

**ASAP Diagnostic Plots for the Major Bridge-Building Milestone Models**

Anthony Wood

October 2022

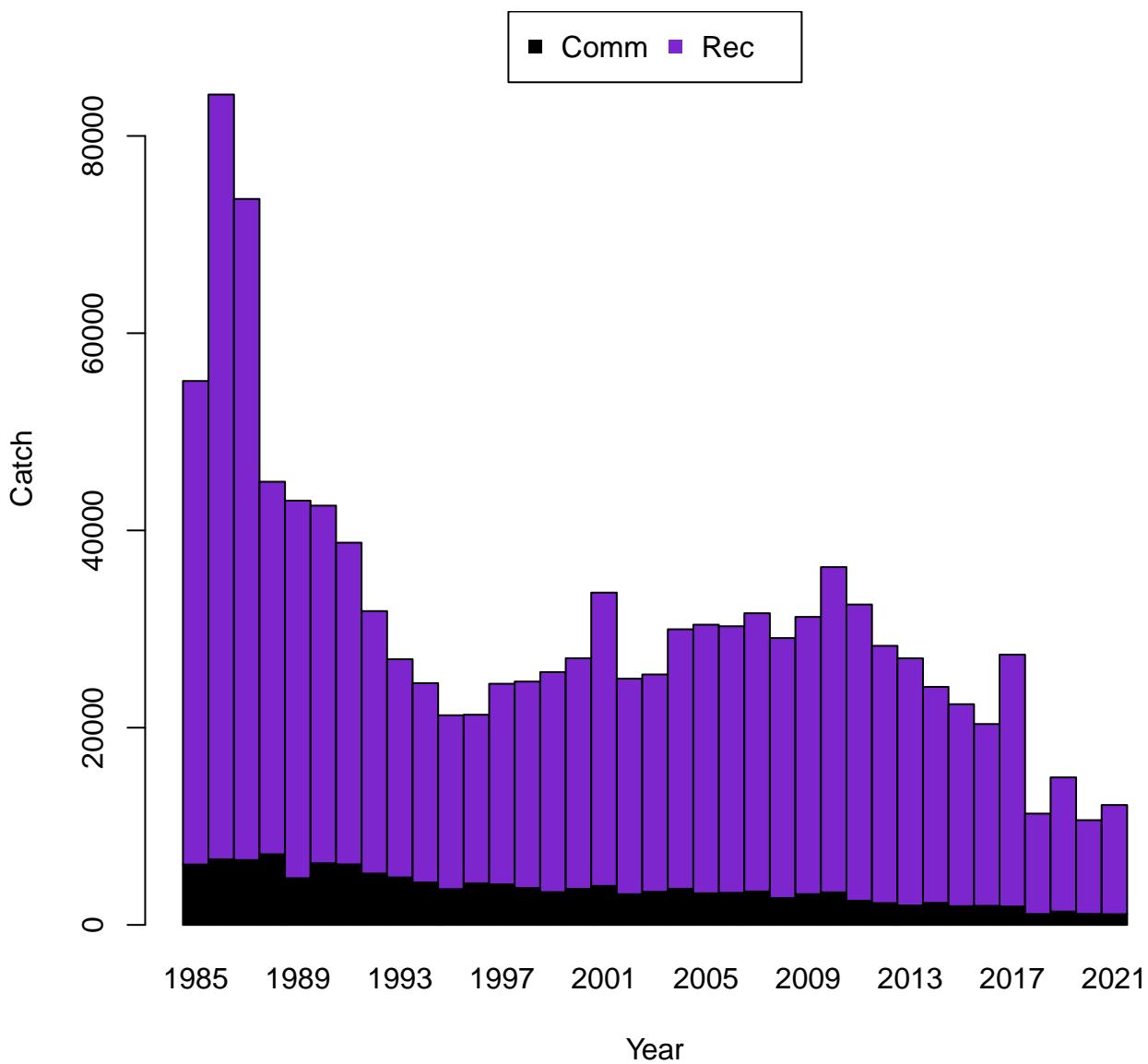
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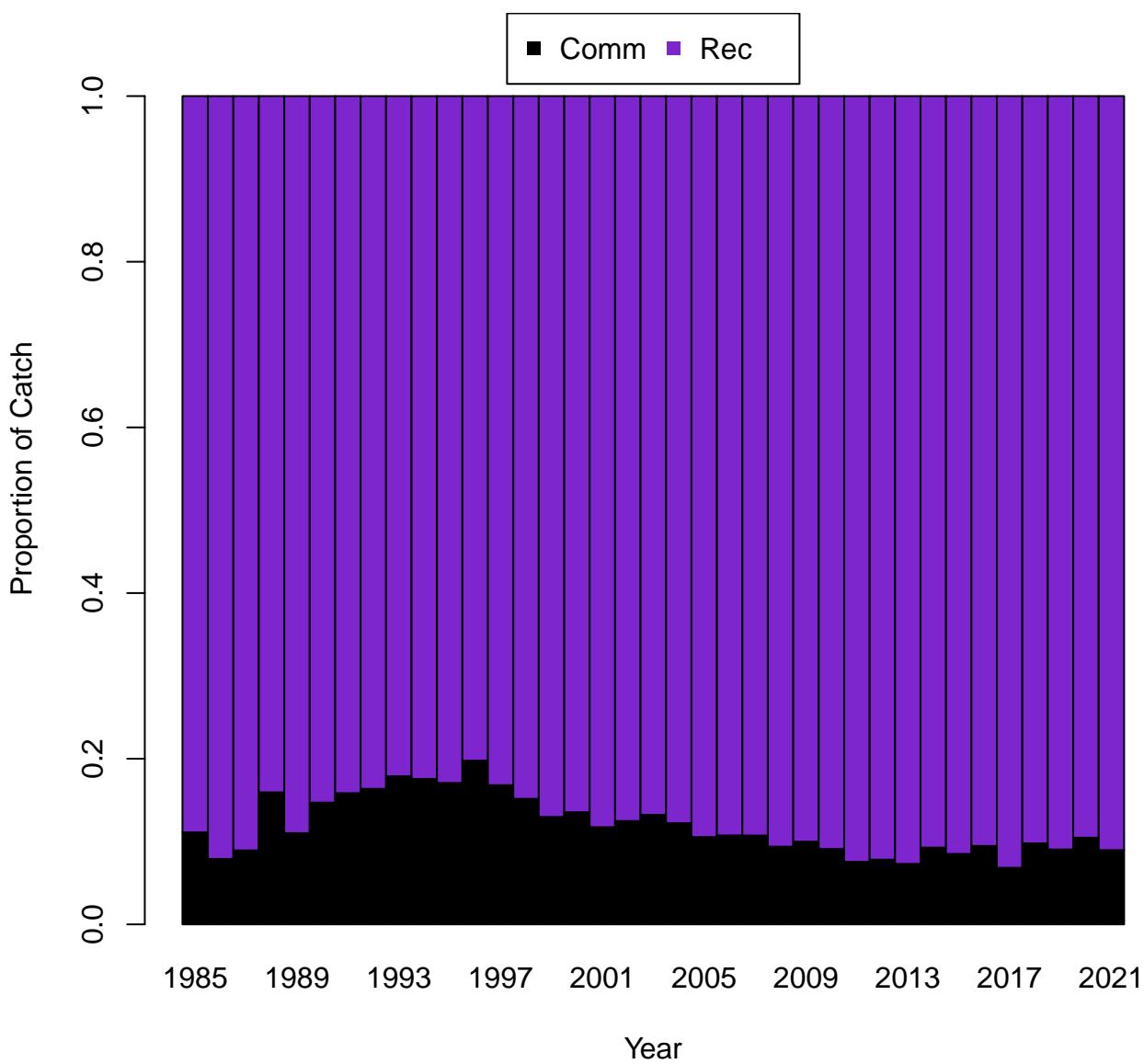
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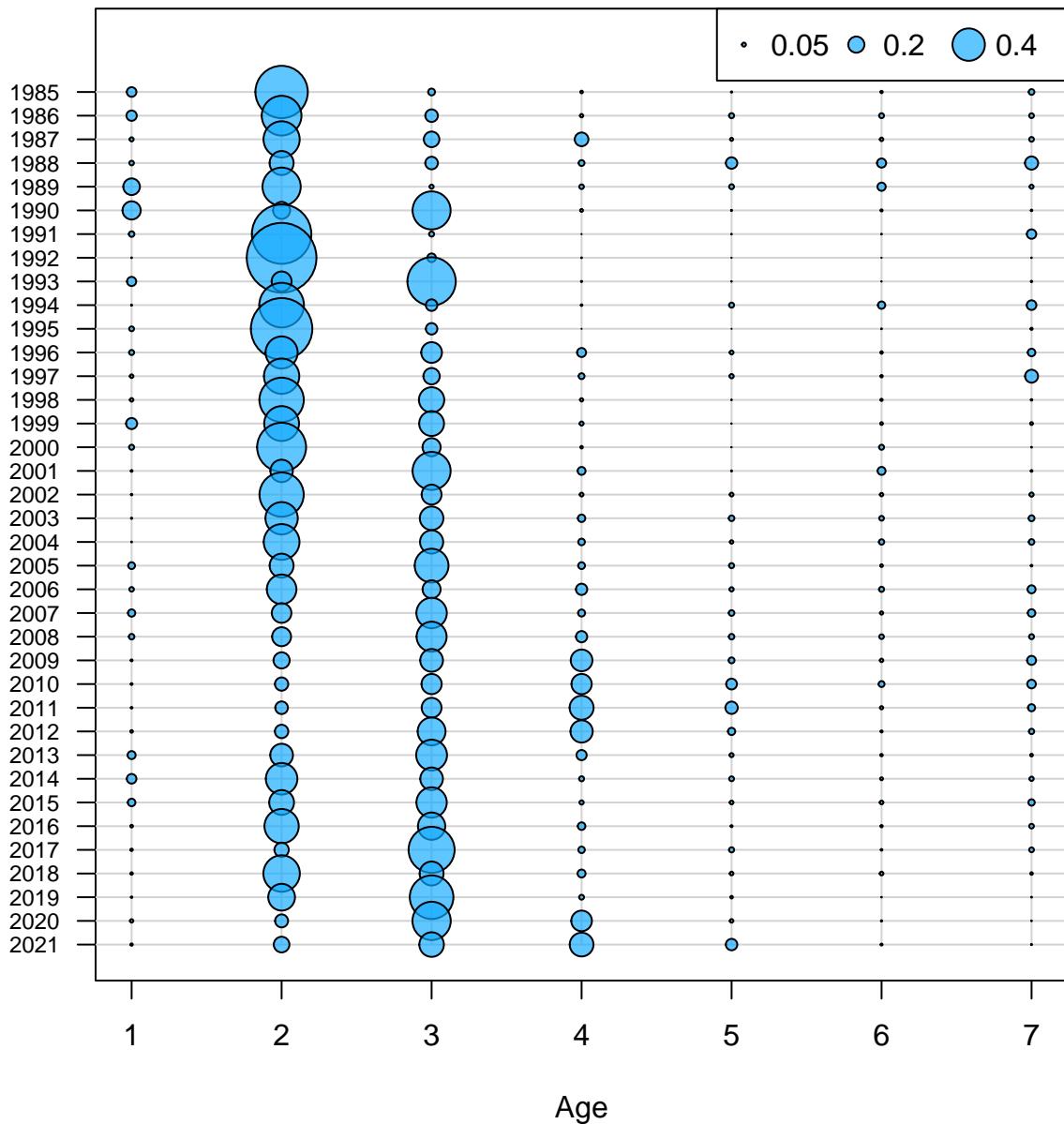
# BF01: Continuity Run

## DATA PLOTS

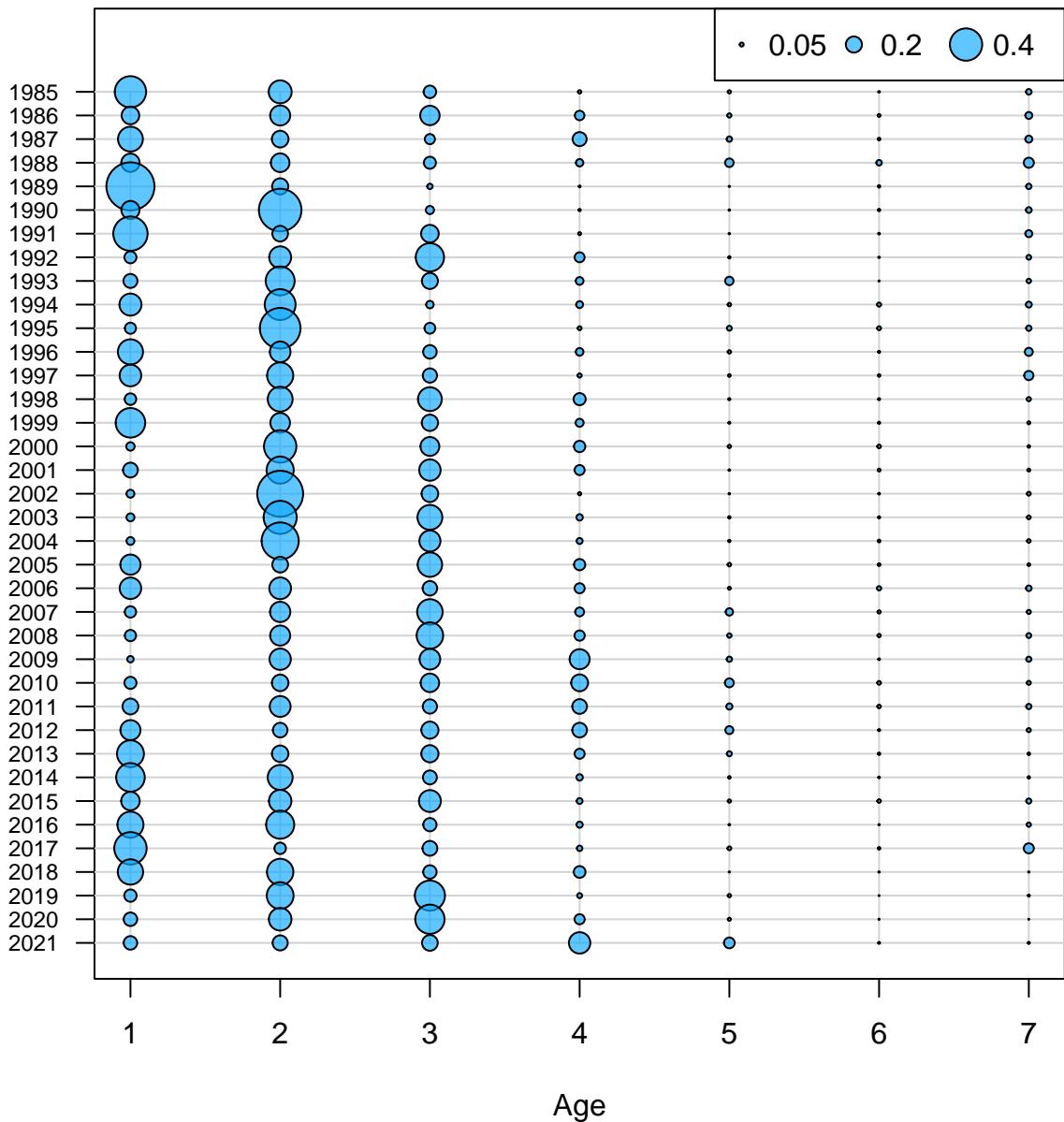


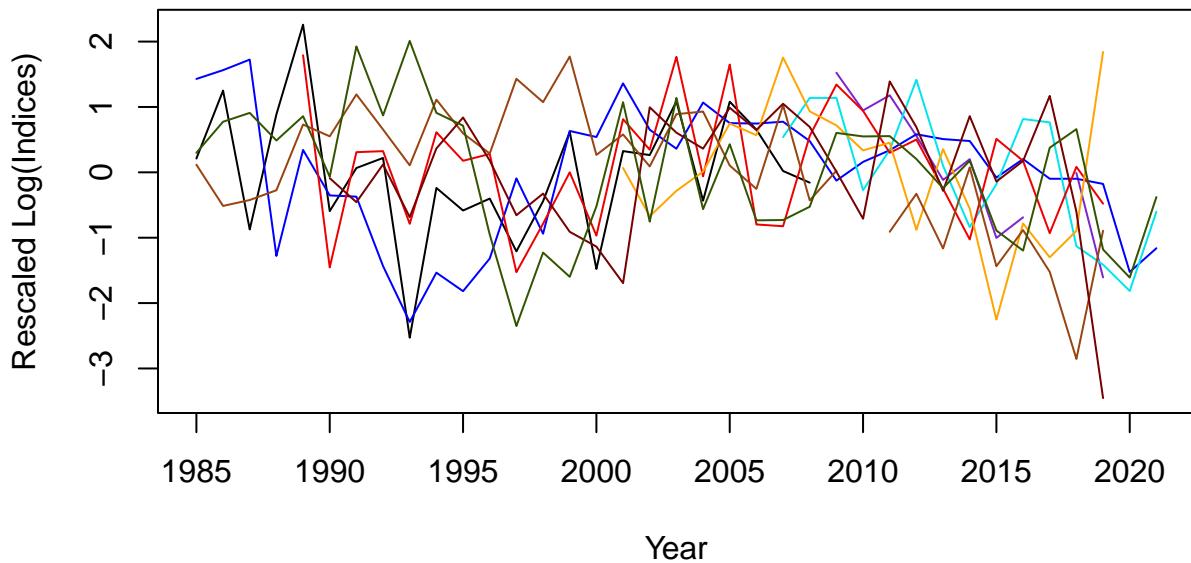
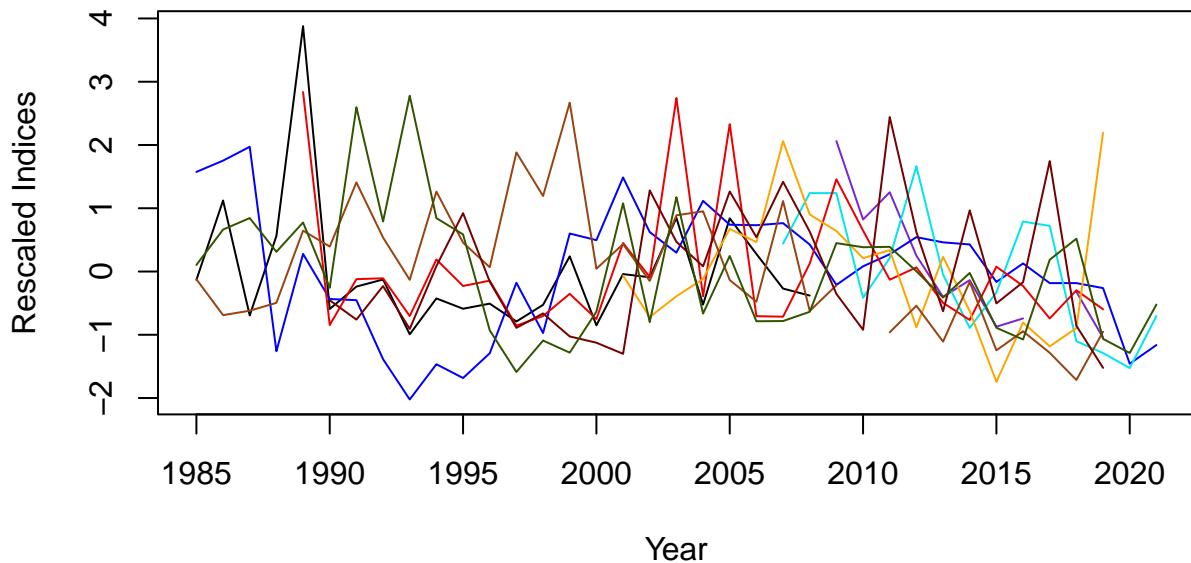


## Age Comps for Catch by Fleet 1 (Comm)

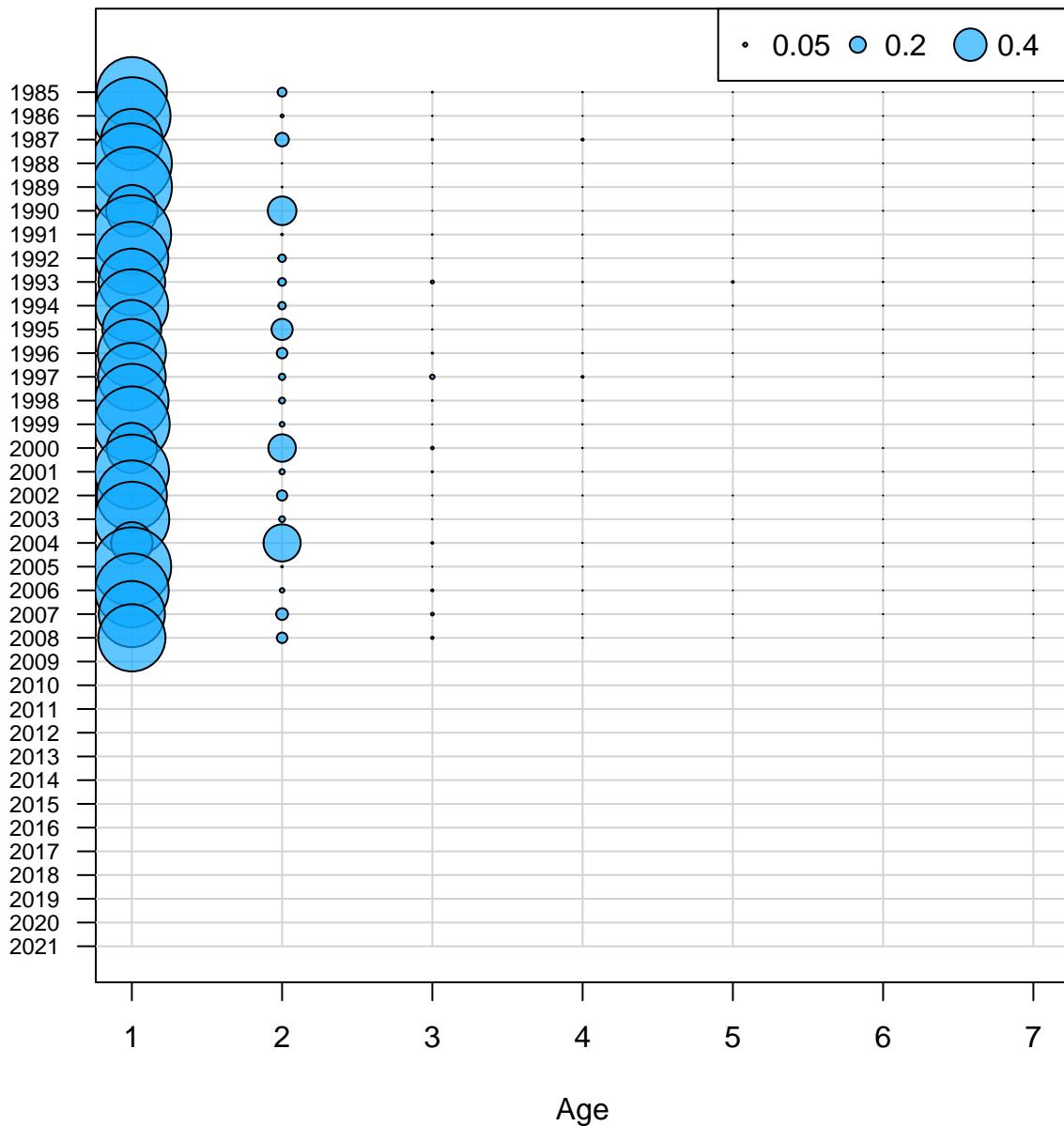


## Age Comps for Catch by Fleet 2 (Rec)

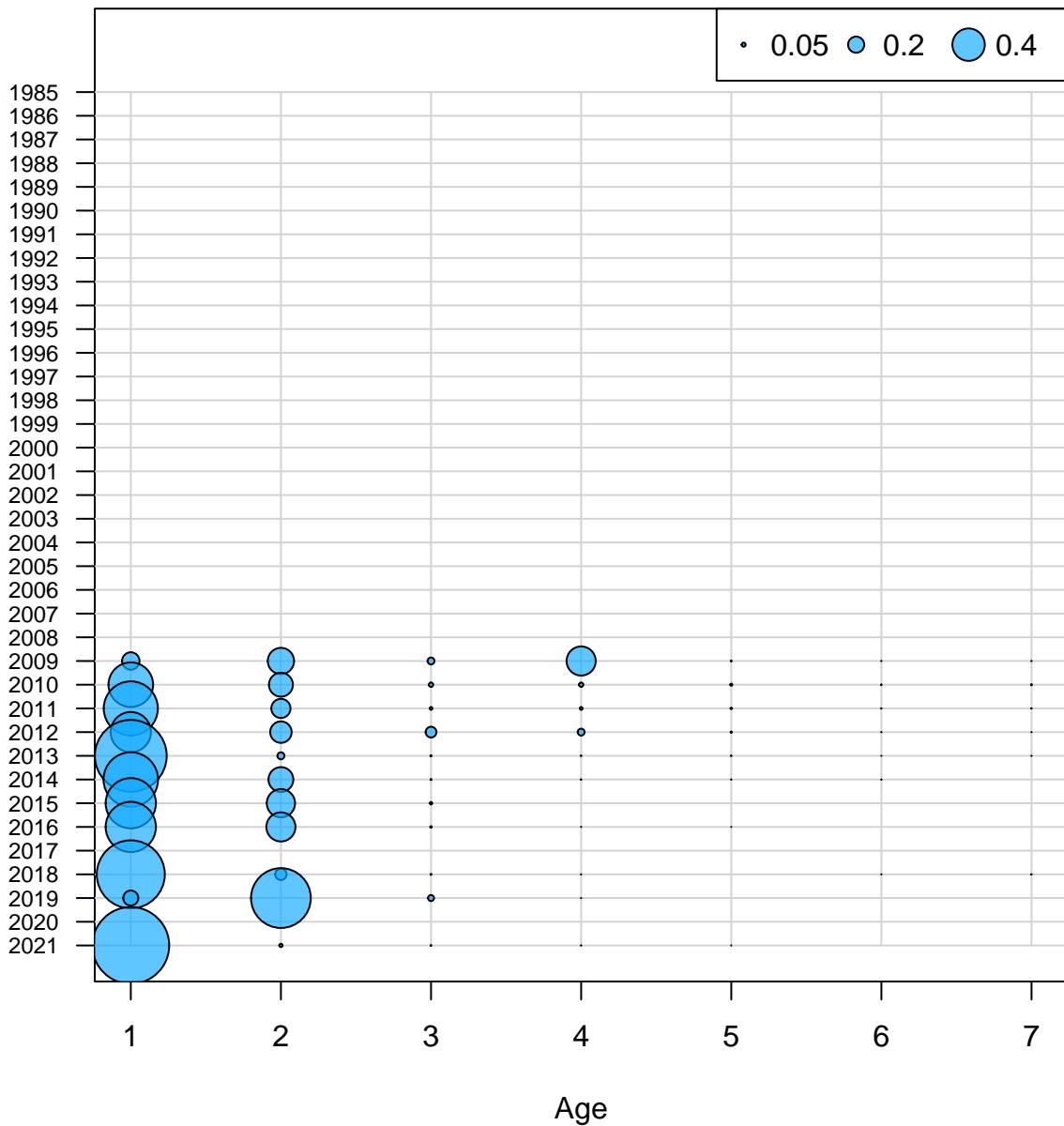




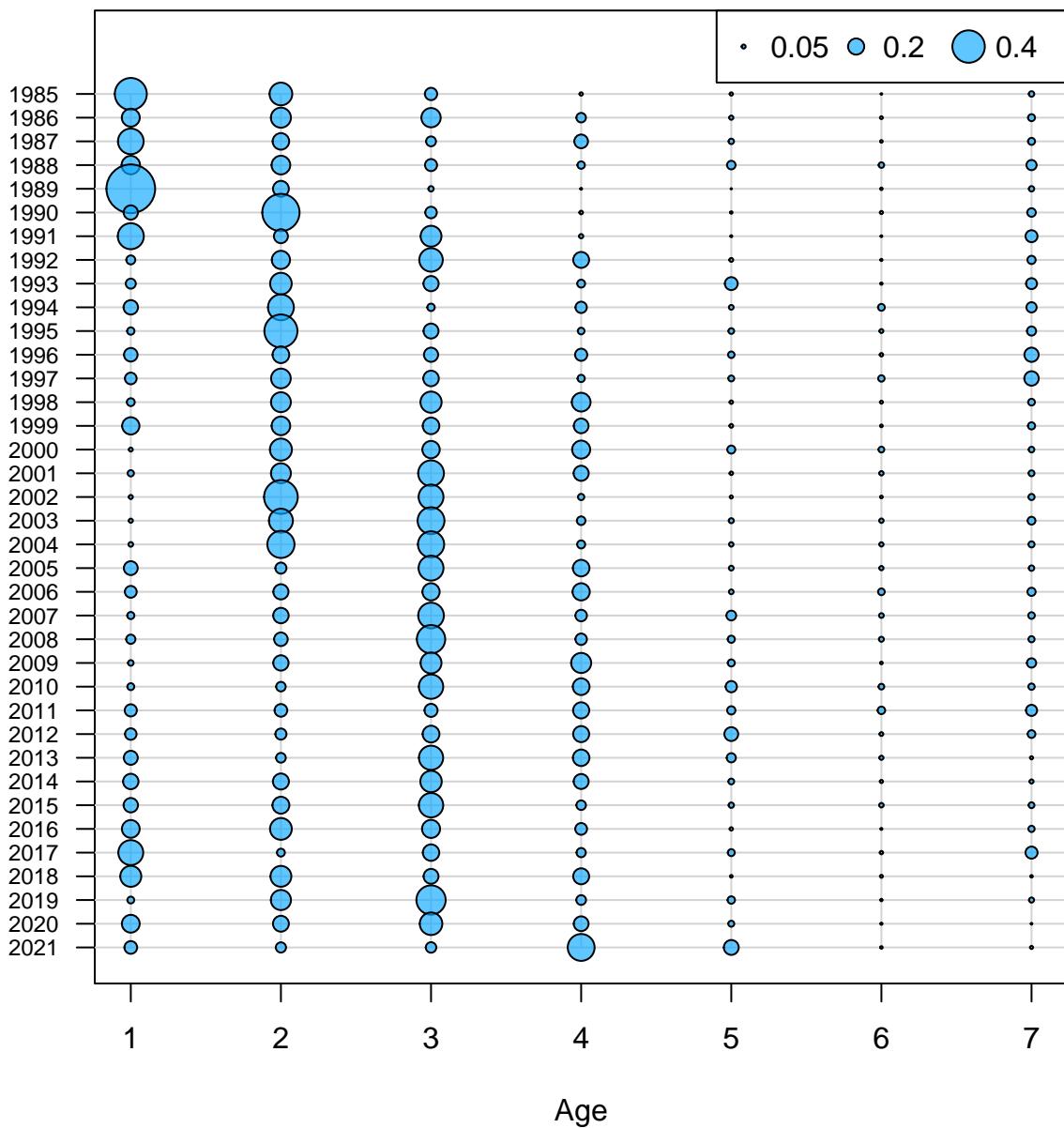
## Age Comps for Index 1 (NEFSC Inshore)



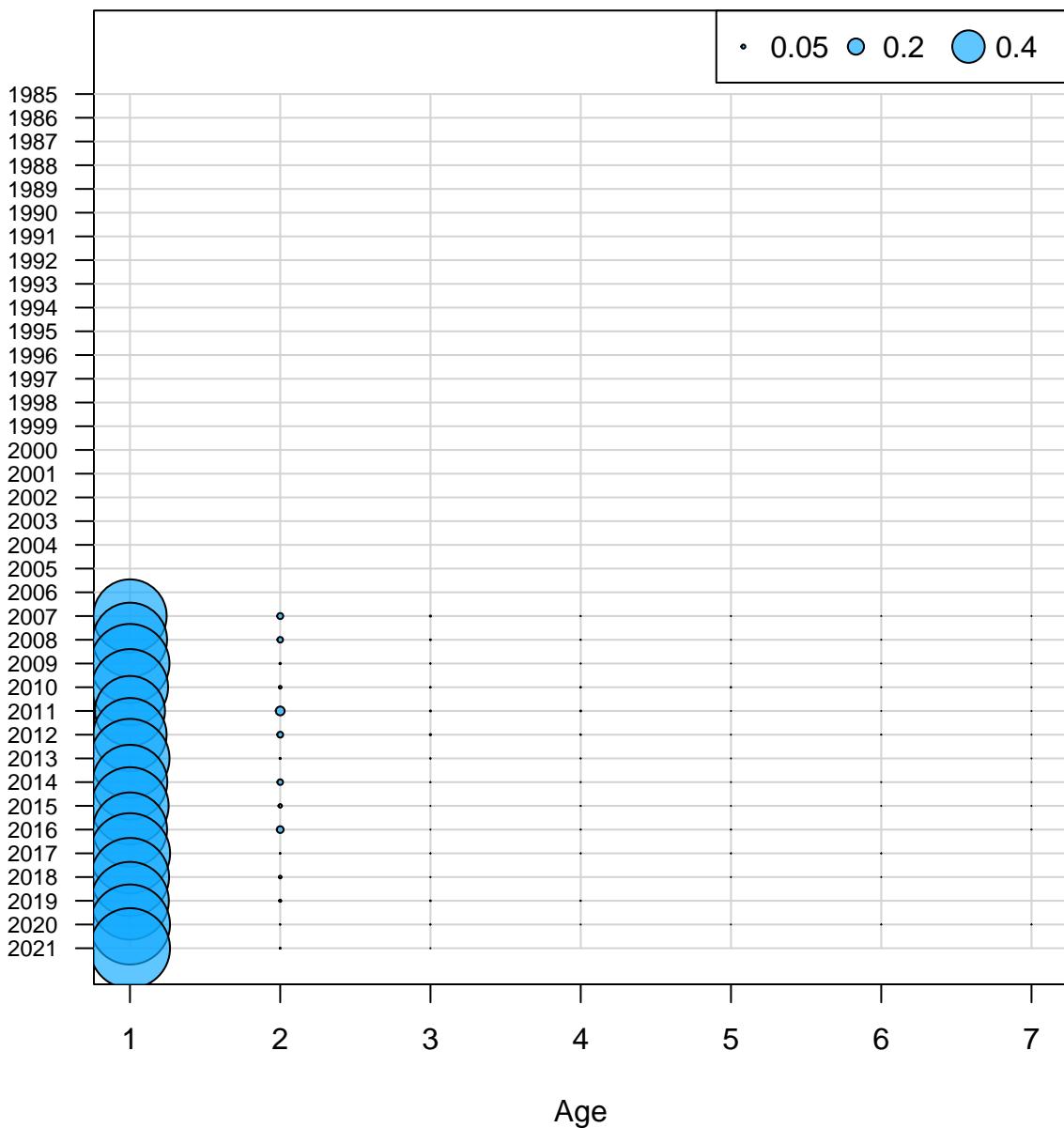
## Age Comps for Index 2 (Bigelow)



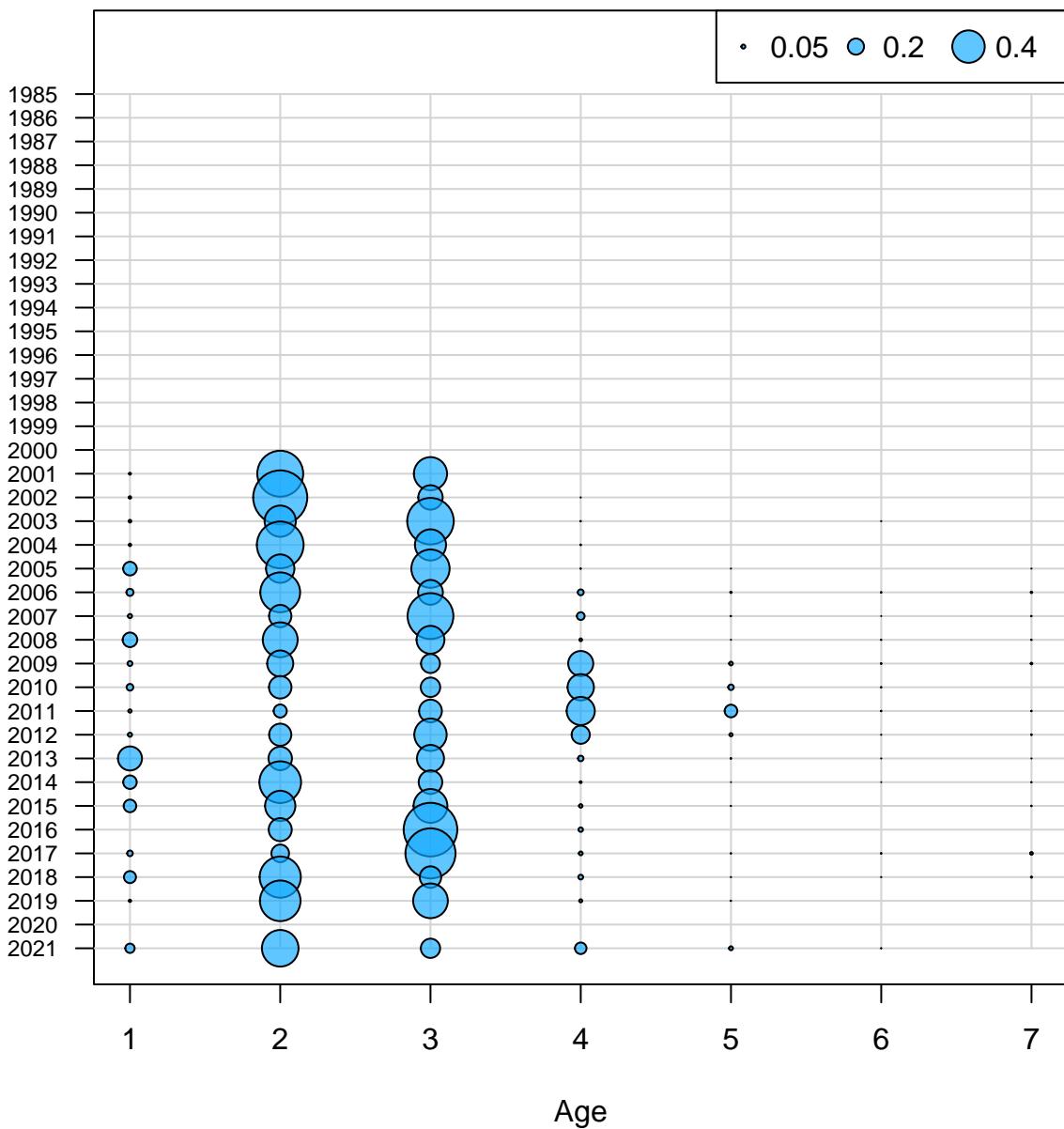
## Age Comps for Index 3 (MRIP)



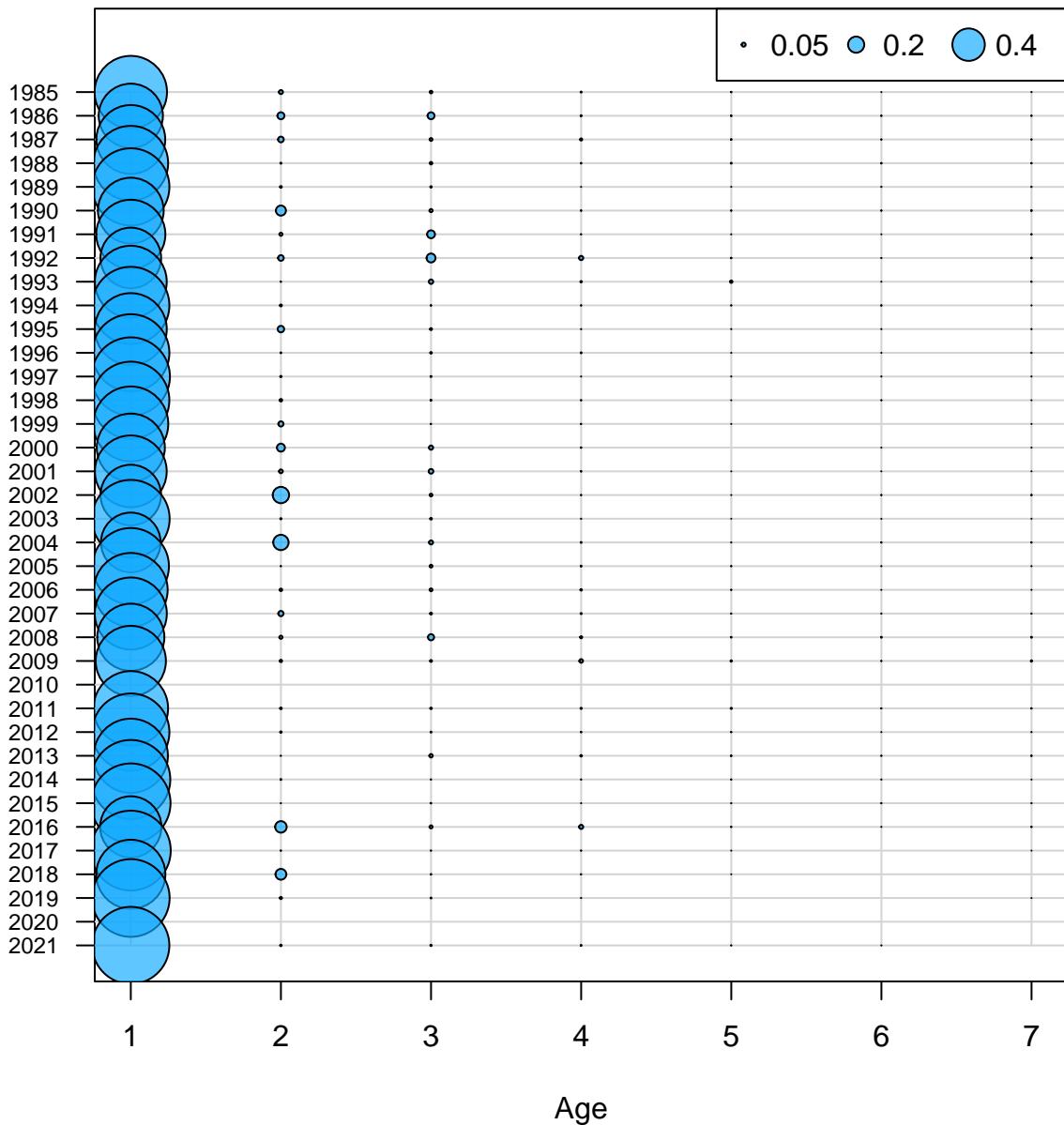
## Age Comps for Index 4 (NEAMAP)



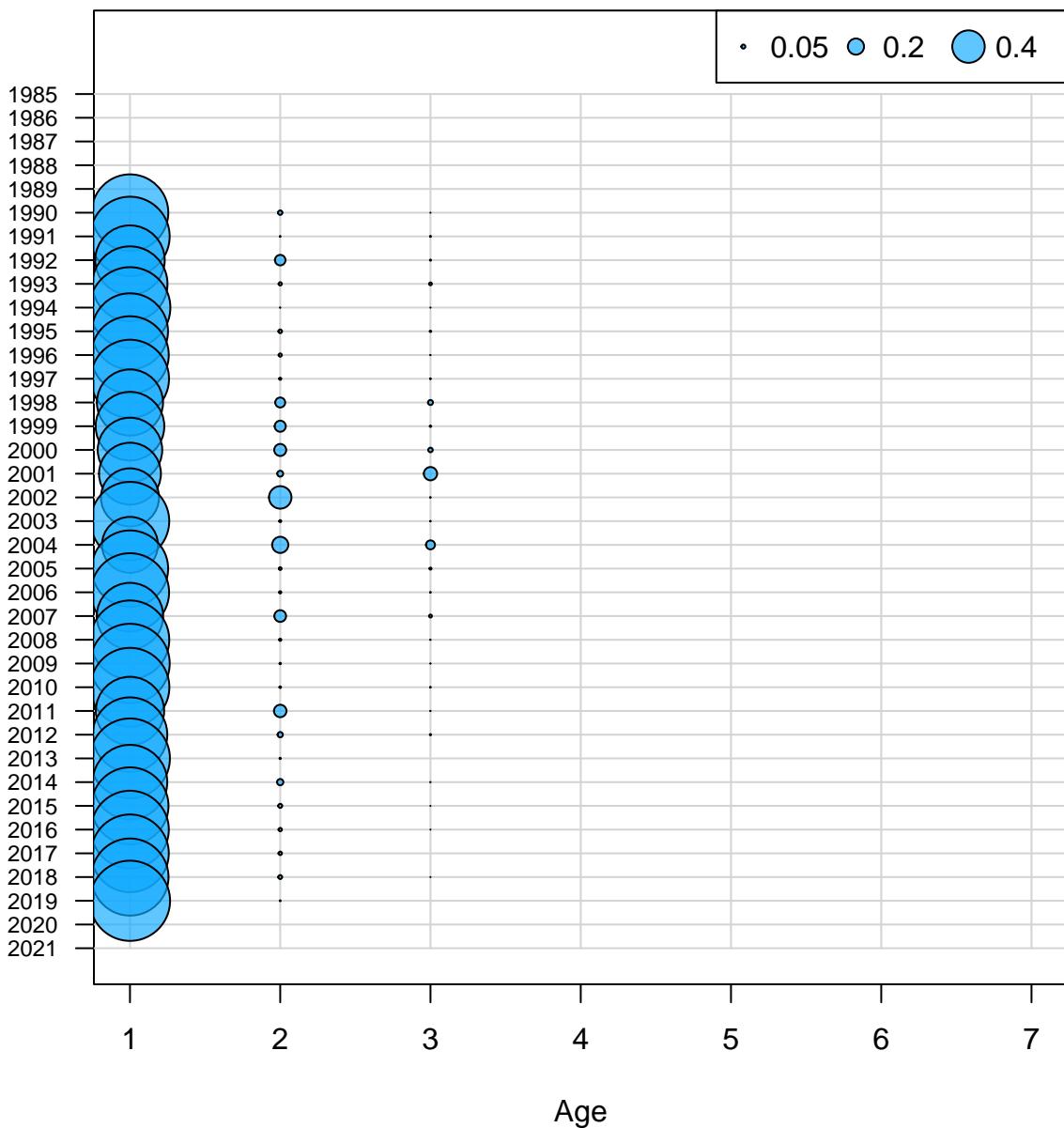
## Age Comps for Index 6 (PSIGN)



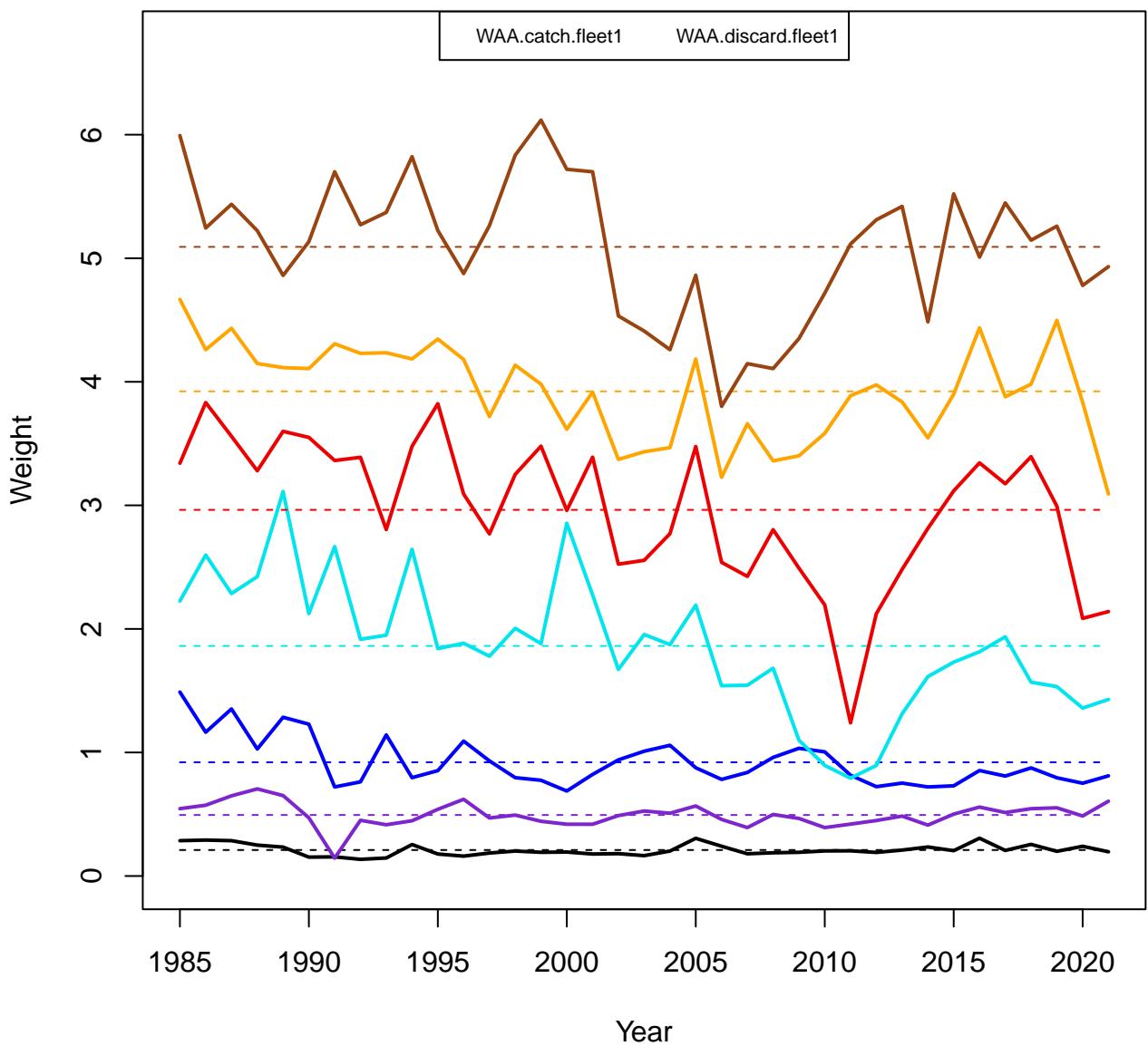
## Age Comps for Index 7 (CT Trawl)



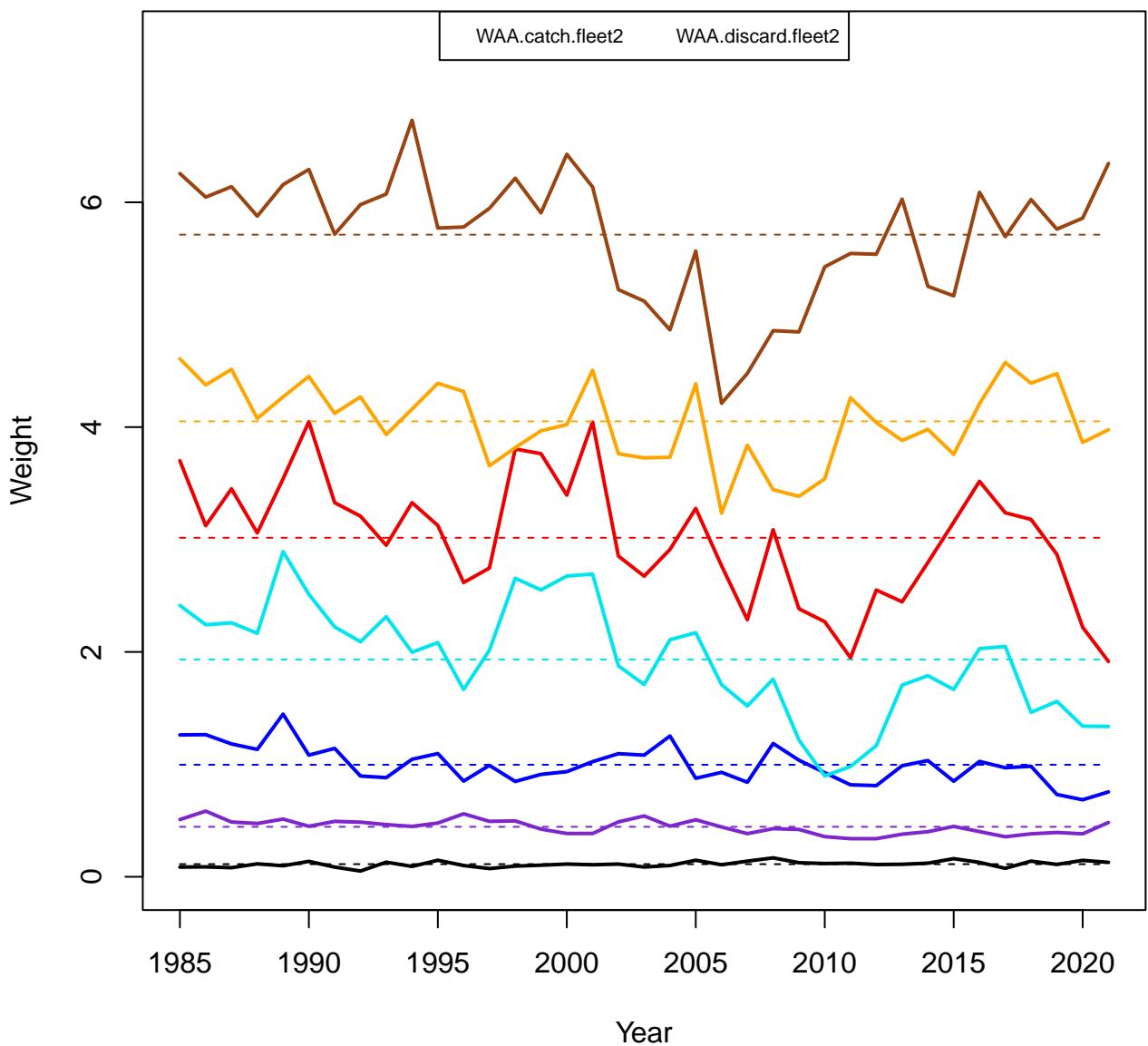
## Age Comps for Index 8 (NJ Trawl)



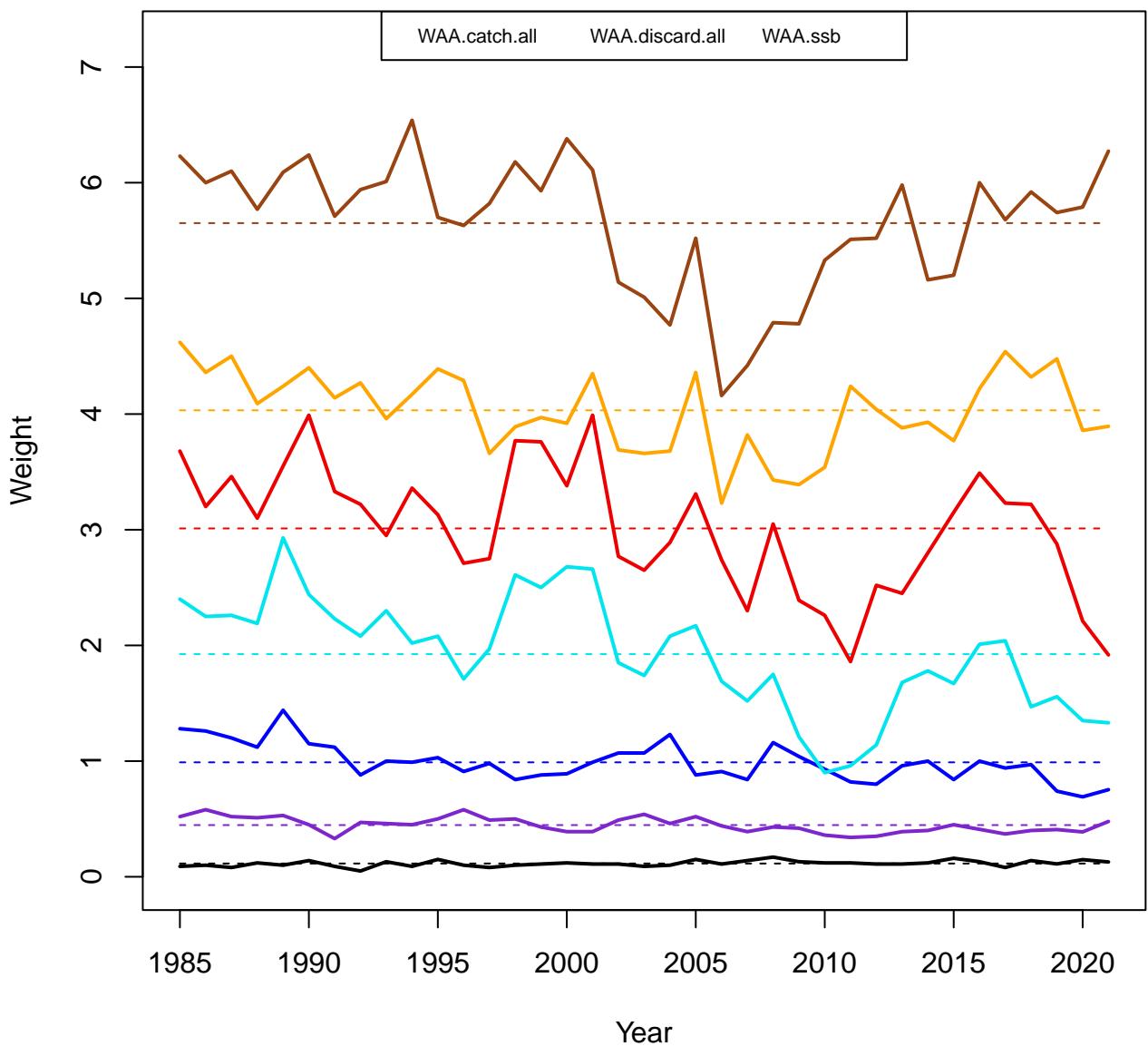
## WAA matrix 1



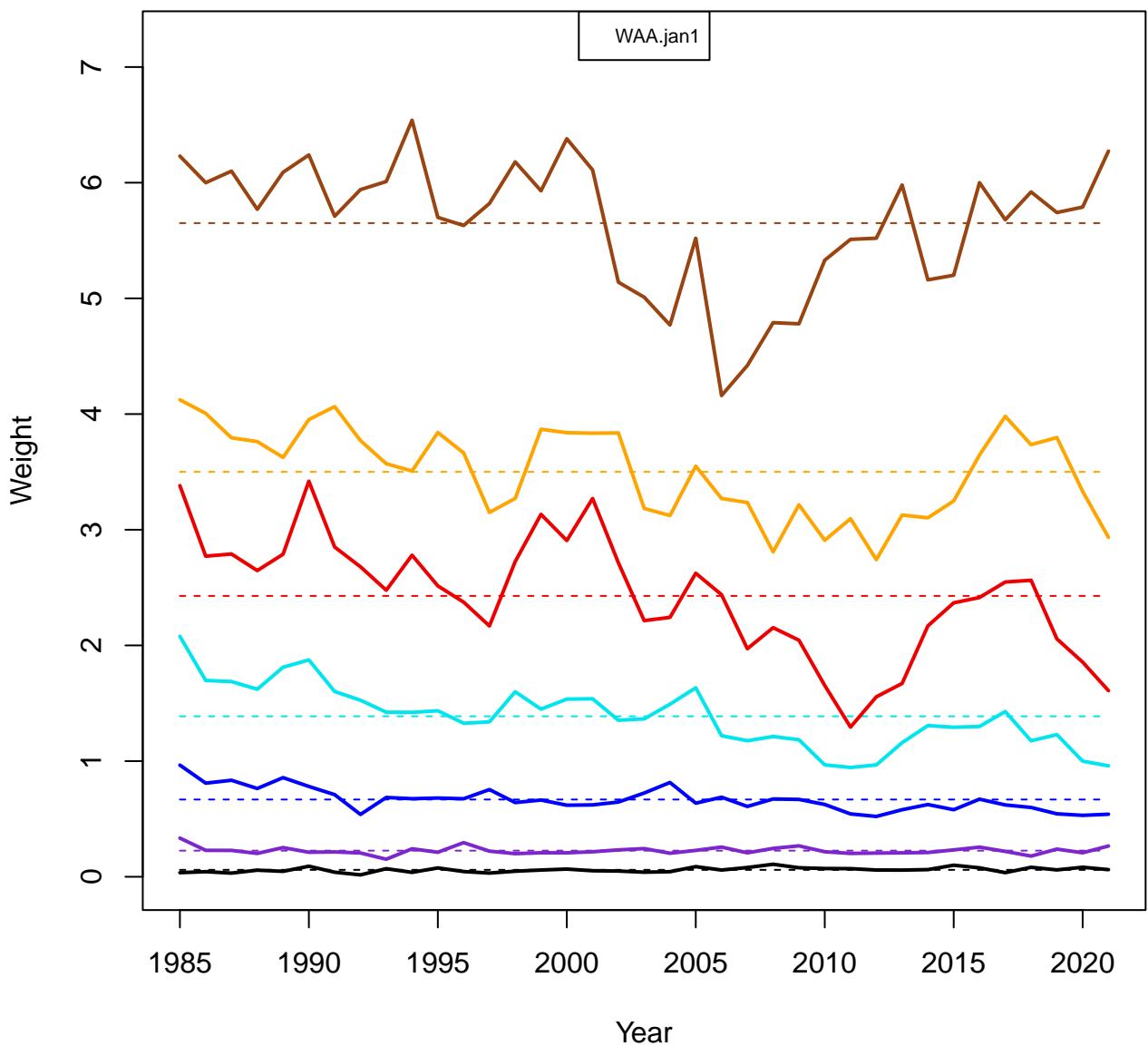
## WAA matrix 2



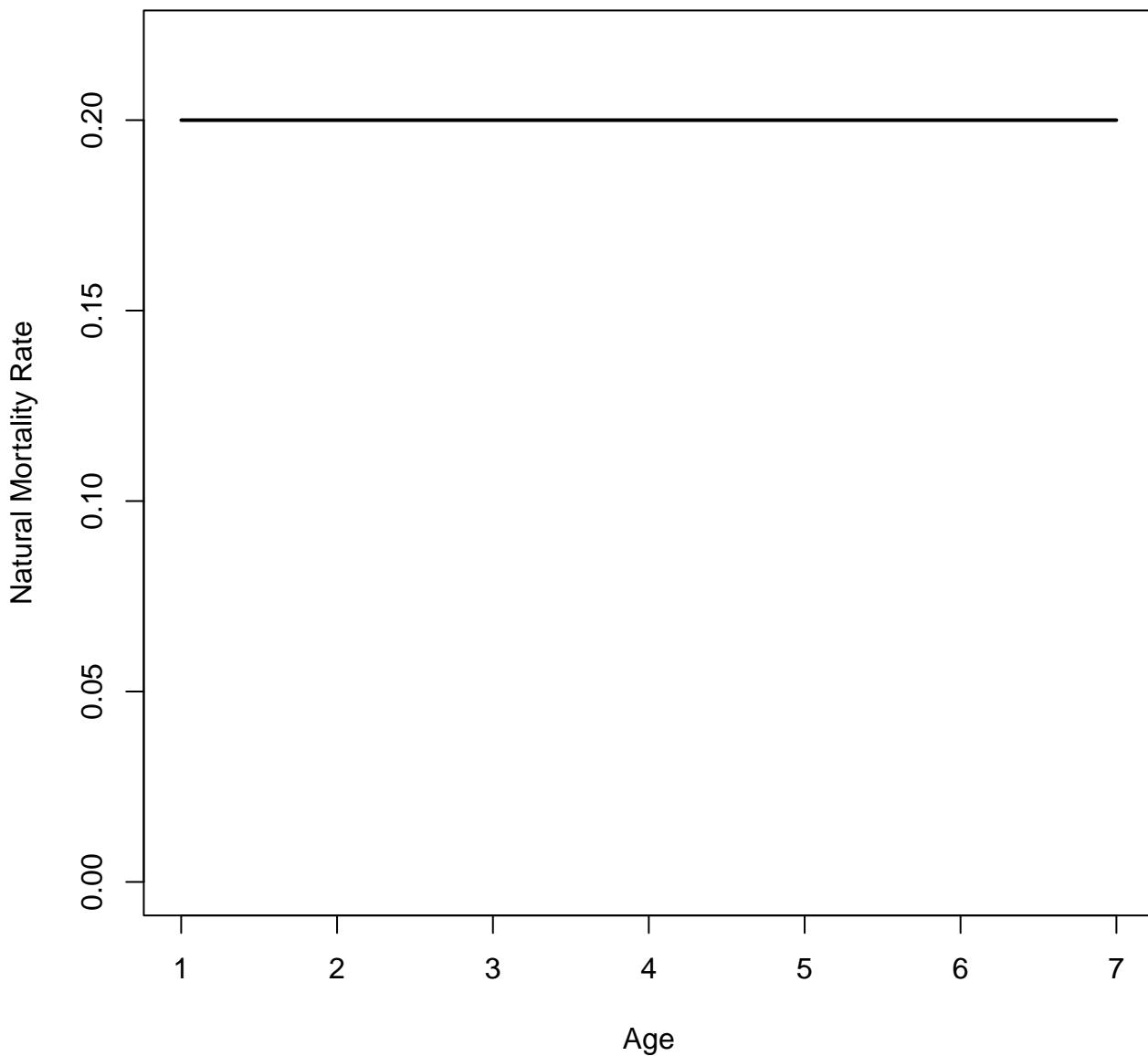
### WAA matrix 3



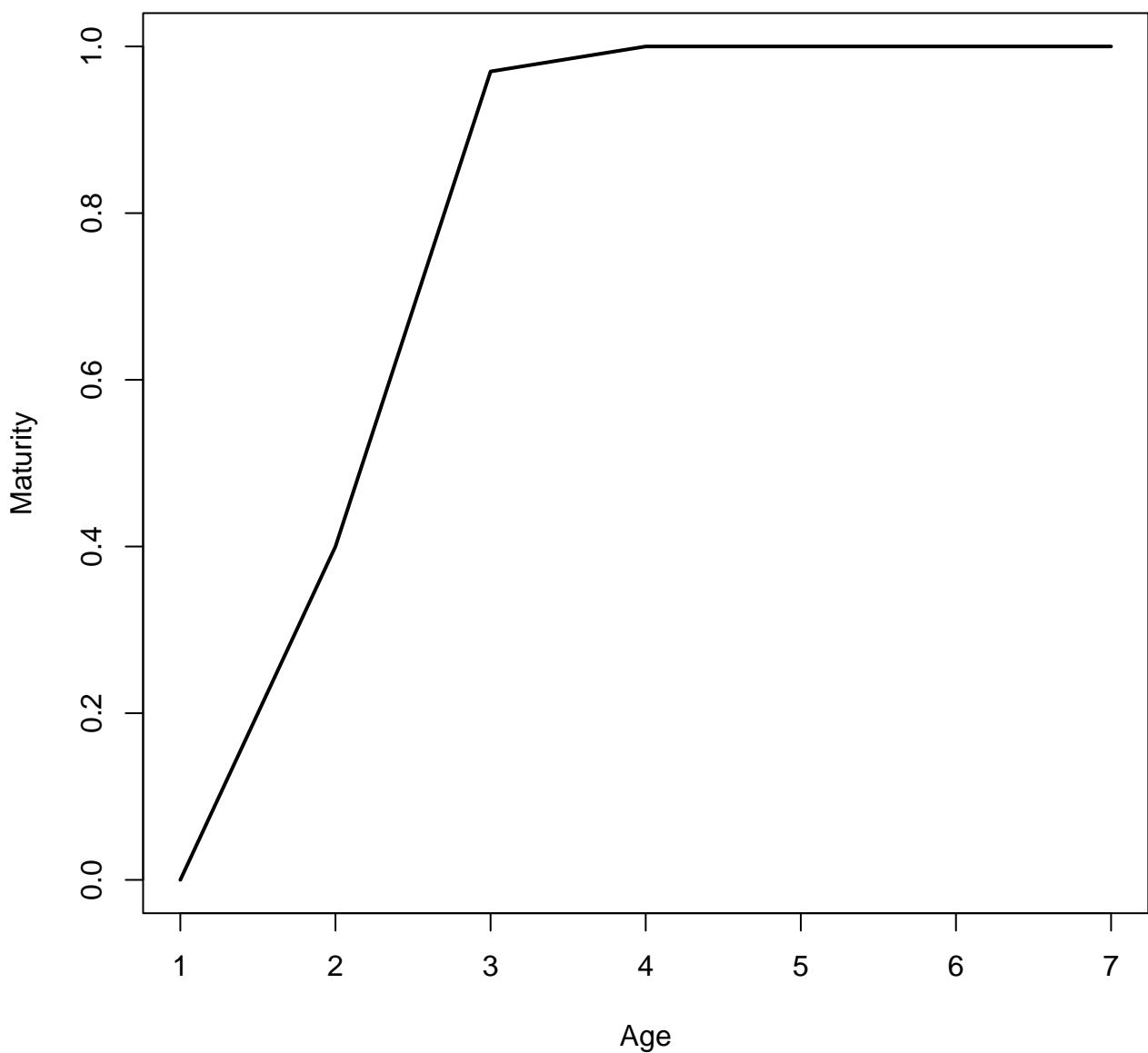
## WAA matrix 4



**M**



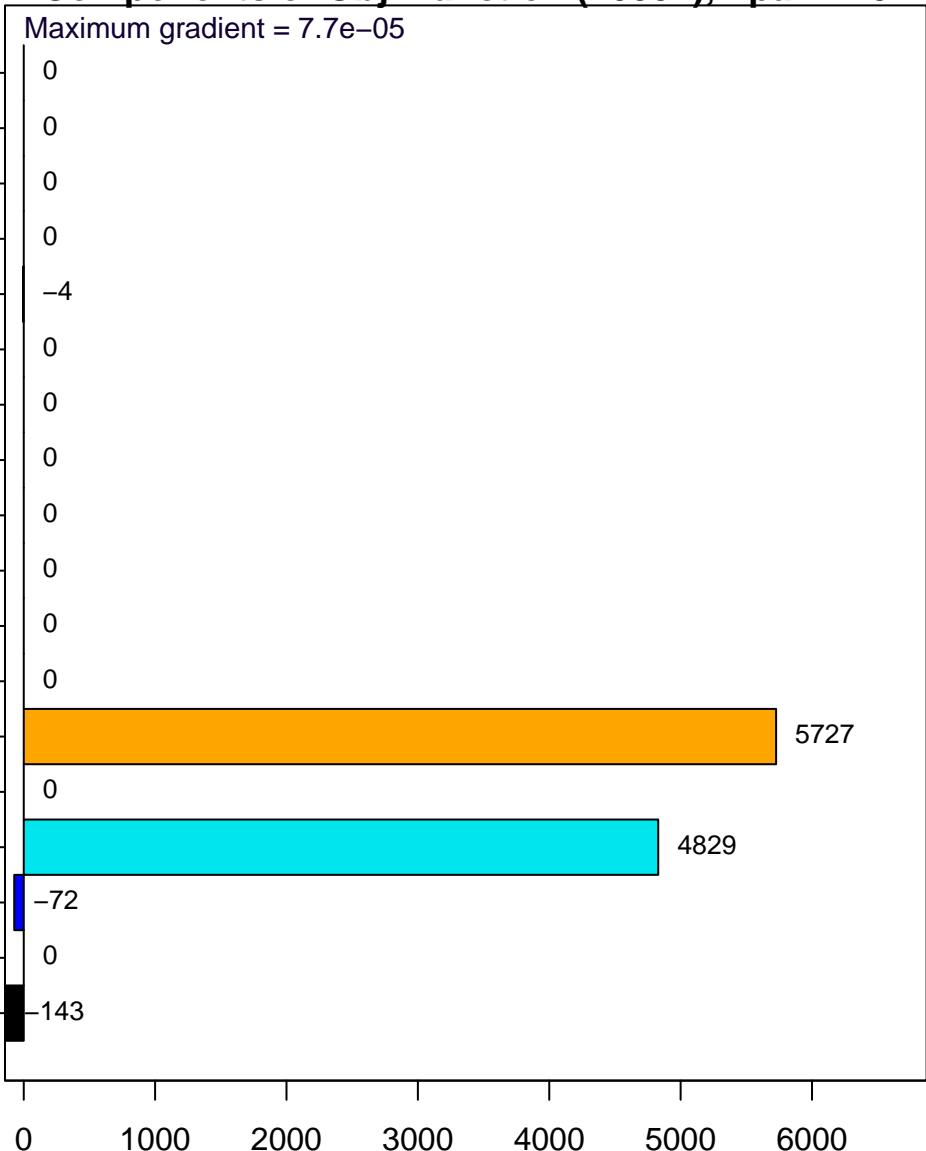
## Maturity



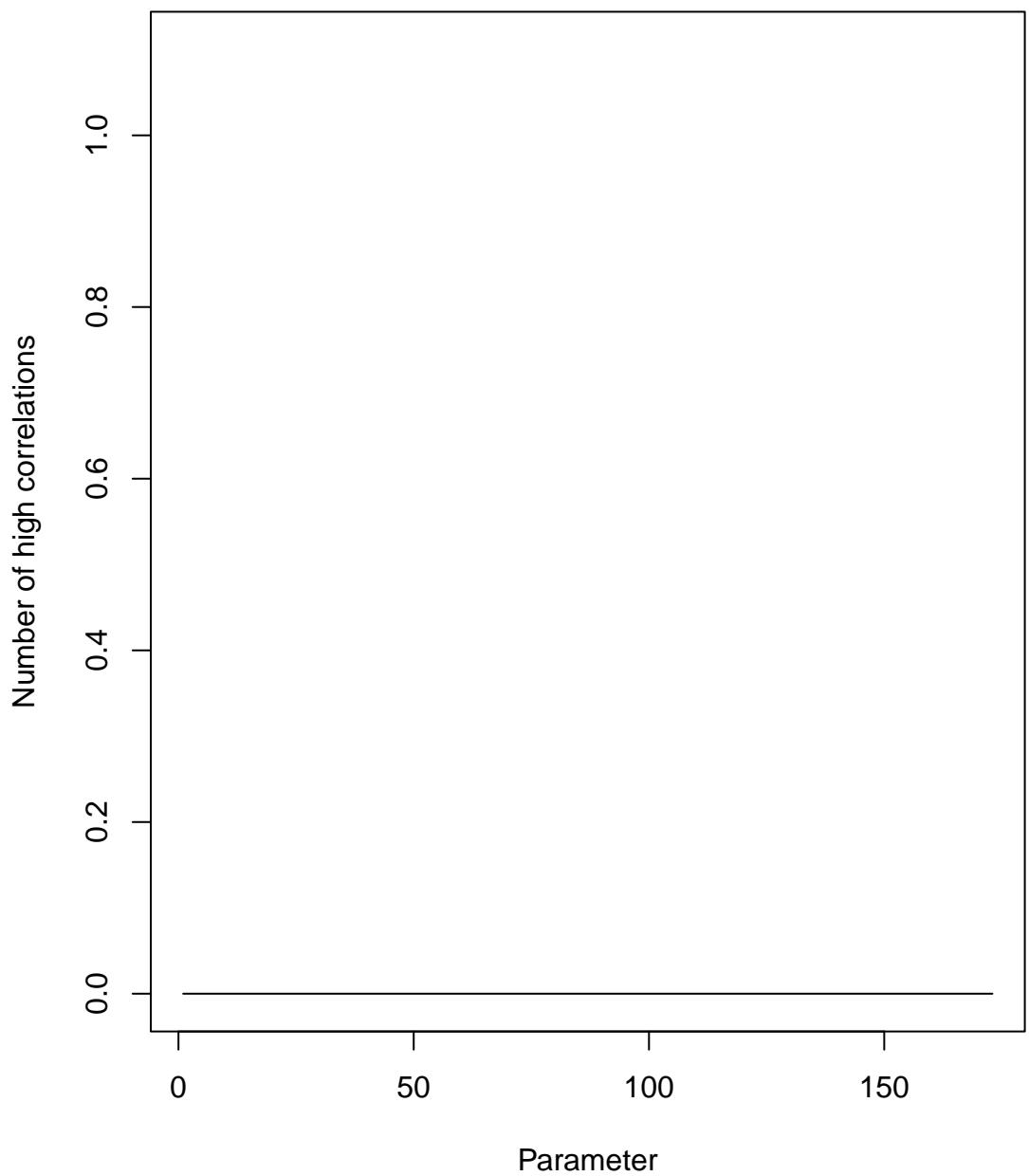
# BF01: Continuity Run

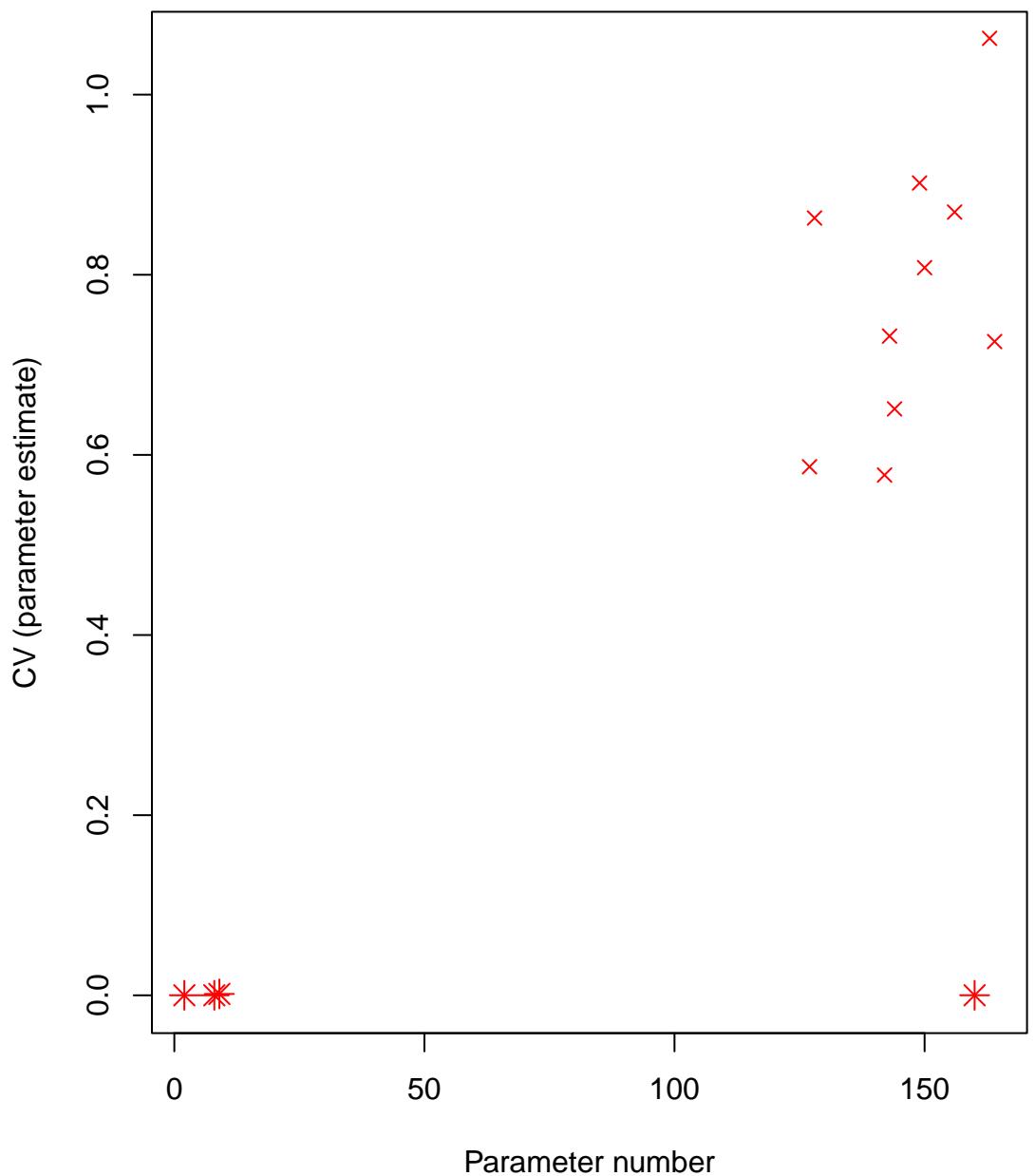
## DIAGNOSTIC PLOTS

# Components of Obj. Function (10337), npar=173



Likelihood Contribution  
Model: BF01 Friday, 23 Sep 2022 at 12:07:26

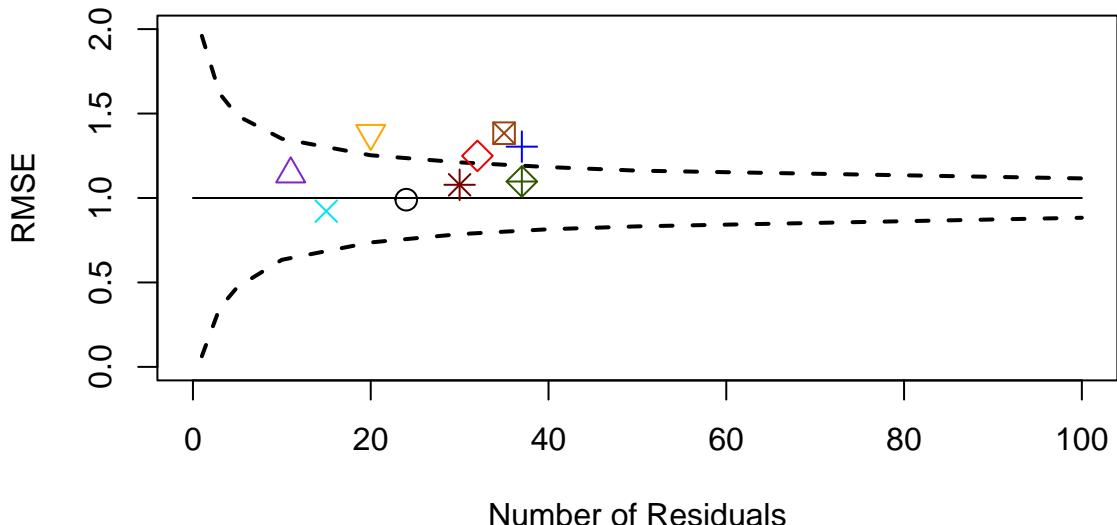




## Root Mean Square Error computed from Standardized Residuals

Component	# resid	RMSE
catch.fleet1	37	0.064
catch.fleet2	37	0.838
catch.tot	74	0.594
discard.fleet1	0	0
discard.fleet2	0	0
discard.tot	0	0
ind01	24	0.99
ind02	11	1.14
ind03	37	1.3
ind04	15	0.922
ind05	32	1.25
ind06	20	1.38
ind07	35	1.38
ind08	30	1.08
ind09	37	1.1
ind.total	241	1.2
N.year1	0	0
Fmult.year1	0	0
Fmult.devs.fleet1	0	0
Fmult.devs.fleet2	0	0
Fmult.devs.total	0	0
recruit.devs	37	0.356
fleet.sel.params	0	0
index.sel.params	0	0
q.year1	0	0
q.devs	0	0
SR.steepness	0	0
SR.scaler	0	0

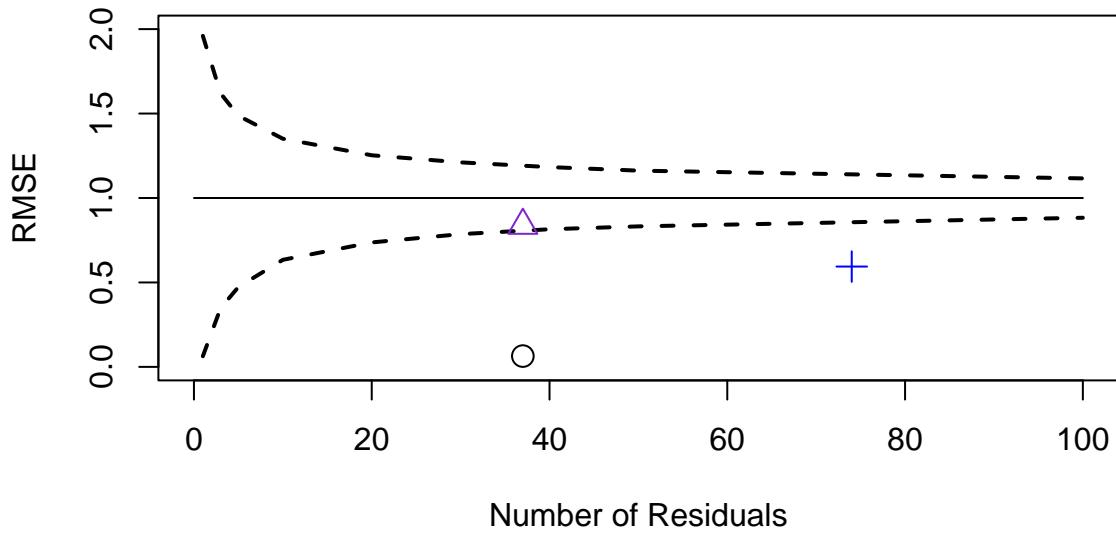
## Root Mean Square Error for Indices



Legend:

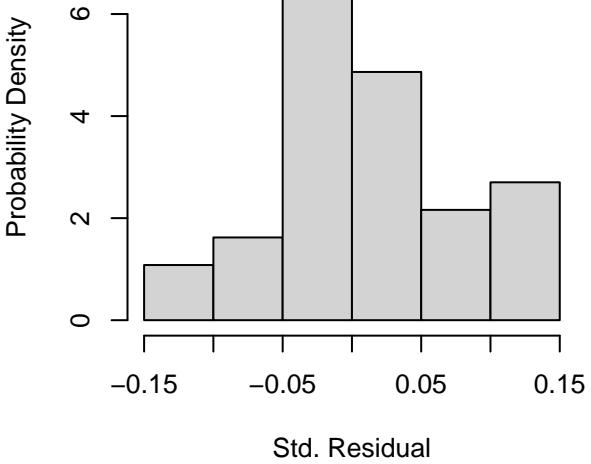
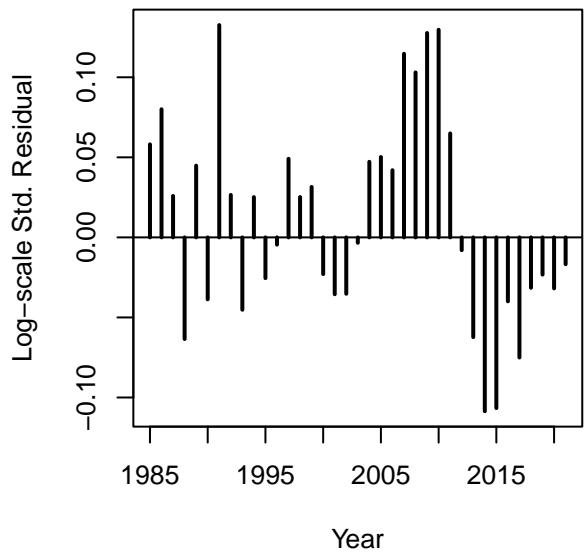
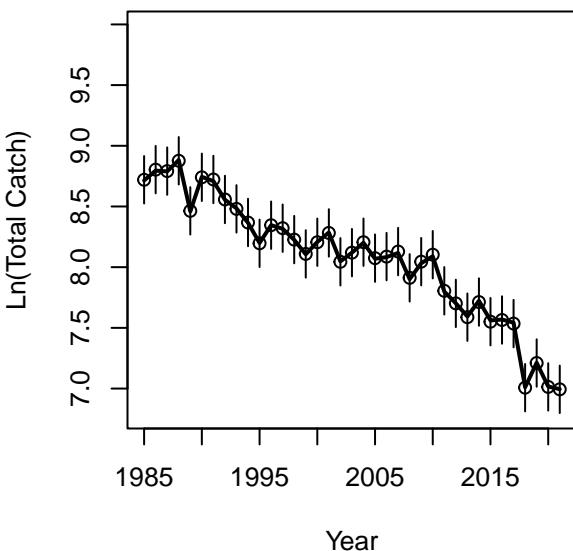
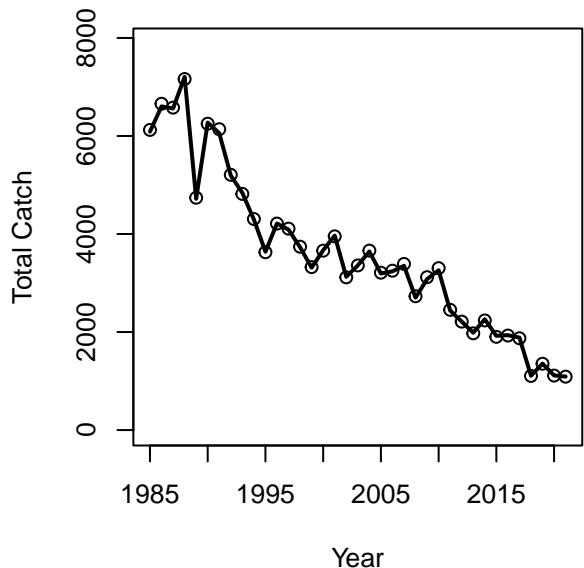
- ind.total
- Compound YOY
- NJ Trawl
- CT Trawl
- DSIGN
- SEAMAP
- NEAMAP
- MRIP
- Bigelow
- NEFSC Inshore

## Root Mean Square Error for Catch

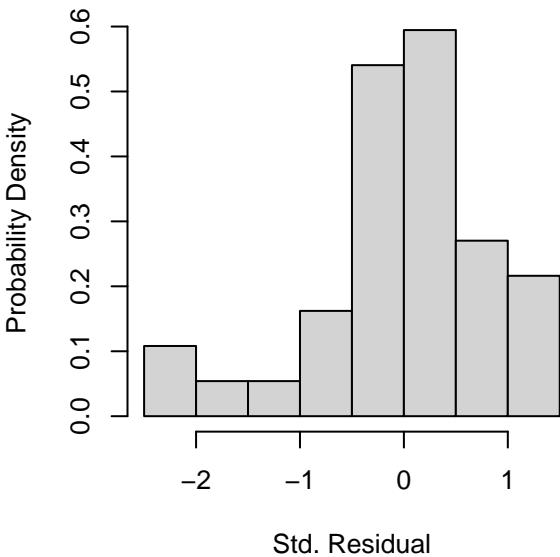
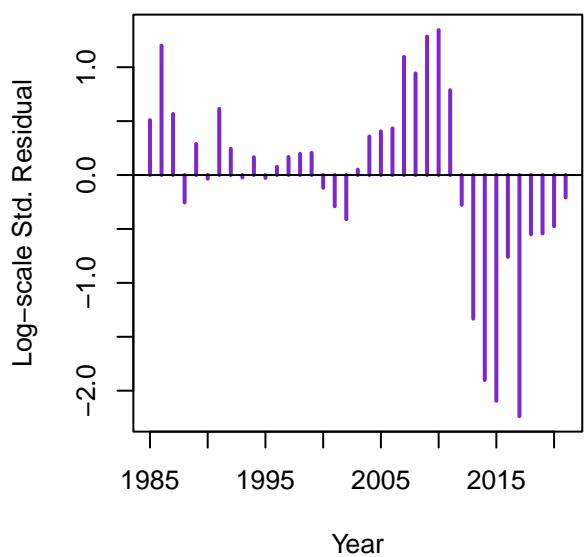
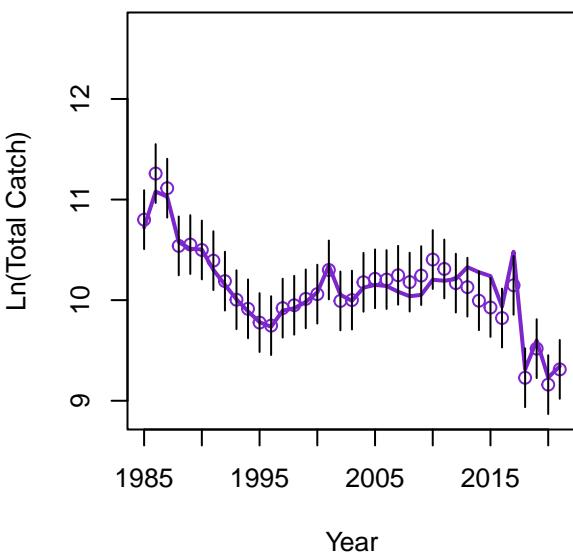
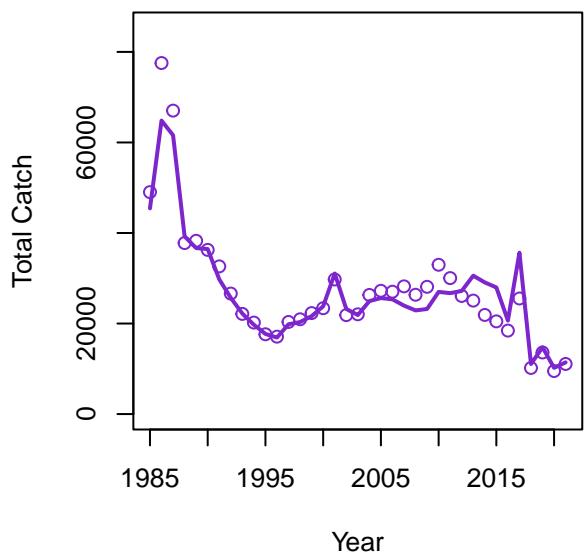


⊕ catch.tot  
○ catch.fleet2  
○ catch.fleet1

### Fleet 1 Catch (Comm)



## Fleet 2 Catch (Rec)



Fleet 1  
Comm  
↓

**Catch**  
**Year = 1989**

**Year = 1985**

**Year = 1986**

**Year = 1987**

**Year = 1988**

**Year = 1990**

**Year = 1991**

**Year = 1992**

**Year = 1993**

**Year = 1995**

**Year = 1996**

**Year = 1997**

**Year = 1998**

**Year = 1994**

Proportion at Age

Age

Age

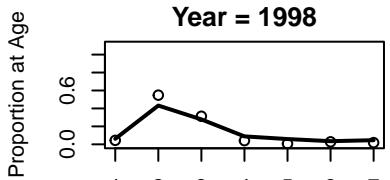
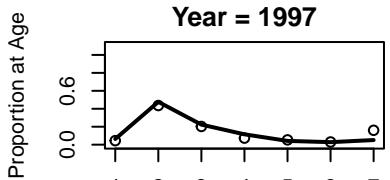
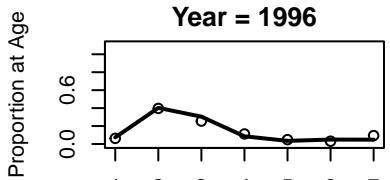
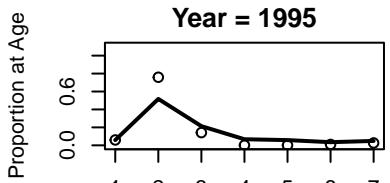
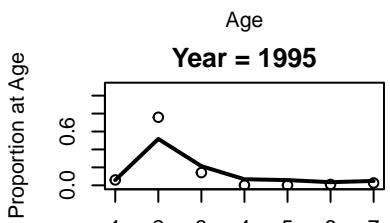
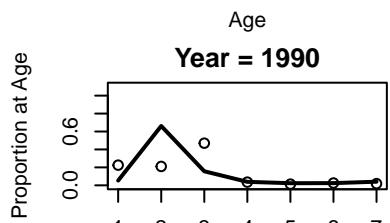
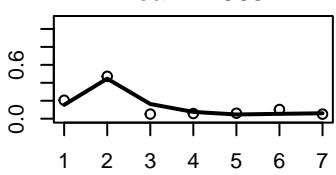
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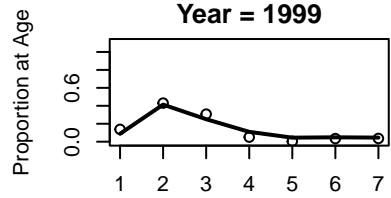
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Age

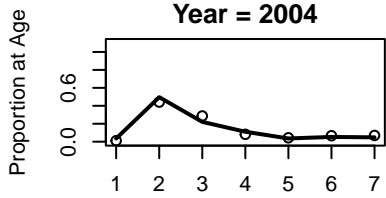
Age

Age

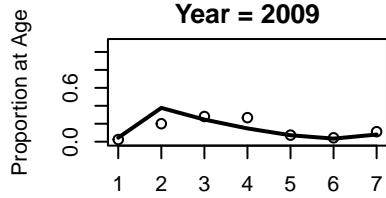




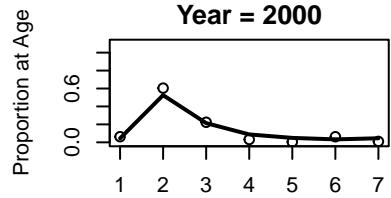
**Year = 1999**



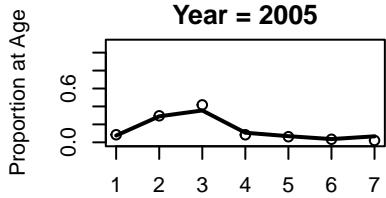
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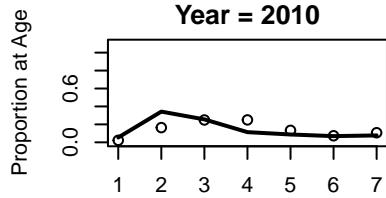
**Year = 2009**



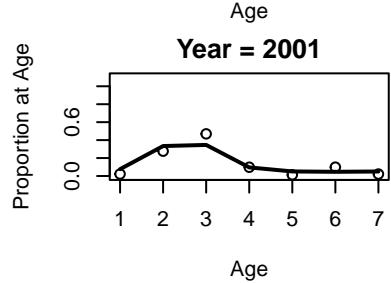
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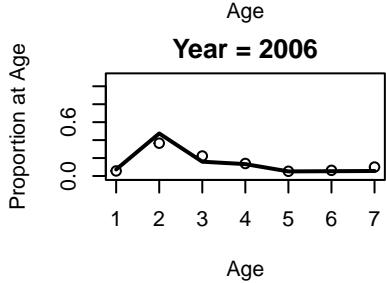
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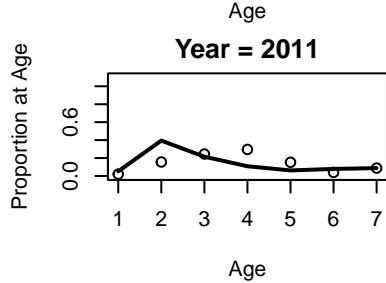
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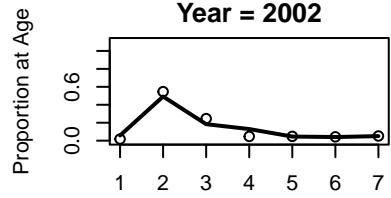
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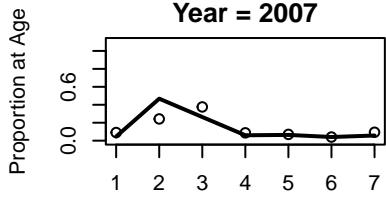
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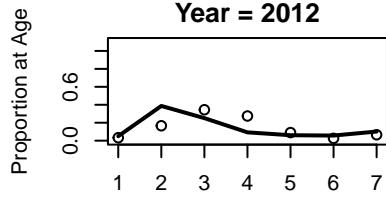
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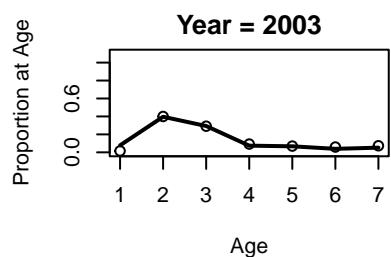
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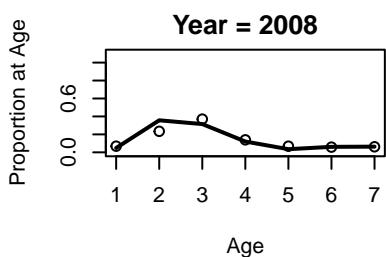
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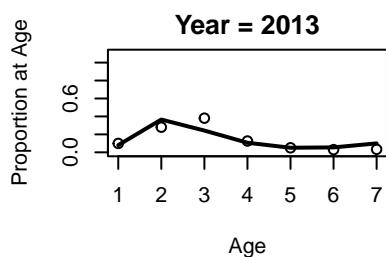
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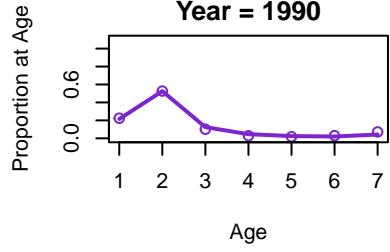
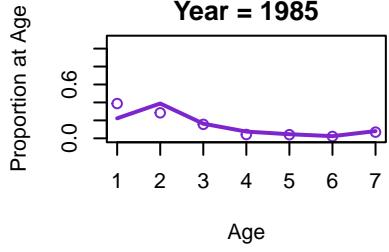
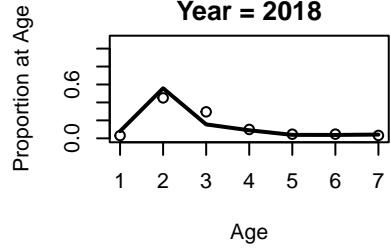
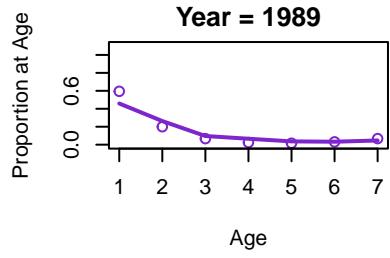
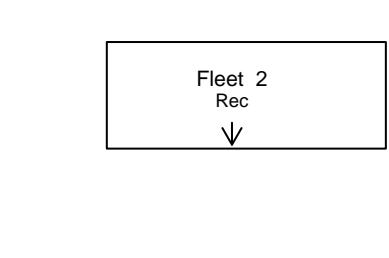
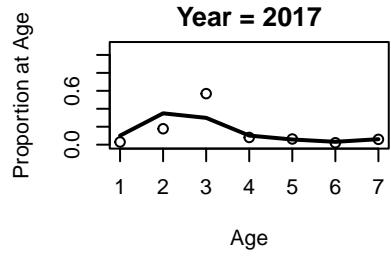
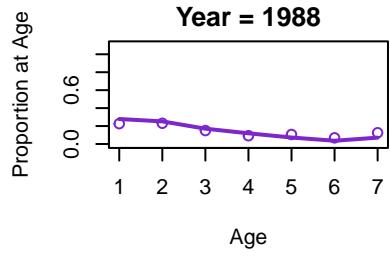
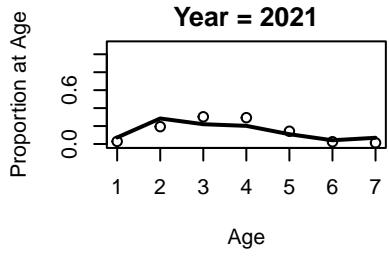
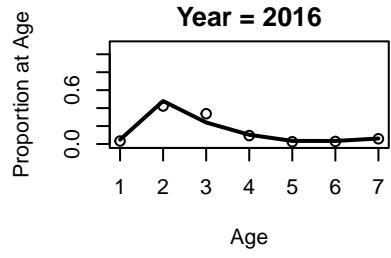
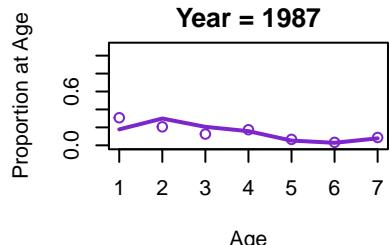
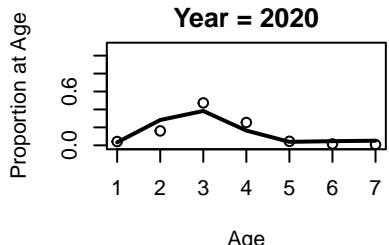
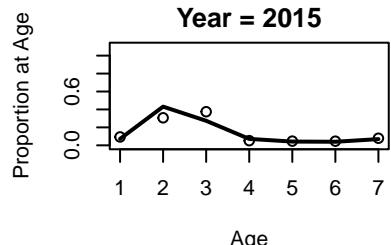
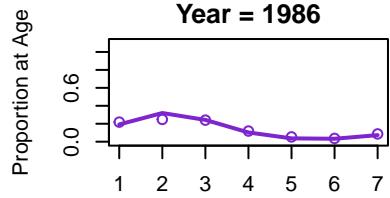
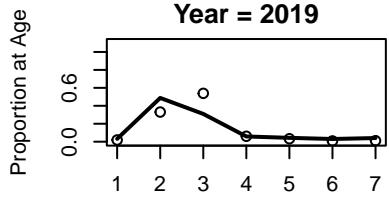
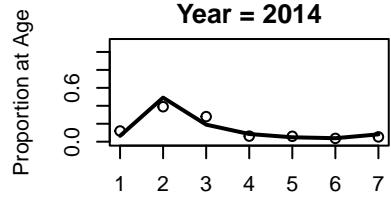
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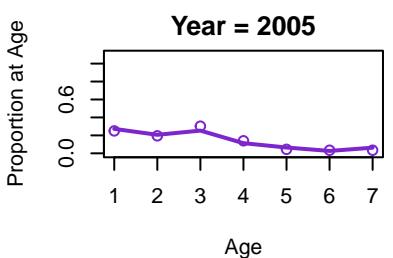
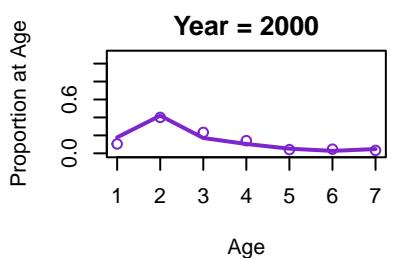
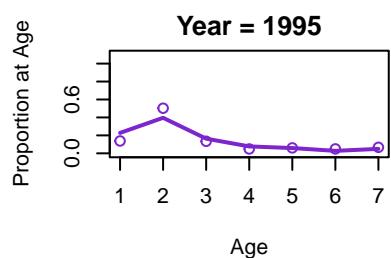
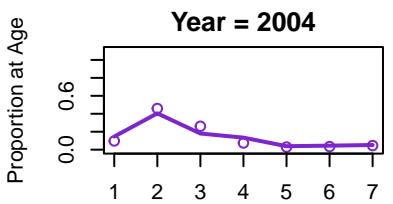
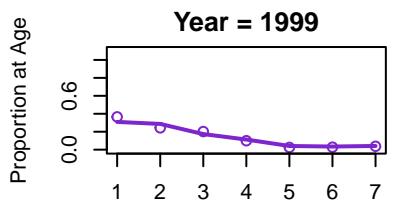
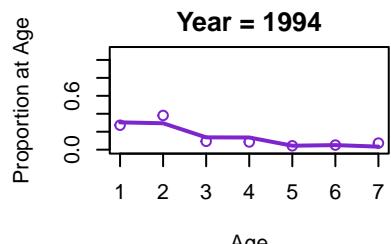
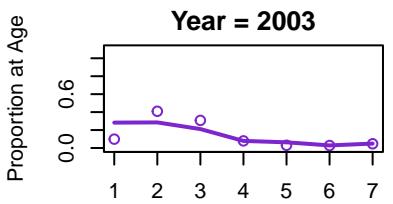
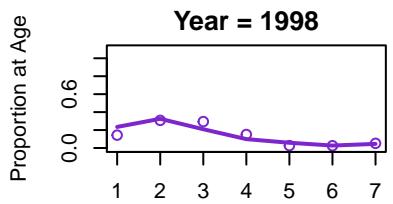
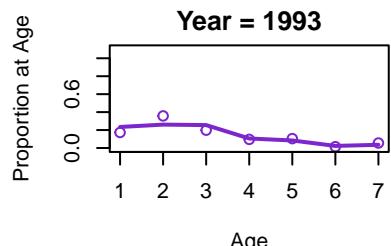
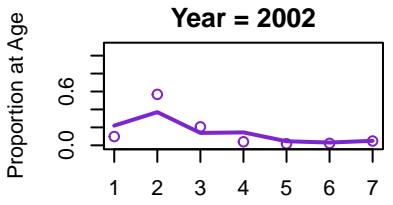
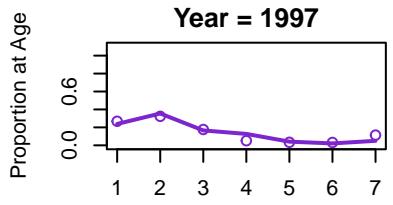
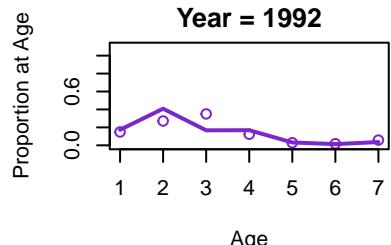
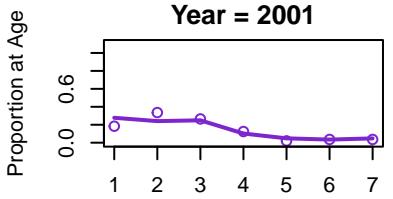
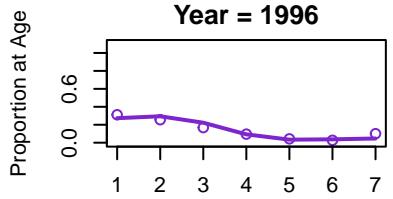
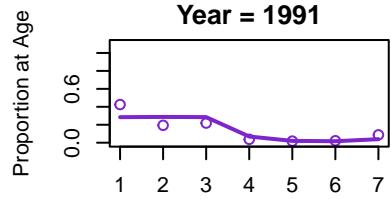


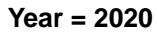
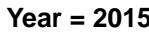
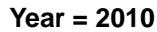
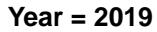
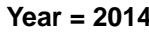
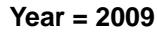
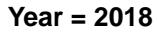
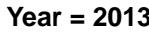
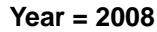
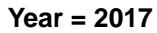
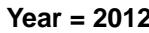
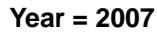
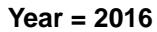
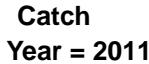
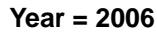
Year = 2008



Year = 2013

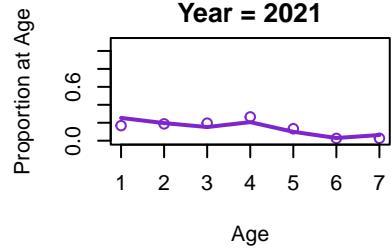




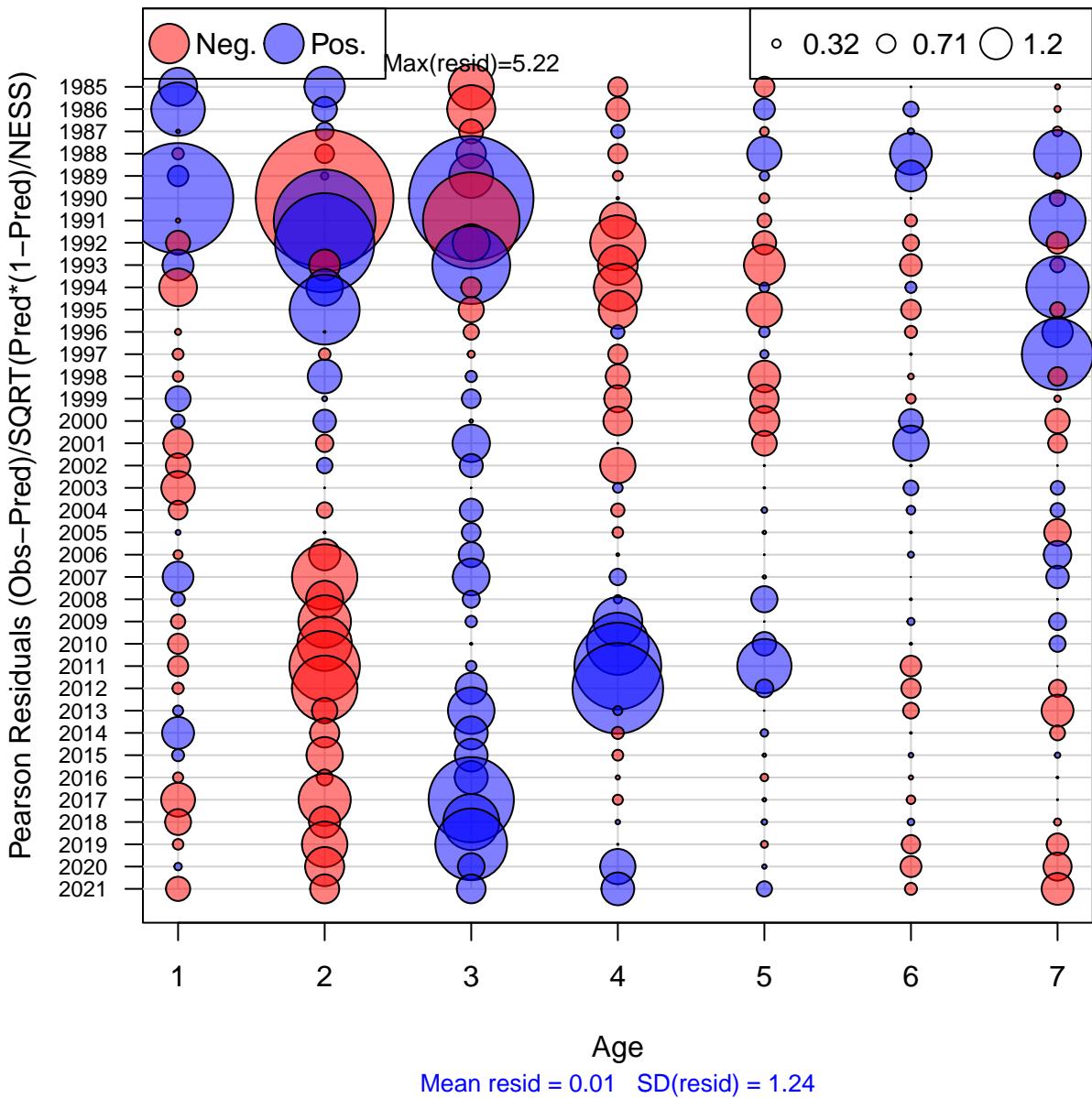


# Catch

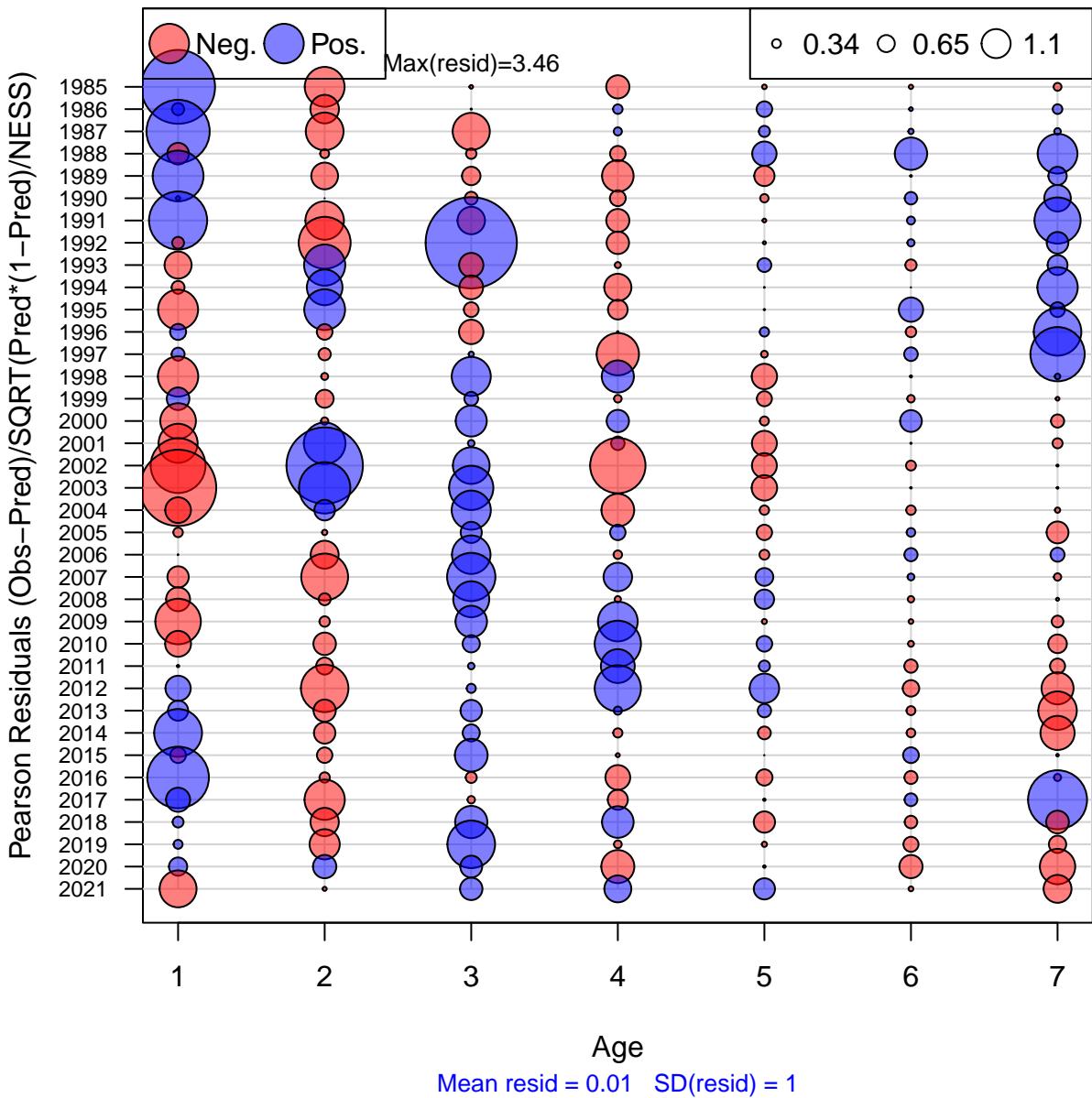
Year = 2021



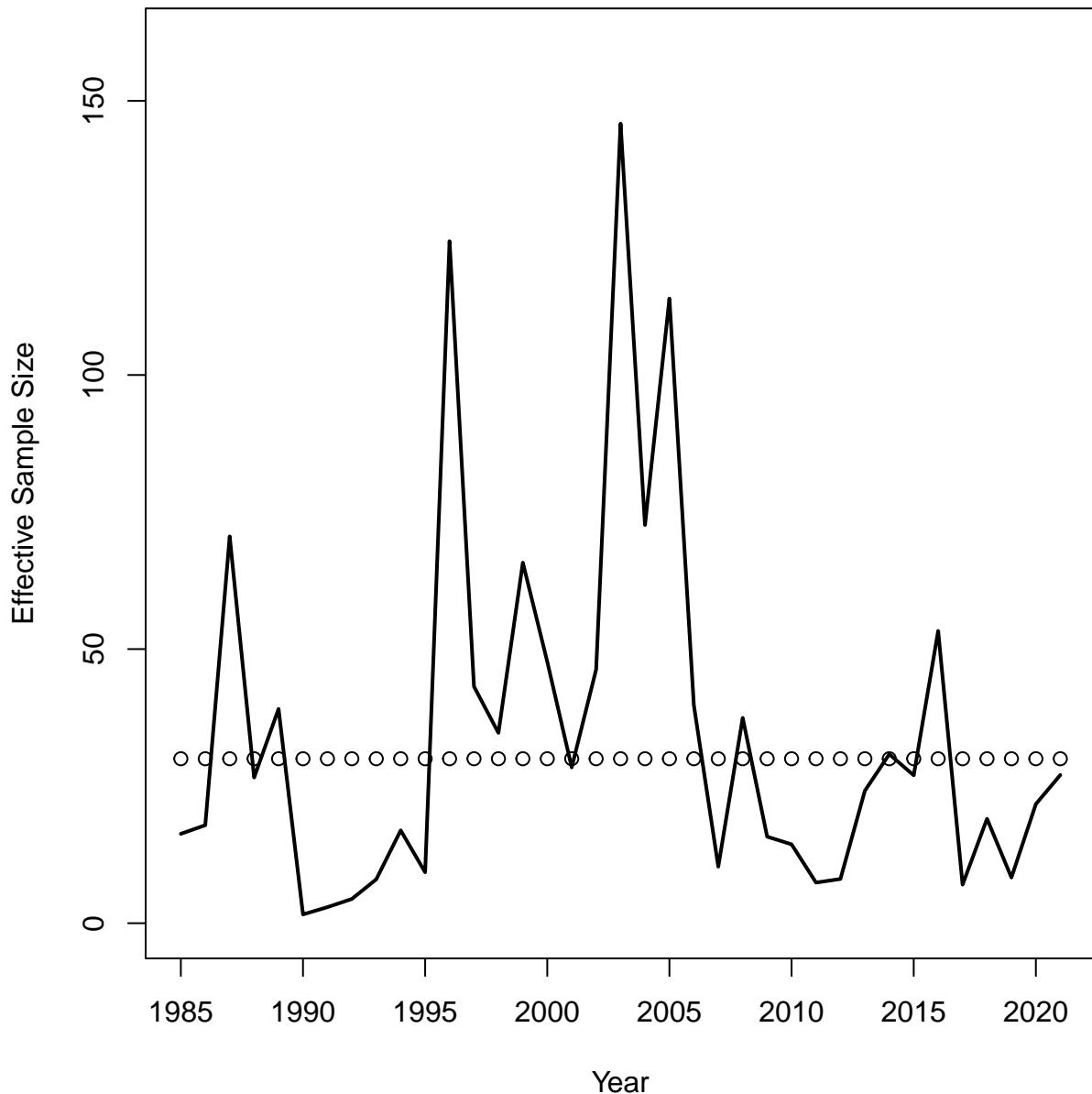
# Age Comp Residuals for Catch by Fleet 1 (Comm)



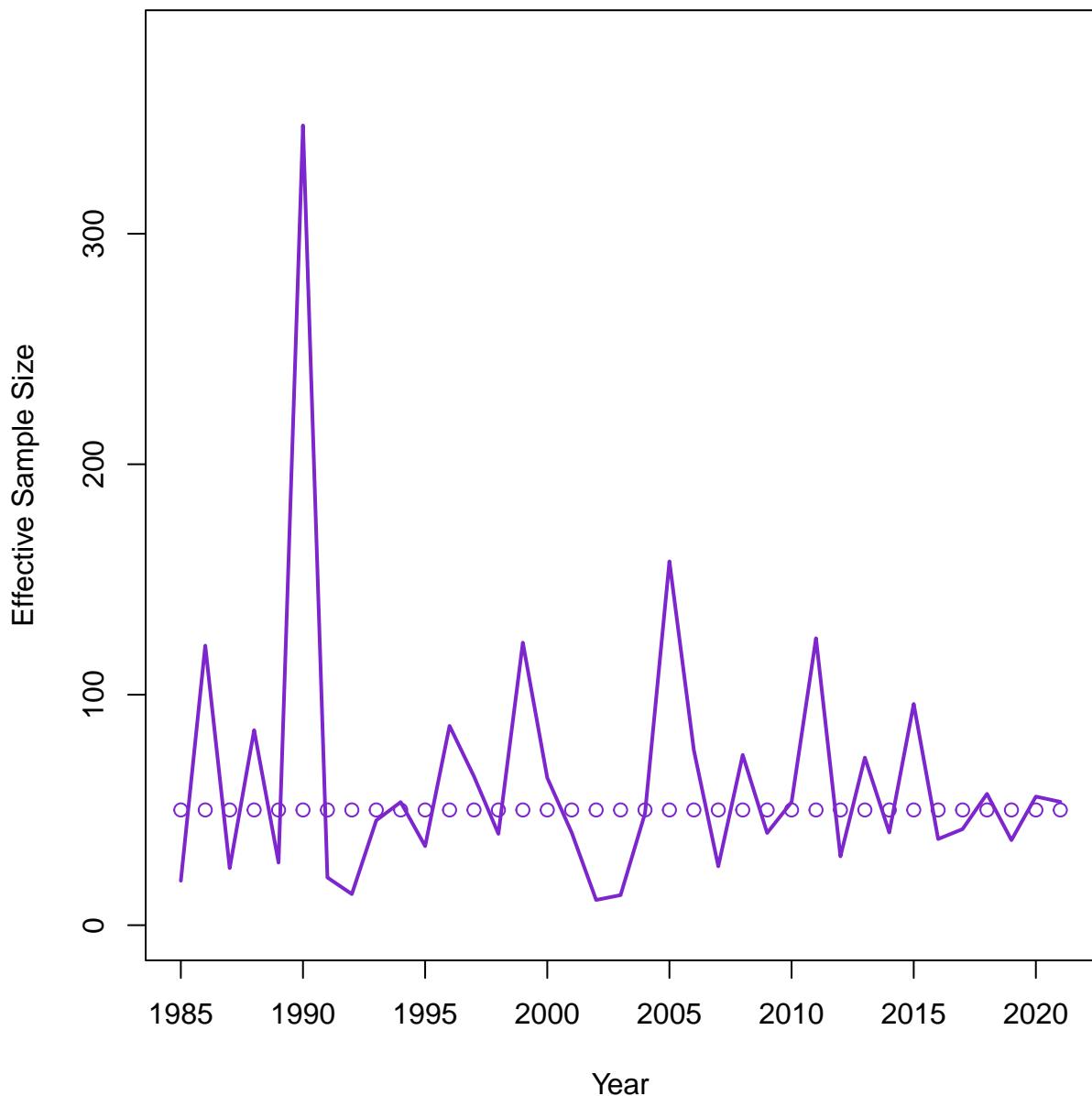
# Age Comp Residuals for Catch by Fleet 2 (Rec)



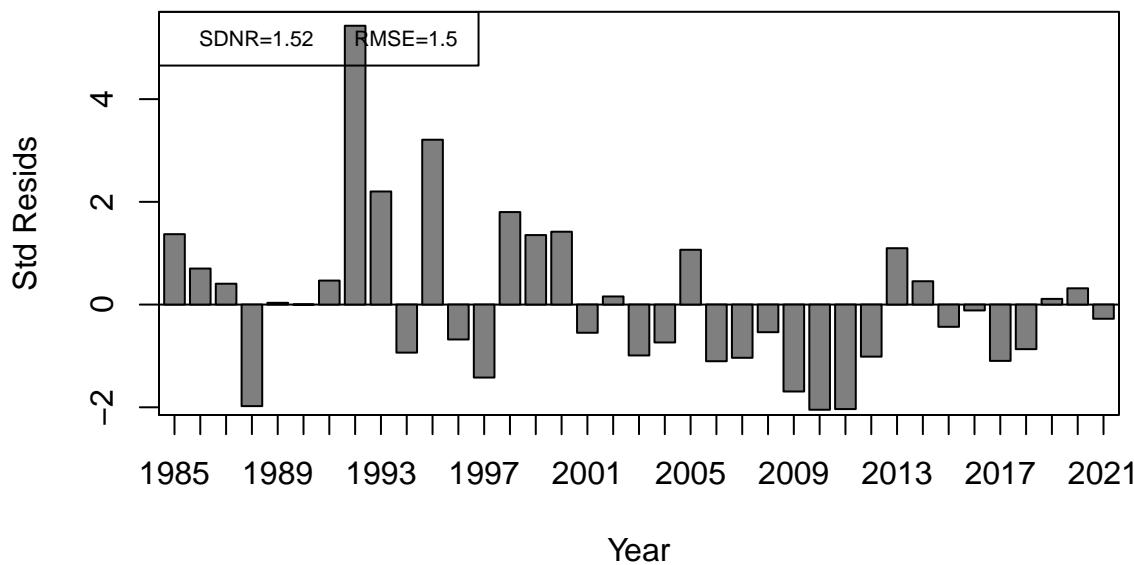
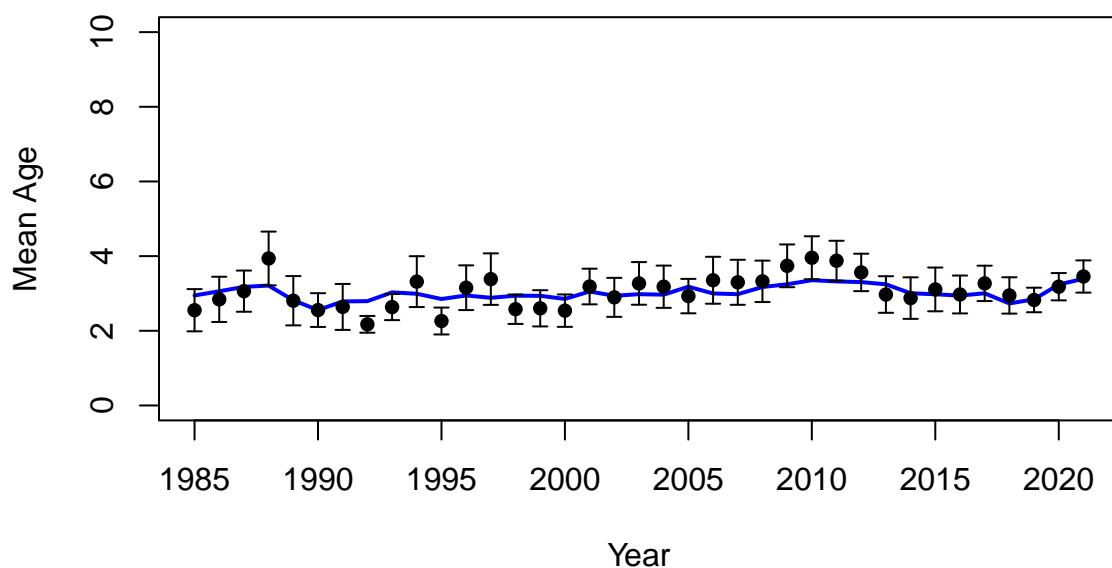
## Catch Neff Fleet 1 (Comm)



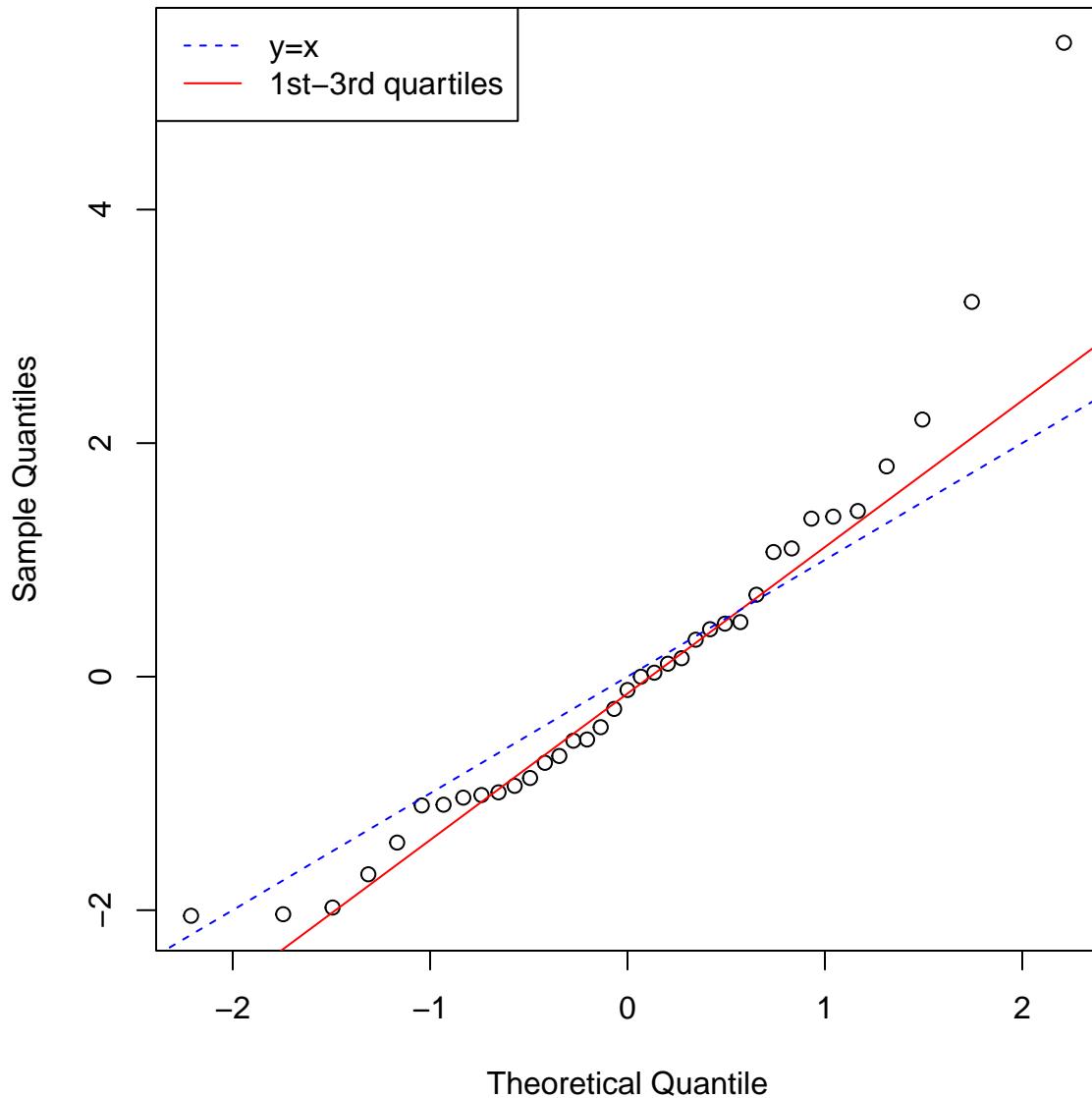
## Catch Neff Fleet 2 (Rec)



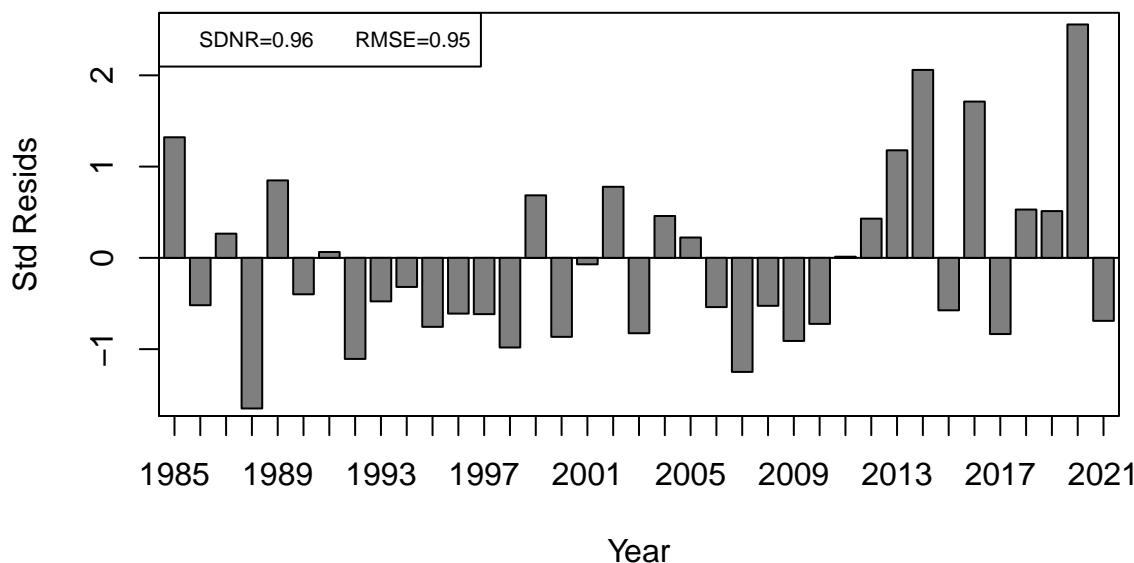
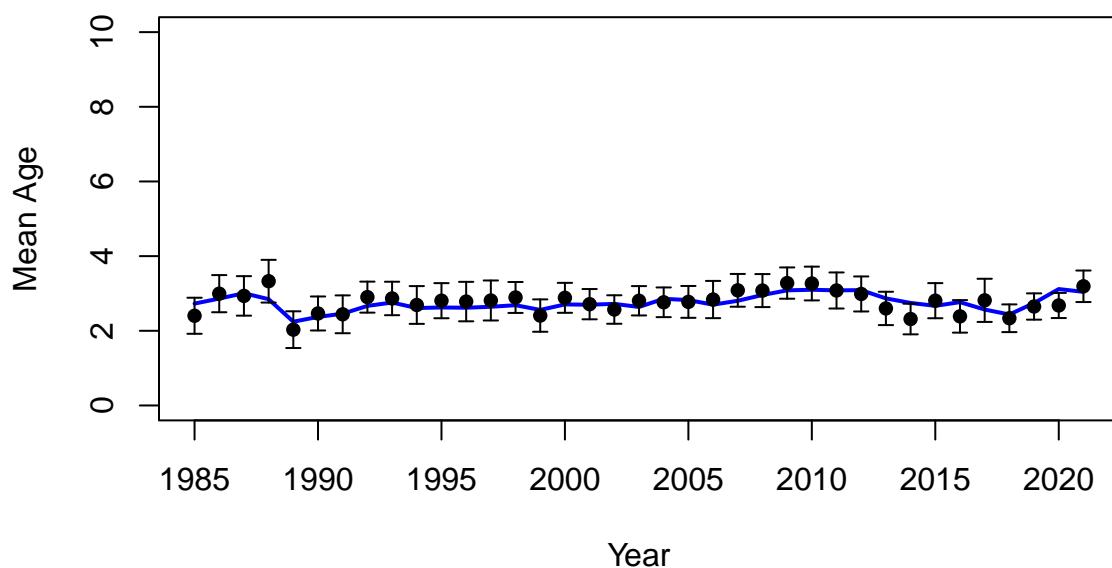
### Catch Fleet 1 (Comm) ESS = 30



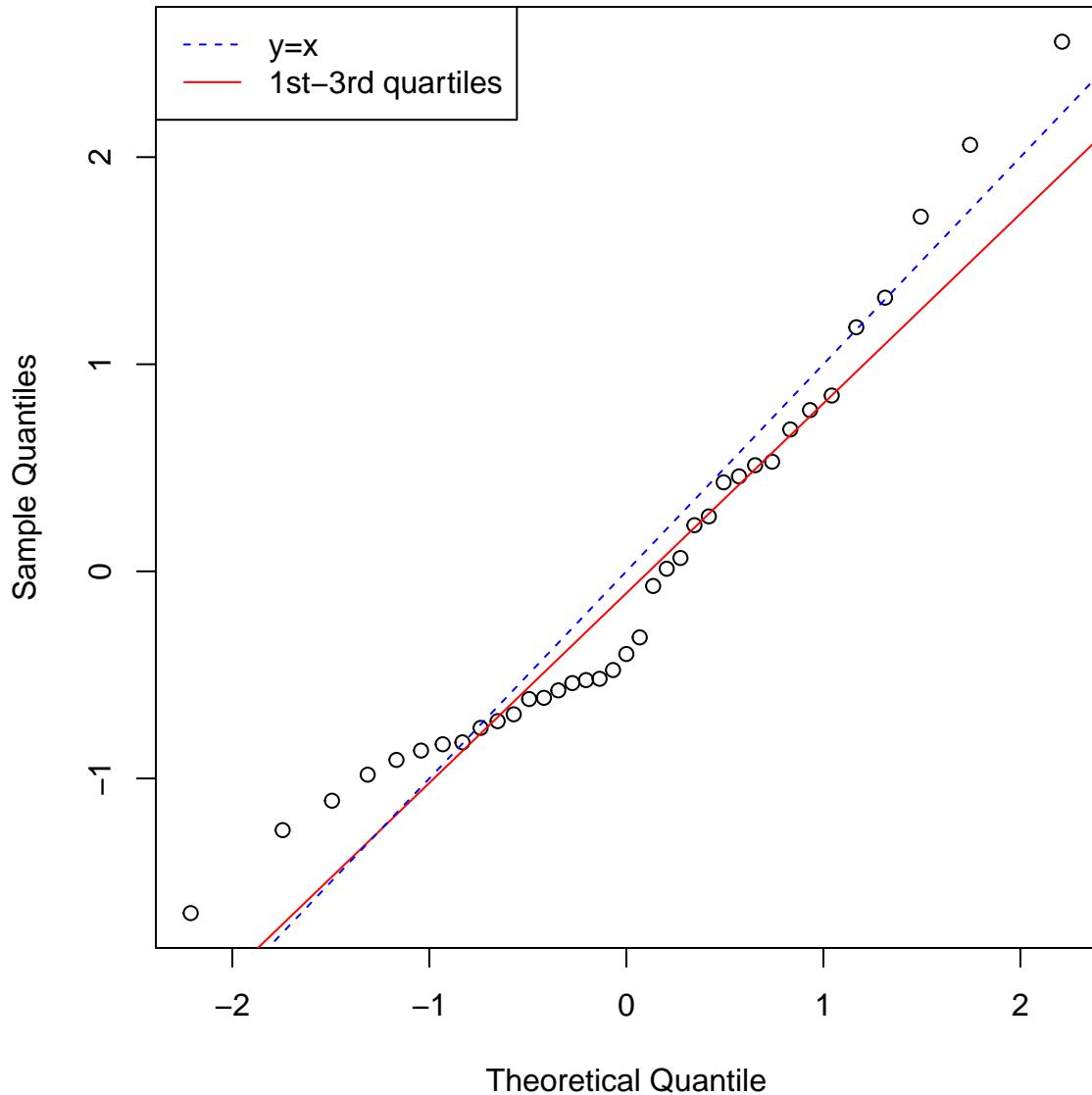
## Catch Fleet 1 (Comm) ESS = 30



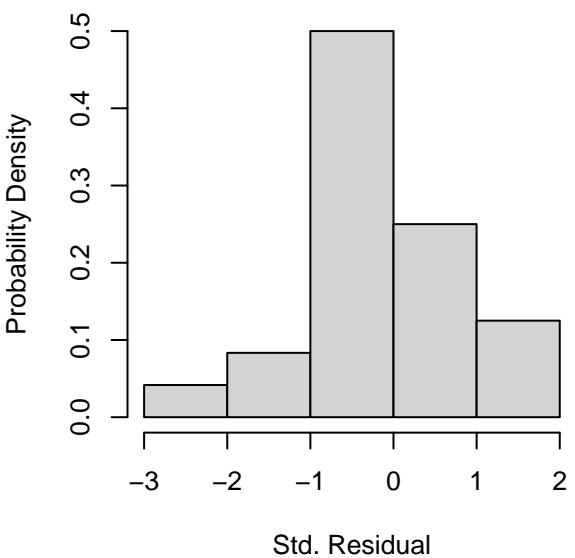
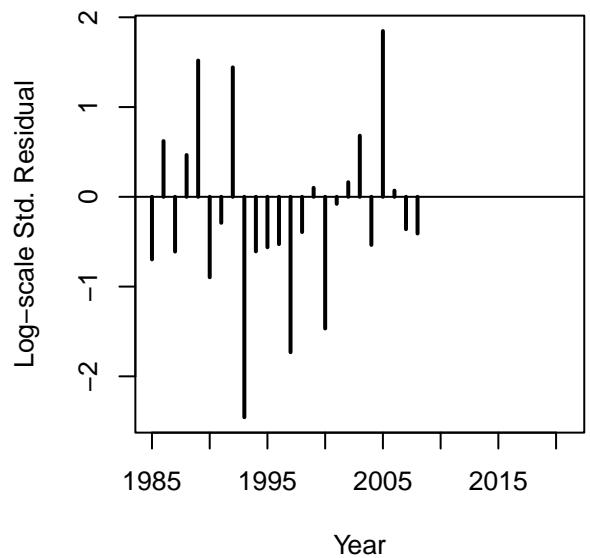
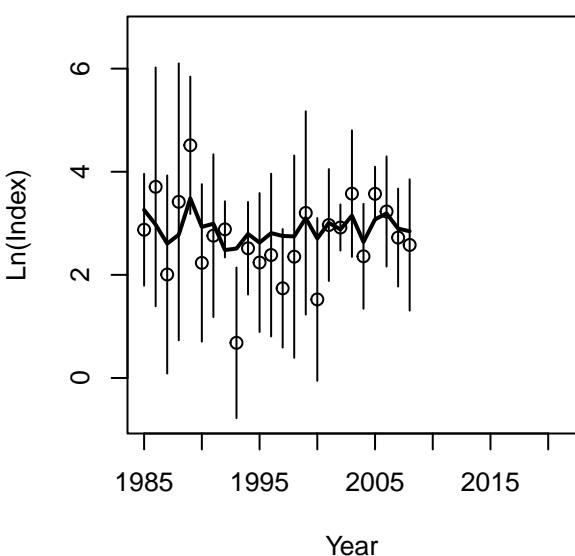
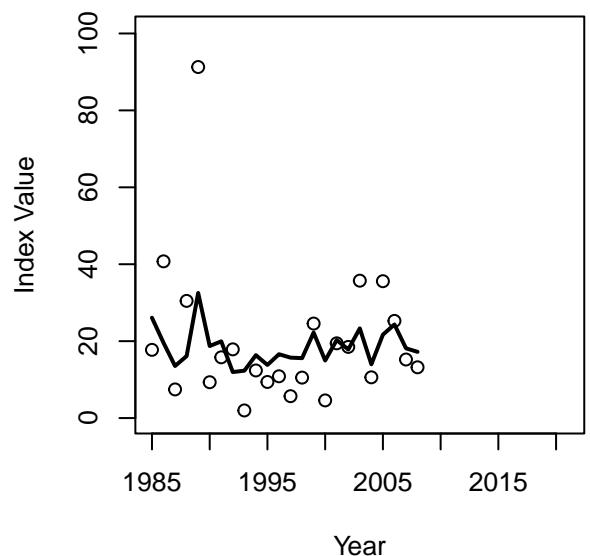
## Catch Fleet 2 (Rec) ESS = 50



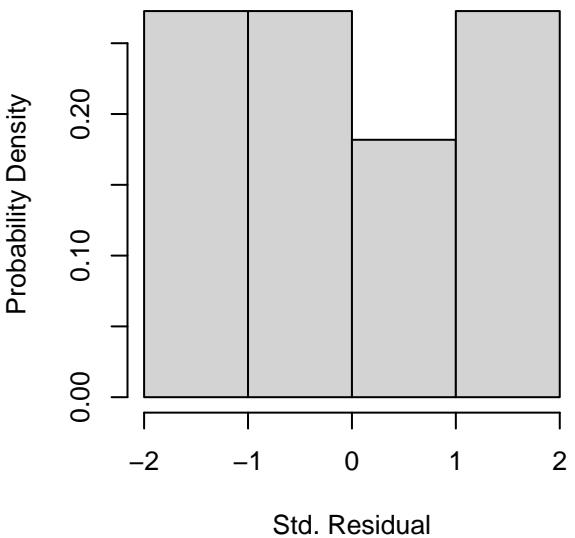
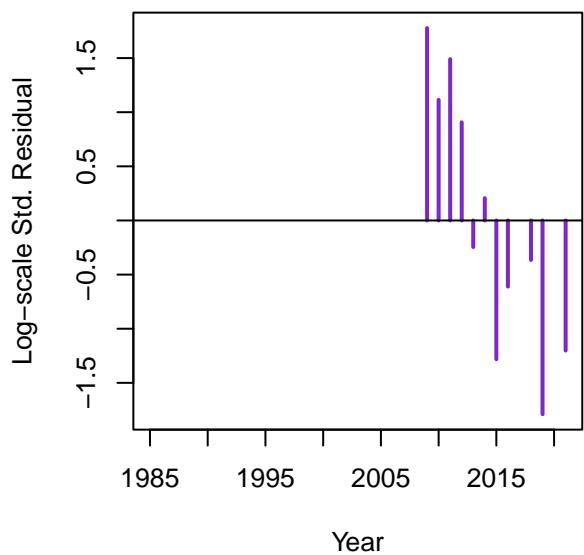
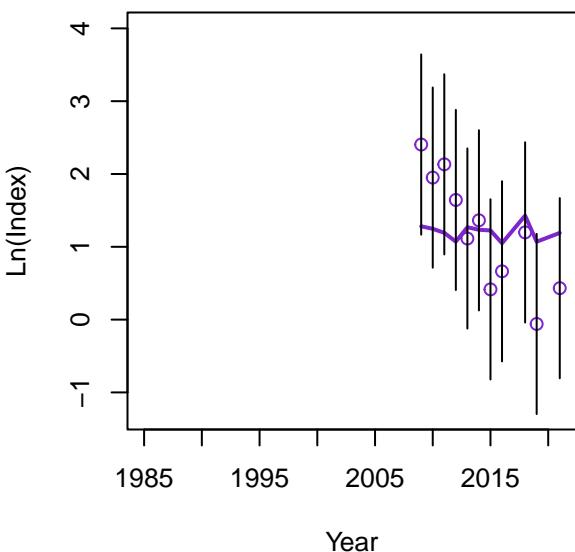
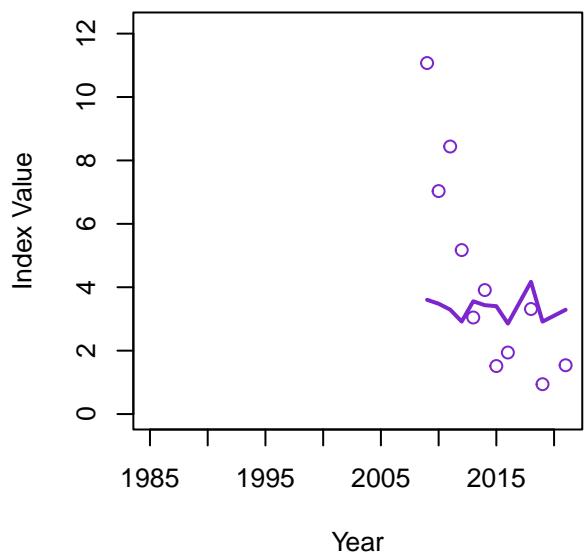
## Catch Fleet 2 (Rec) ESS = 50



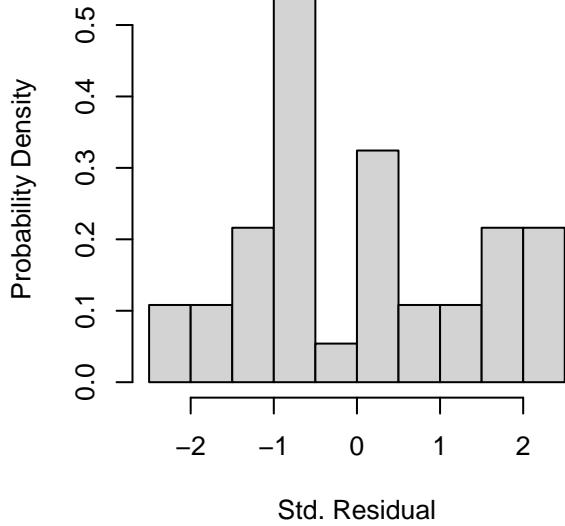
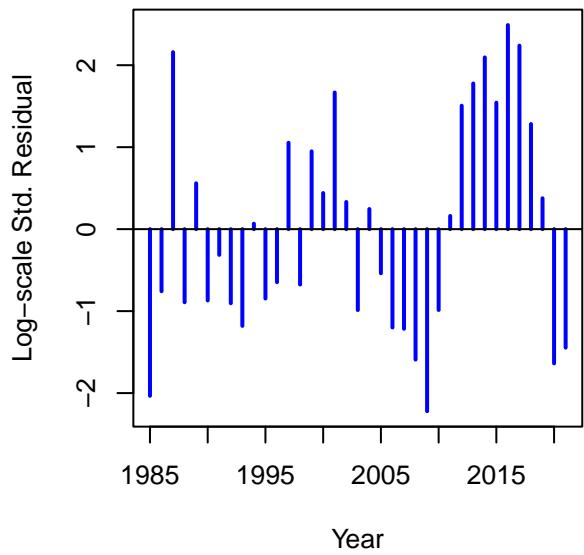
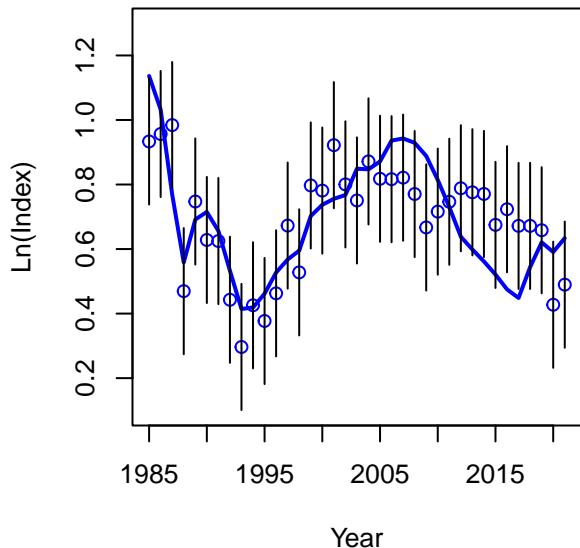
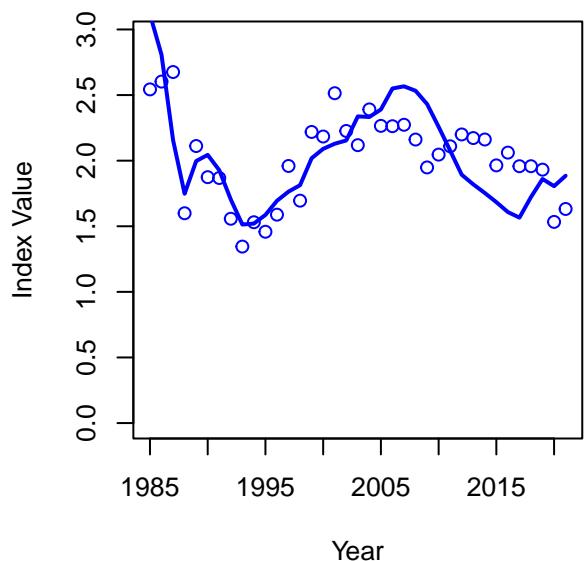
### Index 1 (NEFSC Inshore)



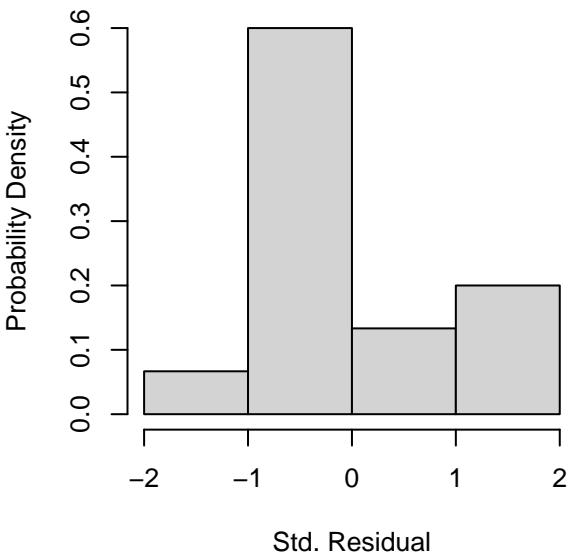
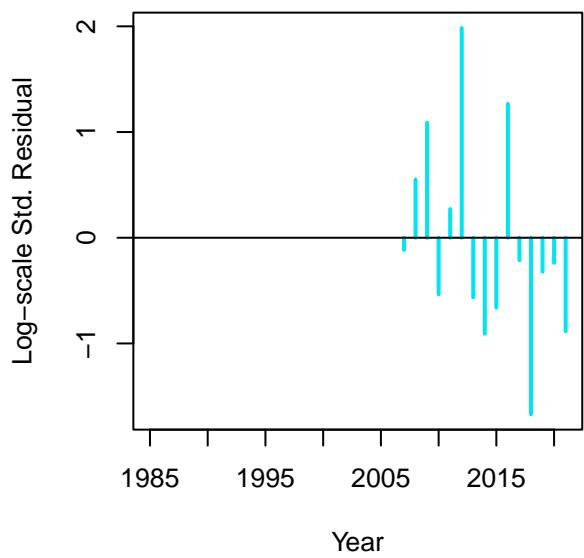
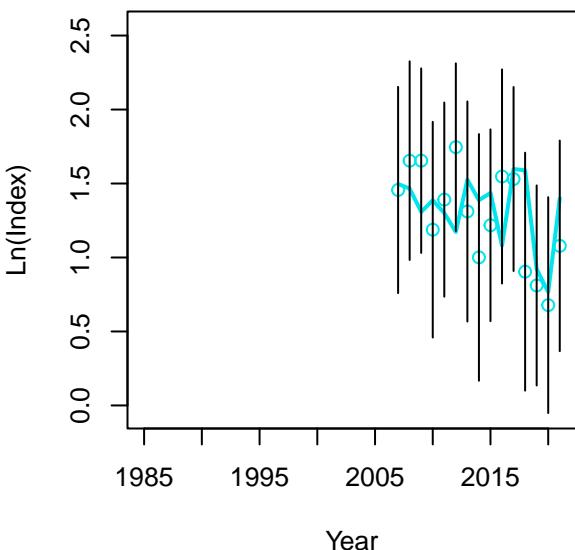
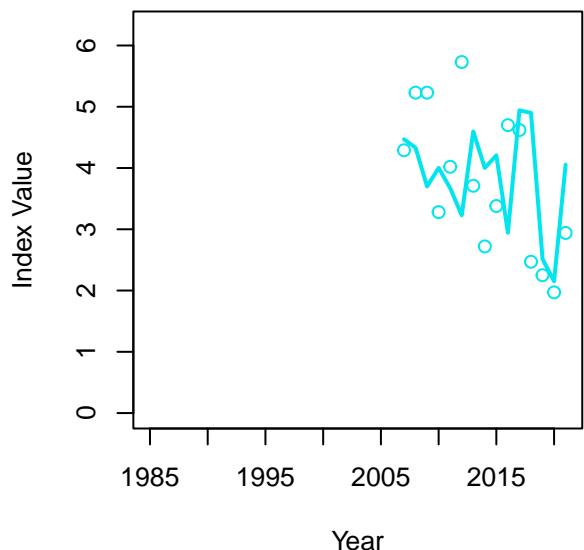
## Index 2 (Bigelow)



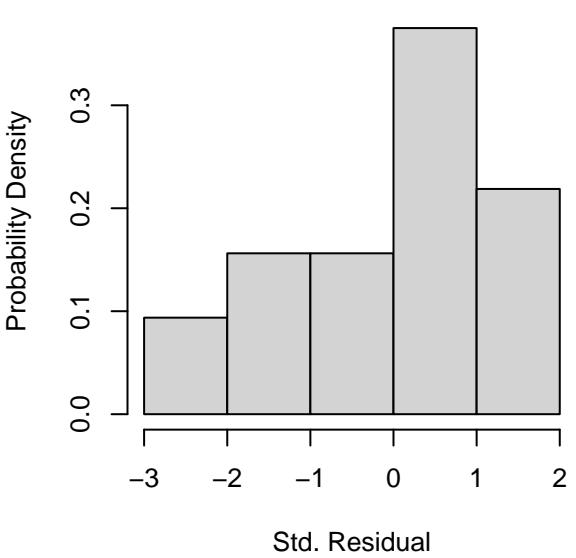
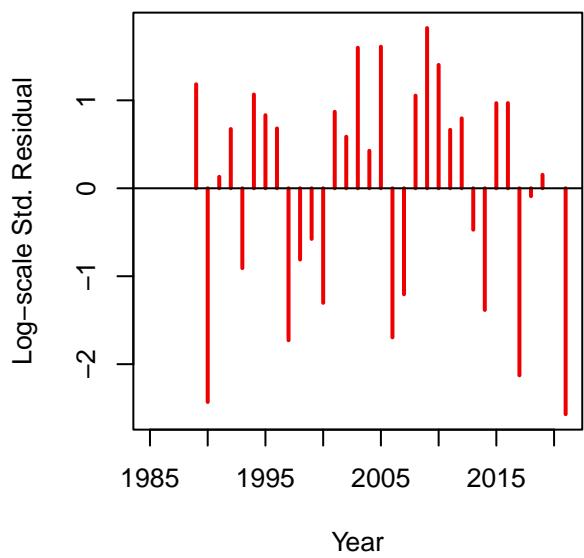
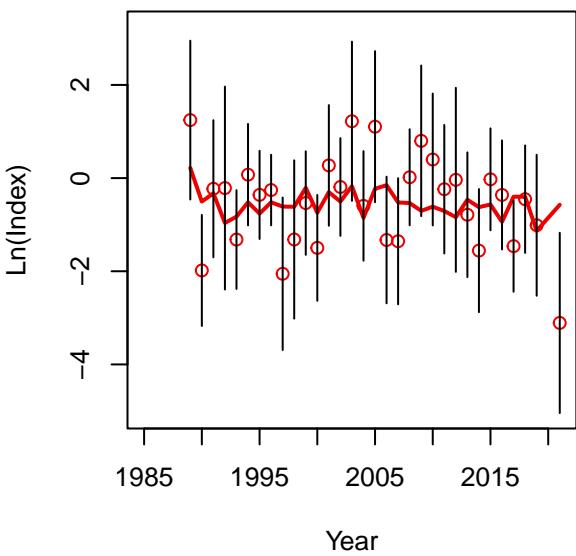
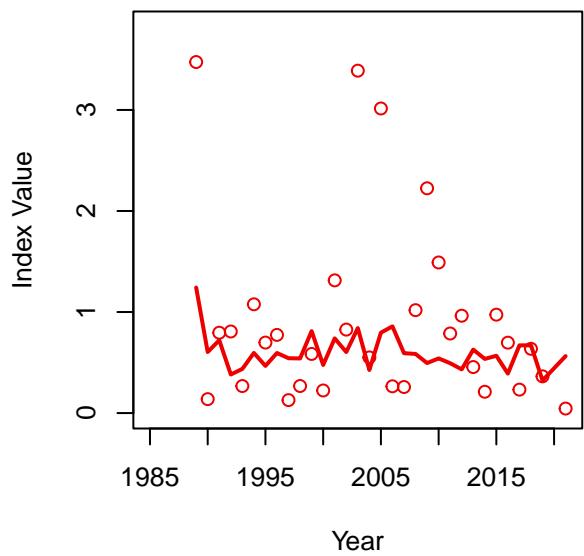
### Index 3 (MRIP)



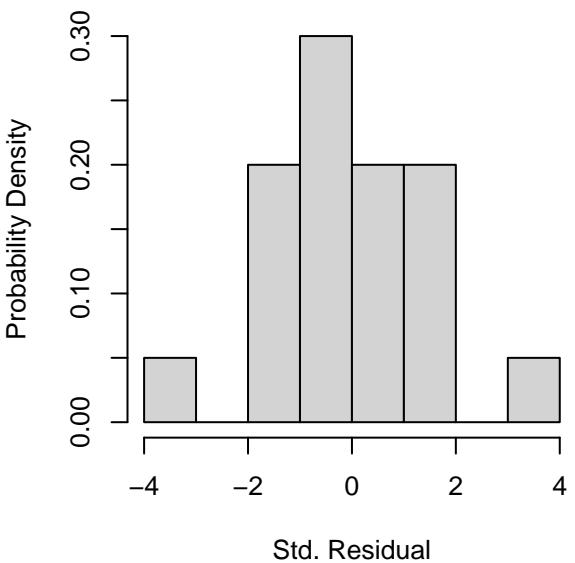
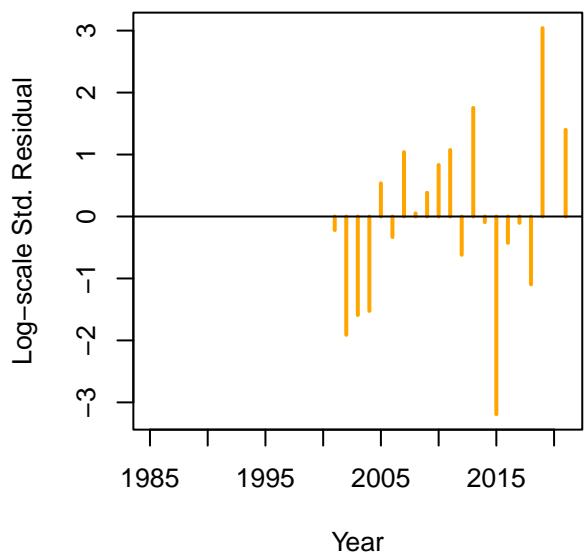
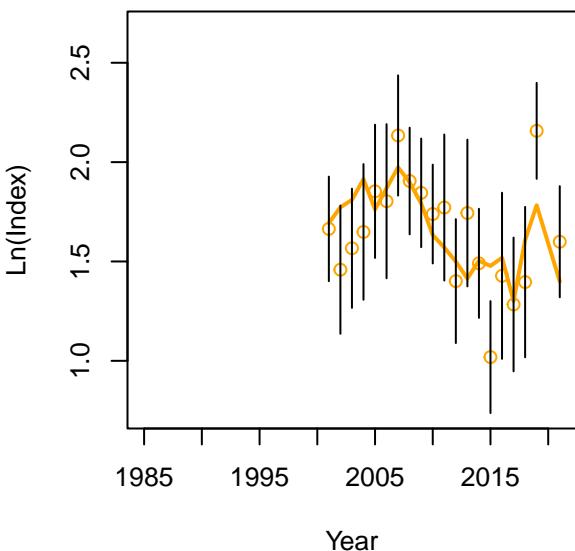
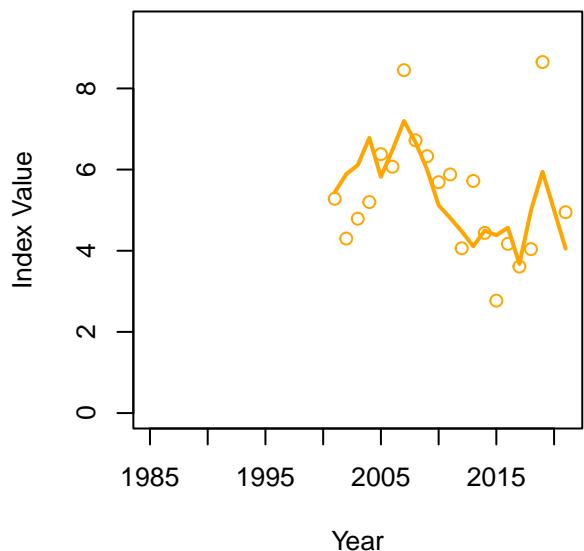
### Index 4 (NEAMAP)



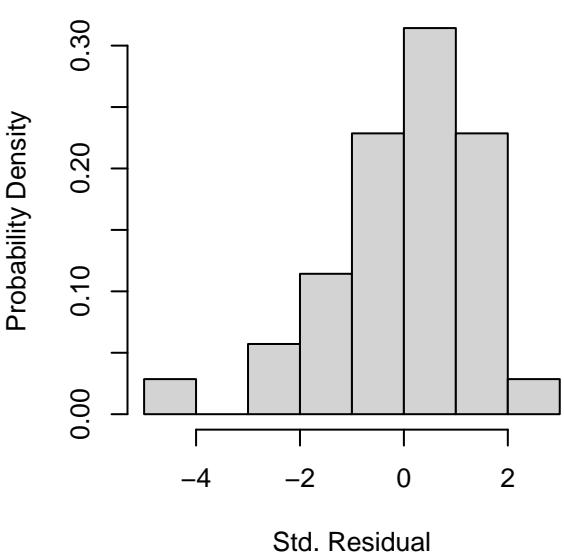
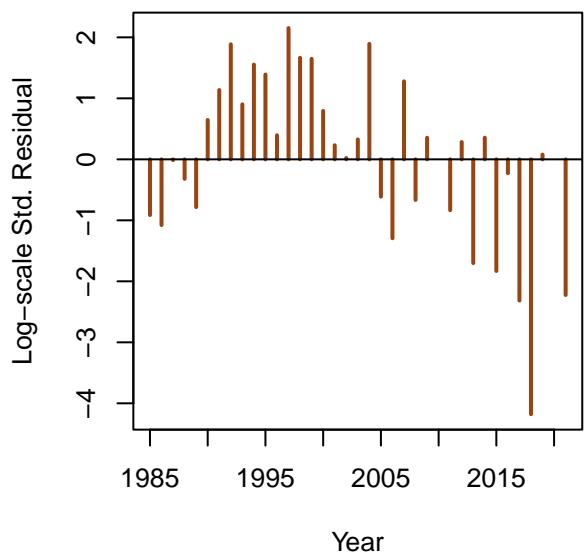
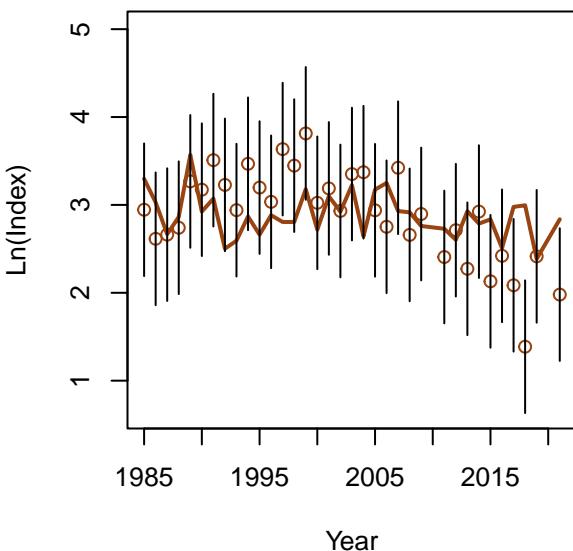
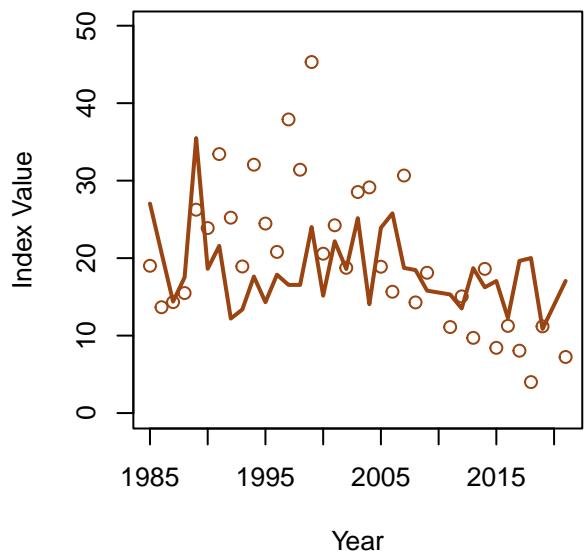
## Index 5 (SEAMAP)



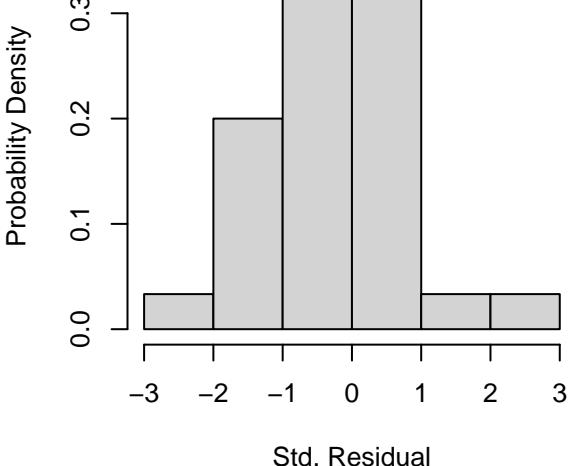
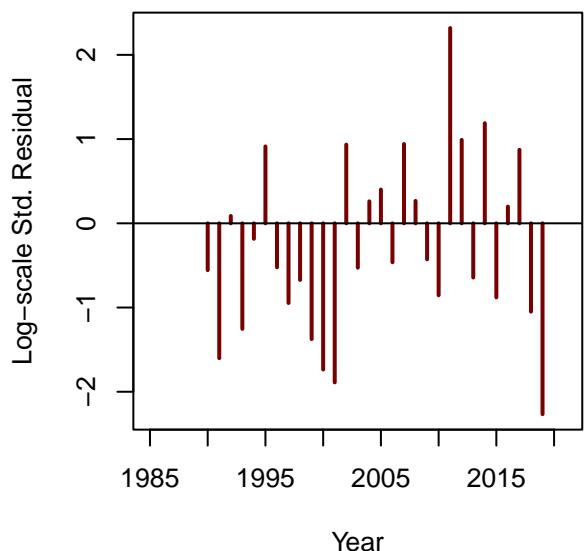
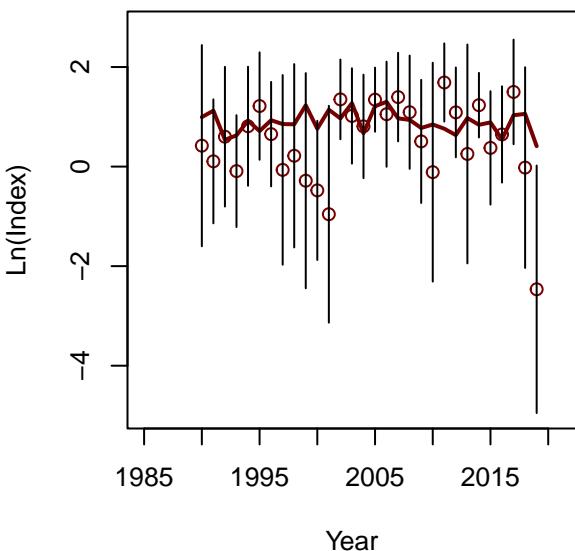
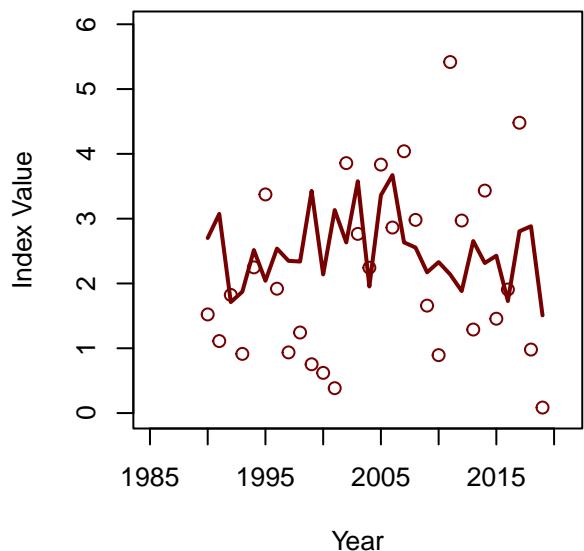
## Index 6 (PSIGN)



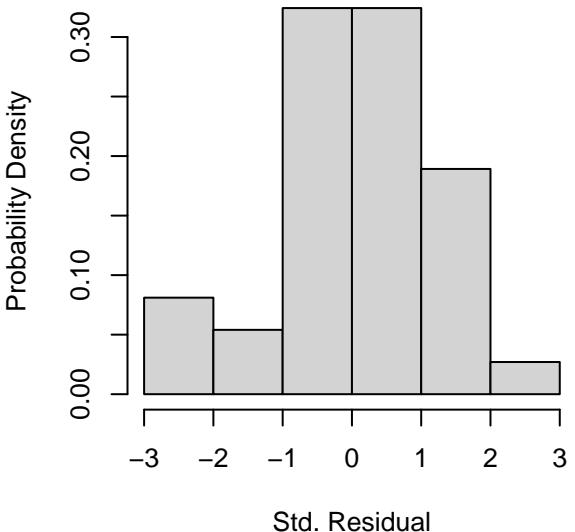
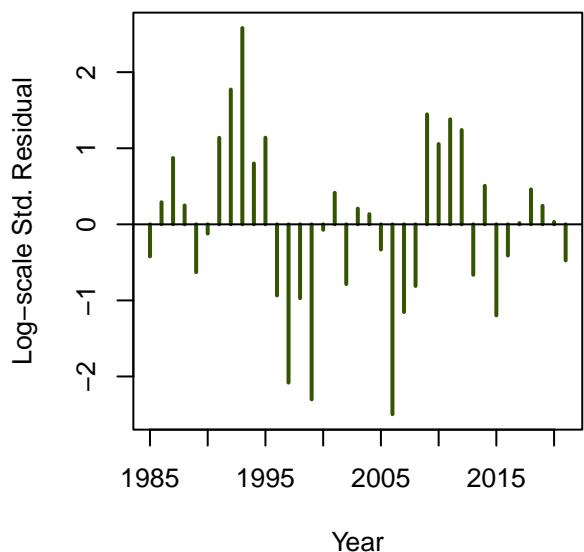
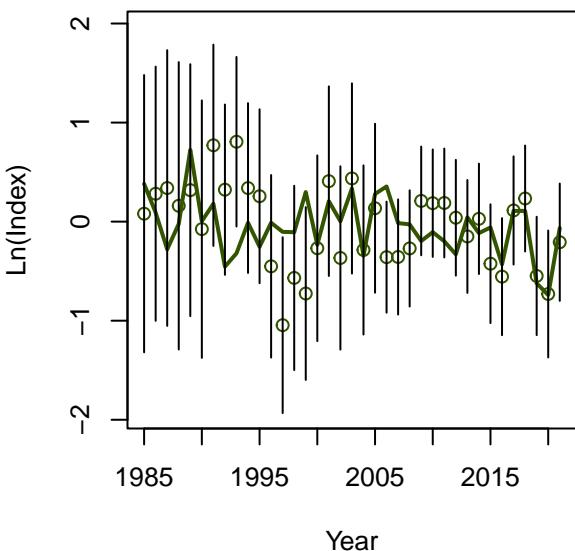
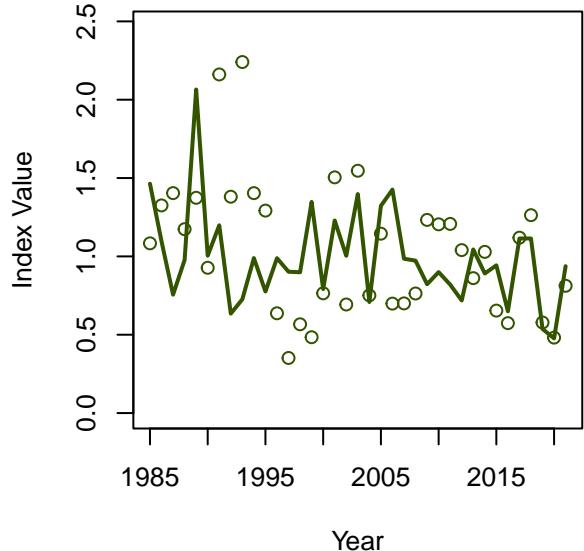
### Index 7 (CT Trawl)



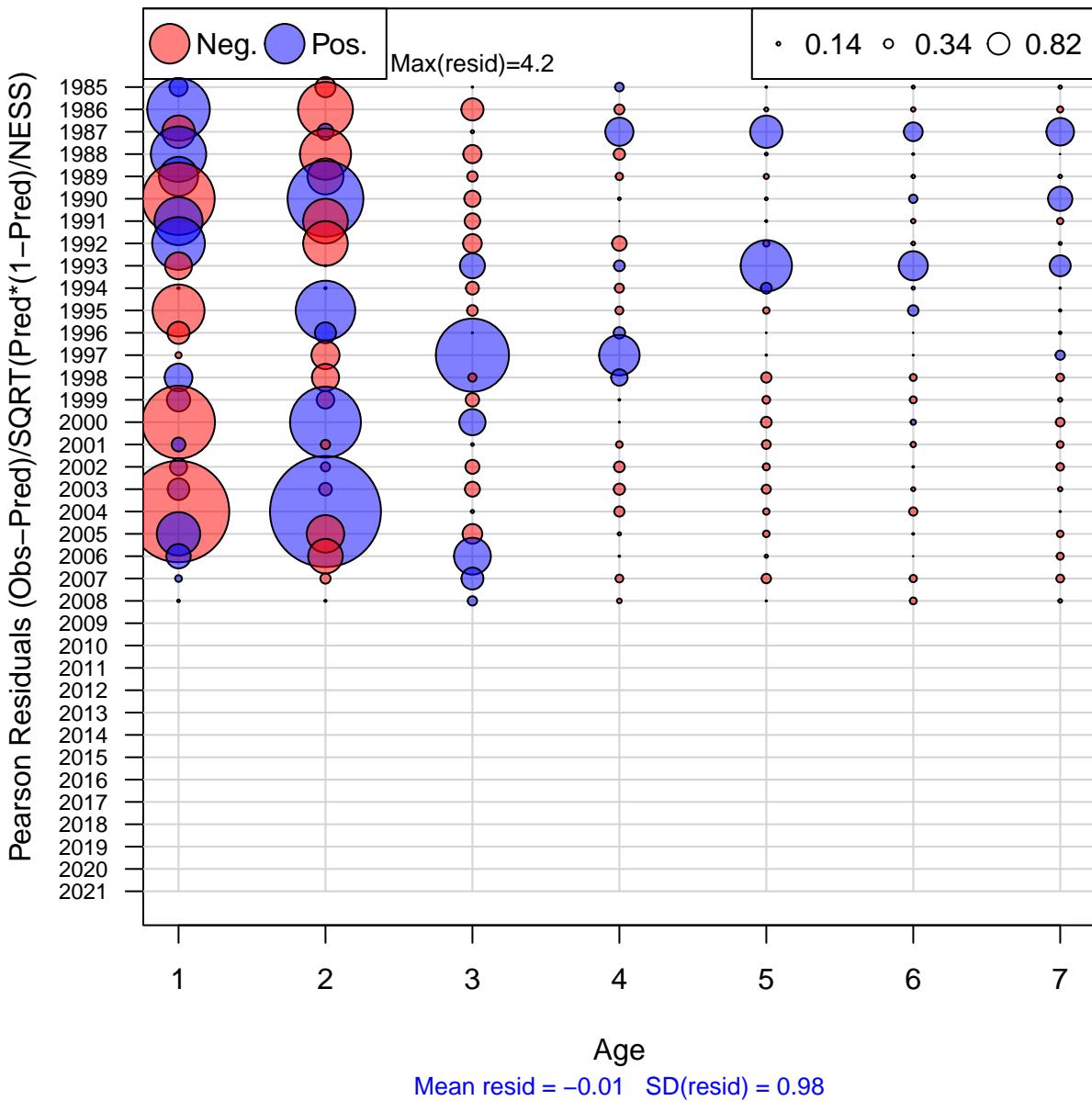
## Index 8 (NJ Trawl)



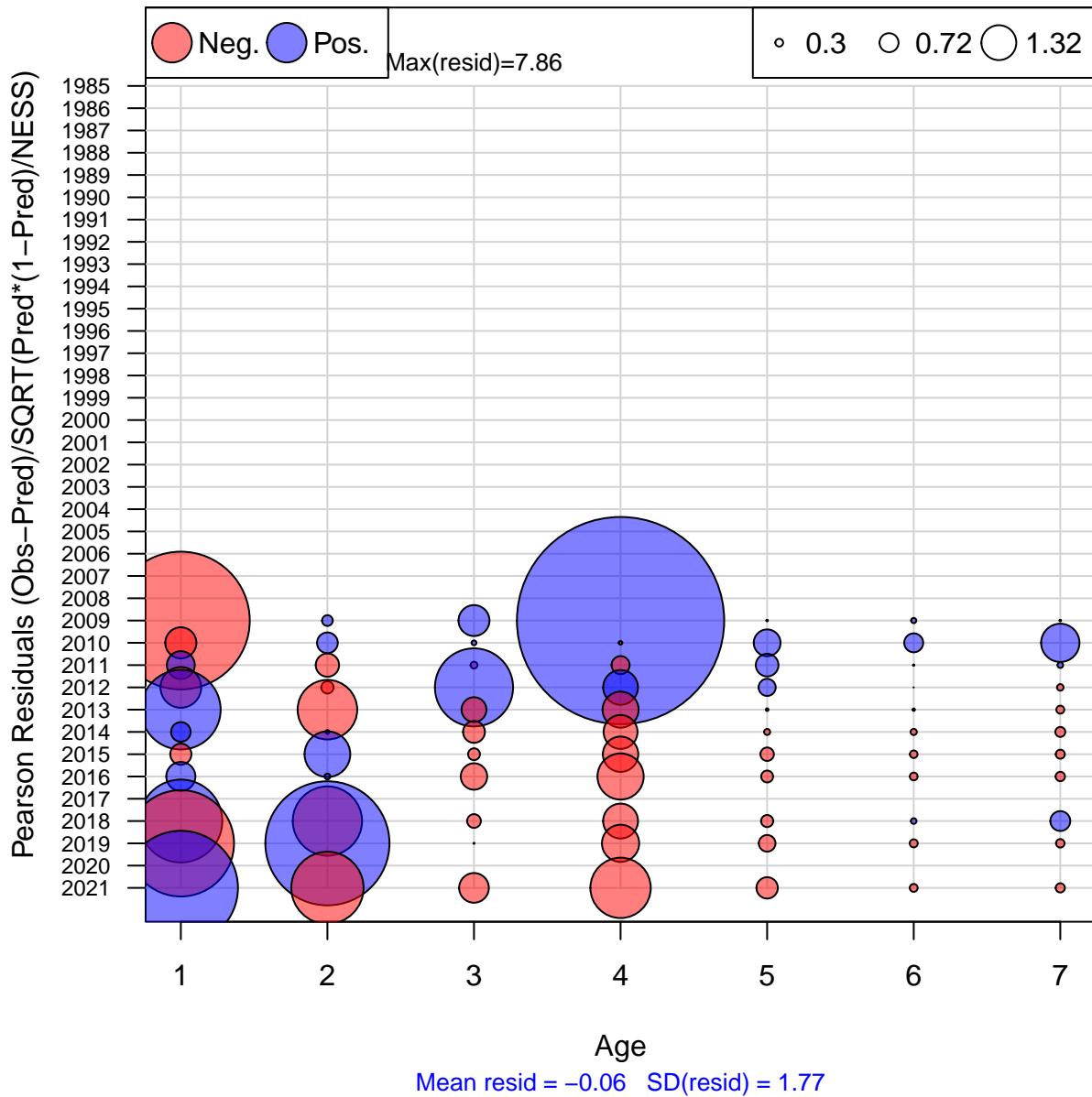
## Index 9 (Compound YOY)



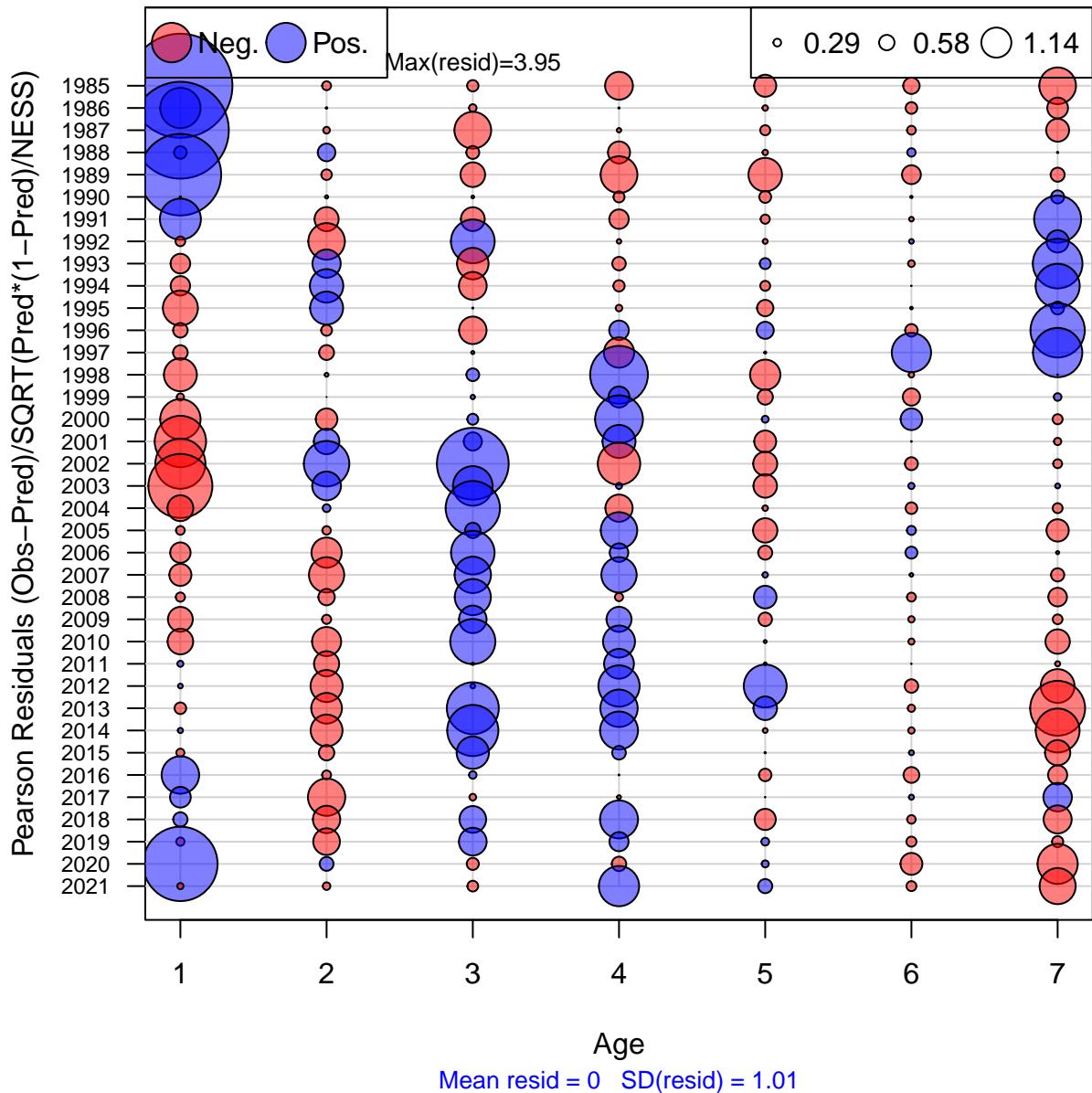
# Age Comp Residuals for Index 1 (NEFSC Inshore)



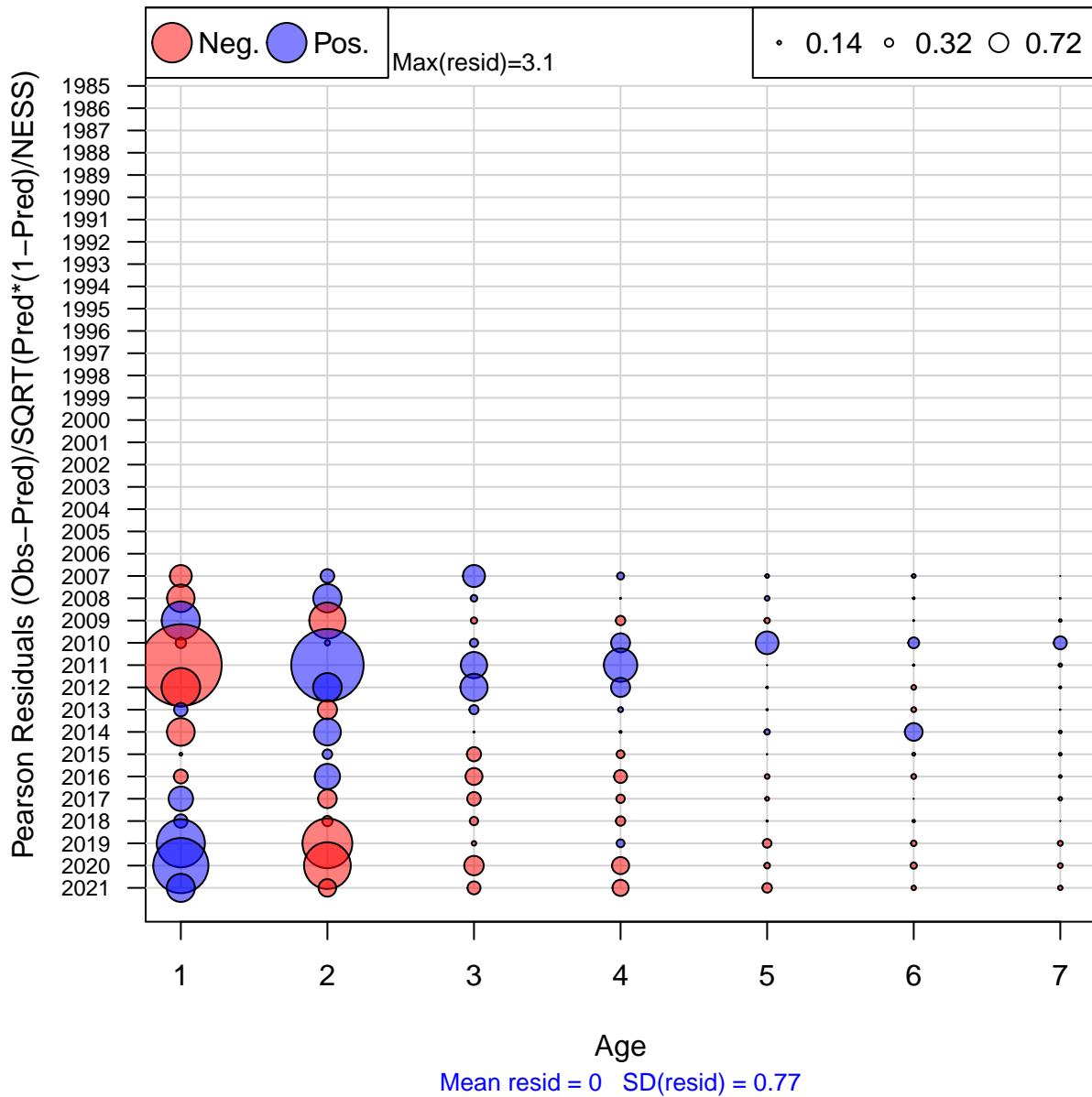
## Age Comp Residuals for Index 2 (Bigelow)



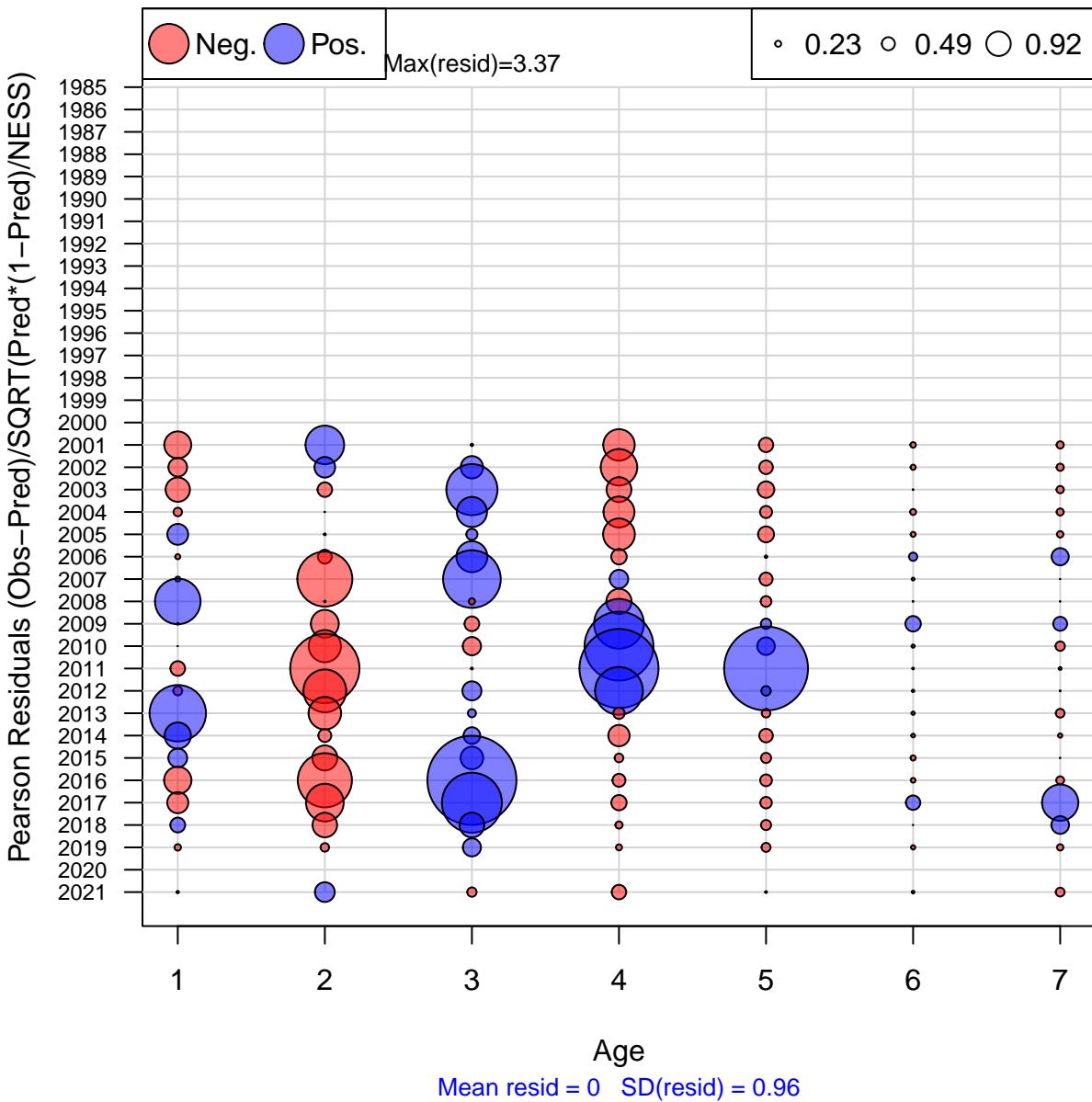
# Age Comp Residuals for Index 3 (MRIP)



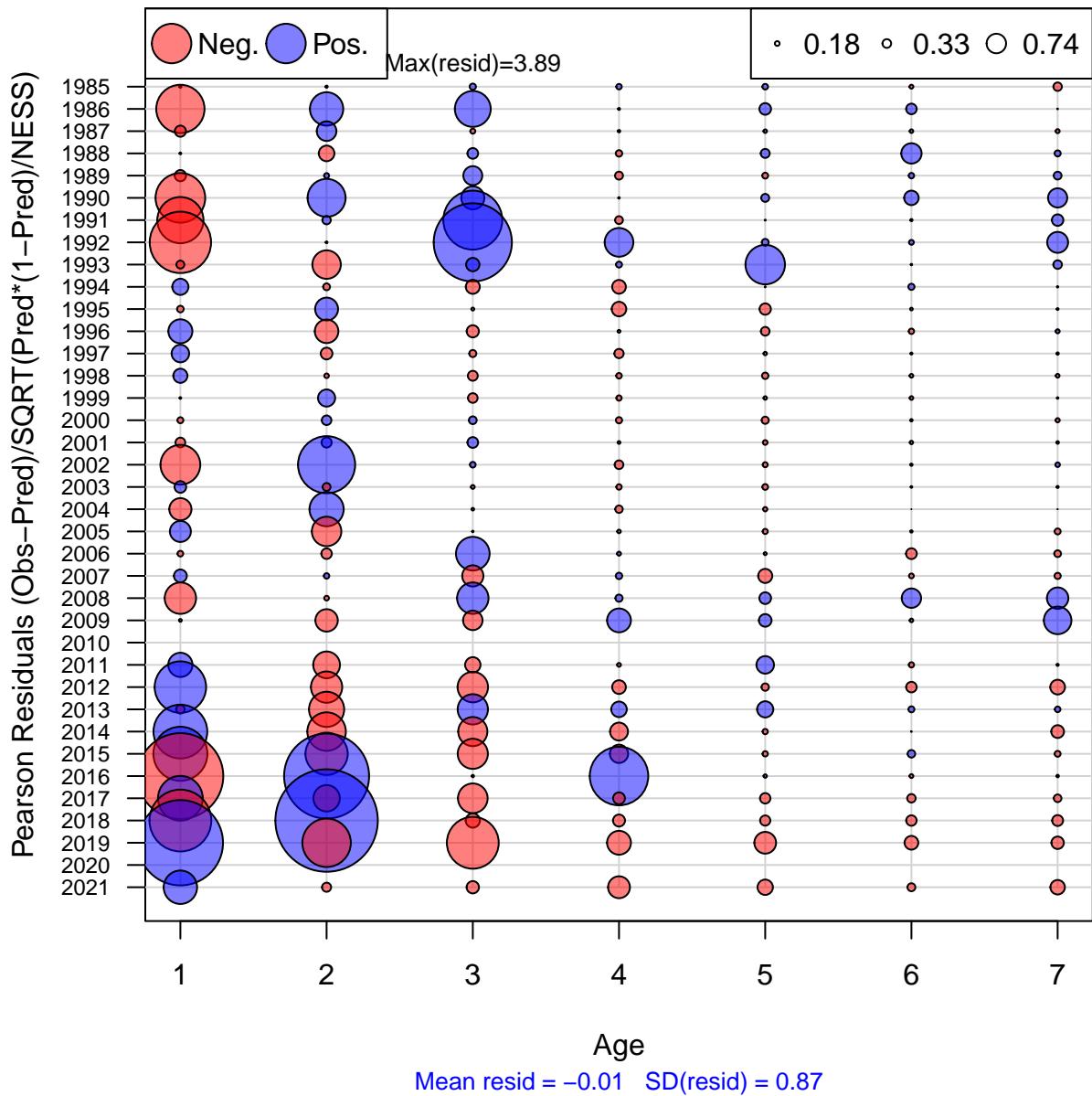
# Age Comp Residuals for Index 4 (NEAMAP)



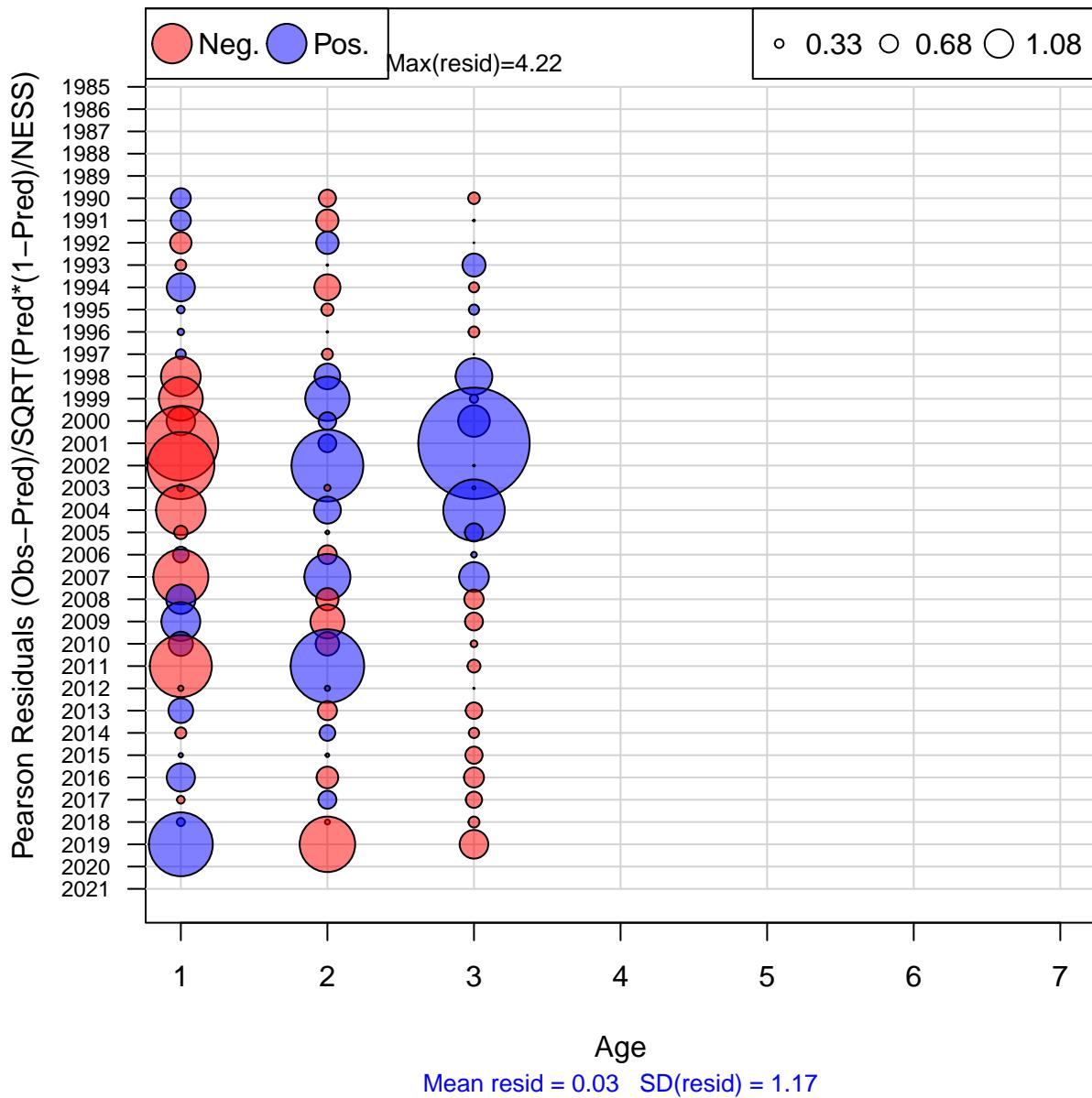
# Age Comp Residuals for Index 6 (PSIGN)



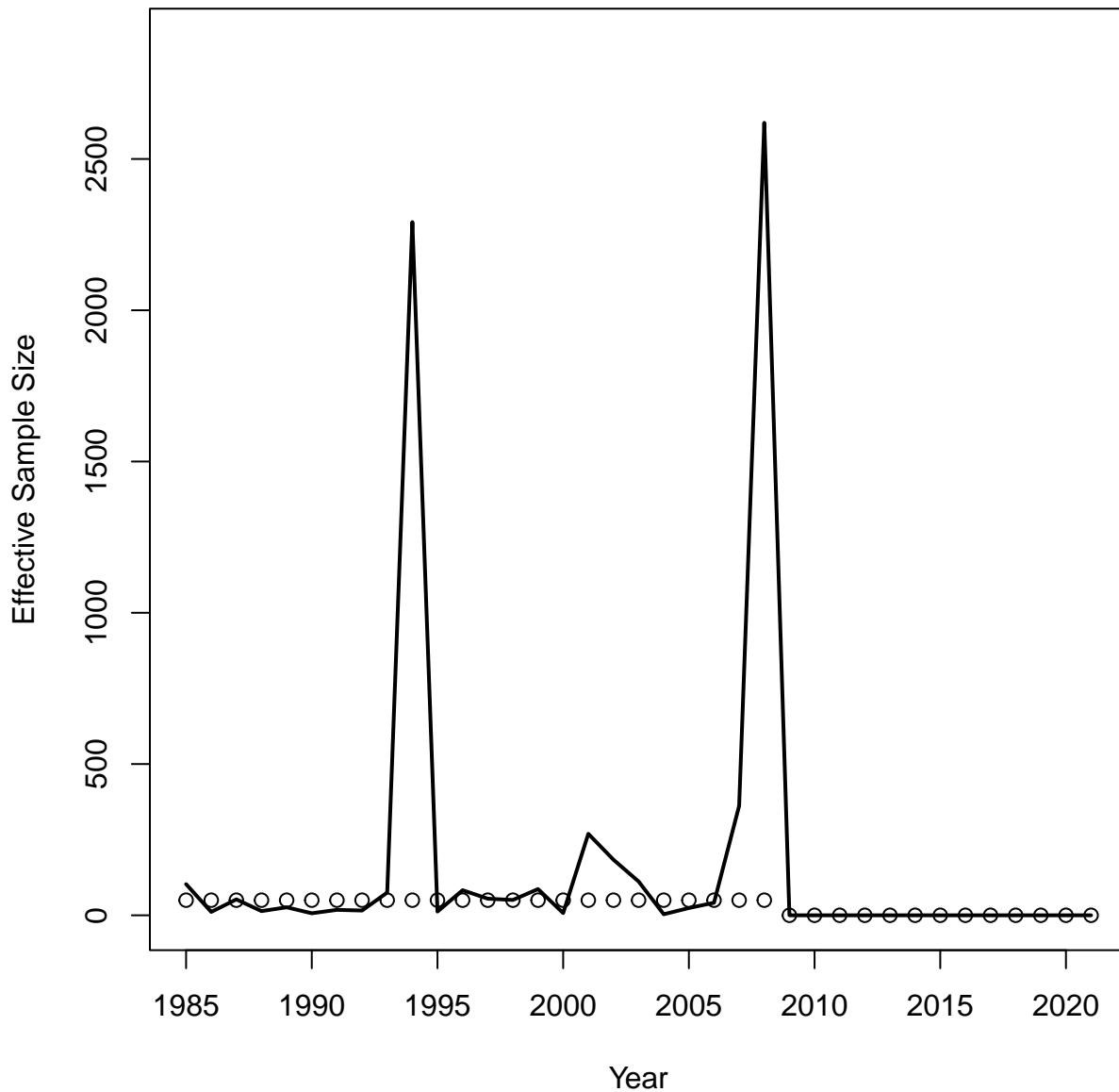
# Age Comp Residuals for Index 7 (CT Trawl)



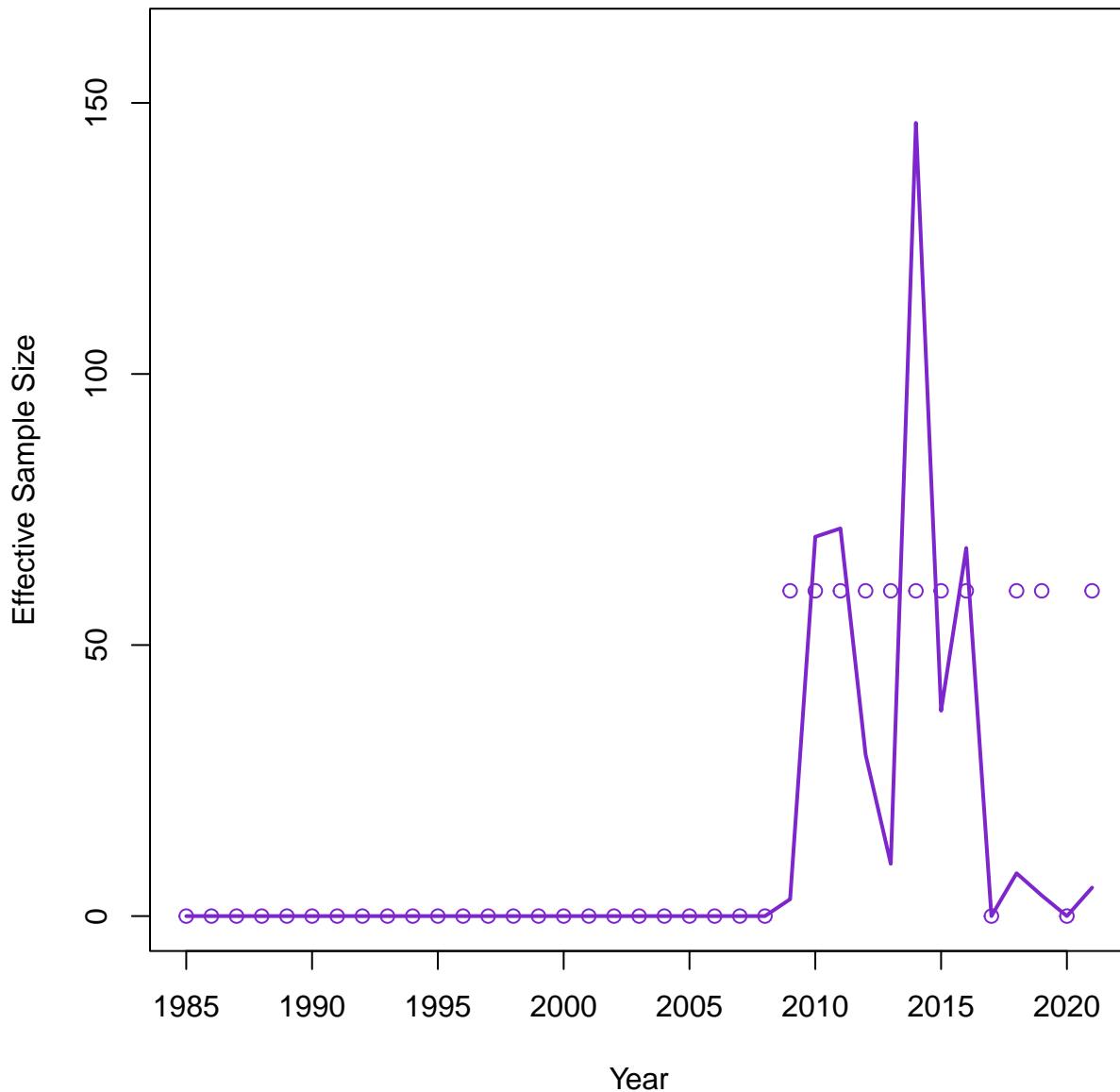
# Age Comp Residuals for Index 8 (NJ Trawl)



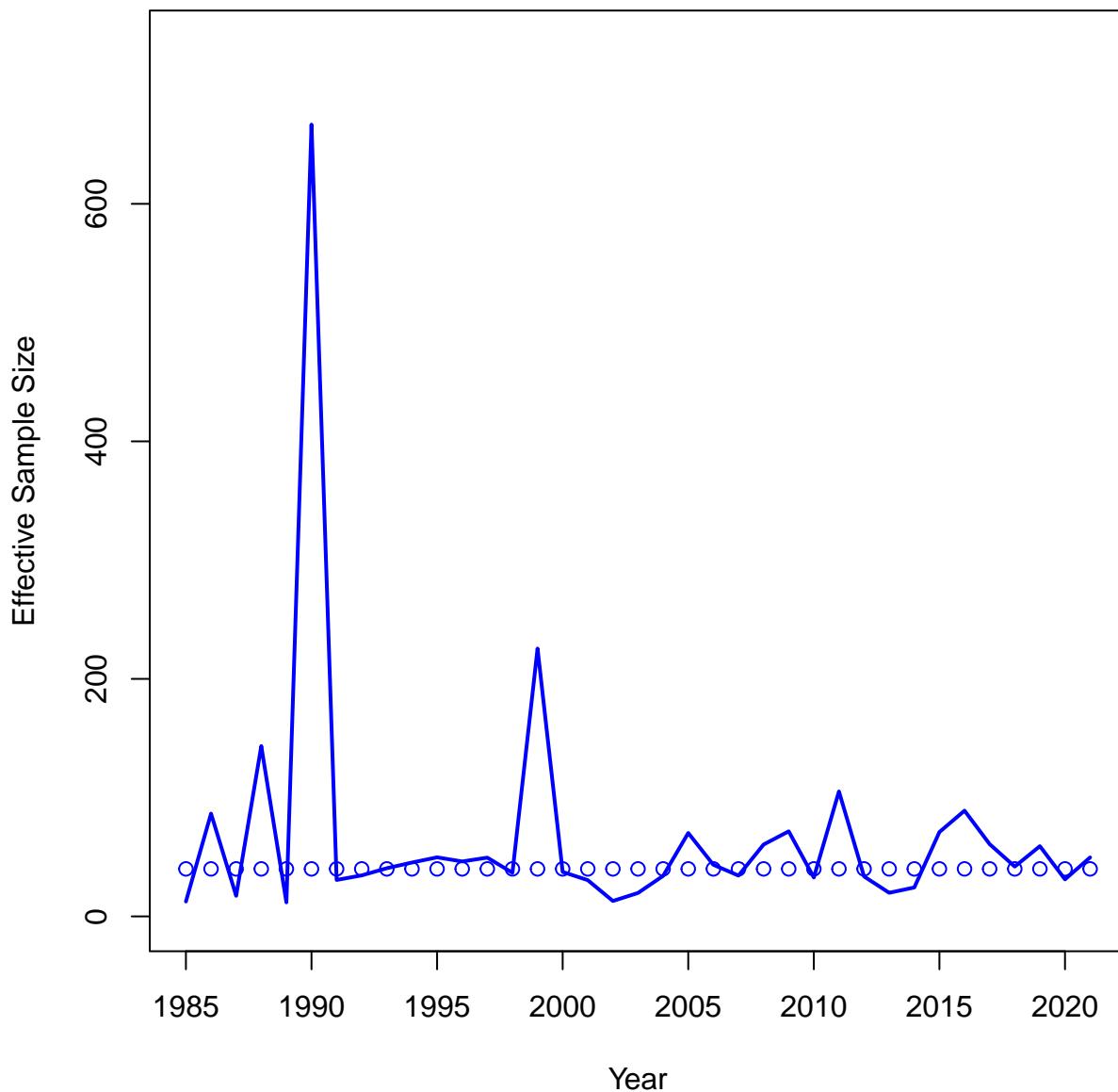
## Index Neff 1 (NEFSC Inshore)



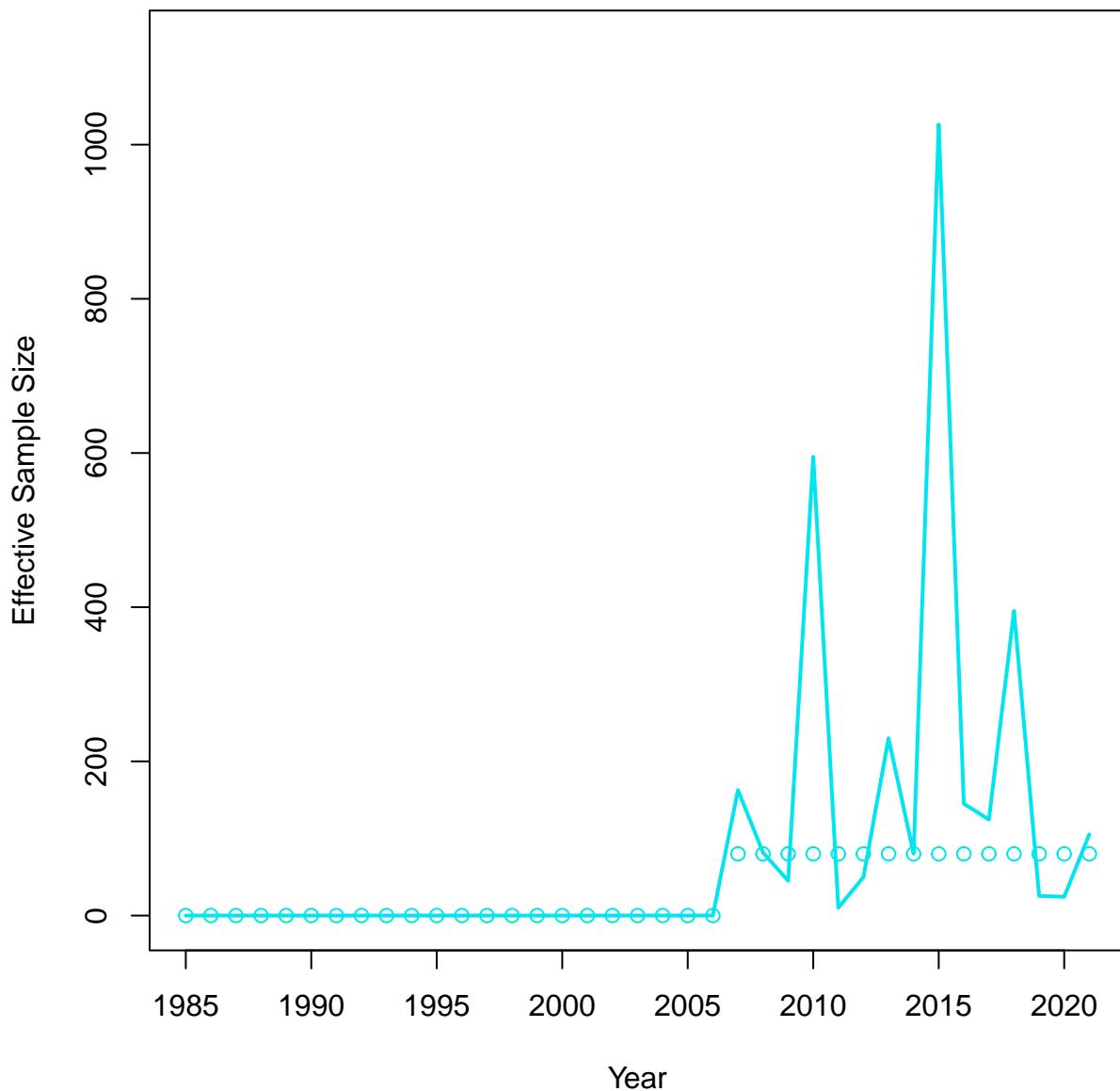
## Index Neff 2 (Bigelow)



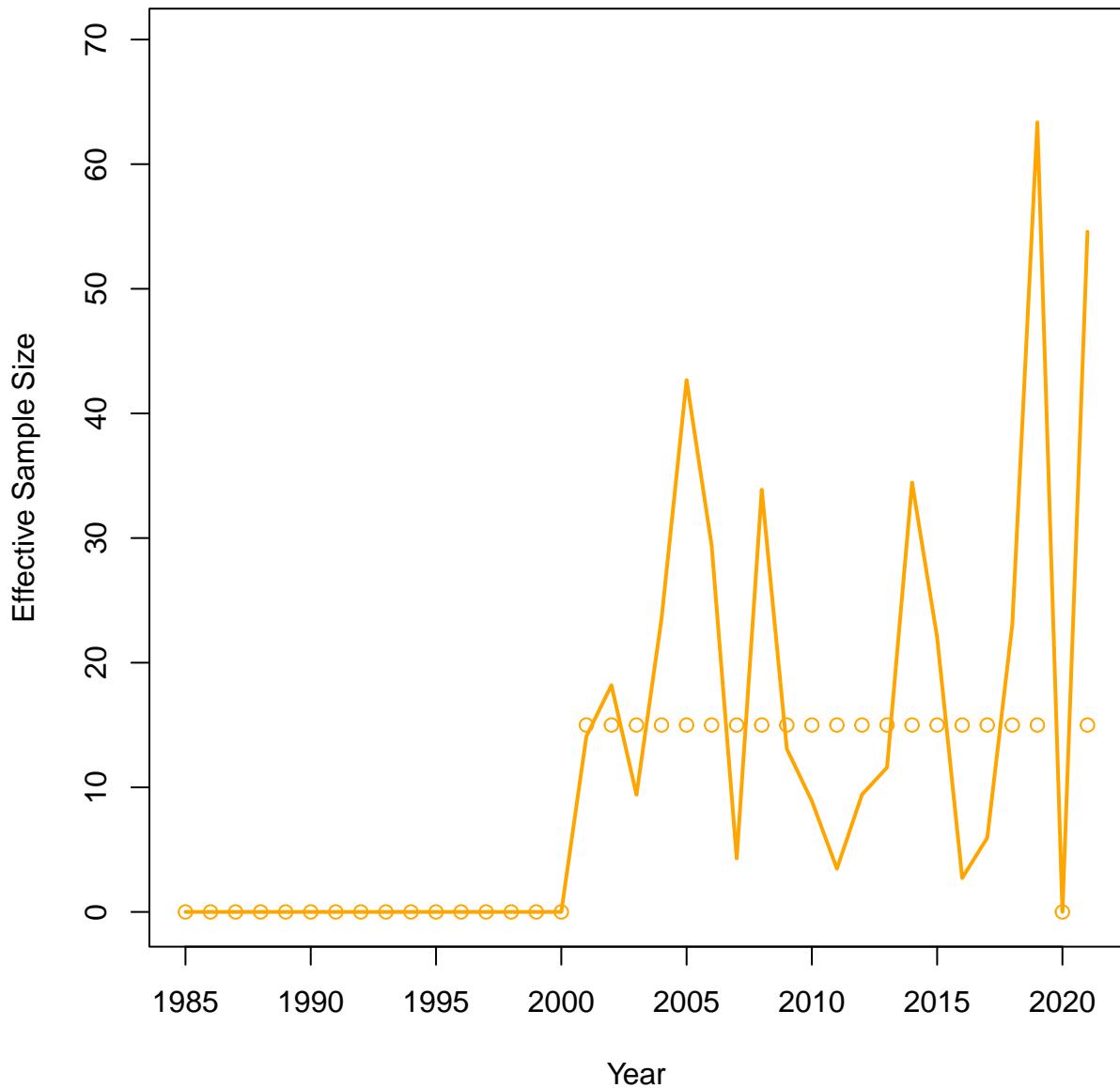
## Index Neff 3 (MRIP)



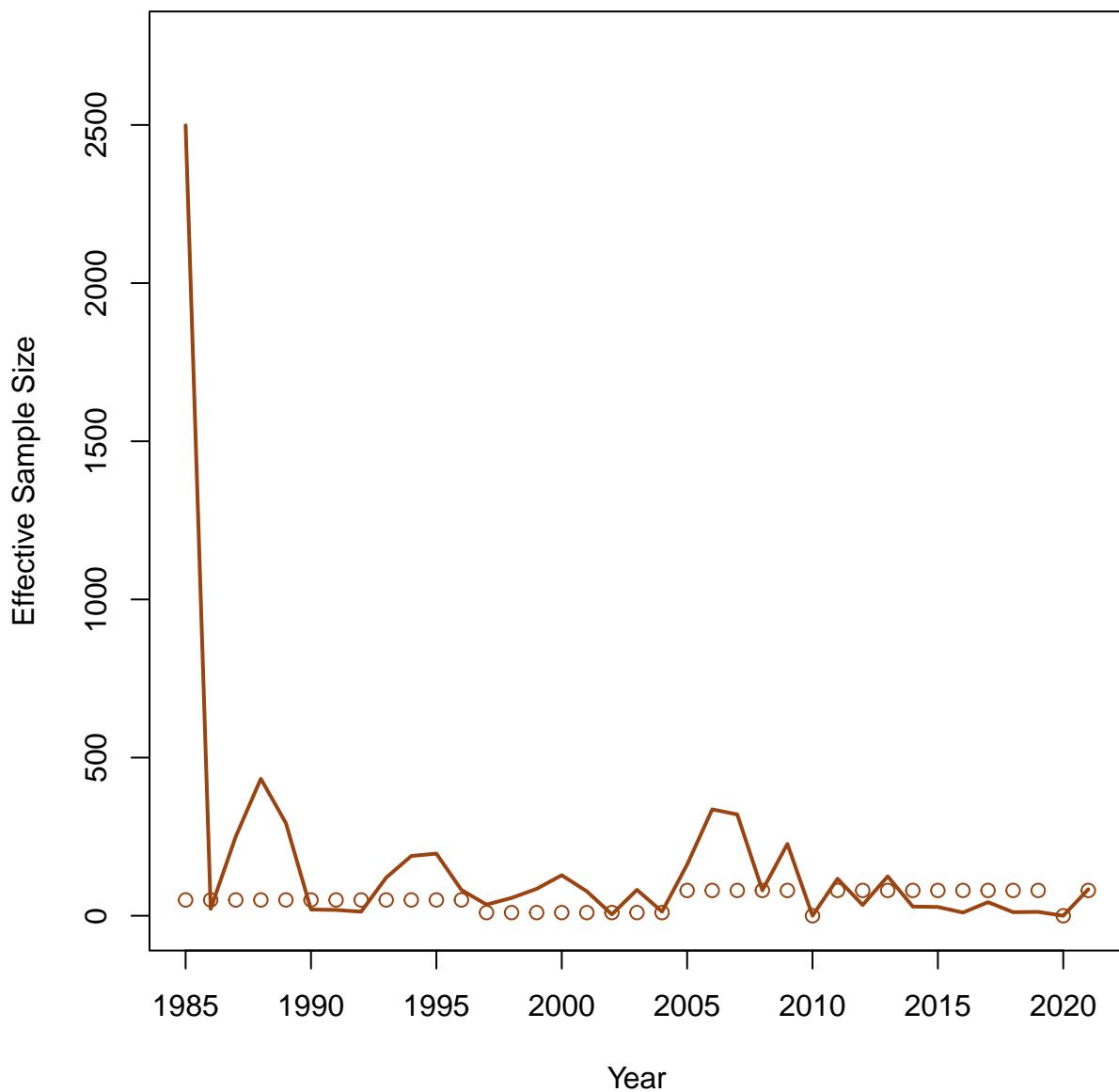
## Index Neff 4 (NEAMAP)



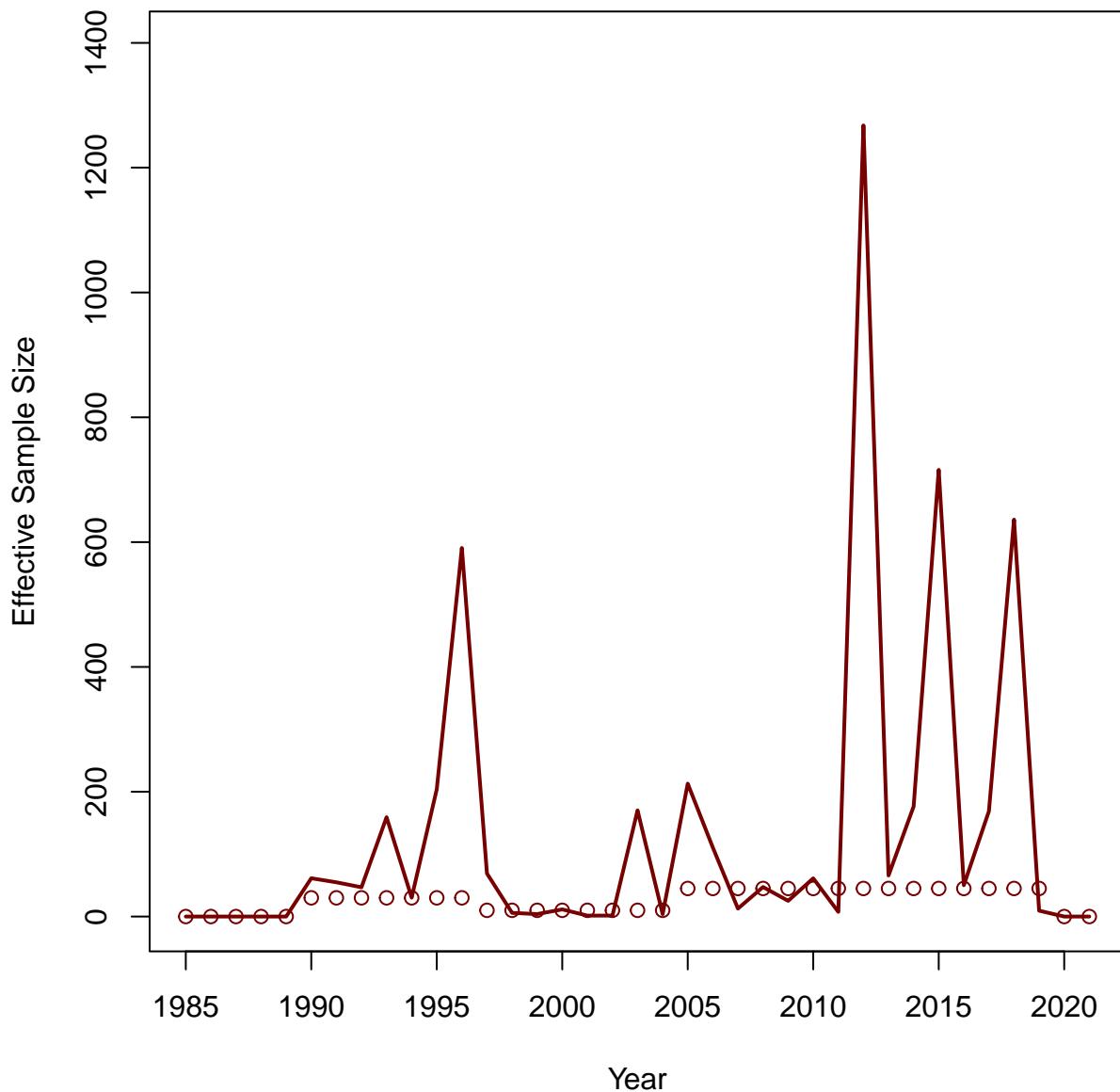
## Index Neff 6 (PSIGN)



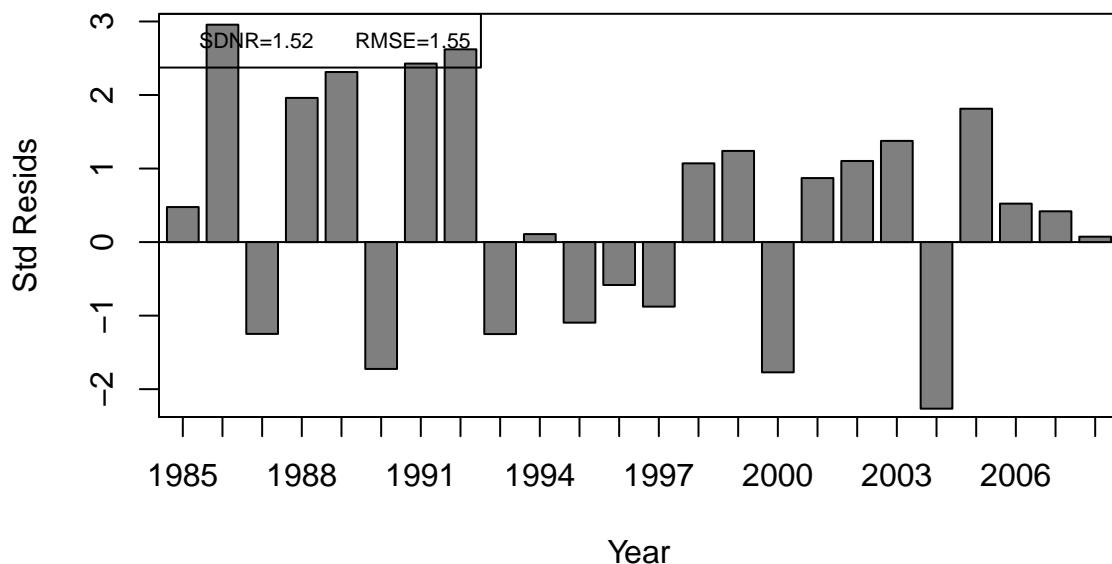
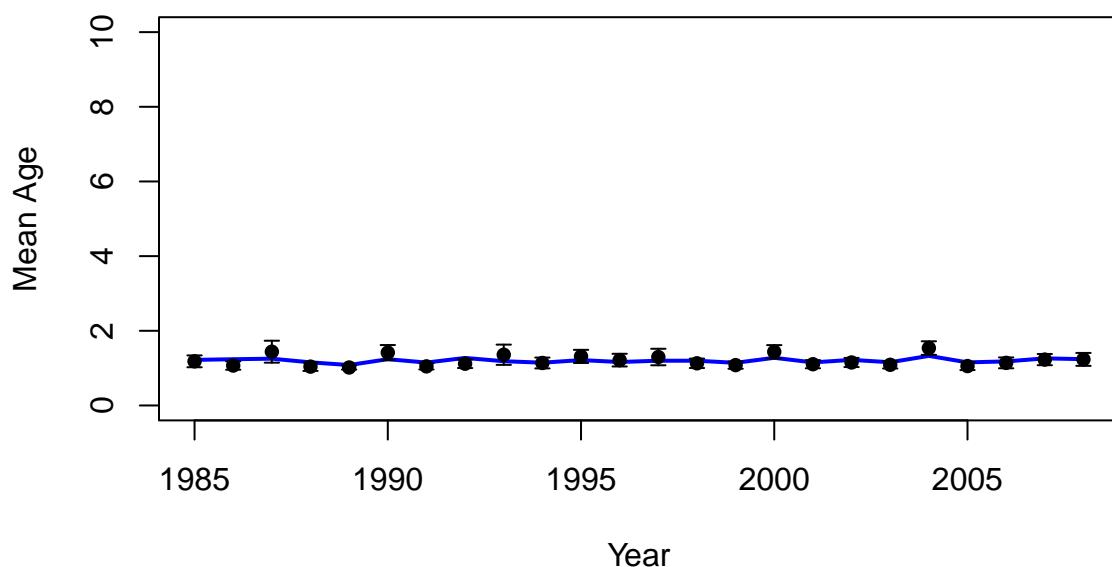
## Index Neff 7 (CT Trawl)



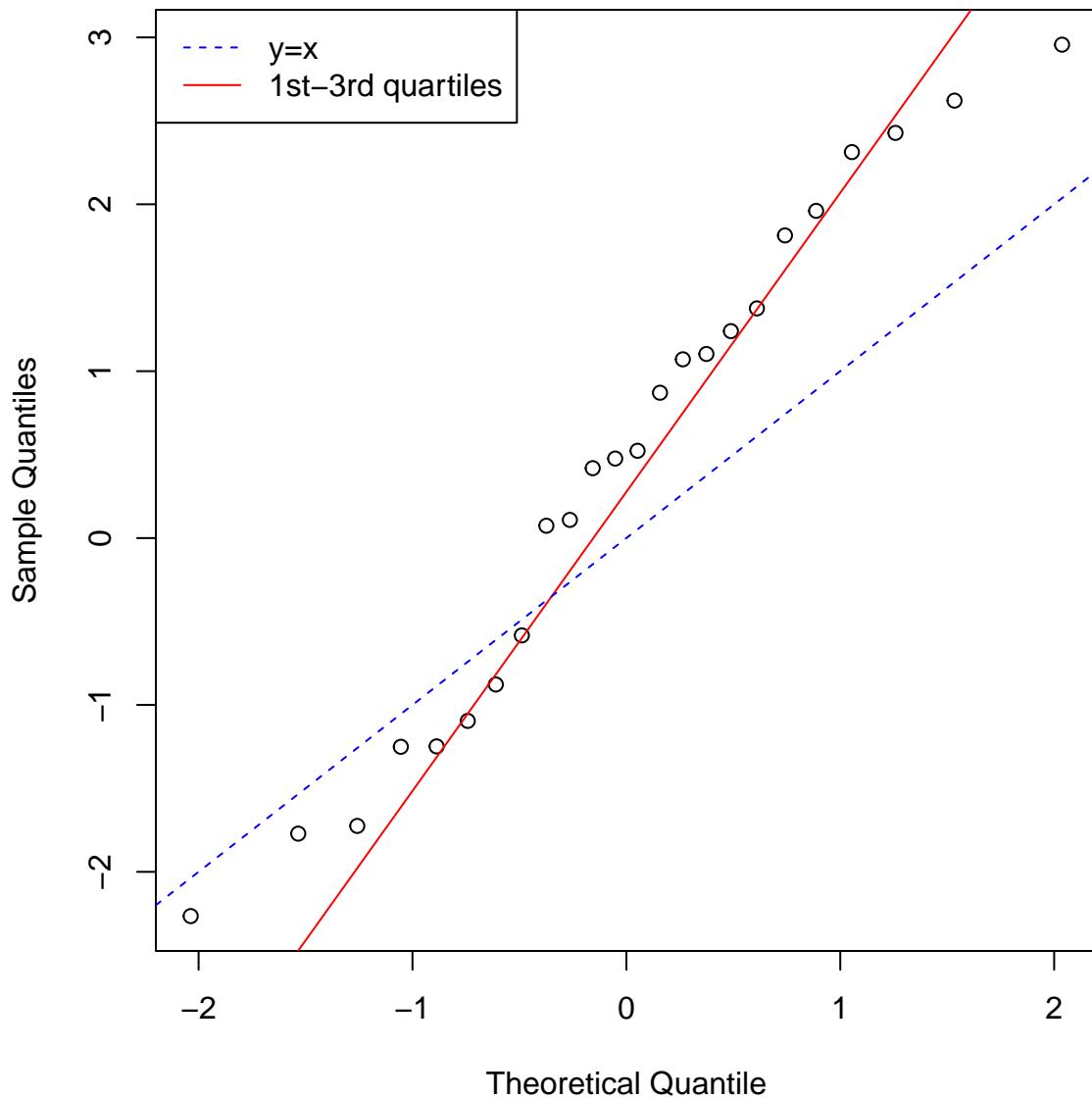
## Index Neff 8 (NJ Trawl)



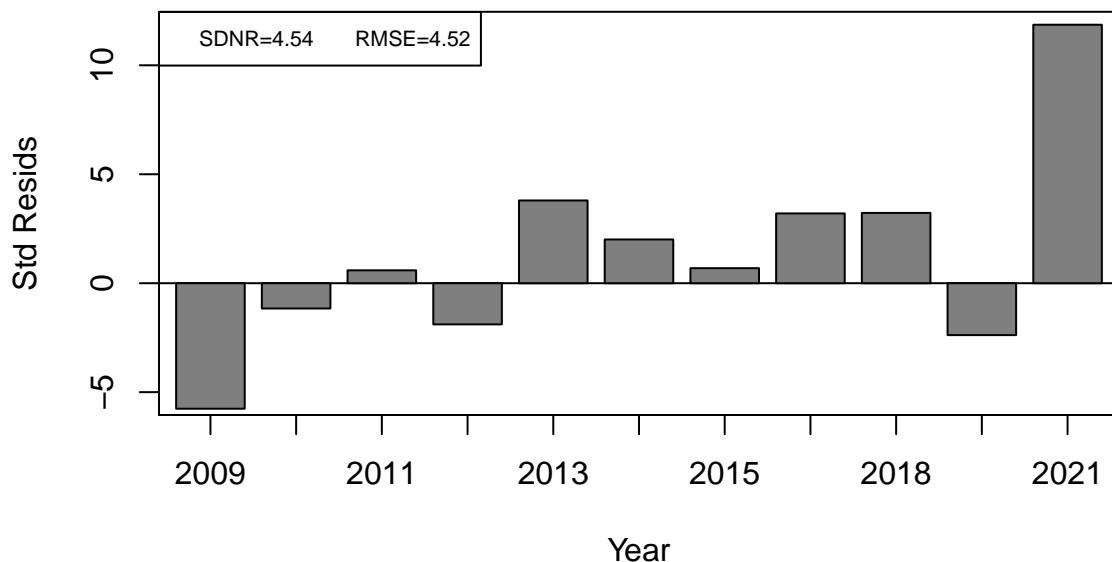
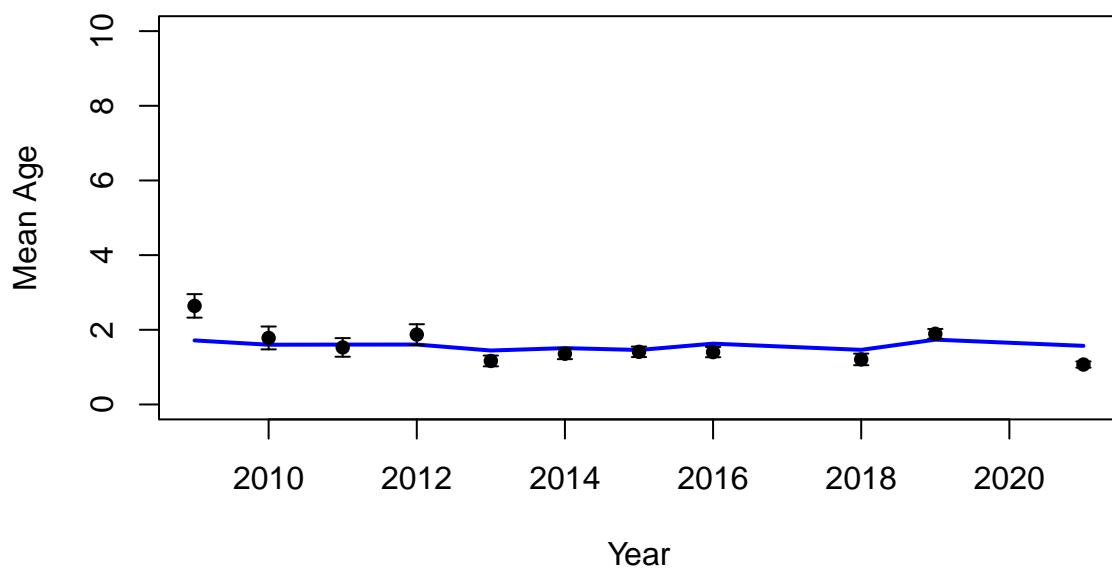
### Index 1 (NEFSC Inshore) ESS = 50



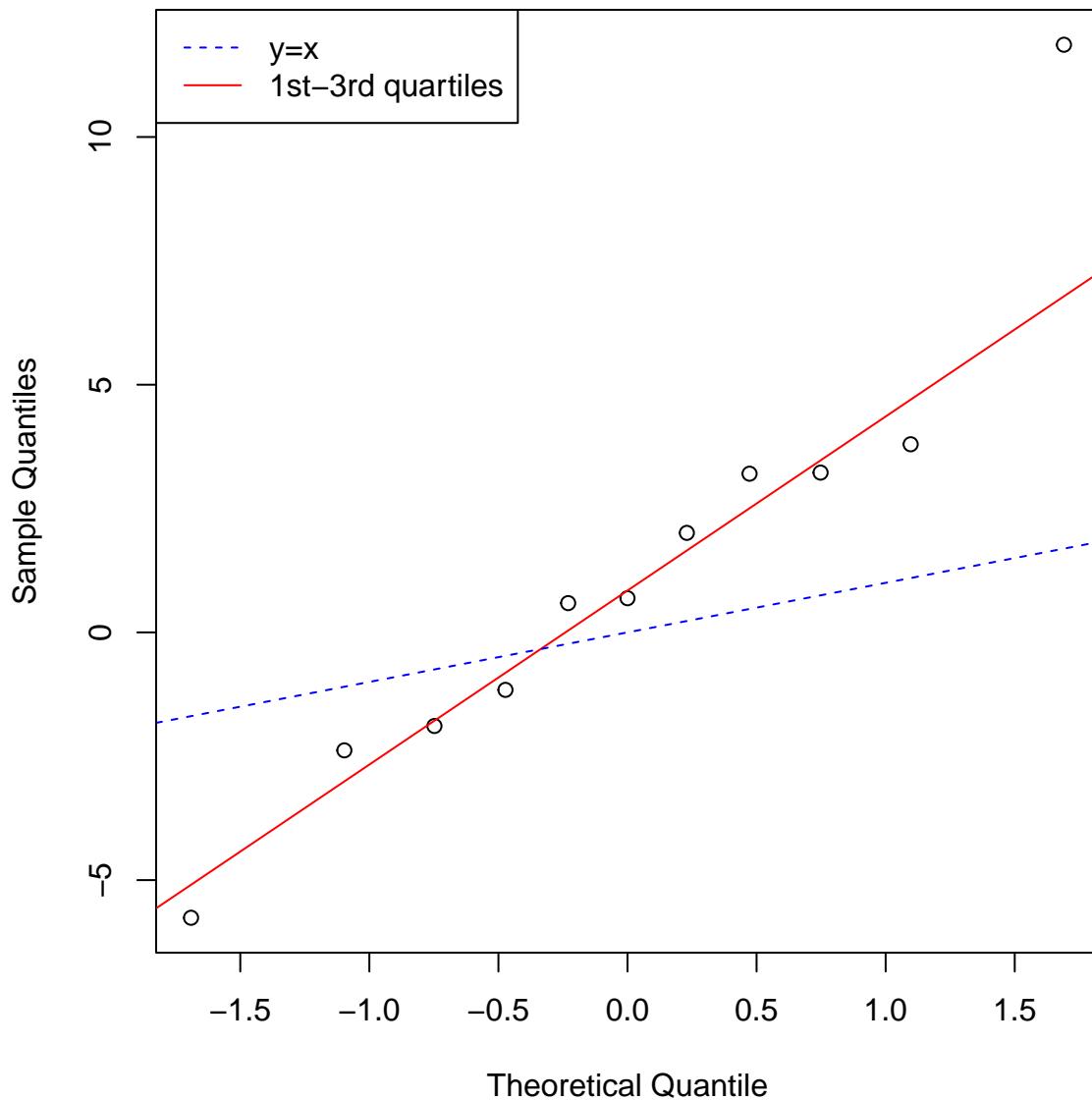
### Index 1 (NEFSC Inshore) ESS = 50



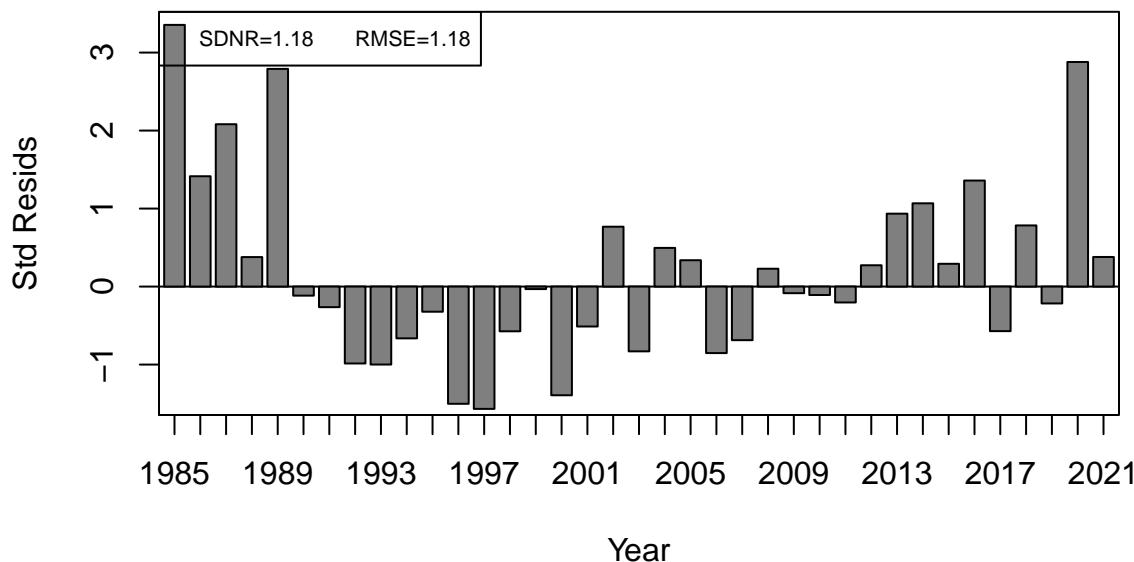
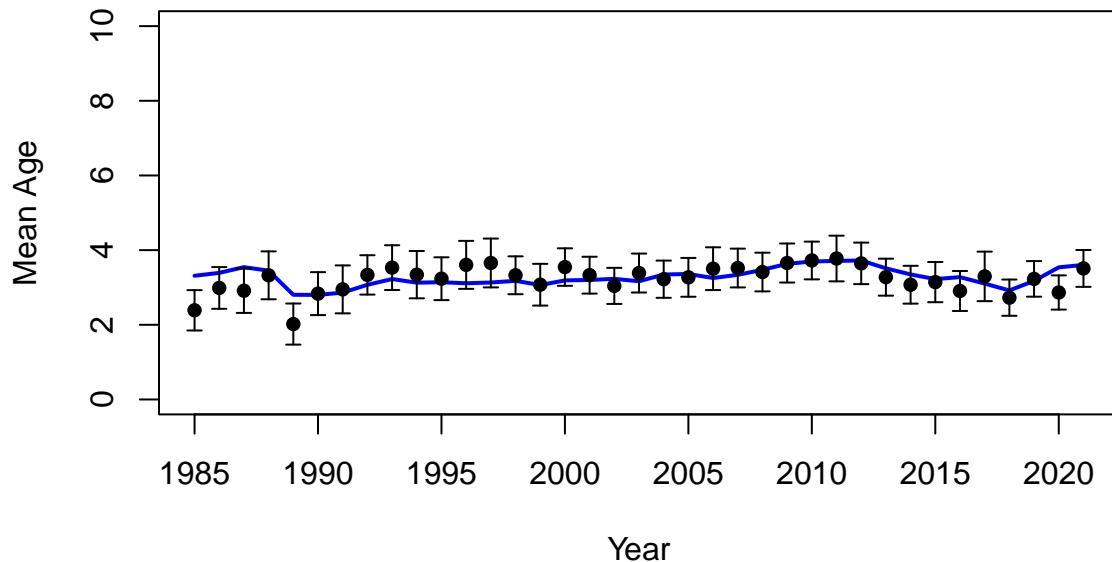
## Index 2 (Bigelow) ESS = 60



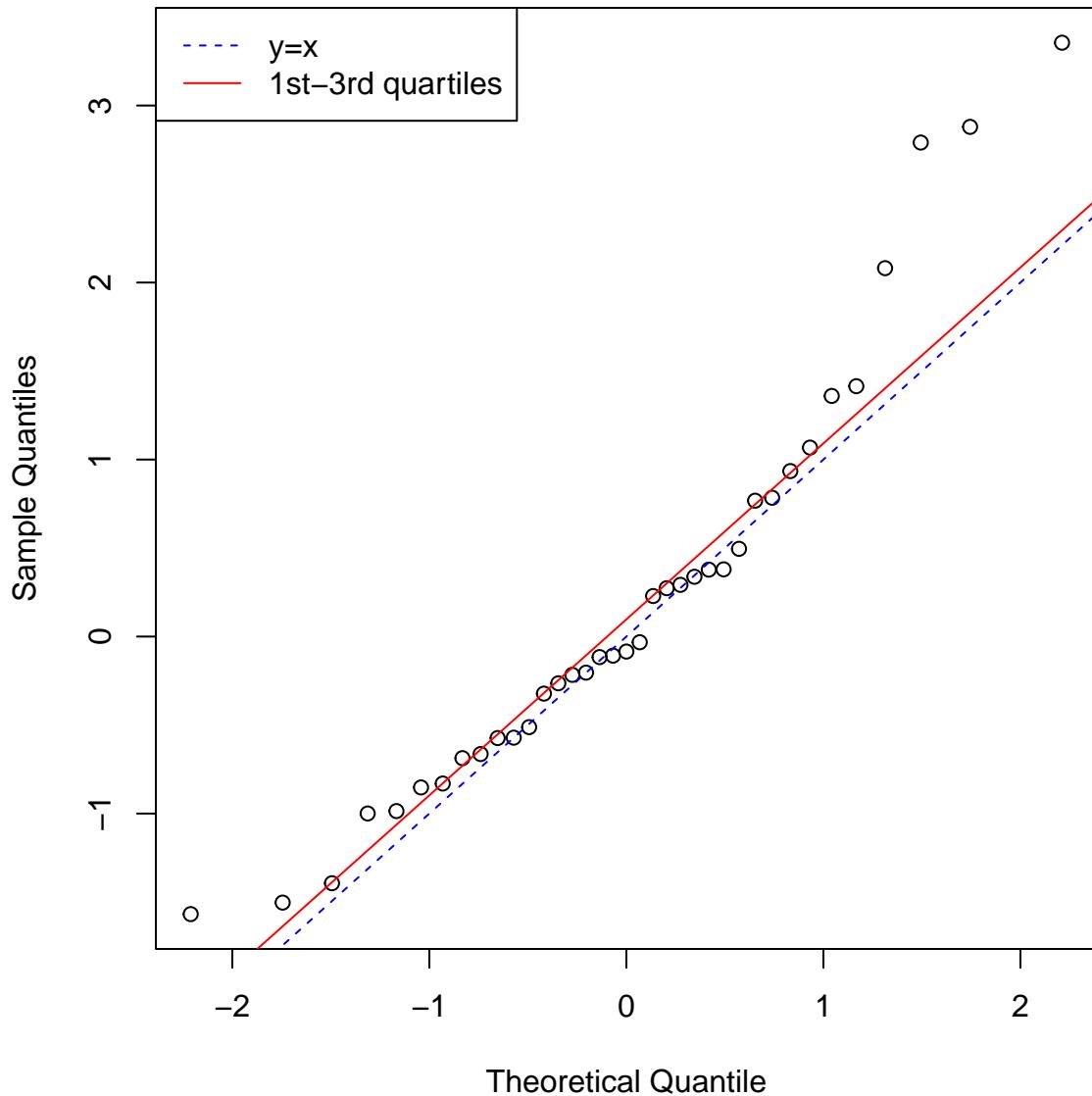
## Index 2 (Bigelow) ESS = 60



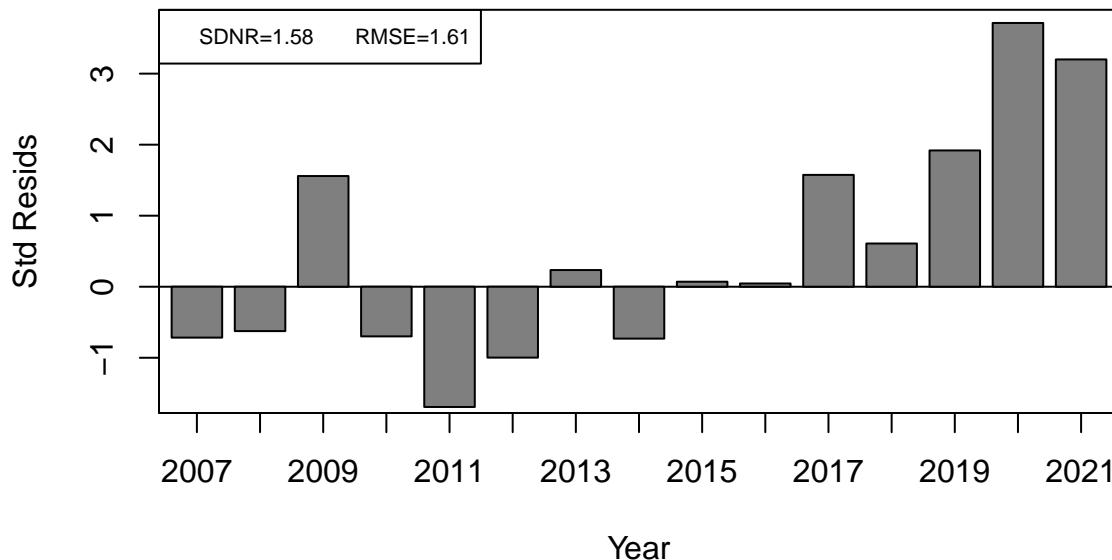
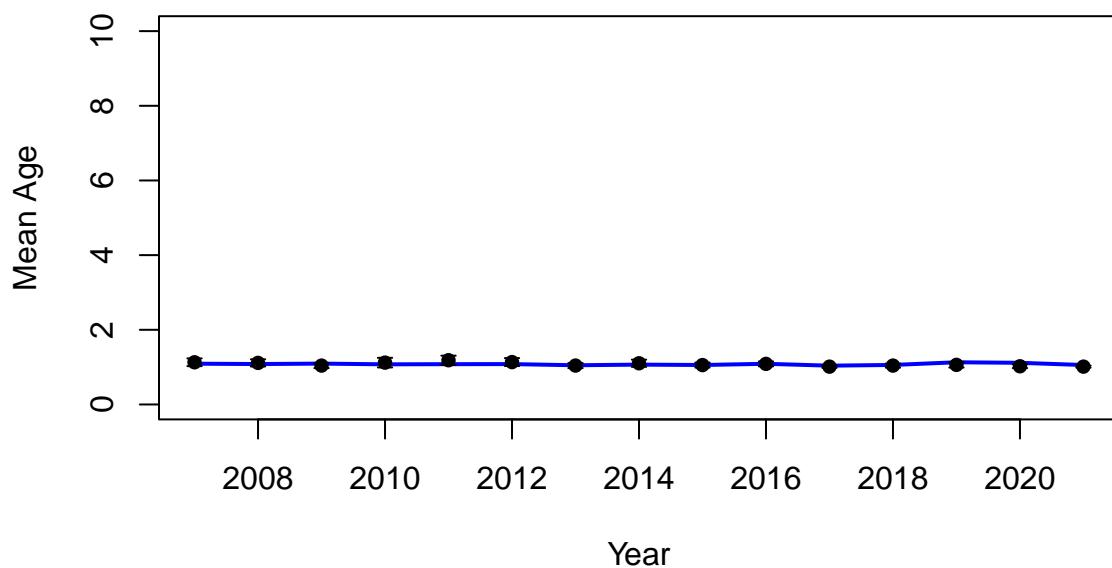
### Index 3 (MRIP) ESS = 40



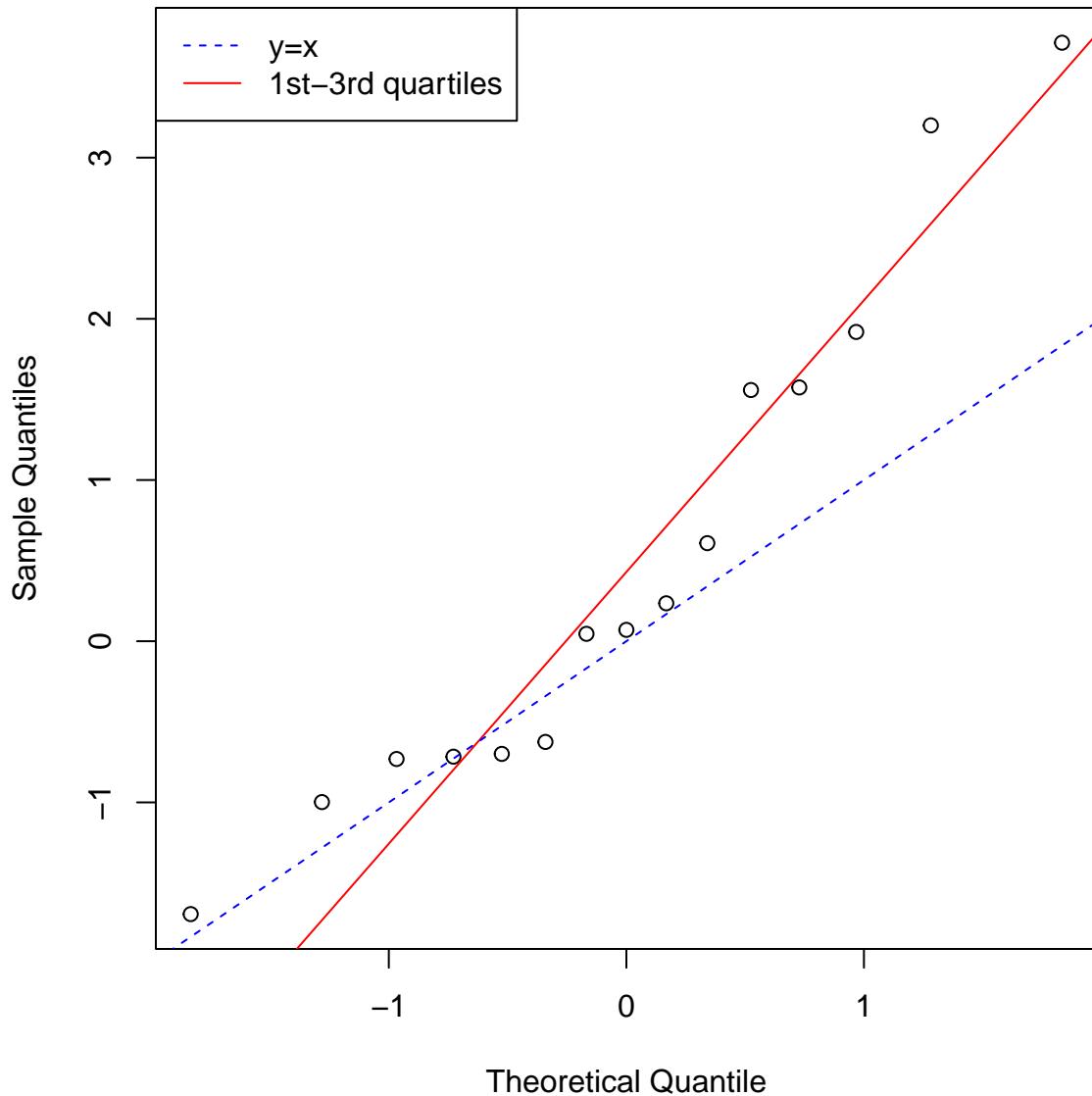
### Index 3 (MRIP) ESS = 40



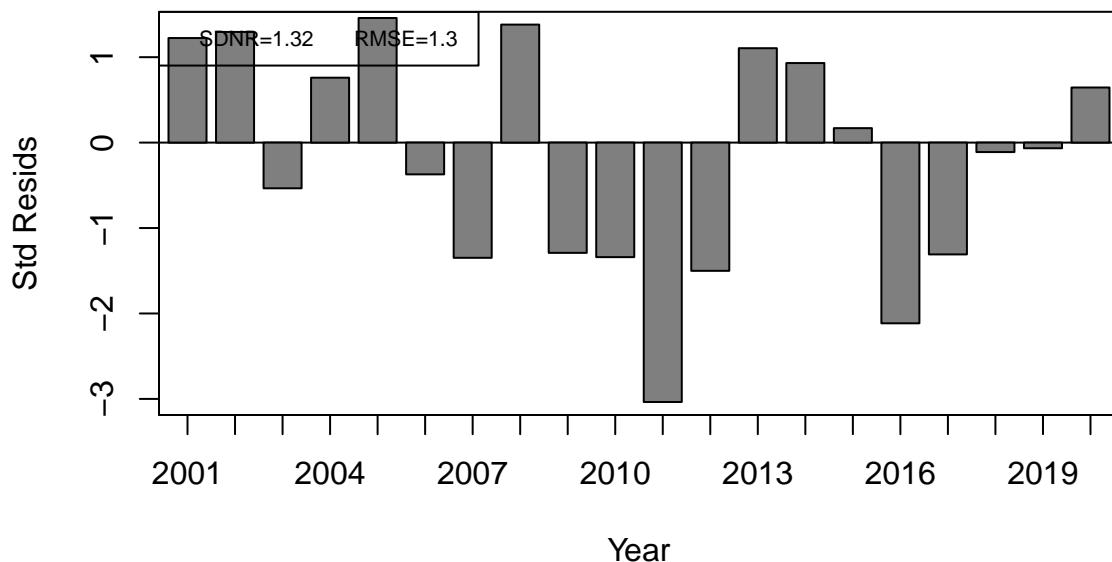
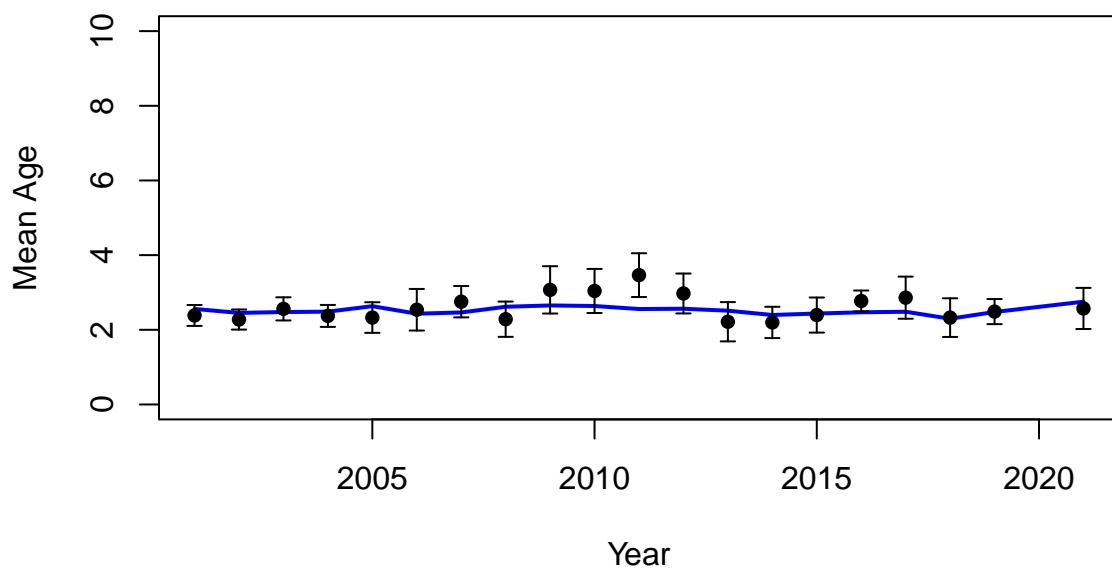
## Index 4 (NEAMAP) ESS = 80



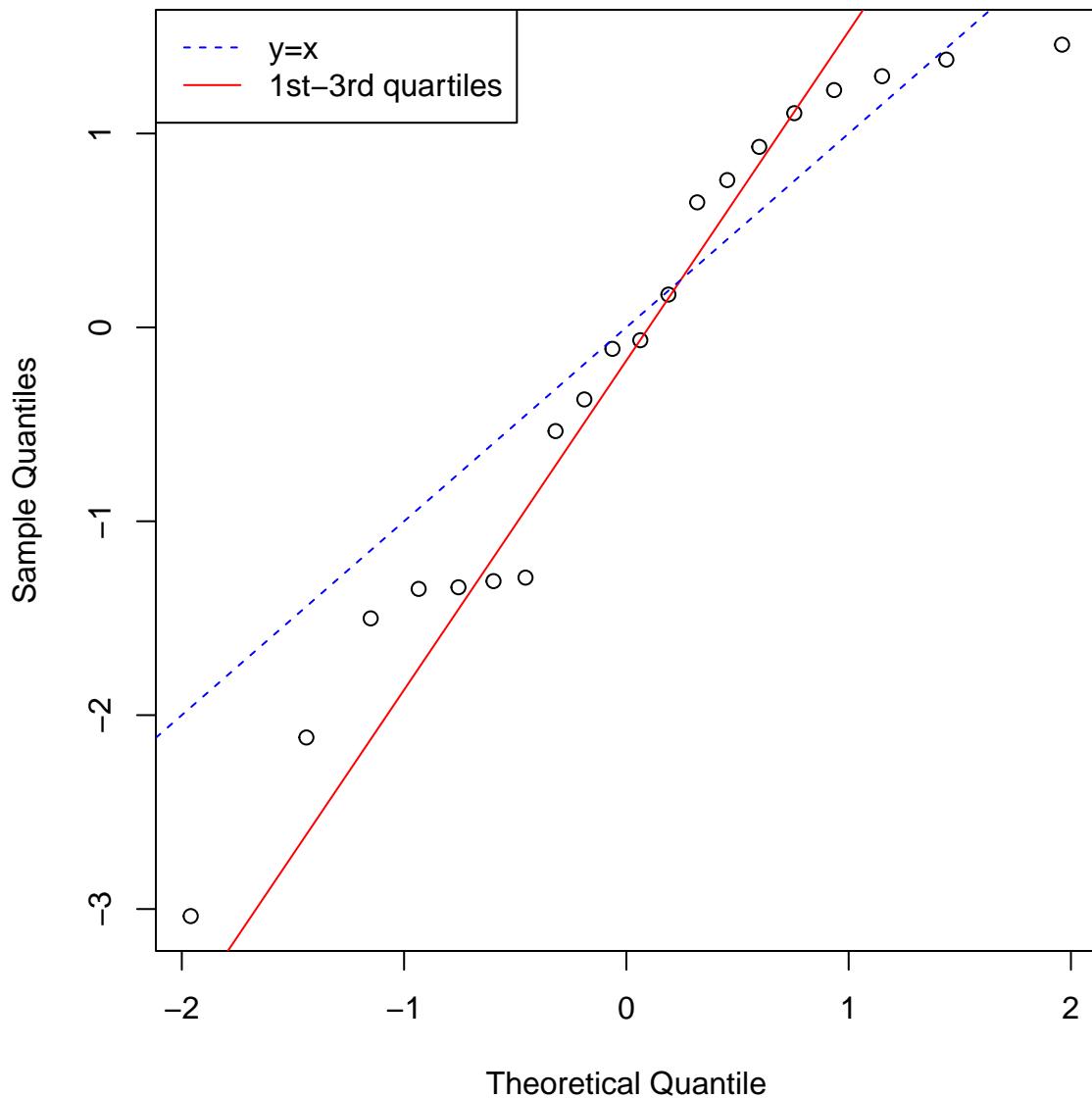
## Index 4 (NEAMAP) ESS = 80



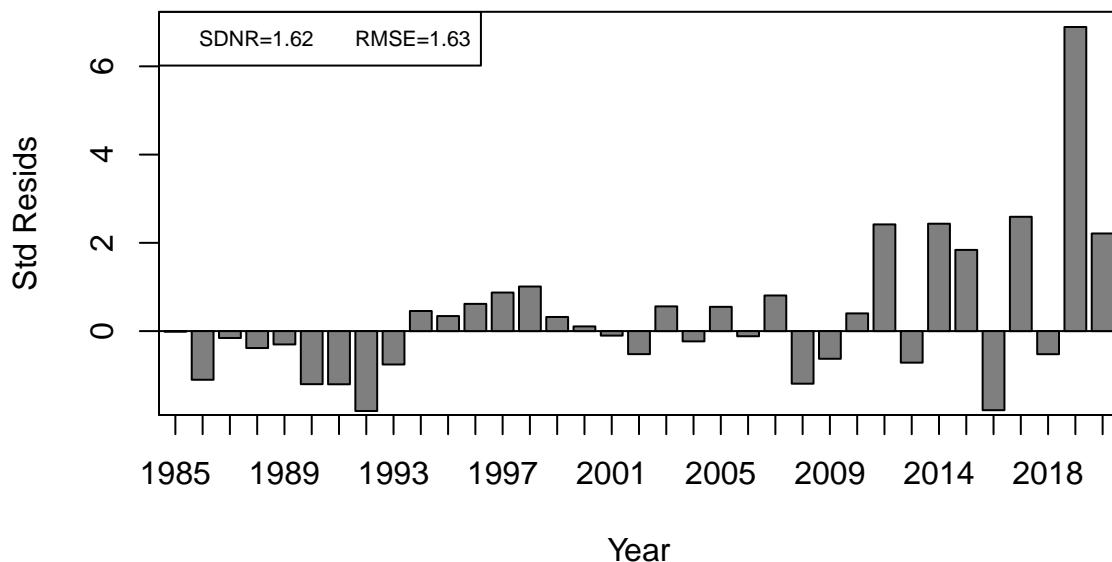
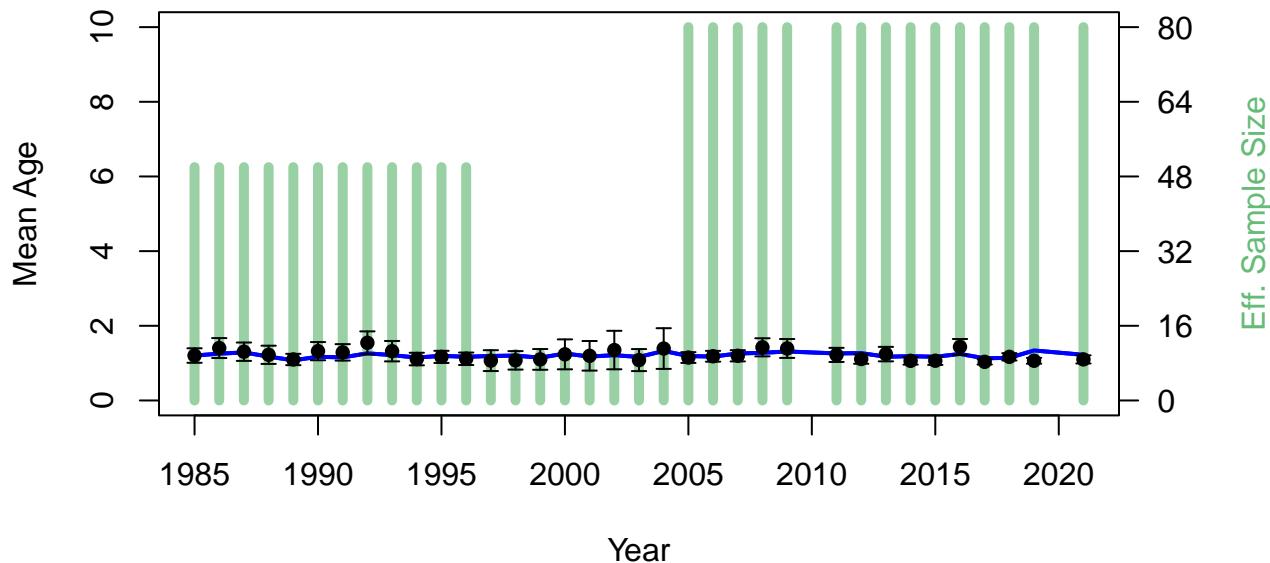
## Index 6 (PSIGN) ESS = 15



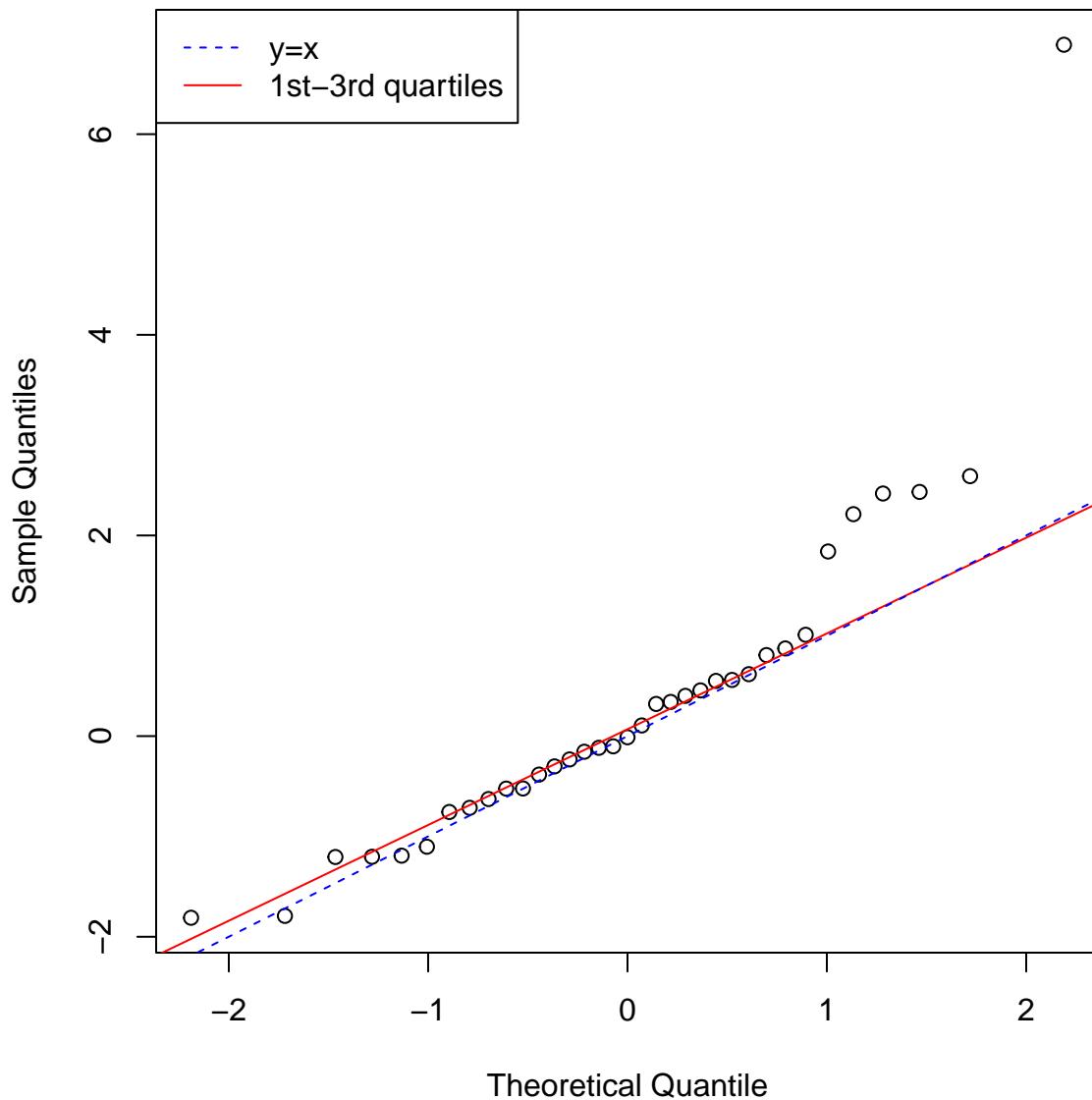
## Index 6 (PSIGN) ESS = 15



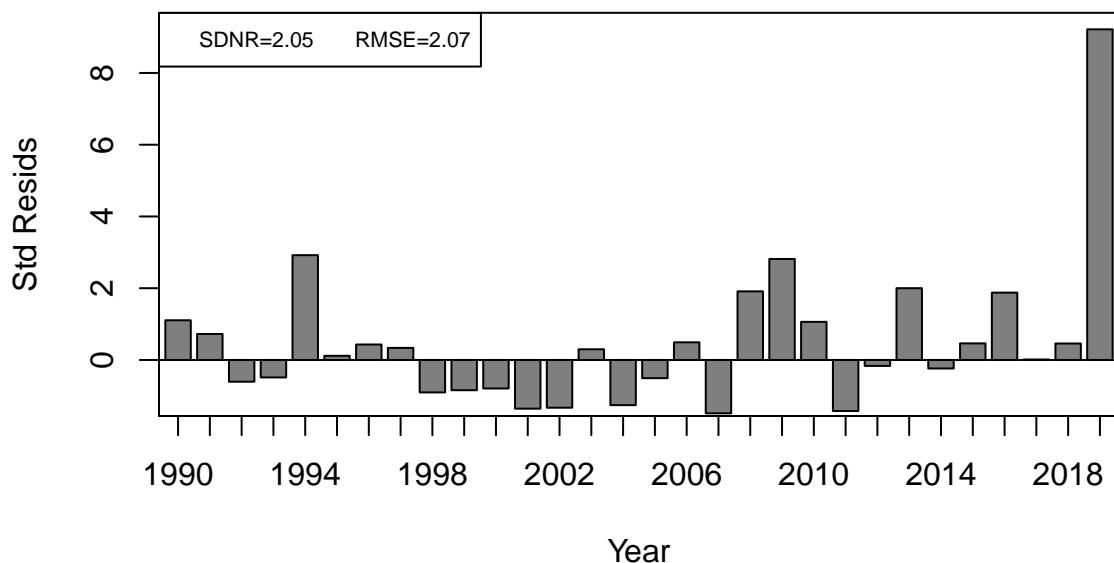
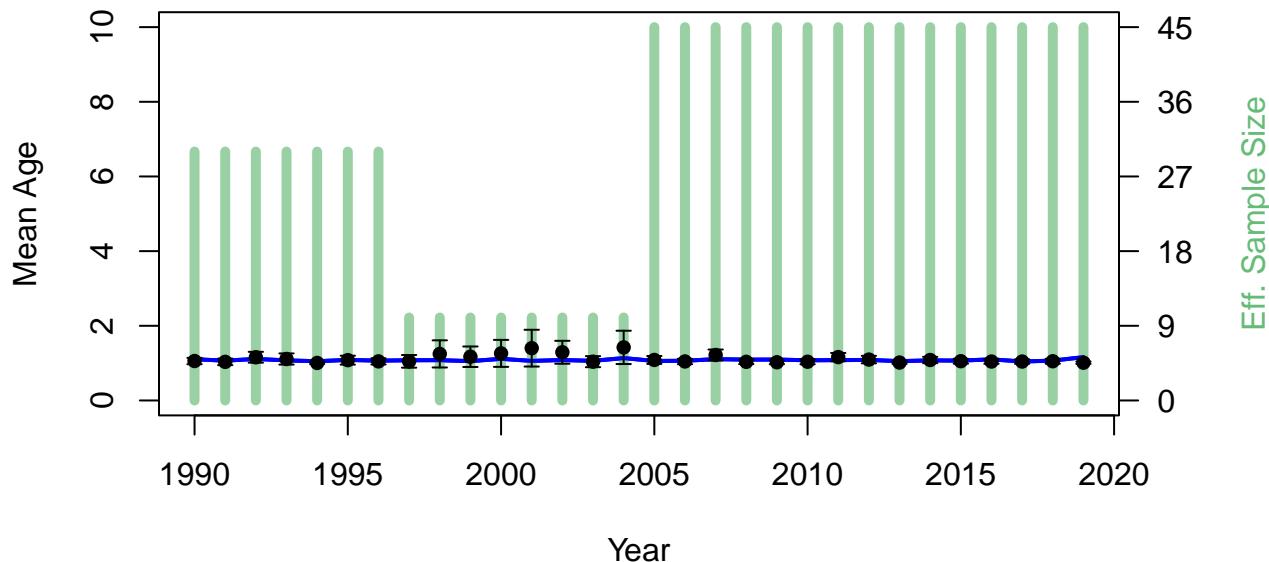
## Index 7 (CT Trawl)



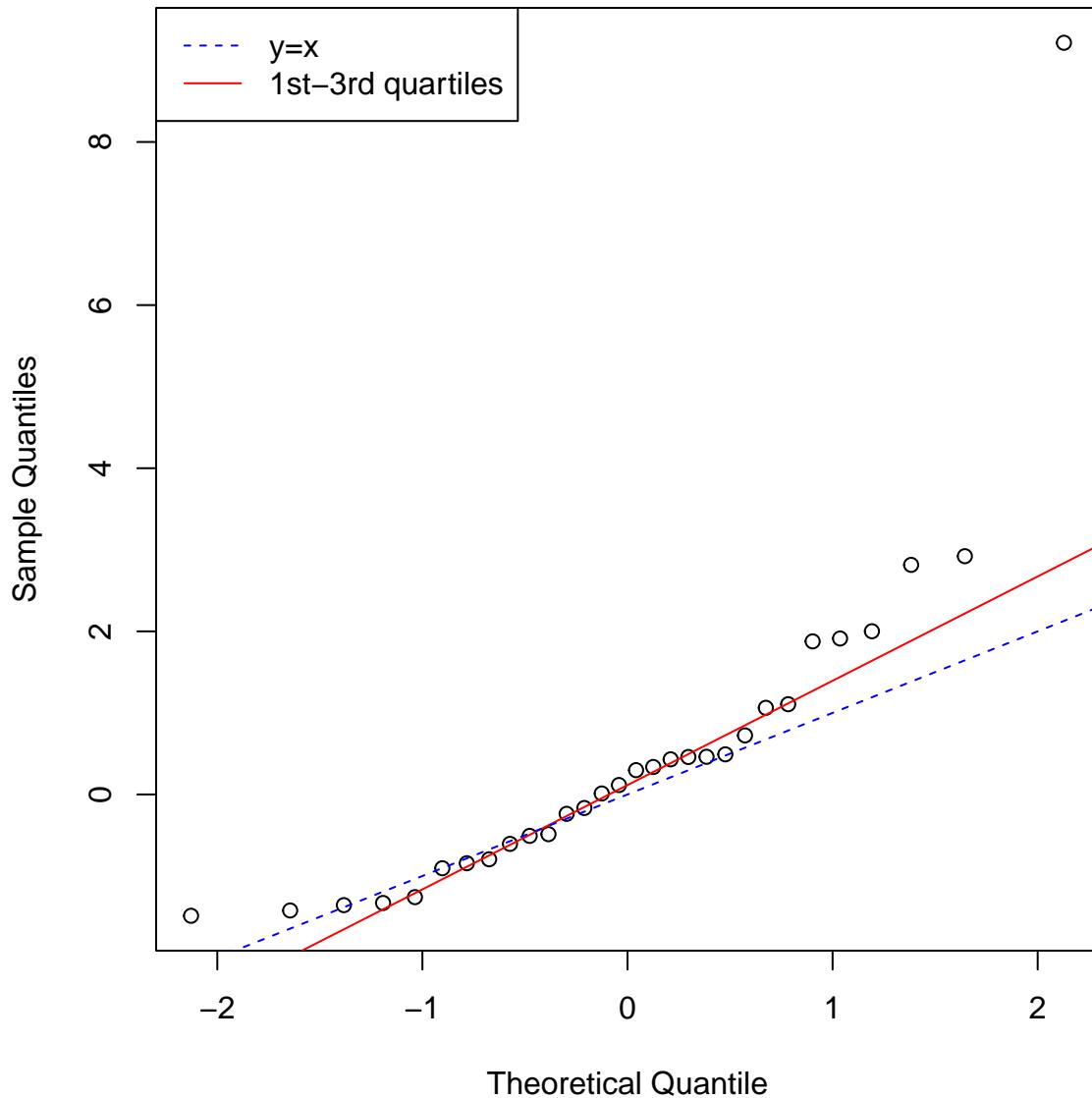
## Index 7 (CT Trawl)



## Index 8 (NJ Trawl)



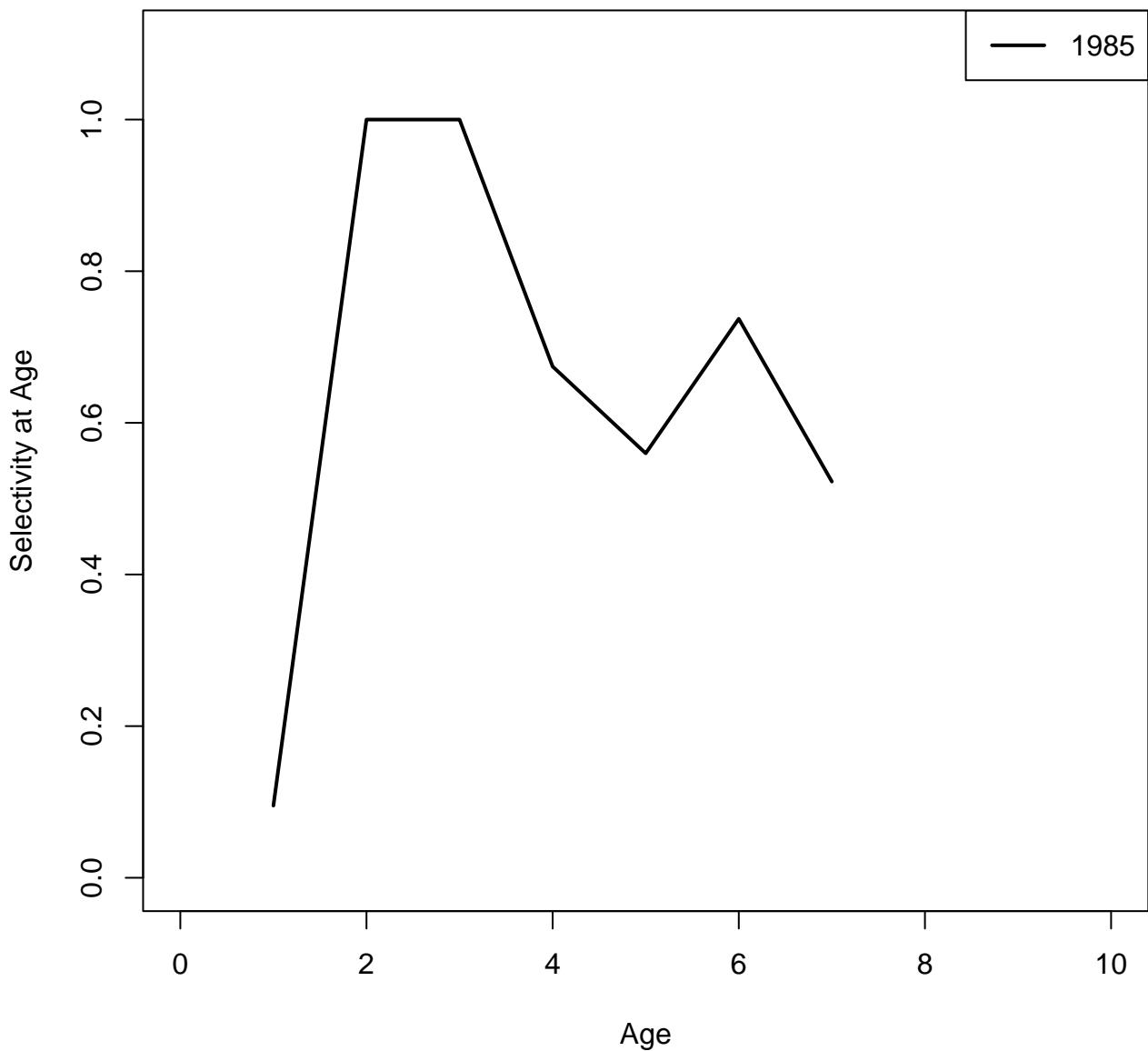
## Index 8 (NJ Trawl)



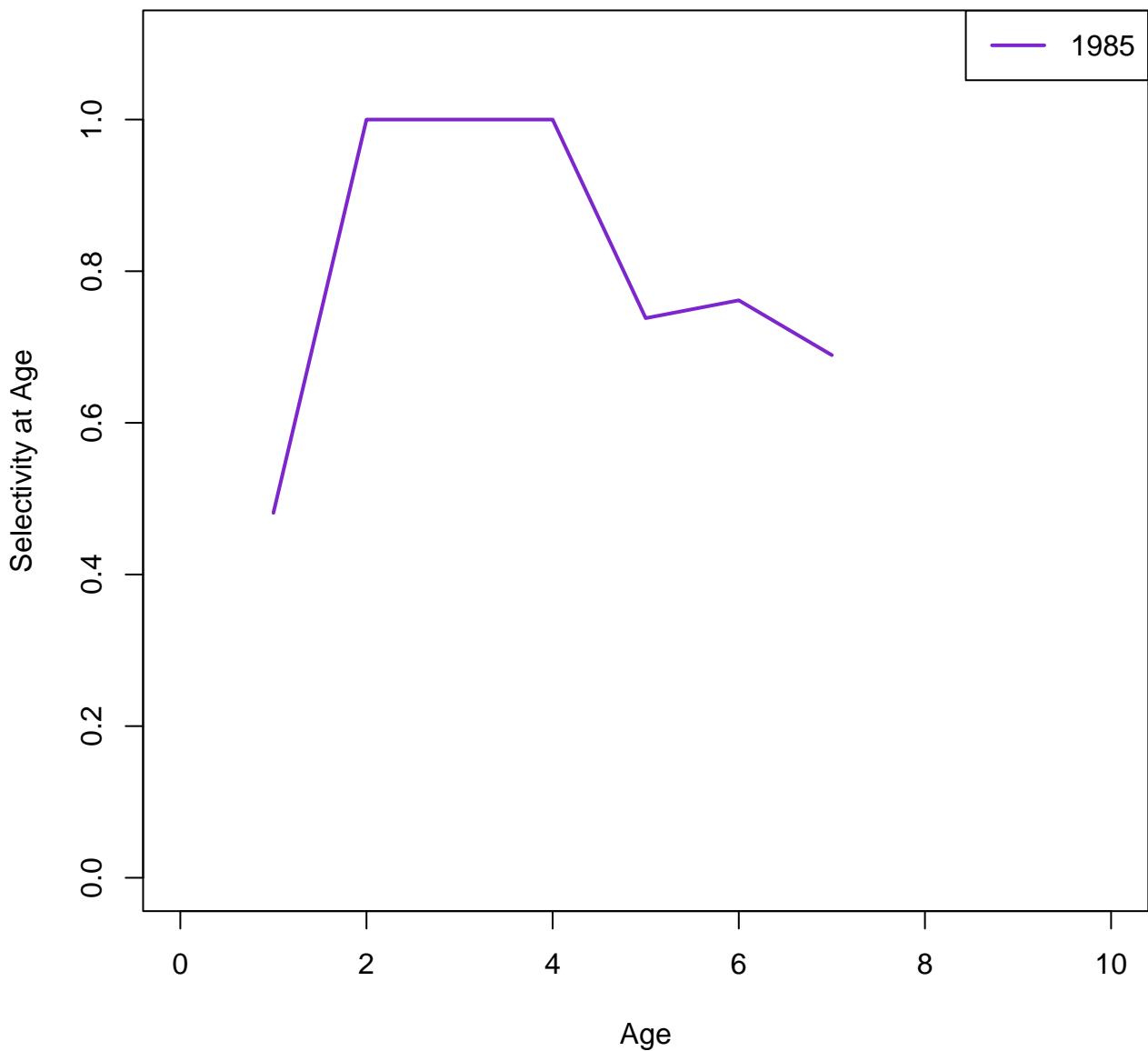
# BF01: Continuity Run

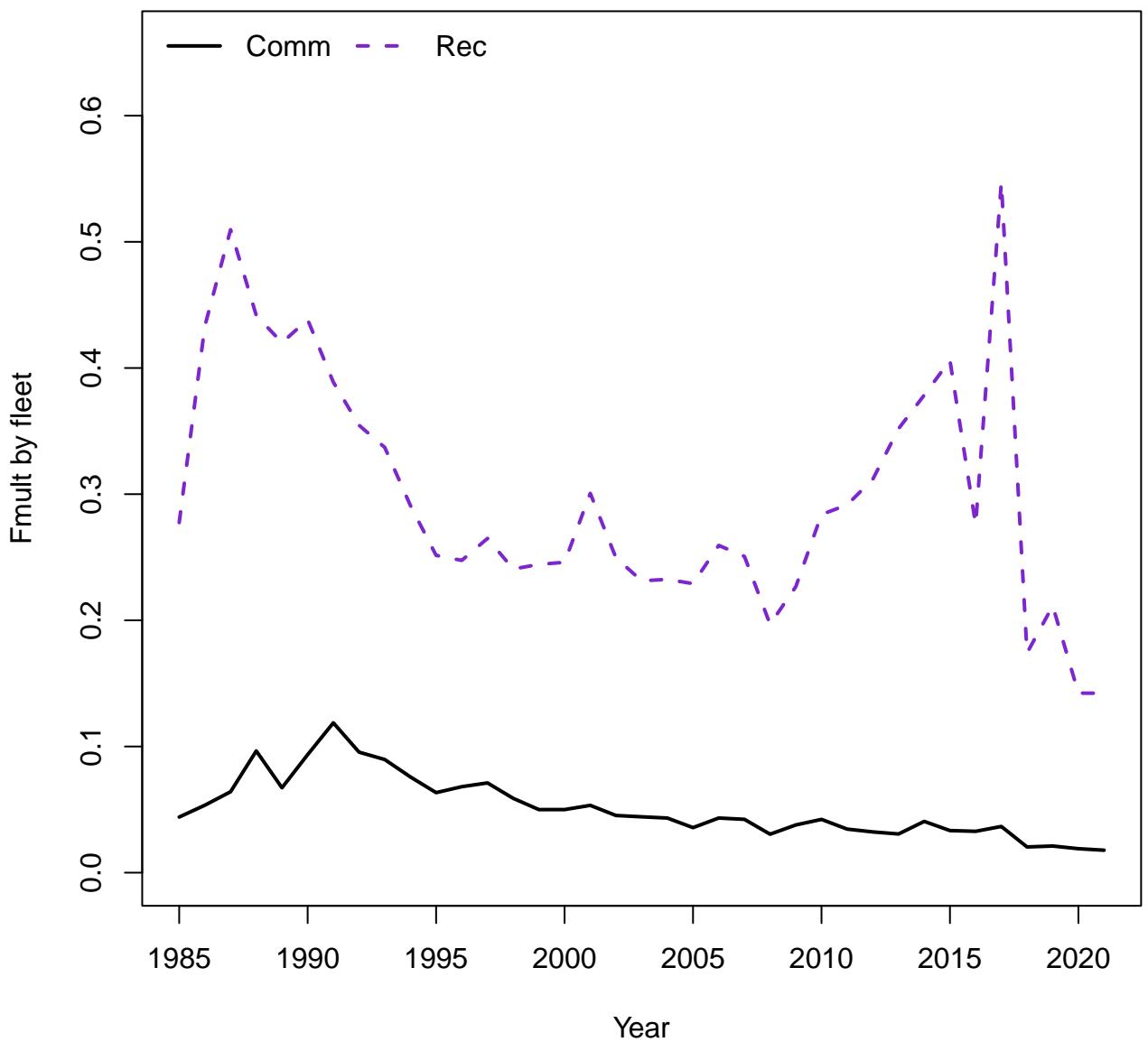
## RESULTS PLOTS

## Fleet 1 (Comm)

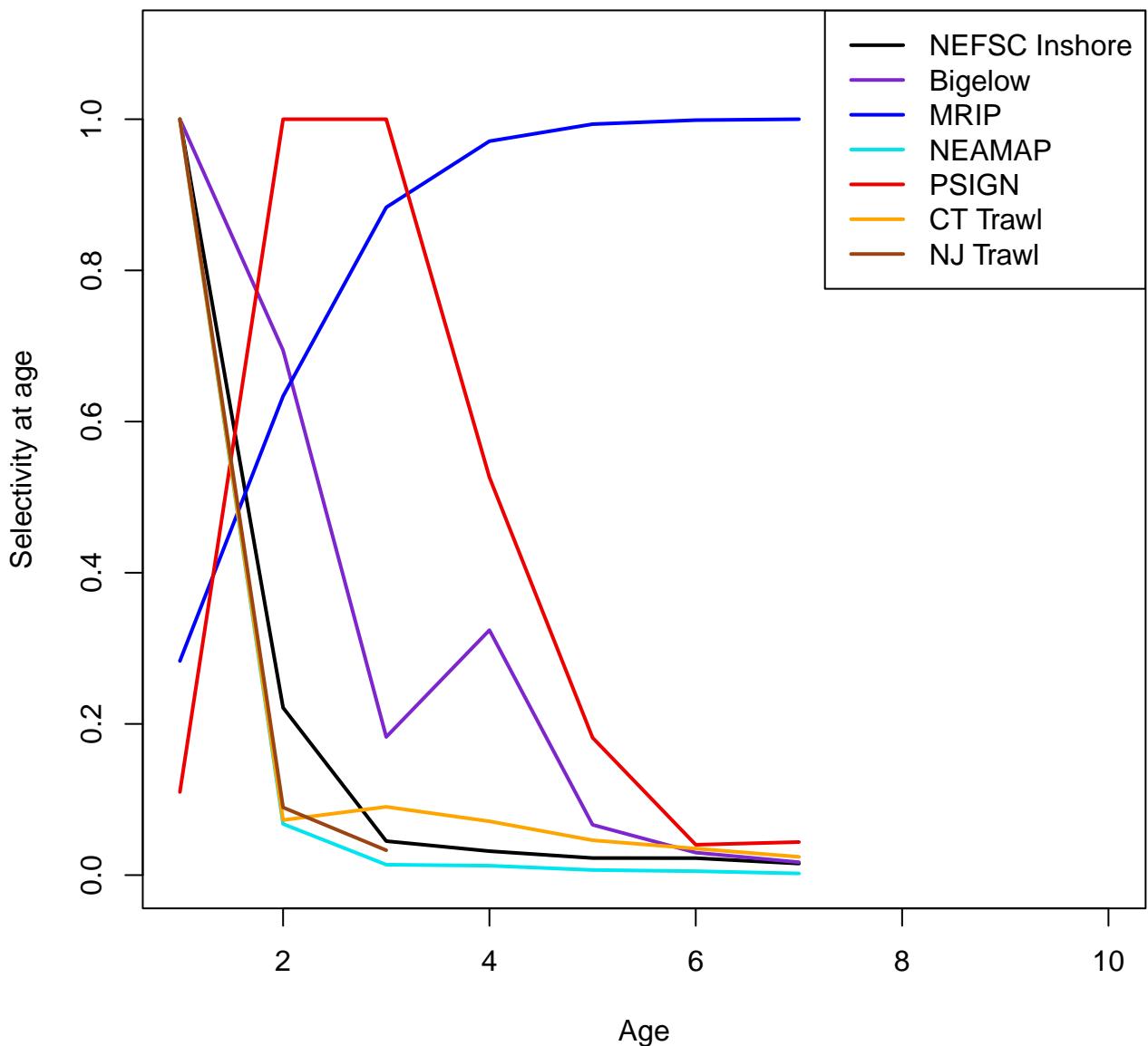


## Fleet 2 (Rec)





## Indices



## Catch for Fleet 1 (Peak Age) Observed

Log(Catch)

8  
6  
4  
2  
0

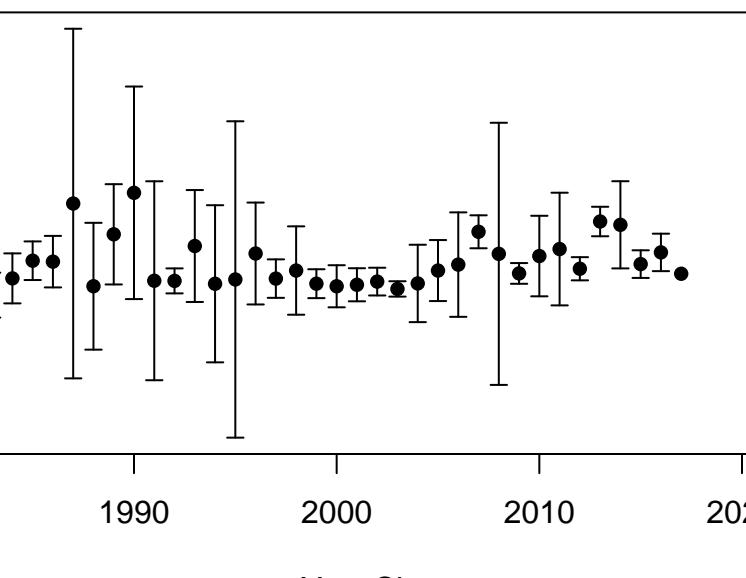
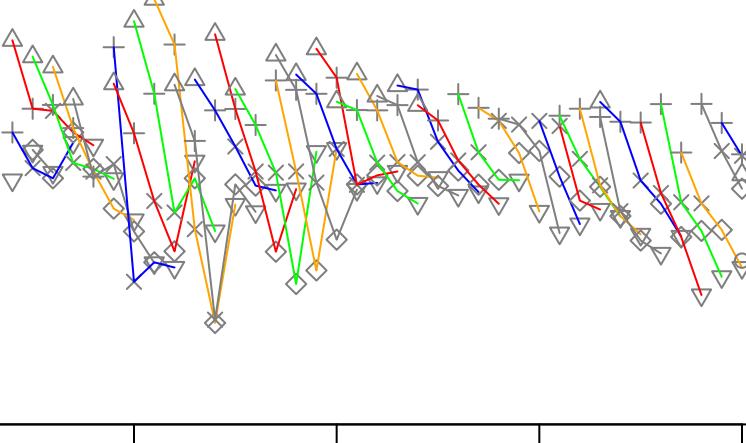
1980 1990 2000 2010 2020

Z

3  
2  
1  
0  
-1

1980 1990 2000 2010 2020

Year Class



## Catch for Fleet 1 (Peak Age) Predicted

Log(Catch)

8  
6  
4  
2  
0

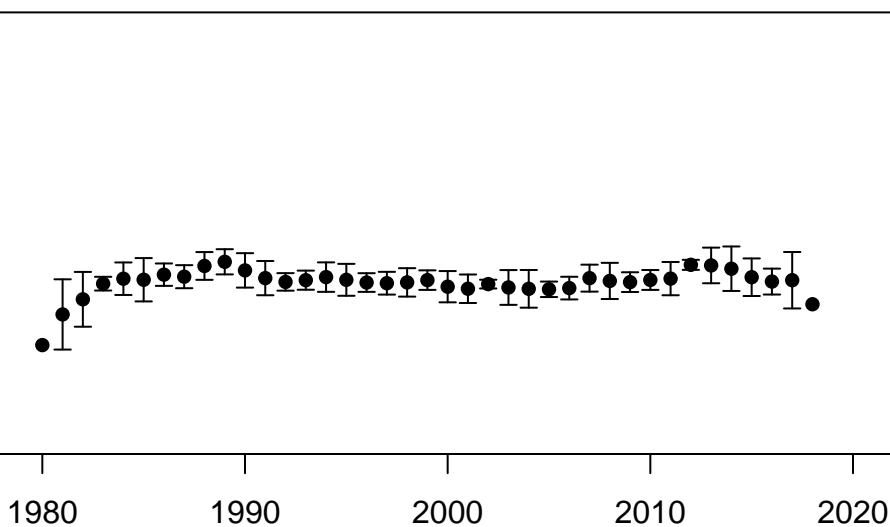
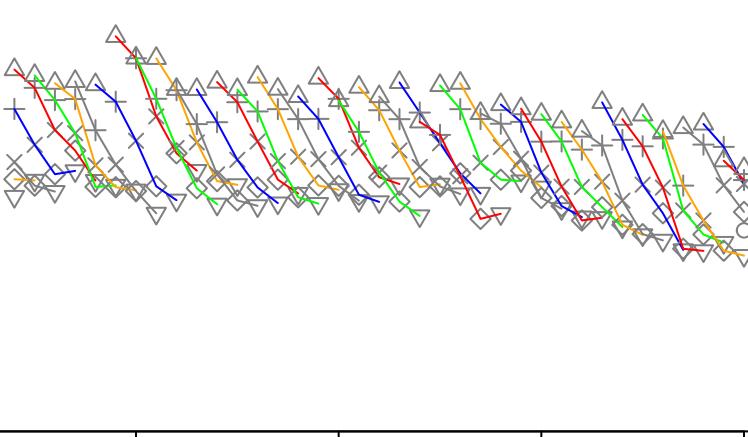
1980 1990 2000 2010 2020

Z

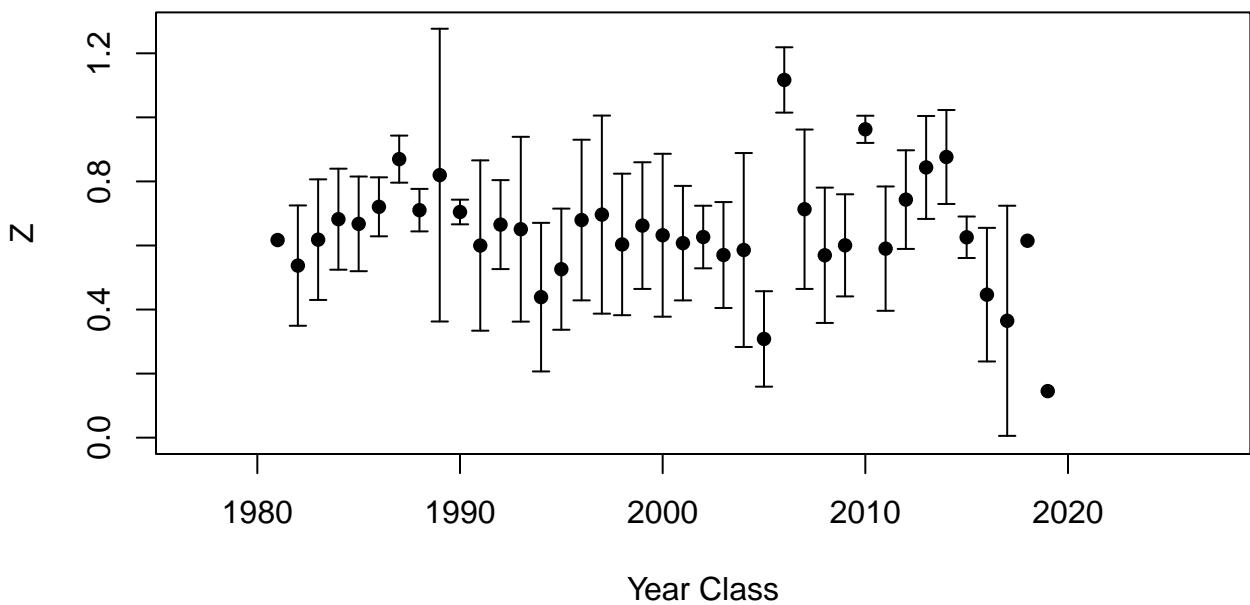
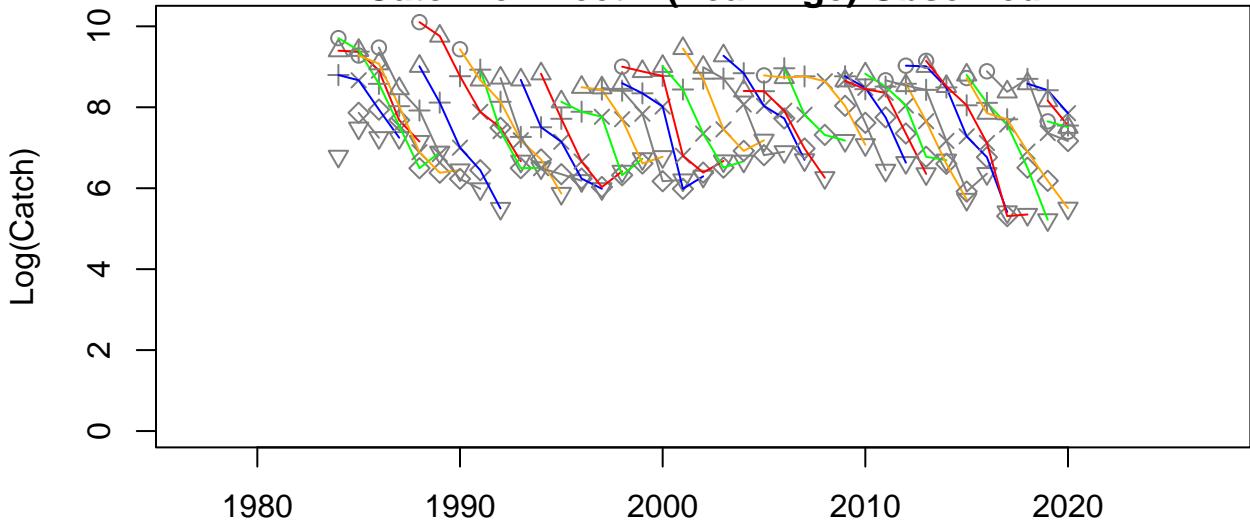
3  
2  
1  
0  
-1

1980 1990 2000 2010 2020

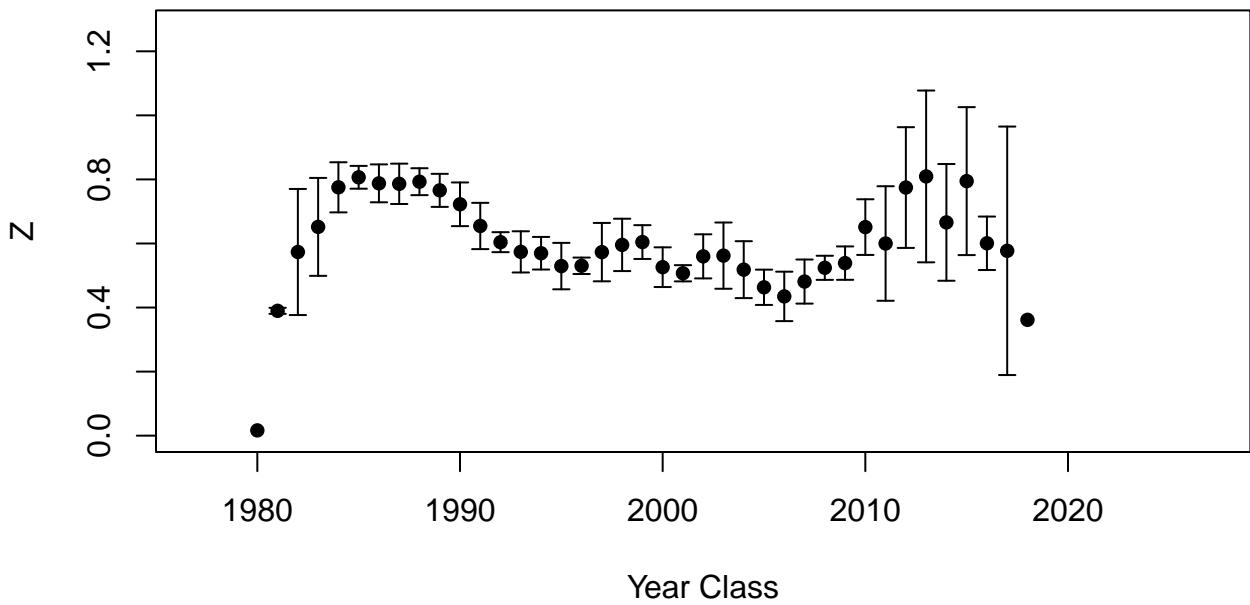
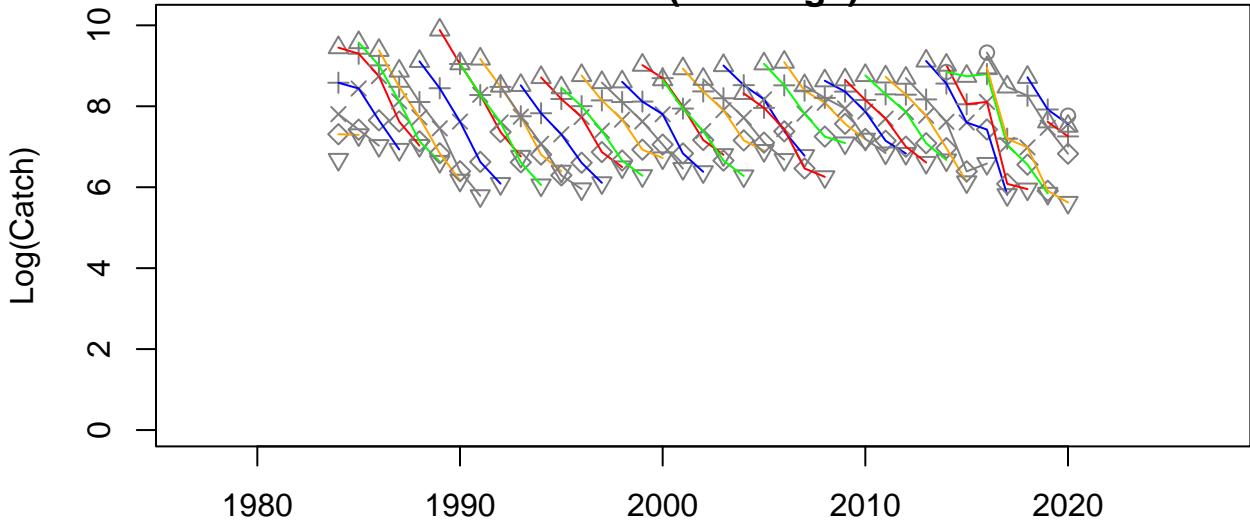
Year Class



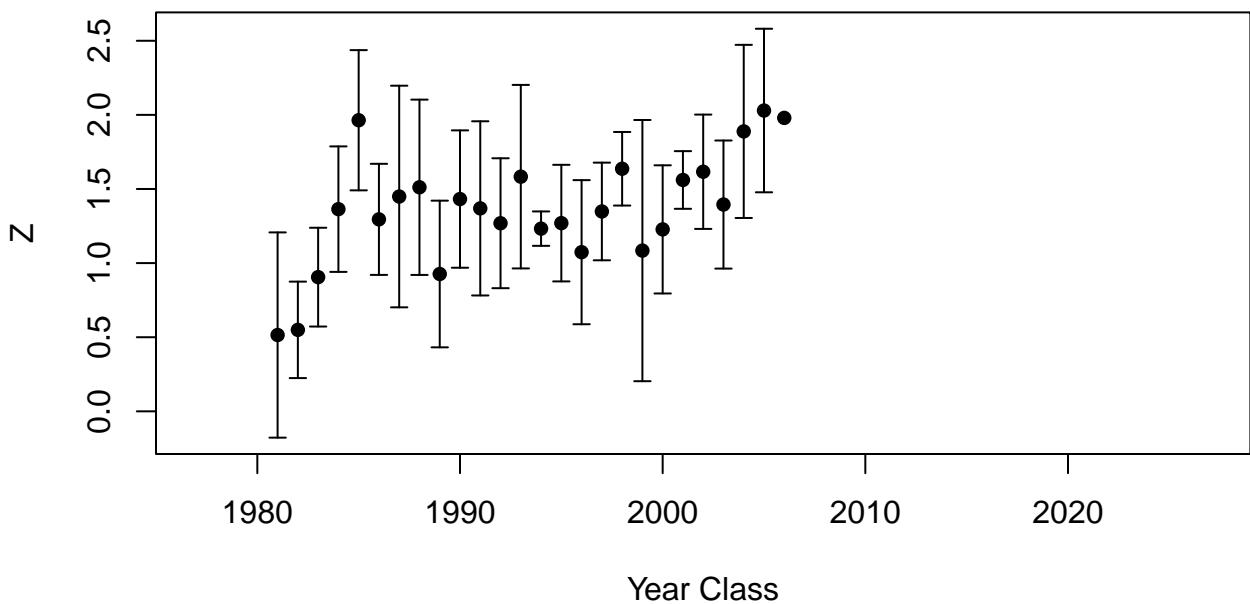
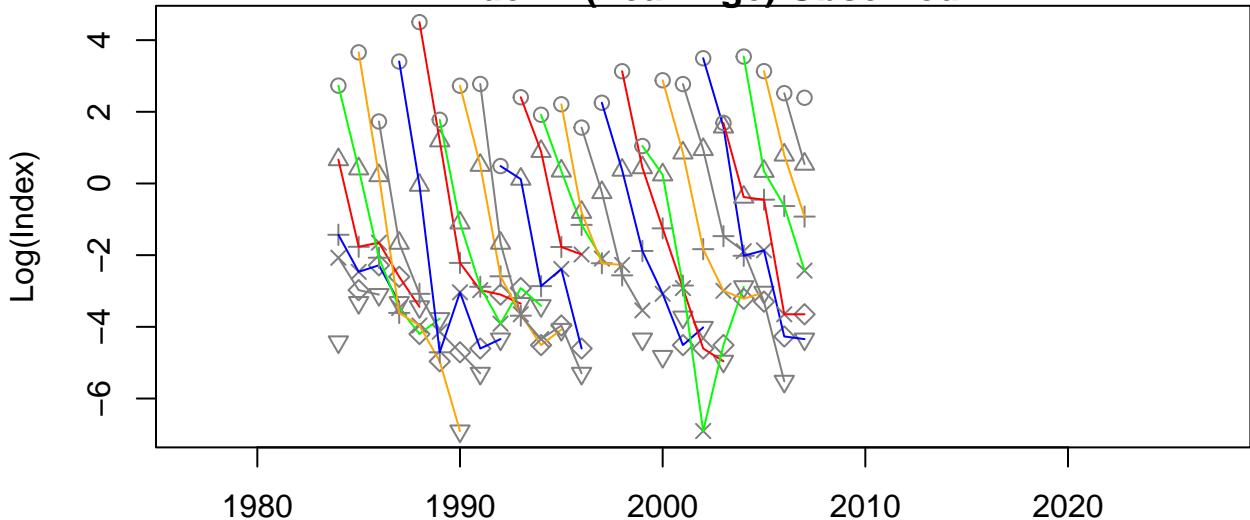
## Catch for Fleet 2 (Peak Age) Observed



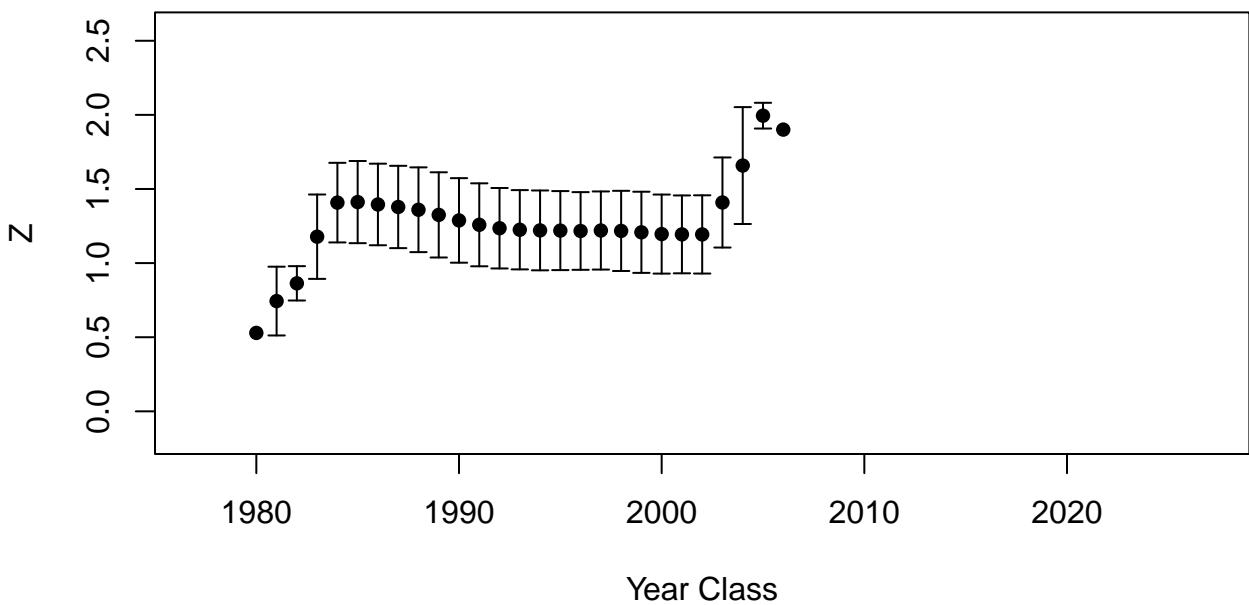
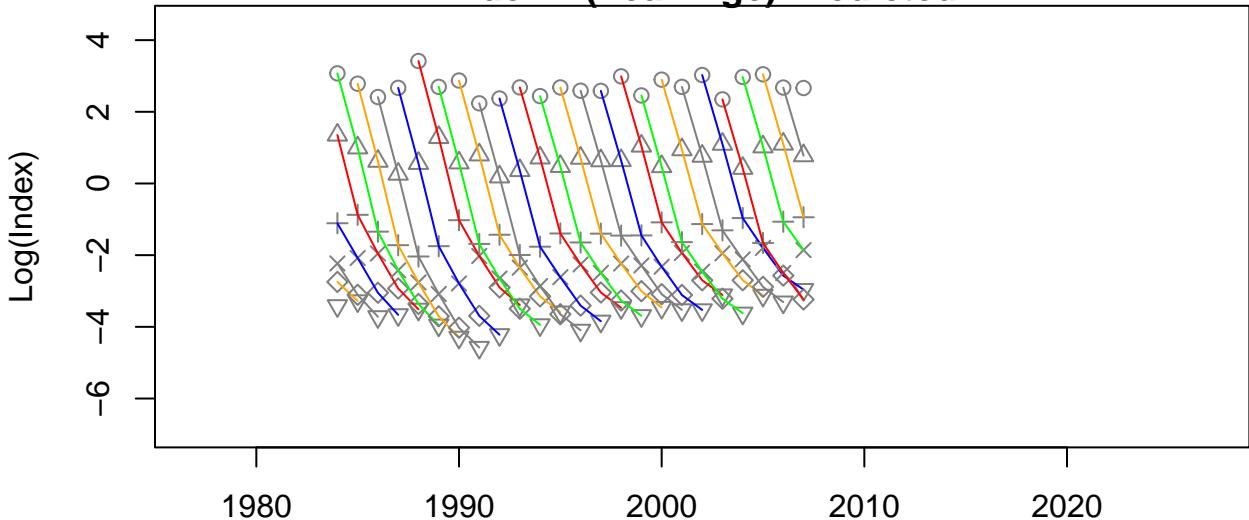
## Catch for Fleet 2 (Peak Age) Predicted



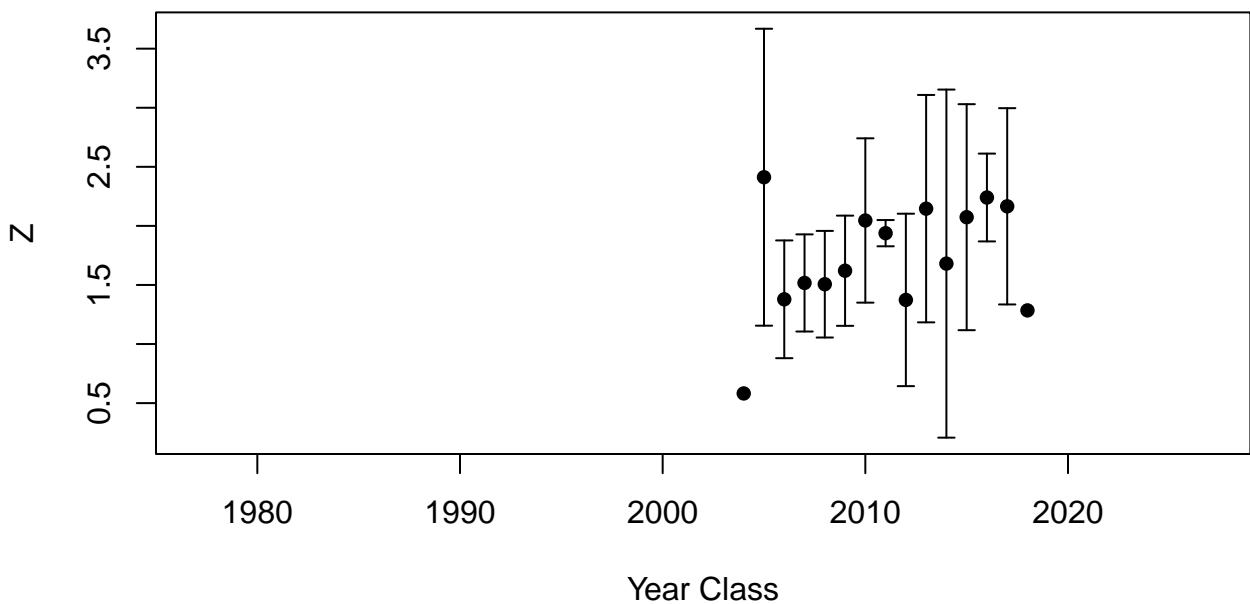
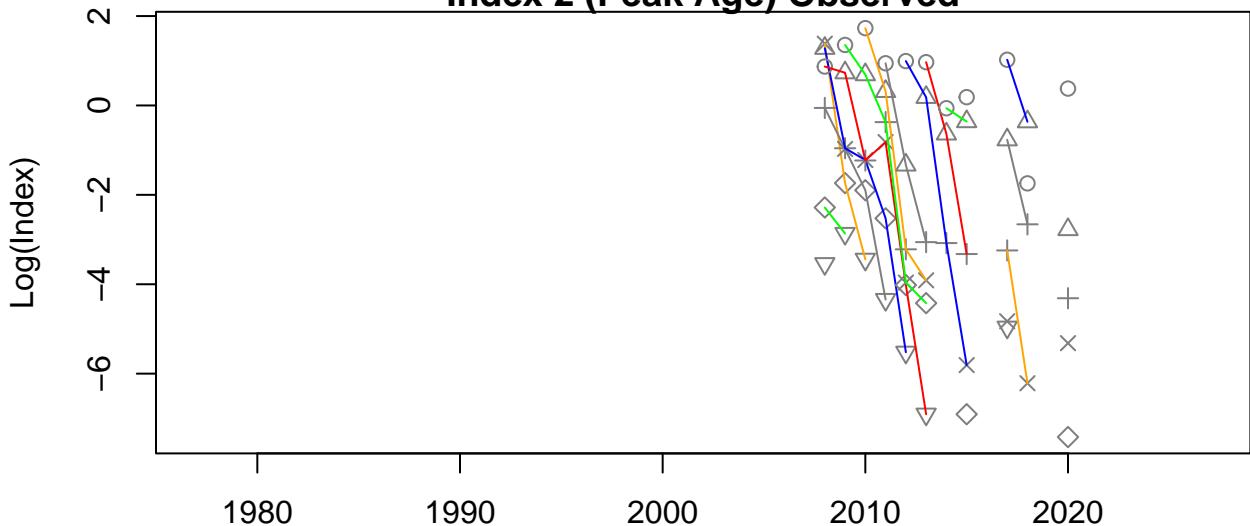
### Index 1 (Peak Age) Observed



## Index 1 (Peak Age) Predicted



## Index 2 (Peak Age) Observed

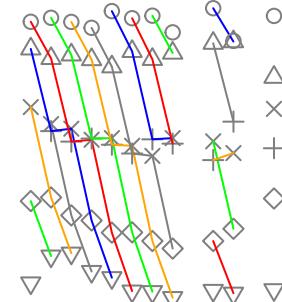


## Index 2 (Peak Age) Predicted

Log(Index)

2  
0  
-2  
-4  
-6

1980 1990 2000 2010 2020

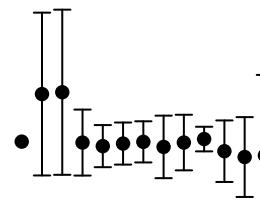


Z

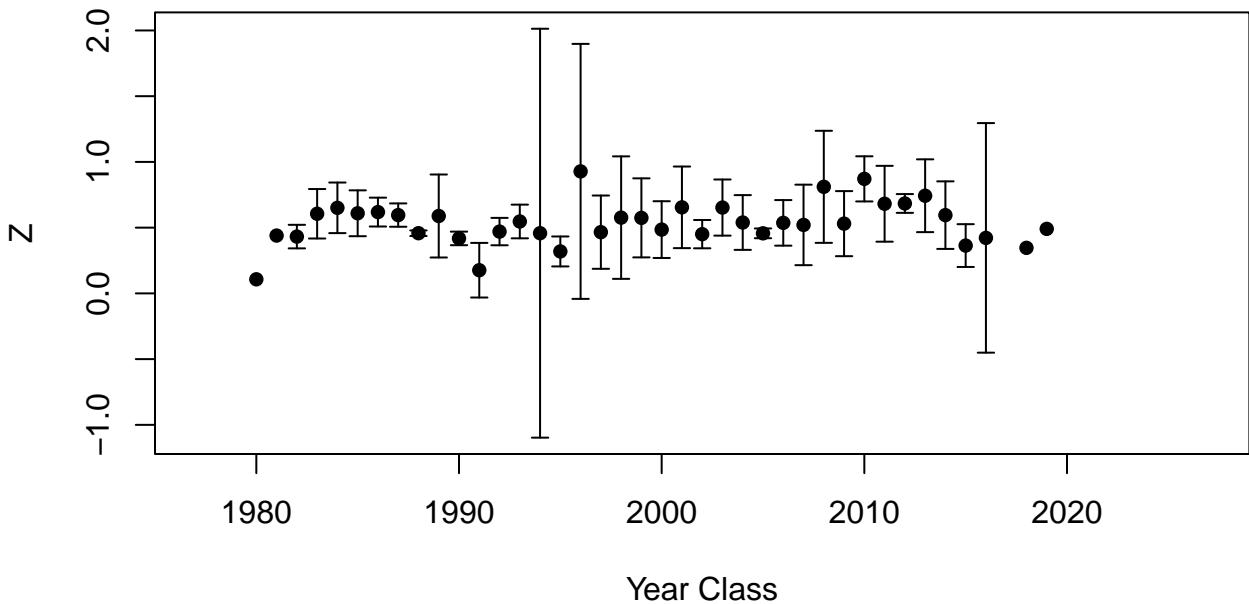
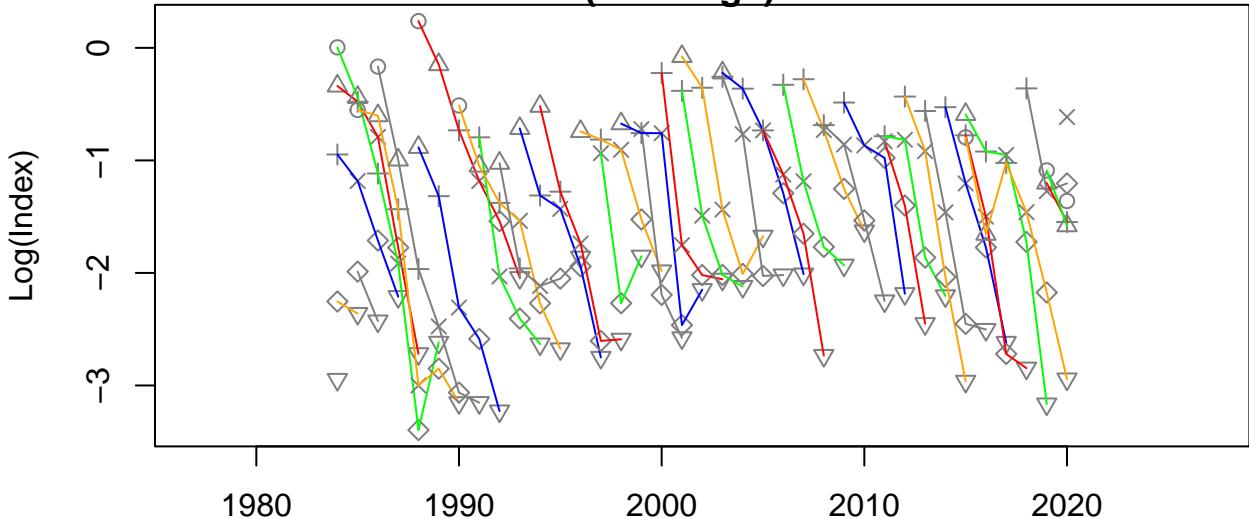
3.5  
2.5  
1.5  
0.5

1980 1990 2000 2010 2020

Year Class



### Index 3 (Peak Age) Observed

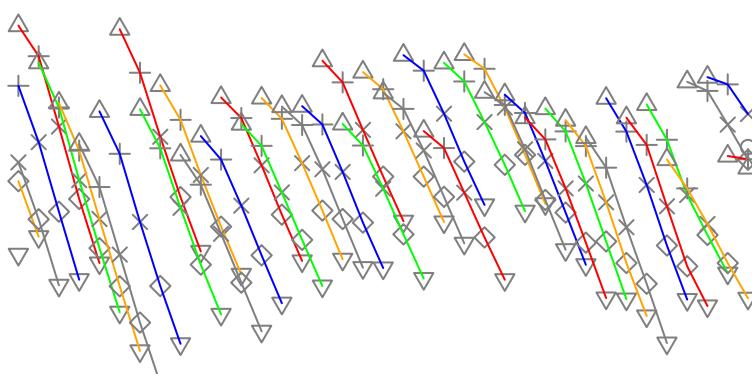


### Index 3 (Peak Age) Predicted

Log(Index)

0  
-1  
-2  
-3

1980 1990 2000 2010 2020

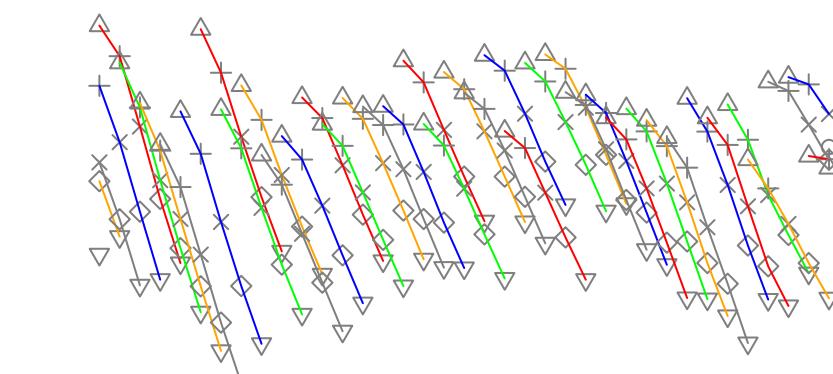


Z

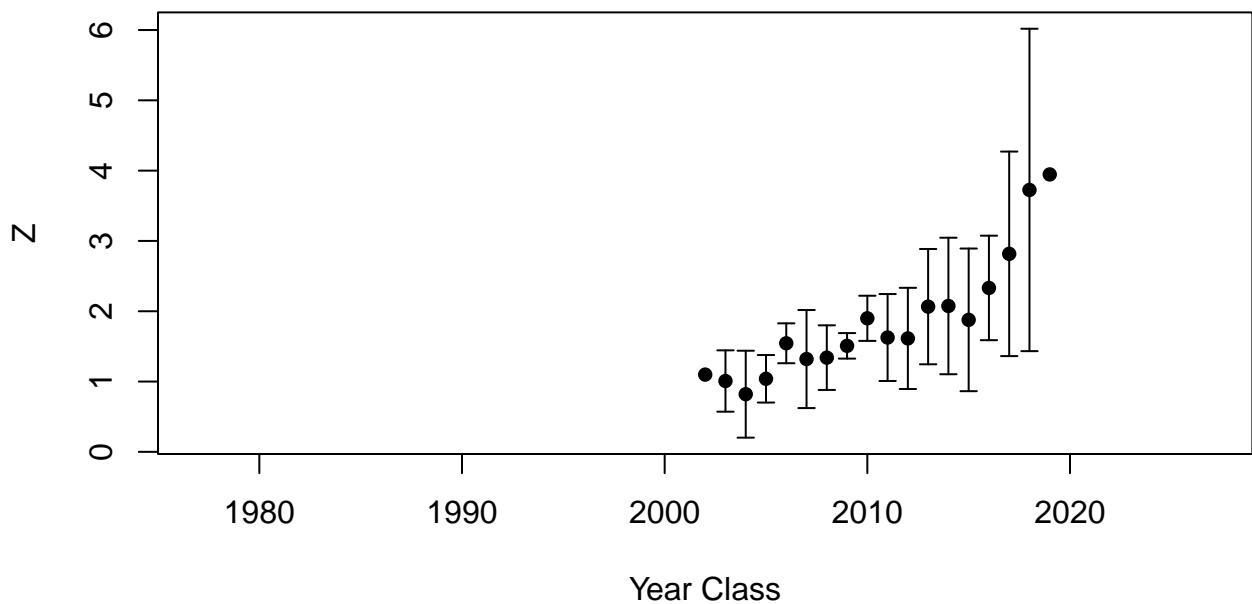
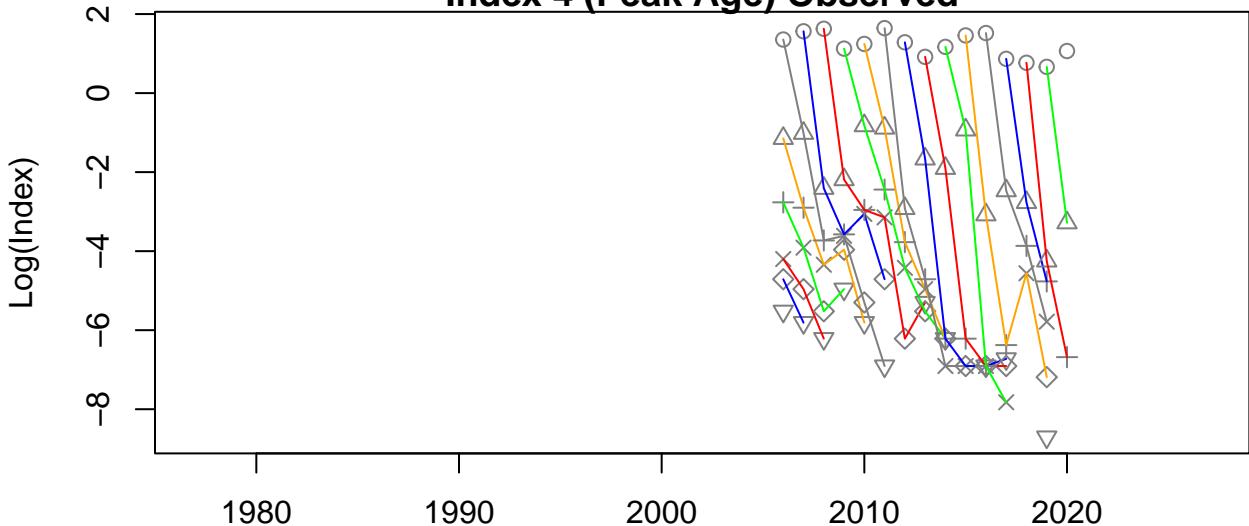
2.0  
1.0  
0.0  
-1.0

1980 1990 2000 2010 2020

Year Class

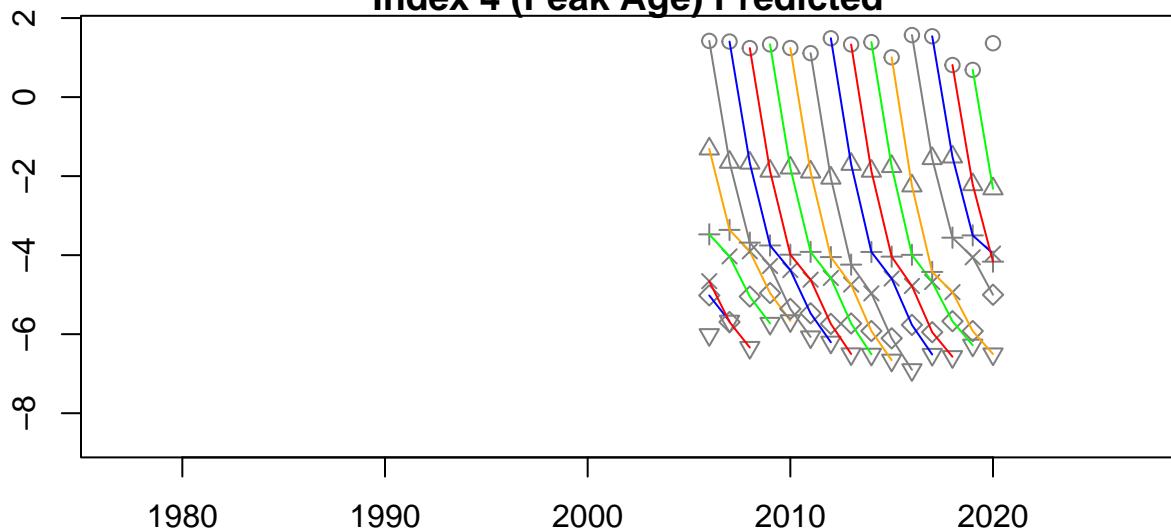


### Index 4 (Peak Age) Observed



### Index 4 (Peak Age) Predicted

Log(Index)

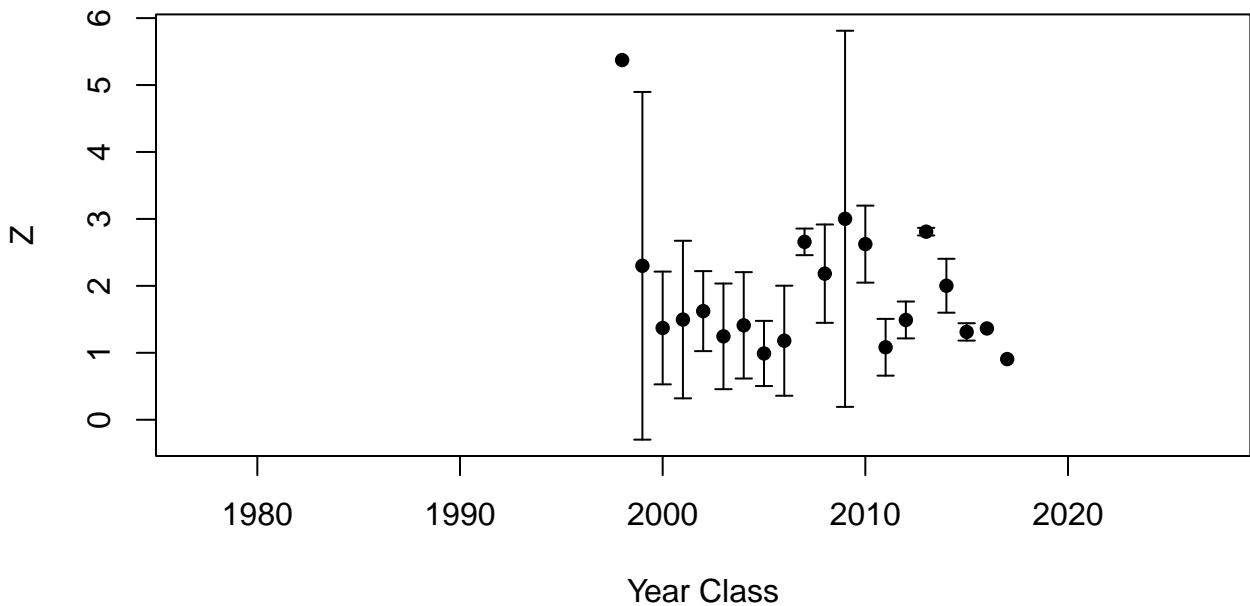
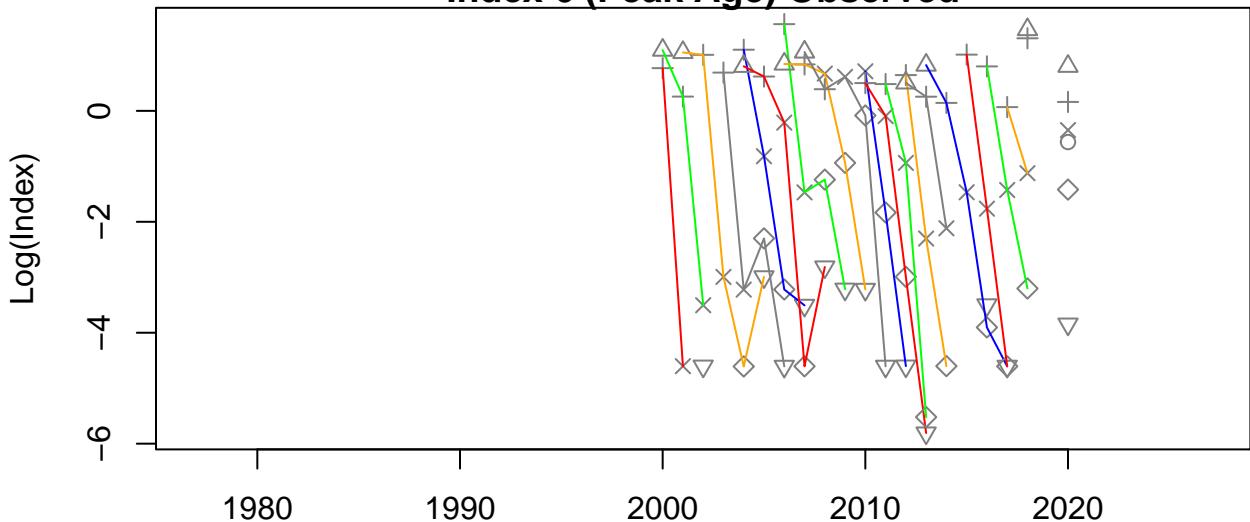


Z

1980 1990 2000 2010 2020

Year Class

### Index 6 (Peak Age) Observed

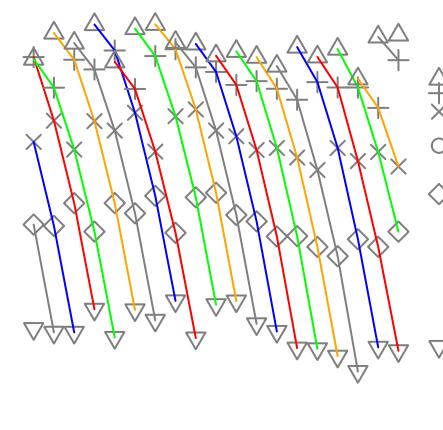


## Index 6 (Peak Age) Predicted

Log(Index)

0  
-2  
-4  
-6

1980 1990 2000 2010 2020

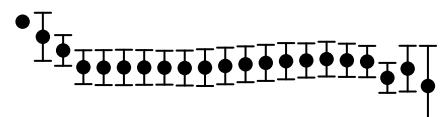


Z

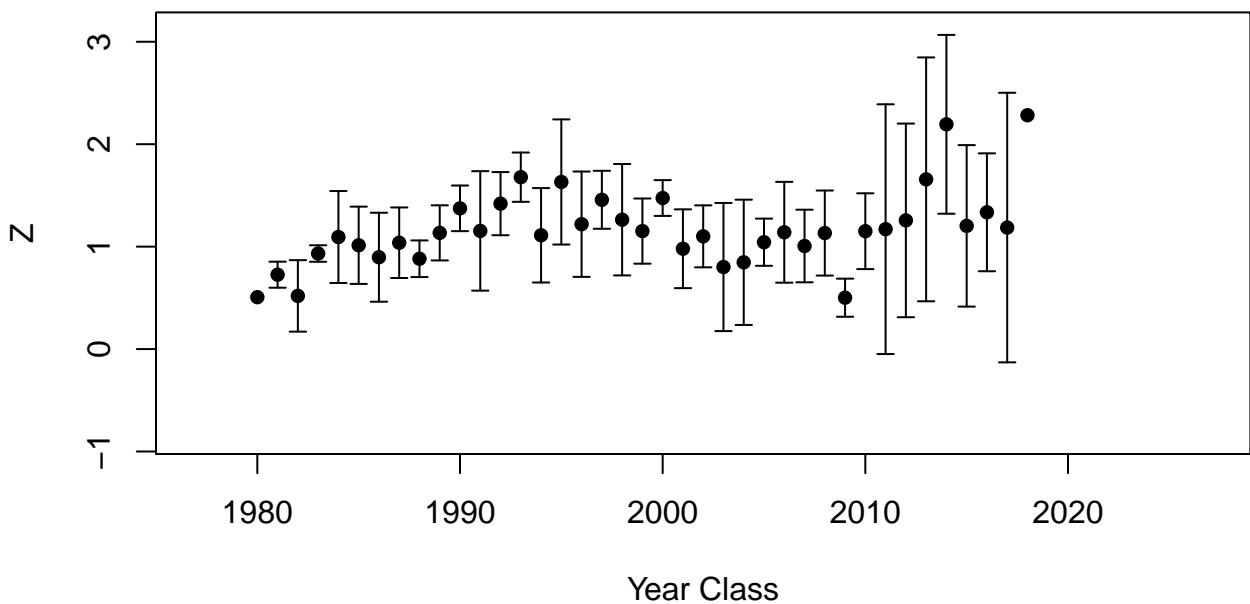
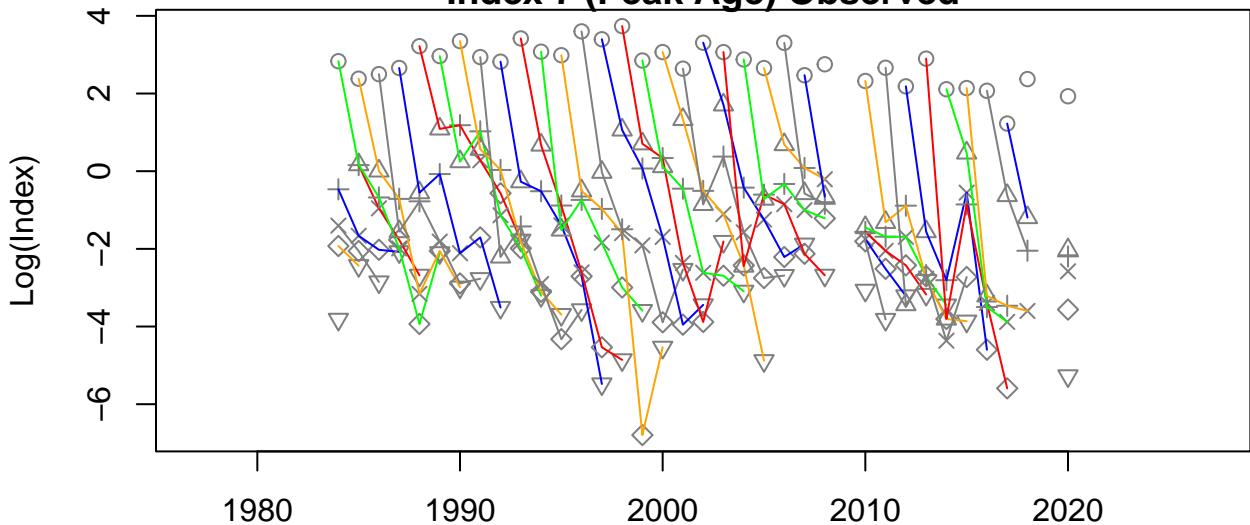
6  
5  
4  
3  
2  
1  
0

1980 1990 2000 2010 2020

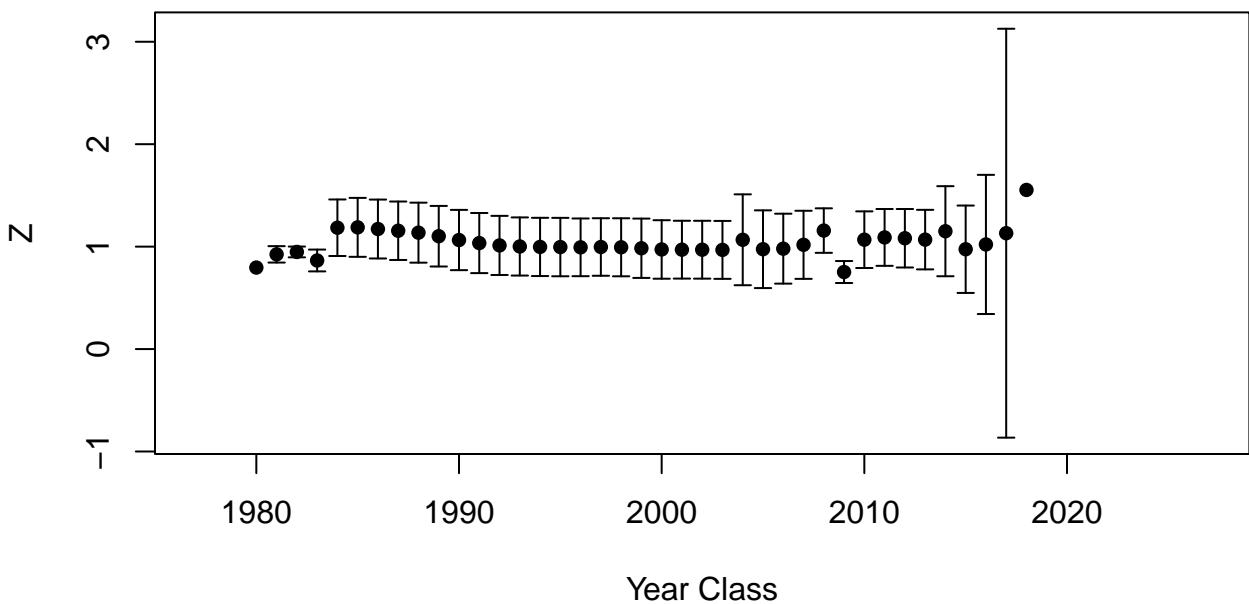
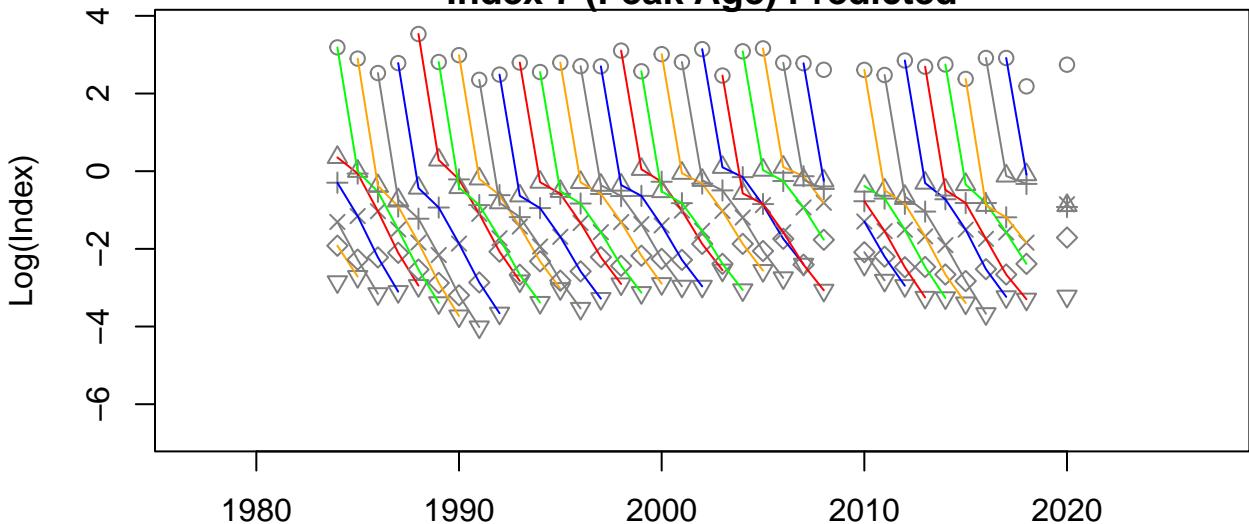
Year Class



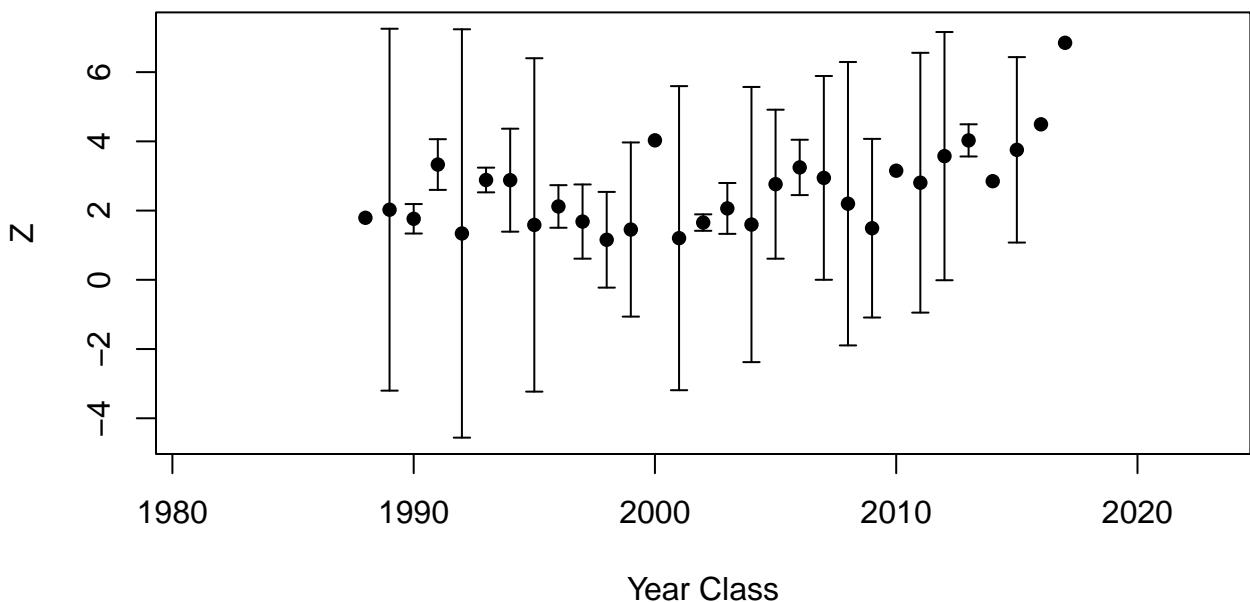
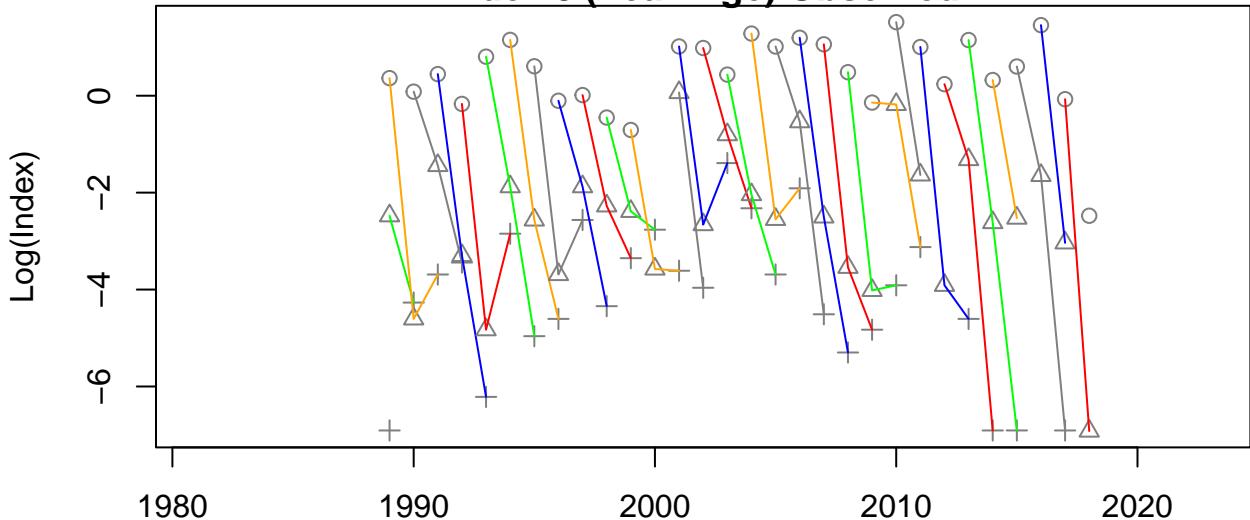
## Index 7 (Peak Age) Observed



## Index 7 (Peak Age) Predicted



## Index 8 (Peak Age) Observed



### Index 8 (Peak Age) Predicted

Log(Index)

0  
-2  
-4  
-6

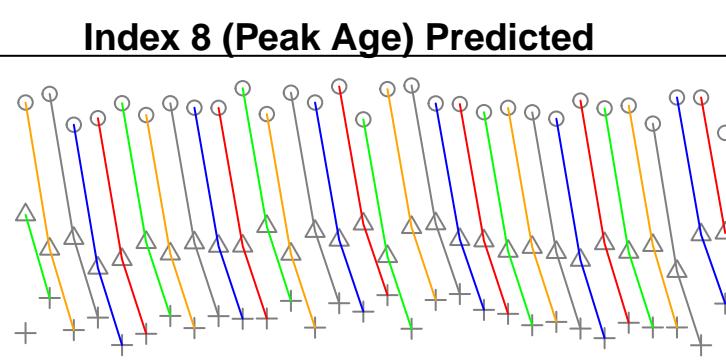
1980

1990

2000

2010

2020



Z

-4  
-2  
0  
2  
4  
6

1980

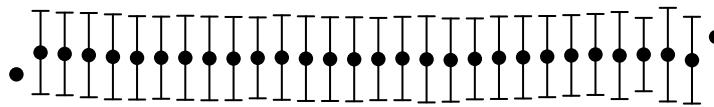
1990

2000

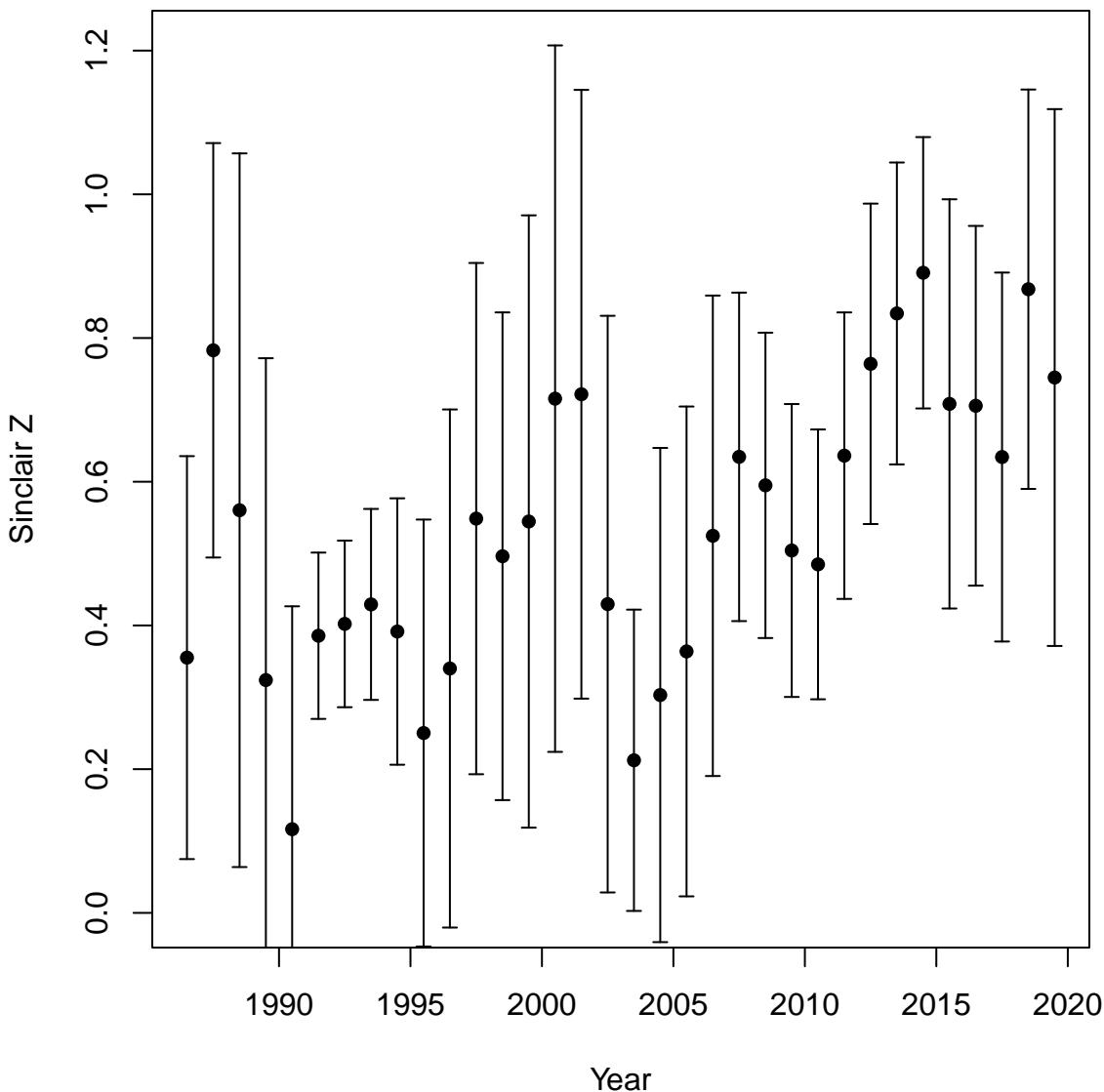
2010

2020

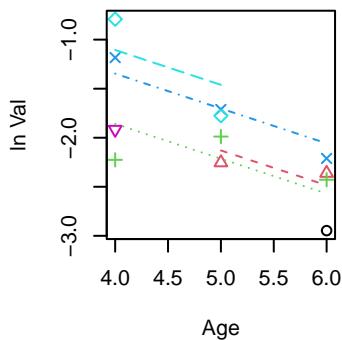
Year Class



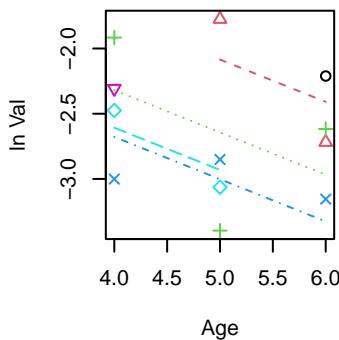
## MRIP



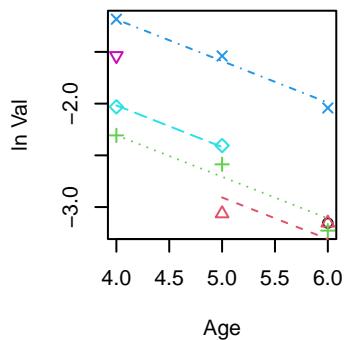
**Years 1985 to 1988**  
 $Z = 0.355$



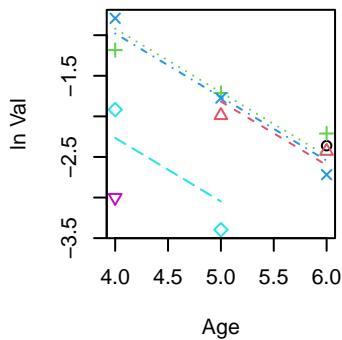
**Years 1988 to 1991**  
 $Z = 0.324$



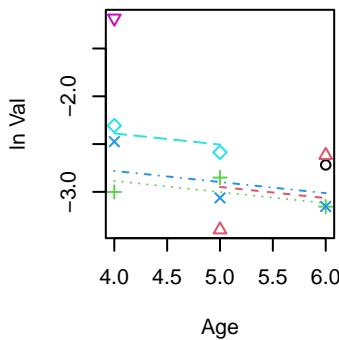
**Years 1991 to 1994**  
 $Z = 0.402$



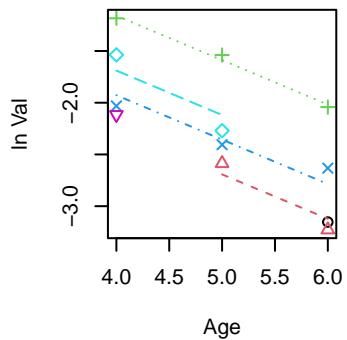
**Years 1986 to 1989**  
 $Z = 0.783$



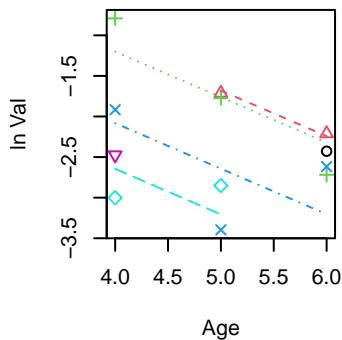
**Years 1989 to 1992**  
 $Z = 0.116$



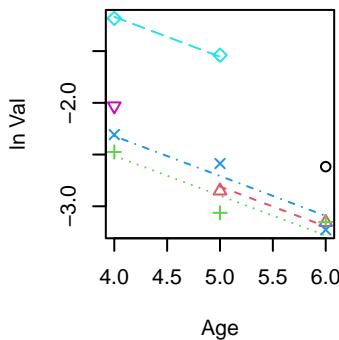
**Years 1992 to 1995**  
 $Z = 0.429$



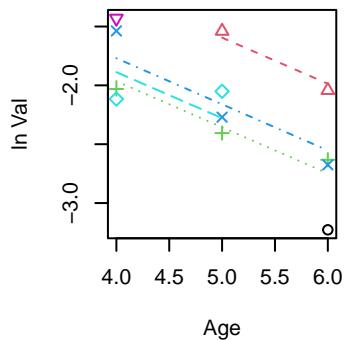
**Years 1987 to 1990**  
 $Z = 0.56$



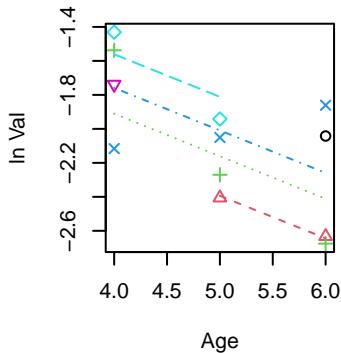
**Years 1990 to 1993**  
 $Z = 0.386$



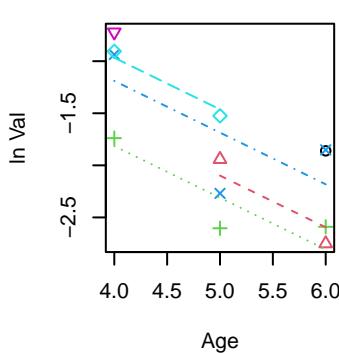
**Years 1993 to 1996**  
 $Z = 0.392$



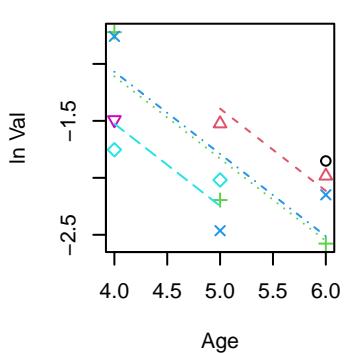
**Years 1994 to 1997**  
 $Z = 0.25$



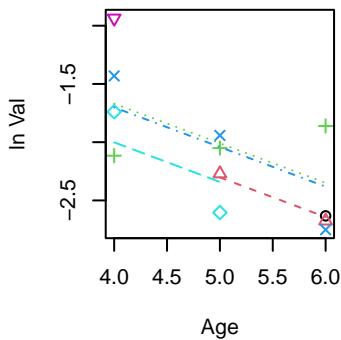
**Years 1997 to 2000**  
 $Z = 0.496$



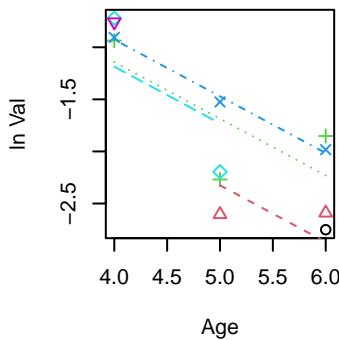
**Years 2000 to 2003**  
 $Z = 0.722$



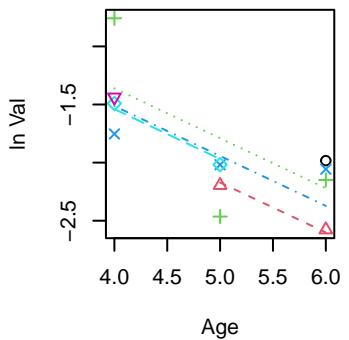
**Years 1995 to 1998**  
 $Z = 0.34$



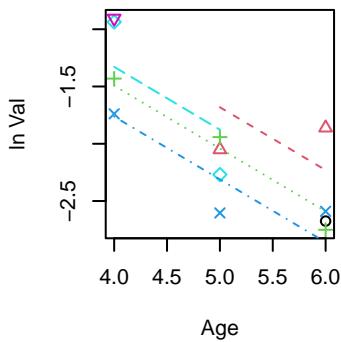
**Years 1998 to 2001**  
 $Z = 0.545$



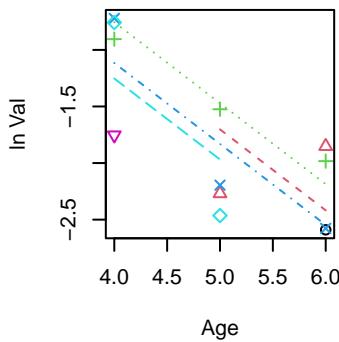
**Years 2001 to 2004**  
 $Z = 0.43$



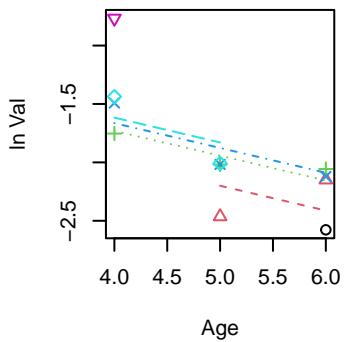
**Years 1996 to 1999**  
 $Z = 0.549$



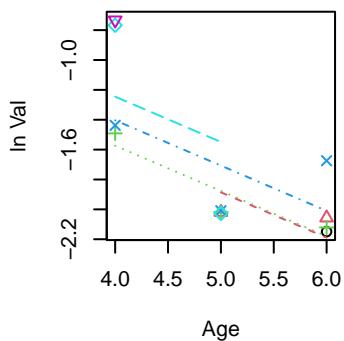
**Years 1999 to 2002**  
 $Z = 0.716$



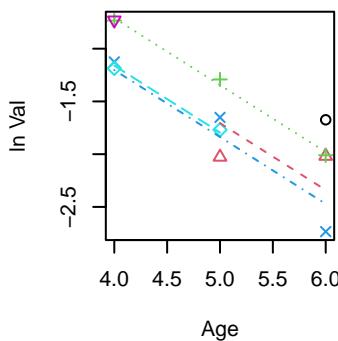
**Years 2002 to 2005**  
 $Z = 0.212$



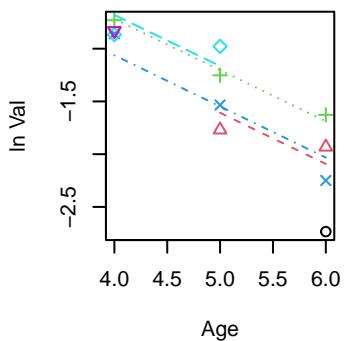
**Years 2003 to 2006**  
 $Z = 0.303$



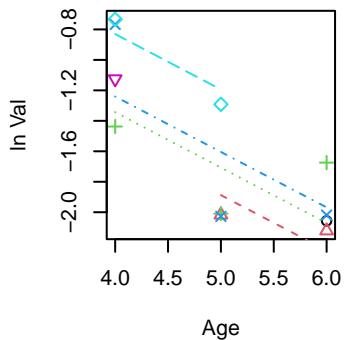
**Years 2006 to 2009**  
 $Z = 0.635$



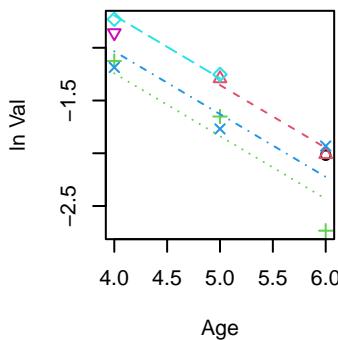
**Years 2009 to 2012**  
 $Z = 0.485$



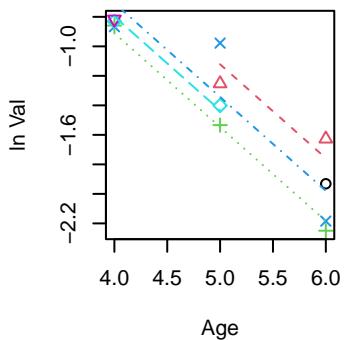
**Years 2004 to 2007**  
 $Z = 0.364$



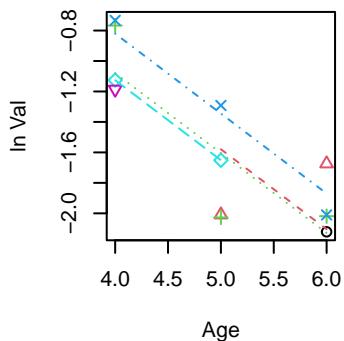
**Years 2007 to 2010**  
 $Z = 0.595$



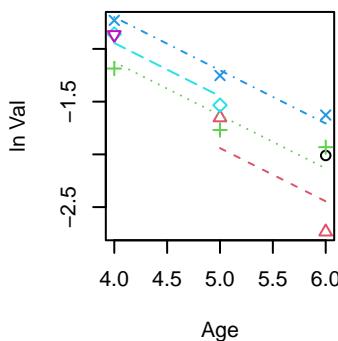
**Years 2010 to 2013**  
 $Z = 0.636$



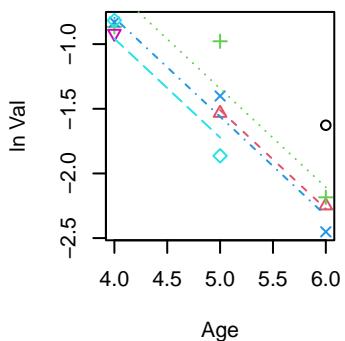
**Years 2005 to 2008**  
 $Z = 0.525$



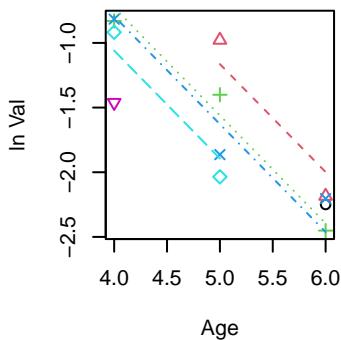
**Years 2008 to 2011**  
 $Z = 0.504$



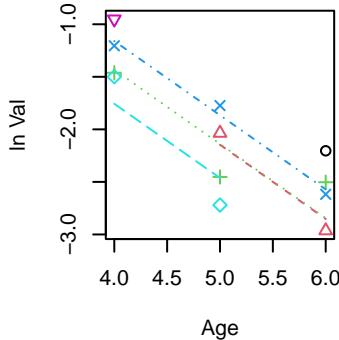
**Years 2011 to 2014**  
 $Z = 0.764$



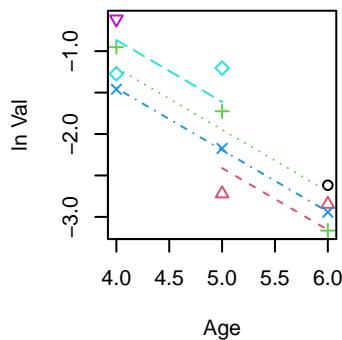
**Years 2012 to 2015**  
 $Z = 0.834$



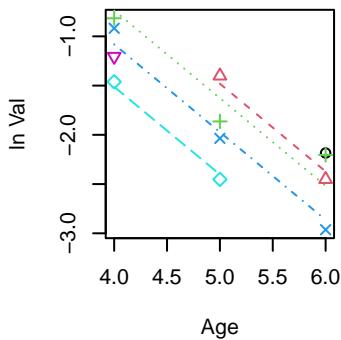
**Years 2015 to 2018**  
 $Z = 0.706$



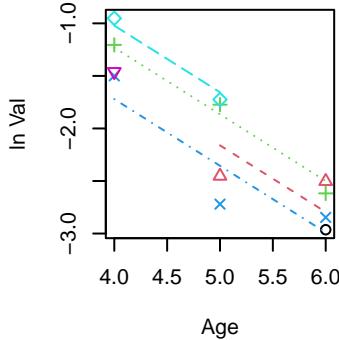
**Years 2018 to 2021**  
 $Z = 0.745$



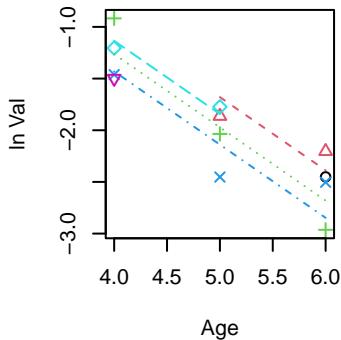
**Years 2013 to 2016**  
 $Z = 0.891$



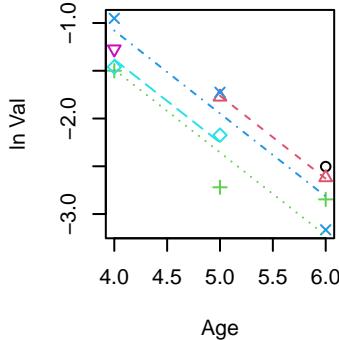
**Years 2016 to 2019**  
 $Z = 0.634$



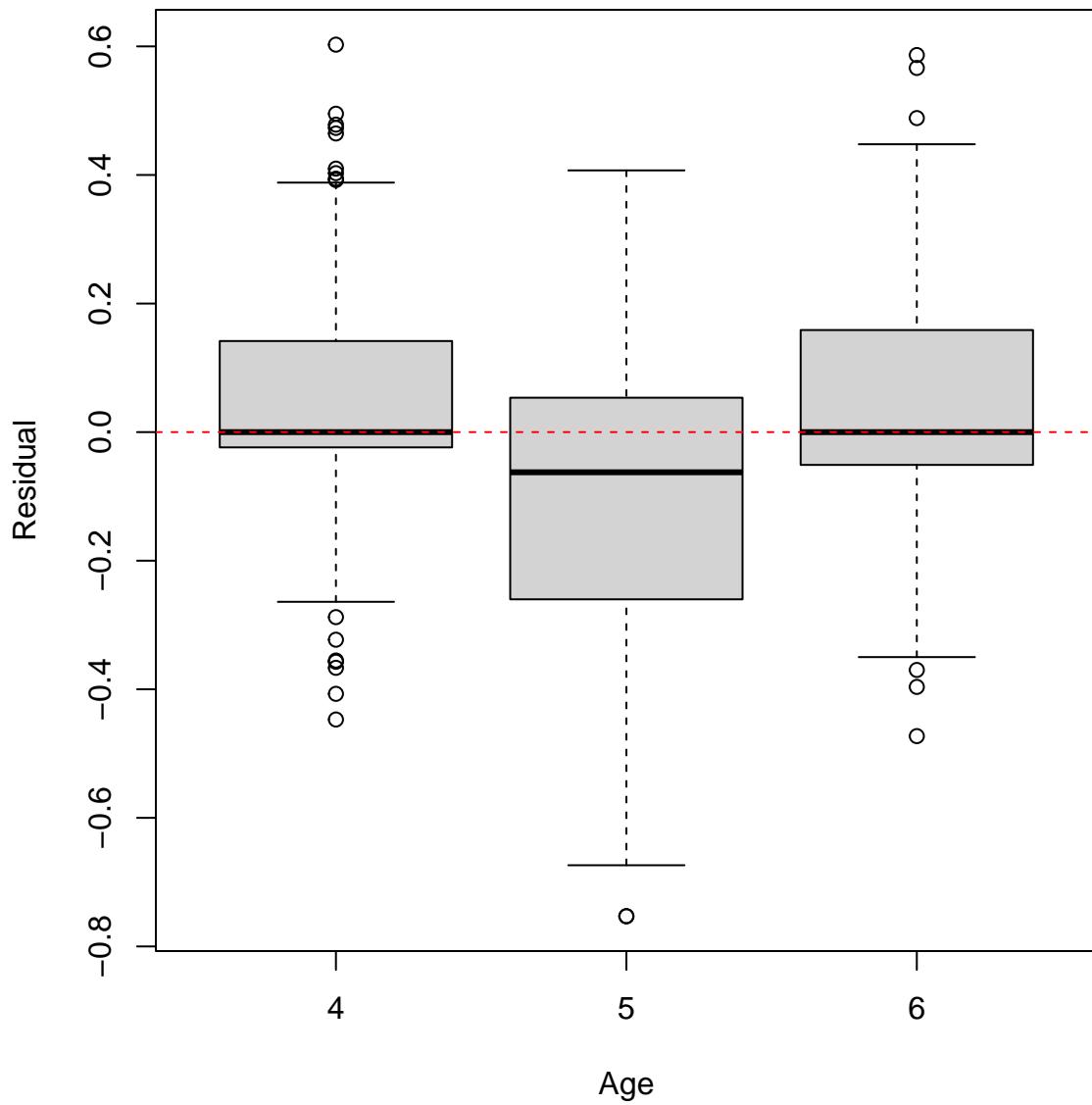
**Years 2014 to 2017**  
 $Z = 0.708$



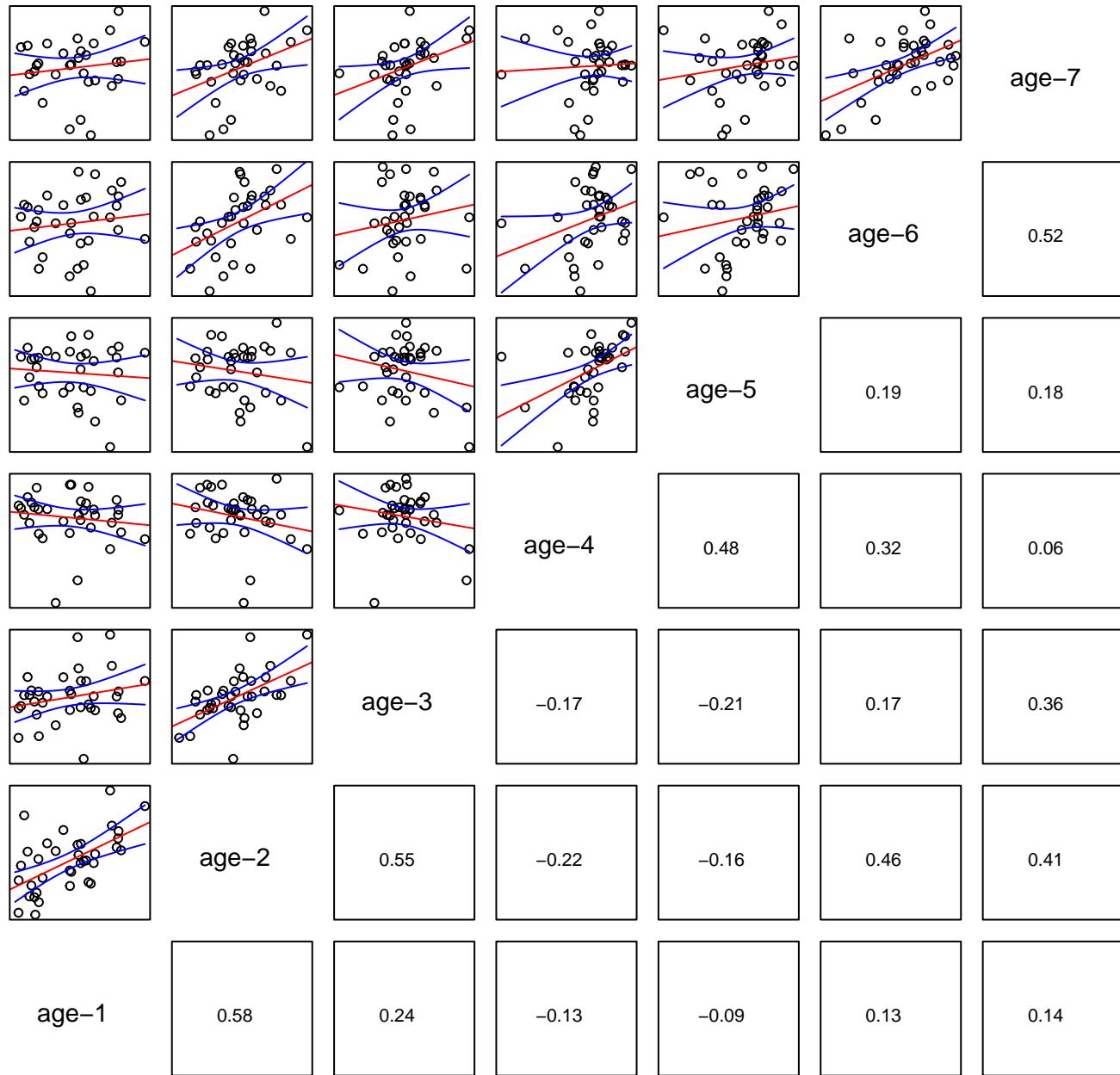
**Years 2017 to 2020**  
 $Z = 0.868$



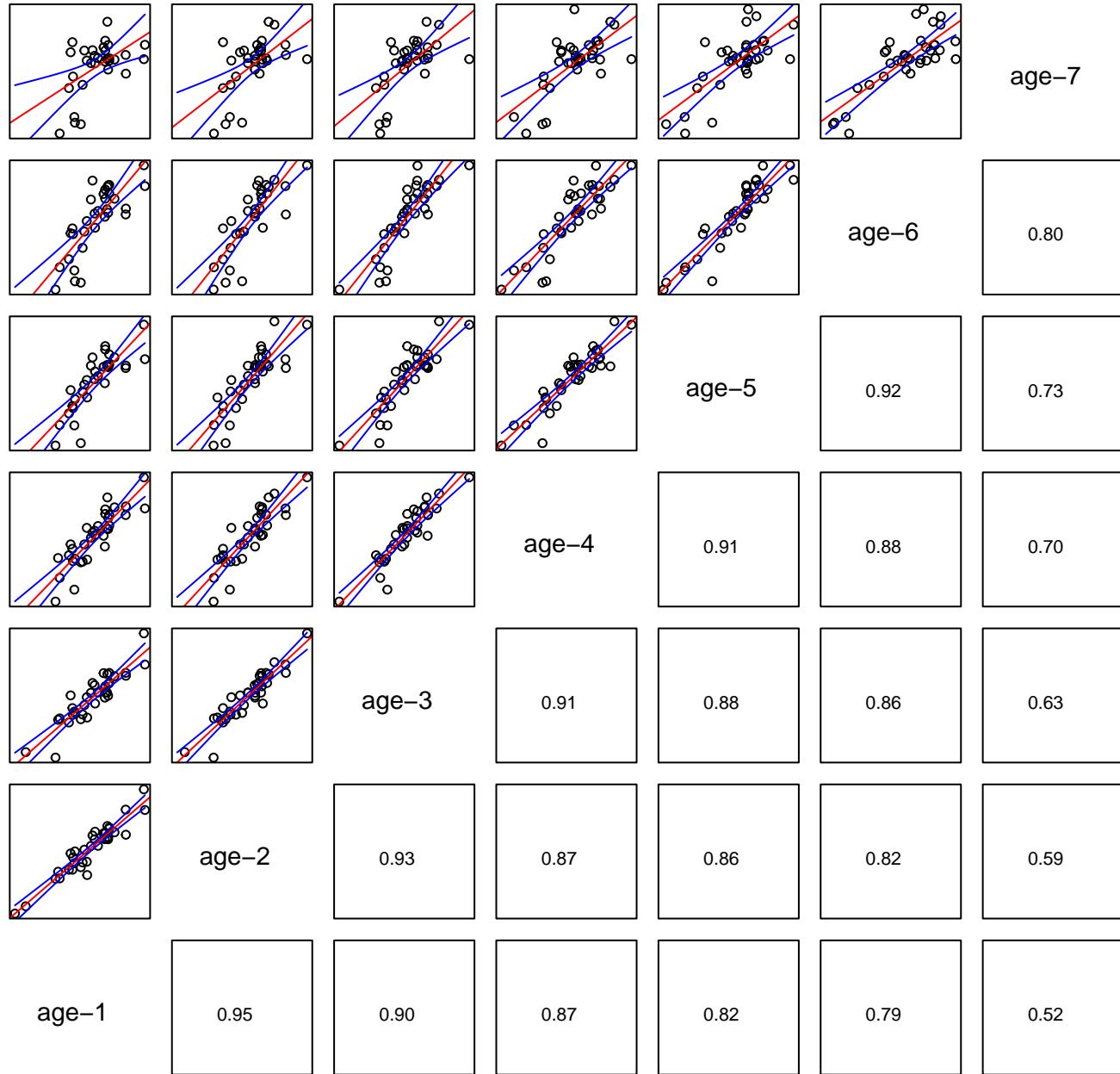
## MRIP



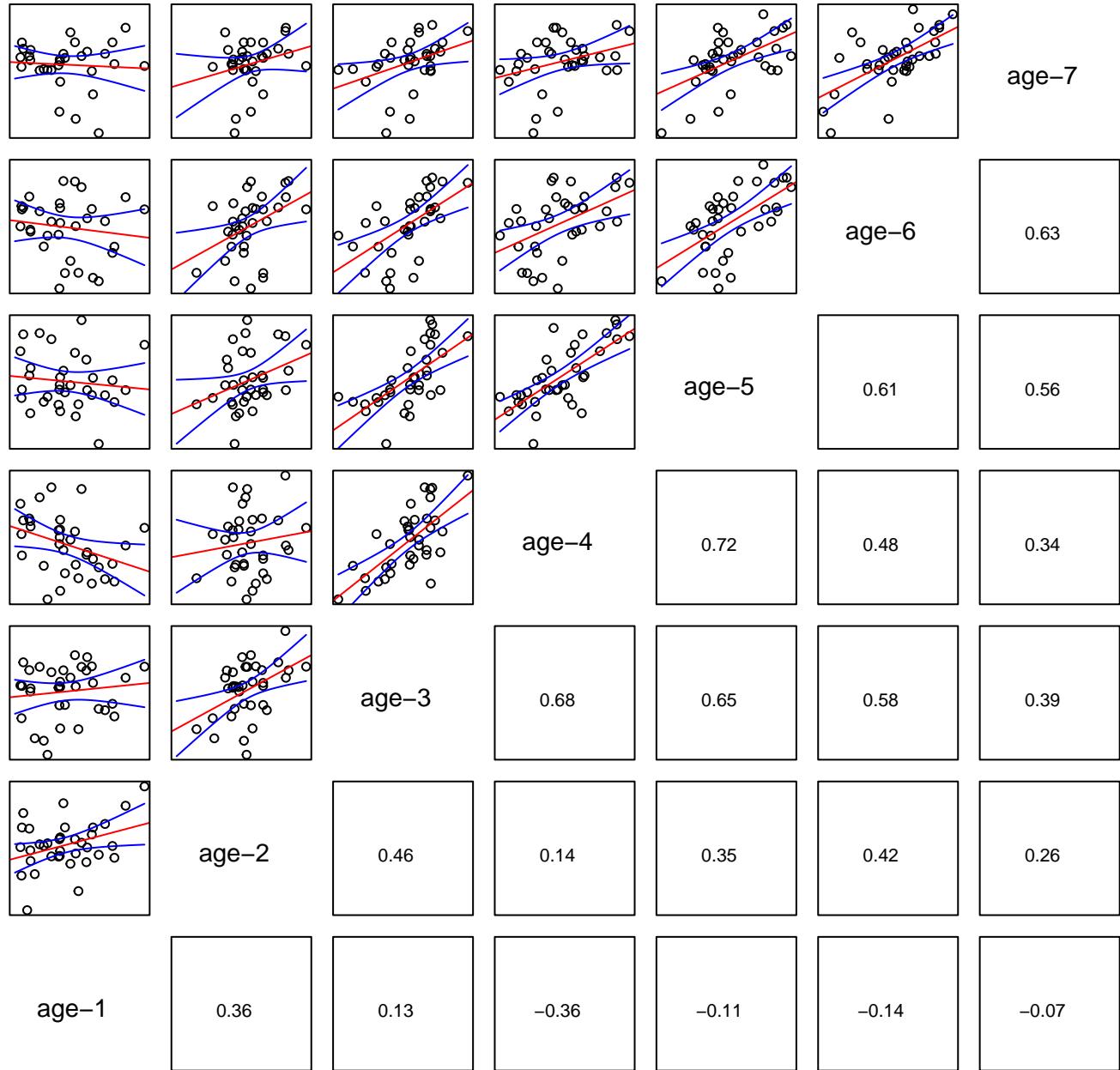
### Catch for Fleet 1 (Comm) Observed



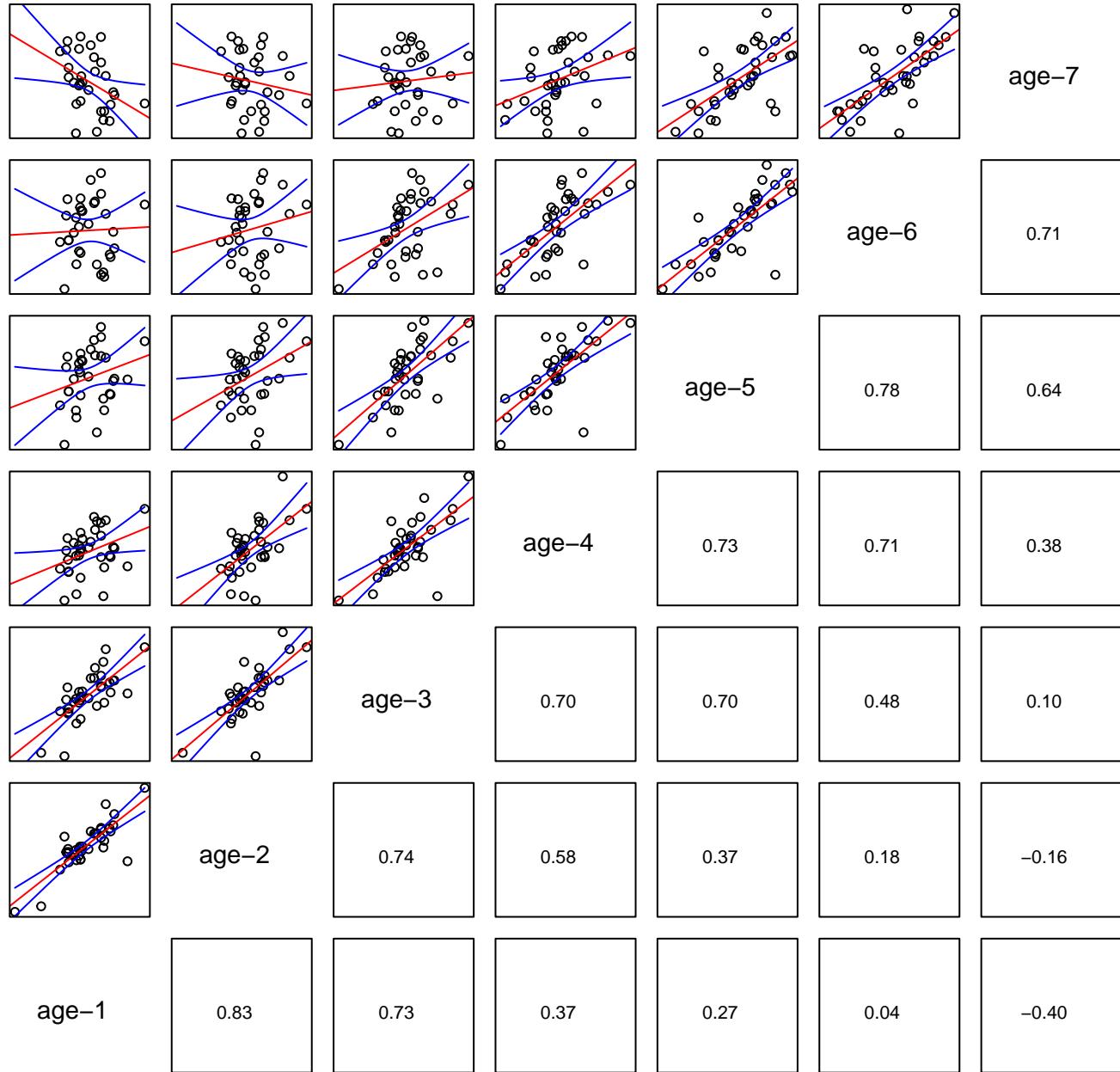
### Catch for Fleet 1 (Comm) Predicted



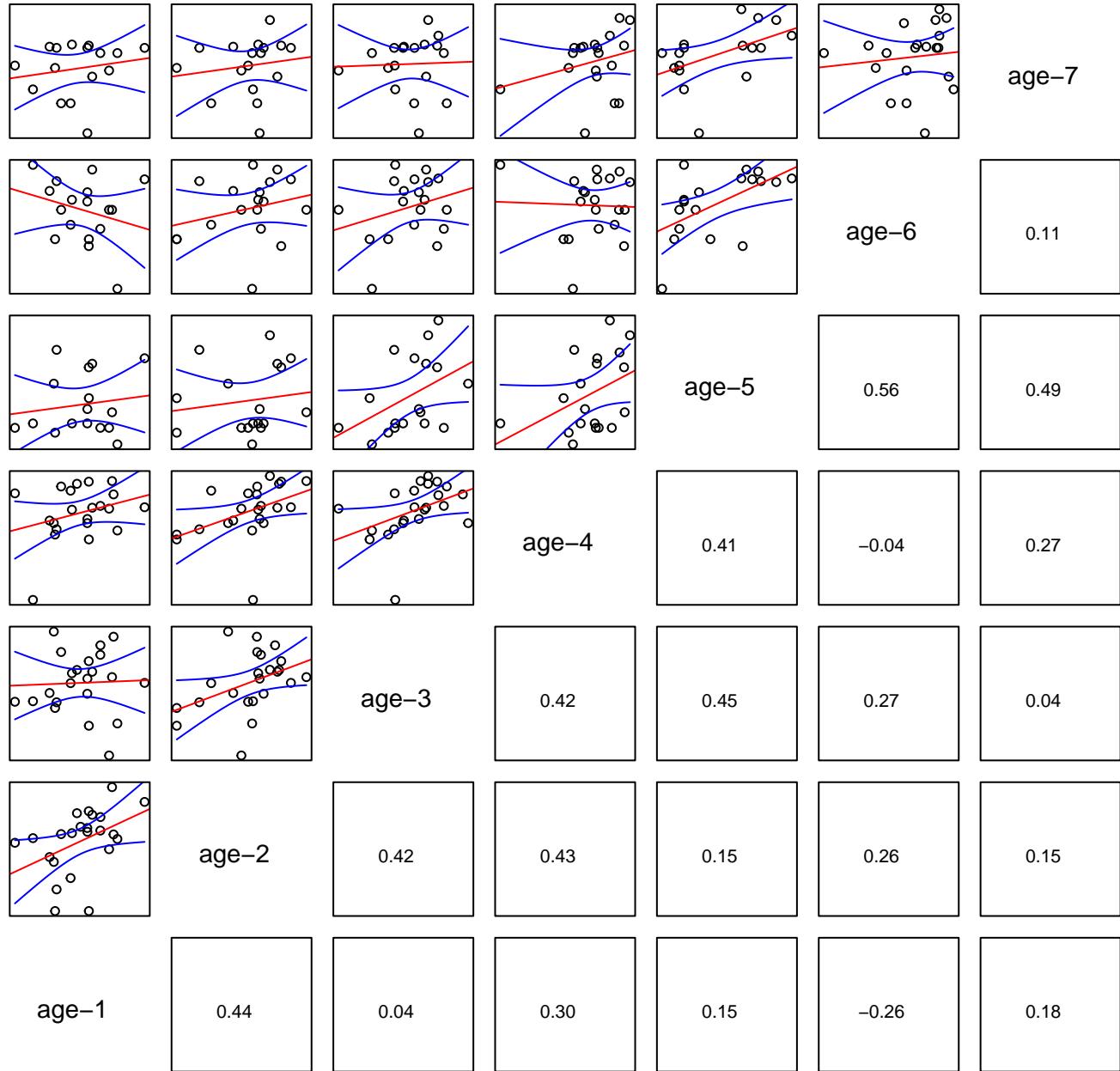
## Catch for Fleet 2 (Rec) Observed



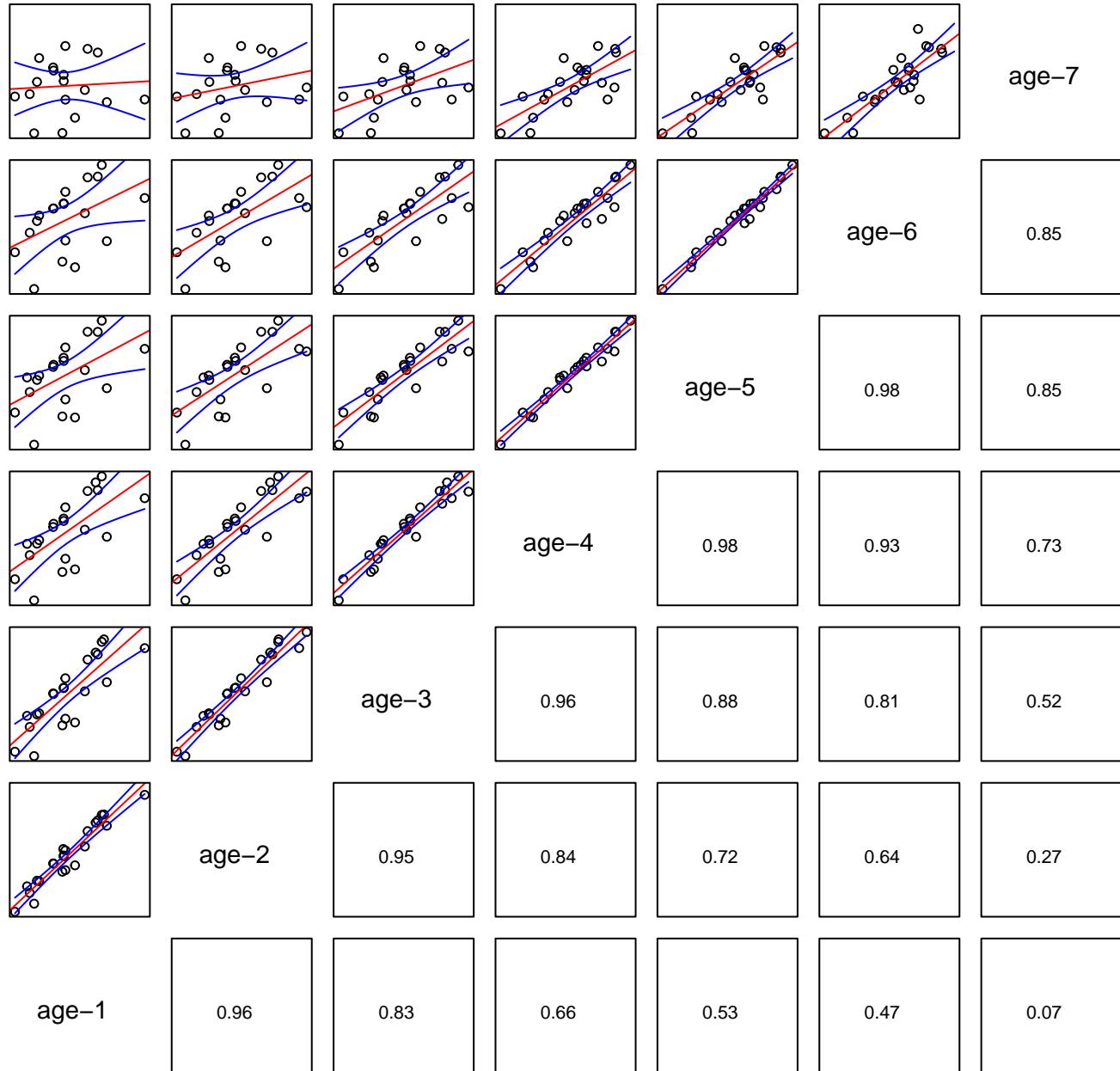
## Catch for Fleet 2 (Rec) Predicted



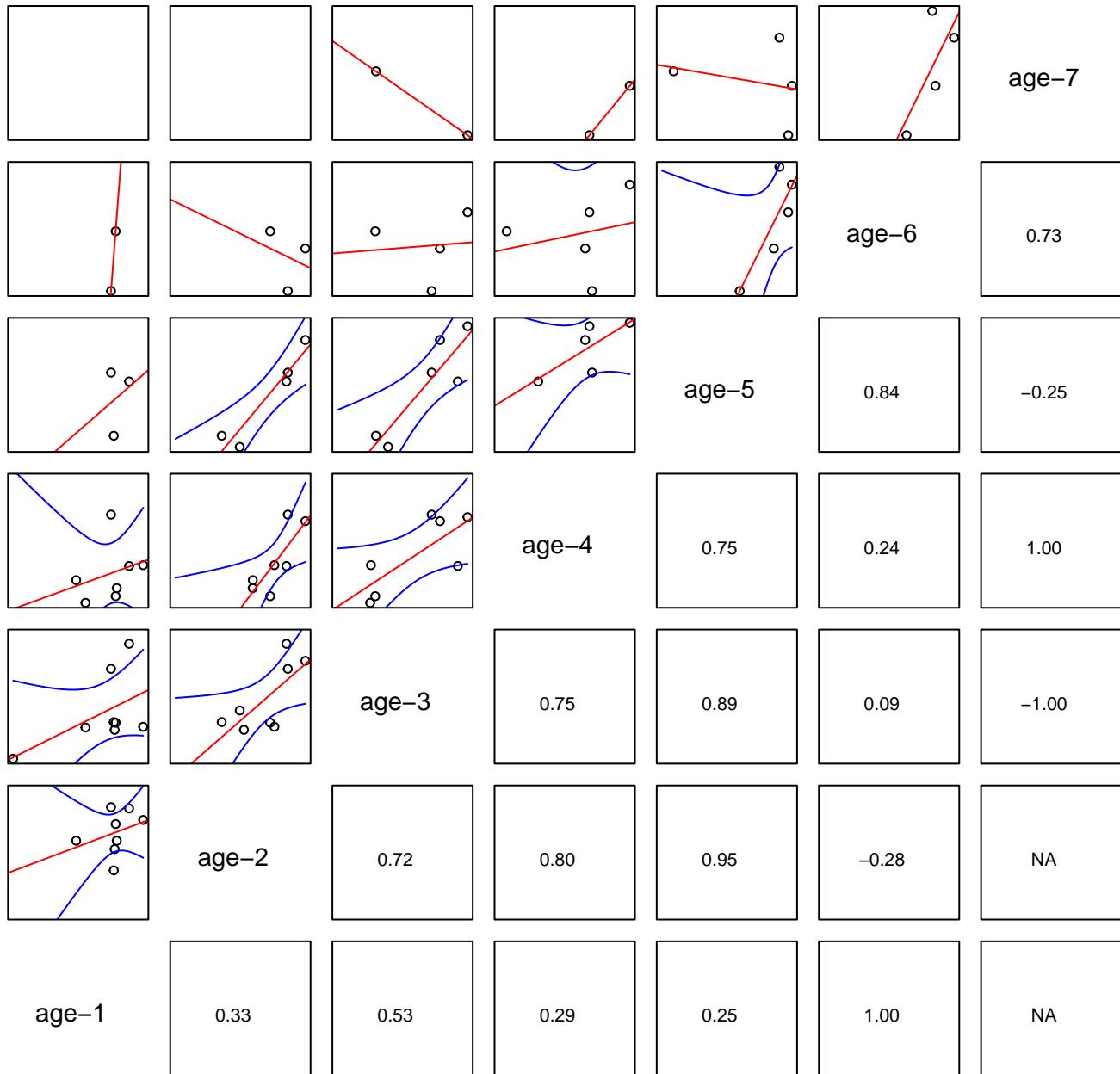
### Index 1 (NEFSC Inshore) Observed



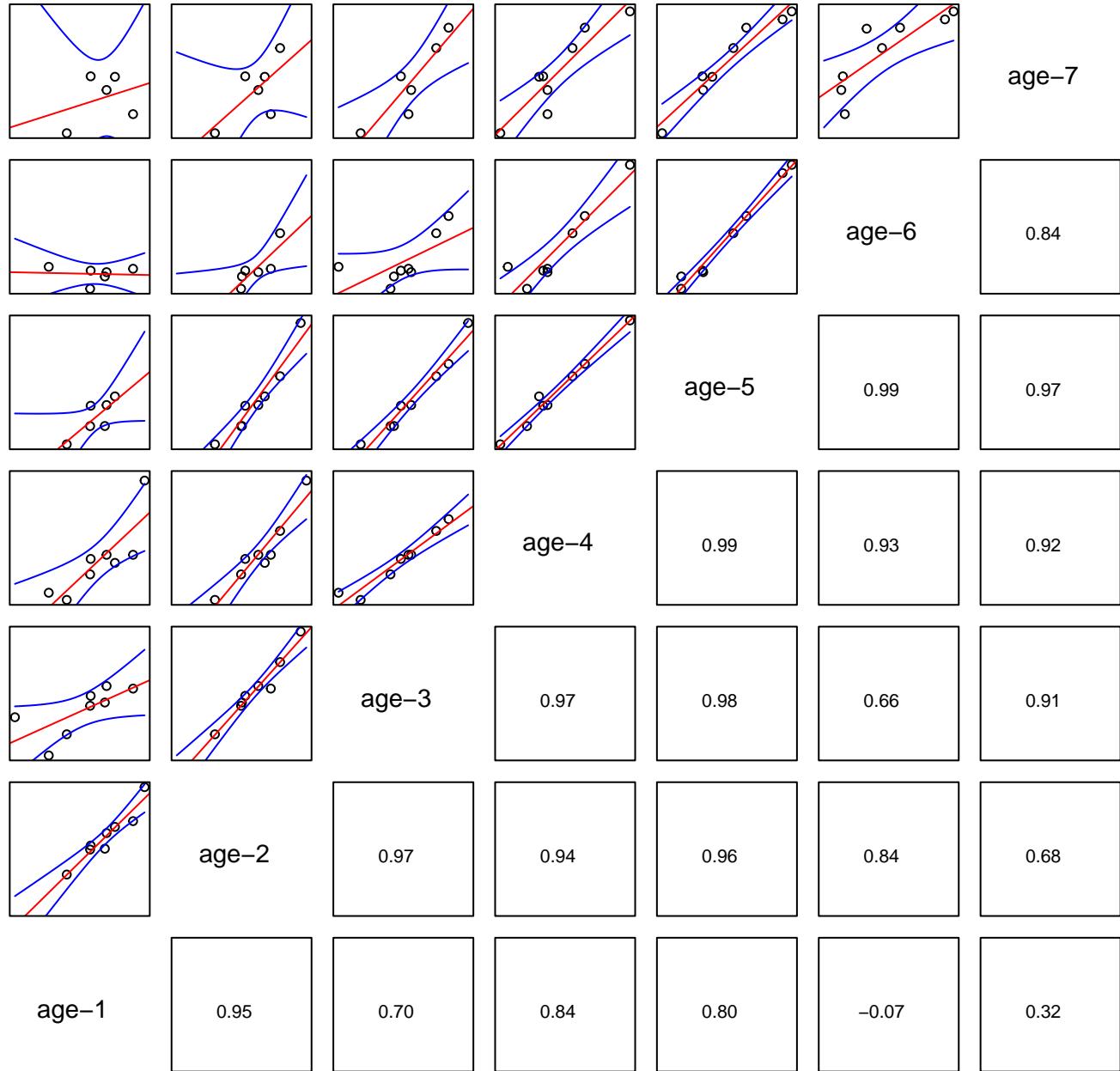
### Index 1 (NEFSC Inshore) Predicted



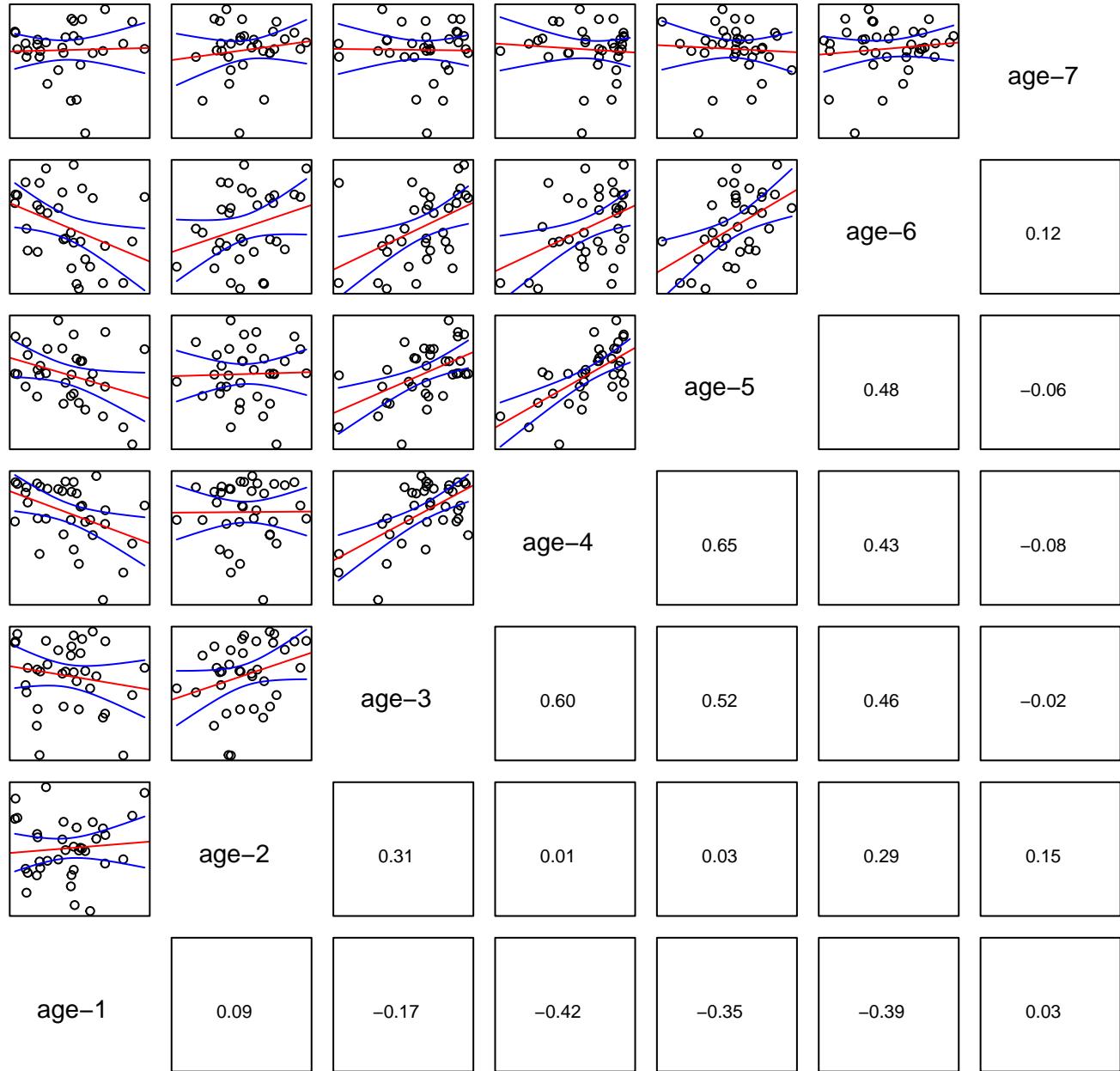
## Index 2 (Bigelow) Observed



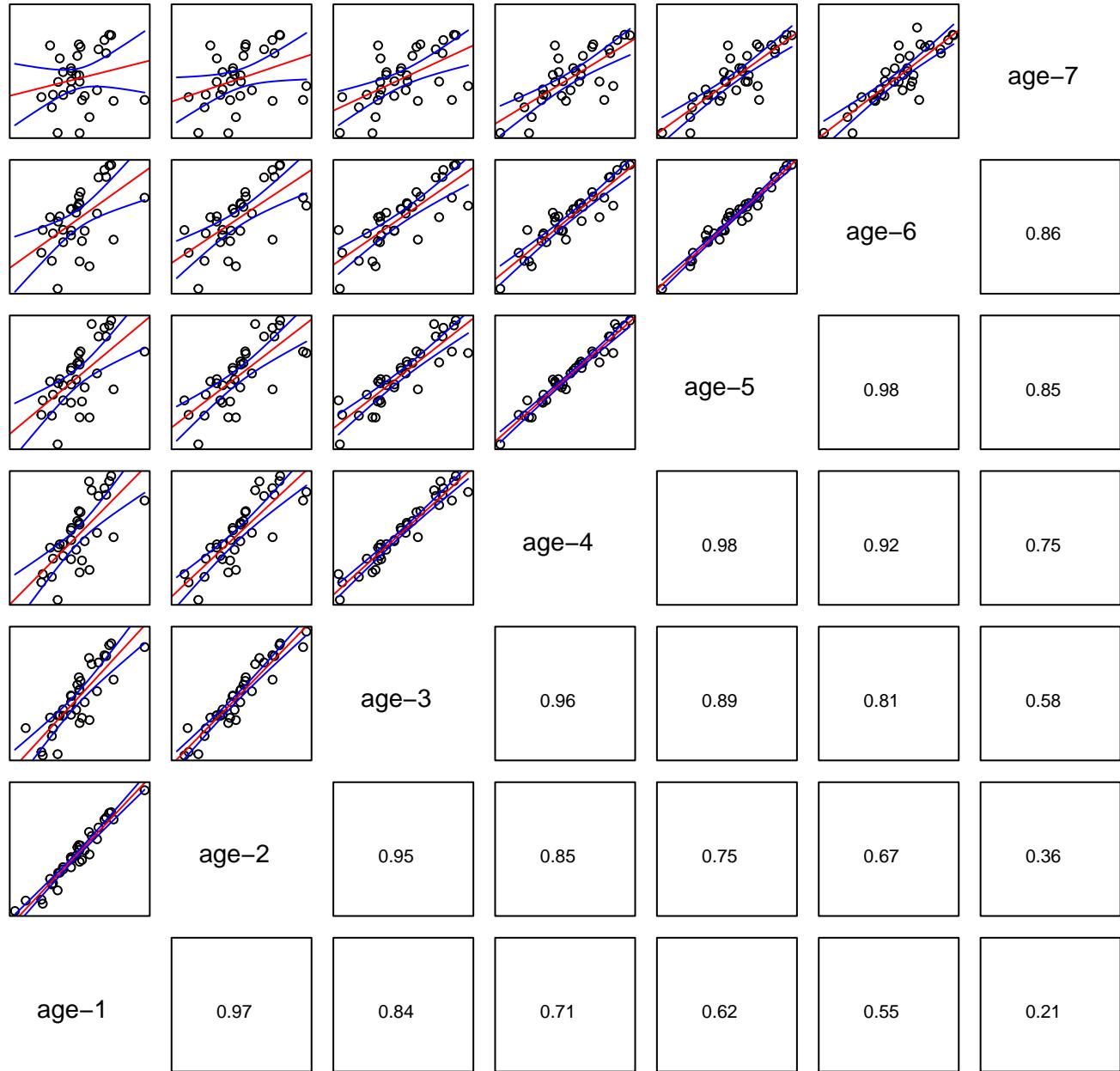
## Index 2 (Bigelow) Predicted



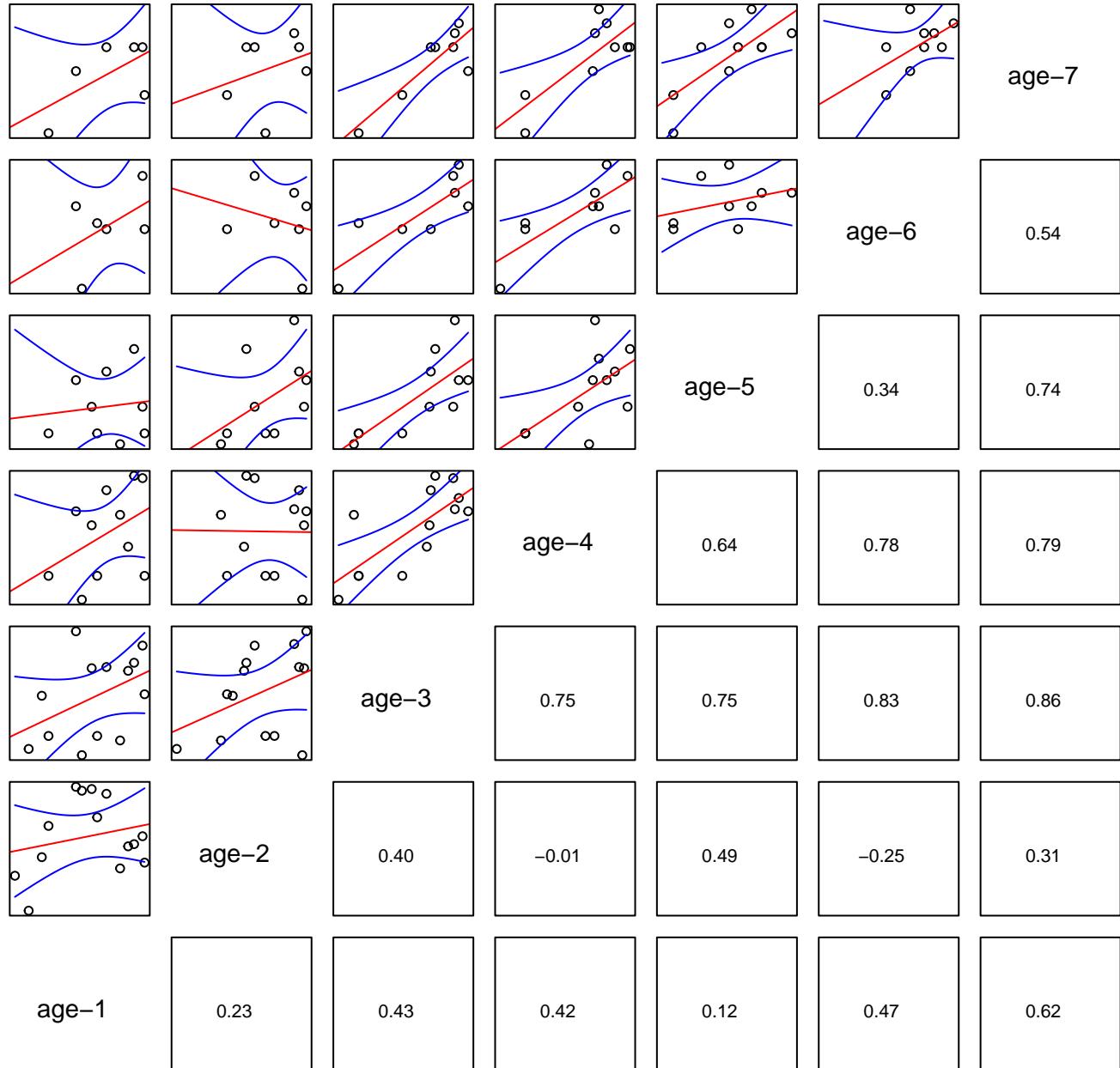
### Index 3 (MRIP) Observed



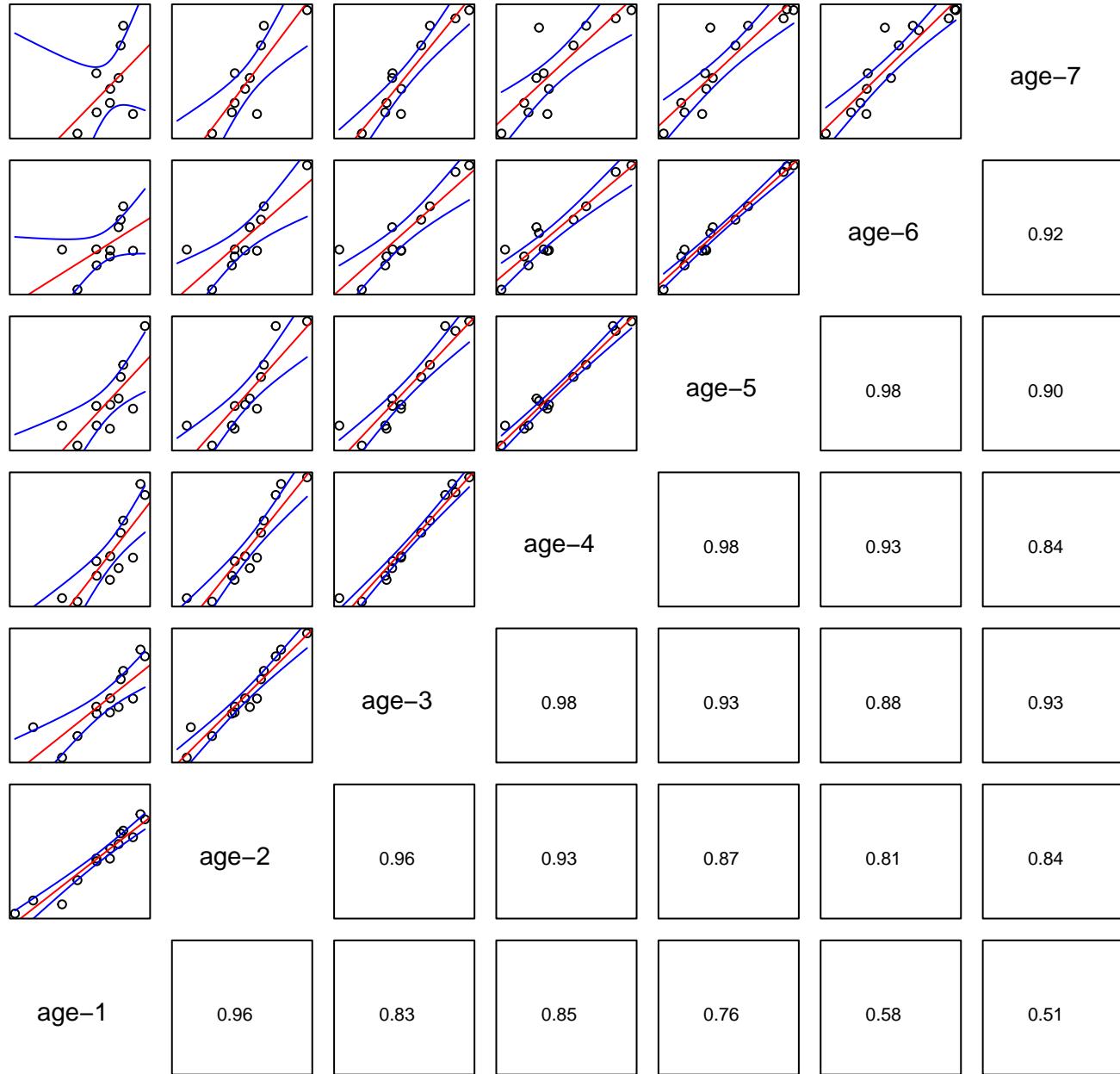
### Index 3 (MRIP) Predicted



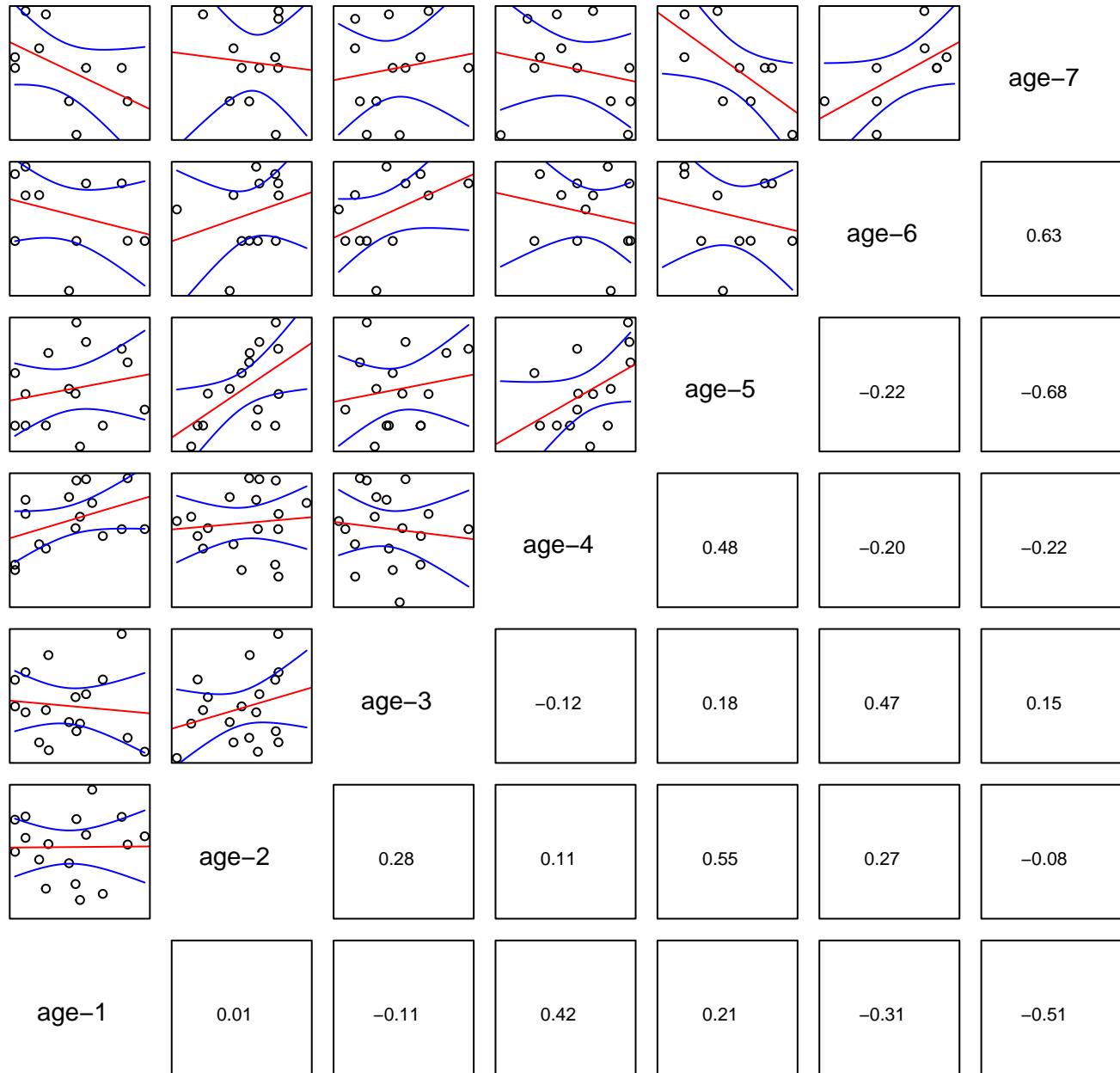
### Index 4 (NEAMAP) Observed



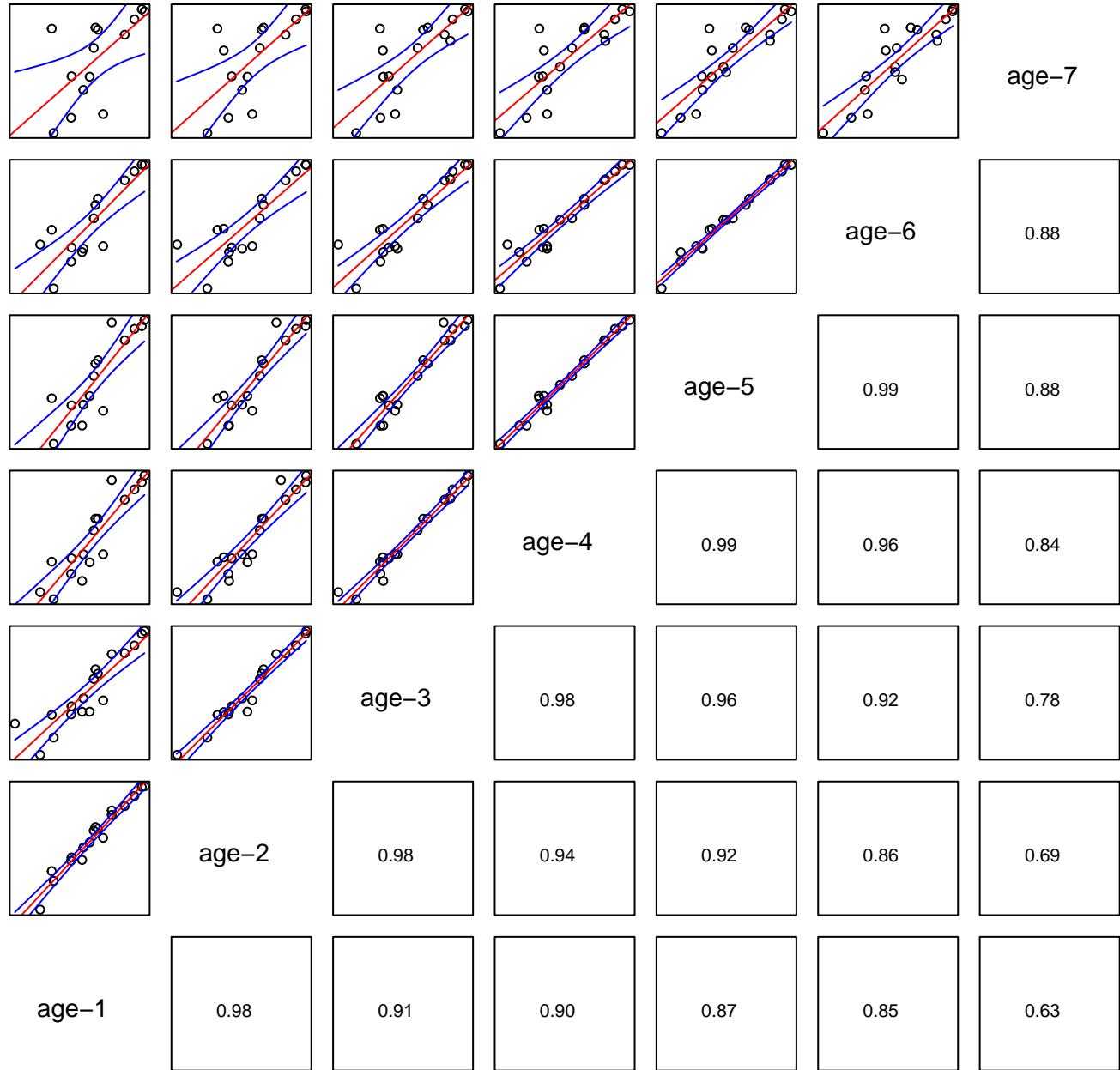
### Index 4 (NEAMAP) Predicted



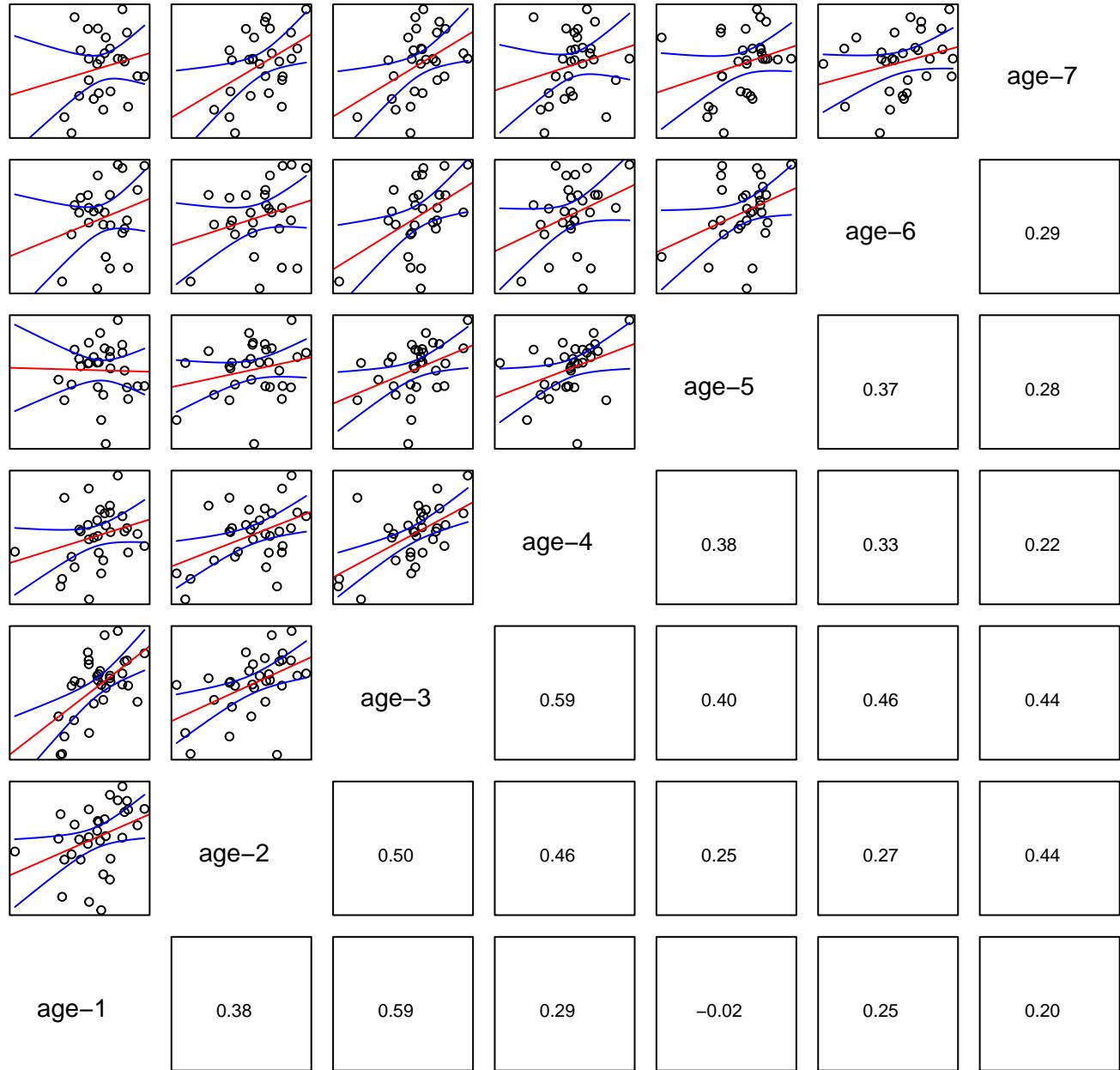
### Index 6 (PSIGN) Observed



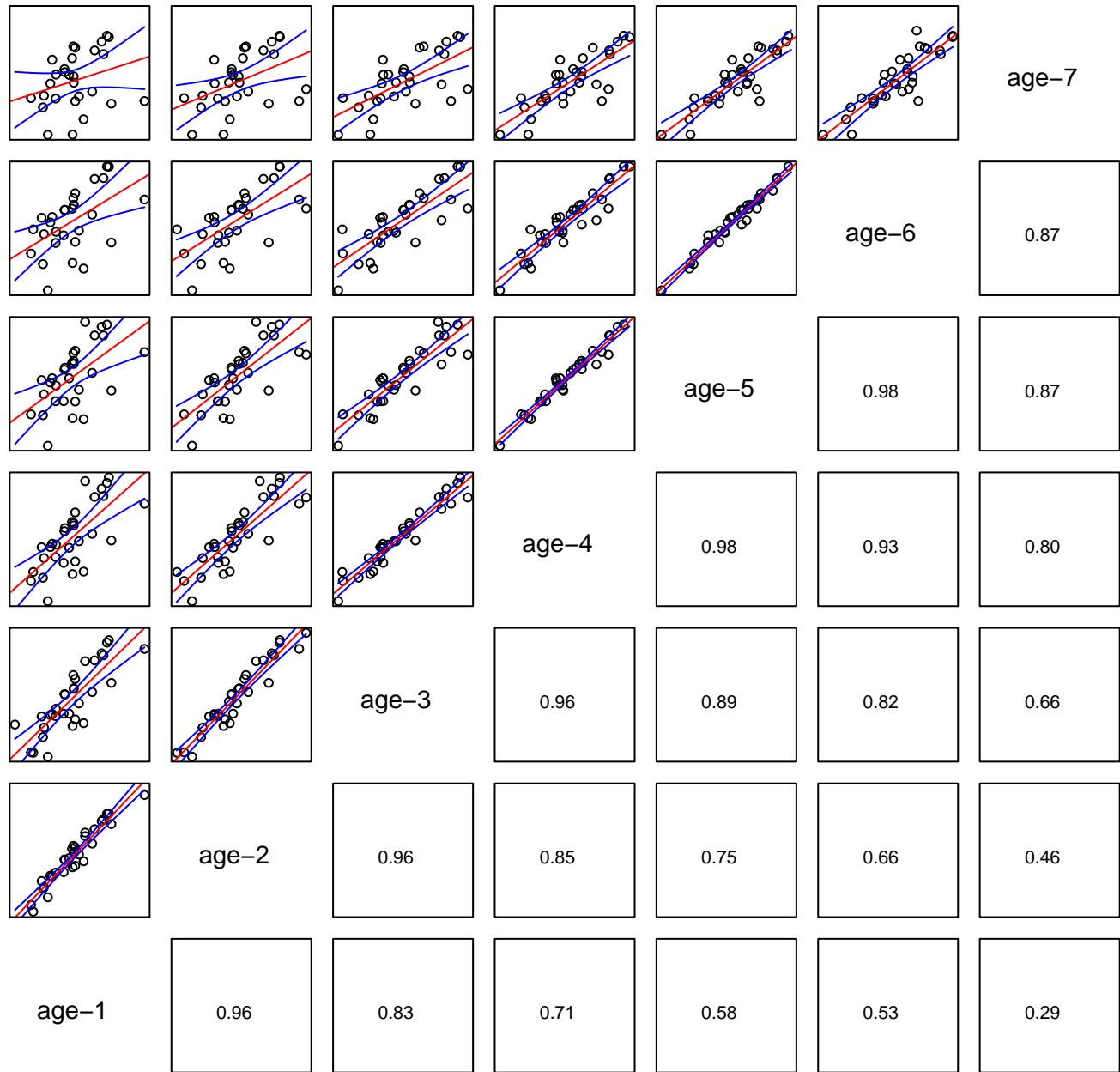
### Index 6 (PSIGN) Predicted



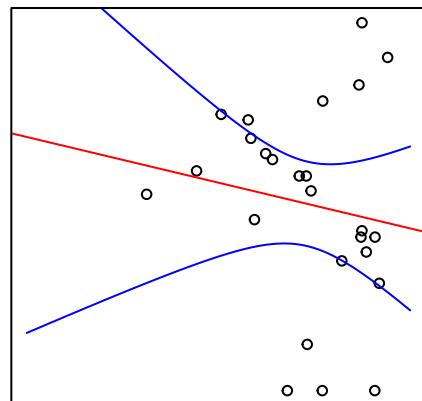
### Index 7 (CT Trawl) Observed



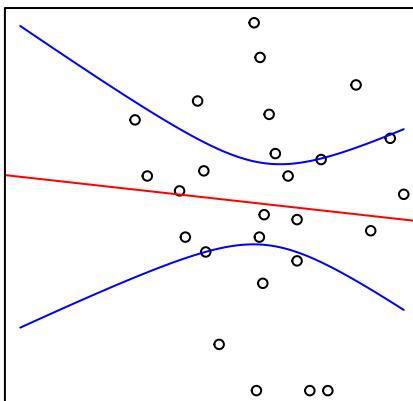
## **Index 7 (CT Trawl) Predicted**



### Index 8 (NJ Trawl) Observed

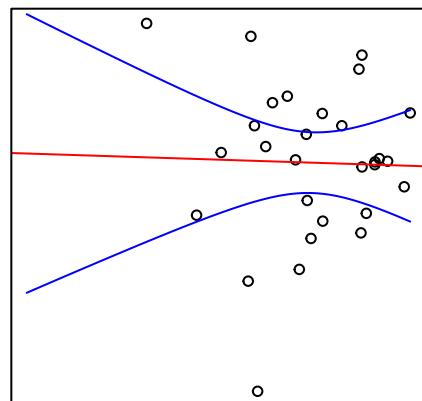


age-1



age-2

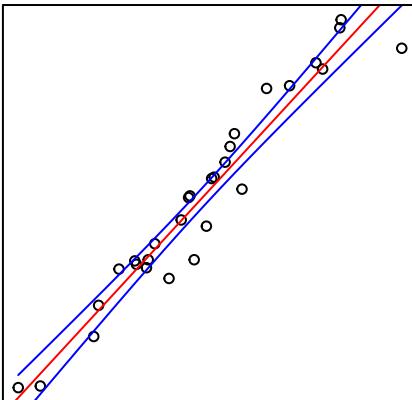
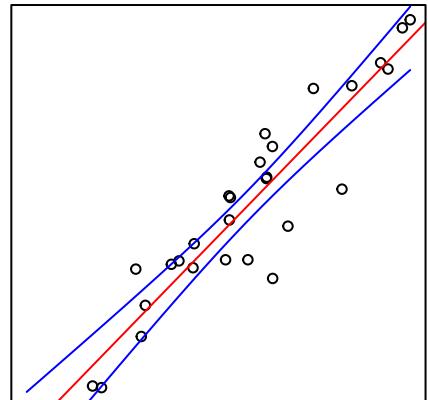
-0.08



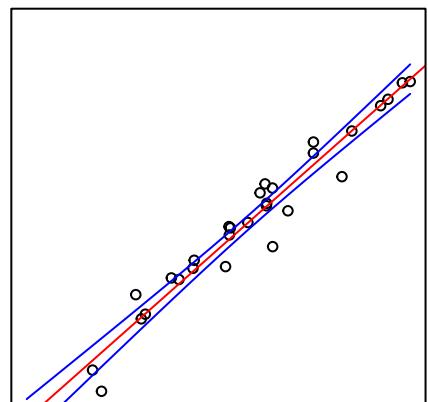
-0.15

-0.03

### Index 8 (NJ Trawl) Predicted



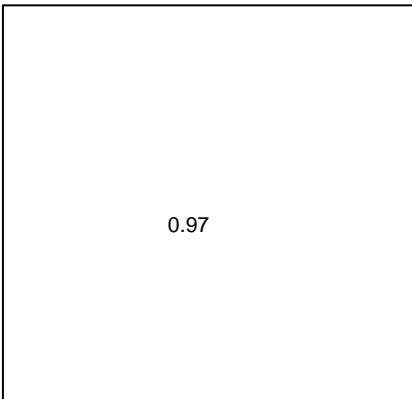
age-3



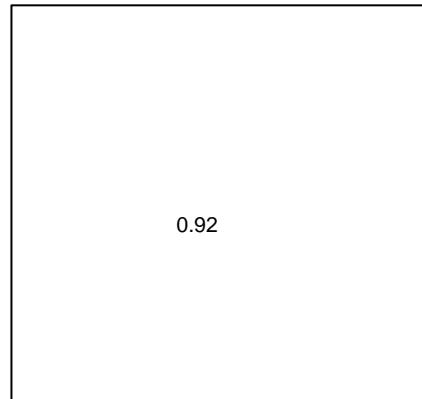
age-2

0.97

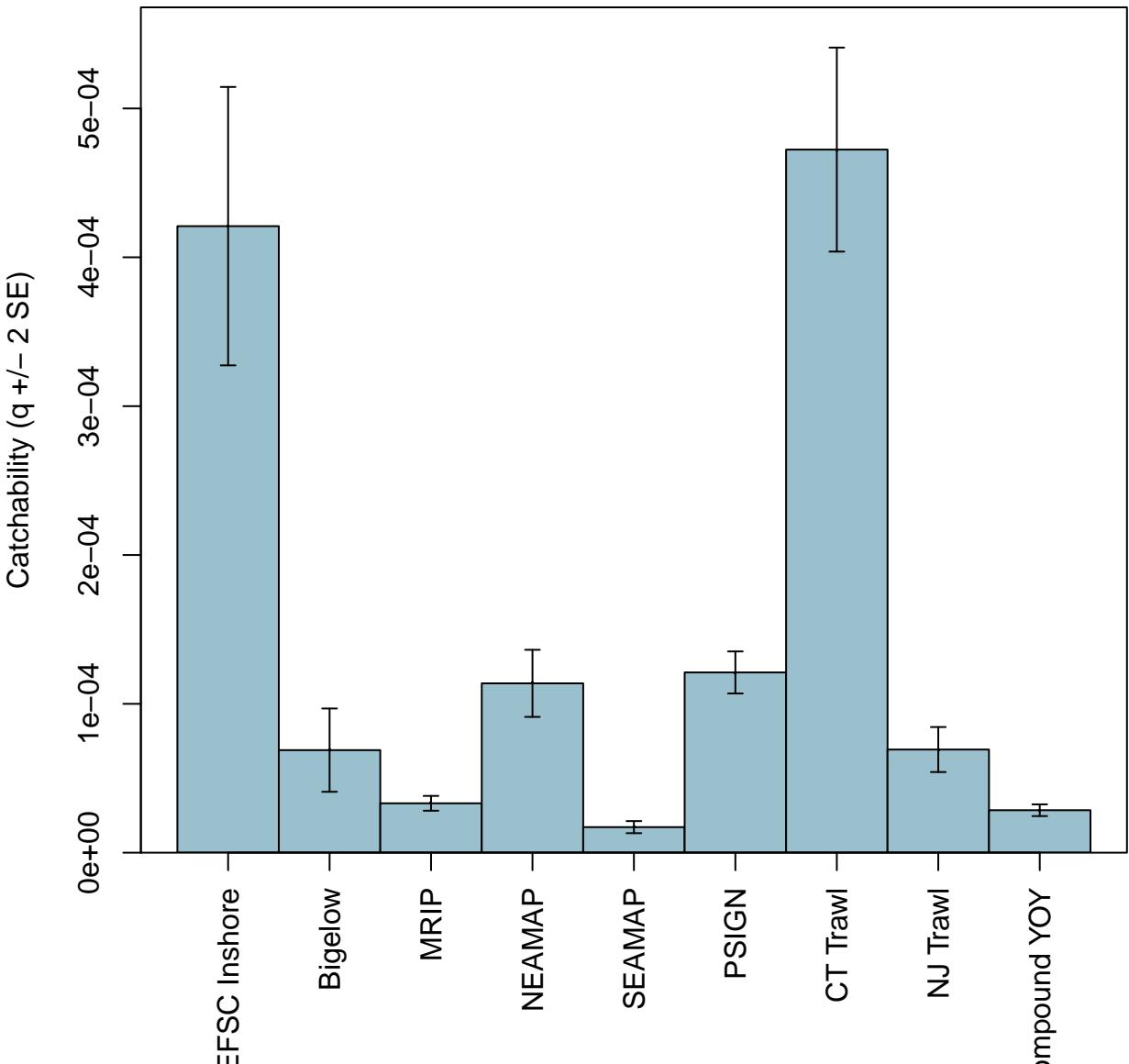
age-1

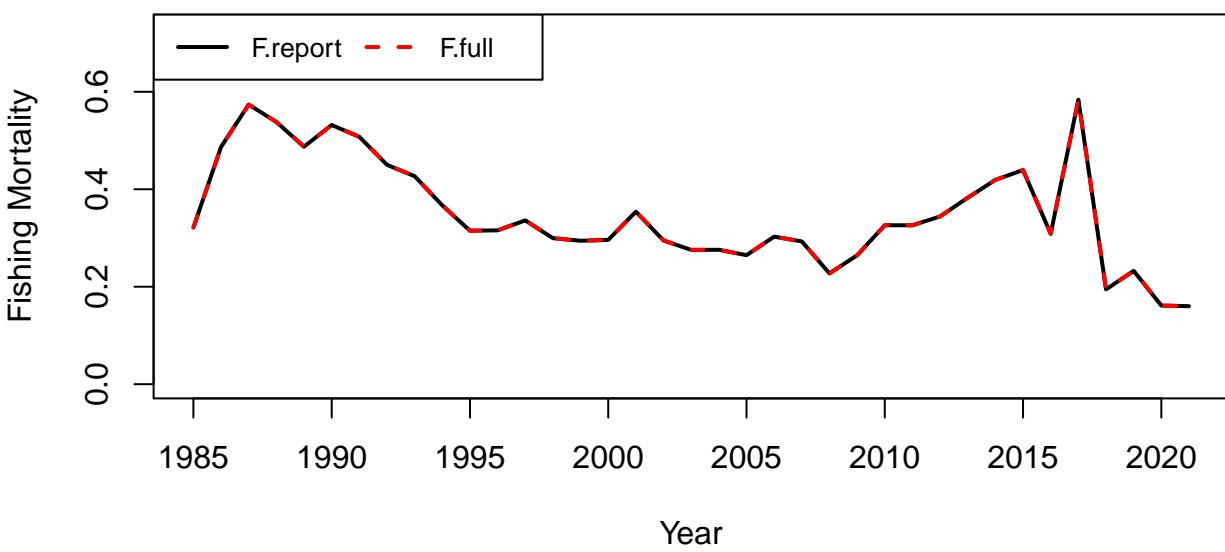
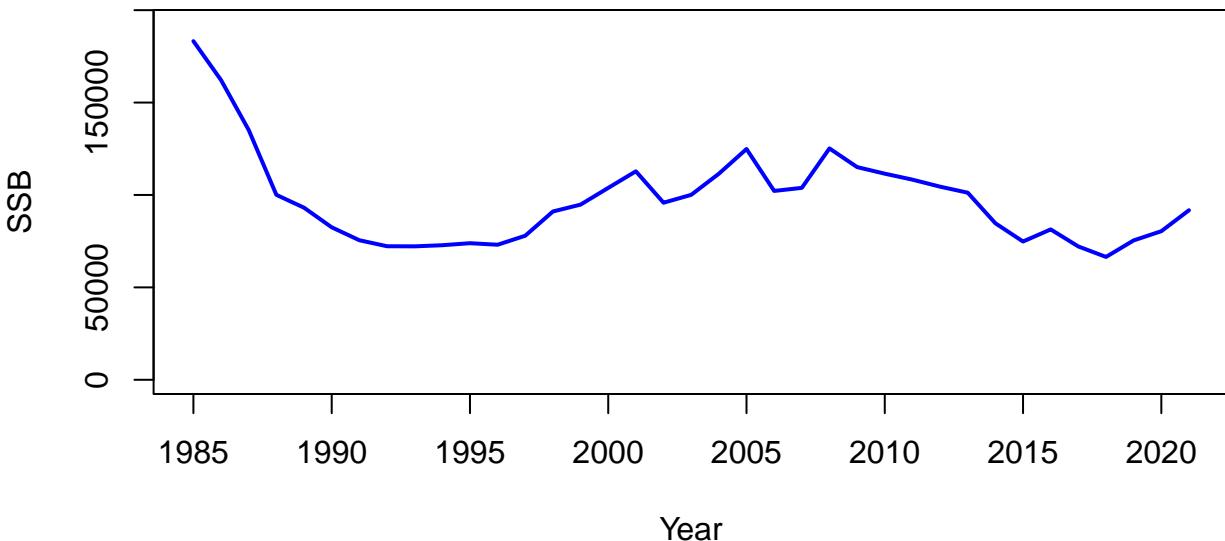


0.97

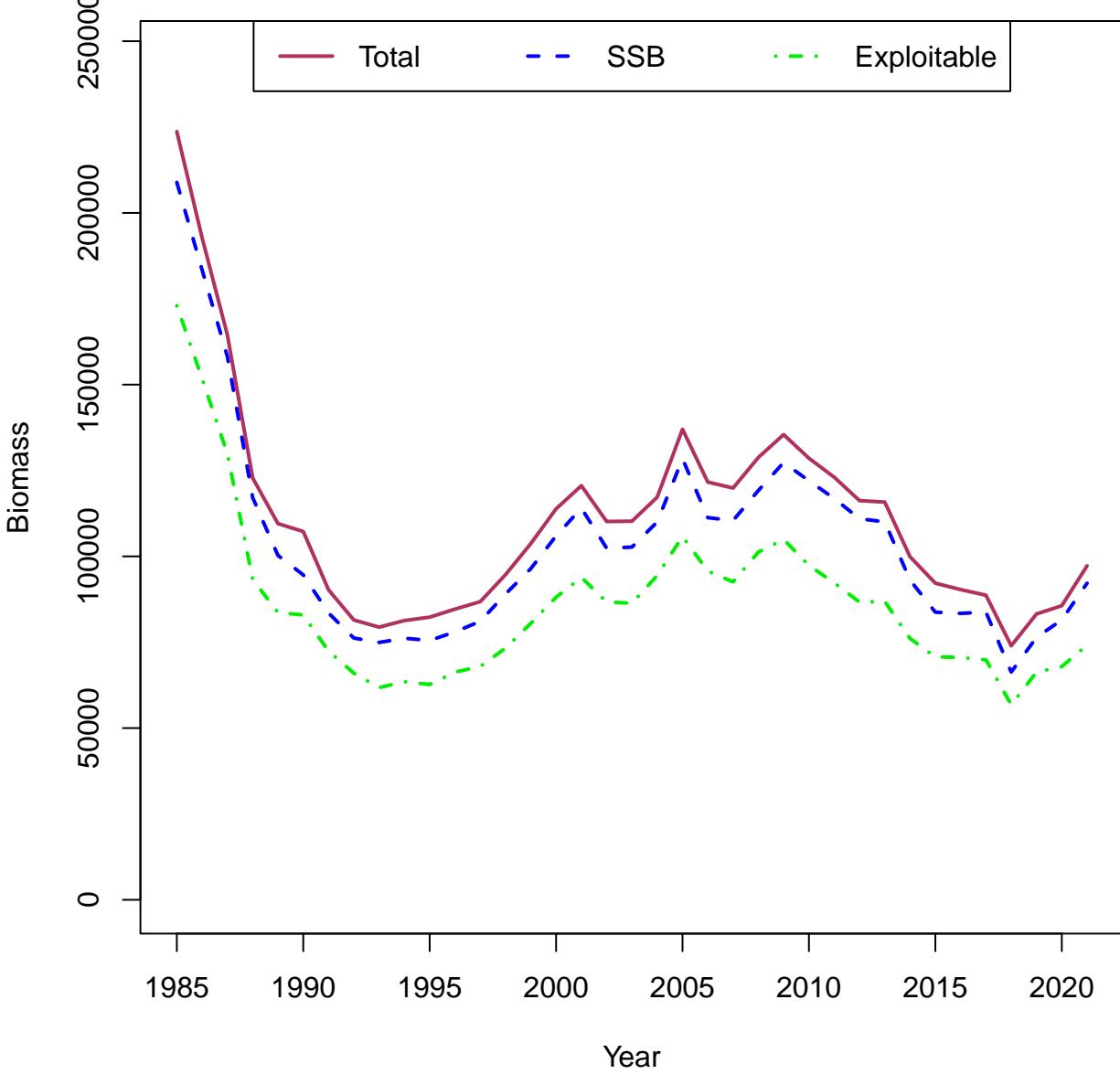


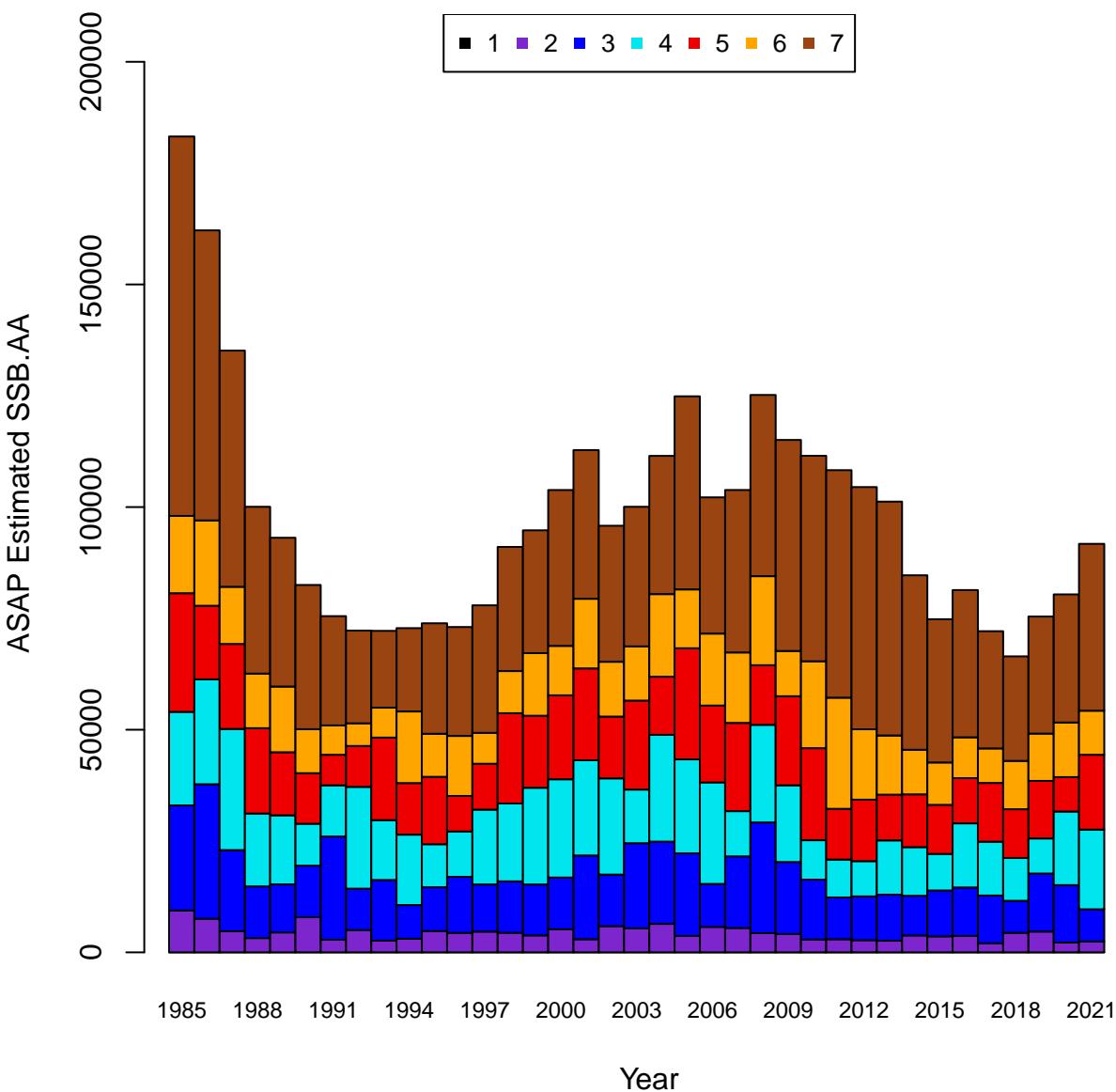
0.92

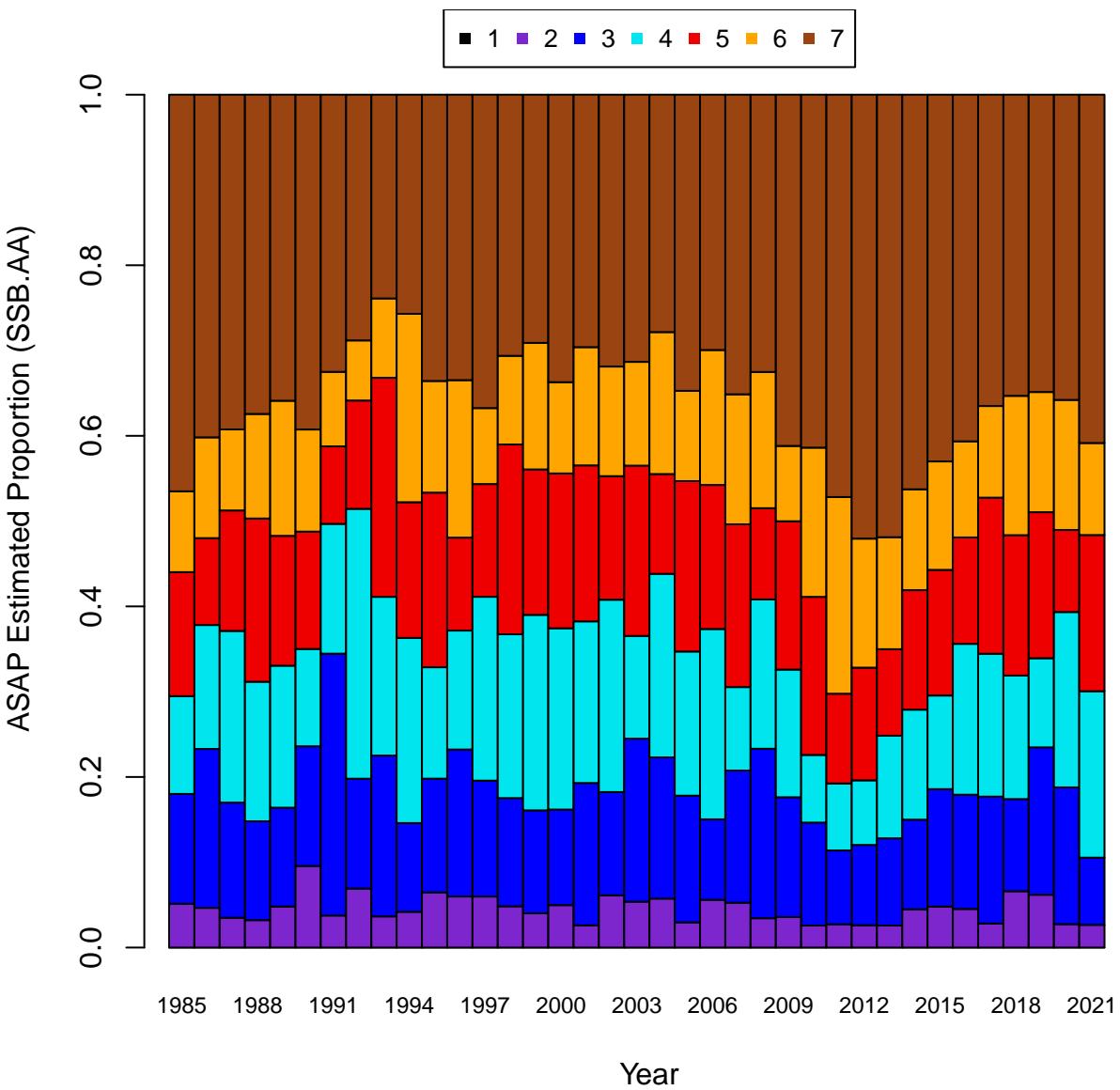


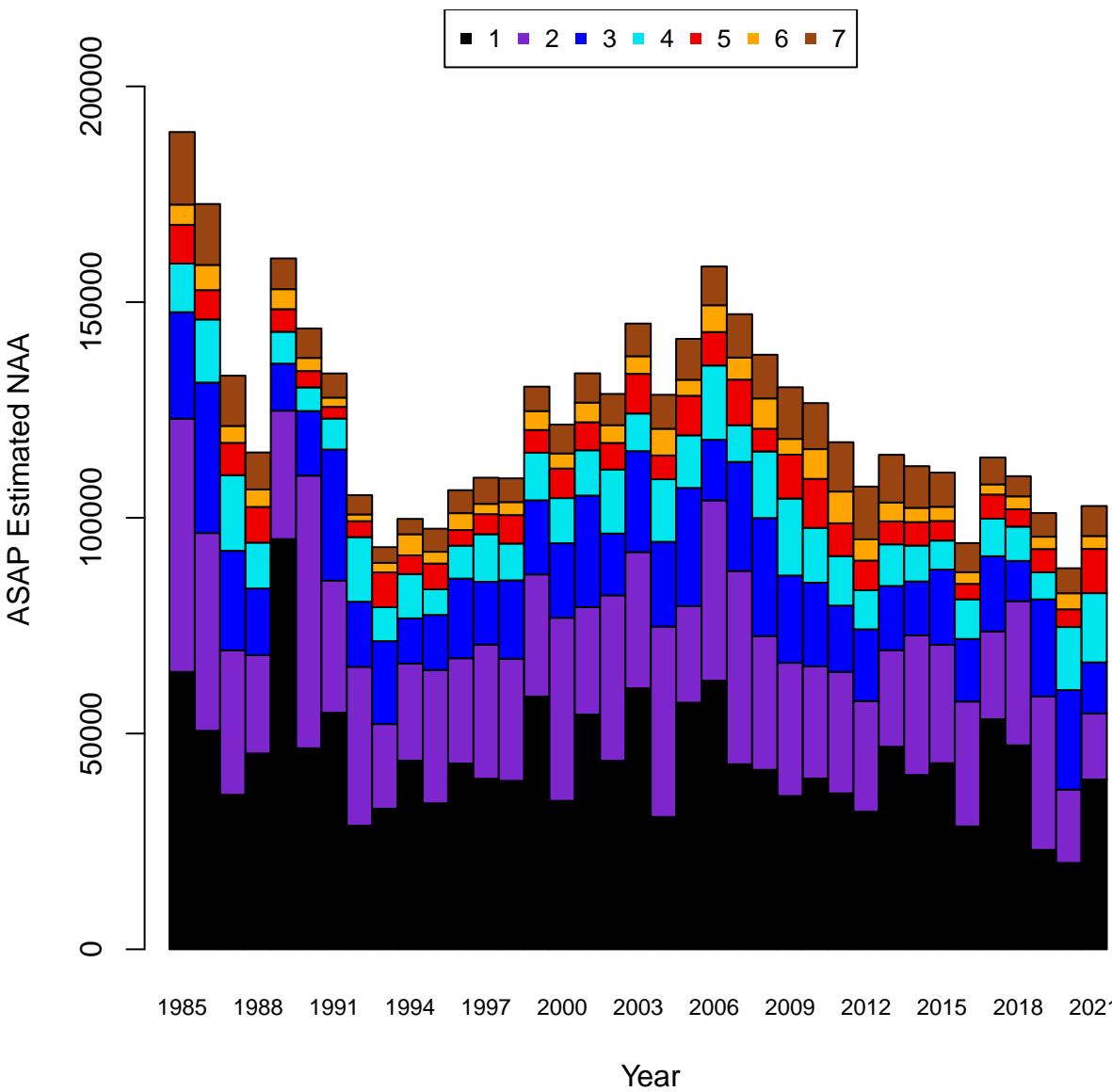


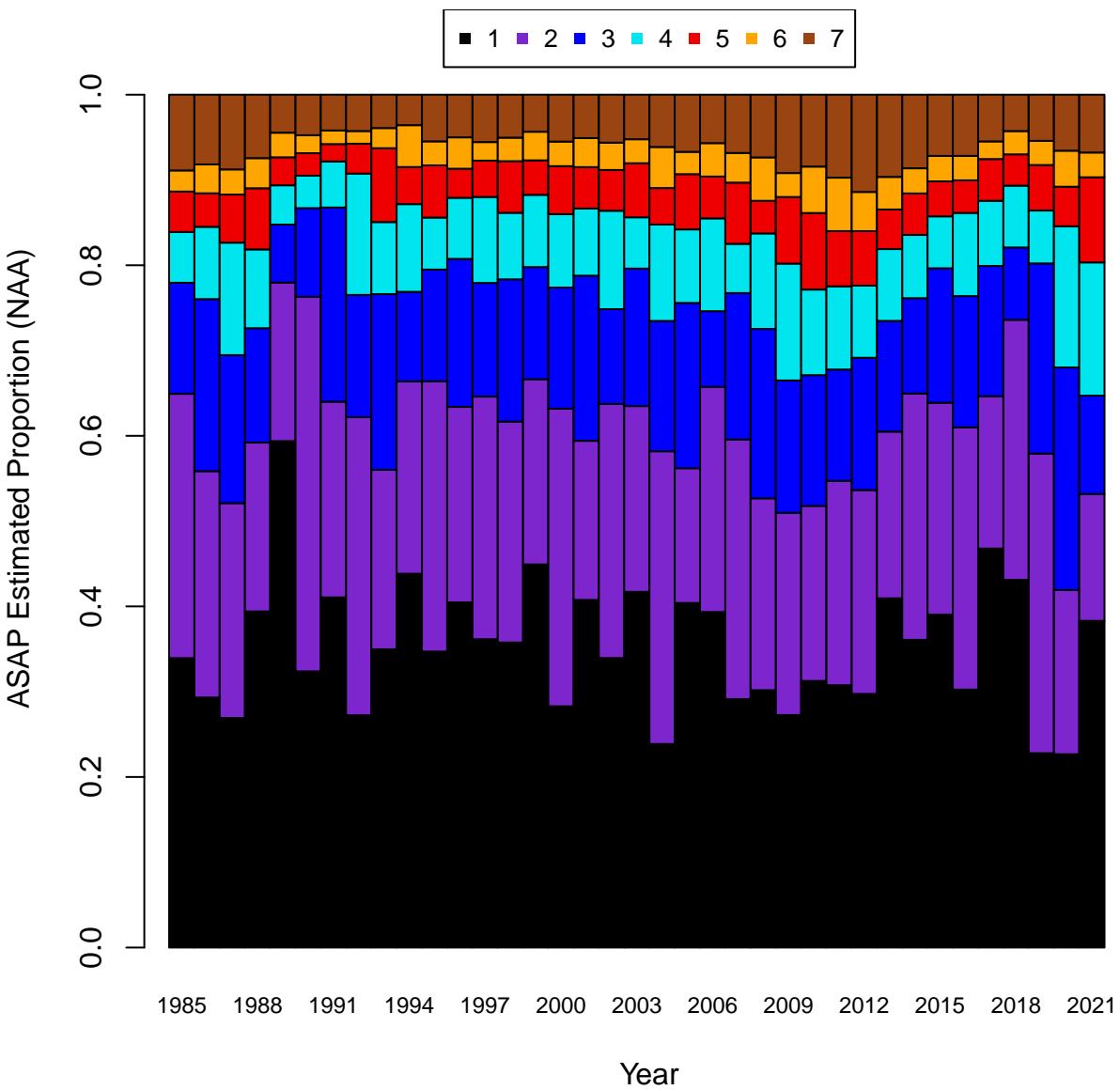
## Comparison of January 1 Biomass

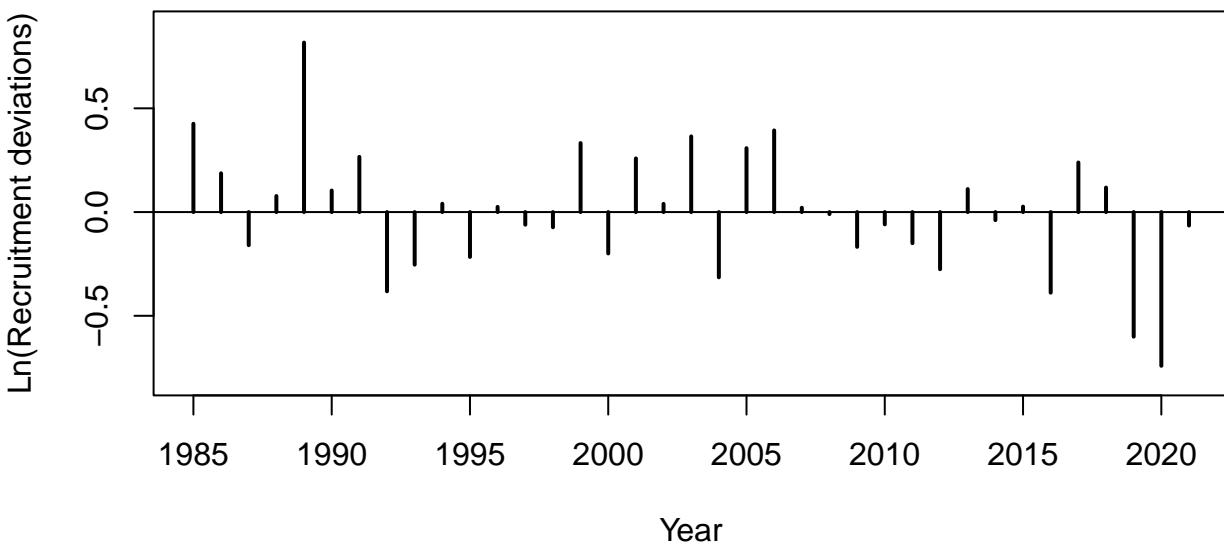
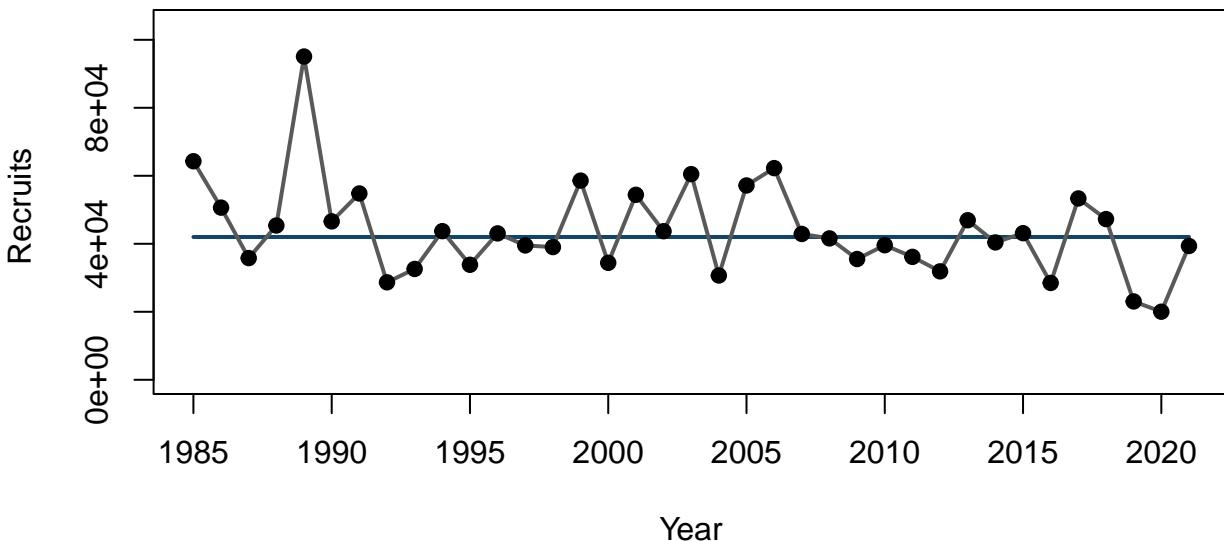


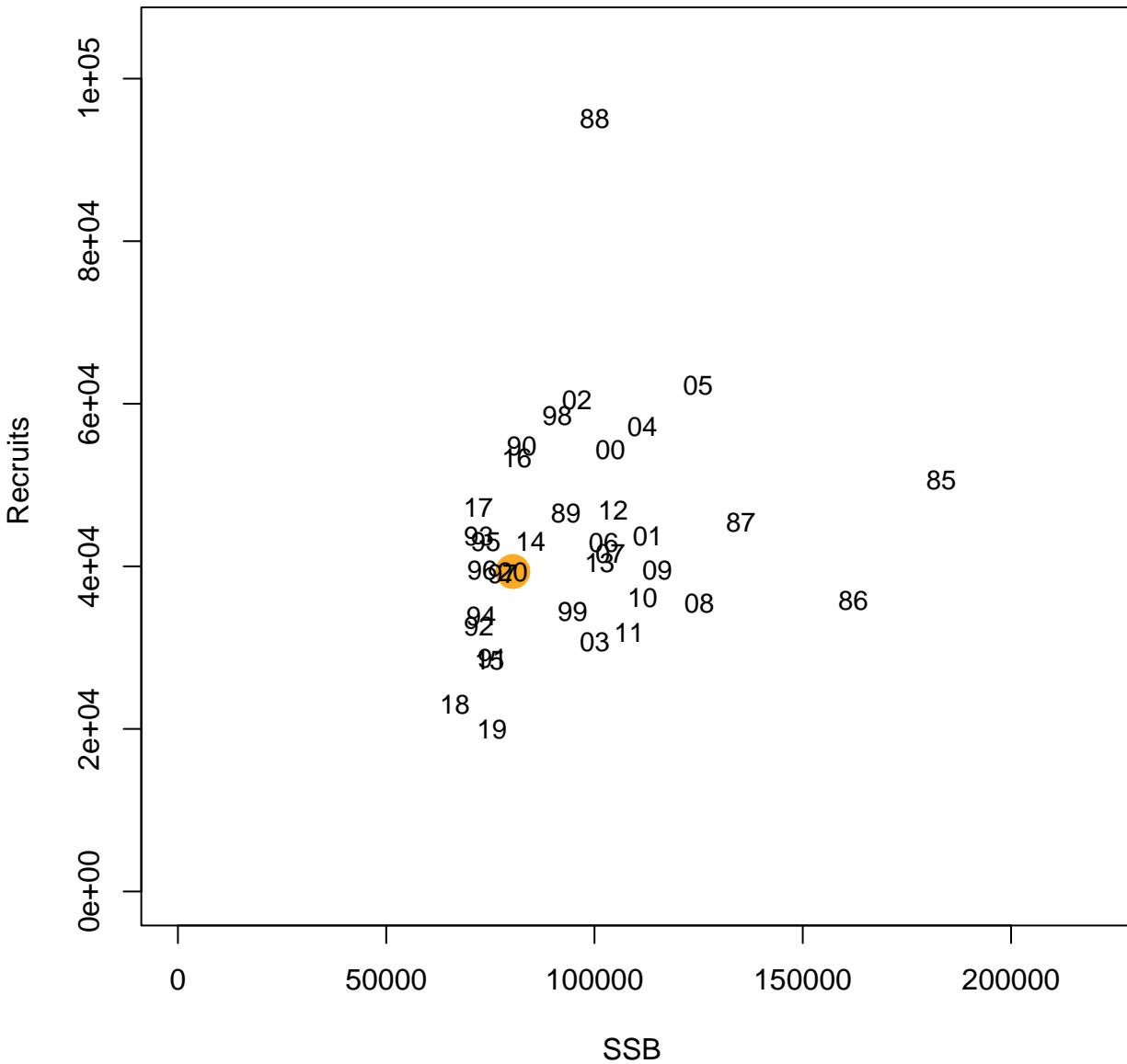


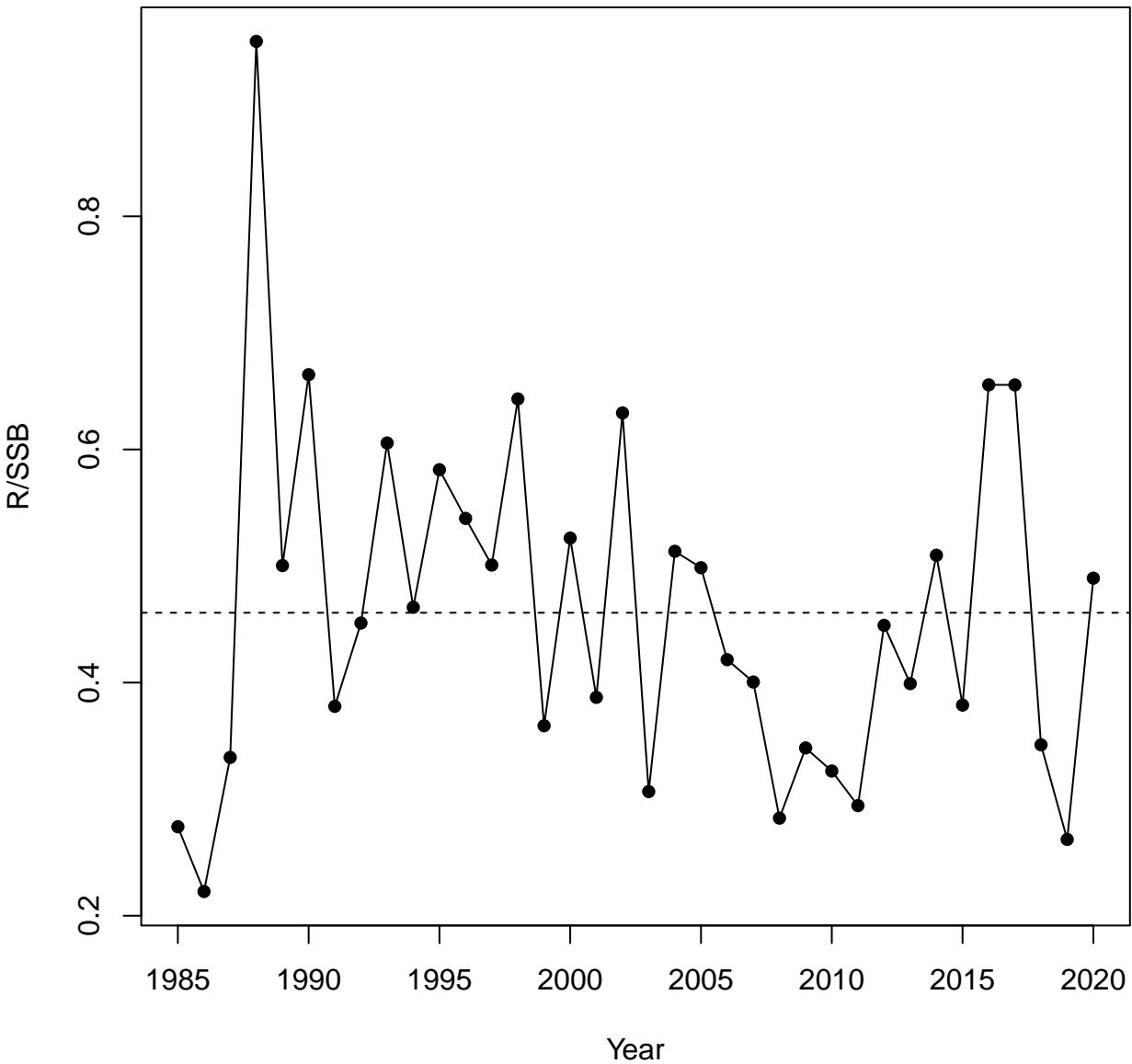


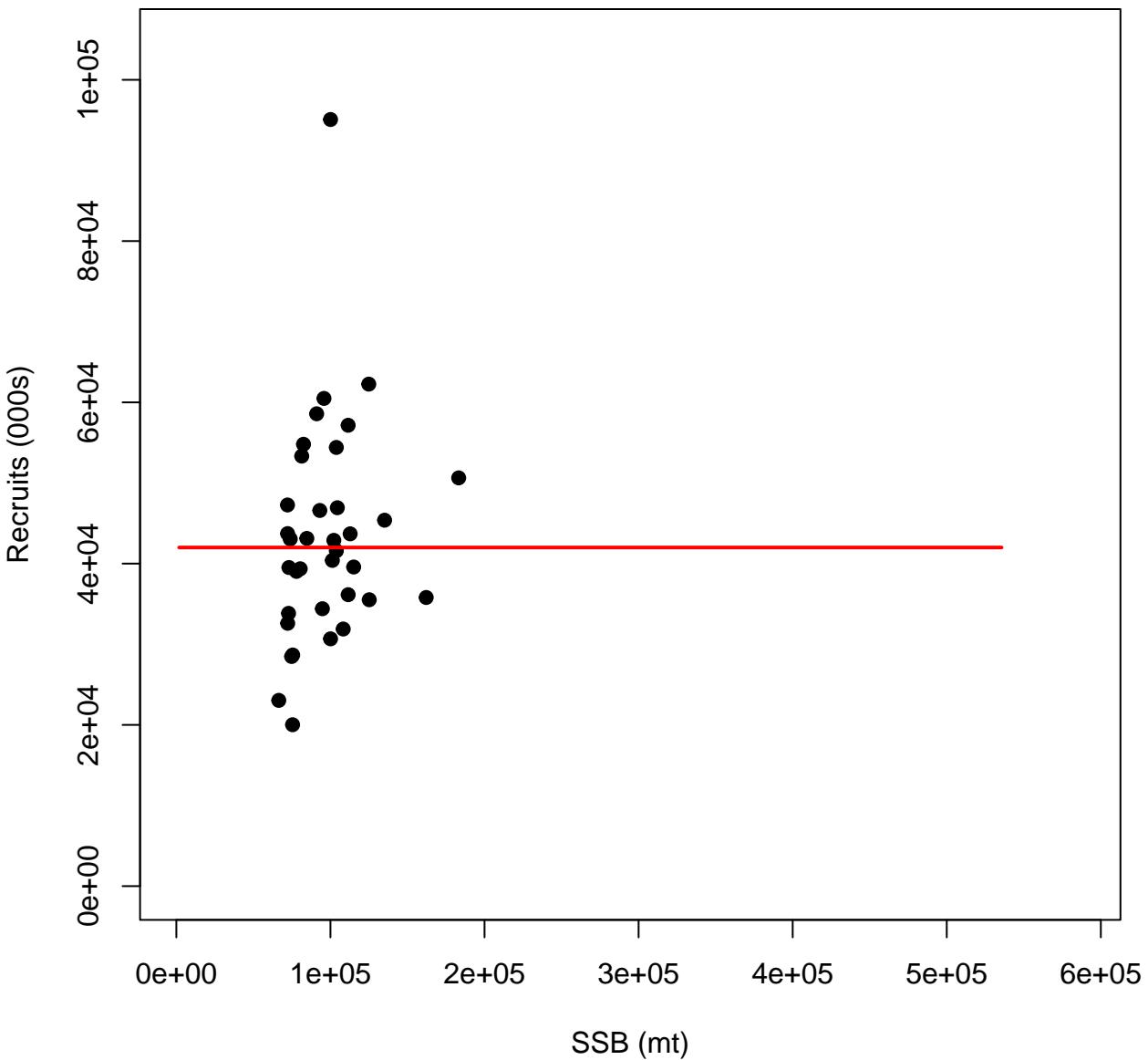




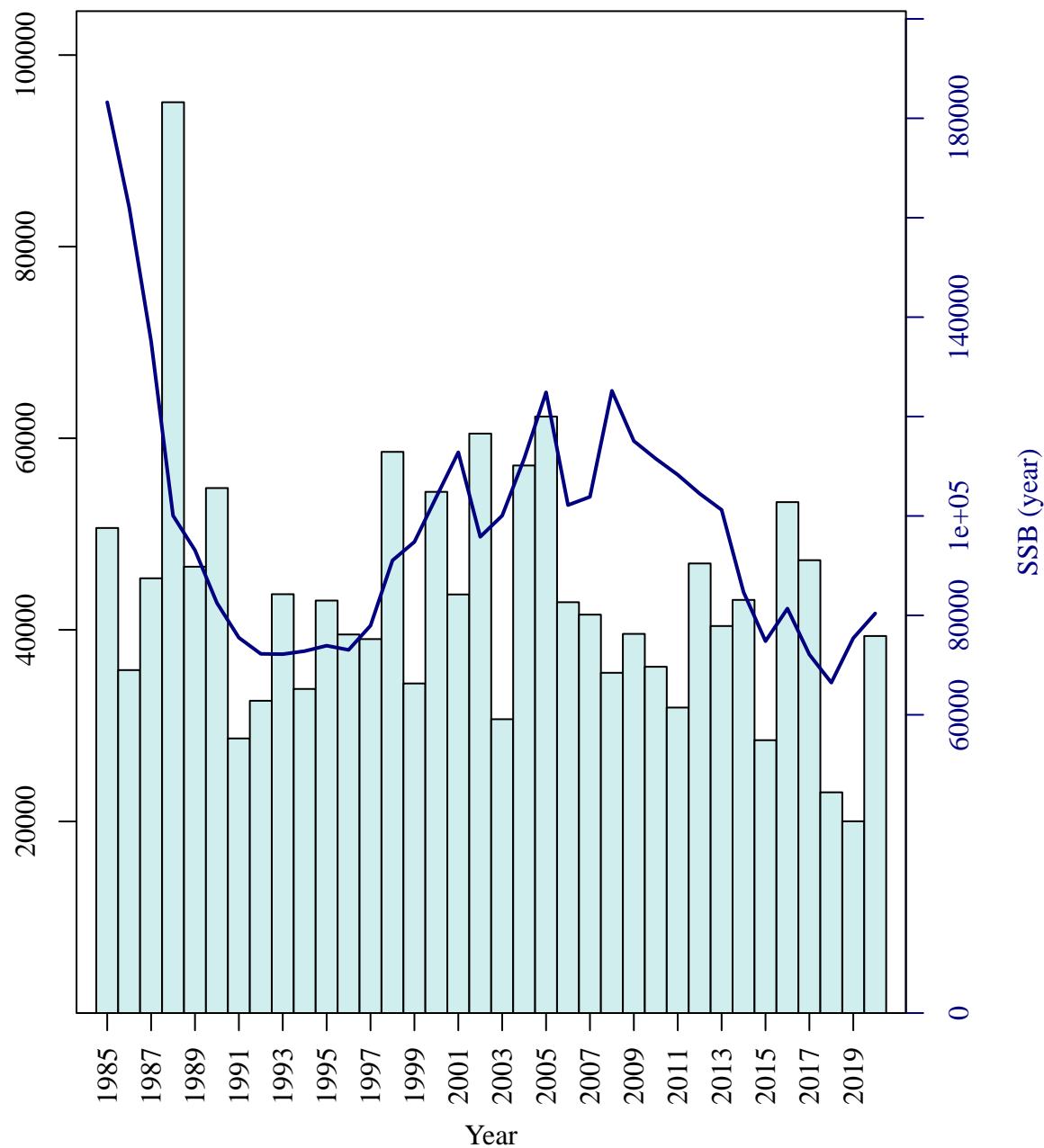


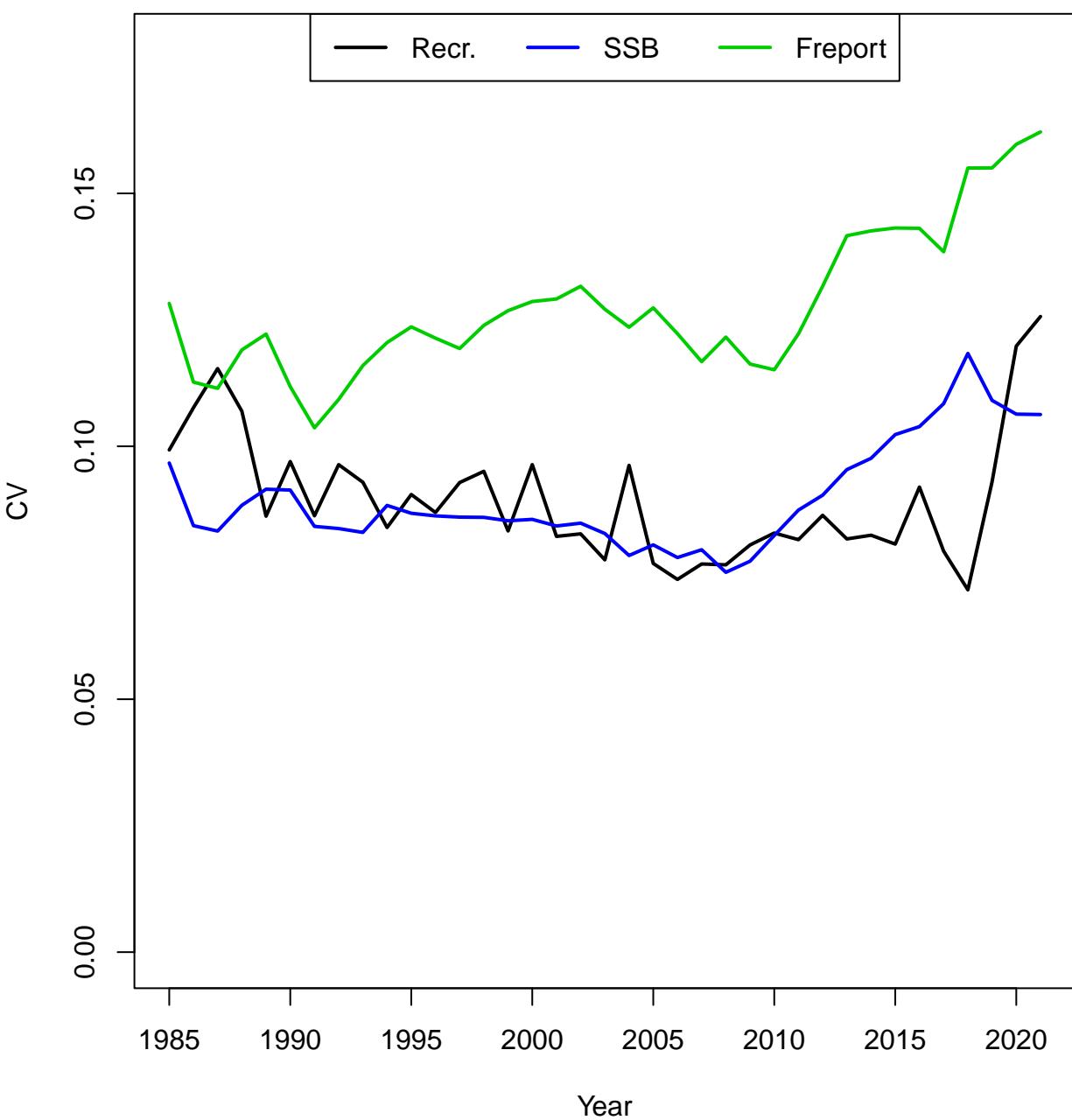




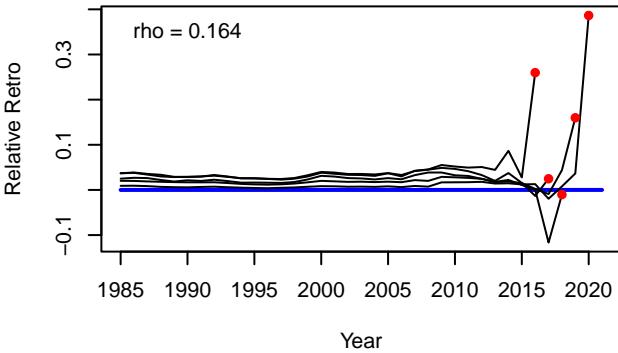
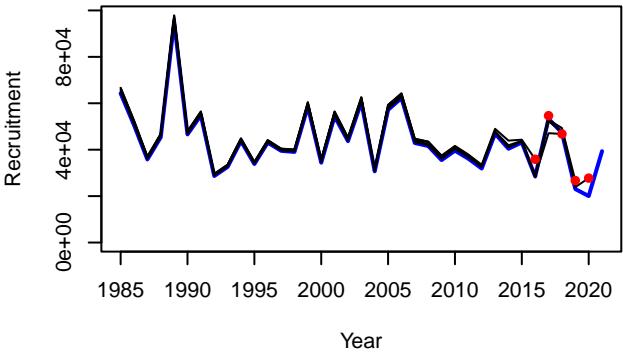
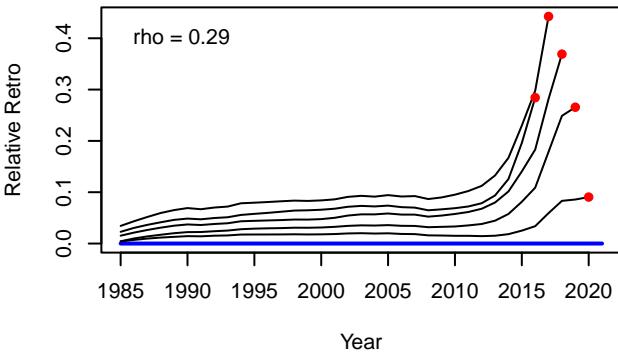
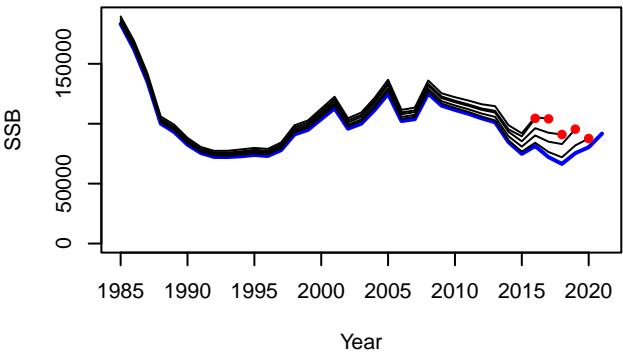
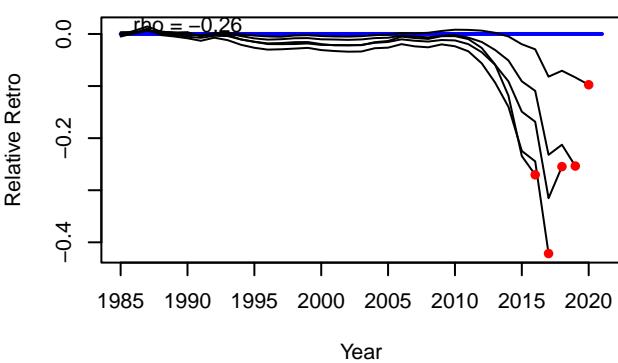
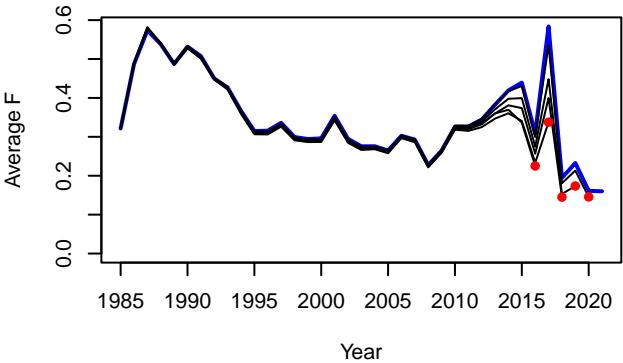


Age-1 Recruits (year-class)



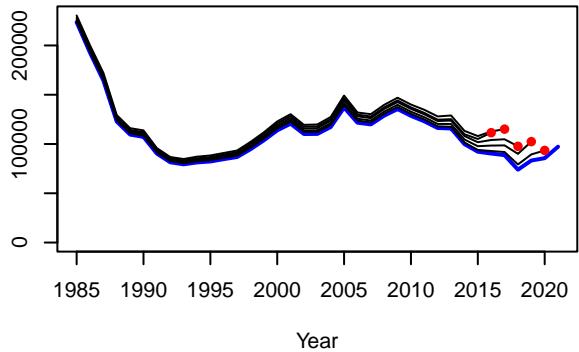


F, SSB, R



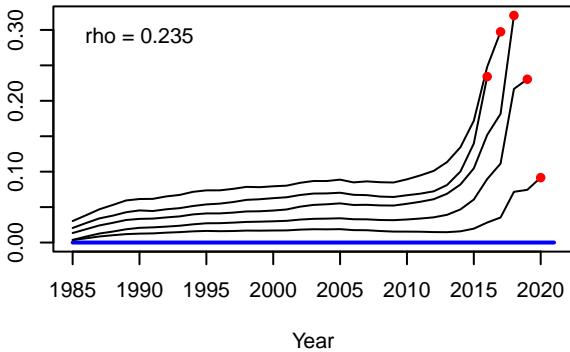
**Jan-1 B, Exploitable B, Total Stock N**

Jan-1 B



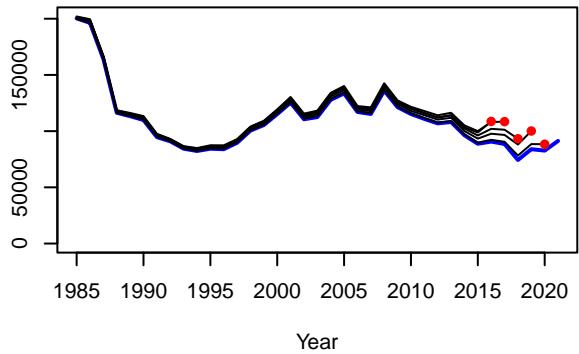
Year

Relative Retro



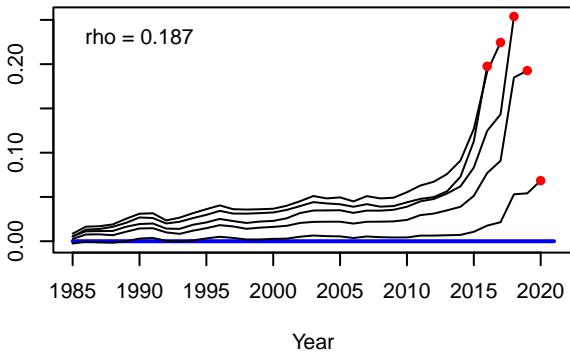
Year

Exploitable B



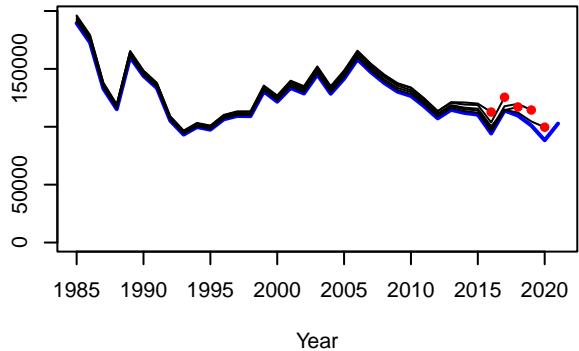
Year

Relative Retro



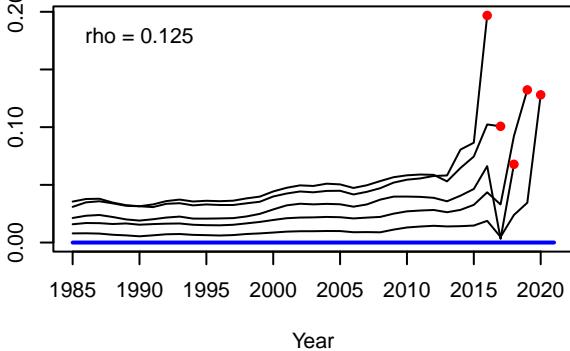
Year

Total Stock N



Year

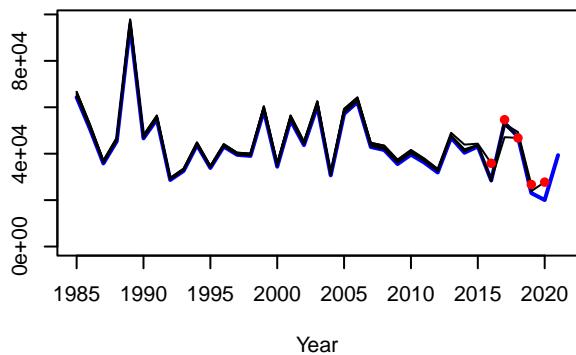
Relative Retro



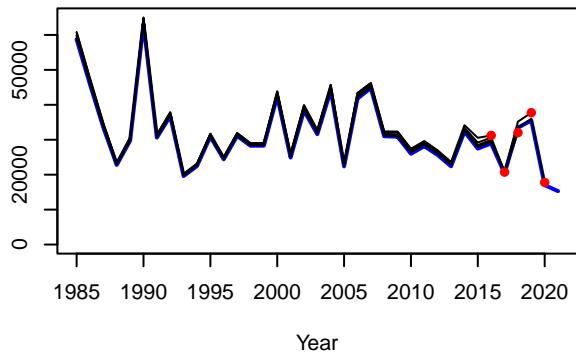
Year

# Stock Numbers at Age

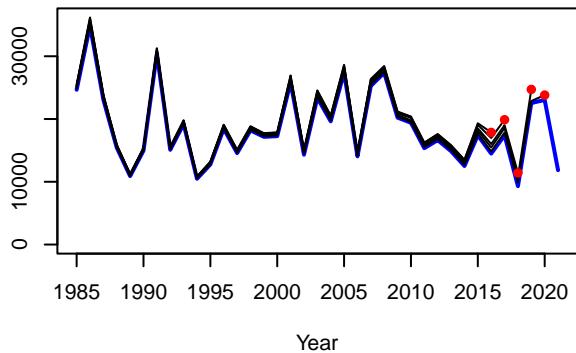
N at Age 1



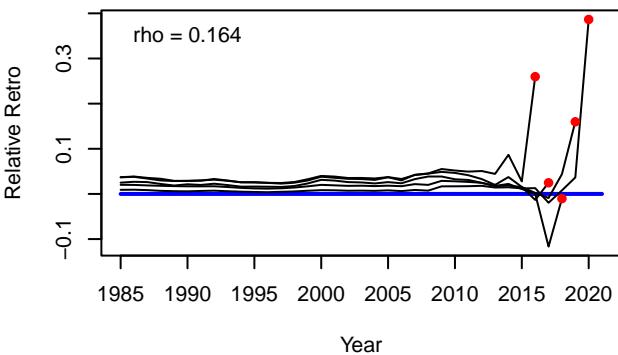
N at Age 2



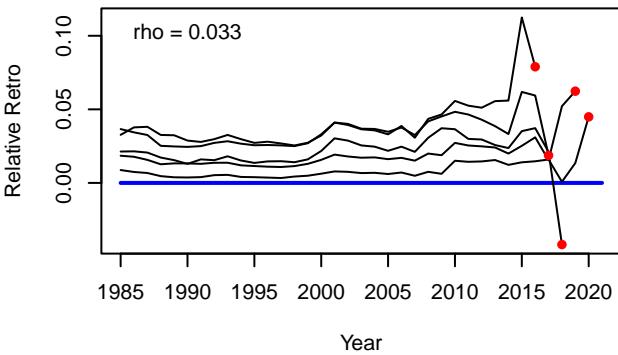
N at Age 3



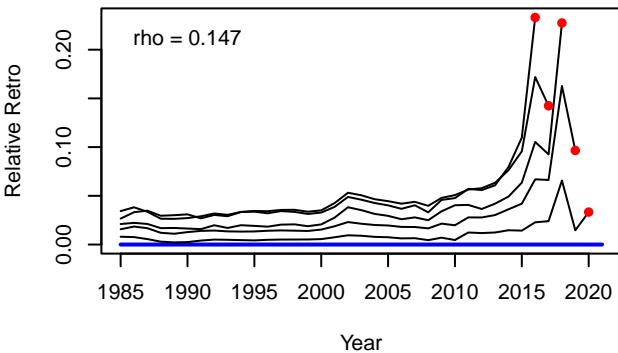
Relative Retro



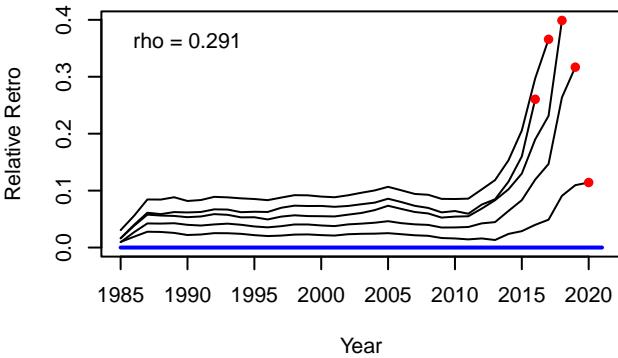
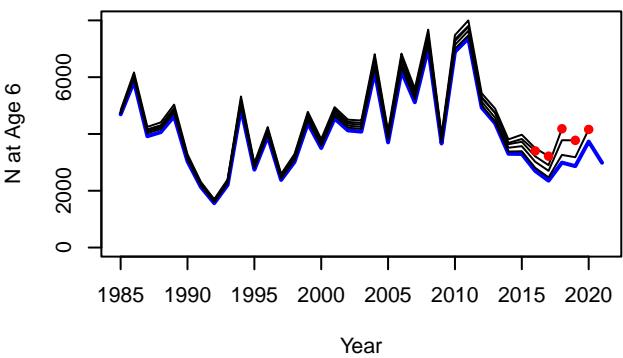
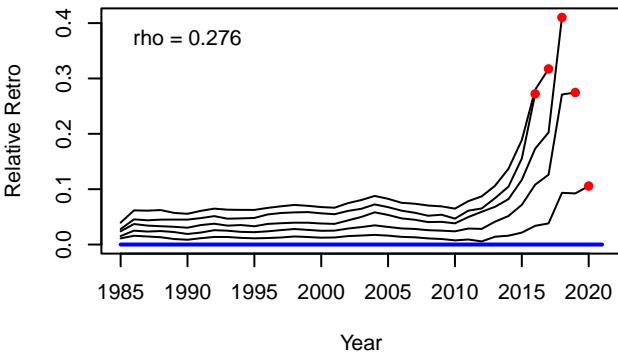
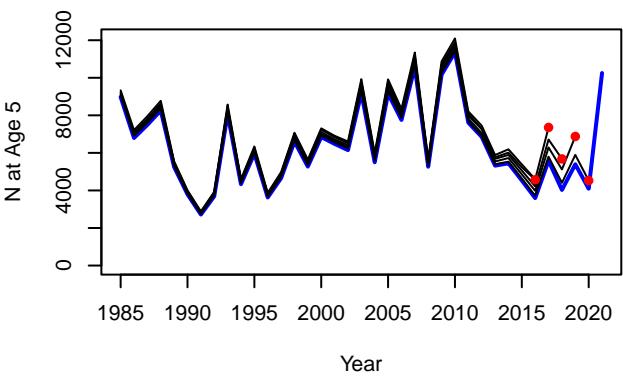
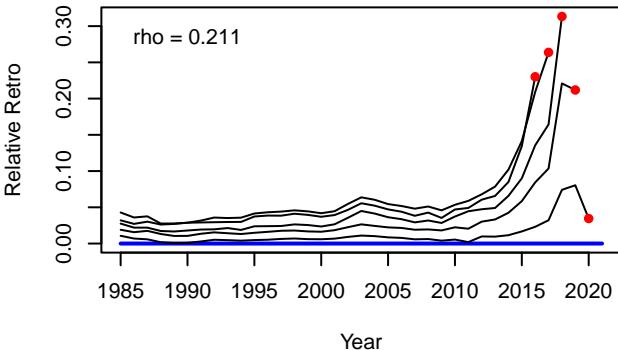
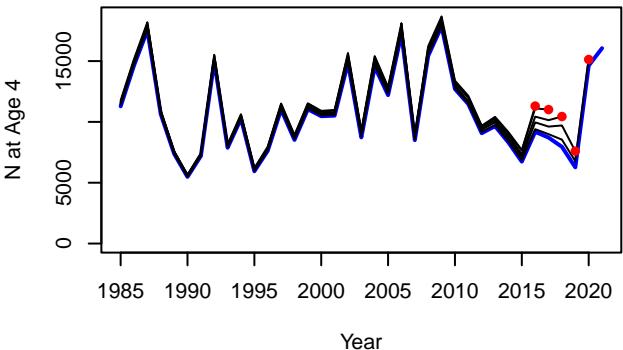
Relative Retro



Relative Retro

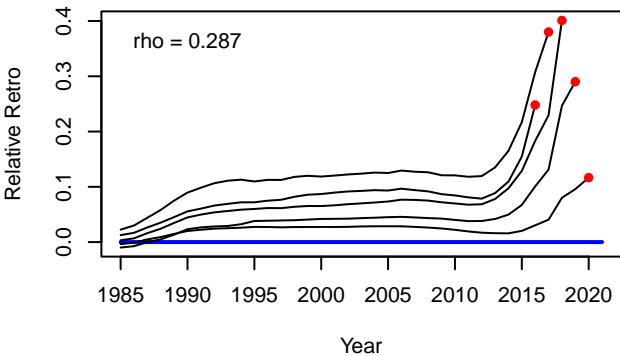
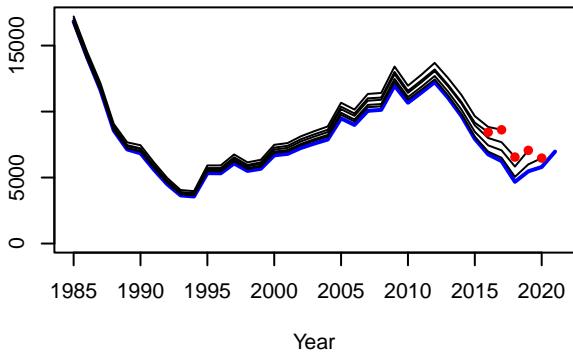


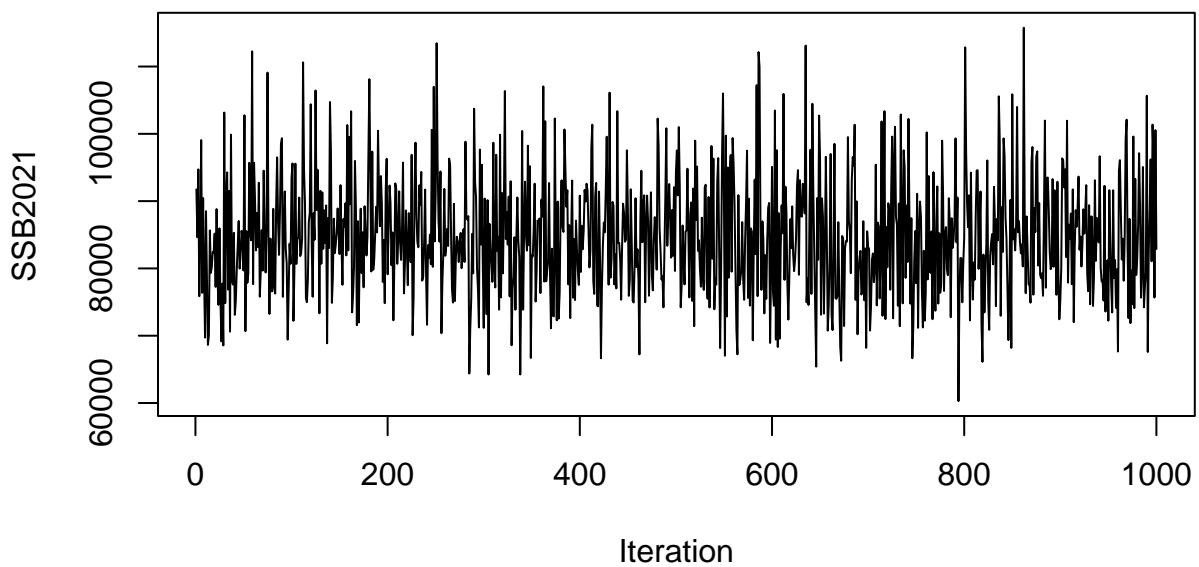
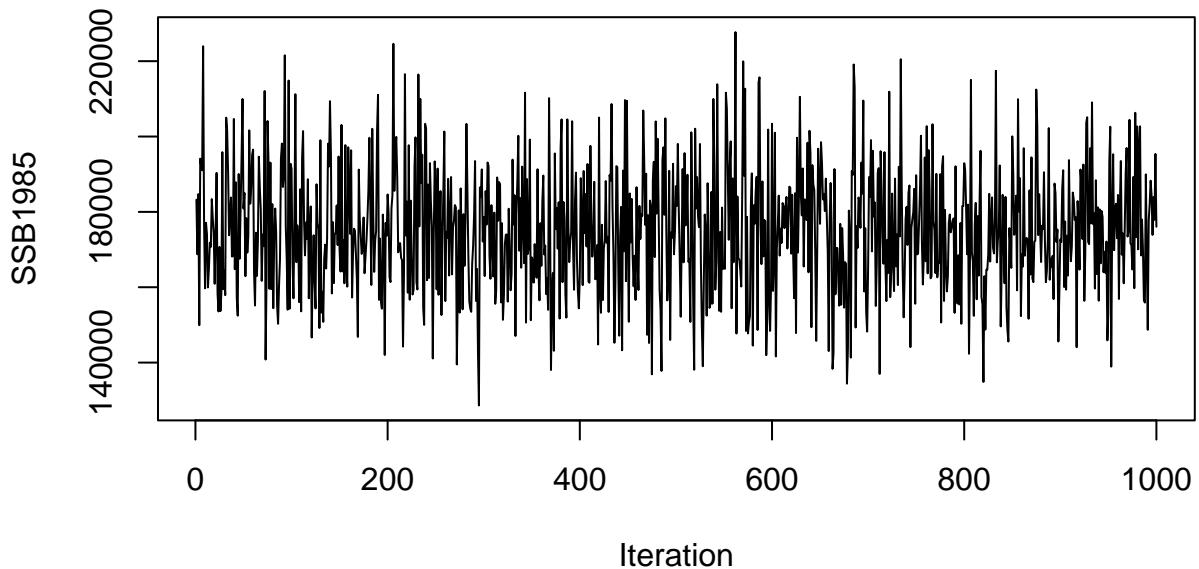
# Stock Numbers at Age

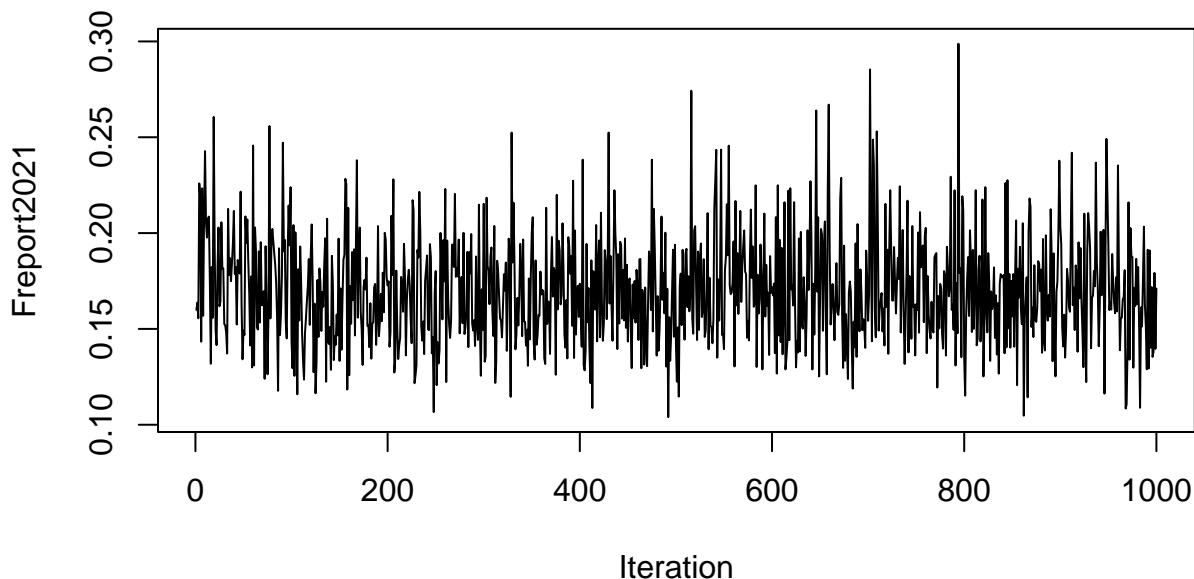
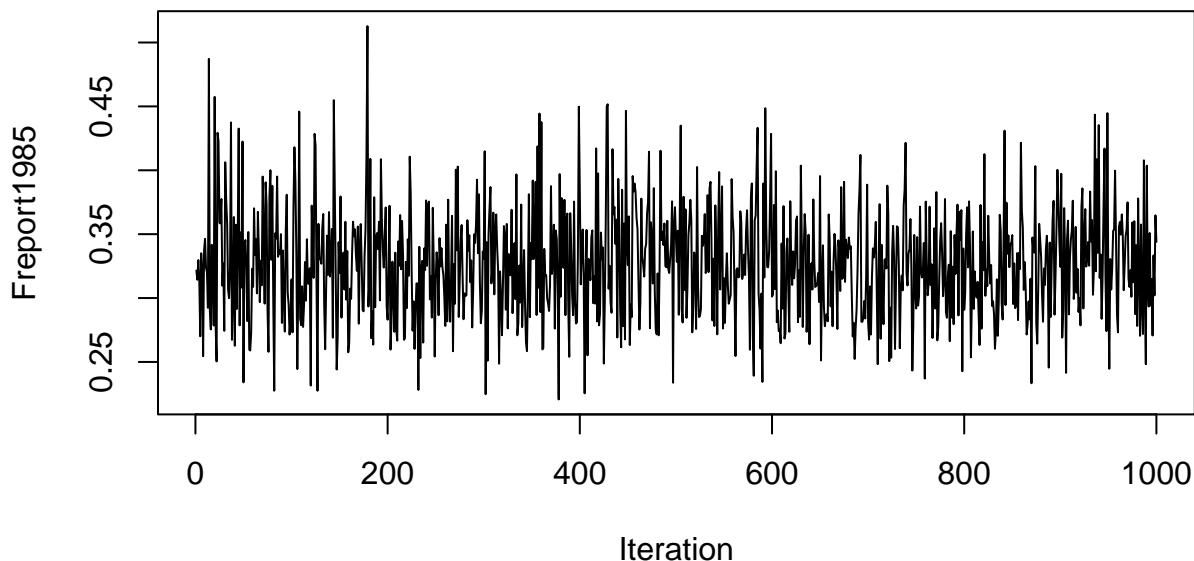


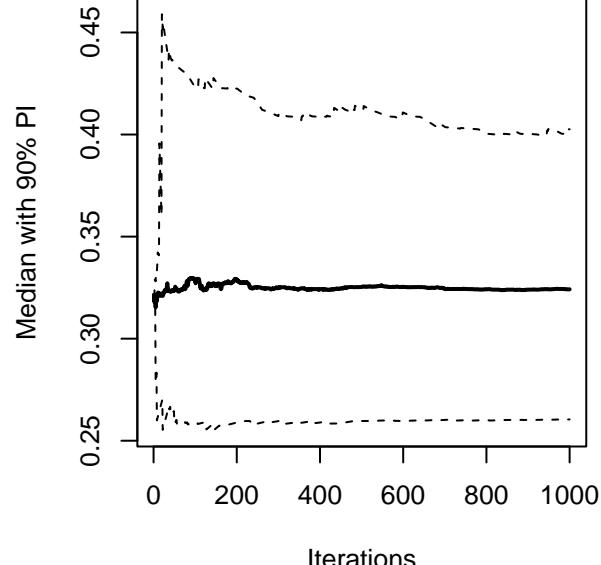
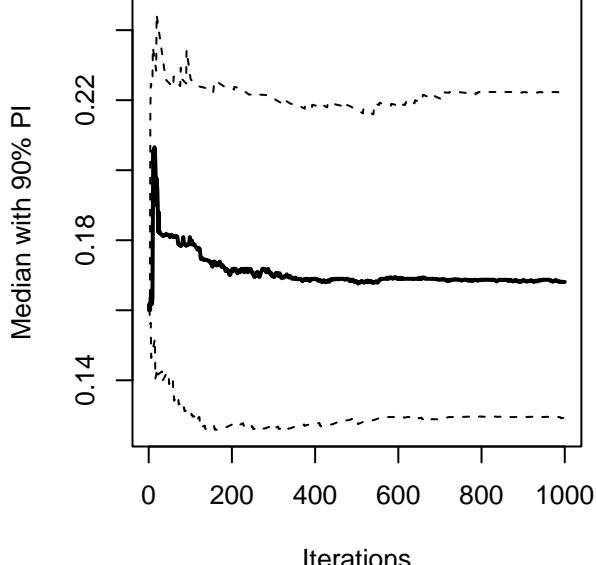
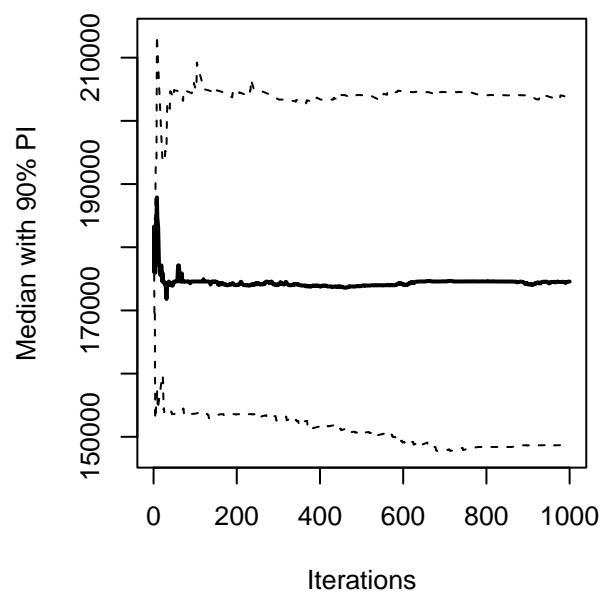
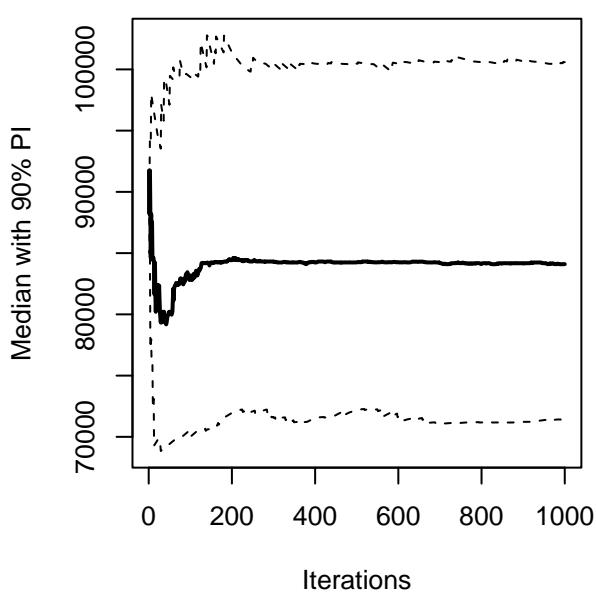
## Stock Numbers at Age

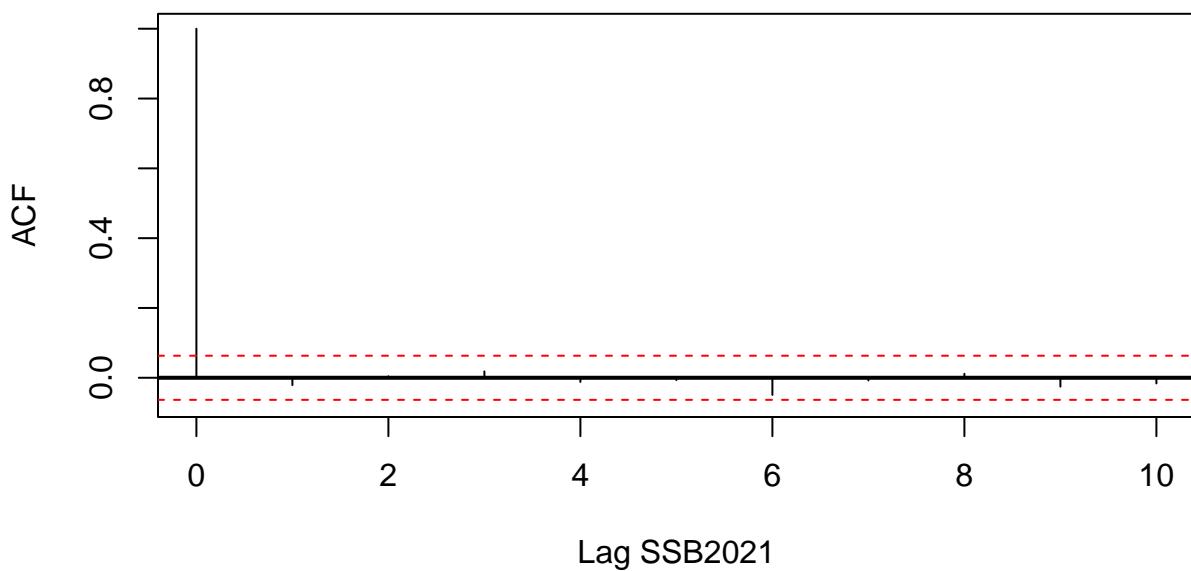
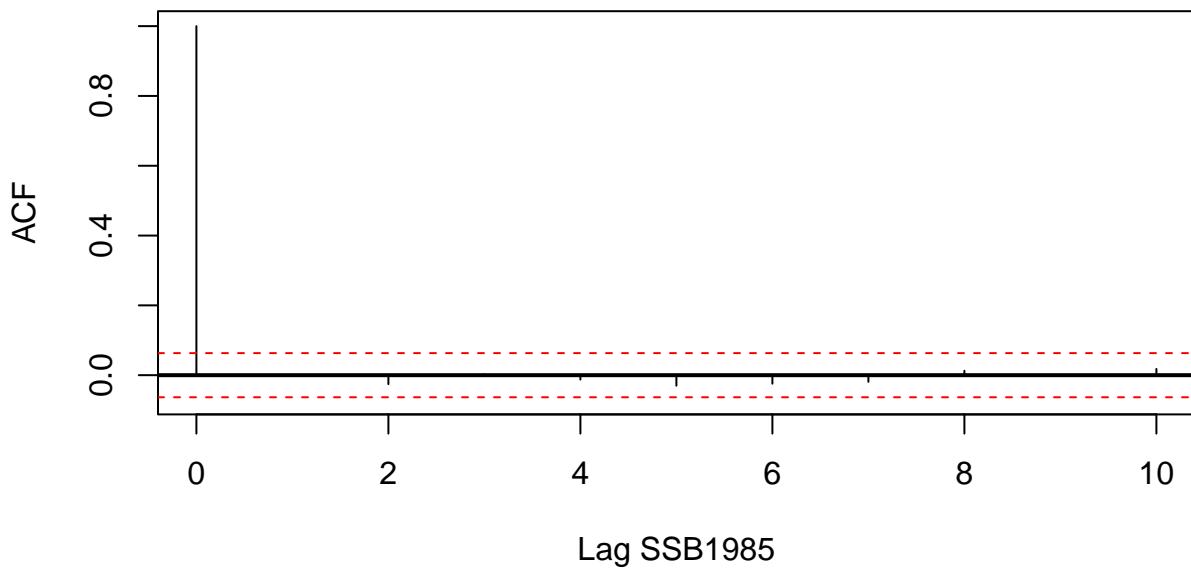
N at Age 7

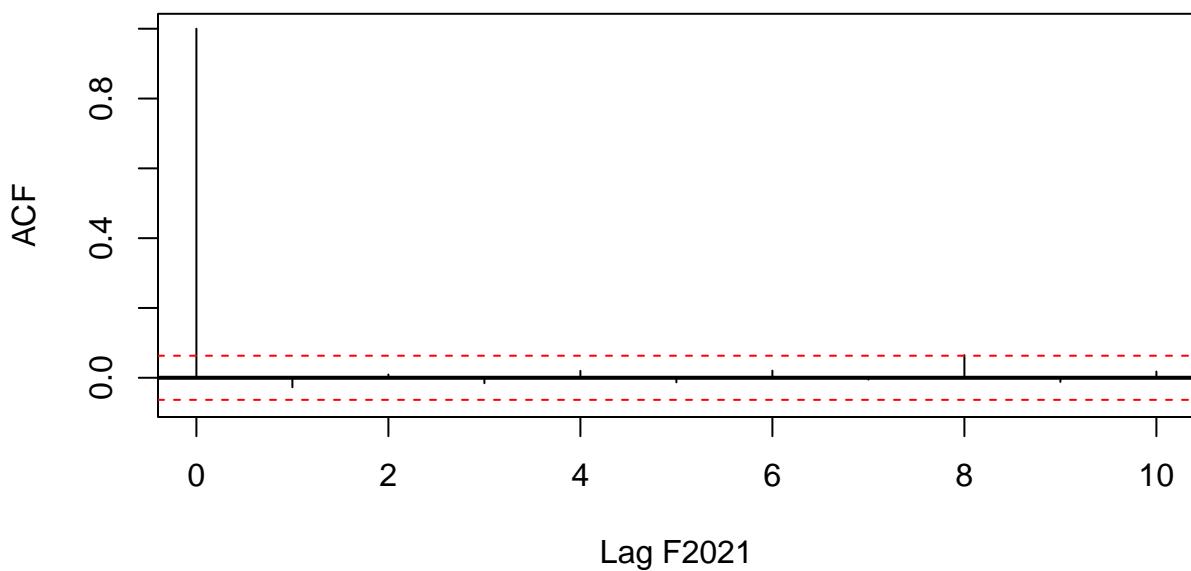
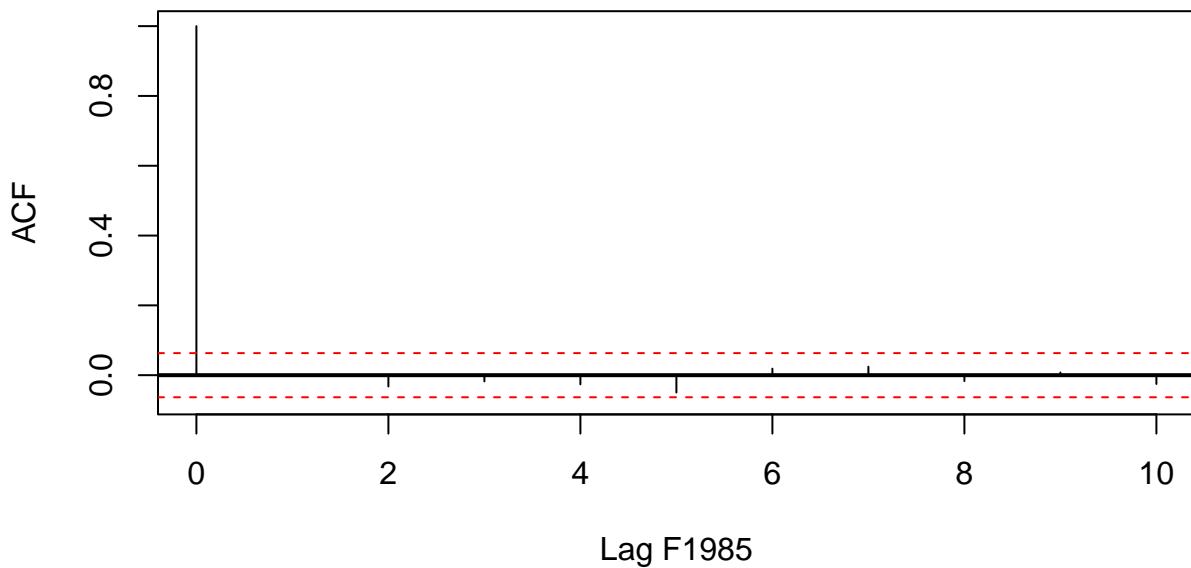


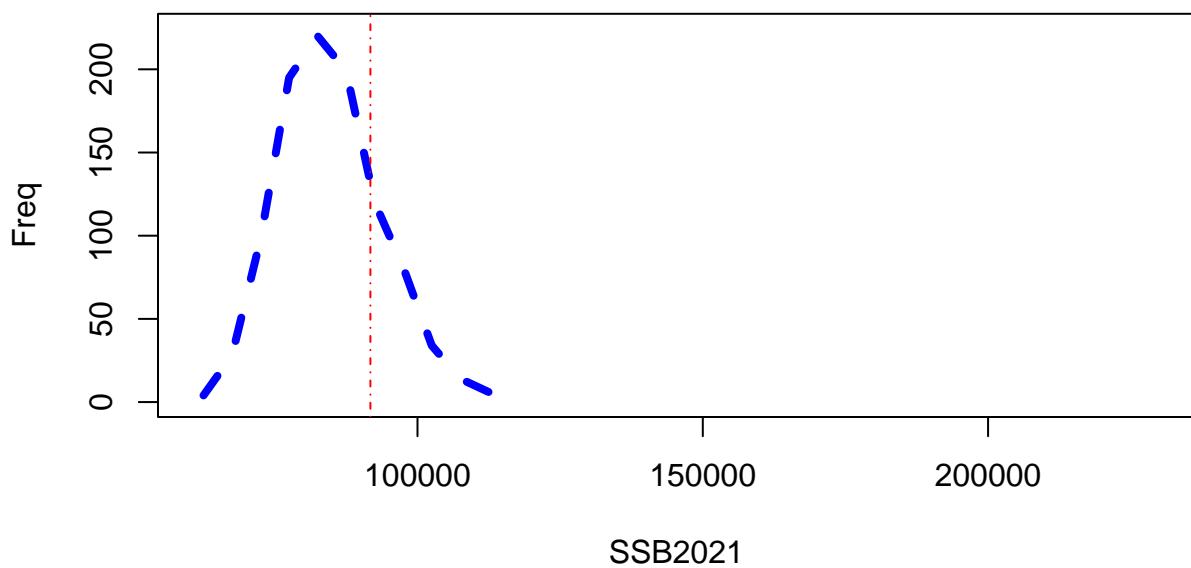
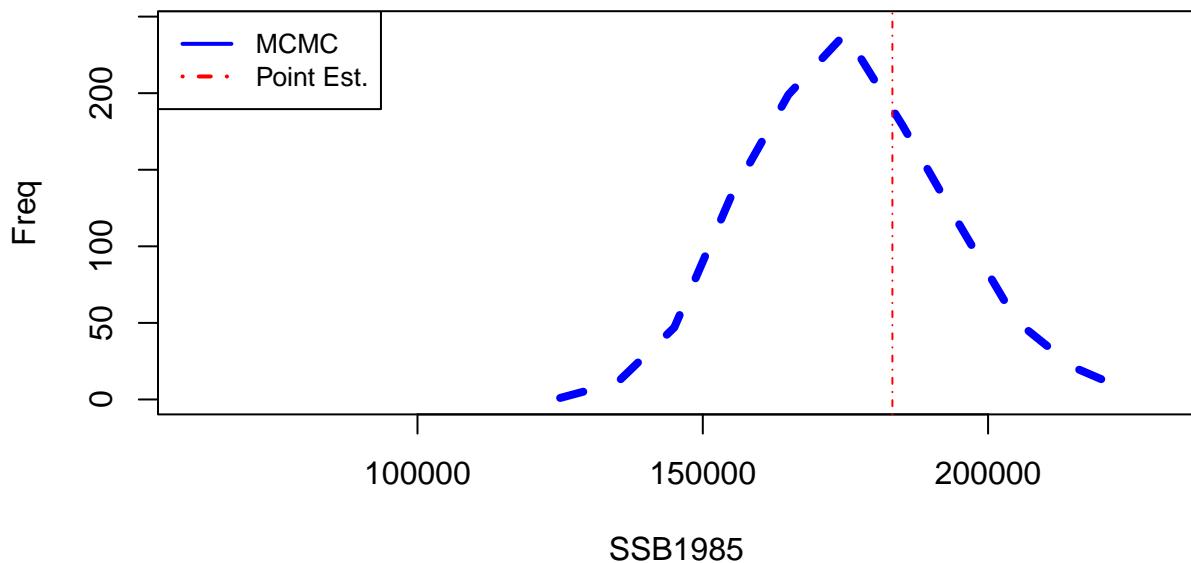


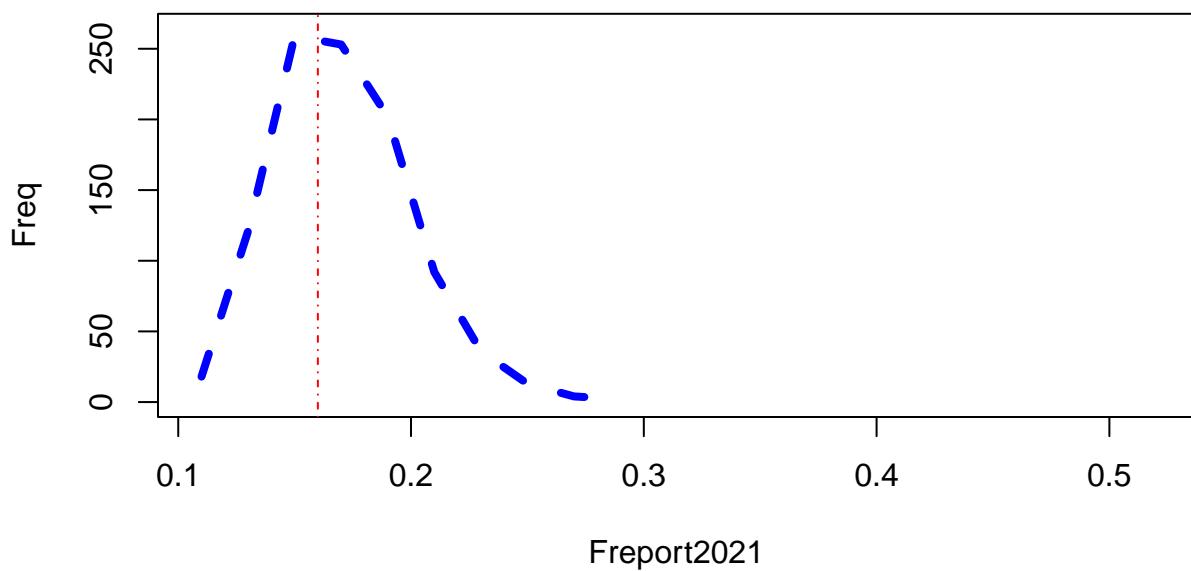
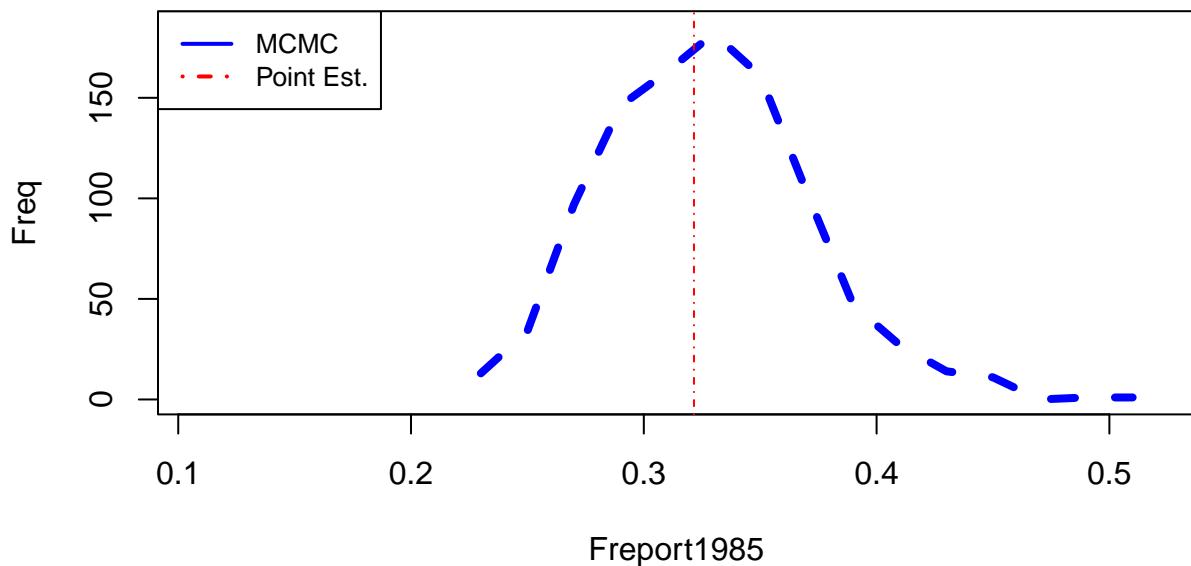


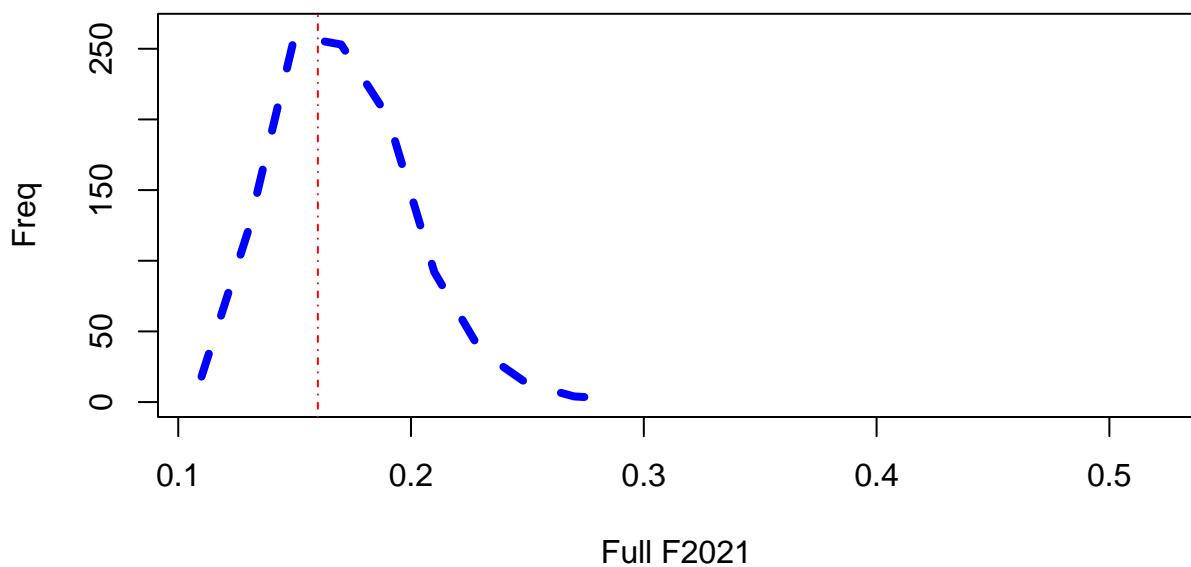
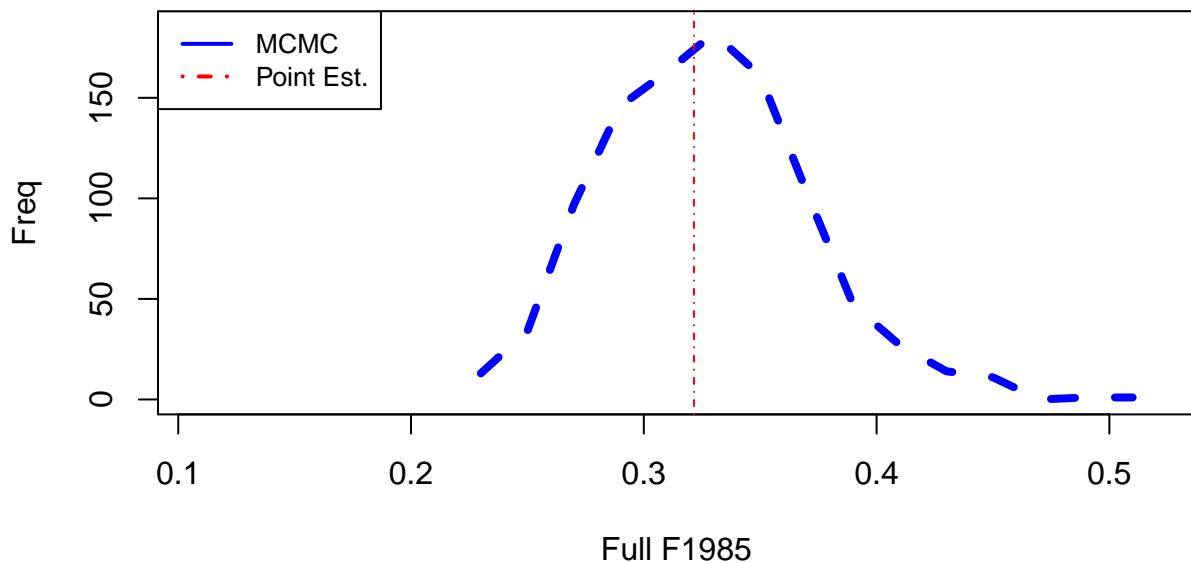
**F1985****F2021****SSB1985****SSB2021**

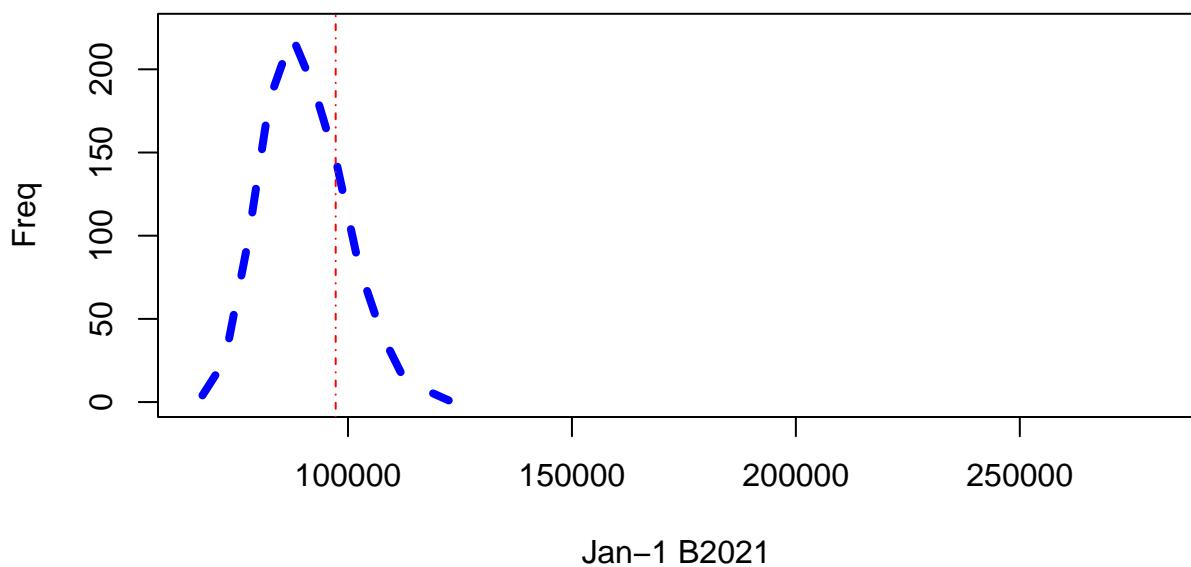
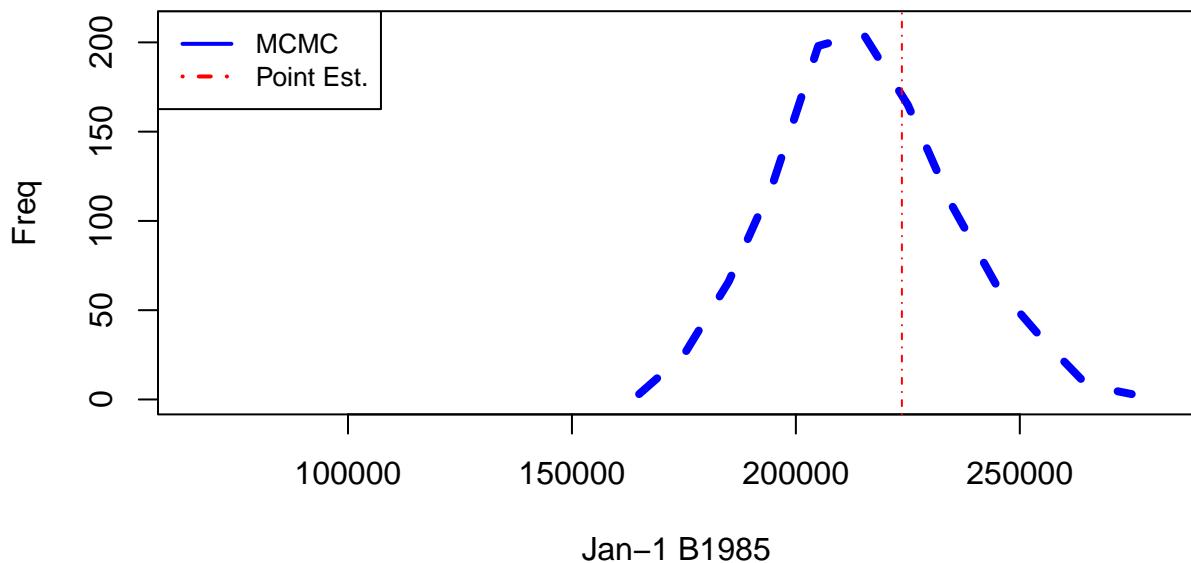


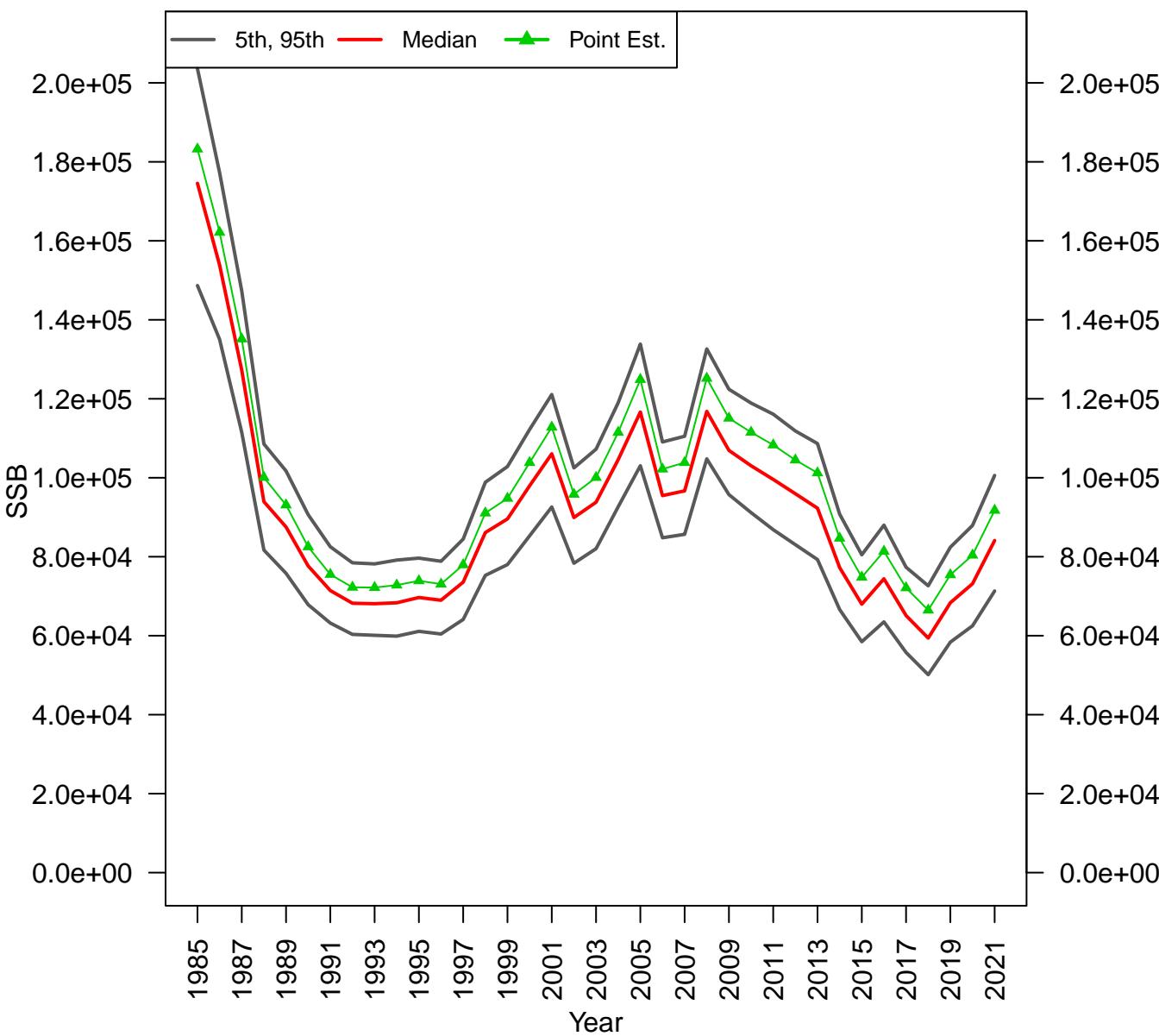


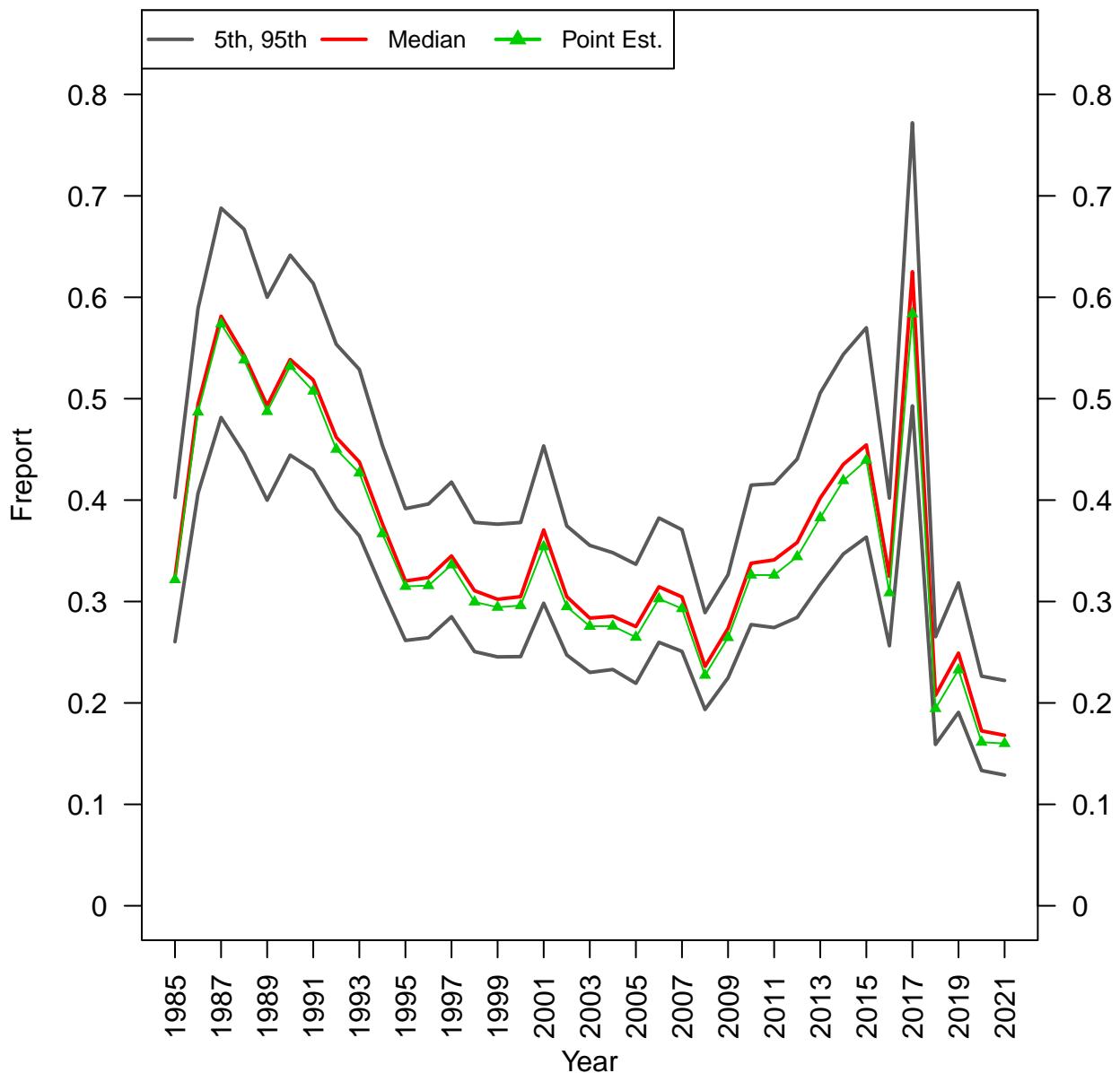


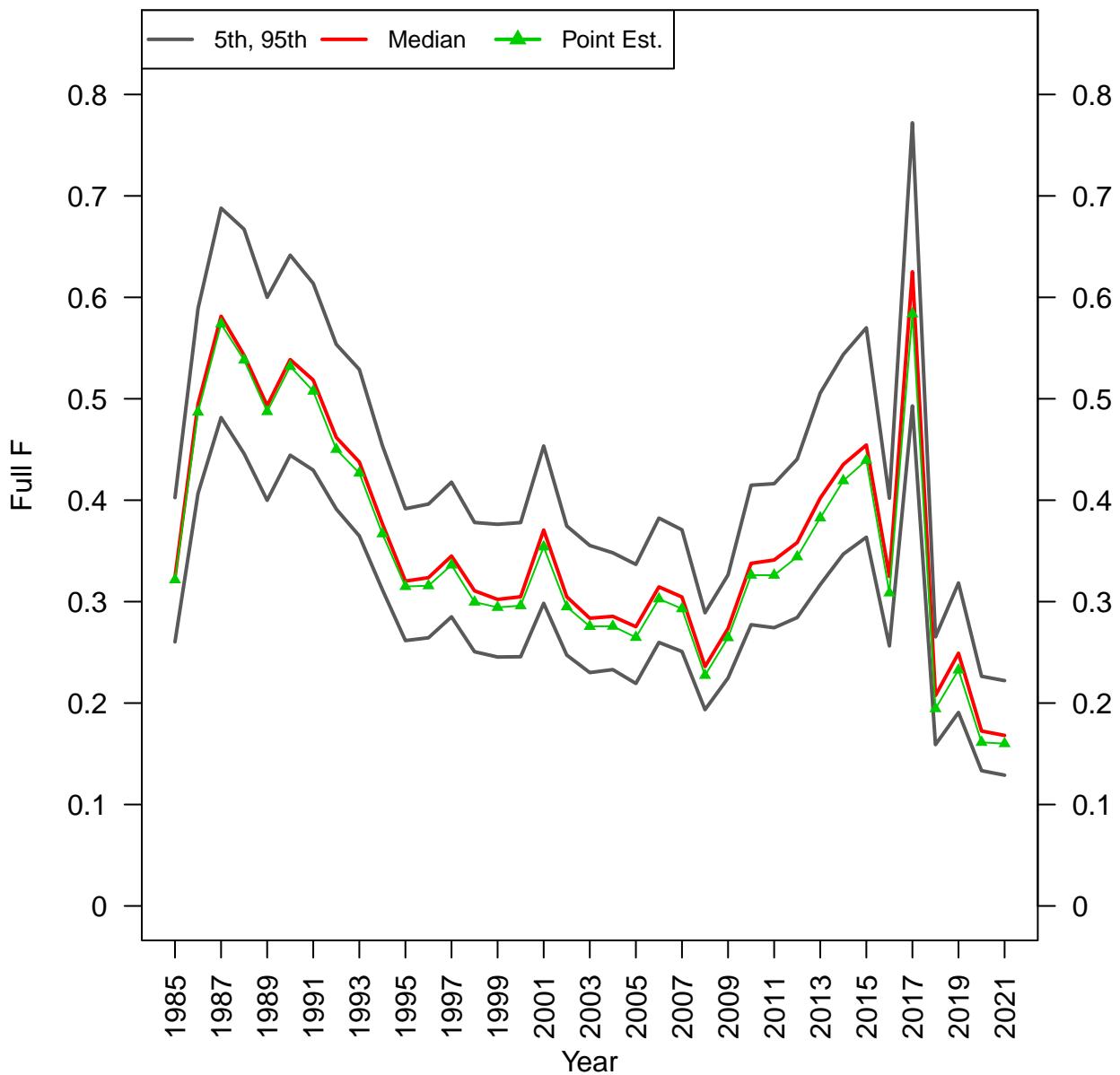


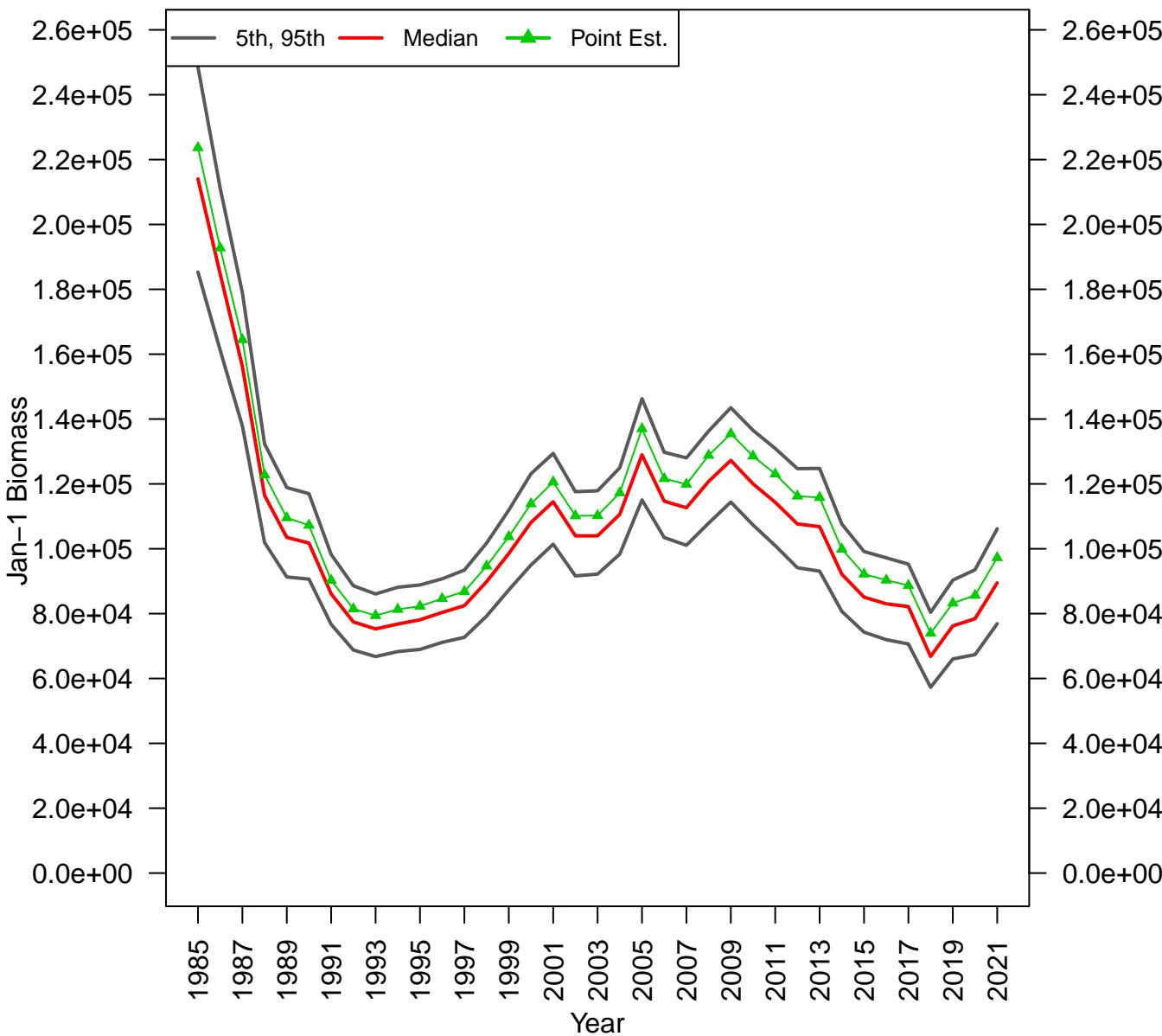








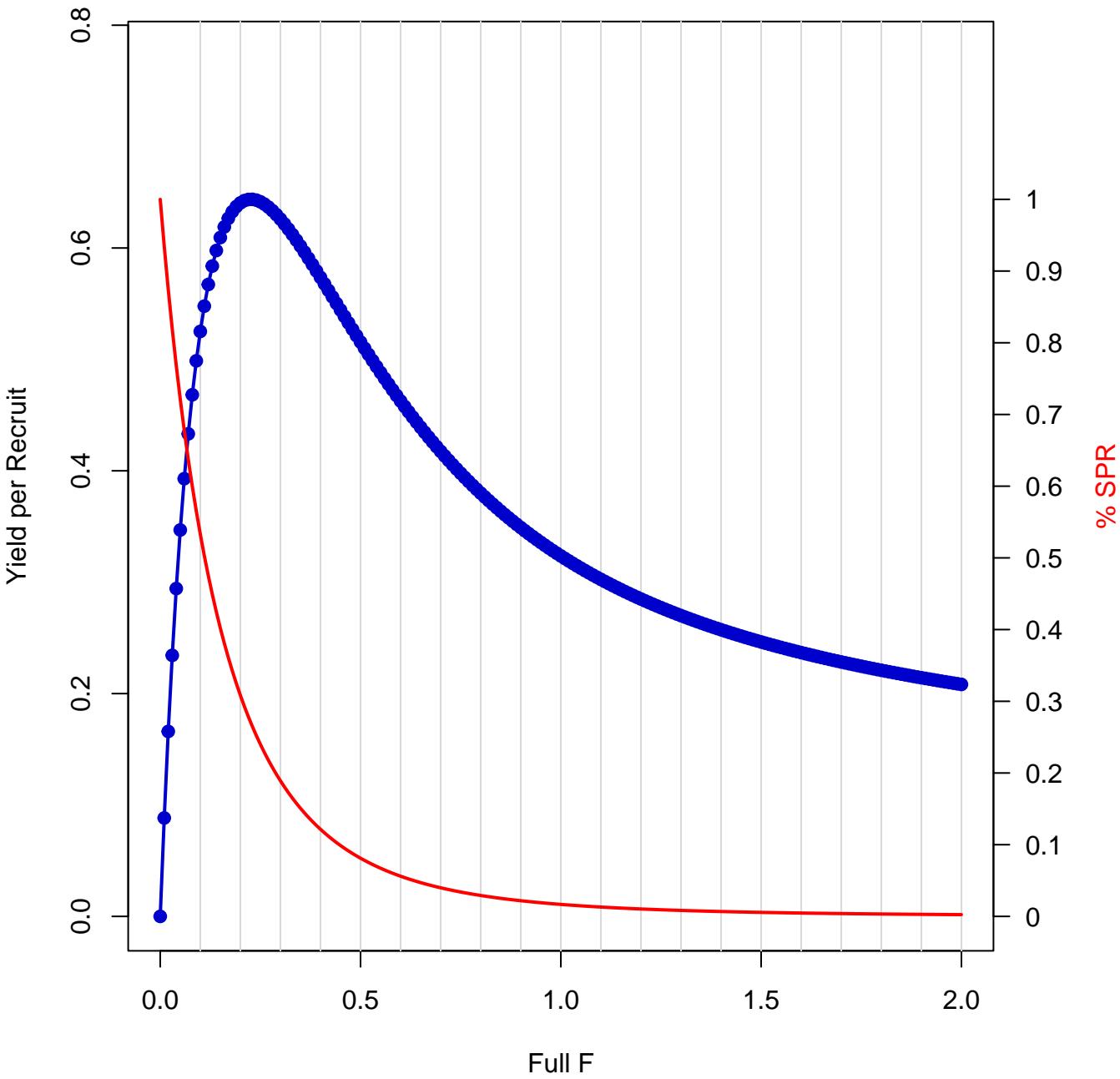




# BF01: Continuity Run

## REFERENCE POINT PLOTS

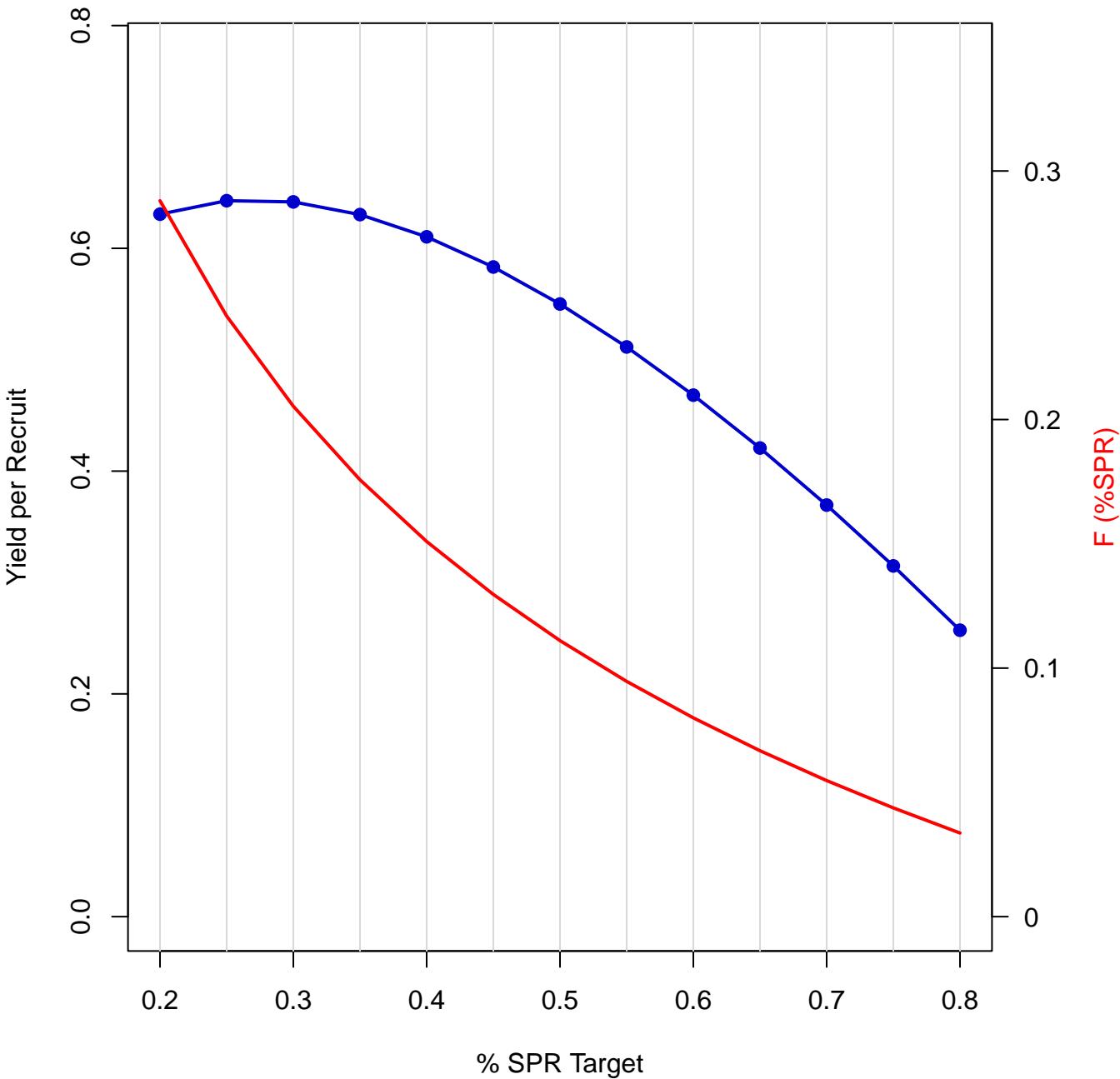
# YPR-SPR Reference Points (Years Avg = 5)



# YPR-SPR Reference Points (Years Avg = 5)

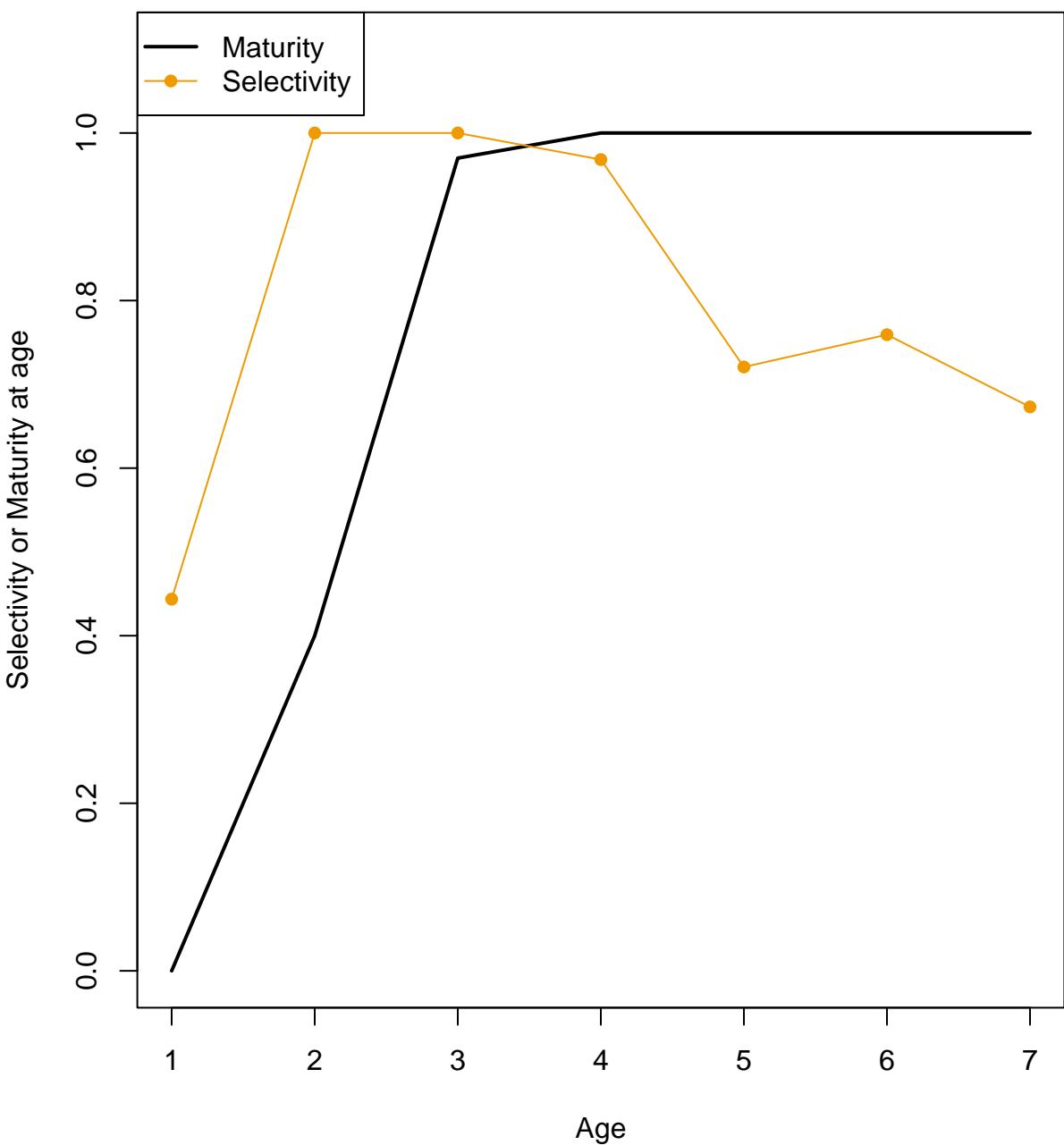
F	YPR	SPR	F	YPR	SPR	F	YPR	SPR
0	0	1	0.35	0.6017	0.1508	0.7	0.4174	0.0399
0.01	0.0884	0.9345	0.36	0.5963	0.1443	0.71	0.4134	0.0386
0.02	0.166	0.8744	0.37	0.5908	0.1381	0.72	0.4094	0.0374
0.03	0.2343	0.8191	0.38	0.5851	0.1323	0.73	0.4054	0.0362
0.04	0.2943	0.7681	0.39	0.5794	0.1268	0.74	0.4016	0.0351
0.05	0.3469	0.7211	0.4	0.5736	0.1215	0.75	0.3978	0.034
0.06	0.3929	0.6776	0.41	0.5678	0.1165	0.76	0.3941	0.033
0.07	0.4332	0.6373	0.42	0.5619	0.1117	0.77	0.3904	0.032
0.08	0.4682	0.5999	0.43	0.5561	0.1072	0.78	0.3869	0.031
0.09	0.4987	0.5653	0.44	0.5502	0.1029	0.79	0.3834	0.0301
0.1	0.5251	0.5331	0.45	0.5444	0.0988	0.8	0.3799	0.0292
0.11	0.5478	0.5031	0.46	0.5385	0.095	0.81	0.3766	0.0283
0.12	0.5673	0.4751	0.47	0.5327	0.0912	0.82	0.3733	0.0275
0.13	0.5838	0.4491	0.48	0.527	0.0877	0.83	0.37	0.0267
0.14	0.5977	0.4248	0.49	0.5213	0.0844	0.84	0.3668	0.0259
0.15	0.6094	0.402	0.5	0.5156	0.0811	0.85	0.3637	0.0252
0.16	0.6189	0.3808	0.51	0.51	0.0781	0.86	0.3607	0.0245
0.17	0.6266	0.3609	0.52	0.5045	0.0752	0.87	0.3577	0.0238
0.18	0.6326	0.3423	0.53	0.499	0.0724	0.88	0.3547	0.0231
0.19	0.6372	0.3248	0.54	0.4936	0.0697	0.89	0.3519	0.0225
0.2	0.6405	0.3084	0.55	0.4882	0.0672	0.9	0.349	0.0219
0.21	0.6425	0.293	0.56	0.4829	0.0648	0.91	0.3463	0.0213
0.22	0.6436	0.2785	0.57	0.4777	0.0624	0.92	0.3436	0.0207
0.23	0.6437	0.2649	0.58	0.4726	0.0602	0.93	0.3409	0.0201
0.24	0.6429	0.252	0.59	0.4676	0.0581	0.94	0.3383	0.0196
0.25	0.6415	0.24	0.6	0.4626	0.0561	0.95	0.3357	0.0191
0.26	0.6394	0.2286	0.61	0.4578	0.0541	0.96	0.3332	0.0186
0.27	0.6367	0.2179	0.62	0.453	0.0523	0.97	0.3307	0.0181
0.28	0.6335	0.2077	0.63	0.4482	0.0505	0.98	0.3283	0.0176
0.29	0.6299	0.1982	0.64	0.4436	0.0488	0.99	0.3259	0.0172
0.3	0.6259	0.1891	0.65	0.439	0.0471	1	0.3236	0.0167
0.31	0.6216	0.1806	0.66	0.4346	0.0456	1.01	0.3213	0.0163
0.32	0.617	0.1725	0.67	0.4302	0.0441	1.02	0.3191	0.0159
0.33	0.6121	0.1649	0.68	0.4258	0.0426	1.03	0.3169	0.0155
0.34	0.607	0.1577	0.69	0.4216	0.0412	1.04	0.3147	0.0151

## SPR Target Reference Points (Years Avg = 5)

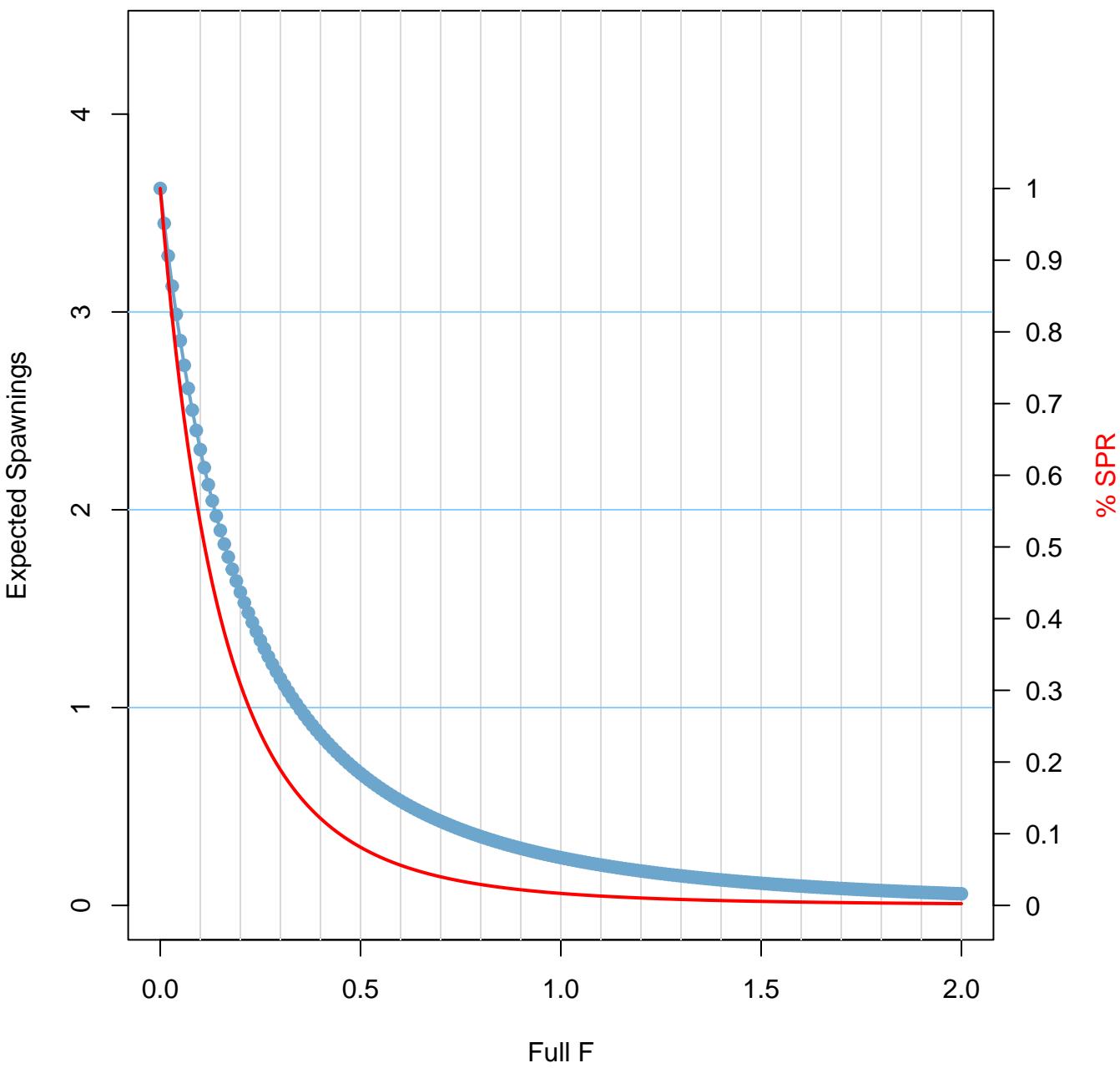


## SPR Target Reference Points (Years Avg = 5)

% SPR	F(%SPR)	YPR
0.2	0.288	0.6307
0.25	0.2416	0.6427
0.3	0.2054	0.6417
0.35	0.1758	0.6303
0.4	0.1509	0.6103
0.45	0.1296	0.5832
0.5	0.1111	0.55
0.55	0.0947	0.5115
0.6	0.08	0.4682
0.65	0.0668	0.4207
0.7	0.0547	0.3695
0.75	0.0438	0.3149
0.8	0.0337	0.2571



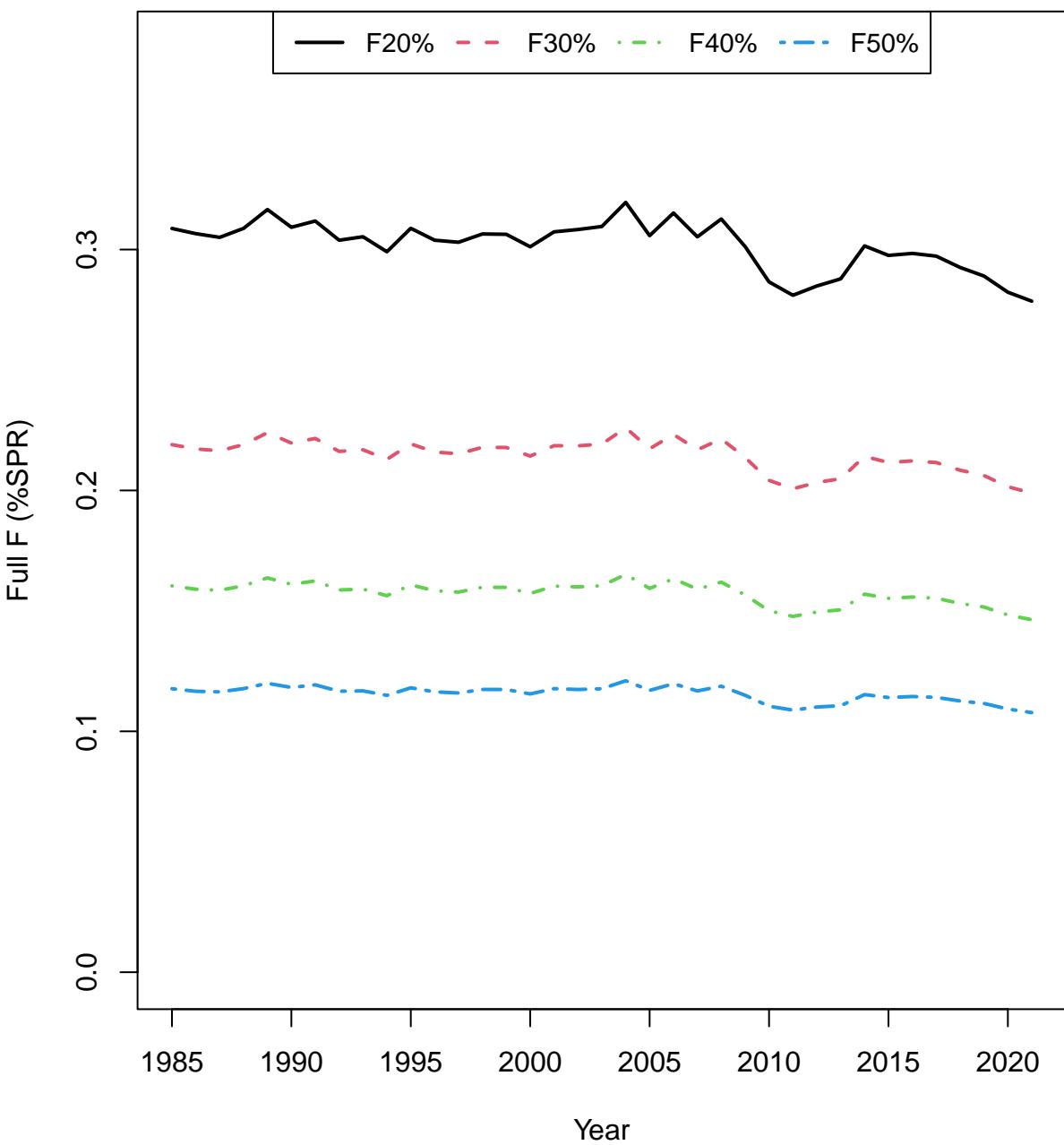
# Expected Spawnings and SPR Reference Points (Years Avg = 5)



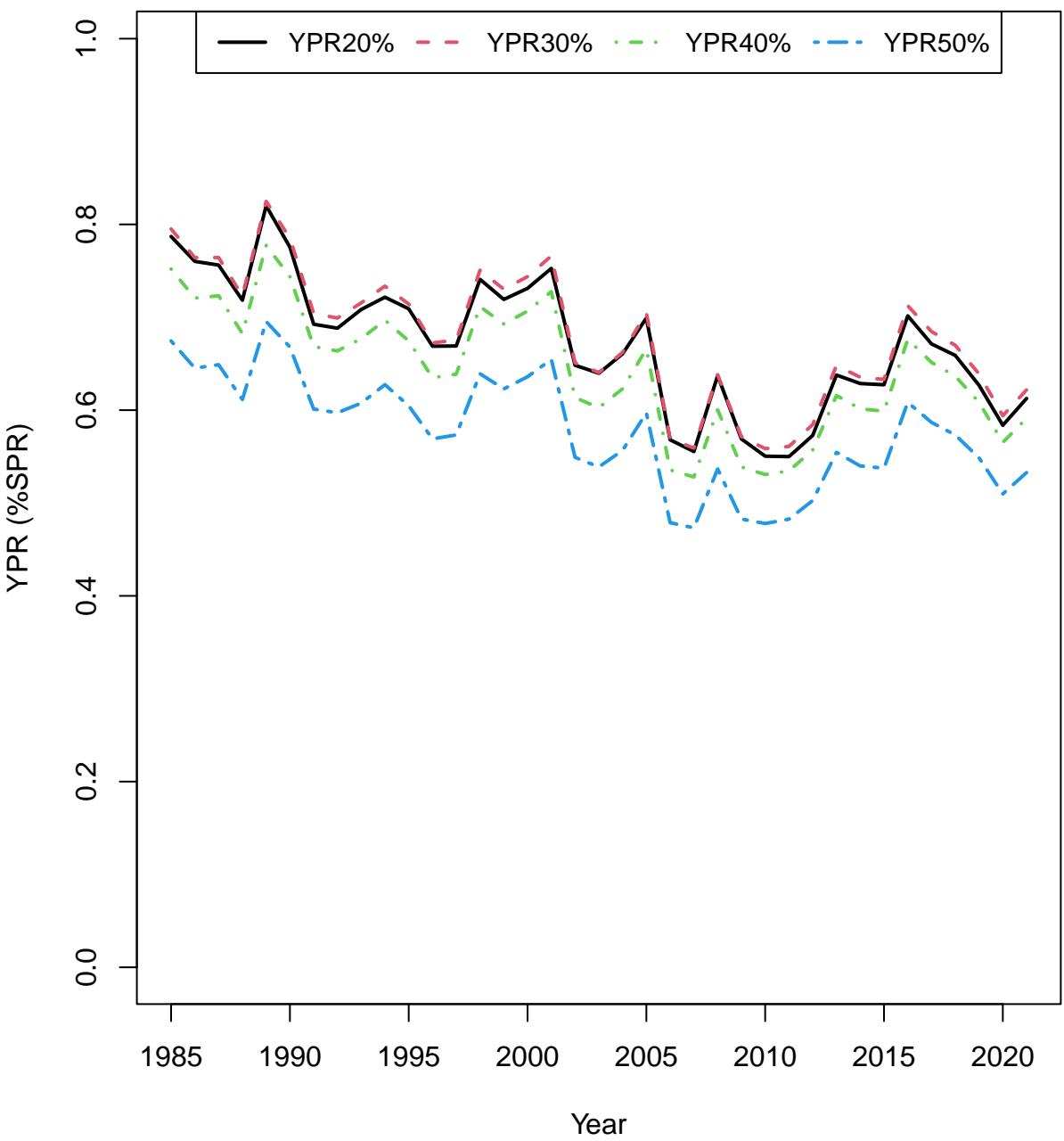
# Expected Spawnings & SPR Reference Points (Years Avg = 5)

F	E[Sp]	SPR	F	E[Sp]	SPR	F	E[Sp]	SPR
0	3.6242	1	0.35	0.9902	0.1508	0.7	0.4254	0.0399
0.01	3.4474	0.9345	0.36	0.9625	0.1443	0.71	0.4167	0.0386
0.02	3.2833	0.8744	0.37	0.9359	0.1381	0.72	0.4083	0.0374
0.03	3.1305	0.8191	0.38	0.9104	0.1323	0.73	0.4	0.0362
0.04	2.988	0.7681	0.39	0.8857	0.1268	0.74	0.392	0.0351
0.05	2.8549	0.7211	0.4	0.8621	0.1215	0.75	0.3842	0.034
0.06	2.7303	0.6776	0.41	0.8392	0.1165	0.76	0.3766	0.033
0.07	2.6136	0.6373	0.42	0.8172	0.1117	0.77	0.3692	0.032
0.08	2.5041	0.5999	0.43	0.796	0.1072	0.78	0.362	0.031
0.09	2.4011	0.5653	0.44	0.7756	0.1029	0.79	0.355	0.0301
0.1	2.3042	0.5331	0.45	0.7559	0.0988	0.8	0.3481	0.0292
0.11	2.2129	0.5031	0.46	0.7368	0.095	0.81	0.3415	0.0283
0.12	2.1267	0.4751	0.47	0.7184	0.0912	0.82	0.335	0.0275
0.13	2.0454	0.4491	0.48	0.7007	0.0877	0.83	0.3286	0.0267
0.14	1.9684	0.4248	0.49	0.6835	0.0844	0.84	0.3225	0.0259
0.15	1.8956	0.402	0.5	0.667	0.0811	0.85	0.3165	0.0252
0.16	1.8265	0.3808	0.51	0.6509	0.0781	0.86	0.3106	0.0245
0.17	1.7611	0.3609	0.52	0.6354	0.0752	0.87	0.3049	0.0238
0.18	1.6989	0.3423	0.53	0.6204	0.0724	0.88	0.2993	0.0231
0.19	1.6399	0.3248	0.54	0.6059	0.0697	0.89	0.2938	0.0225
0.2	1.5837	0.3084	0.55	0.5918	0.0672	0.9	0.2885	0.0219
0.21	1.5302	0.293	0.56	0.5782	0.0648	0.91	0.2833	0.0213
0.22	1.4793	0.2785	0.57	0.565	0.0624	0.92	0.2782	0.0207
0.23	1.4308	0.2649	0.58	0.5522	0.0602	0.93	0.2733	0.0201
0.24	1.3845	0.252	0.59	0.5398	0.0581	0.94	0.2684	0.0196
0.25	1.3403	0.24	0.6	0.5278	0.0561	0.95	0.2637	0.0191
0.26	1.298	0.2286	0.61	0.5162	0.0541	0.96	0.2591	0.0186
0.27	1.2576	0.2179	0.62	0.5049	0.0523	0.97	0.2546	0.0181
0.28	1.219	0.2077	0.63	0.4939	0.0505	0.98	0.2502	0.0176
0.29	1.182	0.1982	0.64	0.4832	0.0488	0.99	0.2459	0.0172
0.3	1.1466	0.1891	0.65	0.4729	0.0471	1	0.2417	0.0167
0.31	1.1127	0.1806	0.66	0.4629	0.0456	1.01	0.2375	0.0163
0.32	1.0802	0.1725	0.67	0.4531	0.0441	1.02	0.2335	0.0159
0.33	1.0489	0.1649	0.68	0.4436	0.0426	1.03	0.2296	0.0155
0.34	1.019	0.1577	0.69	0.4344	0.0412	1.04	0.2257	0.0151

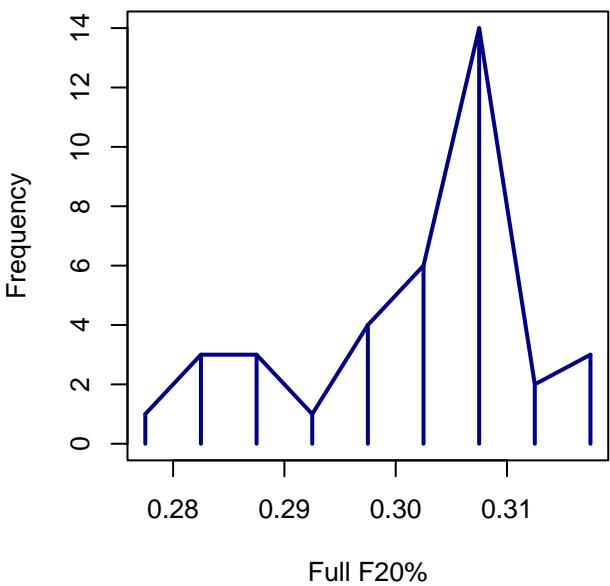
## Annual F(%SPR) Reference Points



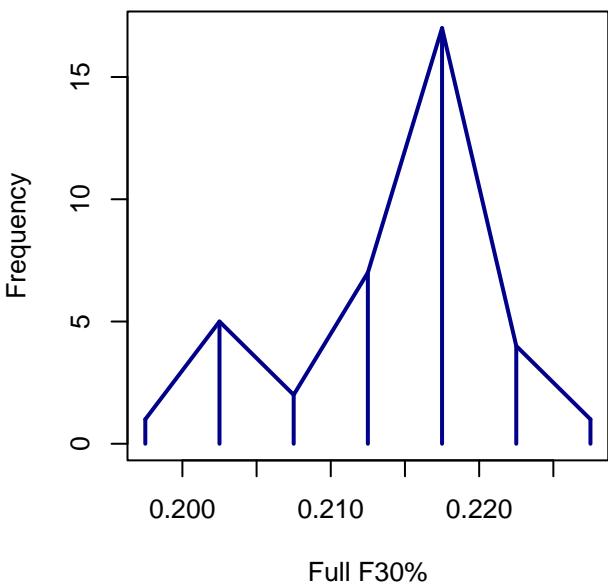
## Annual YPR(%SPR) Reference Points



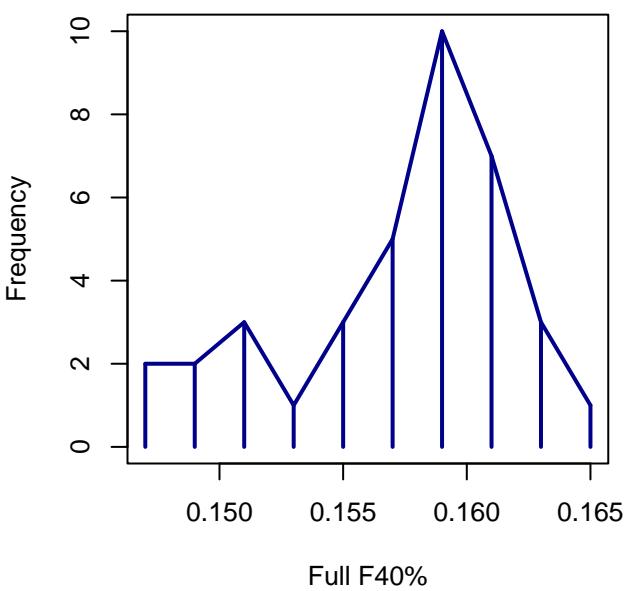
### Annual F (%SPR) Reference Points



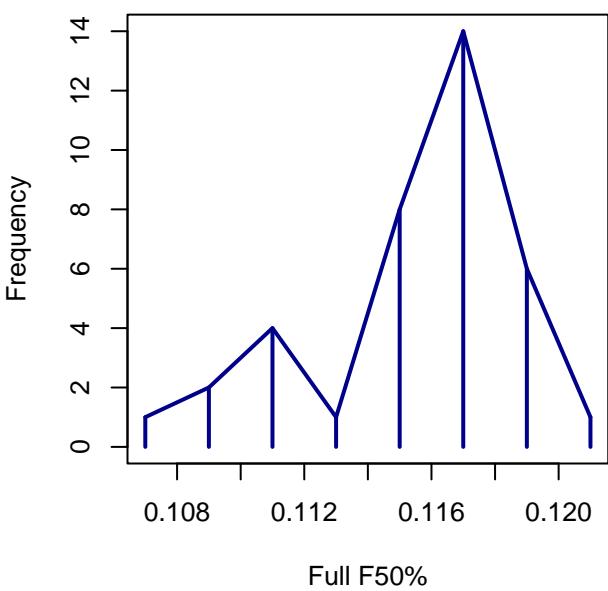
Full F20%



Full F30%

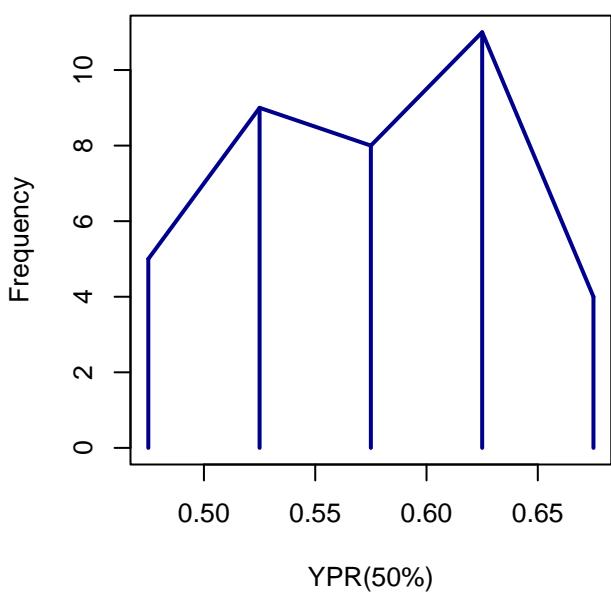
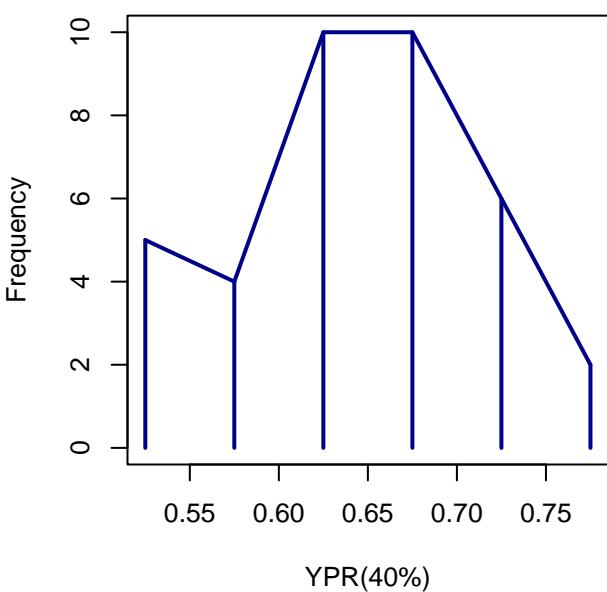
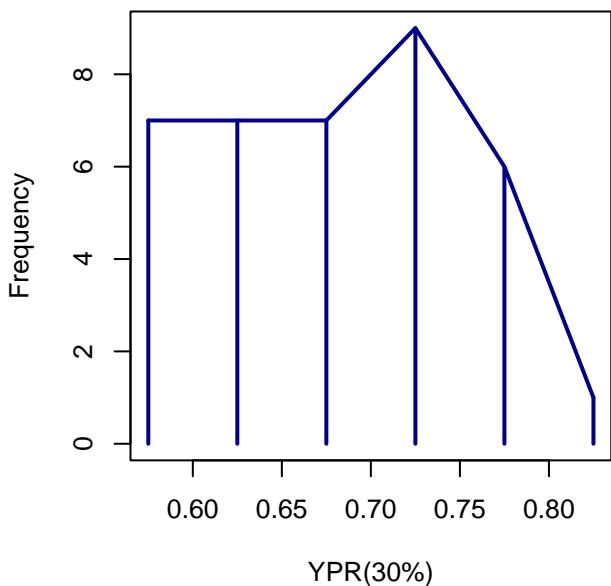
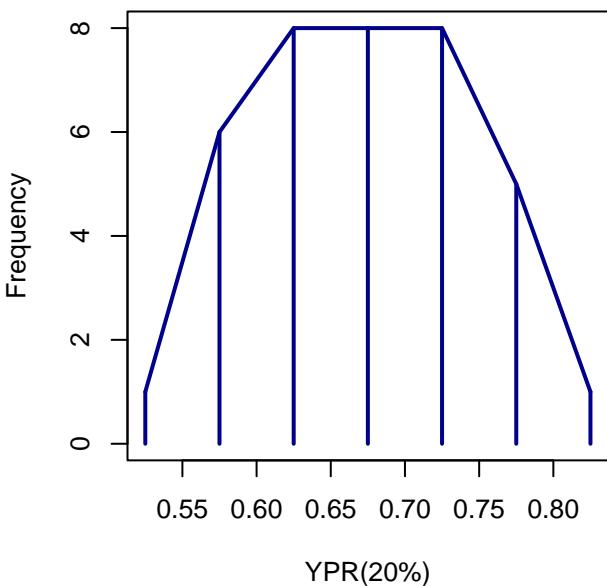


Full F40%



Full F50%

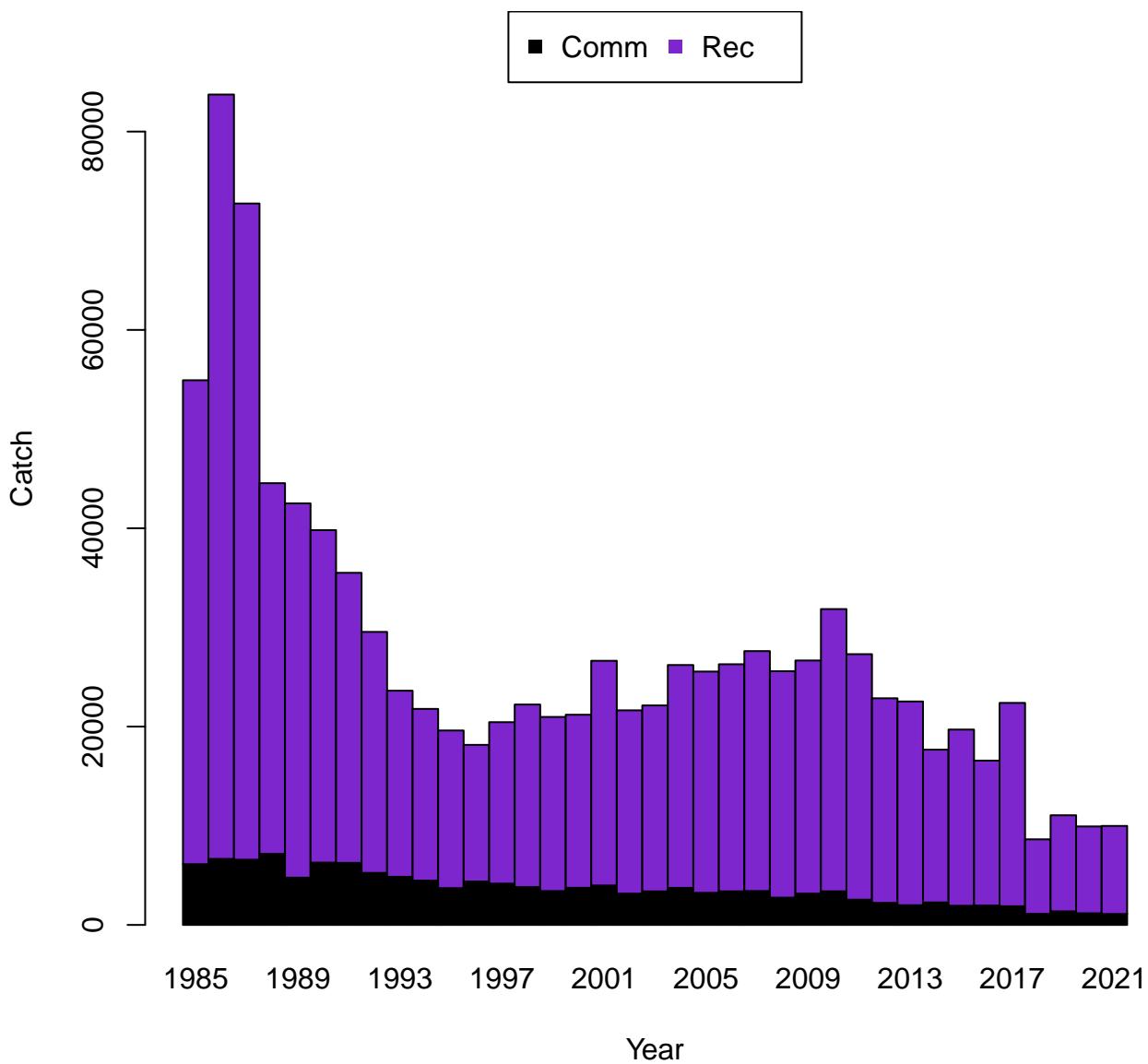
### Annual YPR (%SPR) Reference Points

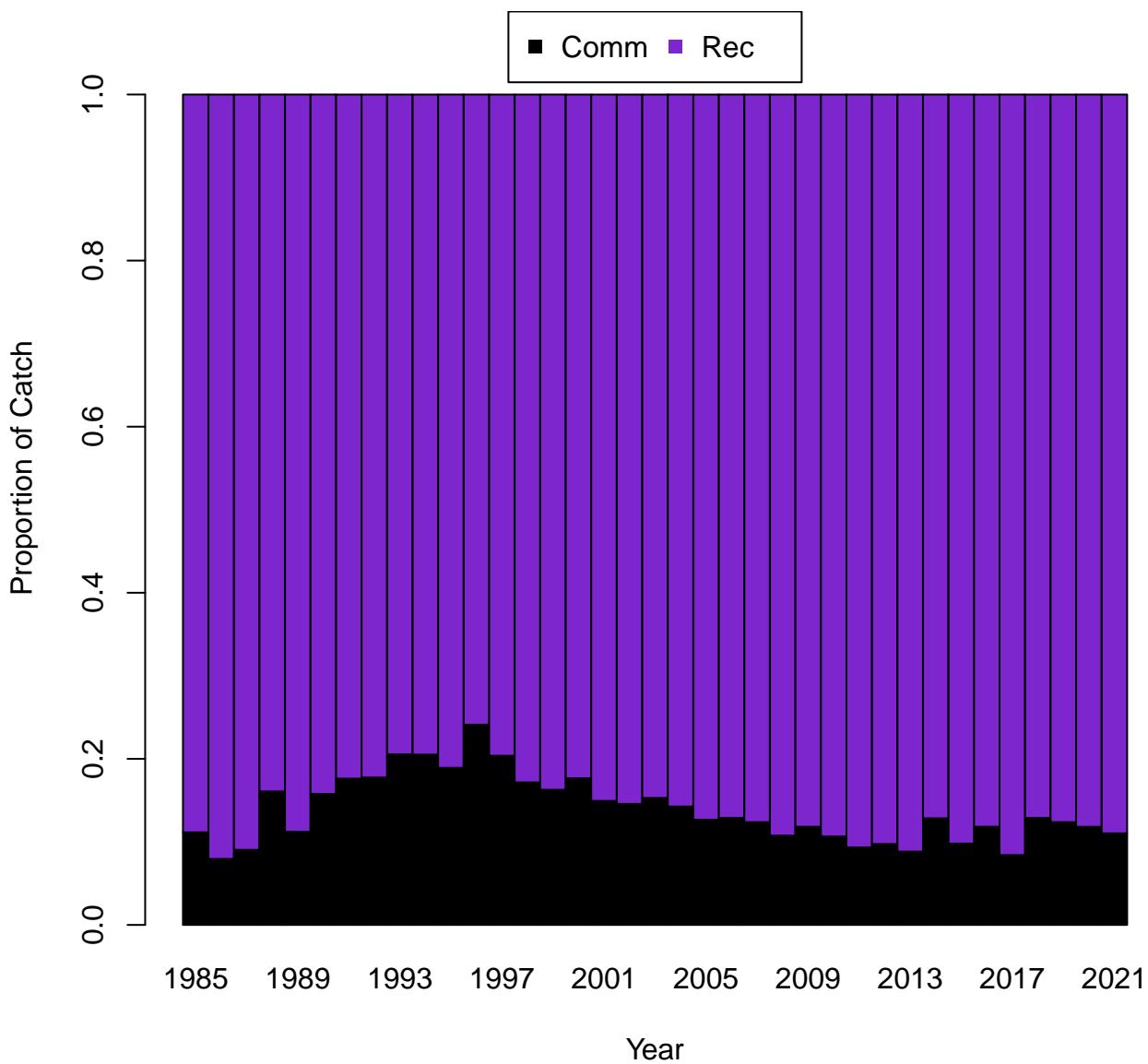


# BF07

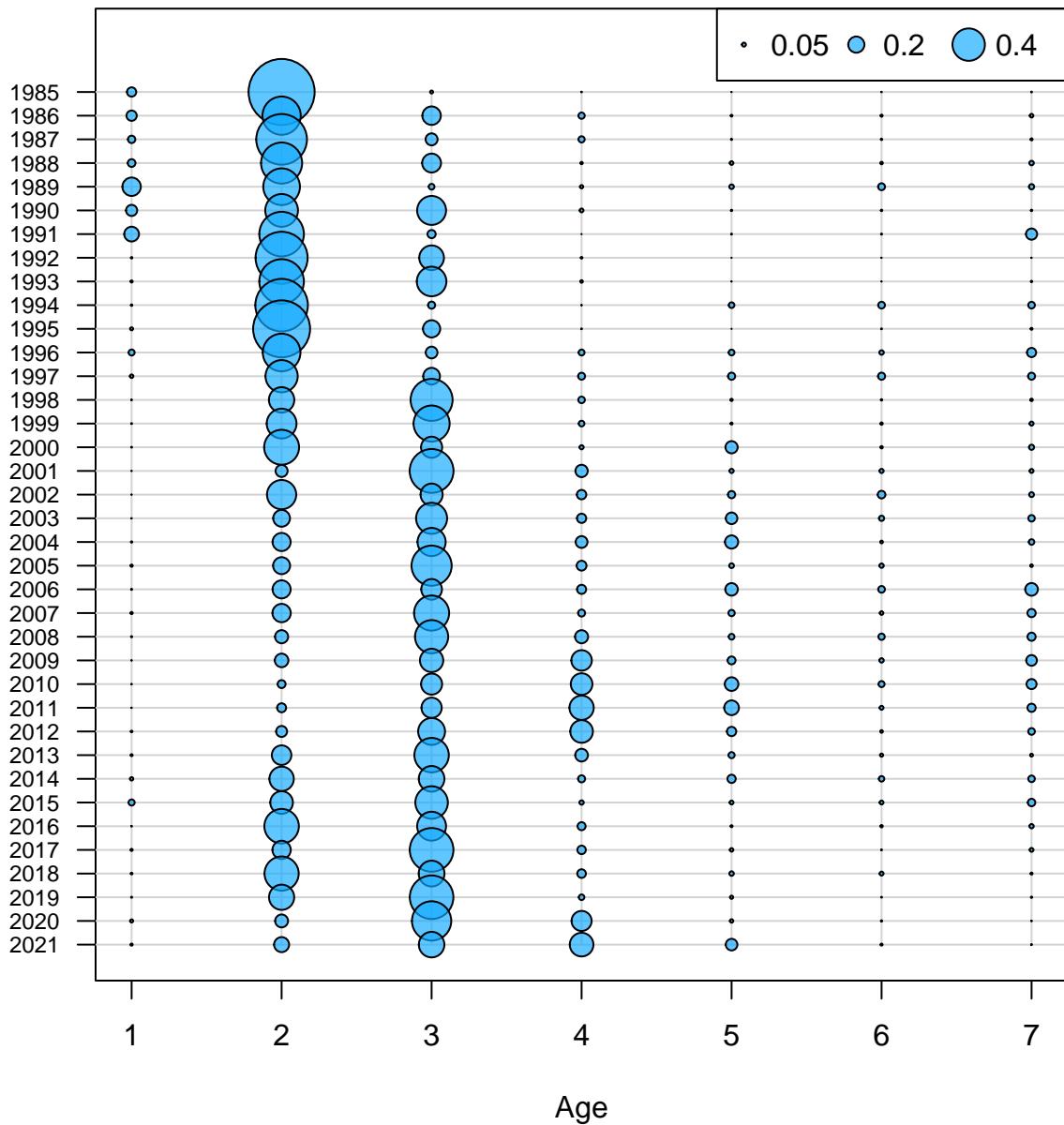
Update all fishery data, new L-W parameters, new  
recreational discard mortality, add commercial discards

## DATA PLOTS

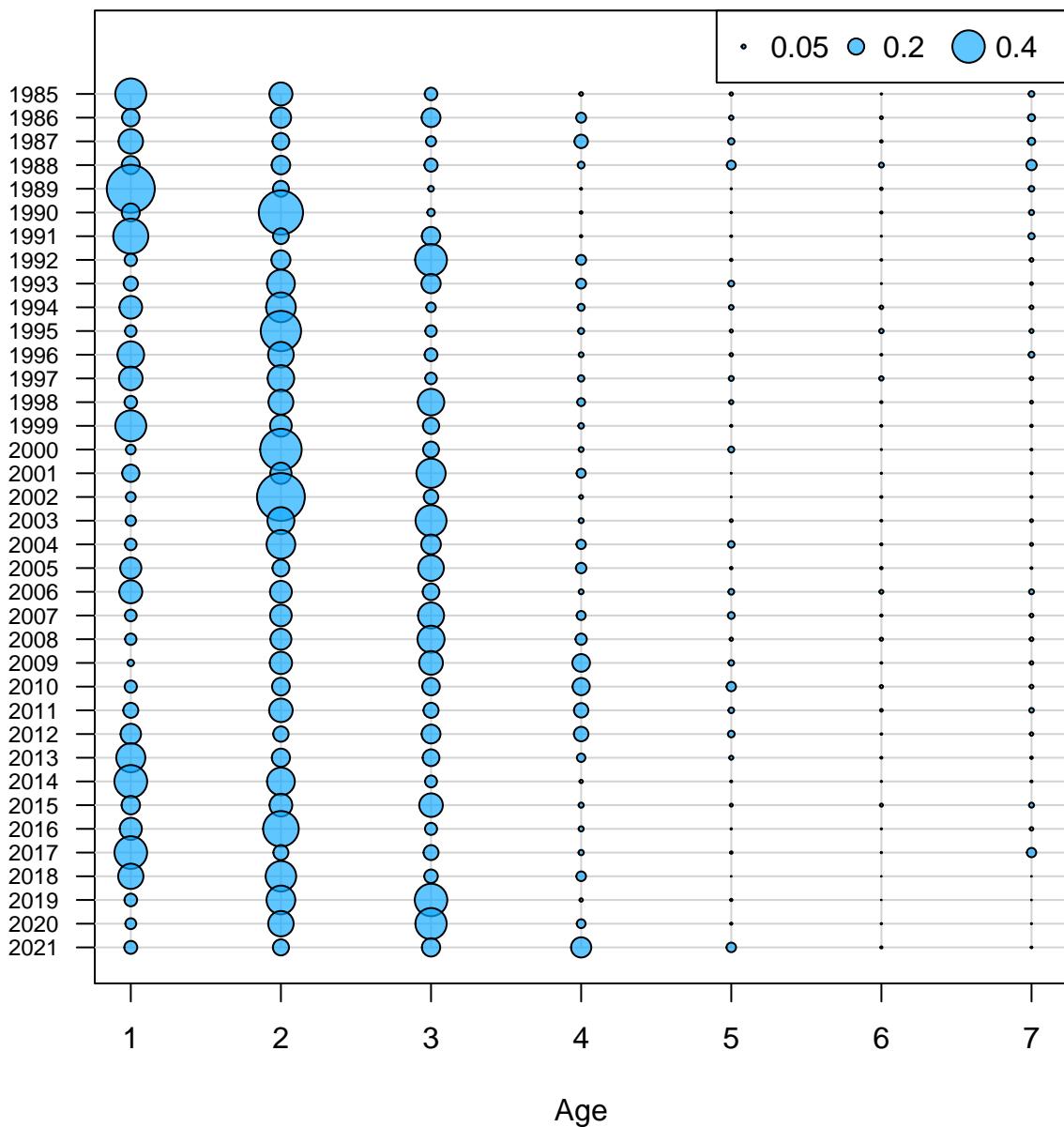


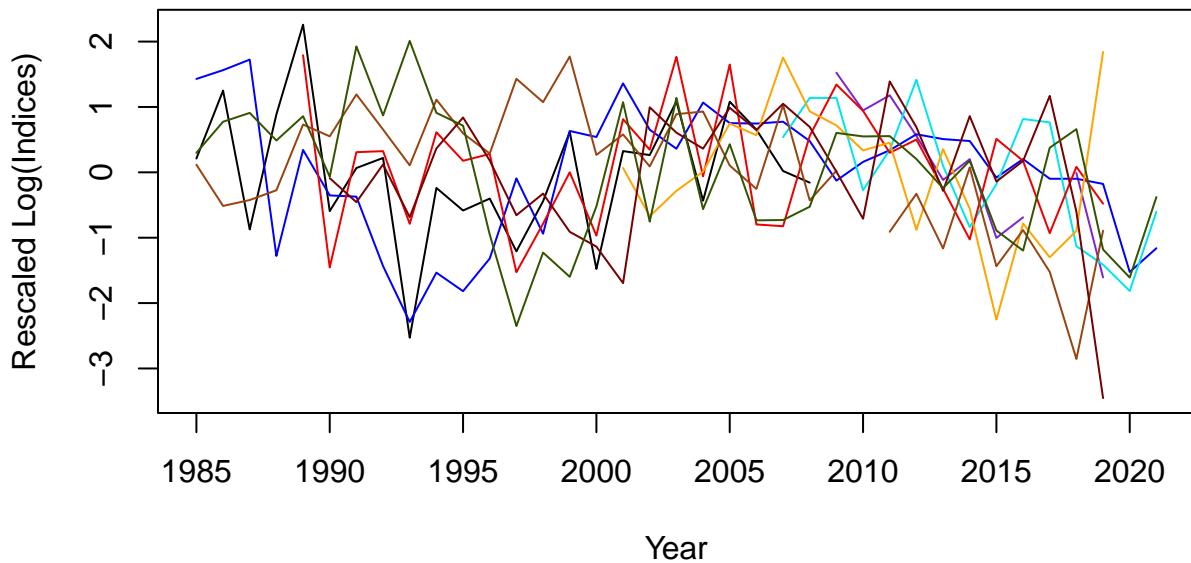
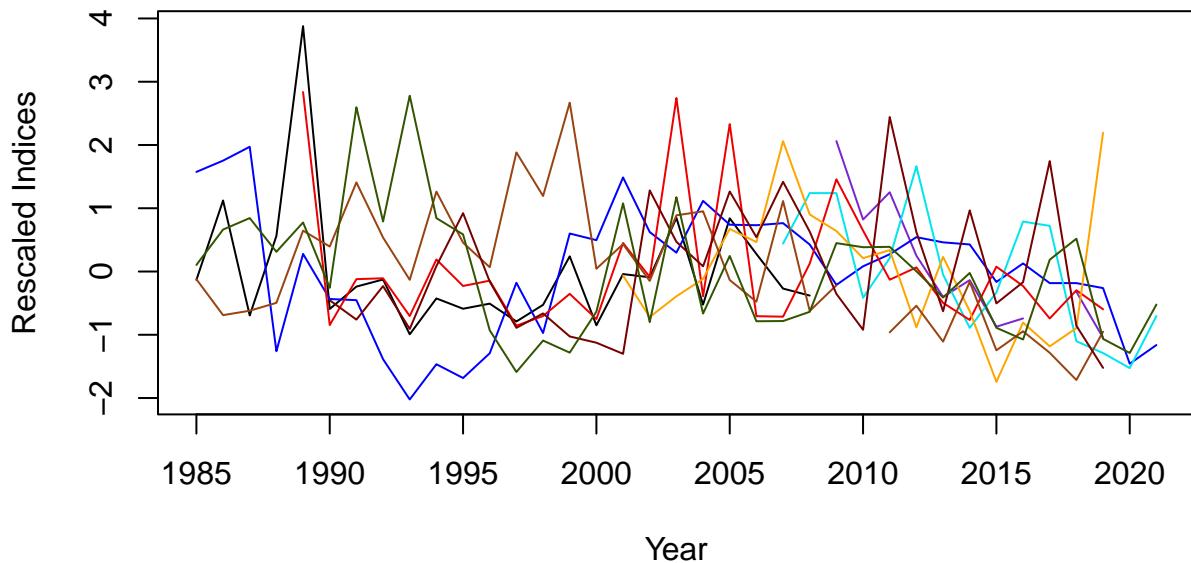


## Age Comps for Catch by Fleet 1 (Comm)

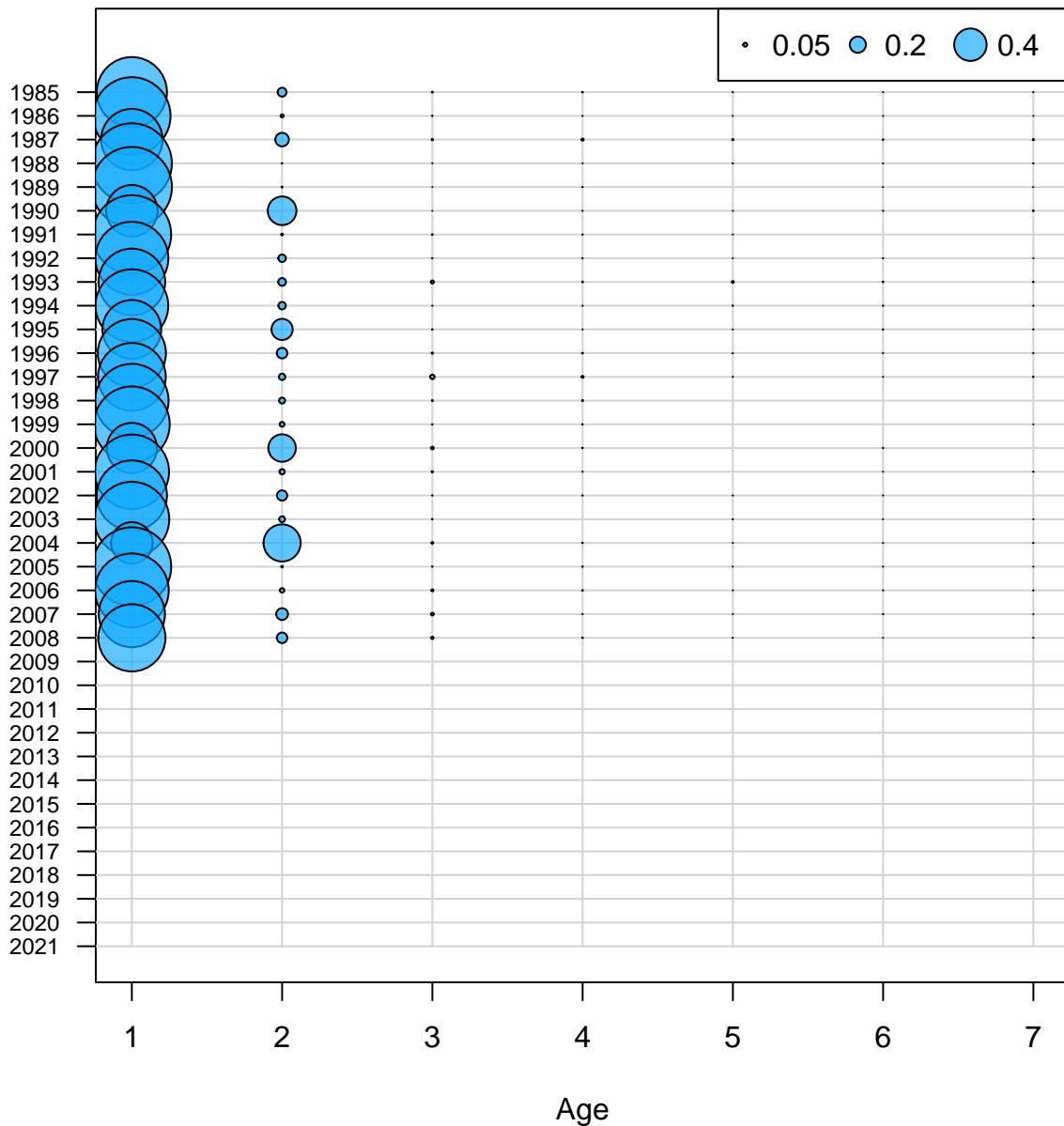


## Age Comps for Catch by Fleet 2 (Rec)

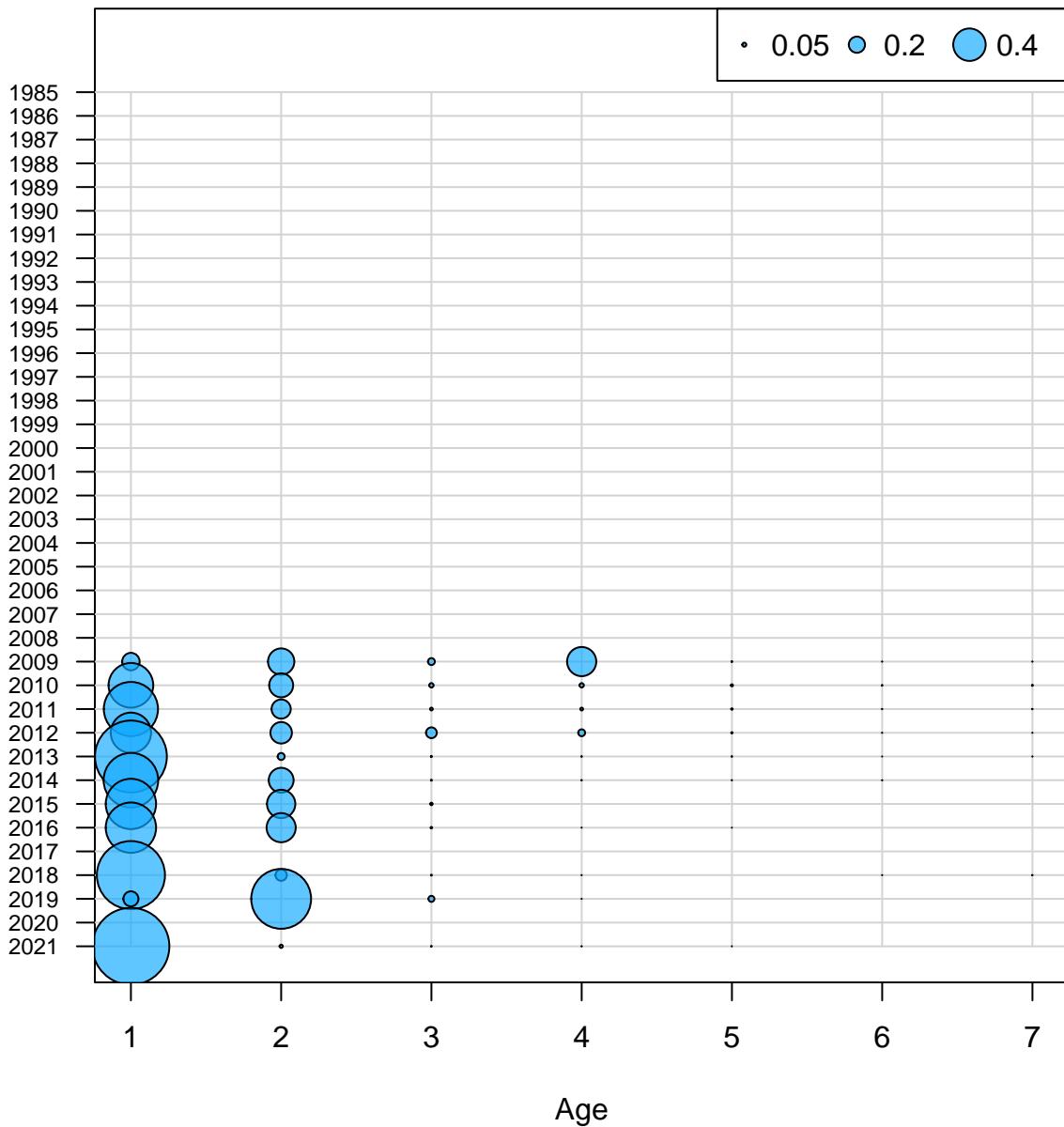




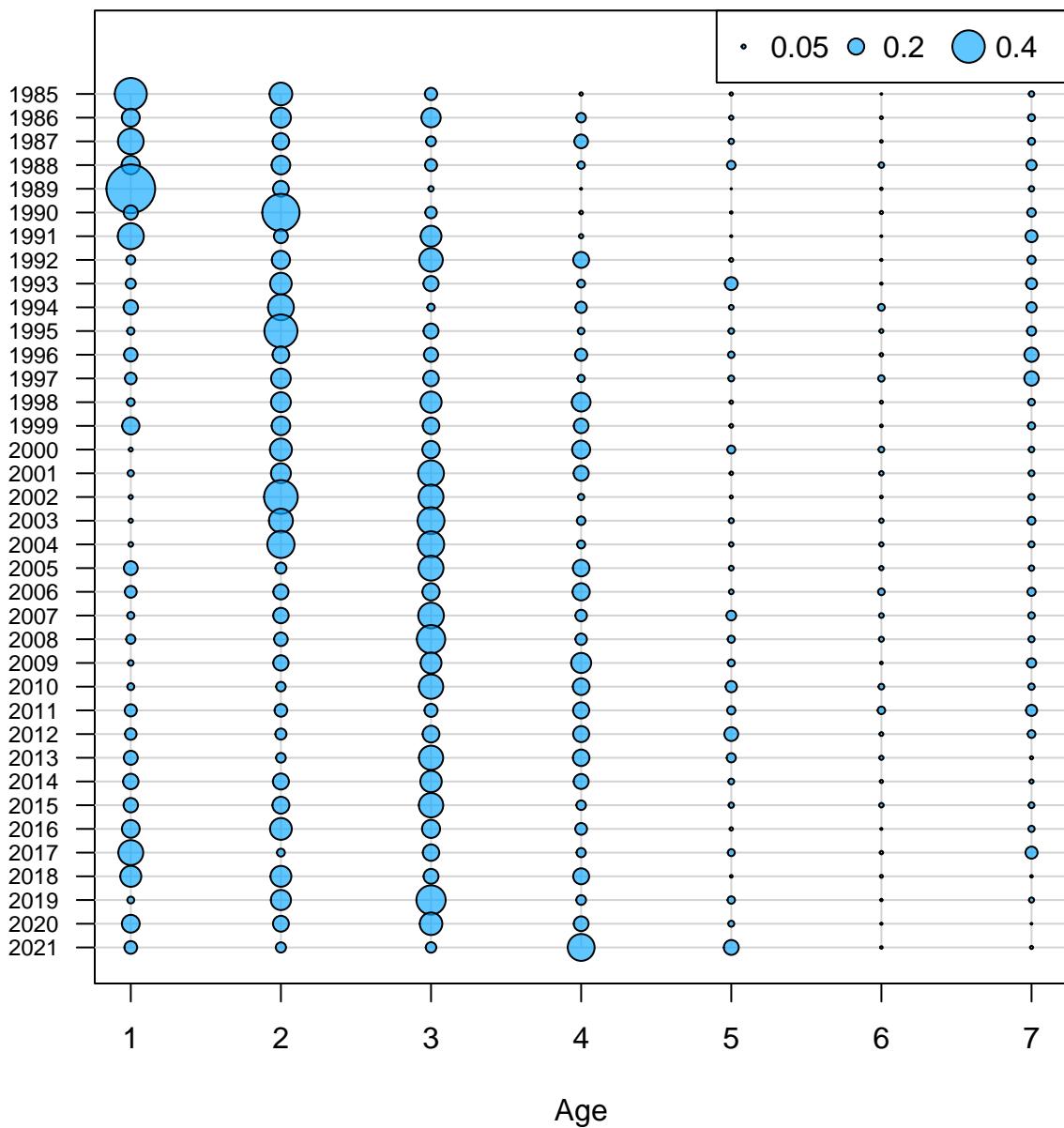
## Age Comps for Index 1 (NEFSC Inshore)



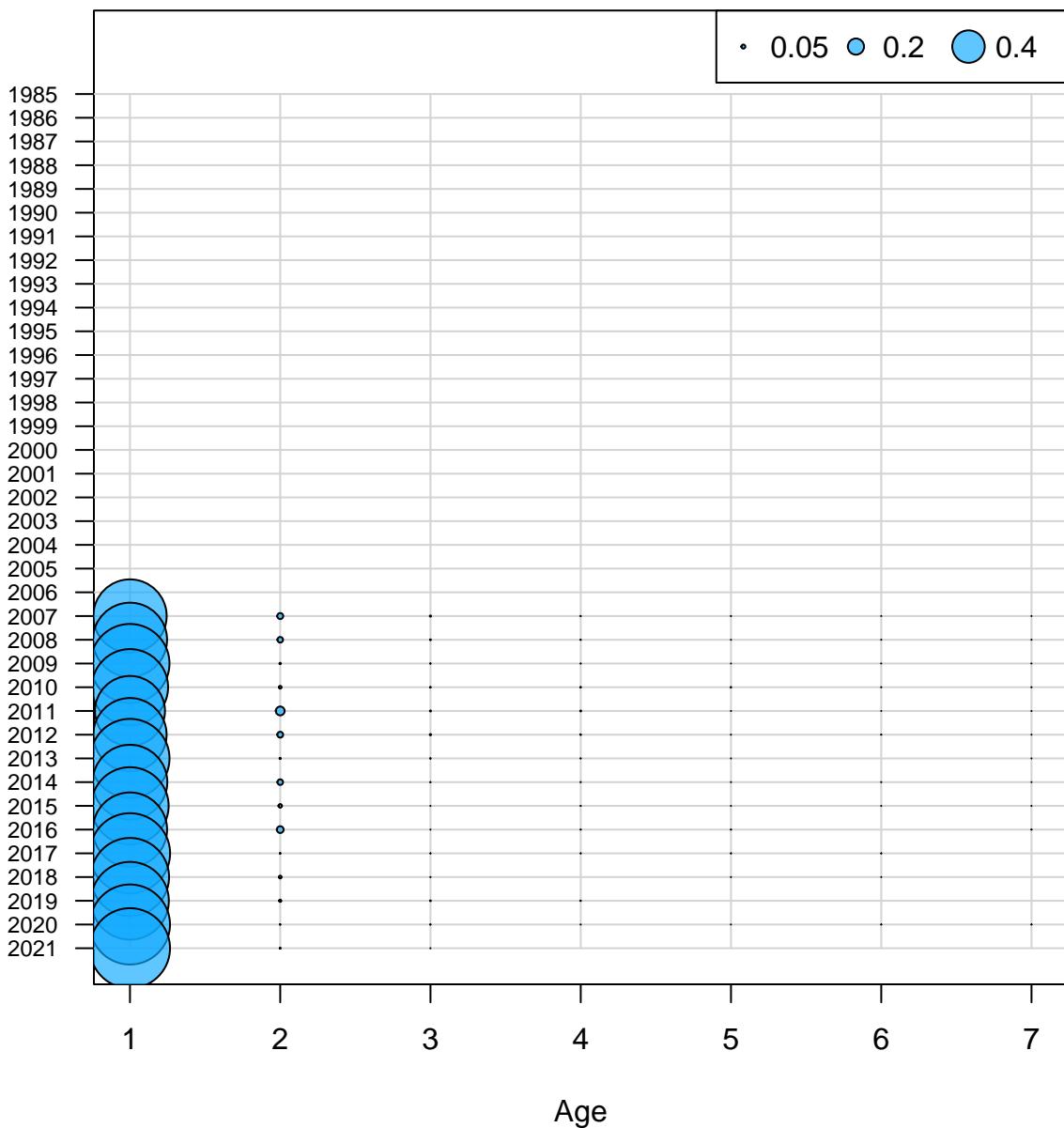
## Age Comps for Index 2 (Bigelow)



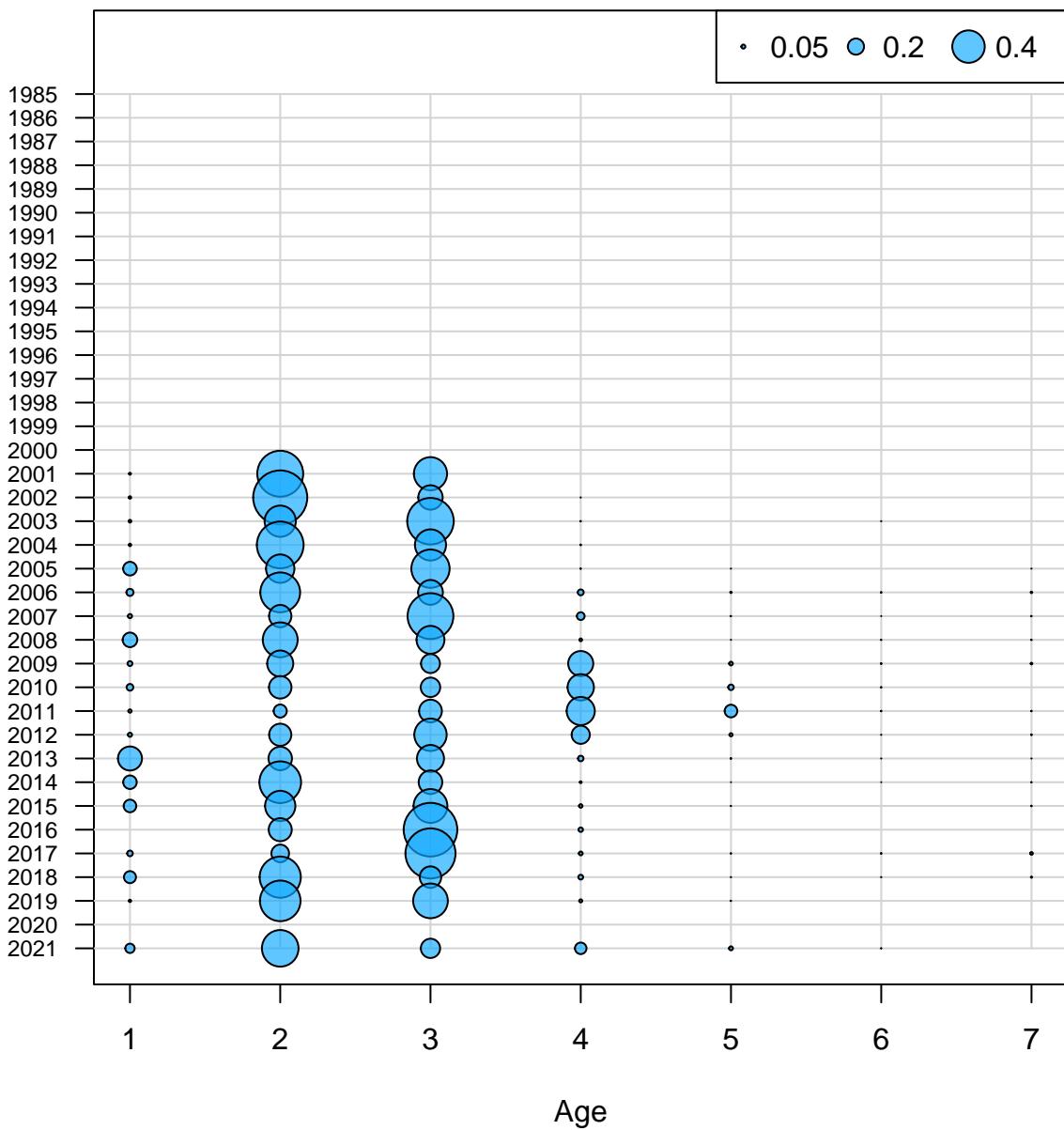
## Age Comps for Index 3 (MRIP)



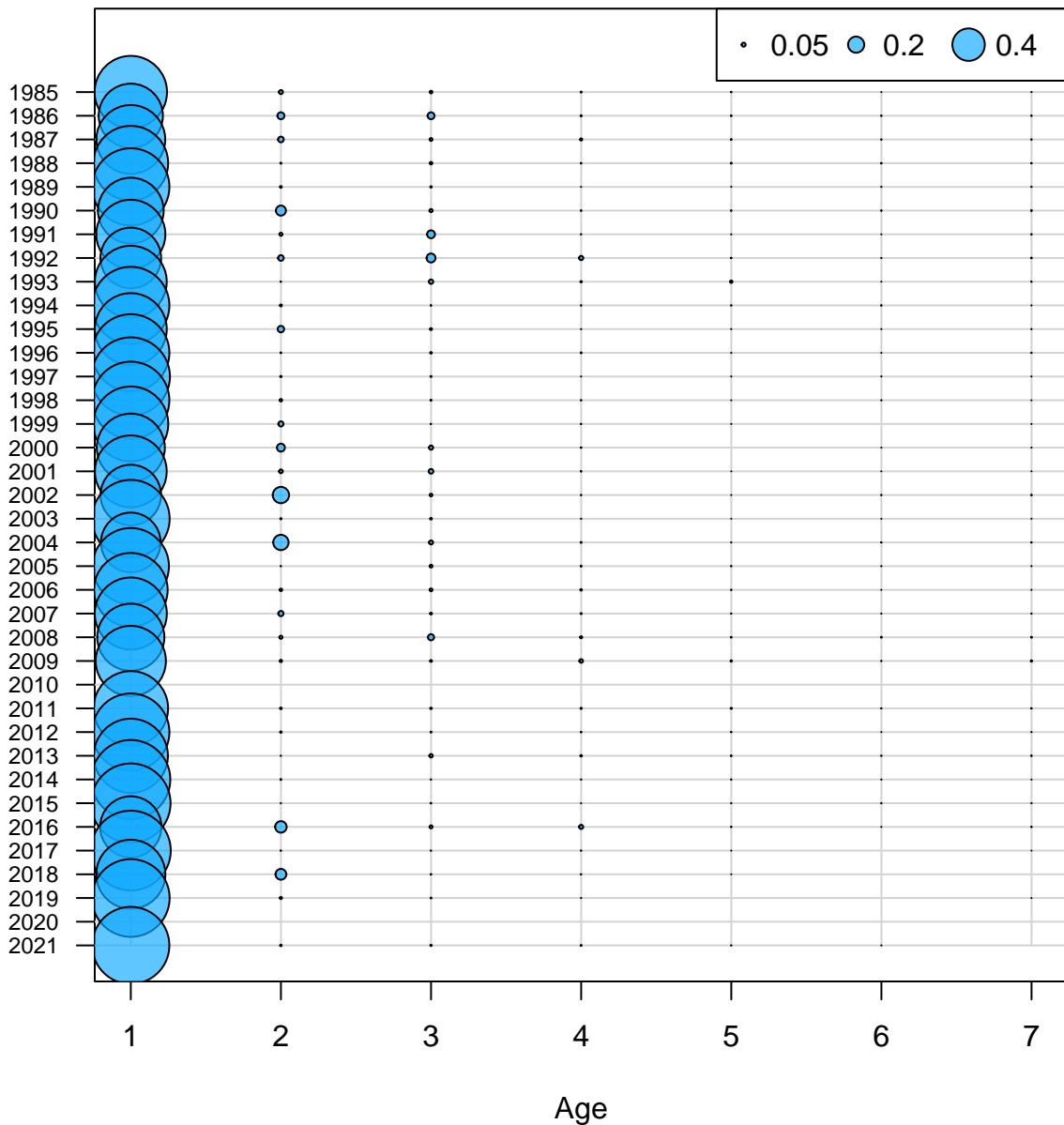
## Age Comps for Index 4 (NEAMAP)



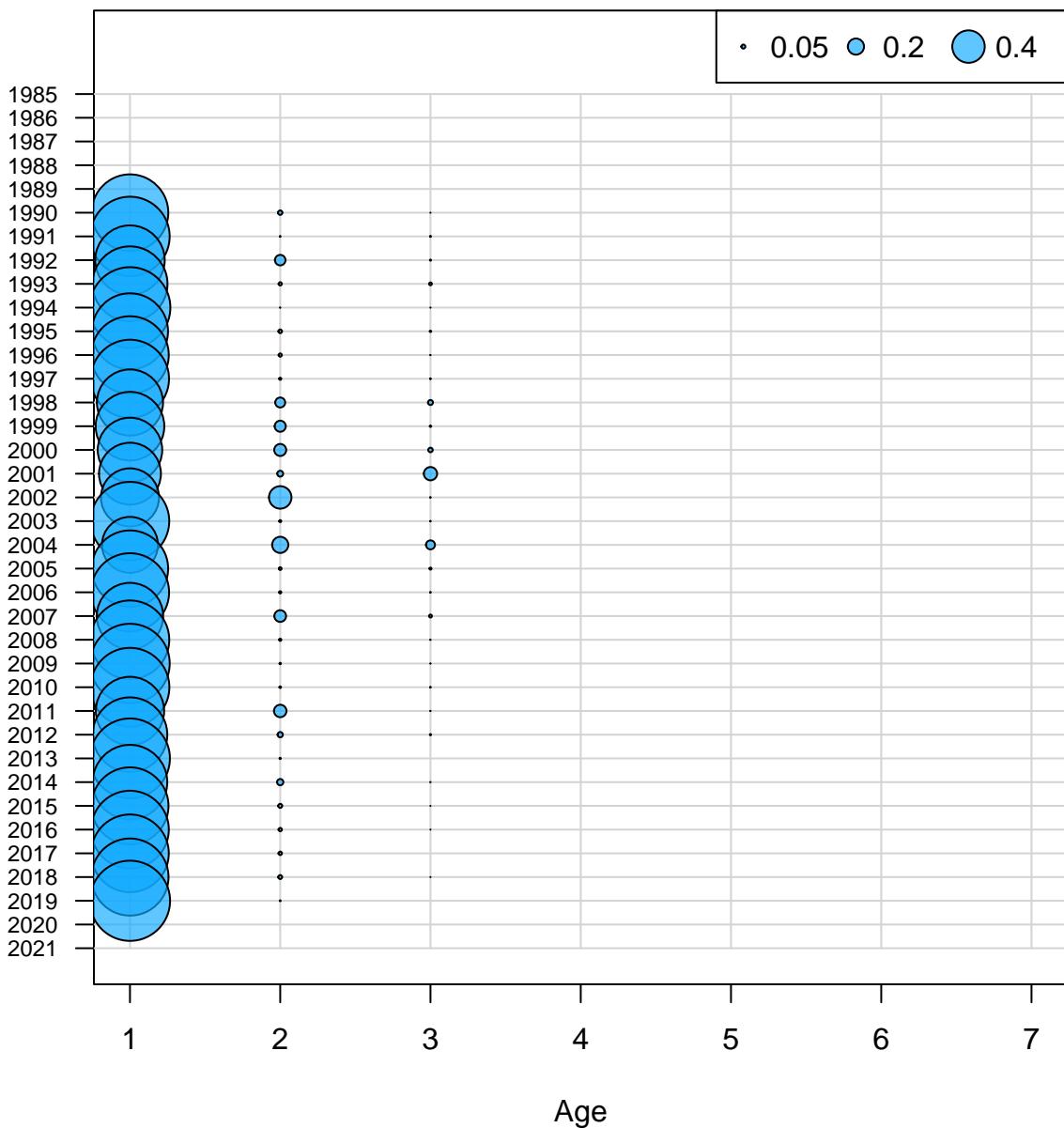
## Age Comps for Index 6 (PSIGN)



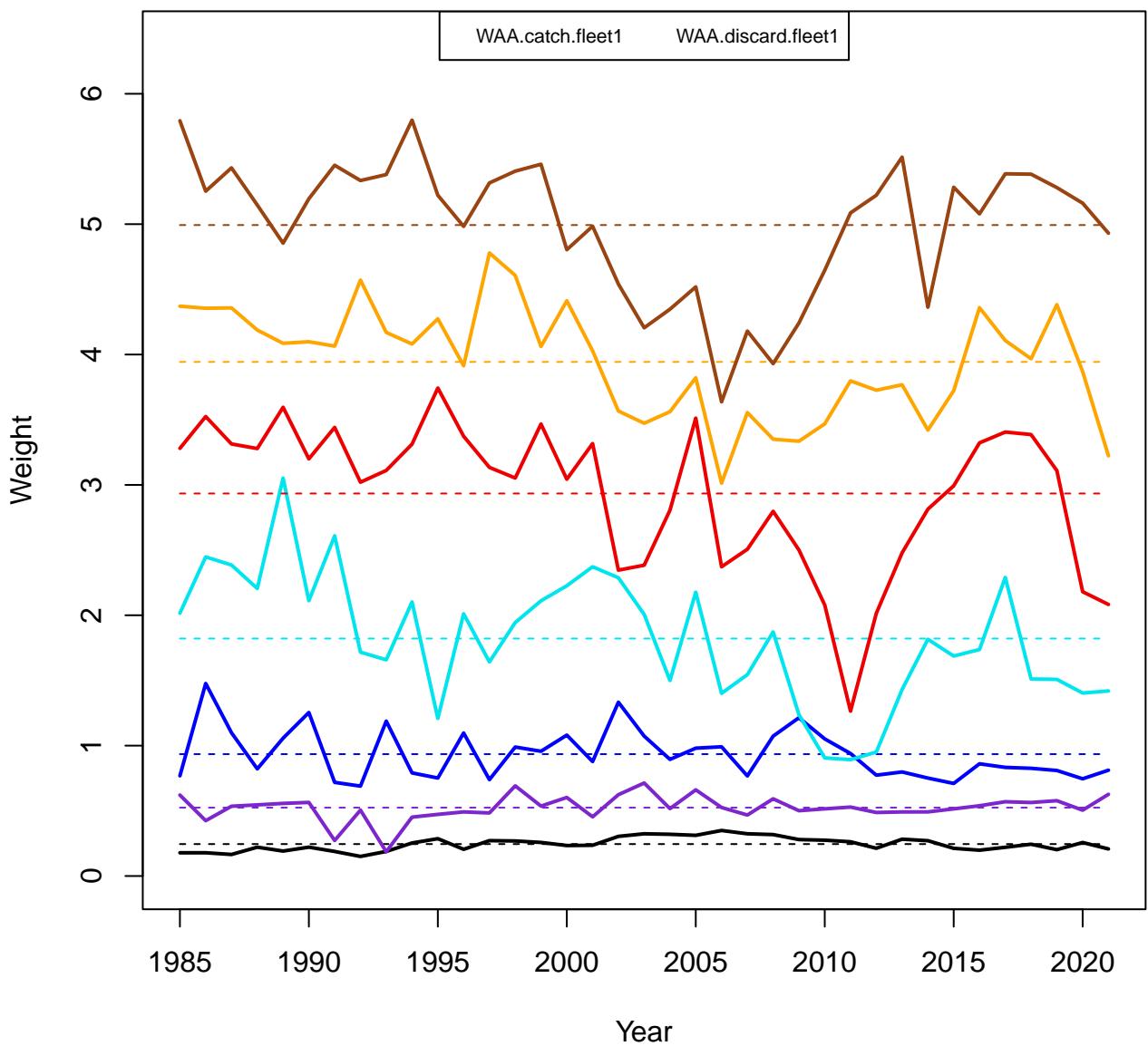
## Age Comps for Index 7 (CT Trawl)



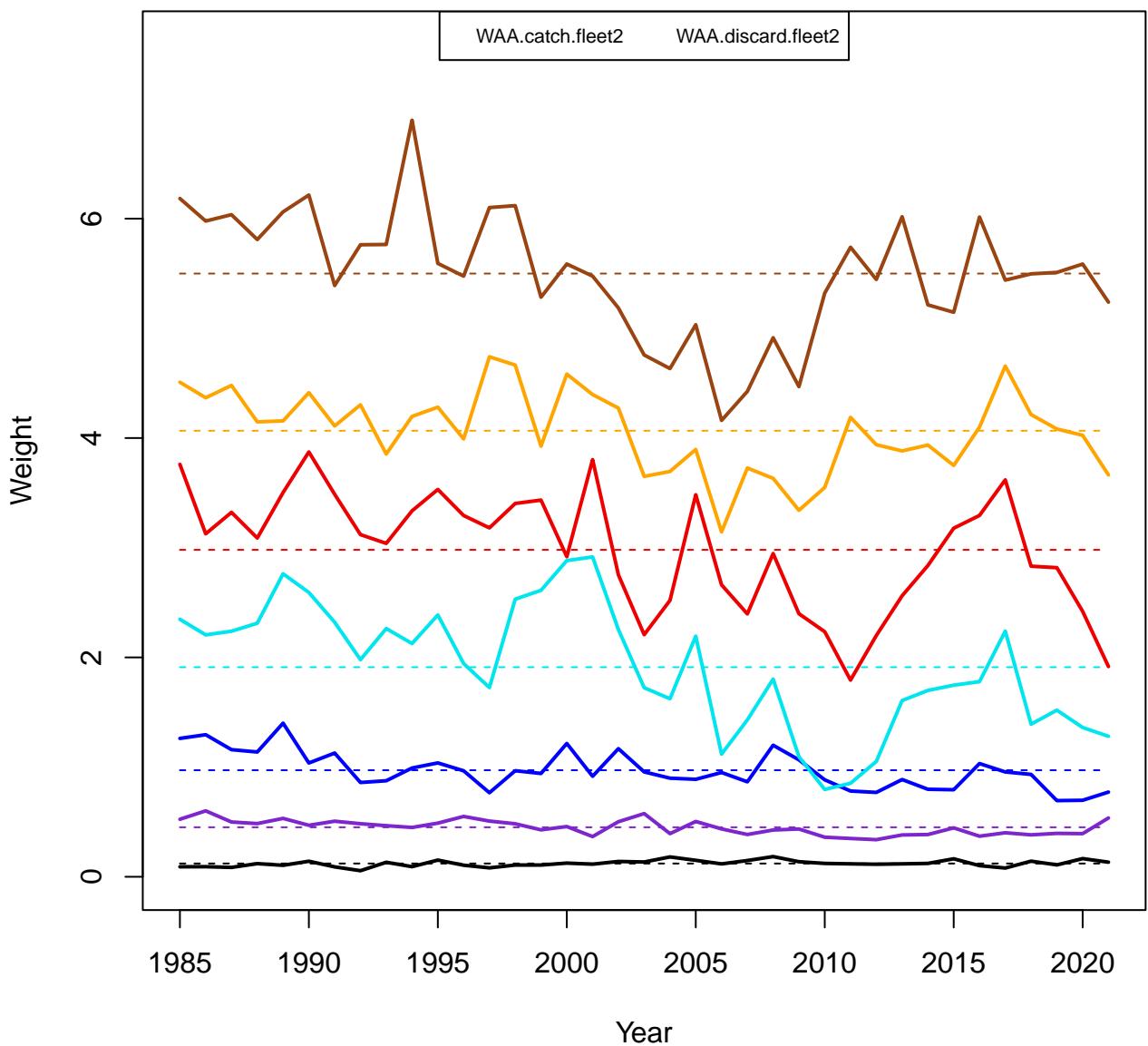
## Age Comps for Index 8 (NJ Trawl)



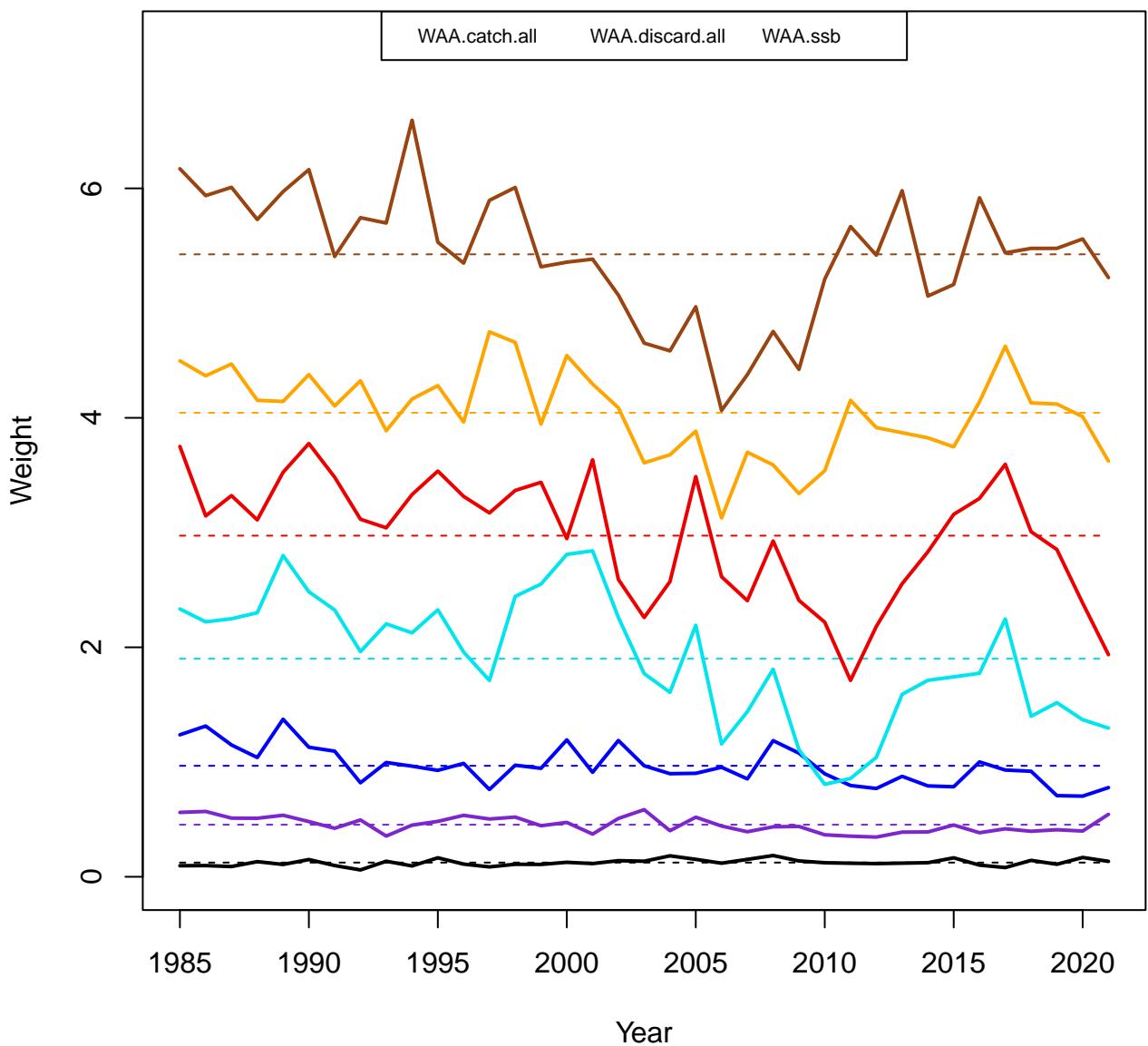
## WAA matrix 1



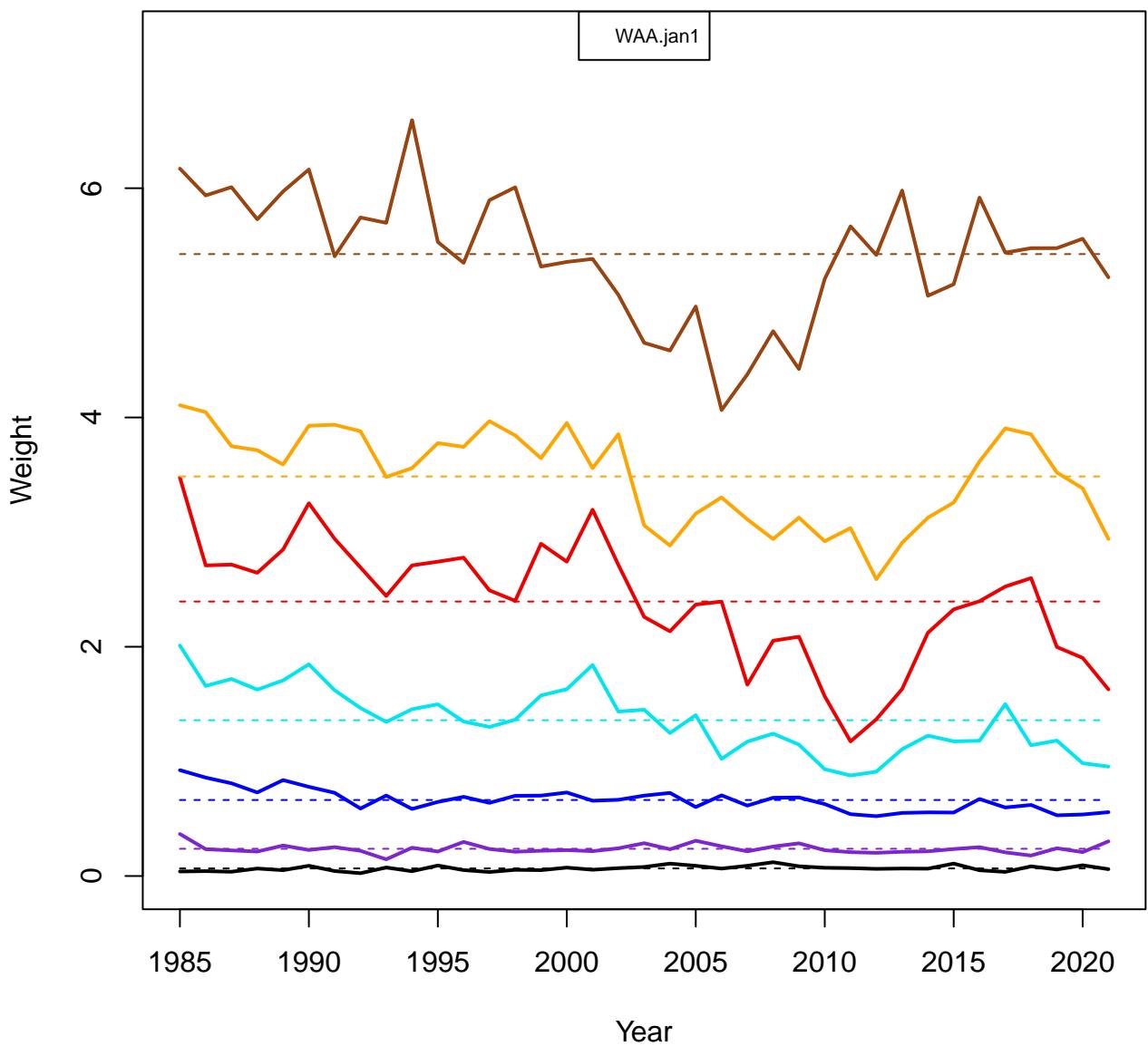
## WAA matrix 2



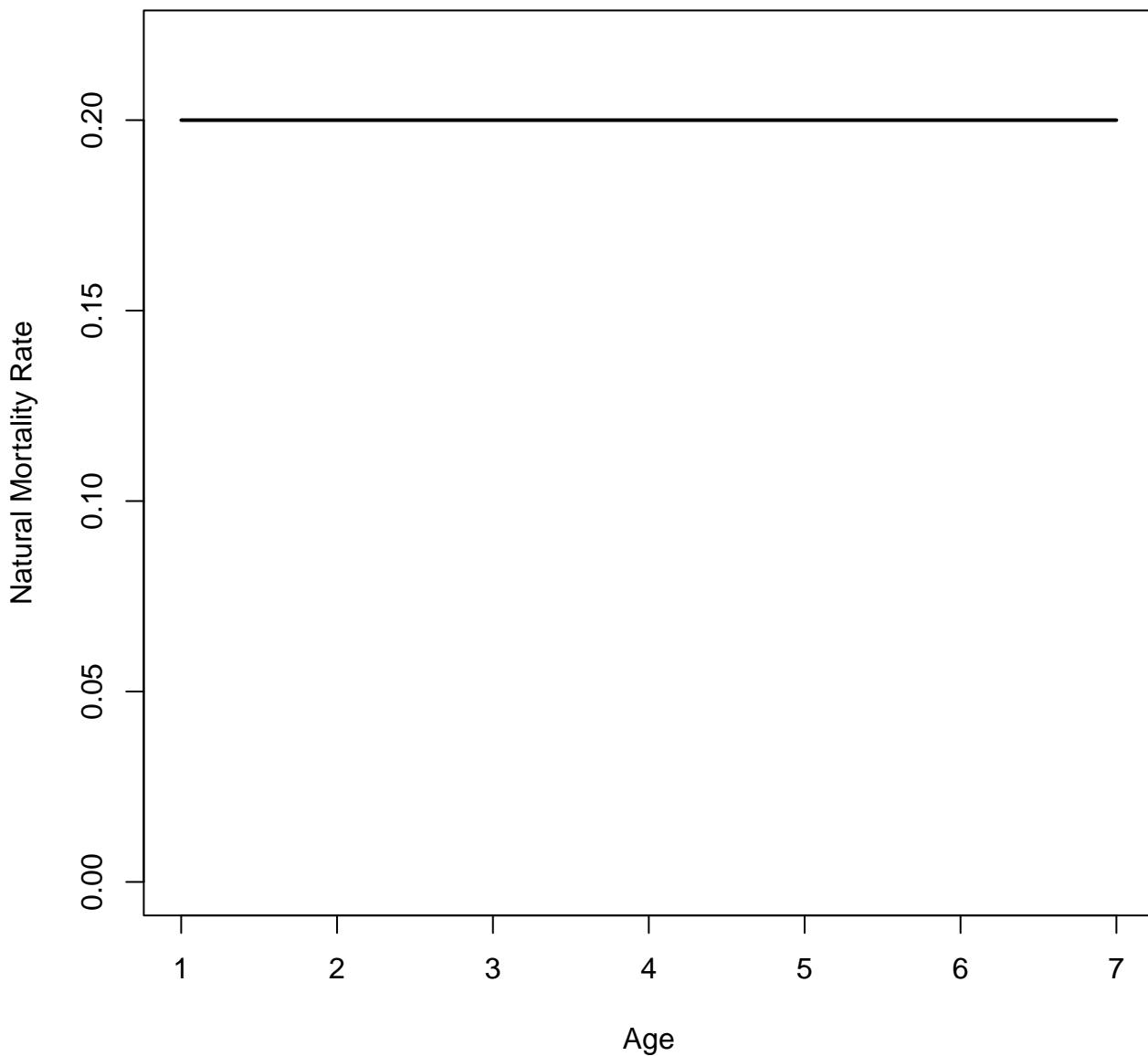
### WAA matrix 3



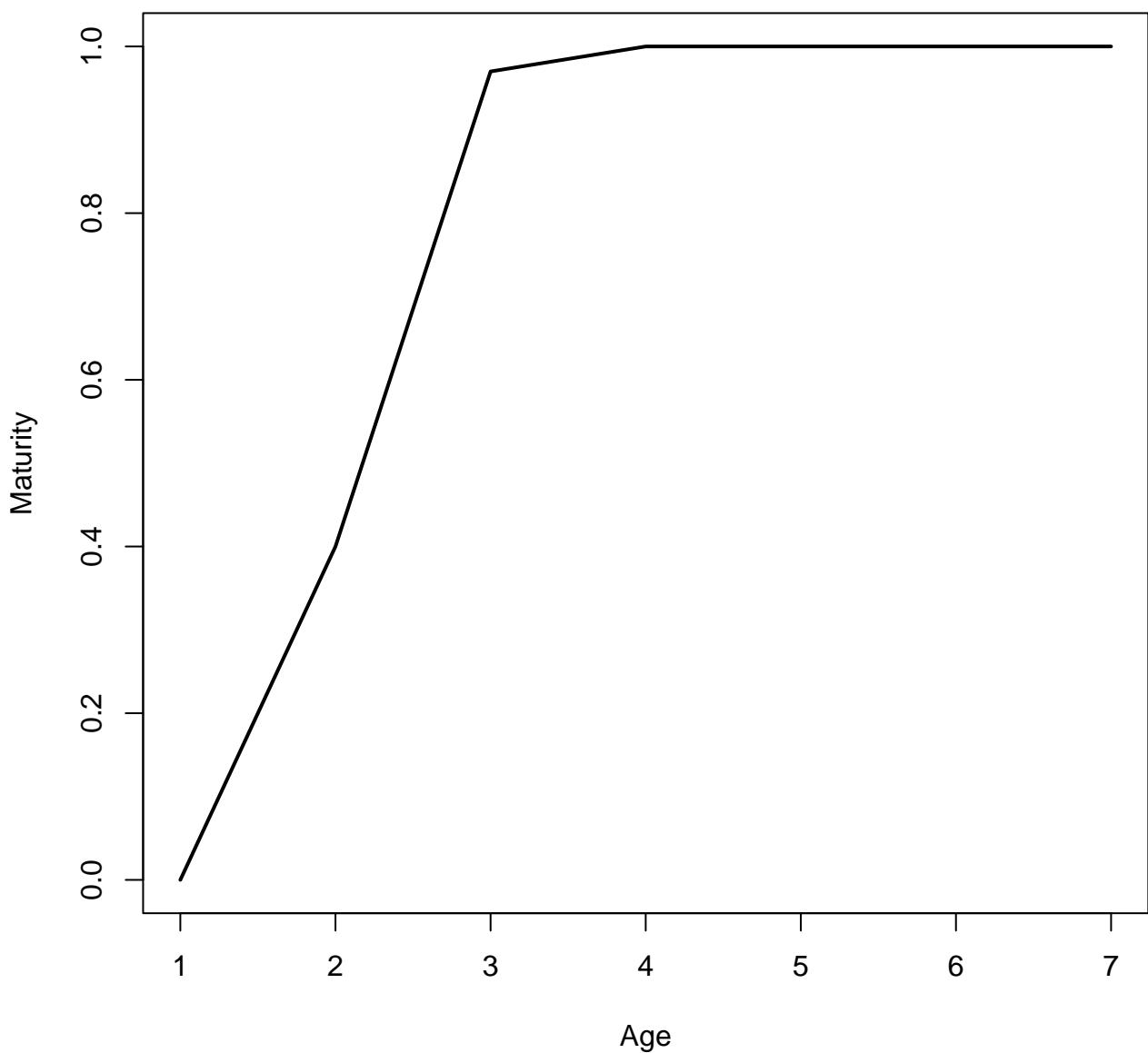
## WAA matrix 4



**M**



## Maturity

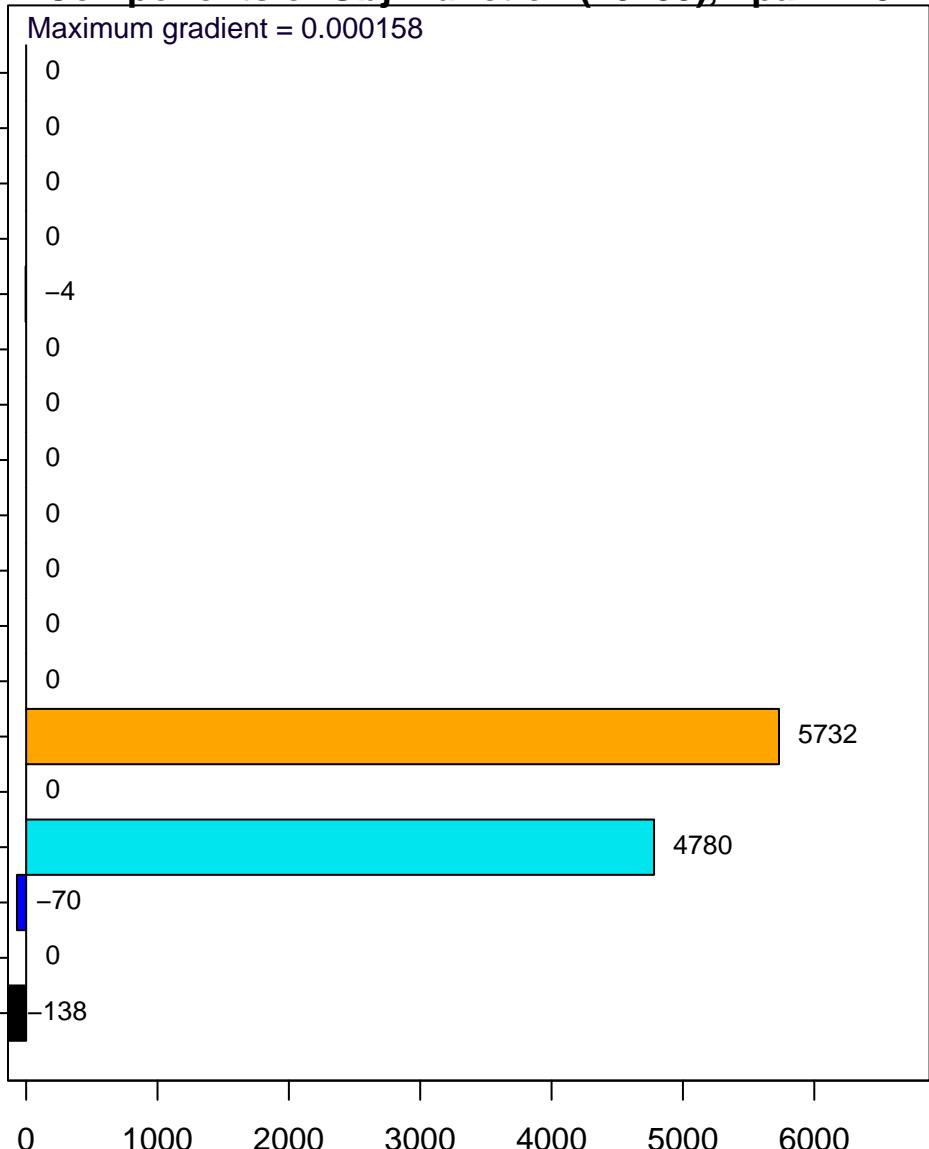


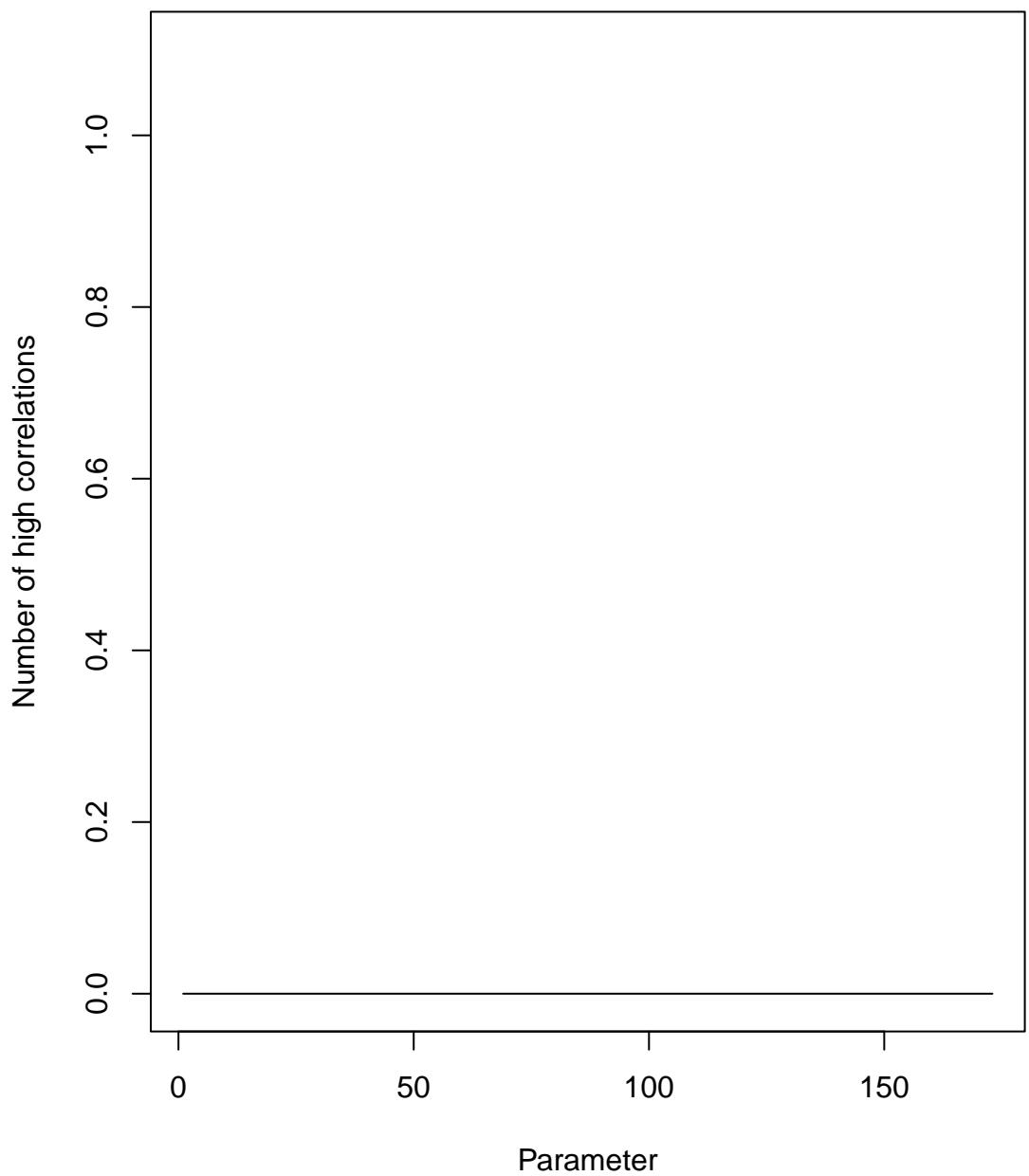
# BF07

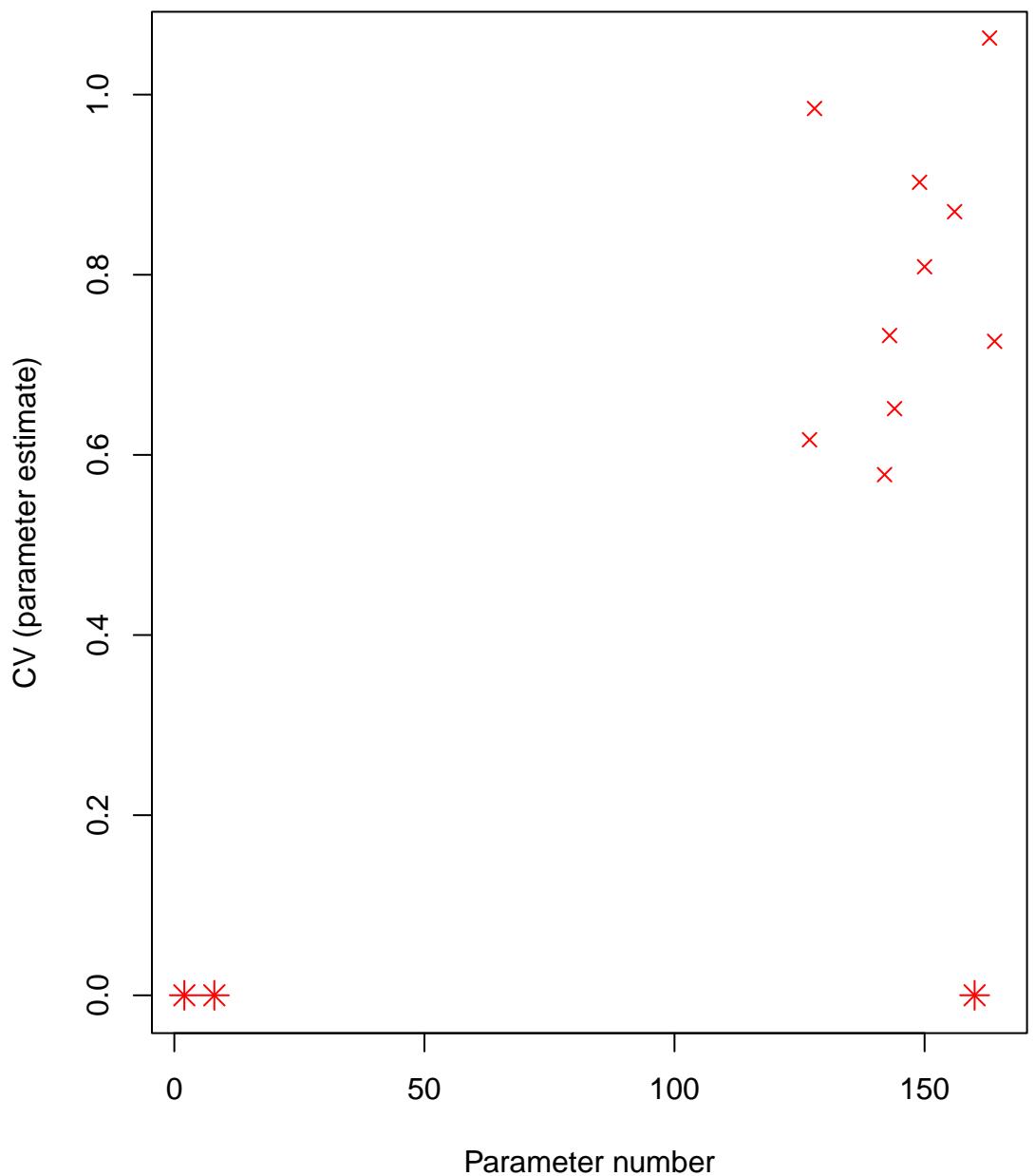
Update all fishery data, new L-W parameters, new recreational discard mortality, add commercial discards

## DIAGNOSTIC PLOTS

# Components of Obj. Function (10299), npar=173



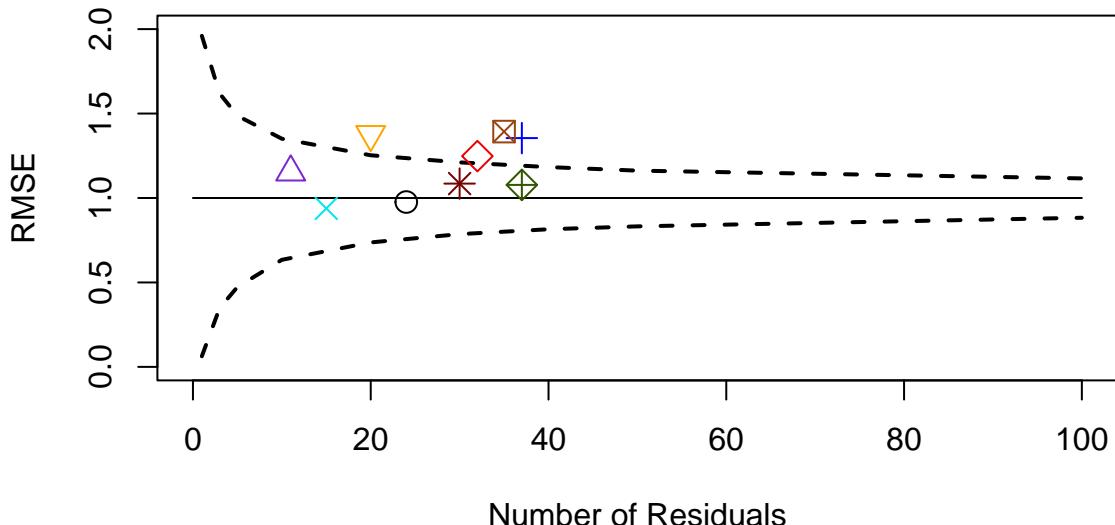




## Root Mean Square Error computed from Standardized Residuals

Component	# resid	RMSE
catch.fleet1	37	0.0789
catch.fleet2	37	0.967
catch.tot	74	0.686
discard.fleet1	0	0
discard.fleet2	0	0
discard.tot	0	0
ind01	24	0.976
ind02	11	1.15
ind03	37	1.35
ind04	15	0.938
ind05	32	1.25
ind06	20	1.38
ind07	35	1.39
ind08	30	1.09
ind09	37	1.08
ind.total	241	1.21
N.year1	0	0
Fmult.year1	0	0
Fmult.devs.fleet1	0	0
Fmult.devs.fleet2	0	0
Fmult.devs.total	0	0
recruit.devs	37	0.372
fleet.sel.params	0	0
index.sel.params	0	0
q.year1	0	0
q.devs	0	0
SR.steepness	0	0
SR.scaler	0	0

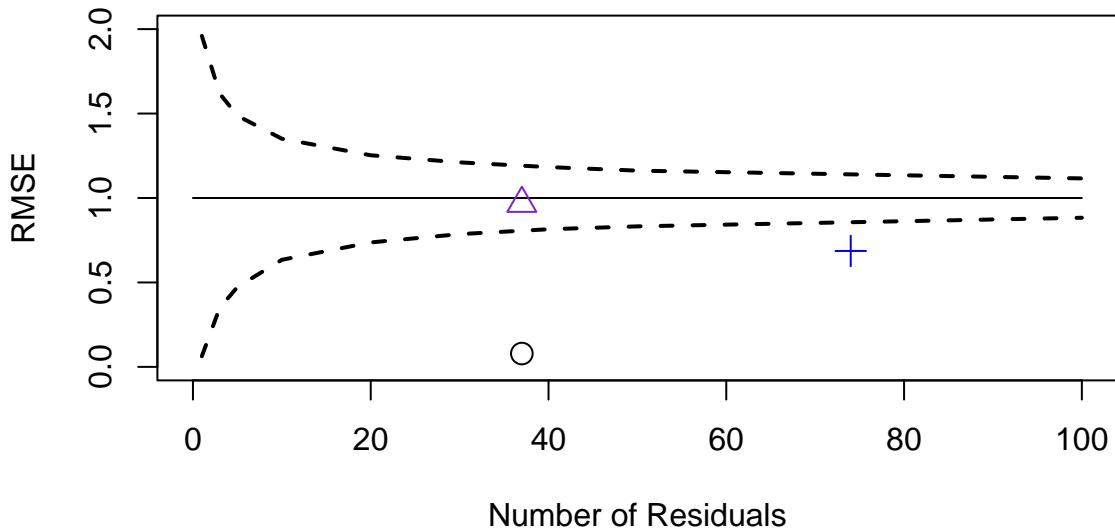
# Root Mean Square Error for Indices



The legend consists of a vertical column of colored symbols next to their corresponding labels:

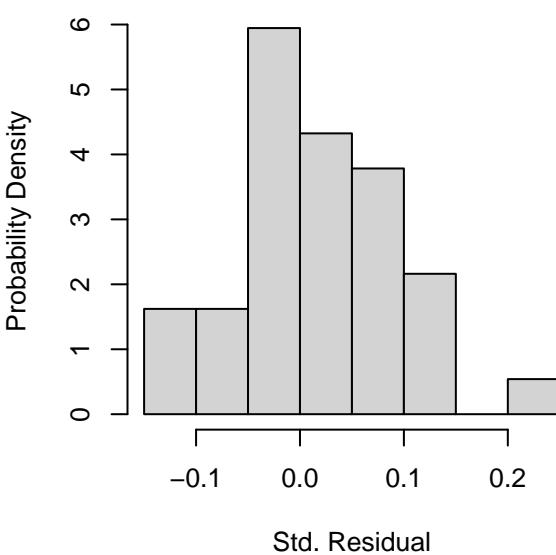
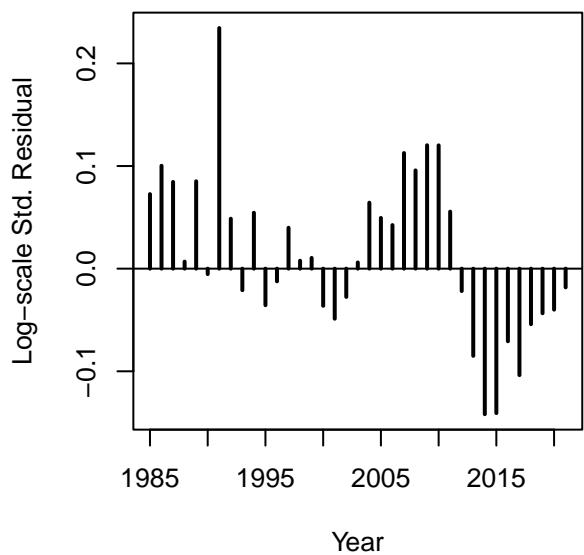
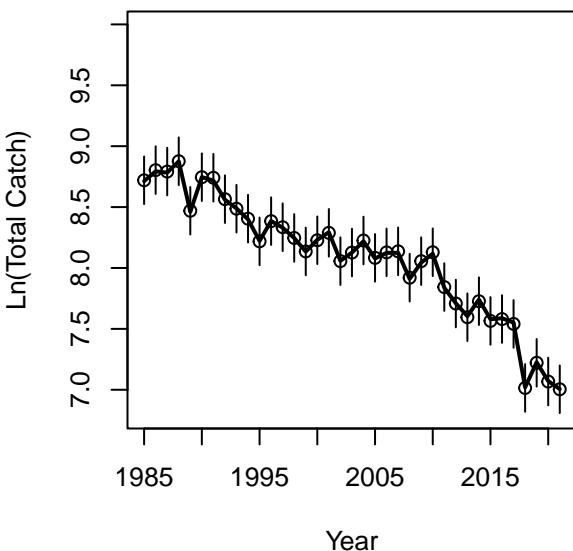
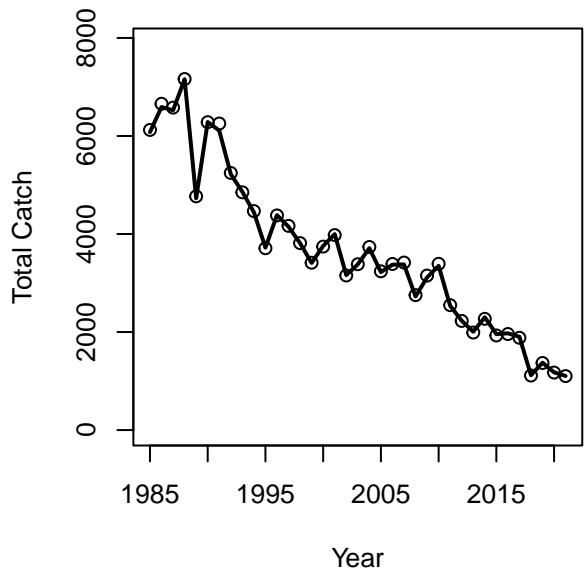
- Ind. total: Green diamond
- Compound YOY: Red asterisk
- NJ Trawl: Orange square
- CT Trawl: Blue triangle
- PSIGN: Yellow circle
- SEAFMAP: Green X
- NEAMAP: Blue checkmark
- MRIP: Purple plus sign
- Bigelow: Magenta cross
- NEFSC Inshore: Light blue circle

## Root Mean Square Error for Catch

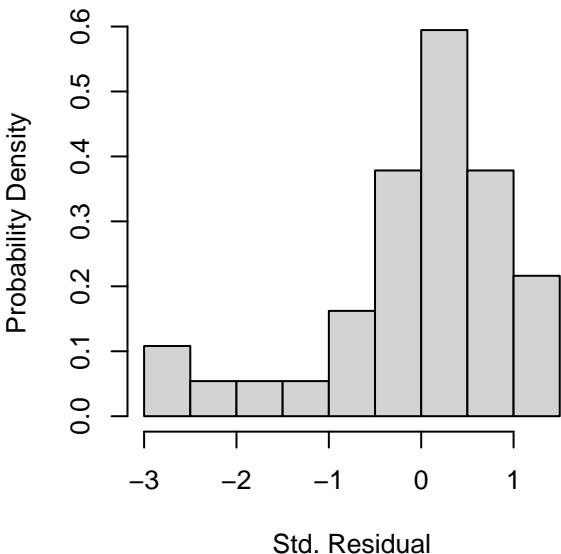
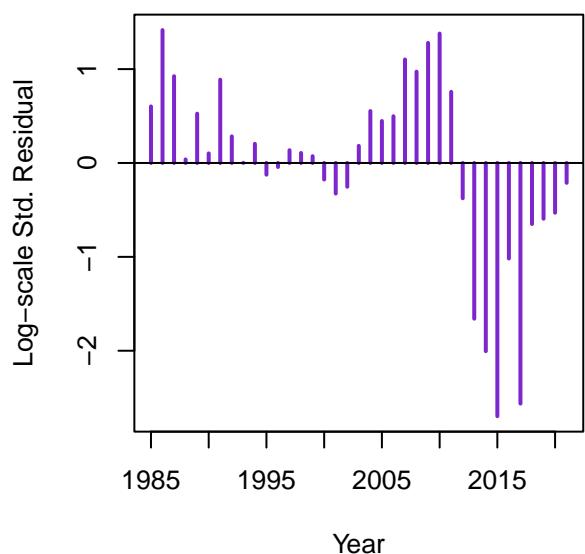
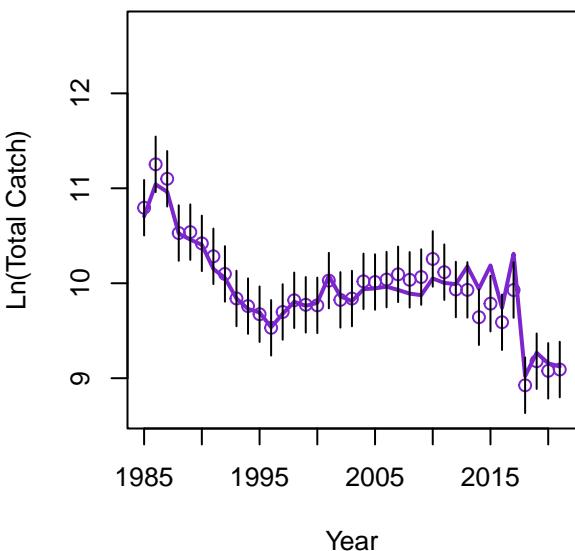
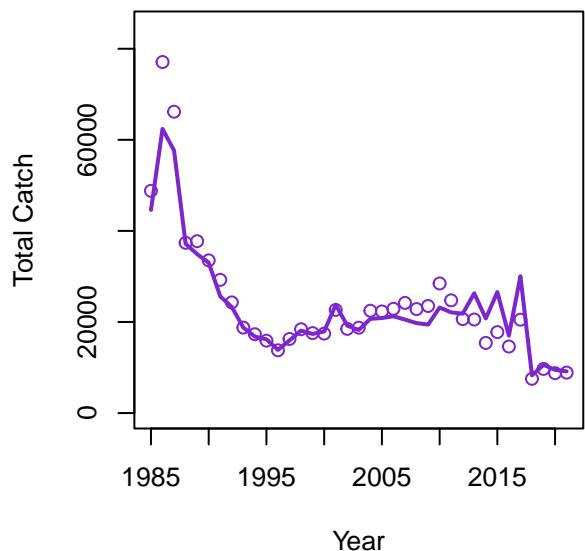


⊕ catch.tot  
○ catch.fleet2  
○ catch.fleet1

### Fleet 1 Catch (Comm)



## Fleet 2 Catch (Rec)



Fleet 1  
Comm  
↓

**Catch**  
**Year = 1989**

**Year = 1985**

**Year = 1986**

**Year = 1987**

**Year = 1988**

**Year = 1994**

**Year = 1995**

**Year = 1996**

**Year = 1997**

**Year = 1998**

Proportion at Age

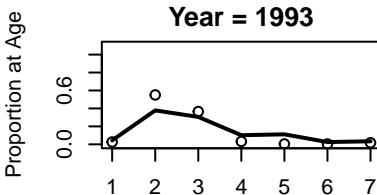
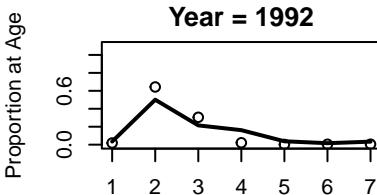
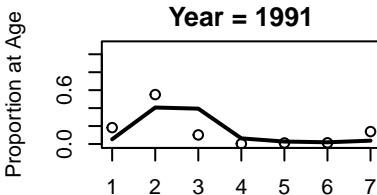
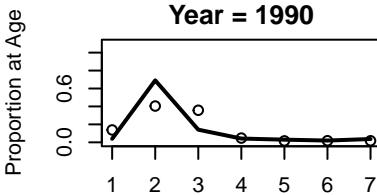
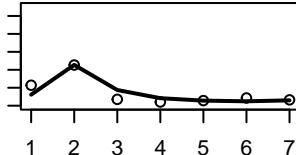
**Catch**  
**Year = 1989**

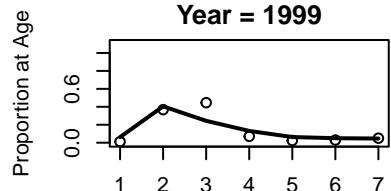
**Year = 1990**

**Year = 1991**

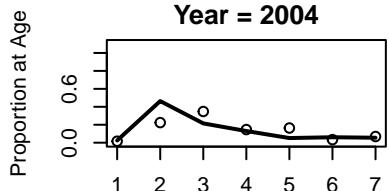
**Year = 1992**

**Year = 1993**

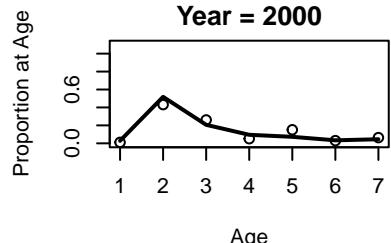




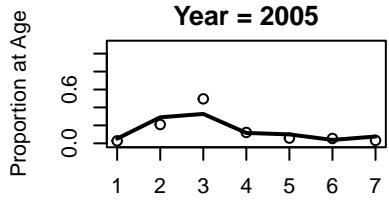
## Catch Year ≡ 2004



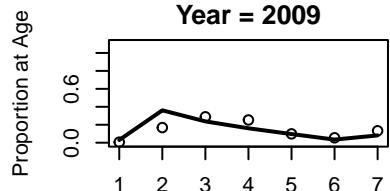
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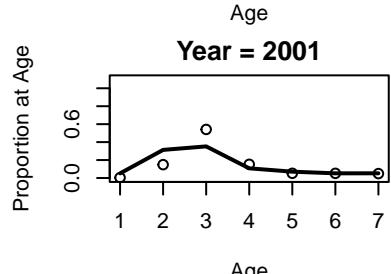
**Year = 2000**



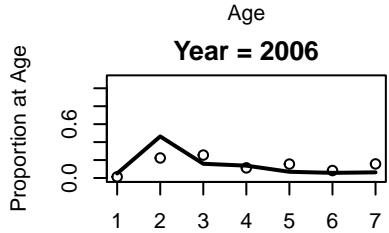
**Year = 2005**



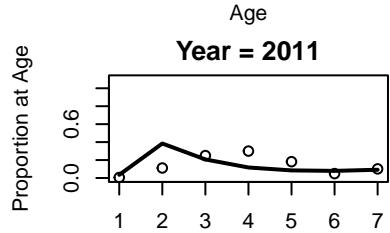
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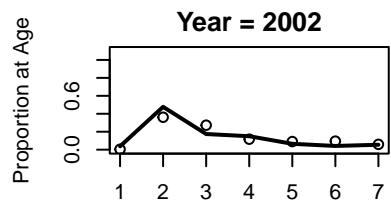
**Year = 2001**



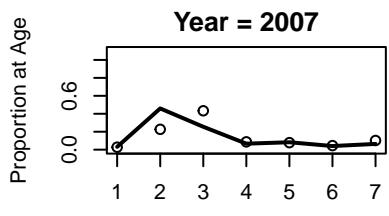
**Year = 2006**



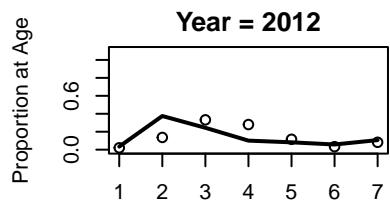
**Year = 2011**



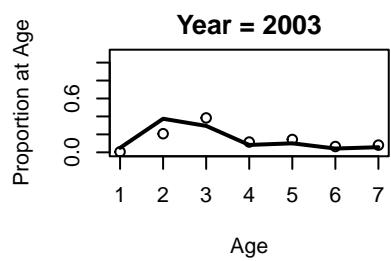
**Year = 2002**



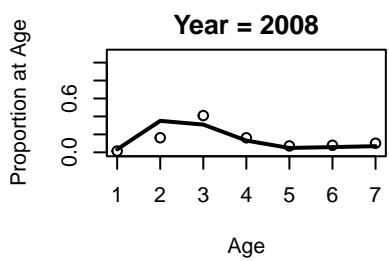
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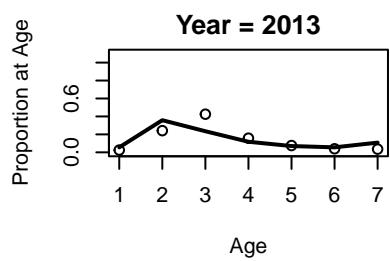
**Year = 2012**



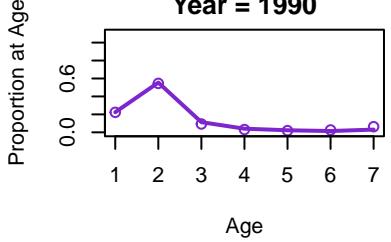
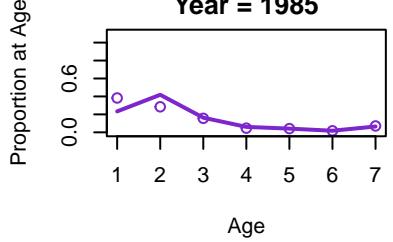
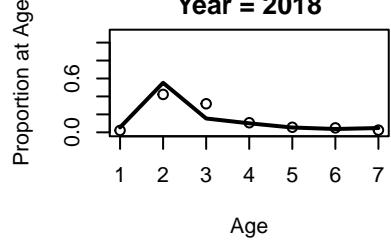
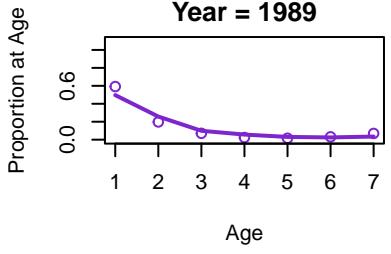
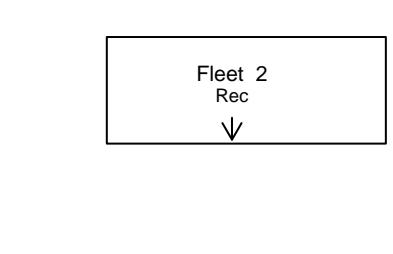
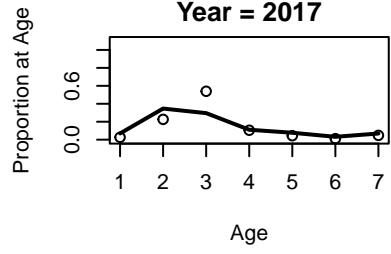
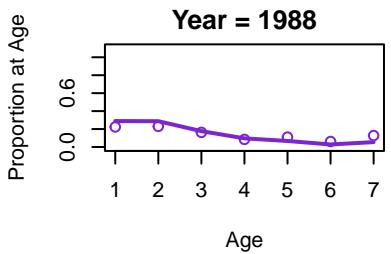
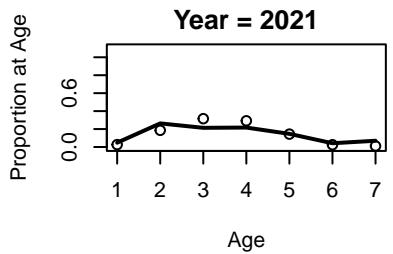
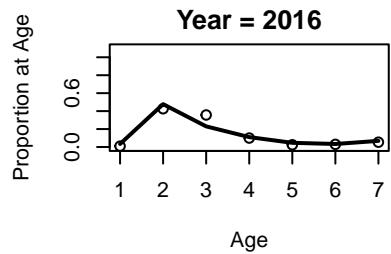
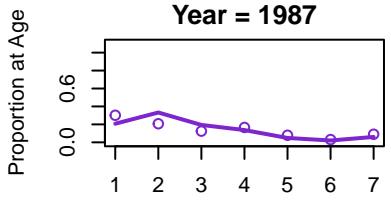
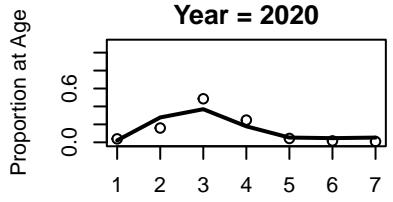
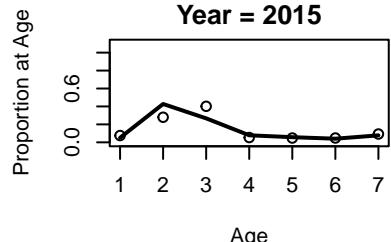
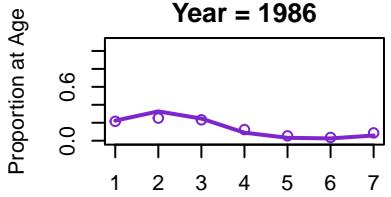
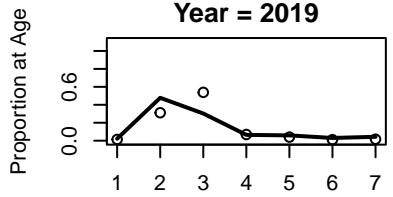
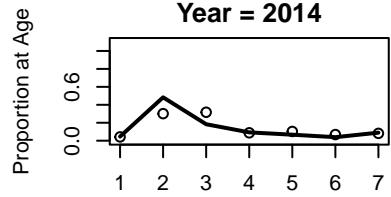
Year = 2003

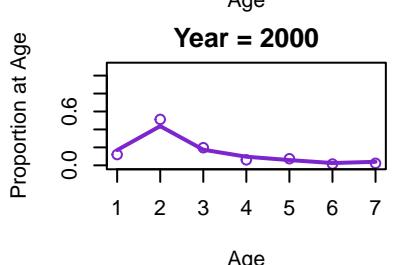
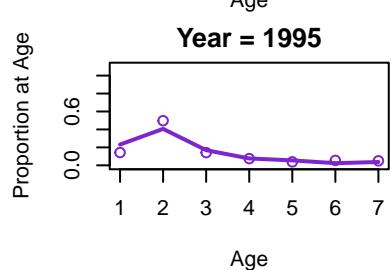
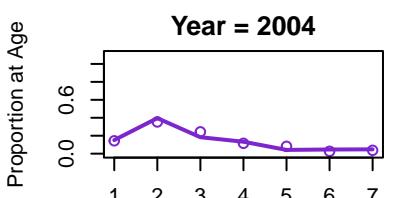
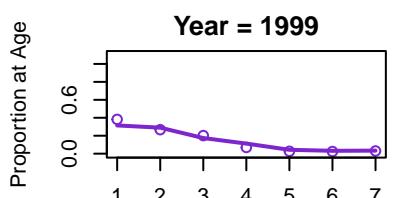
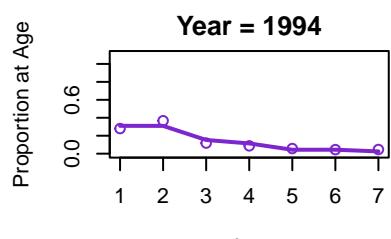
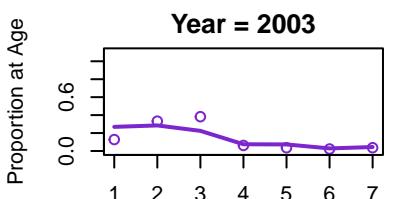
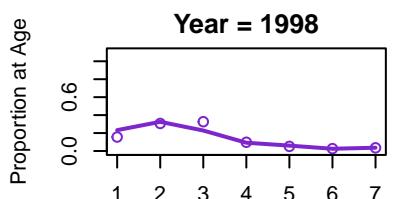
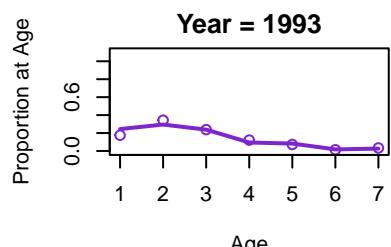
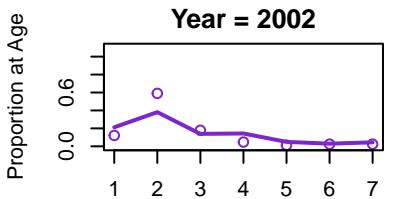
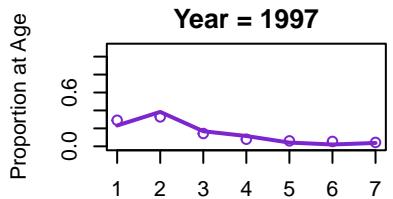
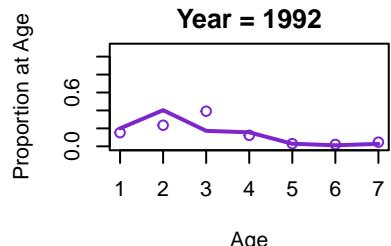
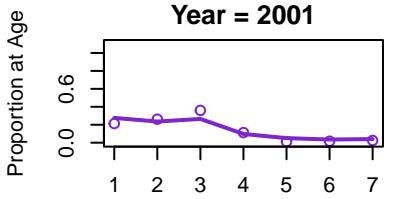
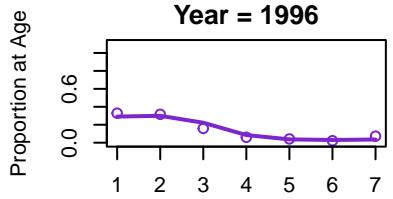
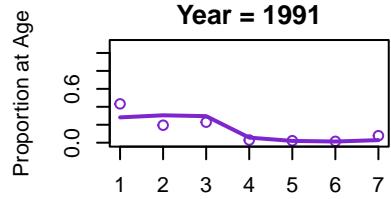


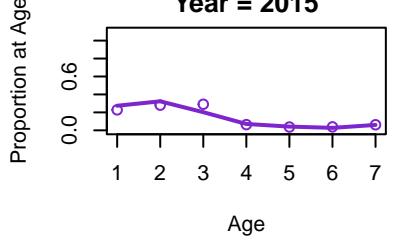
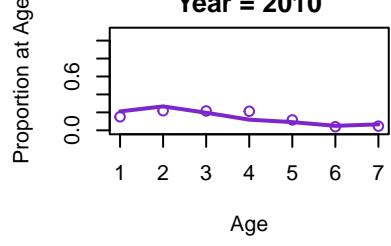
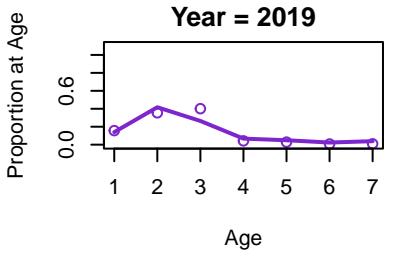
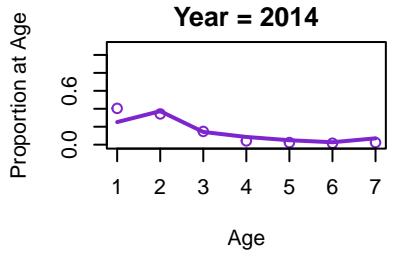
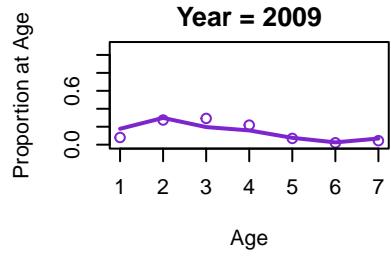
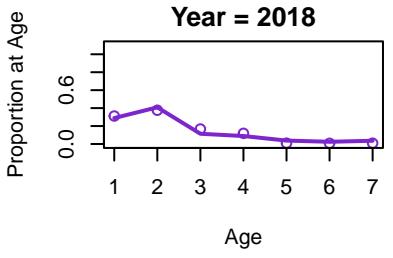
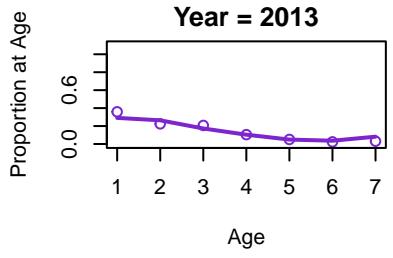
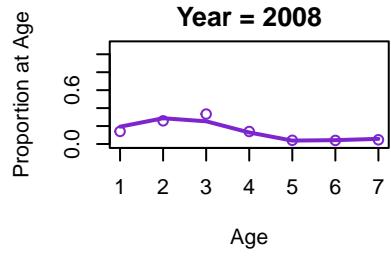
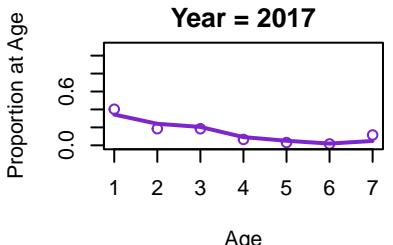
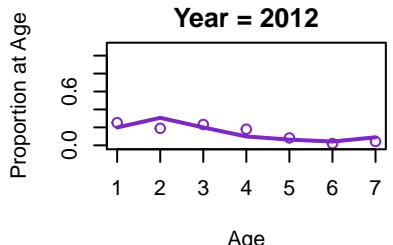
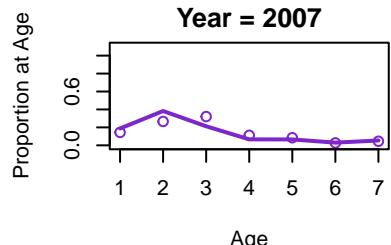
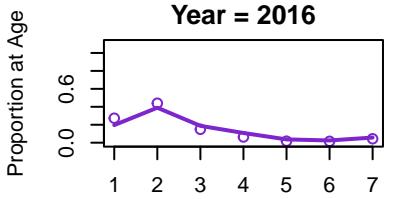
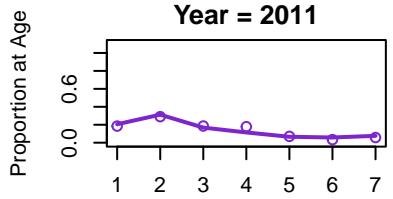
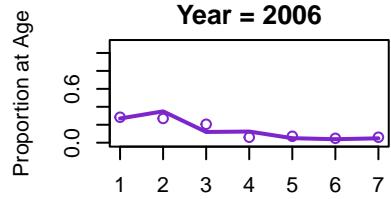
Year = 2008



**Year = 2013**

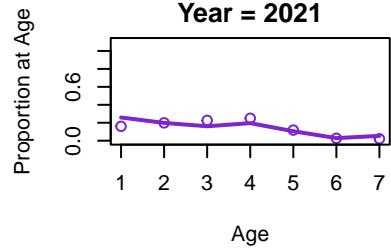




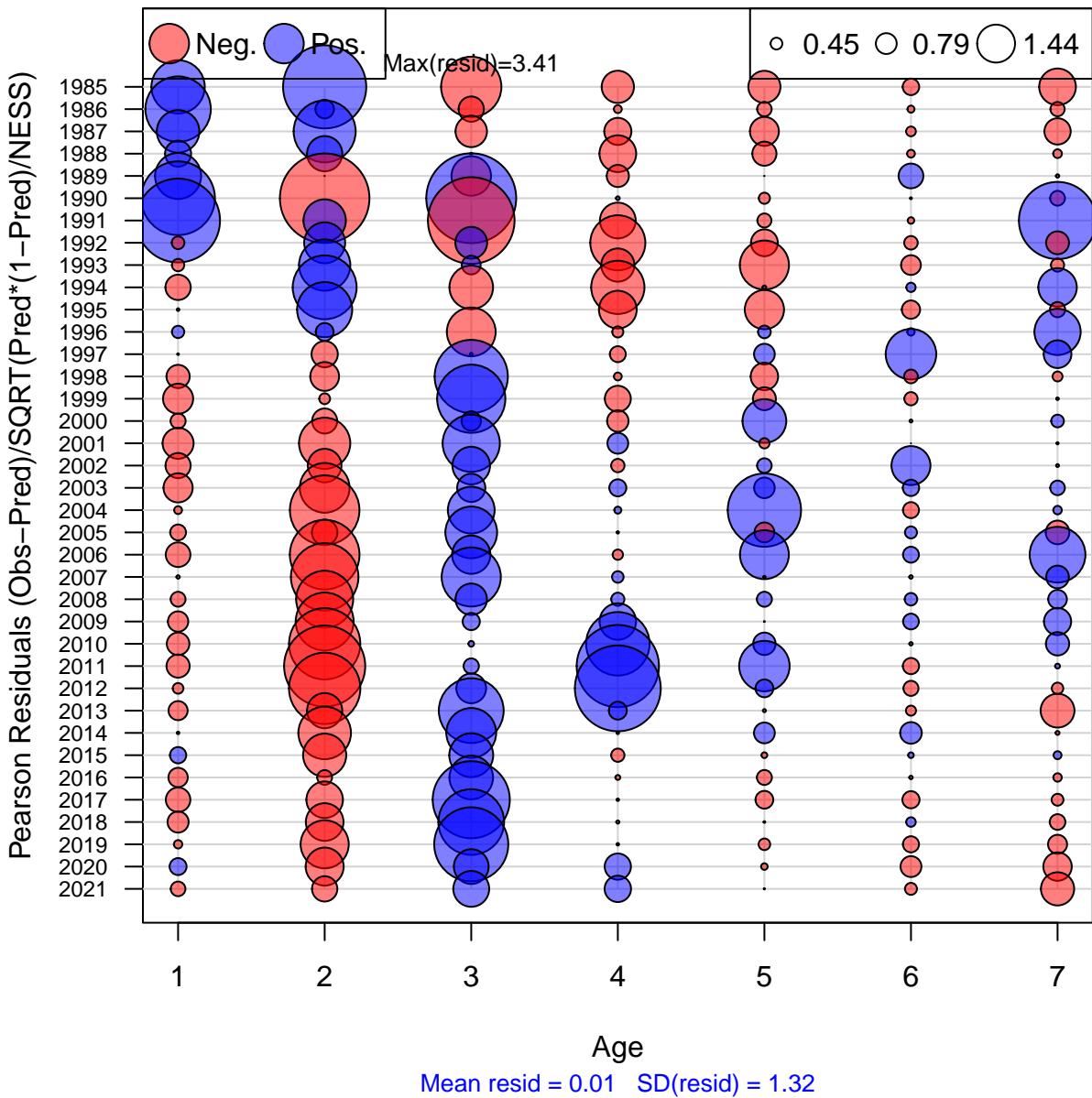


# Catch

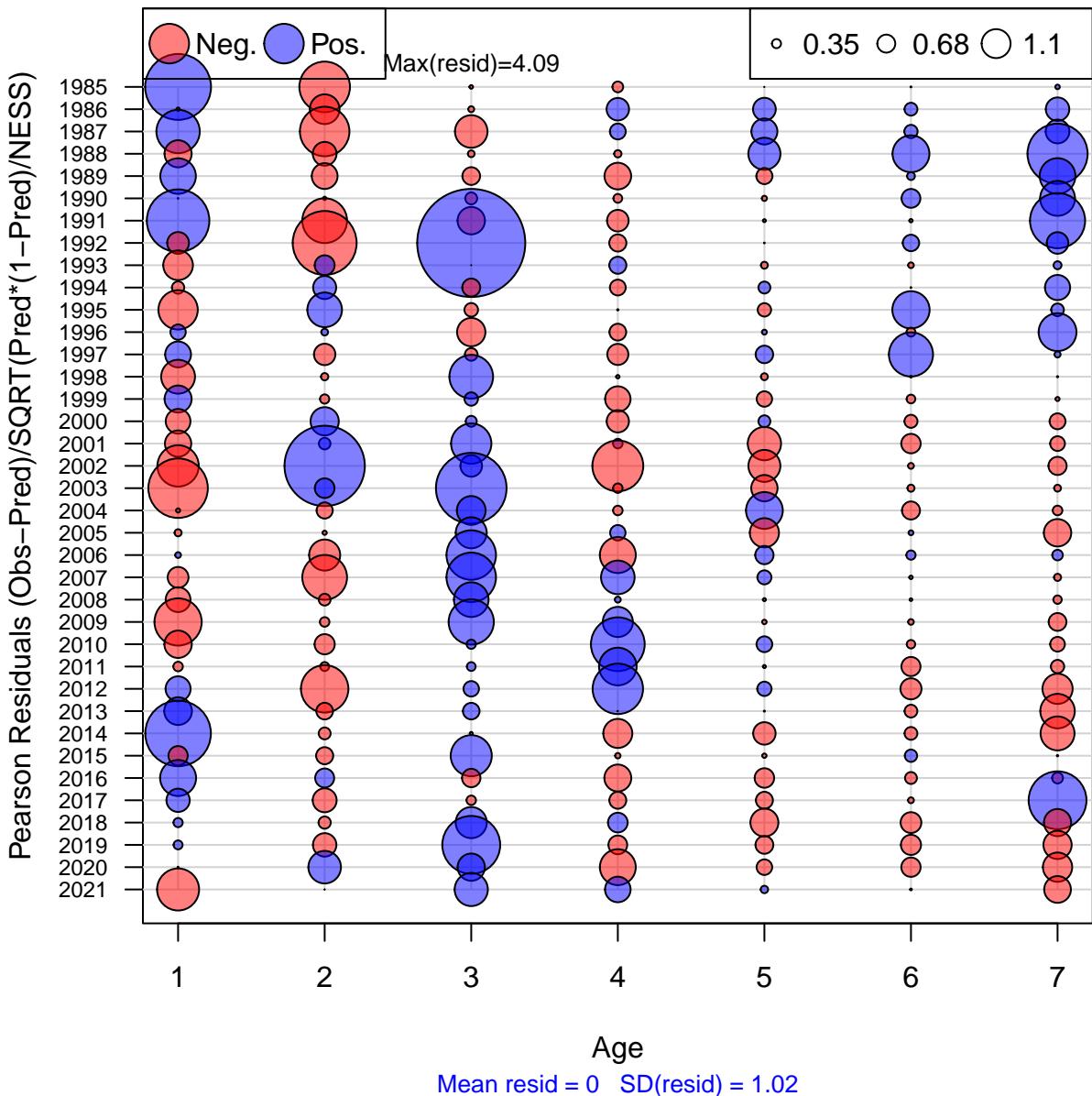
Year = 2021



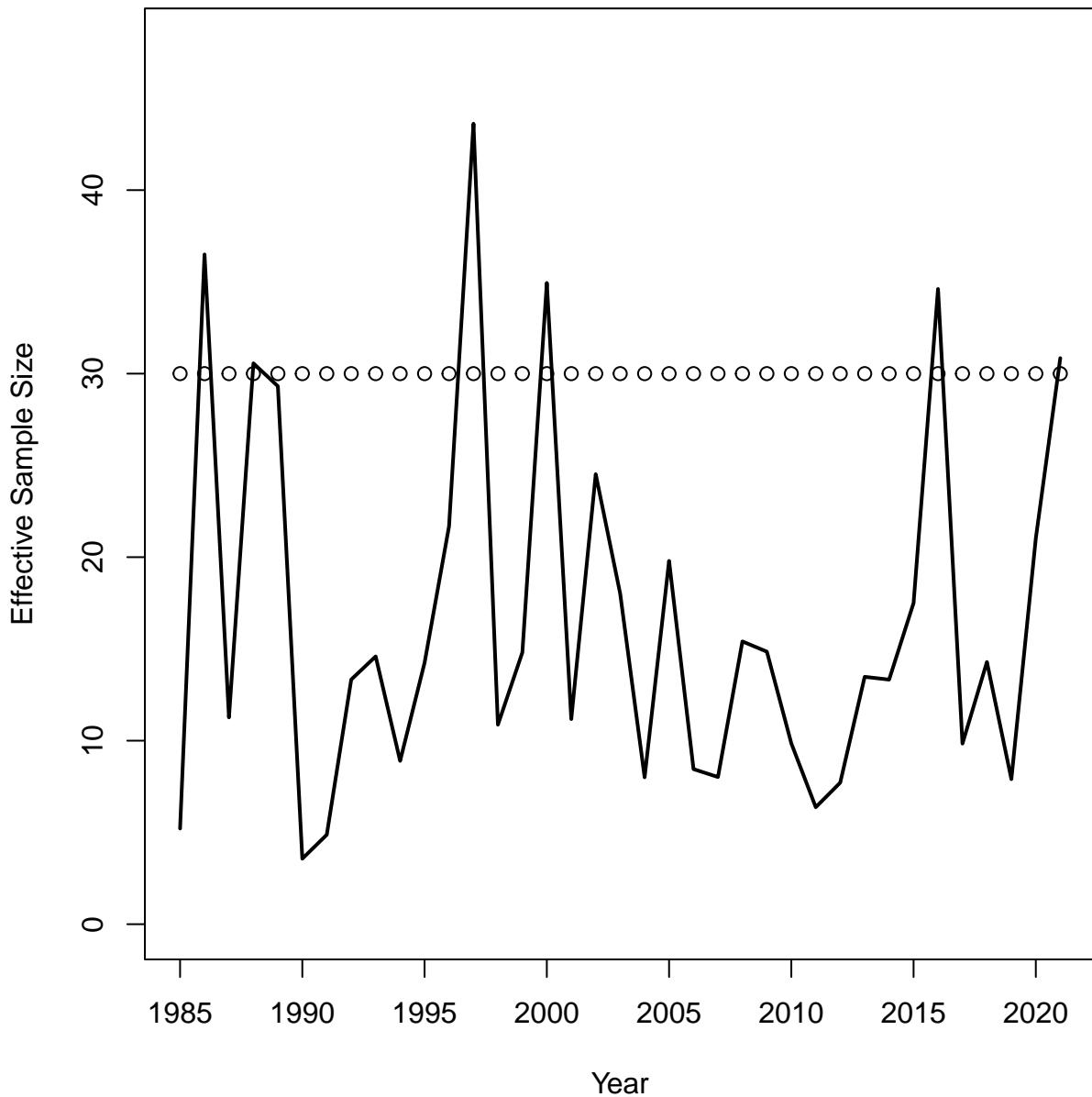
# Age Comp Residuals for Catch by Fleet 1 (Comm)



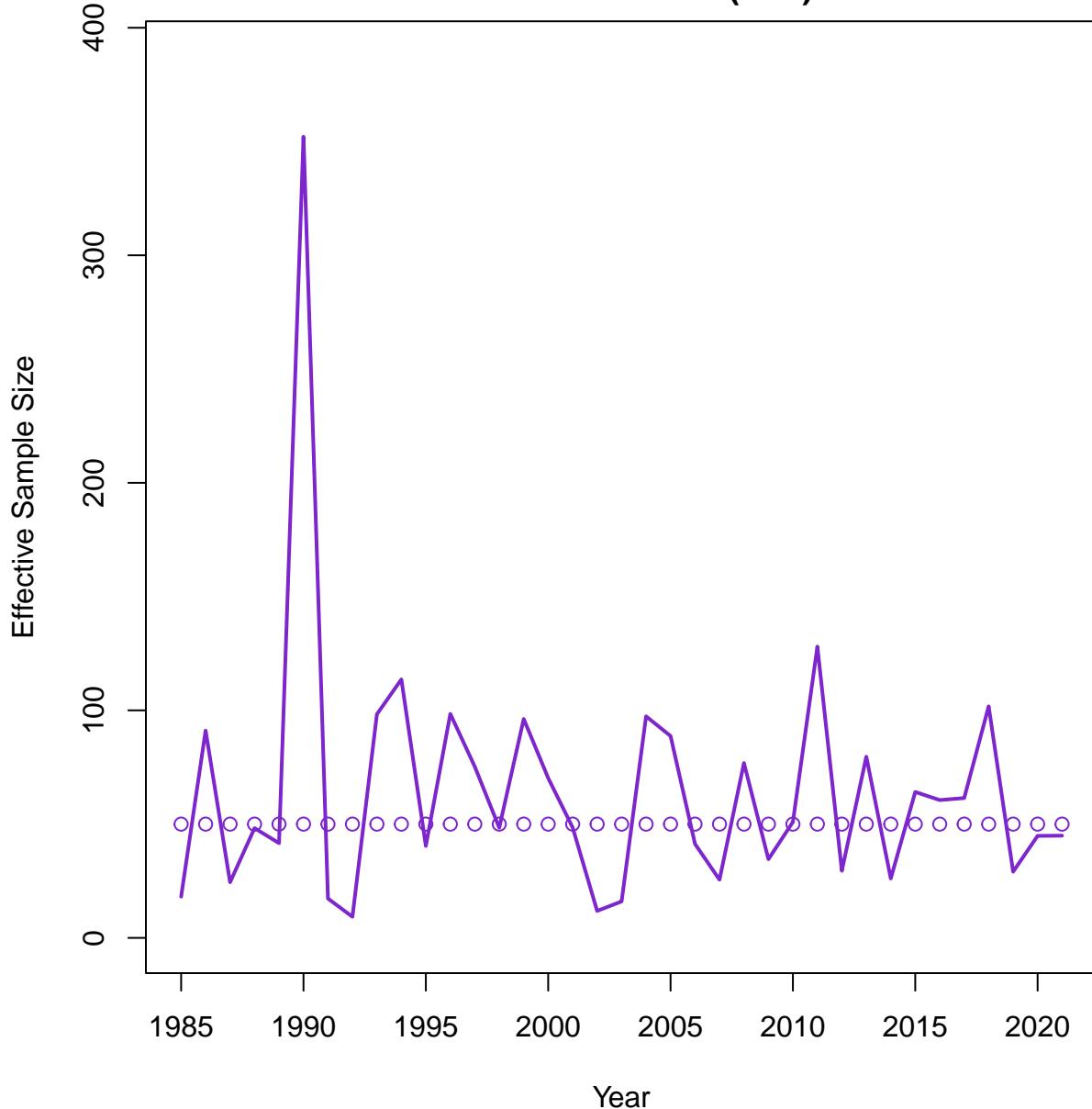
# Age Comp Residuals for Catch by Fleet 2 (Rec)



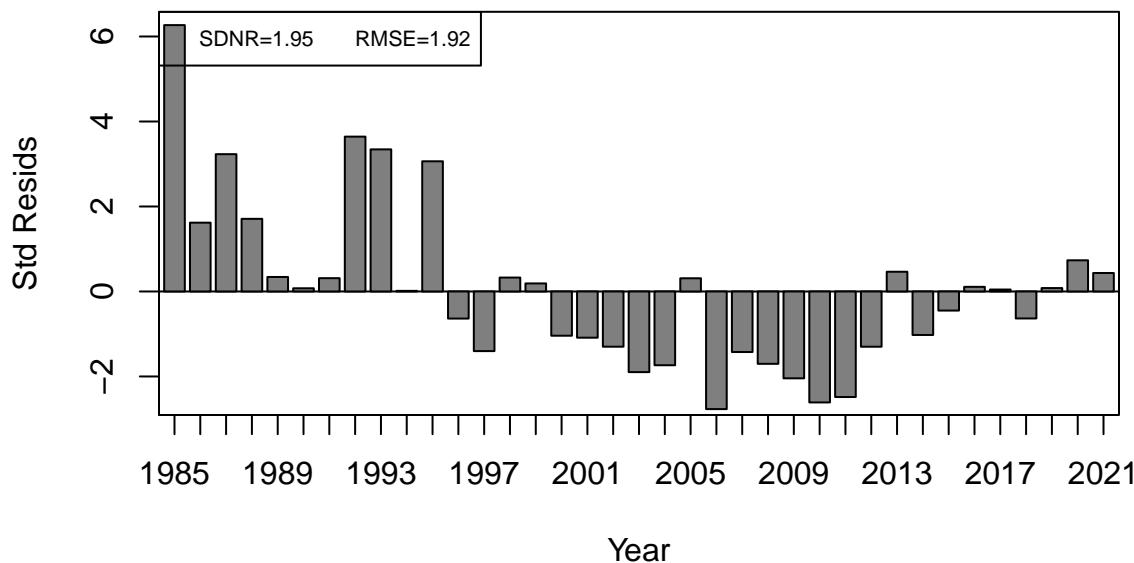
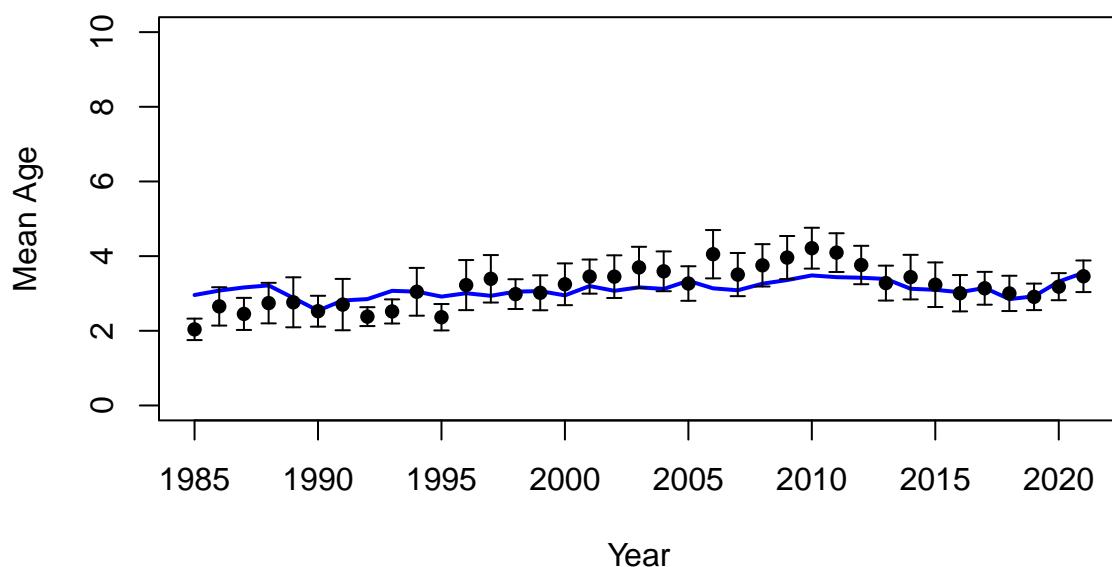
## Catch Neff Fleet 1 (Comm)



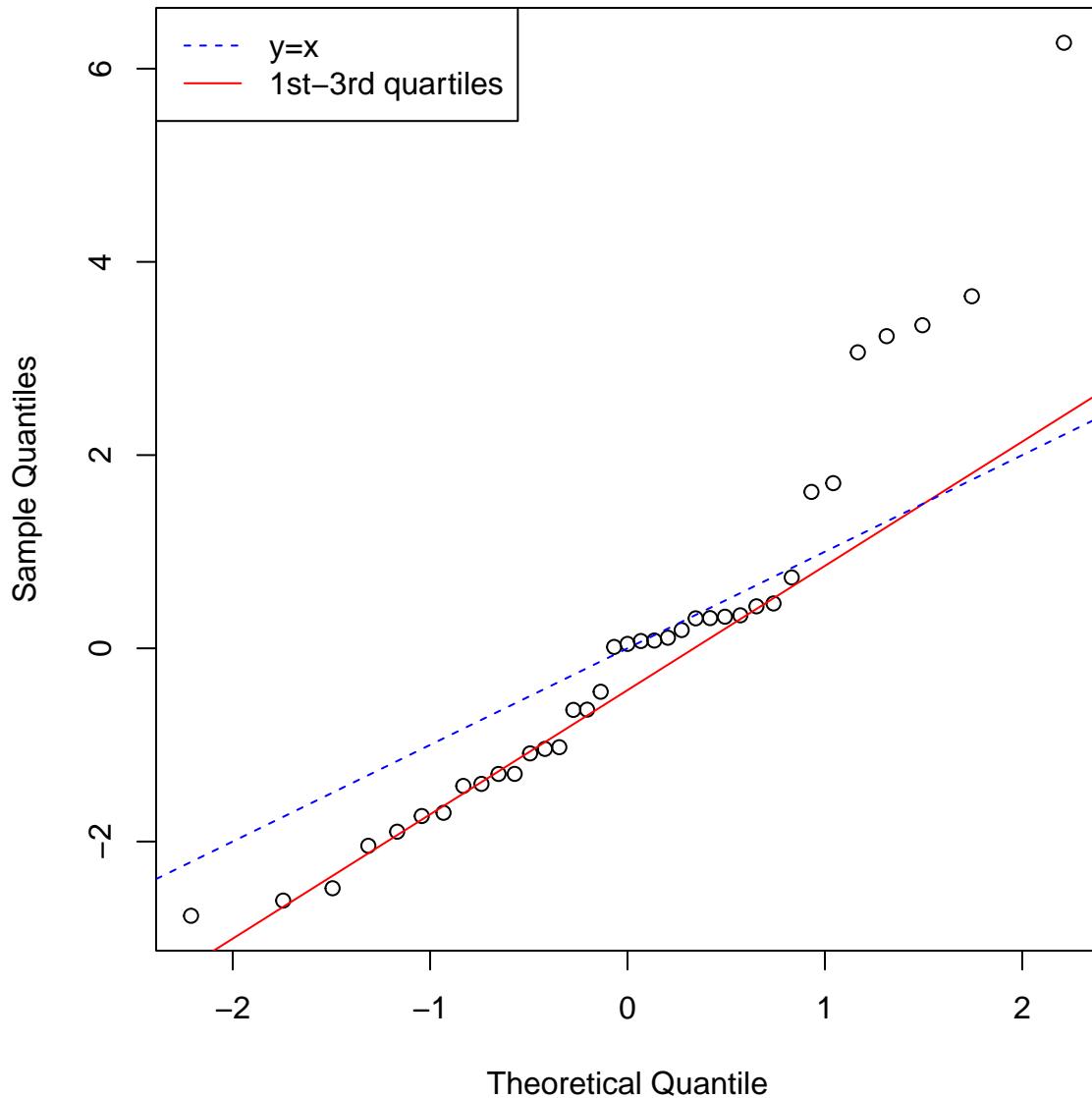
## Catch Neff Fleet 2 (Rec)



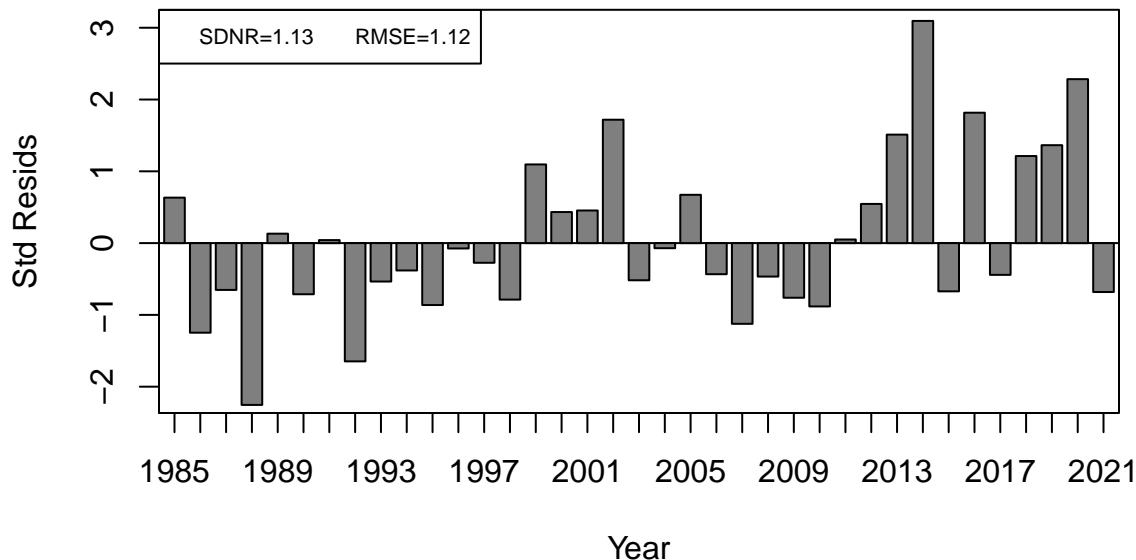
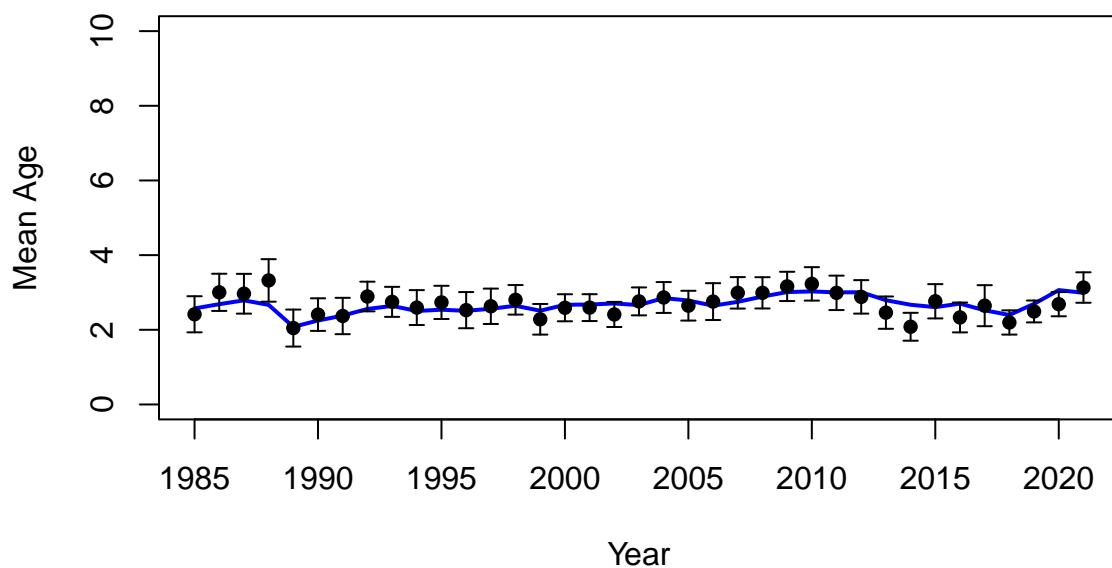
### Catch Fleet 1 (Comm) ESS = 30



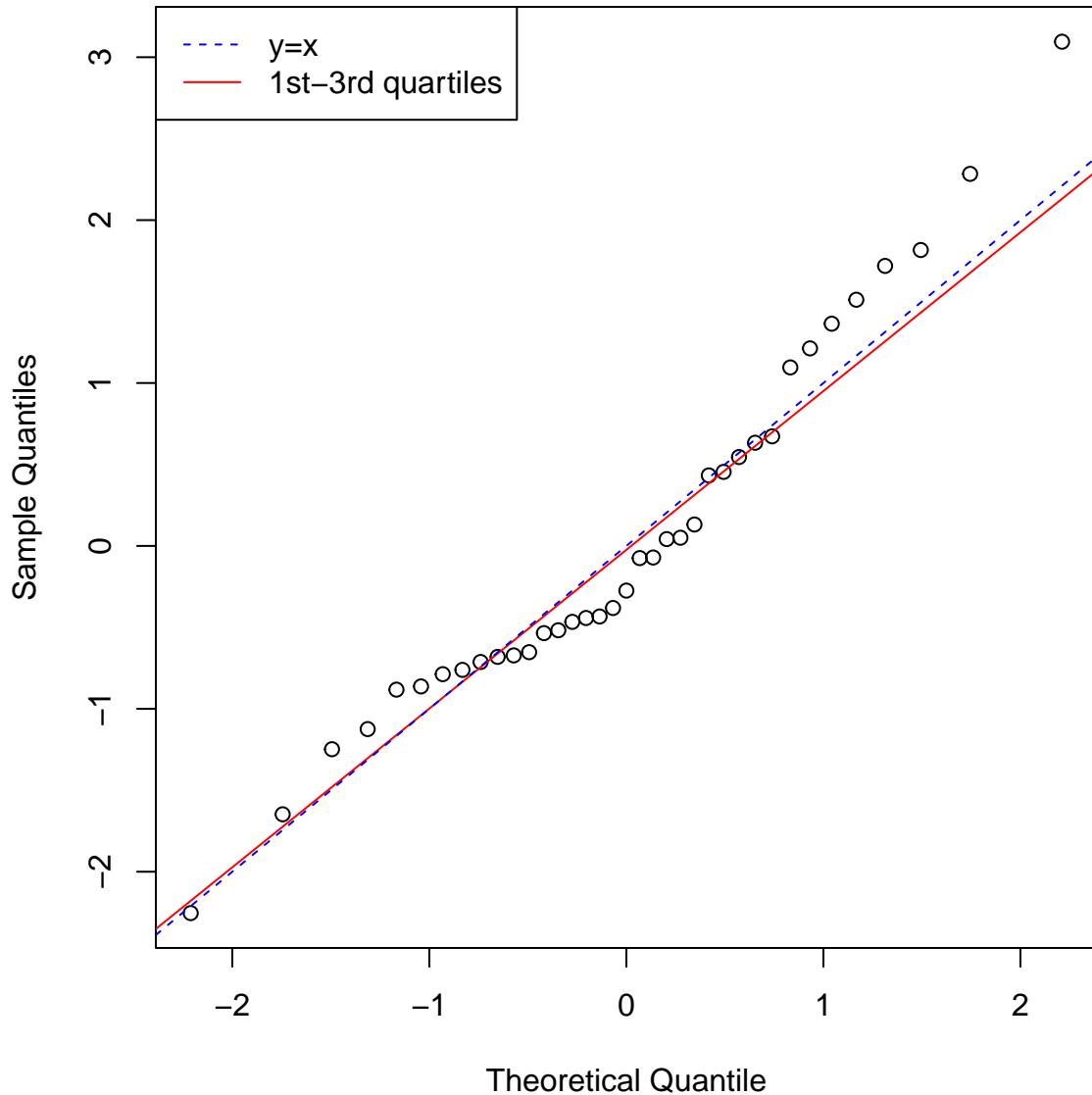
### Catch Fleet 1 (Comm) ESS = 30



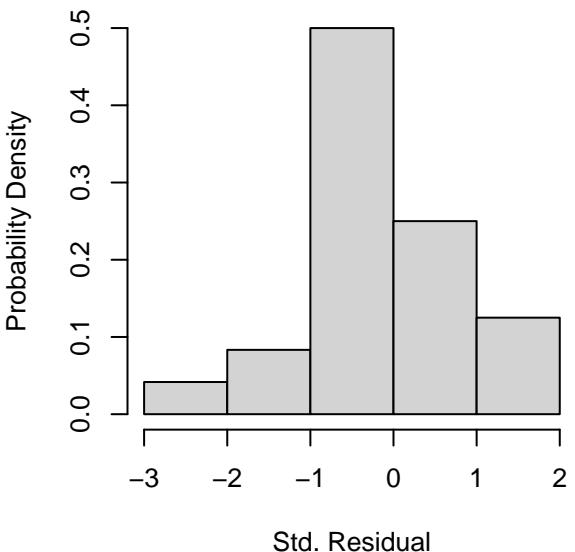
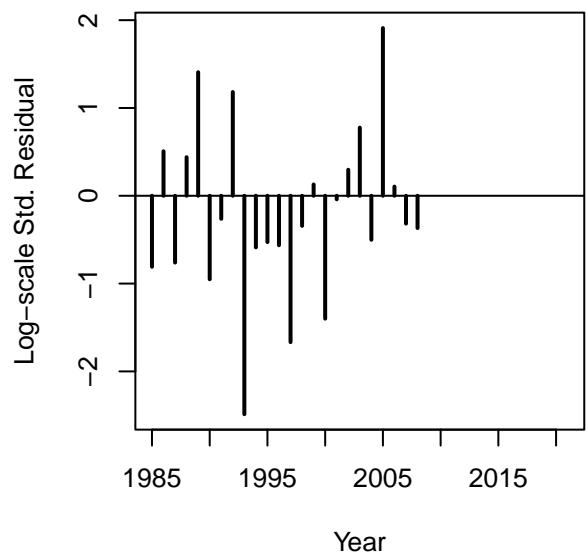
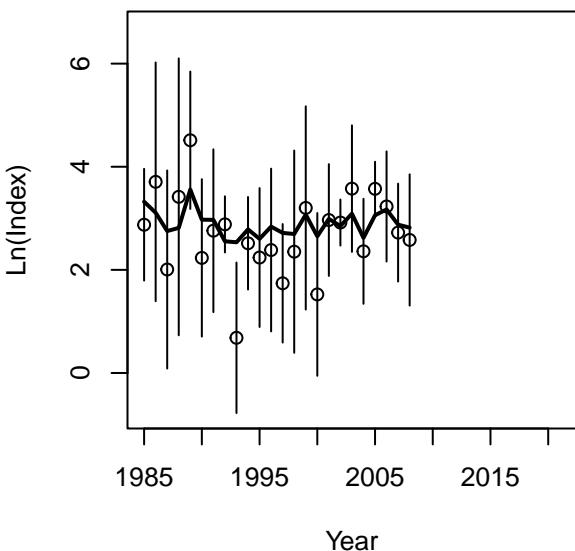
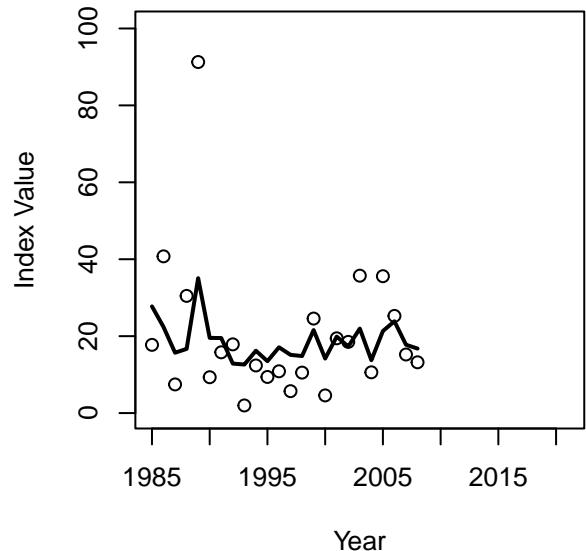
## Catch Fleet 2 (Rec) ESS = 50



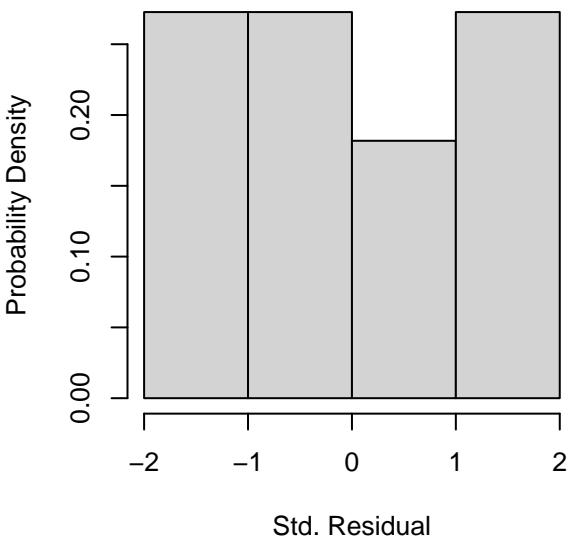
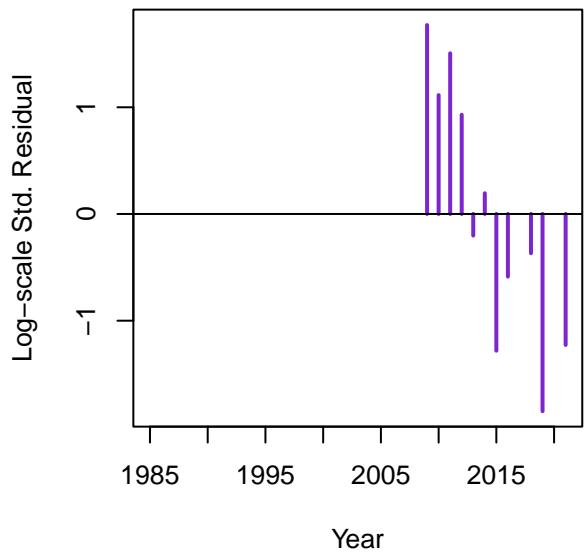
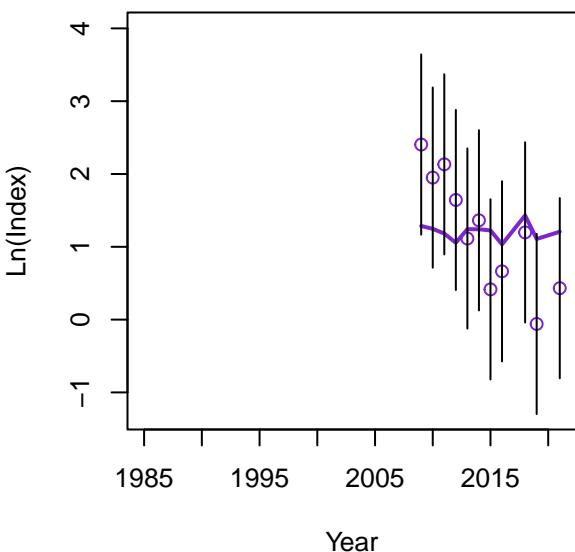
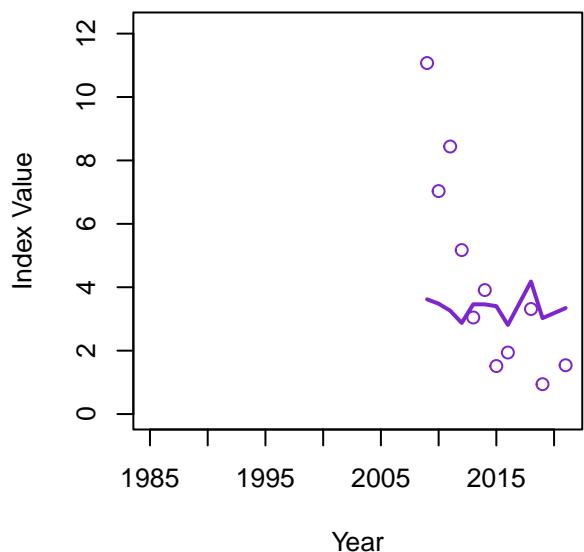
## Catch Fleet 2 (Rec) ESS = 50



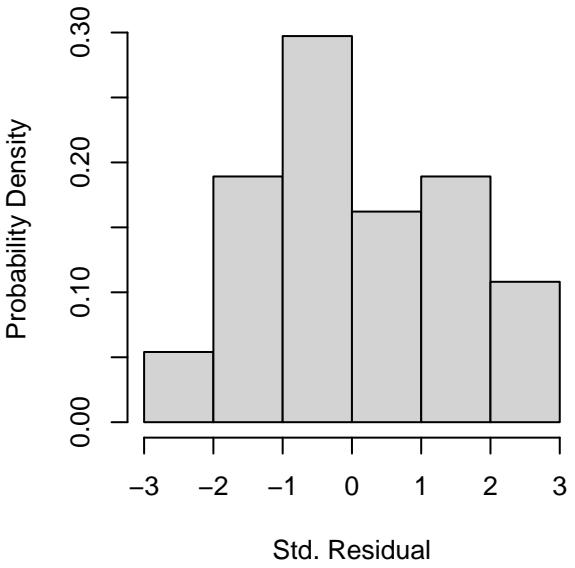
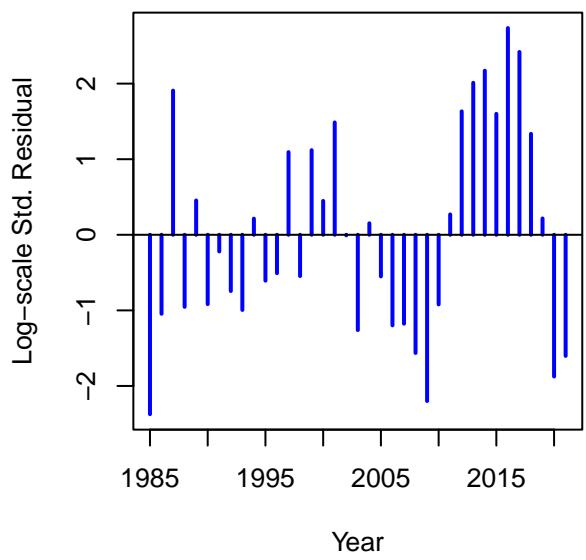
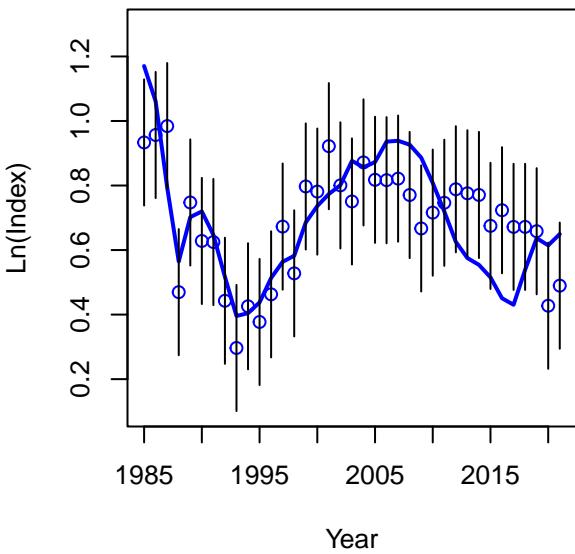
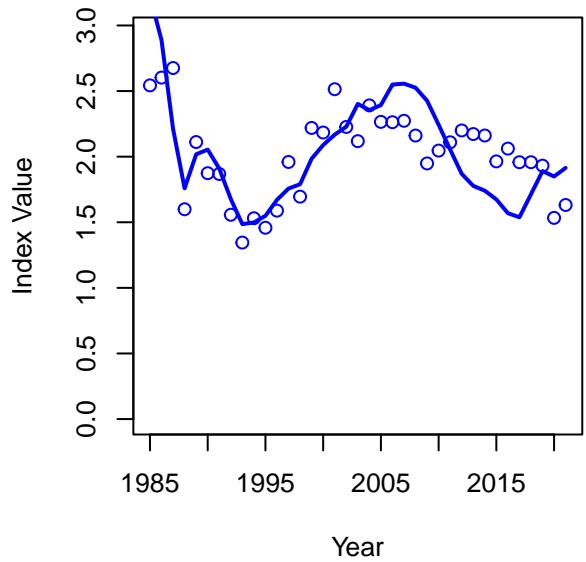
### Index 1 (NEFSC Inshore)



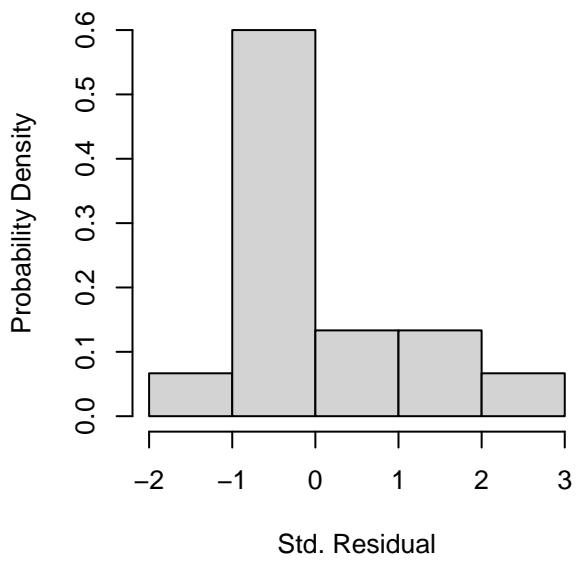
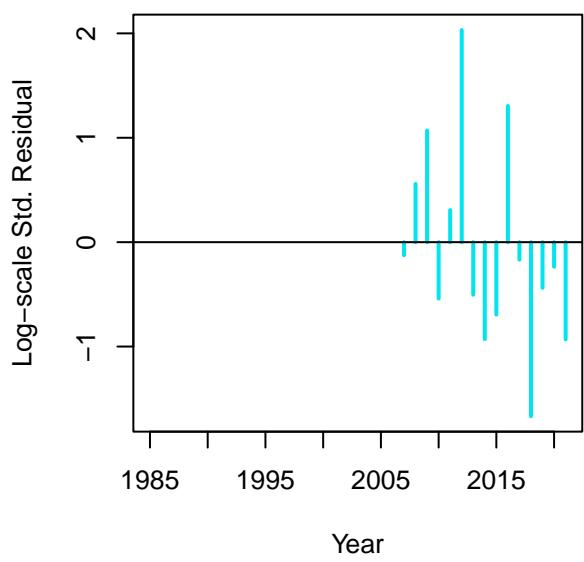
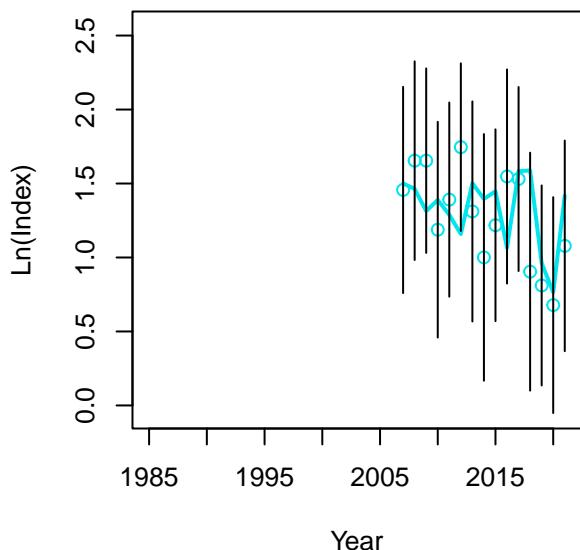
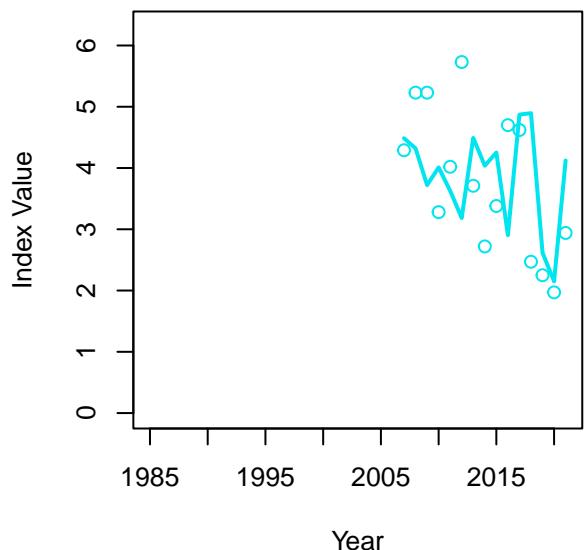
## Index 2 (Bigelow)



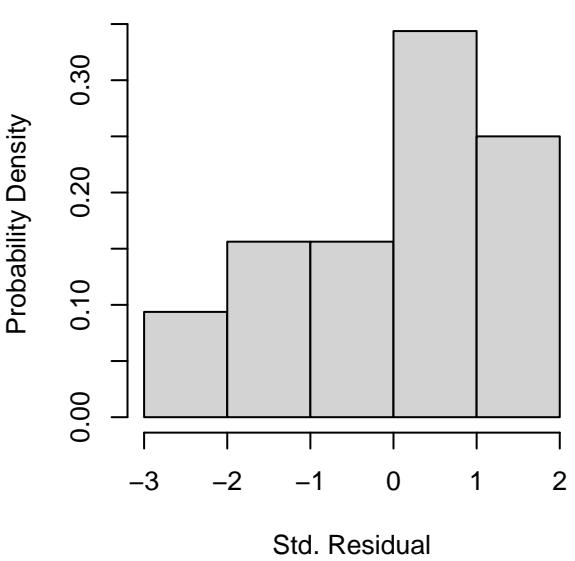
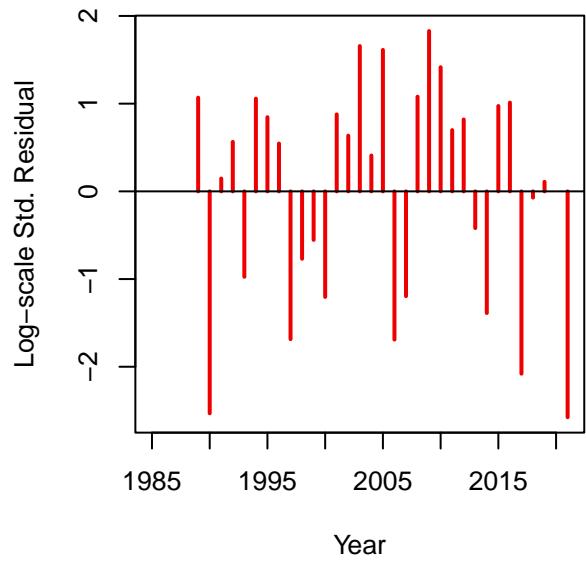
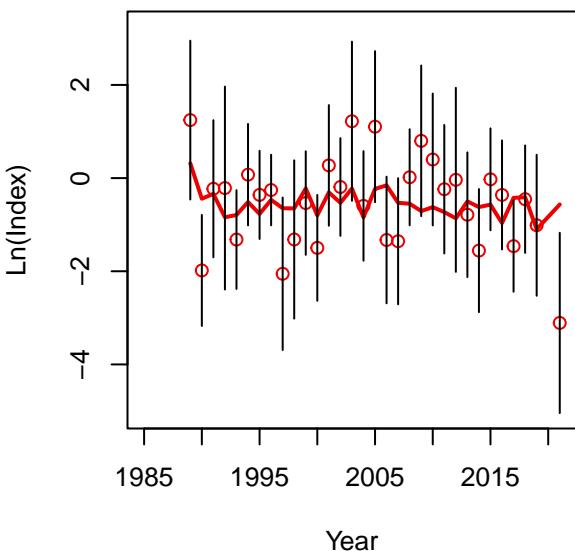
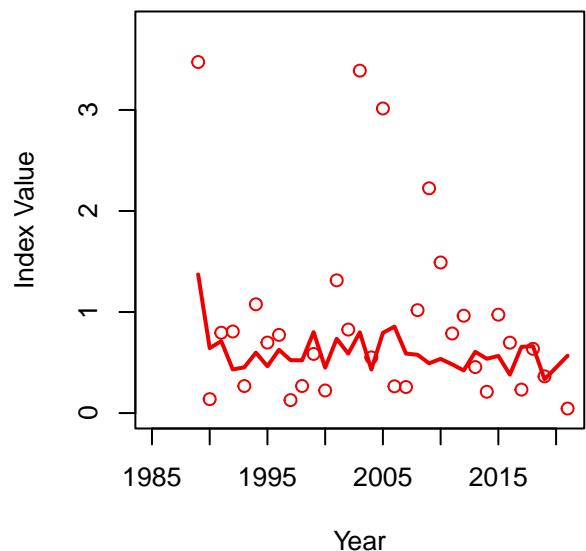
### Index 3 (MRIP)



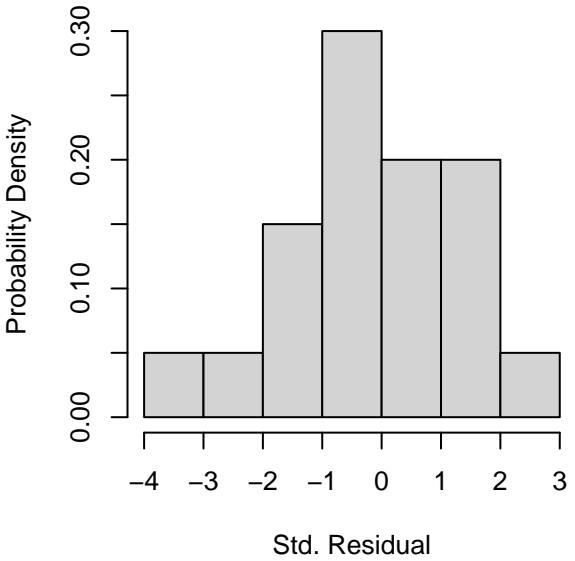
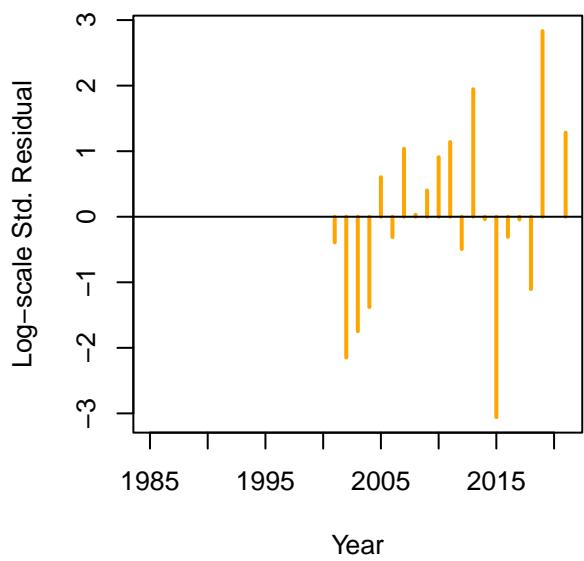
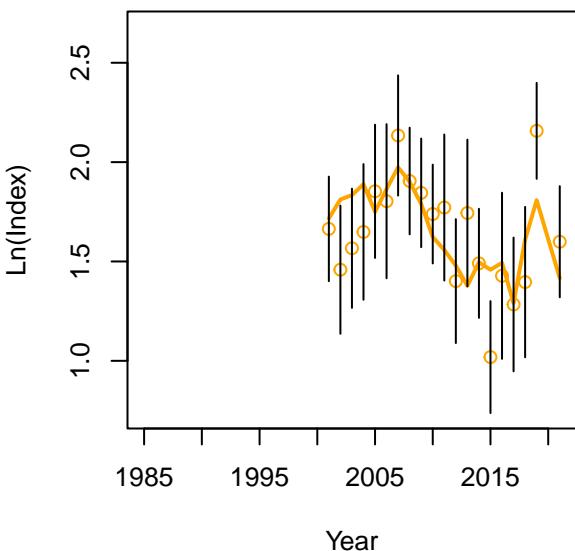
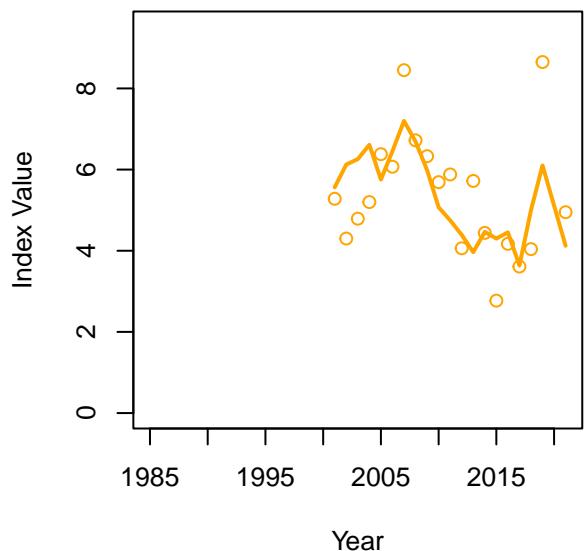
## Index 4 (NEAMAP)



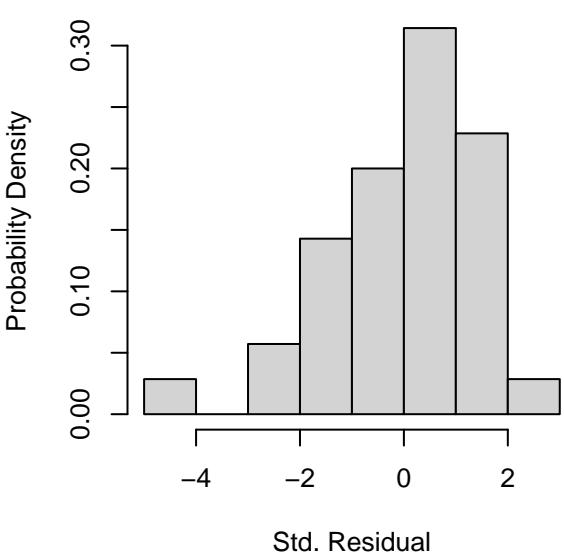
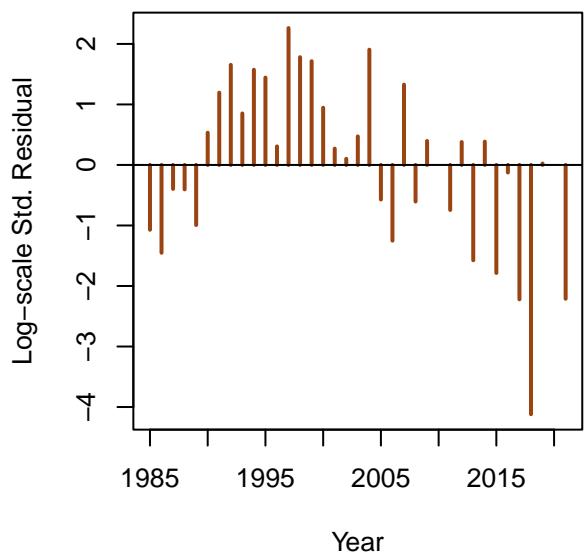
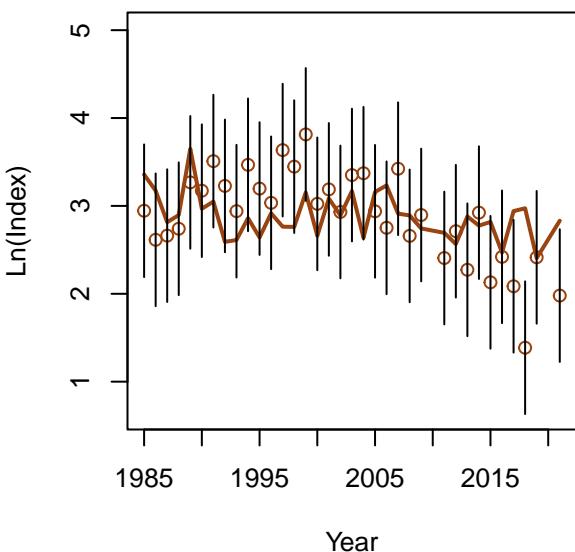
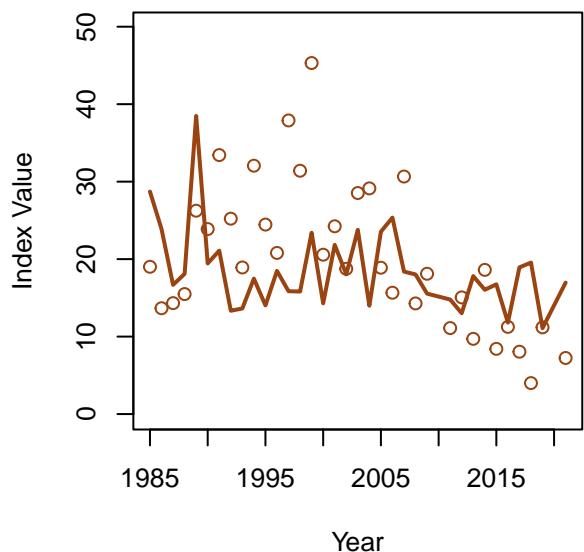
## Index 5 (SEAMAP)



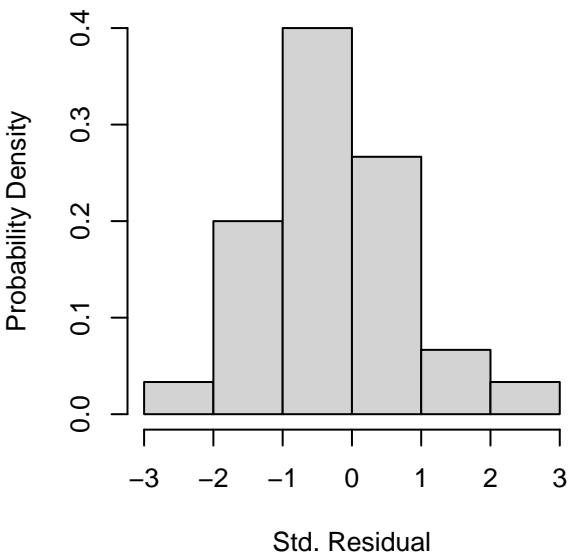
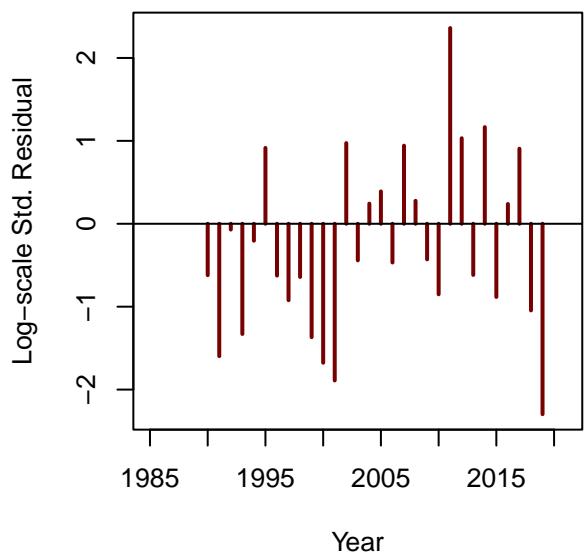
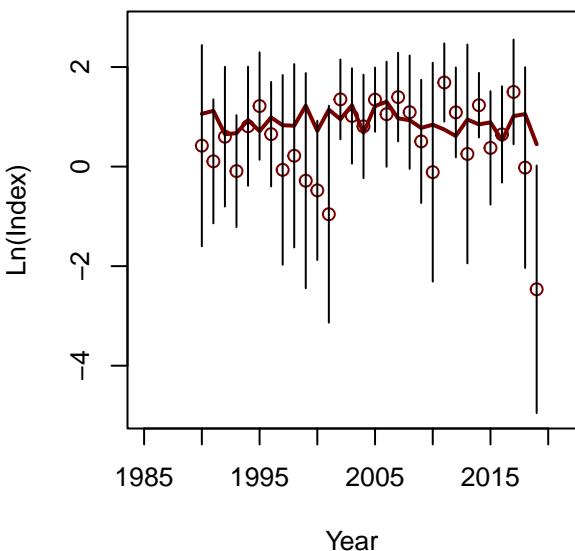
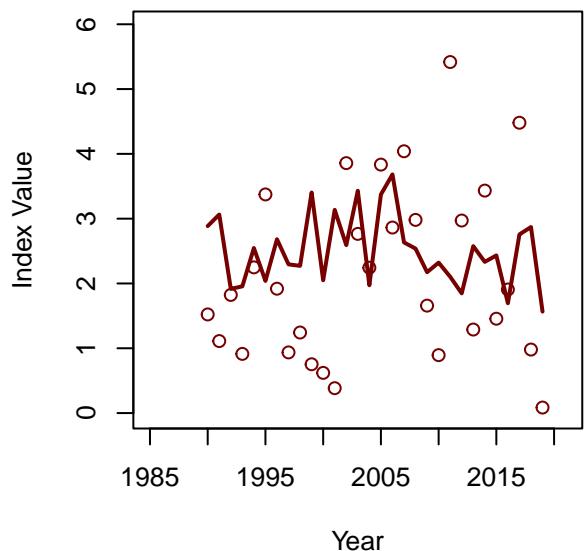
## Index 6 (PSIGN)



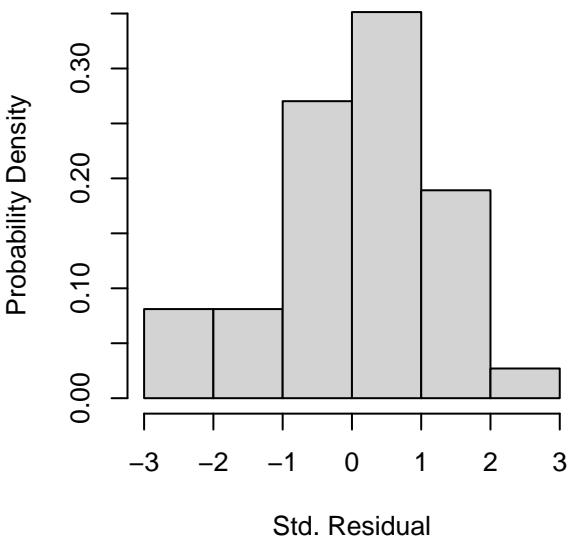
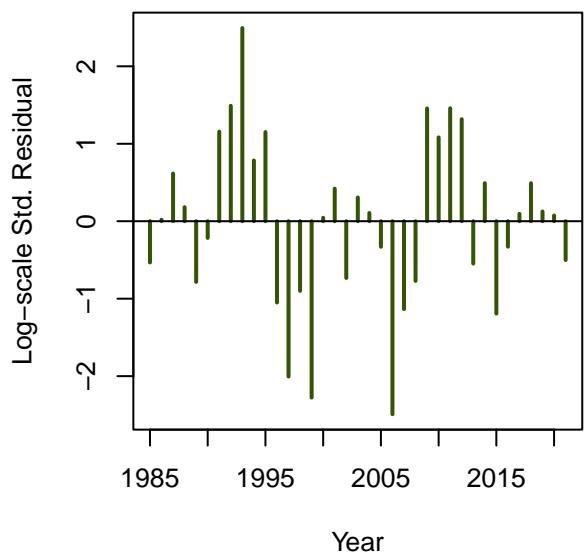
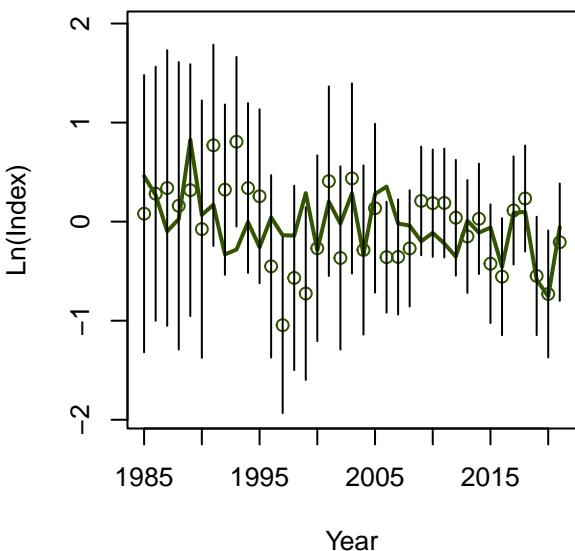
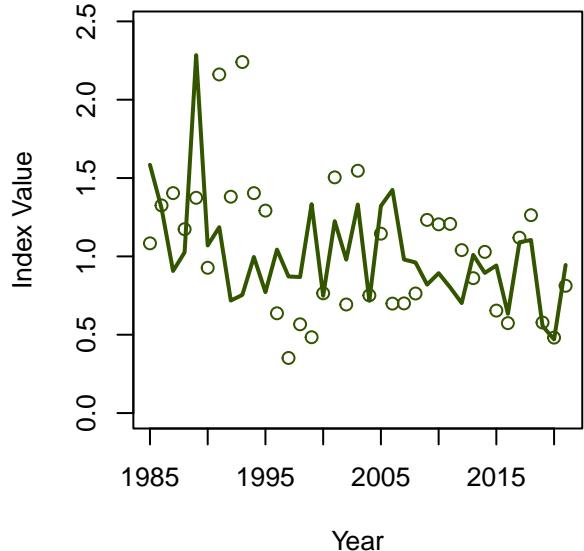
### Index 7 (CT Trawl)



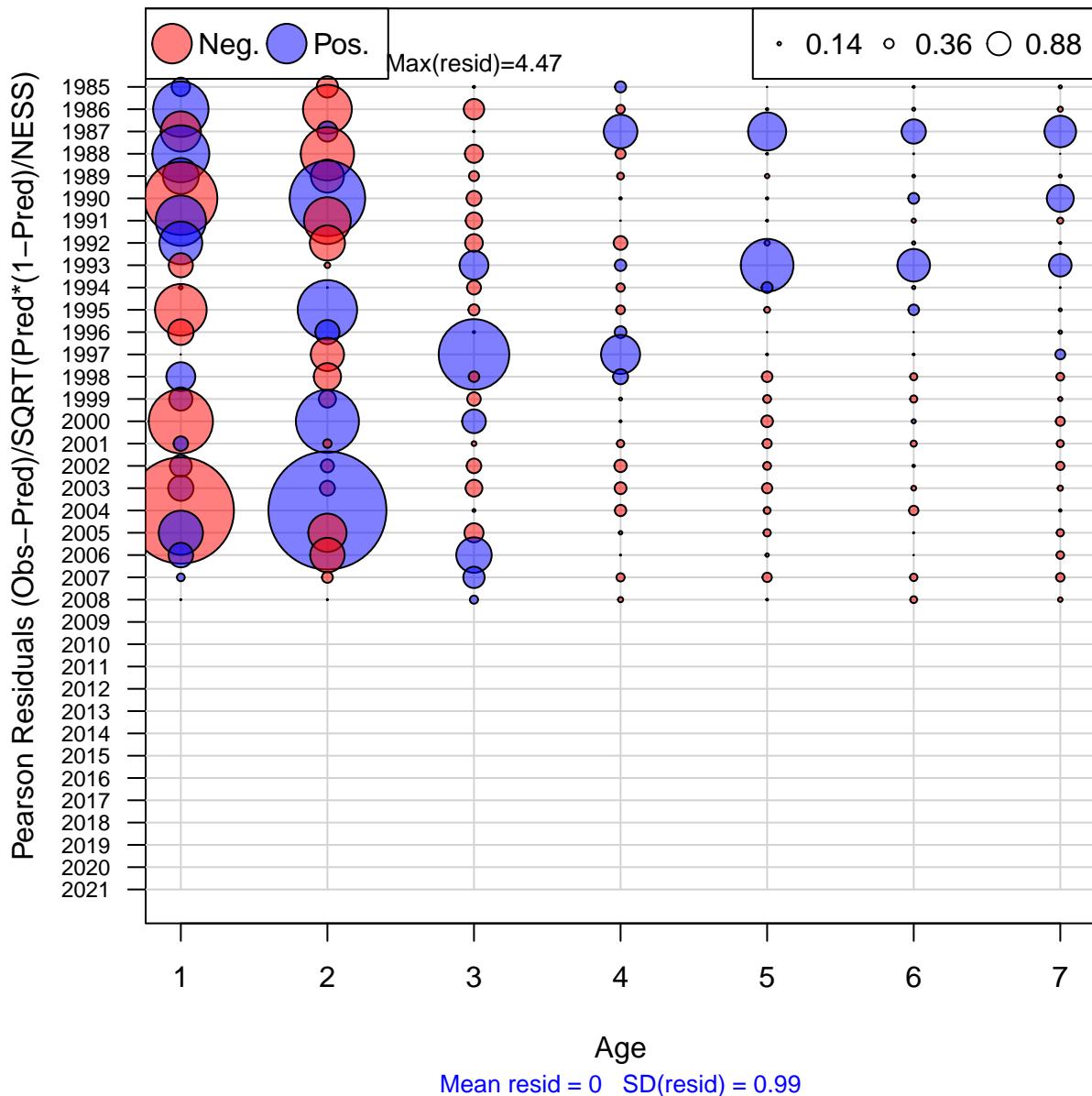
## Index 8 (NJ Trawl)



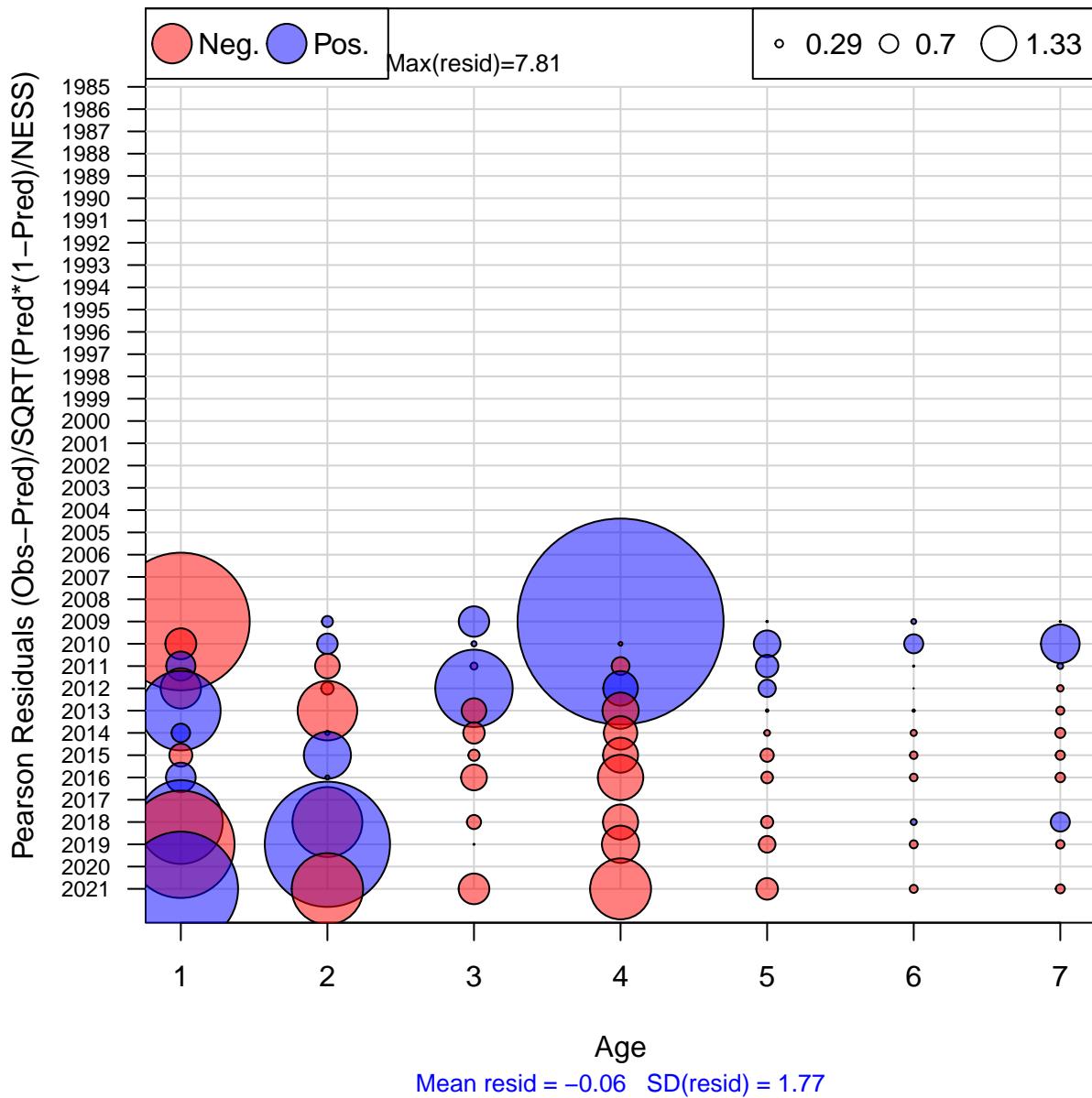
## Index 9 (Compound YOY)



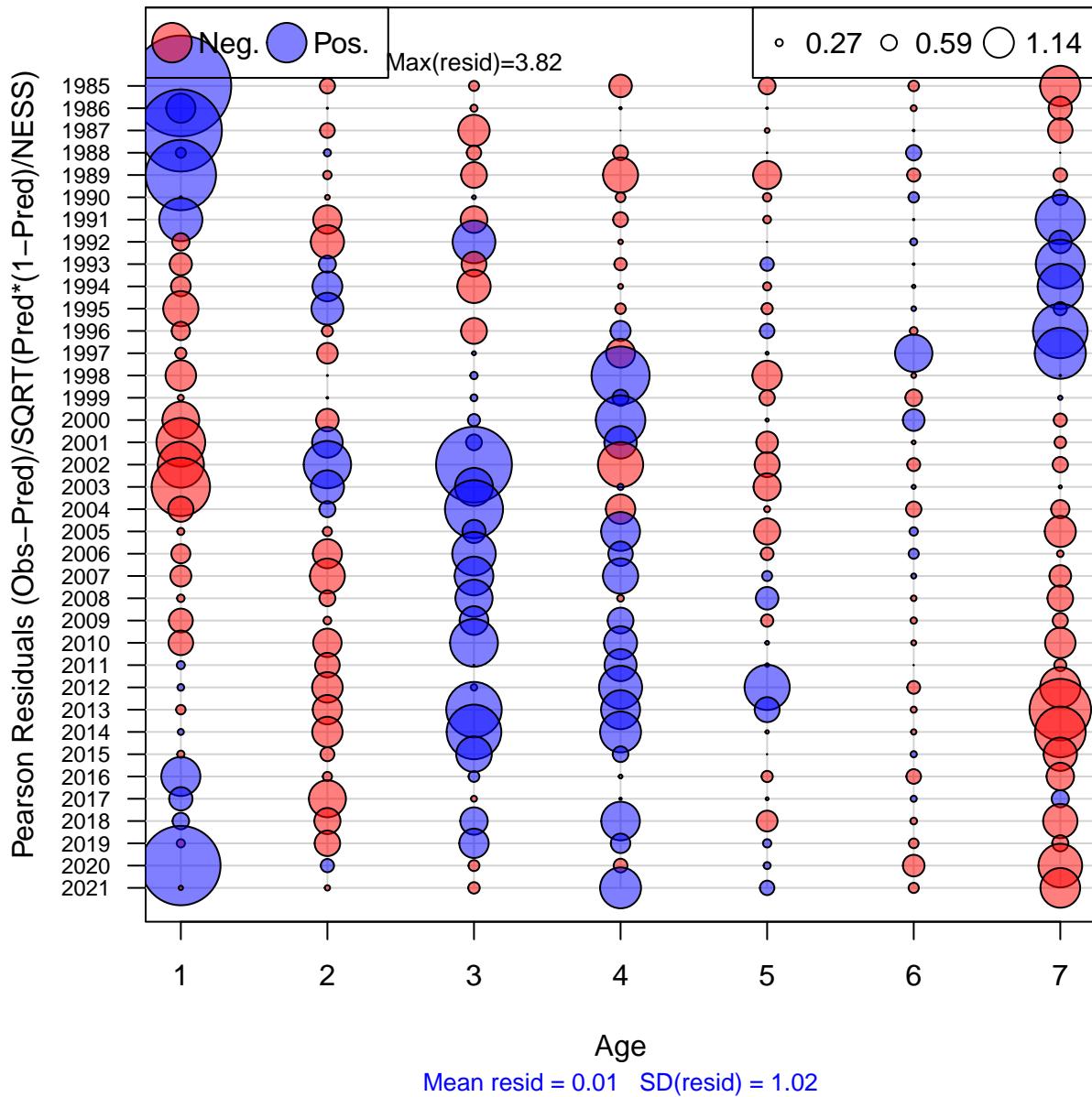
# Age Comp Residuals for Index 1 (NEFSC Inshore)



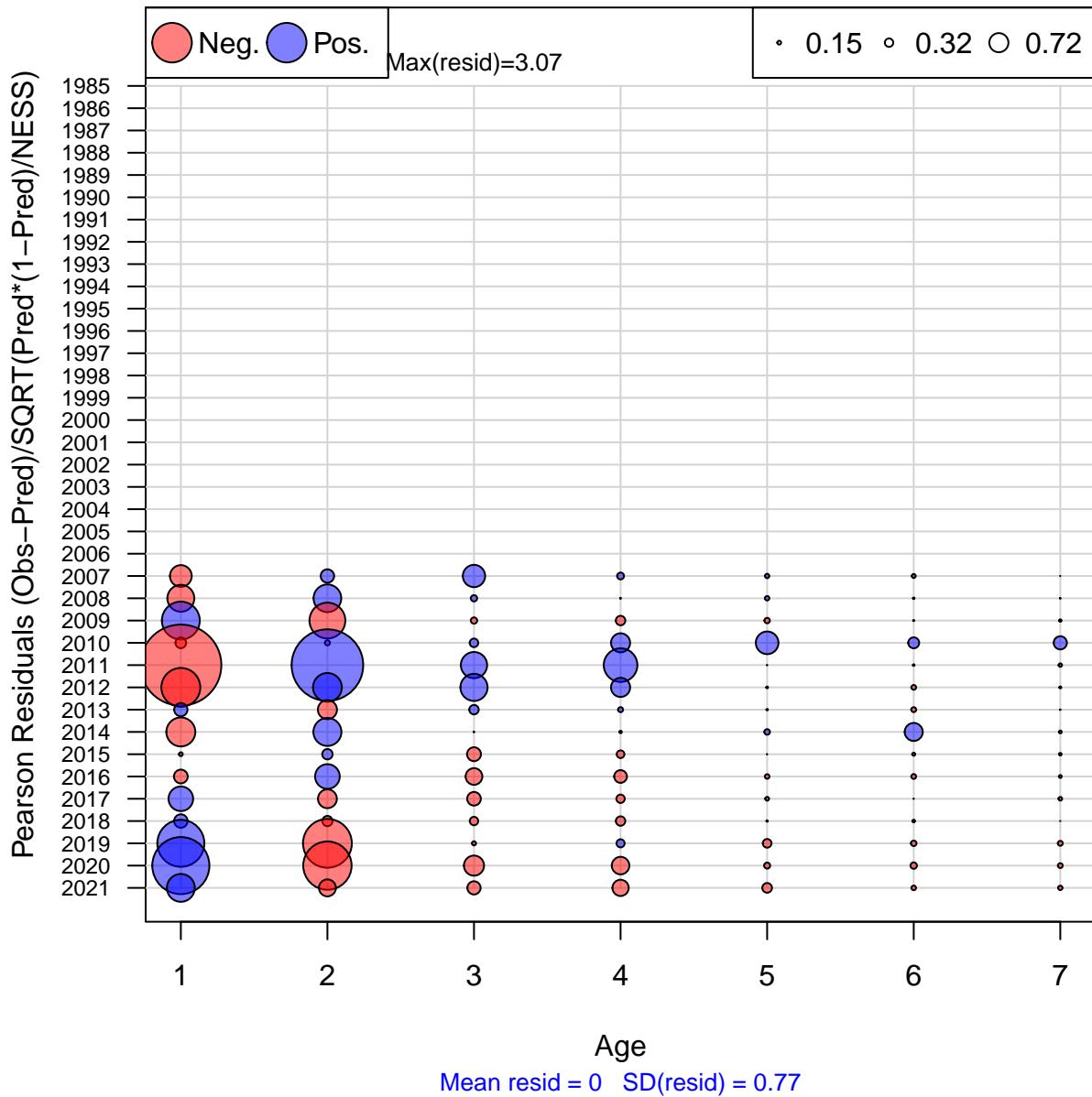
## Age Comp Residuals for Index 2 (Bigelow)



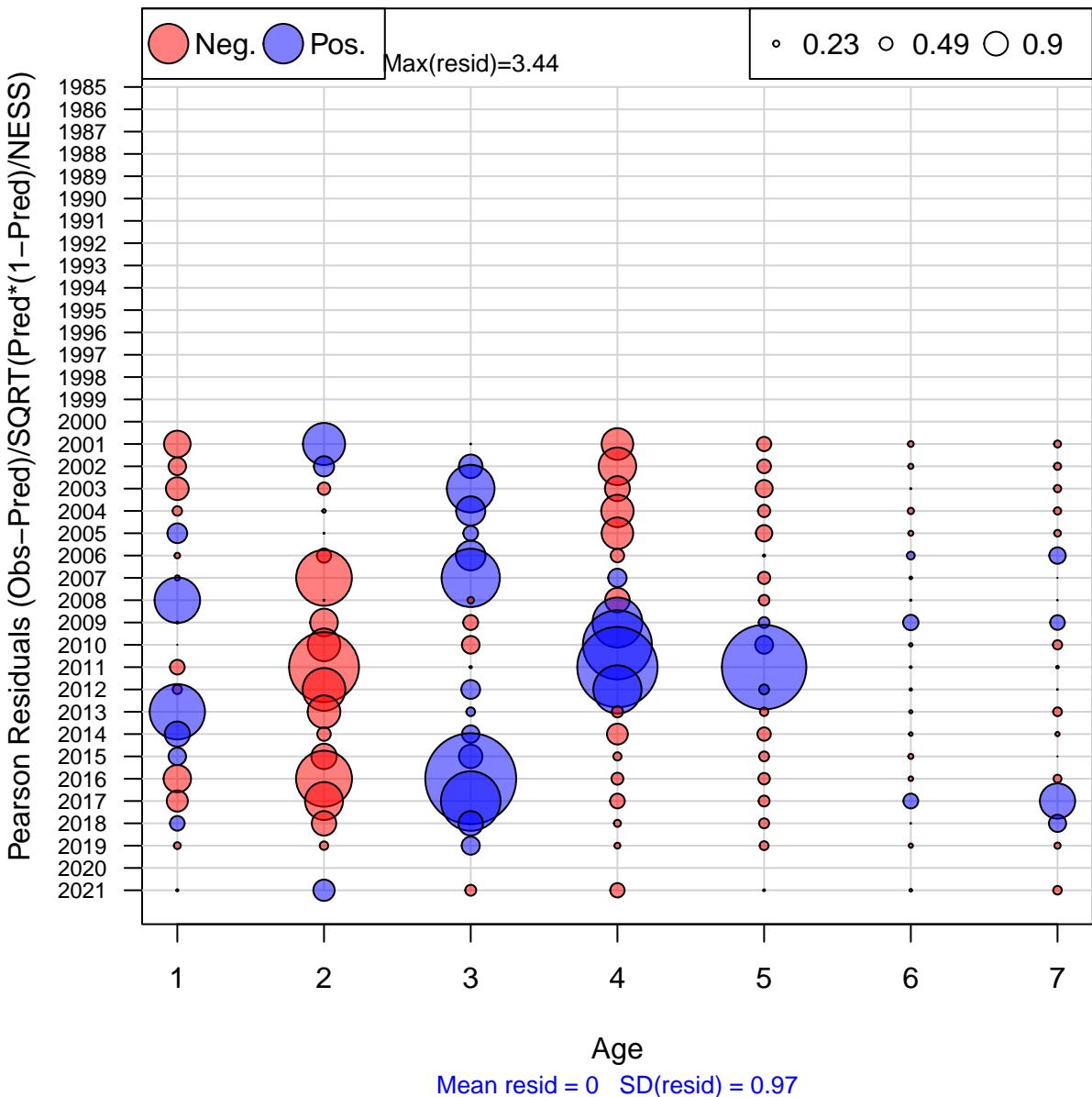
# Age Comp Residuals for Index 3 (MRIP)



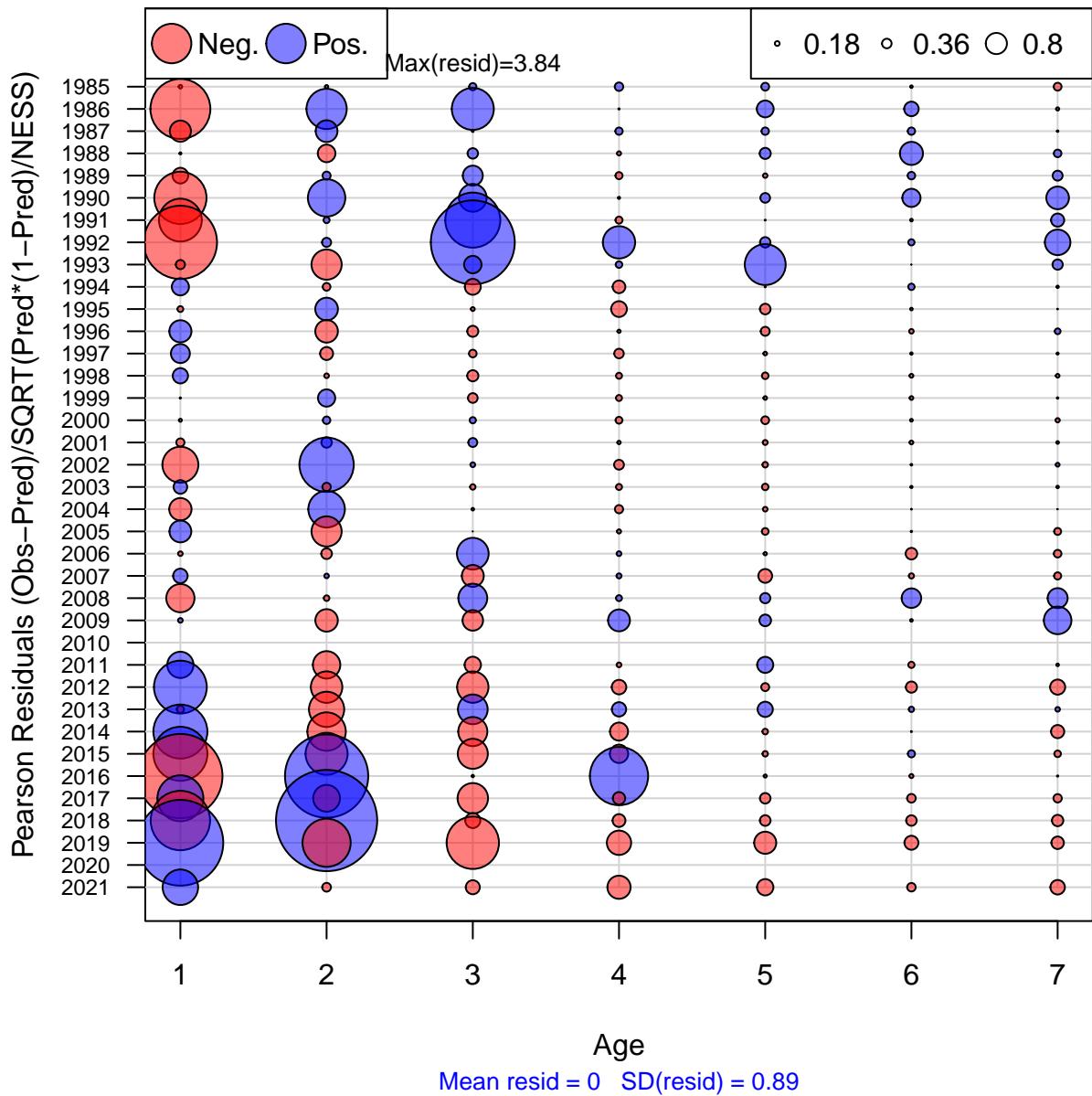
# Age Comp Residuals for Index 4 (NEAMAP)



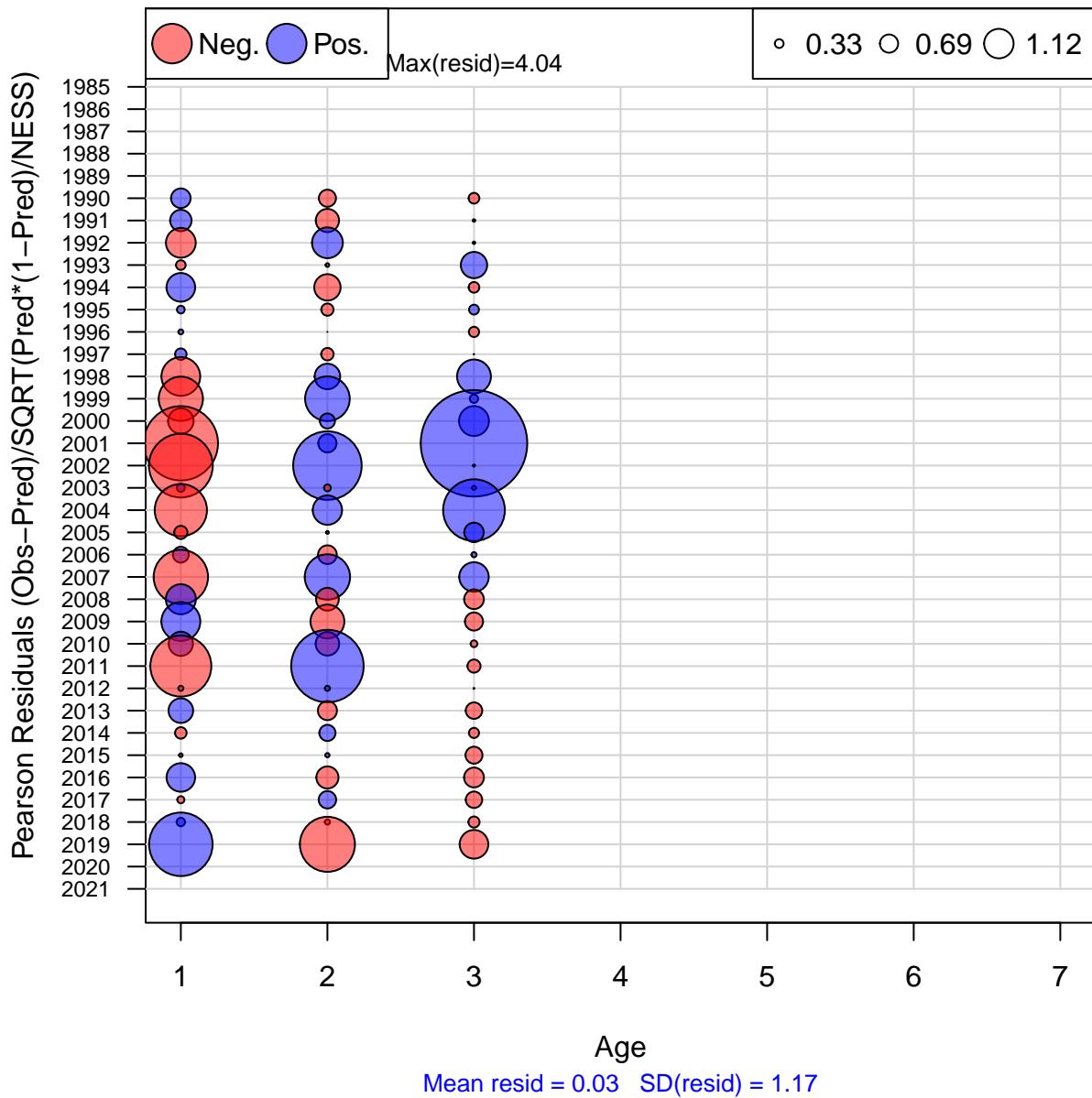
# Age Comp Residuals for Index 6 (PSIGN)



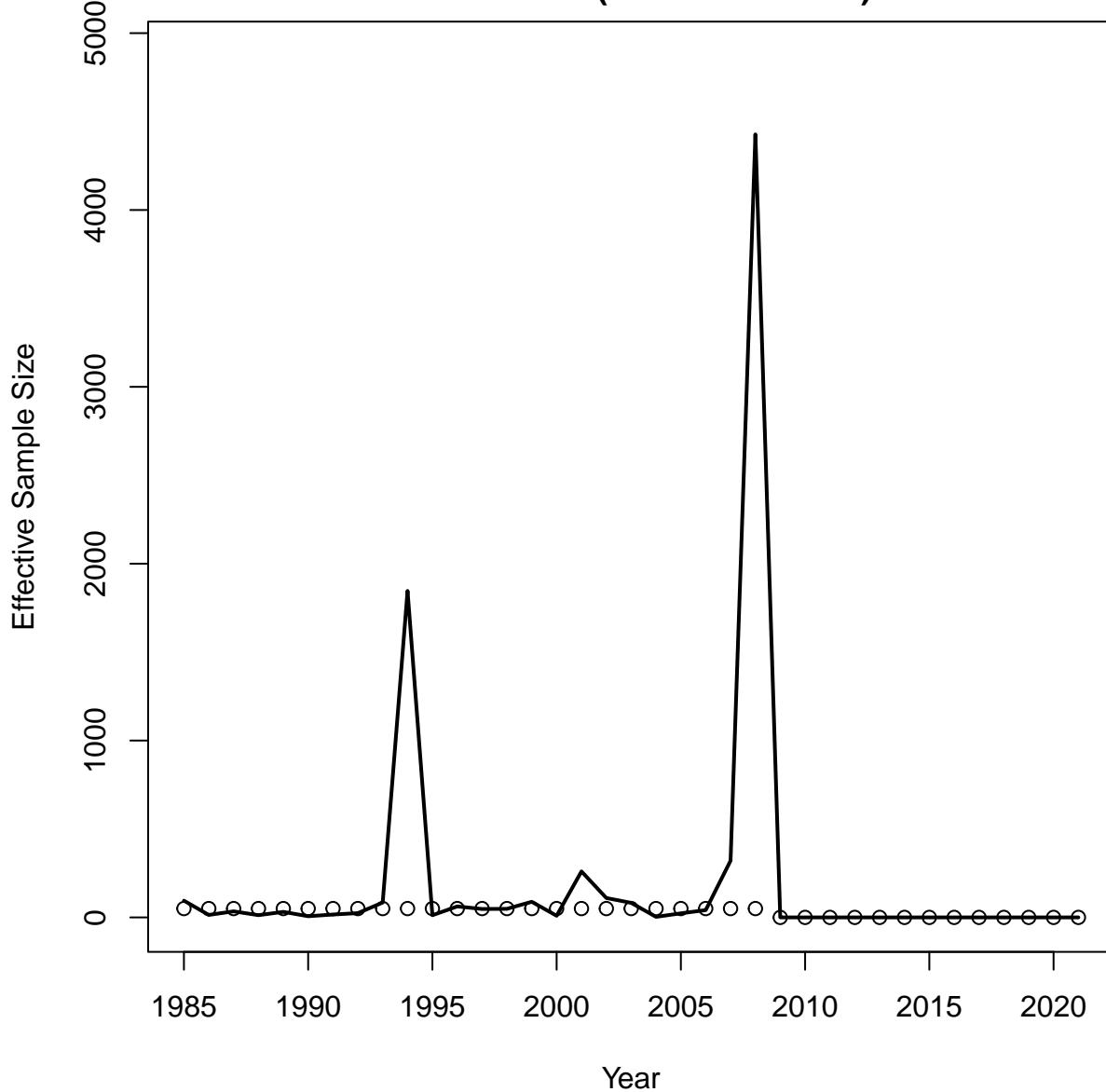
# Age Comp Residuals for Index 7 (CT Trawl)



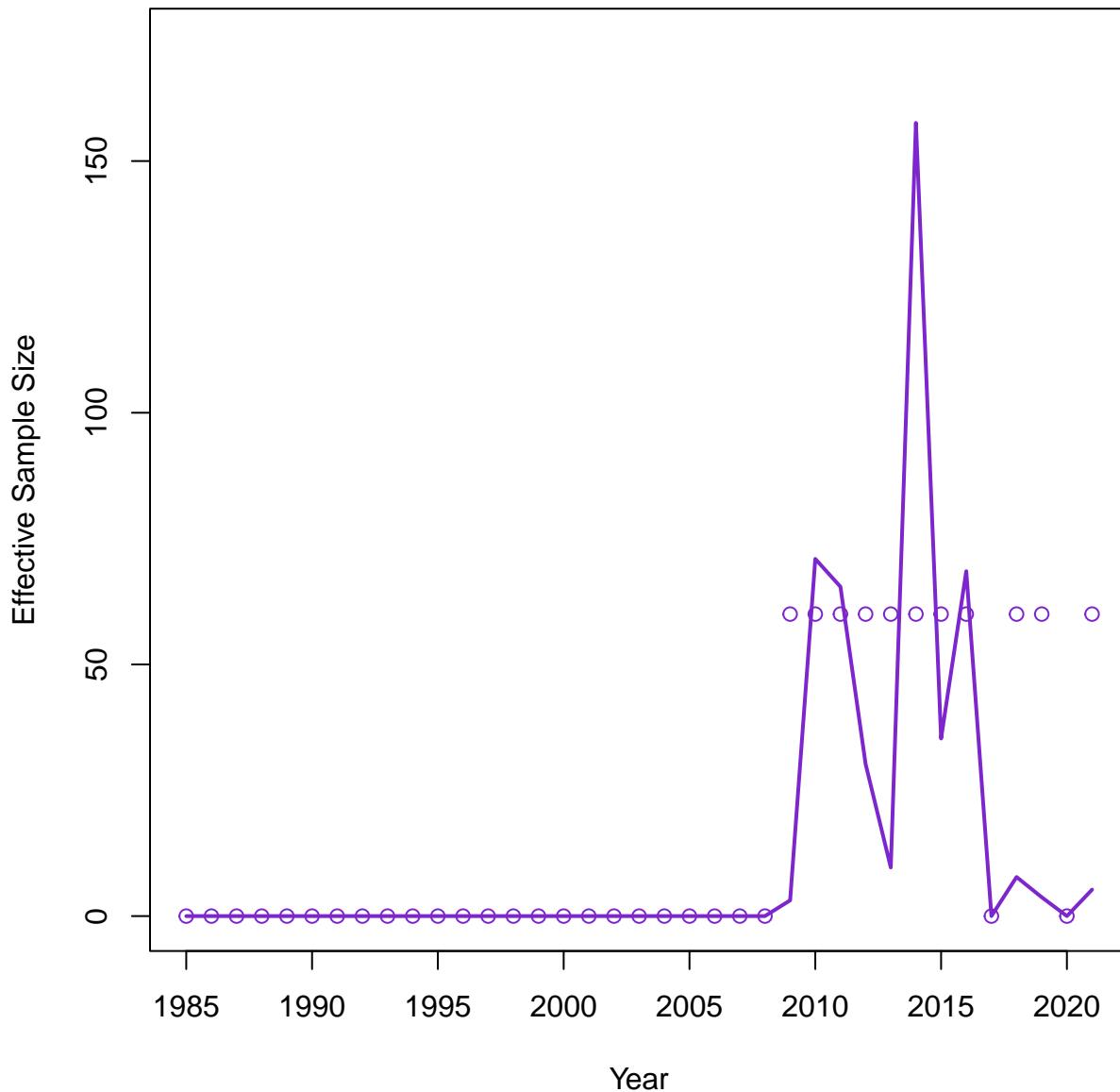
# Age Comp Residuals for Index 8 (NJ Trawl)



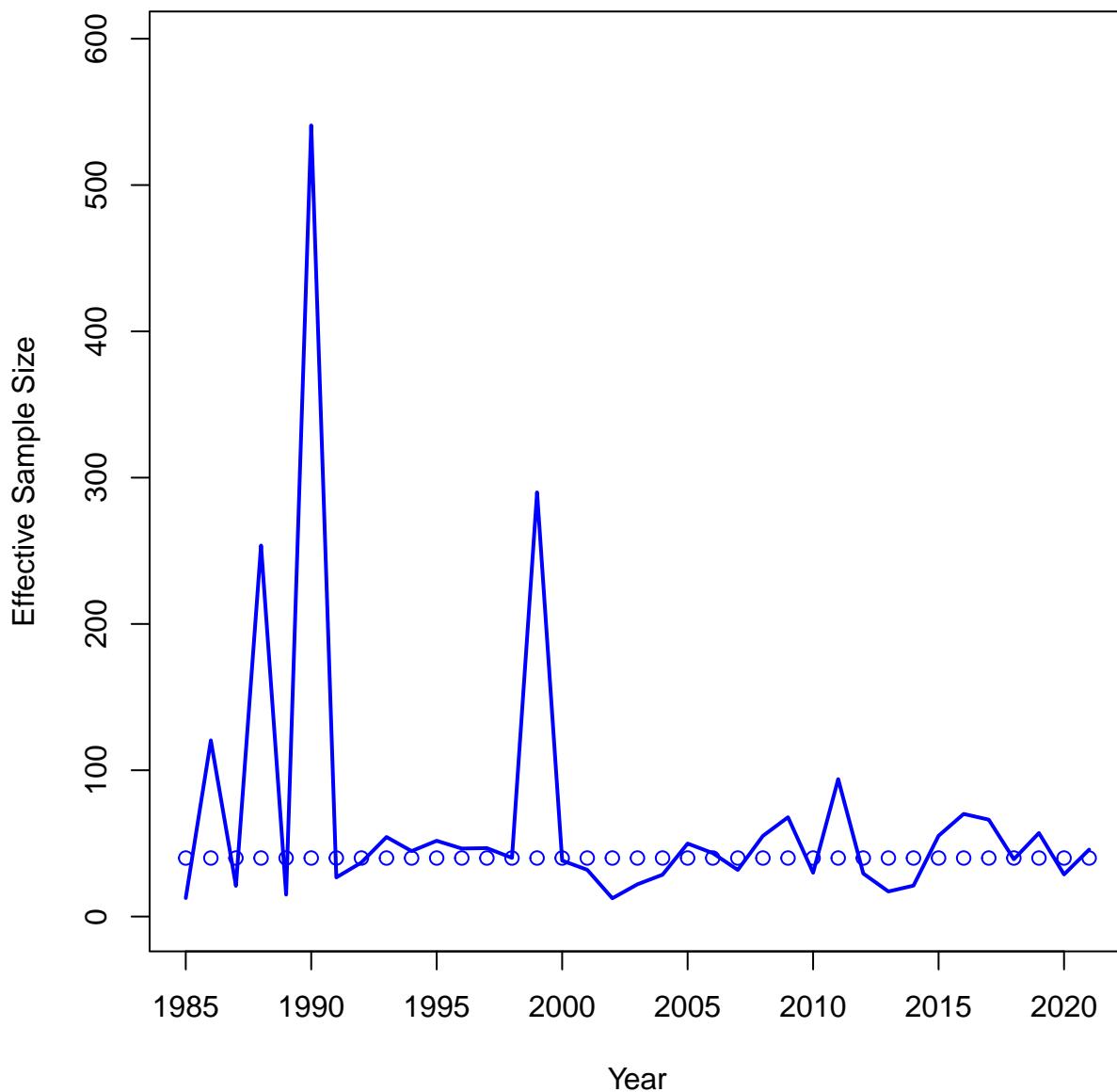
## Index Neff 1 (NEFSC Inshore)



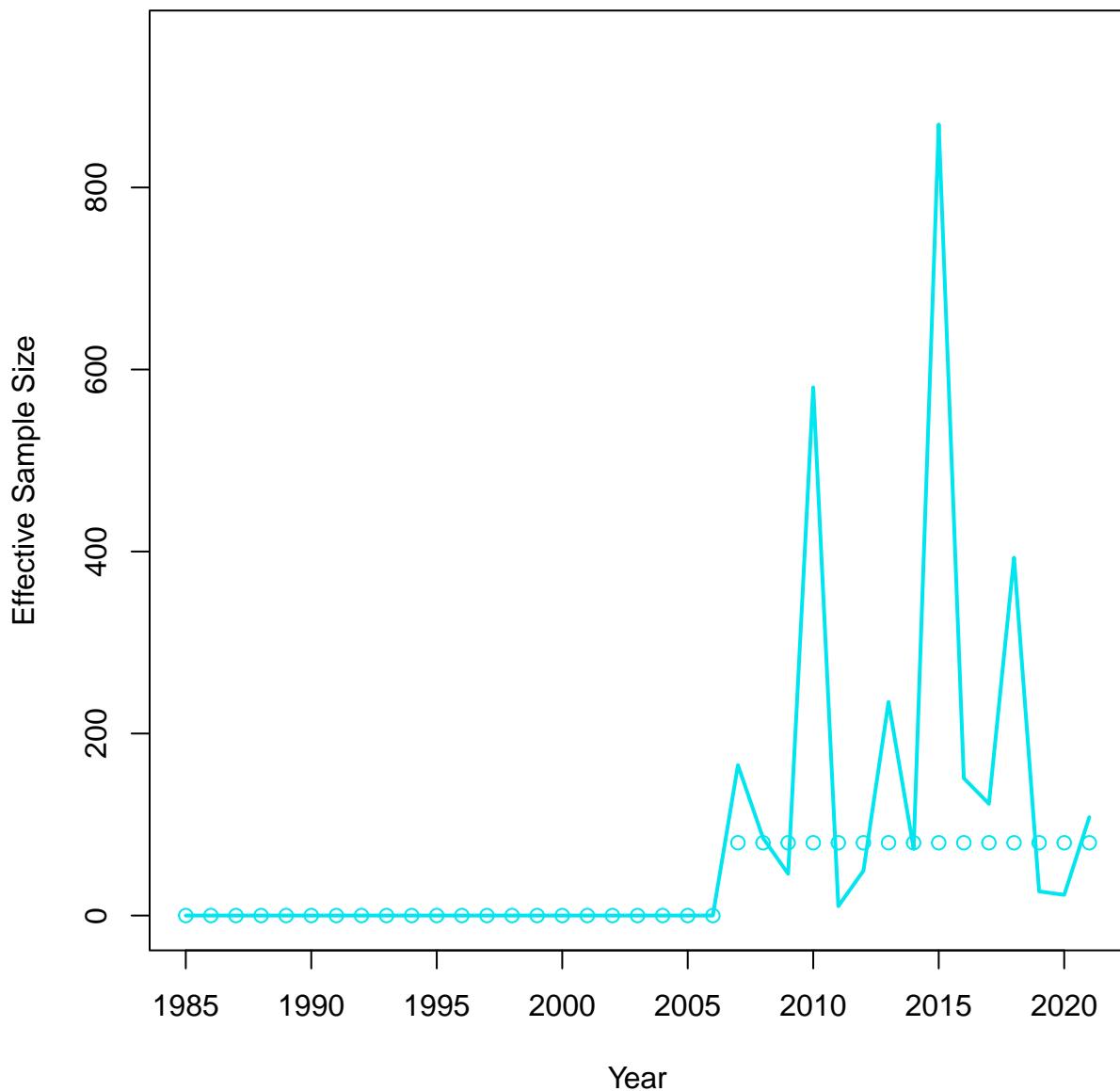
## Index Neff 2 (Bigelow)



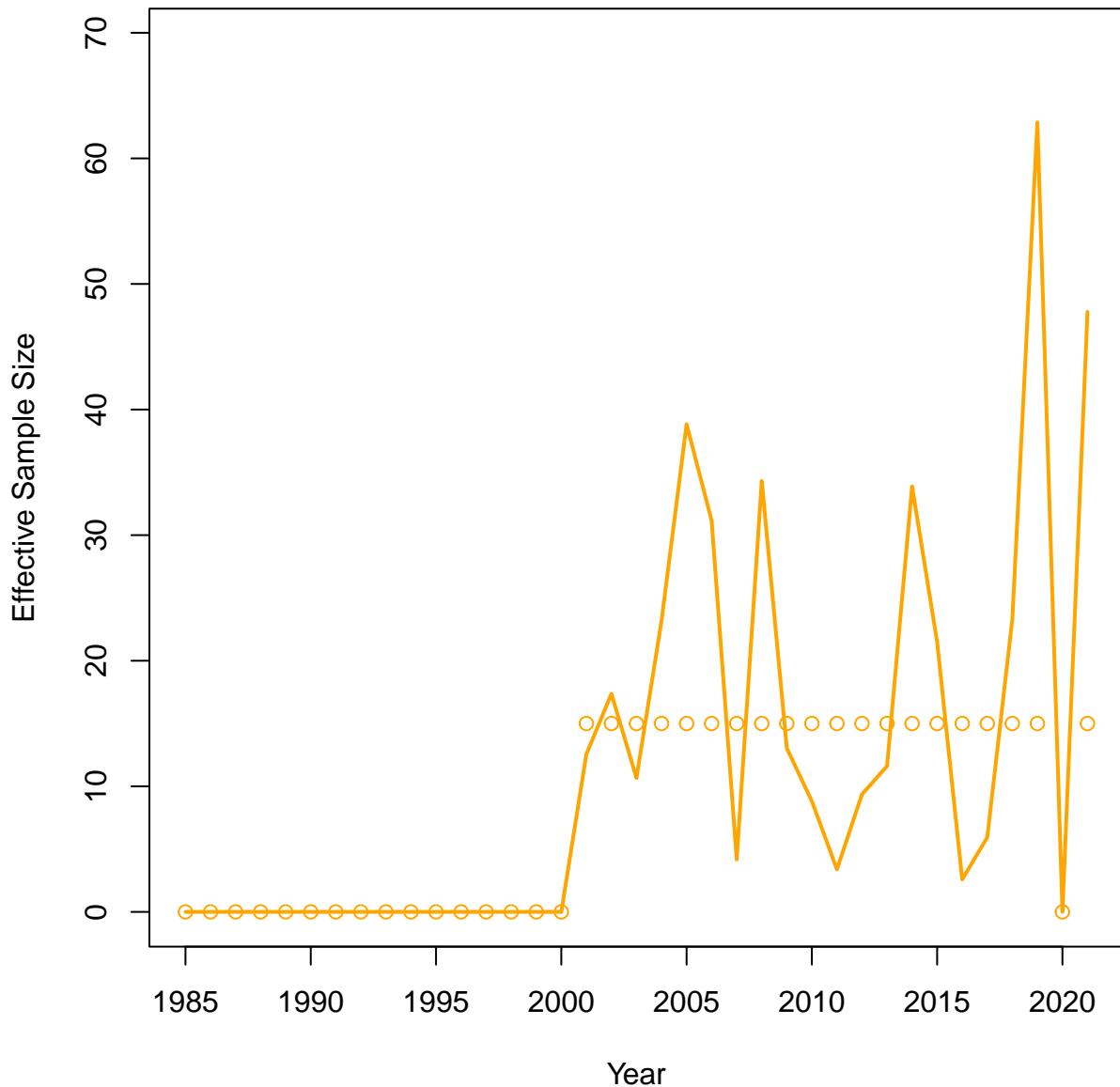
### Index Neff 3 (MRIP)



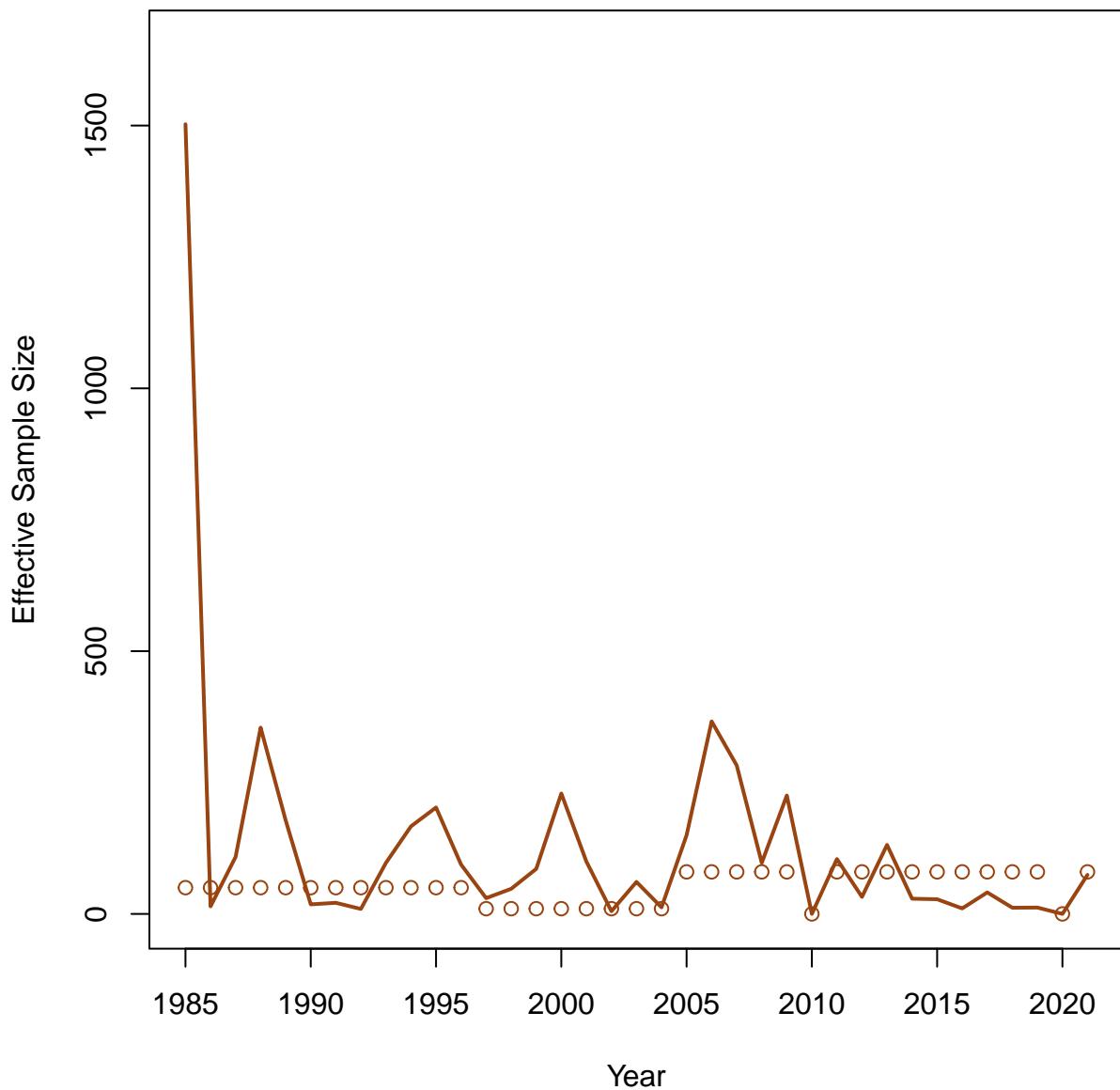
## Index Neff 4 (NEAMAP)



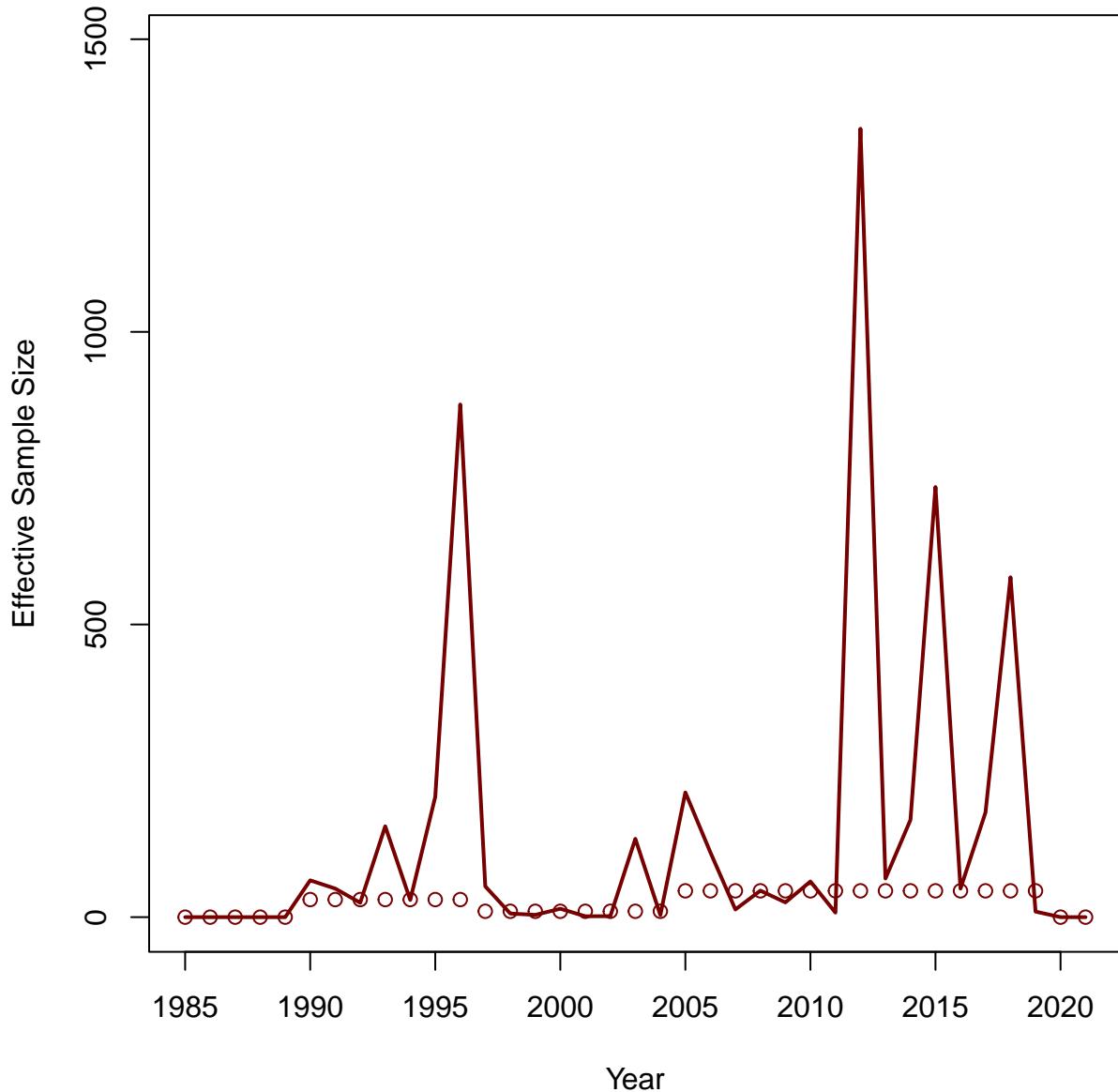
## Index Neff 6 (PSIGN)



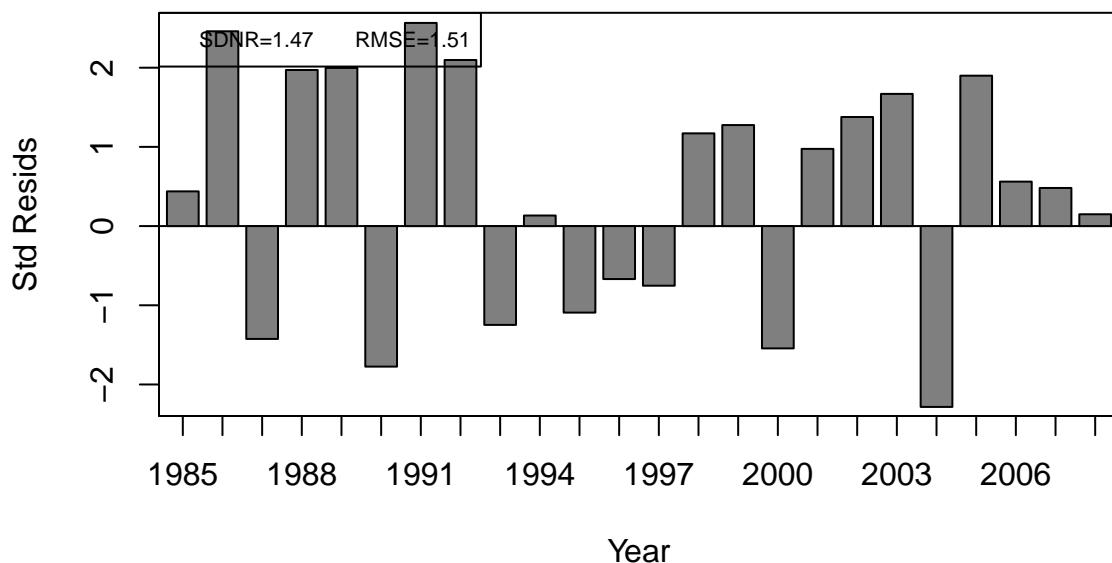
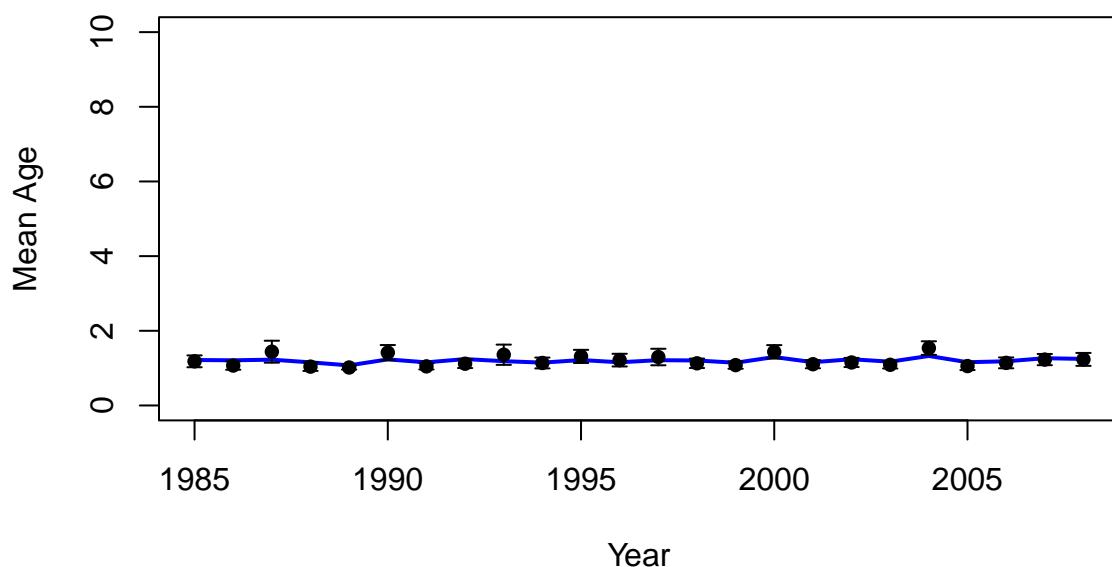
## Index Neff 7 (CT Trawl)



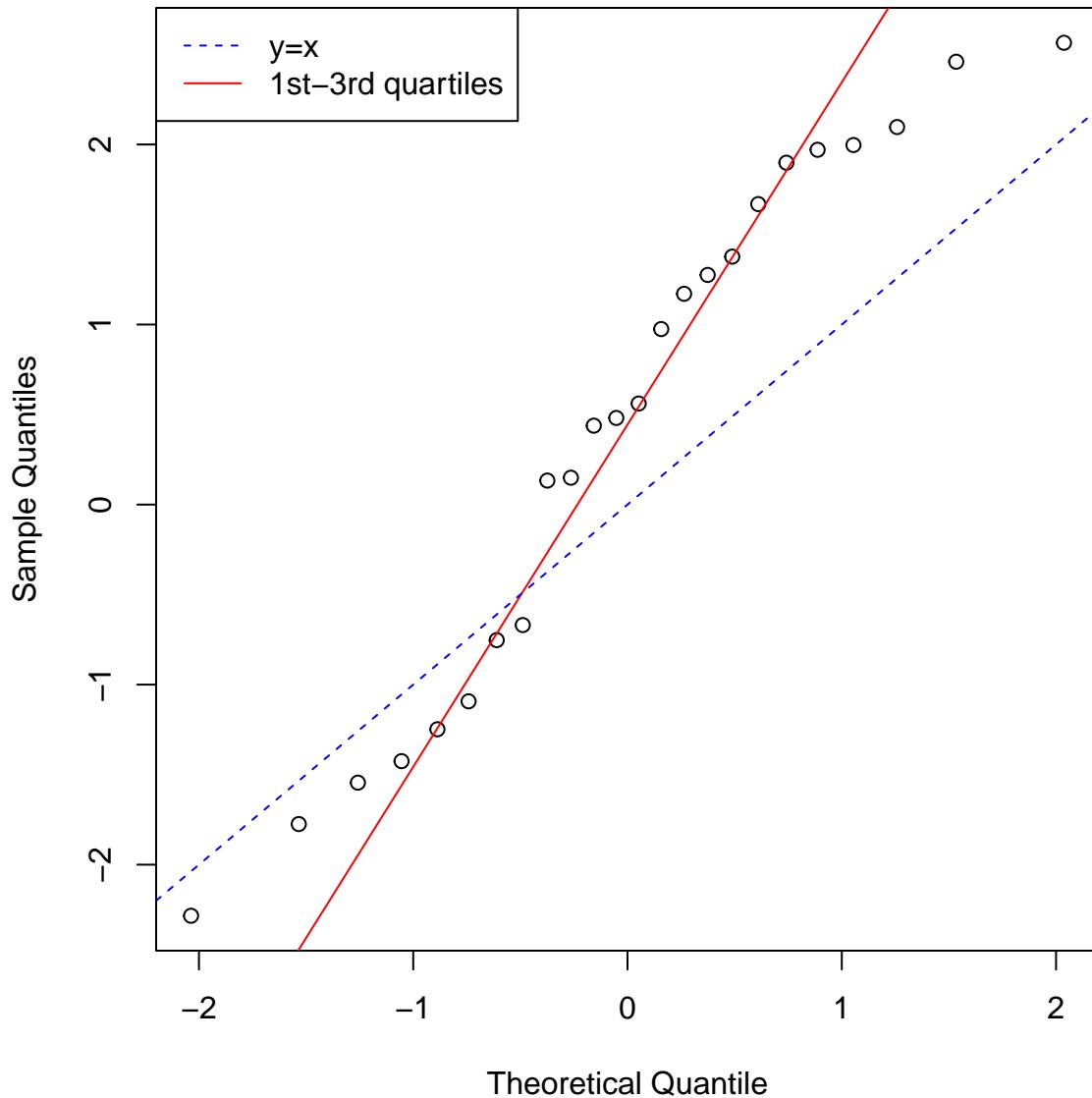
## Index Neff 8 (NJ Trawl)



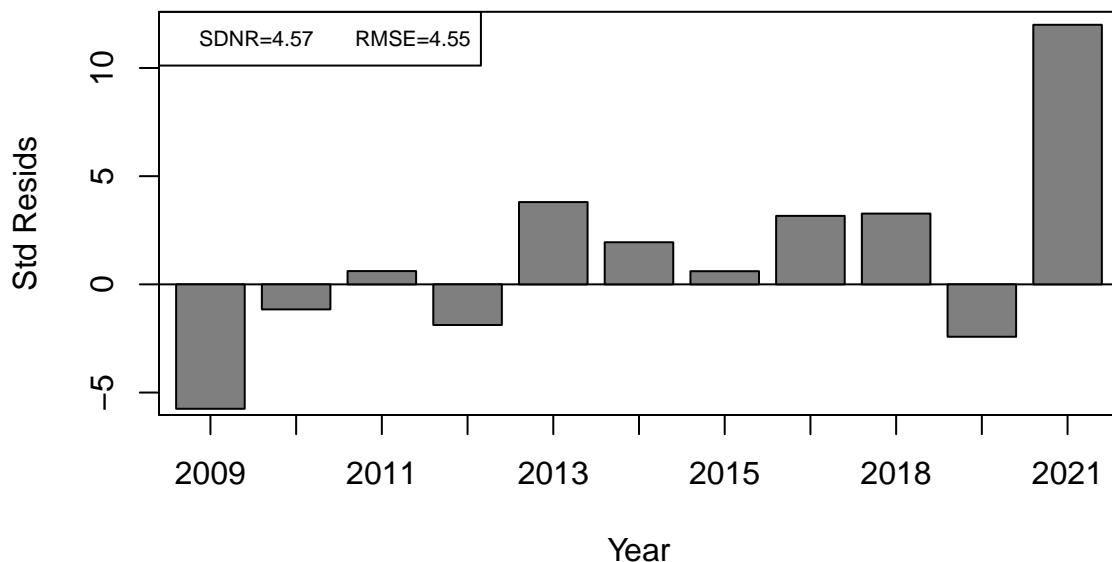
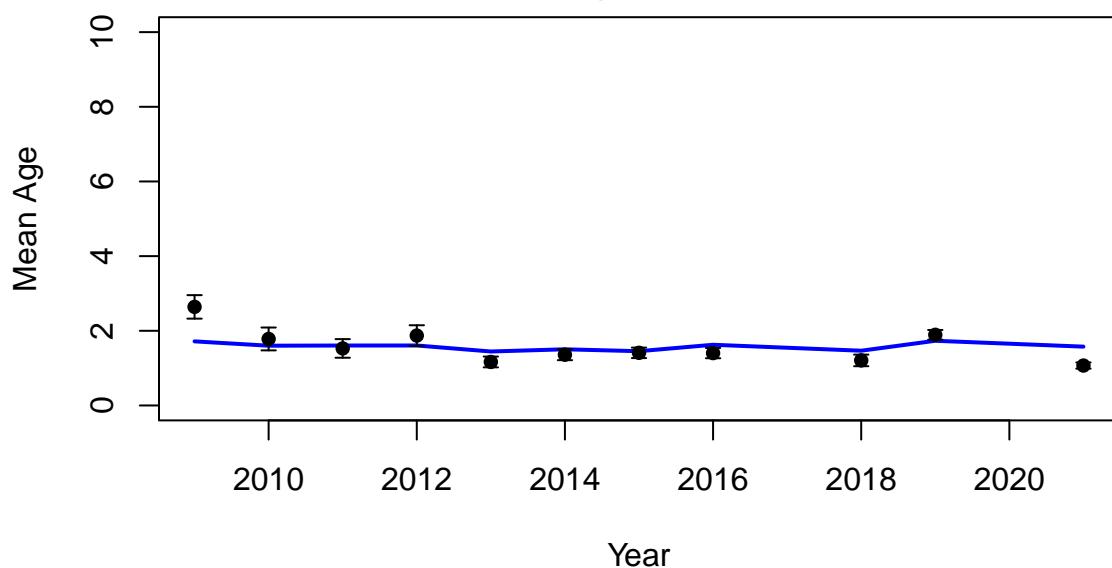
### Index 1 (NEFSC Inshore) ESS = 50



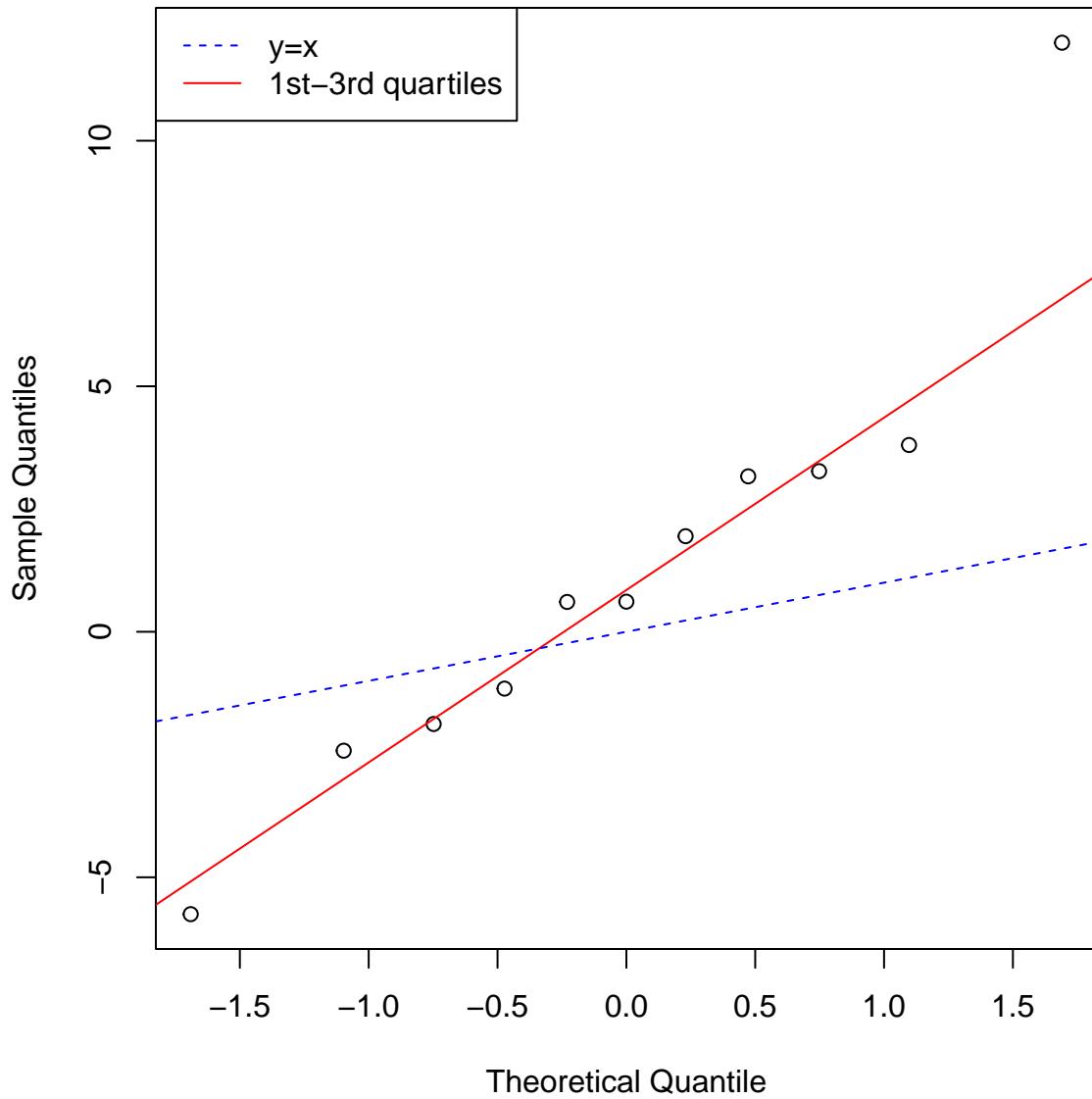
## Index 1 (NEFSC Inshore) ESS = 50



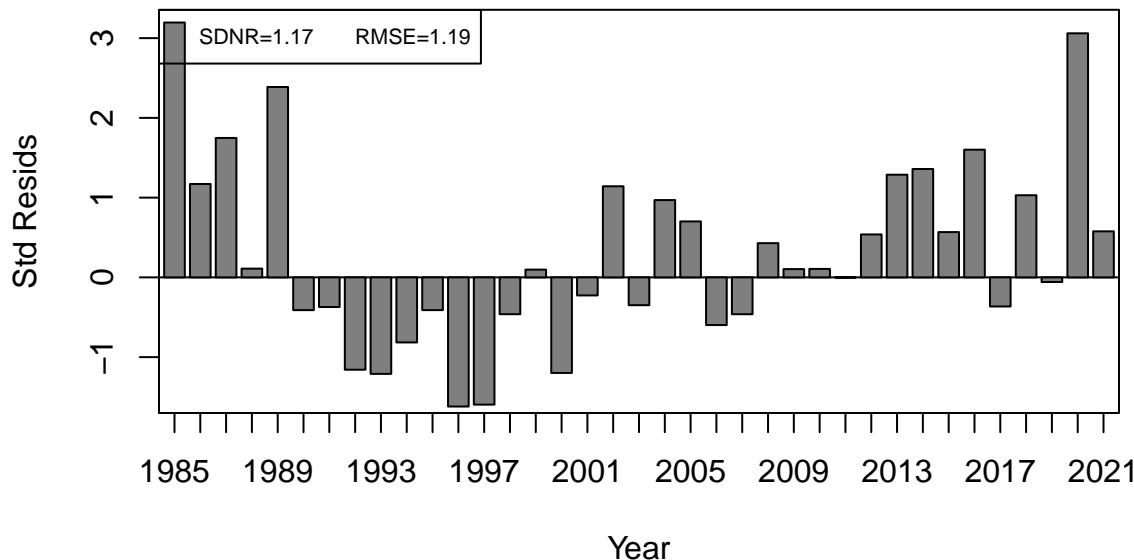
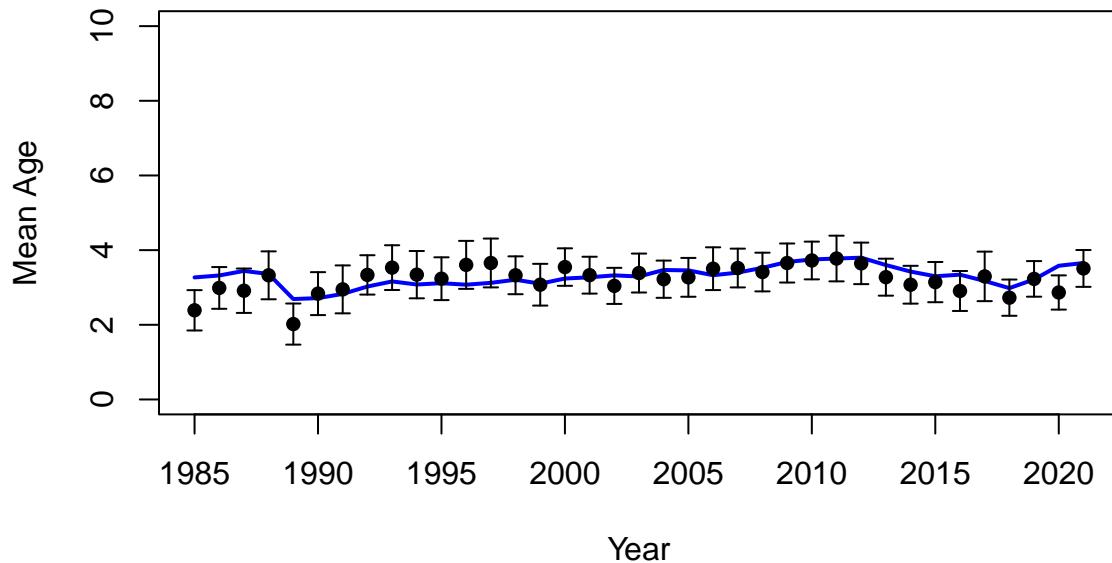
## Index 2 (Bigelow) ESS = 60



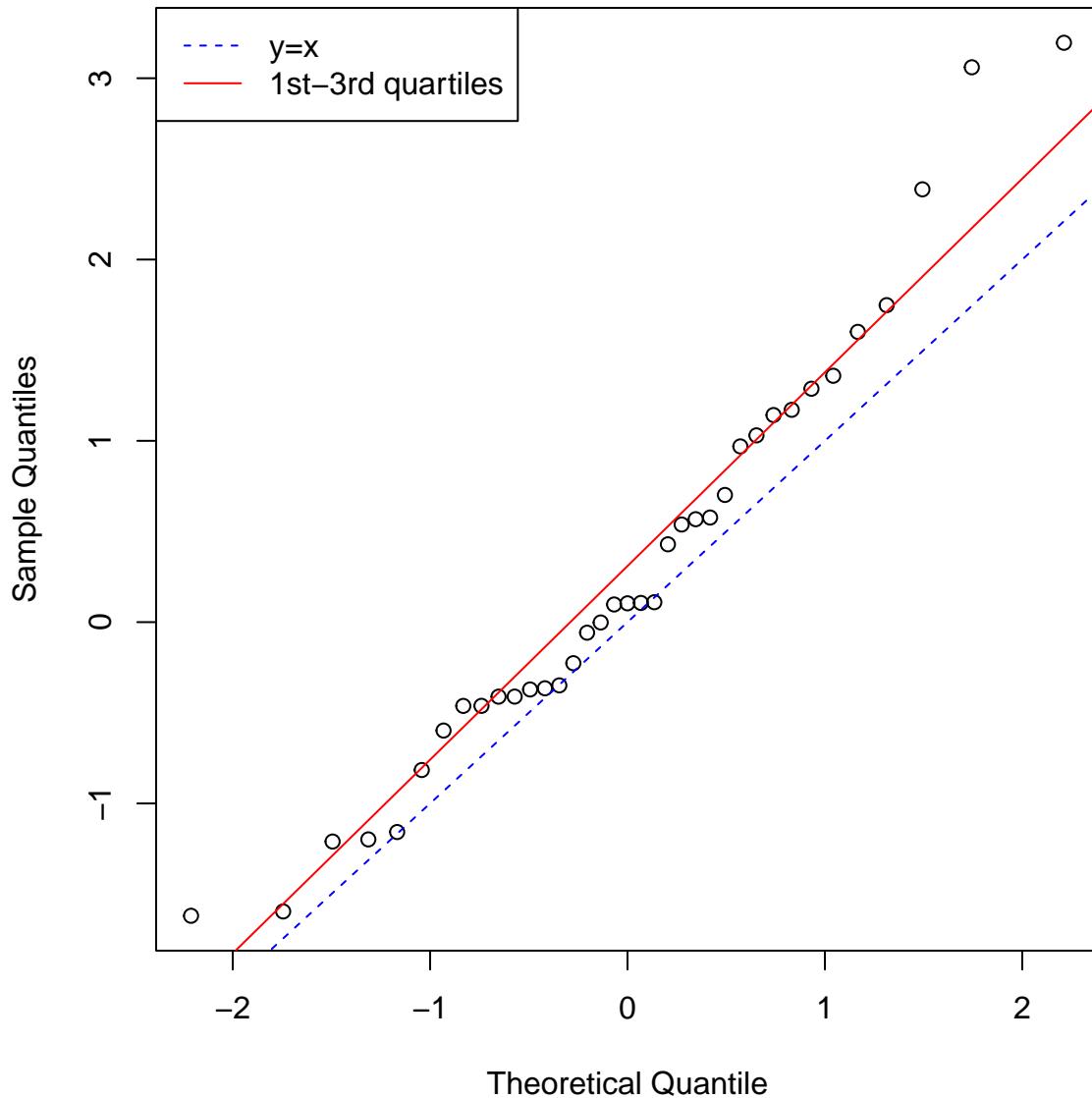
## Index 2 (Bigelow) ESS = 60



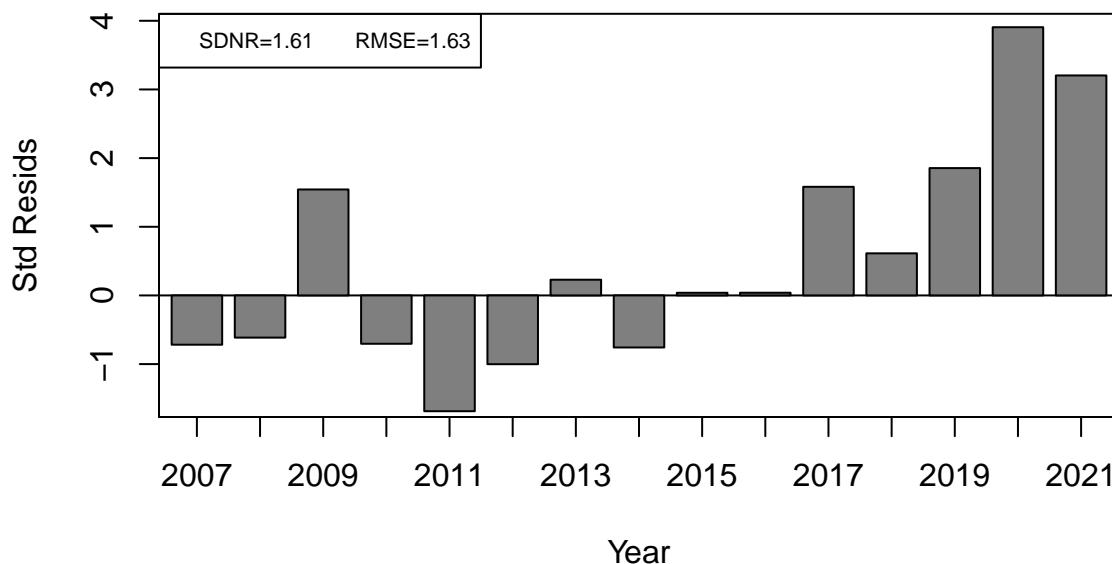
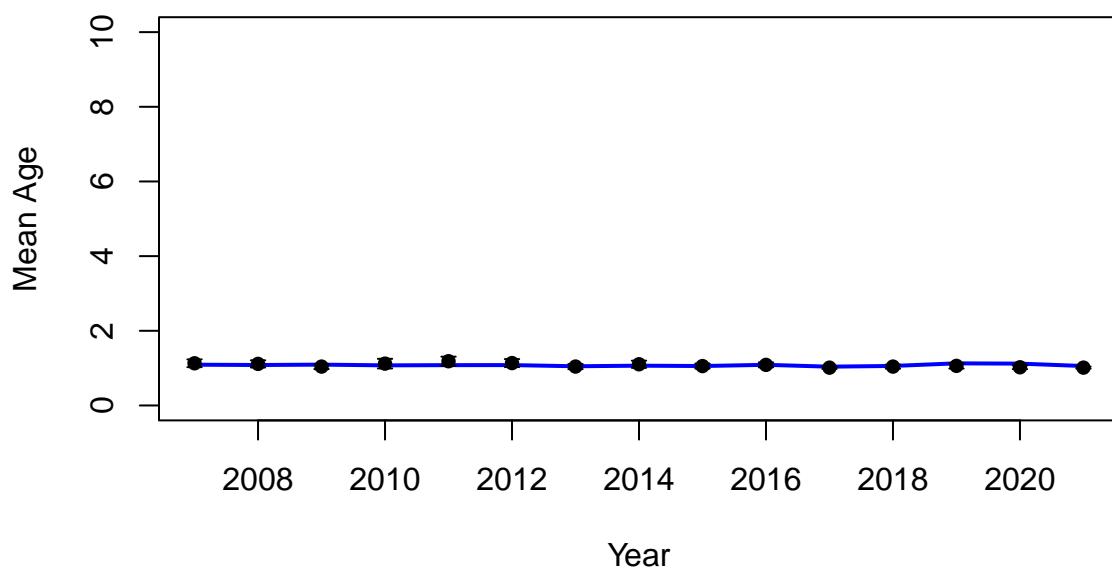
### Index 3 (MRIP) ESS = 40



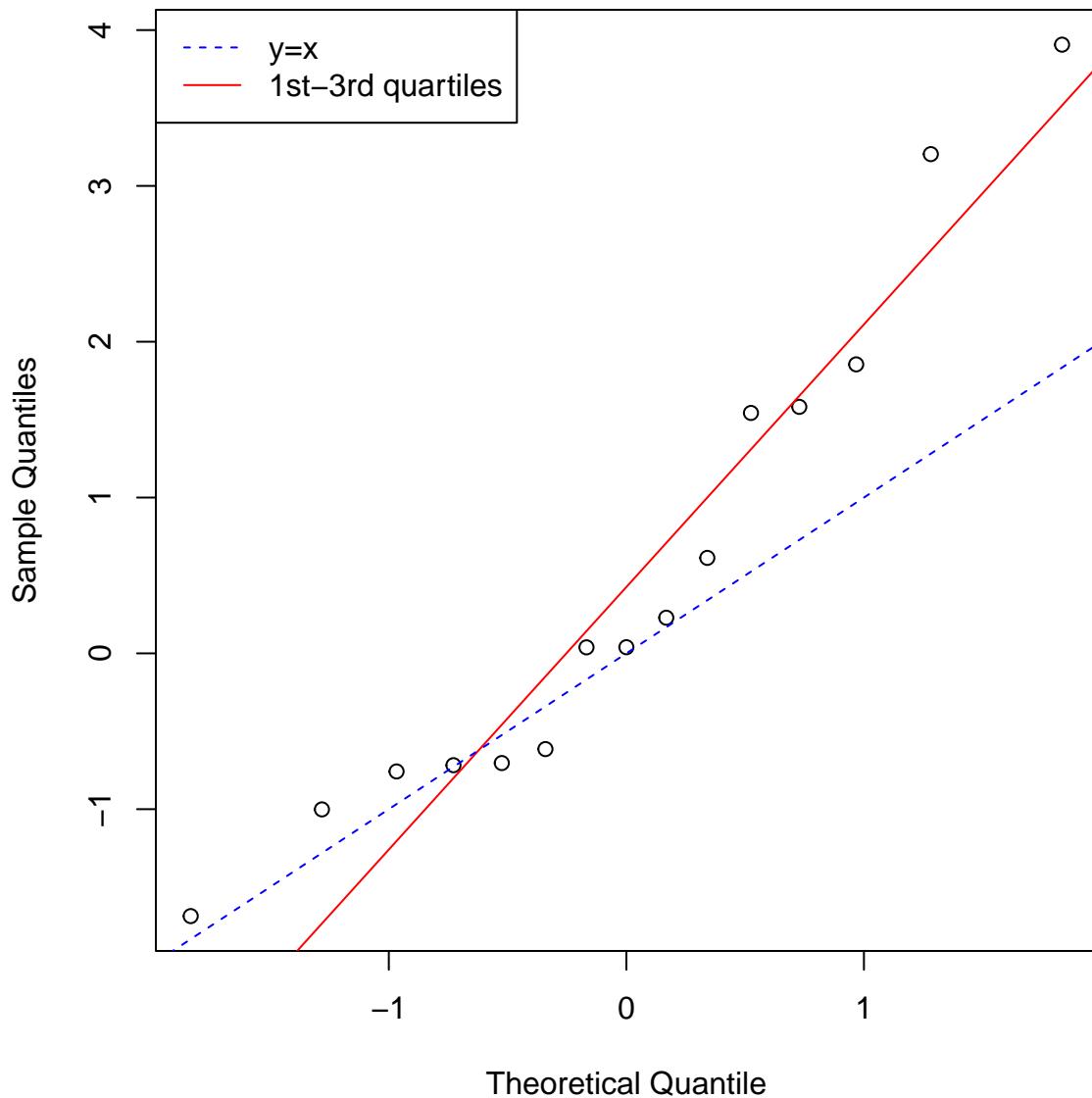
### Index 3 (MRIP) ESS = 40



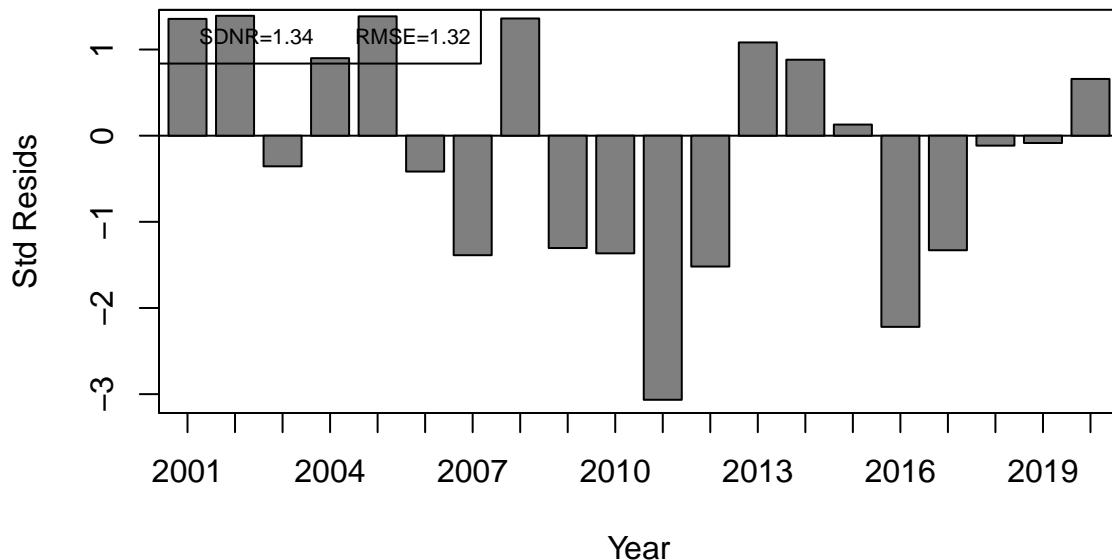
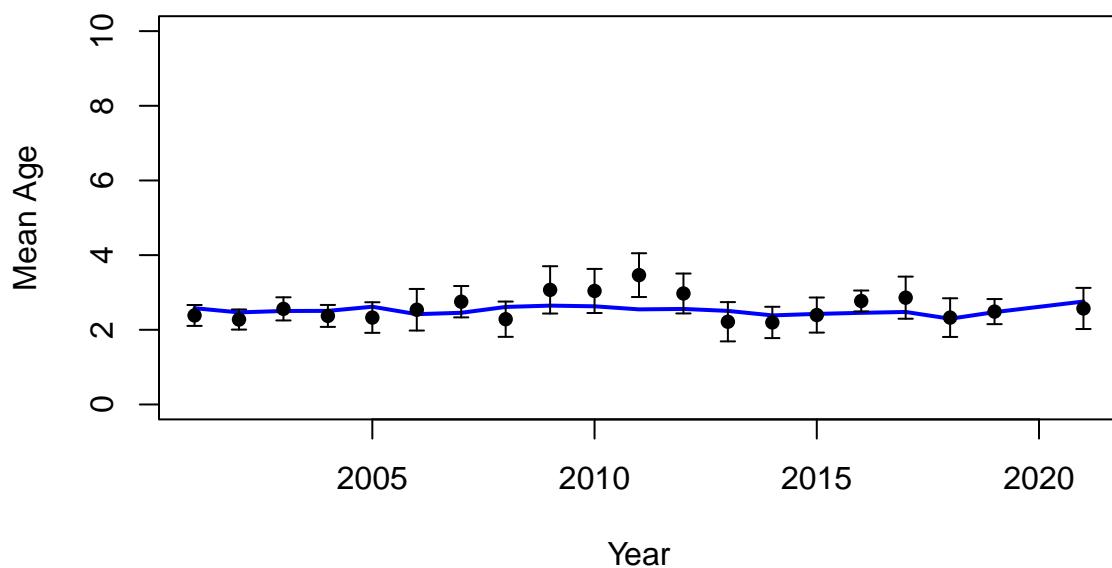
## Index 4 (NEAMAP) ESS = 80



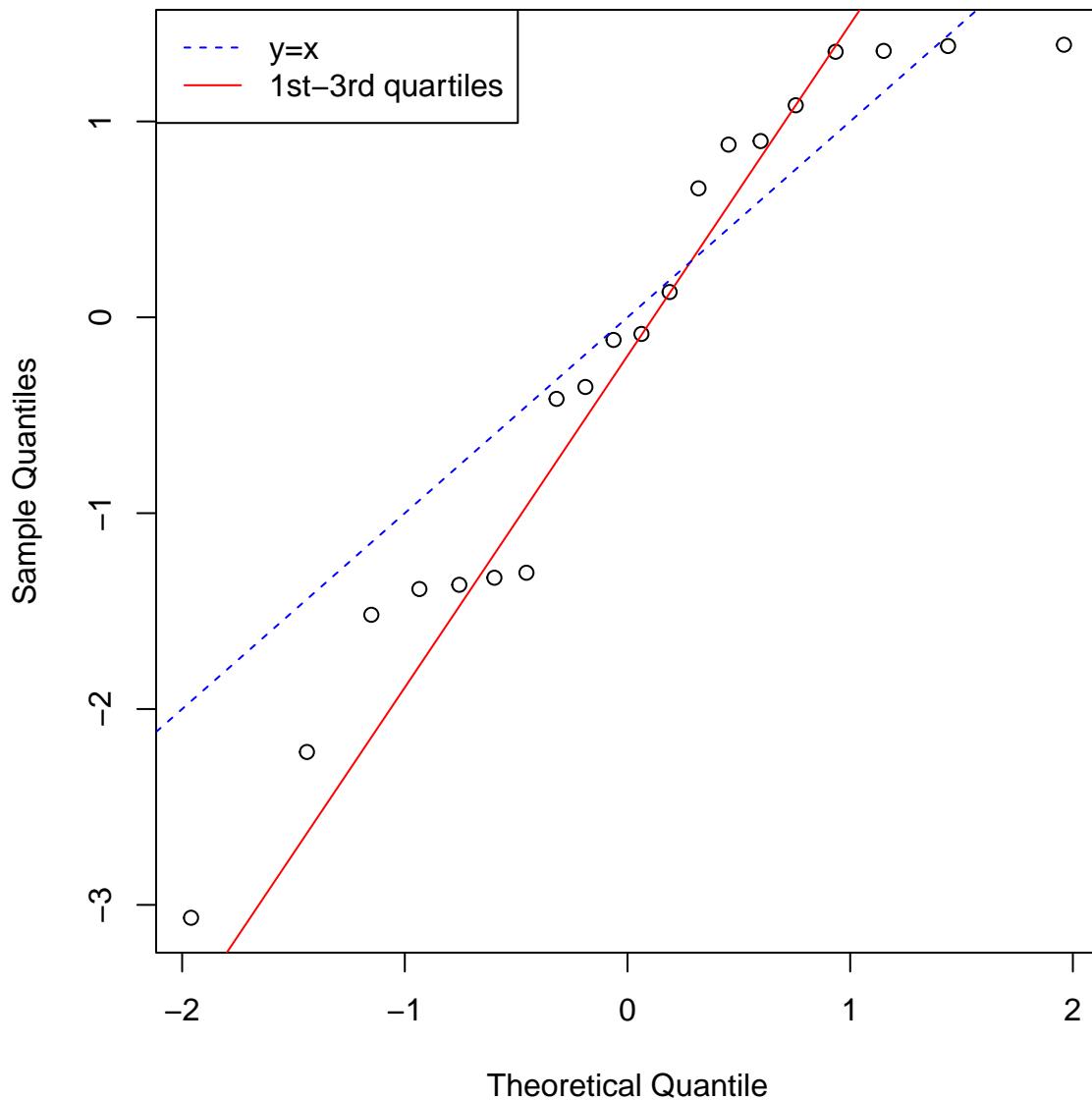
## Index 4 (NEAMAP) ESS = 80



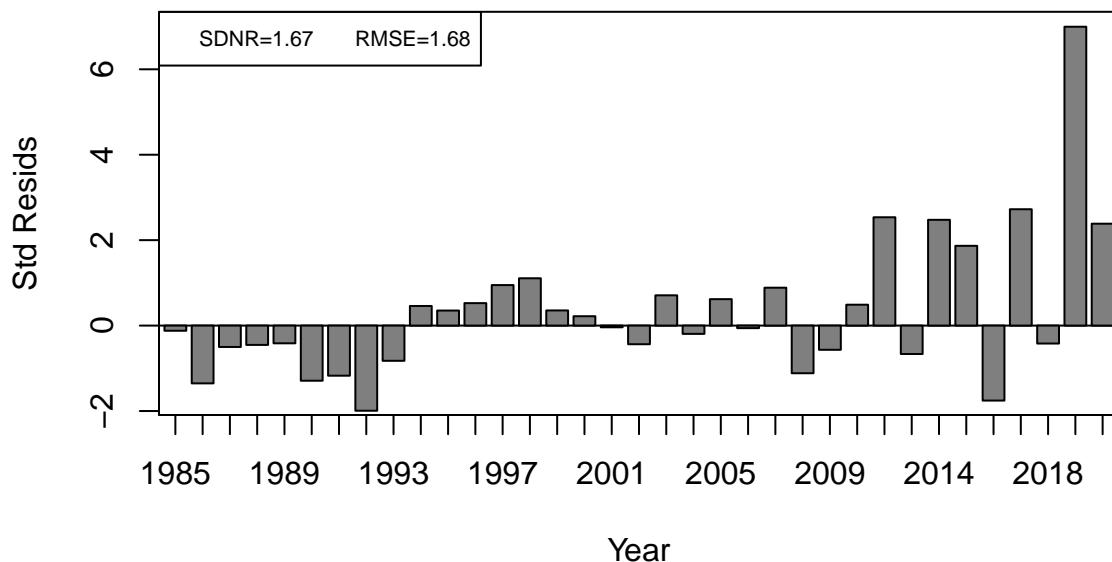
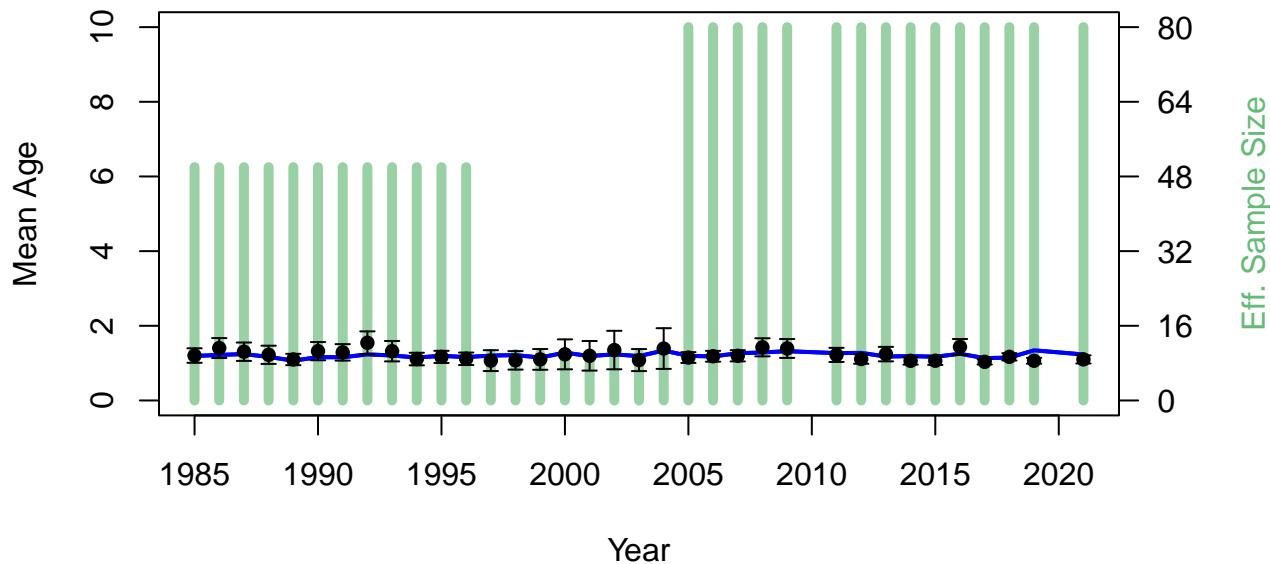
## Index 6 (PSIGN) ESS = 15



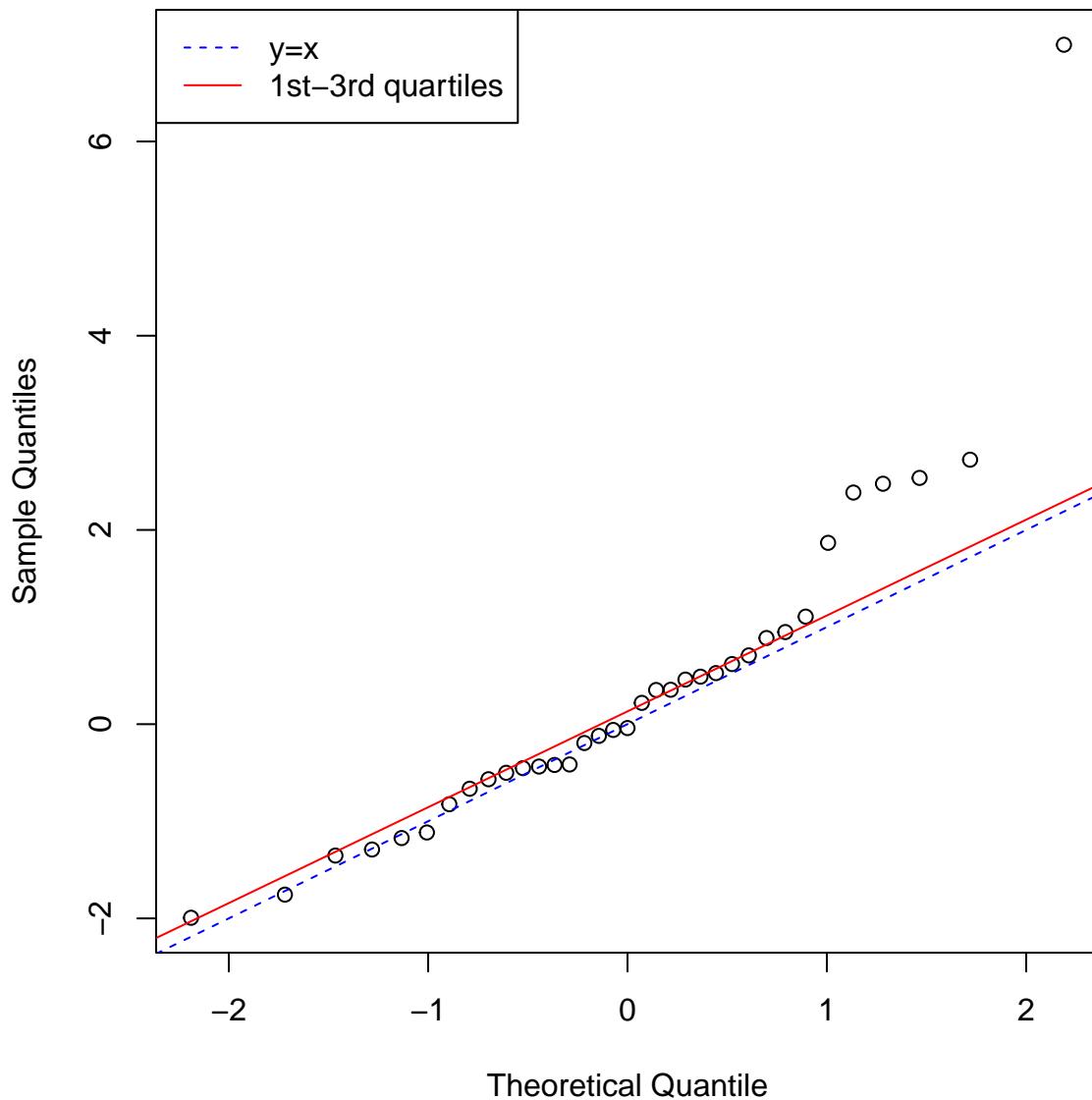
## Index 6 (PSIGN) ESS = 15



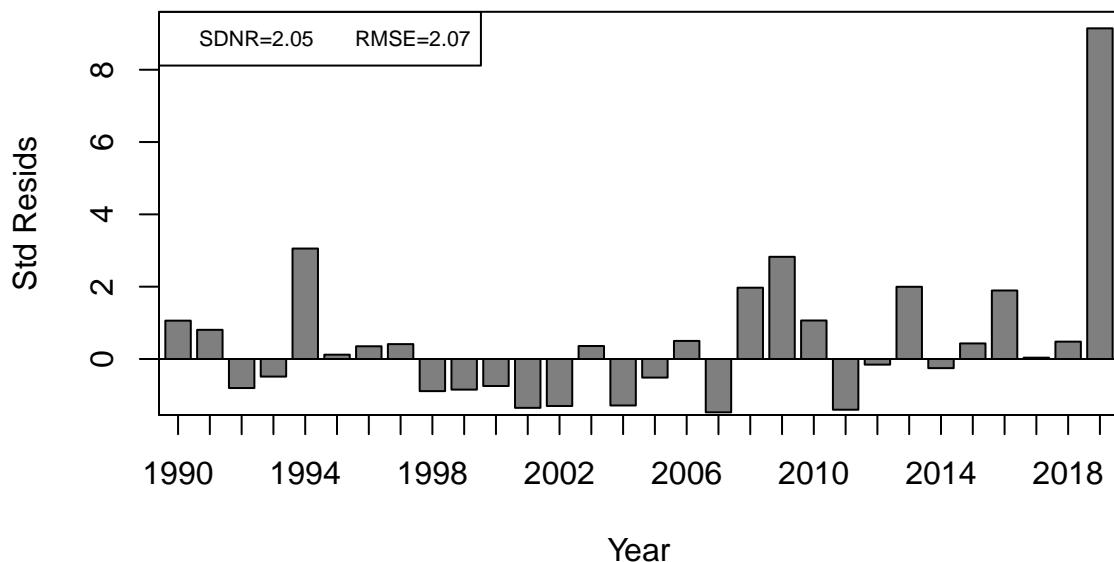
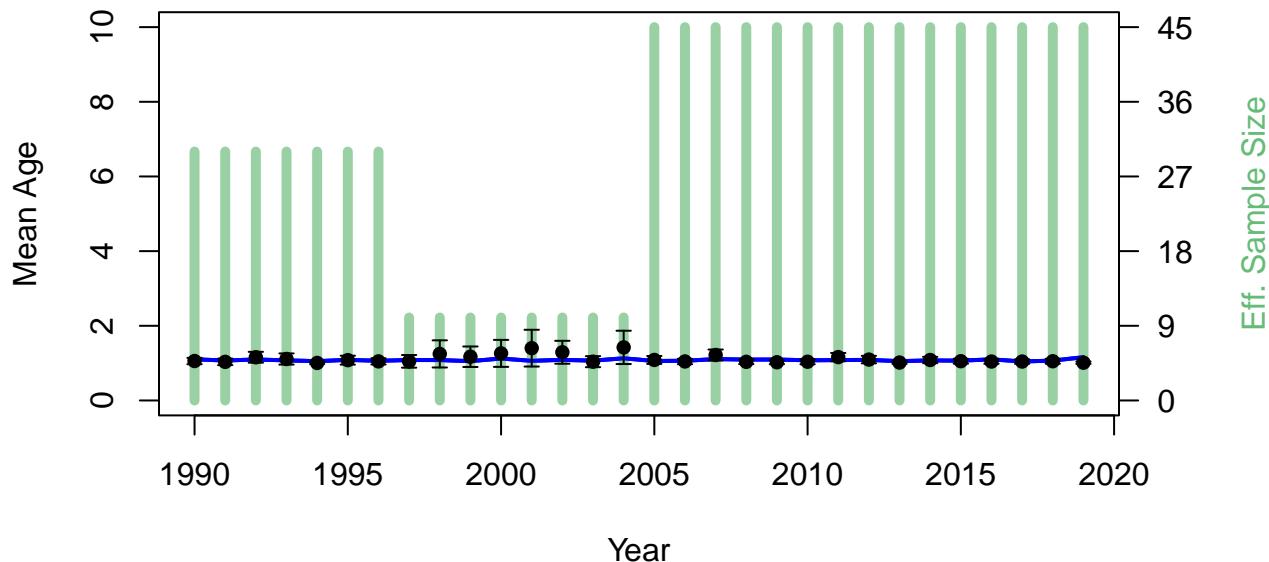
## Index 7 (CT Trawl)



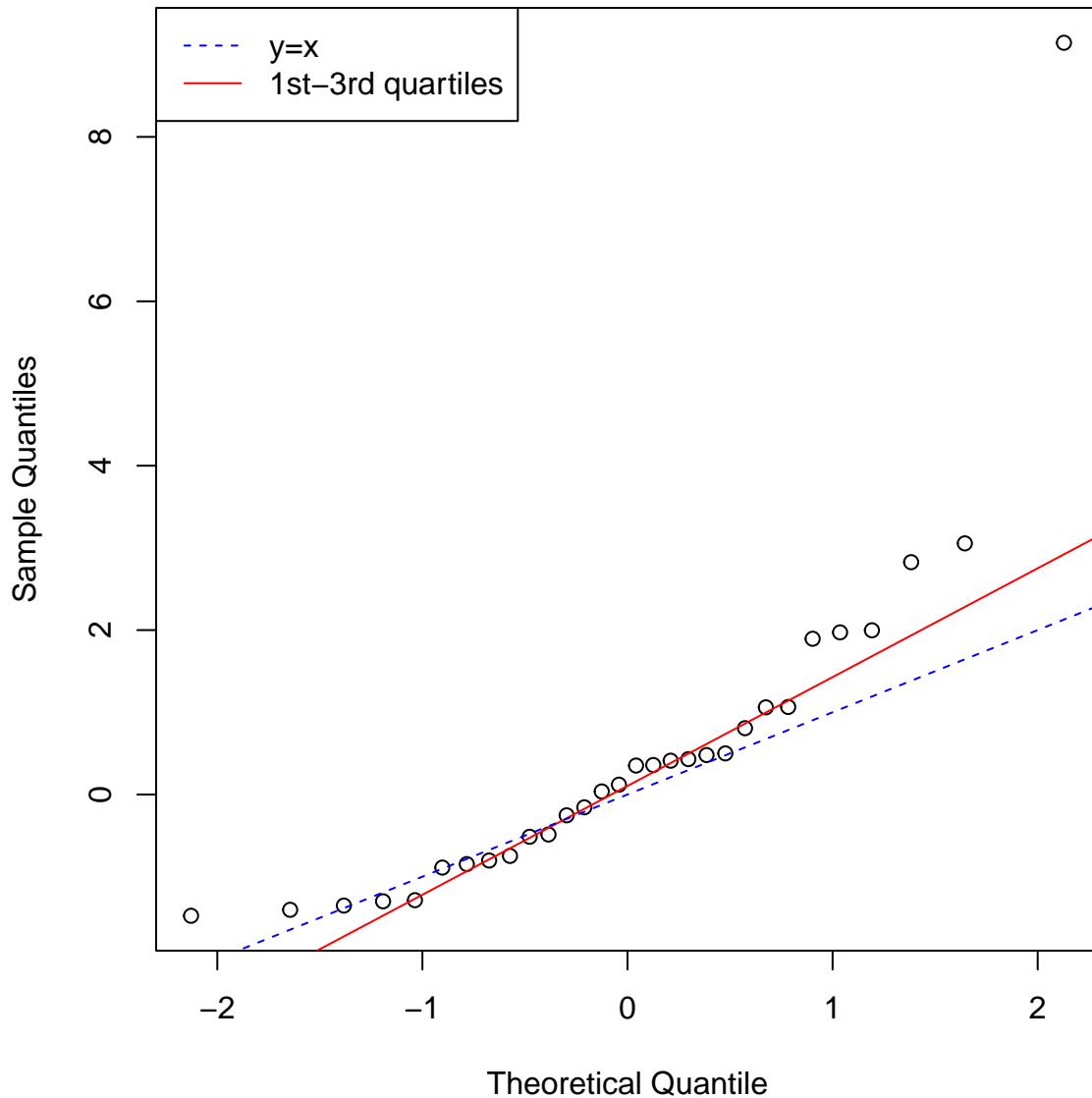
## Index 7 (CT Trawl)



## Index 8 (NJ Trawl)



## Index 8 (NJ Trawl)

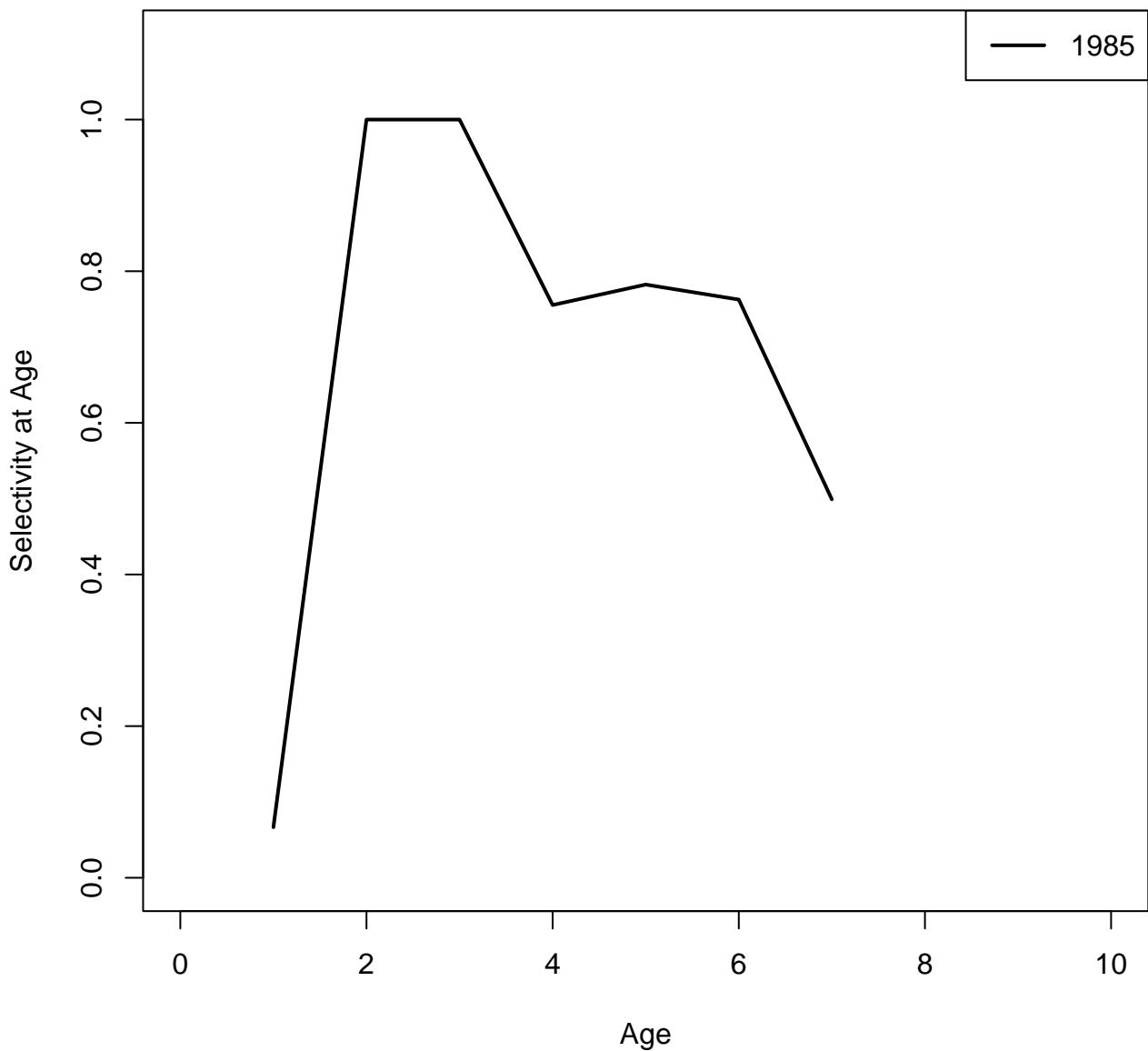


# BF07

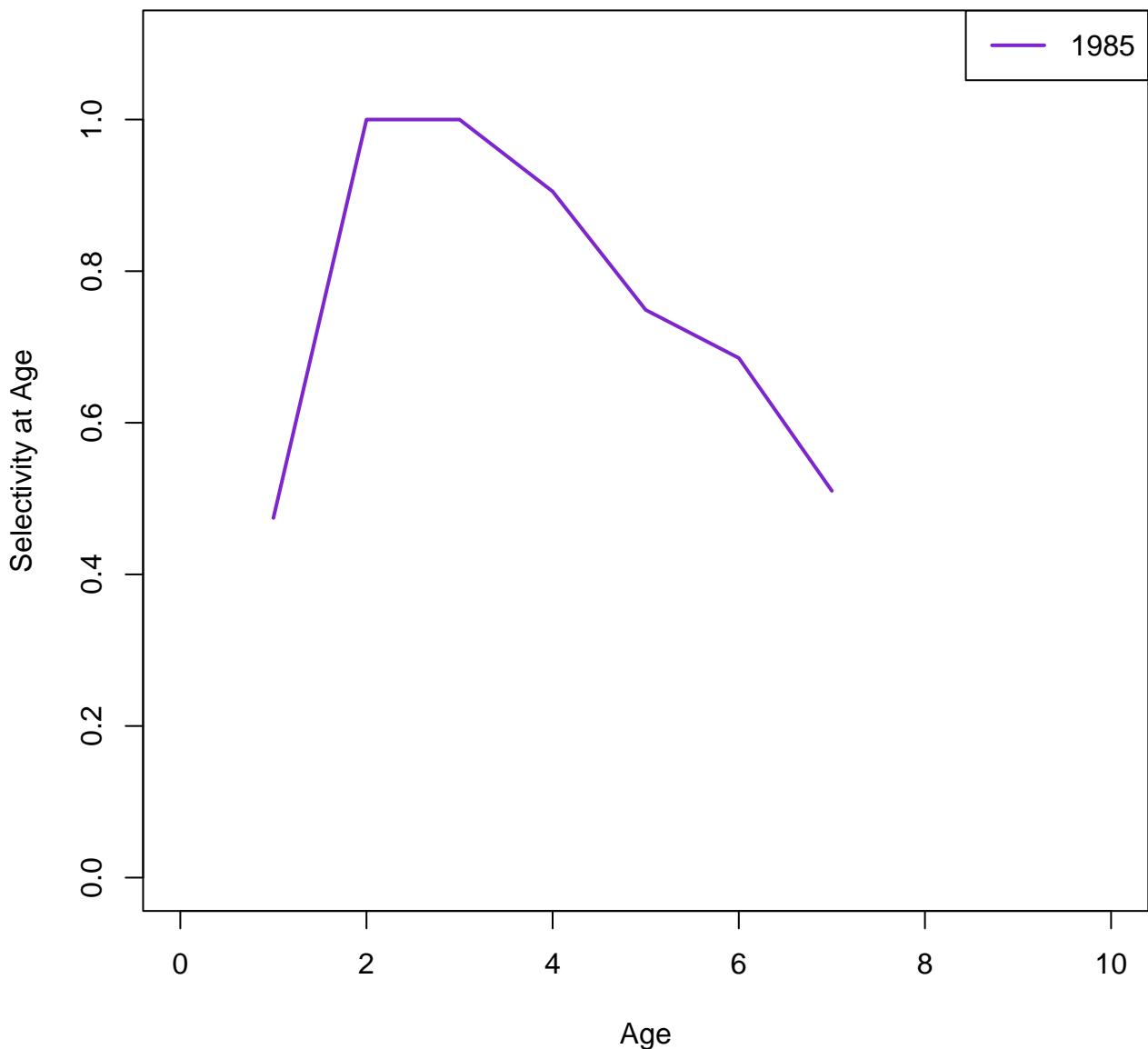
Update all fishery data, new L-W parameters, new  
recreational discard mortality, add commercial discards

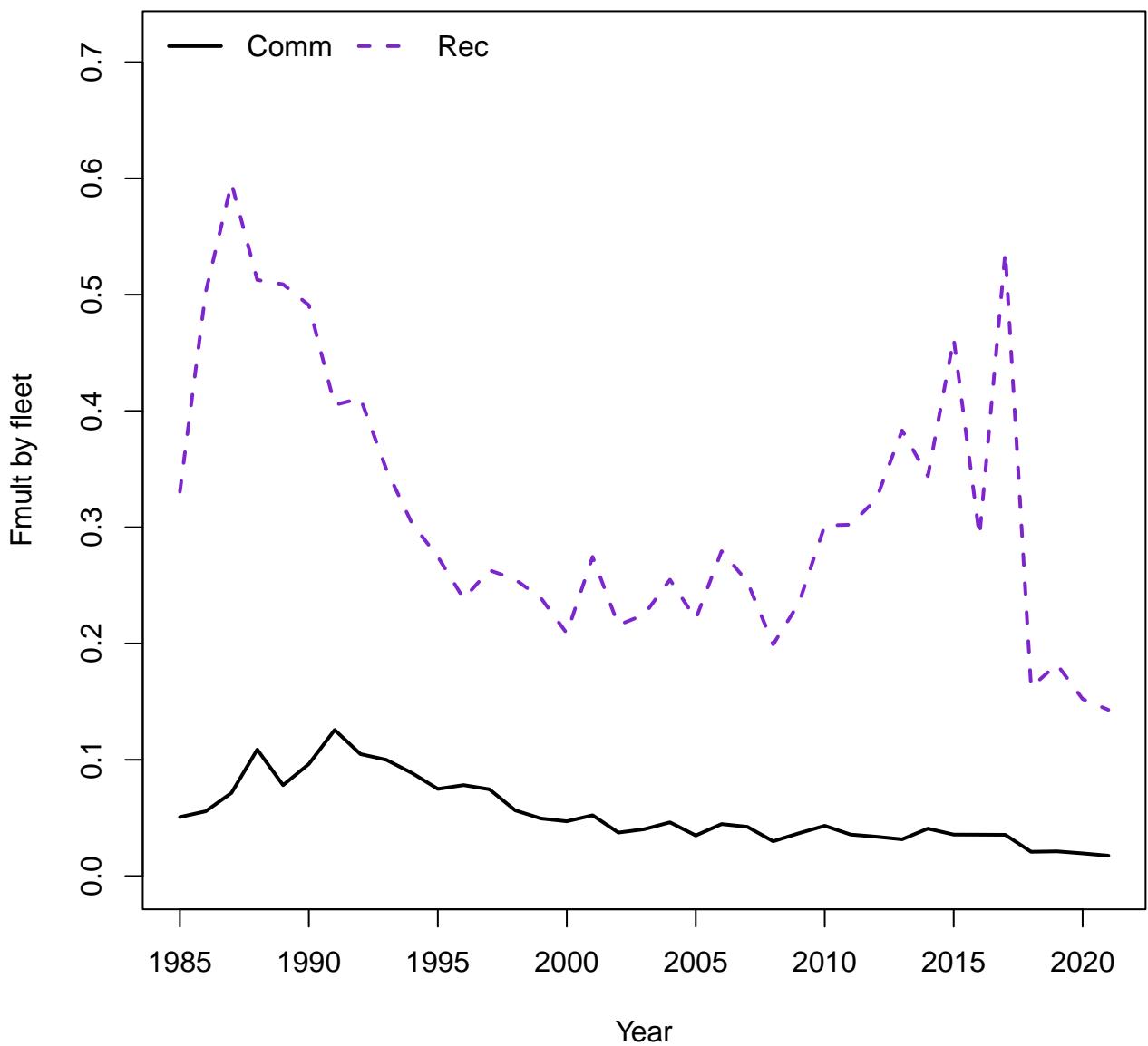
## RESULTS PLOTS

## Fleet 1 (Comm)

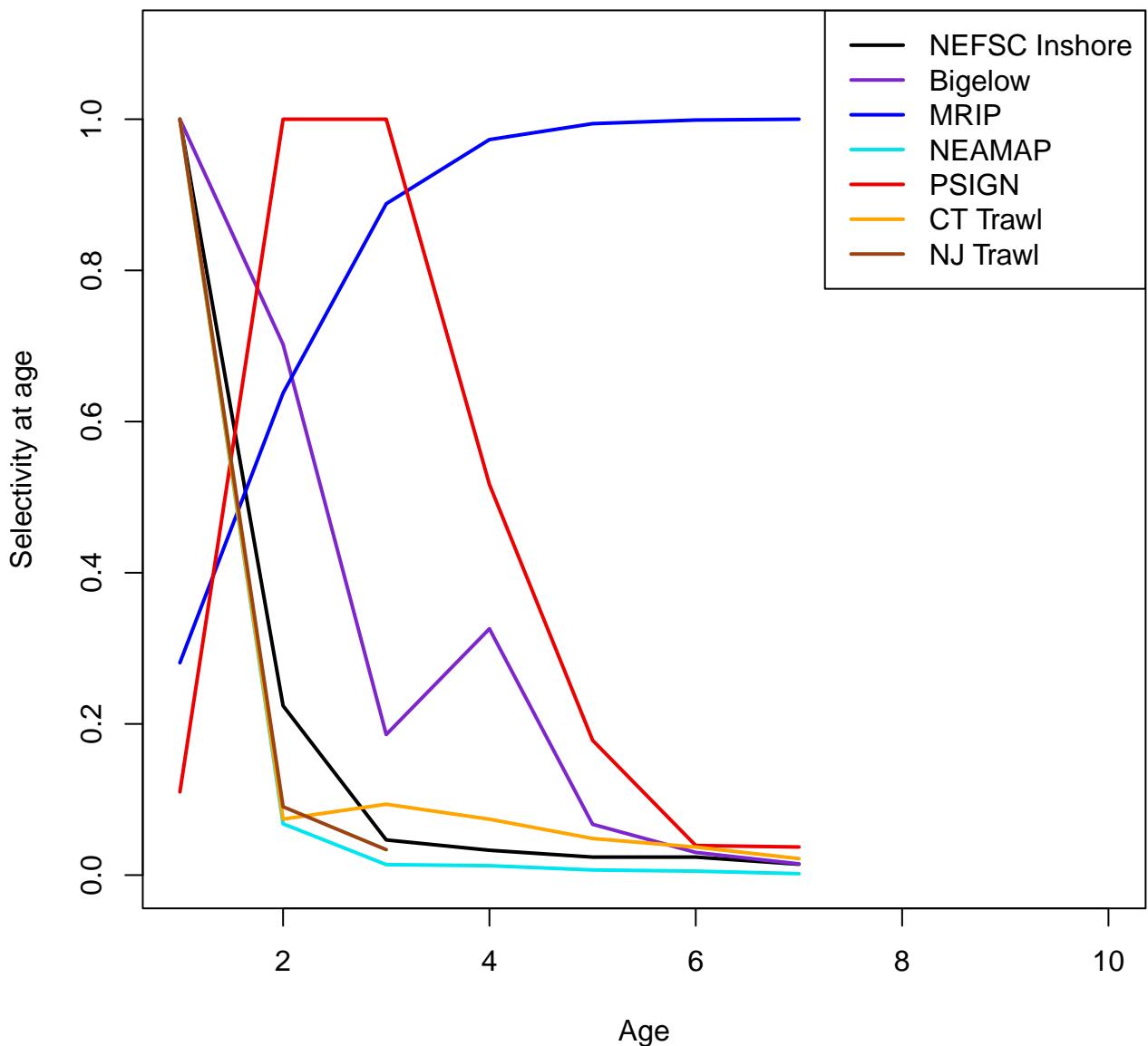


## Fleet 2 (Rec)



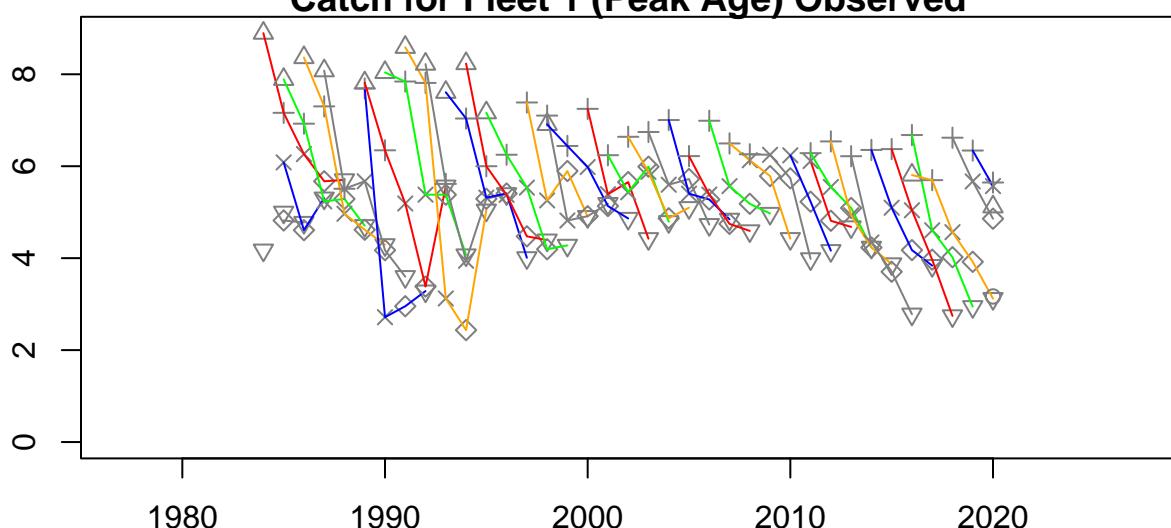


## Indices



## Catch for Fleet 1 (Peak Age) Observed

Log(Catch)



1980 1990 2000 2010 2020

Z

1980 1990 2000 2010 2020

Year Class

## Catch for Fleet 1 (Peak Age) Predicted

Log(Catch)

8  
6  
4  
2  
0

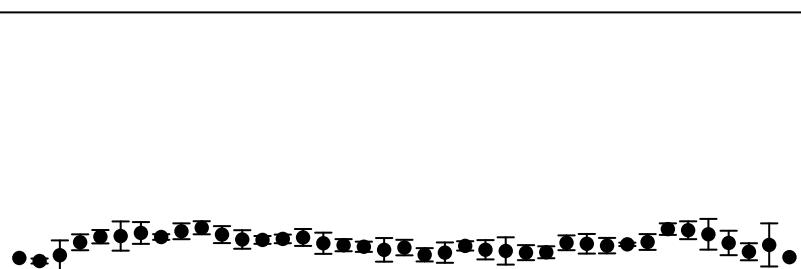
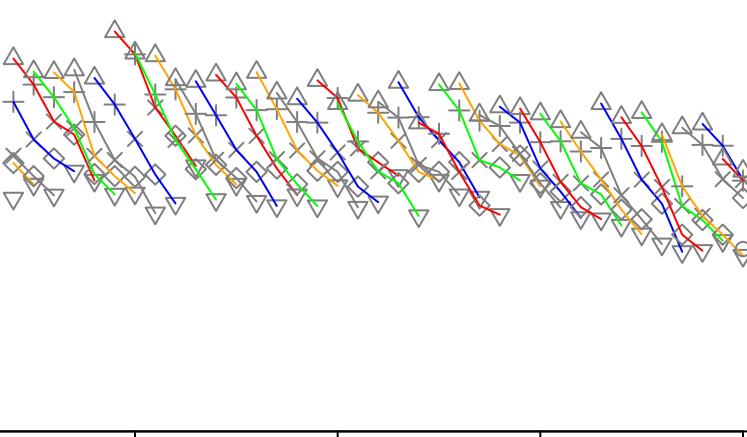
1980 1990 2000 2010 2020

Z

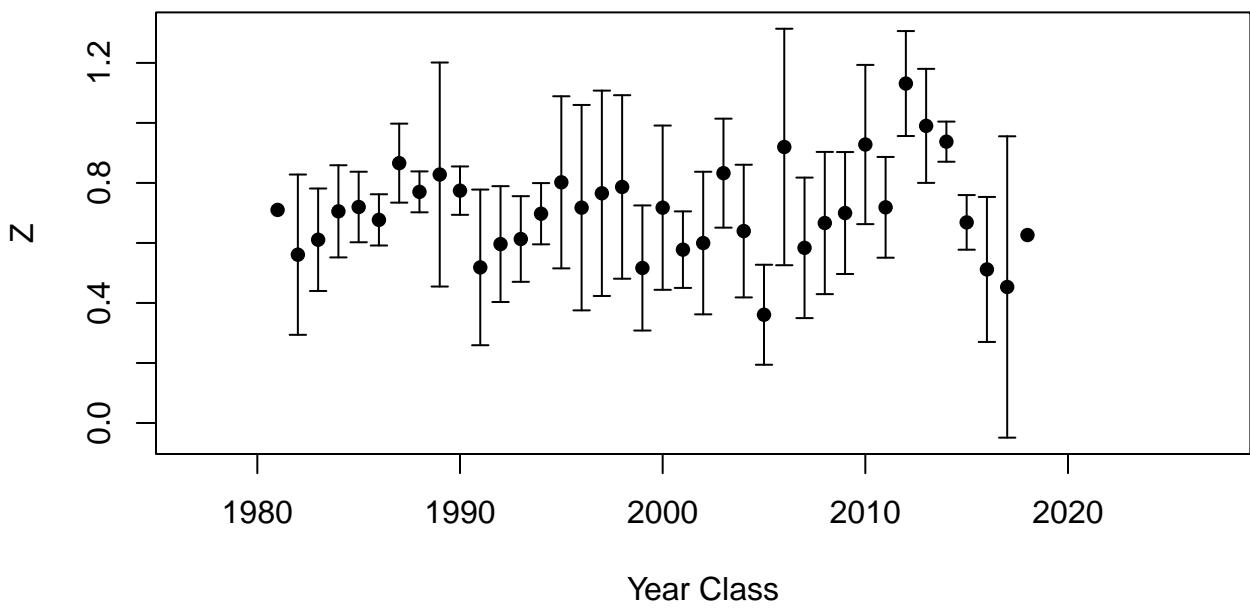
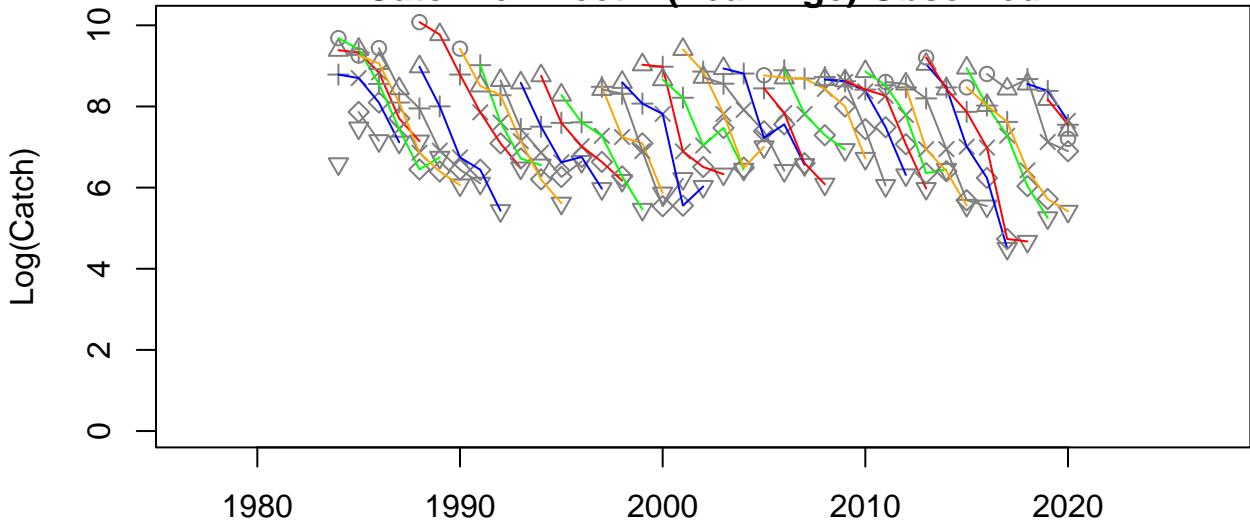
3  
2  
1  
0  
-1

1980 1990 2000 2010 2020

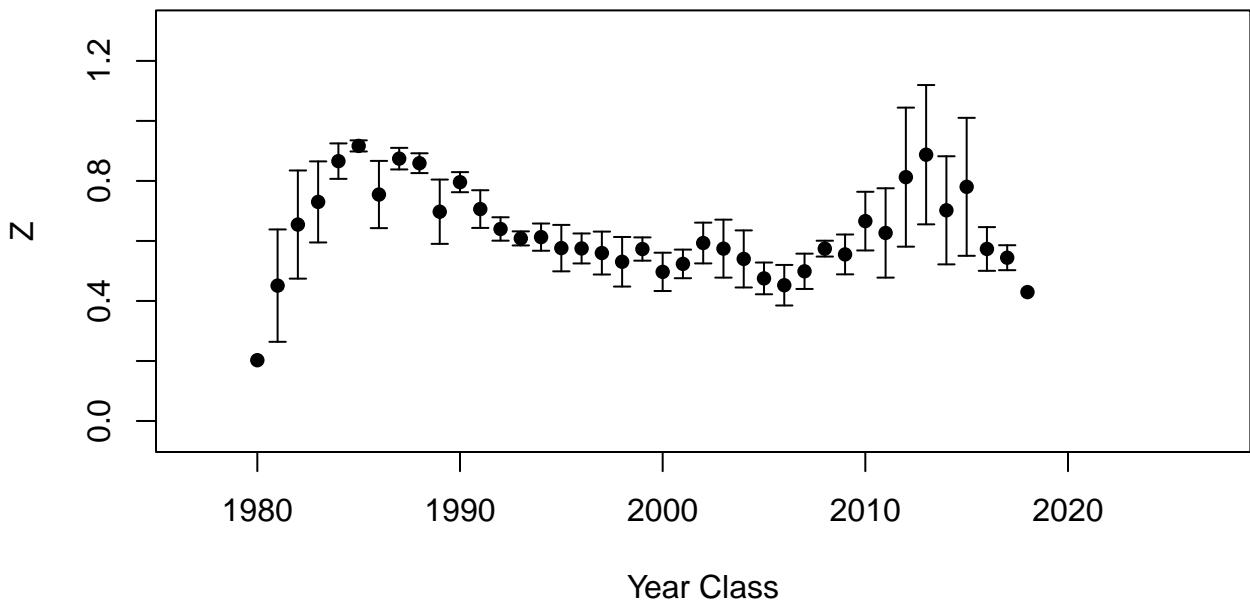
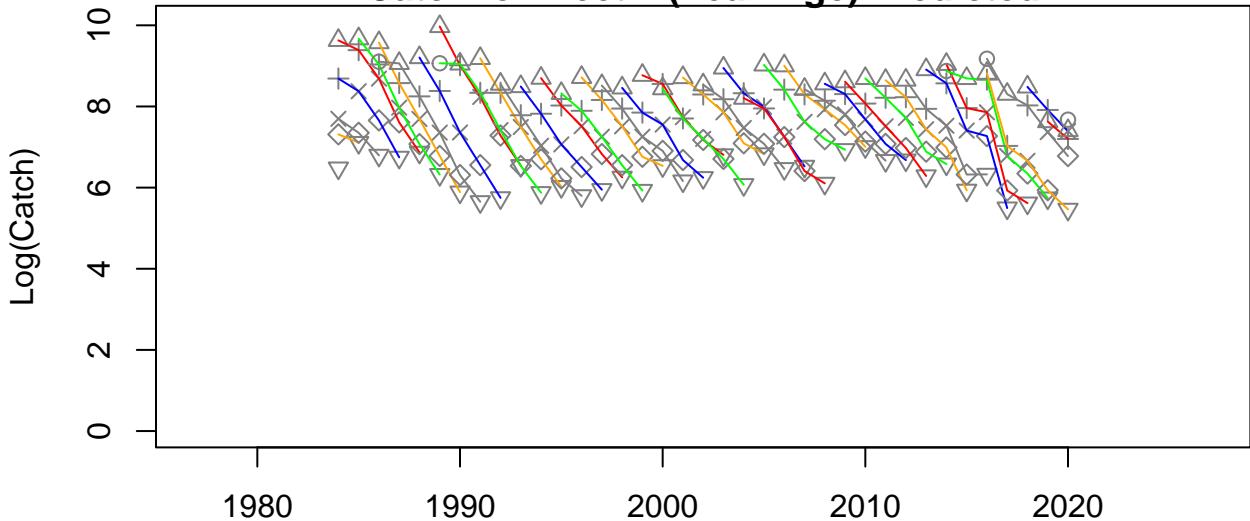
Year Class



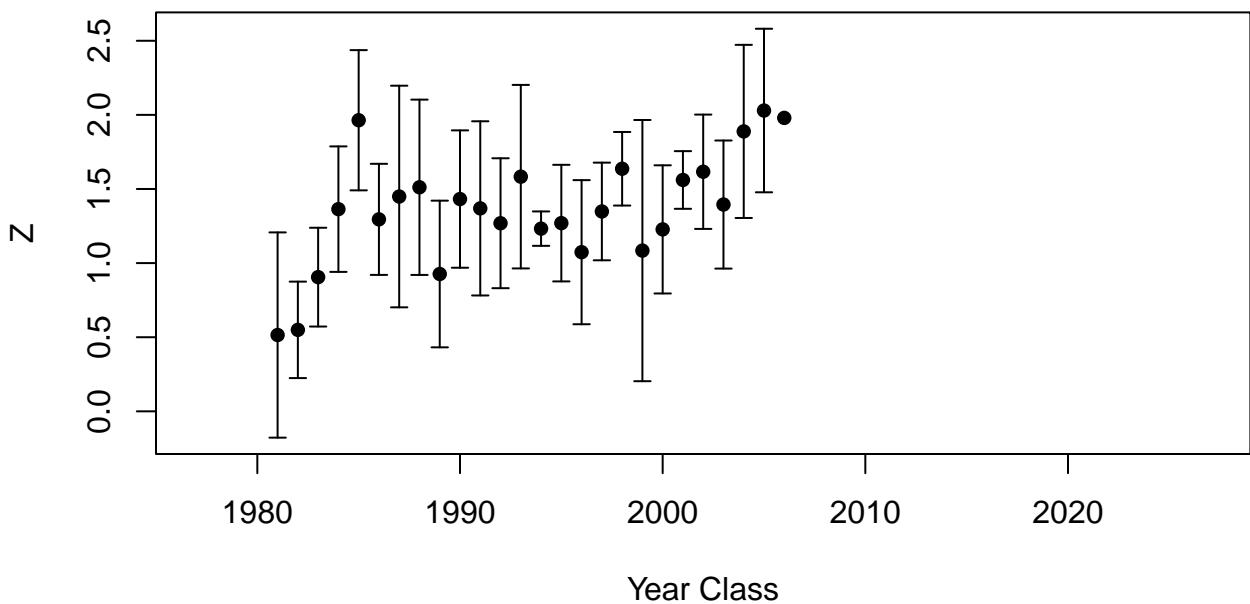
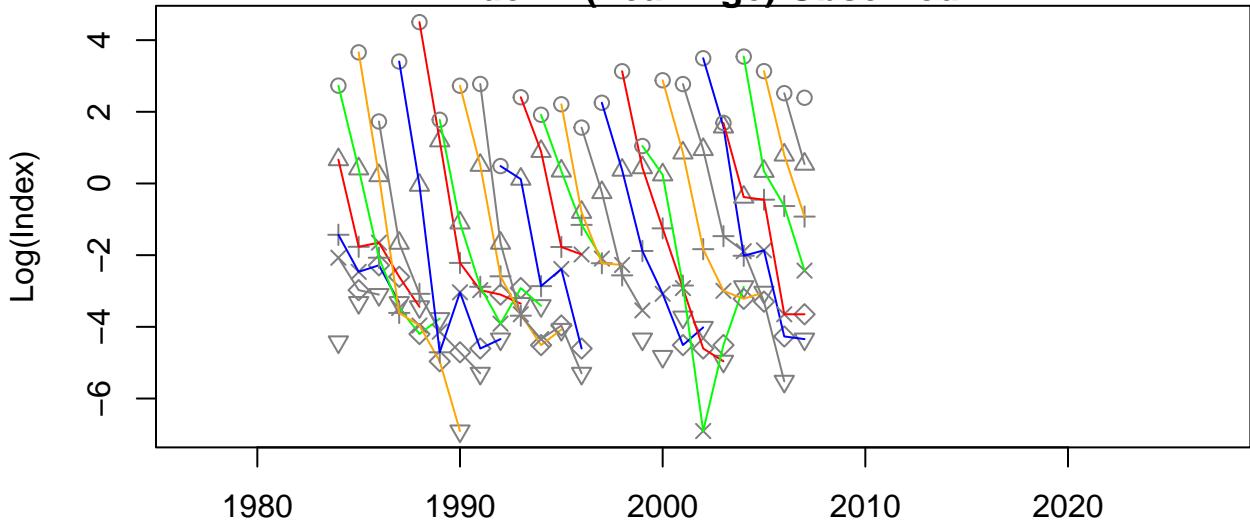
## Catch for Fleet 2 (Peak Age) Observed



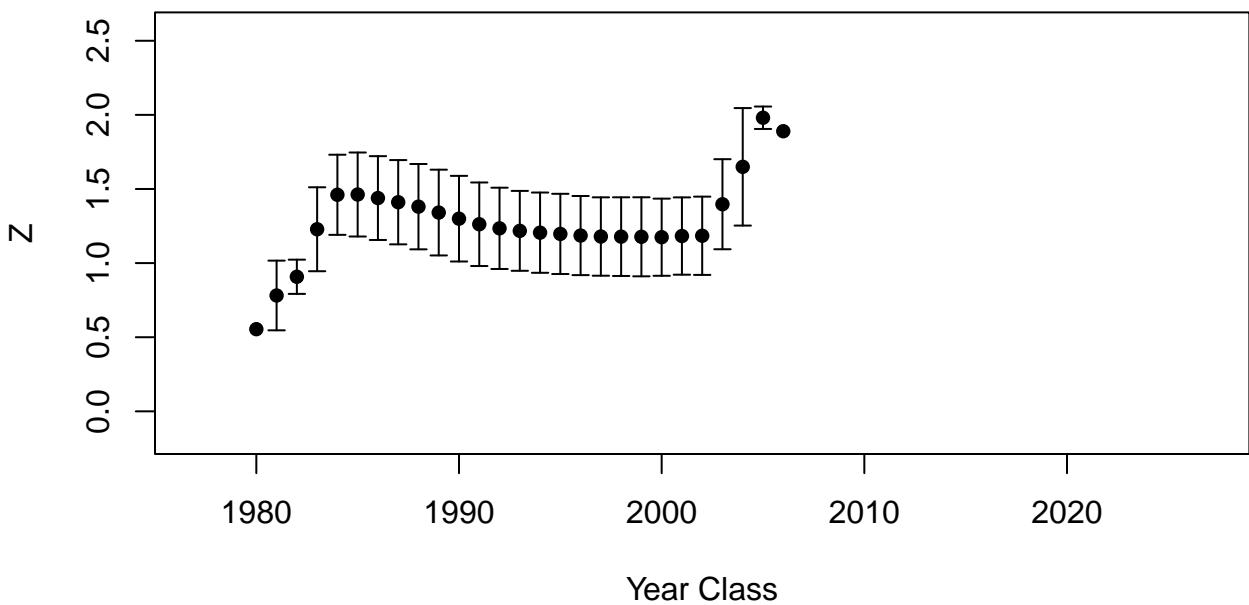
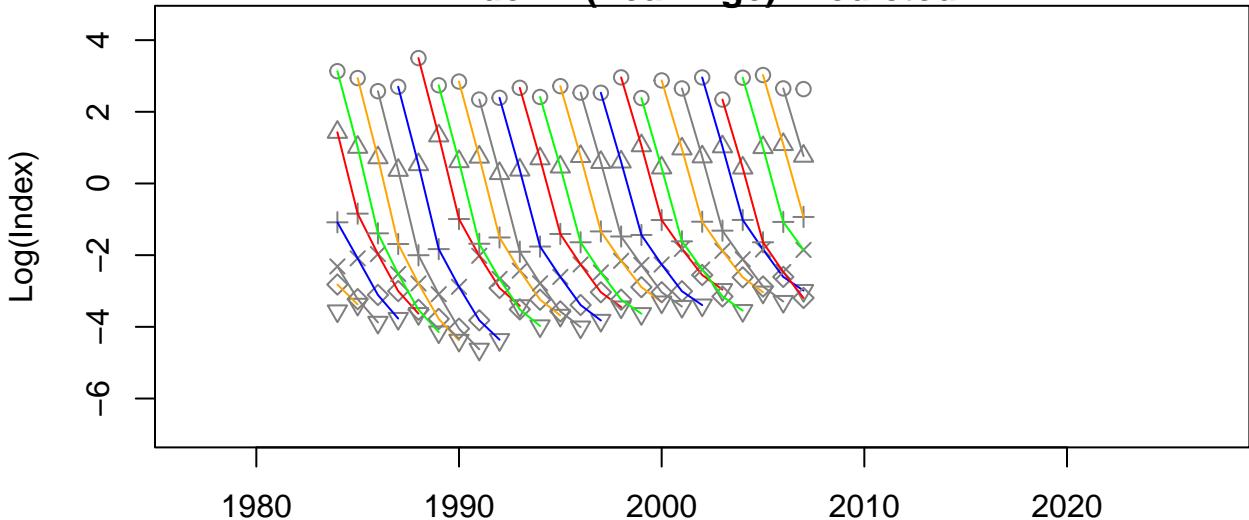
## Catch for Fleet 2 (Peak Age) Predicted



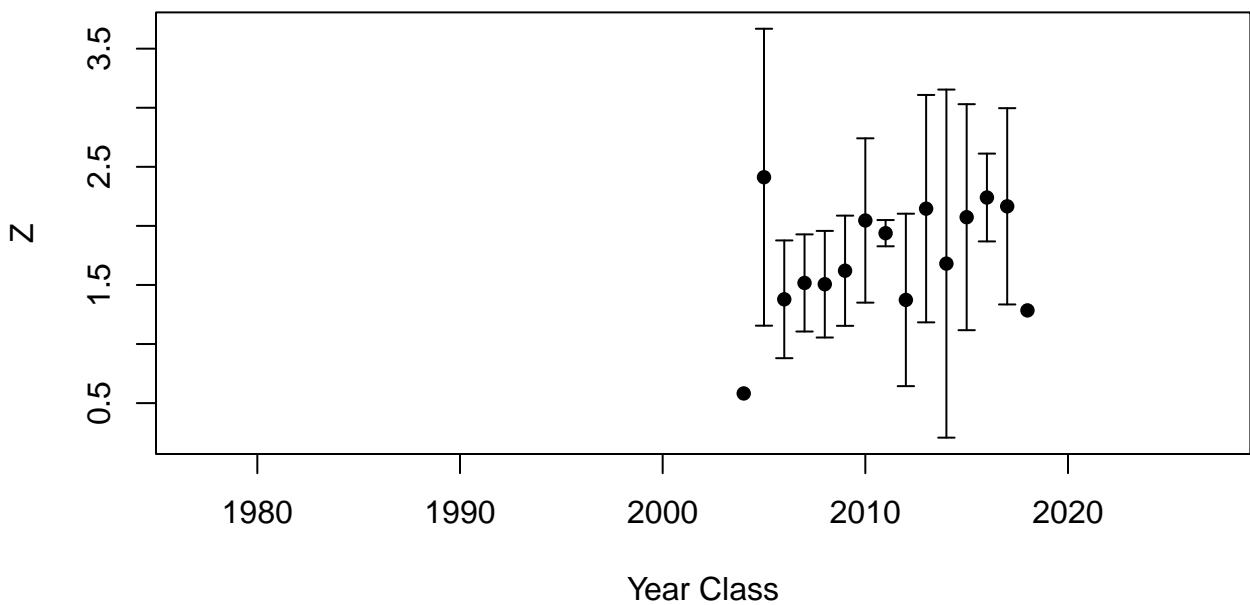
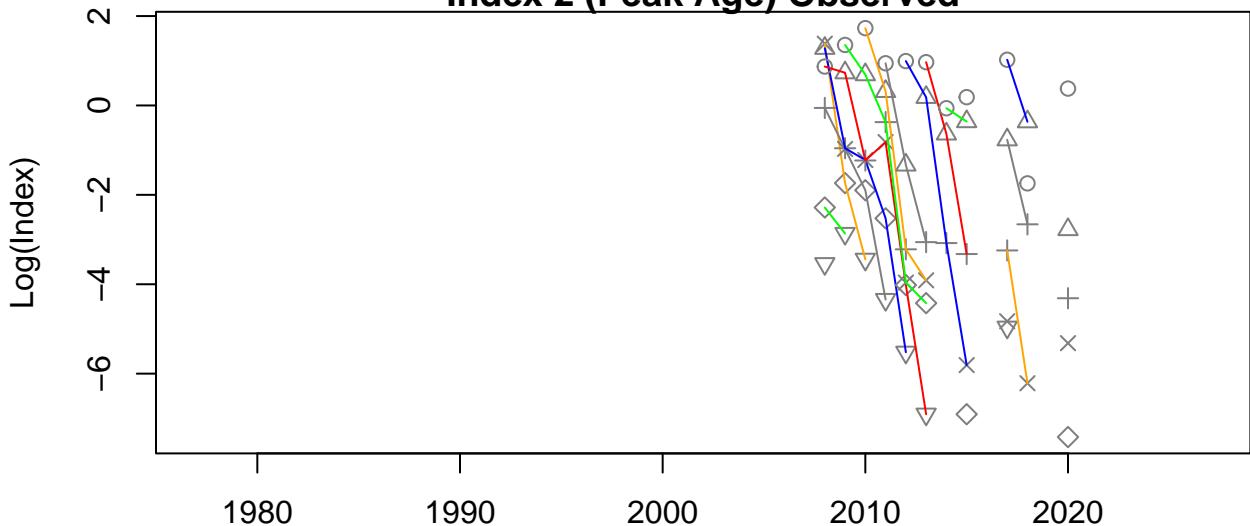
### Index 1 (Peak Age) Observed



## Index 1 (Peak Age) Predicted



## Index 2 (Peak Age) Observed

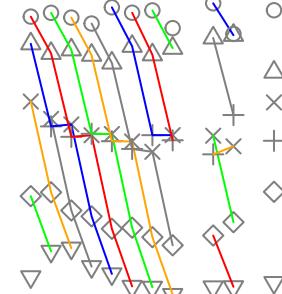


## Index 2 (Peak Age) Predicted

Log(Index)

2  
0  
-2  
-4  
-6

1980 1990 2000 2010 2020

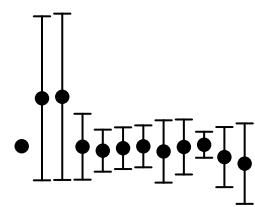


Z

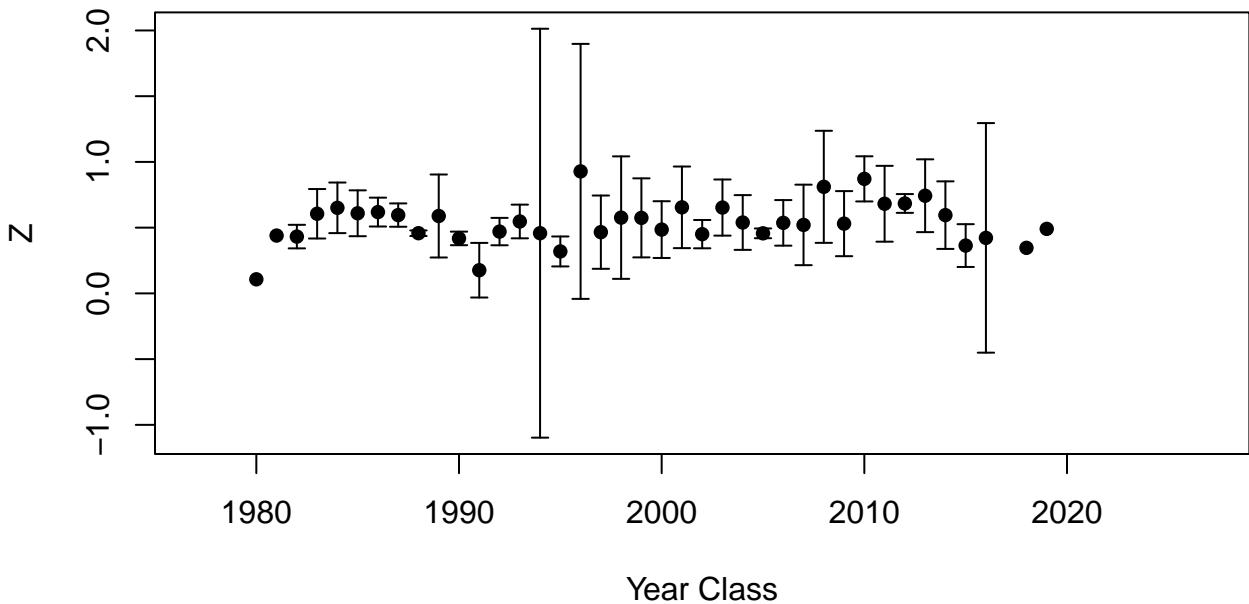
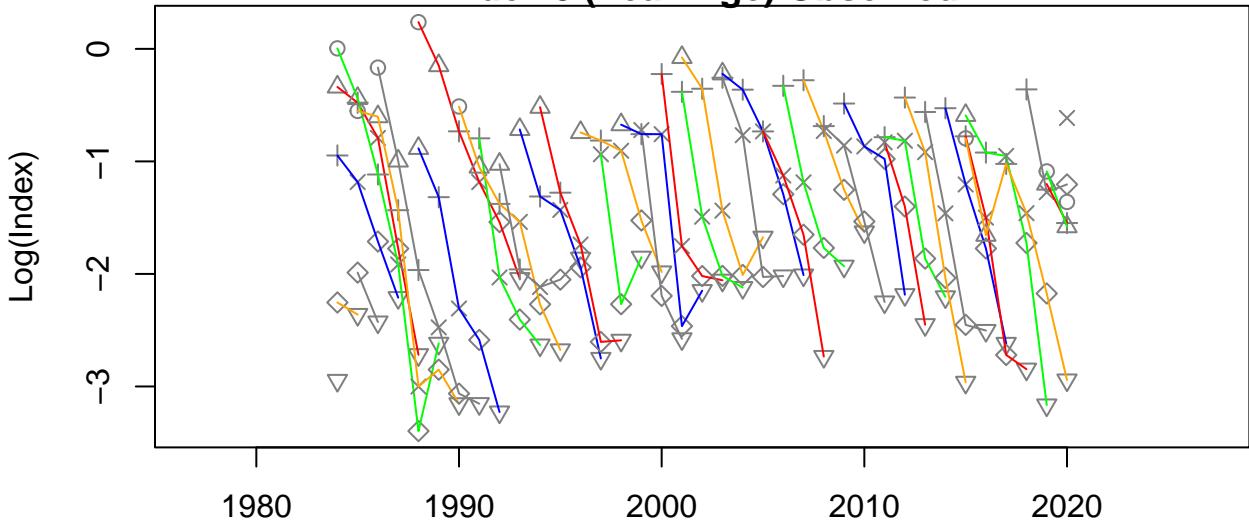
3.5  
2.5  
1.5  
0.5

1980 1990 2000 2010 2020

Year Class



### Index 3 (Peak Age) Observed

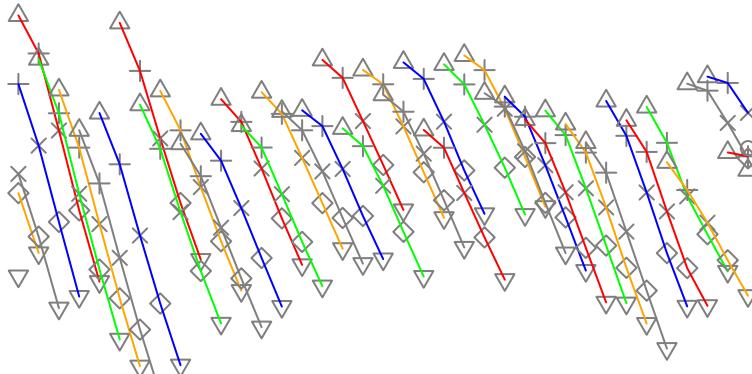


### Index 3 (Peak Age) Predicted

Log(Index)

0  
-1  
-2  
-3

1980 1990 2000 2010 2020

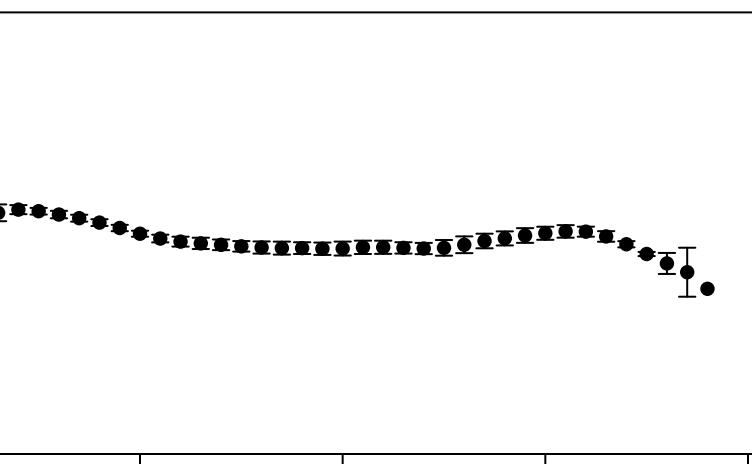


Z

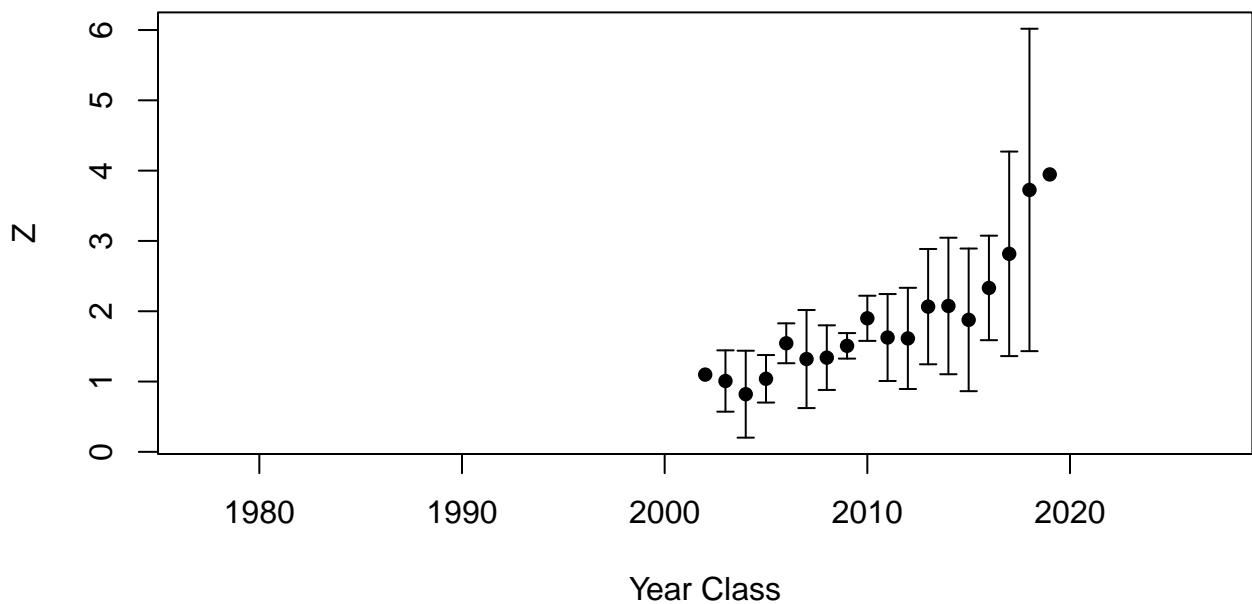
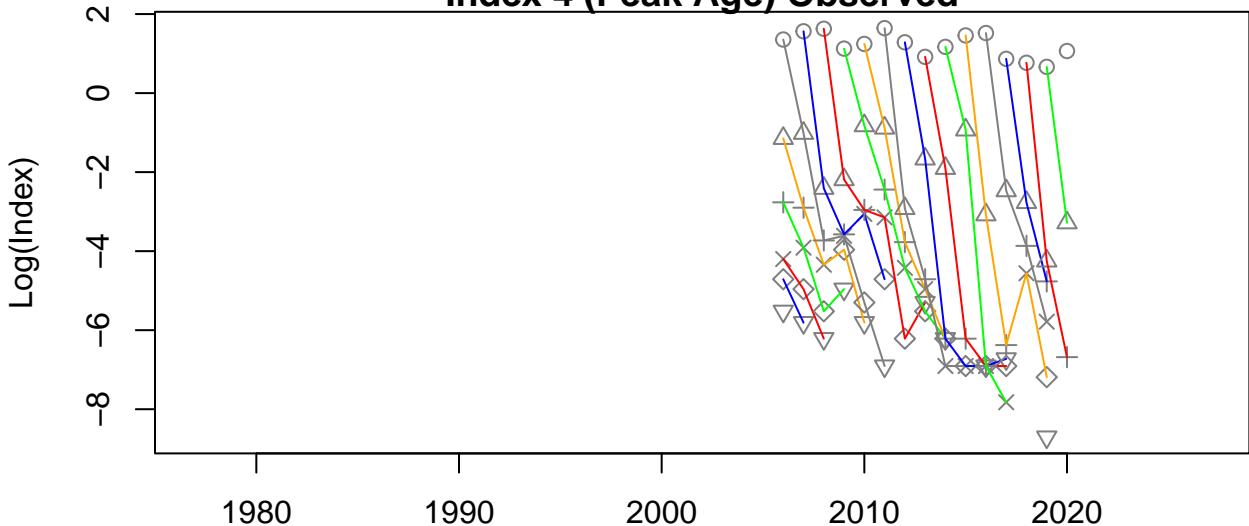
2.0  
1.0  
0.0  
-1.0

1980 1990 2000 2010 2020

Year Class

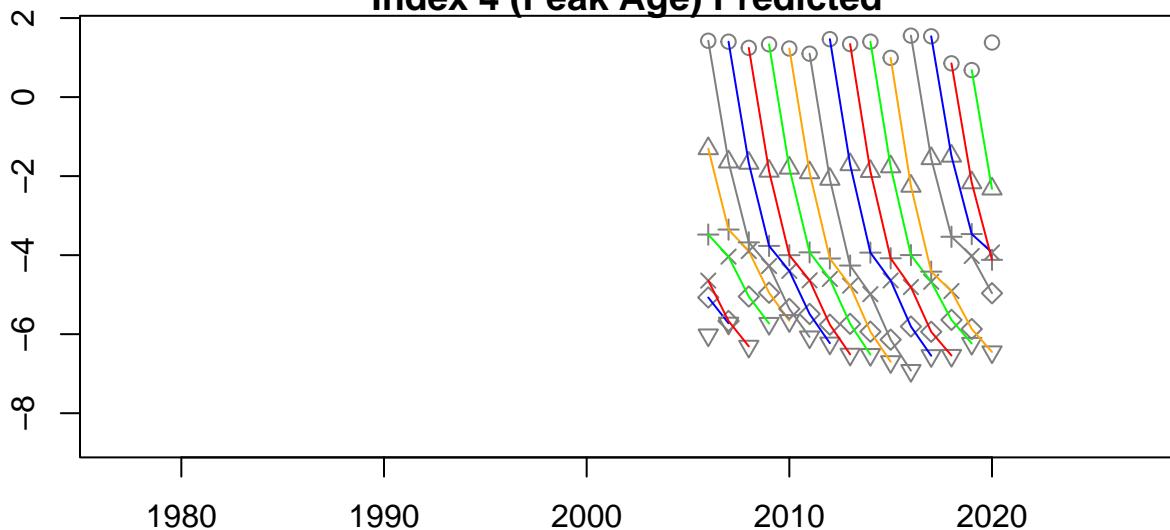


### Index 4 (Peak Age) Observed



### Index 4 (Peak Age) Predicted

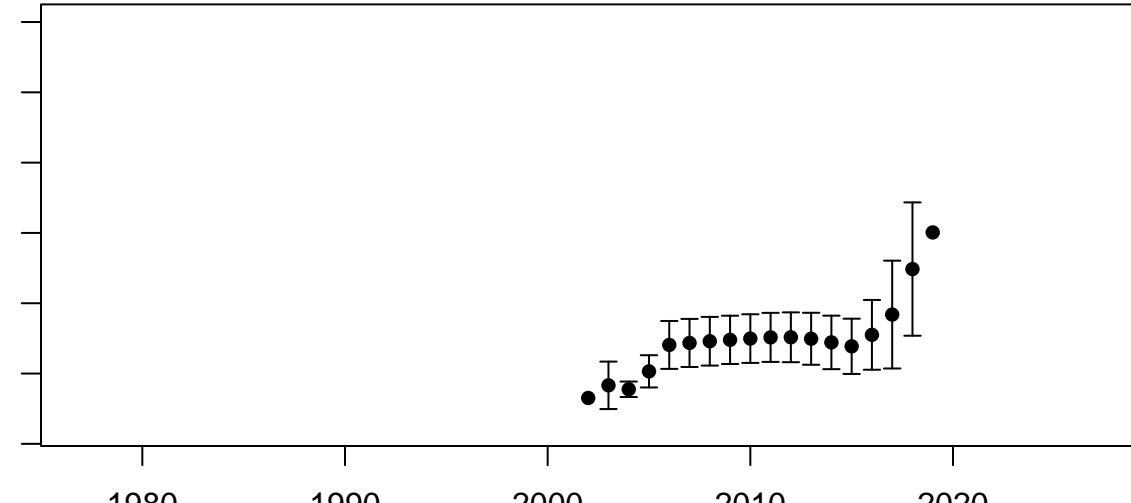
Log(Index)



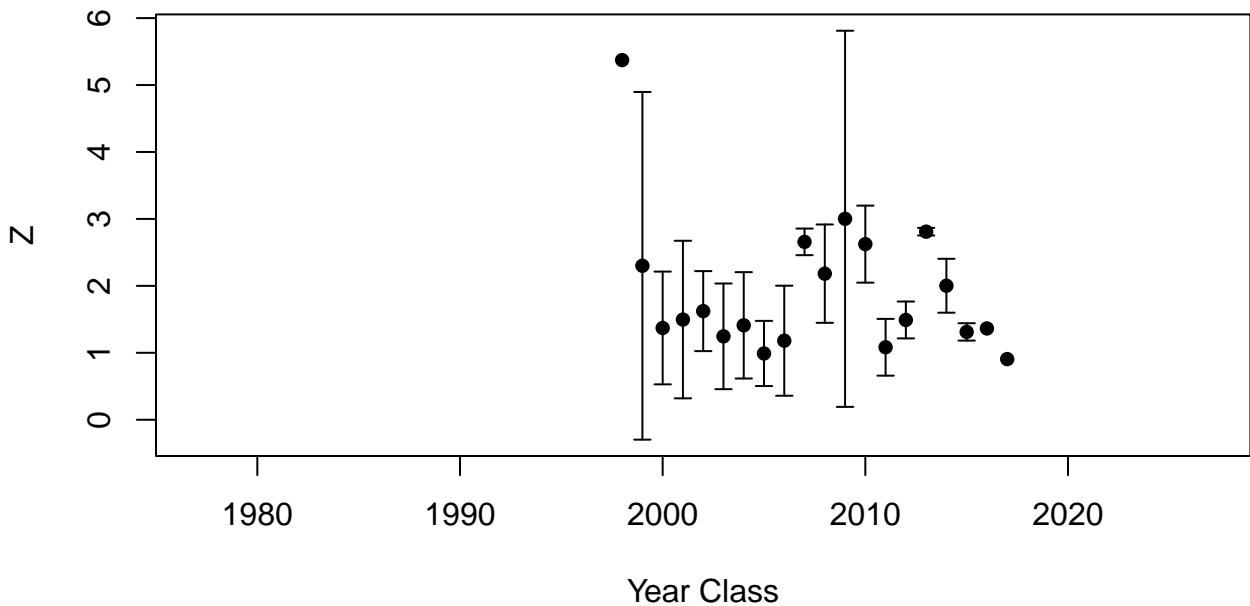
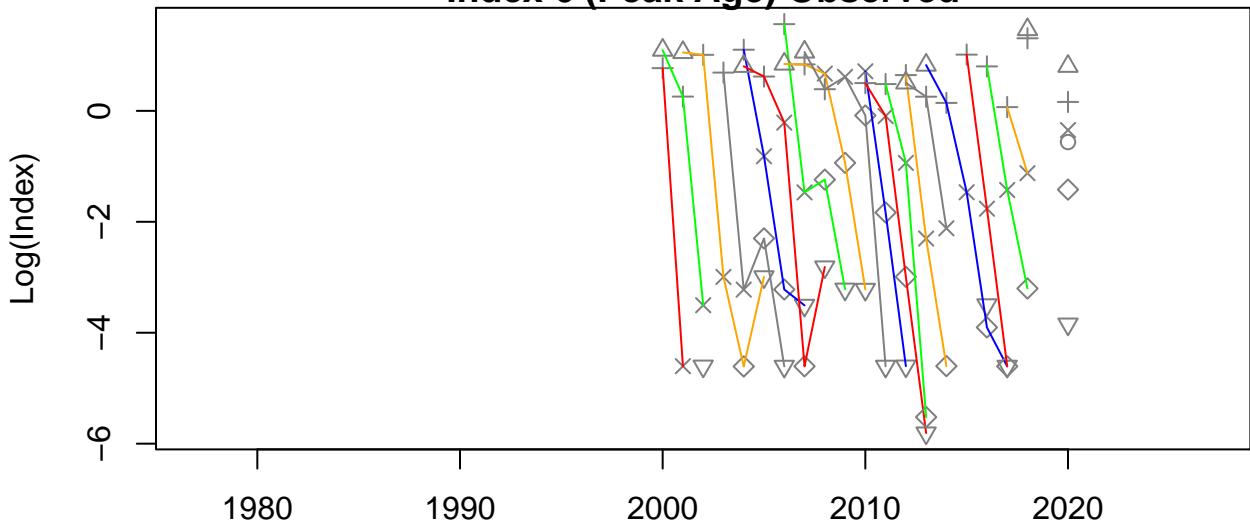
Z

1980 1990 2000 2010 2020

Year Class



### Index 6 (Peak Age) Observed

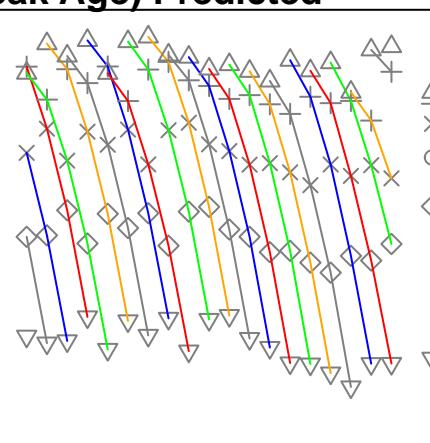


## Index 6 (Peak Age) Predicted

Log(Index)

0  
-2  
-4  
-6

1980 1990 2000 2010 2020

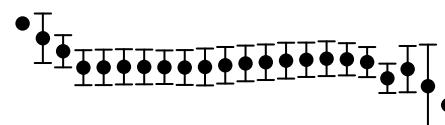


Z

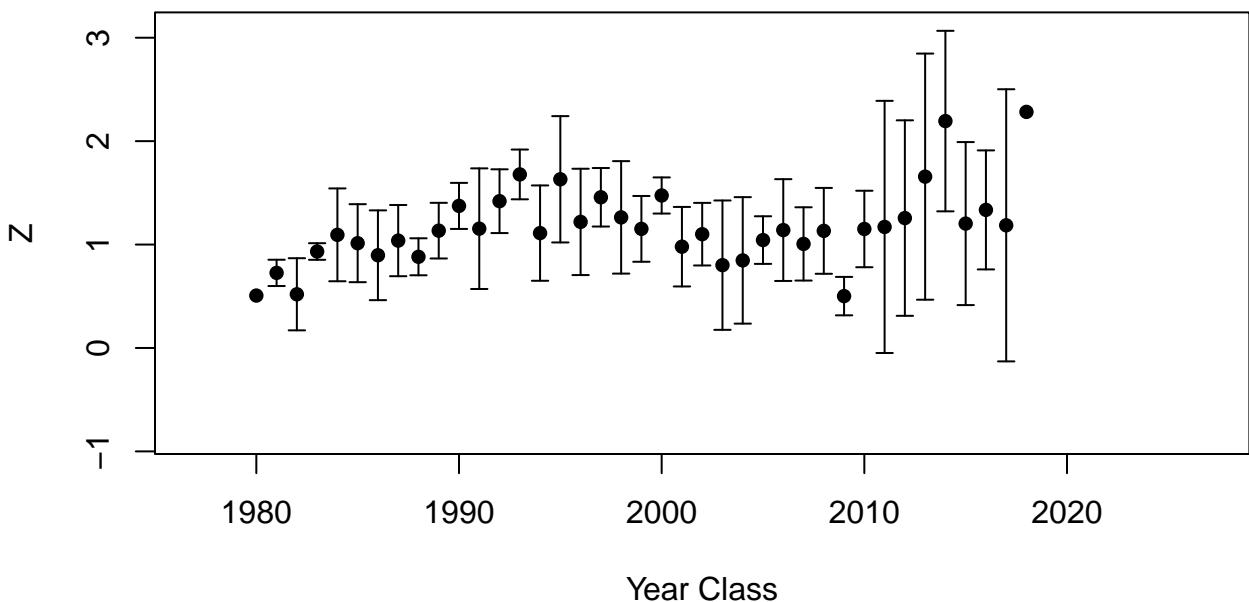
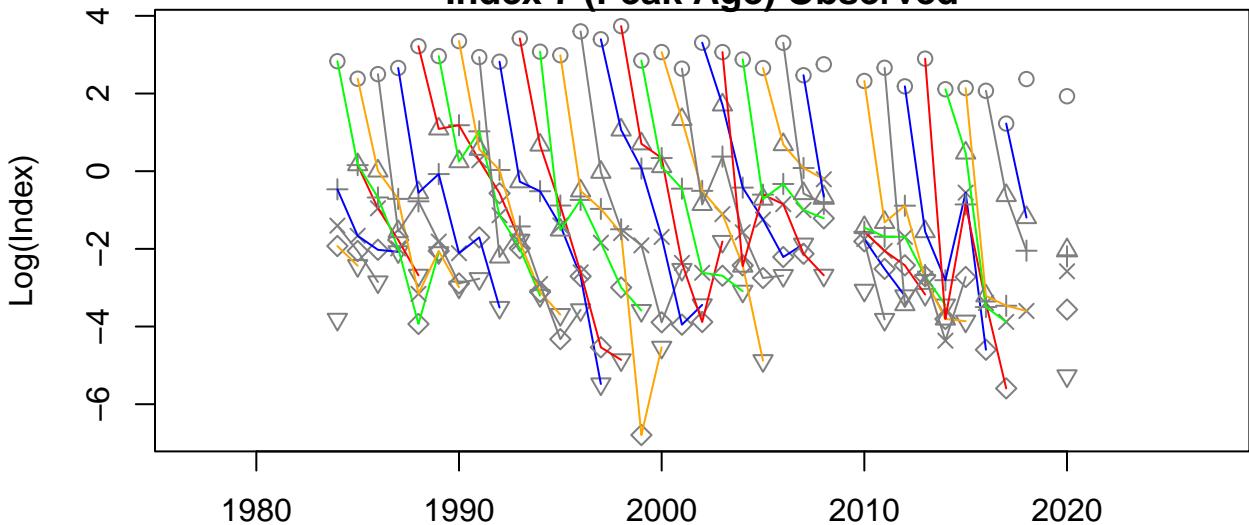
6  
5  
4  
3  
2  
1  
0

1980 1990 2000 2010 2020

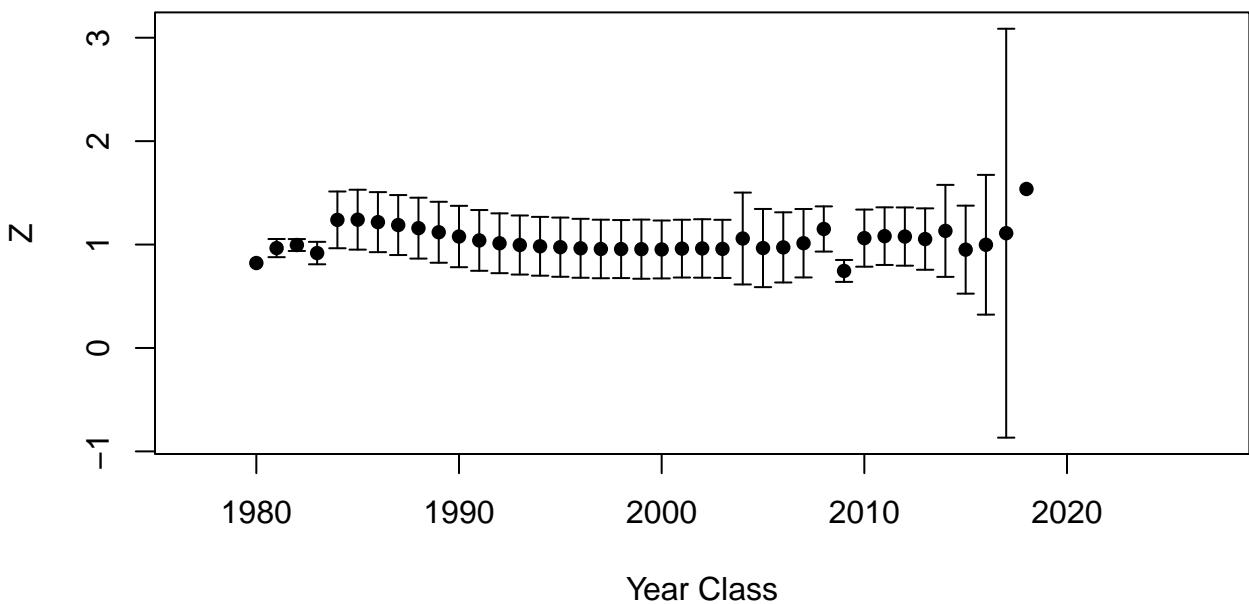
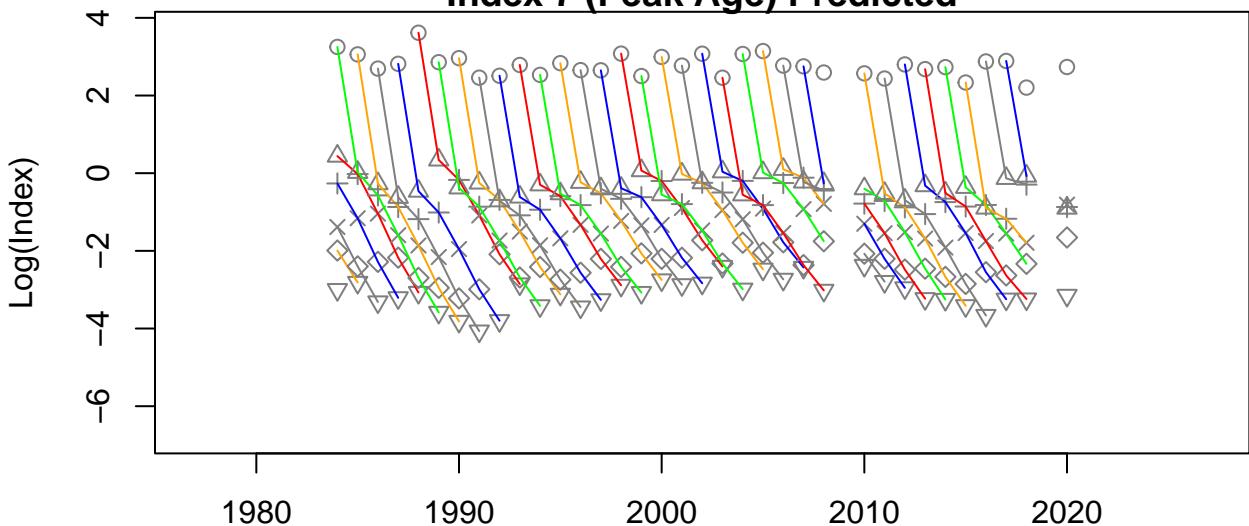
Year Class



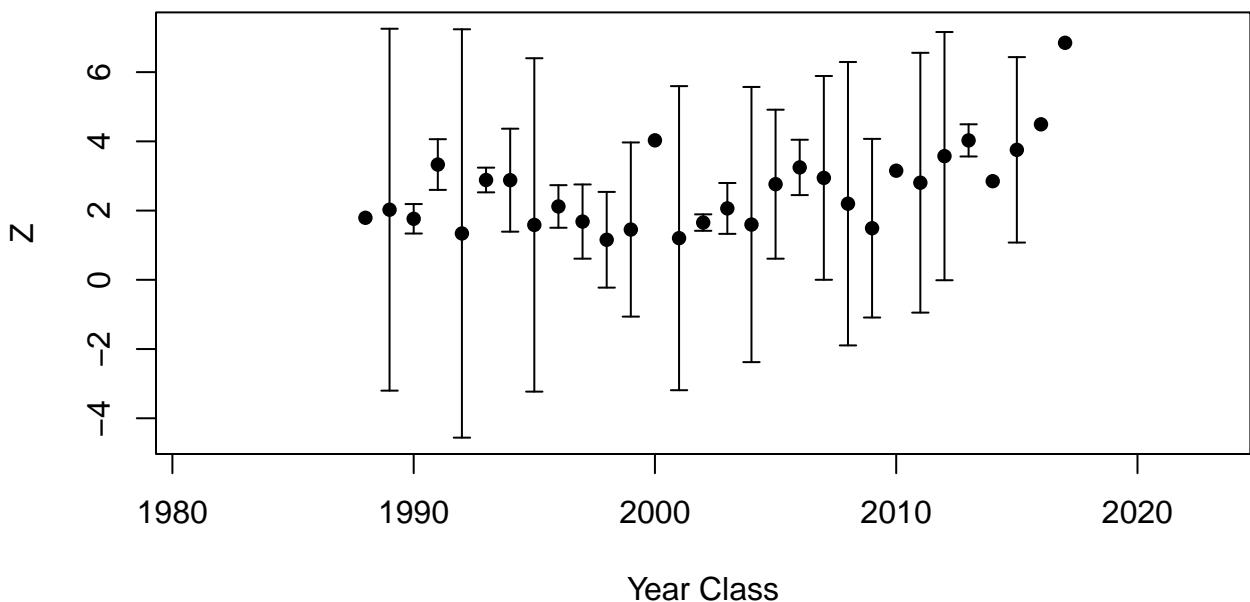
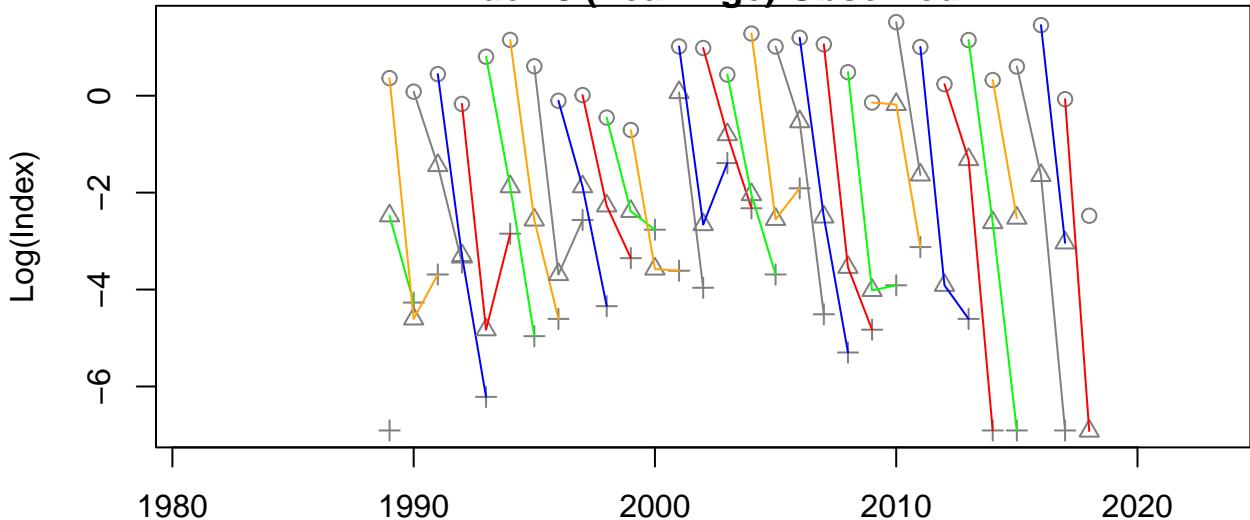
## Index 7 (Peak Age) Observed



## Index 7 (Peak Age) Predicted



## Index 8 (Peak Age) Observed



### Index 8 (Peak Age) Predicted

Log(Index)

0  
-2  
-4  
-6

1980

1990

2000

2010

2020

This line graph displays the predicted log value of the index over time. The y-axis ranges from -6 to 0. The x-axis shows years from 1980 to 2020. Multiple colored lines represent different predictions or models. Most lines start at a positive value around 1990 and decline thereafter. A green line starts lower than the others and declines more sharply after 2000. A blue line starts at a negative value around -3.5 and rises to near zero by 2000. A grey line starts at a negative value around -4.5 and rises to near zero by 2000. An orange line starts at a positive value around 1990 and declines after 2000. A red line starts at a positive value around 1990 and declines after 2000. A yellow line starts at a positive value around 1990 and declines after 2000. A black line starts at a positive value around 1990 and declines after 2000. A purple line starts at a positive value around 1990 and declines after 2000. A pink line starts at a positive value around 1990 and declines after 2000. A brown line starts at a positive value around 1990 and declines after 2000. A light blue line starts at a positive value around 1990 and declines after 2000. A light green line starts at a positive value around 1990 and declines after 2000. A light orange line starts at a positive value around 1990 and declines after 2000. A light red line starts at a positive value around 1990 and declines after 2000. A light yellow line starts at a positive value around 1990 and declines after 2000. A light purple line starts at a positive value around 1990 and declines after 2000. A light pink line starts at a positive value around 1990 and declines after 2000. A light brown line starts at a positive value around 1990 and declines after 2000.

Z

-4  
-2  
0  
2  
4  
6

1980

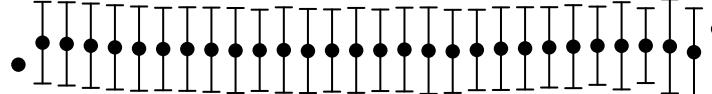
1990

2000

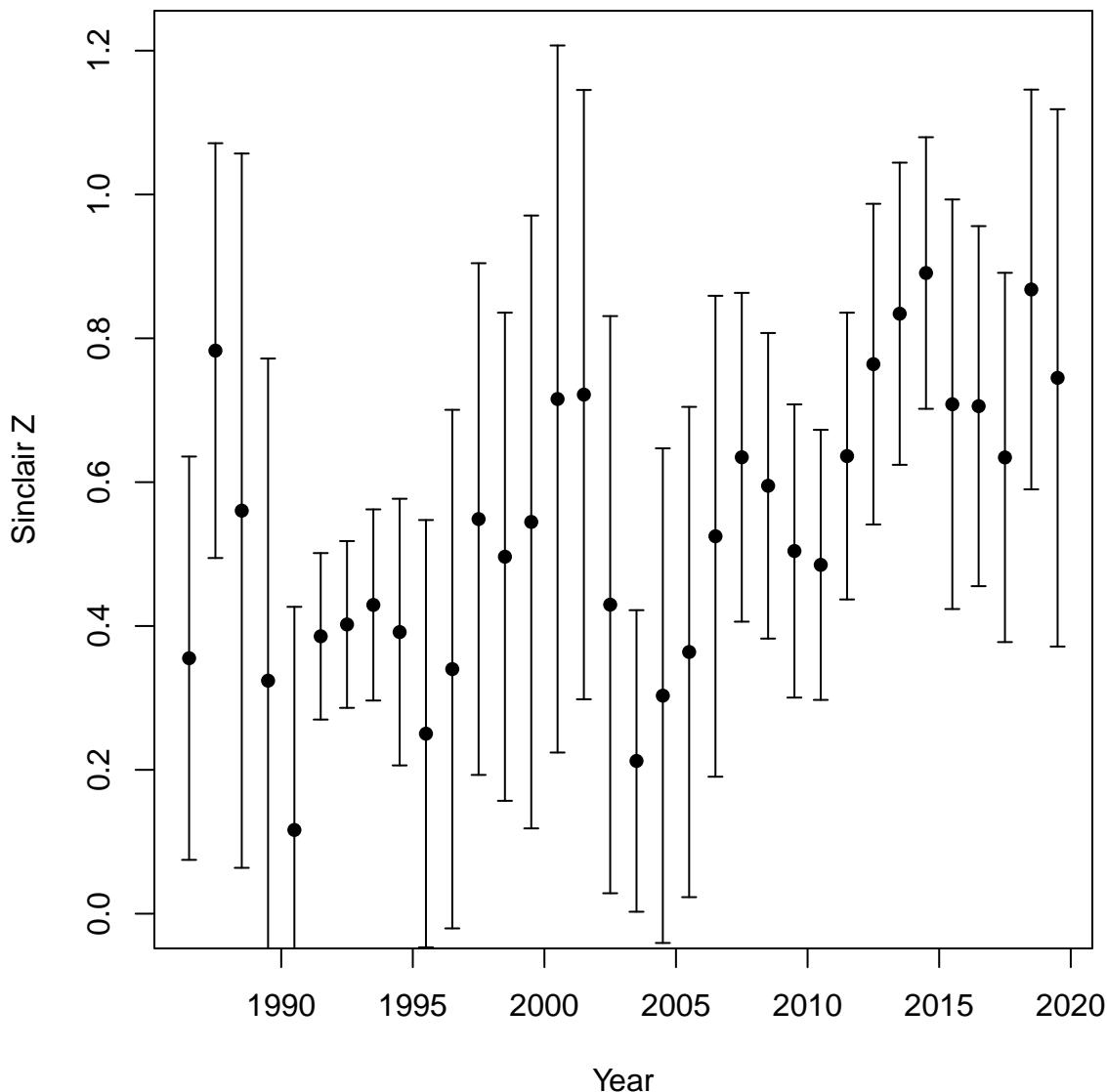
2010

2020

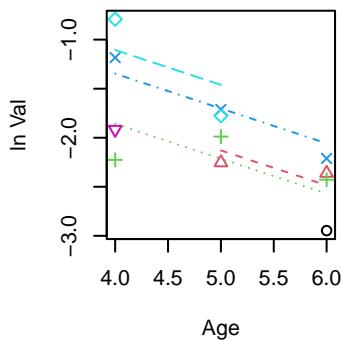
Year Class



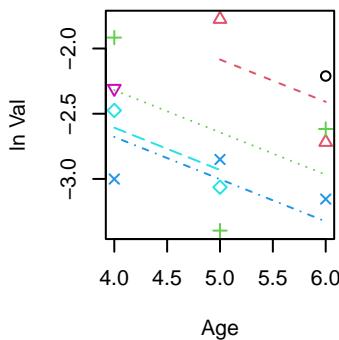
## MRIP



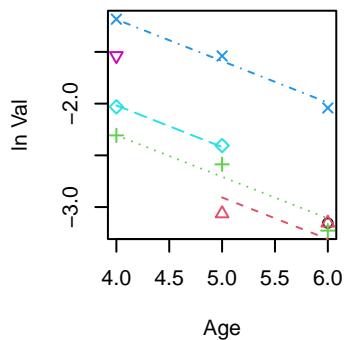
**Years 1985 to 1988**  
 $Z = 0.355$



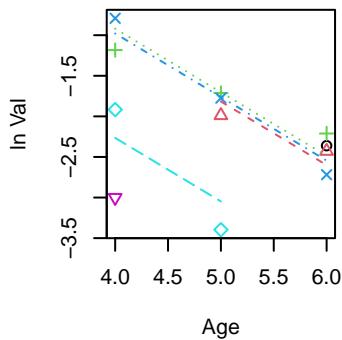
**Years 1988 to 1991**  
 $Z = 0.324$



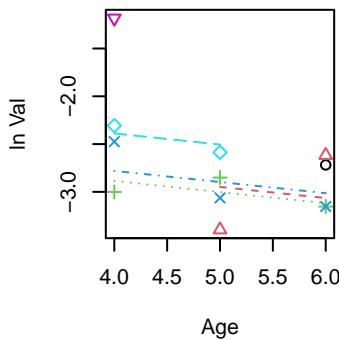
**Years 1991 to 1994**  
 $Z = 0.402$



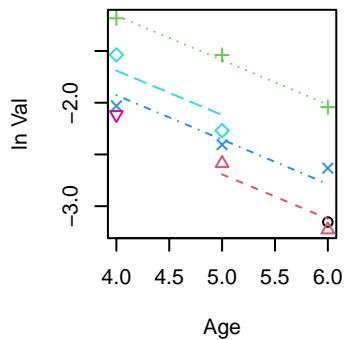
**Years 1986 to 1989**  
 $Z = 0.783$



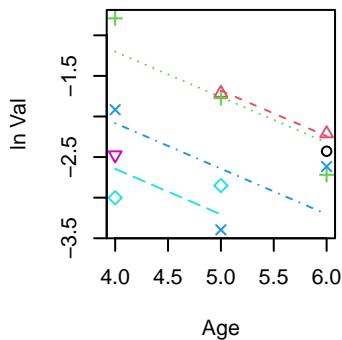
**Years 1989 to 1992**  
 $Z = 0.116$



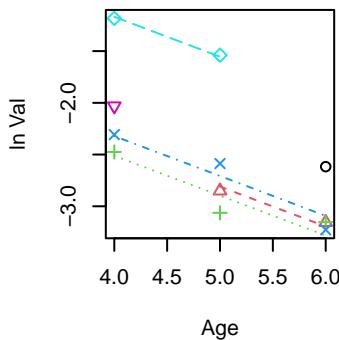
**Years 1992 to 1995**  
 $Z = 0.429$



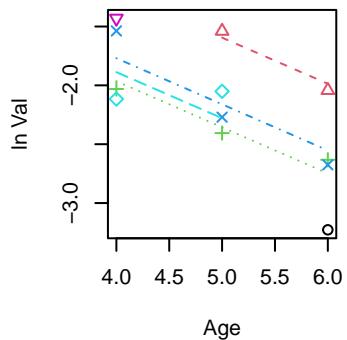
**Years 1987 to 1990**  
 $Z = 0.56$



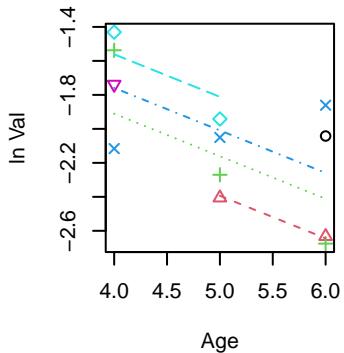
**Years 1990 to 1993**  
 $Z = 0.386$



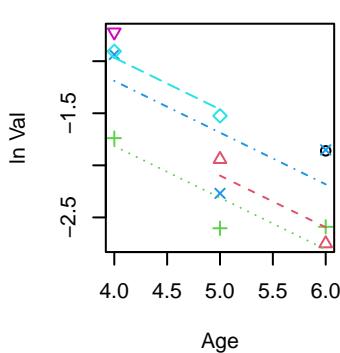
**Years 1993 to 1996**  
 $Z = 0.392$



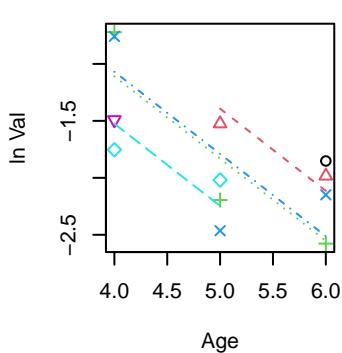
**Years 1994 to 1997**  
 $Z = 0.25$



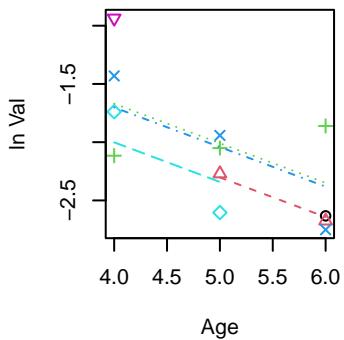
**Years 1997 to 2000**  
 $Z = 0.496$



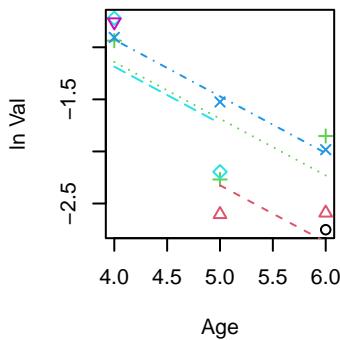
**Years 2000 to 2003**  
 $Z = 0.722$



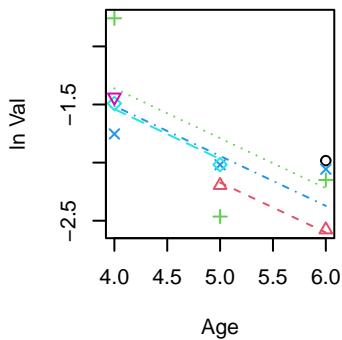
**Years 1995 to 1998**  
 $Z = 0.34$



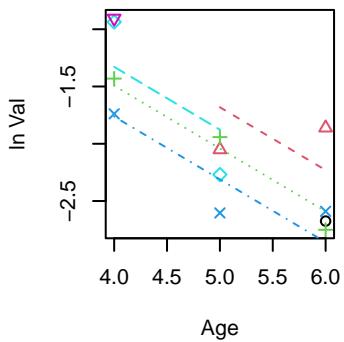
**Years 1998 to 2001**  
 $Z = 0.545$



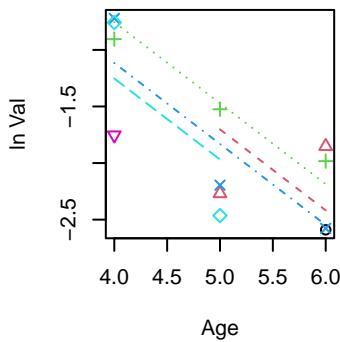
**Years 2001 to 2004**  
 $Z = 0.43$



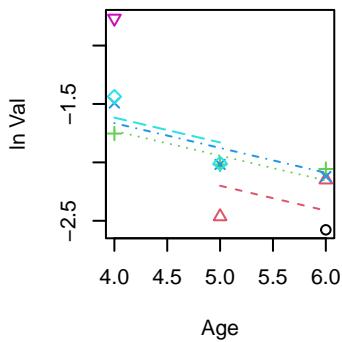
**Years 1996 to 1999**  
 $Z = 0.549$



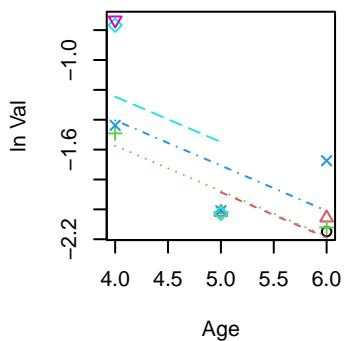
**Years 1999 to 2002**  
 $Z = 0.716$



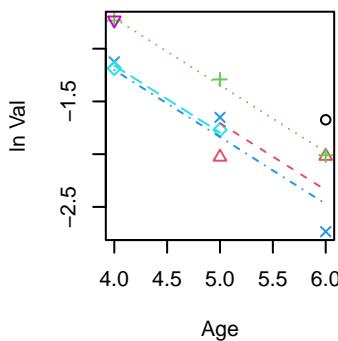
**Years 2002 to 2005**  
 $Z = 0.212$



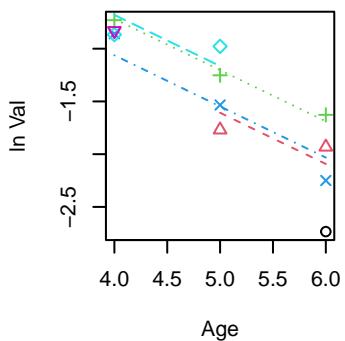
**Years 2003 to 2006**  
 $Z = 0.303$



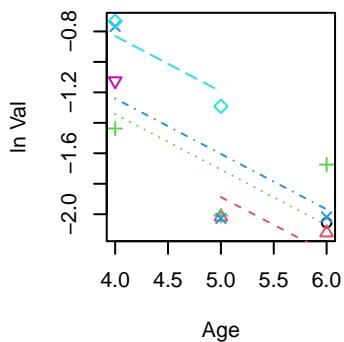
**Years 2006 to 2009**  
 $Z = 0.635$



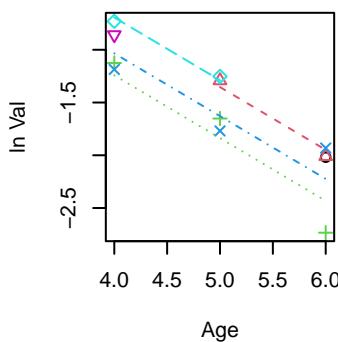
**Years 2009 to 2012**  
 $Z = 0.485$



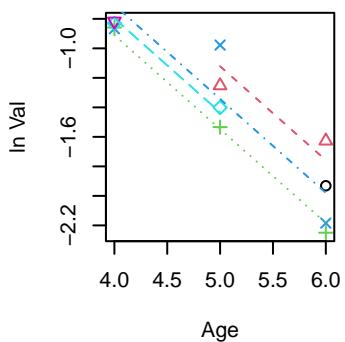
**Years 2004 to 2007**  
 $Z = 0.364$



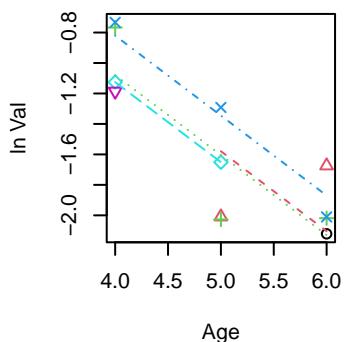
**Years 2007 to 2010**  
 $Z = 0.595$



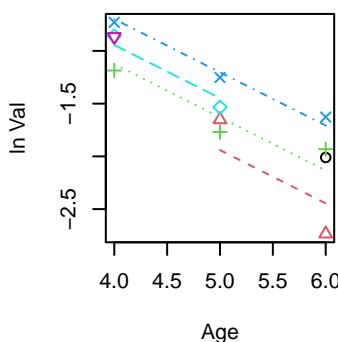
**Years 2010 to 2013**  
 $Z = 0.636$



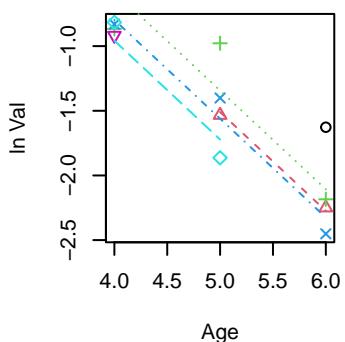
**Years 2005 to 2008**  
 $Z = 0.525$

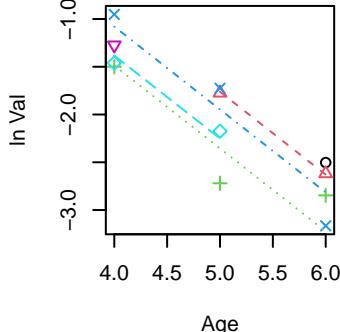
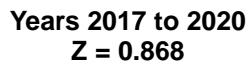
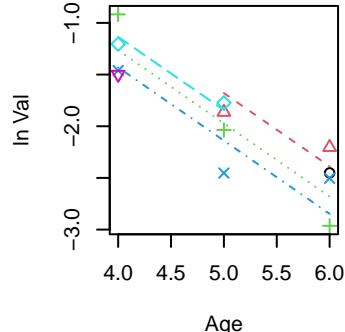
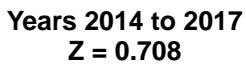
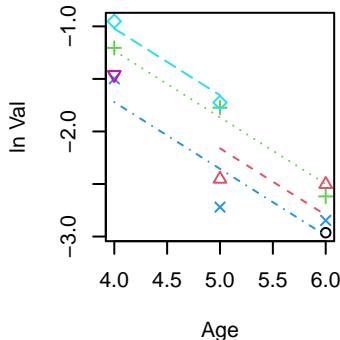
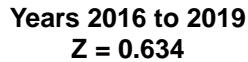
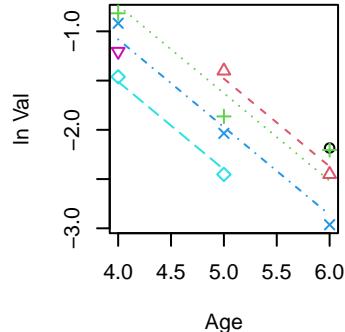
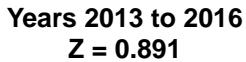
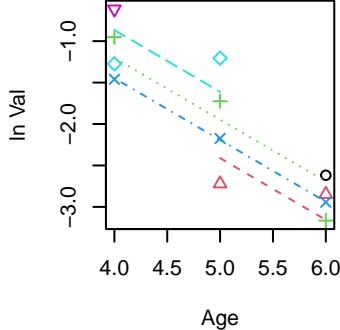
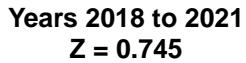
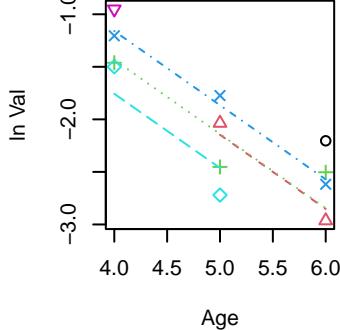
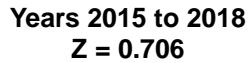
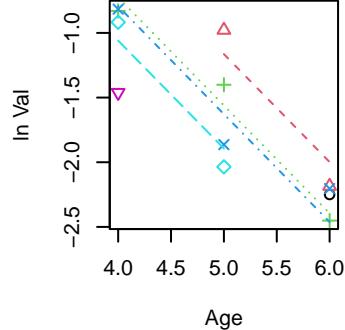
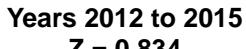


**Years 2008 to 2011**  
 $Z = 0.504$

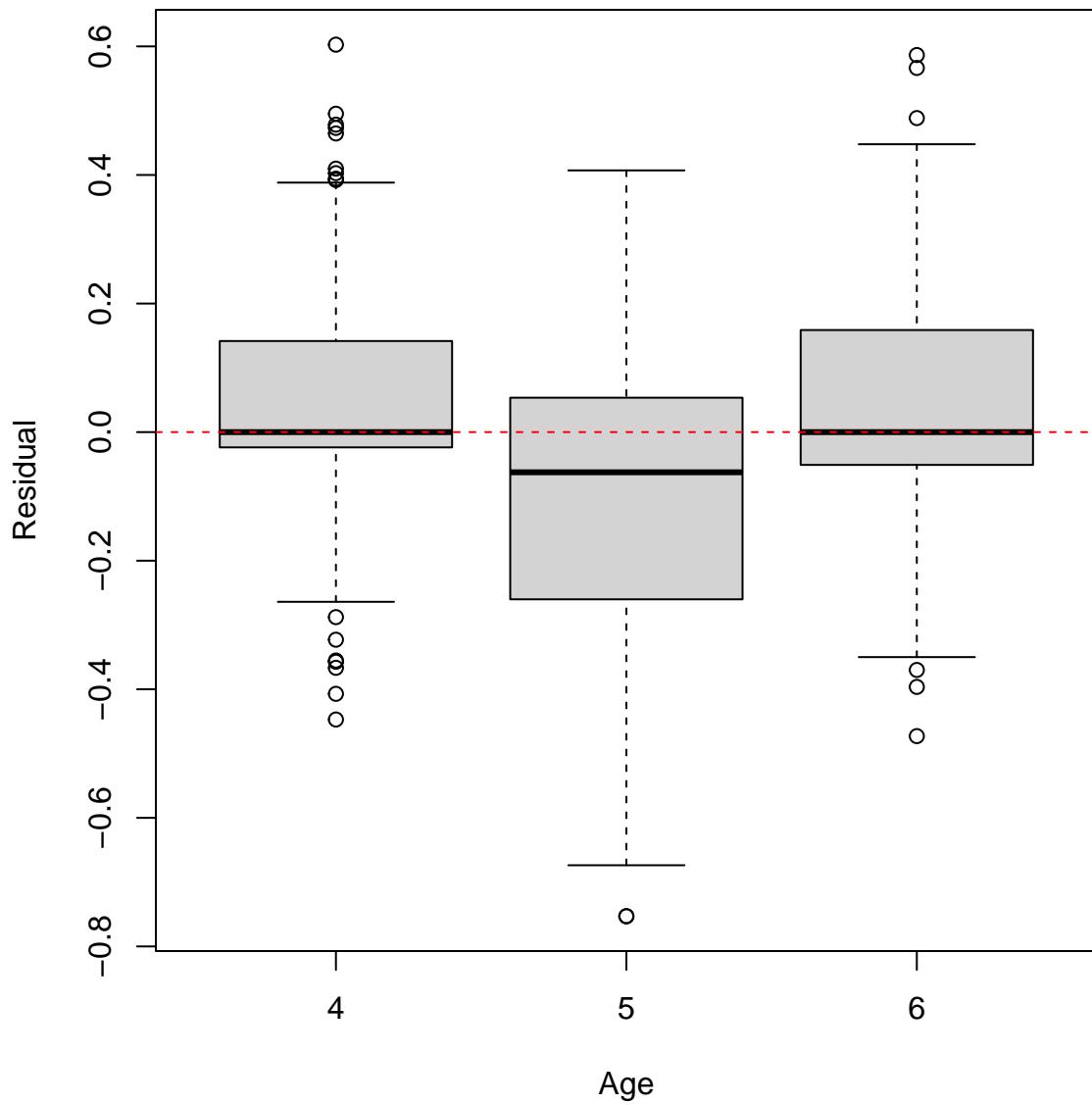


**Years 2011 to 2014**  
 $Z = 0.764$

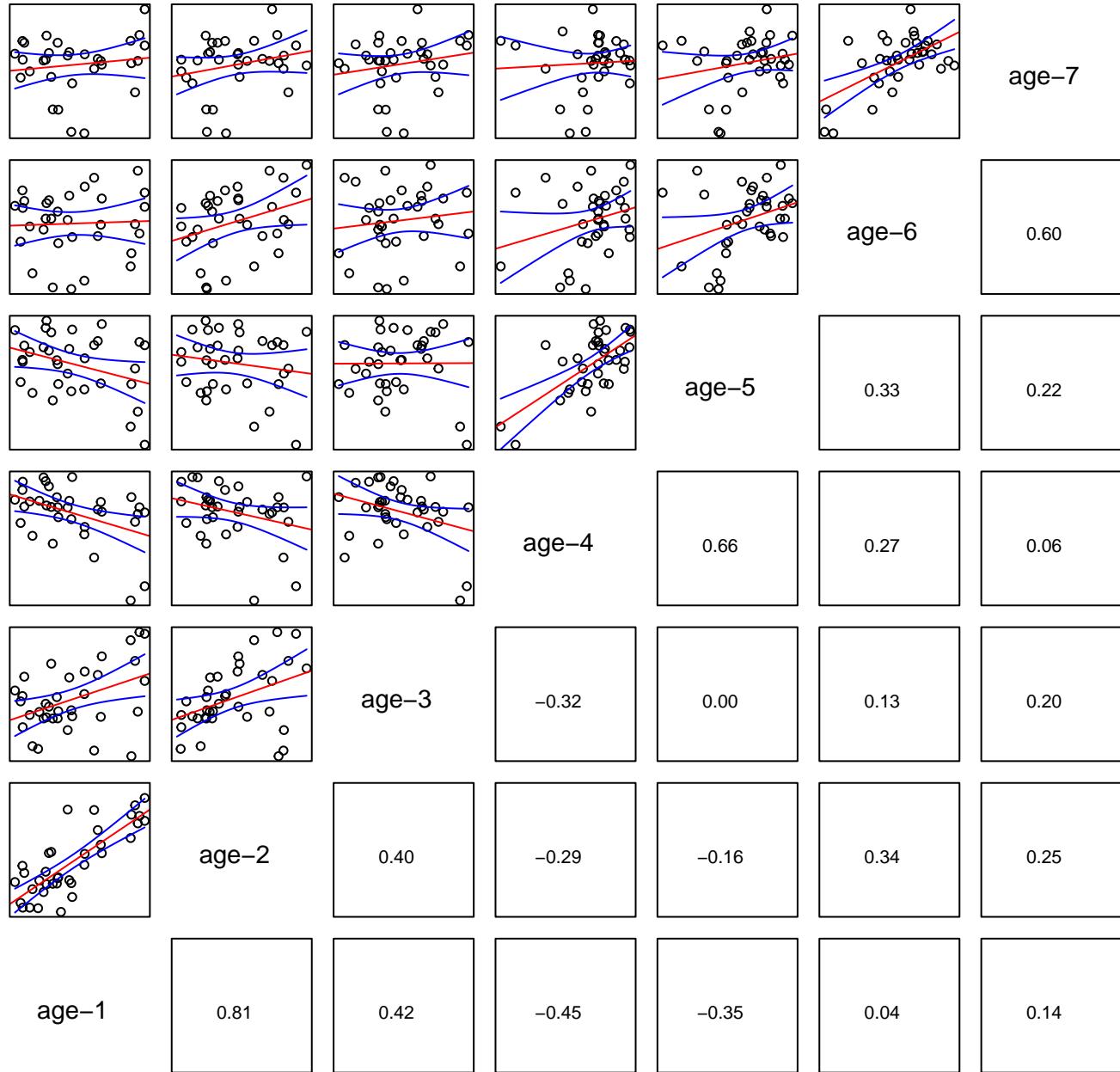




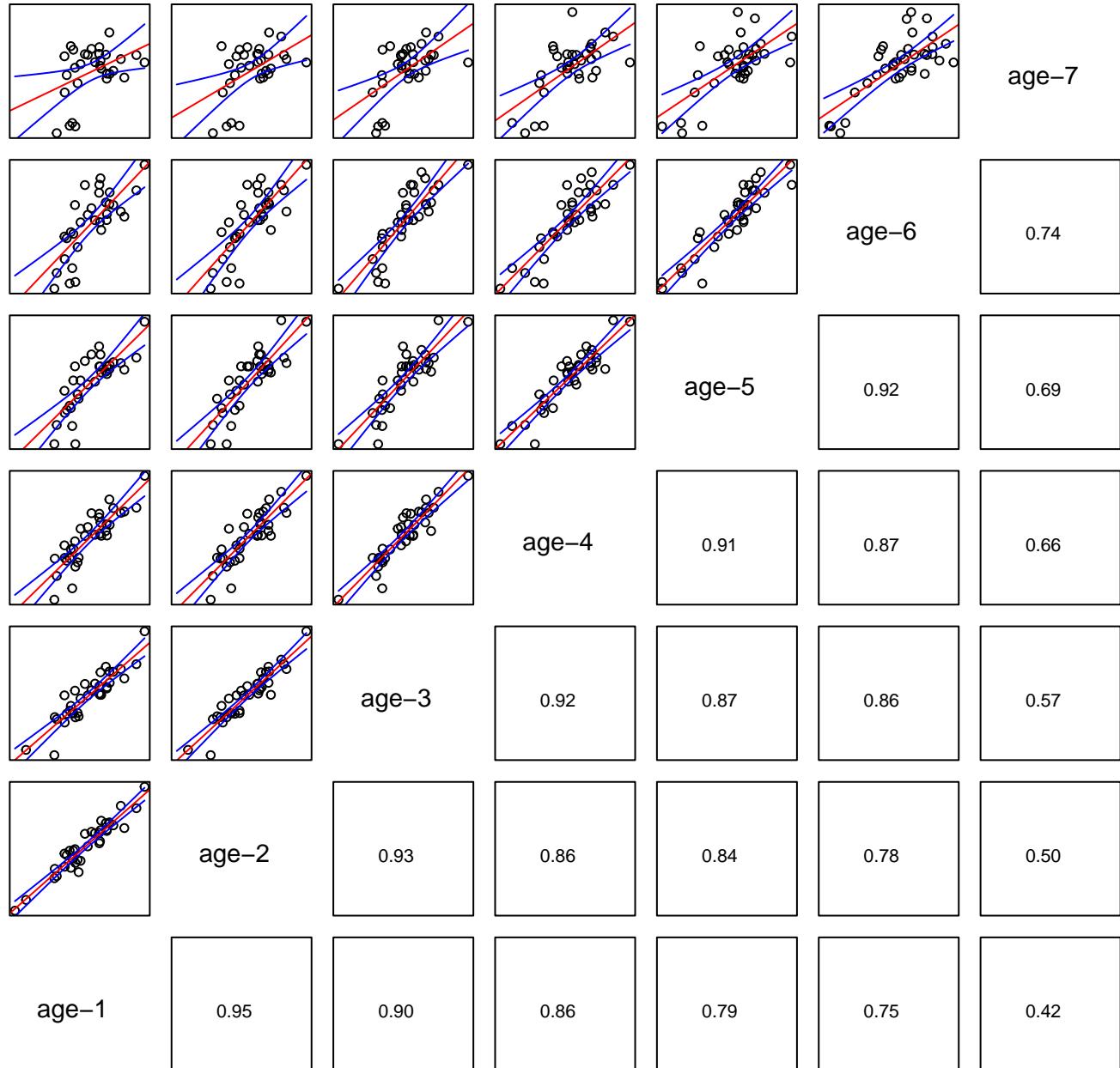
## MRIP



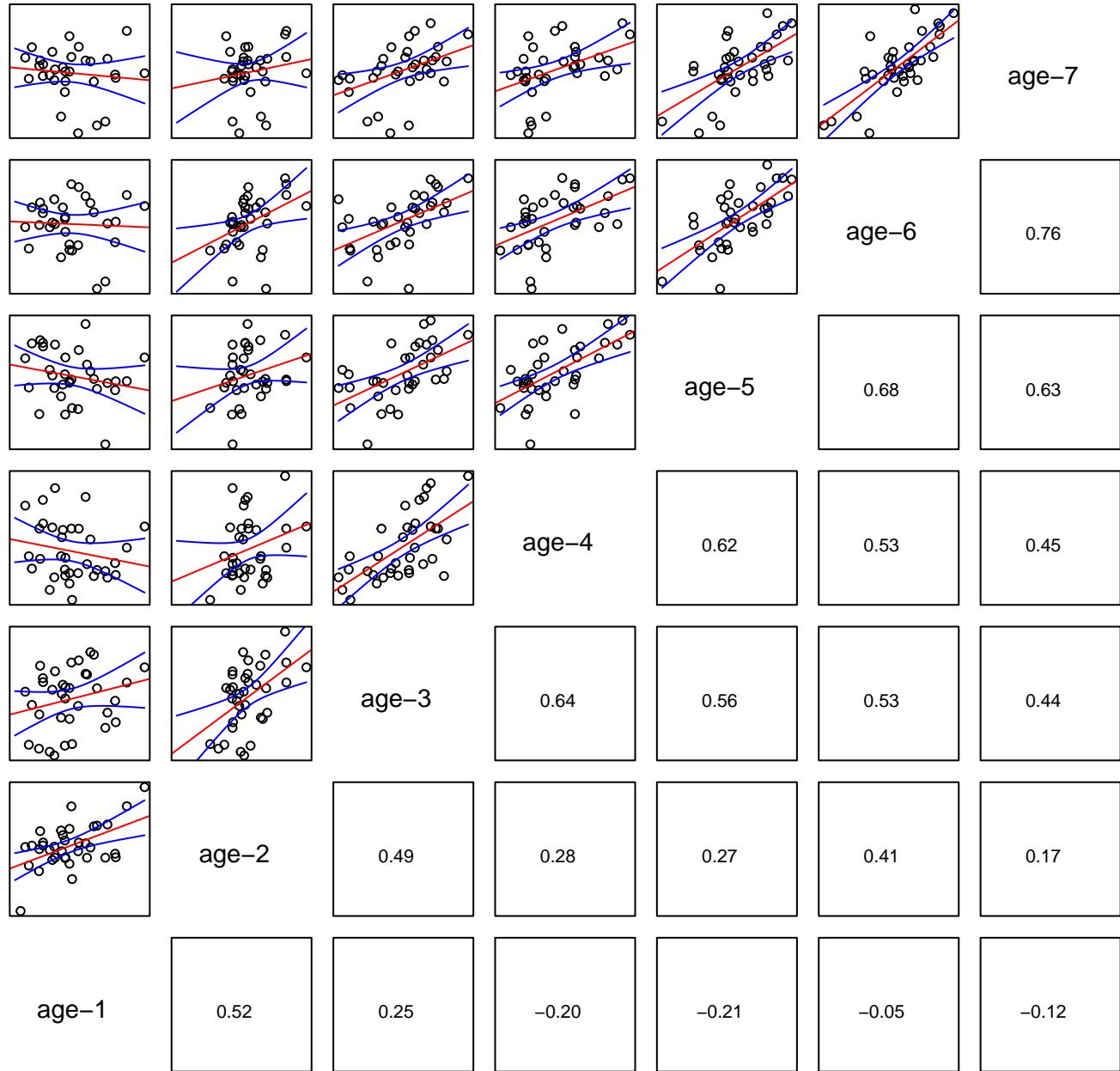
### Catch for Fleet 1 (Comm) Observed



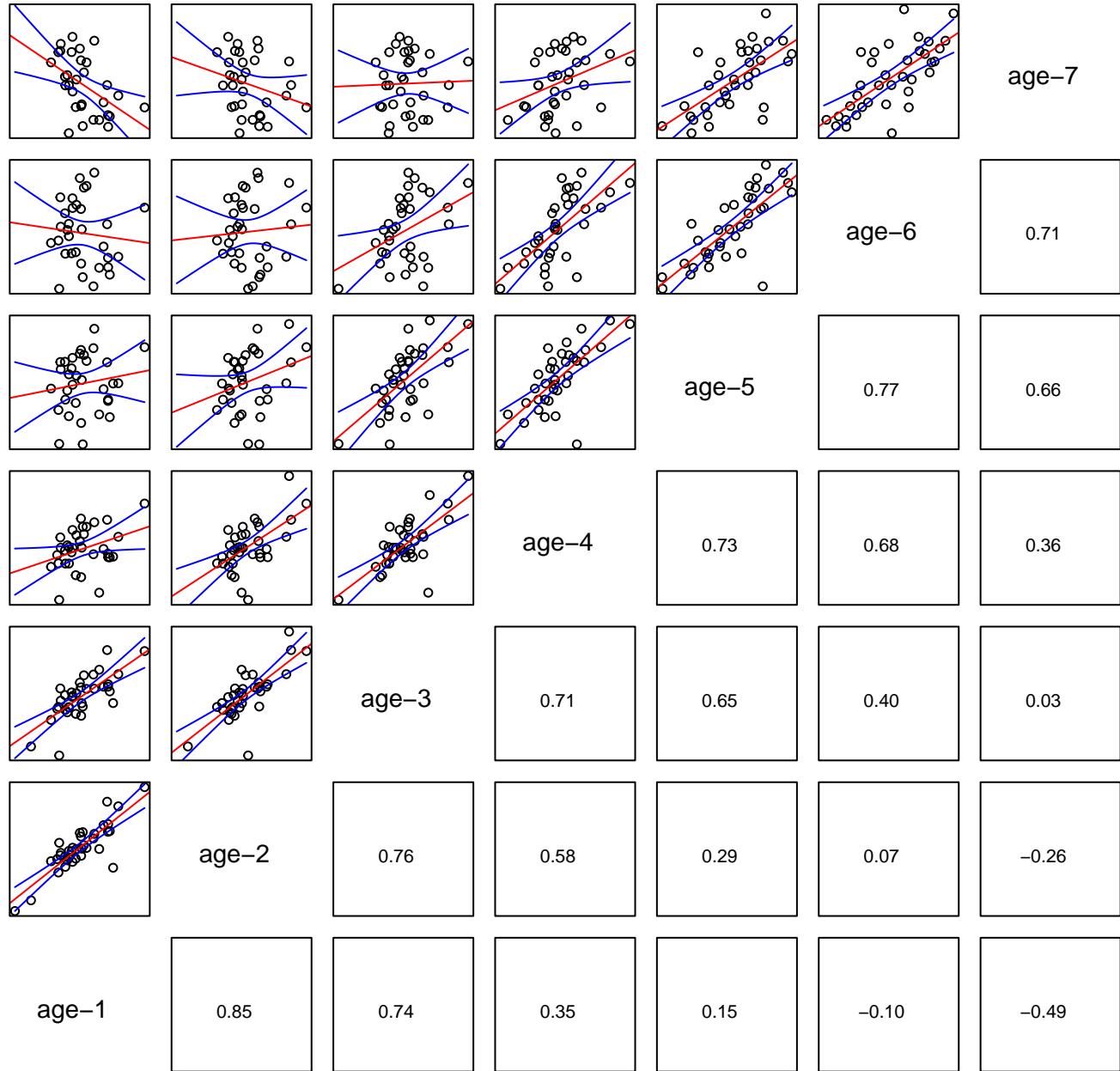
### Catch for Fleet 1 (Comm) Predicted



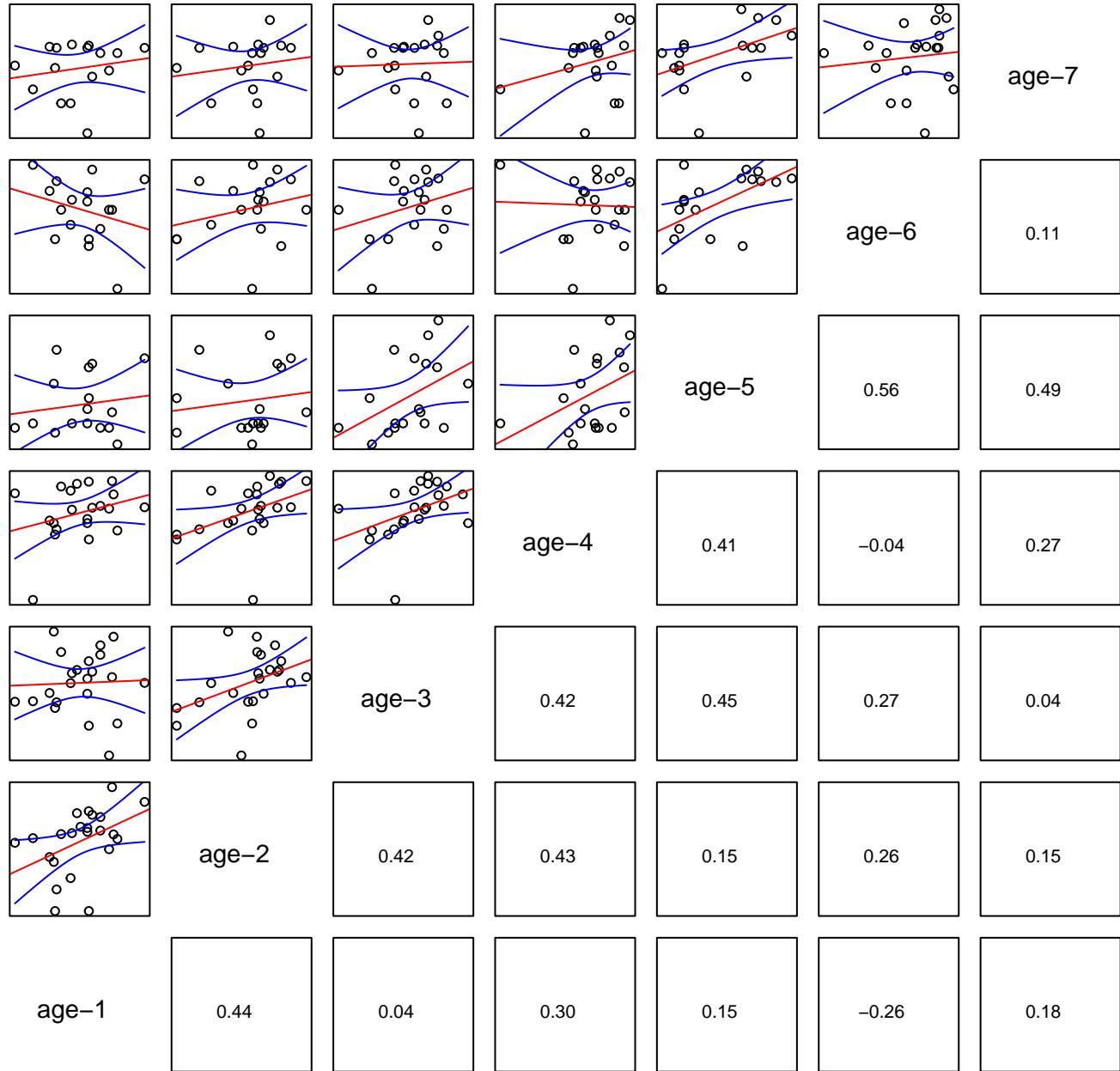
## Catch for Fleet 2 (Rec) Observed



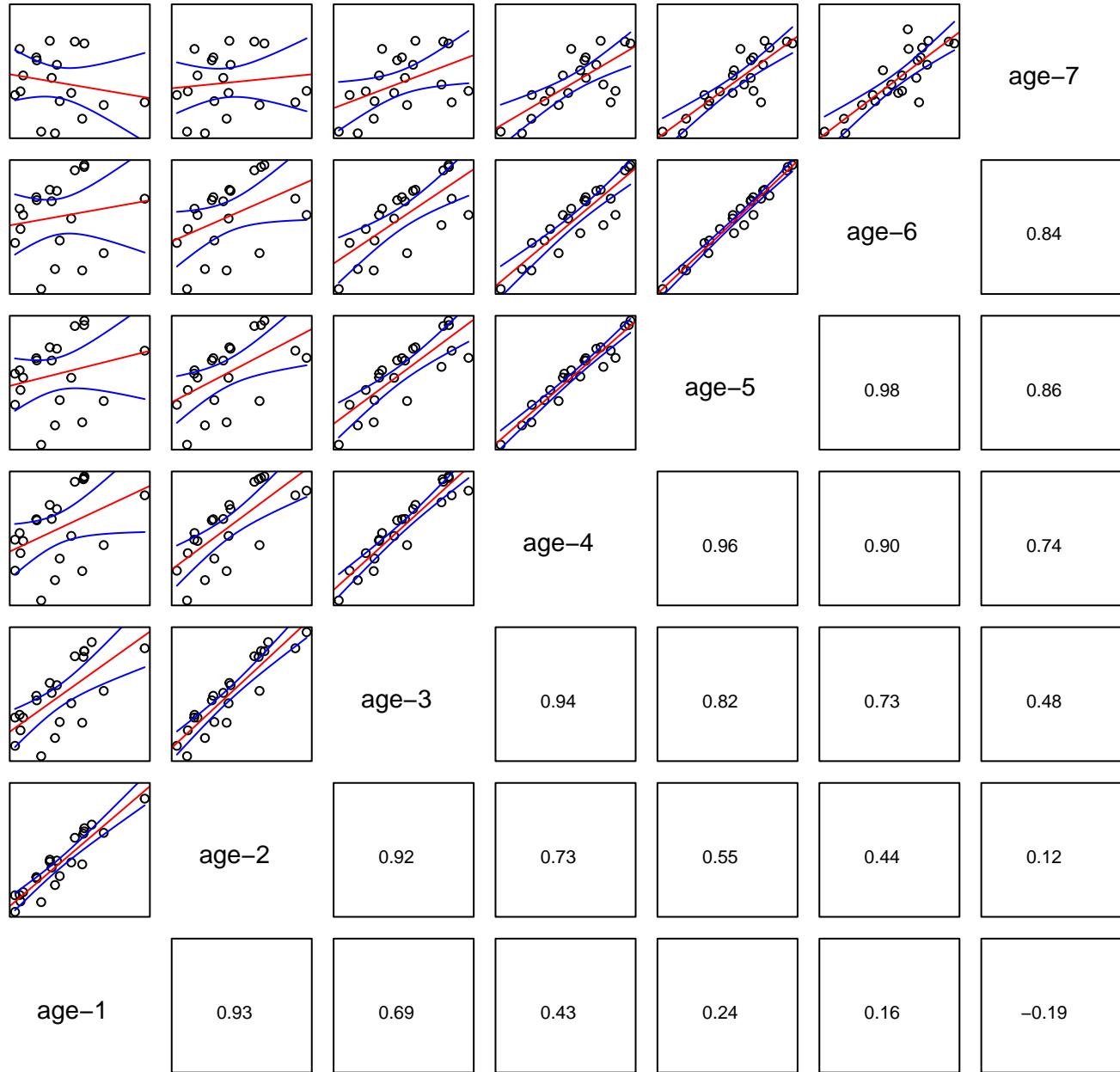
### Catch for Fleet 2 (Rec) Predicted



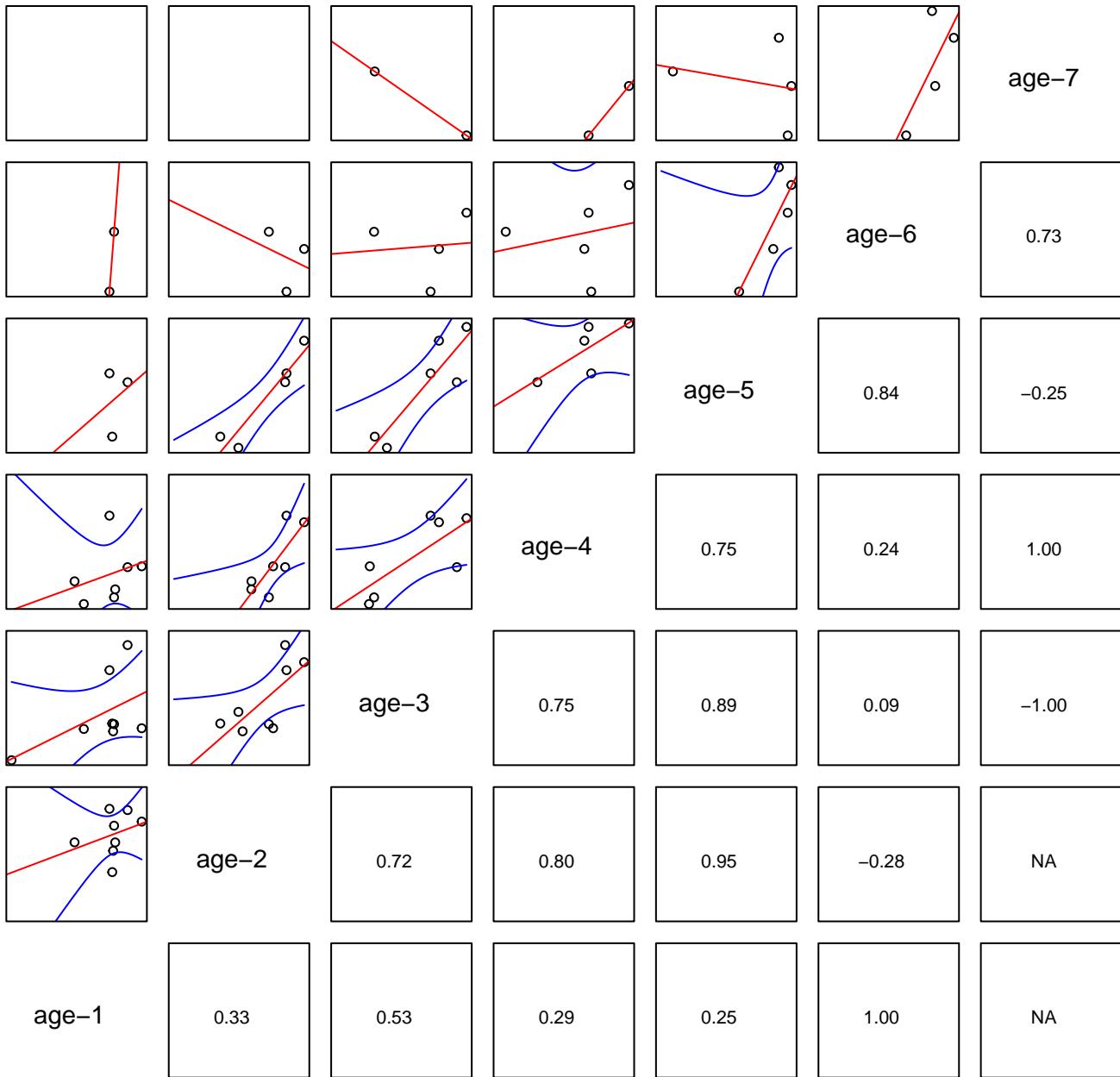
## **Index 1 (NEFSC Inshore) Observed**



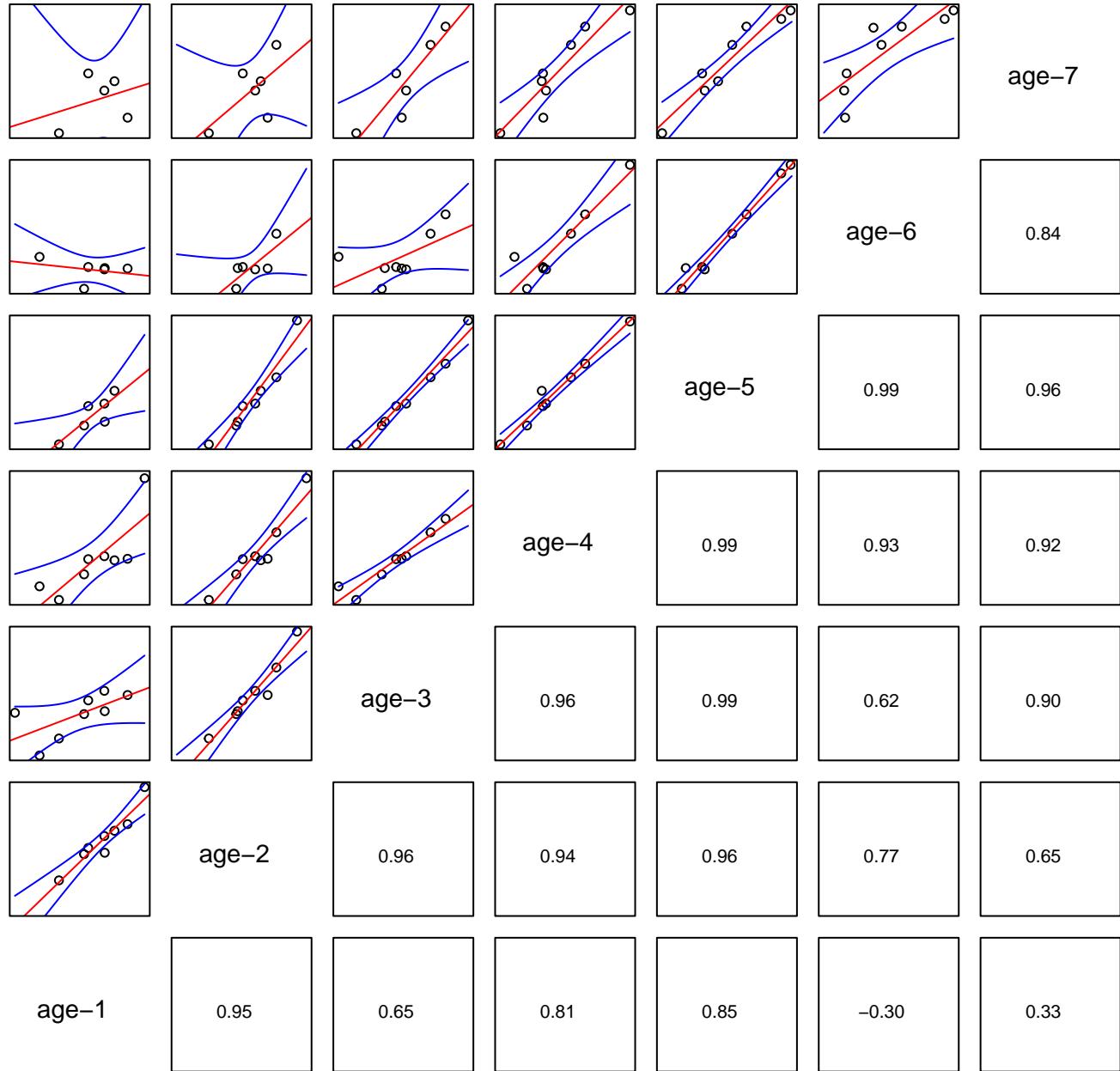
### Index 1 (NEFSC Inshore) Predicted



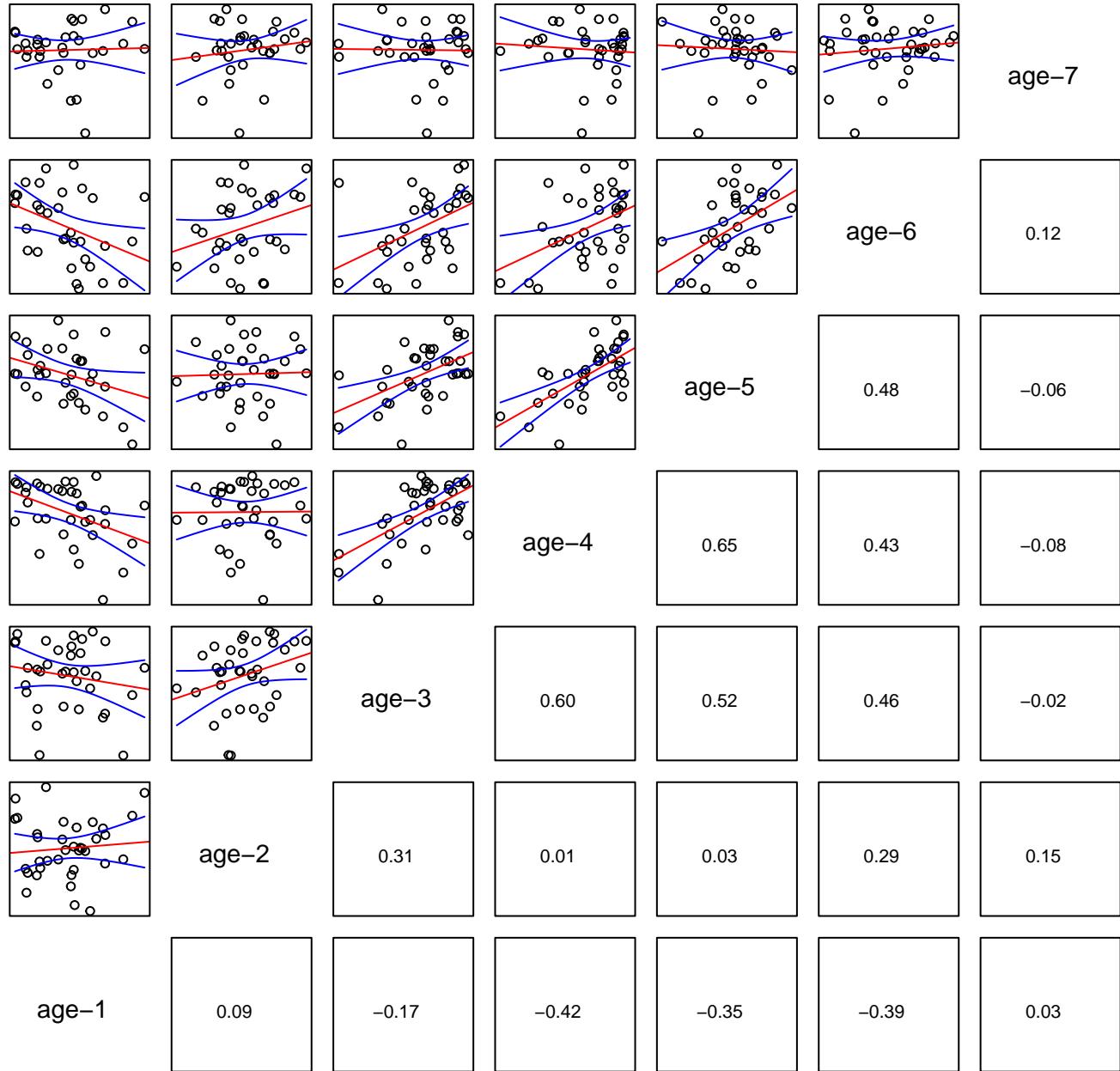
## Index 2 (Bigelow) Observed



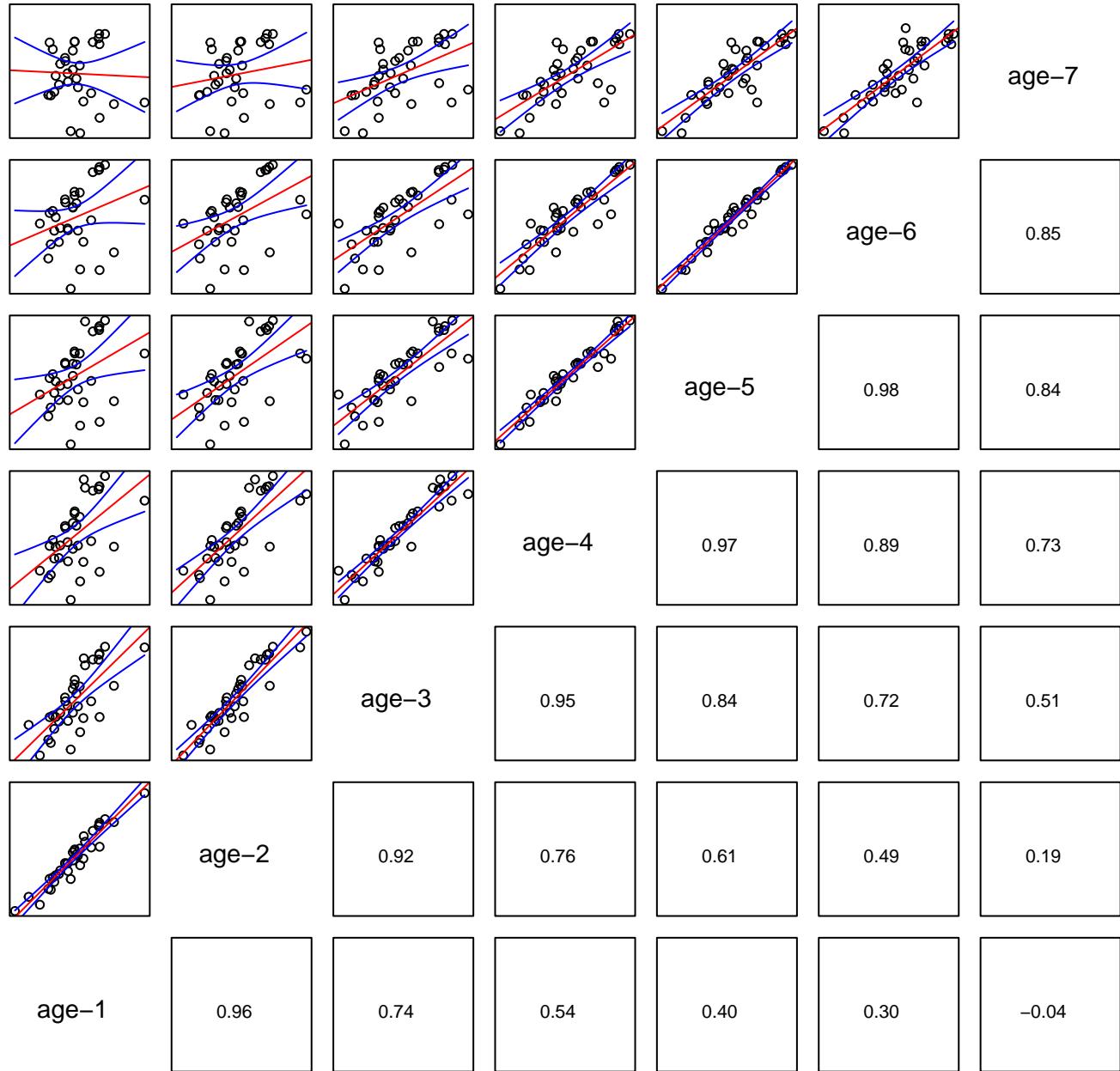
## Index 2 (Bigelow) Predicted



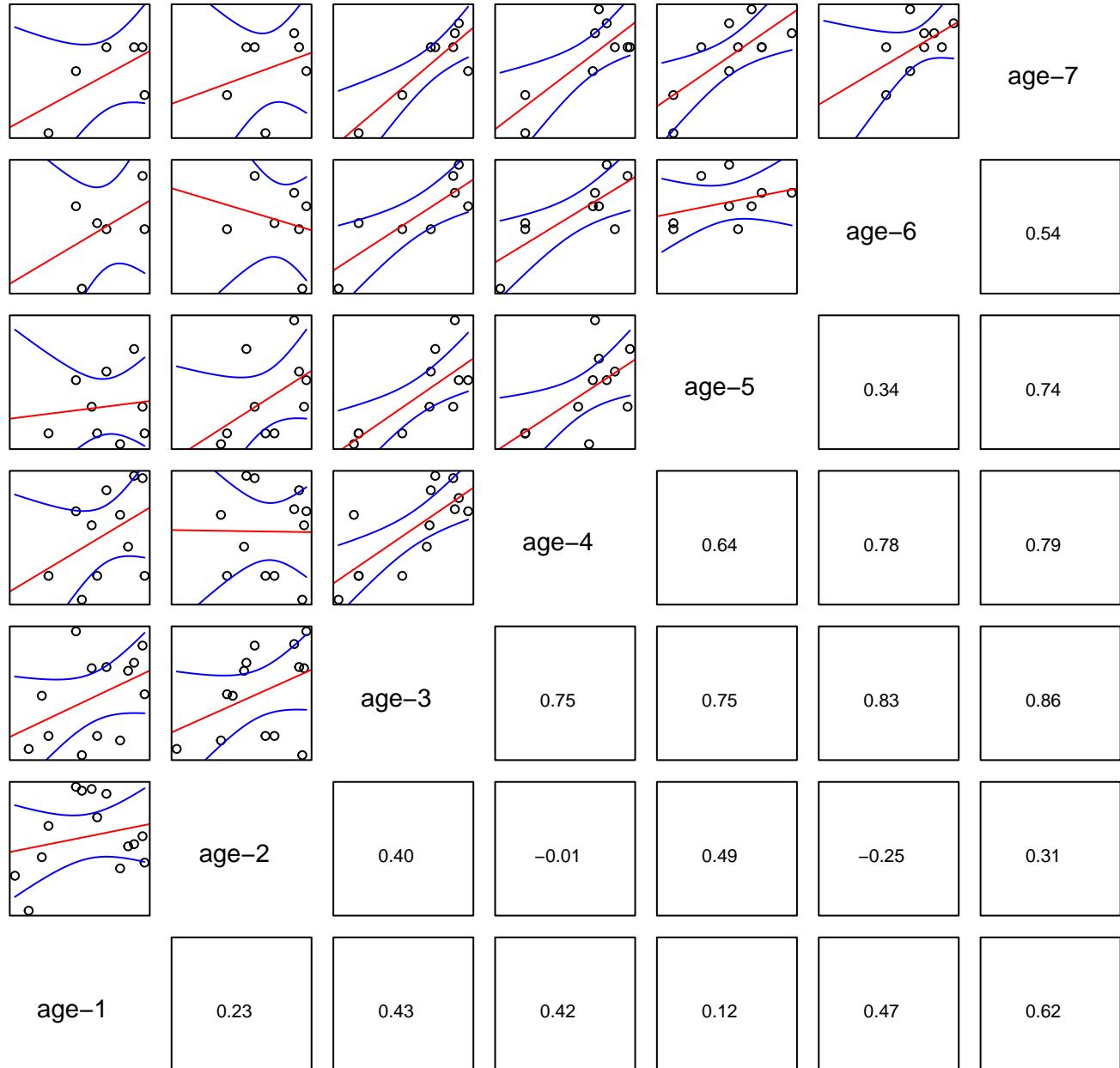
### Index 3 (MRIP) Observed



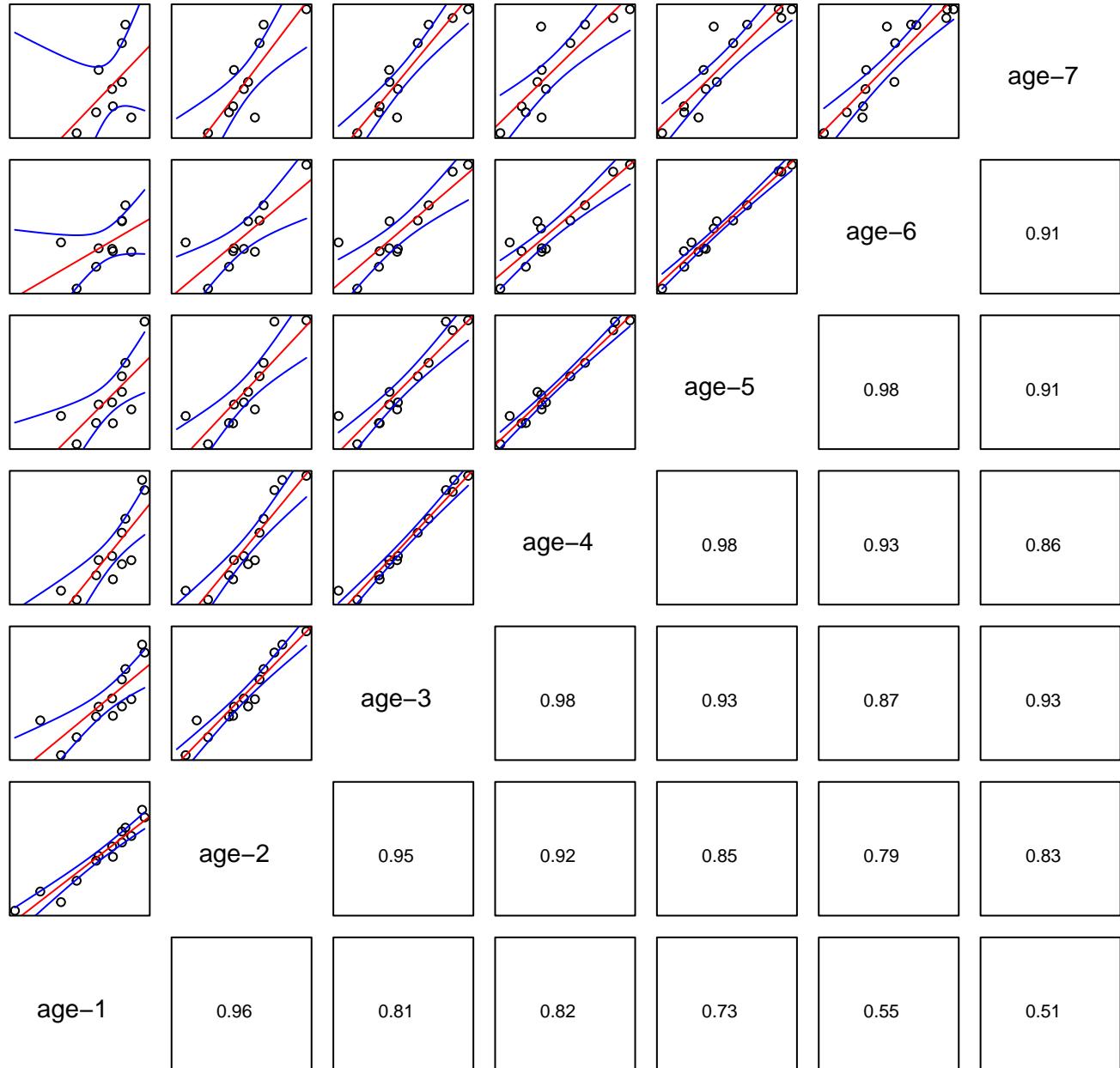
### Index 3 (MRIP) Predicted



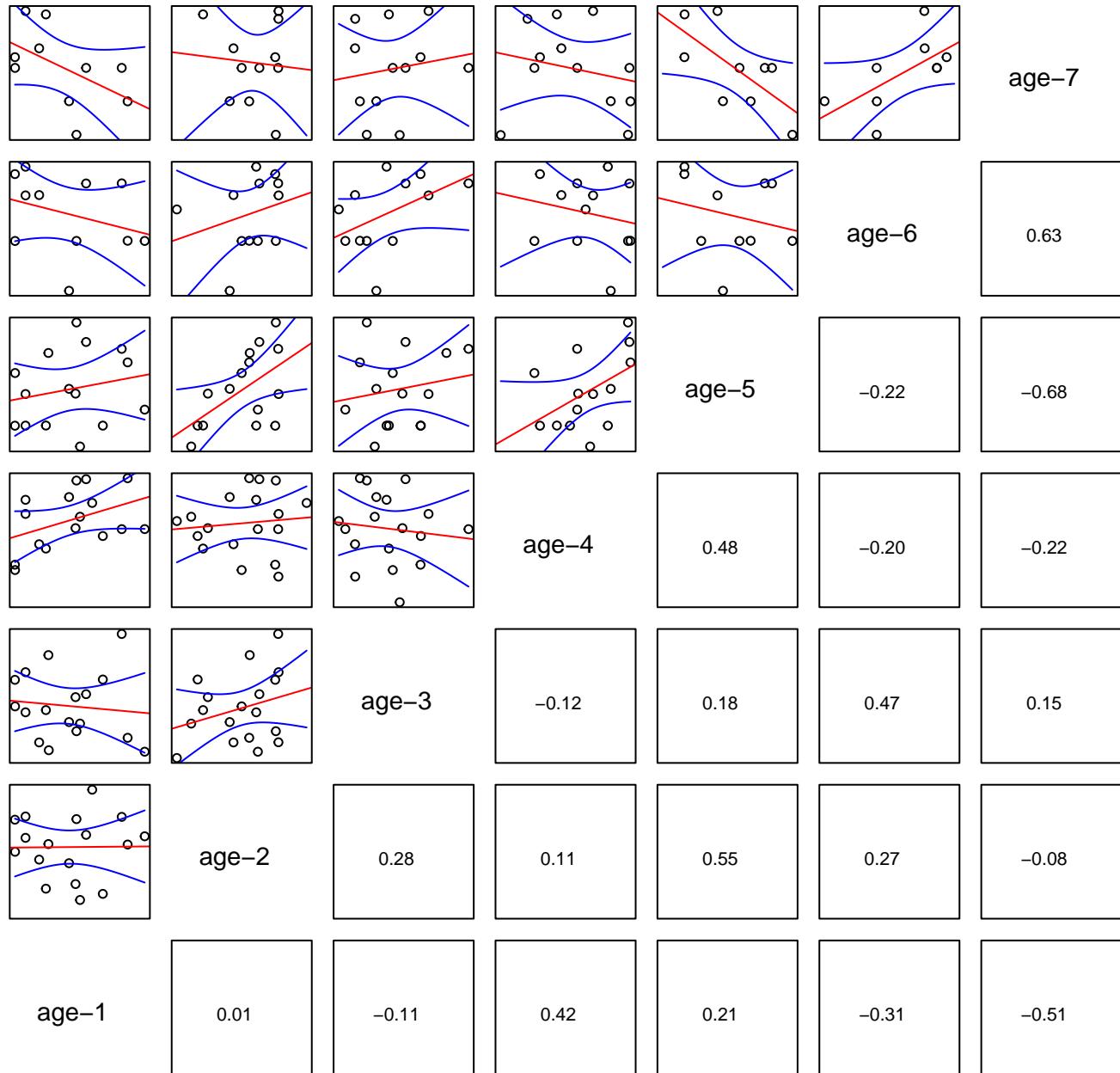
### Index 4 (NEAMAP) Observed



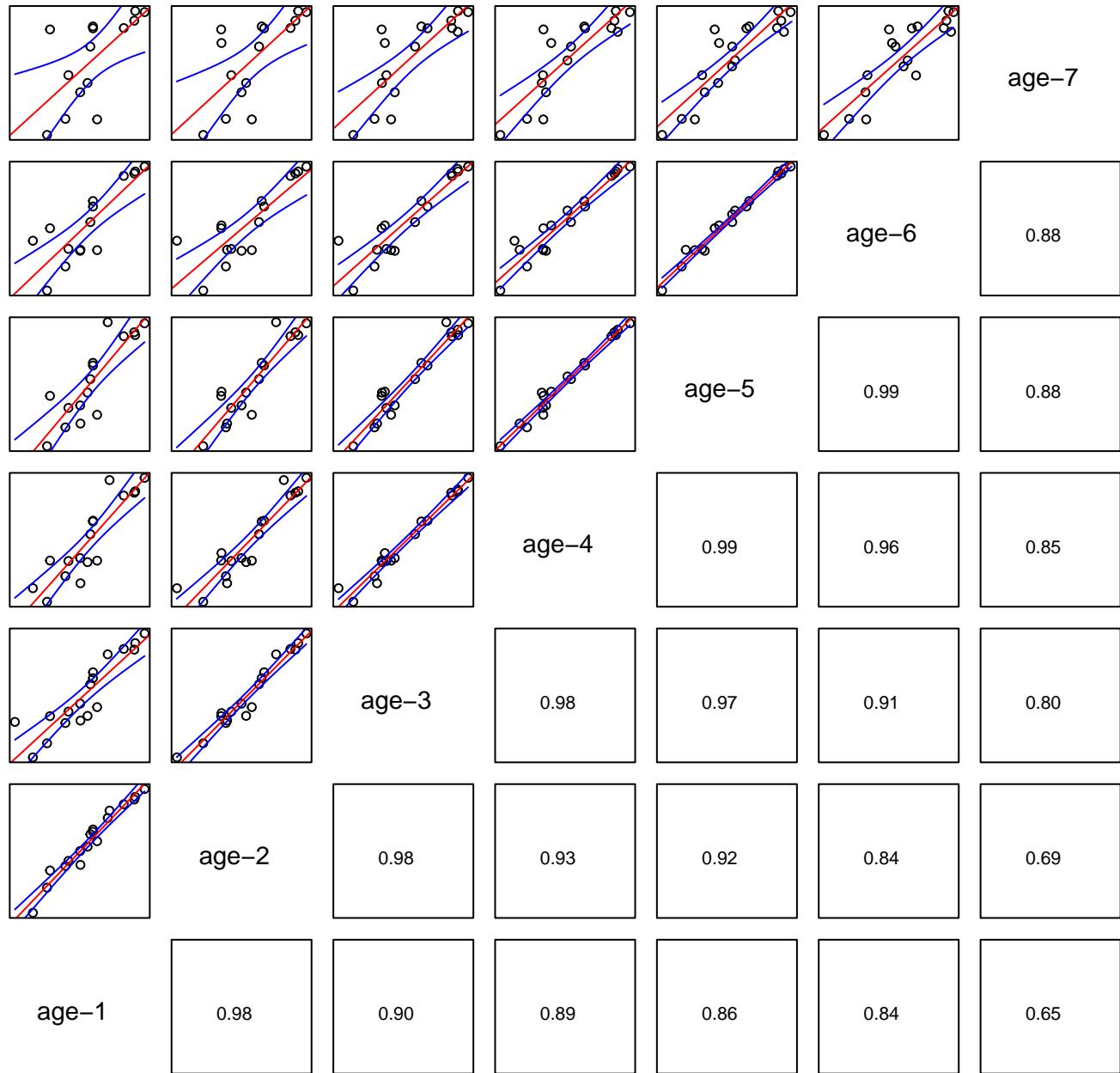
### Index 4 (NEAMAP) Predicted



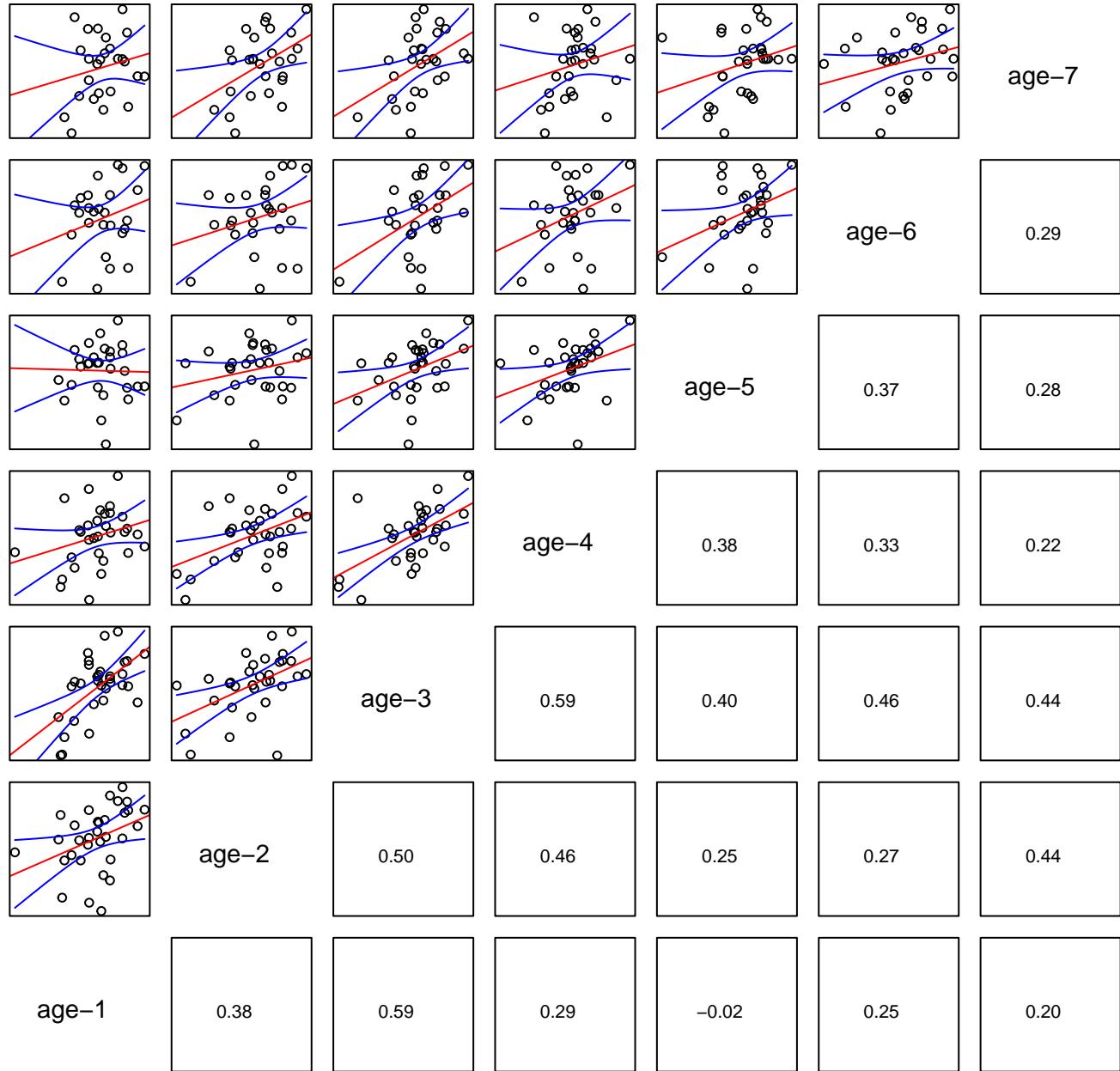
### Index 6 (PSIGN) Observed



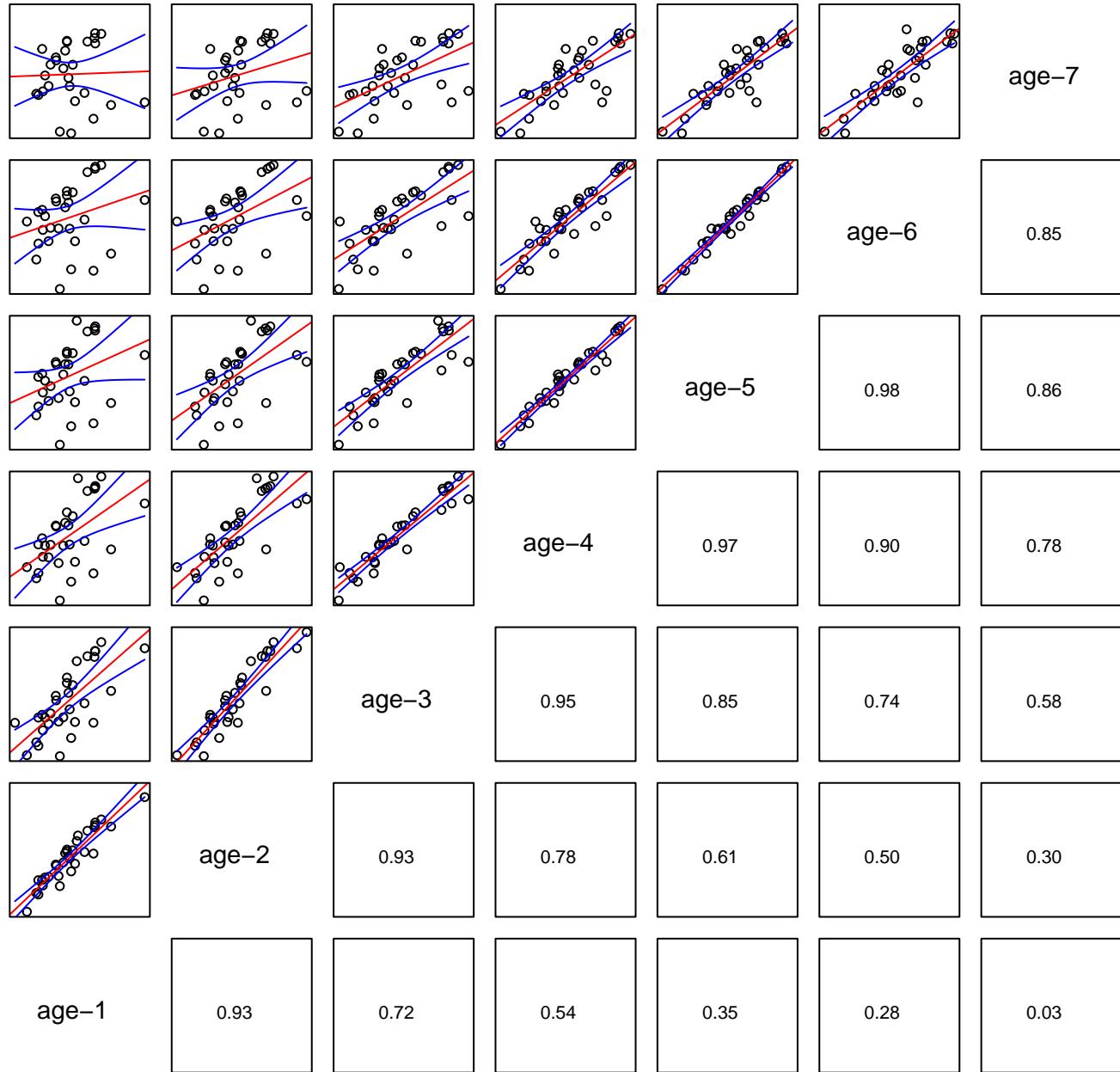
### Index 6 (PSIGN) Predicted



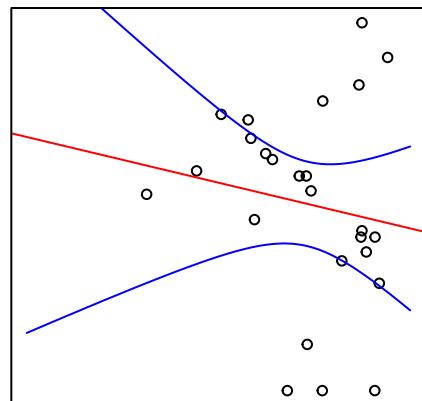
### Index 7 (CT Trawl) Observed



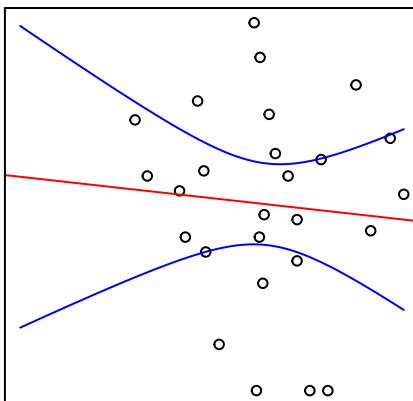
### Index 7 (CT Trawl) Predicted



### Index 8 (NJ Trawl) Observed

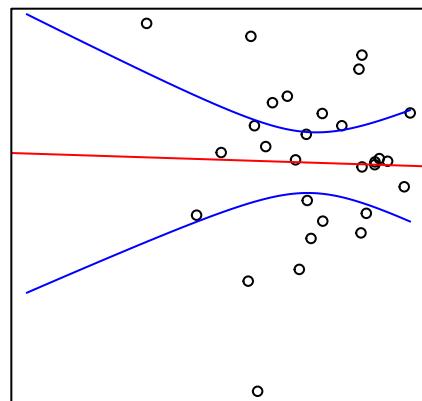


age-1



age-2

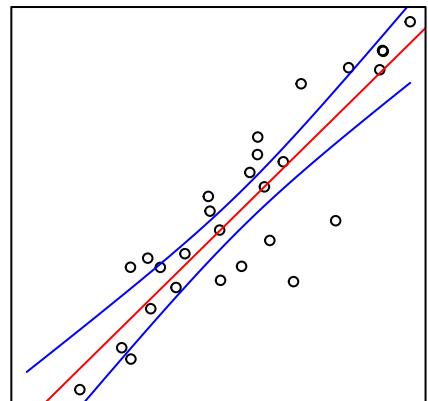
-0.08



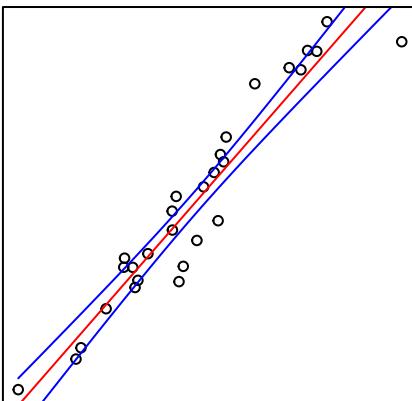
-0.15

-0.03

### Index 8 (NJ Trawl) Predicted

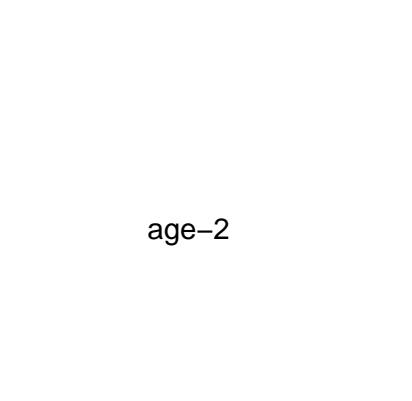


age-1

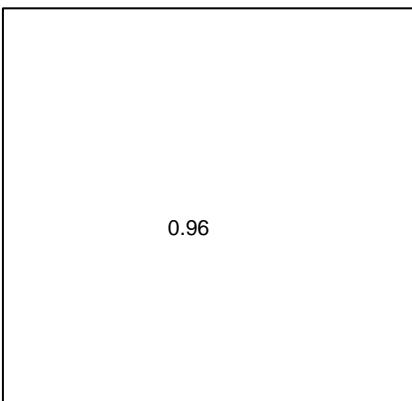


age-2

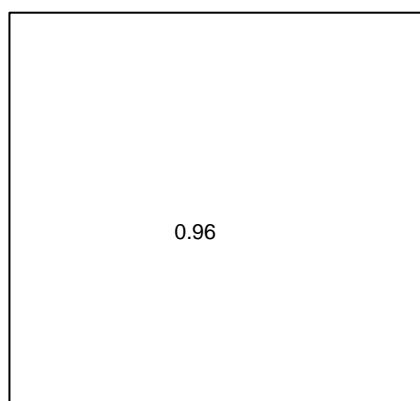
0.96



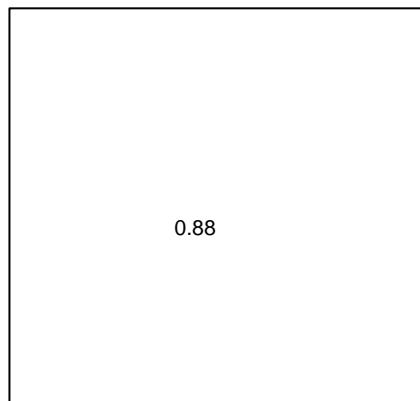
0.96

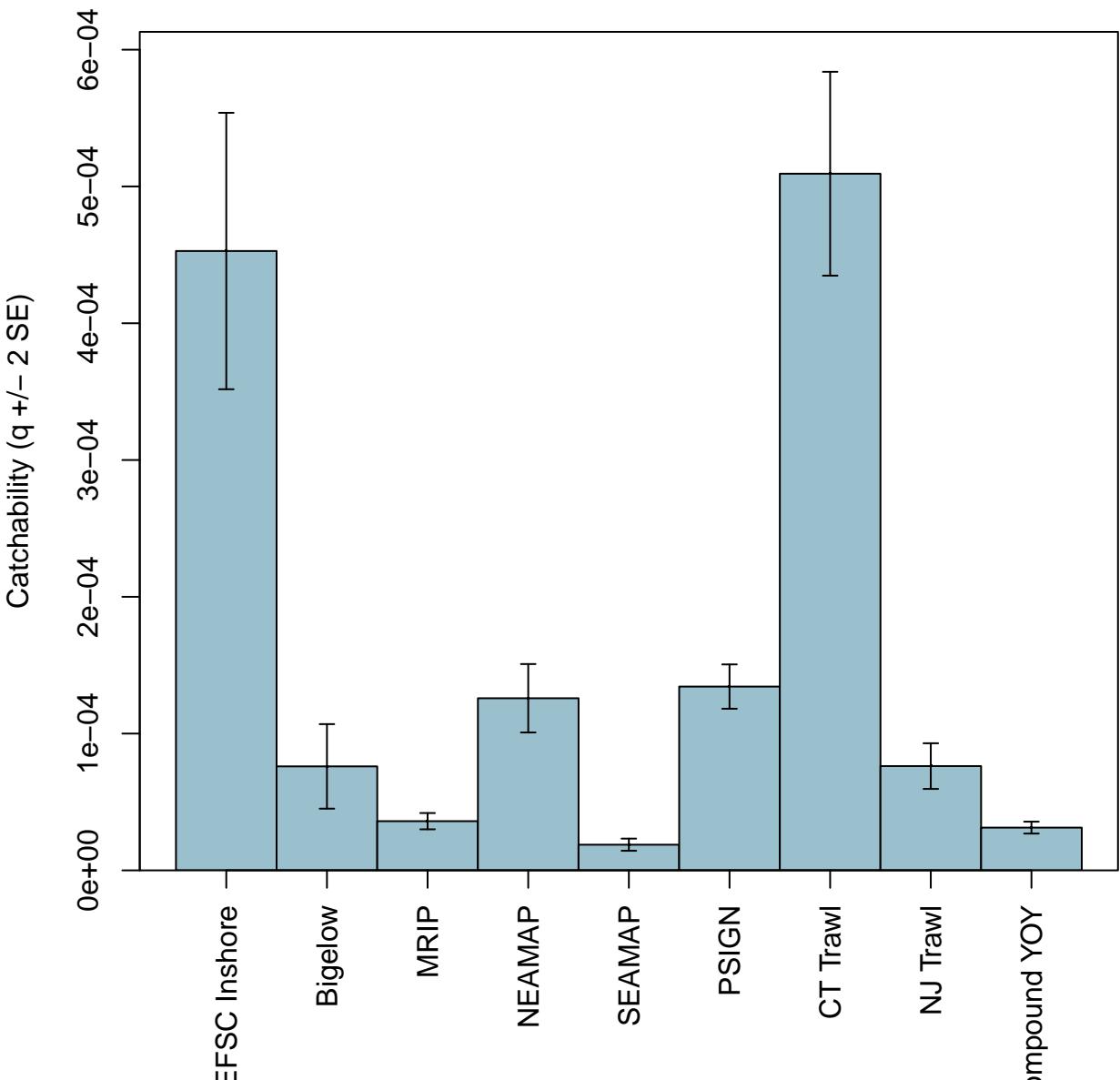


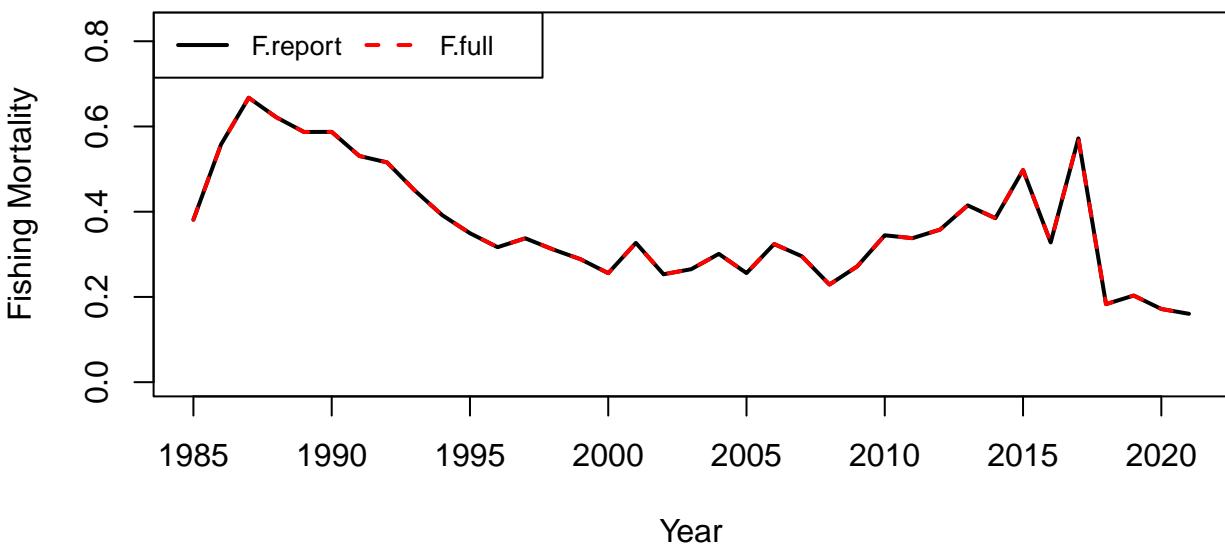
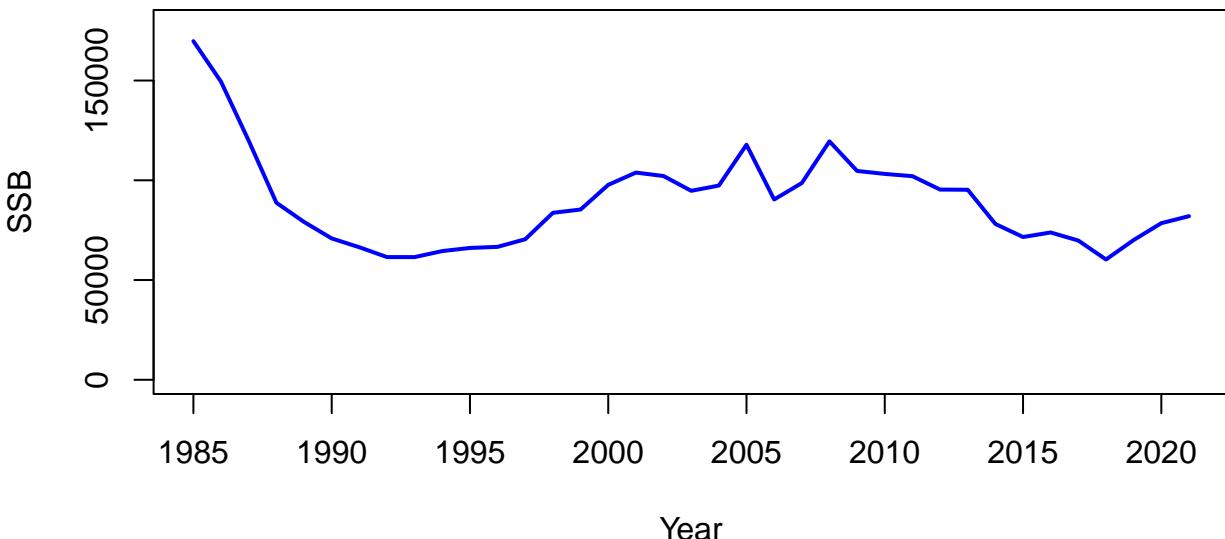
0.96



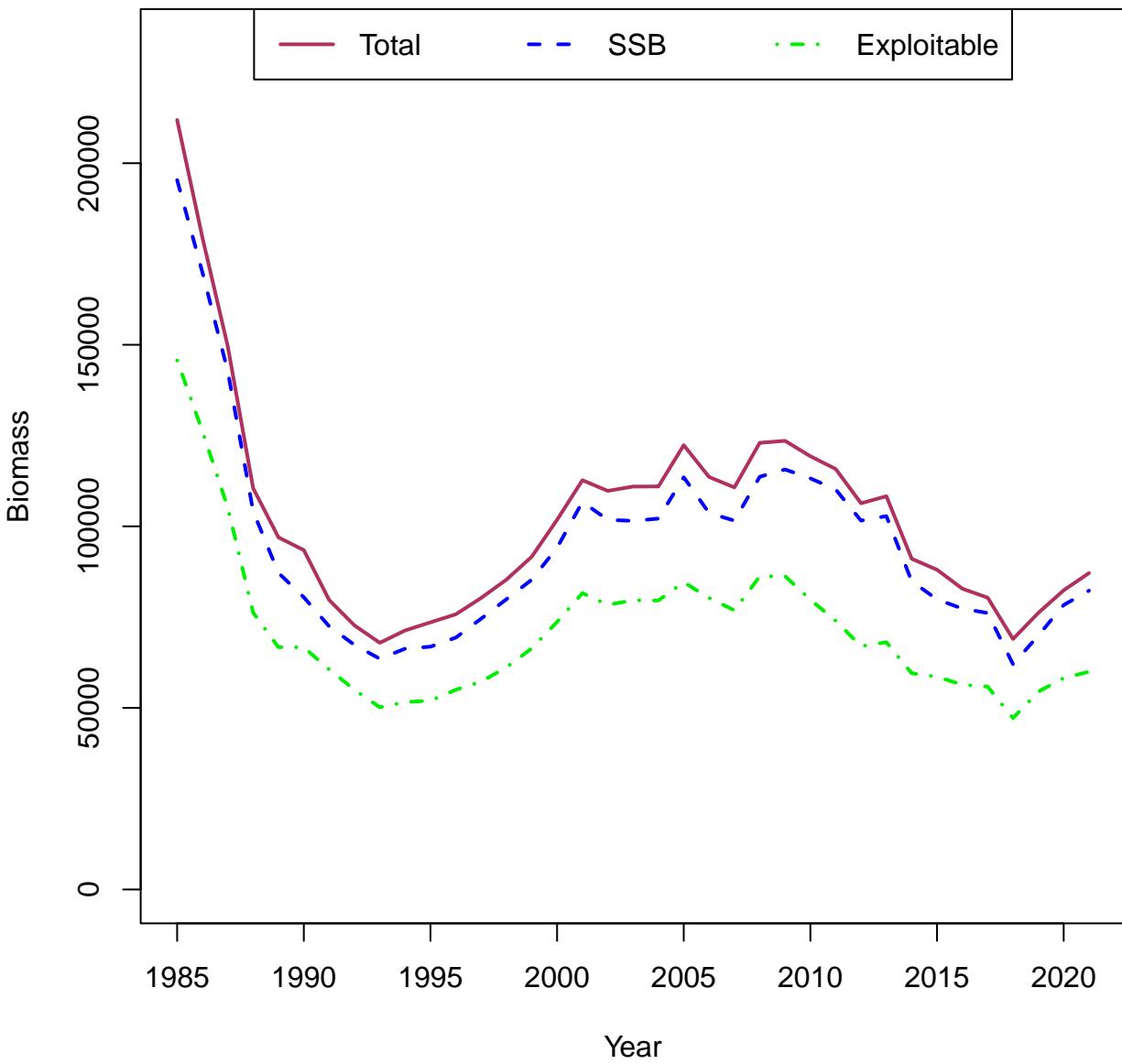
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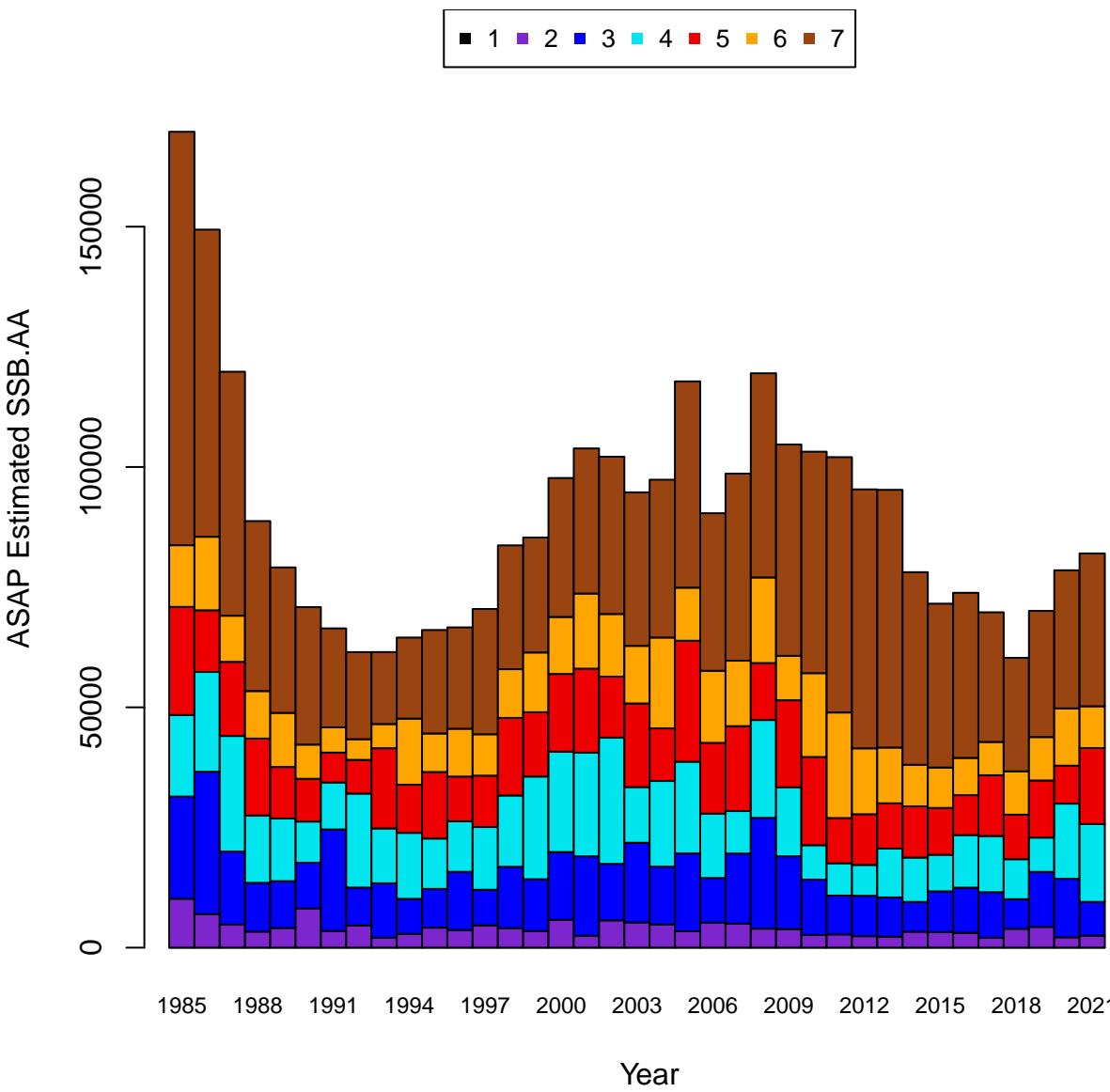


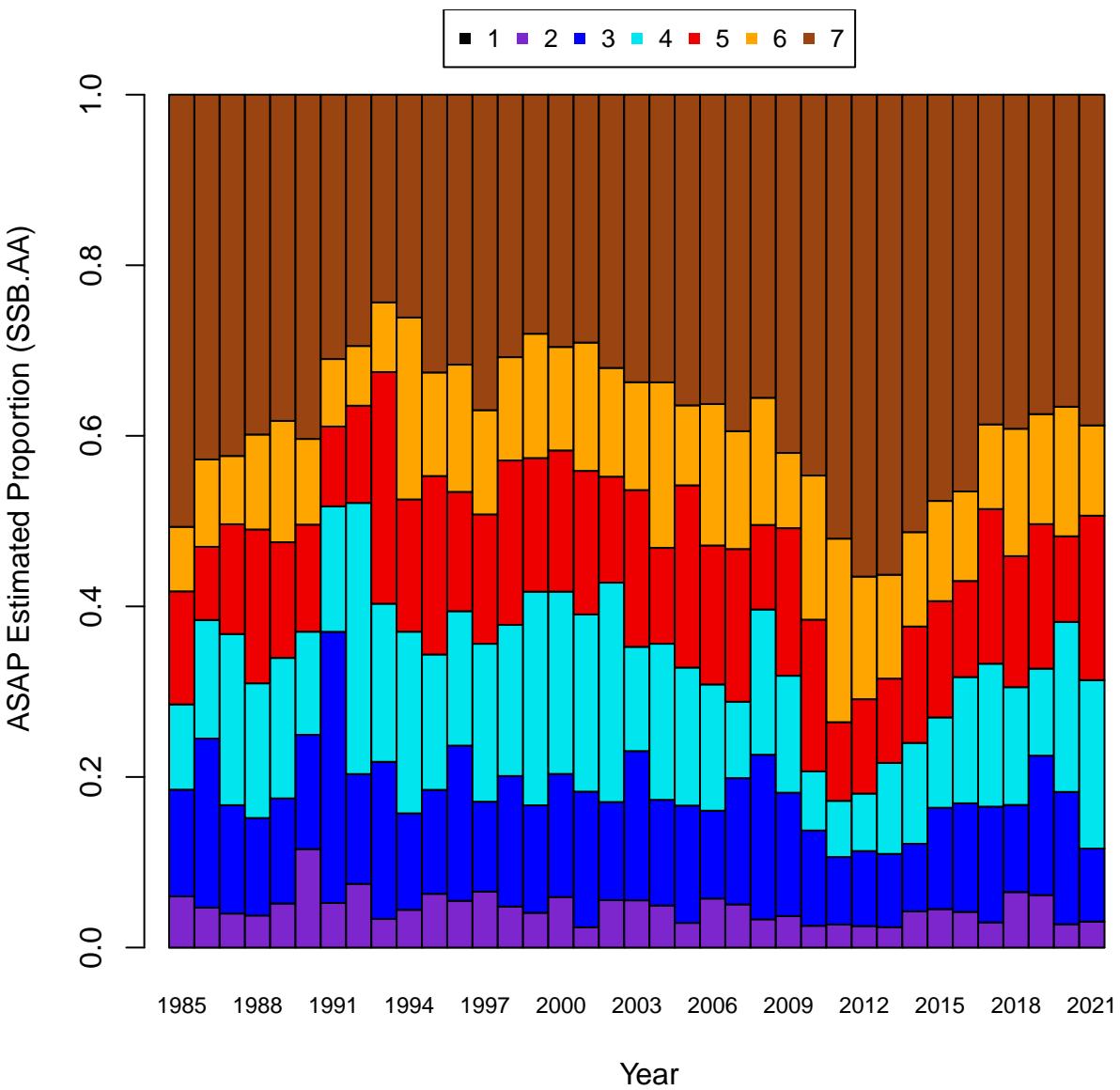


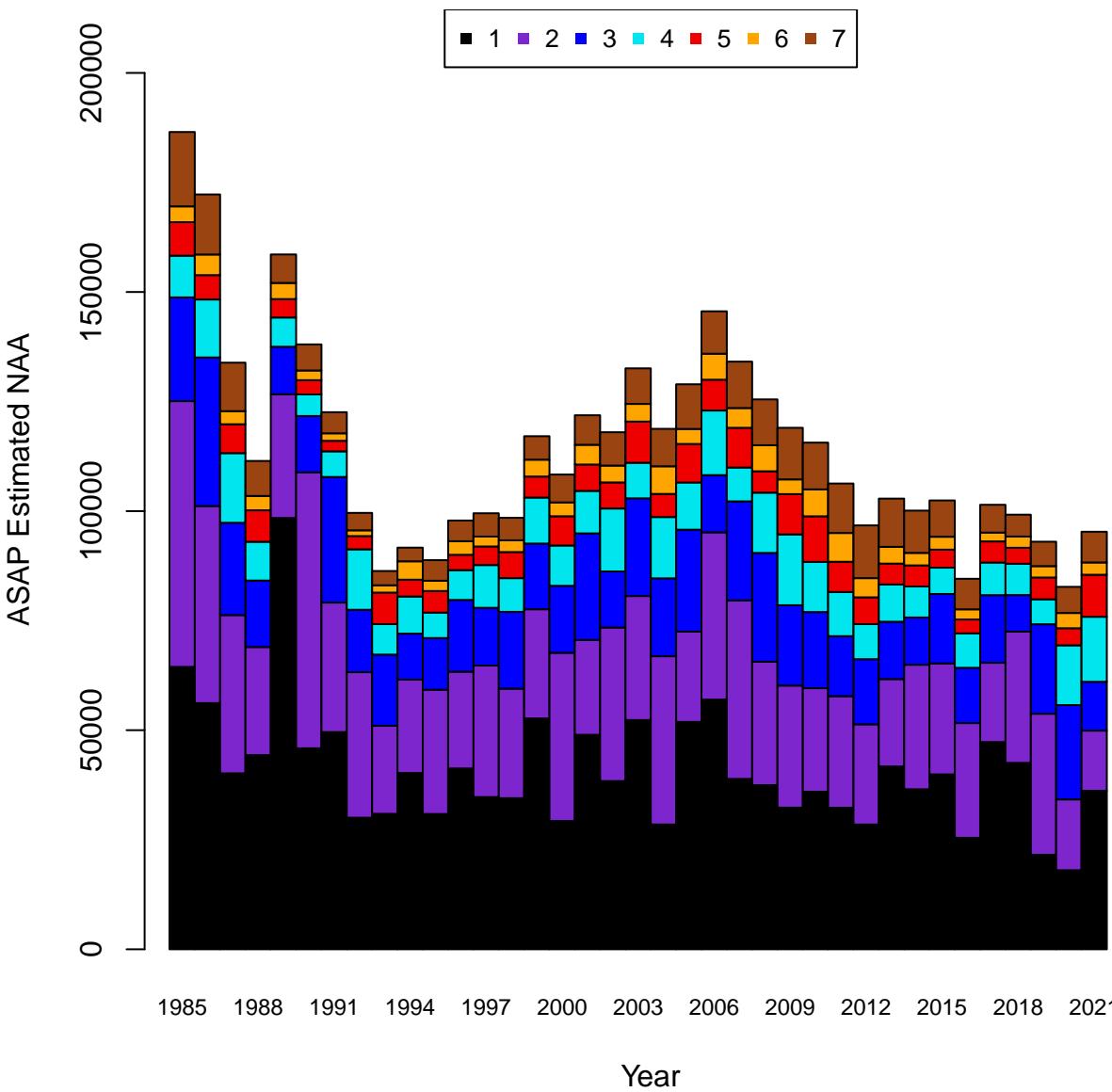


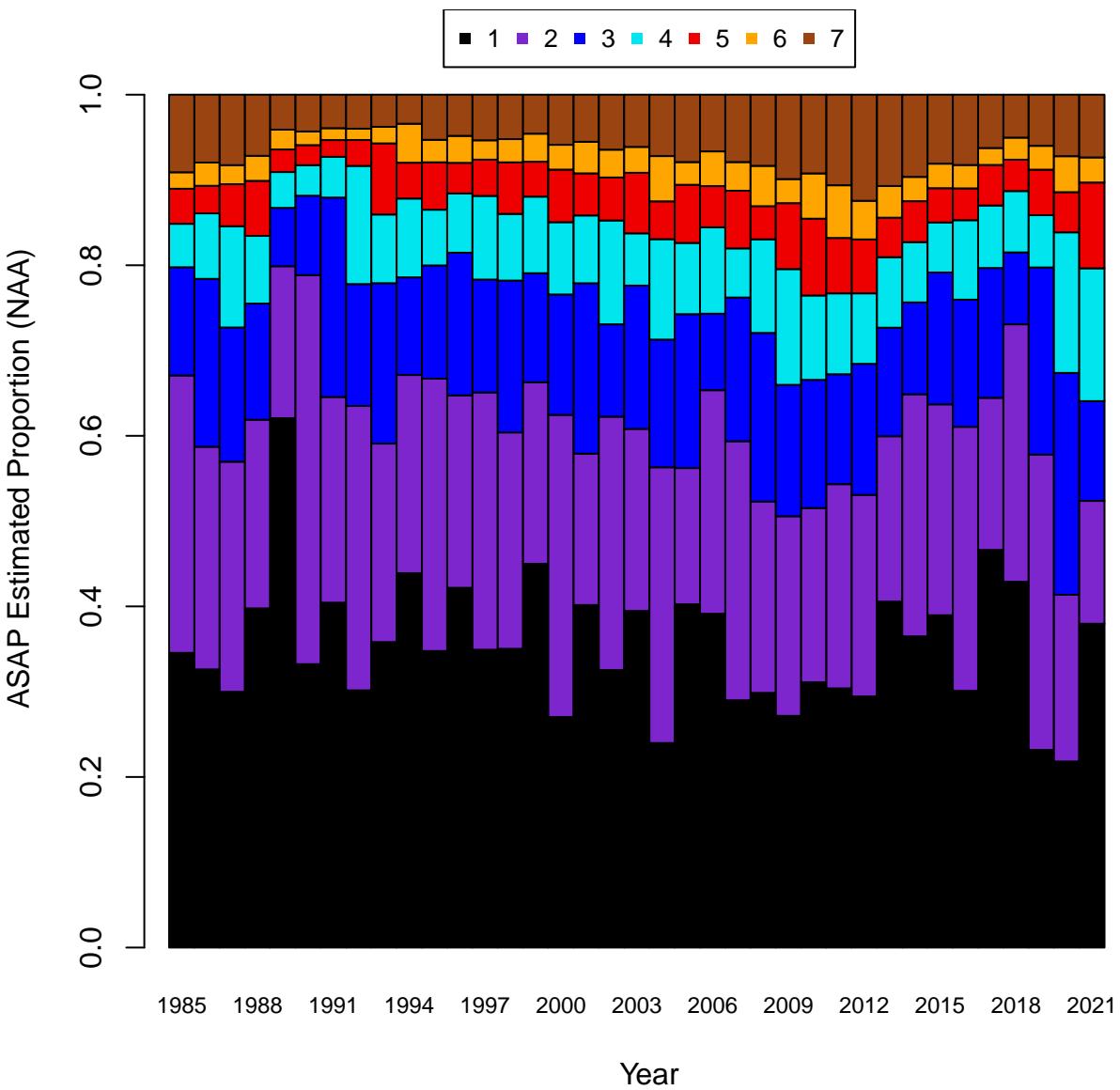
## Comparison of January 1 Biomass

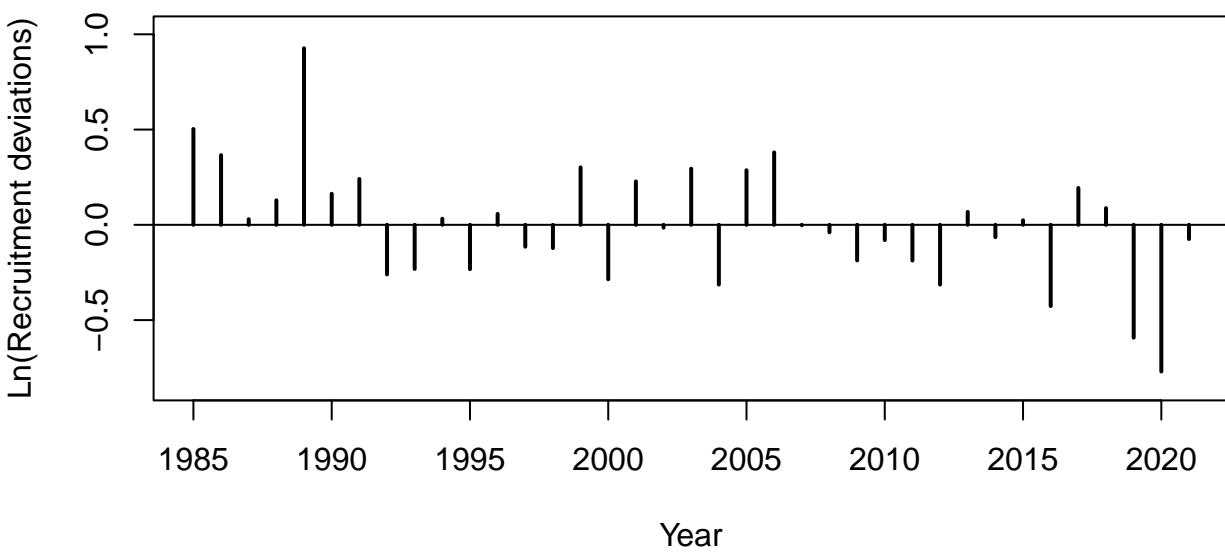
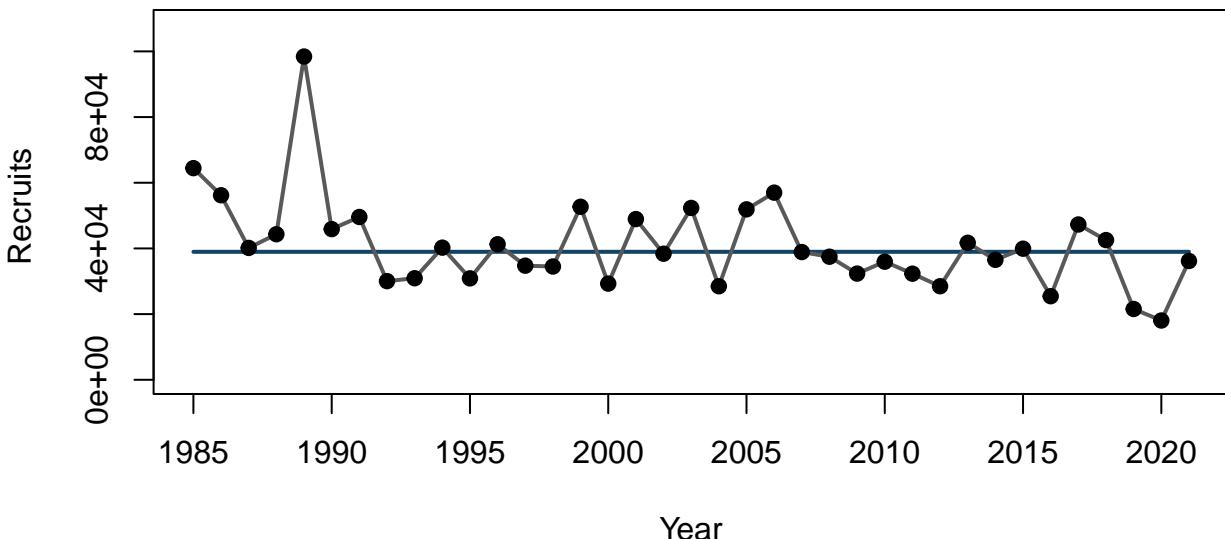


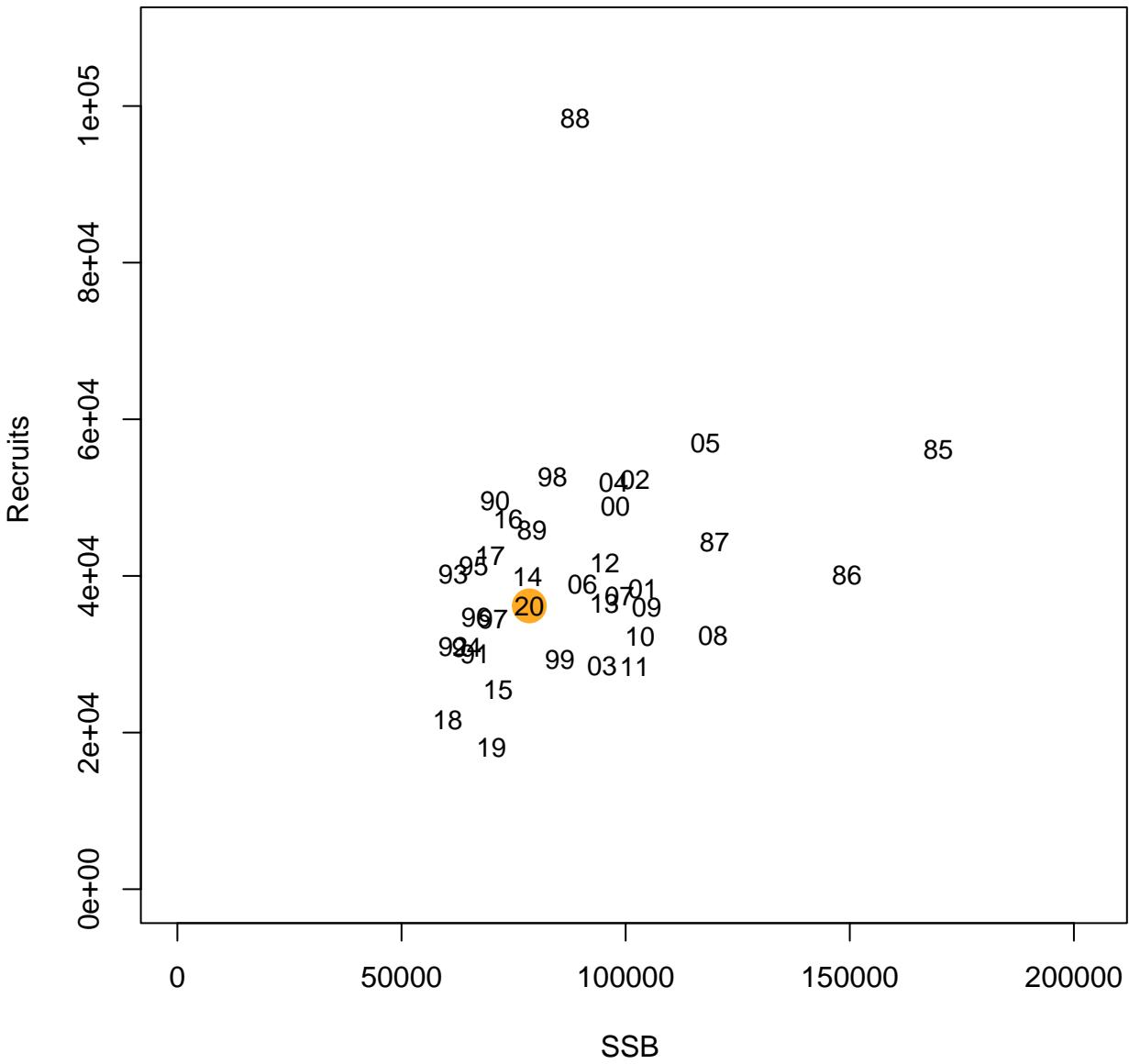


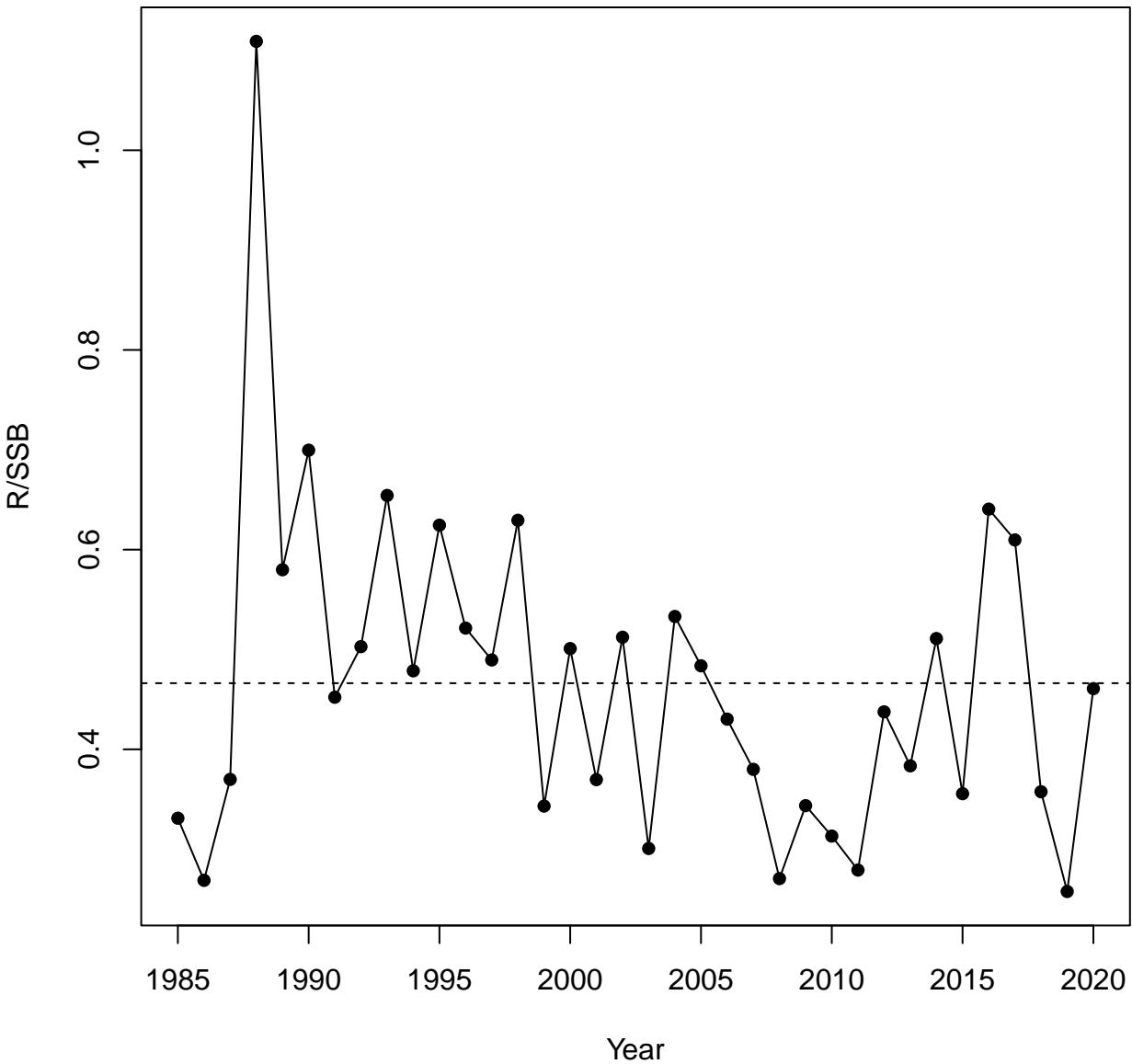


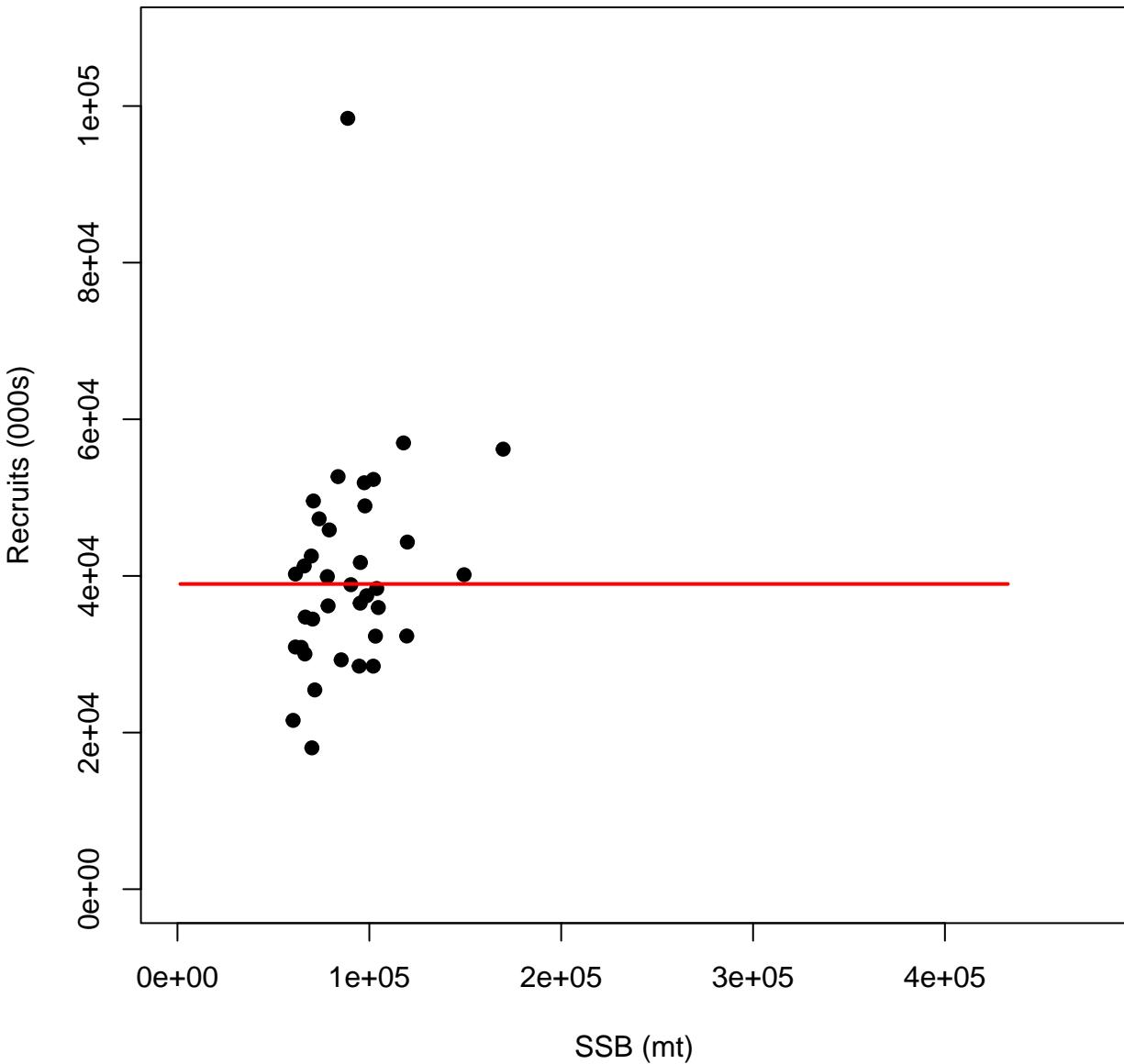


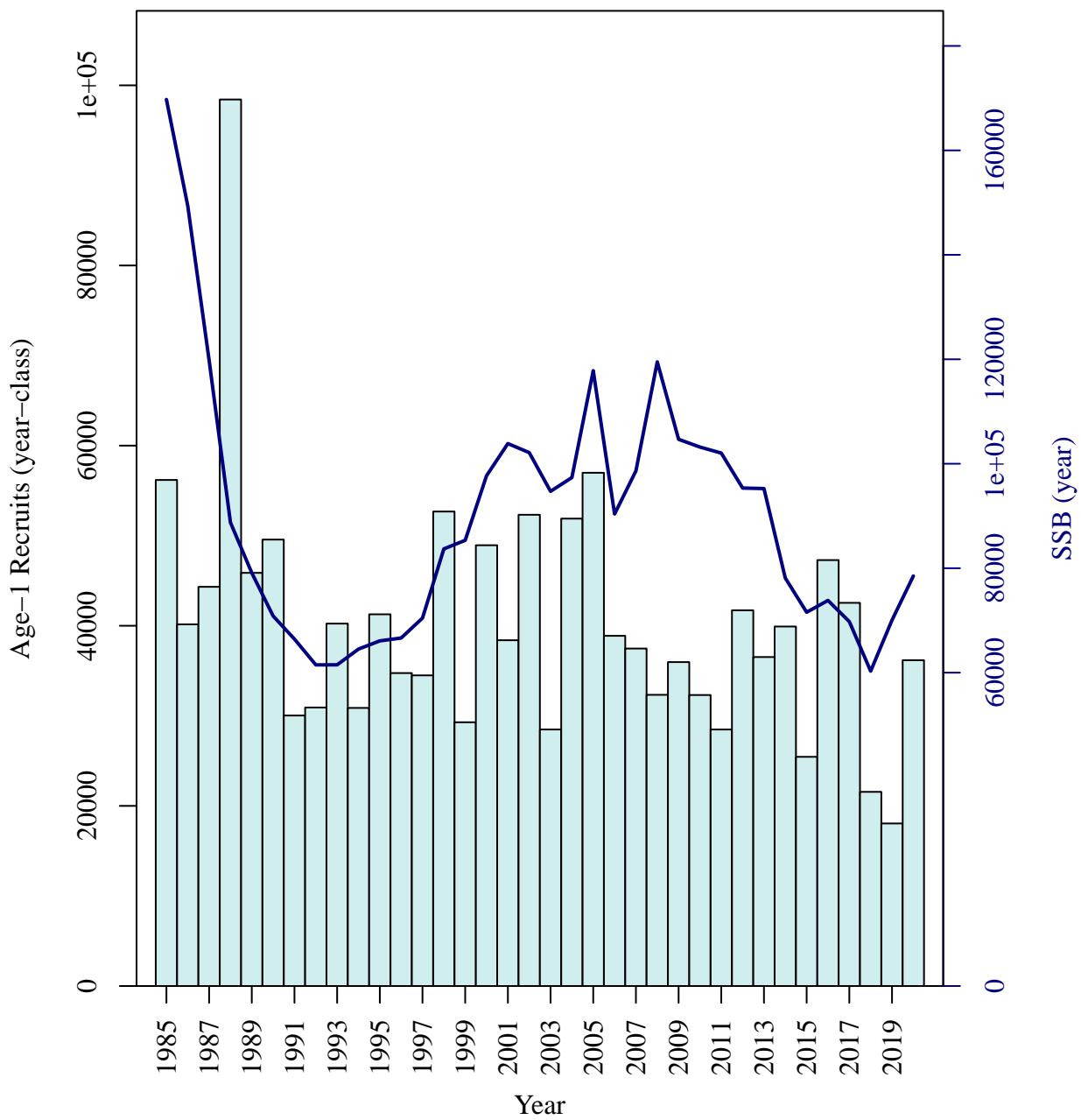


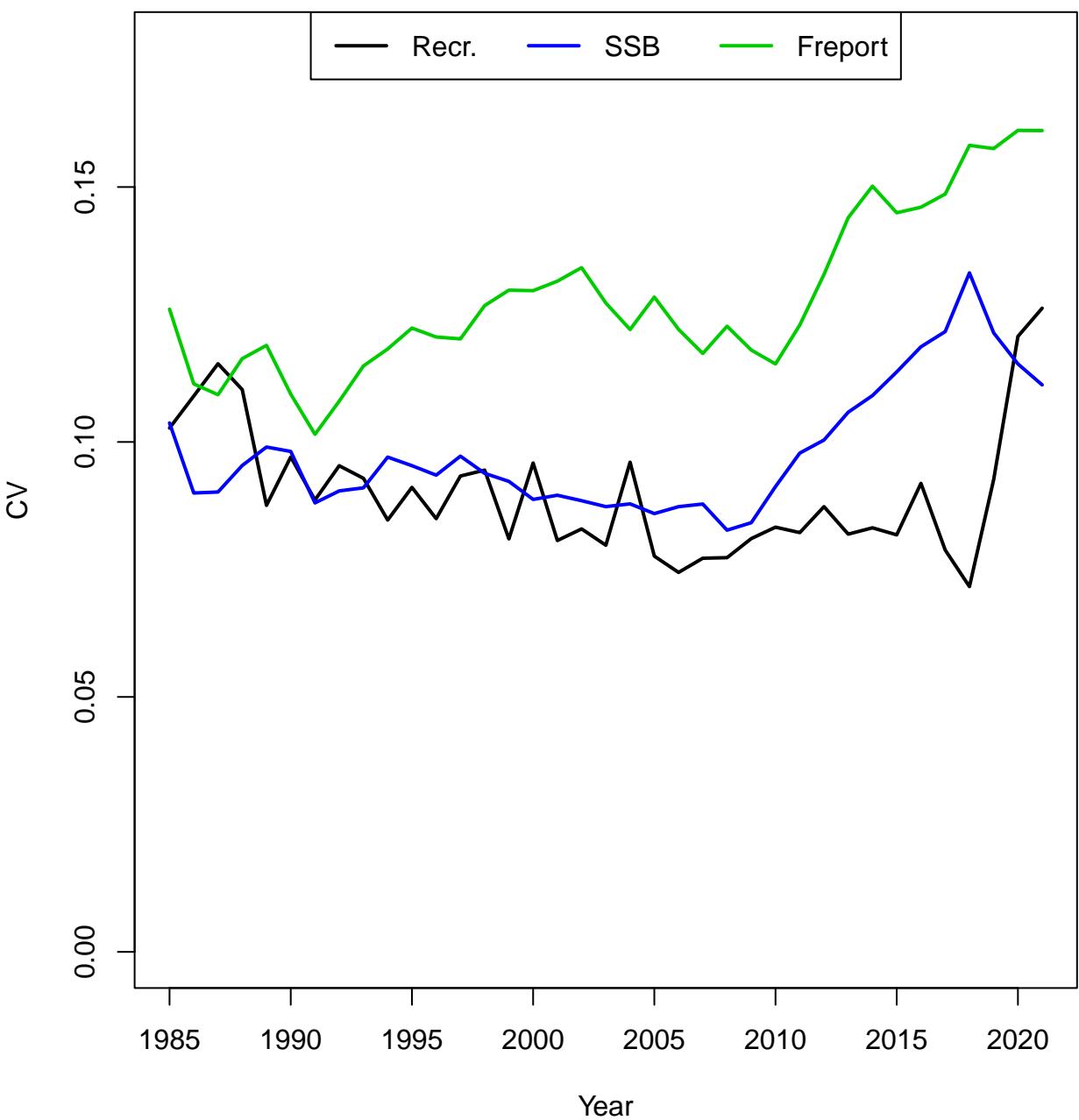




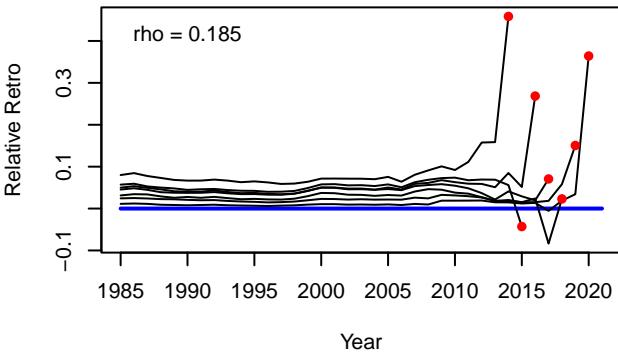
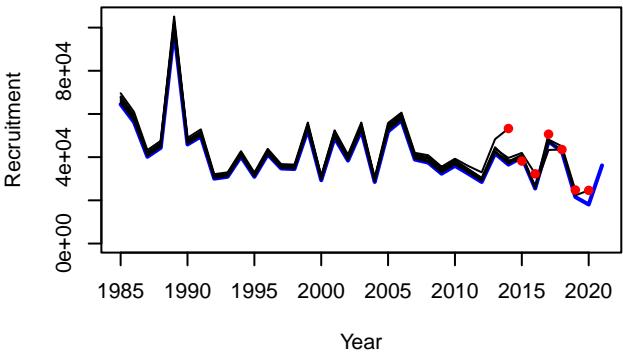
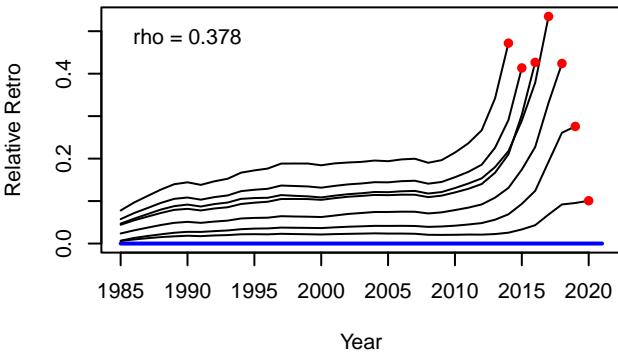
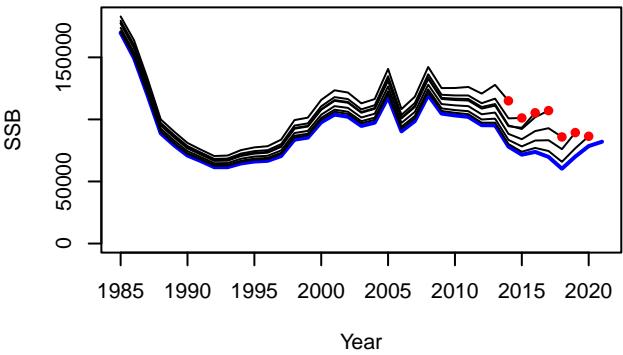
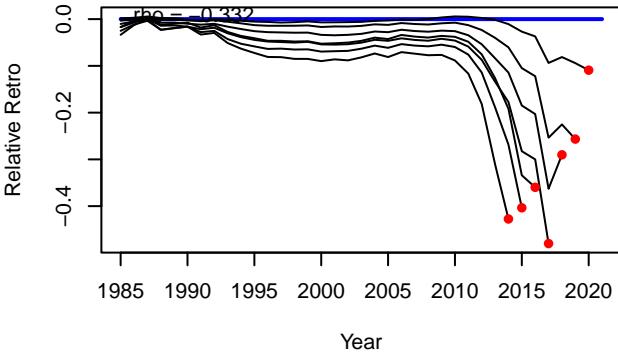
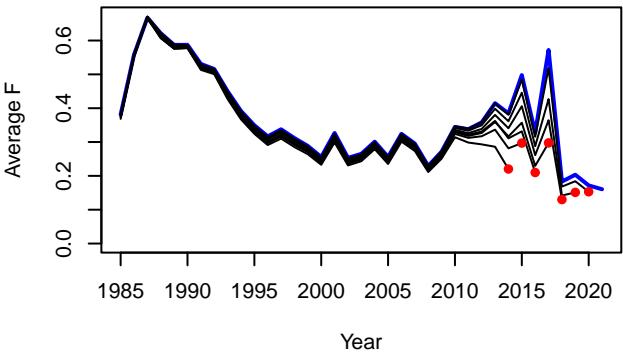






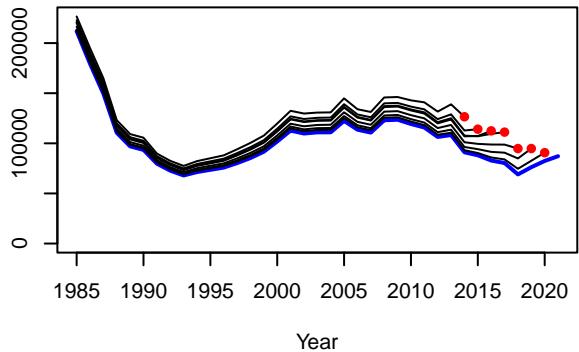


F, SSB, R



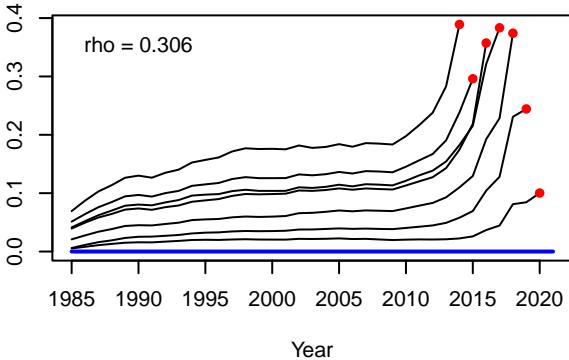
**Jan-1 B, Exploitable B, Total Stock N**

Jan-1 B



Year

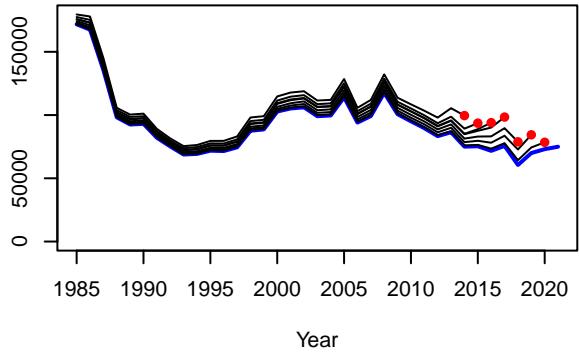
Relative Retro



1985 1990 1995 2000 2005 2010 2015 2020

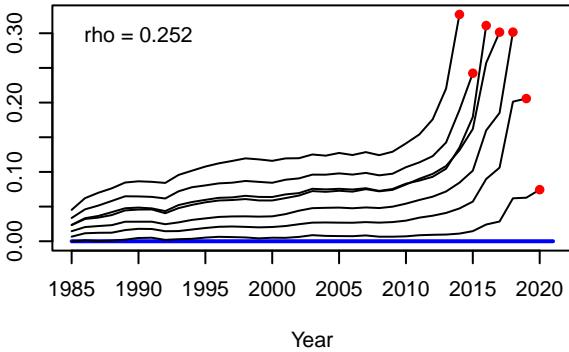
Year

Exploitable B



Year

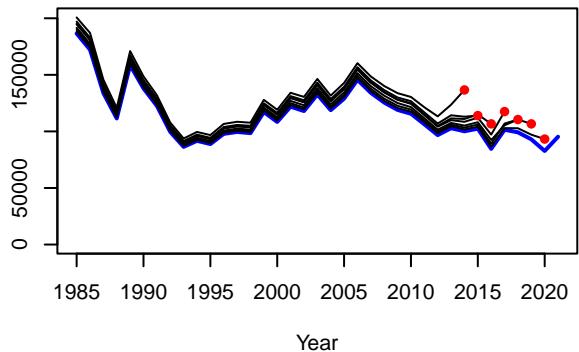
Relative Retro



1985 1990 1995 2000 2005 2010 2015 2020

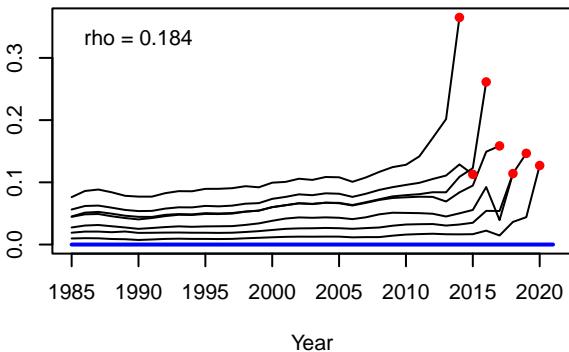
Year

Total Stock N



Year

Relative Retro



1985 1990 1995 2000 2005 2010 2015 2020

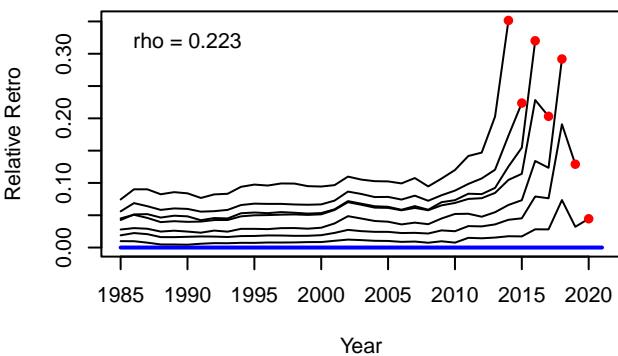
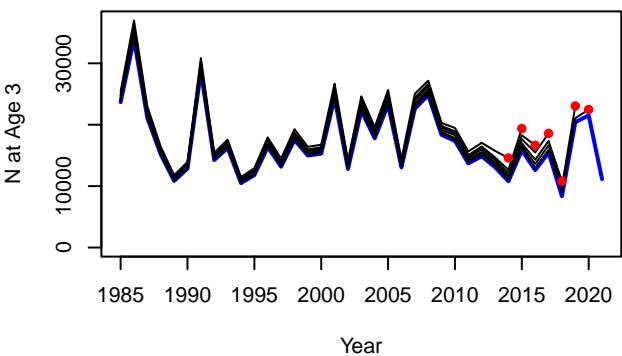
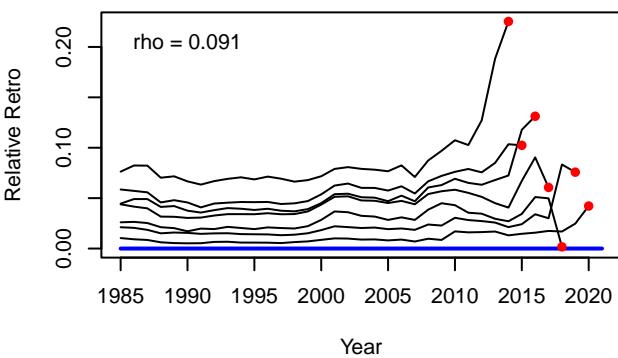
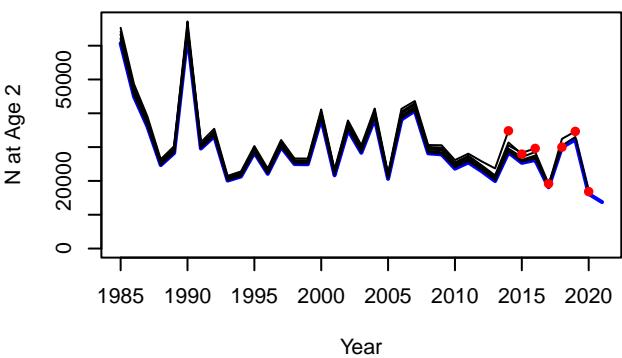
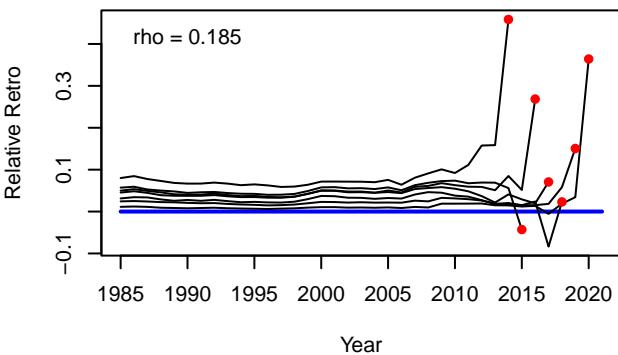
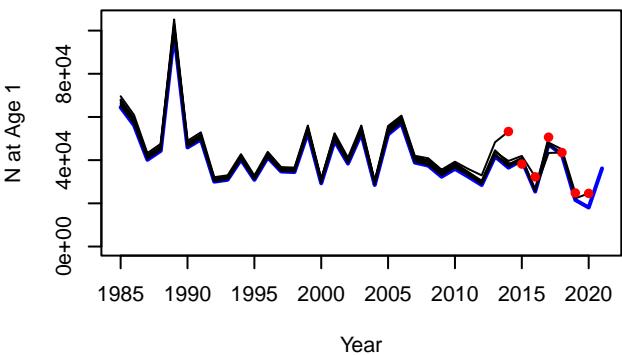
Year

rho = 0.184

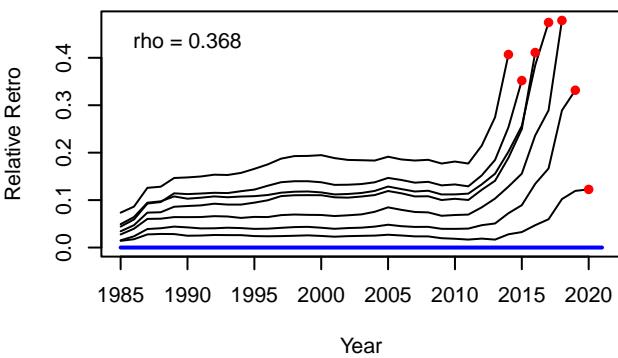
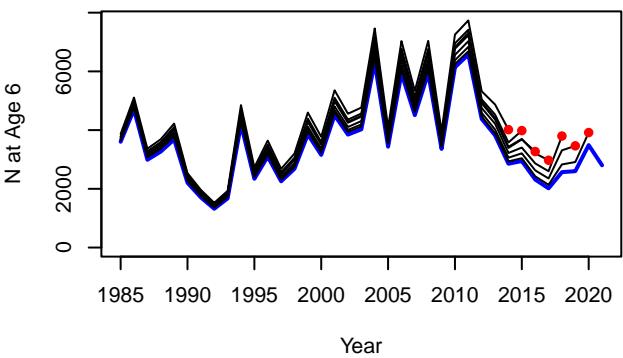
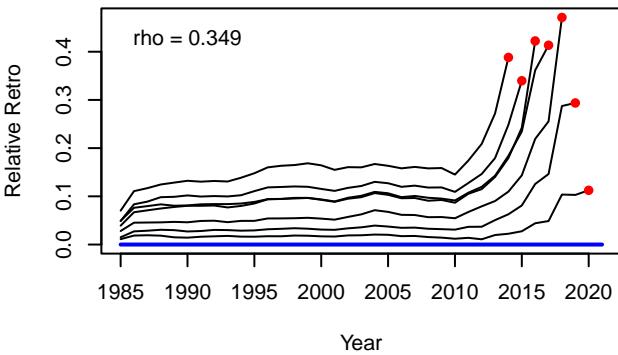
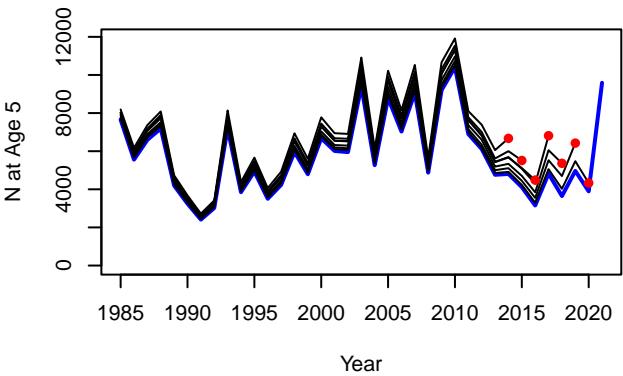
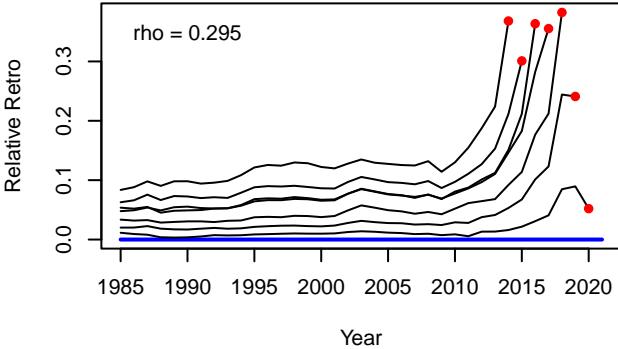
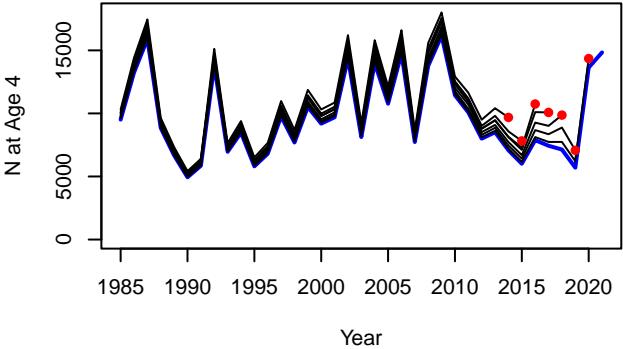
rho = 0.252

rho = 0.306

# Stock Numbers at Age

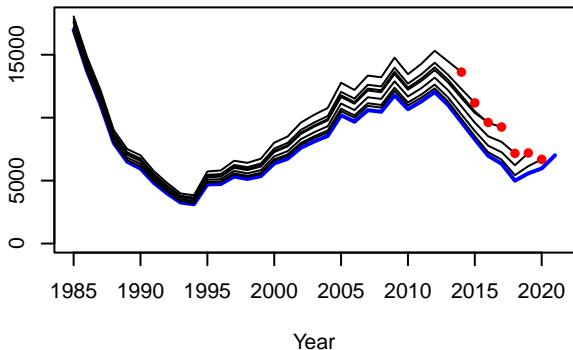


# Stock Numbers at Age

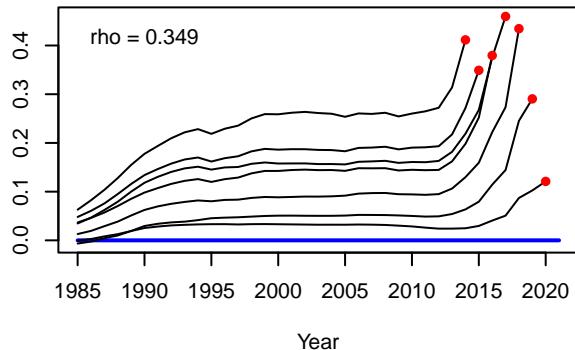


## Stock Numbers at Age

N at Age 7



Relative Retro

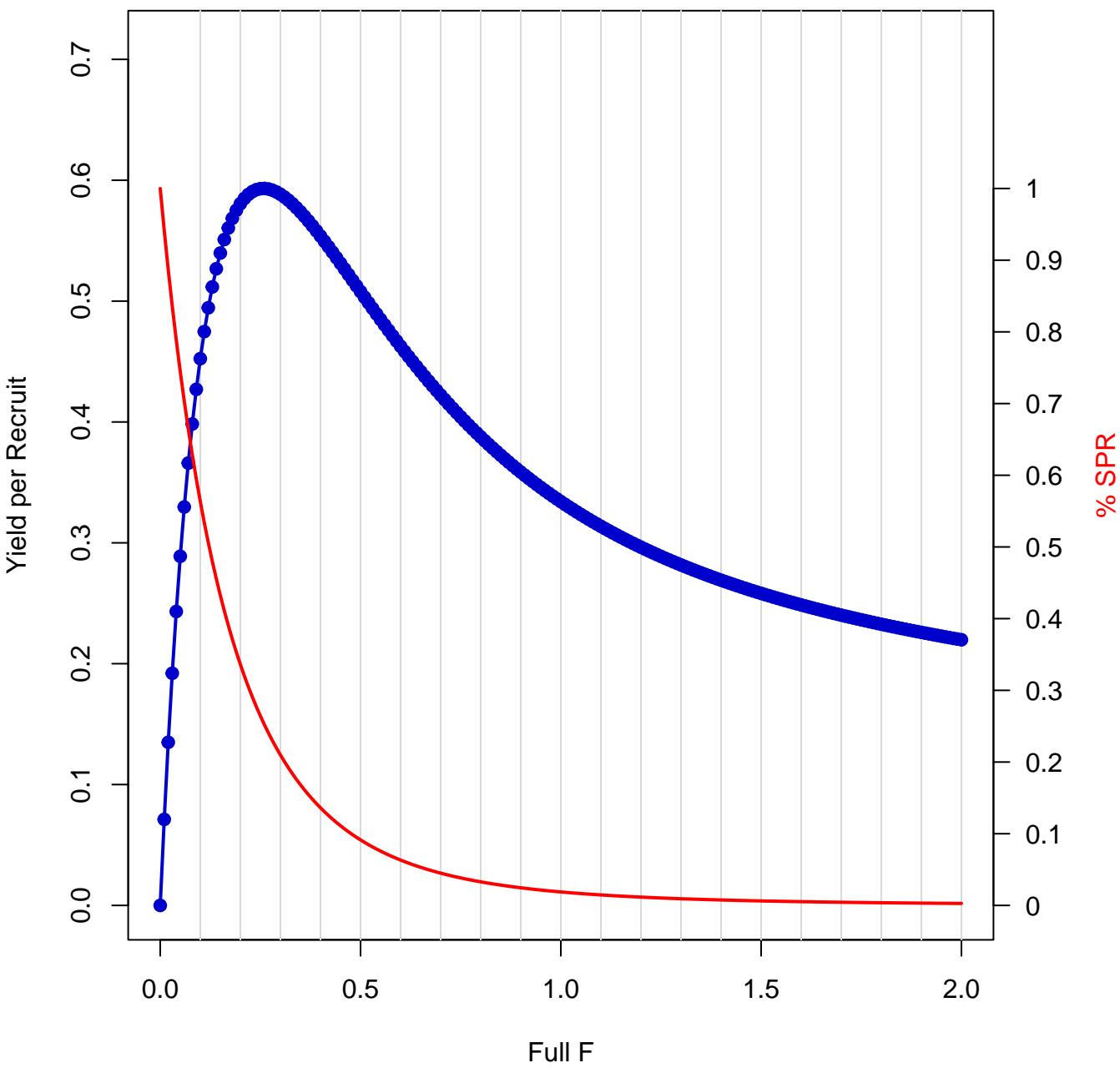


# BF07

Update all fishery data, new L-W parameters, new  
recreational discard mortality, add commercial discards

## REFERENCE POINT PLOTS

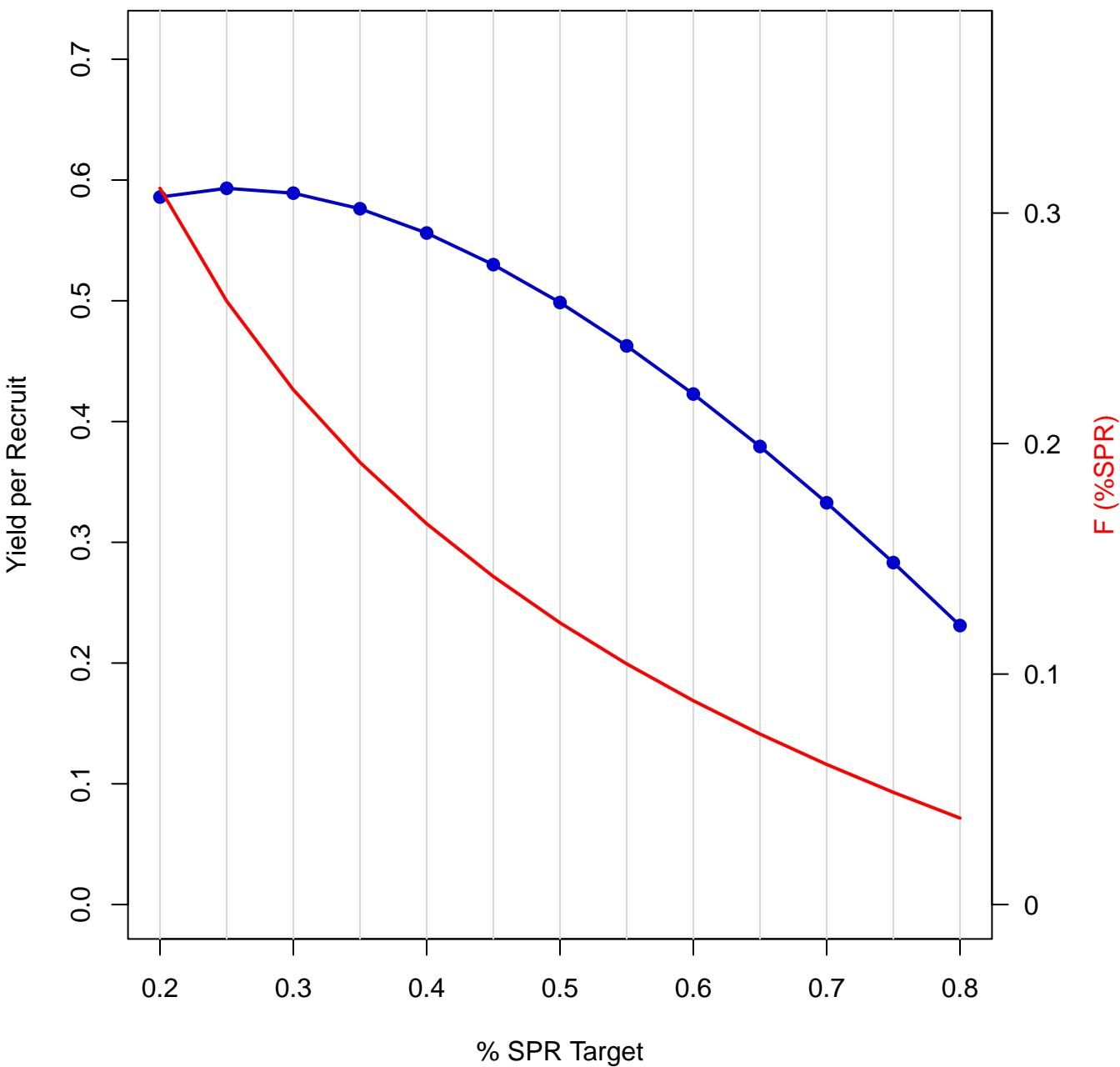
# YPR-SPR Reference Points (Years Avg = 5)



# YPR-SPR Reference Points (Years Avg = 5)

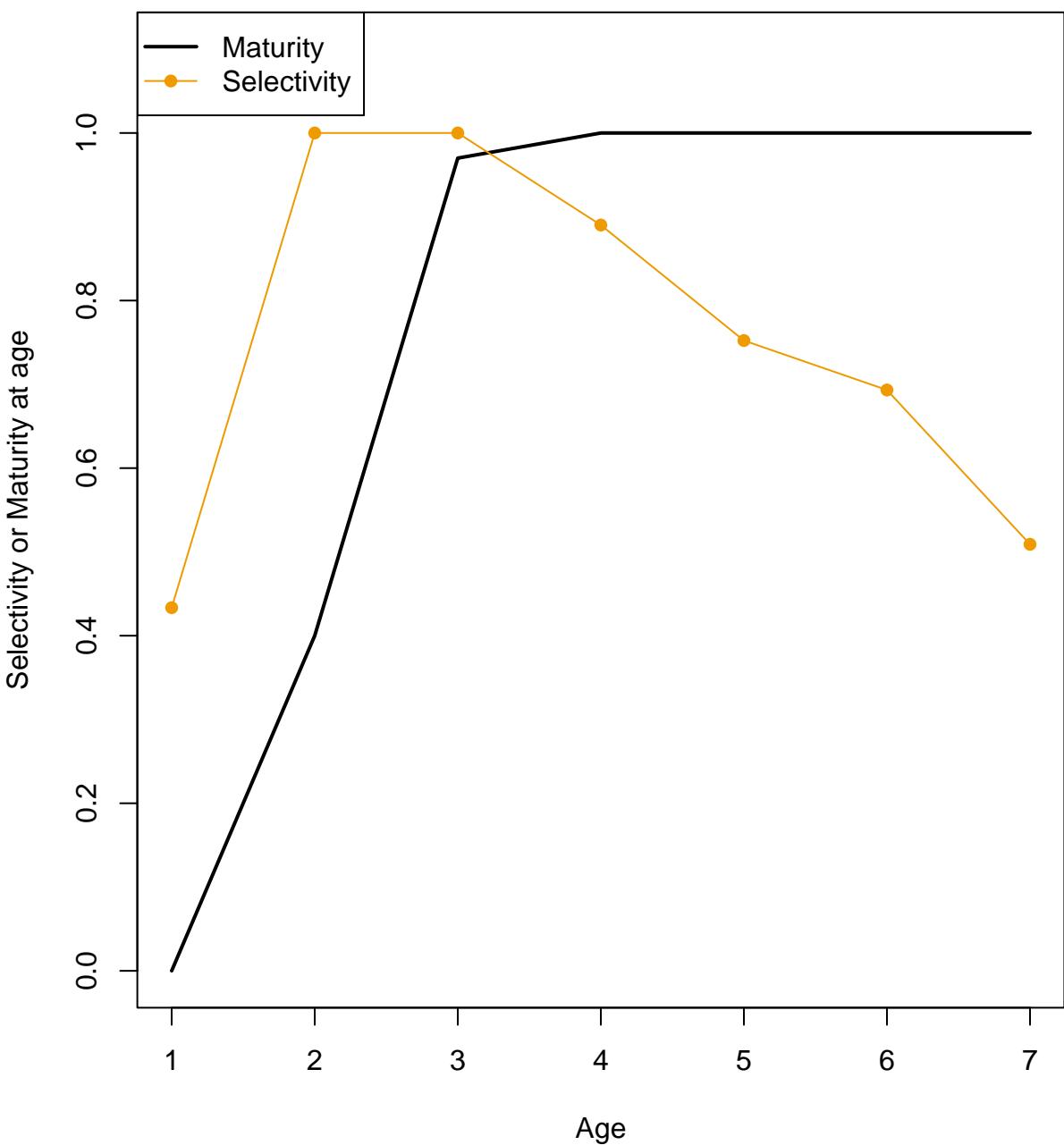
F	YPR	SPR	F	YPR	SPR	F	YPR	SPR
0	0	1	0.35	0.5738	0.1683	0.7	0.4222	0.045
0.01	0.0712	0.9413	0.36	0.5701	0.1612	0.71	0.4185	0.0436
0.02	0.135	0.8867	0.37	0.5663	0.1545	0.72	0.4148	0.0422
0.03	0.1921	0.8359	0.38	0.5623	0.1481	0.73	0.4112	0.0409
0.04	0.2432	0.7886	0.39	0.5581	0.142	0.74	0.4077	0.0396
0.05	0.2889	0.7444	0.4	0.5538	0.1362	0.75	0.4042	0.0384
0.06	0.3296	0.7032	0.41	0.5494	0.1307	0.76	0.4008	0.0372
0.07	0.366	0.6647	0.42	0.545	0.1254	0.77	0.3974	0.0361
0.08	0.3983	0.6287	0.43	0.5405	0.1204	0.78	0.3941	0.035
0.09	0.427	0.5949	0.44	0.5359	0.1157	0.79	0.3908	0.0339
0.1	0.4524	0.5634	0.45	0.5313	0.1111	0.8	0.3876	0.0329
0.11	0.4748	0.5338	0.46	0.5266	0.1068	0.81	0.3845	0.0319
0.12	0.4945	0.506	0.47	0.5219	0.1027	0.82	0.3814	0.031
0.13	0.5117	0.4799	0.48	0.5173	0.0987	0.83	0.3784	0.0301
0.14	0.5267	0.4555	0.49	0.5126	0.095	0.84	0.3754	0.0292
0.15	0.5397	0.4325	0.5	0.5079	0.0914	0.85	0.3724	0.0284
0.16	0.5509	0.4108	0.51	0.5032	0.088	0.86	0.3695	0.0276
0.17	0.5605	0.3904	0.52	0.4986	0.0847	0.87	0.3667	0.0268
0.18	0.5685	0.3713	0.53	0.494	0.0816	0.88	0.3639	0.026
0.19	0.5751	0.3532	0.54	0.4894	0.0786	0.89	0.3612	0.0253
0.2	0.5806	0.3361	0.55	0.4848	0.0758	0.9	0.3585	0.0246
0.21	0.5849	0.3201	0.56	0.4803	0.073	0.91	0.3559	0.0239
0.22	0.5882	0.3049	0.57	0.4758	0.0704	0.92	0.3533	0.0233
0.23	0.5906	0.2906	0.58	0.4714	0.0679	0.93	0.3507	0.0226
0.24	0.5922	0.277	0.59	0.467	0.0656	0.94	0.3482	0.022
0.25	0.593	0.2642	0.6	0.4626	0.0633	0.95	0.3458	0.0214
0.26	0.5932	0.2521	0.61	0.4583	0.0611	0.96	0.3434	0.0209
0.27	0.5927	0.2407	0.62	0.4541	0.059	0.97	0.341	0.0203
0.28	0.5918	0.2299	0.63	0.4499	0.057	0.98	0.3387	0.0198
0.29	0.5903	0.2196	0.64	0.4458	0.055	0.99	0.3364	0.0193
0.3	0.5884	0.2099	0.65	0.4417	0.0532	1	0.3341	0.0188
0.31	0.5861	0.2007	0.66	0.4377	0.0514	1.01	0.3319	0.0183
0.32	0.5834	0.1919	0.67	0.4338	0.0497	1.02	0.3297	0.0178
0.33	0.5805	0.1836	0.68	0.4299	0.0481	1.03	0.3276	0.0174
0.34	0.5773	0.1758	0.69	0.426	0.0465	1.04	0.3255	0.017

## SPR Target Reference Points (Years Avg = 5)

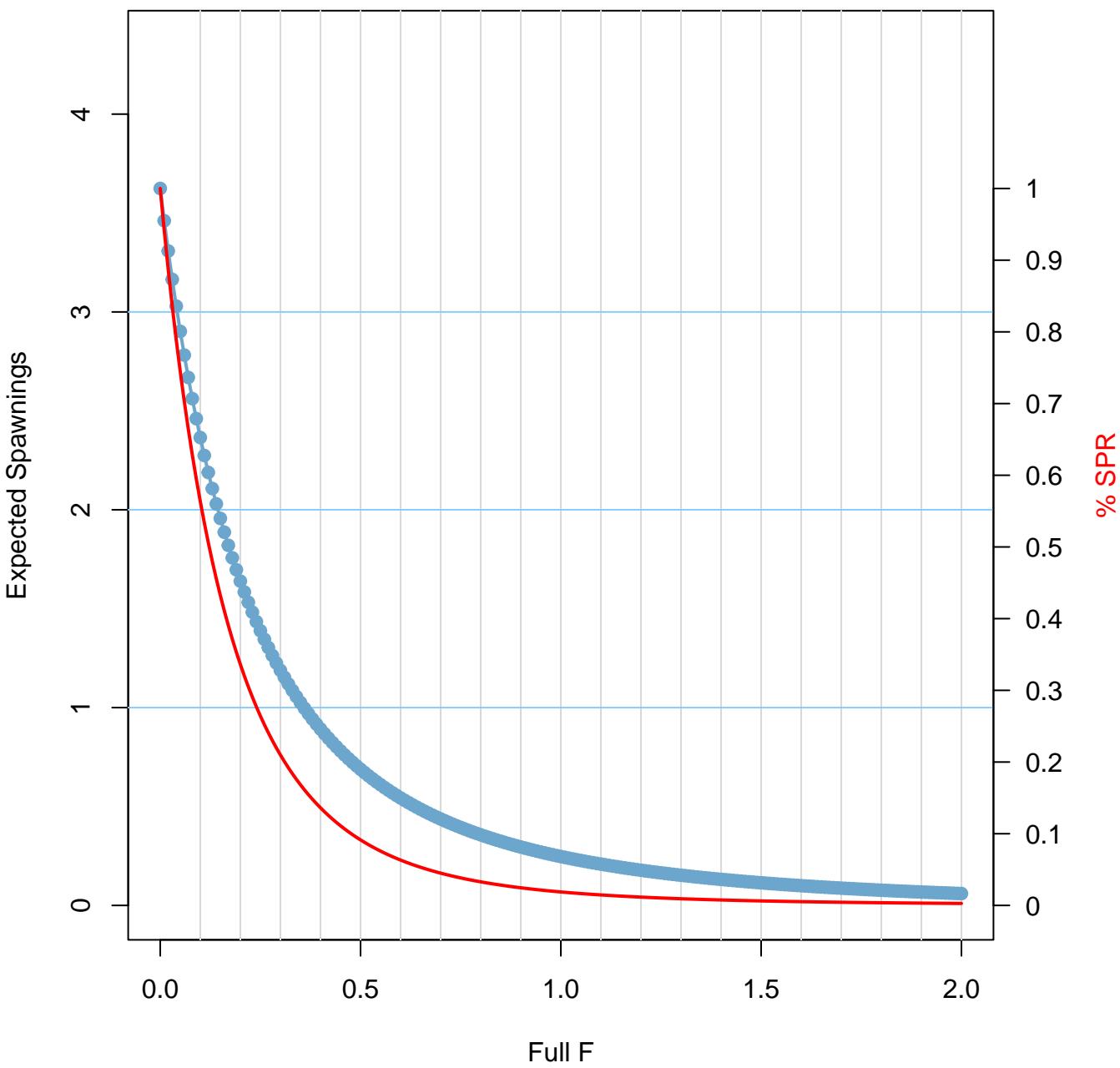


## SPR Target Reference Points (Years Avg = 5)

% SPR	F(%SPR)	YPR
0.2	0.3107	0.5859
0.25	0.2618	0.5931
0.3	0.2234	0.5891
0.35	0.1918	0.5762
0.4	0.1652	0.5561
0.45	0.1423	0.5299
0.5	0.1223	0.4986
0.55	0.1044	0.4627
0.6	0.0885	0.4228
0.65	0.074	0.3793
0.7	0.0608	0.3327
0.75	0.0487	0.2832
0.8	0.0375	0.231



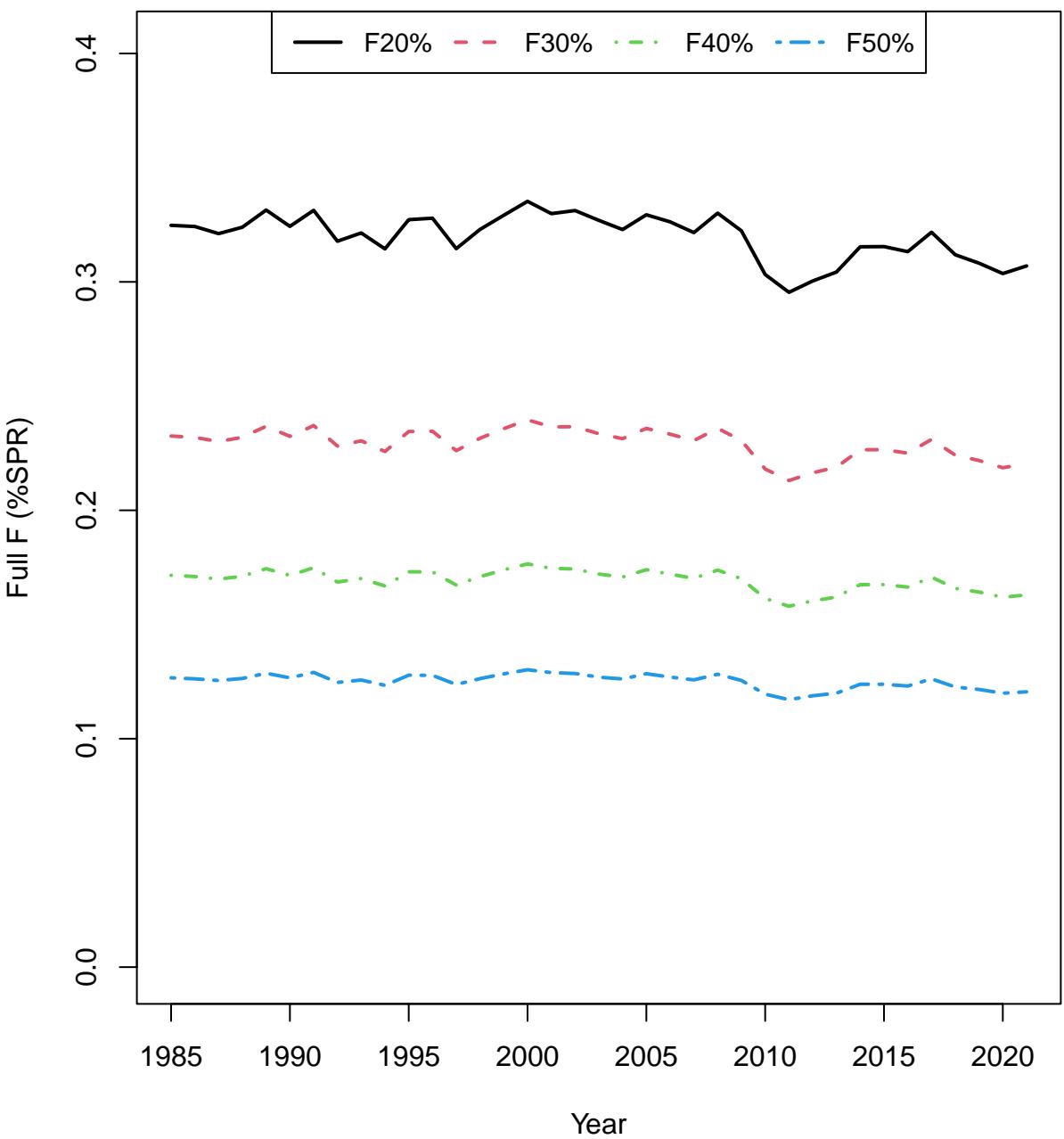
# Expected Spawnings and SPR Reference Points (Years Avg = 5)



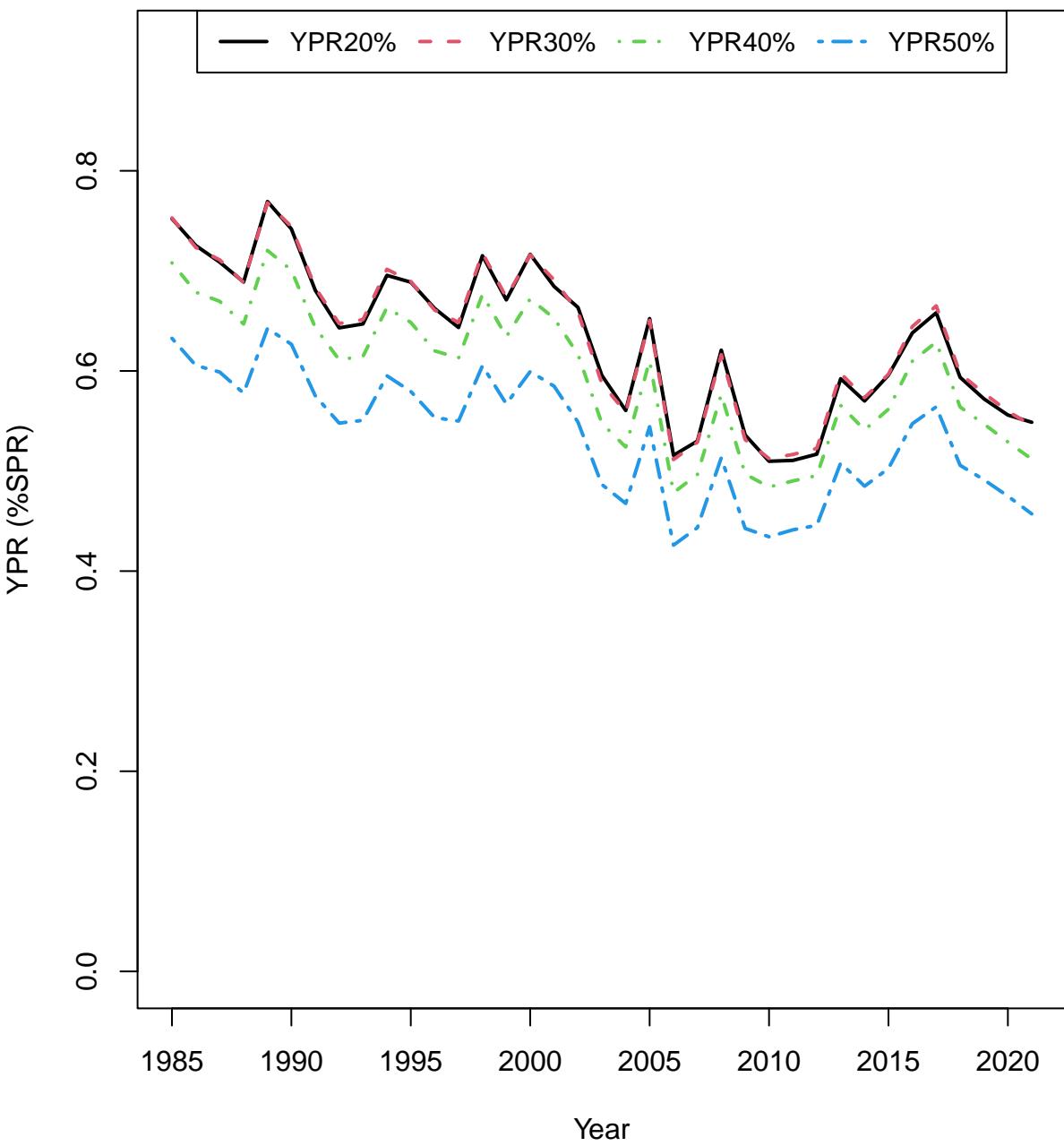
# Expected Spawnings & SPR Reference Points (Years Avg = 5)

F	E[Sp]	SPR	F	E[Sp]	SPR	F	E[Sp]	SPR
0	3.6242	1	0.35	1.0254	0.1683	0.7	0.4369	0.045
0.01	3.4612	0.9413	0.36	0.9966	0.1612	0.71	0.4279	0.0436
0.02	3.3082	0.8867	0.37	0.9689	0.1545	0.72	0.4191	0.0422
0.03	3.1645	0.8359	0.38	0.9422	0.1481	0.73	0.4106	0.0409
0.04	3.0293	0.7886	0.39	0.9166	0.142	0.74	0.4023	0.0396
0.05	2.902	0.7444	0.4	0.8918	0.1362	0.75	0.3942	0.0384
0.06	2.782	0.7032	0.41	0.868	0.1307	0.76	0.3863	0.0372
0.07	2.6688	0.6647	0.42	0.8451	0.1254	0.77	0.3786	0.0361
0.08	2.5618	0.6287	0.43	0.8229	0.1204	0.78	0.3712	0.035
0.09	2.4607	0.5949	0.44	0.8016	0.1157	0.79	0.3639	0.0339
0.1	2.3651	0.5634	0.45	0.781	0.1111	0.8	0.3569	0.0329
0.11	2.2745	0.5338	0.46	0.7612	0.1068	0.81	0.35	0.0319
0.12	2.1886	0.506	0.47	0.742	0.1027	0.82	0.3433	0.031
0.13	2.1072	0.4799	0.48	0.7234	0.0987	0.83	0.3367	0.0301
0.14	2.0299	0.4555	0.49	0.7055	0.095	0.84	0.3304	0.0292
0.15	1.9564	0.4325	0.5	0.6883	0.0914	0.85	0.3242	0.0284
0.16	1.8866	0.4108	0.51	0.6715	0.088	0.86	0.3181	0.0276
0.17	1.8202	0.3904	0.52	0.6554	0.0847	0.87	0.3122	0.0268
0.18	1.7569	0.3713	0.53	0.6397	0.0816	0.88	0.3064	0.026
0.19	1.6967	0.3532	0.54	0.6246	0.0786	0.89	0.3008	0.0253
0.2	1.6392	0.3361	0.55	0.6099	0.0758	0.9	0.2953	0.0246
0.21	1.5844	0.3201	0.56	0.5957	0.073	0.91	0.29	0.0239
0.22	1.5321	0.3049	0.57	0.582	0.0704	0.92	0.2847	0.0233
0.23	1.4822	0.2906	0.58	0.5687	0.0679	0.93	0.2796	0.0226
0.24	1.4344	0.277	0.59	0.5558	0.0656	0.94	0.2747	0.022
0.25	1.3888	0.2642	0.6	0.5433	0.0633	0.95	0.2698	0.0214
0.26	1.3451	0.2521	0.61	0.5312	0.0611	0.96	0.265	0.0209
0.27	1.3034	0.2407	0.62	0.5194	0.059	0.97	0.2604	0.0203
0.28	1.2633	0.2299	0.63	0.508	0.057	0.98	0.2559	0.0198
0.29	1.225	0.2196	0.64	0.4969	0.055	0.99	0.2514	0.0193
0.3	1.1882	0.2099	0.65	0.4862	0.0532	1	0.2471	0.0188
0.31	1.1529	0.2007	0.66	0.4757	0.0514	1.01	0.2429	0.0183
0.32	1.1191	0.1919	0.67	0.4656	0.0497	1.02	0.2387	0.0178
0.33	1.0866	0.1836	0.68	0.4558	0.0481	1.03	0.2347	0.0174
0.34	1.0554	0.1758	0.69	0.4462	0.0465	1.04	0.2307	0.017

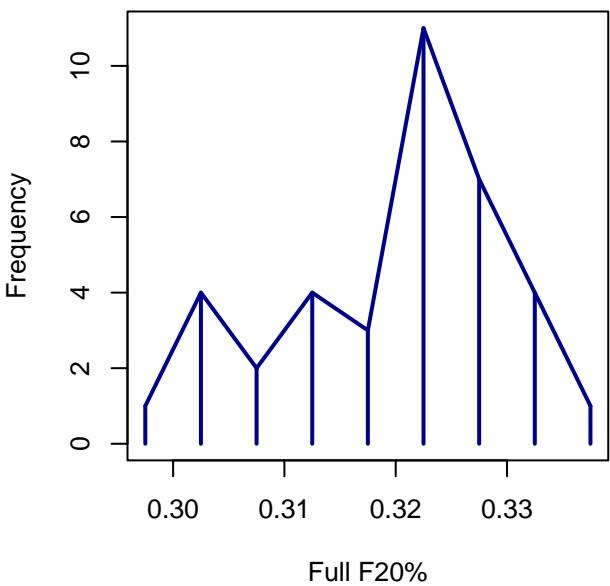
## Annual F(%SPR) Reference Points



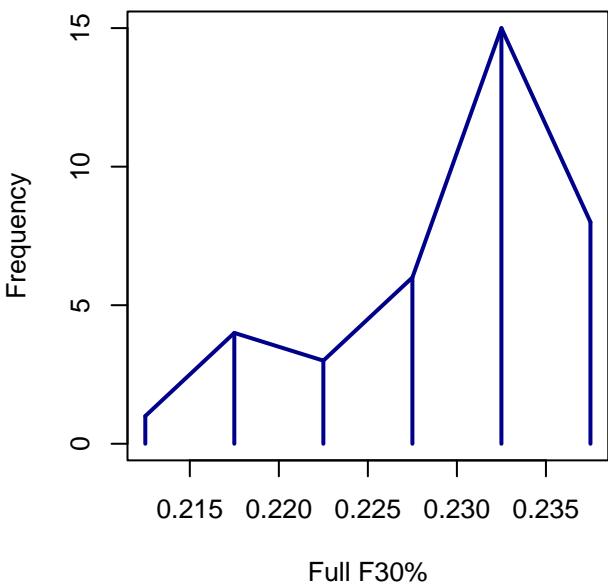
# Annual YPR(%SPR) Reference Points



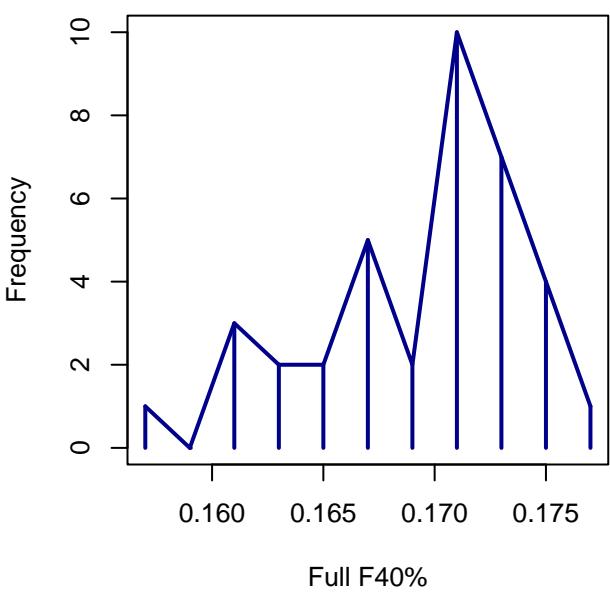
### Annual F (%SPR) Reference Points



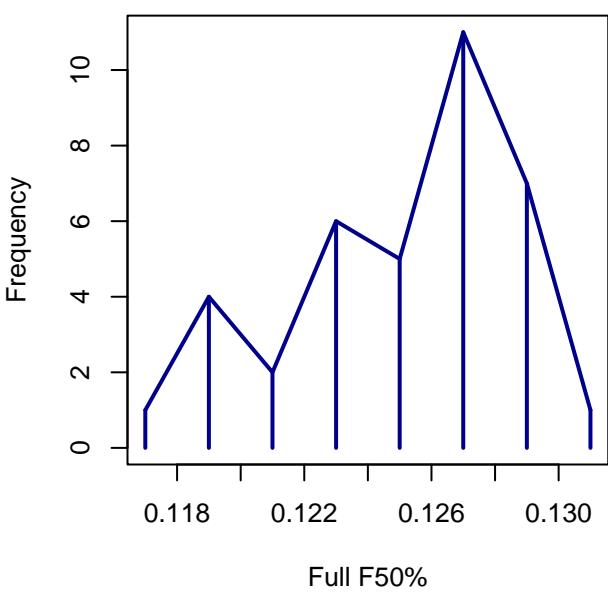
Full F20%



Full F30%

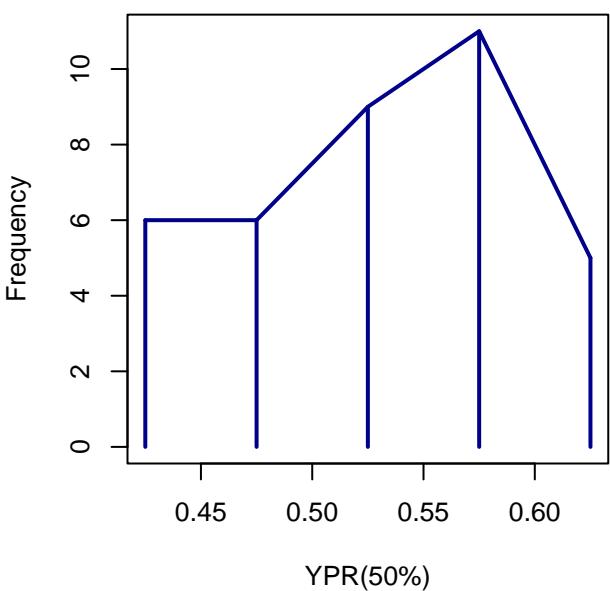
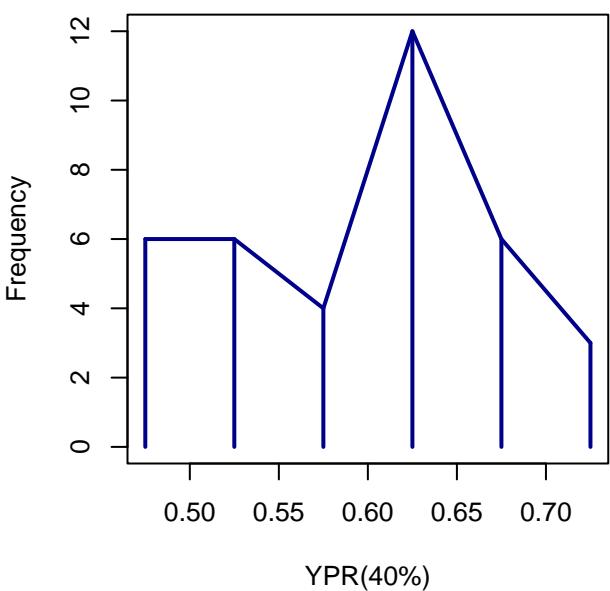
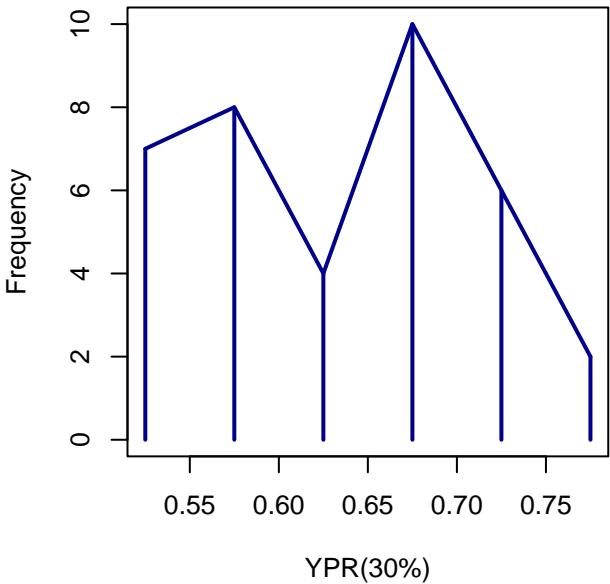
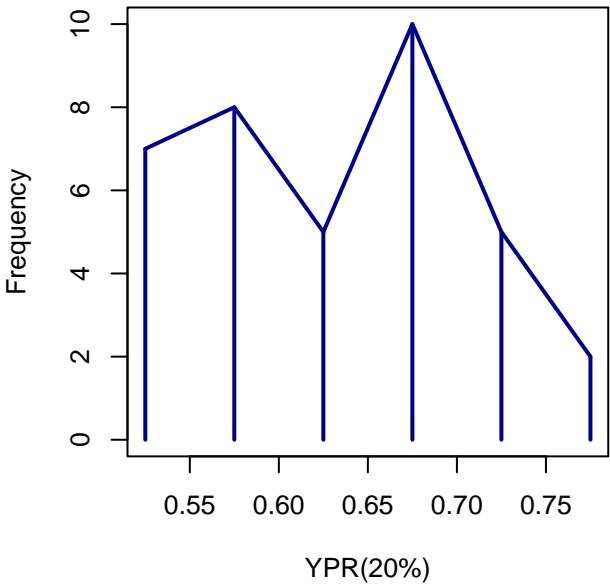


Full F40%



Full F50%

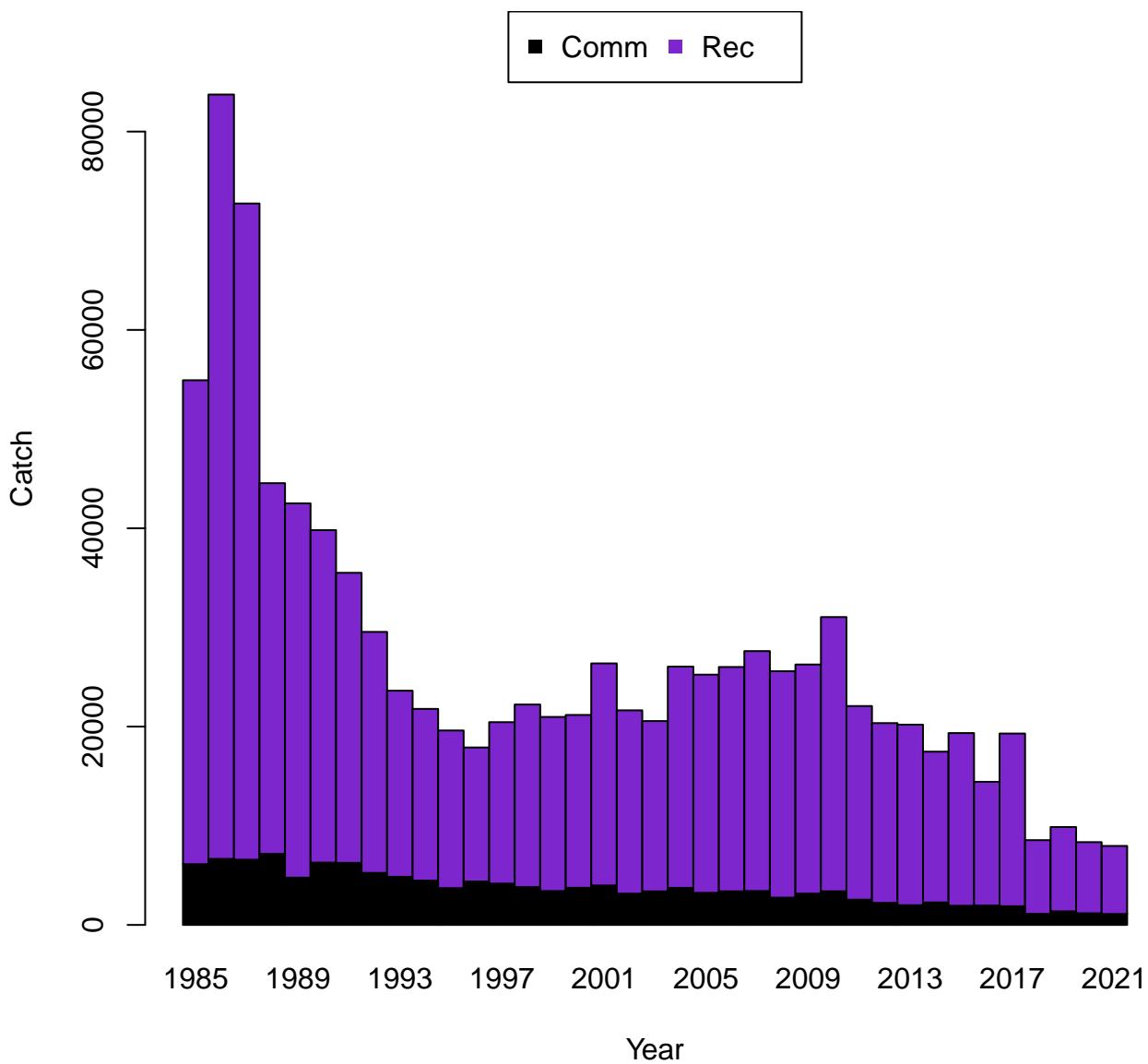
### Annual YPR (%SPR) Reference Points

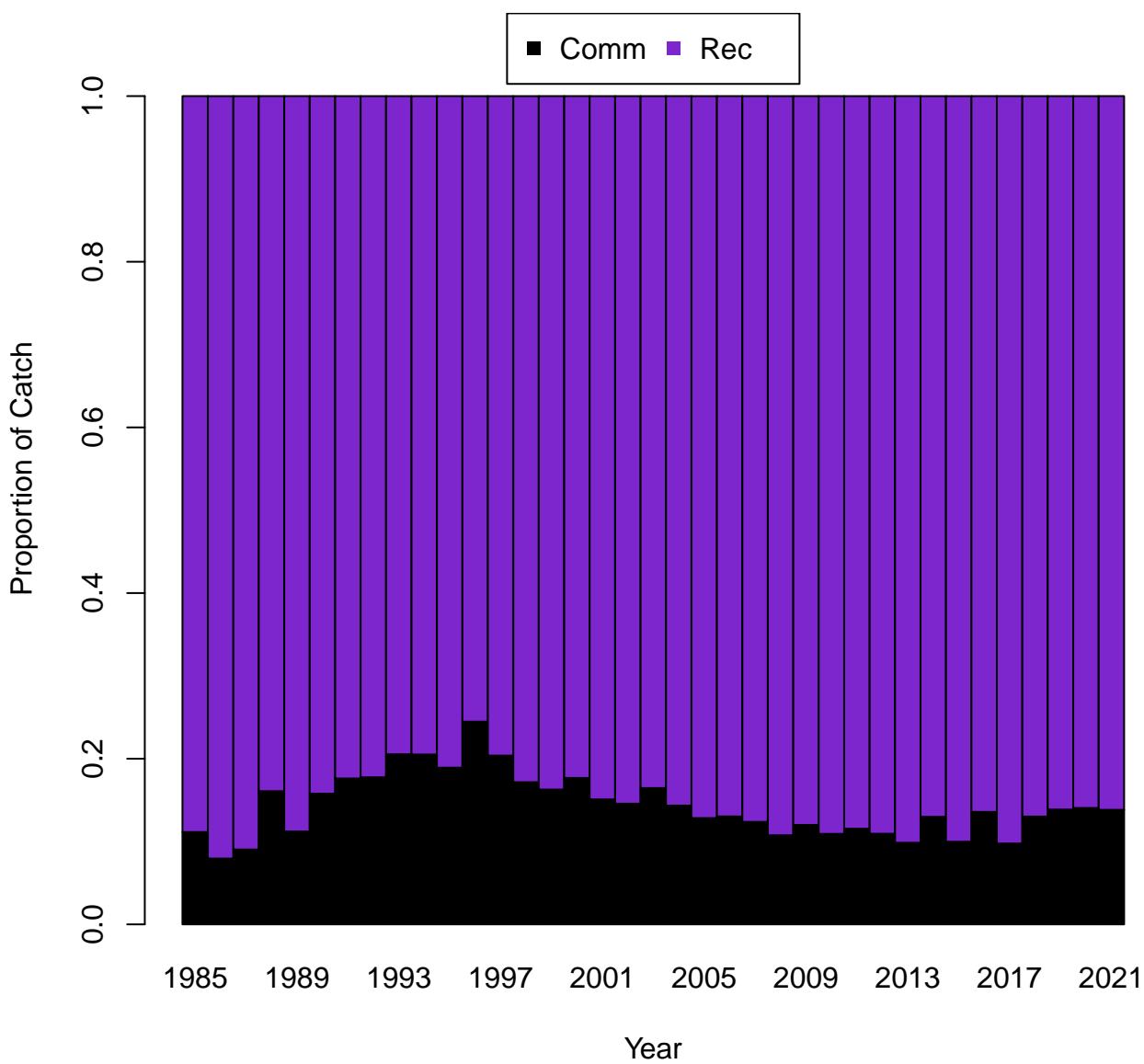


# BF19

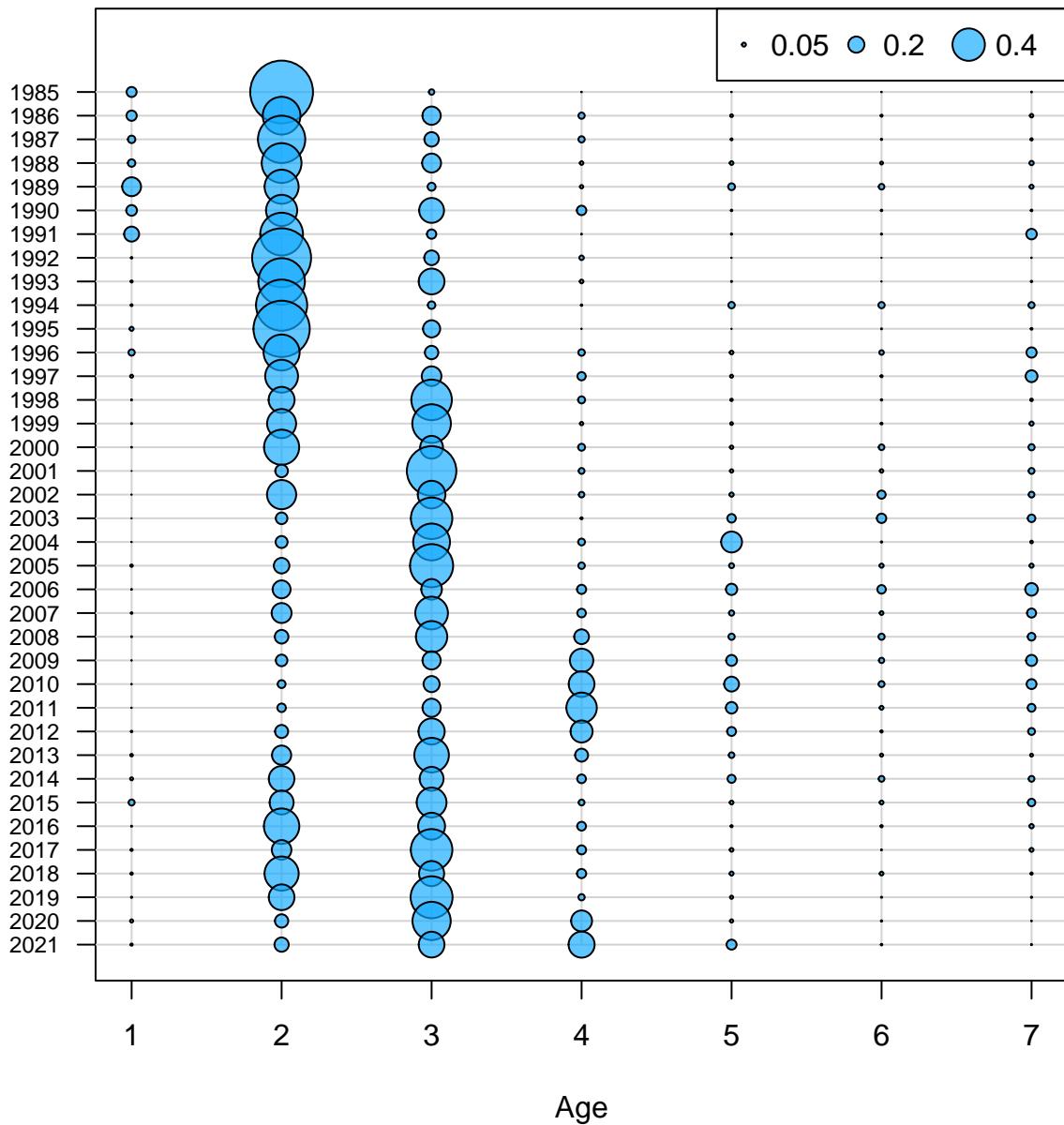
5 fleet selectivity blocks, average F from age 1 to ages 1-2

## DATA PLOTS

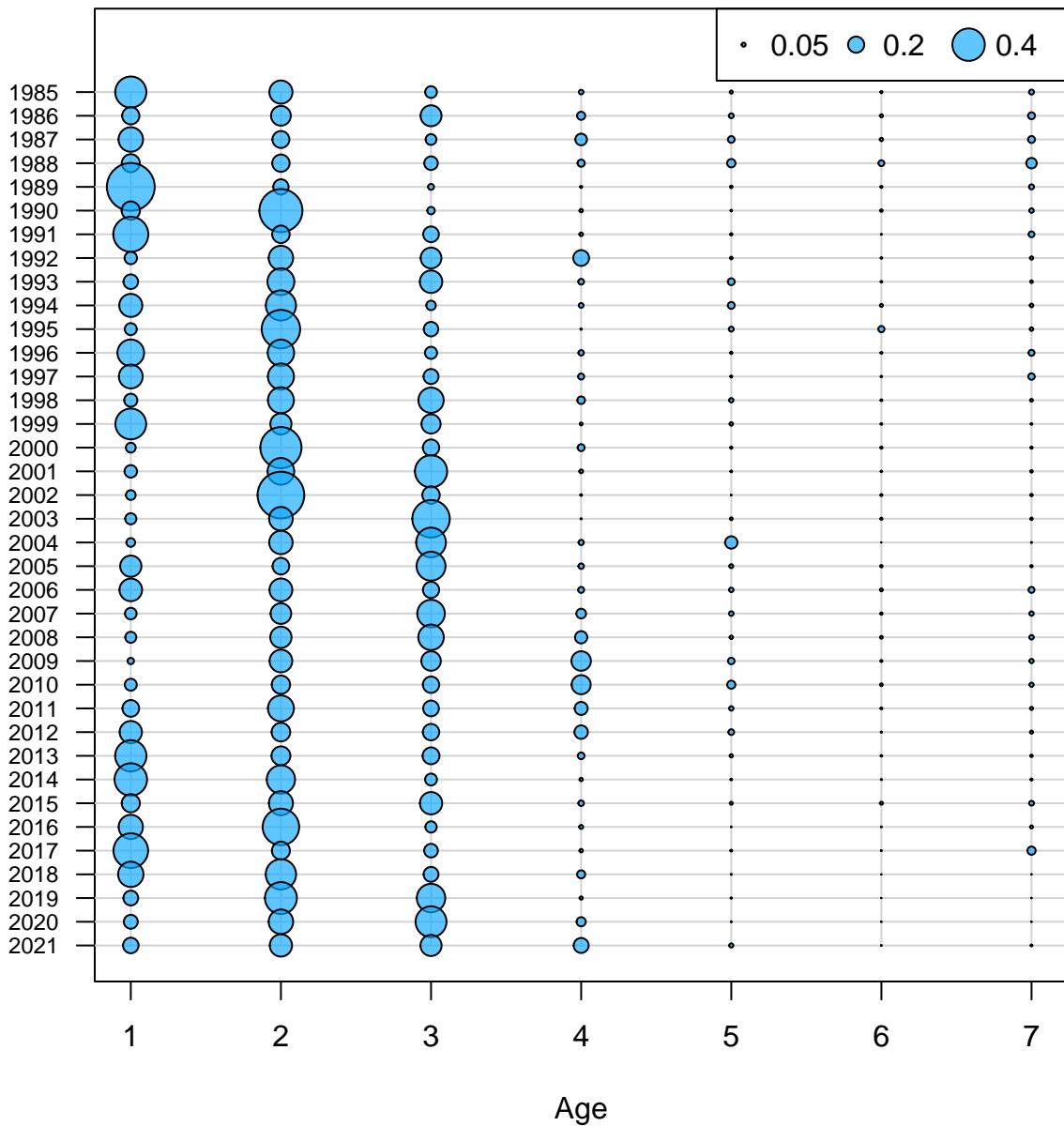


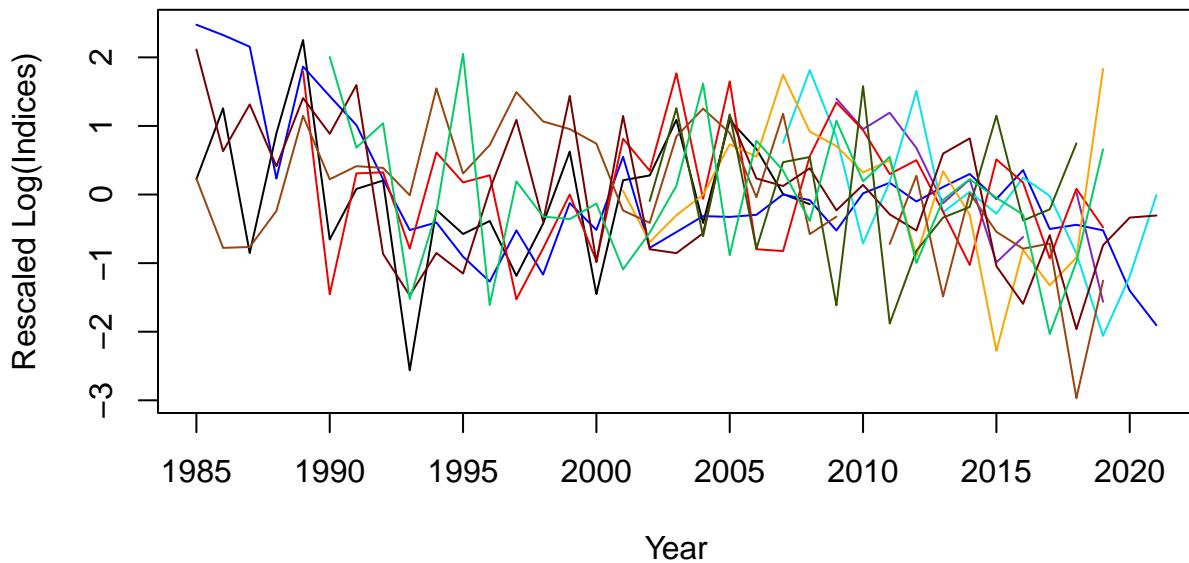
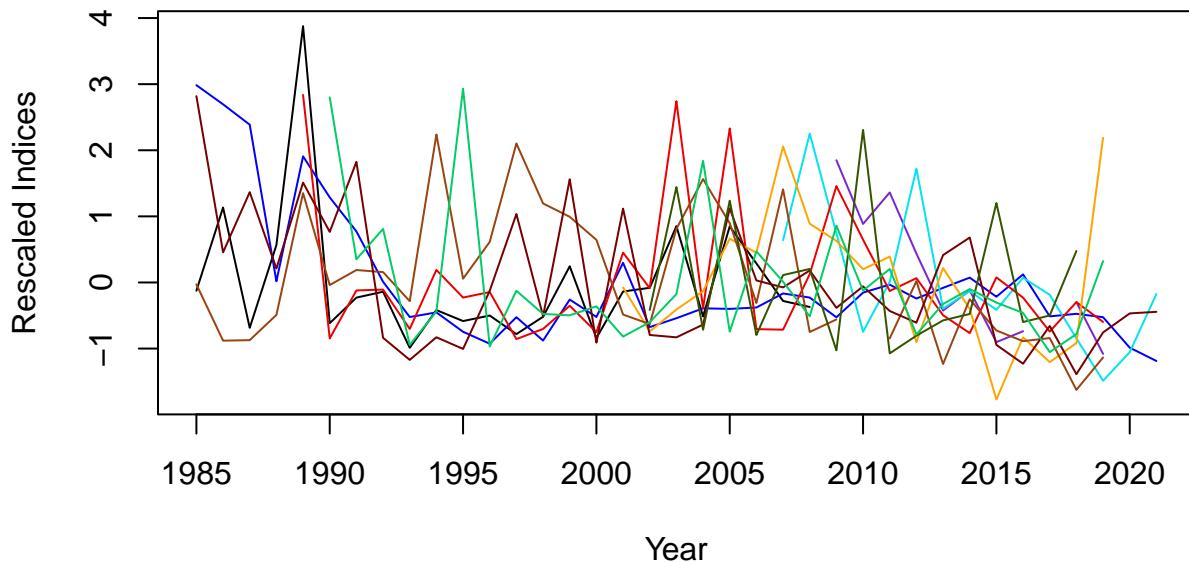


## Age Comps for Catch by Fleet 1 (Comm)

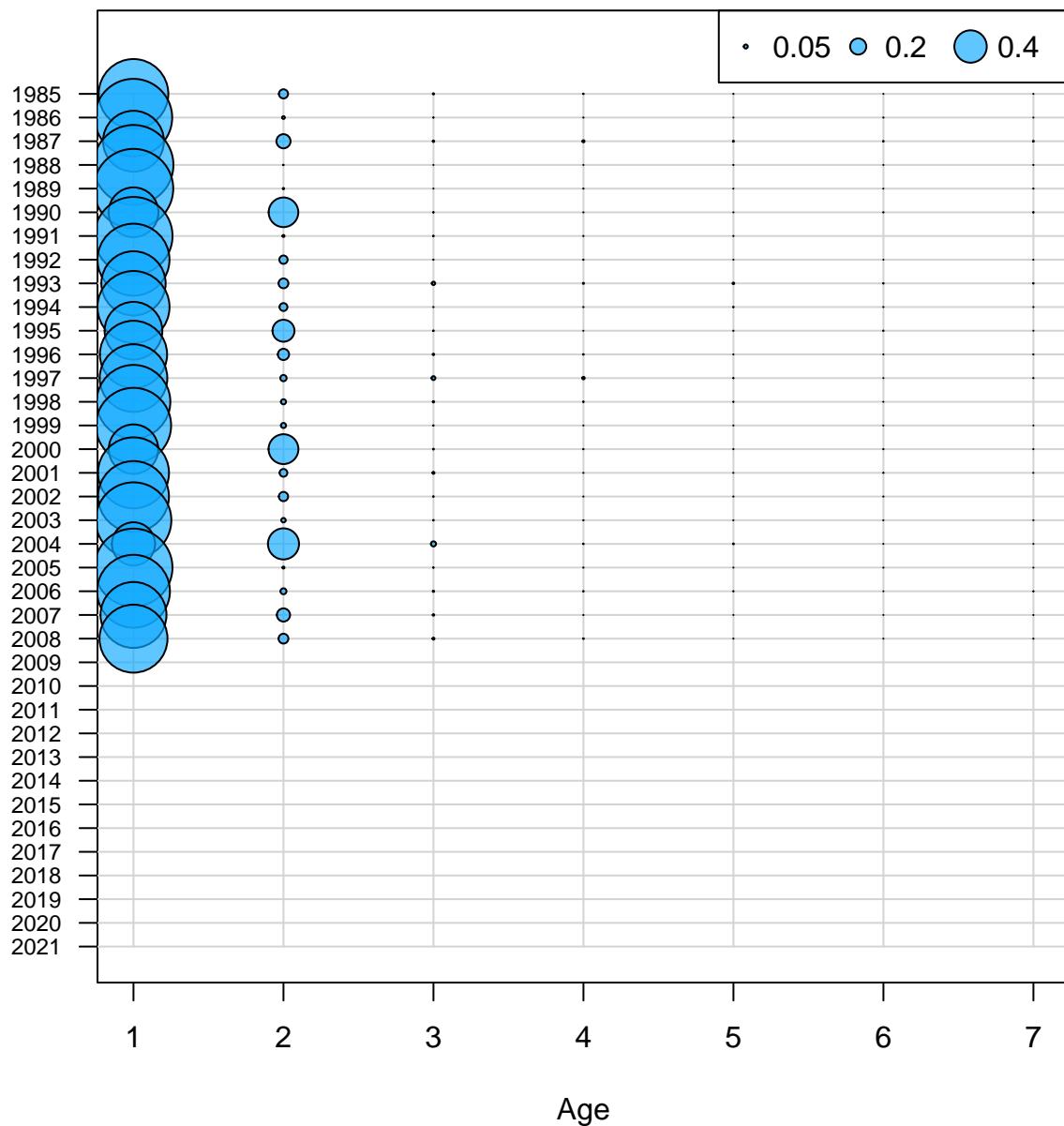


## Age Comps for Catch by Fleet 2 (Rec)

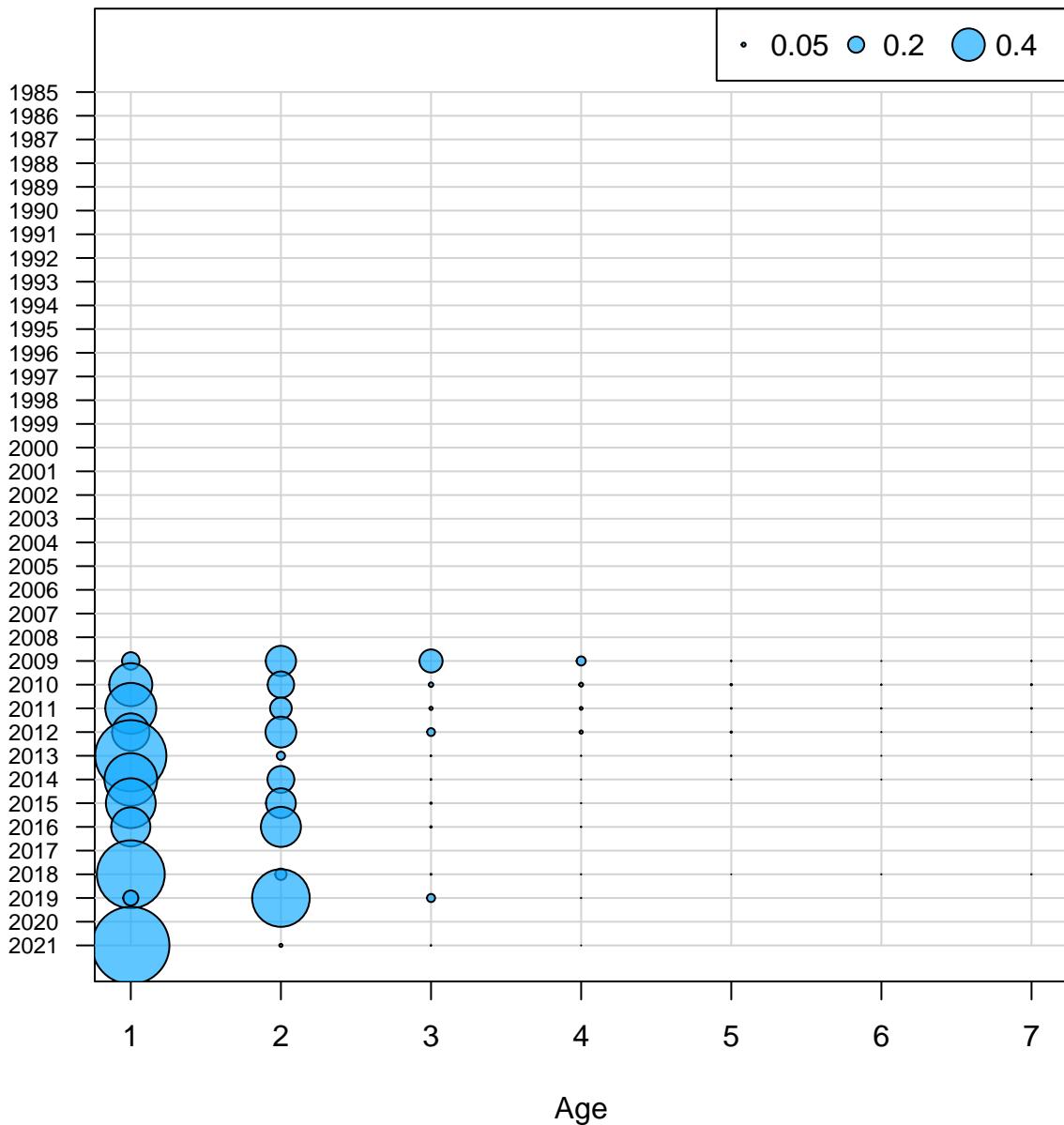




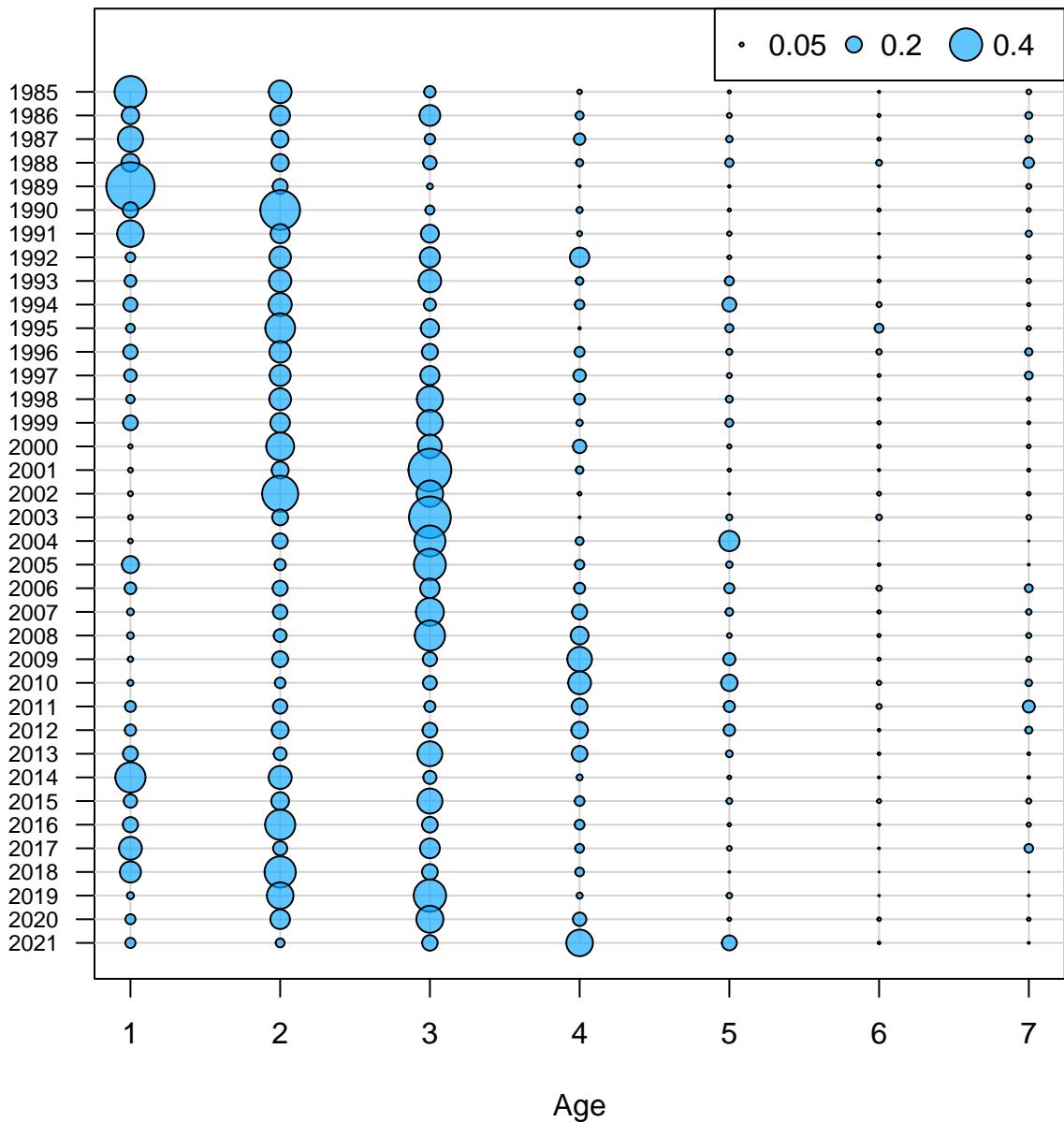
## Age Comps for Index 1 (NEFSC Inshore)



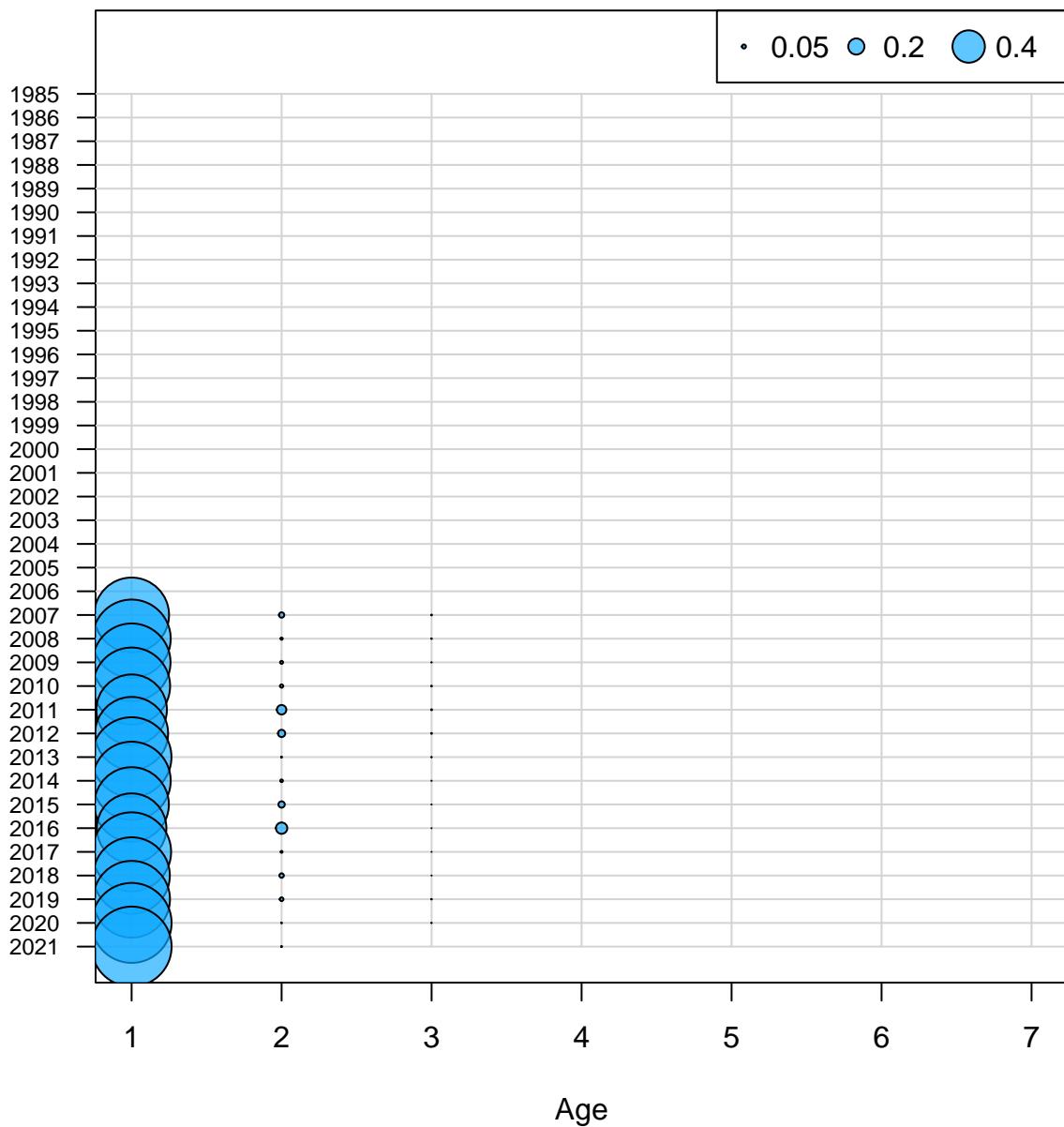
## Age Comps for Index 2 (Bigelow)



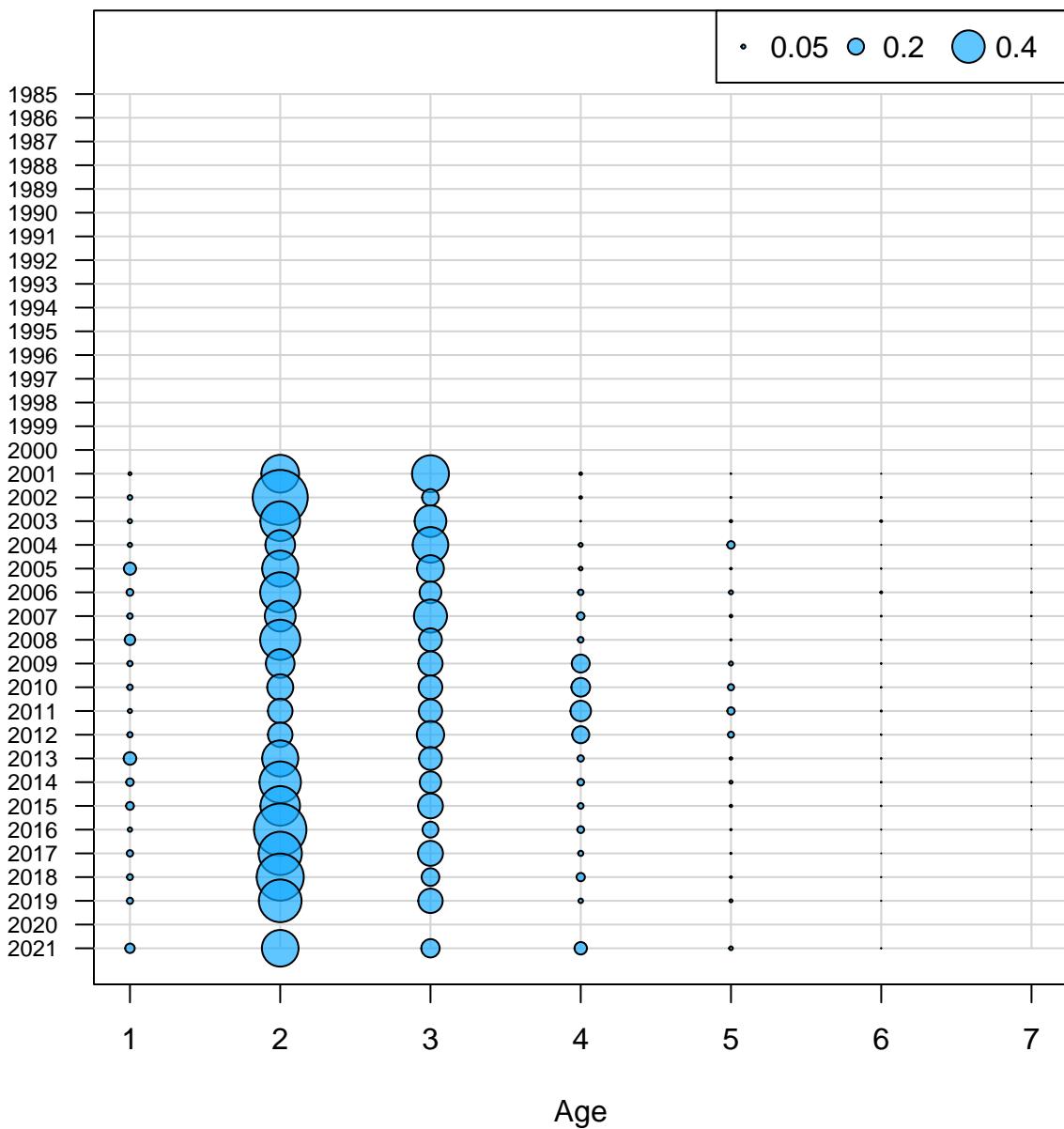
## **Age Comps for Index 3 (MRIP)**



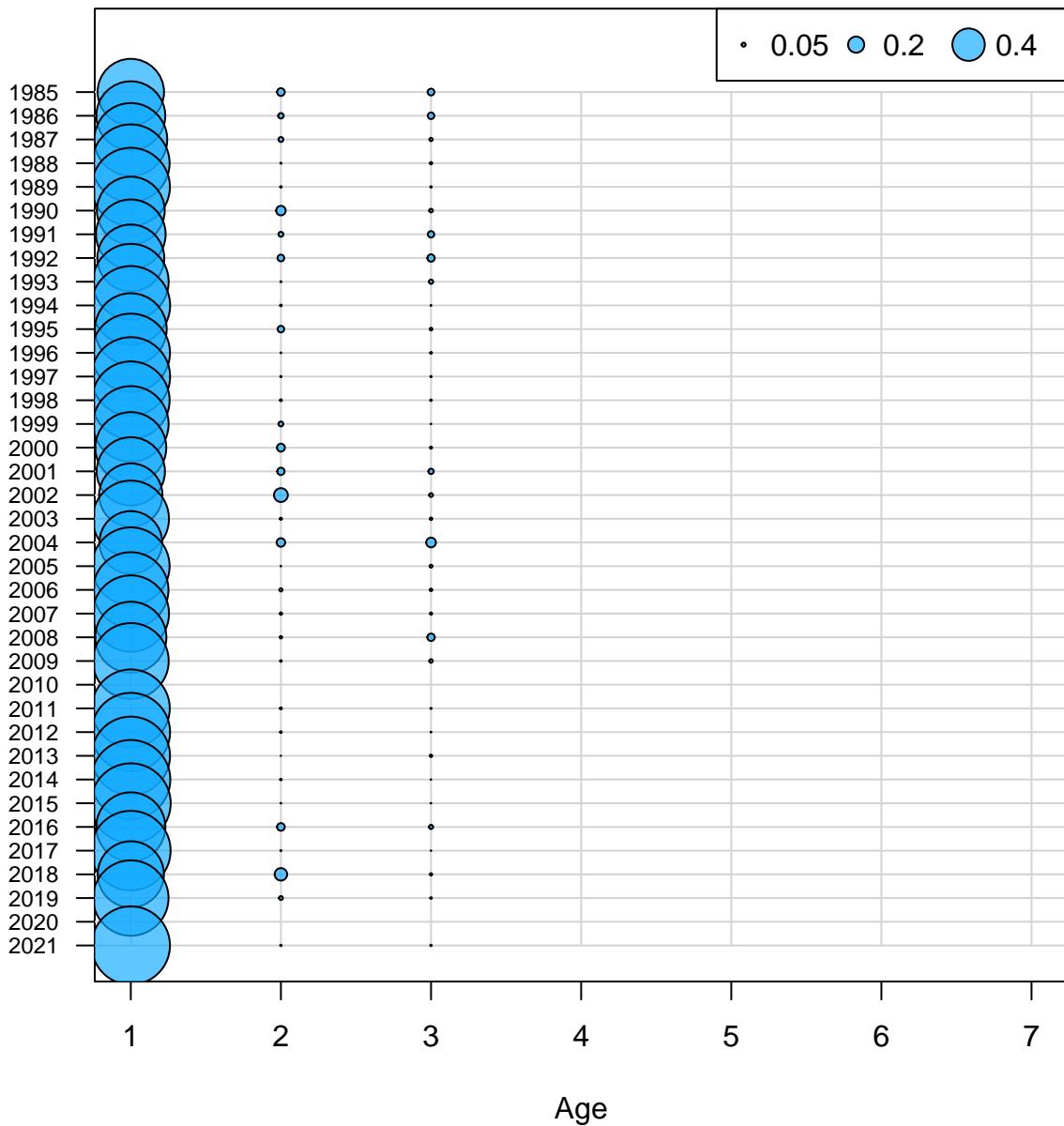
## Age Comps for Index 4 (NEAMAP)



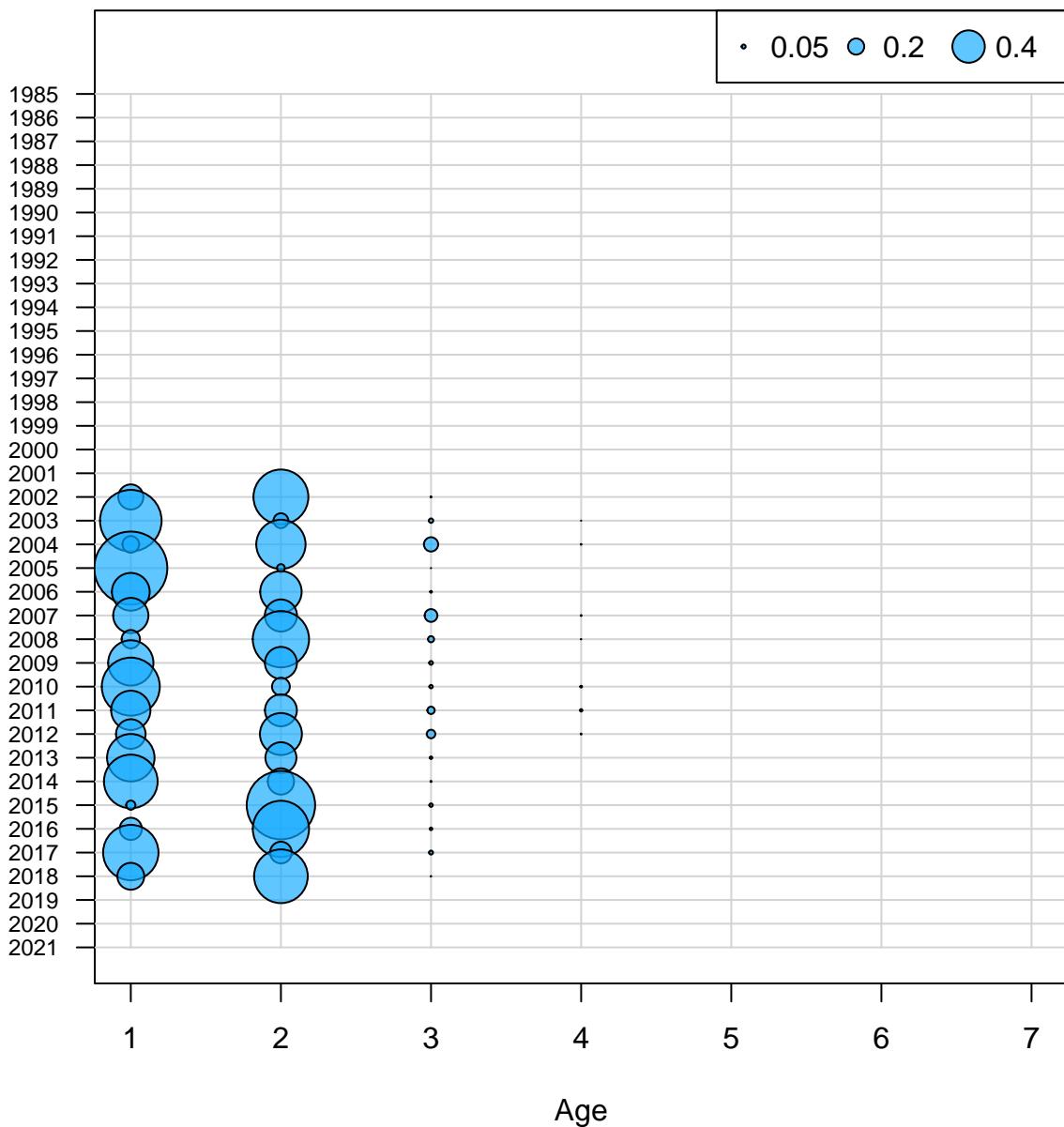
## Age Comps for Index 6 (PSIGN)



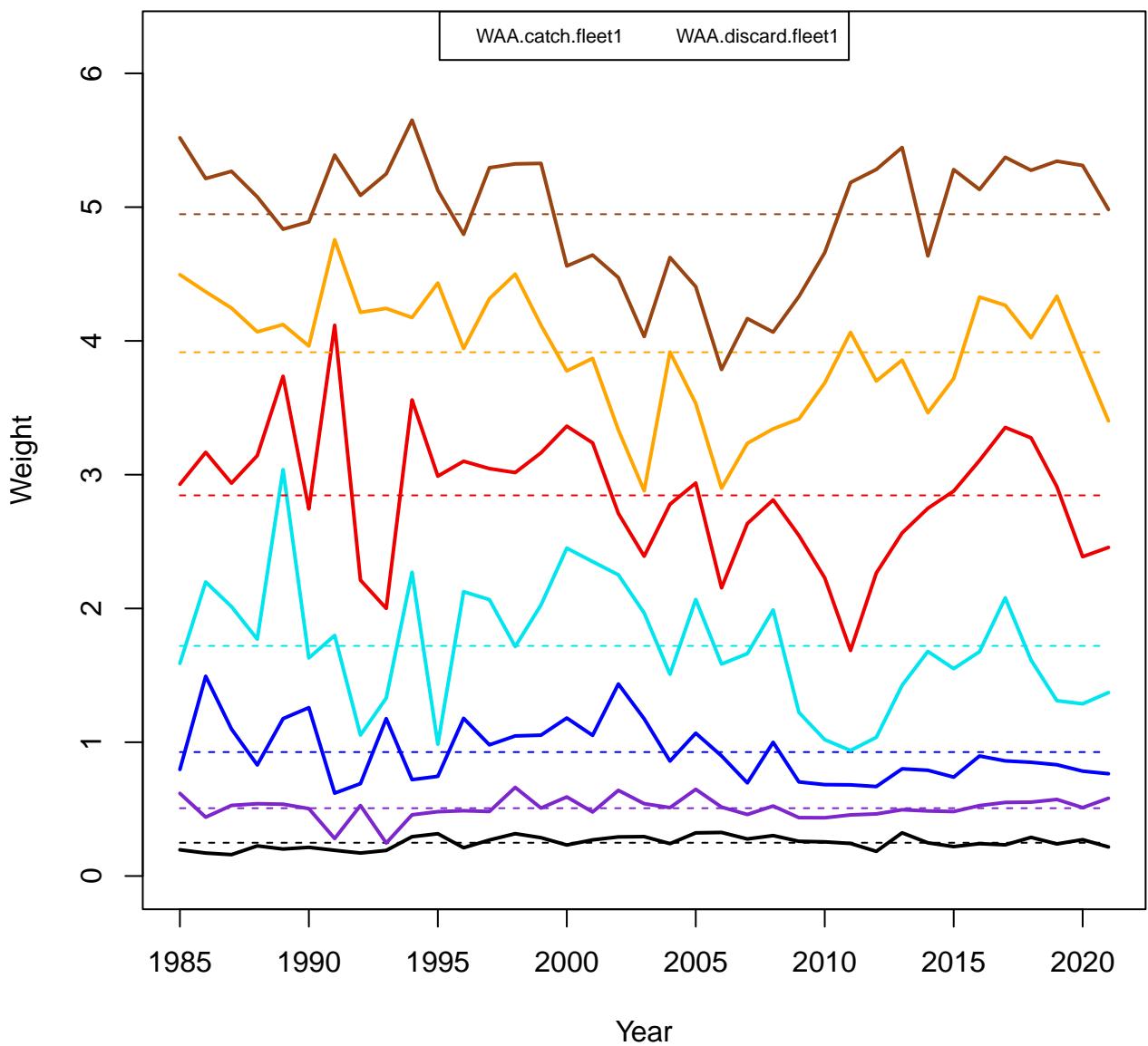
## Age Comps for Index 7 (CT Trawl)



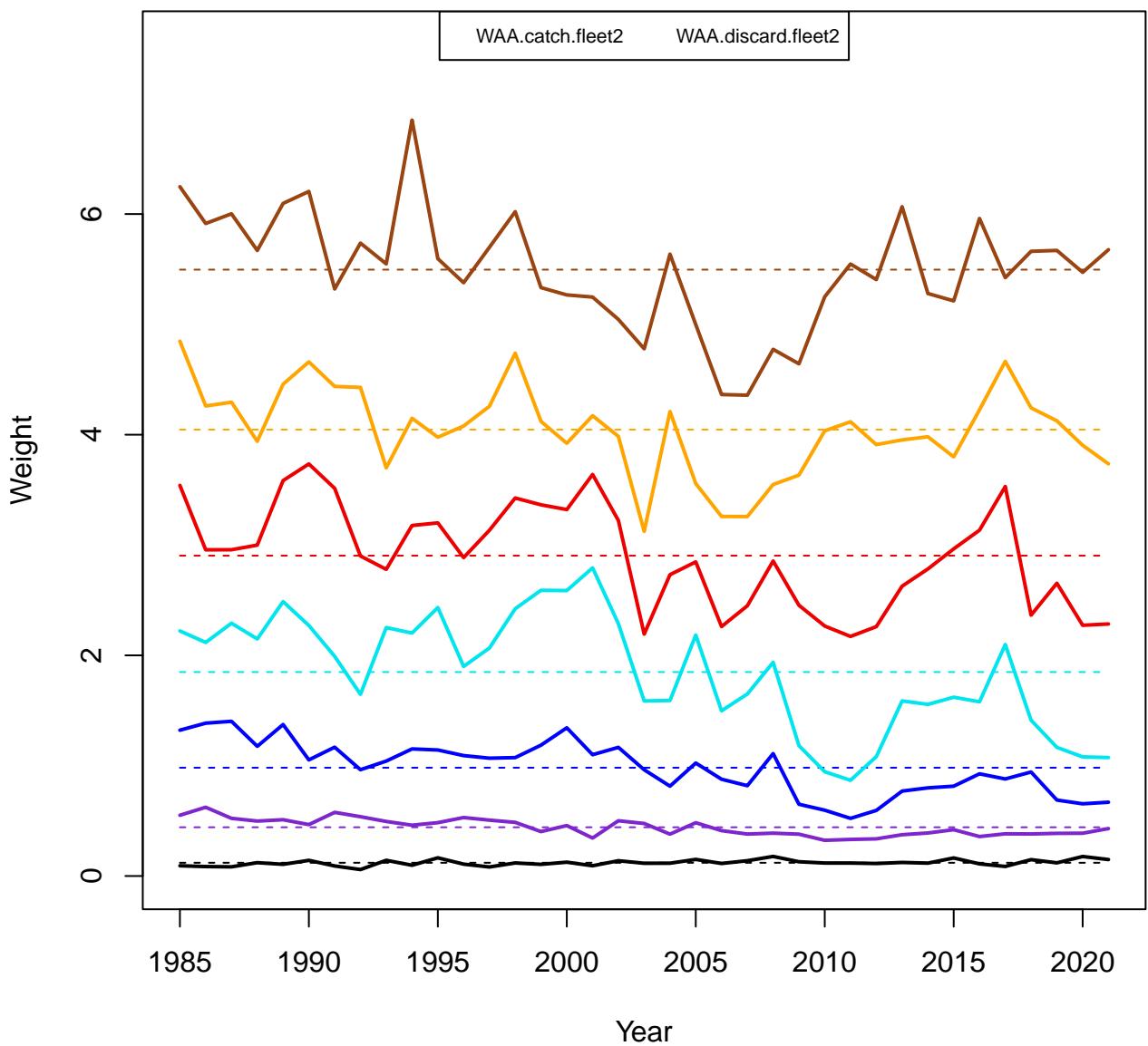
## Age Comps for Index 9 (ChesMMAP)



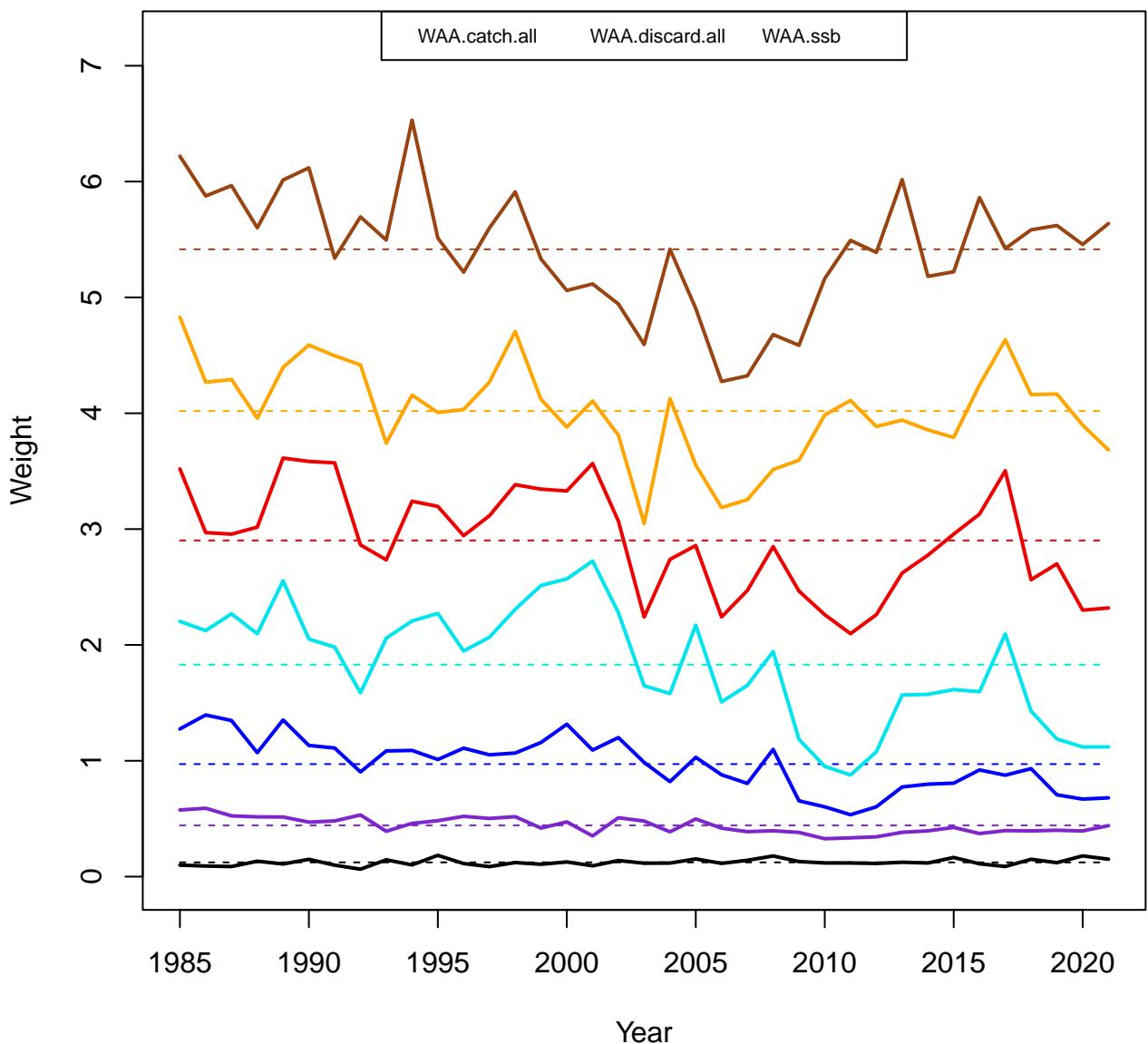
## WAA matrix 1



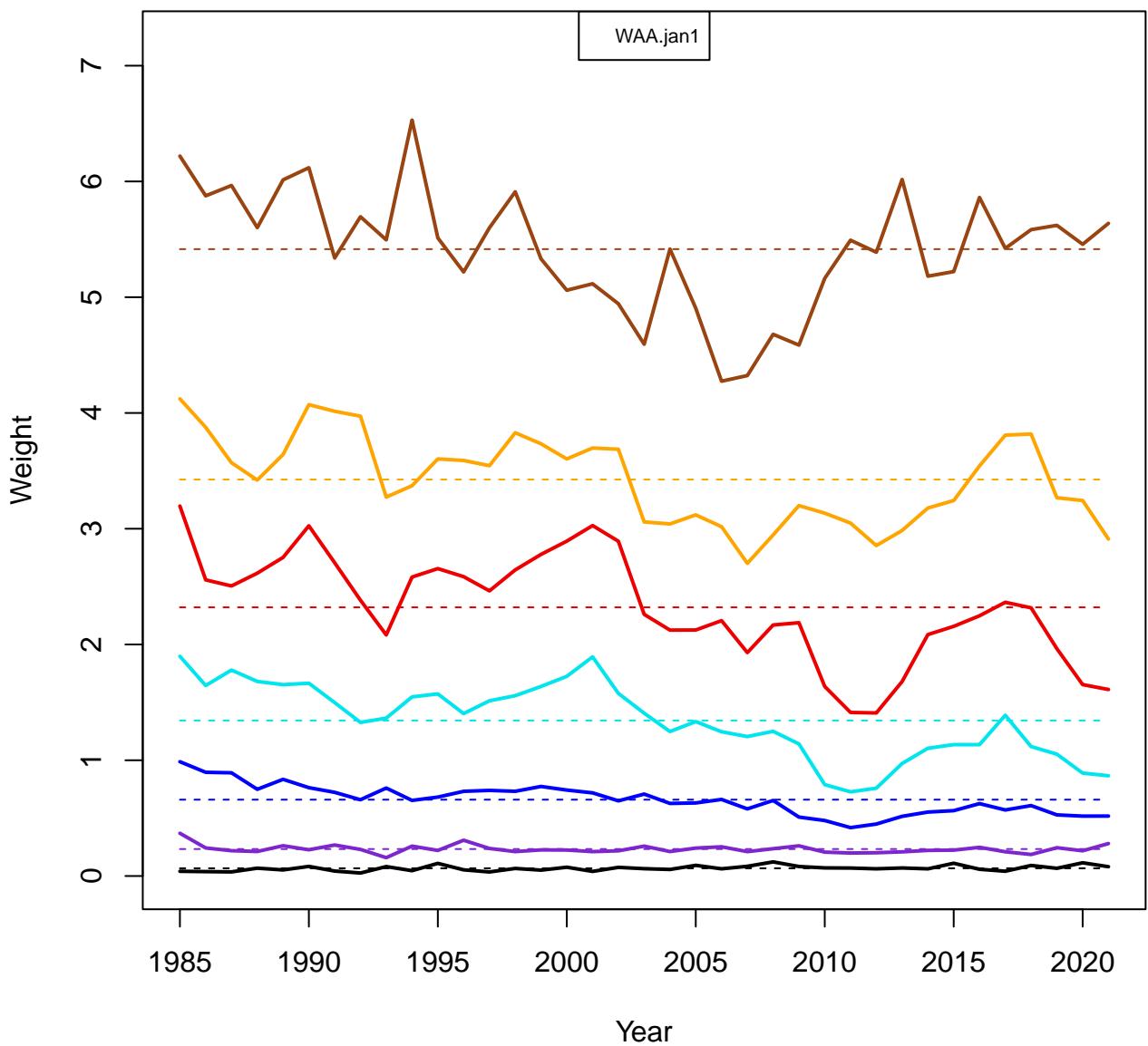
## WAA matrix 2



### WAA matrix 3



## WAA matrix 4



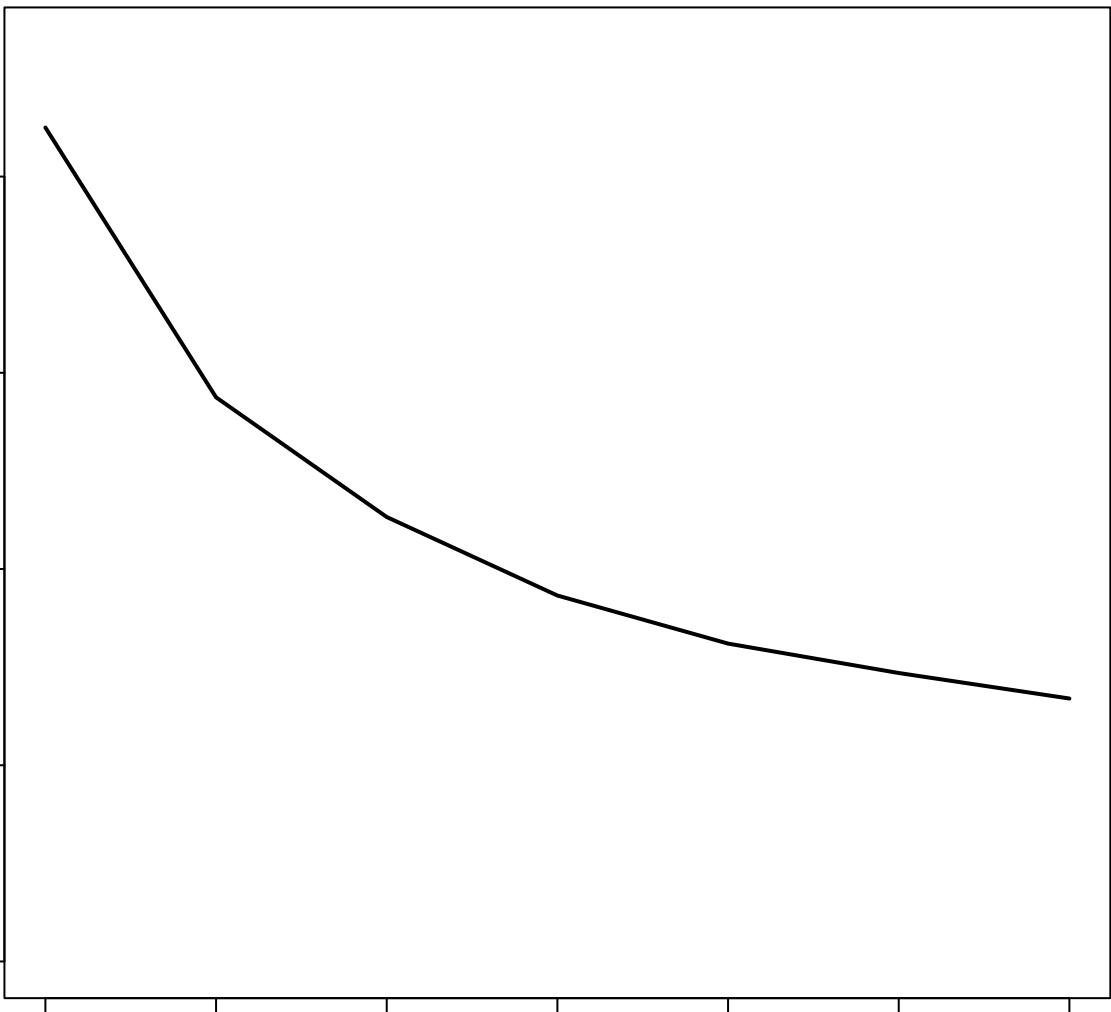
**M**

Natural Mortality Rate

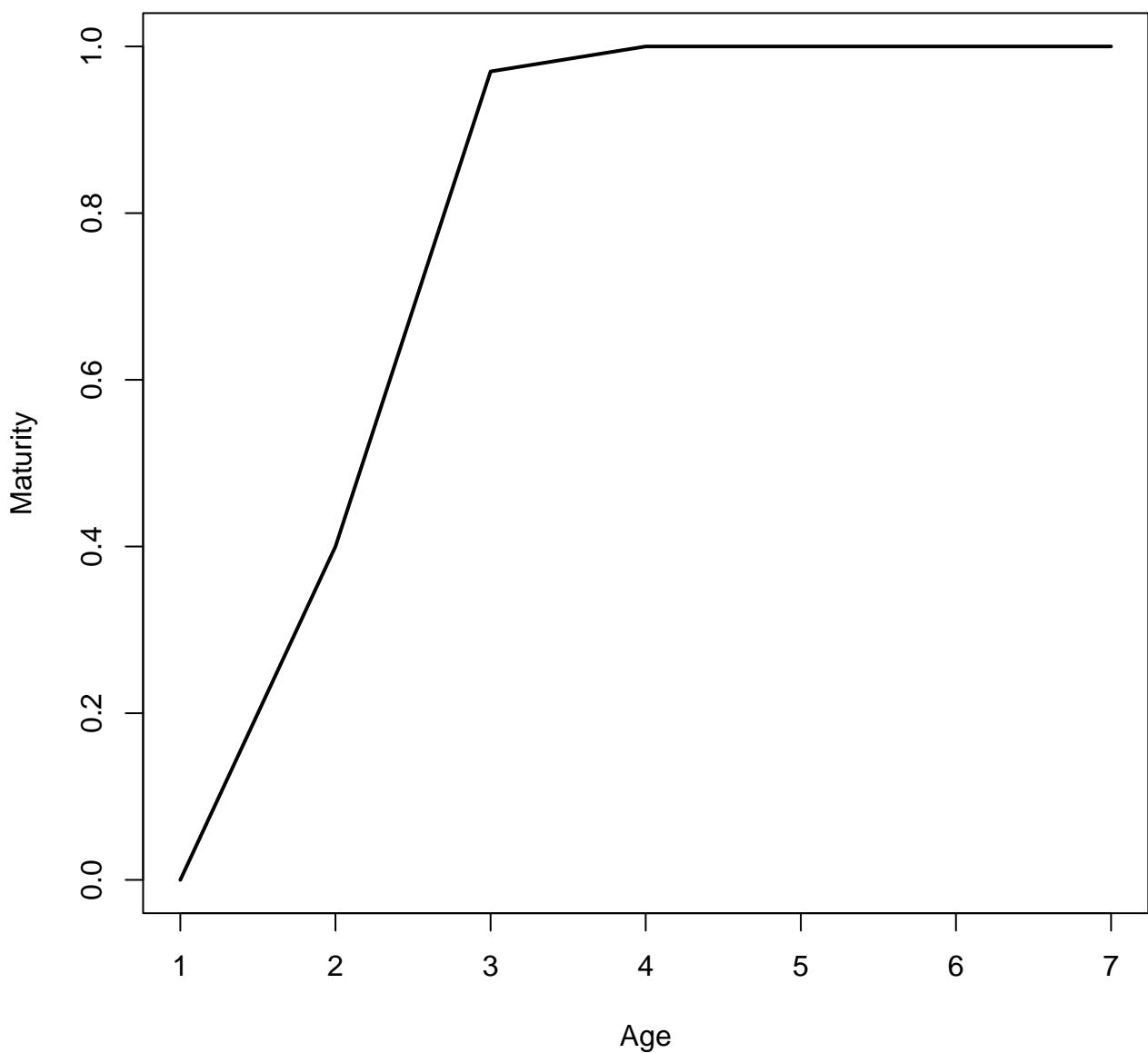
0.8  
0.6  
0.4  
0.2  
0.0

1 2 3 4 5 6 7

Age



## Maturity

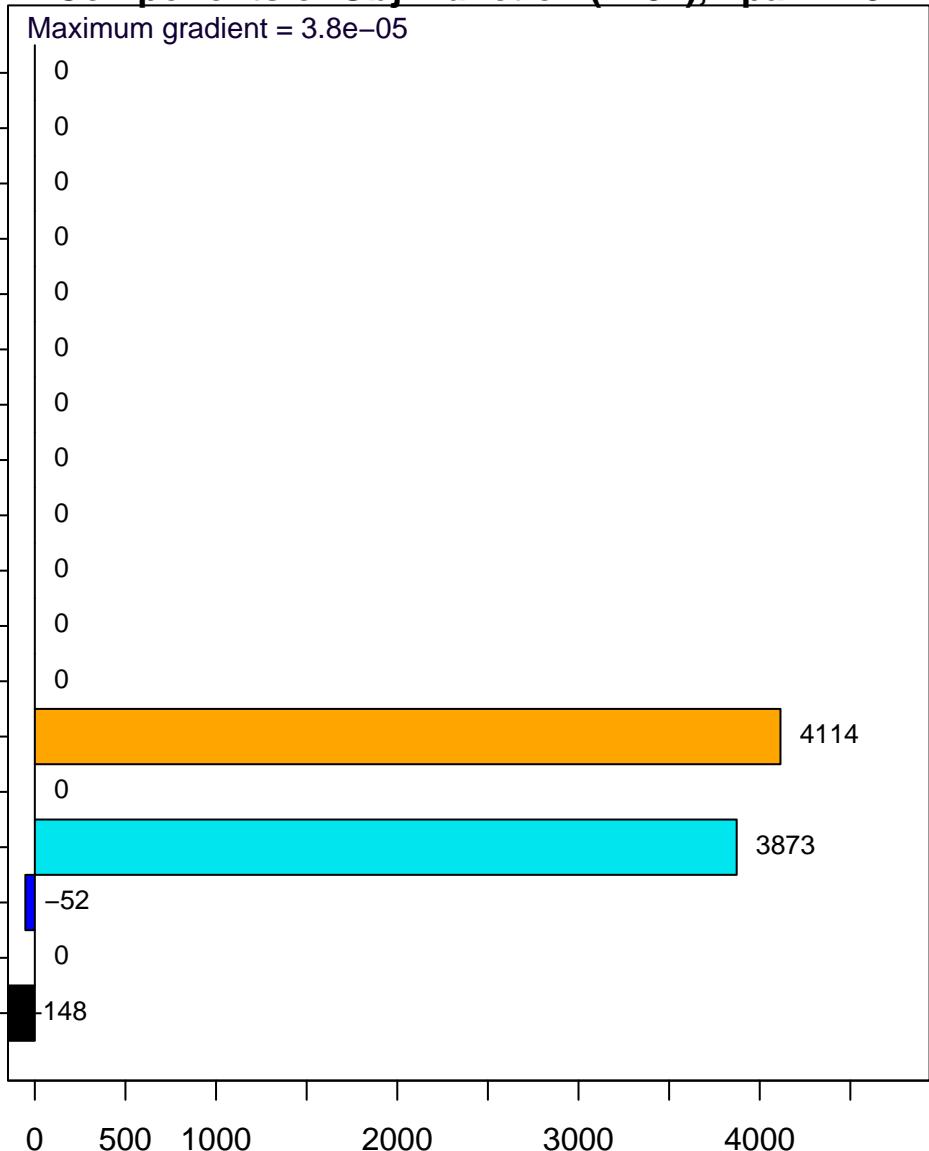


# BF19

5 fleet selectivity blocks, average F from age 1 to ages 1-2

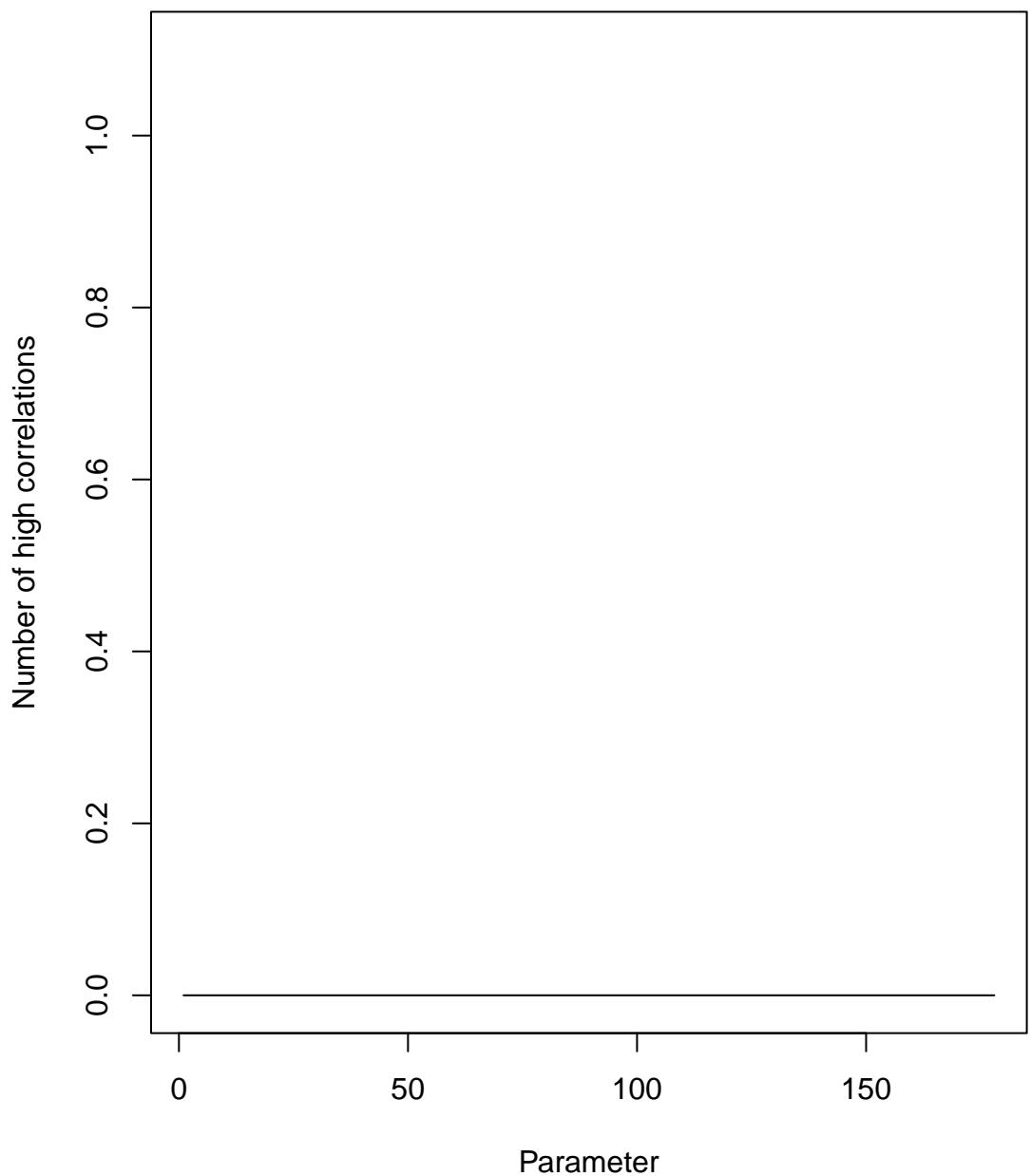
## DIAGNOSTIC PLOTS

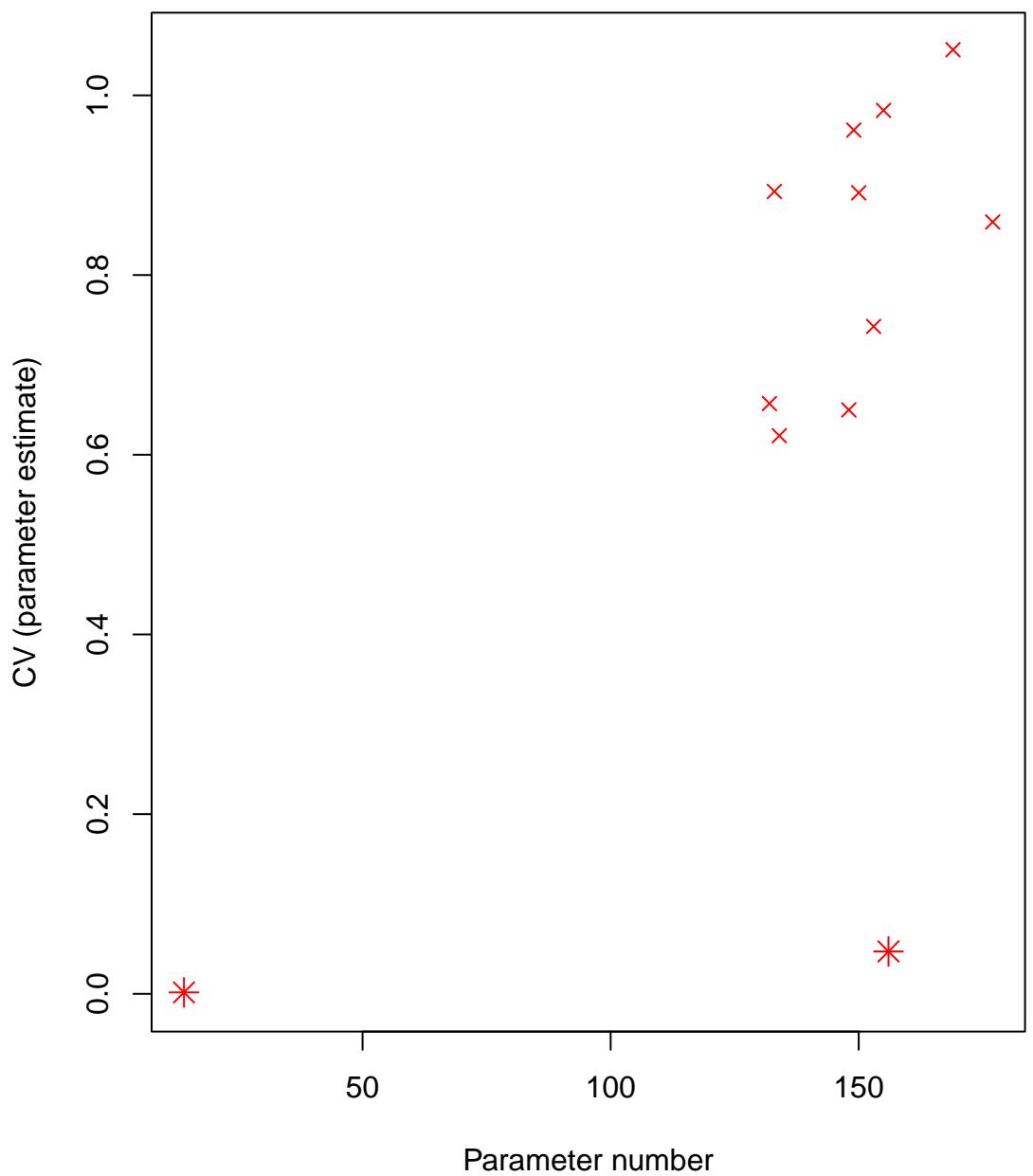
# Components of Obj. Function (7787), npar=178



Likelihood Contribution

Model: BF19    Tuesday, 18 Oct 2022 at 18:05:05

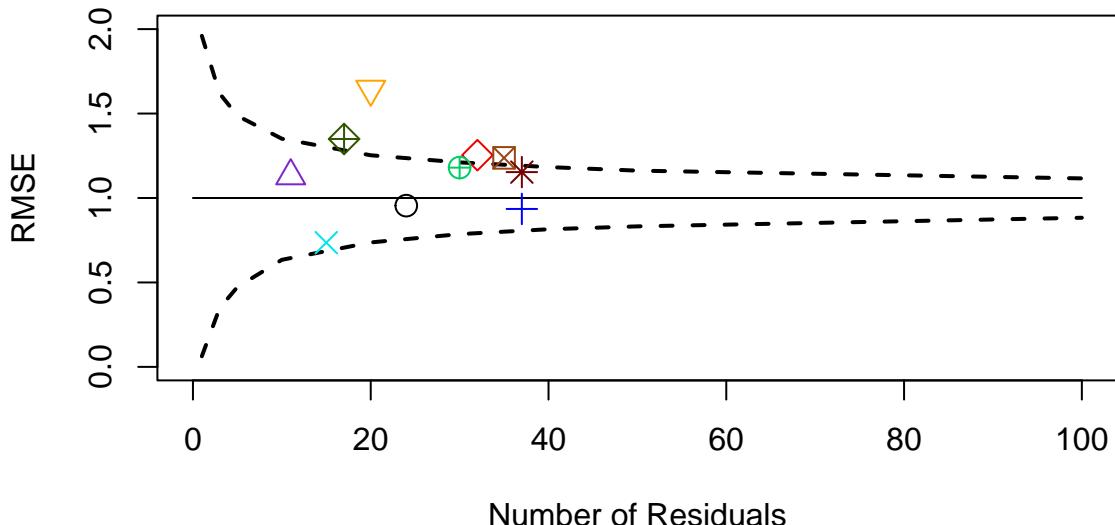




## Root Mean Square Error computed from Standardized Residuals

Component	# resids	RMSE
catch.fleet1	37	0.067
catch.fleet2	37	0.641
catch.tot	74	0.456
discard.fleet1	0	0
discard.fleet2	0	0
discard.tot	0	0
ind01	24	0.955
ind02	11	1.13
ind03	37	0.935
ind04	15	0.735
ind05	32	1.25
ind06	20	1.64
ind07	35	1.24
ind08	37	1.15
ind09	17	1.35
ind10	30	1.18
ind.total	258	1.18
N.year1	0	0
Fmult.year1	0	0
Fmult.devs.fleet1	0	0
Fmult.devs.fleet2	0	0
Fmult.devs.total	0	0
recruit.devs	0	0
fleet.sel.params	0	0
index.sel.params	0	0
q.year1	0	0
q.devs	0	0
SR.steepness	0	0
SR.scaler	0	0

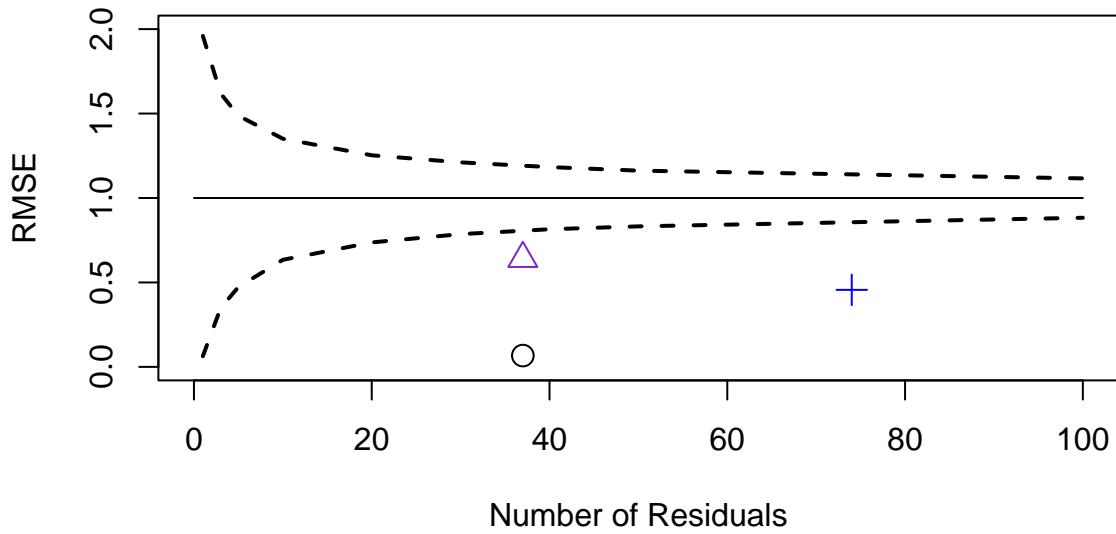
## Root Mean Square Error for Indices



Legend:

- ind.total
- SEAMAP1
- ChesMMAP
- Compound YOY
- CT Trawl
- PSIGN
- SEAMAP
- NEAMAP
- MRIP
- Bigelow
- NEFSC Inshore

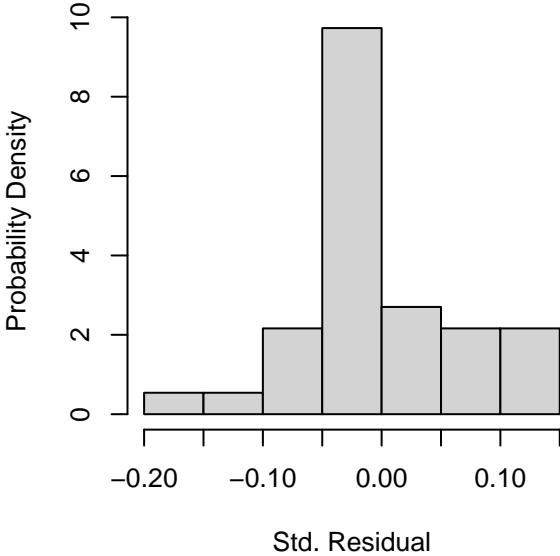
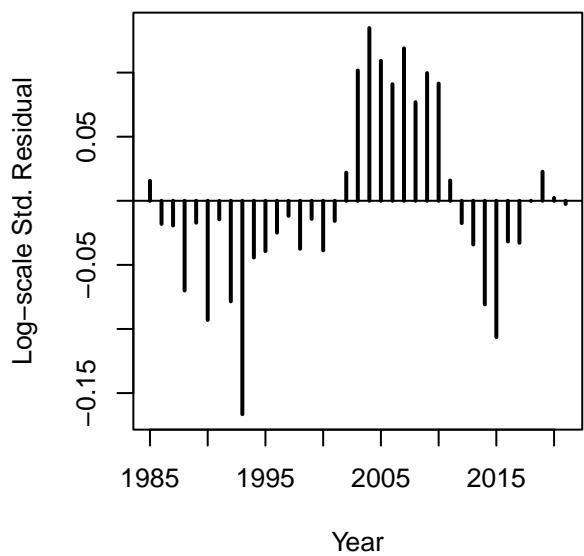
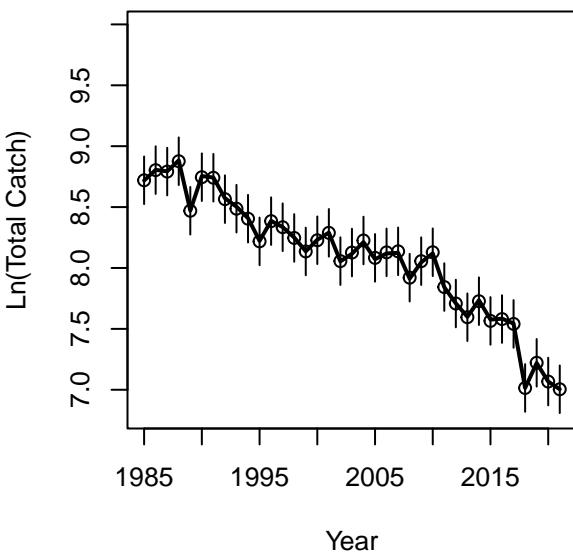
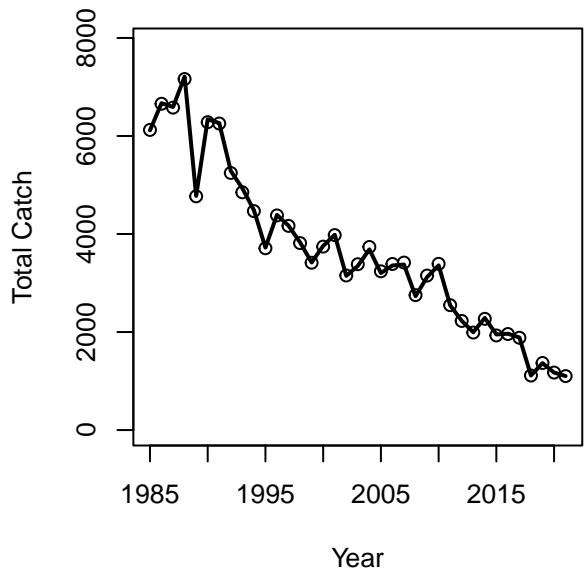
## Root Mean Square Error for Catch



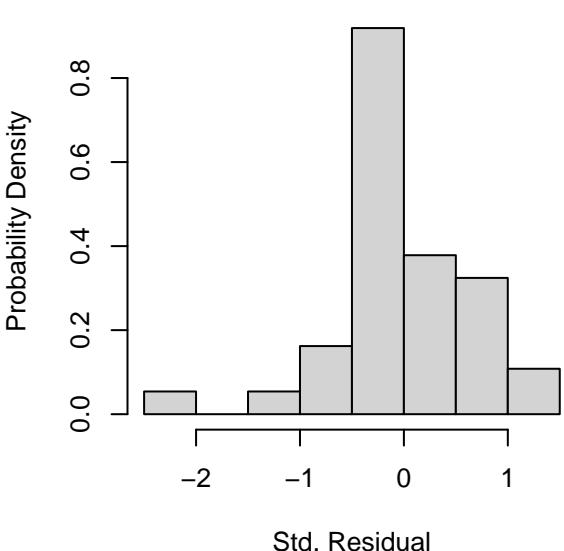
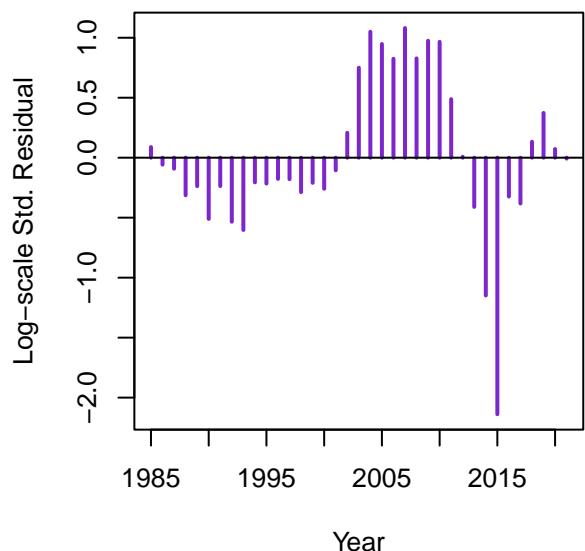
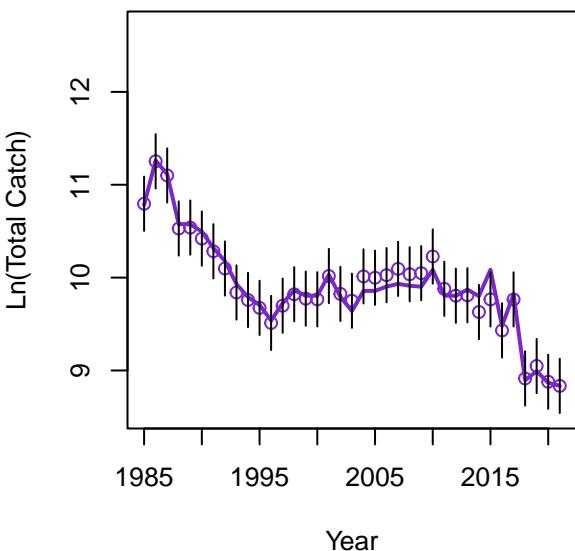
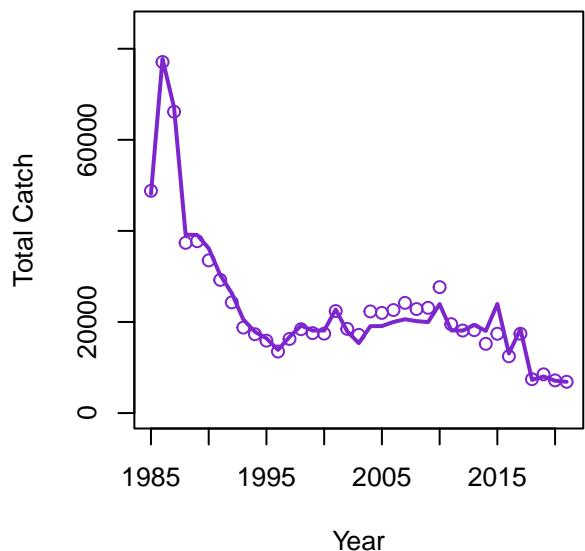
+

catch.tot  
catch.fleet2  
o catch.fleet1

### Fleet 1 Catch (Comm)



## Fleet 2 Catch (Rec)



Fleet 1  
Comm  
↓

**Catch**  
**Year = 1989**

**Year = 1985**

**Year = 1986**

**Year = 1987**

**Year = 1988**

**Year = 1994**

**Year = 1995**

**Year = 1996**

**Year = 1997**

**Year = 1998**

Proportion at Age

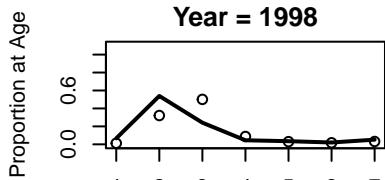
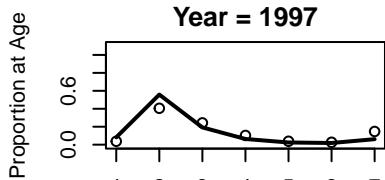
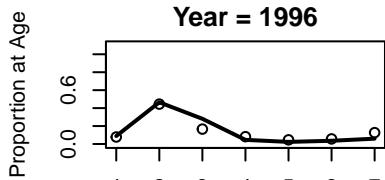
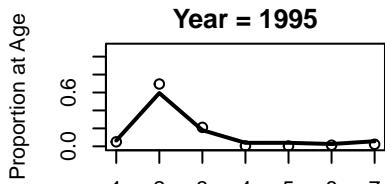
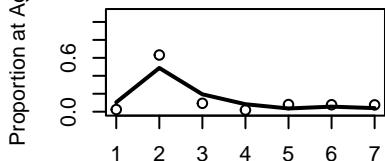
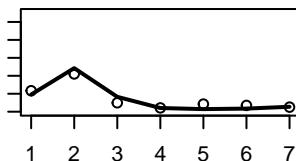
**Catch**  
**Year = 1989**

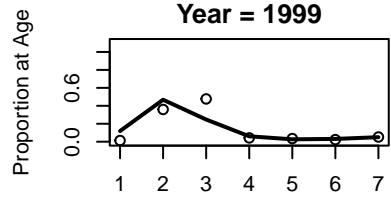
**Year = 1990**

**Year = 1991**

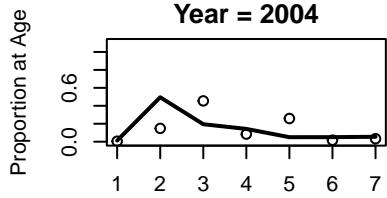
**Year = 1992**

**Year = 1993**

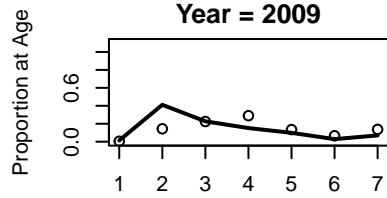




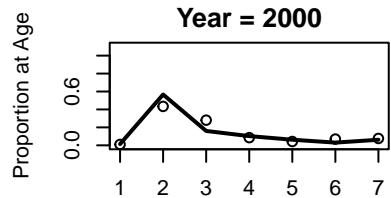
**Year = 1999**



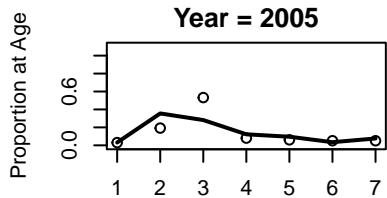
**Year = 2004**



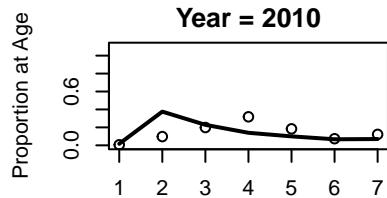
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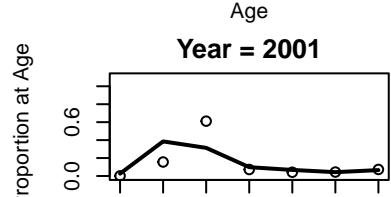
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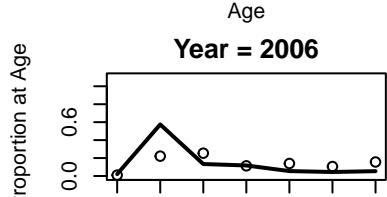
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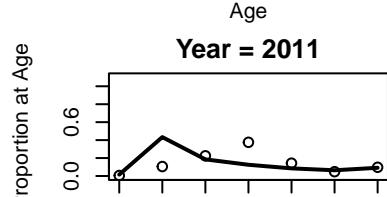
**Year = 2010**



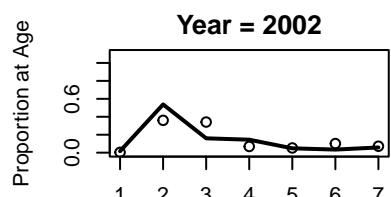
Year = 2001



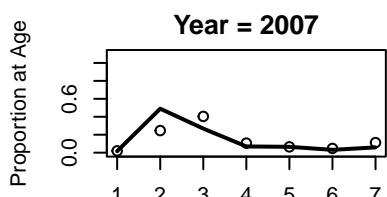
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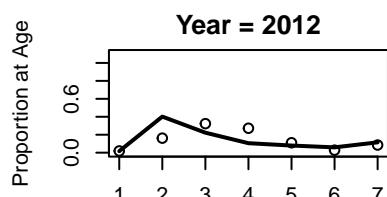
Year = 2011



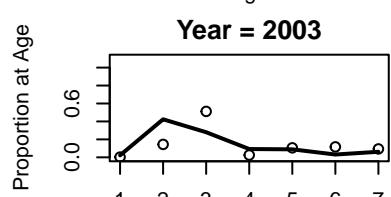
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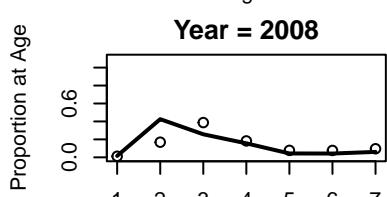
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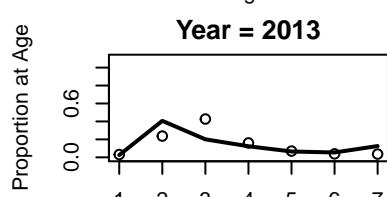
Year = 2012



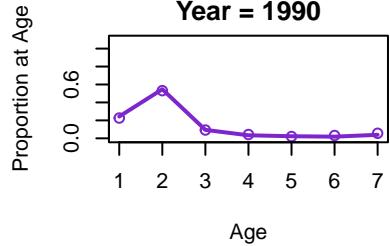
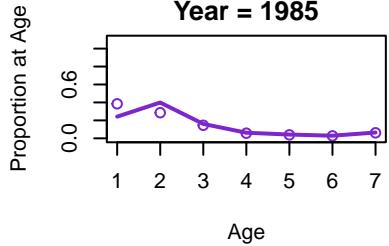
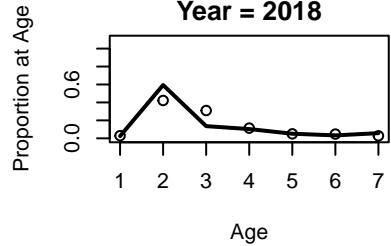
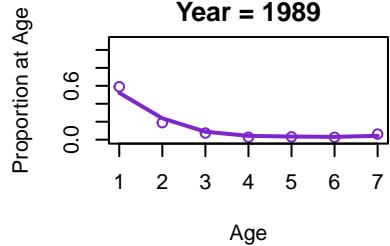
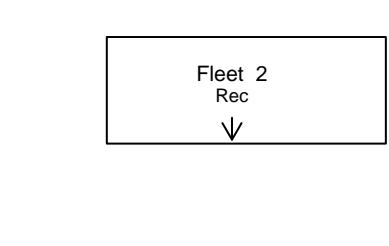
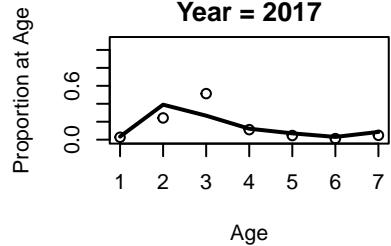
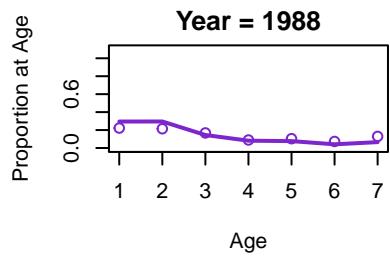
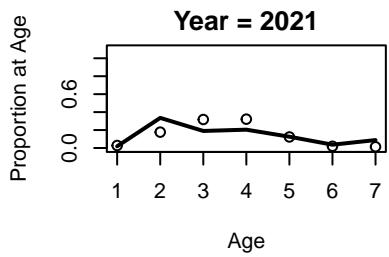
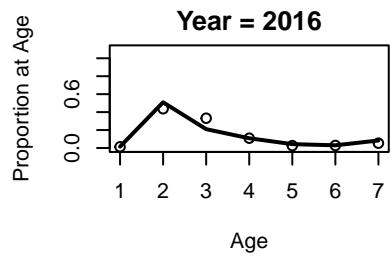
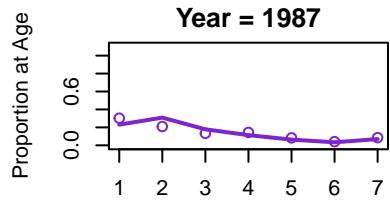
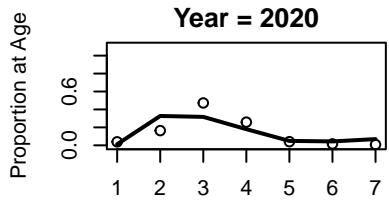
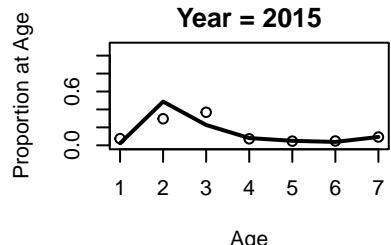
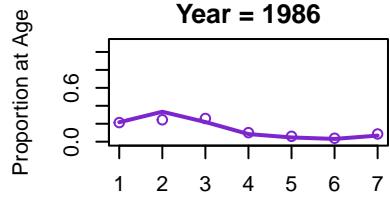
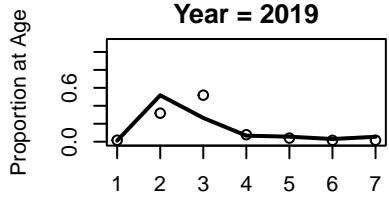
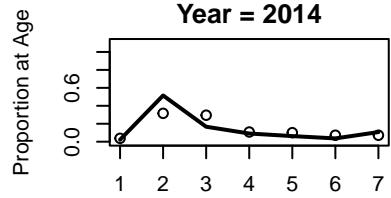
Year - 2003

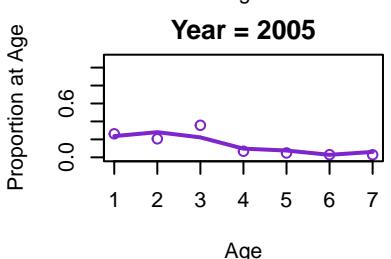
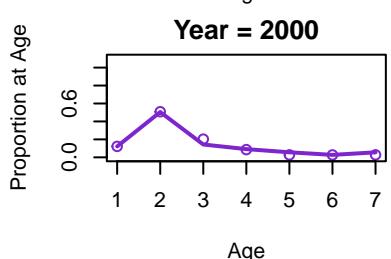
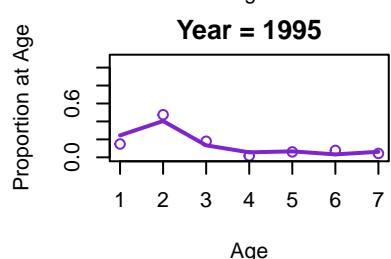
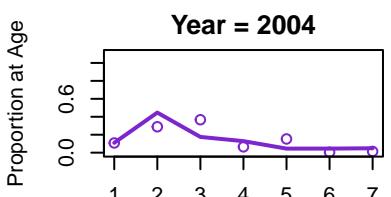
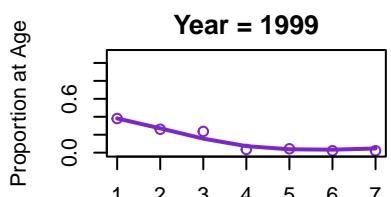
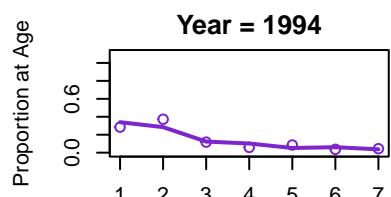
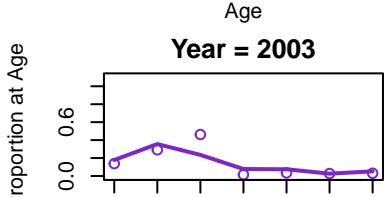
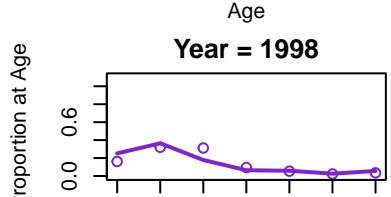
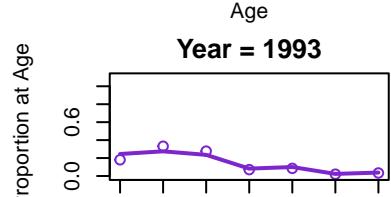
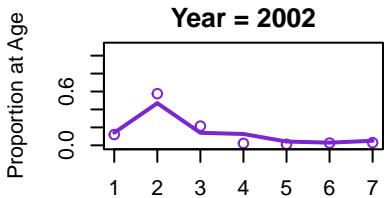
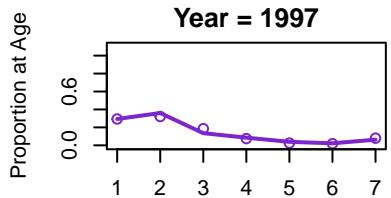
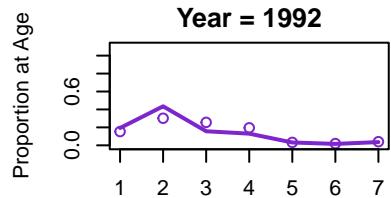
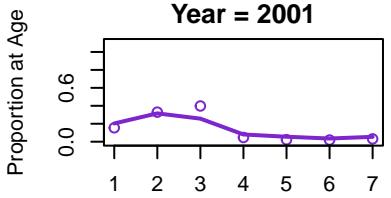
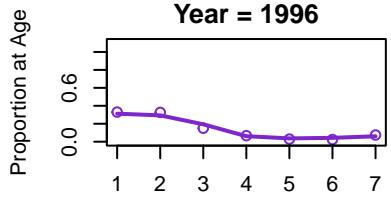
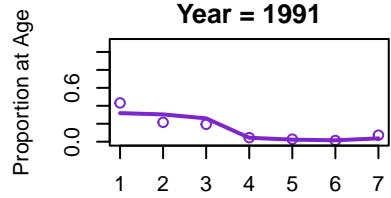


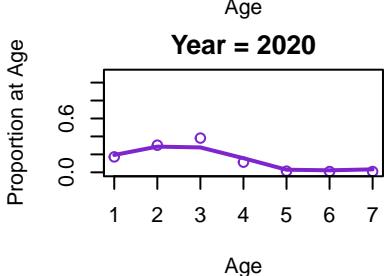
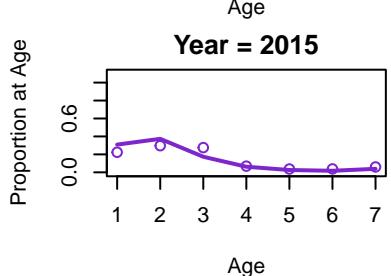
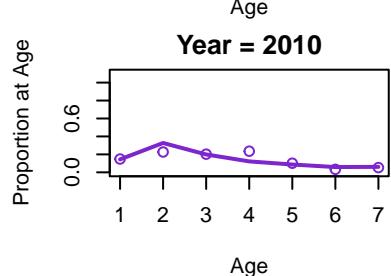
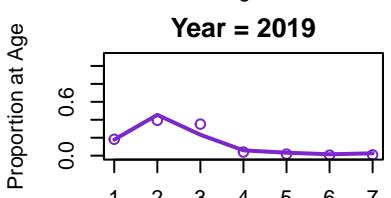
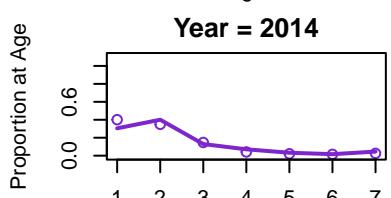
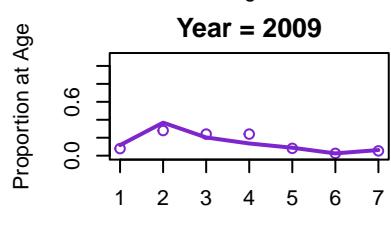
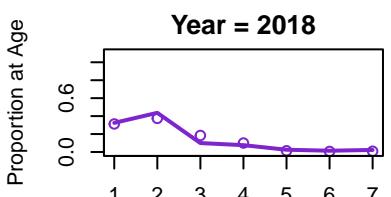
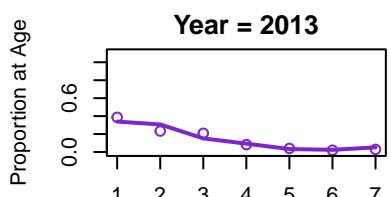
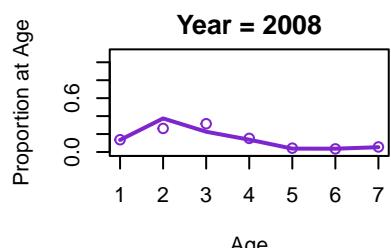
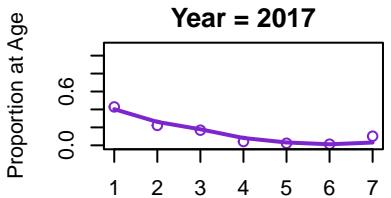
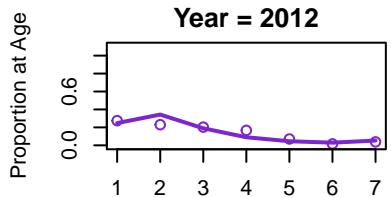
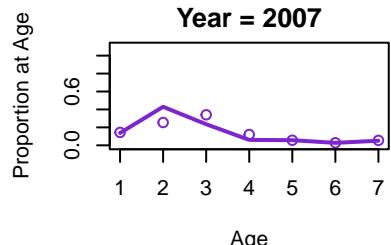
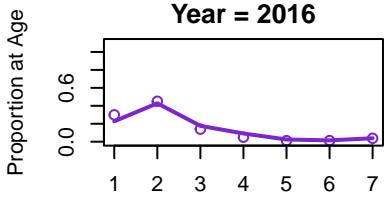
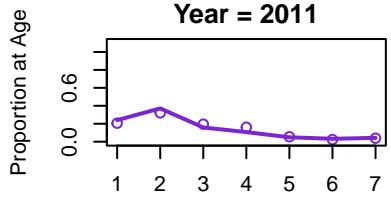
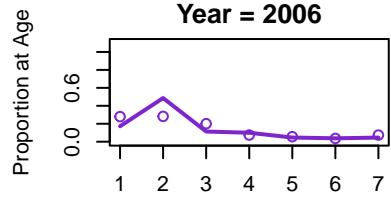
Year - 2008



Year - 2013

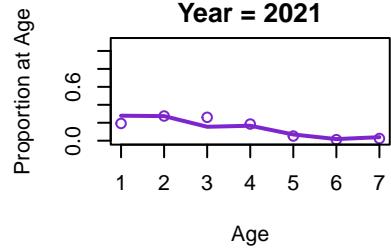




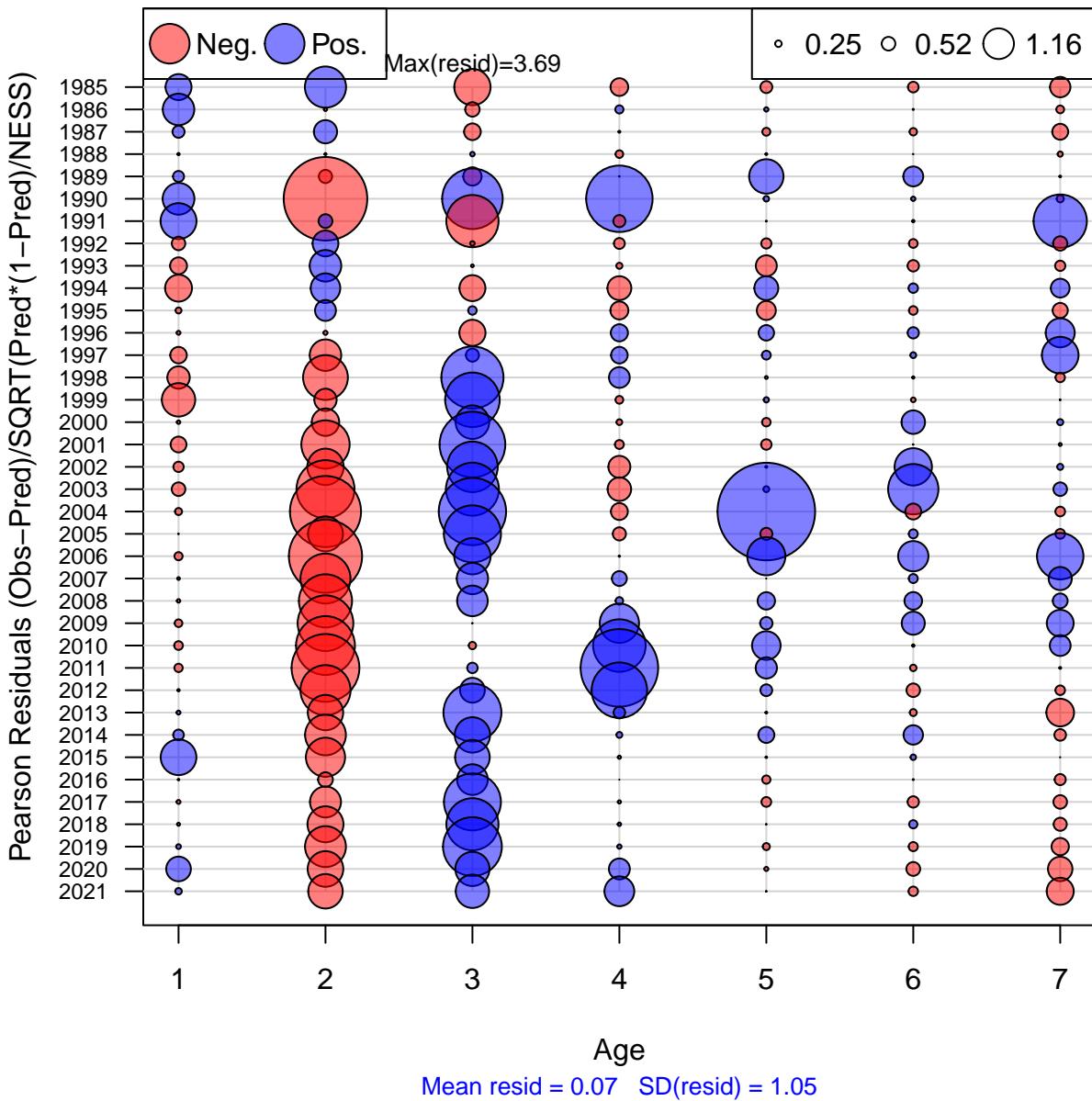


# Catch

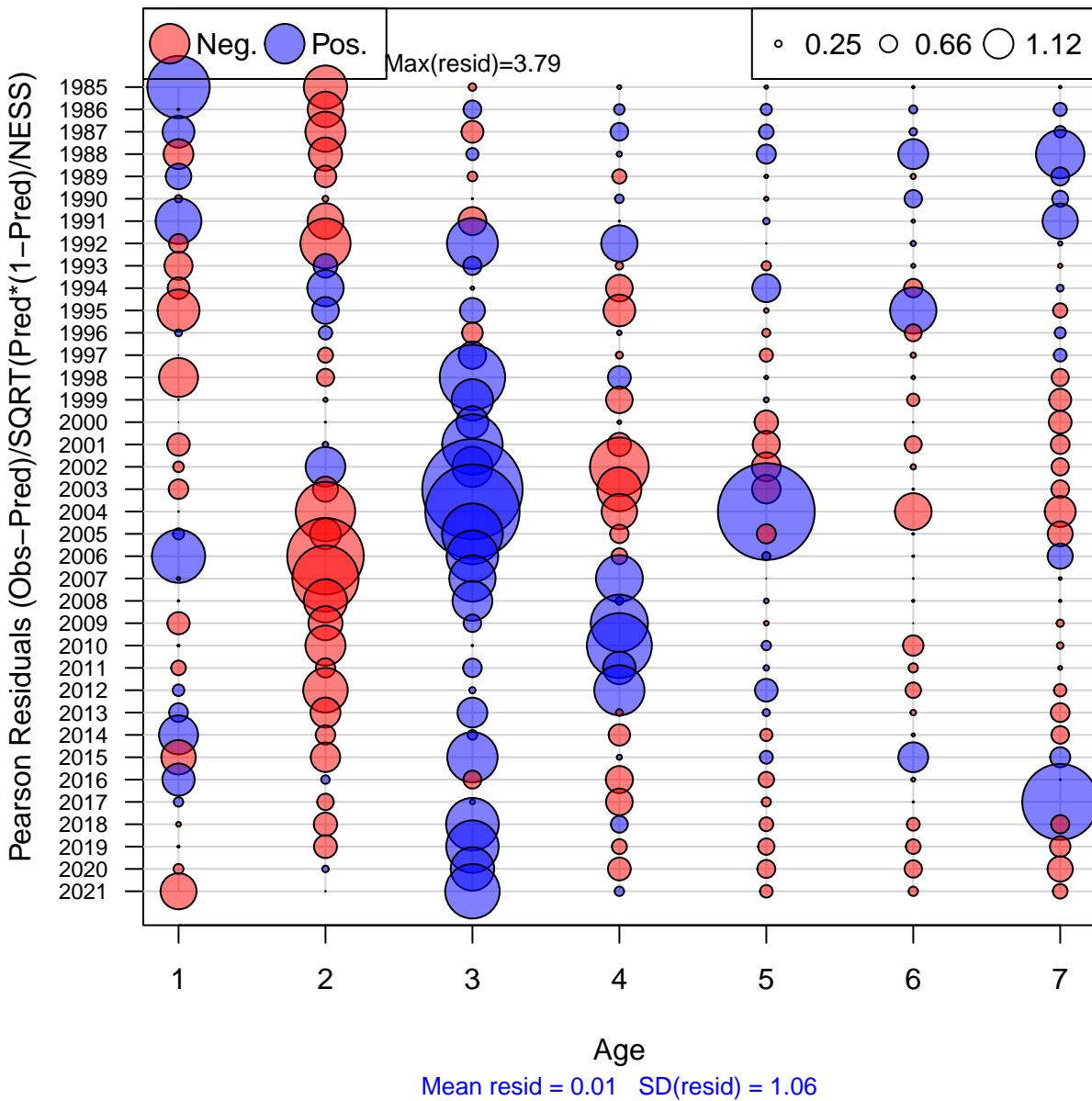
Year = 2021



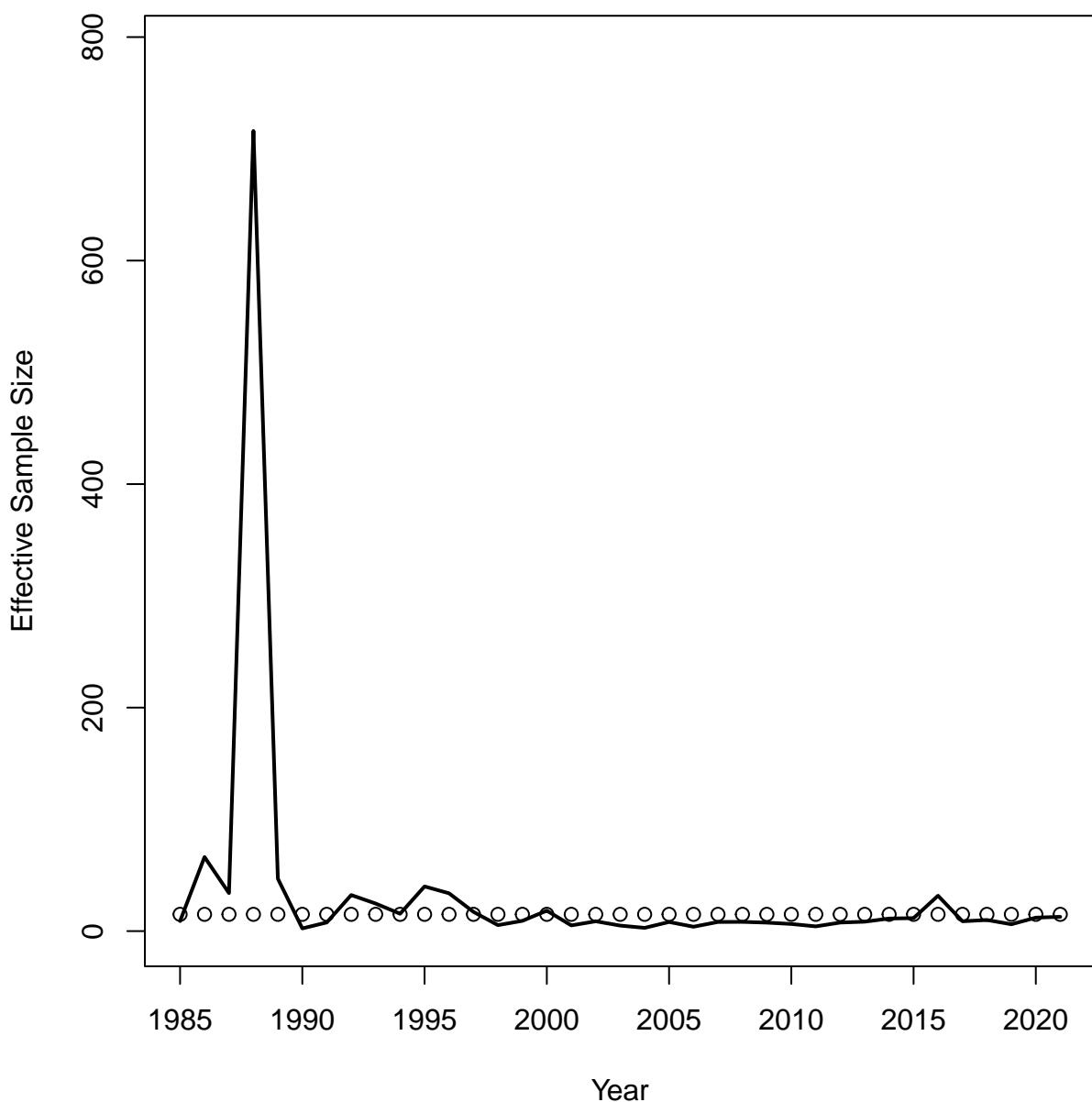
# Age Comp Residuals for Catch by Fleet 1 (Comm)



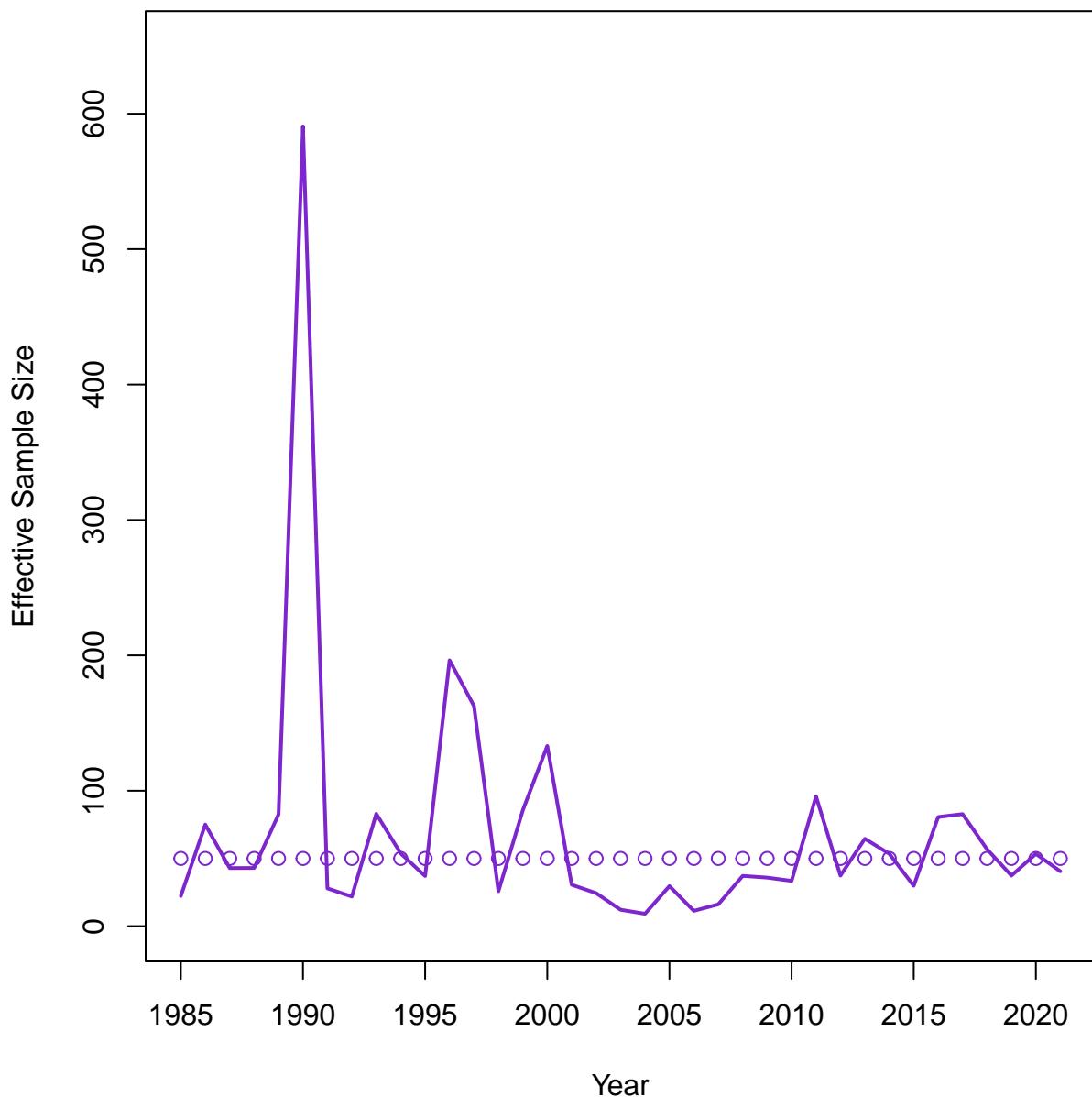
## Age Comp Residuals for Catch by Fleet 2 (Rec)



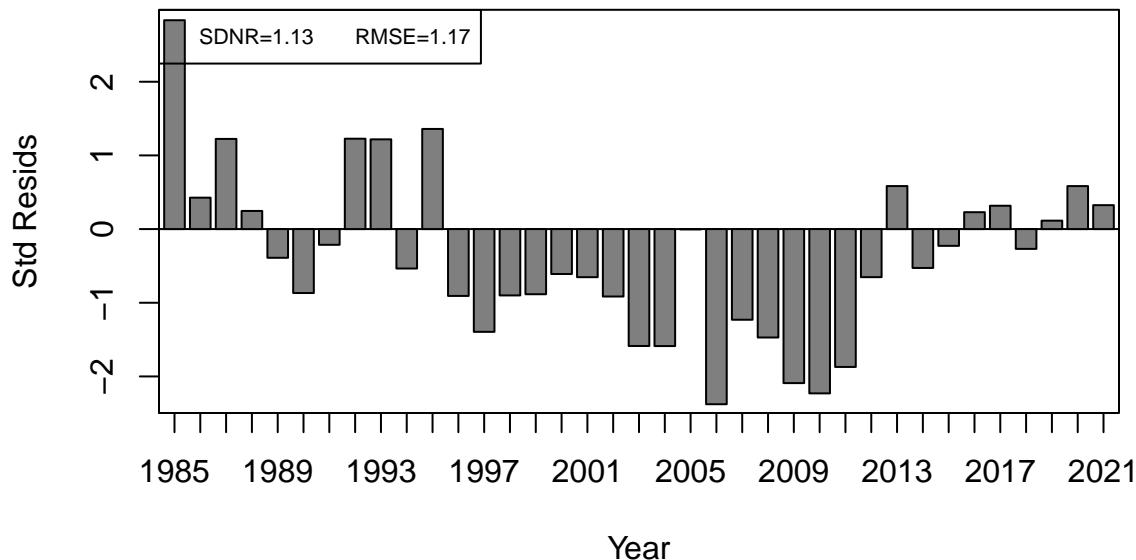
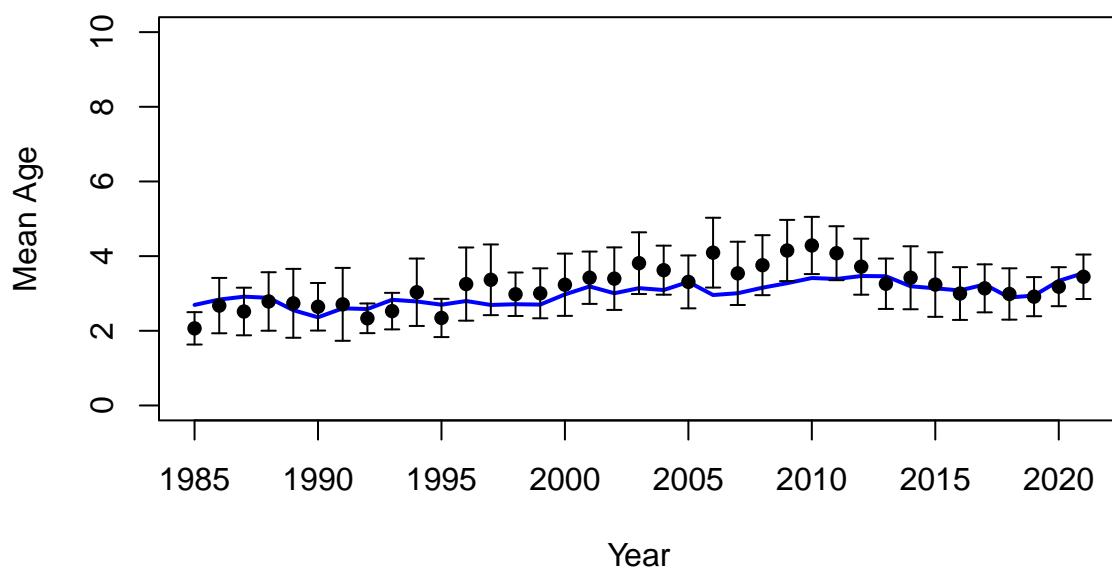
## Catch Neff Fleet 1 (Comm)



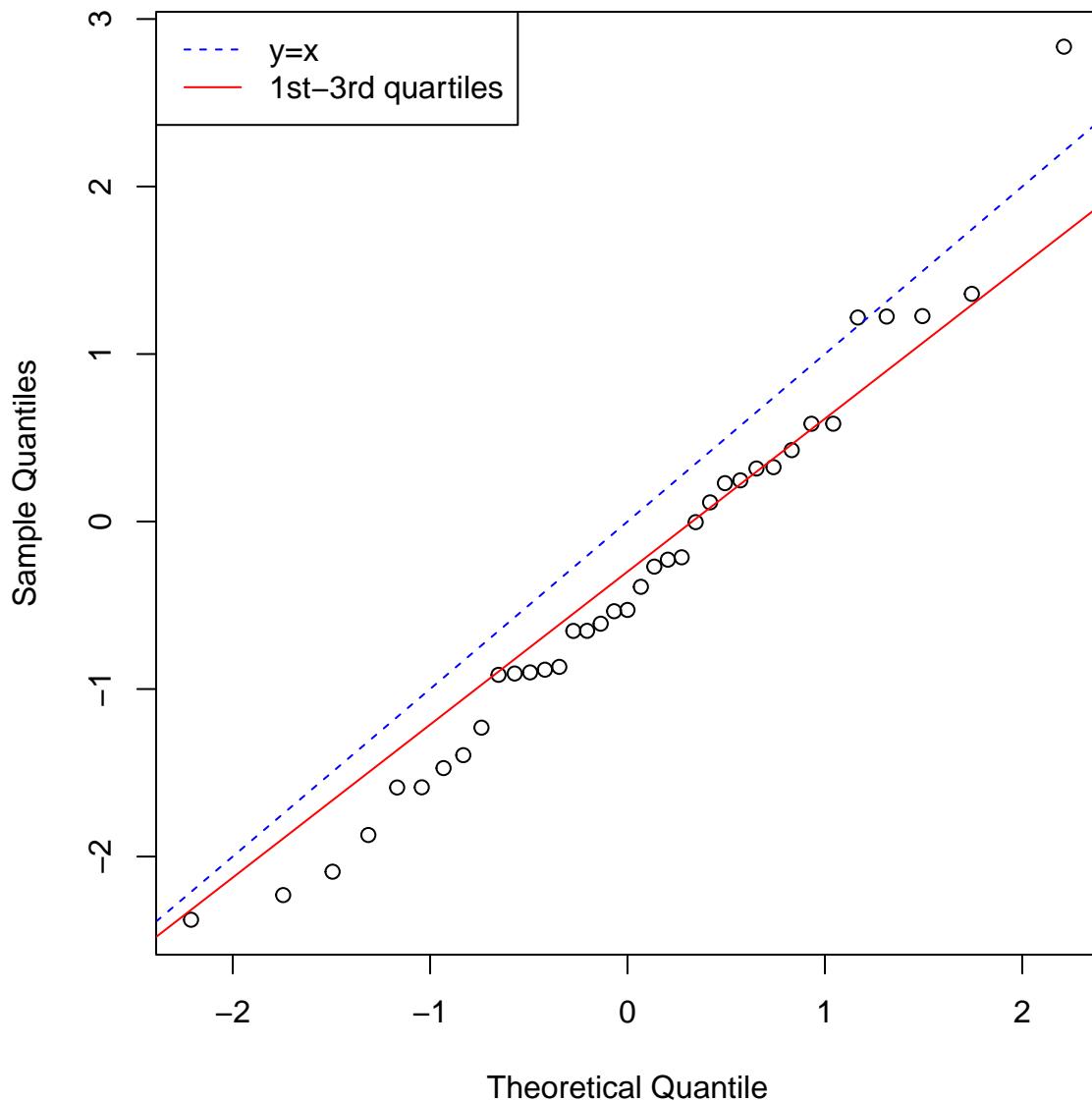
## Catch Neff Fleet 2 (Rec)



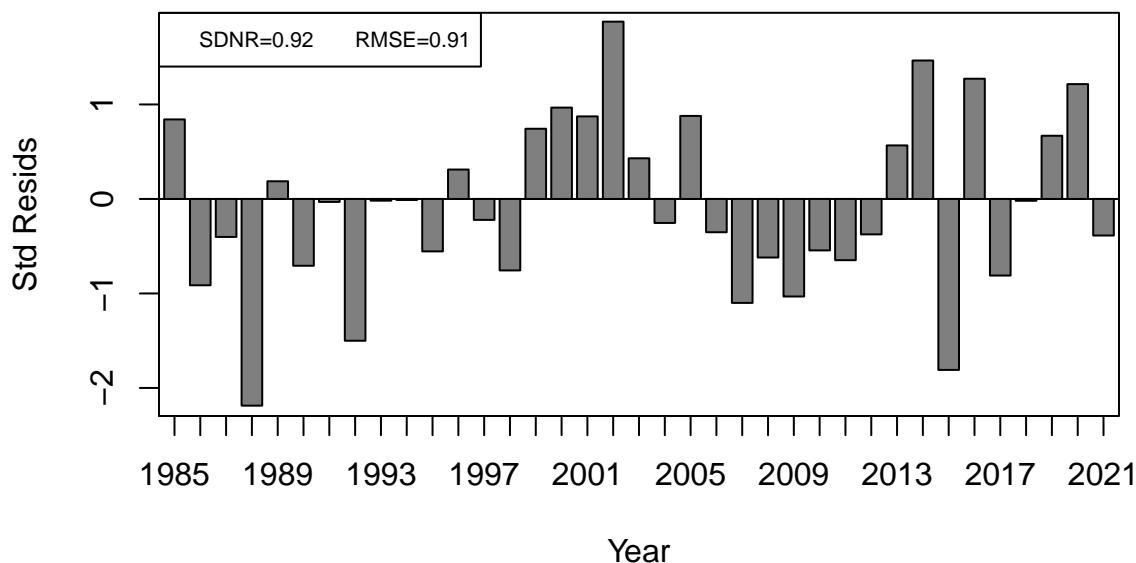
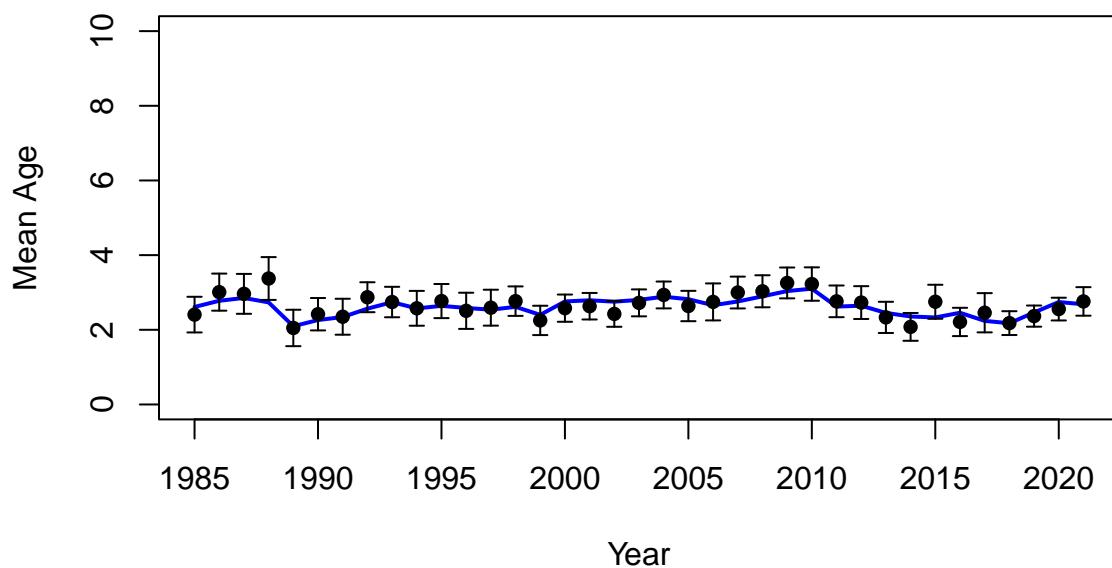
### Catch Fleet 1 (Comm) ESS = 15



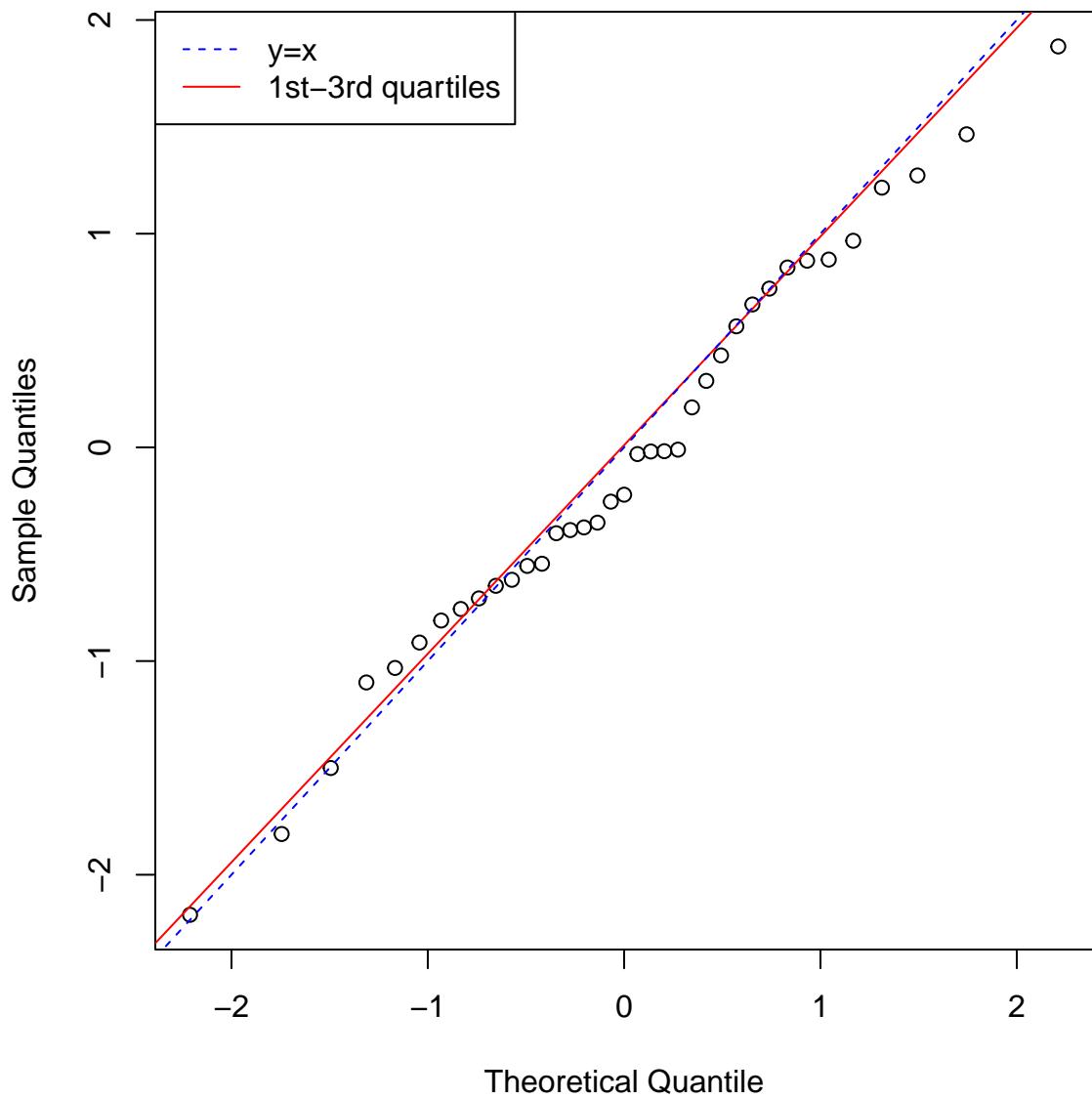
### Catch Fleet 1 (Comm) ESS = 15



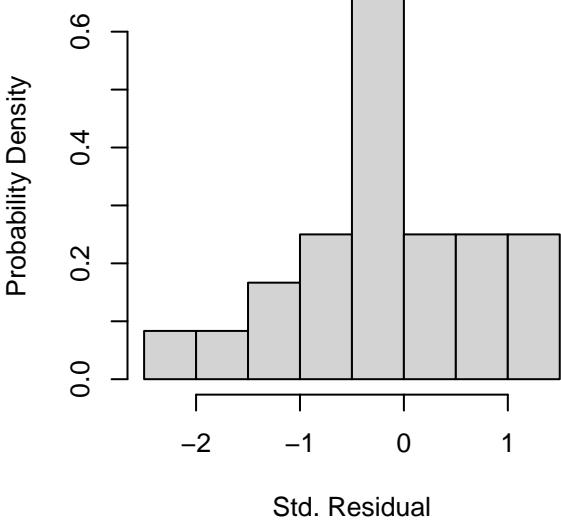
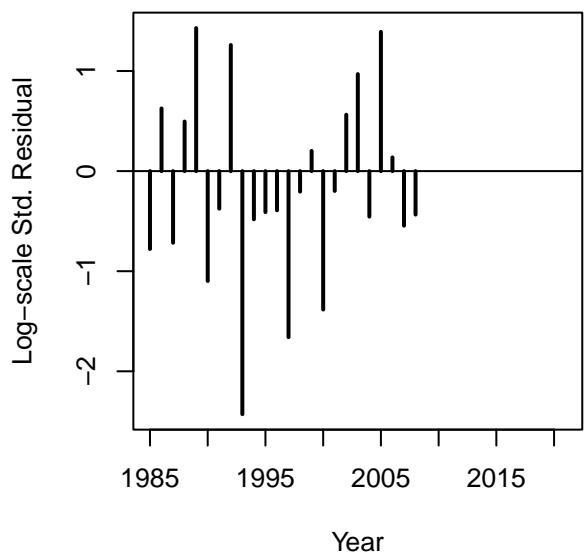
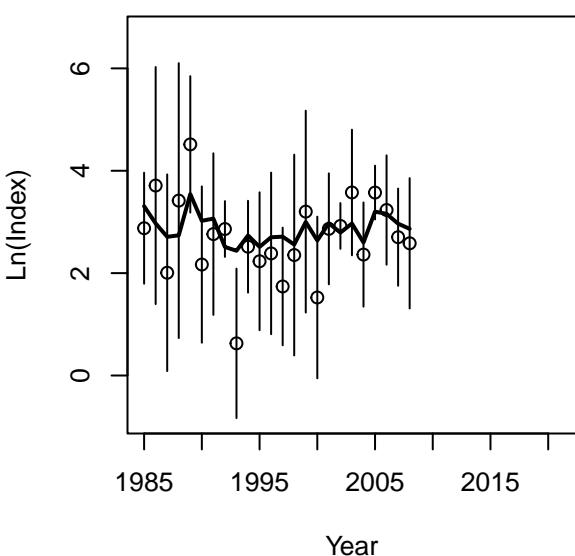
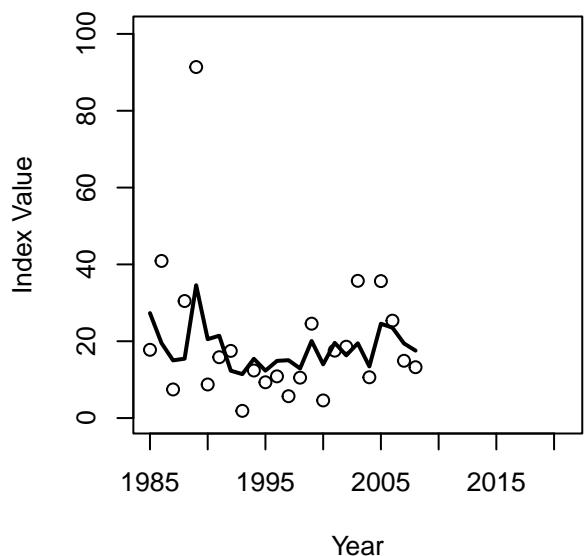
## Catch Fleet 2 (Rec) ESS = 50



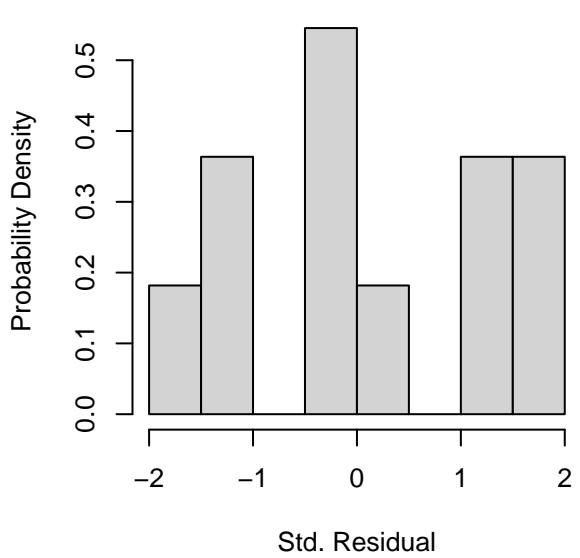
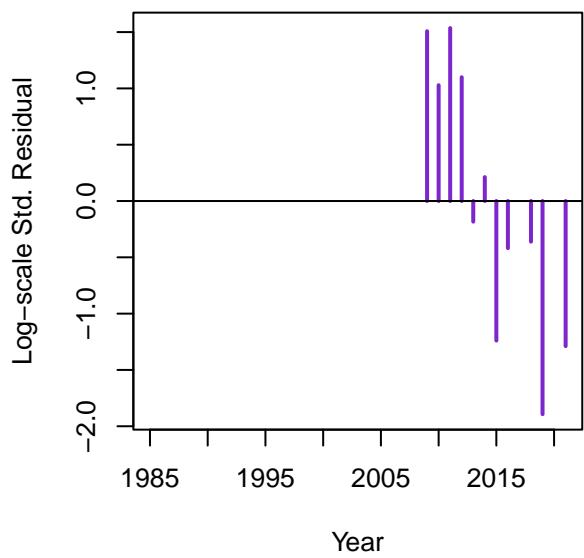
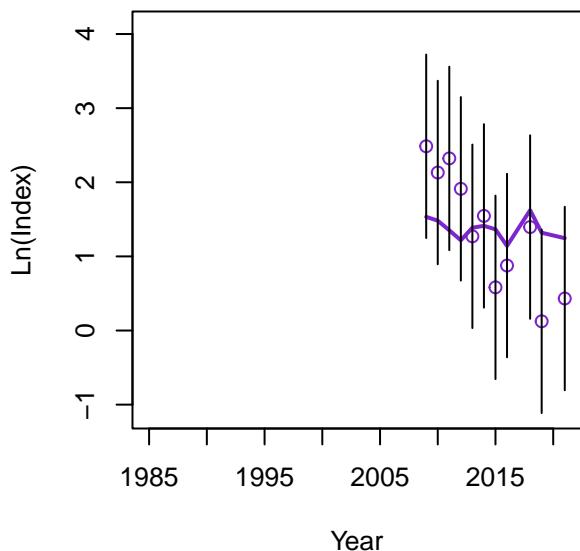
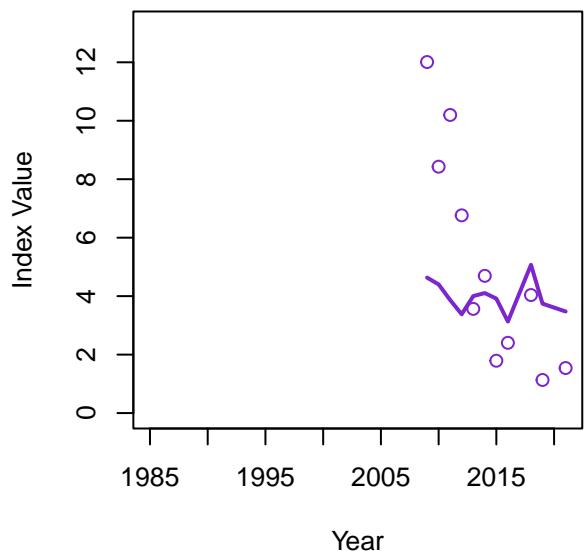
## Catch Fleet 2 (Rec) ESS = 50



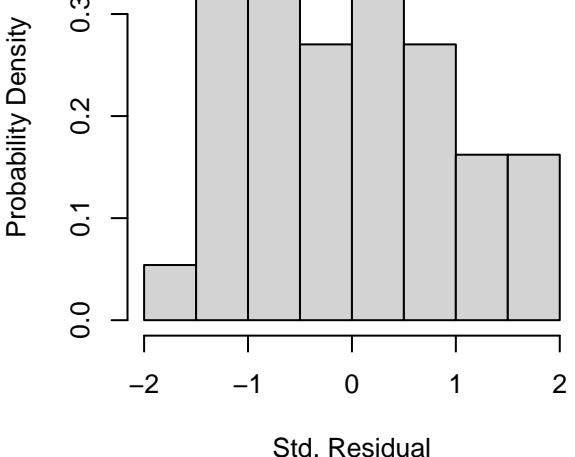
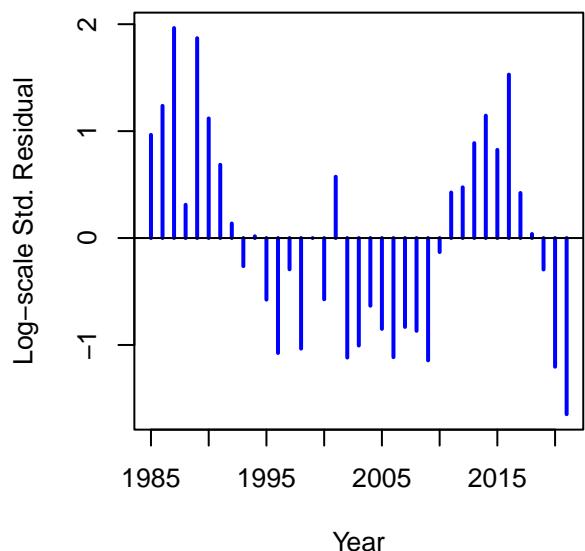
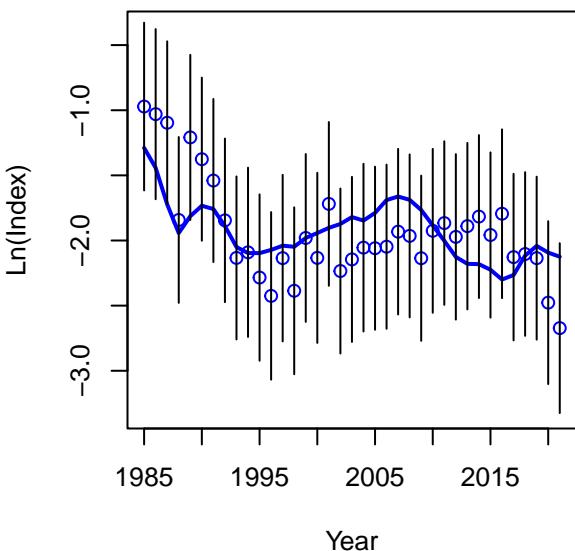
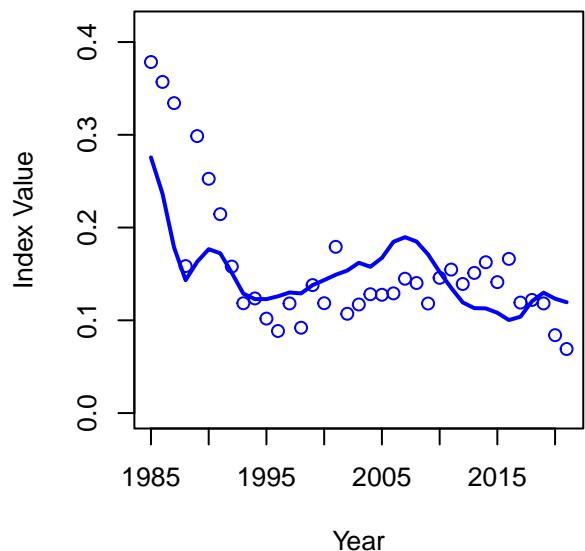
### Index 1 (NEFSC Inshore)



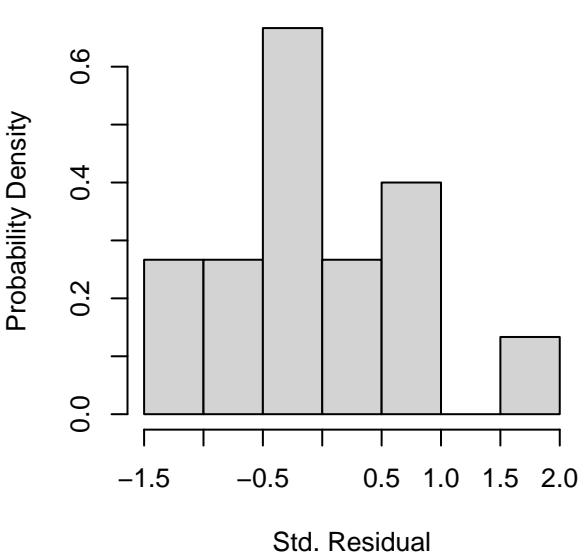
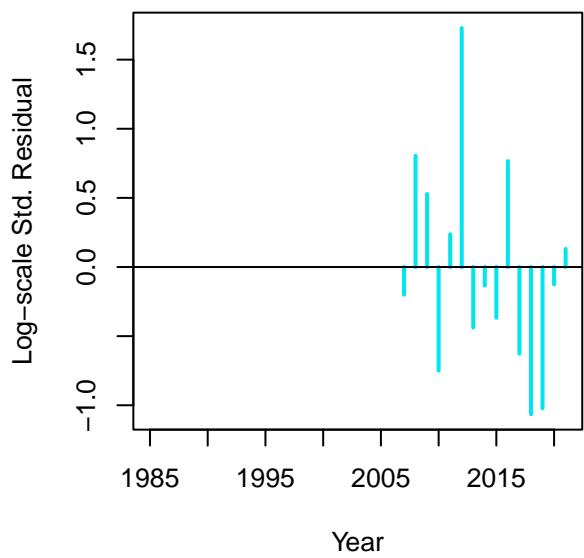
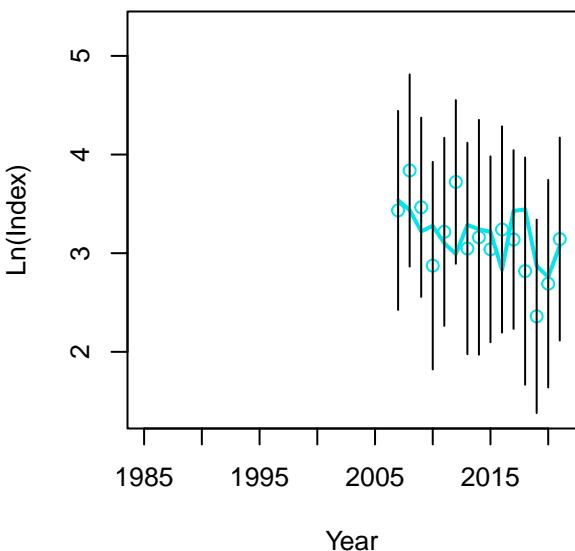
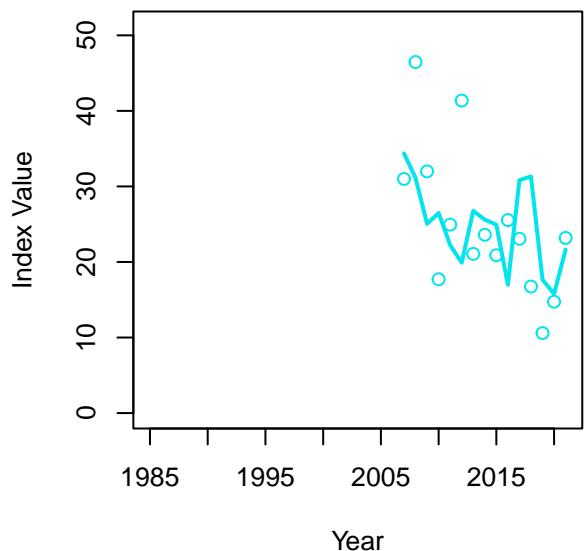
## Index 2 (Bigelow)



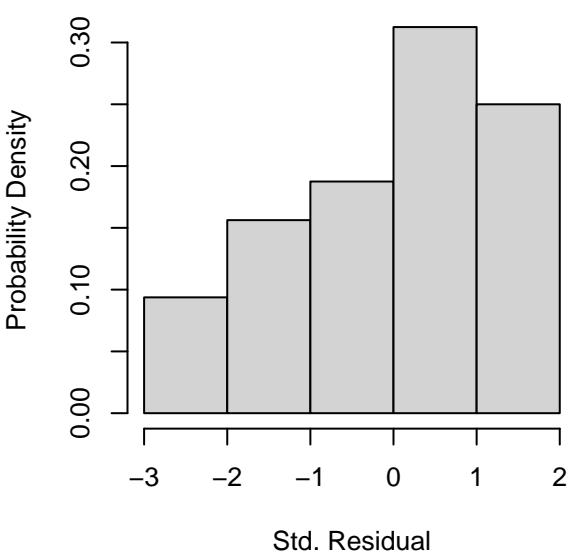
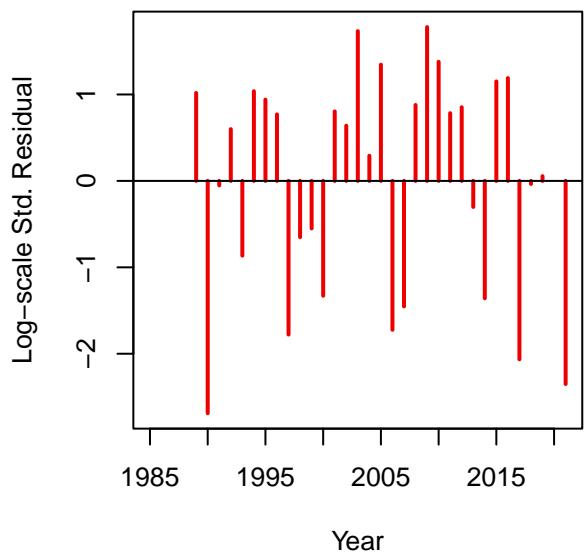
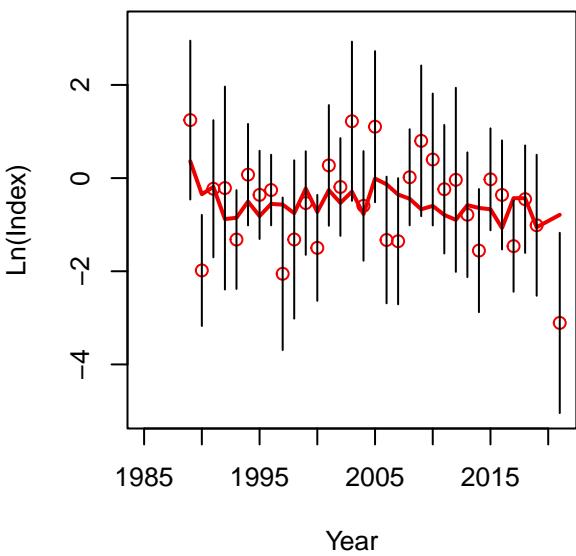
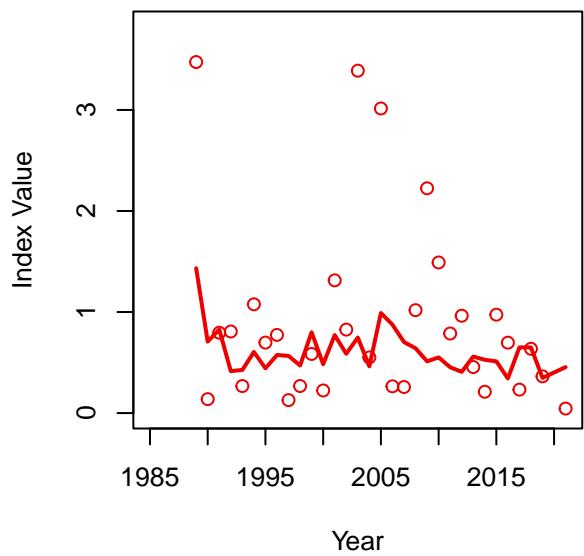
### Index 3 (MRIP)



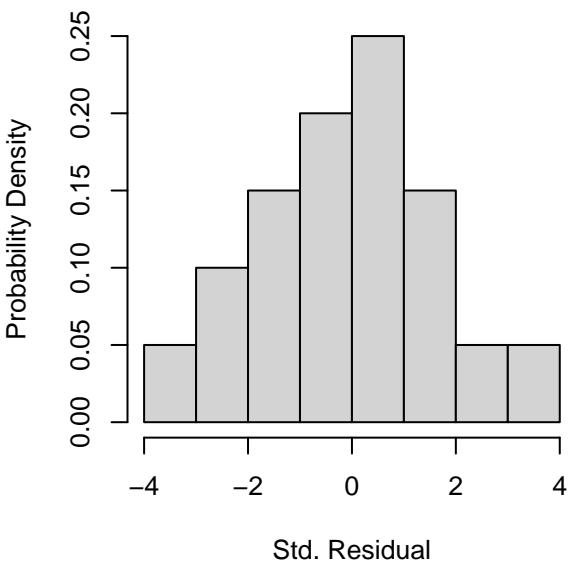
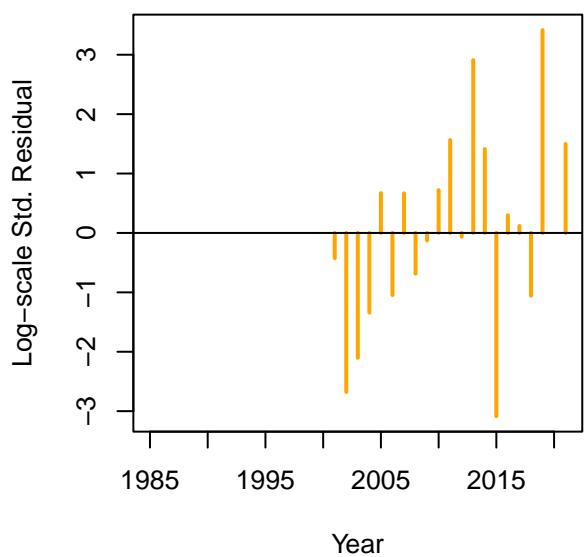
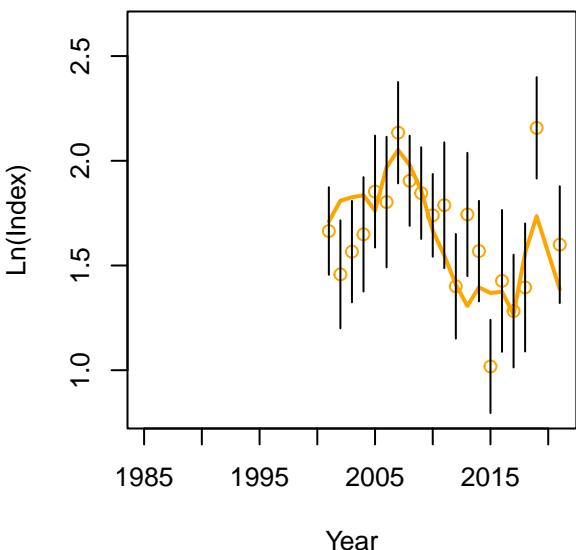
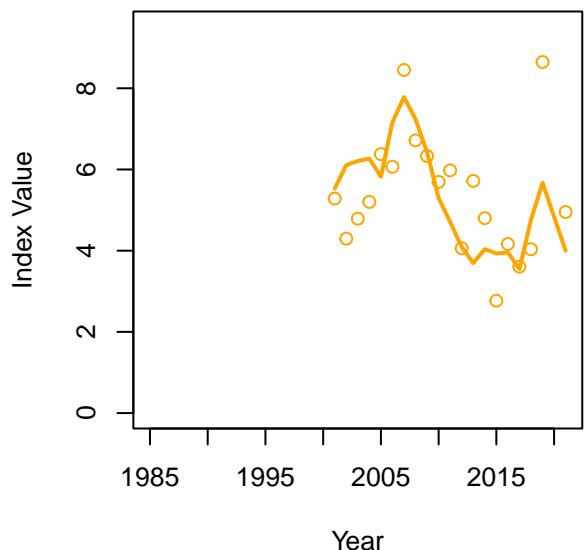
## Index 4 (NEAMAP)



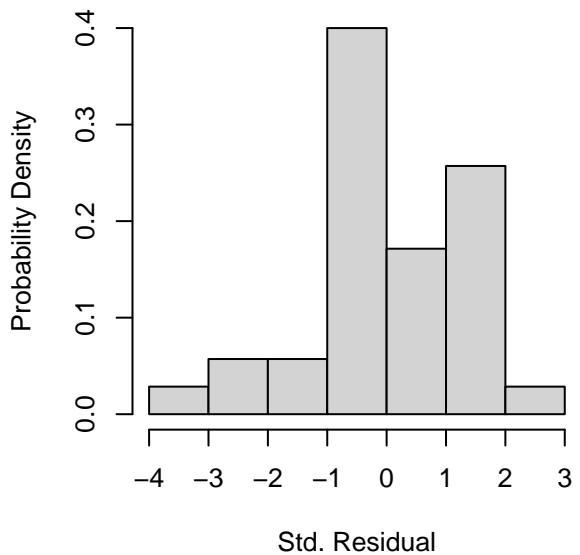
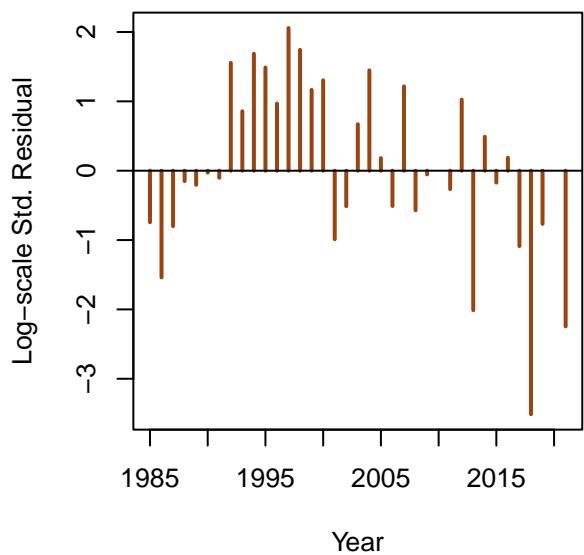
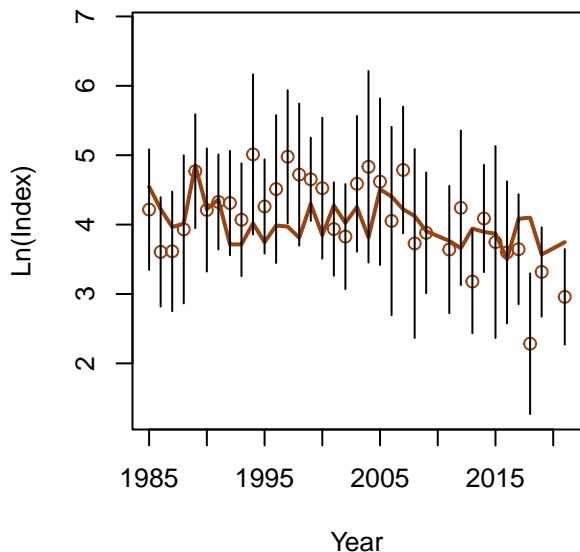
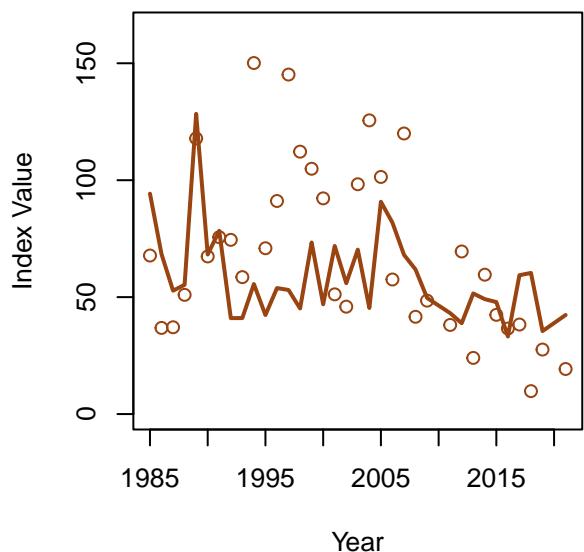
## Index 5 (SEAMAP)



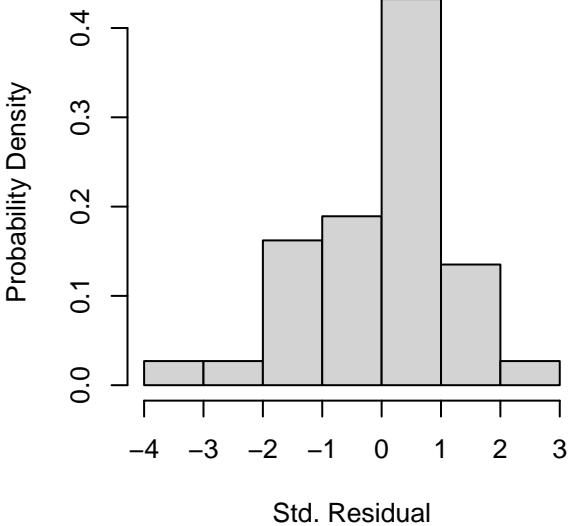
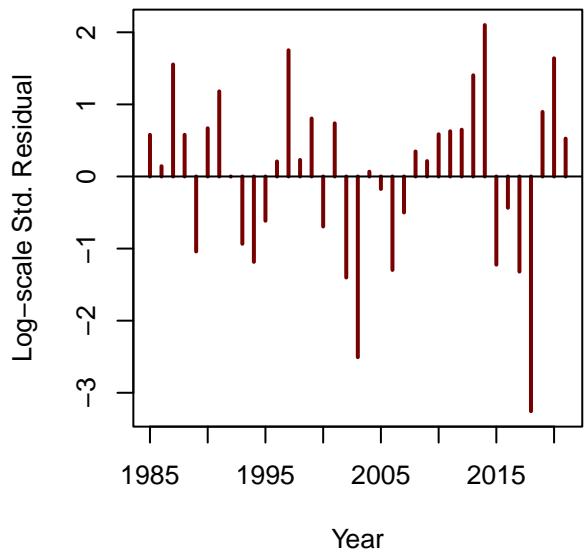
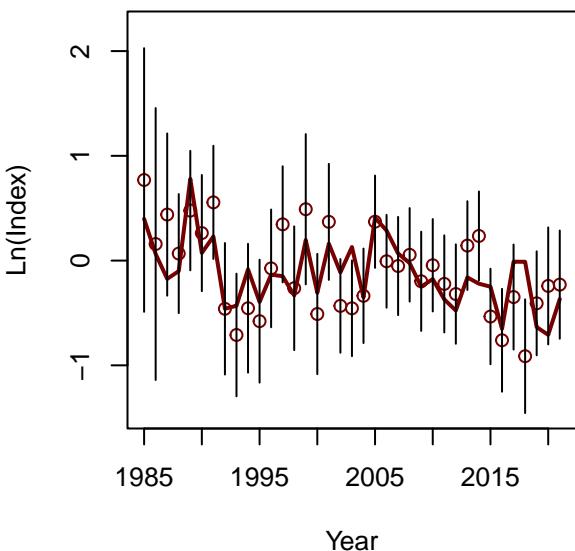
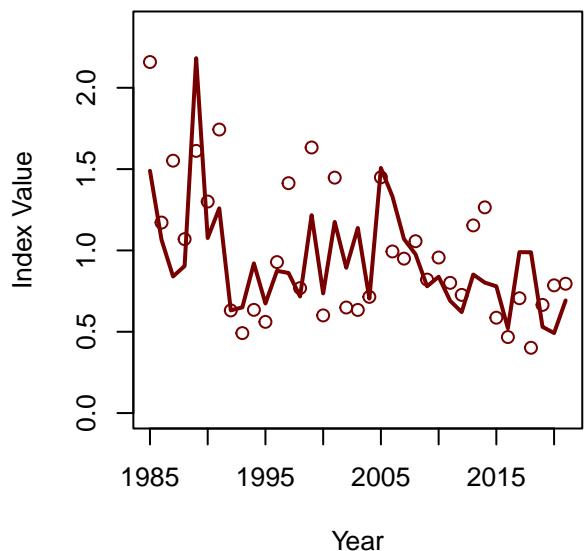
## Index 6 (PSIGN)



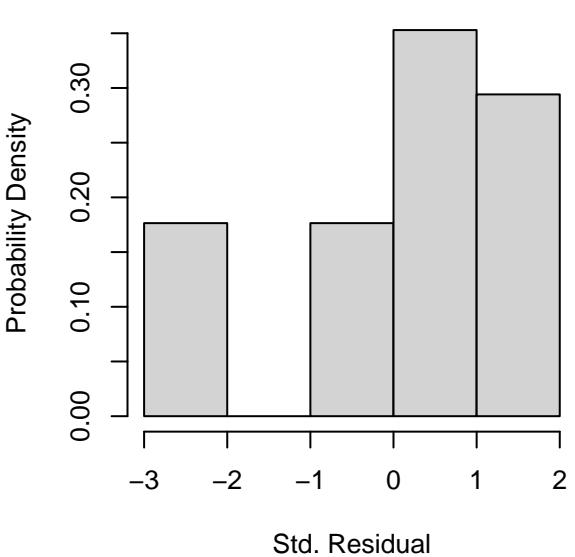
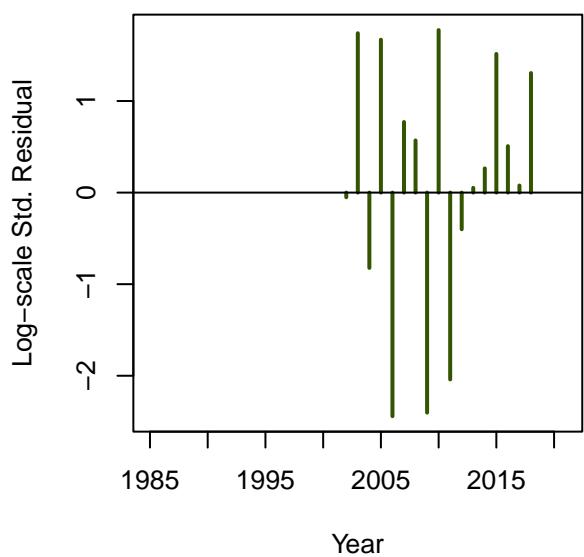
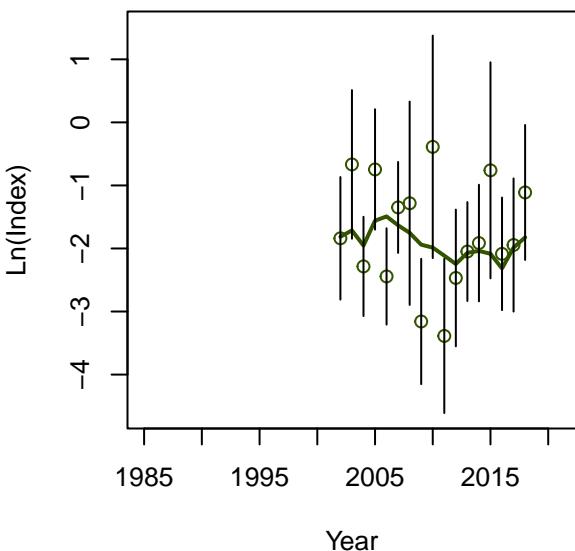
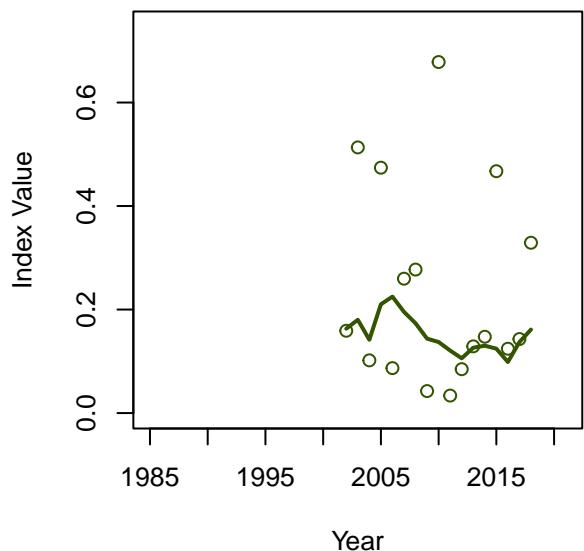
## Index 7 (CT Trawl)



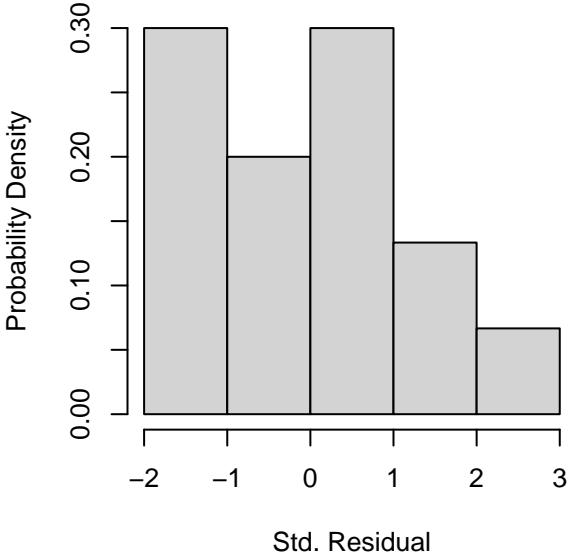
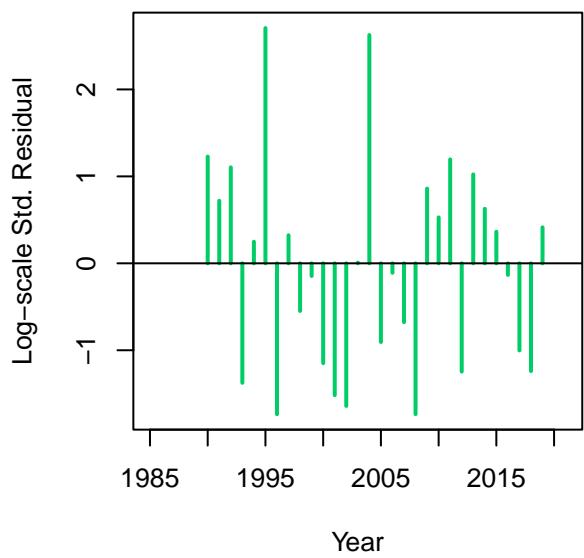
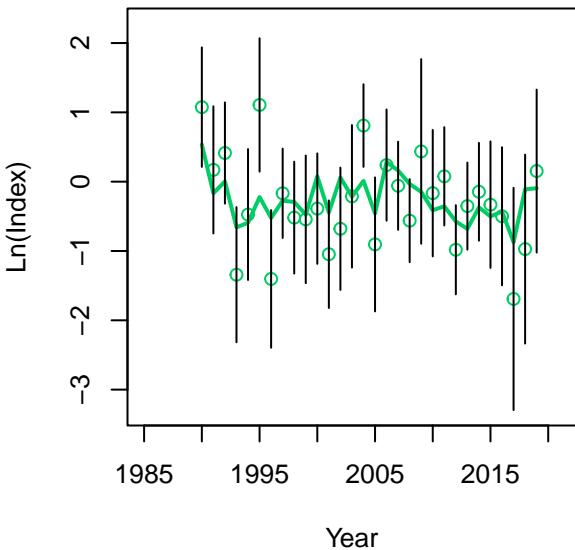
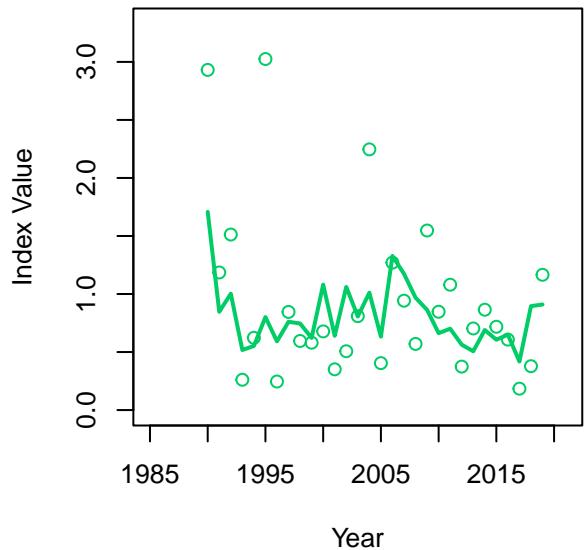
## Index 8 (Compound YOY)



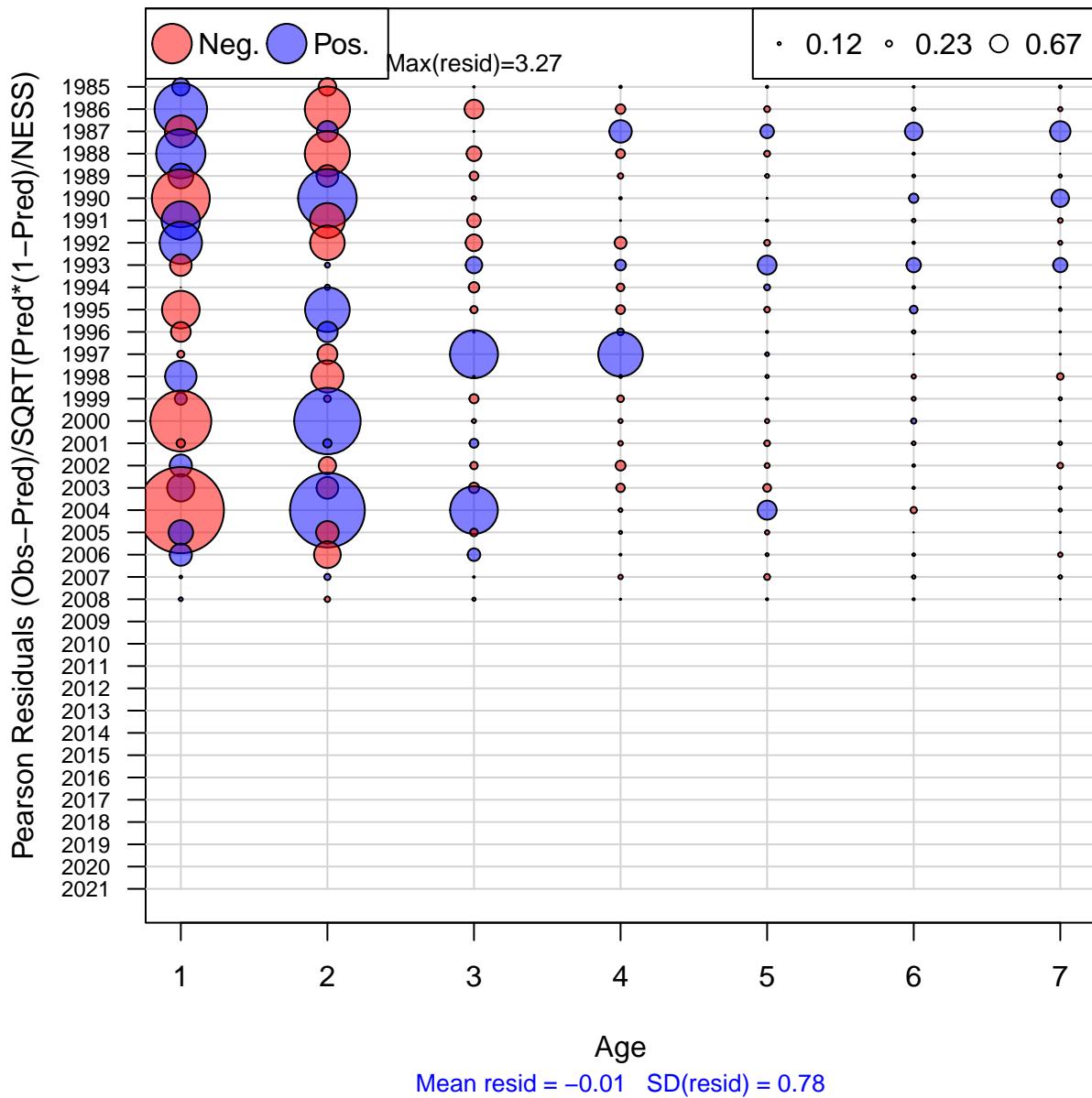
### Index 9 (ChesMMAP)



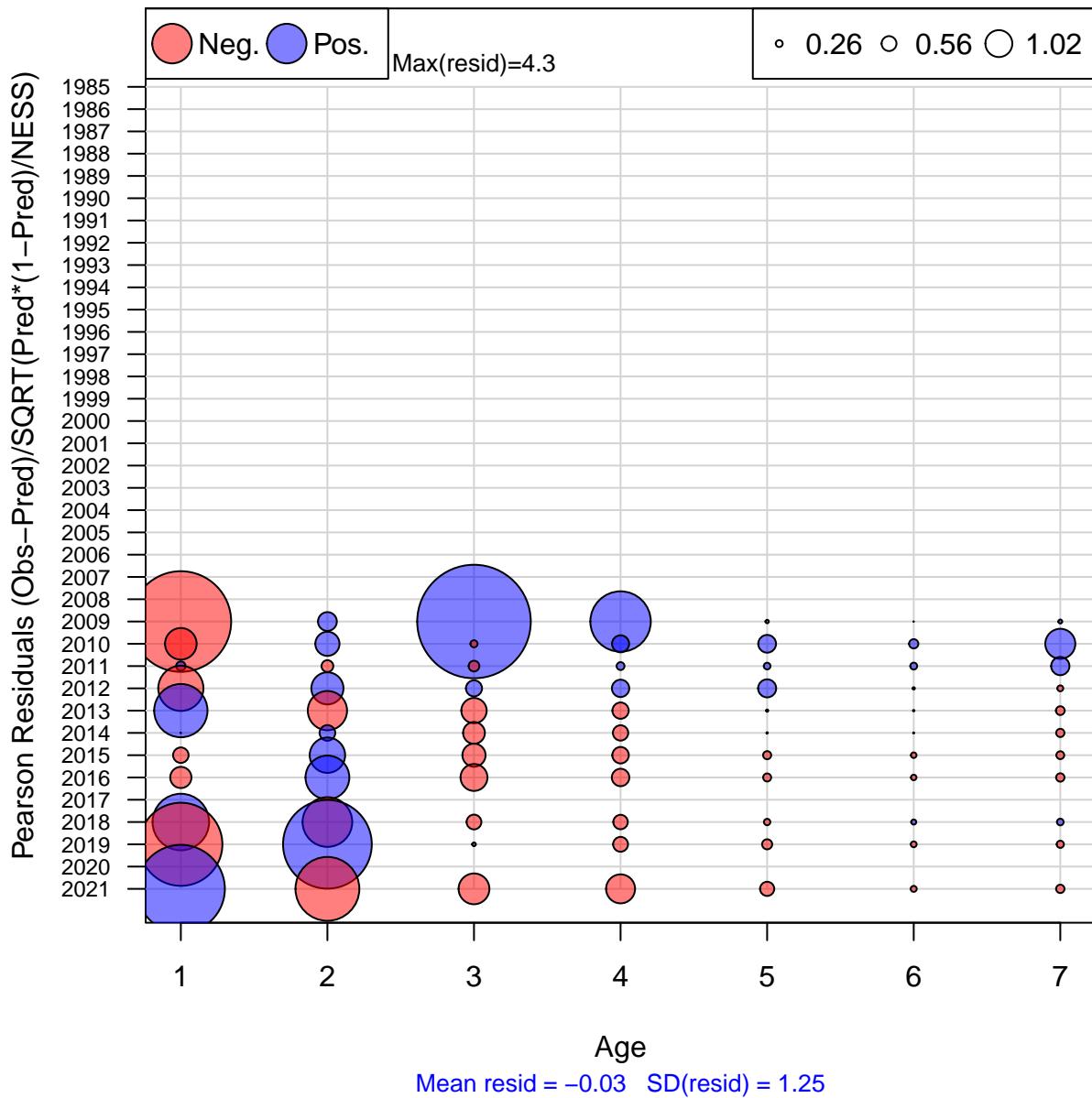
### Index 10 (SEAMAP1)



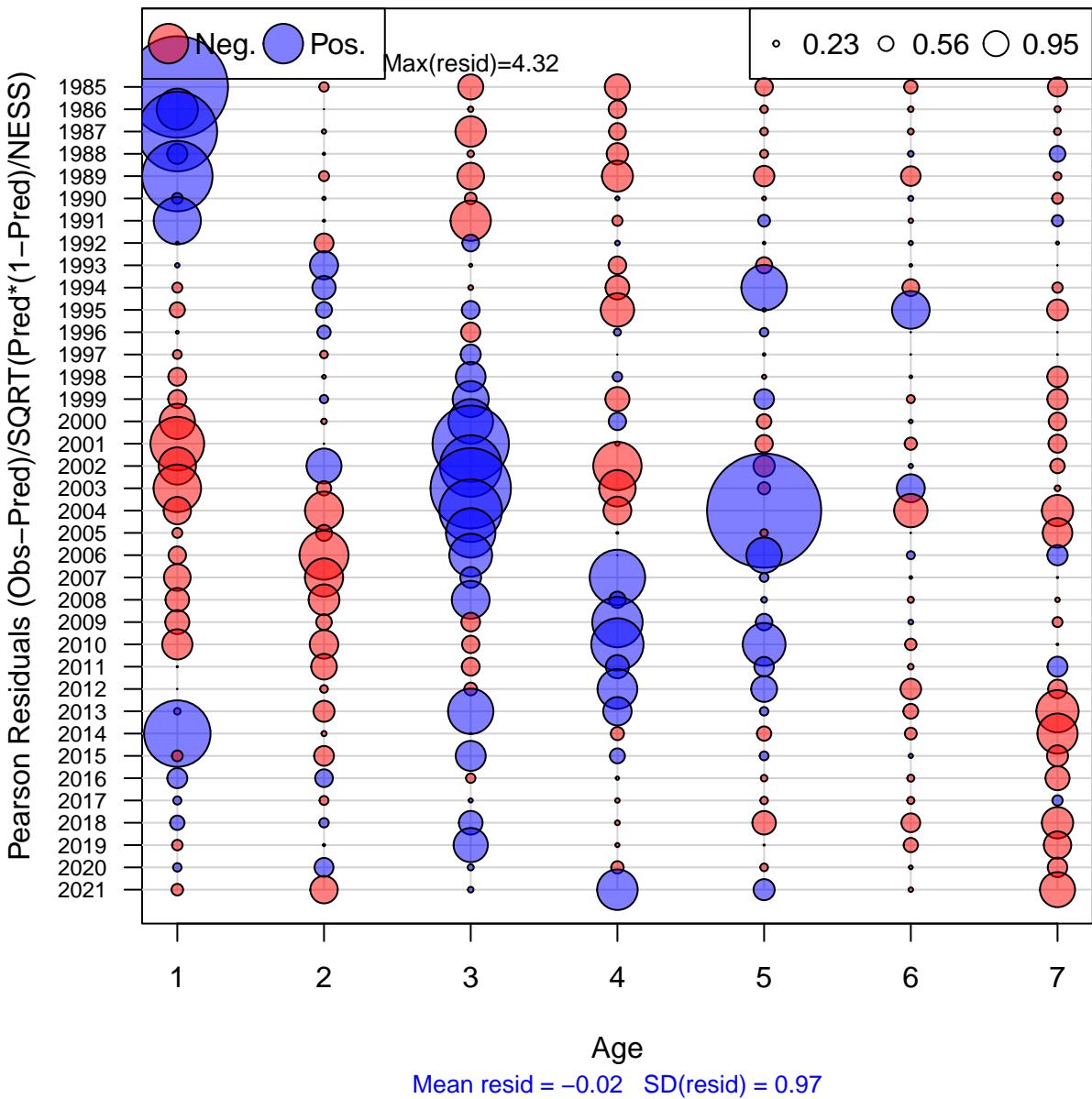
# Age Comp Residuals for Index 1 (NEFSC Inshore)



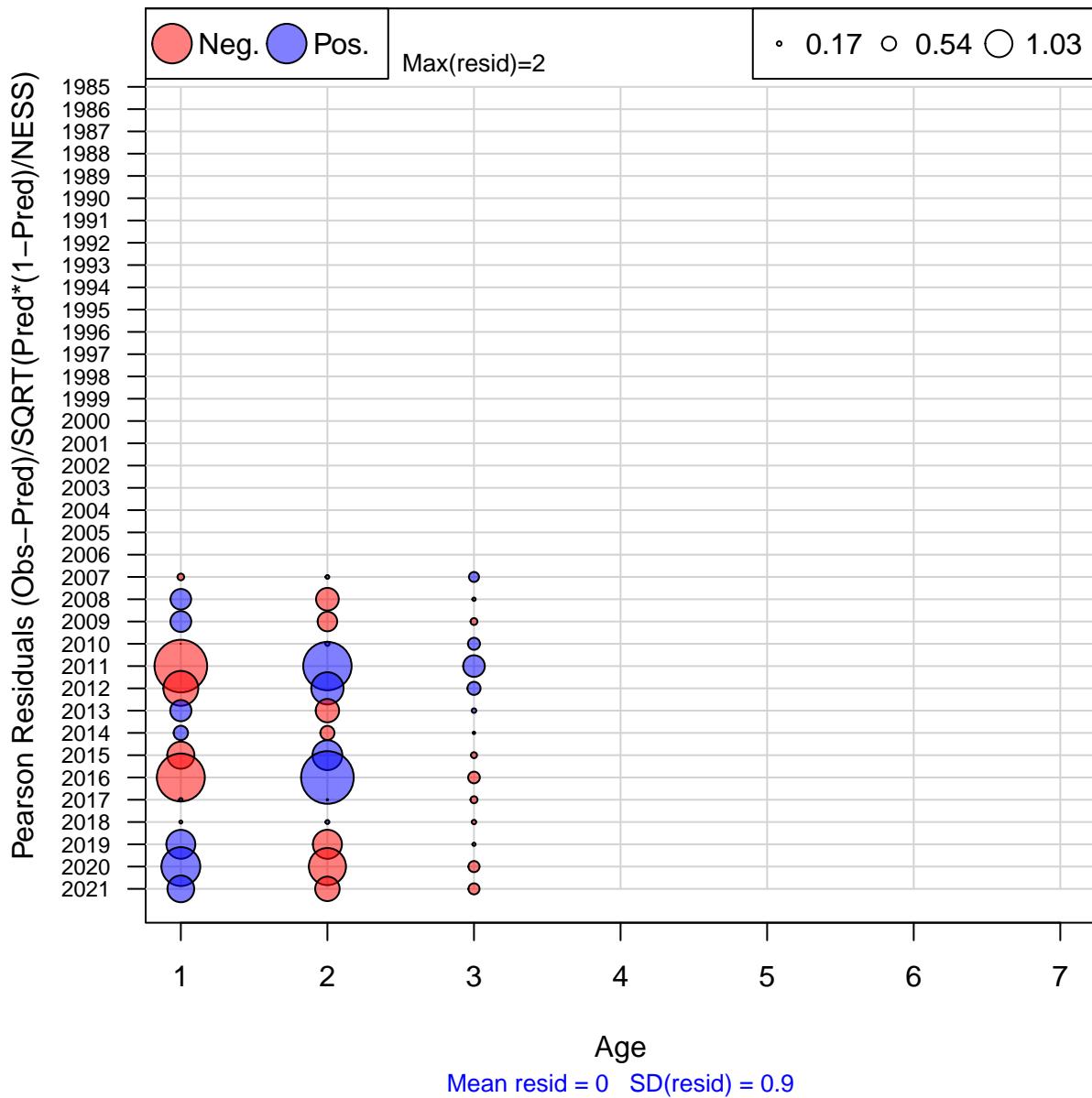
## Age Comp Residuals for Index 2 (Bigelow)



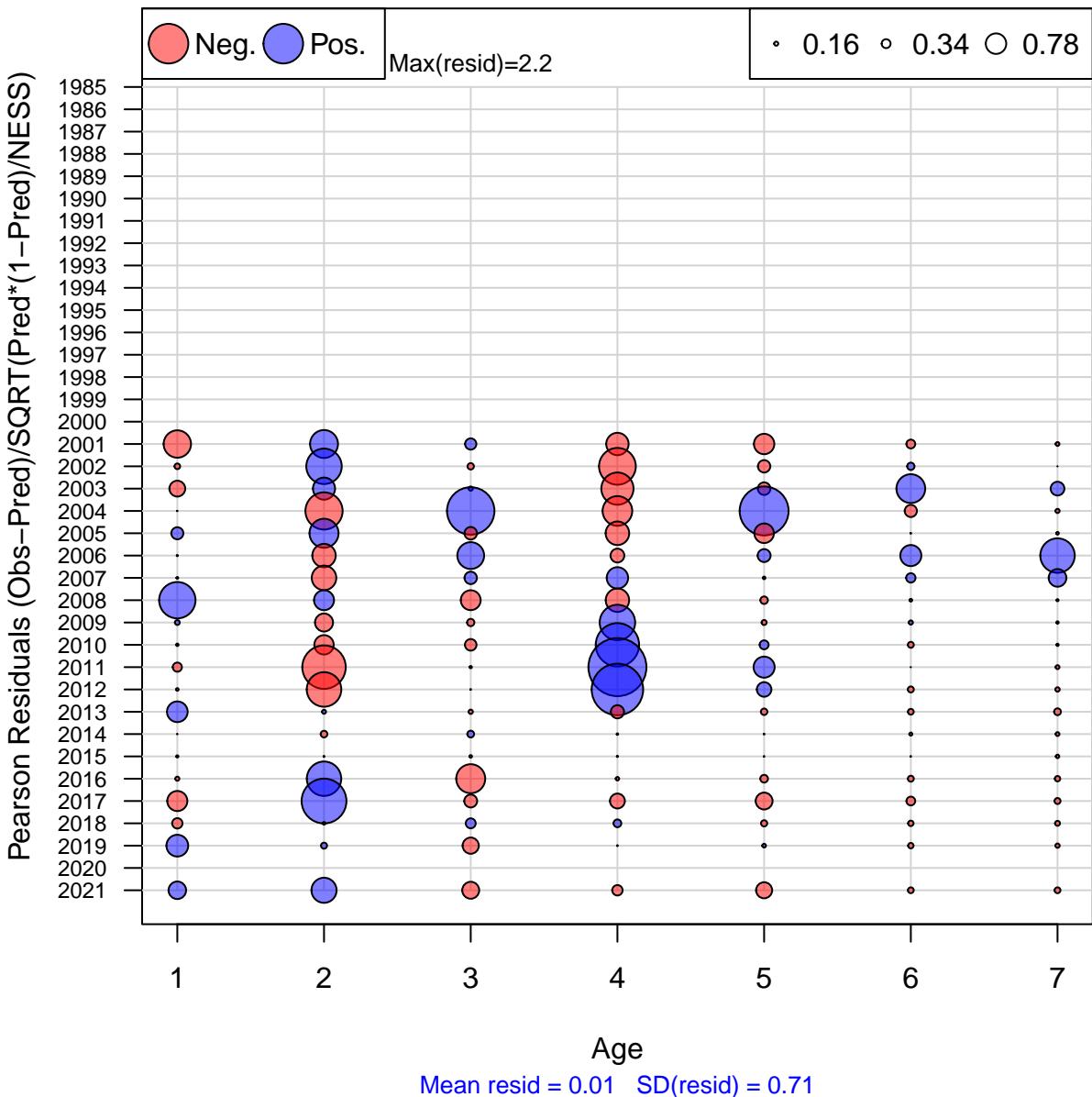
# Age Comp Residuals for Index 3 (MRIP)



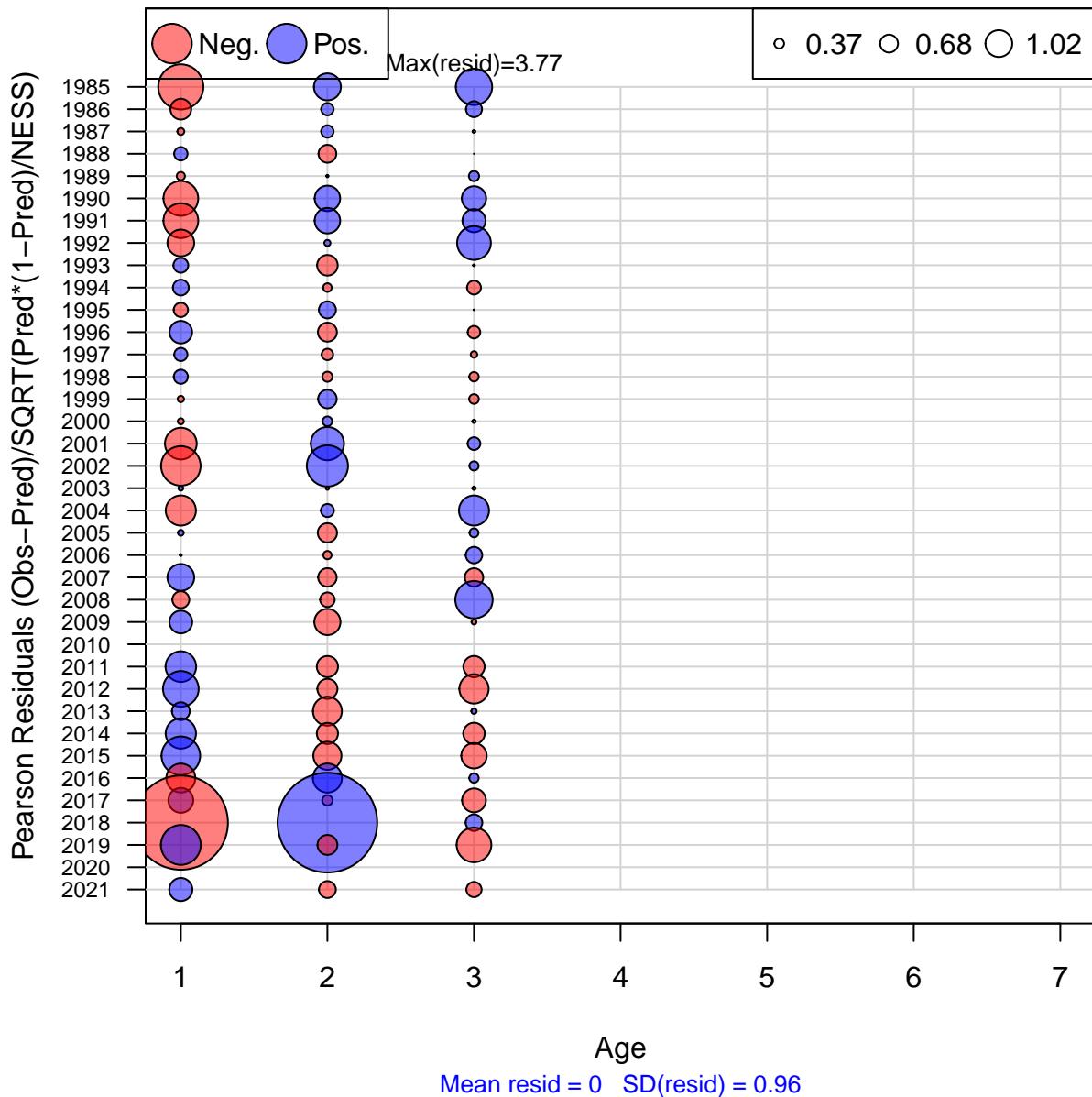
# Age Comp Residuals for Index 4 (NEAMAP)



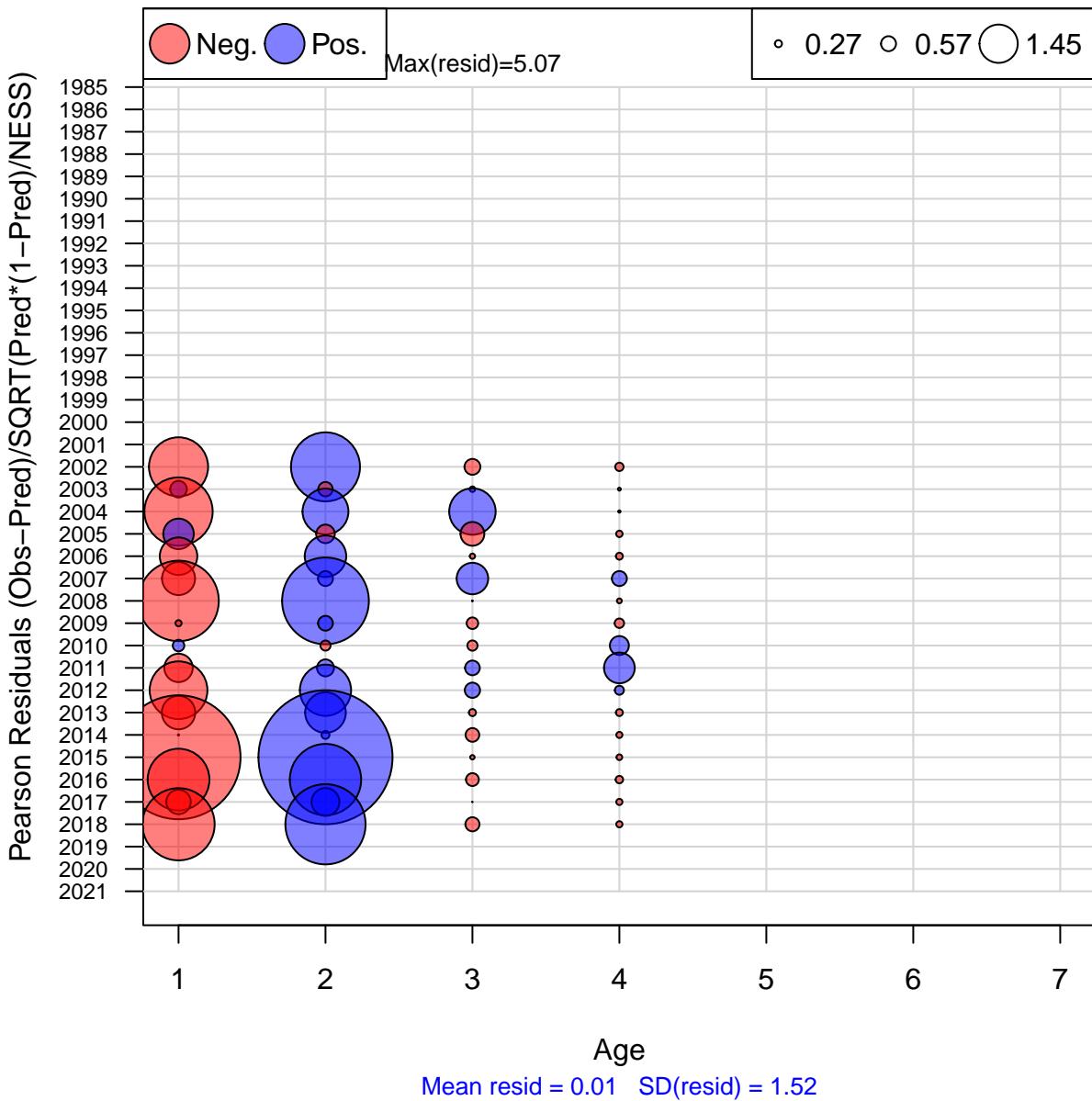
# Age Comp Residuals for Index 6 (PSIGN)



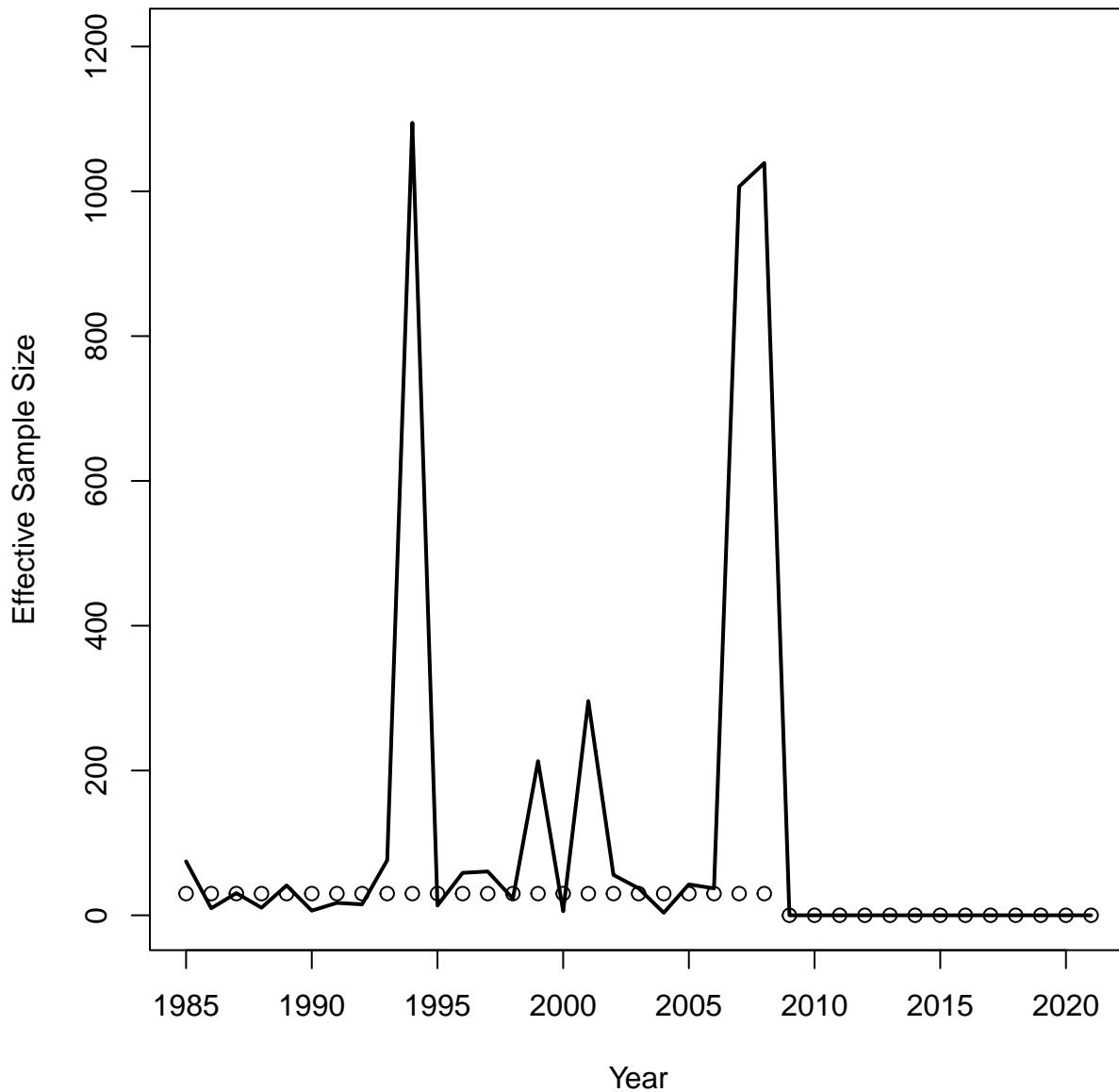
# Age Comp Residuals for Index 7 (CT Trawl)



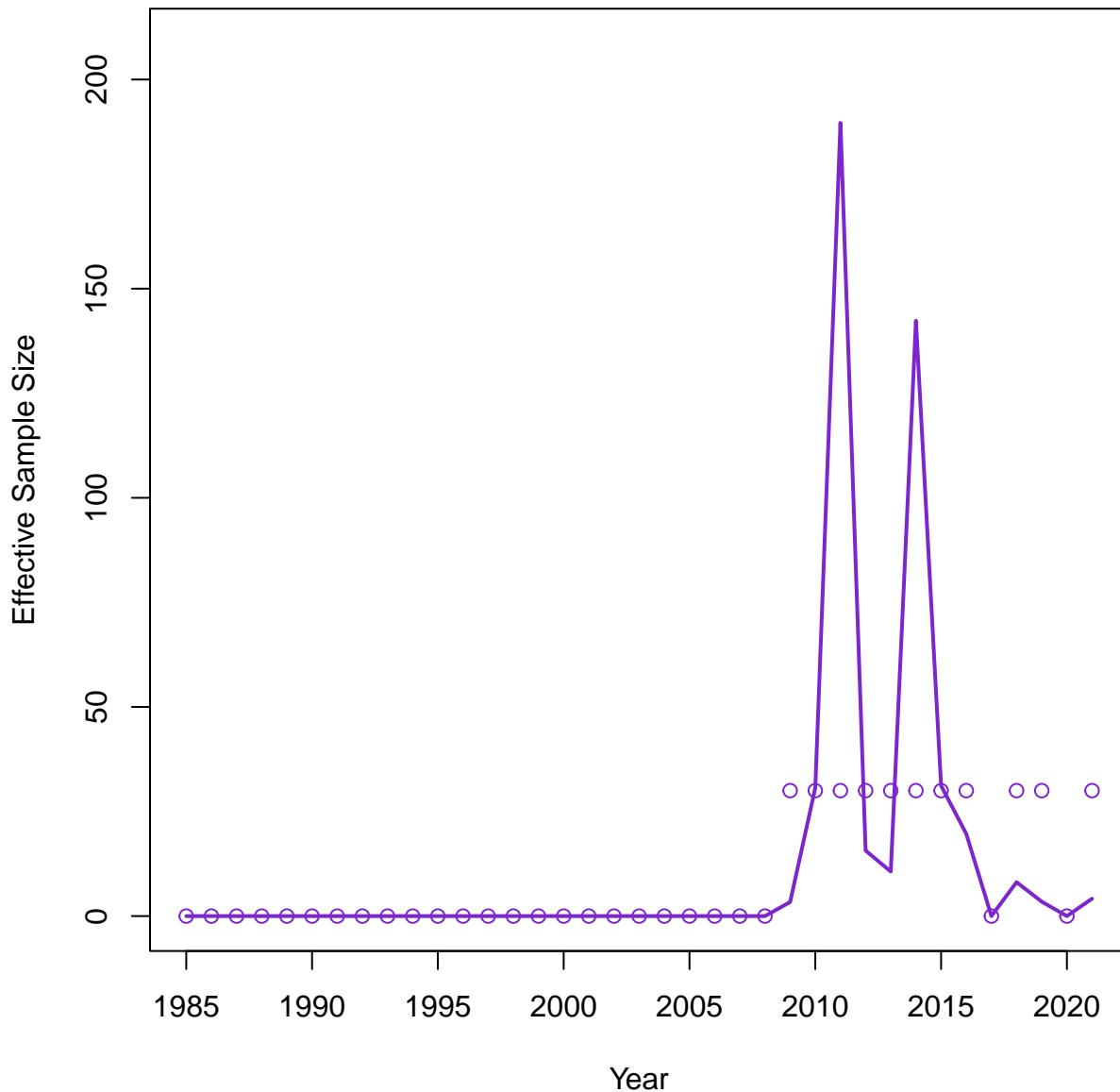
## Age Comp Residuals for Index 9 (ChesMMAP)



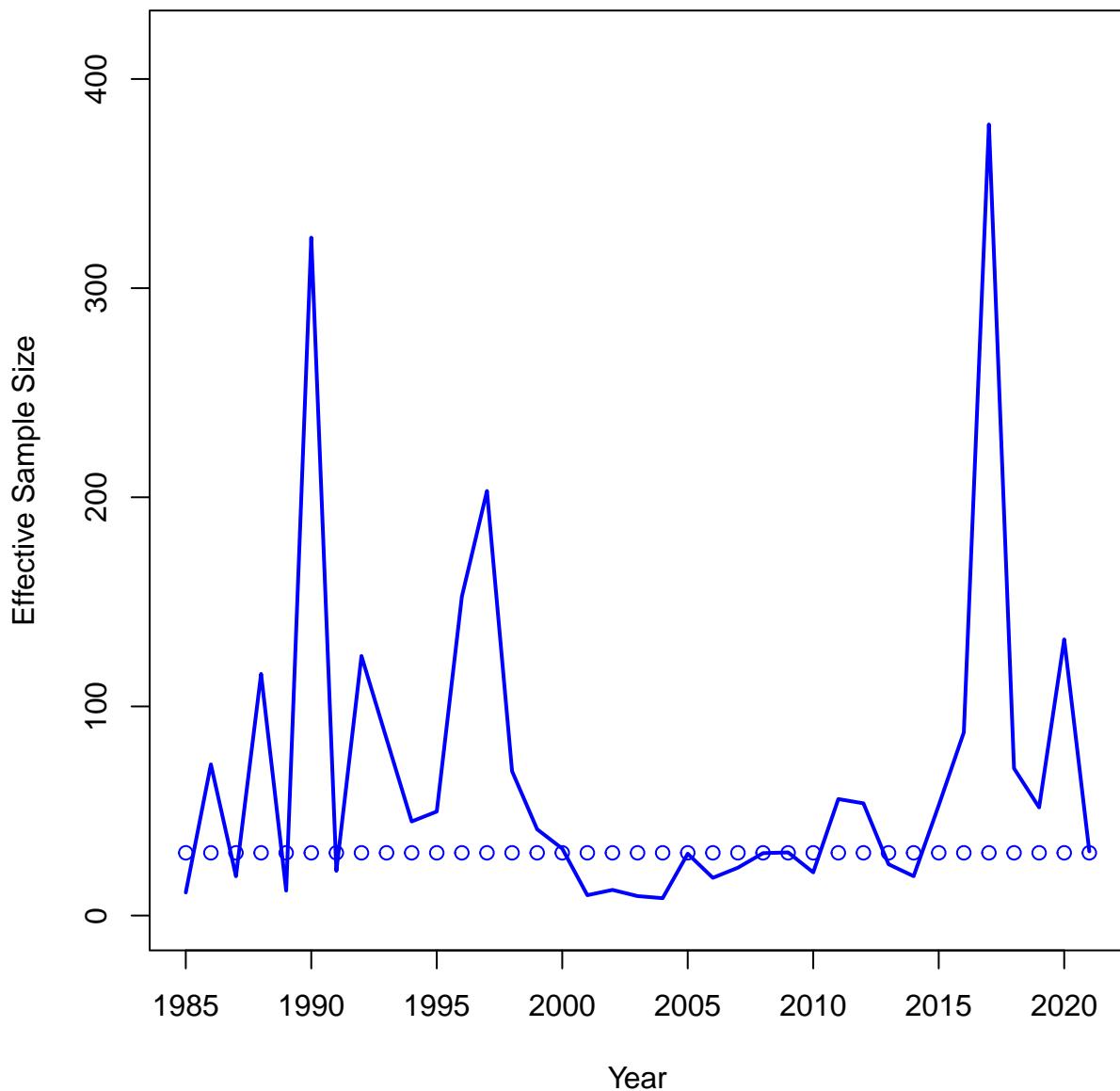
## Index Neff 1 (NEFSC Inshore)



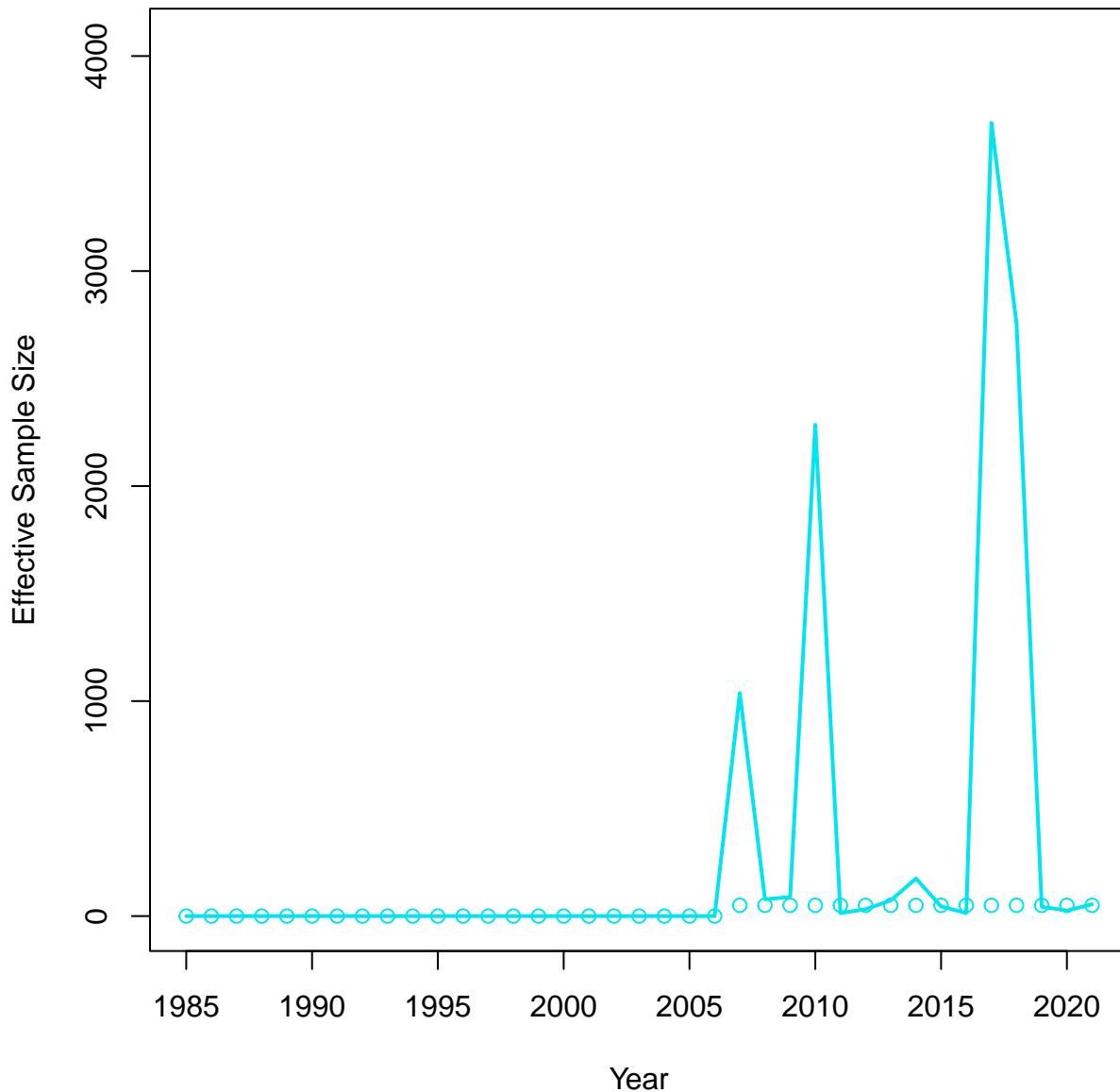
## Index Neff 2 (Bigelow)



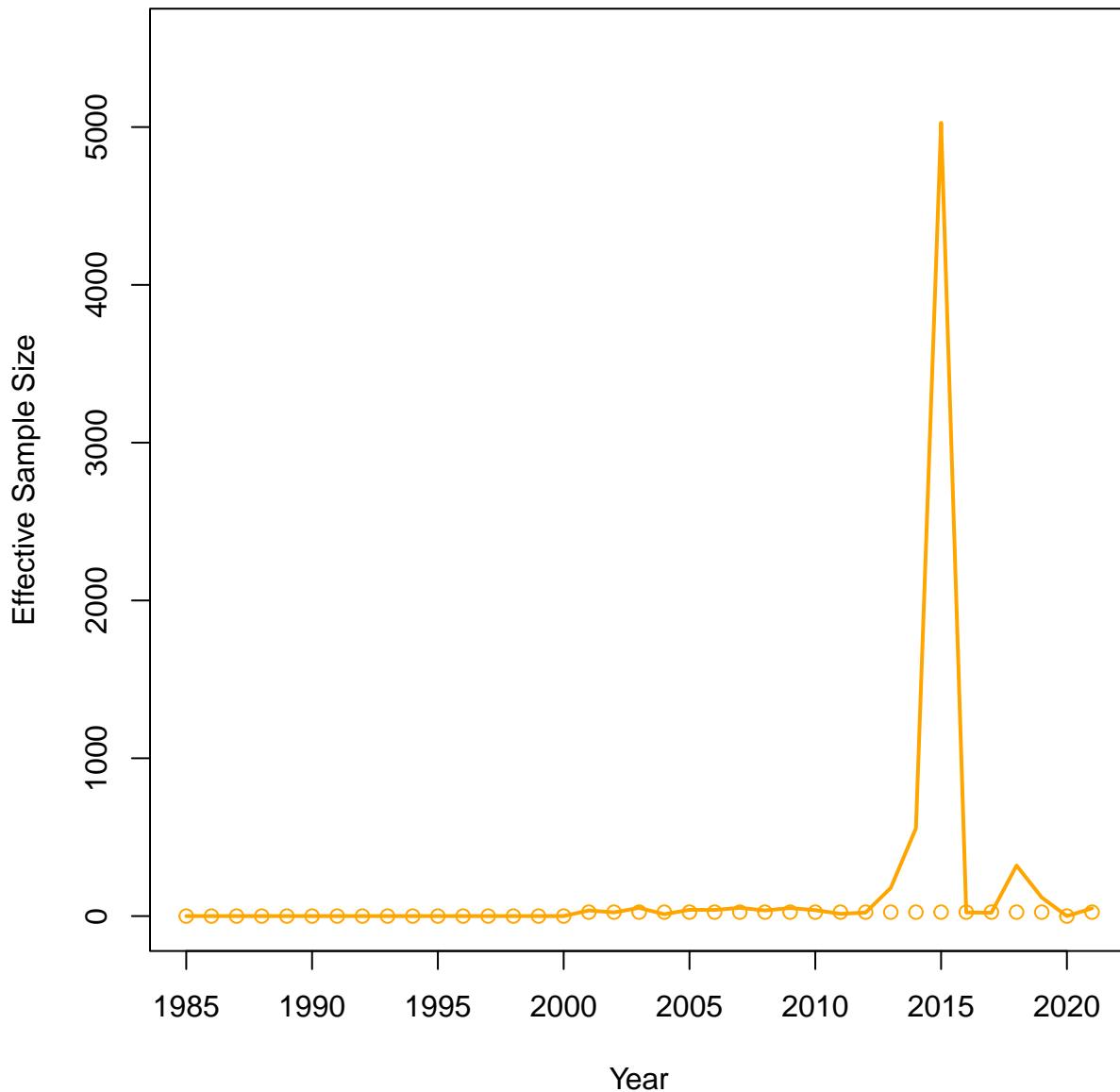
## Index Neff 3 (MRIP)



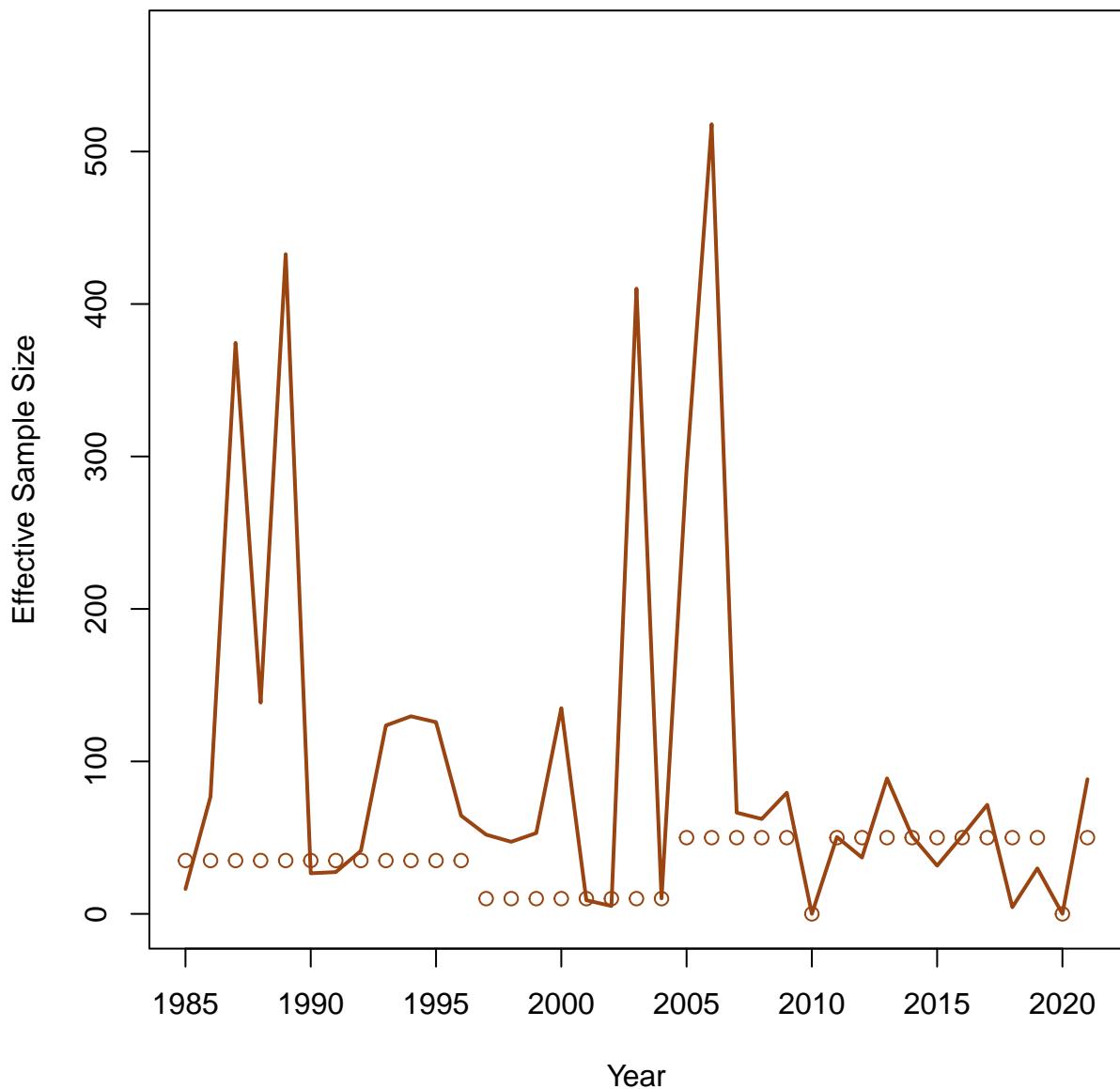
## Index Neff 4 (NEAMAP)



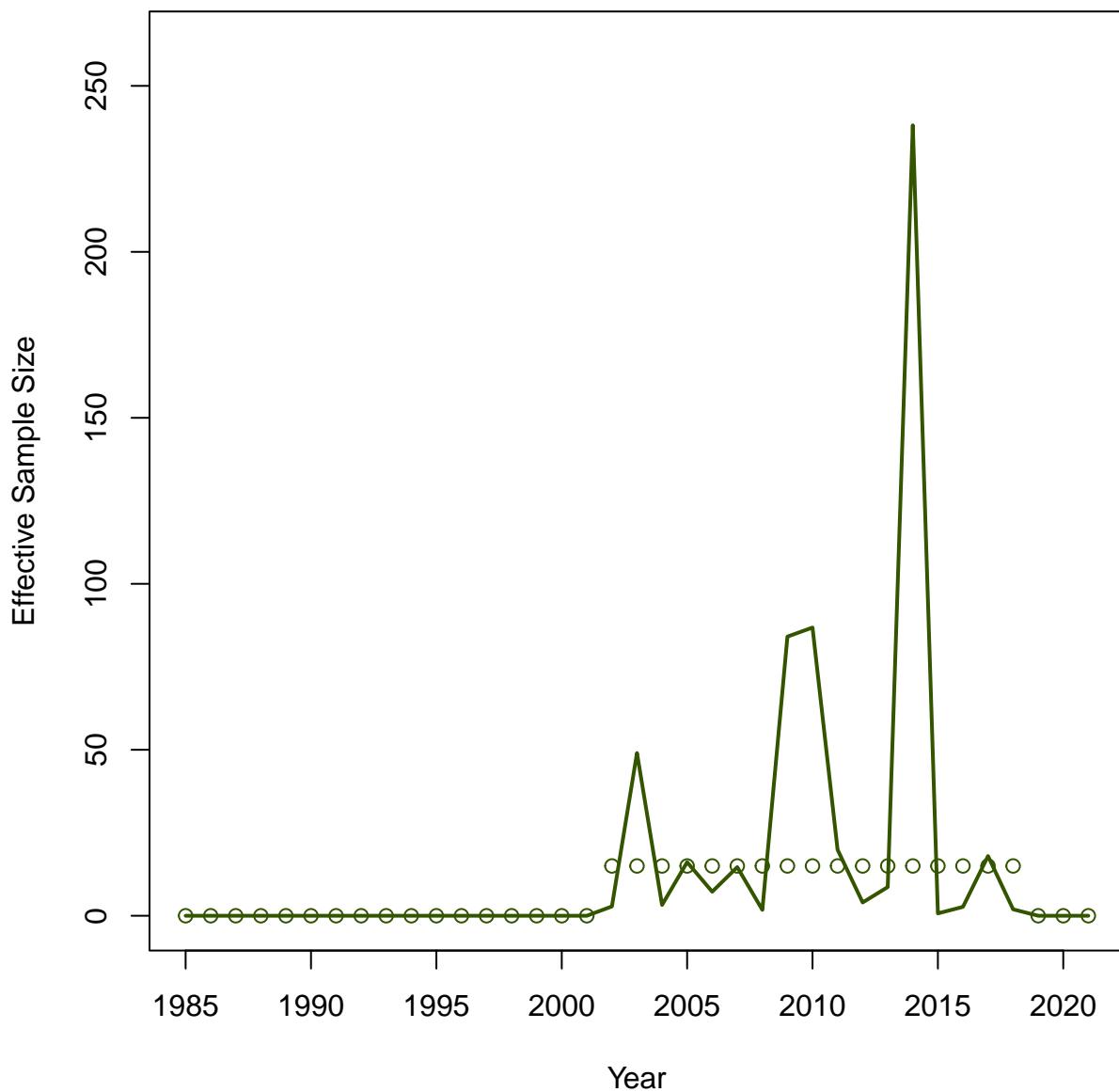
## Index Neff 6 (PSIGN)



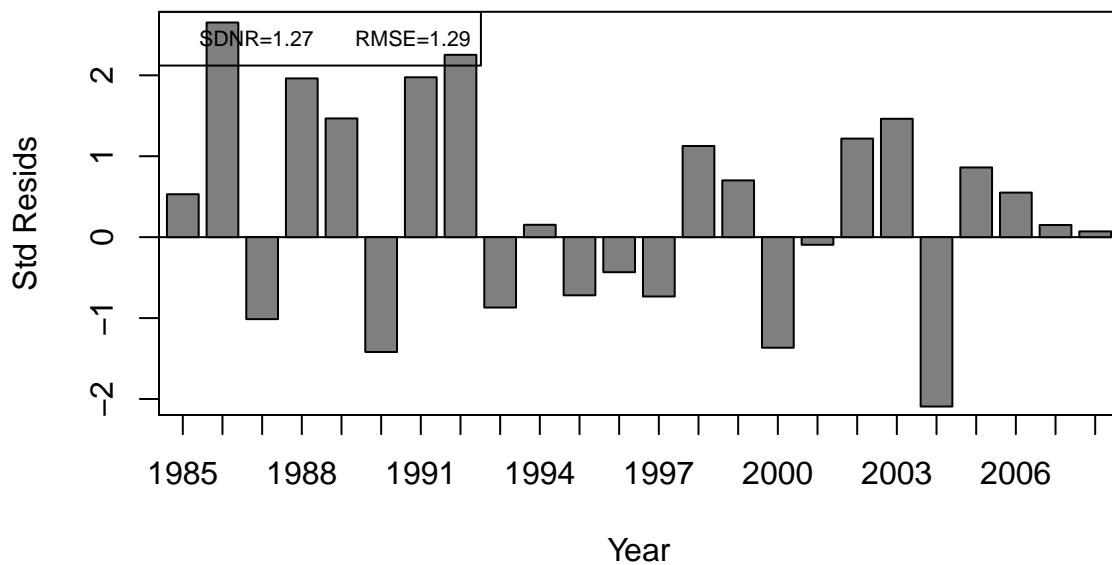
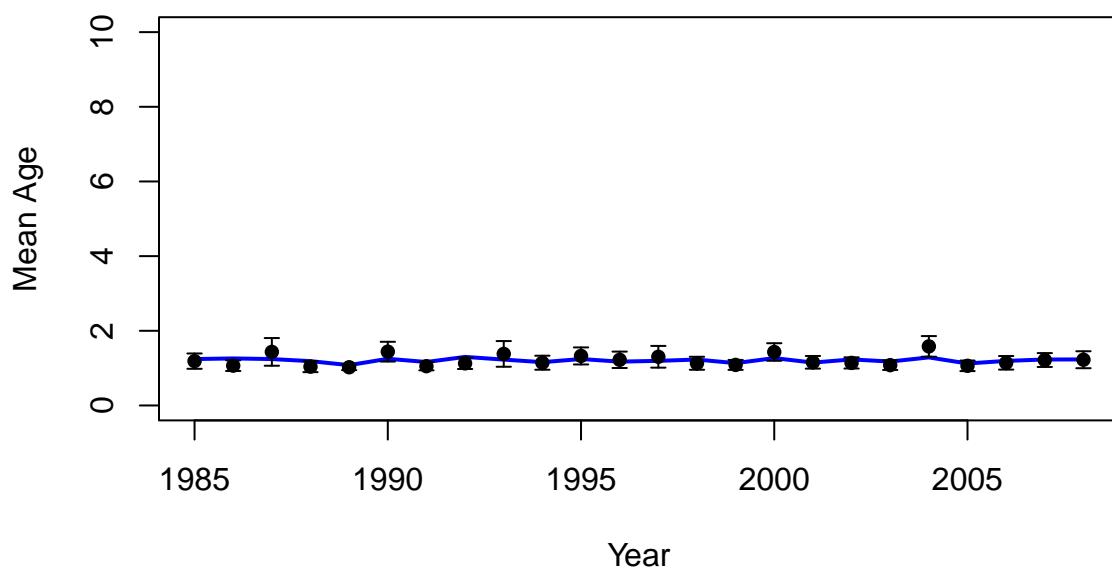
## Index Neff 7 (CT Trawl)



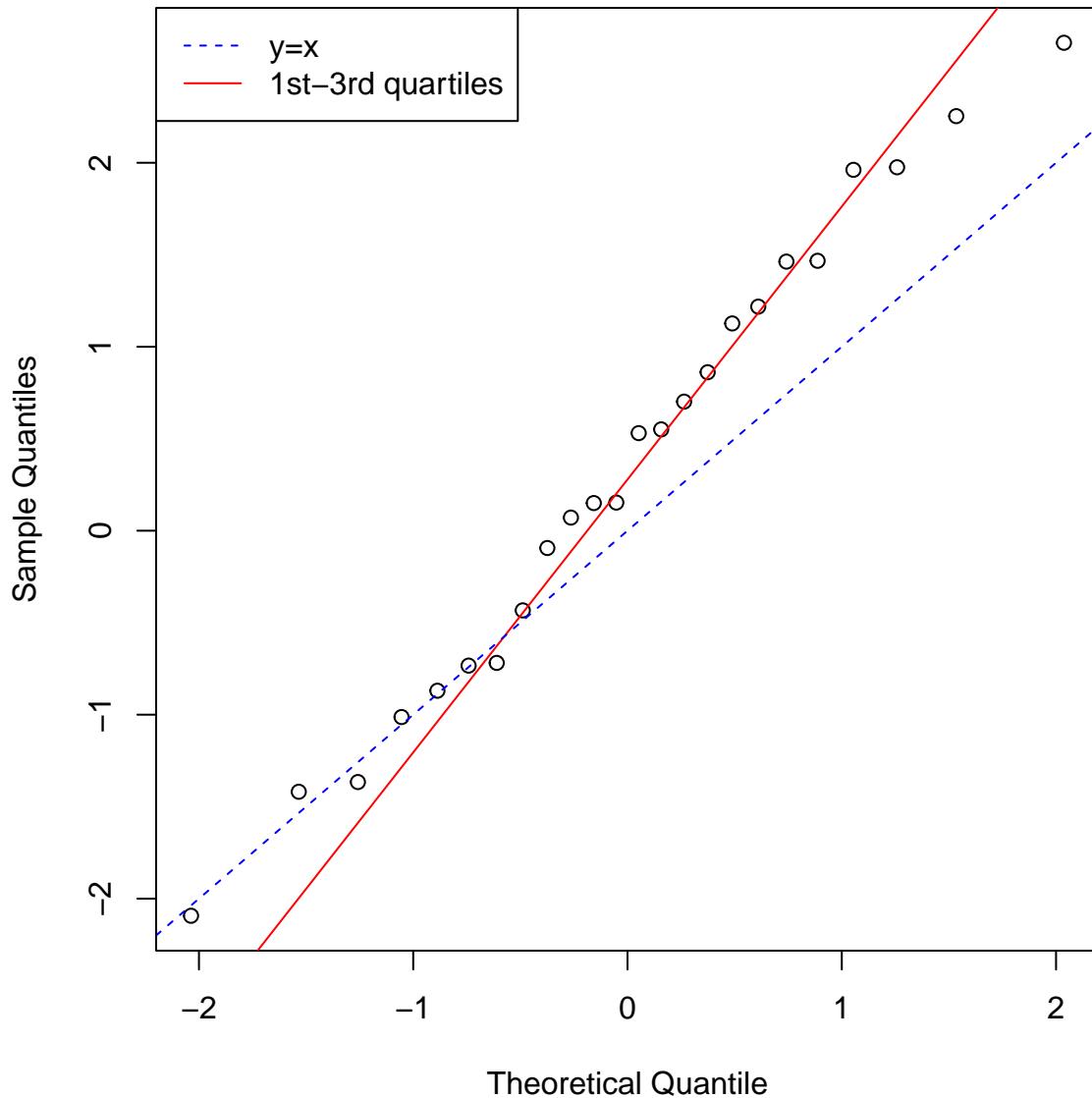
## Index Neff 9 (ChesMMAP)



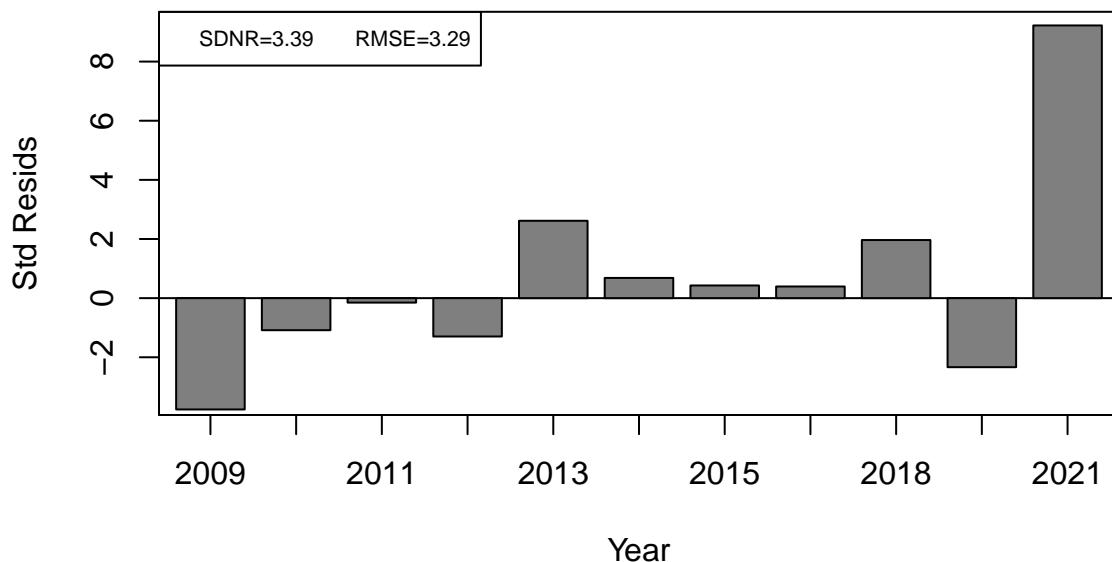
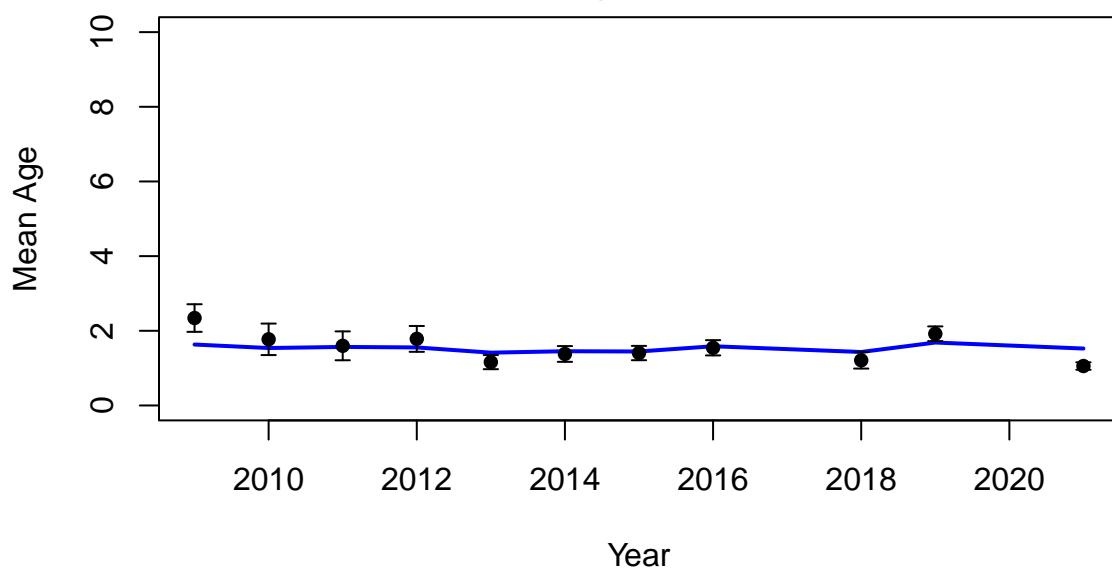
### Index 1 (NEFSC Inshore) ESS = 30



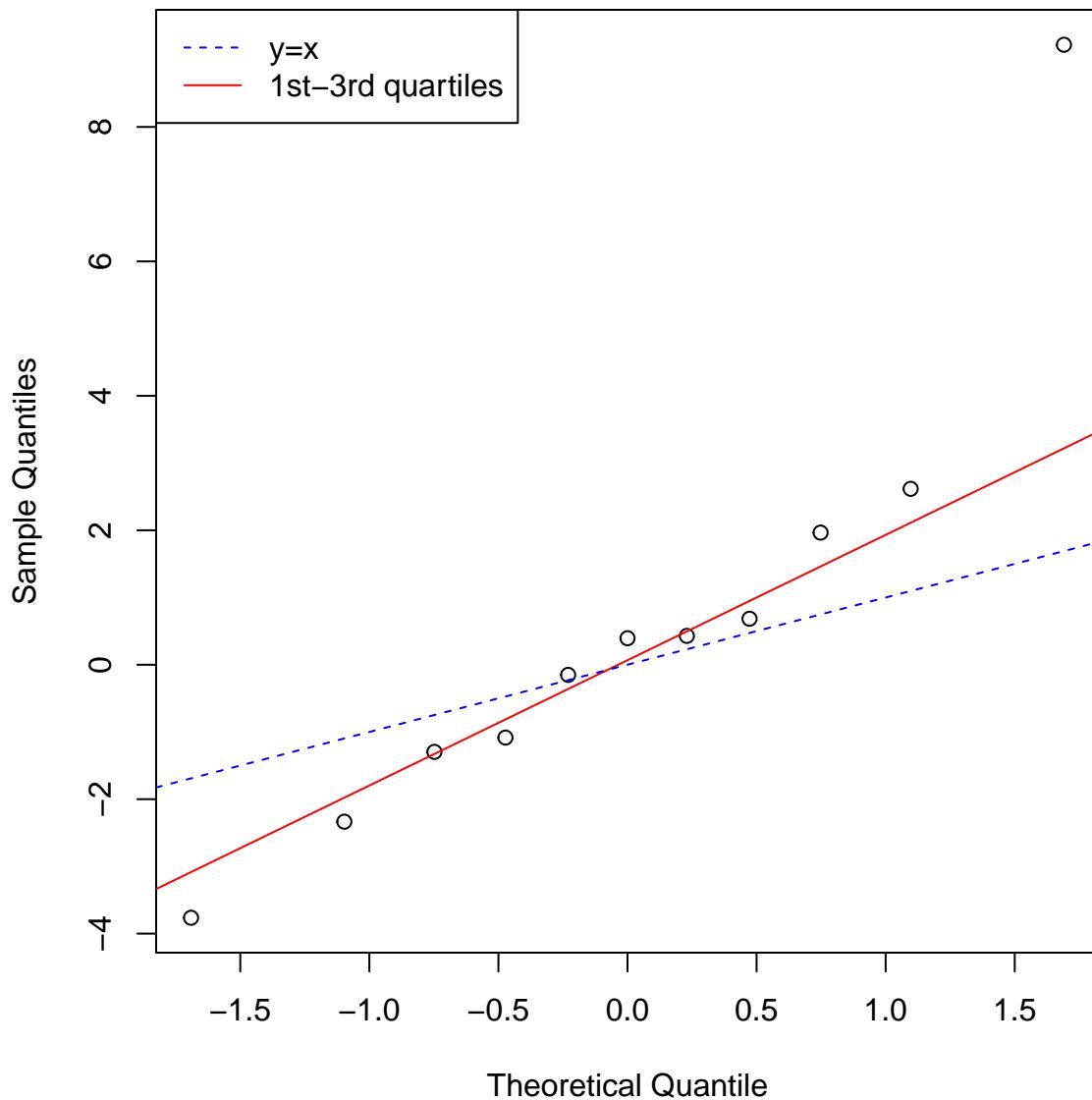
### Index 1 (NEFSC Inshore) ESS = 30



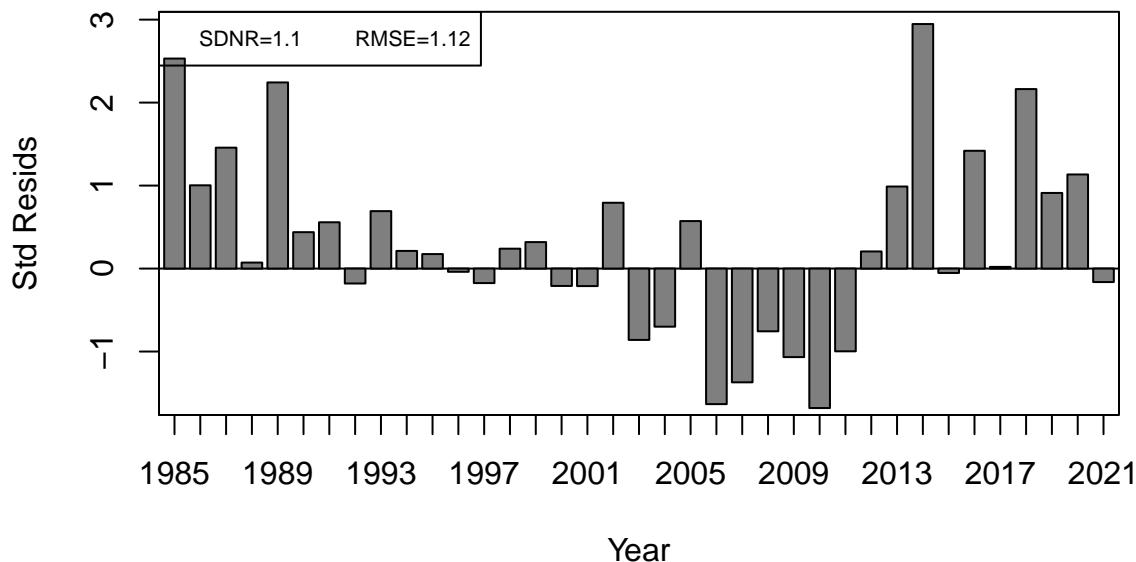
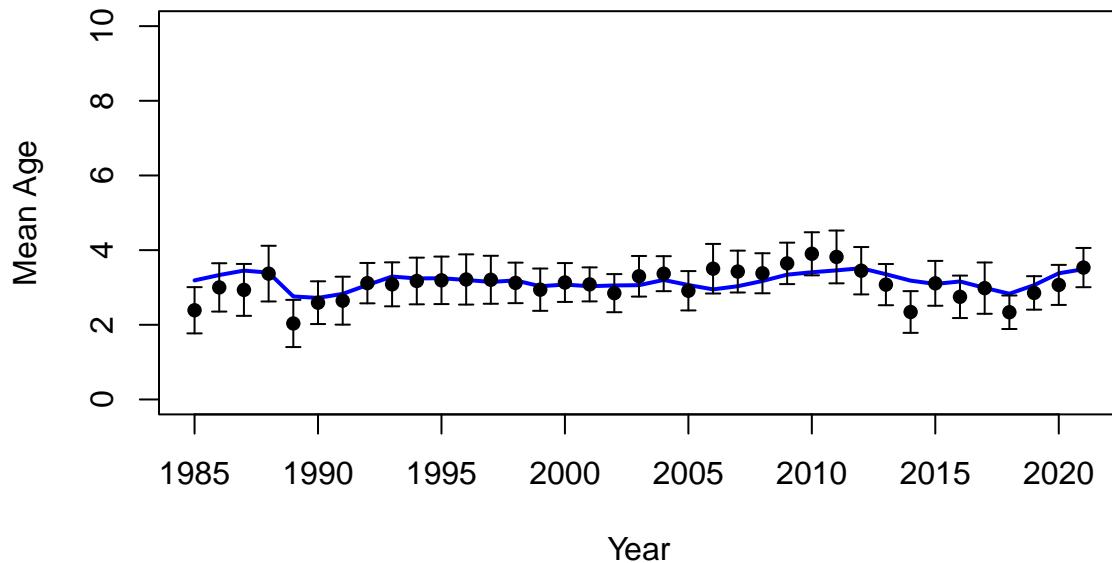
## Index 2 (Bigelow) ESS = 30



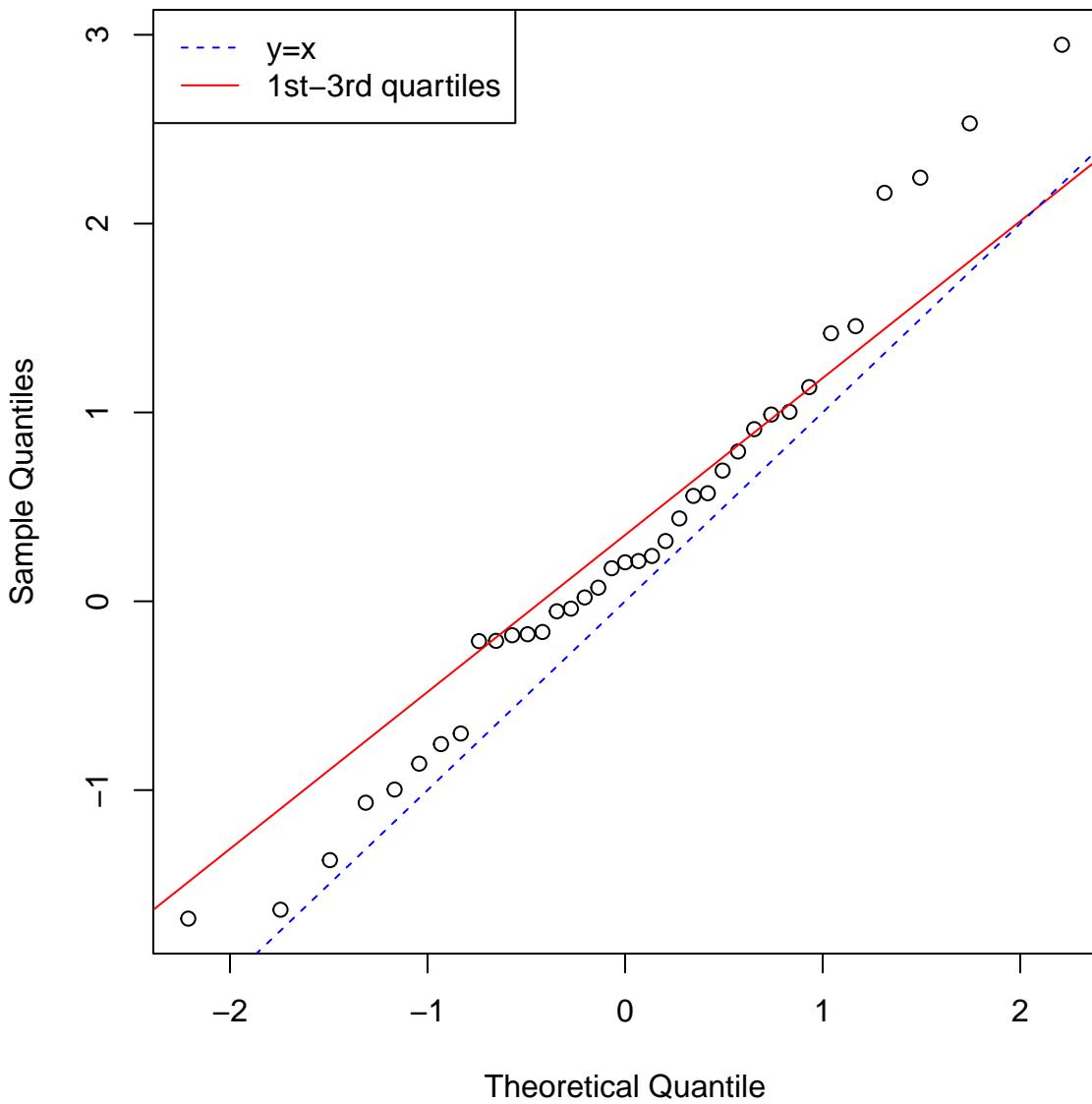
## Index 2 (Bigelow) ESS = 30



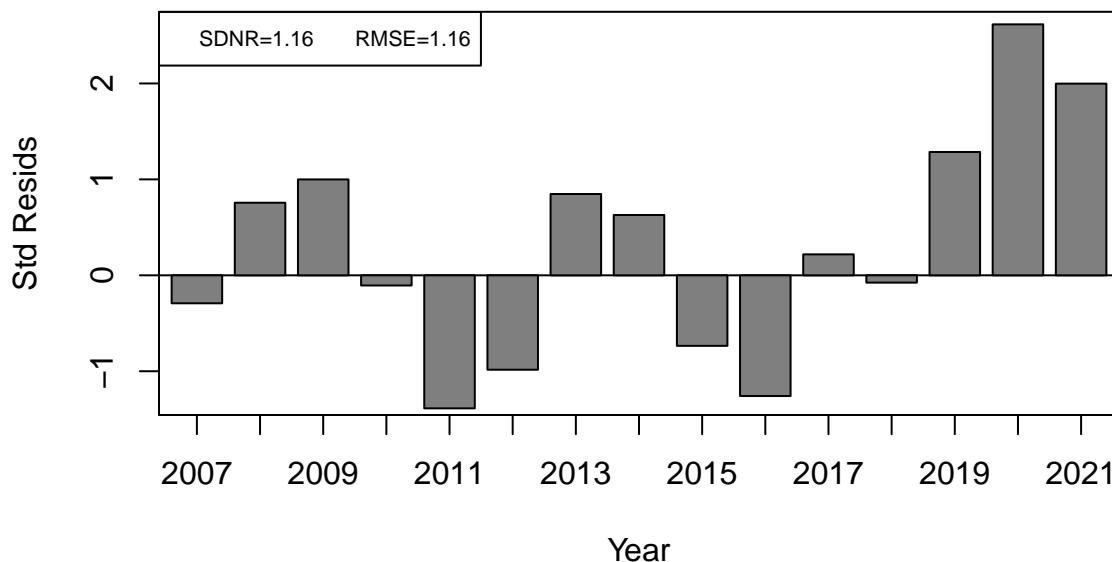
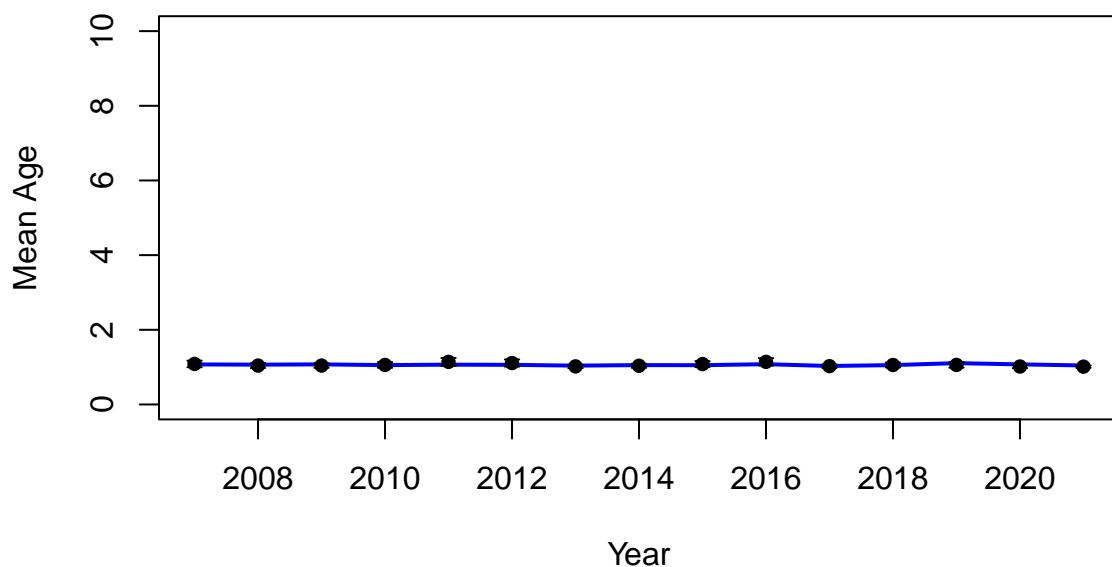
### Index 3 (MRIP) ESS = 30



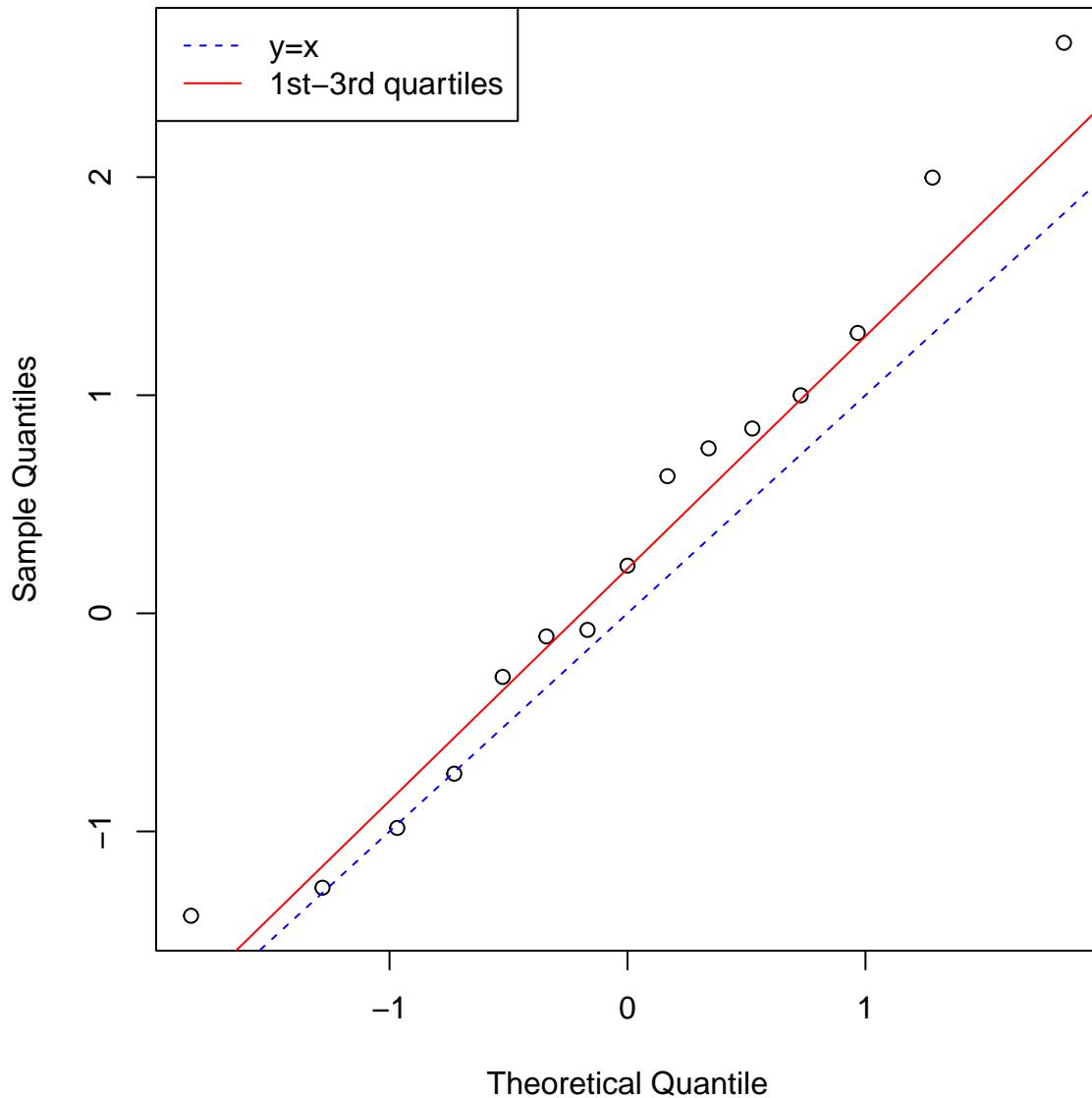
### Index 3 (MRIP) ESS = 30



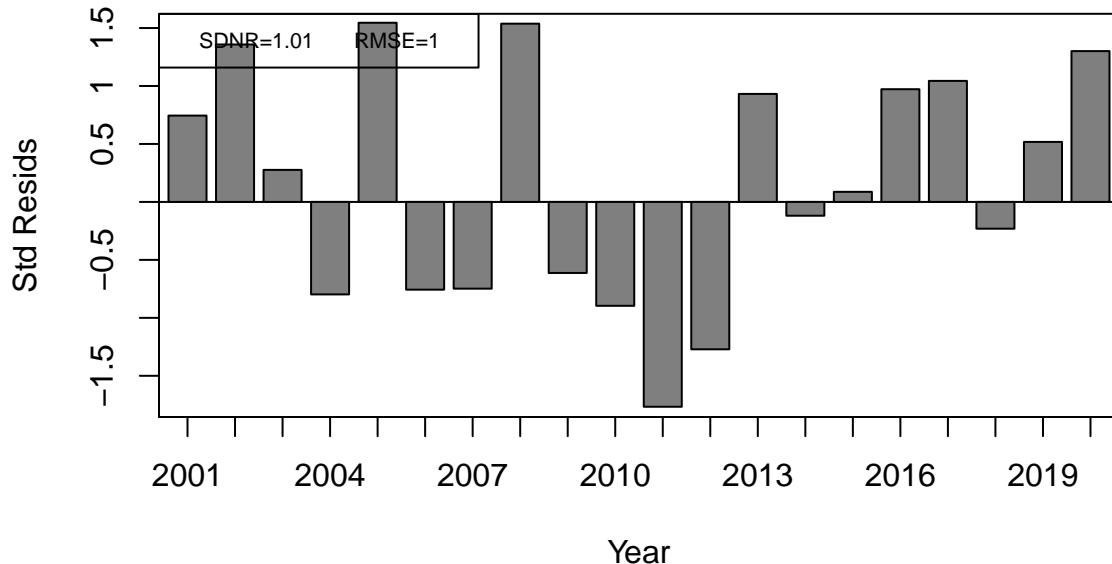
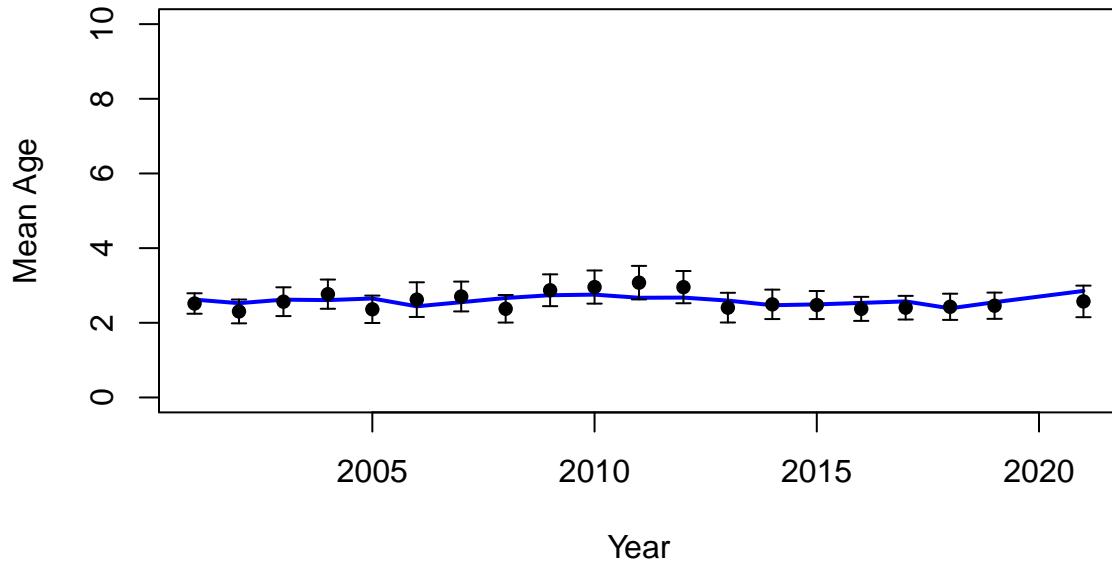
## Index 4 (NEAMAP) ESS = 50



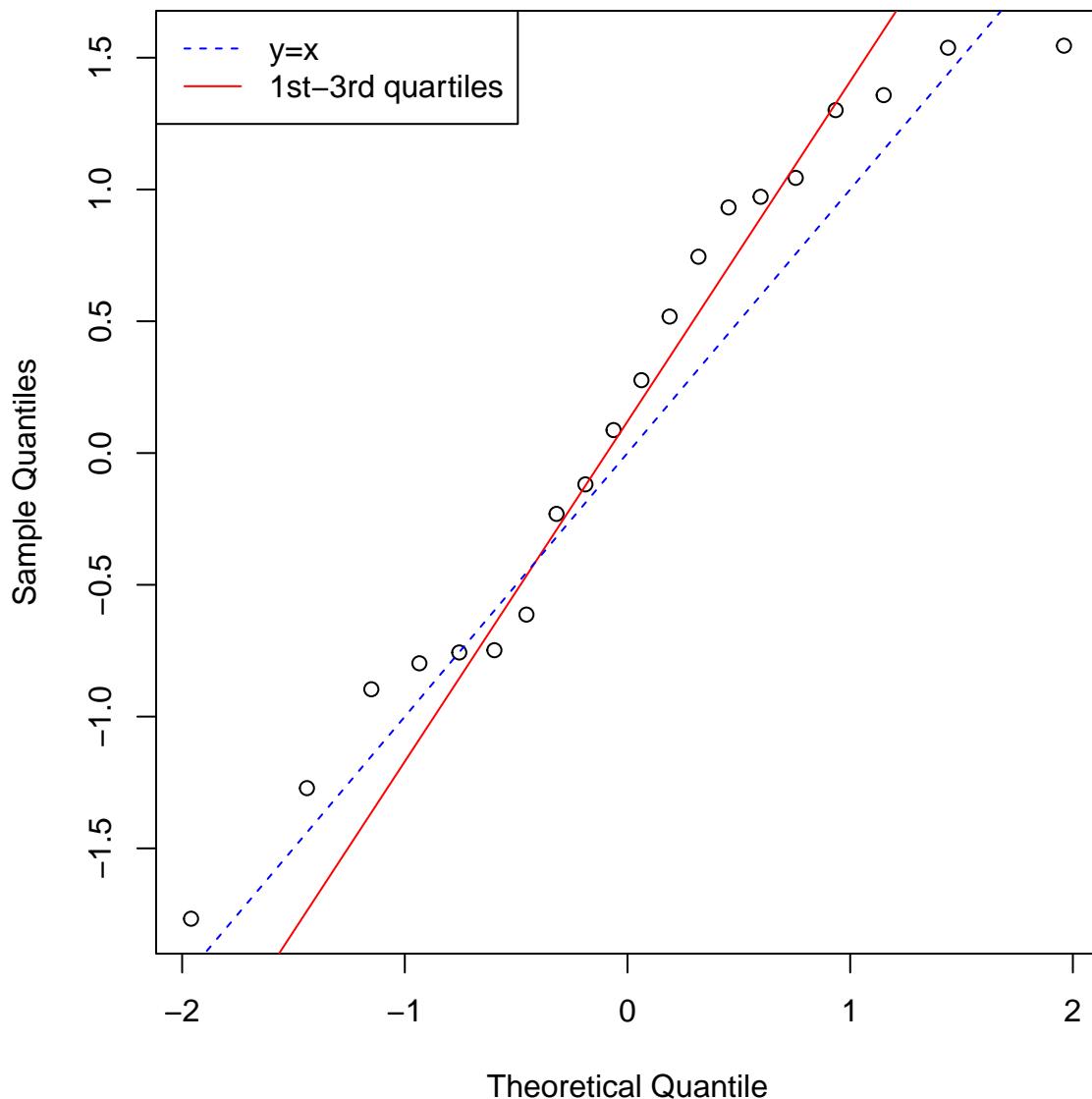
## Index 4 (NEAMAP) ESS = 50



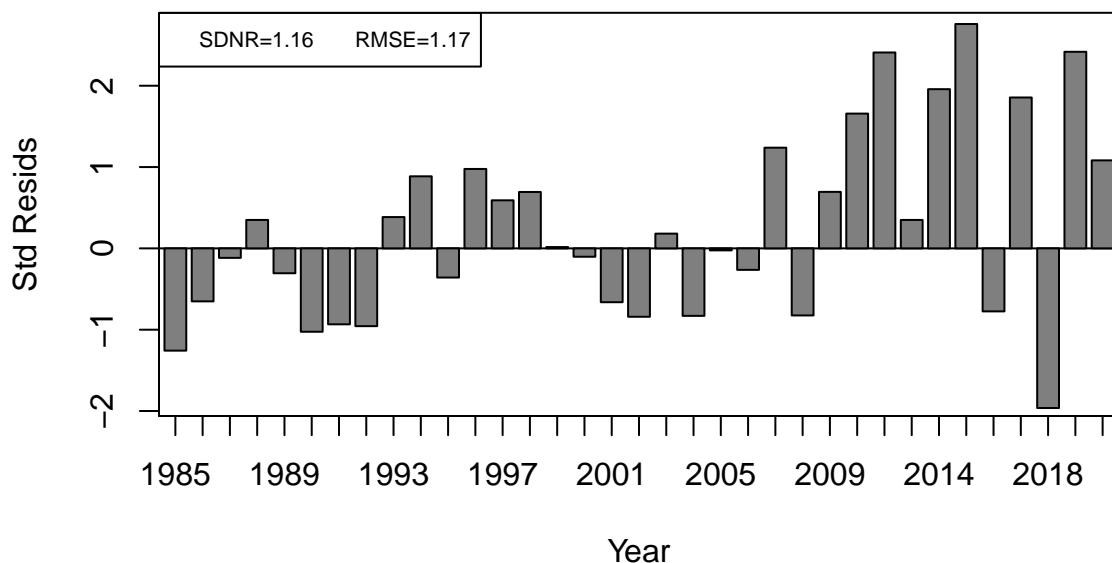
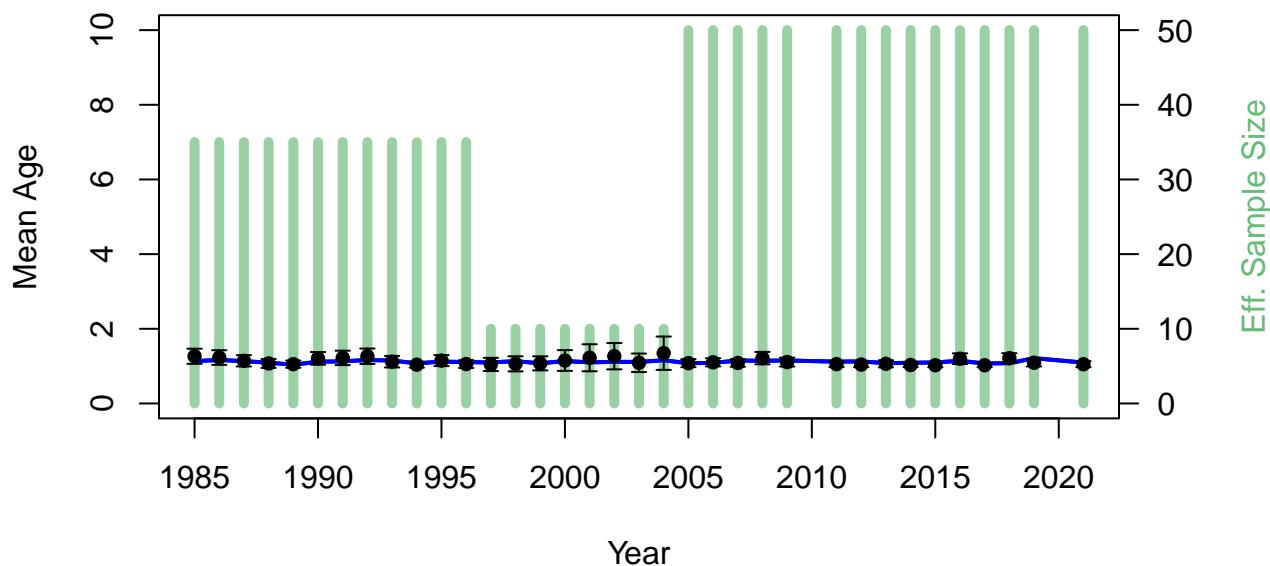
## Index 6 (PSIGN) ESS = 25



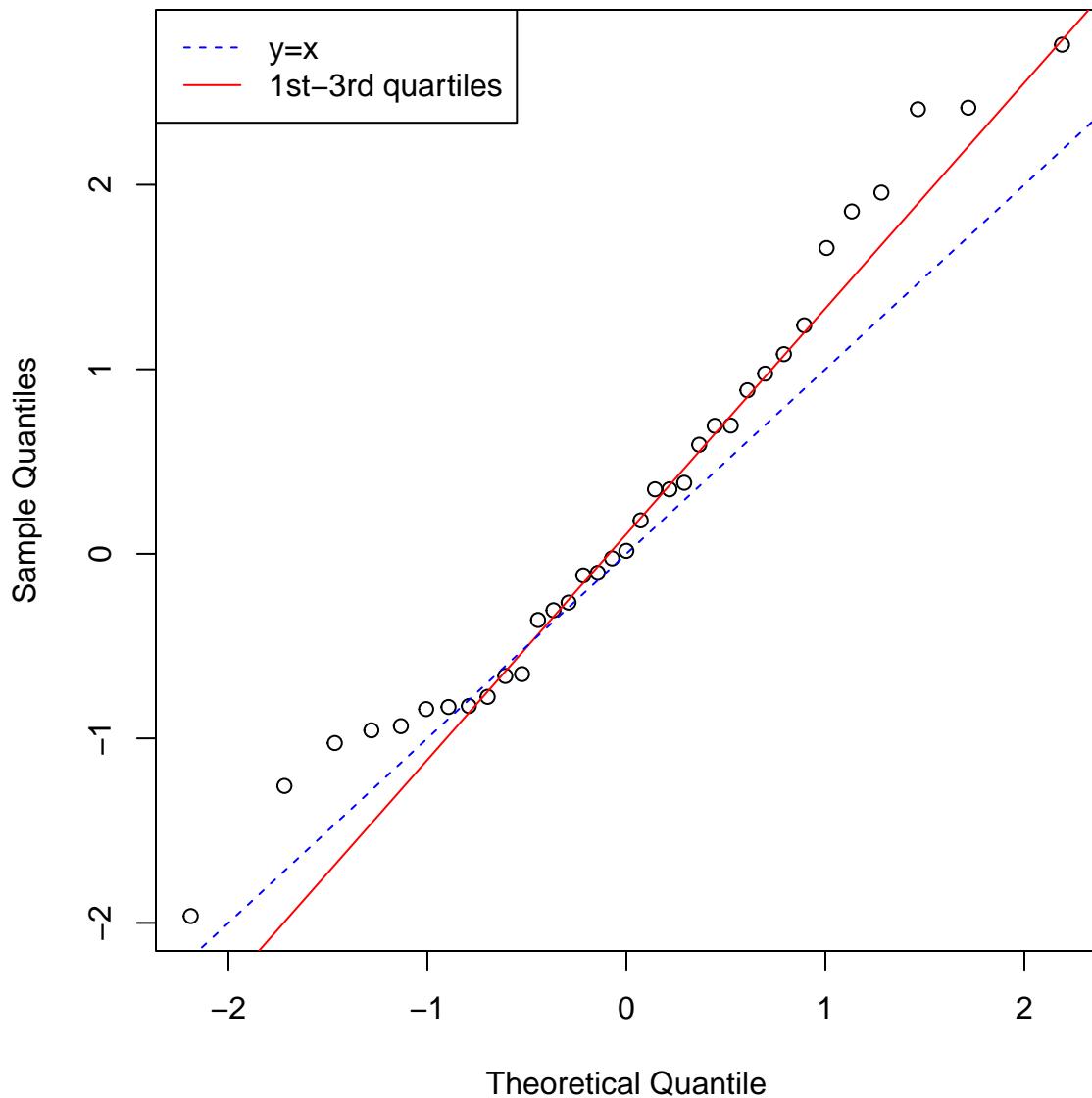
## Index 6 (PSIGN) ESS = 25



## Index 7 (CT Trawl)

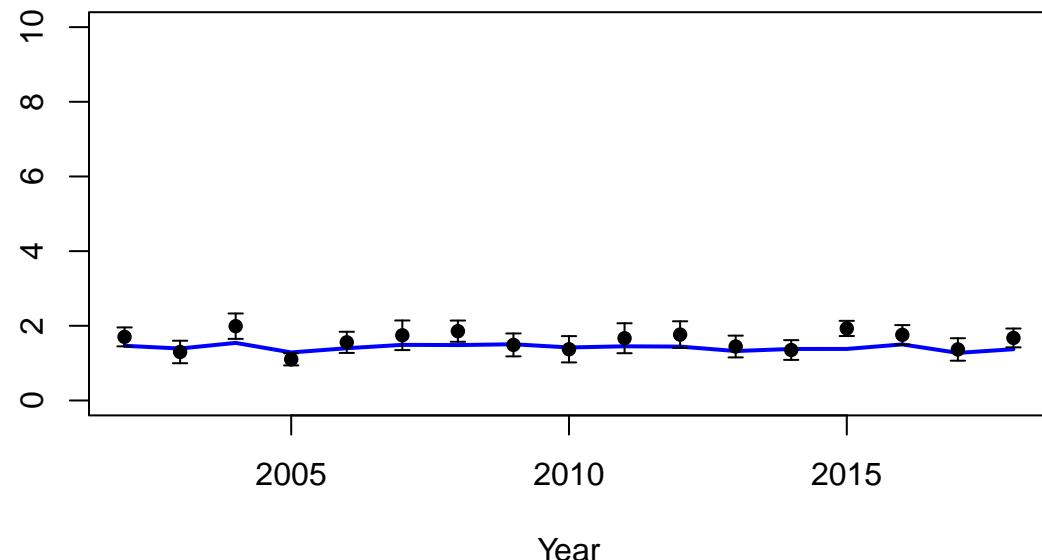


## Index 7 (CT Trawl)

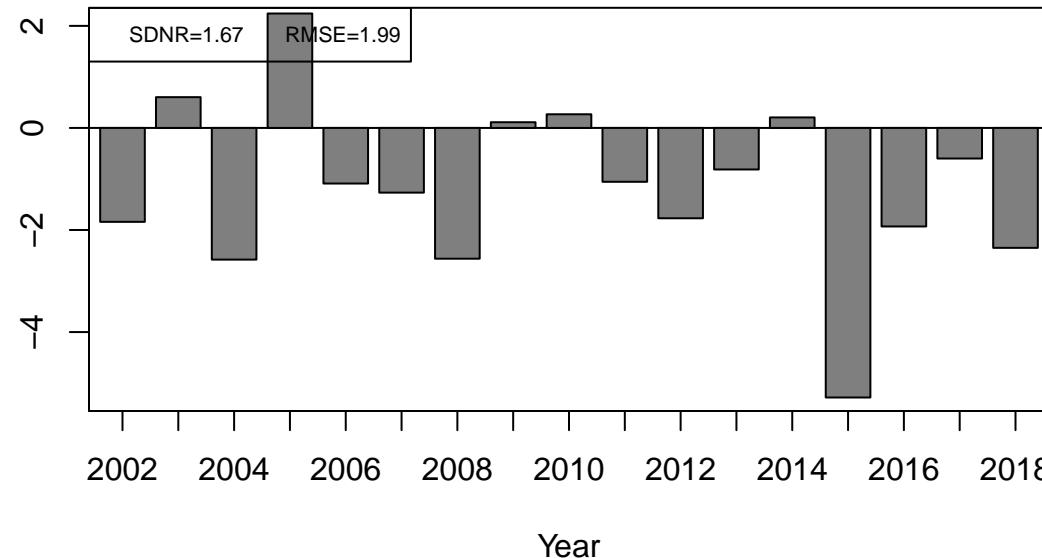


### Index 9 (ChesMMAP) ESS = 15

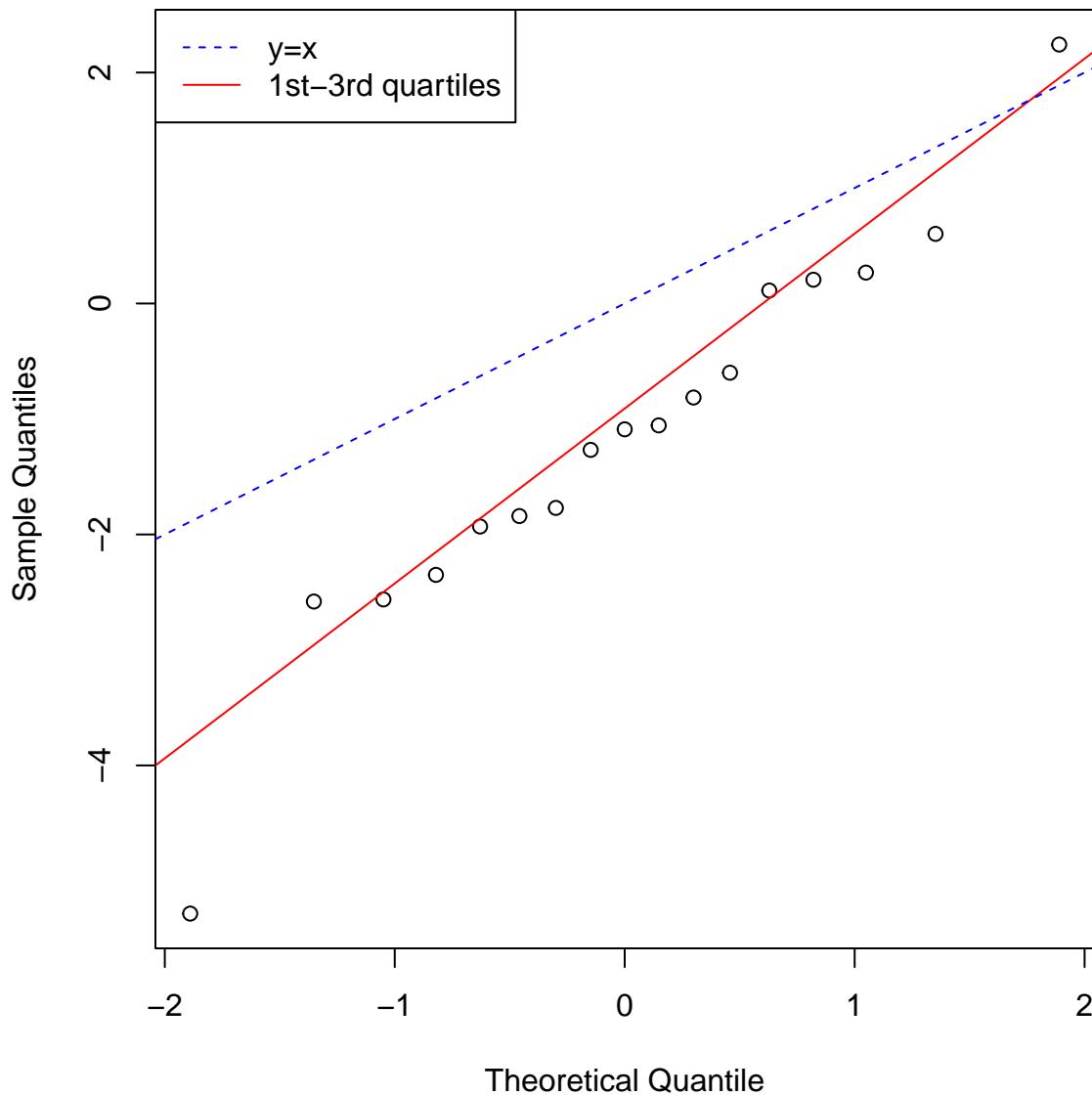
Mean Age



Std Resids



### Index 9 (ChesMMAP) ESS = 15

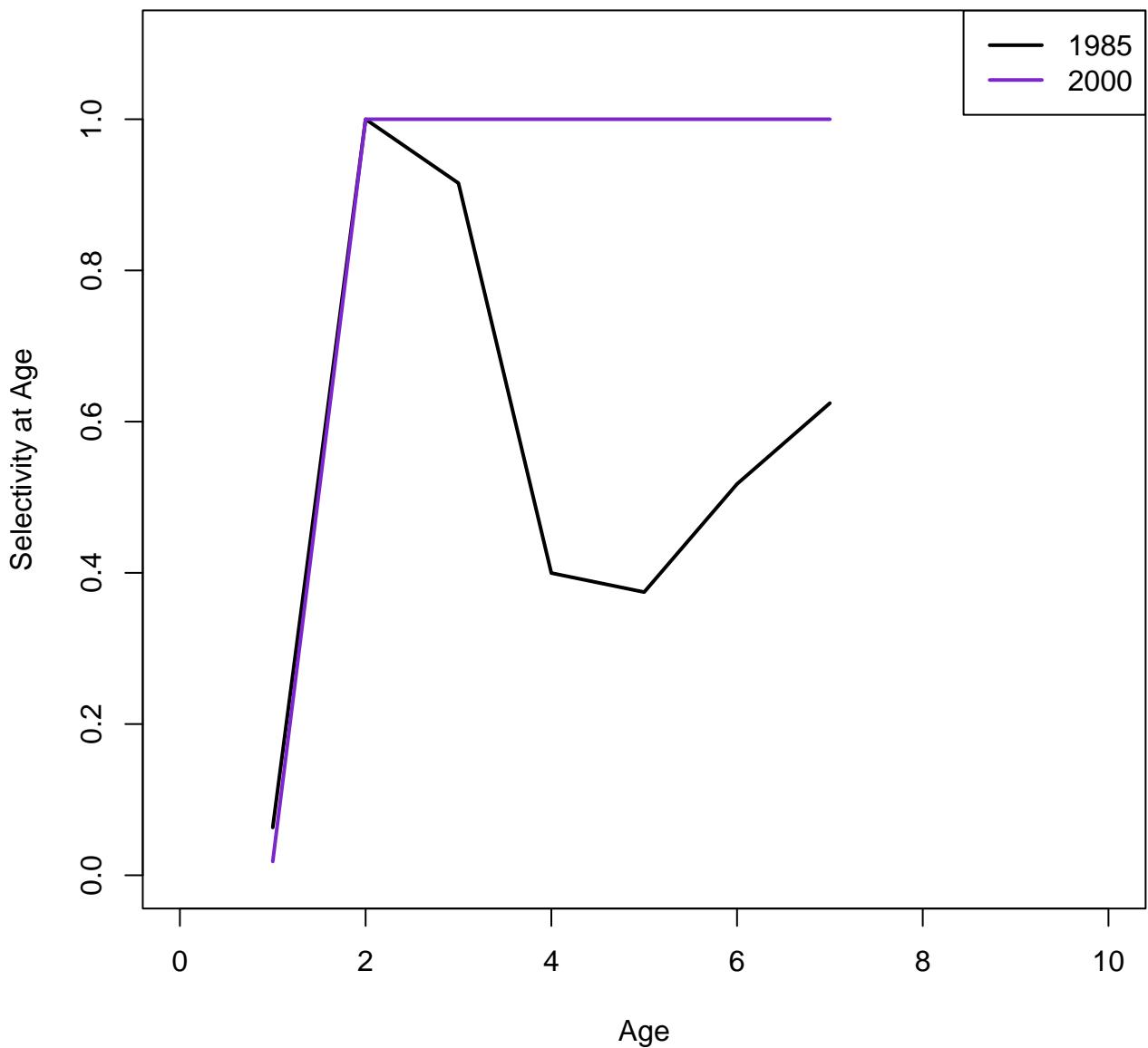


# BF19

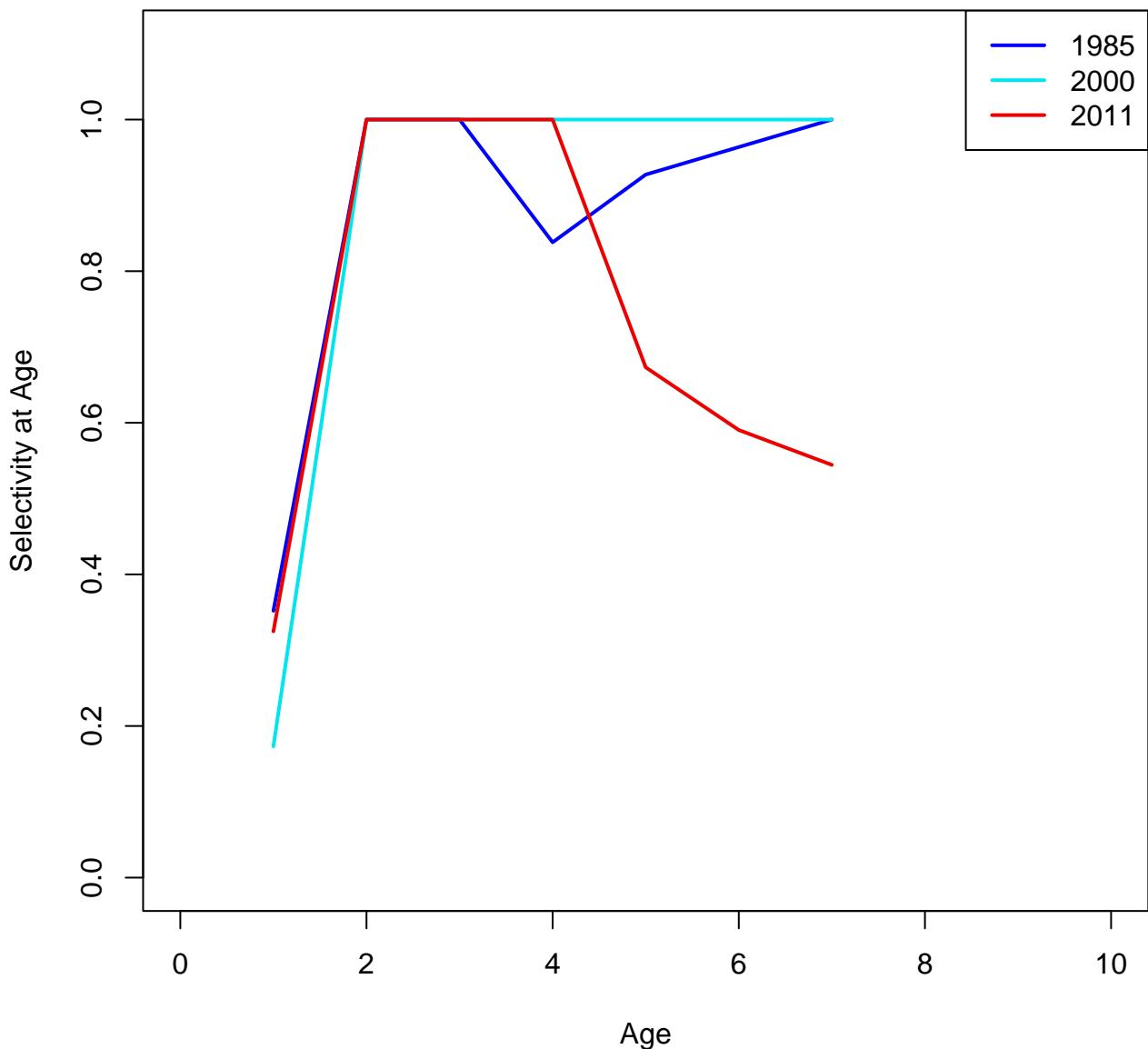
5 fleet selectivity blocks, average F from age 1 to ages 1-2

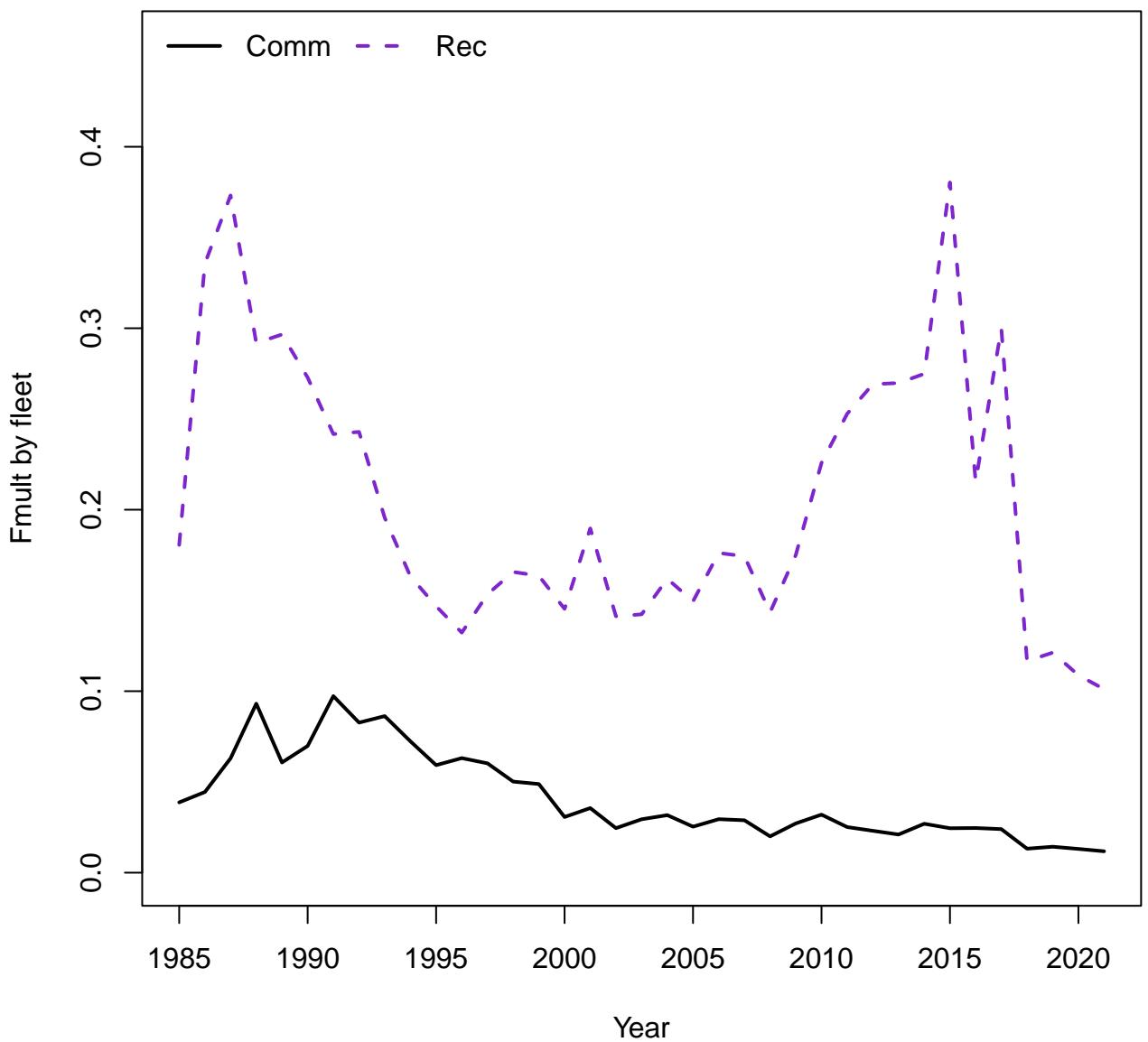
## RESULTS PLOTS

## Fleet 1 (Comm)

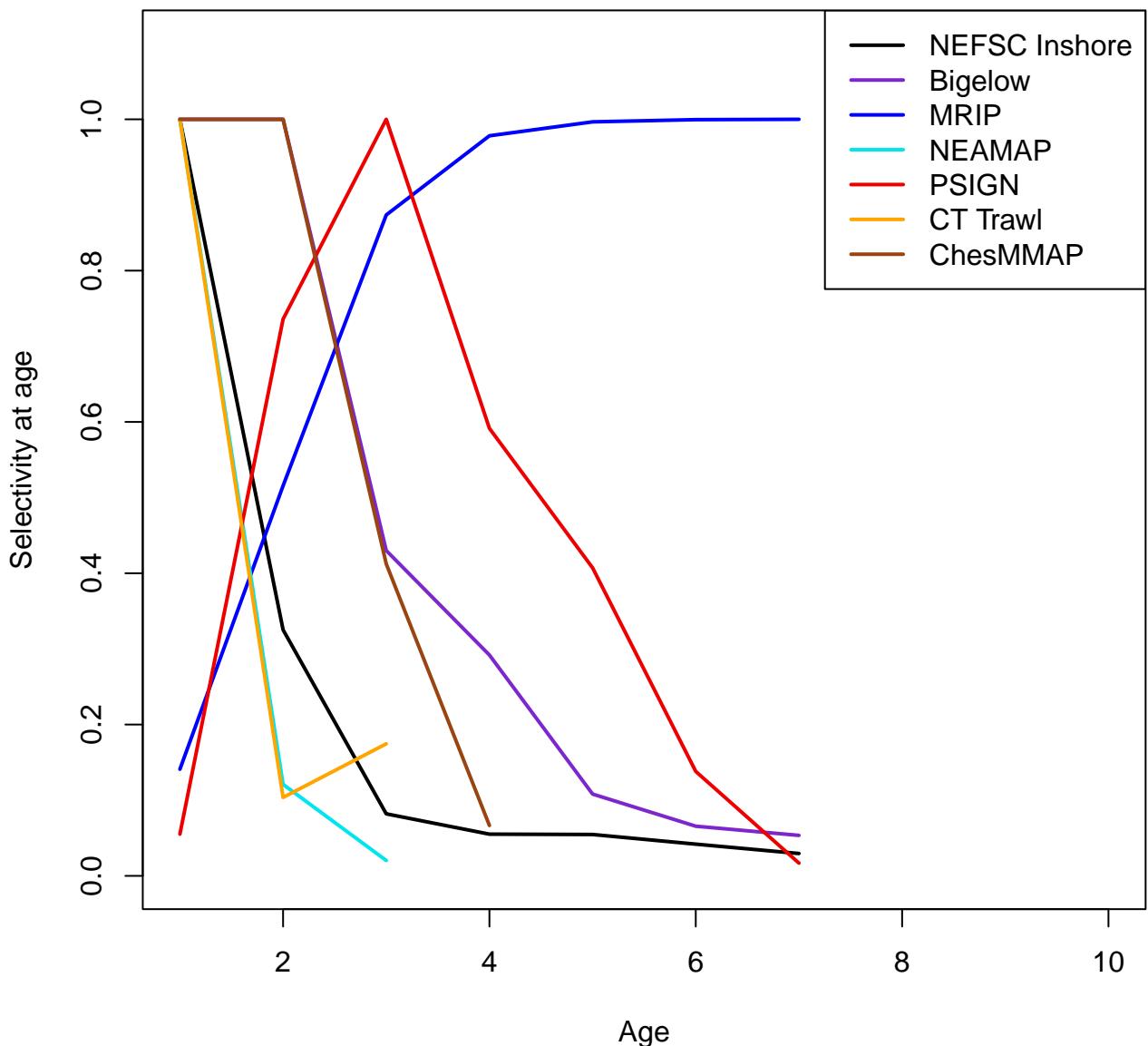


## Fleet 2 (Rec)



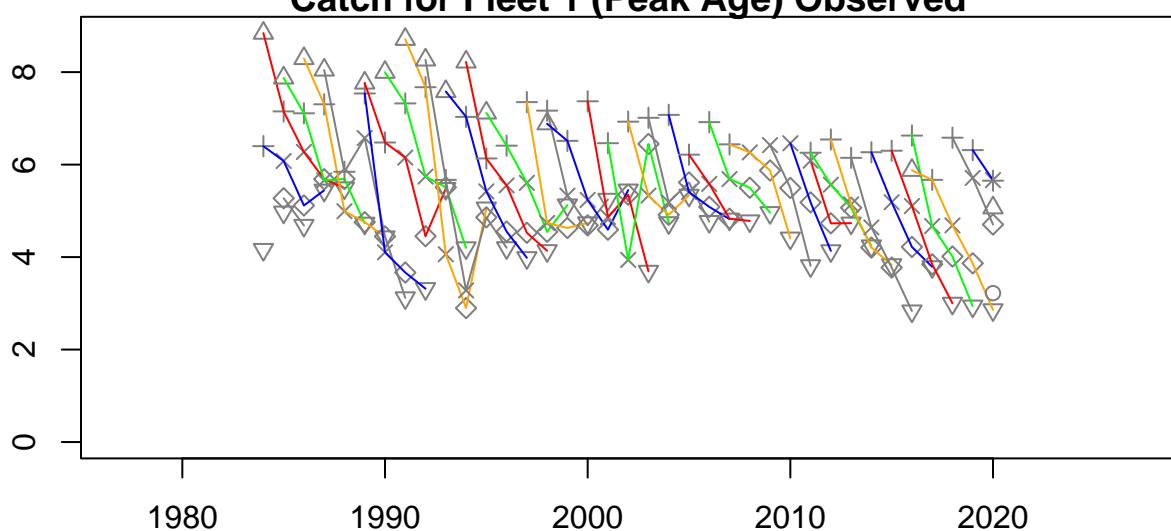


## Indices



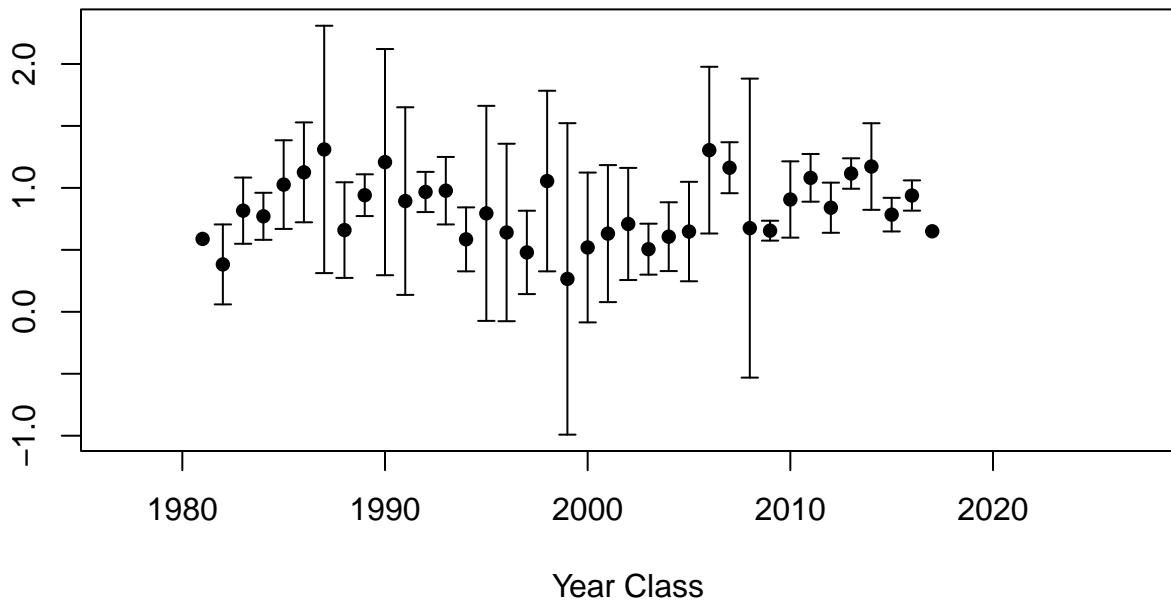
## Catch for Fleet 1 (Peak Age) Observed

Log(Catch)



1980 1990 2000 2010 2020

Z



1980 1990 2000 2010 2020

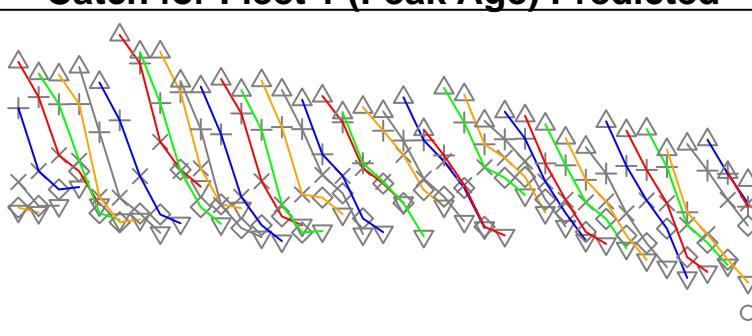
Year Class

## Catch for Fleet 1 (Peak Age) Predicted

Log(Catch)

8  
6  
4  
2  
0

1980 1990 2000 2010 2020

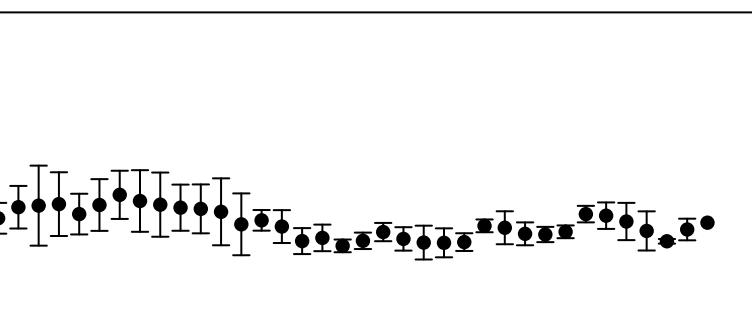


Z

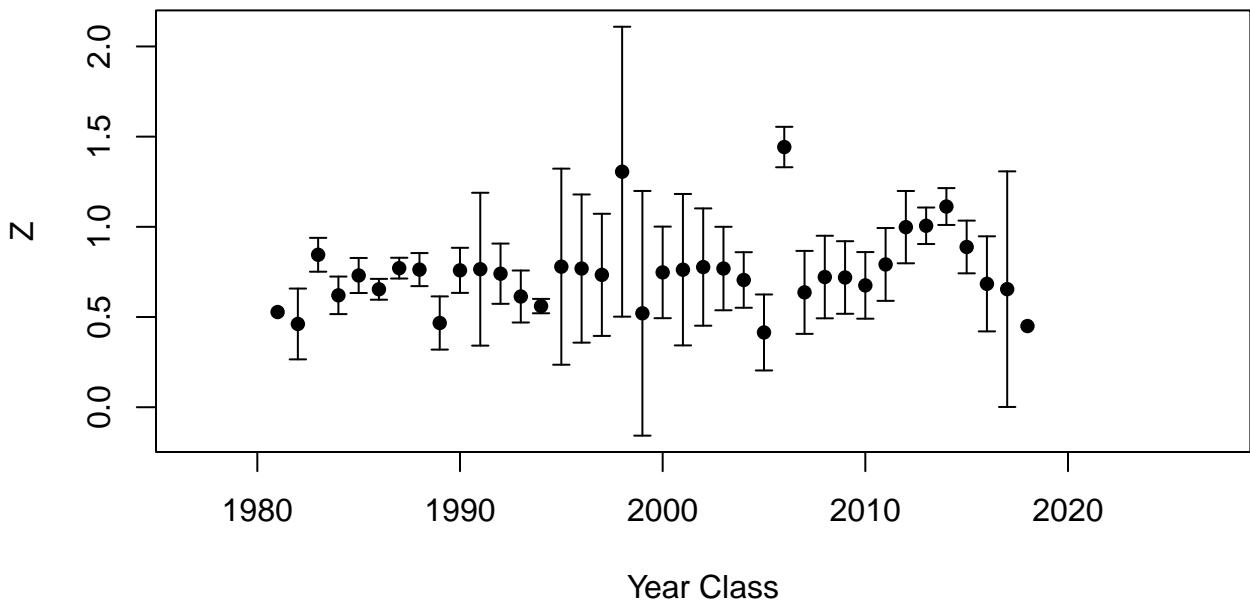
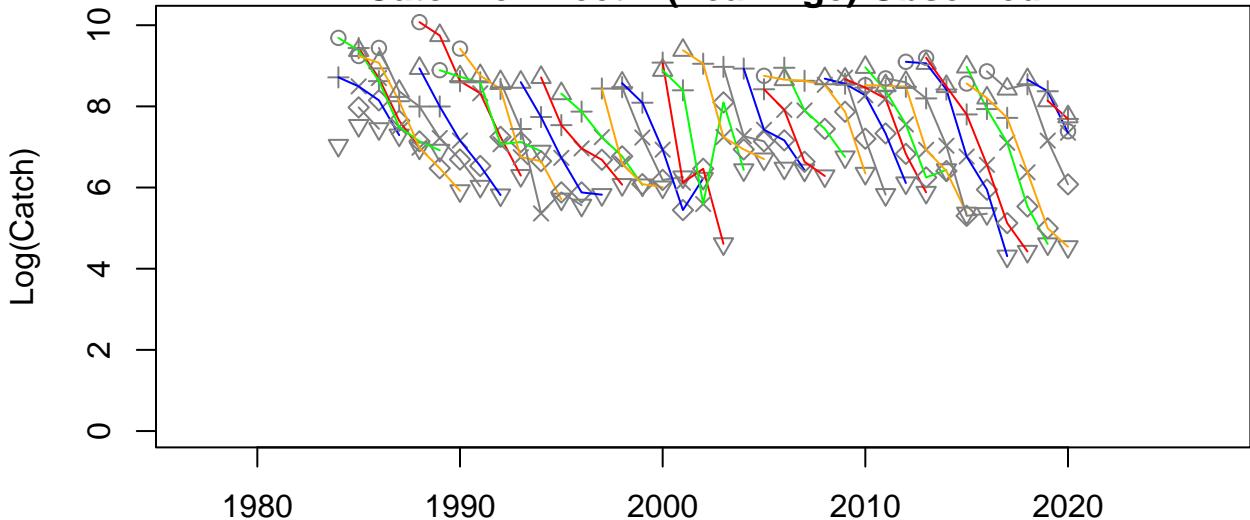
2.0  
1.0  
0.0  
-1.0

1980 1990 2000 2010 2020

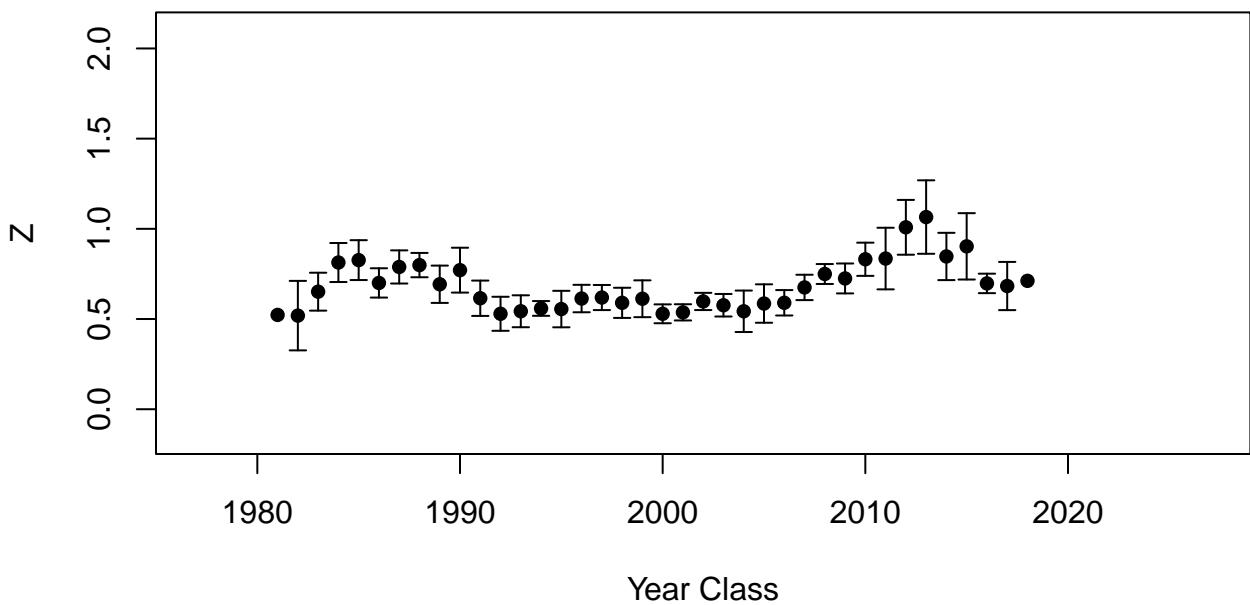
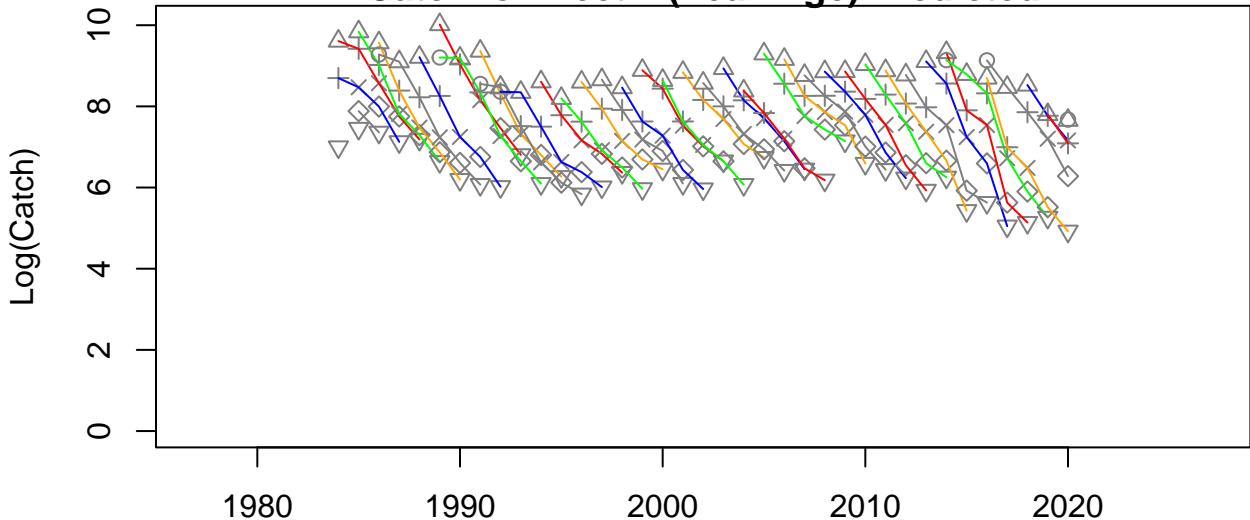
Year Class



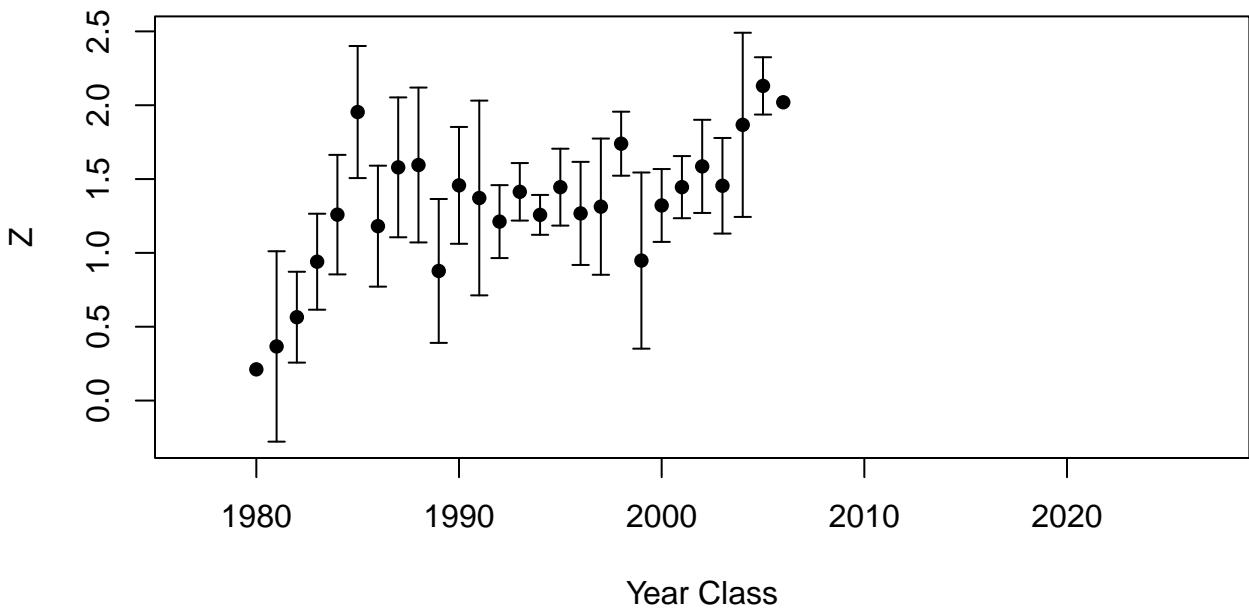
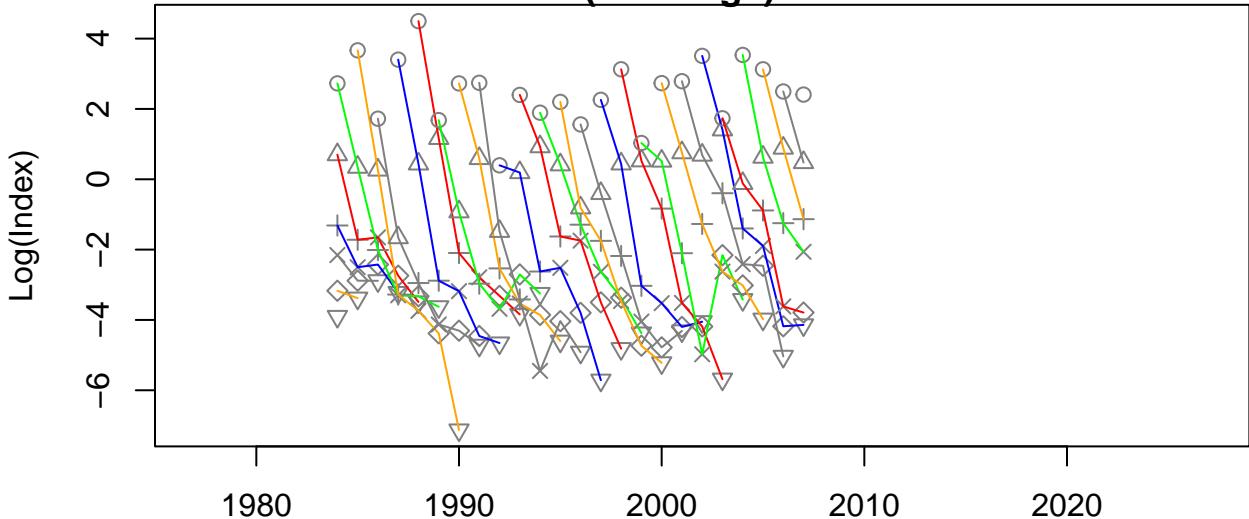
## Catch for Fleet 2 (Peak Age) Observed



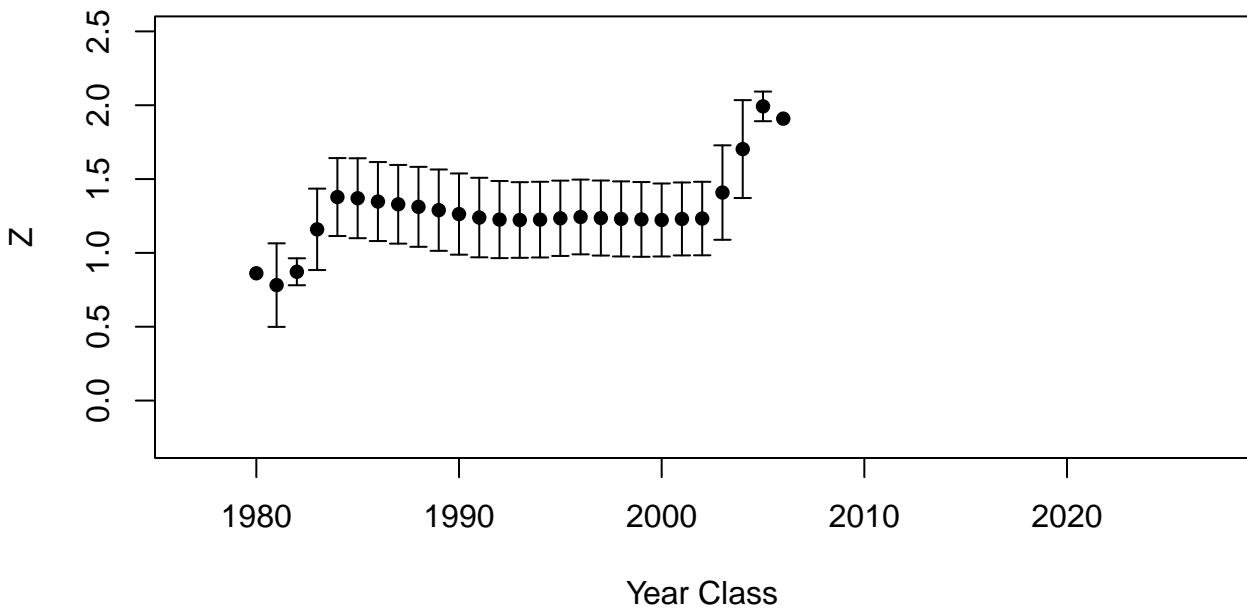
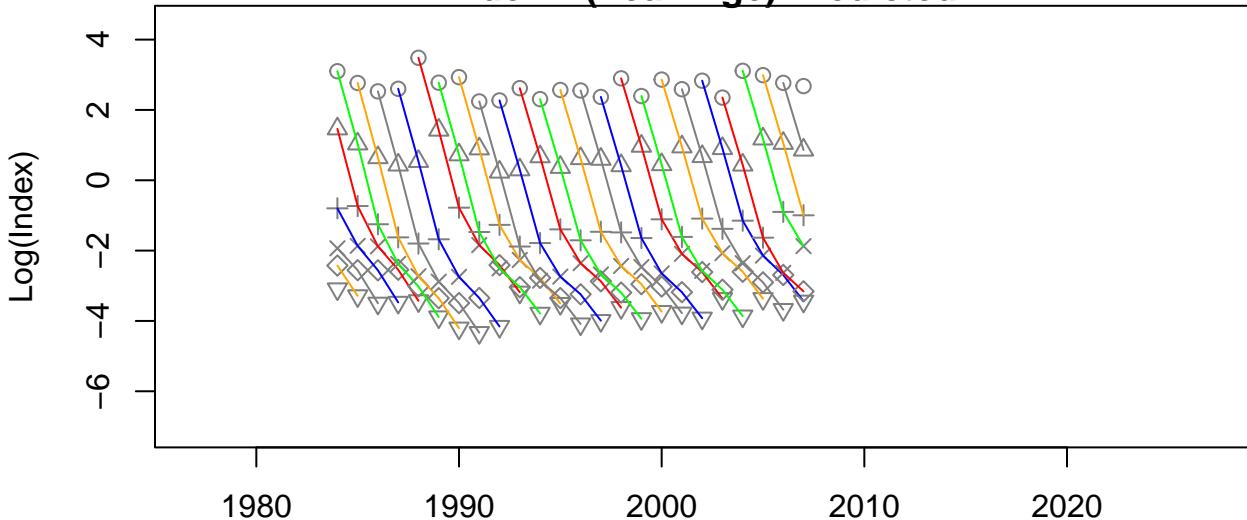
## Catch for Fleet 2 (Peak Age) Predicted



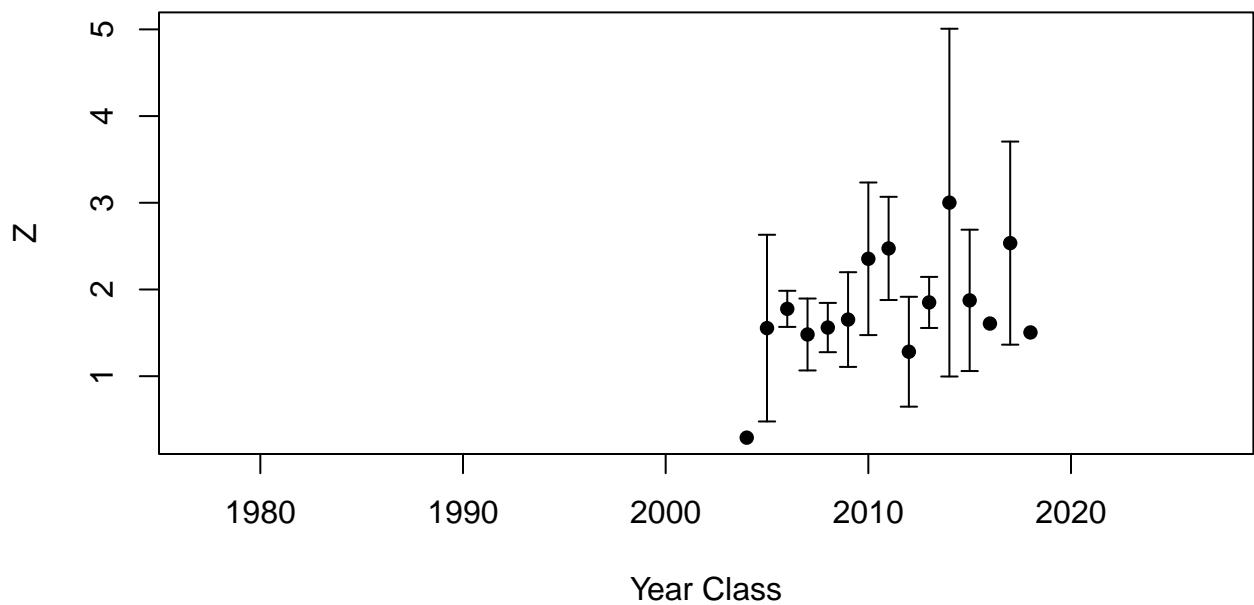
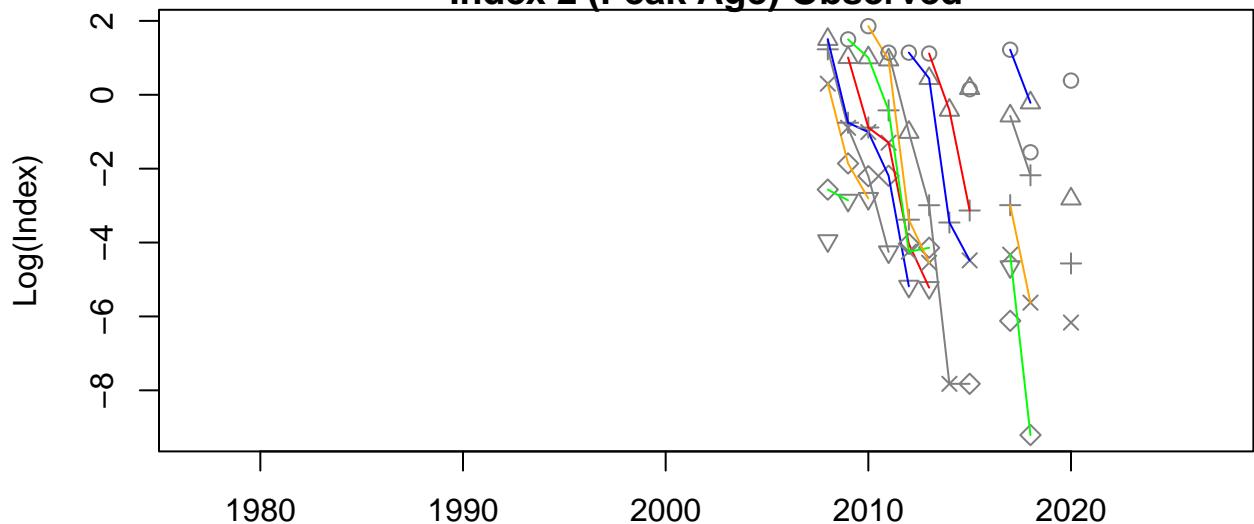
### Index 1 (Peak Age) Observed



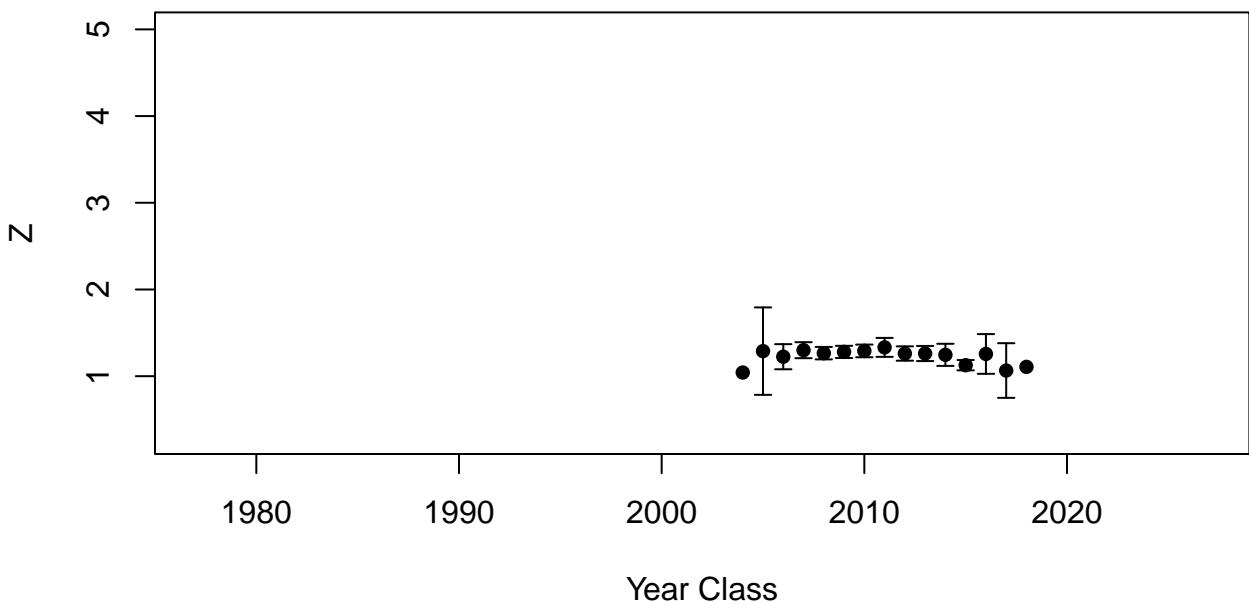
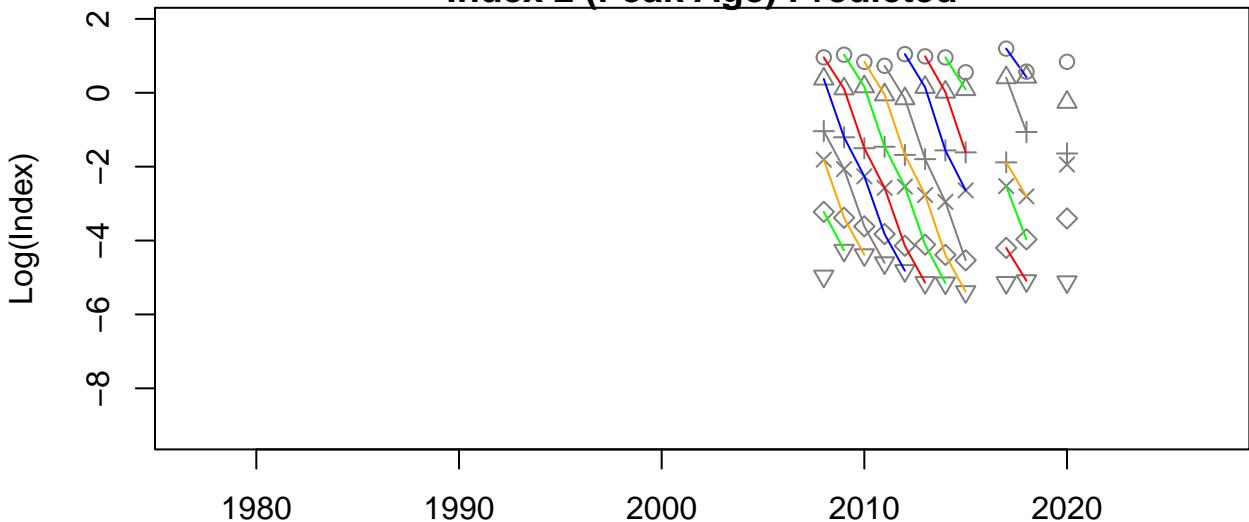
## Index 1 (Peak Age) Predicted



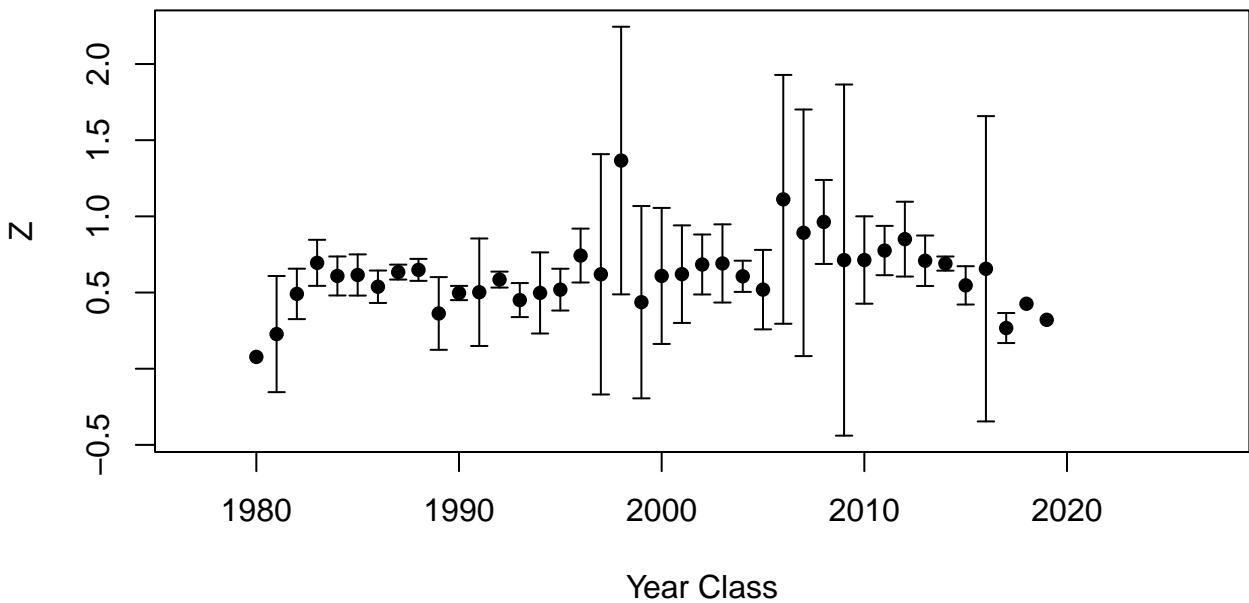
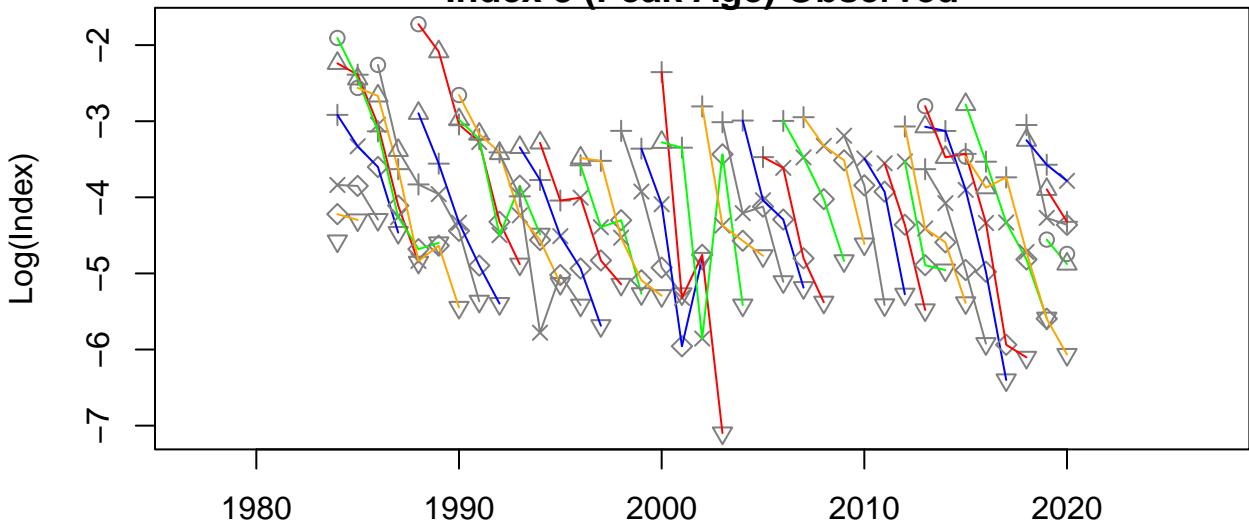
## Index 2 (Peak Age) Observed



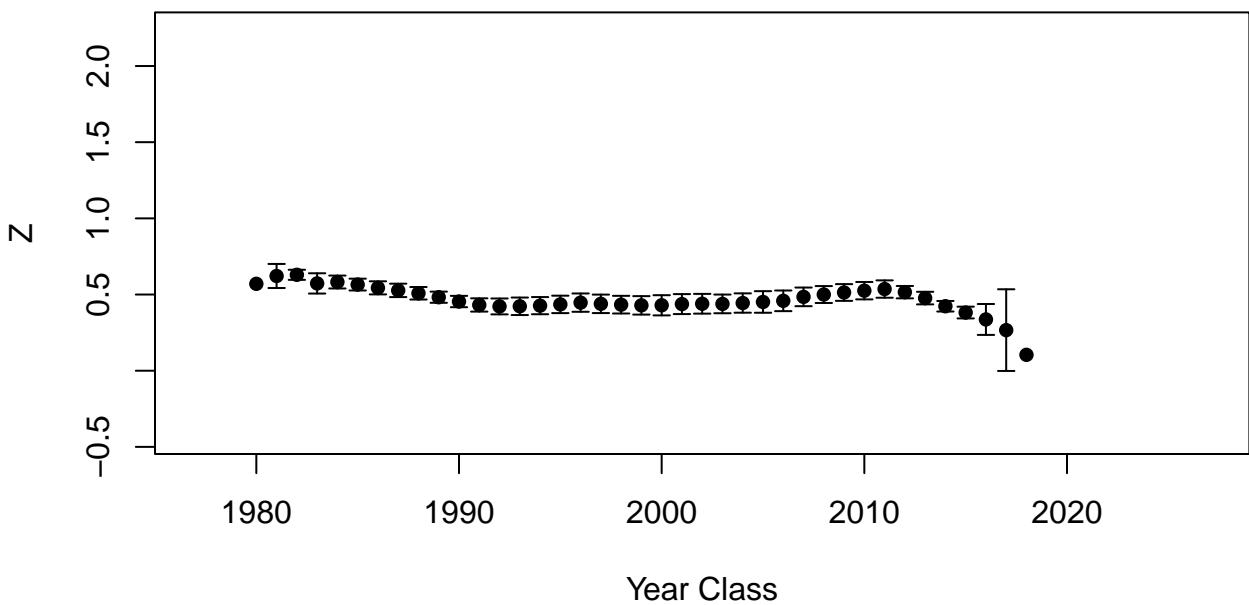
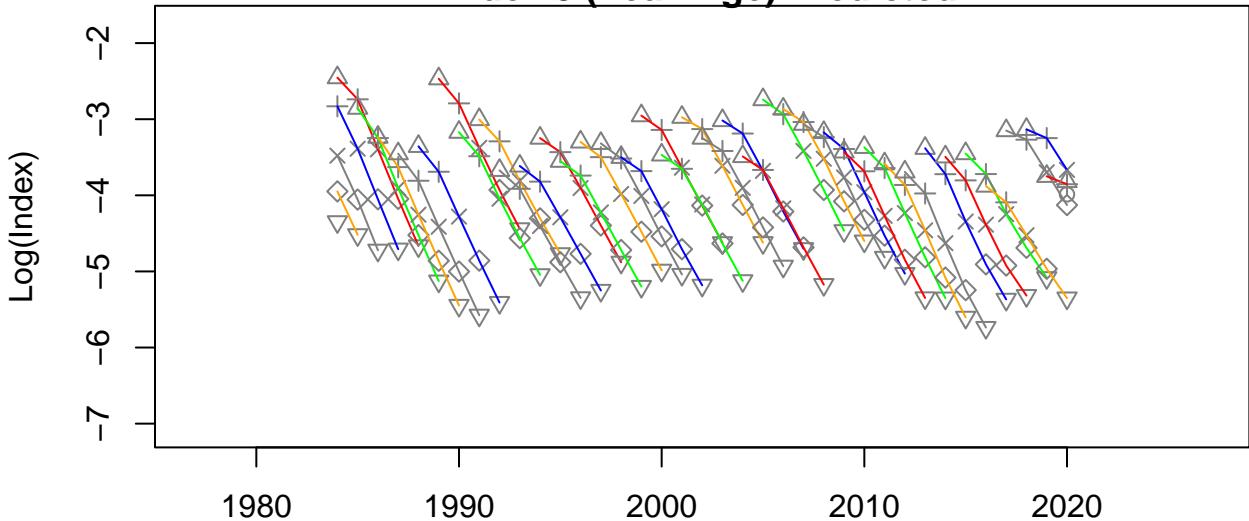
## Index 2 (Peak Age) Predicted



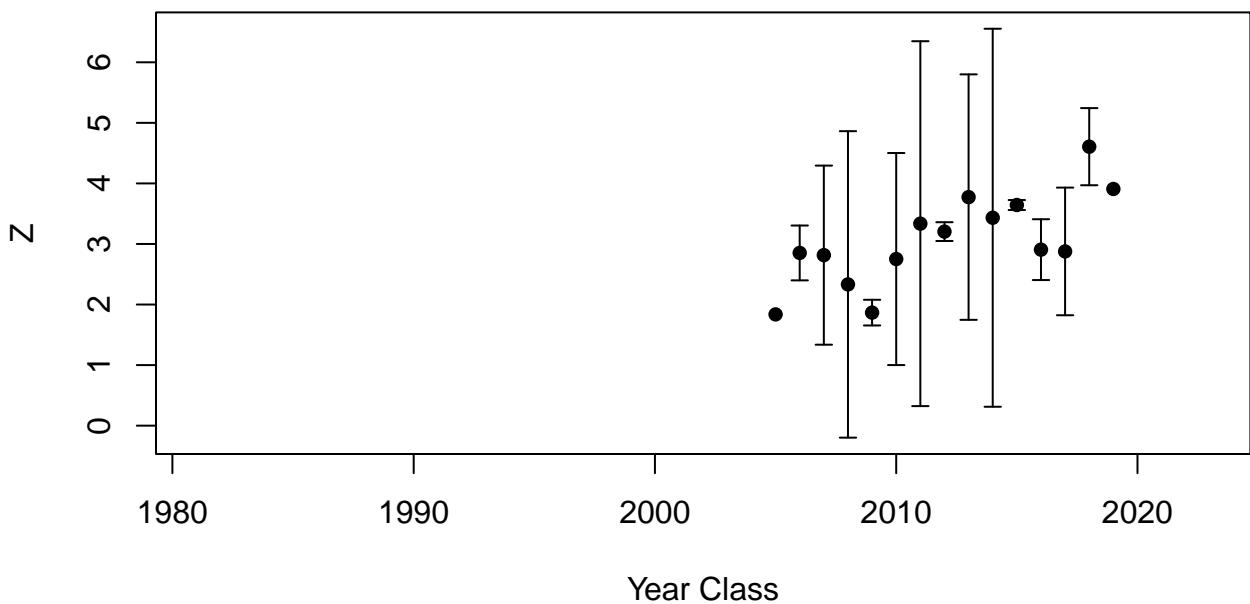
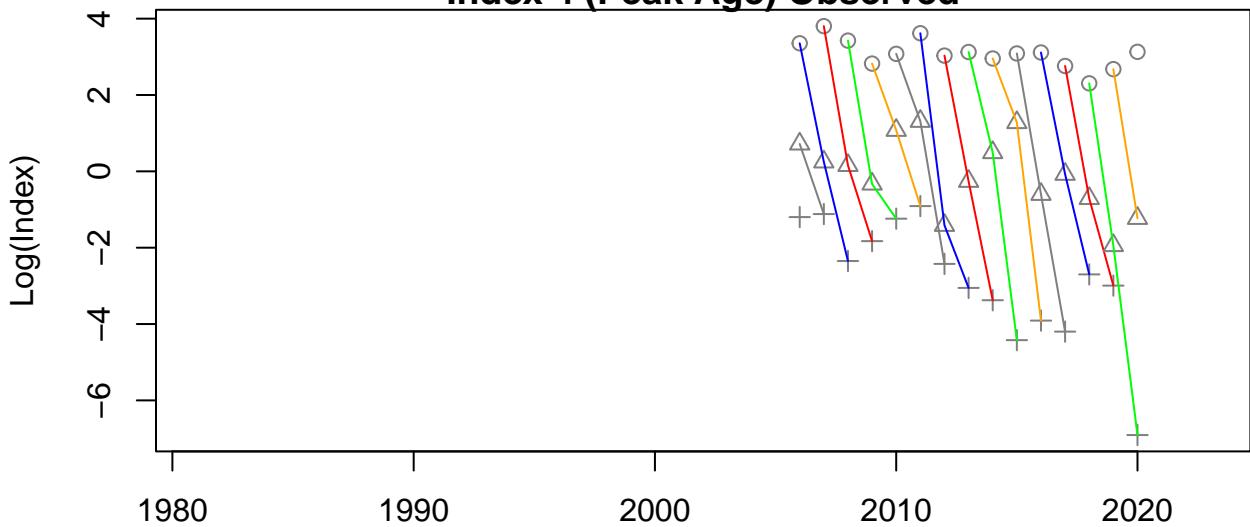
### Index 3 (Peak Age) Observed



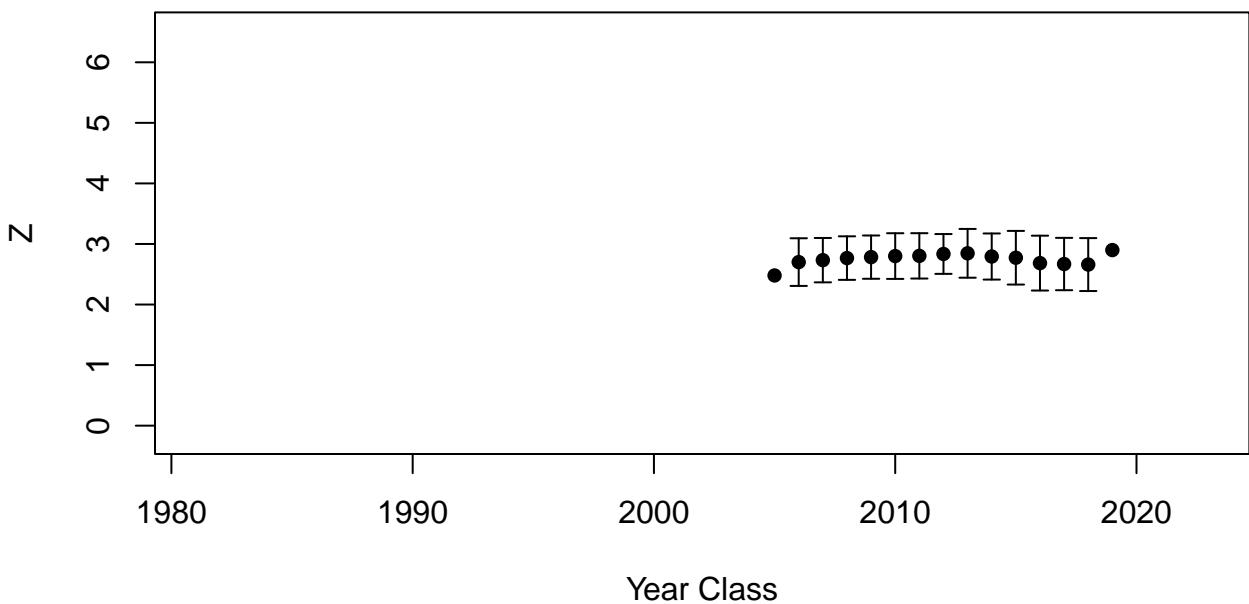
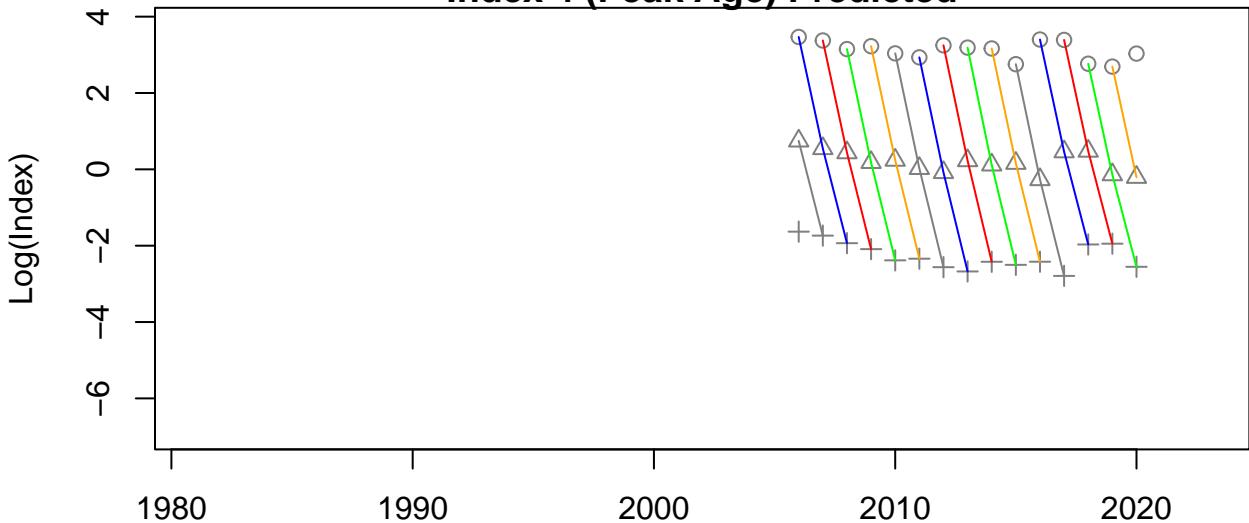
### Index 3 (Peak Age) Predicted



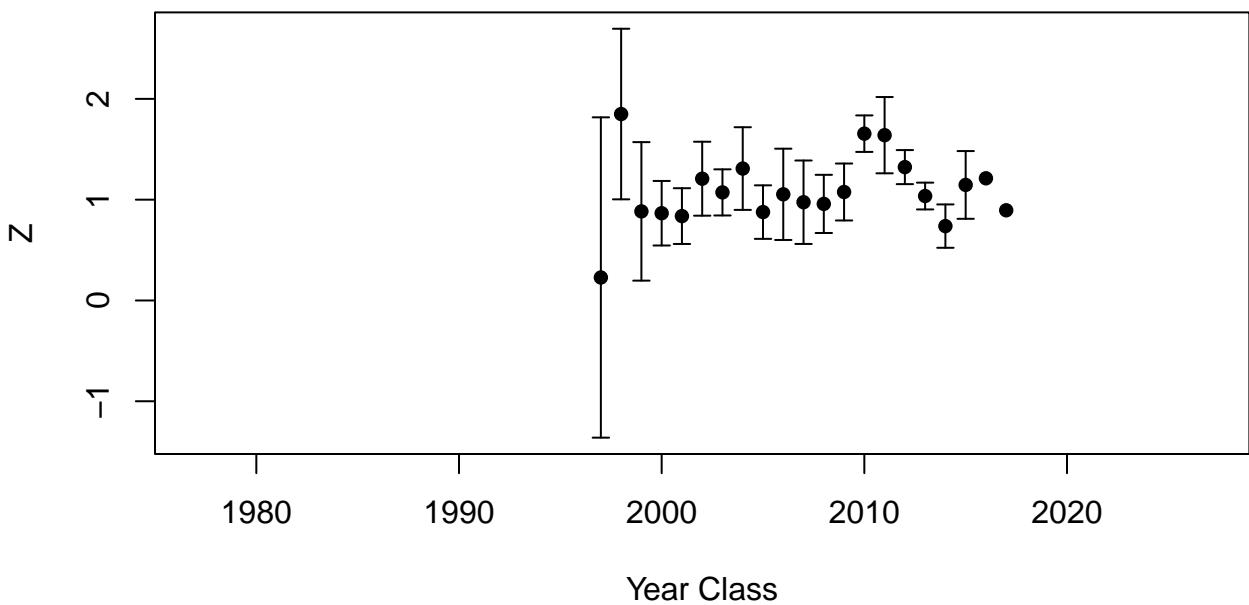
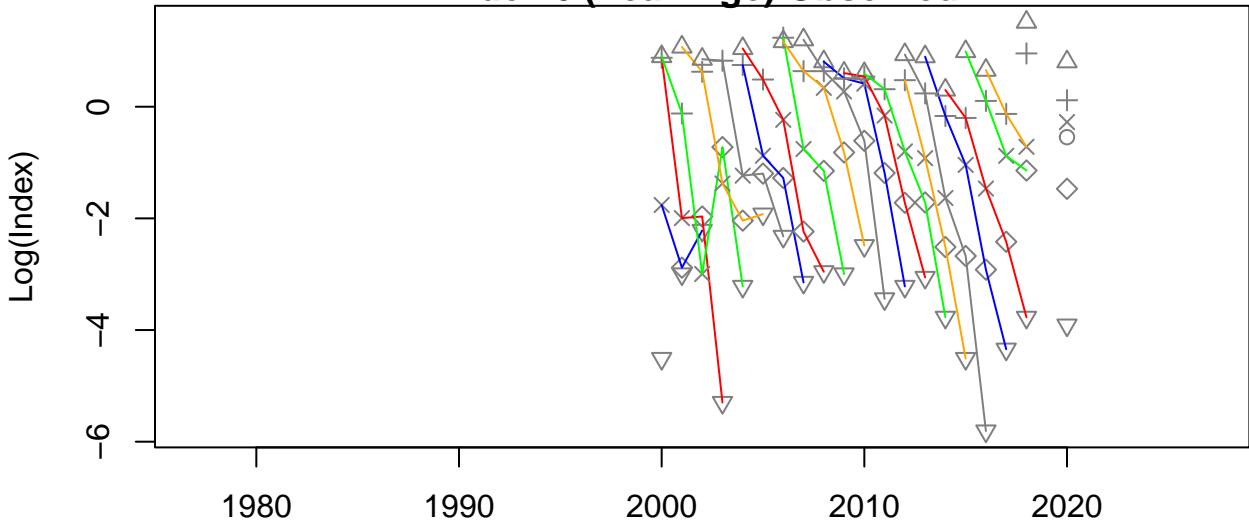
### Index 4 (Peak Age) Observed



### Index 4 (Peak Age) Predicted



### Index 6 (Peak Age) Observed



## Index 6 (Peak Age) Predicted

Log(Index)

0  
-2  
-4  
-6

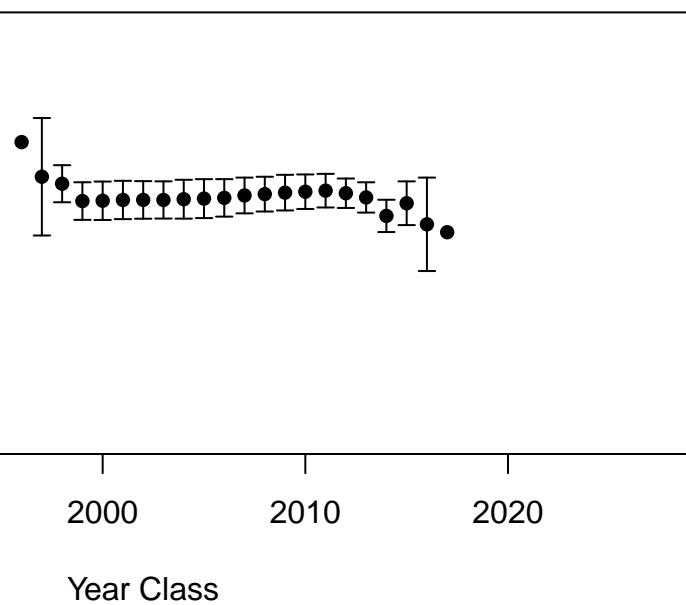
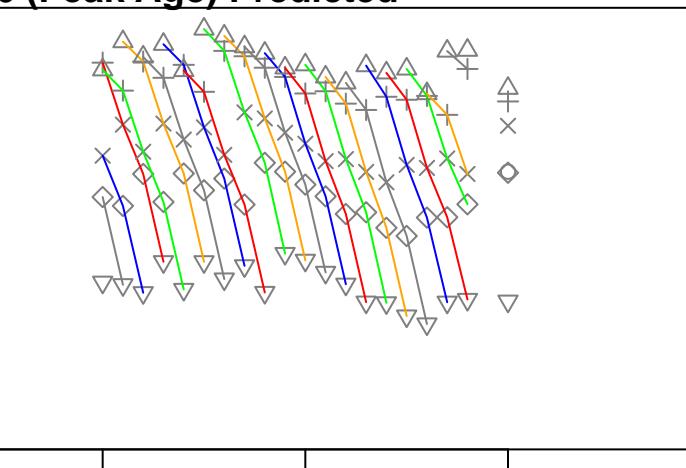
1980 1990 2000 2010 2020

Z

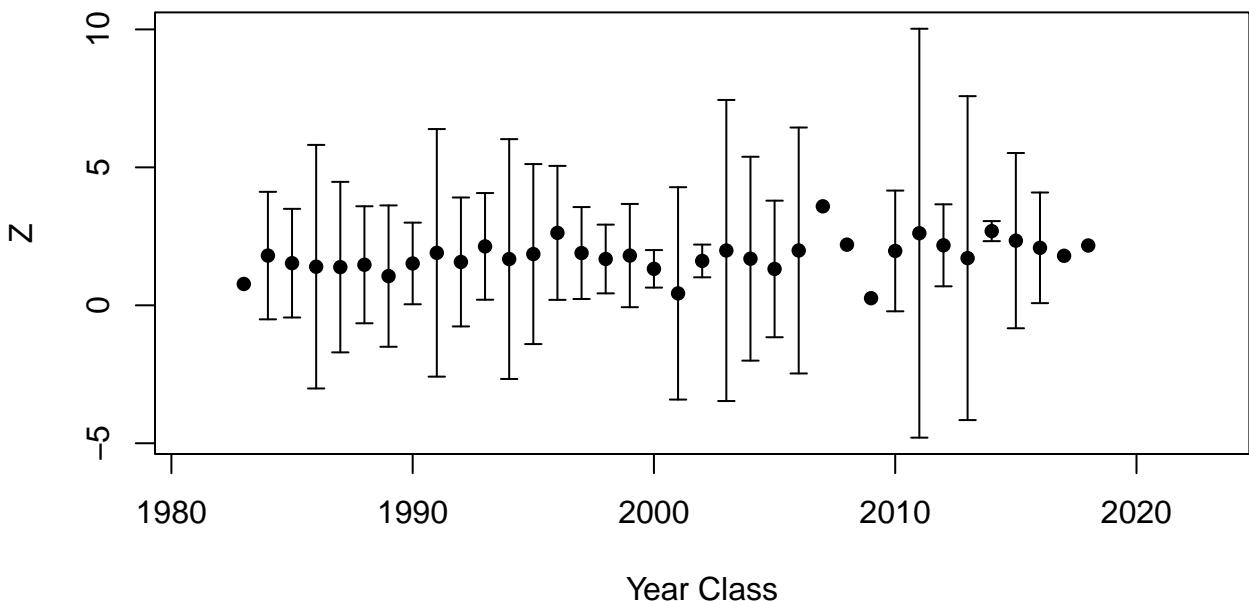
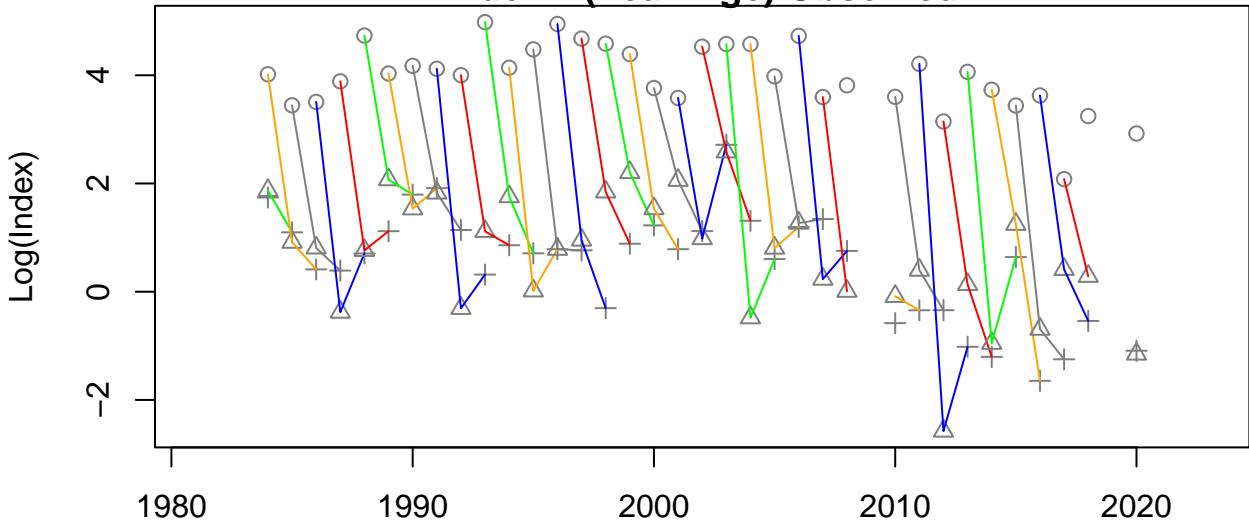
2  
1  
0  
-1

1980 1990 2000 2010 2020

Year Class



### Index 7 (Peak Age) Observed



## Index 7 (Peak Age) Predicted

Log(Index)

4  
2  
0  
-2

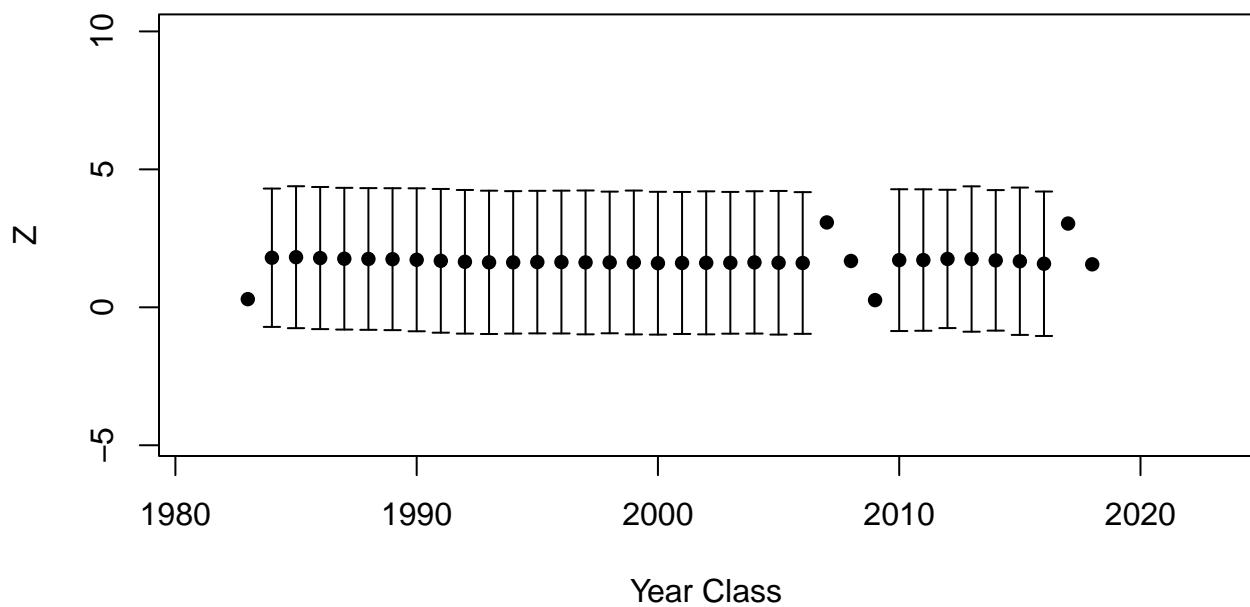
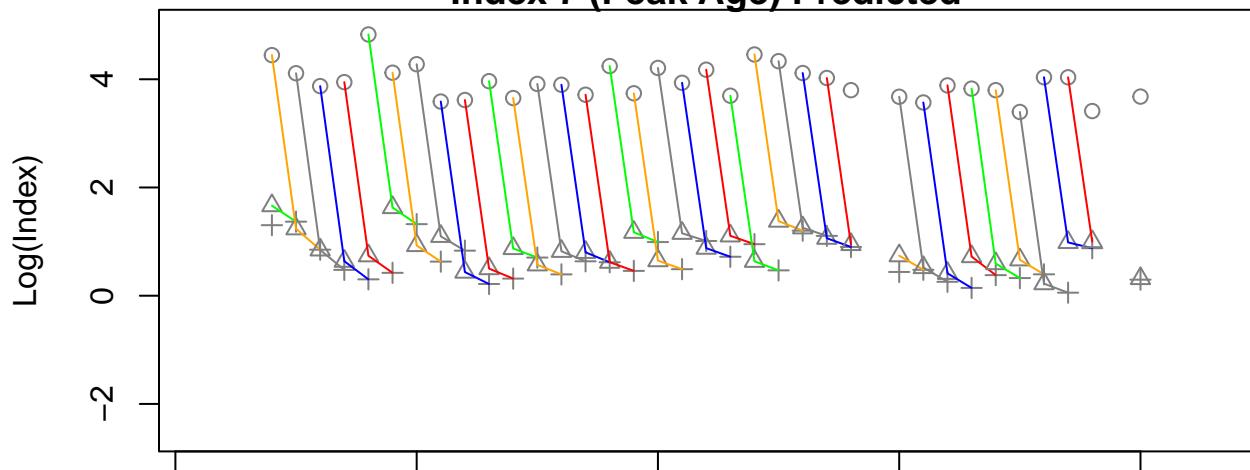
1980 1990 2000 2010 2020

Z

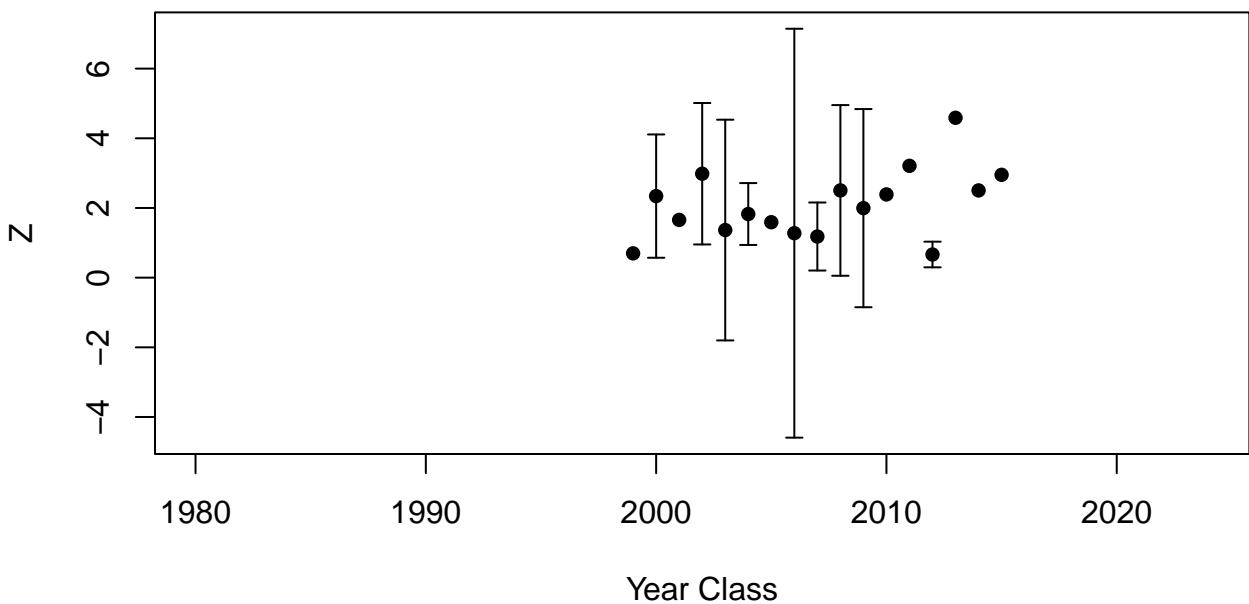
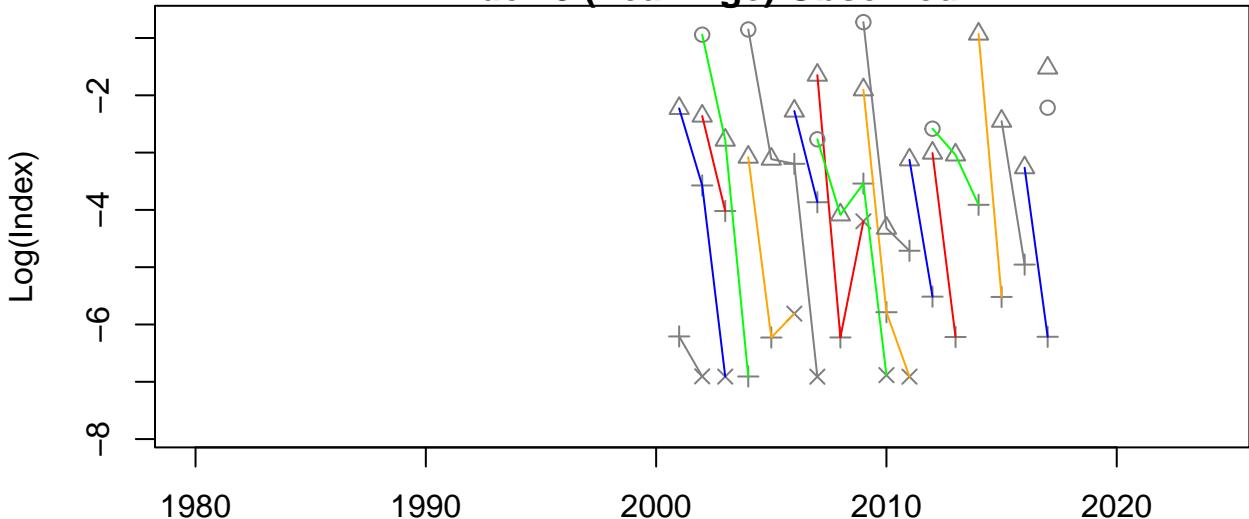
10  
5  
0  
-5

1980 1990 2000 2010 2020

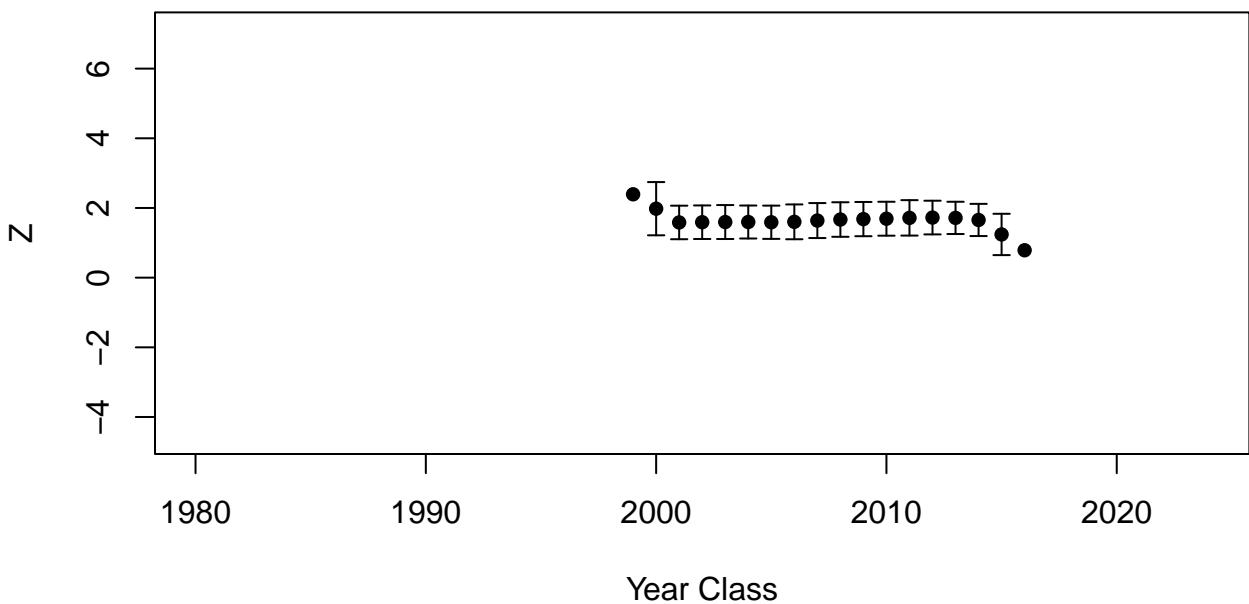
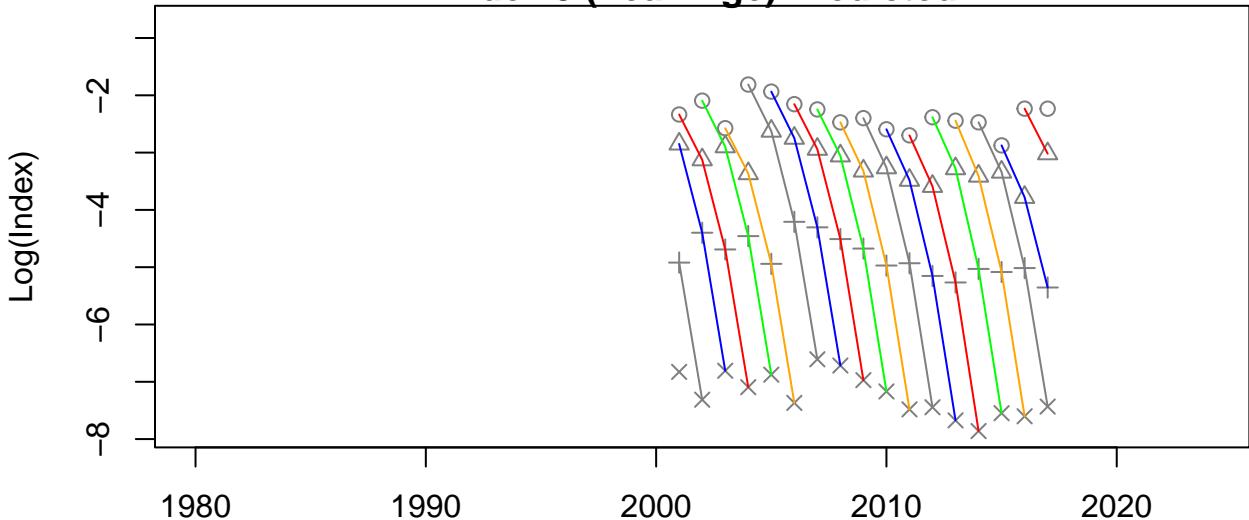
Year Class



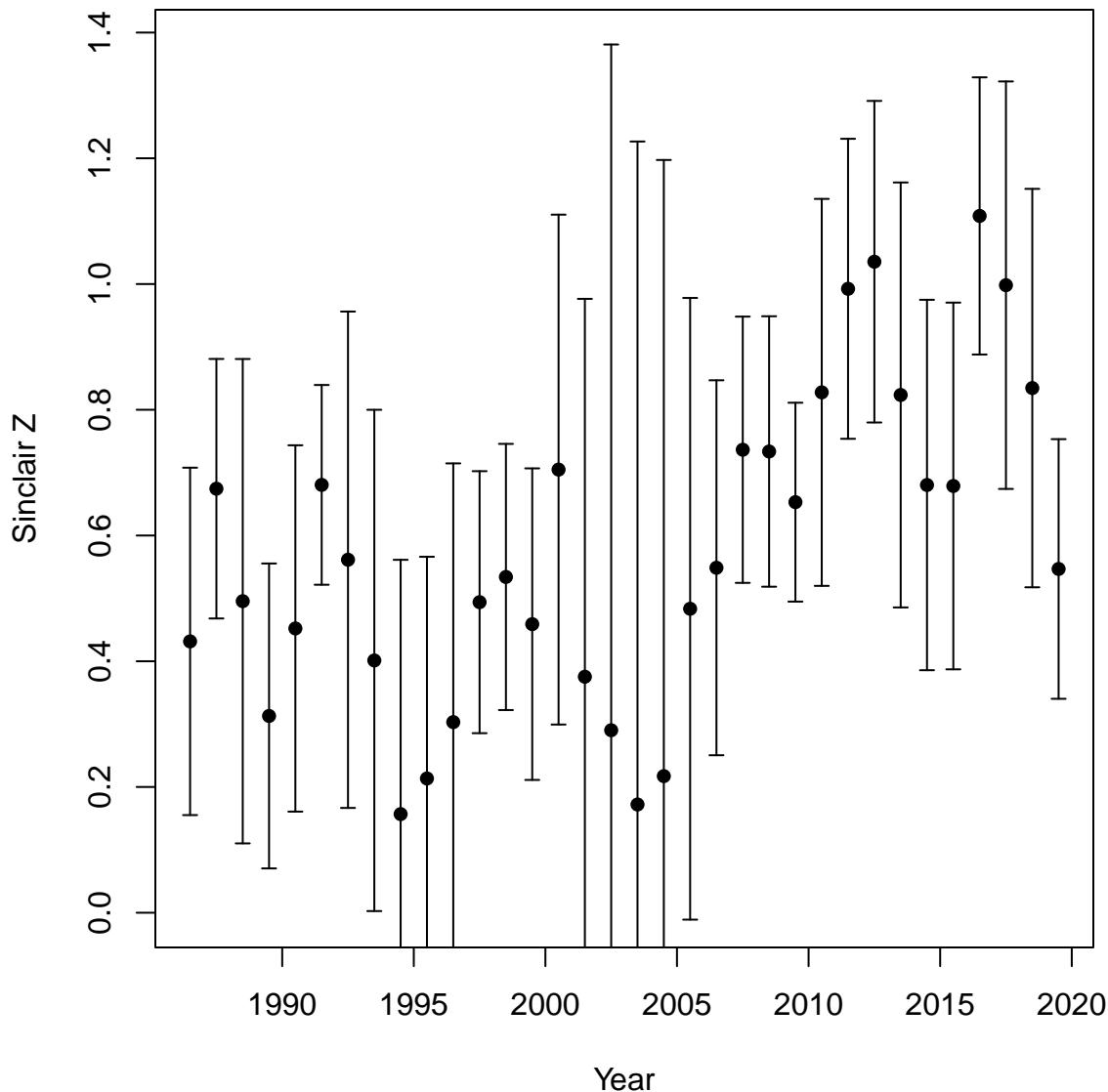
### Index 9 (Peak Age) Observed



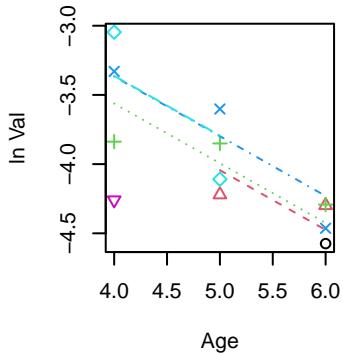
## Index 9 (Peak Age) Predicted



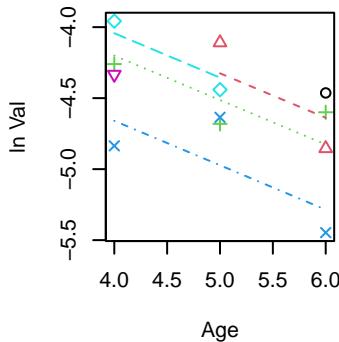
## MRIP



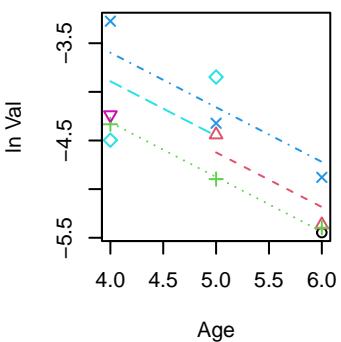
**Years 1985 to 1988**  
 $Z = 0.432$



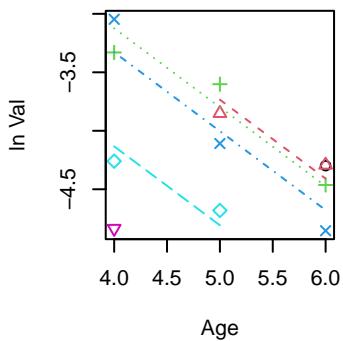
**Years 1988 to 1991**  
 $Z = 0.313$



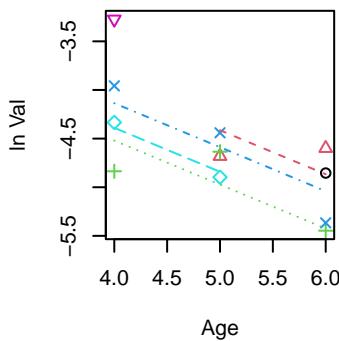
**Years 1991 to 1994**  
 $Z = 0.561$



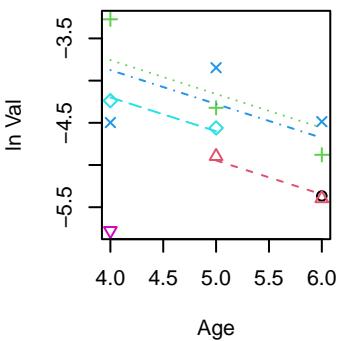
**Years 1986 to 1989**  
 $Z = 0.674$



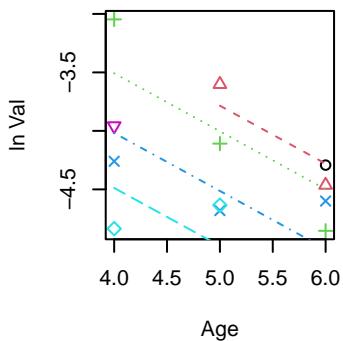
**Years 1989 to 1992**  
 $Z = 0.452$



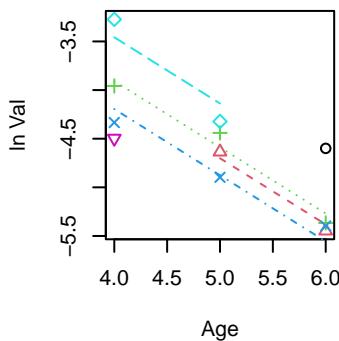
**Years 1992 to 1995**  
 $Z = 0.401$



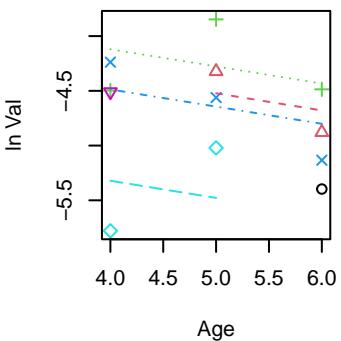
**Years 1987 to 1990**  
 $Z = 0.496$



**Years 1990 to 1993**  
 $Z = 0.681$

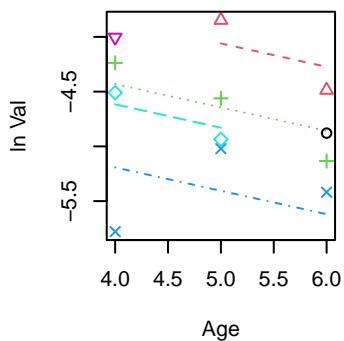


**Years 1993 to 1996**  
 $Z = 0.157$



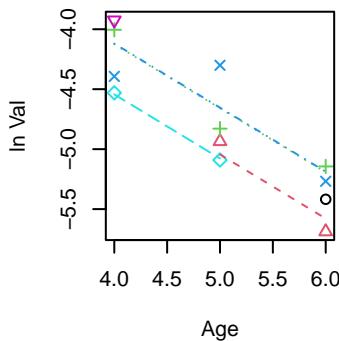
**Years 1994 to 1997**

$$Z = 0.214$$



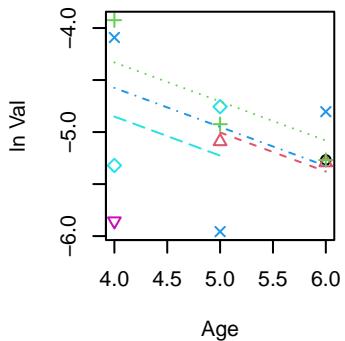
**Years 1997 to 2000**

$$Z = 0.534$$



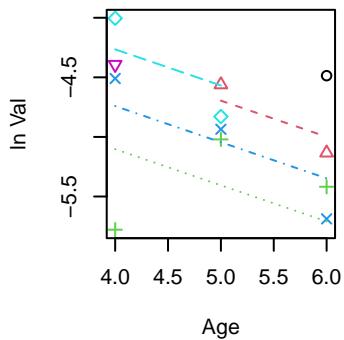
**Years 2000 to 2003**

$$Z = 0.375$$



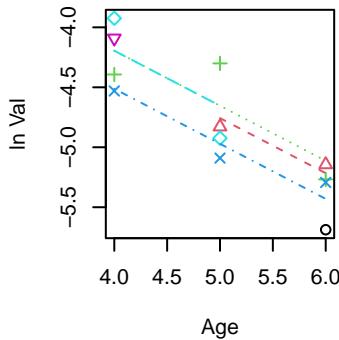
**Years 1995 to 1998**

$$Z = 0.303$$



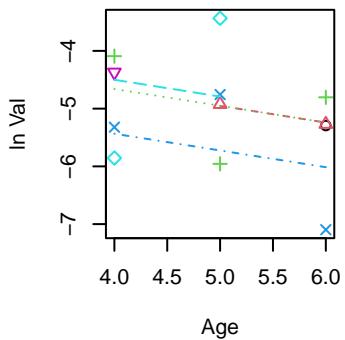
**Years 1998 to 2001**

$$Z = 0.459$$



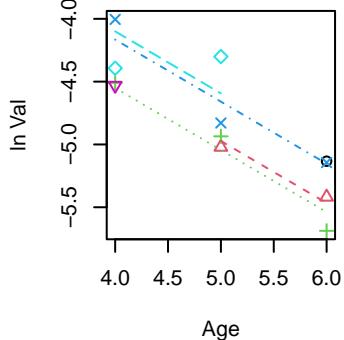
**Years 2001 to 2004**

$$Z = 0.29$$



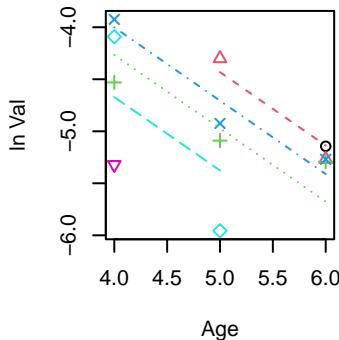
**Years 1996 to 1999**

$$Z = 0.494$$



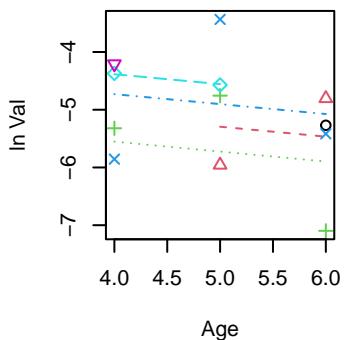
**Years 1999 to 2002**

$$Z = 0.705$$



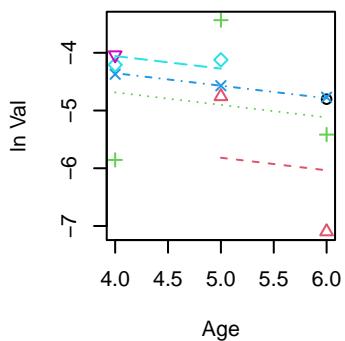
**Years 2002 to 2005**

$$Z = 0.172$$



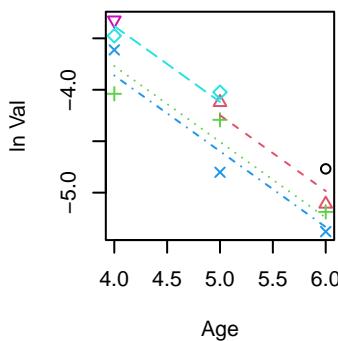
**Years 2003 to 2006**

$$Z = 0.217$$



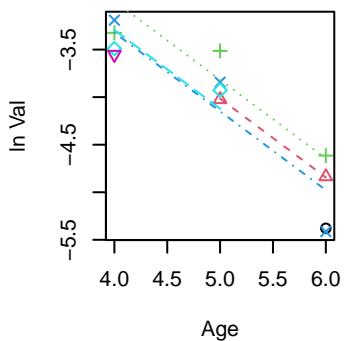
**Years 2006 to 2009**

$$Z = 0.736$$



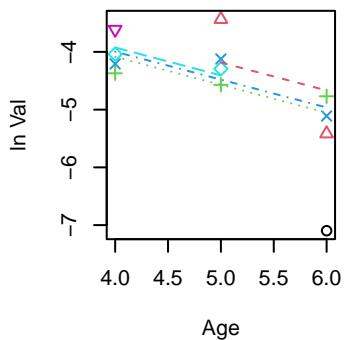
**Years 2009 to 2012**

$$Z = 0.828$$



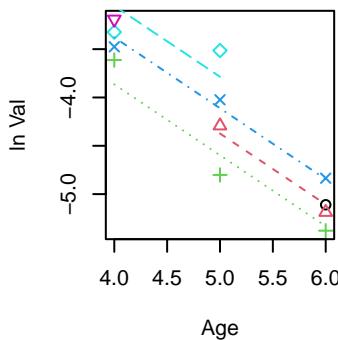
**Years 2004 to 2007**

$$Z = 0.483$$



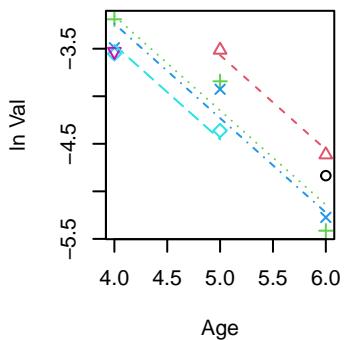
**Years 2007 to 2010**

$$Z = 0.734$$



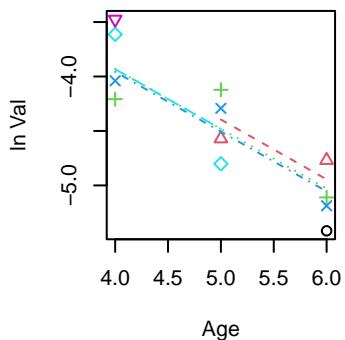
**Years 2010 to 2013**

$$Z = 0.992$$



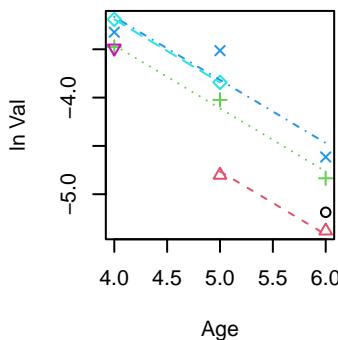
**Years 2005 to 2008**

$$Z = 0.549$$



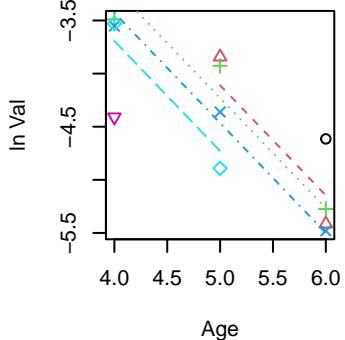
**Years 2008 to 2011**

$$Z = 0.653$$

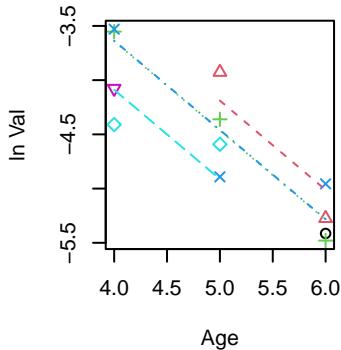


**Years 2011 to 2014**

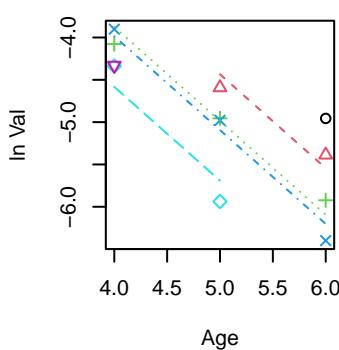
$$Z = 1.036$$



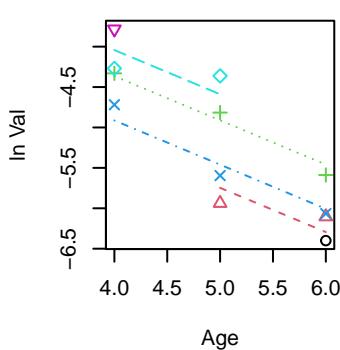
**Years 2012 to 2015**  
 $Z = 0.824$



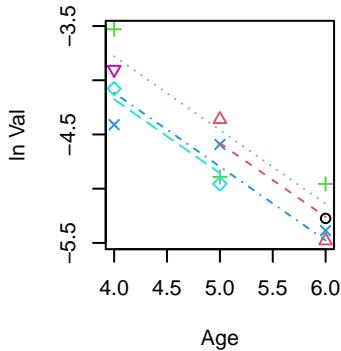
**Years 2015 to 2018**  
 $Z = 1.108$



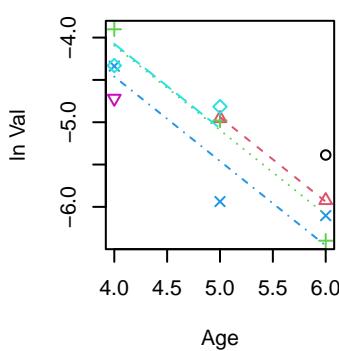
**Years 2018 to 2021**  
 $Z = 0.547$



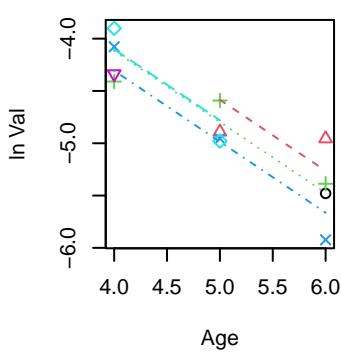
**Years 2013 to 2016**  
 $Z = 0.68$



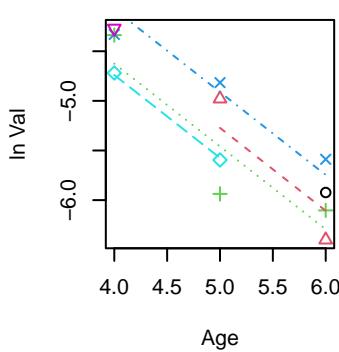
**Years 2016 to 2019**  
 $Z = 0.998$



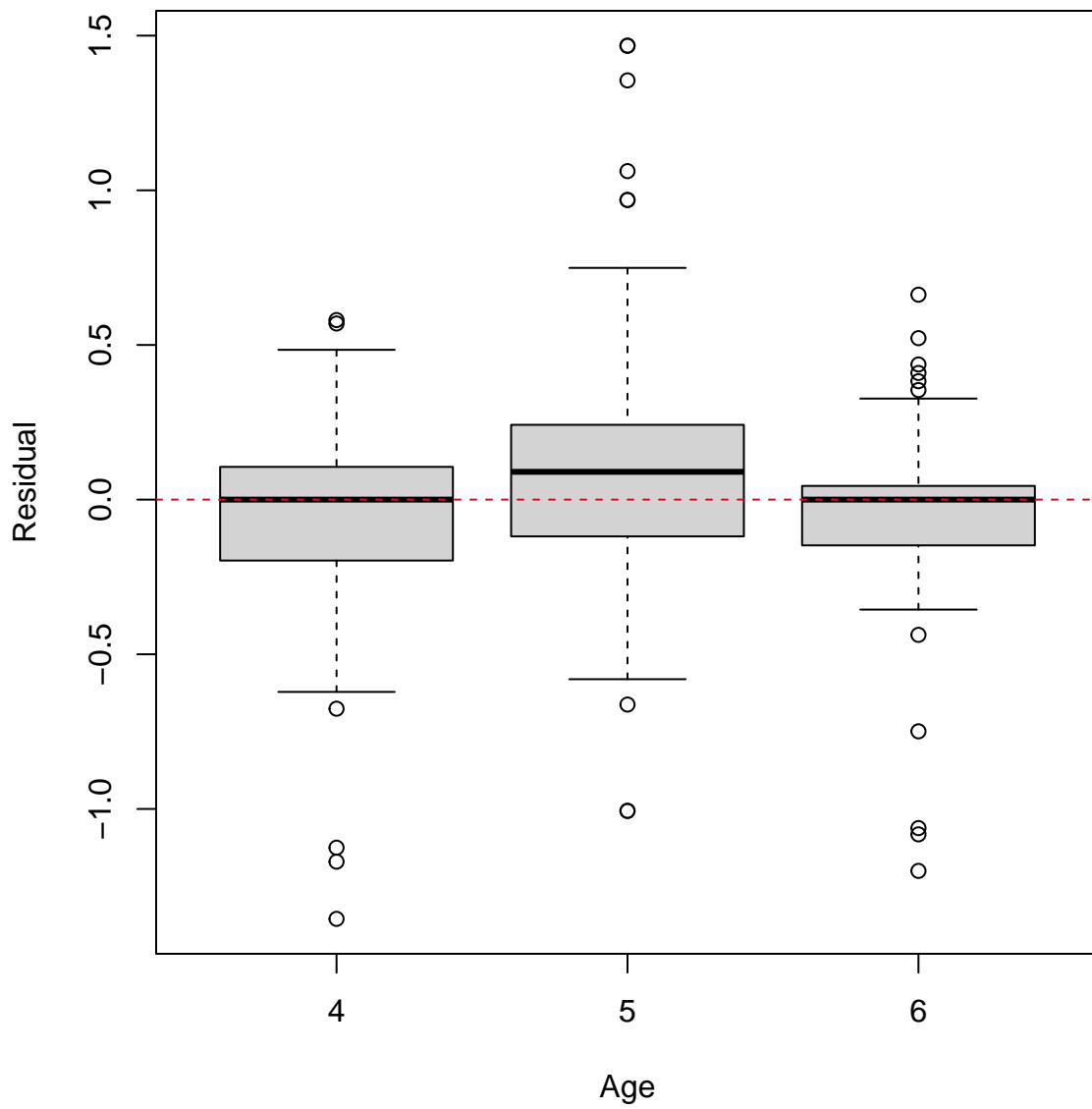
**Years 2014 to 2017**  
 $Z = 0.679$



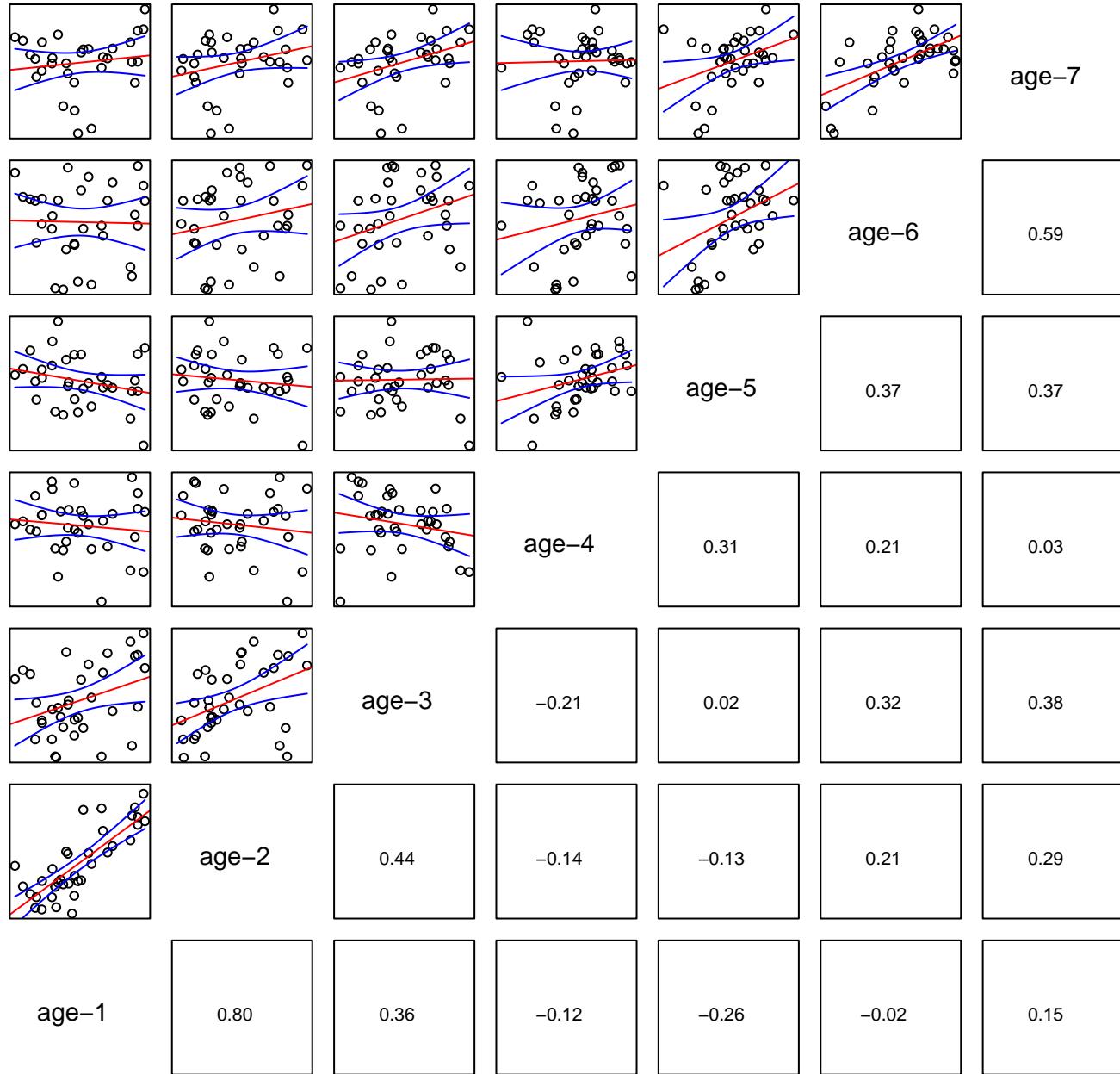
**Years 2017 to 2020**  
 $Z = 0.835$



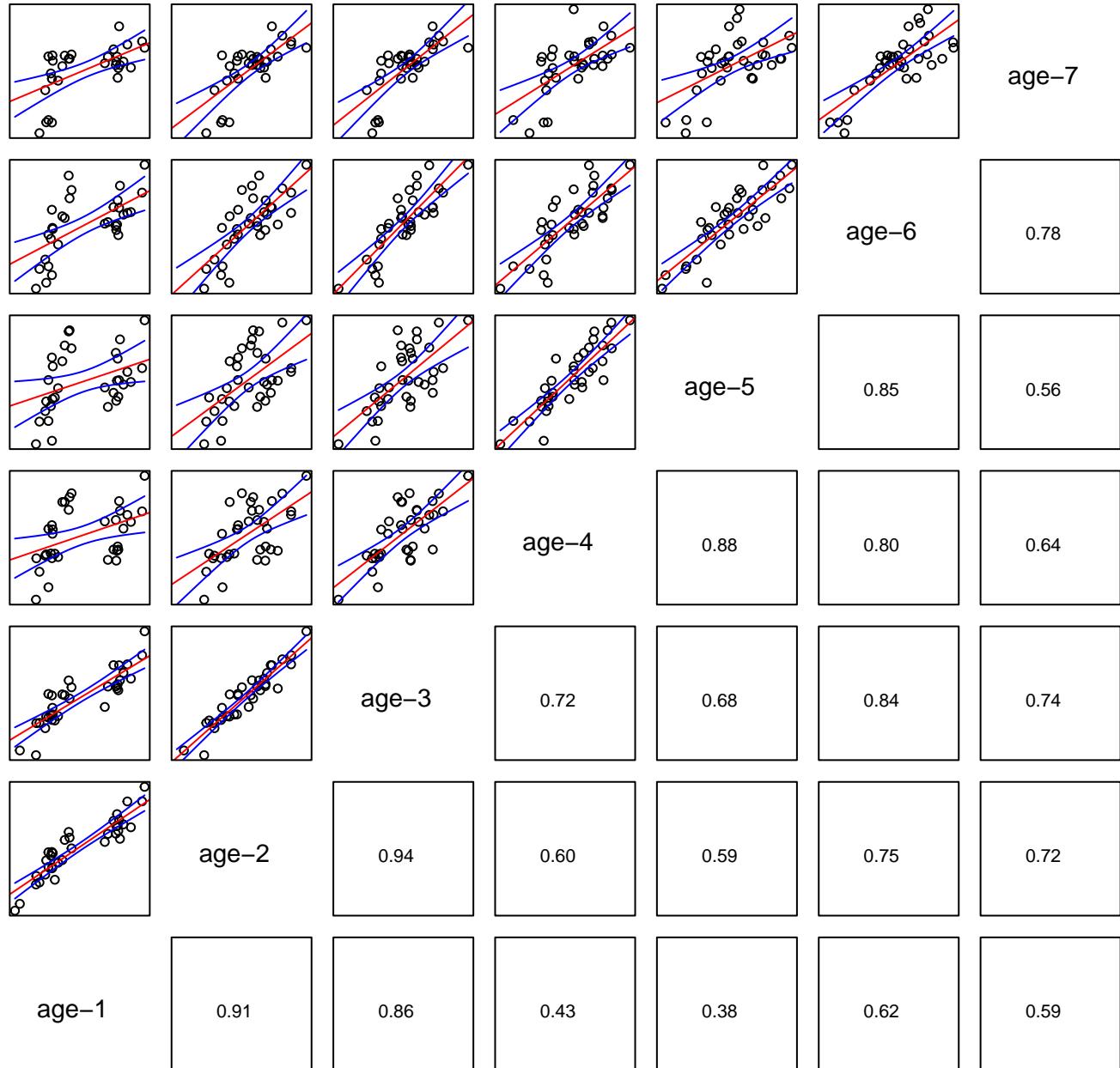
## MRIP



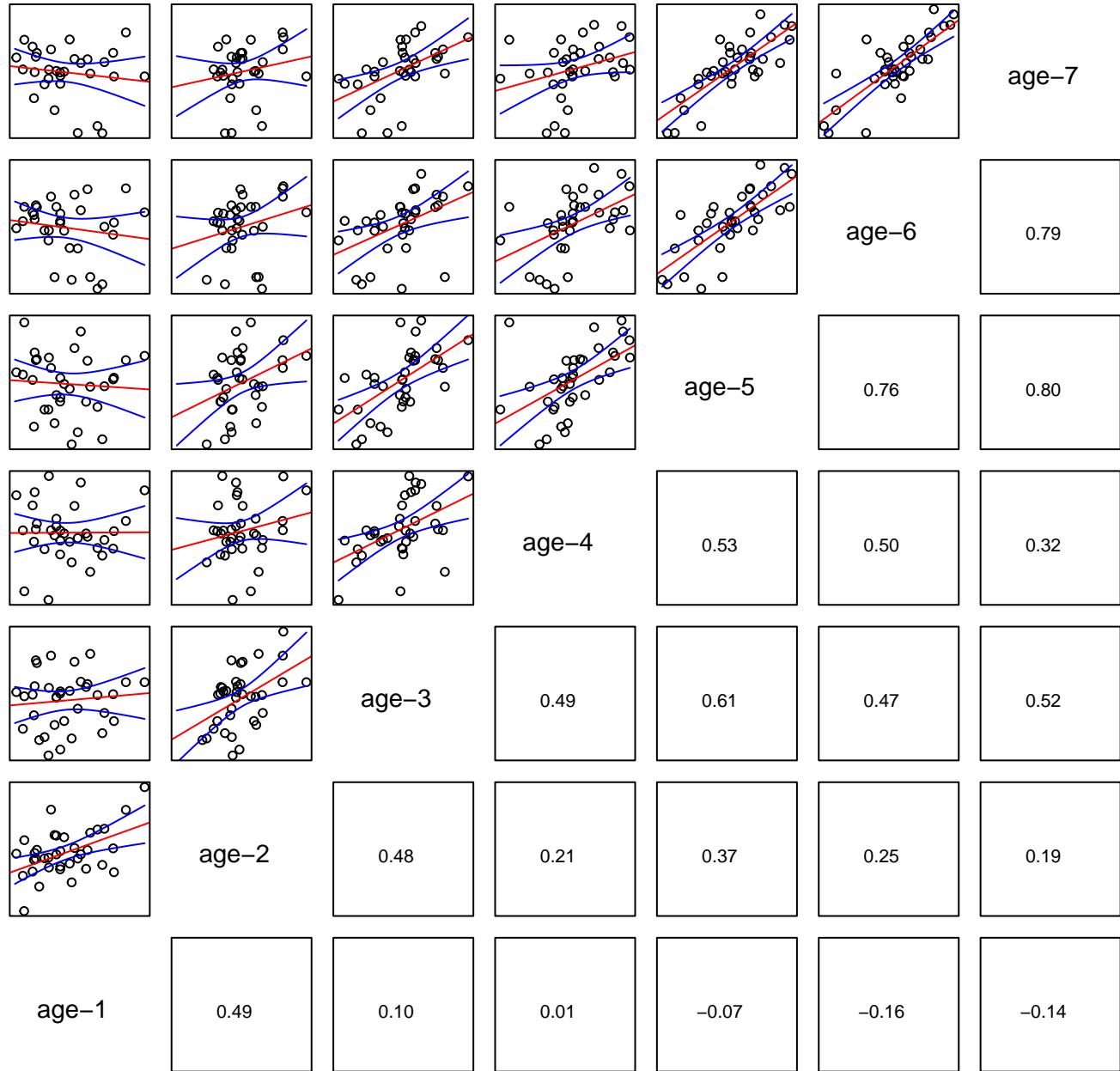
### Catch for Fleet 1 (Comm) Observed



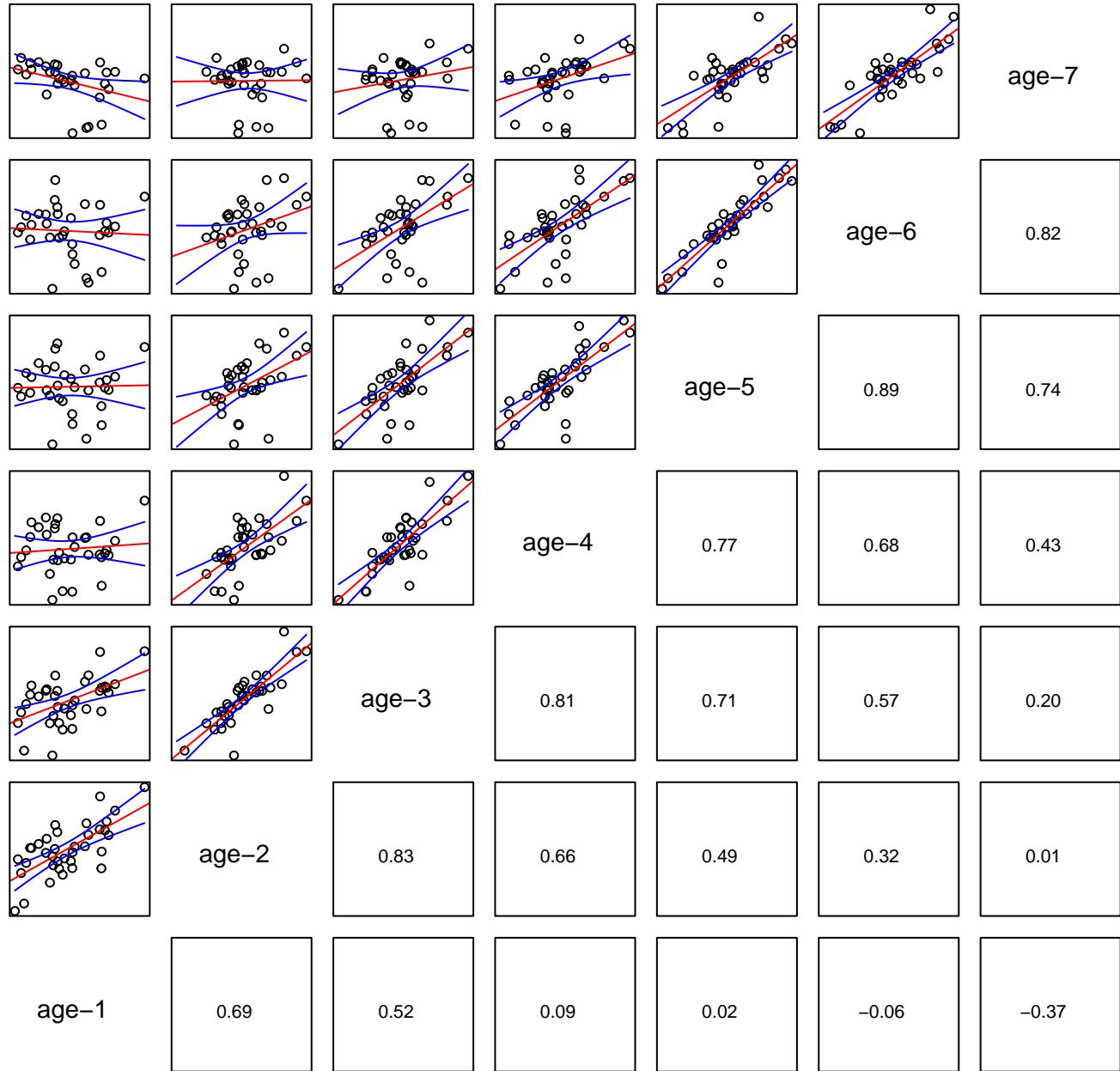
### Catch for Fleet 1 (Comm) Predicted



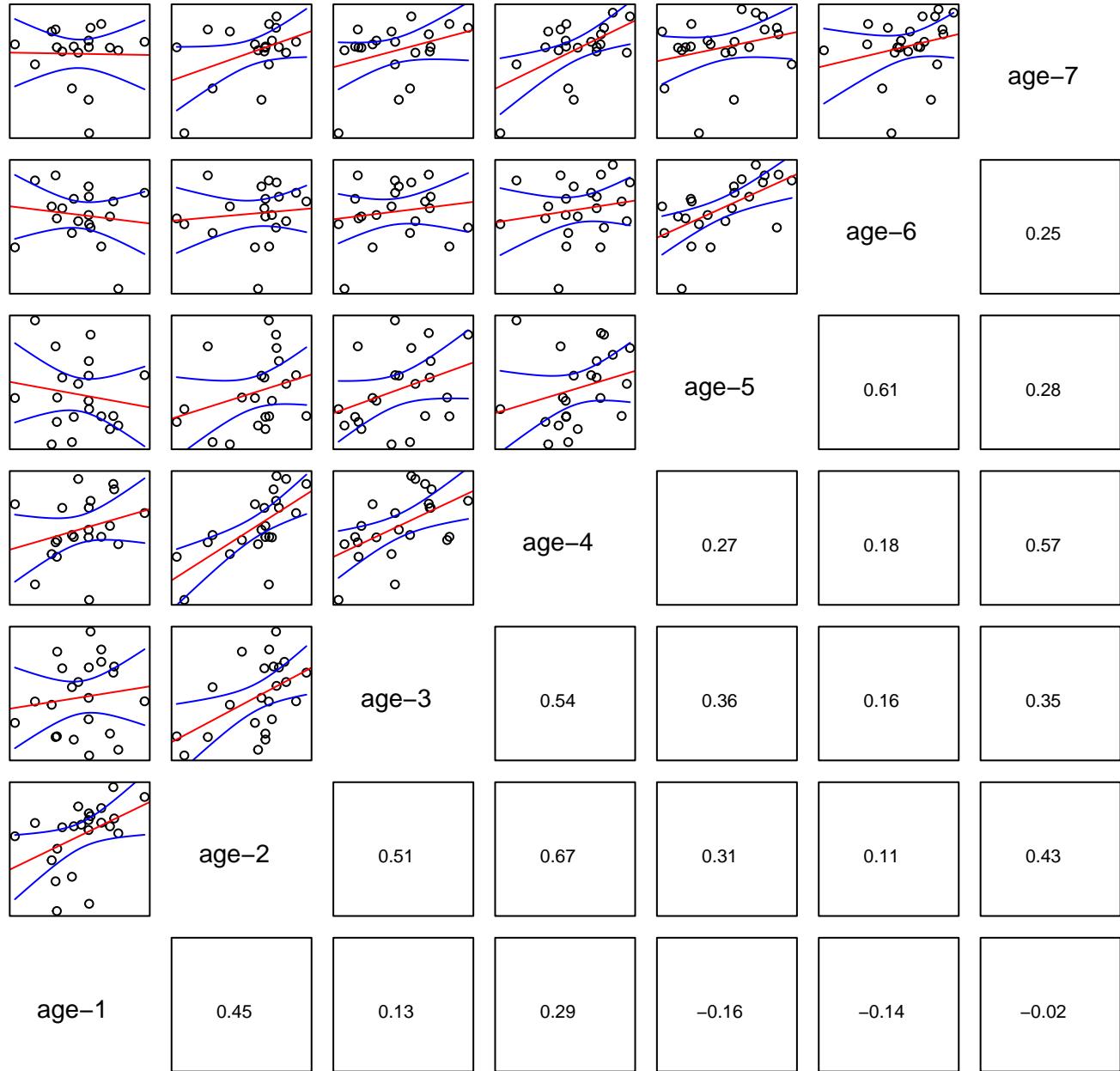
### Catch for Fleet 2 (Rec) Observed



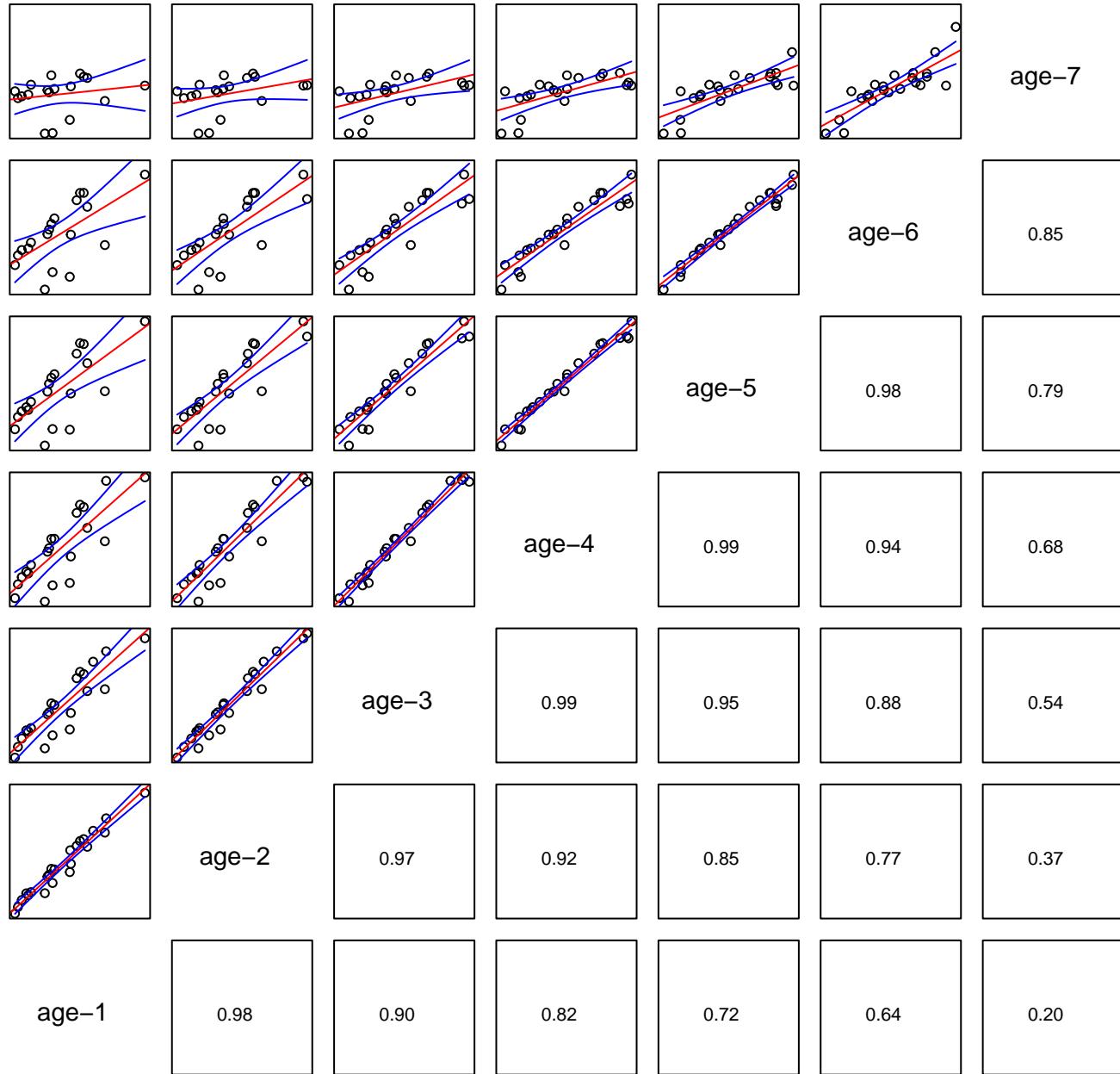
## Catch for Fleet 2 (Rec) Predicted



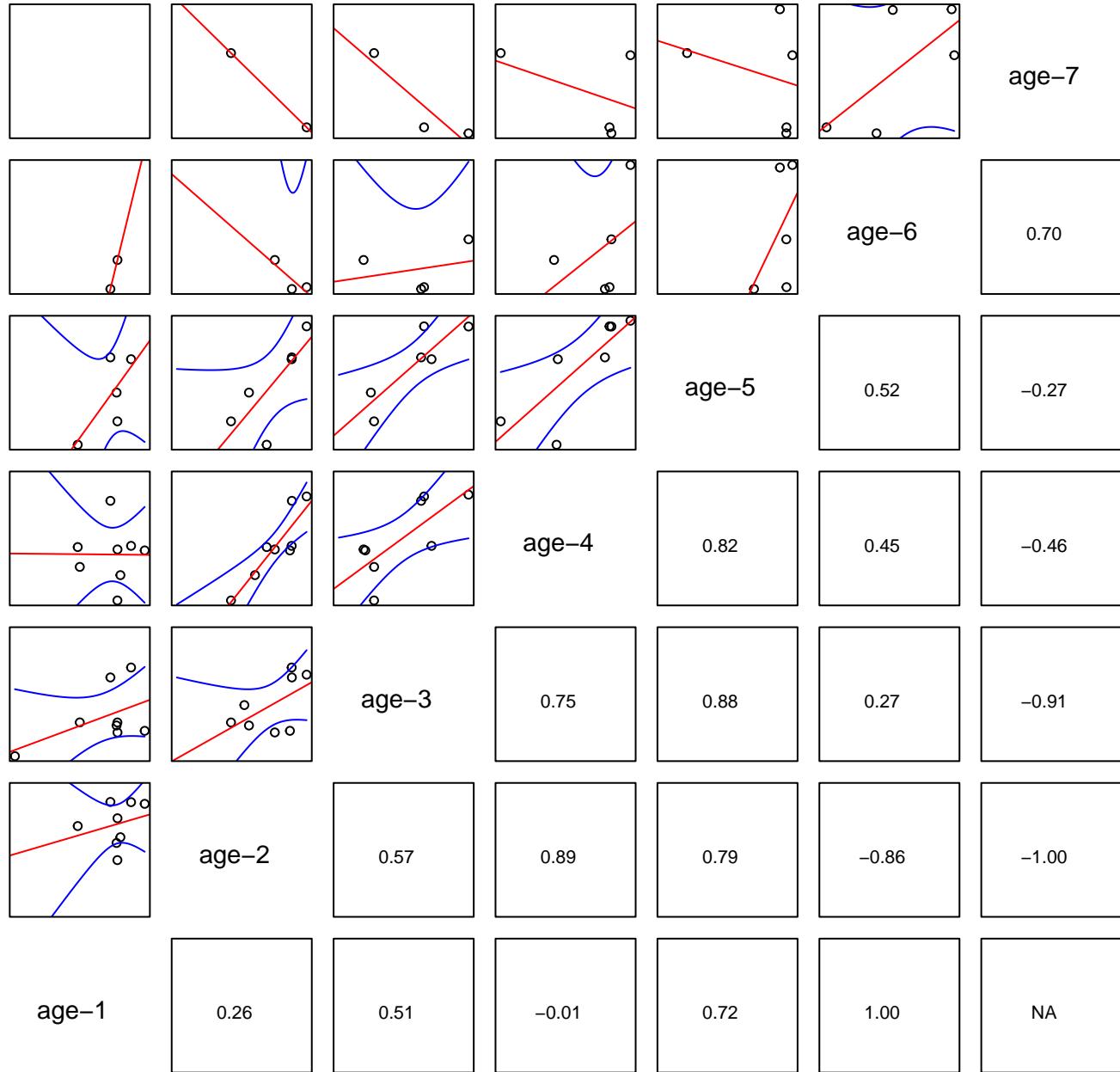
### Index 1 (NEFSC Inshore) Observed



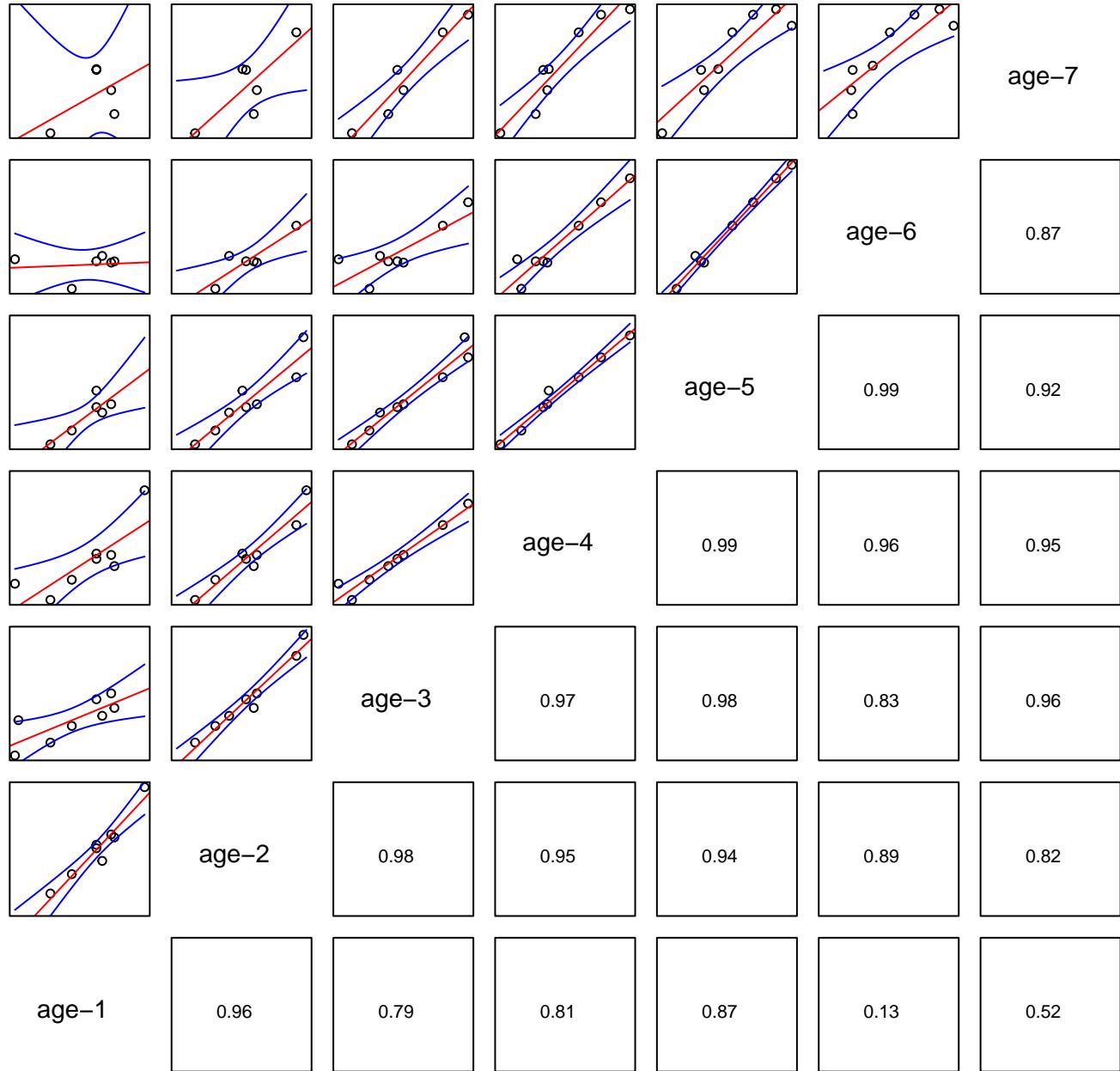
# Index 1 (NEFSC Inshore) Predicted



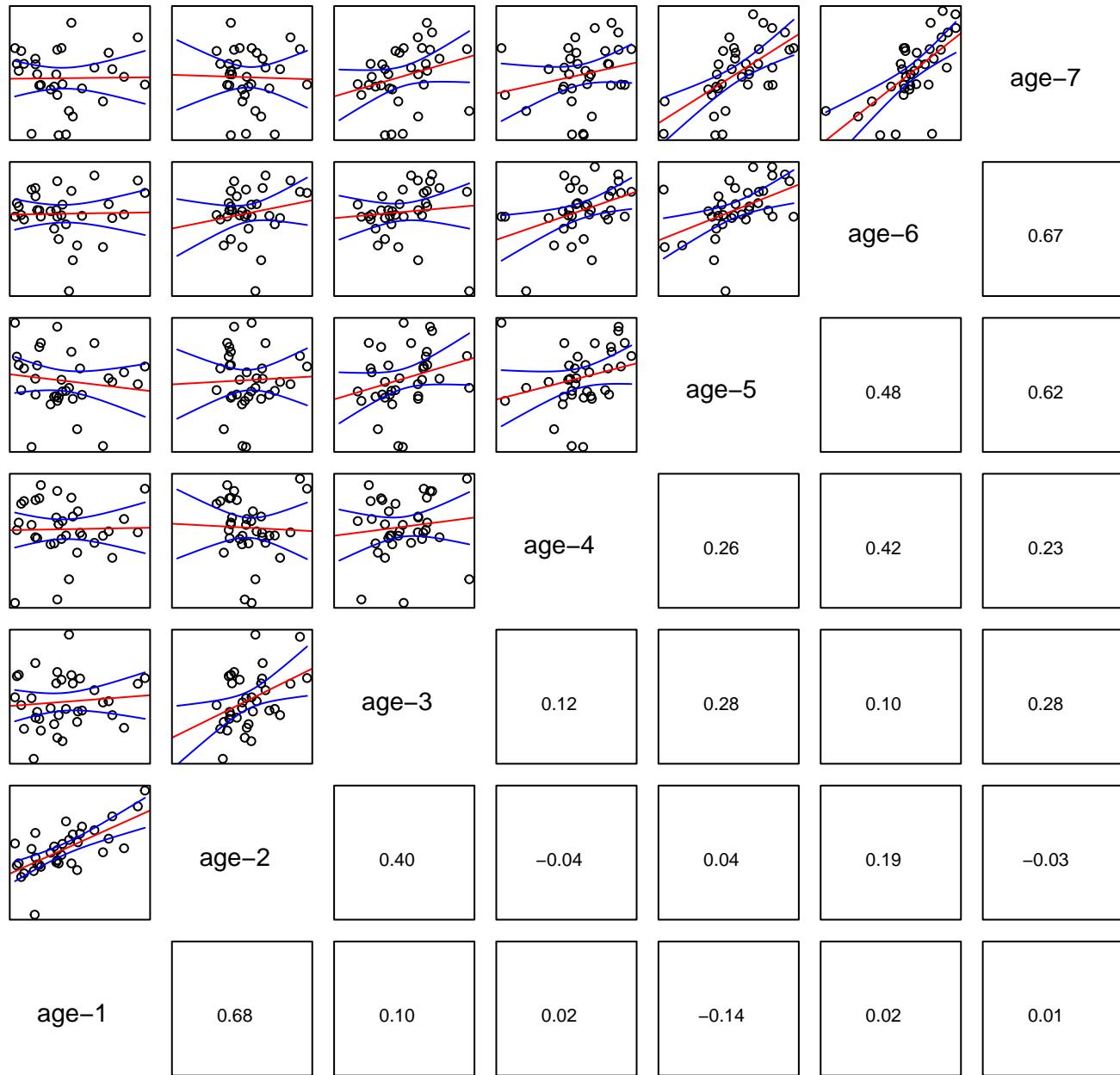
## Index 2 (Bigelow) Observed



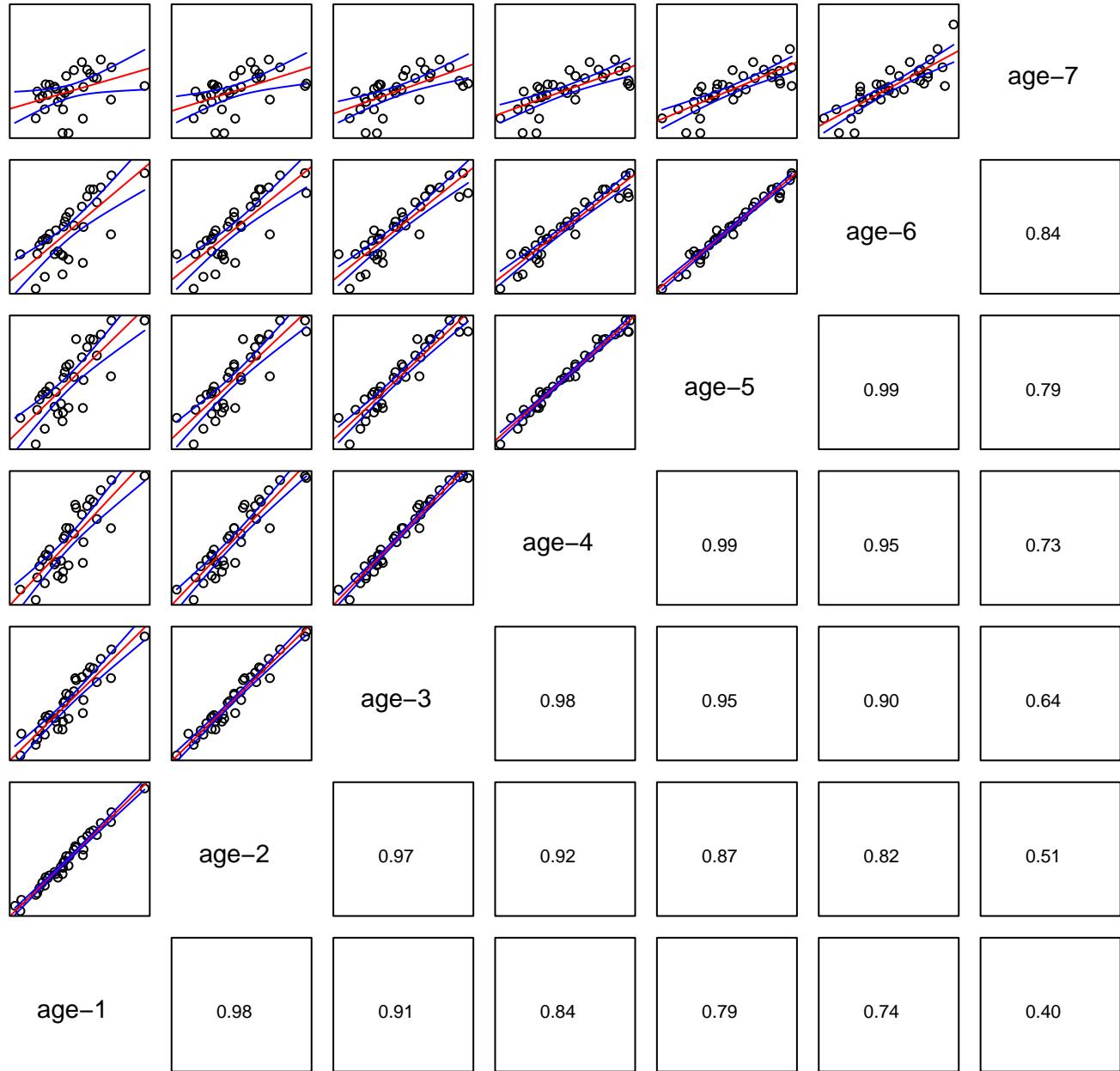
## Index 2 (Bigelow) Predicted



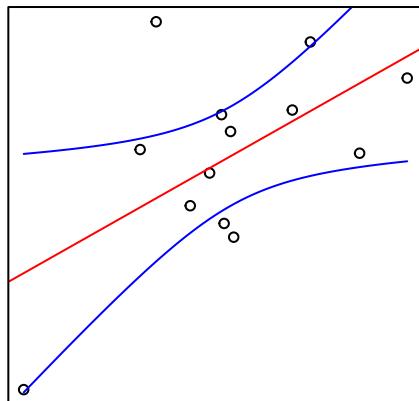
### Index 3 (MRIP) Observed



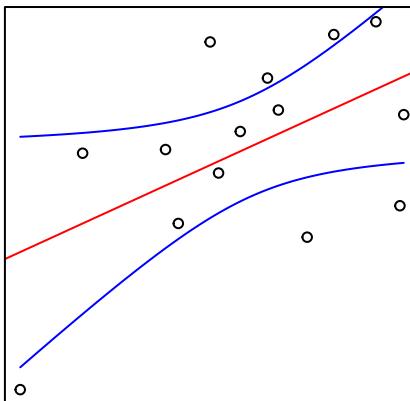
### Index 3 (MRIP) Predicted



### Index 4 (NEAMAP) Observed

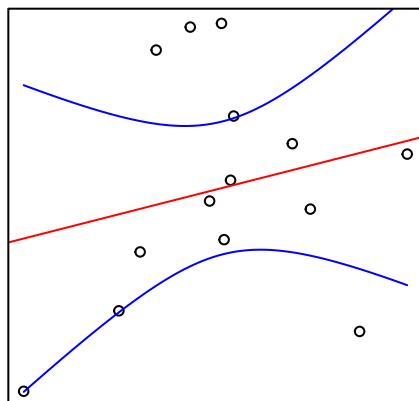


age-1

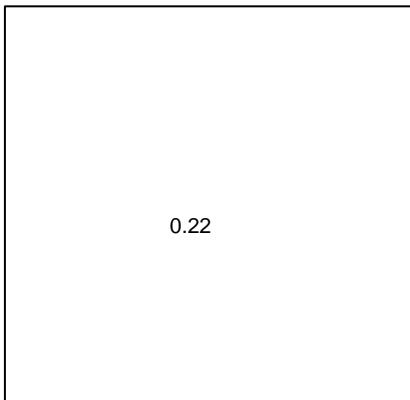


age-2

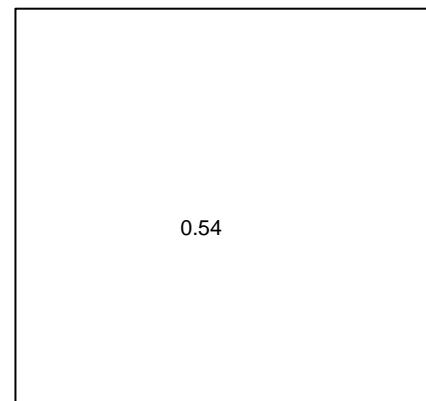
0.54



0.22



0.58



### Index 4 (NEAMAP) Predicted

age-1

0.98

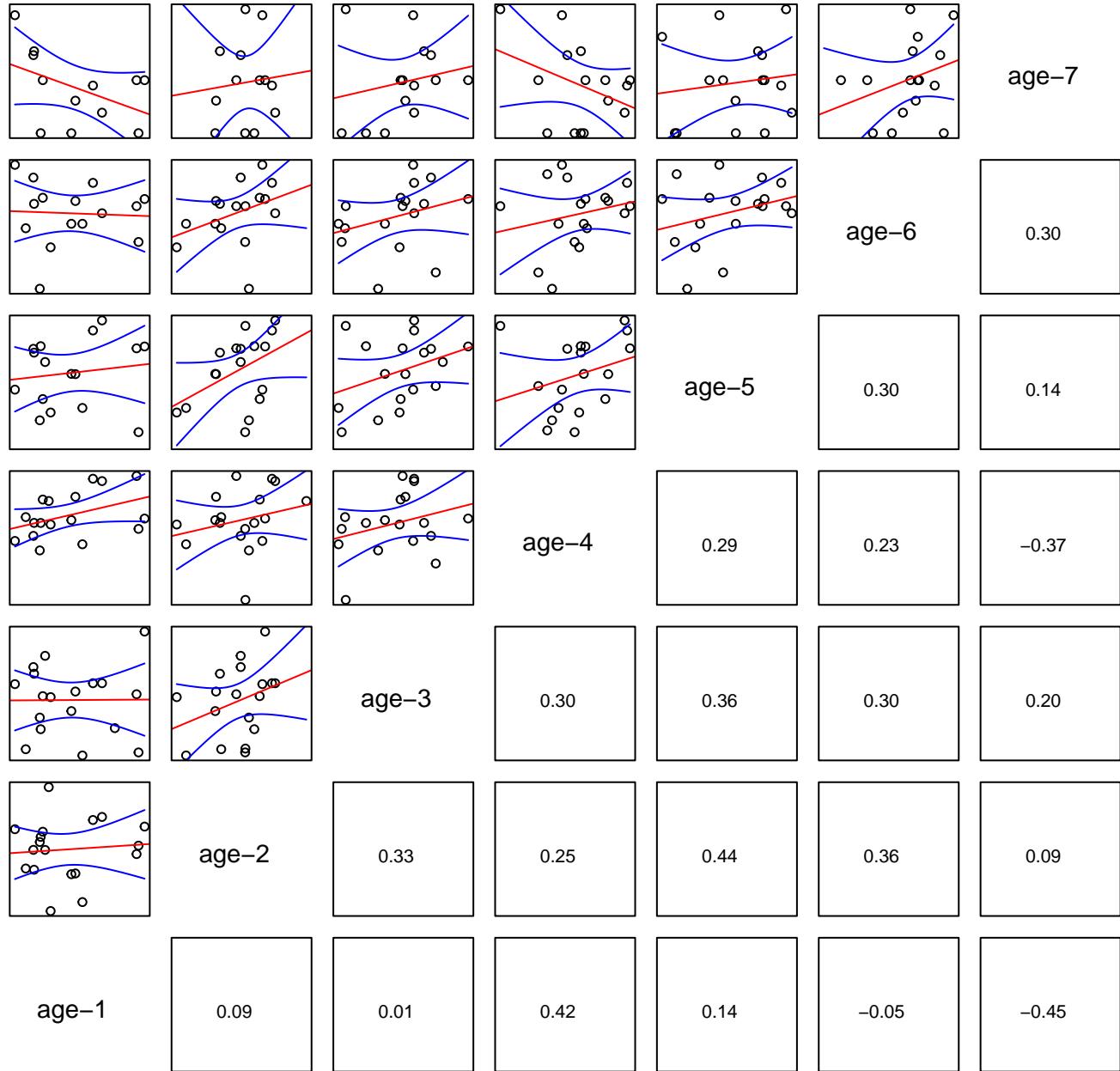
0.90

age-2

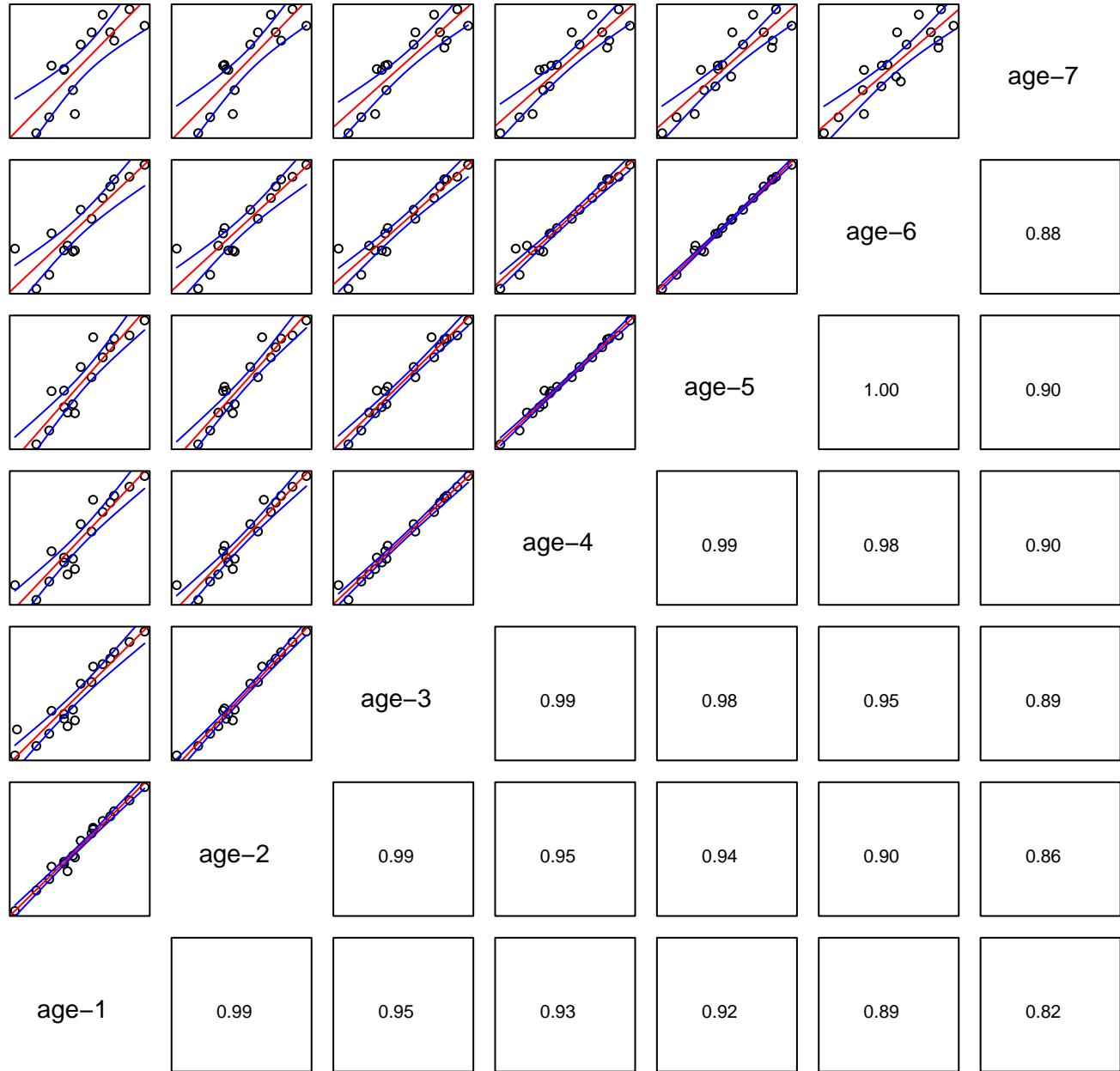
0.97

age-3

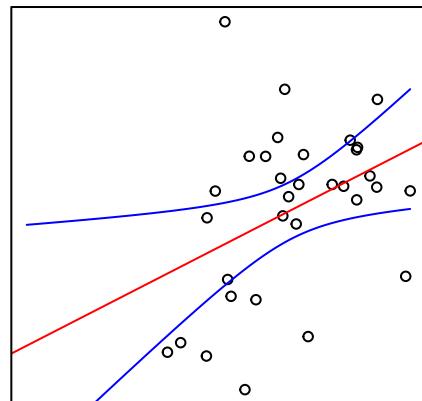
### Index 6 (PSIGN) Observed



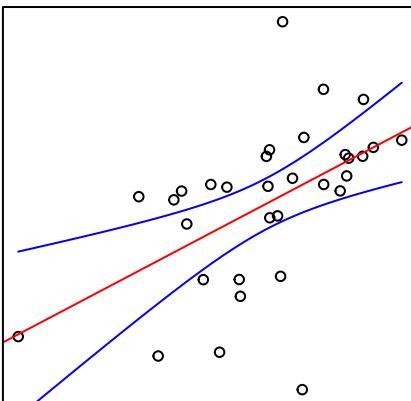
### Index 6 (PSIGN) Predicted



### Index 7 (CT Trawl) Observed

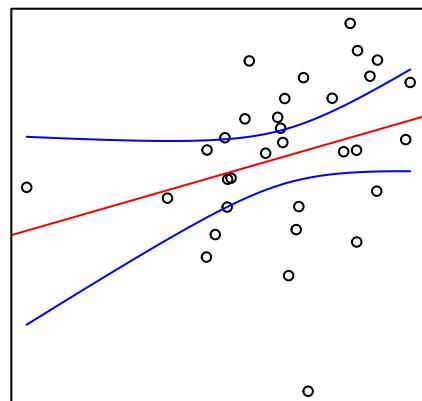


age-1

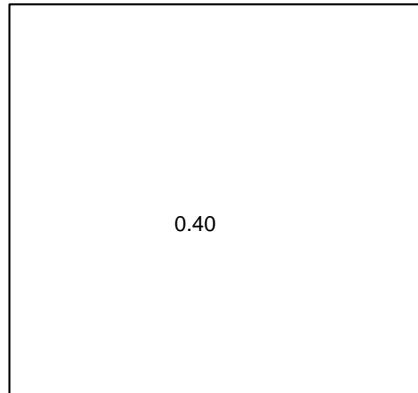
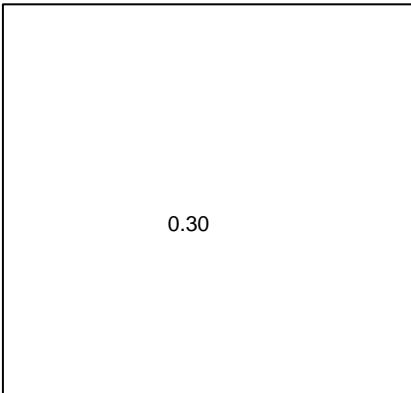


age-2

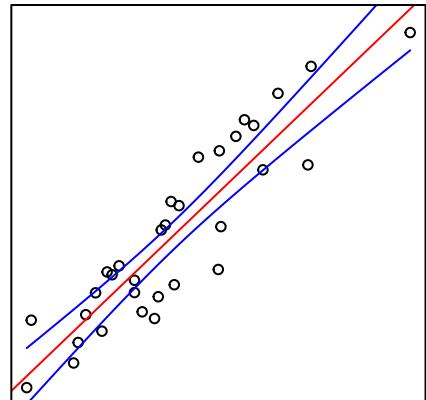
0.53



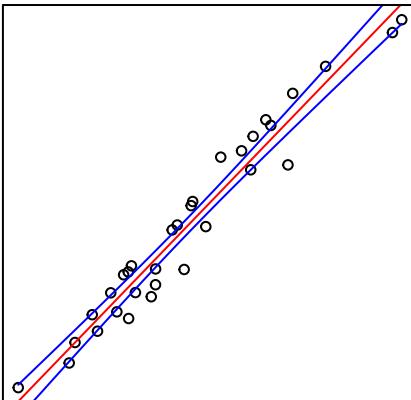
0.40



### Index 7 (CT Trawl) Predicted

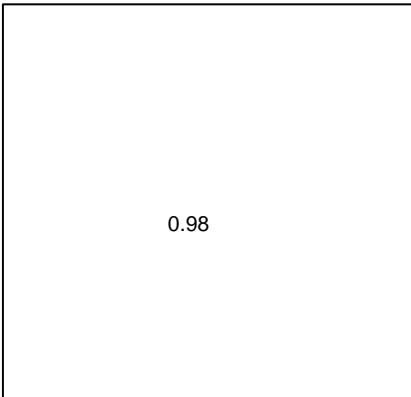
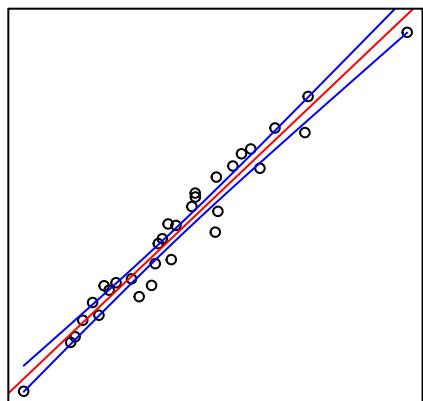


age-1

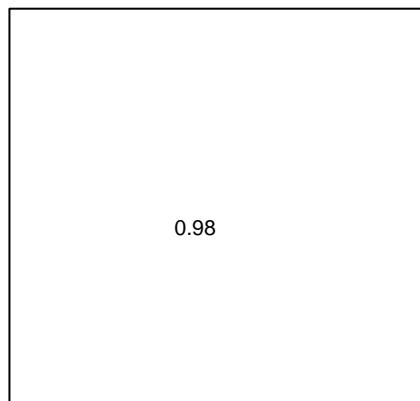


age-2

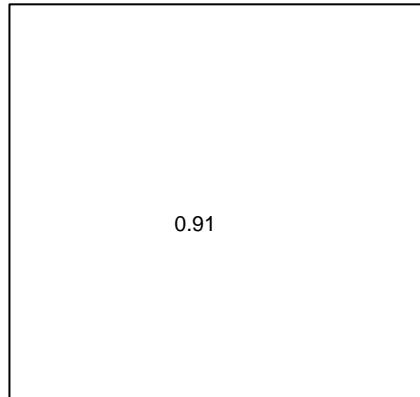
0.98



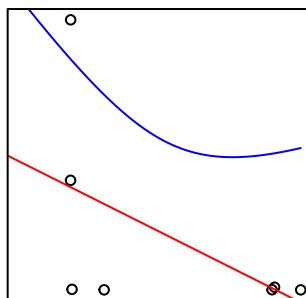
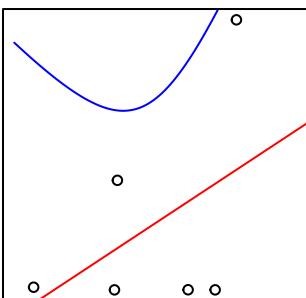
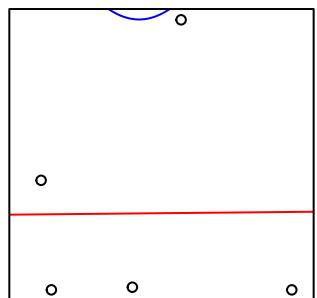
0.98



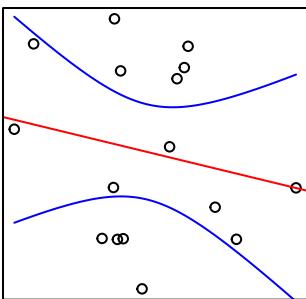
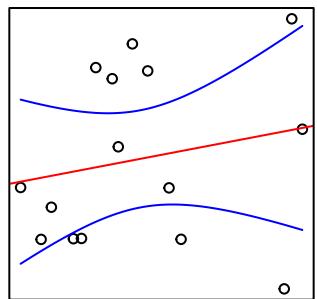
0.91



### Index 9 (ChesMMAP) Observed

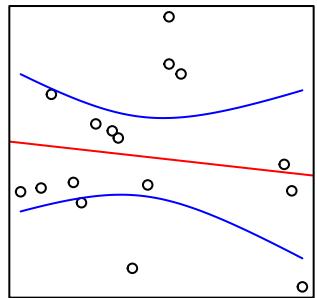


age-4

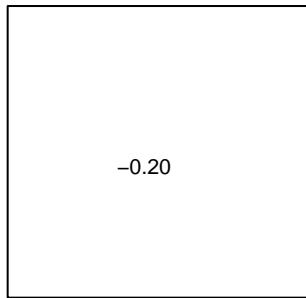


age-3

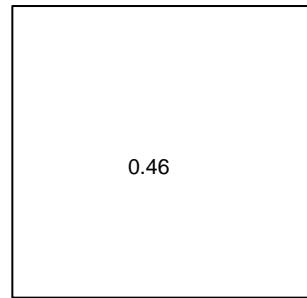
-0.53



age-2

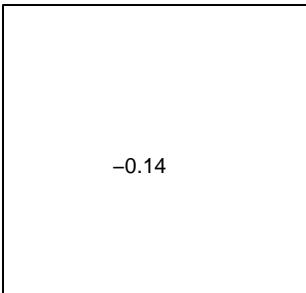


-0.20

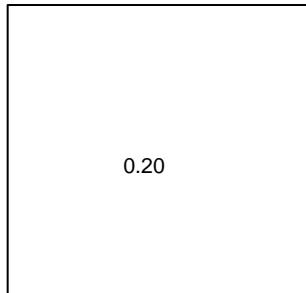


0.46

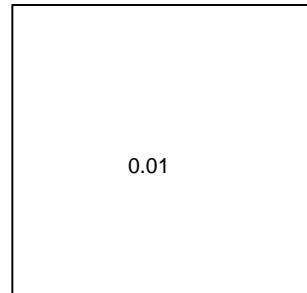
age-1



-0.14

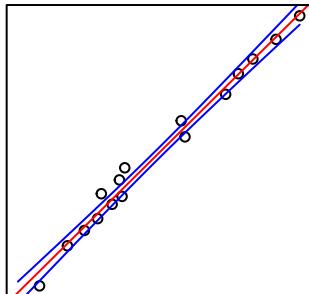
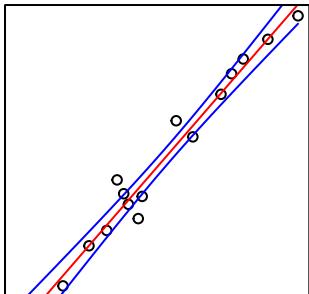
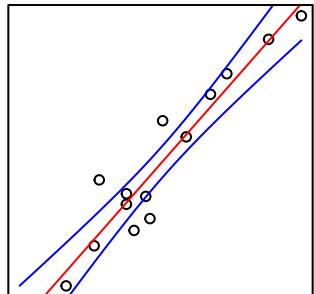


0.20

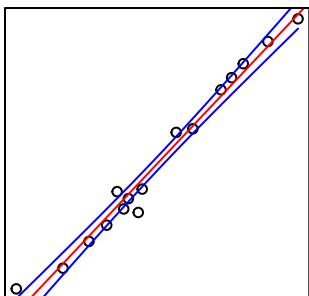
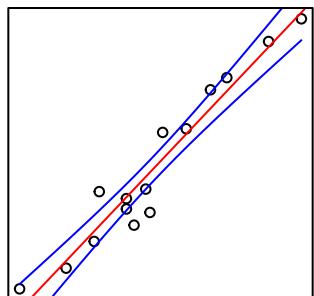


0.01

### Index 9 (ChesMMAP) Predicted

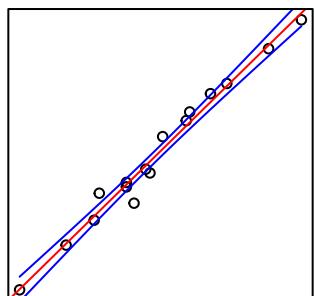


age-4

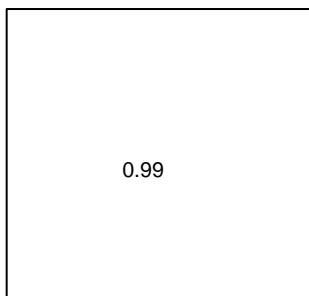


age-3

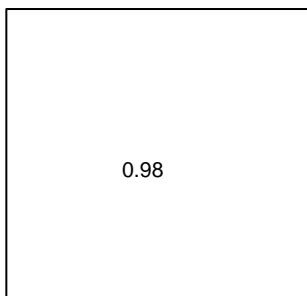
0.99



age-2

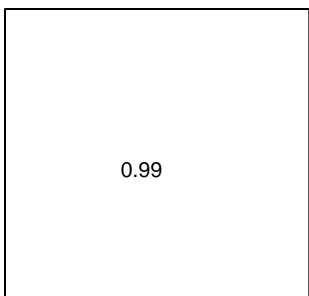


0.99

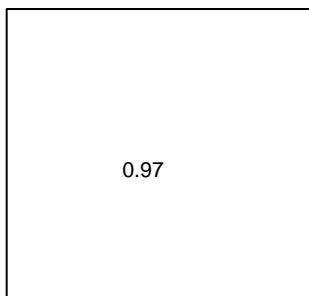


0.98

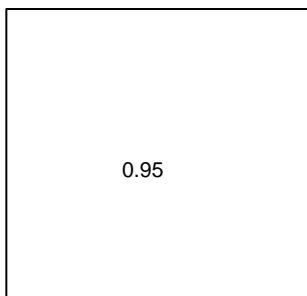
age-1



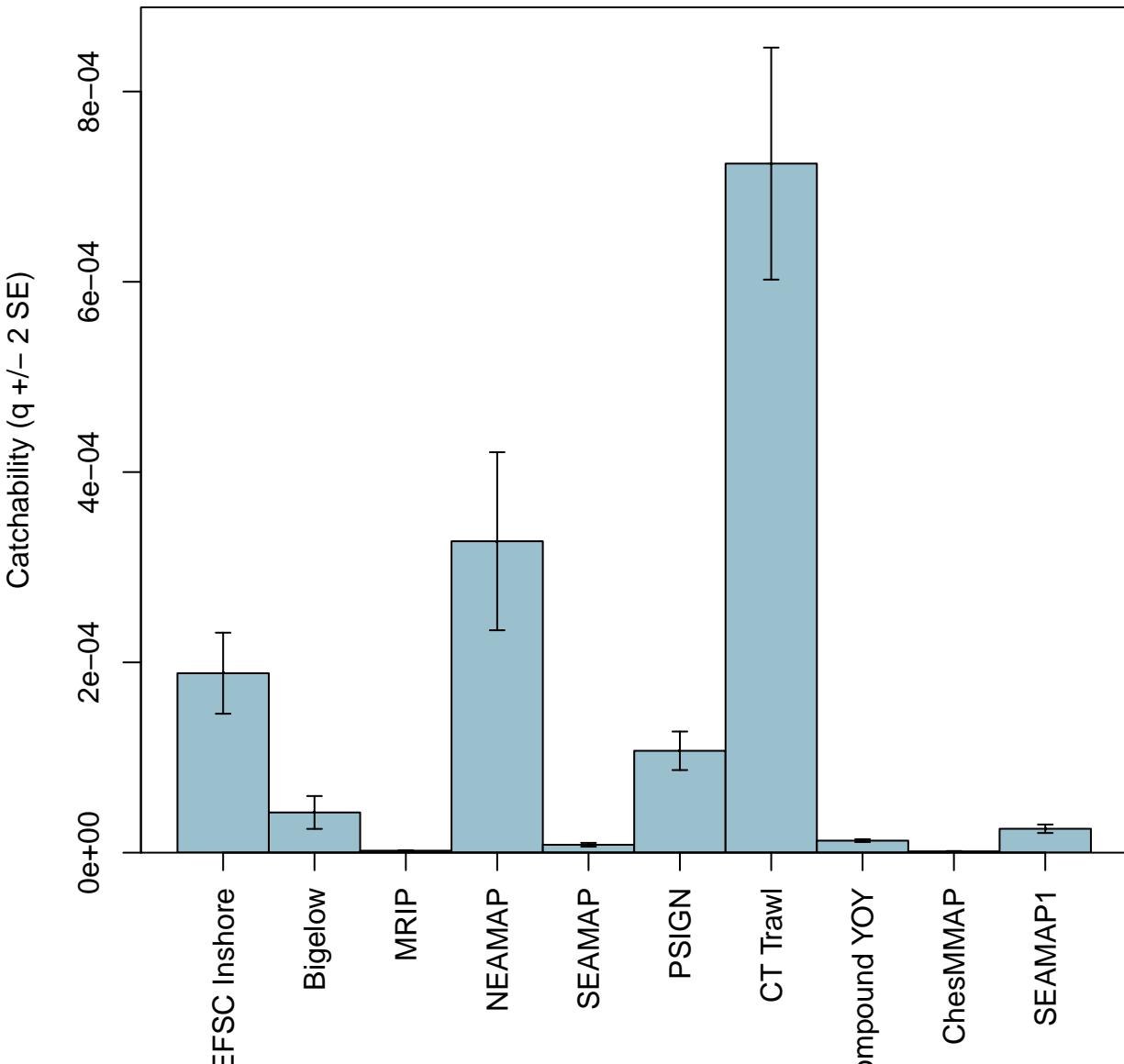
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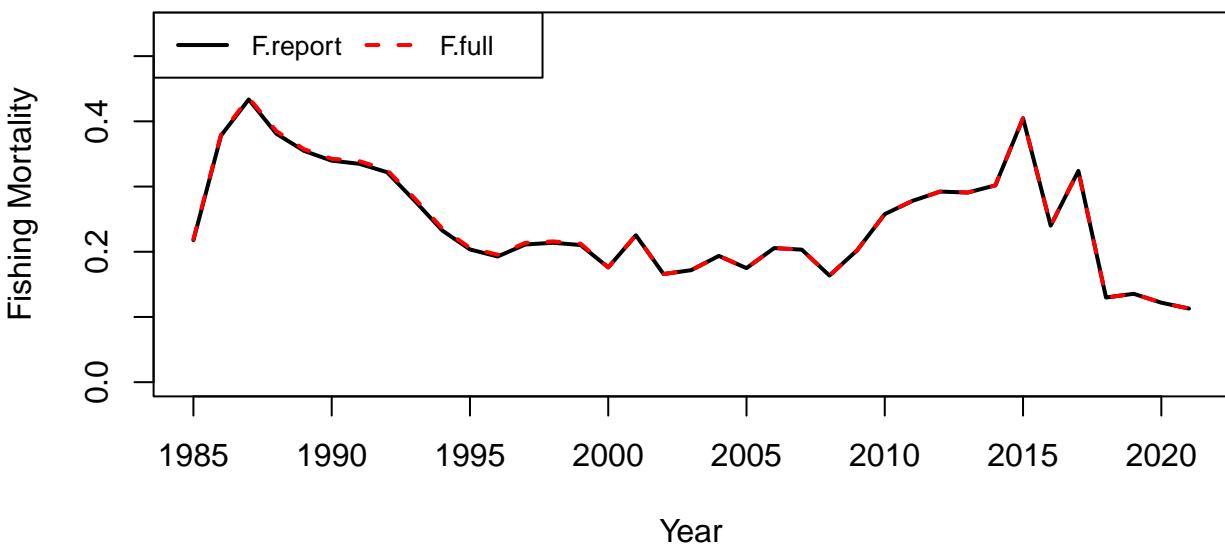
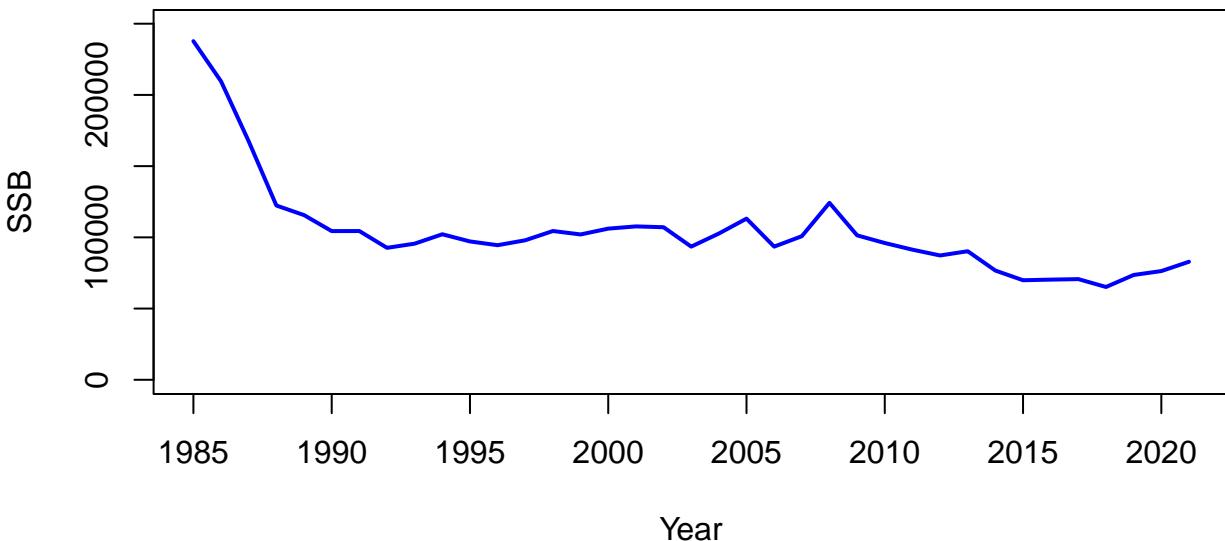


0.97

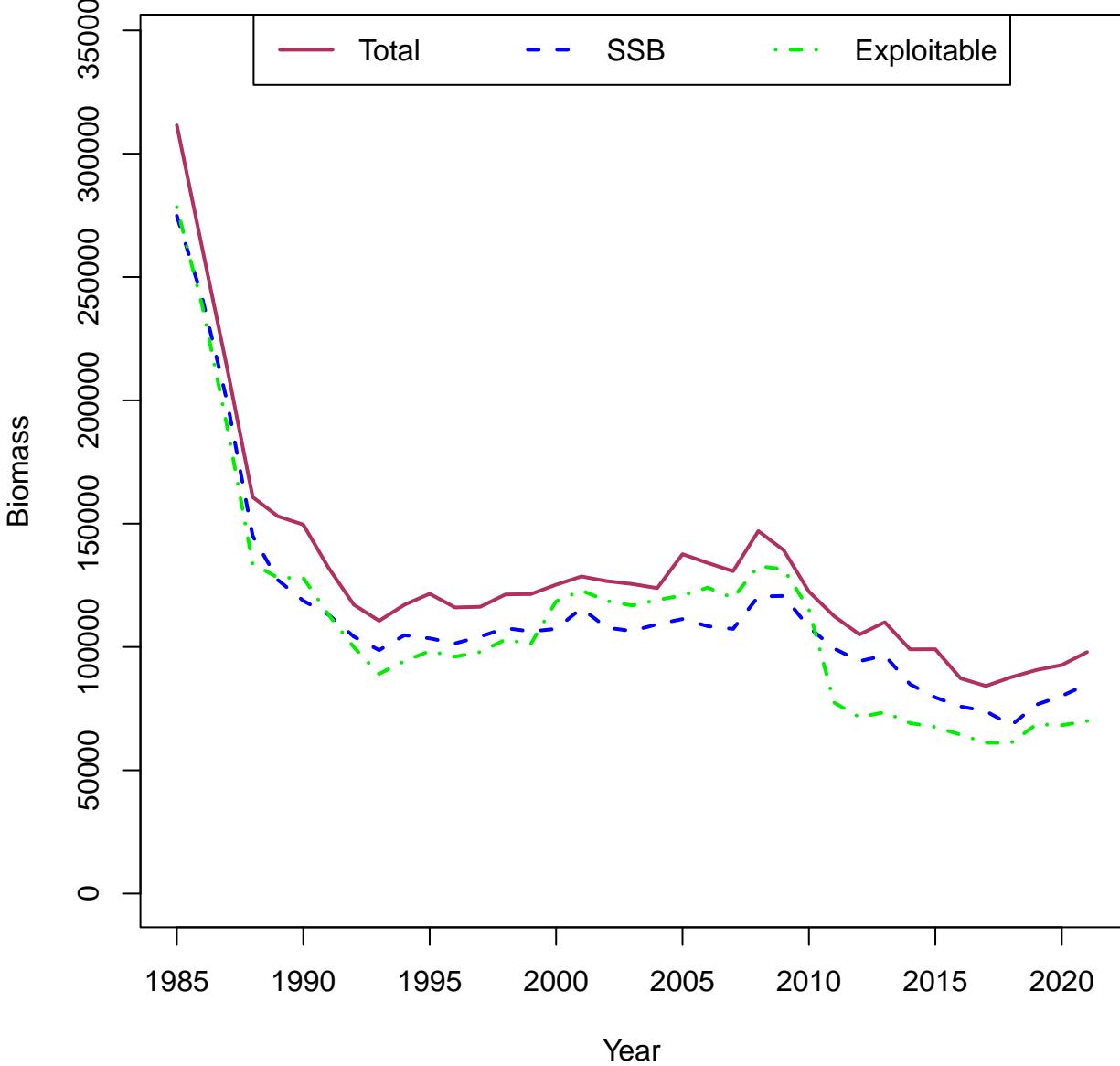


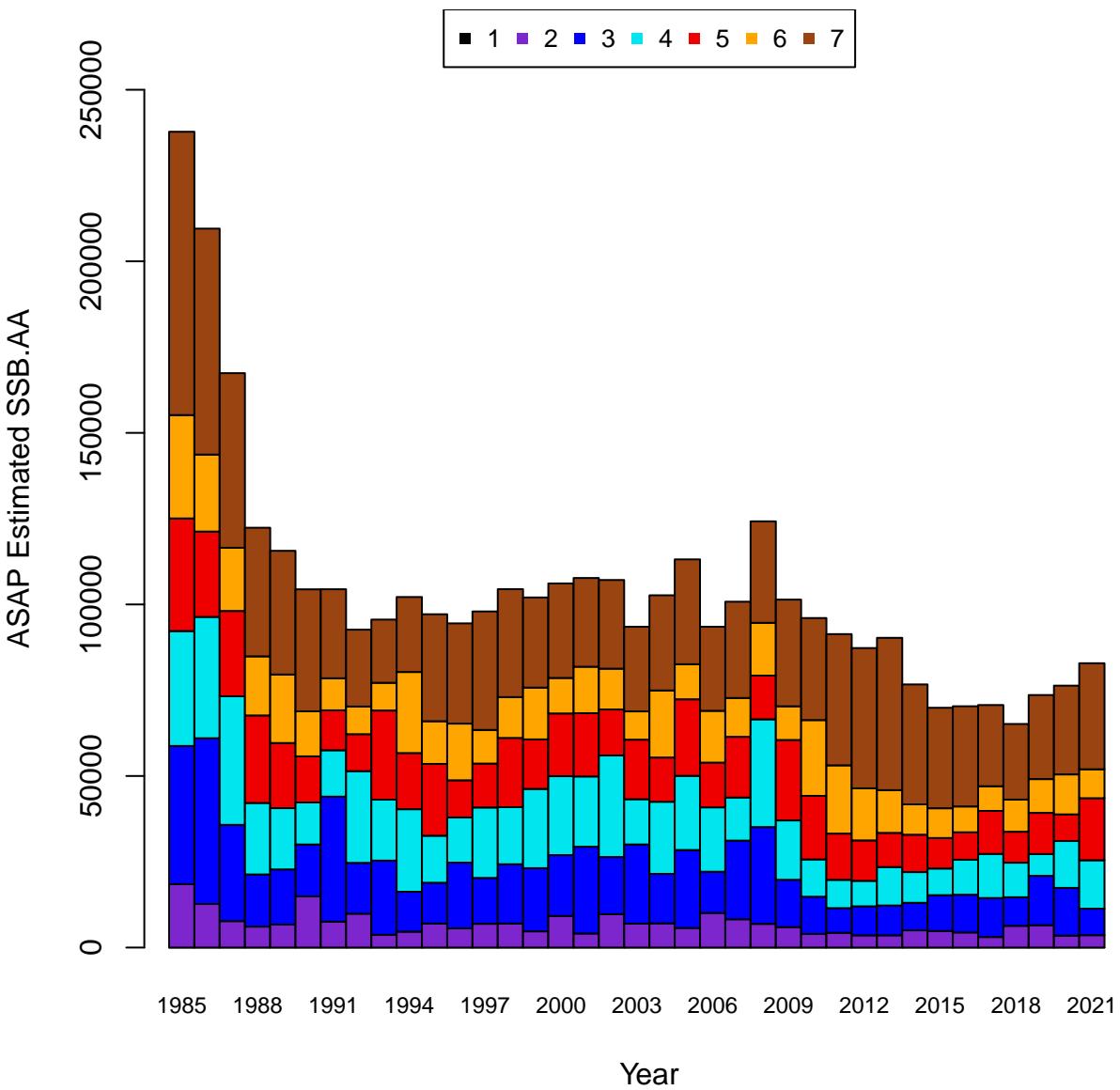
0.95

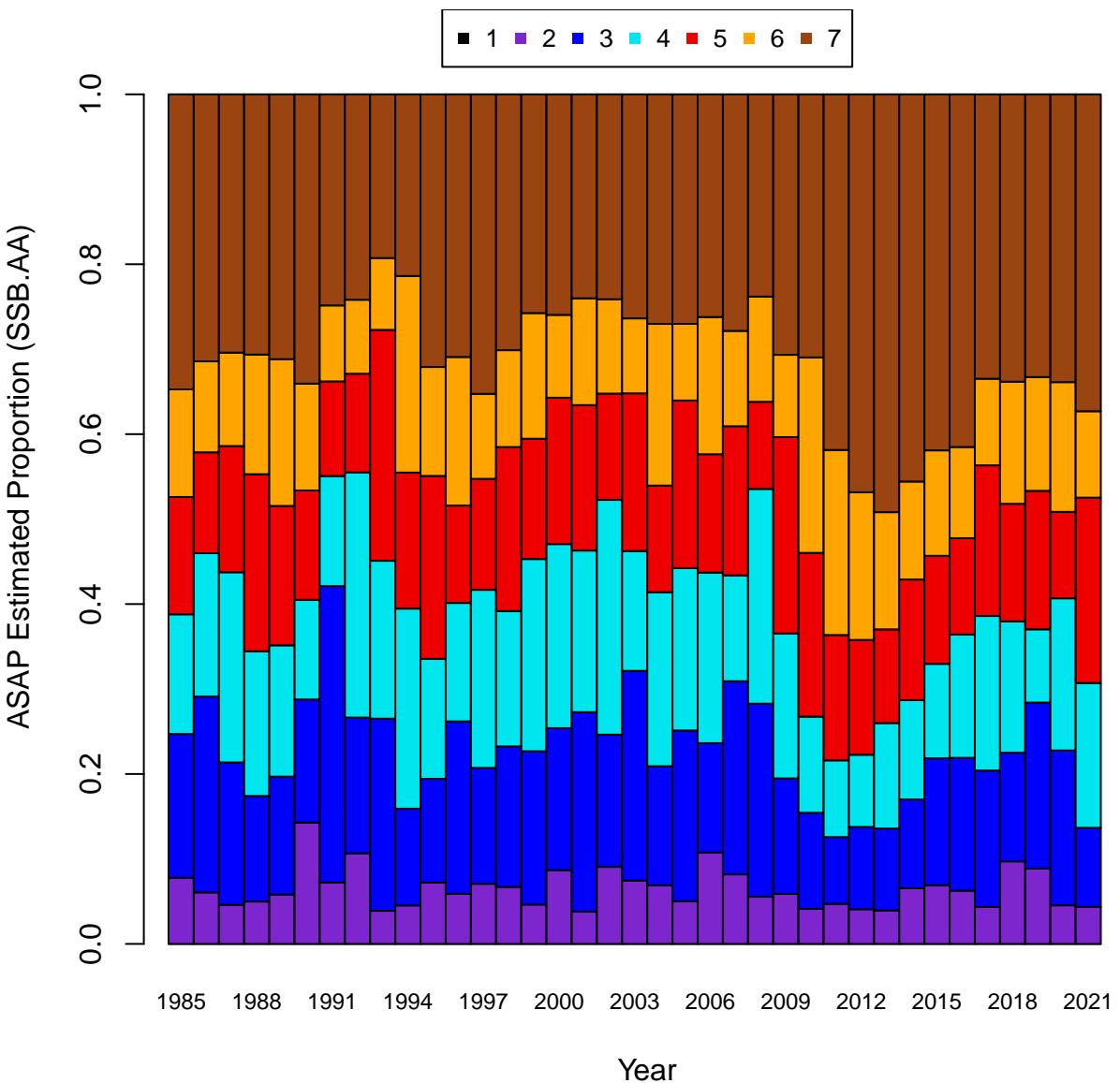


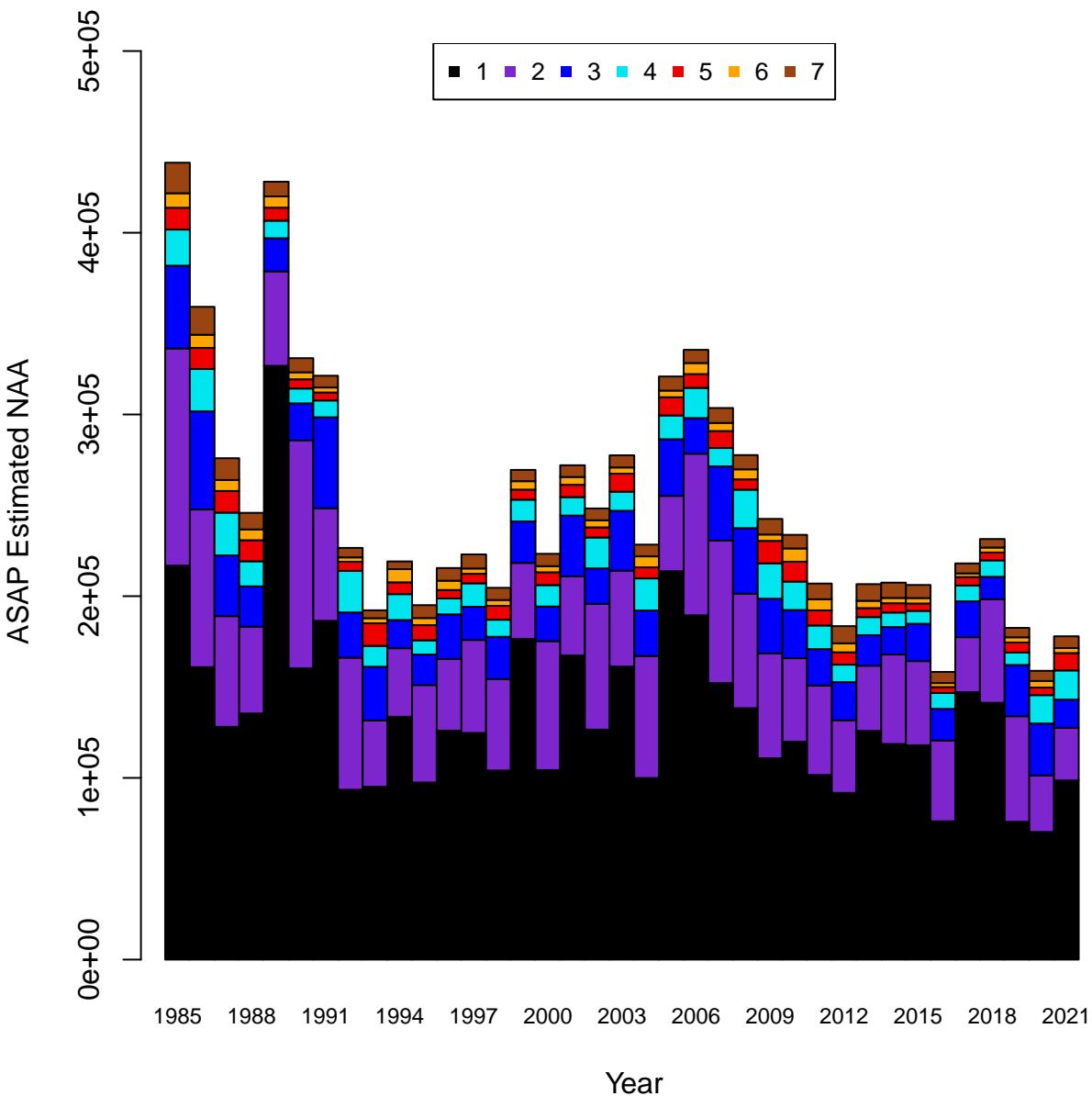


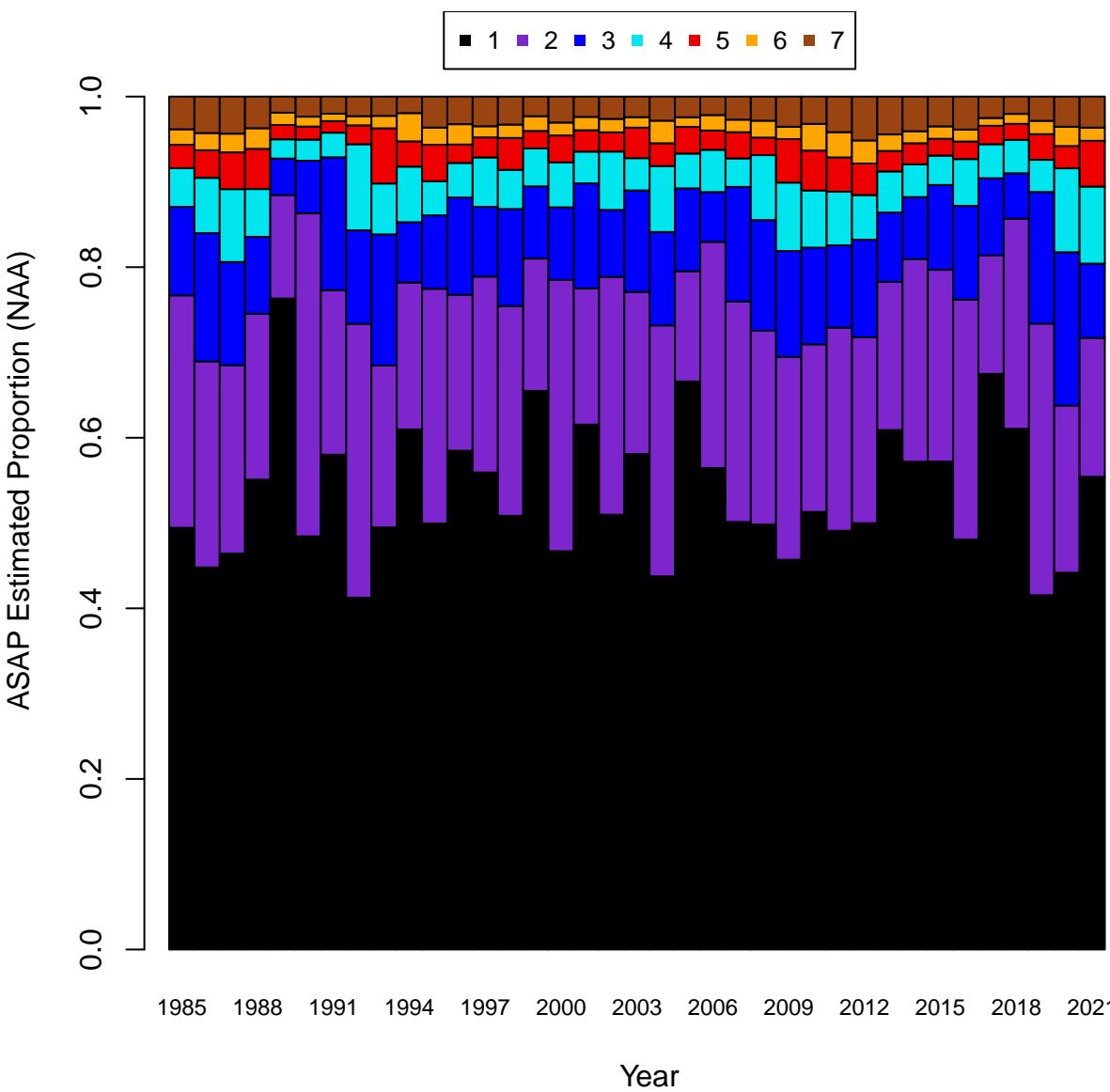
## Comparison of January 1 Biomass

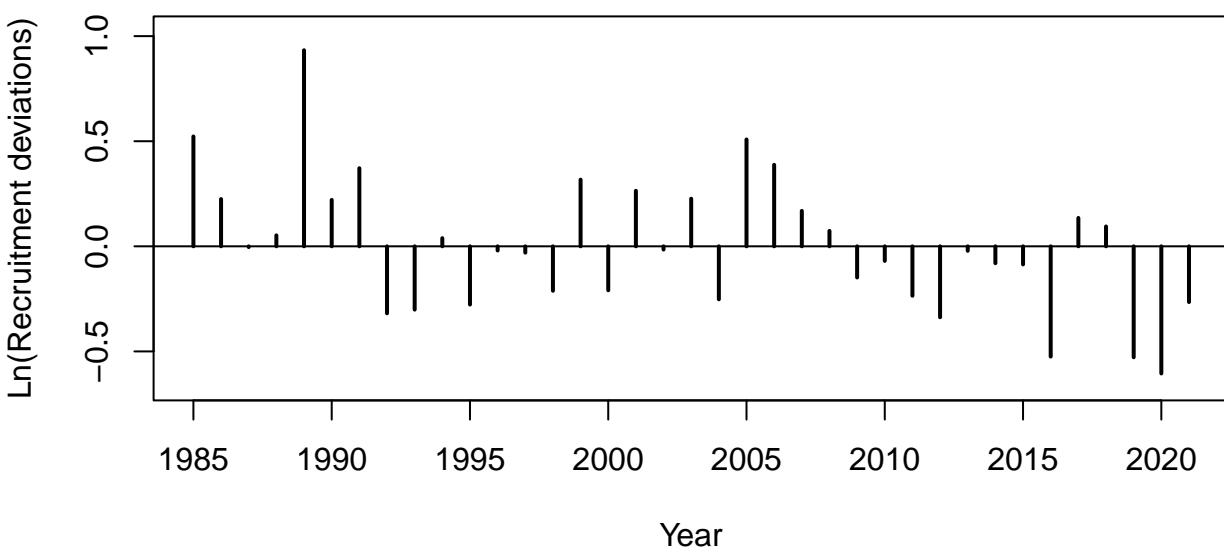
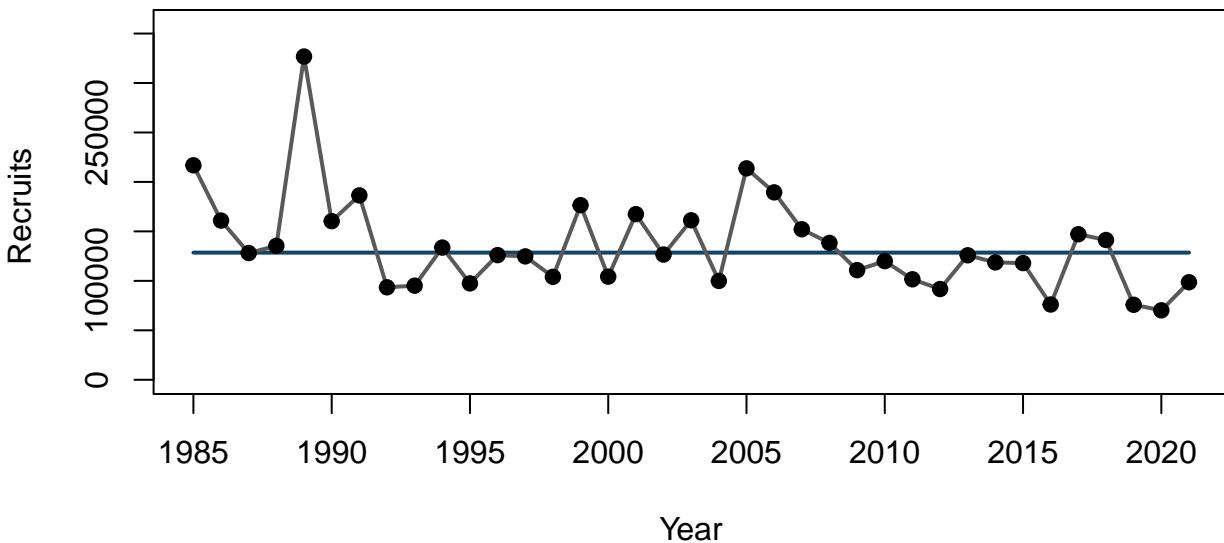


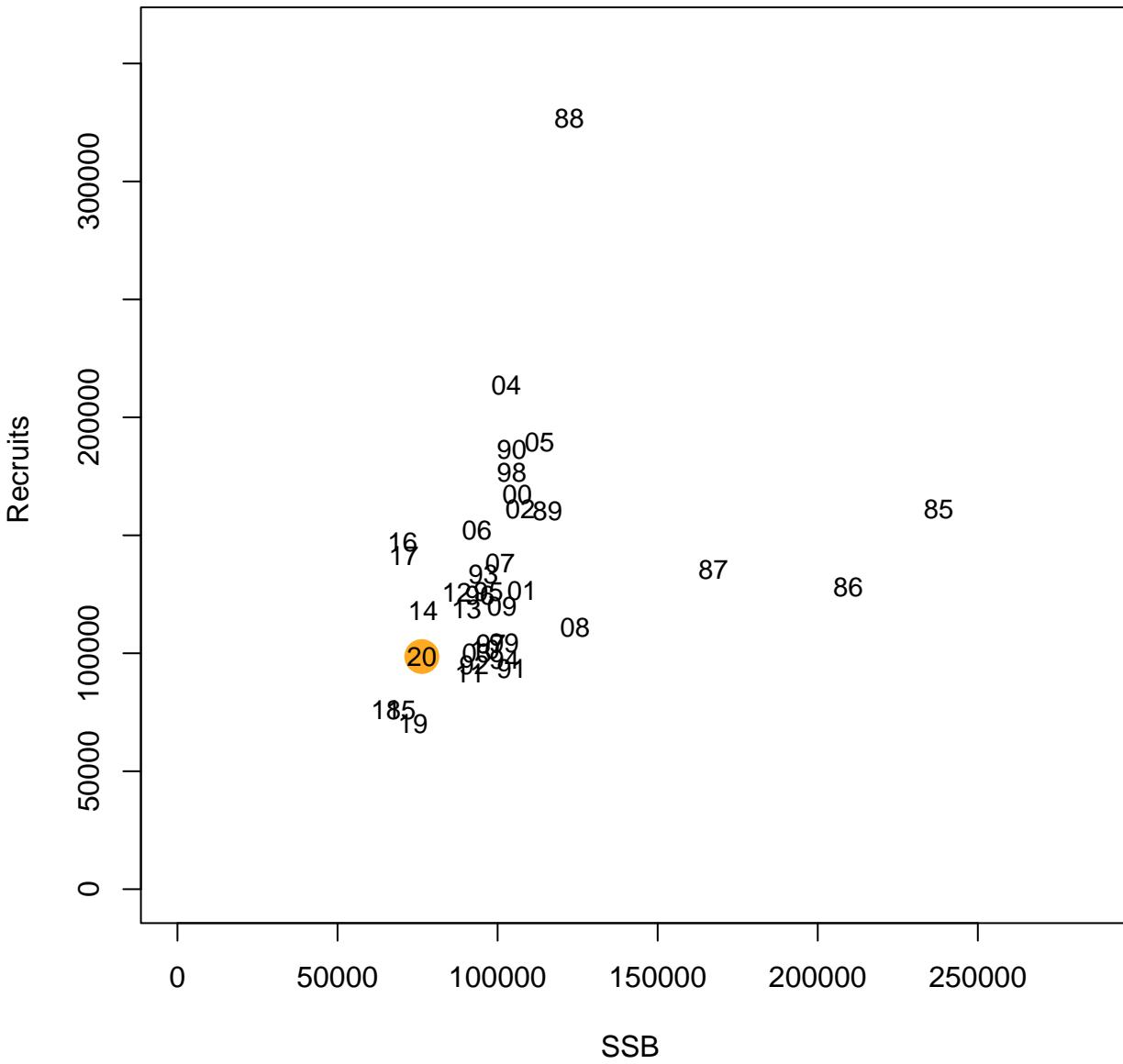


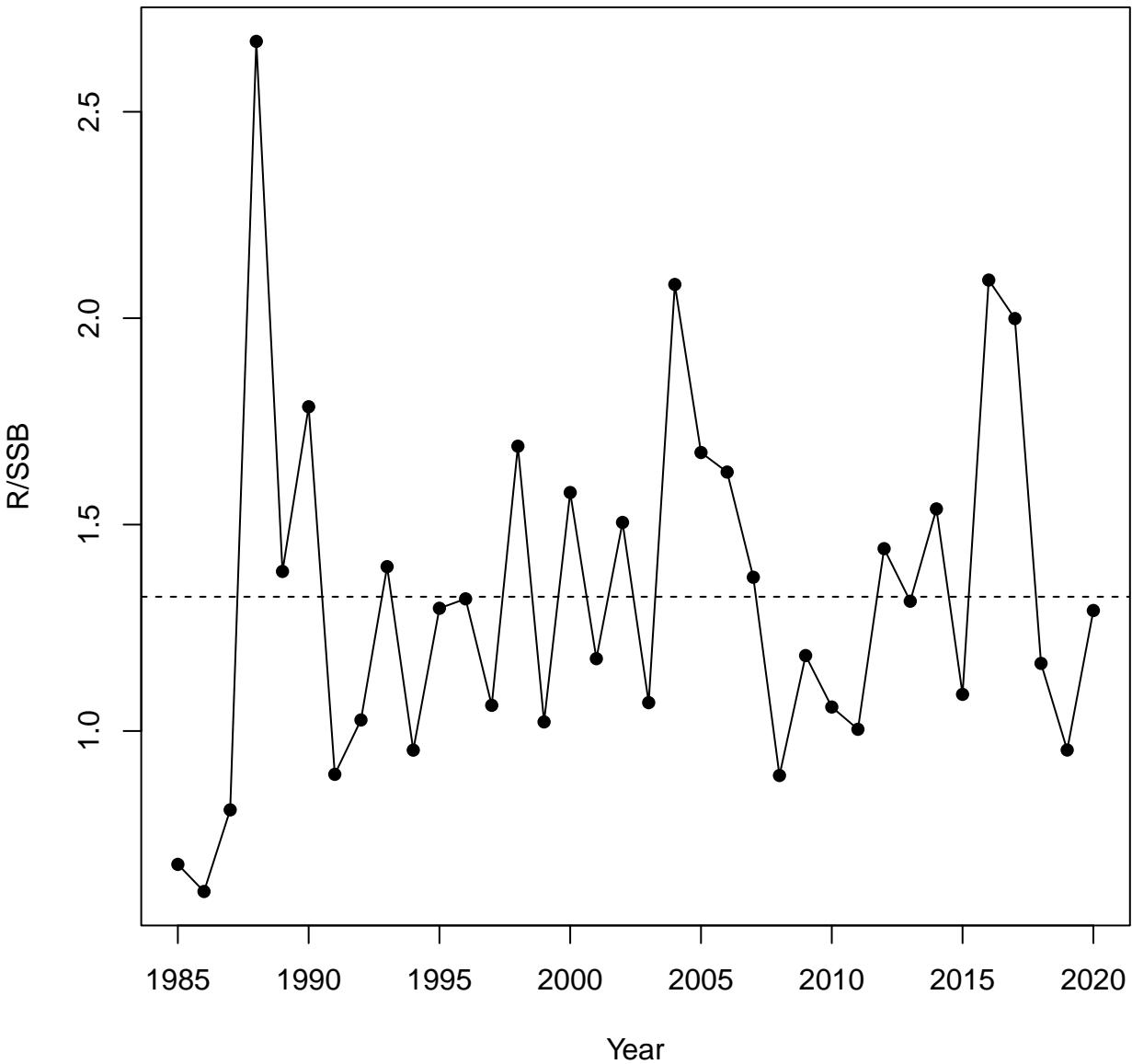


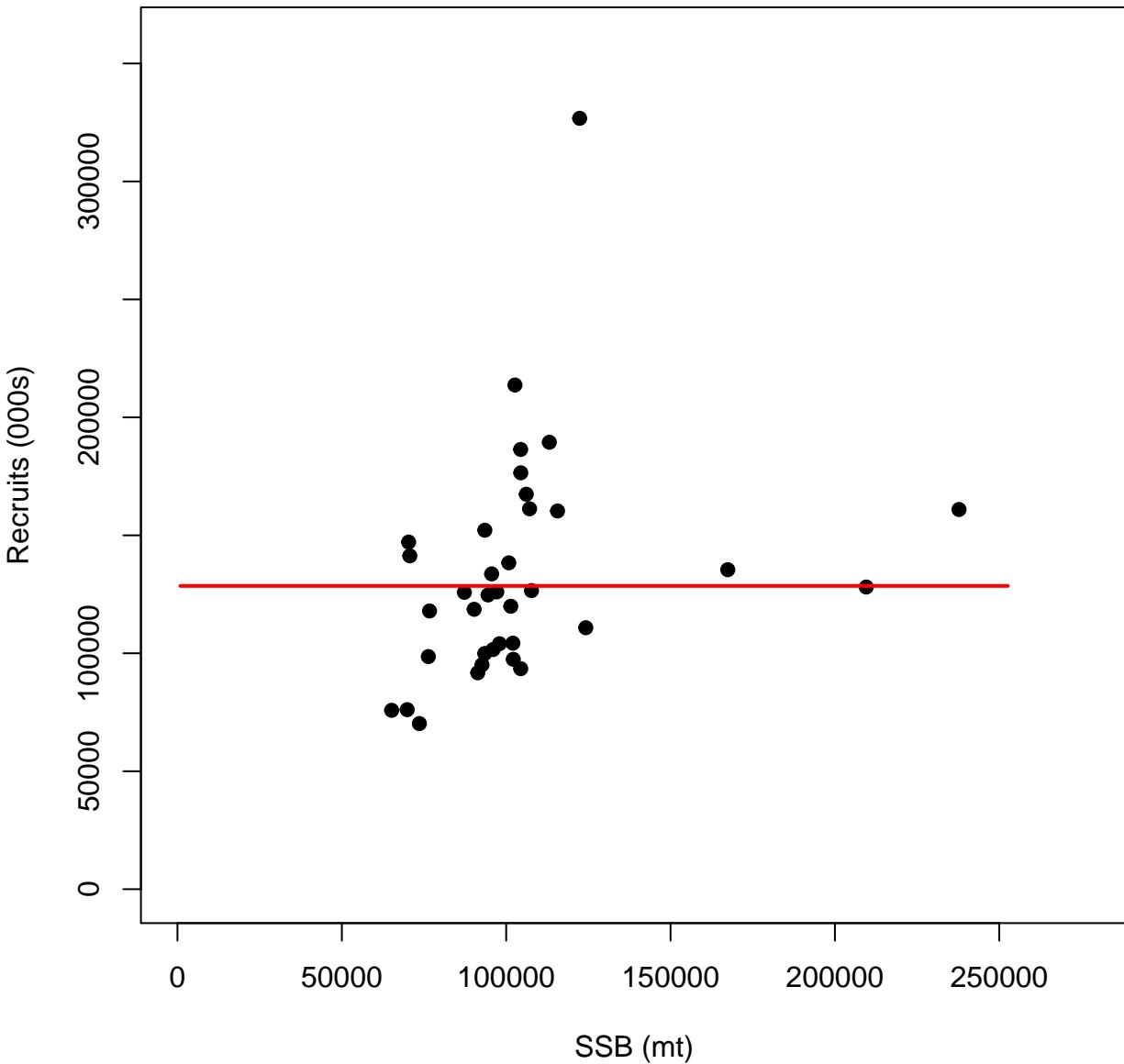


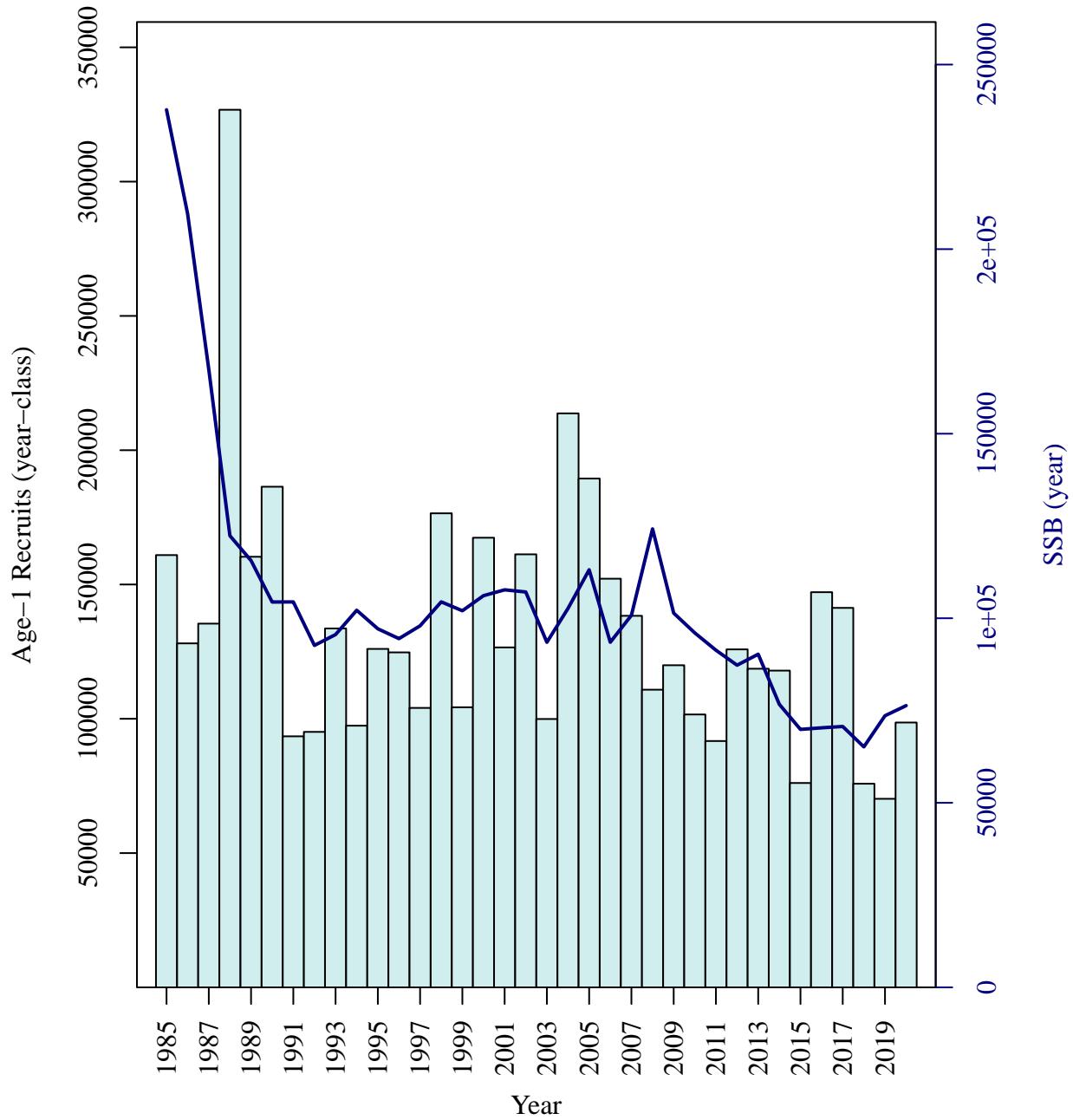


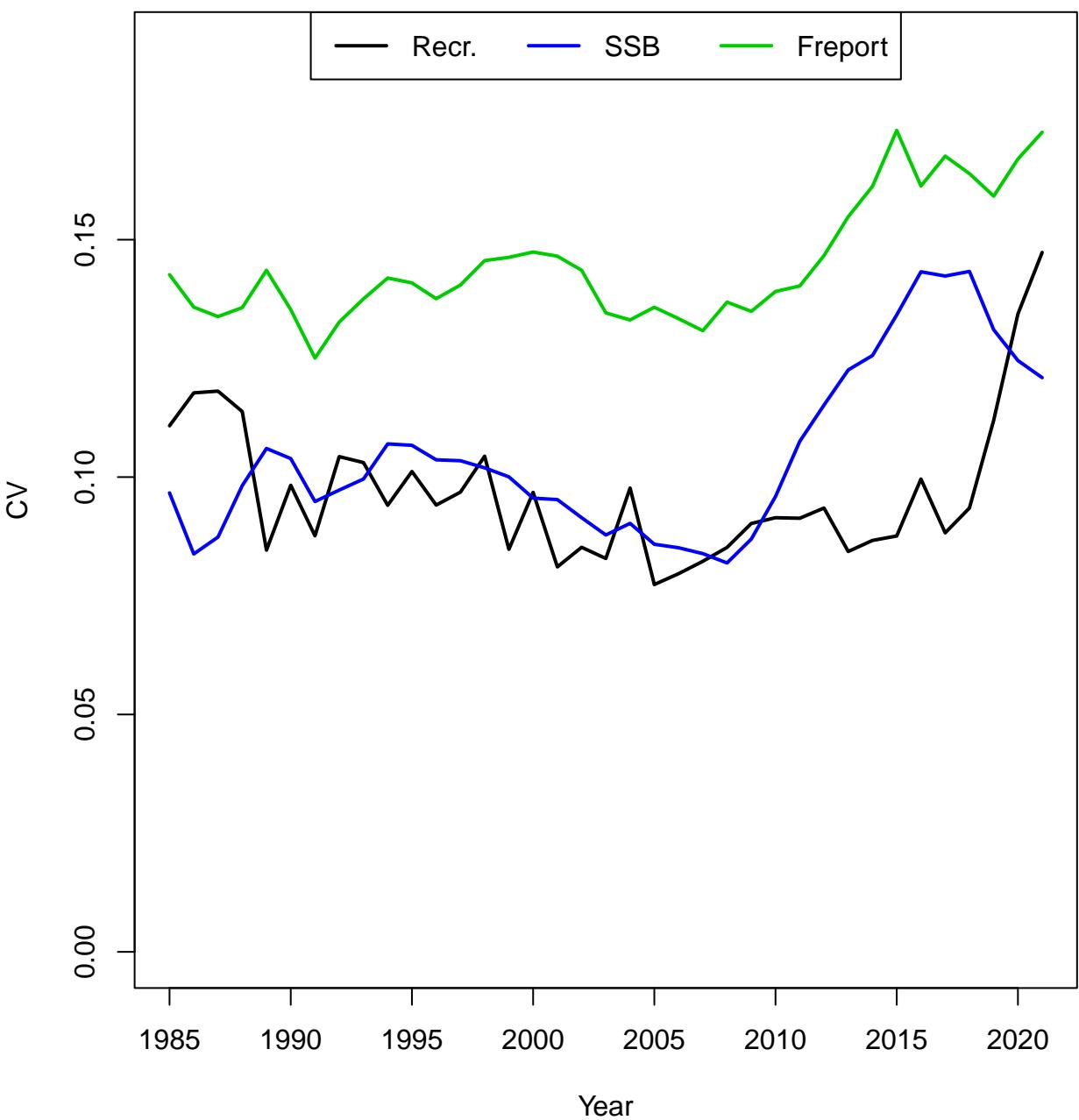




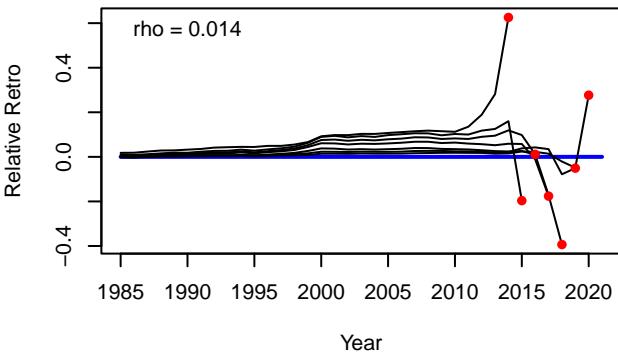
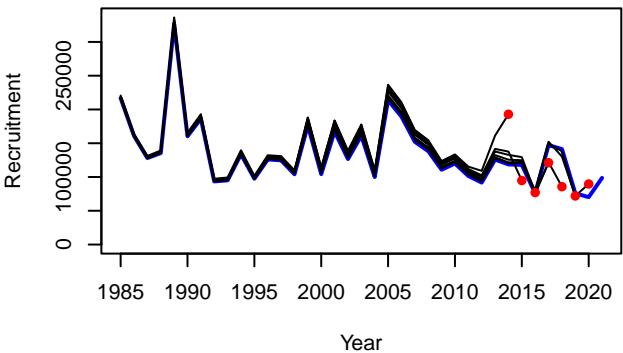
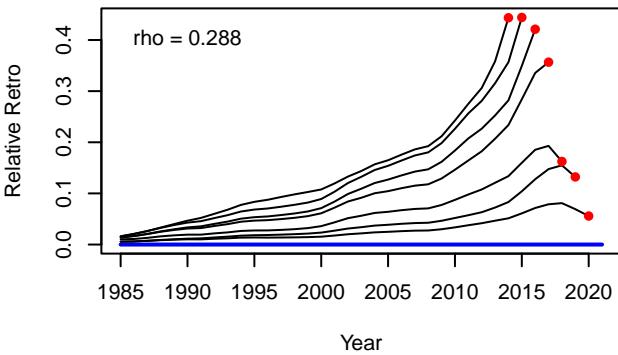
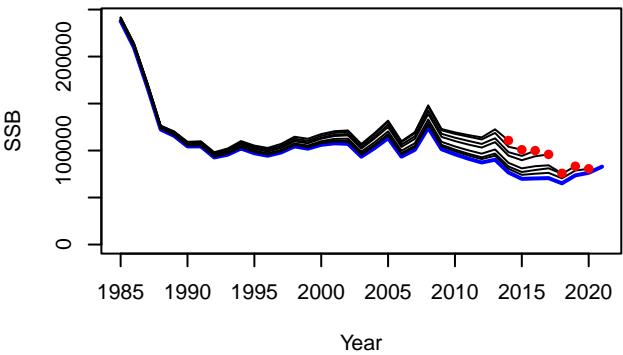
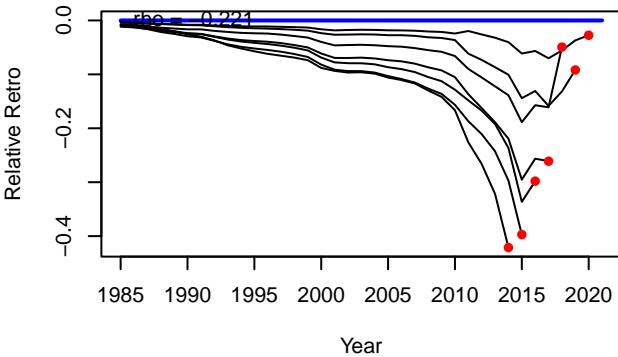
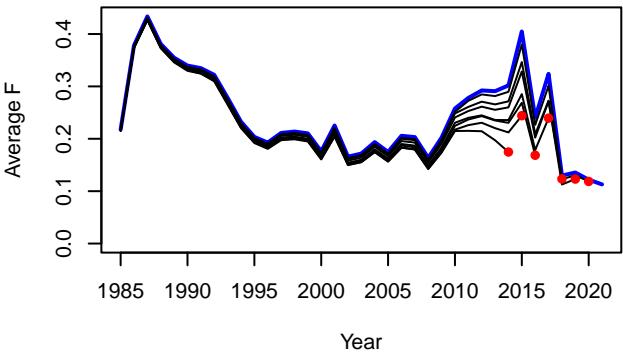




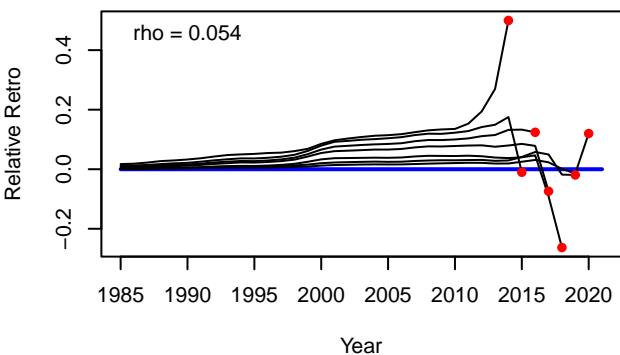
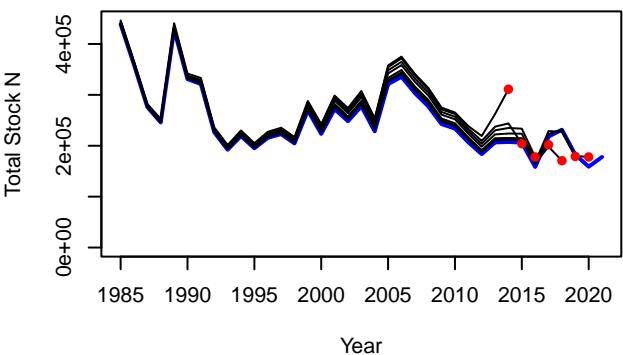
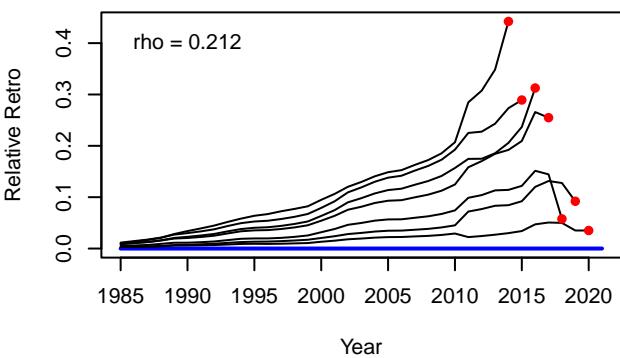
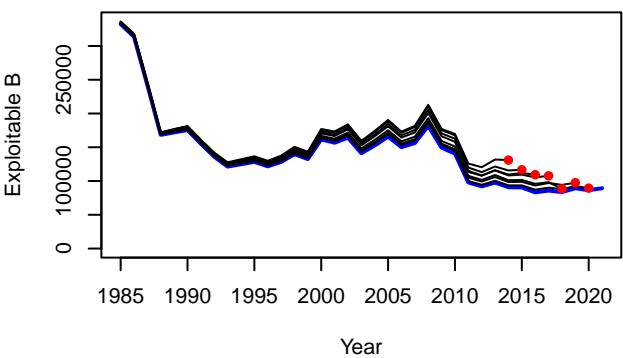
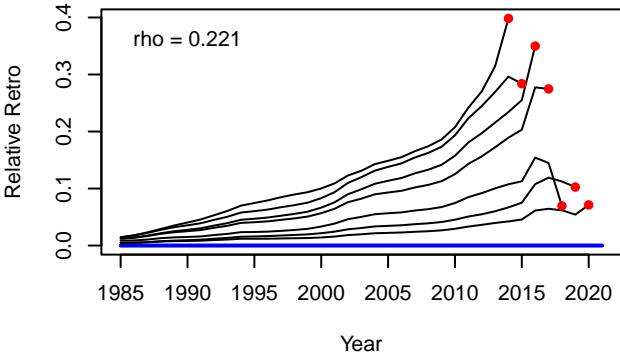
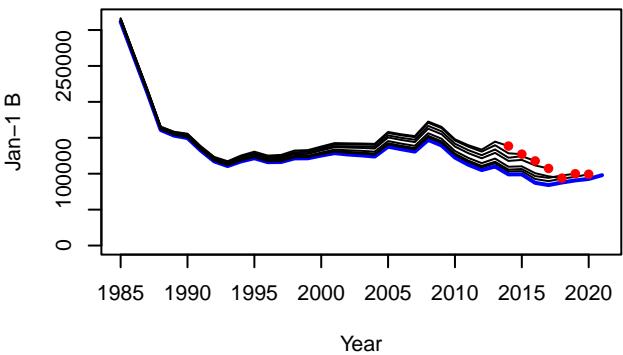




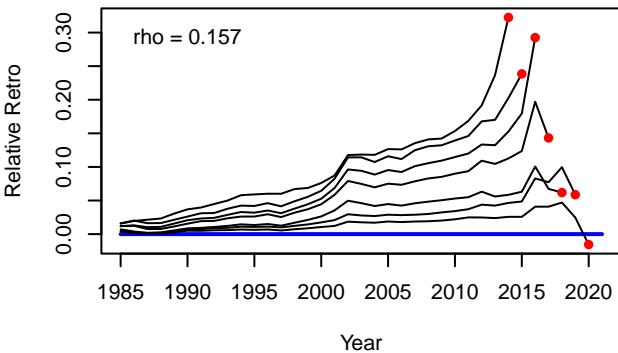
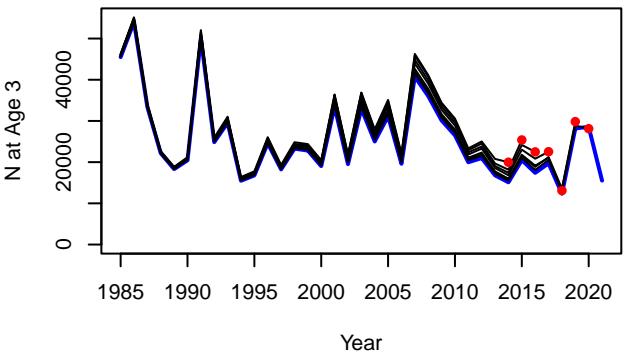
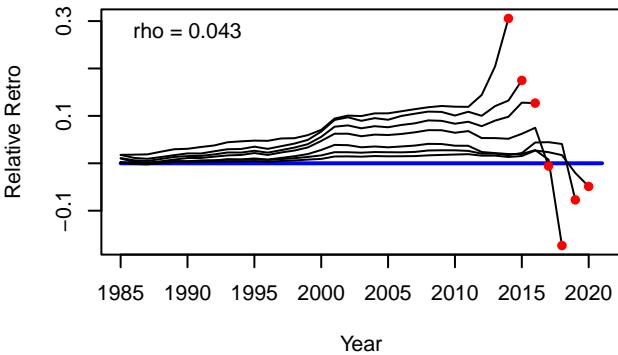
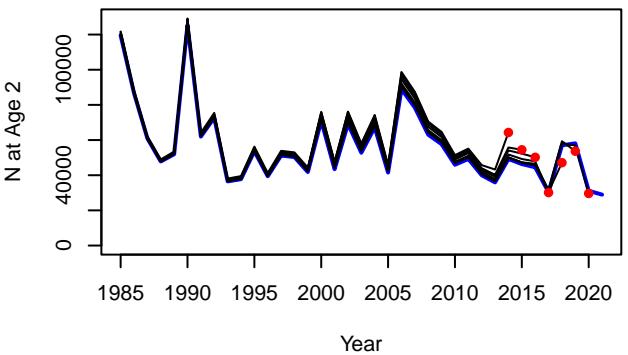
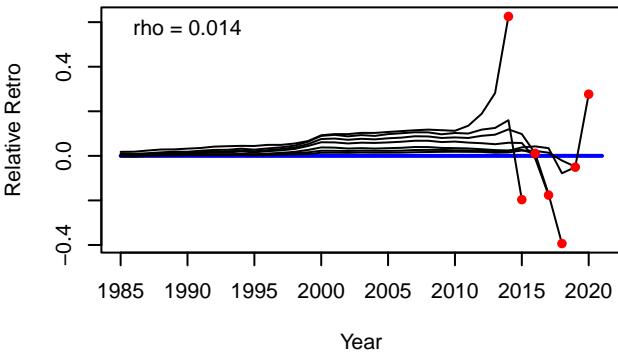
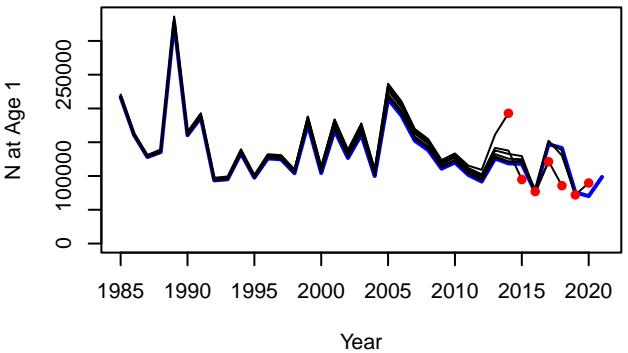
F, SSB, R



**Jan-1 B, Exploitable B, Total Stock N**

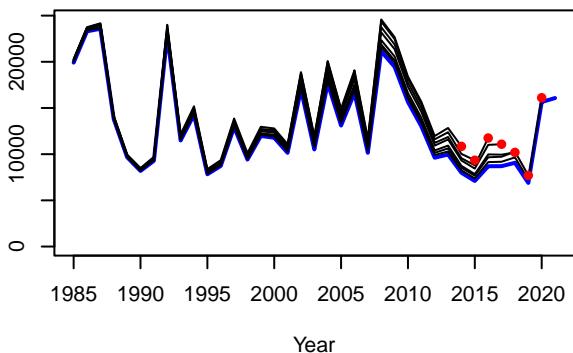


# Stock Numbers at Age

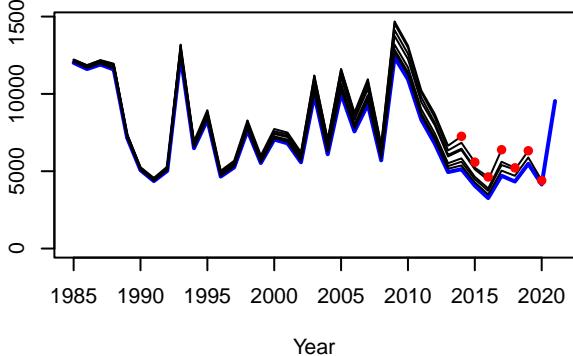


# Stock Numbers at Age

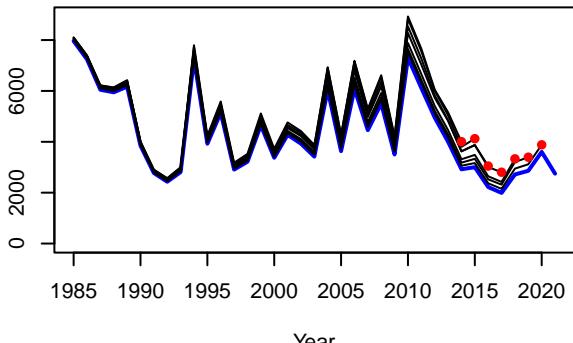
N at Age 4



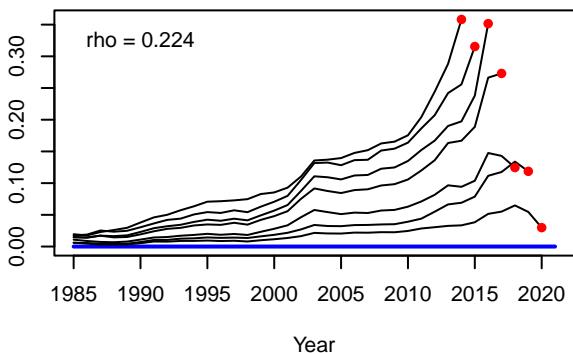
N at Age 5



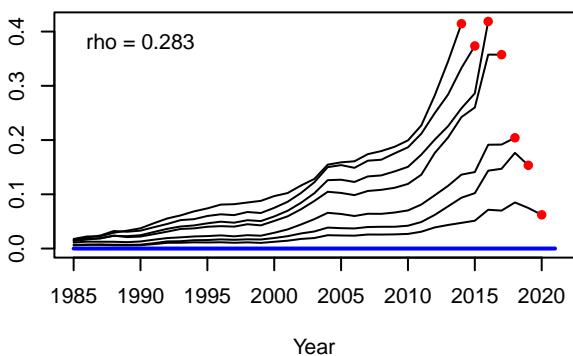
N at Age 6



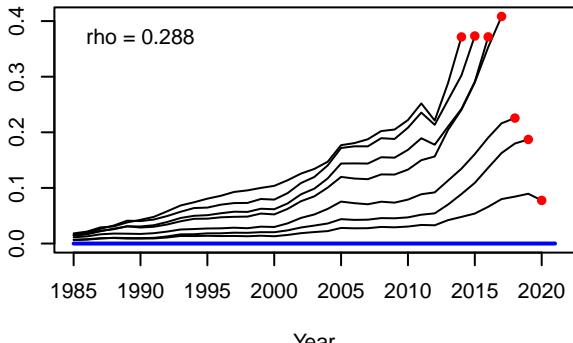
Relative Retro



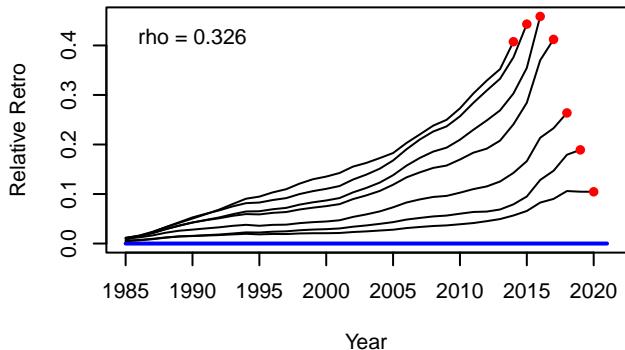
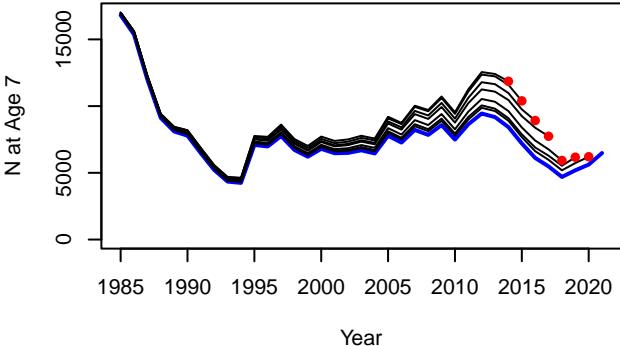
Relative Retro



Relative Retro



## Stock Numbers at Age

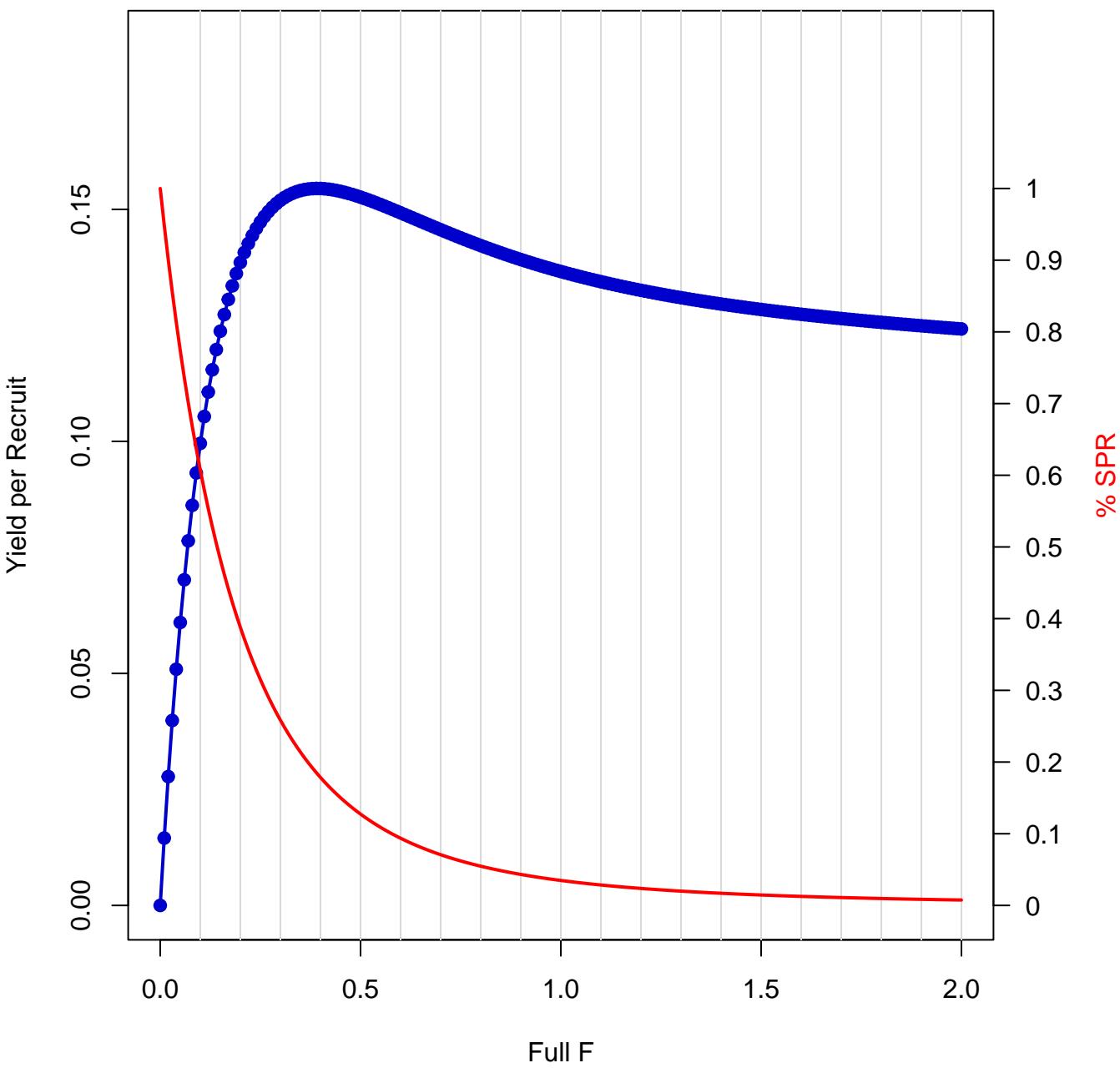


# BF19

5 fleet selectivity blocks, average F from age 1 to ages 1-2

## REFERENCE POINT PLOTS

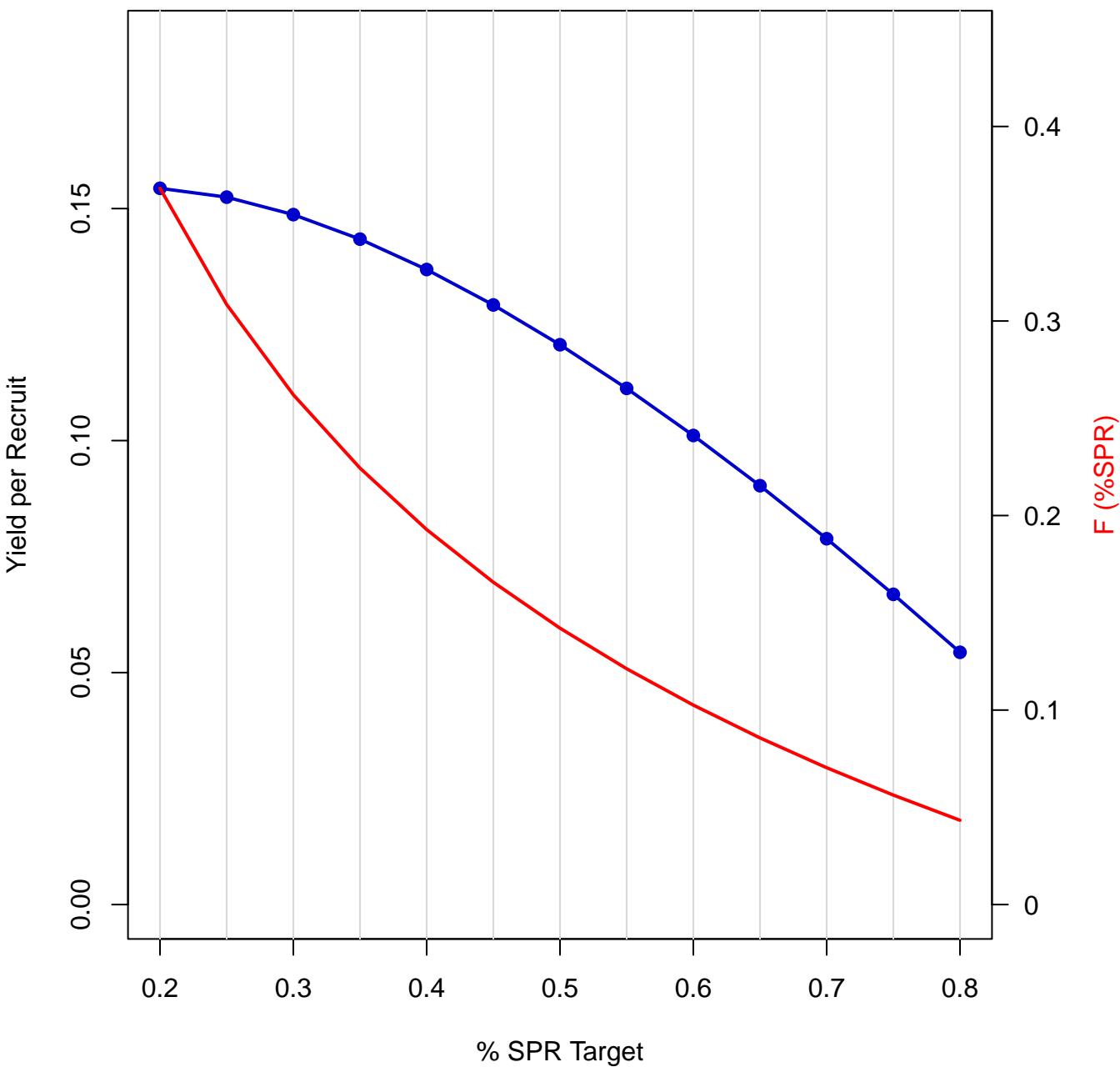
# YPR-SPR Reference Points (Years Avg = 5)



# YPR-SPR Reference Points (Years Avg = 5)

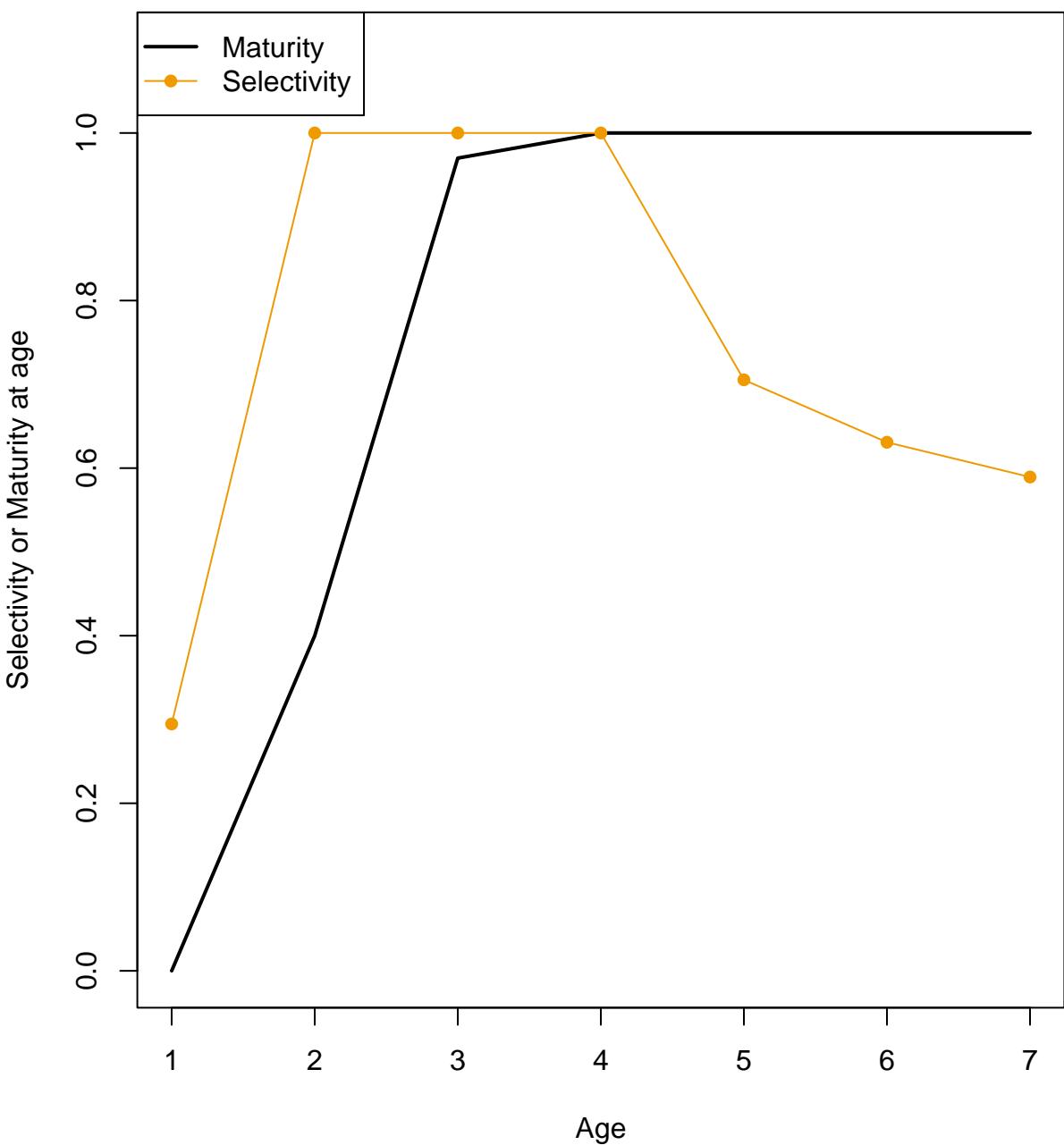
F	YPR	SPR	F	YPR	SPR	F	YPR	SPR
0	0	1	0.35	0.1541	0.2138	0.7	0.1456	0.0708
0.01	0.0145	0.9488	0.36	0.1543	0.2061	0.71	0.1453	0.0689
0.02	0.0278	0.9009	0.37	0.1544	0.1987	0.72	0.1449	0.0671
0.03	0.0399	0.8558	0.38	0.1545	0.1917	0.73	0.1446	0.0653
0.04	0.0509	0.8136	0.39	0.1545	0.1849	0.74	0.1442	0.0637
0.05	0.061	0.7738	0.4	0.1545	0.1785	0.75	0.1439	0.062
0.06	0.0702	0.7364	0.41	0.1544	0.1723	0.76	0.1435	0.0605
0.07	0.0786	0.7012	0.42	0.1543	0.1664	0.77	0.1432	0.059
0.08	0.0862	0.668	0.43	0.1542	0.1608	0.78	0.1429	0.0575
0.09	0.0932	0.6368	0.44	0.1541	0.1554	0.79	0.1425	0.0561
0.1	0.0996	0.6073	0.45	0.1539	0.1502	0.8	0.1422	0.0547
0.11	0.1054	0.5794	0.46	0.1537	0.1453	0.81	0.1419	0.0534
0.12	0.1106	0.5531	0.47	0.1534	0.1405	0.82	0.1416	0.0521
0.13	0.1154	0.5283	0.48	0.1532	0.136	0.83	0.1413	0.0509
0.14	0.1198	0.5048	0.49	0.1529	0.1316	0.84	0.1409	0.0497
0.15	0.1237	0.4826	0.5	0.1526	0.1274	0.85	0.1406	0.0485
0.16	0.1273	0.4615	0.51	0.1523	0.1234	0.86	0.1403	0.0474
0.17	0.1306	0.4416	0.52	0.152	0.1195	0.87	0.14	0.0463
0.18	0.1335	0.4227	0.53	0.1517	0.1158	0.88	0.1398	0.0453
0.19	0.1362	0.4048	0.54	0.1514	0.1123	0.89	0.1395	0.0442
0.2	0.1386	0.3879	0.55	0.151	0.1089	0.9	0.1392	0.0432
0.21	0.1407	0.3717	0.56	0.1507	0.1056	0.91	0.1389	0.0423
0.22	0.1426	0.3565	0.57	0.1503	0.1024	0.92	0.1386	0.0413
0.23	0.1444	0.3419	0.58	0.15	0.0994	0.93	0.1384	0.0404
0.24	0.1459	0.3281	0.59	0.1496	0.0965	0.94	0.1381	0.0396
0.25	0.1473	0.315	0.6	0.1493	0.0937	0.95	0.1378	0.0387
0.26	0.1485	0.3025	0.61	0.1489	0.091	0.96	0.1376	0.0379
0.27	0.1495	0.2907	0.62	0.1485	0.0884	0.97	0.1373	0.0371
0.28	0.1505	0.2794	0.63	0.1482	0.0859	0.98	0.1371	0.0363
0.29	0.1513	0.2686	0.64	0.1478	0.0835	0.99	0.1368	0.0356
0.3	0.152	0.2583	0.65	0.1474	0.0812	1	0.1366	0.0348
0.31	0.1525	0.2486	0.66	0.1471	0.0789	1.01	0.1364	0.0341
0.32	0.153	0.2393	0.67	0.1467	0.0768	1.02	0.1361	0.0334
0.33	0.1535	0.2304	0.68	0.1463	0.0747	1.03	0.1359	0.0327
0.34	0.1538	0.2219	0.69	0.146	0.0727	1.04	0.1357	0.0321

## SPR Target Reference Points (Years Avg = 5)

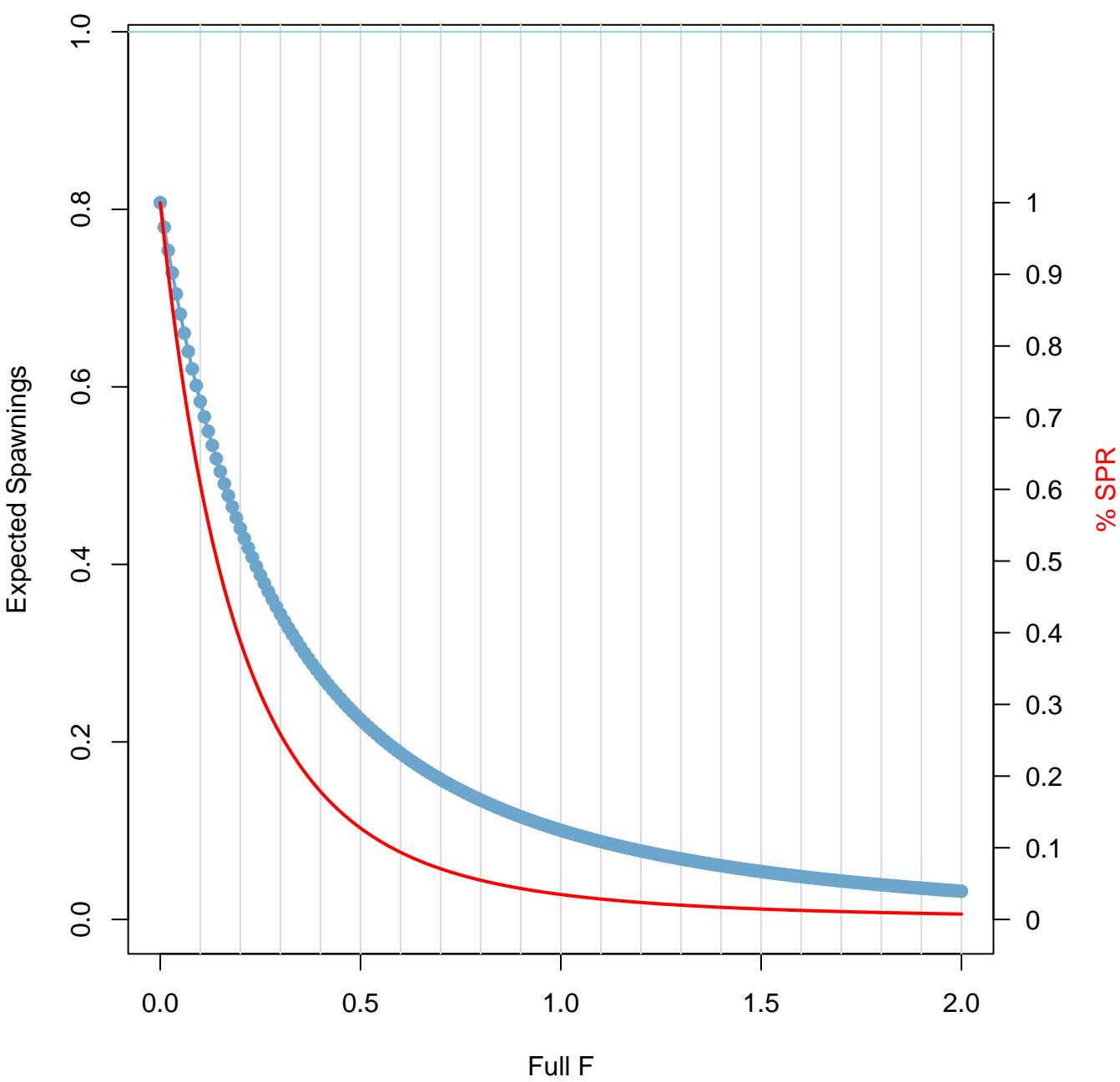


## SPR Target Reference Points (Years Avg = 5)

% SPR	F(%SPR)	YPR
0.2	0.3682	0.1544
0.25	0.3085	0.1525
0.3	0.2621	0.1487
0.35	0.2244	0.1434
0.4	0.1928	0.1369
0.45	0.1657	0.1292
0.5	0.1421	0.1207
0.55	0.1212	0.1112
0.6	0.1026	0.1011
0.65	0.0857	0.0903
0.7	0.0703	0.0788
0.75	0.0563	0.0669
0.8	0.0433	0.0544



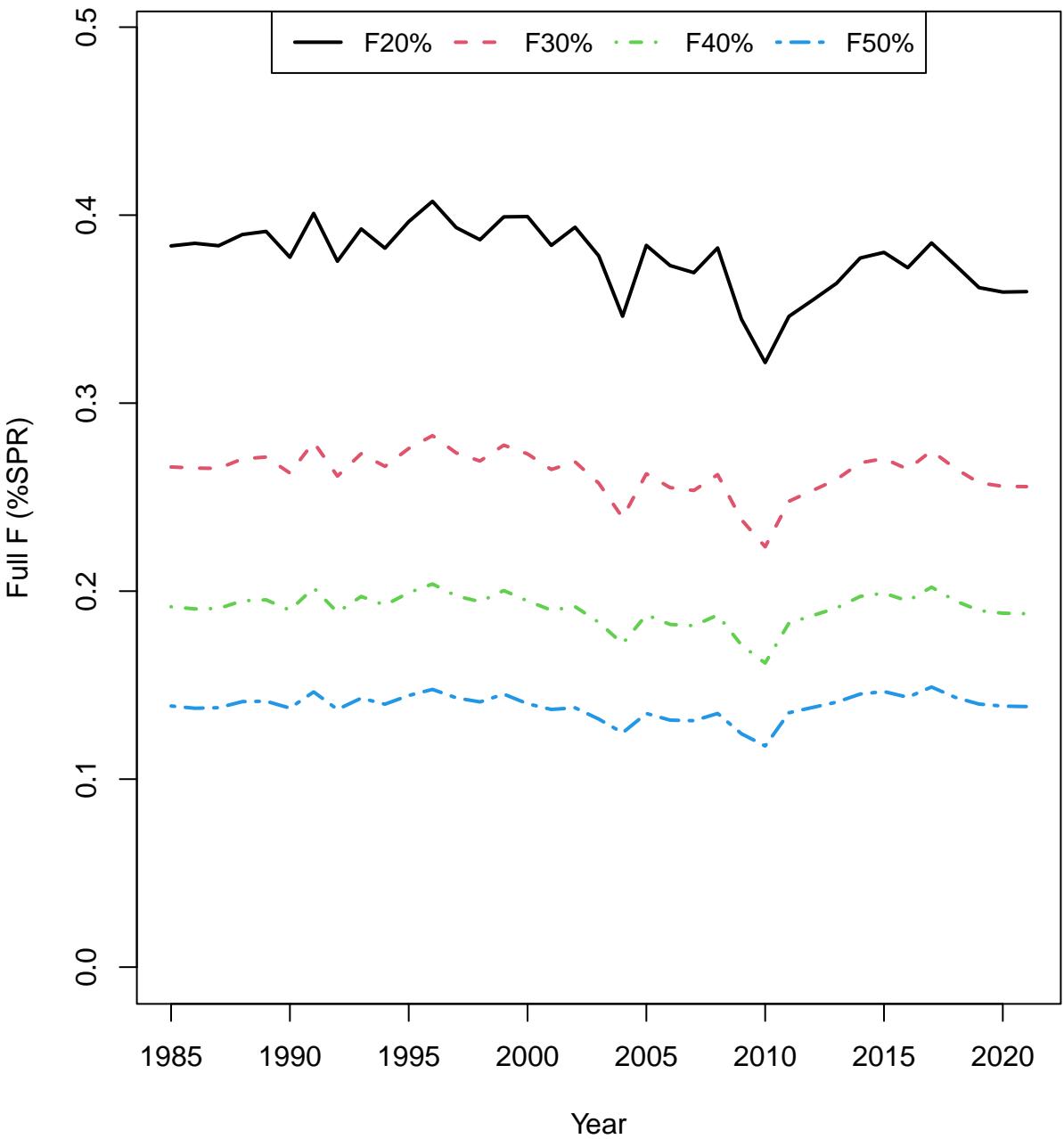
# Expected Spawnings and SPR Reference Points (Years Avg = 5)



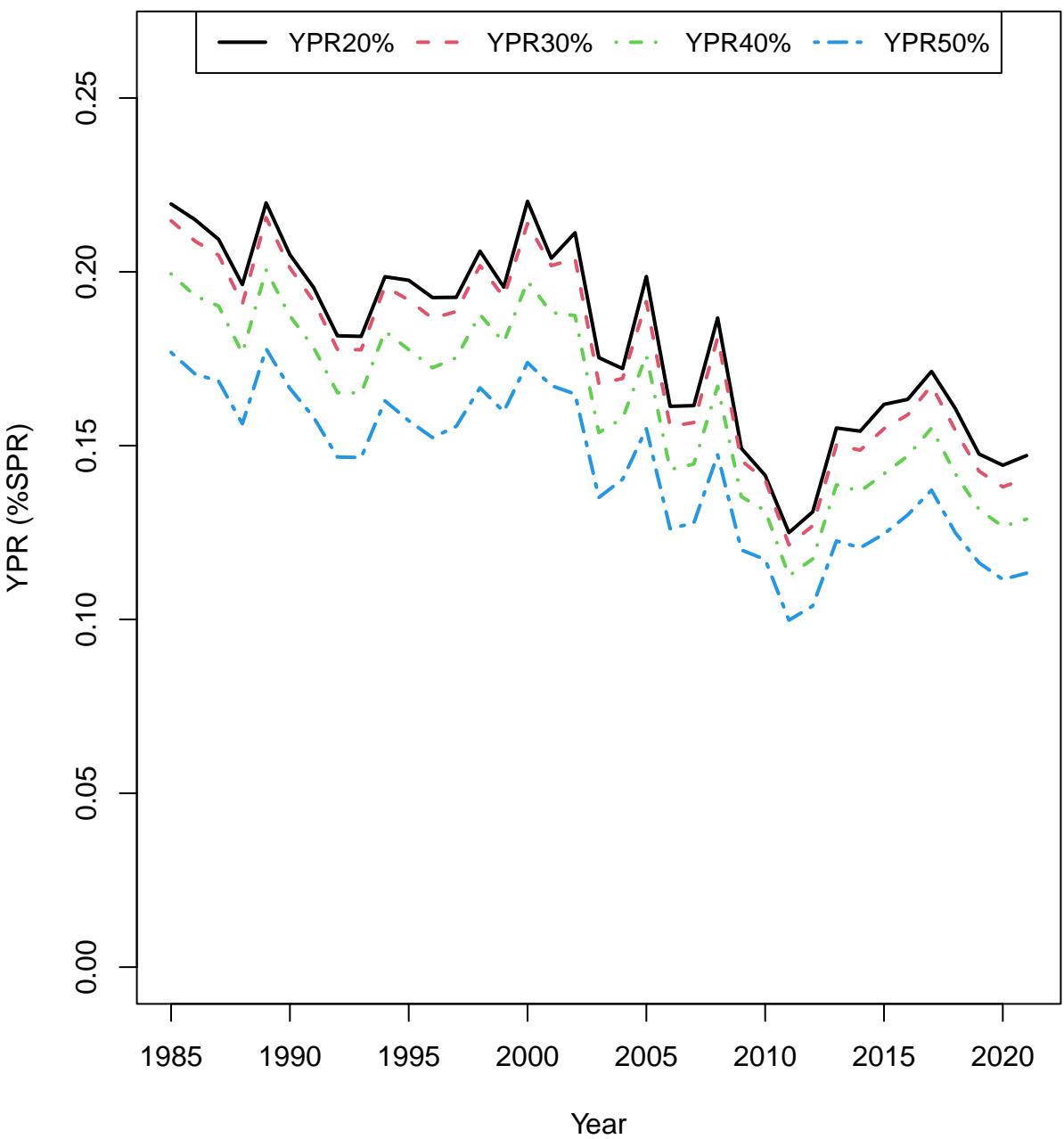
# Expected Spawnings & SPR Reference Points (Years Avg = 5)

F	E[Sp]	SPR	F	E[Sp]	SPR	F	E[Sp]	SPR
0	0.8076	1	0.35	0.307	0.2138	0.7	0.1578	0.0708
0.01	0.7798	0.9488	0.36	0.3003	0.2061	0.71	0.1552	0.0689
0.02	0.7535	0.9009	0.37	0.2938	0.1987	0.72	0.1527	0.0671
0.03	0.7285	0.8558	0.38	0.2875	0.1917	0.73	0.1503	0.0653
0.04	0.7047	0.8136	0.39	0.2815	0.1849	0.74	0.1479	0.0637
0.05	0.682	0.7738	0.4	0.2756	0.1785	0.75	0.1455	0.062
0.06	0.6604	0.7364	0.41	0.2698	0.1723	0.76	0.1432	0.0605
0.07	0.6399	0.7012	0.42	0.2643	0.1664	0.77	0.141	0.059
0.08	0.6202	0.668	0.43	0.2589	0.1608	0.78	0.1388	0.0575
0.09	0.6014	0.6368	0.44	0.2537	0.1554	0.79	0.1366	0.0561
0.1	0.5835	0.6073	0.45	0.2486	0.1502	0.8	0.1345	0.0547
0.11	0.5663	0.5794	0.46	0.2437	0.1453	0.81	0.1325	0.0534
0.12	0.5499	0.5531	0.47	0.2389	0.1405	0.82	0.1304	0.0521
0.13	0.5342	0.5283	0.48	0.2342	0.136	0.83	0.1285	0.0509
0.14	0.5191	0.5048	0.49	0.2297	0.1316	0.84	0.1265	0.0497
0.15	0.5047	0.4826	0.5	0.2253	0.1274	0.85	0.1246	0.0485
0.16	0.4908	0.4615	0.51	0.221	0.1234	0.86	0.1228	0.0474
0.17	0.4775	0.4416	0.52	0.2168	0.1195	0.87	0.121	0.0463
0.18	0.4648	0.4227	0.53	0.2128	0.1158	0.88	0.1192	0.0453
0.19	0.4525	0.4048	0.54	0.2088	0.1123	0.89	0.1175	0.0442
0.2	0.4407	0.3879	0.55	0.205	0.1089	0.9	0.1158	0.0432
0.21	0.4293	0.3717	0.56	0.2013	0.1056	0.91	0.1141	0.0423
0.22	0.4184	0.3565	0.57	0.1976	0.1024	0.92	0.1125	0.0413
0.23	0.4079	0.3419	0.58	0.1941	0.0994	0.93	0.1108	0.0404
0.24	0.3977	0.3281	0.59	0.1906	0.0965	0.94	0.1093	0.0396
0.25	0.388	0.315	0.6	0.1873	0.0937	0.95	0.1077	0.0387
0.26	0.3785	0.3025	0.61	0.184	0.091	0.96	0.1062	0.0379
0.27	0.3694	0.2907	0.62	0.1808	0.0884	0.97	0.1047	0.0371
0.28	0.3607	0.2794	0.63	0.1777	0.0859	0.98	0.1033	0.0363
0.29	0.3522	0.2686	0.64	0.1746	0.0835	0.99	0.1018	0.0356
0.3	0.344	0.2583	0.65	0.1716	0.0812	1	0.1004	0.0348
0.31	0.3361	0.2486	0.66	0.1687	0.0789	1.01	0.0991	0.0341
0.32	0.3285	0.2393	0.67	0.1659	0.0768	1.02	0.0977	0.0334
0.33	0.3211	0.2304	0.68	0.1631	0.0747	1.03	0.0964	0.0327
0.34	0.3139	0.2219	0.69	0.1604	0.0727	1.04	0.0951	0.0321

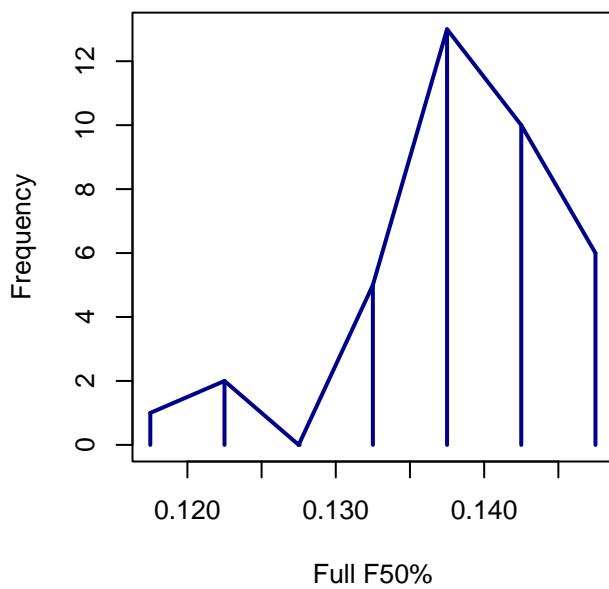
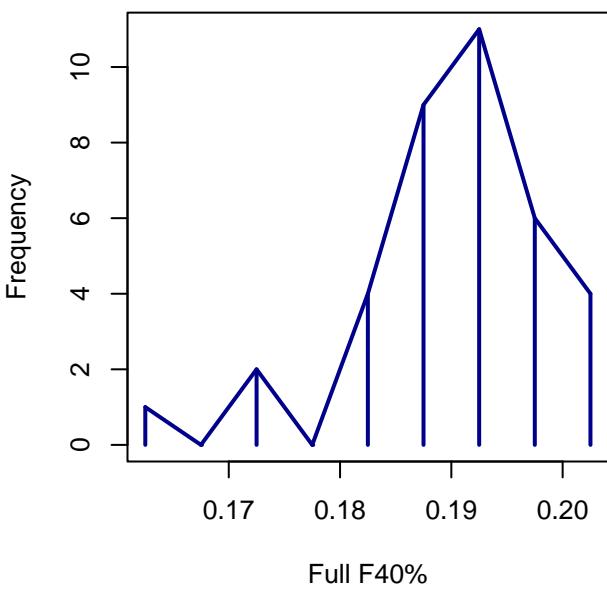
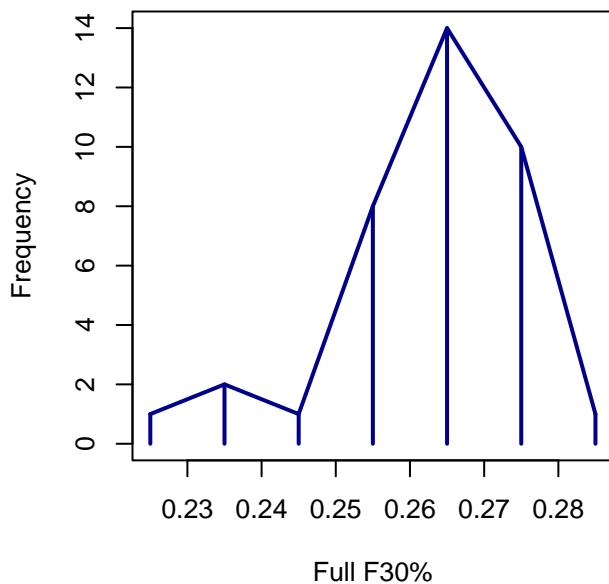
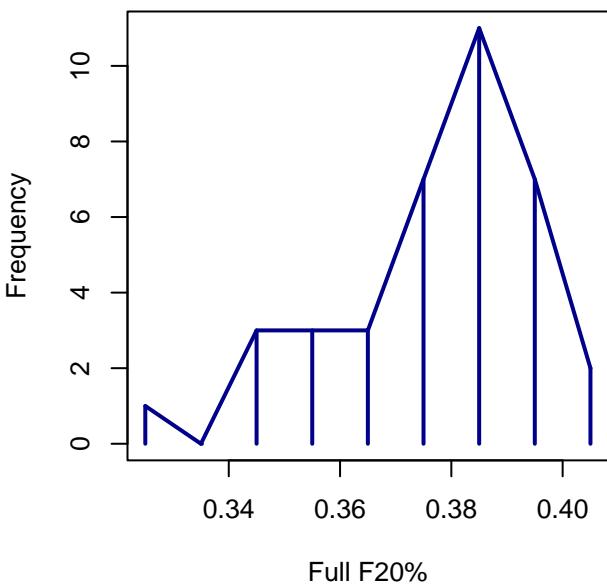
## Annual F(%SPR) Reference Points



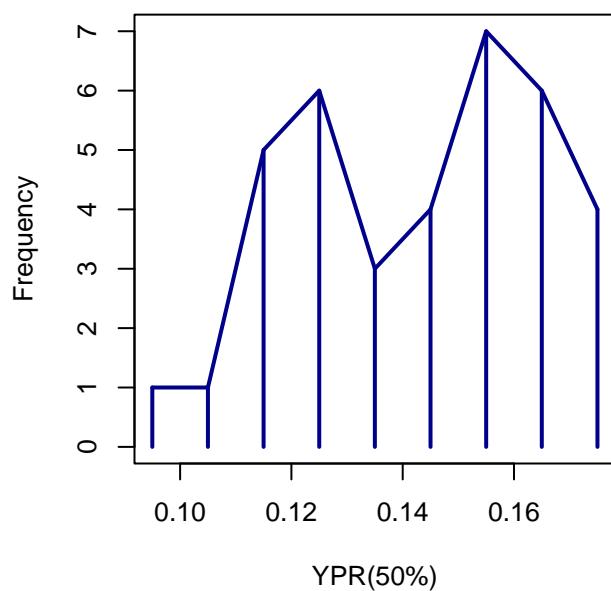
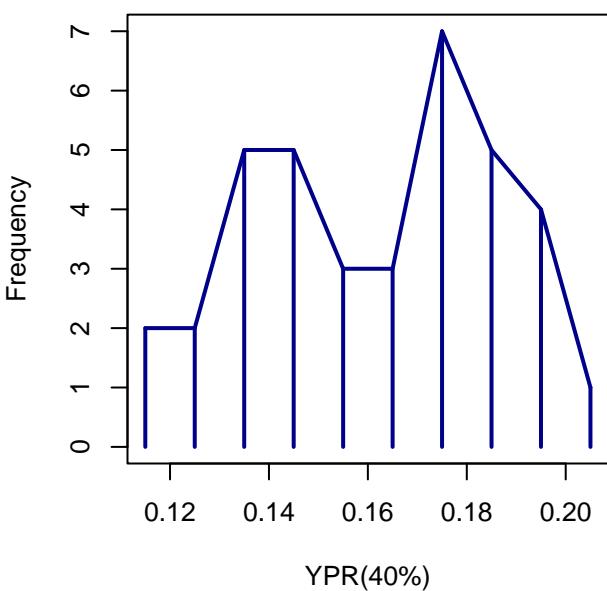
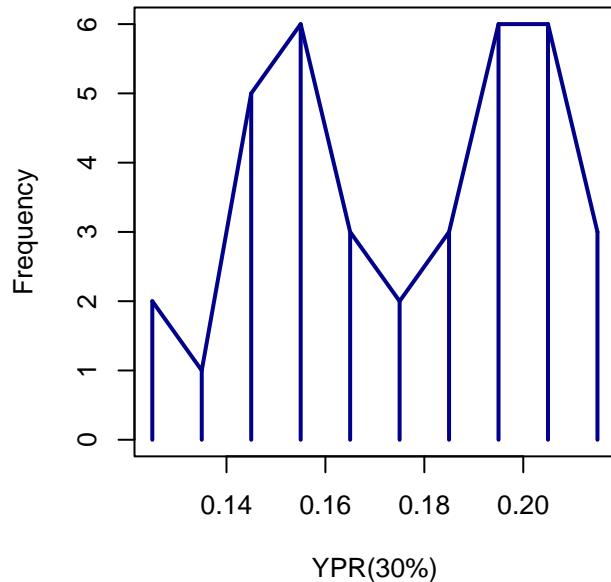
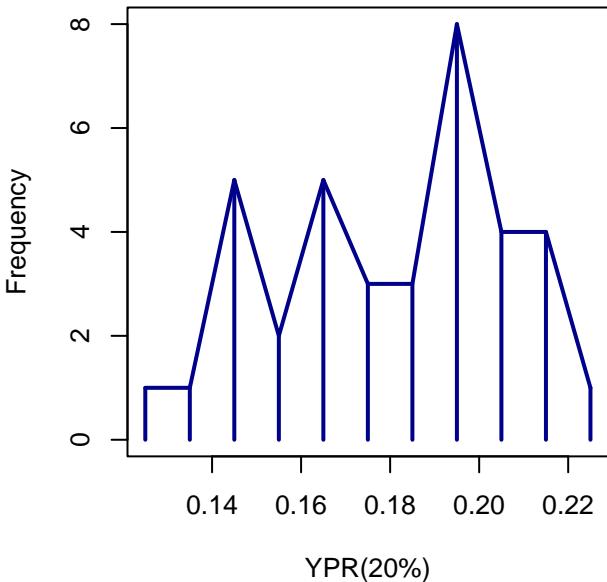
## Annual YPR(%SPR) Reference Points



### Annual F (%SPR) Reference Points



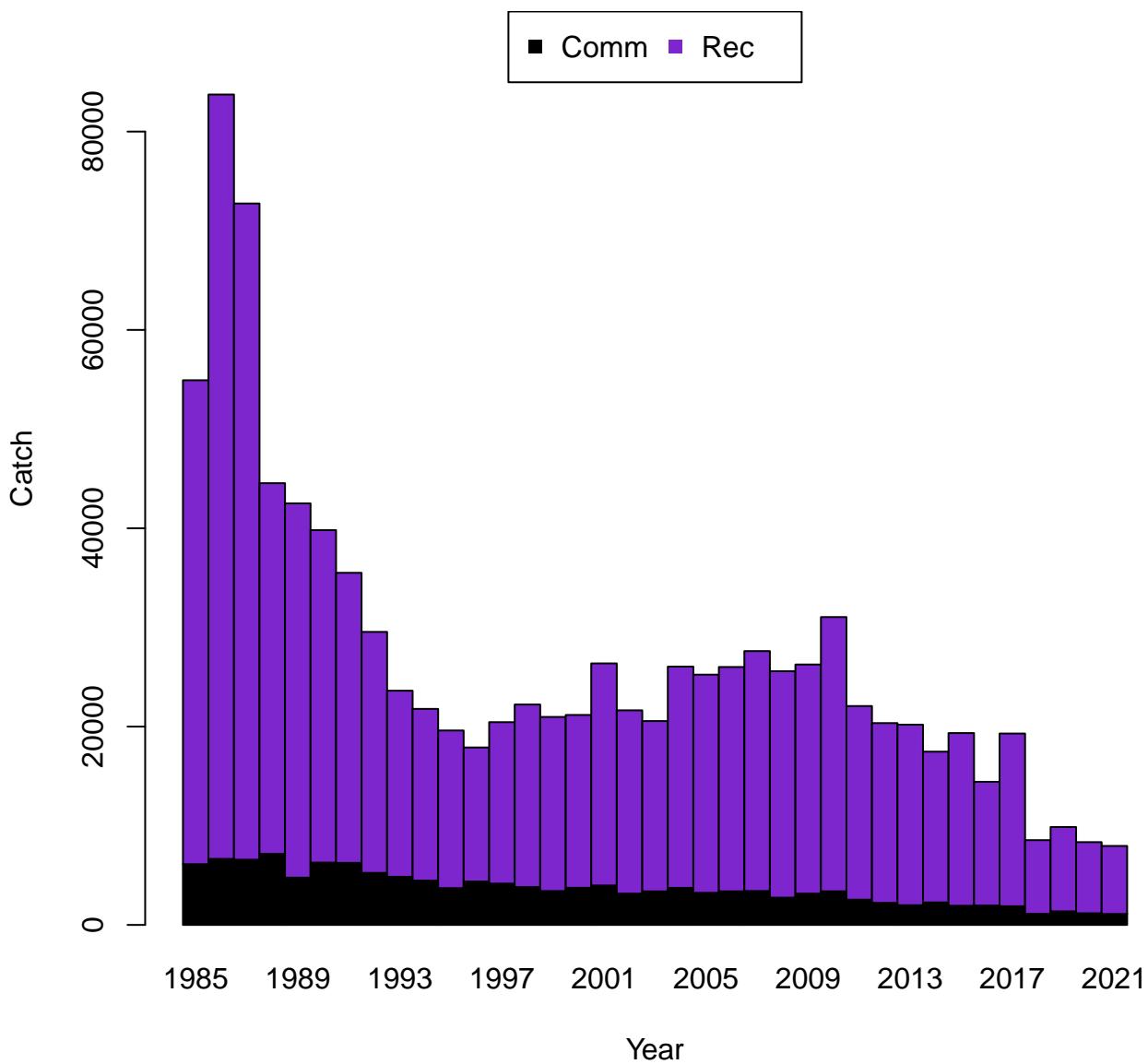
### Annual YPR (%SPR) Reference Points

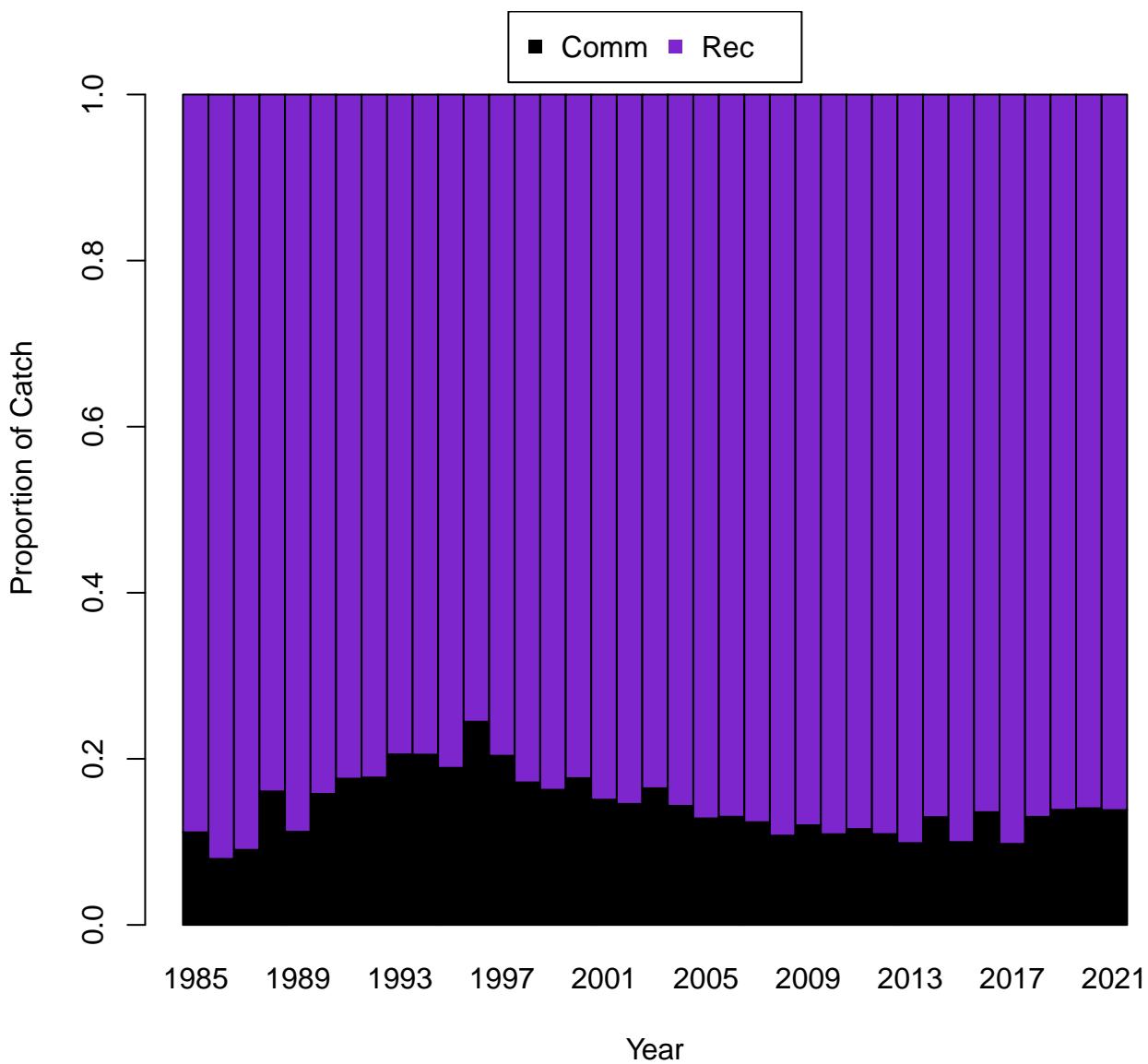


# BF24

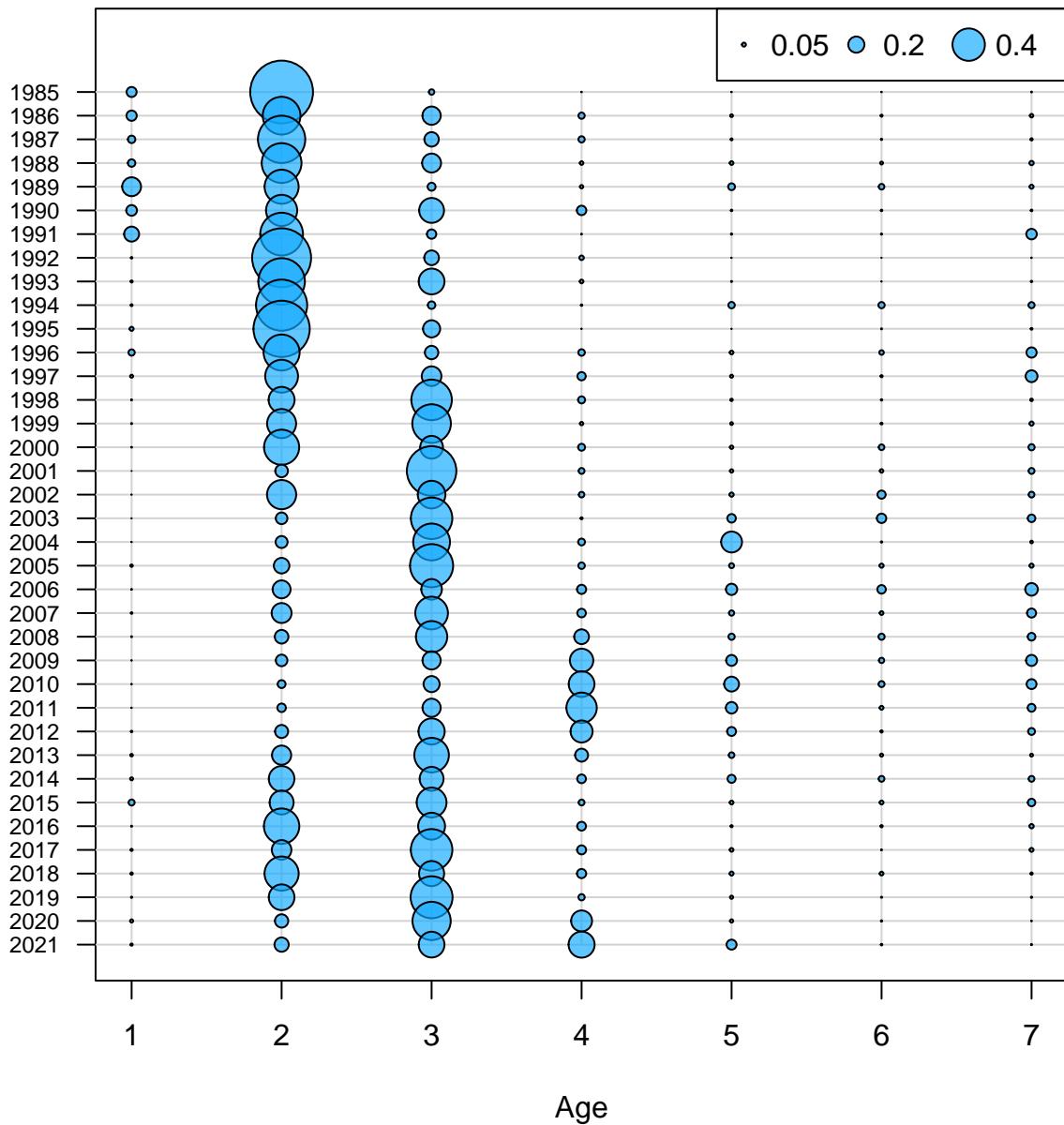
Final ASAP model

## DATA PLOTS

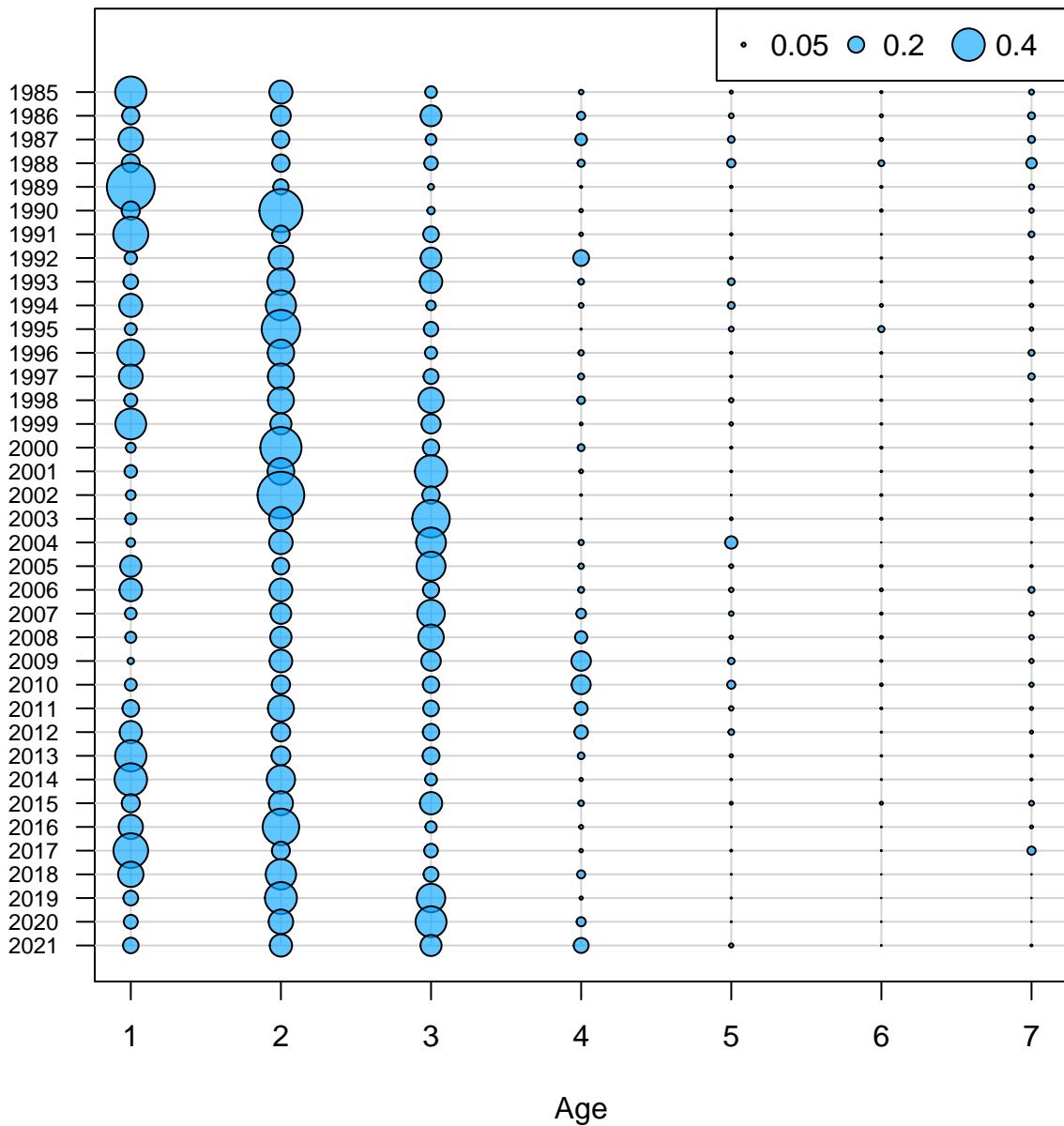


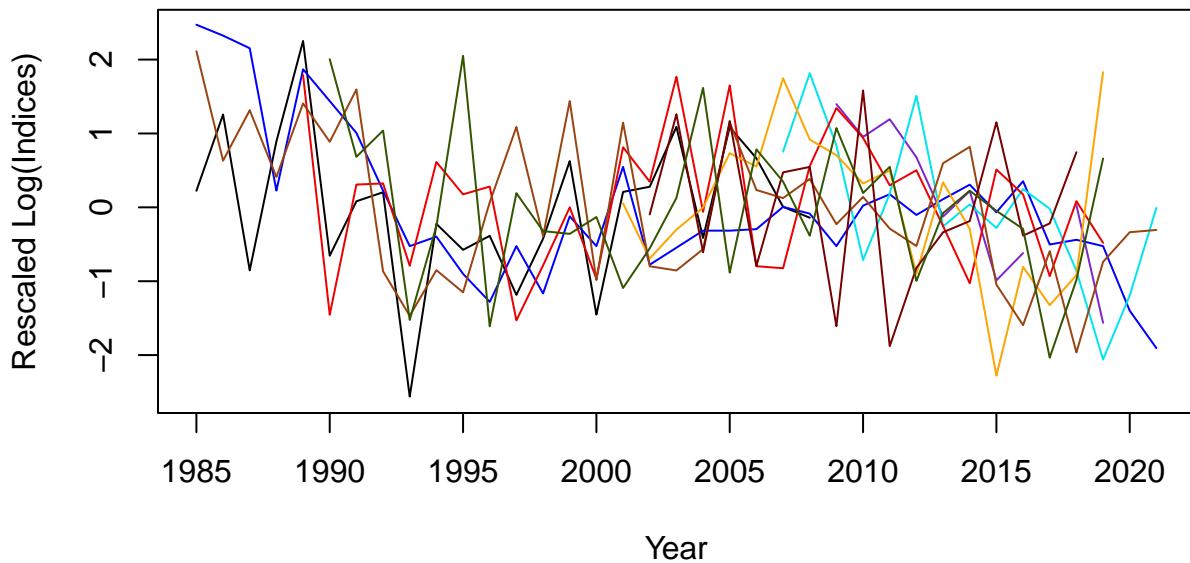
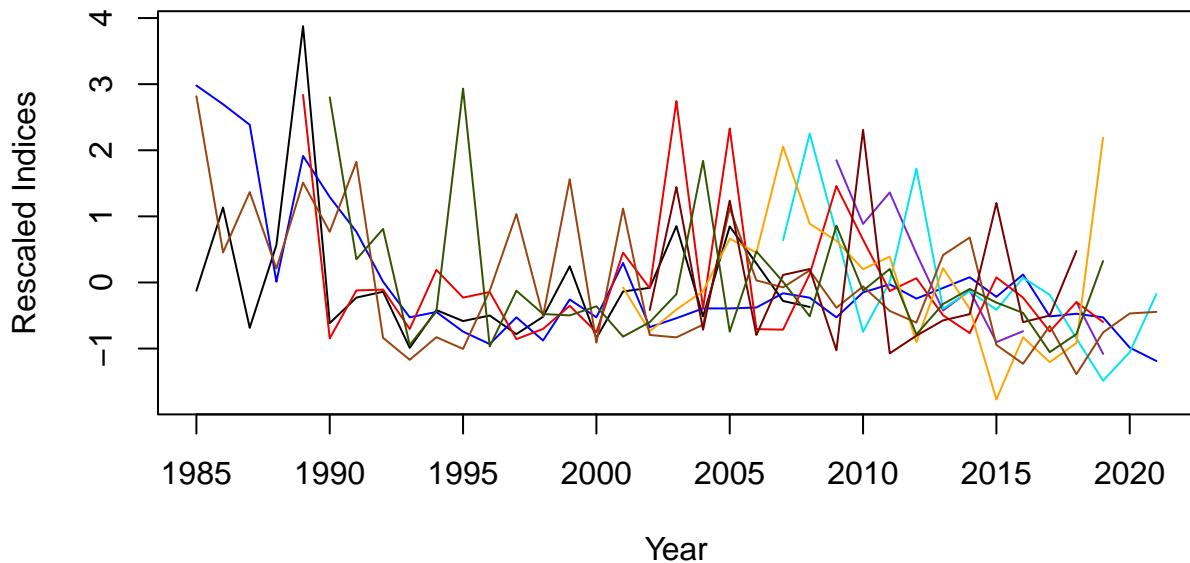


## Age Comps for Catch by Fleet 1 (Comm)

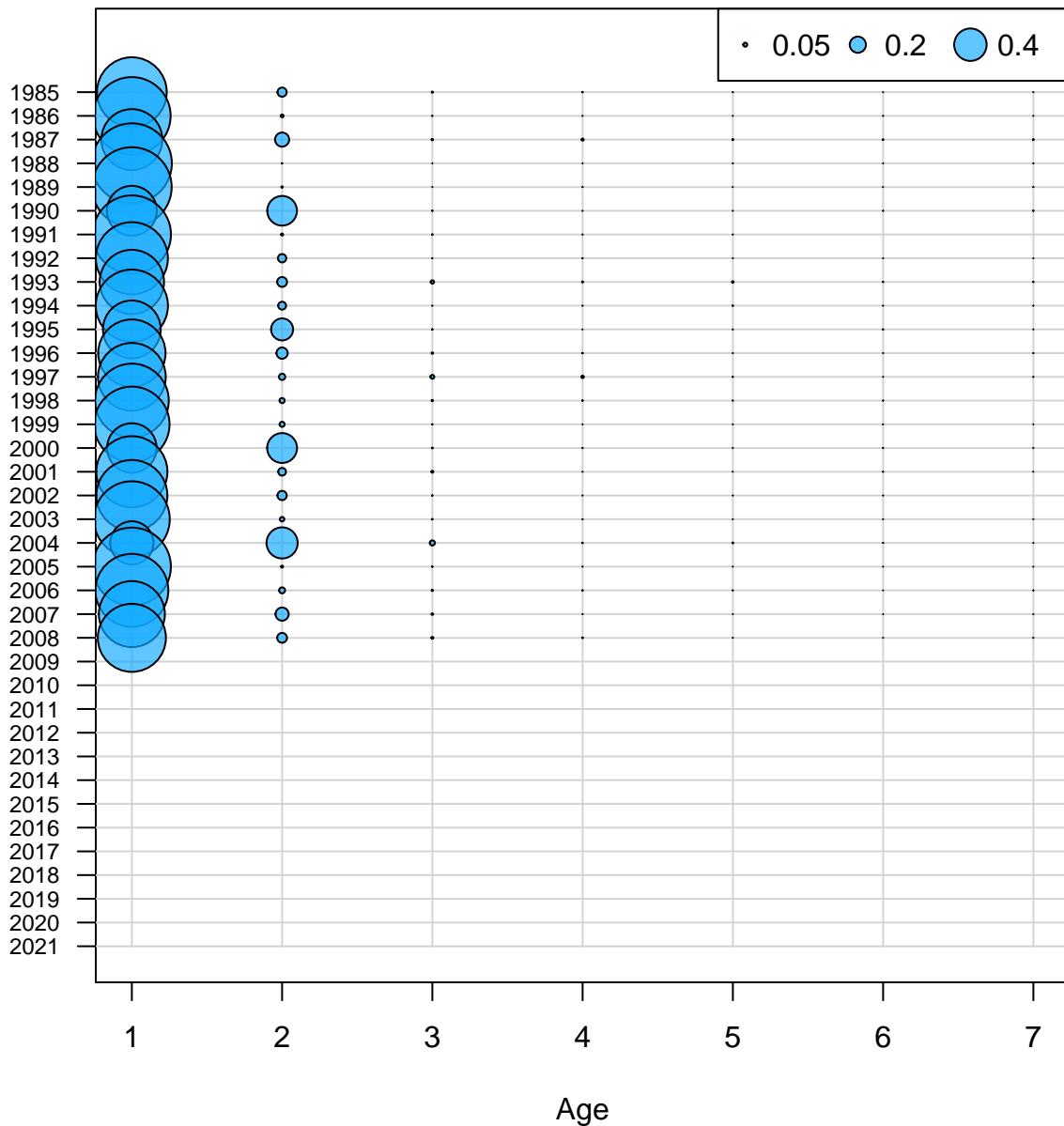


## Age Comps for Catch by Fleet 2 (Rec)

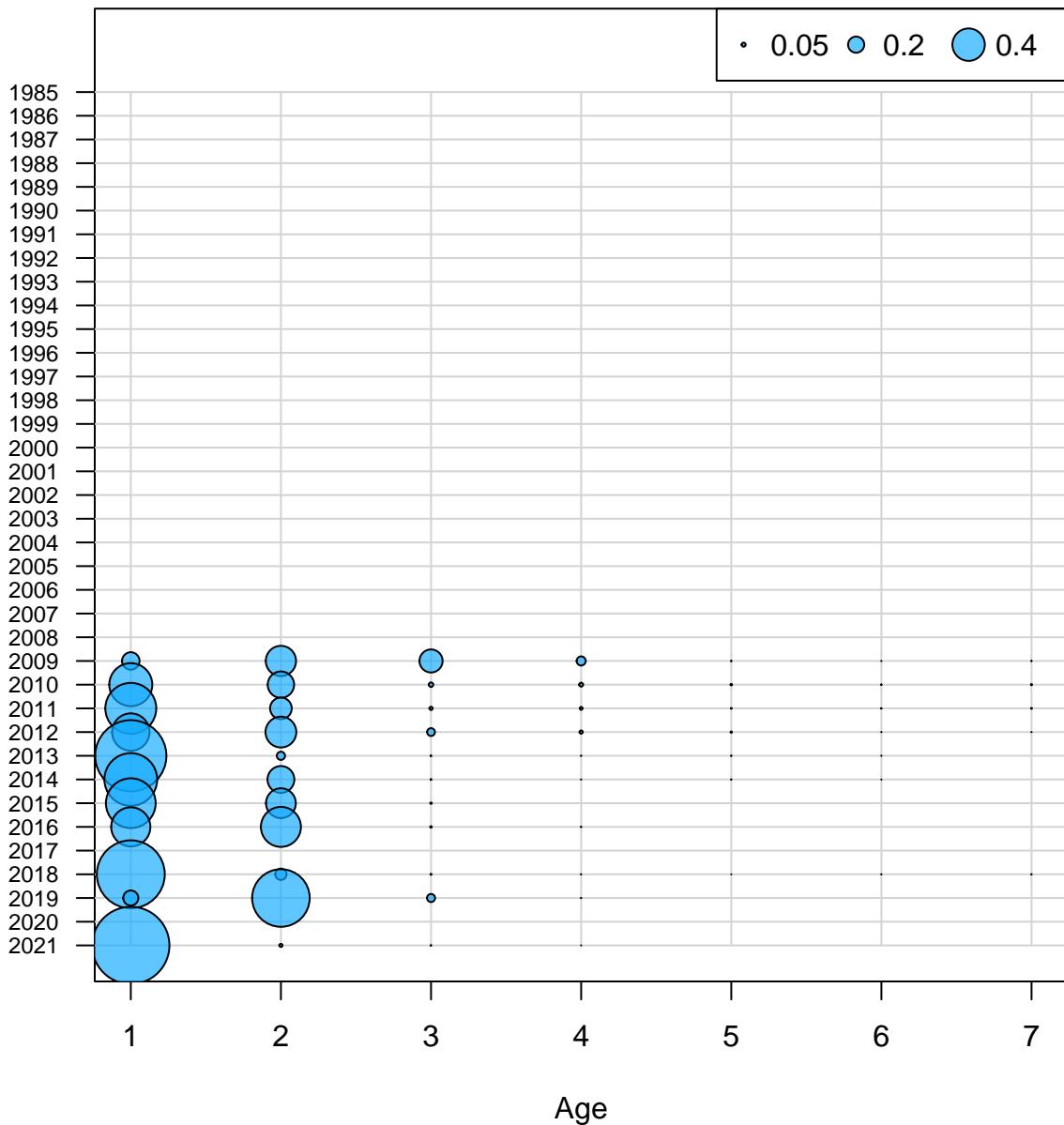




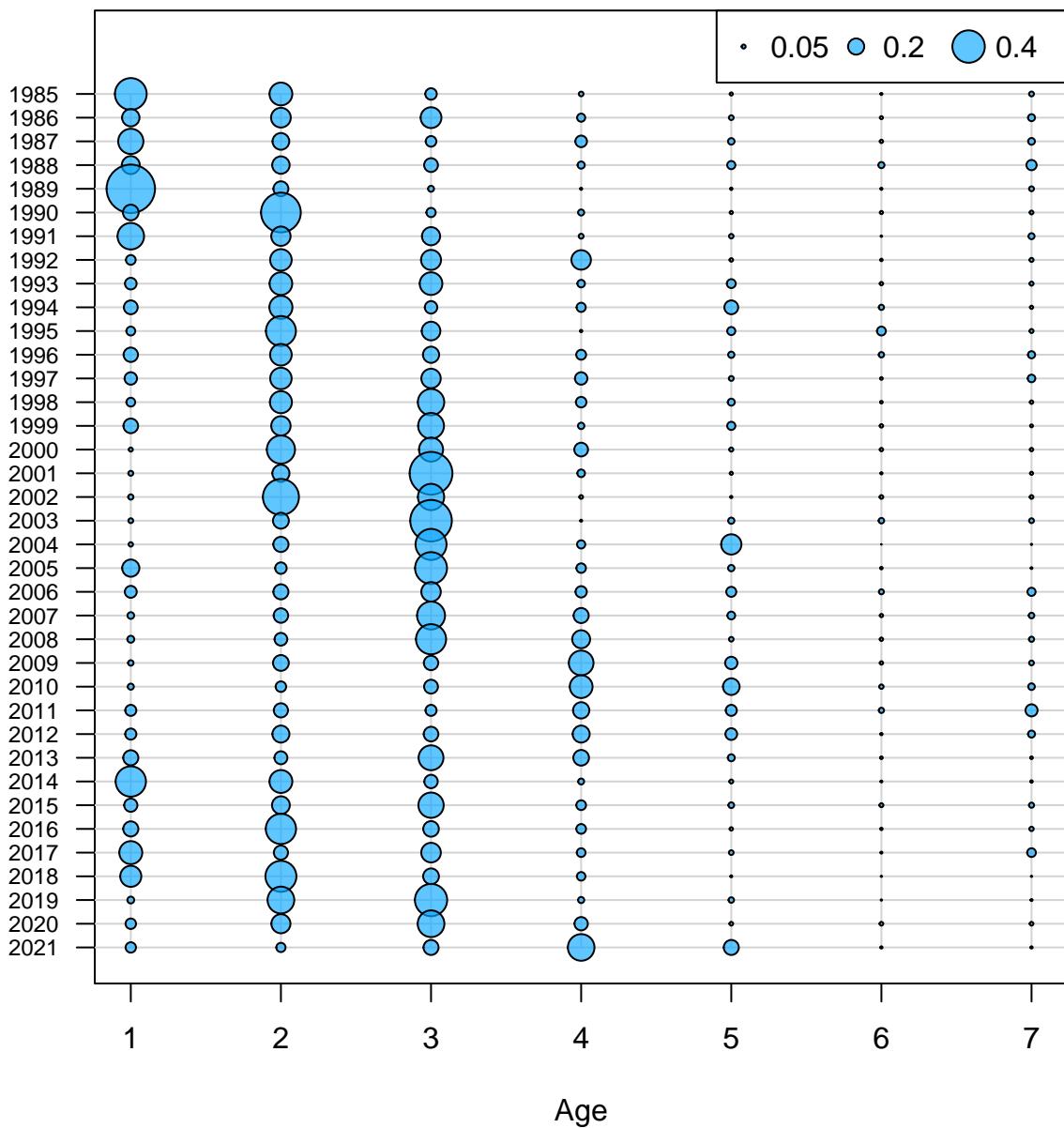
## Age Comps for Index 1 (NEFSC Inshore)



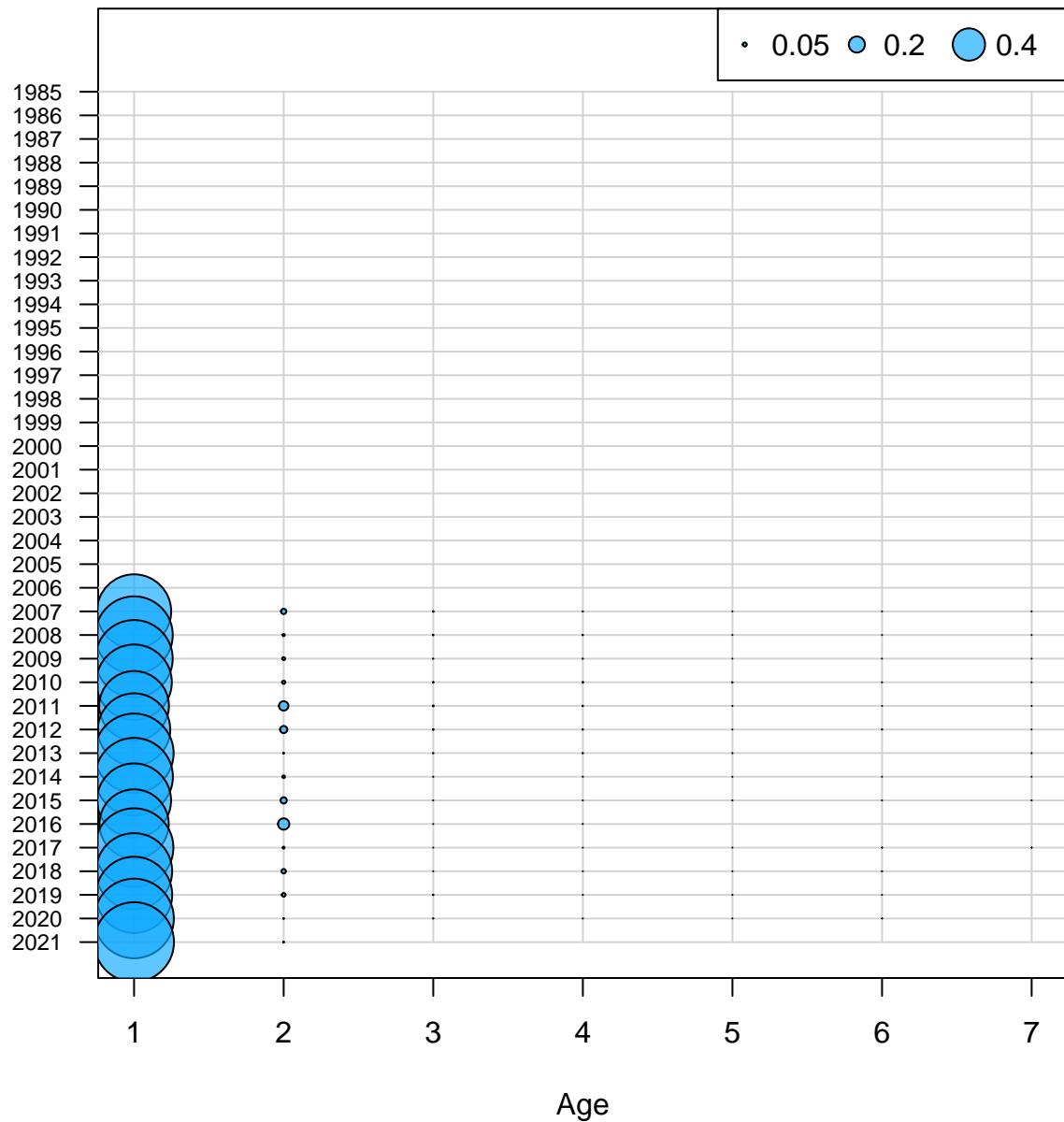
## Age Comps for Index 2 (Bigelow)



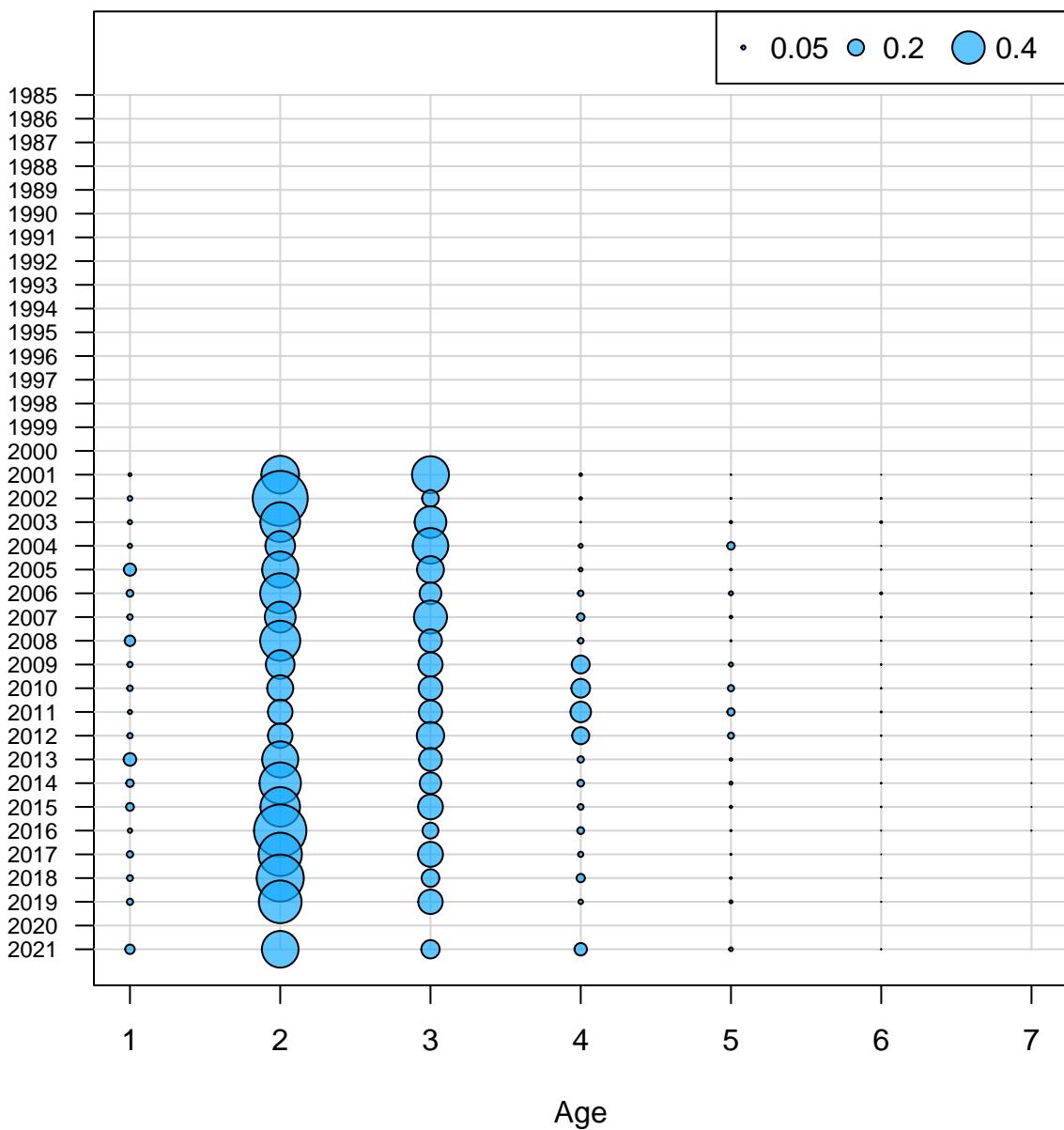
## Age Comps for Index 3 (MRIP)



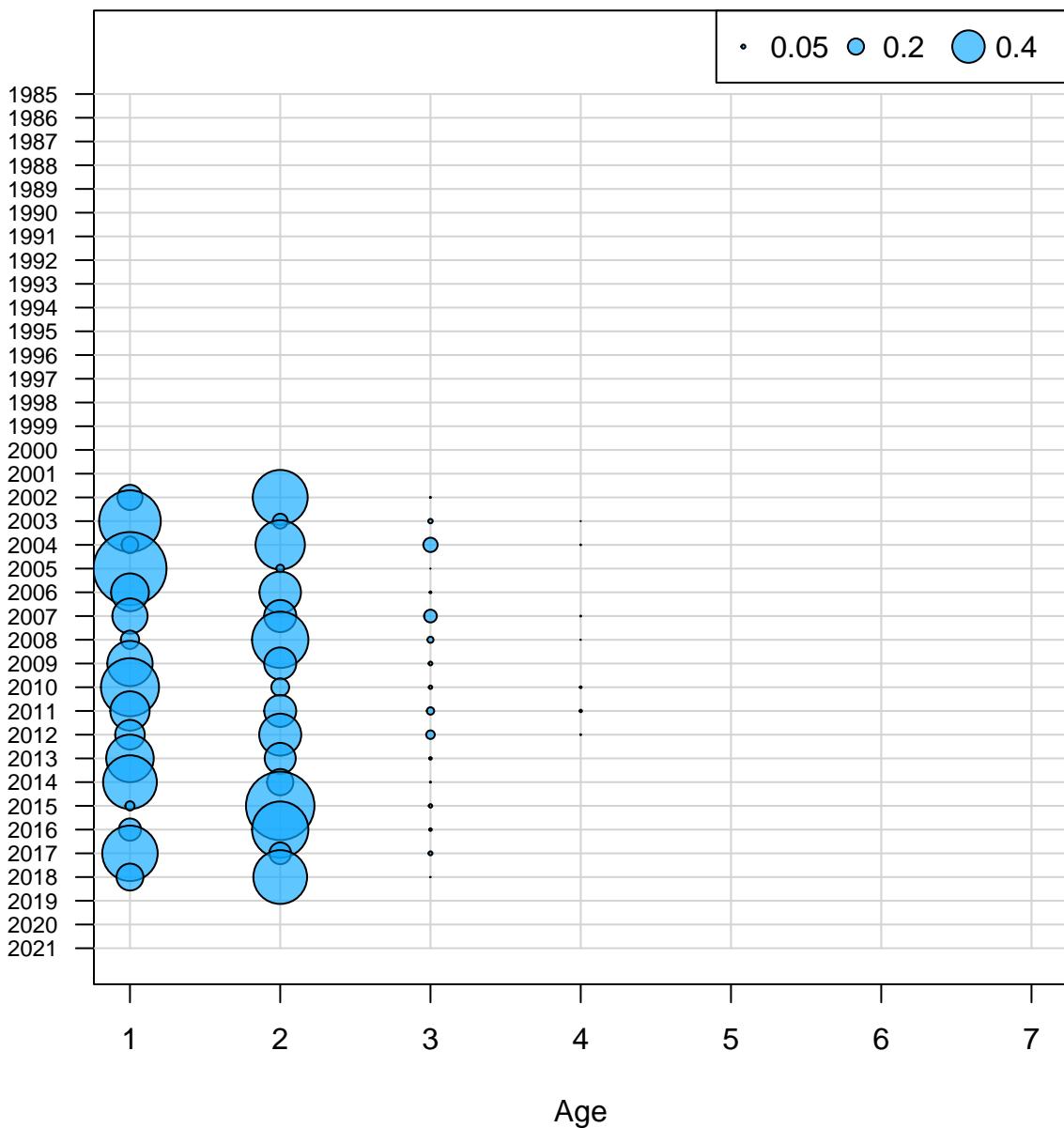
## **Age Comps for Index 4 (NEAMAP)**



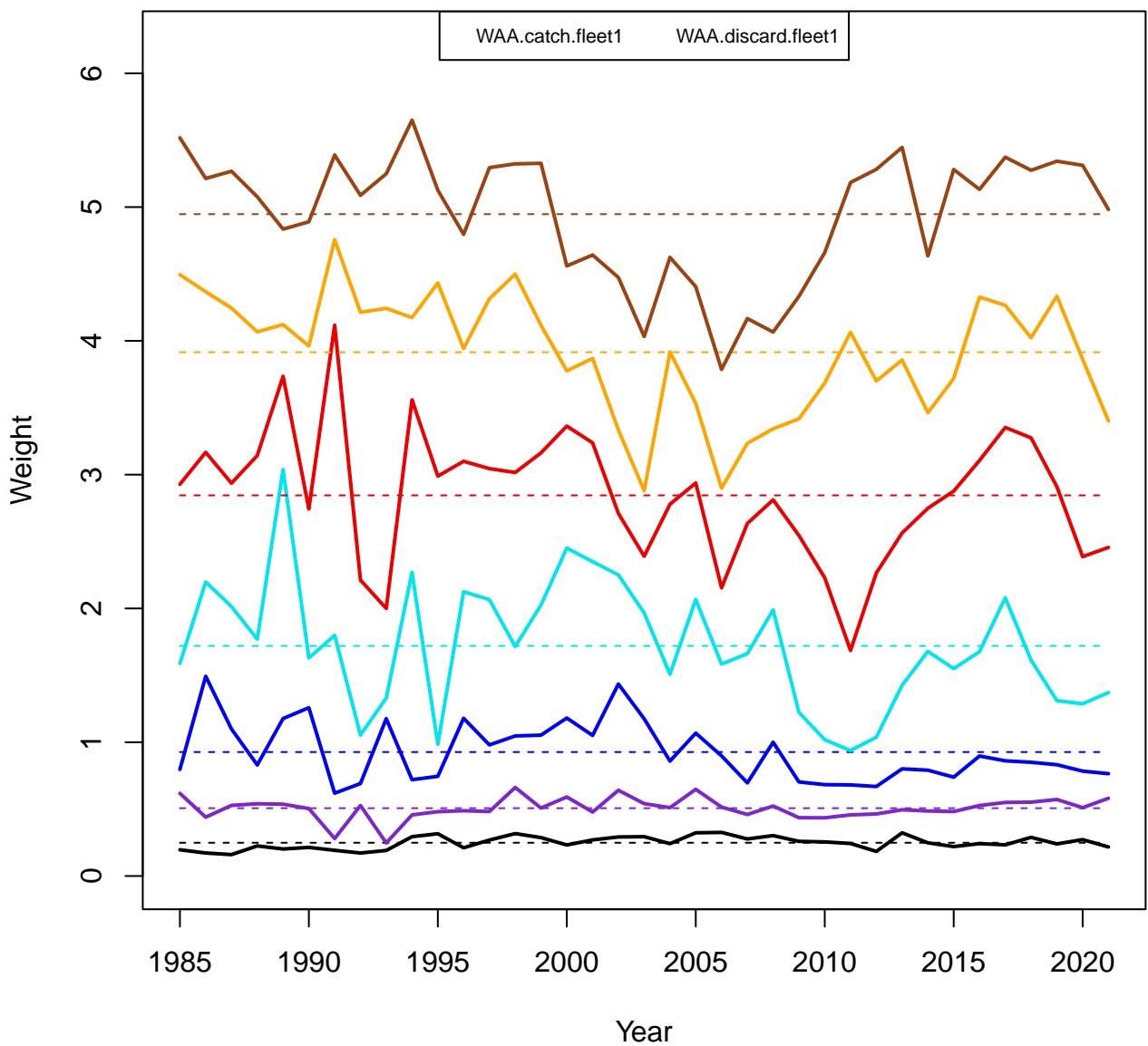
## Age Comps for Index 6 (PSIGN)



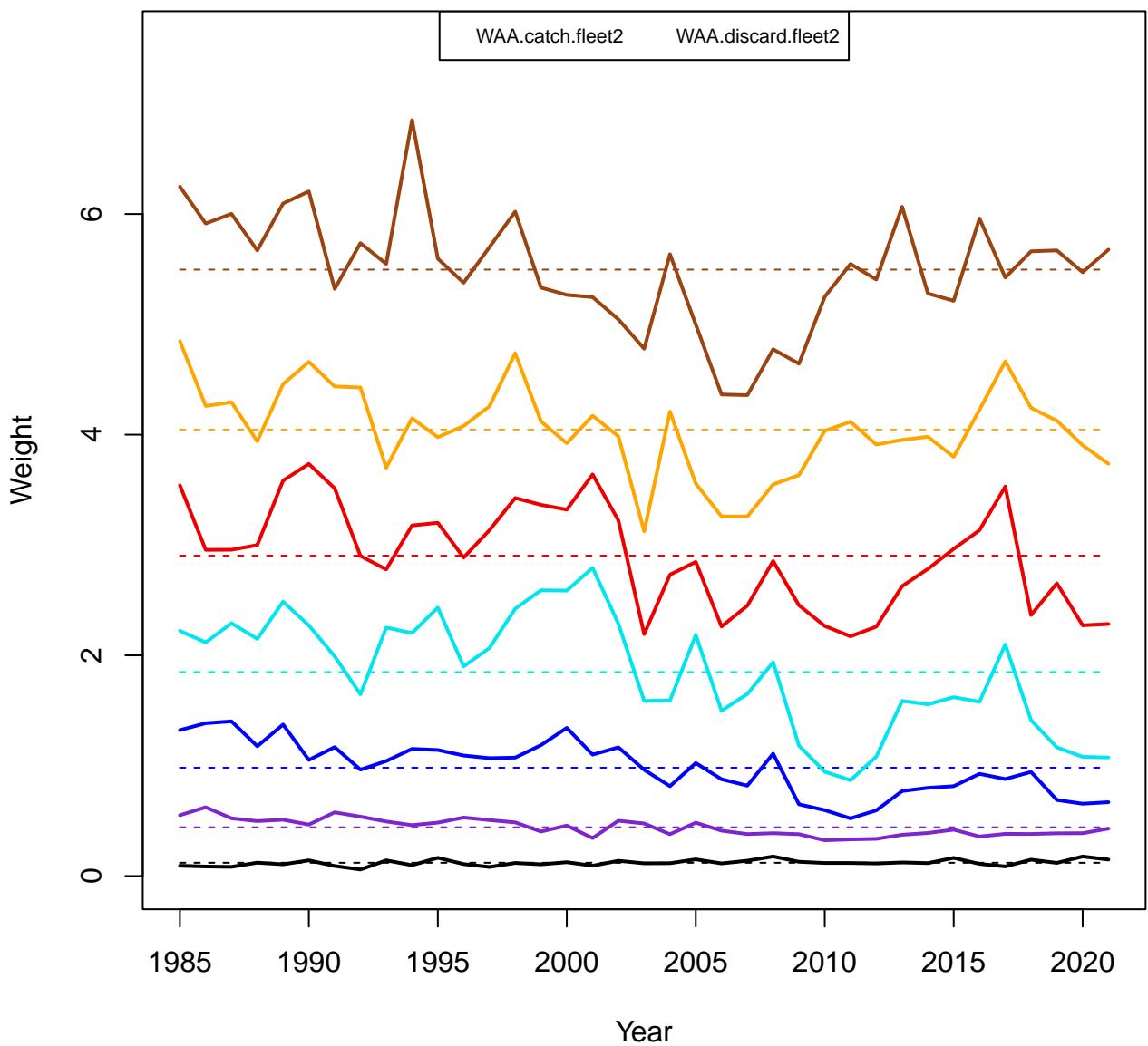
## Age Comps for Index 8 (ChesMMAP)



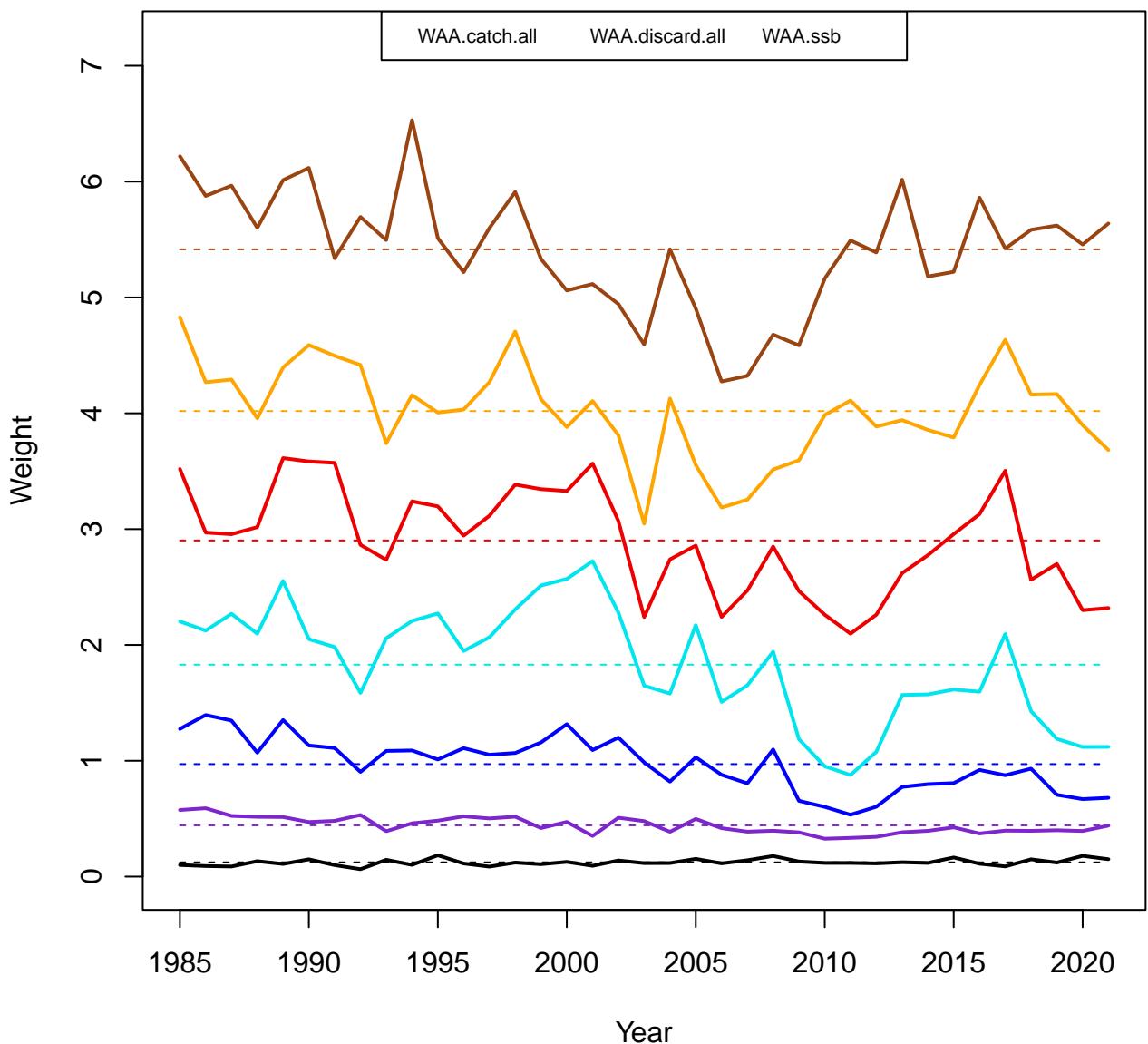
## WAA matrix 1



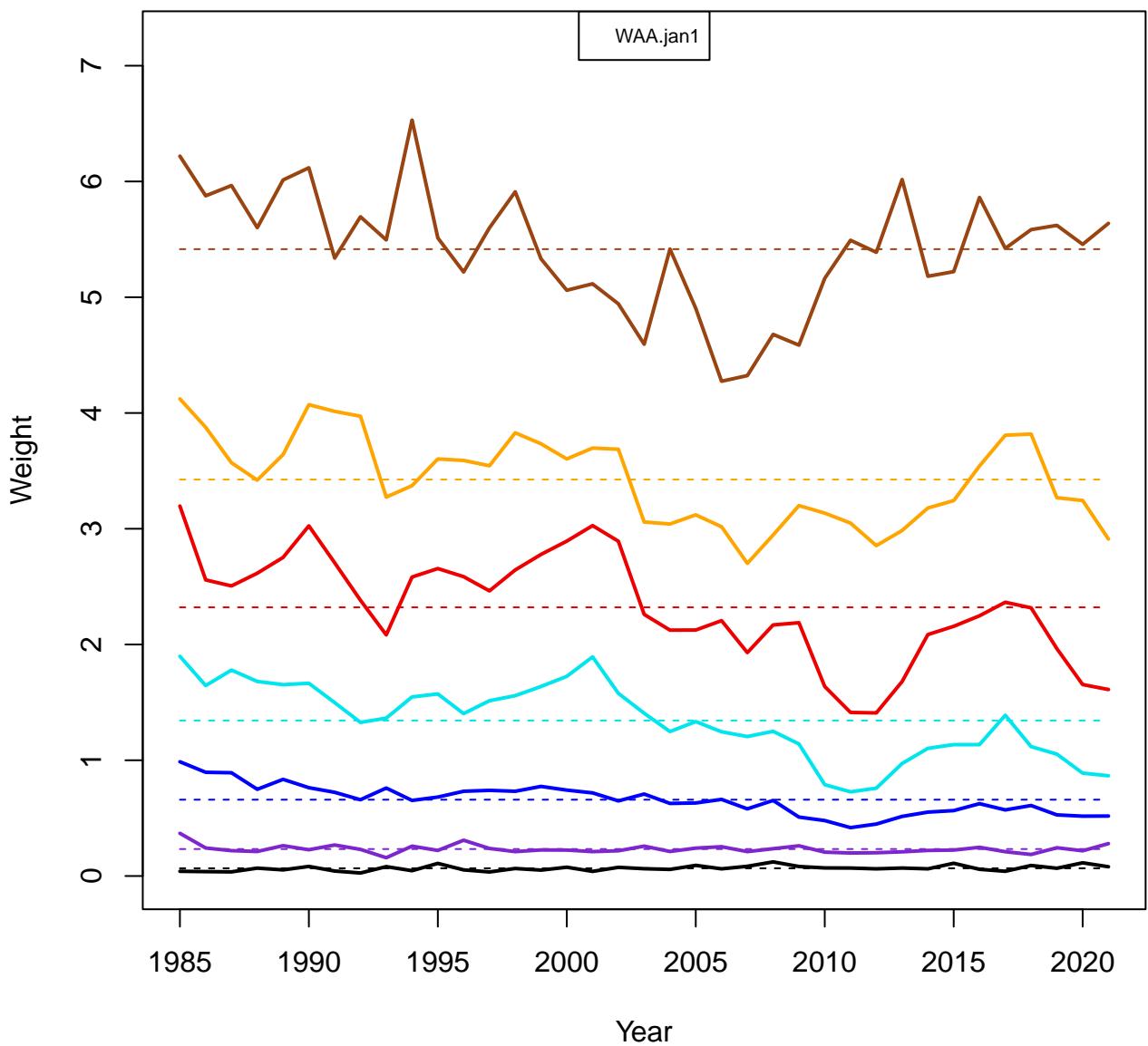
## WAA matrix 2



### WAA matrix 3



## WAA matrix 4



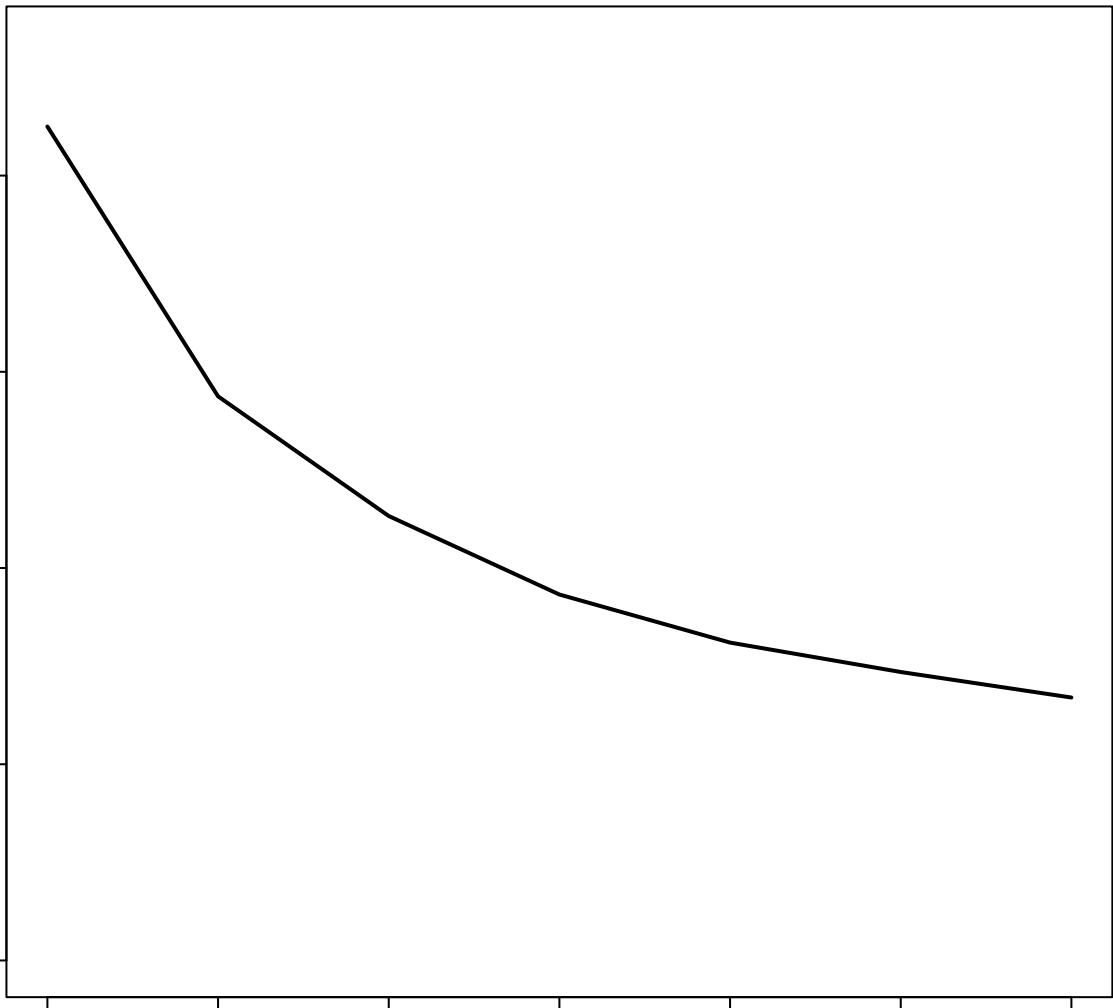
**M**

Natural Mortality Rate

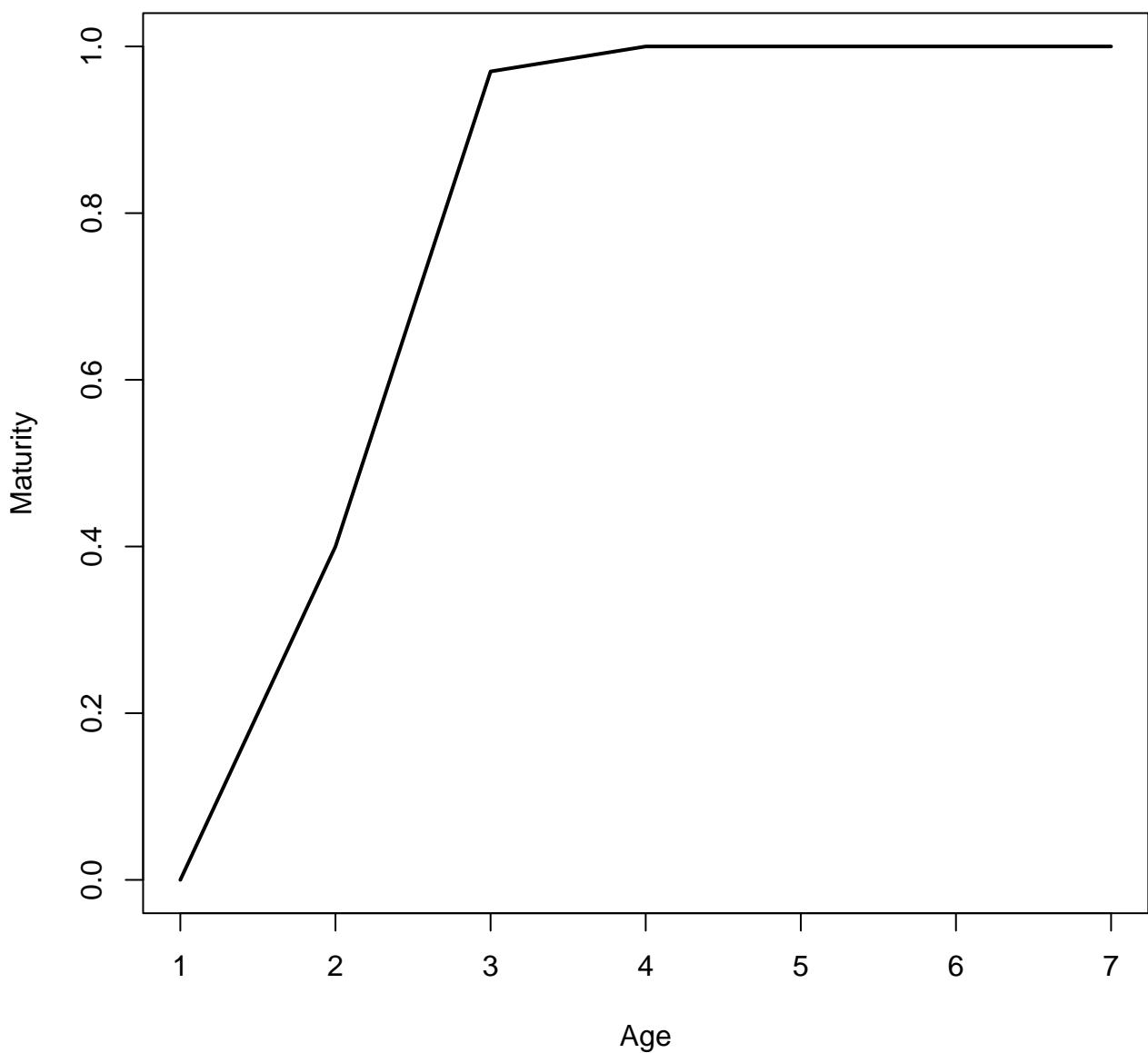
0.8  
0.6  
0.4  
0.2  
0.0

1 2 3 4 5 6 7

Age



## Maturity

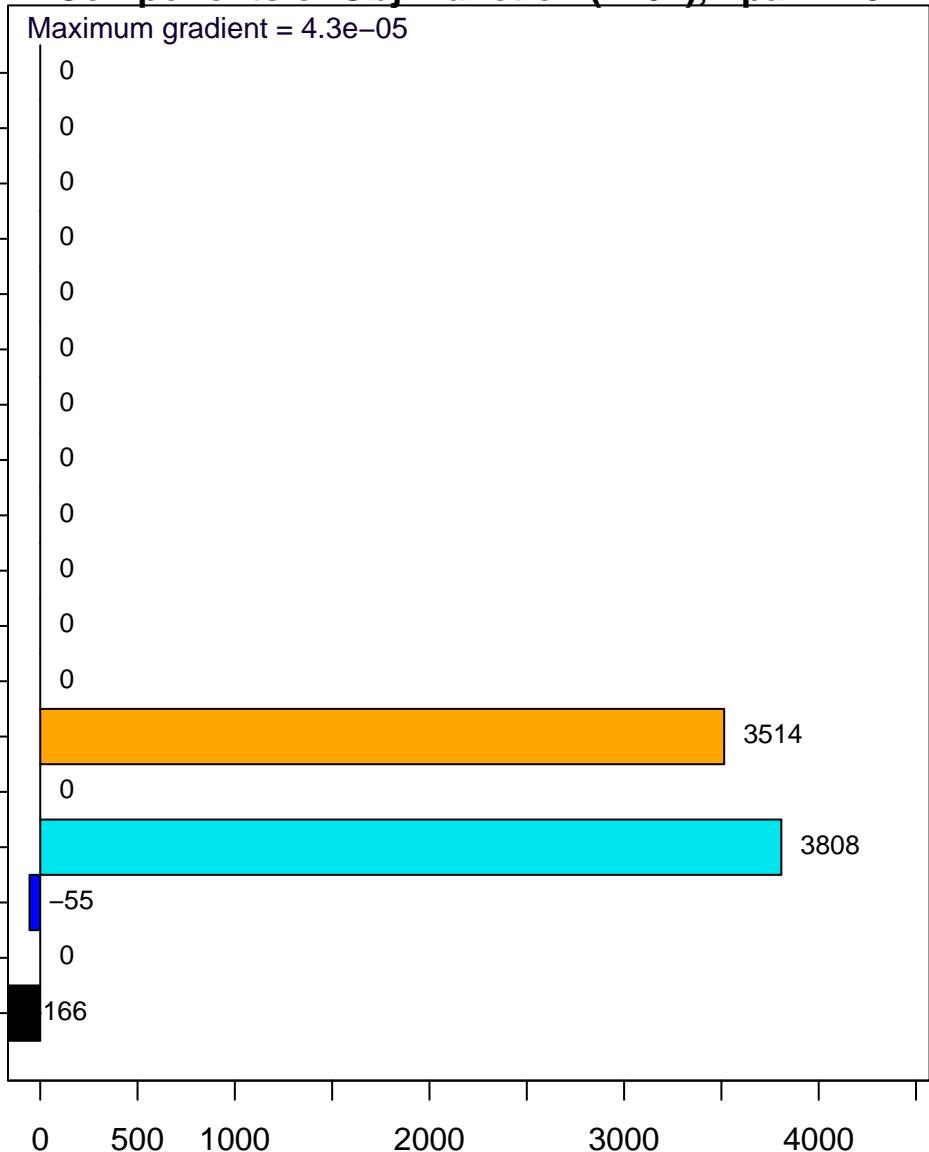


# BF24

Final ASAP model

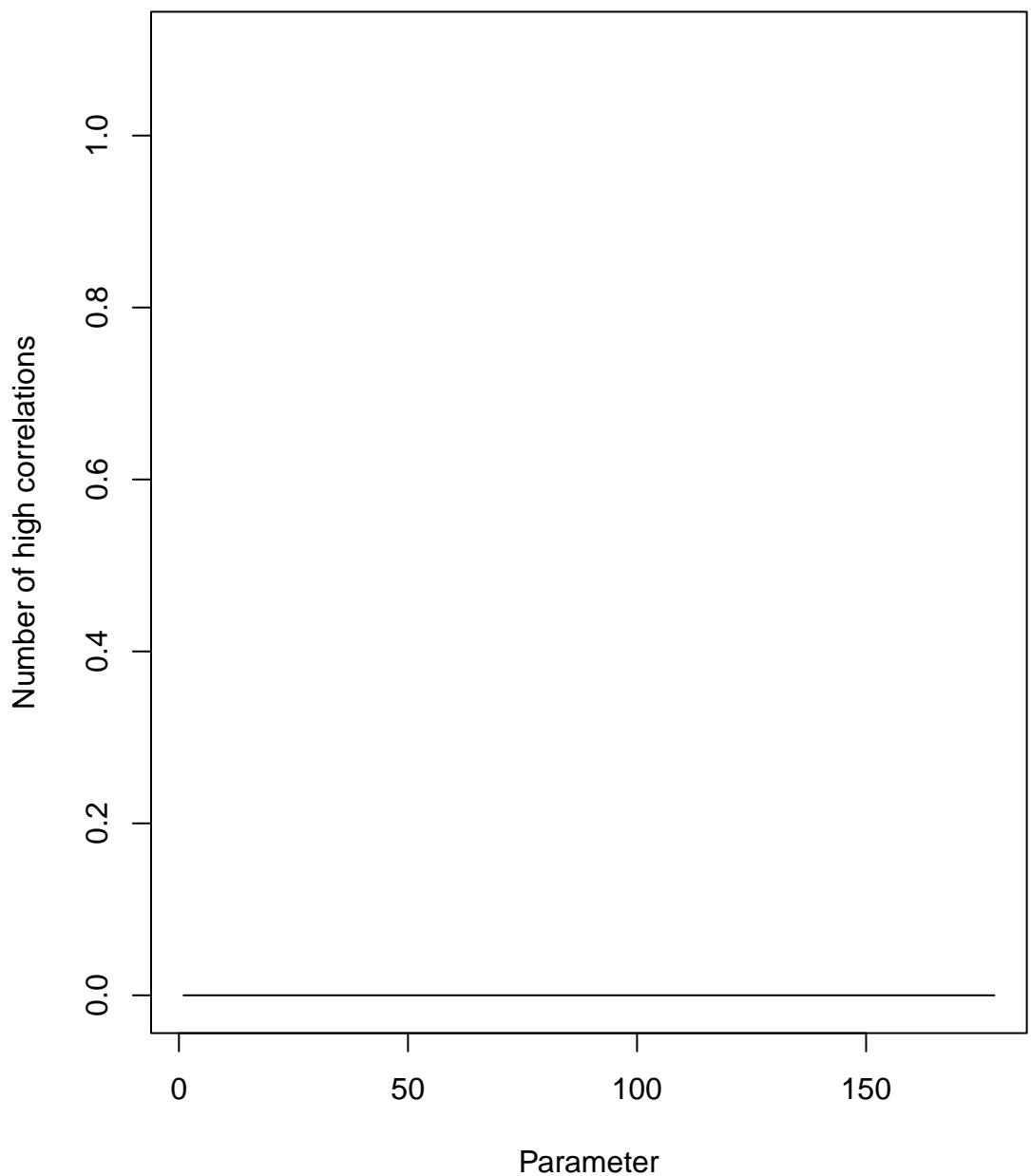
## DIAGNOSTIC PLOTS

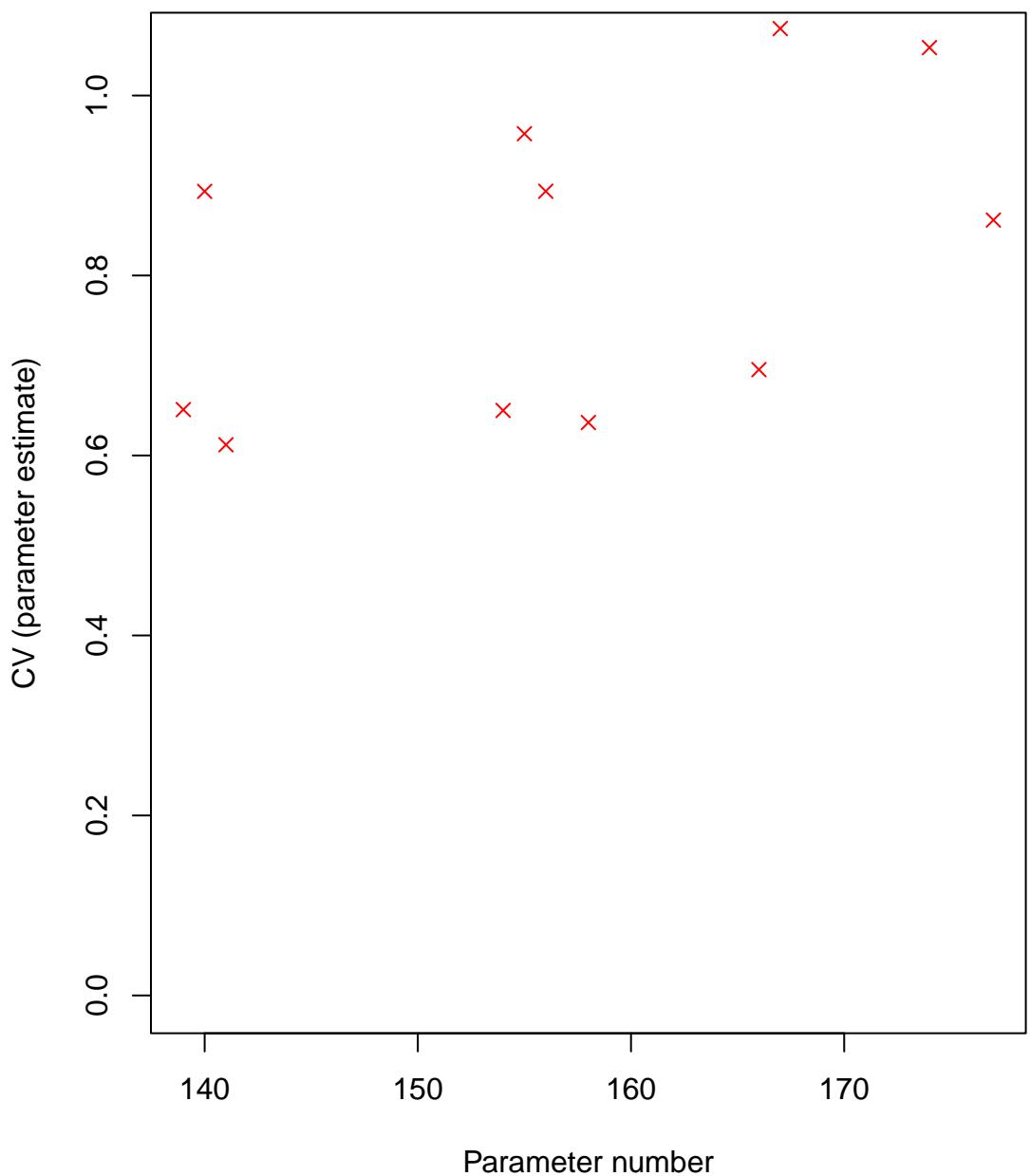
# Components of Obj. Function (7102), npar=178



Likelihood Contribution

Model: BF24    Tuesday, 18 Oct 2022 at 10:39:21

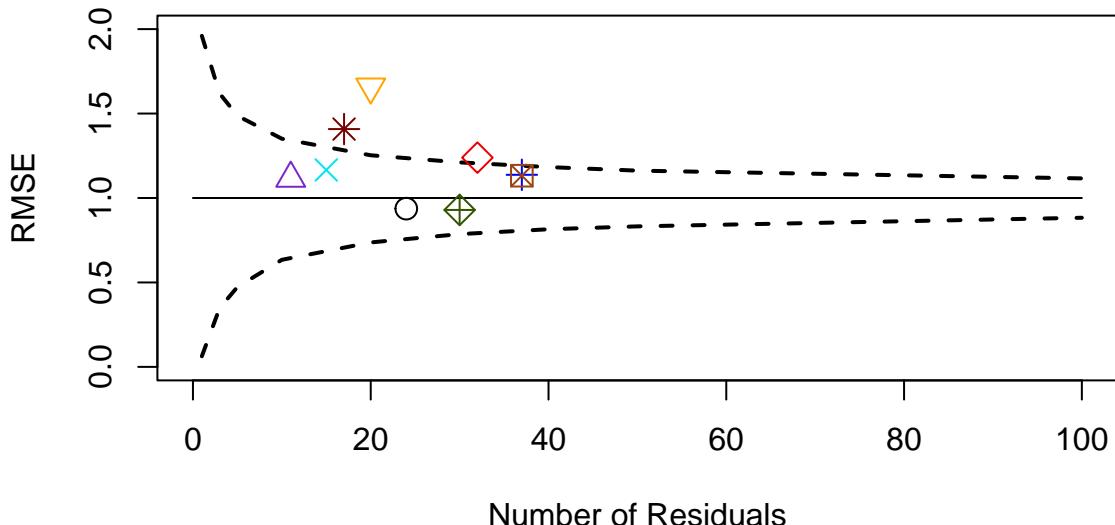




## Root Mean Square Error computed from Standardized Residuals

Component	# resid	RMSE
catch.fleet1	37	0.0923
catch.fleet2	37	0.567
catch.tot	74	0.406
discard.fleet1	0	0
discard.fleet2	0	0
discard.tot	0	0
ind01	24	0.937
ind02	11	1.12
ind03	37	1.14
ind04	15	1.17
ind05	32	1.24
ind06	20	1.66
ind07	37	1.13
ind08	17	1.41
ind09	30	0.929
ind.total	223	1.19
N.year1	0	0
Fmult.year1	0	0
Fmult.devs.fleet1	0	0
Fmult.devs.fleet2	0	0
Fmult.devs.total	0	0
recruit.devs	0	0
fleet.sel.params	0	0
index.sel.params	0	0
q.year1	0	0
q.devs	0	0
SR.steepness	0	0
SR.scaler	0	0

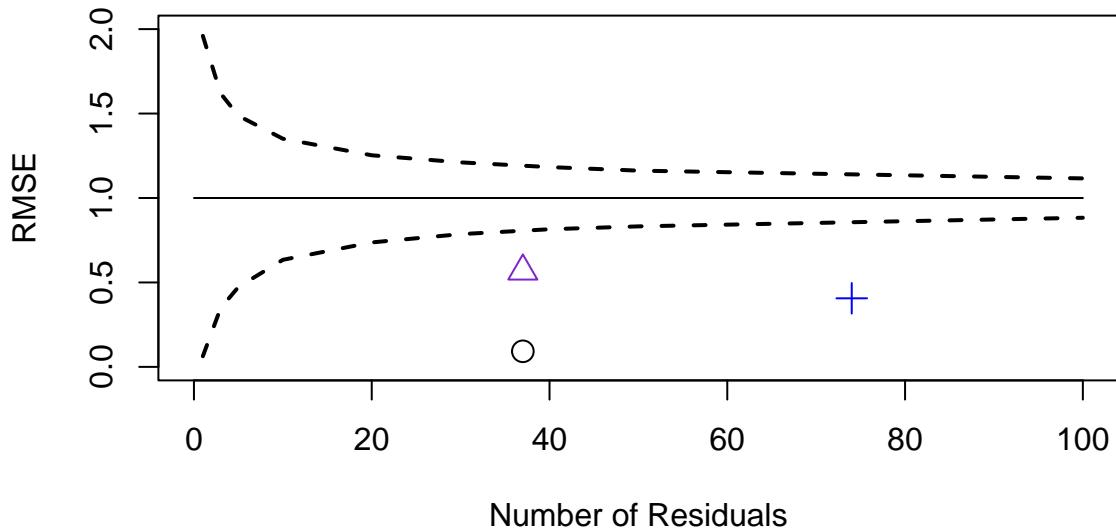
## Root Mean Square Error for Indices



Legend:

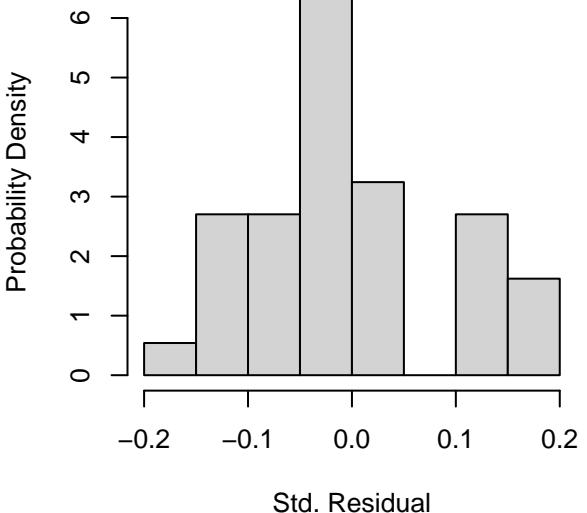
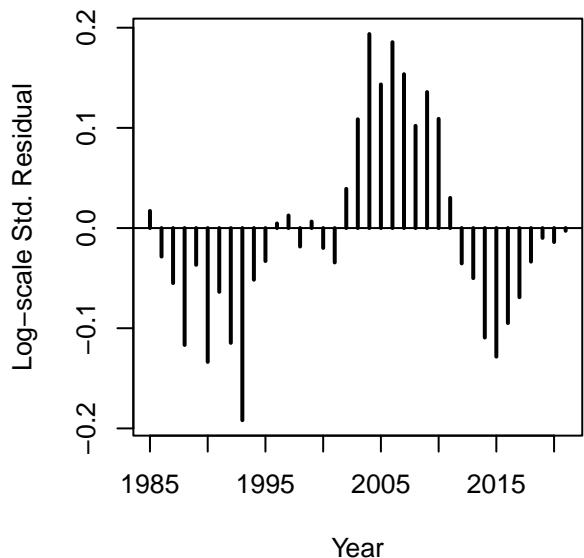
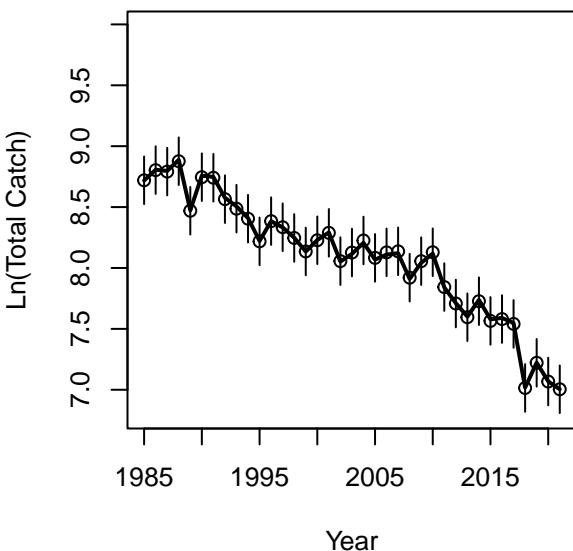
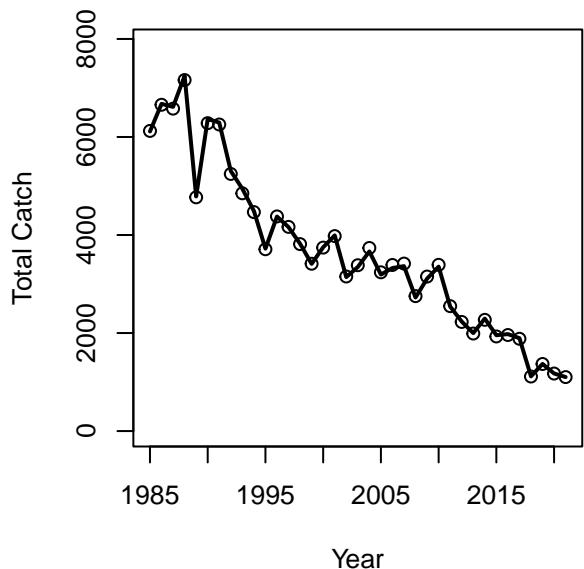
- ind total
- SEAMAP1
- ChesMMAP
- Compound YOY
- BIGN
- SEAMAP
- NEAMAP
- MRIP
- Pigelow
- NEFSC Inshore

## Root Mean Square Error for Catch

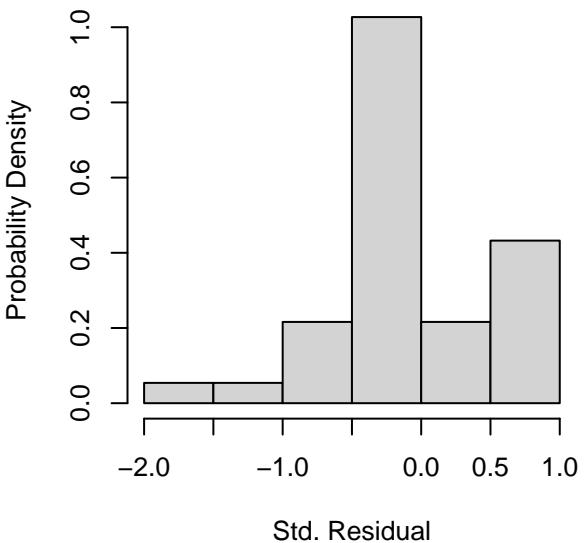
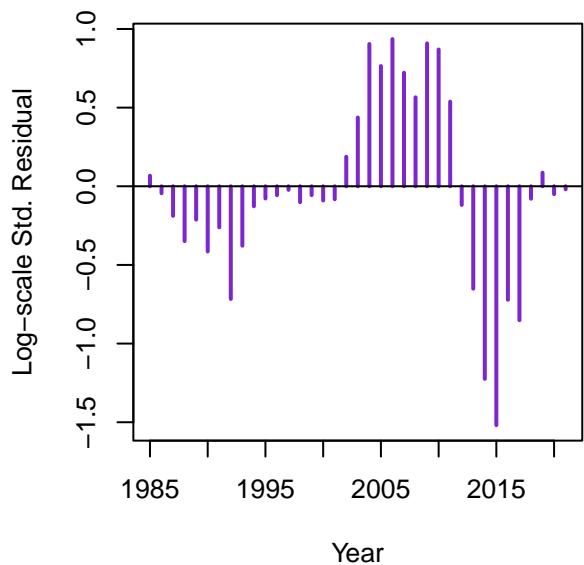
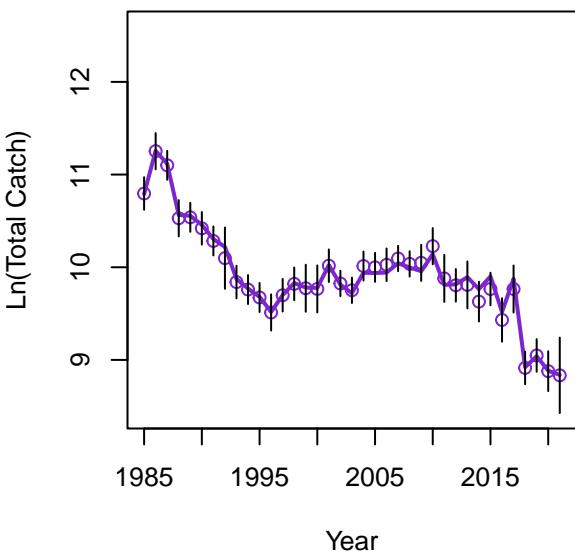
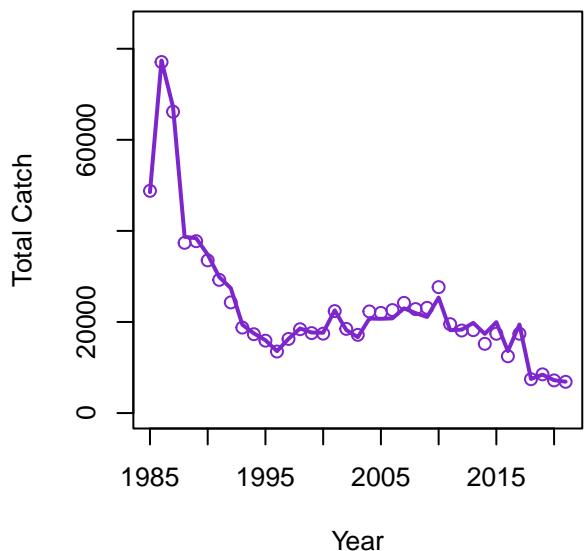


⊕ catch.tot  
○ catch.fleet2  
○ catch.fleet1

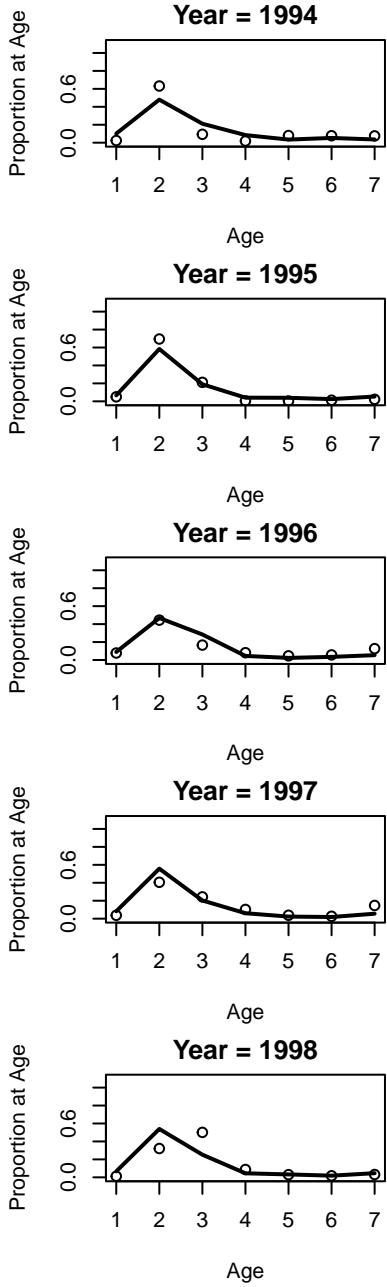
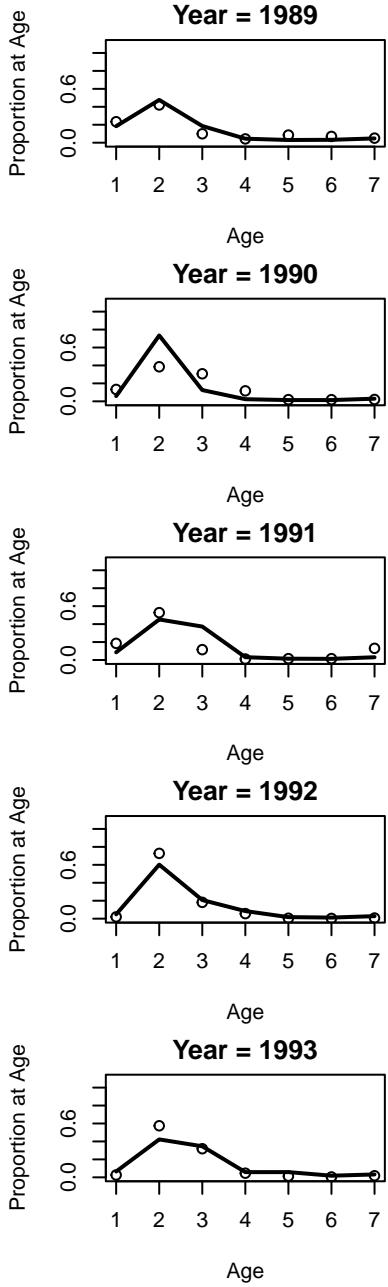
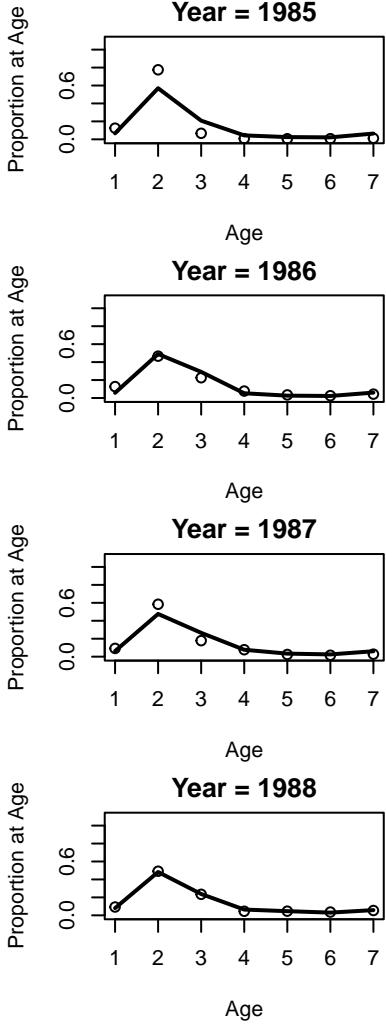
### Fleet 1 Catch (Comm)

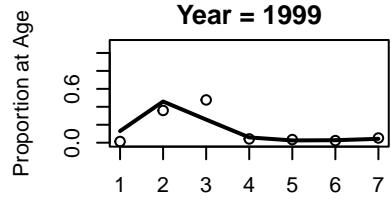


## Fleet 2 Catch (Rec)

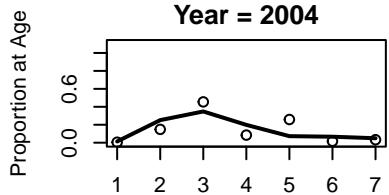


Fleet 1  
Comm  
↓

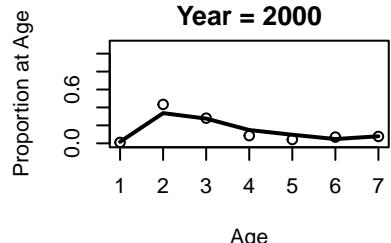




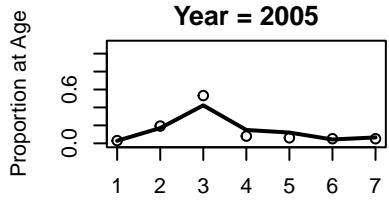
Catch  
Year = 2004



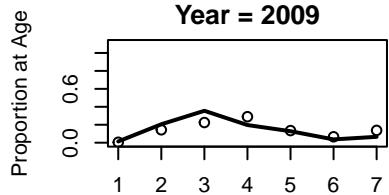
**Year = 2009**



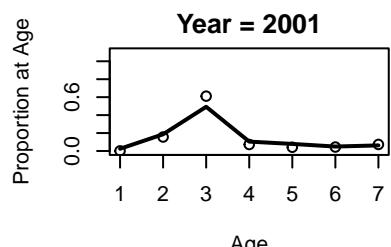
**Year = 2000**



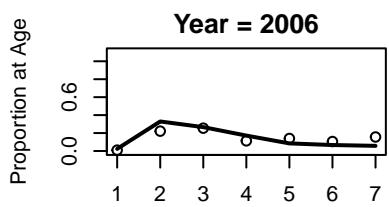
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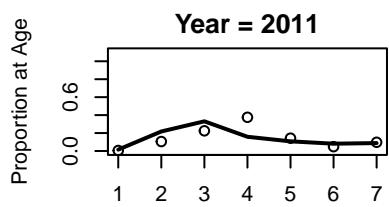
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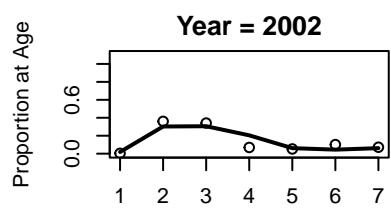
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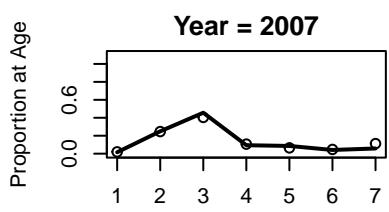
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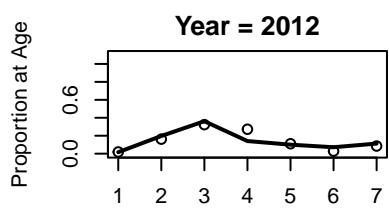
Year = 2011



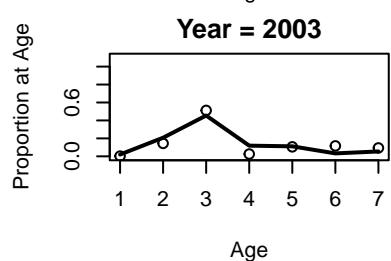
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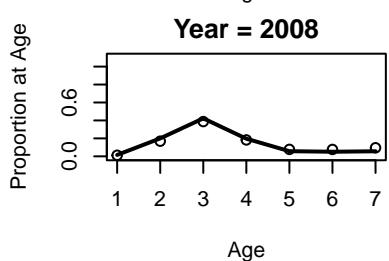
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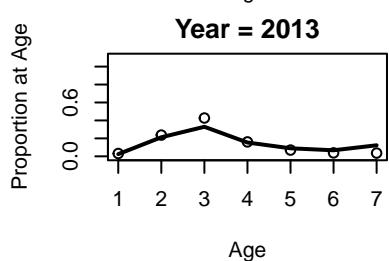
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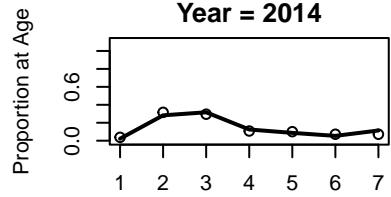
Year - 2003



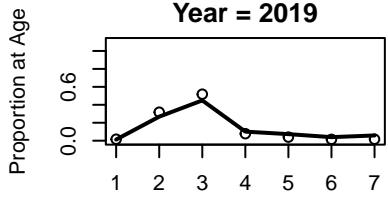
Year - 2008



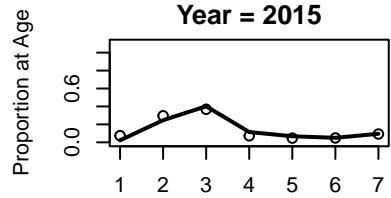
Year - 2013



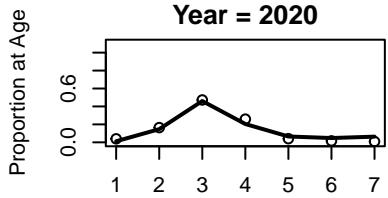
**Catch  
Year = 2019**



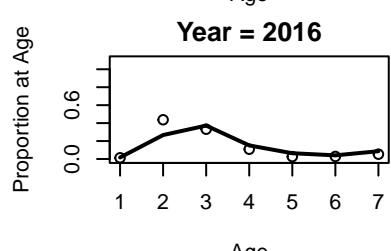
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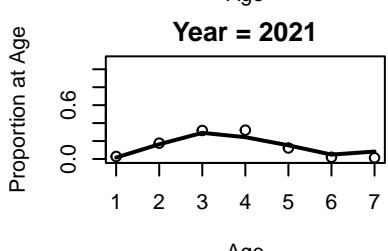
**Year = 2020**



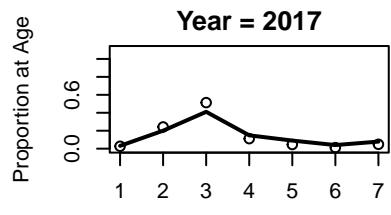
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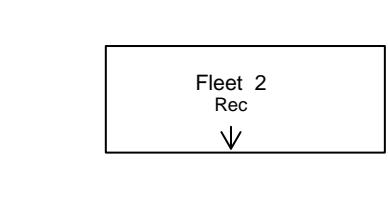
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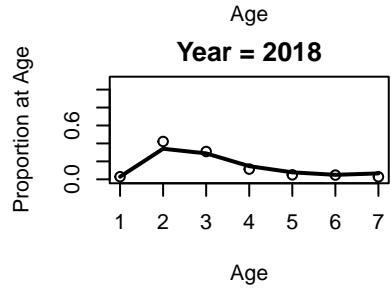
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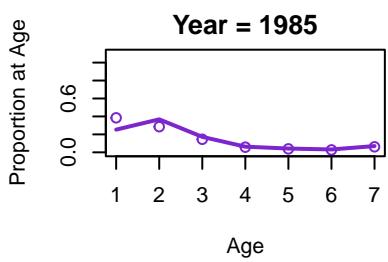
Fleet 2  
Rec  
▼



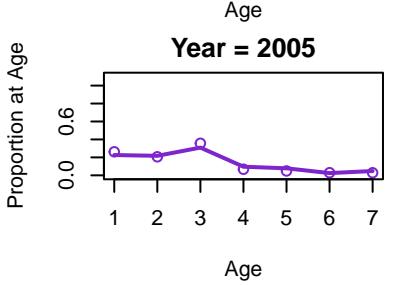
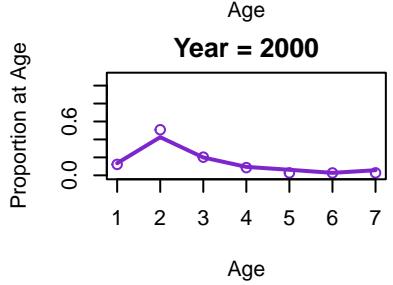
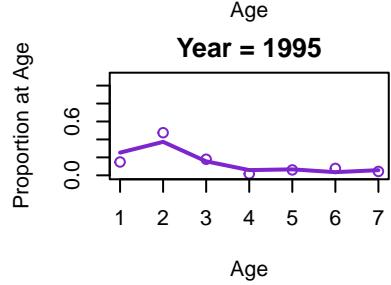
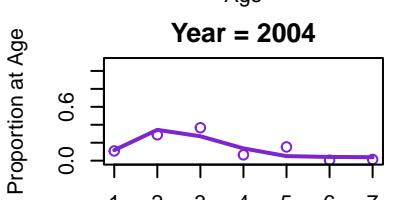
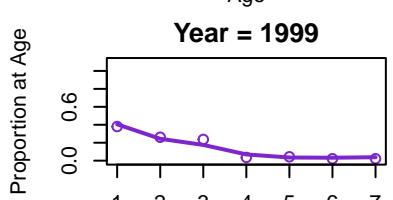
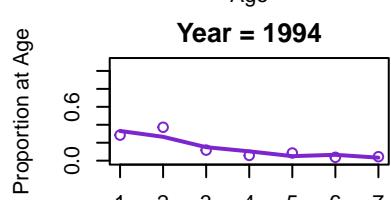
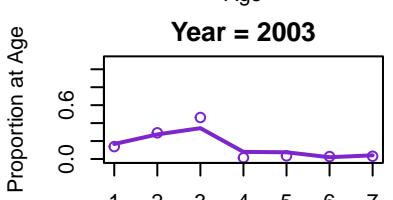
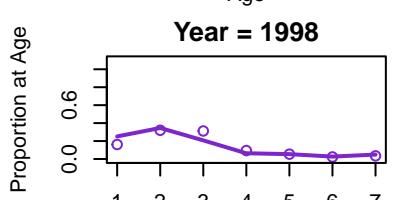
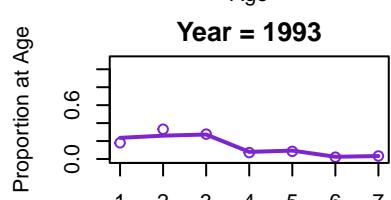
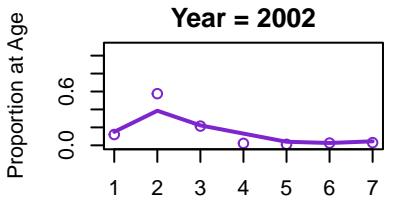
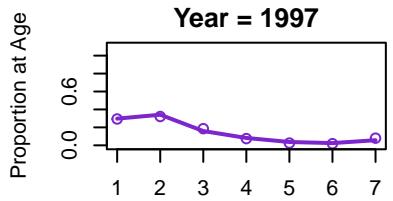
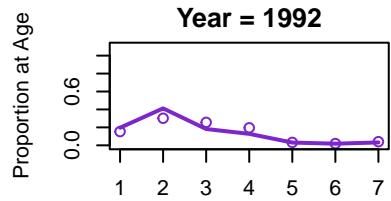
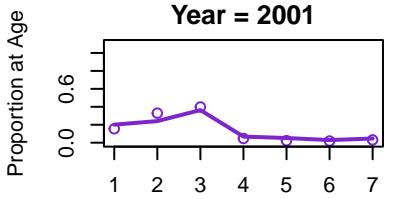
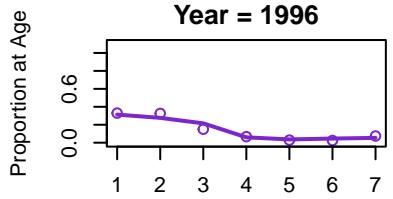
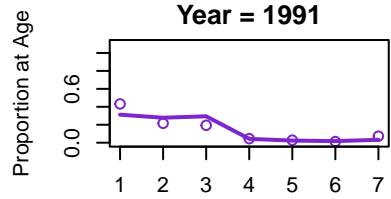
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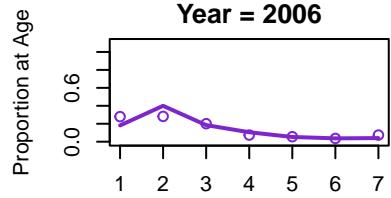


**Year = 1985**

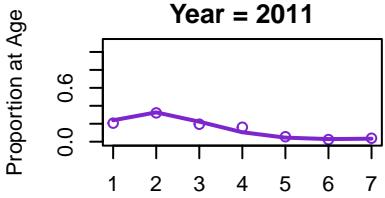


Year = 1990

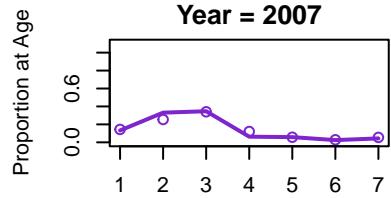




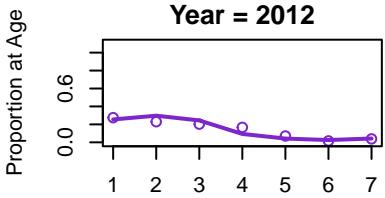
**Catch  
Year = 2011**



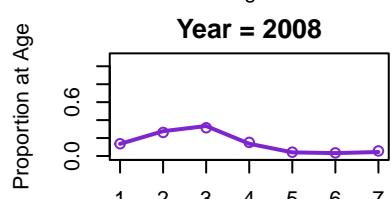
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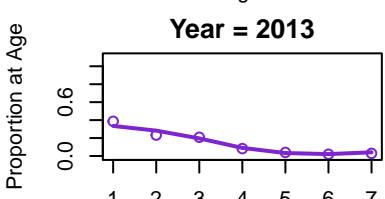
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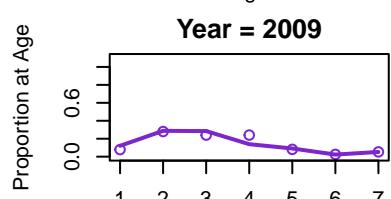
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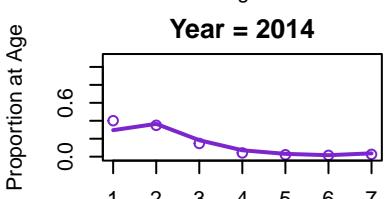
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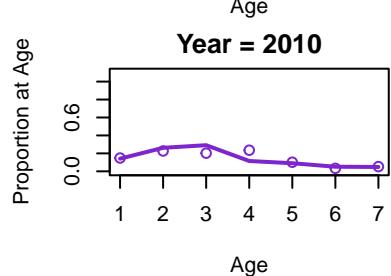
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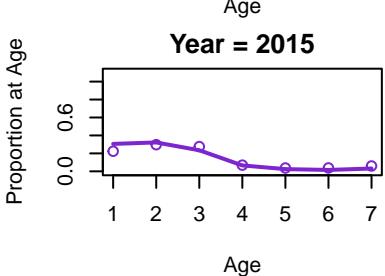
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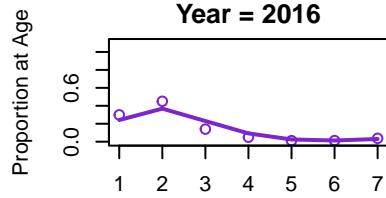
Year = 2014



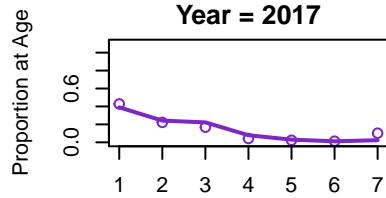
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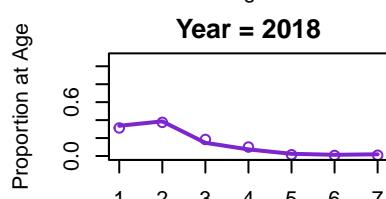
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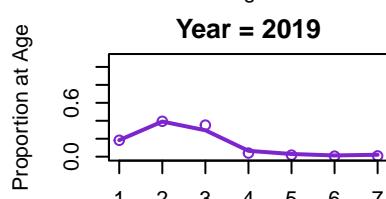
**Year = 2017**



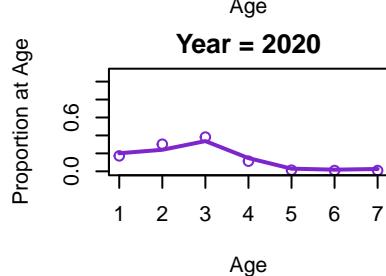
**Year = 2017**



**Year = 2018**



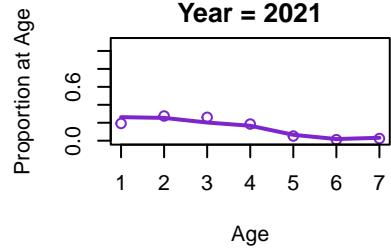
**Year = 2019**



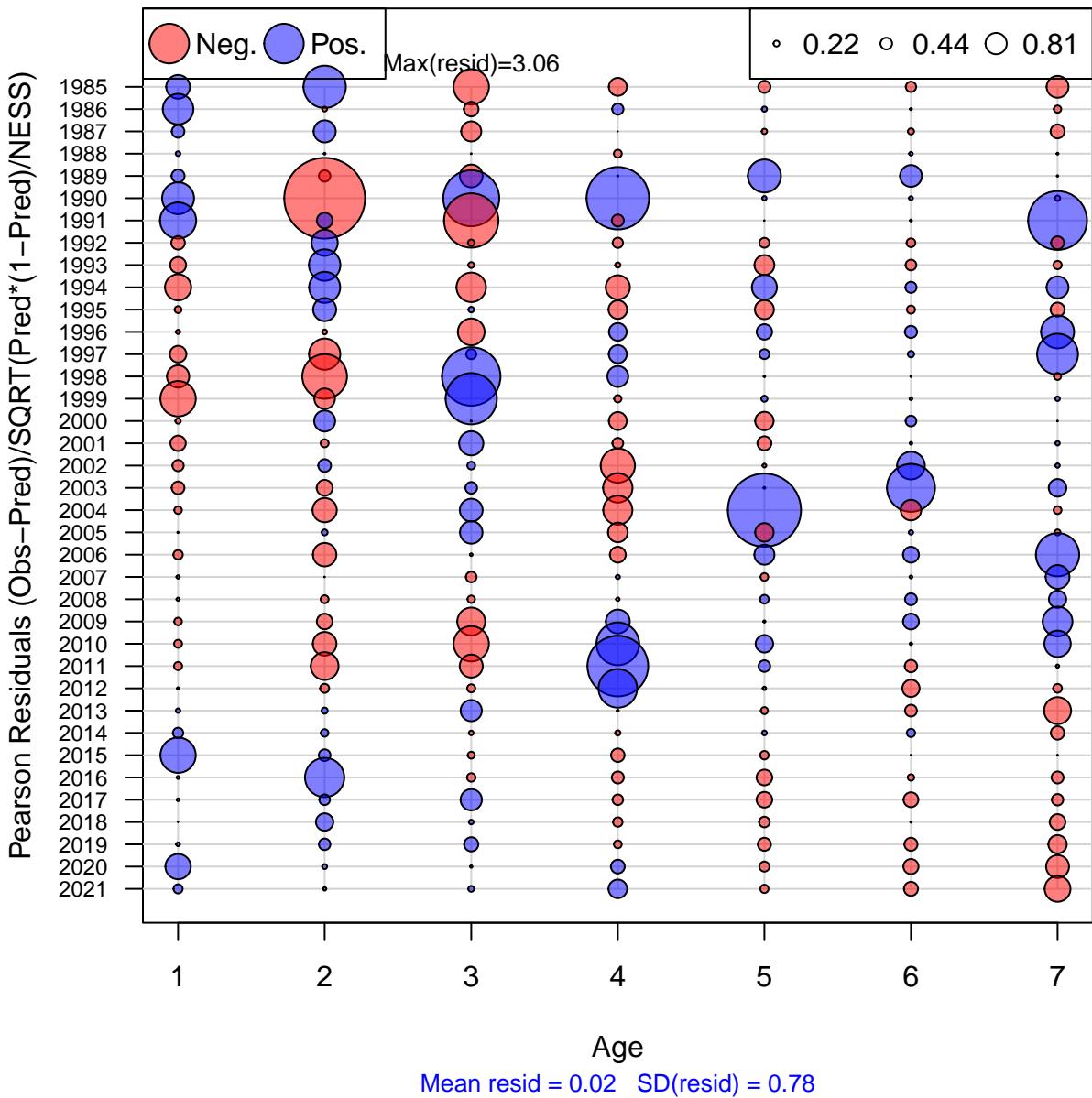
Year = 2020

# Catch

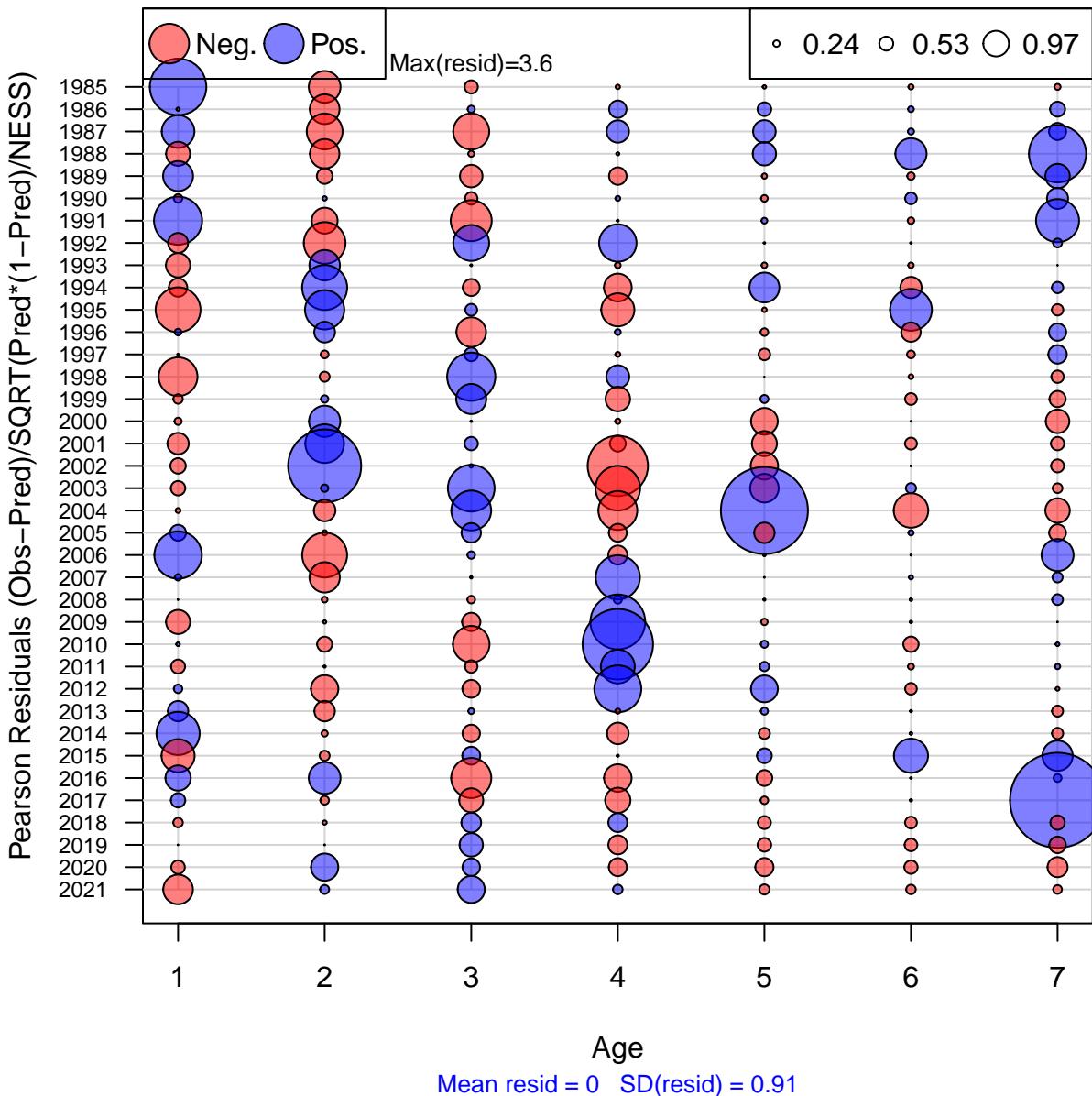
Year = 2021



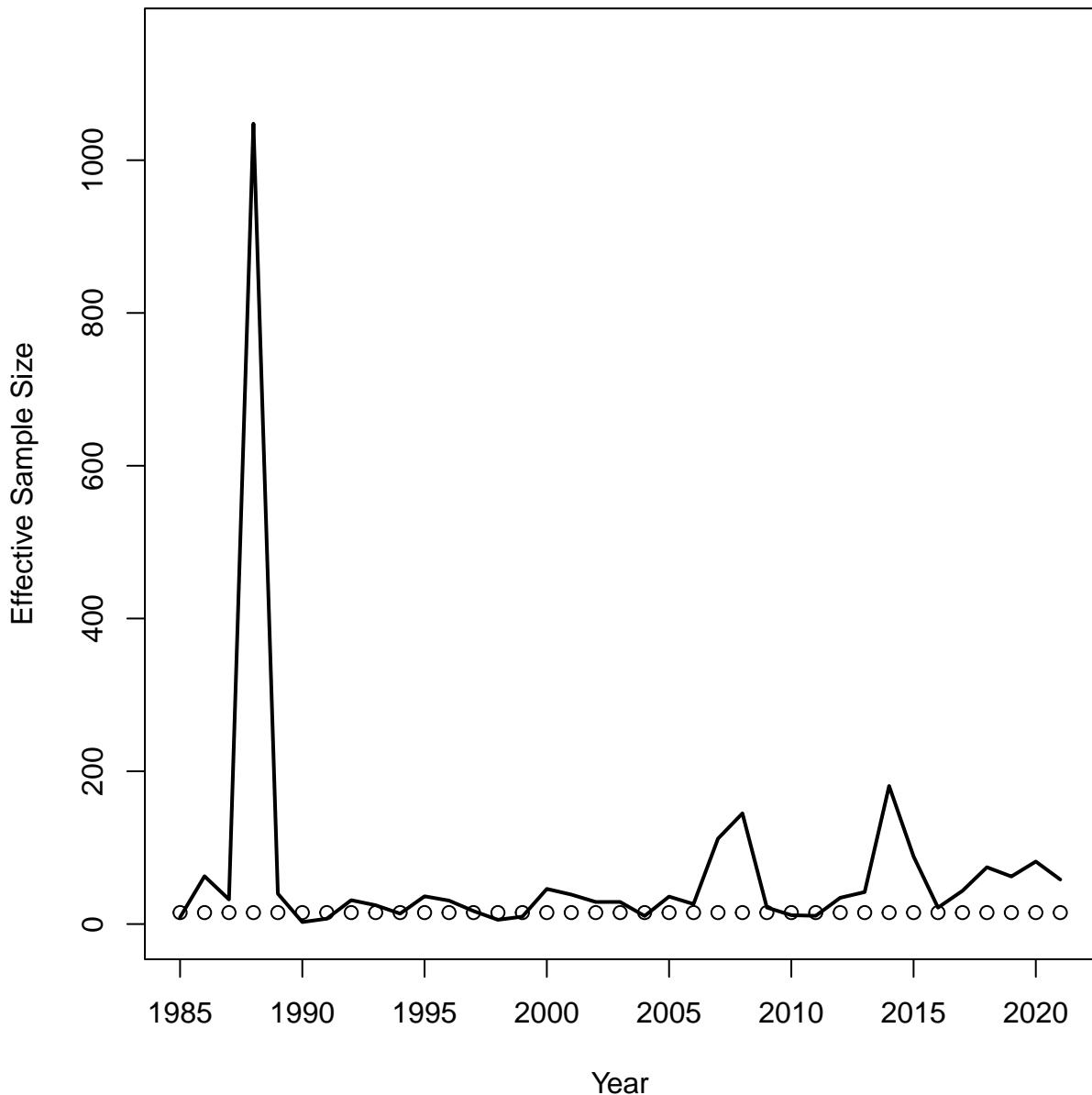
# Age Comp Residuals for Catch by Fleet 1 (Comm)



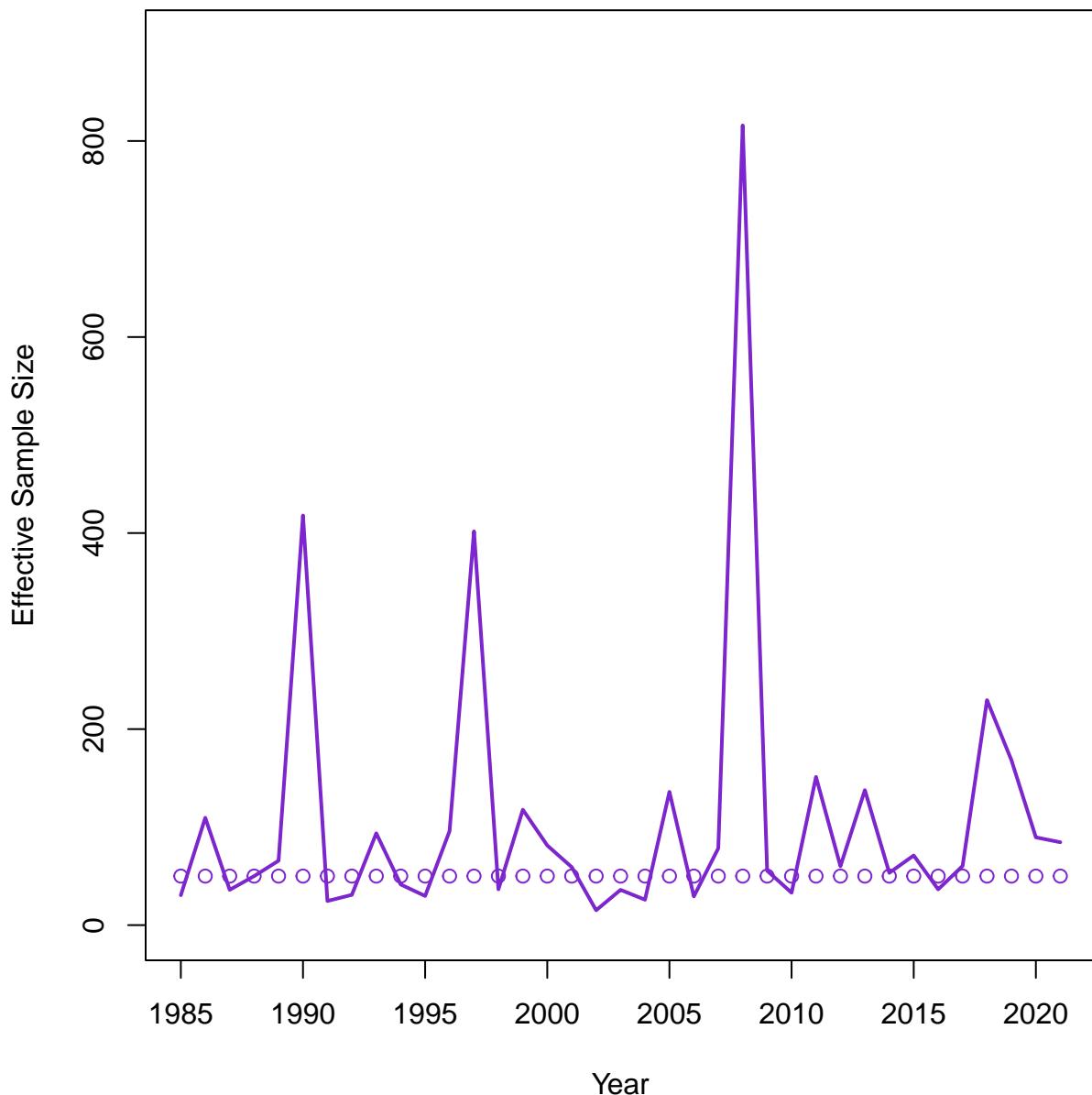
# Age Comp Residuals for Catch by Fleet 2 (Rec)



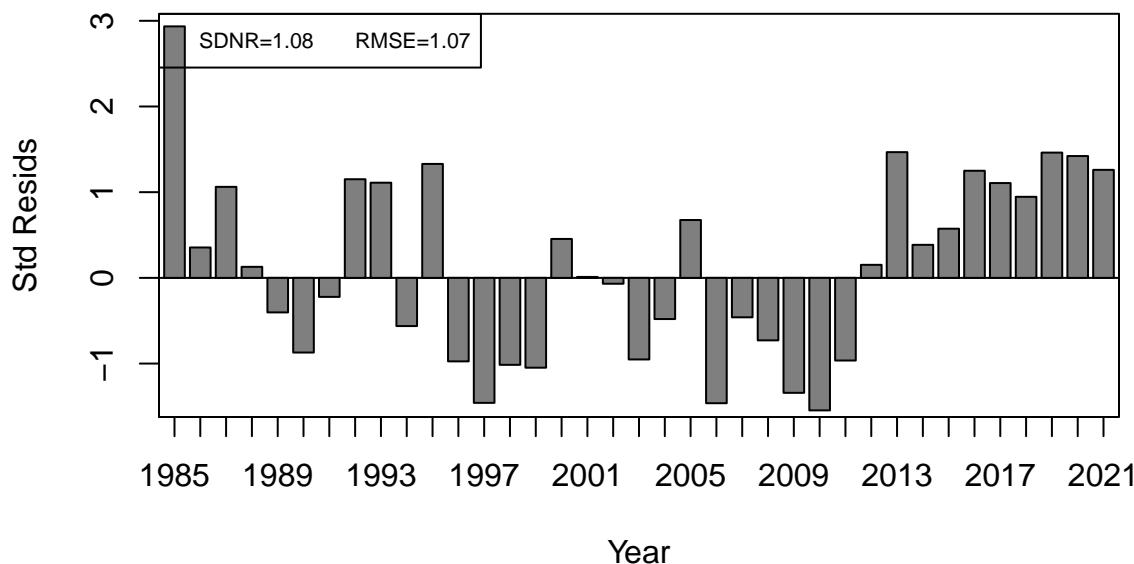
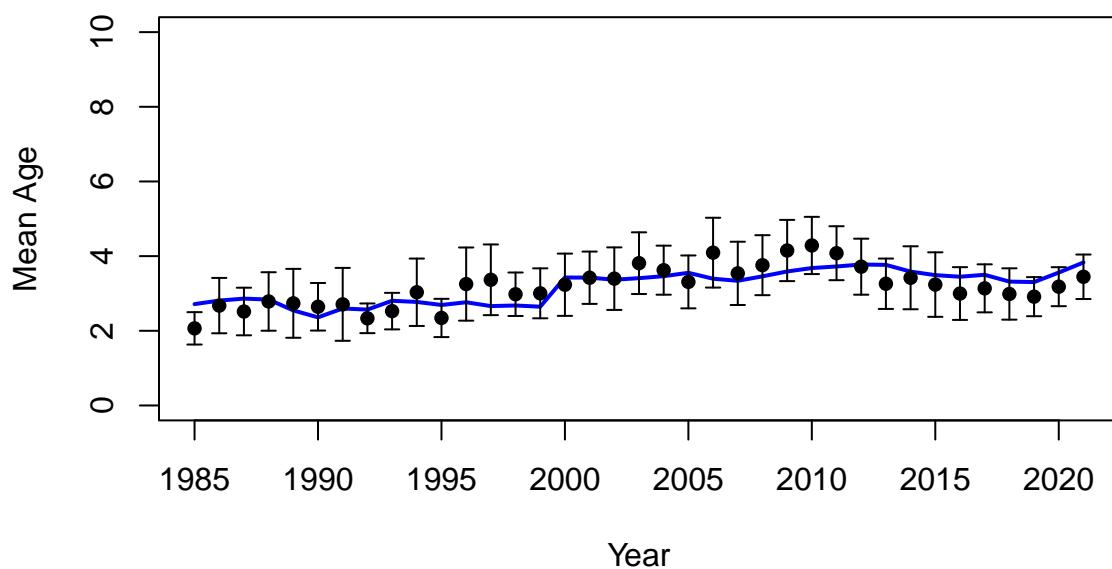
## Catch Neff Fleet 1 (Comm)



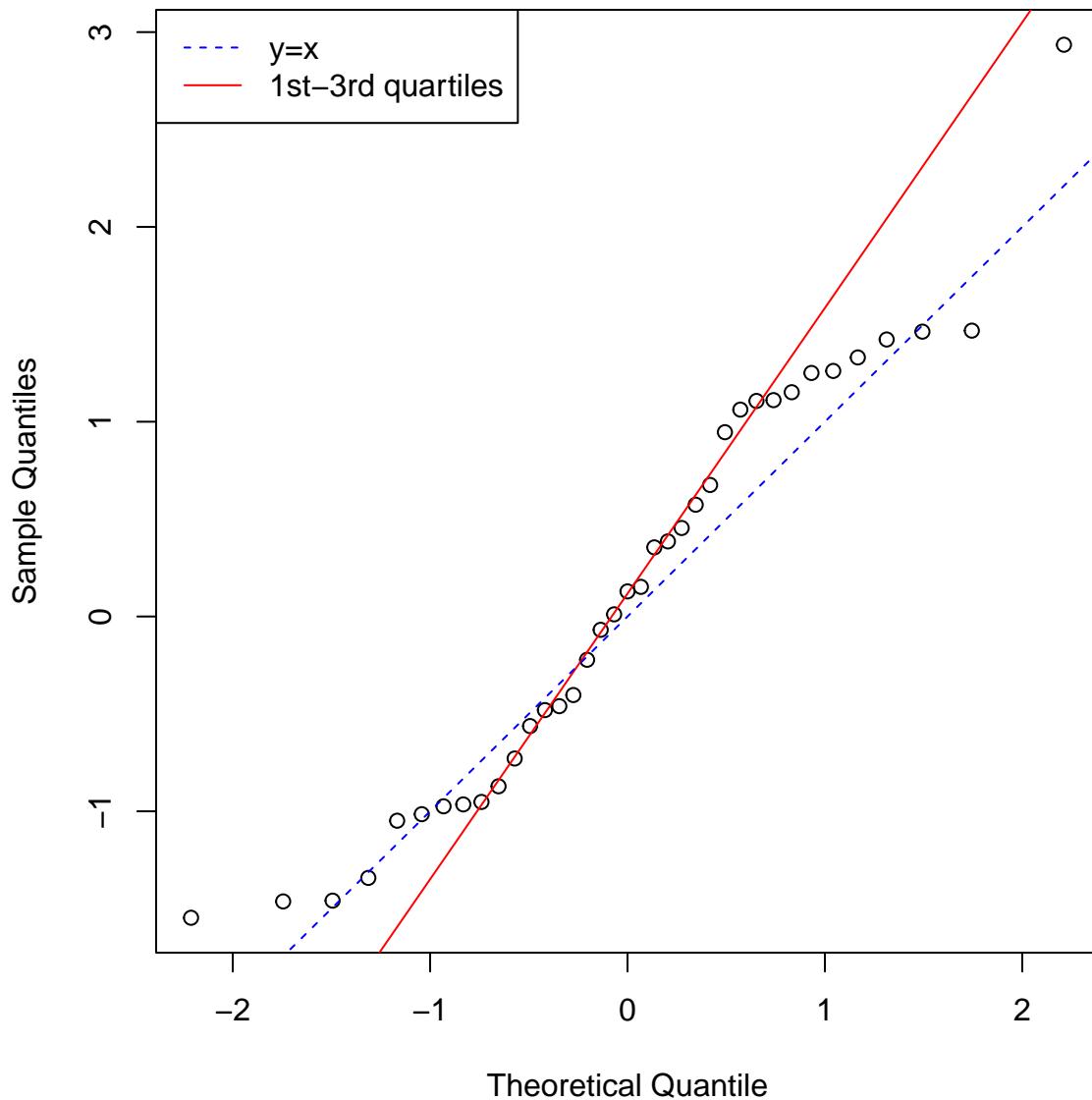
## Catch Neff Fleet 2 (Rec)



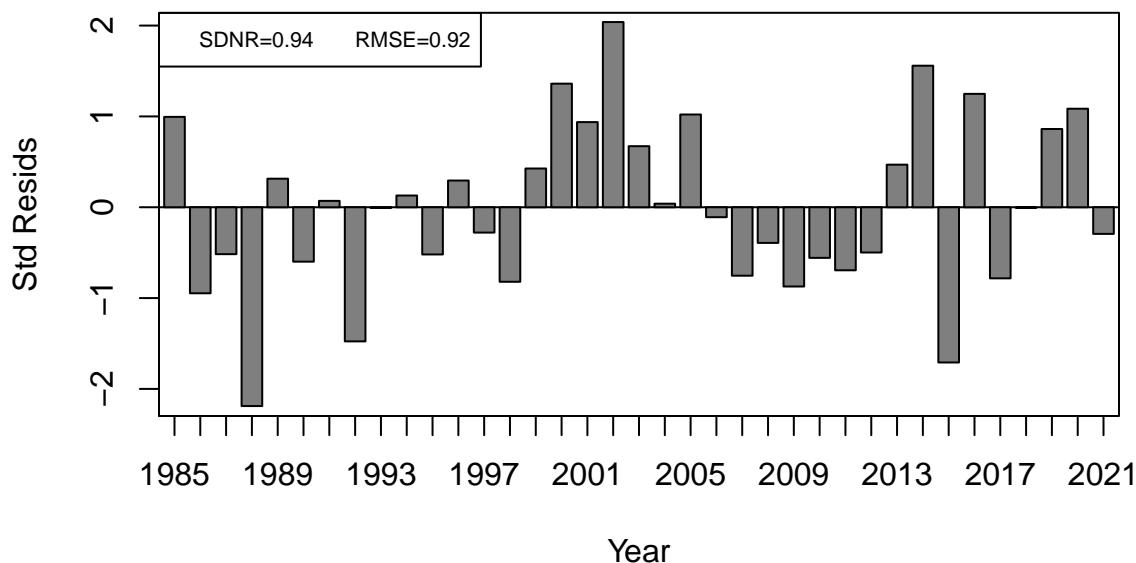
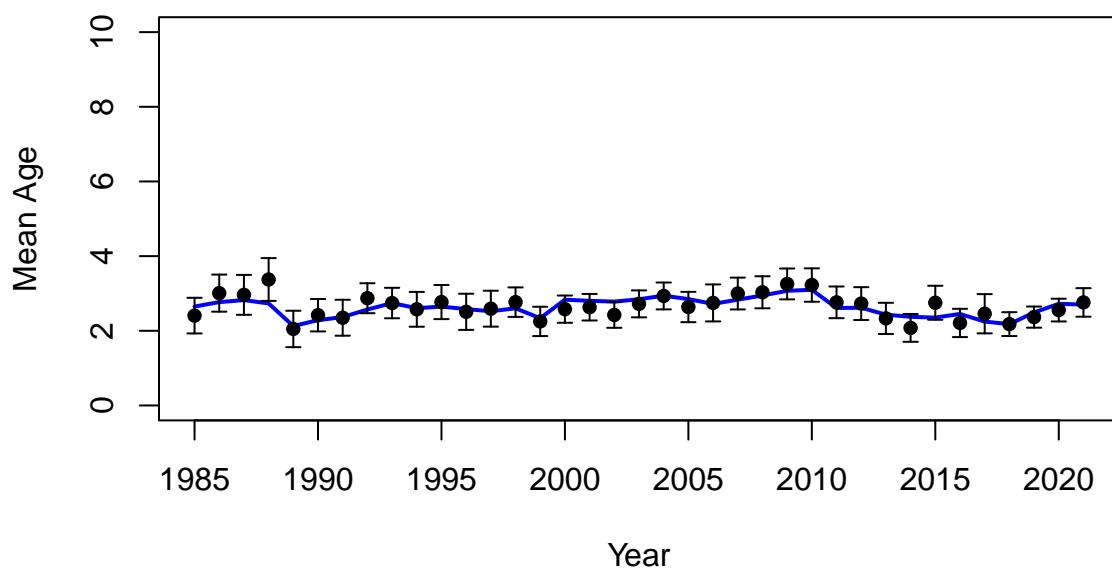
### Catch Fleet 1 (Comm) ESS = 15



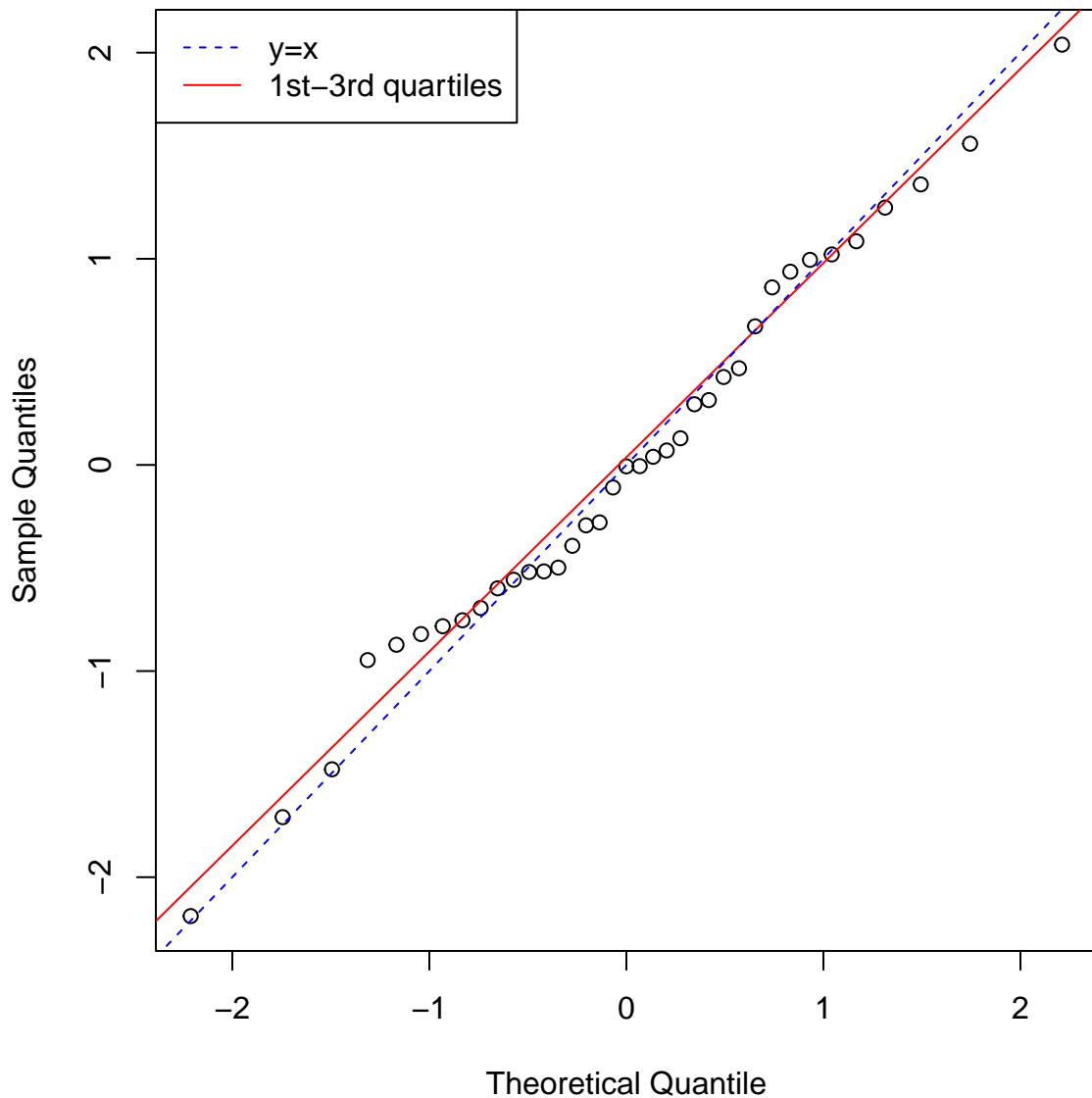
### Catch Fleet 1 (Comm) ESS = 15



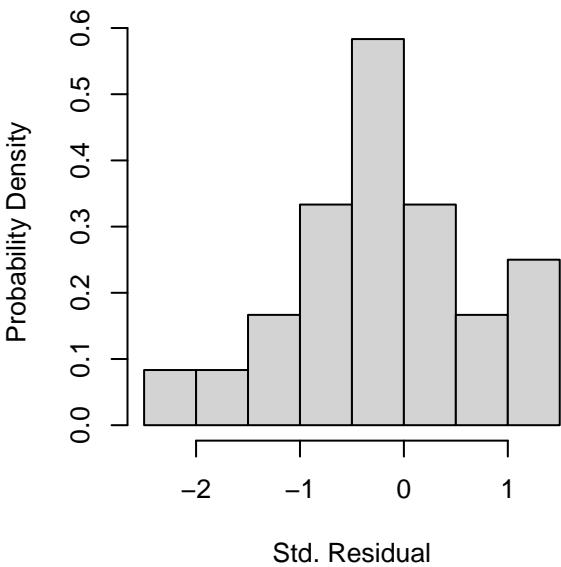
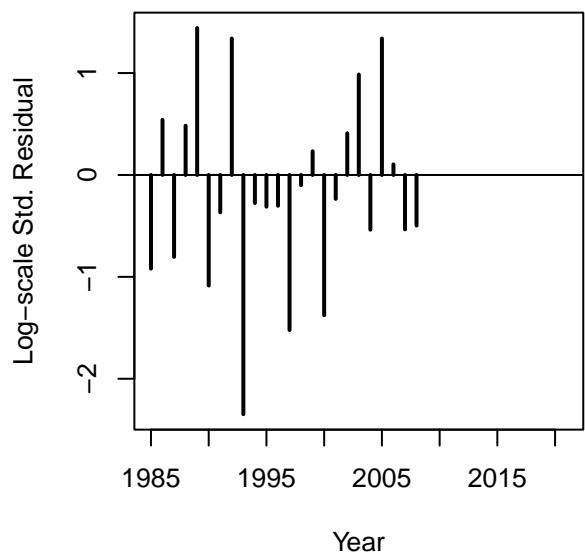
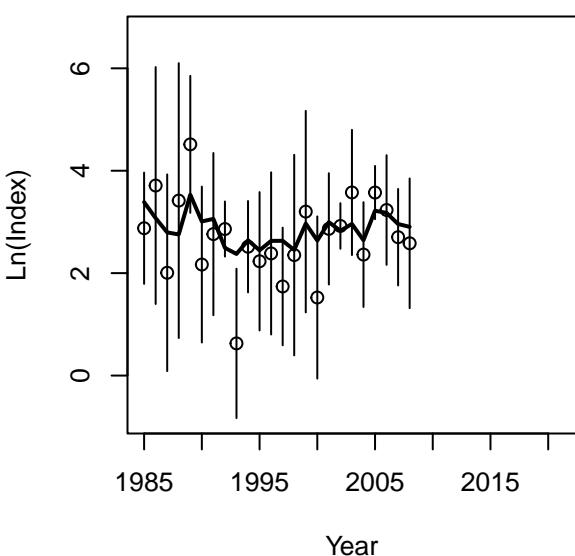
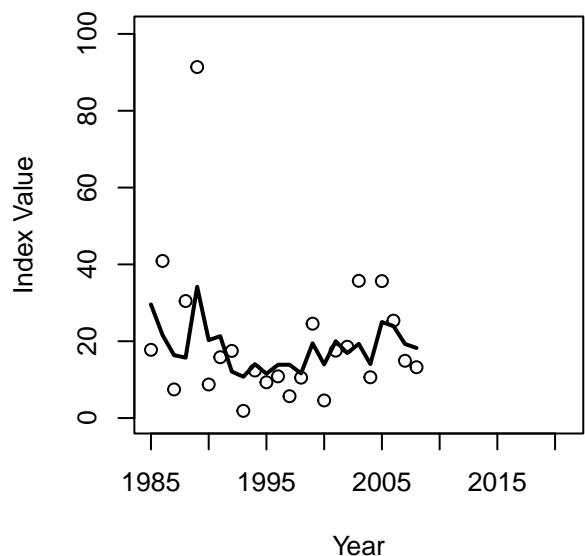
## Catch Fleet 2 (Rec) ESS = 50



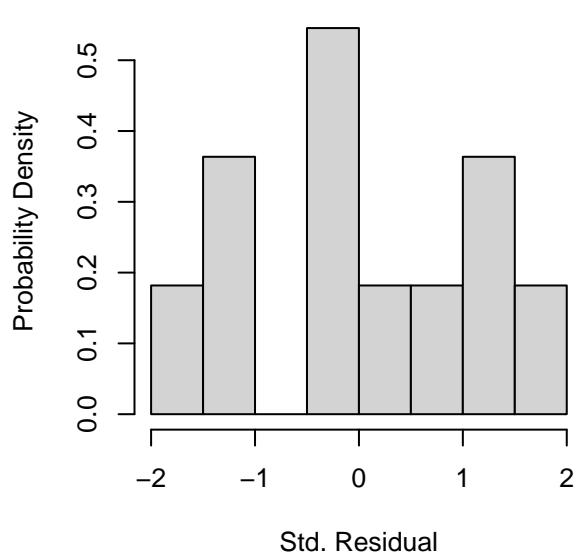
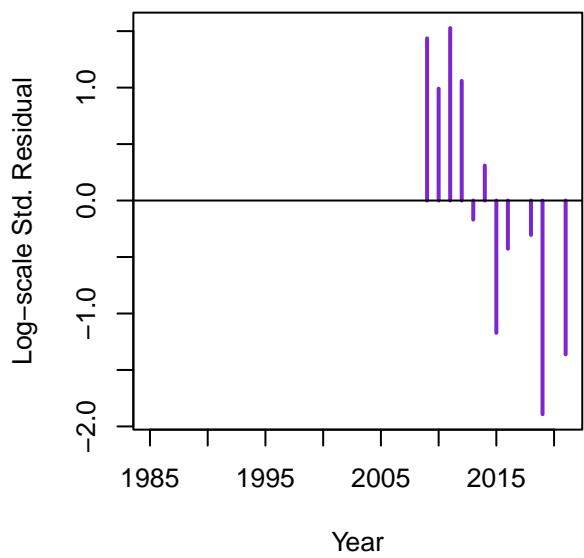
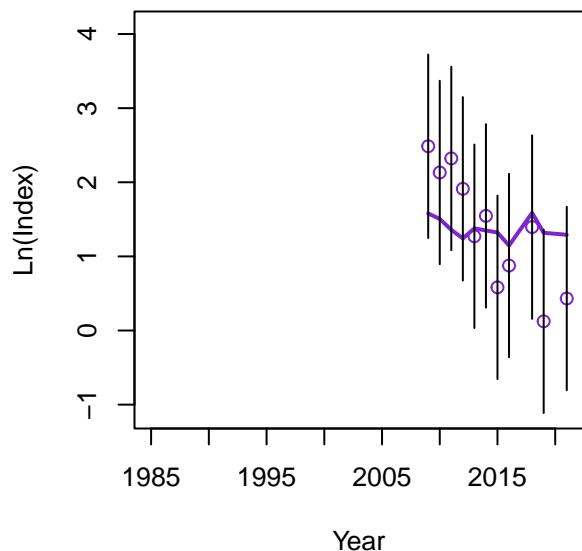
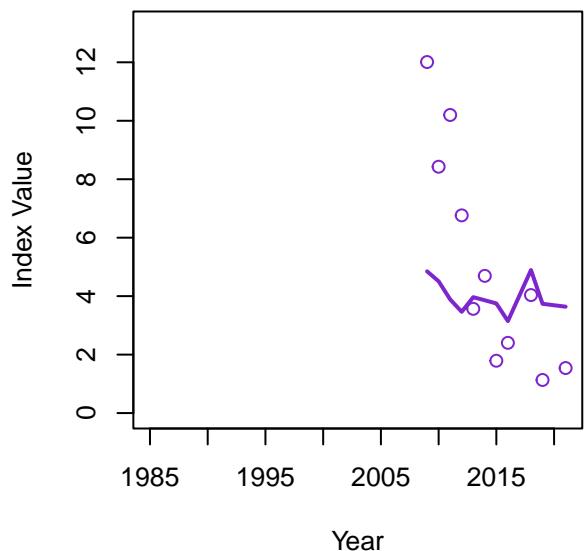
## Catch Fleet 2 (Rec) ESS = 50



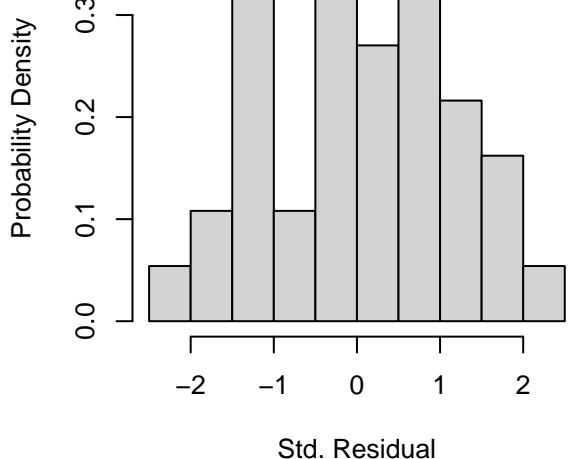
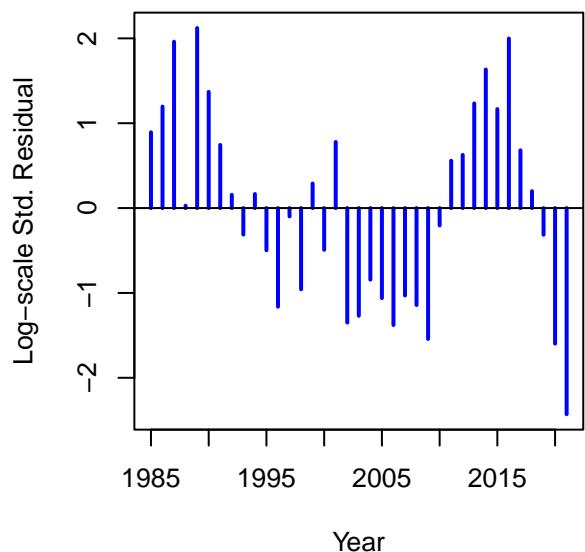
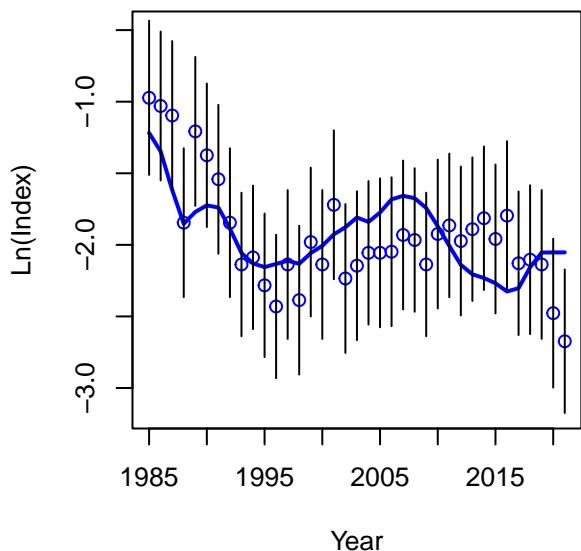
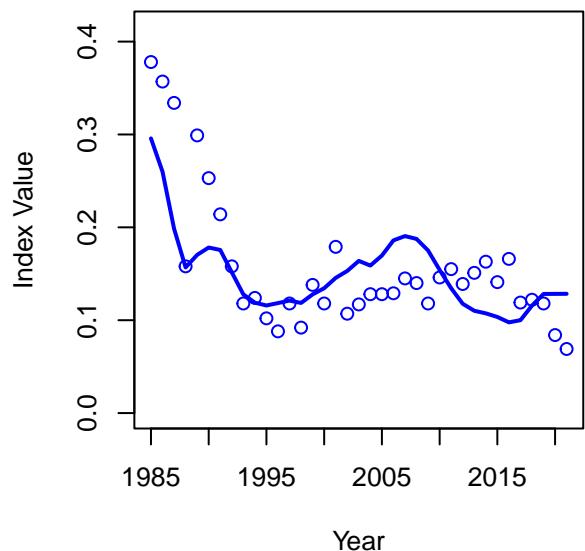
### Index 1 (NEFSC Inshore)



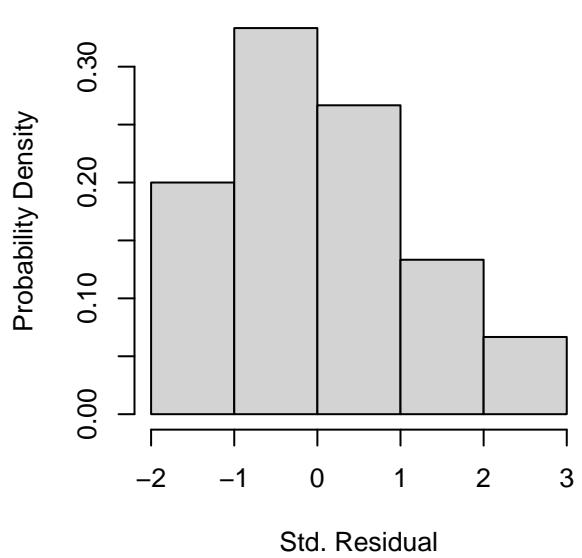
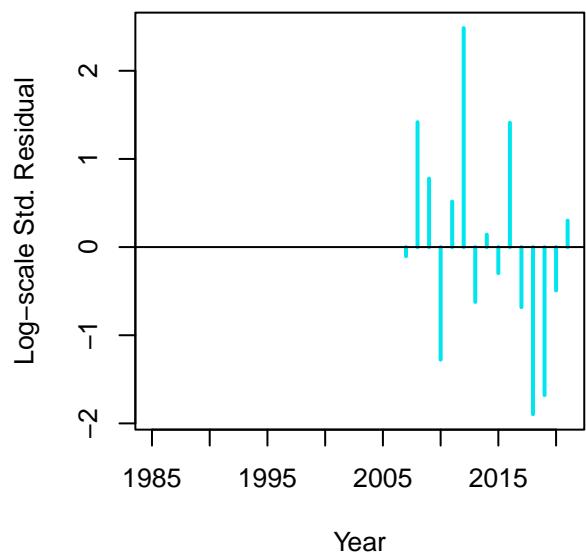
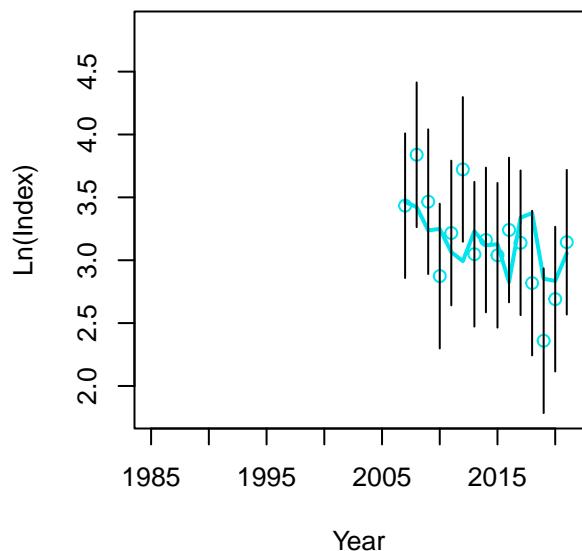
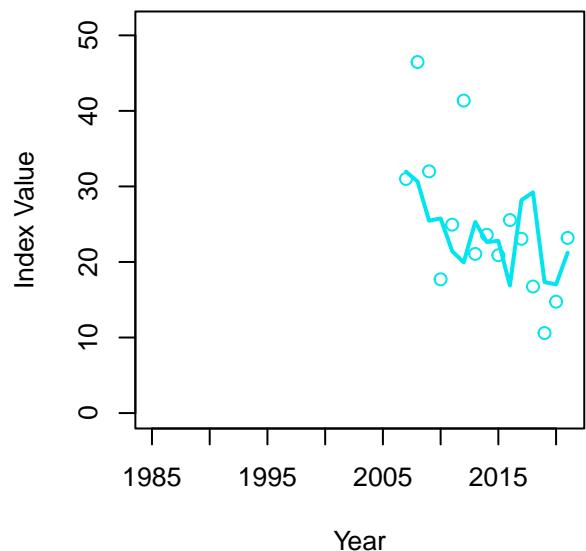
## Index 2 (Bigelow)



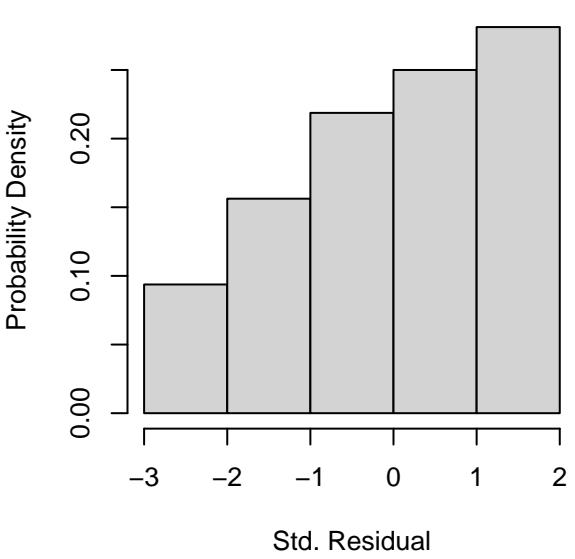
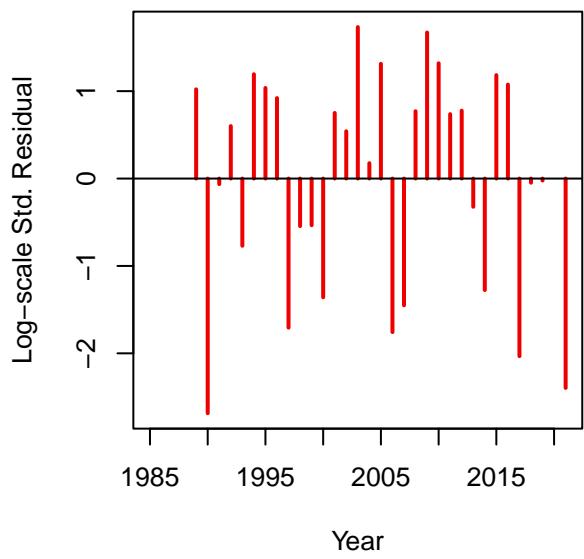
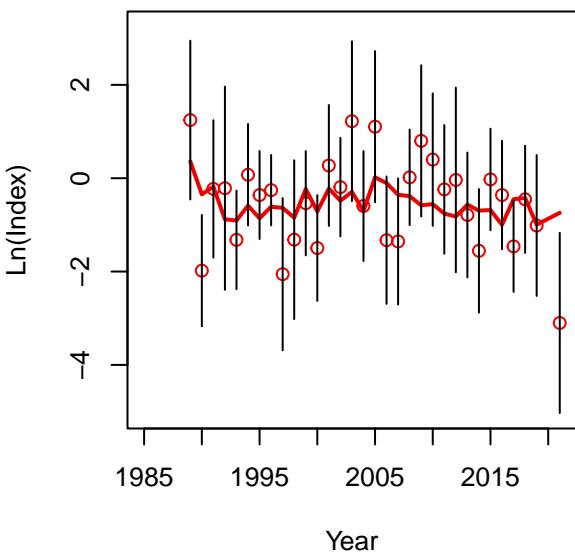
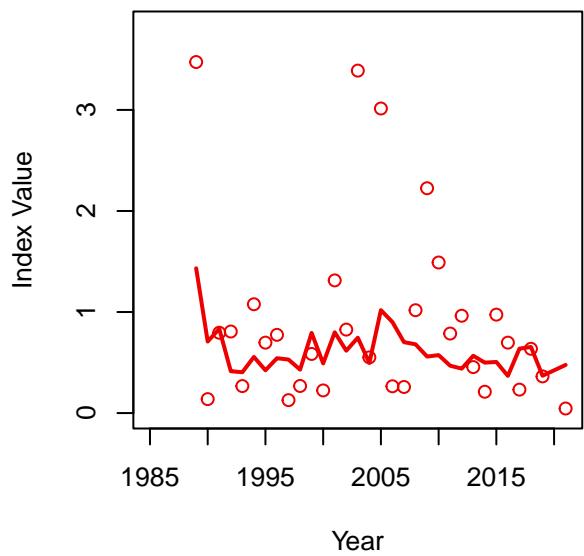
### Index 3 (MRIP)



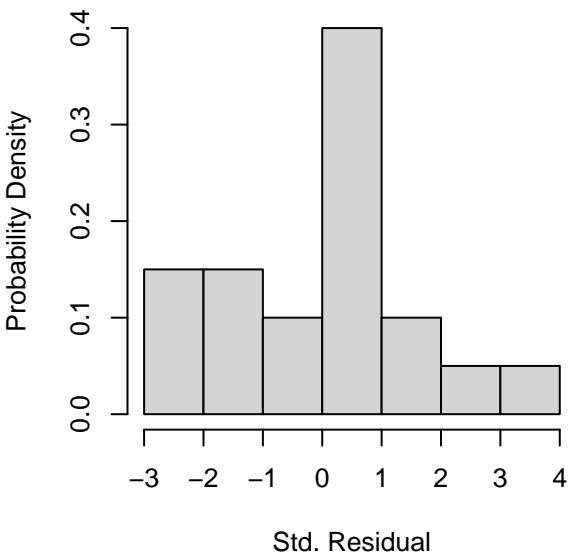
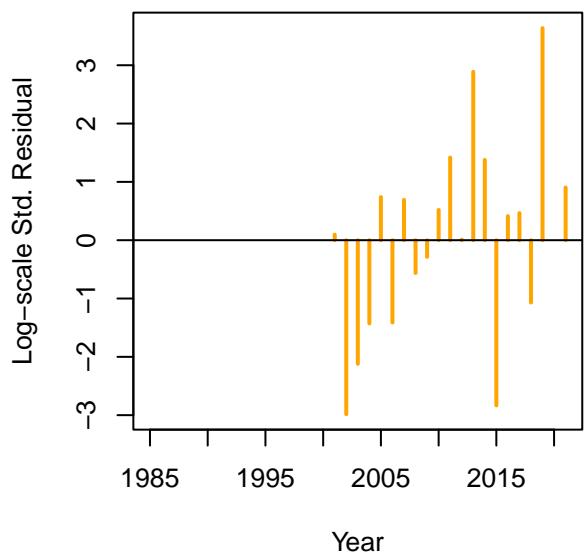
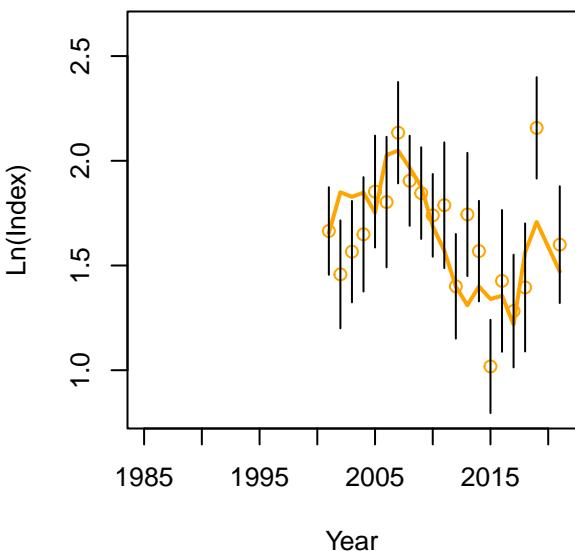
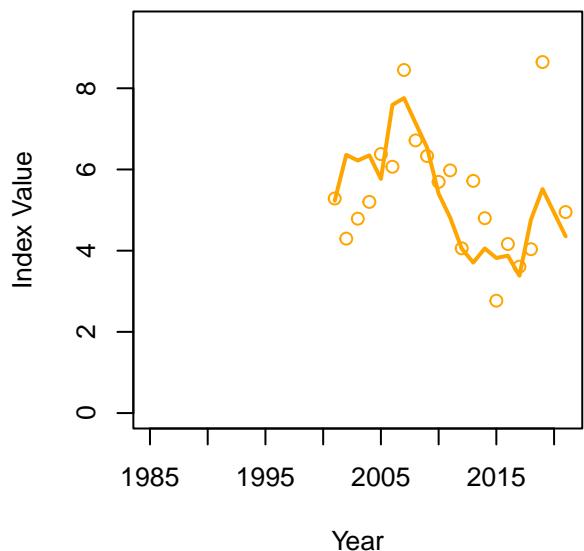
## Index 4 (NEAMAP)



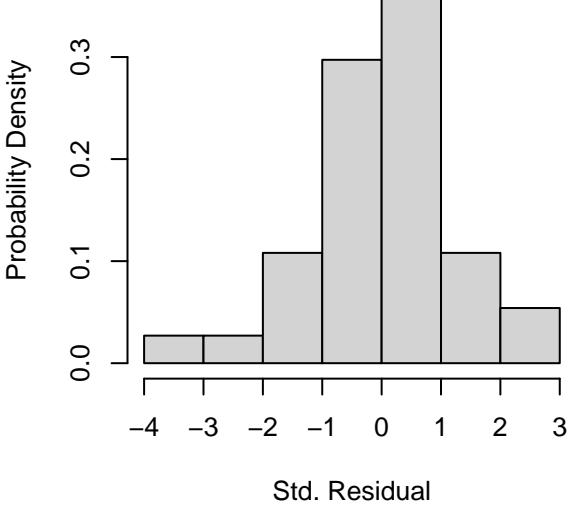
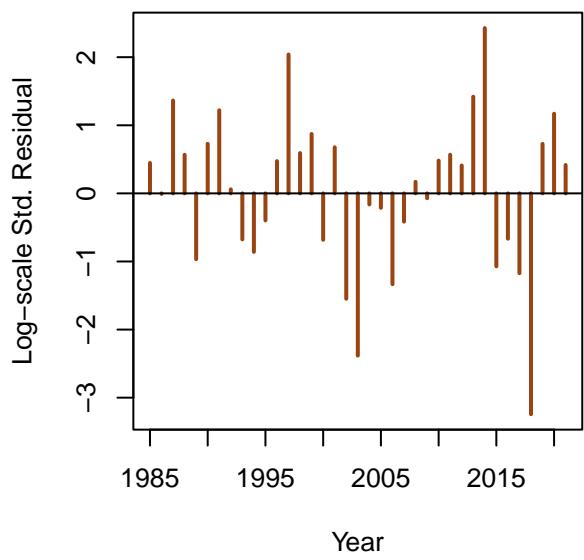
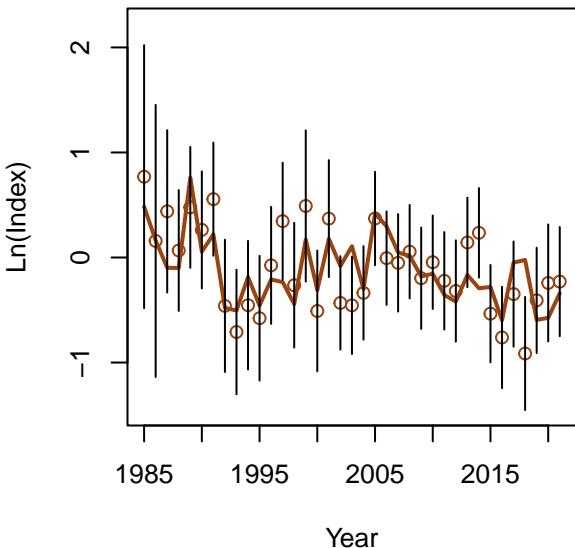
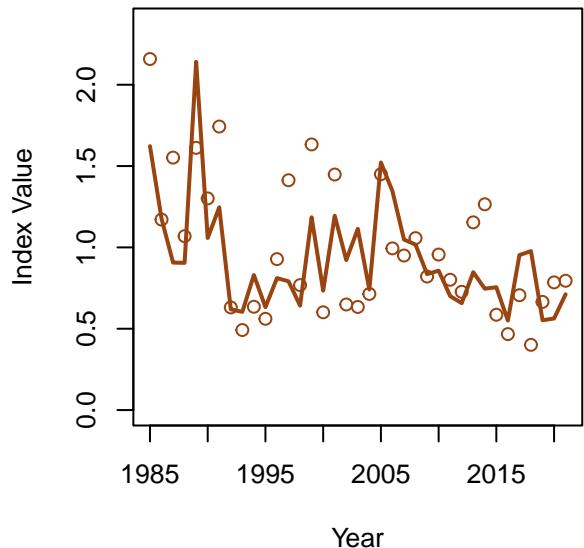
## Index 5 (SEAMAP)



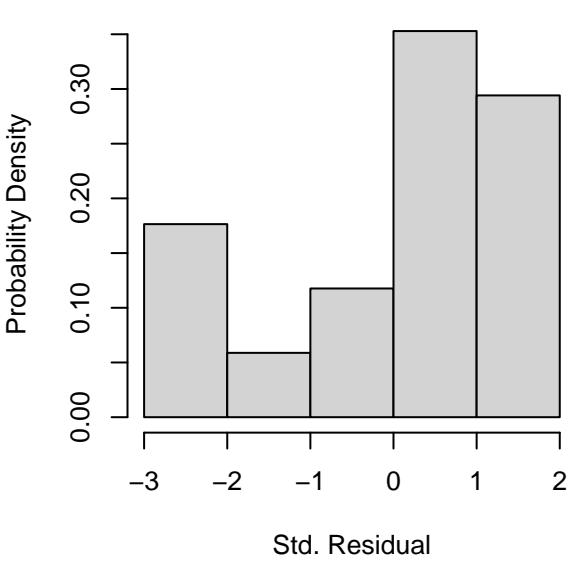
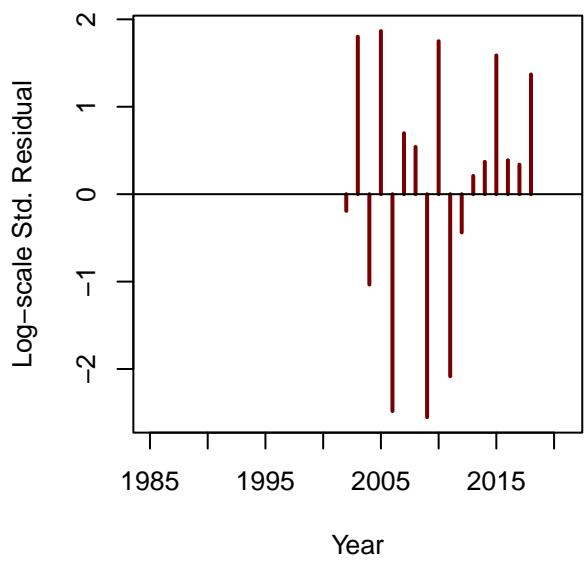
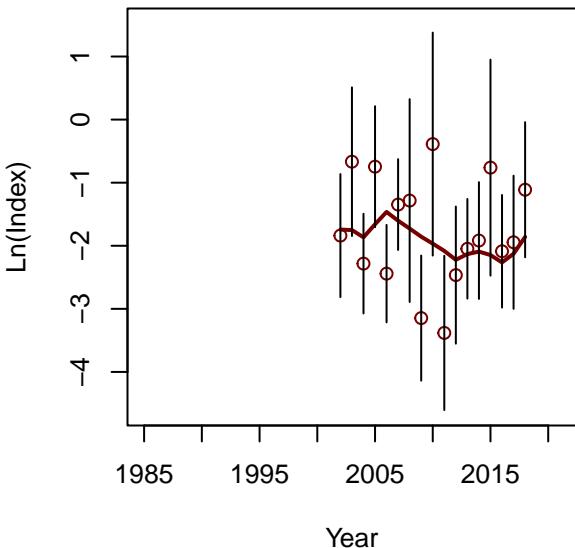
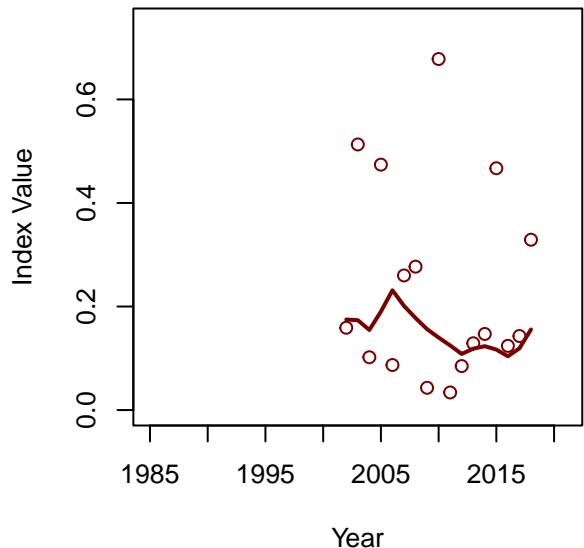
## Index 6 (PSIGN)



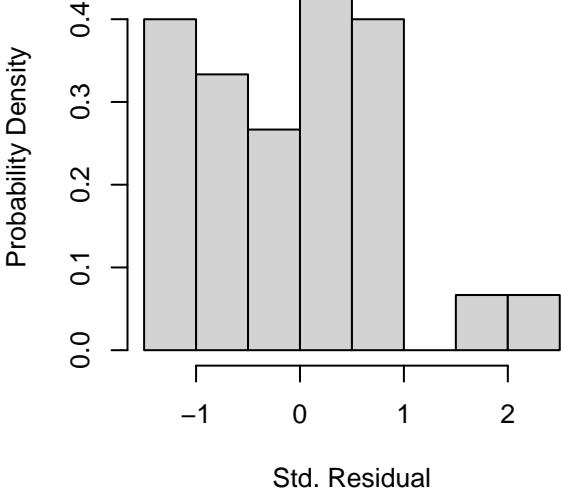
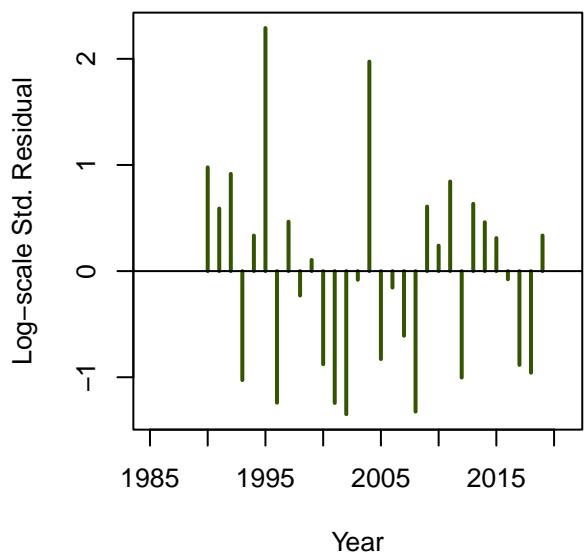
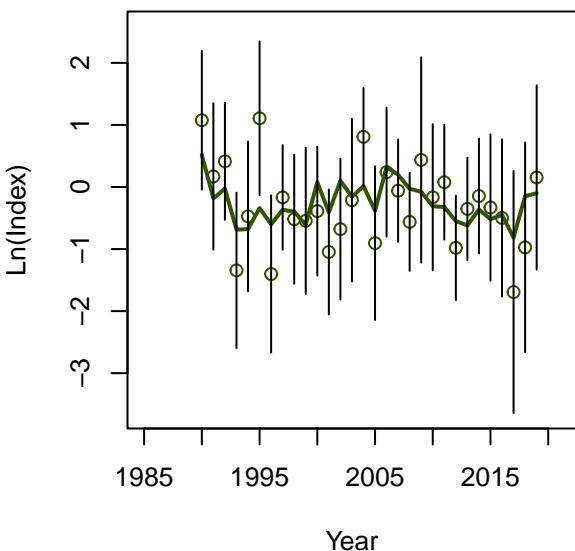
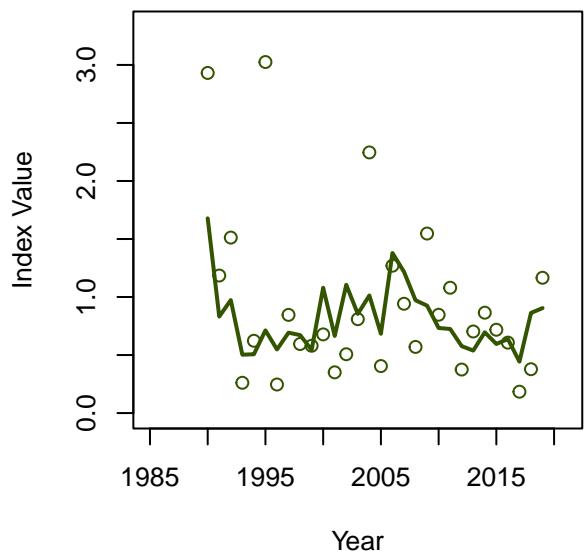
## Index 7 (Compound YOY)



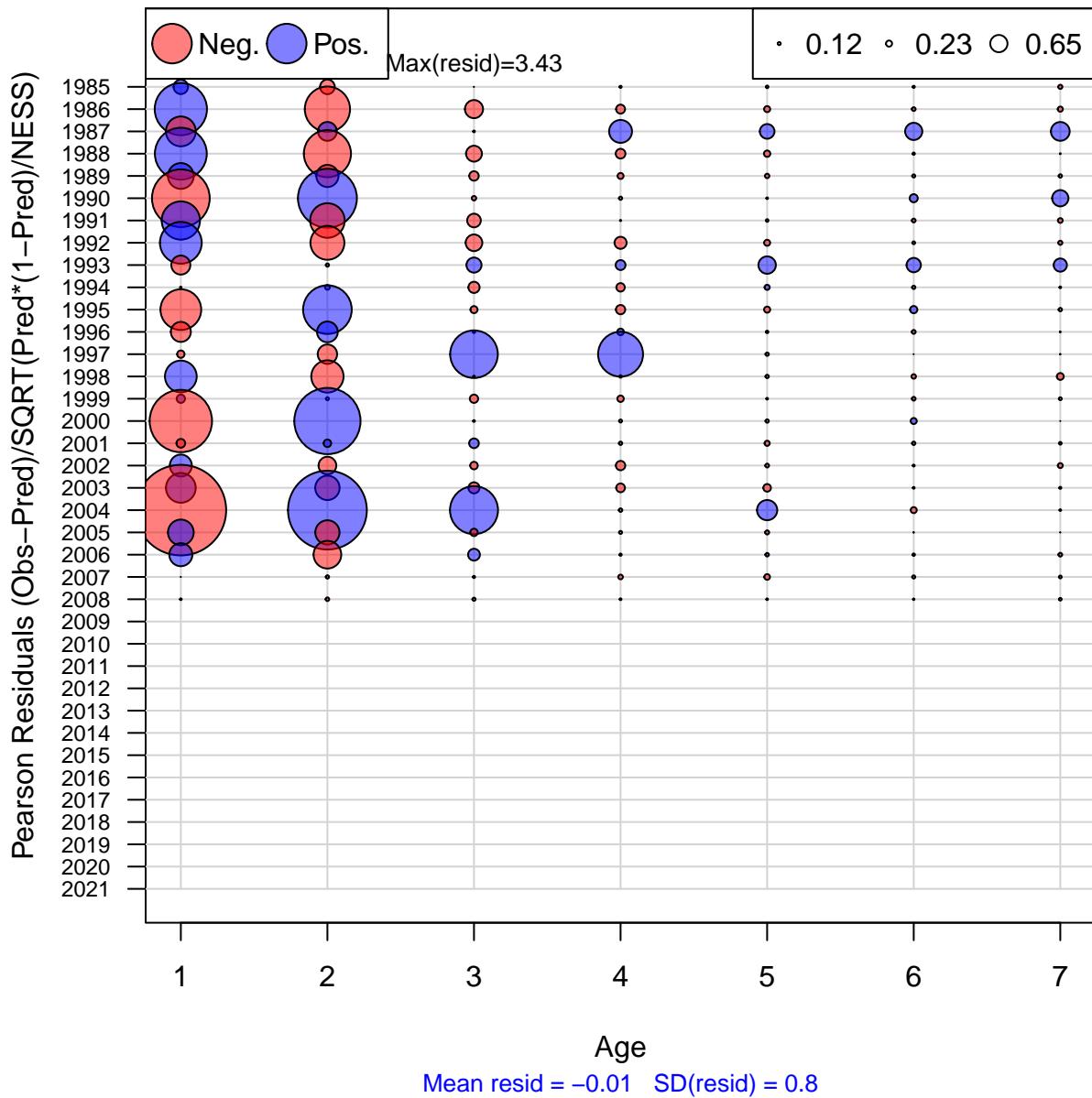
### Index 8 (ChesMMAP)



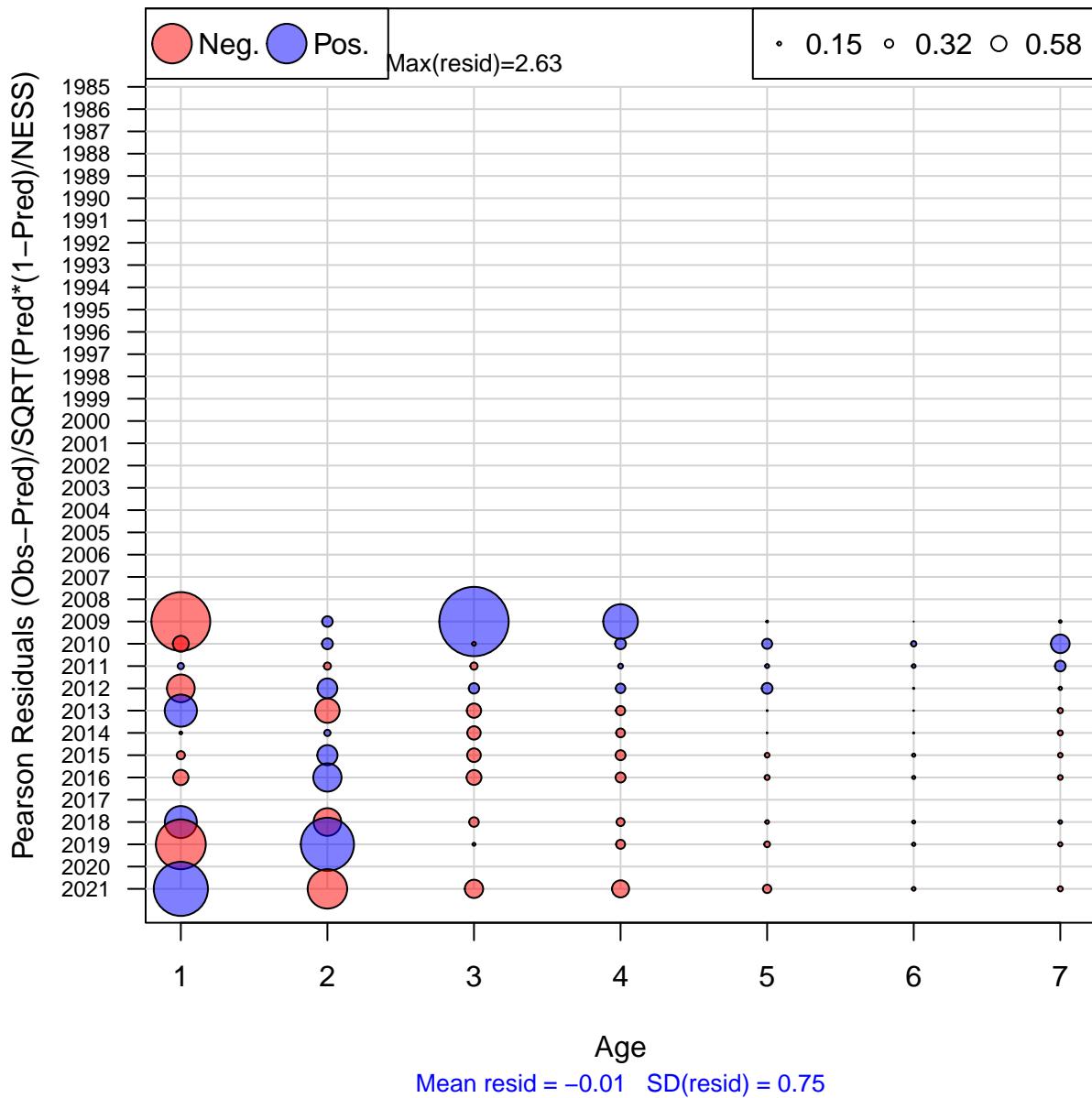
### Index 9 (SEAMAP1)



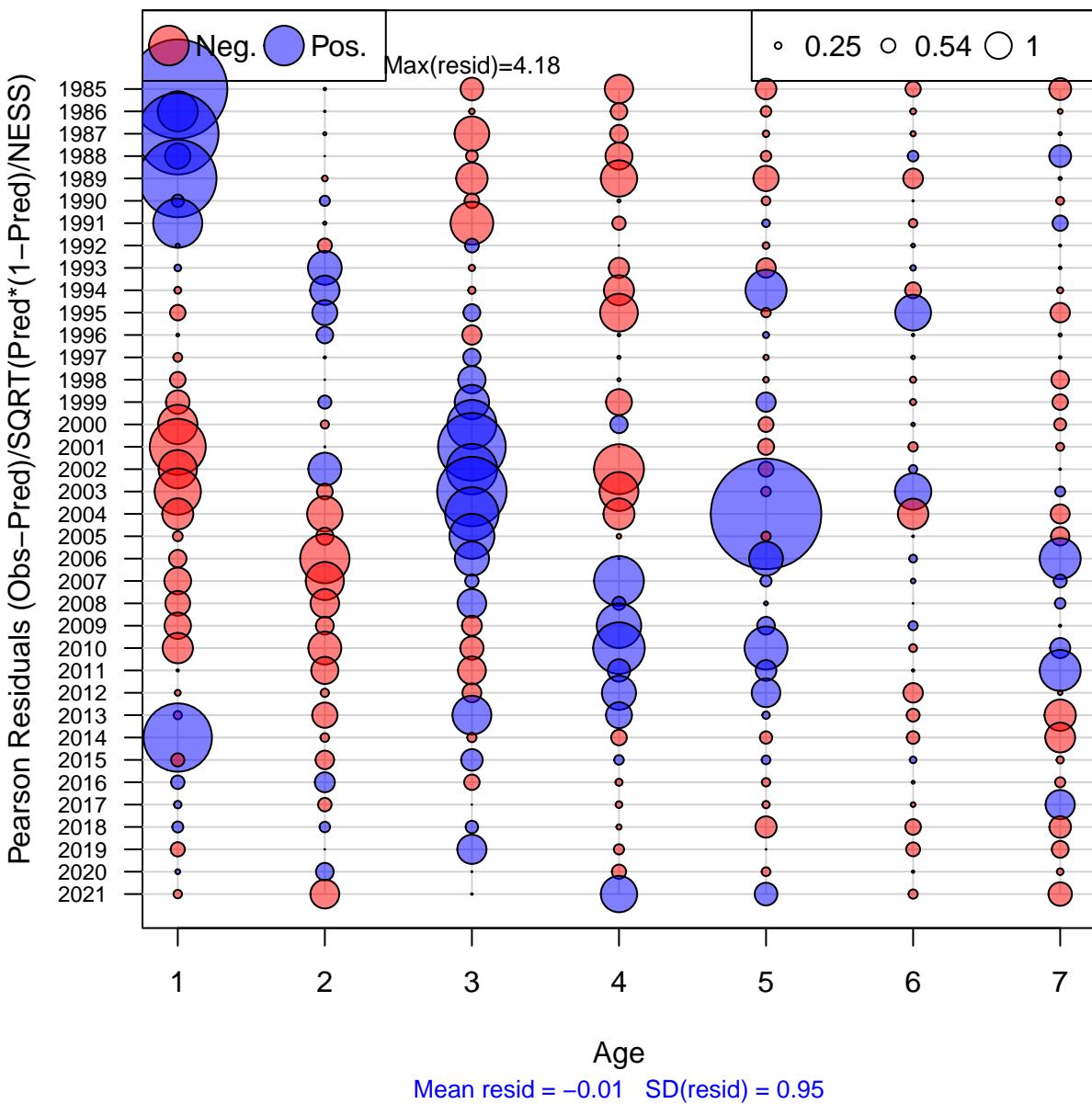
# Age Comp Residuals for Index 1 (NEFSC Inshore)



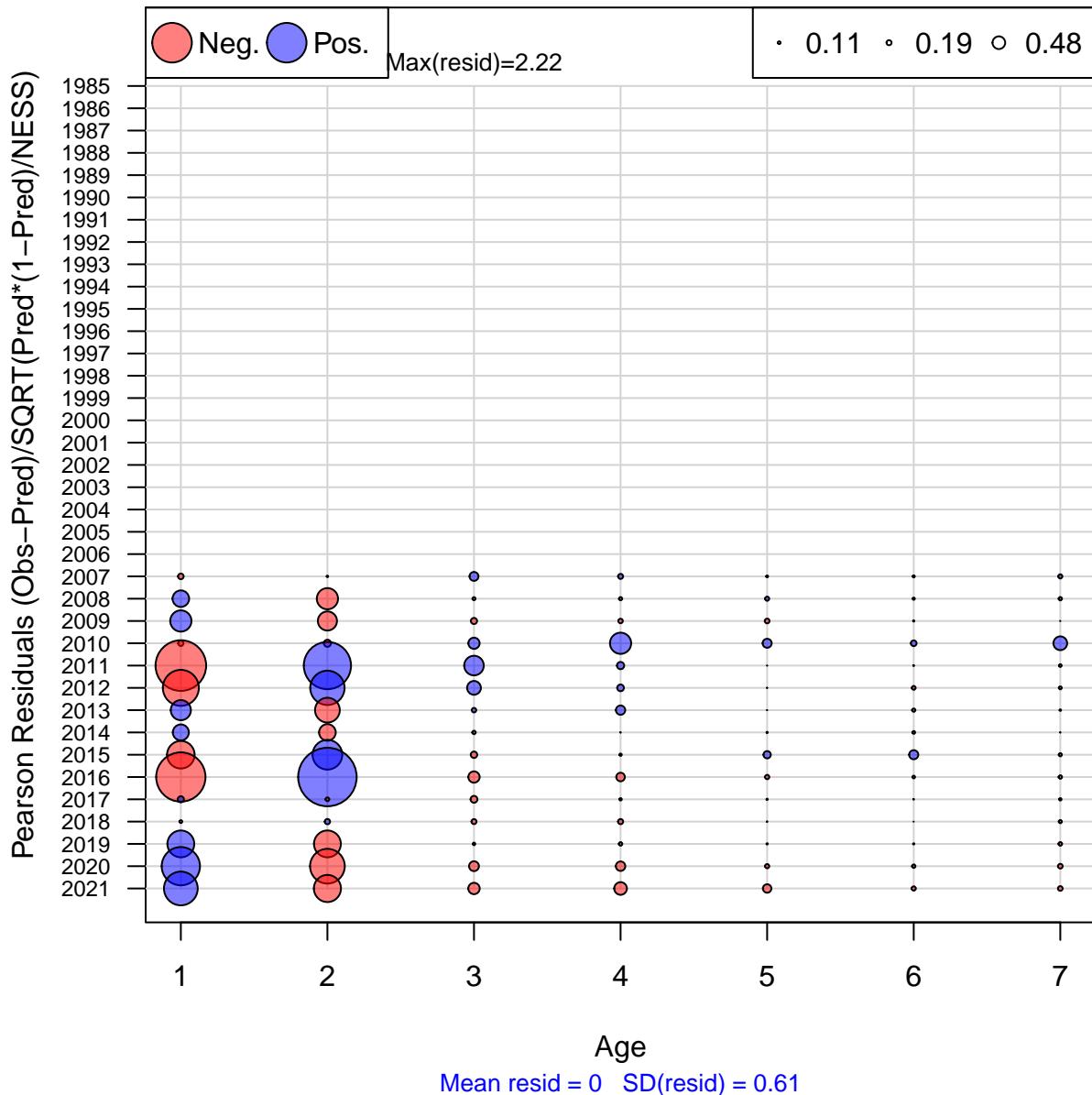
## Age Comp Residuals for Index 2 (Bigelow)



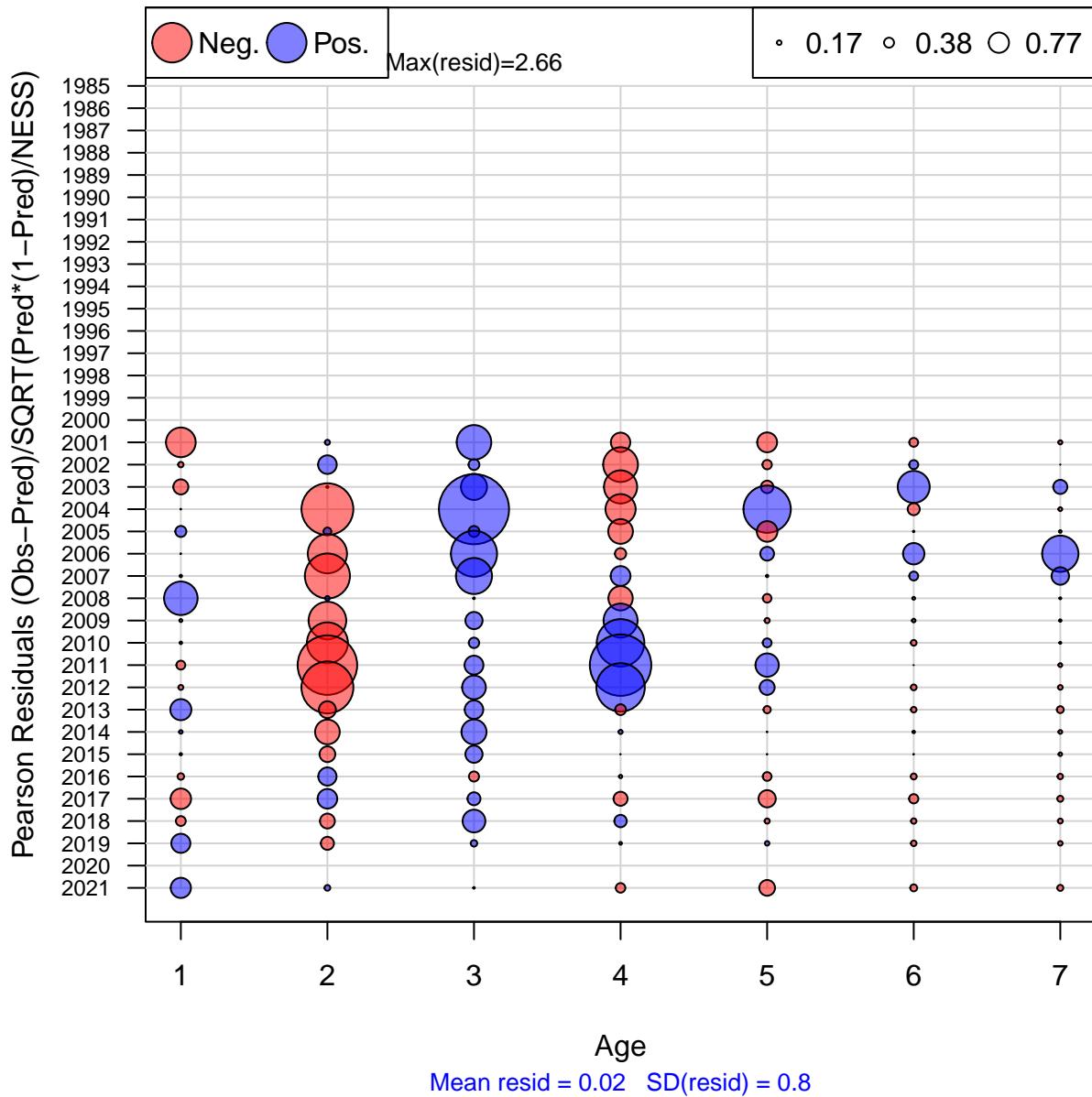
# Age Comp Residuals for Index 3 (MRIP)



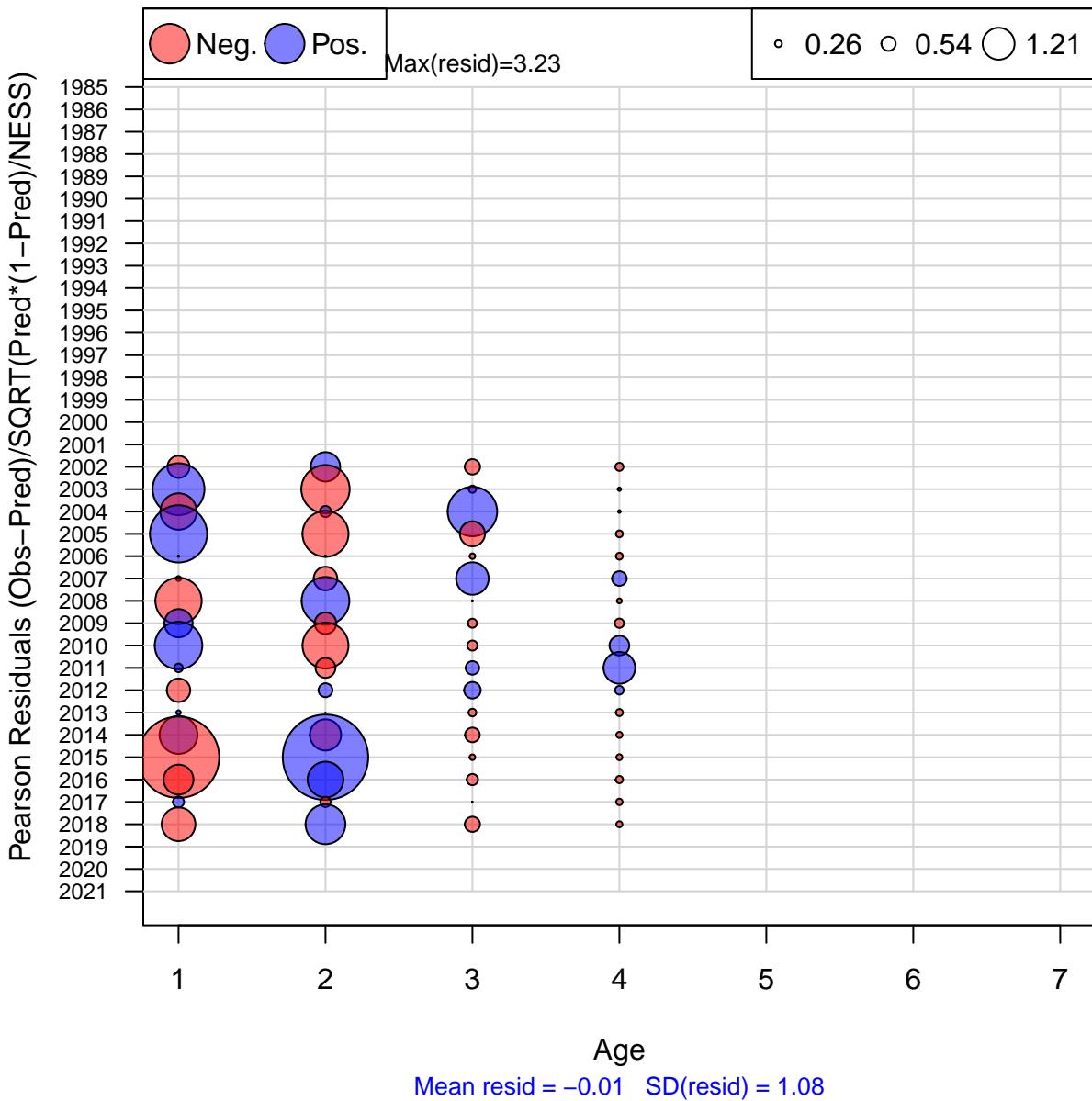
# Age Comp Residuals for Index 4 (NEAMAP)



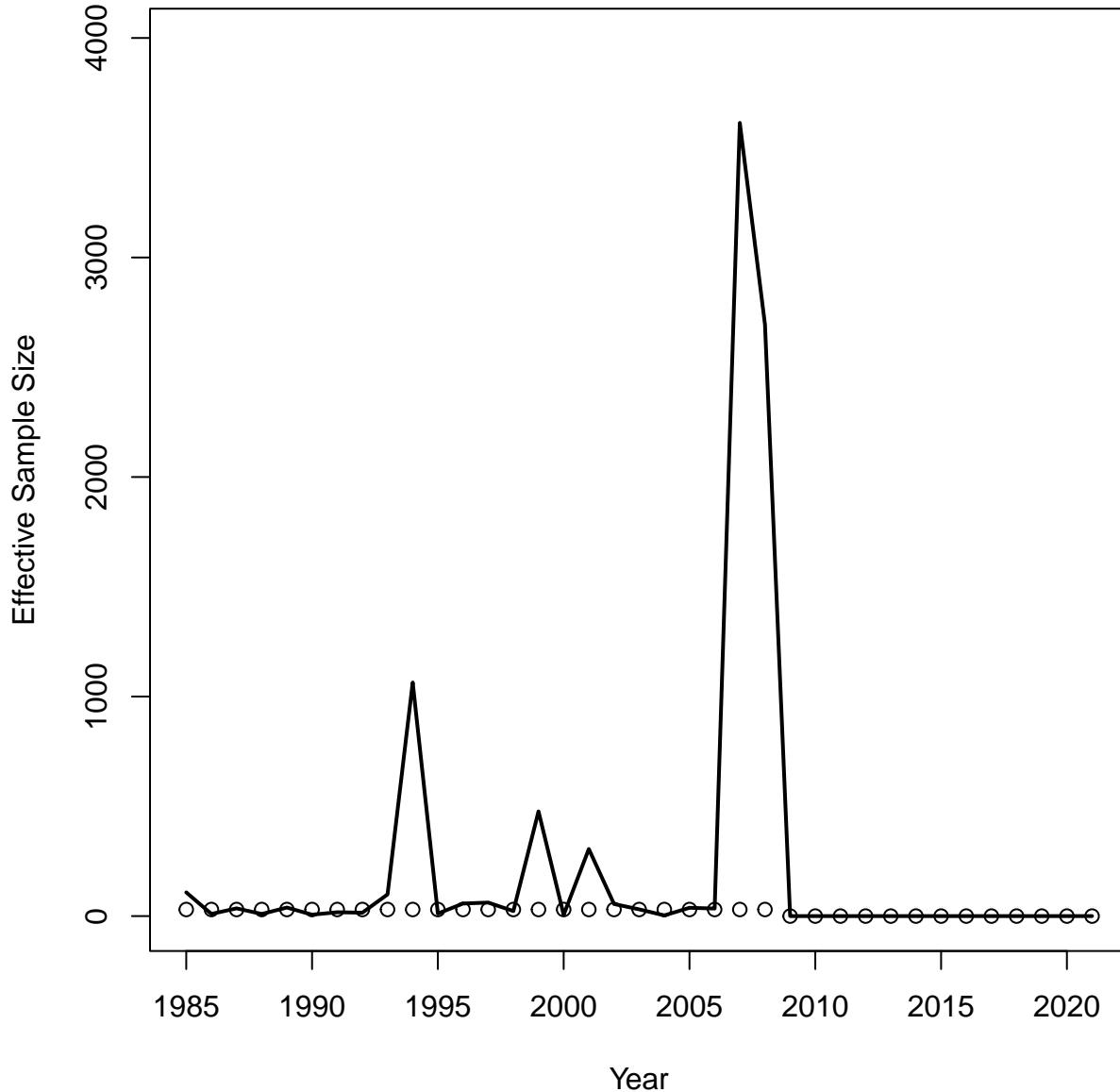
# Age Comp Residuals for Index 6 (PSIGN)



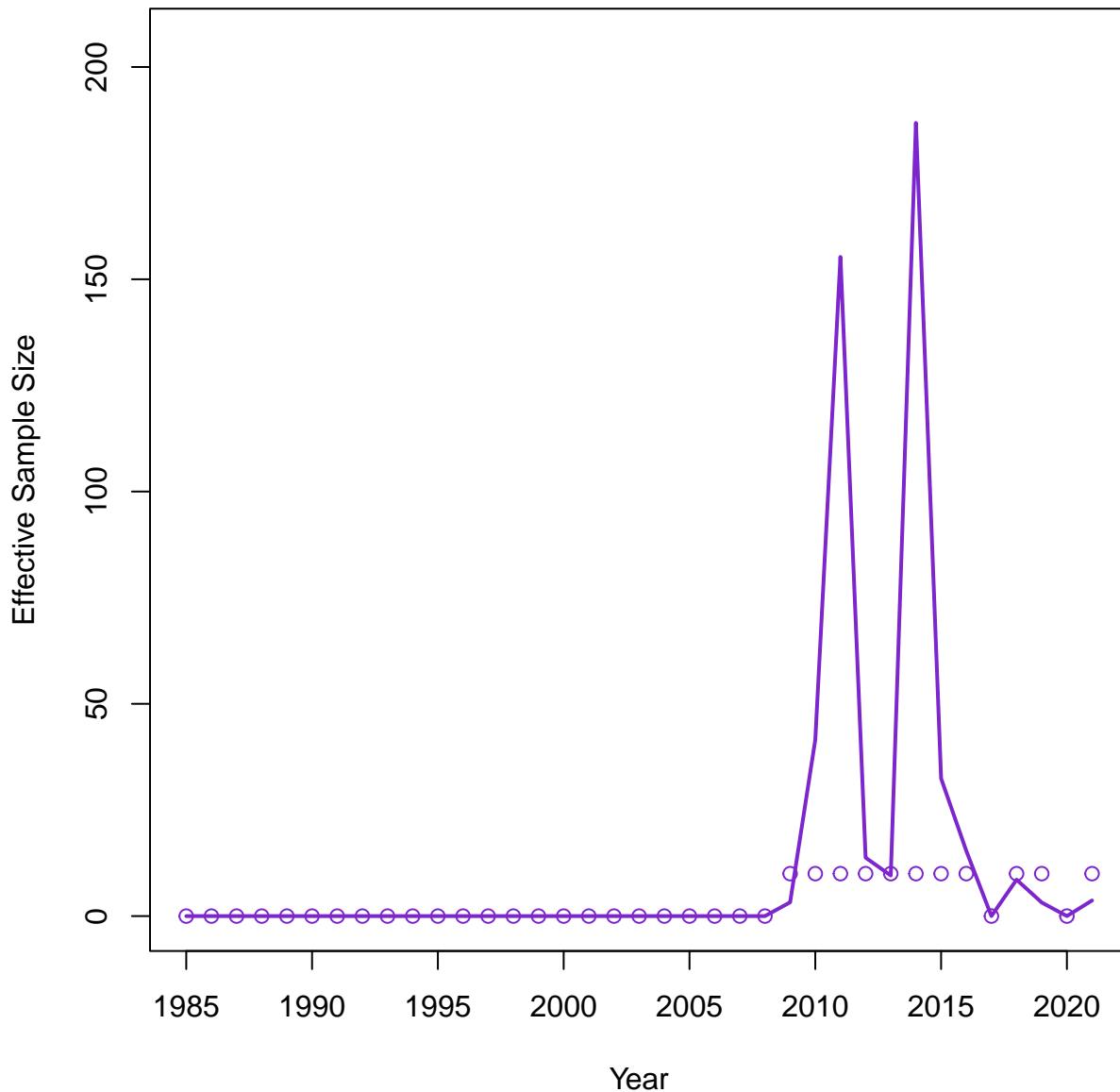
## Age Comp Residuals for Index 8 (ChesMMAP)



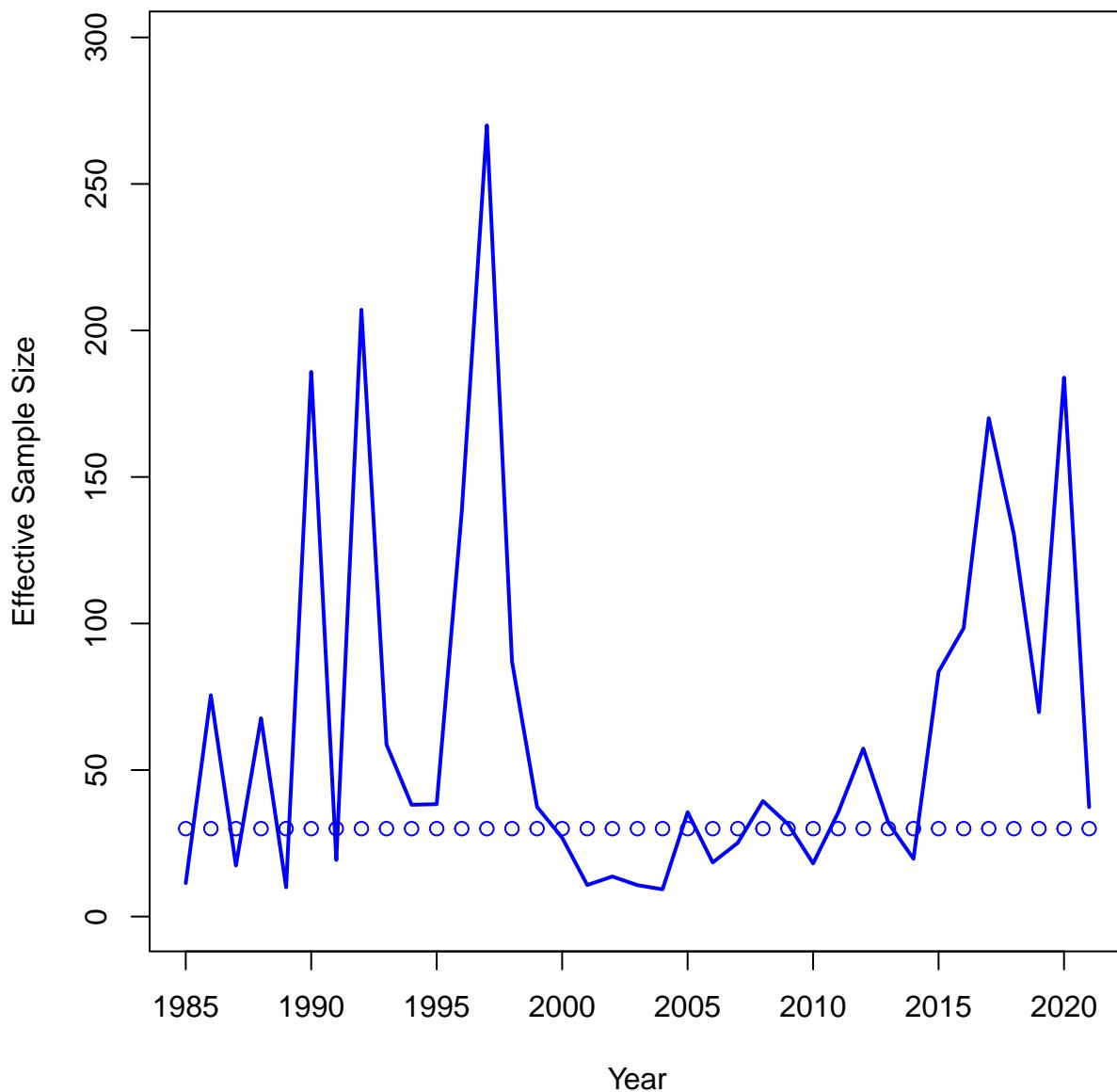
## Index Neff 1 (NEFSC Inshore)



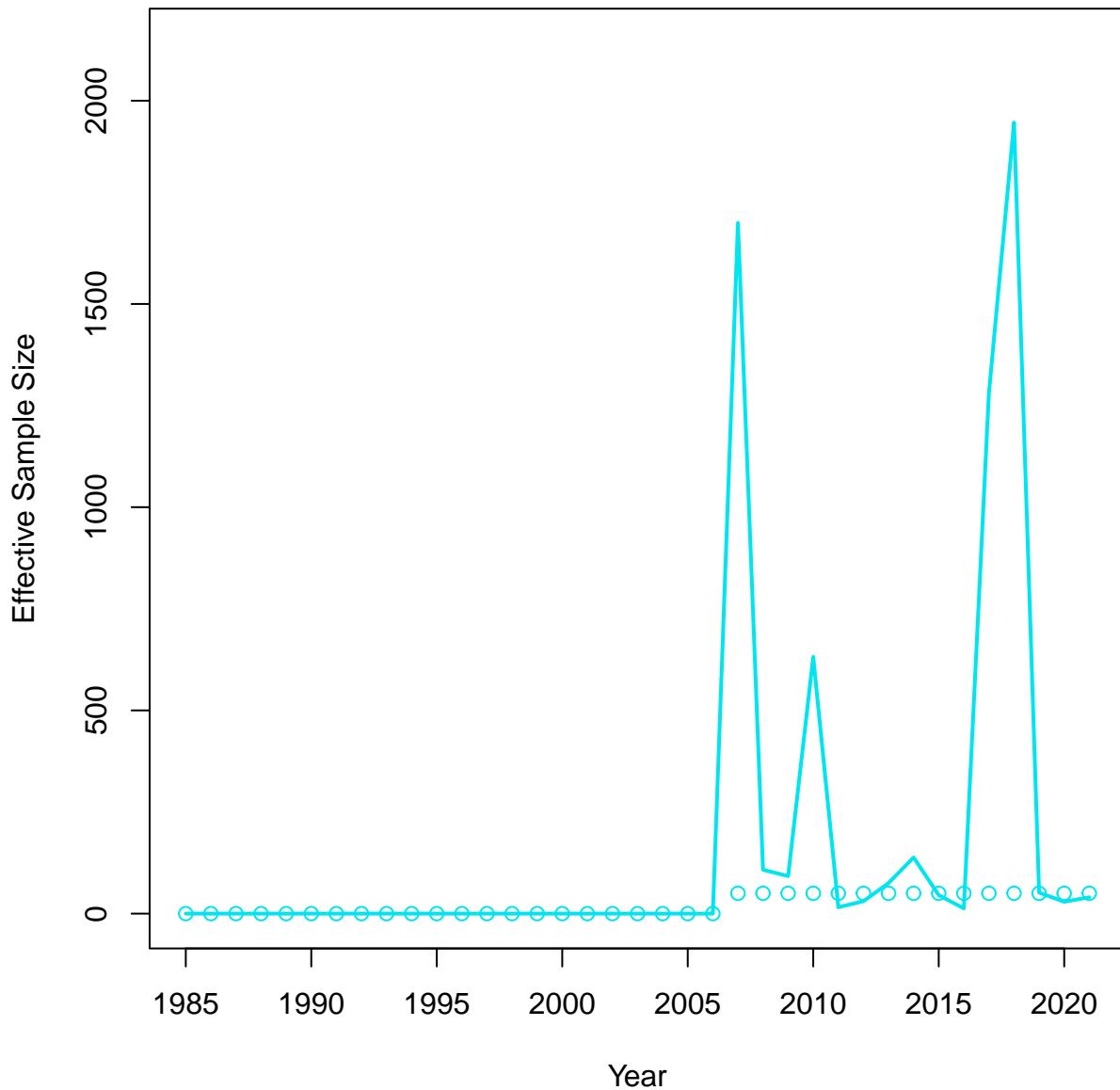
## Index Neff 2 (Bigelow)



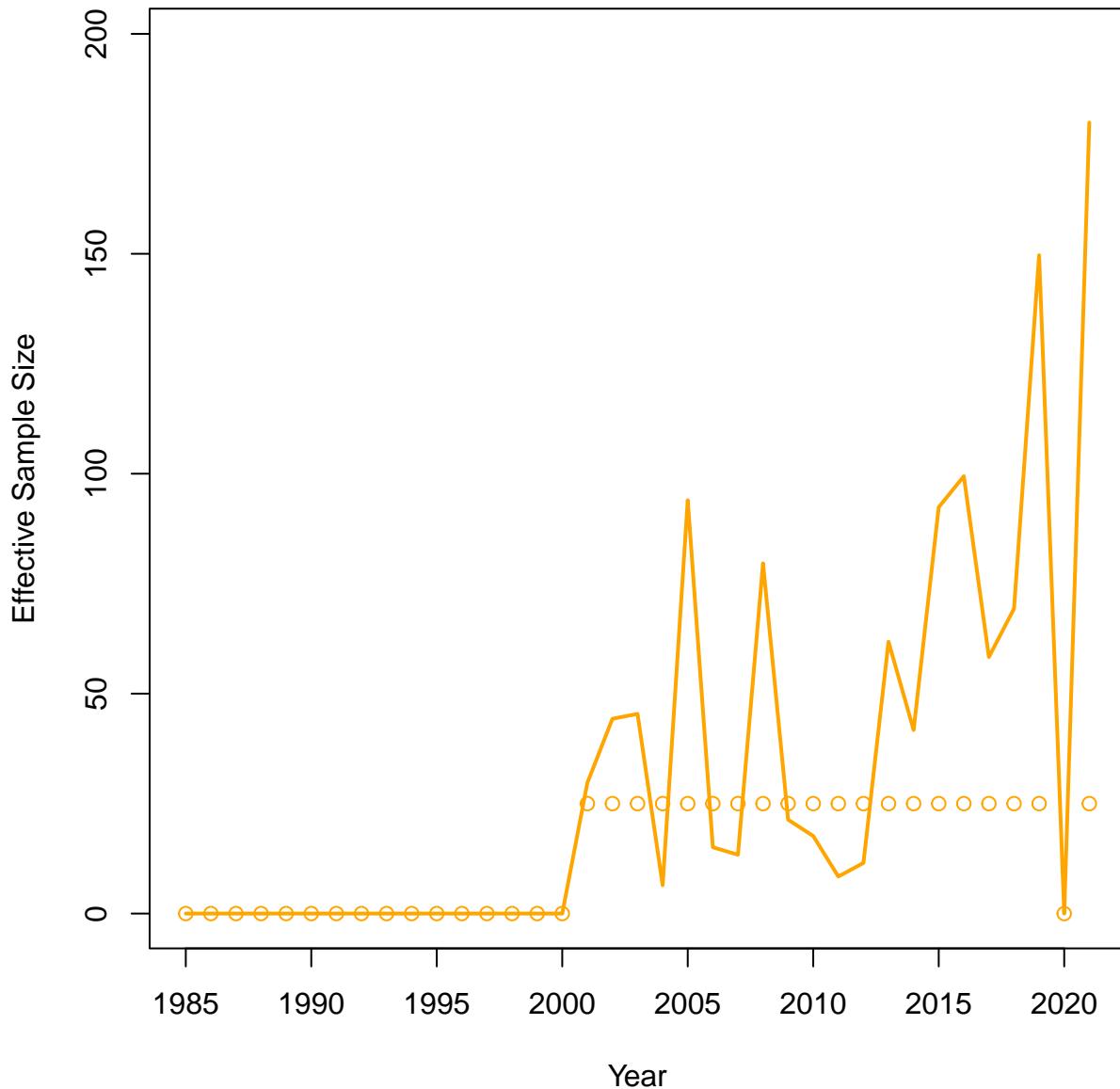
## Index Neff 3 (MRIP)



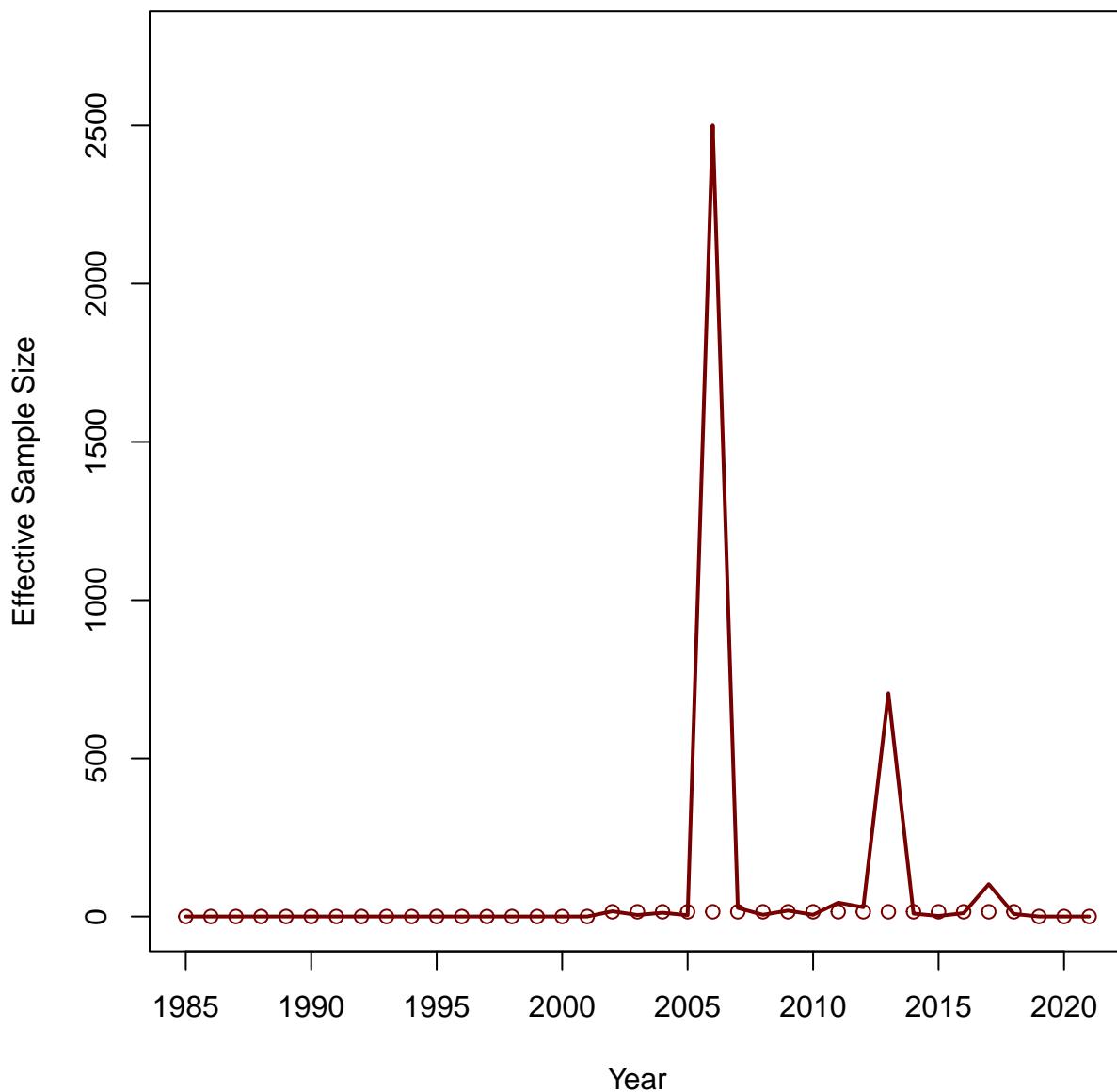
## Index Neff 4 (NEAMAP)



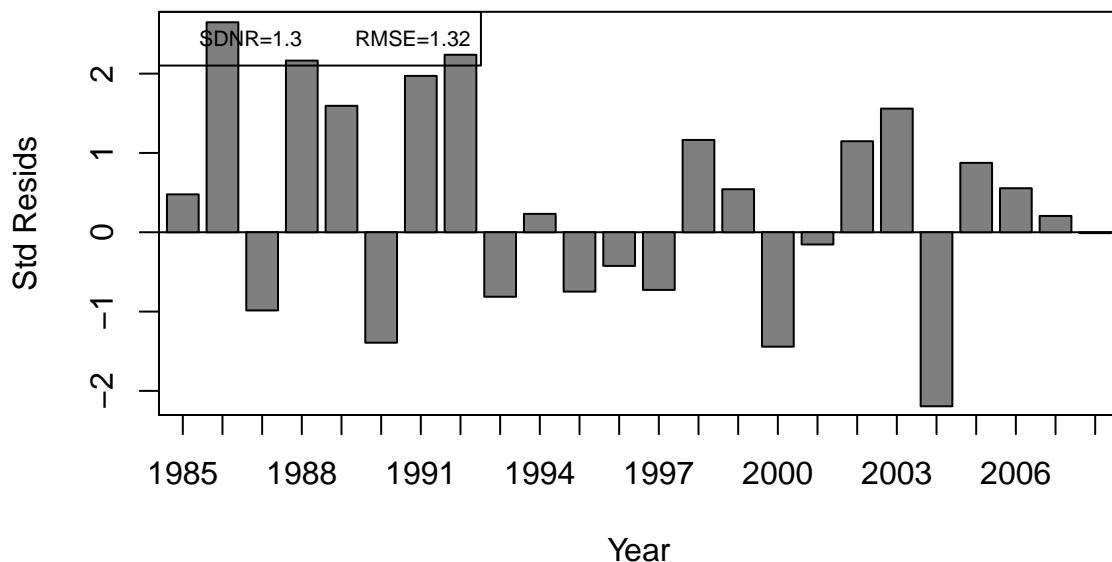
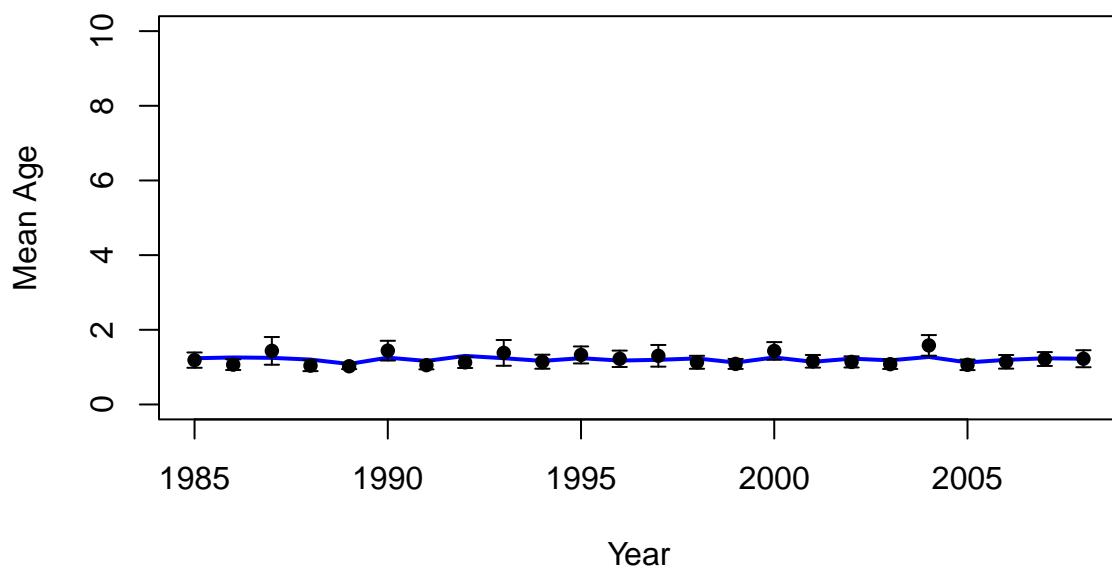
## Index Neff 6 (PSIGN)



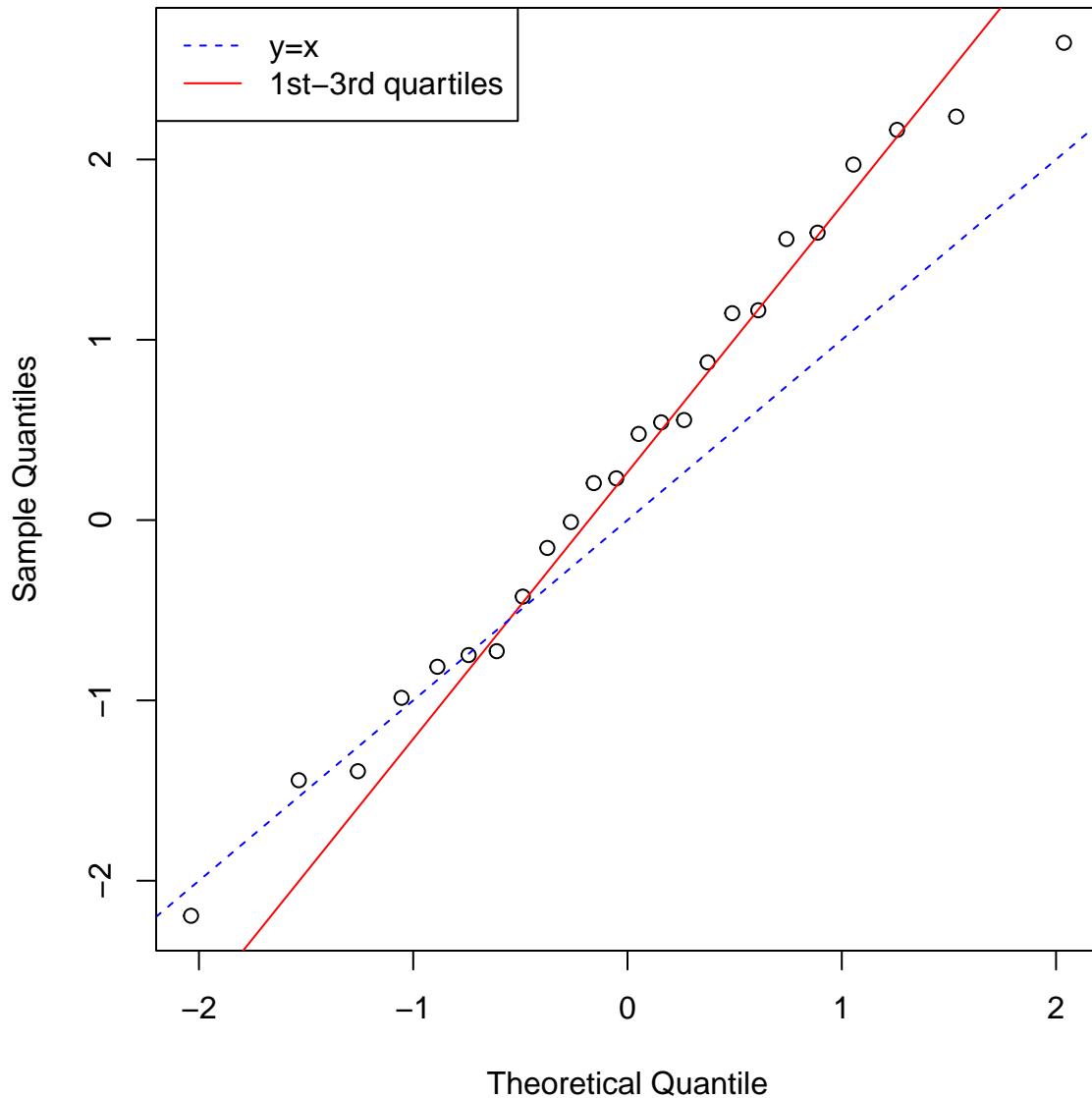
## Index Neff 8 (ChesMMAP)



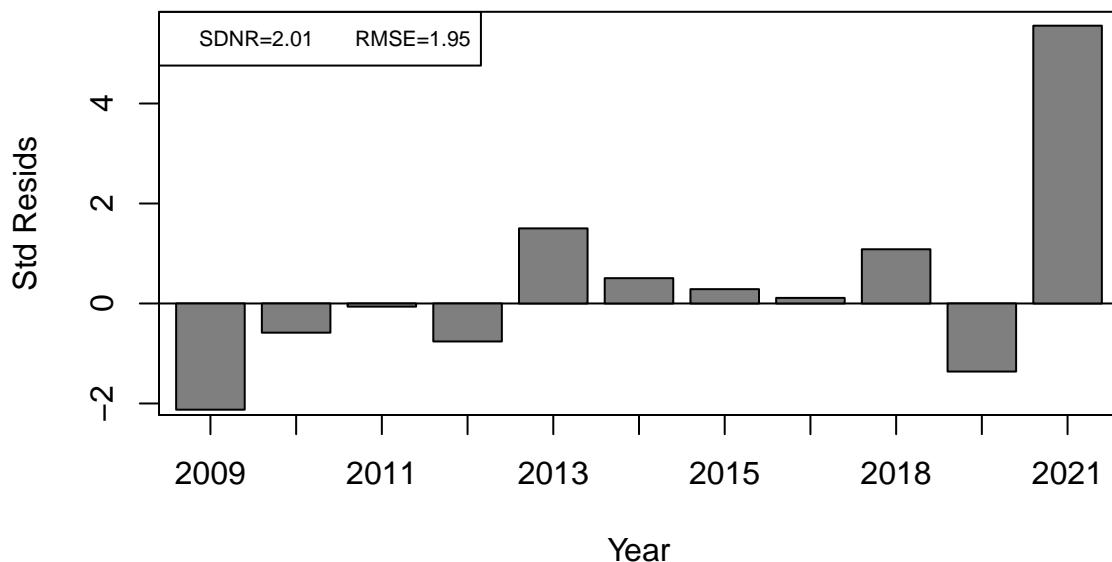
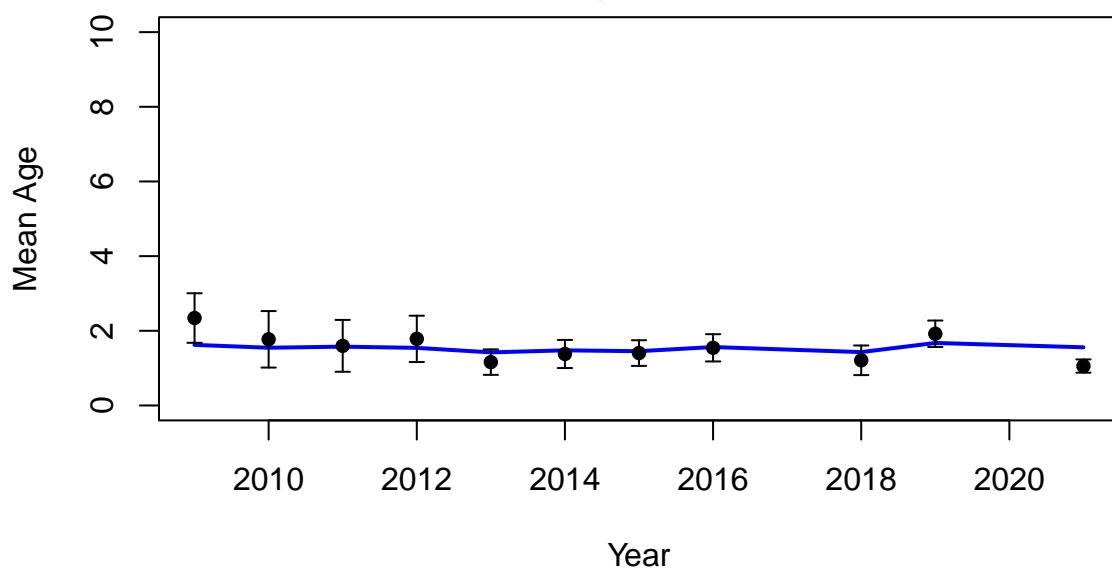
### Index 1 (NEFSC Inshore) ESS = 30



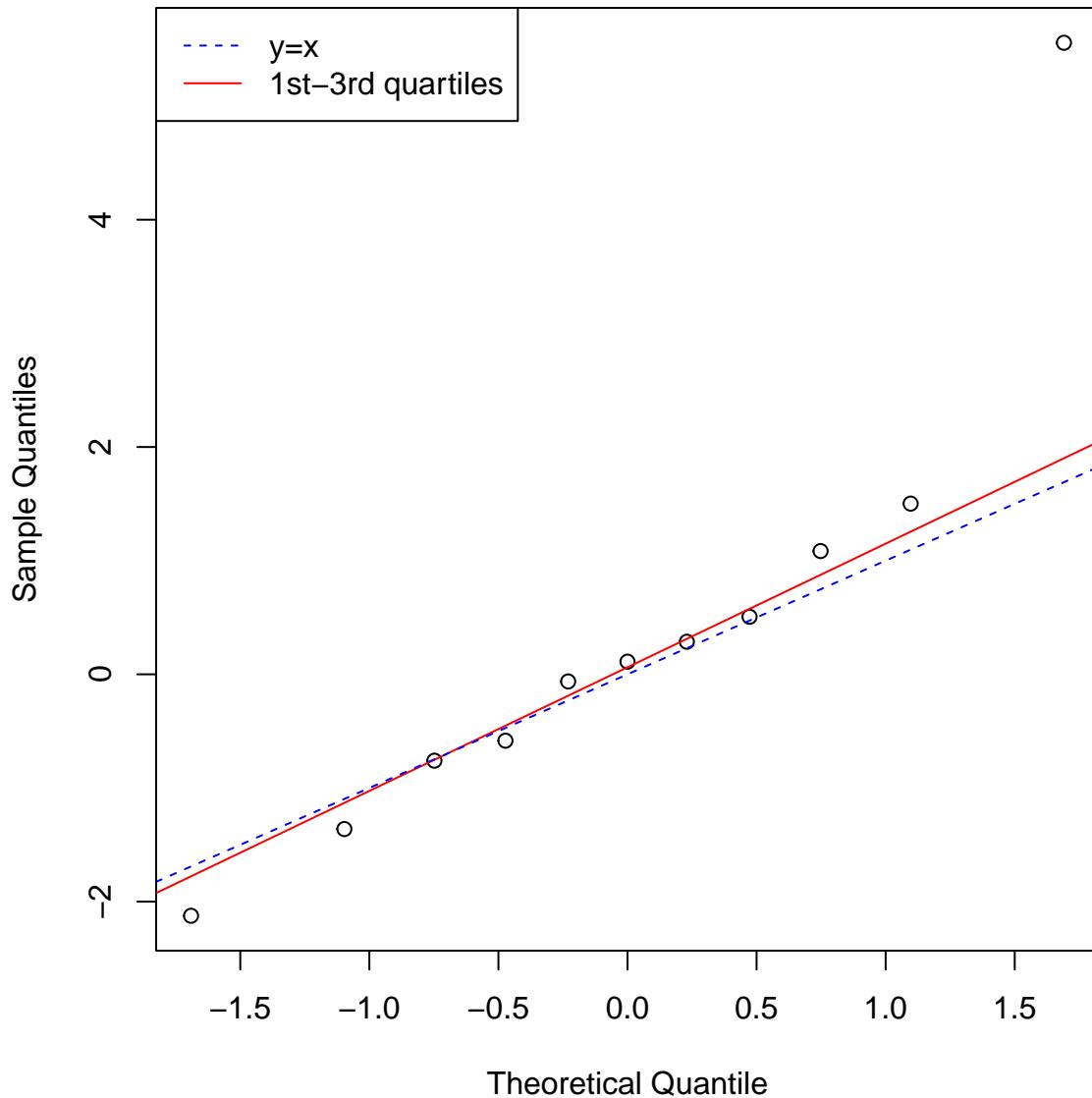
### Index 1 (NEFSC Inshore) ESS = 30



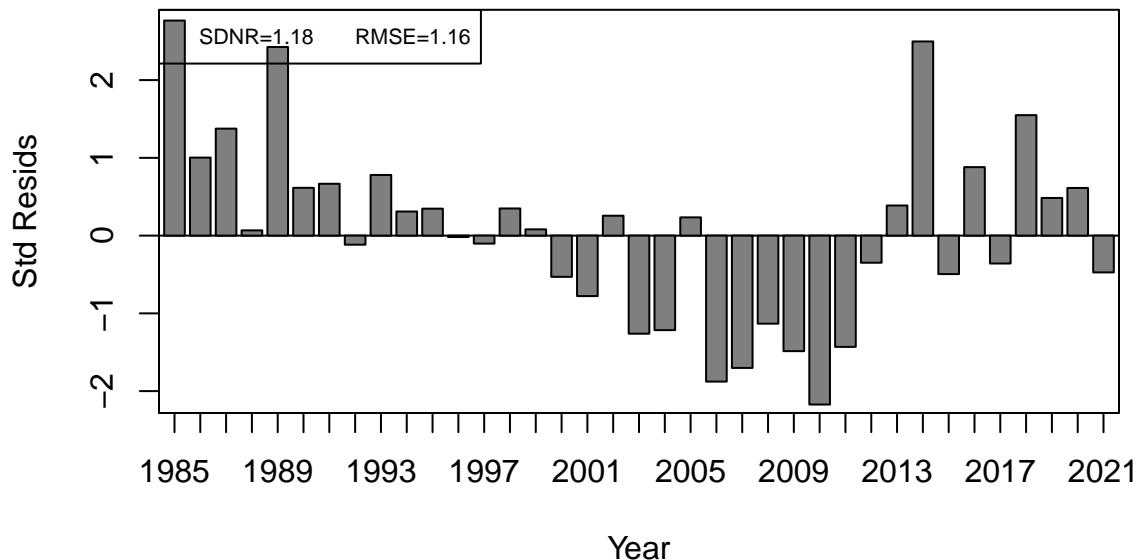
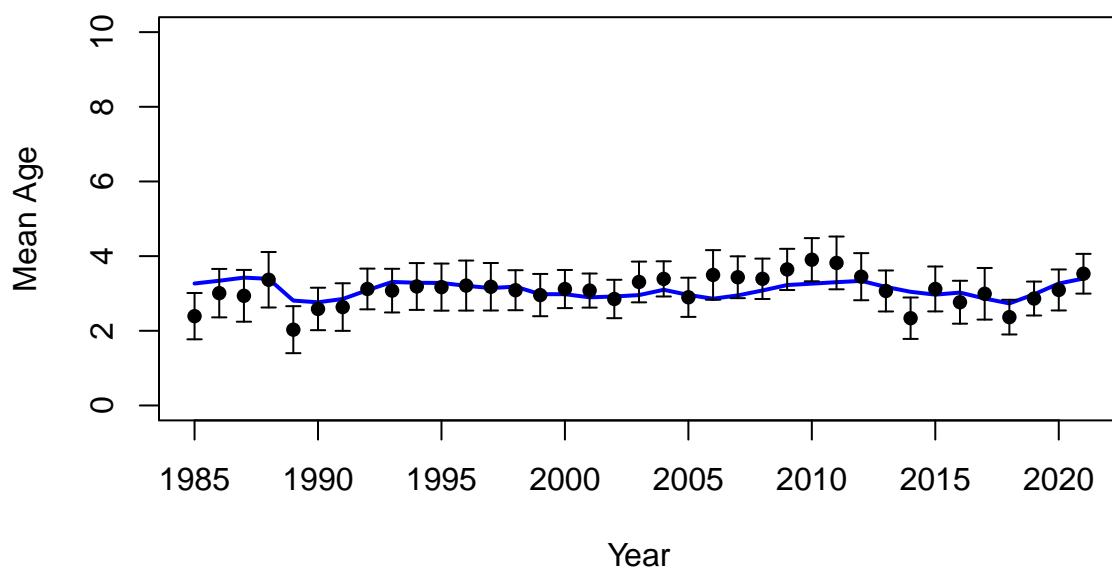
## Index 2 (Bigelow) ESS = 10



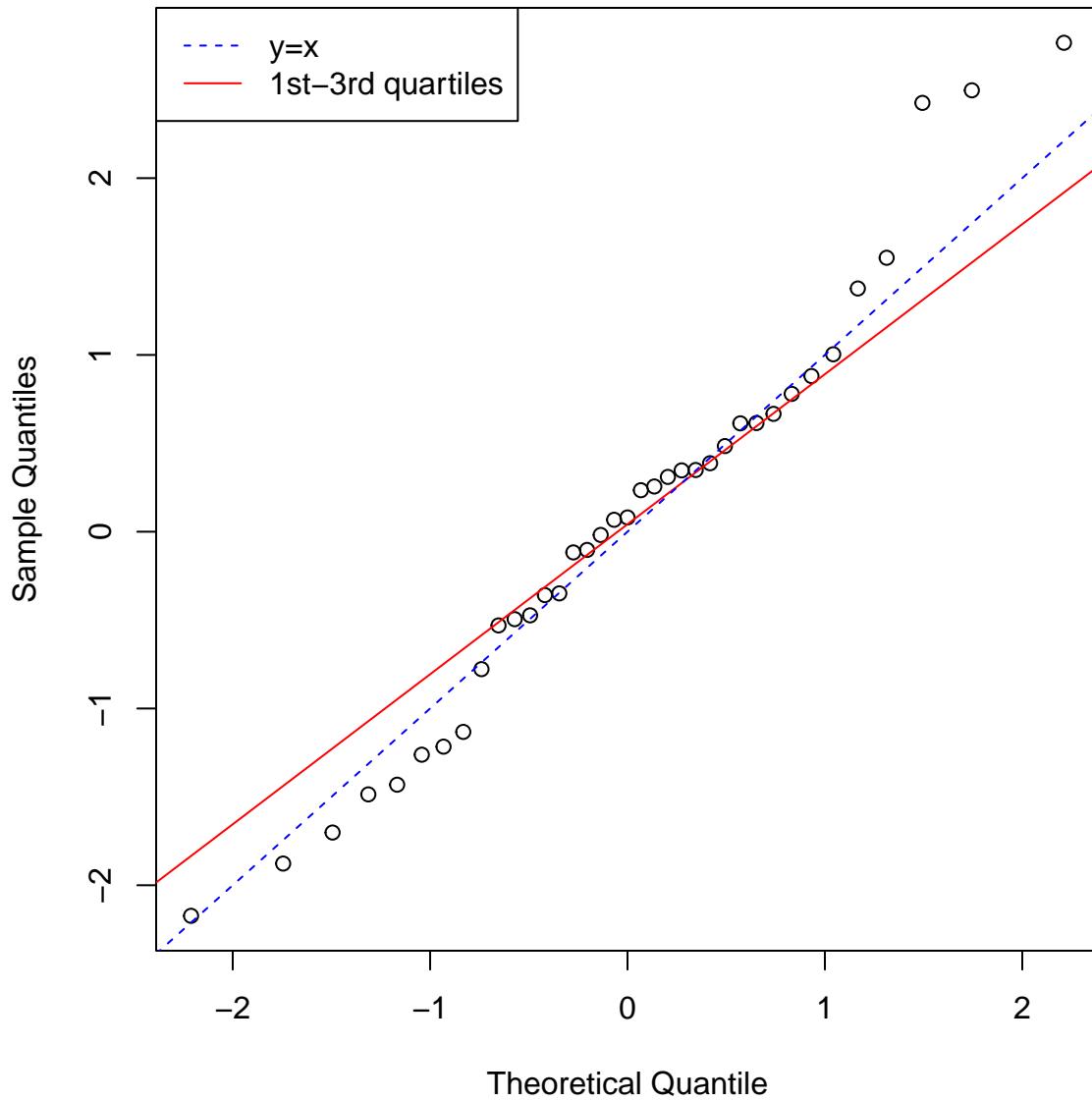
## Index 2 (Bigelow) ESS = 10



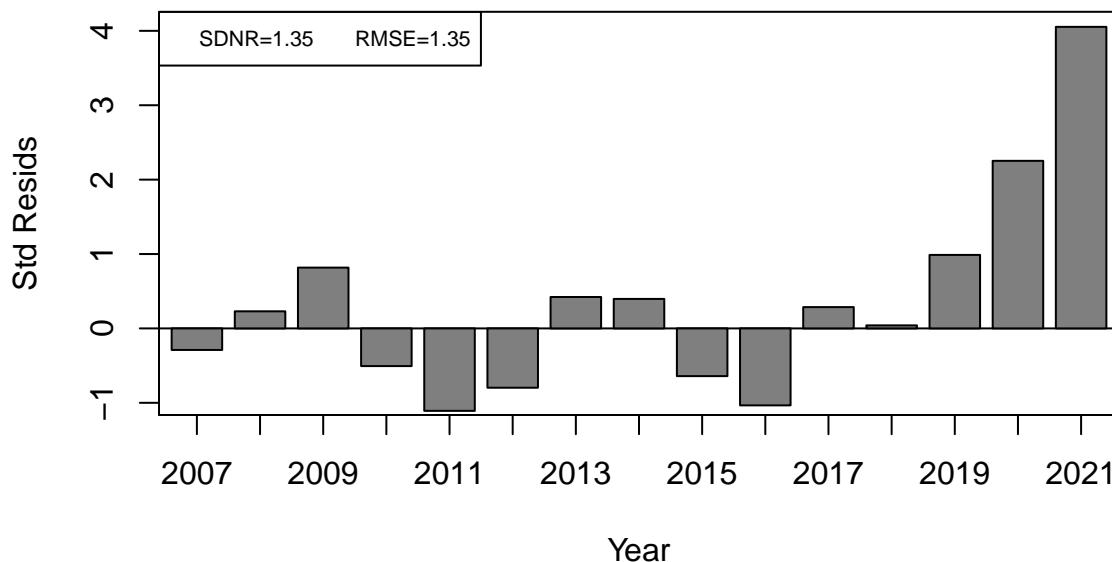
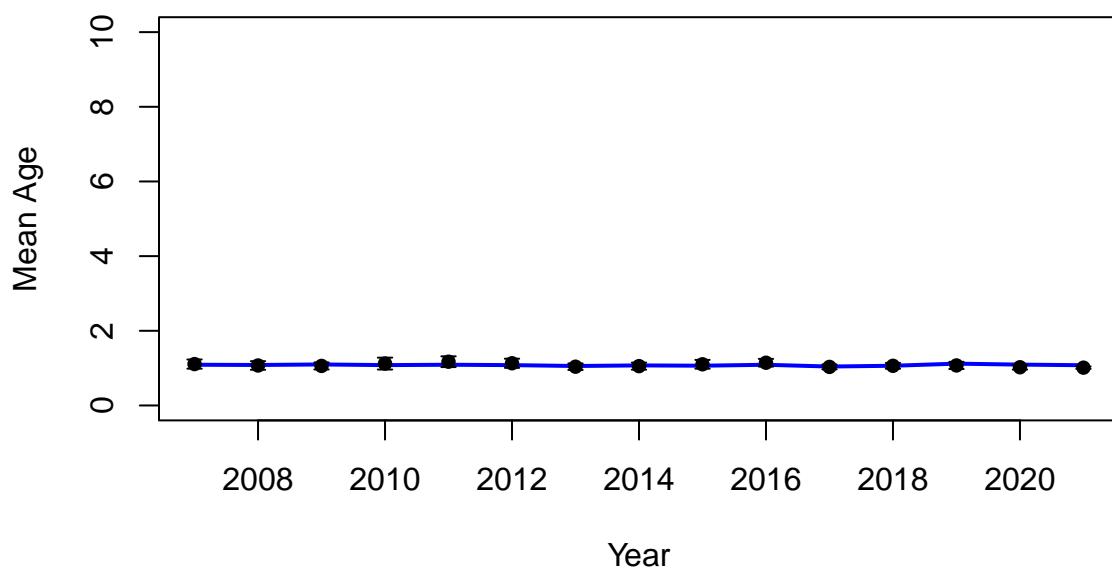
### Index 3 (MRIP) ESS = 30



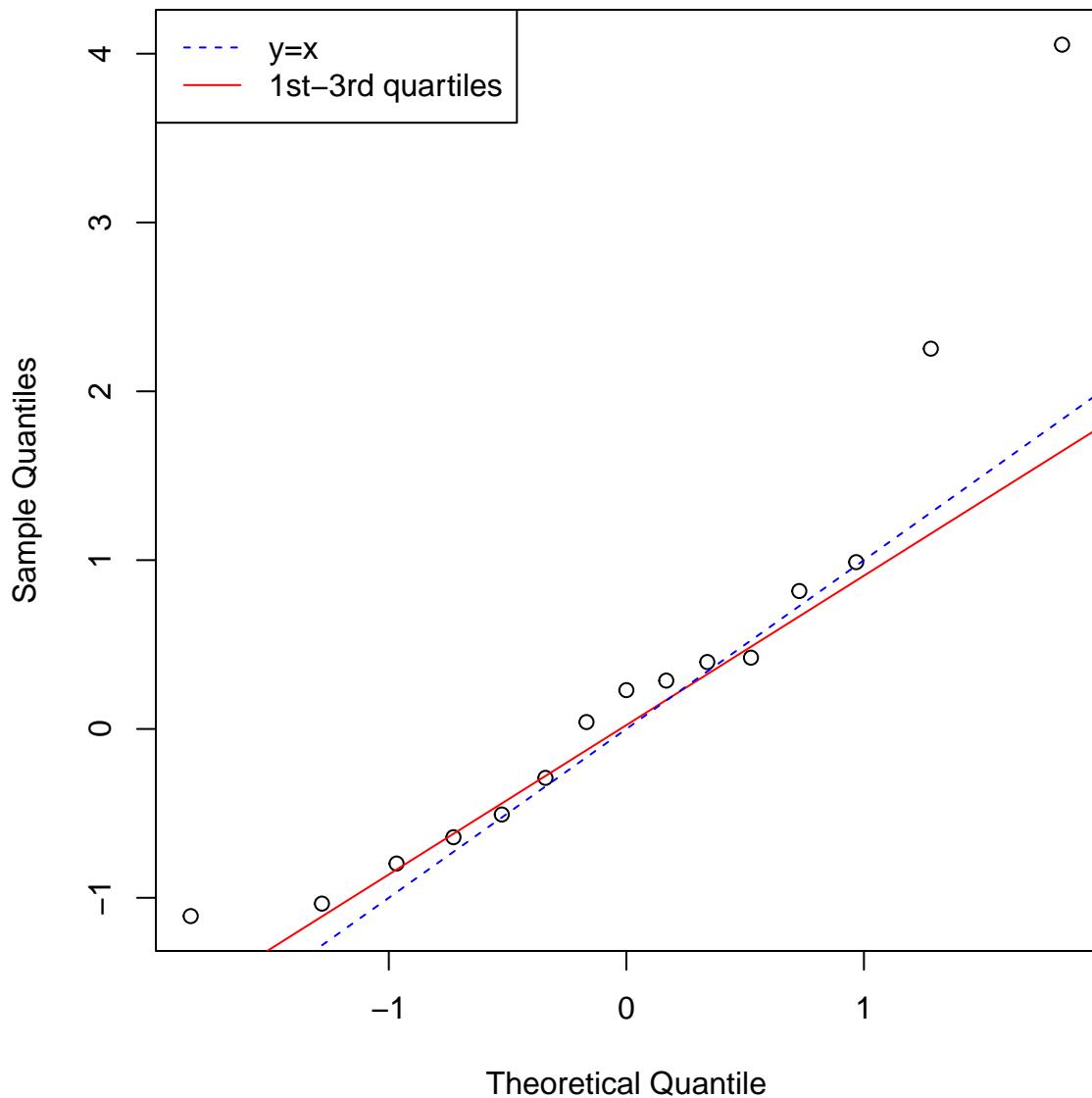
### Index 3 (MRIP) ESS = 30



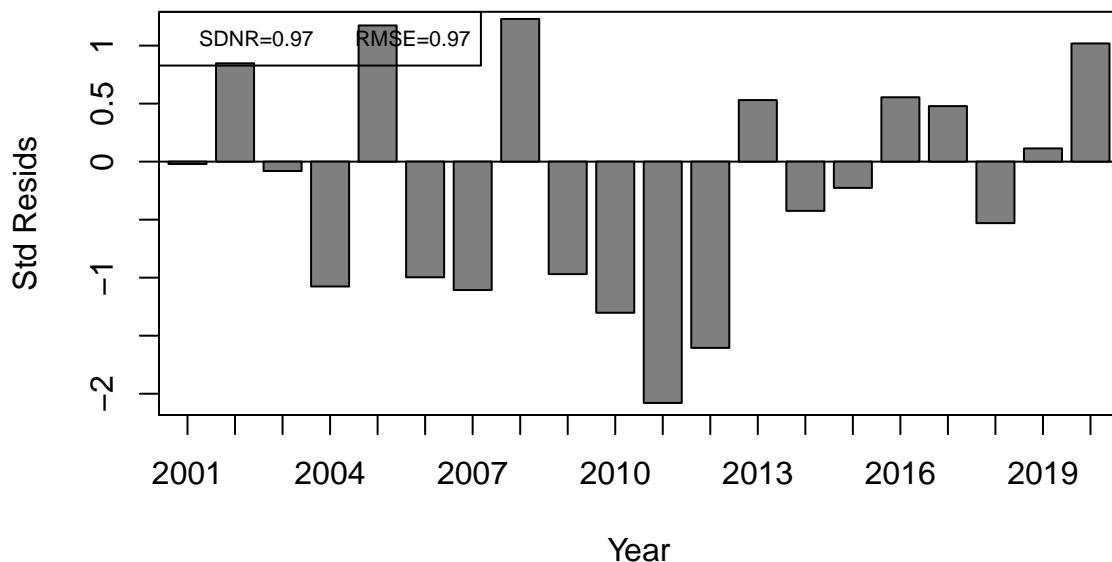
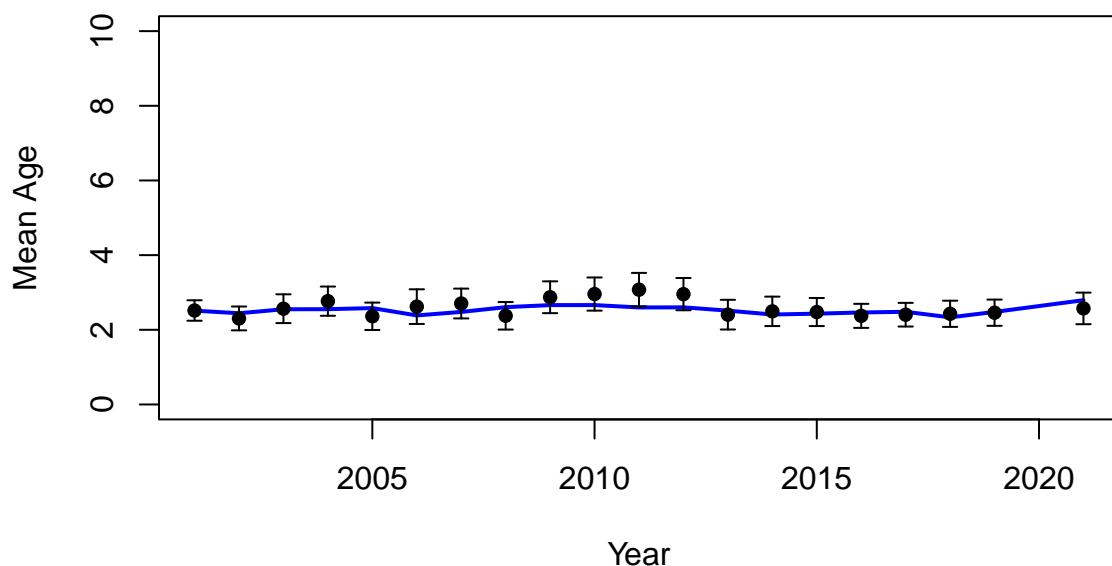
## Index 4 (NEAMAP) ESS = 50



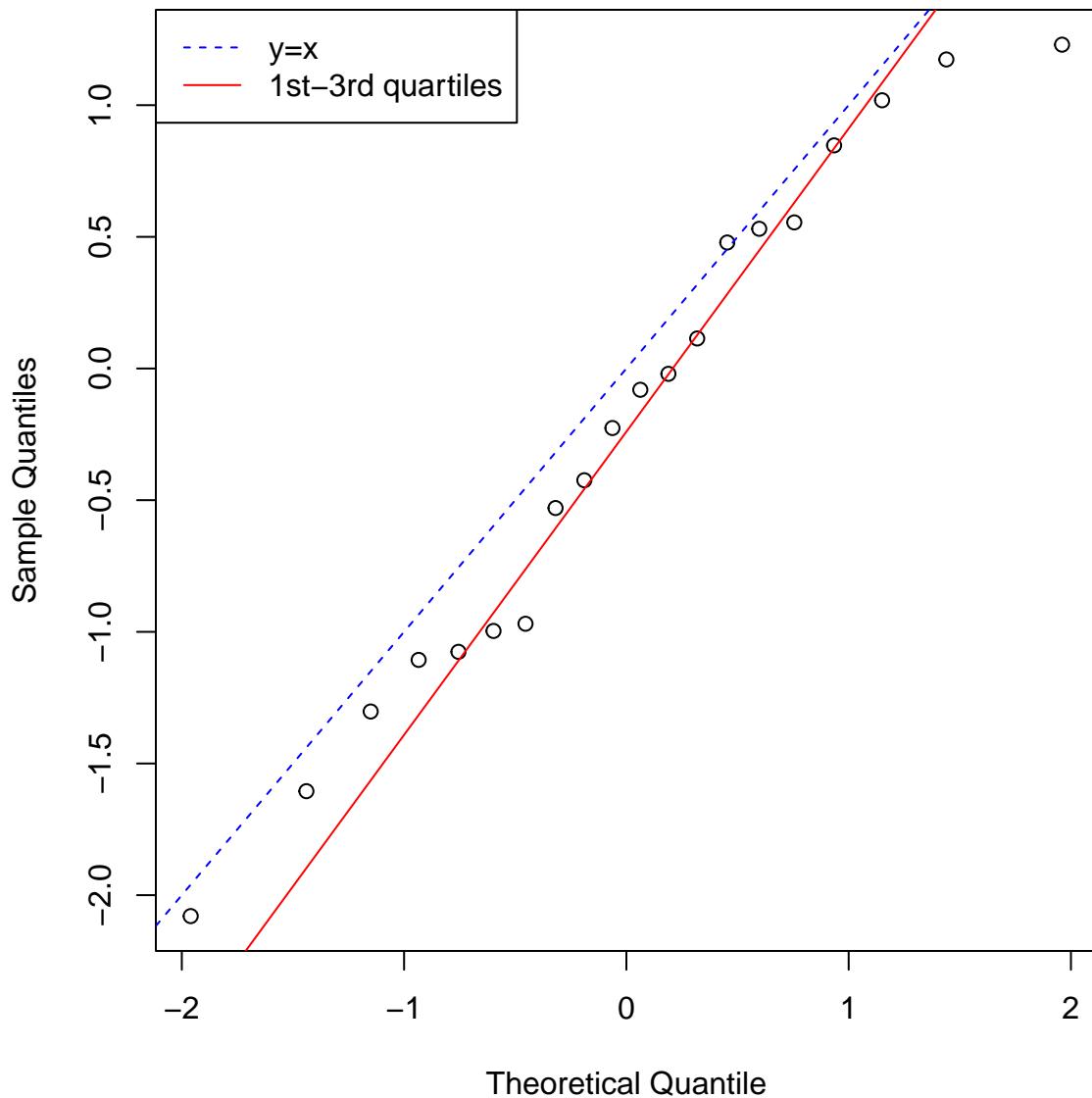
## Index 4 (NEAMAP) ESS = 50



## Index 6 (PSIGN) ESS = 25

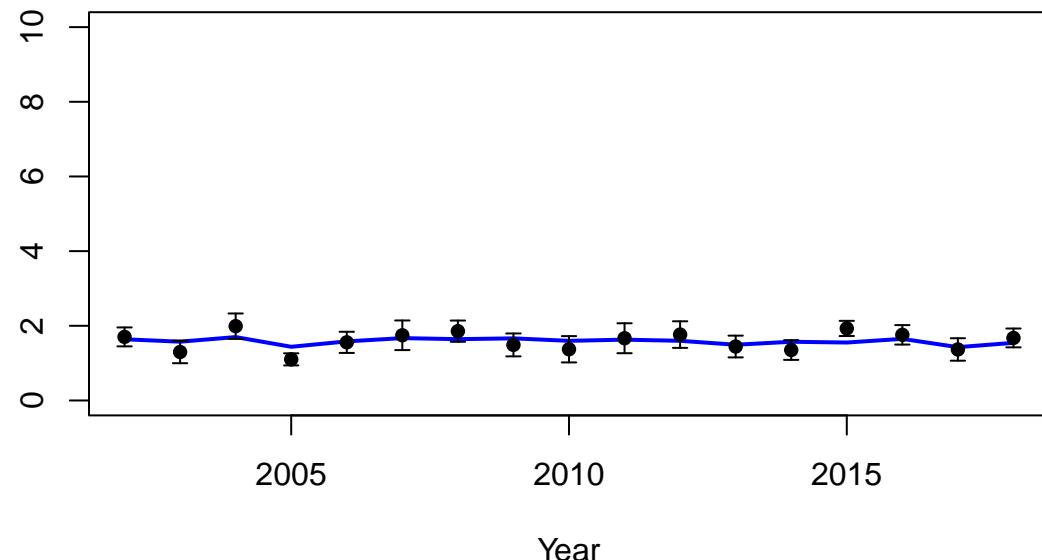


## Index 6 (PSIGN) ESS = 25

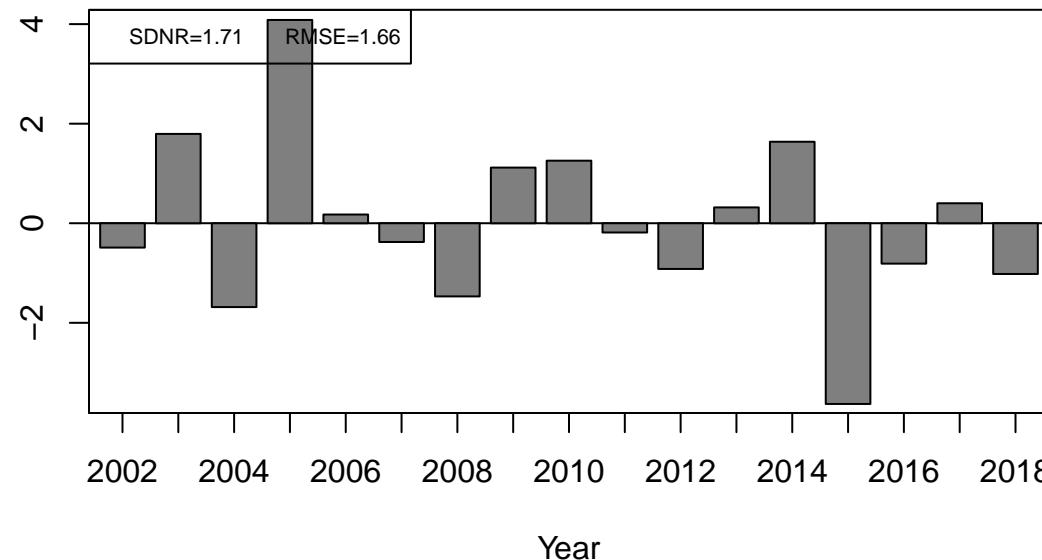


## Index 8 (ChesMMAP) ESS = 15

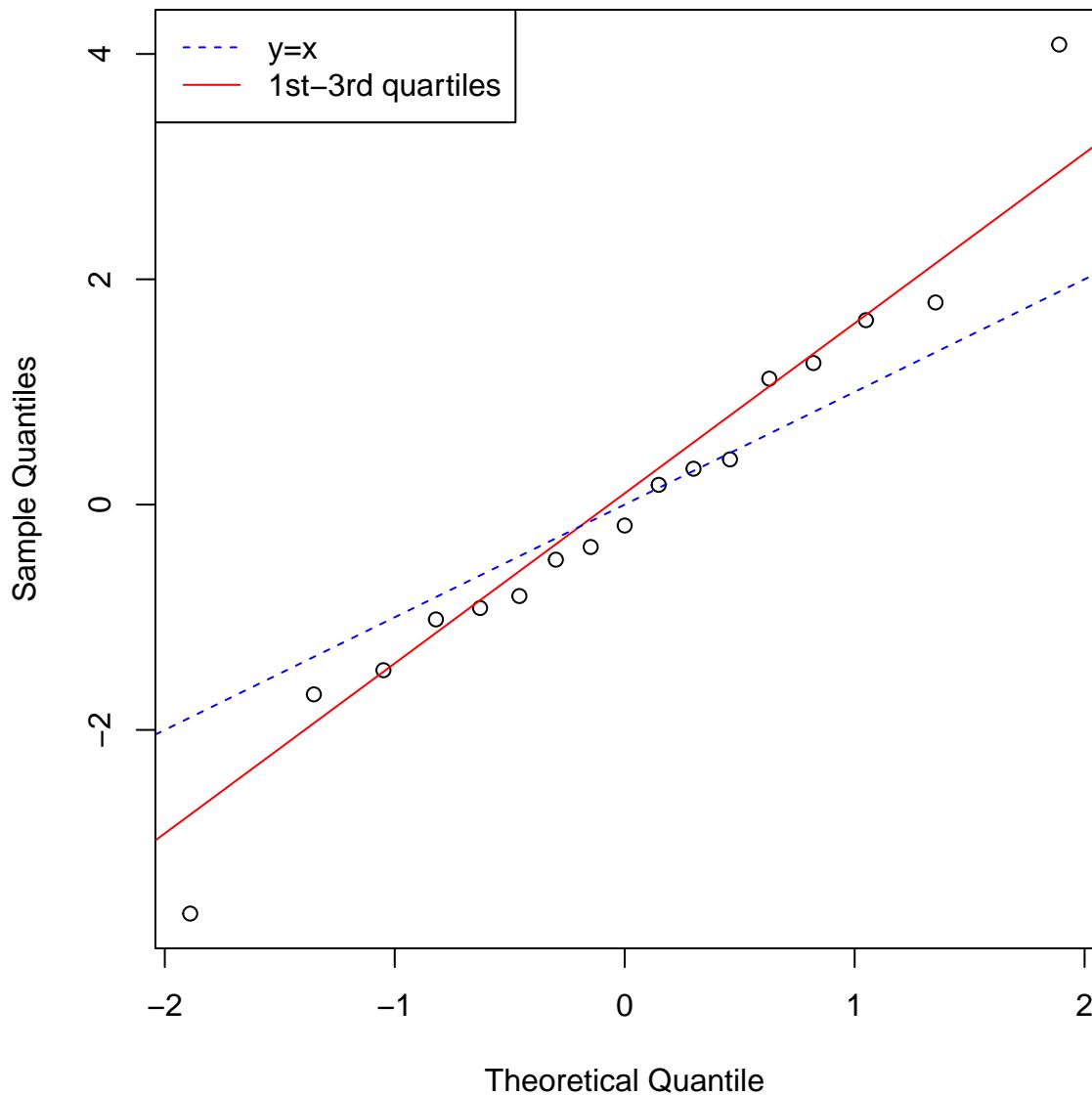
Mean Age



Std Resids



## Index 8 (ChesMMAP) ESS = 15

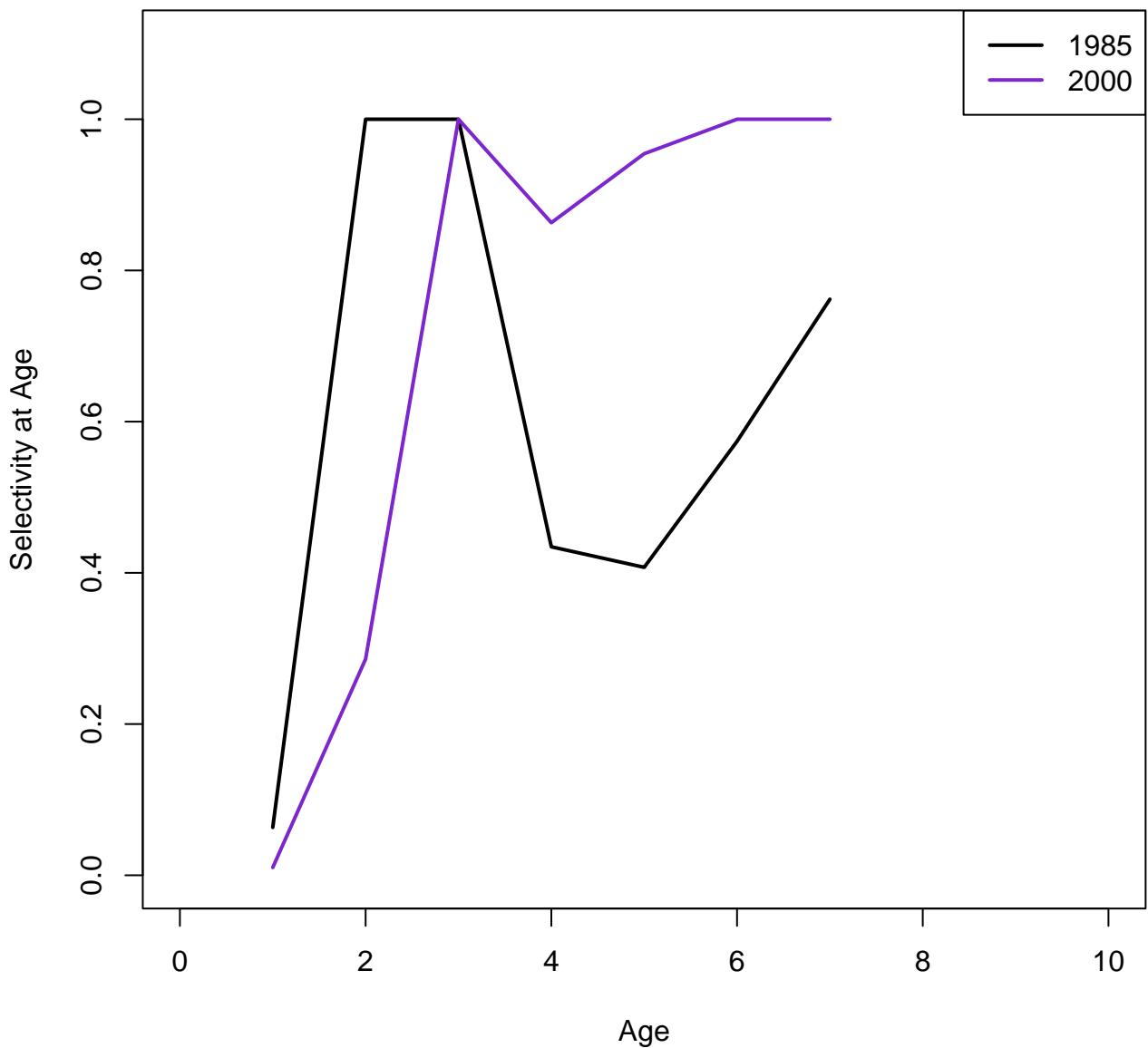


BF24

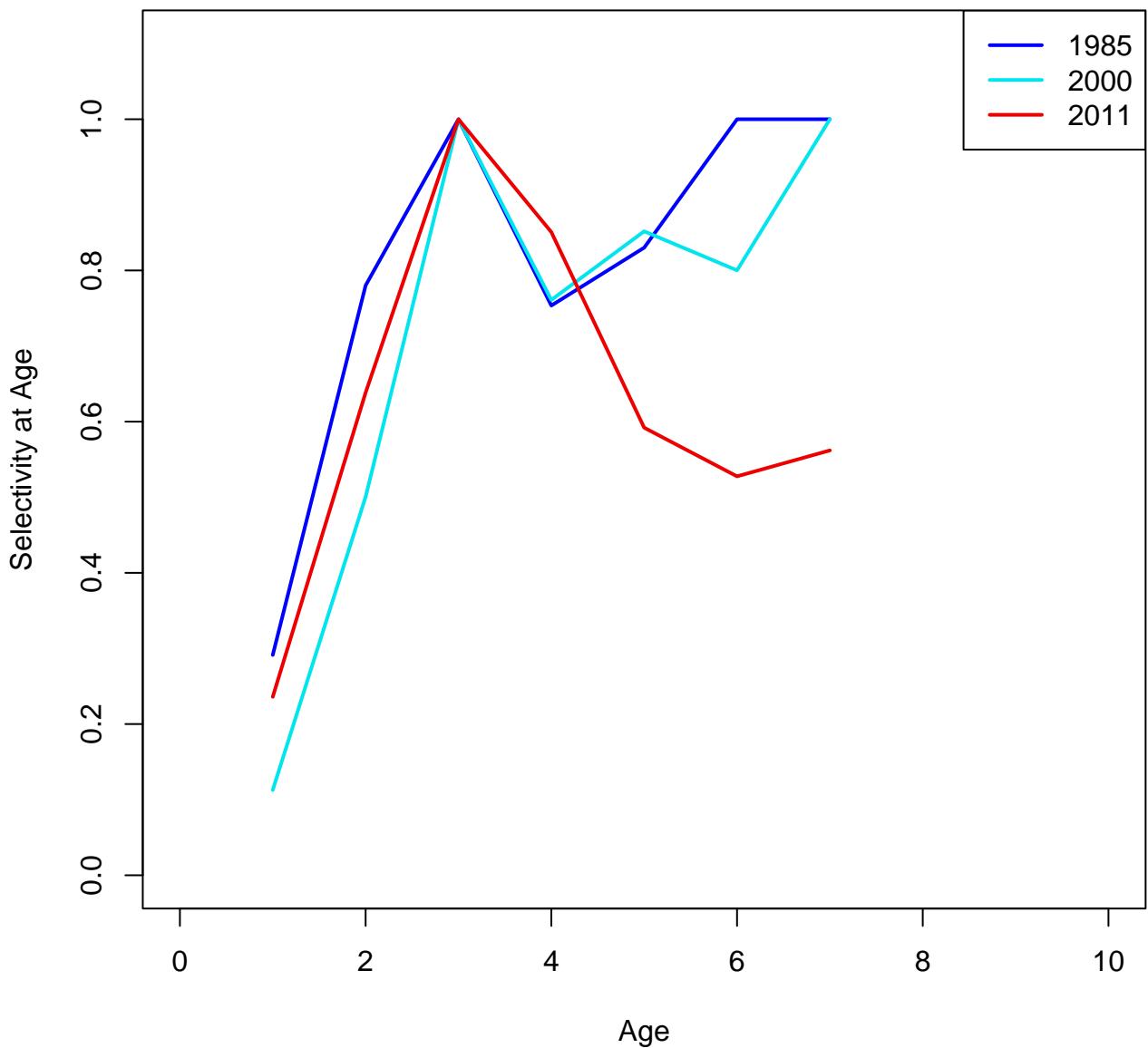
Final ASAP model

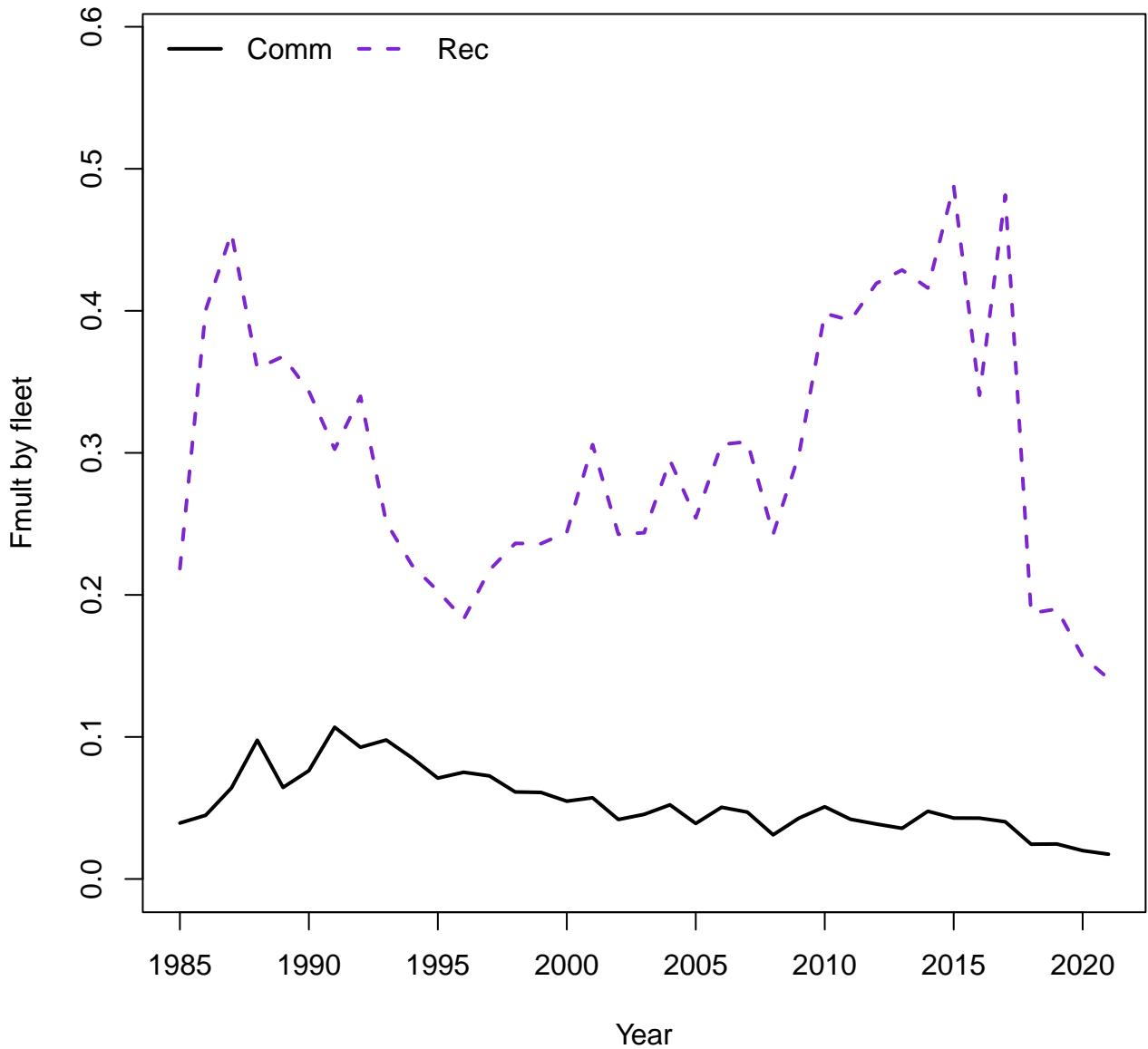
RESULTS PLOTS

## Fleet 1 (Comm)

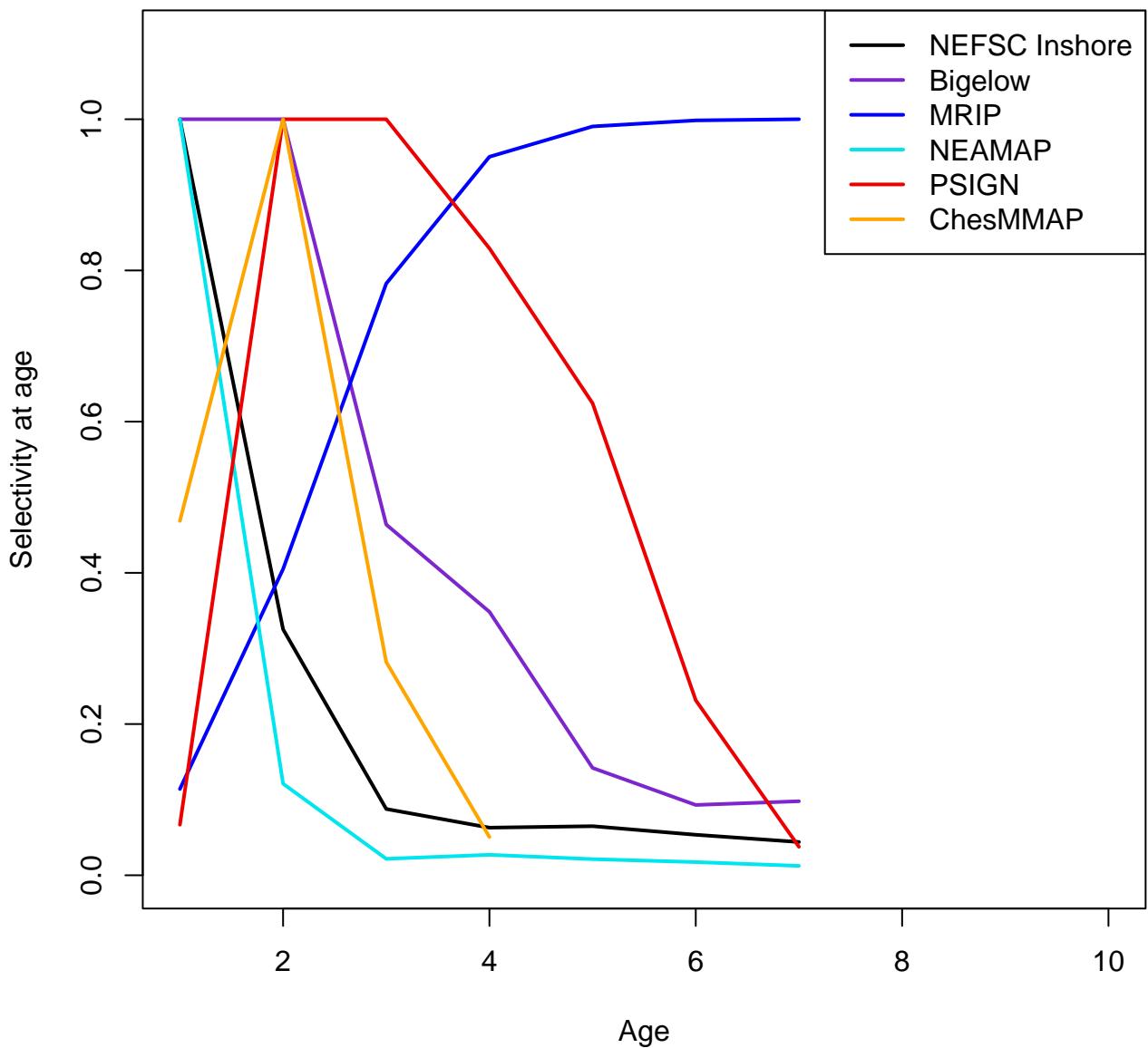


## Fleet 2 (Rec)



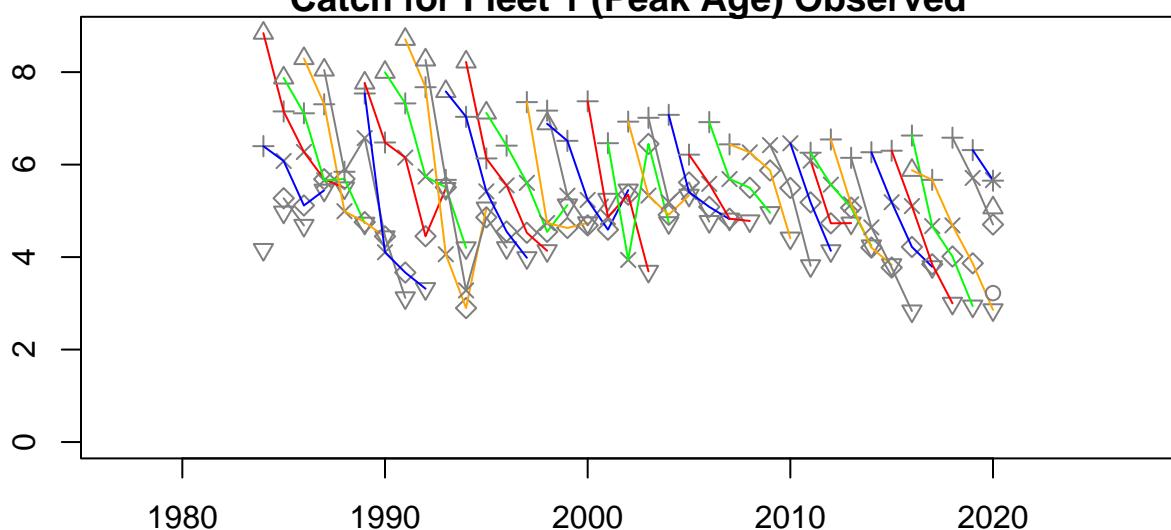


## Indices



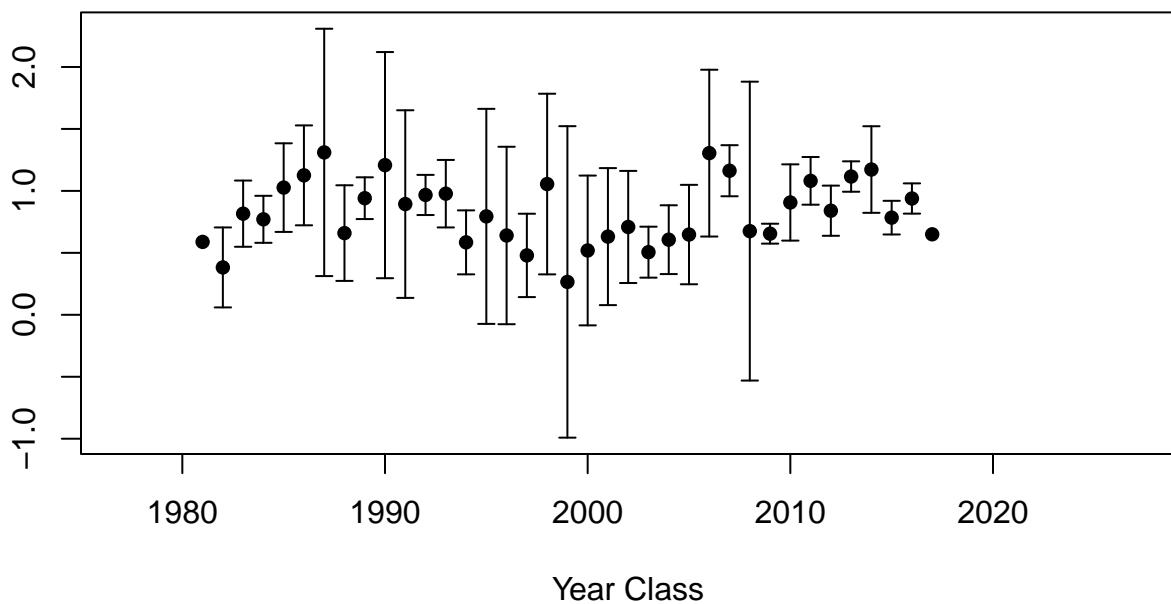
## Catch for Fleet 1 (Peak Age) Observed

Log(Catch)



1980 1990 2000 2010 2020

Z



1980 1990 2000 2010 2020

Year Class

## Catch for Fleet 1 (Peak Age) Predicted

Log(Catch)

8  
6  
4  
2  
0

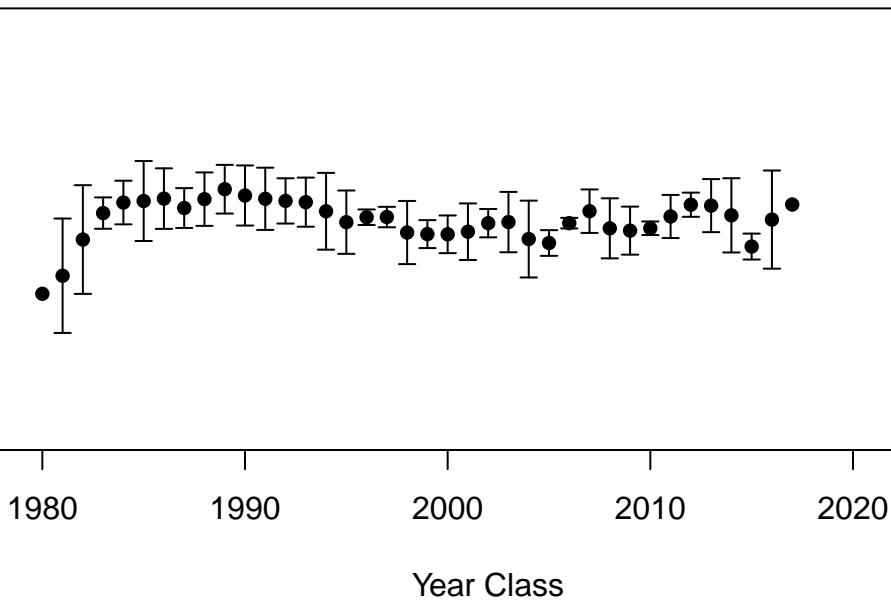
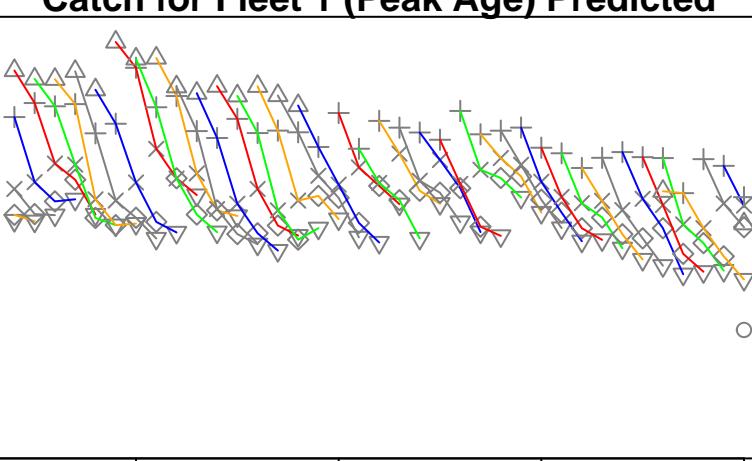
1980 1990 2000 2010 2020

Z

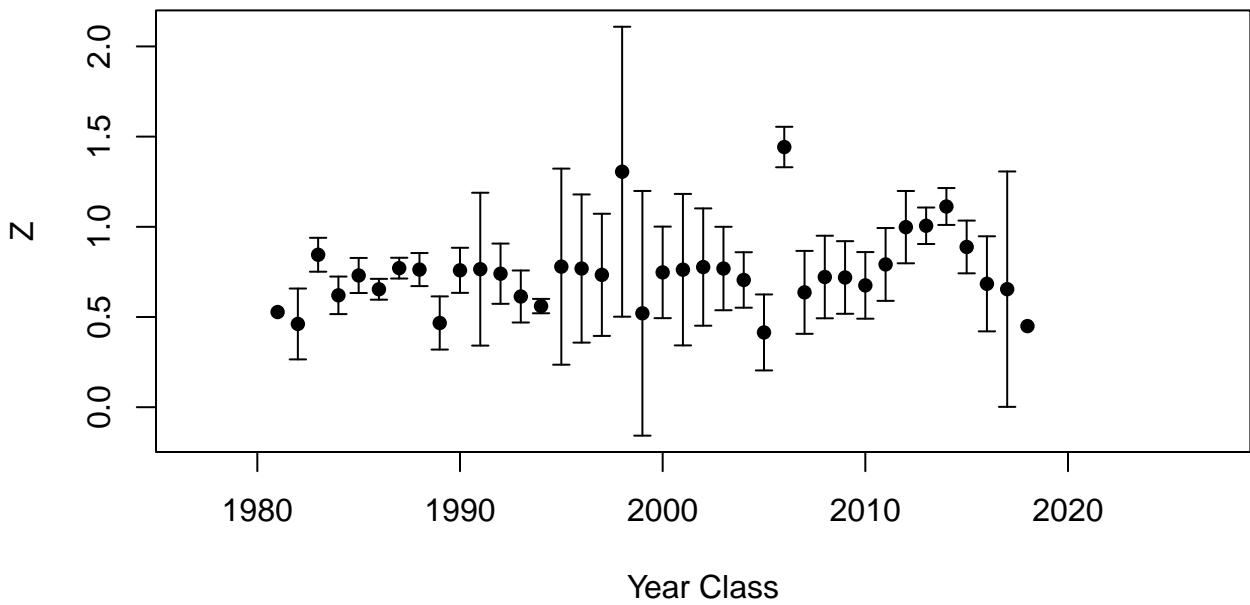
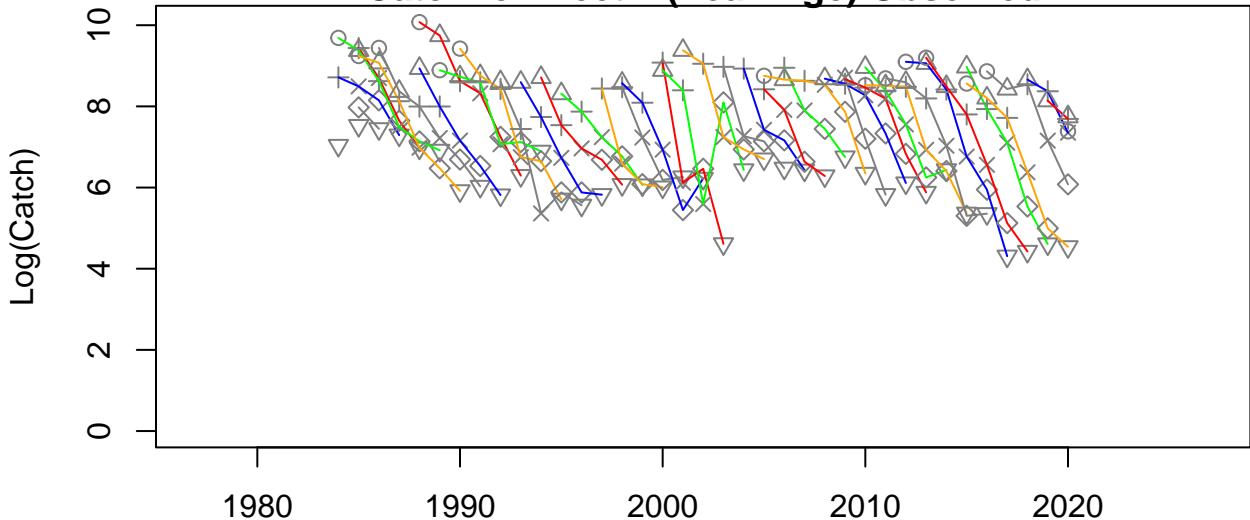
2.0  
1.0  
0.0  
-1.0

1980 1990 2000 2010 2020

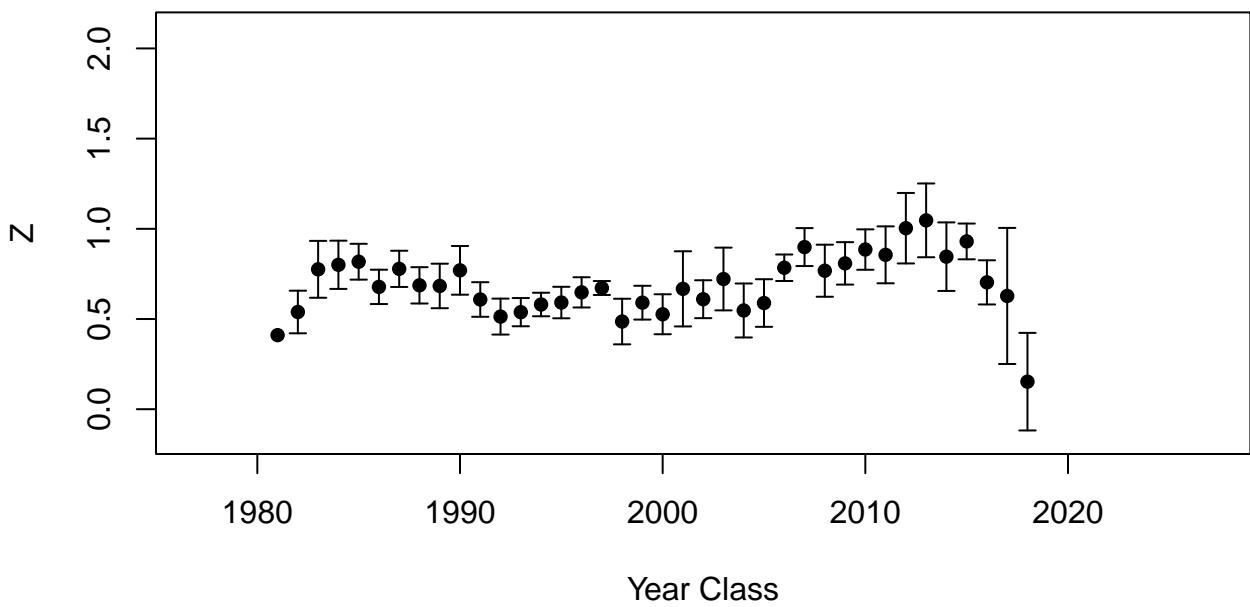
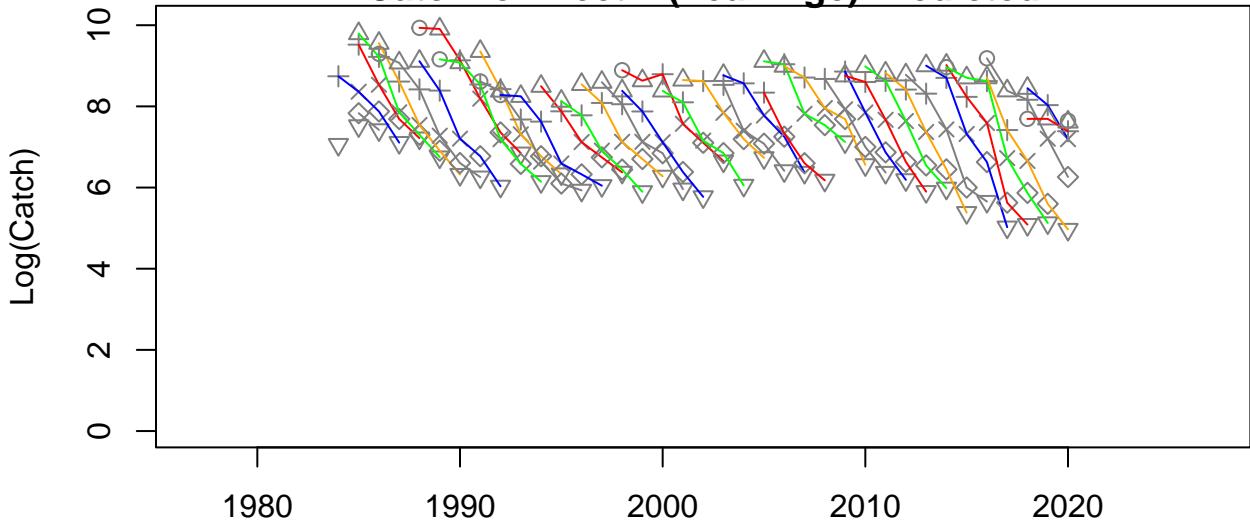
Year Class



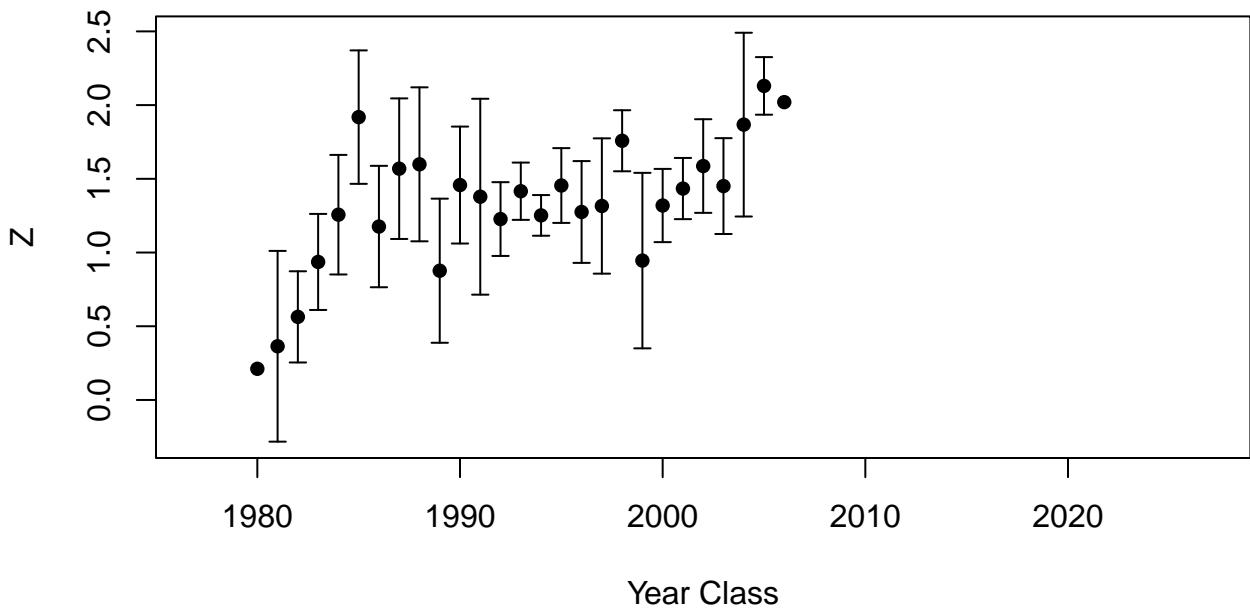
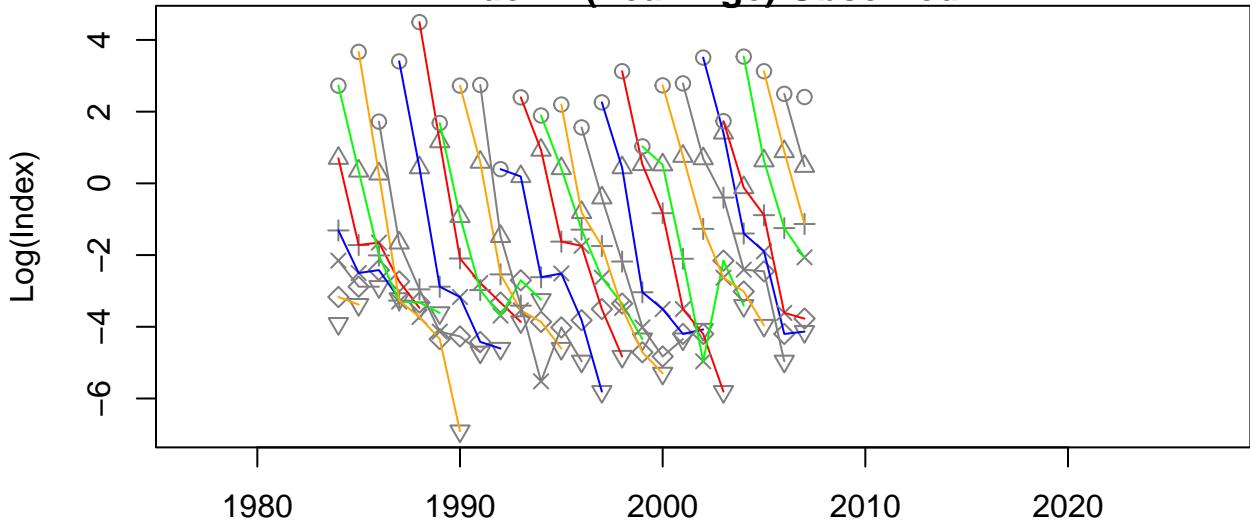
## Catch for Fleet 2 (Peak Age) Observed



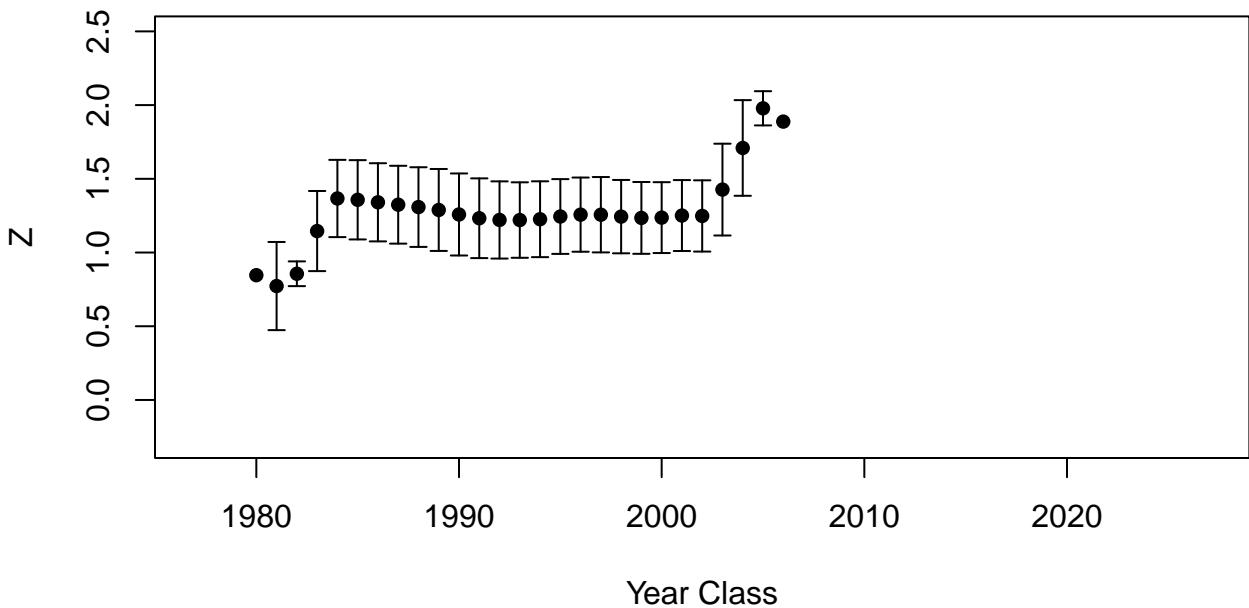
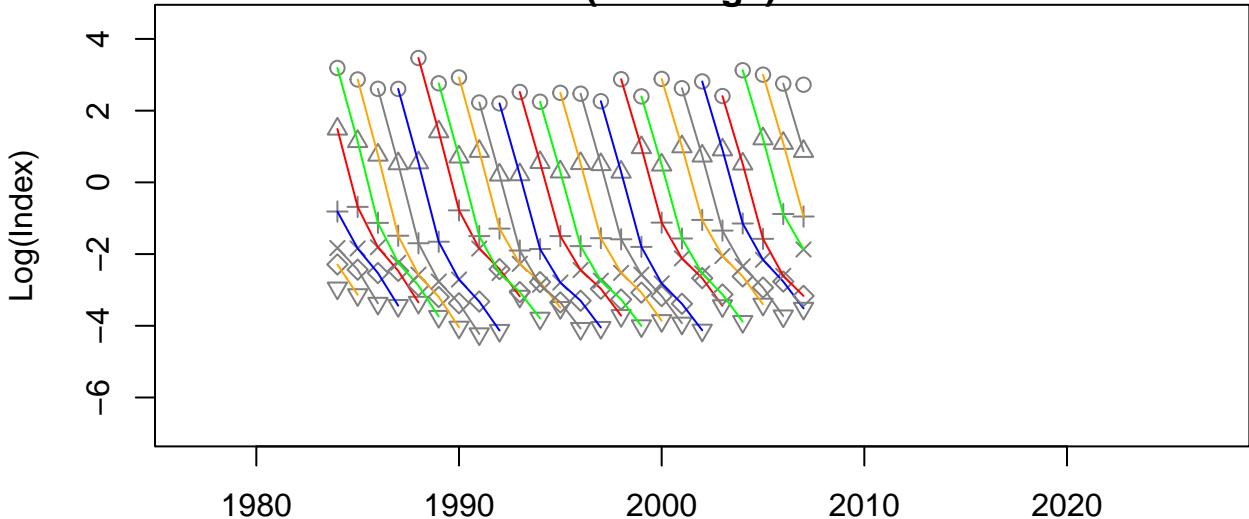
## Catch for Fleet 2 (Peak Age) Predicted



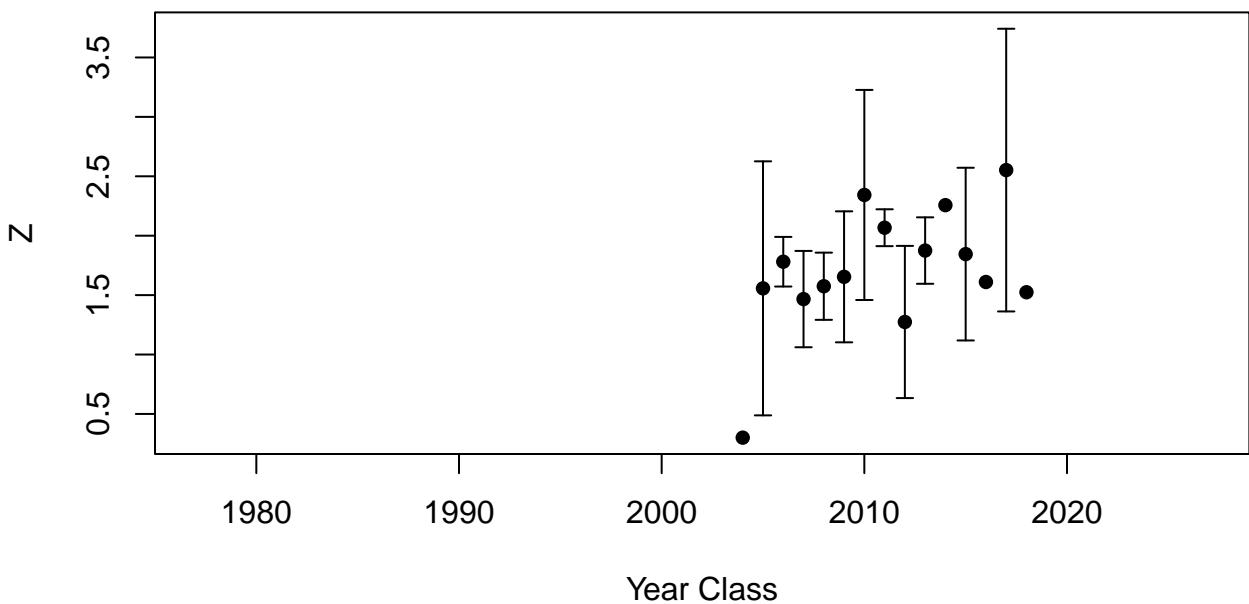
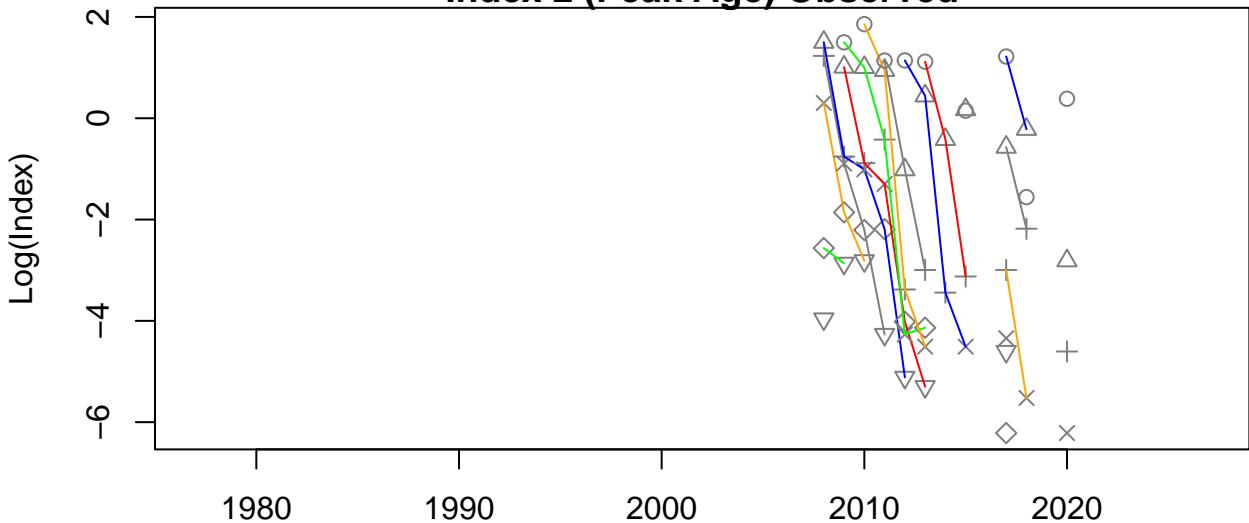
### Index 1 (Peak Age) Observed



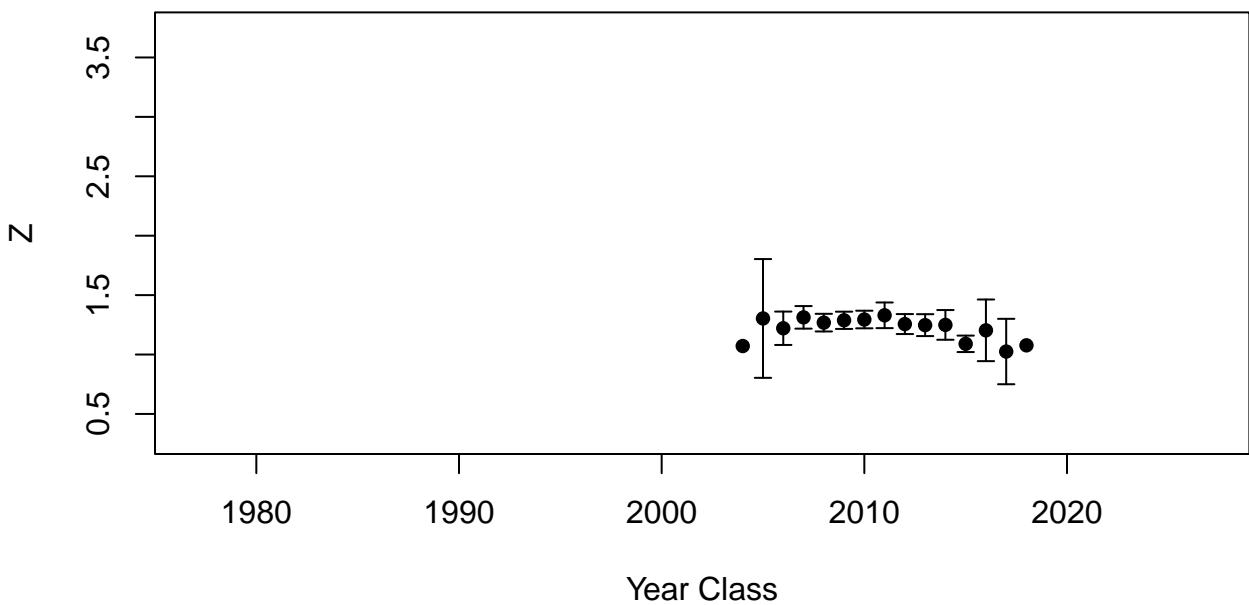
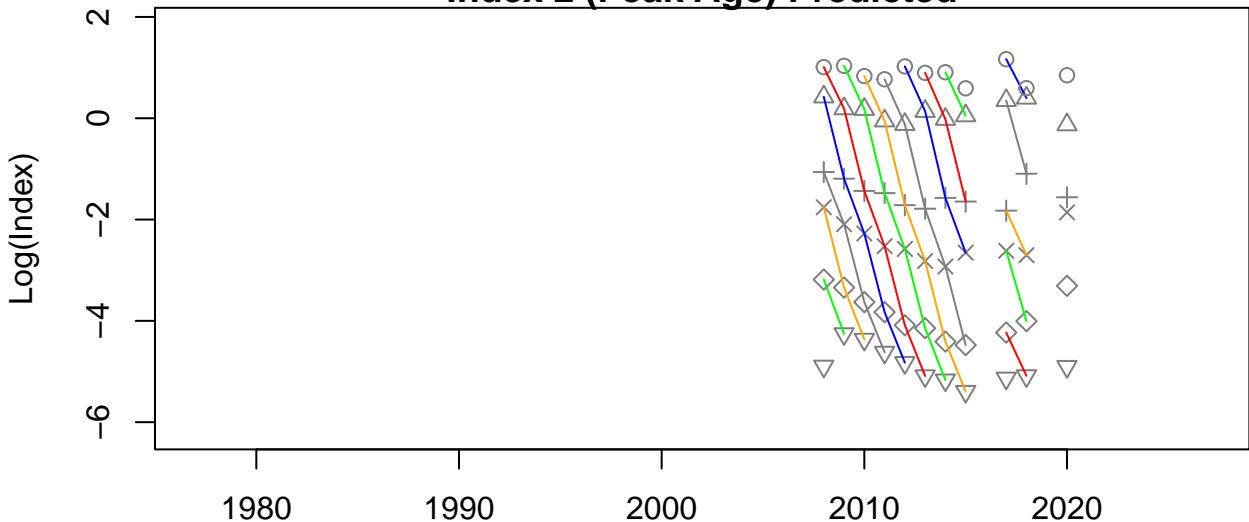
## Index 1 (Peak Age) Predicted



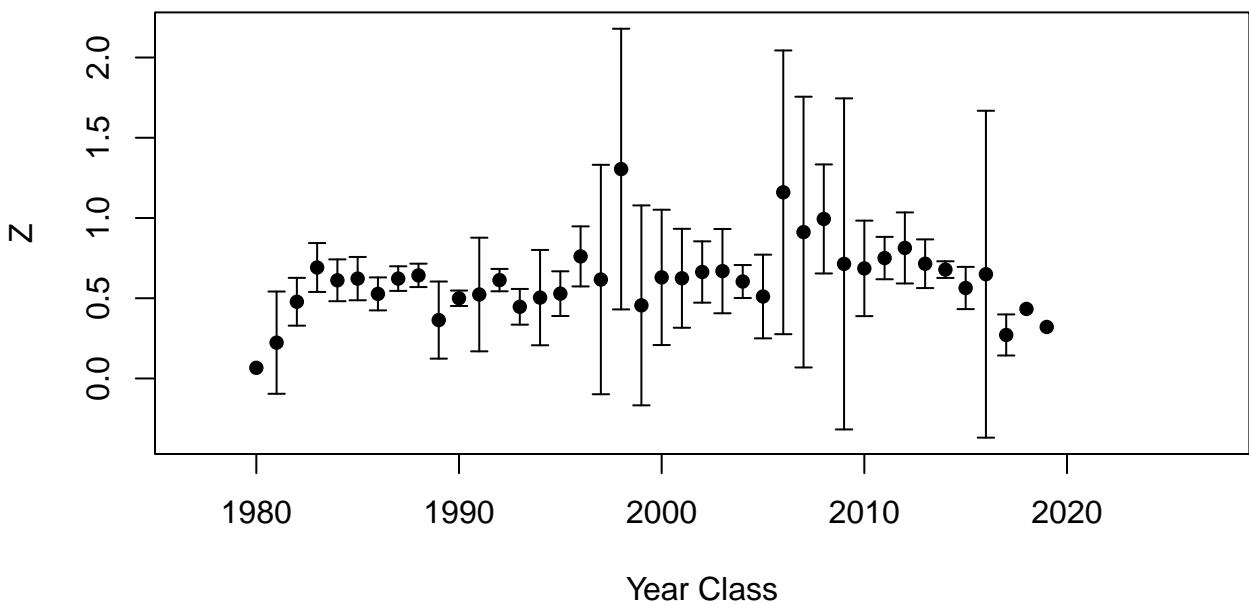
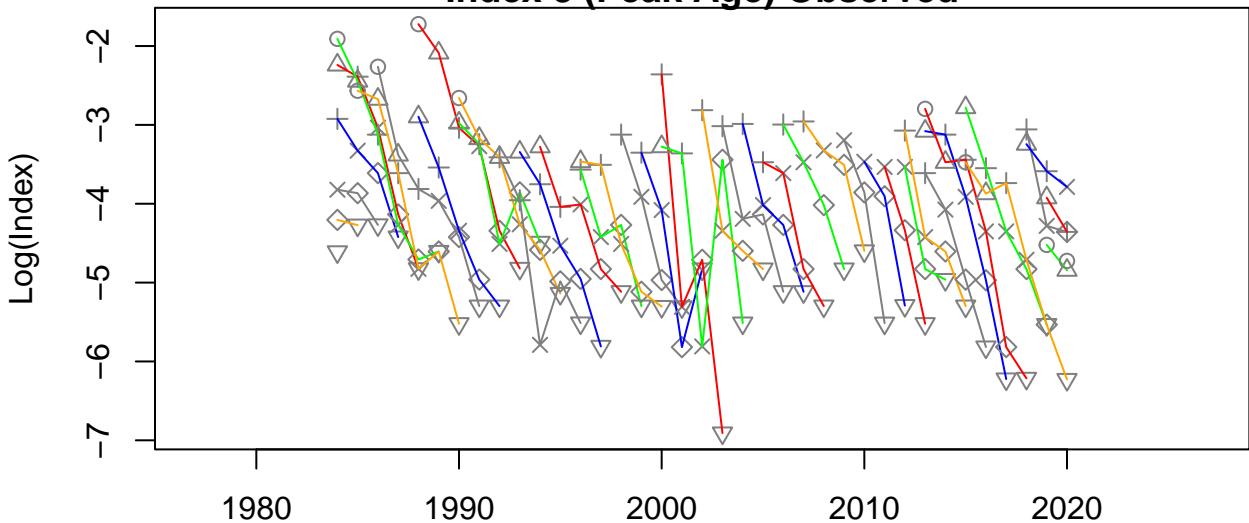
## Index 2 (Peak Age) Observed



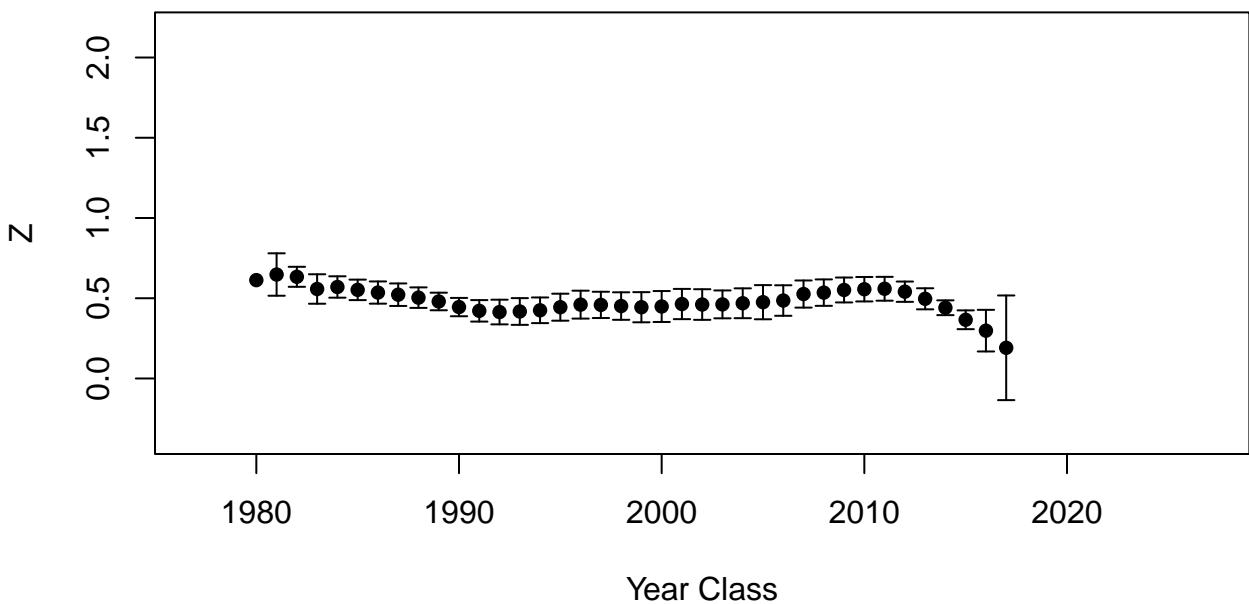
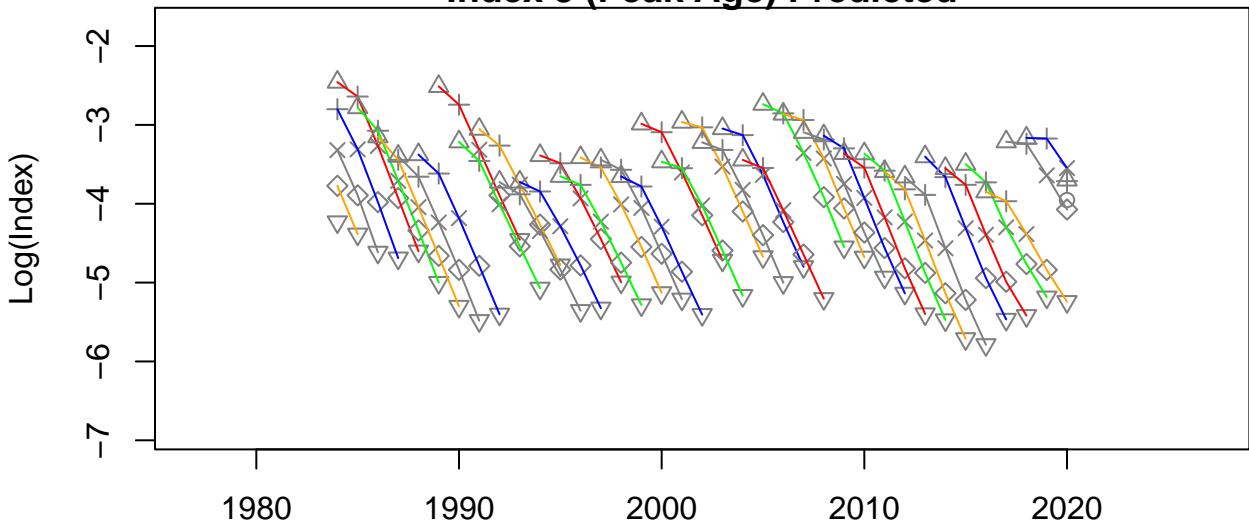
## Index 2 (Peak Age) Predicted



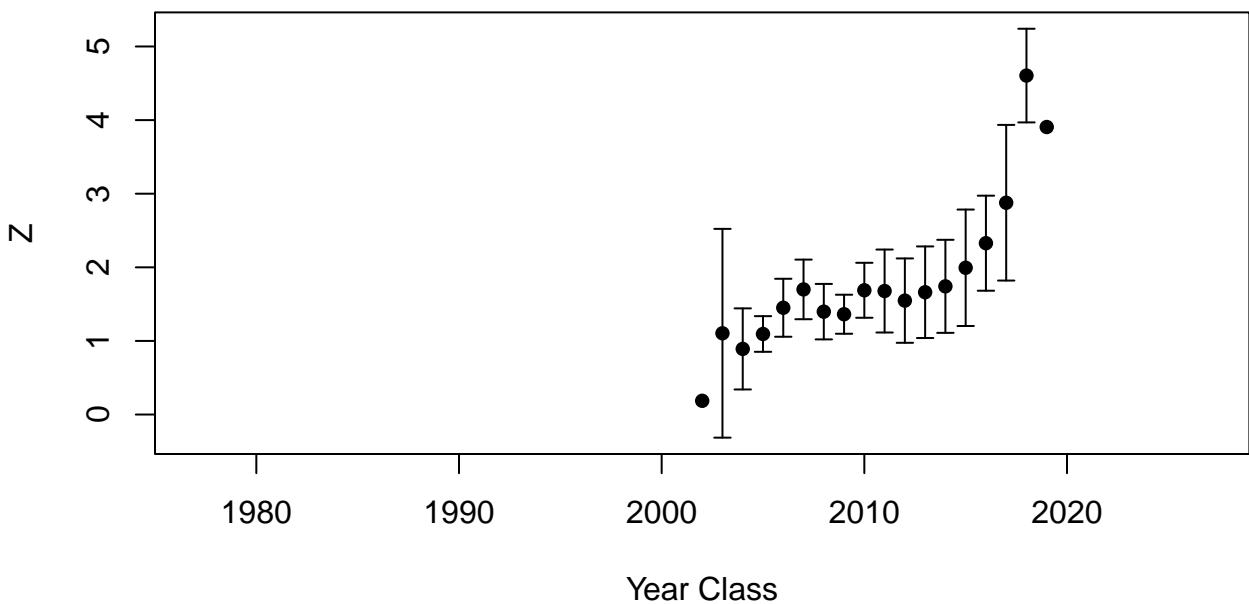
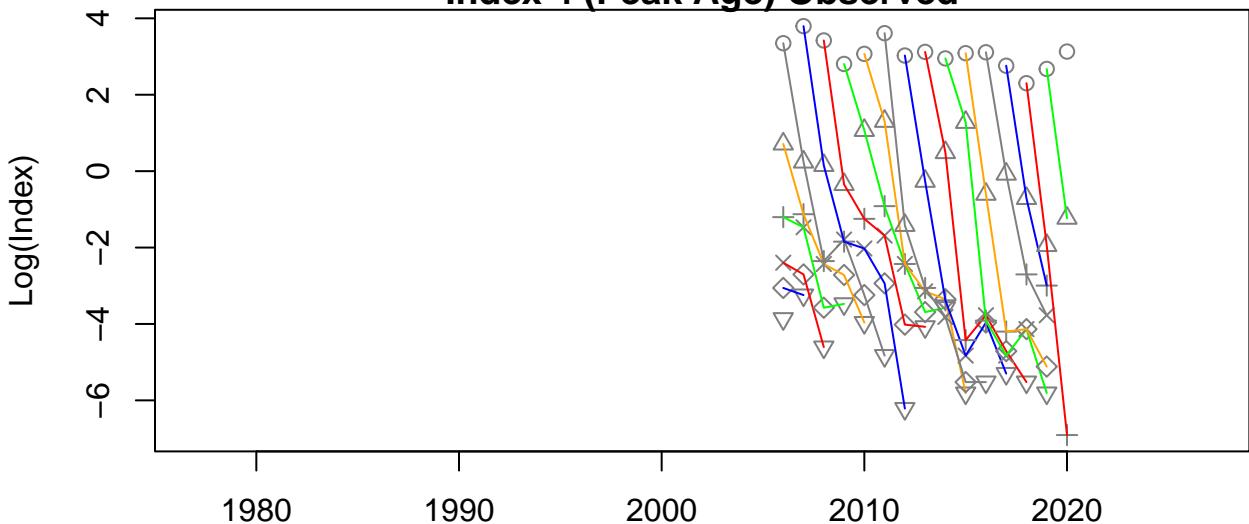
### Index 3 (Peak Age) Observed



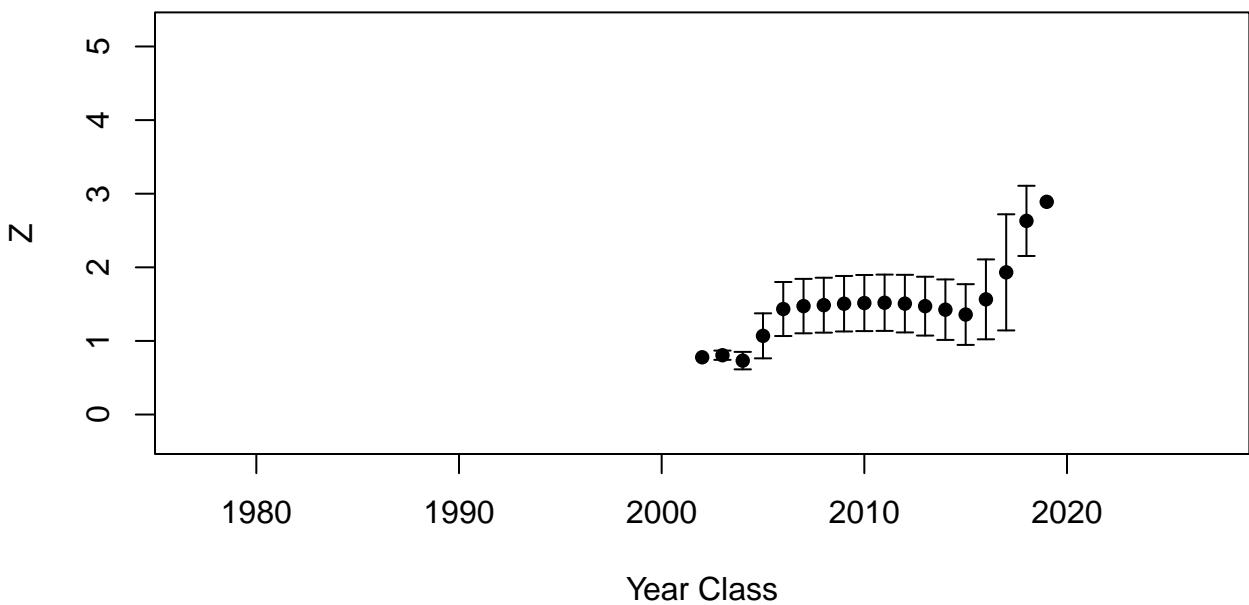
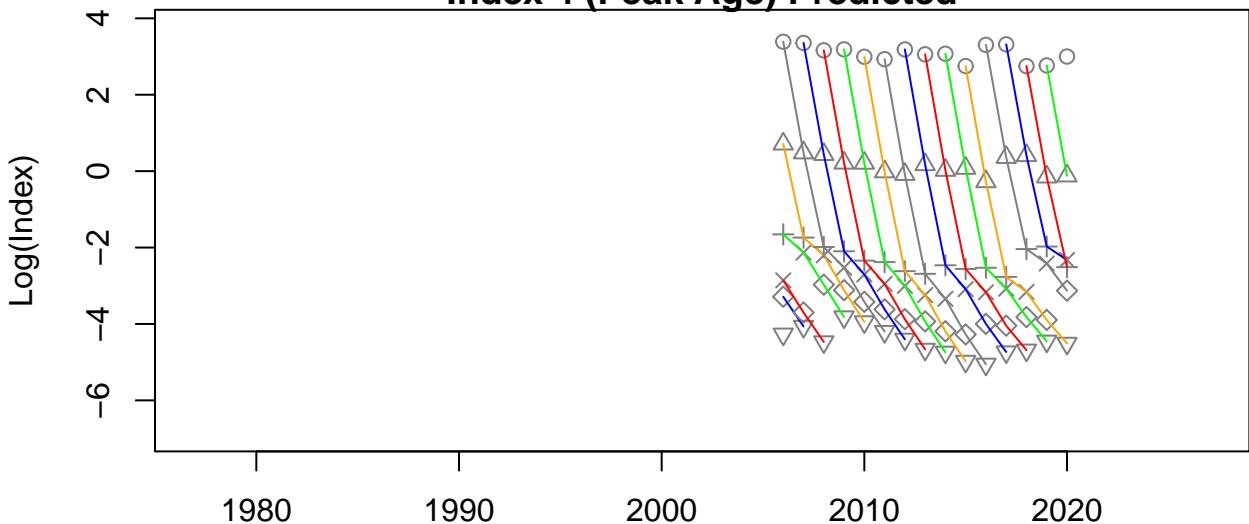
### Index 3 (Peak Age) Predicted



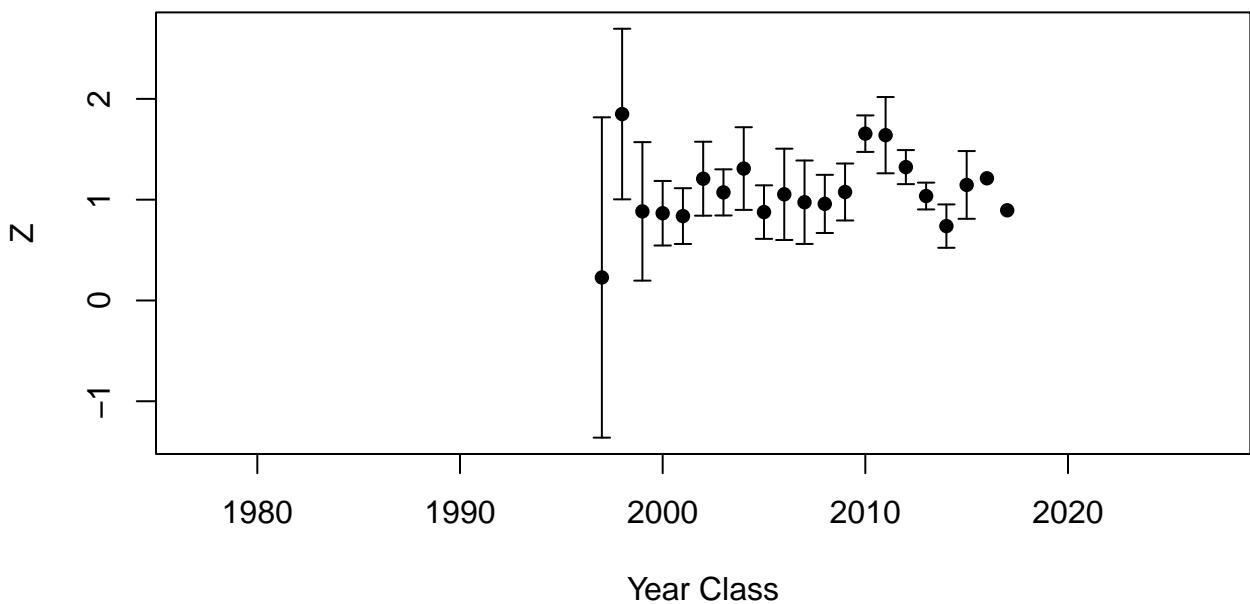
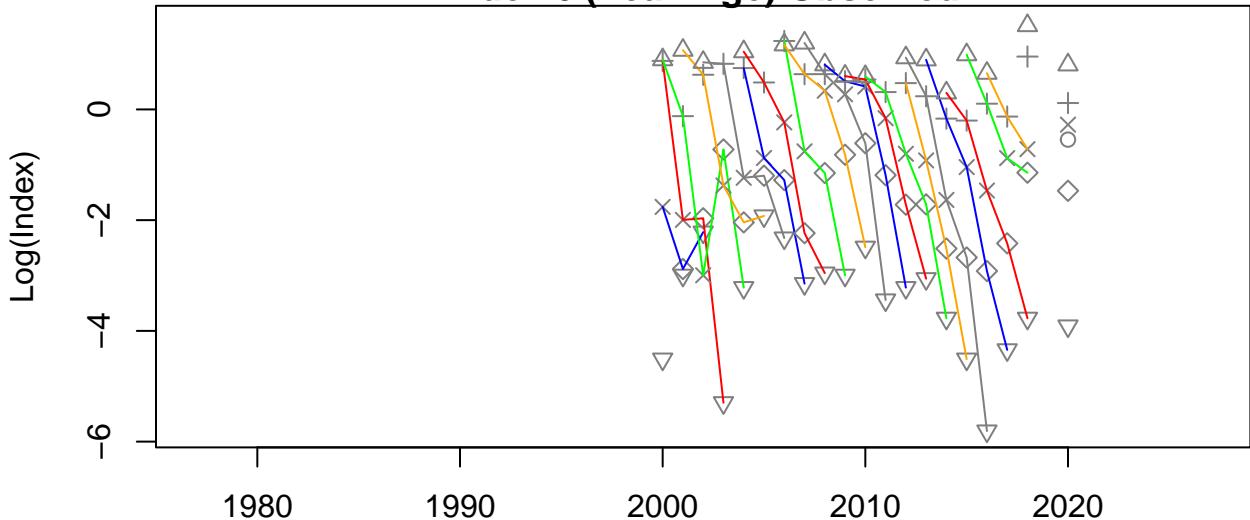
### Index 4 (Peak Age) Observed



### Index 4 (Peak Age) Predicted



### Index 6 (Peak Age) Observed

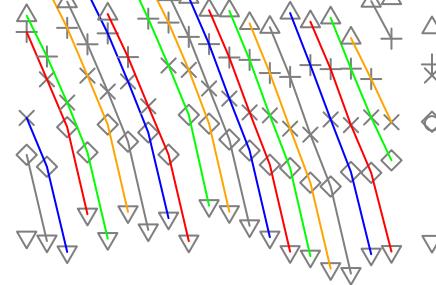


## Index 6 (Peak Age) Predicted

Log(Index)

0  
-2  
-4  
-6

1980 1990 2000 2010 2020

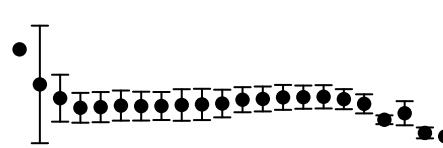


Z

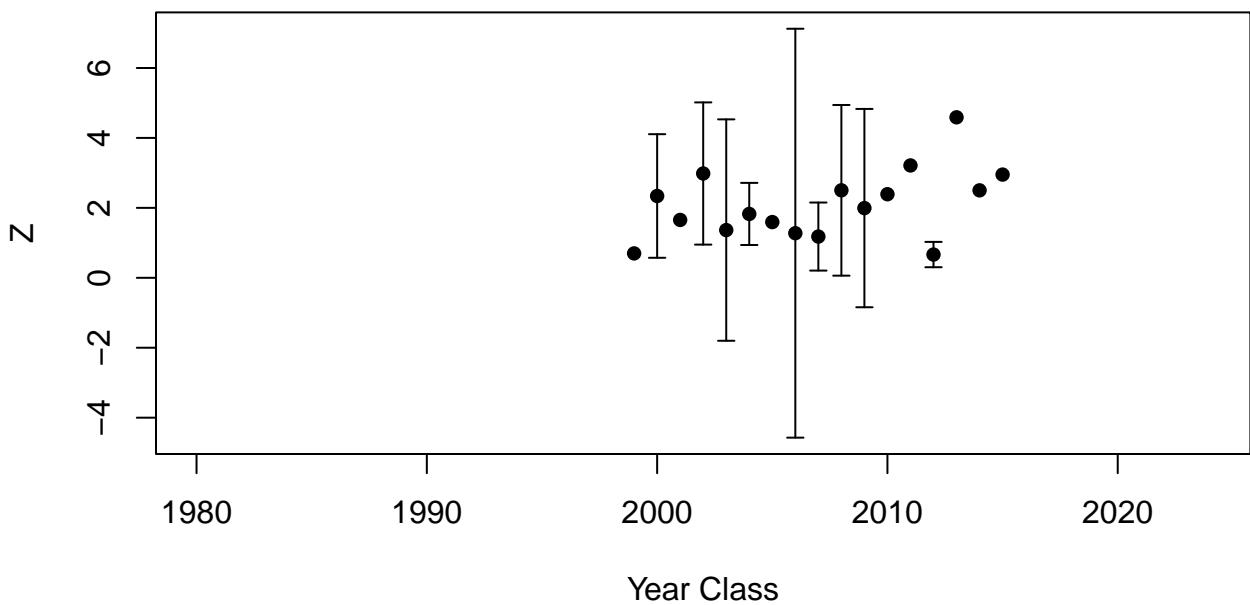
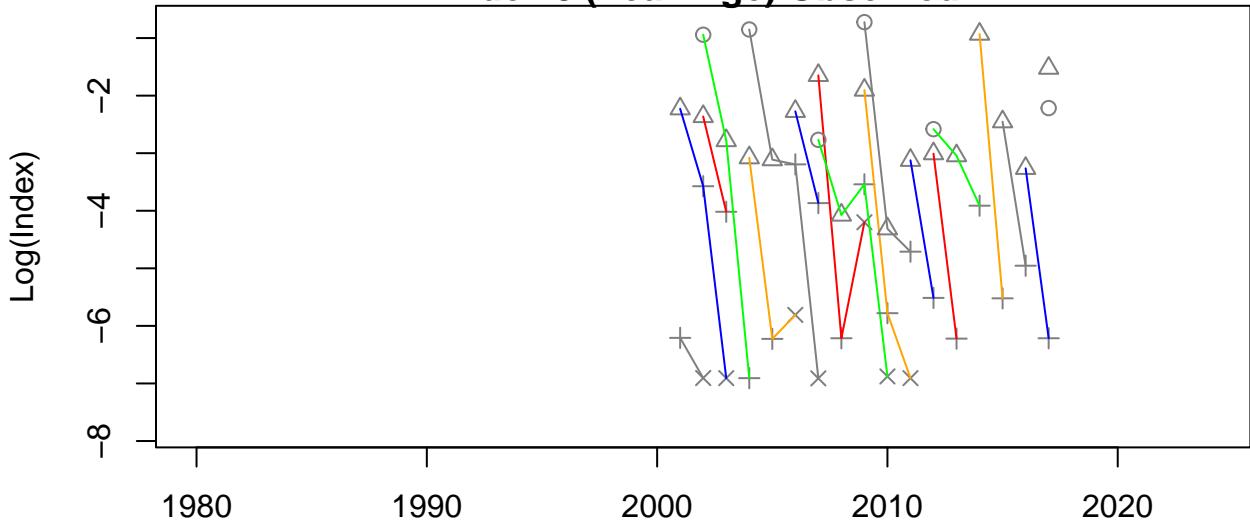
2  
1  
0  
-1

1980 1990 2000 2010 2020

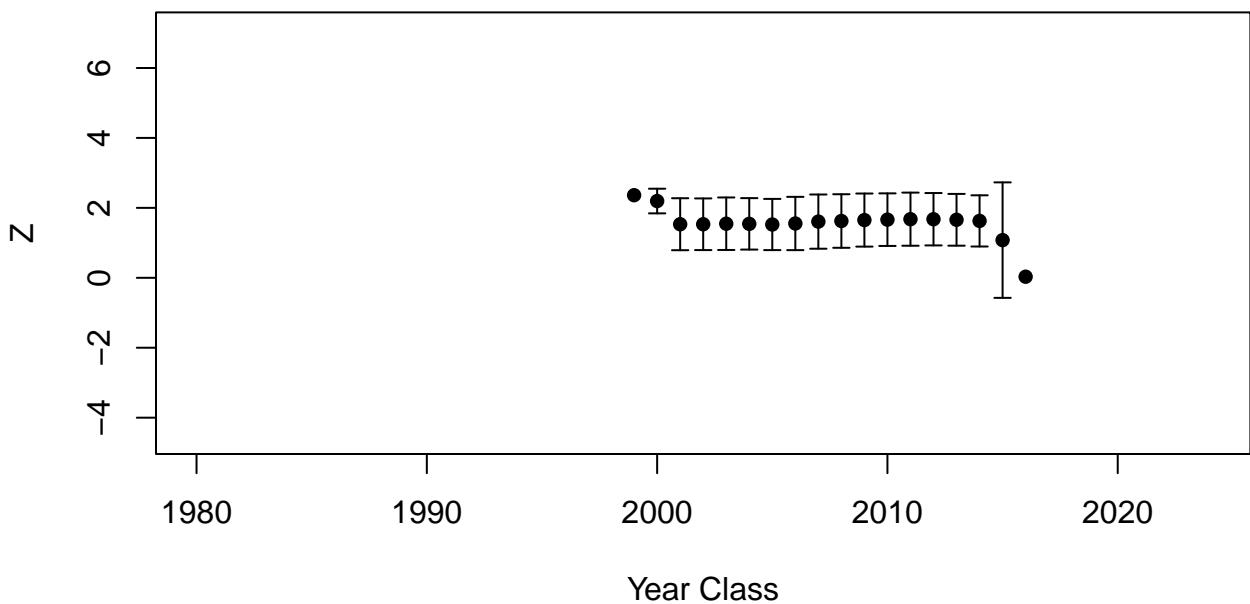
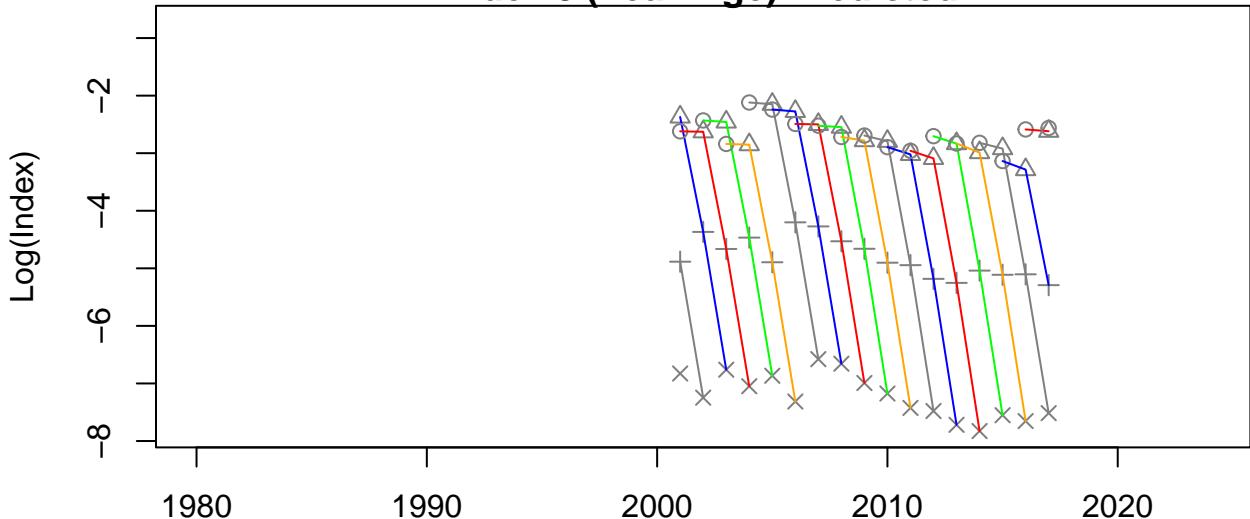
Year Class



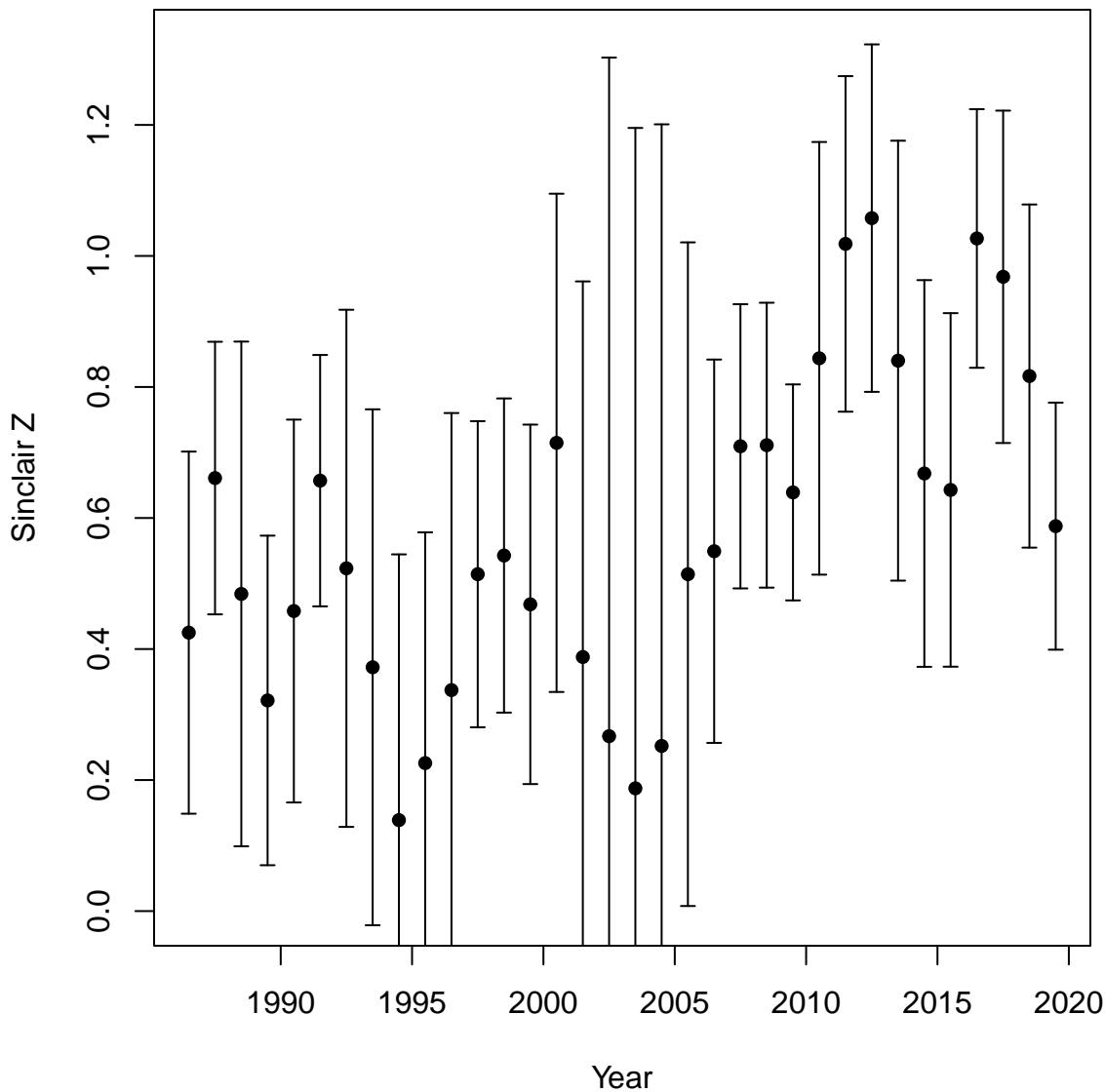
### Index 8 (Peak Age) Observed



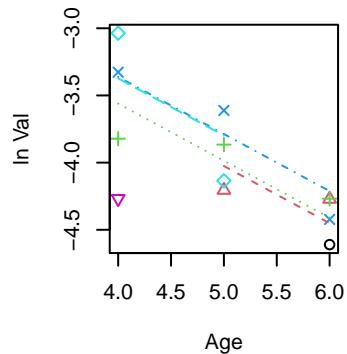
## Index 8 (Peak Age) Predicted



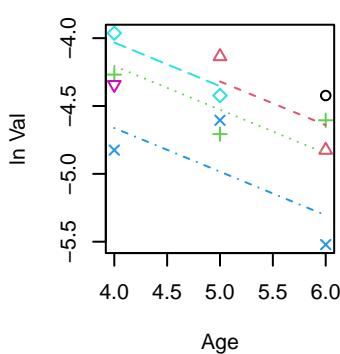
## MRIP



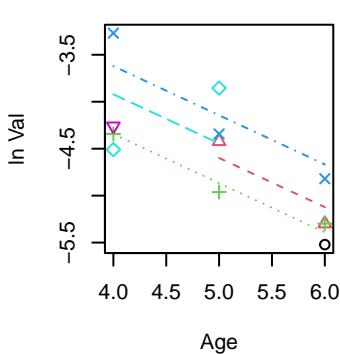
**Years 1985 to 1988**  
 $Z = 0.425$



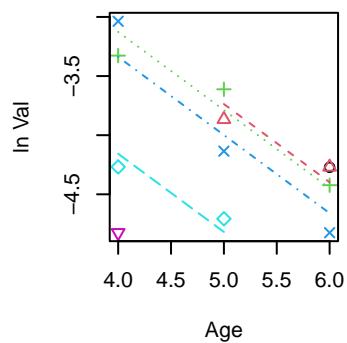
**Years 1988 to 1991**  
 $Z = 0.322$



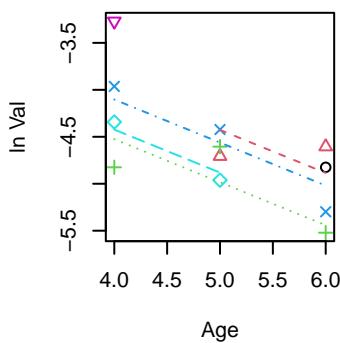
**Years 1991 to 1994**  
 $Z = 0.523$



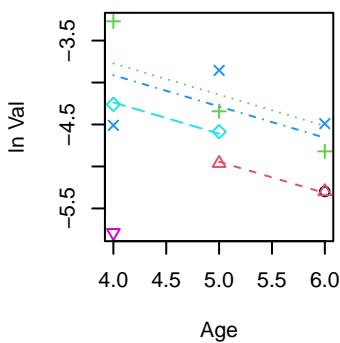
**Years 1986 to 1989**  
 $Z = 0.661$



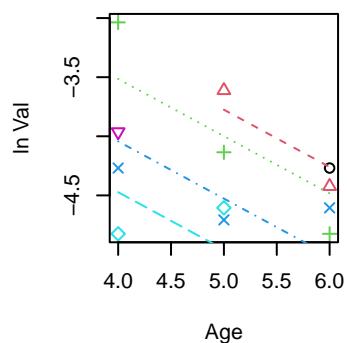
**Years 1989 to 1992**  
 $Z = 0.458$



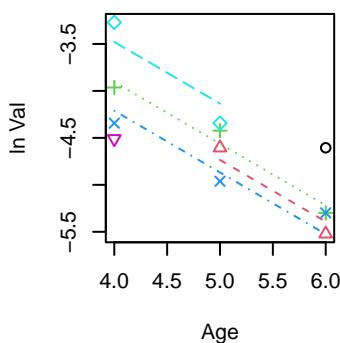
**Years 1992 to 1995**  
 $Z = 0.372$



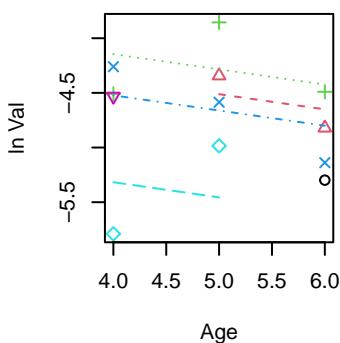
**Years 1987 to 1990**  
 $Z = 0.484$



**Years 1990 to 1993**  
 $Z = 0.657$

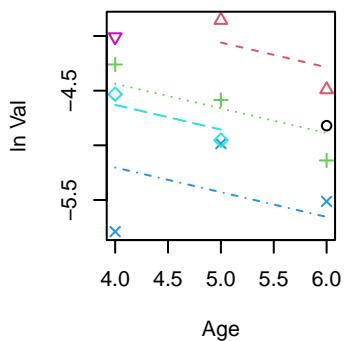


**Years 1993 to 1996**  
 $Z = 0.139$



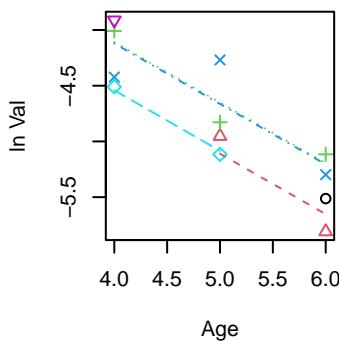
**Years 1994 to 1997**

$$Z = 0.226$$



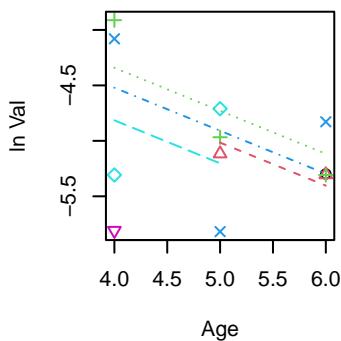
**Years 1997 to 2000**

$$Z = 0.543$$



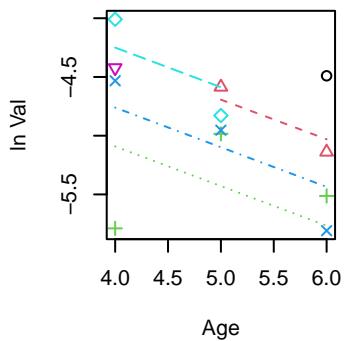
**Years 2000 to 2003**

$$Z = 0.388$$



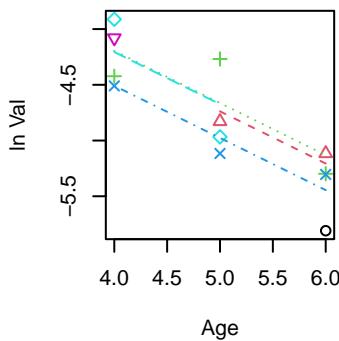
**Years 1995 to 1998**

$$Z = 0.337$$



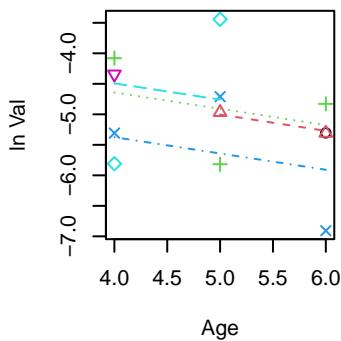
**Years 1998 to 2001**

$$Z = 0.468$$



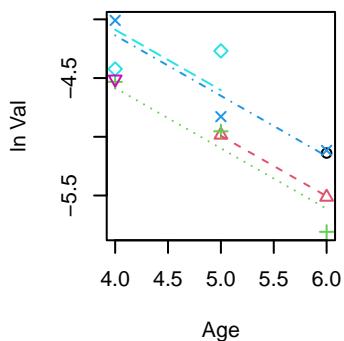
**Years 2001 to 2004**

$$Z = 0.267$$



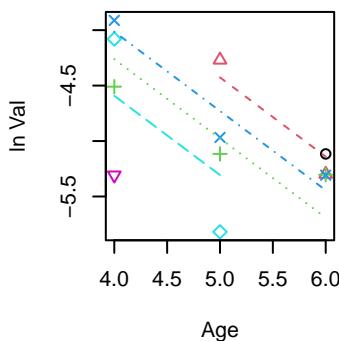
**Years 1996 to 1999**

$$Z = 0.514$$



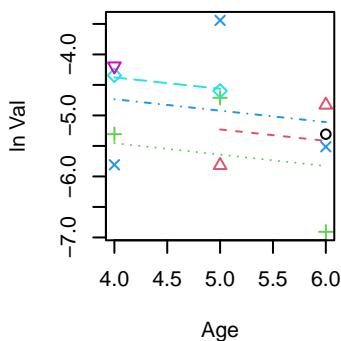
**Years 1999 to 2002**

$$Z = 0.715$$

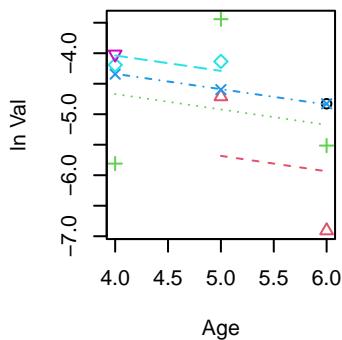


**Years 2002 to 2005**

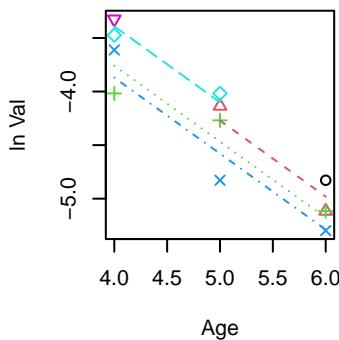
$$Z = 0.187$$



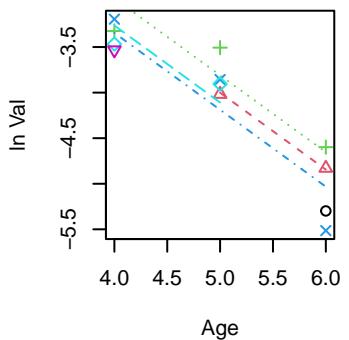
**Years 2003 to 2006**  
 $Z = 0.252$



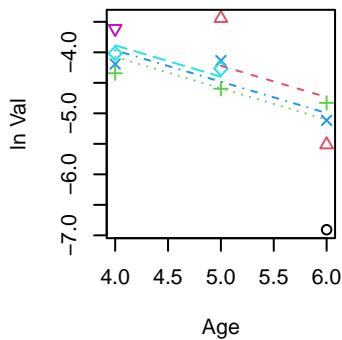
**Years 2006 to 2009**  
 $Z = 0.709$



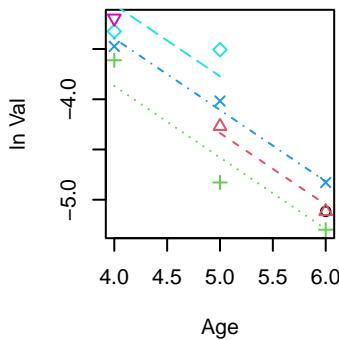
**Years 2009 to 2012**  
 $Z = 0.844$



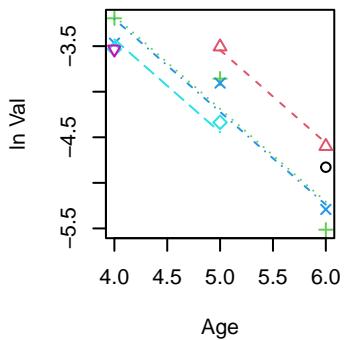
**Years 2004 to 2007**  
 $Z = 0.514$



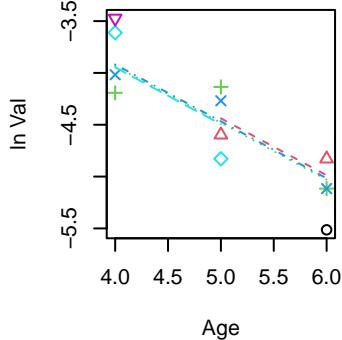
**Years 2007 to 2010**  
 $Z = 0.711$



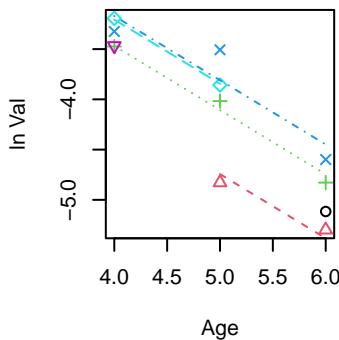
**Years 2010 to 2013**  
 $Z = 1.018$



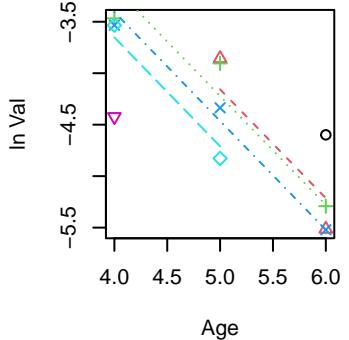
**Years 2005 to 2008**  
 $Z = 0.549$



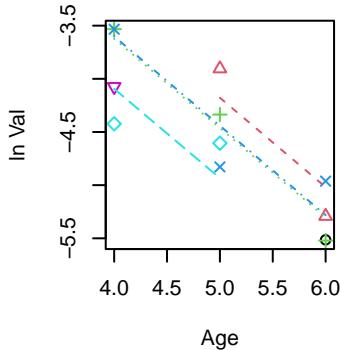
**Years 2008 to 2011**  
 $Z = 0.639$



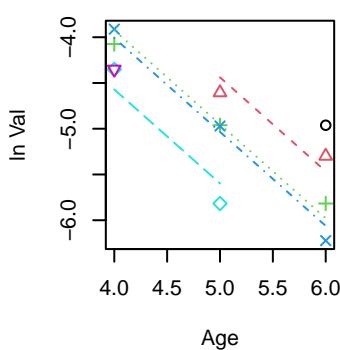
**Years 2011 to 2014**  
 $Z = 1.058$



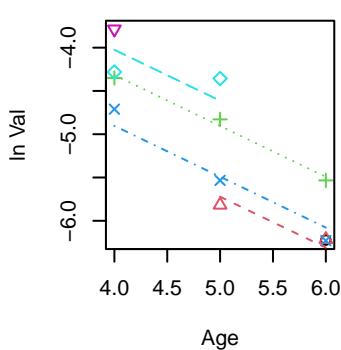
**Years 2012 to 2015**  
 $Z = 0.84$



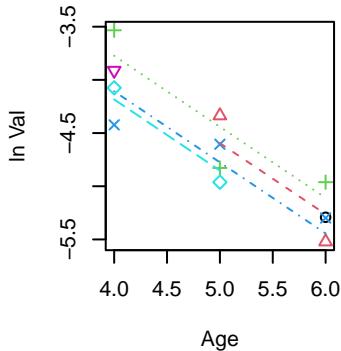
**Years 2015 to 2018**  
 $Z = 1.027$



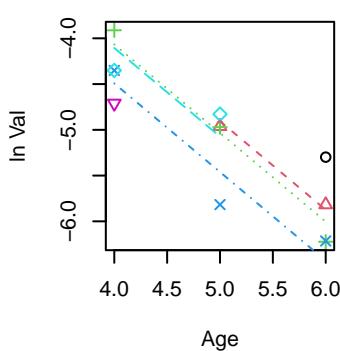
**Years 2018 to 2021**  
 $Z = 0.588$



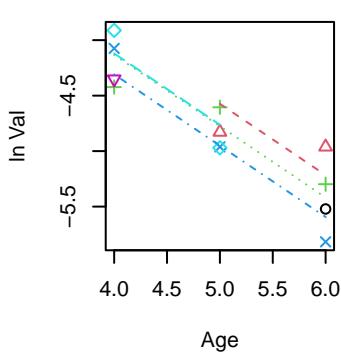
**Years 2013 to 2016**  
 $Z = 0.668$



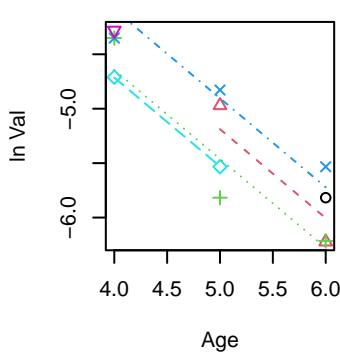
**Years 2016 to 2019**  
 $Z = 0.968$



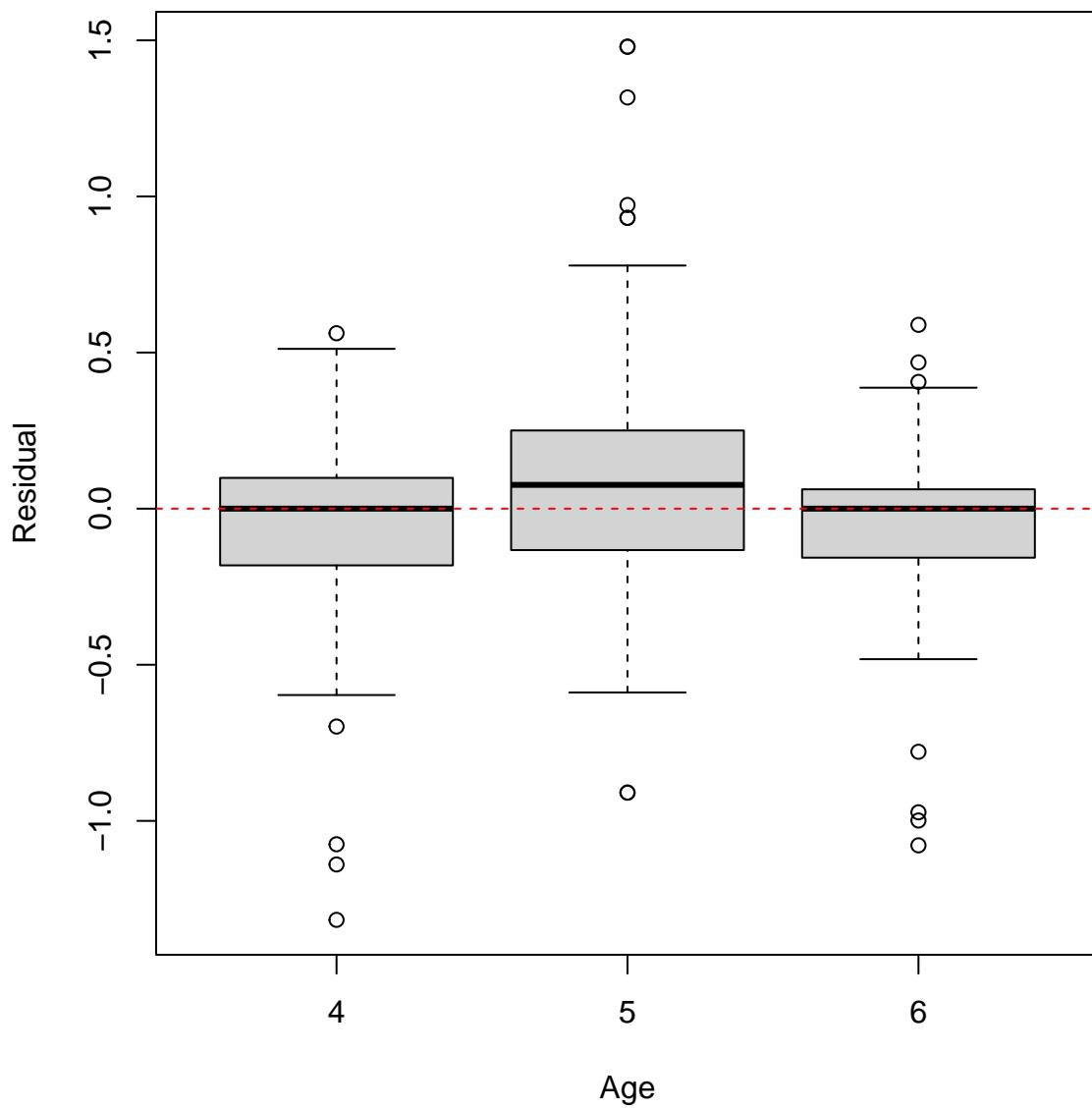
**Years 2014 to 2017**  
 $Z = 0.643$



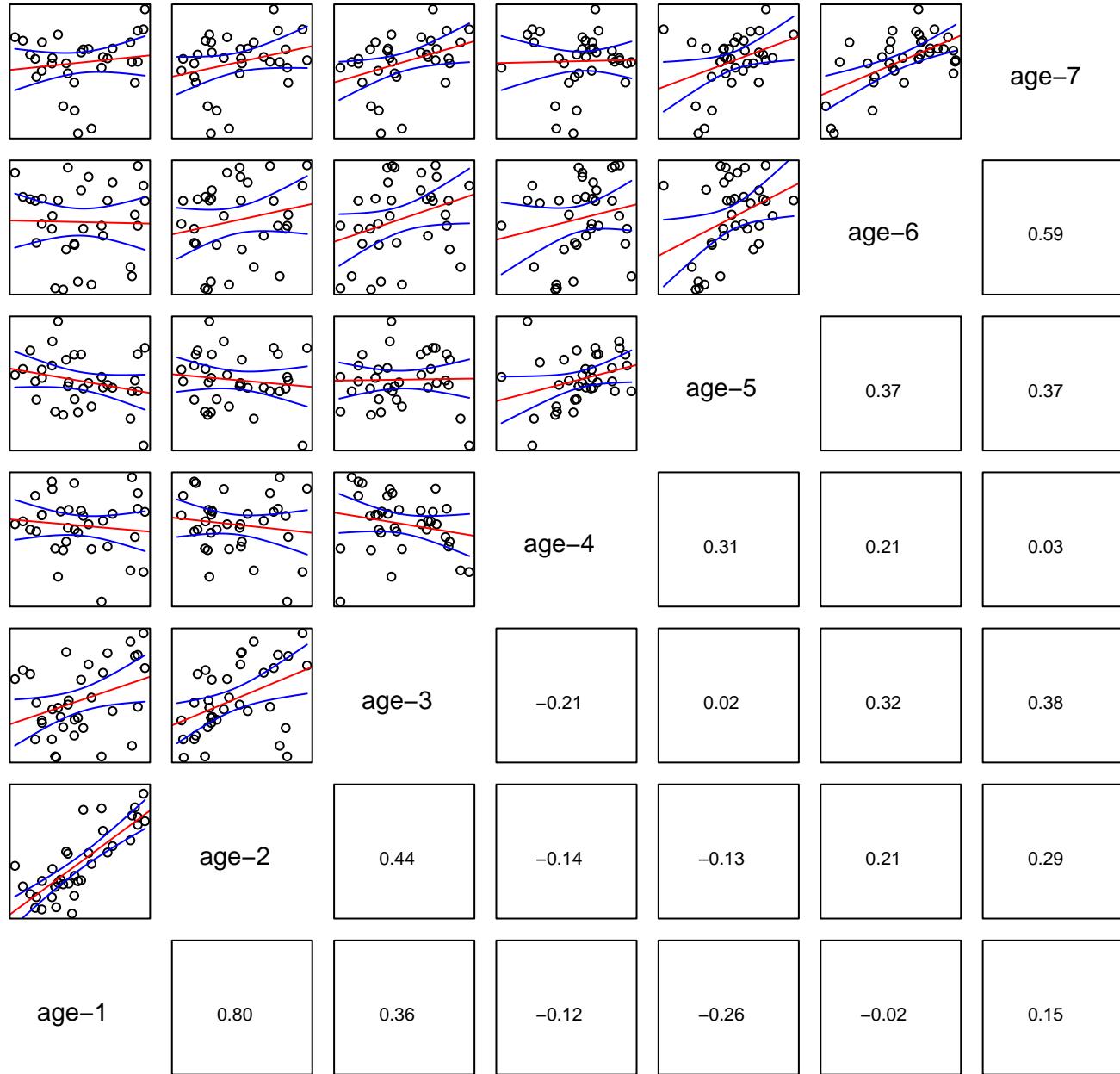
**Years 2017 to 2020**  
 $Z = 0.817$



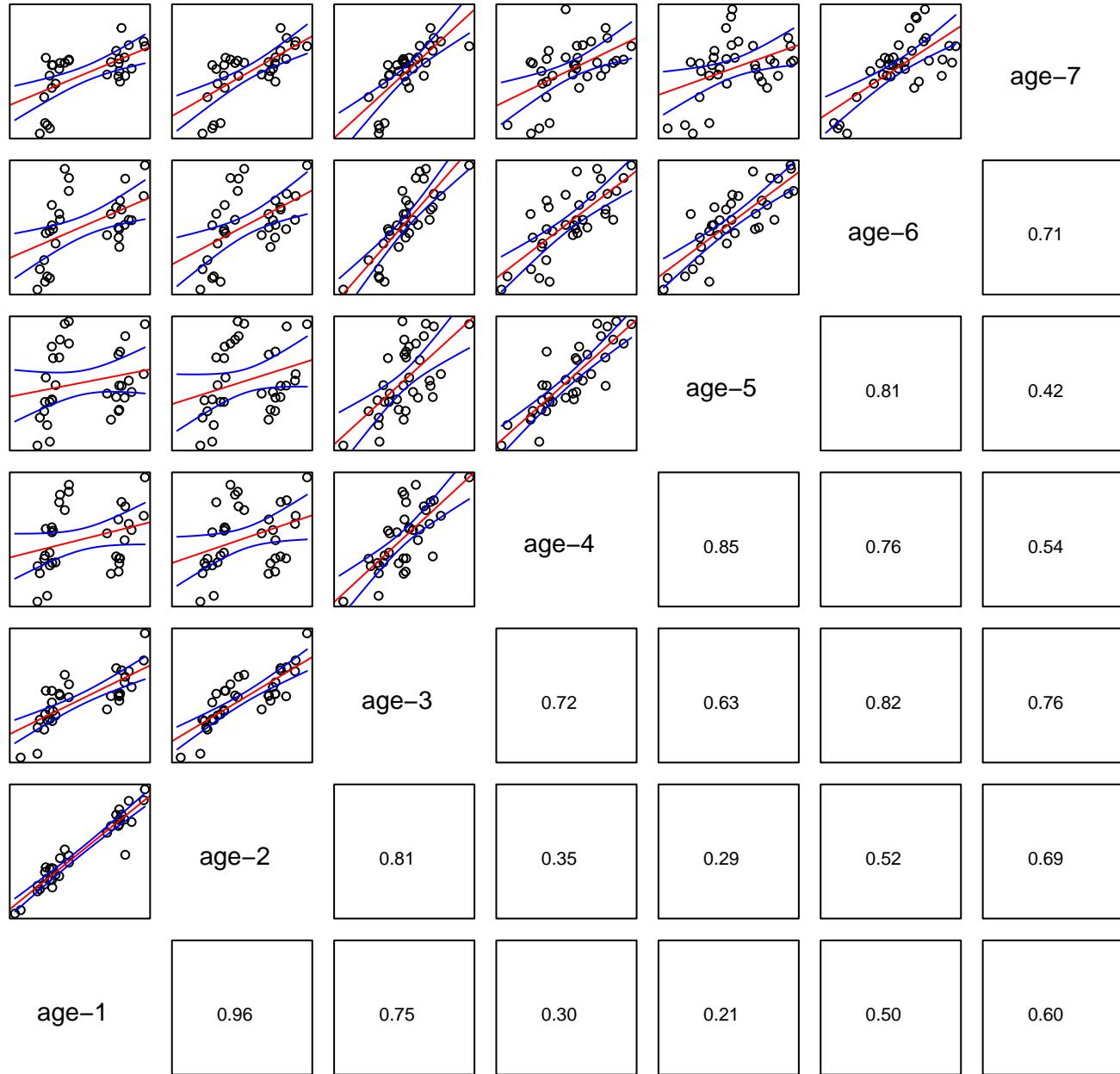
## MRIP



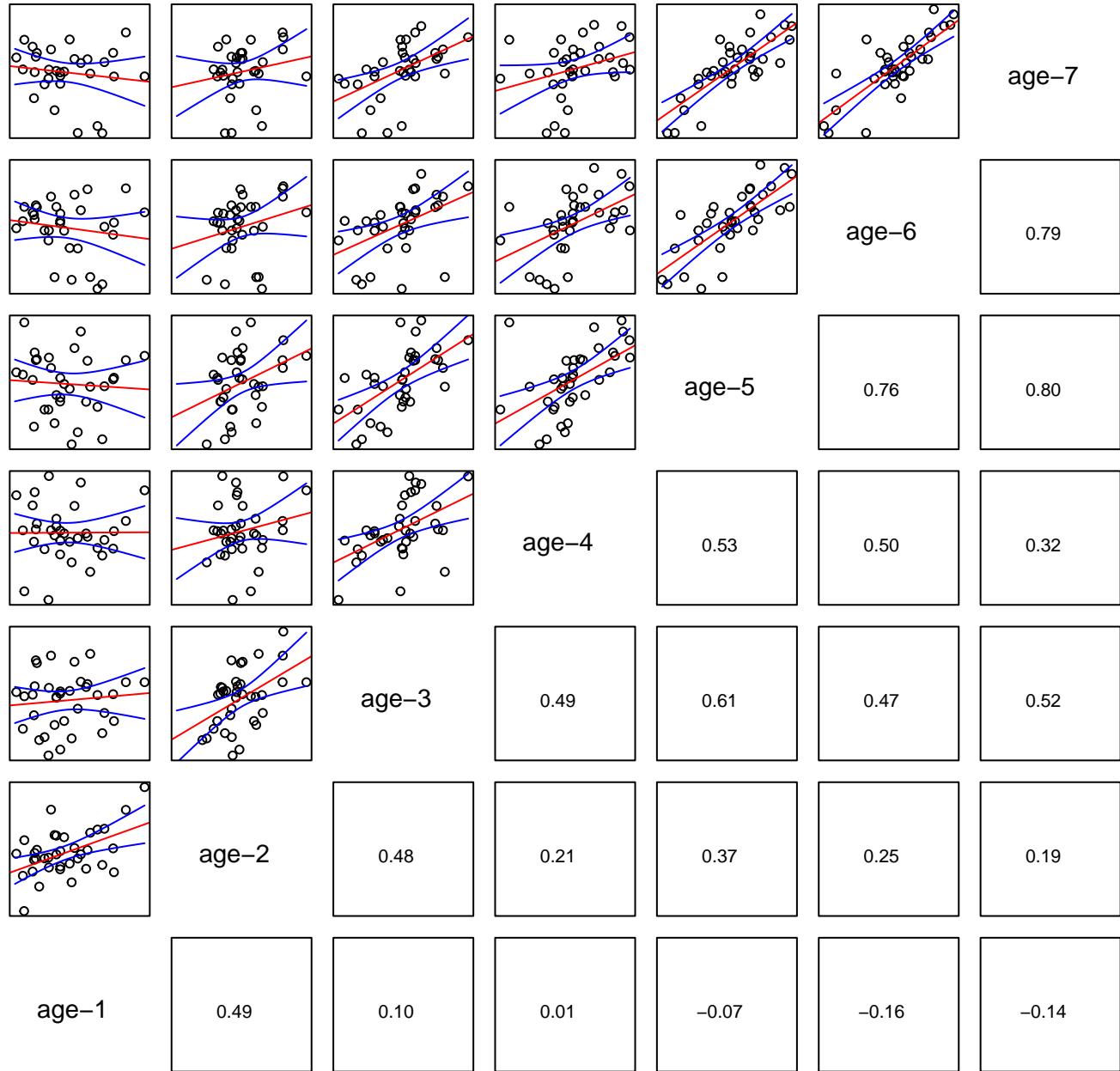
### Catch for Fleet 1 (Comm) Observed



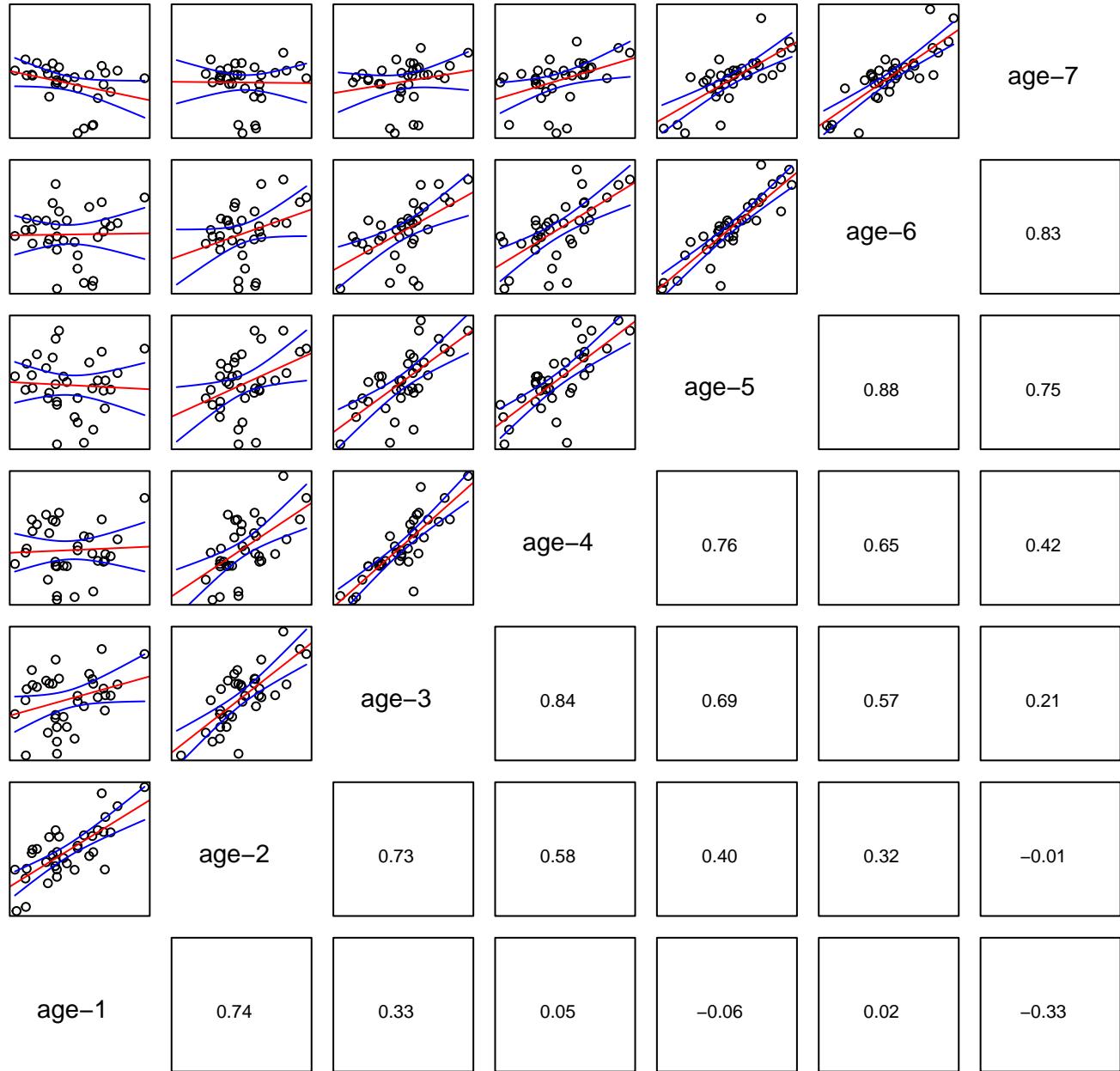
### Catch for Fleet 1 (Comm) Predicted



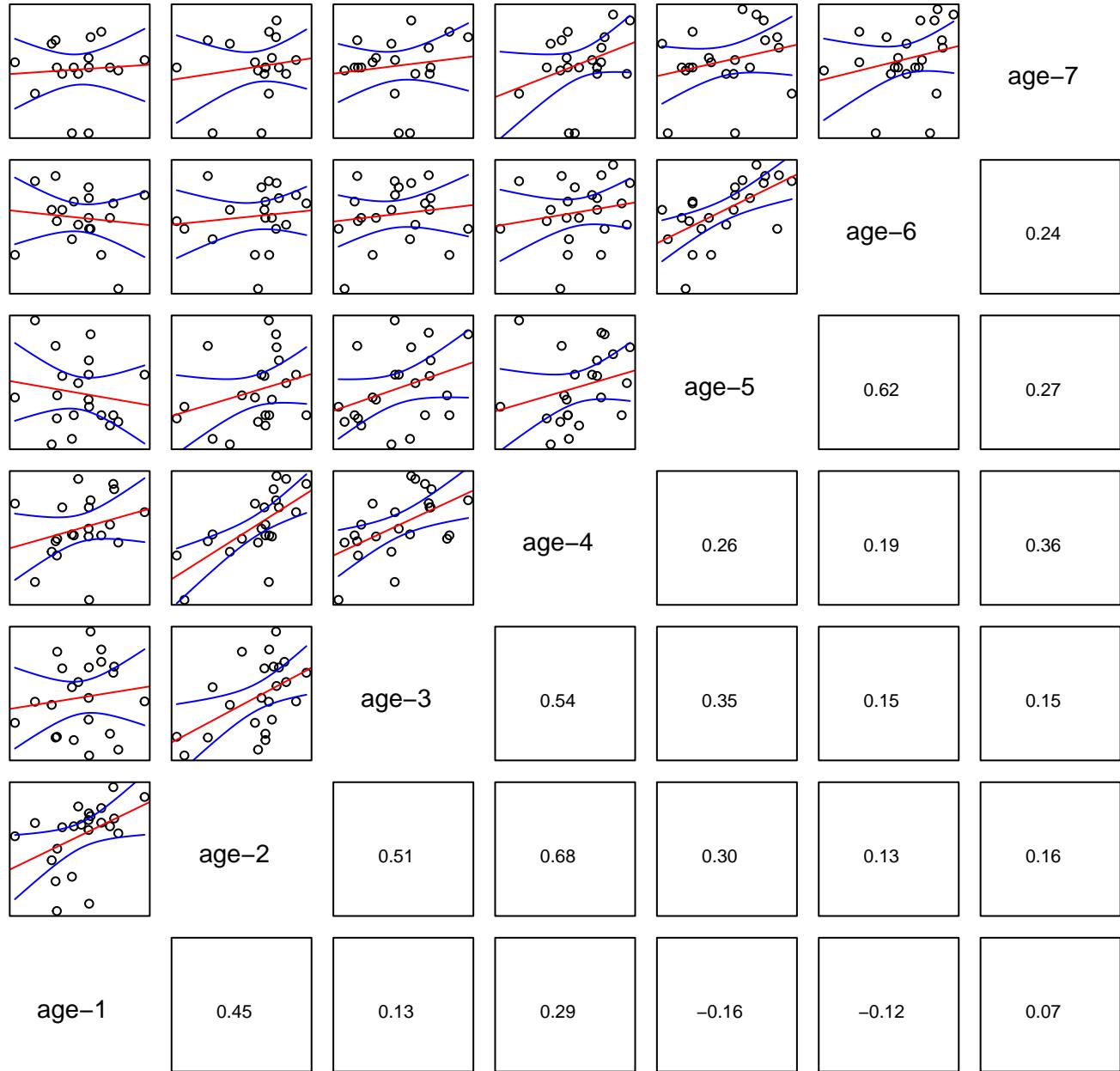
### Catch for Fleet 2 (Rec) Observed



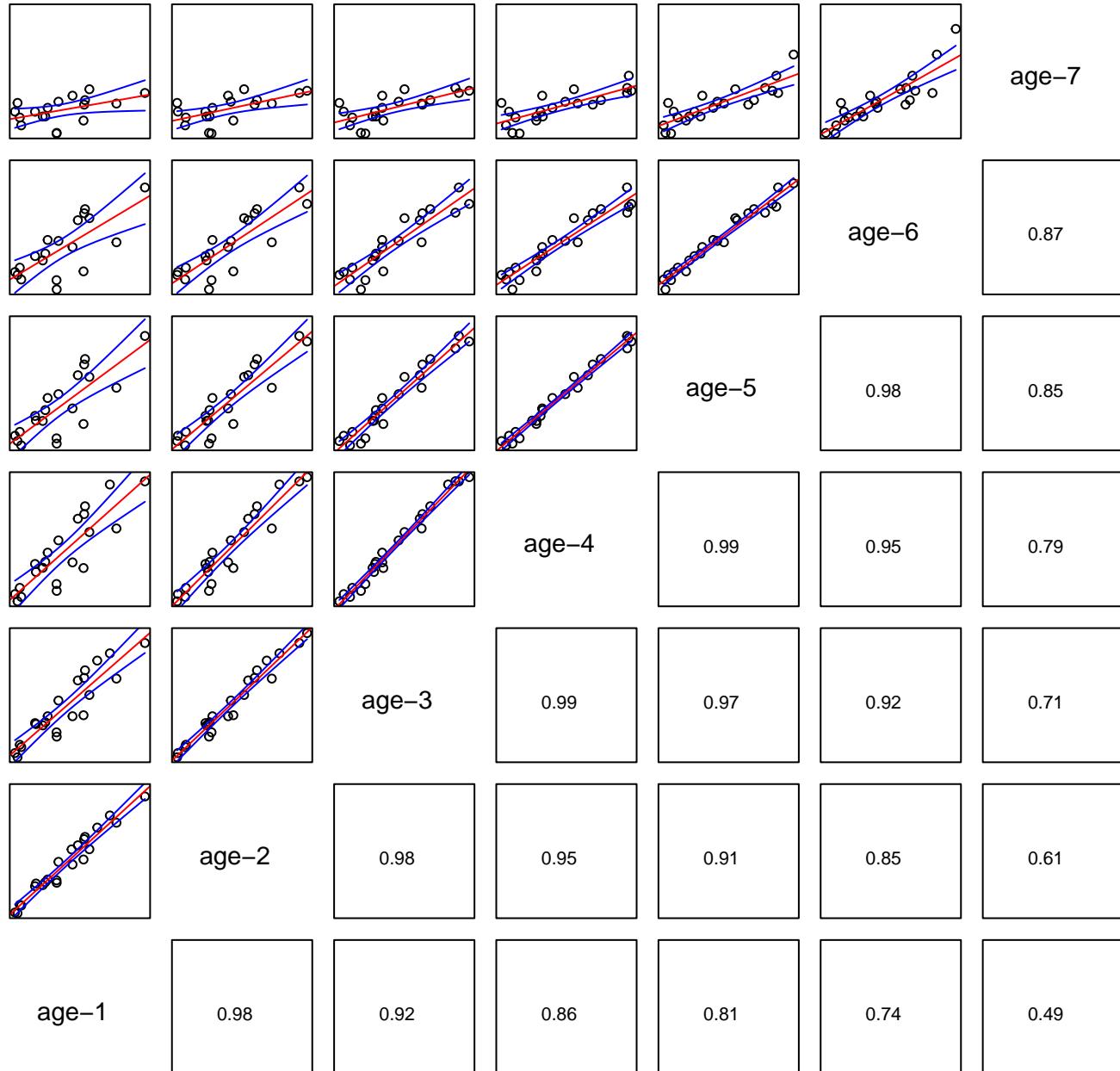
## Catch for Fleet 2 (Rec) Predicted



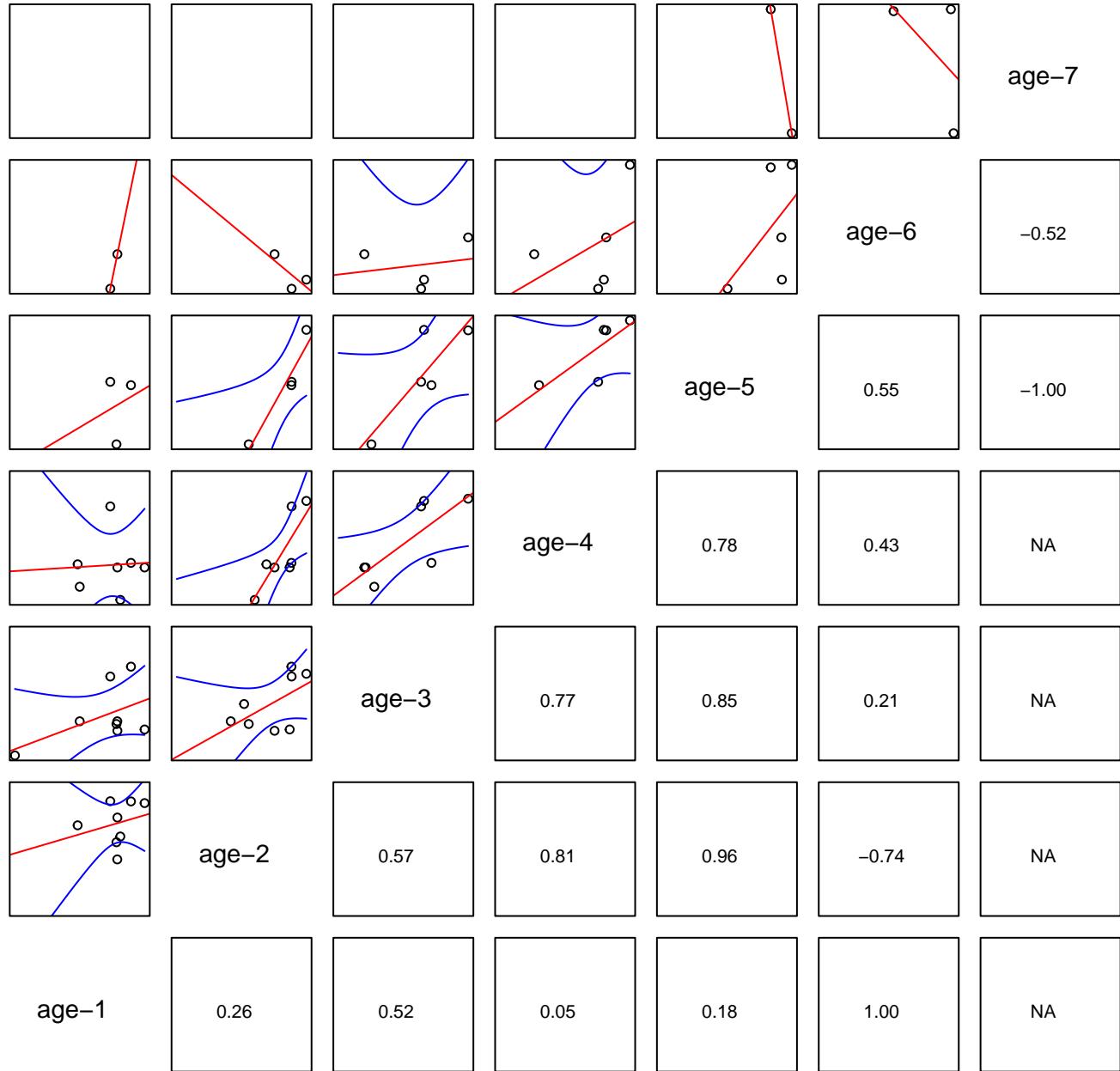
## **Index 1 (NEFSC Inshore) Observed**



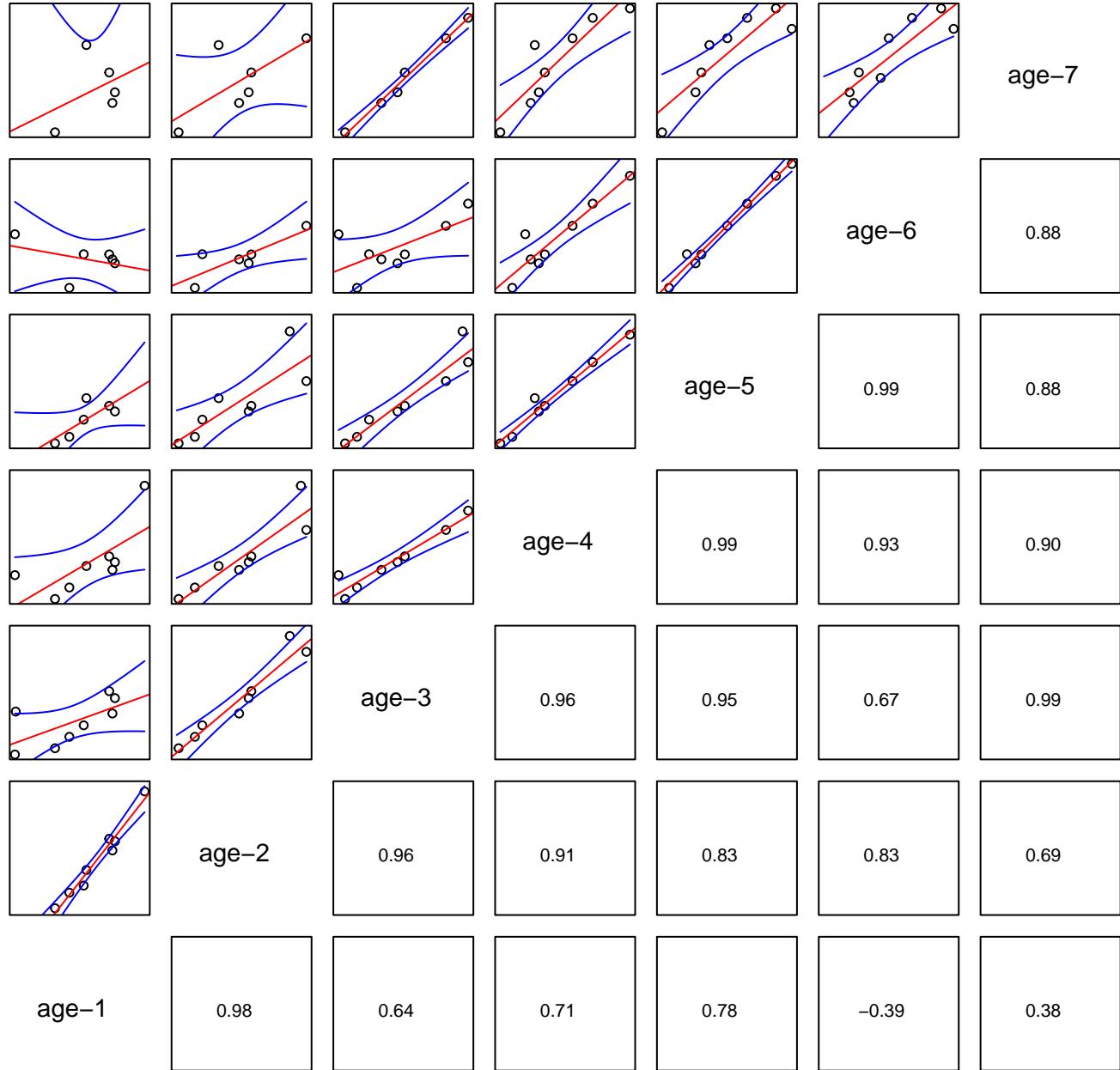
# Index 1 (NEFSC Inshore) Predicted



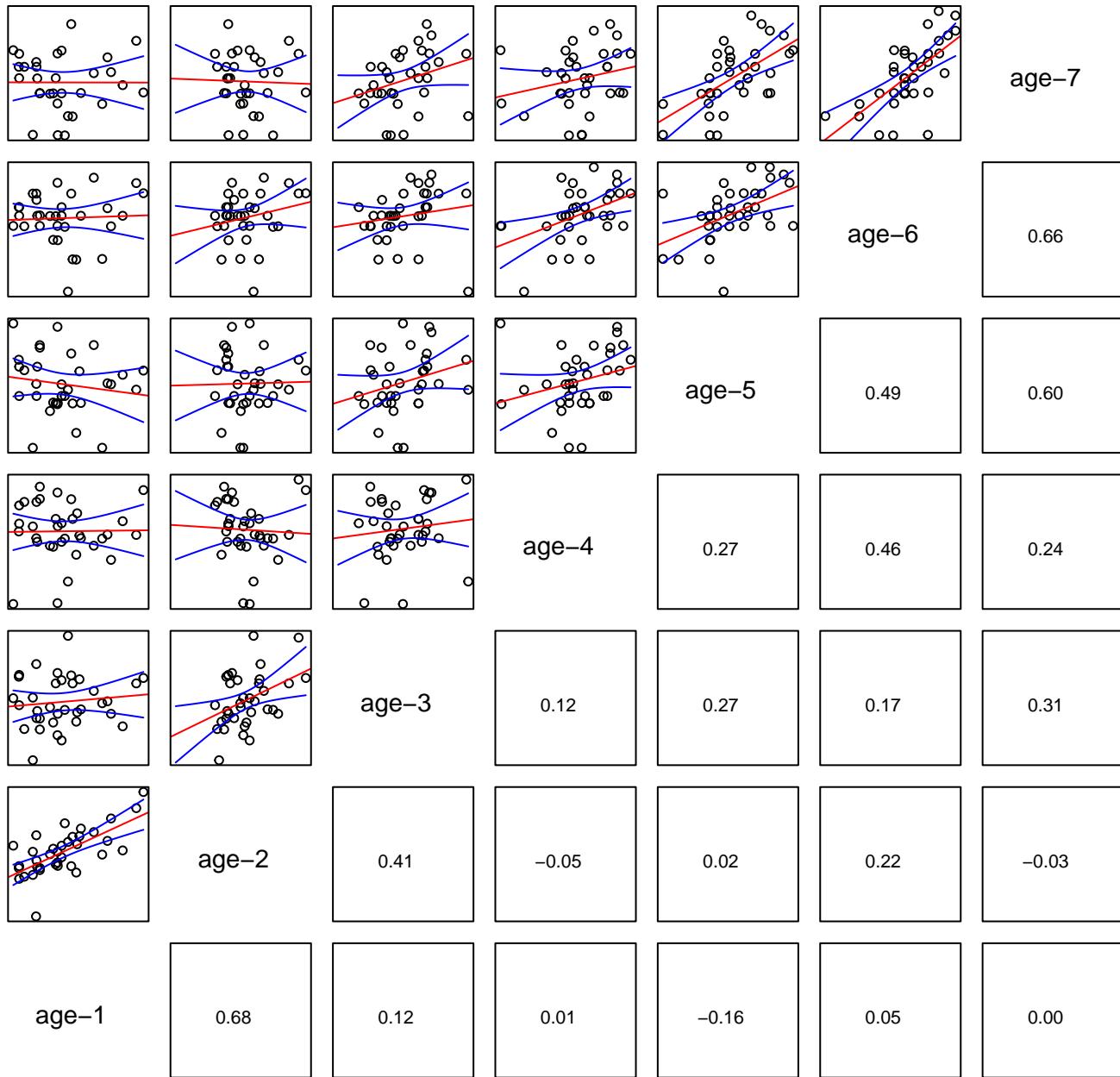
## Index 2 (Bigelow) Observed



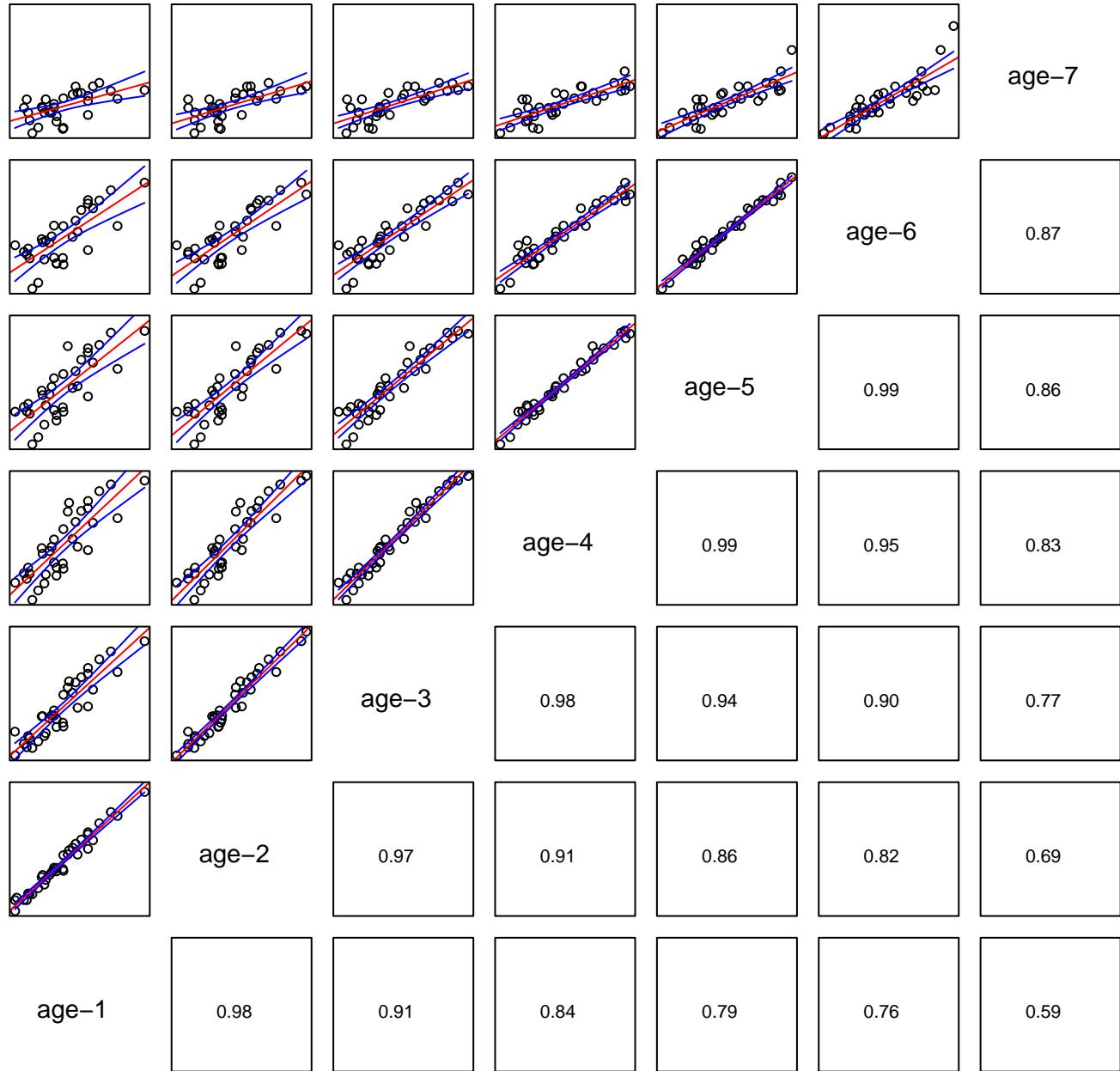
## Index 2 (Bigelow) Predicted



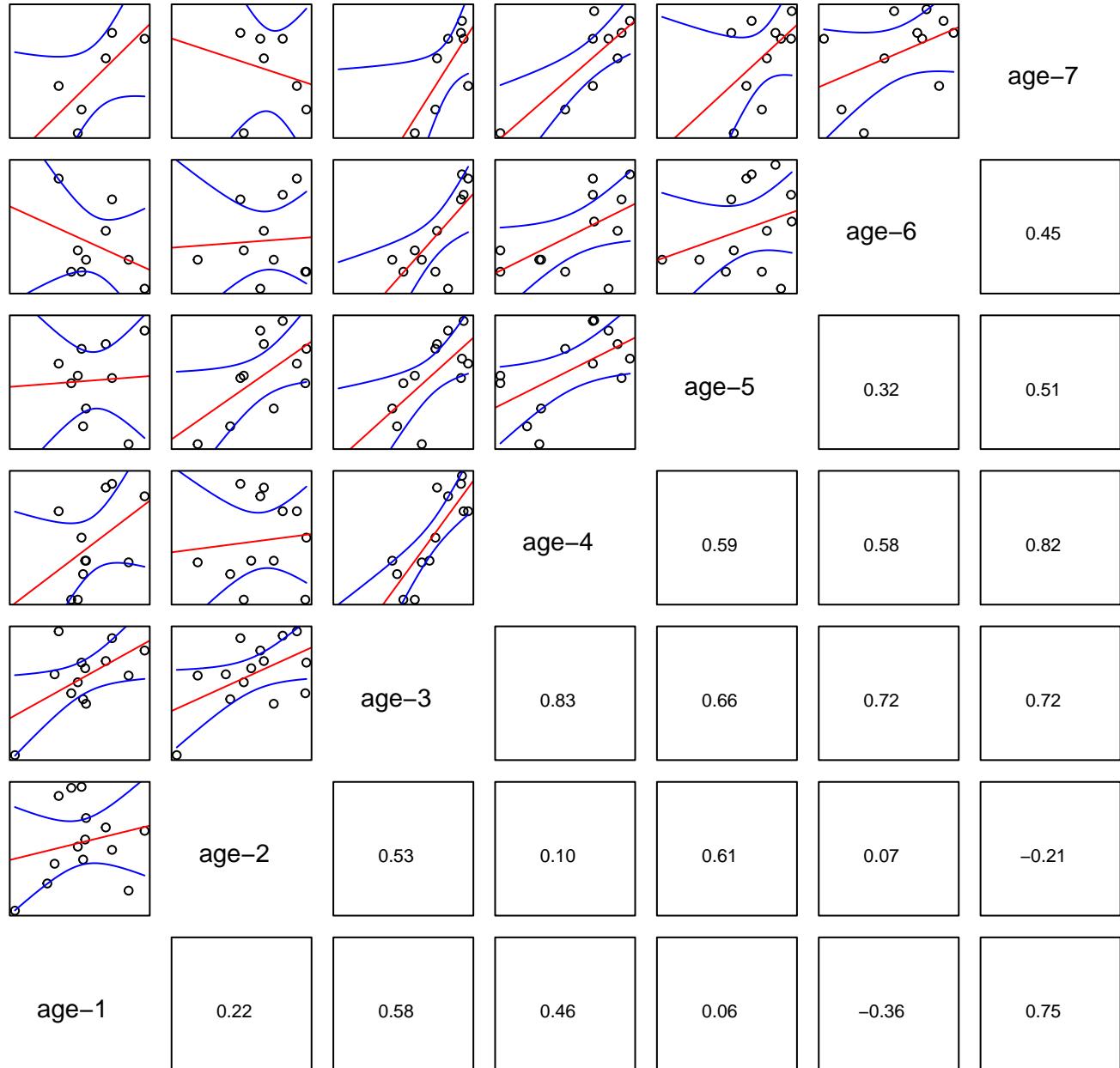
### **Index 3 (MRIP) Observed**



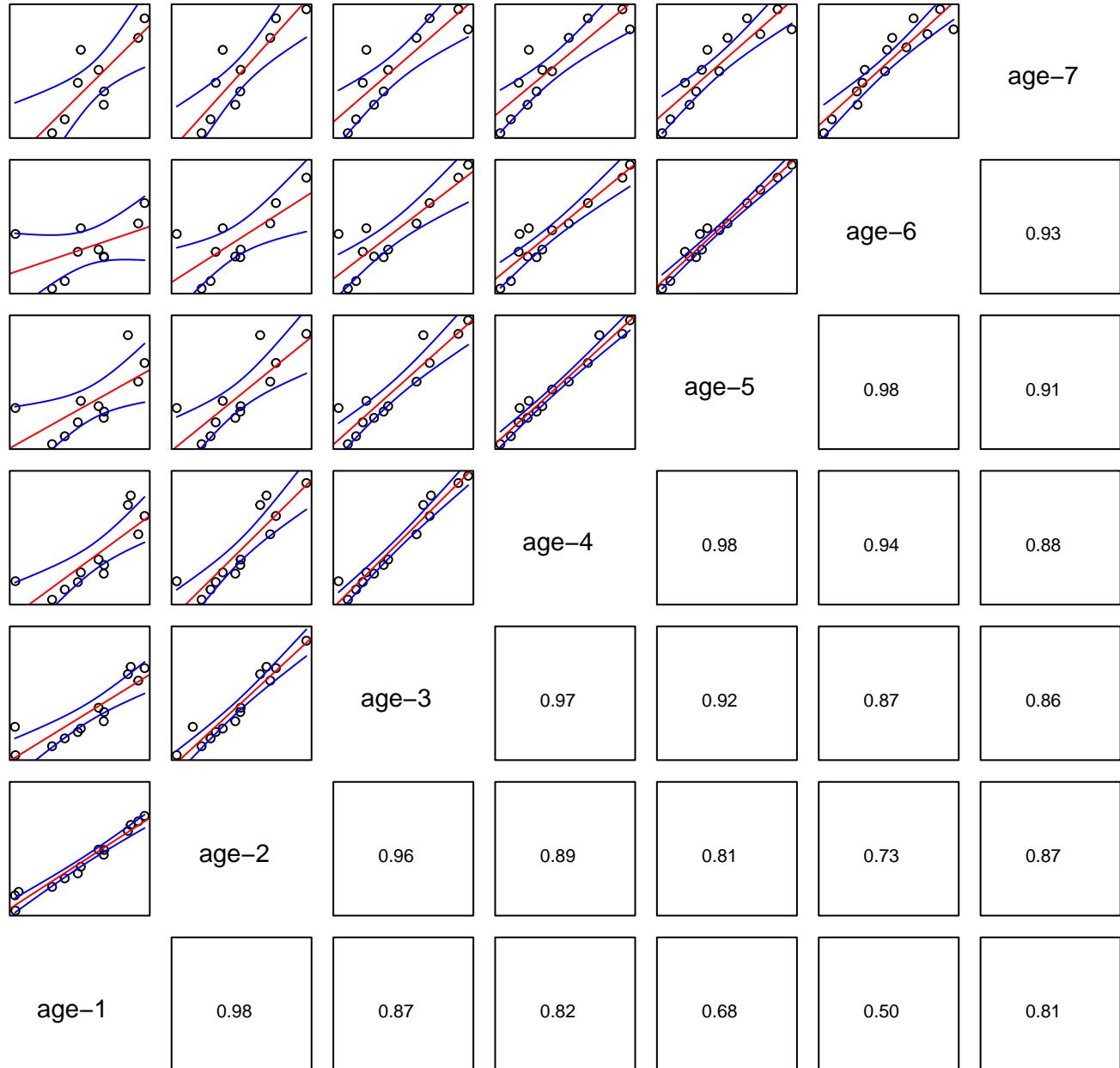
### Index 3 (MRIP) Predicted



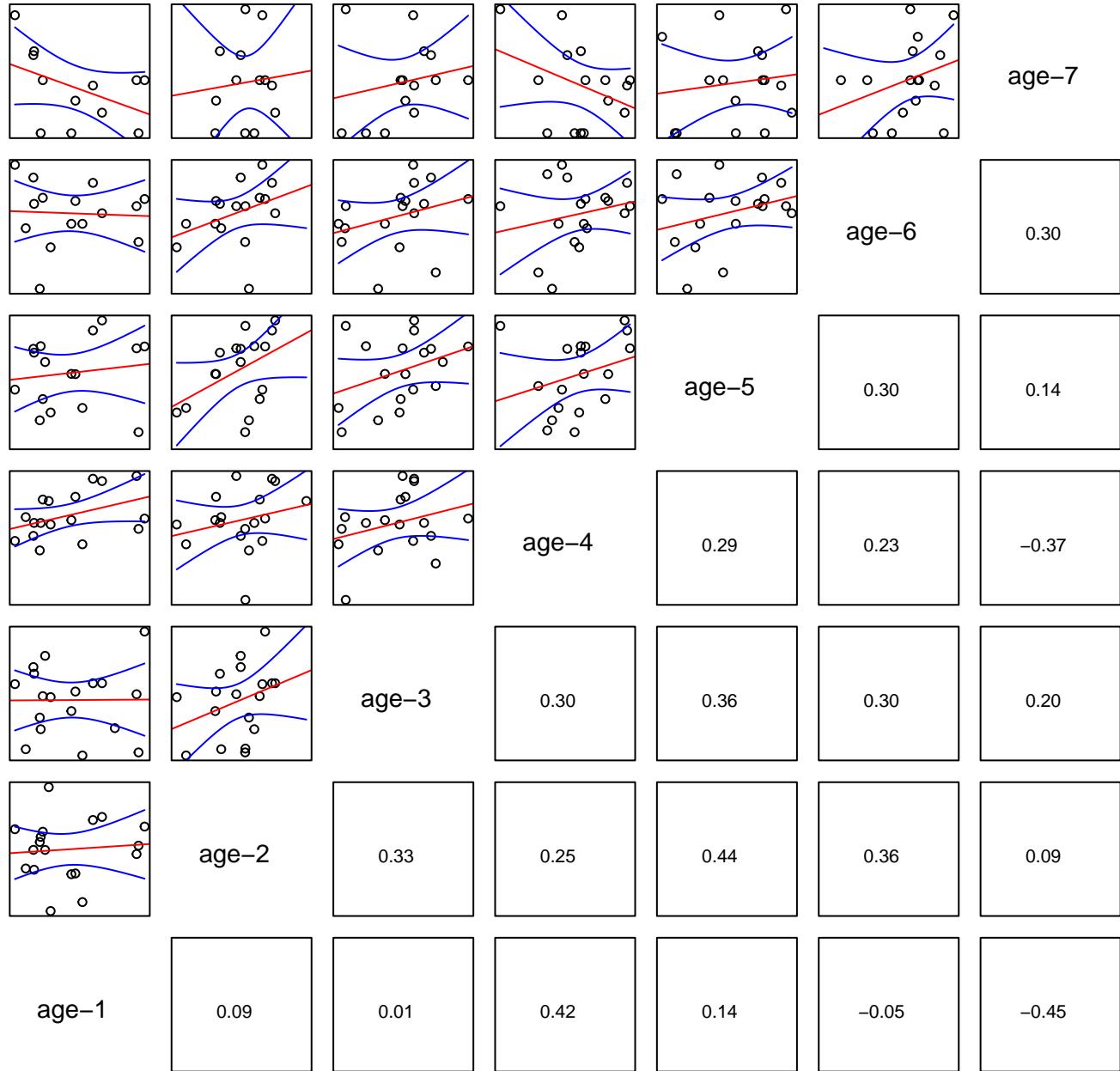
## **Index 4 (NEAMAP) Observed**



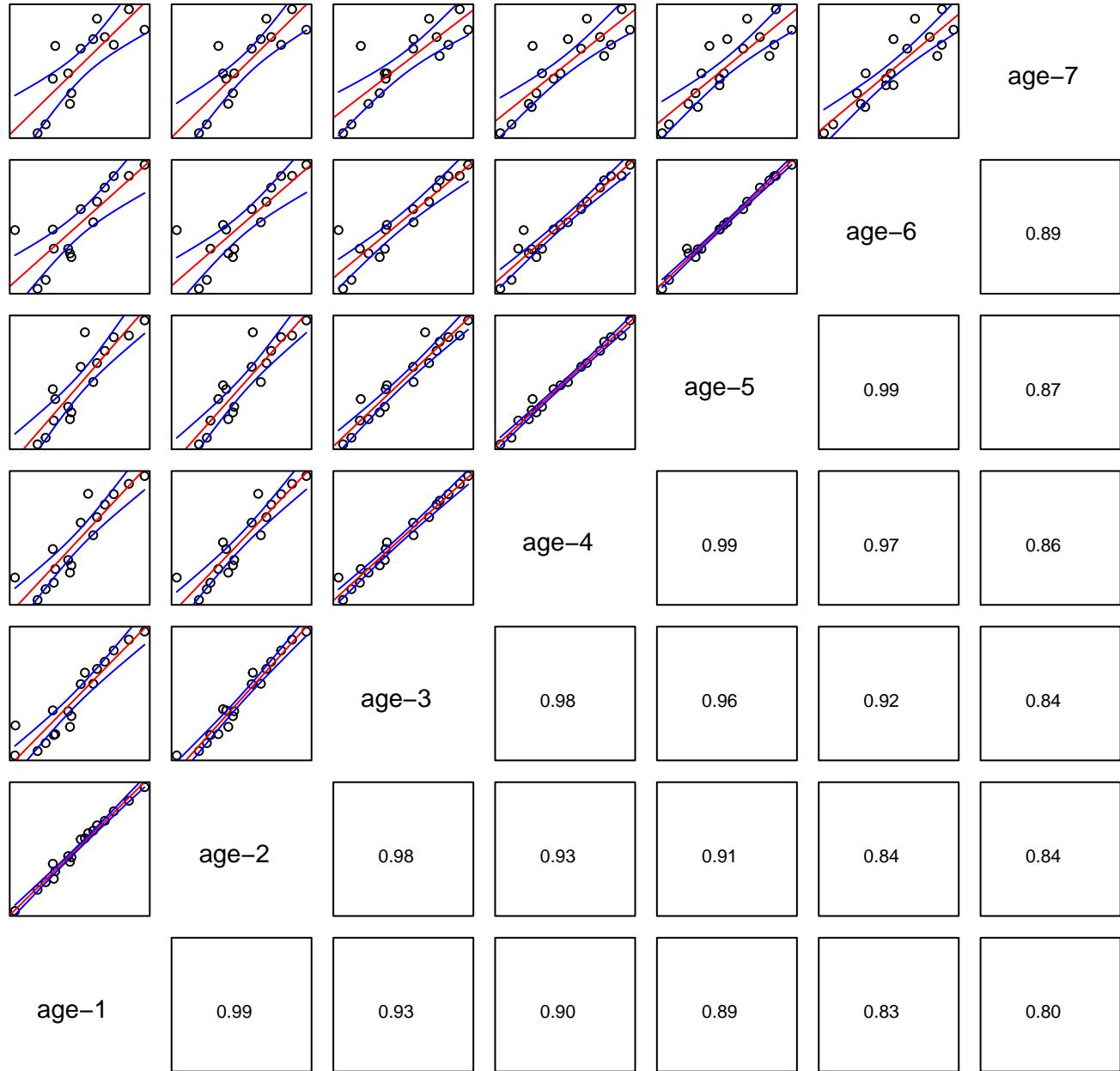
### Index 4 (NEAMAP) Predicted



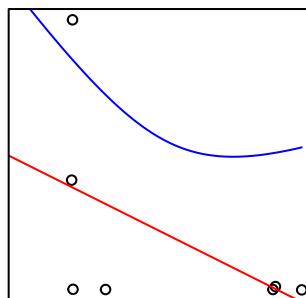
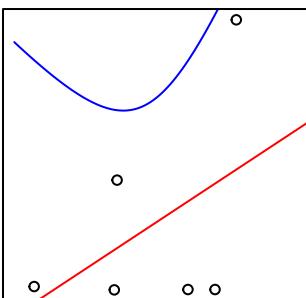
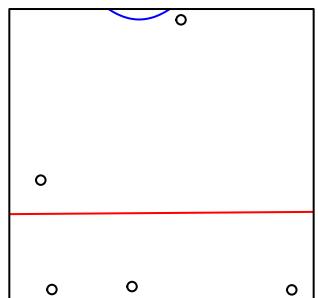
### Index 6 (PSIGN) Observed



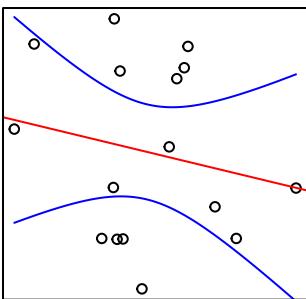
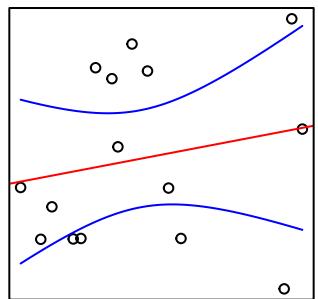
### Index 6 (PSIGN) Predicted



### Index 8 (ChesMMAP) Observed

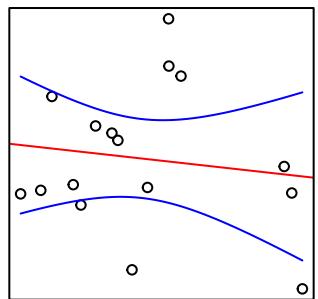


age-4



age-3

-0.53



age-2

-0.20

0.46

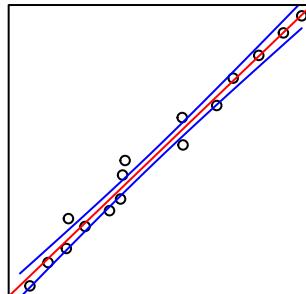
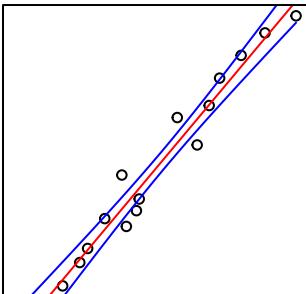
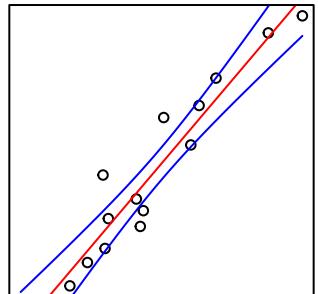
age-1

-0.14

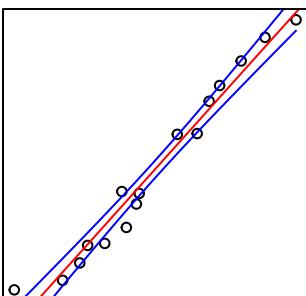
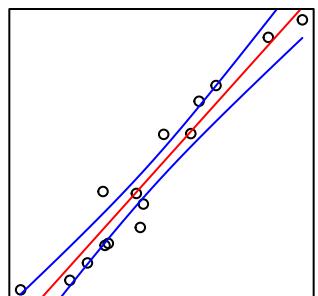
0.20

0.01

### Index 8 (ChesMMAP) Predicted

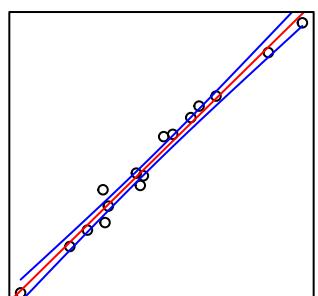


age-4



age-3

0.99



age-2

0.98

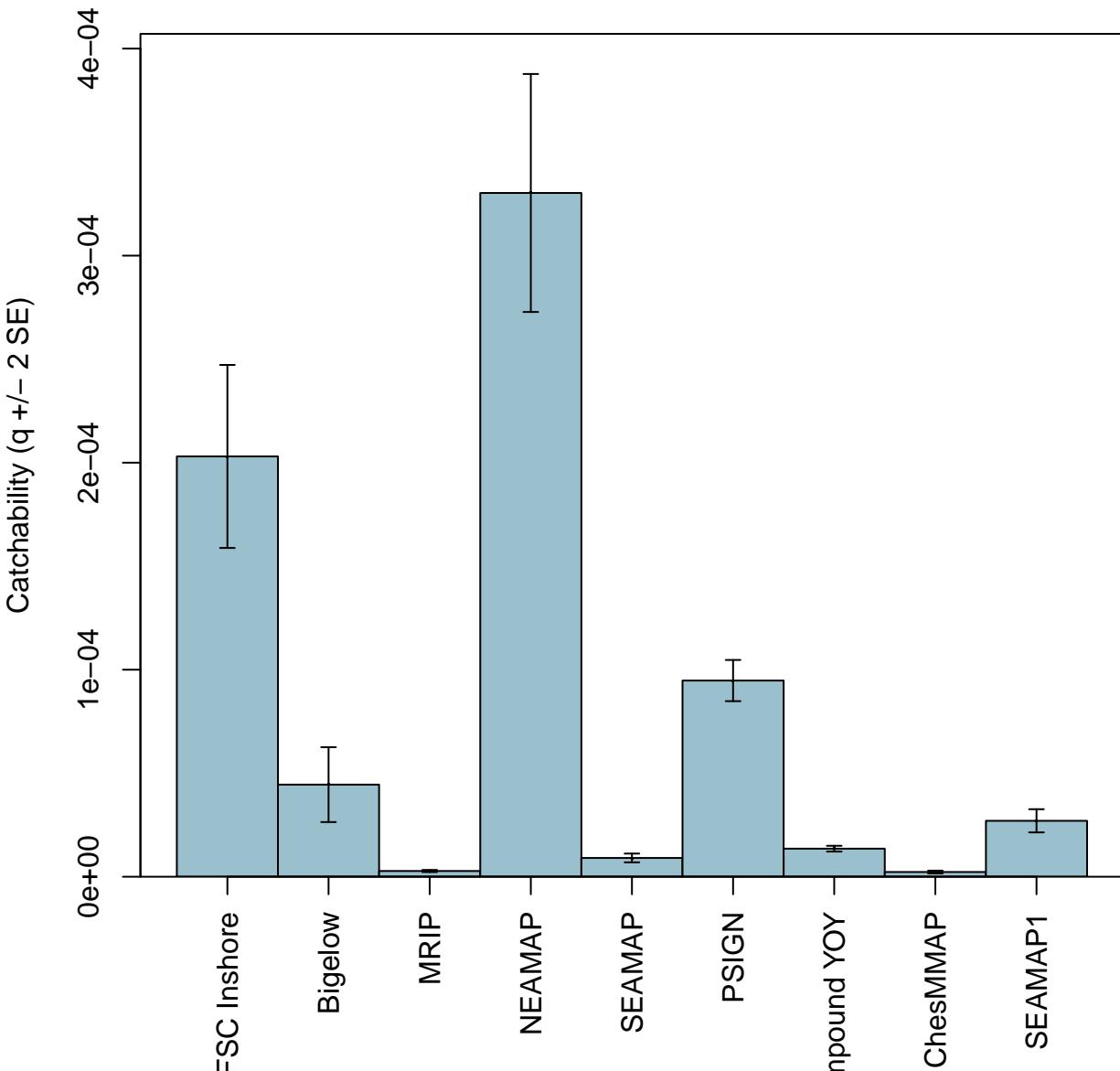
0.98

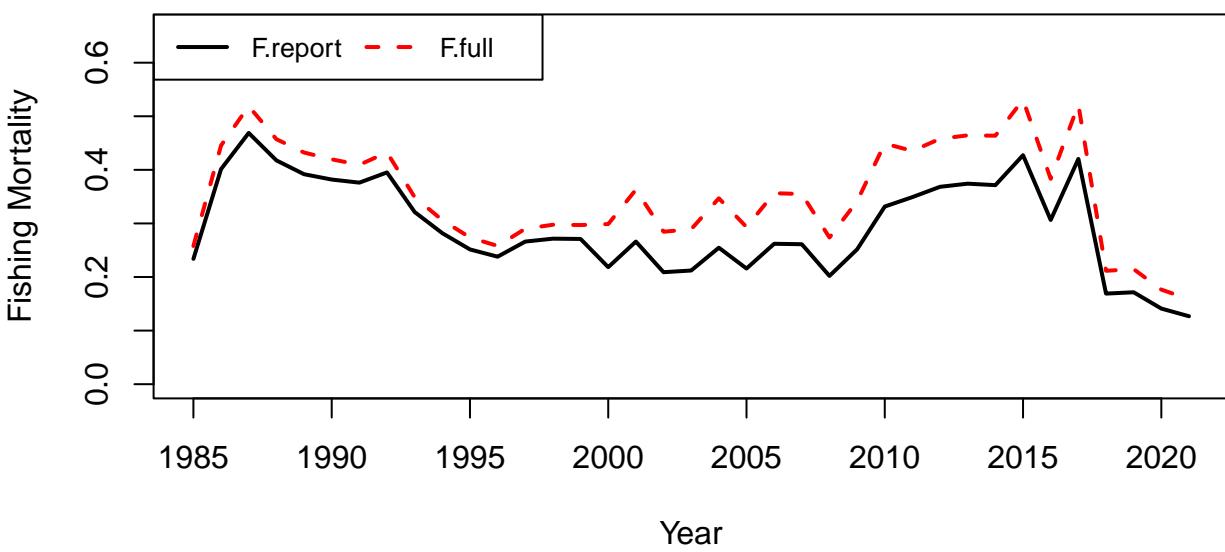
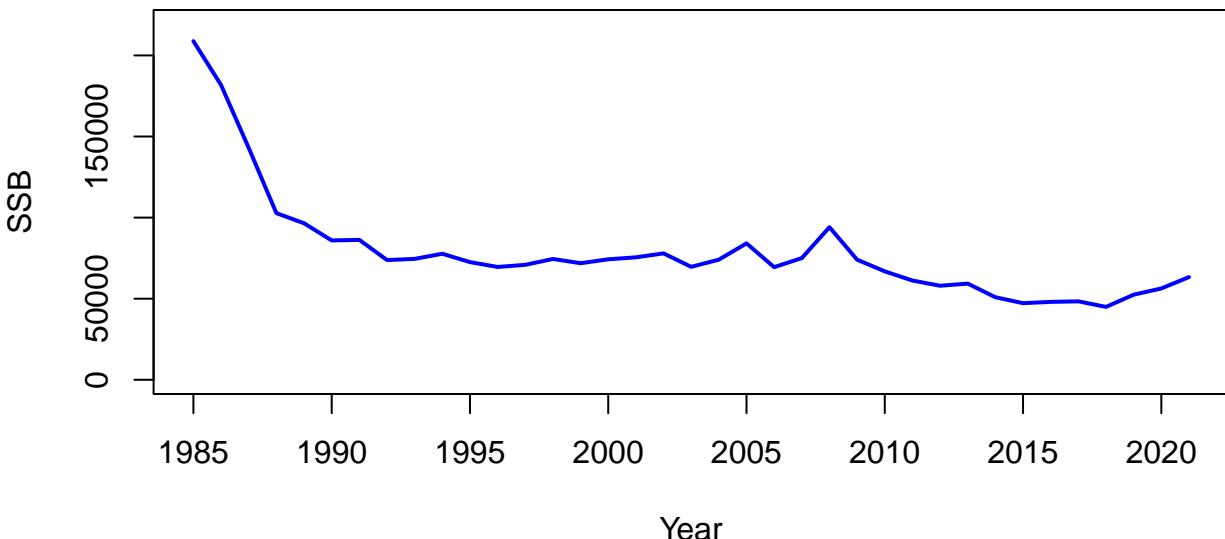
age-1

0.99

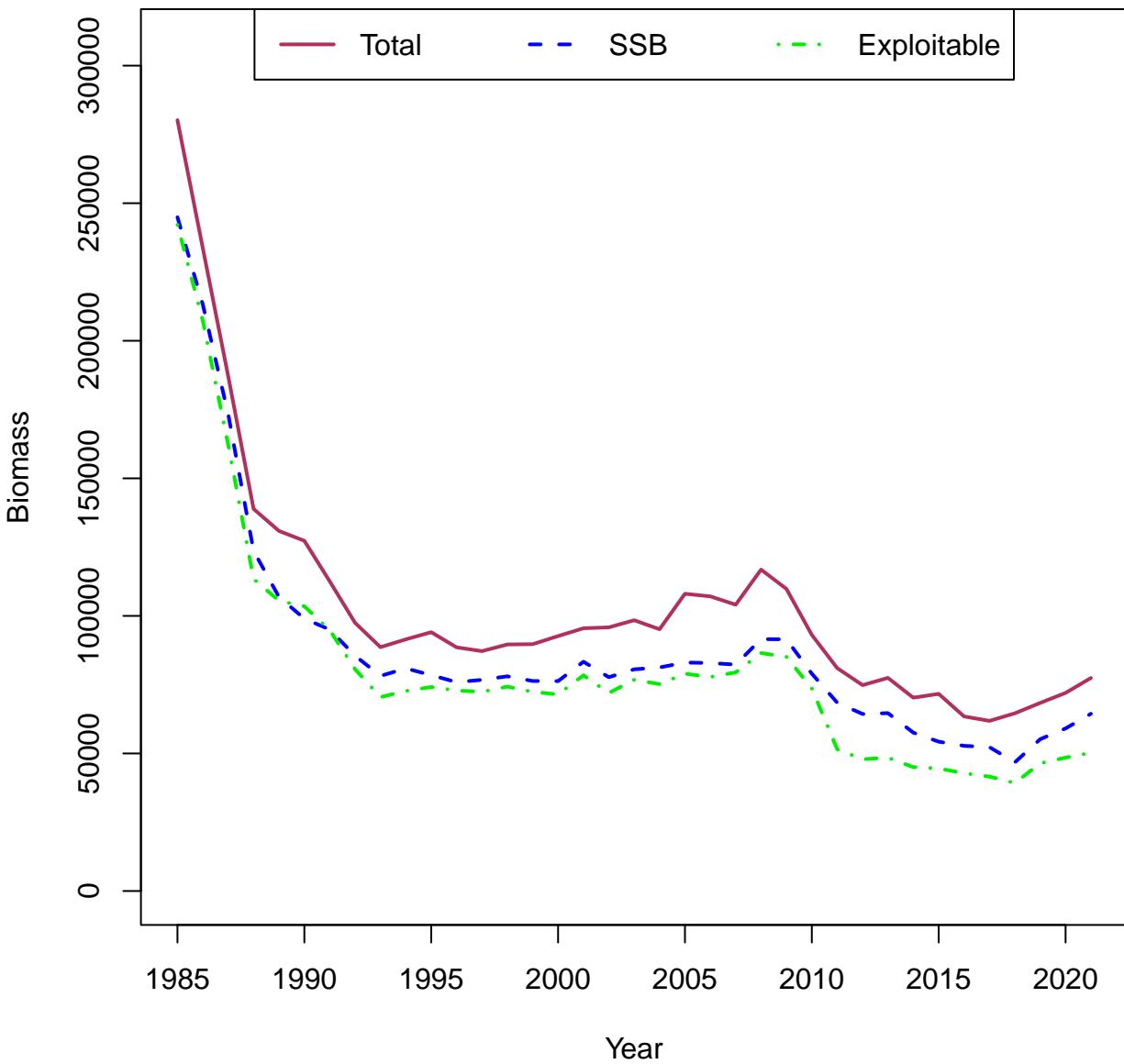
0.96

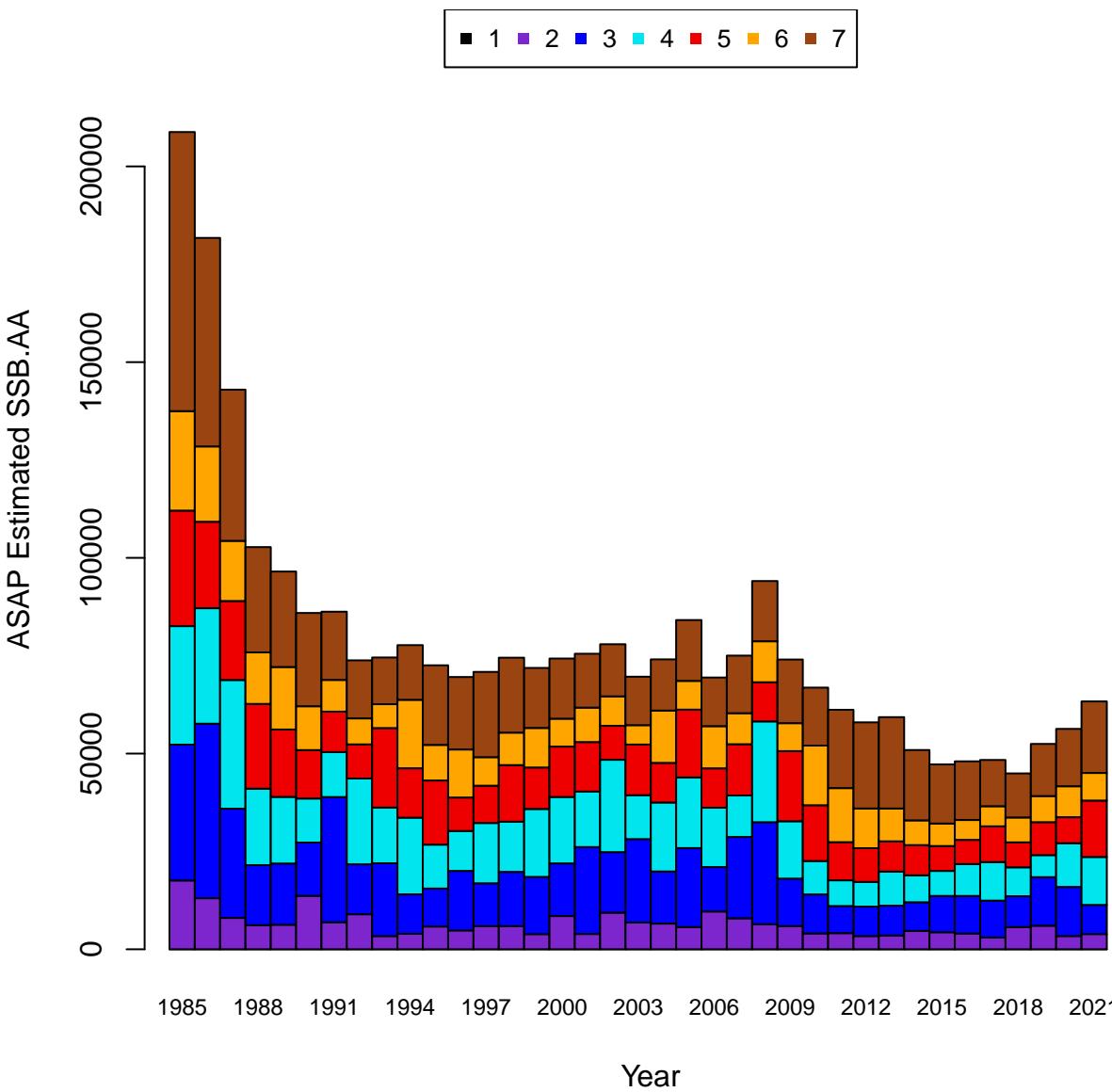
0.95

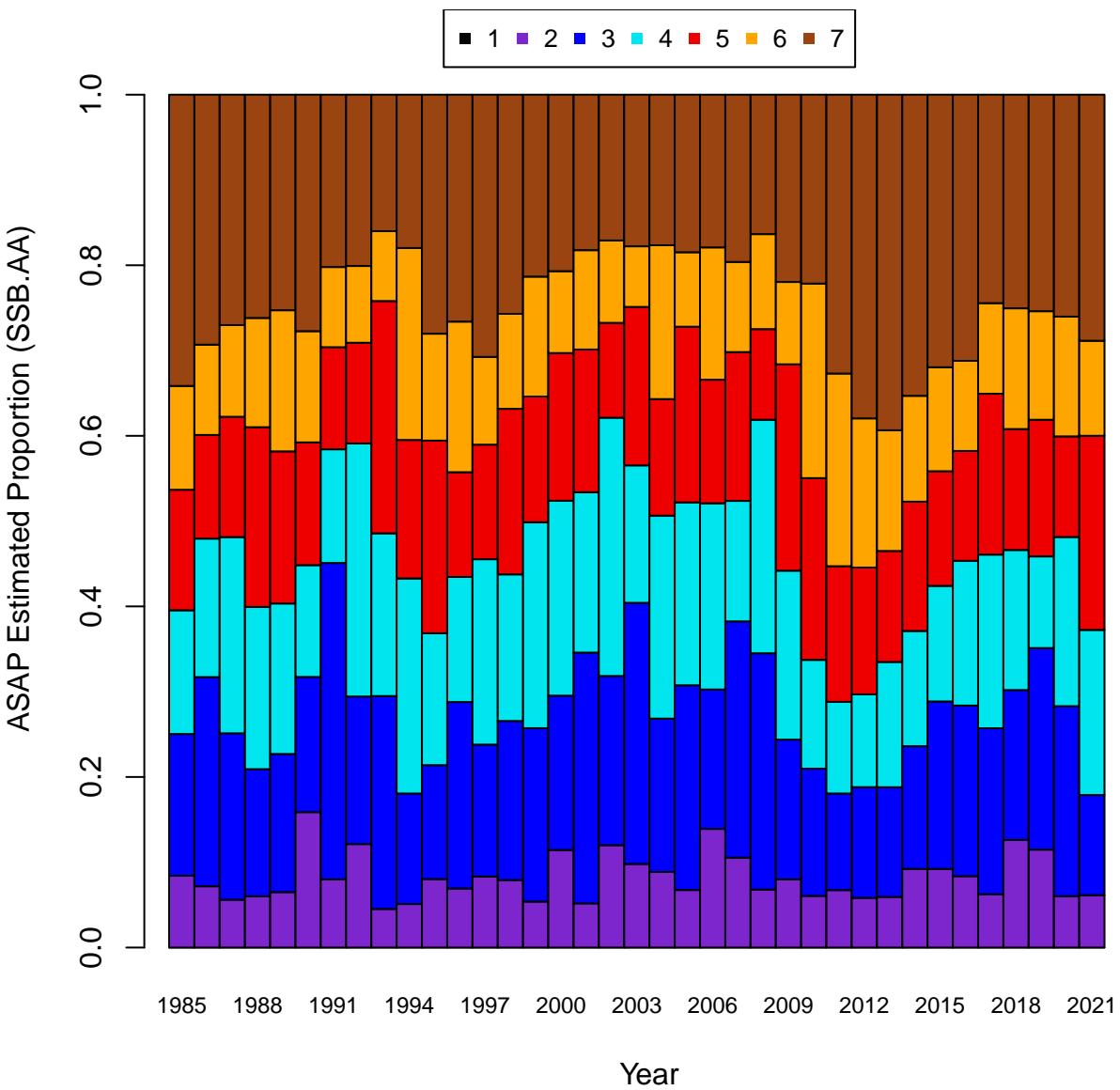


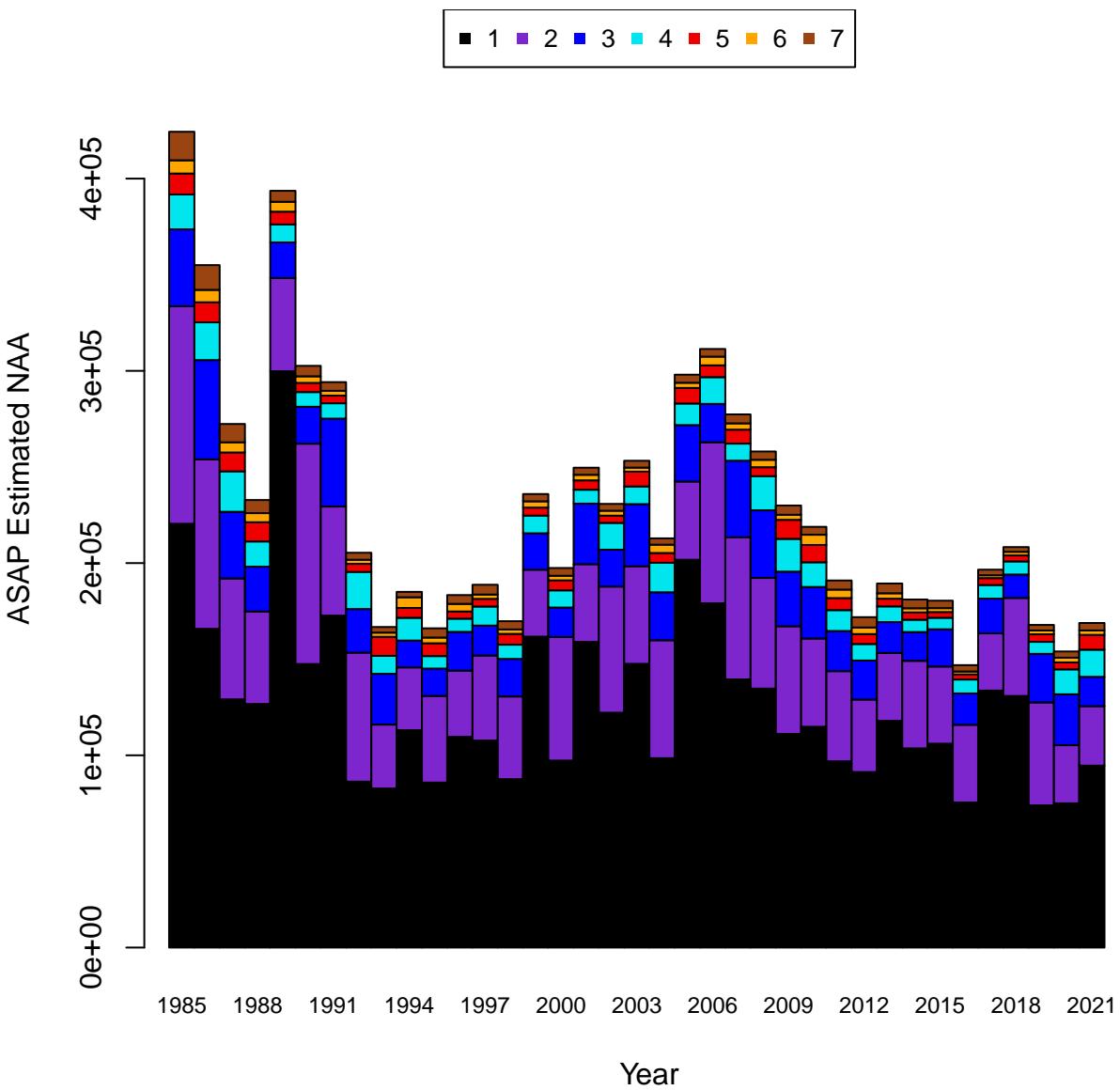


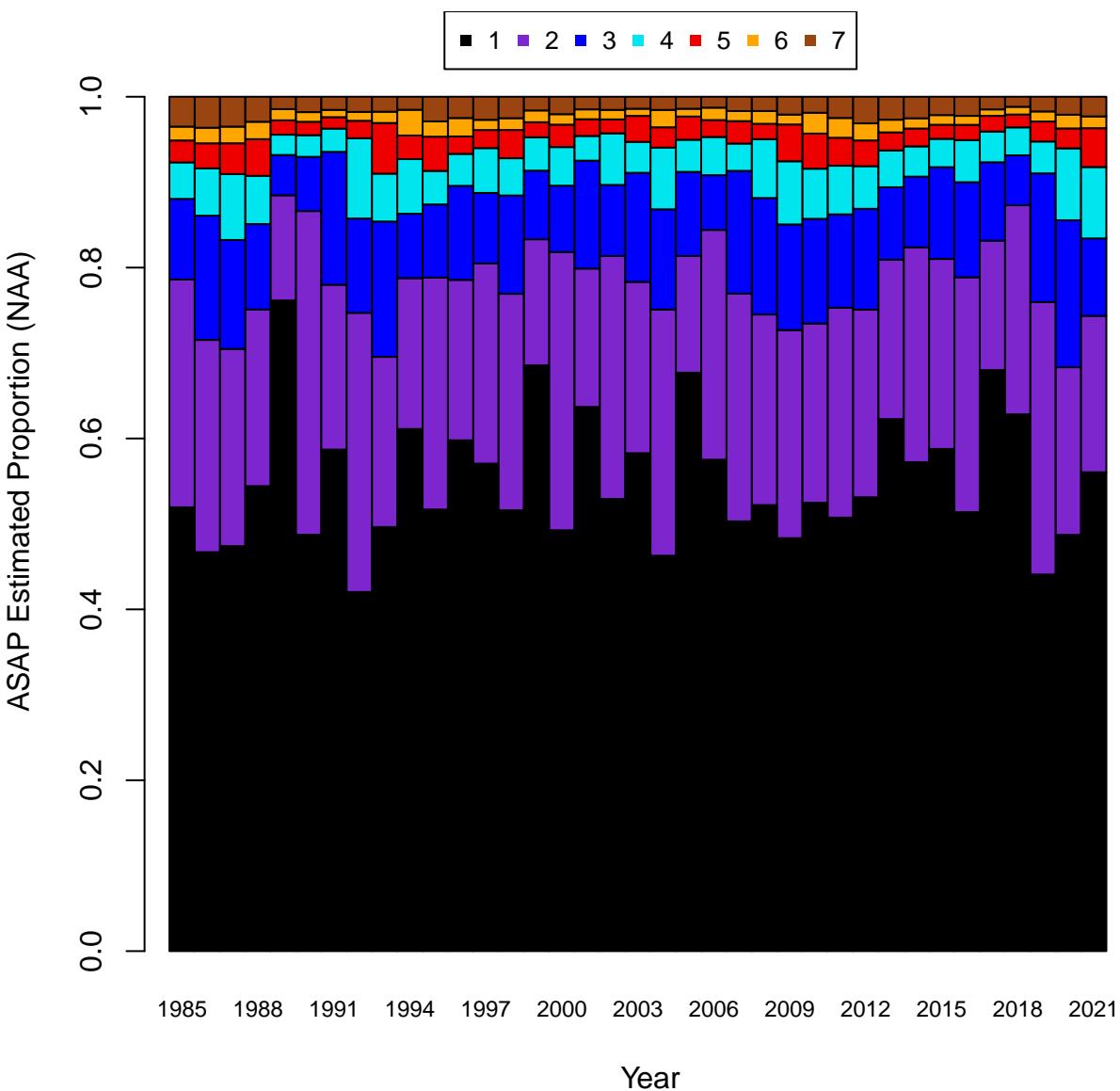
## Comparison of January 1 Biomass

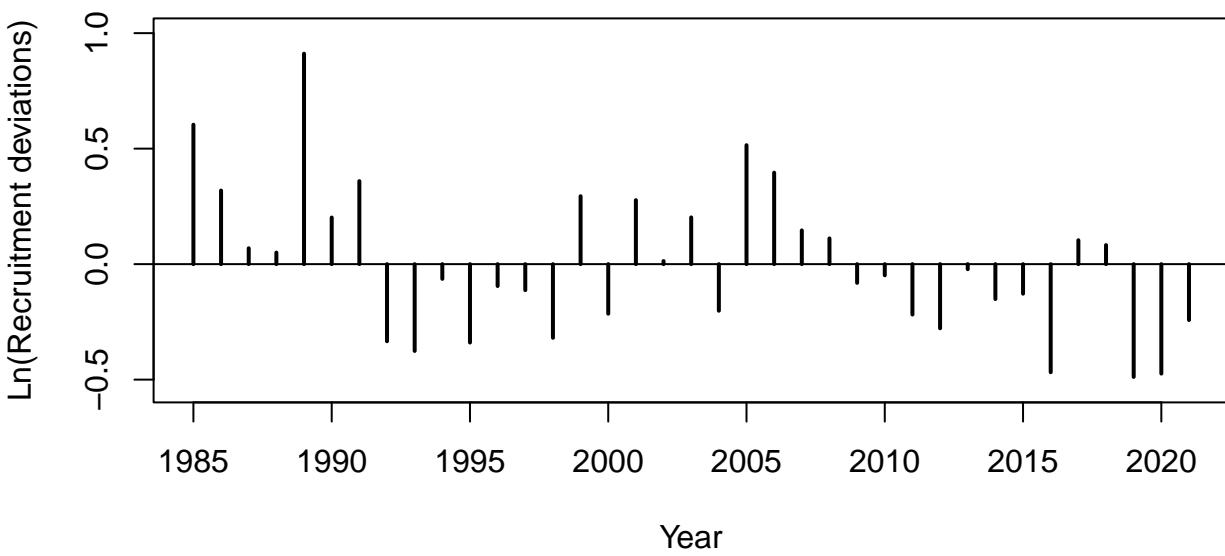
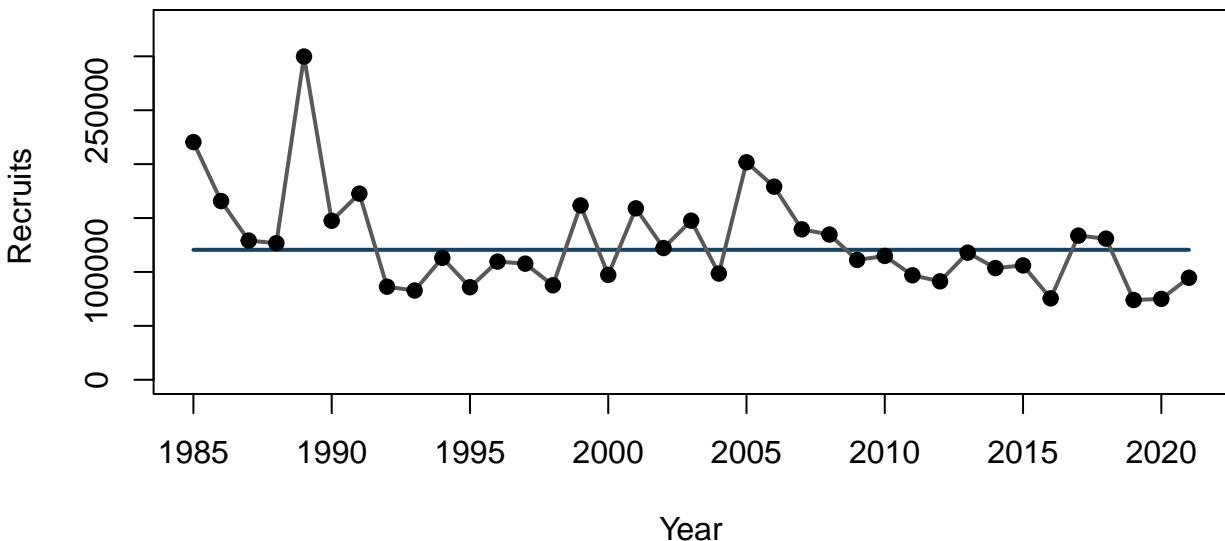


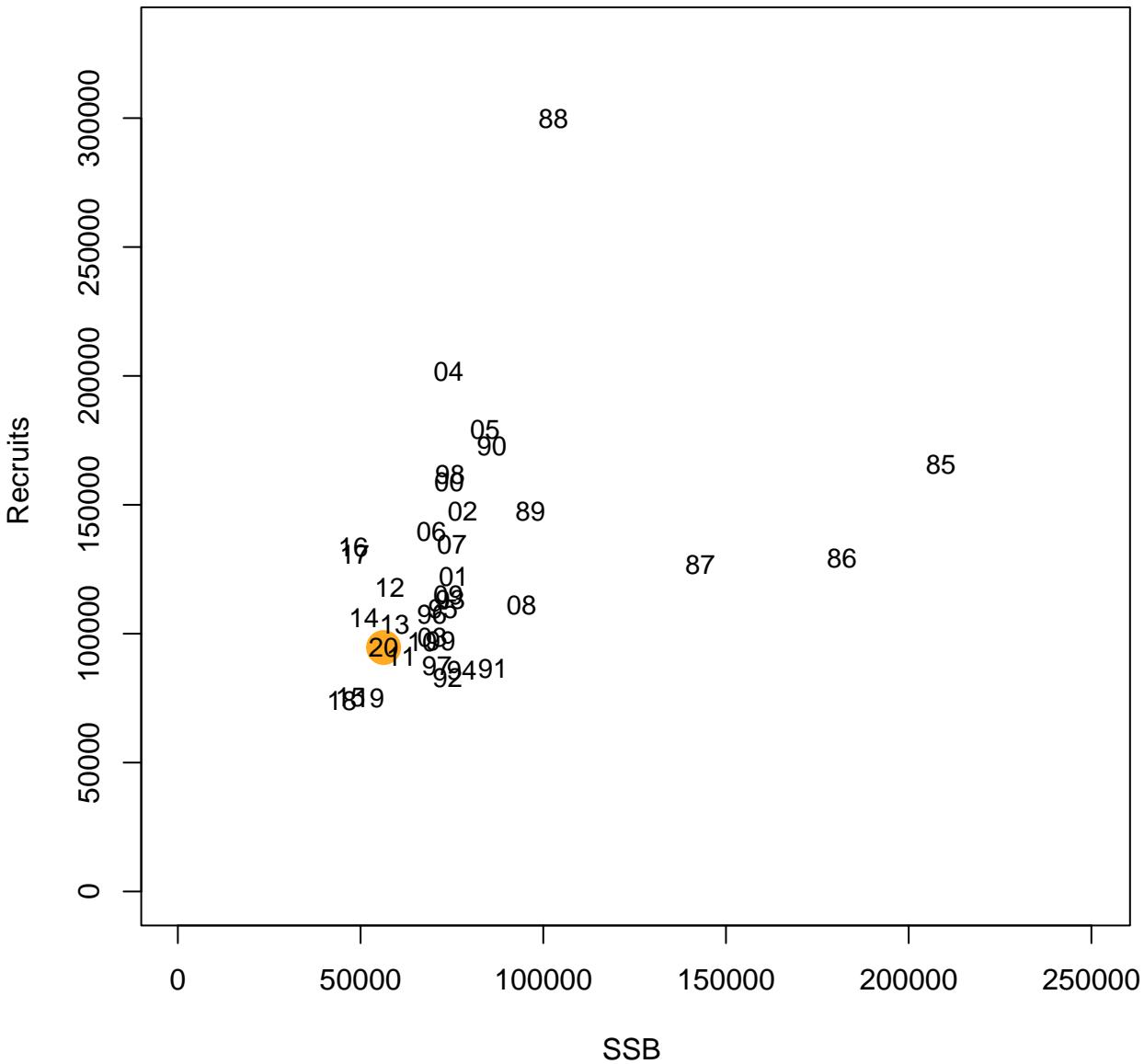


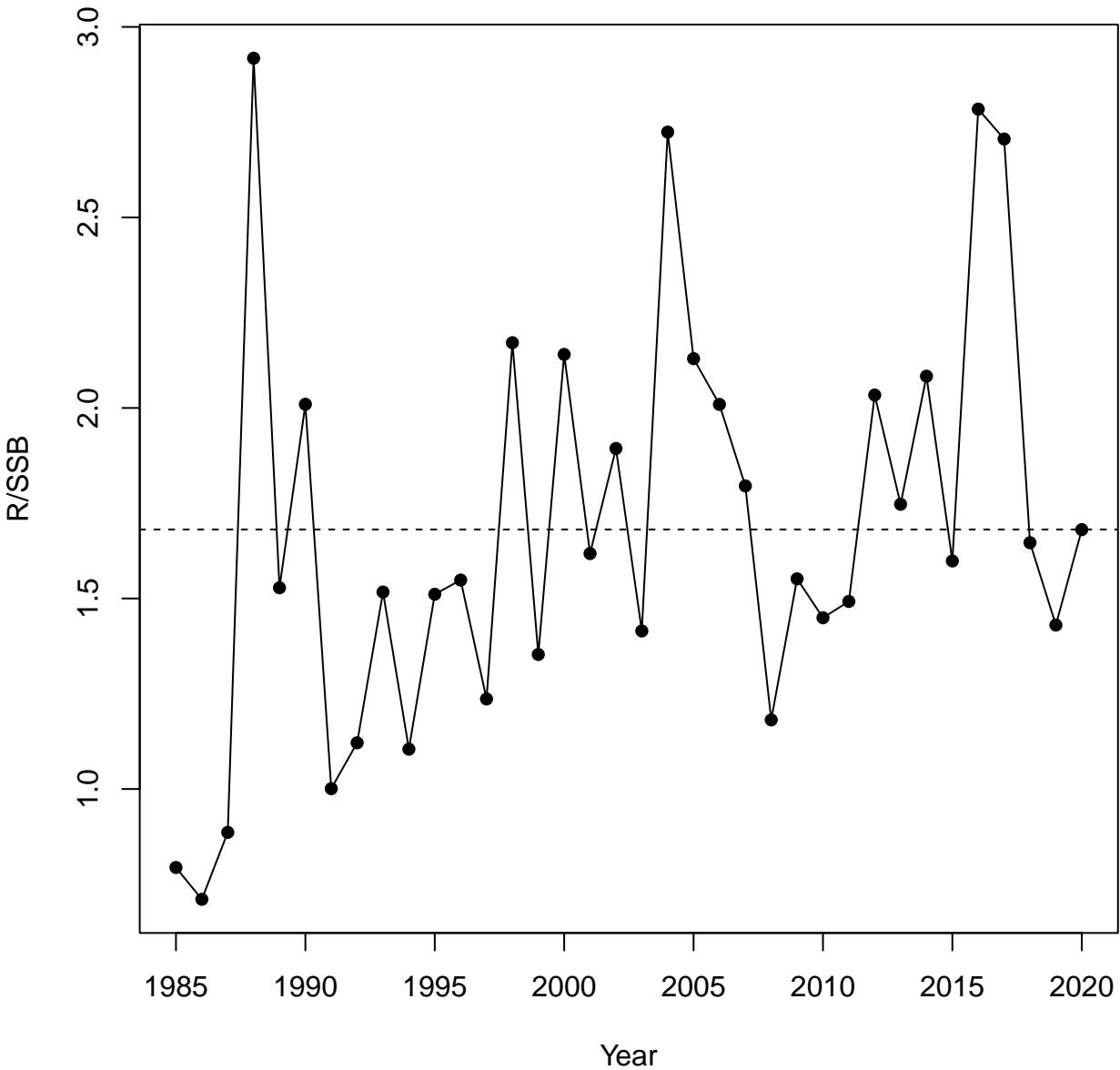


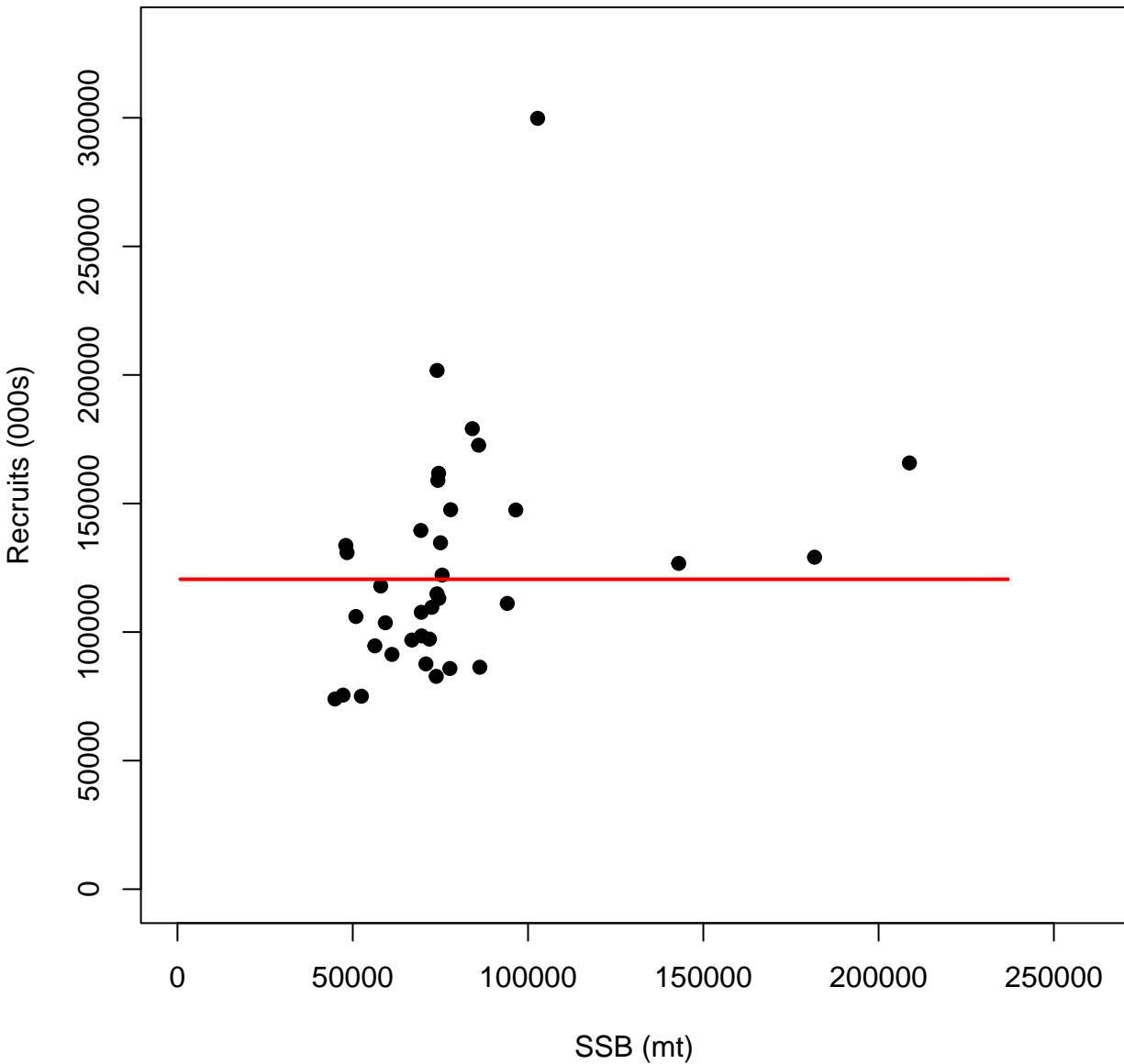












Age-1 Recruits (year-class)

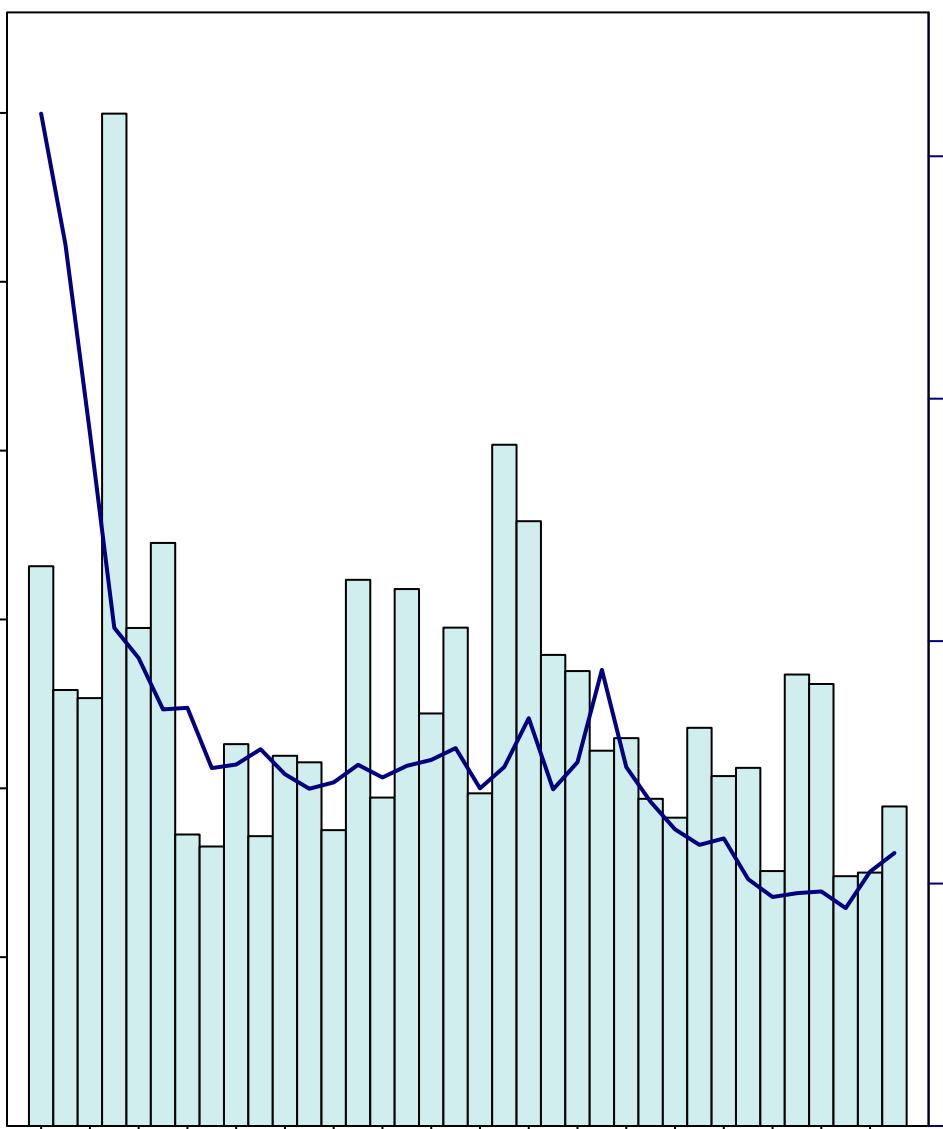
300000  
250000  
200000  
150000  
100000  
50000

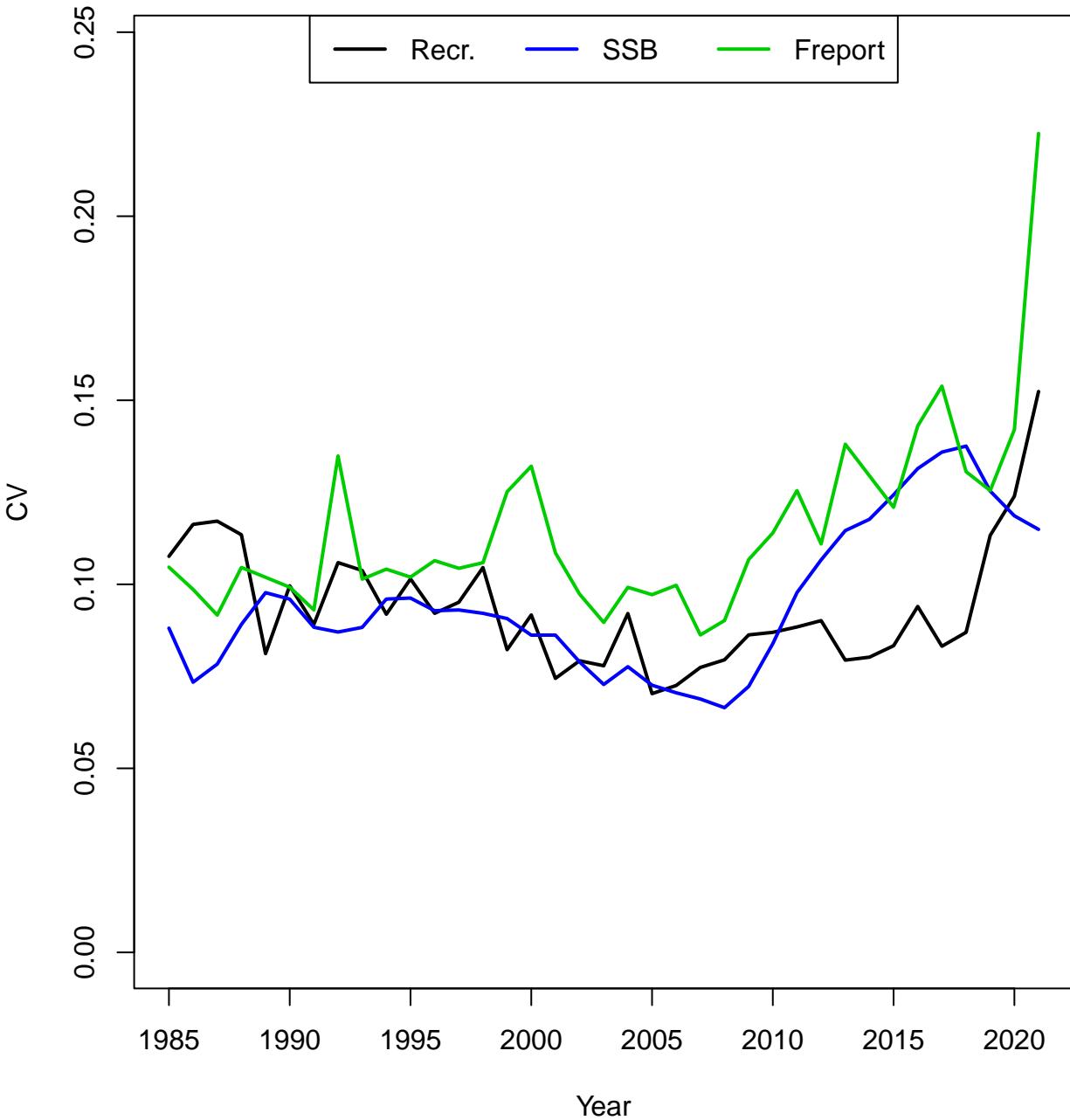
1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017 2019

Year

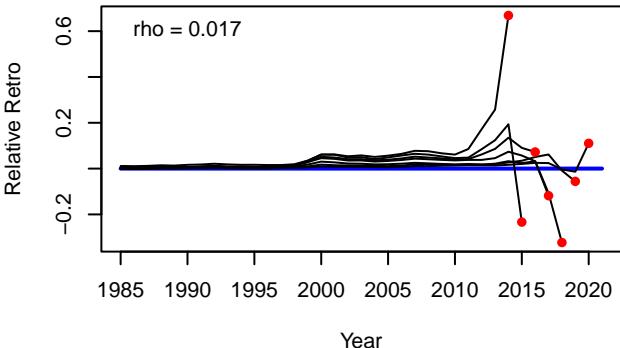
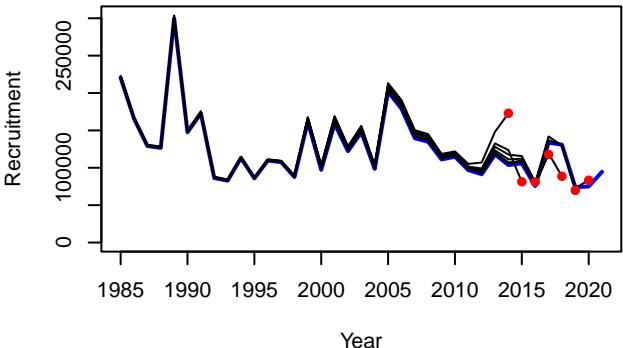
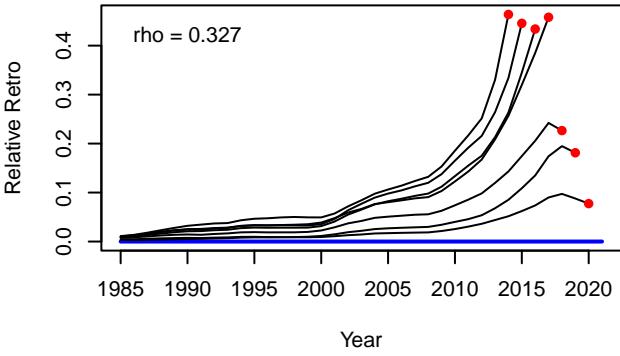
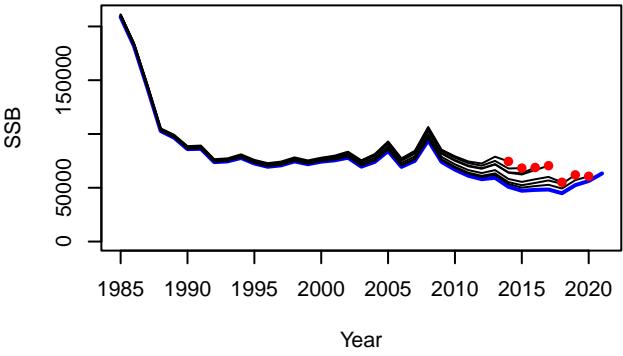
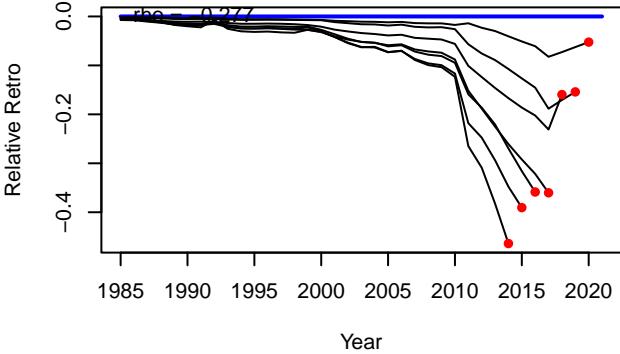
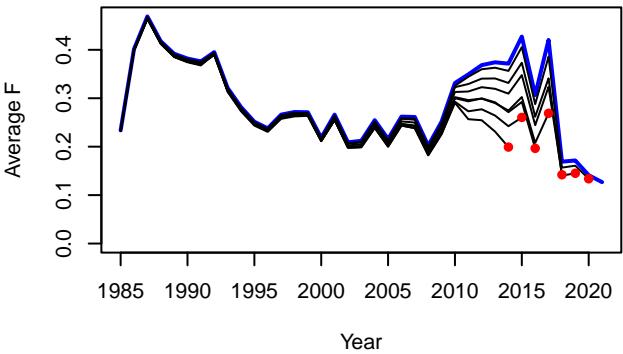
SSB (year)  
0 50000 1e+05 150000 2e+05

SSB (year)



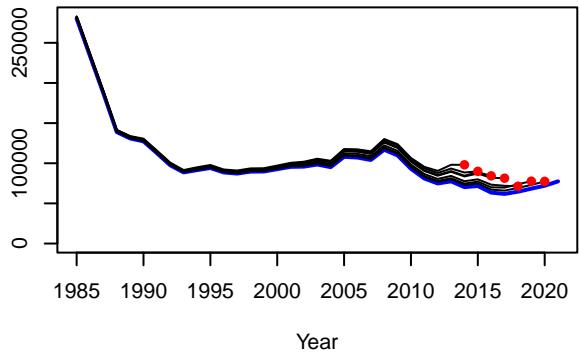


F, SSB, R



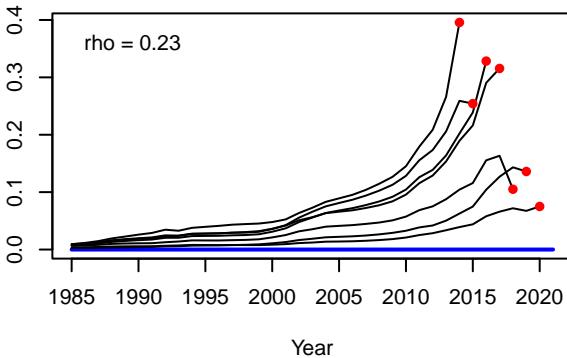
**Jan-1 B, Exploitable B, Total Stock N**

Jan-1 B



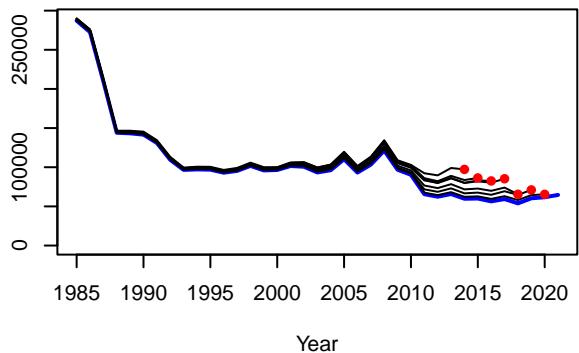
Year

Relative Retro



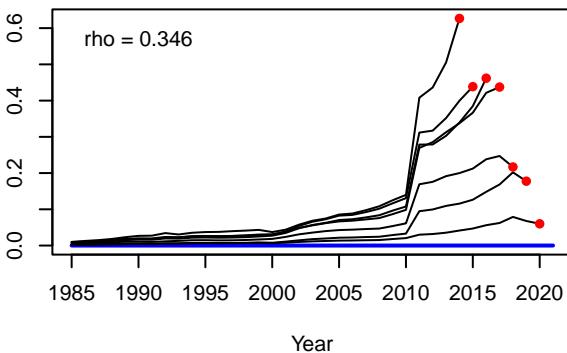
Year

Exploitable B



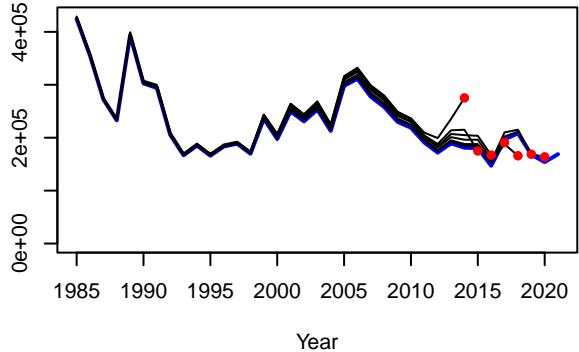
Year

Relative Retro



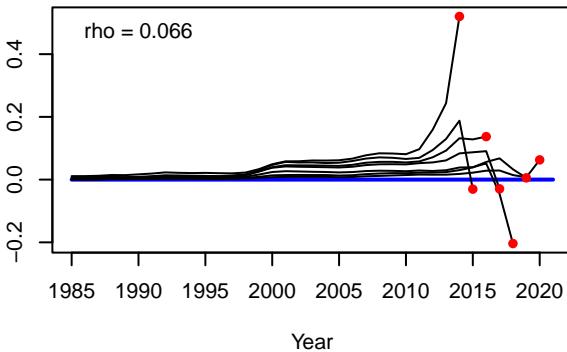
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Total Stock N



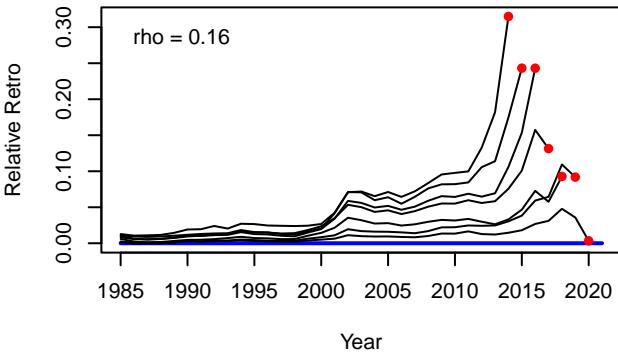
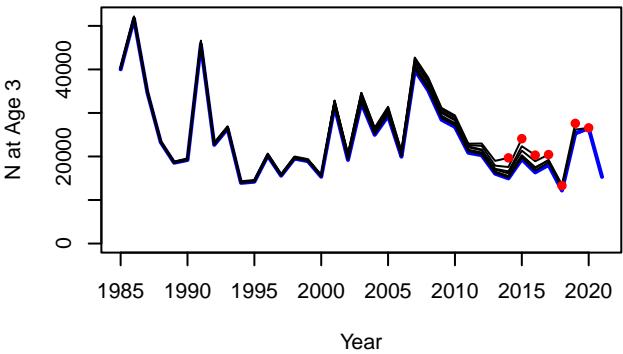
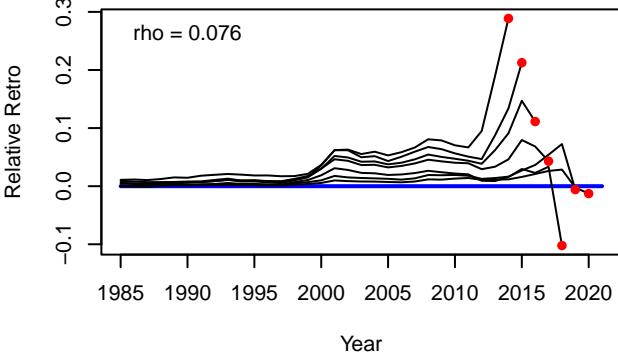
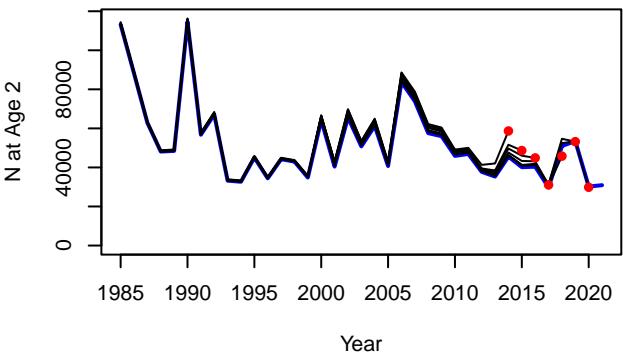
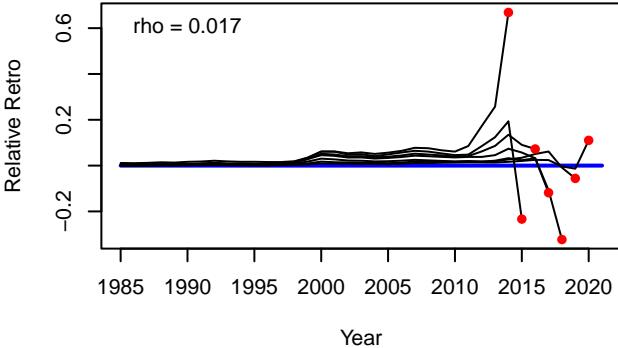
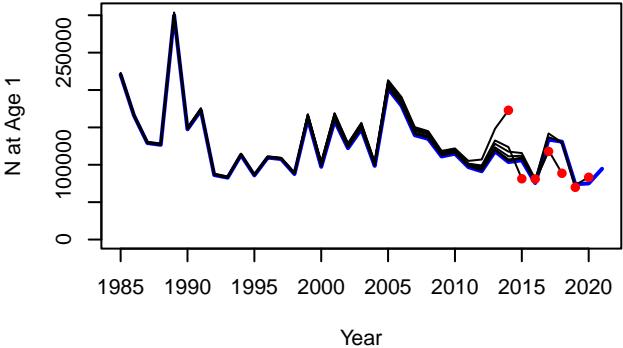
Year

Relative Retro

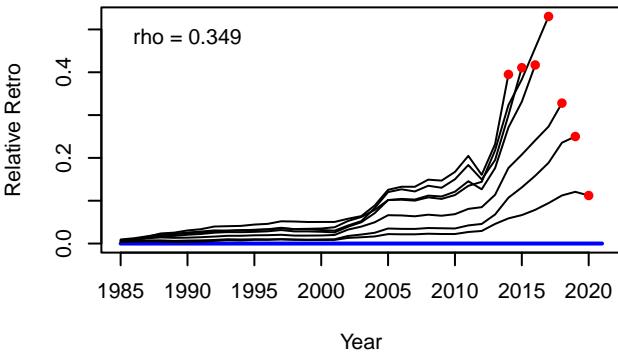
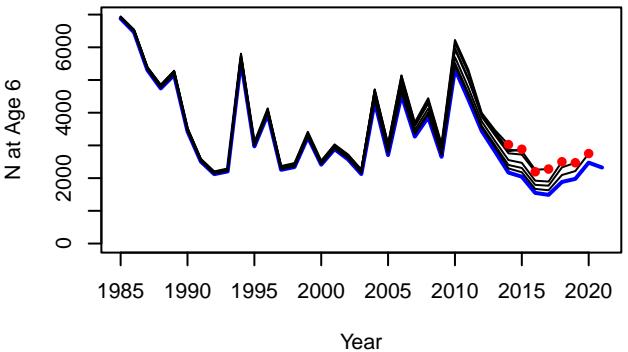
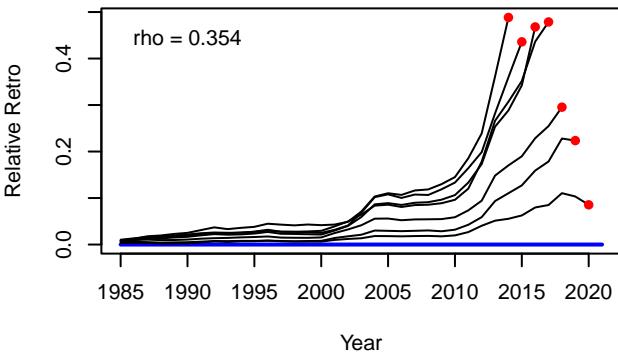
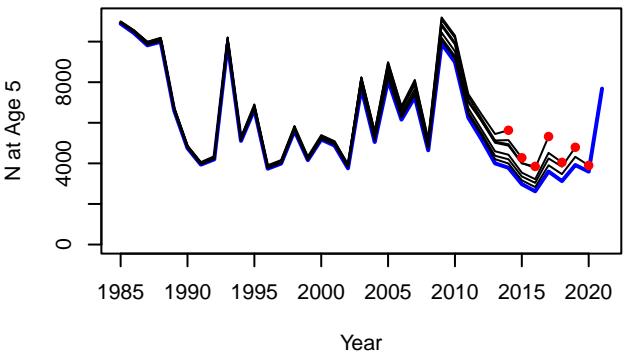
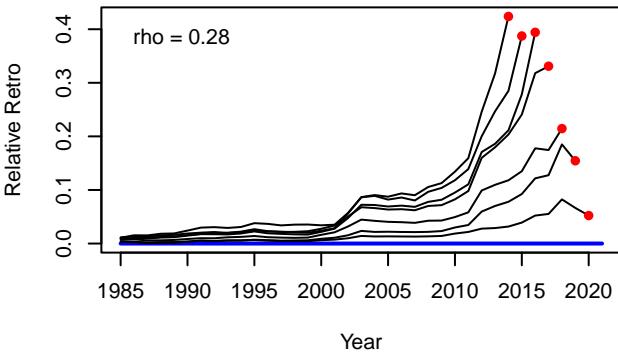
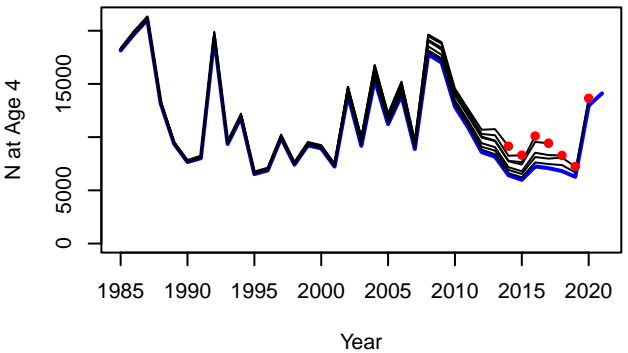


Year

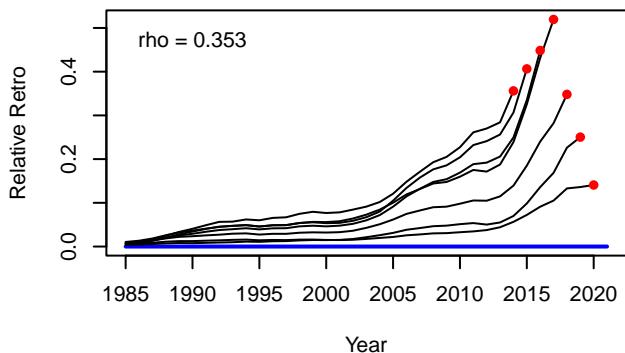
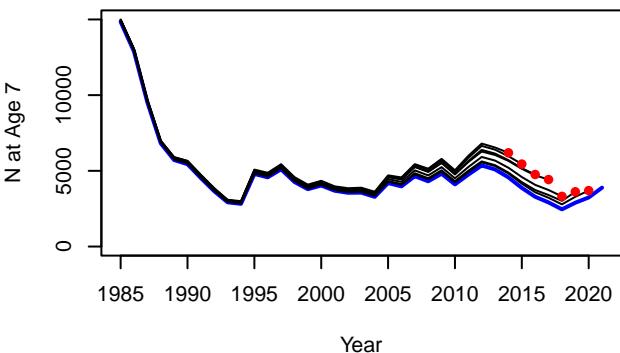
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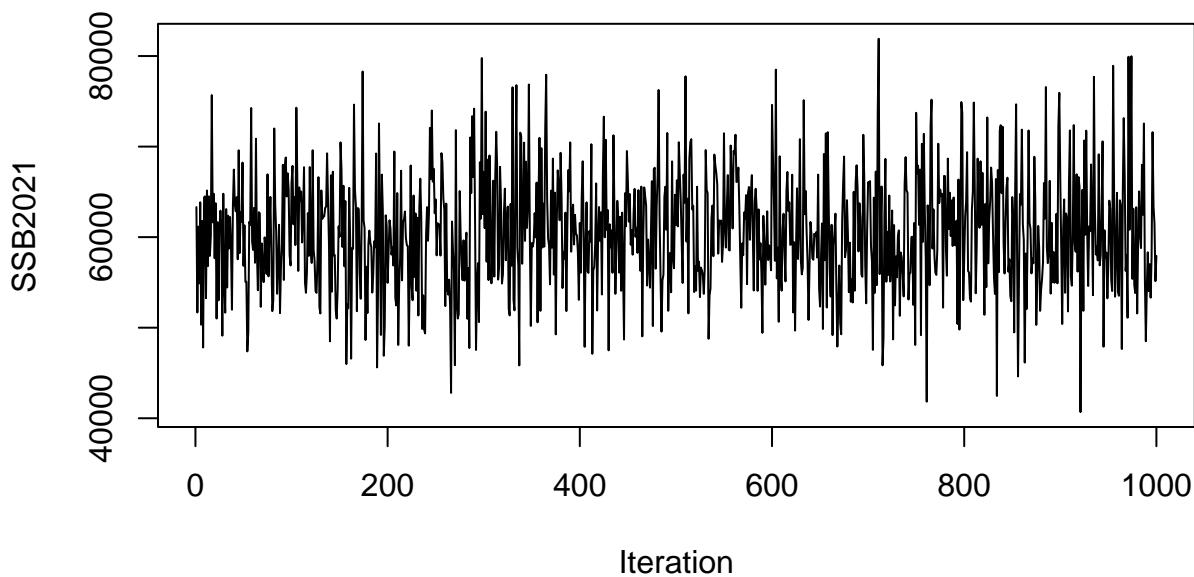
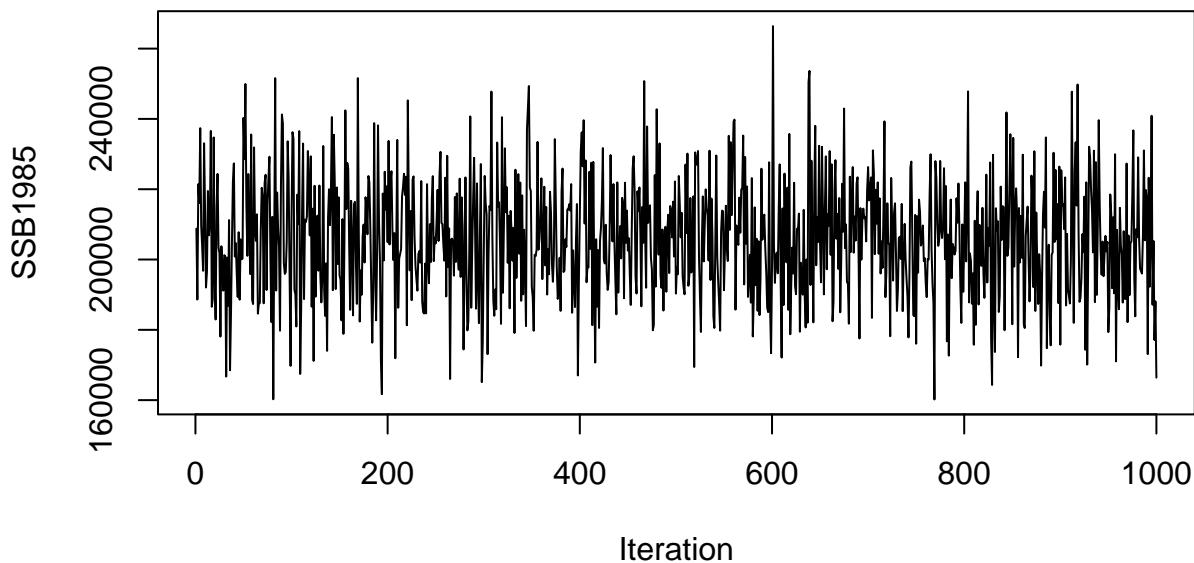


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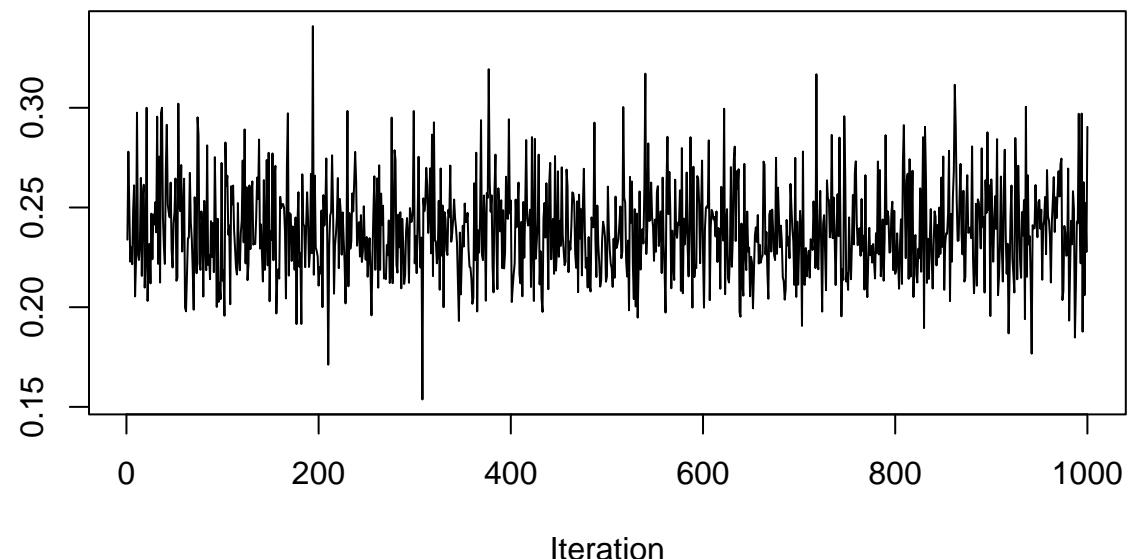


## Stock Numbers at Age

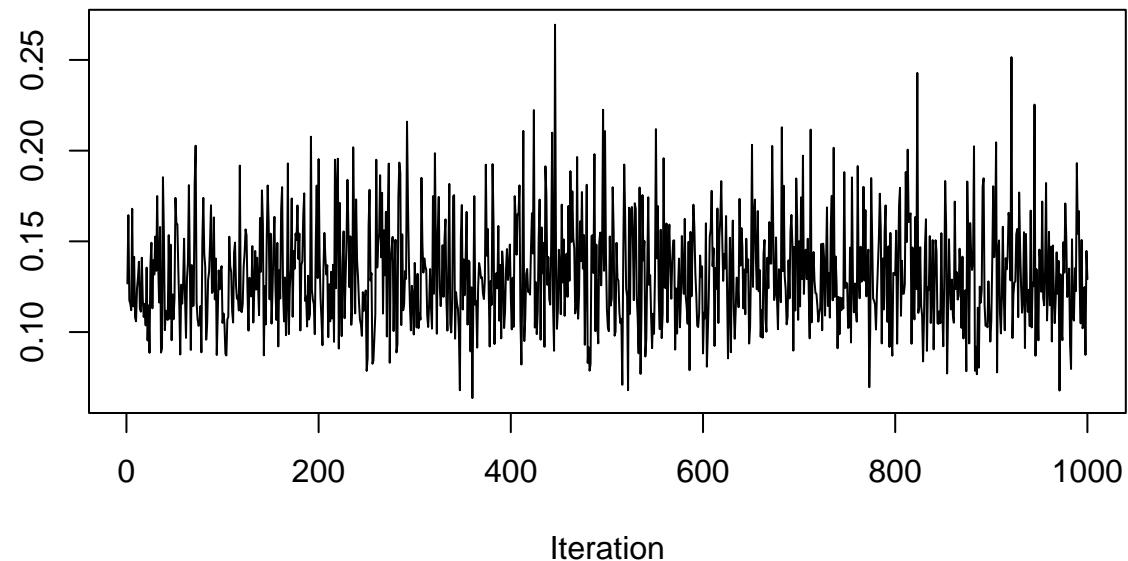


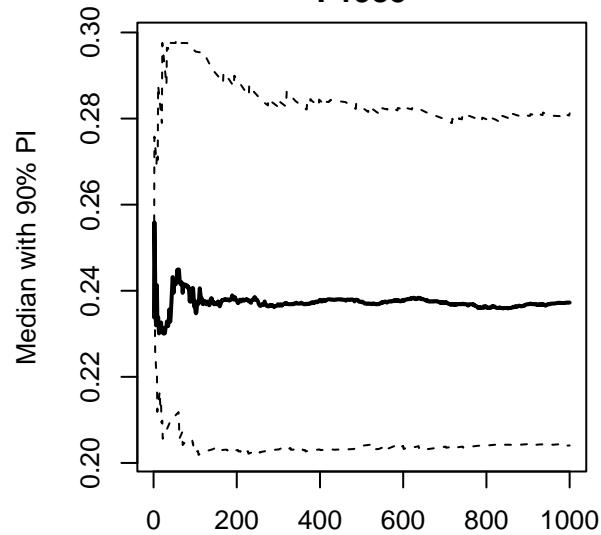
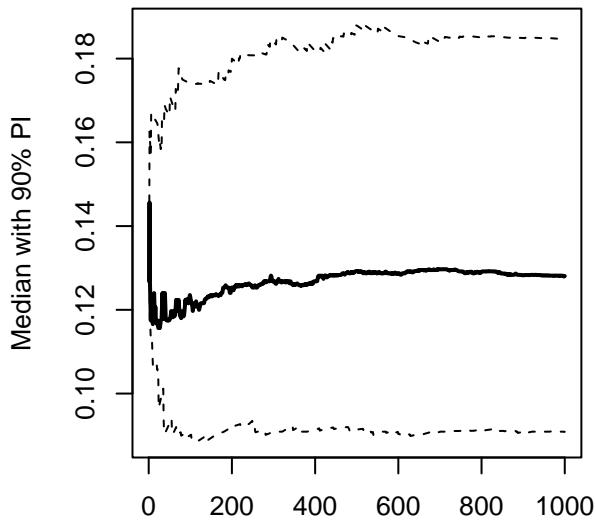
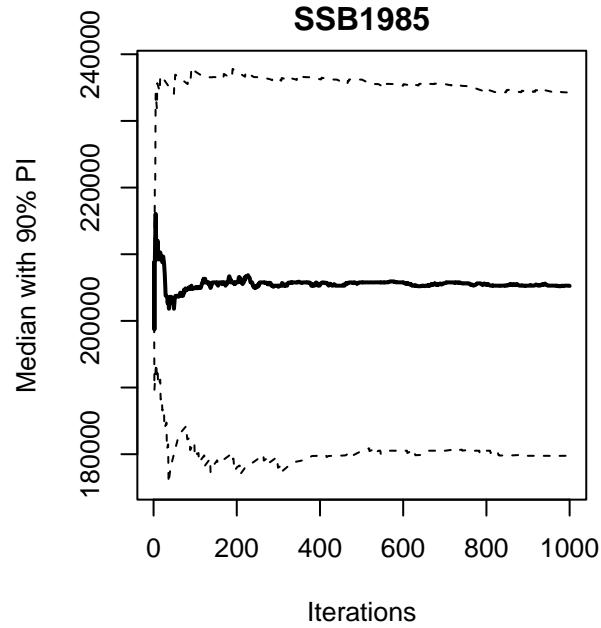
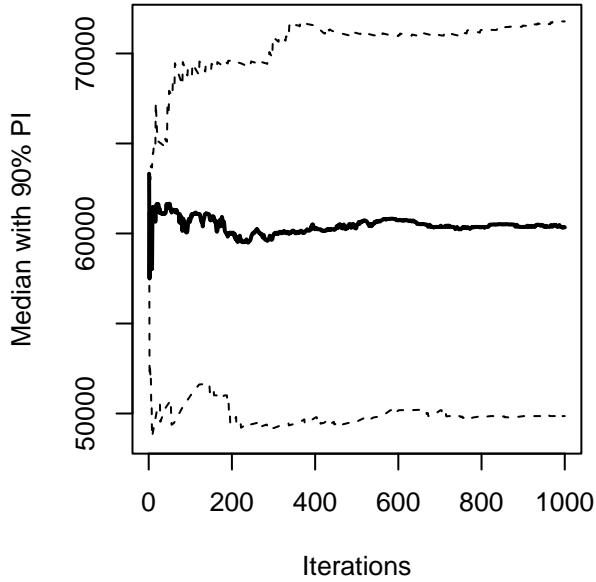


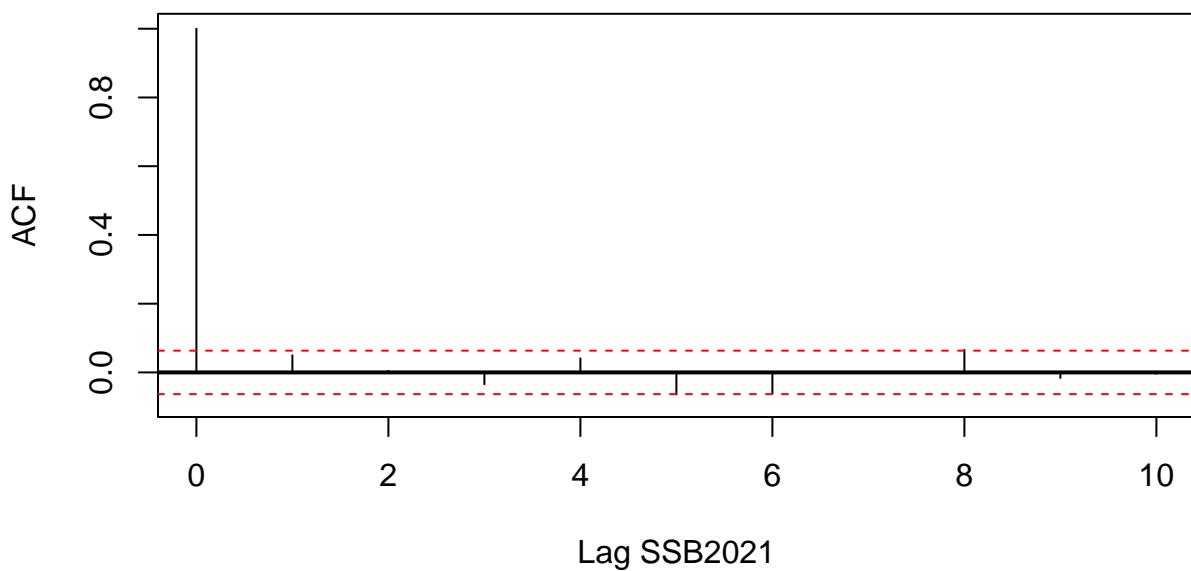
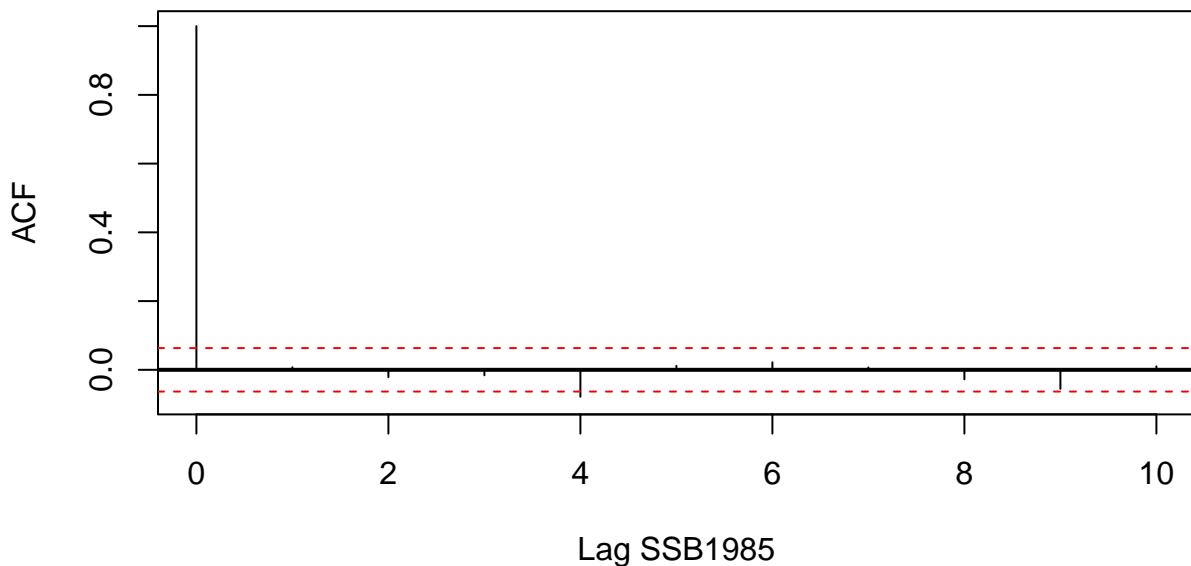
Freport1985

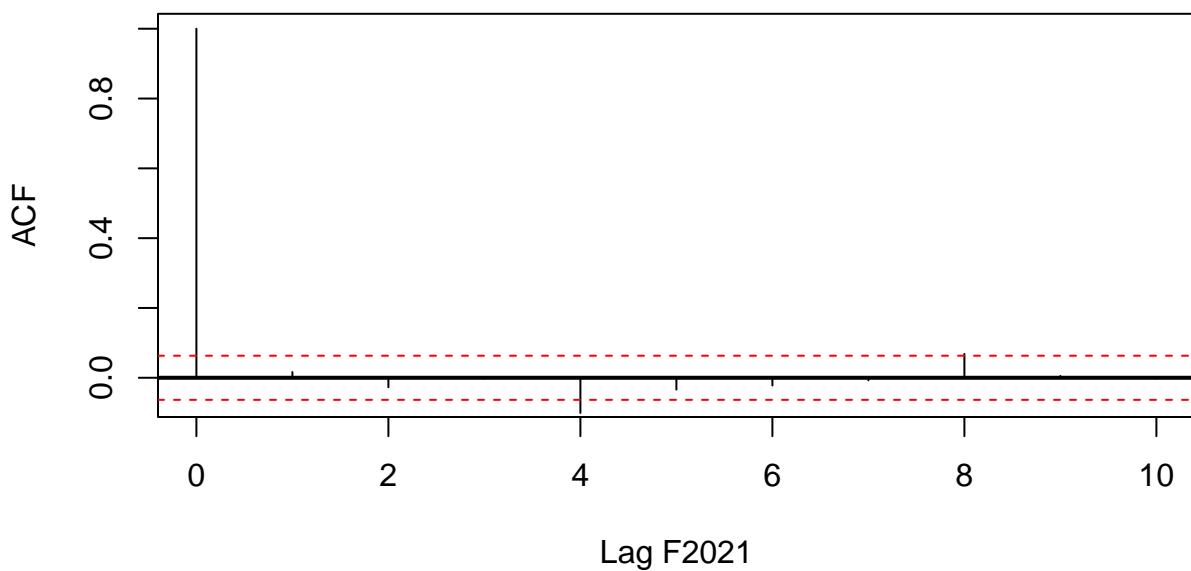
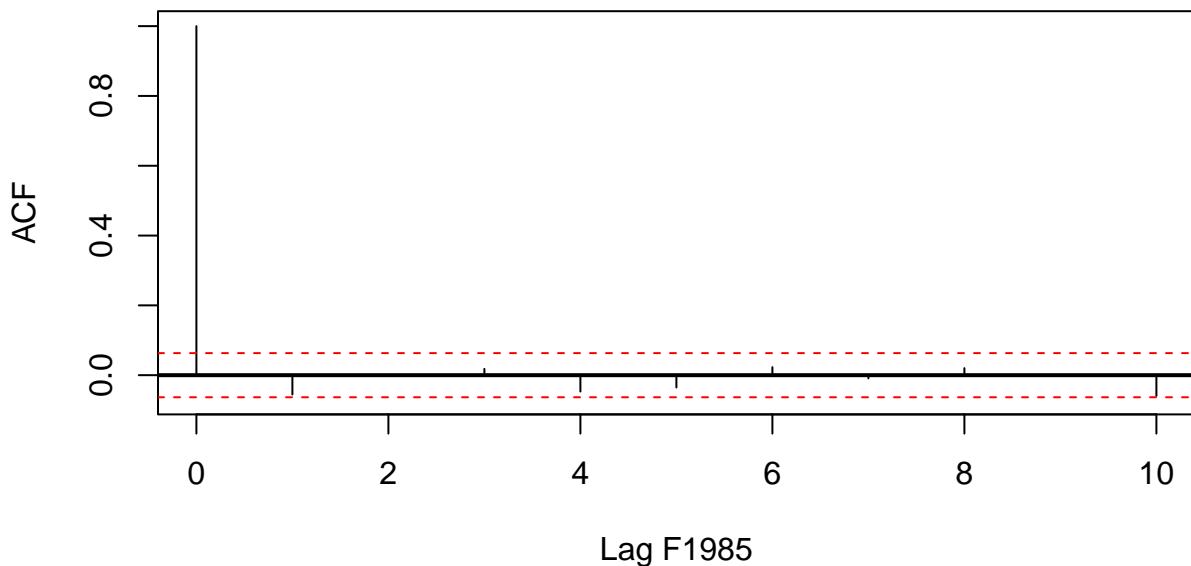


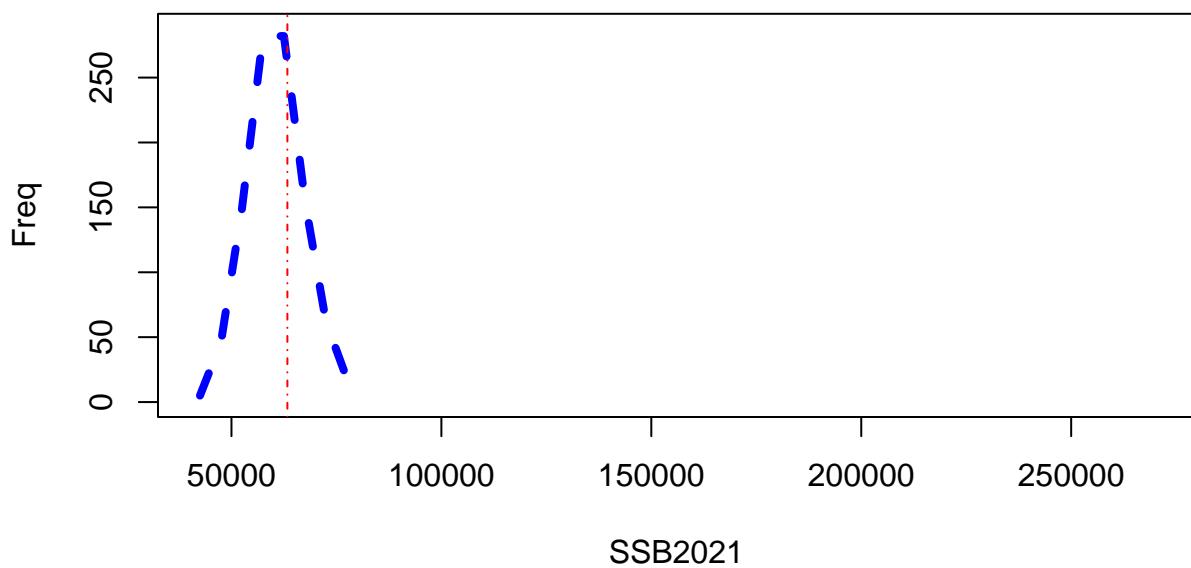
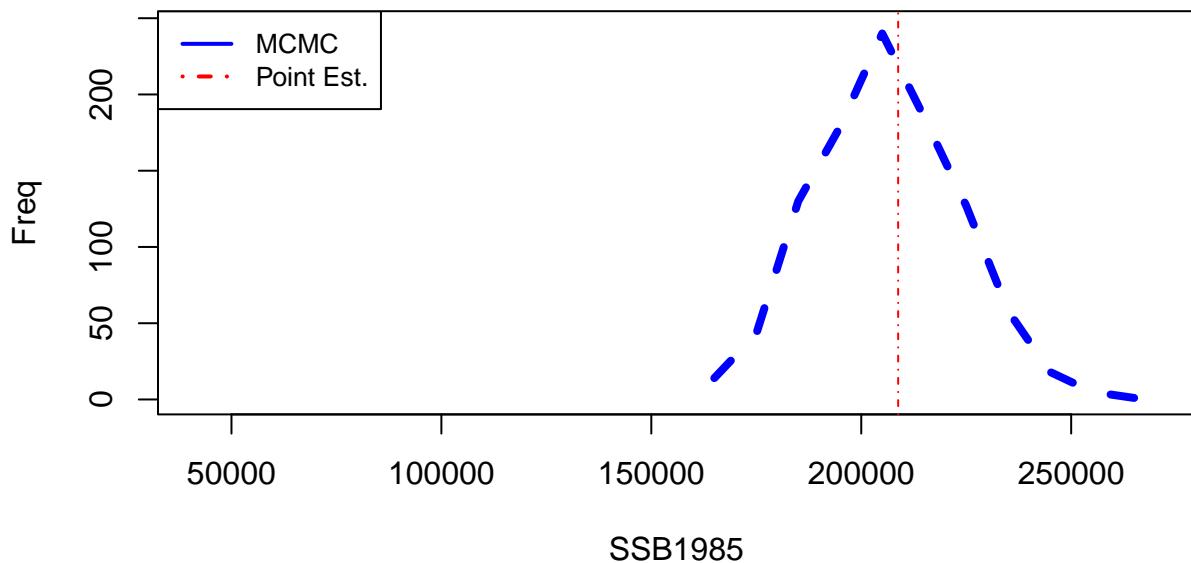
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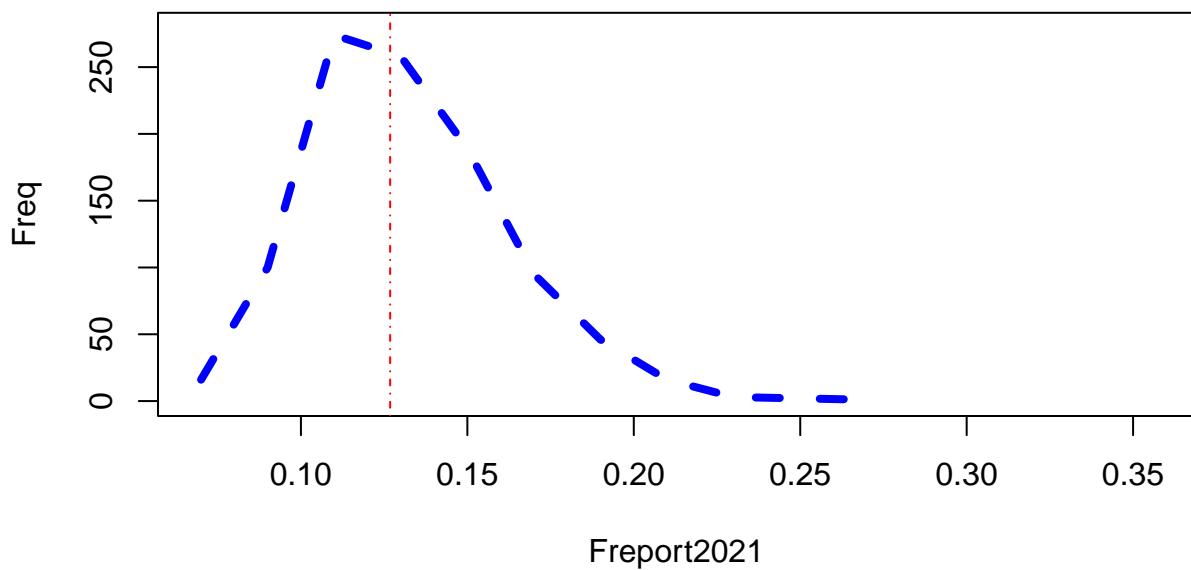
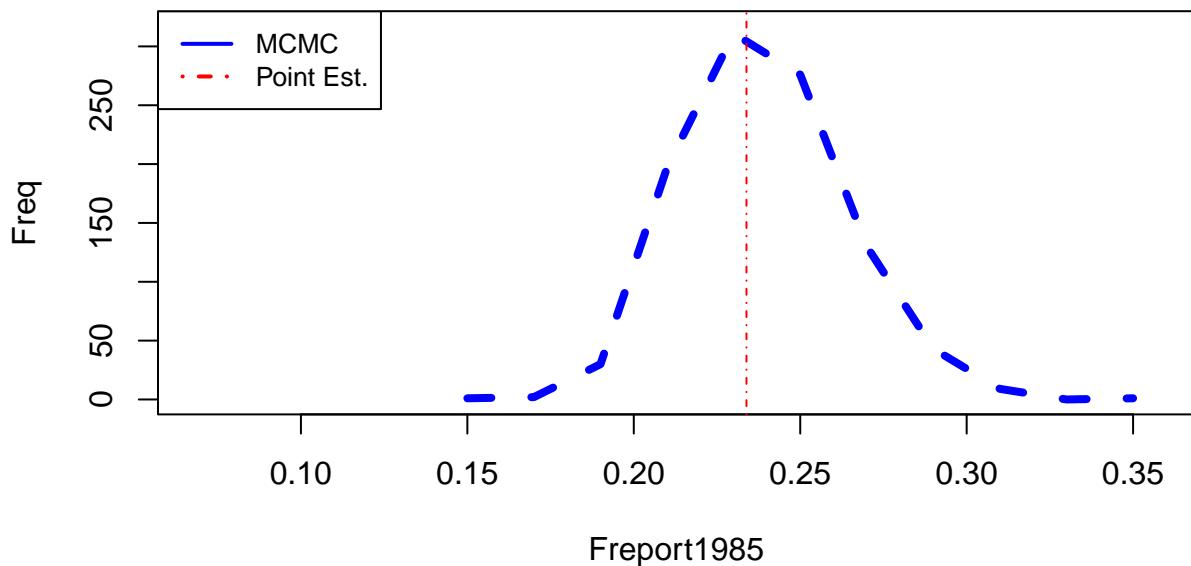


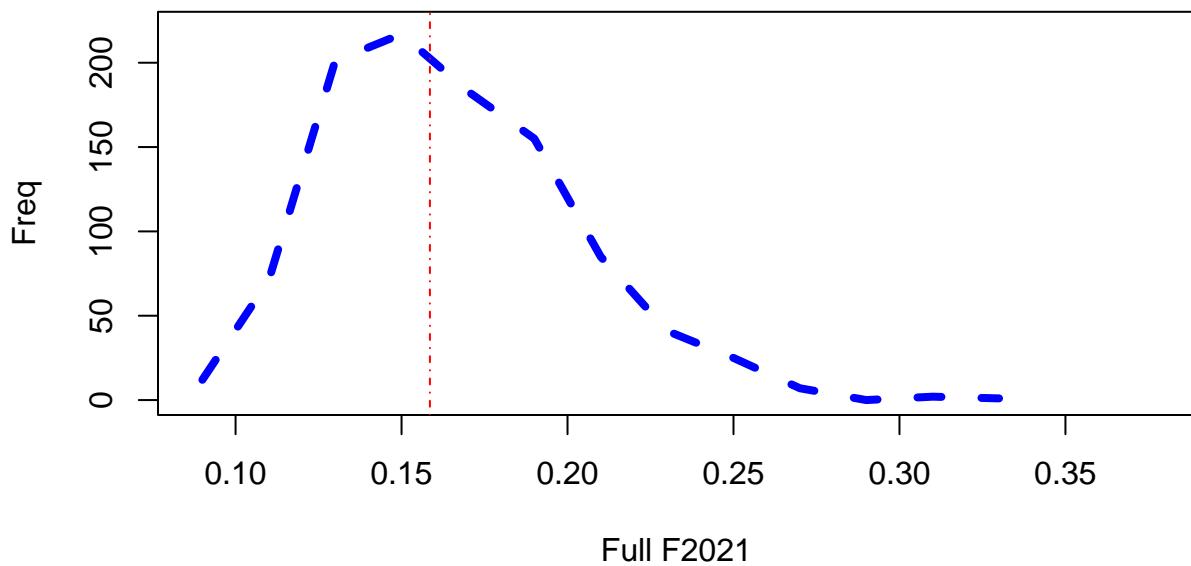
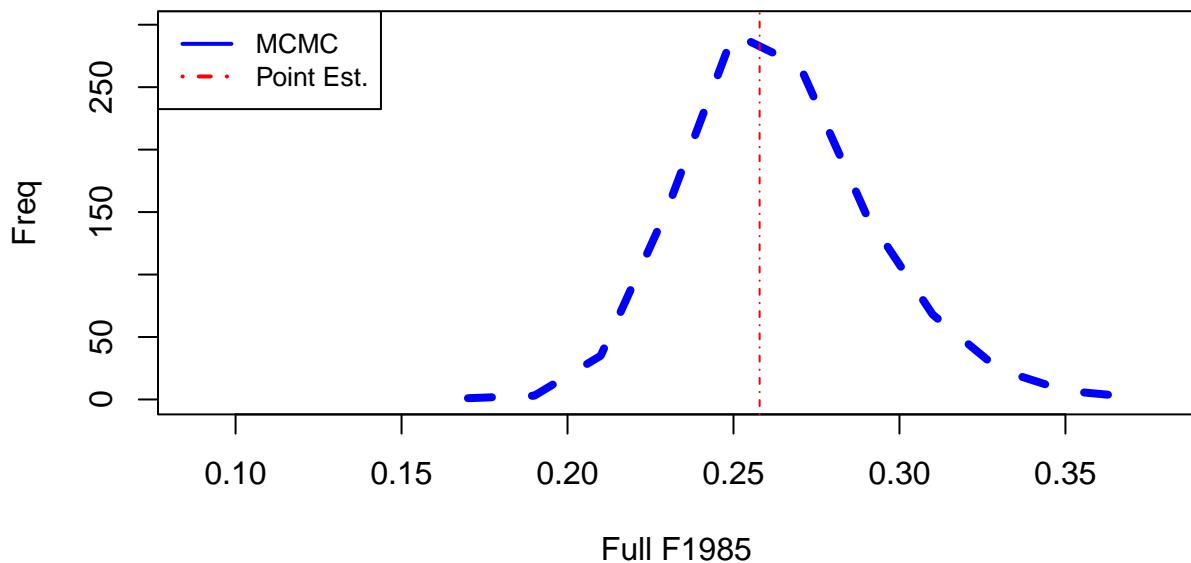
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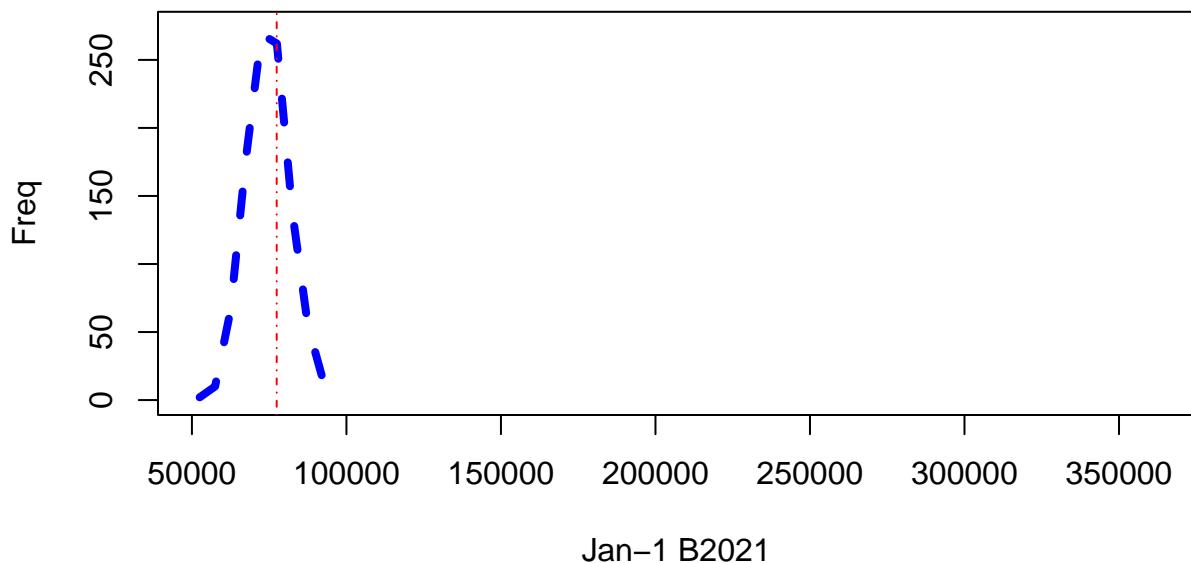
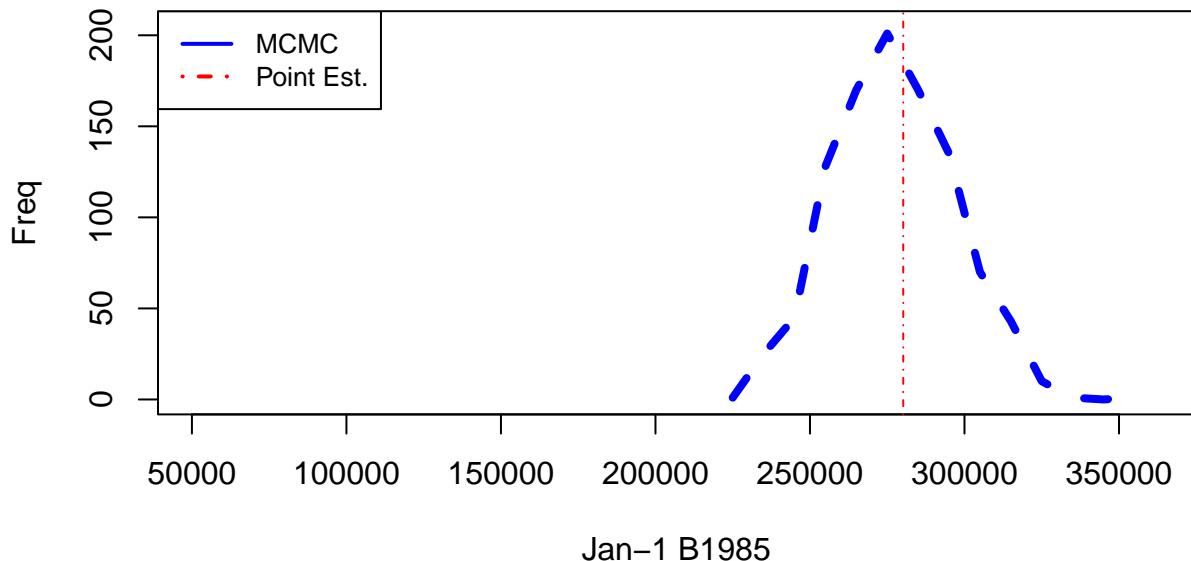


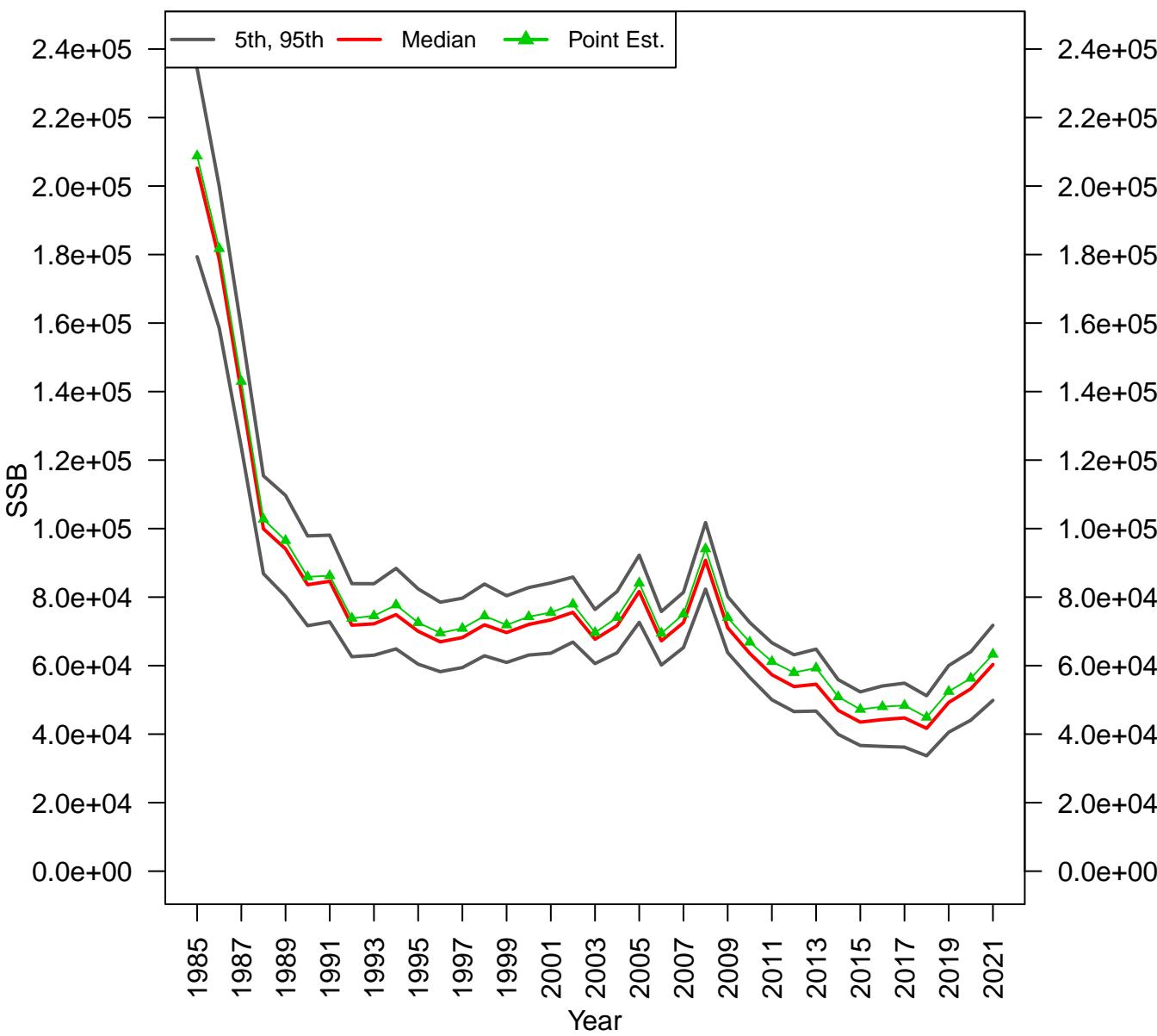


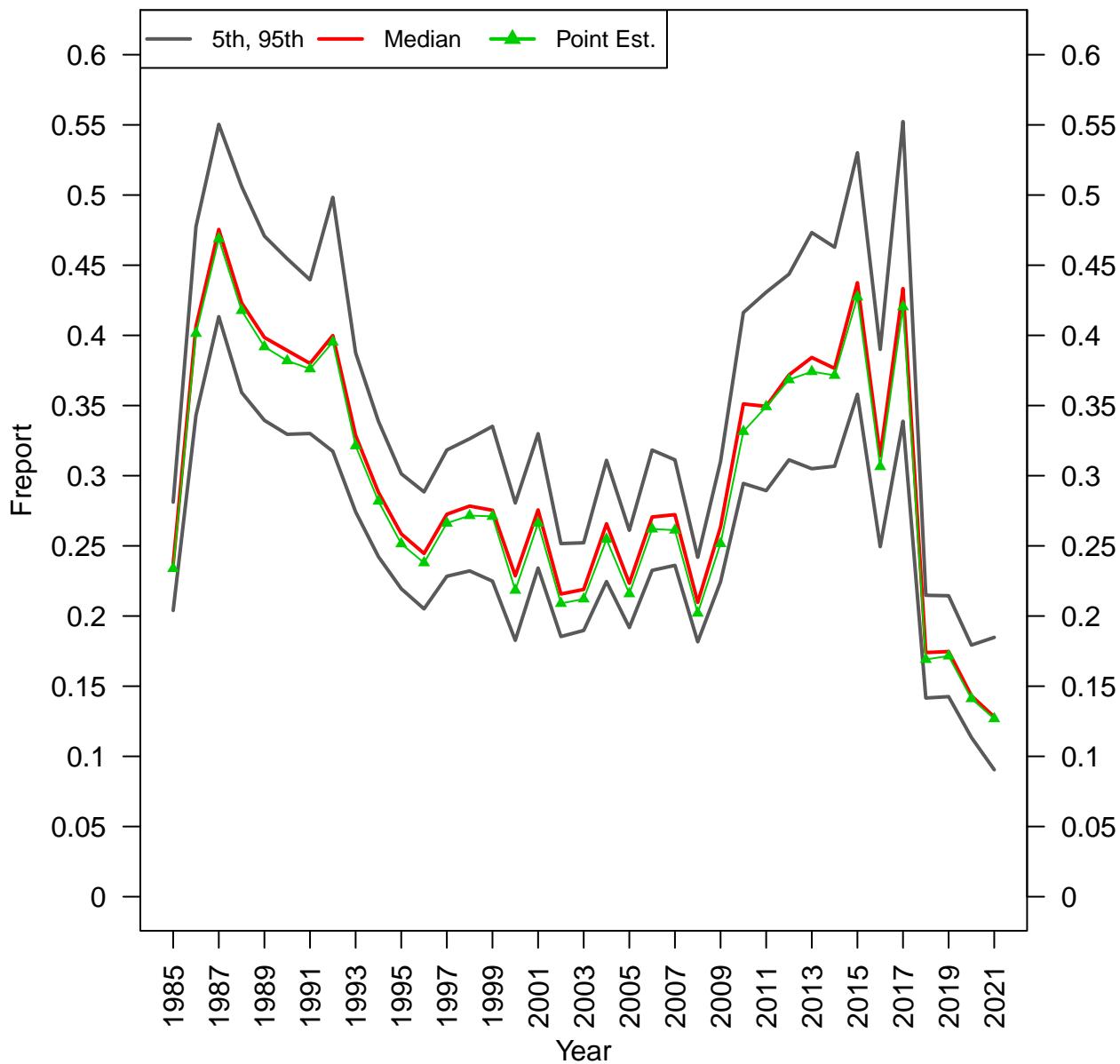


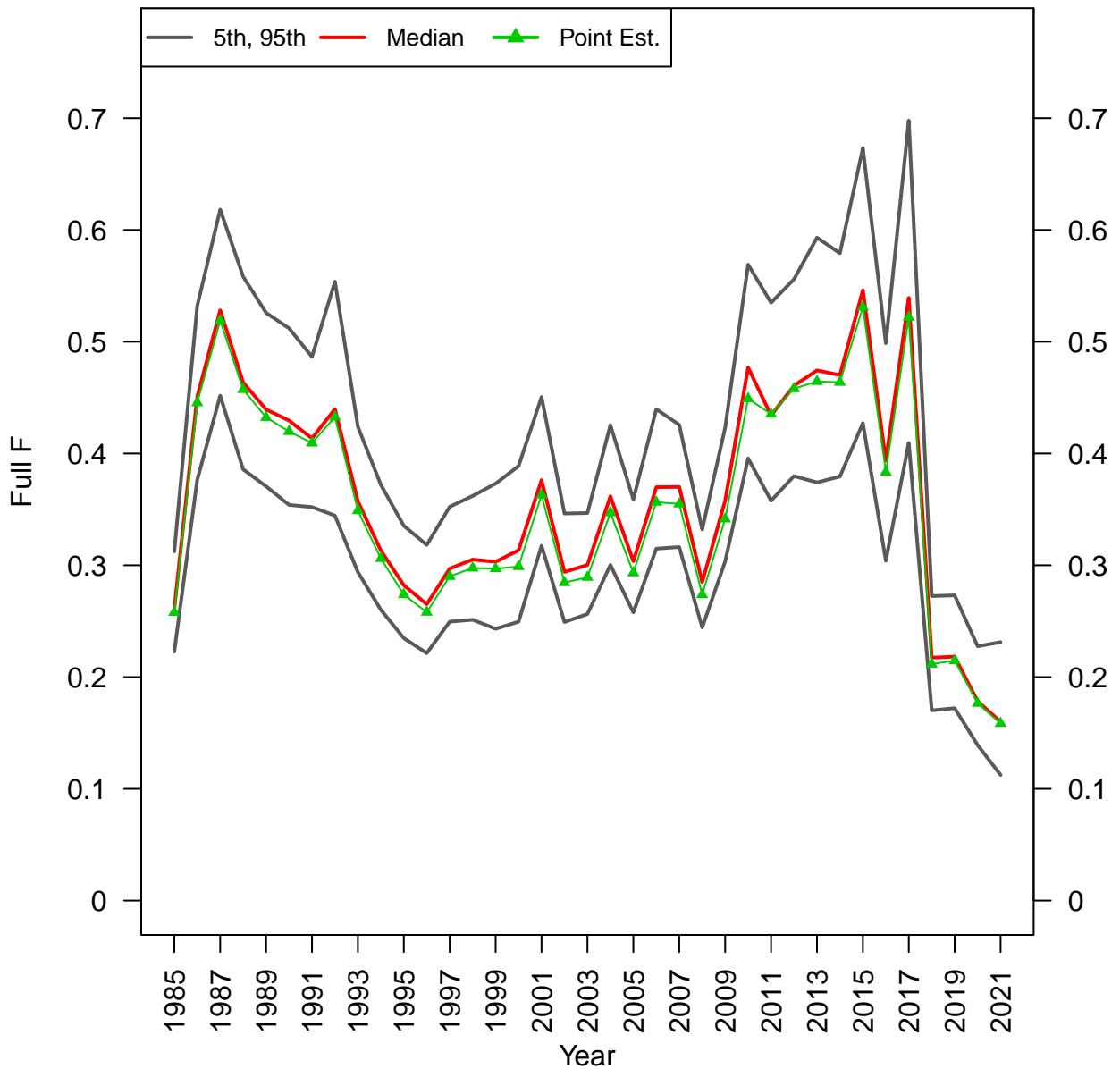


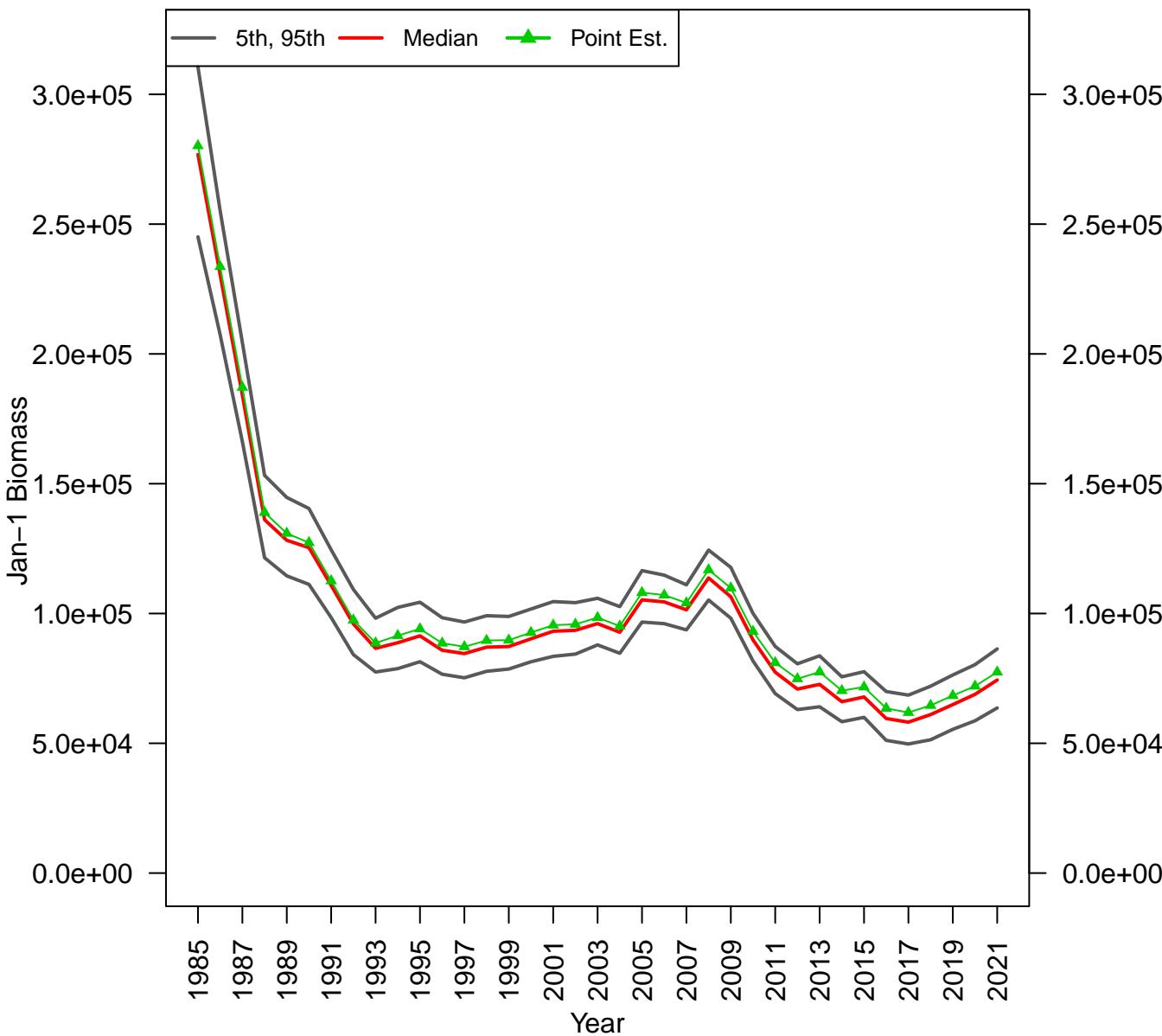










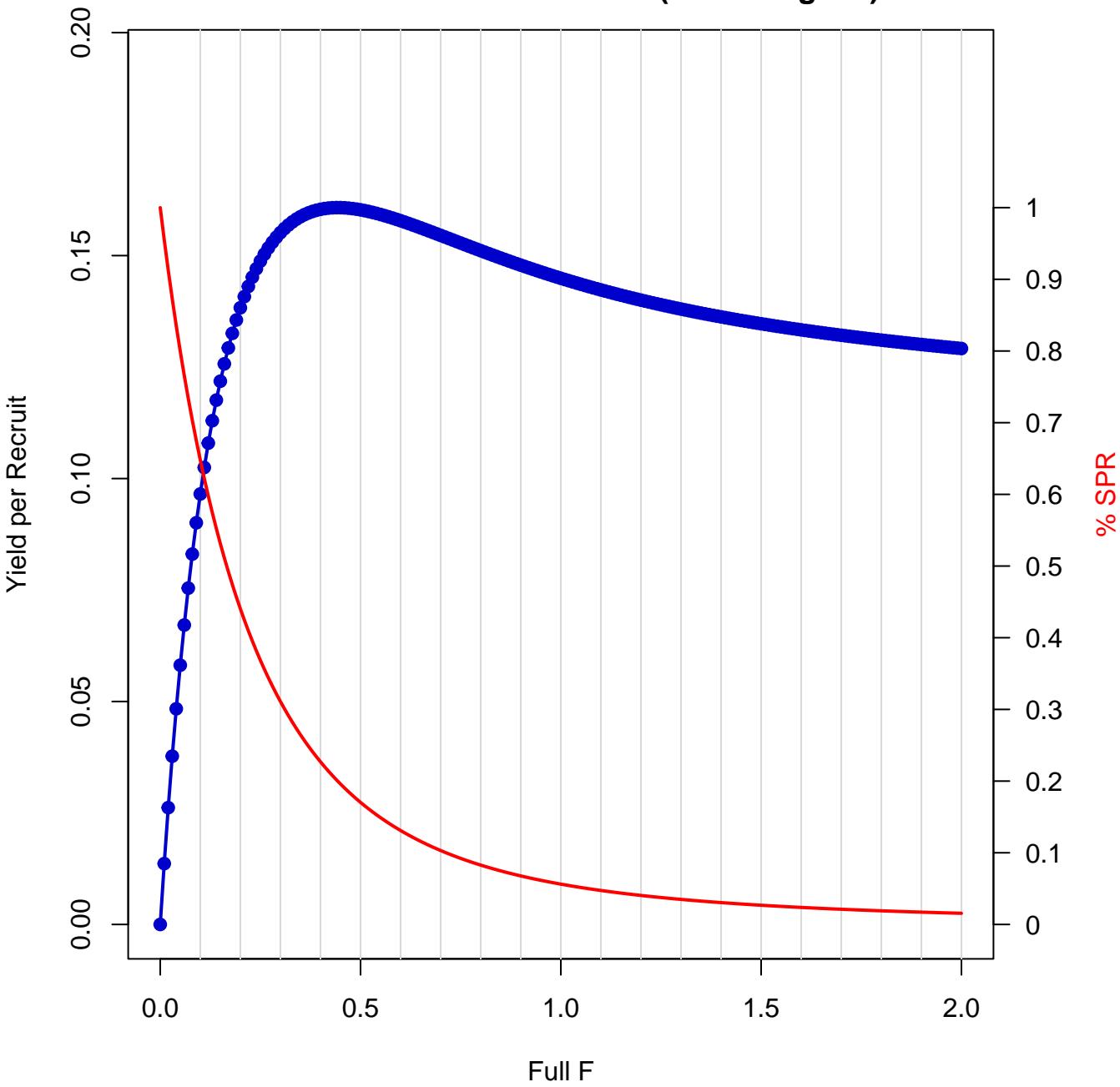


# BF24

Final ASAP model

## REFERENCE POINT PLOTS

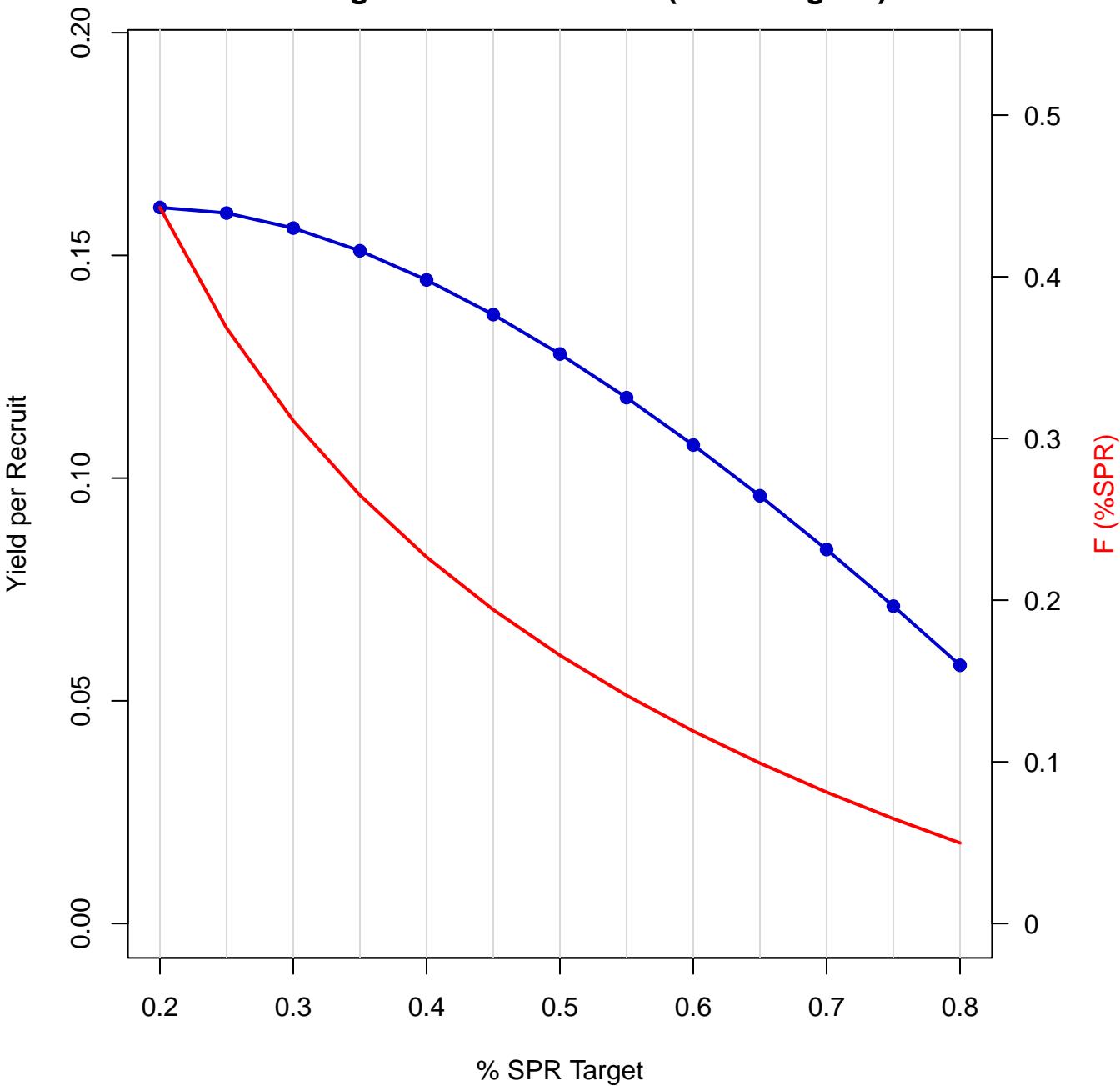
# YPR-SPR Reference Points (Years Avg = 5)



# YPR-SPR Reference Points (Years Avg = 5)

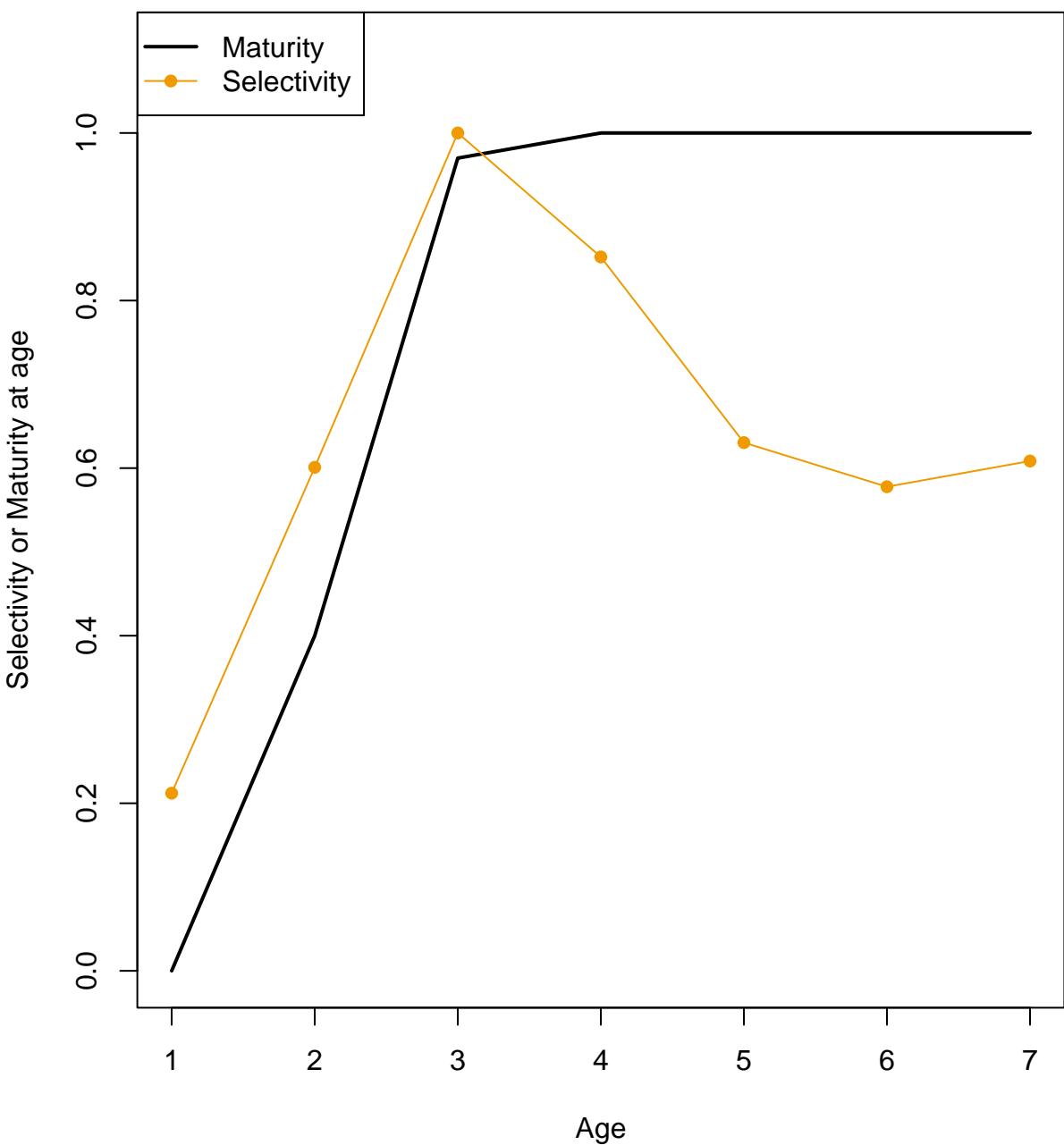
F	YPR	SPR	F	YPR	SPR	F	YPR	SPR
0	0	1	0.35	0.1587	0.2647	0.7	0.1545	0.1031
0.01	0.0136	0.9551	0.36	0.1592	0.2565	0.71	0.1542	0.1008
0.02	0.0262	0.9127	0.37	0.1596	0.2487	0.72	0.1538	0.0985
0.03	0.0377	0.8728	0.38	0.1599	0.2411	0.73	0.1535	0.0964
0.04	0.0484	0.8351	0.39	0.1602	0.2339	0.74	0.1532	0.0942
0.05	0.0581	0.7994	0.4	0.1604	0.2269	0.75	0.1528	0.0922
0.06	0.0671	0.7657	0.41	0.1605	0.2202	0.76	0.1525	0.0902
0.07	0.0754	0.7338	0.42	0.1607	0.2138	0.77	0.1521	0.0883
0.08	0.0831	0.7036	0.43	0.1607	0.2076	0.78	0.1518	0.0864
0.09	0.0901	0.675	0.44	0.1608	0.2017	0.79	0.1514	0.0846
0.1	0.0965	0.6479	0.45	0.1607	0.1959	0.8	0.1511	0.0828
0.11	0.1025	0.6221	0.46	0.1607	0.1904	0.81	0.1508	0.0811
0.12	0.1079	0.5977	0.47	0.1606	0.1851	0.82	0.1504	0.0794
0.13	0.1113	0.5744	0.48	0.1605	0.18	0.83	0.1501	0.0778
0.14	0.1176	0.5523	0.49	0.1604	0.1751	0.84	0.1498	0.0762
0.15	0.1218	0.5313	0.5	0.1603	0.1703	0.85	0.1494	0.0747
0.16	0.1257	0.5113	0.51	0.1601	0.1657	0.86	0.1491	0.0732
0.17	0.1293	0.4923	0.52	0.1599	0.1613	0.87	0.1488	0.0718
0.18	0.1326	0.4742	0.53	0.1597	0.157	0.88	0.1485	0.0704
0.19	0.1356	0.4569	0.54	0.1595	0.1529	0.89	0.1482	0.069
0.2	0.1383	0.4404	0.55	0.1592	0.1489	0.9	0.1479	0.0677
0.21	0.1408	0.4246	0.56	0.159	0.1451	0.91	0.1475	0.0664
0.22	0.1431	0.4096	0.57	0.1587	0.1414	0.92	0.1472	0.0652
0.23	0.1452	0.3953	0.58	0.1584	0.1378	0.93	0.1469	0.0639
0.24	0.1471	0.3816	0.59	0.1581	0.1344	0.94	0.1466	0.0628
0.25	0.1488	0.3685	0.6	0.1578	0.131	0.95	0.1463	0.0616
0.26	0.1503	0.356	0.61	0.1575	0.1278	0.96	0.1461	0.0605
0.27	0.1517	0.344	0.62	0.1572	0.1247	0.97	0.1458	0.0594
0.28	0.153	0.3325	0.63	0.1569	0.1217	0.98	0.1455	0.0583
0.29	0.1541	0.3216	0.64	0.1566	0.1188	0.99	0.1452	0.0573
0.3	0.1551	0.3111	0.65	0.1562	0.1159	1	0.1449	0.0563
0.31	0.156	0.301	0.66	0.1559	0.1132	1.01	0.1446	0.0553
0.32	0.1568	0.2913	0.67	0.1556	0.1106	1.02	0.1444	0.0543
0.33	0.1576	0.2821	0.68	0.1552	0.108	1.03	0.1441	0.0534
0.34	0.1582	0.2732	0.69	0.1549	0.1055	1.04	0.1438	0.0525

## SPR Target Reference Points (Years Avg = 5)

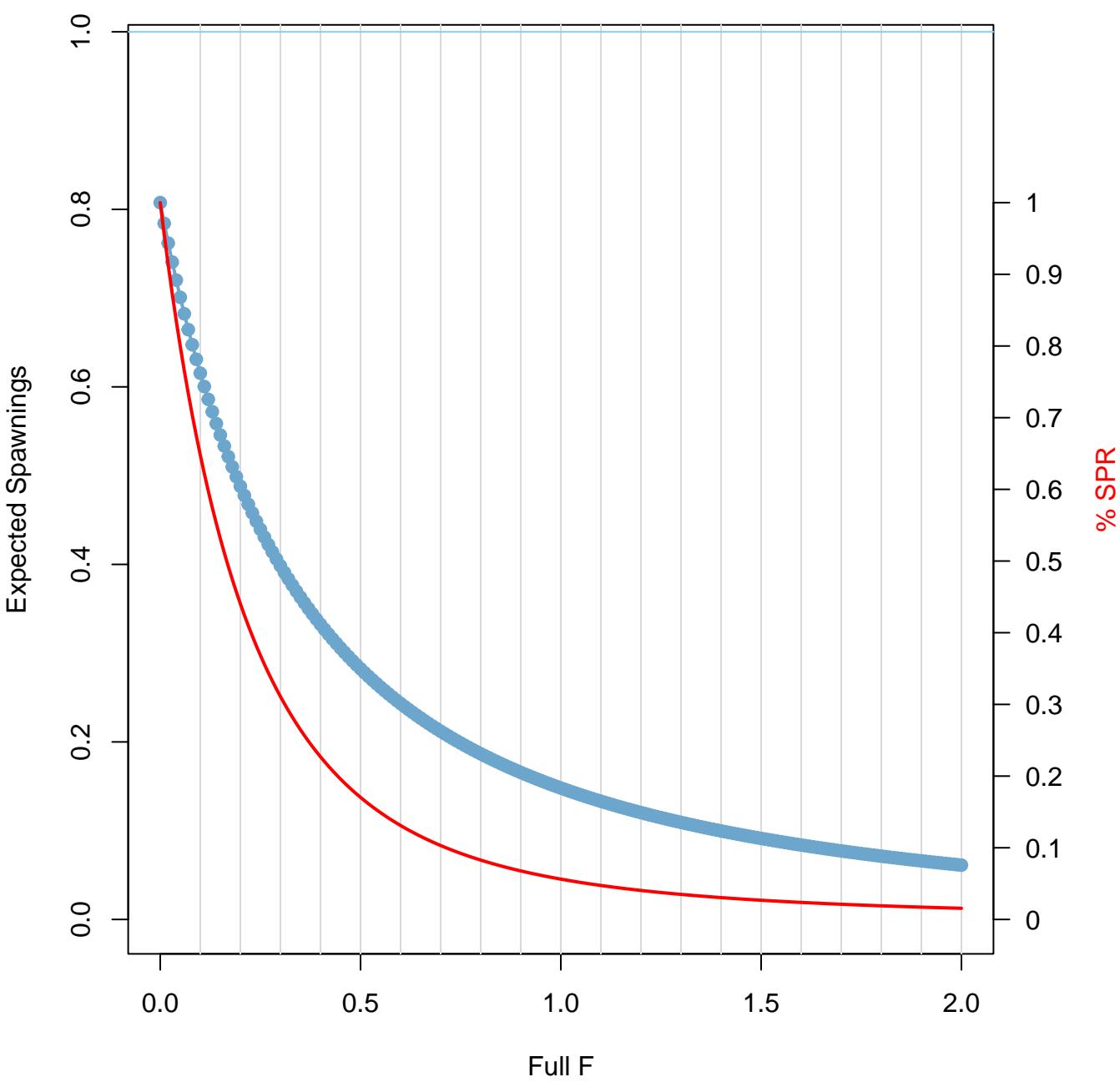


## SPR Target Reference Points (Years Avg = 5)

% SPR	F(%SPR)	YPR
0.2	0.4429	0.1608
0.25	0.3683	0.1595
0.3	0.311	0.1561
0.35	0.2649	0.151
0.4	0.2267	0.1445
0.45	0.1941	0.1367
0.5	0.1659	0.1279
0.55	0.1411	0.1181
0.6	0.119	0.1074
0.65	0.0992	0.096
0.7	0.0812	0.084
0.75	0.0649	0.0713
0.8	0.0498	0.058



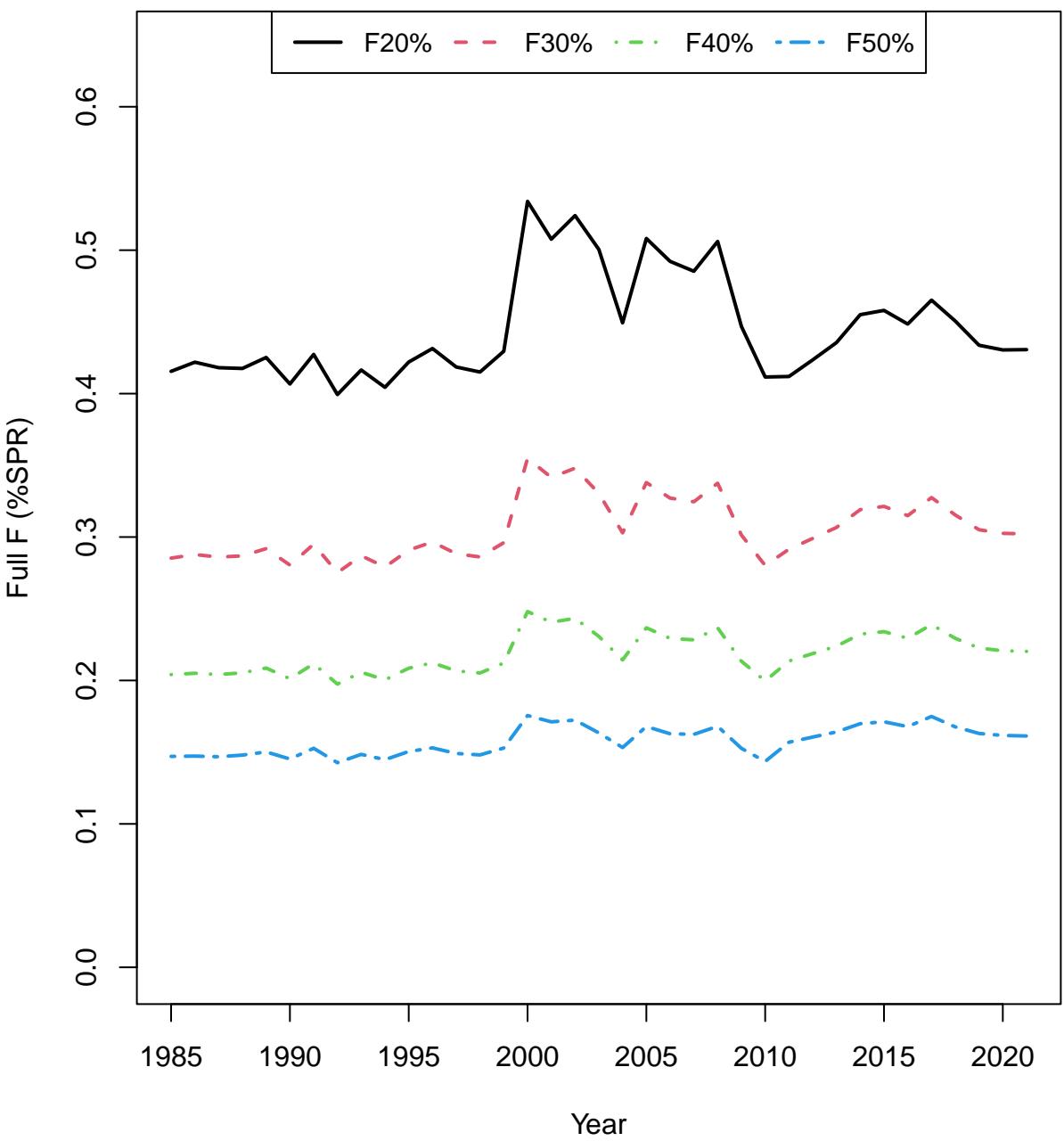
# Expected Spawnings and SPR Reference Points (Years Avg = 5)



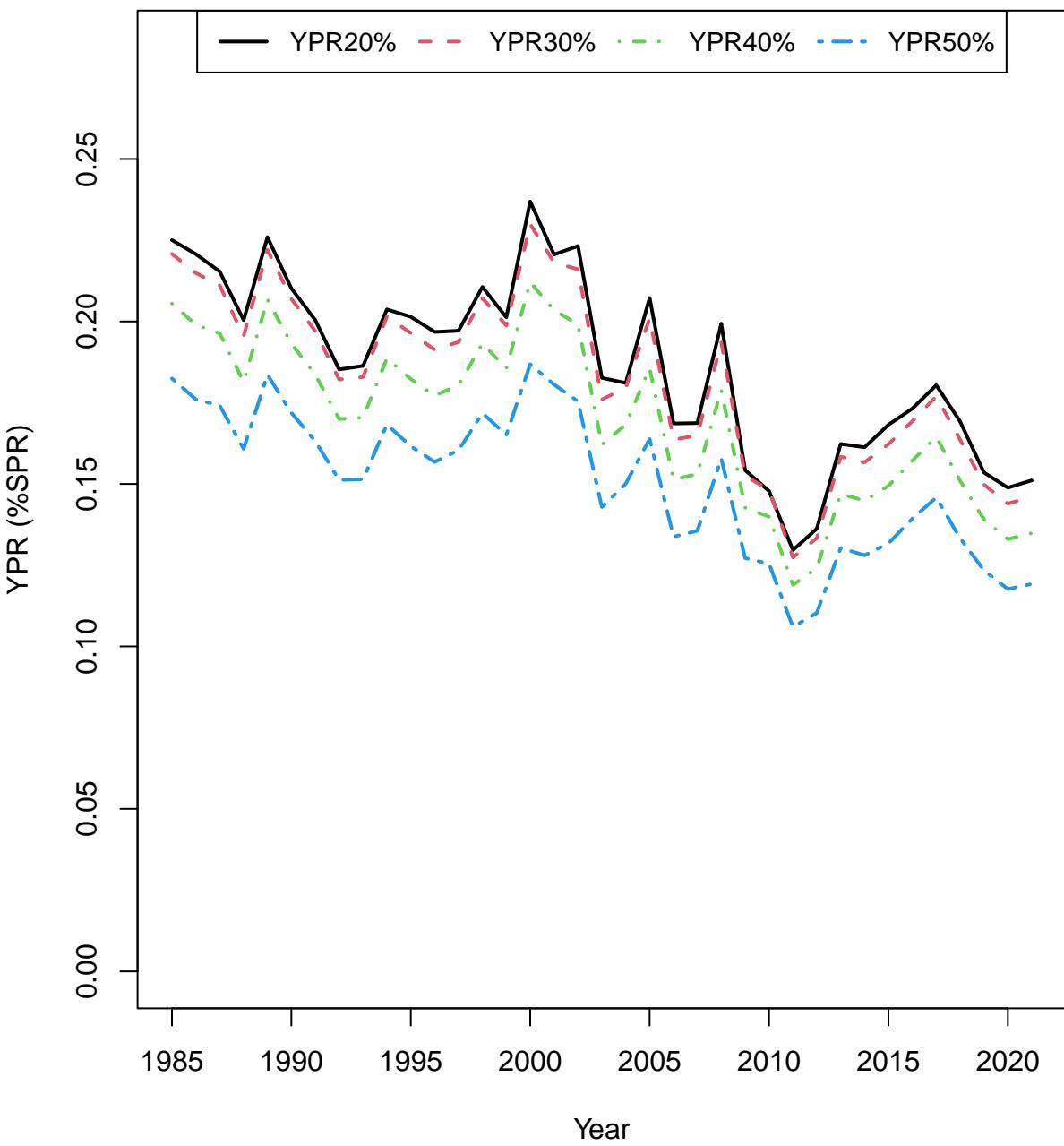
# Expected Spawnings & SPR Reference Points (Years Avg = 5)

F	E[Sp]	SPR	F	E[Sp]	SPR	F	E[Sp]	SPR
0	0.8076	1	0.35	0.363	0.2647	0.7	0.212	0.1031
0.01	0.7842	0.9551	0.36	0.3566	0.2565	0.71	0.2093	0.1008
0.02	0.7619	0.9127	0.37	0.3503	0.2487	0.72	0.2065	0.0985
0.03	0.7406	0.8728	0.38	0.3442	0.2411	0.73	0.2039	0.0964
0.04	0.7203	0.8351	0.39	0.3383	0.2339	0.74	0.2013	0.0942
0.05	0.7009	0.7994	0.4	0.3325	0.2269	0.75	0.1987	0.0922
0.06	0.6823	0.7657	0.41	0.3269	0.2202	0.76	0.1962	0.0902
0.07	0.6645	0.7338	0.42	0.3214	0.2138	0.77	0.1937	0.0883
0.08	0.6475	0.7036	0.43	0.3161	0.2076	0.78	0.1913	0.0864
0.09	0.6311	0.675	0.44	0.3109	0.2017	0.79	0.189	0.0846
0.1	0.6154	0.6479	0.45	0.3058	0.1959	0.8	0.1866	0.0828
0.11	0.6004	0.6221	0.46	0.3009	0.1904	0.81	0.1844	0.0811
0.12	0.5859	0.5977	0.47	0.2961	0.1851	0.82	0.1821	0.0794
0.13	0.572	0.5744	0.48	0.2914	0.18	0.83	0.1799	0.0778
0.14	0.5586	0.5523	0.49	0.2868	0.1751	0.84	0.1778	0.0762
0.15	0.5458	0.5313	0.5	0.2824	0.1703	0.85	0.1757	0.0747
0.16	0.5334	0.5113	0.51	0.278	0.1657	0.86	0.1736	0.0732
0.17	0.5214	0.4923	0.52	0.2738	0.1613	0.87	0.1715	0.0718
0.18	0.5099	0.4742	0.53	0.2697	0.157	0.88	0.1695	0.0704
0.19	0.4988	0.4569	0.54	0.2656	0.1529	0.89	0.1676	0.069
0.2	0.488	0.4404	0.55	0.2617	0.1489	0.9	0.1656	0.0677
0.21	0.4777	0.4246	0.56	0.2578	0.1451	0.91	0.1637	0.0664
0.22	0.4676	0.4096	0.57	0.2541	0.1414	0.92	0.1619	0.0652
0.23	0.458	0.3953	0.58	0.2504	0.1378	0.93	0.16	0.0639
0.24	0.4486	0.3816	0.59	0.2468	0.1344	0.94	0.1582	0.0628
0.25	0.4395	0.3685	0.6	0.2433	0.131	0.95	0.1565	0.0616
0.26	0.4308	0.356	0.61	0.2398	0.1278	0.96	0.1547	0.0605
0.27	0.4223	0.344	0.62	0.2365	0.1247	0.97	0.153	0.0594
0.28	0.4141	0.3325	0.63	0.2332	0.1217	0.98	0.1513	0.0583
0.29	0.4061	0.3216	0.64	0.23	0.1188	0.99	0.1497	0.0573
0.3	0.3984	0.3111	0.65	0.2268	0.1159	1	0.1481	0.0563
0.31	0.3909	0.301	0.66	0.2237	0.1132	1.01	0.1465	0.0553
0.32	0.3836	0.2913	0.67	0.2207	0.1106	1.02	0.1449	0.0543
0.33	0.3765	0.2821	0.68	0.2178	0.108	1.03	0.1433	0.0534
0.34	0.3697	0.2732	0.69	0.2149	0.1055	1.04	0.1418	0.0525

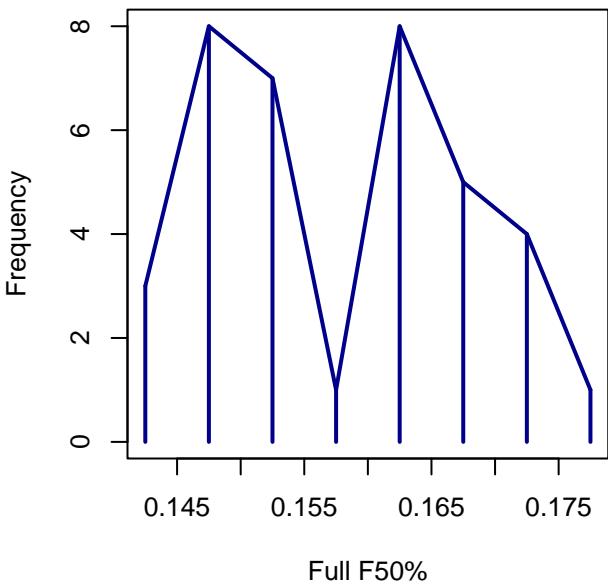
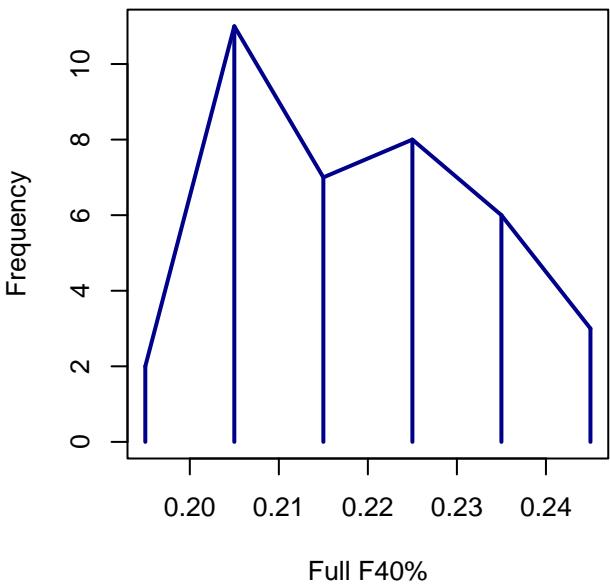
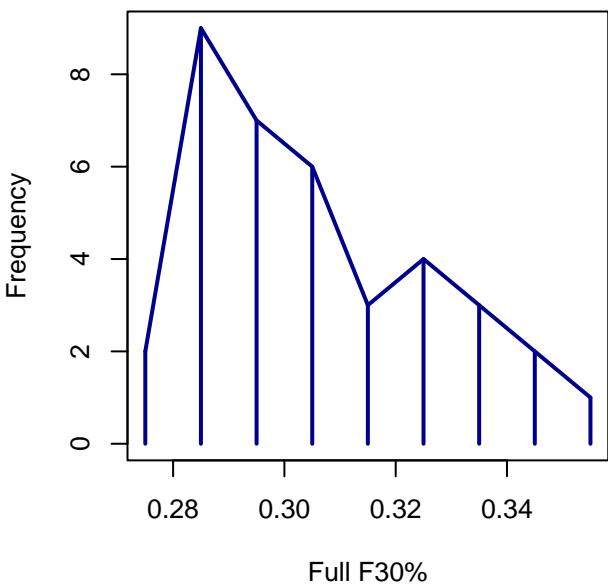
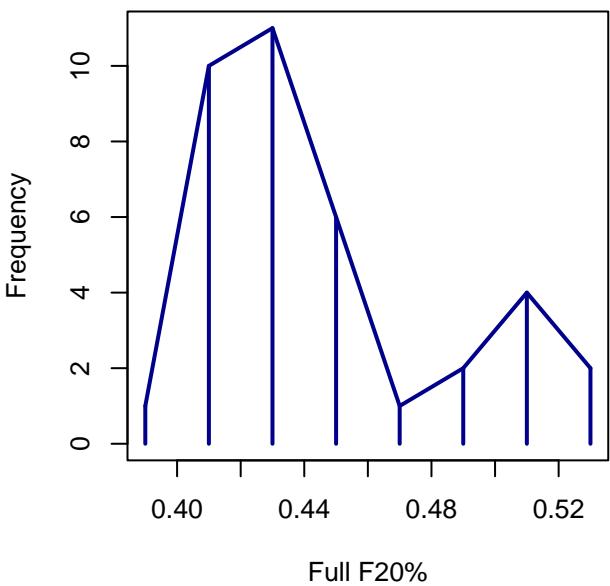
## Annual F(%SPR) Reference Points



# Annual YPR(%SPR) Reference Points



### Annual F (%SPR) Reference Points



### Annual YPR (%SPR) Reference Points

