New England Fishery Management Council
50 WATER STREET | NEWBURYPORT, MASSACHUSETTS 01950 | PHONE 978 465 0492 | FAX 978 465 3116
John Pappalardo, *Chairman* | Paul J. Howard, *Executive Director*

MEMORANDUM

DATE: May 31, 2011

TO: Groundfish Oversight Committee
Science and Statistical Committee

FROM: Augmented Groundfish Plan Development Team (APDT)

SUBJECT: Groundfish ABCs, 2012 -2014

1. On May 18, 2011, the APDT held a conference call to continue work on setting groundfish ABCs for fishing years 2012 -2014. The APDT reviewed and discussed regressions of survey indices to estimates of stock biomass in order identify surveys that appear to give a reliable signal of changes in stock size. Members also discussed criteria for evaluating when the surveys indicate that stock biomass may be different than projected biomass. Finally, an example illustrating the planned analyses to determine the accurately of projections was presented. Participating in the call were Tom Nies and Anne Hawkins (NEFMC), Tom Warren, Melissa Vasquez, and Sara Heil (NMFS NERO), Paul Rago, Mike Palmer, Paul Nitschke (NMFS NEFSC), Chris Legault (NMFS NEFSC/SSC), Steve Cadrin (SMAST/SSC), and Kohl Kanwit (Maine DMR).

Survey/Biomass Regressions

2. As discussed in a previous report, the APDT decided to investigate whether survey indices are a reliable indicator of changes in stock size. If they are, then the surveys can be used to verify stock size as projected from the last assessment. The APDT reviewed regressions of survey indices and biomass for GB cod, GOM cod, GB haddock, GOM haddock, CC/GOM yellowtail flounder, SNE/MA yellowtail flounder, plaice, witch flounder, and white hake (see attachments (a) and (b)). Results of the regressions are summarized in Table 1.

Table 1 – Summary of regression of survey biomass to assessment biomass

Stock	Biomass	Spring	Spring Ln	Autumn	Autumn Ln	MA Spring	MA Spring Ln	MA Autumn	MA Autumn Ln
GB Cod	Jan 1	-0.04	-0.07	-0.08	-0.07				
GB Cod	Mean	-0.09	-0.09	0.01	0				
GB Haddock	Jan 1	0.24	0.44	***0.81***	**0.77**				
GB Haddock	Mean	0.19	0.4	**0.81**	**0.77**				
GOM Cod	Jan 1	0.16	0.06	0.02	0.14				
GOM Cod	Mean	0.11	-0.02	-0.04	0.06				
GOM Haddock	Jan 1	**0.61**	**0.72**	**0.58**	**0.75**				
GOM Haddock	Mean	**0.57**	**0.66**	**0.67**	**0.72**				
SNMEA Yellowtail	Jan 1	**0.64**	**0.61**	**0.6**	**0.59**				
SNMEA Yellowtail	Mean	**0.53**	**0.58**	**0.59**	**0.62**				
CCGOM Yellowtail	Jan 1	0.13	0.17	0.03	0.15	-0.03	0	0.01	0.05
CCGOM Yellowtail	Mean	0.09	0.13	0.11	0.18	-0.04	-0.02	0	0.01
American Plaice	Jan 1	**0.75**	**0.62**	0.45	0.18				
American Plaice	Mean	**0.74**	**0.57**	**0.55**	0.35				
Witch	Jan 1	0.24	0.23	0.33	0.29				
Witch	Mean	0.08	0.05	0.34	0.35				
White Hake	Jan 1	0.34	0.34	0.34	0.32				
White Hake (2)	Jan 1	0.35	0.36	0.36	0.34				

Green boldfaced font means r^2 >= 0.5
Yellow highlight means regression significant (p<= 0.05)
Note: Acadian redfish will be analyzed in a subsequent report

3. Members discussed criteria for determining whether a survey may be giving a reliable signal of changes in stock size. The initial criteria that were agreed to were:

a) The regression coefficient is statistically significant at $\alpha=0.05$;
b) The relationship between survey and stock size is positive

4. Members discussed whether a minimum correlation coefficient should be a third criteria used to evaluate the regressions. As an alternative, criteria that will be examined will be to jackknife the regression analysis for each survey/stock combination, predict the dependent variable for each missing year, and evaluate the frequency that the prediction interval includes the actual data. This should facilitate development of more objective criteria for evaluating whether a regression that meets the first two criteria is a reliable indicator of stock size. It is possible that a significant regression nay not be a reliable indicator of stock size.

5. As shown in Table 1, none of the regressions for either cod stock were significant. Additional steps for these stocks will include:

a) GOM cod will be assessed in December, 2011 (SAW 53), so it seems of little value to pursue the survey approach with a pending assessment. Staff will explore alternative processes that would allow the Council to delay setting the GOM cod ABC until after the assessment is completed.
b) The DFO GB cod survey index will be obtained to see if that regression performs any better.
c) Age-based indices for GB cod will be examined to see if they provide information that may be useful. Unlike other stocks, these indices will be available for the years 2008-2010 because they are used in the TRAC.
d) Eastern GB cod will be assessed at the TRAC in June. While at times there have been diverging trends between the TRAC assessment and the assessment for the entire stock, in the absence of other data this assessment may be an indicator of GB cod stock size.

6. If the APDT concludes that a survey is a reliable indicator of changes in stock size, the next step is determining when the survey stock size is sufficiently different from the projected stock size that the survey estimate is preferred to the projection. The APDT believes that this evaluation should not be based on a single year due to the variability of the surveys.

a) An idea considered by the APDT is that the survey is only considered sufficiently different from the projection results if the appropriate confidence intervals do not overlap. The APDT discussed whether this would lead to less likelihood that adjustments would be made when either the survey regression or the projection is highly uncertain: with wider confidence intervals it is less likely that they will not overlap. The counter interpretation is that the surveys that are the best predictor (that is, have the smallest confidence intervals) are the ones most likely to lead to a change in catch advice.

b) It may be possible to quantify the degree of overlap between the derived survey biomass (S) and projected biomass (P) intervals. The probability of observing S within the confidence interval of P might be computed.

7. Assuming the analyses suggest that the projected biomass is incorrect, the survey estimate could be larger or smaller. An adjustment to catch advice could be made in either case, or only if survey biomass is lower than projected biomass. The APDT asks the SSC for guidance on whether they anticipate increasing catches if the survey suggests stock size is larger than the projected stock size.

8. Some options were identified for adjusting catch advice when the survey biomass differs from the projected biomass:

a) Adjust catch advice from the projection down (or up) by a percentage based on the difference between the survey and projected biomass.

b) If the projection is deemed unreliable, ad hoc approaches might include status quo ABC or catch.

Review of Projection Performance

9. The APDT reviewed an example of the work planned to determine if projections are reliable (see attachment c). Briefly, the example used the 2010 Georges Bank yellowtail flounder assessment as the starting point. A retrospective analysis was conducted to peel back data to 2000 and this assessment was used as the starting point for projections. Five year average weights, selectivity, and maturity along with the recruitment estimated from this assessment were input to AgePro and projections conducted through 2010. The projections set the catches in years 2001 through 2010 equal to the values used in the 2010 assessment. The 80% confidence intervals for the projected SSB from the AgePro results were compared to the SSB point estimates from the 2010 assessment under three different starting conditions: 1) the estimated numbers from the short time series assessment, 2) an adjustment to these starting numbers that represented a well-implemented retrospective adjustment, and 3) the actual numbers at age in 2001 from the 2010 assessment without any uncertainty. The first case SSB projections were all well above the 2010 assessment estimates of SSB due to the starting point being well above the 2010 assessment value in 2001. Both the second and third case performed reasonably well, meaning the confidence intervals overlapped the 2010 assessment SSB values and the medians were similar to the estimated values for 3-4 years, but then the projections diverged to much higher SSB values because the recruitment used in the projections was too high relative to that estimated in the 2010 assessment. In both the second and third case, some of the projection realizations “crashed” because the catch was too high relative to the projected population

abundance even though the medians increased dramatically. Once this system is automated and a large number of stocks and projection starting years are analyzed, it is hoped that some rules of thumb can be developed regarding the number of years which can be projected with reasonable skill and which factors are driving any mismatch issues.

Attachments:

(a) Survey-biomass regressions

(b) Data appendix for survey-biomass regressions

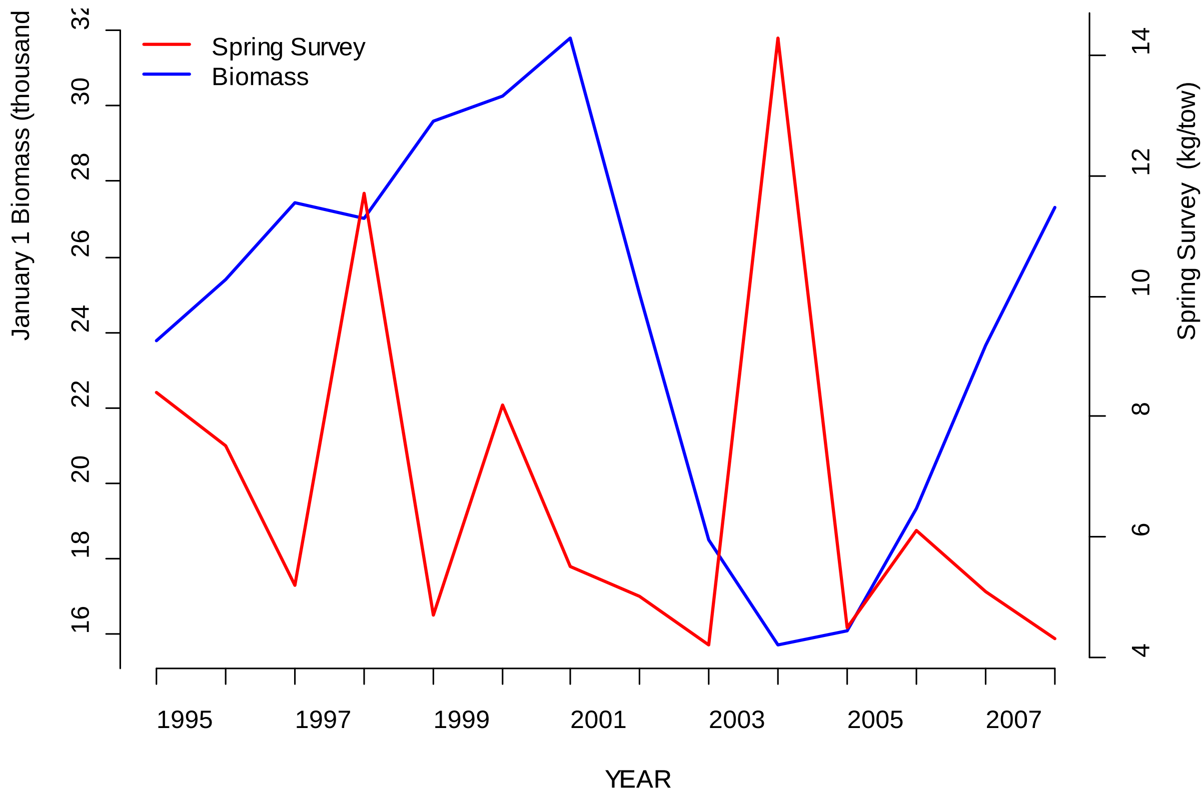
(c) Powerpoint presentation titled “Example Projection Results (preliminary)”

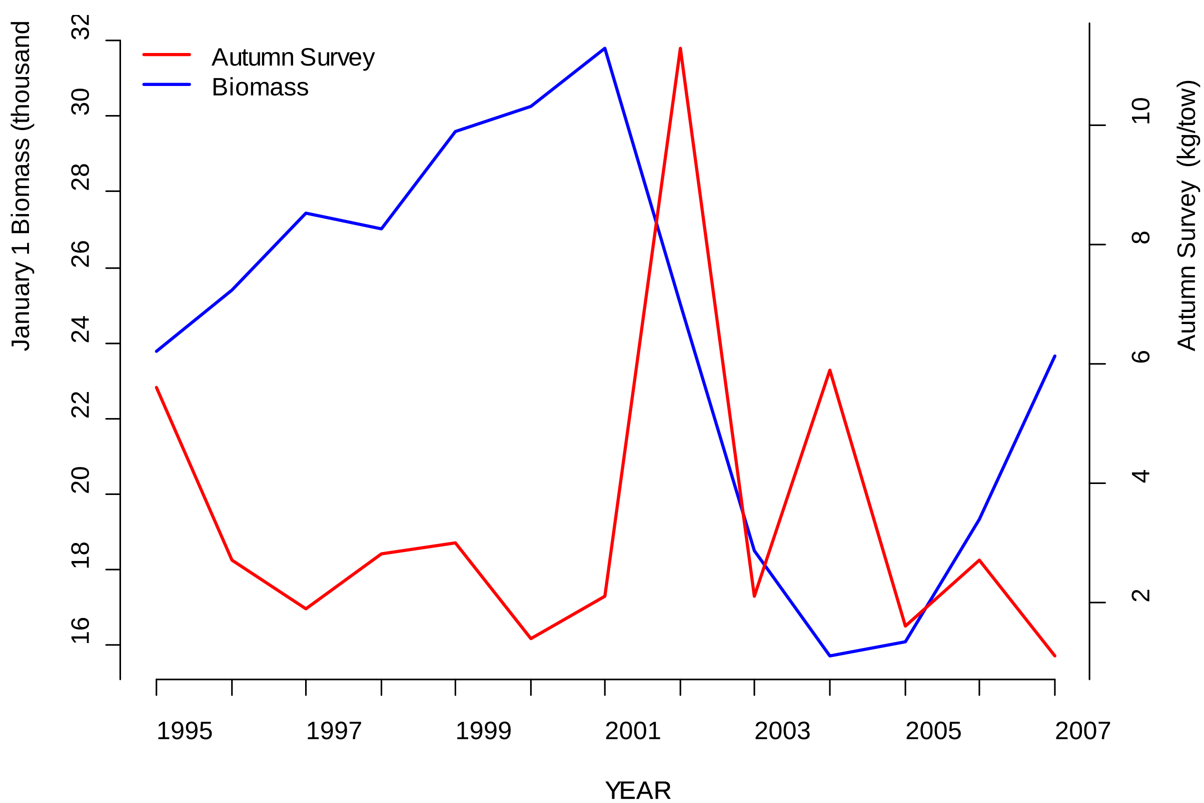
Survey –Biomass Regressions

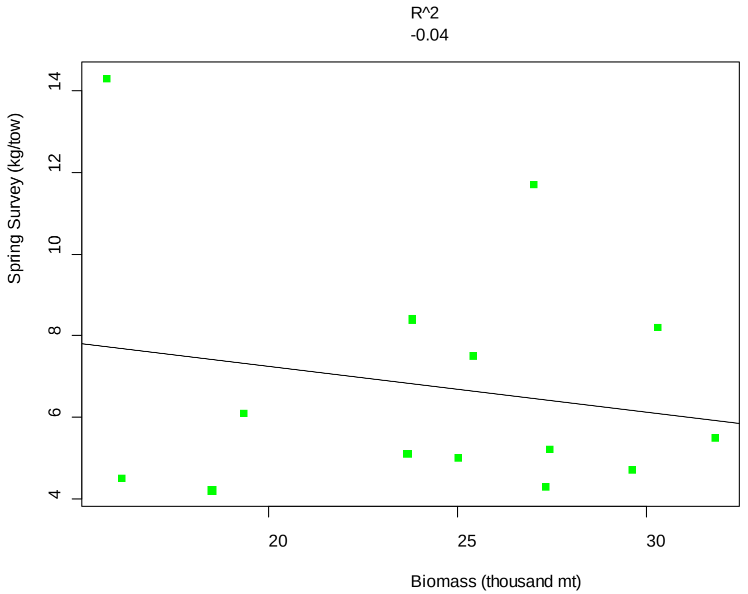
stock	survey split?	survey 1	survey 2
GB cod	SPLIT (between '94 and '95)	NEFSC S&F	DFO
GM cod		NEFSC S&F	
GB haddock		NEFSC S&F	DFO
GM haddock		NEFSC S&F	
SNE yellowtail		NEFSC S&F	
CCGM yellowtail		NEFSC S&F	MADMF S&F
plaice		NEFSC S&F	
witch flounder	SPLIT (between '94 and '95)	NEFSC S&F	
redfish		NEFSC S&F	
white hake		NEFSC S&F	

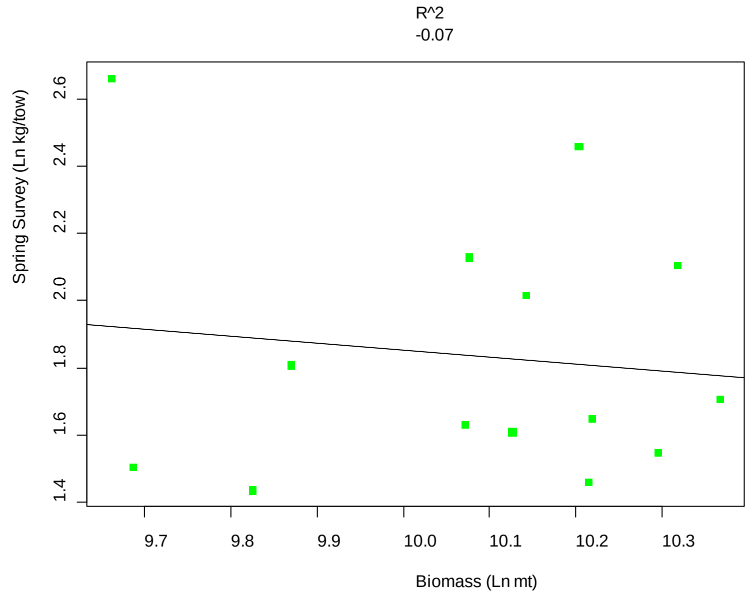
- The appendix has the data for each stock used, regression output and diagnostics.

Georges Bank Cod - January 1 Biomass






R^2
-0.04
Spring Survey (kg/tow)
Biomass (thousand mt)


R^2
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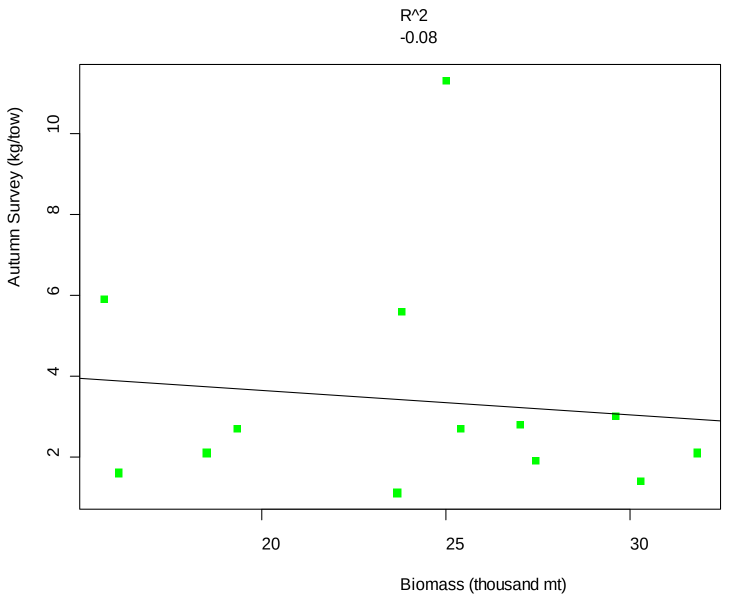
Spring Survey (Ln kg/tow)
Biomass (Ln mt)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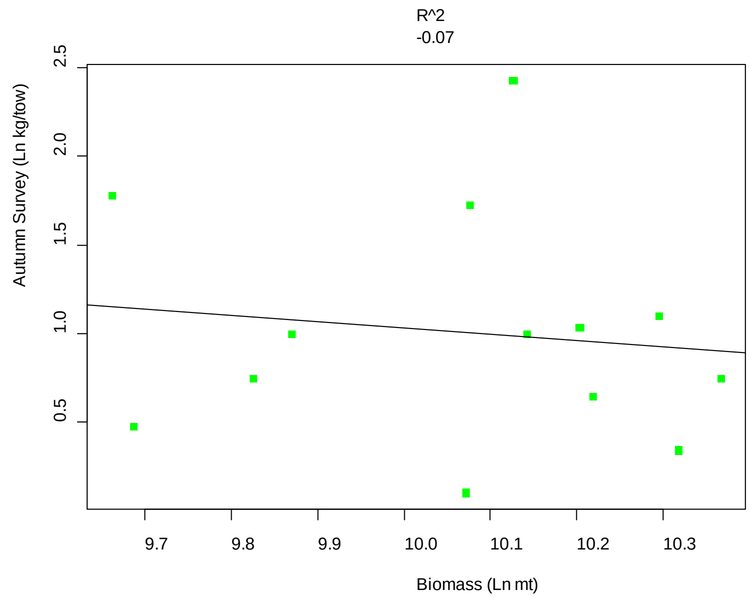
Autumn Survey (kg/tow)
Biomass (thousand mt)


R^2
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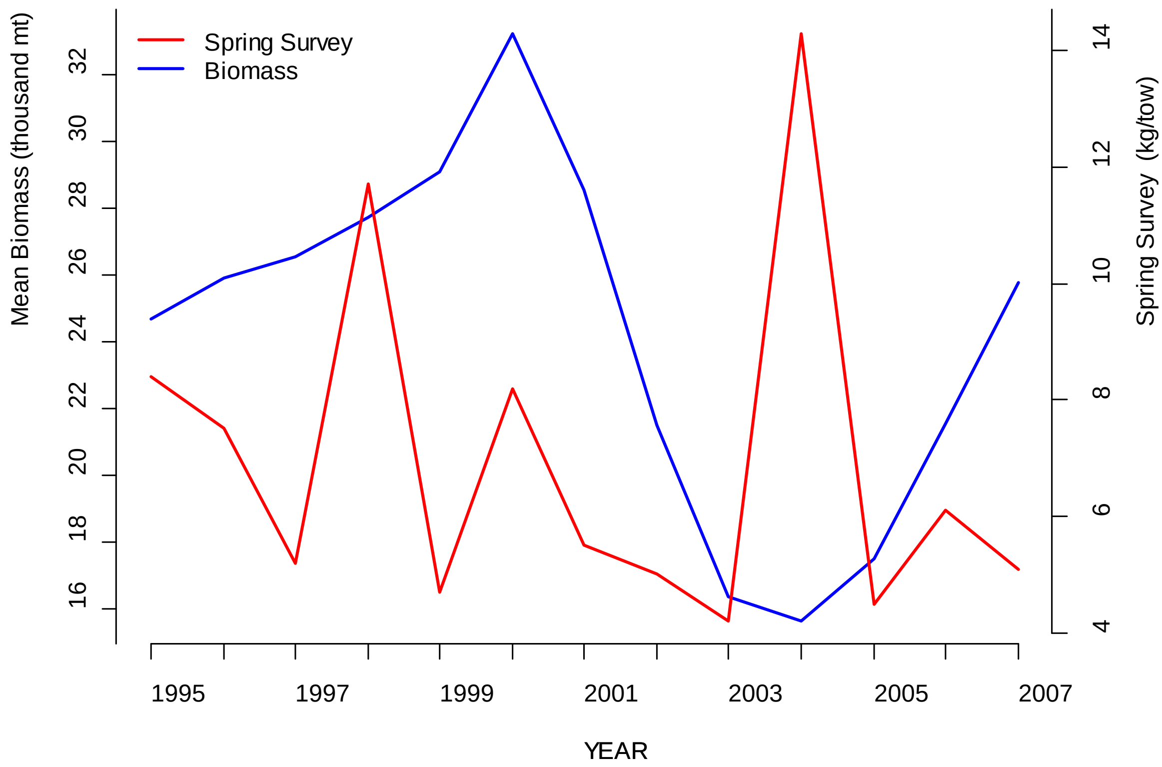
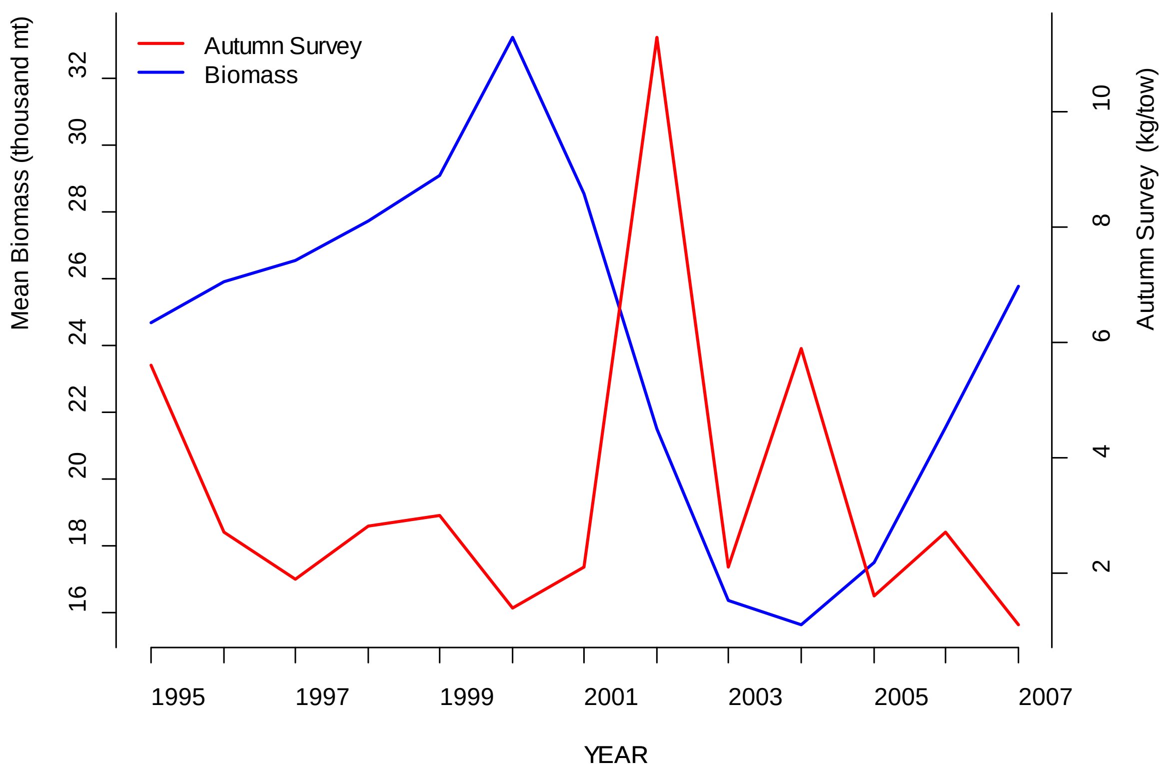
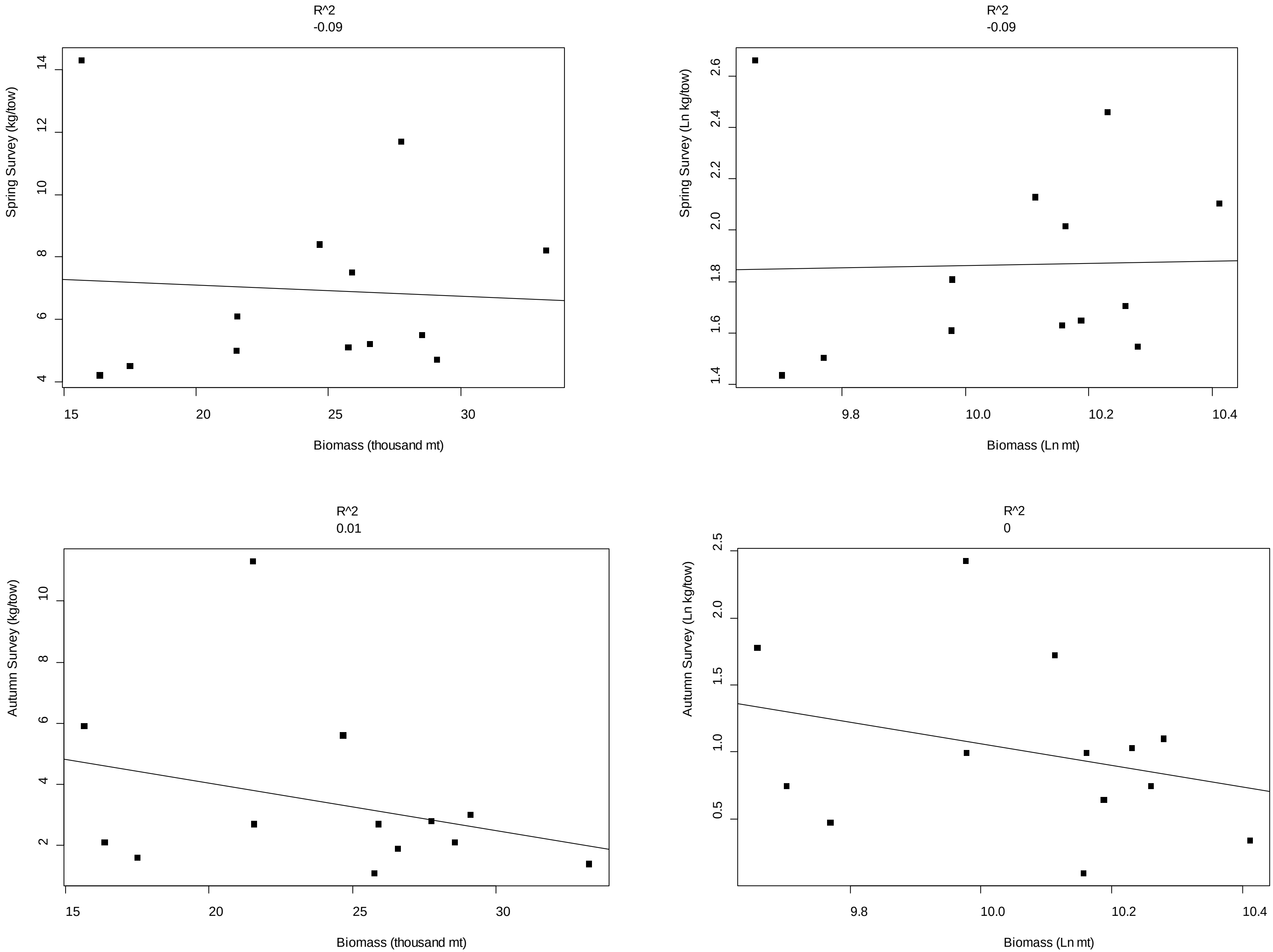
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

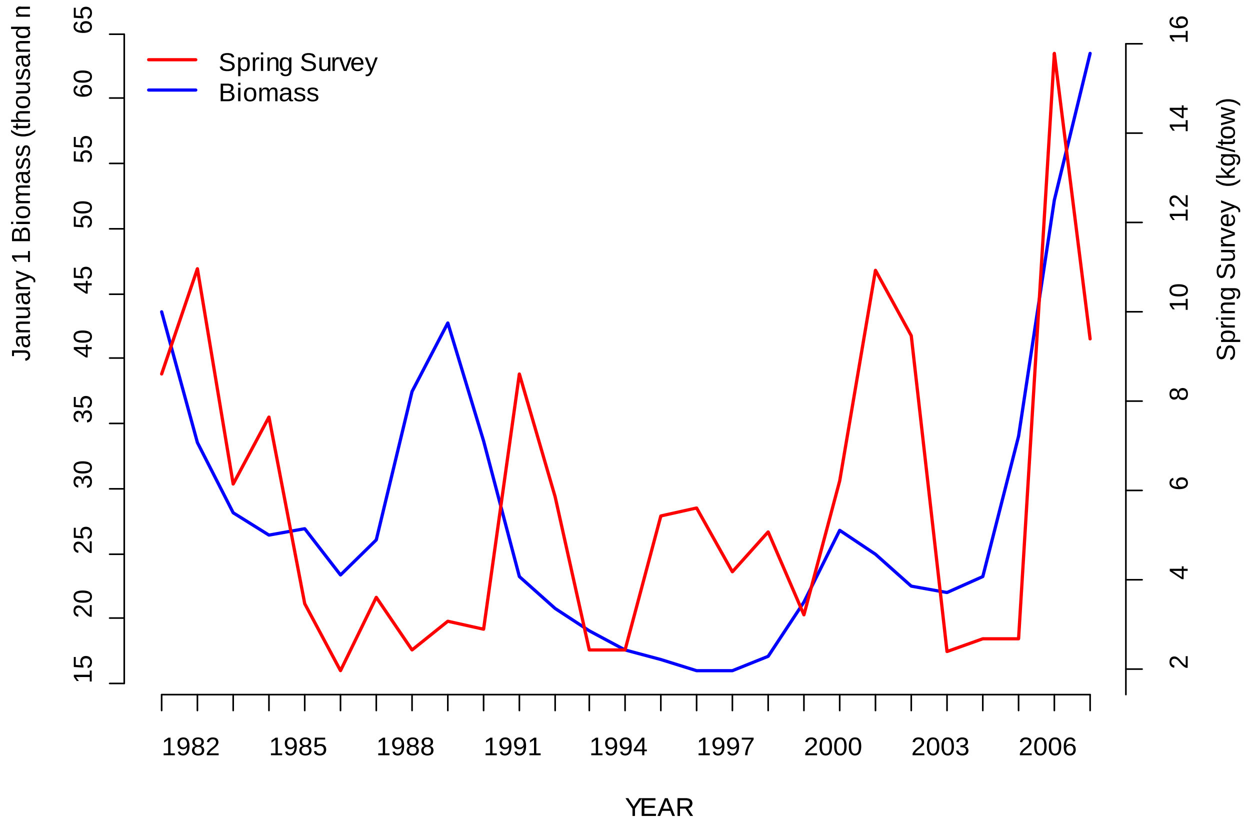
Georges Bank Cod - Mean Biomass

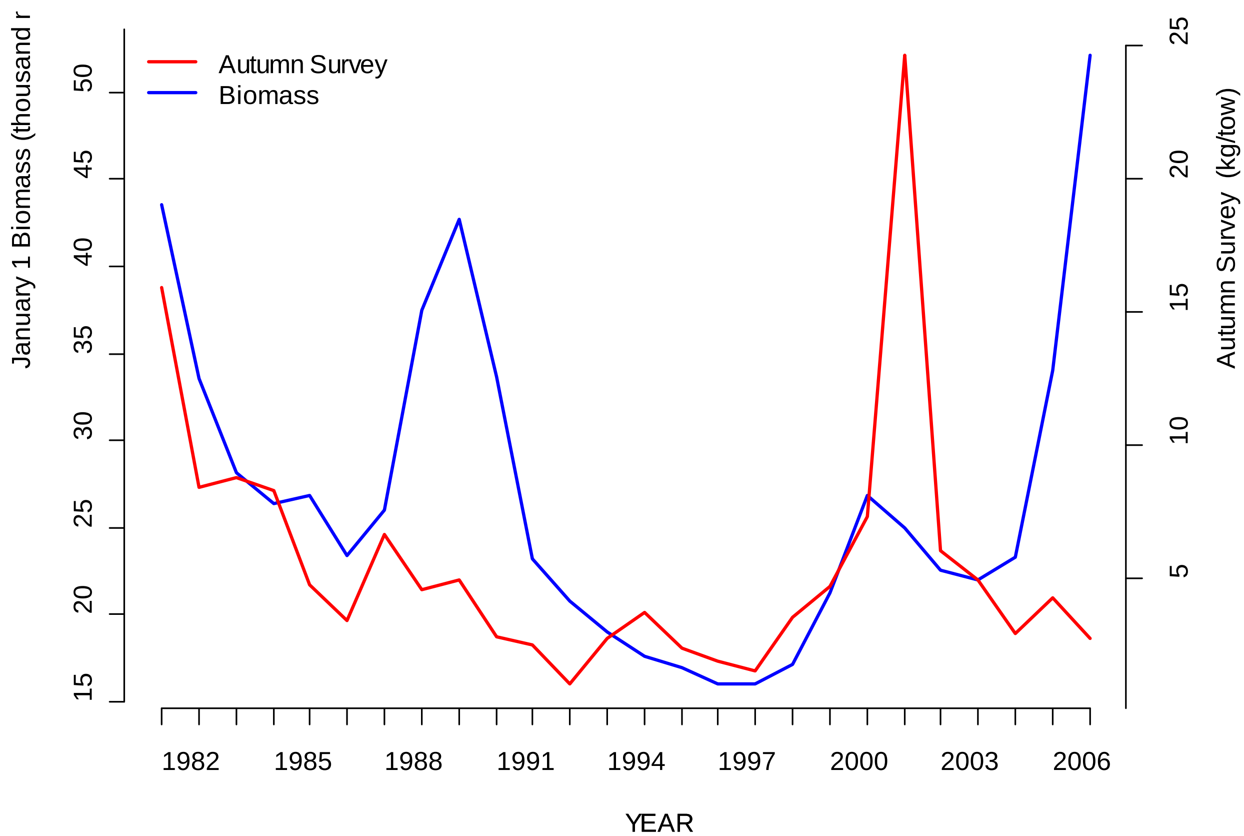


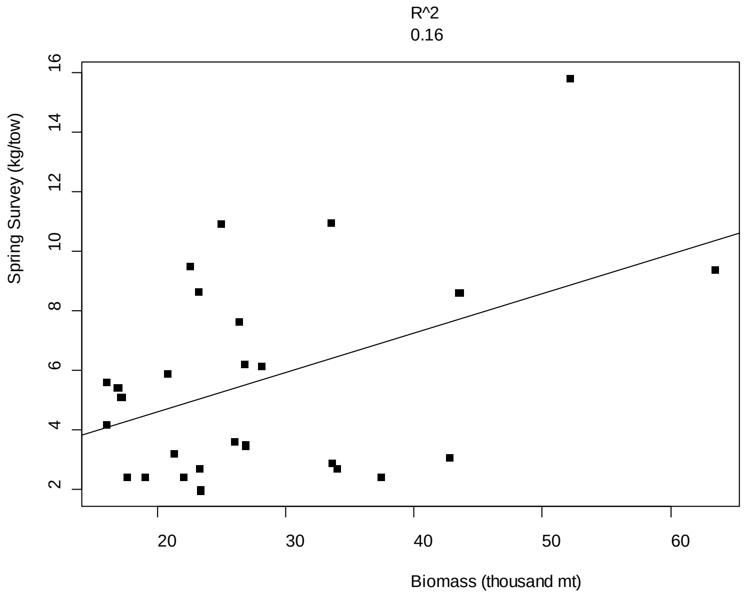


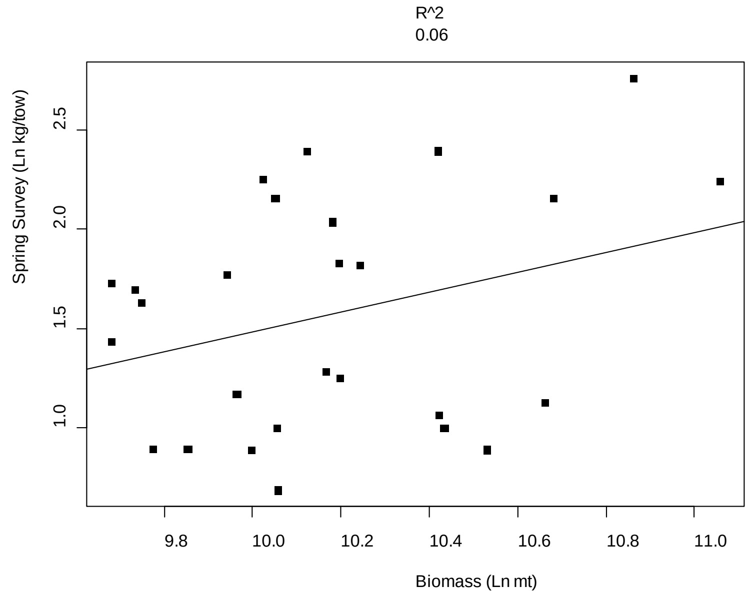

R^2
-0.09
Spring Survey (kg/tow)
Biomass (thousand mt)
R^2
-0.09
Spring Survey (Ln kg/tow)
Biomass (Ln mt)
R^2
0.01
Autumn Survey (kg/tow)
Biomass (thousand mt)
R^2
0
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

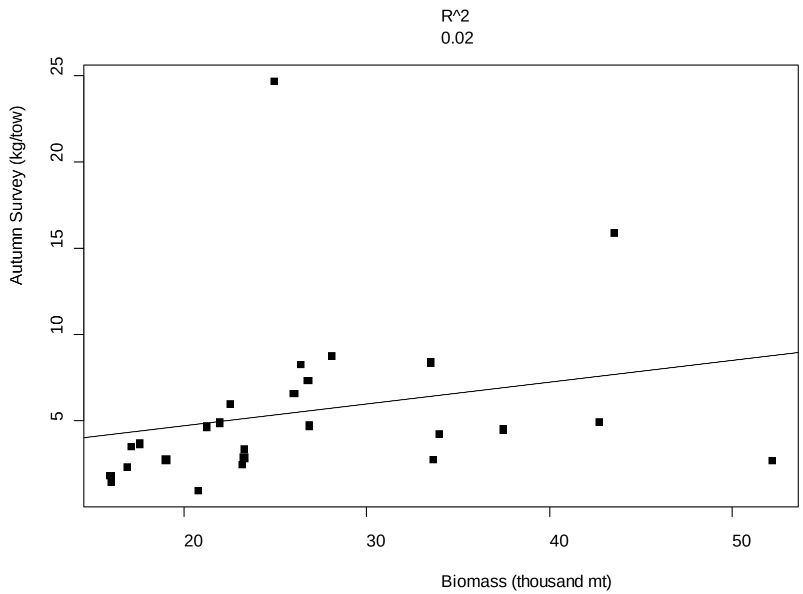
Gulf of Maine Cod - January 1 Biomass

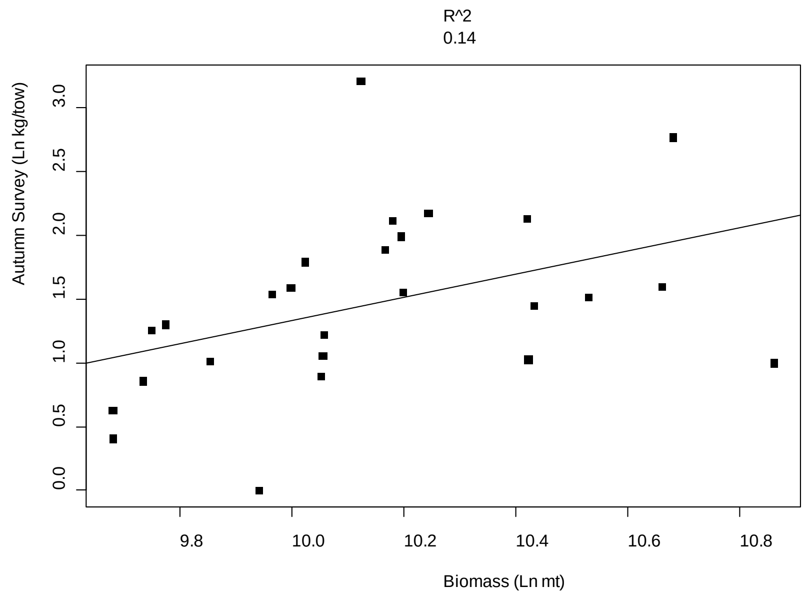





R^2
0.16
Spring Survey (kg/tow)
Biomass (thousand mt)


R^2
0.06
Spring Survey (Ln kg/tow)
Biomass (Ln mt)


R^2
0.02
Autumn Survey (kg/tow)
Biomass (thousand mt)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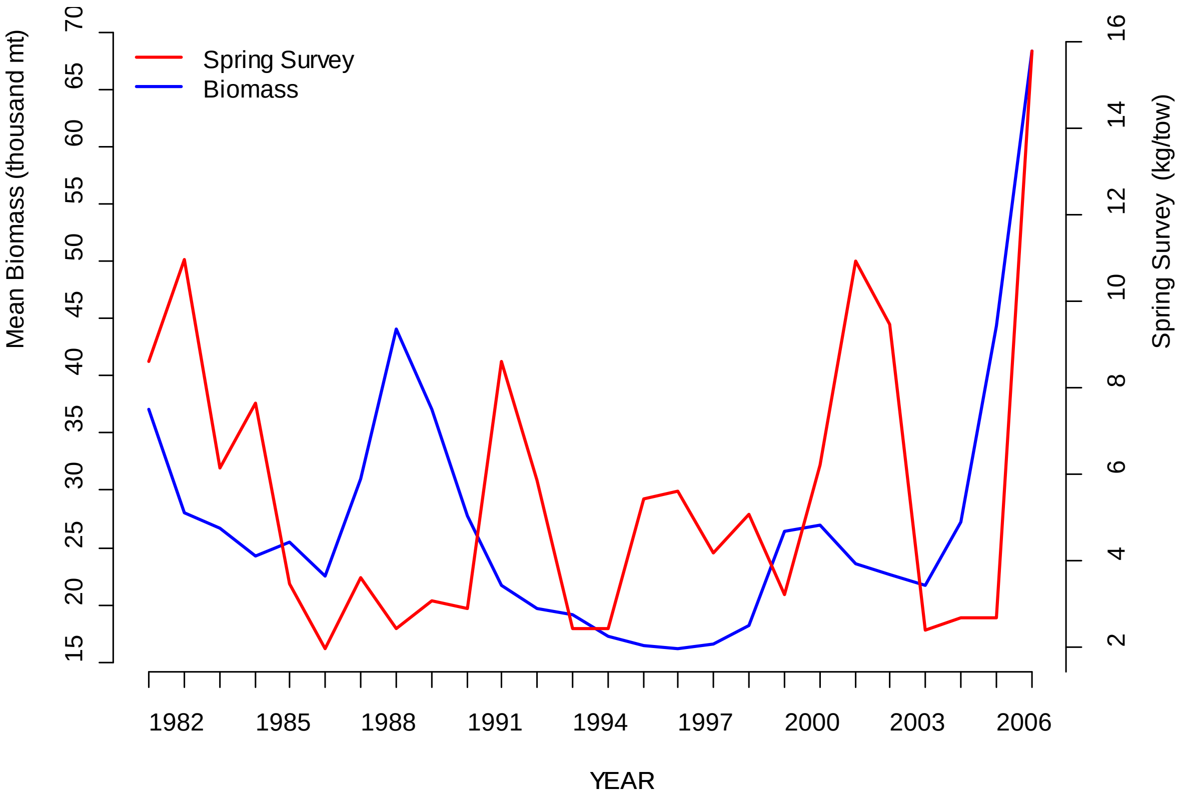
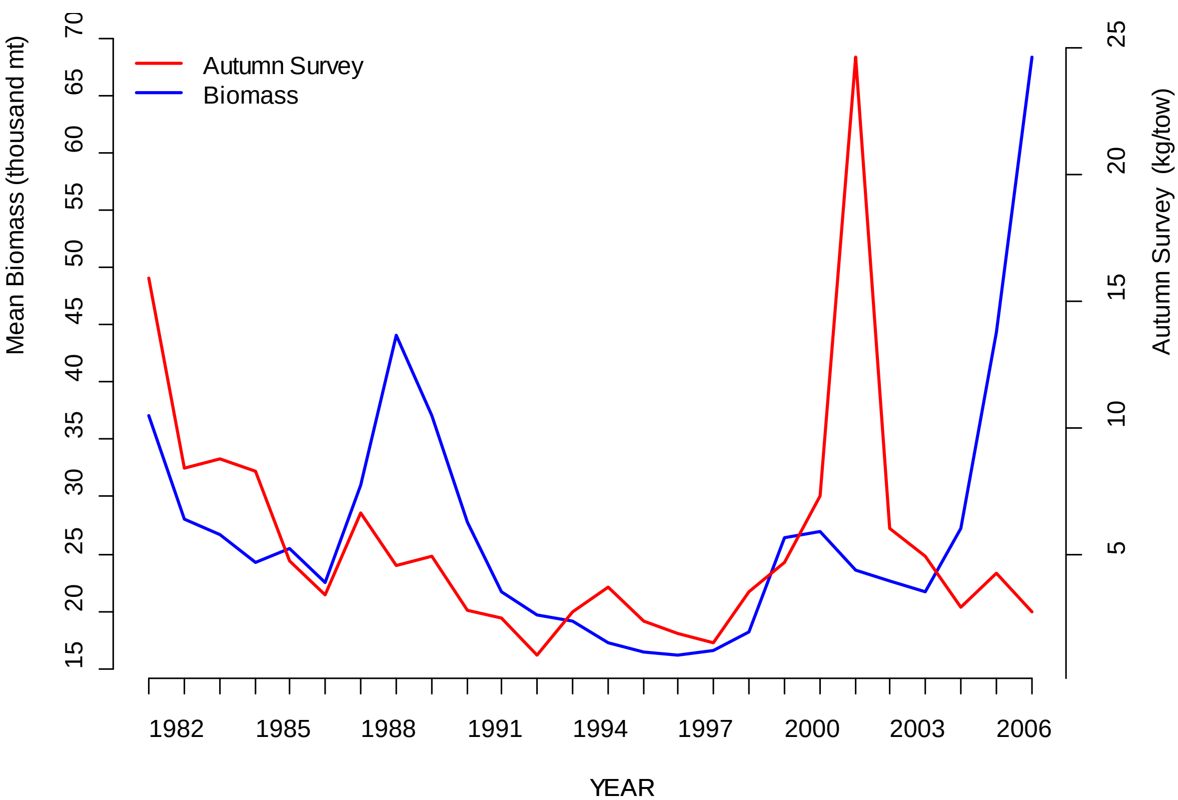
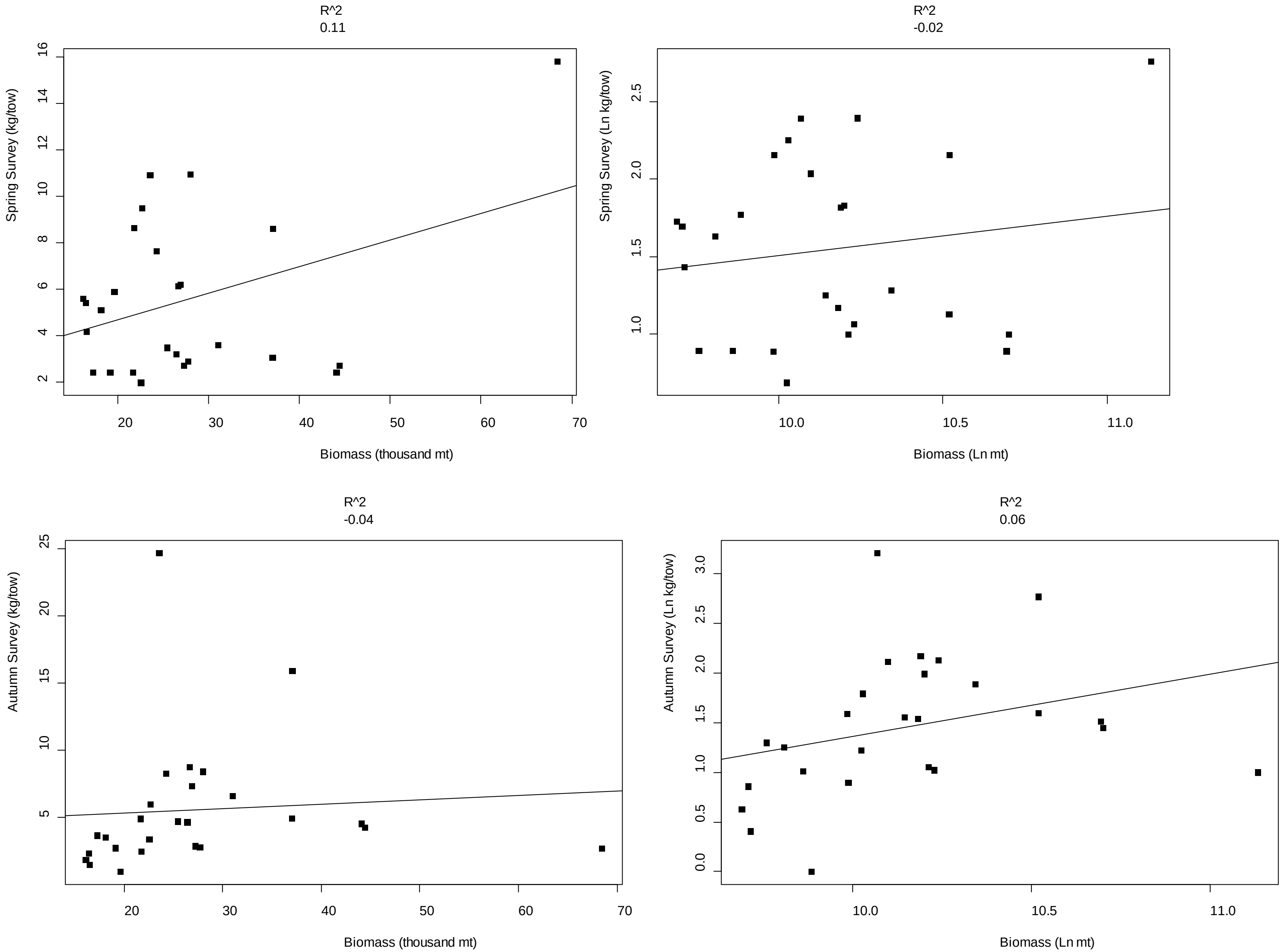
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

Gulf of Maine Cod - Mean Biomass

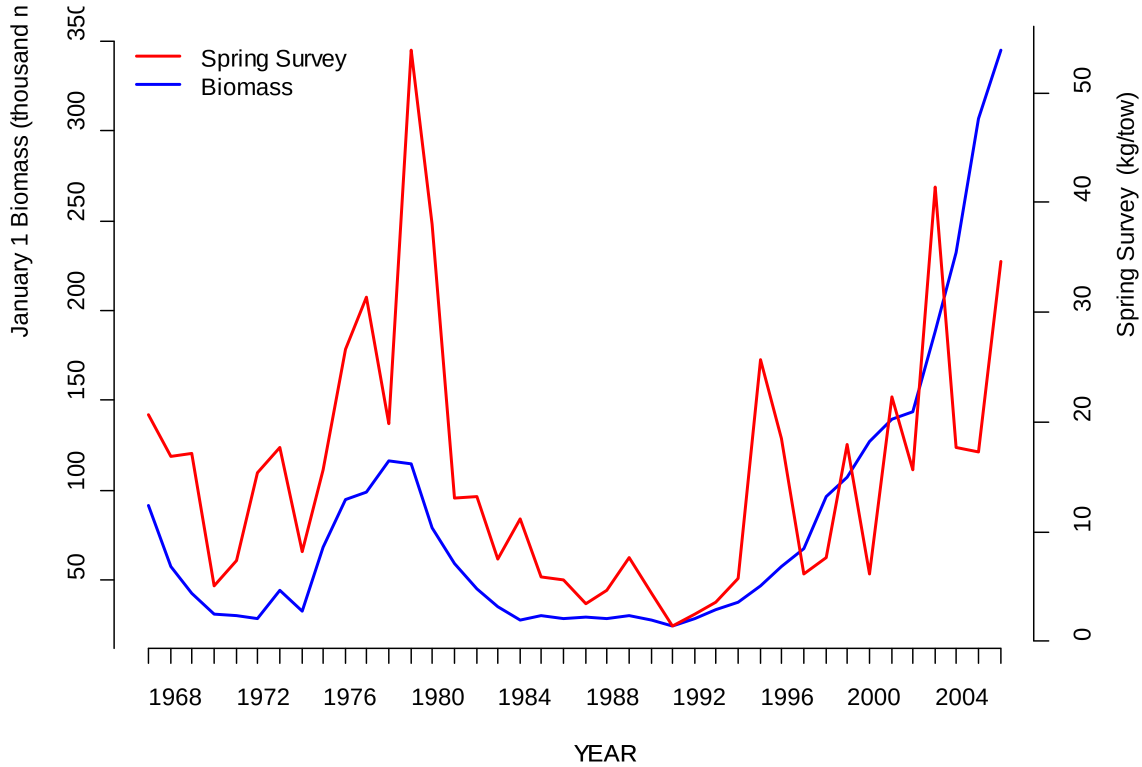


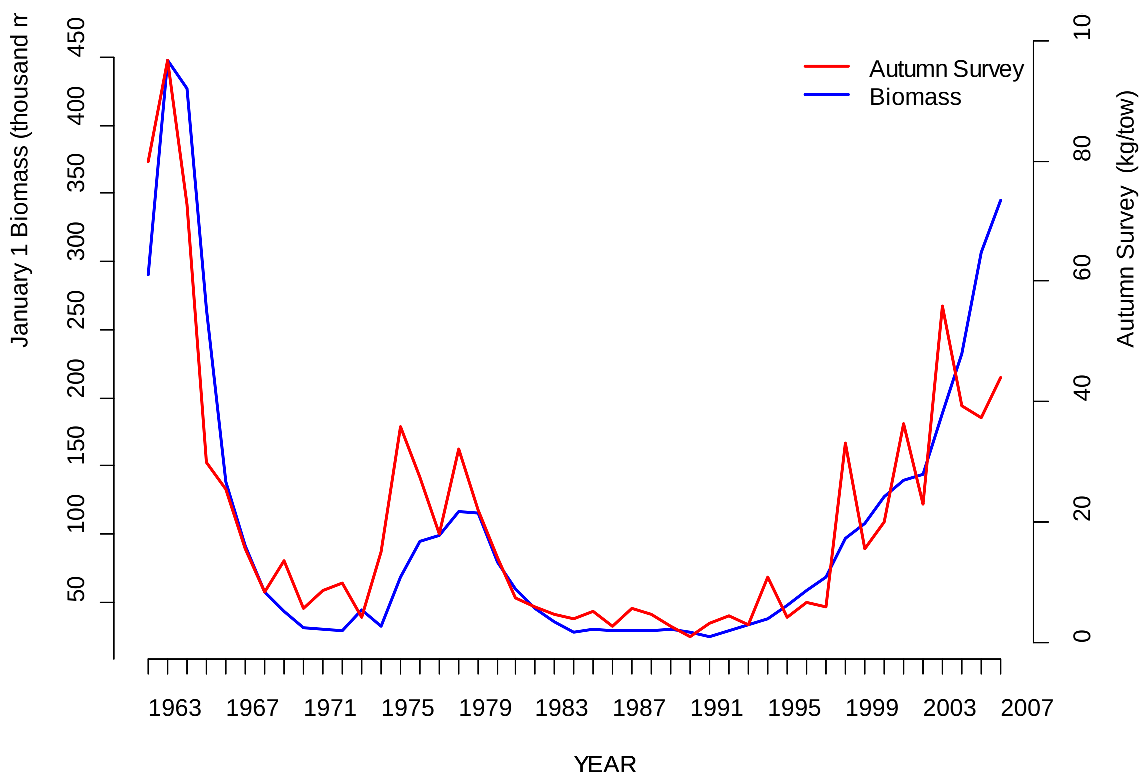


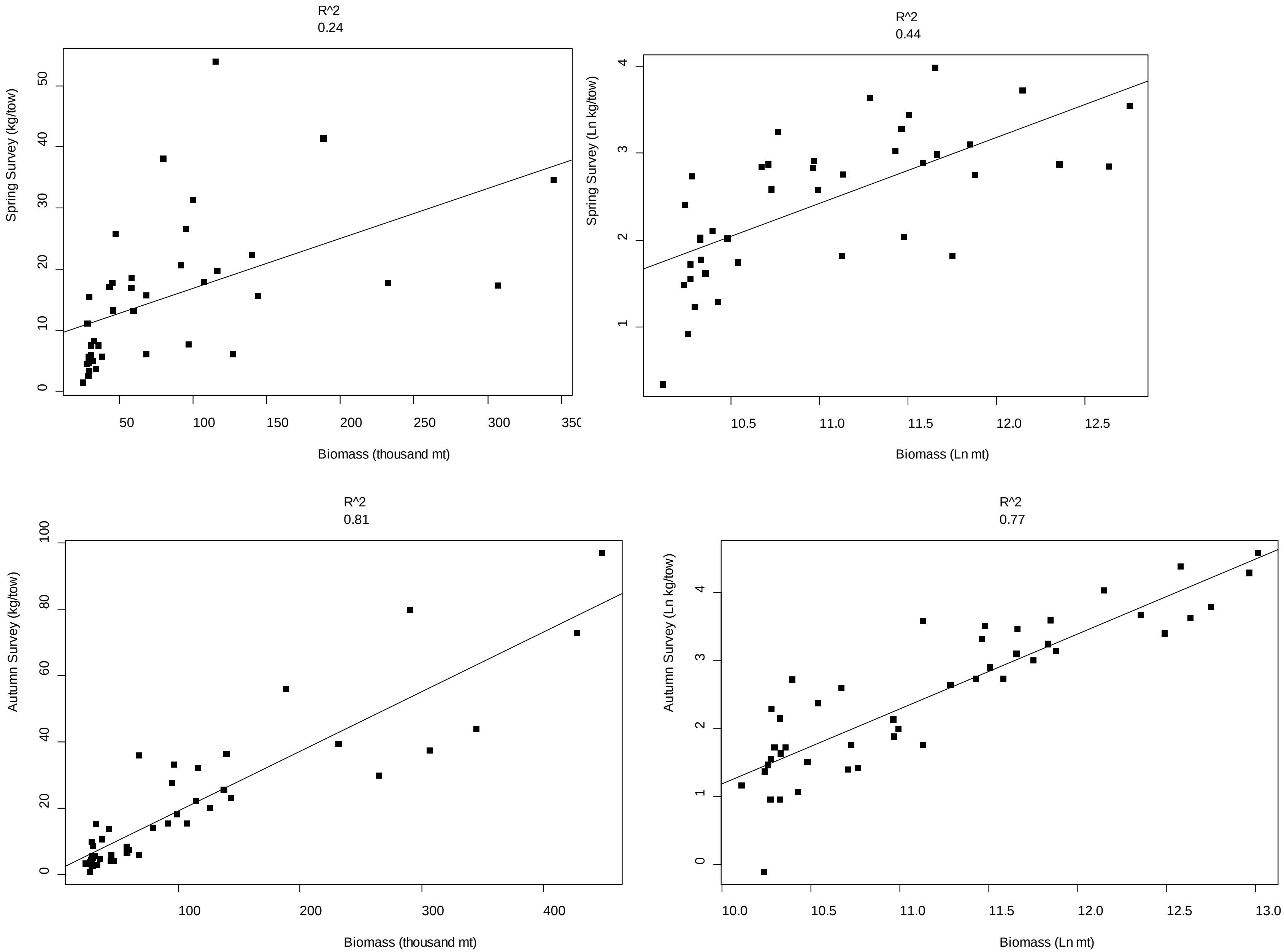


R^2
0.11
Spring Survey (kg/tow)
Biomass (thousand mt)
R^2
-0.02
Spring Survey (Ln kg/tow)
Biomass (Ln mt)
R^2
-0.04
Autumn Survey (kg/tow)
Biomass (thousand mt)
R^2
0.06
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

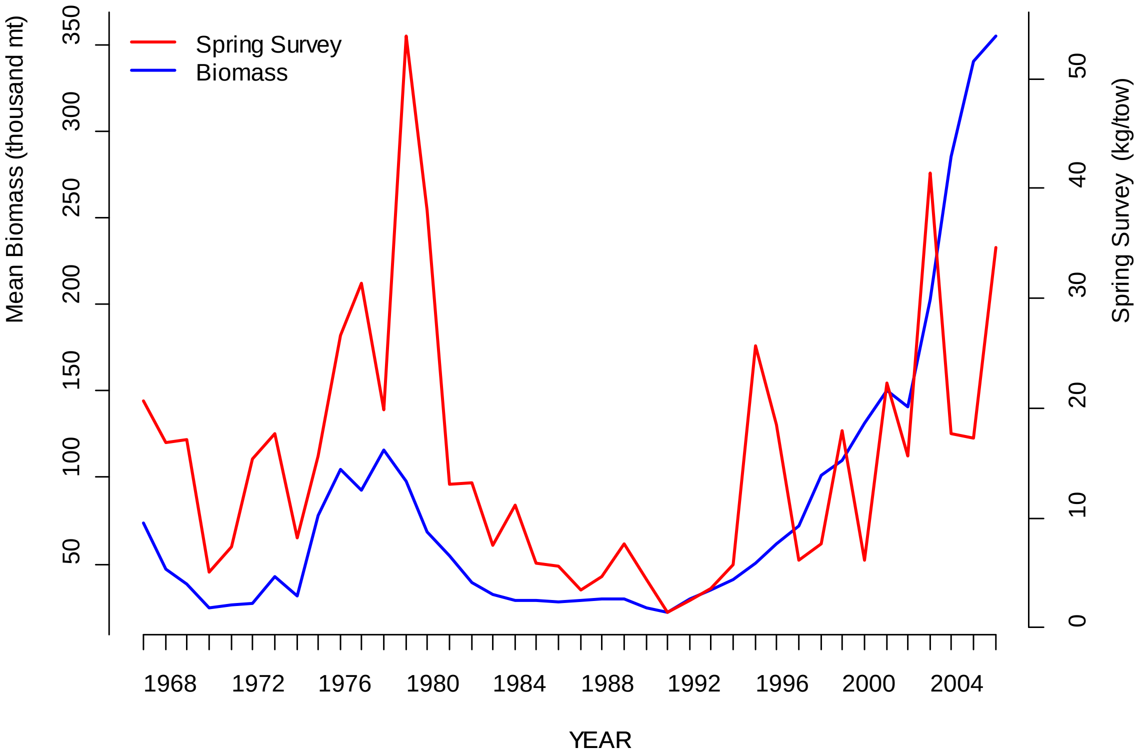
Georges Bank Haddock - January 1 Biomass

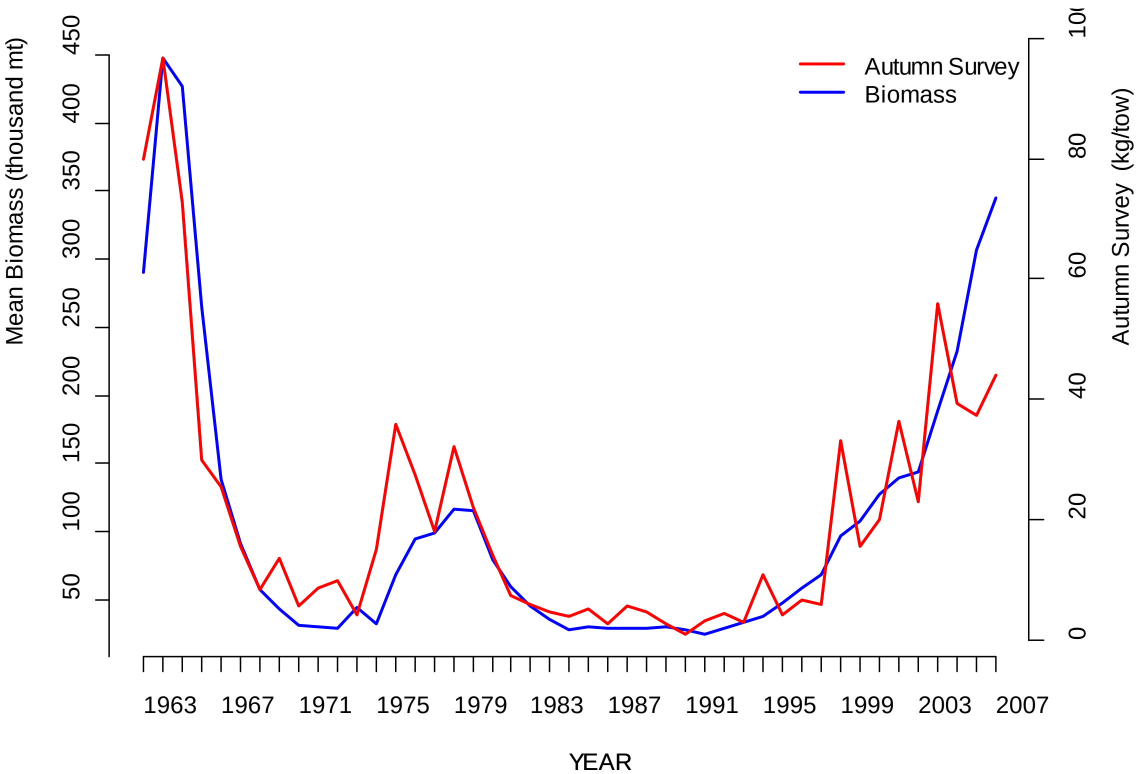


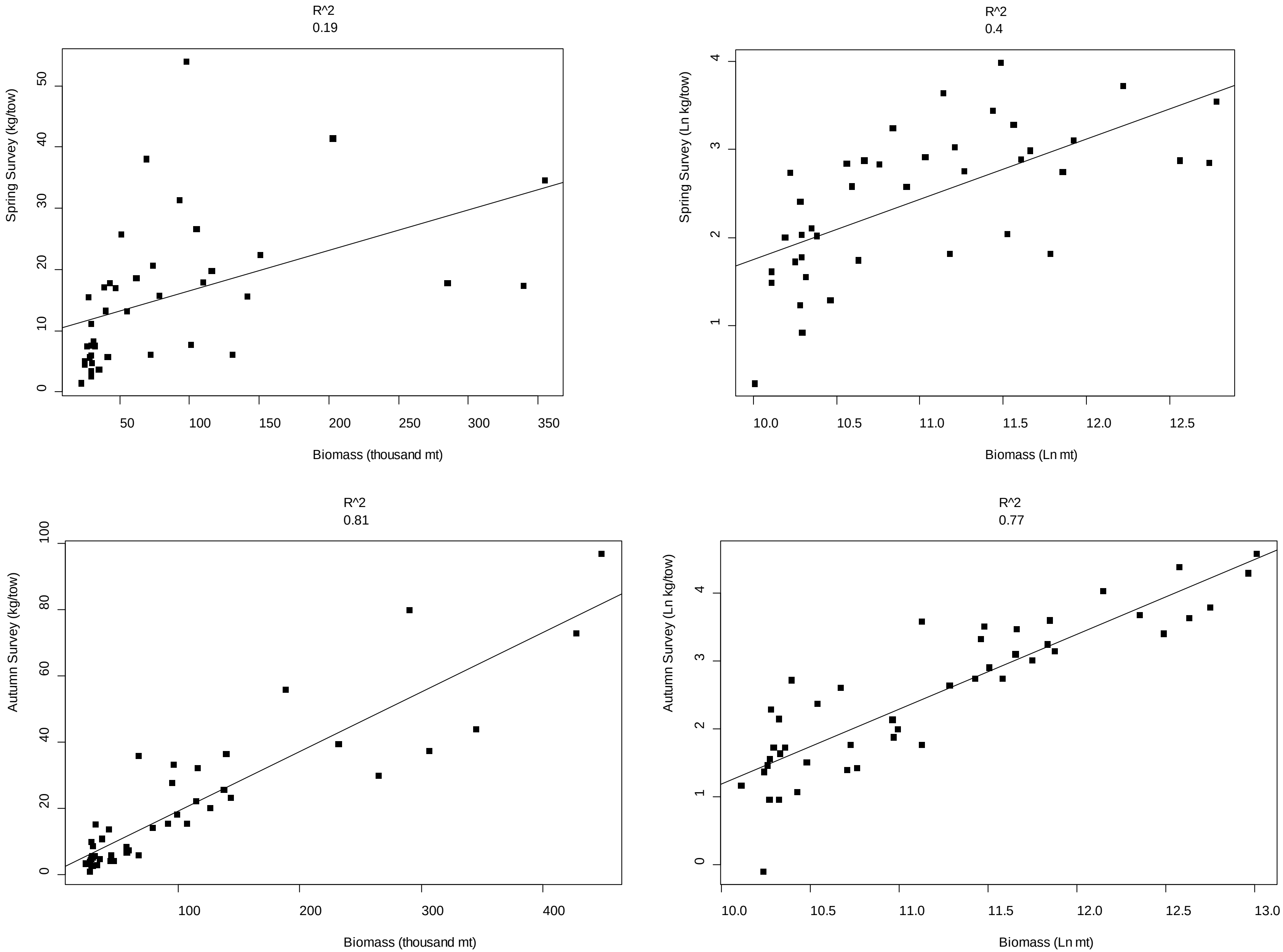



R^2
0.24
Spring Survey (kg/tow)
Biomass (thousand mt)
R^2
0.44
Spring Survey (Ln kg/tow)
Biomass (Ln mt)
R^2
0.81
Autumn Survey (kg/tow)
Biomass (thousand mt)
R^2
0.77
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

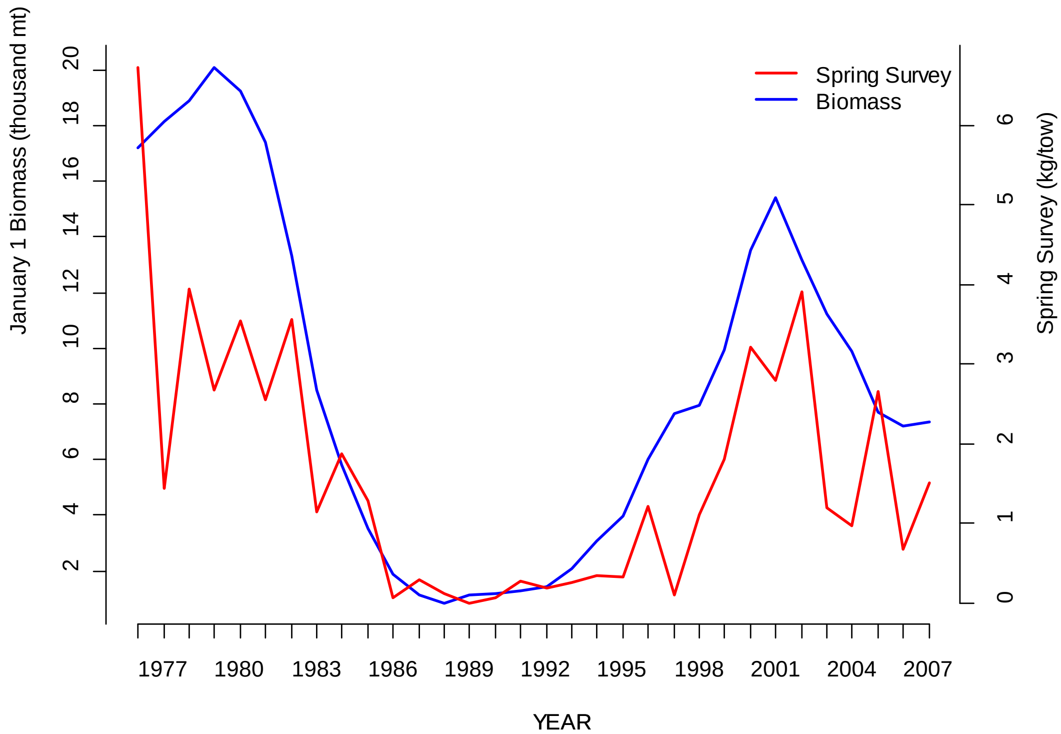
Georges Bank Haddock - Mean Biomass

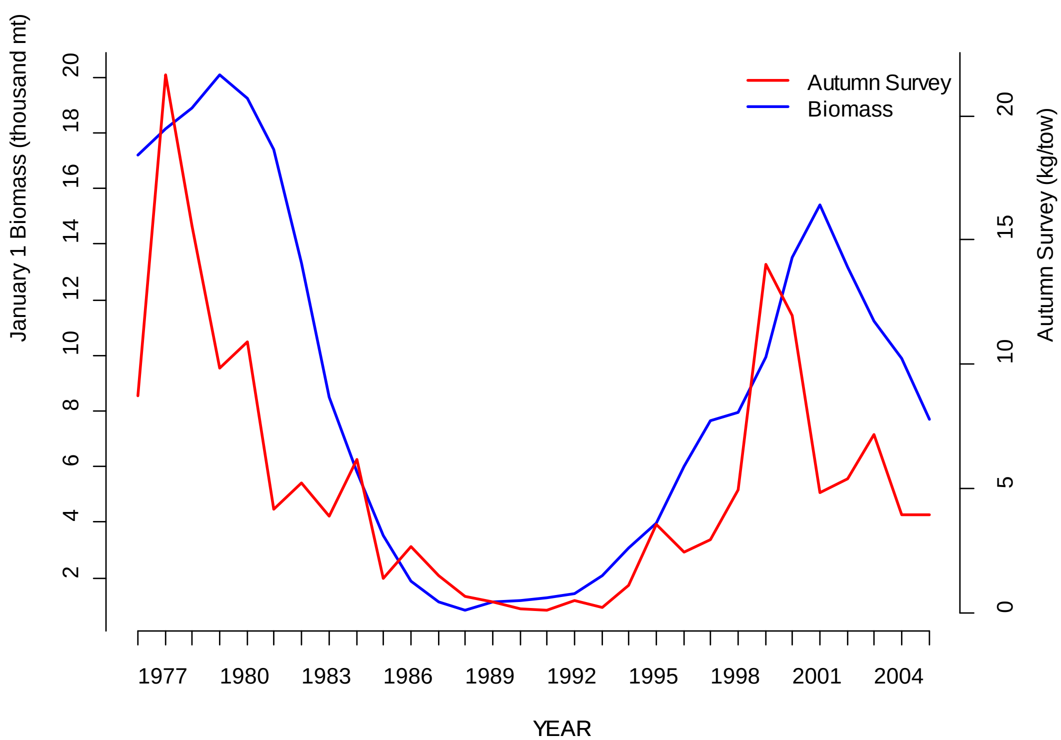


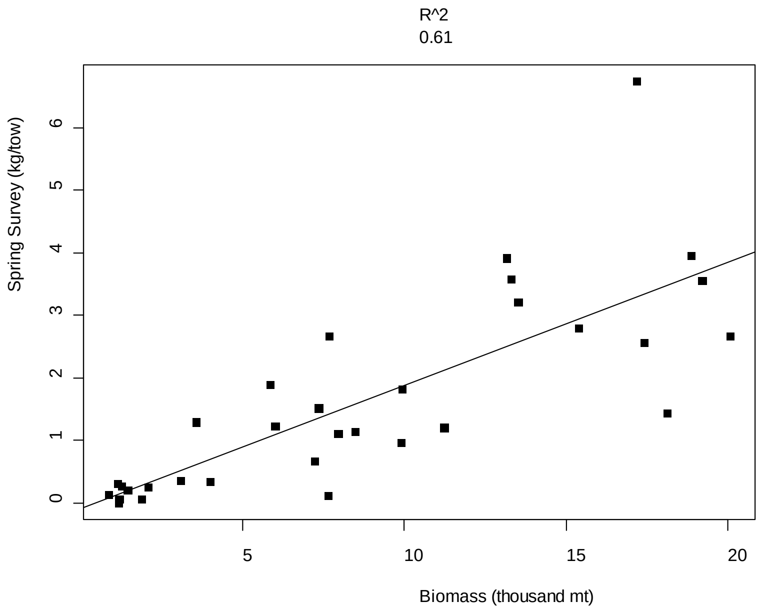


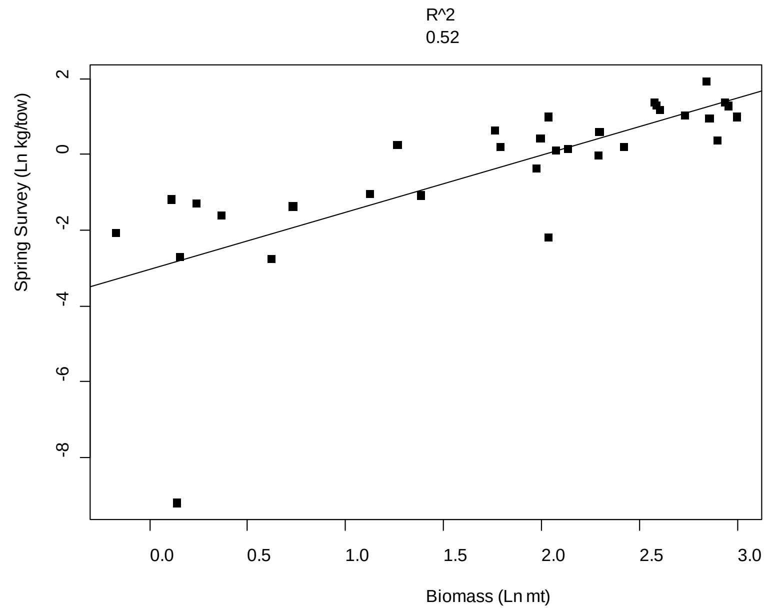

R^2
0.19
Spring Survey (kg/tow)
Biomass (thousand mt)
R^2
0.4
Spring Survey (Ln kg/tow)
Biomass (Ln mt)
R^2
0.81
Autumn Survey (kg/tow)
Biomass (thousand mt)
R^2
0.77
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

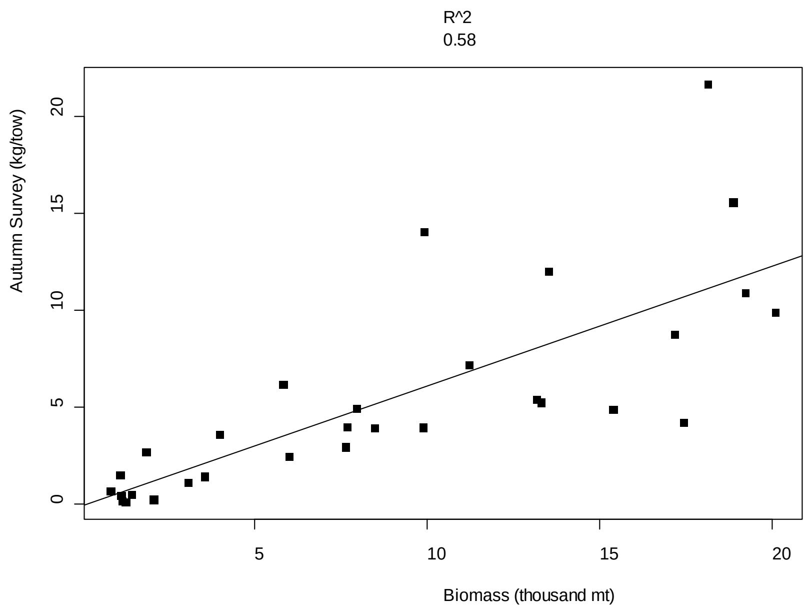
Gulf of Maine Haddock - January 1 Biomass

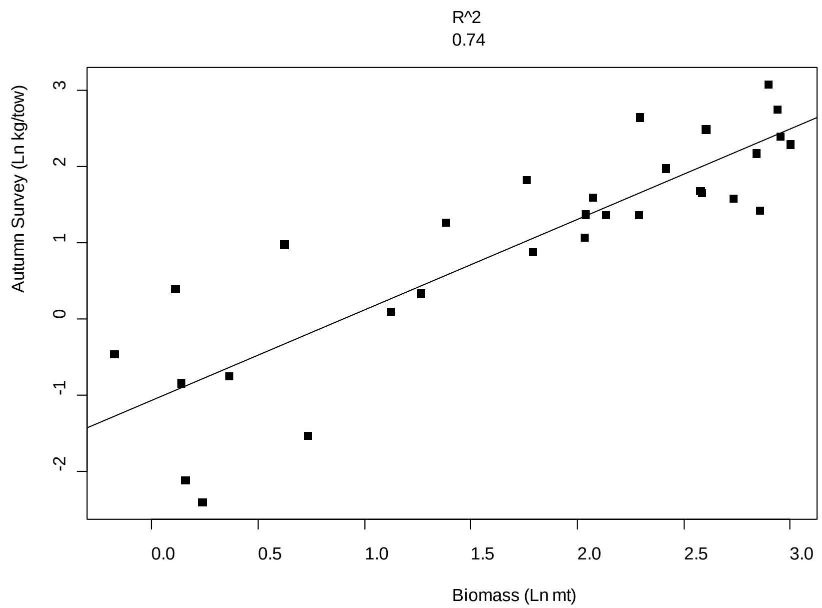




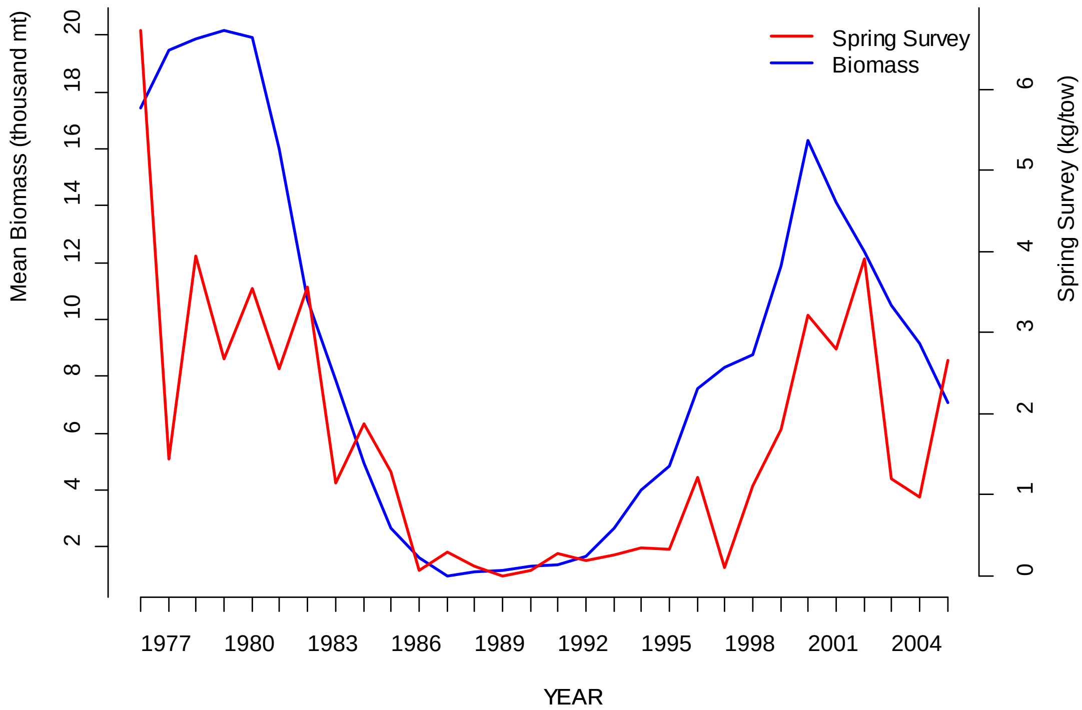

R^2
0.61
Spring Survey (kg/tow)
Biomass (thousand mt)

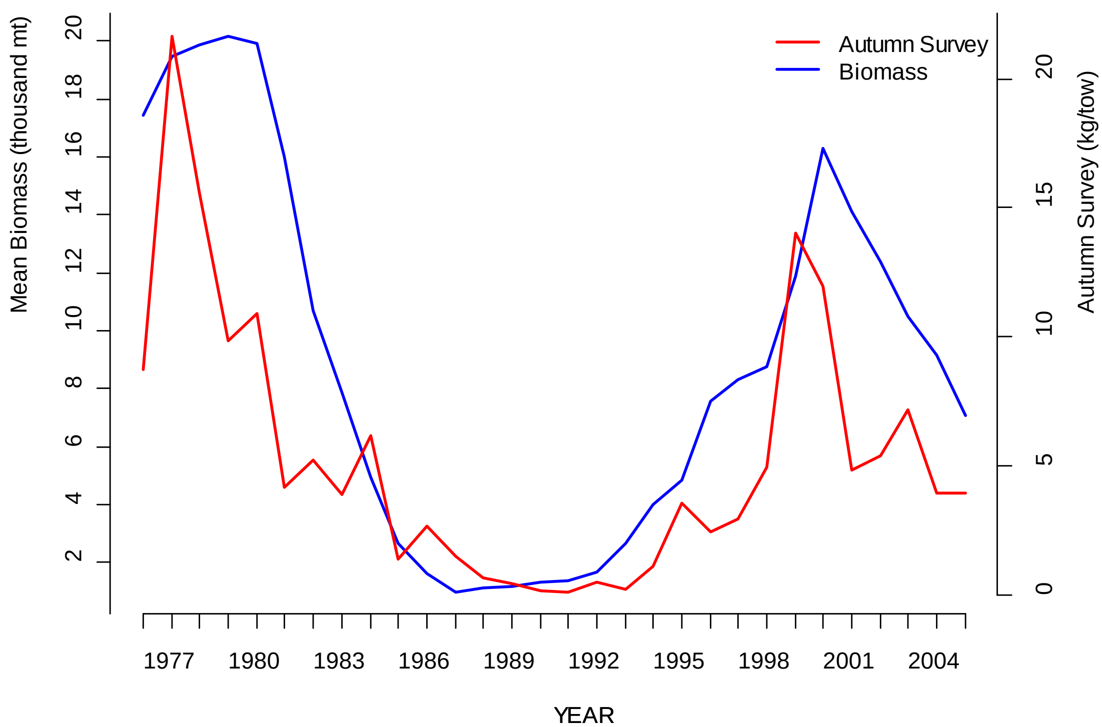

R^2
0.52
Spring Survey (Ln kg/tow)
Biomass (Ln mt)

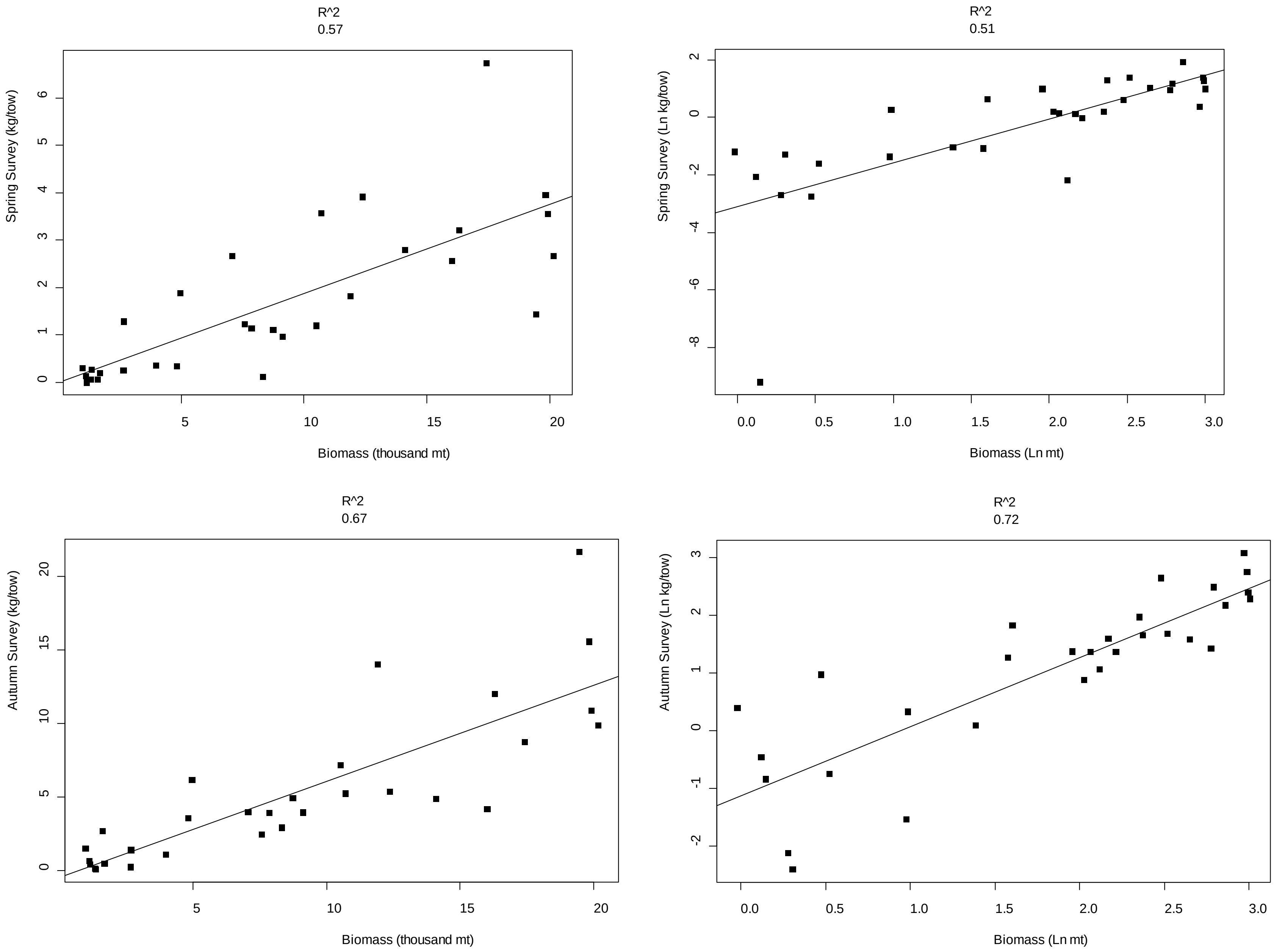

R^2
0.58
Autumn Survey (kg/tow)
Biomass (thousand mt)


R^2
0.74
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

Gulf of Maine Haddock – Mean Biomass

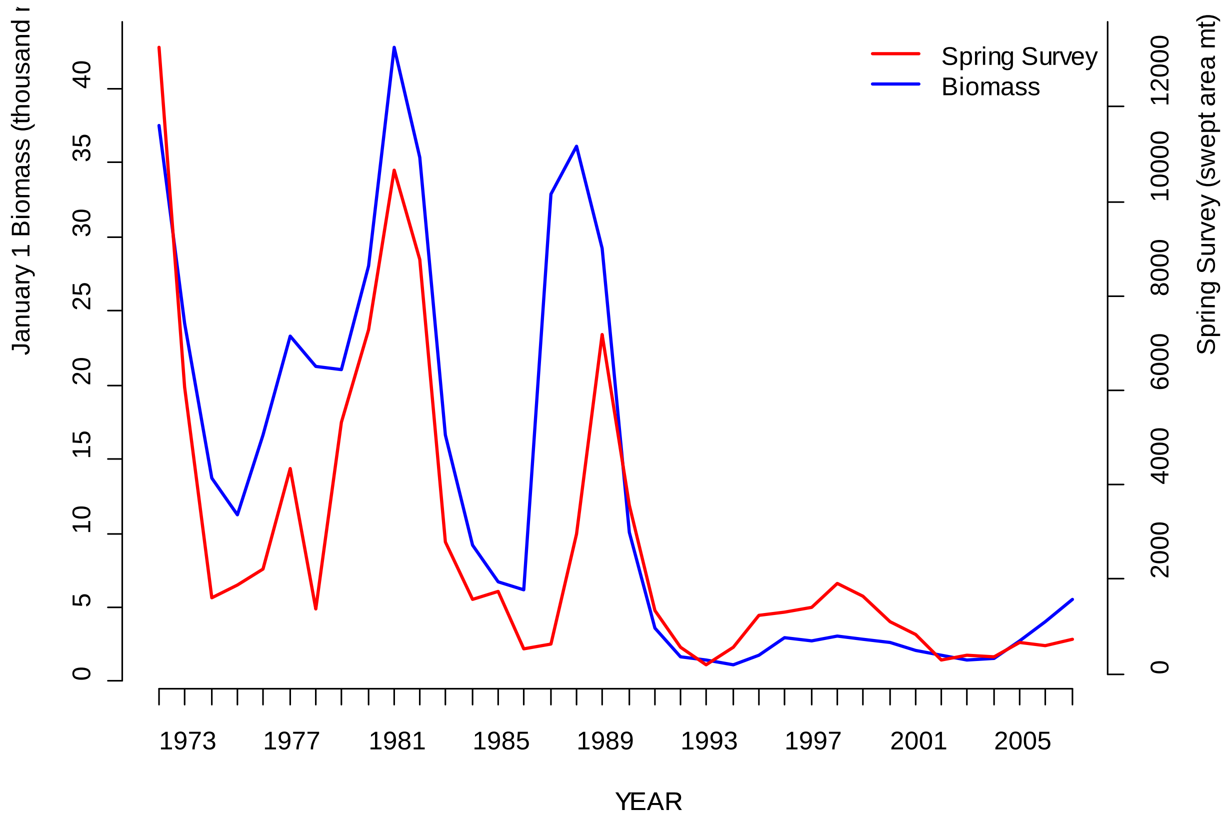


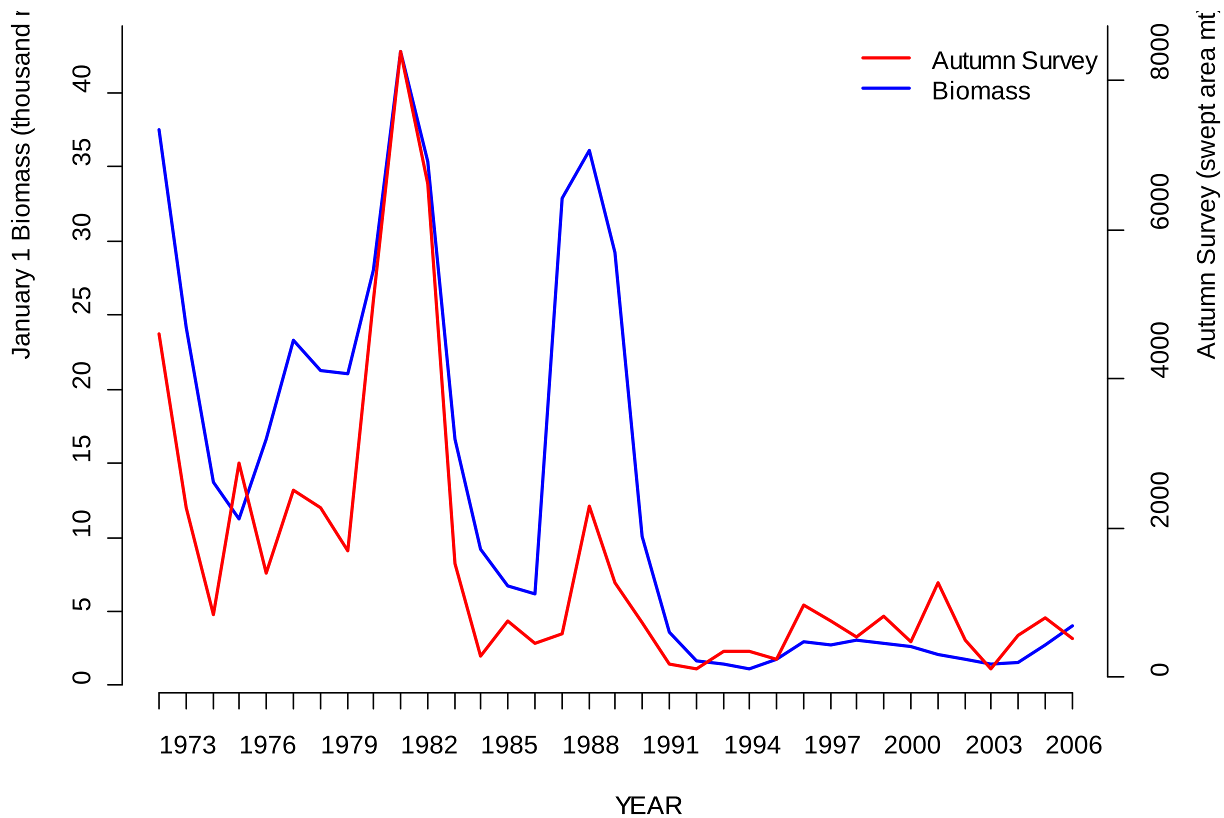


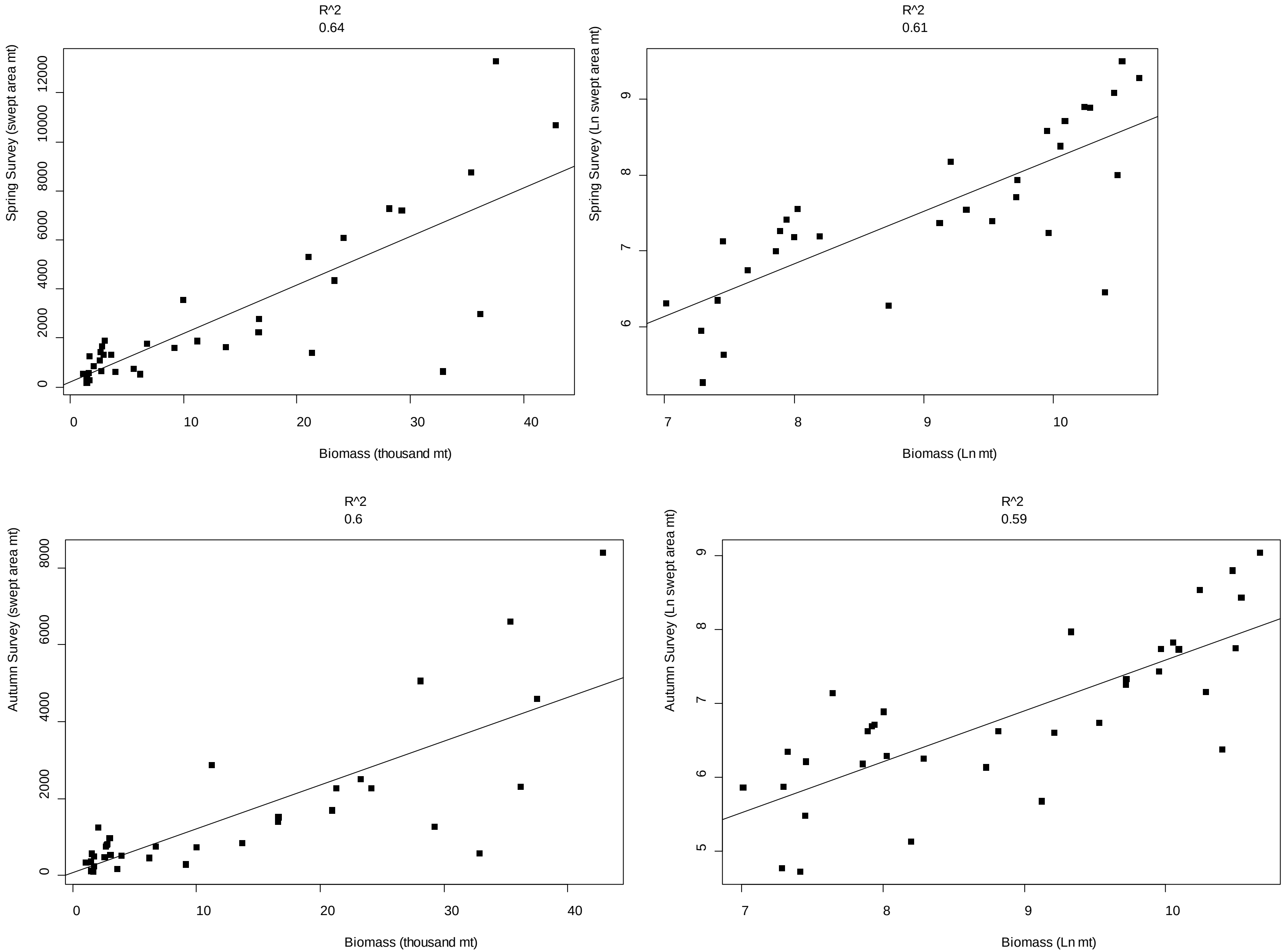


R^2
0.57
Spring Survey (kg/tow)
Biomass (thousand mt)
R^2
0.51
Spring Survey (Ln kg/tow)
Biomass (Ln mt)
R^2
0.67
Autumn Survey (kg/tow)
Biomass (thousand mt)
R^2
0.72
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

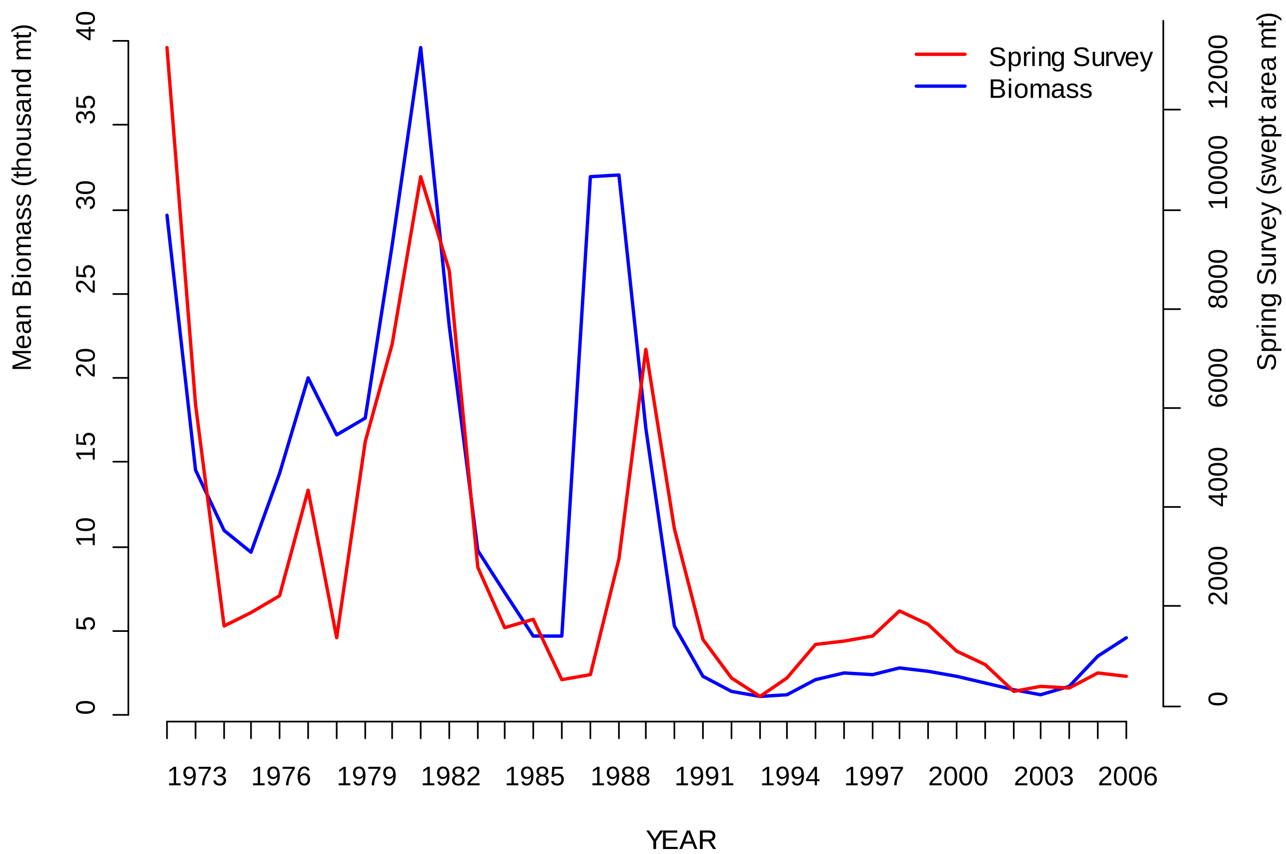
Southern New England Yellowtail - January 1 Biomass

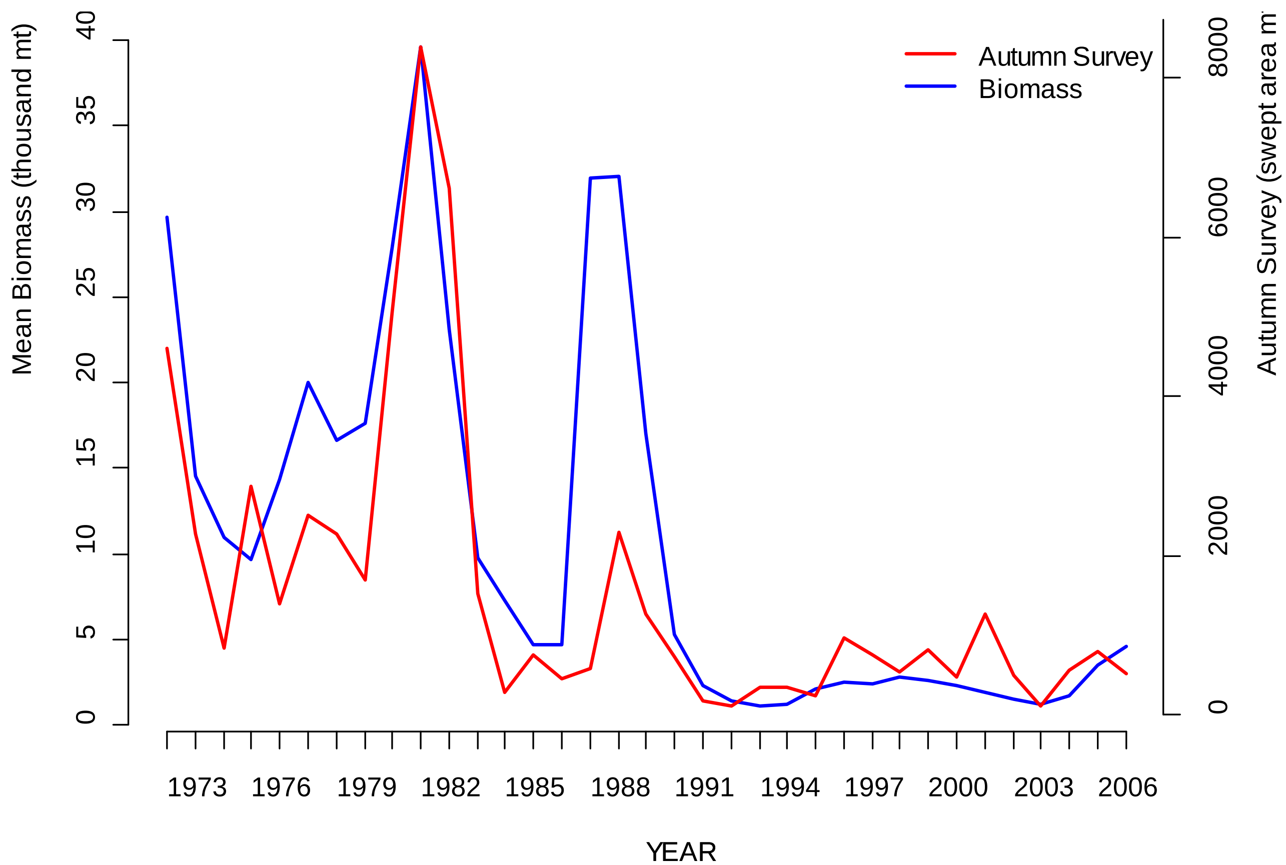


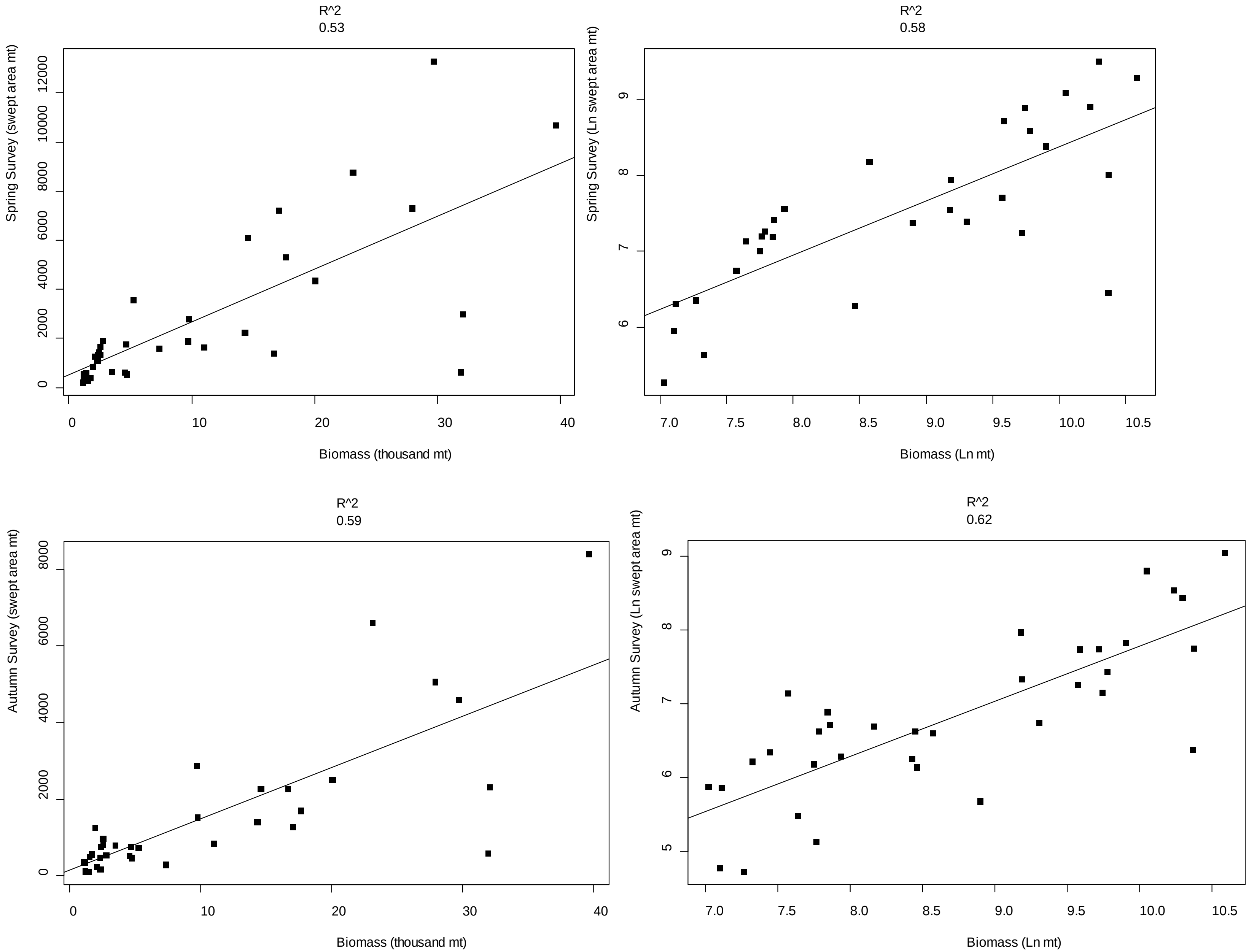



R^2
0.64
Spring Survey (swept area mt)
Biomass (thousand mt)
R^2
0.61
Spring Survey (Ln swept area mt)
Biomass (Ln mt)
R^2
0.6
Autumn Survey (swept area mt)
Biomass (thousand mt)
R^2
0.59
Autumn Survey (Ln swept area mt)
Biomass (Ln mt)

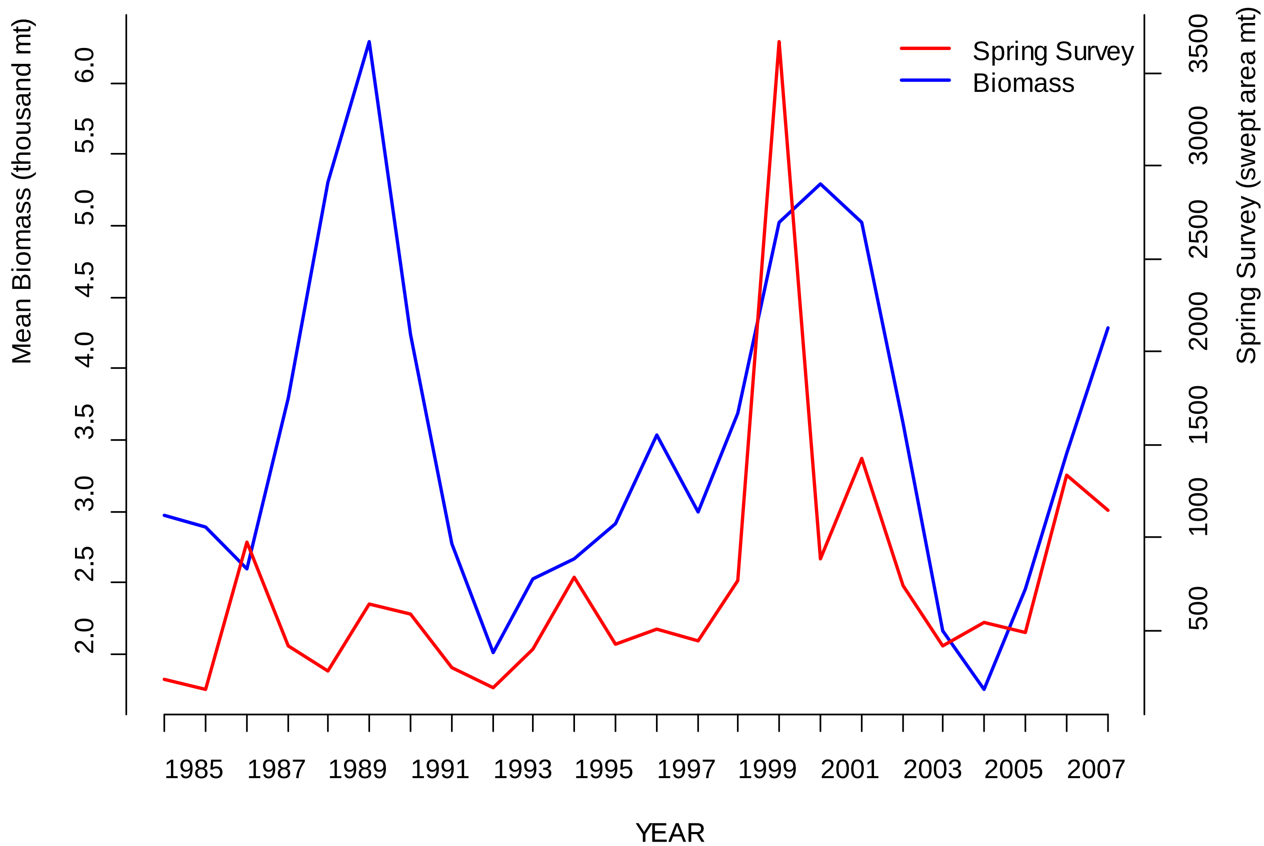
Southern New England Yellowtail Flounder - Mean Biomass

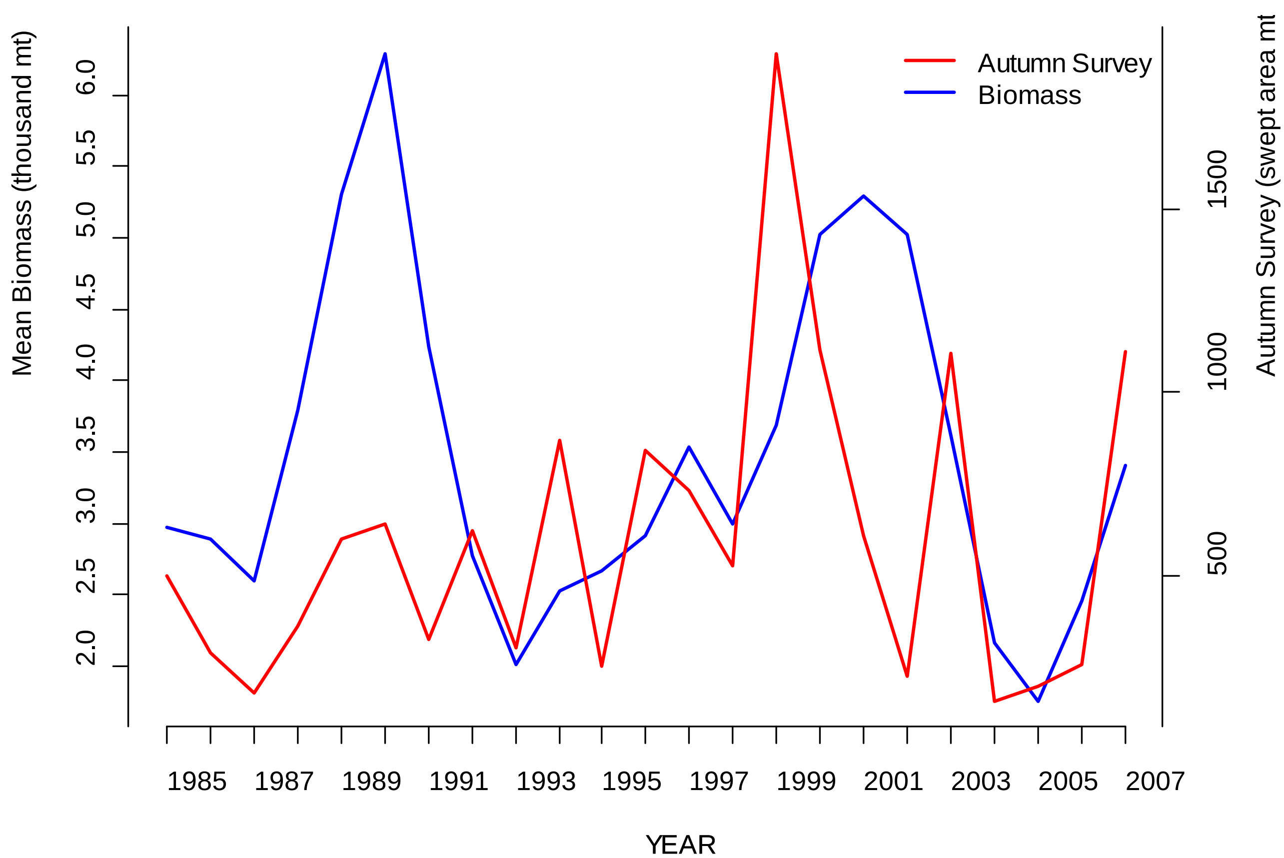


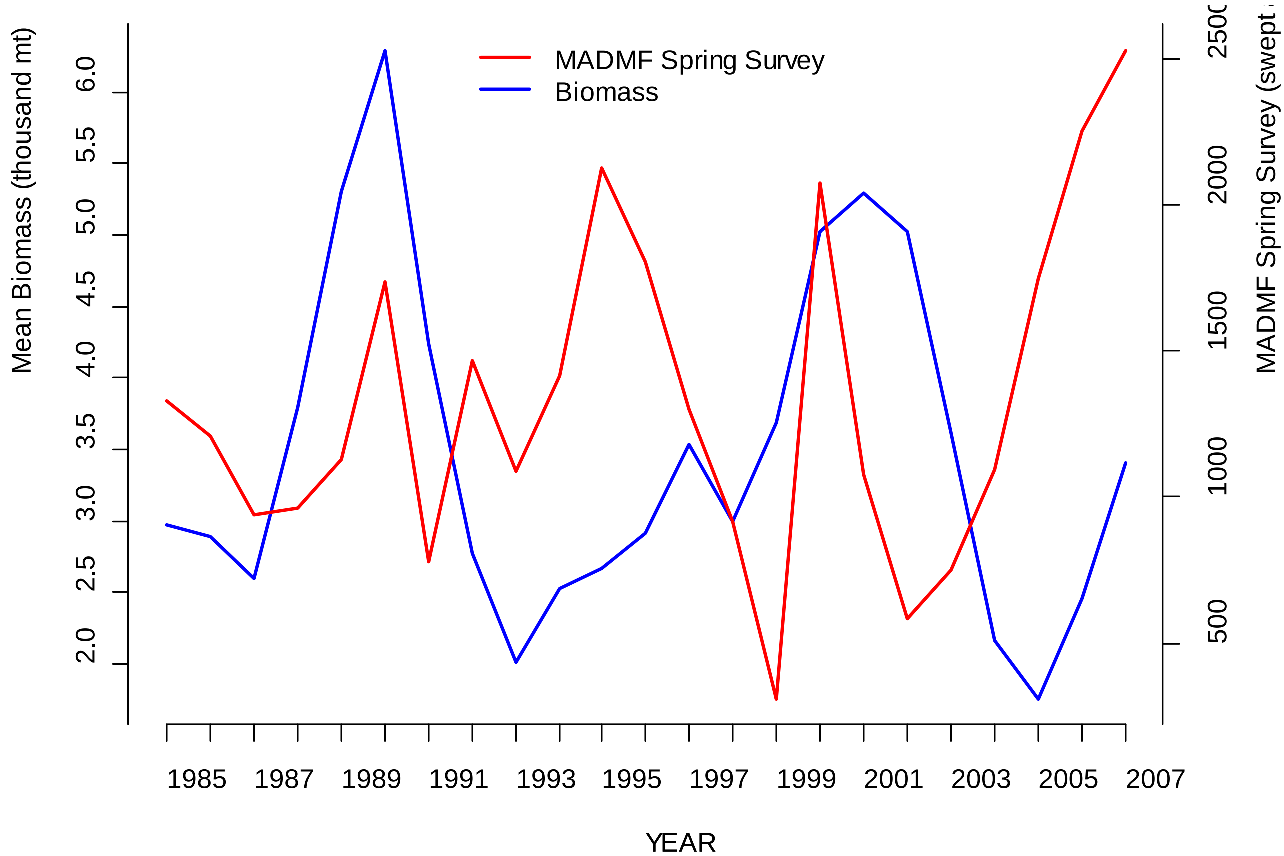



R^2
0.53
Spring Survey (swept area mt)
Biomass (thousand mt)
0
2000
4000
6000
8000
10000
12000
0
10
20
30
40
R^2
0.58
Spring Survey (Ln swept area mt)
Biomass (Ln mt)
6
7
8
9
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
R^2
0.59
Autumn Survey (swept area mt)
Biomass (thousand mt)
0
2000
4000
6000
8000
0
10
20
30
40
R^2
0.62
Autumn Survey (Ln swept area mt)
Biomass (Ln mt)
5
6
7
8
9
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5

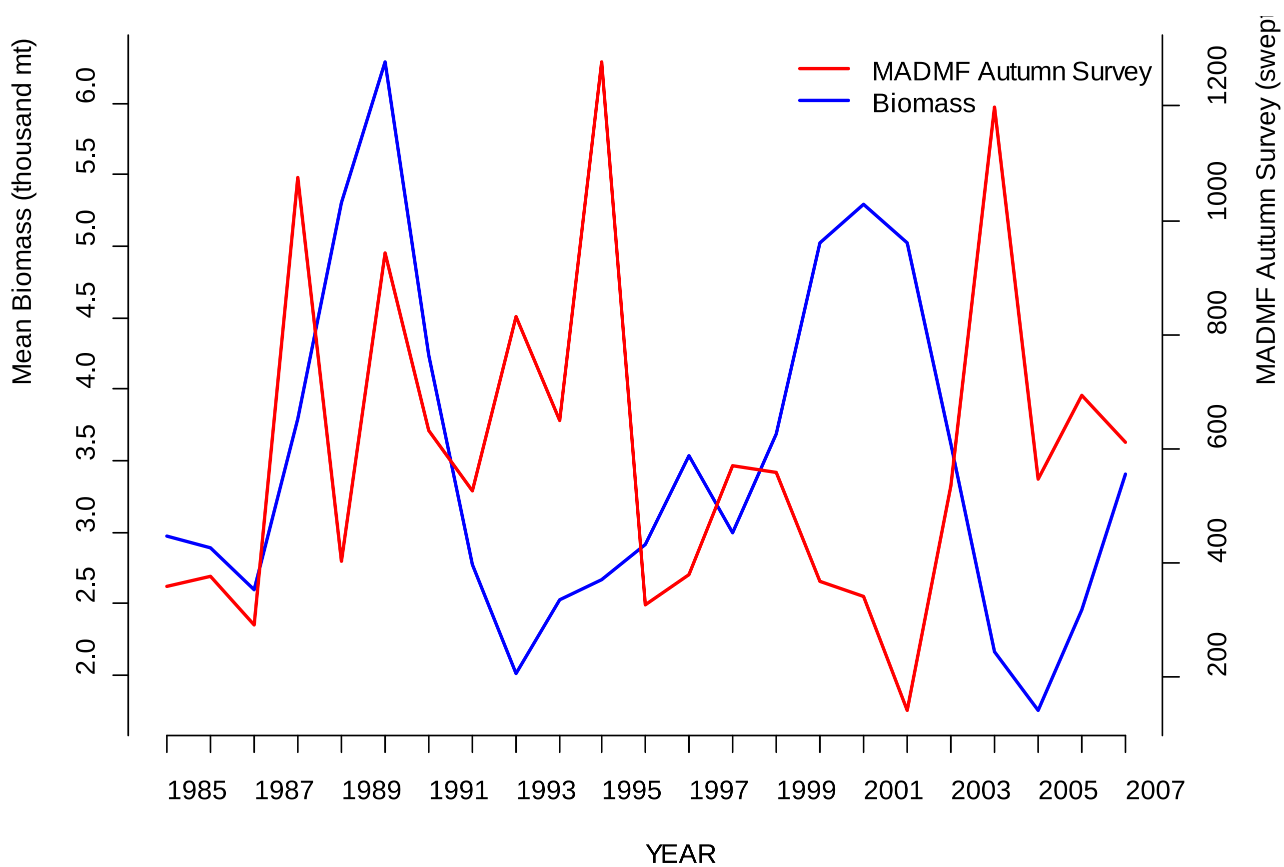
Cape Cod/Gulf of Maine Yellowtail Flounder - January 1 Biomass



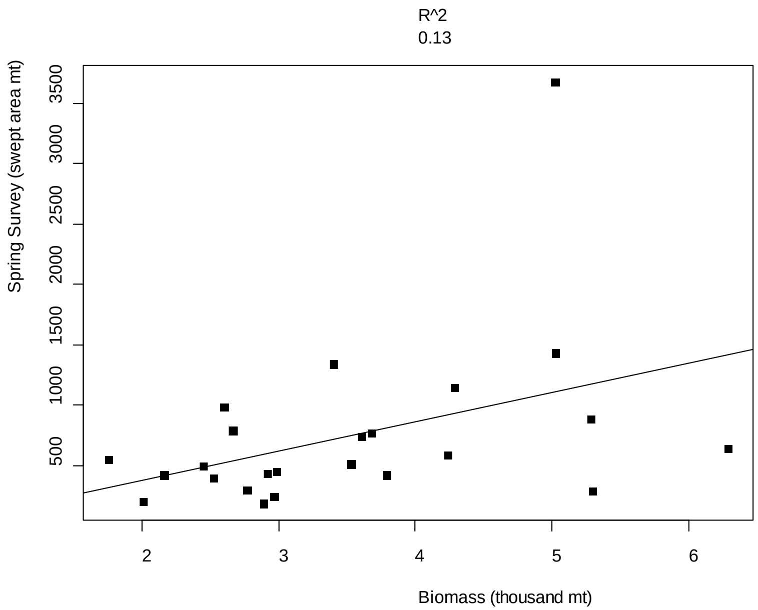


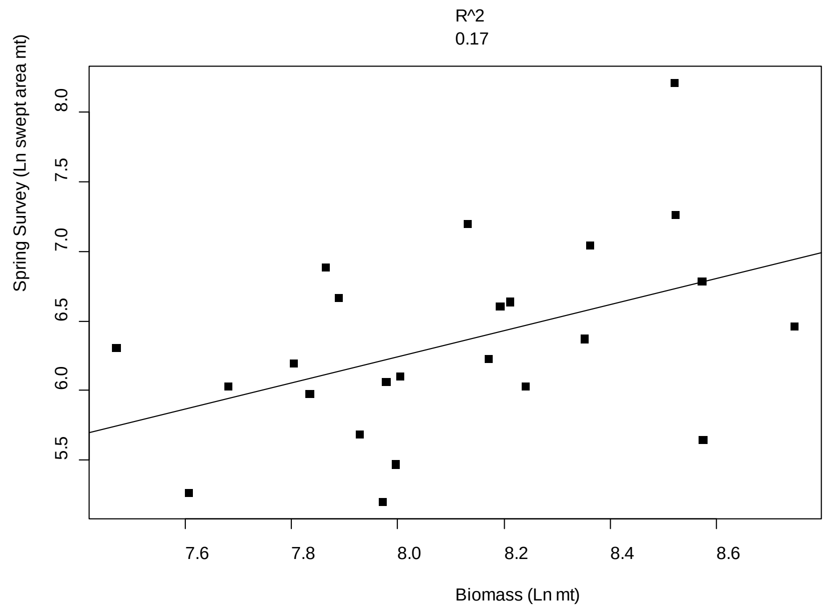


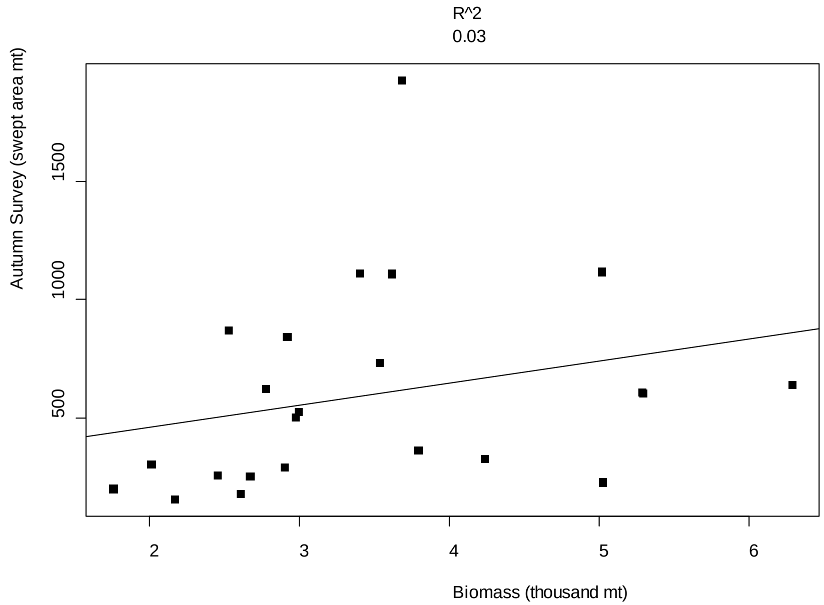
MADMF Spring Survey
Biomass
Mean Biomass (thousand mt)
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
500
1000
1500
2000
2500
MADMF Spring Survey (swept
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
YEAR

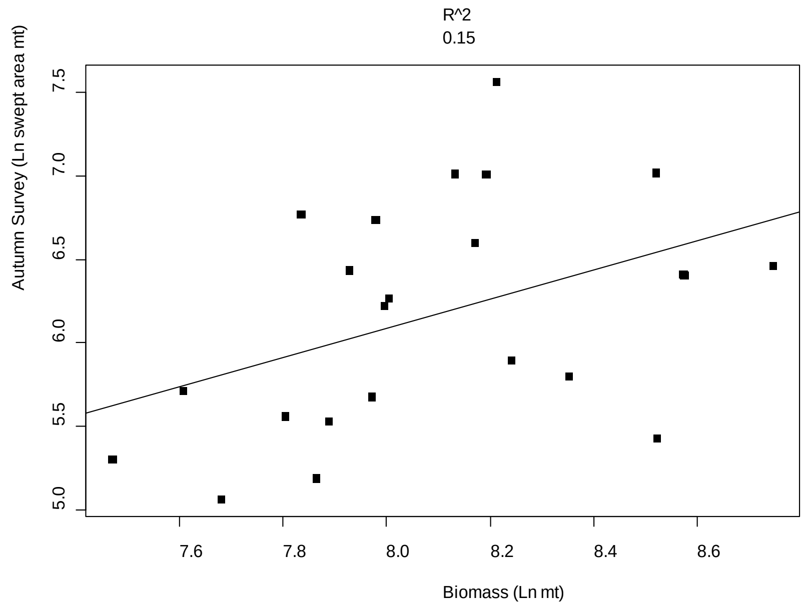


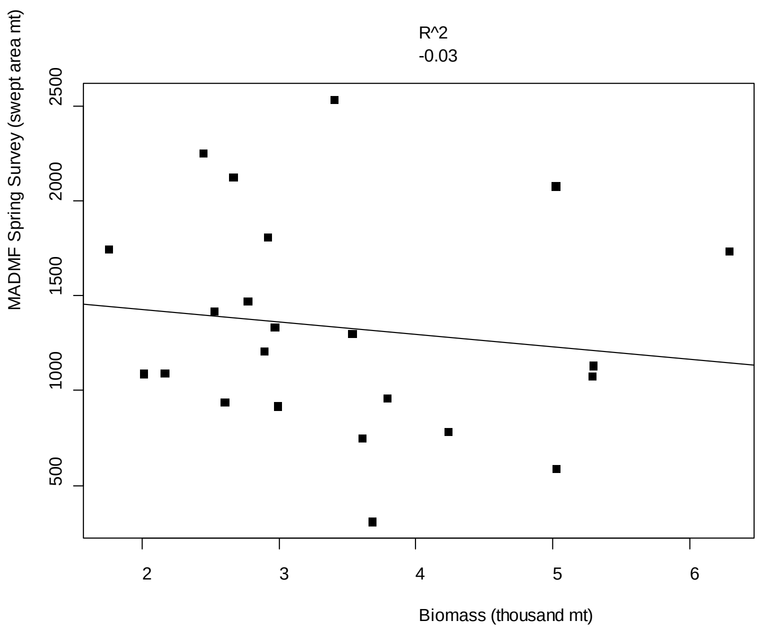
MADMF Autumn Survey
Biomass
Mean Biomass (thousand mt)
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
200
400
600
800
1000
1200
MADMF Autumn Survey (swep
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
YEAR

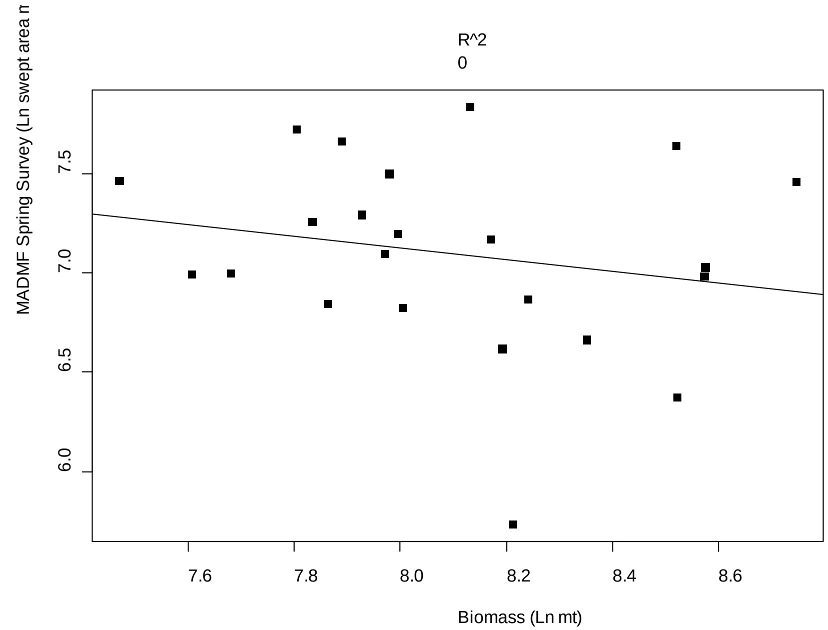

R^2
0.13
Spring Survey (swept area mt)
500
1000
1500
2000
2500
3000
3500
2
3
4
5
6
Biomass (thousand mt)

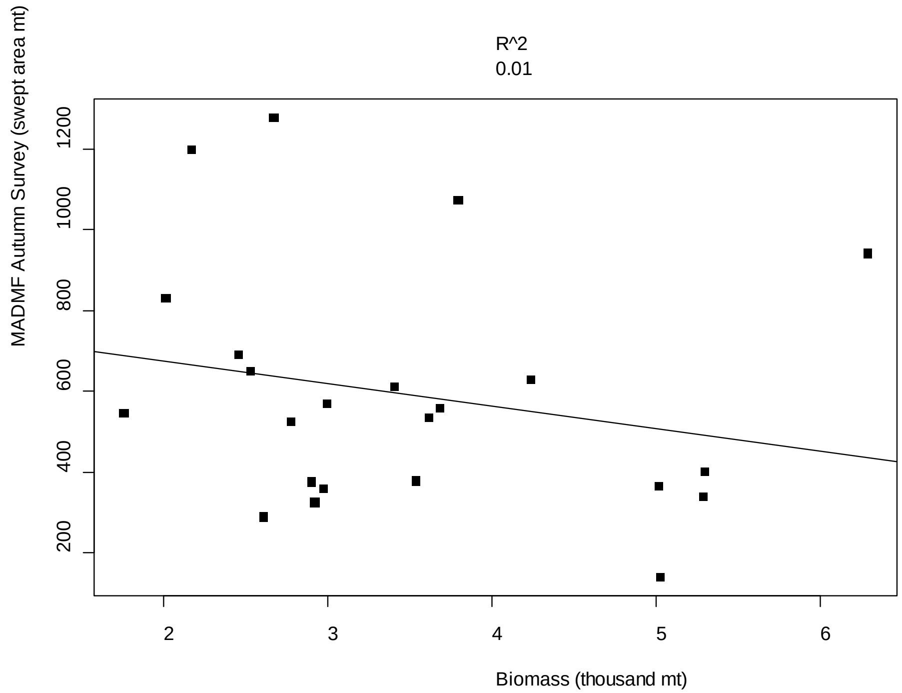

R^2
0.17
Spring Survey (Ln swept area mt)
5.5
6.0
6.5
7.0
7.5
8.0
7.6
7.8
8.0
8.2
8.4
8.6
Biomass (Ln mt)

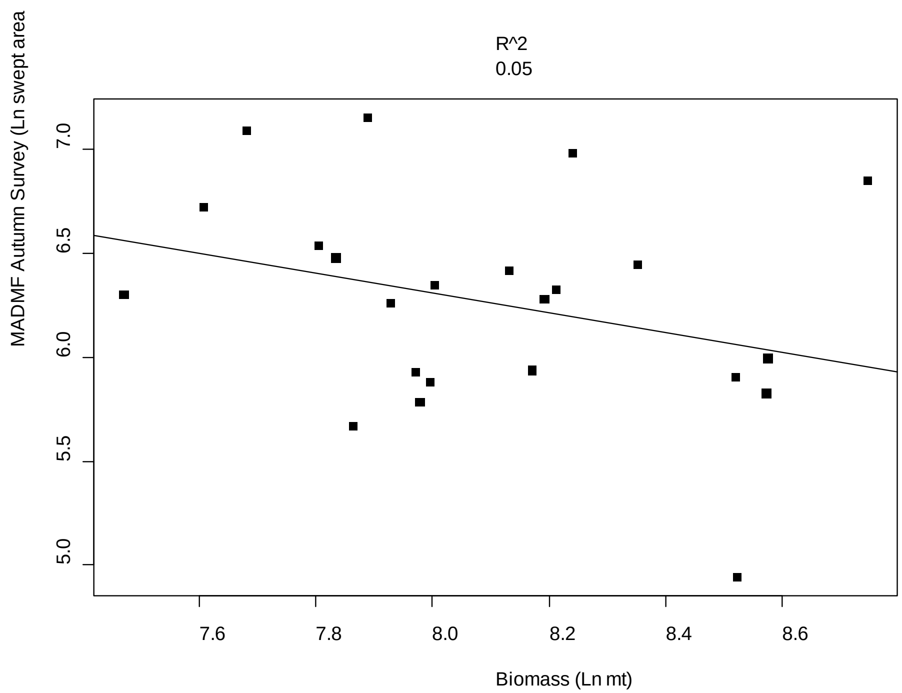

R^2
0.03
Autumn Survey (swept area mt)
500
1000
1500
2
3
4
5
6
Biomass (thousand mt)


R^2
0.15
Autumn Survey (Ln swept area mt)
5.0
5.5
6.0
6.5
7.0
7.5
7.6
7.8
8.0
8.2
8.4
8.6
Biomass (Ln mt)

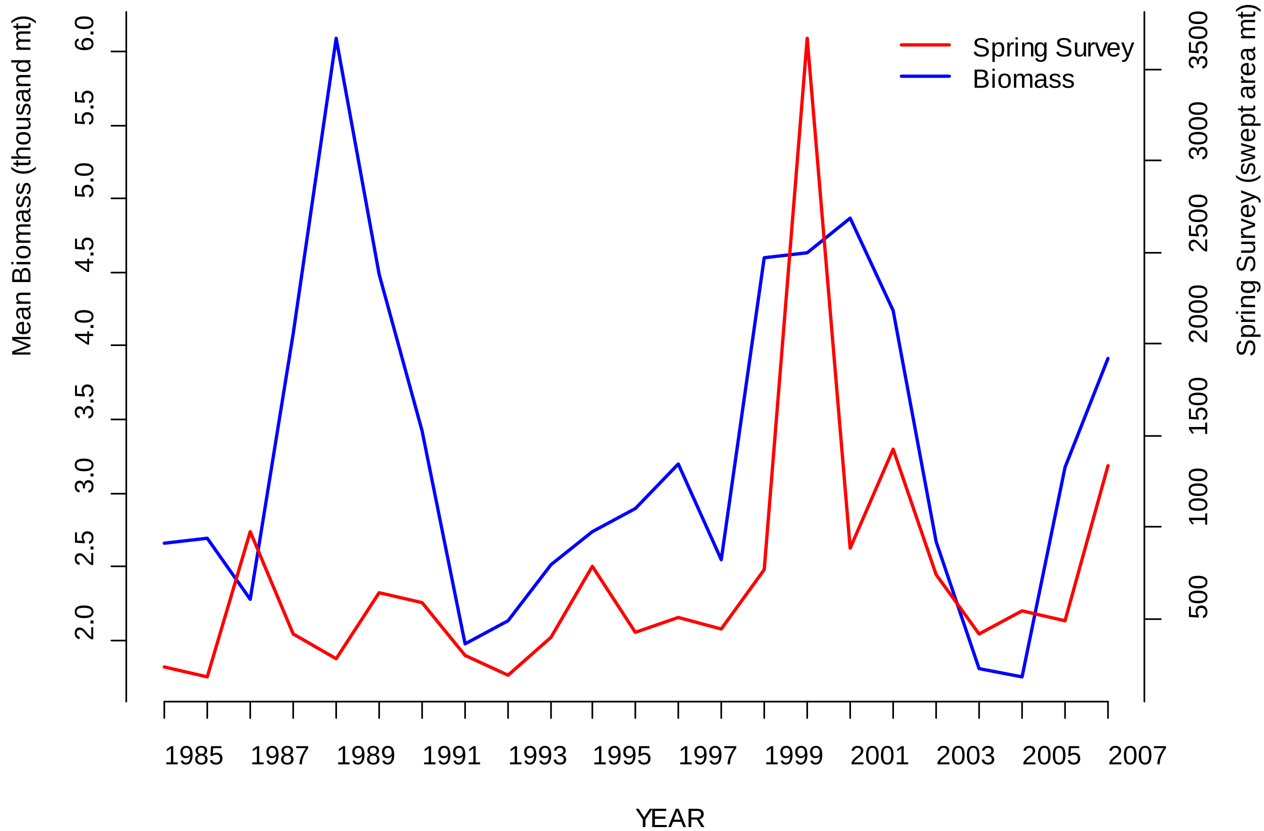

R^2
-0.03
MADMF Spring Survey (swept area mt)
Biomass (thousand mt)

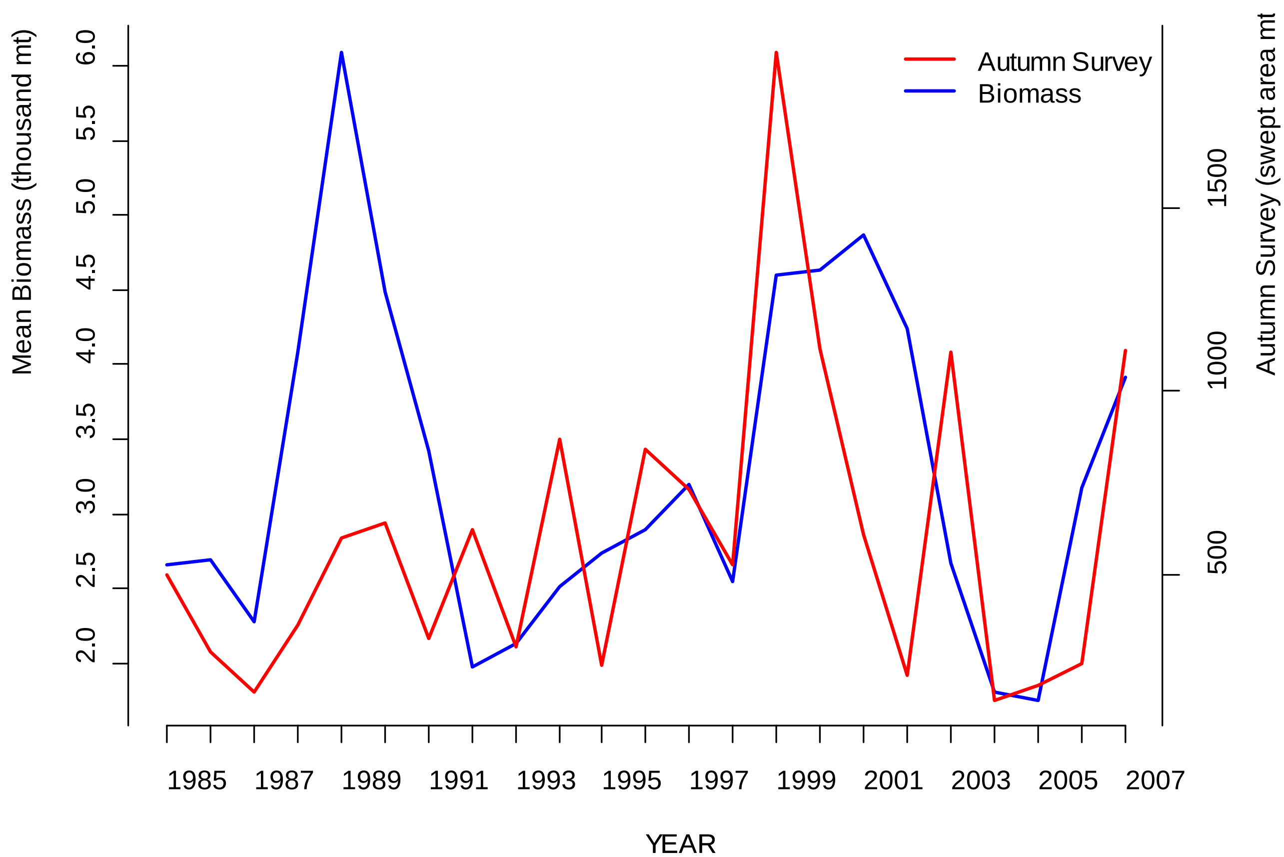

R^2
0
MADMF Spring Survey (Ln swept area n
Biomass (Ln mt)

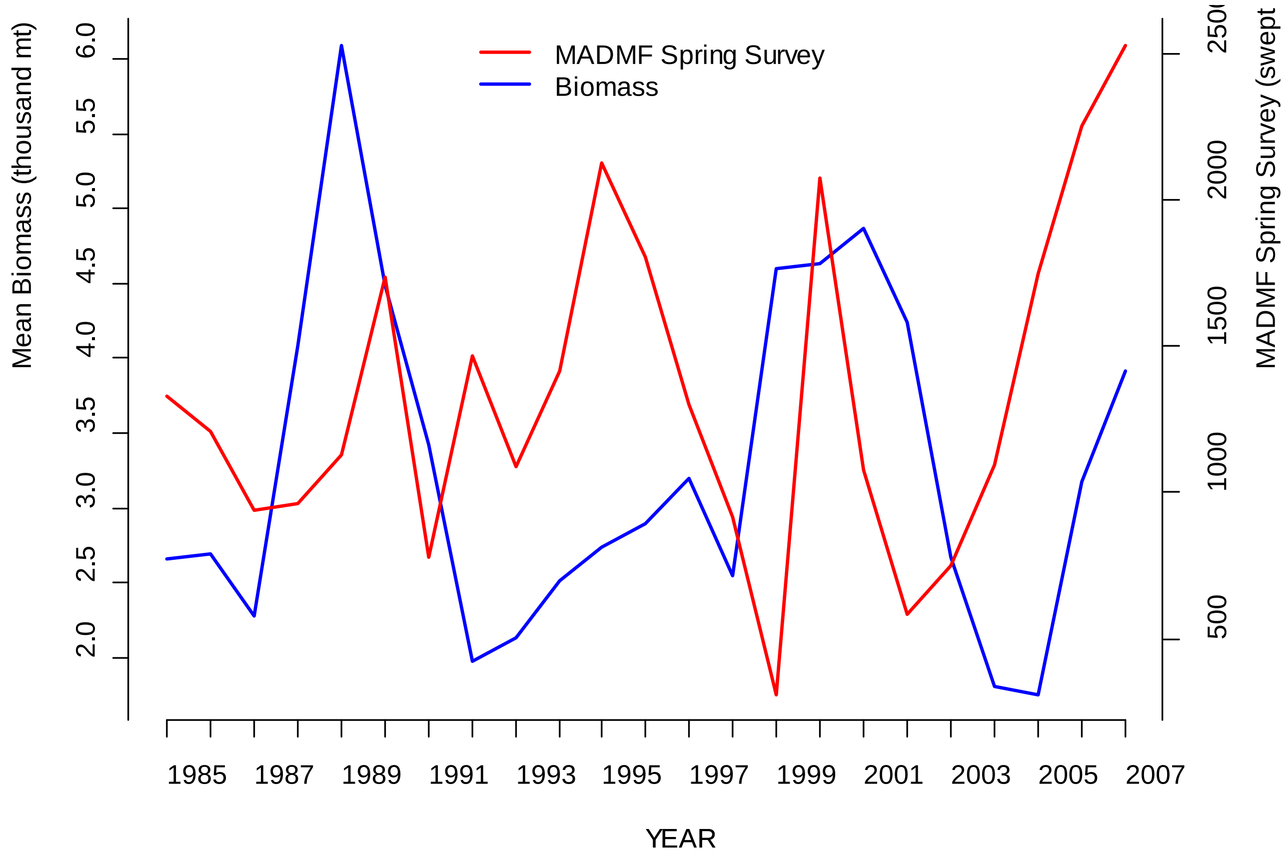

R^2
0.01
MADMF Autumn Survey (swept area mt)
Biomass (thousand mt)

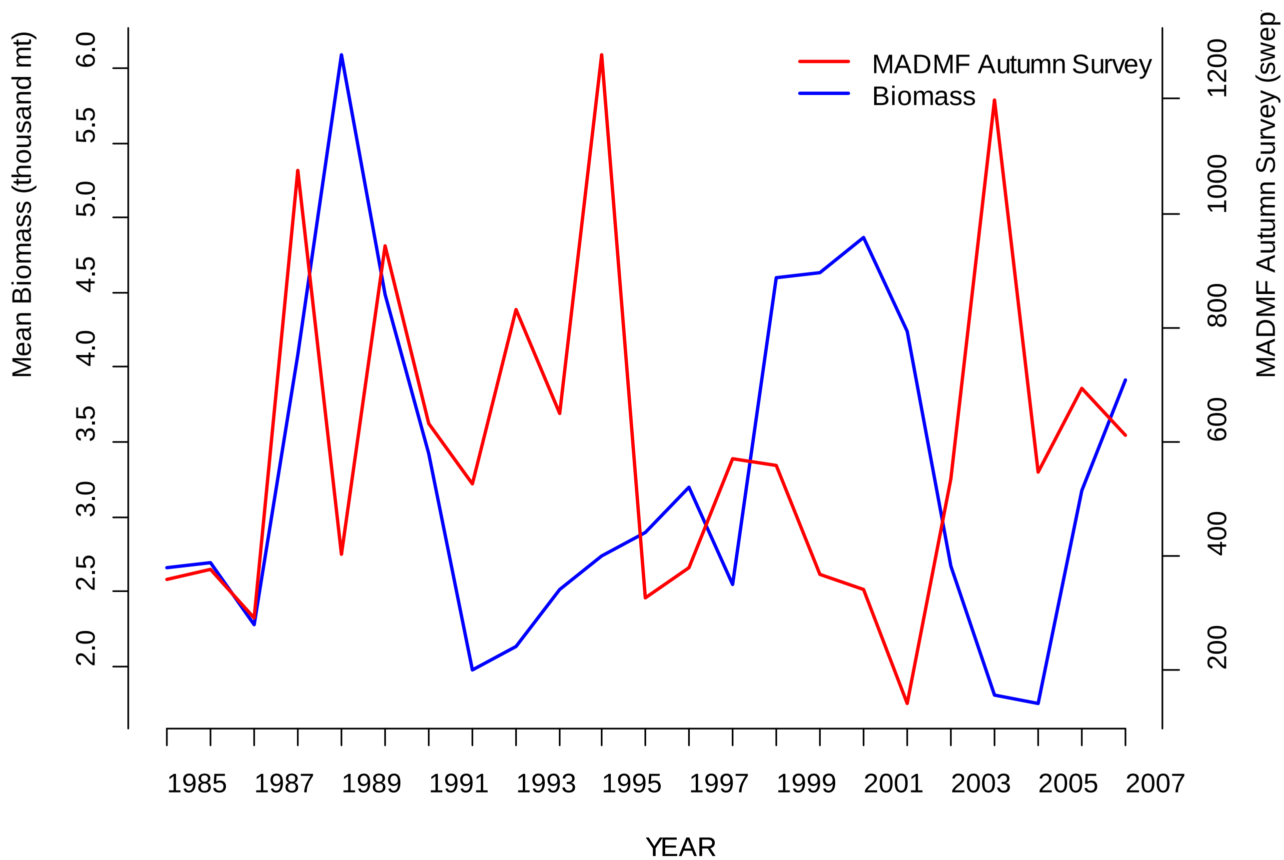

R^2
0.05
MADMF Autumn Survey (Ln swept area
Biomass (Ln mt)

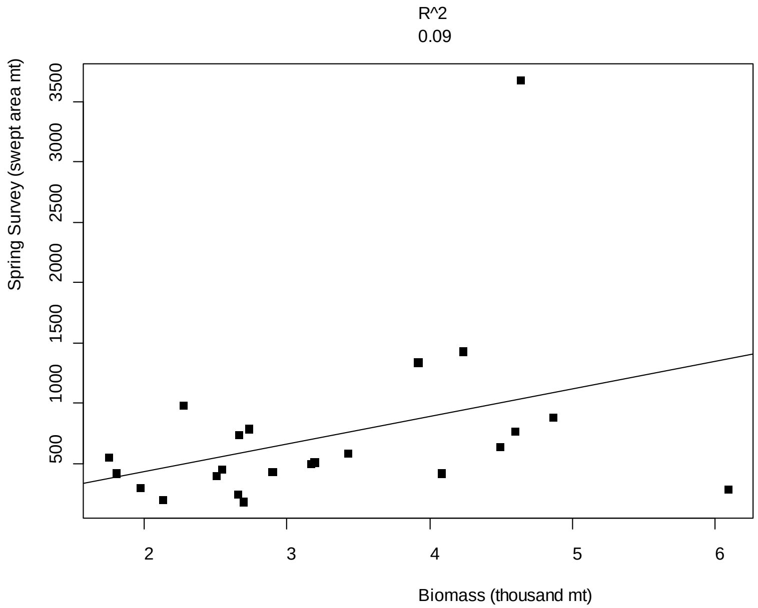
Cape Cod/Gulf of Maine Yellowtail Flounder - Mean Biomass

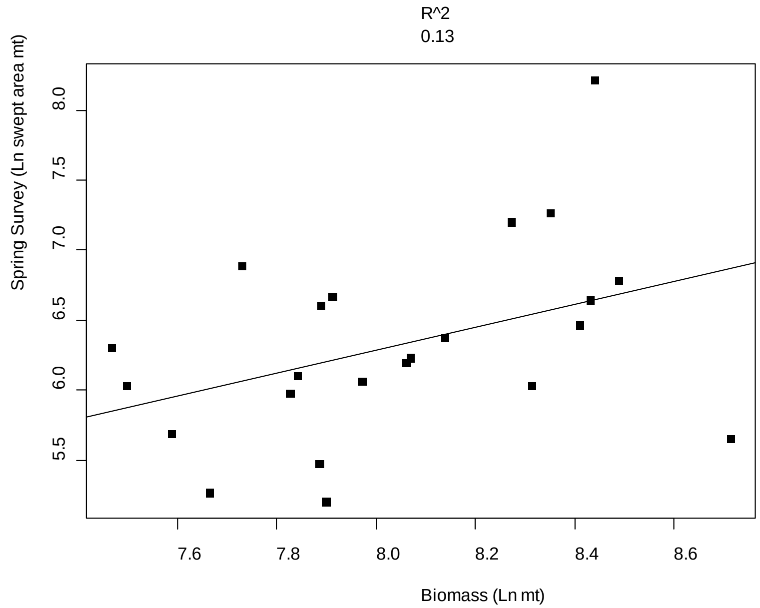


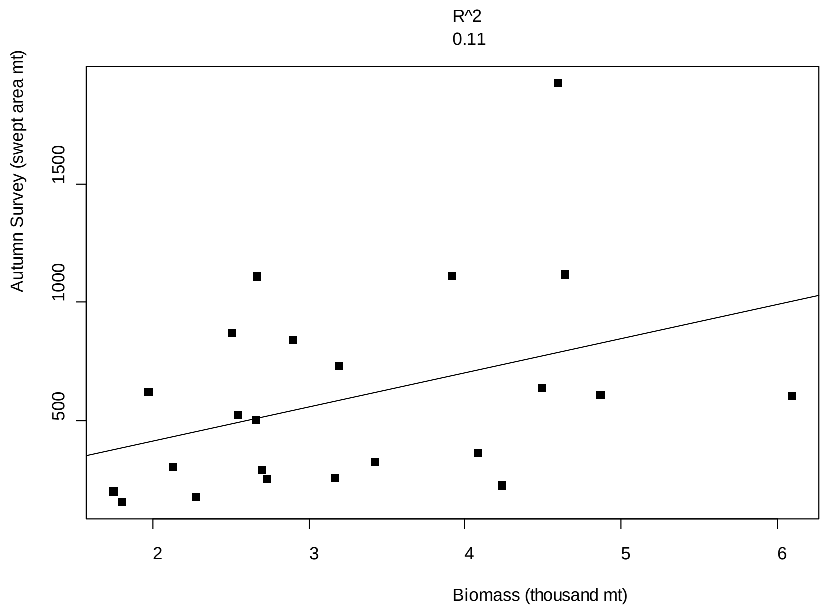


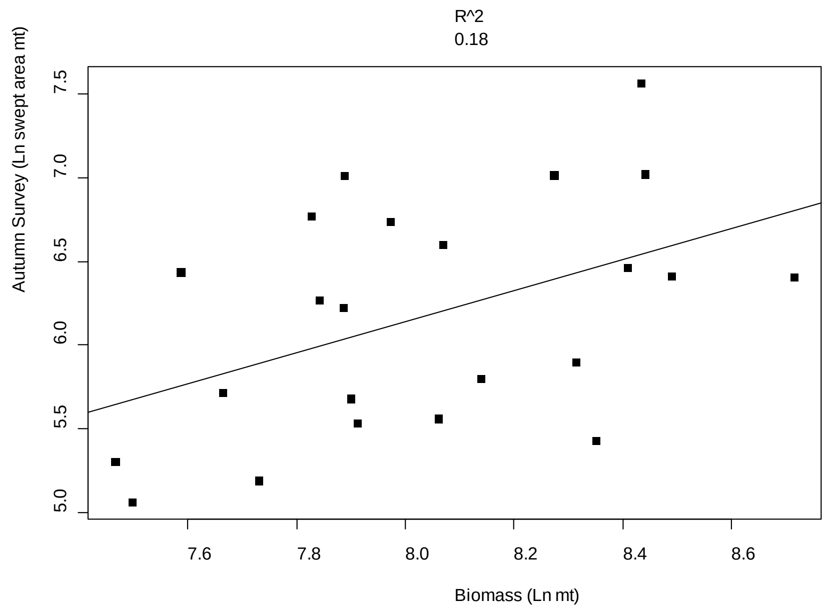

MADMF Spring Survey
Biomass
Mean Biomass (thousand mt)
MADMF Spring Survey (swept
YEAR

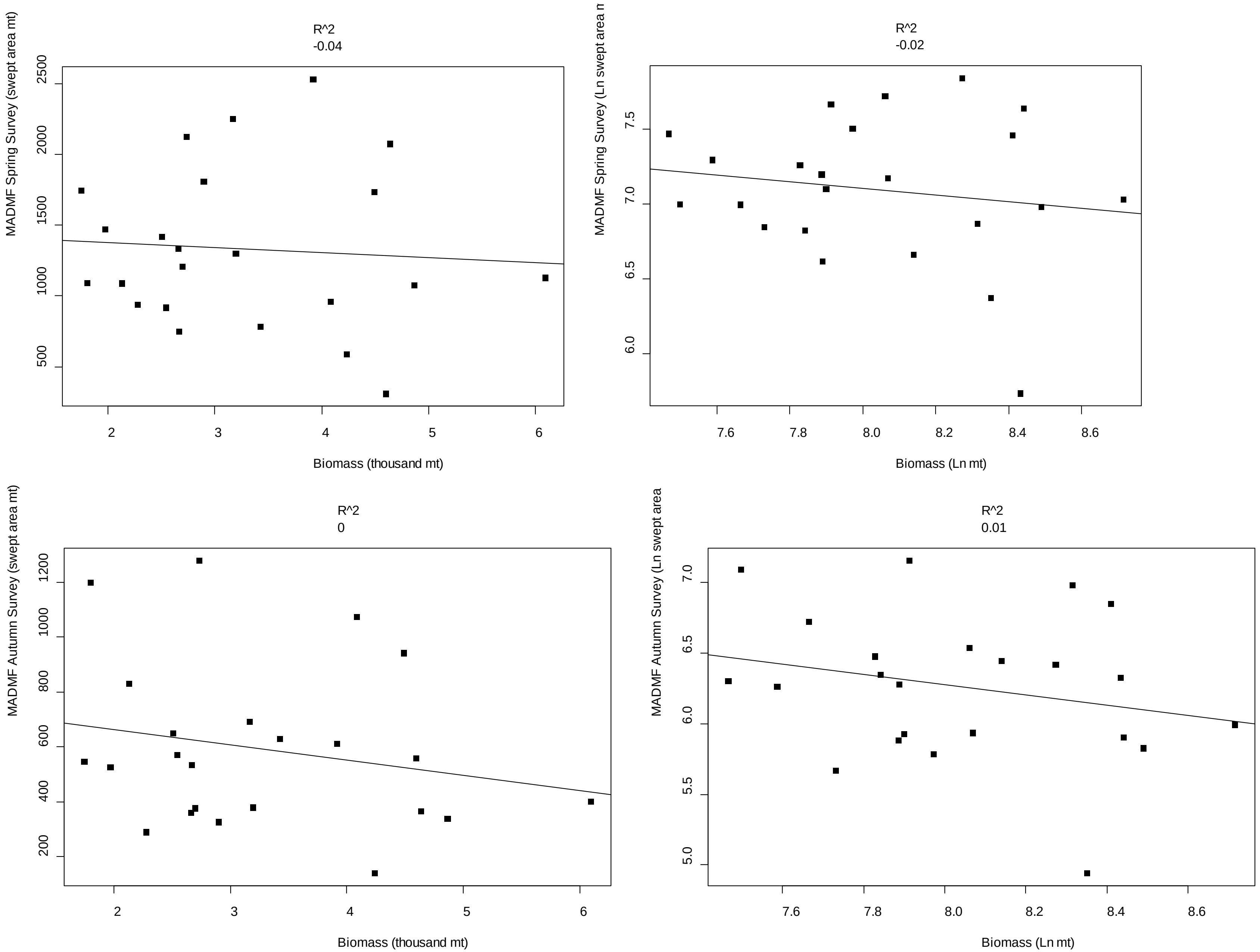

MADMF Autumn Survey
Biomass
Mean Biomass (thousand mt)
MADMF Autumn Survey (swep
YEAR


R^2
0.09
Spring Survey (swept area mt)
Biomass (thousand mt)
500
1000
1500
2000
2500
3000
3500
2
3
4
5
6

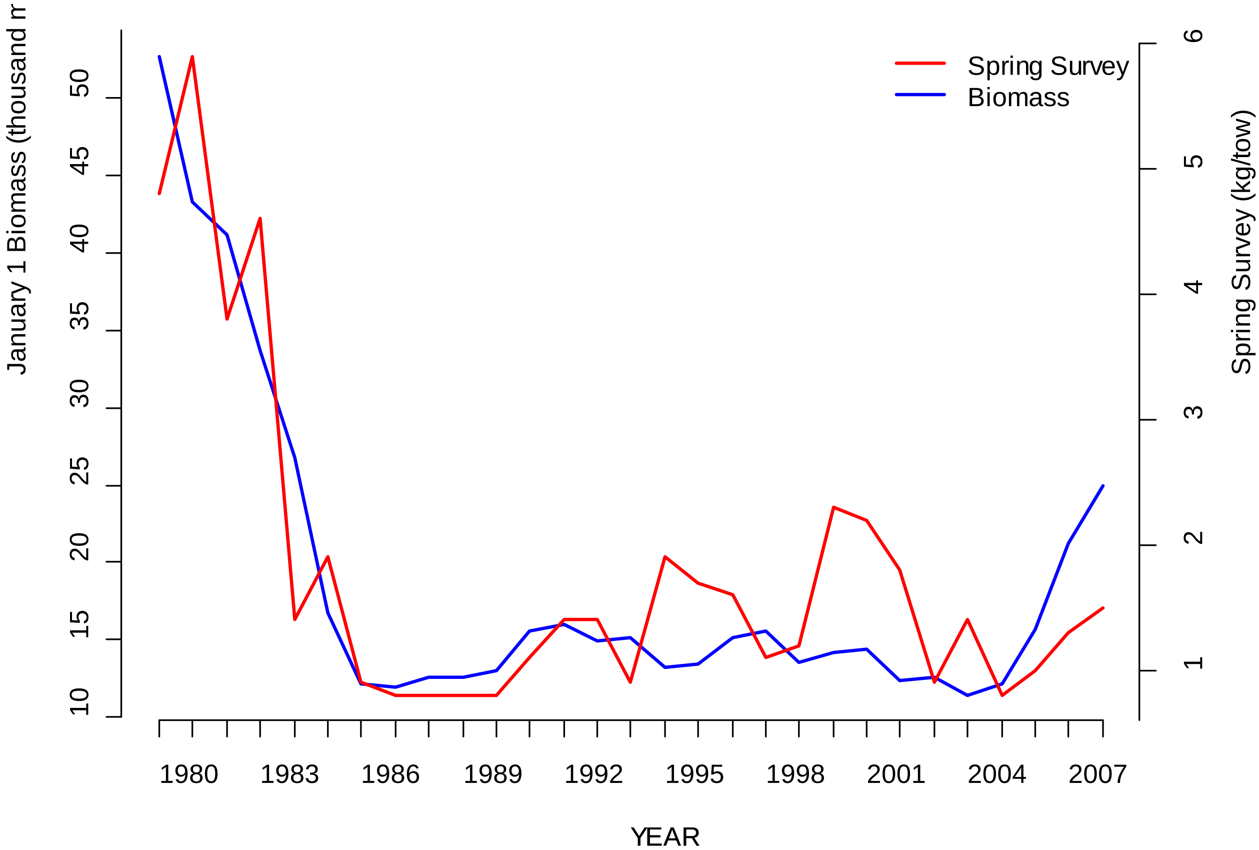

R^2
0.13
Spring Survey (Ln swept area mt)
Biomass (Ln mt)
5.5
6.0
6.5
7.0
7.5
8.0
7.6
7.8
8.0
8.2
8.4
8.6

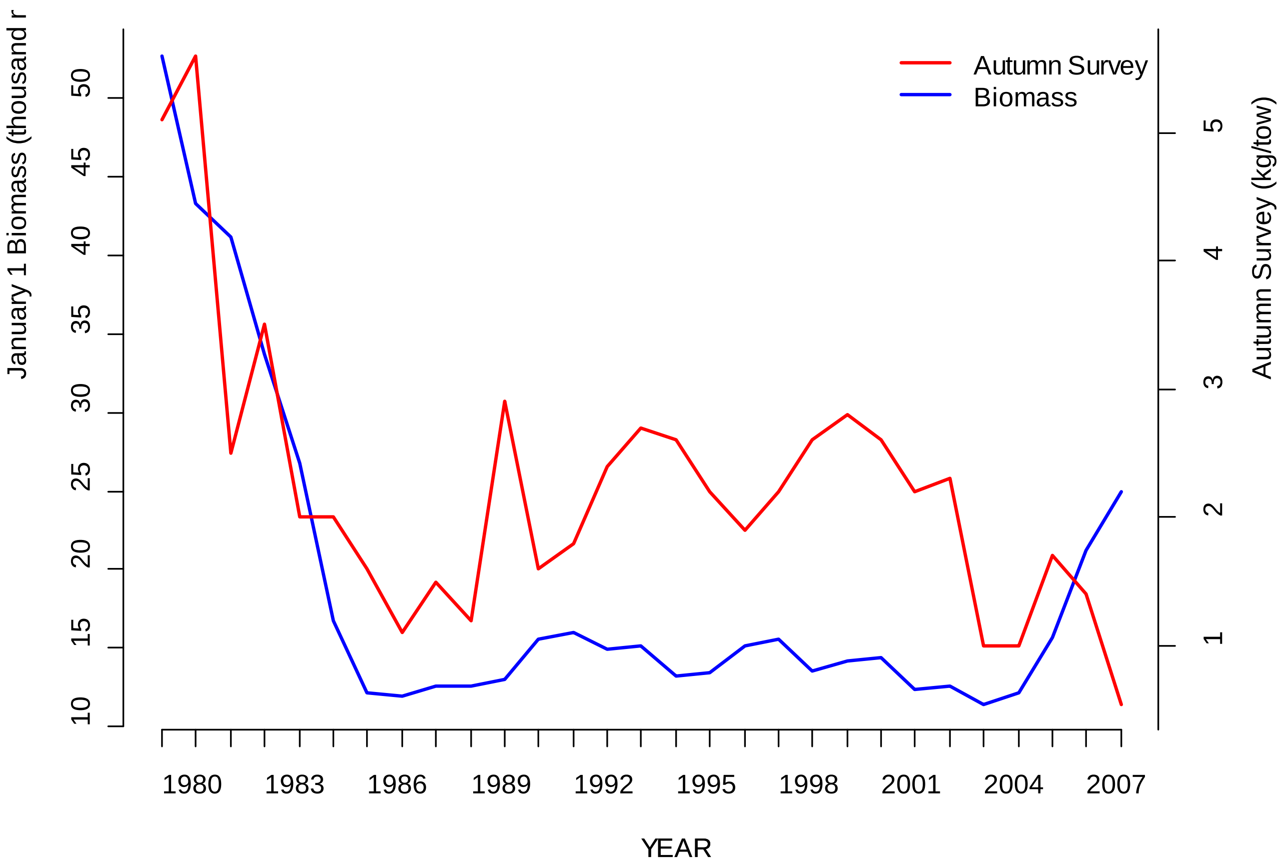

R^2
0.11
Autumn Survey (swept area mt)
Biomass (thousand mt)
500
1000
1500
2
3
4
5
6

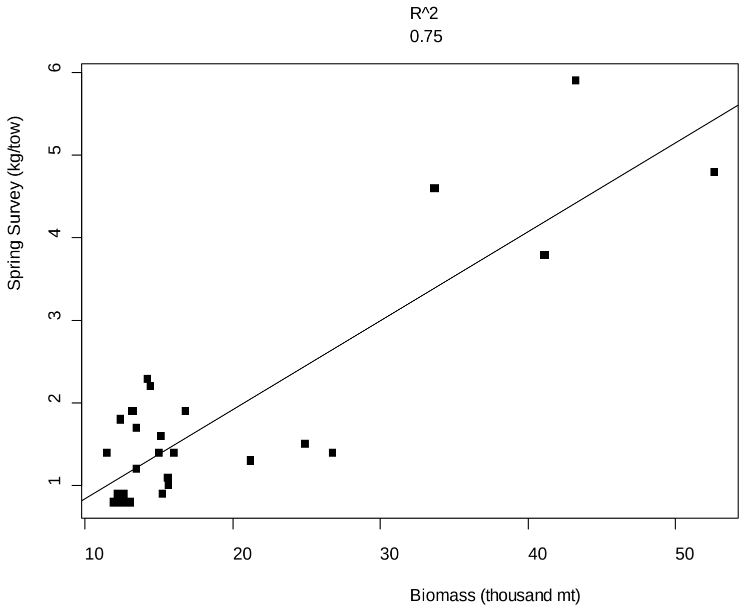

R^2
0.18
Autumn Survey (Ln swept area mt)
Biomass (Ln mt)
5.0
5.5
6.0
6.5
7.0
7.5
7.6
7.8
8.0
8.2
8.4
8.6


R^2
-0.04
MADMF Spring Survey (swept area mt)
Biomass (thousand mt)
R^2
-0.02
MADMF Spring Survey (Ln swept area n
Biomass (Ln mt)
R^2
0
MADMF Autumn Survey (swept area mt)
Biomass (thousand mt)
R^2
0.01
MADMF Autumn Survey (Ln swept area
Biomass (Ln mt)

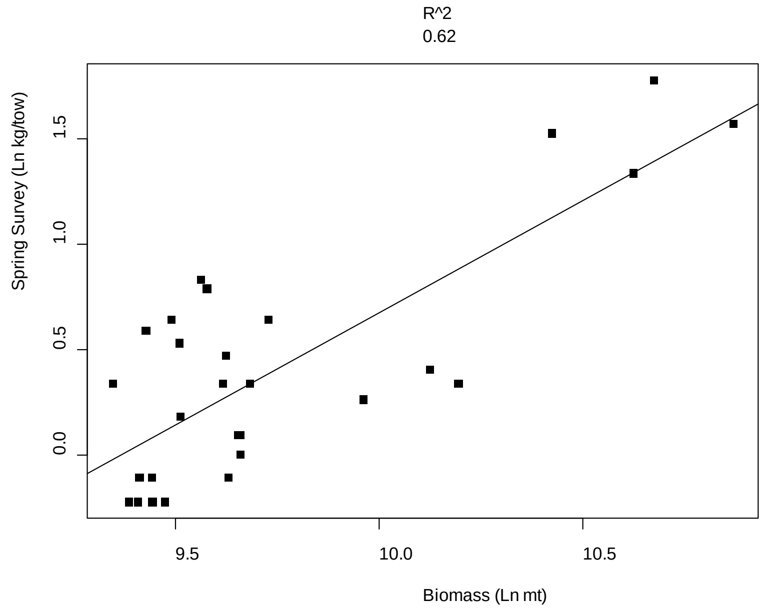
American Plaice - January 1 Biomass



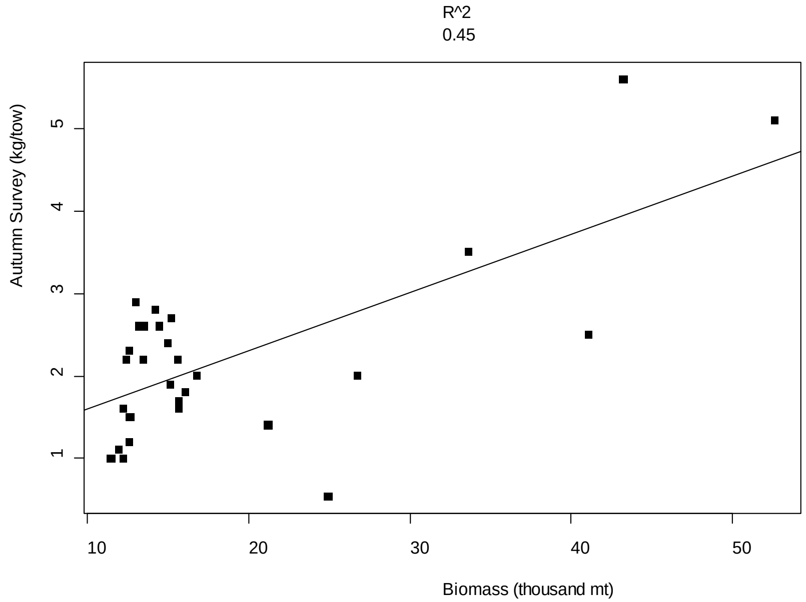




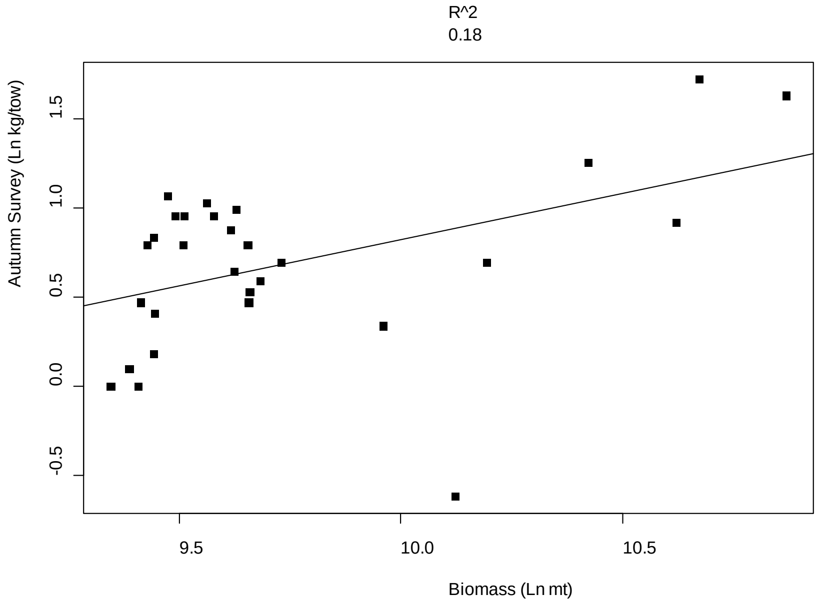
R^2
0.75
Spring Survey (kg/tow)
Biomass (thousand mt)



R^2
0.62
Spring Survey (Ln kg/tow)
Biomass (Ln mt)

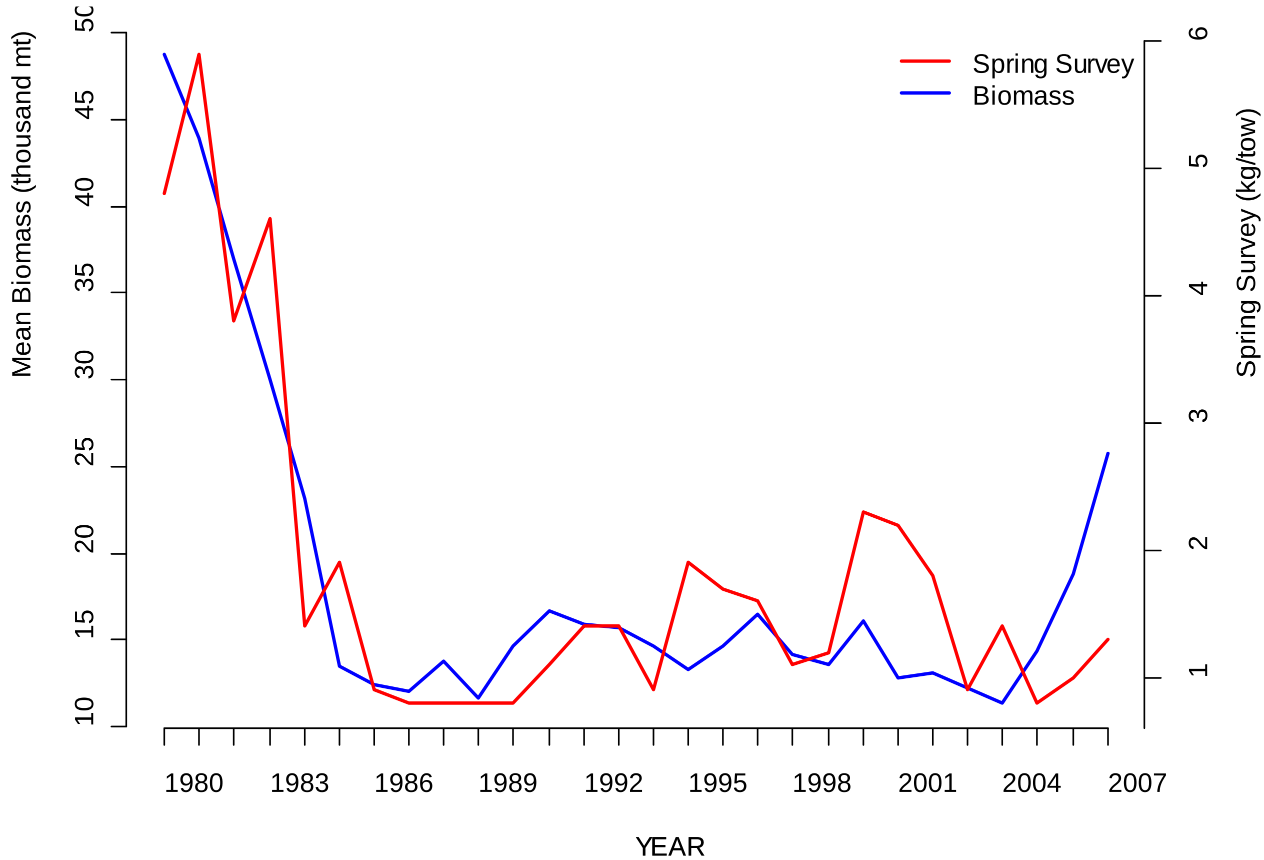


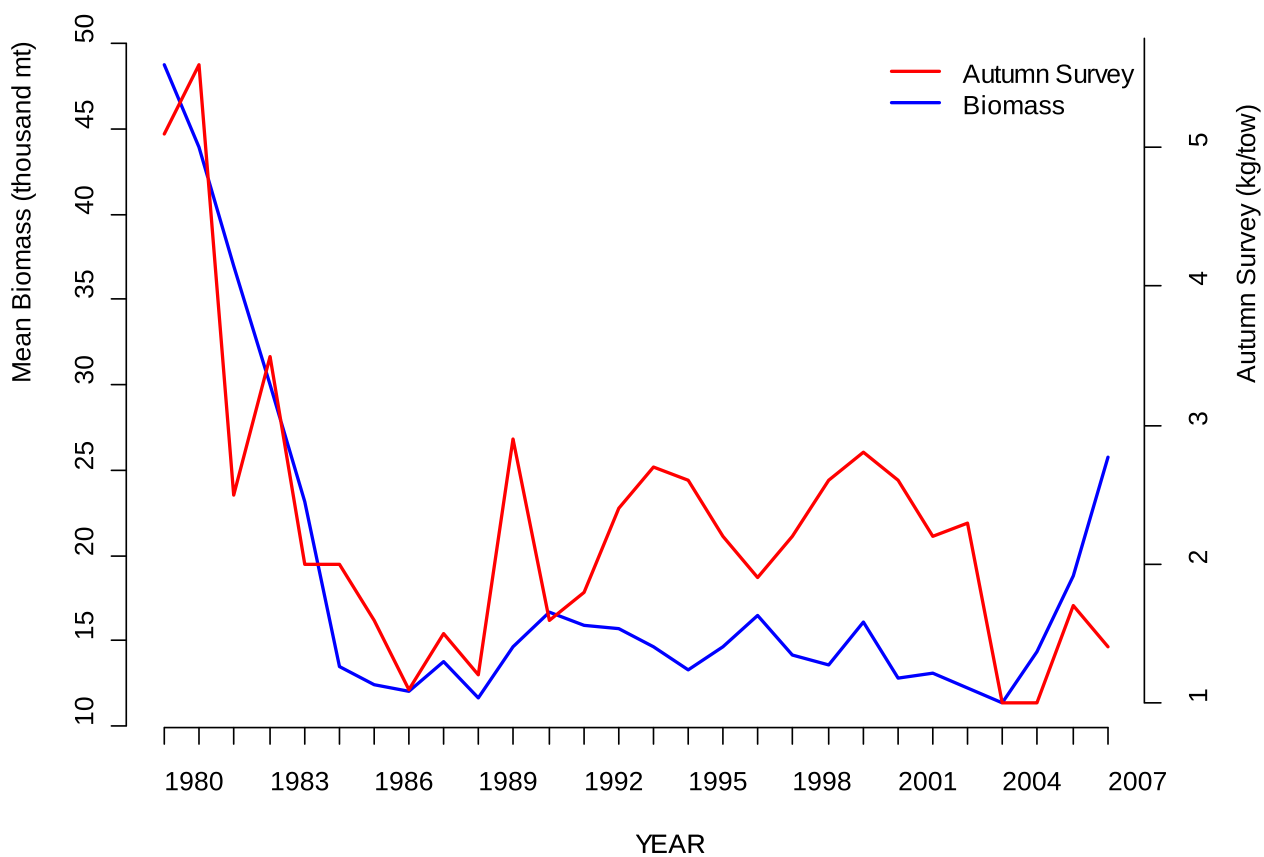
R^2
0.45
Autumn Survey (kg/tow)
Biomass (thousand mt)

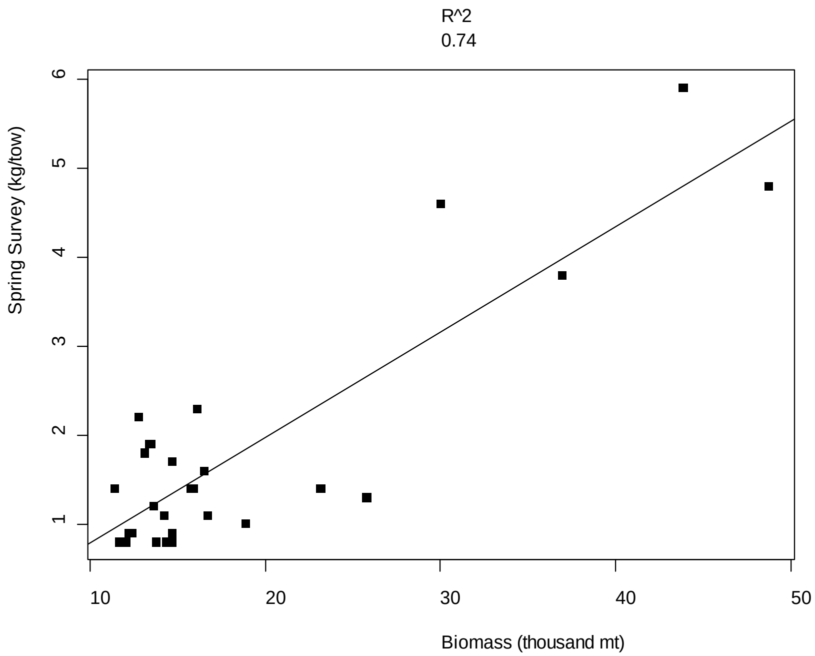


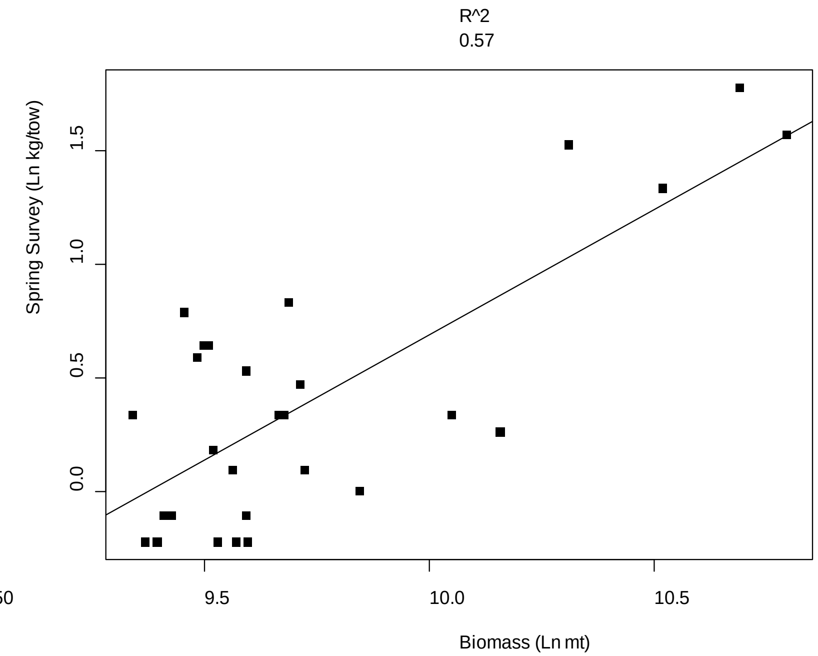
R^2
0.18
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

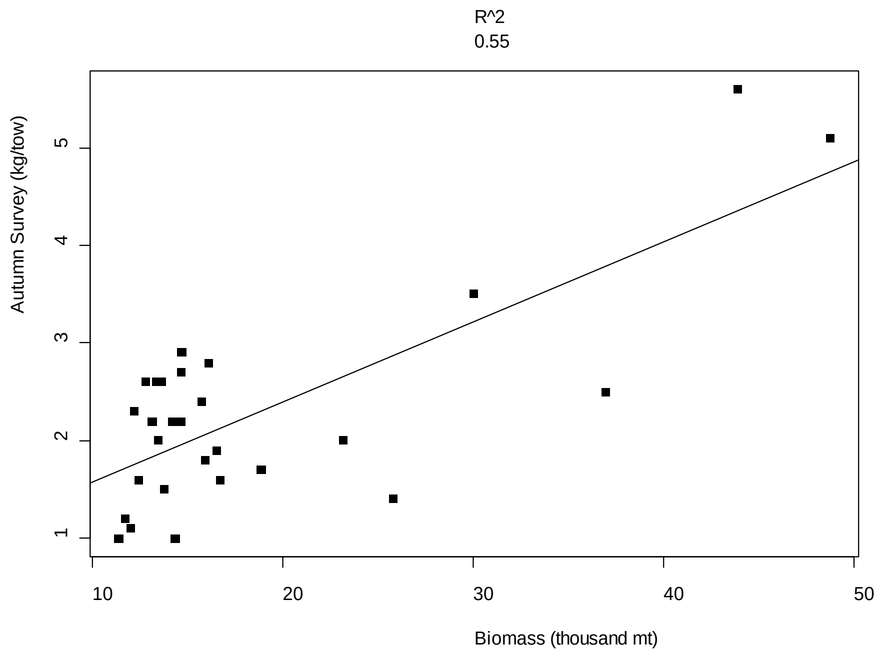
American Plaice - Mean Biomass

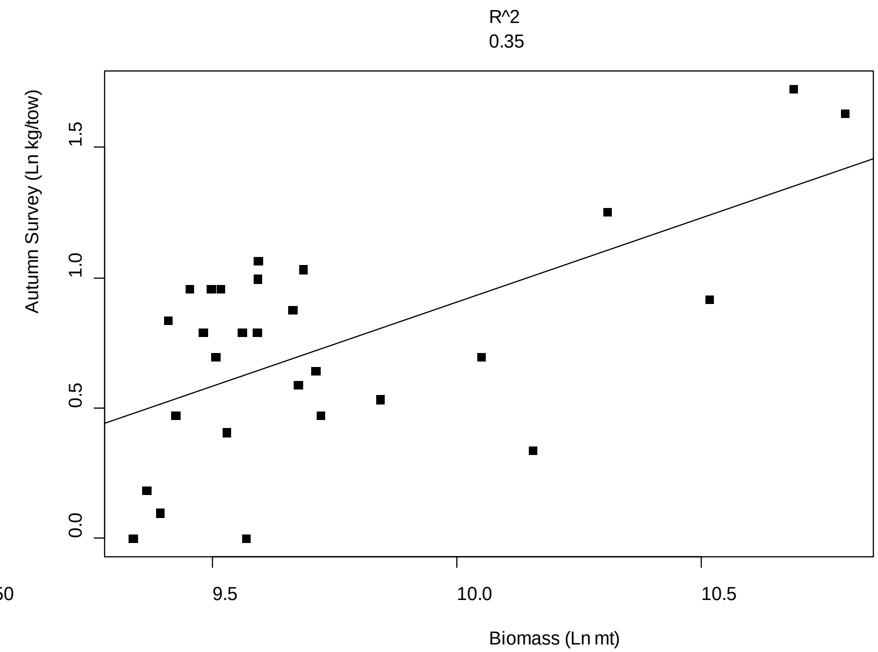




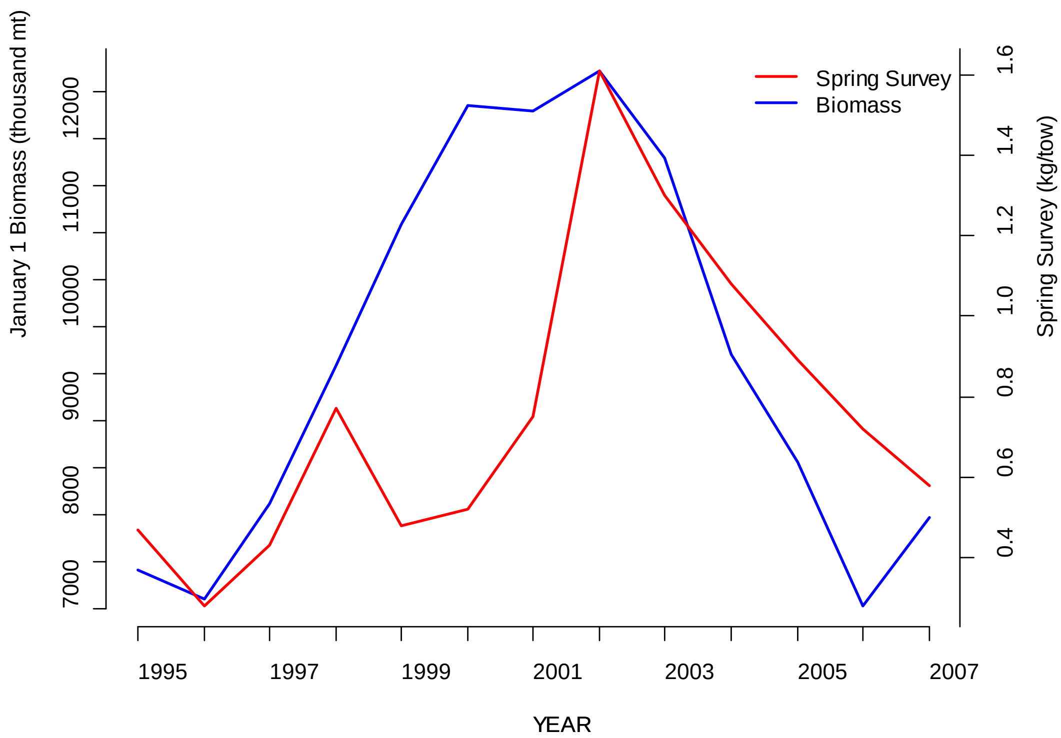

R^2
0.74
Spring Survey (kg/tow)
Biomass (thousand mt)
1
2
3
4
5
6
10
20
30
40
50

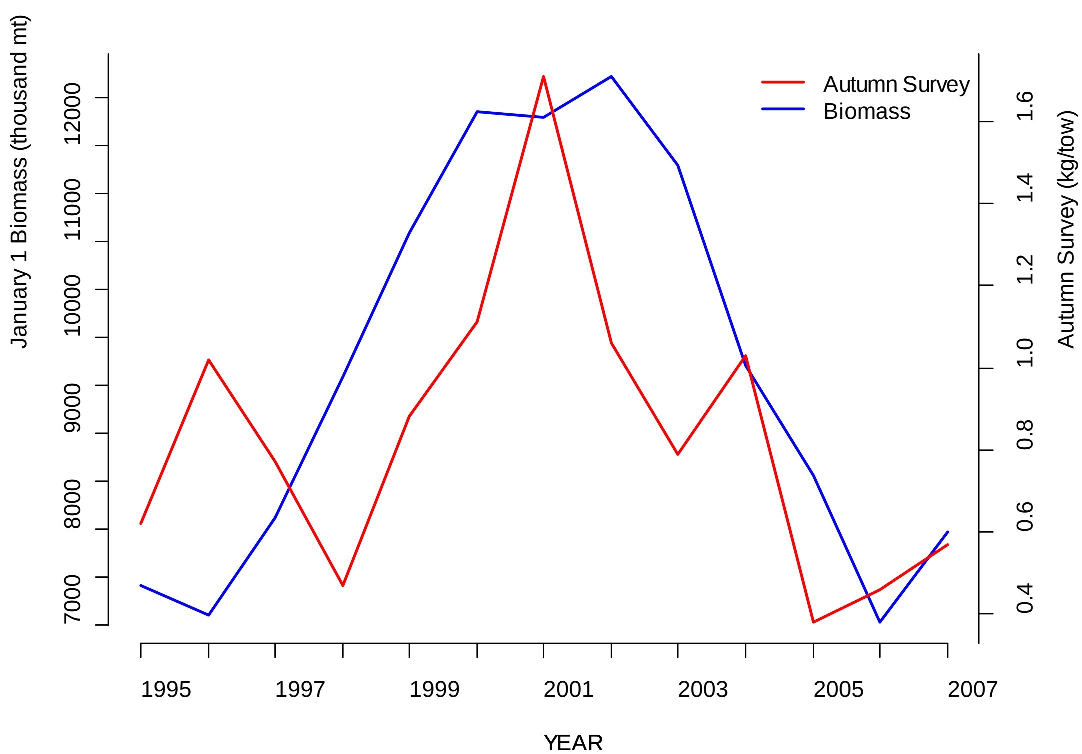

R^2
0.57
Spring Survey (Ln kg/tow)
Biomass (Ln mt)
0.0
0.5
1.0
1.5
9.5
10.0
10.5

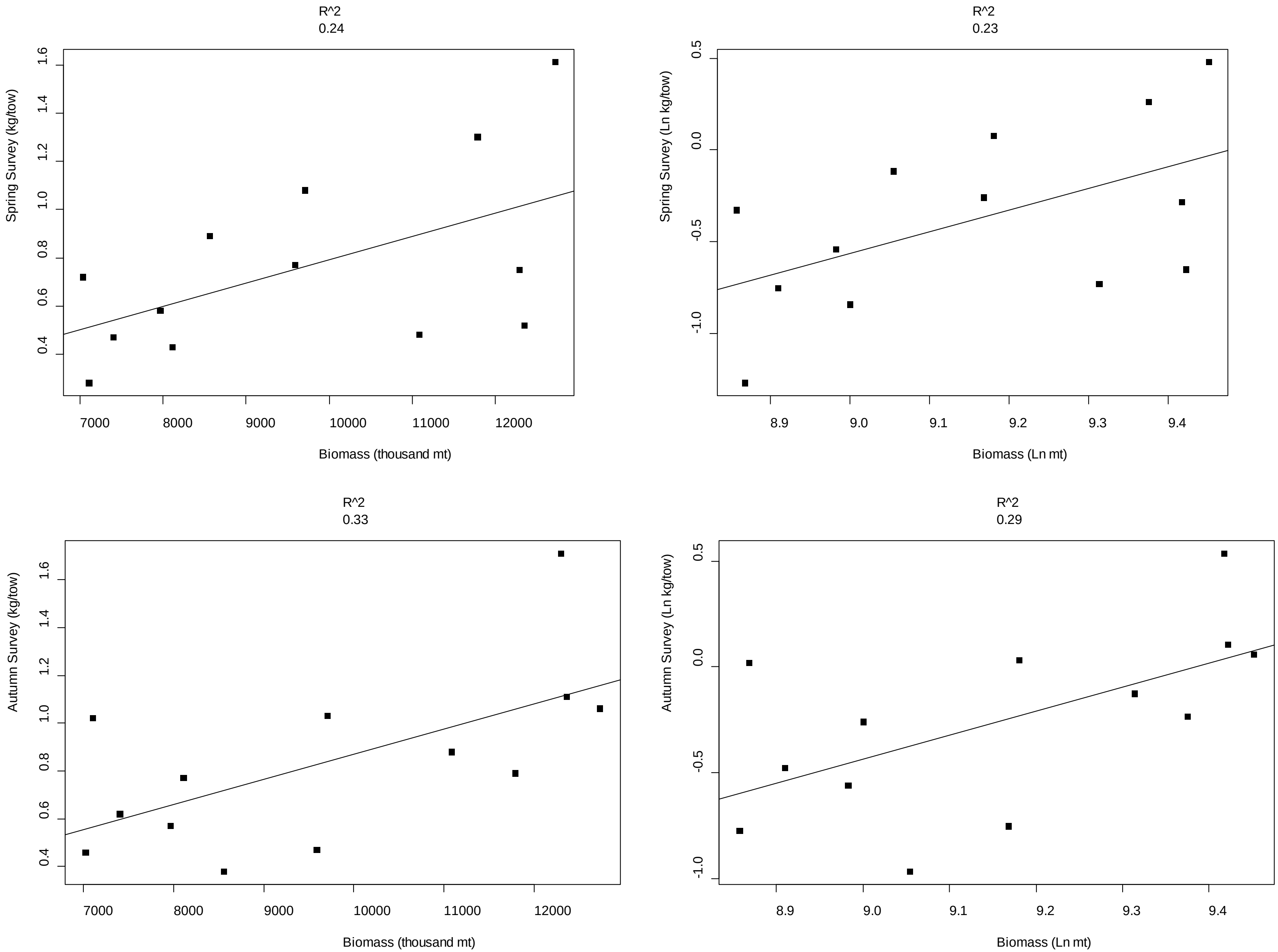

R^2
0.55
Autumn Survey (kg/tow)
Biomass (thousand mt)
1
2
3
4
5
10
20
30
40
50


R^2
0.35
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)
0.0
0.5
1.0
1.5
9.5
10.0
10.5

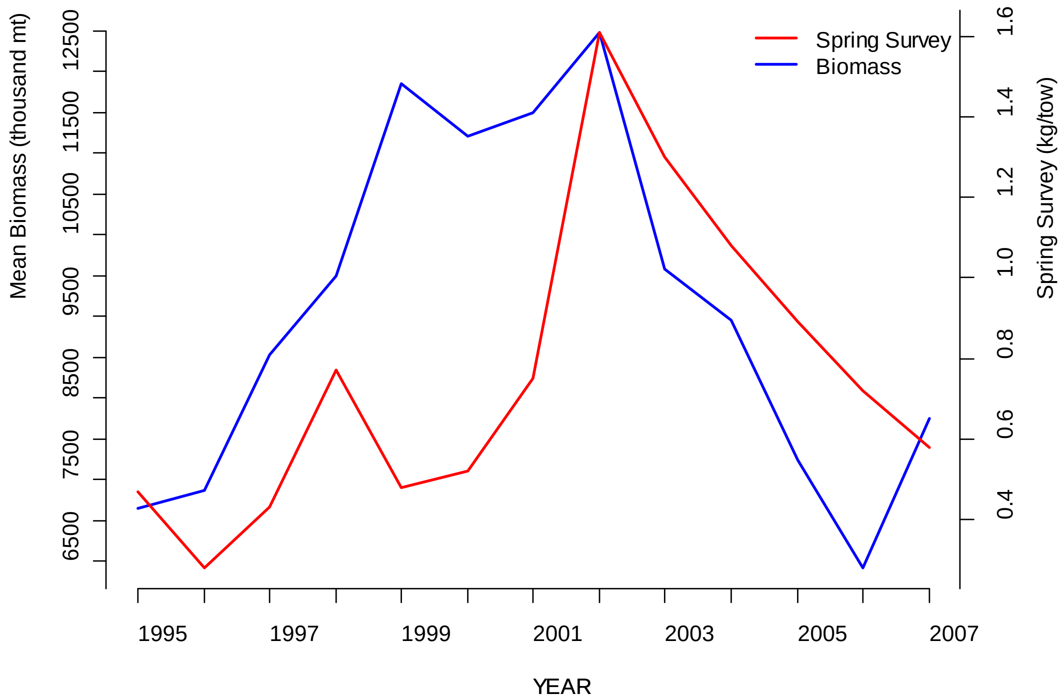
Witch Flounder - January 1 Biomass

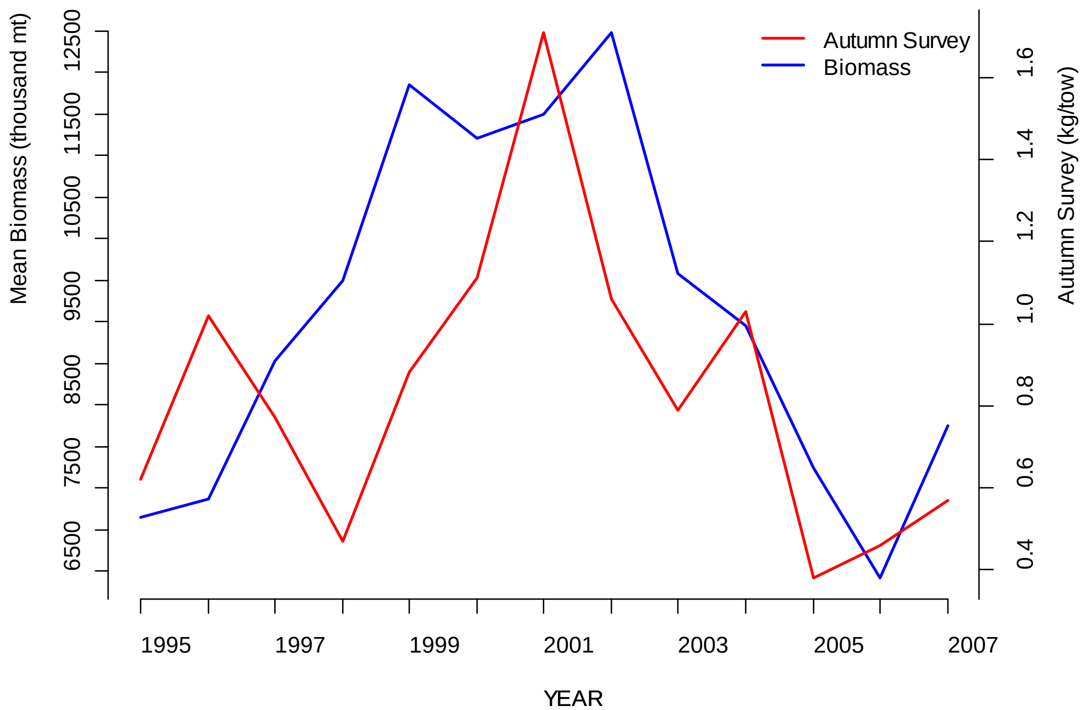


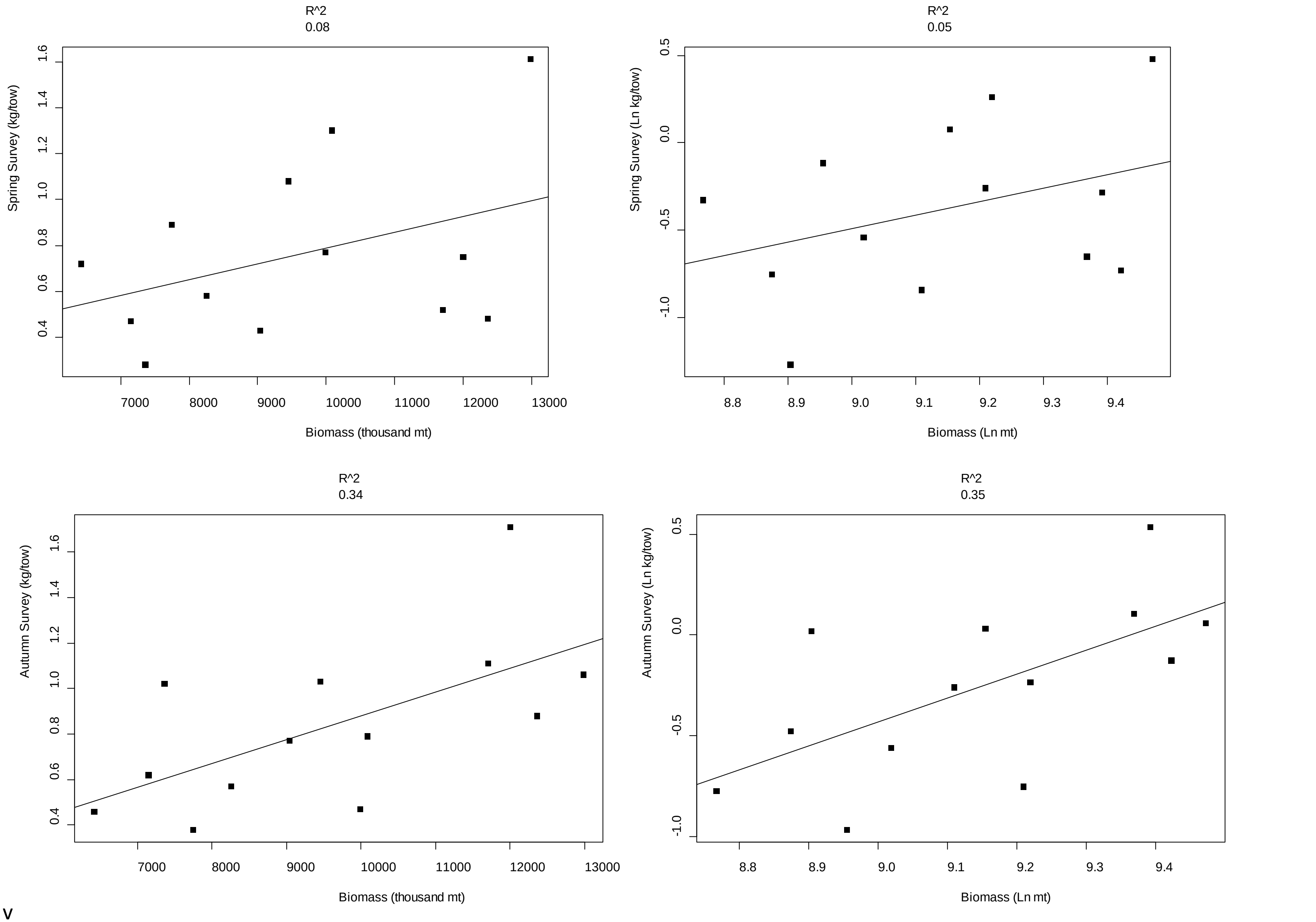



R^2
0.24
Spring Survey (kg/tow)
Biomass (thousand mt)
R^2
0.23
Spring Survey (Ln kg/tow)
Biomass (Ln mt)
R^2
0.33
Autumn Survey (kg/tow)
Biomass (thousand mt)
R^2
0.29
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

Witch Flounder - Mean Biomass



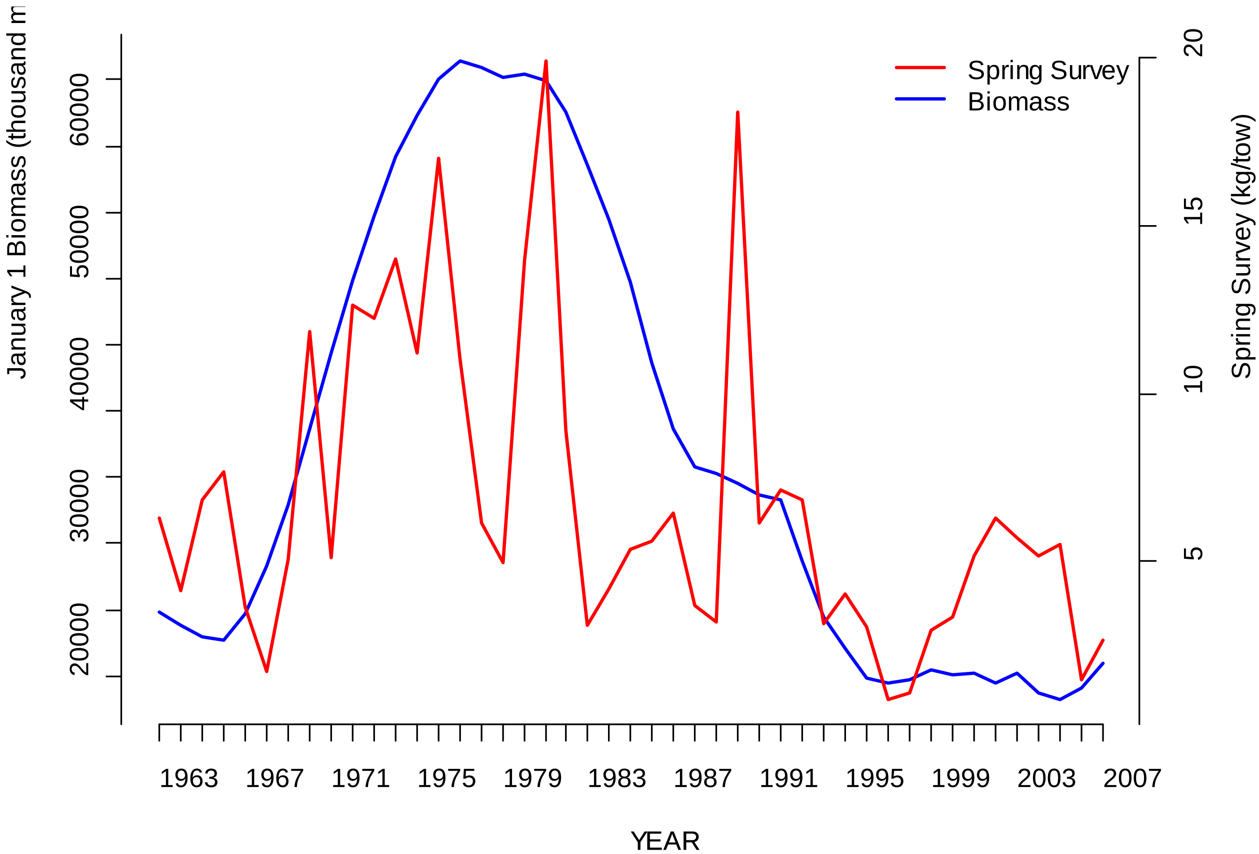


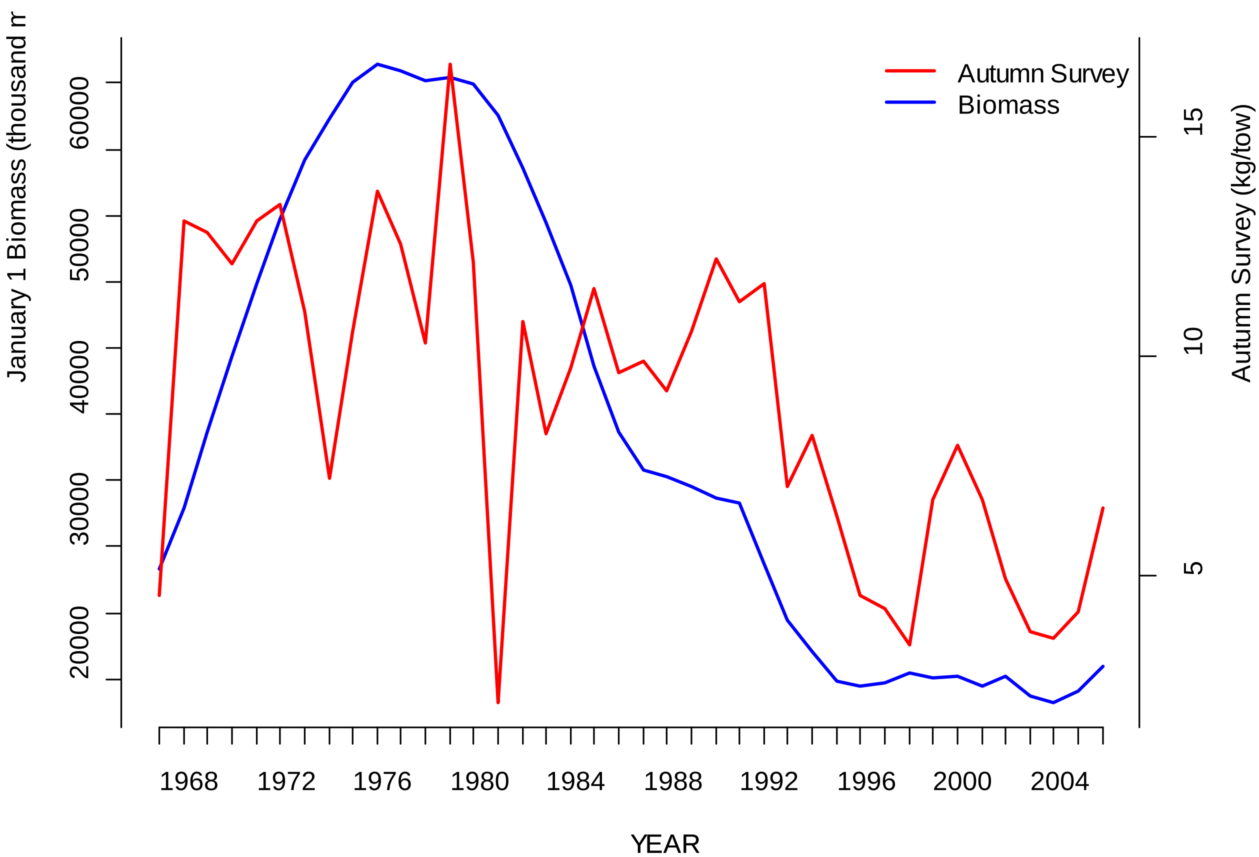


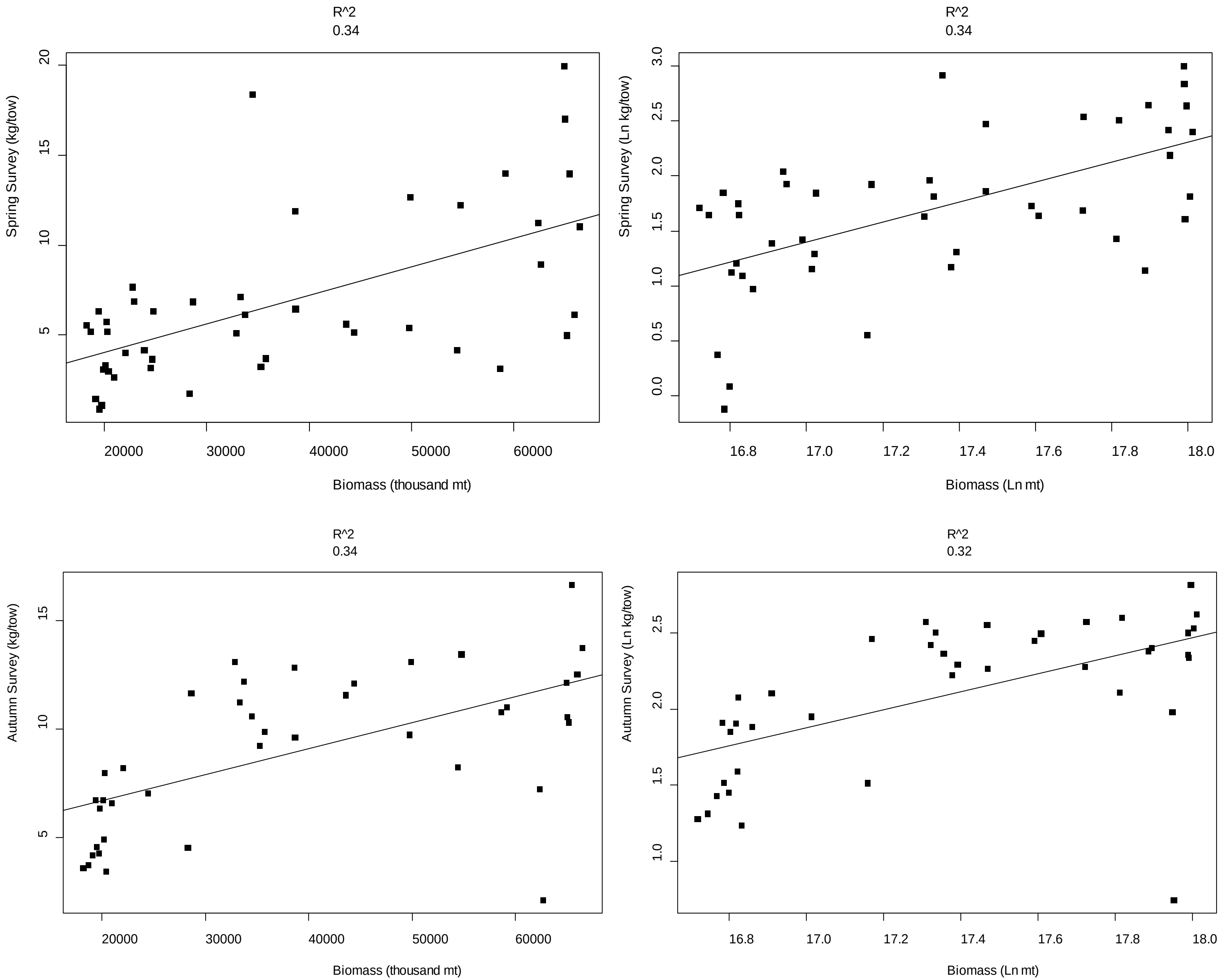
R^2
0.08
Spring Survey (kg/tow)
0.4
0.6
0.8
1.0
1.2
1.4
1.6
7000
8000
9000
10000
11000
12000
13000
Biomass (thousand mt)
R^2
0.05
Spring Survey (Ln kg/tow)
-1.0
-0.5
0.0
0.5
8.8
8.9
9.0
9.1
9.2
9.3
9.4
Biomass (Ln mt)
R^2
0.34
Autumn Survey (kg/tow)
0.4
0.6
0.8
1.0
1.2
1.4
1.6
7000
8000
9000
10000
11000
12000
13000
Biomass (thousand mt)
R^2
0.35
Autumn Survey (Ln kg/tow)
-1.0
-0.5
0.0
0.5
8.8
8.9
9.0
9.1
9.2
9.3
9.4
Biomass (Ln mt)

v

Hake - January 1 Biomass – Using average stock weights from last 5 years (1)

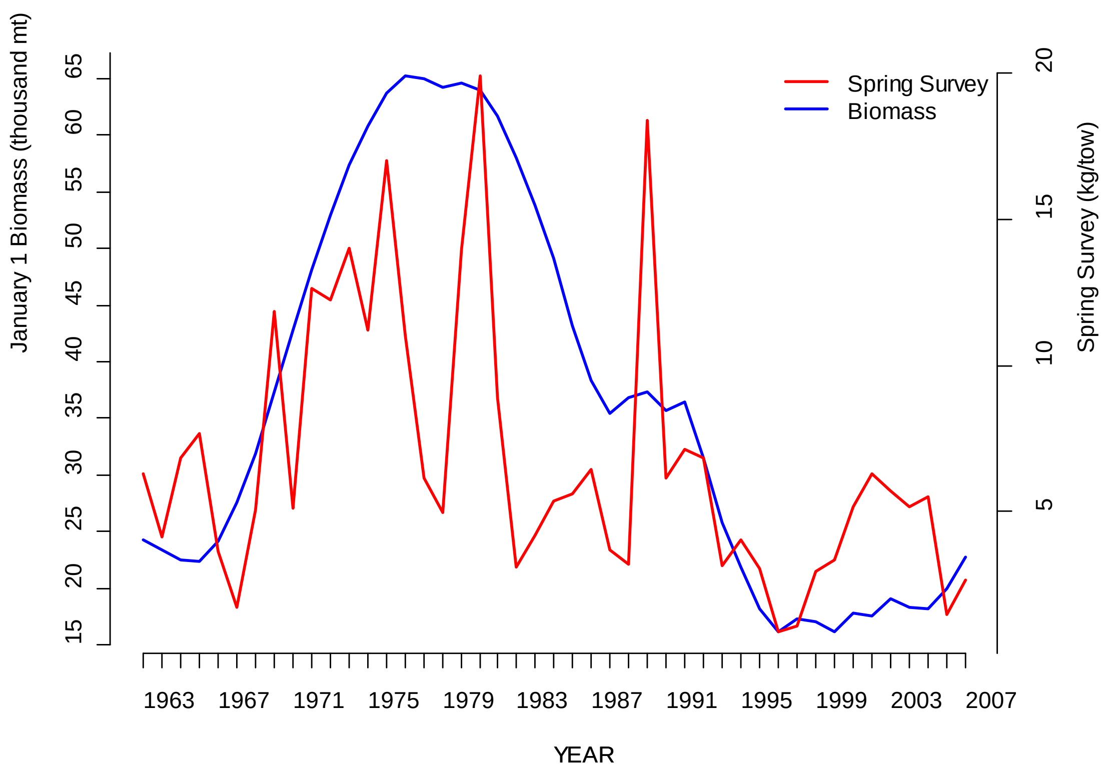


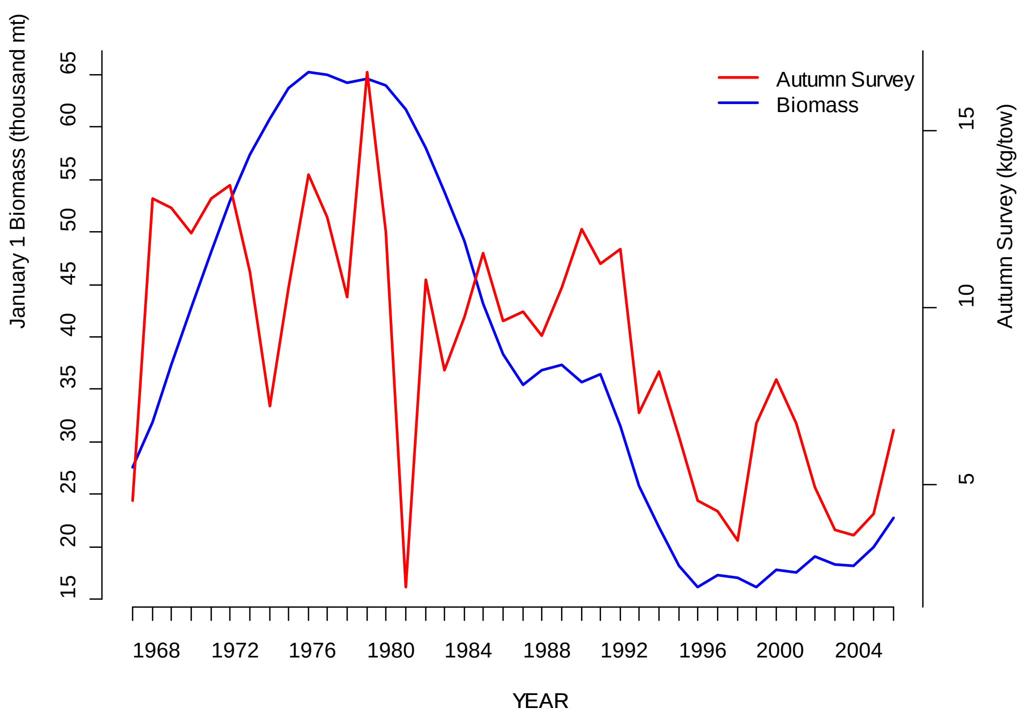


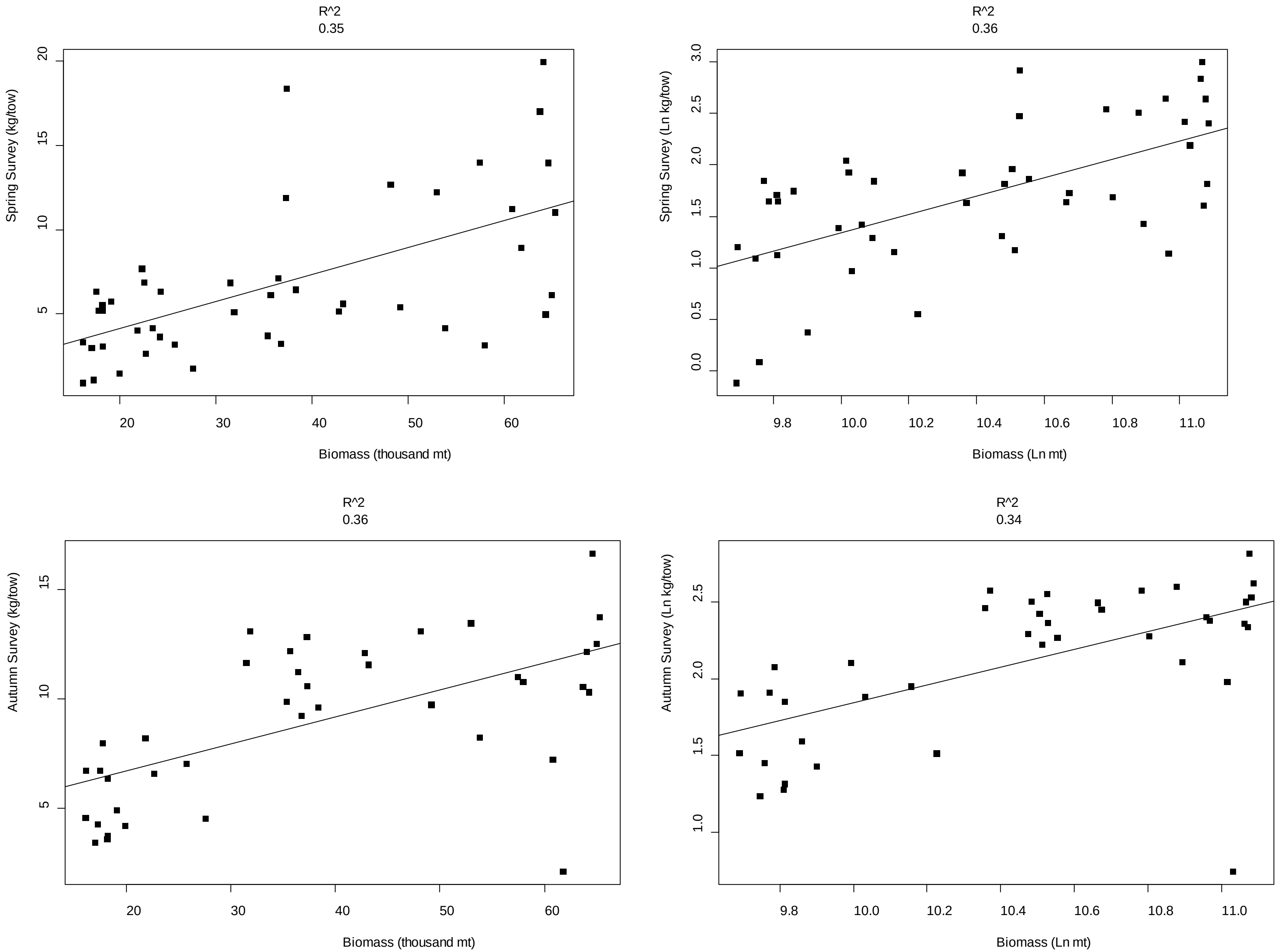


R^2
0.34
Spring Survey (kg/tow)
Biomass (thousand mt)
R^2
0.34
Spring Survey (Ln kg/tow)
Biomass (Ln mt)
R^2
0.34
Autumn Survey (kg/tow)
Biomass (thousand mt)
R^2
0.32
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

Hake - January 1 Biomass – Using Rivard weights 1989-2007 (2)






R^2
0.35
Spring Survey (kg/tow)
Biomass (thousand mt)
R^2
0.36
Spring Survey (Ln kg/tow)
Biomass (Ln mt)
R^2
0.36
Autumn Survey (kg/tow)
Biomass (thousand mt)
R^2
0.34
Autumn Survey (Ln kg/tow)
Biomass (Ln mt)

Attachment (b)

Appendix

Data and Regression Diagnostics

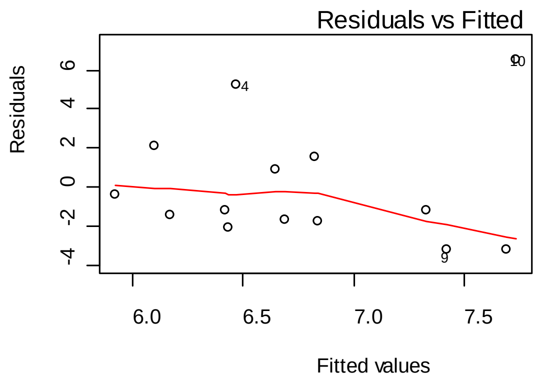
Table of Contents

Georges Bank Cod

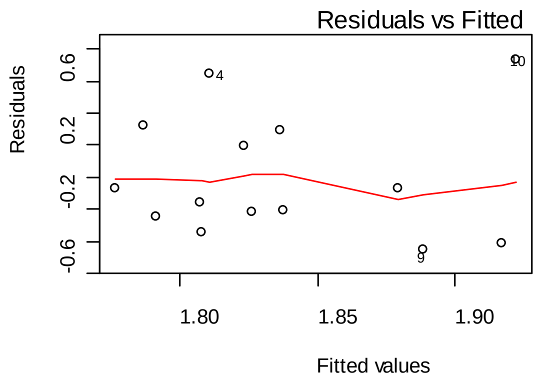
Year	Jan.1	Mean	skgtow	akgtow
1995	23789	24669	8.4	5.6
1996	25400	25901	7.5	2.7
1997	27430	26571	5.2	1.9
1998	27000	27742	11.7	2.8
1999	29599	29111	4.7	3
2000	30284	33240	8.2	1.4
2001	31814	28556	5.5	2.1
2002	25004	21530	5	11.3
2003	18498	16359	4.2	2.1
2004	15704	15652	14.3	5.9
2005	16099	17499	4.5	1.6
2006	19336	21553	6.1	2.7
2007	23663	25760	5.1	1.1
2008	27315		4.3	

skgtow - Spring kg/tow
akgtow - Autumn kg/tow

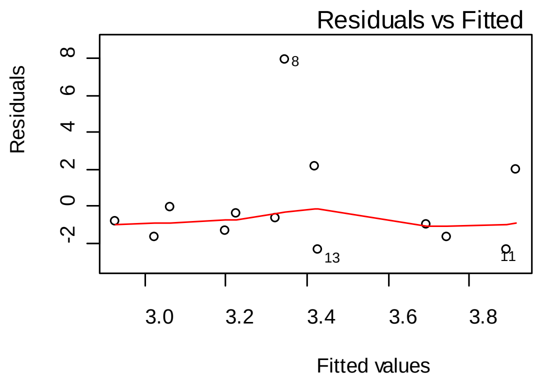
Georges Bank Cod - January 1 Biomass - Spring Survey



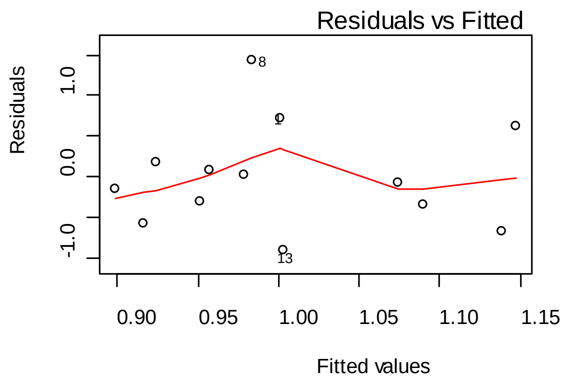
Georges Bank Cod - January 1 Biomass - Spring Survey - Log Transformed



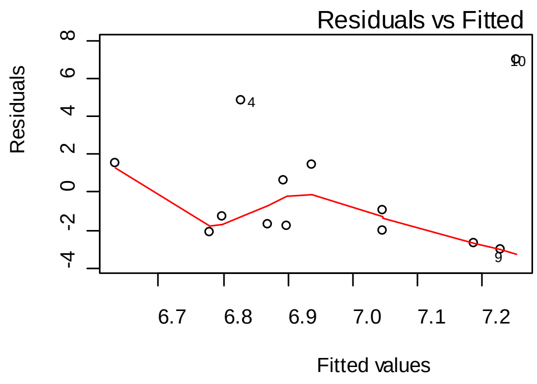
Georges Bank Cod - January 1 Biomass - Autumn Survey



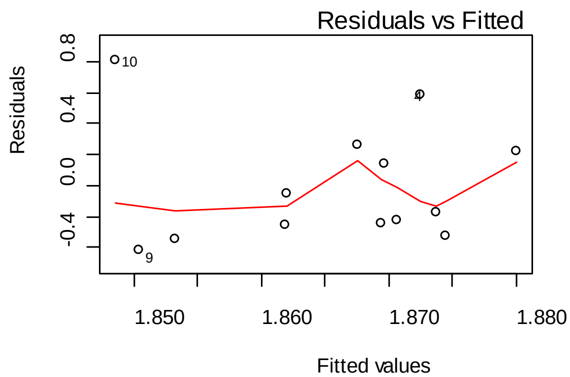
Georges Bank Cod - January 1 Biomass - Autumn Survey - Log Transformed



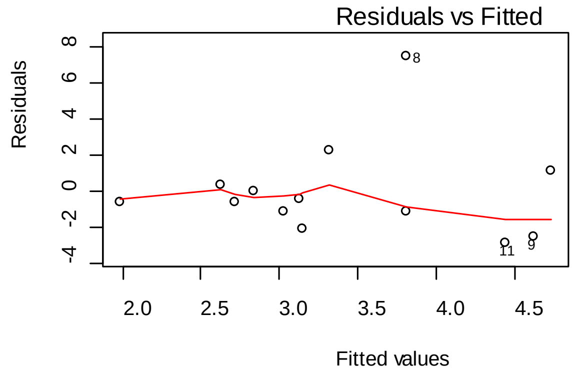
Georges Bank Cod - Mean Biomass - Spring Survey



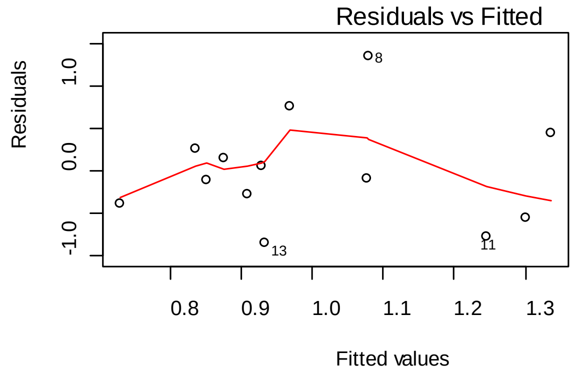
Georges Bank Cod - Mean Biomass - Spring Survey - Log Transformed



Georges Bank Cod - Mean Biomass - Autumn Survey



Georges Bank Cod - Mean Biomass - Autumn Survey - Log Transformed

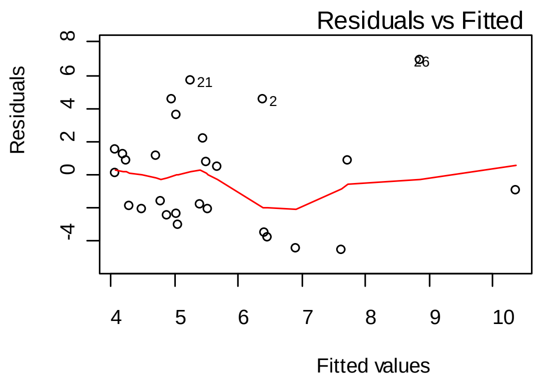


Gulf of Maine Cod

Year	Jan.1	Mean	skgtow	akgtow
1982	43548	37067	8.616	15.919
1983	33522	28028	10.962	8.416
1984	28112	26644	6.143	8.735
1985	26386	24281	7.645	8.264
1986	26871	25443	3.476	4.715
1987	23334	22561	1.976	3.394
1988	26023	31056	3.603	6.616
1989	37458	44098	2.424	4.535
1990	42729	37048	3.076	4.912
1991	33630	27708	2.891	2.781
1992	23202	21758	8.626	2.448
1993	20795	19631	5.875	1.002
1994	19031	19164	2.427	2.737
1995	17583	17294	2.431	3.665
1996	16899	16438	5.427	2.351
1997	15999	16154	5.615	1.872
1998	16006	16548	4.18	1.5
1999	17147	18164	5.089	3.505
2000	21274	26440	3.211	4.652
2001	26787	26901	6.216	7.325
2002	24934	23566	10.933	24.659
2003	22558	22683	9.495	5.993
2004	21993	21698	2.414	4.9
2005	23280	27259	2.703	2.87
2006	33992	44415	2.7	4.23
2007	52161	68452	15.81	2.71
2008	63509		9.39	

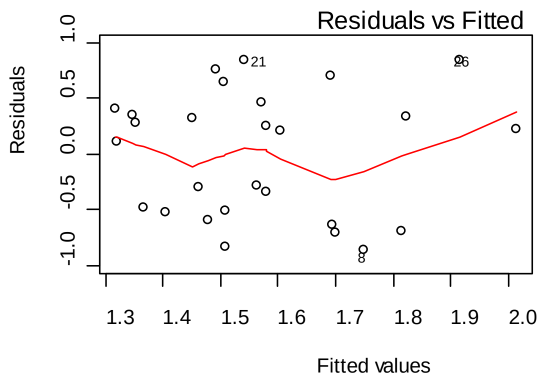
skgtow - Spring kg/tow
akgtow - Autumn kg/tow

Gulf of Maine Cod - January 1 Biomass - Spring Survey

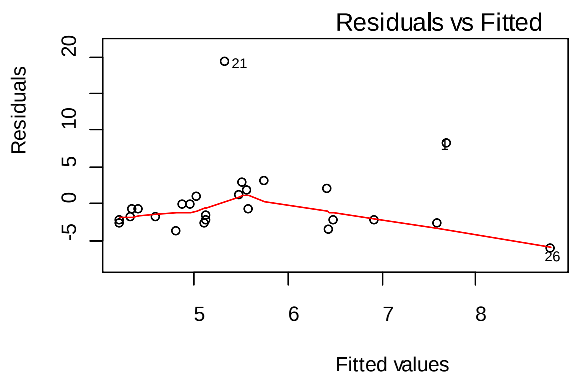


Multiple R-squared: 0.1926,   Adjusted R-squared: 0.1603
F-statistic: 5.963 on 1 and 25 DF, p-value: 0.02202

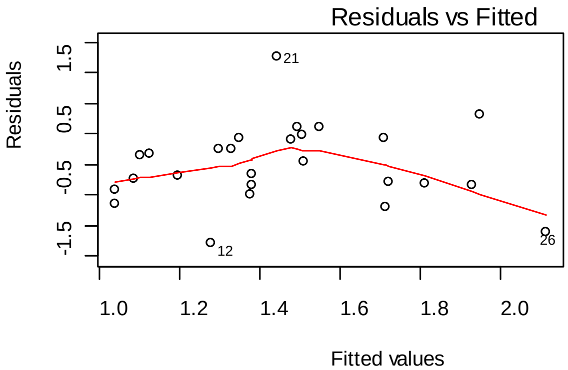
Gulf of Maine Cod - January 1 Biomass - Spring Survey - Log Transformed



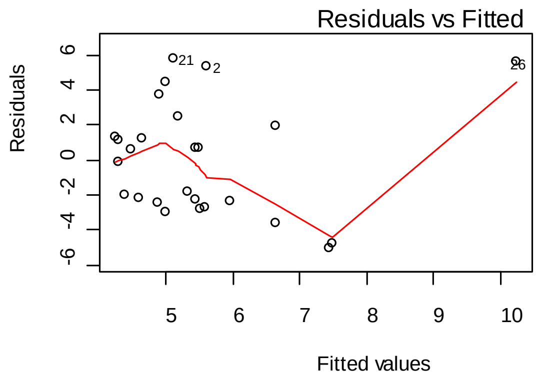
Gulf of Maine Cod - January 1 Biomass - Autumn Survey



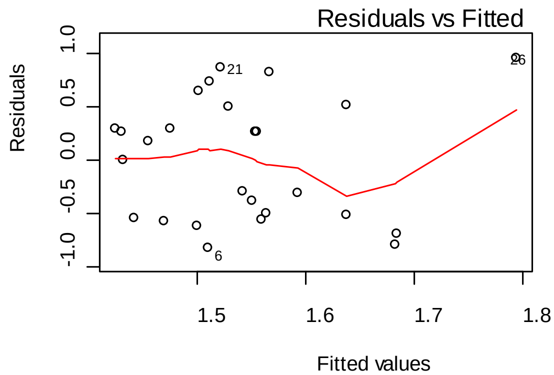
Gulf of Maine Cod - January 1 Biomass - Autumn Survey - Log Transformed



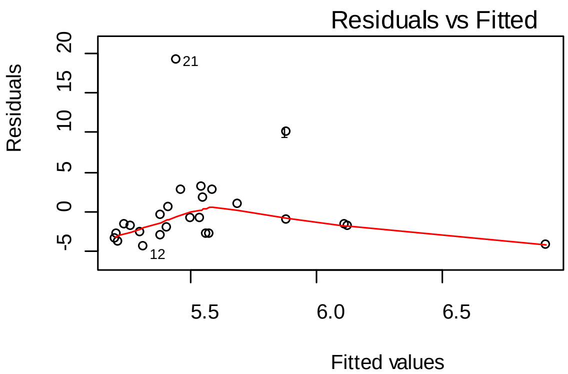
Gulf of Maine Cod - Mean Biomass - Spring Survey



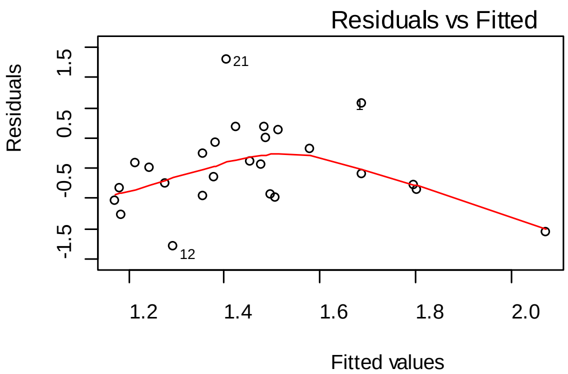
Gulf of Maine Cod - Mean Biomass - Spring Survey - Log Transformed



Gulf of Maine Cod - Mean Biomass - Autumn Survey



Gulf of Maine Cod - Mean Biomass - Autumn Survey - Log Transformed

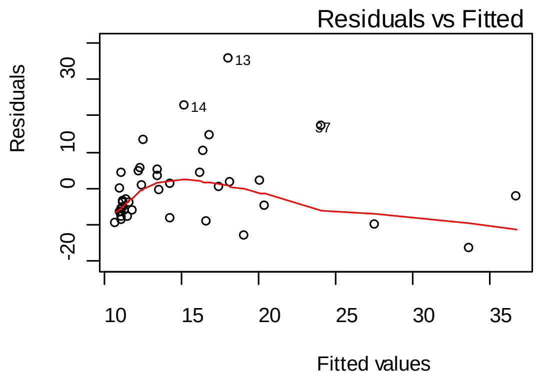


Georges Bank Haddock

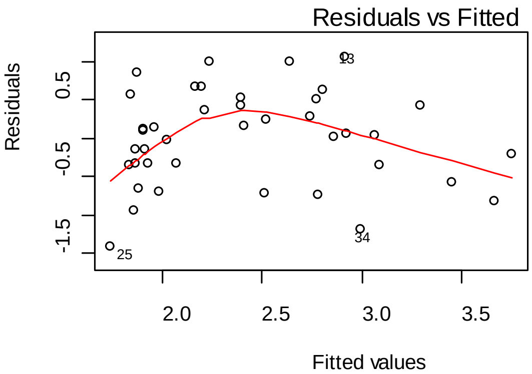
Year	Jan.1	Mean	skgtow	akgtow
1963	290348	276191		79.8
1964	447882	432578		96.8
1965	427380	345129		72.8
1966	265251	193478		29.9
1967	137890	111825		25.5
1968	91654	73881	20.6	15.4
1969	57664	46888	16.9	8.4
1970	43090	38598	17.1	13.5
1971	31423	24592	5	5.6
1972	30466	26663	7.4	8.5
1973	29102	27539	15.4	9.8
1974	44728	42949	17.7	4
1975	32703	31288	8.2	15.1
1976	68129	78259	15.7	35.8
1977	94995	104995	26.6	27.5
1978	99303	92878	31.3	18.1
1979	116120	116035	19.8	32
1980	115199	97554	53.9	22
1981	79622	68970	38	14
1982	59322	55273	13.1	7.3
1983	45592	39801	13.2	5.8
1984	35618	32285	7.5	4.5
1985	27947	29259	11.1	3.9
1986	30628	29473	5.9	5.1
1987	28843	28307	5.6	2.6
1988	29525	29174	3.4	5.6
1989	28899	30134	4.7	4.7
1990	30458	29512	7.6	2.6
1991	27822	24651	4.4	0.9
1992	24608	22182	1.4	3.2
1993	28481	29522	2.5	4.3
1994	33749	34999	3.6	2.9
1995	37729	41369	5.7	10.7
1996	47291	50881	25.7	4.1
1997	58018	61834	18.5	6.5
1998	67993	71834	6.1	5.8
1999	96686	101112	7.7	33.1
2000	107289	110142	17.9	15.4
2001	126863	131061	6.1	20
2002	139939	150673	22.3	36.3
2003	143664	141253	15.6	23
2004	188479	203010	41.4	55.8
2005	231992	285194	17.7	39.4
2006	306808	340000	17.3	37.4
2007	345015	355077	34.6	43.9
2008	375431		23.8	

skgtow - Spring kg/tow
akgtow - Autumn kg/tow

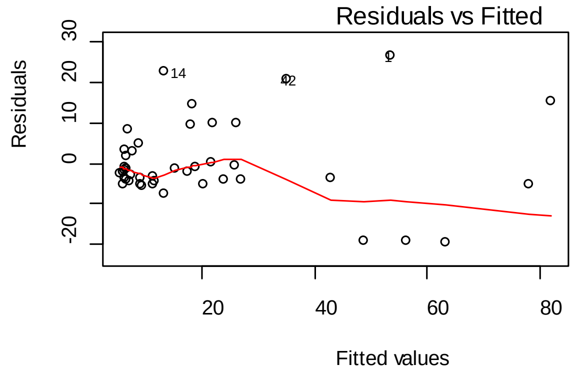
Georges Bank Haddock - January 1 Biomass - Spring Survey



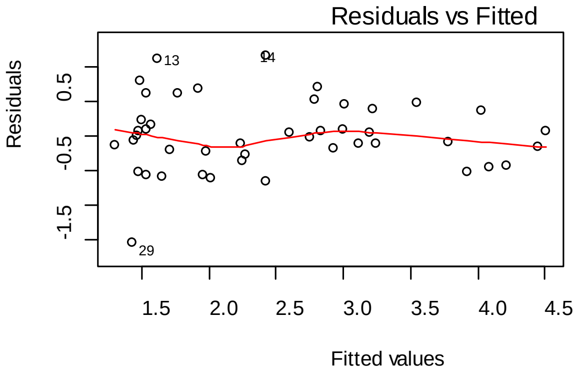
Georges Bank Haddock - January 1 Biomass - Spring Survey - Log Transformed



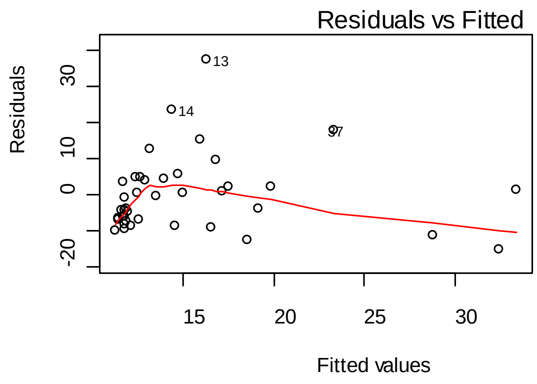
Georges Bank Haddock - January 1 Biomass - Autumn Survey



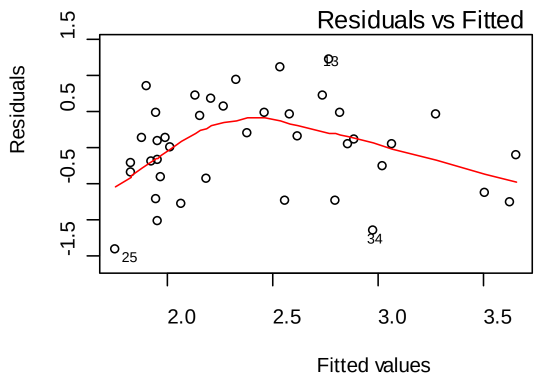
Georges Bank Haddock - January 1 Biomass - Autumn Survey - Log Transformed



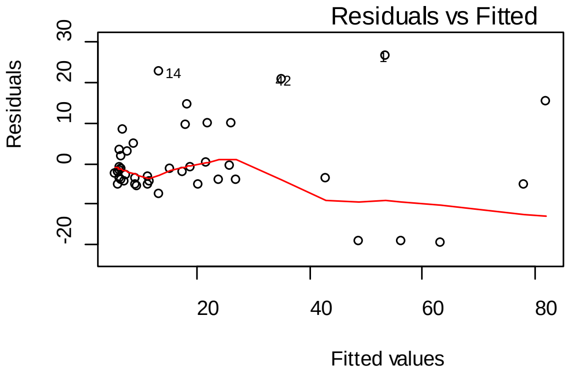
Georges Bank Haddock - Mean Biomass - Spring Survey



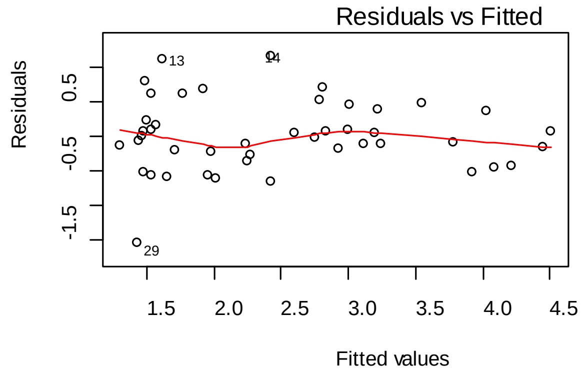
Georges Bank Haddock - Mean Biomass - Spring Survey - Log Transformed



Georges Bank Haddock - Mean Biomass - Autumn Survey



Georges Bank Haddock - Mean Biomass - Autumn Survey - Log Transformed

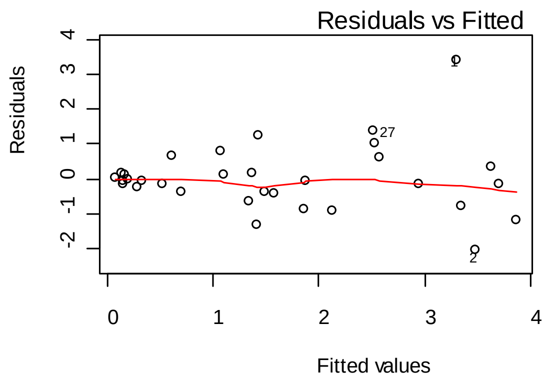


Gulf of Maine Haddock

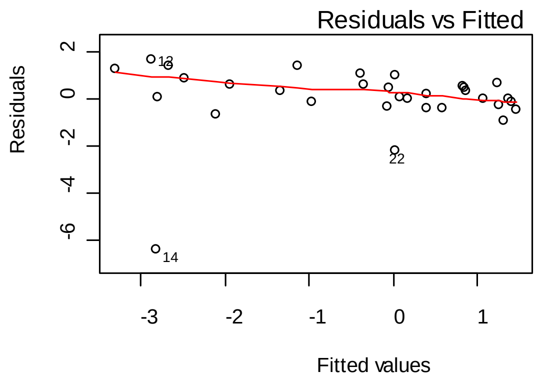
Year	Jan.1	Mean	skgtow	akgtow
1977	17192	17433	6.725	8.752
1978	18141	19456	1.434	21.658
1979	18882	19847	3.948	15.567
1980	20102	20172	2.673	9.835
1981	19238	19936	3.545	10.874
1982	17430	16016	2.555	4.164
1983	13303	10718	3.567	5.219
1984	8484	7872	1.144	3.893
1985	5838	4967	1.882	6.149
1986	3545	2680	1.284	1.392
1987	1864	1608	0.063	2.645
1988	1117	979	0.301	1.476
1989	839	1128	0.125	0.631
1990	1149	1156	0	0.432
1991	1170	1322	0.066	0.12
1992	1270	1357	0.271	0.091
1993	1441	1688	0.2	0.472
1994	2078	2659	0.253	0.217
1995	3078	3990	0.35	1.099
1996	3988	4839	0.338	3.543
1997	5999	7587	1.222	2.424
1998	7651	8314	0.112	2.917
1999	7959	8746	1.108	4.91
2000	9927	11903	1.815	14.032
2001	13526	16318	3.205	11.981
2002	15400	14119	2.793	4.835
2003	13181	12386	3.908	5.359
2004	11236	10518	1.199	7.171
2005	9888	9135	0.971	3.932
2006	7682	7072	2.661	3.945
2007	7220	7334	0.675	4.393
2008	7352		1.51	

skgtow - Spring kg/tow
akgtow - Autumn kg/tow

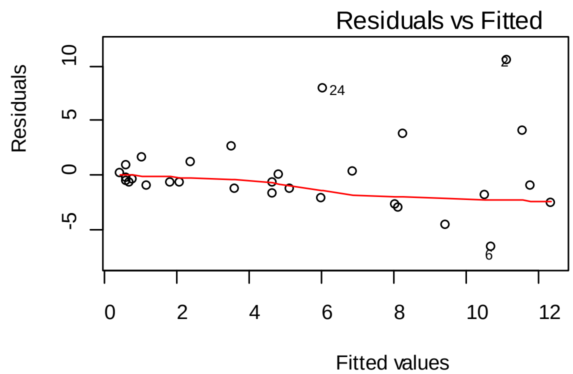
Gulf of Maine Haddock - January 1 Biomass - Spring Survey



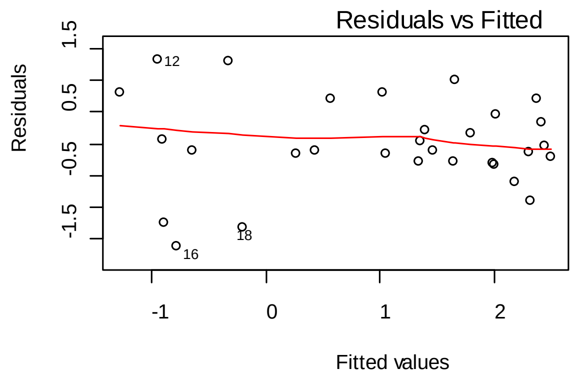
Gulf of Maine Haddock - January 1 Biomass - Spring Survey - Log Transformed



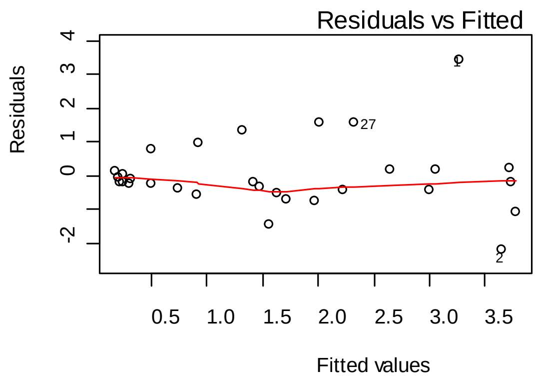
Gulf of Maine Haddock - January 1 Biomass - Autumn Survey



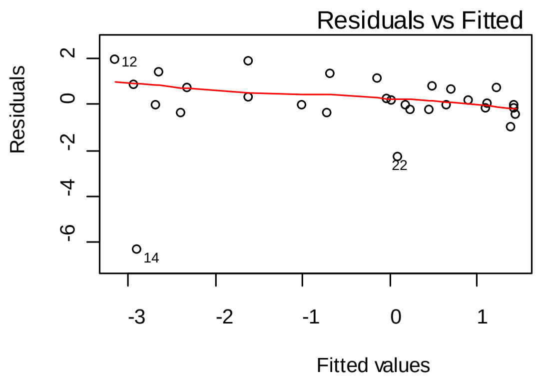
Gulf of Maine Haddock - January 1 Biomass - Autumn Survey - Log Transformed



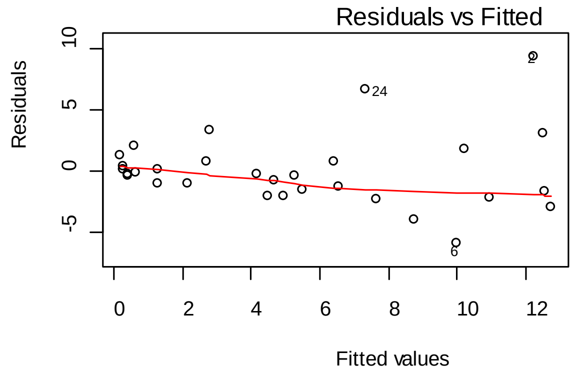
Gulf of Maine Haddock – Mean Biomass and Spring Survey



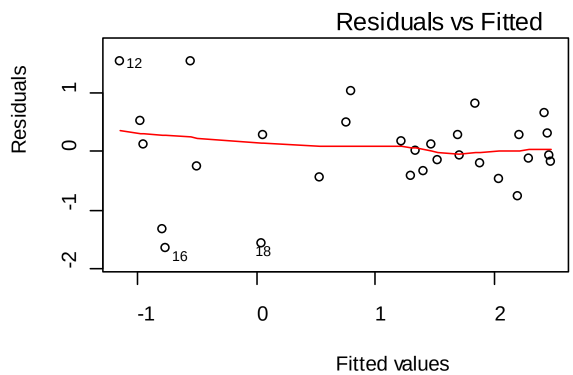
Gulf of Maine Haddock – Mean Biomass – Spring Survey Log Transformed



Gulf of Maine Haddock – Mean Biomass – Autumn Survey



Gulf of Maine Haddock – Mean Biomass – Autumn Survey Log Transformed

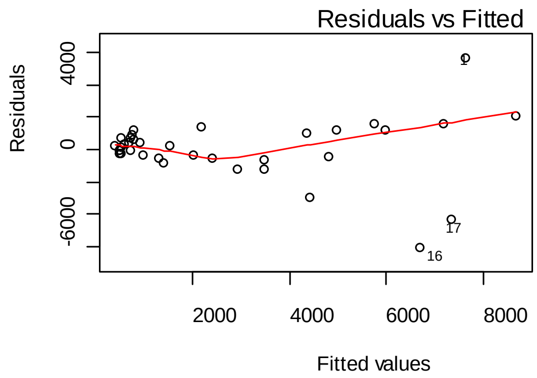


Southern New England Yellowtail Flounder

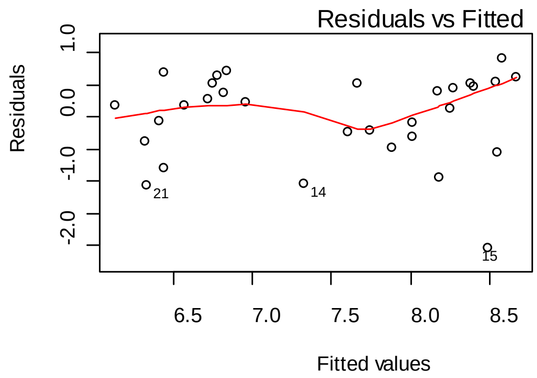
year	Jan.1	Mean	ssweptmt	asweptmt
1973	37538	29688	13266.215	4595.242
1974	24128	14590	6081.679	2271.715
1975	13741	11012	1616.433	837.848
1976	11251	9716	1879.989	2873.017
1977	16609	14351	2226.606	1406.064
1978	23280	20053	4344.414	2504.814
1979	21294	16680	1384.965	2272.404
1980	21004	17672	5314.074	1692.585
1981	28100	27922	7284.143	5057.076
1982	42835	39636	10663.745	8390.548
1983	35368	23126	8764.871	6603.069
1984	16649	9772	2786.308	1519.57
1985	9170	7339	1584.178	291.001
1986	6750	4681	1758.656	754.213
1987	6180	4729	532.962	461.029
1988	32904	31929	631.733	586.482
1989	36175	32071	2968.641	2303.882
1990	29262	17070	7193.394	1274.063
1991	10012	5283	3563.105	737.44
1992	3638	2358	1326.973	168.879
1993	1656	1435	569.896	112.931
1994	1472	1123	193.364	353.728
1995	1109	1226	550.176	349.247
1996	1720	2084	1247.922	238.499
1997	2987	2552	1318.115	978.122
1998	2677	2407	1417.22	752.375
1999	3058	2794	1902.384	537.082
2000	2810	2585	1654.37	824.867
2001	2585	2325	1090.491	481.938
2002	2087	1944	851.669	1257.519
2003	1727	1519	279.266	498.826
2004	1457	1216	383.051	118.216
2005	1518	1716	370.182	569.25
2006	2755	3506	651.286	804.992
2007	3978	4579	613.85	518.356
2008	5578		741.199	

ssweptmt - Spring area swept in mt
asweptmt - Autumn area swept in mt

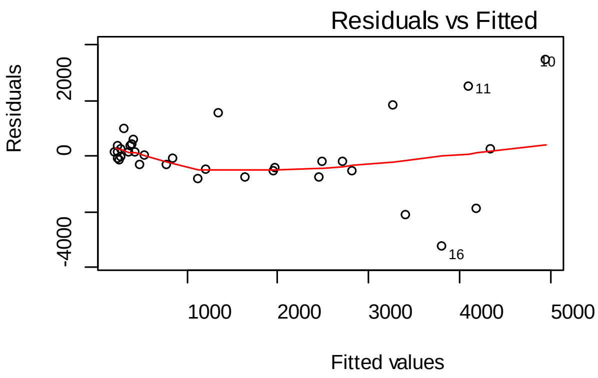
Southern New England Yellowtail Flounder - January 1 Biomass - Spring Survey



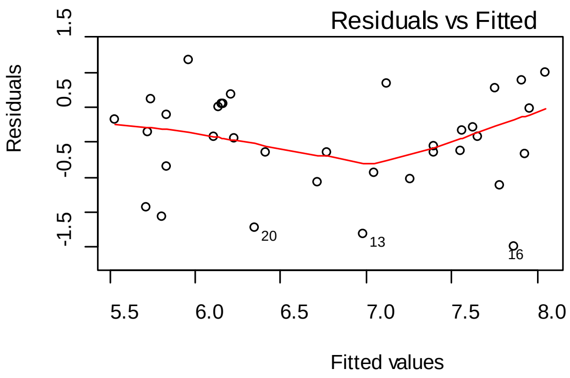
SNE Yellowtail Flounder - January 1 Biomass - Spring Survey - Log Transformed



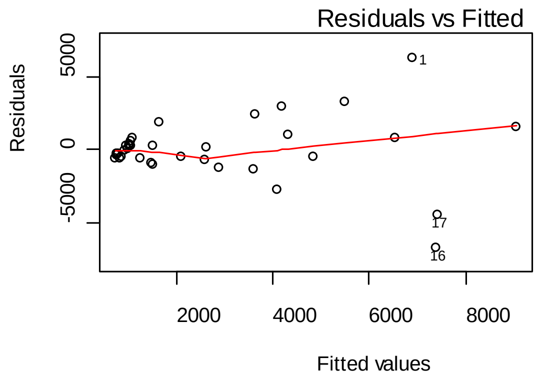
SNE Yellowtail Flounder - January 1 Biomass - Autumn Survey



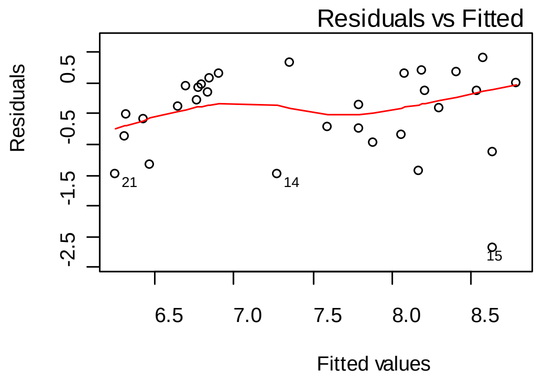
SNE Yellowtail Flounder - January 1 Biomass - Autumn Survey - Log Transformed



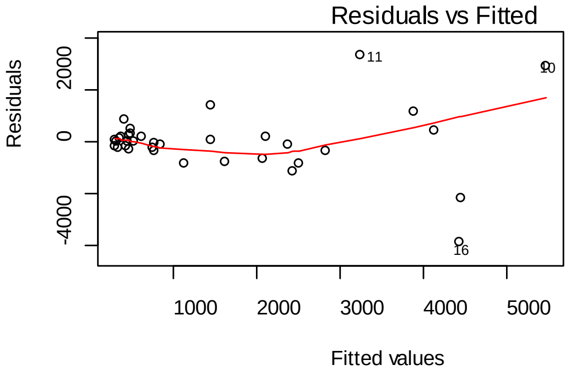
SNE Yellowtail Flounder - Mean Biomass - Spring Survey



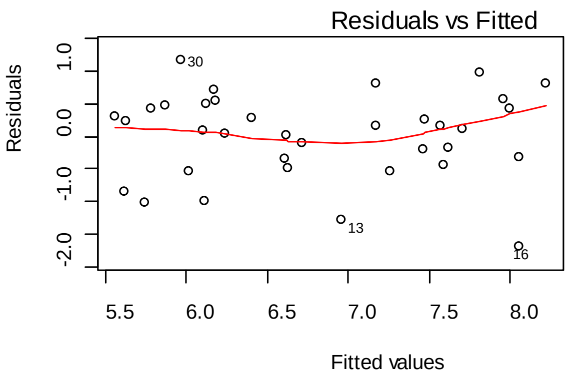
SNE Yellowtail Flounder - Mean Biomass - Spring Survey - Log Transformed



SNE Yellowtail Flounder - Mean Biomass - Autumn Survey



SNE Yellowtail Flounder - Mean Biomass - Autumn Survey - Log Transformed

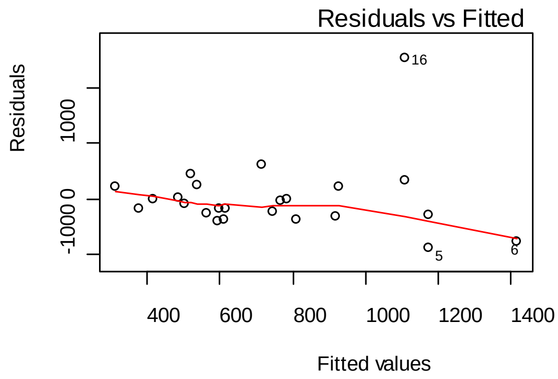


Cape Cod/Gulf of Maine Yellowtail Flounder

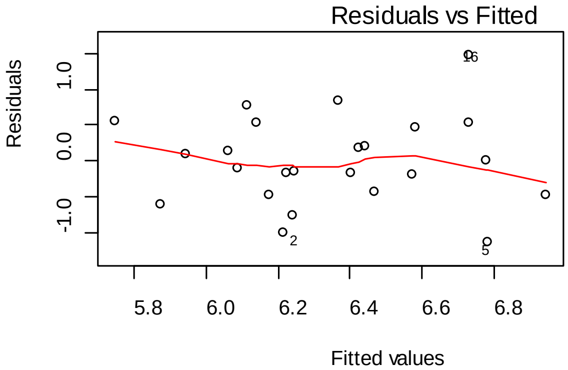
year	Jan.1	Mean	ssweptmt	asweptmt	MADMF ssweptmt	MADMF asweptmt
1985	2971	2661	237.3	502	1330.9	358.8
1986	2898	2697	181.6	291.8	1208	375.5
1987	2605	2278	975.5	178.9	937.2	289.3
1988	3795	4084	415.7	362.2	960.3	1074.2
1989	5299	6095	283	602	1128	400.9
1990	6291	4492	639.2	641.1	1734.3	942.1
1991	4238	3426	585	328.8	781.6	629.9
1992	2773	1973	295.1	621.5	1467	524.7
1993	2012	2133	193.3	302.4	1088.6	831.3
1994	2527	2509	393.9	868.8	1416.7	650.1
1995	2669	2732	785.9	251.8	2123.2	1278.4
1996	2918	2899	427.7	841	1805.8	325.1
1997	3535	3195	506.1	732.6	1298.3	378.5
1998	2994	2546	445.7	526.6	916.7	570.5
1999	3684	4598	763.1	1924.7	309.3	557.4
2000	5022	4637	3669.2	1116.9	2073.2	366
2001	5288	4867	882.5	608.3	1075	338.9
2002	5025	4237	1425.2	227.6	586.2	140.3
2003	3614	2668	737.6	1107.9	748	533.2
2004	2168	1804	415	157.9	1093.3	1198.3
2005	1756	1749	546.1	200.2	1745.8	545
2006	2453	3170	489.8	259.4	2249.5	691.5
2007	3402	3919	1334.3	1110.1	2527.2	611
2008	4285		1141.6			

ssweptmt - Spring area swept in mt
asweptmt - Autumn area swept in mt

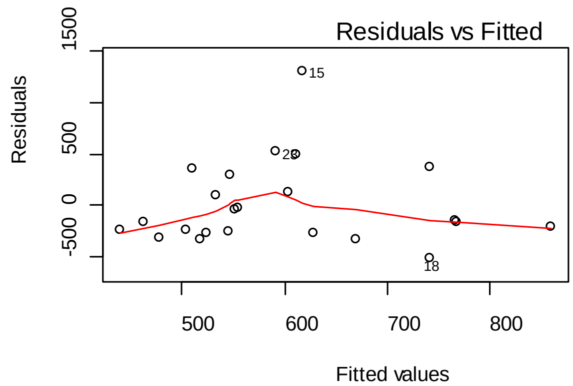
Cape Cod/Gulf of Maine Yellowtail Flounder - January 1 Biomass - Spring Survey



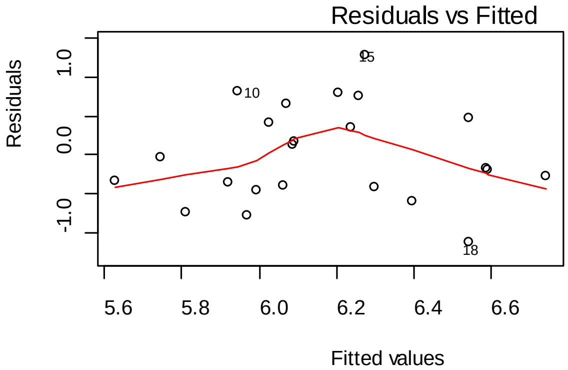
CCGOM Yellowtail Flounder - January 1 Biomass - Spring Survey - Log Transformed



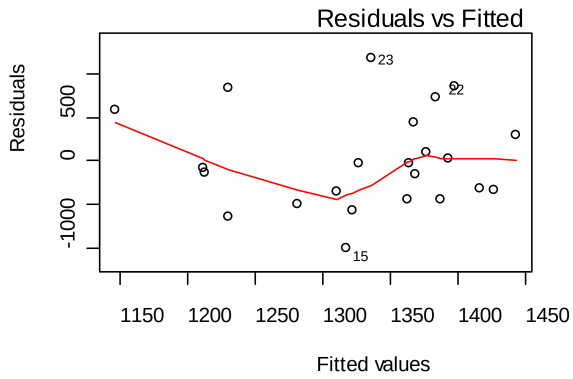
CCGOM Yellowtail Flounder - January 1 Biomass - Autumn Survey



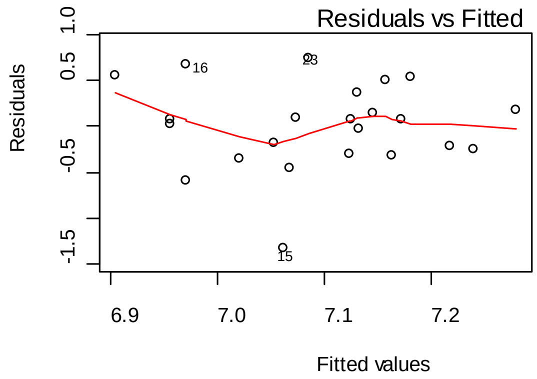
CCGOM Yellowtail Flounder - January 1 Biomass - Autumn Survey - Log Transformed



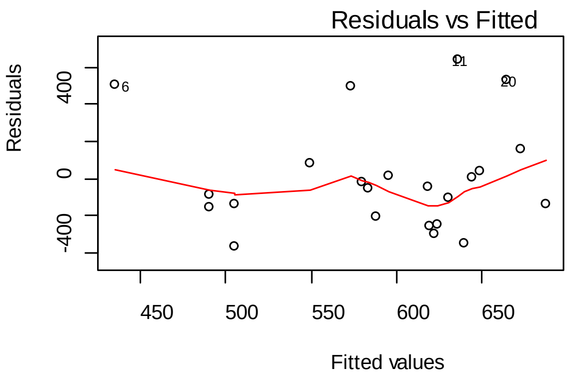
CCGOM Yellowtail Flounder - January 1 Biomass - MADMF Spring Survey



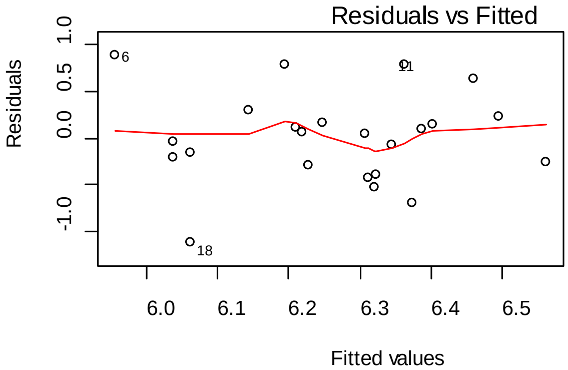
CCGOM Yellowtail Flounder - January 1 Biomass - MADMF Spring Survey - Log Transformed



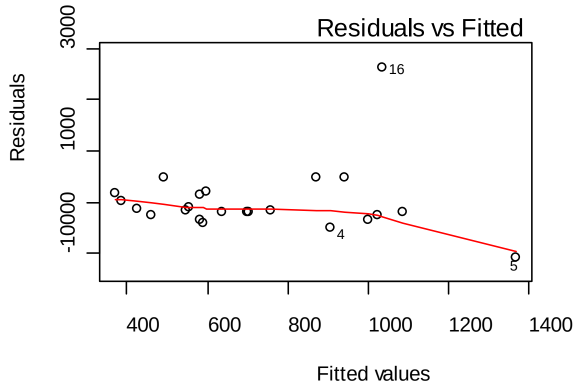
CCGOM Yellowtail Flounder - January 1 Biomass - MADMF Autumn Survey



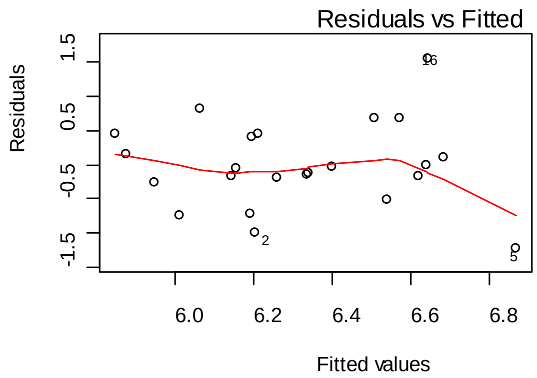
CCGOM Yellowtail Flounder - January 1 Biomass - MADMF Autumn Survey - Log Transformed



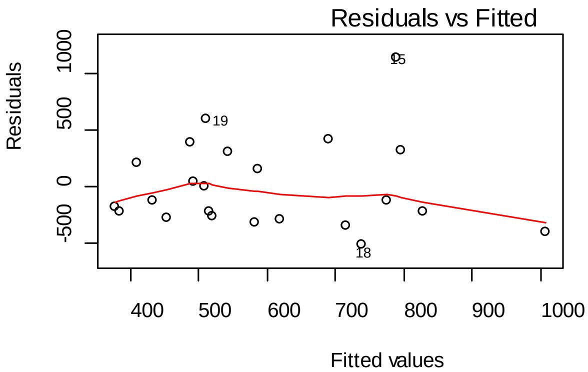
Cape Cod/Gulf of Maine Yellowtail Flounder - Mean Biomass - Spring Survey



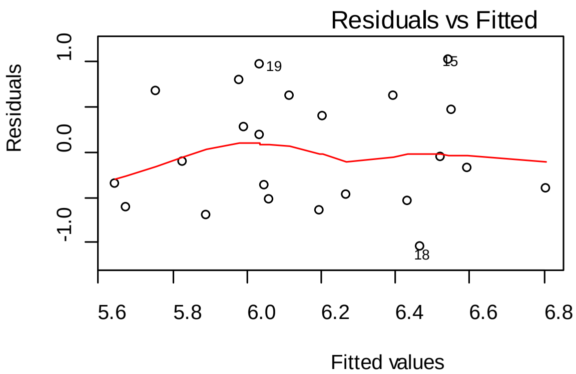
CCGOM Yellowtail Flounder - Mean Biomass - Spring Survey - Log Transformed



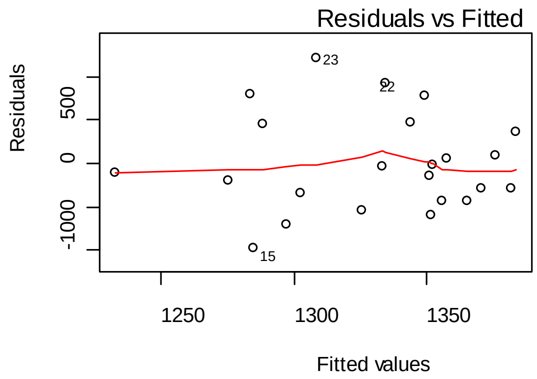
CCGOM Yellowtail Flounder - Mean Biomass - Autumn Survey



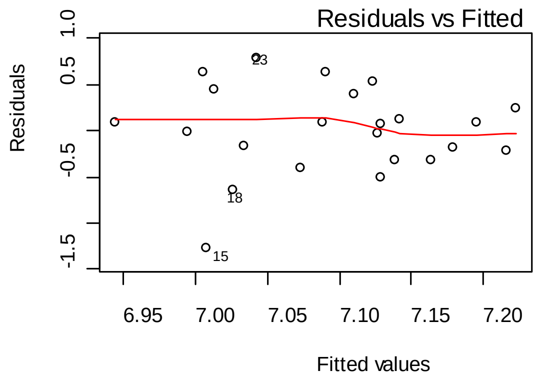
CCGOM Yellowtail Flounder - Mean Biomass - Autumn Survey - Log Transformed



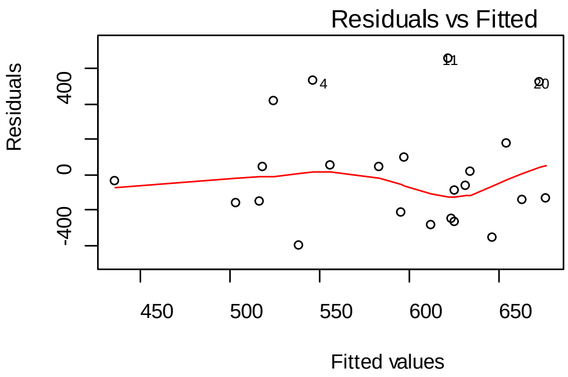
CCGOM Yellowtail Flounder - Mean Biomass - MADMF Spring Survey



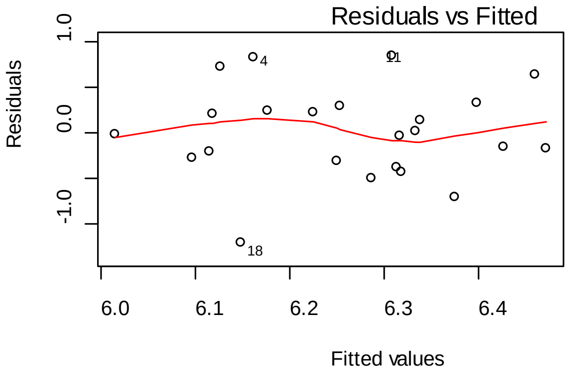
CCGOM Yellowtail Flounder - Mean Biomass - MADMF Spring Survey - Log Transformed



CCGOM Yellowtail Flounder - Mean Biomass - MADMF Autumn Survey



CCGOM Yellowtail Flounder - Mean Biomass - MADMF Autumn Survey - Log Transformed

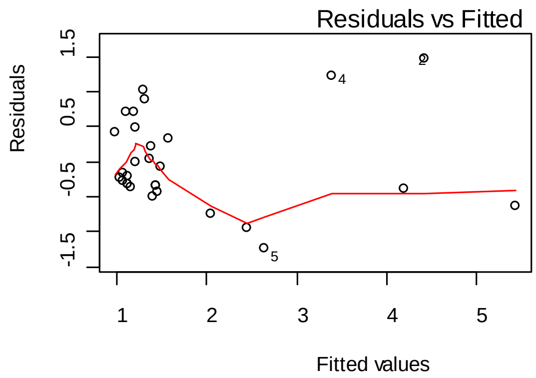


American Plaice

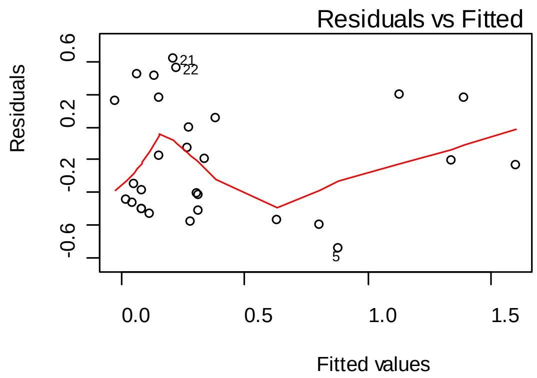
year	Jan.1	Mean	skgtow	akgtow
1980	52640	48765	4.8	5.1
1981	43252	43874	5.9	5.6
1982	41105	36978	3.8	2.5
1983	33670	30035	4.6	3.5
1984	26761	23161	1.4	2
1985	16788	13467	1.9	2
1986	12220	12404	0.9	1.6
1987	11921	12026	0.8	1.1
1988	12623	13759	0.8	1.5
1989	12591	11698	0.8	1.2
1990	13010	14687	0.8	2.9
1991	15630	16698	1.1	1.6
1992	16037	15942	1.4	1.8
1993	14997	15756	1.4	2.4
1994	15203	14665	0.9	2.7
1995	13224	13339	1.9	2.6
1996	13477	14655	1.7	2.2
1997	15122	16515	1.6	1.9
1998	15588	14209	1.1	2.2
1999	13509	13617	1.2	2.6
2000	14210	16103	2.3	2.8
2001	14426	12775	2.2	2.6
2002	12419	13124	1.8	2.2
2003	12600	12208	0.9	2.3
2004	11432	11373	1.4	1
2005	12171	14322	0.8	1
2006	15664	18848	1	1.7
2007	21193	25784	1.3	1.4
2008	24918		1.5	0.54

skgtow - Spring kg/tow
akgtow - Autumn kg/tow

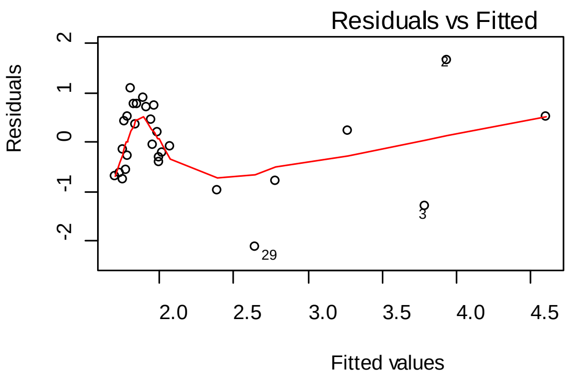
American Plaice - January 1 Biomass - Spring Survey



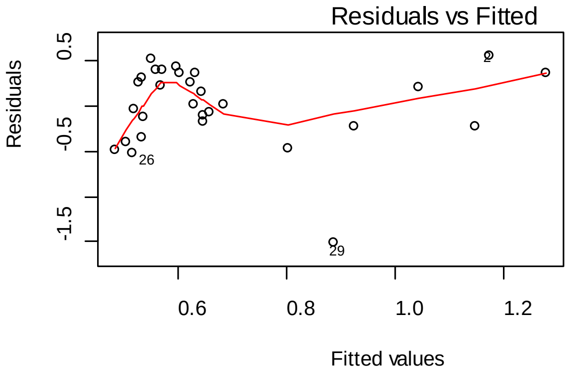
American Plaice - January 1 Biomass - Spring Survey - Log Transformation



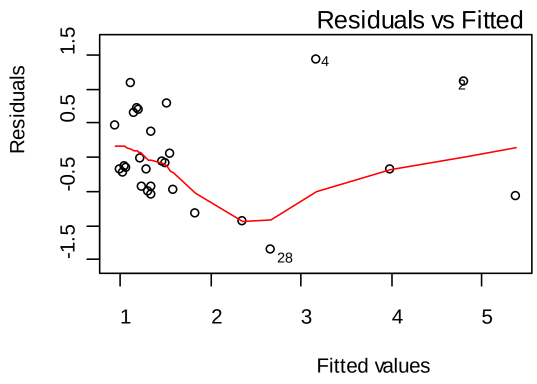
American Plaice - January 1 Biomass - Autumn Survey



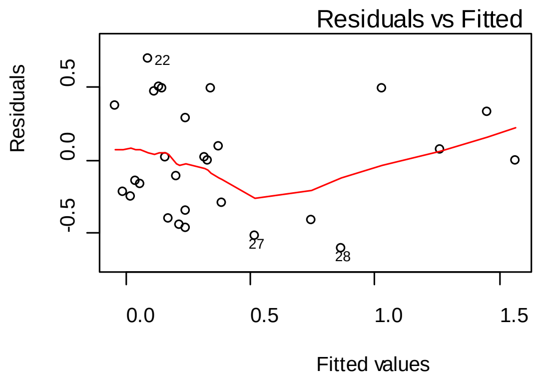
American Plaice - January 1 Biomass - Autumn Survey - Log Transformation



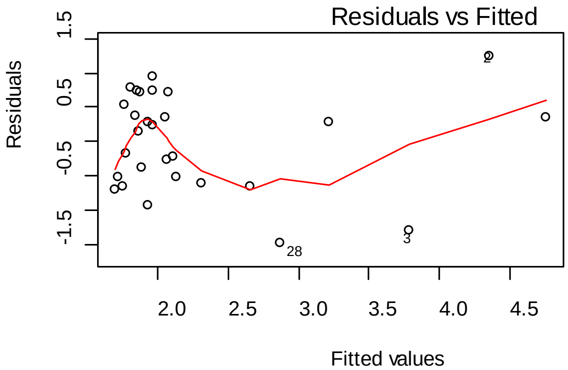
American Plaice - Mean Biomass - Spring Survey



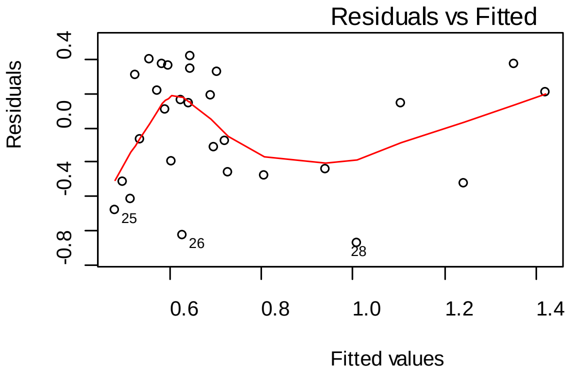
American Plaice - Mean Biomass - Spring Survey - Log Transformation



American Plaice - Mean Biomass - Autumn Survey



American Plaice - Mean Biomass - Autumn Survey - Log Transformation

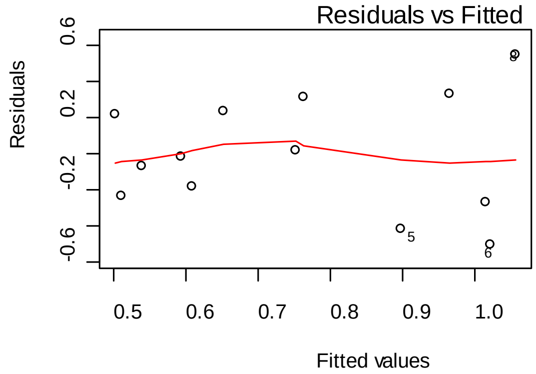


Witch Flounder

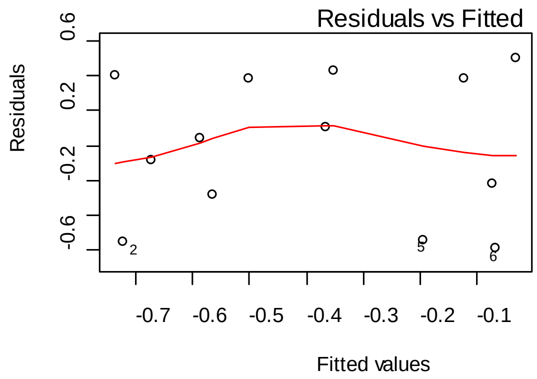
year	Jan.1	Mean	skgtow	akgtow
1995	7,404	7,147	0.47	0.62
1996	7,107	7,359	0.28	1.02
1997	8,112	9,038	0.43	0.77
1998	9,591	9,989	0.77	0.47
1999	11,087	12,362	0.48	0.88
2000	12,360	11,710	0.52	1.11
2001	12,301	12,000	0.75	1.71
2002	12,729	12,987	1.61	1.06
2003	11,793	10,087	1.3	0.79
2004	9,710	9,454	1.08	1.03
2005	8,557	7,748	0.89	0.38
2006	7,028	6,417	0.72	0.46
2007	7,967	8,255	0.58	0.57
2008	7,404	7,147	1.4	

skgtow - Spring kg/tow
akgtow - Autumn kg/tow

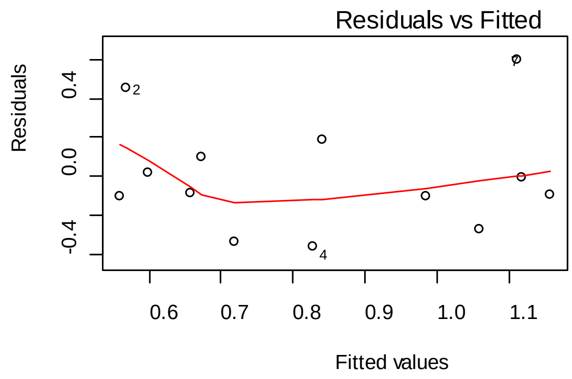
Witch Flounder - January 1 Biomass - Spring Survey



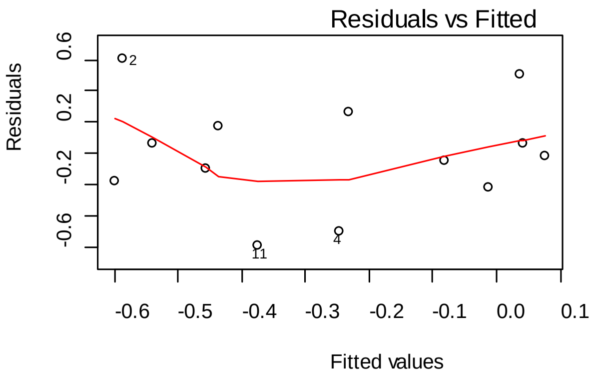
Witch Flounder - January 1 Biomass - Spring Survey - Log Transformation



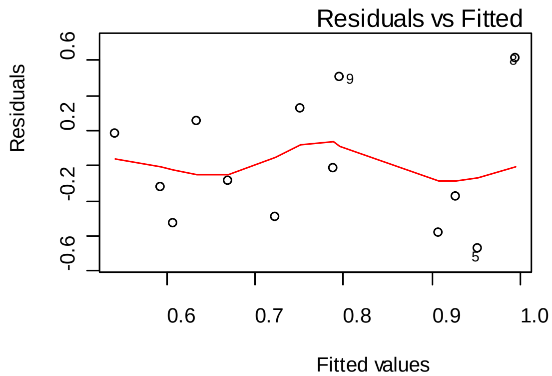
Witch Flounder - January 1 Biomass - Autumn Survey



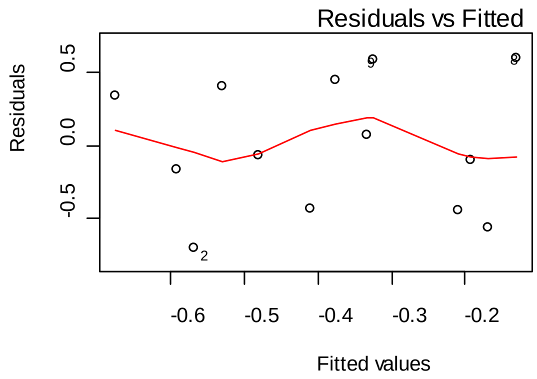
Witch Flounder - January 1 Biomass - Autumn Survey - Log Transformation



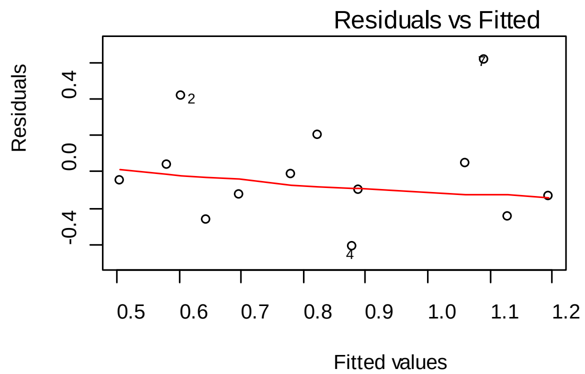
Witch Flounder – Mean Biomass – Spring Survey



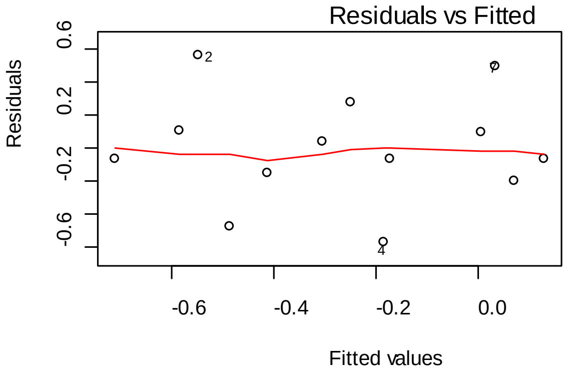
Witch Flounder –Mean Biomass – Spring Survey Log Transformed



Witch Flounder –Mean Biomass – Autumn Survey



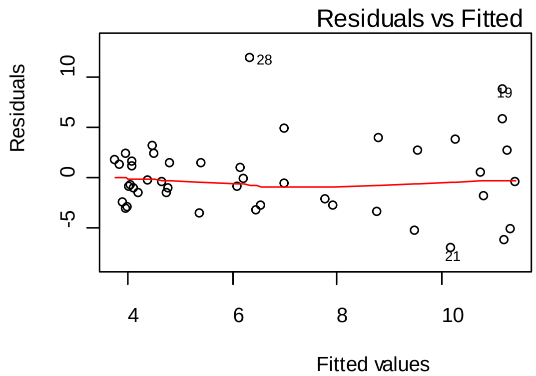
Witch Flounder – Mean Biomass – Autumn Survey Log Transformed



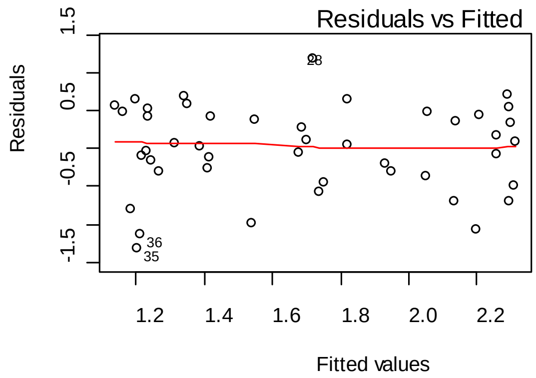
Hake – Using Recent 5-year Average weights (1)

year	Jan.1	skgtow	akgtow
1963	24762229.2	6.31	
1964	23866088	4.14	
1965	22933817.4	6.86	
1966	22732413.3	7.67	
1967	24667171.9	3.64	
1968	28321875.2	1.74	4.54
1969	32886274.2	5.09	13.09
1970	38605238	11.86	12.82
1971	44388945.5	5.14	12.1
1972	49888764.9	12.66	13.1
1973	54760426.6	12.22	13.46
1974	59179358.1	13.99	11
1975	62355224	11.22	7.23
1976	65006875.3	17.01	10.56
1977	66445844.4	11.01	13.74
1978	65944043	6.14	12.54
1979	65140852.3	4.97	10.31
1980	65428444.1	13.96	16.66
1981	64929062.5	19.92	12.16
1982	62616099.4	8.91	2.11
1983	58631559.6	3.12	10.79
1984	54405565.2	4.17	8.23
1985	49755144.2	5.38	9.74
1986	43587570.5	5.61	11.56
1987	38664491.3	6.44	9.62
1988	35733145.8	3.69	9.88
1989	35278141.7	3.22	9.23
1990	34485328.7	18.37	10.58
1991	33718746	6.14	12.2
1992	33310064.3	7.11	11.24
1993	28632233	6.84	11.66
1994	24475343.7	3.17	7.02
1995	22075130.6	4.02	8.2
1996	19838829.9	3.07	6.35
1997	19492752.3	0.89	4.55
1998	19739384.2	1.09	4.27
1999	20414798.7	2.97	3.44
2000	20107470.1	3.33	6.72
2001	20248890.6	5.18	7.97
2002	19413970.2	6.32	6.73
2003	20199410.2	5.73	4.91
2004	18694833.5	5.19	3.72
2005	18220928.7	5.52	3.59
2006	19132826.3	1.46	4.18
2007	20973697.7	2.64	6.56

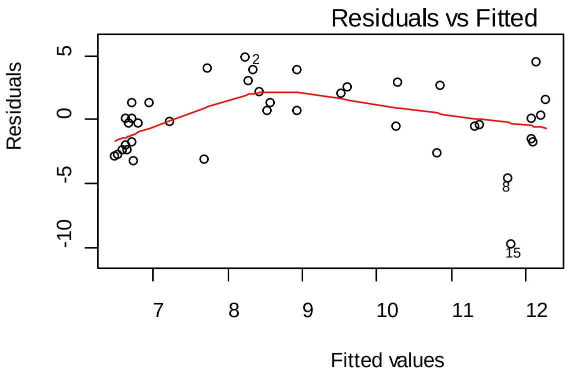
Hake - January 1 Biomass - Spring Survey



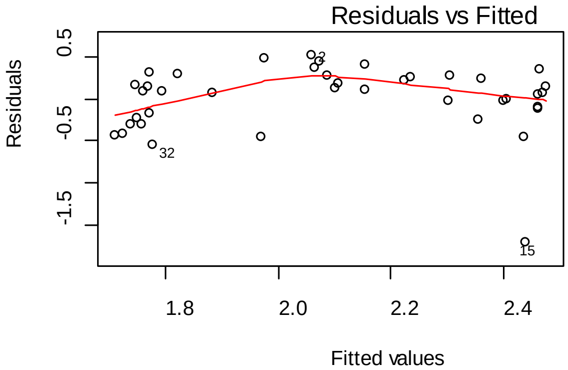
Hake - January 1 Biomass - Spring Survey - Log Transformed



Hake - January 1 Biomass - Autumn Survey



Hake - January 1 Biomass - Autumn Survey - Log Transformed



White Hake – Using Rivard Weights (2)

year	Jan.1	skgtow	akgtow
1963	24,277	6.31	
1964	23,420	4.14	
1965	22,539	6.86	
1966	22,357	7.67	
1967	24,187	3.64	
1968	27,609	1.74	4.54
1969	31,904	5.09	13.09
1970	37,302	11.86	12.82
1971	42,795	5.14	12.1
1972	48,174	12.66	13.1
1973	52,969	12.22	13.46
1974	57,440	13.99	11
1975	60,810	11.22	7.23
1976	63,656	17.01	10.56
1977	65,268	11.01	13.74
1978	64,935	6.14	12.54
1979	64,257	4.97	10.31
1980	64,549	13.96	16.66
1981	64,015	19.92	12.16
1982	61,750	8.91	2.11
1983	57,954	3.12	10.79
1984	53,795	4.17	8.23
1985	49,167	5.38	9.74
1986	43,202	5.61	11.56
1987	38,344	6.44	9.62
1988	35,378	3.69	9.88
1989	36,774	3.22	9.23
1990	37,356	18.37	10.58
1991	35,696	6.14	12.2
1992	36,488	7.11	11.24
1993	31,512	6.84	11.66
1994	25,774	3.17	7.02
1995	21,855	4.02	8.2
1996	18,255	3.07	6.35
1997	16,163	0.89	4.55
1998	17,307	1.09	4.27
1999	17,098	2.97	3.44
2000	16,224	3.33	6.72
2001	17,799	5.18	7.97
2002	17,551	6.32	6.73
2003	19,142	5.73	4.91
2004	18,271	5.19	3.72
2005	18,213	5.52	3.59
2006	19,948	1.46	4.18
2007	22,717	2.64	6.56

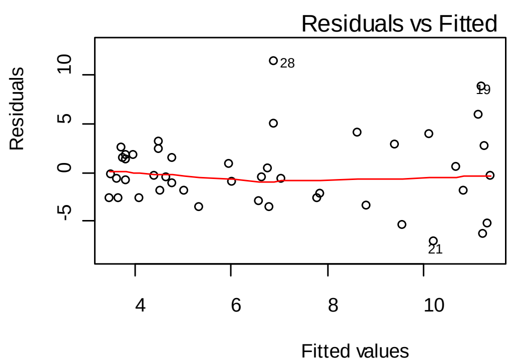
Call: Spring Survey and January 1 Biomass

```
lm(formula = y2 ~ y1)

Residuals:
    Min      1Q  Median      3Q     Max 
-7.0978 -2.5908 -0.4981  1.7542 11.4649 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  0.89725    1.30225   0.689    0.495    
y1           0.16083    0.03225   4.986 1.06e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1 

Residual standard error: 3.697 on 43 degrees of freedom
Multiple R-squared: 0.3664,     Adjusted R-squared: 0.3516 
F-statistic: 24.86 on 1 and 43 DF,  p-value: 1.058e-05
```



Call: Ln(Spring Survey) and Ln(January 1 Biomass)
lm(formula = y.2 ~ y.1)

Residuals:

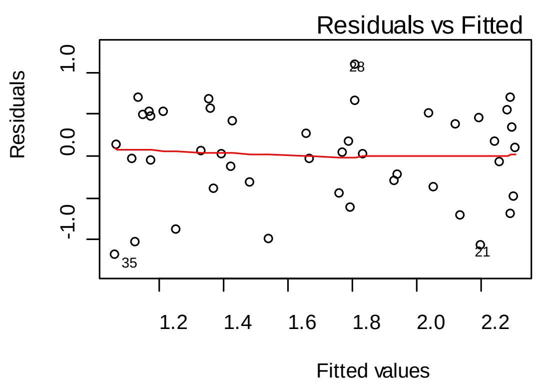
Min	1Q	Median	3Q	Max
-1.18342	-0.37243	0.04414	0.47095	1.09965

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-7.5411	1.8173	-4.150	0.000154	***
y.1	0.8883	0.1746	5.086	7.63e-06	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5611 on 43 degrees of freedom
Multiple R-squared: 0.3756,   Adjusted R-squared: 0.3611
F-statistic: 25.87 on 1 and 43 DF, p-value: 7.627e-06



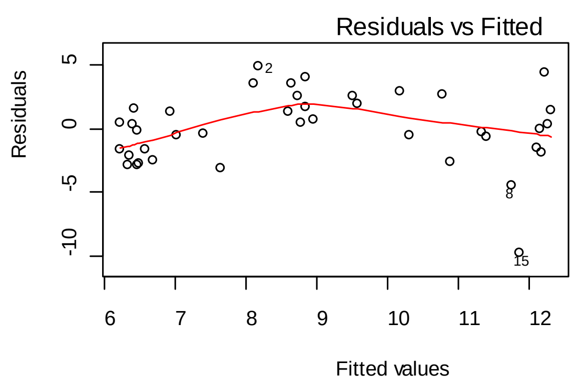
Call: Autumn Survey and January 1 Biomass

```
lm(formula = y2.a ~ y1.a)

Residuals:
    Min      1Q  Median      3Q     Max 
-9.7633 -1.7305  0.1391  1.7939  4.9157 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  4.22036    1.08761   3.880 0.000402 ***
y1.a         0.12393    0.02588   4.788 2.57e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 

Residual standard error: 2.853 on 38 degrees of freedom
Multiple R-squared: 0.3763,     Adjusted R-squared: 0.3599 
F-statistic: 22.93 on 1 and 38 DF,  p-value: 2.567e-05
```



Call: Ln(Autumn Survey) and Ln(January 1 Biomass)
lm(formula = y.2 ~ y.1)

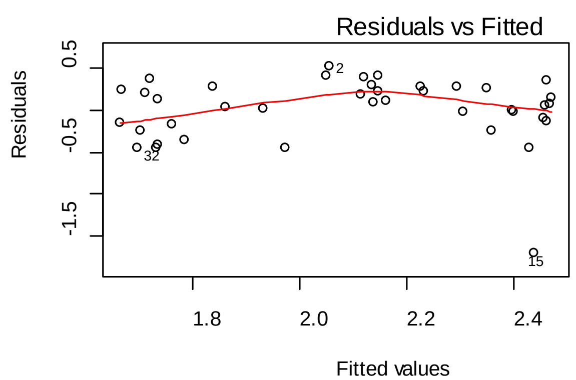
Residuals:

```
     Min       1Q   Median       3Q      Max
-1.69113 -0.15367  0.07308  0.25451  0.51558
```

Coefficients:

```
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  -3.9354     1.3154  -2.992  0.00485 **
y.1           0.5778     0.1259   4.589 4.75e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Residual standard error: 0.3917 on 38 degrees of freedom
Multiple R-squared: 0.3566,   Adjusted R-squared: 0.3396
F-statistic: 21.06 on 1 and 38 DF, p-value: 4.75e-05



Example Projection Results (Preliminary)

May 18, 2011

Caveat: this work was done quickly by hand and may contain errors, it is for demonstration purposes only

Basis

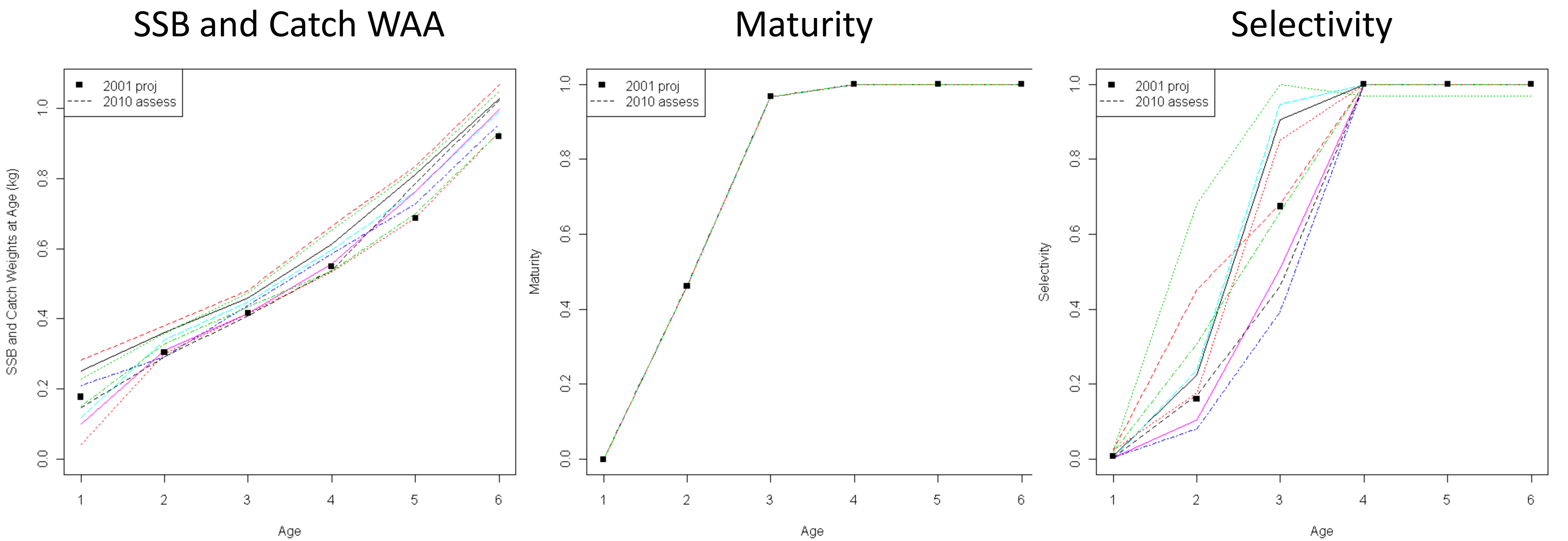
- Georges Bank yellowtail flounder
- 2010 TRAC assessment = “truth”
- Conduct retrospective and bootstrap
- Data through 2000 denoted 2001 assess
- Project forward from 2001 assess 10,000 times
  - Use 5 year average weights, selectivity, and maturity
  - Recruitment from 2 stage empirical cdf
  - Catches in 2001-2010 set equal to values used in 2010 assessment

2010 Assessment

- Note the case with data ending in 2000 (2001 assess) has much higher SSB than 2010 assess (labeled 2009 in graph below)

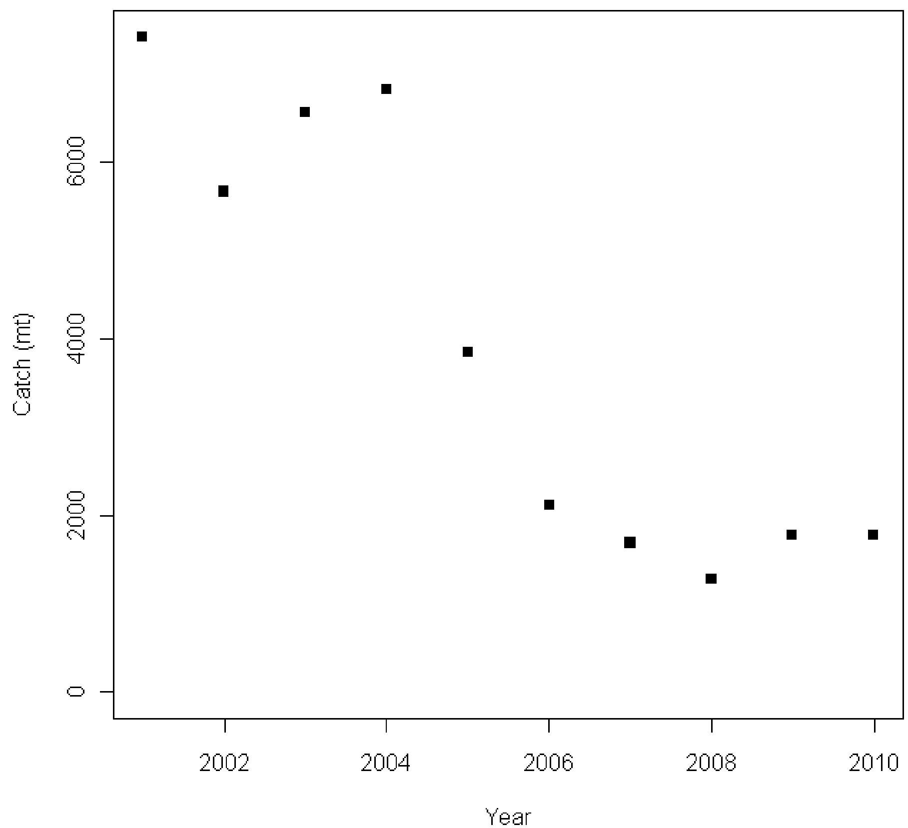
Projection vs "Truth"

- Dots are values used in projections
- Lines are 2001-2009 values from 2010 assess



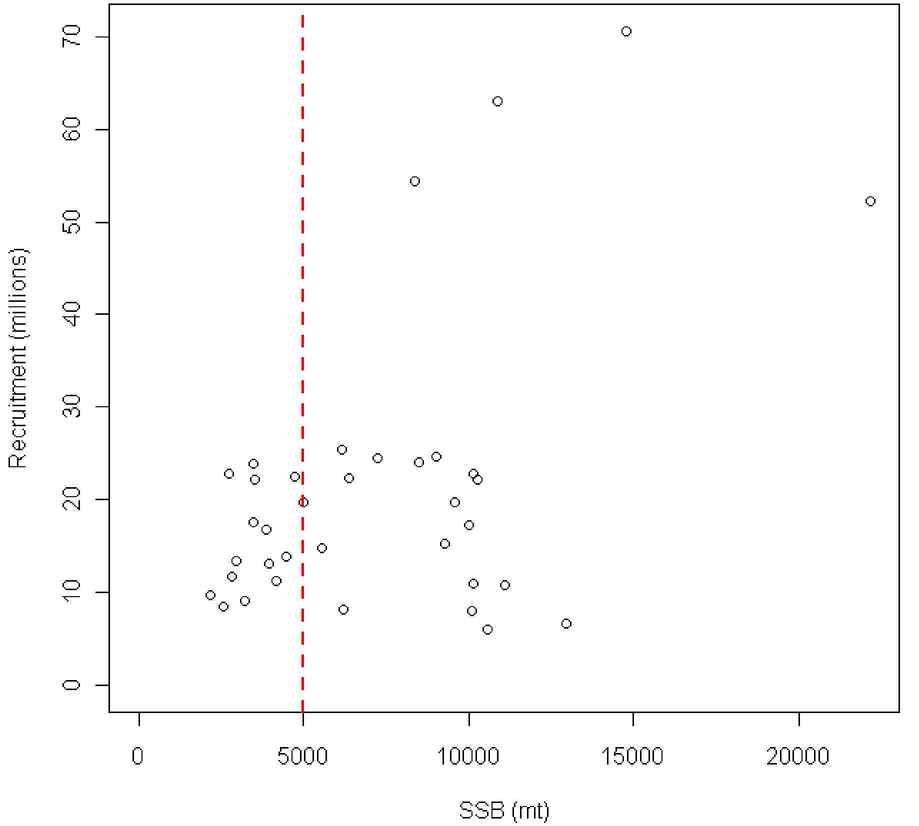
Projected Catches

- 2010 value set equal to 2009 for this example



Recruitment

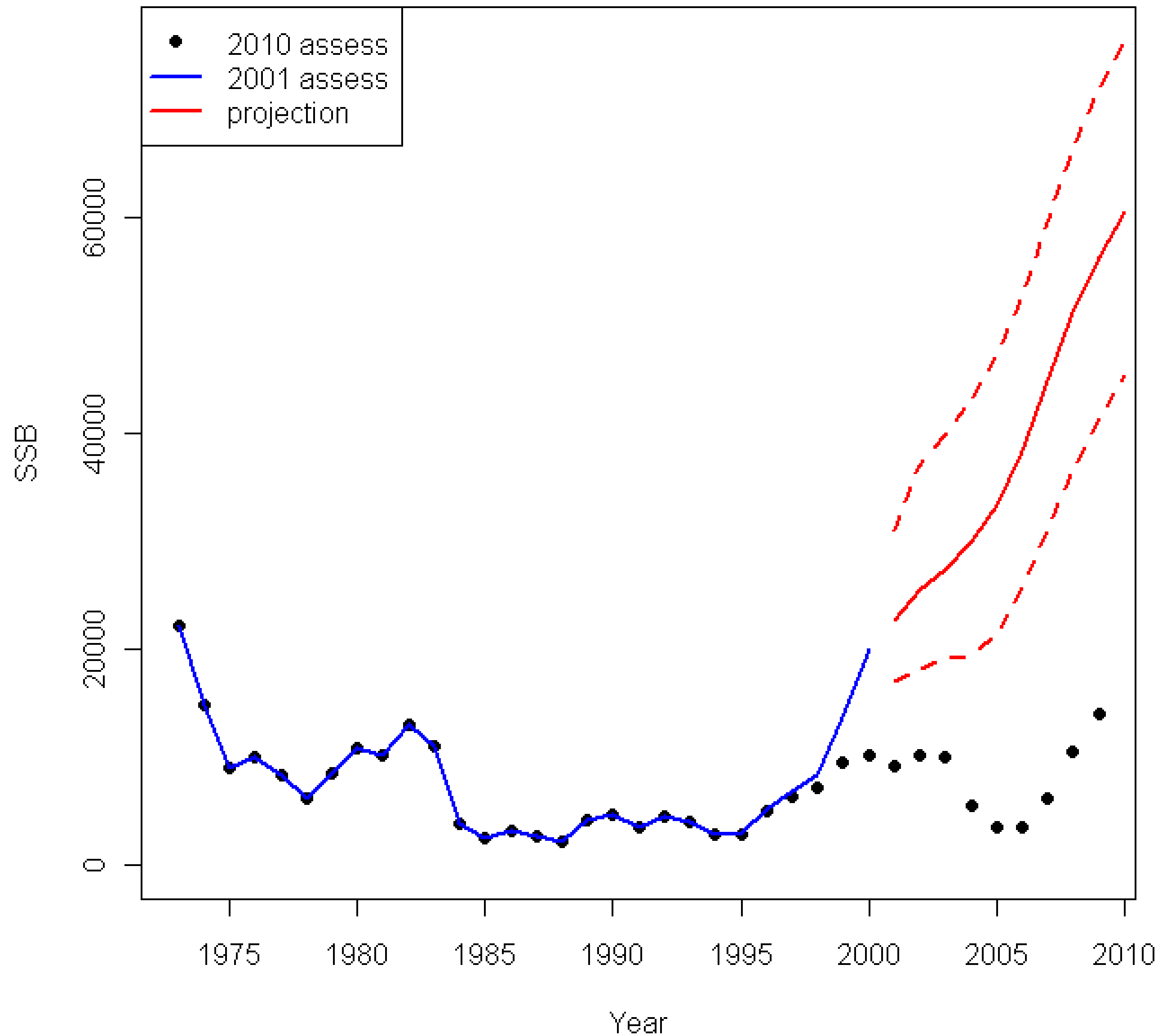
- SR plot from 2001 assessment
- Two stage empirical cdf, no hindcast R in this example



Projections

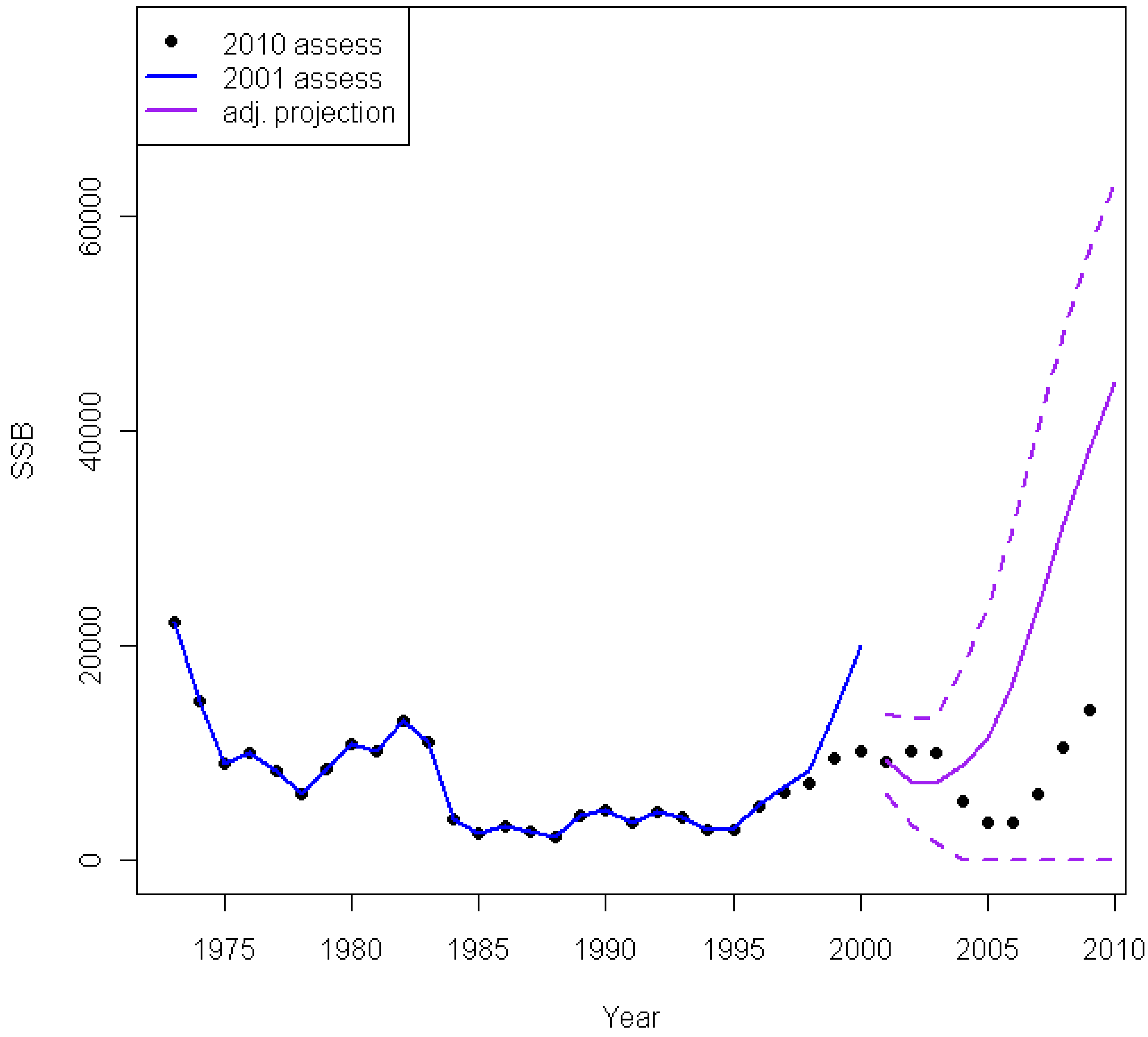
- 3 example cases
  - Simple projection from 2001 assess
  - Adjust 2001 NAA to account for "retro"
  - Fix NAA in 2001 at values from 2010 assess
- Plots compare
  - 2010 assess dots
  - 2001 assess blue line
  - 2001 projection other color showing median and 80% confidence intervals (10th and 90th quantiles)

Simple

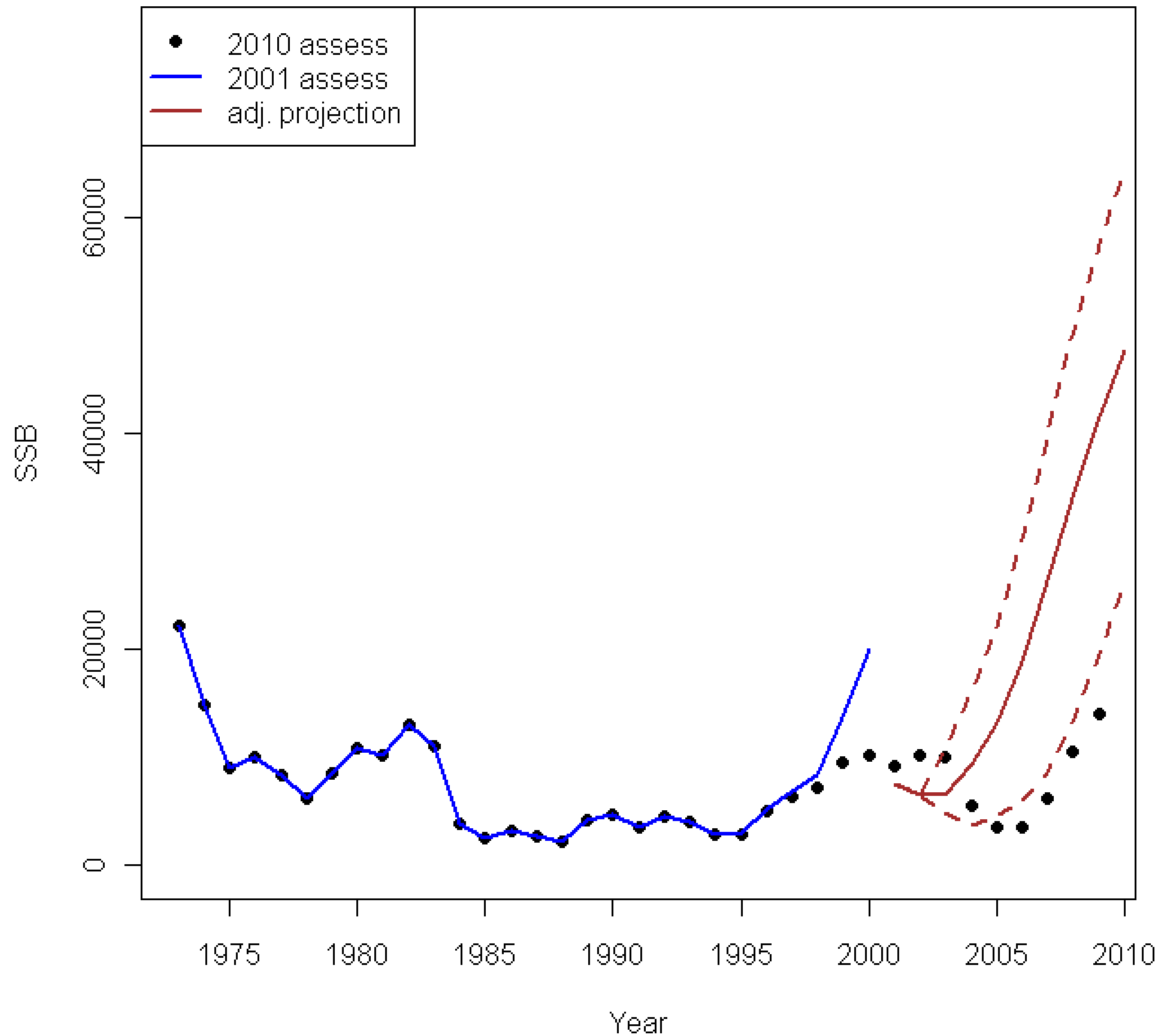


2010 assess
2001 assess
projection
SSB
0
20000
40000
60000
1975
1980
1985
1990
1995
2000
2005
2010
Year

“Retro Adjusted”

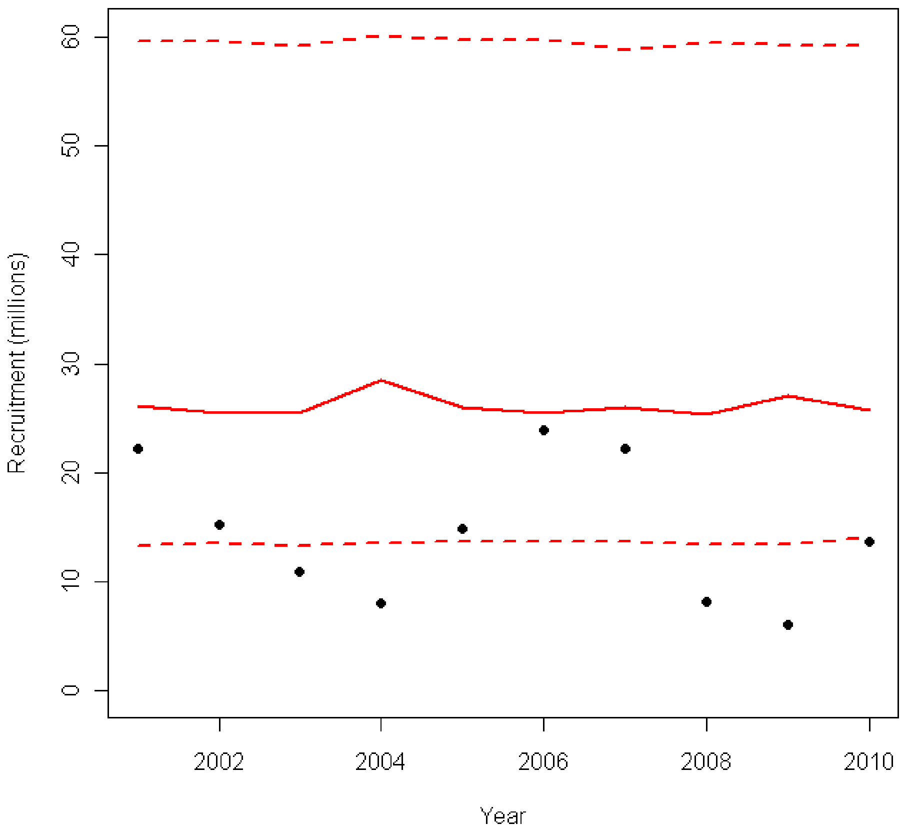


NAA 2001 from 2010 Assess



Recruitment

- “True” recruitment (from 2010 assess) not well matched by 2001 projections (projections too high)



Notes on Projection Plots

- Simple
  - Start with population too high means observed catches allow population to grow rapidly
  - "Truth" well outside 80% CI for all projection years
- "Retro Adjusted"
  - Starting in correct place on average
  - Approx 15% of projections have stock collapse (catch>population), causing lower CI to be zero
  - Median reasonable for first 3-4 years, but then diverges
  - "retro adjustment" faked for this this example to make 2001 SSB close to that estimated from 2010 assessment
- NAA 2001 from 2010 Assess
  - SSB 2001 differs due to difference in WAA and selectivity
  - Approx 1.5% of projections have stock collapse
  - Median reasonable first 4 years, but then diverges, 2010 values just outside 80% CI for years 2005-2010

Lessons Learned So Far

- Starting conditions matter
- Recruitment assumptions vs realizations matter
- Potential for projections to perform reasonably well in short-term (1-5ish years)
- Projections get sketchy beyond 5 years
  - May be due to age 6+ used in this case
  - Accumulation of paper fish

Future Work

- Need to automate
  - This example done by hand, too many places for errors to enter to do all stocks and years this way
  - Once automated, running many years for each stock will increase sample size to allow better conclusions to be drawn
- Need to consider additional factors
  - Output comparisons such as F
  - Input conditions such as range of years to average WAA, how recruitment determined, retro adjustments, etc.
  - Factorial comparisons of input vs output performance