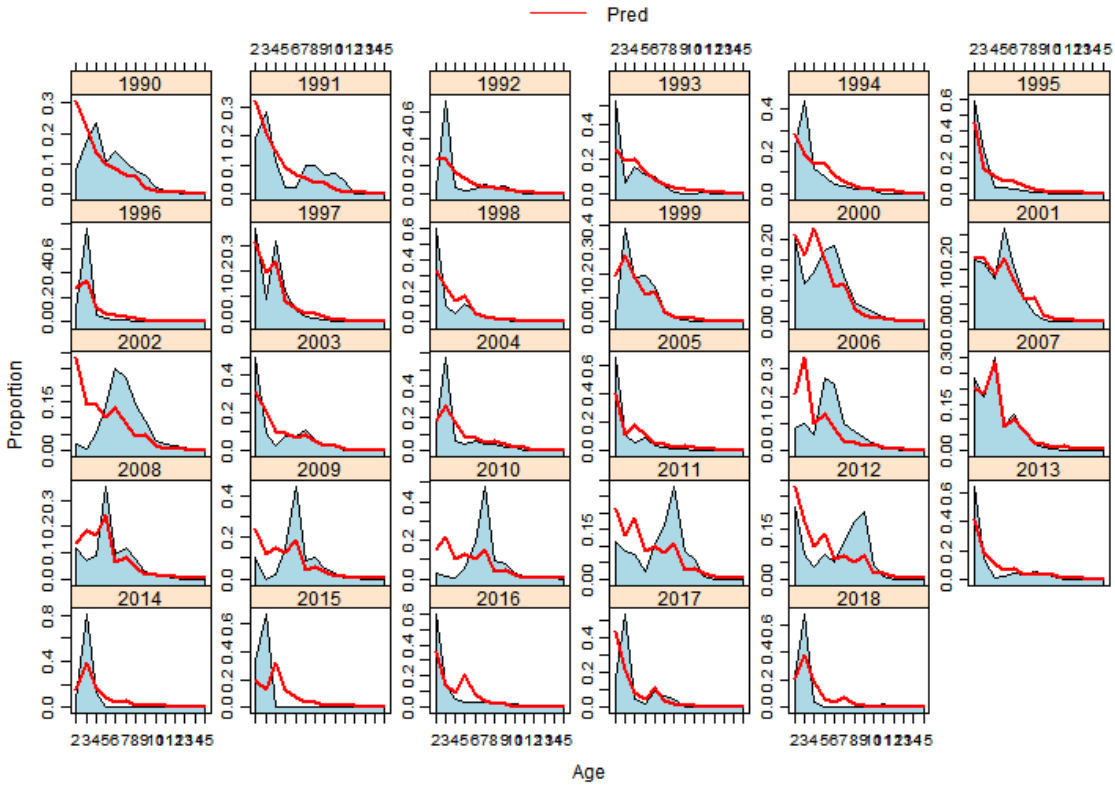
1998
1999
2000
2001
2002
2003
2004
2005
2006
5
10
15
Standardized Residual
Age


NYOHS Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year


NYOHS Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


NJTrawl Age Composition By Age
Pred
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year


NJTrawl Age Composition By Year
Pred
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
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2006
2007
2008
2009
2010
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2012
2013
2014
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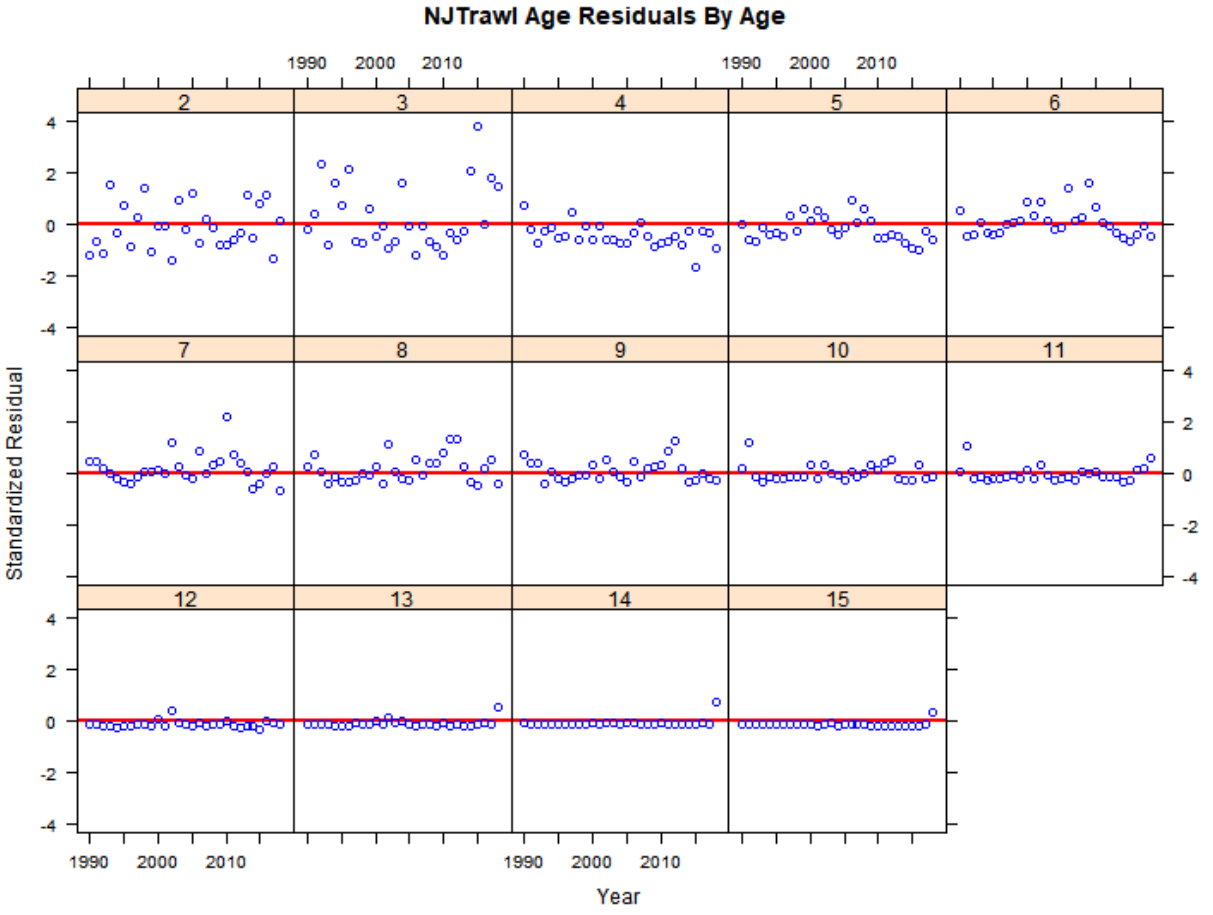
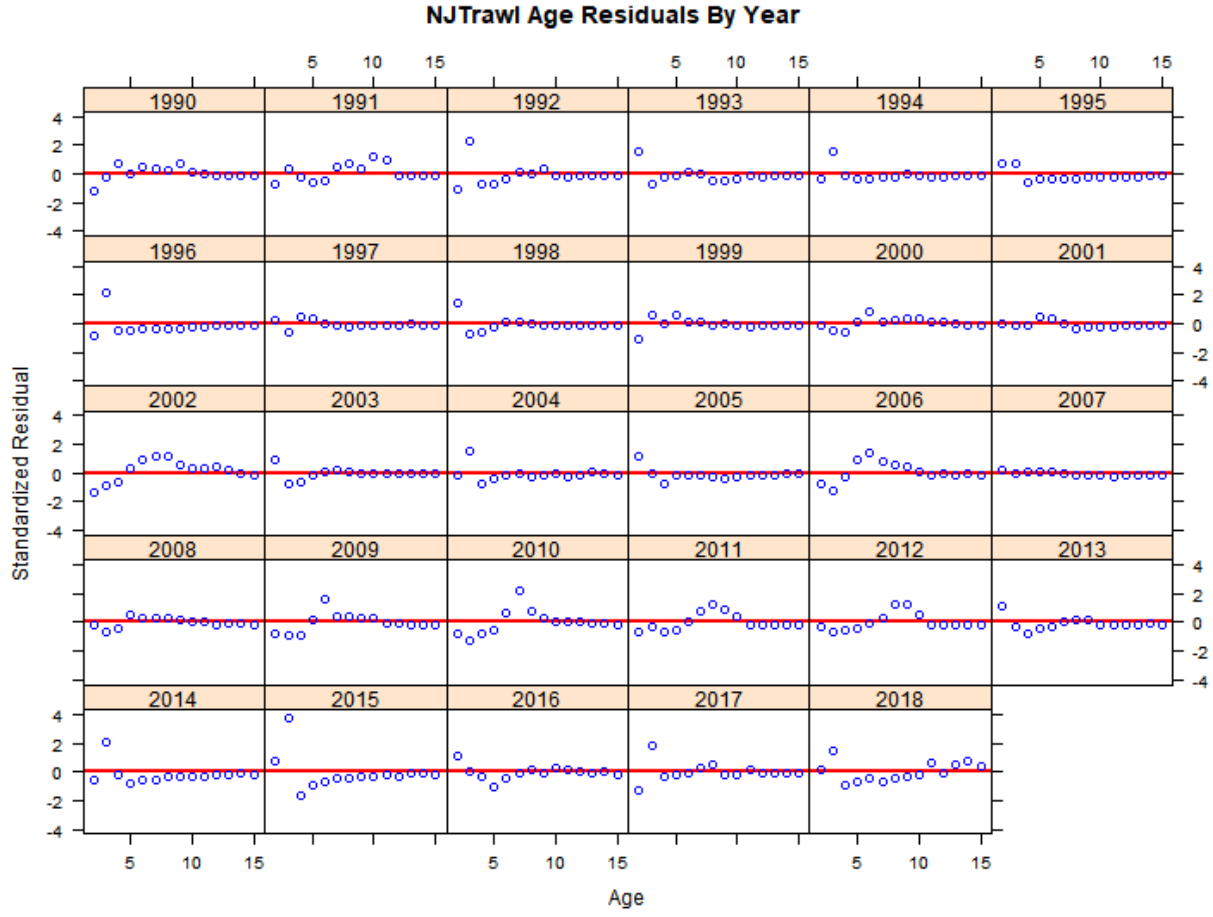
2016
2017
2018
Proportion
Age


NJTrawl Age Residuals By Age
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1990
2000
2010
Standardized Residual
Year


NJTrawl Age Residuals By Year
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
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2007
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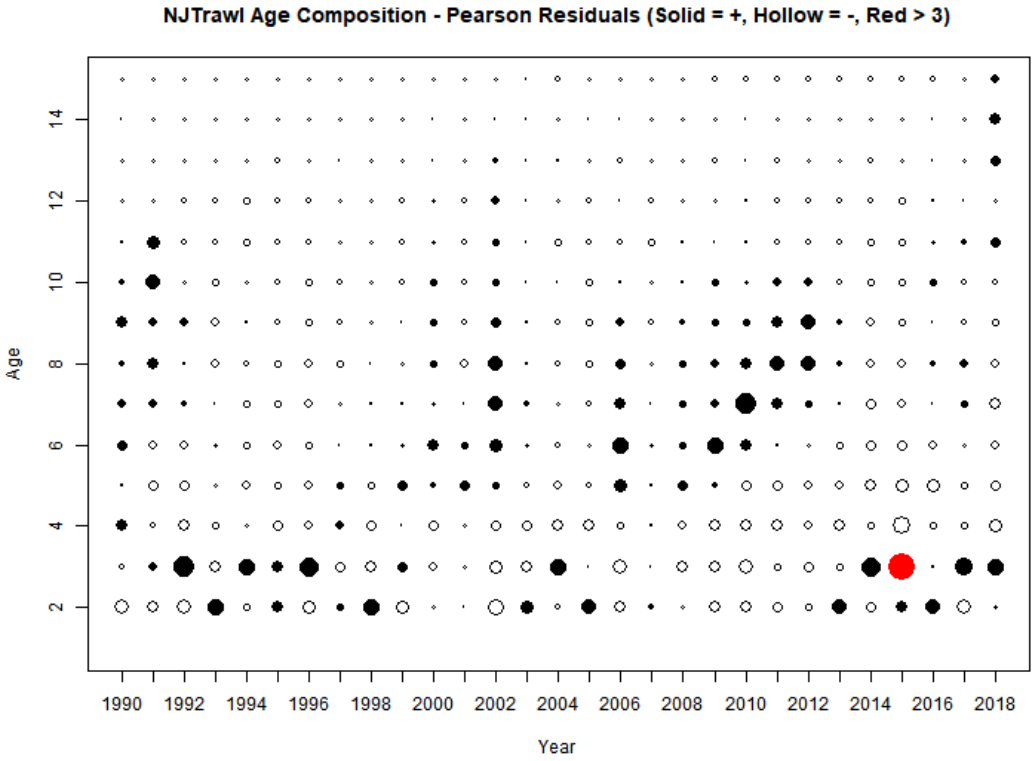
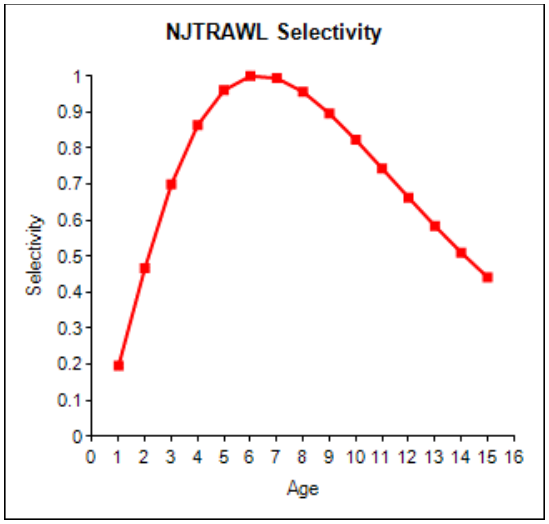
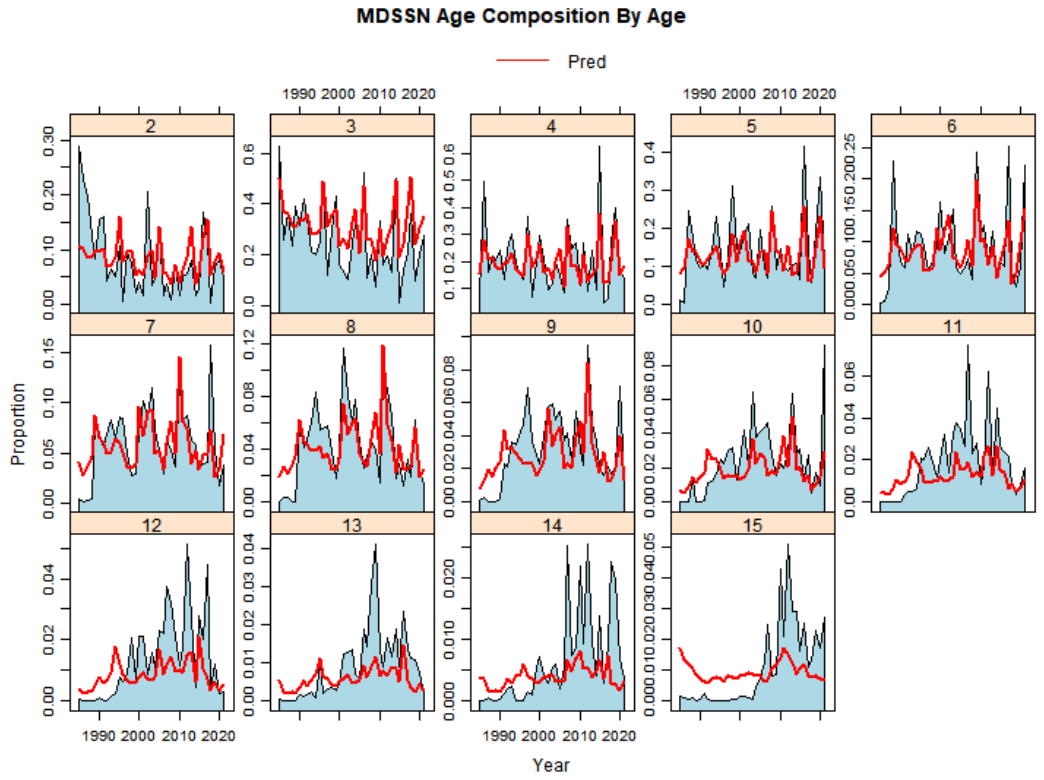
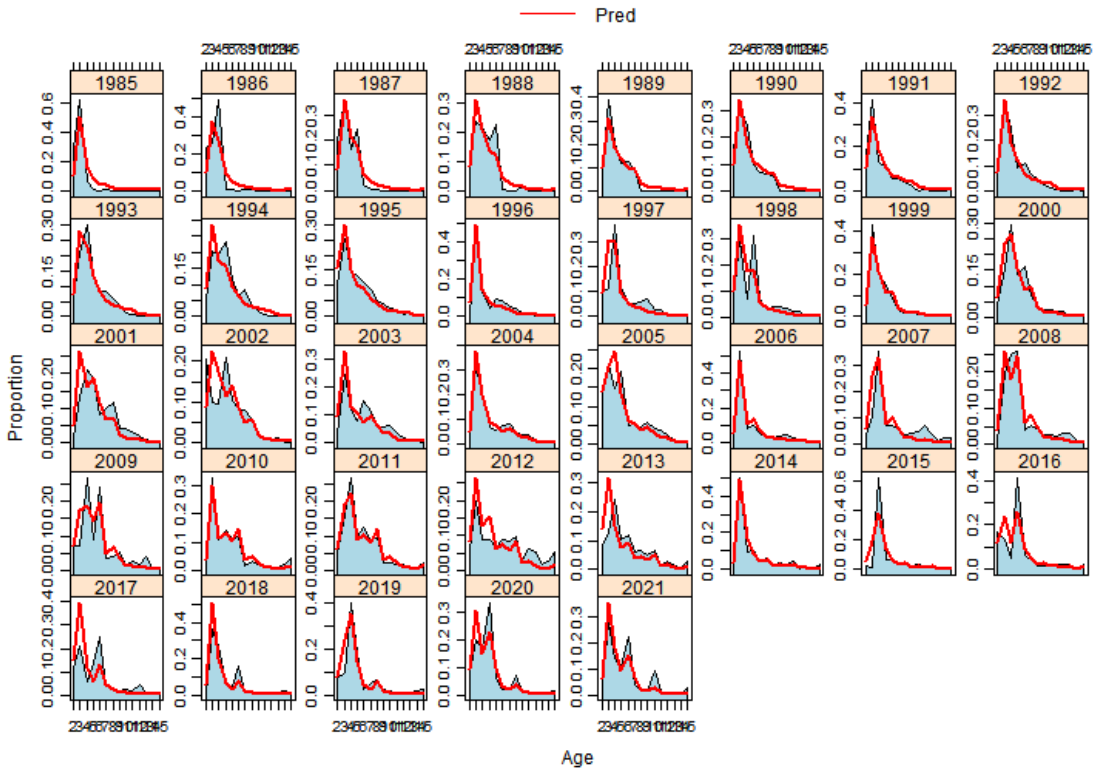
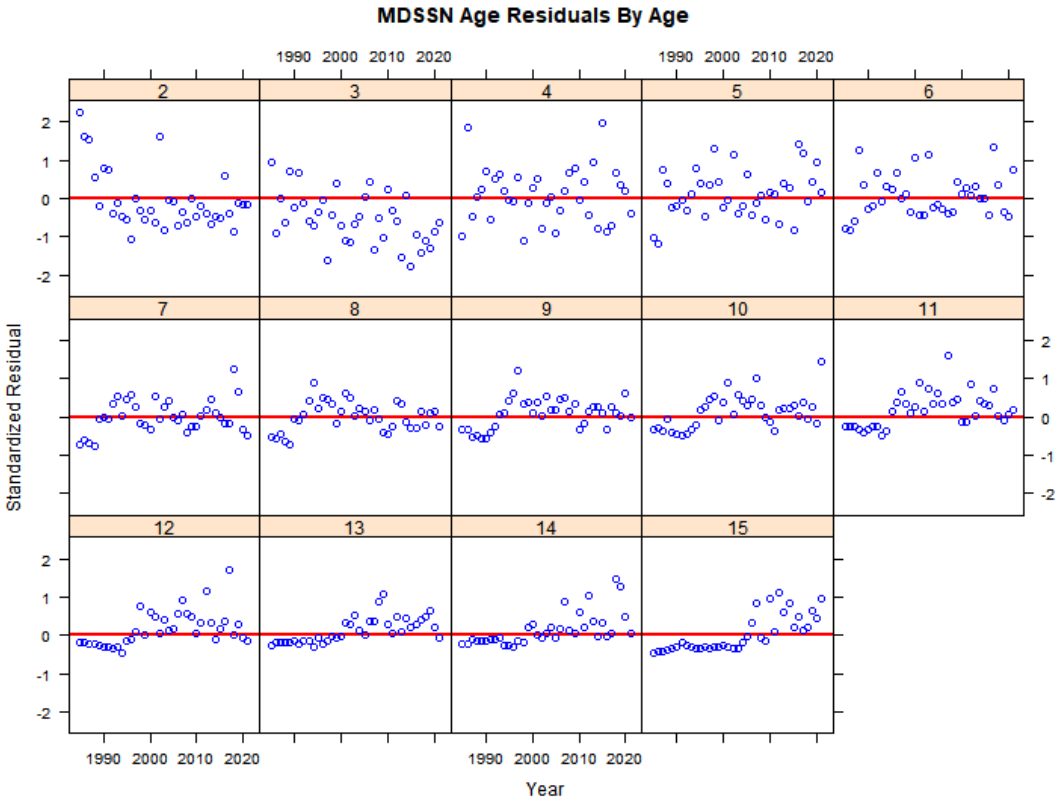
2010
2011
2012
2013
2014
2015
2016
2017
2018
5
10
15
Standardized Residual
Age

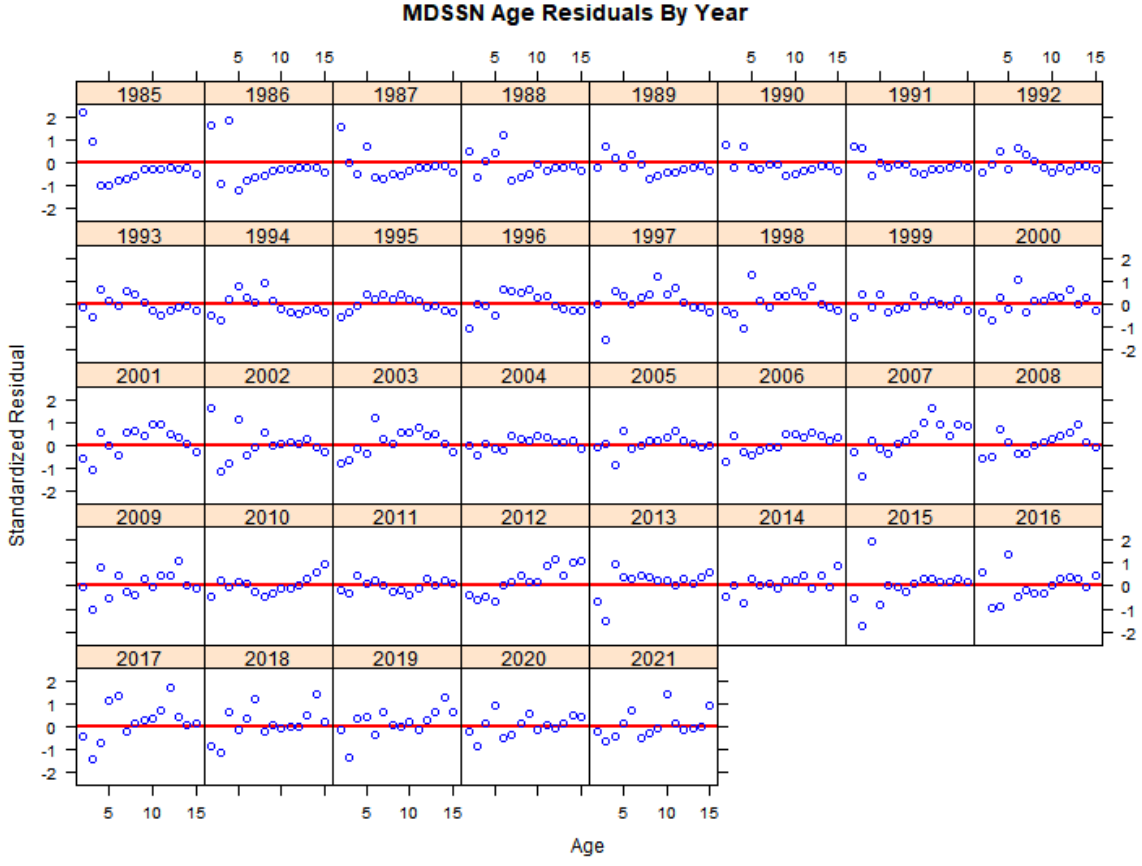

NJTrawl Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year


NJTRAWL Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


MDSSN Age Composition By Age
Pred
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year


MDSSN Age Composition By Year
Pred
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Proportion
Age


MDSSN Age Residuals By Age
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1990 2000 2010 2020
Standardized Residual
Year


MDSSN Age Residuals By Year
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
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2009
2010
2011
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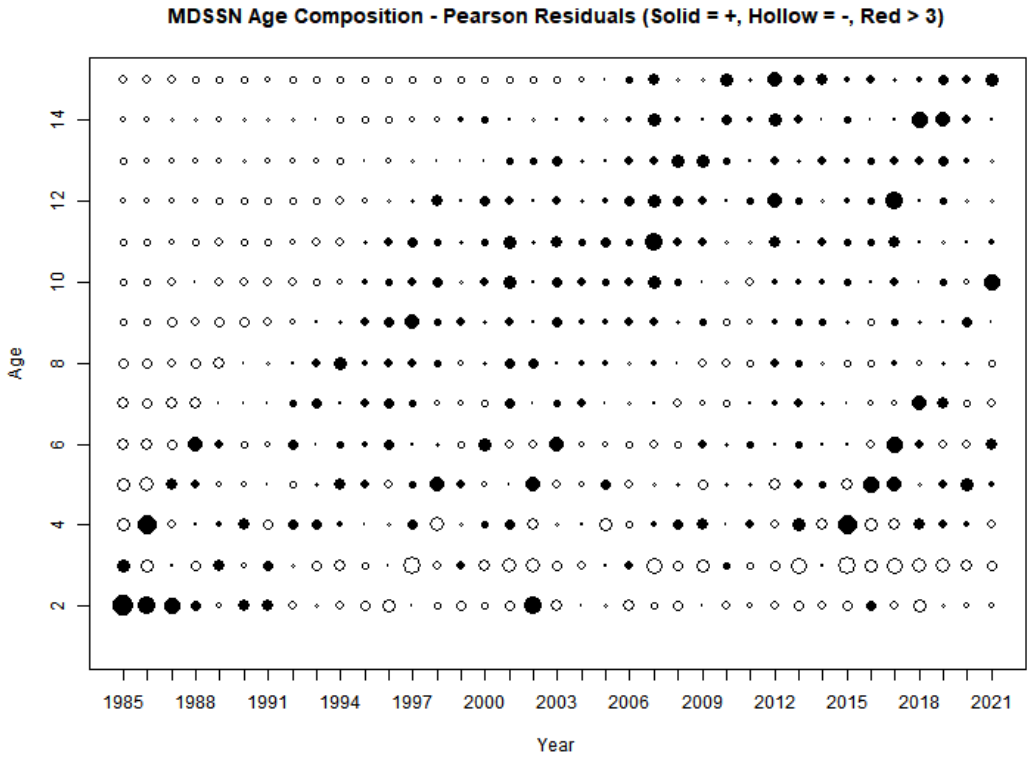
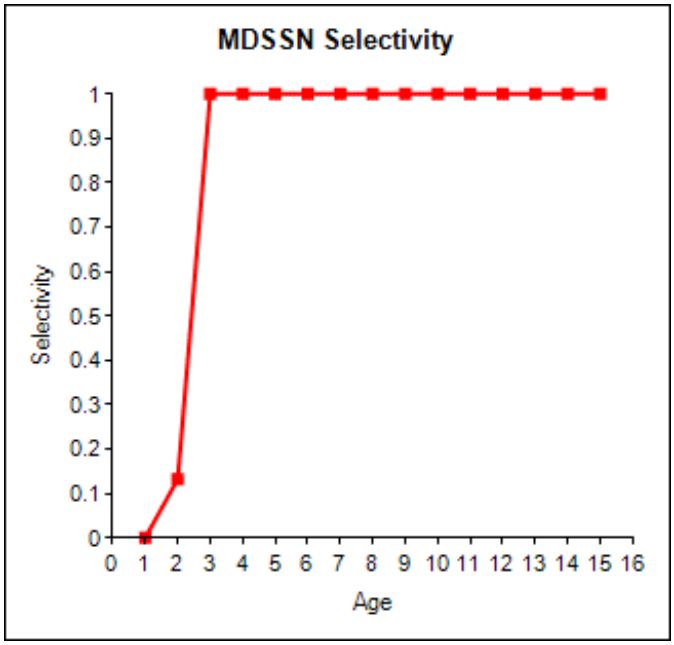
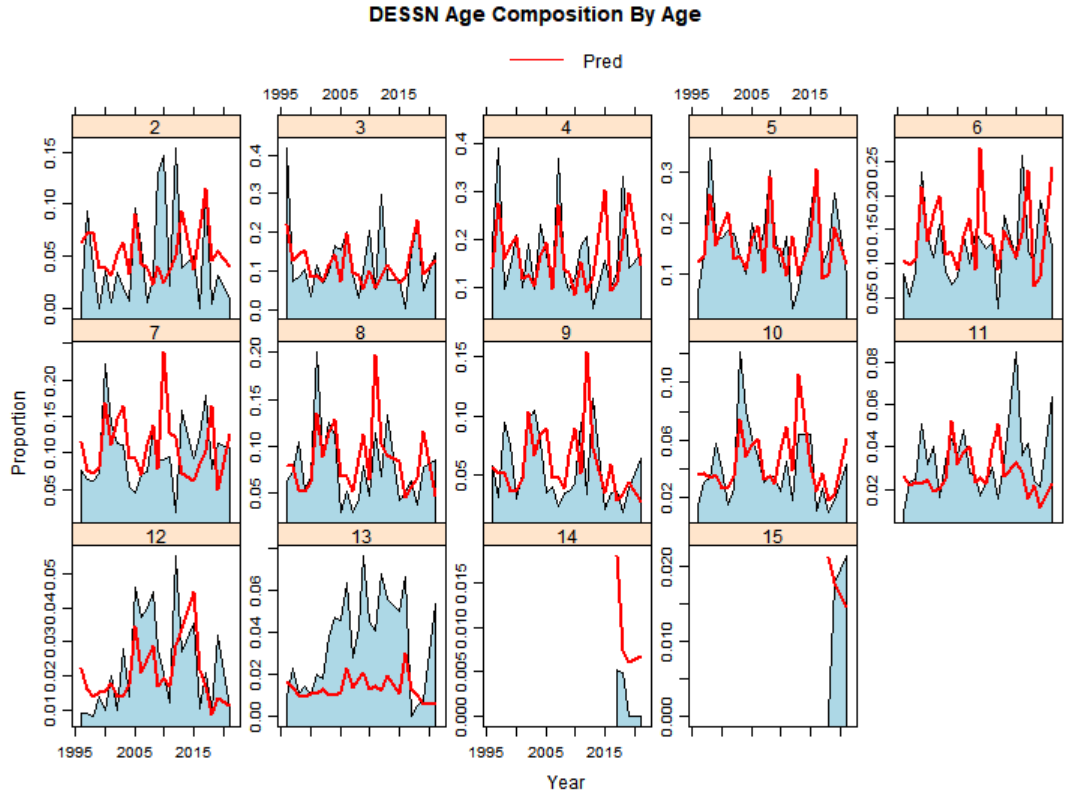
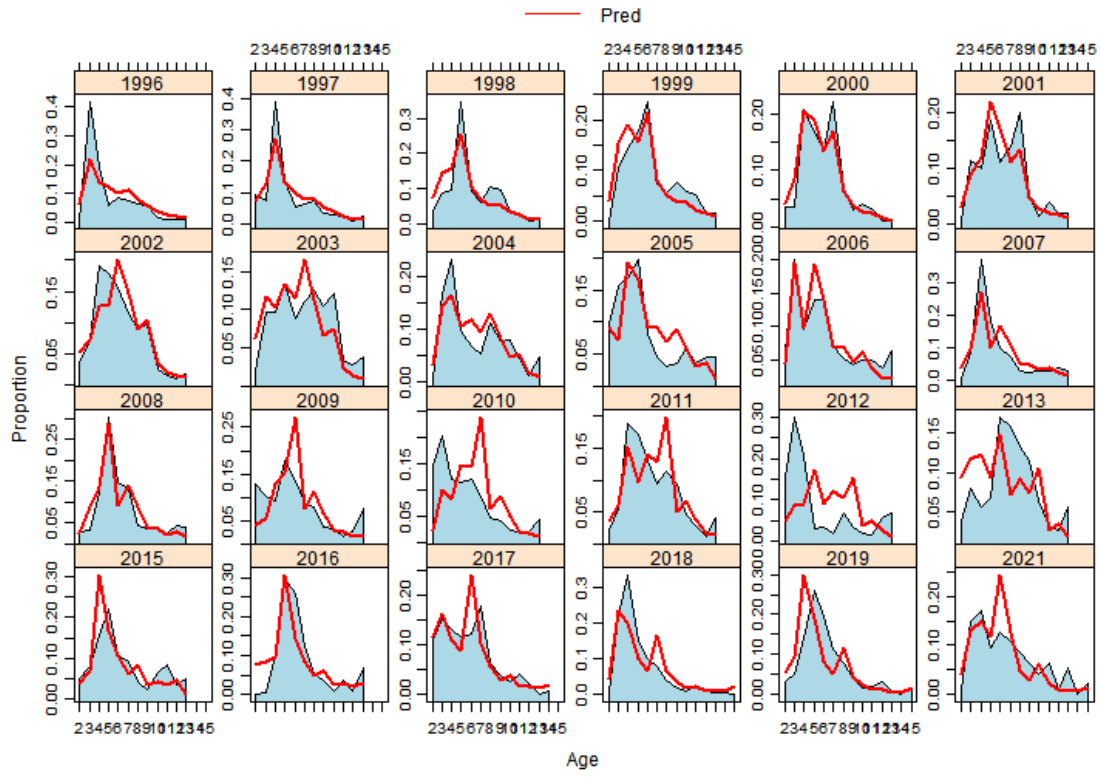
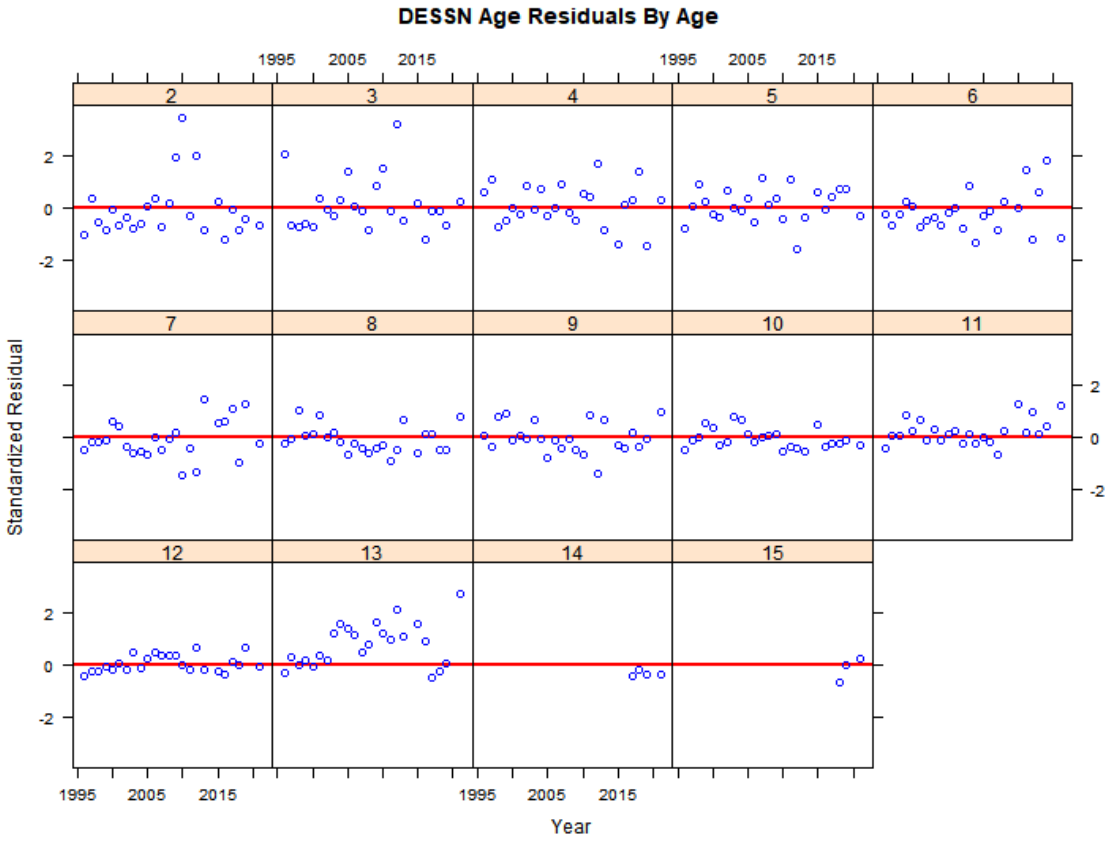
2013
2014
2015
2016
2017
2018
2019
2020
2021
5 10 15
Standardized Residual
Age

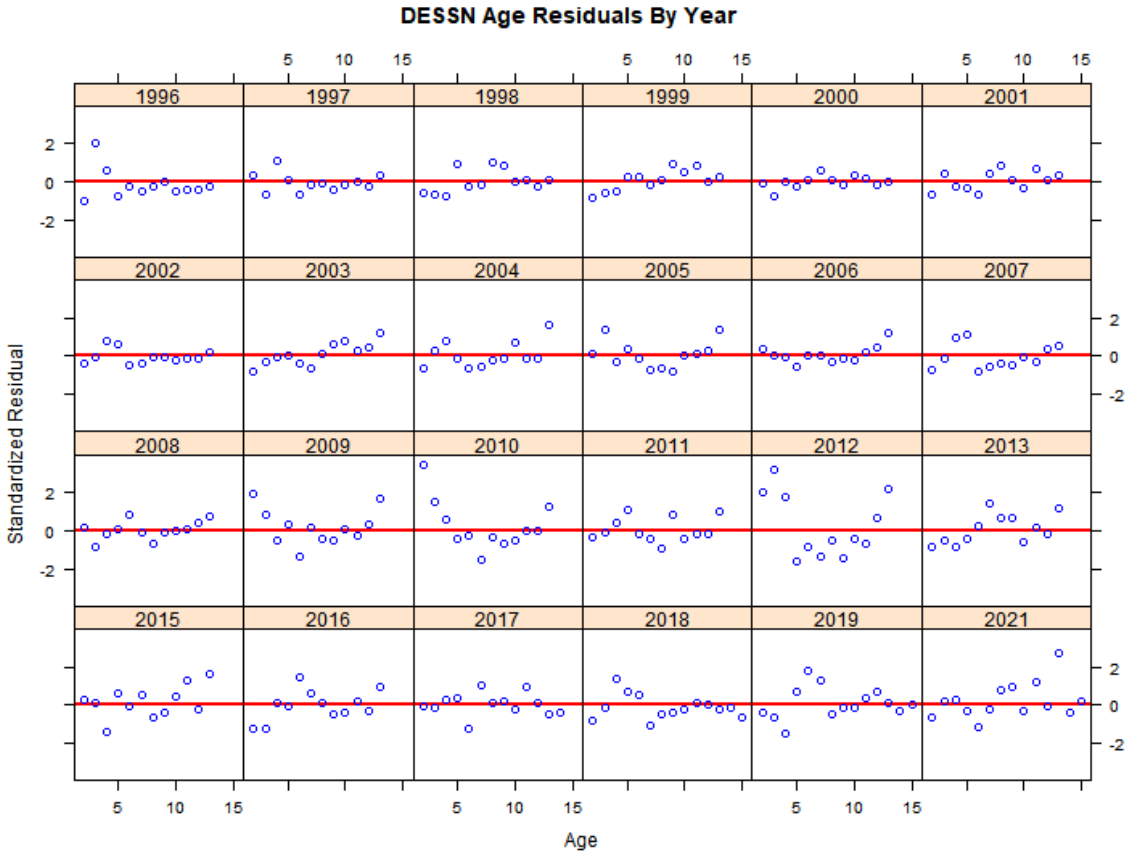

MDSSN Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
2021
Year

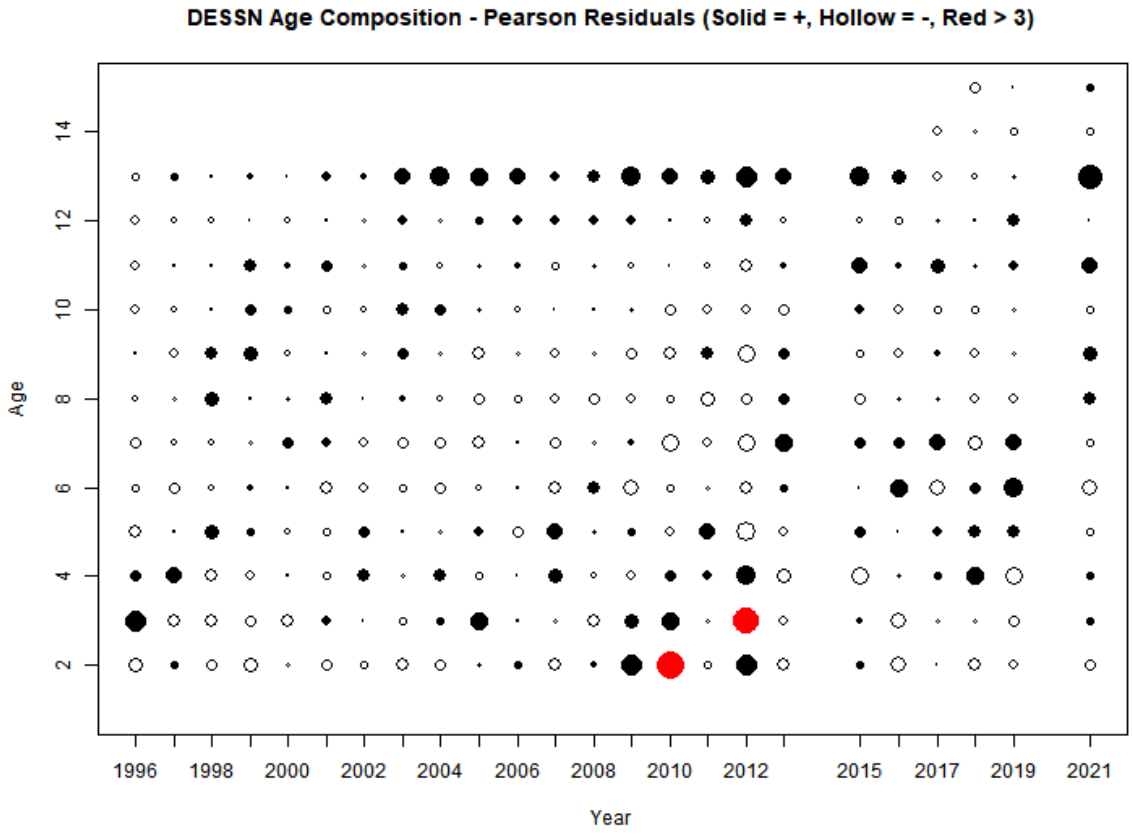

MDSSN Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age

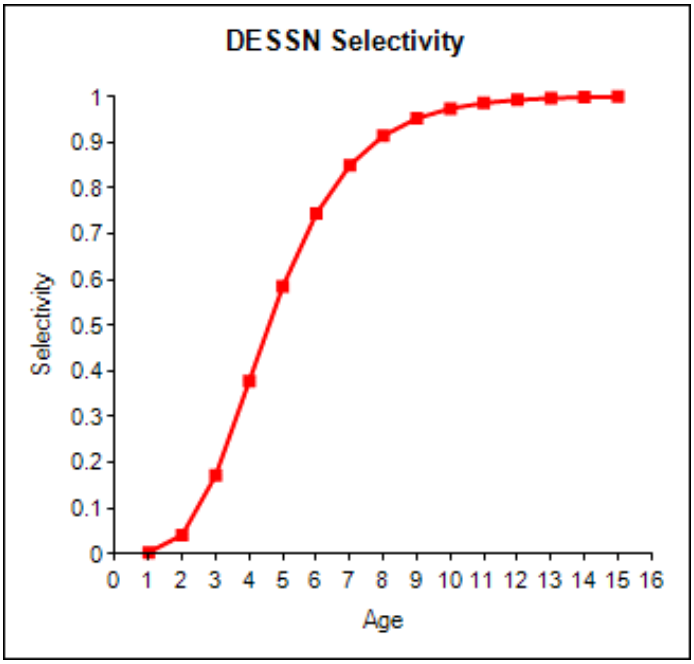

DESSN Age Composition By Age
Pred
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year

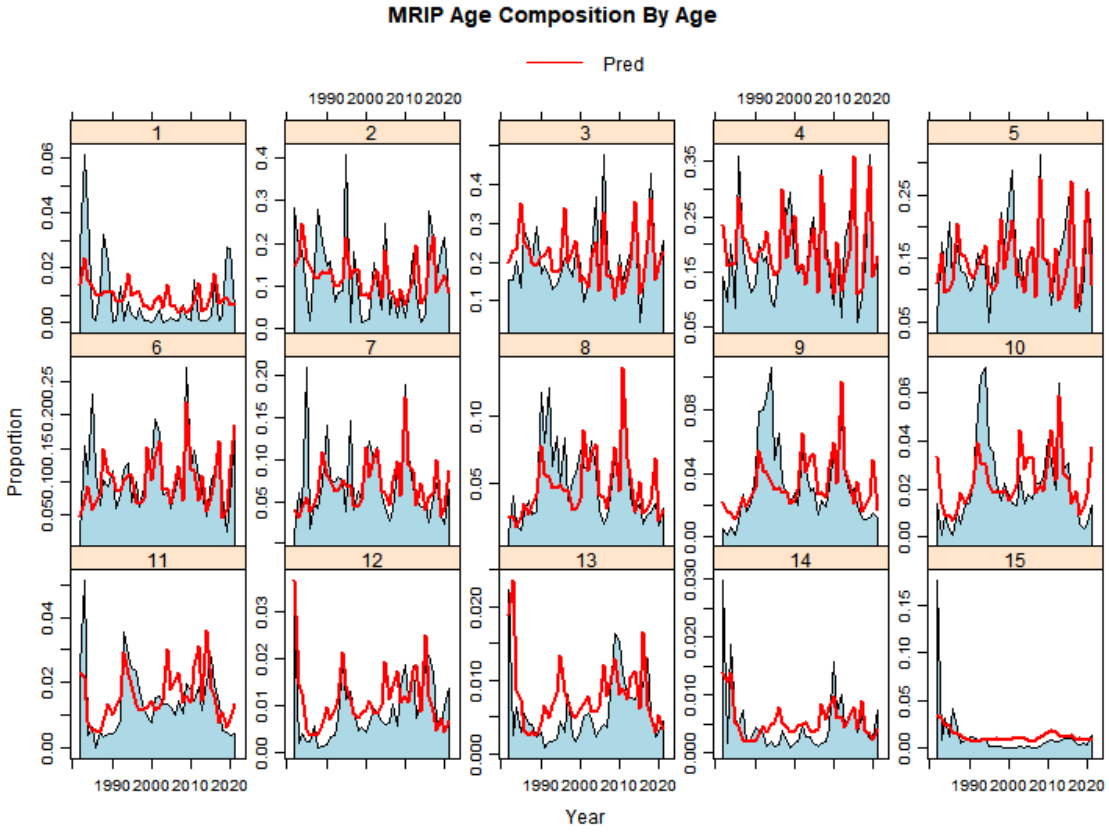

DESSN Age Composition By Year
Pred
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2015
2016
2017
2018
2019
2021
Proportion
Age

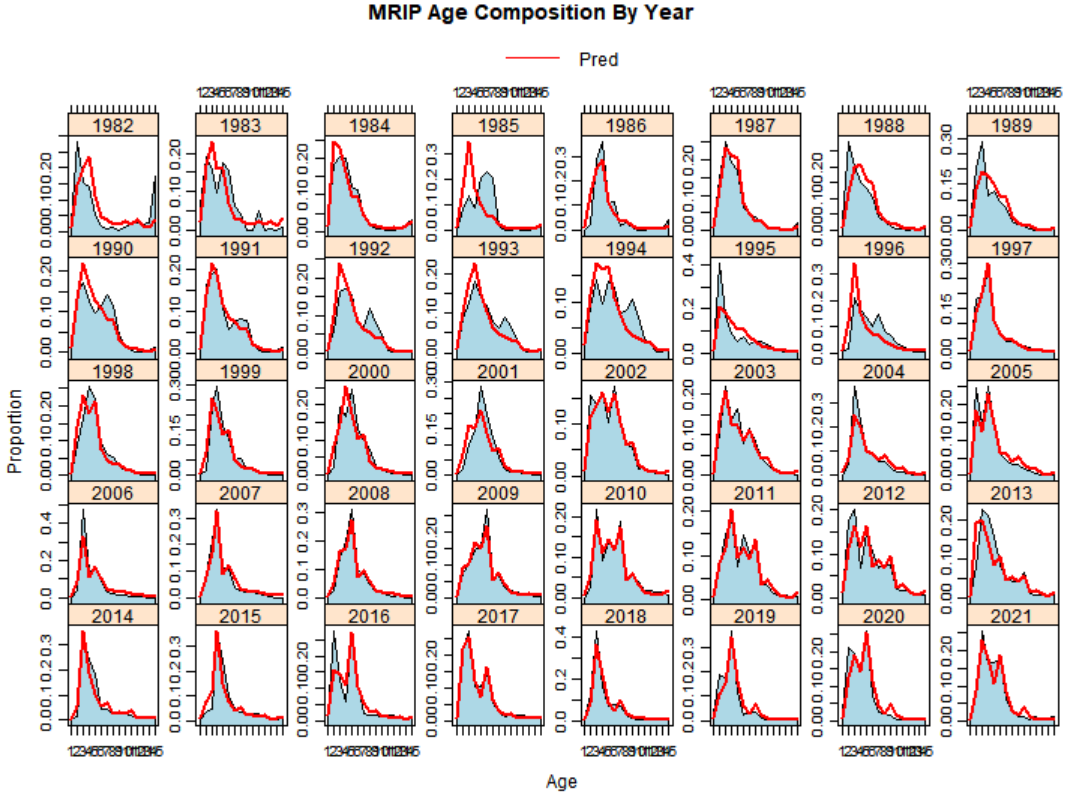

DESSN Age Residuals By Age
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1995
2005
2015
Standardized Residual
Year


DESSN Age Residuals By Year
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2015
2016
2017
2018
2019
2021
5
10
15
Standardized Residual
Age

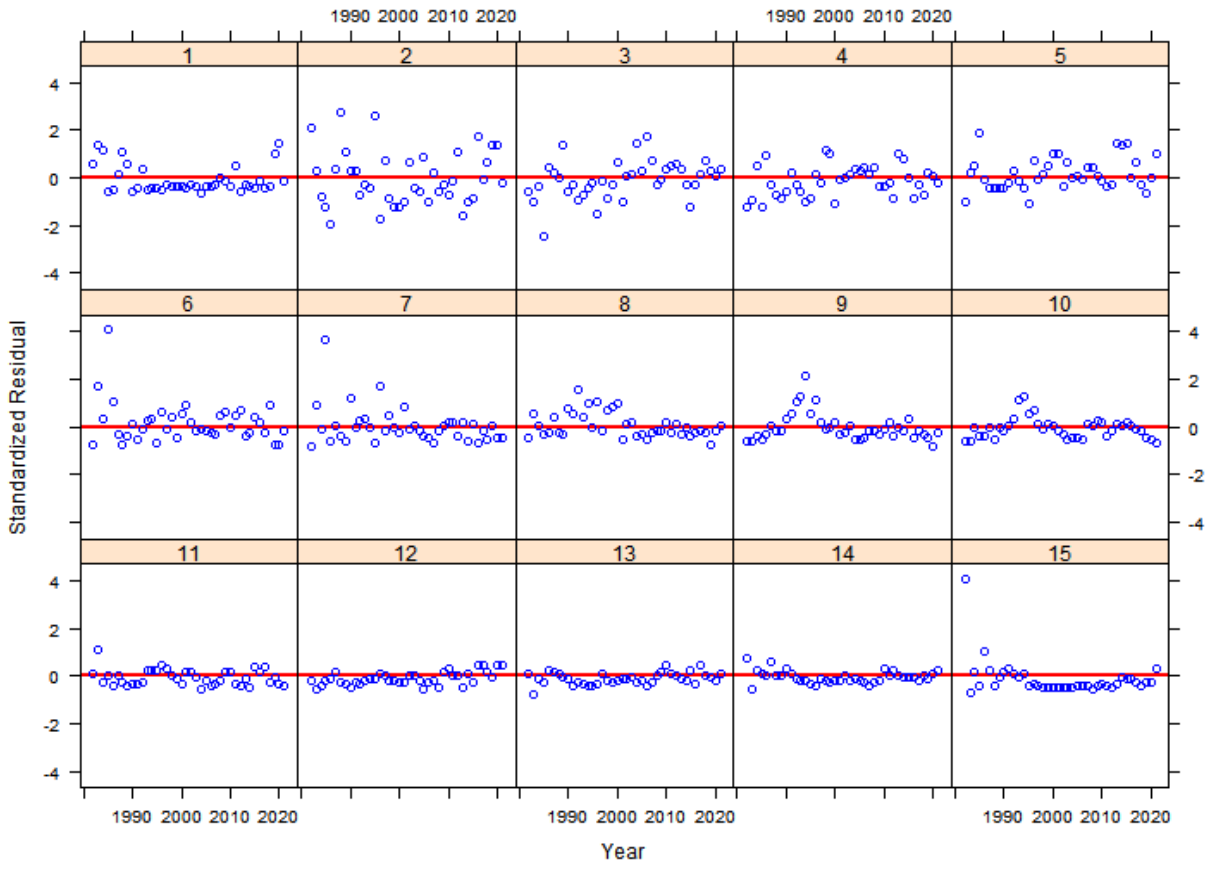

DESSN Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1996
1998
2000
2002
2004
2006
2008
2010
2012
2015
2017
2019
2021
Year


DESSN Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age

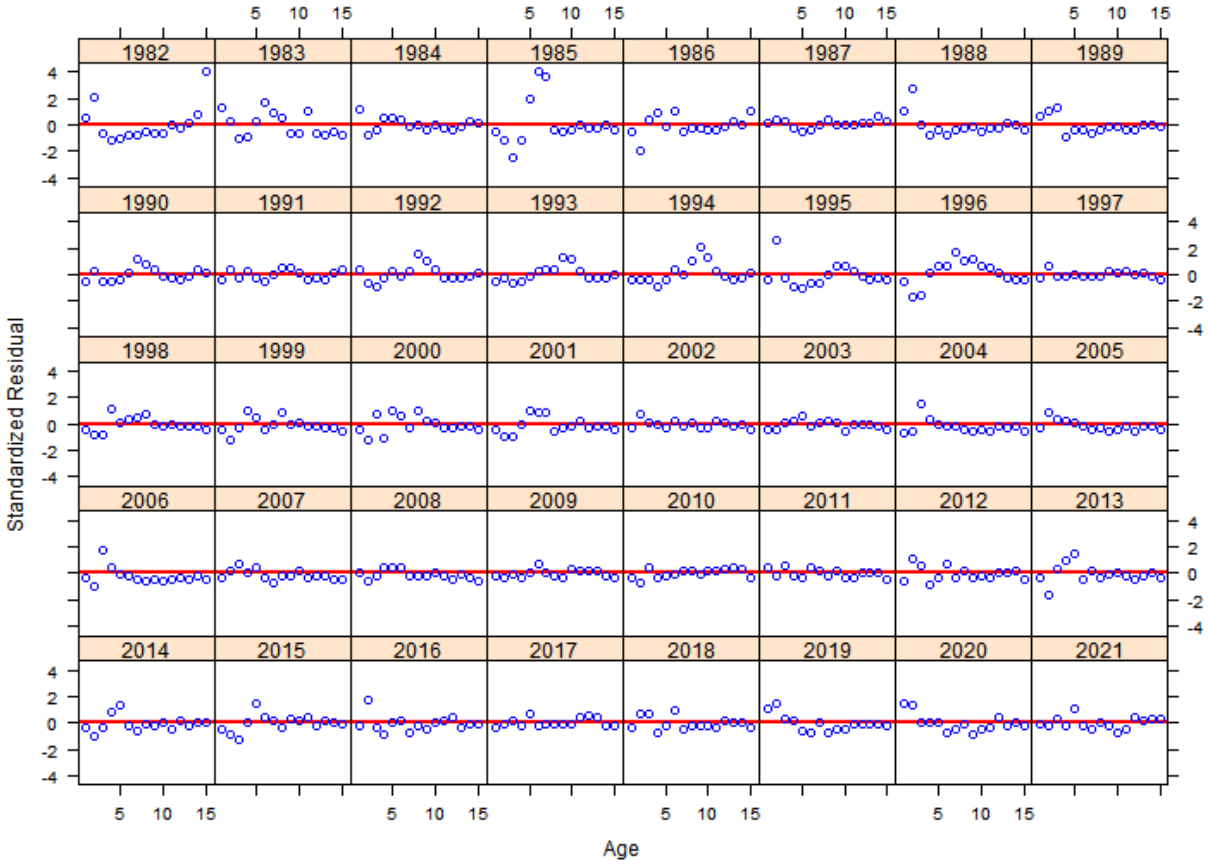

MRIP Age Composition By Age
Pred
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year
1990 2000 2010 2020

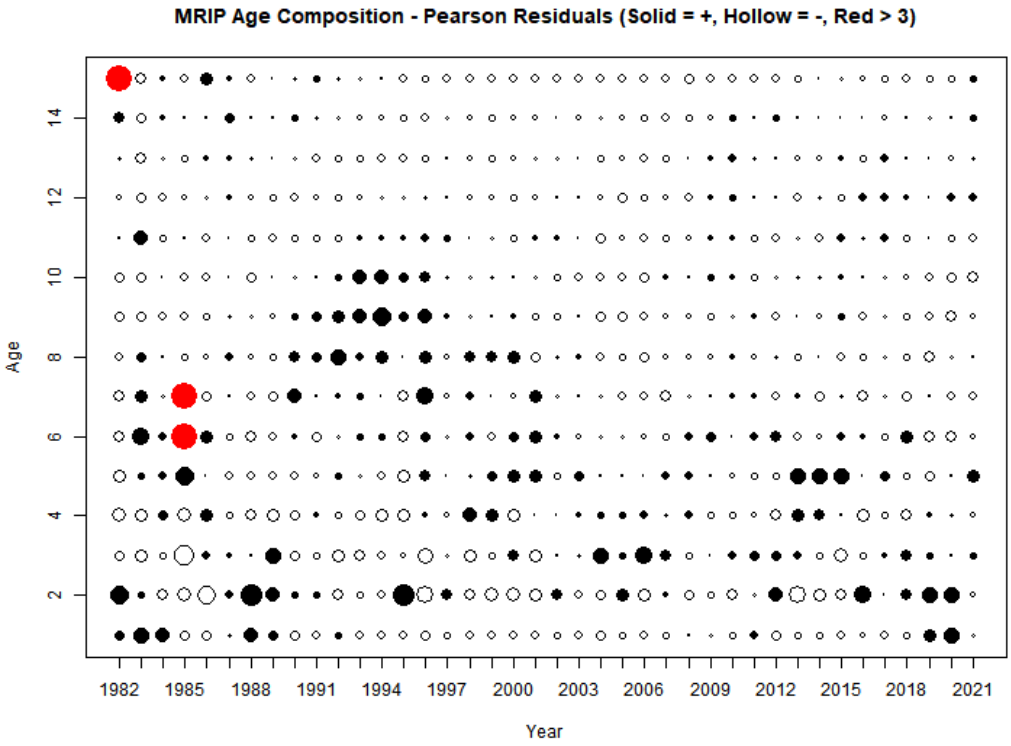

MRIP Age Composition By Year
Pred
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Proportion
Age

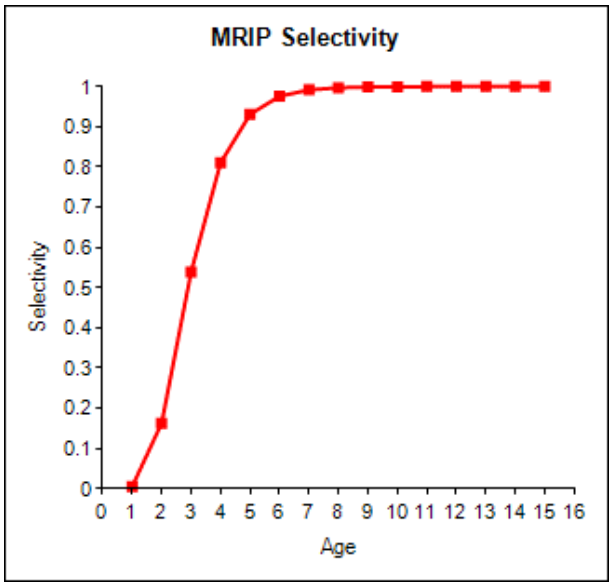
MRIP Age Residuals By Age

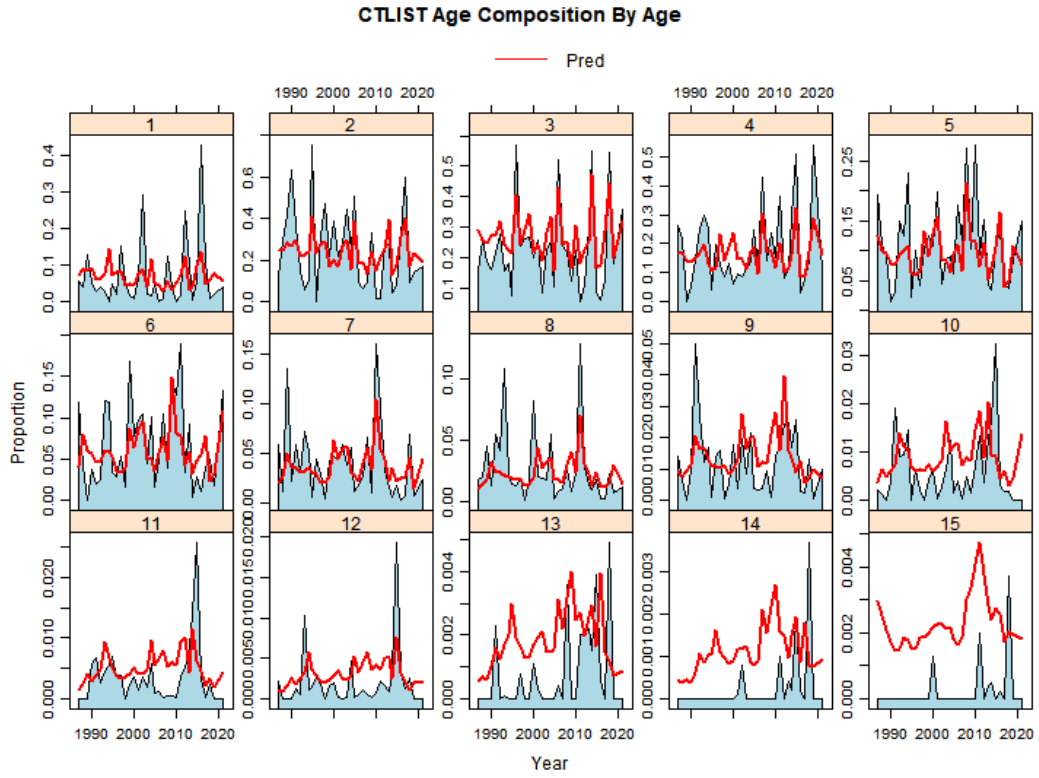


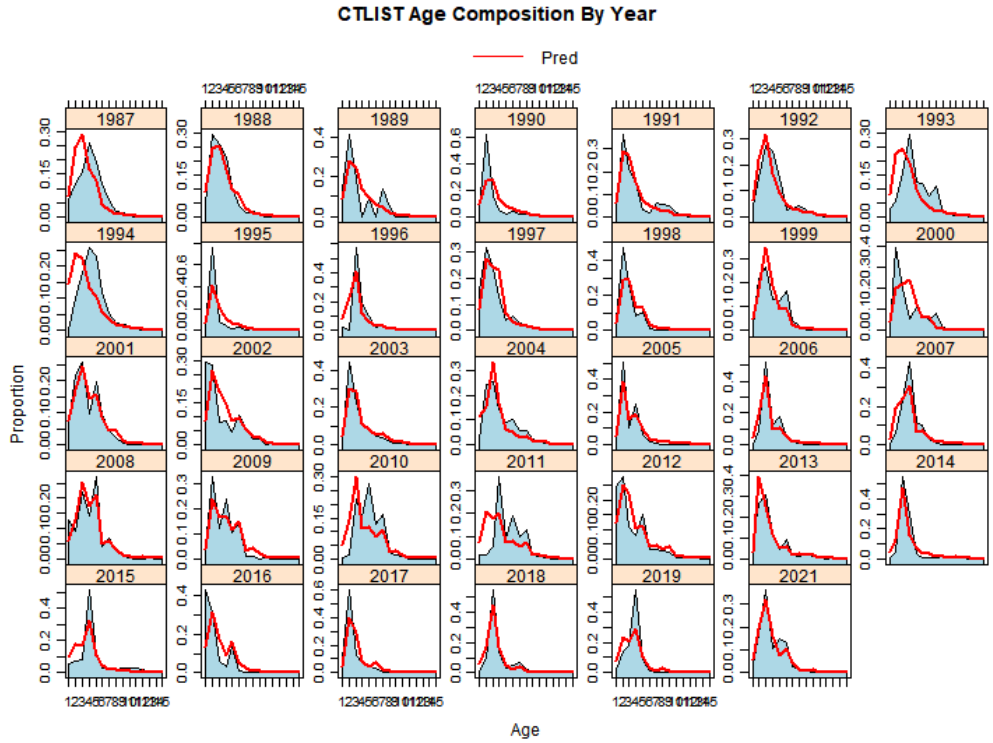
MRIP Age Residuals By Year

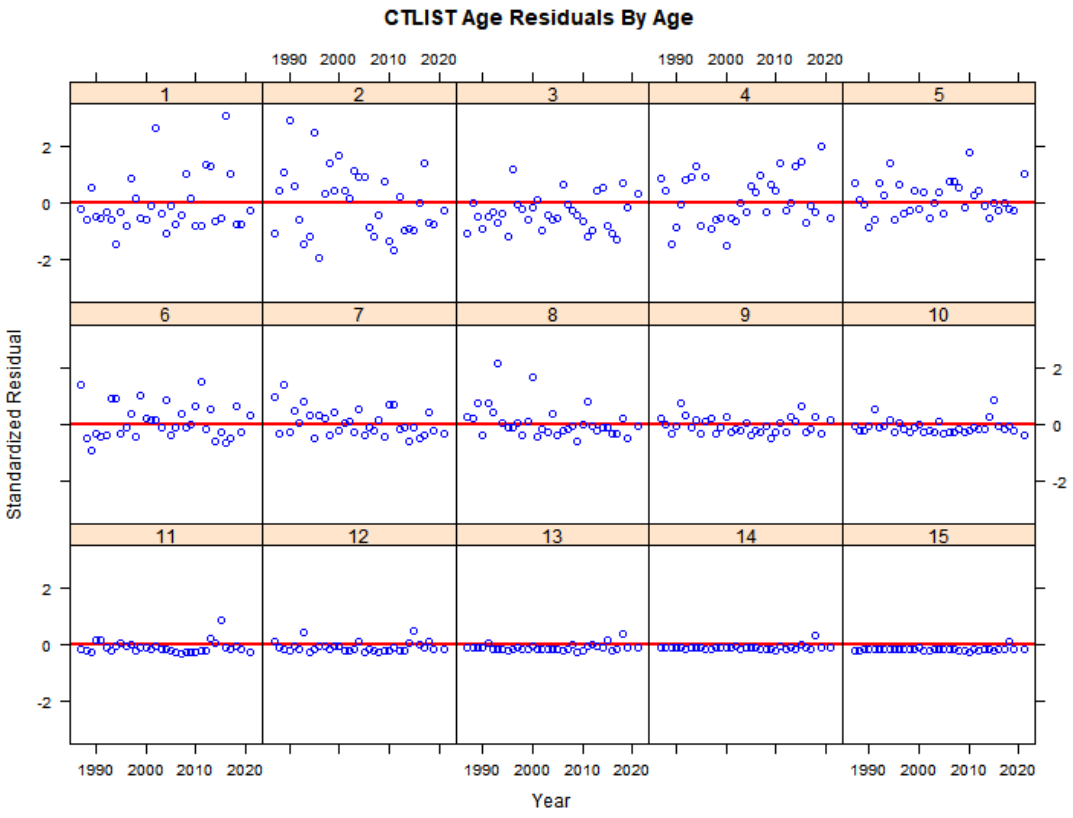


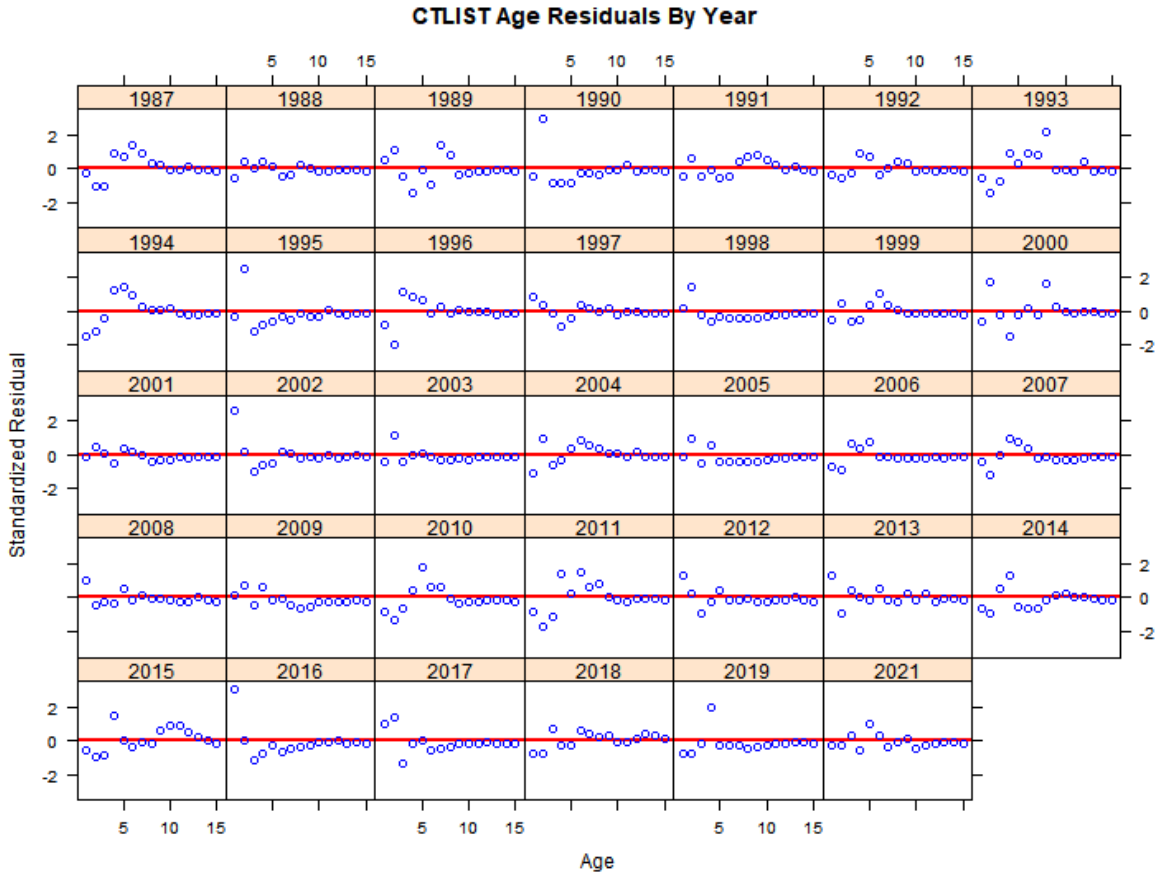

MRIP Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
2021
Year

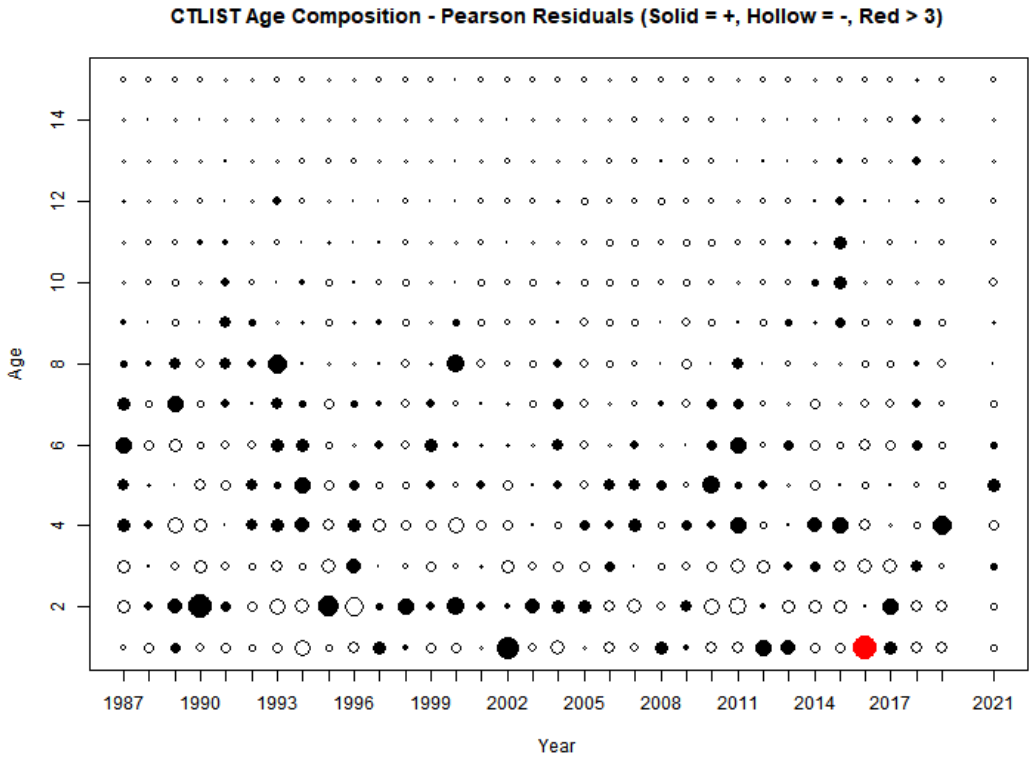

MRIP Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age

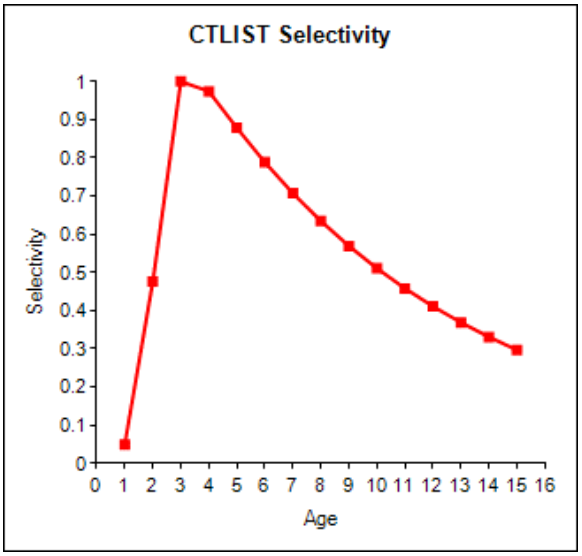

CTLIST Age Composition By Age
Pred
Proportion
Year

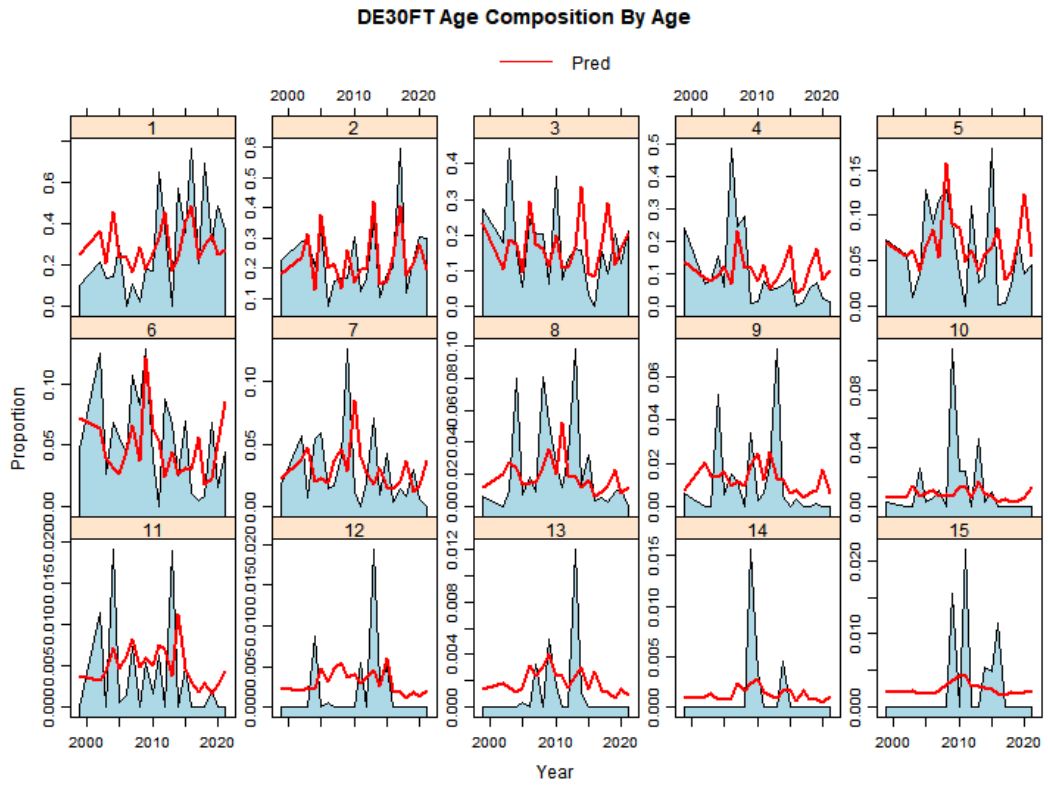

CTLIST Age Composition By Year
Pred
Proportion
Age

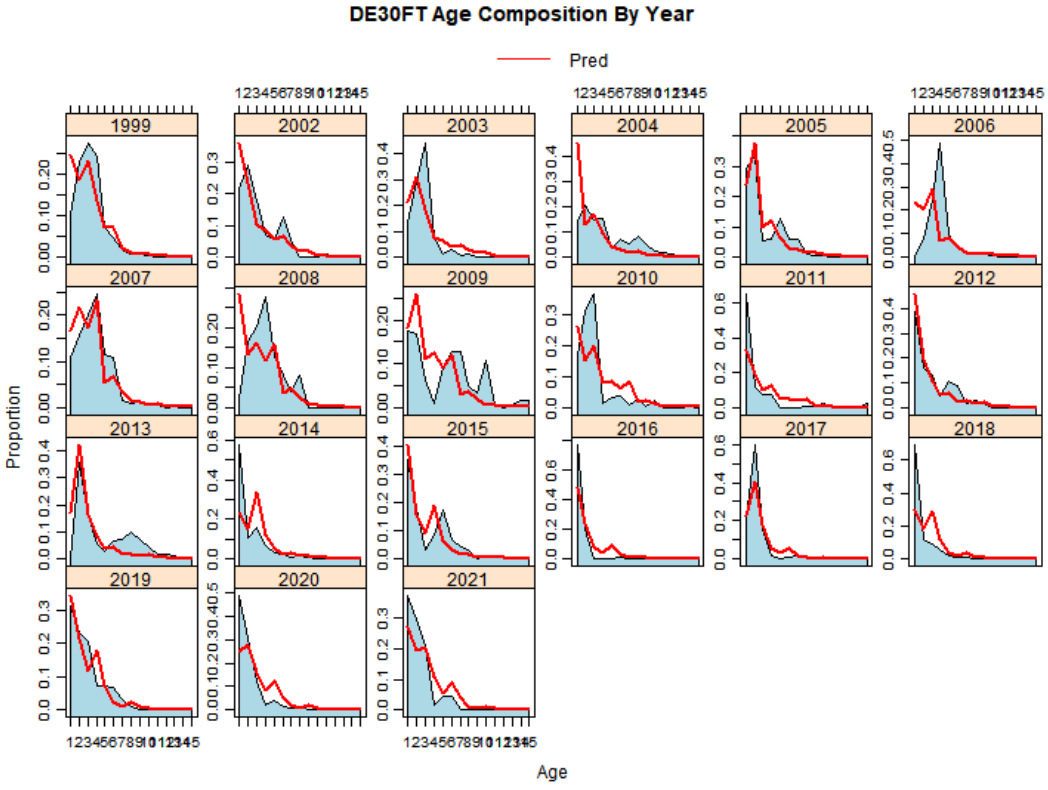

CTLIST Age Residuals By Age
1 2 3 4 5
6 7 8 9 10
11 12 13 14 15
1990 2000 2010 2020
Standardized Residual
Year

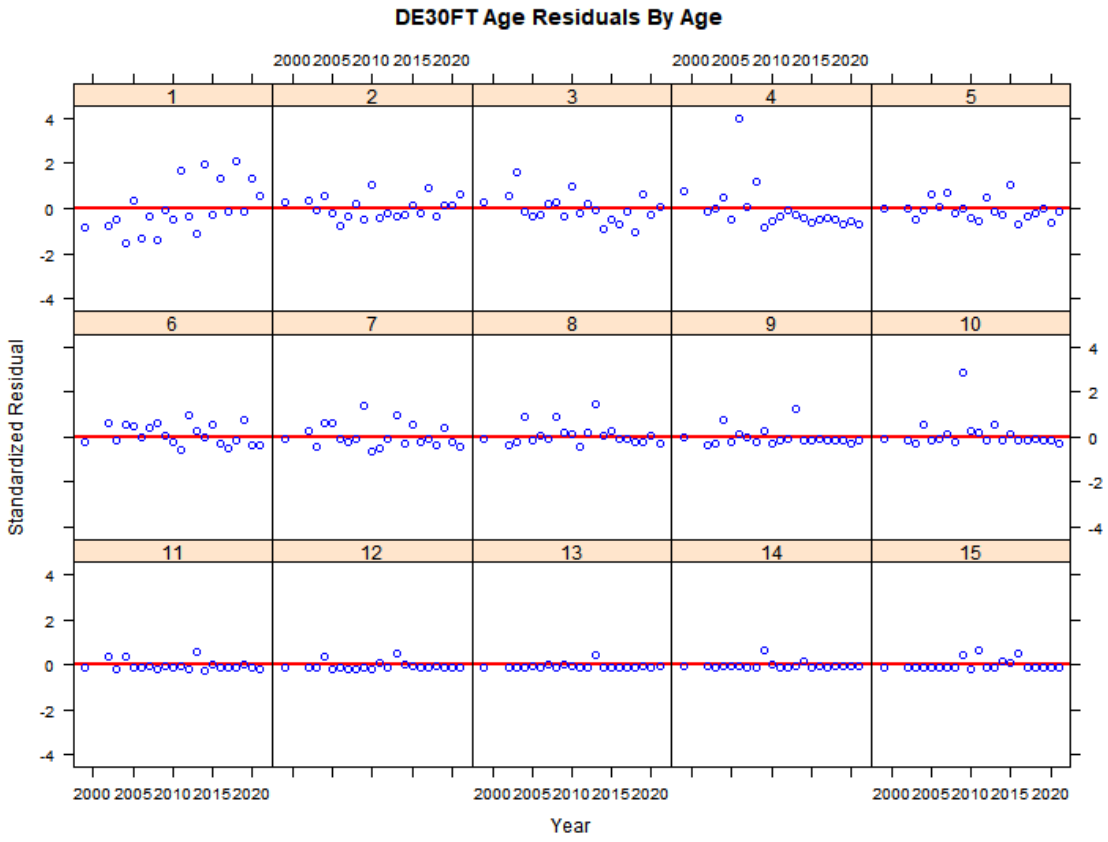

CTLIST Age Residuals By Year
1987 1988 1989 1990 1991 1992 1993
1994 1995 1996 1997 1998 1999 2000
2001 2002 2003 2004 2005 2006 2007
2008 2009 2010 2011 2012 2013 2014
2015 2016 2017 2018 2019 2021
5 10 15
Standardized Residual
Age

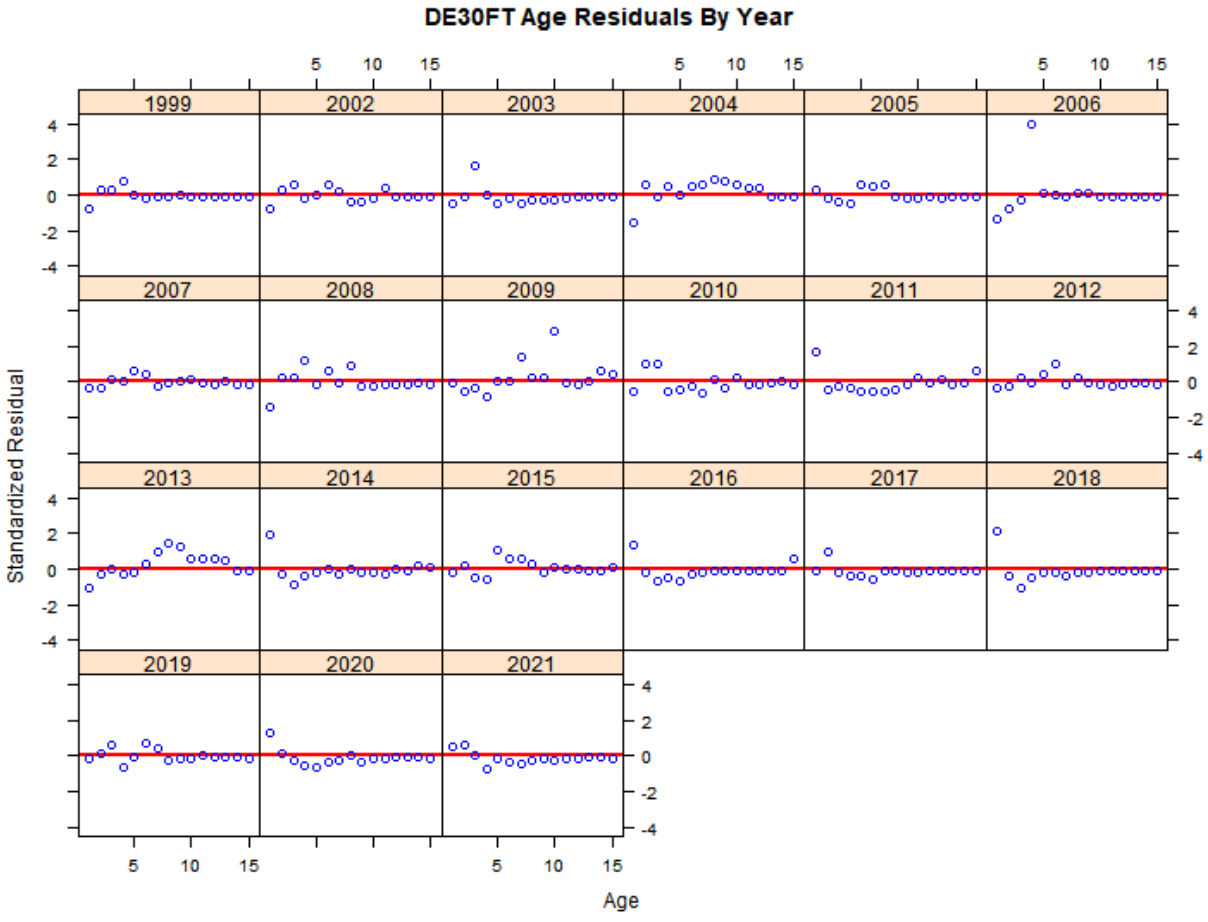

CTLIST Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017
2021
Year

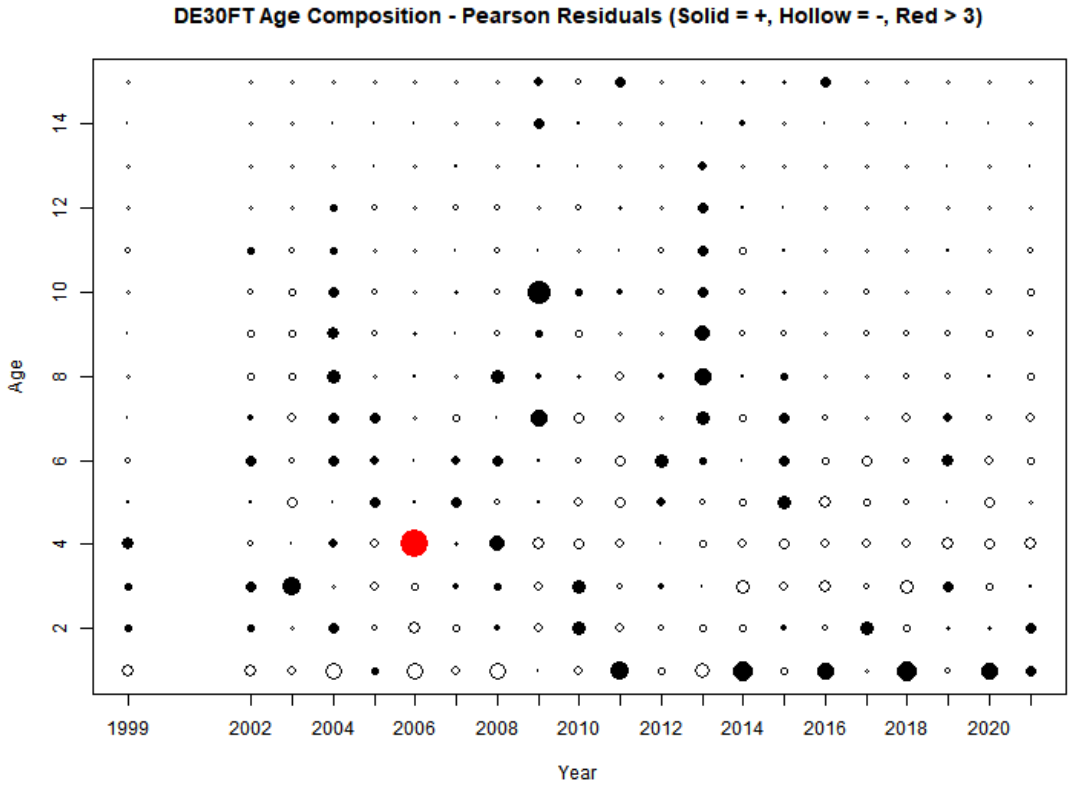

CTLIST Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age

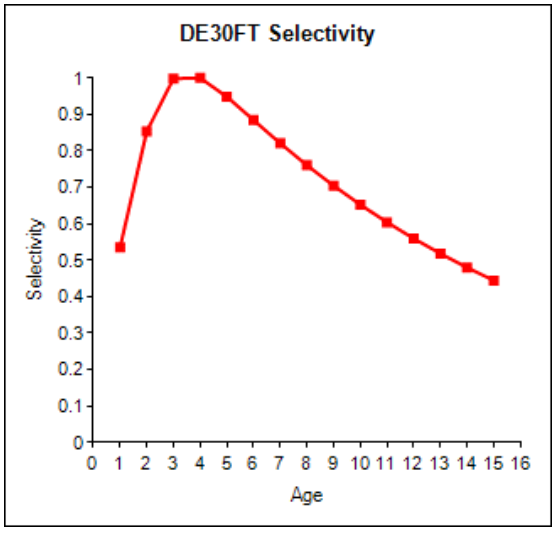

DE30FT Age Composition By Age
Pred
Proportion
Year

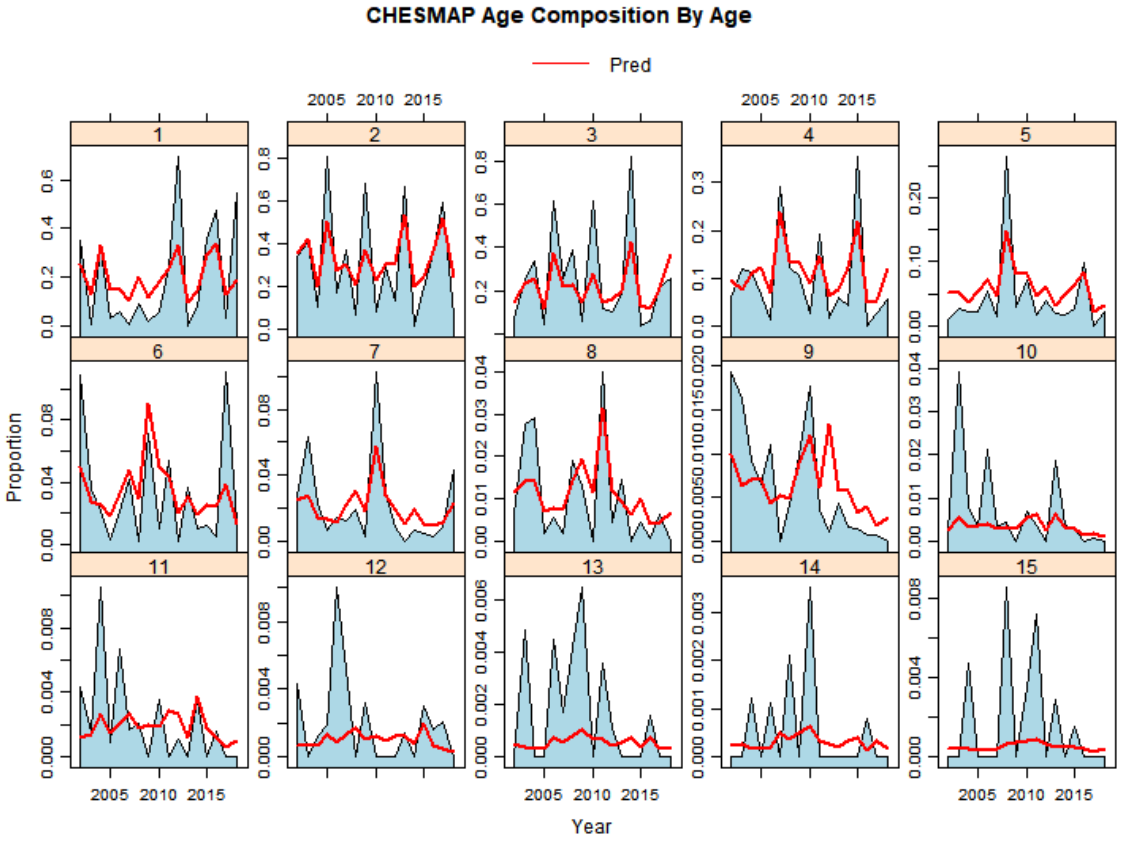

DE30FT Age Composition By Year
Pred
Proportion
Age

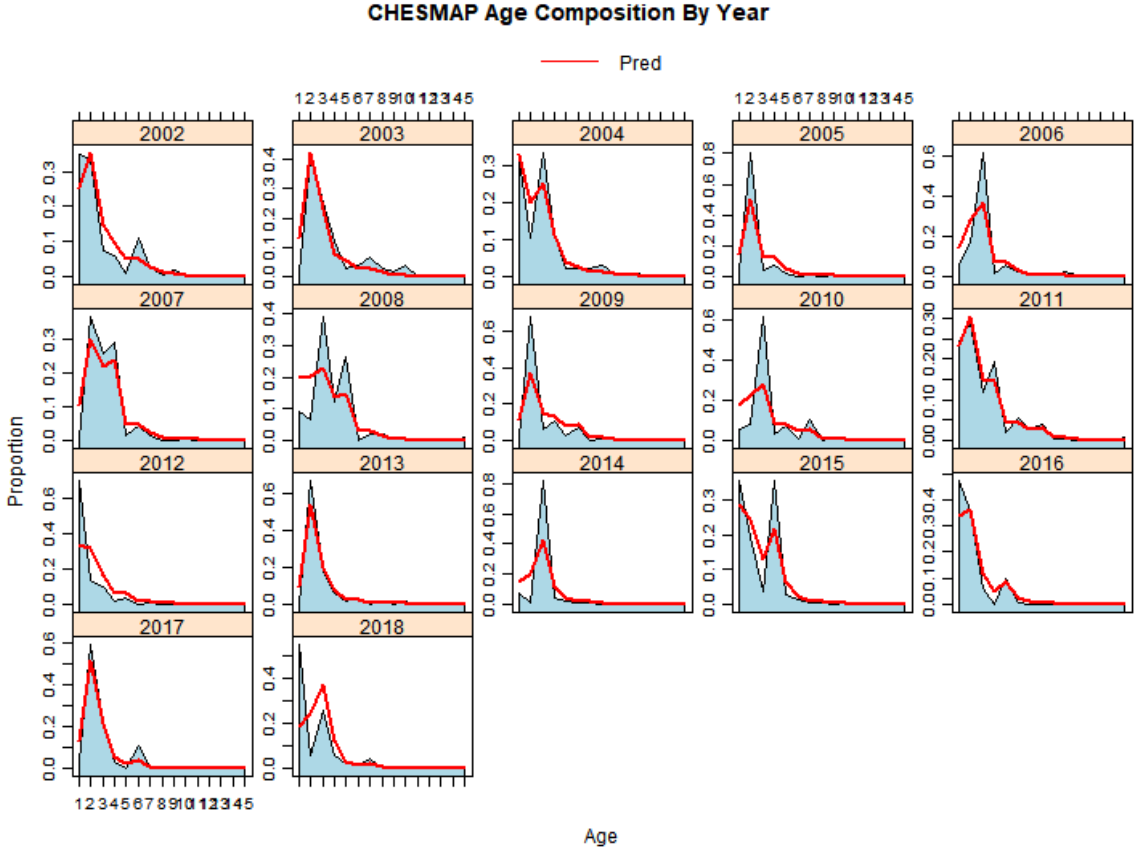

DE30FT Age Residuals By Age
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Standardized Residual
Year

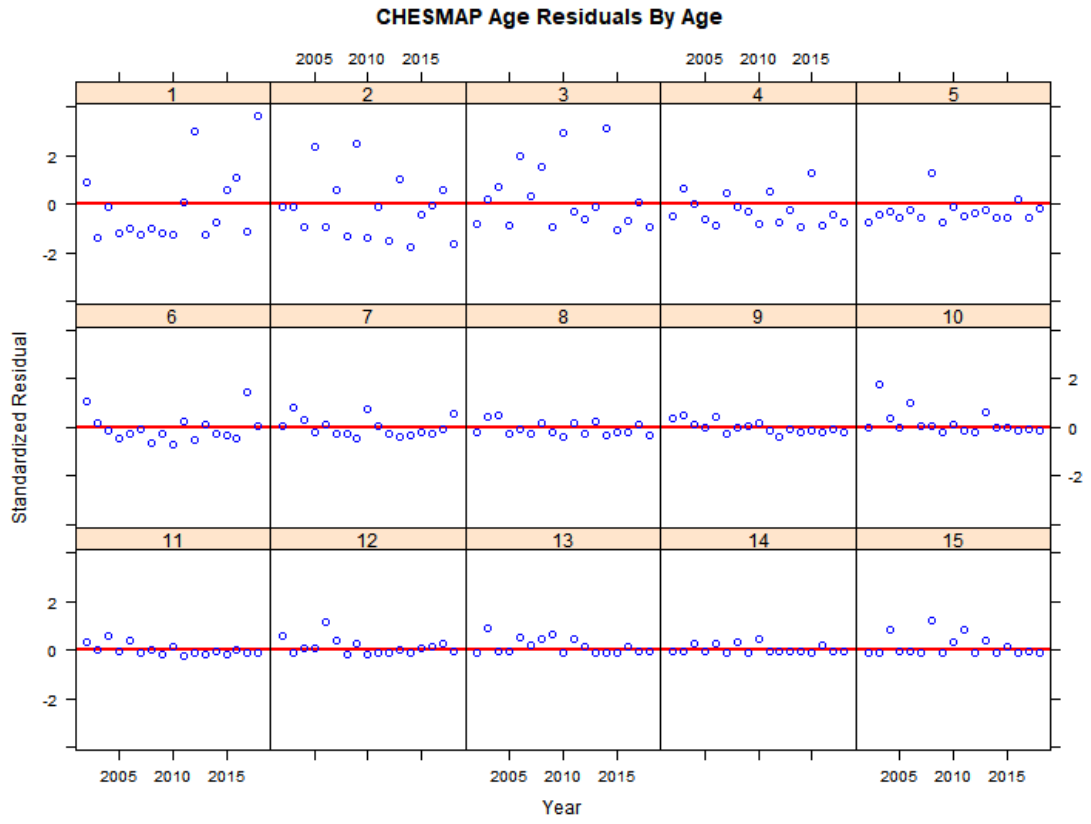

DE30FT Age Residuals By Year
1999
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Standardized Residual
Age

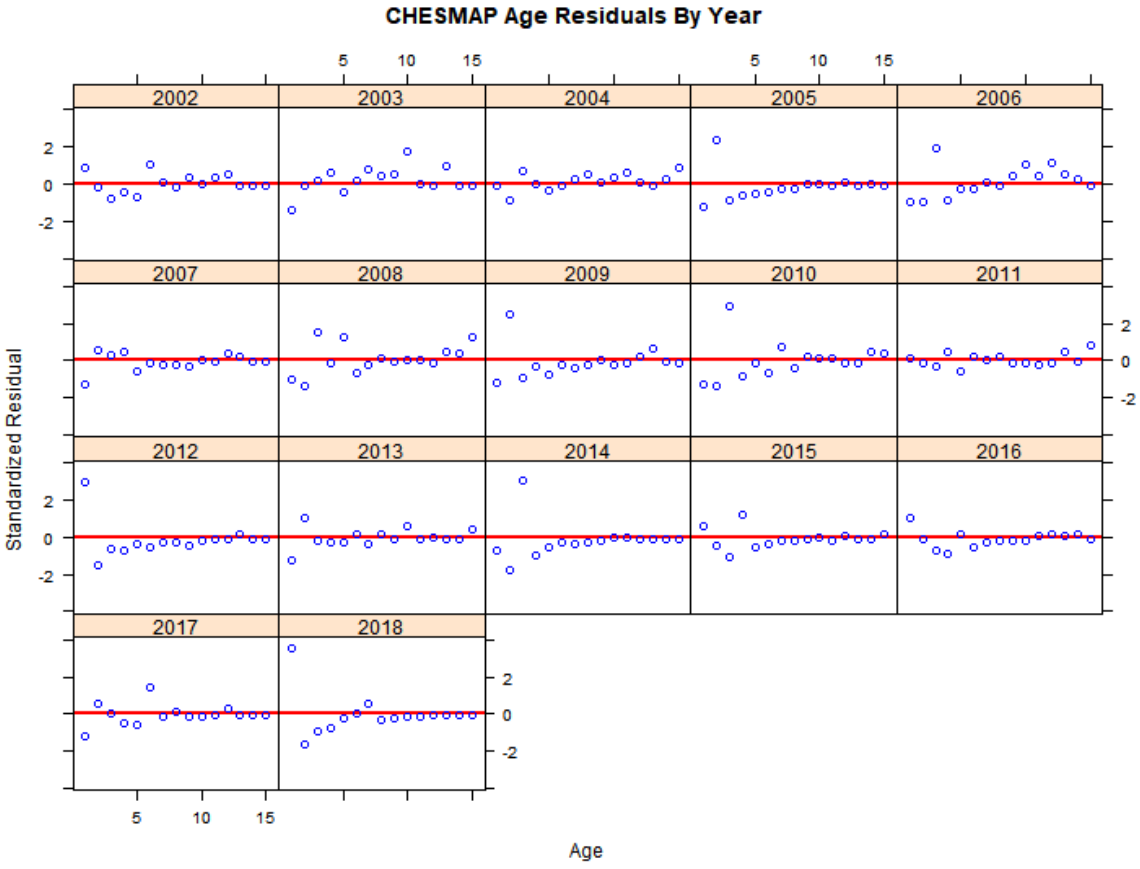

DE30FT Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1999
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

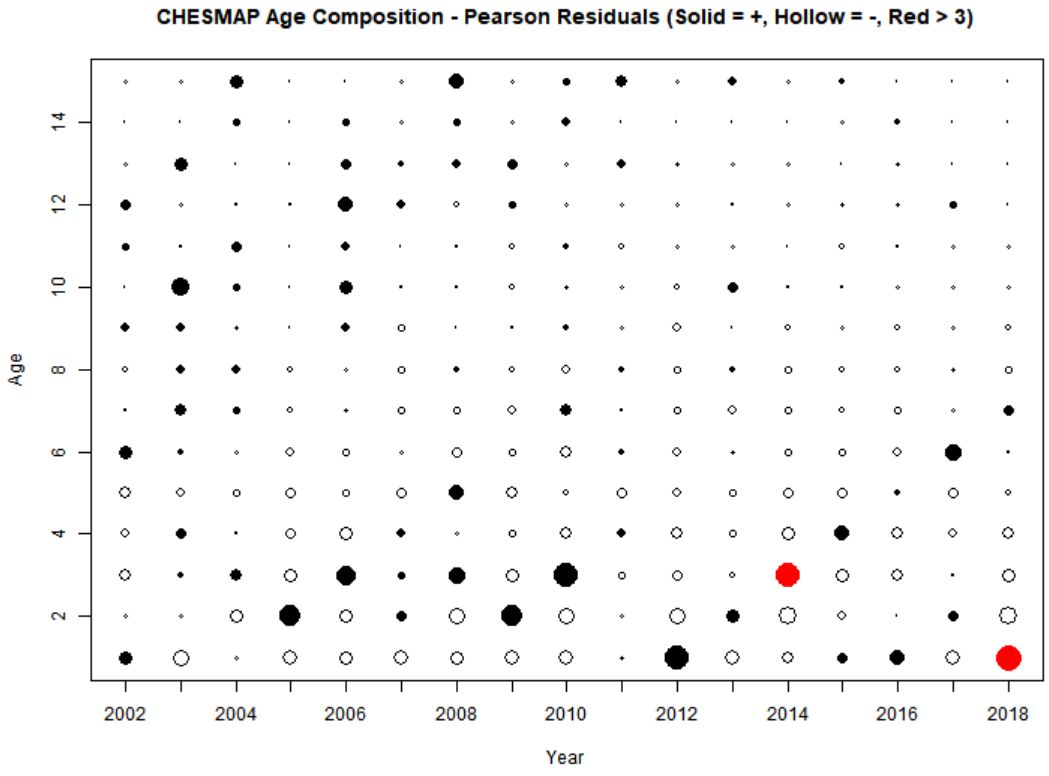

DE30FT Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age

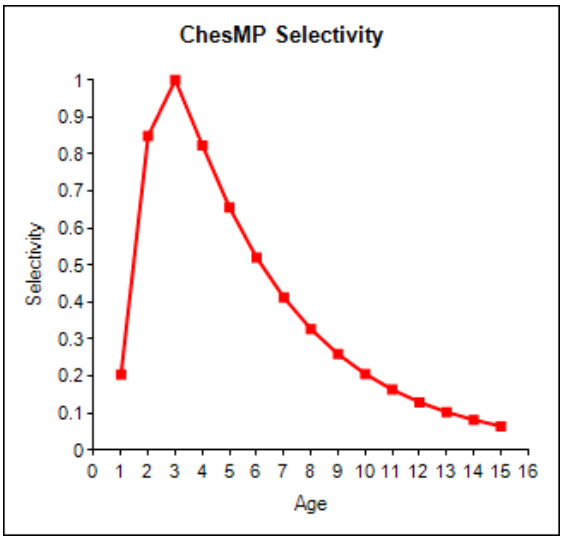

CHESMAP Age Composition By Age
Pred
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year


CHESMAP Age Composition By Year
Pred
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Proportion
Age

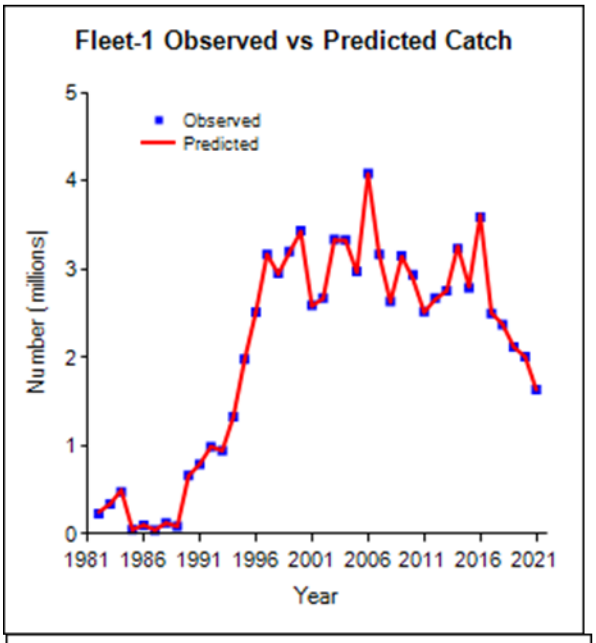

CHESMAP Age Residuals By Age
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
2005 2010 2015
Standardized Residual
Year

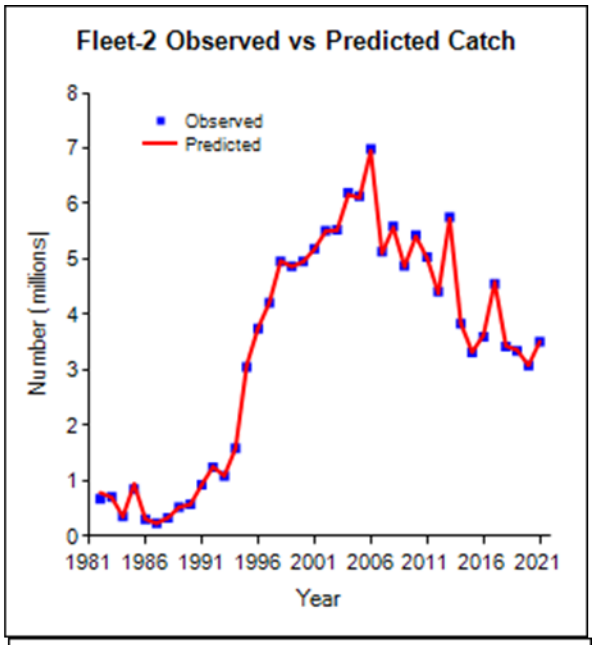

CHESMAP Age Residuals By Year
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
5 10 15
Standardized Residual
Age

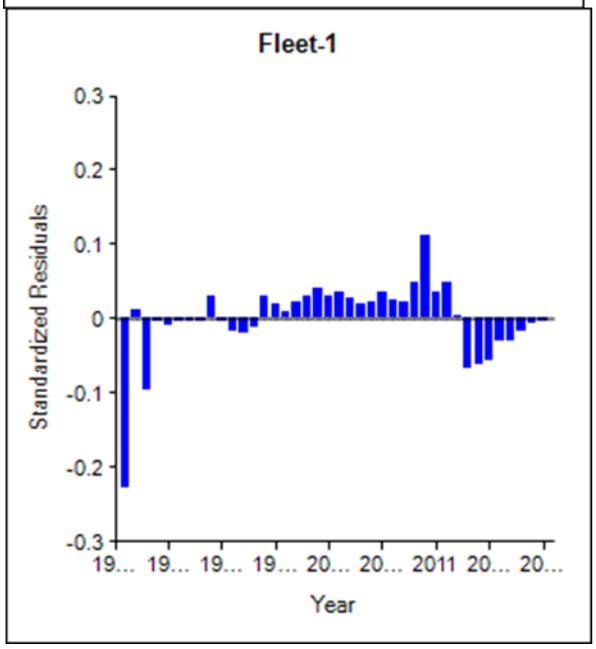

CHESMAP Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year

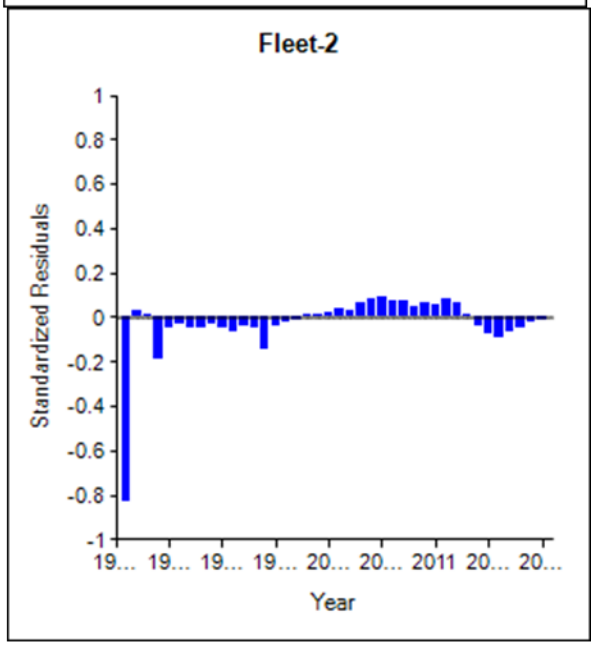

ChesMP Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age

Appendix 3. Diagnostic plots and results for a model run in which a new 2020-2021 selectivity block was added for the Ocean region only.

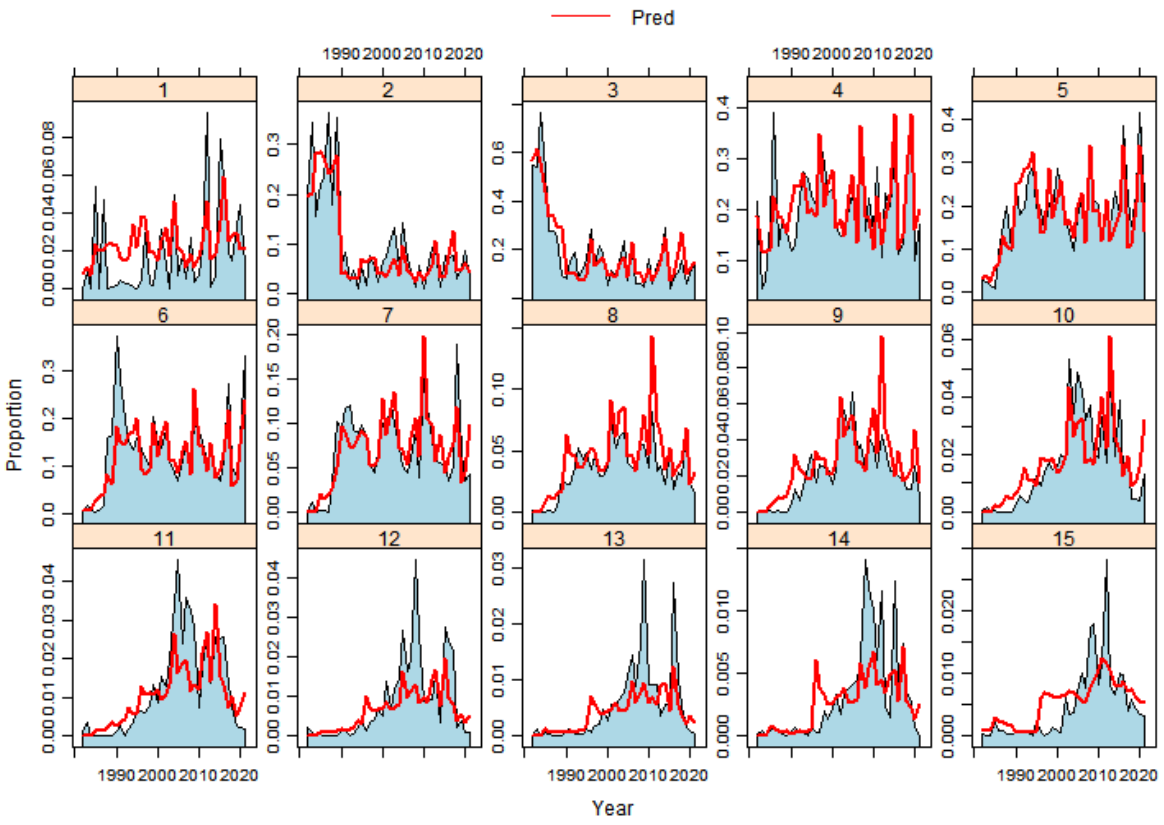




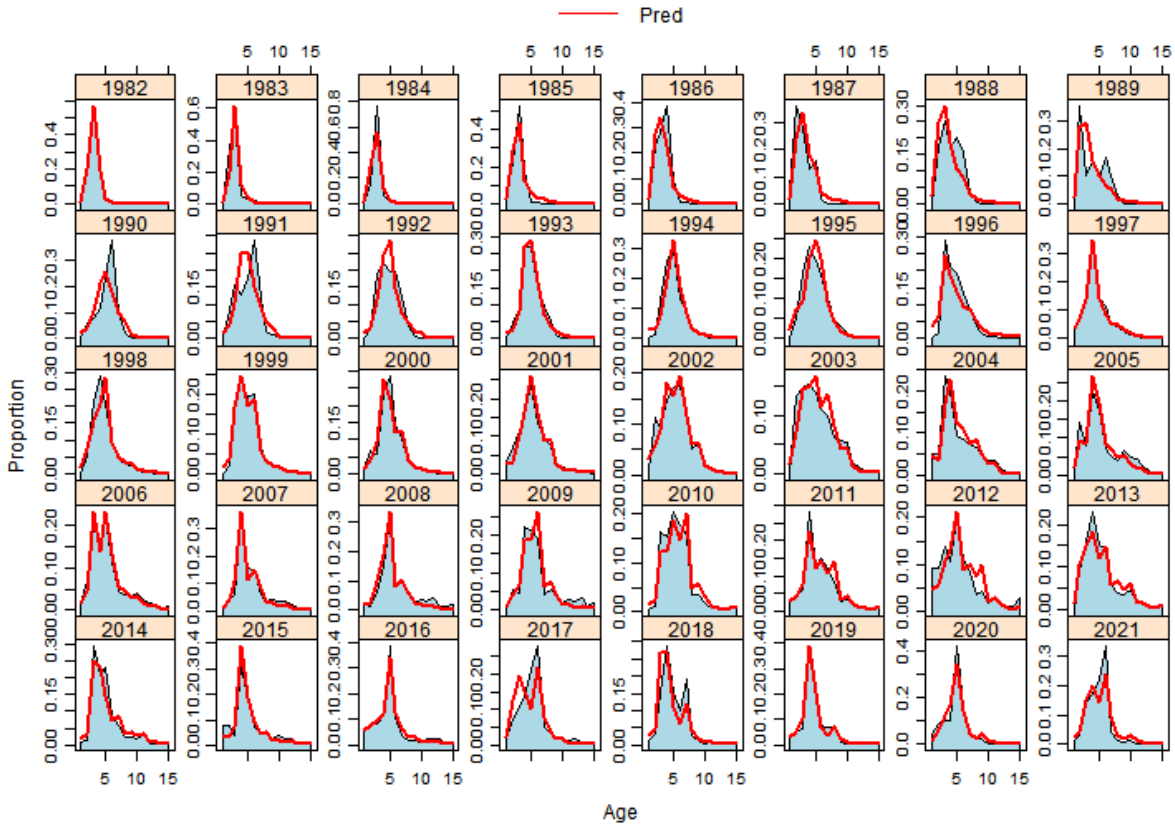


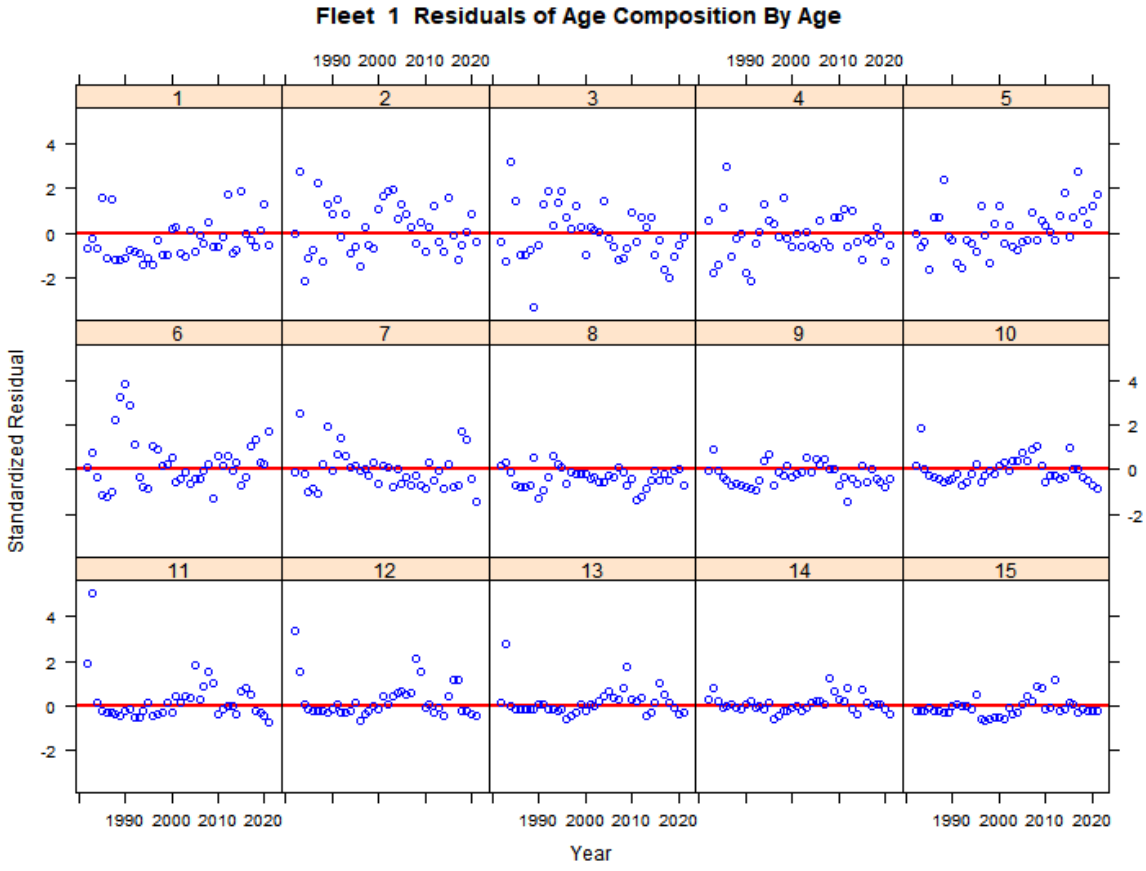


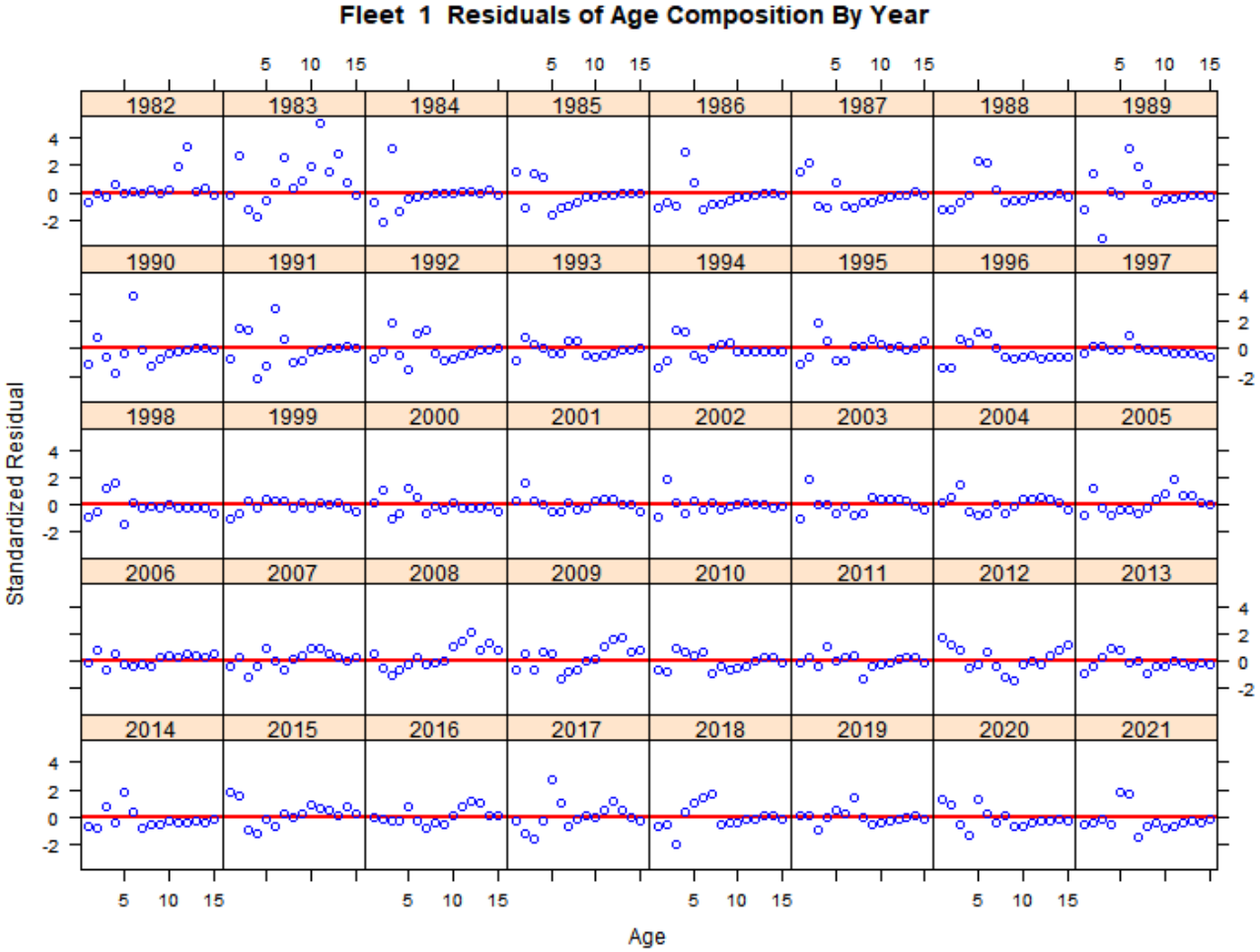
Fleet 1 Catch Age Composition By Age

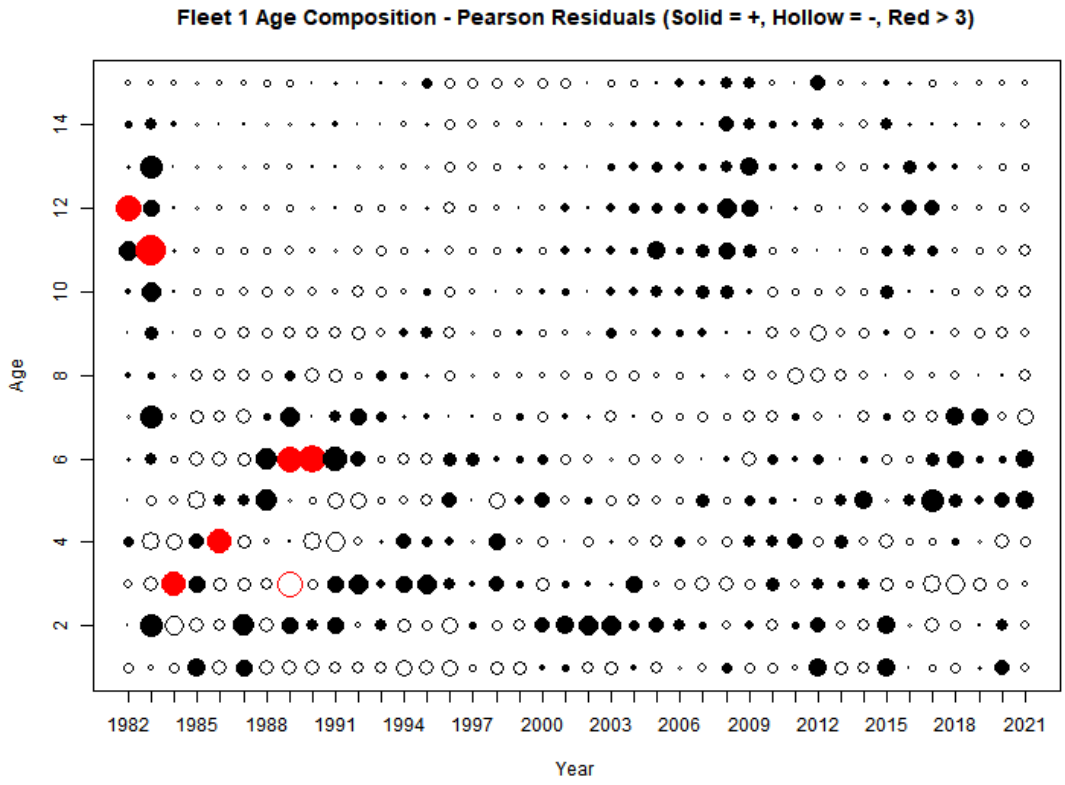


Fleet 1 Catch Age Composition By Year

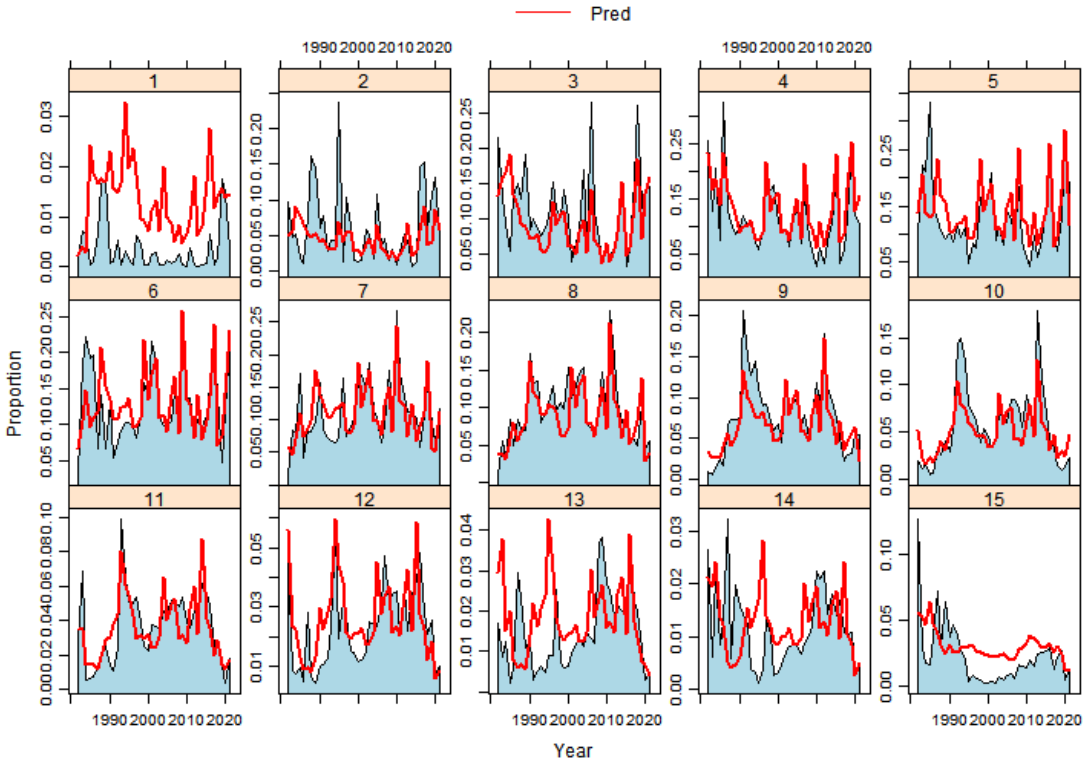



Fleet 1 Residuals of Age Composition By Age
1 2 3 4 5
6 7 8 9 10
11 12 13 14 15
Standardized Residual
Year

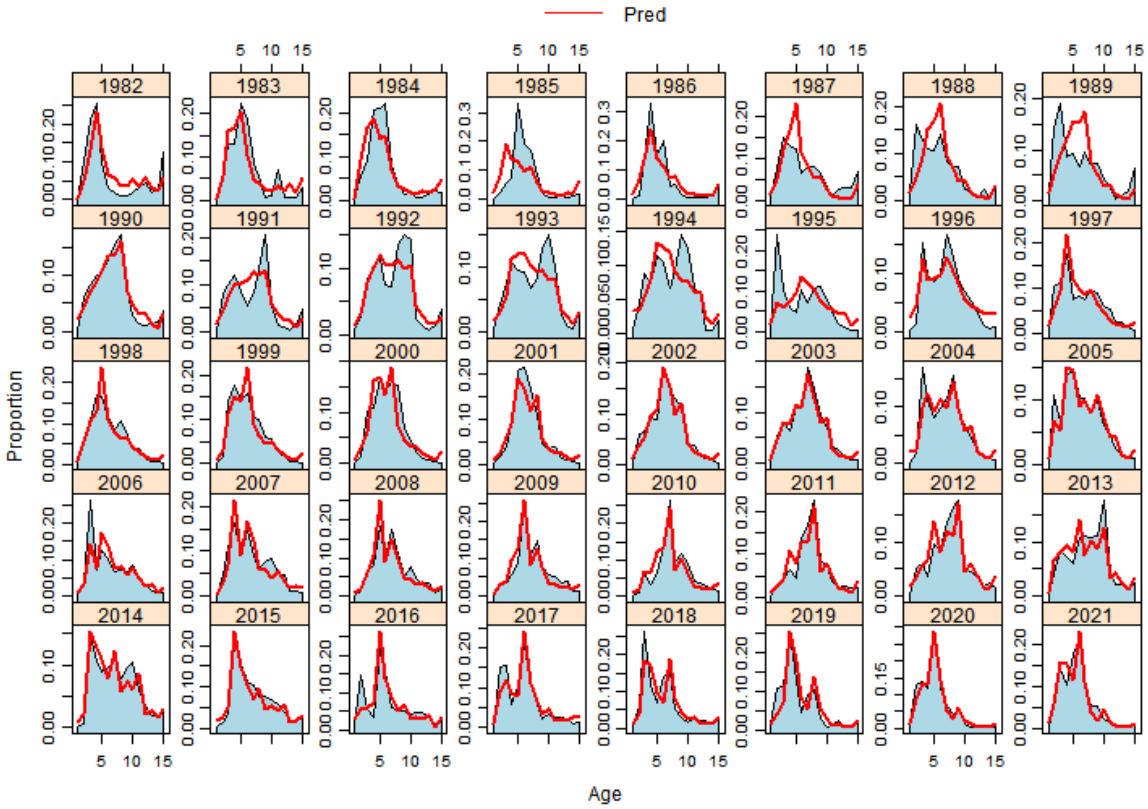

Fleet 1 Residuals of Age Composition By Year
1982 1983 1984 1985 1986 1987 1988 1989
1990 1991 1992 1993 1994 1995 1996 1997
1998 1999 2000 2001 2002 2003 2004 2005
2006 2007 2008 2009 2010 2011 2012 2013
2014 2015 2016 2017 2018 2019 2020 2021
Standardized Residual
Age

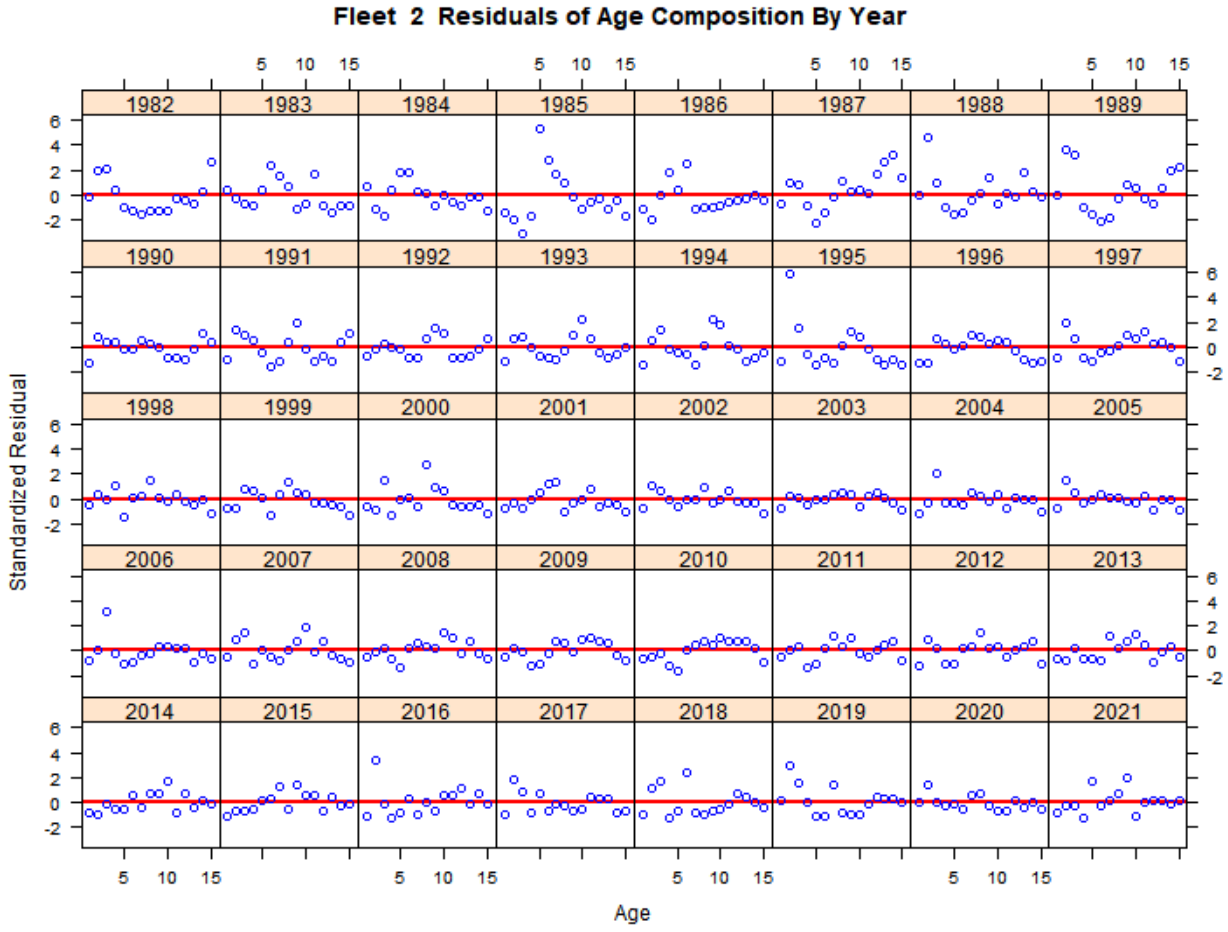

Fleet 1 Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
2021
Year

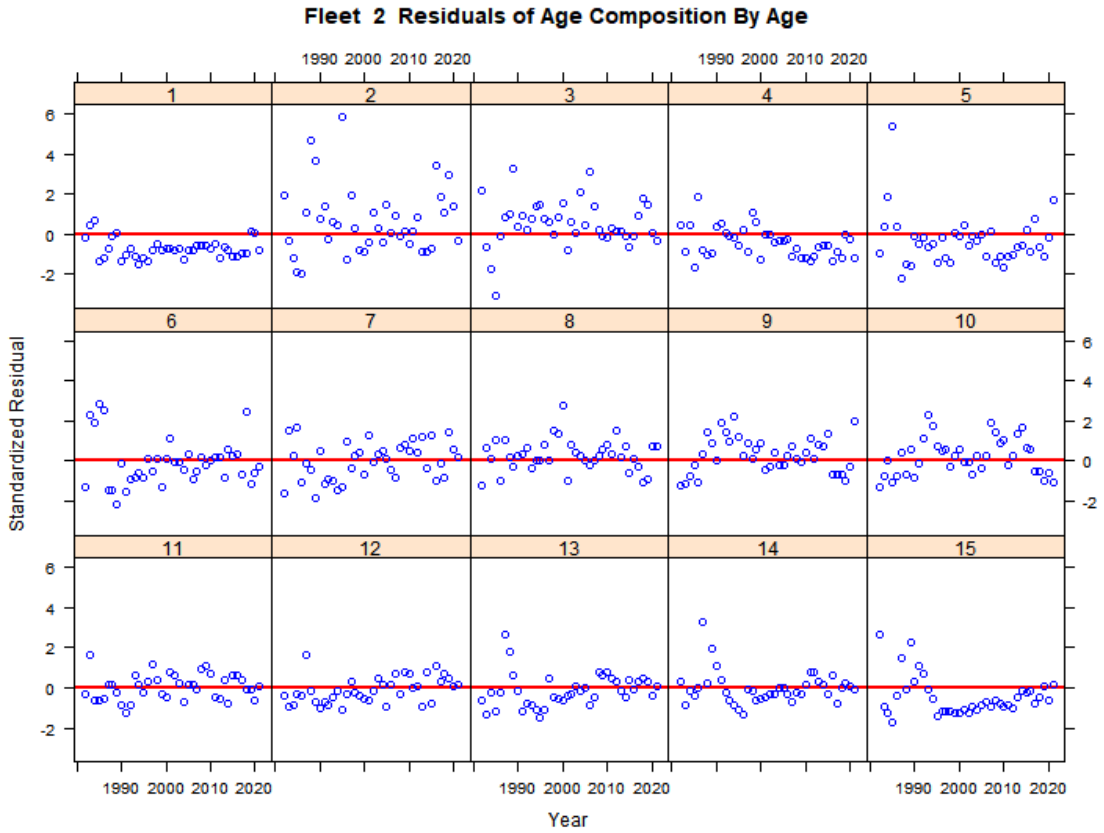
Fleet 2 Catch Age Composition By Age

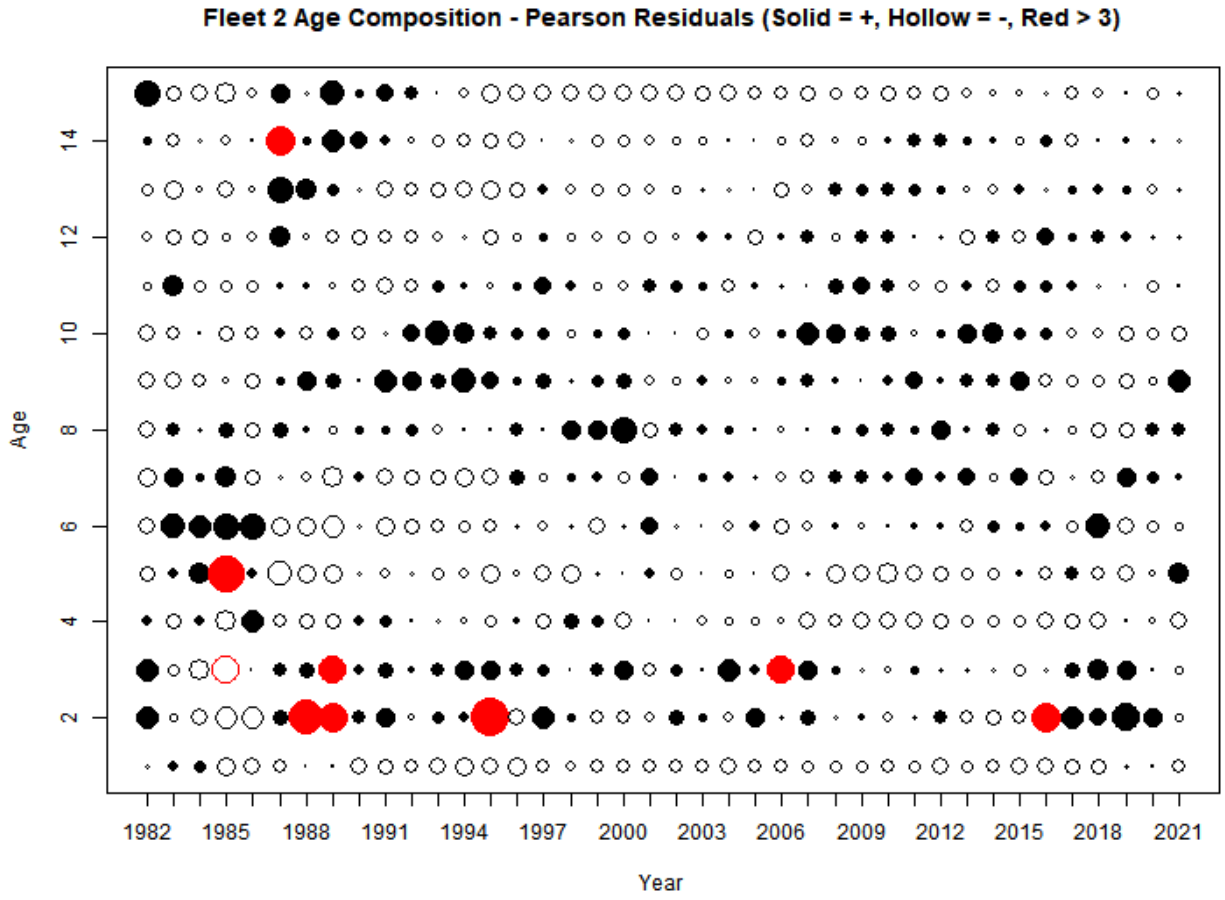


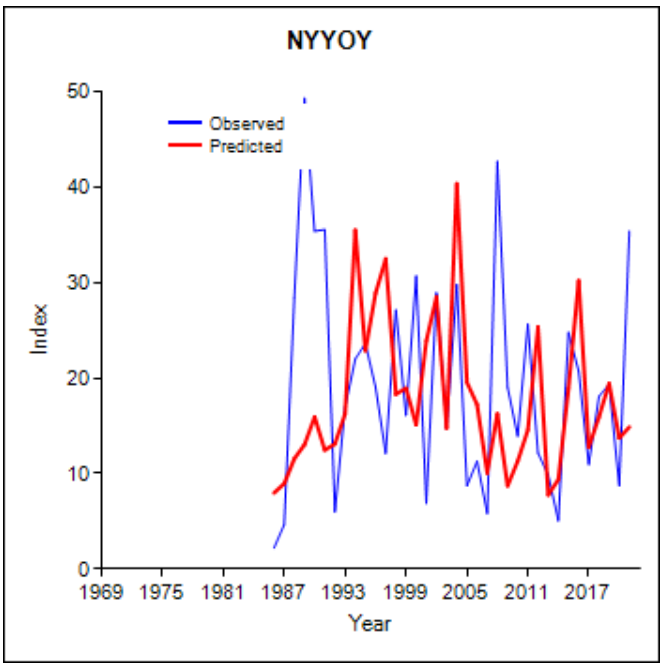
Fleet 2 Catch Age Composition By Year

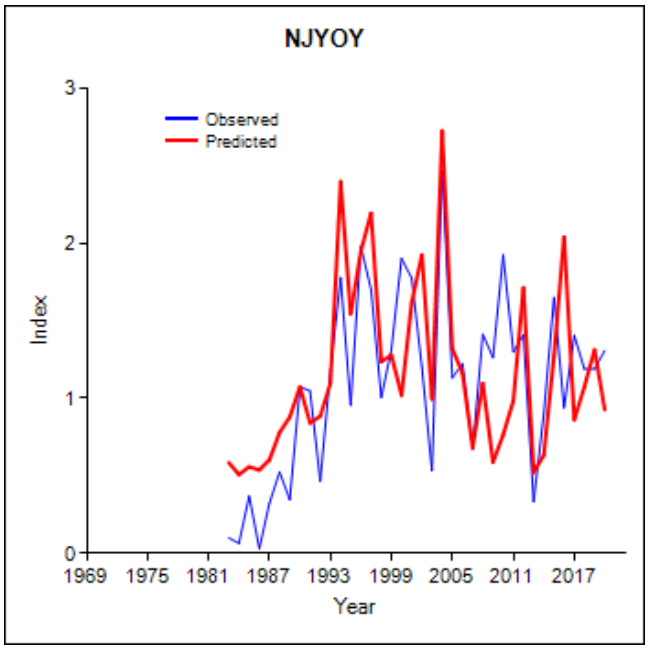


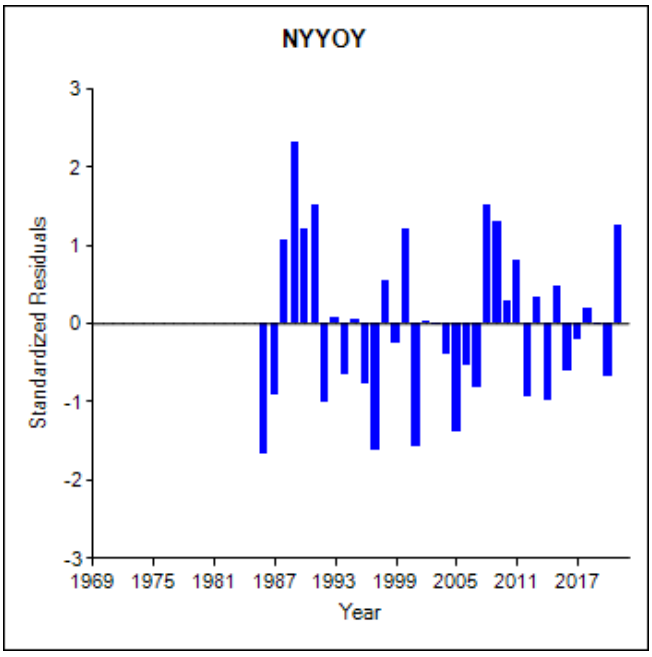

Fleet 2 Residuals of Age Composition By Year
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Standardized Residual
Age

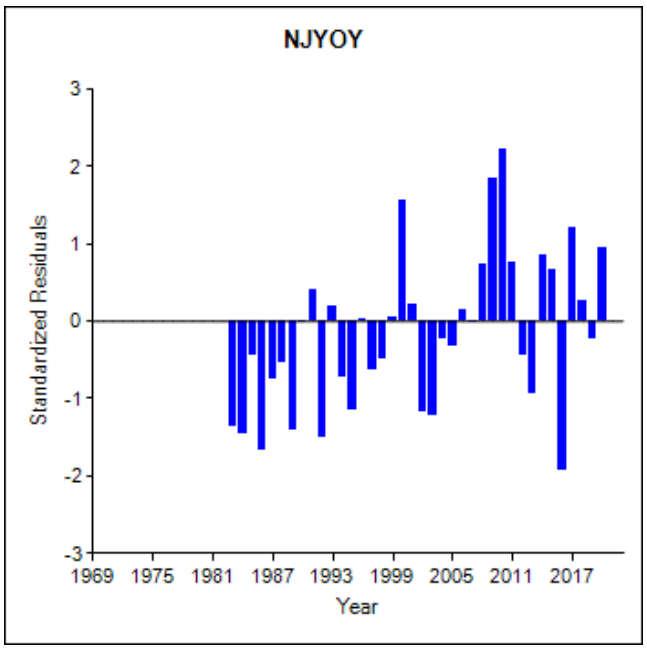

Fleet 2 Residuals of Age Composition By Age
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Standardized Residual
Year

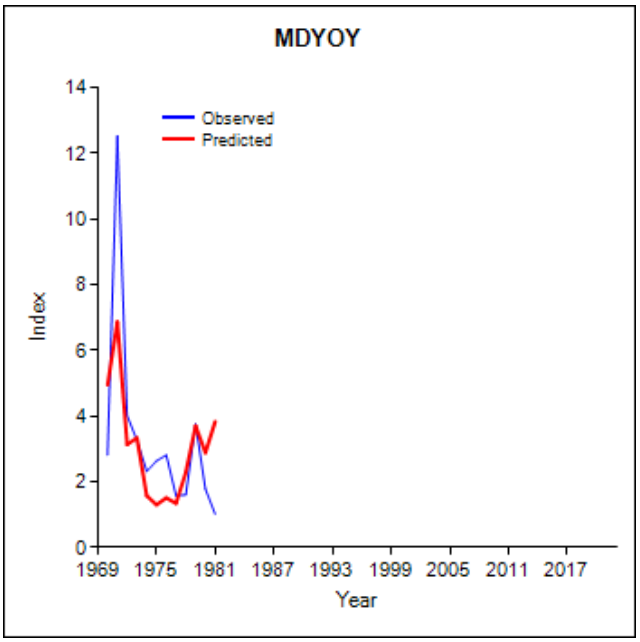

Fleet 2 Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
2021
Year

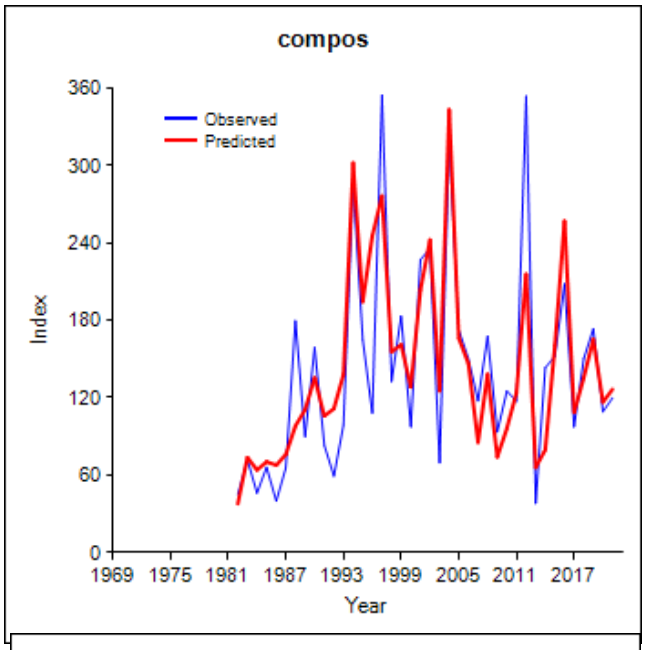

NYYOY
Observed
Predicted
Index
Year
0
10
20
30
40
50
1969
1975
1981
1987
1993
1999
2005
2011
2017

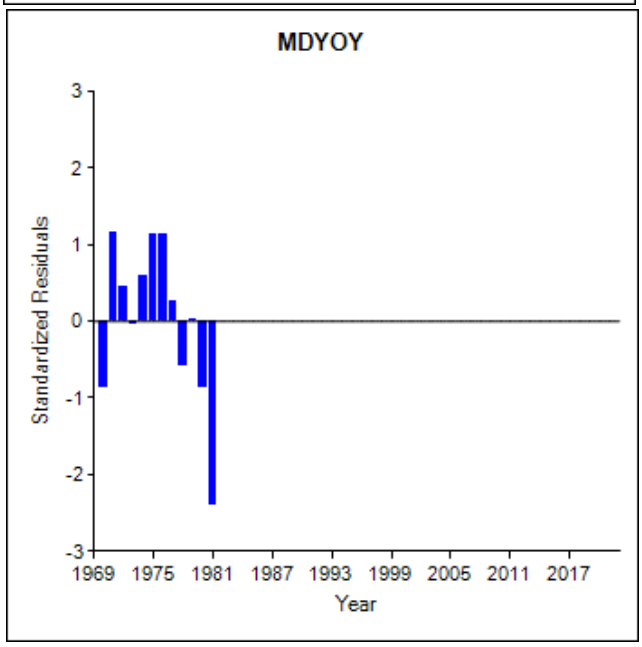

NJYOY
Observed
Predicted
Index
Year
0
1
2
3
1969
1975
1981
1987
1993
1999
2005
2011
2017

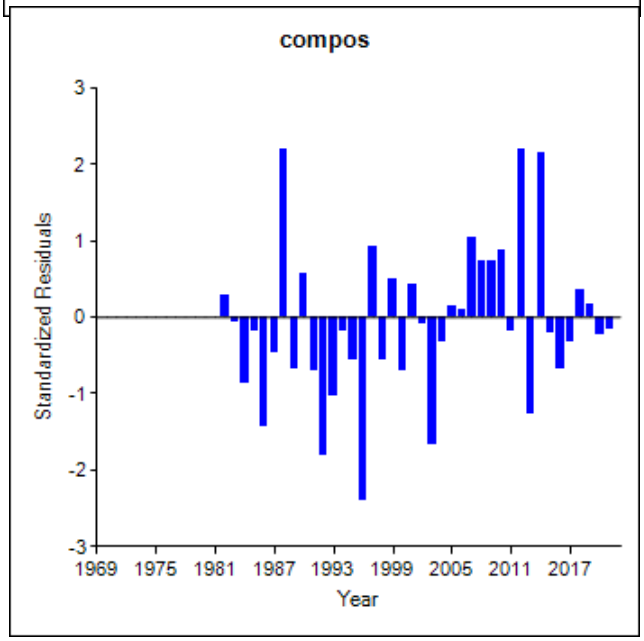

NYYOY
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1975
1981
1987
1993
1999
2005
2011
2017

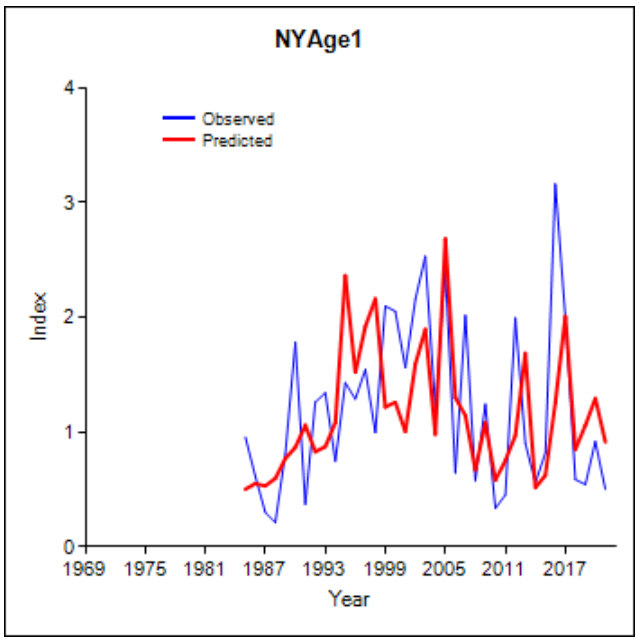

NJYOY
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1975
1981
1987
1993
1999
2005
2011
2017

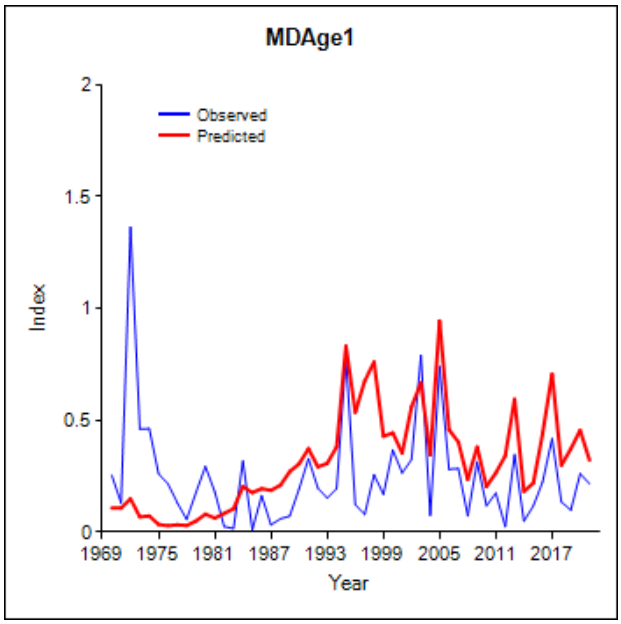

MDYOY
Observed
Predicted
Index
Year
0
2
4
6
8
10
12
14
1969
1975
1981
1987
1993
1999
2005
2011
2017

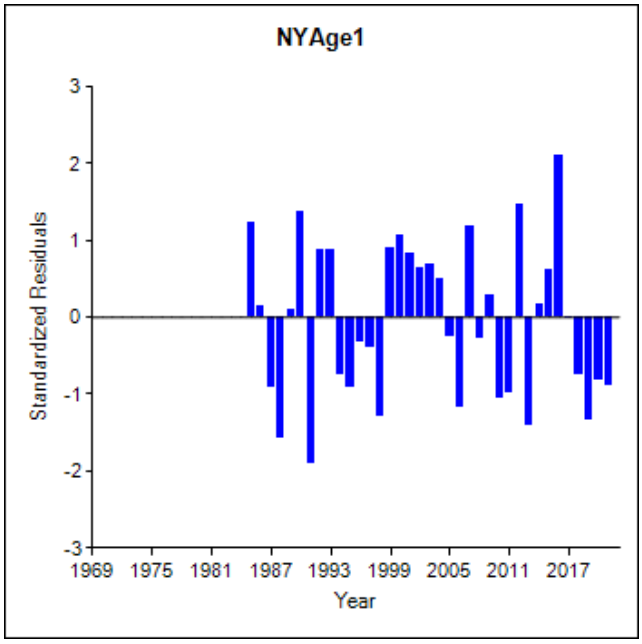

compos
Observed
Predicted
Index
Year
0
60
120
180
240
300
360
1969
1975
1981
1987
1993
1999
2005
2011
2017

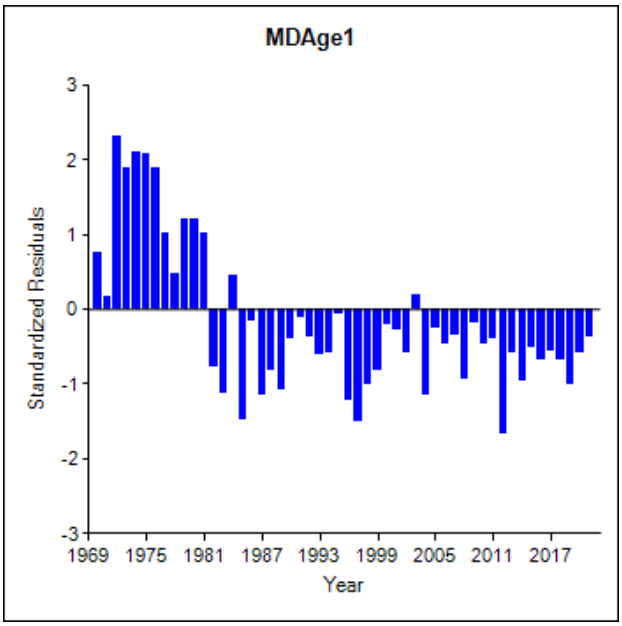

MDYOY
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1975
1981
1987
1993
1999
2005
2011
2017

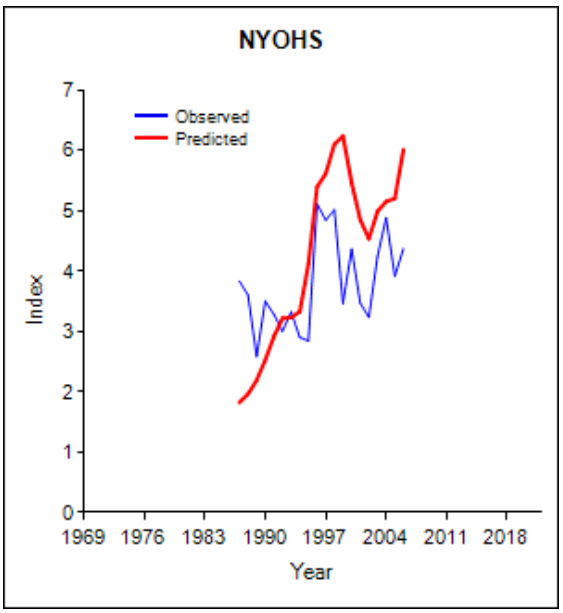

compos
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1975
1981
1987
1993
1999
2005
2011
2017

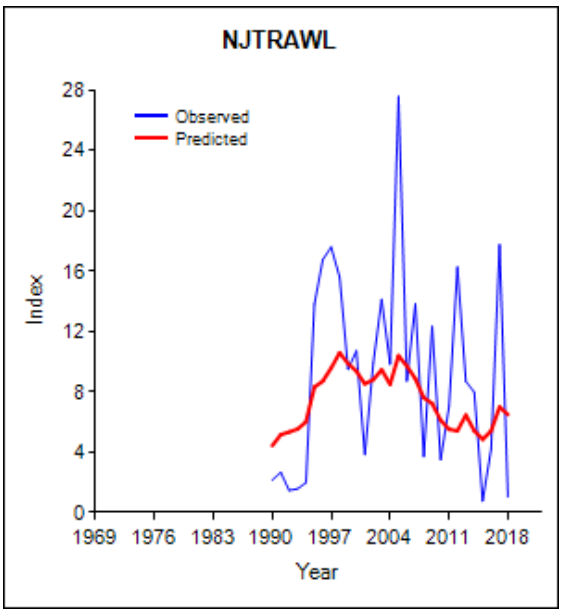

NYAge1
Observed
Predicted
Index
Year
0
1
2
3
4
1969
1975
1981
1987
1993
1999
2005
2011
2017

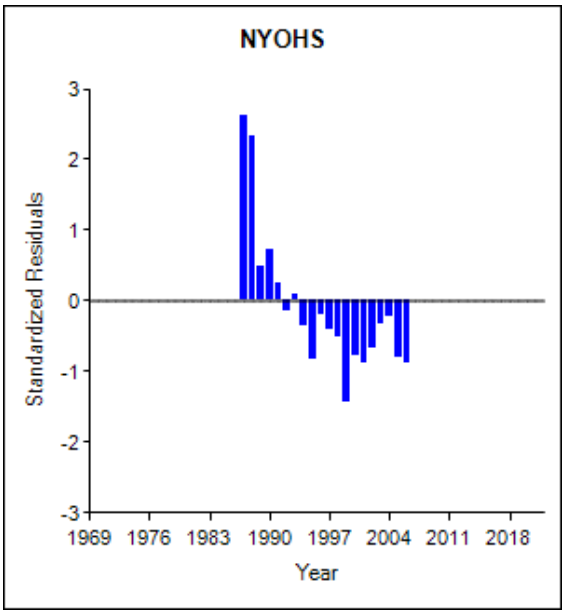

MDAge1
Observed
Predicted
Index
Year
0
0.5
1
1.5
2
1969
1975
1981
1987
1993
1999
2005
2011
2017

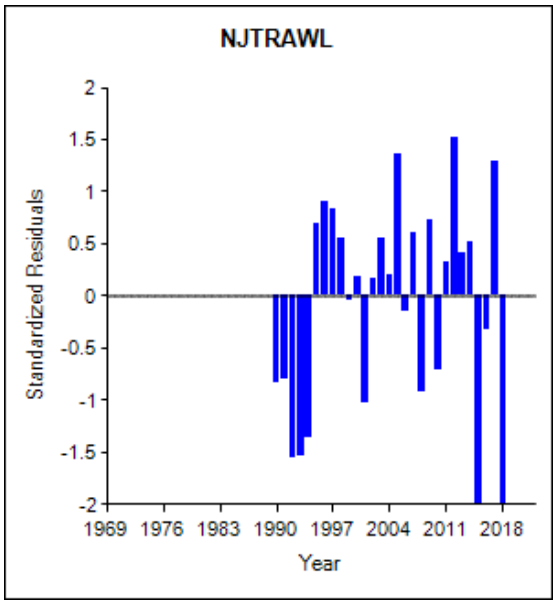

NYAge1
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1975
1981
1987
1993
1999
2005
2011
2017

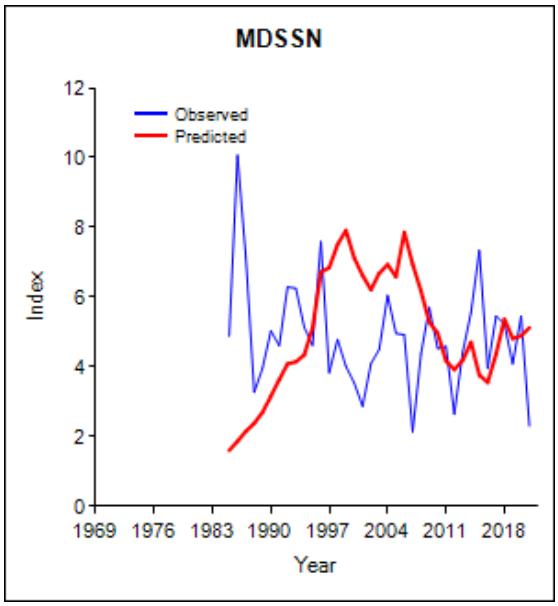

MDAge1
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1975
1981
1987
1993
1999
2005
2011
2017

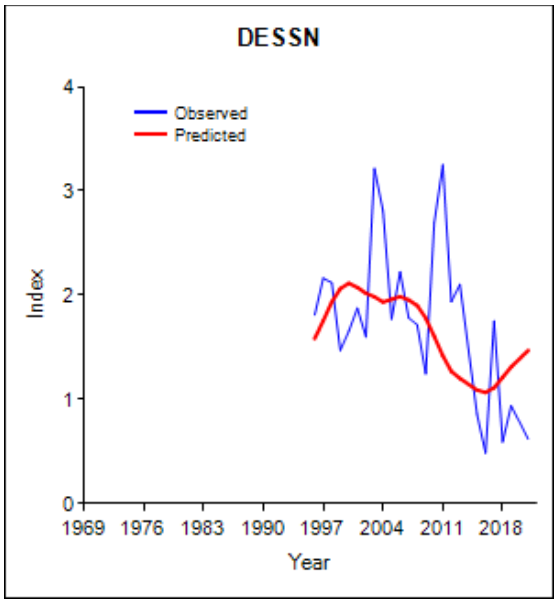

NYOHS
Observed
Predicted
Index
Year
0
1
2
3
4
5
6
7
1969
1976
1983
1990
1997
2004
2011
2018

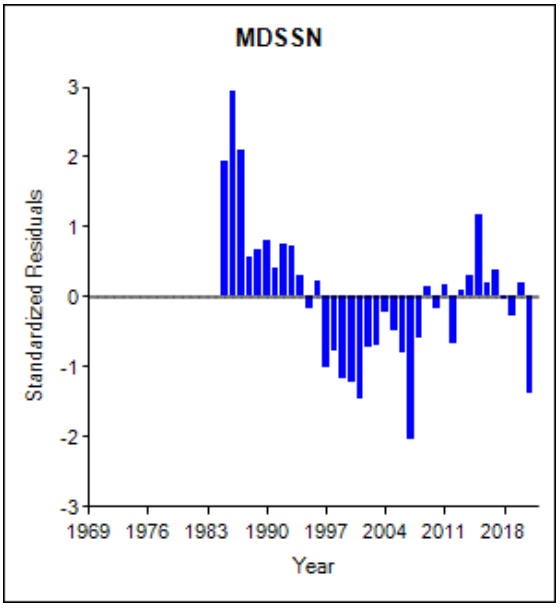

NJTRAWL
Observed
Predicted
Index
Year
0
4
8
12
16
20
24
28
1969
1976
1983
1990
1997
2004
2011
2018

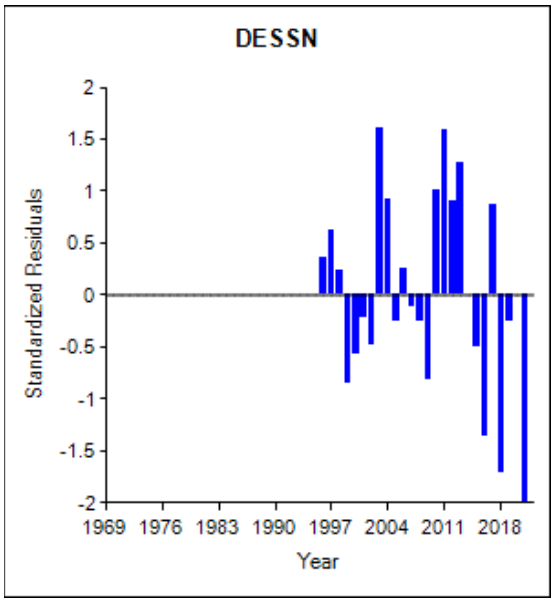

NYOHS
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1976
1983
1990
1997
2004
2011
2018

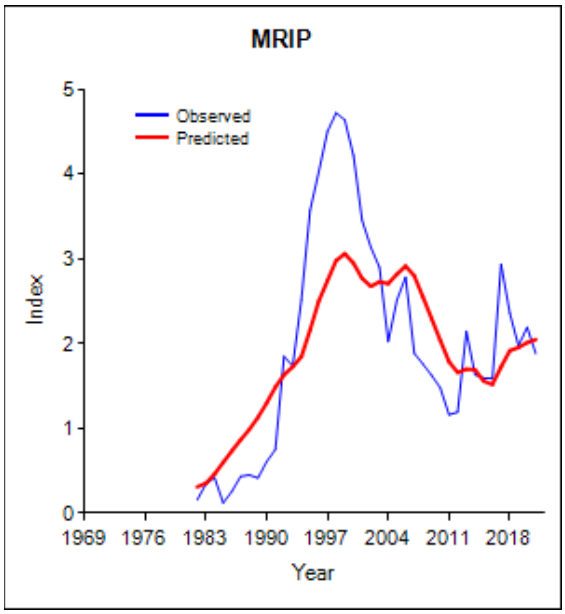

NJTRAWL
Standardized Residuals
Year
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
1969
1976
1983
1990
1997
2004
2011
2018

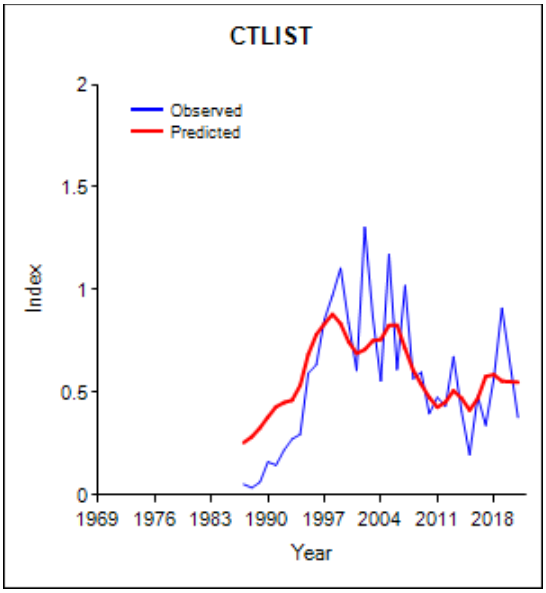

MDSSN
Observed
Predicted
Index
Year
0
2
4
6
8
10
12
1969
1976
1983
1990
1997
2004
2011
2018

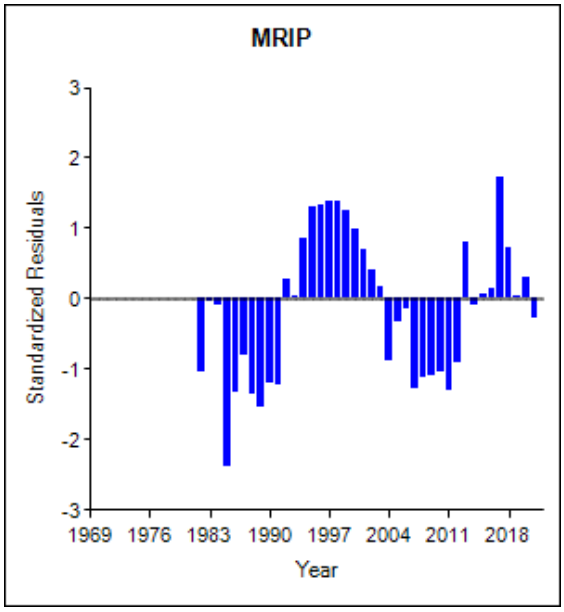

DESSN
Observed
Predicted
Index
Year
0
1
2
3
4
1969
1976
1983
1990
1997
2004
2011
2018

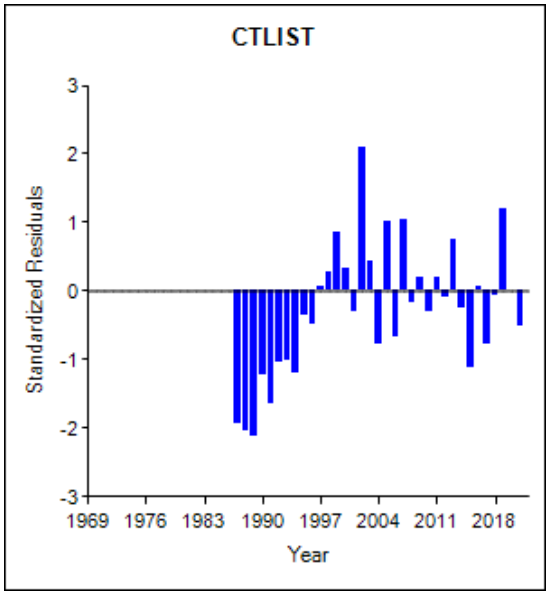

MDSSN
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1976
1983
1990
1997
2004
2011
2018

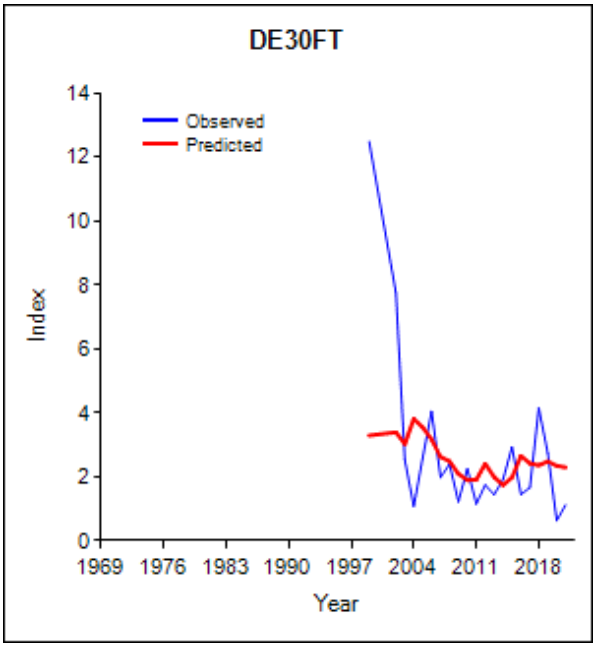

DESSN
Standardized Residuals
Year
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
1969
1976
1983
1990
1997
2004
2011
2018

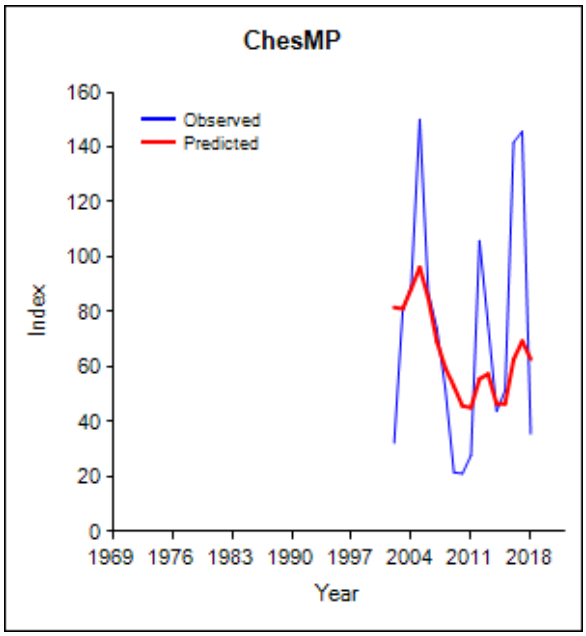

MRIP
Observed
Predicted
Index
Year
0
1
2
3
4
5
1969
1976
1983
1990
1997
2004
2011
2018

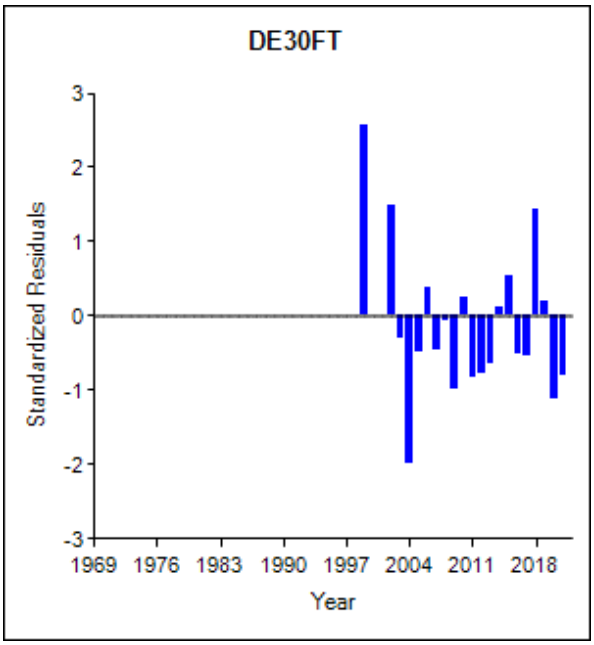

CTLIST
Observed
Predicted
Index
Year
0
0.5
1
1.5
2
1969
1976
1983
1990
1997
2004
2011
2018

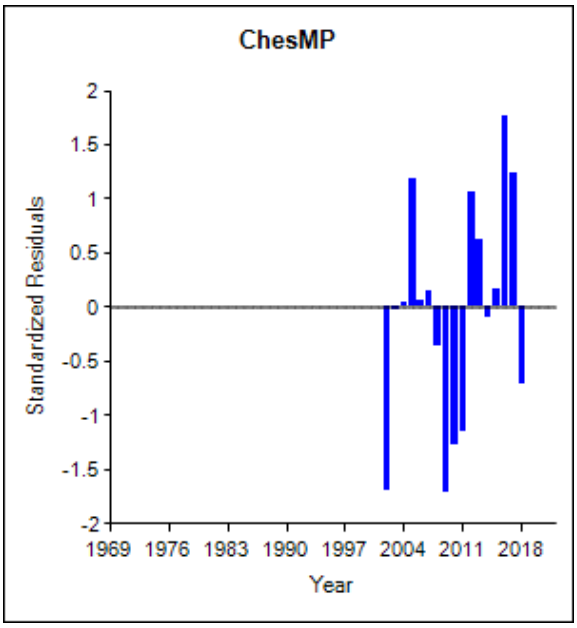

MRIP
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1976
1983
1990
1997
2004
2011
2018

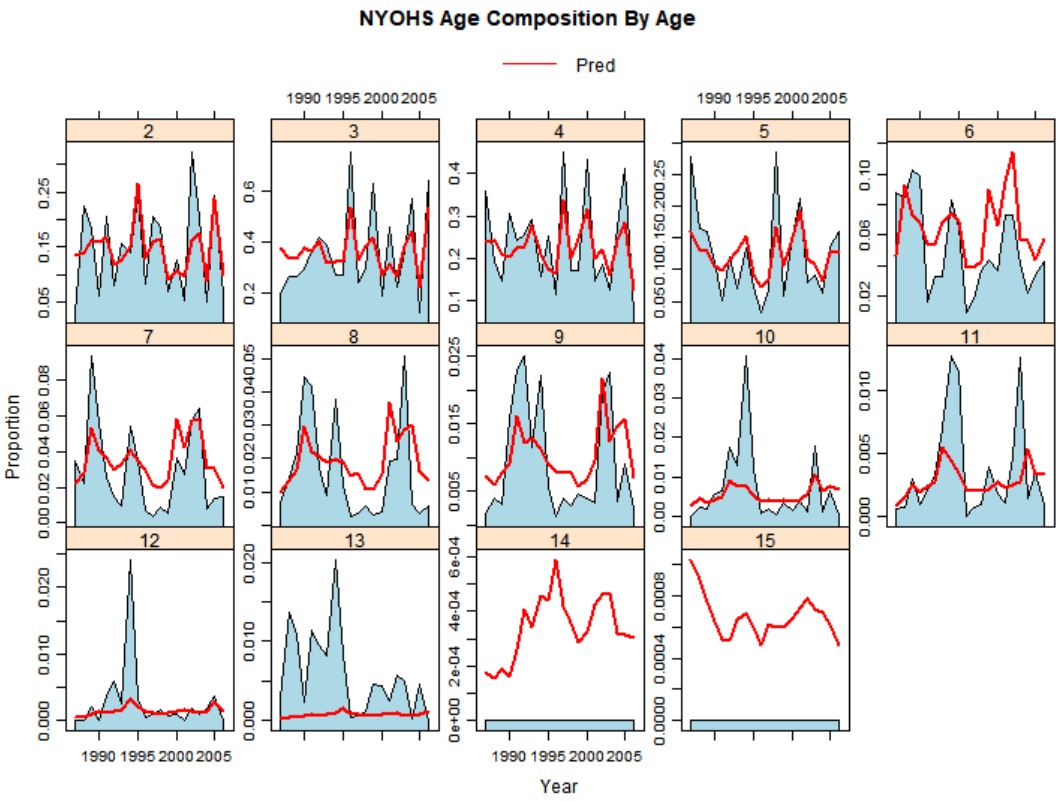

CTLIST
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1976
1983
1990
1997
2004
2011
2018

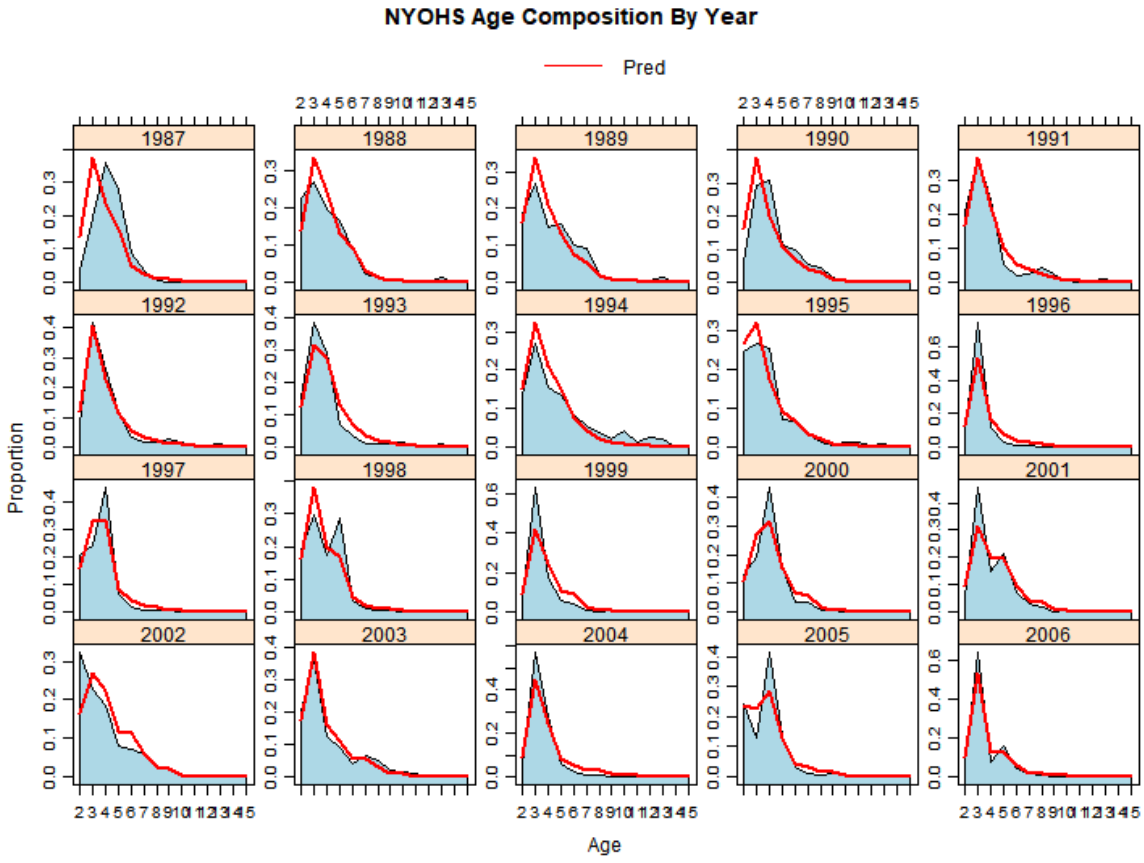

DE30FT
Observed
Predicted
Index
Year
0
2
4
6
8
10
12
14
1969
1976
1983
1990
1997
2004
2011
2018

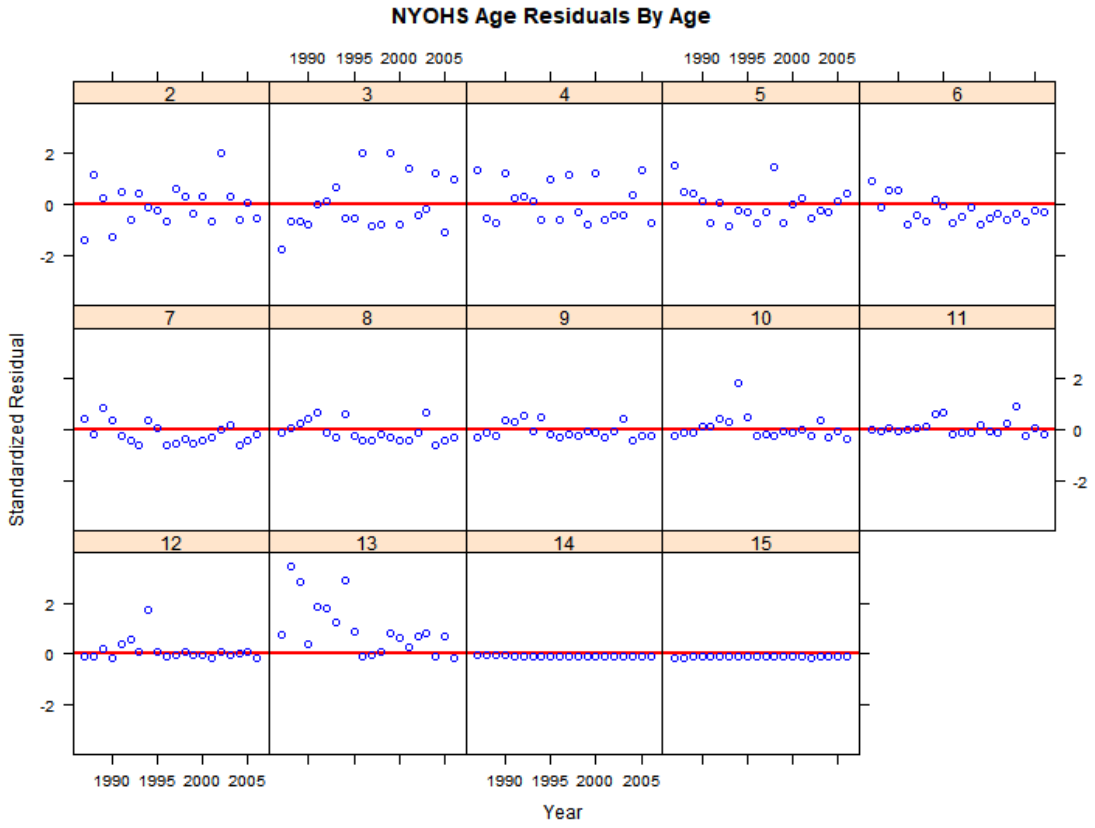

ChesMP
Observed
Predicted
Index
Year
0
20
40
60
80
100
120
140
160
1969
1976
1983
1990
1997
2004
2011
2018

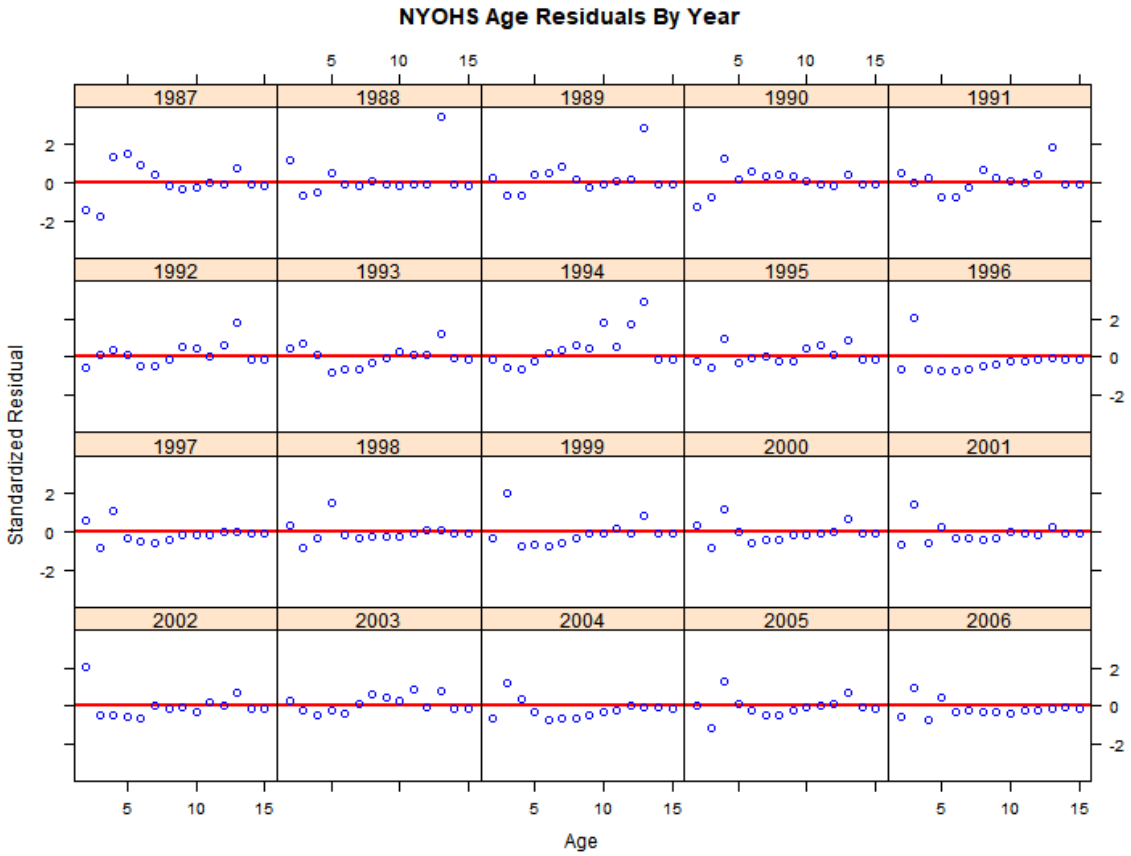

DE30FT
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1976
1983
1990
1997
2004
2011
2018

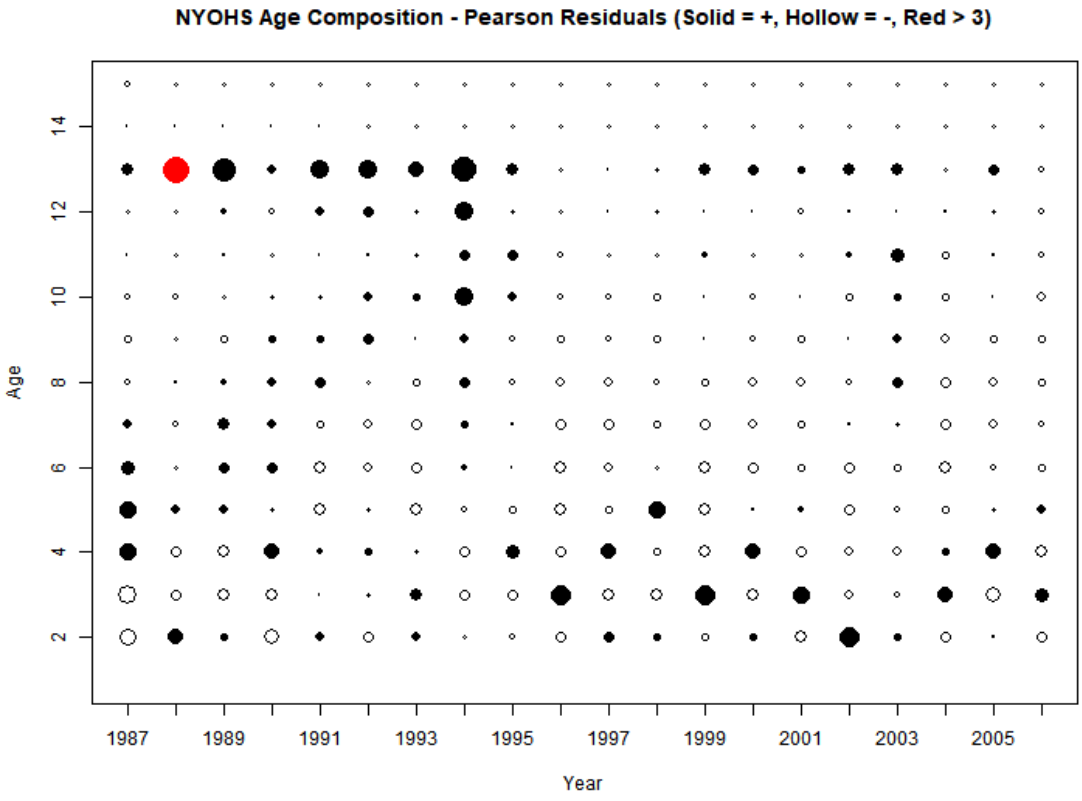

ChesMP
Standardized Residuals
Year
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
1969
1976
1983
1990
1997
2004
2011
2018

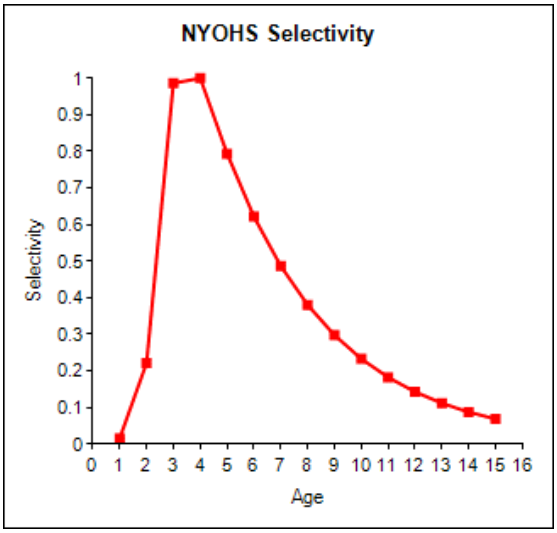

NYOHS Age Composition By Age
Pred
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year

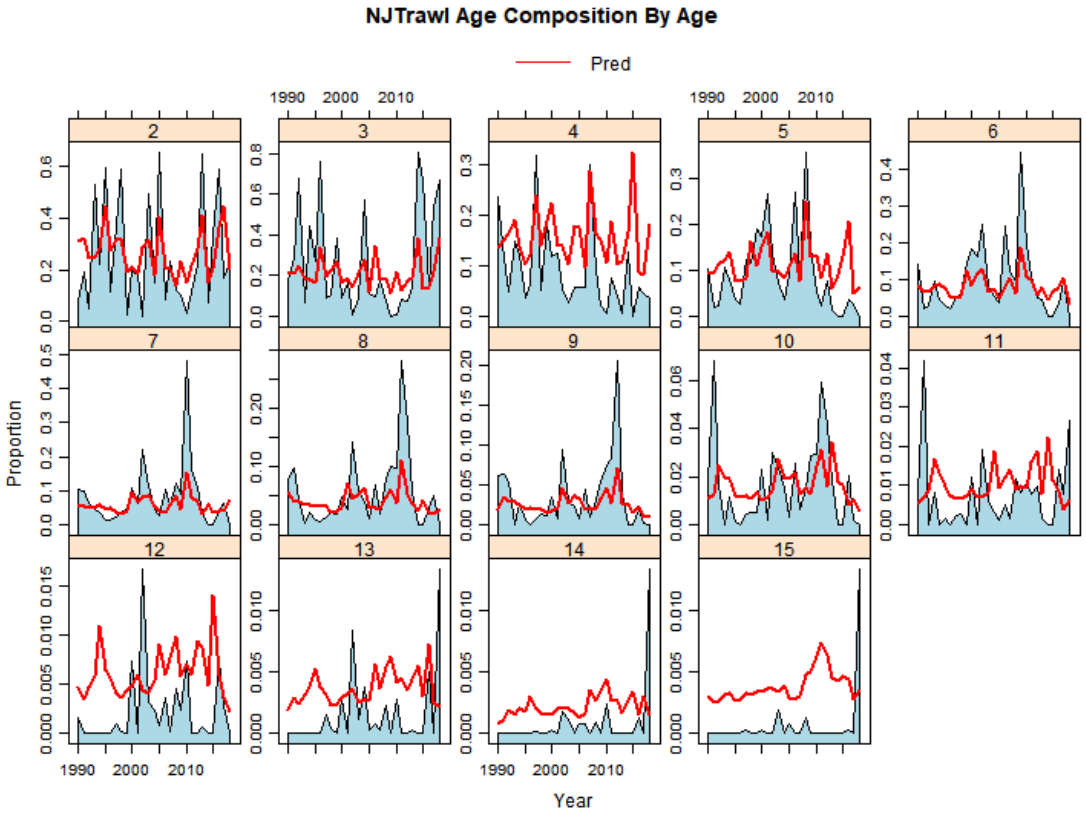

NYOHS Age Composition By Year
Pred
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Proportion
Age

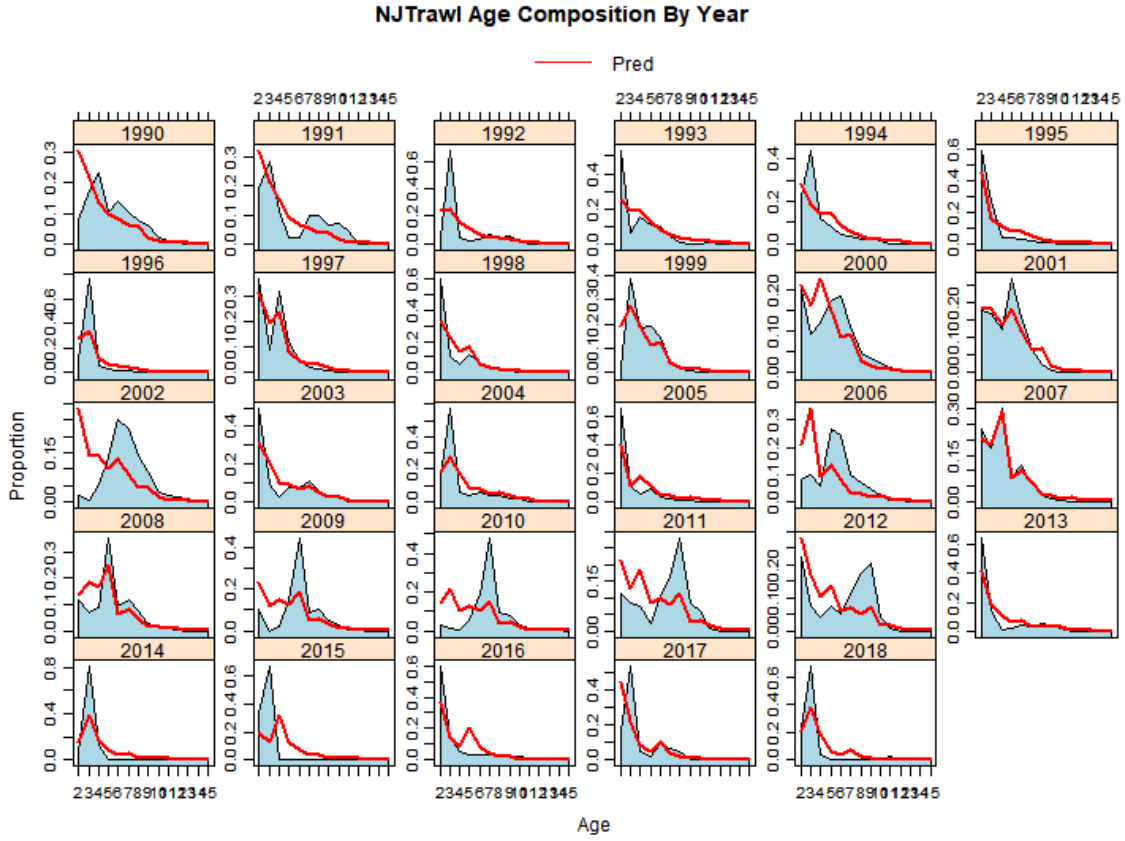

NYOHS Age Residuals By Age
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1990 1995 2000 2005
Standardized Residual
Year


NYOHS Age Residuals By Year
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
5 10 15
Standardized Residual
Age


NYOHS Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year


NYOHS Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


NJTrawl Age Composition By Age
Pred
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year


NJTrawl Age Composition By Year
Pred
1990
1991
1992
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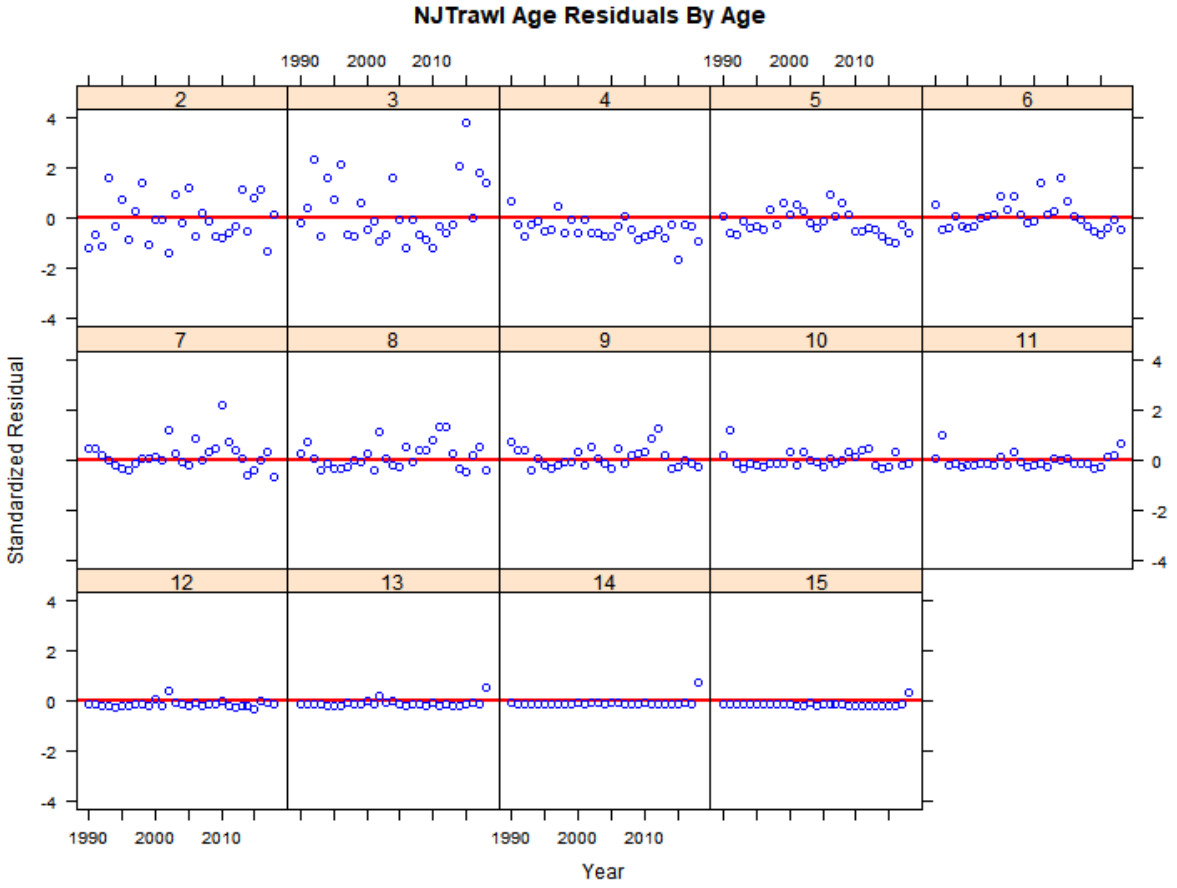
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Proportion
Age


NJTrawl Age Residuals By Age
2
3
4
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9
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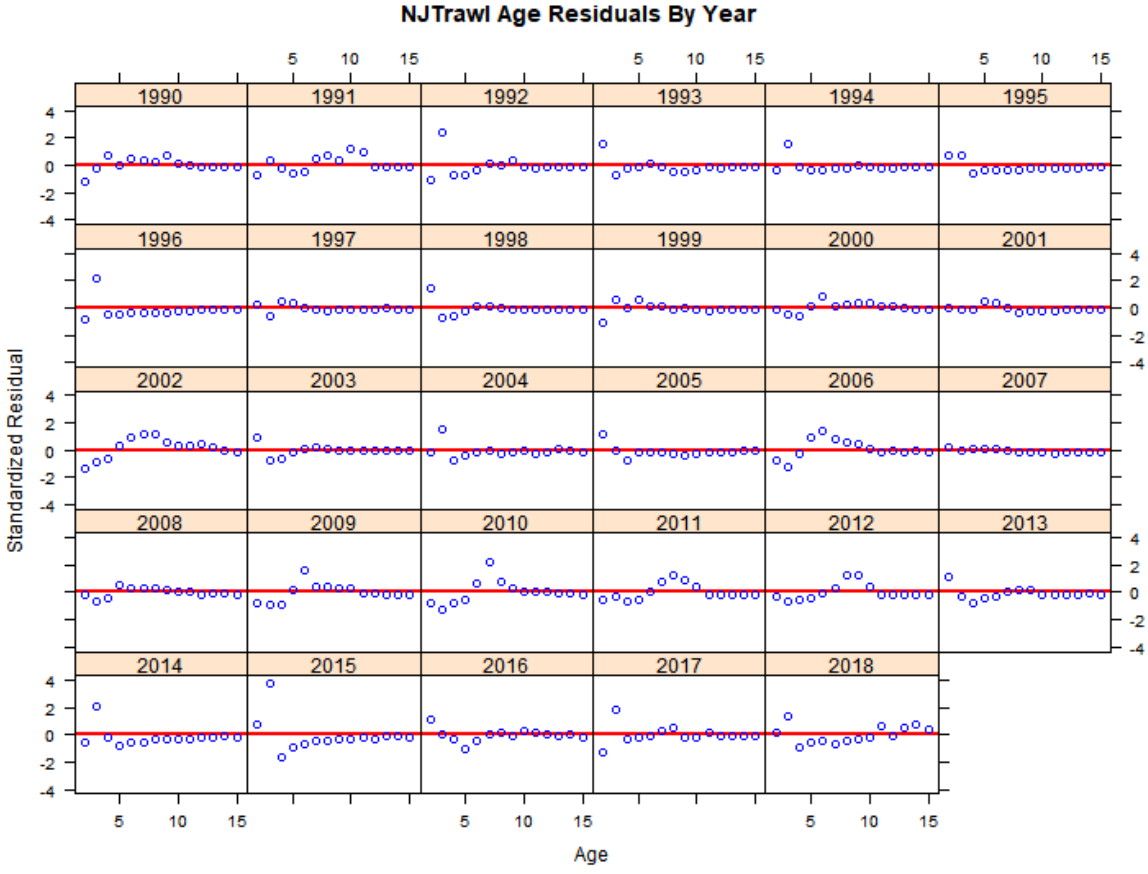
11
12
13
14
15
Standardized Residual
Year


NJTrawl Age Residuals By Year
1990
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2014
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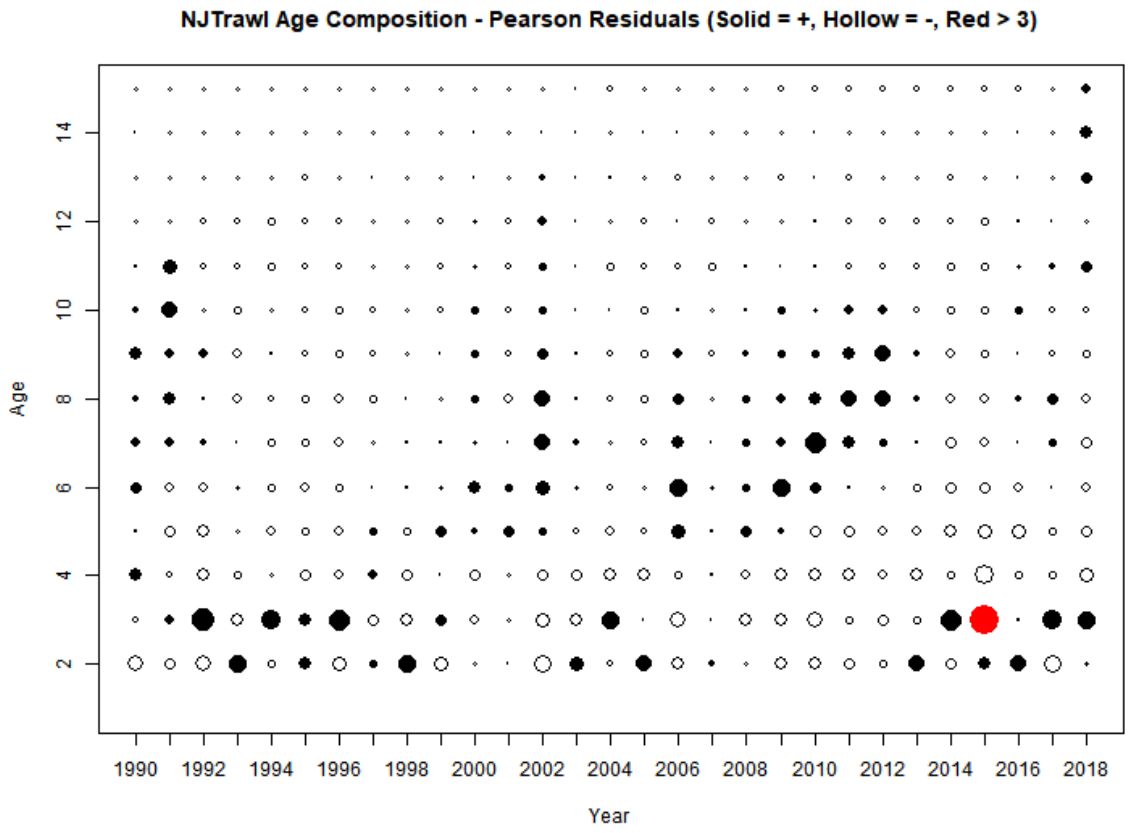
2016
2017
2018
Standardized Residual
Age


NJTrawl Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
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12
14
1990
1992
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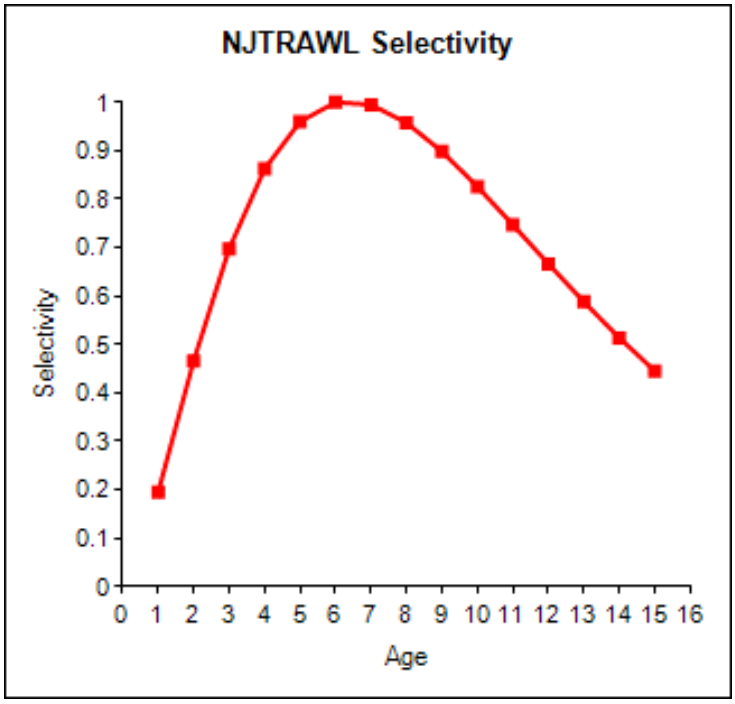
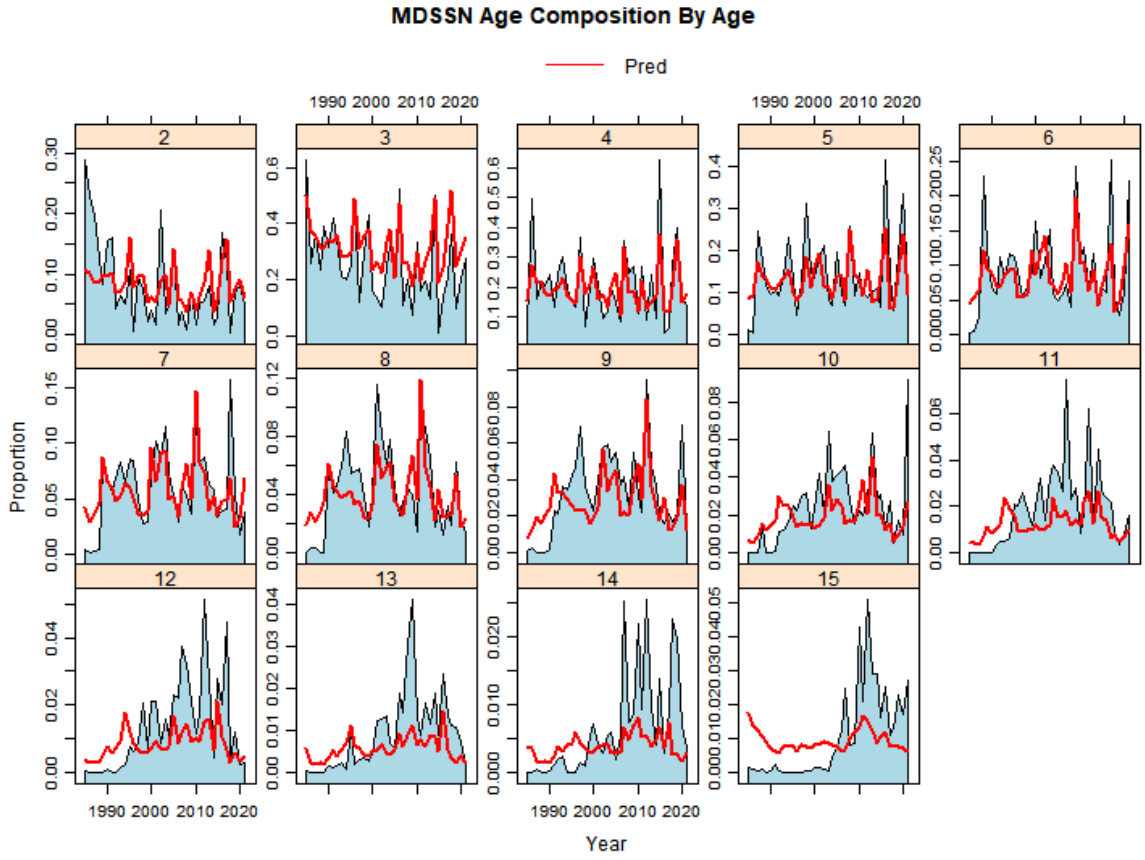
2008
2010
2012
2014
2016
2018
Year


NJTRAWL Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


MDSSN Age Composition By Age
Pred
2
3
4
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8
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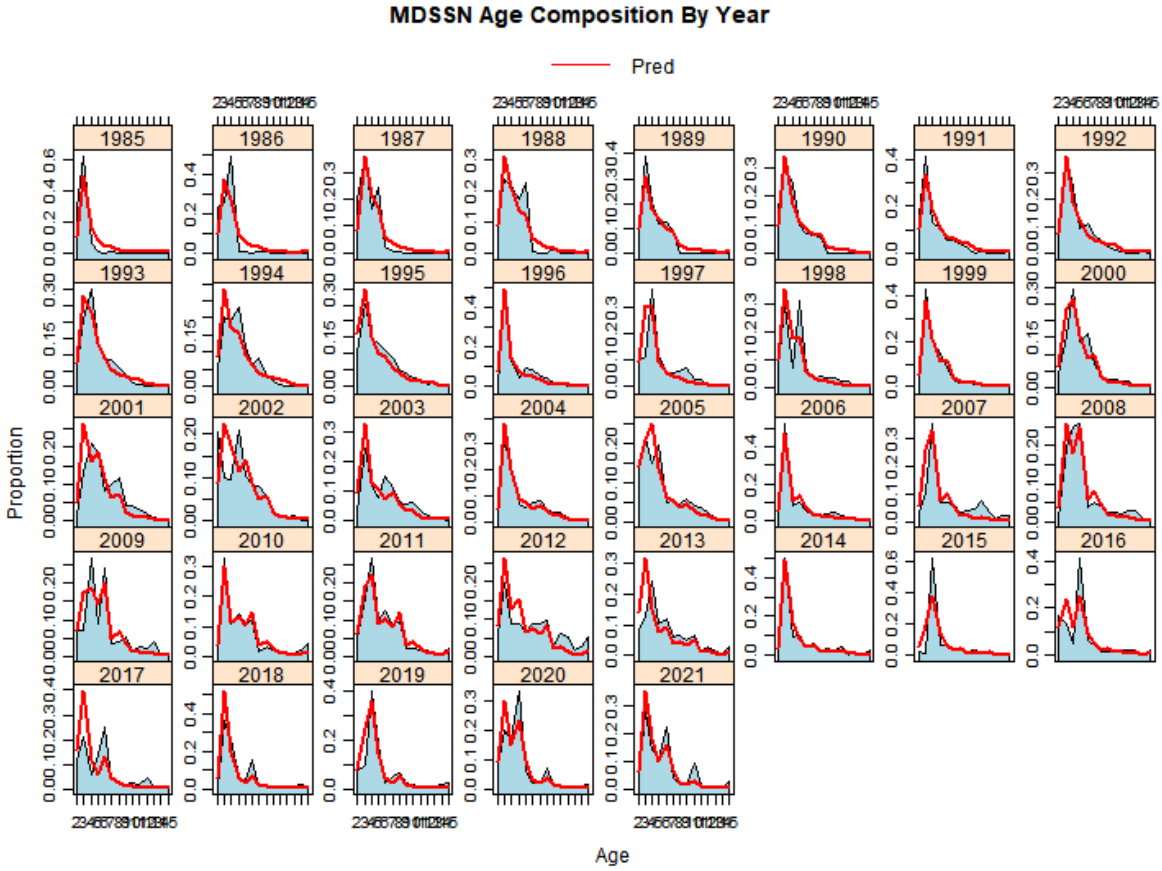
11
12
13
14
15
Proportion
Year


MDSSN Age Composition By Year
Pred
1985
1986
1987
1988
1989
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2000
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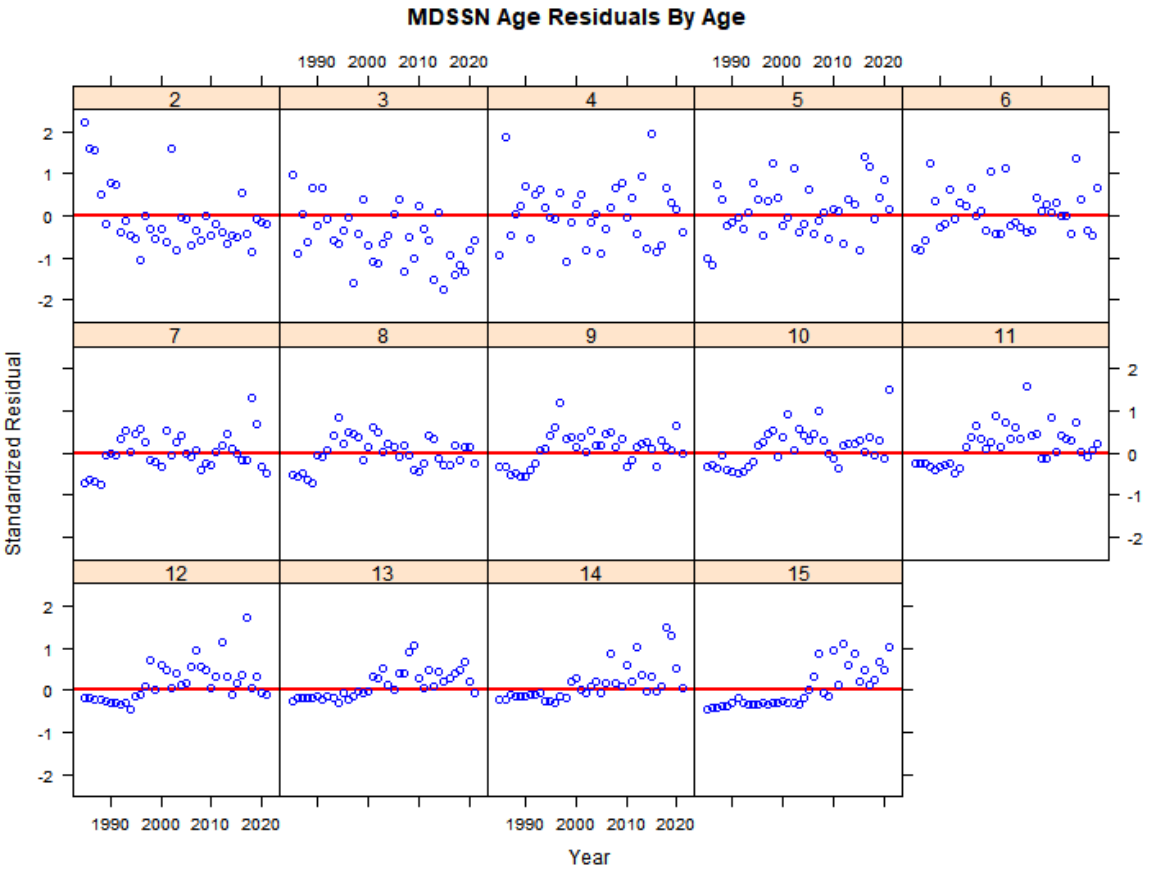
2017
2018
2019
2020
2021
Proportion
Age


MDSSN Age Residuals By Age
2
3
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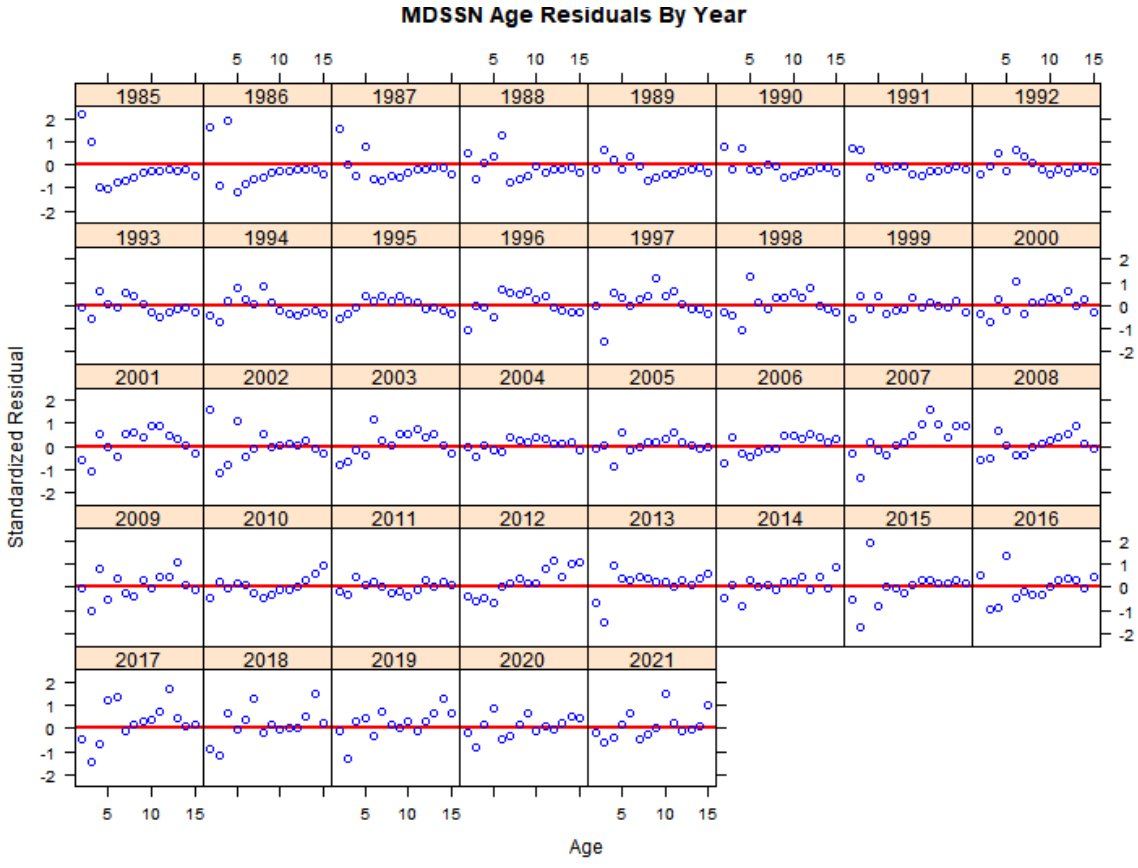
11
12
13
14
15
1990 2000 2010 2020
Standardized Residual
Year


MDSSN Age Residuals By Year
1985
1986
1987
1988
1989
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2000
2001
2002
2003
2004
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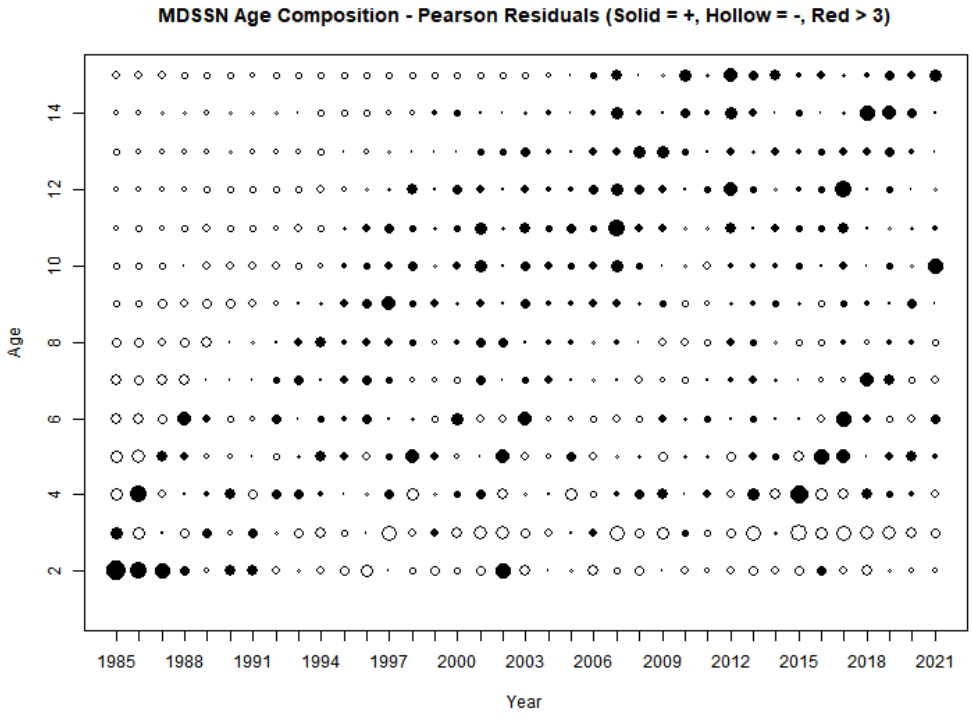
2019
2020
2021
5 10 15
Standardized Residual
Age


MDSSN Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
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12
14
1985
1988
1991
1994
1997
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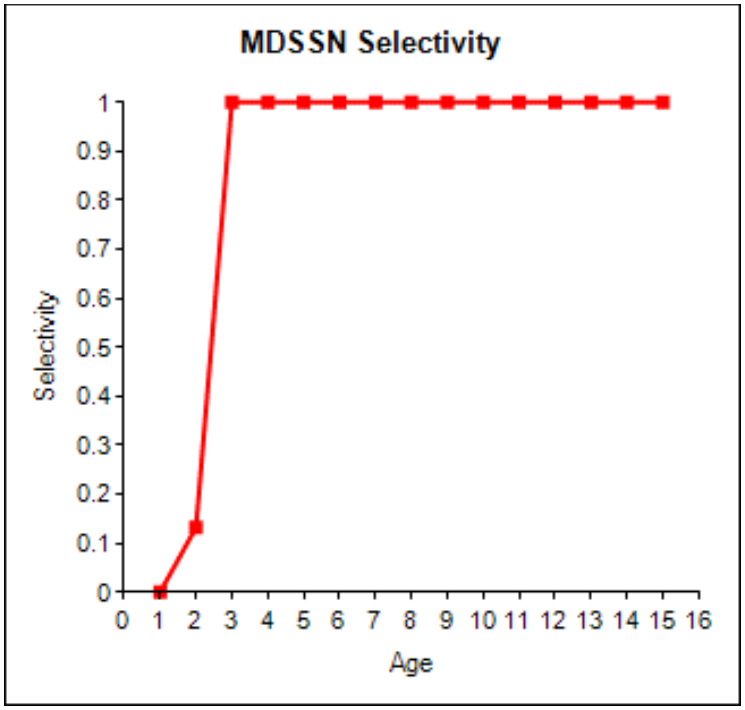
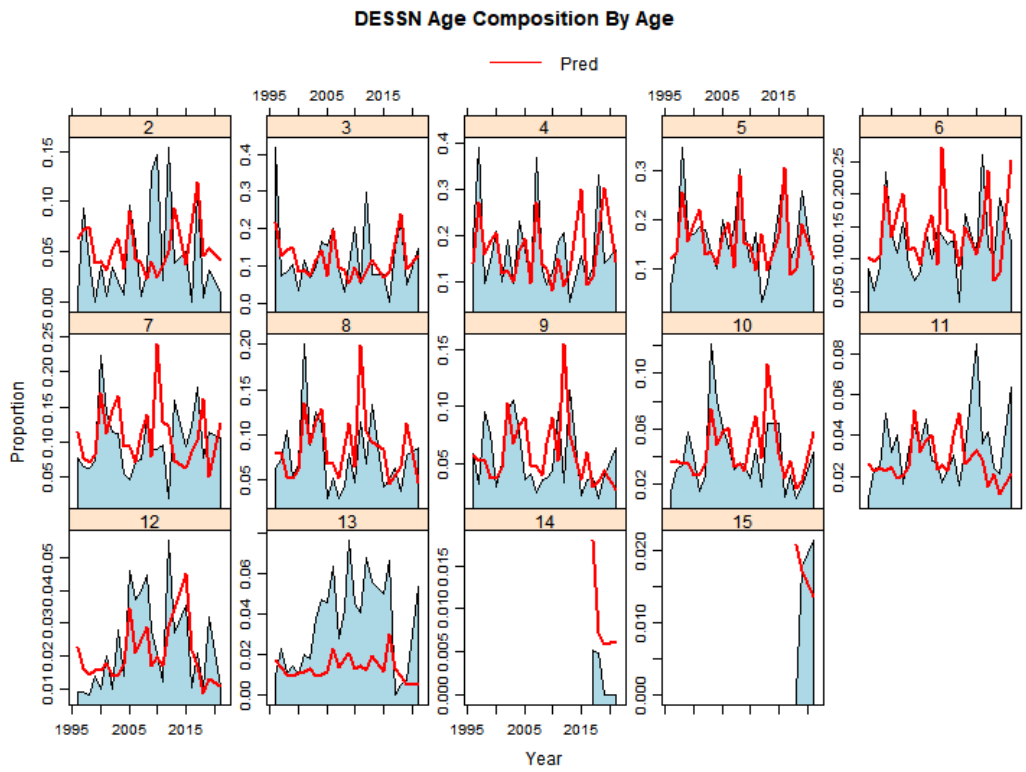
2006
2009
2012
2015
2018
2021
Year


MDSSN Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


DESSN Age Composition By Age
Pred
Proportion
Year
2
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12
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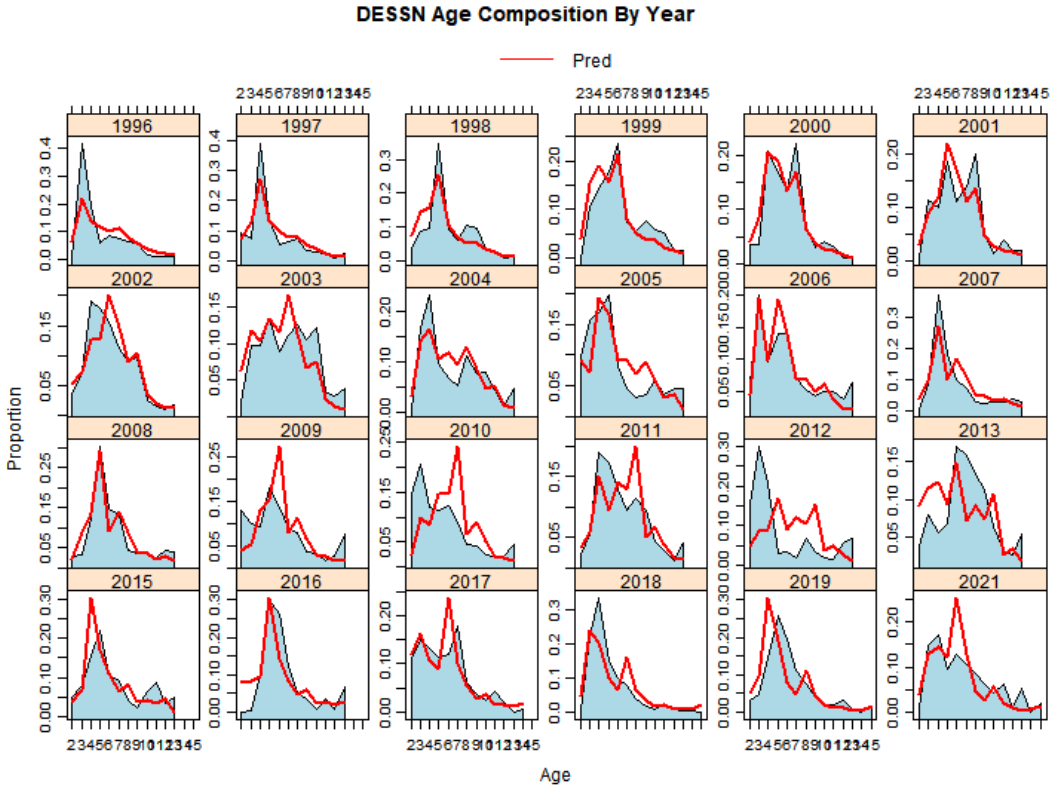
14
15


DESSN Age Composition By Year
Pred
Proportion
Age
1996
1997
1998
1999
2000
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2004
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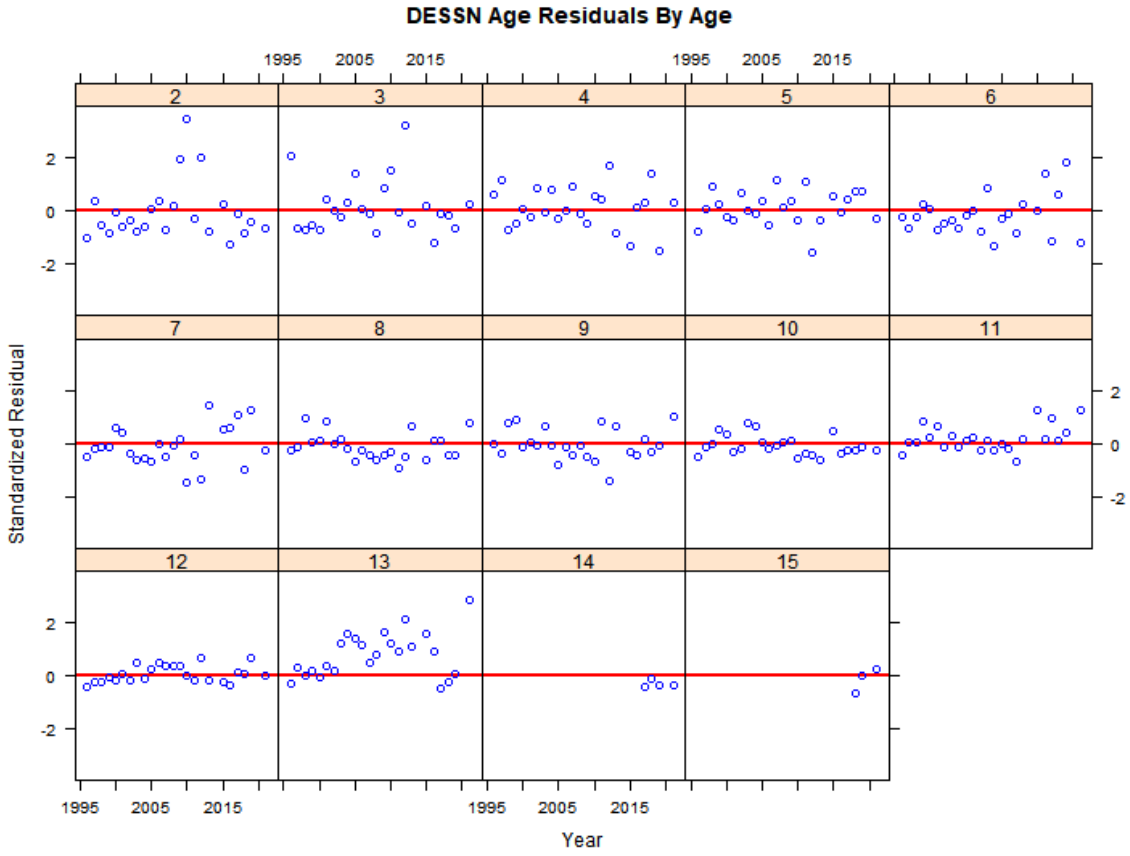
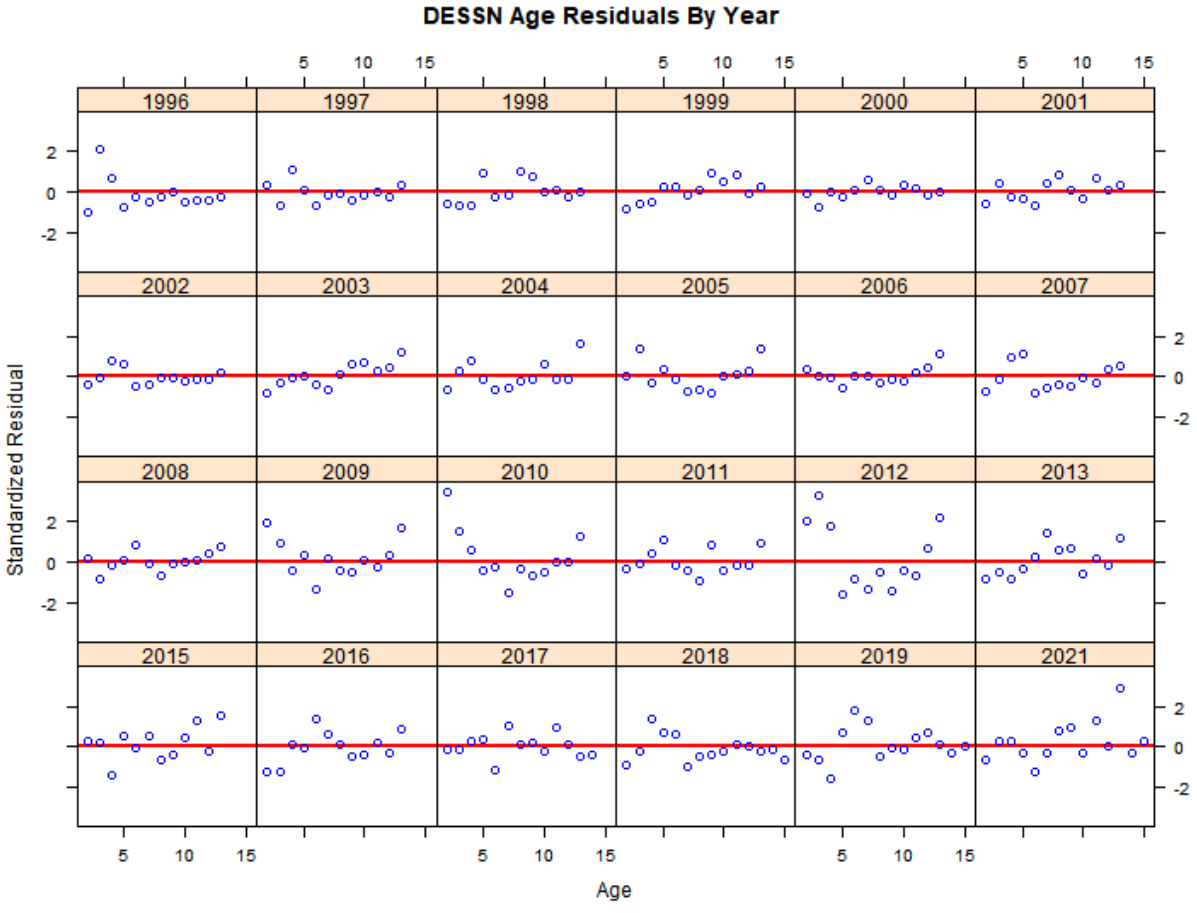
2010
2011
2012
2013
2015
2016
2017
2018
2019
2021


DESSN Age Residuals By Age
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1995
2005
2015
Standardized Residual
Year


DESSN Age Residuals By Year
1996
1997
1998
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2011
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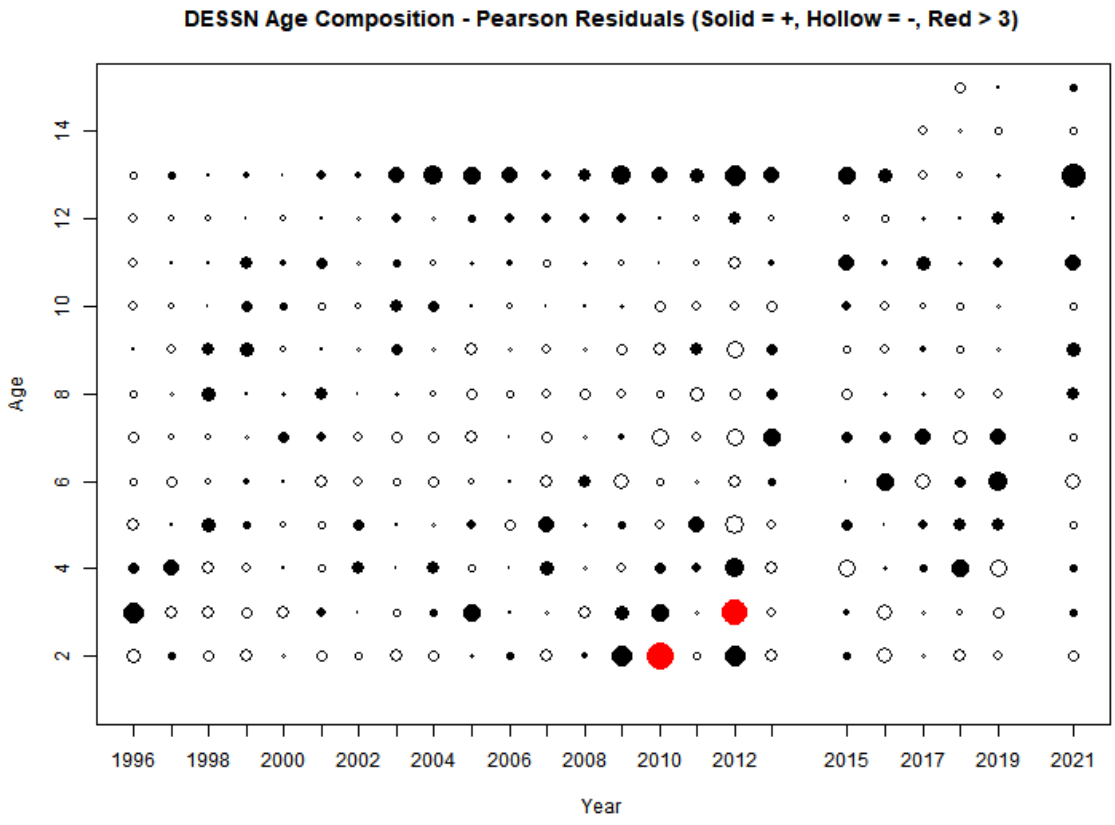
2015
2016
2017
2018
2019
2021
5
10
15
Standardized Residual
Age


DESSN Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
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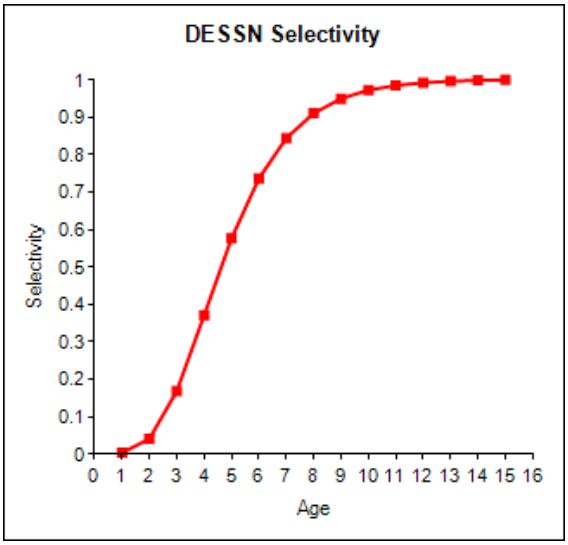
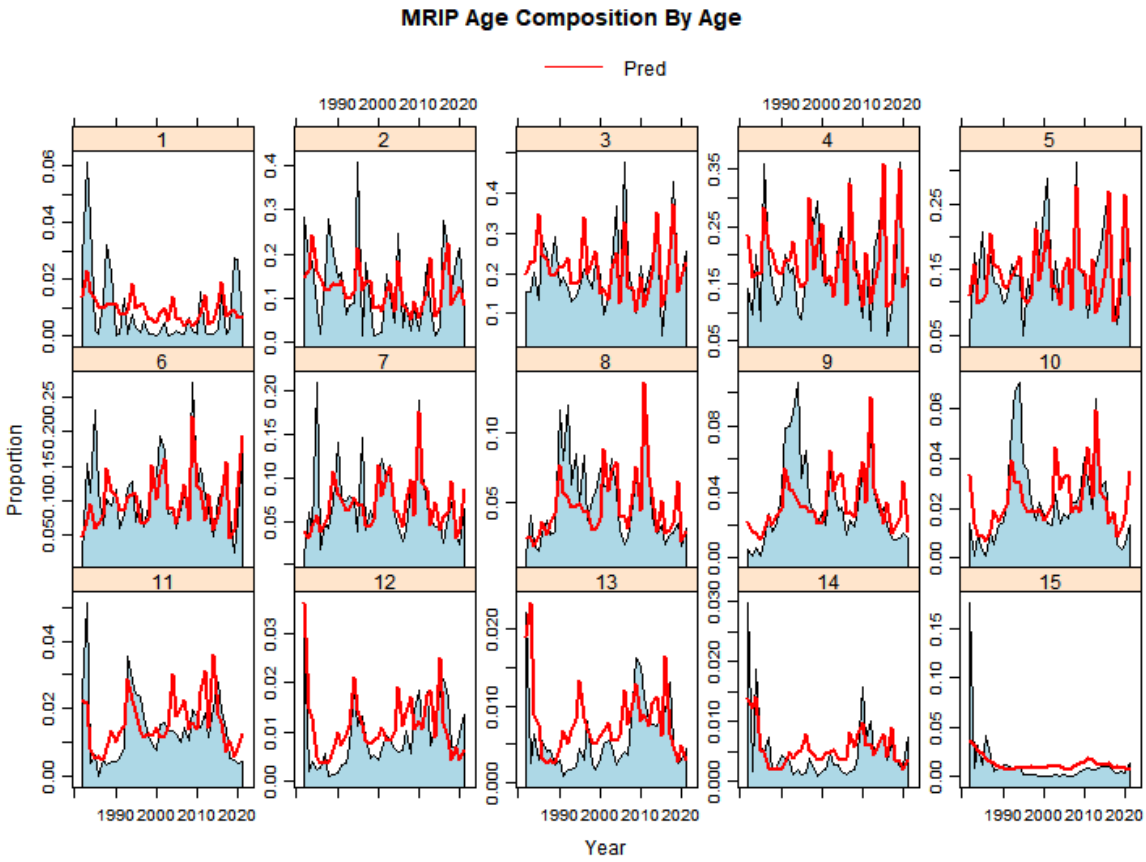
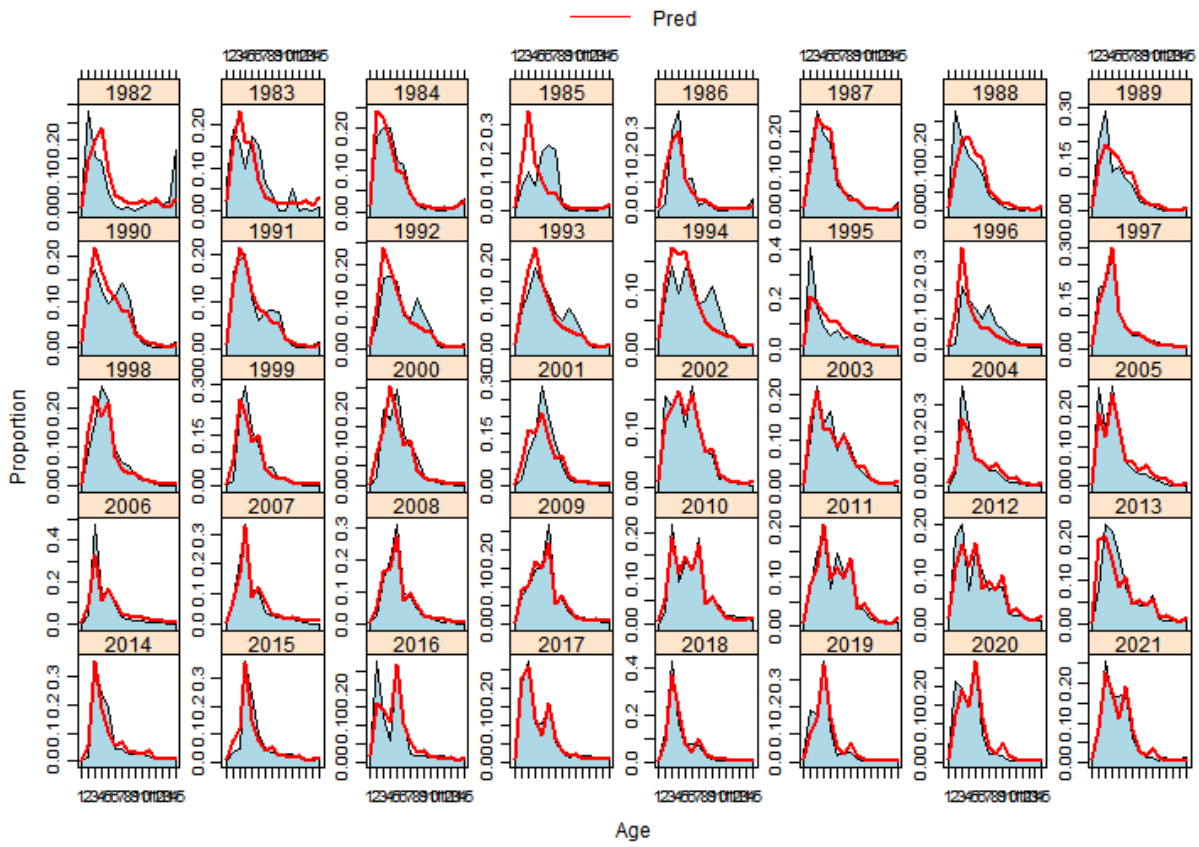
12
14
1996
1998
2000
2002
2004
2006
2008
2010
2012
2015
2017
2019
2021
Year


DESSN Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


MRIP Age Composition By Age
Pred
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year


MRIP Age Composition By Year
Pred
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
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2012
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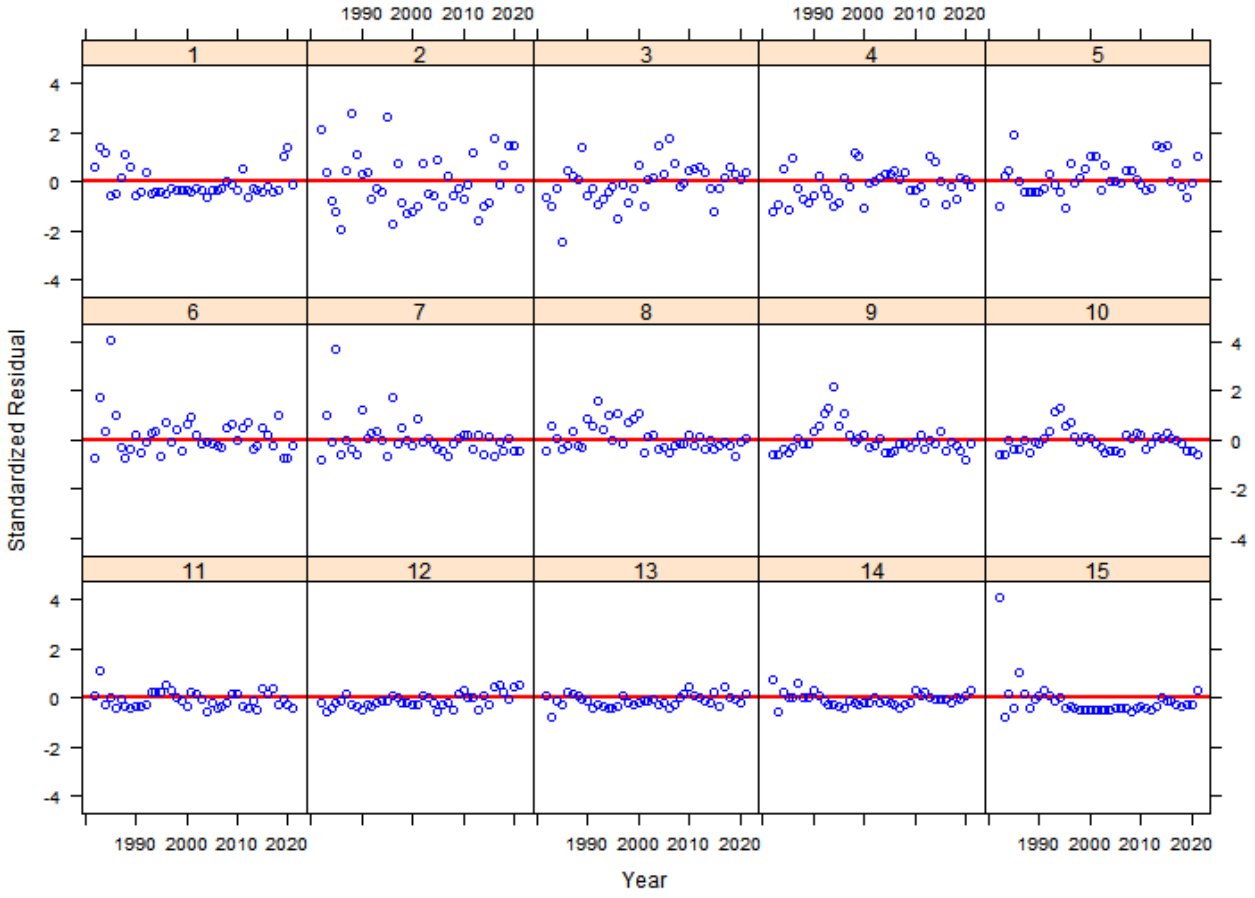
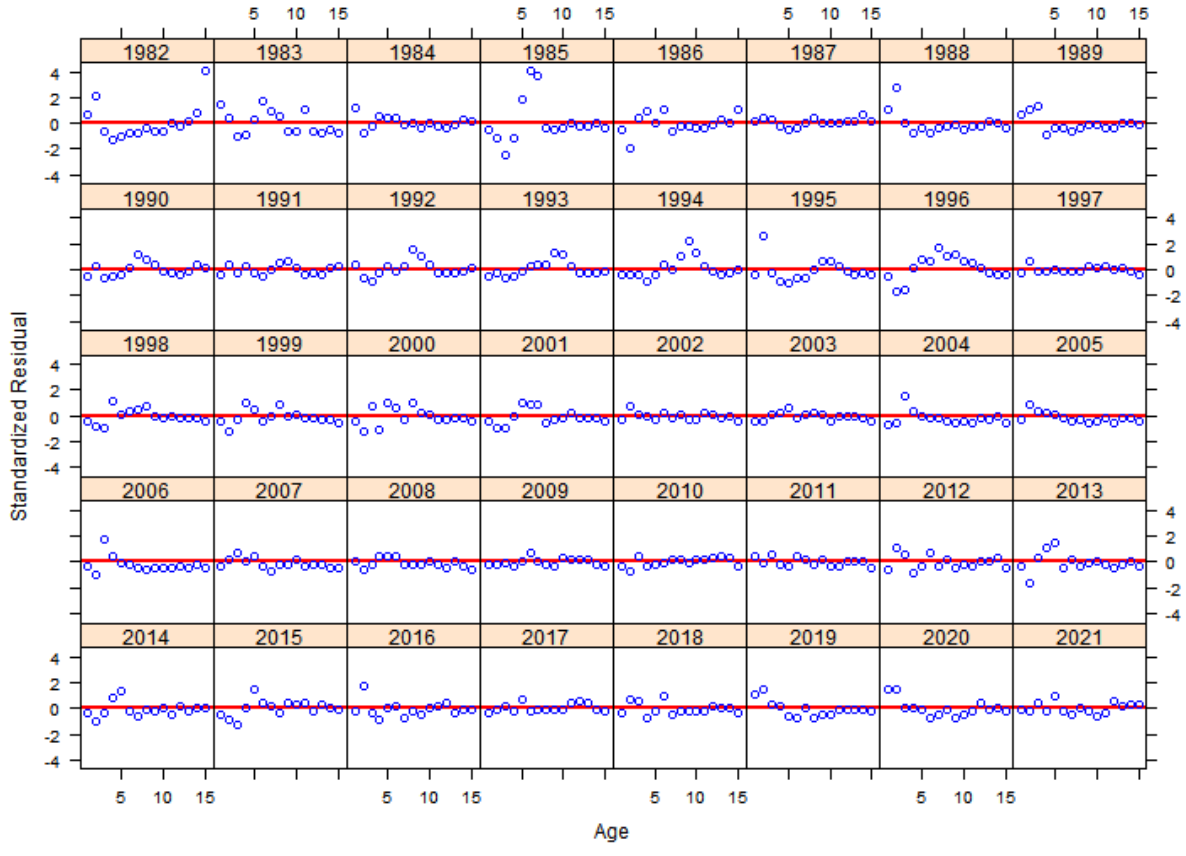
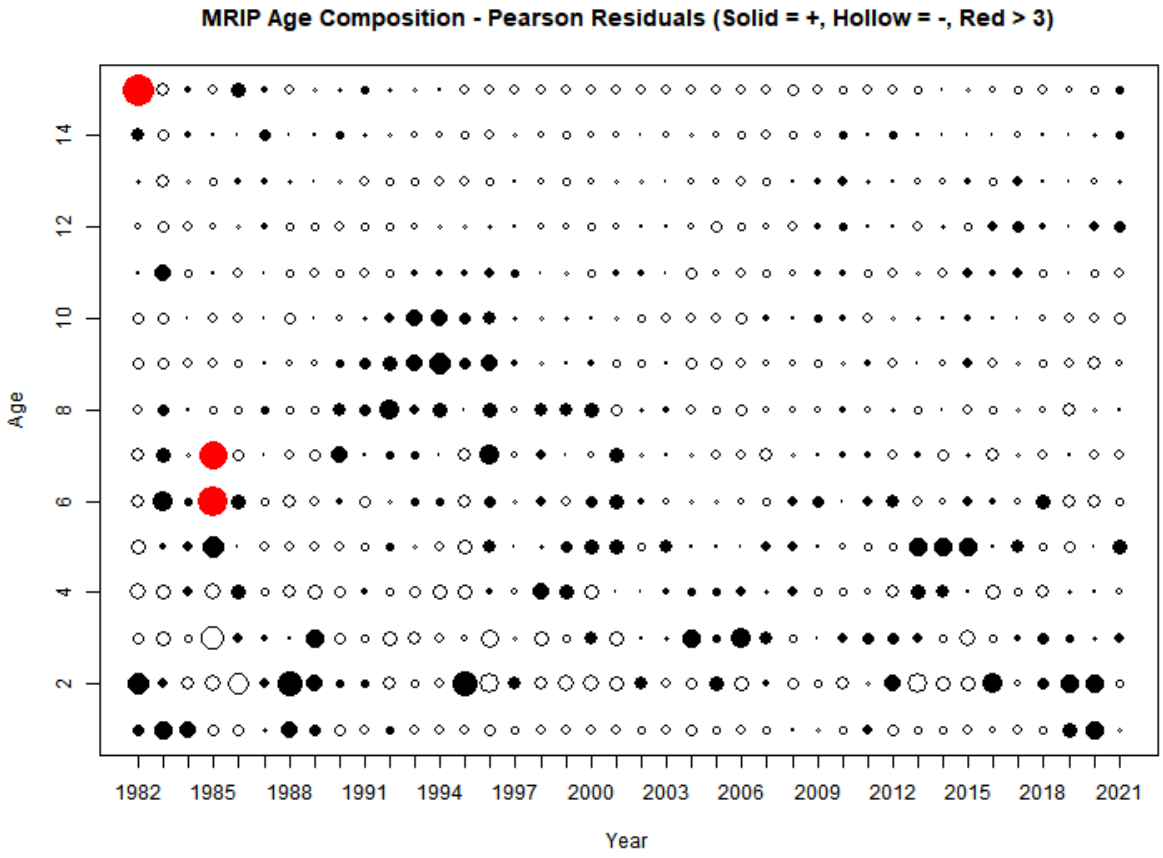
2016
2017
2018
2019
2020
2021
Proportion
Age

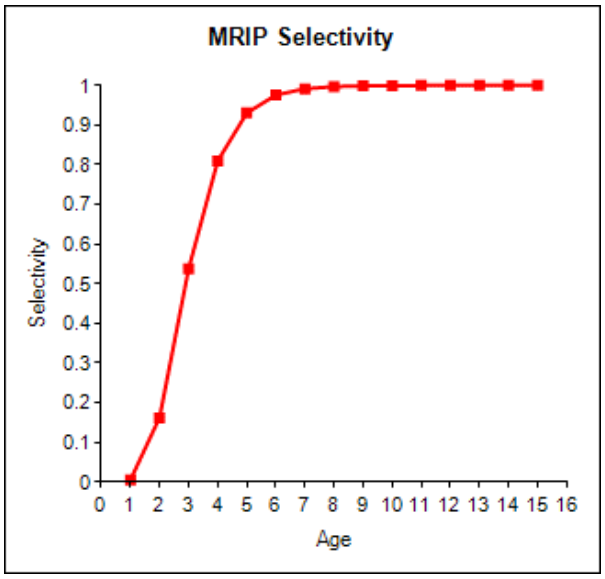
MRIP Age Residuals By Age

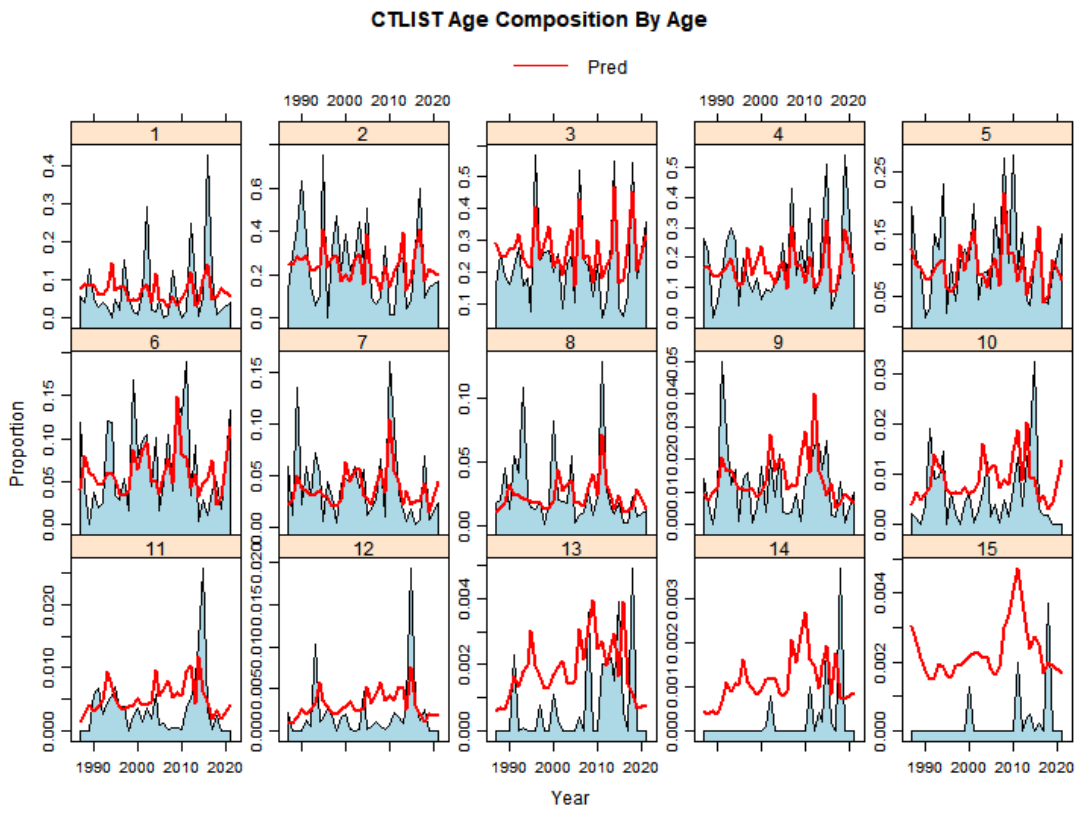


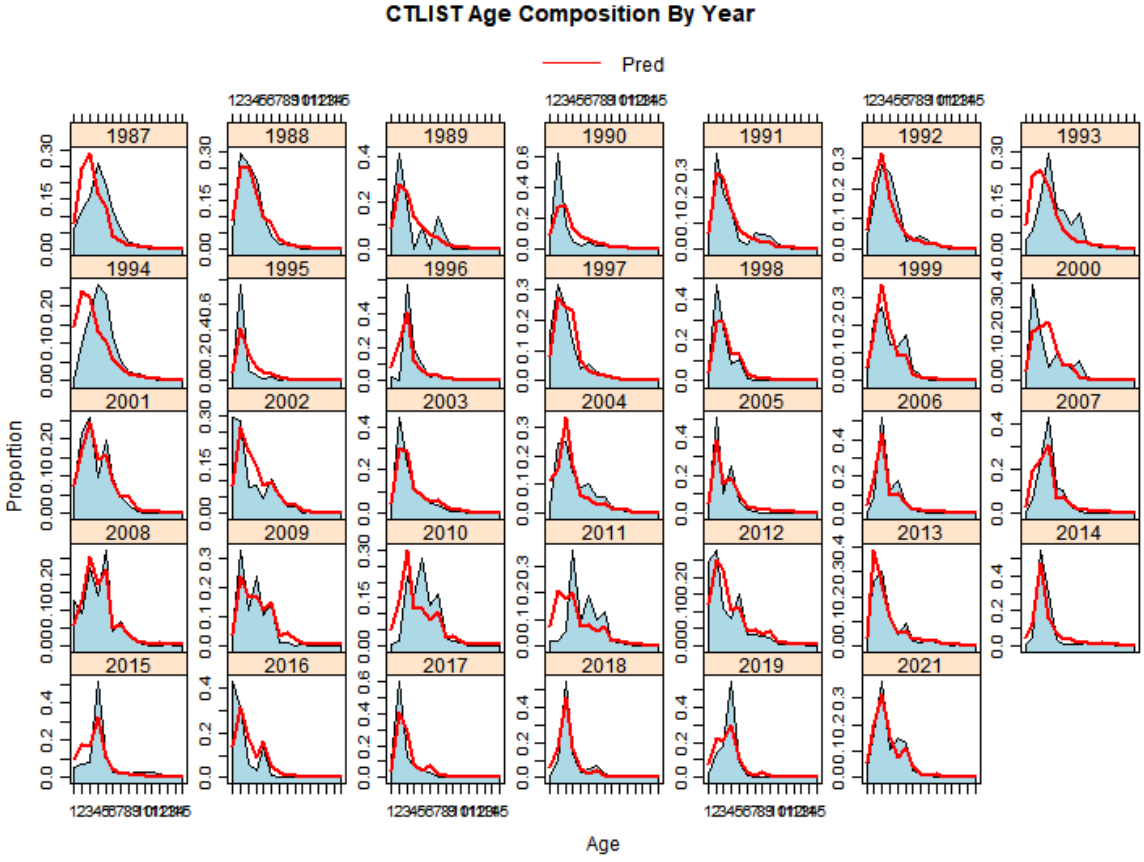
MRIP Age Residuals By Year




MRIP Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
2021
Year


MRIP Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


CTLIST Age Composition By Age
Pred
Proportion
Year
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


CTLIST Age Composition By Year
Pred
Proportion
Age
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
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2006
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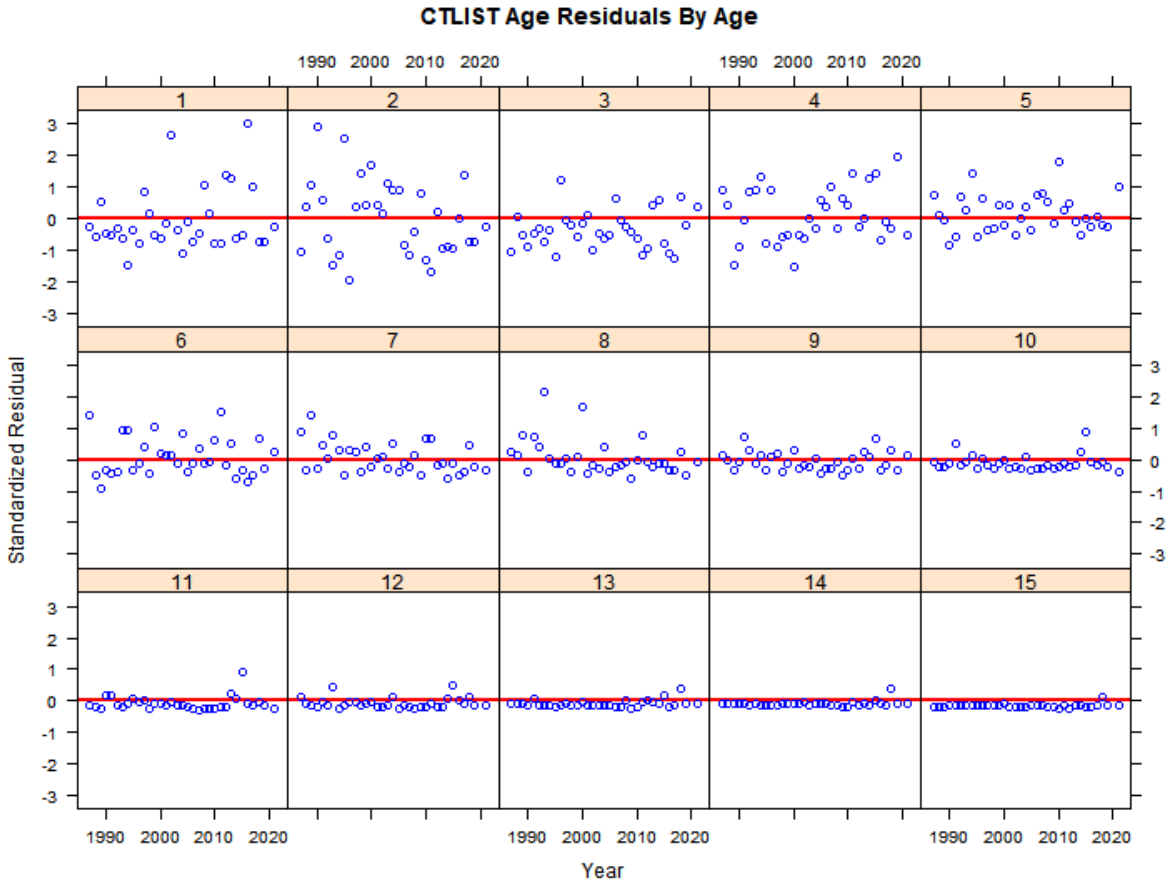
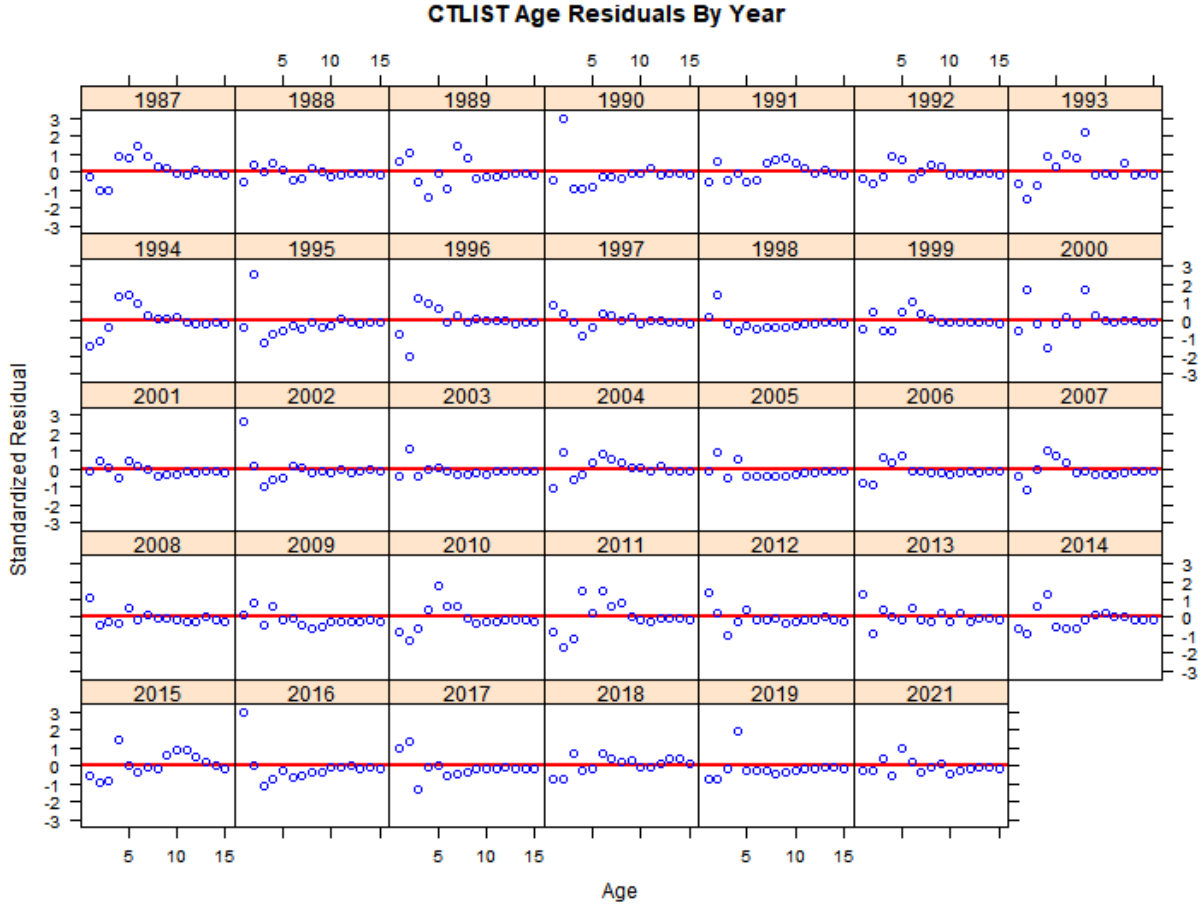
2017
2018
2019
2021


CTLIST Age Residuals By Age
1 2 3 4 5
6 7 8 9 10
11 12 13 14 15
1990 2000 2010 2020
Standardized Residual
Year


CTLIST Age Residuals By Year
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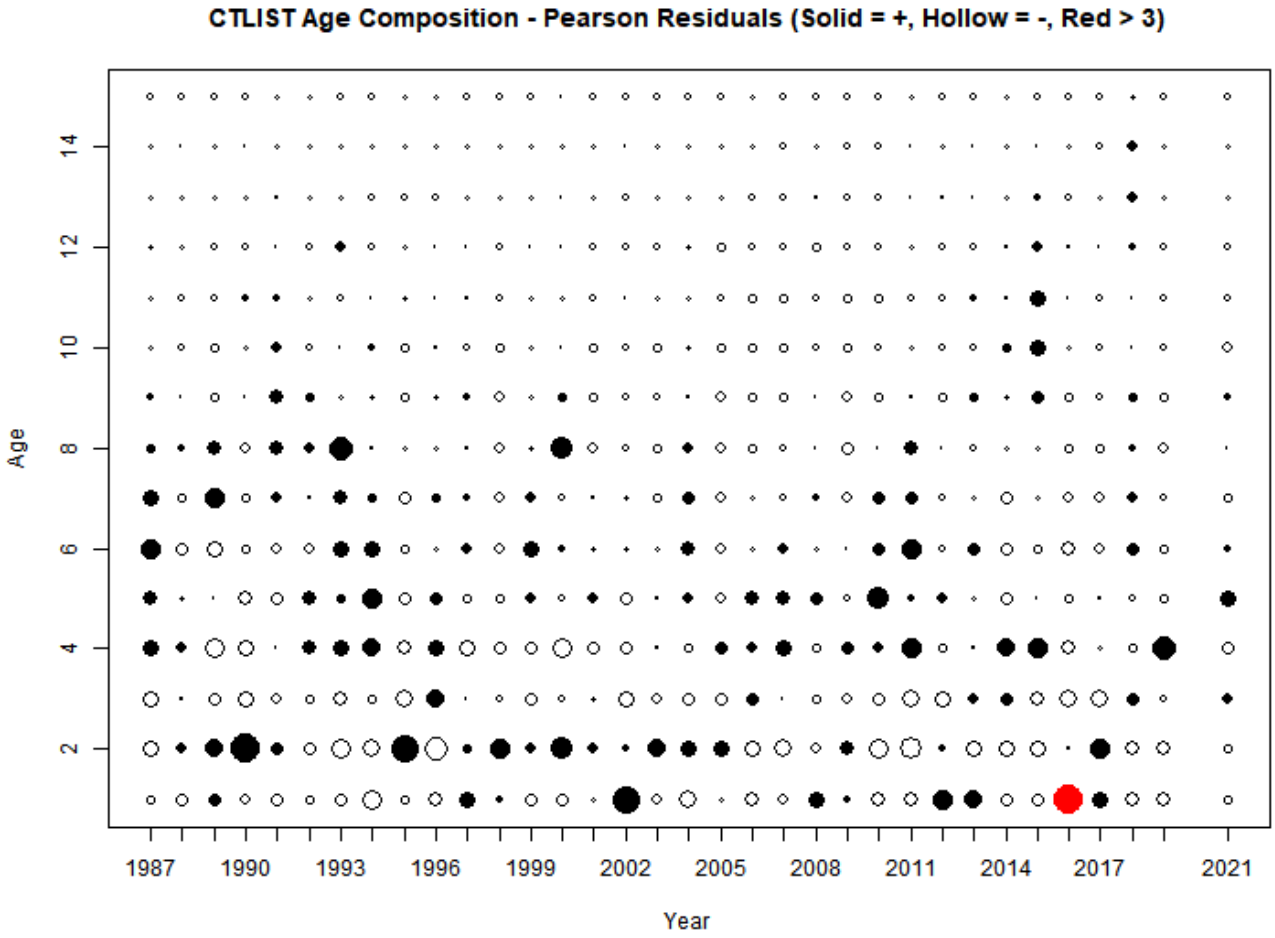
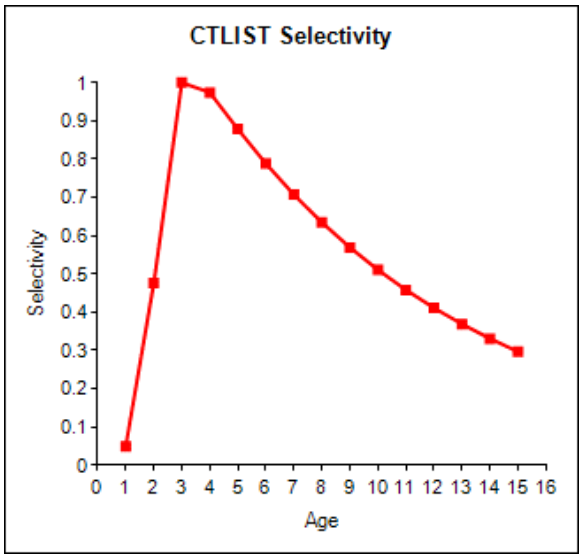
1994 1995 1996 1997 1998 1999 2000
2001 2002 2003 2004 2005 2006 2007
2008 2009 2010 2011 2012 2013 2014
2015 2016 2017 2018 2019 2021
5 10 15
Standardized Residual
Age


CTLIST Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017
2021
Year


CTLIST Selectivity
Selectivity
0
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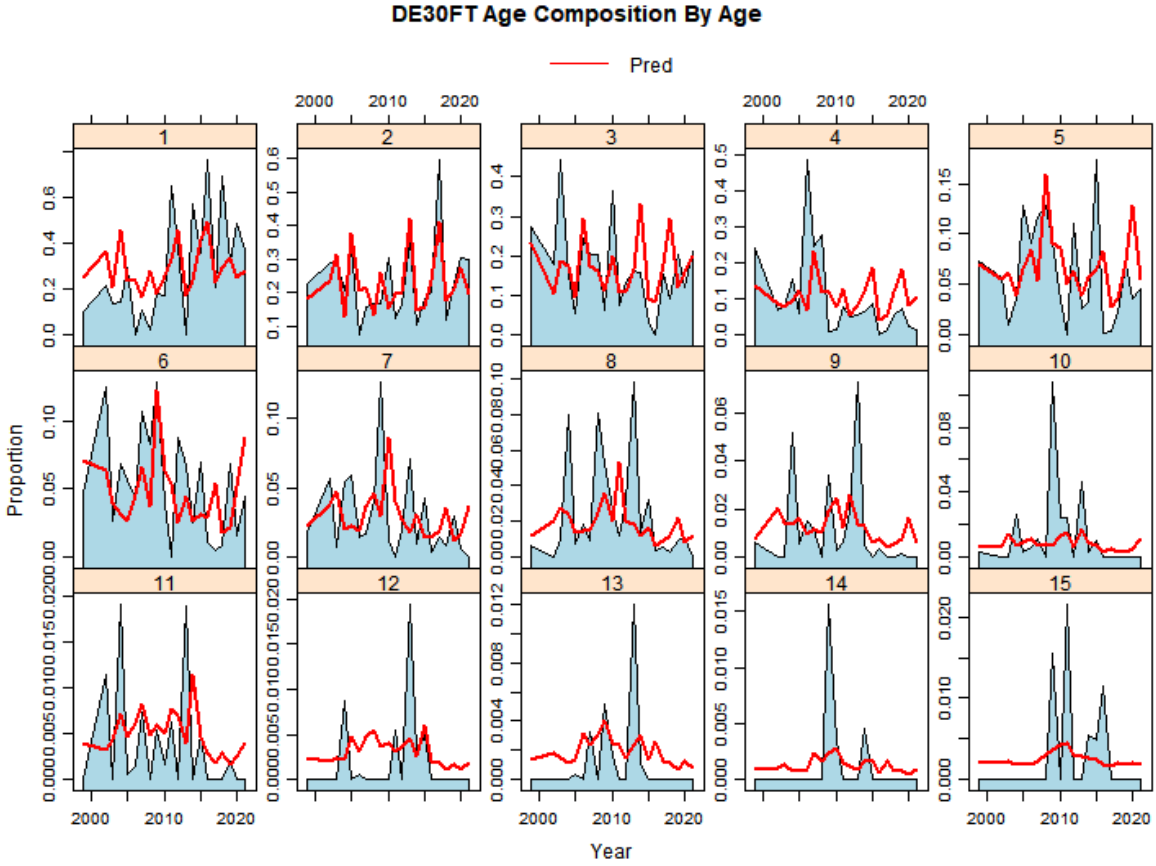
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


DE30FT Age Composition By Age
Pred
1
2
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5
6
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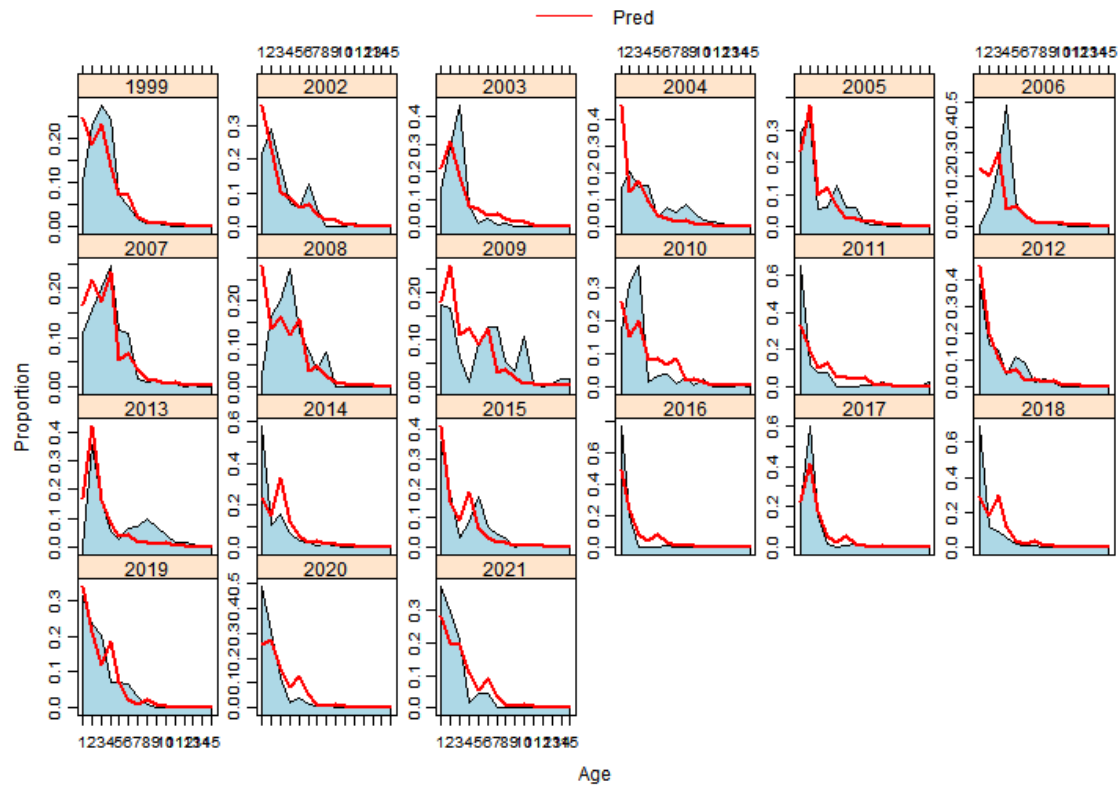
8
9
10
11
12
13
14
15
Proportion
Year


DE30FT Age Composition By Year
Pred
1999
2002
2003
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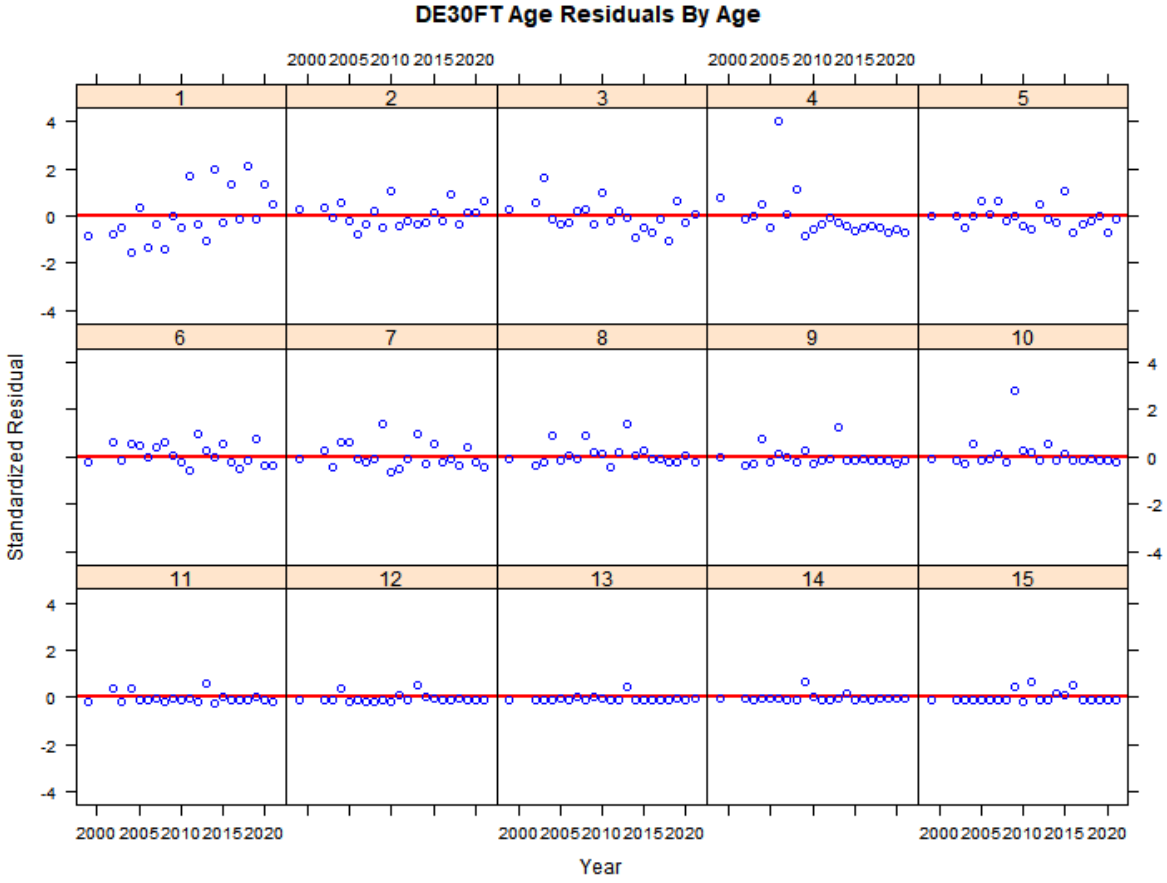
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Proportion
Age


DE30FT Age Residuals By Age
1
2
3
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9
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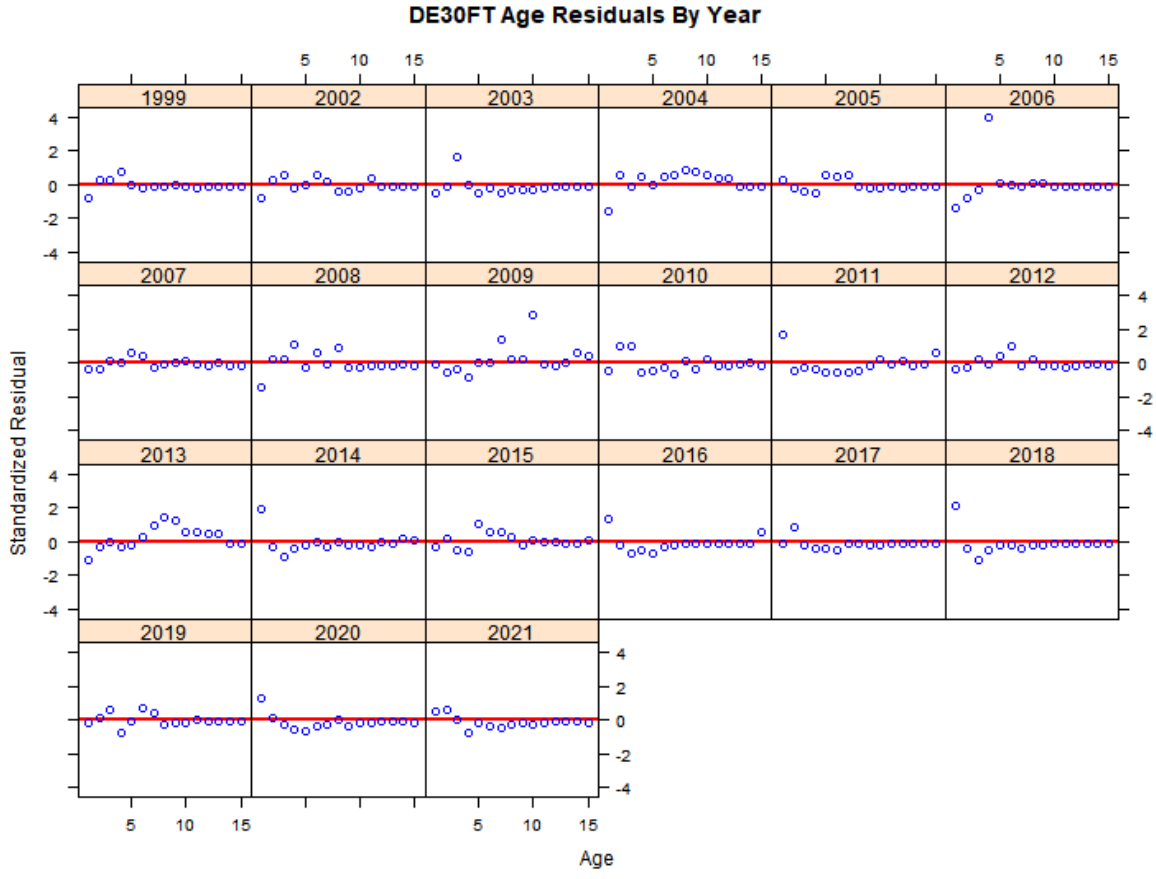
11
12
13
14
15
Standardized Residual
Year


DE30FT Age Residuals By Year
1999
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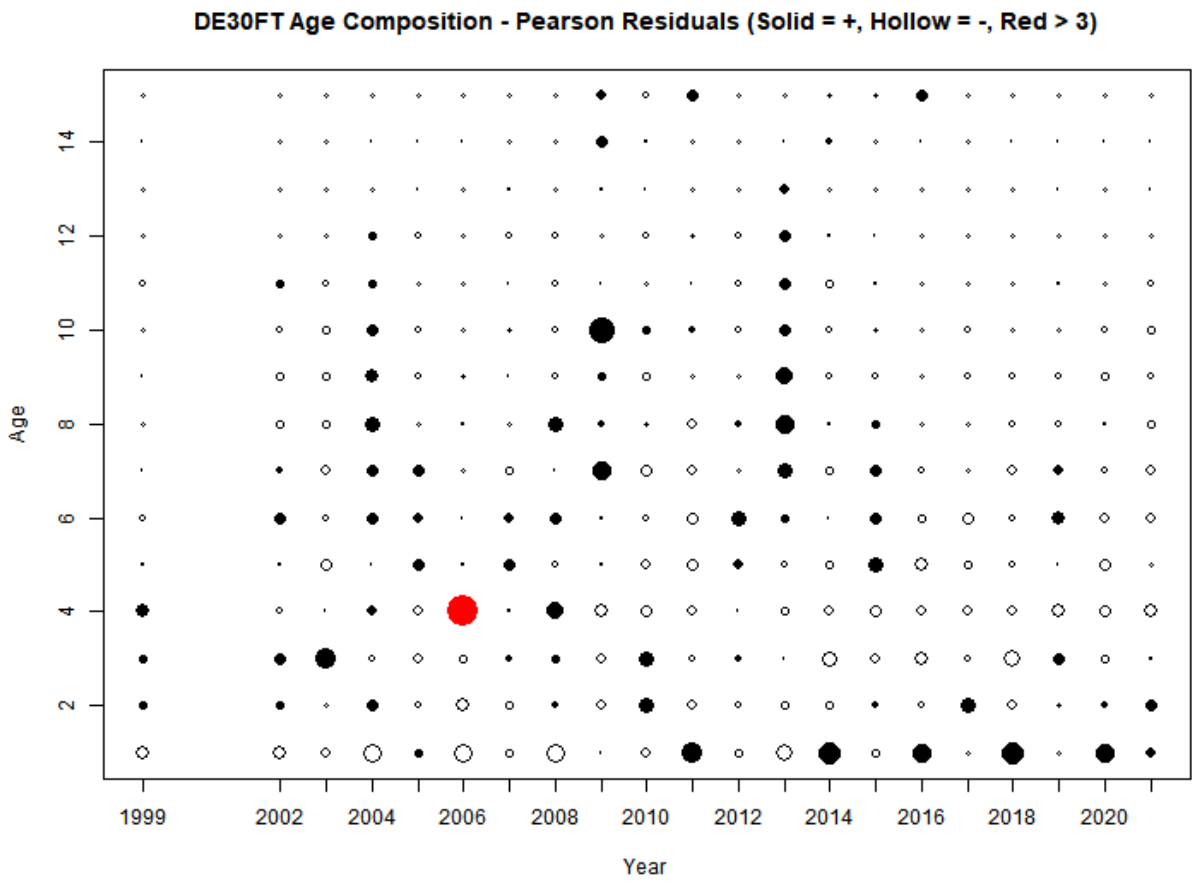
2016
2017
2018
2019
2020
2021
Standardized Residual
Age


DE30FT Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
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1999
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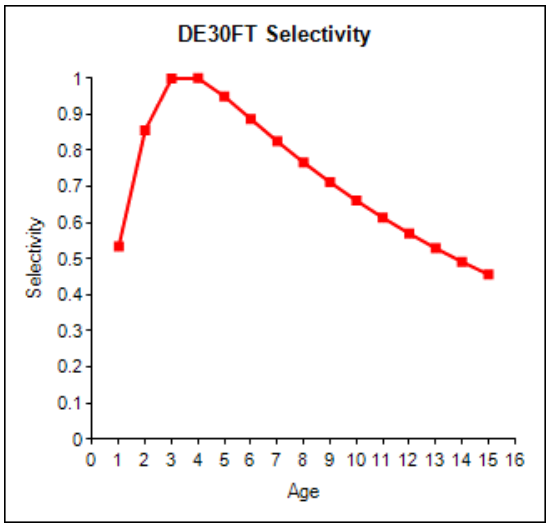
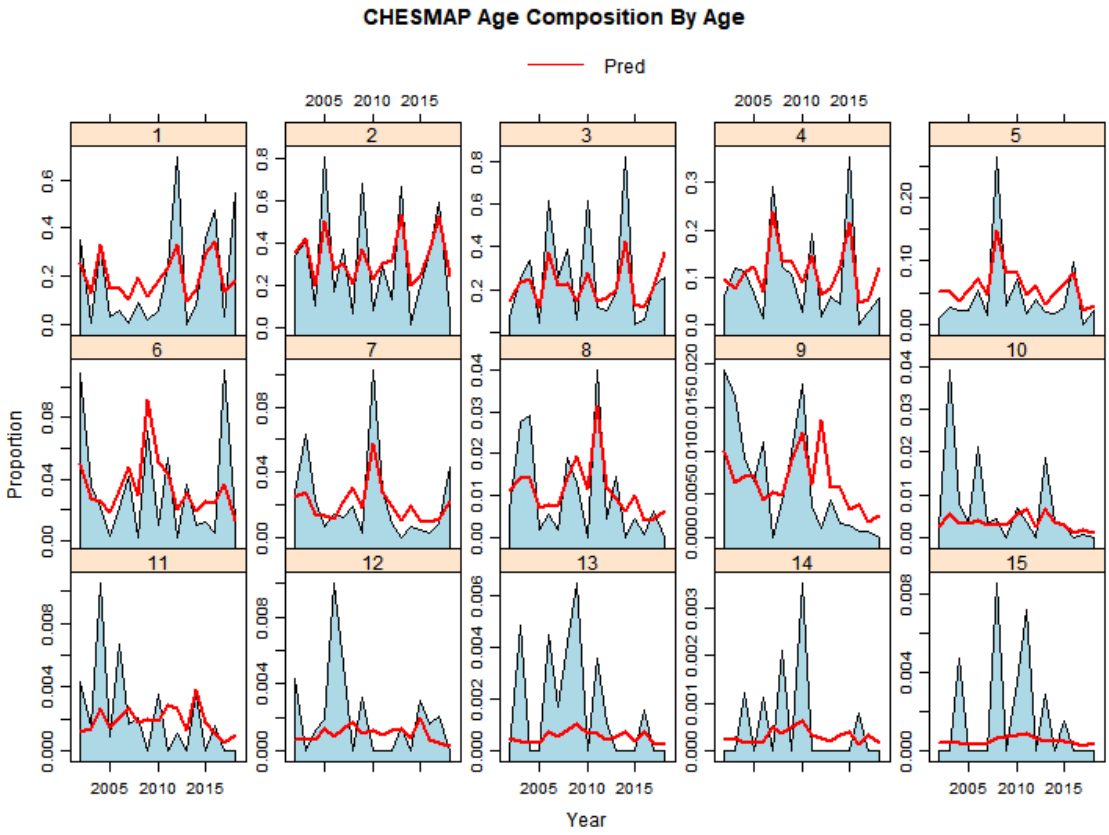
2008
2010
2012
2014
2016
2018
2020
Year


DE30FT Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


CHESMAP Age Composition By Age
Pred
1
2
3
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5
6
7
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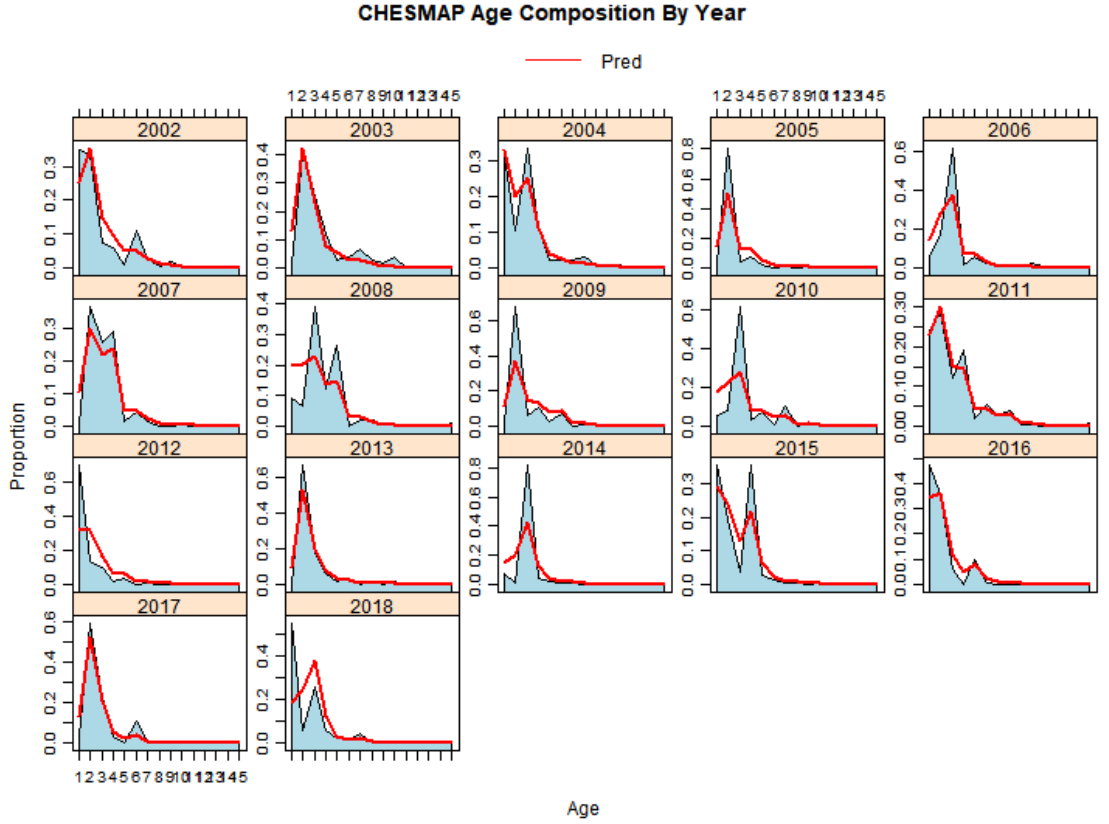
9
10
11
12
13
14
15
Proportion
Year


CHESMAP Age Composition By Year
Pred
2002
2003
2004
2005
2006
2007
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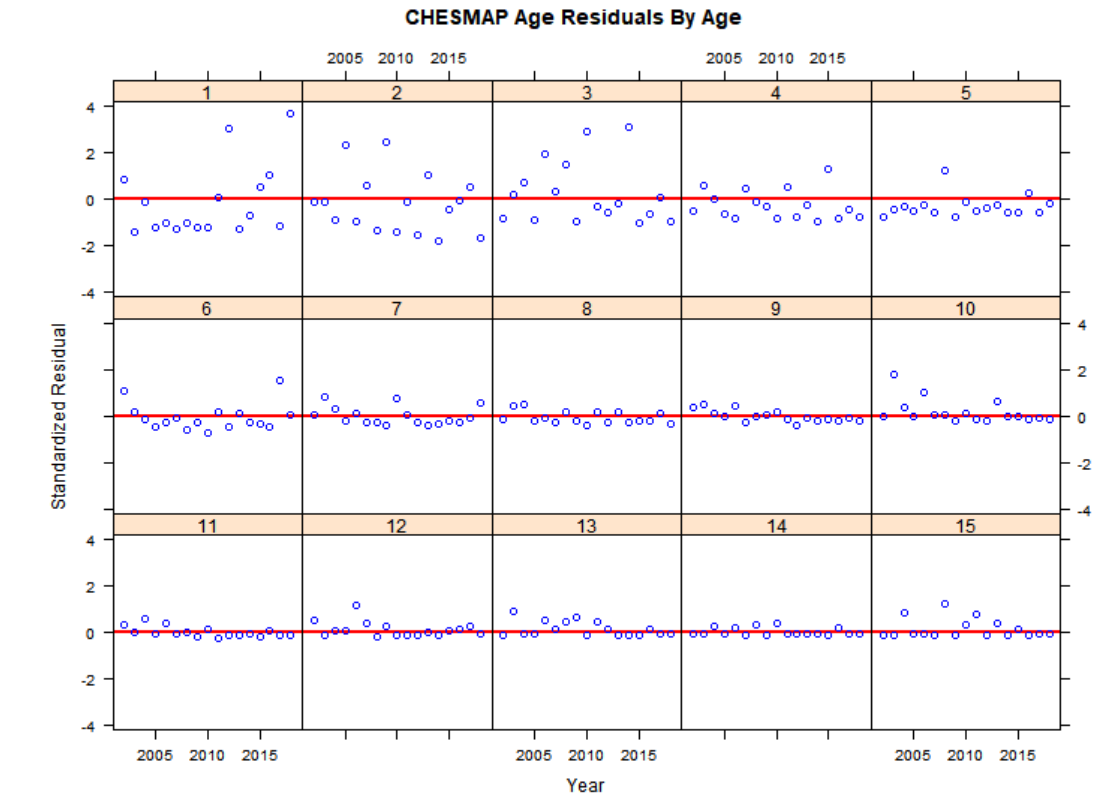
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Proportion
Age


CHESMAP Age Residuals By Age
1
2
3
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6
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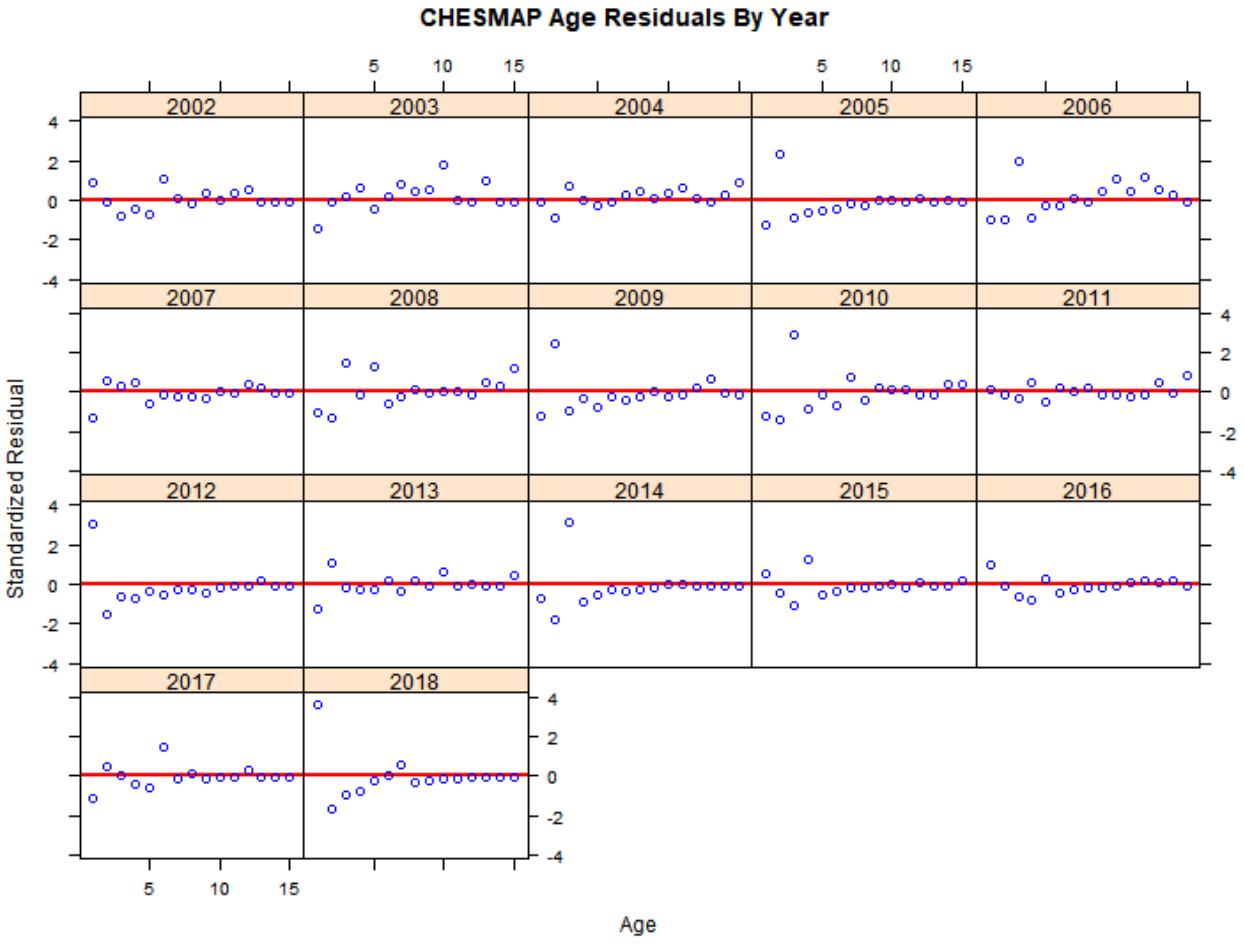
8
9
10
11
12
13
14
15
Standardized Residual
Year
2005
2010
2015


CHESMAP Age Residuals By Year
2002
2003
2004
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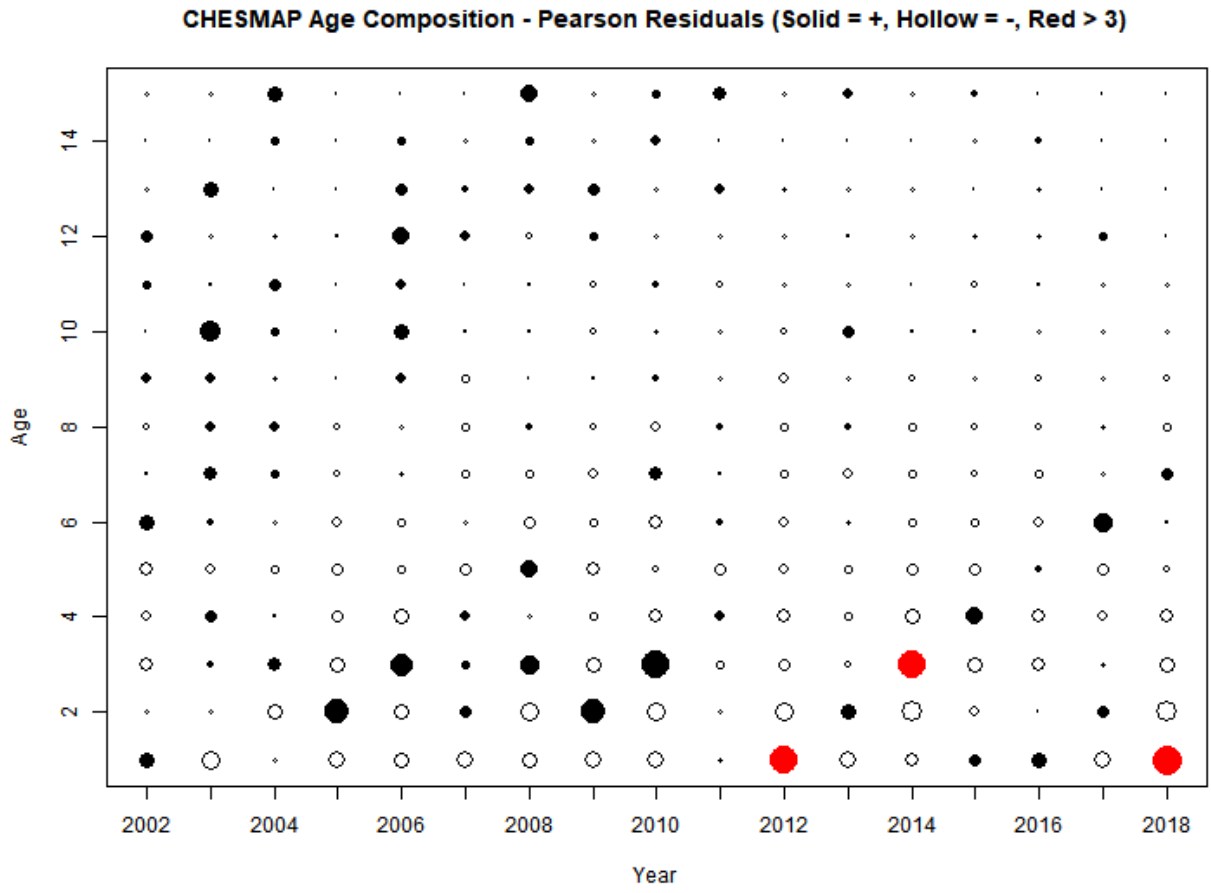
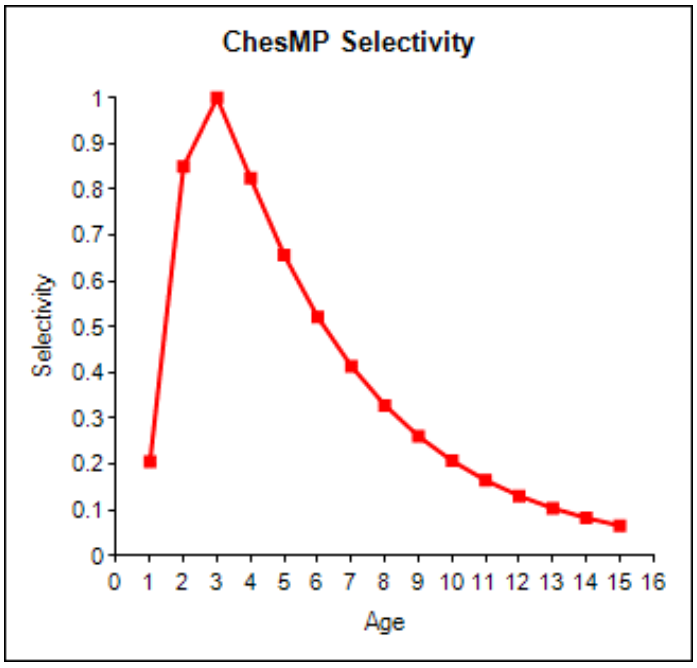
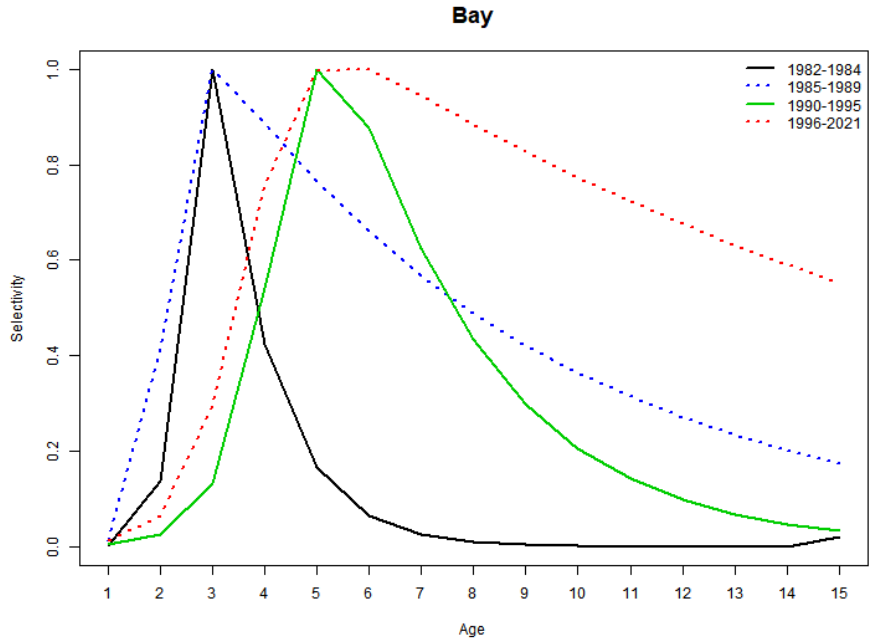
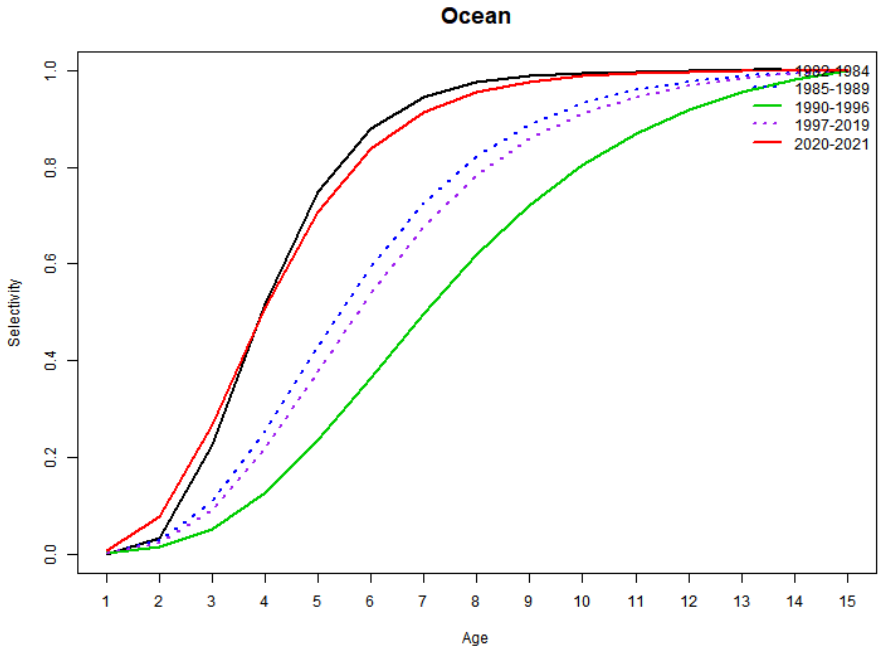
2014
2015
2016
2017
2018
Standardized Residual
Age
5
10
15


CHESMAP Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year

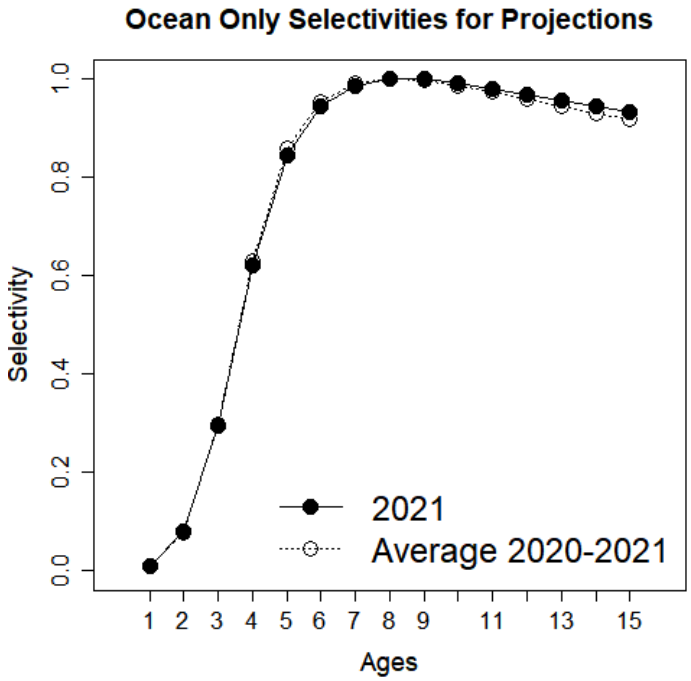

ChesMP Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


Bay
1982-1984
1985-1989
1990-1995
1996-2021
Selectivity
Age
0.0
0.2
0.4
0.6
0.8
1.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


Ocean
1982-1984
1985-1989
1990-1996
1997-2019
2020-2021
Selectivity
Age
0.0
0.2
0.4
0.6
0.8
1.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

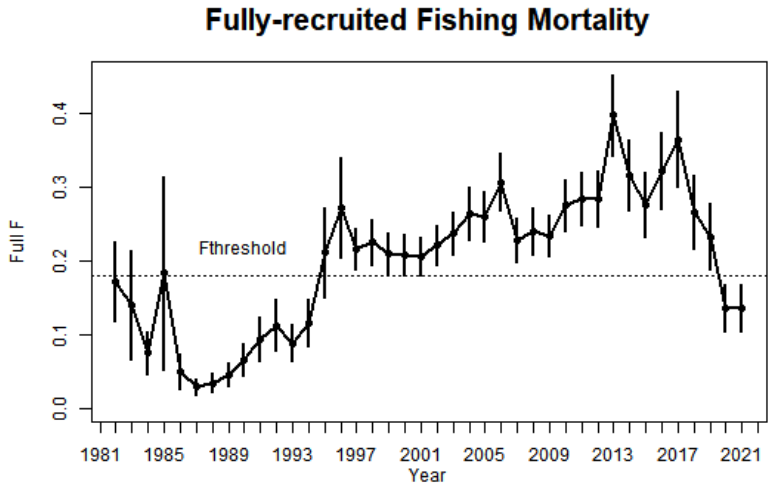
	Likelihood Weight	RSS
Fleet 1 Total Catch:	2	0.203941
Fleet 2 Total Catch:	2	1.64944
Aggregate Abundance Indices		
NYYOY	1	27.9845
NJYOY	1	30.2953
MDYOY	1	10.3757
Compos	1	37.8359
NYAge1	1	32.1299
MDAge1	1	24.3735
Age Comp Abundance Indices		
NYOHS	1	18.844
NJTRAWL	1	20.5861
MDSSN	1	31.1651
DESSN	1	21.9651
MRIP	1	36.0729
CTLIST	1	27.1042
DE30FT	1	17.2646
ChesMap	1	14.7549
Total RSS		352.605
No. of Obs		517
Conc. Likel.		-98.9265
Age Composition Data	Likelihood	
Fleet 1 Age Comp:	1	4757.8
Fleet 2 Age Comp:	1	7441.8
NYOHS	1	735.133
NJTRAWL	1	309.569
MDSSN	1	1099.63
DESSN	1	1011.45
MRIP	1	2604.06
CTLIST	1	824.734
DE30FT	1	232.384
ChesMap	1	397.019
Recr Devs :	1	42.4776
Total Likelihood :		19287.9
AIC :		38951.7

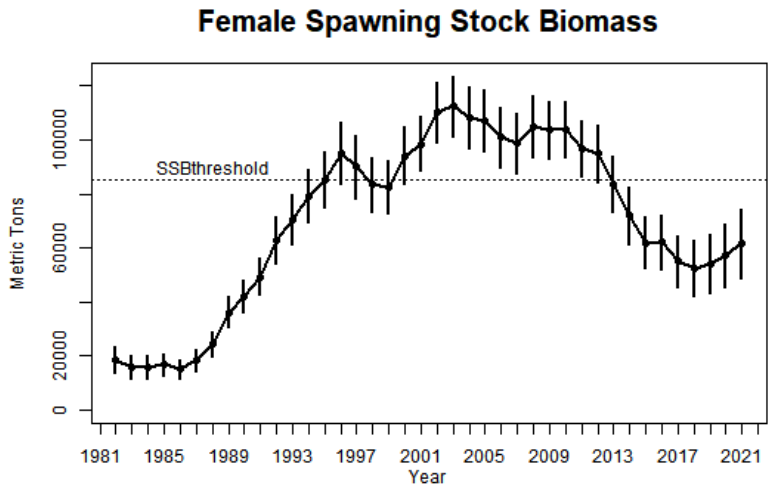
Index	n	RMSE	CV Weight	Effective Sample
NYYOY	36	0.990473	2.97	
NJYOY	38	1.0041	1.75	
MDYOY	12	1.00956	2.14	
compos	40	0.996992	0.98	
NYAge1	37	0.99948	1.19	
MDAge1	52	0.998066	3.25	
NYOHS	20	0.997169	2.65	22.09
NJTRAWL	29	1.00089	2.95	5.68
MDSSN	37	0.998892	2.5	14.53
DESSN	24	1.00292	1.17	18.3
MRIP	40	1.00968	2.28	30.43
CTLIST	34	0.996532	3	13.07
DE30FT	21	1.00038	0.85	5.88
ChesMP	17	1.00036	2.45	15.06


Ocean Only Selectivities for Projections
Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
1 2 3 4 5 6 7 8 9 11 13 15
Ages
2021
Average 2020-2021

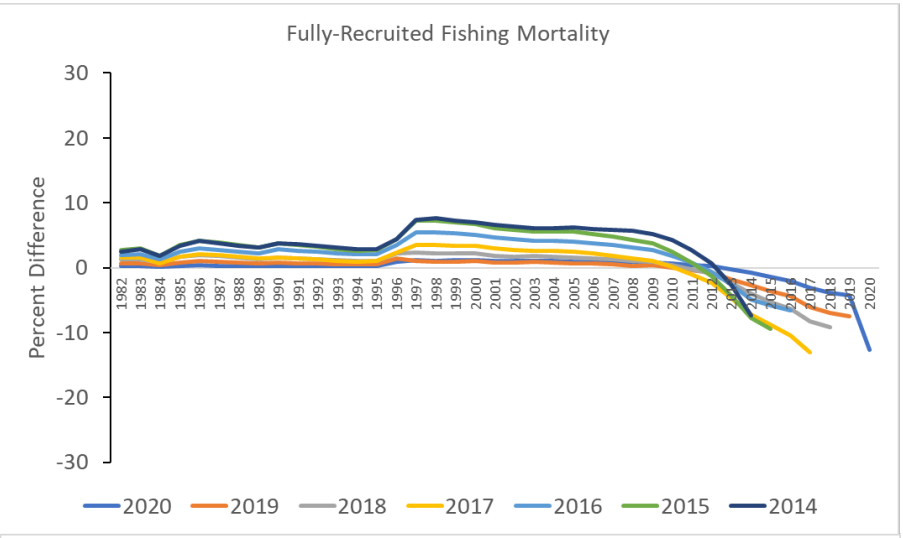
SSBthreshold=85333.6; Fthreshold=0.1807
SSBtarget=106667;Ftarget=0.1495
Fcurrent=0.1355

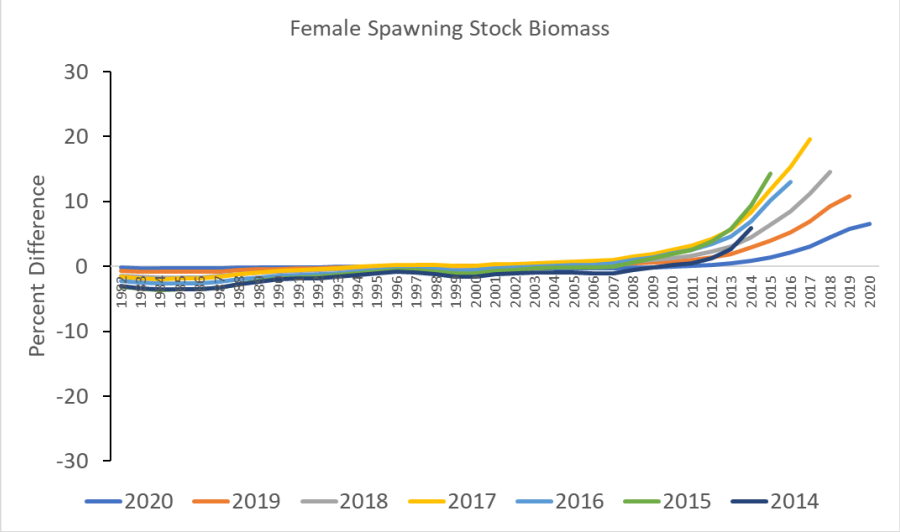
Estimates with 95% Confidence Intervals

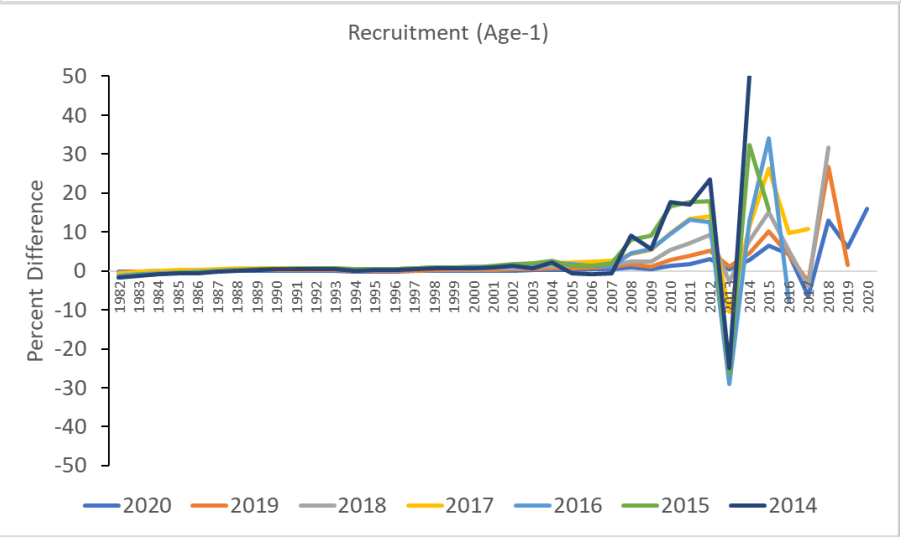




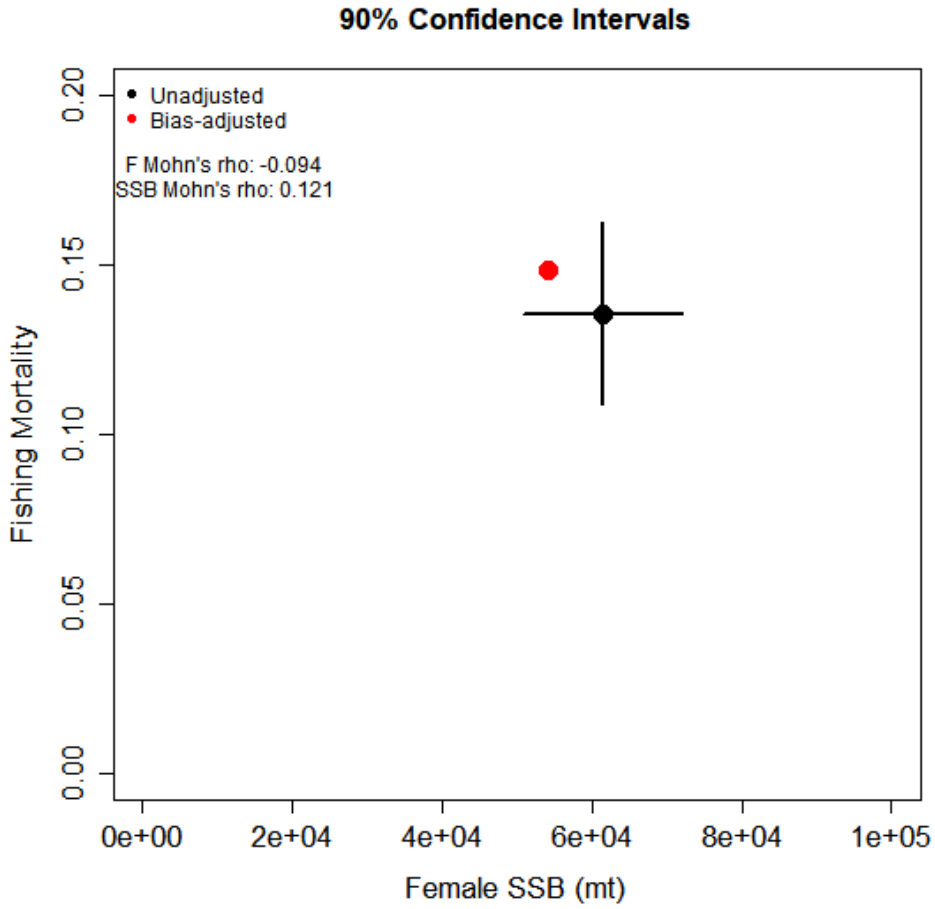
Number of peels = 7 (NMFS standard)



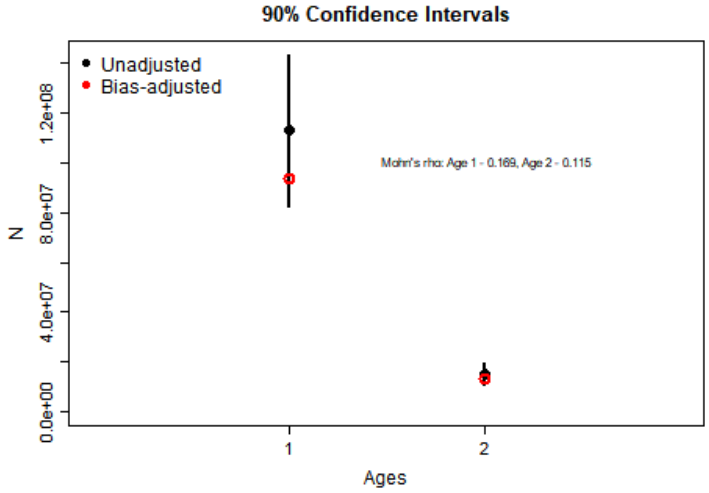


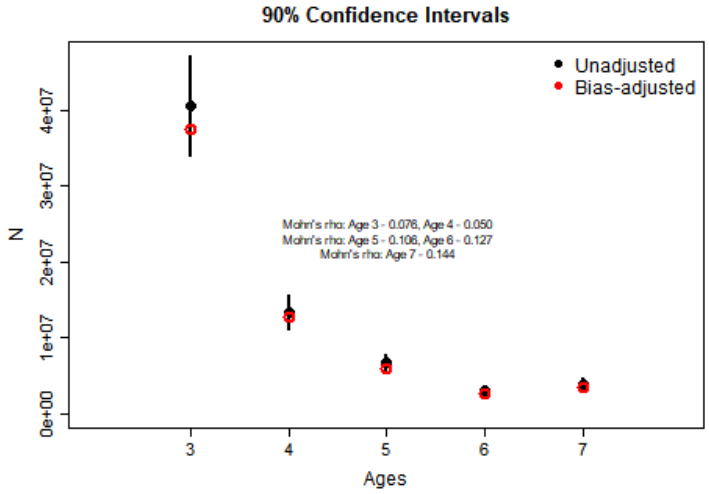


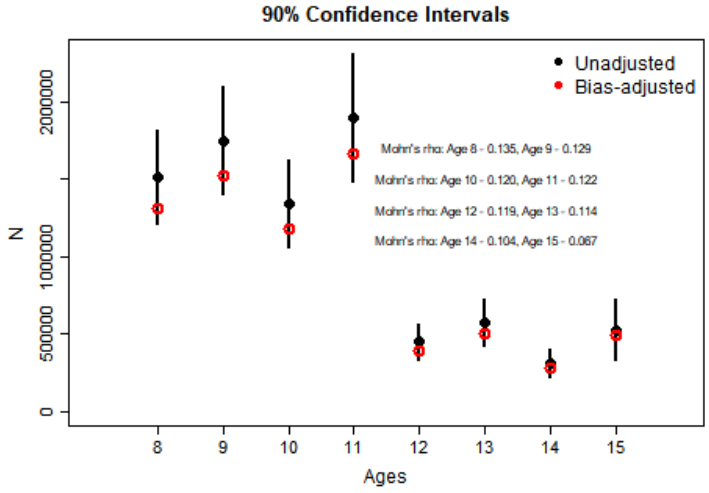
Retrospective bias corrected values within 90% confidence intervals of original values, so bias-correction not required.



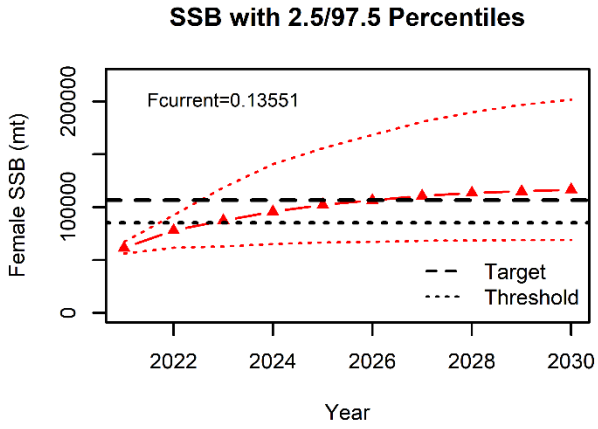
Most retro corrected N values inside 90% CIs of original estimates – Bias-correction not required.

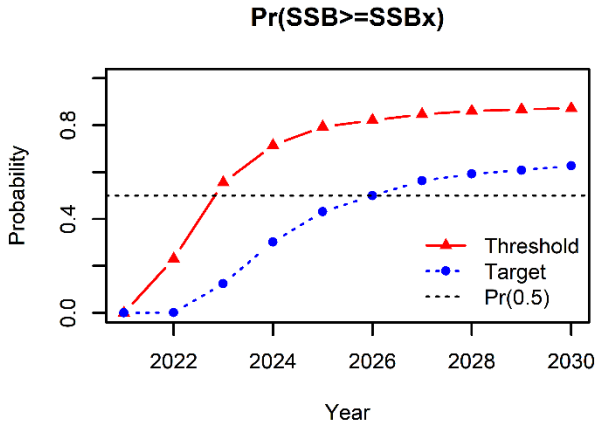


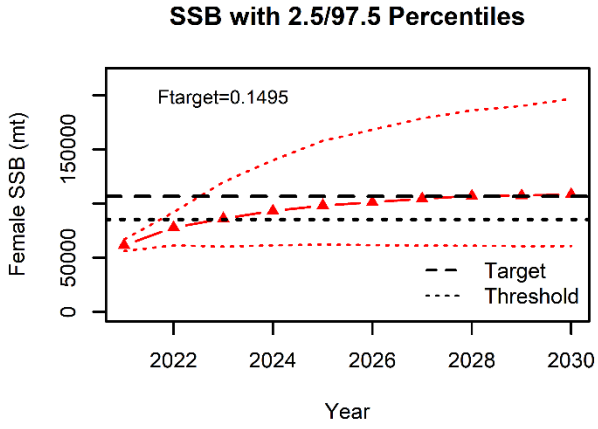


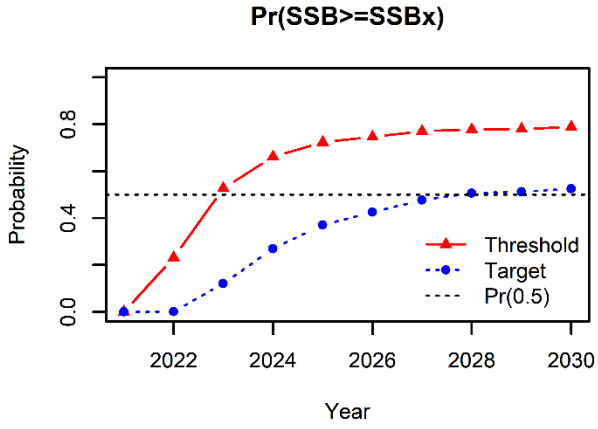


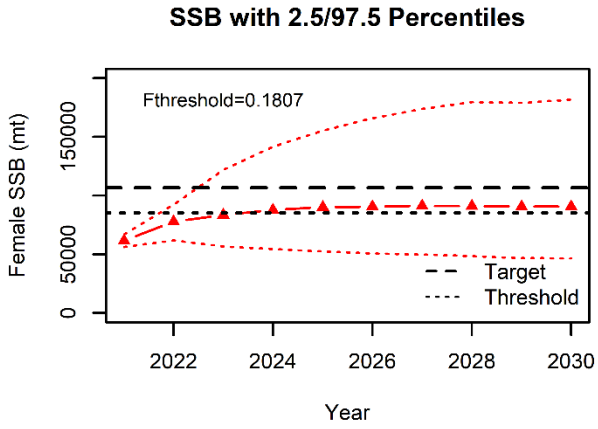
using non-bias-corrected estimates of F and N-at-age
SSBtarget reached by 2026 at current F and 2028 at target F

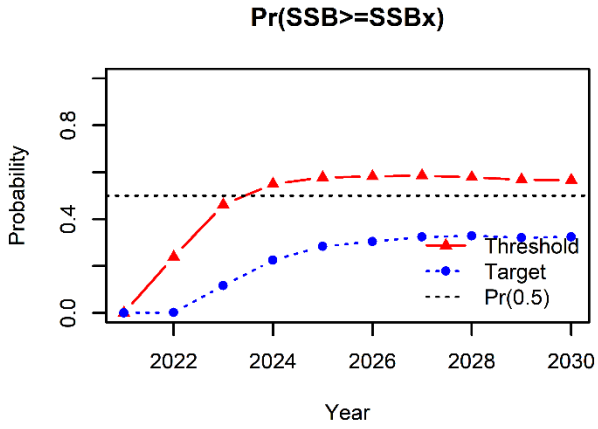




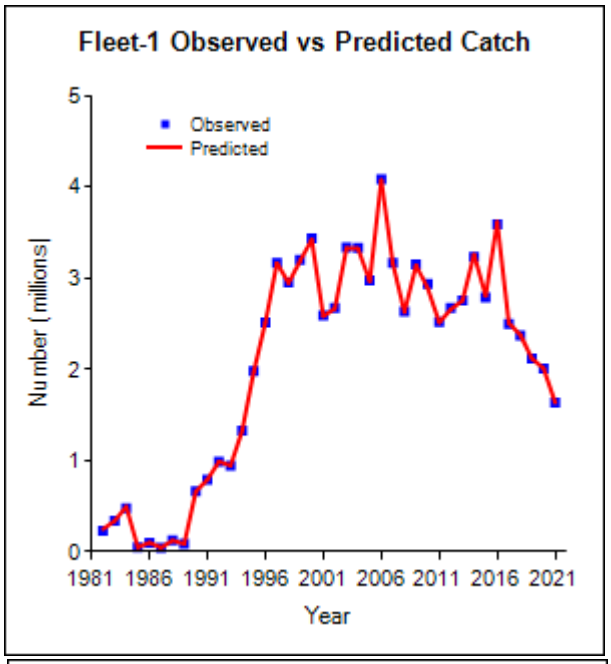


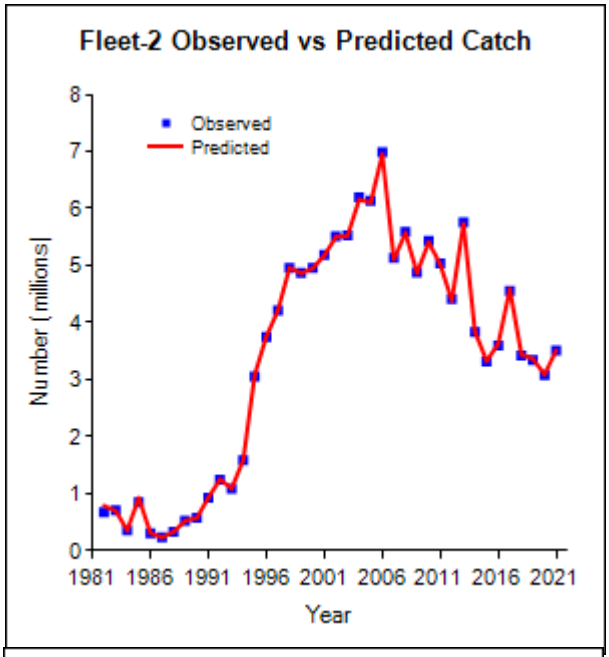


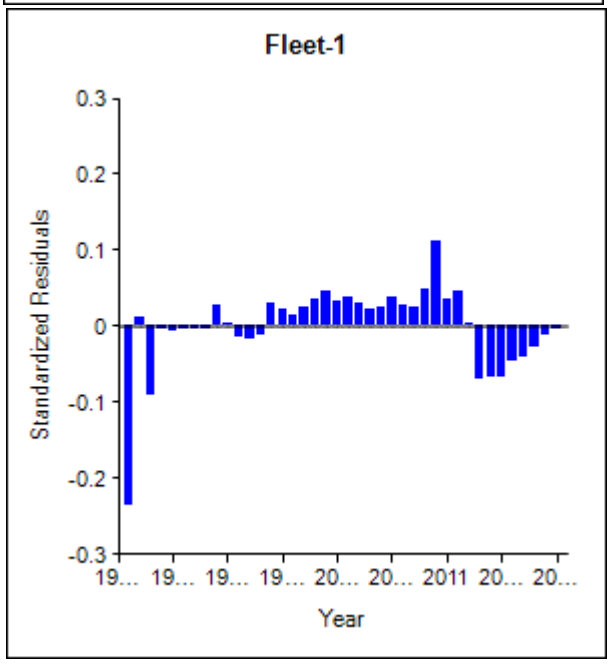


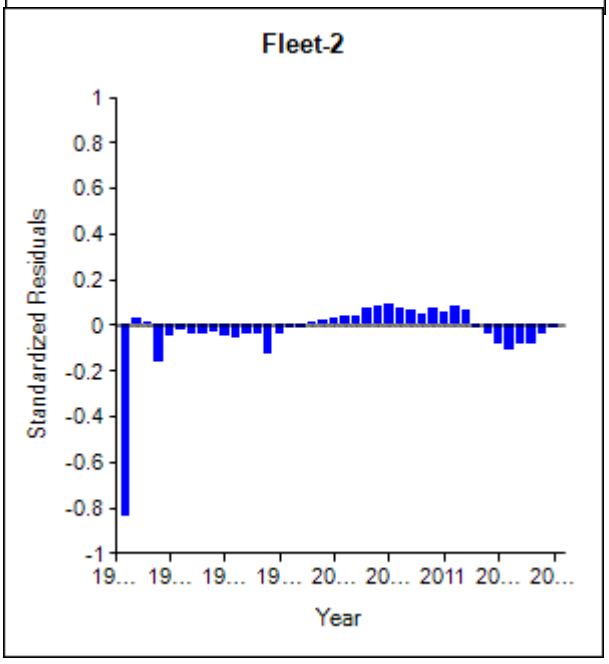


Appendix 4. Diagnostic plots and results from the SCA model with no new selectivity blocks added to the model.

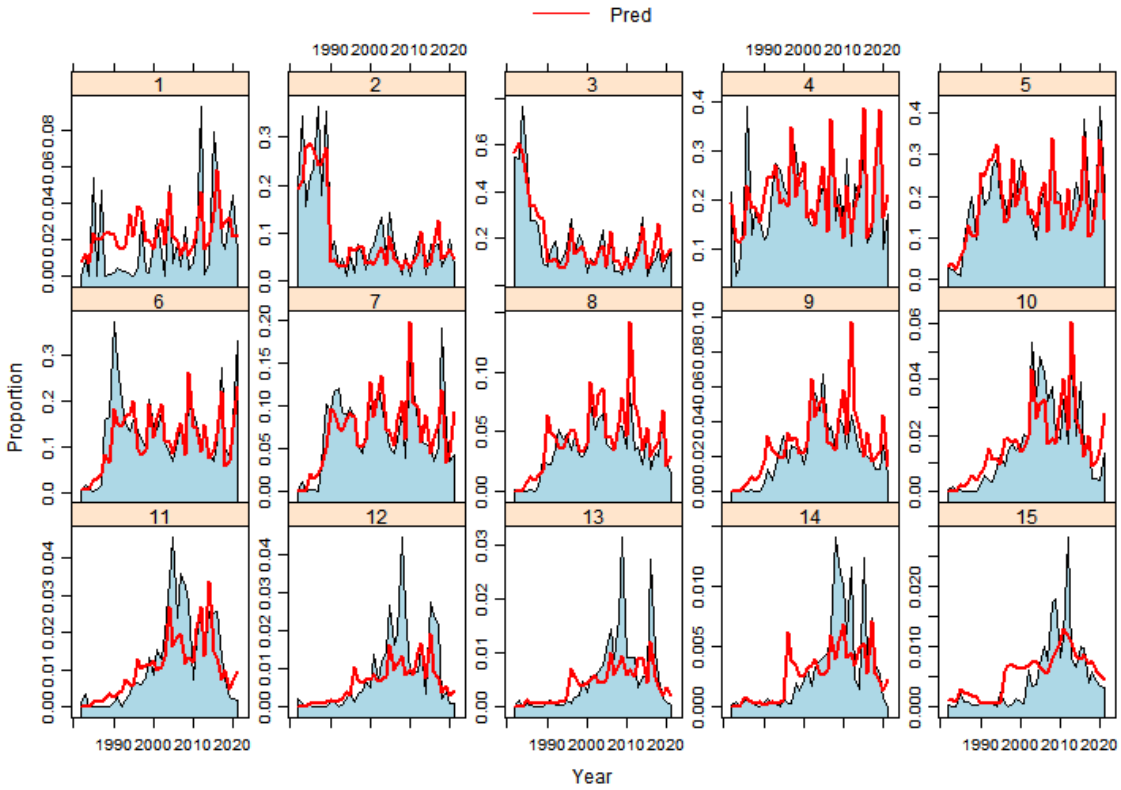




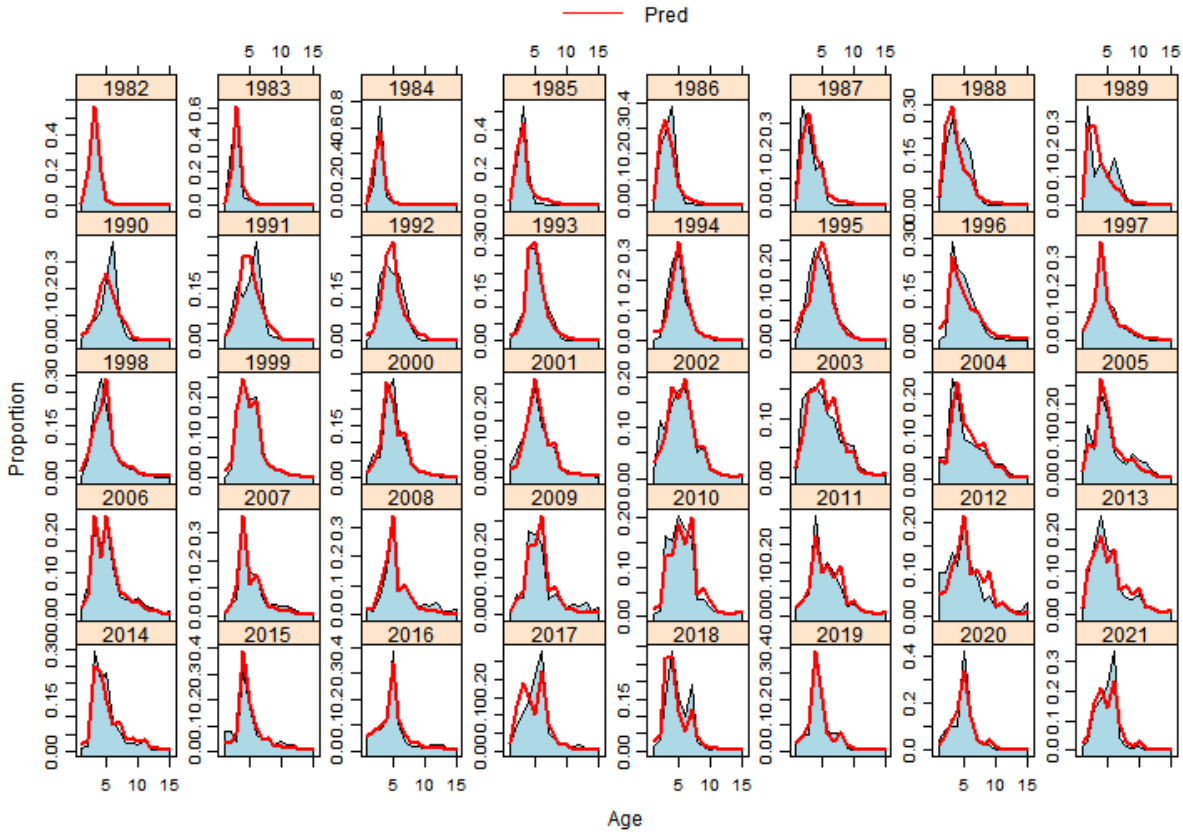


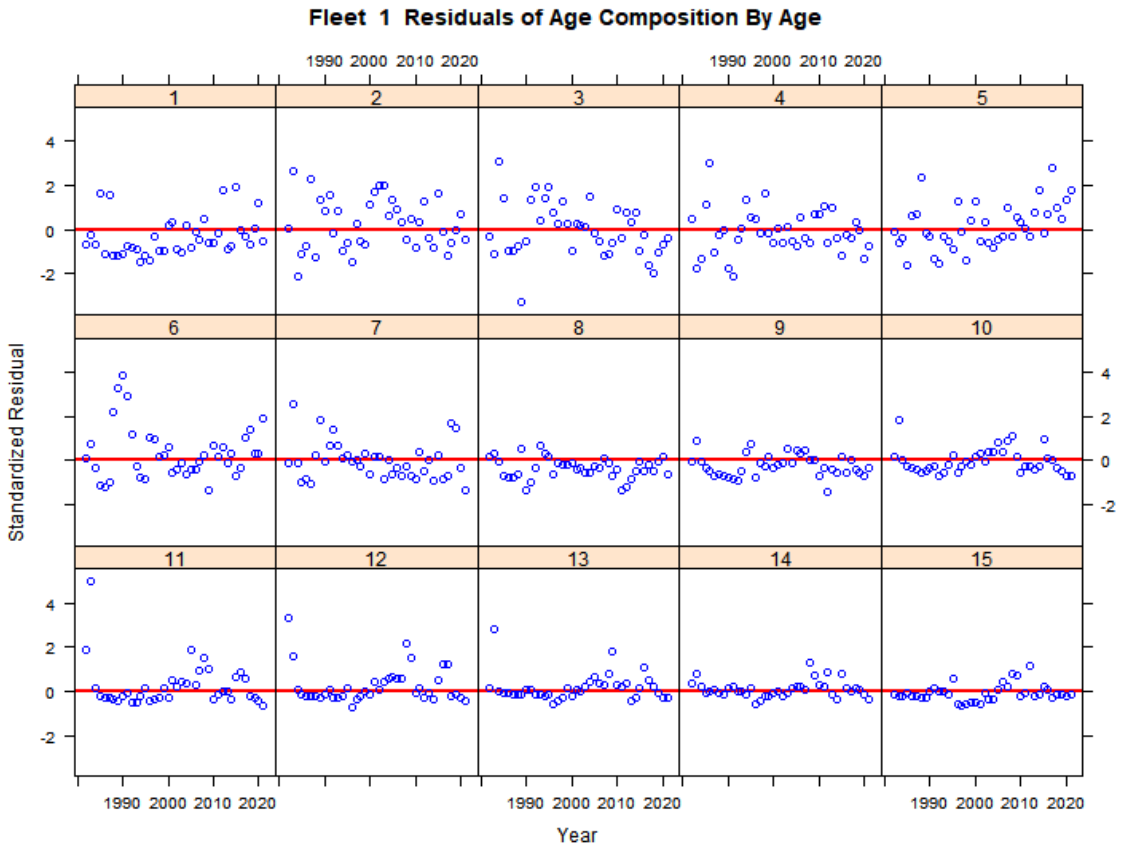


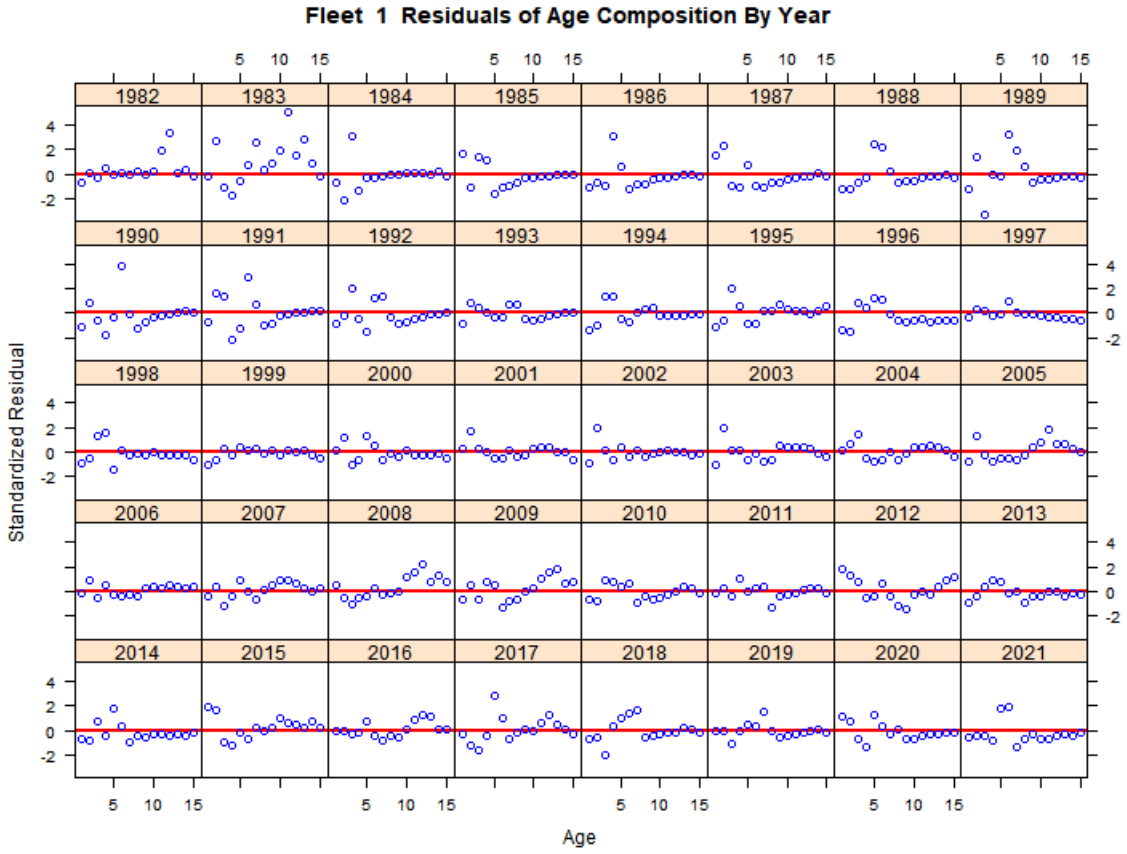
Fleet 1 Catch Age Composition By Age

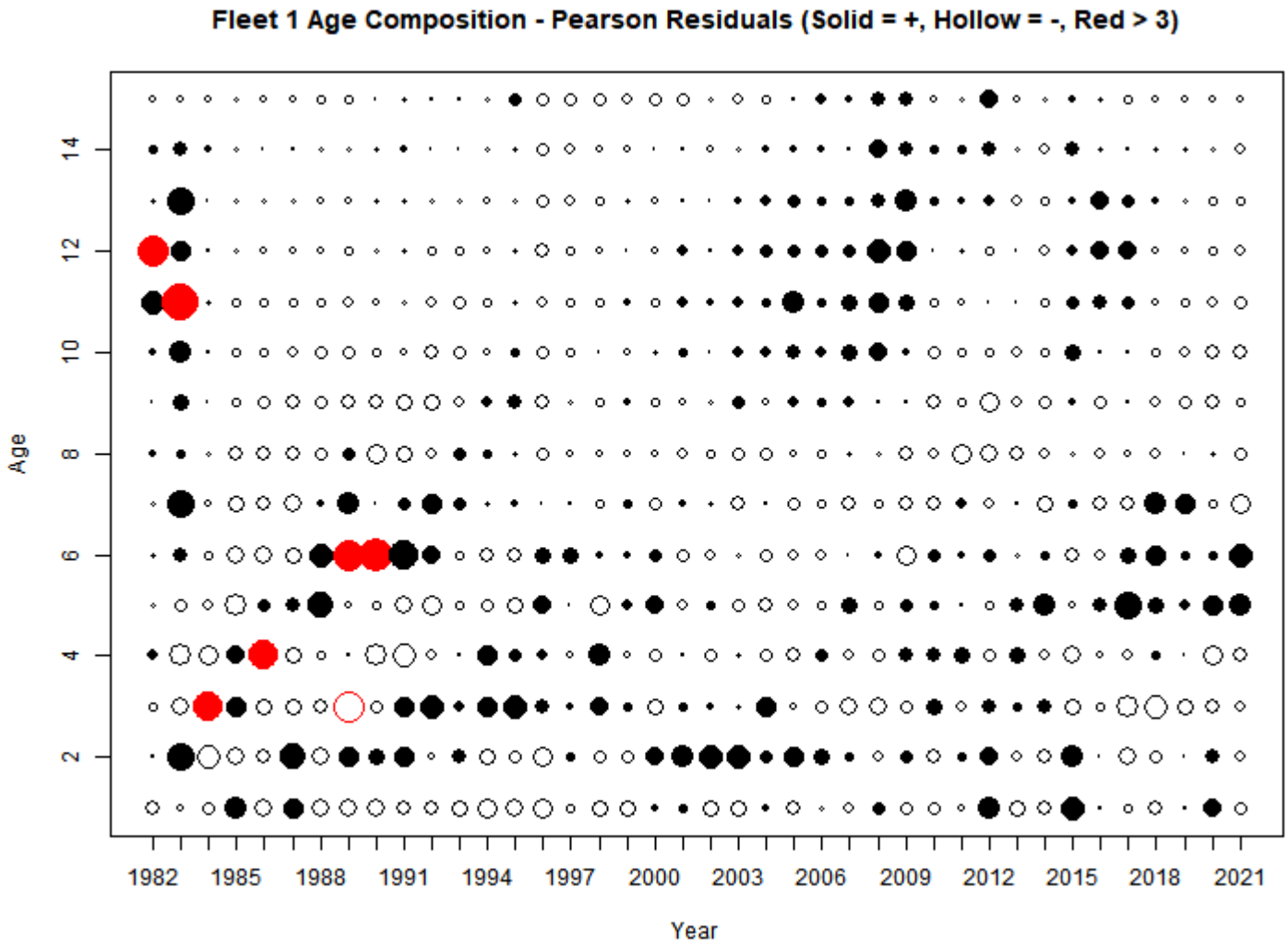


Fleet 1 Catch Age Composition By Year

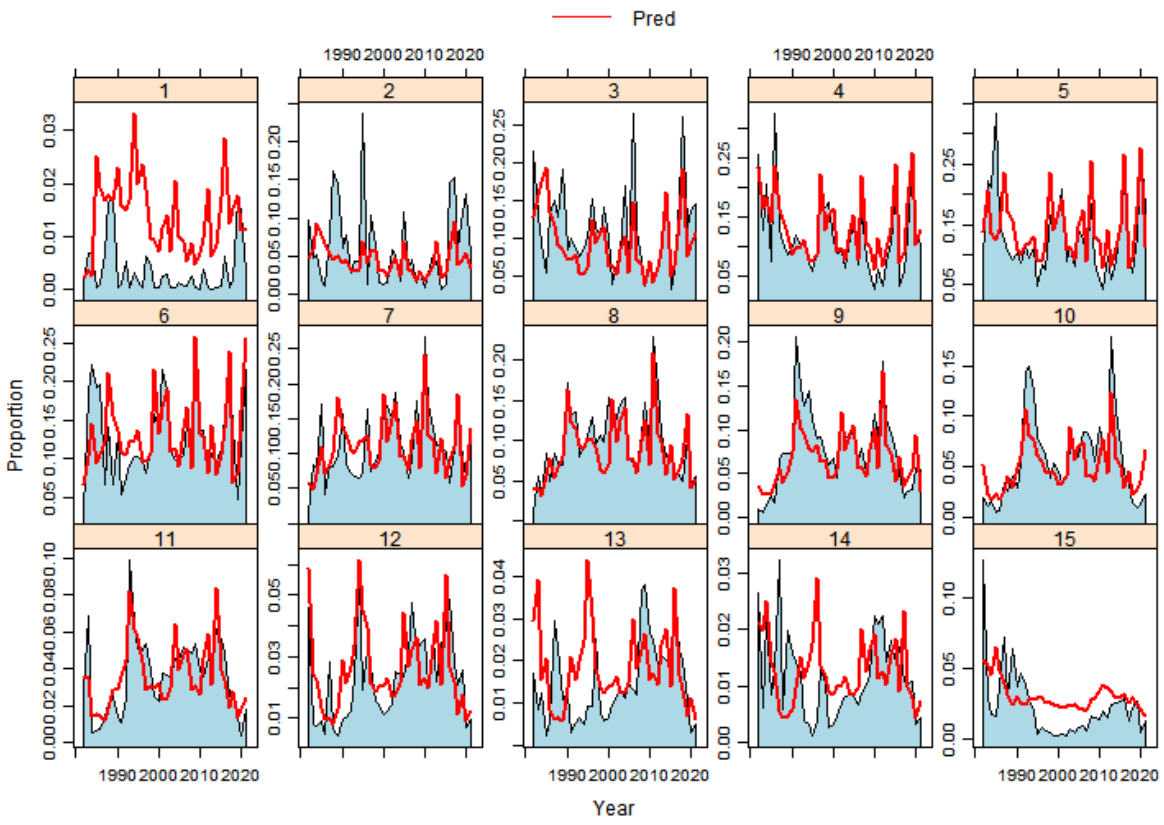



Fleet 1 Residuals of Age Composition By Age
1 2 3 4 5
6 7 8 9 10
11 12 13 14 15
1990 2000 2010 2020
Standardized Residual
Year

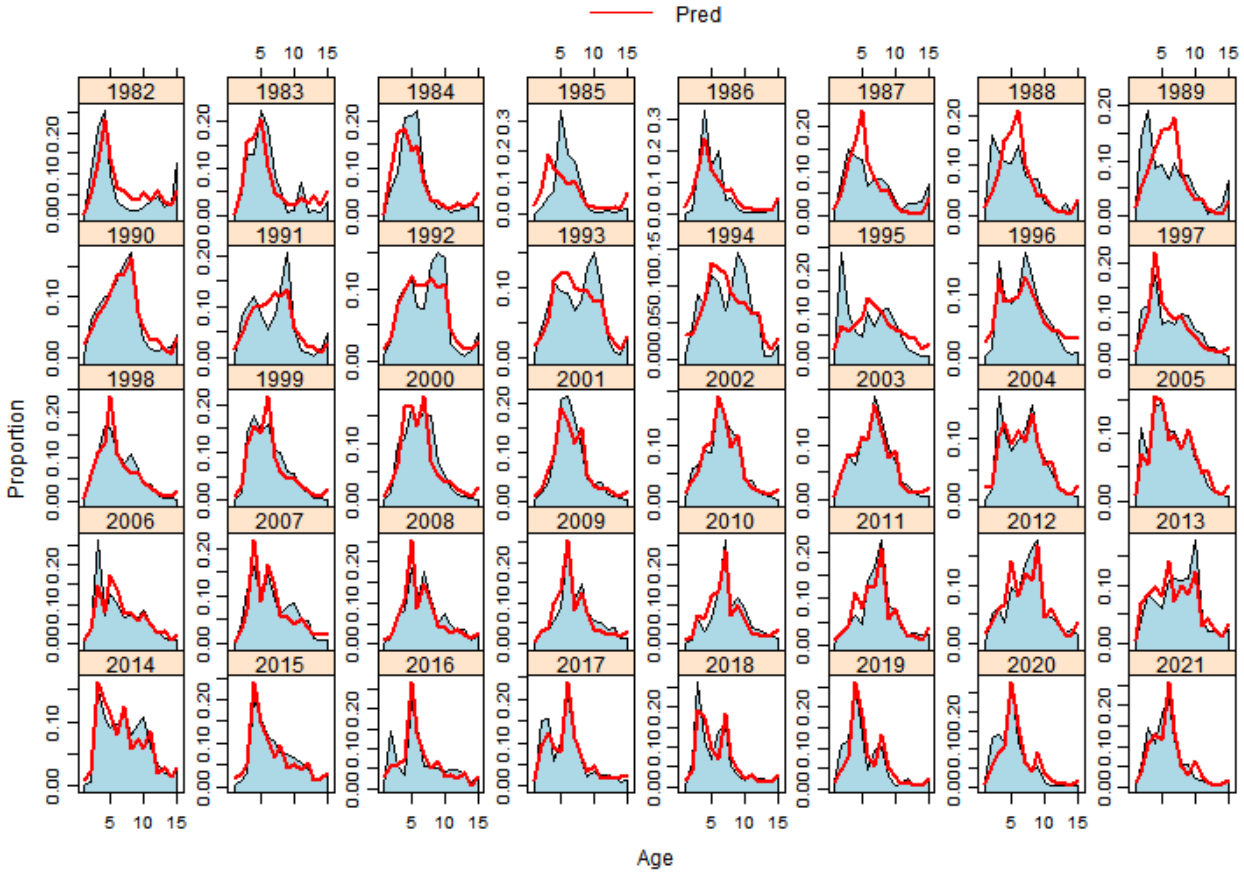

Fleet 1 Residuals of Age Composition By Year
1982 1983 1984 1985 1986 1987 1988 1989
1990 1991 1992 1993 1994 1995 1996 1997
1998 1999 2000 2001 2002 2003 2004 2005
2006 2007 2008 2009 2010 2011 2012 2013
2014 2015 2016 2017 2018 2019 2020 2021
5 10 15
Standardized Residual
Age


Fleet 1 Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
2021
Year

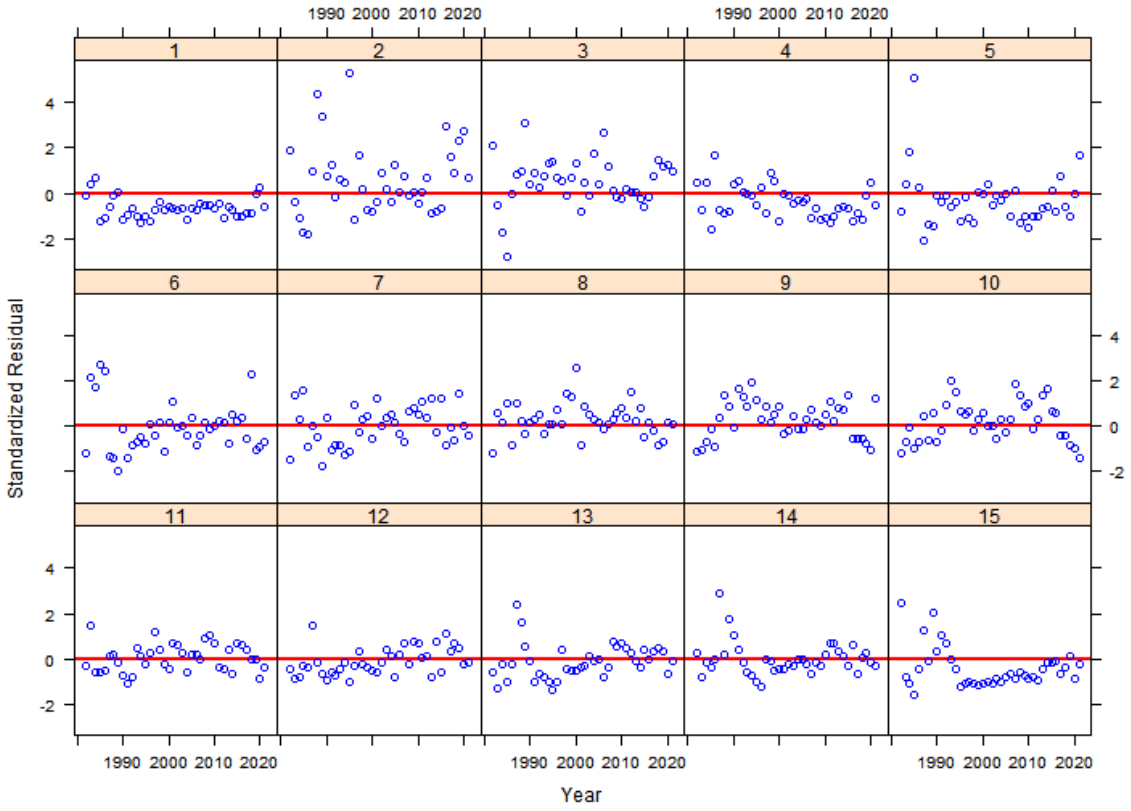
Fleet 2 Catch Age Composition By Age



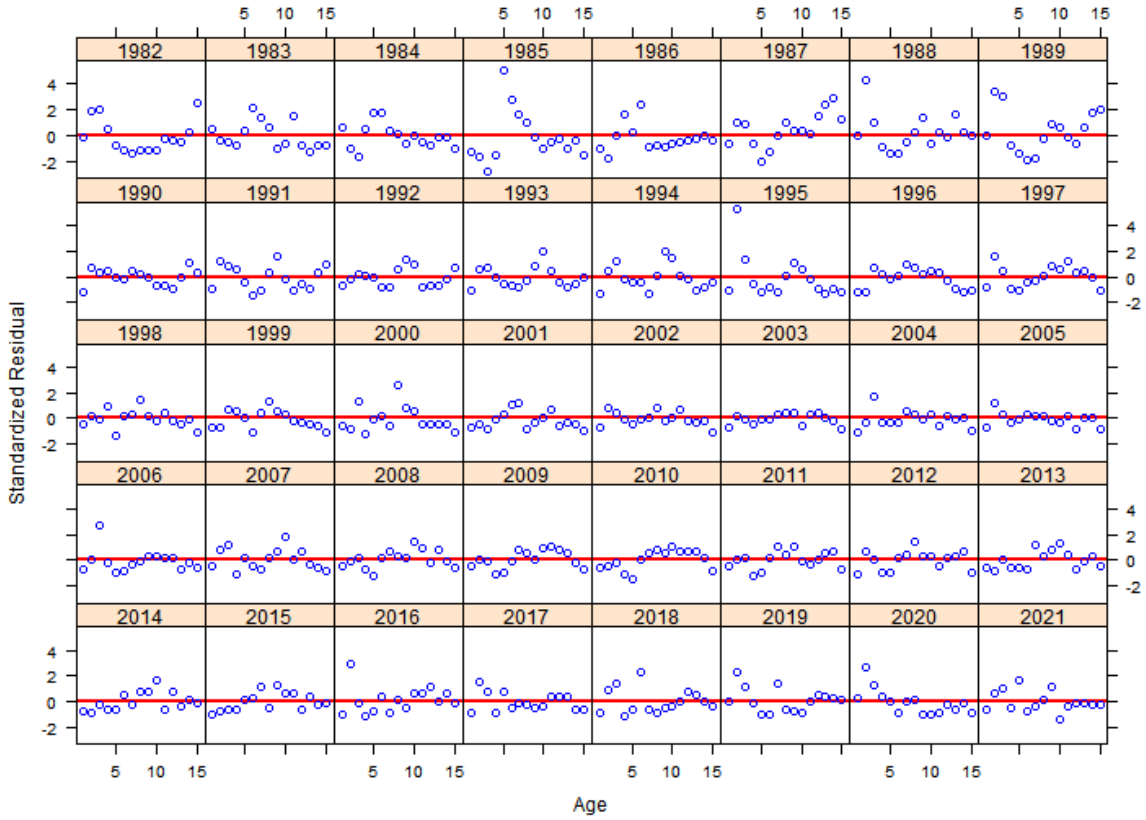
Fleet 2 Catch Age Composition By Year

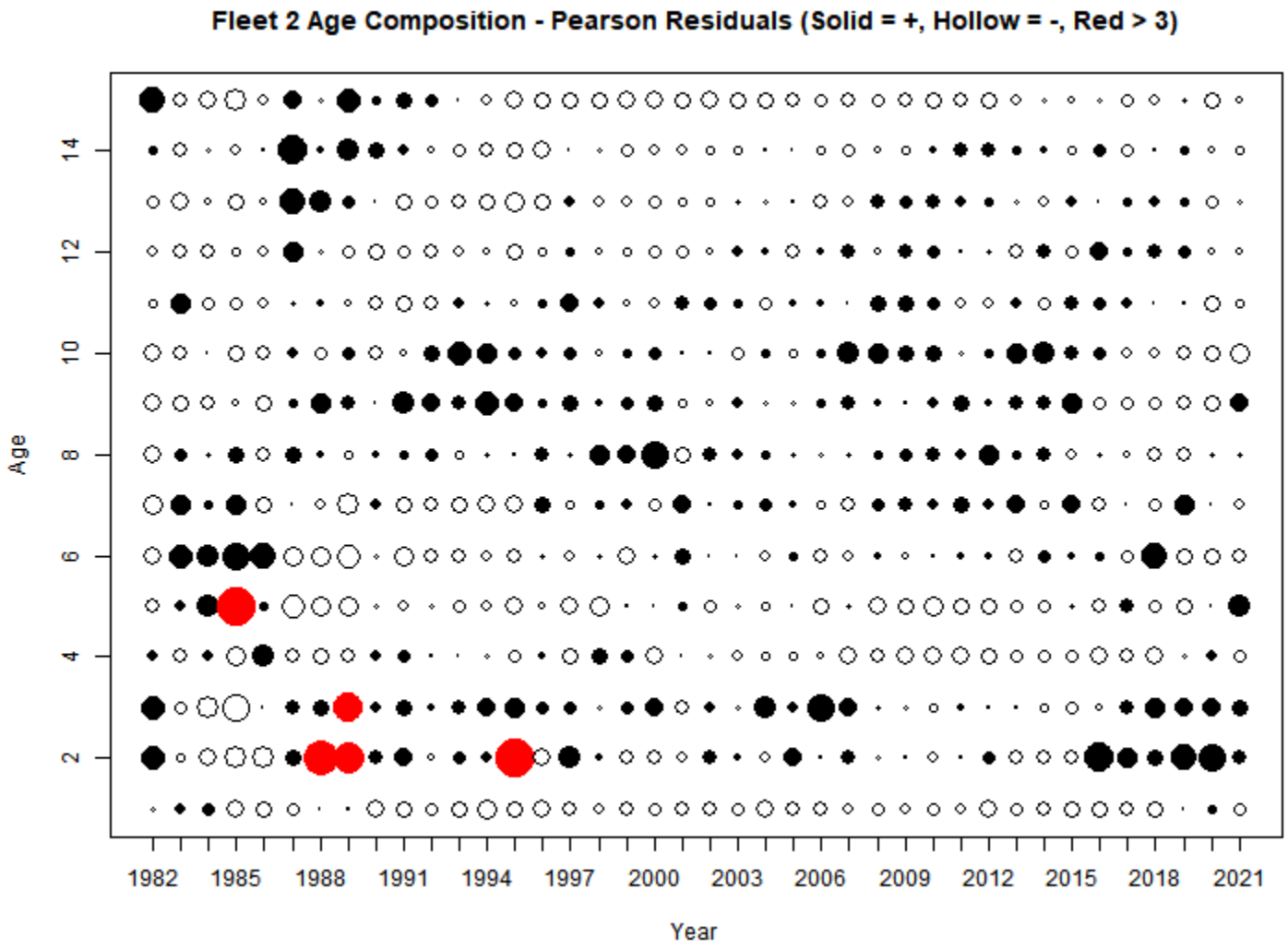


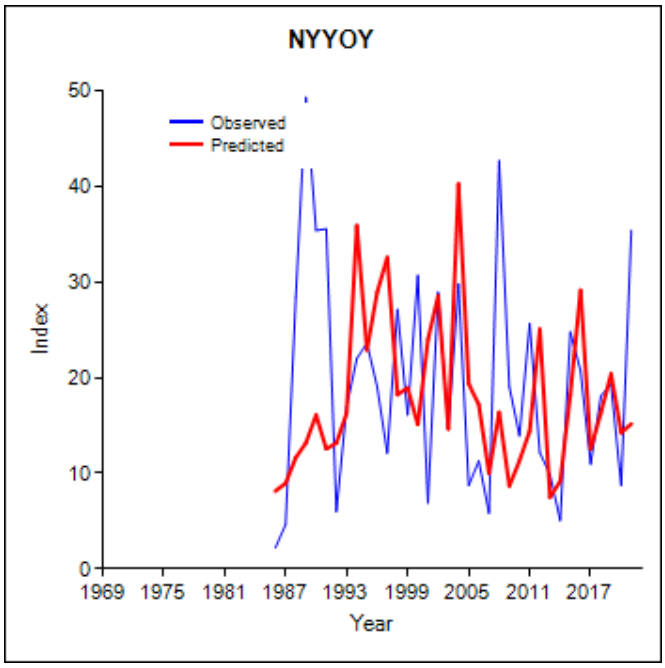
Fleet 2 Residuals of Age Composition By Age

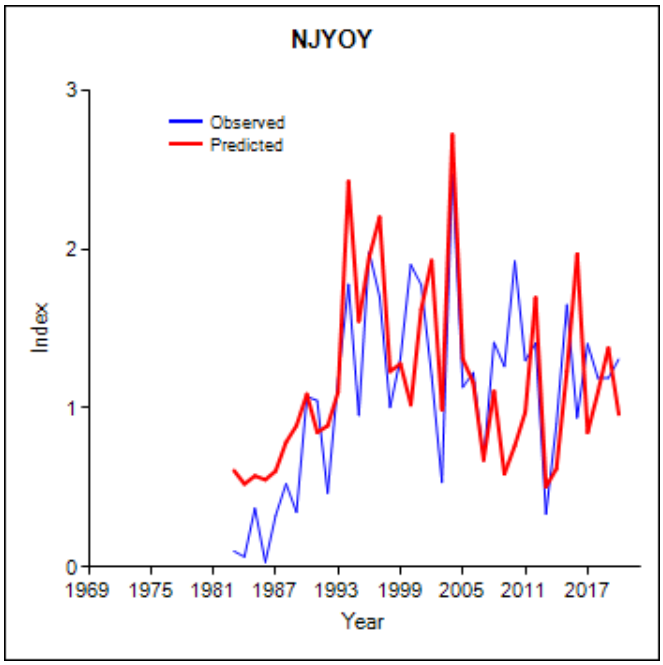


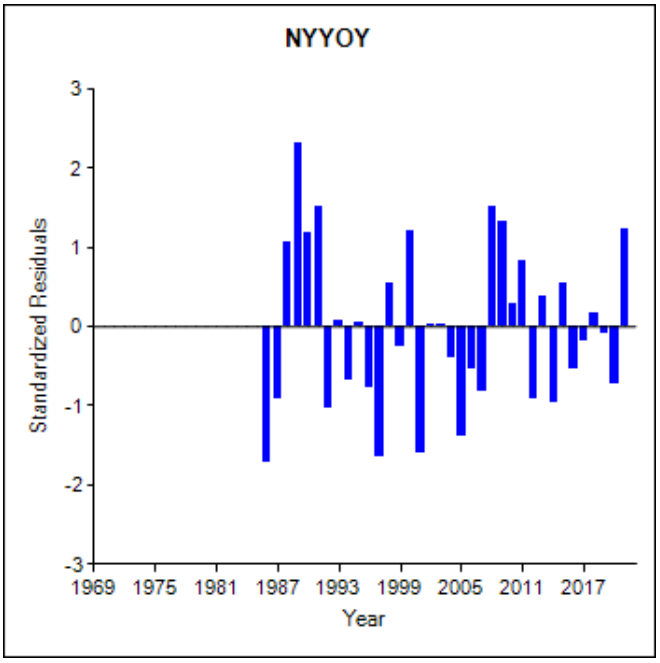
Fleet 2 Residuals of Age Composition By Year

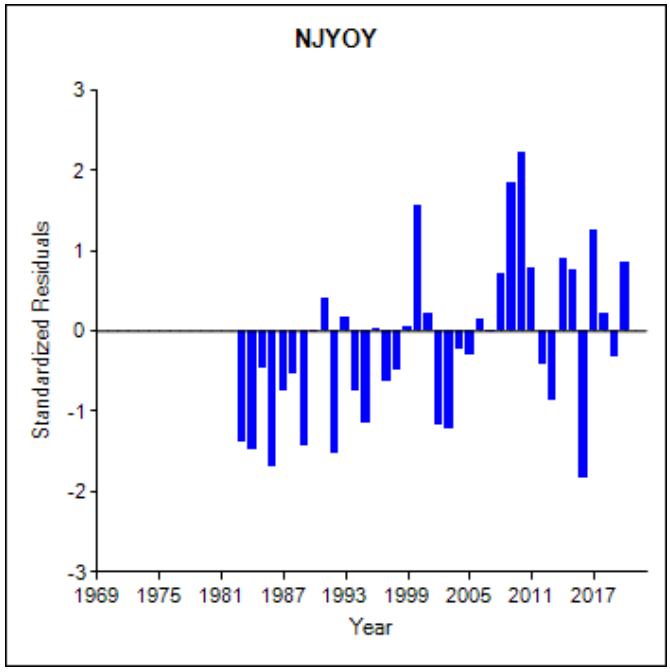


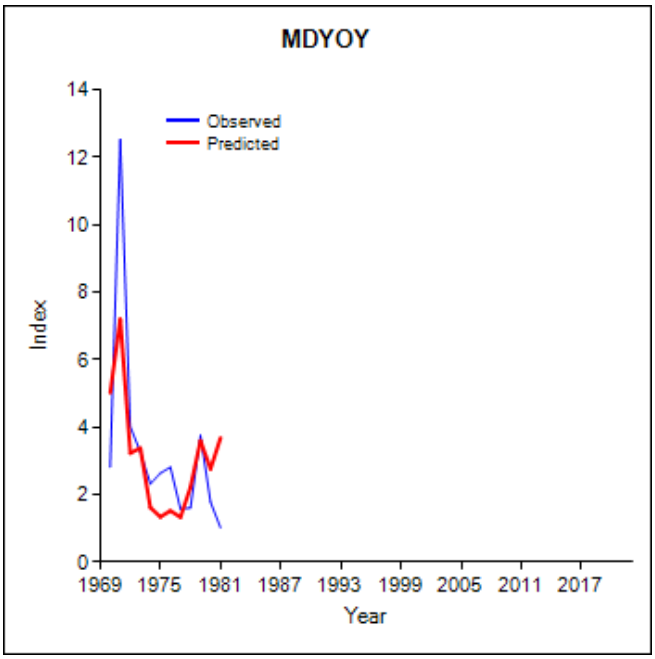

Fleet 2 Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
2021
Year

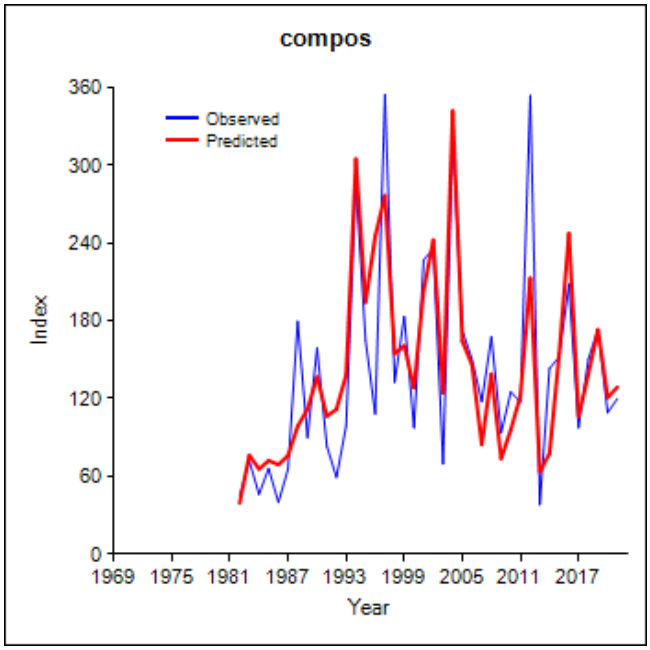

NYYOY
Observed
Predicted
Index
50
40
30
20
10
0
1969 1975 1981 1987 1993 1999 2005 2011 2017
Year

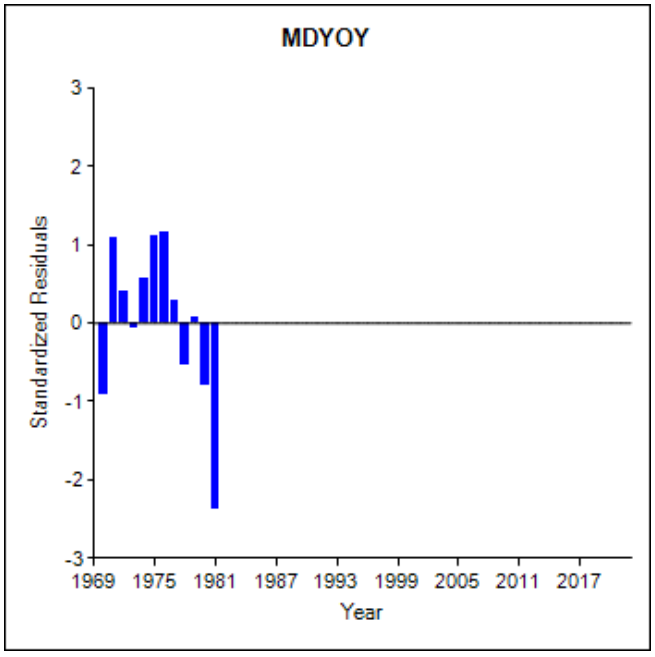

NJYOY
Observed
Predicted
Index
3
2
1
0
1969 1975 1981 1987 1993 1999 2005 2011 2017
Year

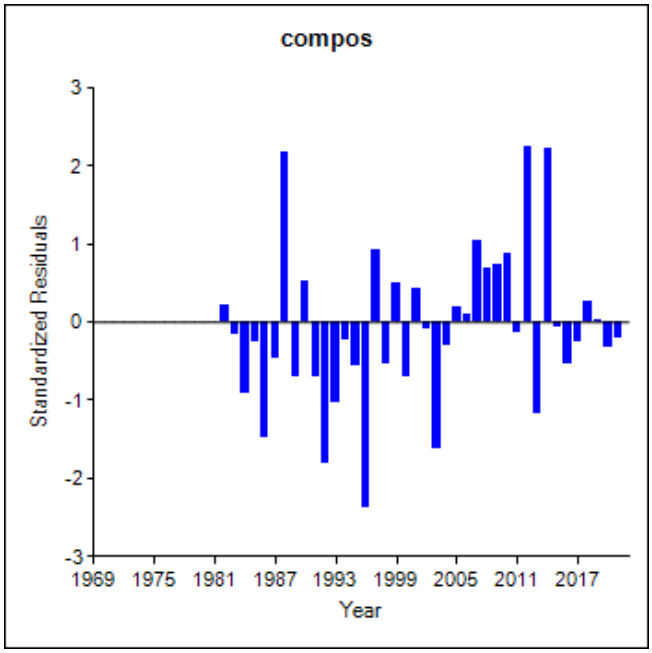

NYYOY
Standardized Residuals
3
2
1
0
-1
-2
-3
1969 1975 1981 1987 1993 1999 2005 2011 2017
Year

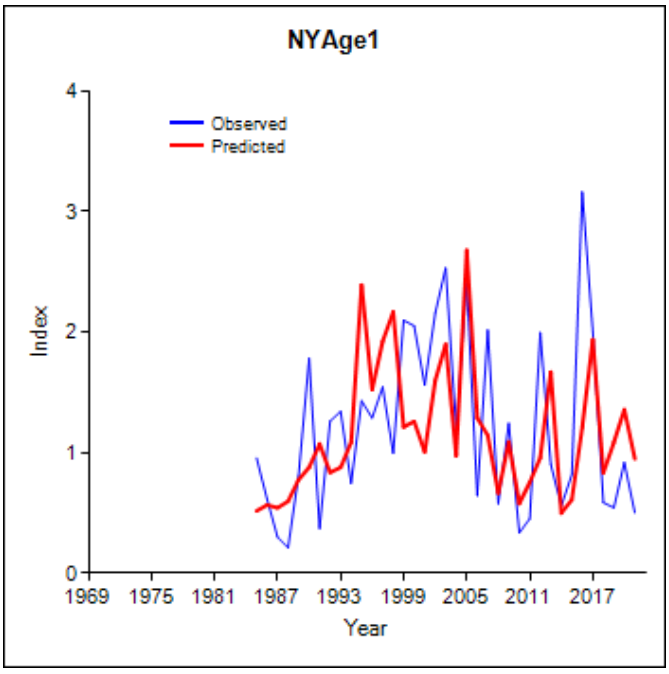

NJYOY
Standardized Residuals
3
2
1
0
-1
-2
-3
1969 1975 1981 1987 1993 1999 2005 2011 2017
Year

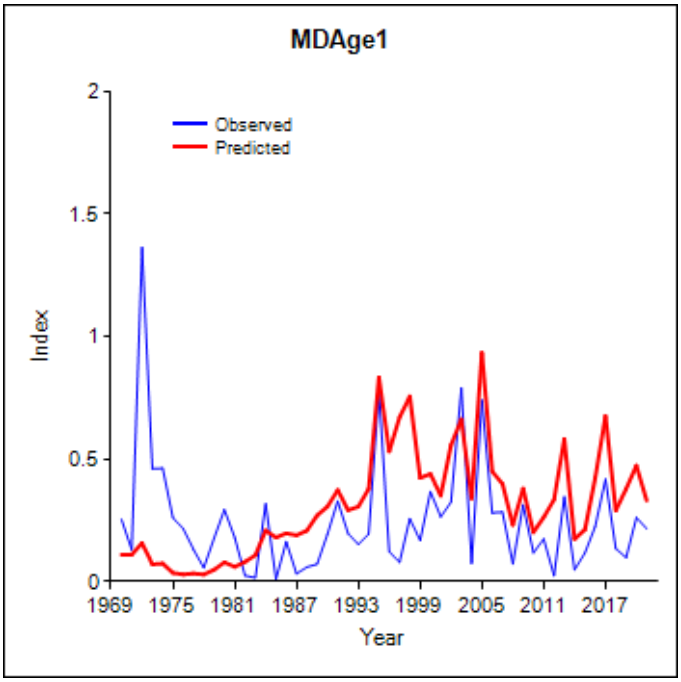

MDYOY
Observed
Predicted
Index
Year
0
2
4
6
8
10
12
14
1969
1975
1981
1987
1993
1999
2005
2011
2017

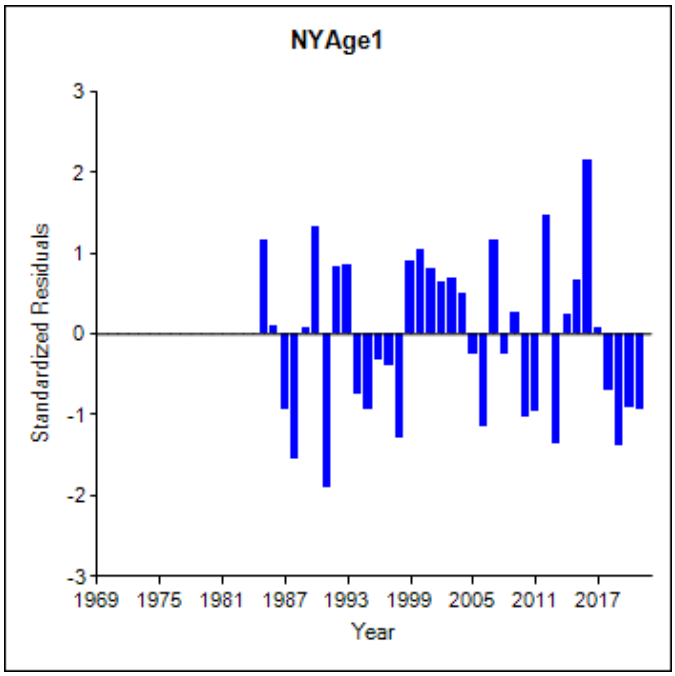

compos
Observed
Predicted
Index
Year
0
60
120
180
240
300
360
1969
1975
1981
1987
1993
1999
2005
2011
2017


MDYOY
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1975
1981
1987
1993
1999
2005
2011
2017


compos
Standardized Residuals
Year
-3
-2
-1
0
1
2
3
1969
1975
1981
1987
1993
1999
2005
2011
2017


NYAge1
Observed
Predicted
Index
Year
0
1
2
3
4
1969
1975
1981
1987
1993
1999
2005
2011
2017


MDAge1
Observed
Predicted
Index
Year
0
0.5
1
1.5
2
1969
1975
1981
1987
1993
1999
2005
2011
2017


NYAge1
Standardized Residuals
Year
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1975
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1999
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2011
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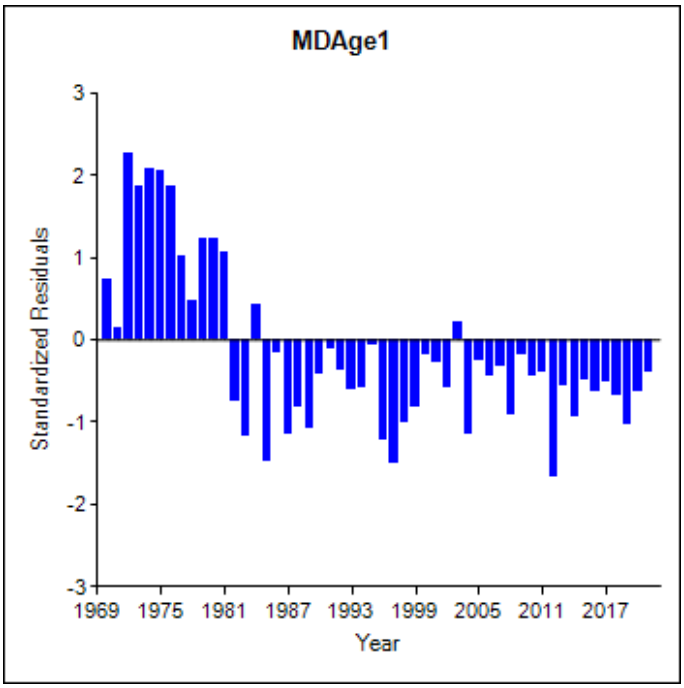
MDAge1
Standardized Residuals
Year
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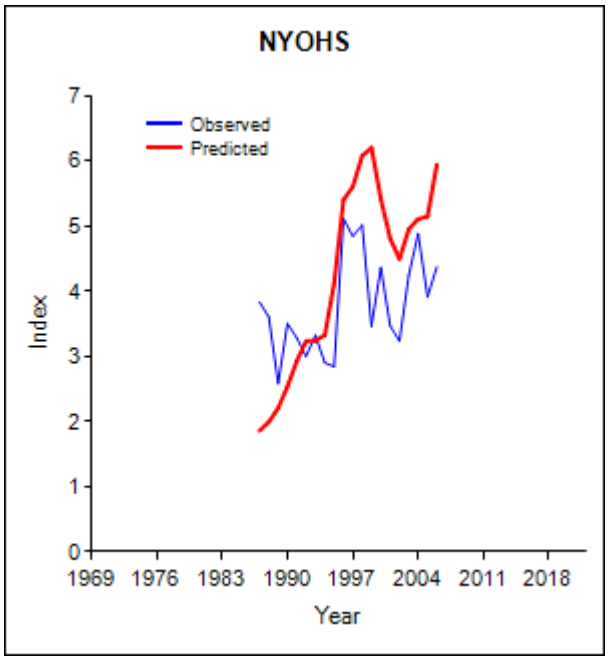
NYOHS
Observed
Predicted
Index
Year
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1997
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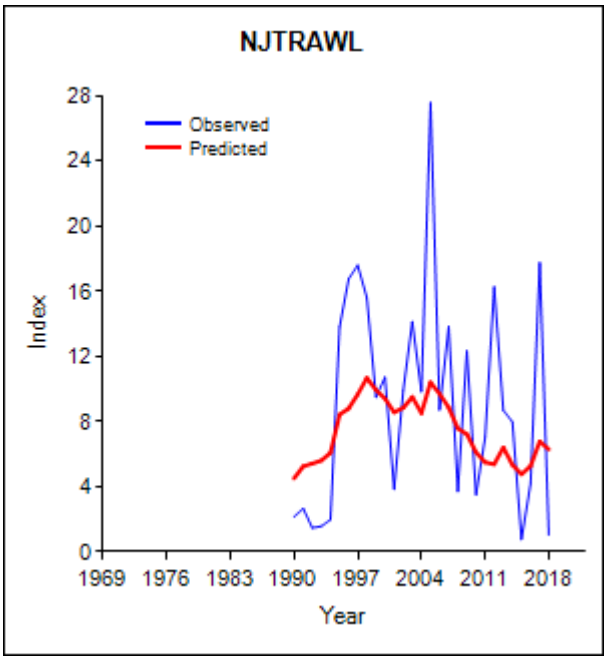
2011
2018


NJTRAWL
Observed
Predicted
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2011
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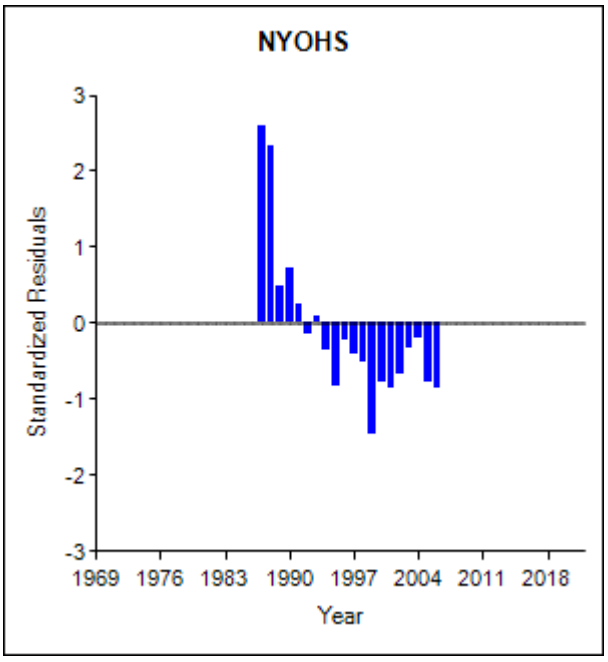
NYOHS
Standardized Residuals
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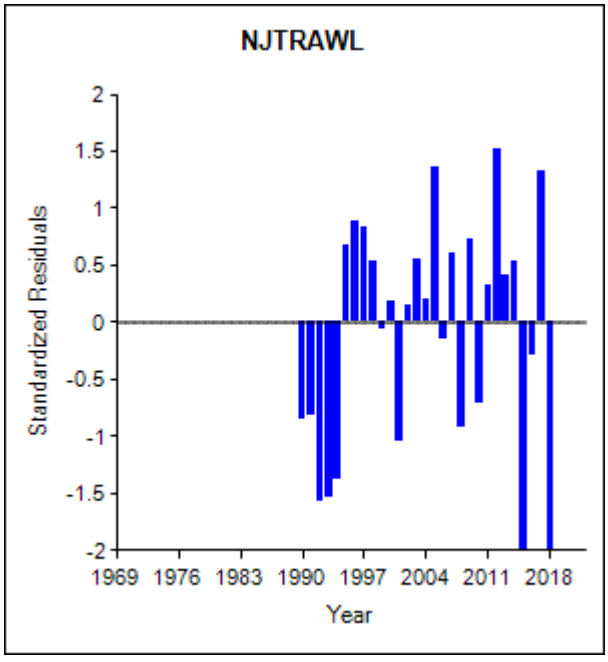
2011
2018


NJTRAWL
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Year
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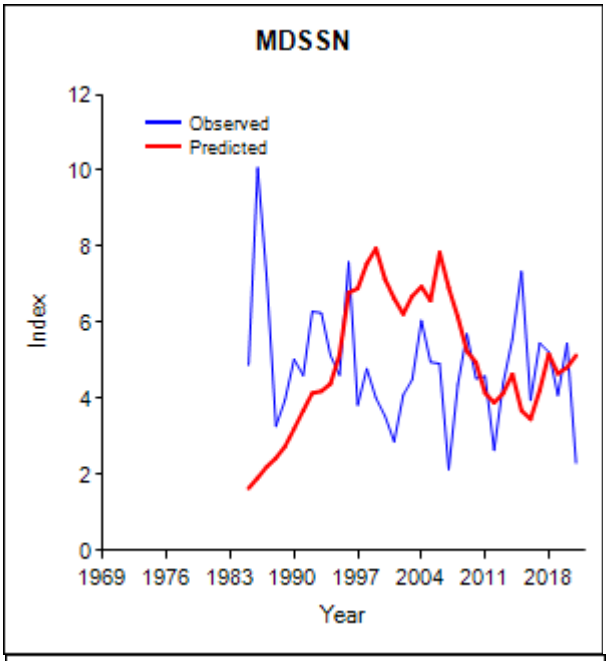
MDSSN
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Predicted
Index
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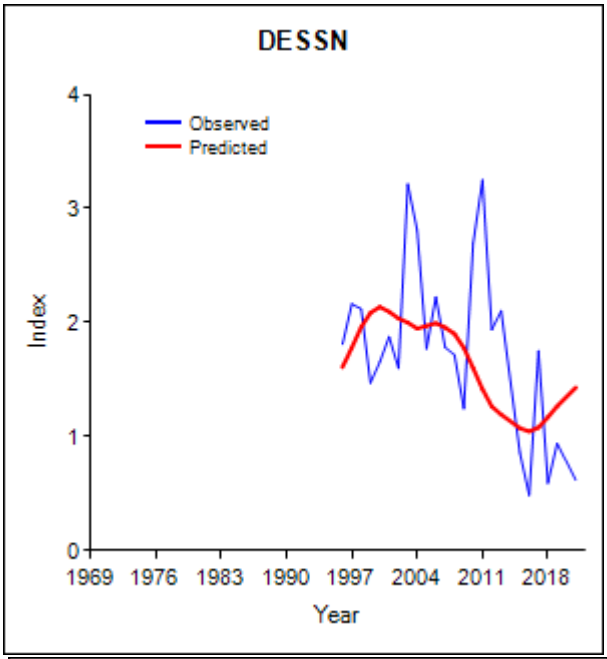
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Observed
Predicted
Index
Year
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1976
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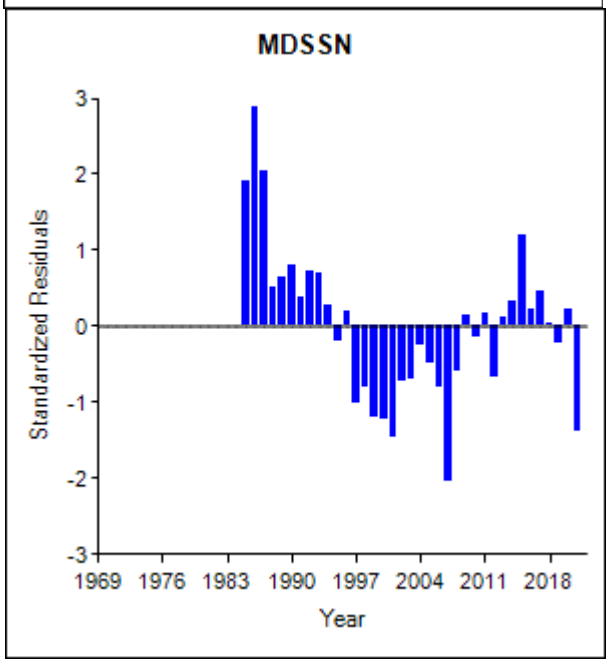
MDSSN
Standardized Residuals
Year
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2011
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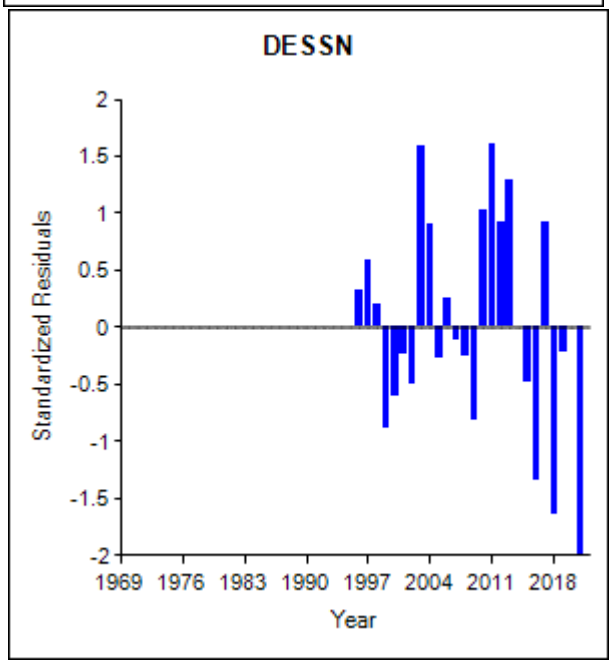
DESSN
Standardized Residuals
Year
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0
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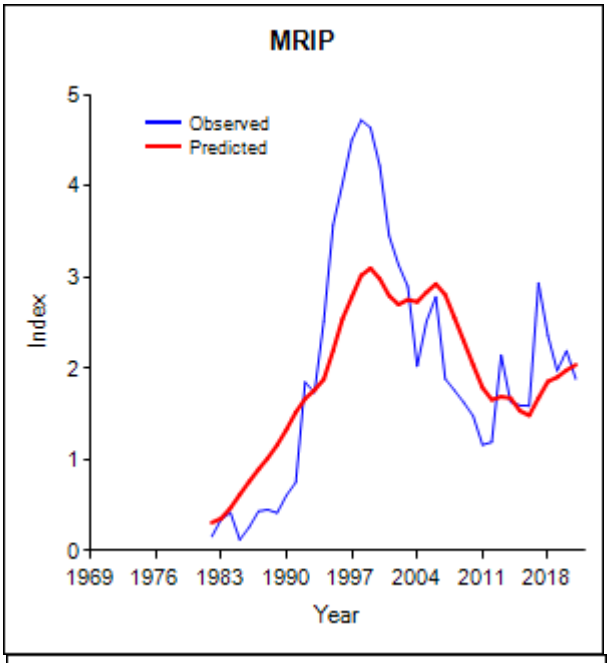
MRIP
Observed
Predicted
Index
Year
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5
1969
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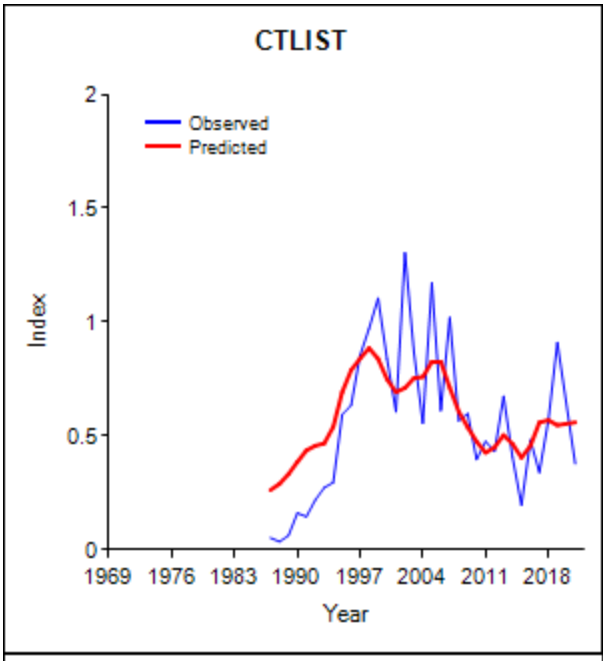
1997
2004
2011
2018


CTLIST
Observed
Predicted
Index
Year
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1
1.5
2
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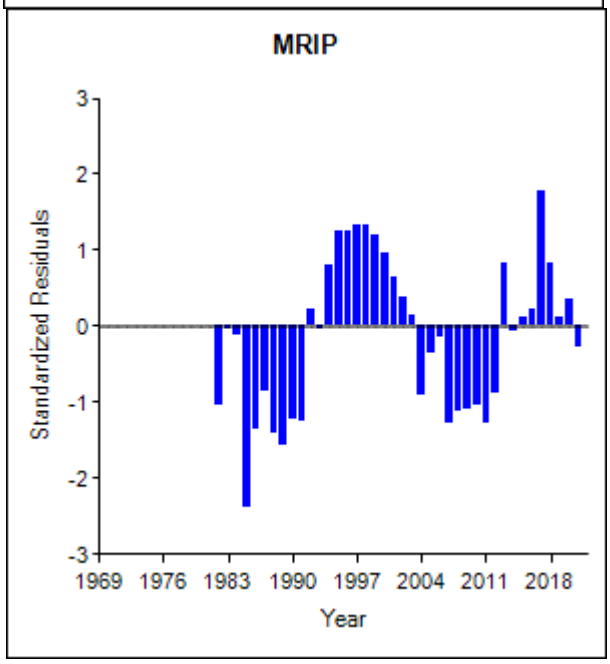
1990
1997
2004
2011
2018


MRIP
Standardized Residuals
Year
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2011
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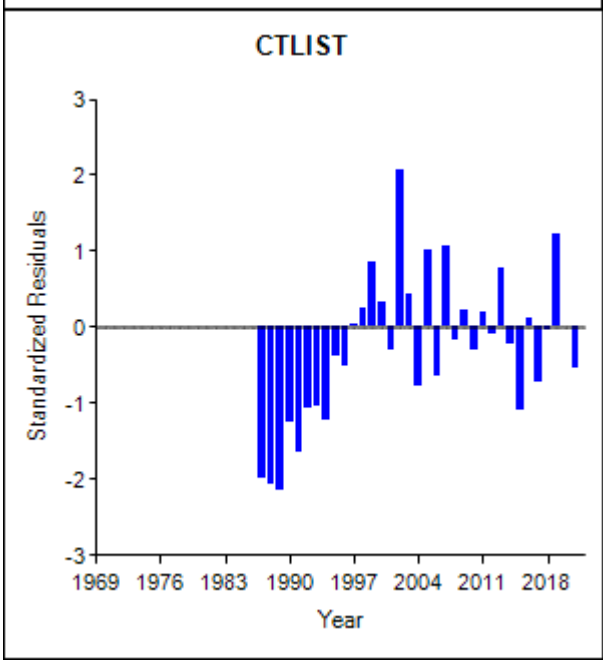
CTLIST
Standardized Residuals
Year
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3
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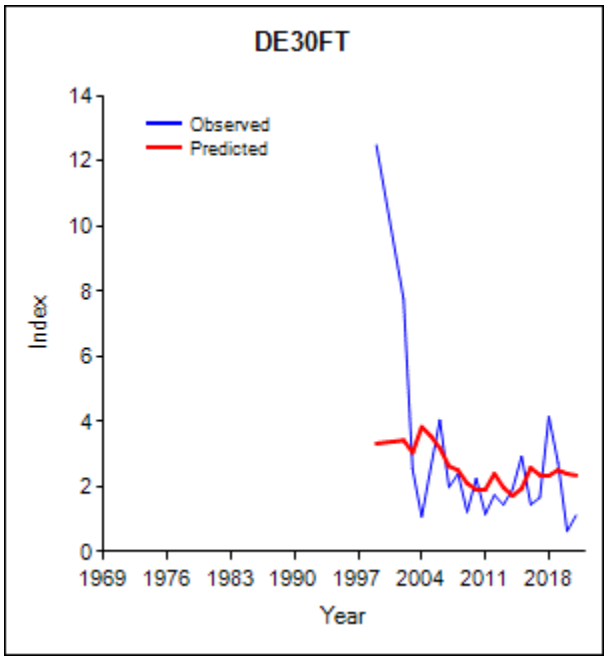
2004
2011
2018


DE30FT
Observed
Predicted
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Year
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2
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6
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14
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1976
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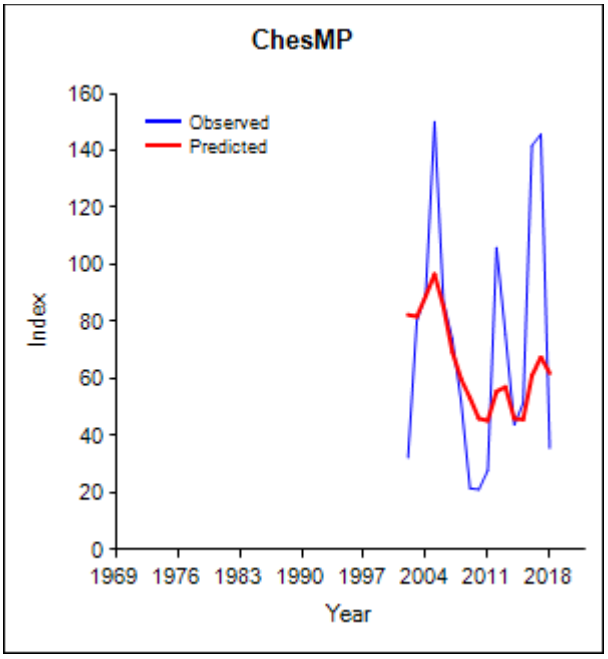
1990
1997
2004
2011
2018


ChesMP
Observed
Predicted
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120
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1969
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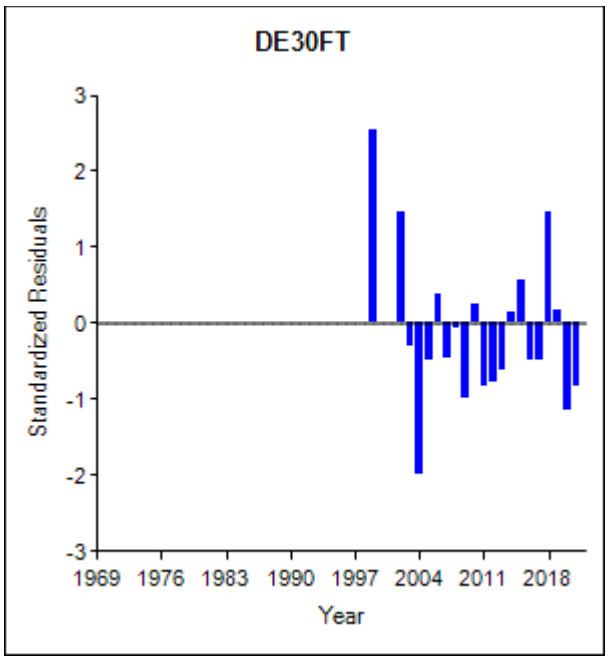
1997
2004
2011
2018


DE30FT
Standardized Residuals
Year
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2
3
1969
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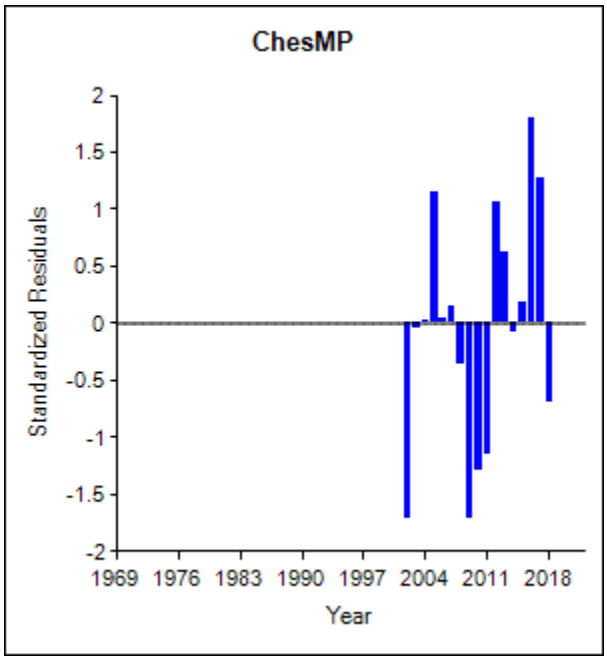
1997
2004
2011
2018


ChesMP
Standardized Residuals
Year
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0
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1
1.5
2
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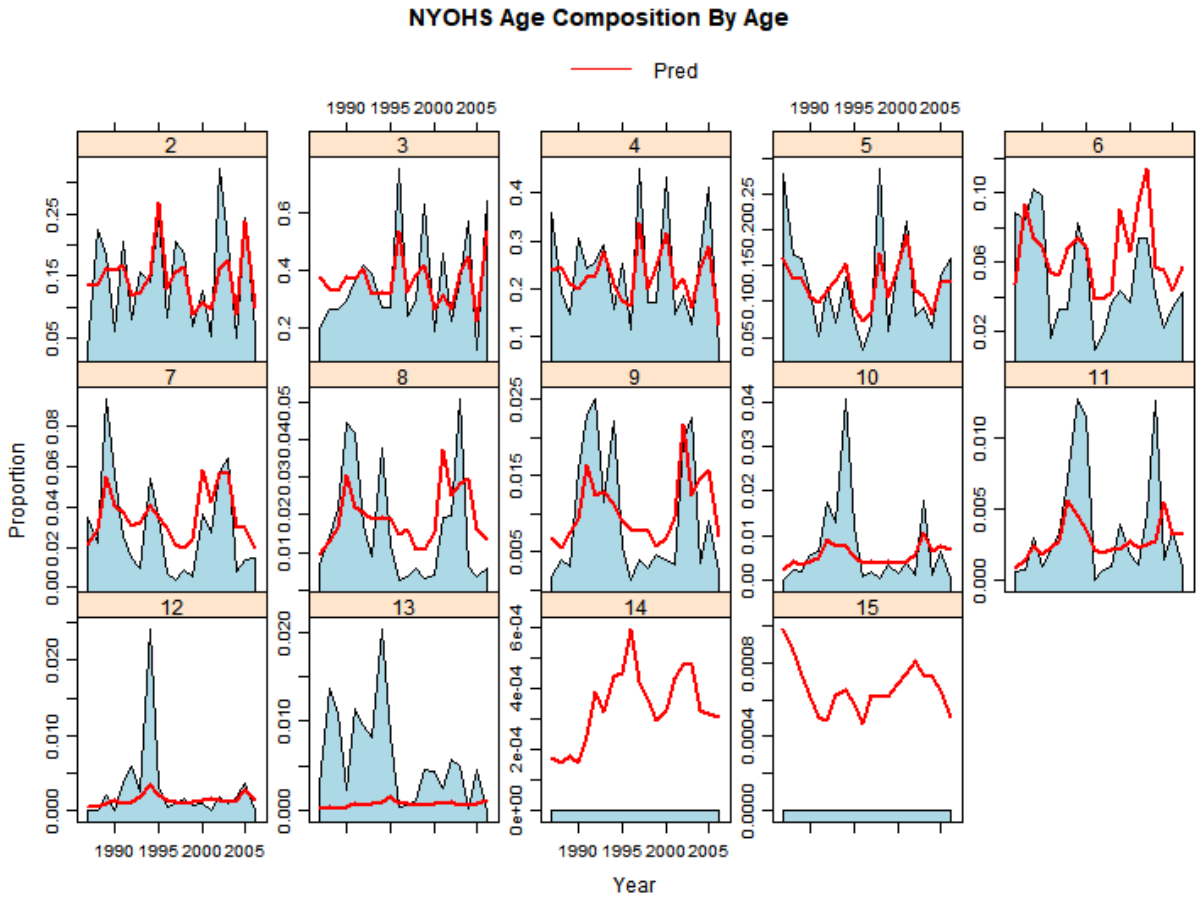
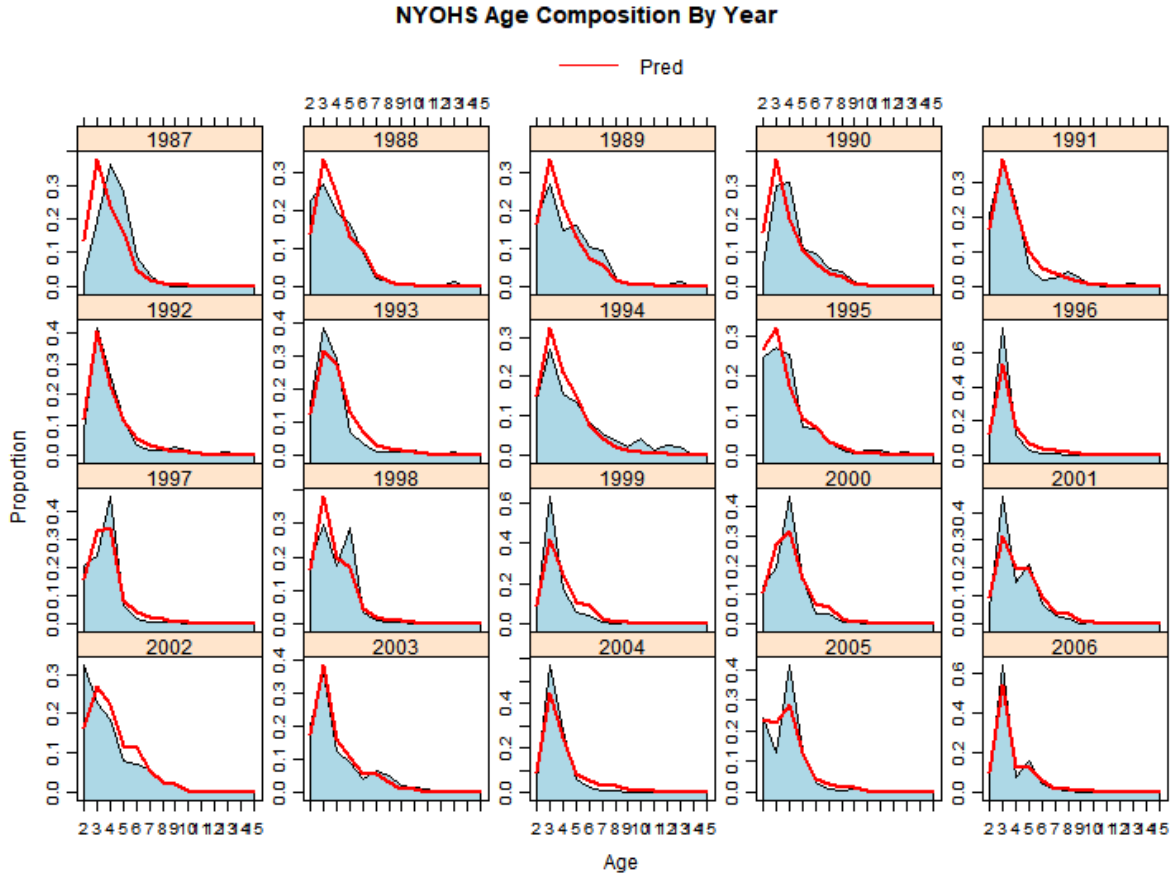
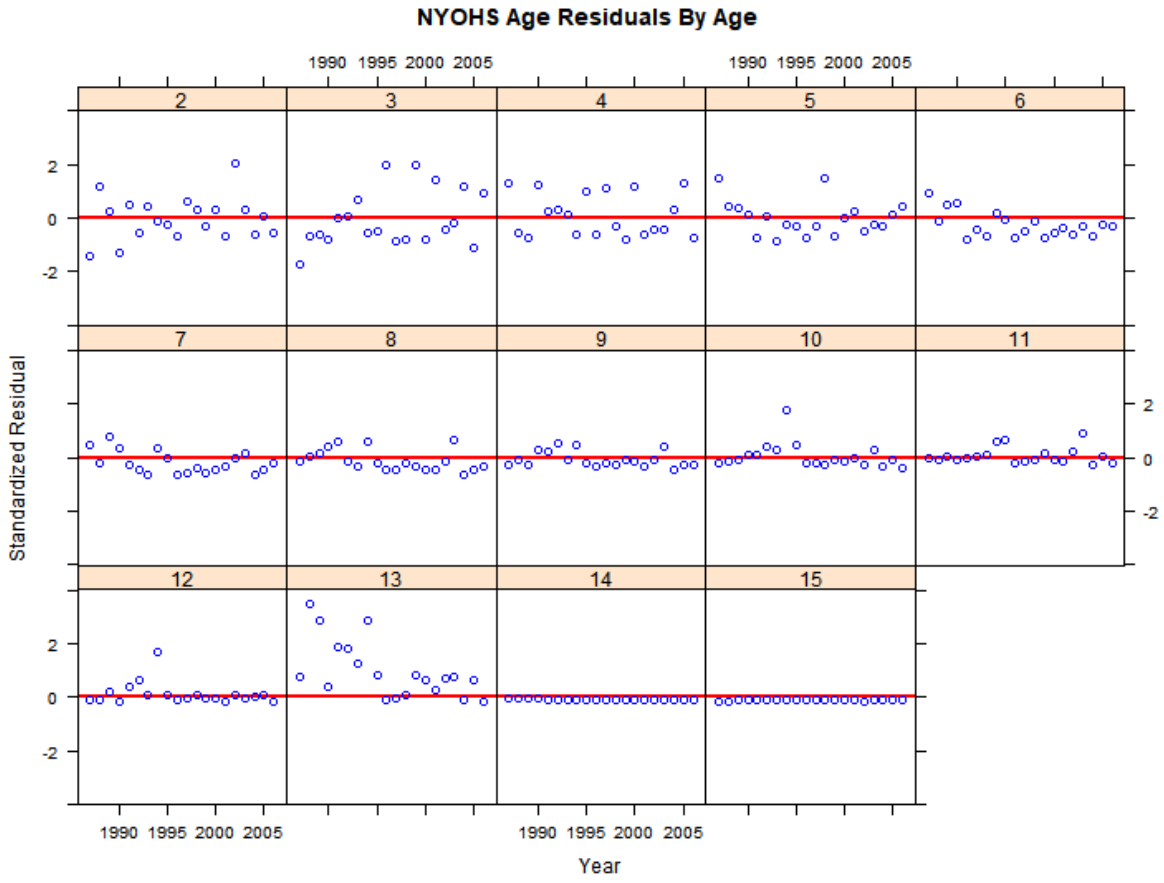
1976
1983
1990
1997
2004
2011
2018


NYOHS Age Composition By Age
Pred
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year
1990 1995 2000 2005


NYOHS Age Composition By Year
Pred
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Proportion
Age


NYOHS Age Residuals By Age
2
3
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6
7
8
9
10
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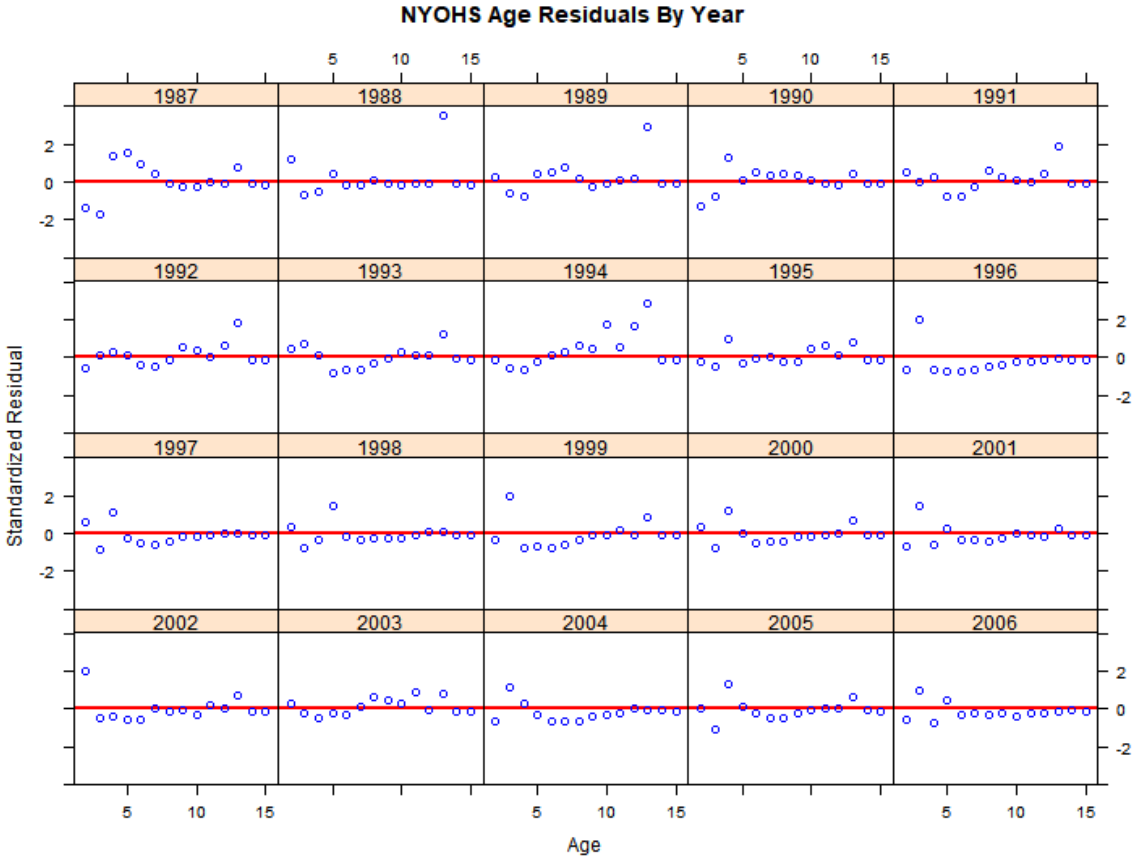
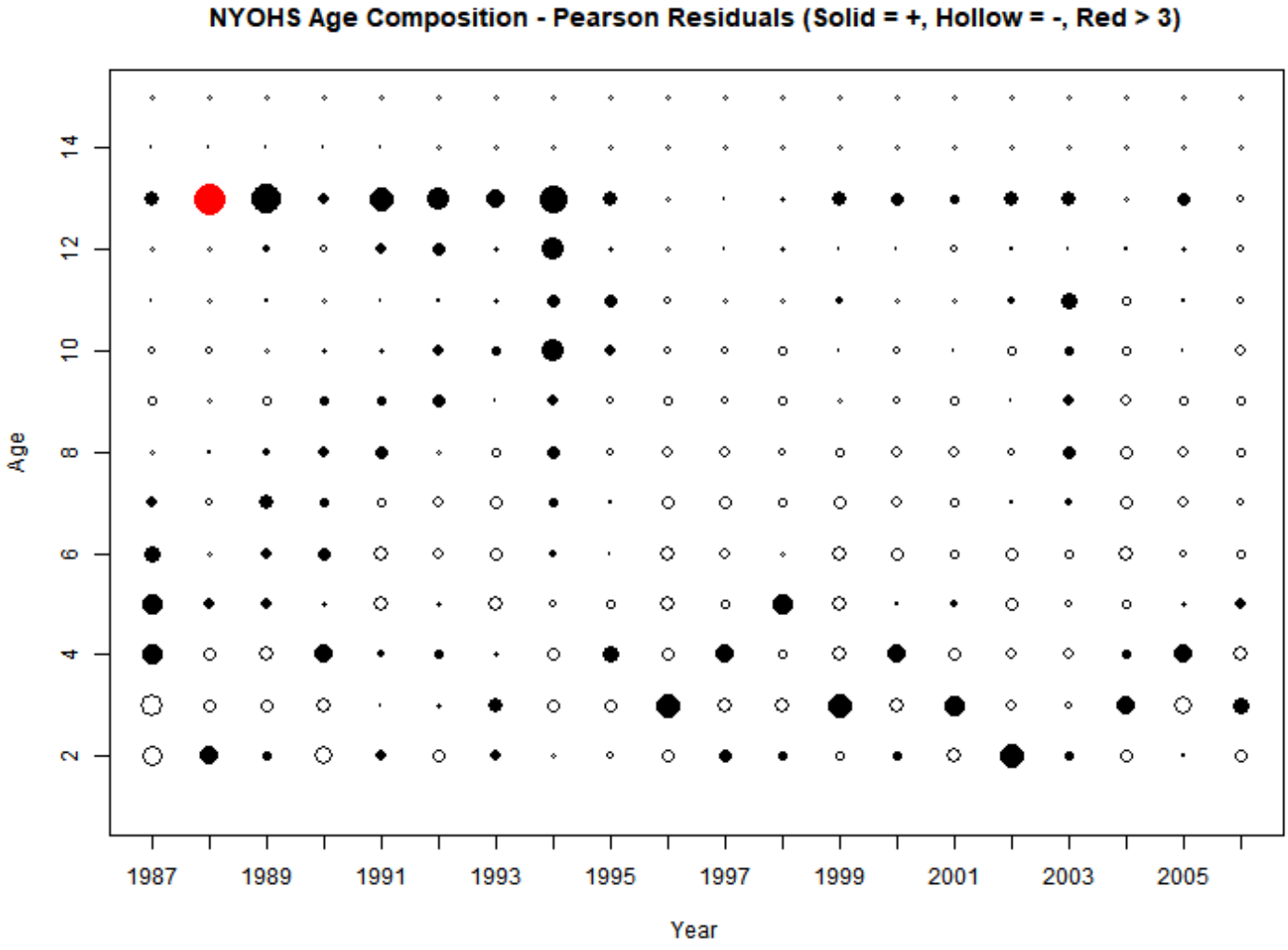
13
14
15
1990 1995 2000 2005
Standardized Residual
Year


NYOHS Age Residuals By Year
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
5 10 15
Standardized Residual
Age


NYOHS Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
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4
6
8
10
12
14
1987
1989
1991
1993
1995
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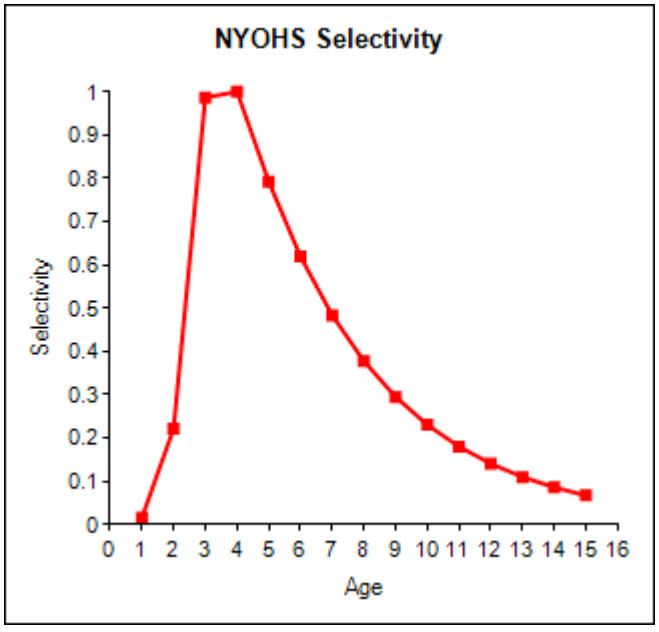
1999
2001
2003
2005
Year


NYOHS Selectivity
Selectivity
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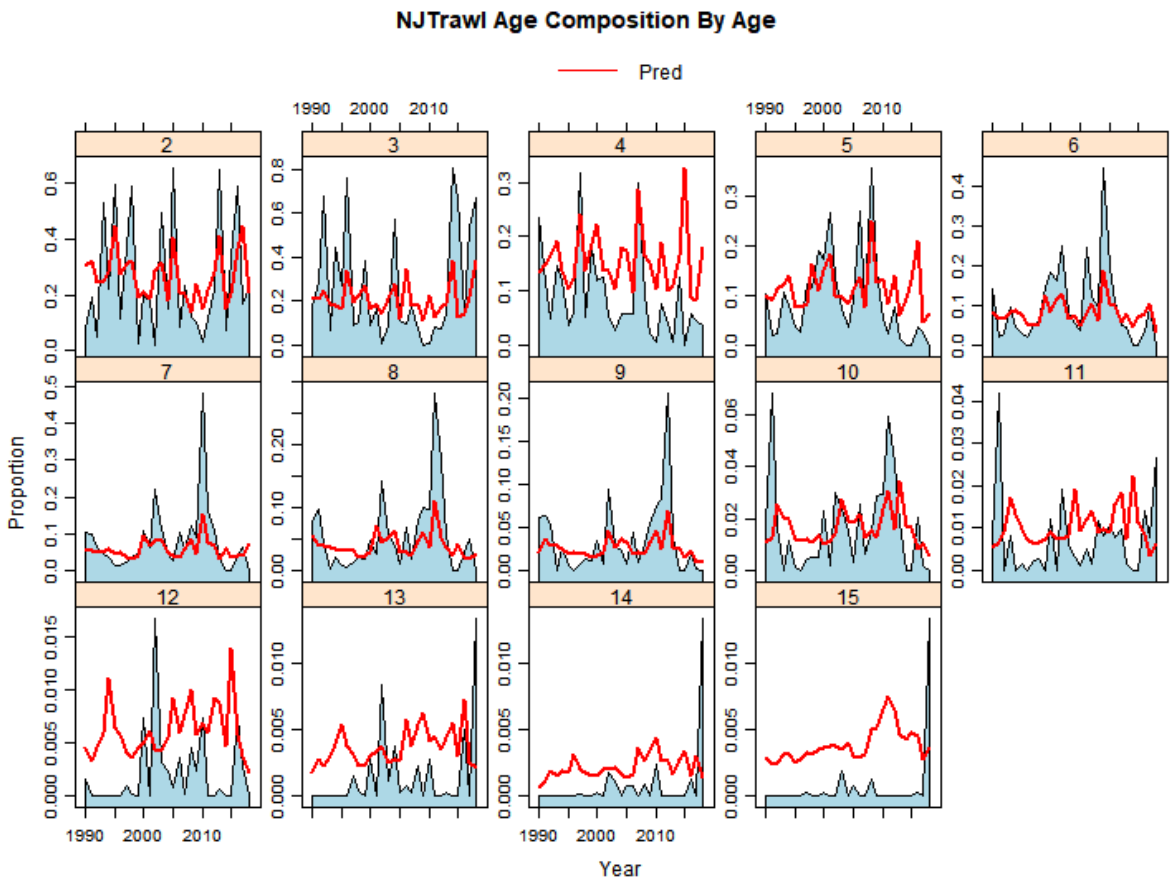
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


NJTrawl Age Composition By Age
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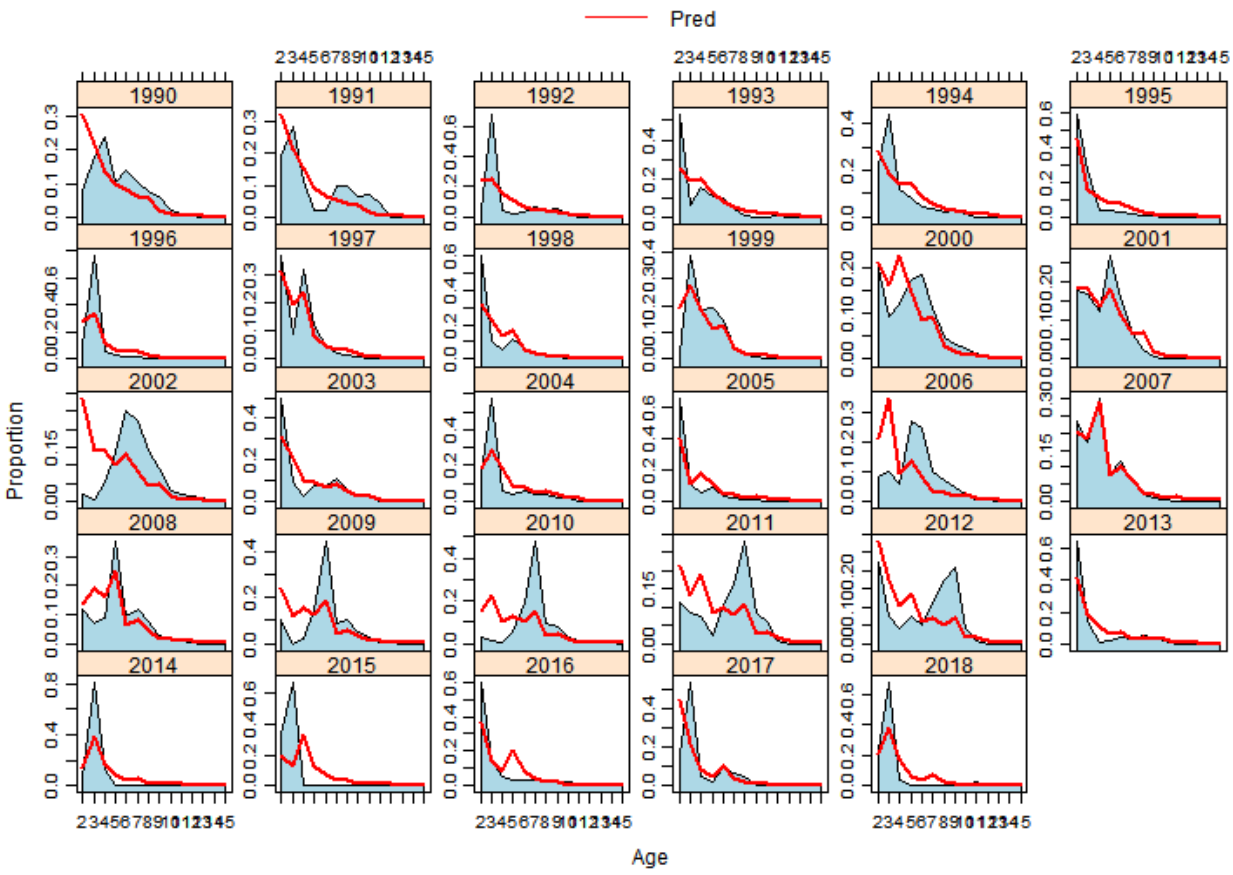
8
9
10
11
12
13
14
15
Proportion
Year


NJTrawl Age Composition By Year
Pred
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
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2007
2008
2009
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2014
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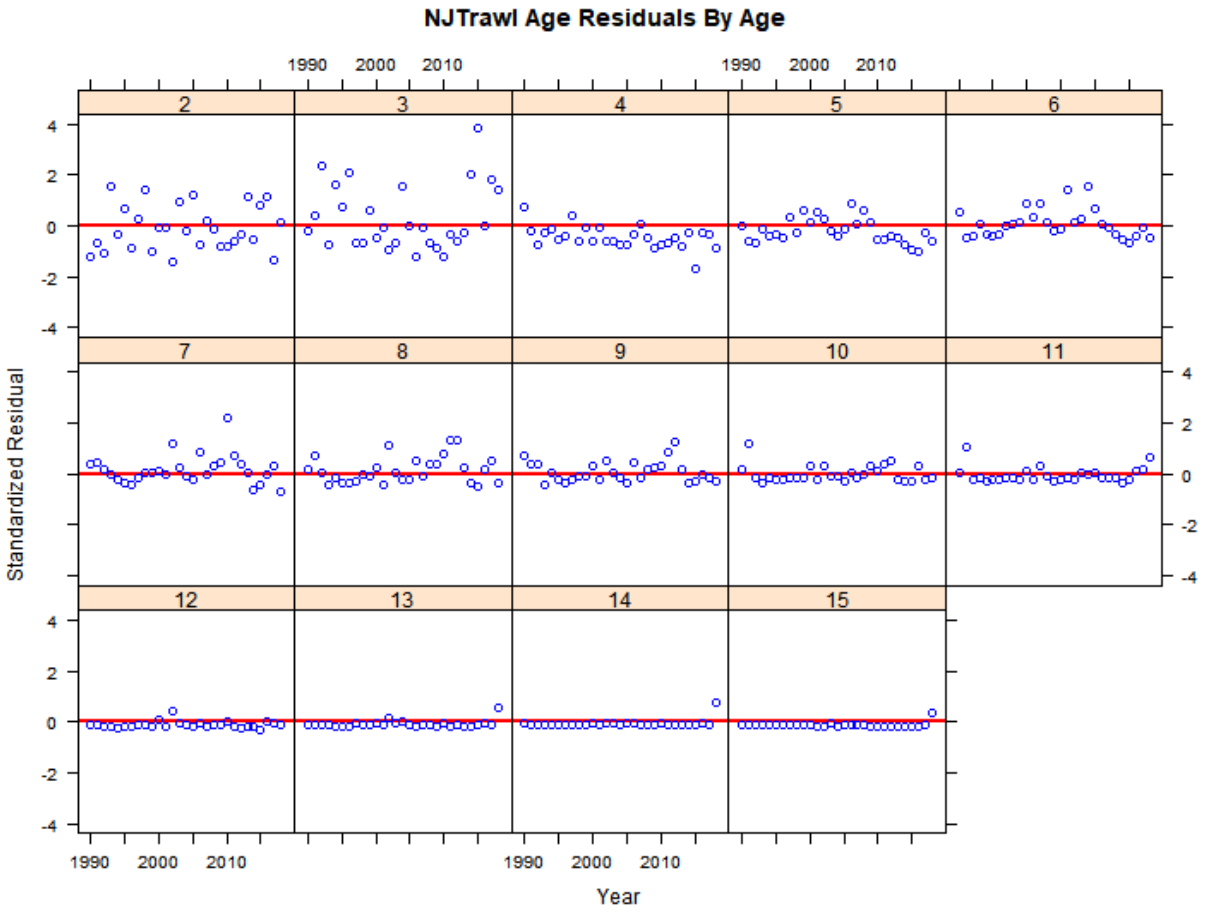
2016
2017
2018
Proportion
Age


NJTrawl Age Residuals By Age
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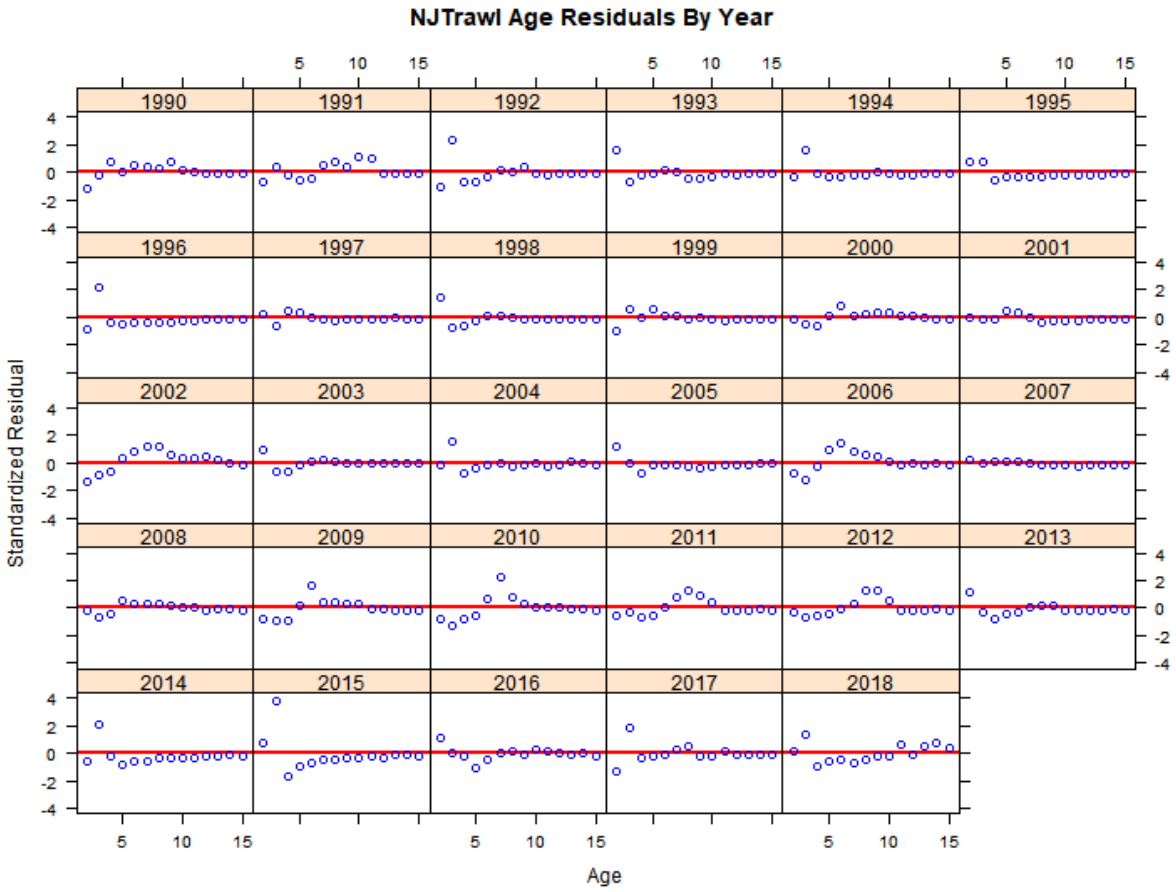
3
4
5
6
7
8
9
10
11
12
13
14
15
Standardized Residual
Year


NJTrawl Age Residuals By Year
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1991
1992
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1994
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1996
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2010
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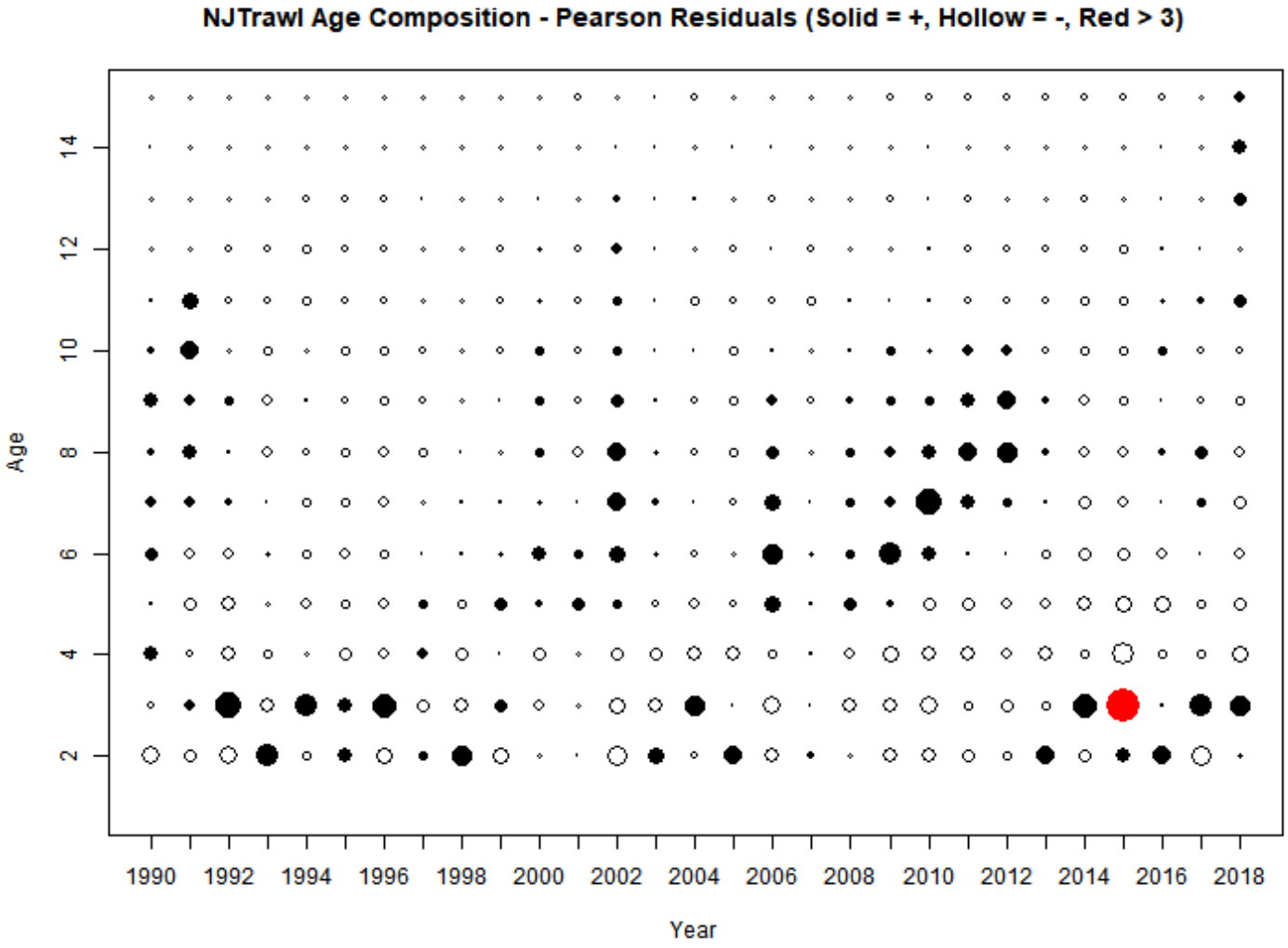
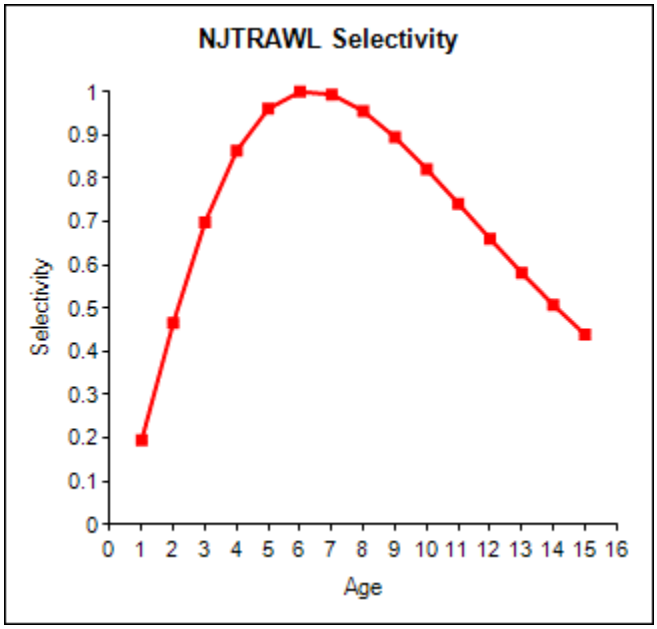
2018
Standardized Residual
Age


NJTrawl Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year


NJTRAWL Selectivity
Selectivity
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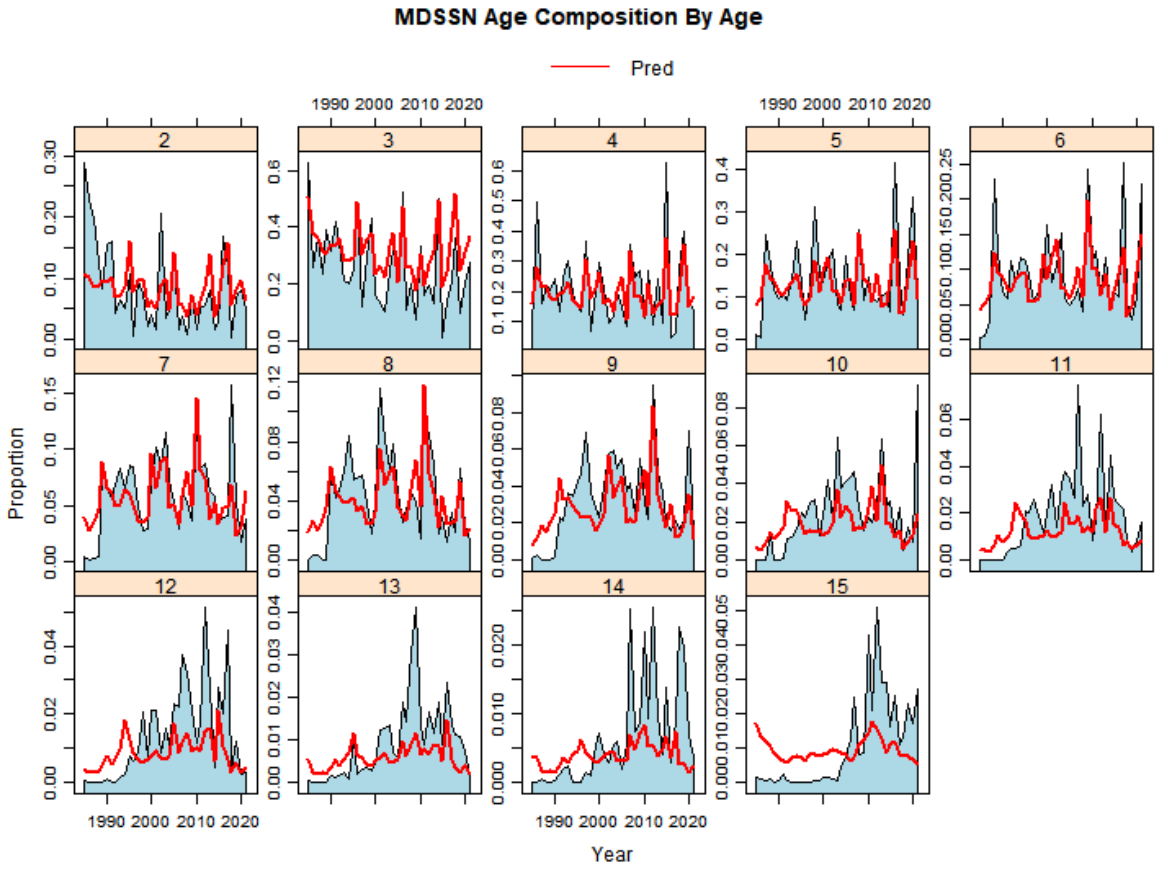
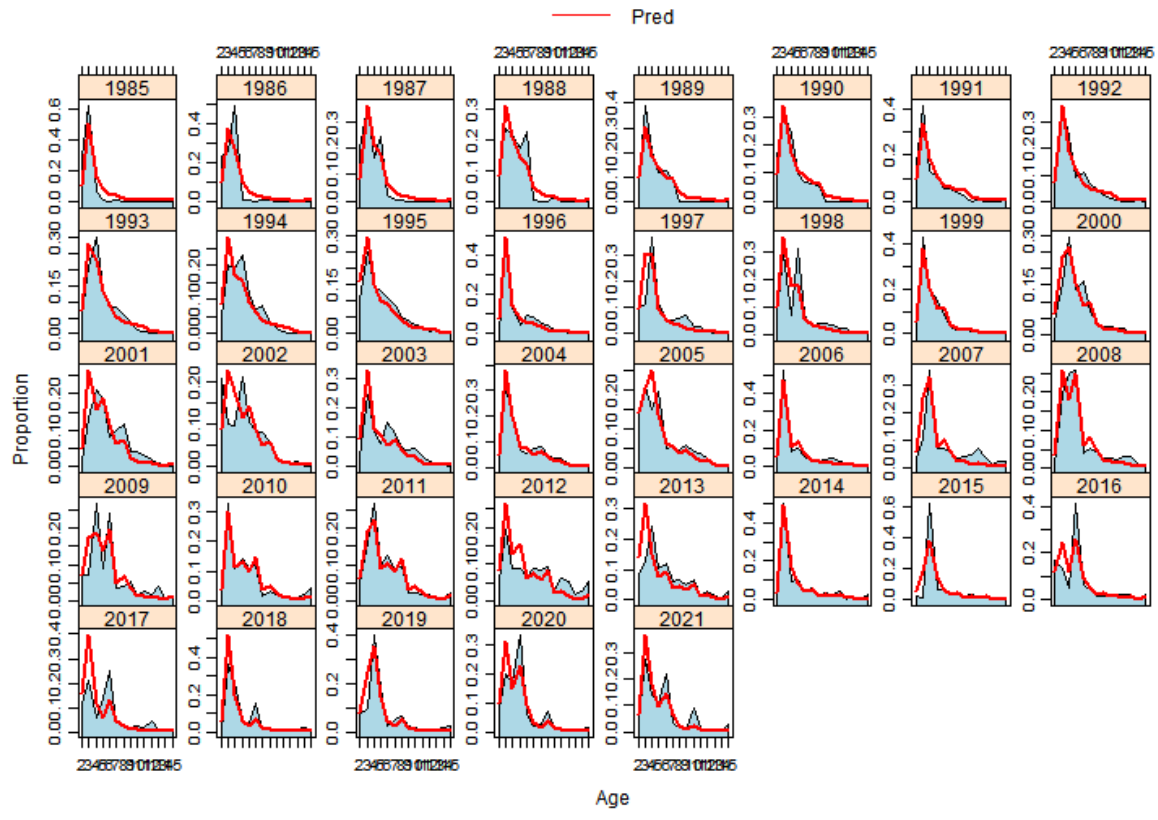
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


MDSSN Age Composition By Age
Pred
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year
1990 2000 2010 2020


MDSSN Age Composition By Year
Pred
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
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2012
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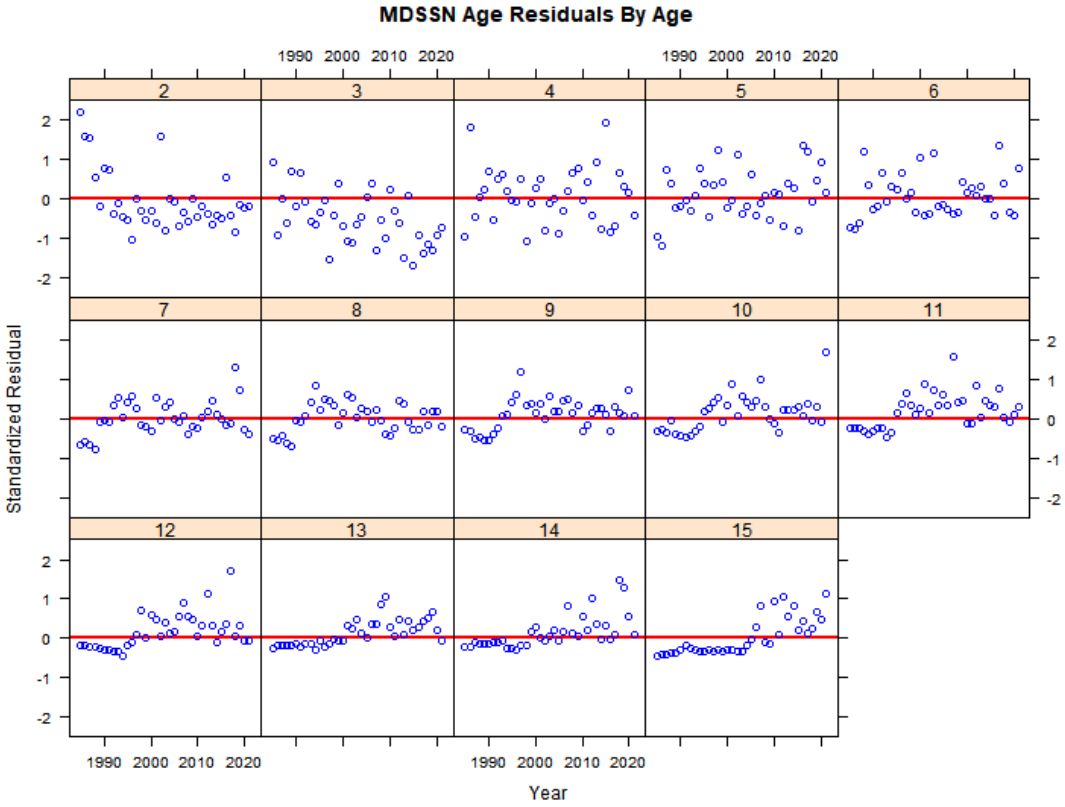
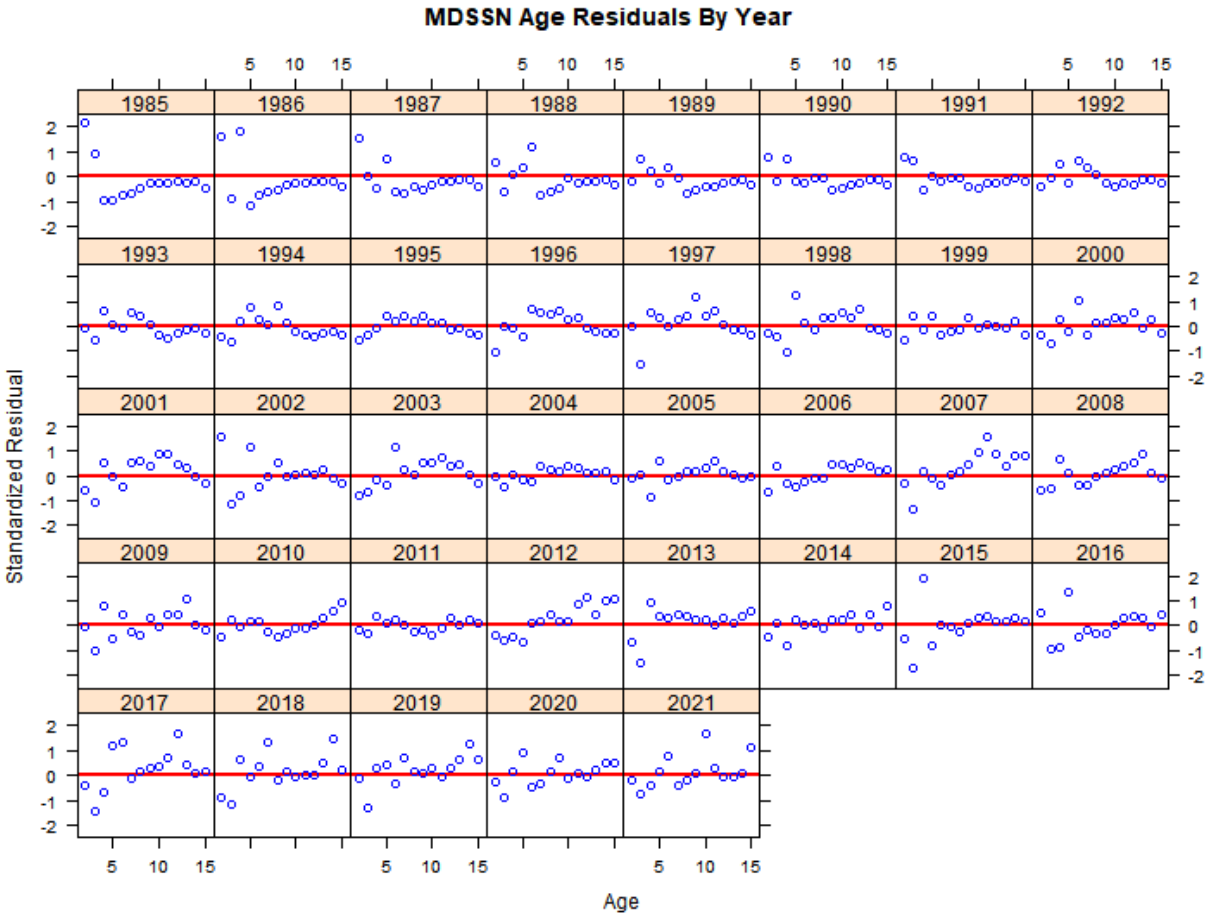
2017
2018
2019
2020
2021
Proportion
Age


MDSSN Age Residuals By Age
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1990 2000 2010 2020
Standardized Residual
Year


MDSSN Age Residuals By Year
1985
1986
1987
1988
1989
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2000
2001
2002
2003
2004
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2006
2007
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2015
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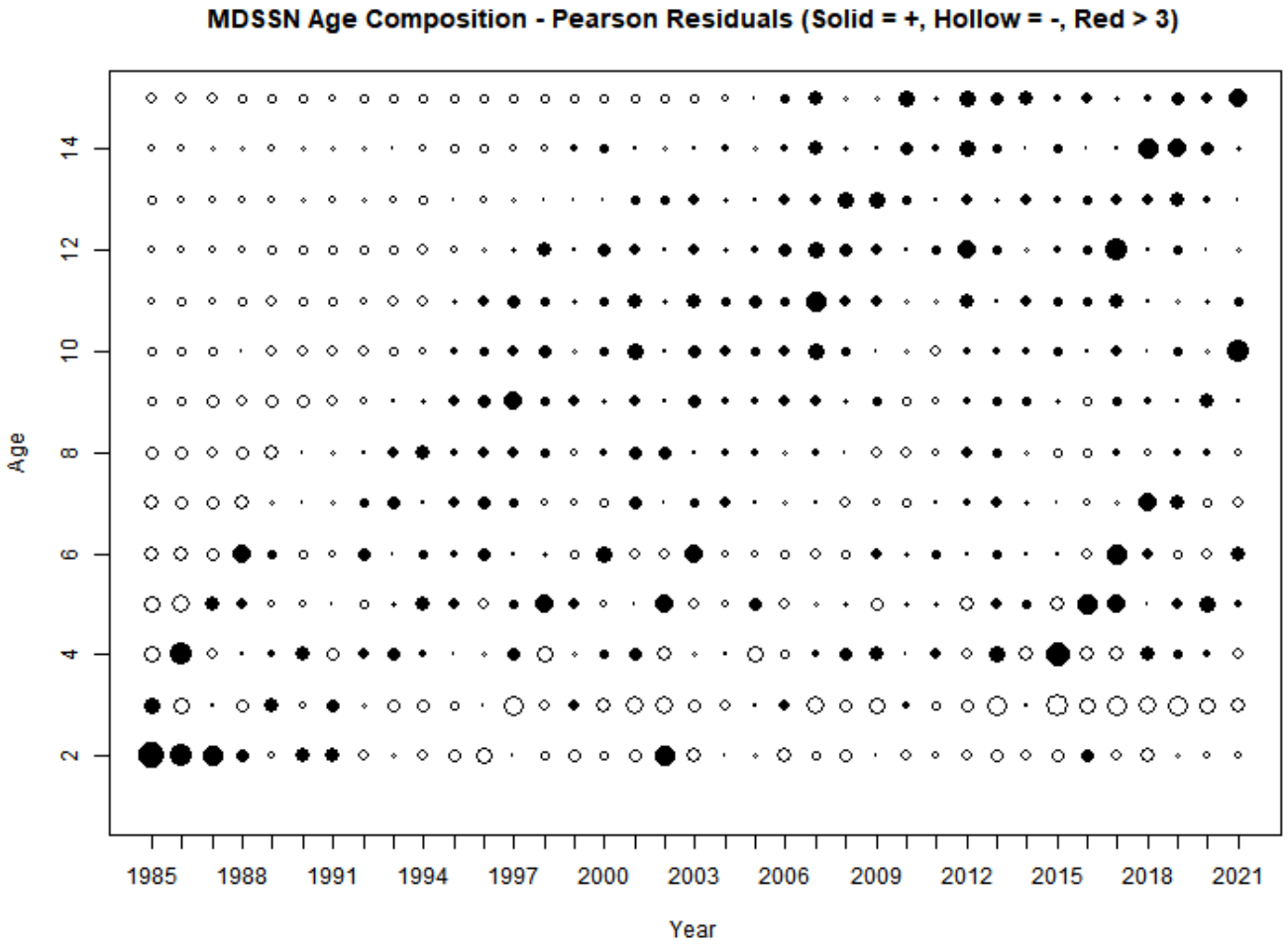
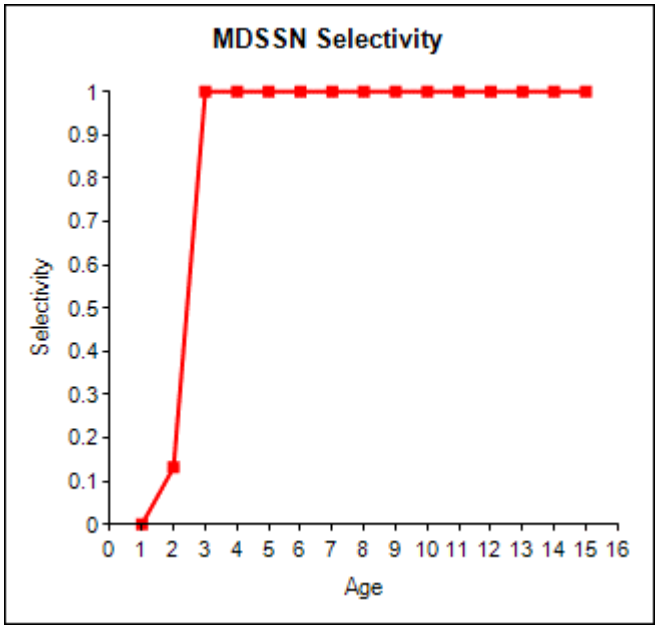
2018
2019
2020
2021
5 10 15
Standardized Residual
Age


MDSSN Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
2021
Year


MDSSN Selectivity
Selectivity
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0.2
0.3
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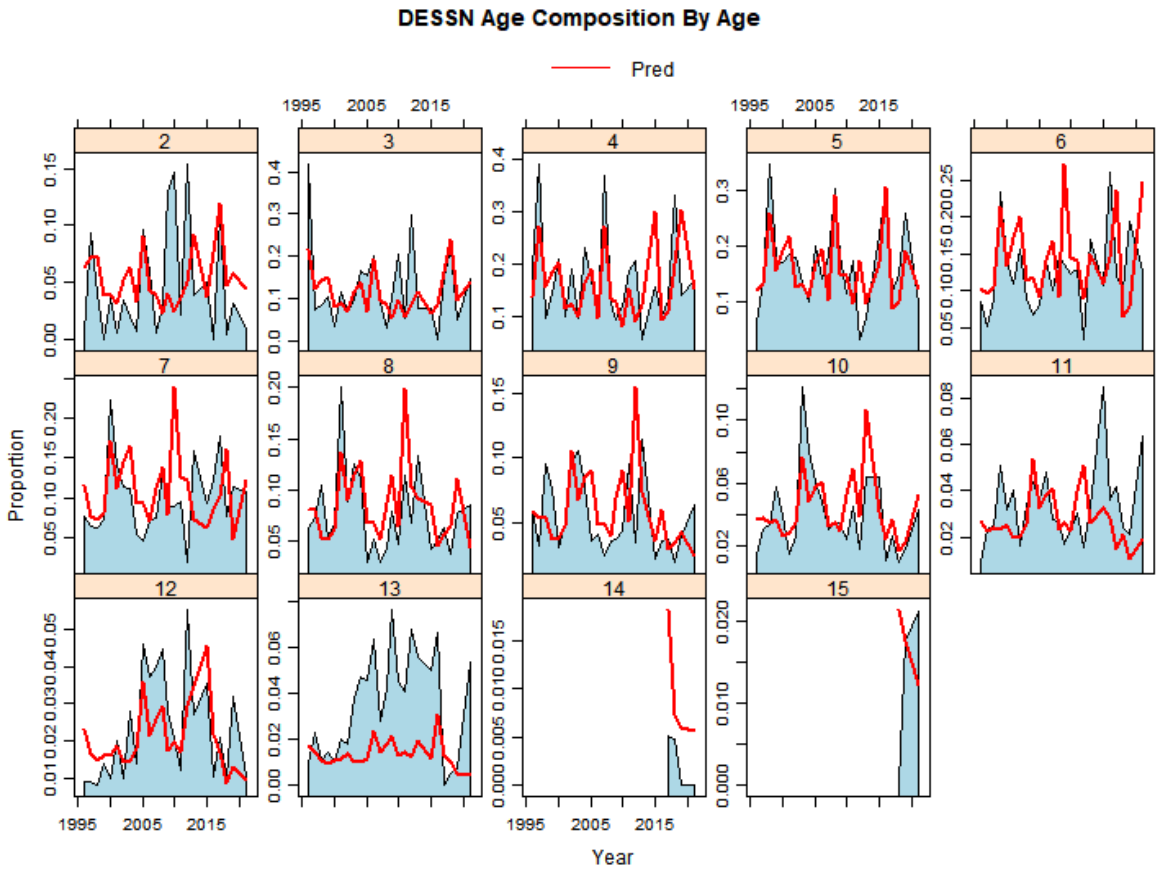
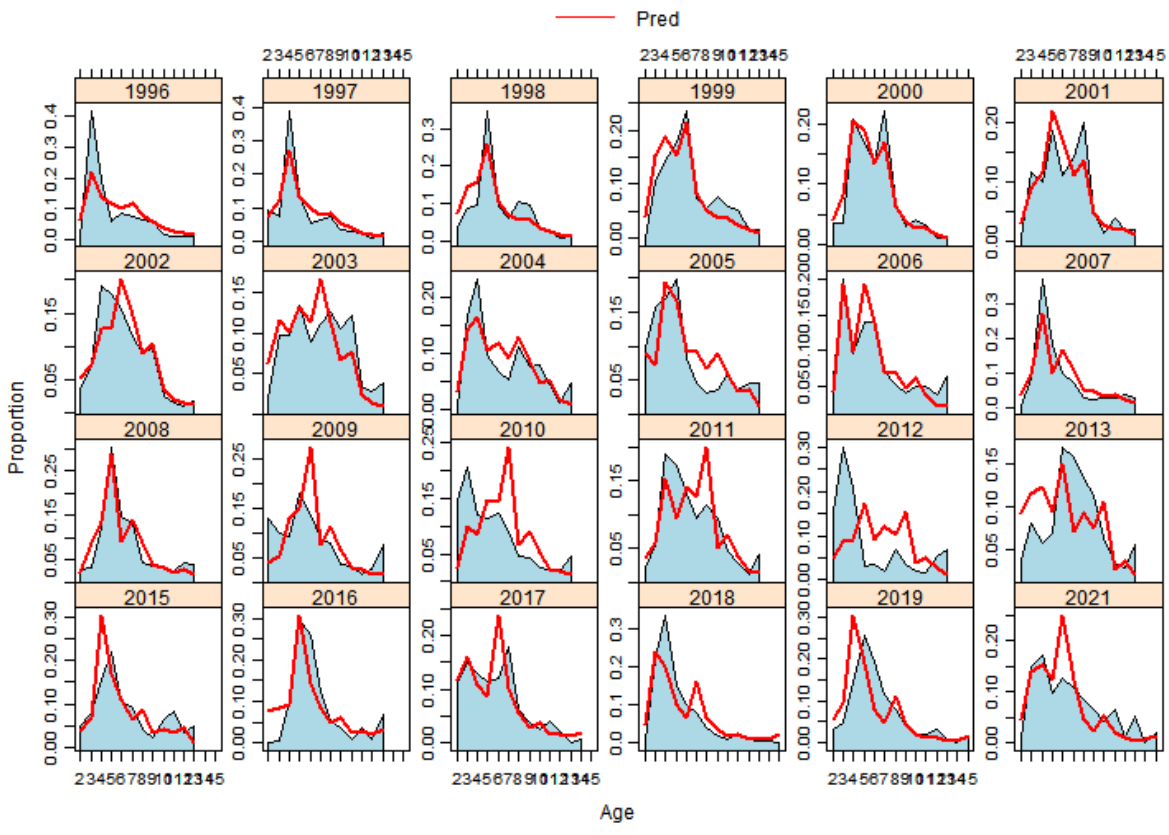
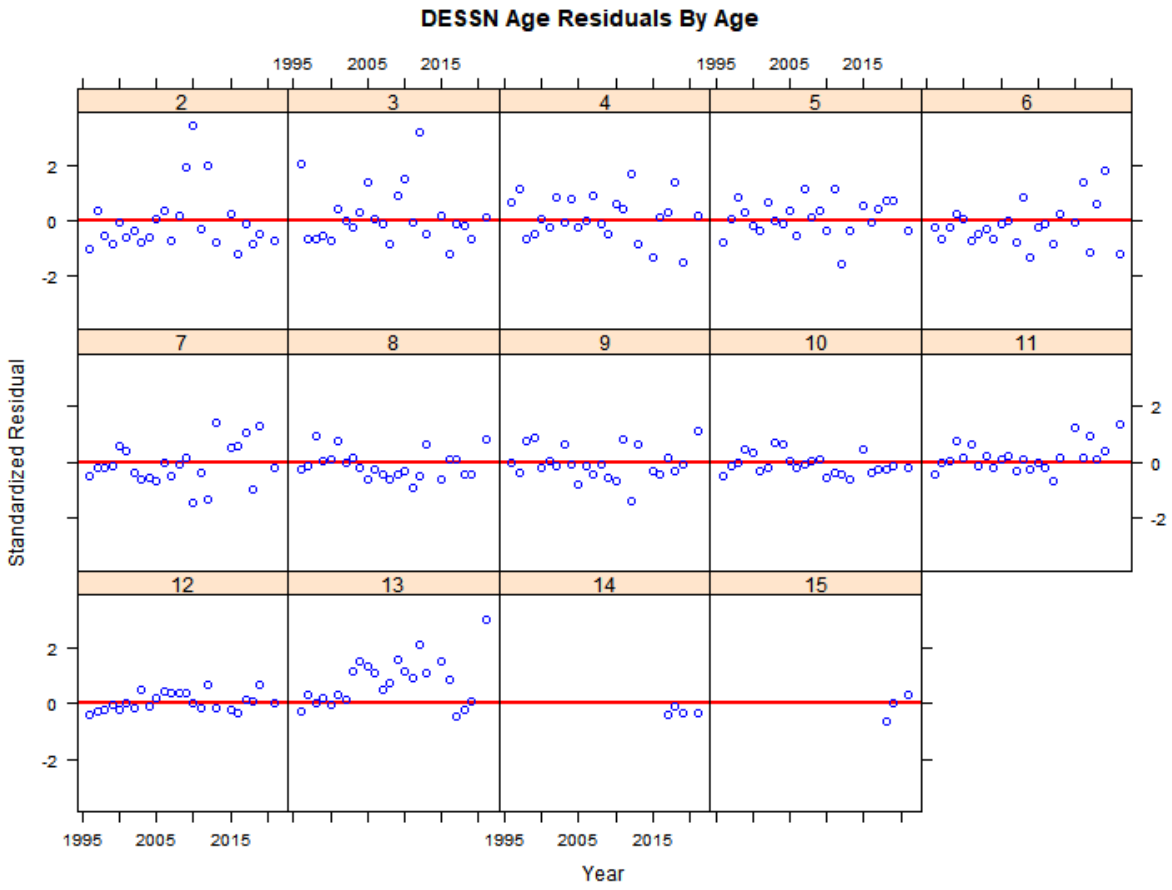
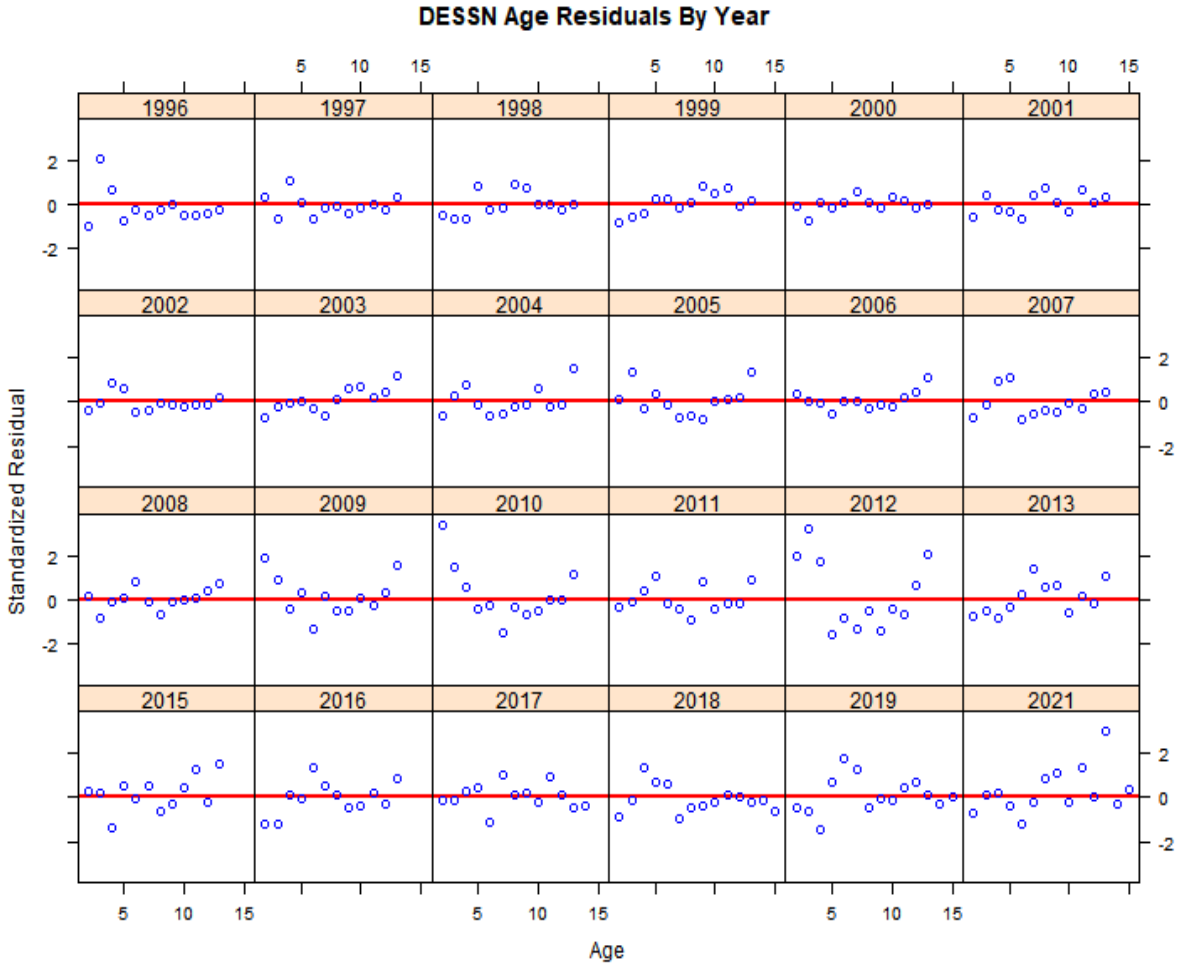
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


DESSN Age Composition By Age
Pred
Proportion
Year


DESSN Age Composition By Year
Pred
Proportion
Age


DESSN Age Residuals By Age
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1995
2005
2015
Standardized Residual
Year


DESSN Age Residuals By Year
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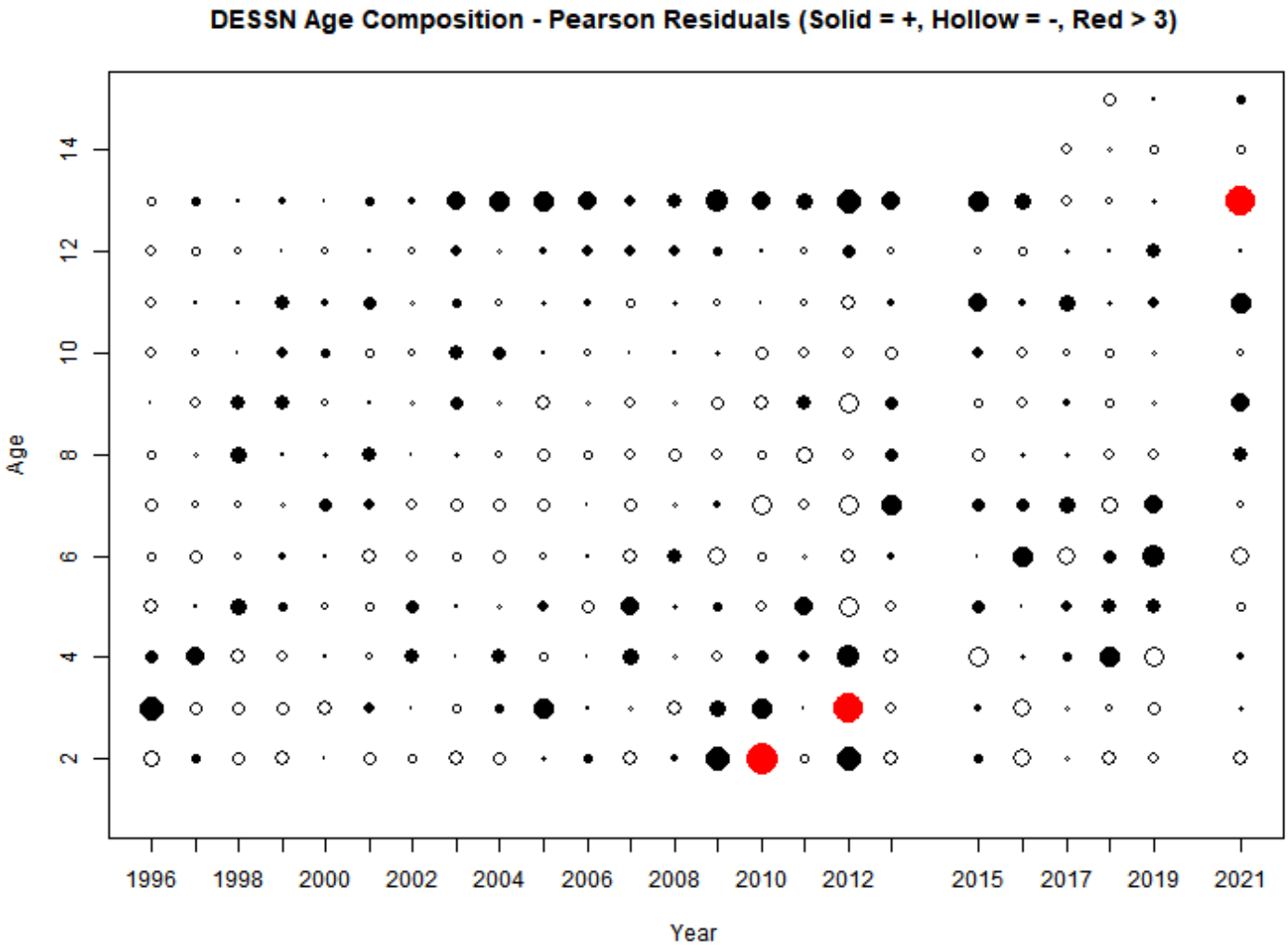
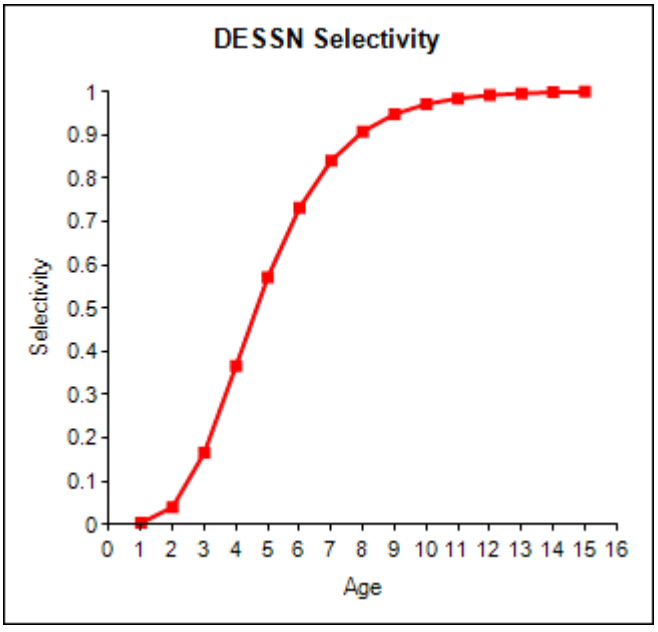
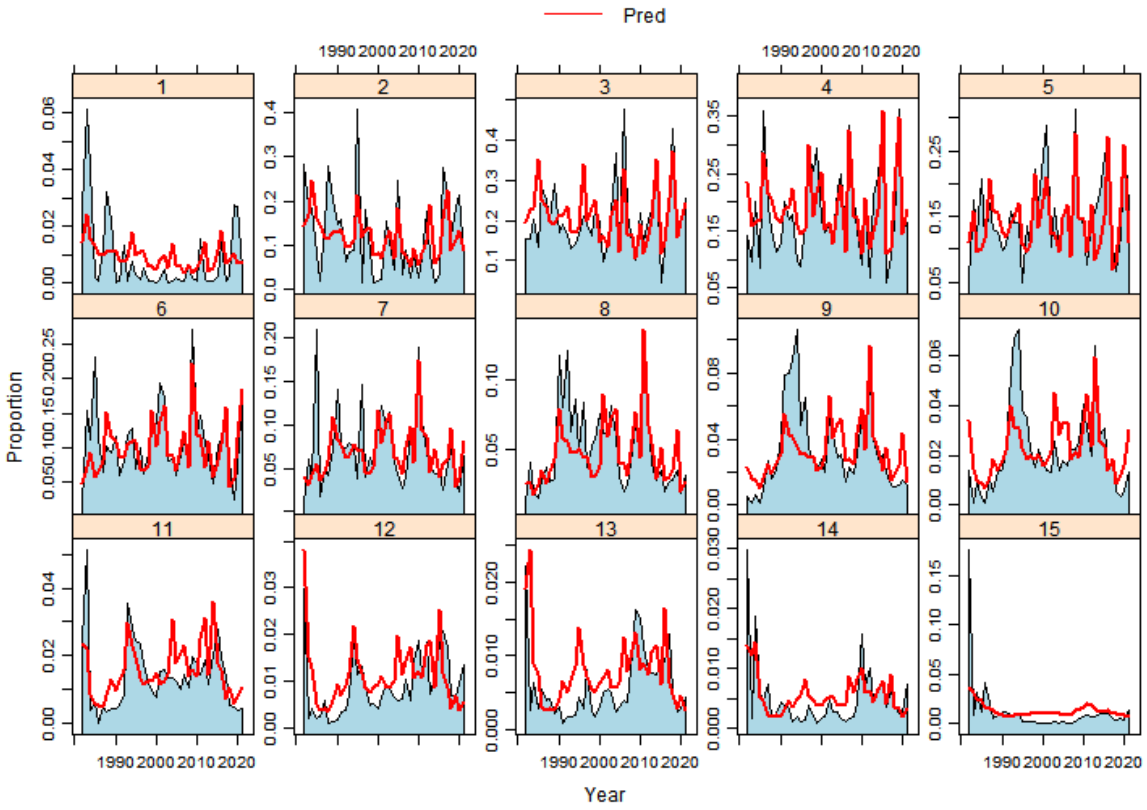
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2015
2016
2017
2018
2019
2021
5
10
15
Standardized Residual
Age

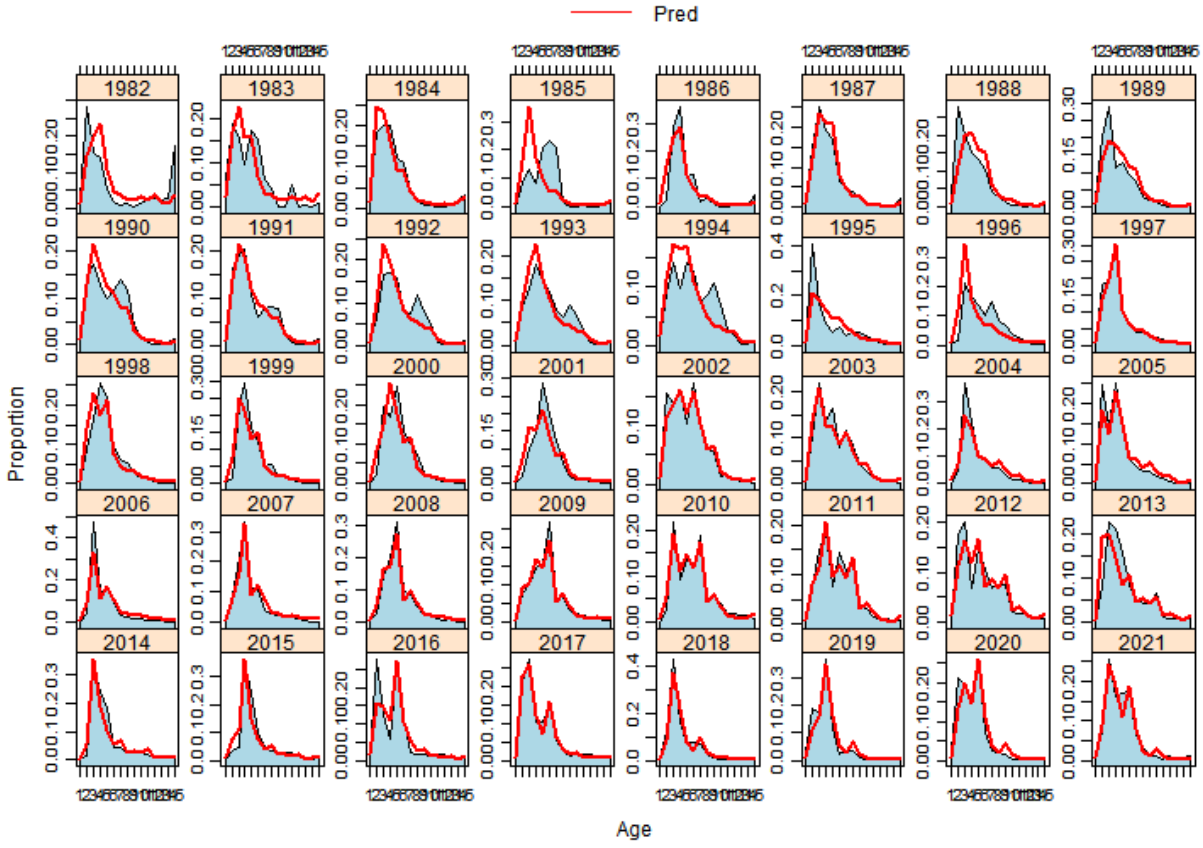

DESSN Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1996
1998
2000
2002
2004
2006
2008
2010
2012
2015
2017
2019
2021
Year

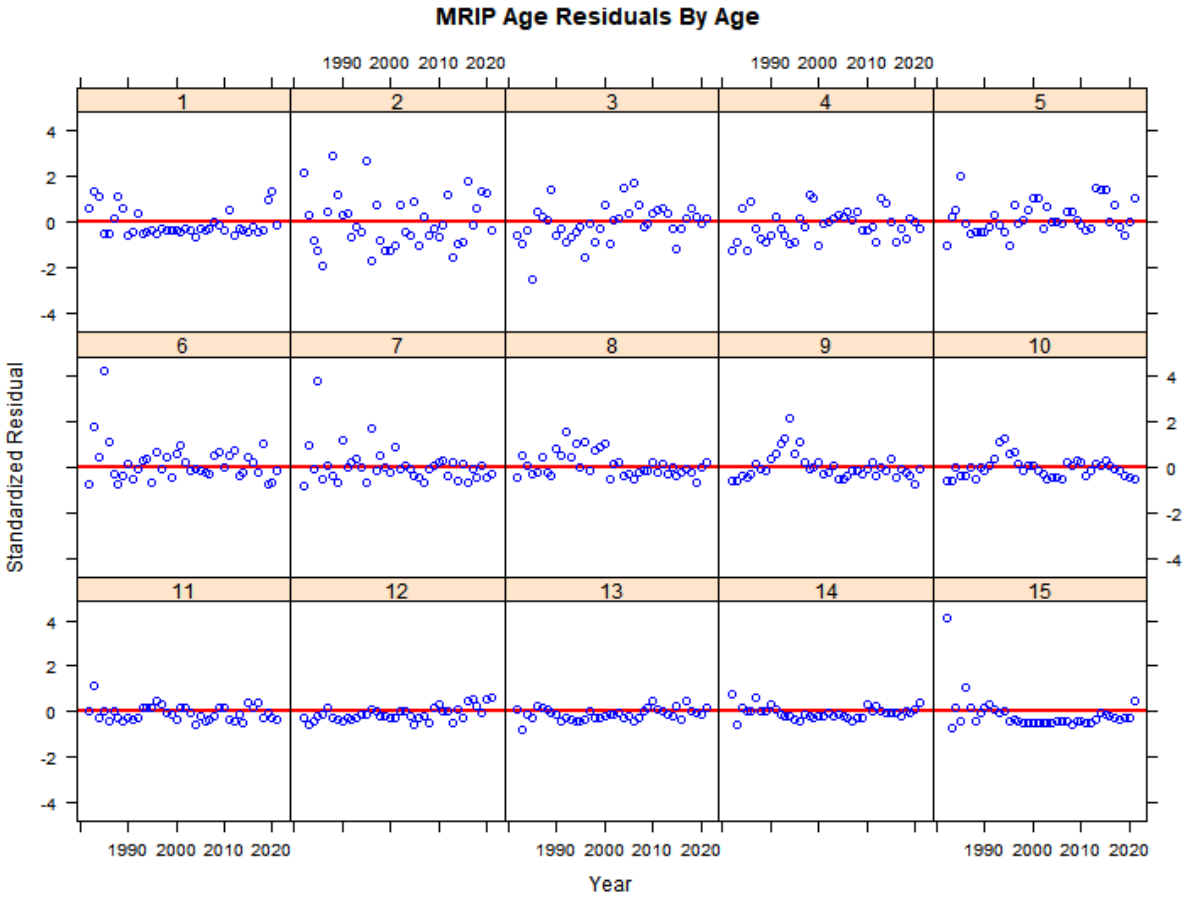

DESSN Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age

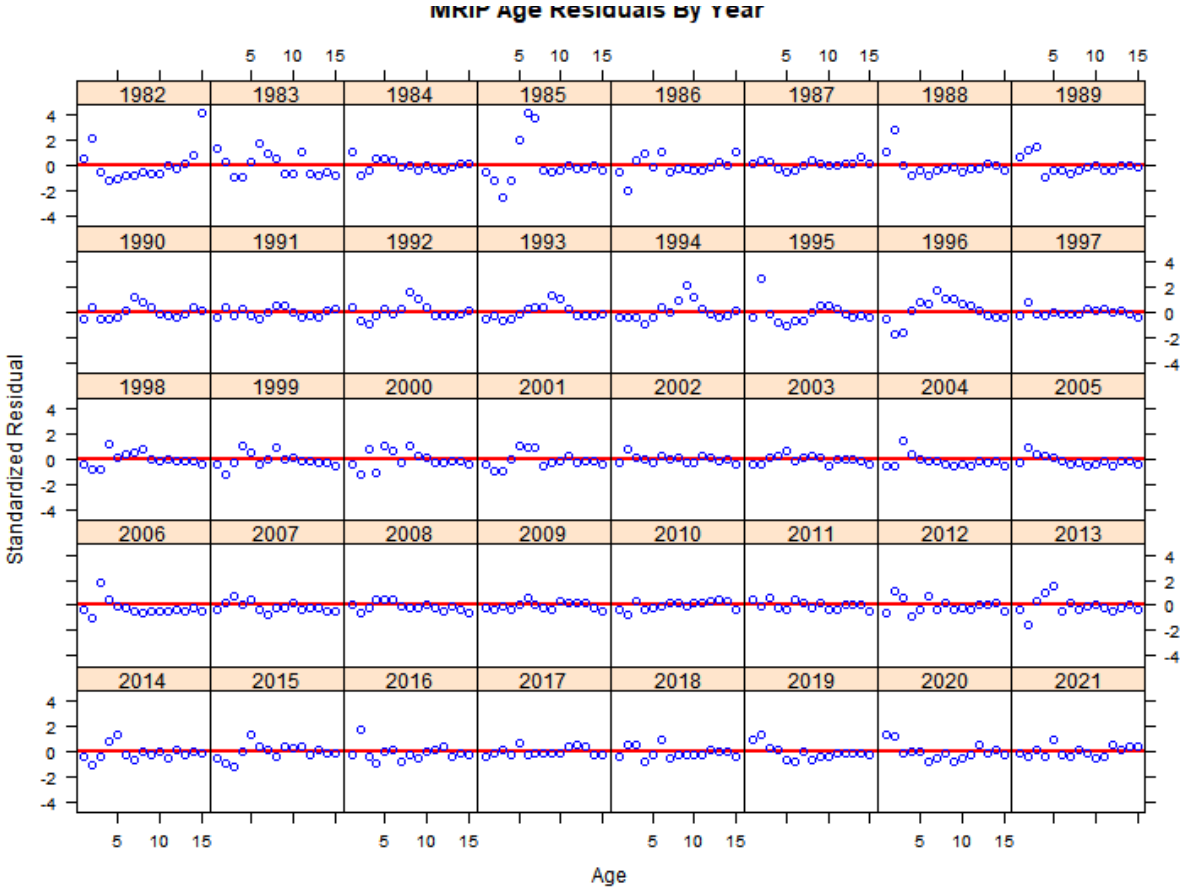
MRIP Age Composition By Age

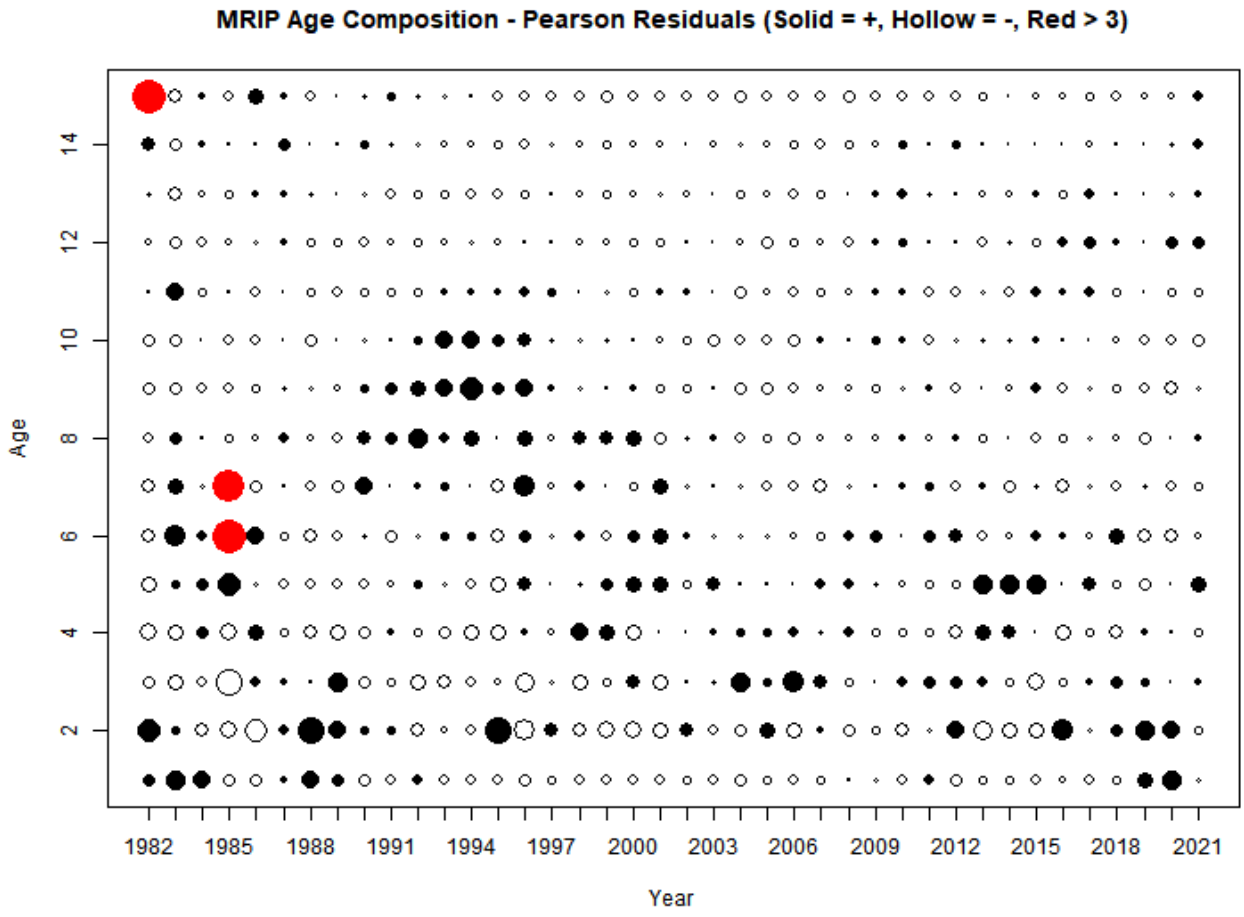


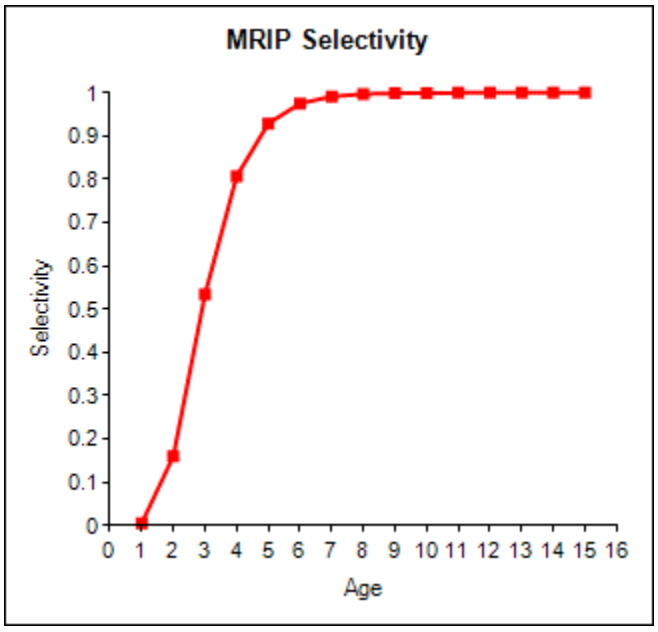
MRIP Age Composition By Year

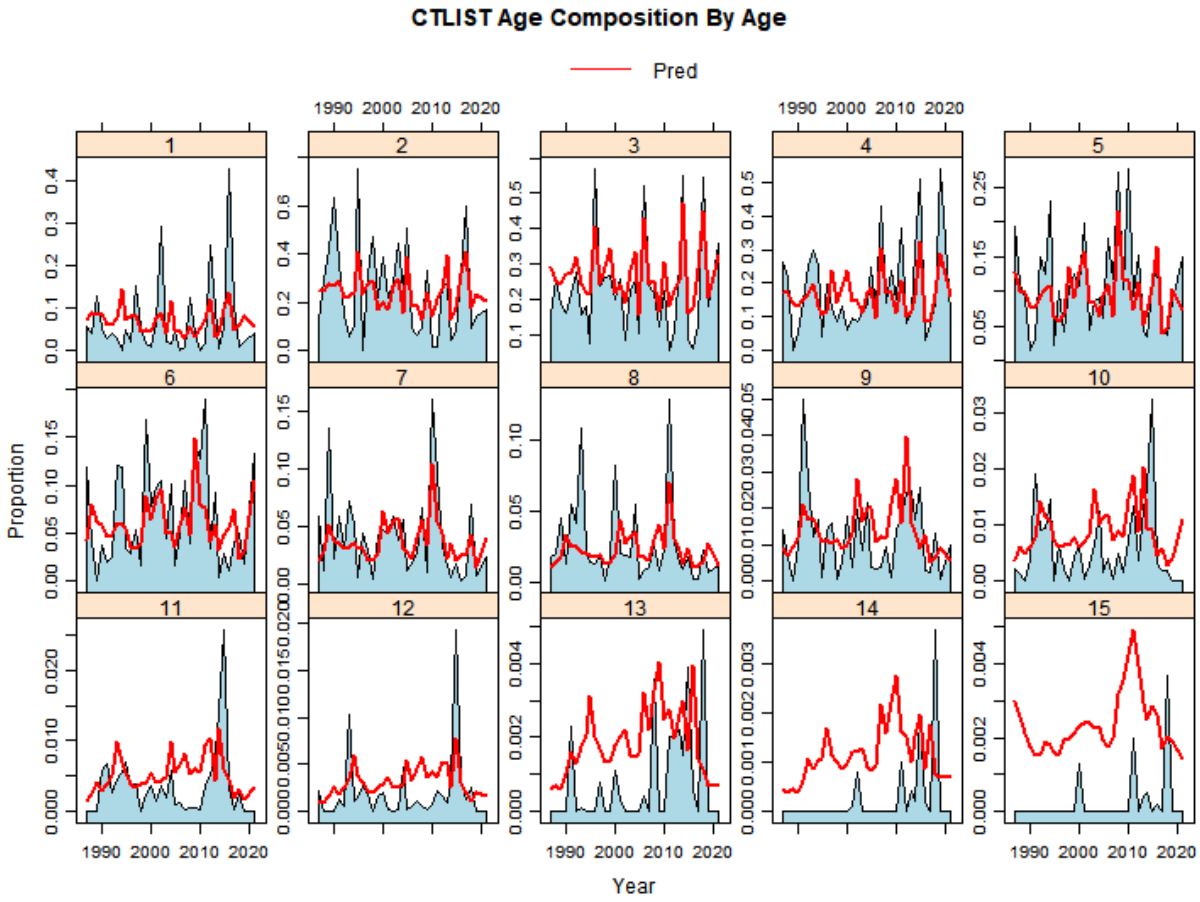


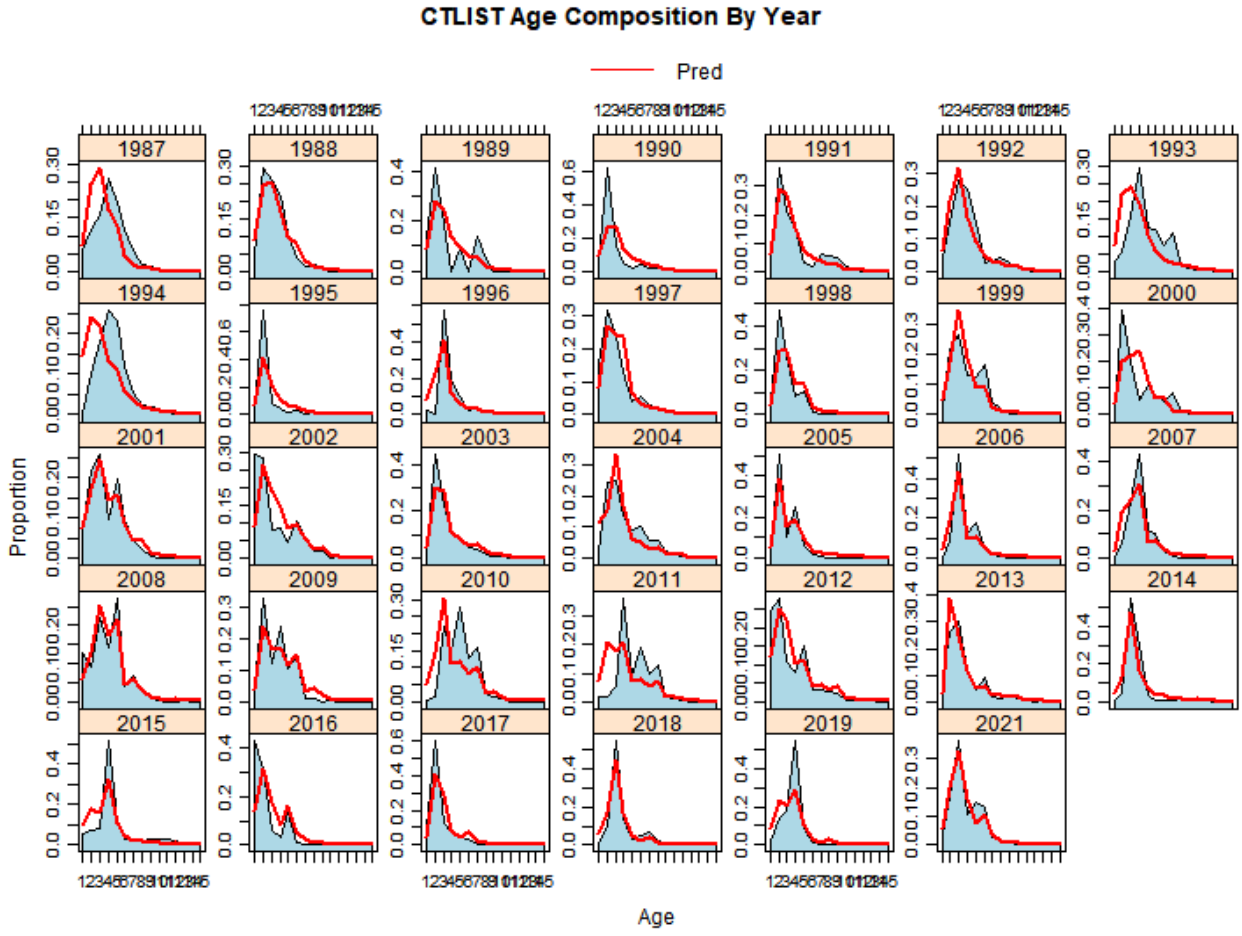

MRIP Age Residuals By Age
1990 2000 2010 2020
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Standardized Residual
Year

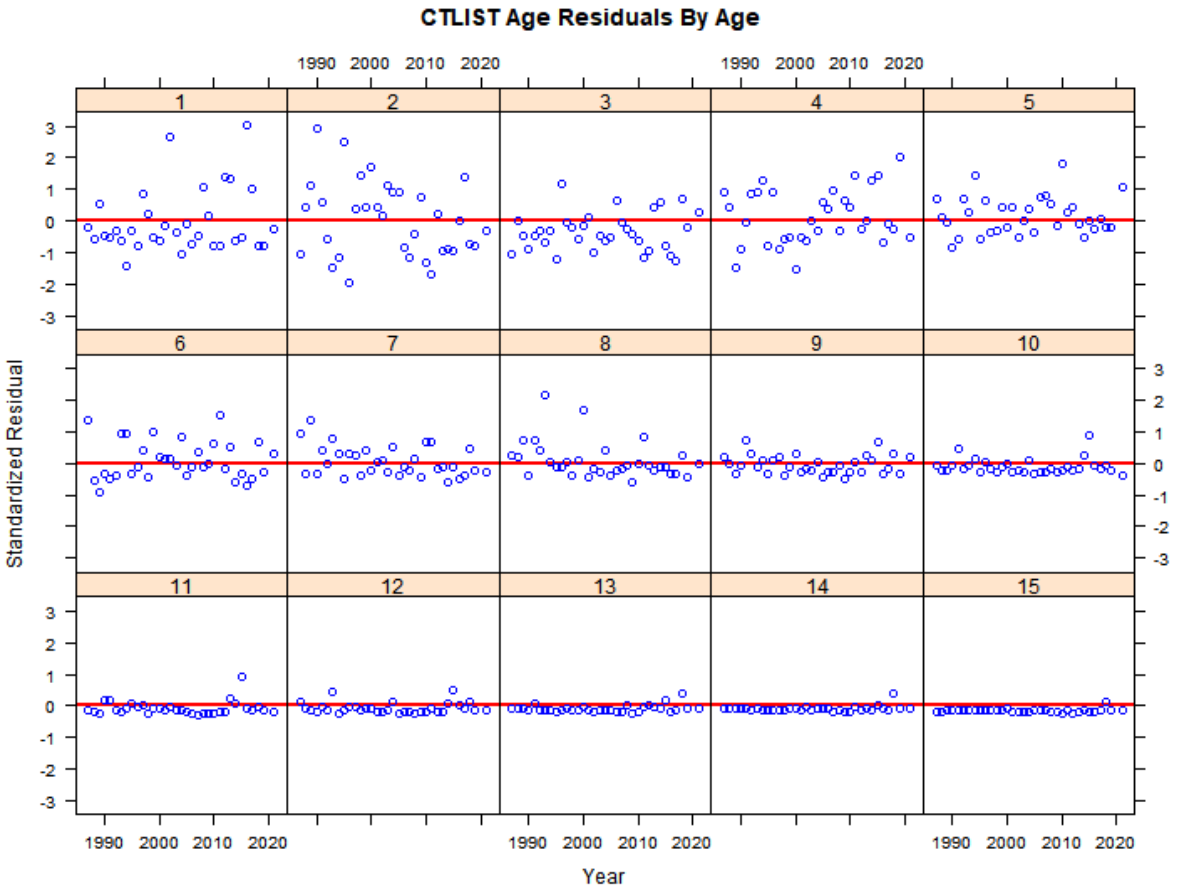

MRIP Age Residuals By Year
5 10 15
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Standardized Residual
Age

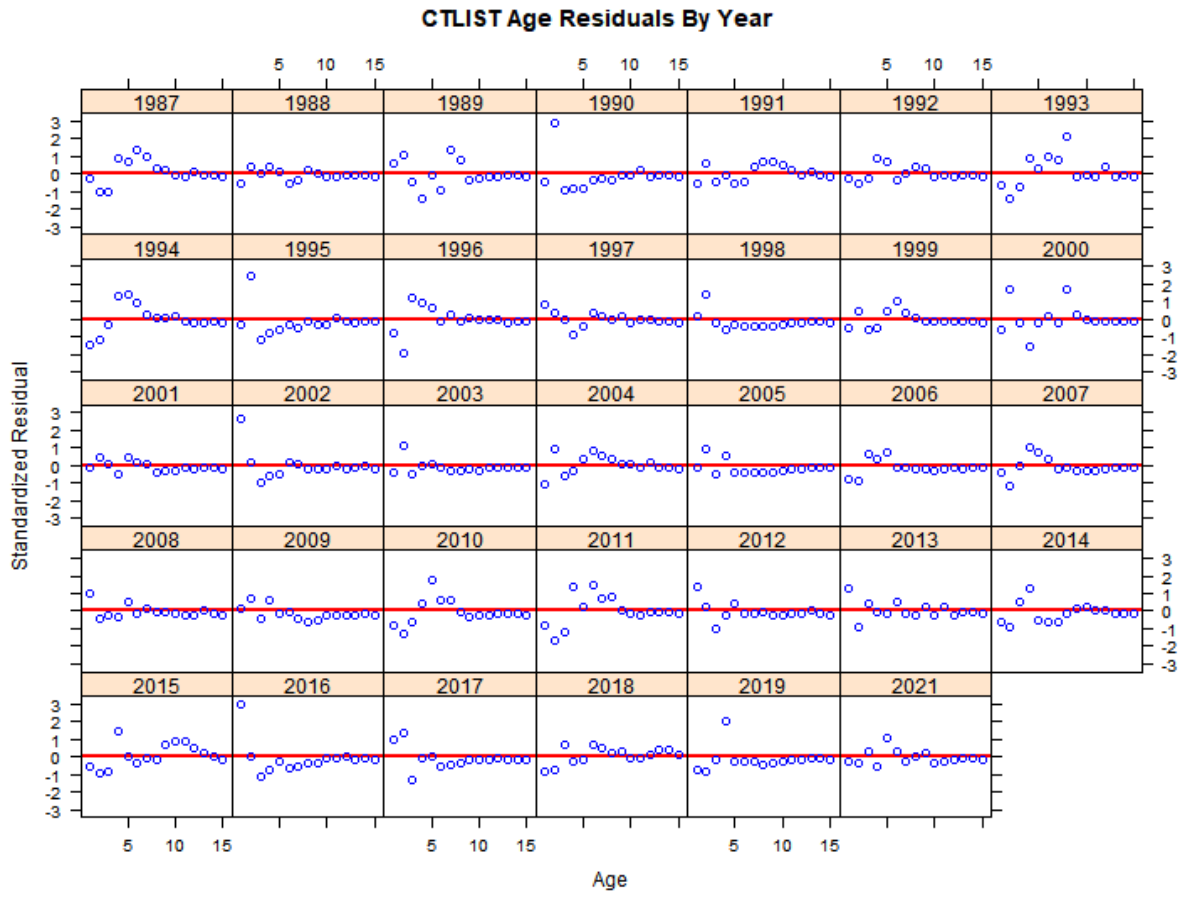

MRIP Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
2021
Year

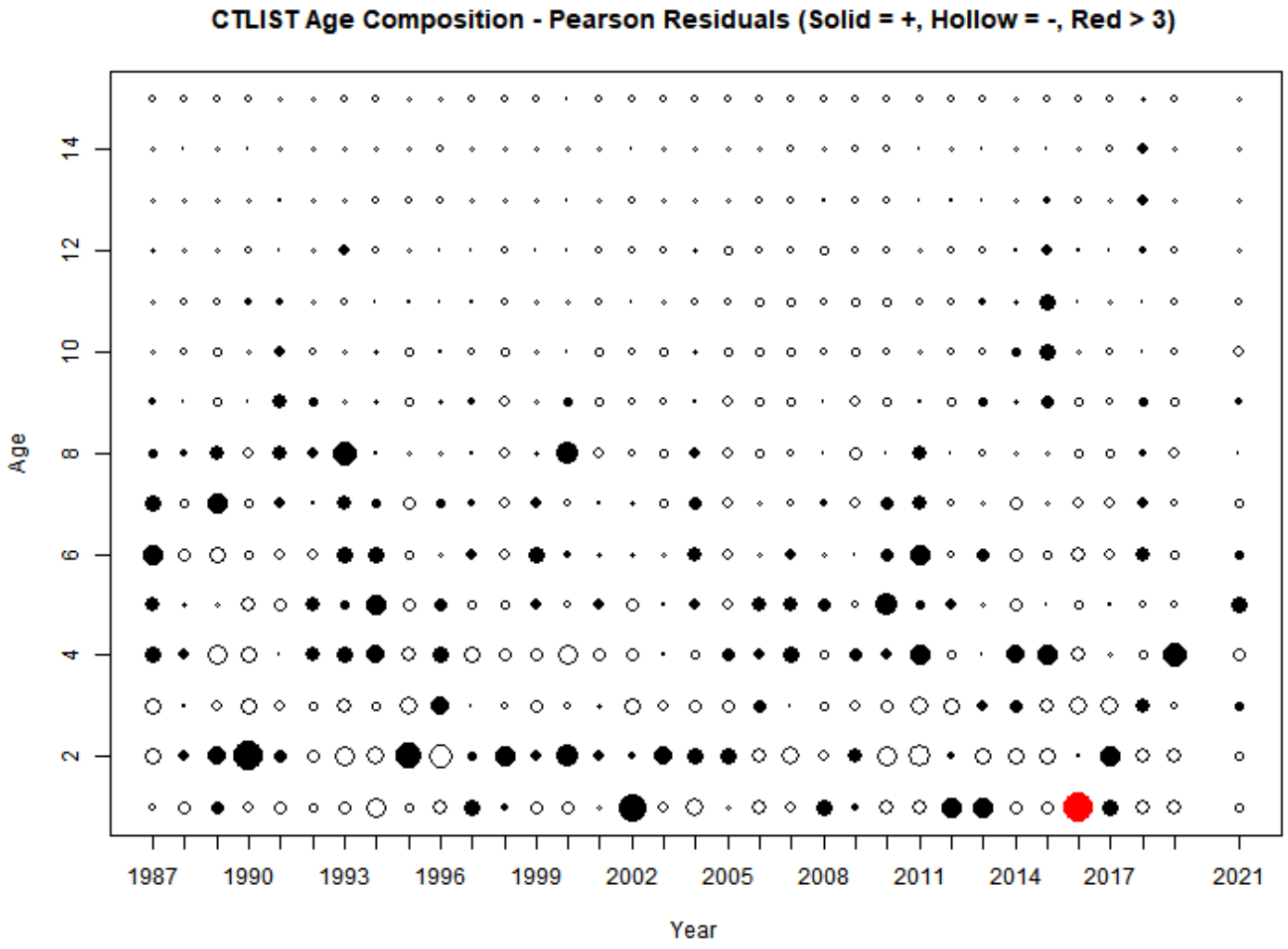

MRIP Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age

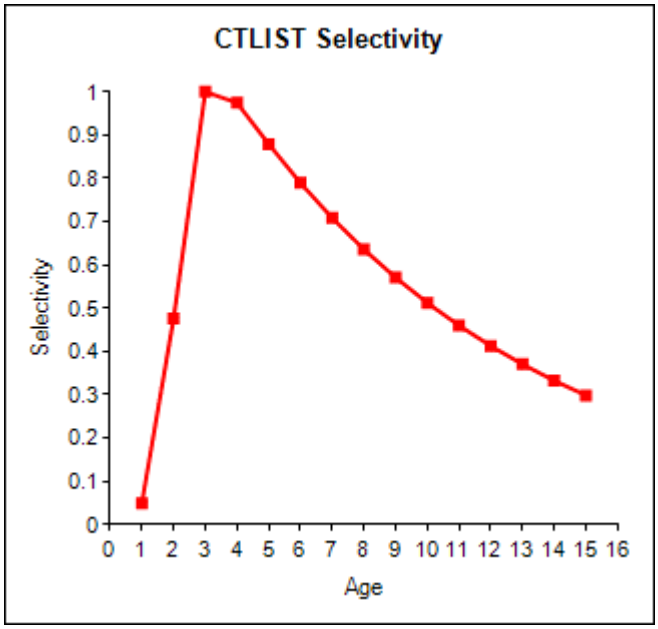

CTLIST Age Composition By Age
Pred
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year

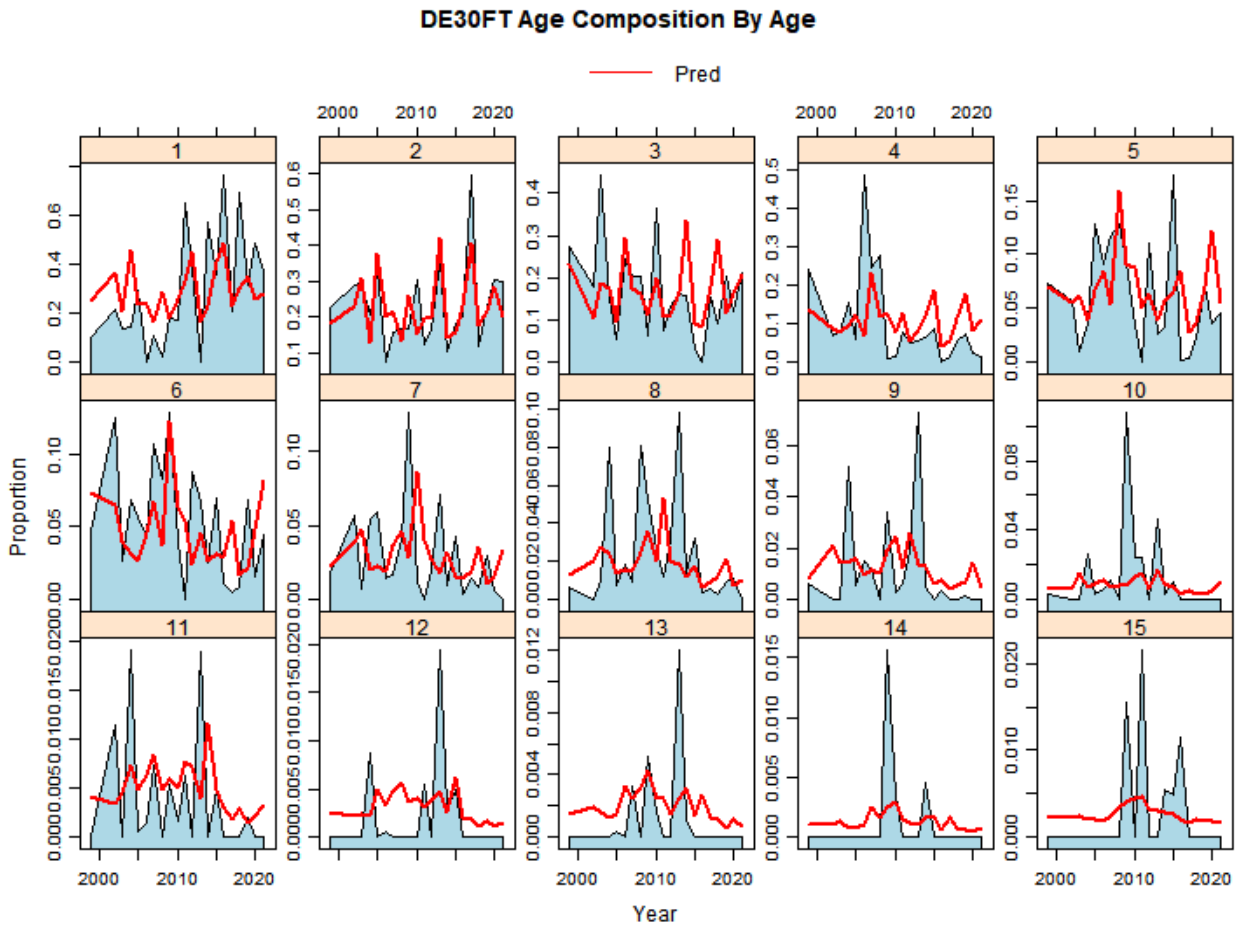

CTLIST Age Composition By Year
Pred
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2021
Proportion
Age

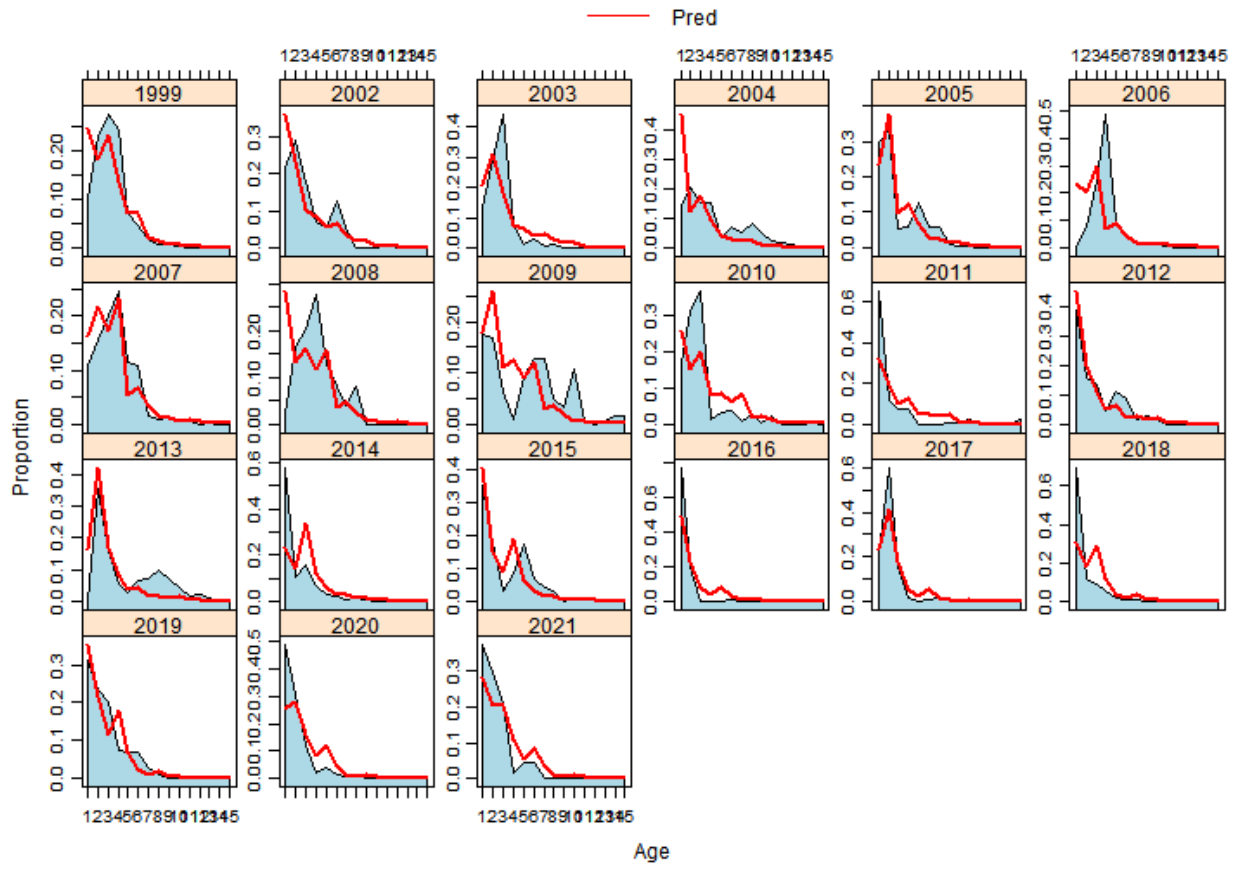

CTLIST Age Residuals By Age
1 2 3 4 5
6 7 8 9 10
11 12 13 14 15
1990 2000 2010 2020
Standardized Residual
Year

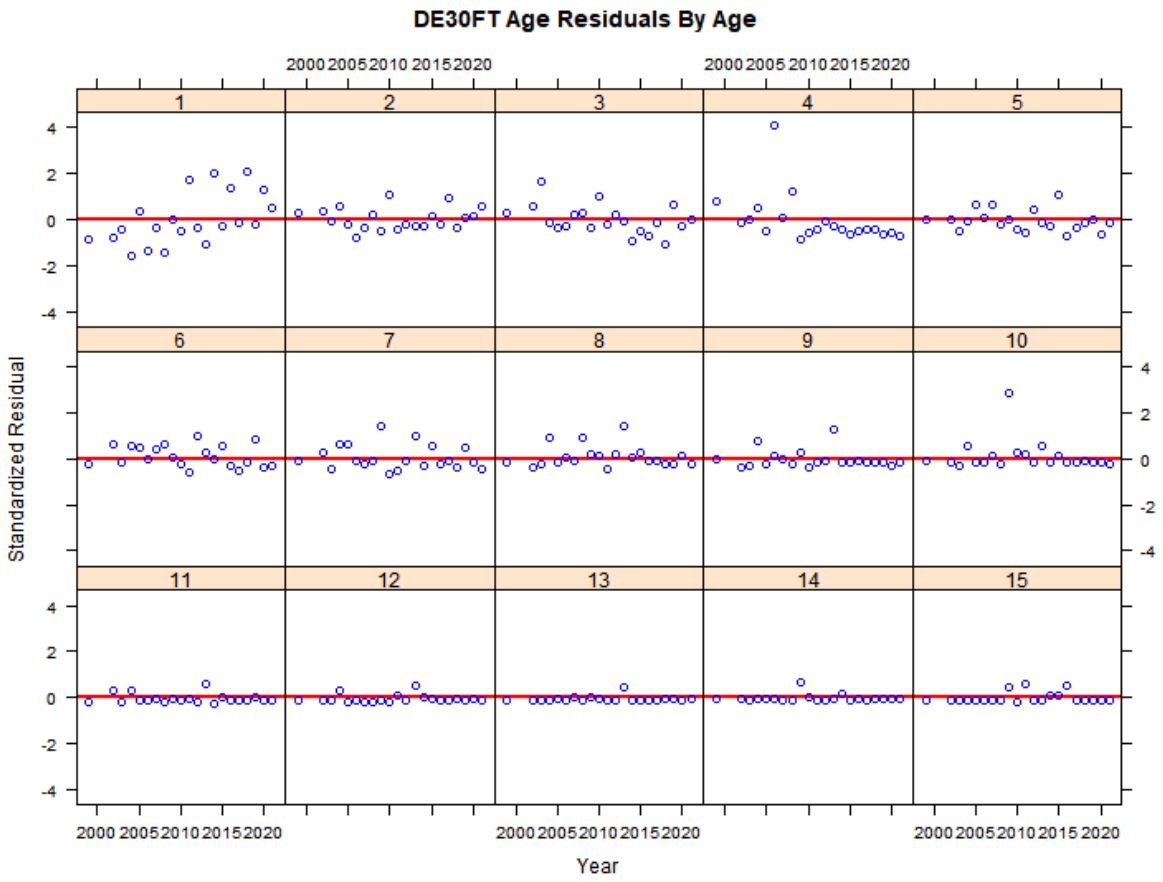

CTLIST Age Residuals By Year
1987 1988 1989 1990 1991 1992 1993
1994 1995 1996 1997 1998 1999 2000
2001 2002 2003 2004 2005 2006 2007
2008 2009 2010 2011 2012 2013 2014
2015 2016 2017 2018 2019 2021
5 10 15
Standardized Residual
Age

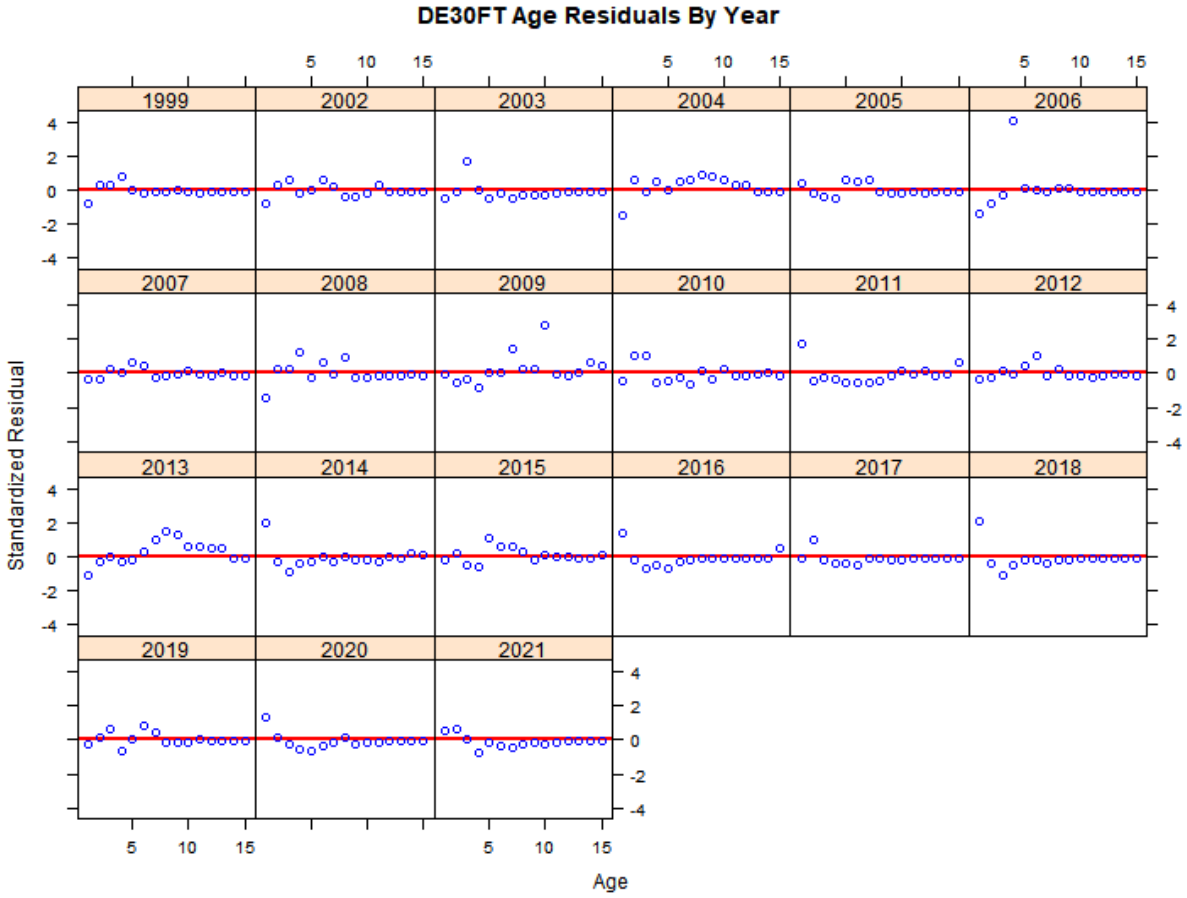

CTLIST Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017
2021
Year

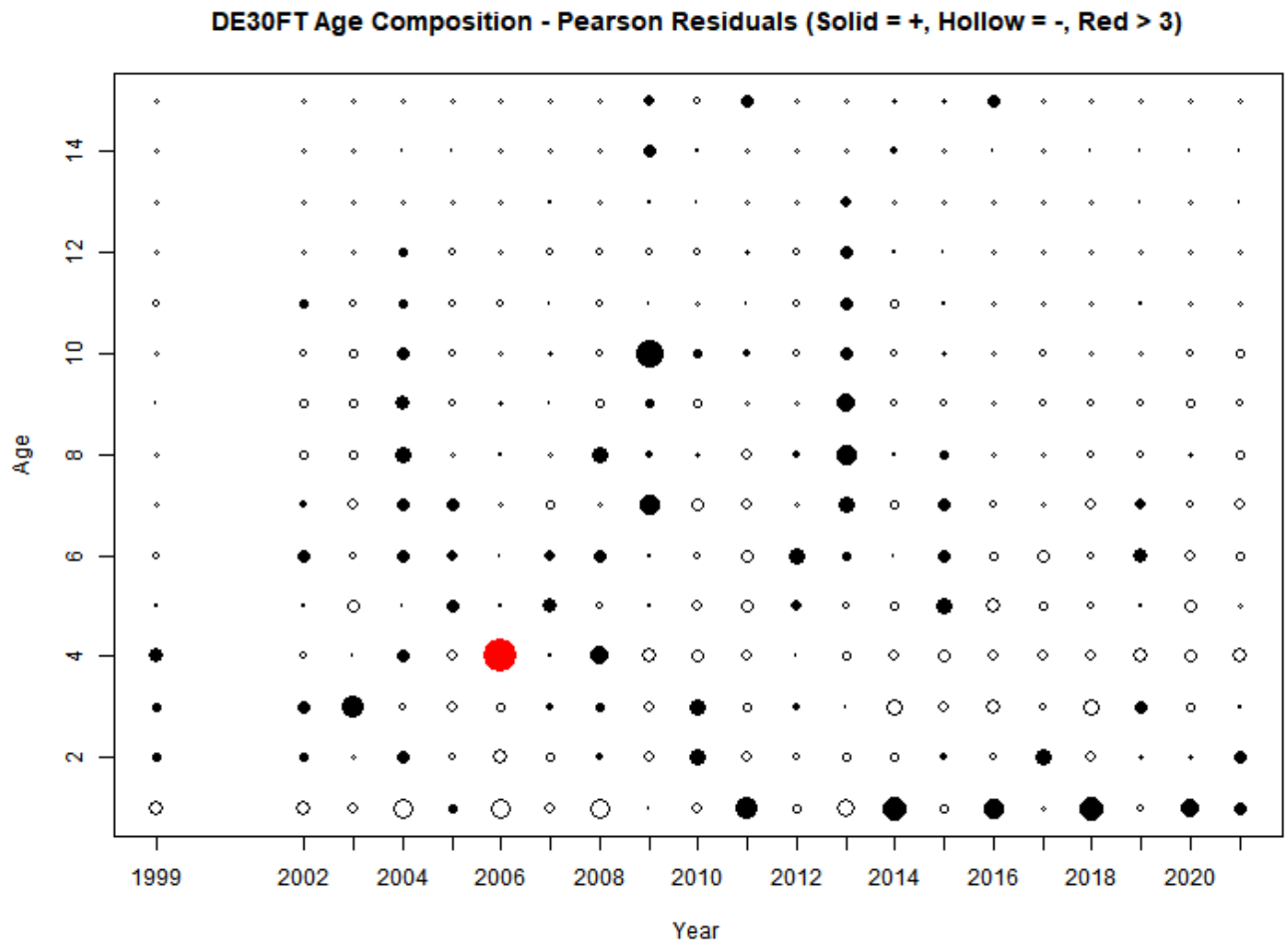

CTLIST Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age

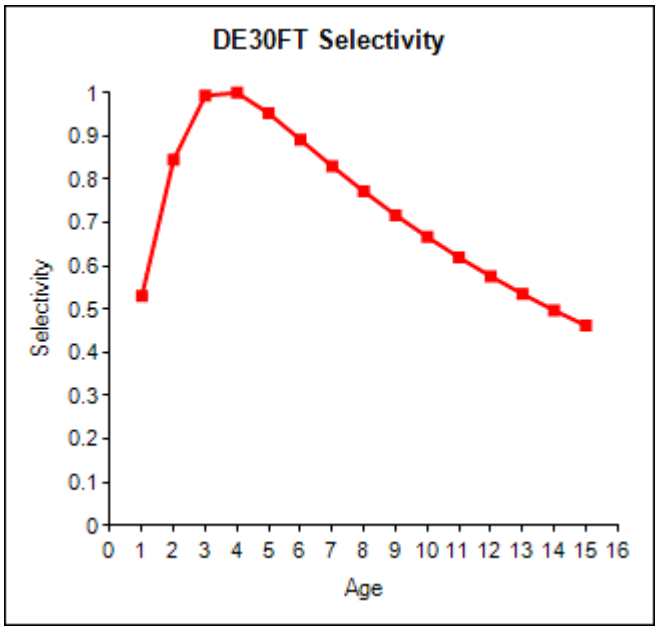

DE30FT Age Composition By Age
Pred
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year

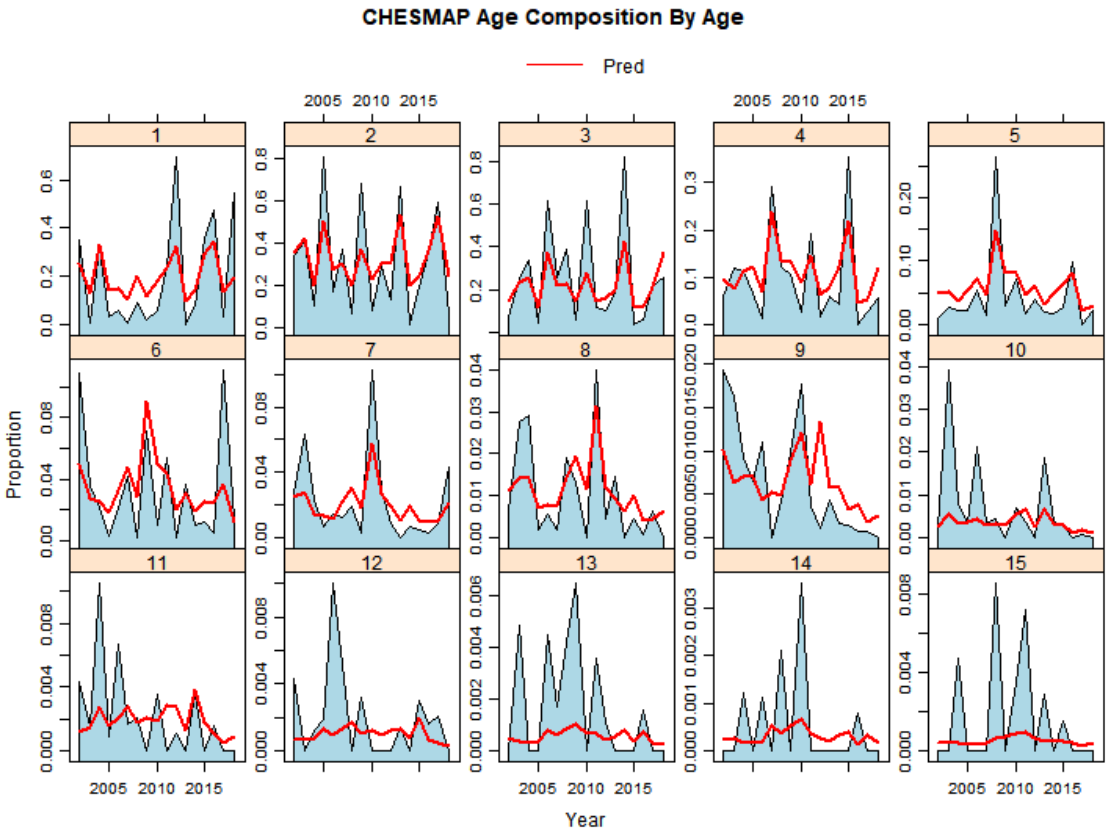

DE30FT Age Composition By Year
Pred
1999
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Proportion
Age

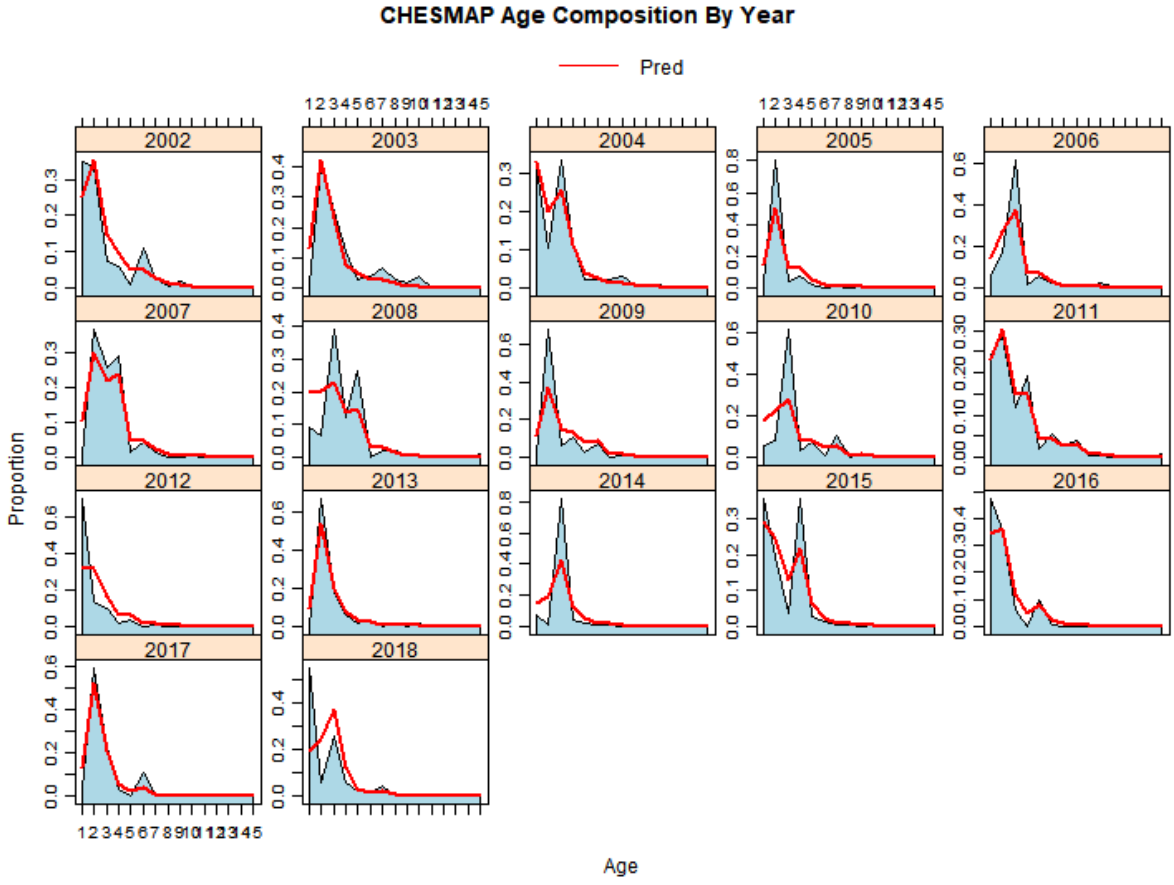

DE30FT Age Residuals By Age
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Standardized Residual
Year


DE30FT Age Residuals By Year
1999
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Standardized Residual
Age

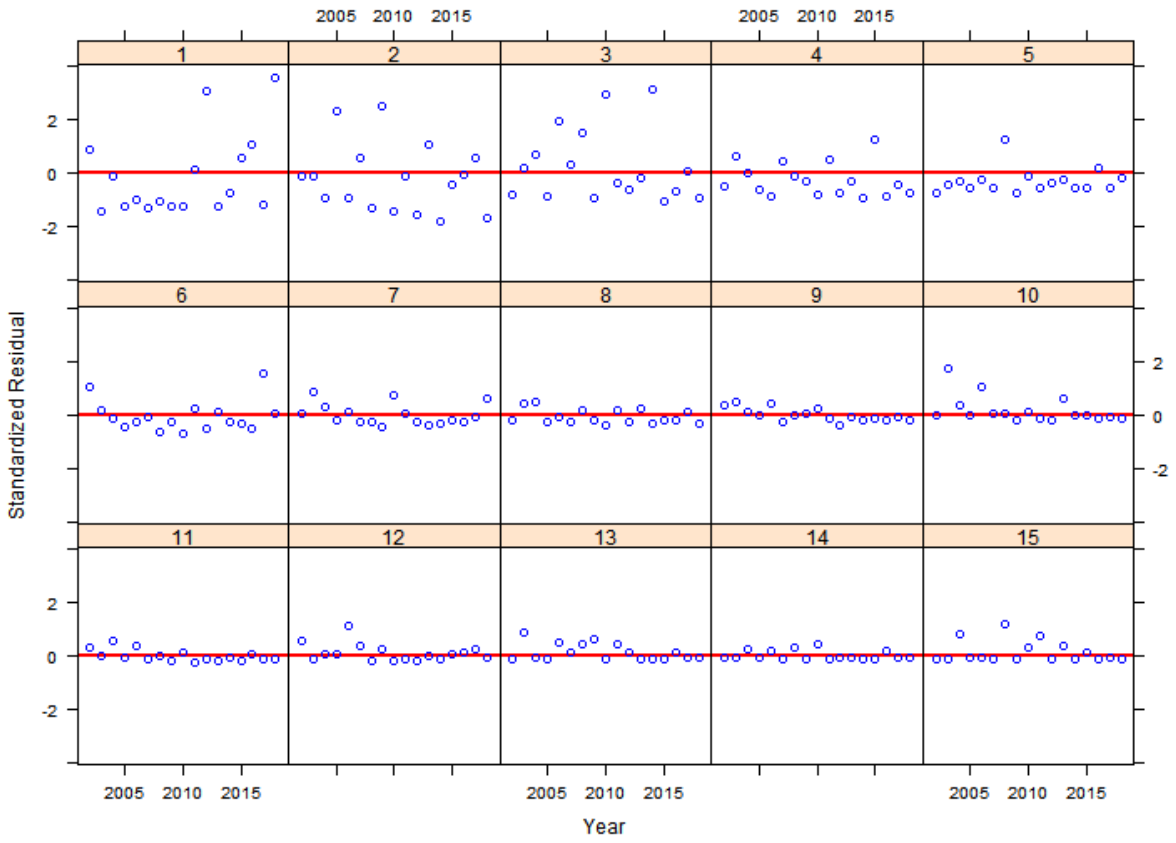

DE30FT Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
1999
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year


DE30FT Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age

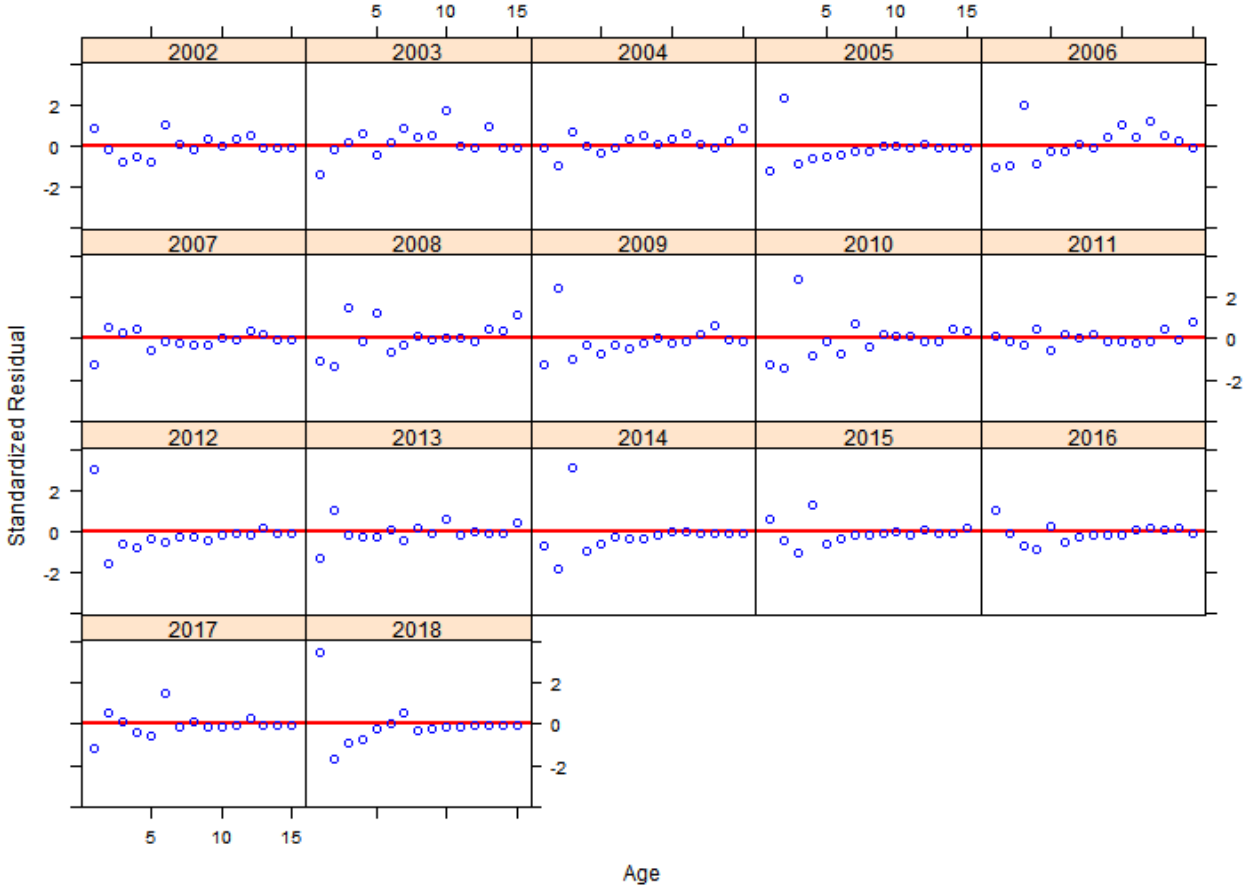

CHESMAP Age Composition By Age
Pred
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Proportion
Year

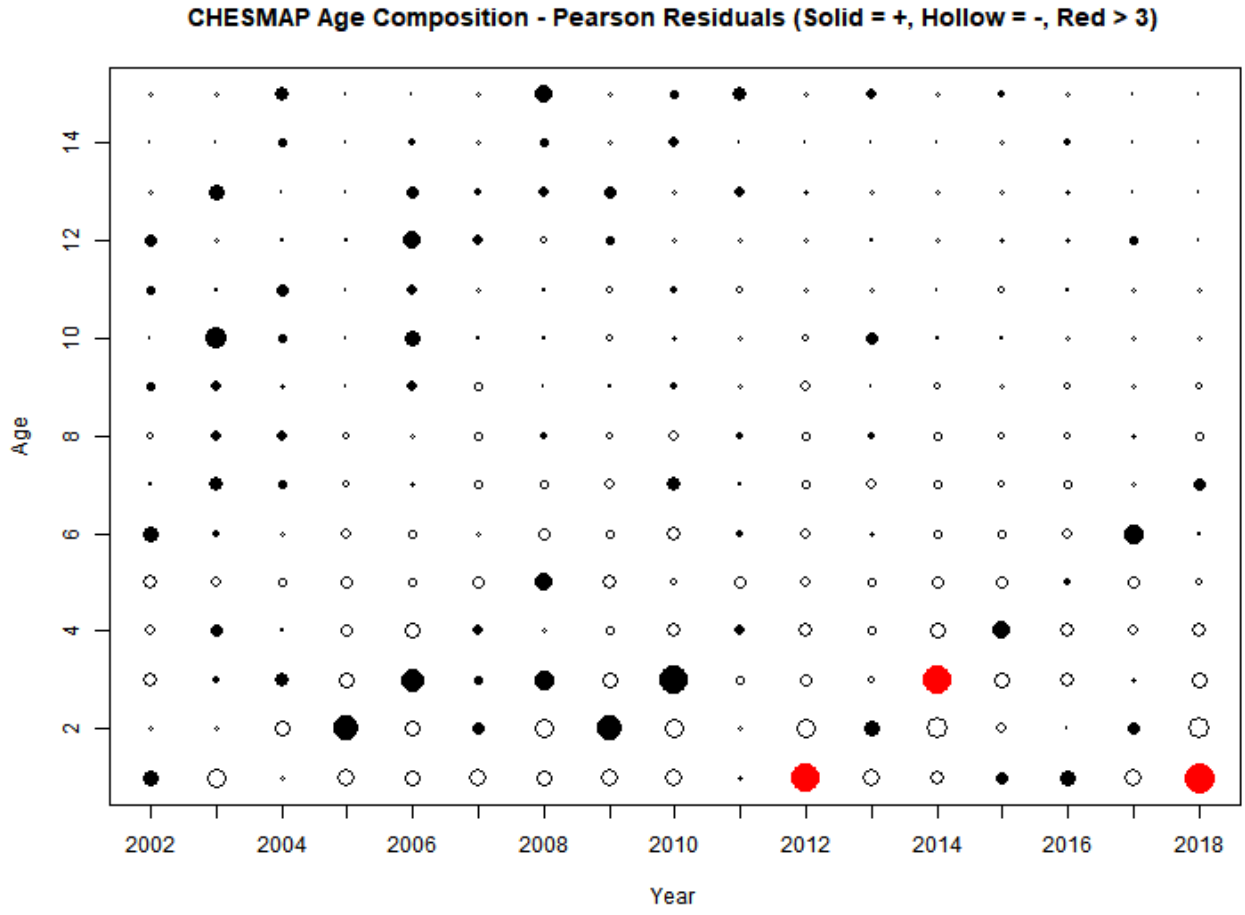

CHESMAP Age Composition By Year
Pred
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Proportion
Age

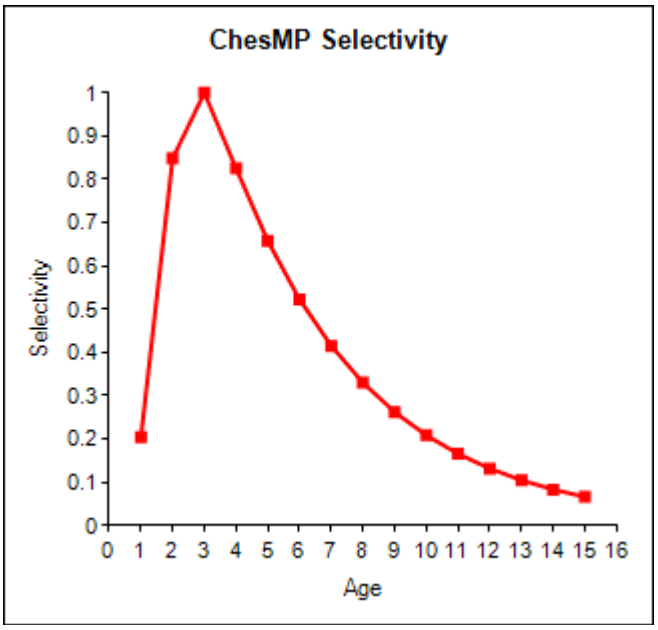
CHESMAP Age Residuals By Age

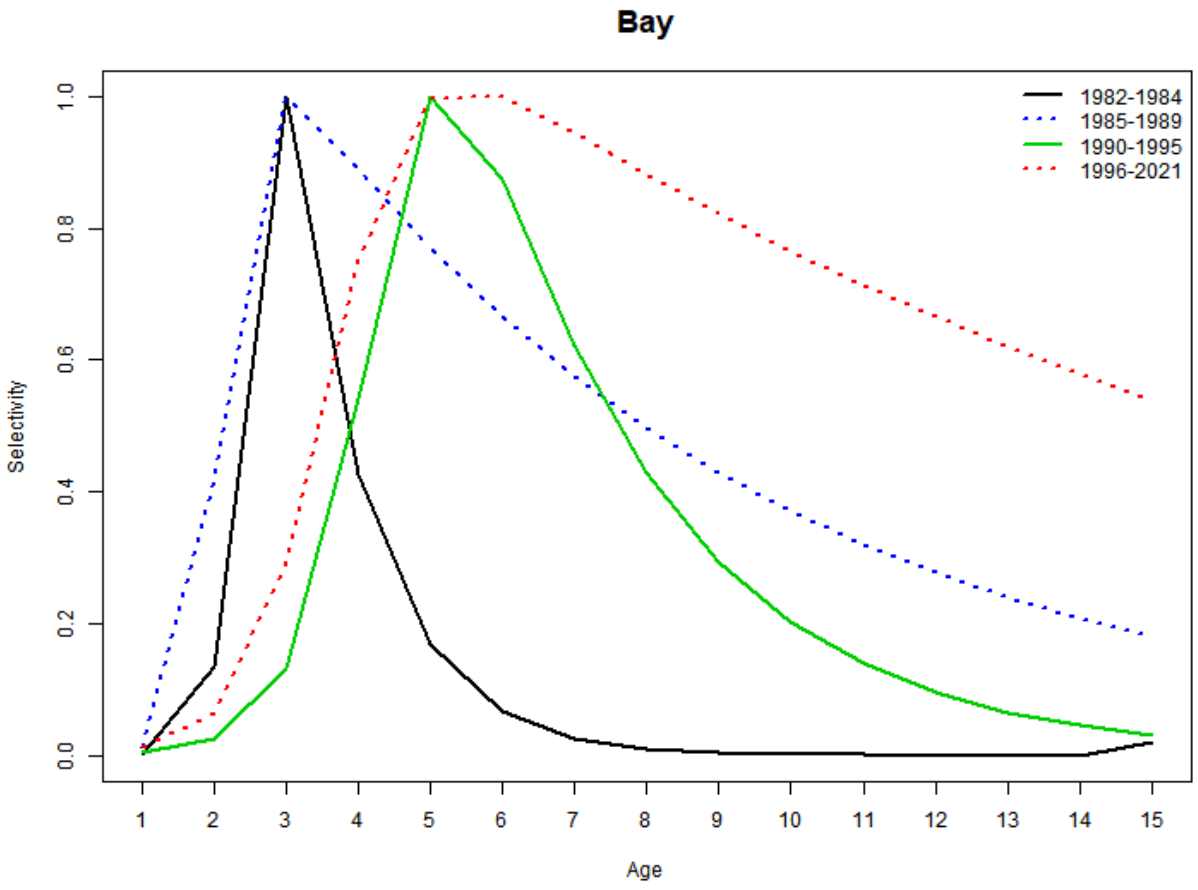


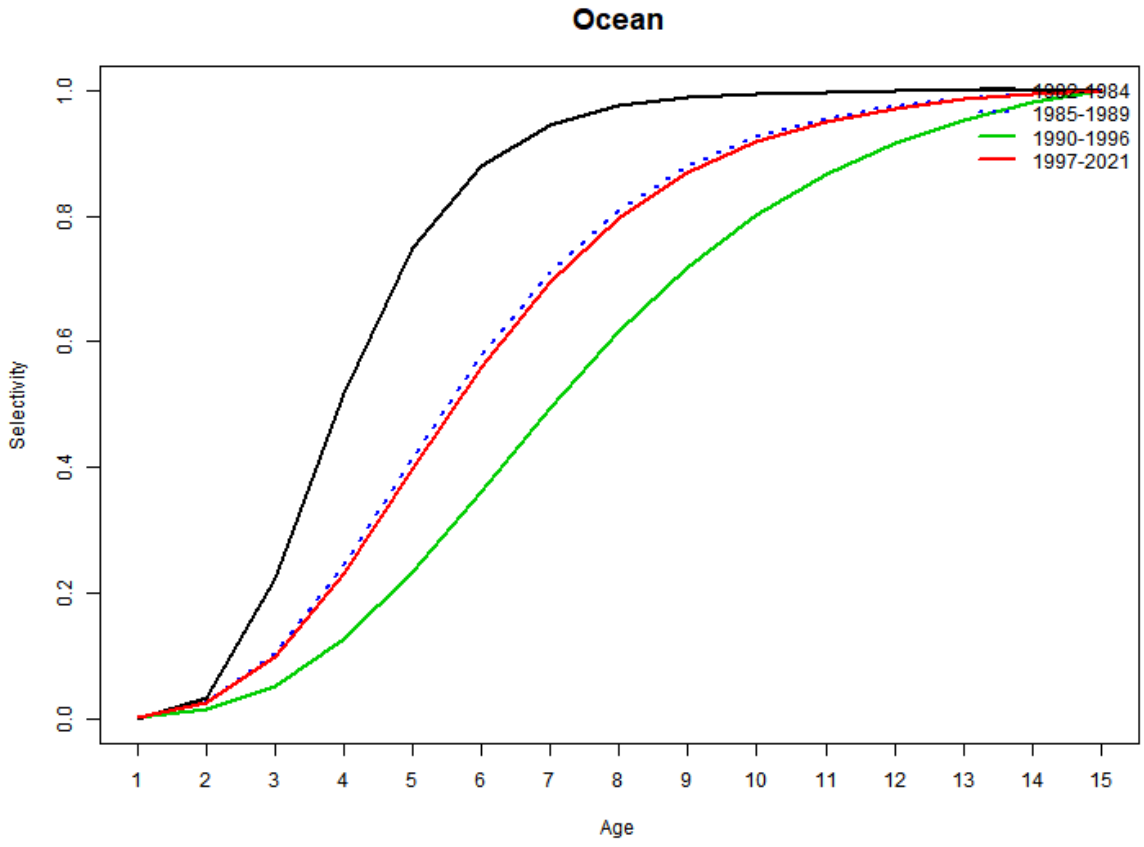
CHESMAP Age Residuals By Year




CHESMAP Age Composition - Pearson Residuals (Solid = +, Hollow = -, Red > 3)
Age
2
4
6
8
10
12
14
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year

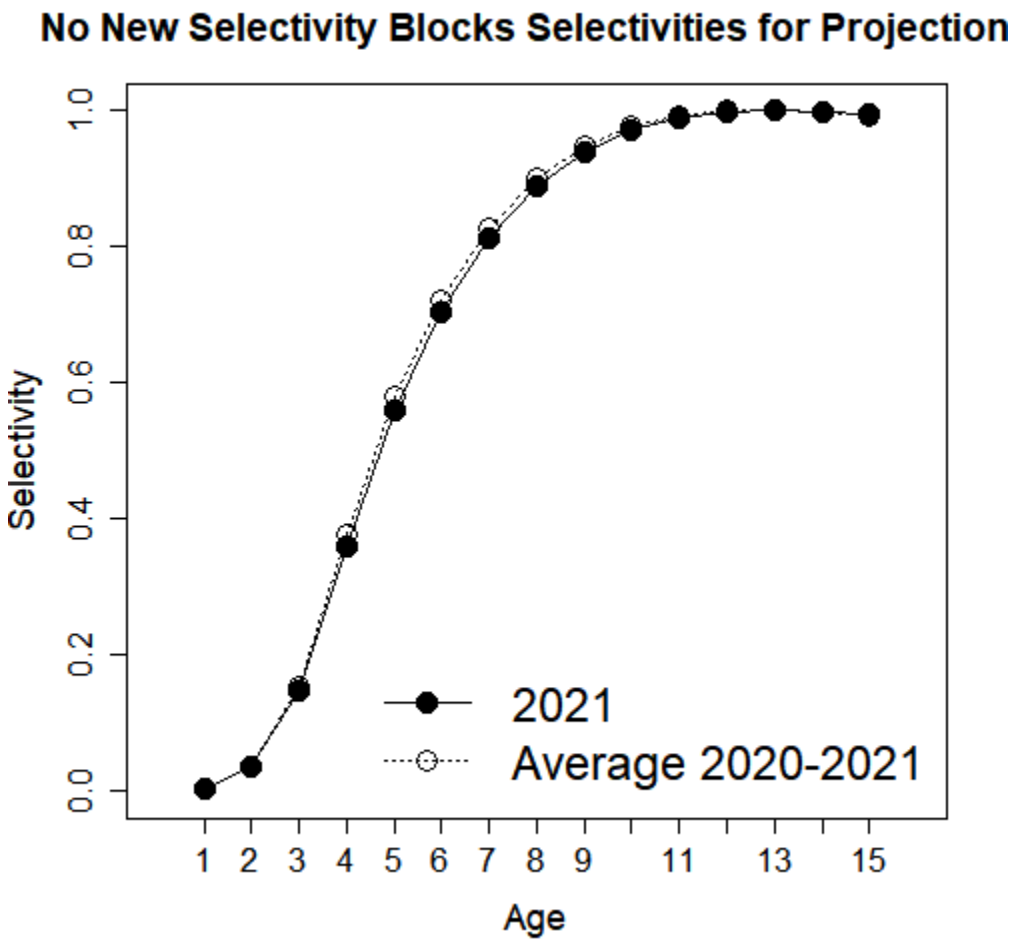

ChesMP Selectivity
Selectivity
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Age


Bay
1982-1984
1985-1989
1990-1995
1996-2021
Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Age


Ocean
1982-1984
1985-1989
1990-1996
1997-2021
Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Age

	Likelihood Weight	RSS
Fleet 1 Total Catch:	2	0.222509
Fleet 2 Total Catch:	2	1.69769
Aggregate Abundance Indices		
NYYOY	1	28.2264
NJYOY	1	30.1896
MDYOY	1	10.0705
Compos	1	37.511
NYAge1	1	31.7116
MDAge1	1	24.2042
Age Comp Abundance Indices		
NYOHS	1	18.6369
NJTRAWL	1	20.626
MDSSN	1	30.6333
DESSN	1	21.6587
MRIP	1	35.7363
CTLIST	1	27.5067
DE30FT	1	17.2643
ChesMap	1	14.889
Total RSS		350.785
No. of Obs		517
Conc. Likel.		-100.264
Age Composition Data Likelihood		
Fleet 1 Age Comp:	1	4929.84
Fleet 2 Age Comp:	1	6138.57
NYOHS	1	728.002
NJTRAWL	1	310.785
MDSSN	1	1084.42
DESSN	1	984.378
MRIP	1	2625.57
CTLIST	1	819.882
DE30FT	1	240.59
ChesMap	1	401.496
Recr Devs :	1	41.7836
Total Likelihood :		18136
AIC :		36644

Index	n	RMSE	CV Weight	Effective Sample Size
NYYOY	36	0.993619	2.95	
NJYOY	38	1.00437	1.75	
MDYOY	12	0.99145	2.09	
compos	40	0.992974	0.99	
NYAge1	37	0.99486	1.21	
MDAge1	52	0.992657	3.22	
NYOHS	20	0.990824	2.60	21.88
NJTRAWL	29	1.00158	2.95	5.70
MDSSN	37	0.990333	2.50	14.33
DESSN	24	0.995435	1.16	17.81
MRIP	40	1.00725	2.31	30.68
CTLIST	34	1.00434	3.00	12.99
DE30FT	21	1.00074	0.85	6.09
ChesMP	17	1.00582	2.47	15.26

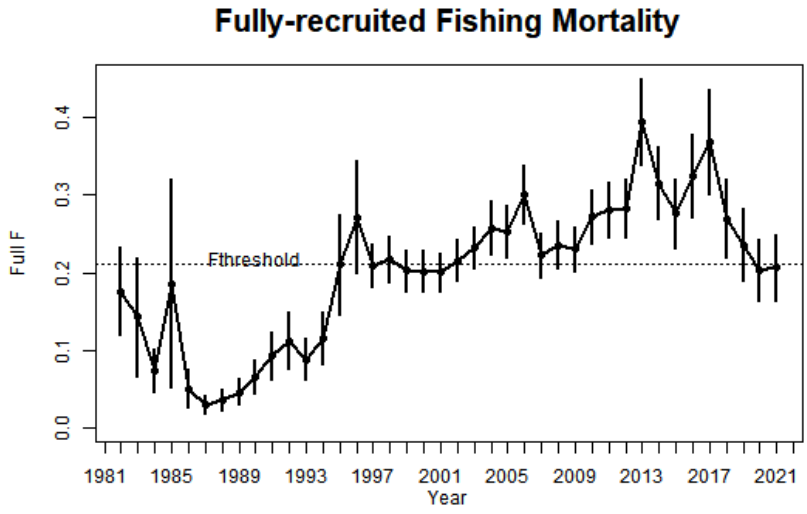

No New Selectivity Blocks Selectivities for Projection
Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
1 2 3 4 5 6 7 8 9 11 13 15
Age
2021
Average 2020-2021

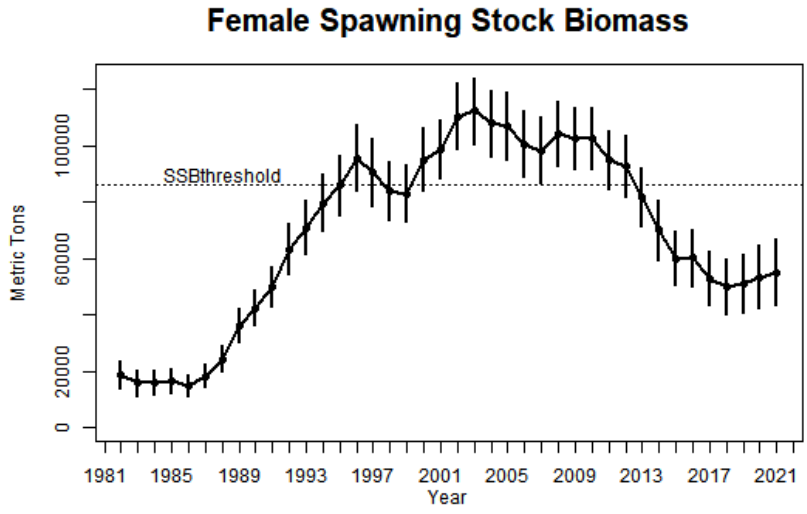
SSBthreshold=86016.6’Fthreshold=0.2120

SSBtarget=107520.7;Ftarget=0.1727

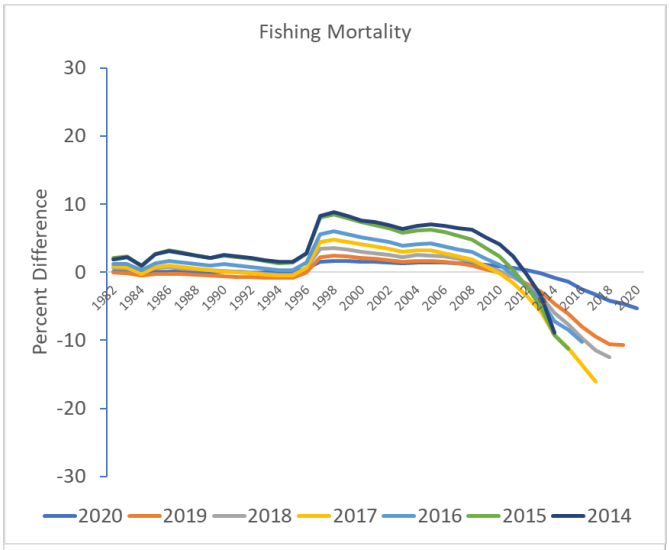
Fcurrent=0.2069

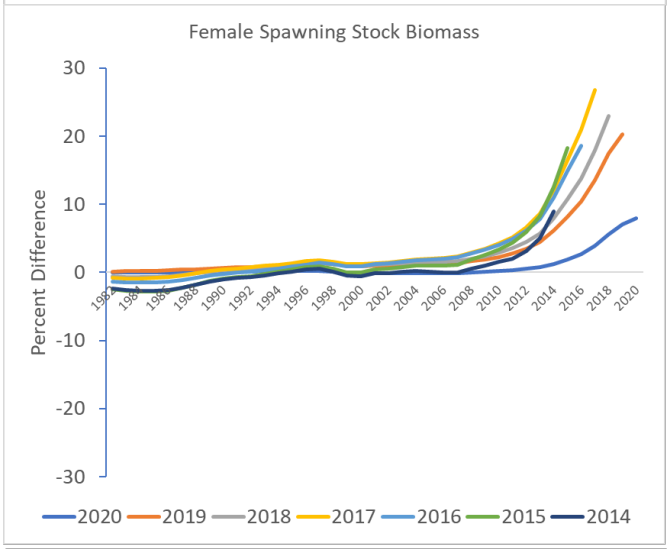
Estimates with 95% Confidence Intervals

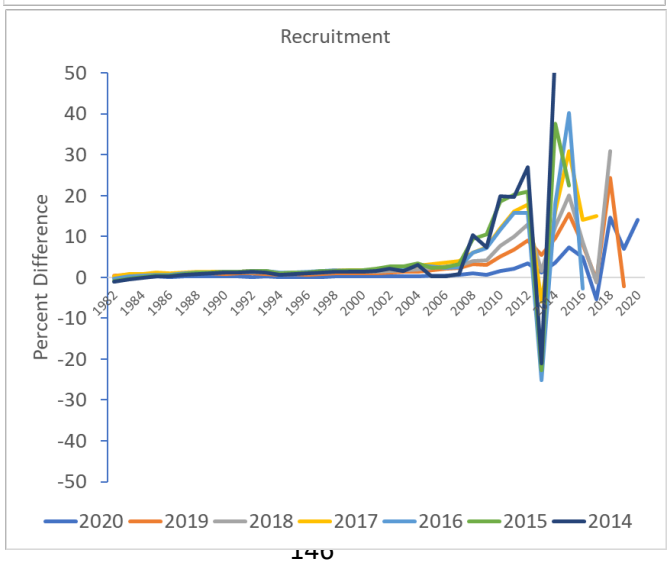




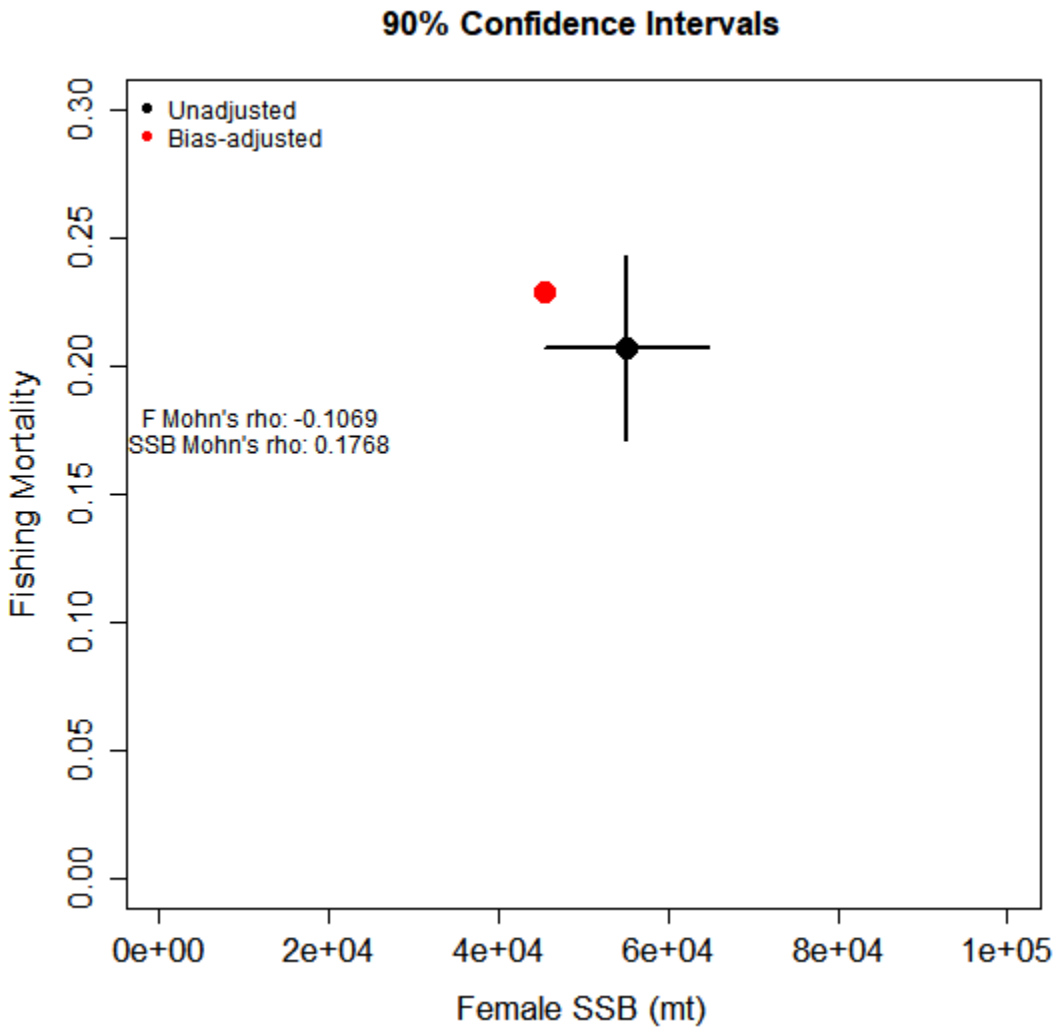
Number of peels = 7 (NMFS standard)



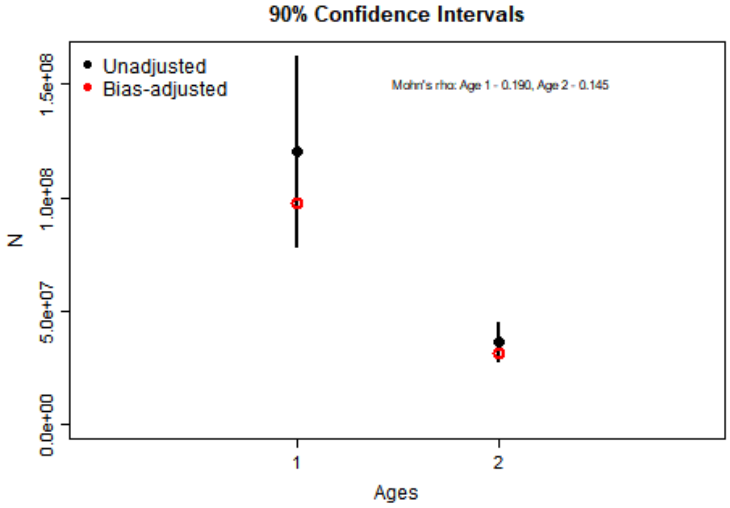


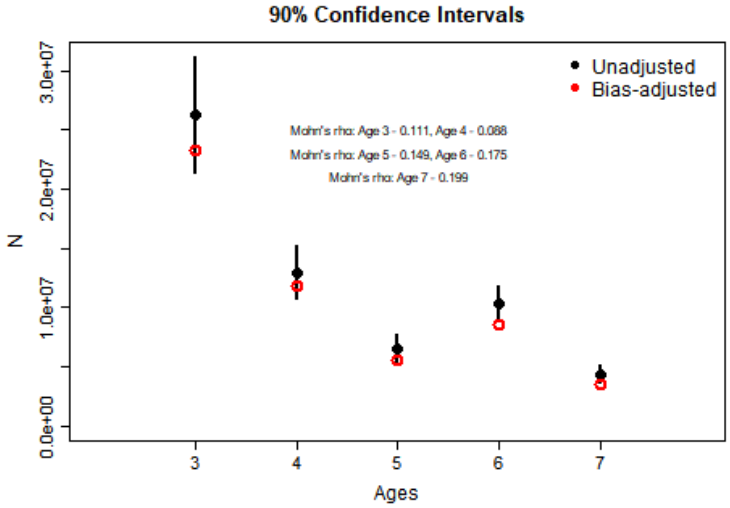


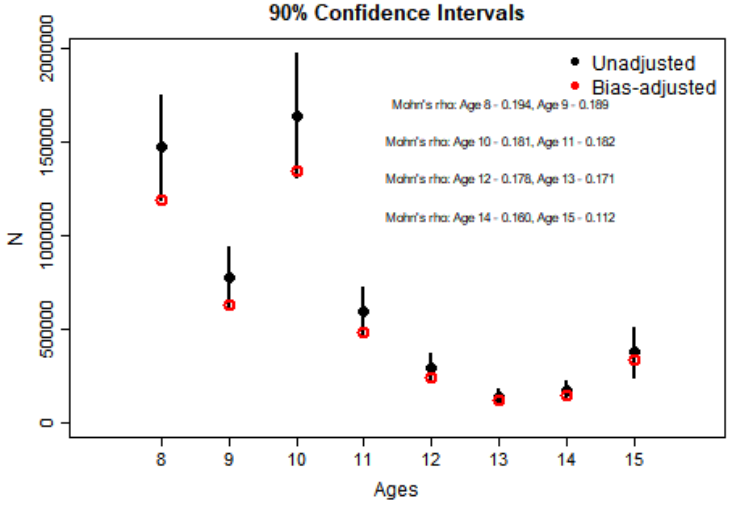
Retrospective Bias corrected values just barely within 90% confidence intervals of original values; no bias-correction required.



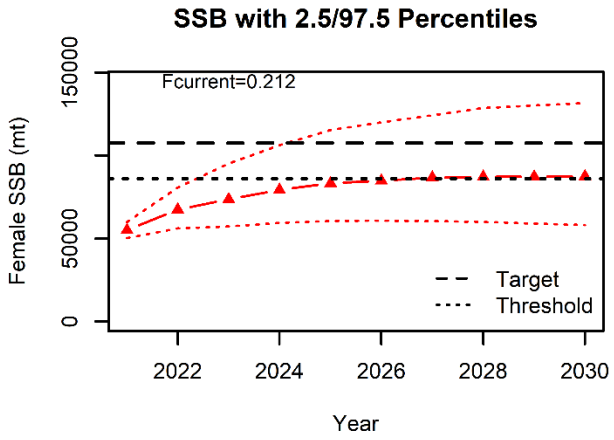
Only 2 retrospective values outside 90% Cis of original values

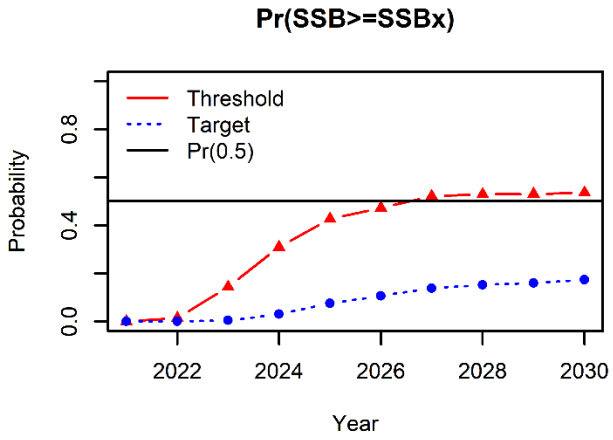


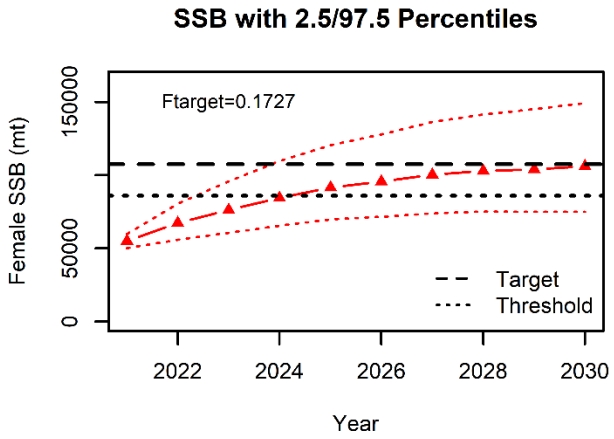


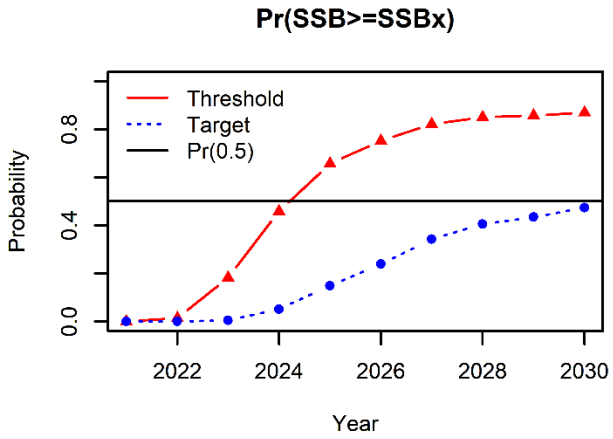


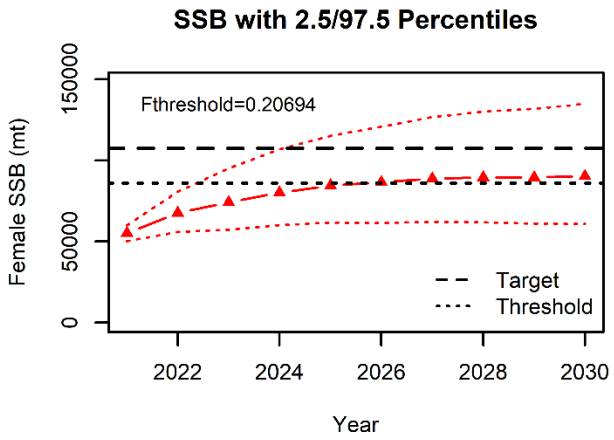
SSBtarget not reached by 2029 under current fishing mortality but it is reached by 2030 under Ftarget

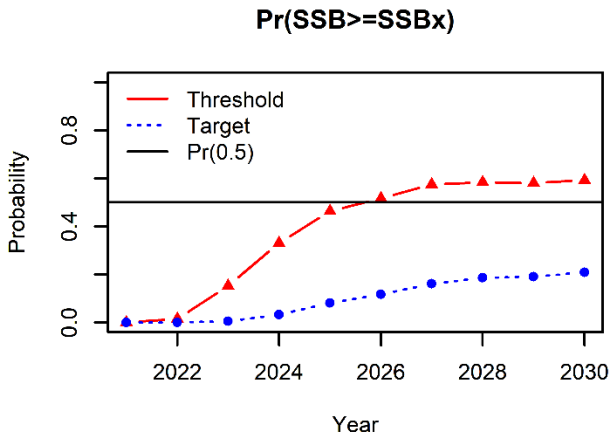












Because SSBtarget will not be reached by 2029 under current F, how much should removals be reduced.

Not Bias-Corrected

Catch = 4700757; F_{2029}=0.162

%Reduction from current:

(4,700,757-5,144534)/5,144,534*100 = -8.6%