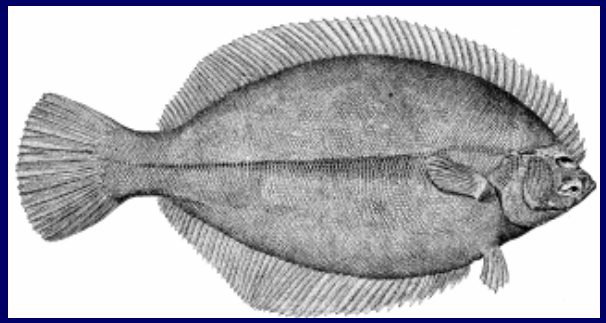
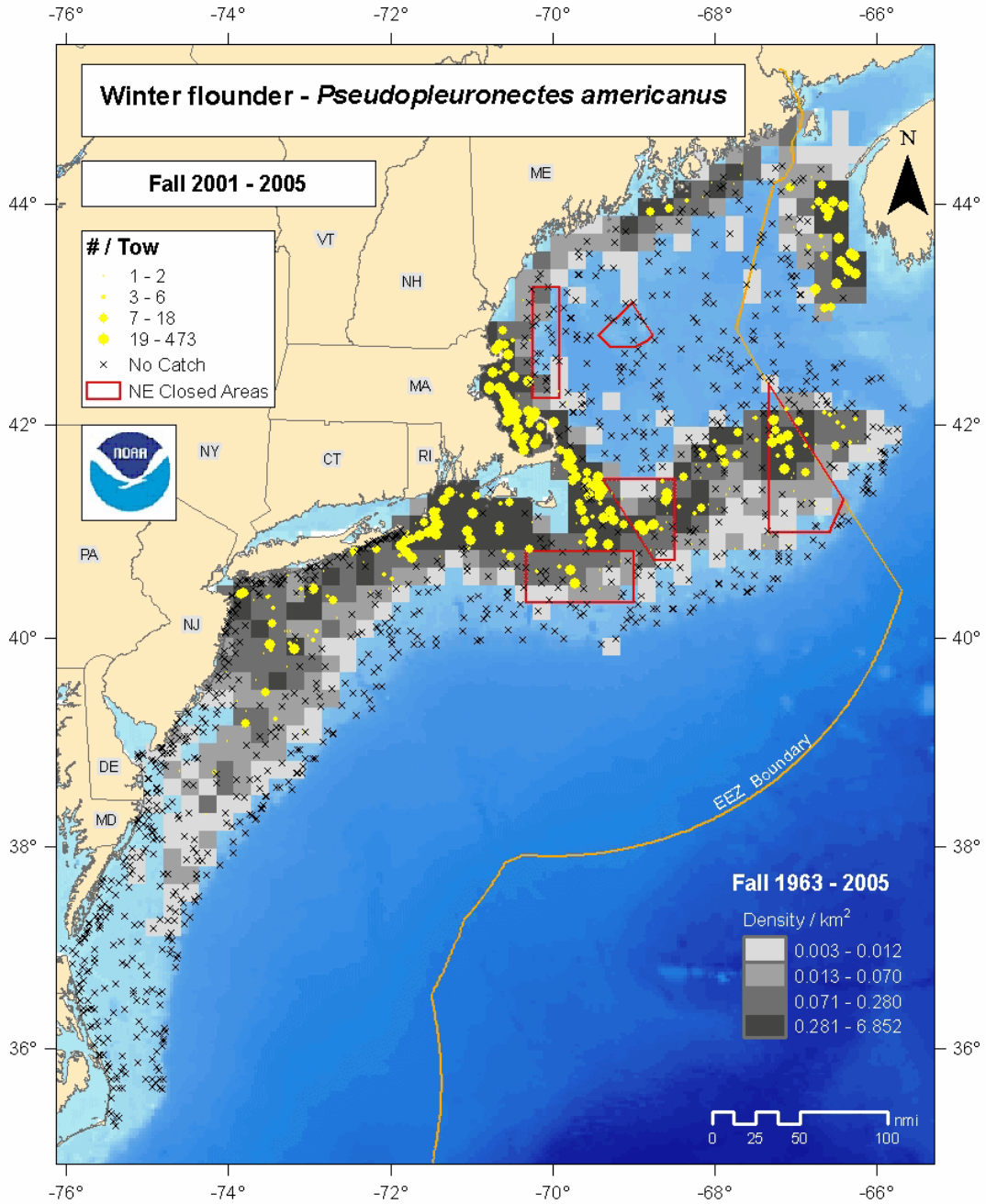
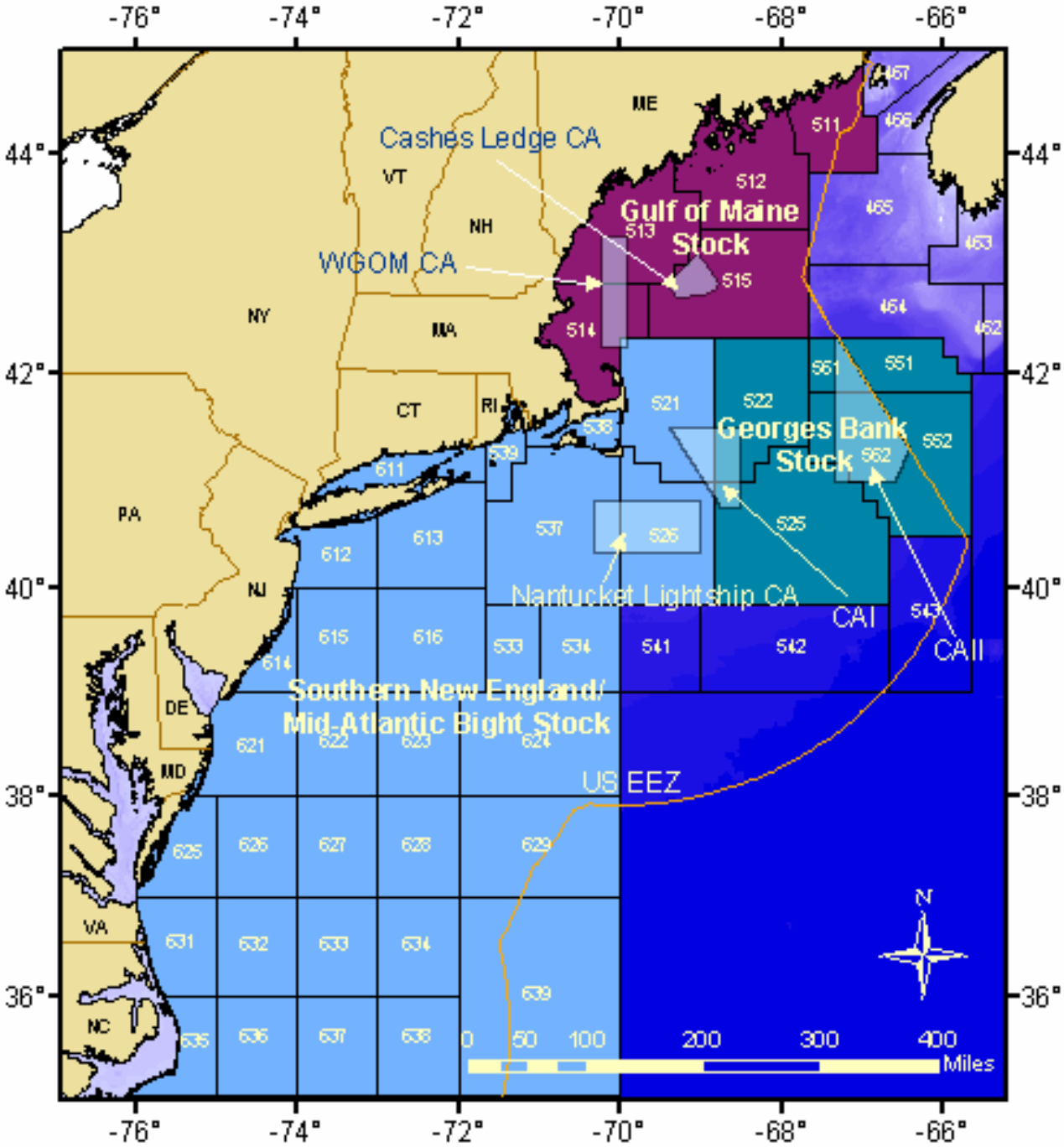
Draft Presentation
For Peer Review Only.
Does not represent
final NOAA Decision/Policy.
4/28/08

Gulf of Maine Winter Flounder



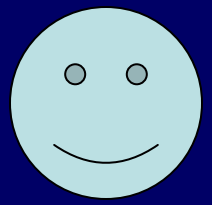
GARM III BRP Meeting


Winter flounder - *Pseudopleuronectes americanus*
Fall 2001 - 2005
/ Tow
1 - 2
3 - 6
7 - 18
19 - 473
No Catch
NE Closed Areas
NOAA
N
ME
VT
NH
MA
NY
CT
RI
PA
NJ
DE
MD
EEZ Boundary
Fall 1963 - 2005
Density / km²
0.003 - 0.012
0.013 - 0.070
0.071 - 0.280
0.281 - 6.852
nmi
0 25 50 100
-76° -74° -72° -70° -68° -66°
44° 42° 40° 38° 36°

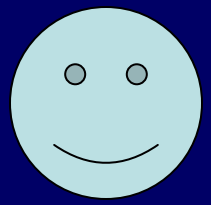

Cashes Ledge CA
WGOM CA
Gulf of Maine Stock
Georges Bank Stock
Nantucket Lightship CA
CAI
CAII
Southern New England/ Mid-Atlantic Bight Stock
US EEZ
ME
VT
NH
NY
MA
CT
RI
PA
NJ
DE
MD
VA
NC
N
0 50 100 200 300 400 Miles
-76° -74° -72° -70° -68° -66°
44° 42° 40° 38° 36°

GARM II STATUS VPA

- SSB in 2004 was 3,400 mt or about 84% of BMSY = 4,100 mt (NOT overfished)



- Fishing mortality in 2004 was 0.13 or about 30% of FMSY = 0.43 (Overfishing is NOT occurring)



GARM III
Gulf of Maine
Winter Flounder
Models

Wicked retrospective pattern!

Models have difficulty with the apparent lack of a relationship between a large decrease in catch and little change in the indices and size & age distributions (2005 & 2006 adult and catch both decline).

GARM III

Investigation of conflicting trends in the input data (surveys and catch).

Update VPA and try an alternative forward projection model (SCALE).

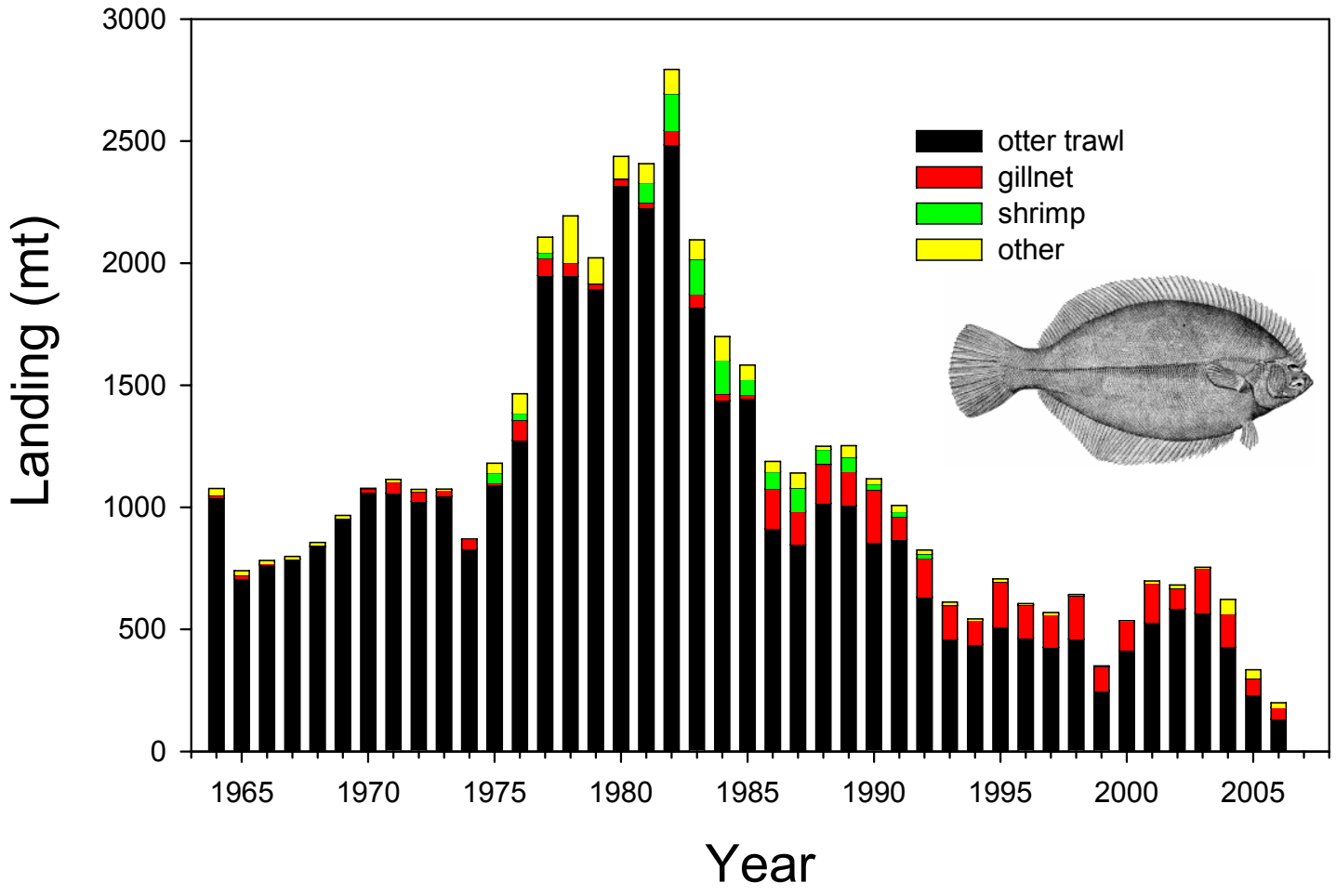


Figure Commercial landings by gear 1964-2006.

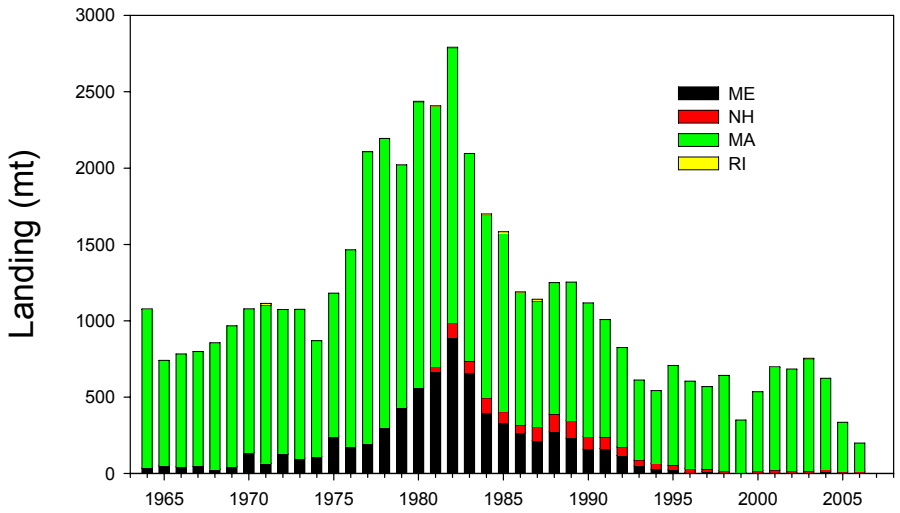


Figure Commercial landings by state from 1964-2006.

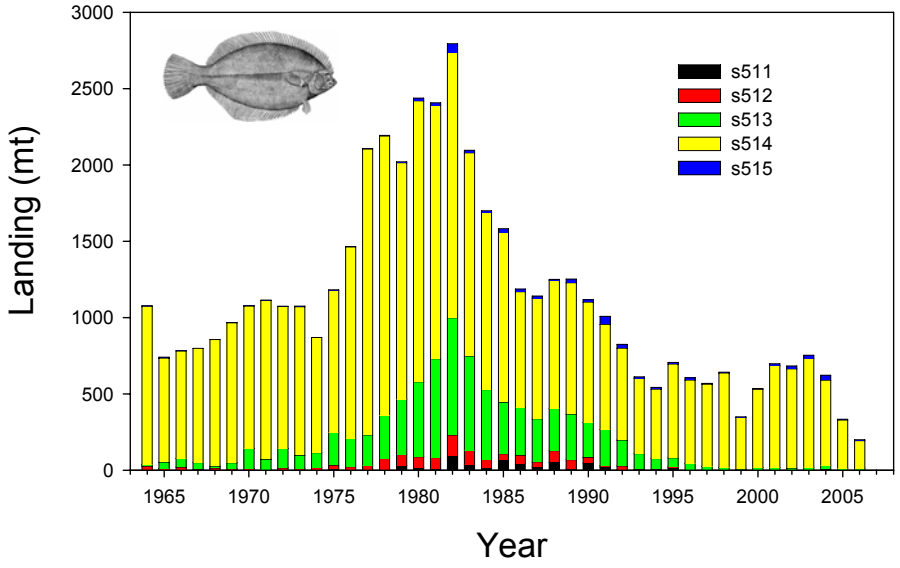


Figure Commercial landings by statistical area from 1964-2006.

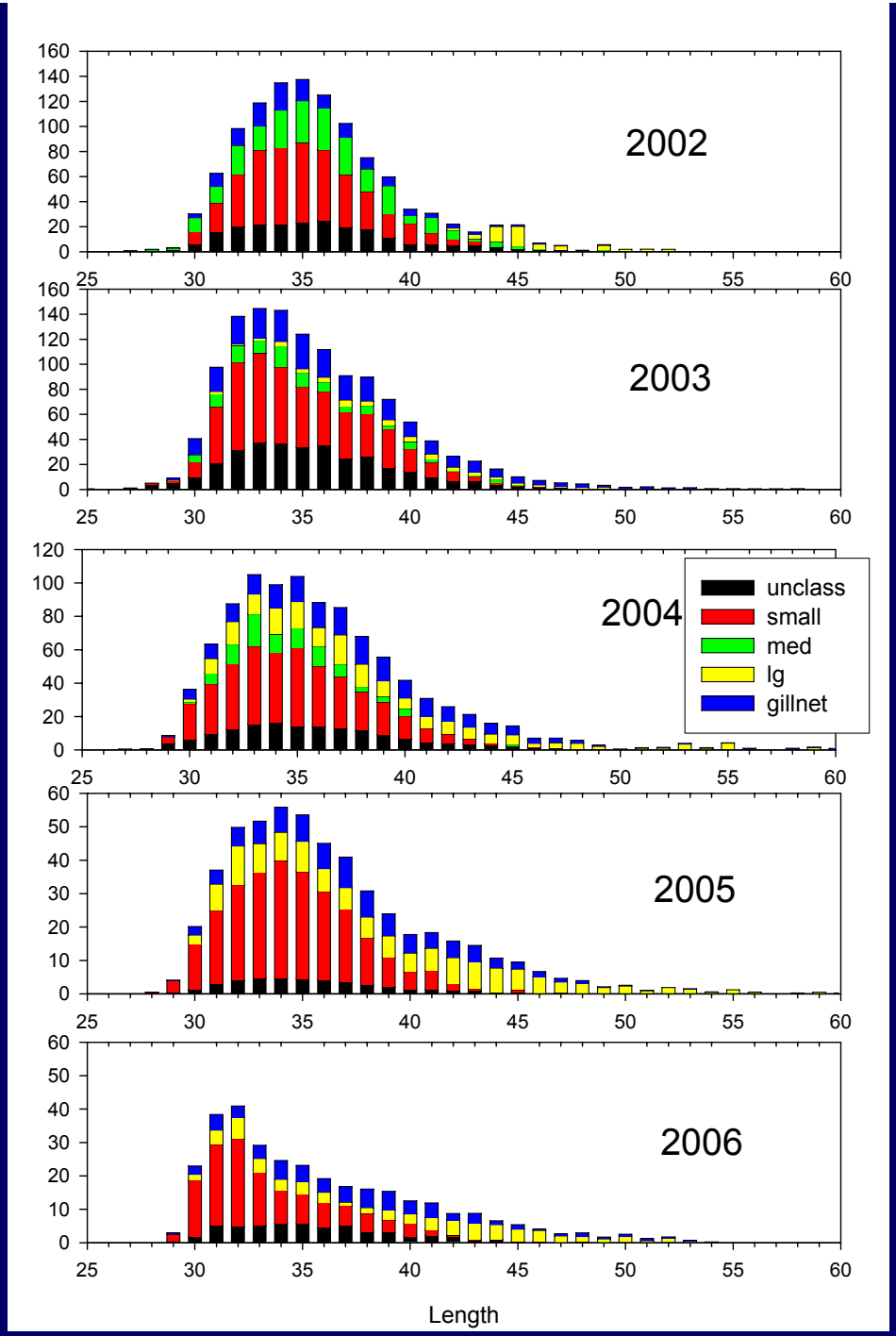
Table I8.

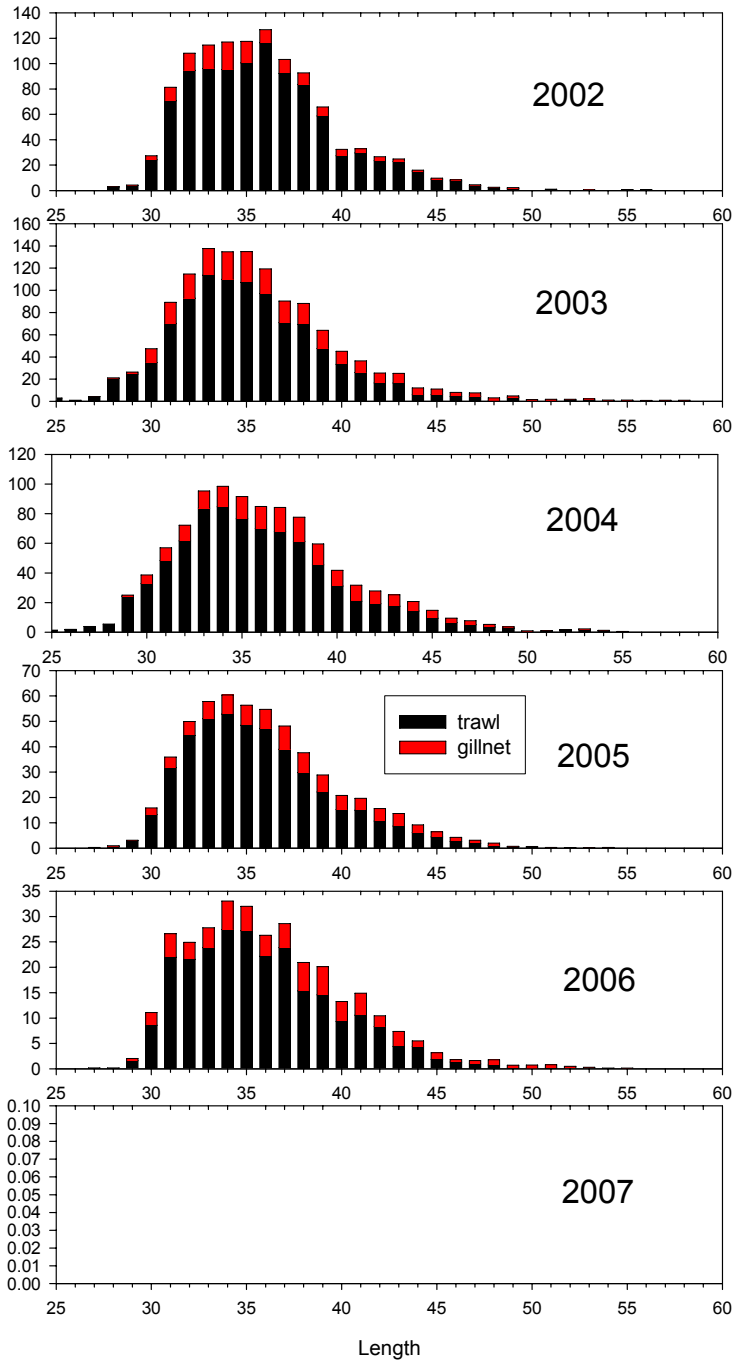
Construction of Catch at Age and length

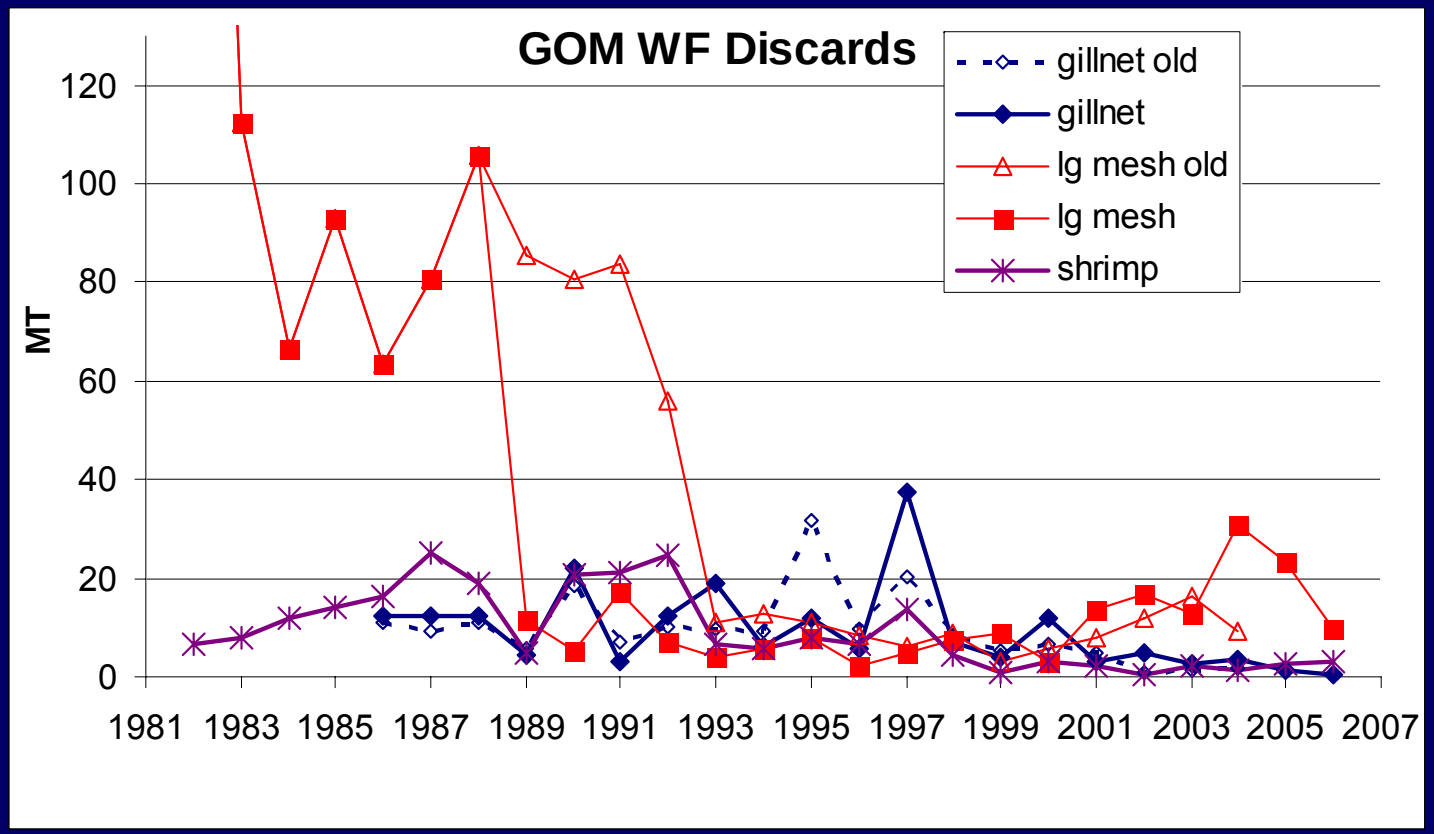
Catch at age component	years	halfyear	length data	age data
trawl and other commercial landings	82-98	mix	commercial and observer (unclassified)	commercial
trawl and other commercial landings	**99-06**	whole & halfyear	**Observer (Trawl kept)**	commercial
gillnet commercial Landings	90-06	whole **& halfyear**	observer (gillnet kept)	commercial
recreational Landings	82-06	halfyear	MRFSS	combine NEFSC and MA DMF ages by halfyear
recreational Discards	82-06	halfyear	spr & fall MA DMF	combine NEFSC and MA DMF ages by halfyear
large mesh trawl discards (survey filter)	82-88	whole year	survey method (spr & fall MA DMF)	combine NEFSC spr & fall survey
large mesh trawl **disc (obs disc/keptall)**	**89-06**	whole year	survey method (89-00) observer disc (01-06)	combine NEFSC spr & fall survey
gillnet discards **(obs disc/keptall)**	**86-06**	Whole & halfyear	observer discards	combine spr NEFSC and MA DMF ages
shrimp discards (obs disc/days fished)	82-04	shrimp season	observer (discards)	combine spr NEFSC and MA DMF ages

Table I3

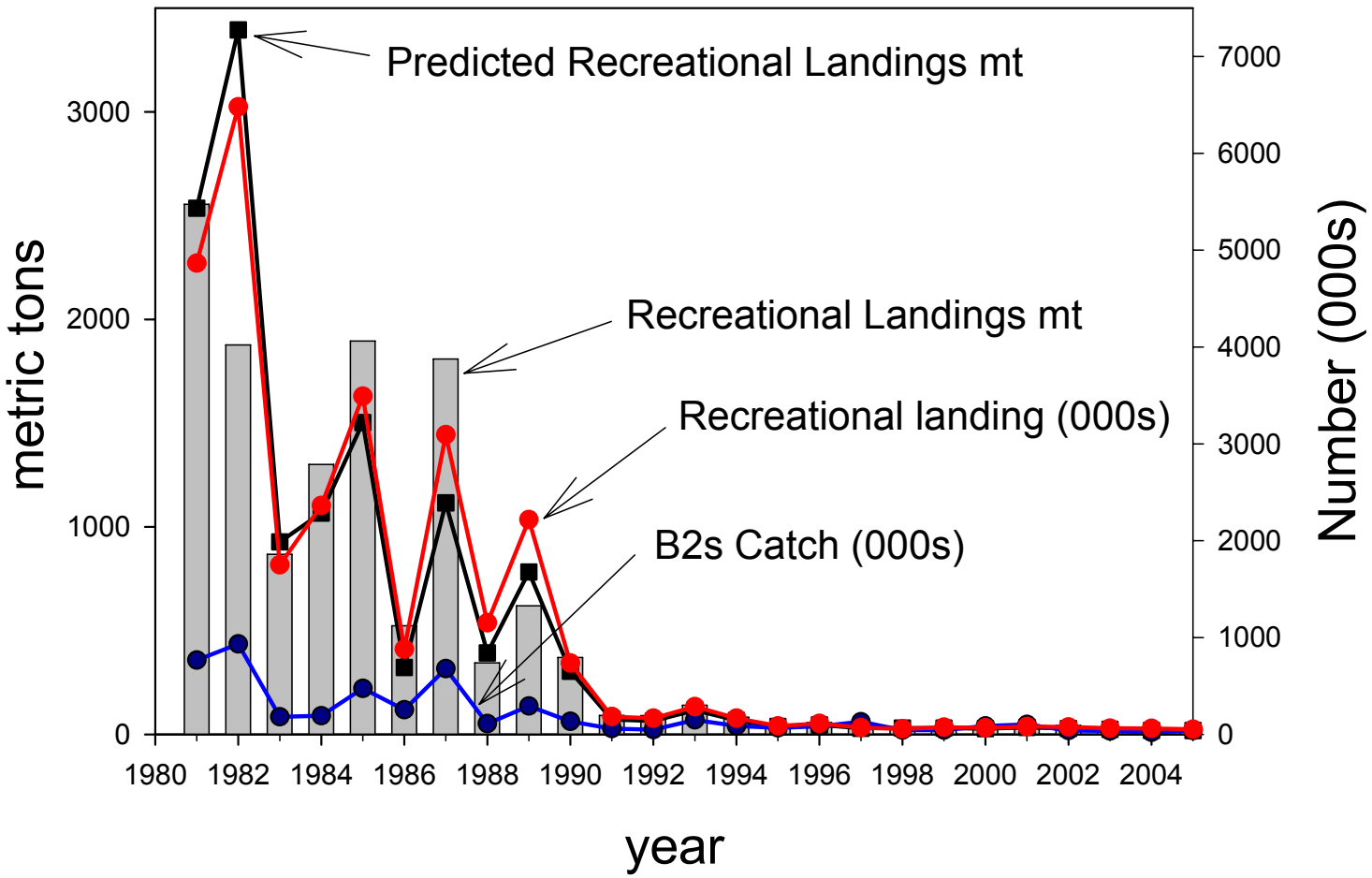
		Number of lengths.					Number of samples					mt/samples				
year	half	lg	sm	med	un	total	lg	sm	med	un	total	lg	sm	med	un	total
1994	1		71	92				1	1					57		
	2	94		235	*	492	1		3		6	118	157	18		64
1995	1	101		474	**33**	474	1		5					29		
	2			414	**609**	1631			4		10	94		59		52
		↑														
1996	1		378					4					29			
	2		795	338	**112**	1623		7	4		15		23	16		31
		↓														
1997	1		127	75	*			2	1	*			34	33		
	2	407	1014	218	*	1841	5	11	3	*	22	20	11	19		18
1998	1		299	280	*			5	3	*			16	16		
	2	69	746	110	*	1504	1	9	1	*	19	51	12	32		17
		↑					↑									
1999	1			275	**122**				3							
	2		80		**430**	907		2			5		42	15		50
		↓				552										
2000	1	104	4331	250	**1046**		1	59	4			19	1			
	2	244	344		**130**	6449	4	6		**1**	75	7	20	24		6
		↑														
2001	1		89	474	**795**			1	6				66	10		
	2		254	250	**1756**	3618		3	3		13		35	47		41
		↓														
2002	1	28	507	173	**573**		1	7	2	**1**			7	34	**59**	
	2		982	133	**2734**	5130		14	2	**2**	29	57	14	48	**35**	21
2003	1		744		**2410**		1	10	1	**2**			11		**48**	
	2	384	818	110	**914**	5380	12	19	1	**6**	52	3	9	28	**18**	11
2004	1	223	692	86	**1915**		7	14	1	**6**			6		**12**	
	2	7	706		**2955**	6584	1	12		**4**	45	18	9	48	**6**	11
2005	1		269		**3202**			4		**11**			16.8		**1**	
	2	600	807		**5696**	10574	10	7		**11**	43	11	10		**1**	6
2006	1		732		**2330**			3		**11**			7		**1**	
	2	341	281		**823**	4507	4	3		**9**	30	14	14		**3**	5
2007	1												####		####	
	2					0					0	####	####	####	####	####

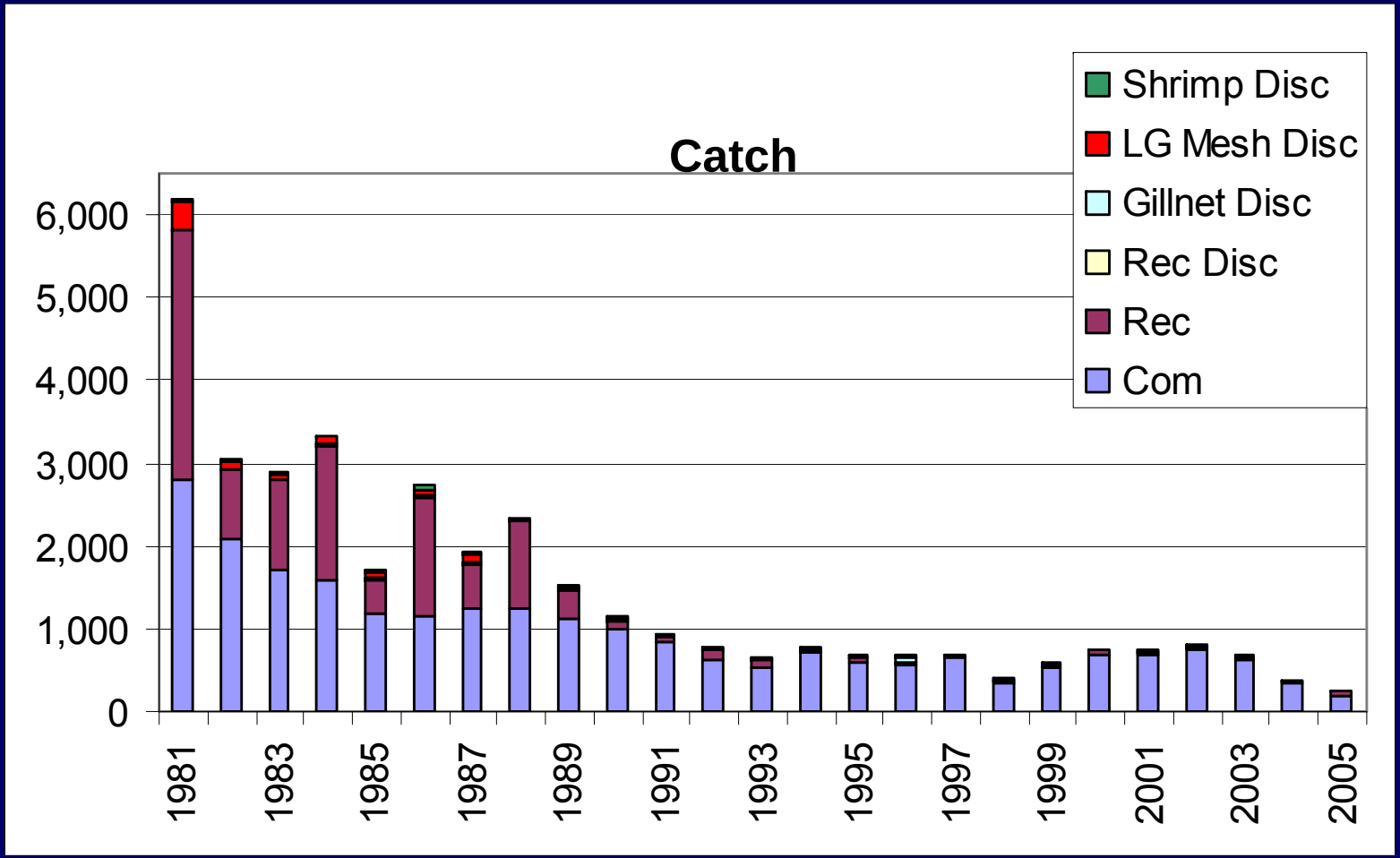

2002
2003
2004
2005
2006
unclass
small
med
lg
gillnet
Length


2002
2003
2004
2005
2006
2007
trawl
gillnet
Length

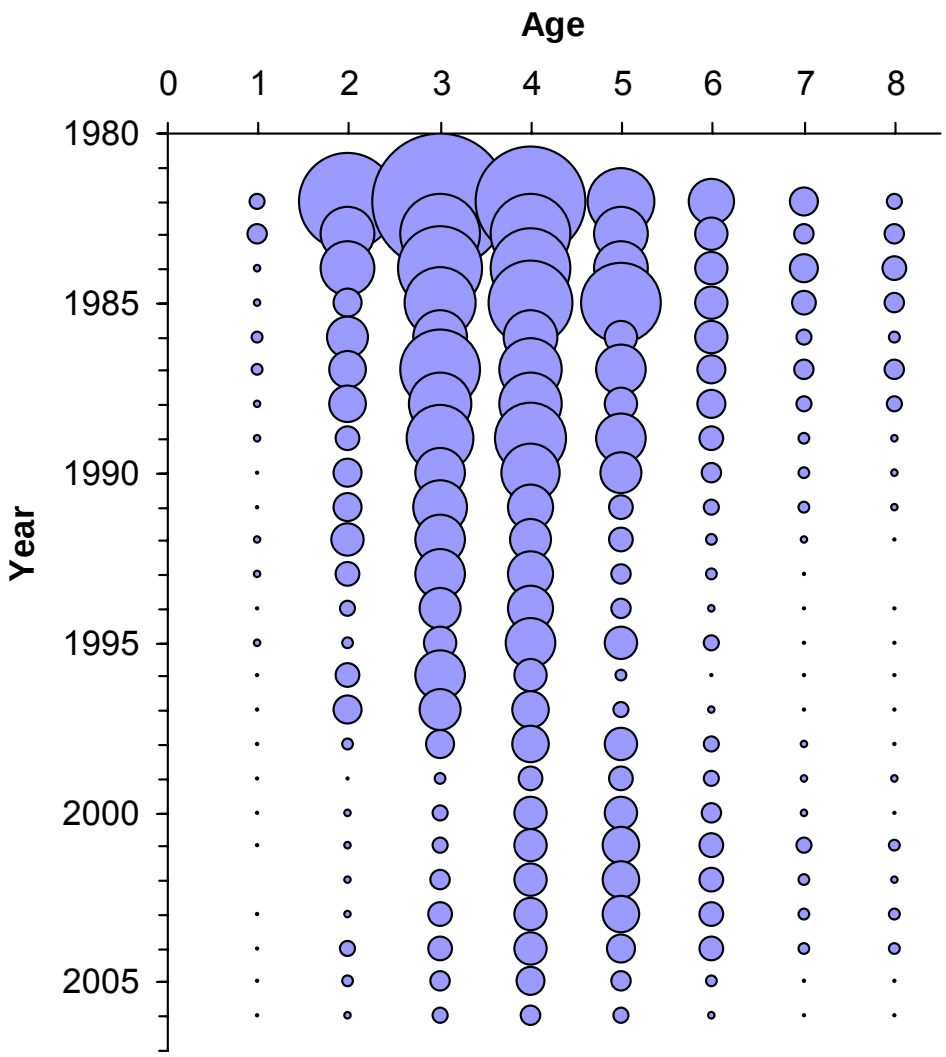

GOM WF Discards
MT
120
100
80
60
40
20
0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
gillnet old
gillnet
lg mesh old
lg mesh
shrimp

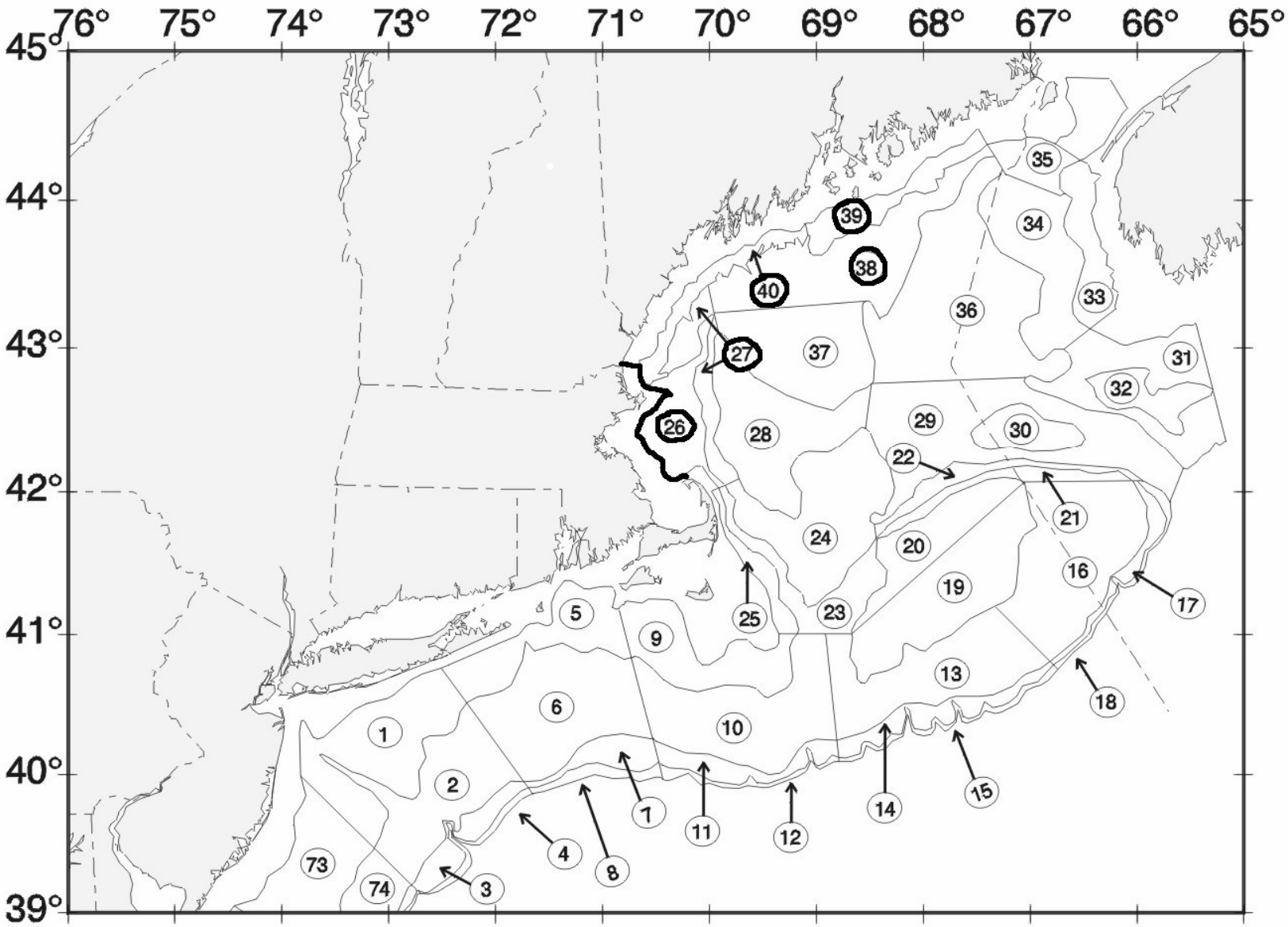
Gulf of Maine Winter Flounder Recreational landings and b2 Catch

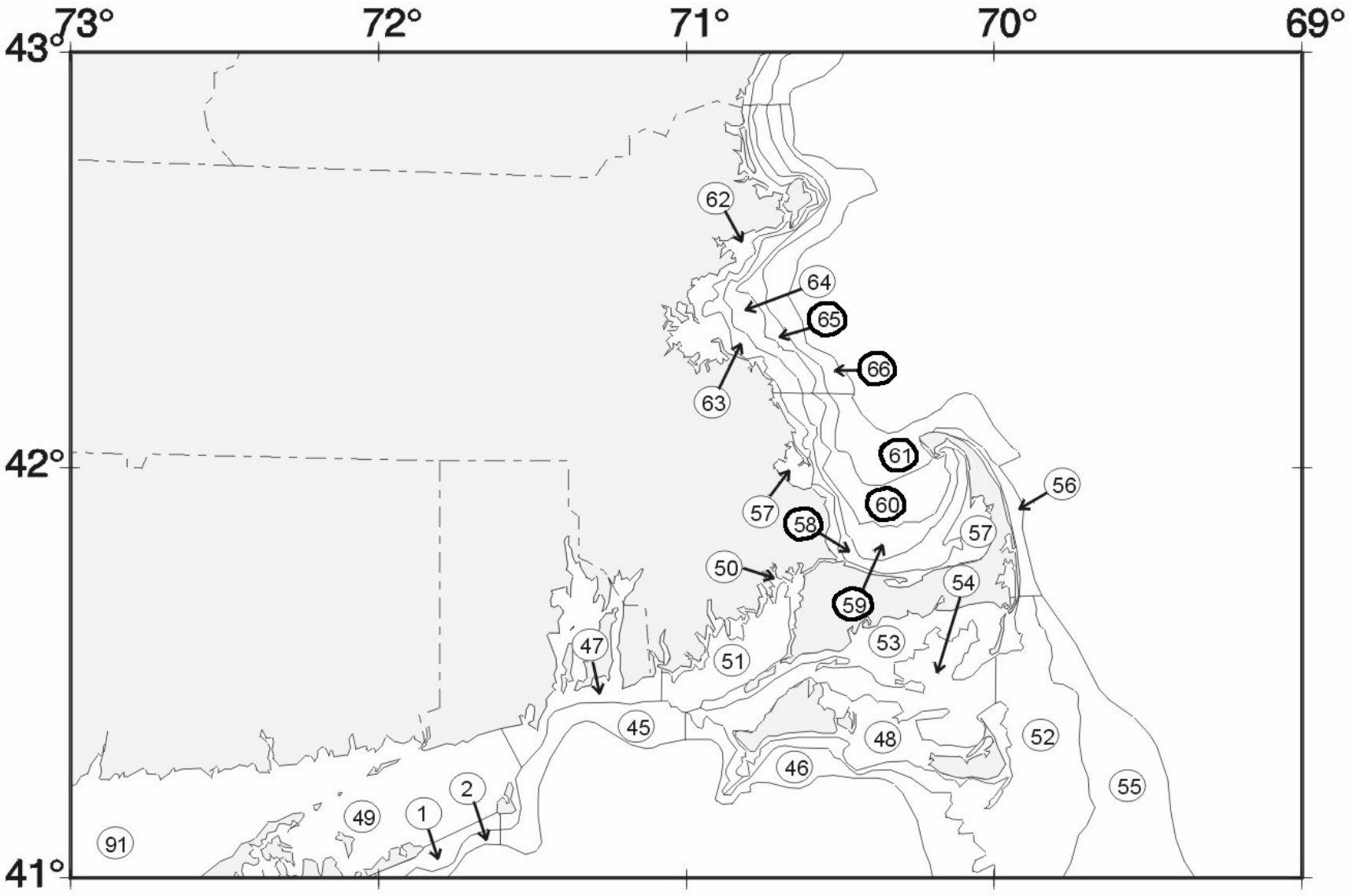


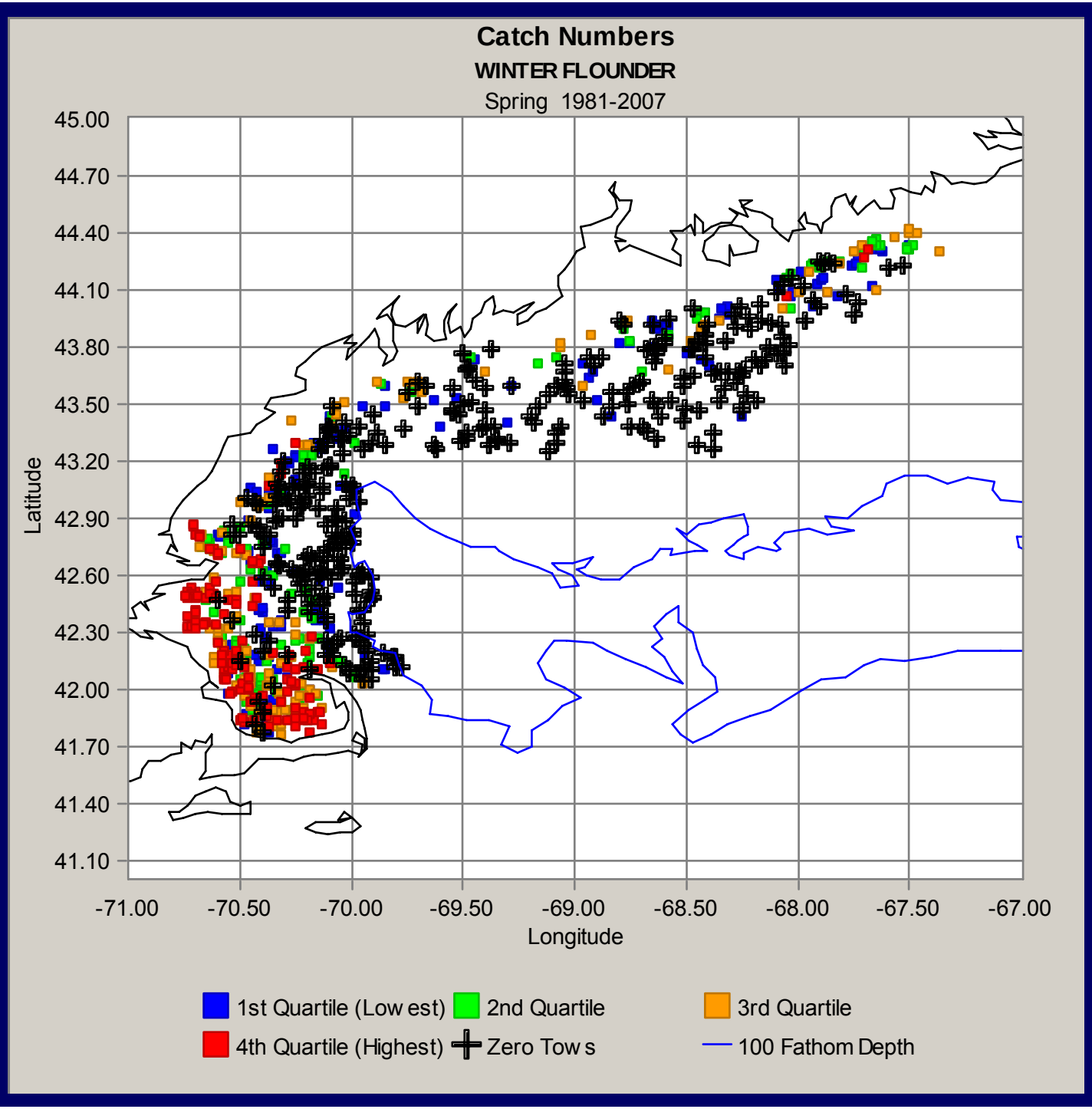

Catch
Shrimp Disc
LG Mesh Disc
Gillnet Disc
Rec Disc
Rec
Com
6,000
5,000
4,000
3,000
2,000
1,000
0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

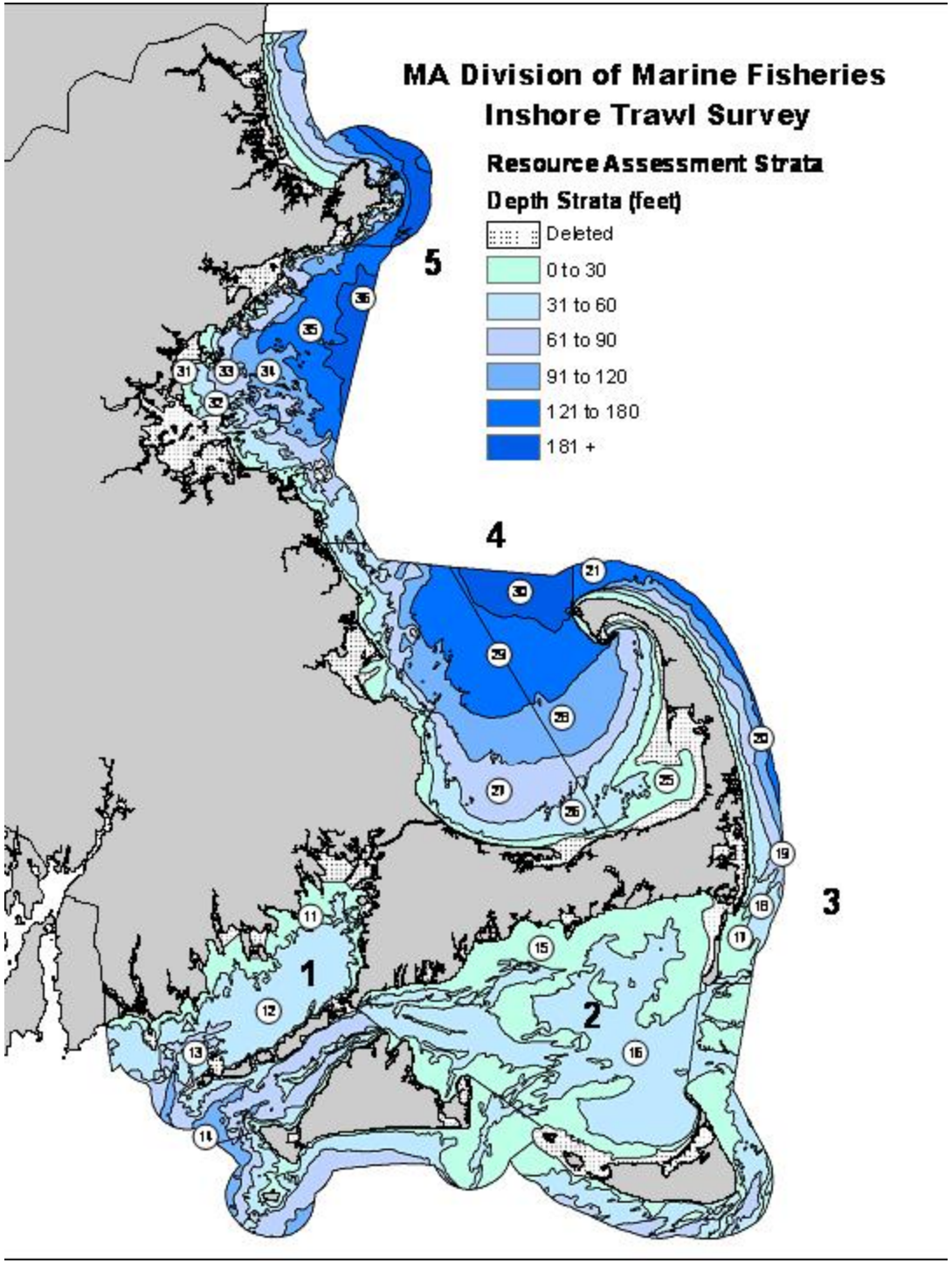
Catch at AGE

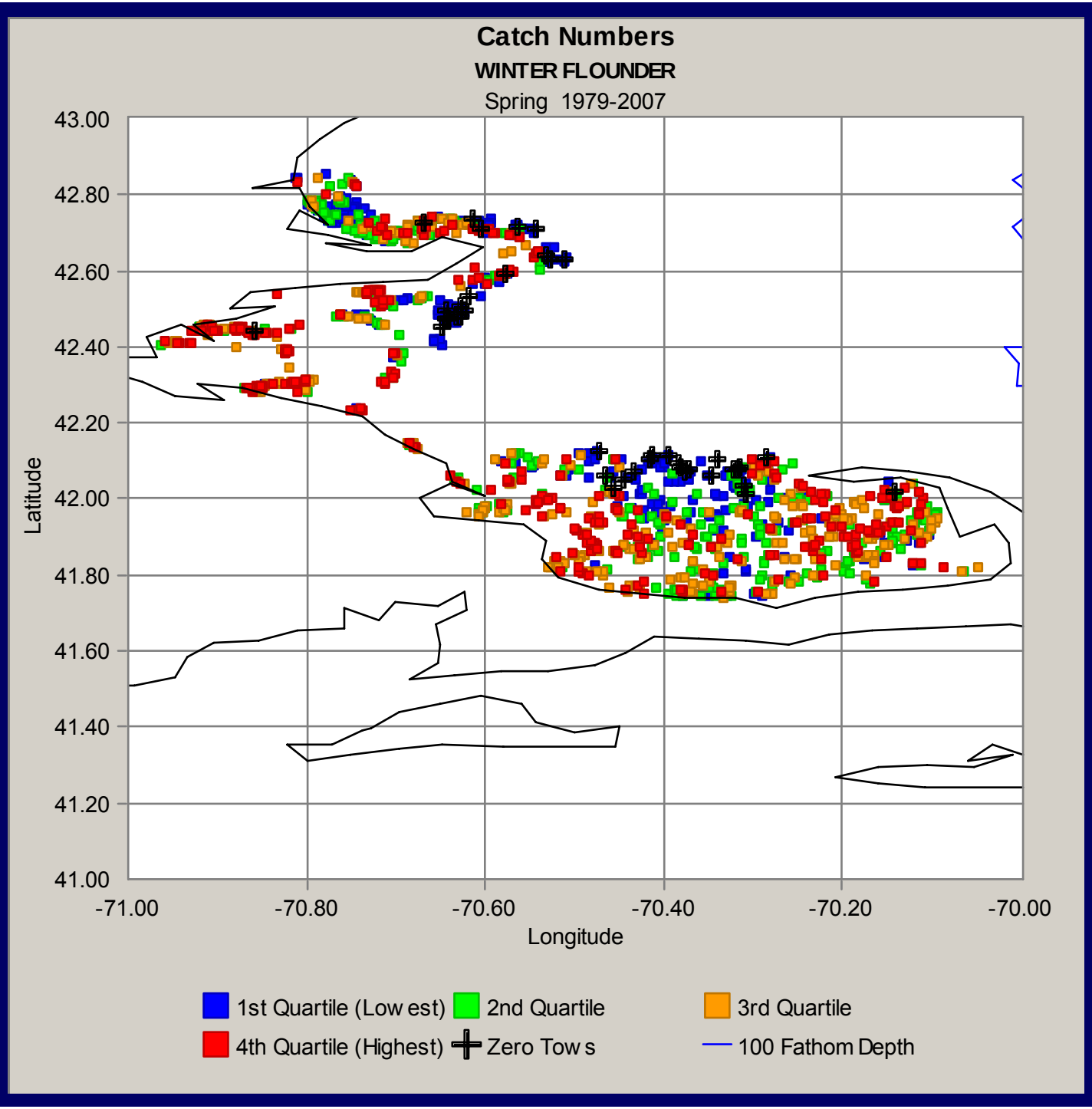


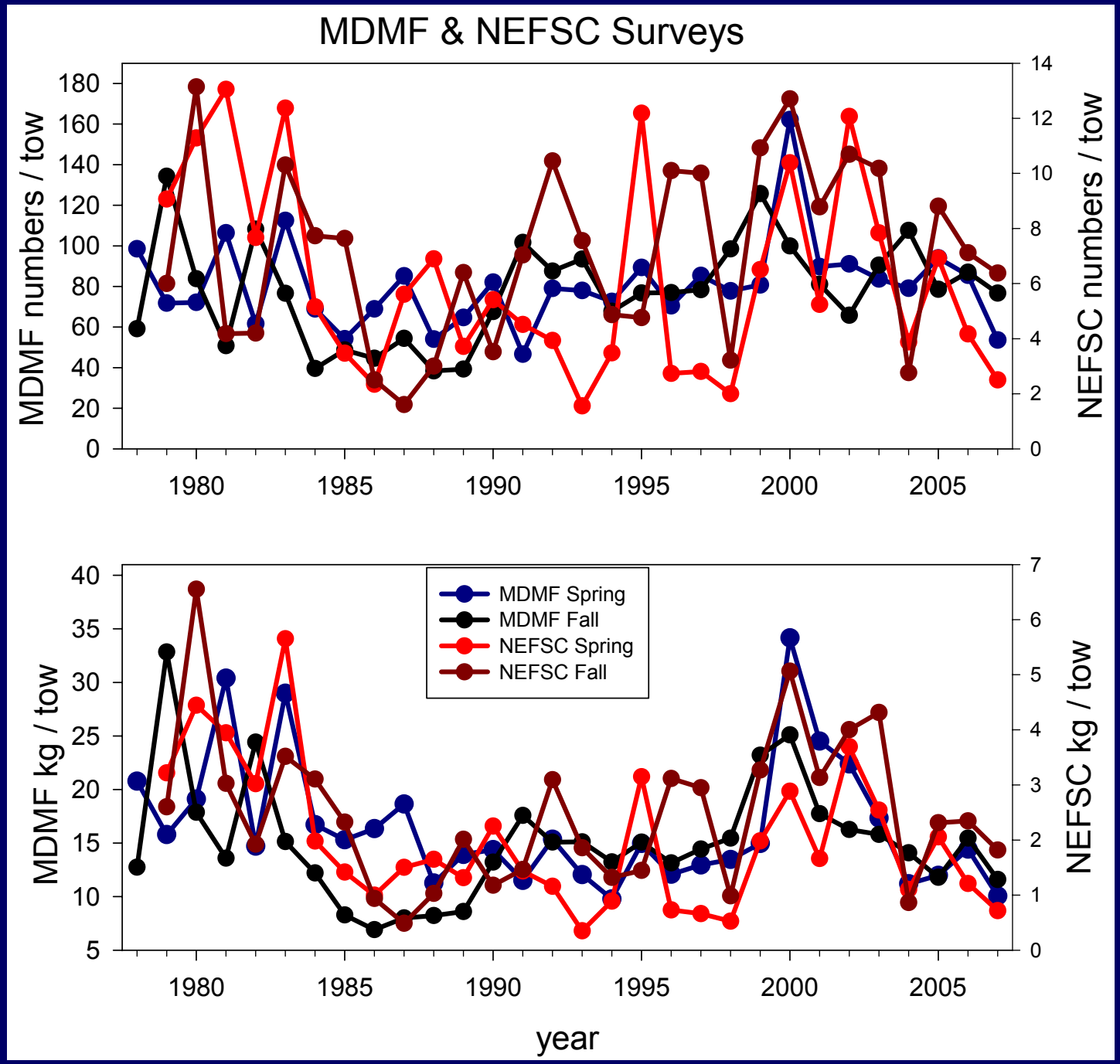

76°
75°
74°
73°
72°
71°
70°
69°
68°
67°
66°
65°
45°
44°
43°
42°
41°
40°
39°
35
34
39
38
40
36
33
27
37
31
32
26
28
29
30
22
21
24
20
16
19
17
25
23
5
9
13
18
6
10
1
2
7
11
12
14
15
4
8
73
74
3

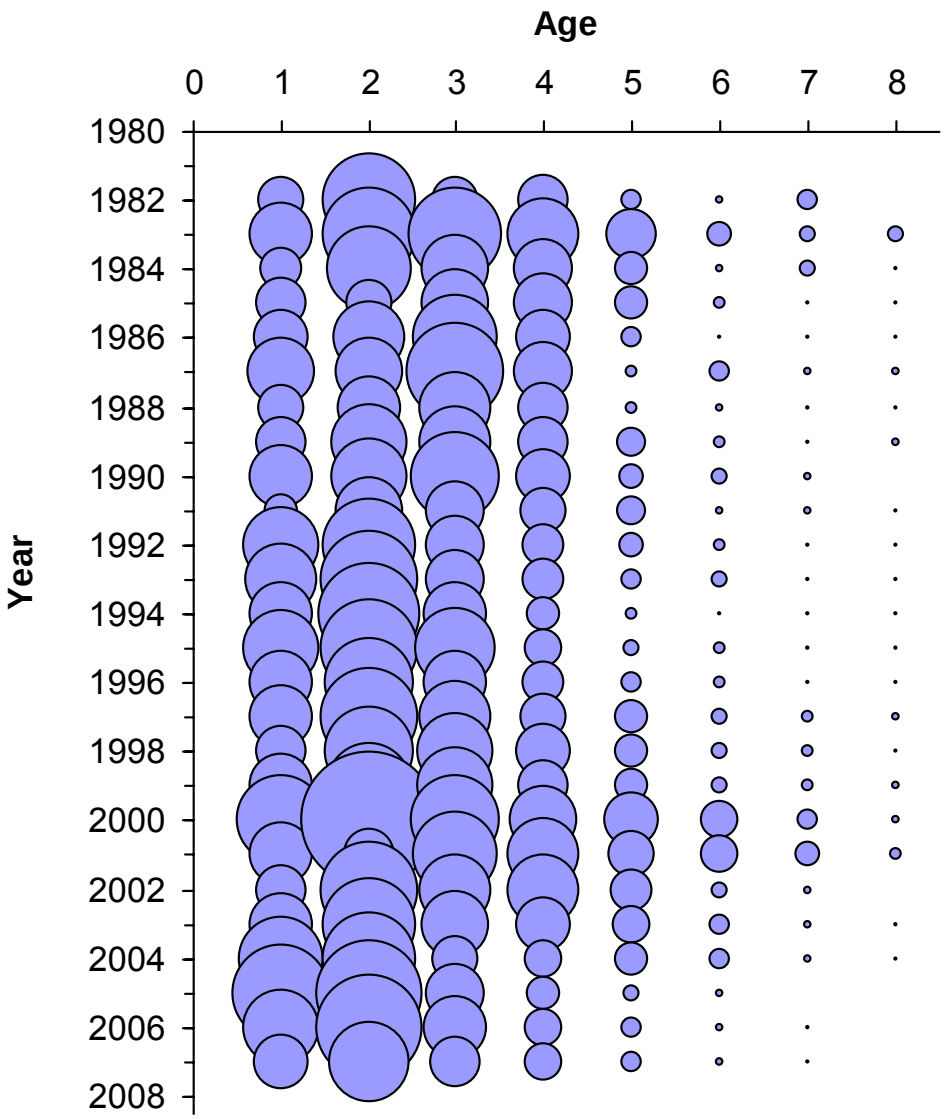

73°
72°
71°
70°
69°
43°
42°
41°
62
64
65
66
63
61
56
57
60
58
57
50
54
59
53
47
51
45
48
52
46
55
2
1
49
91


Catch Numbers
WINTER FLOUNDER
Spring 1981-2007
45.00
44.70
44.40
44.10
43.80
43.50
43.20
42.90
42.60
42.30
42.00
41.70
41.40
41.10
Latitude
-71.00
-70.50
-70.00
-69.50
-69.00
-68.50
-68.00
-67.50
-67.00
Longitude
1st Quartile (Low est)
2nd Quartile
3rd Quartile
4th Quartile (Highest)
Zero Tow s
100 Fathom Depth

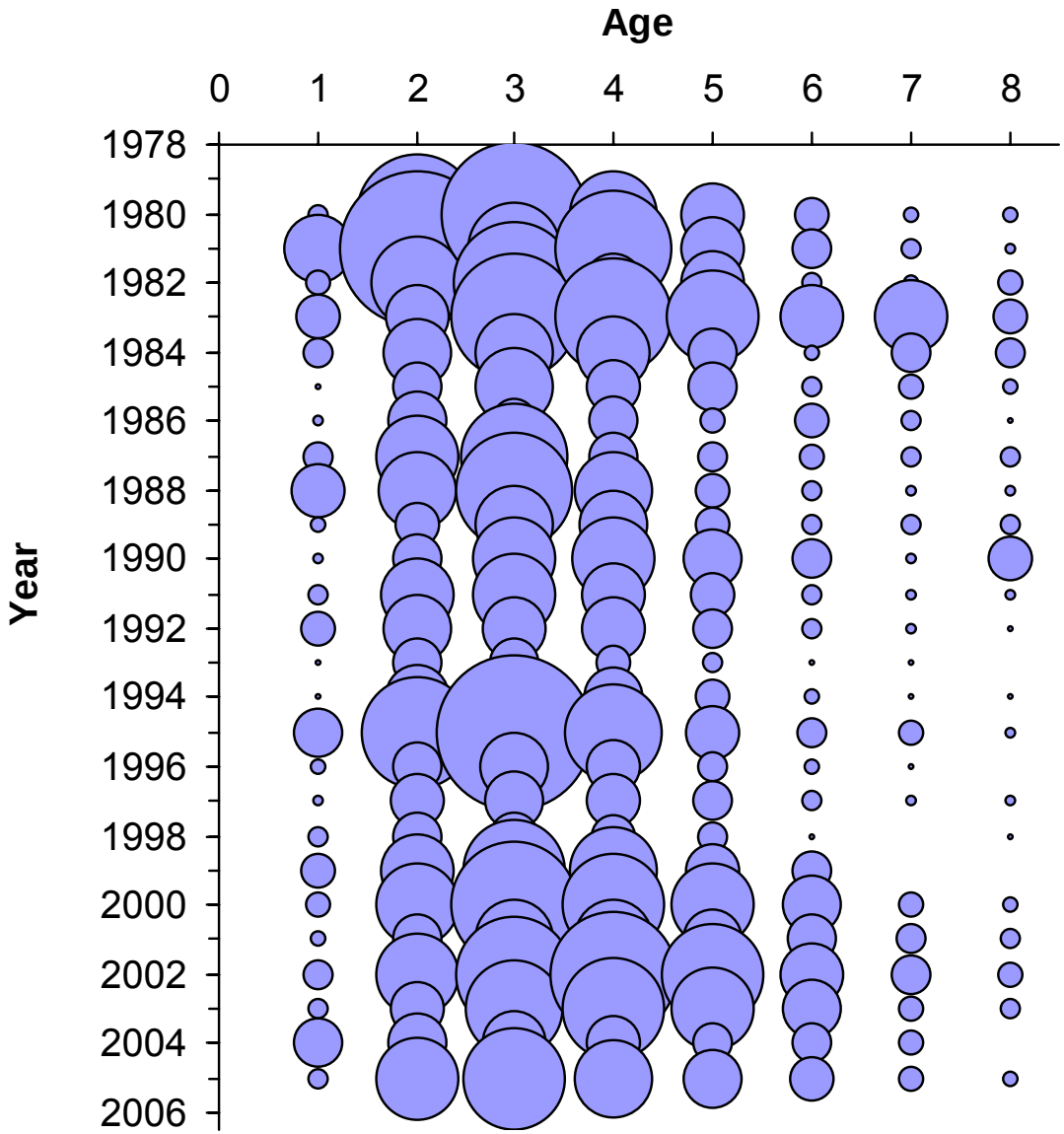

MA Division of Marine Fisheries
Inshore Trawl Survey
Resource Assessment Strata
Depth Strata (feet)
Deleted
0 to 30
31 to 60
61 to 90
91 to 120
121 to 180
181 +
1
2
3
4
5


Catch Numbers
WINTER FLOUNDER
Spring 1979-2007
43.00
42.80
42.60
42.40
42.20
42.00
41.80
41.60
41.40
41.20
41.00
Latitude
-71.00
-70.80
-70.60
-70.40
-70.20
-70.00
Longitude
1st Quartile (Low est)
2nd Quartile
3rd Quartile
4th Quartile (Highest)
Zero Tow s
100 Fathom Depth

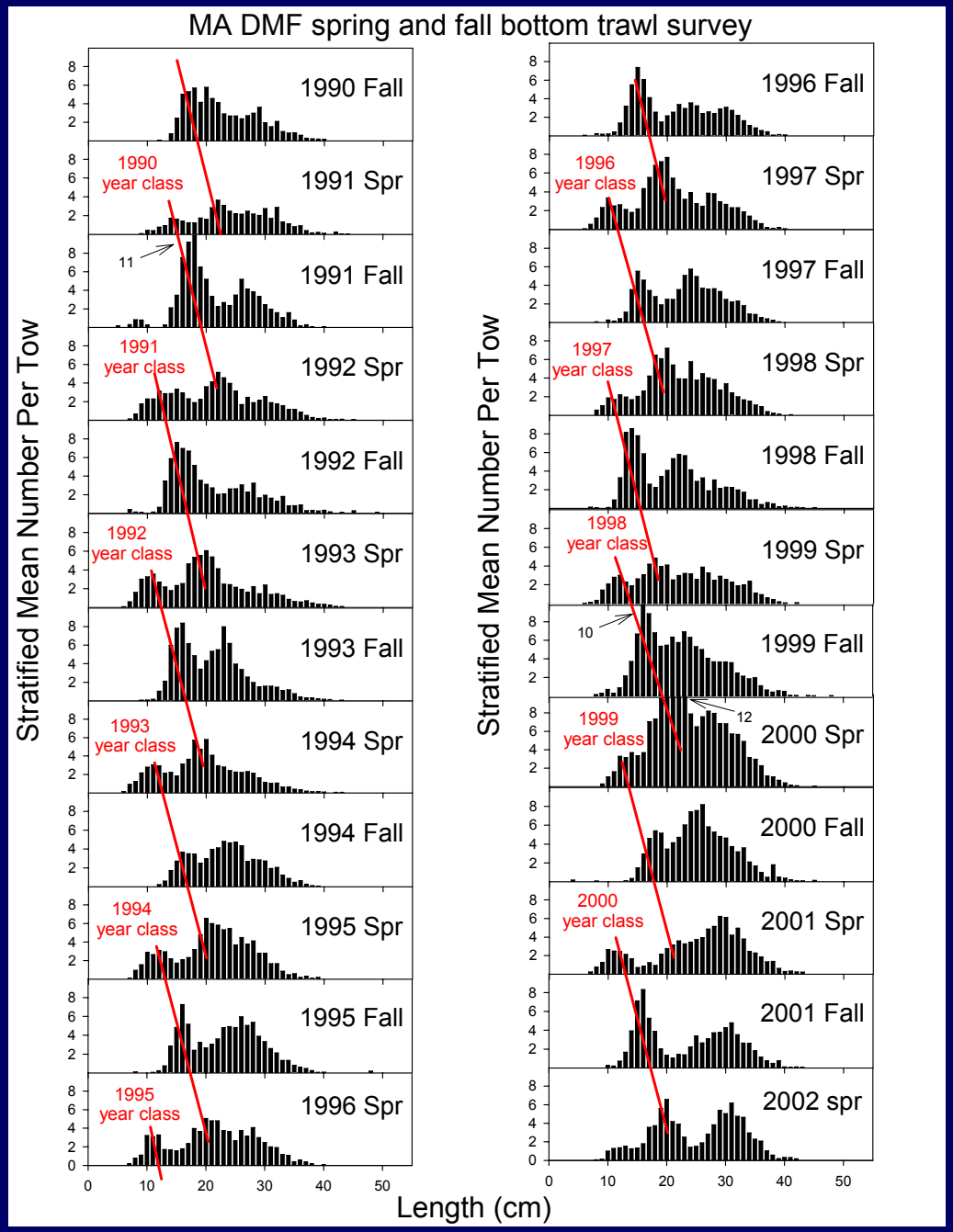

MDMF & NEFSC Surveys
MDMF numbers / tow
NEFSC numbers / tow
MDMF kg / tow
NEFSC kg / tow
MDMF Spring
MDMF Fall
NEFSC Spring
NEFSC Fall
year
1980
1985
1990
1995
2000
2005



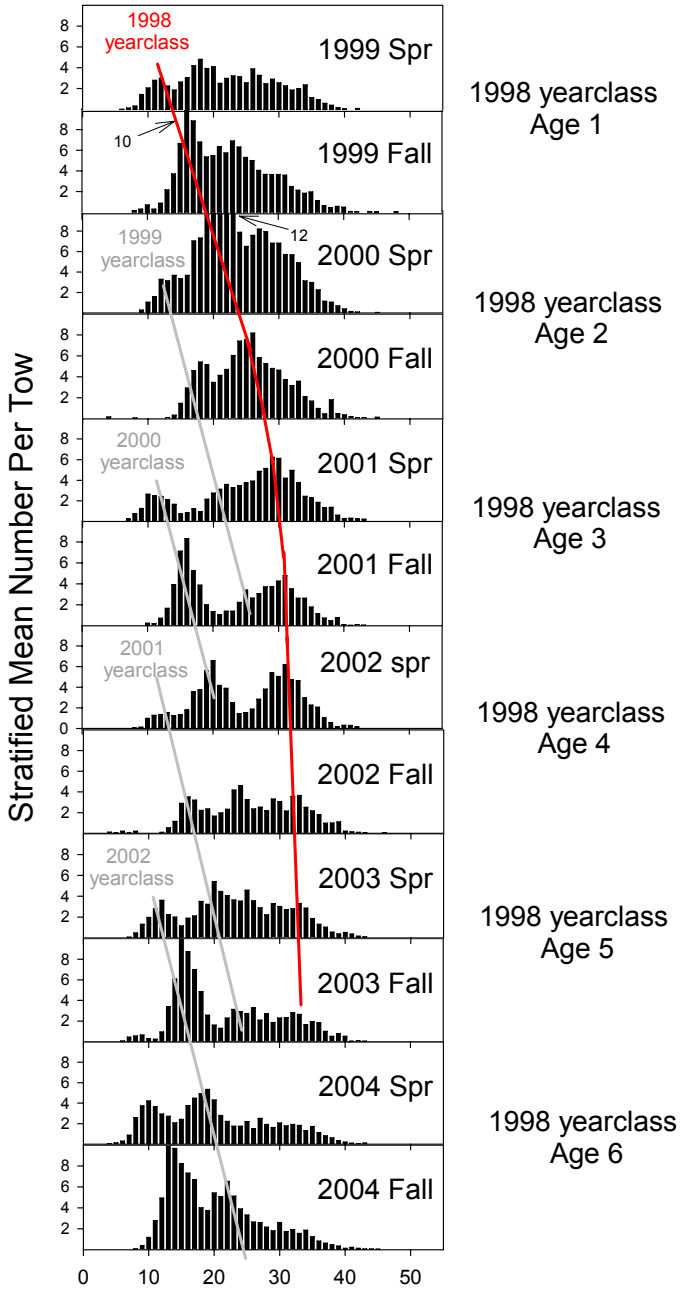
MDMF Spring bubble plot by age.



NEFSC Spring bubble plot by age.


MA DMF spring and fall bottom trawl survey
Stratified Mean Number Per Tow
Length (cm)
1990 Fall
1990 year class
1991 Spr
11
1991 Fall
1991 year class
1992 Spr
1992 Fall
1992 year class
1993 Spr
1993 Fall
1993 year class
1994 Spr
1994 Fall
1994 year class
1995 Spr
1995 Fall
1995 year class
1996 Spr
1996 Fall
1996 year class
1997 Spr
1997 Fall
1997 year class
1998 Spr
1998 Fall
1998 year class
1999 Spr
10
1999 Fall
12
1999 year class
2000 Spr
2000 Fall
2000 year class
2001 Spr
2001 Fall
2002 spr

1998 yearclass in the MA DMF spring and fall bottom trawl survey



1998 yearclass Age 1

1998 yearclass Age 2

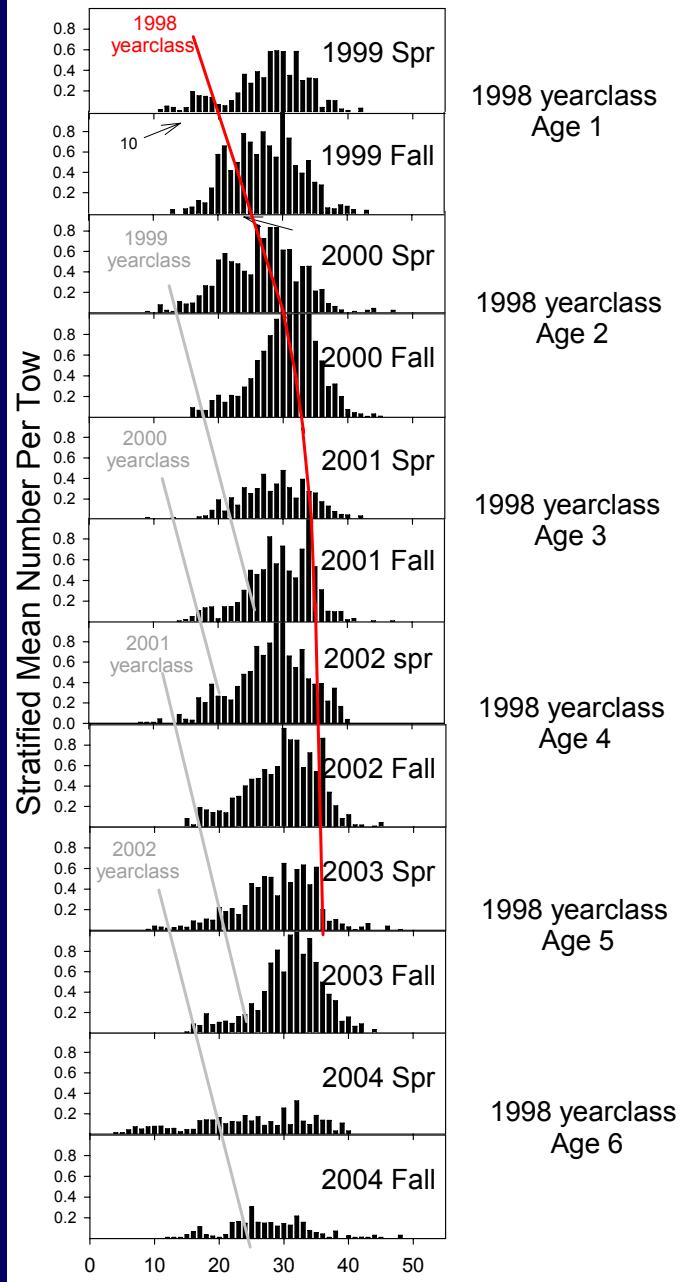
1998 yearclass Age 3

1998 yearclass Age 4

1998 yearclass Age 5

1998 yearclass Age 6

1998 yearclass in the NEFSC spring and fall bottom trawl survey



1998 yearclass Age 1

1998 yearclass Age 2

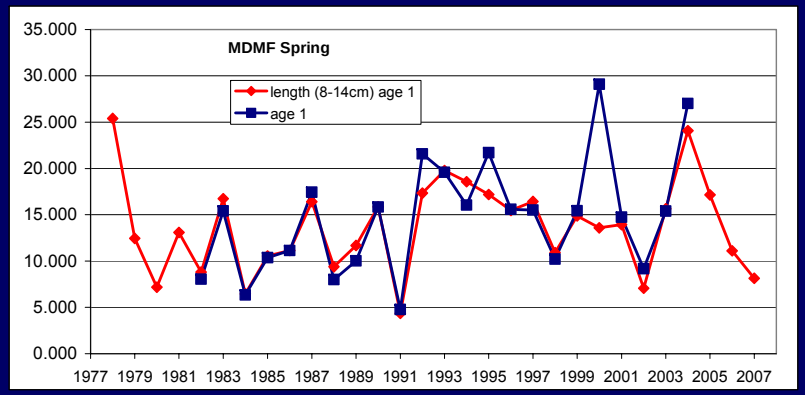
1998 yearclass Age 3

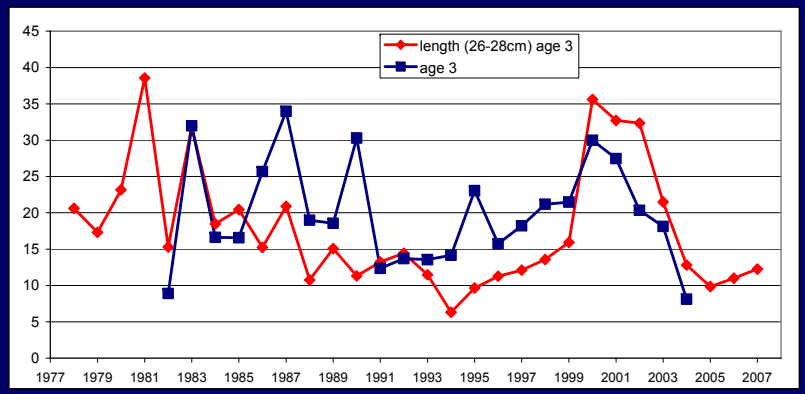
1998 yearclass Age 4

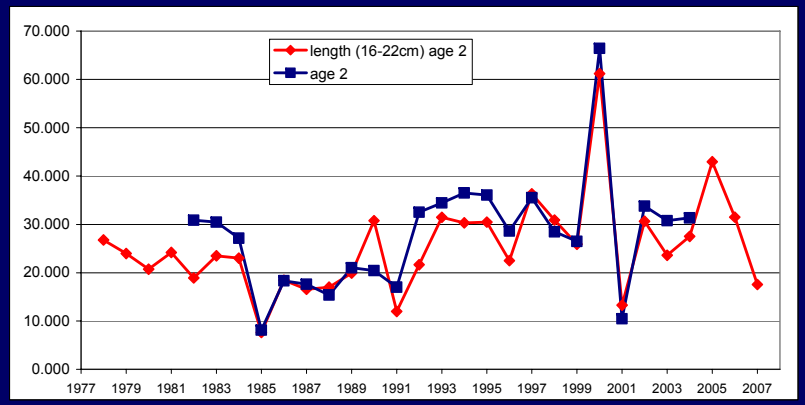
1998 yearclass Age 5

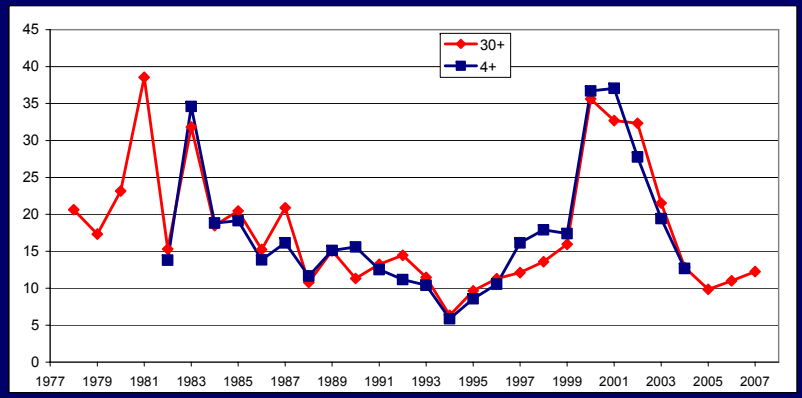
1998 yearclass Age 6

MDMF Spring Survey

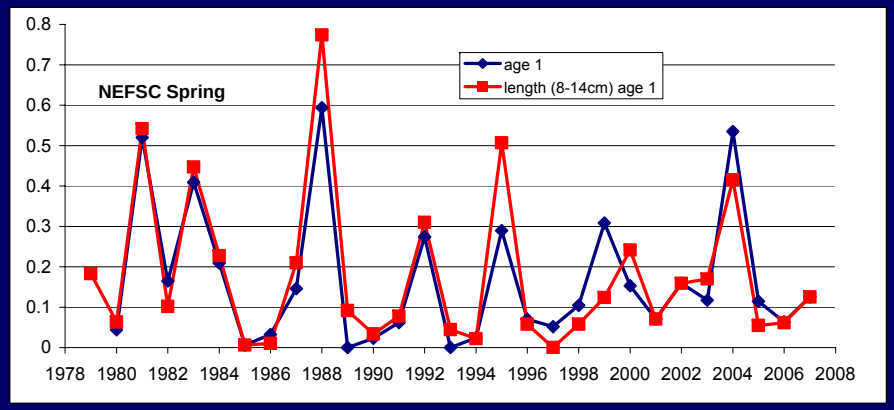


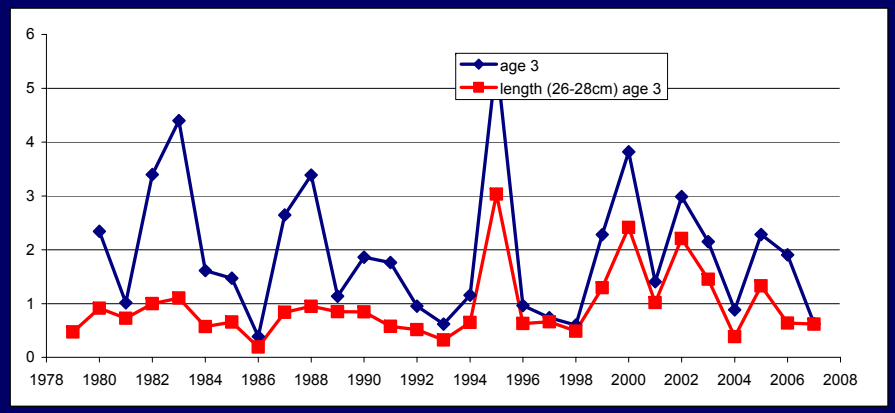


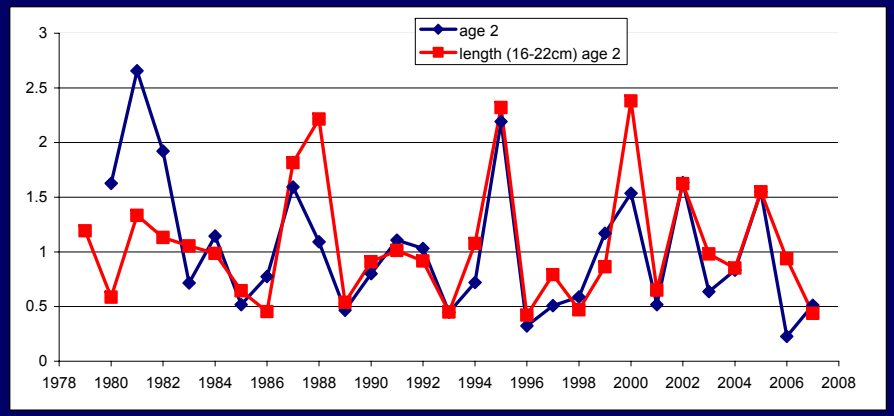


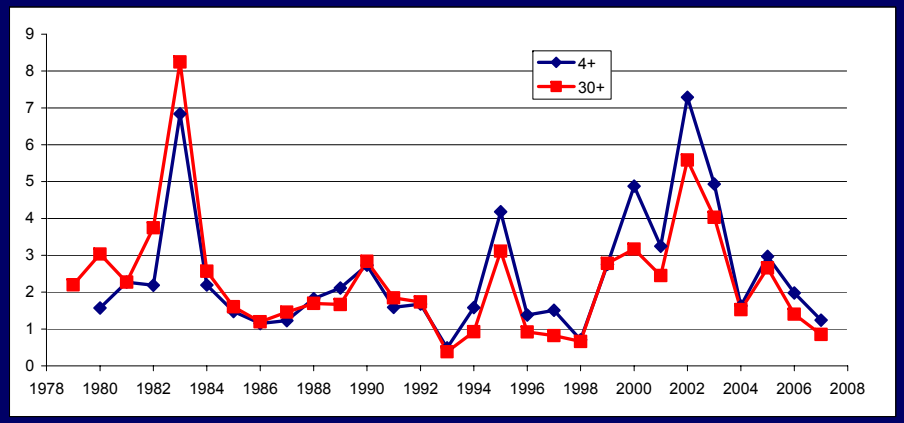


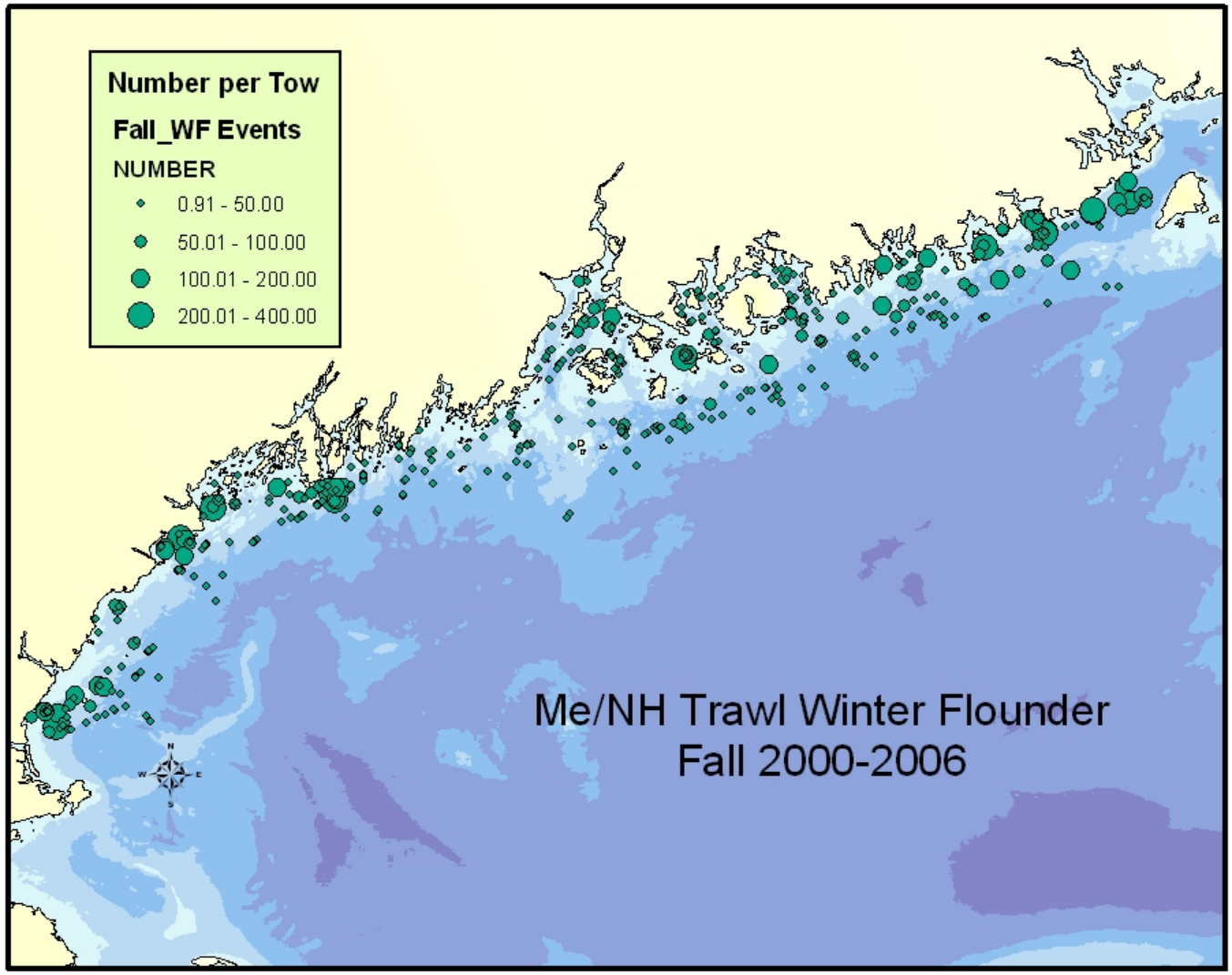
NEFSC Spring Survey

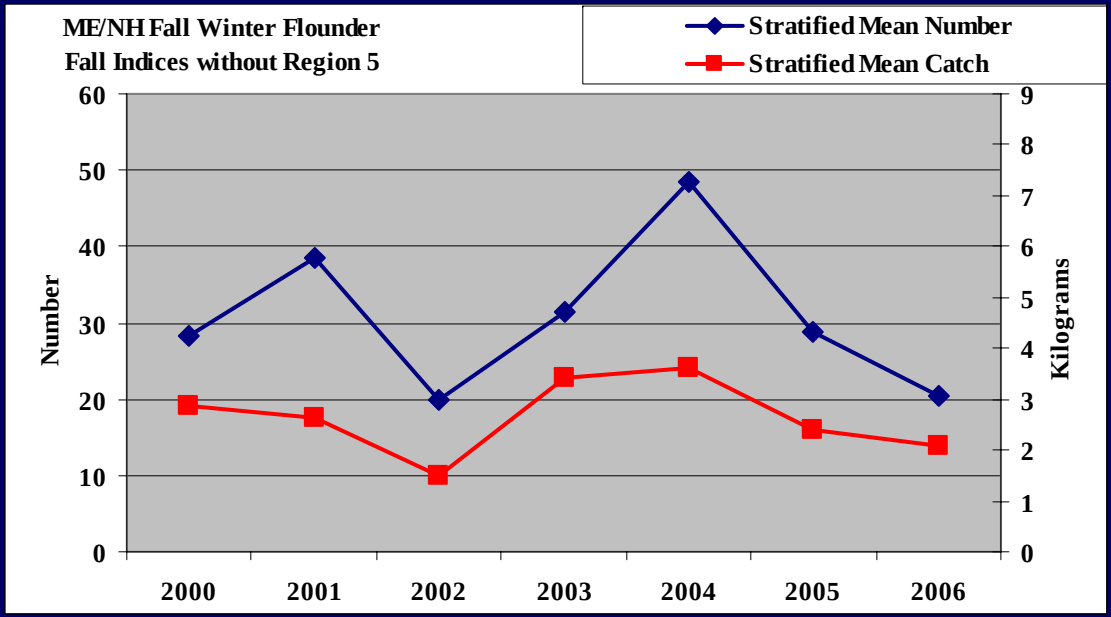


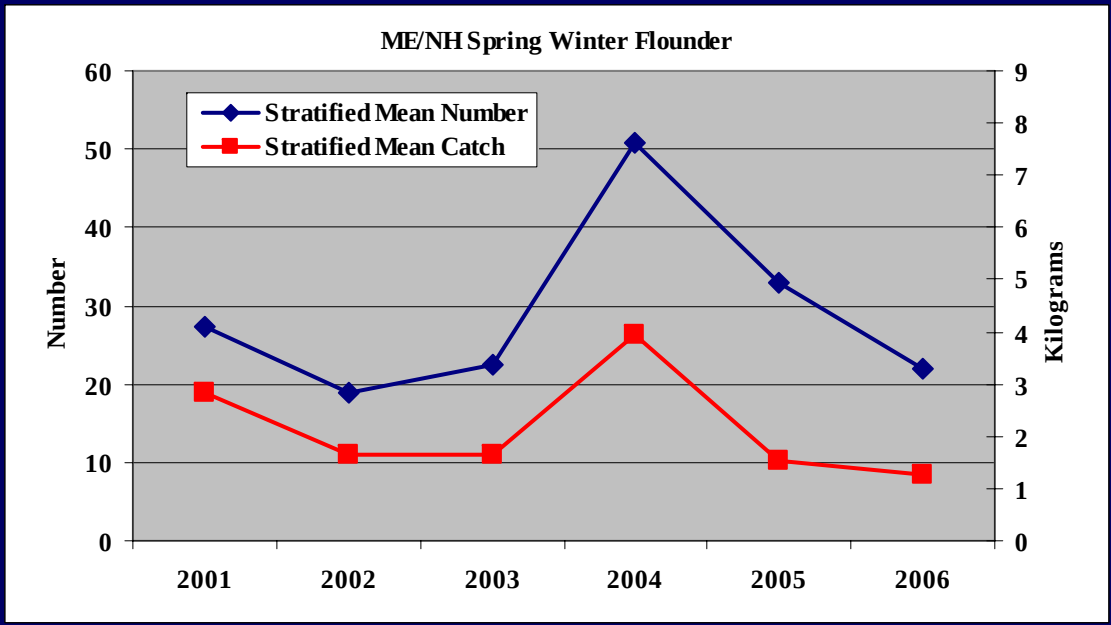


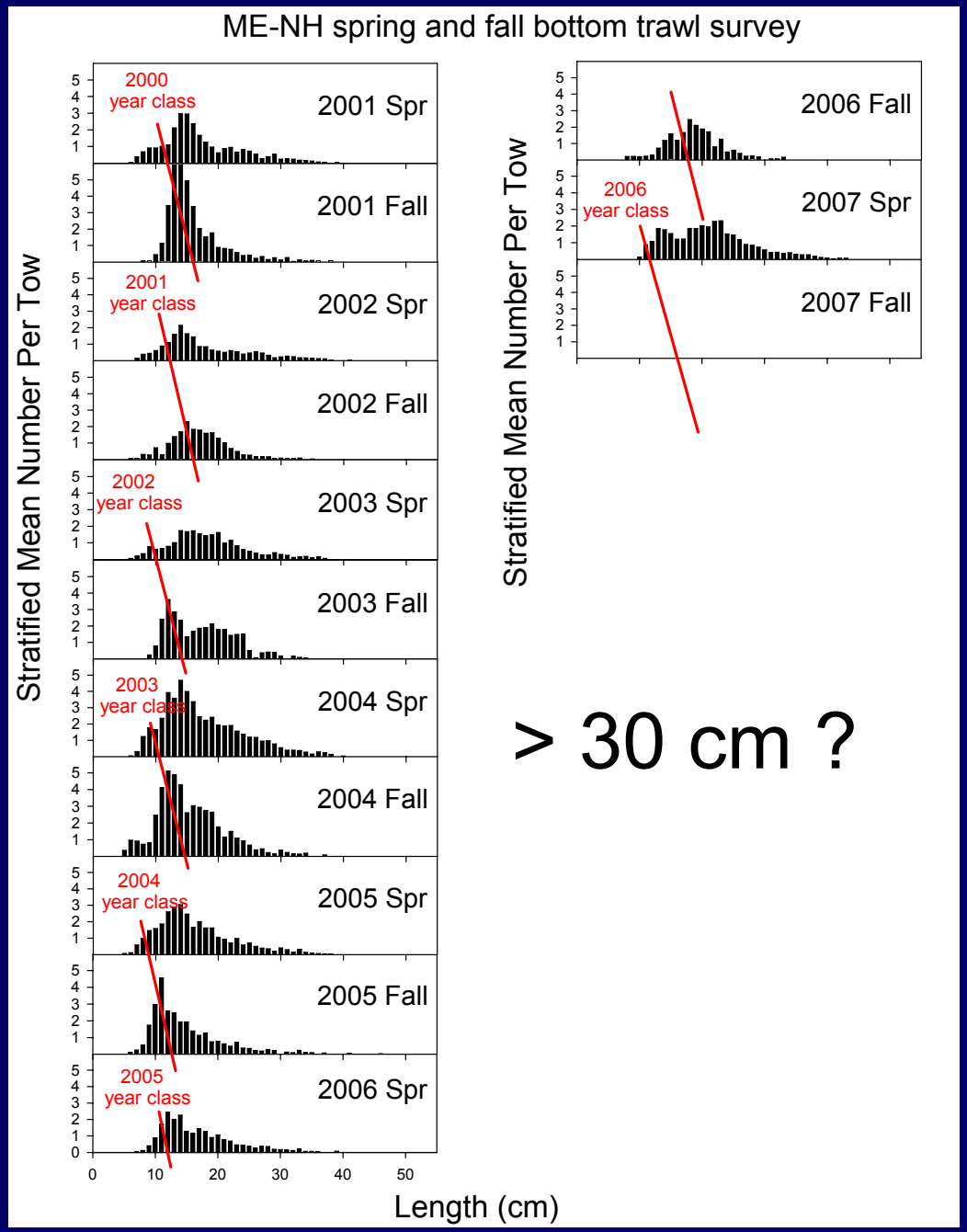




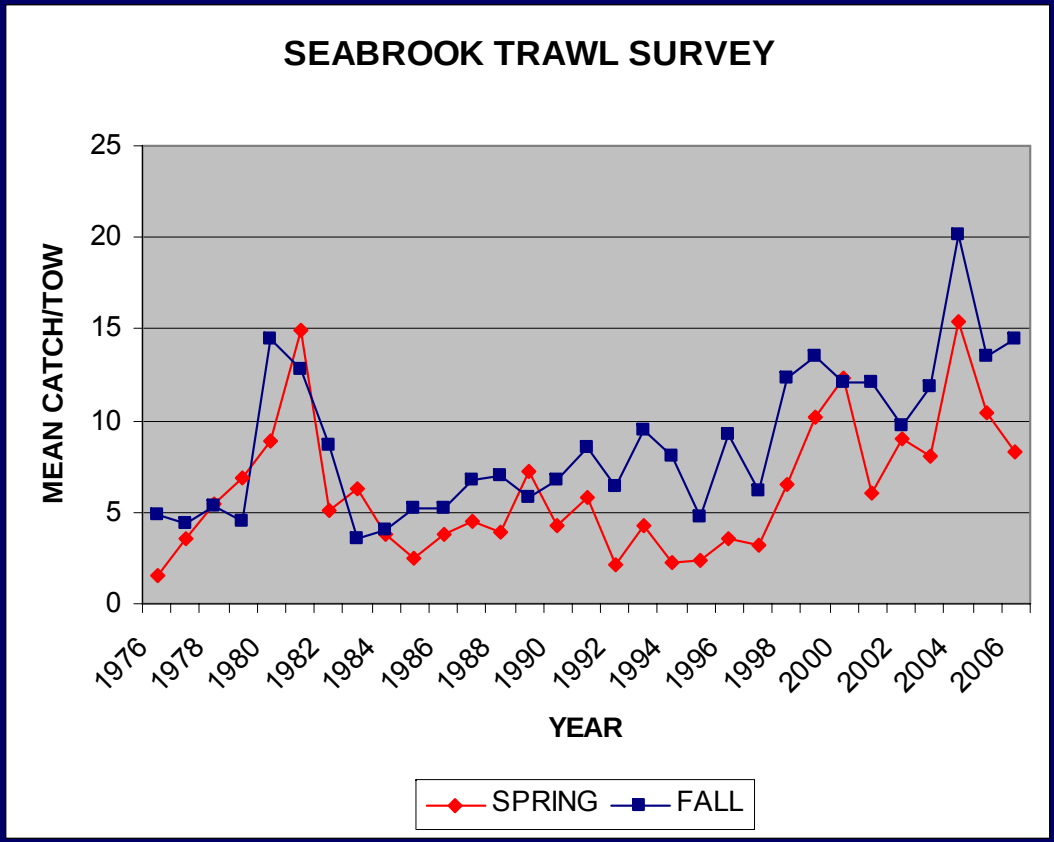

Number per Tow
Fall_WF Events
NUMBER
0.91 - 50.00
50.01 - 100.00
100.01 - 200.00
200.01 - 400.00
Me/NH Trawl Winter Flounder
Fall 2000-2006


ME/NH Fall Winter Flounder
Fall Indices without Region 5
Stratified Mean Number
Stratified Mean Catch
Number
Kilograms
0
10
20
30
40
50
60
0
1
2
3
4
5
6
7
8
9
2000
2001
2002
2003
2004
2005
2006

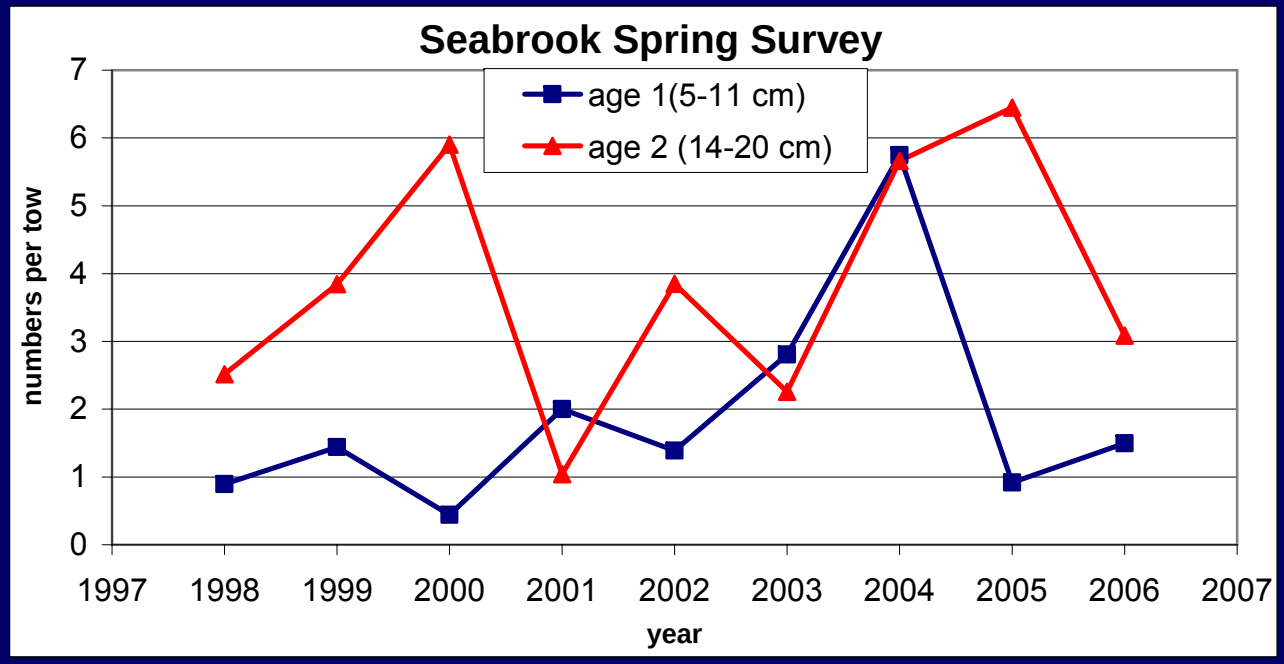

ME/NH Spring Winter Flounder
Stratified Mean Number
Stratified Mean Catch
Number
Kilograms
0
10
20
30
40
50
60
0
1
2
3
4
5
6
7
8
9
2001
2002
2003
2004
2005
2006

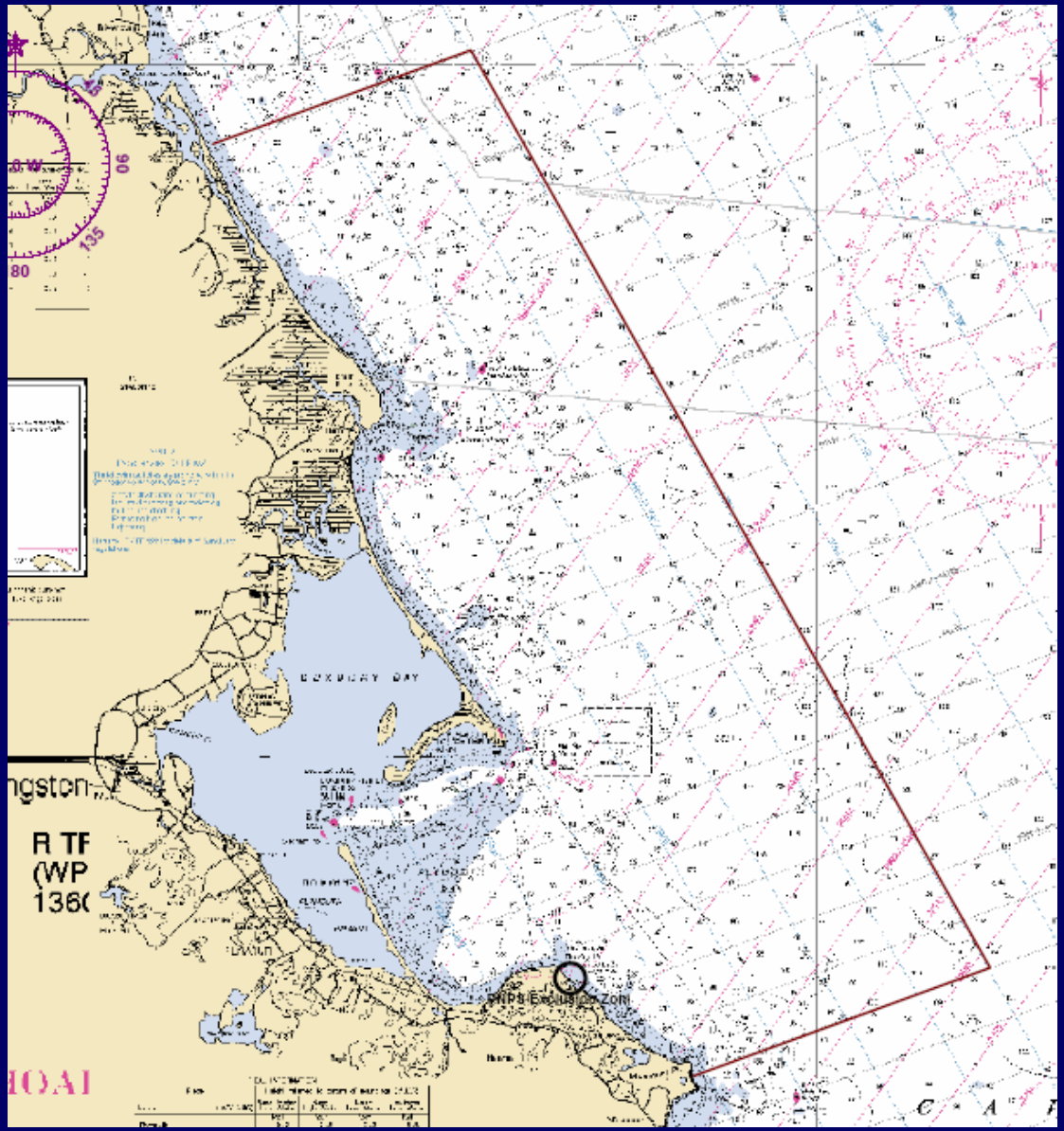

ME-NH spring and fall bottom trawl survey
Stratified Mean Number Per Tow
Length (cm)
2000 year class
2001 Spr
2001 Fall
2001 year class
2002 Spr
2002 Fall
2002 year class
2003 Spr
2003 Fall
2003 year class
2004 Spr
2004 Fall
2004 year class
2005 Spr
2005 Fall
2005 year class
2006 Spr
2006 Fall
2006 year class
2007 Spr
2007 Fall

> 30 cm ?

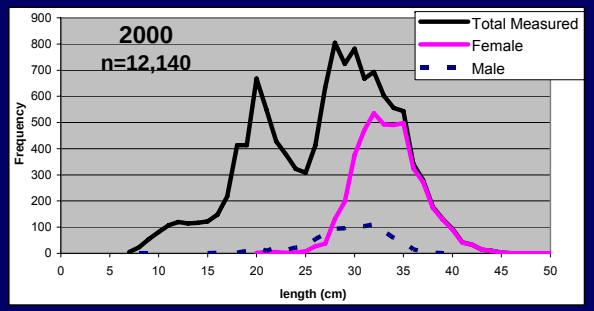


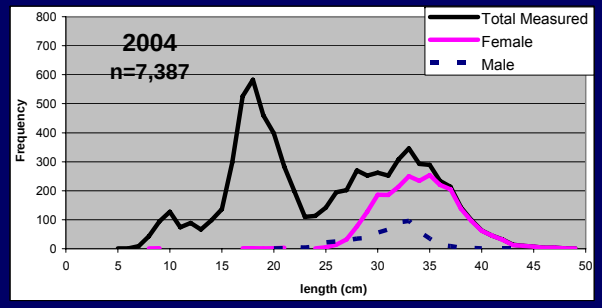
3 fix sites sampled monthly near the MA-NH border

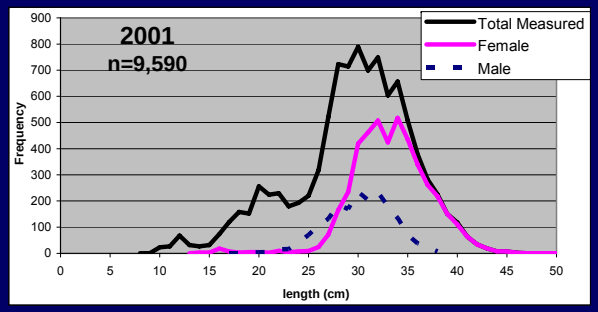

Seabrook Spring Survey
age 1(5-11 cm)
age 2 (14-20 cm)
numbers per tow
0
1
2
3
4
5
6
7
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
year

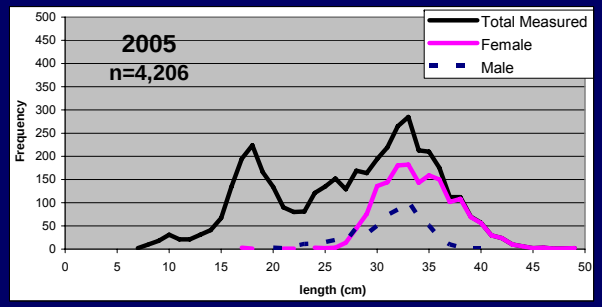


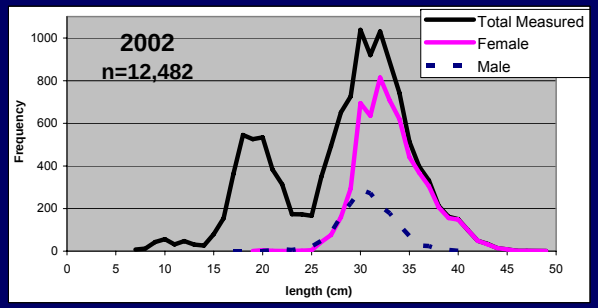
90
135
80
R TF
(WP
136(
HOAI
PNPS Exclusion Zone

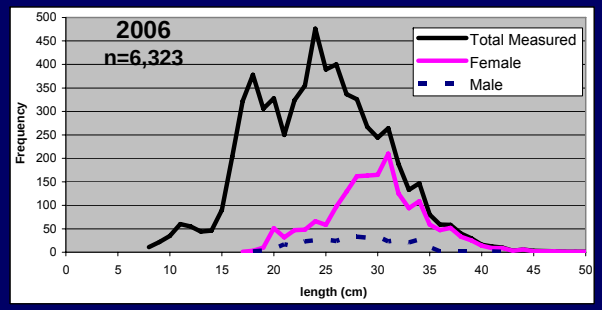

2000
n=12,140
Total Measured
Female
Male
Frequency
length (cm)

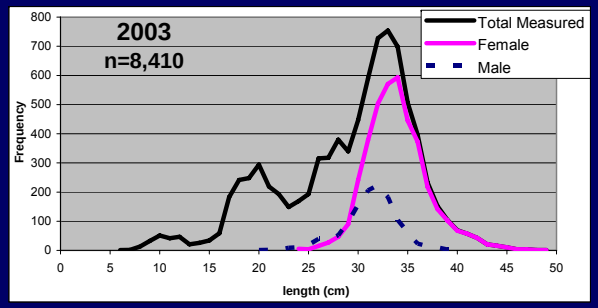

2004
n=7,387
Total Measured
Female
Male
Frequency
length (cm)

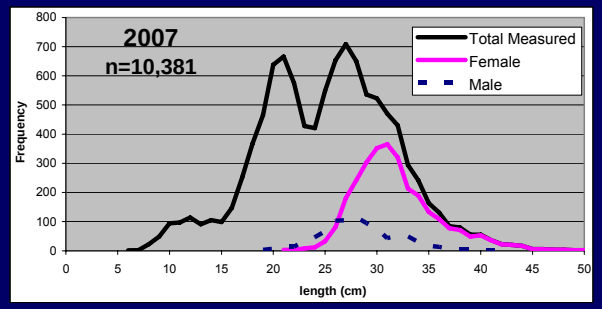

2001
n=9,590
Total Measured
Female
Male
Frequency
length (cm)

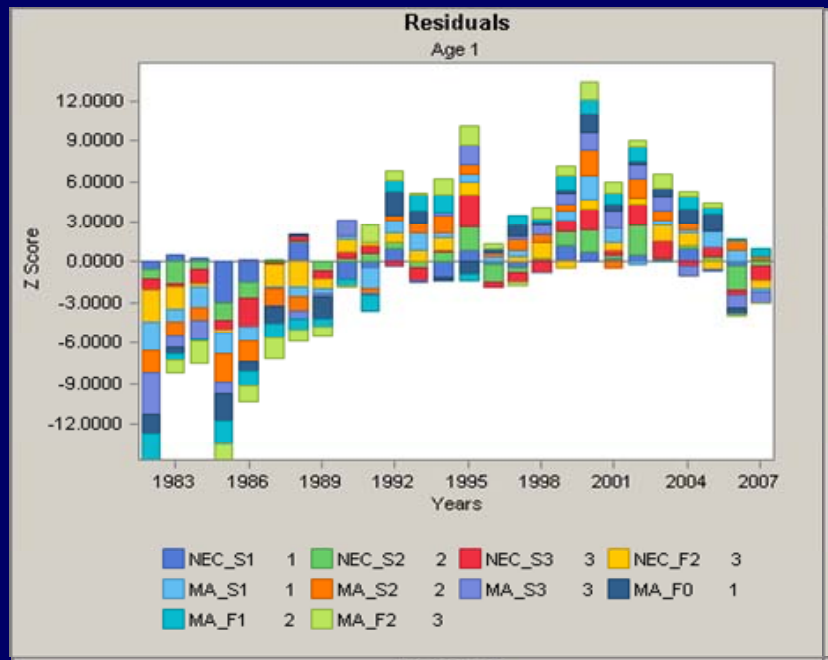

2005
n=4,206
Total Measured
Female
Male
Frequency
length (cm)

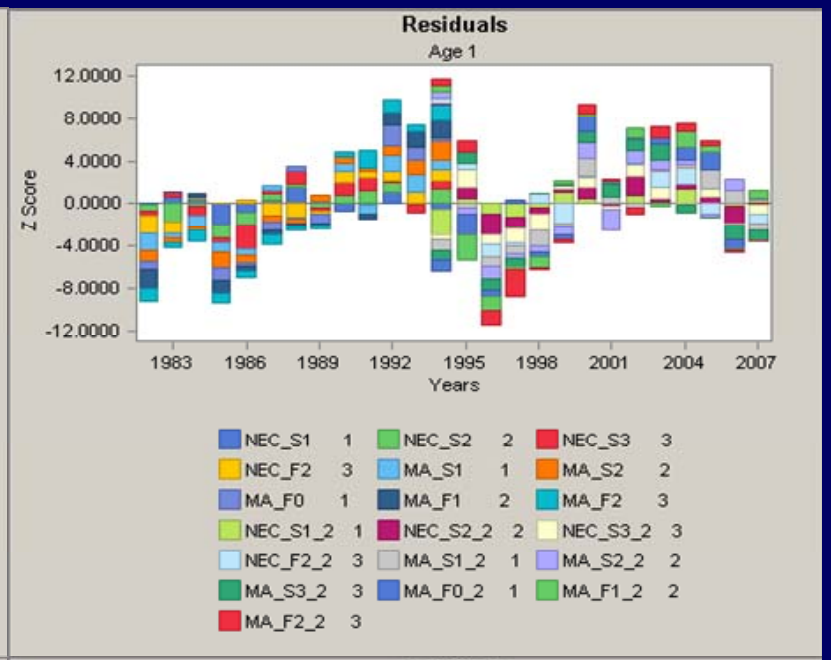

2002
n=12,482
Total Measured
Female
Male
Frequency
length (cm)

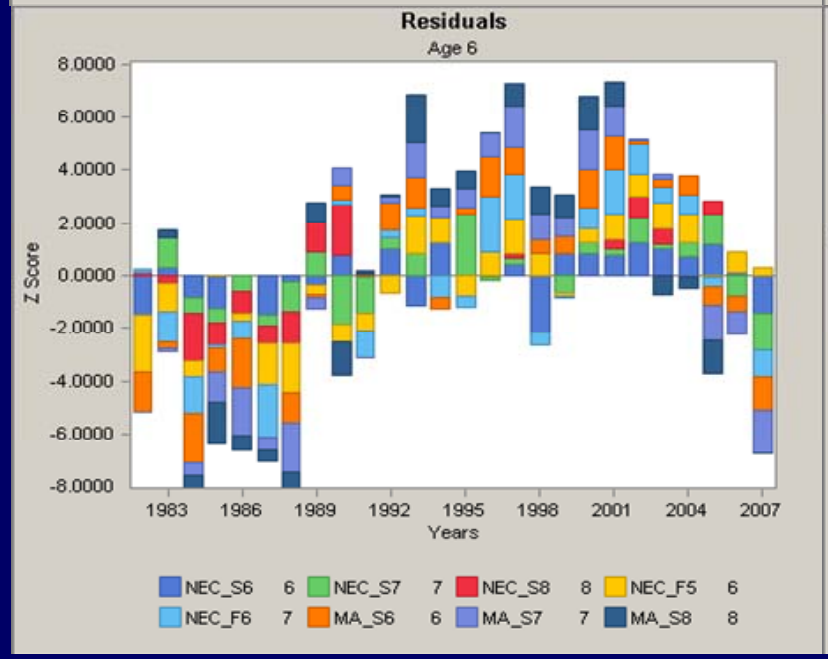

2006
n=6,323
Total Measured
Female
Male
Frequency
length (cm)

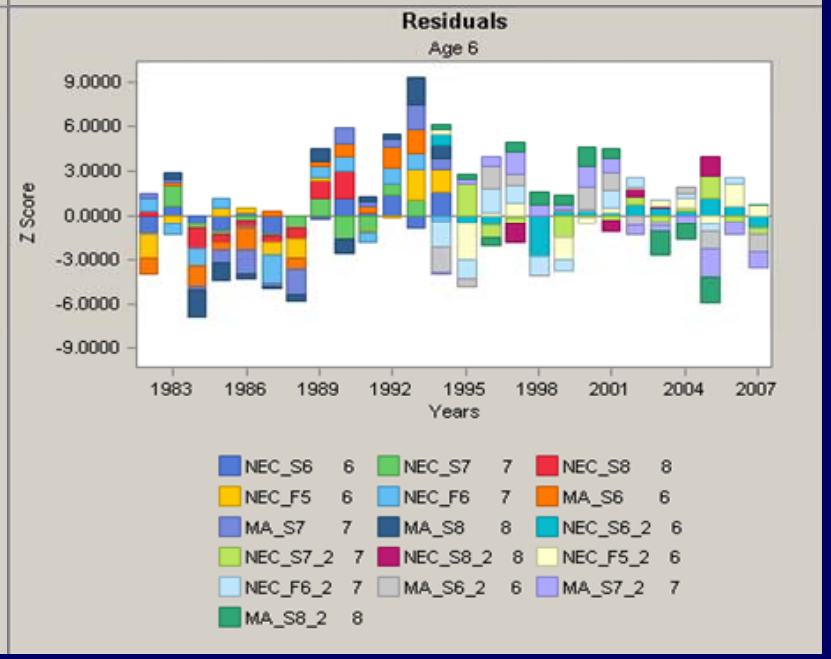

2003
n=8,410
Total Measured
Female
Male
Frequency
length (cm)


2007
n=10,381
Total Measured
Female
Male
Frequency
length (cm)

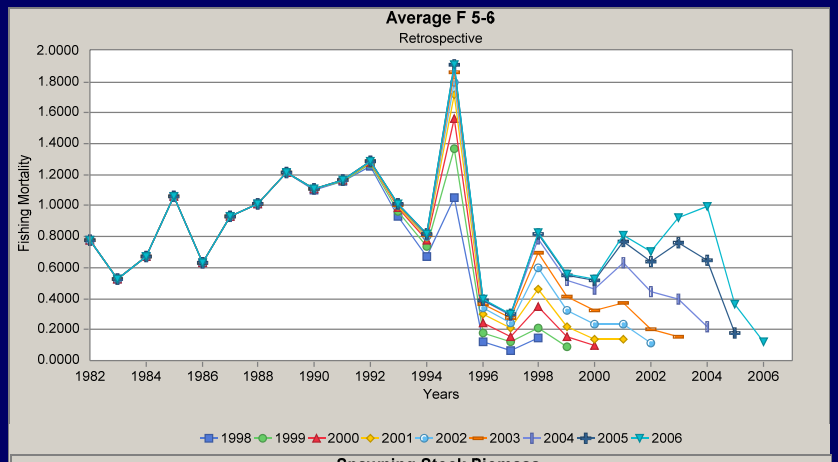

Residuals
Age 1
Z Score
12.0000
9.0000
6.0000
3.0000
0.0000
-3.0000
-6.0000
-9.0000
-12.0000
1983 1986 1989 1992 1995 1998 2001 2004 2007
Years
NEC_S1 1 NEC_S2 2 NEC_S3 3 NEC_F2 3
MA_S1 1 MA_S2 2 MA_S3 3 MA_F0 1
MA_F1 2 MA_F2 3

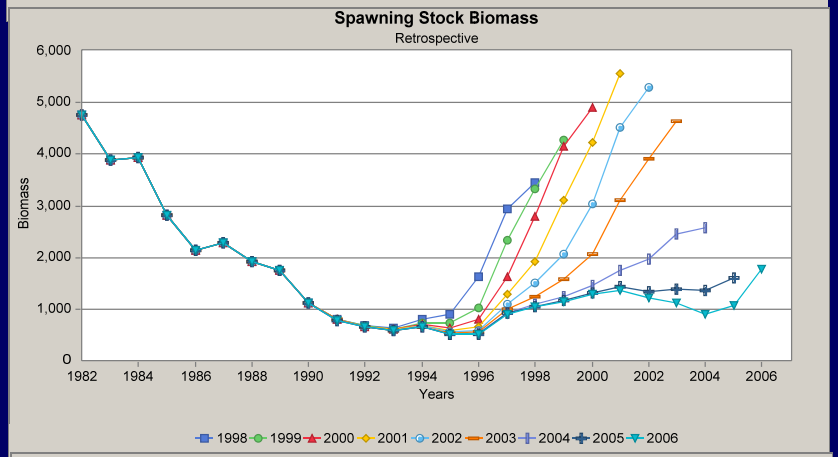

Residuals
Age 1
Z Score
12.0000
8.0000
4.0000
0.0000
-4.0000
-8.0000
-12.0000
1983 1986 1989 1992 1995 1998 2001 2004 2007
Years
NEC_S1 1 NEC_S2 2 NEC_S3 3
NEC_F2 3 MA_S1 1 MA_S2 2
MA_F0 1 MA_F1 2 MA_F2 3
NEC_S1_2 1 NEC_S2_2 2 NEC_S3_2 3
NEC_F2_2 3 MA_S1_2 1 MA_S2_2 2
MA_S3_2 3 MA_F0_2 1 MA_F1_2 2
MA_F2_2 3

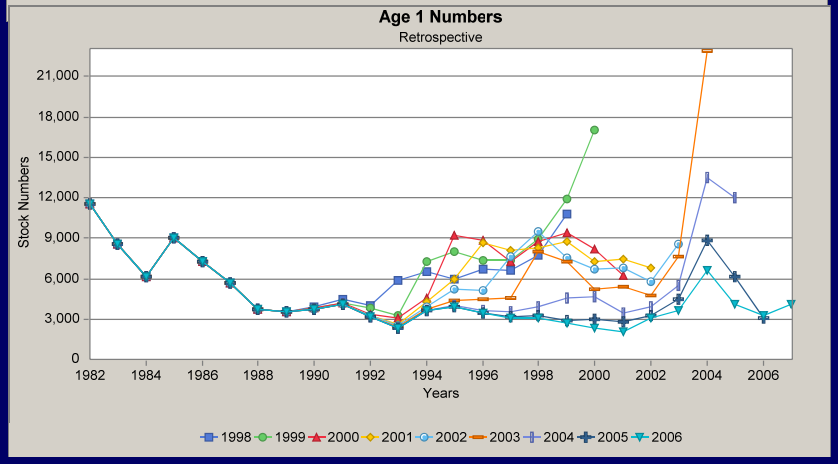

Residuals
Age 6
Z Score
8.0000
6.0000
4.0000
2.0000
0.0000
-2.0000
-4.0000
-6.0000
-8.0000
1983 1986 1989 1992 1995 1998 2001 2004 2007
Years
NEC_S6 6 NEC_S7 7 NEC_S8 8 NEC_F5 6
NEC_F6 7 MA_S6 6 MA_S7 7 MA_S8 8


Residuals
Age 6
Z Score
9.0000
6.0000
3.0000
0.0000
-3.0000
-6.0000
-9.0000
1983 1986 1989 1992 1995 1998 2001 2004 2007
Years
NEC_S6 6 NEC_S7 7 NEC_S8 8
NEC_F5 6 NEC_F6 7 MA_S6 6
MA_S7 7 MA_S8 8 NEC_S6_2 6
NEC_S7_2 7 NEC_S8_2 8 NEC_F5_2 6
NEC_F6_2 7 MA_S6_2 6 MA_S7_2 7
MA_S8_2 8

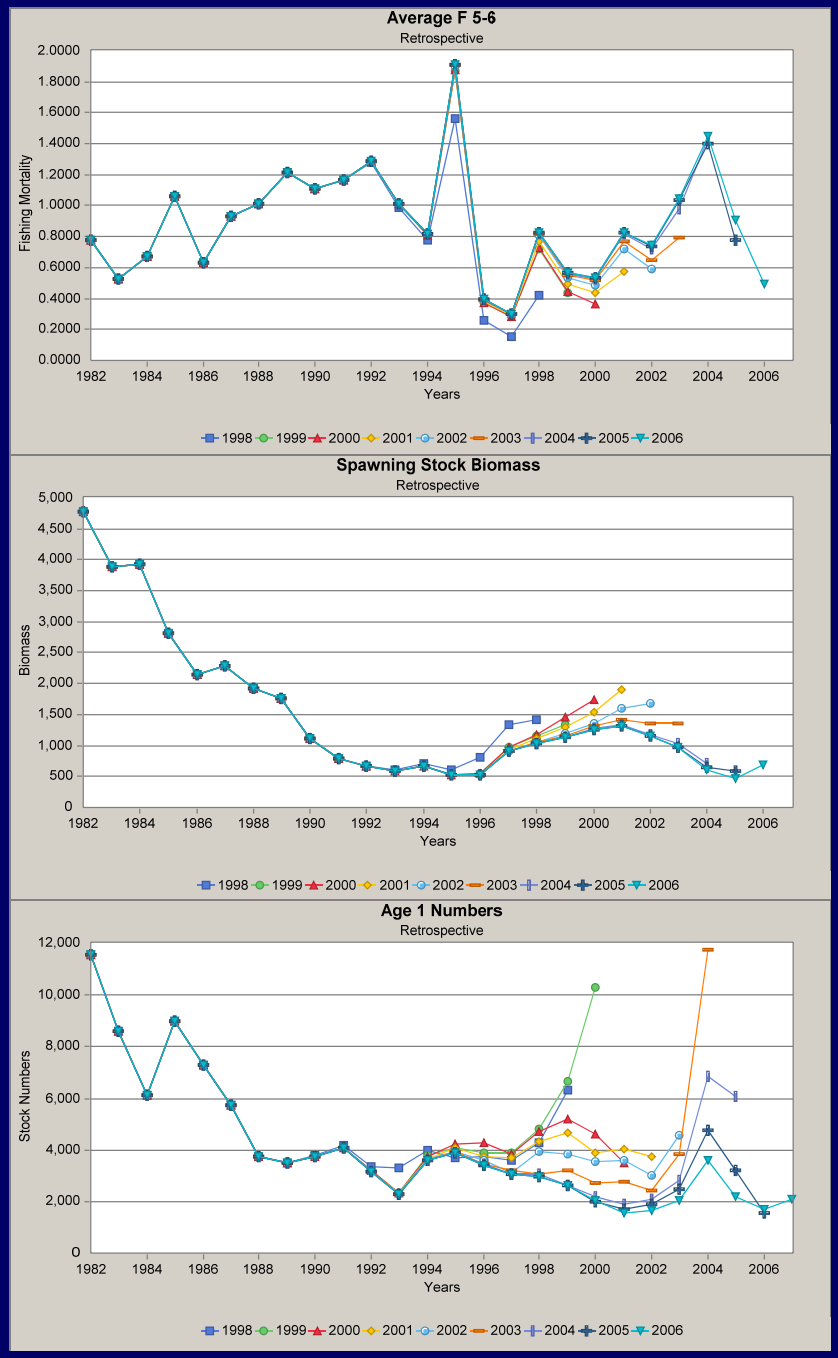
VPA

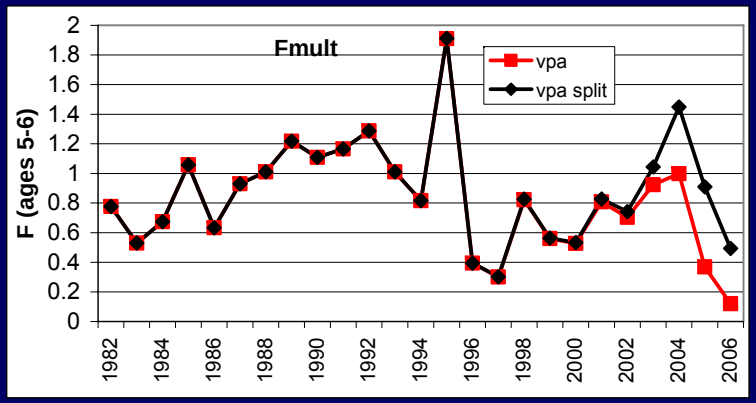

Average F 5-6
Retrospective
Fishing Mortality
2.0000
1.8000
1.6000
1.4000
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006
Years
1998 1999 2000 2001 2002 2003 2004 2005 2006

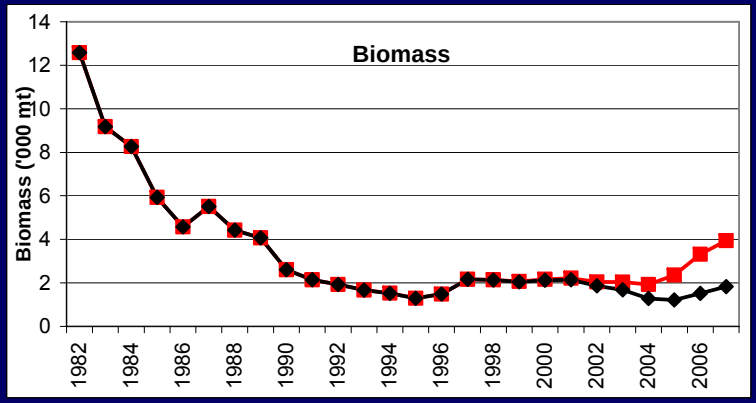

Spawning Stock Biomass
Retrospective
Biomass
6,000
5,000
4,000
3,000
2,000
1,000
0
1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006
Years
1998 1999 2000 2001 2002 2003 2004 2005 2006

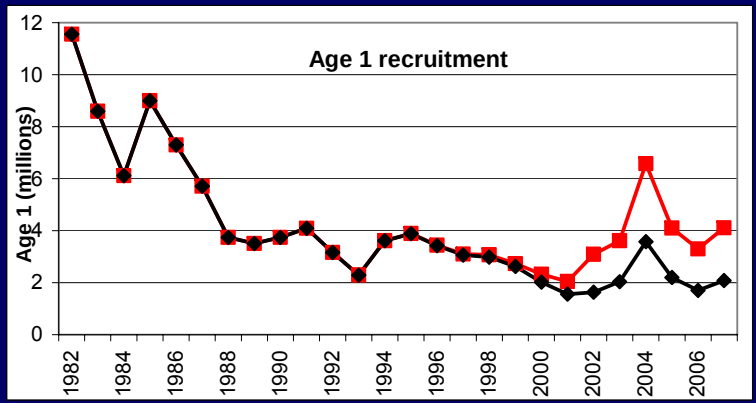

Age 1 Numbers
Retrospective
Stock Numbers
21,000
18,000
15,000
12,000
9,000
6,000
3,000
0
1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006
Years
1998 1999 2000 2001 2002 2003 2004 2005 2006

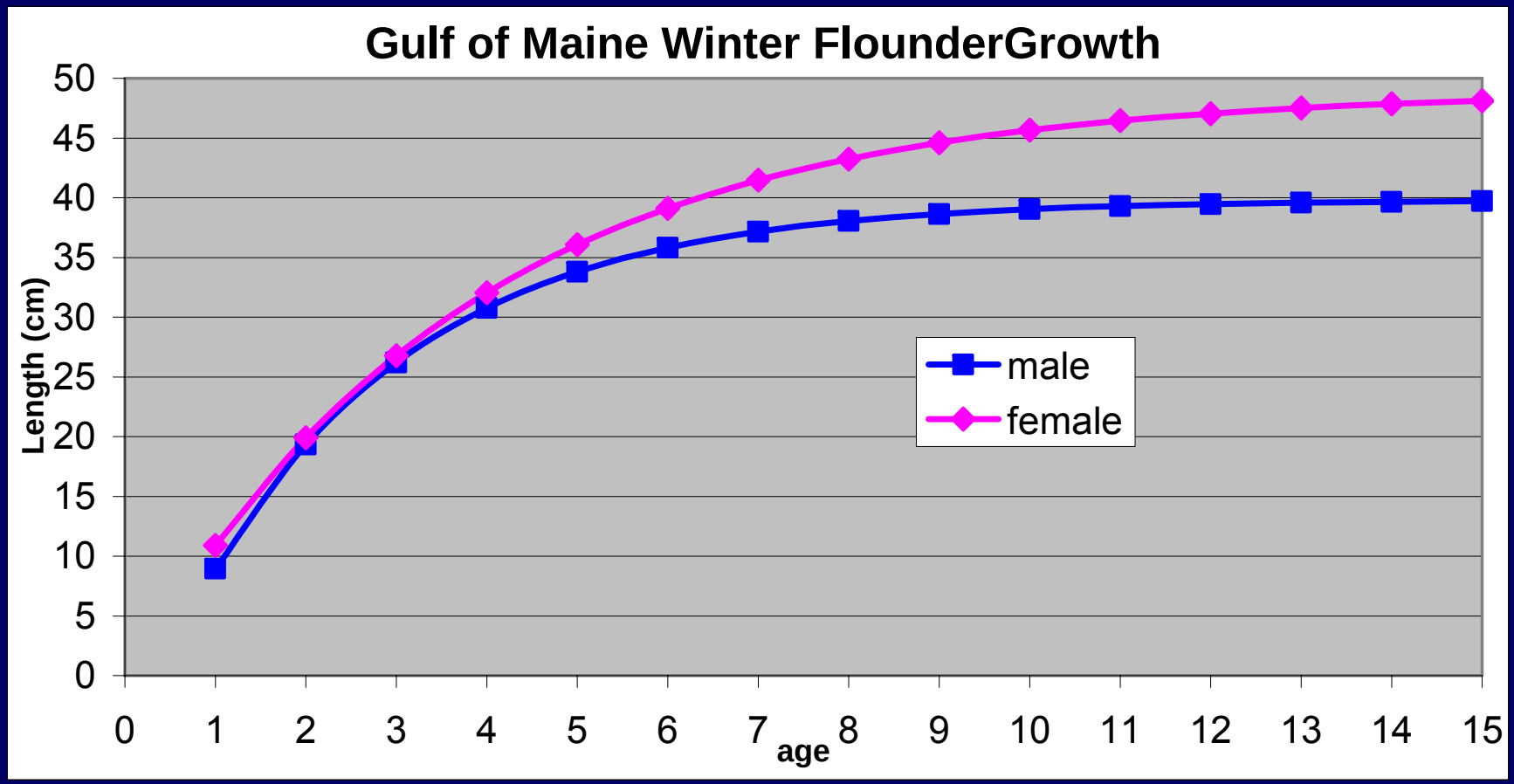
VPA split

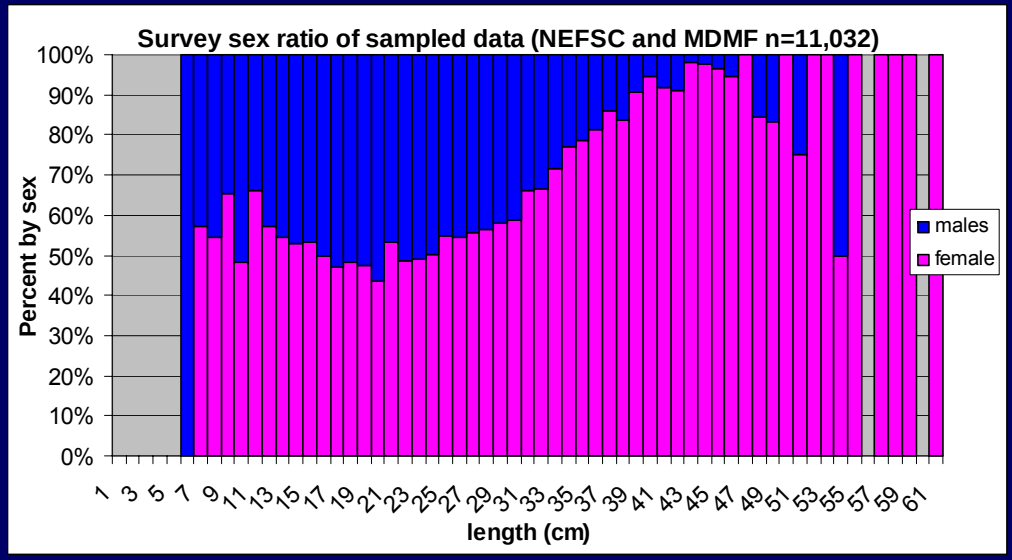

Average F 5-6
Retrospective
Fishing Mortality
Years
Spawning Stock Biomass
Retrospective
Biomass
Years
Age 1 Numbers
Retrospective
Stock Numbers
Years
1998 1999 2000 2001 2002 2003 2004 2005 2006

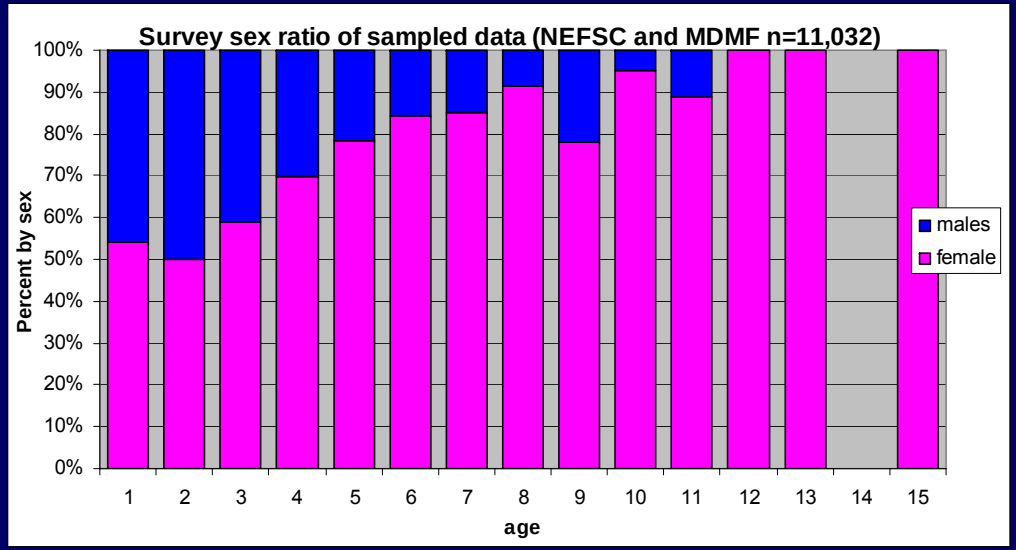

Fmult
vpa
vpa split
F (ages 5-6)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

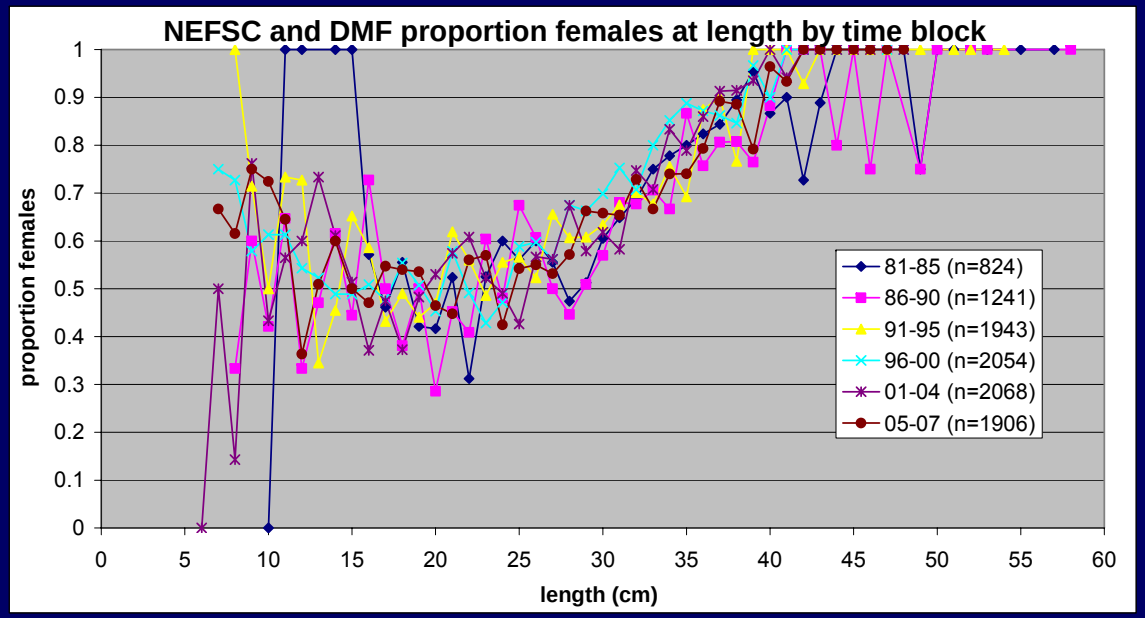

Biomass
Biomass ('000 mt)
0
2
4
6
8
10
12
14
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

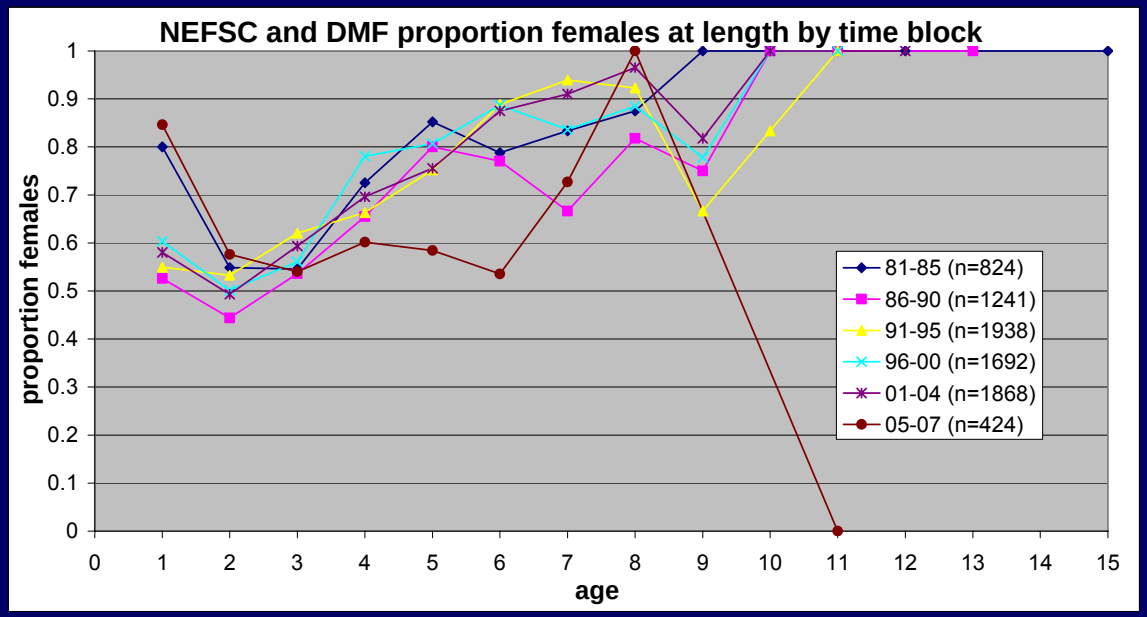

Age 1 recruitment
Age 1 (millions)
0
2
4
6
8
10
12
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006


Gulf of Maine Winter FlounderGrowth
Length (cm)
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
age
male
female


Survey sex ratio of sampled data (NEFSC and MDMF n=11,032)
Percent by sex
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61
length (cm)
males
female


Survey sex ratio of sampled data (NEFSC and MDMF n=11,032)
Percent by sex
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
age
males
female


NEFSC and DMF proportion females at length by time block
proportion females
length (cm)
81-85 (n=824)
86-90 (n=1241)
91-95 (n=1943)
96-00 (n=2054)
01-04 (n=2068)
05-07 (n=1906)


NEFSC and DMF proportion females at length by time block
proportion females
age
81-85 (n=824)
86-90 (n=1241)
91-95 (n=1938)
96-00 (n=1692)
01-04 (n=1868)
05-07 (n=424)

Model Issues

The VPA and SCALE model suffer from unstable estimates of fishing mortality and population abundance. There are conflicting trends between the relativity stable age 1 and 2 recruitment indices and a large decline in the catch over the time series.

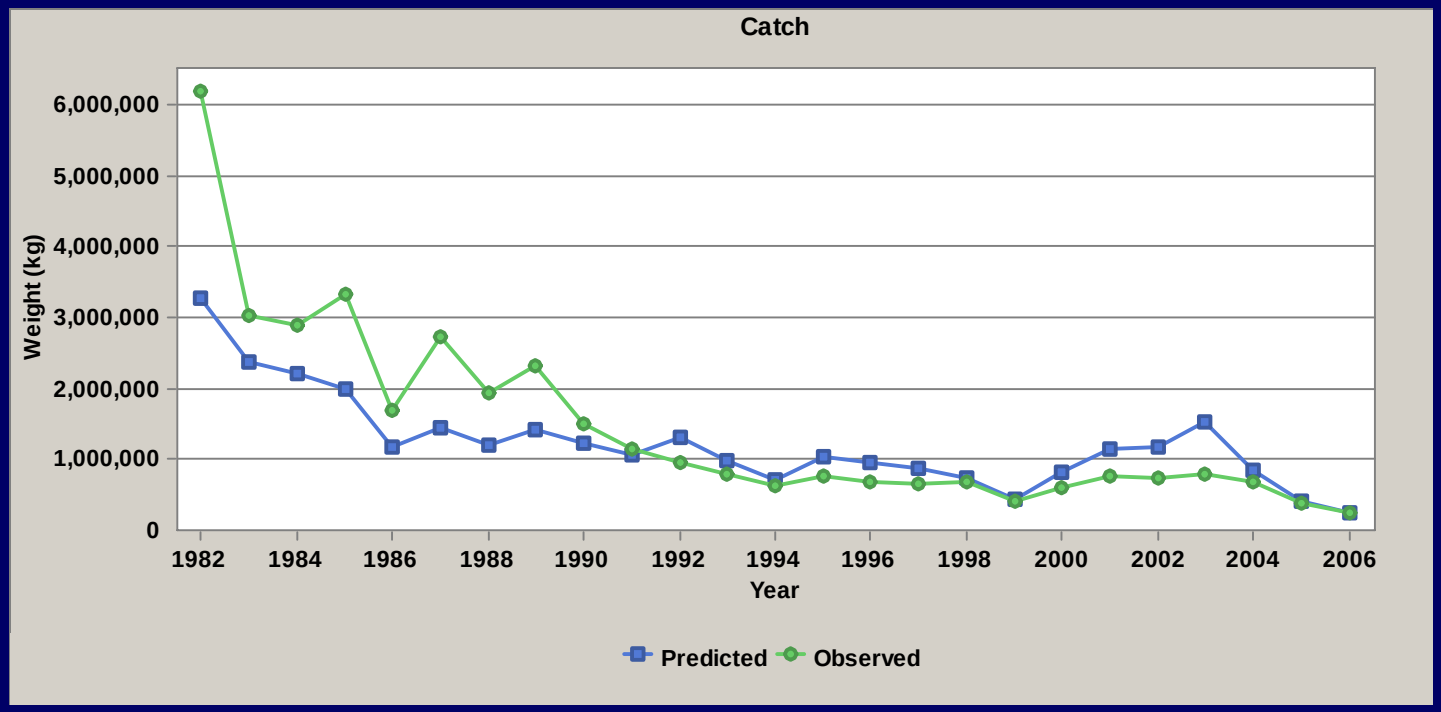
SCALE Model Issues

Lower weights on the recruitment indices and a low penalty on recruitment variation were used to allow the model to produce a lack of fit to the recruitment indices so that a larger initial population in 1982 can be estimated by the model.

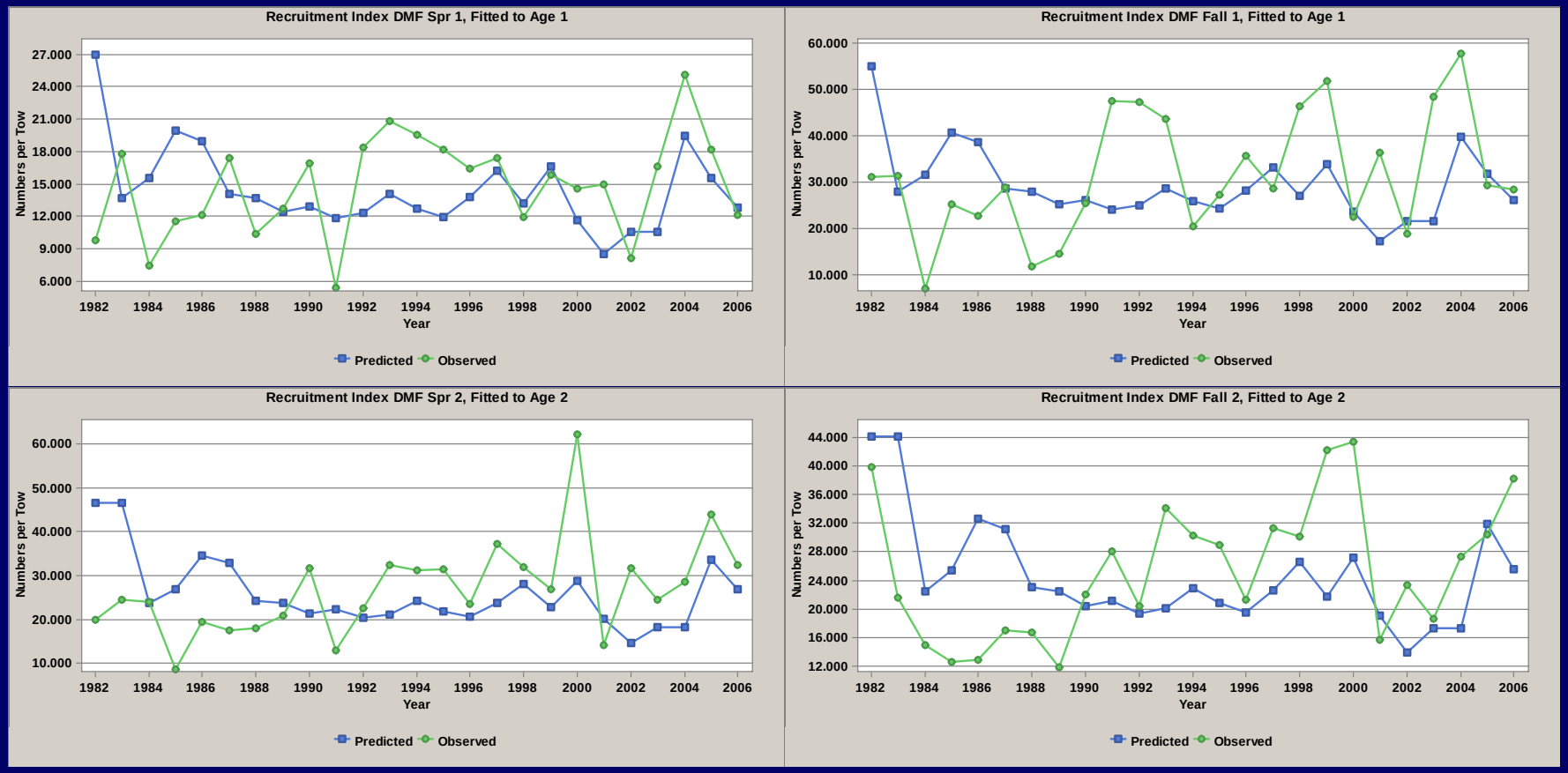
The model needs to estimate a declining trend in recruitment to fit the trend in the catch and the adult abundance in the surveys.

SCALE RUNS 1982-2006

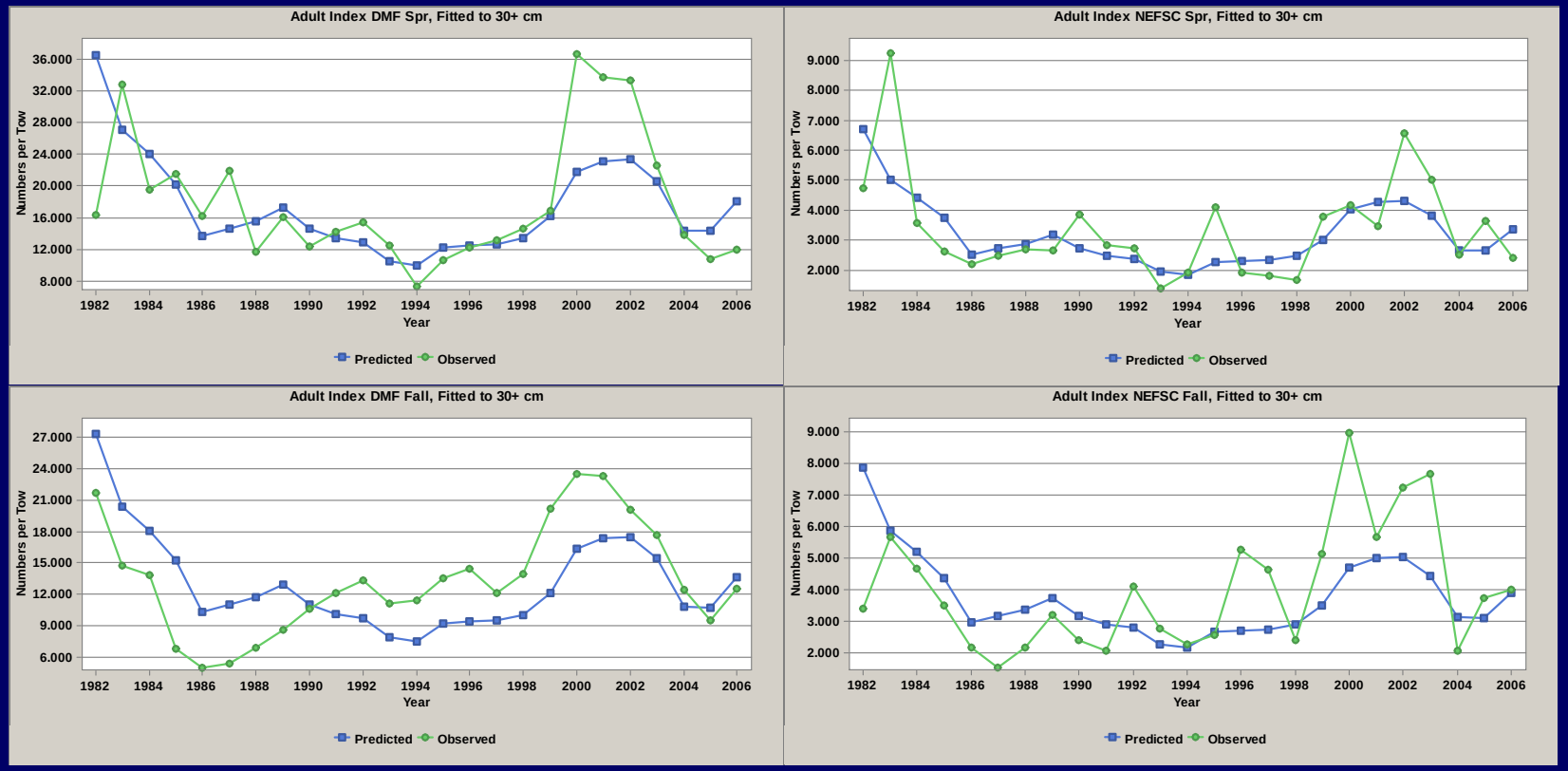
- Separate sexes, ♀ m=0.2, ♂ m=0.3
- Two Length based selectivity blocks (82-84, 85-06)
- Spring & Fall DMF & NEFSC & Seabrook age 1 & age 2 recruitment
- Spring & Fall DMF & NEFSC 30+ cm indices
- Spring & Fall DMF & NEFSC 30+ cm & Pilgrim 35+ cm length frequencies
- Catch at length 1982-2006
- Total catch



SCALE no split



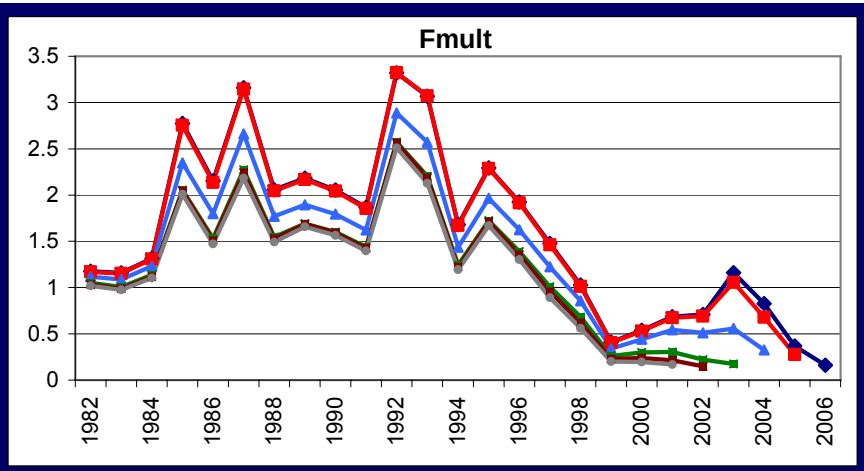
No split SCALE DMF Recruitment Indices

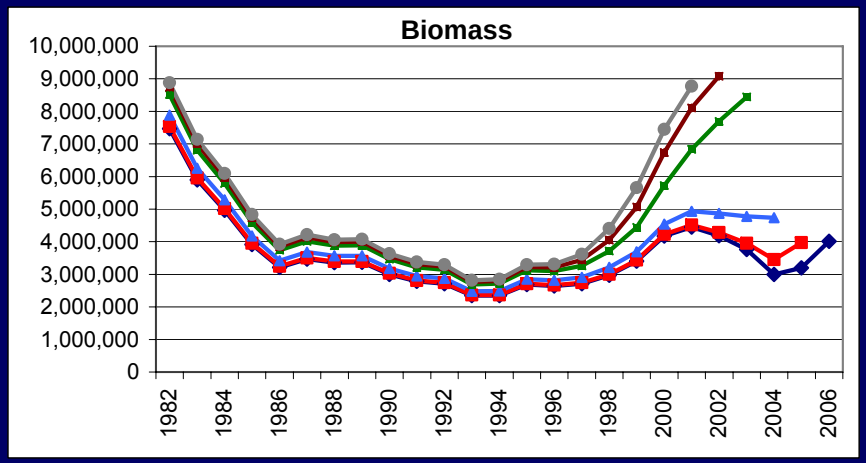


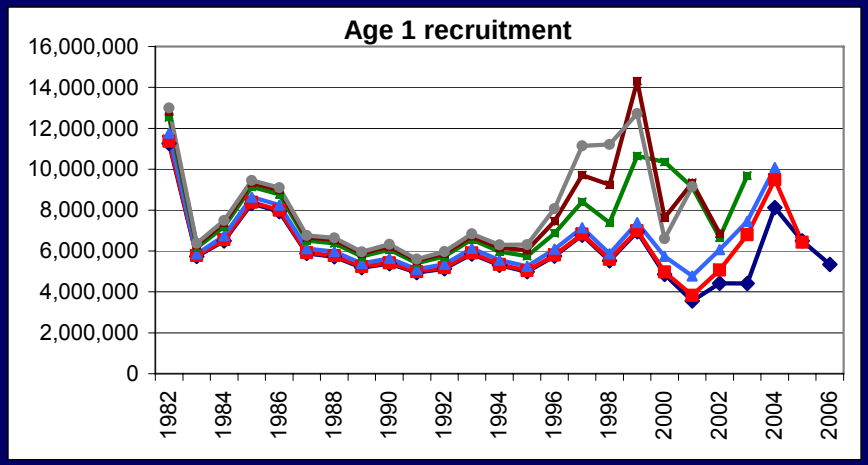
Non split SCALE DMF 30+ cm Indices

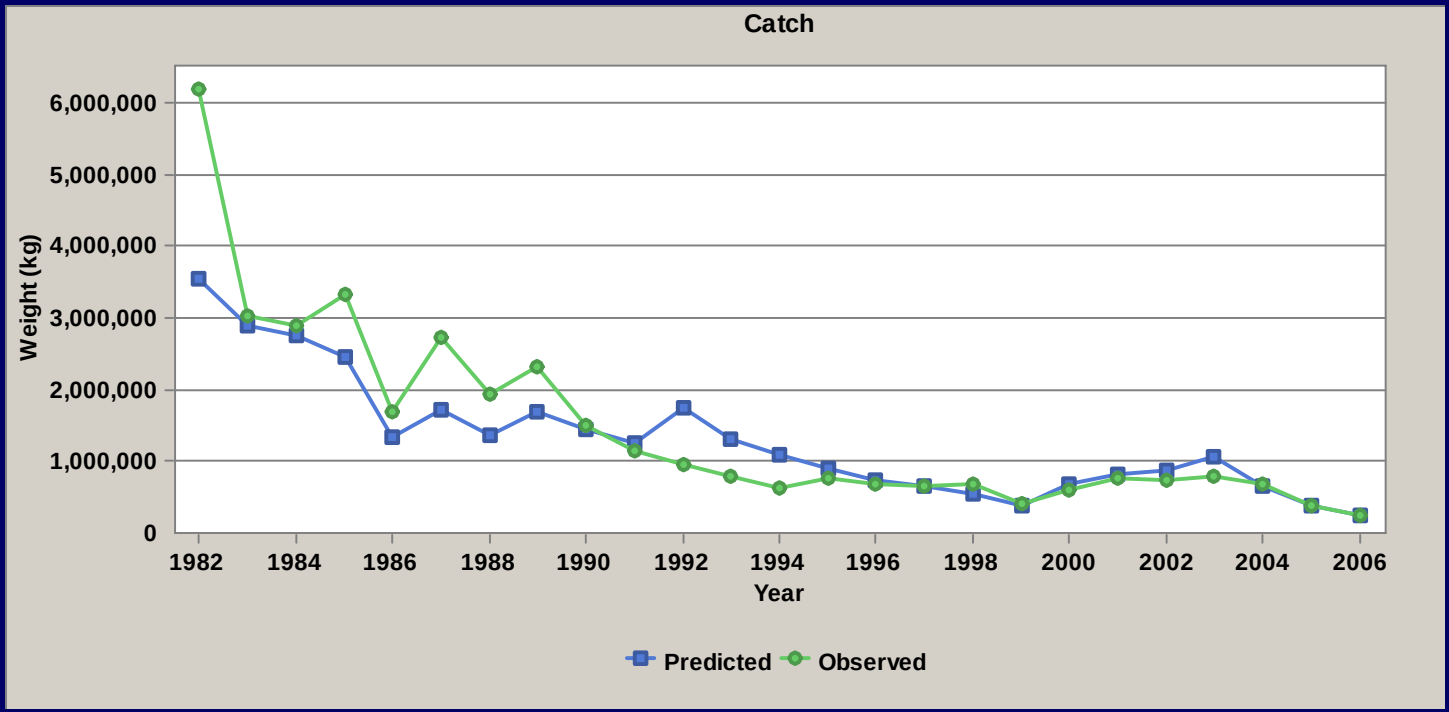
SCALE
No Split

Low wt
On recruitment ages





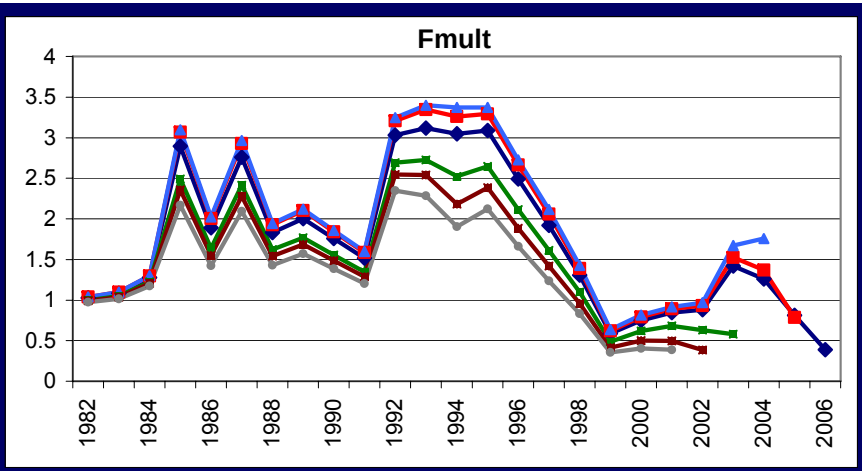


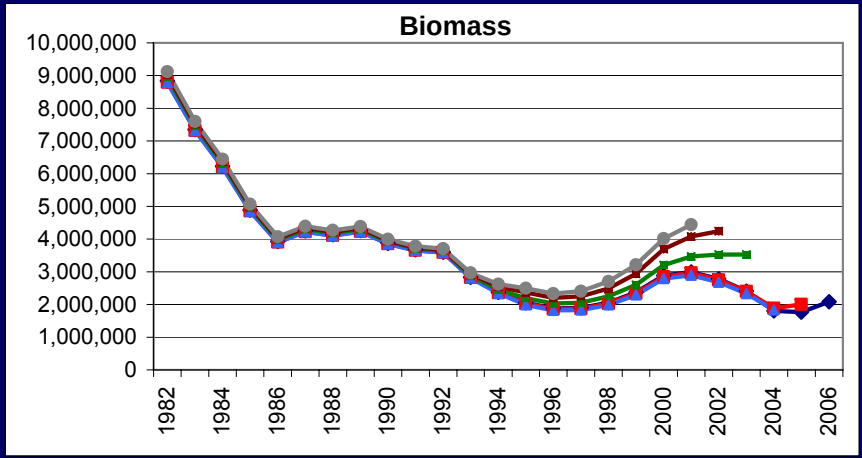

Catch
Weight (kg)
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
Year
Predicted
Observed

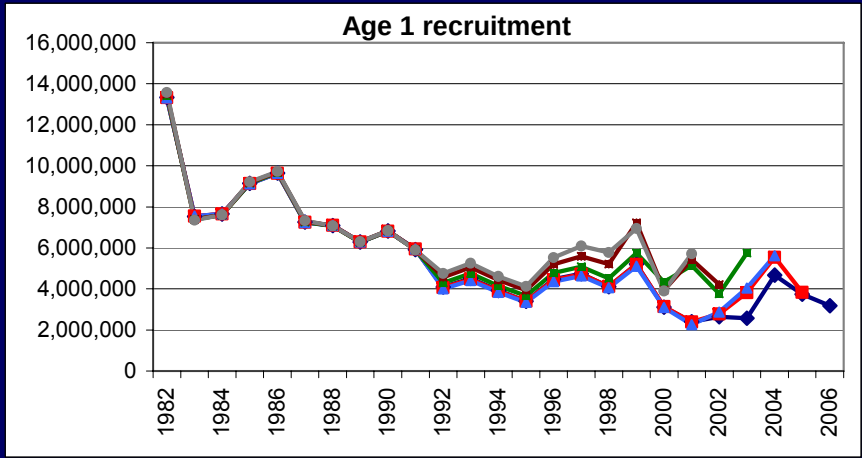
SCALE split

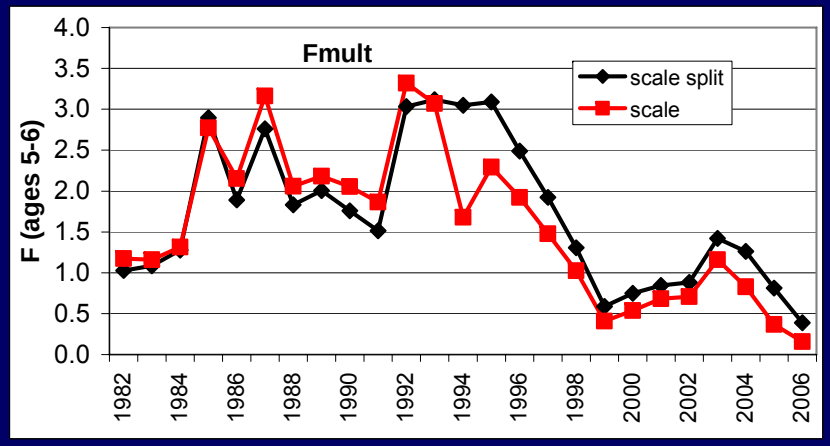
SCALE Split

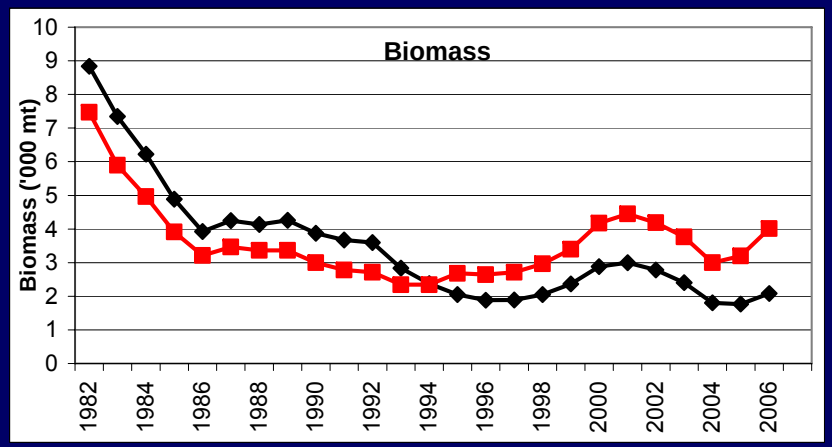
Low wt
On recruitment
Ages

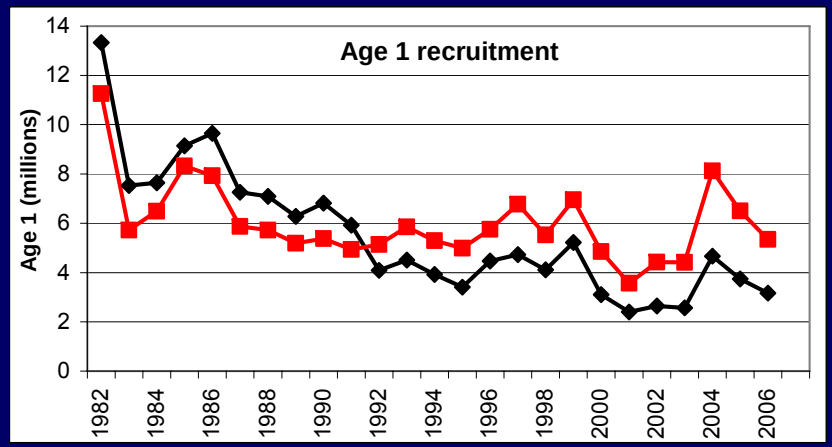







Fmult
F (ages 5-6)
scale split
scale
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006


Biomass
Biomass ('000 mt)
10
9
8
7
6
5
4
3
2
1
0
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

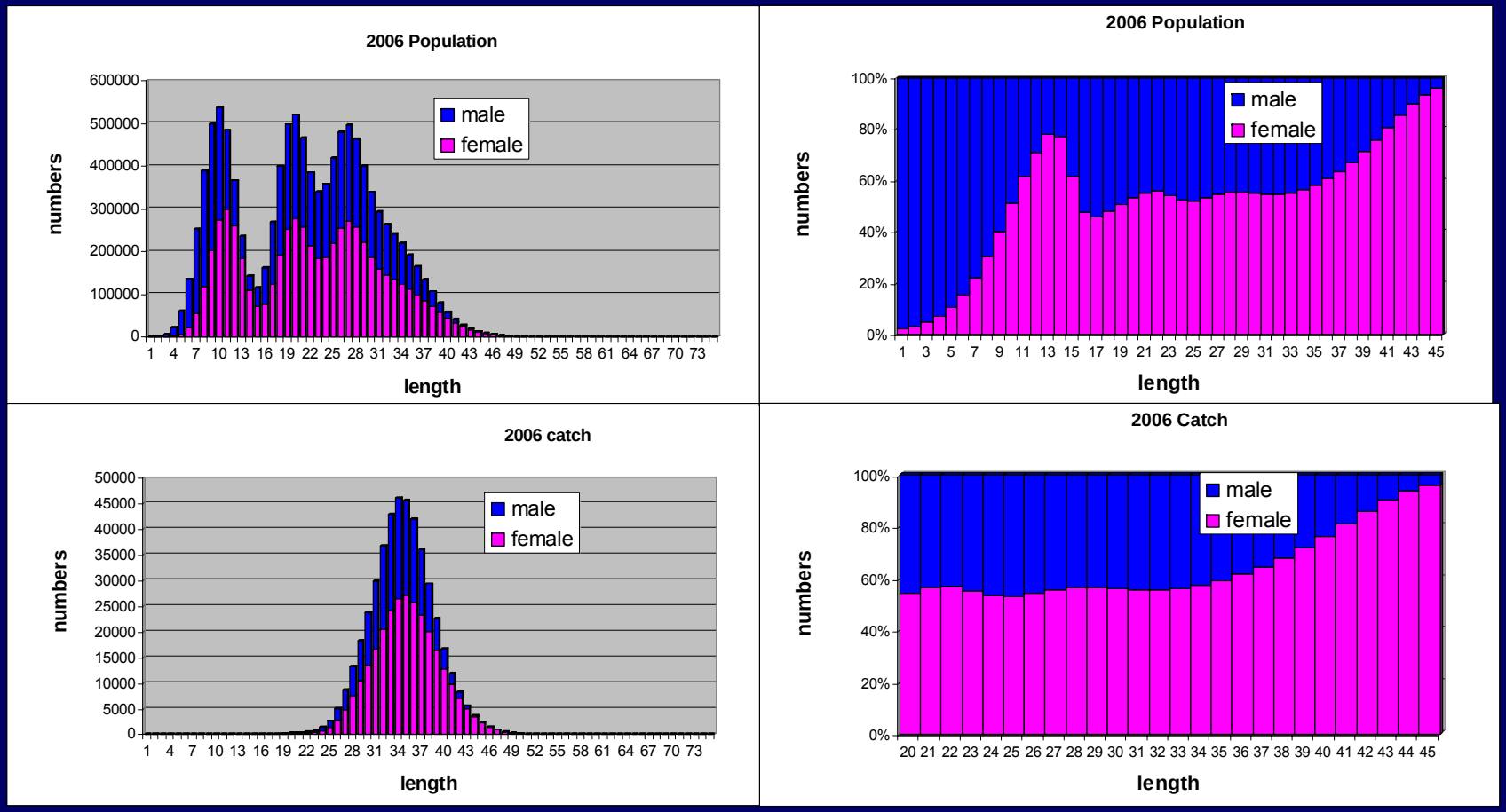

Age 1 recruitment
Age 1 (millions)
14
12
10
8
6
4
2
0
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

♀

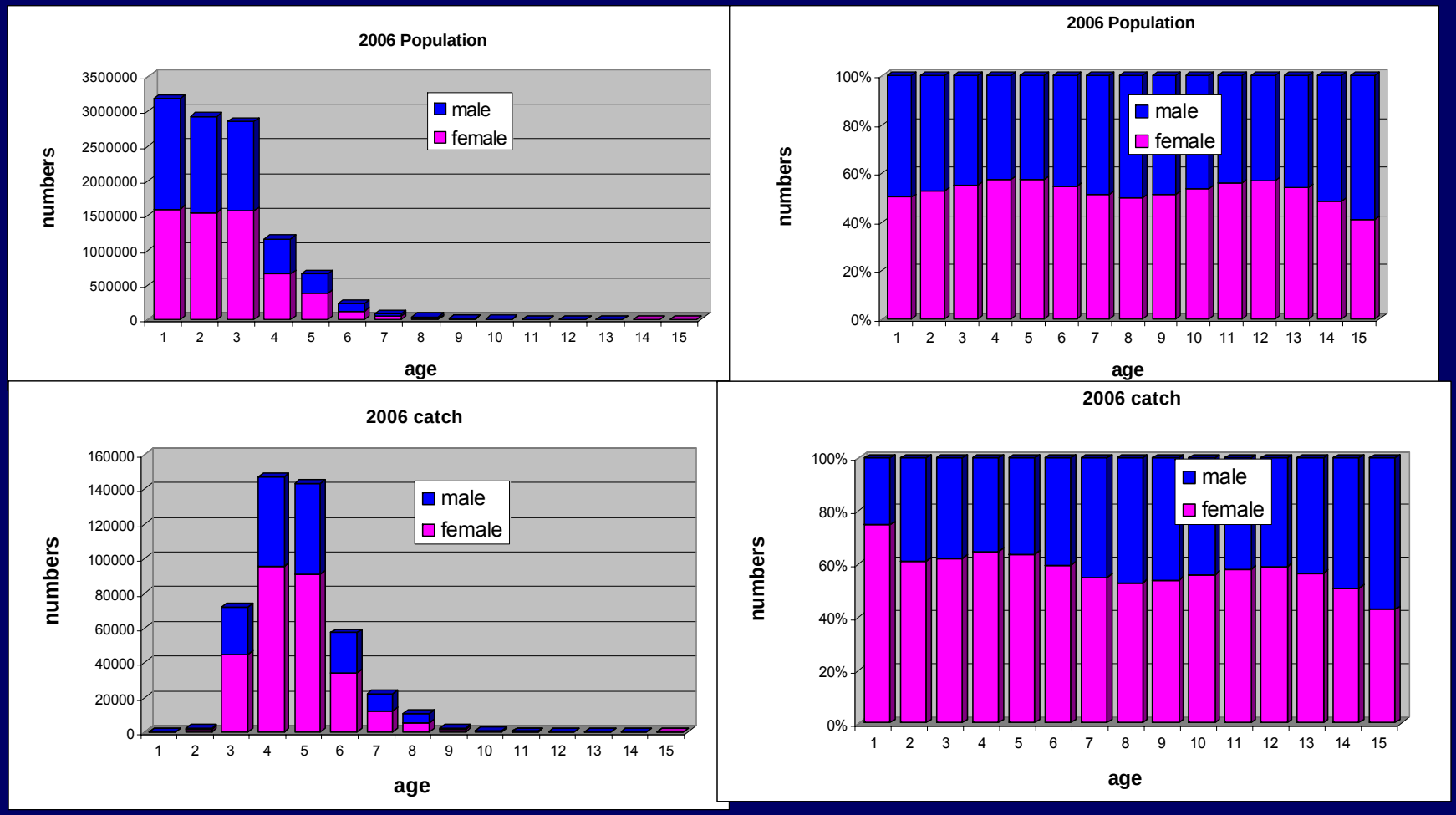
Fishing mortality
x
length based selectivity
x
natural mortality by sex
x
sexual dimorphic growth

♂

= “Sex Ratio”



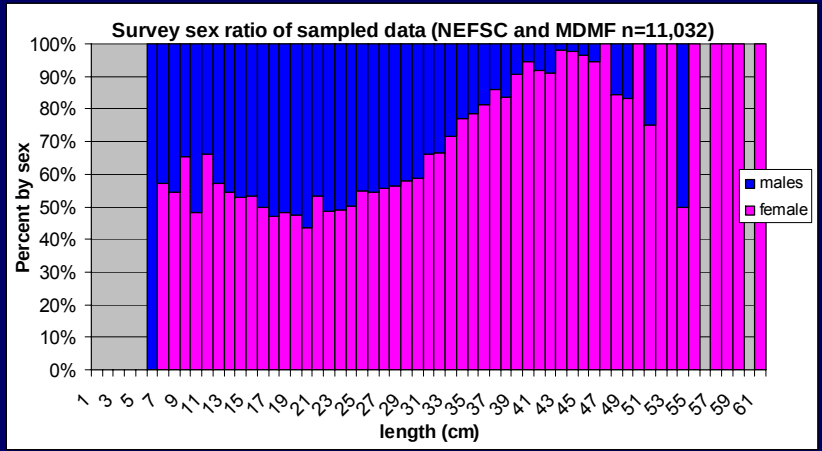
SCALE Split Population and Catch numbers at length

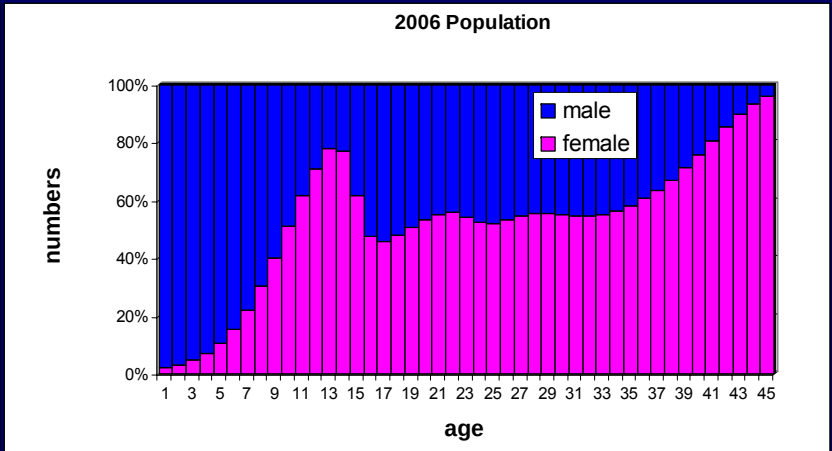


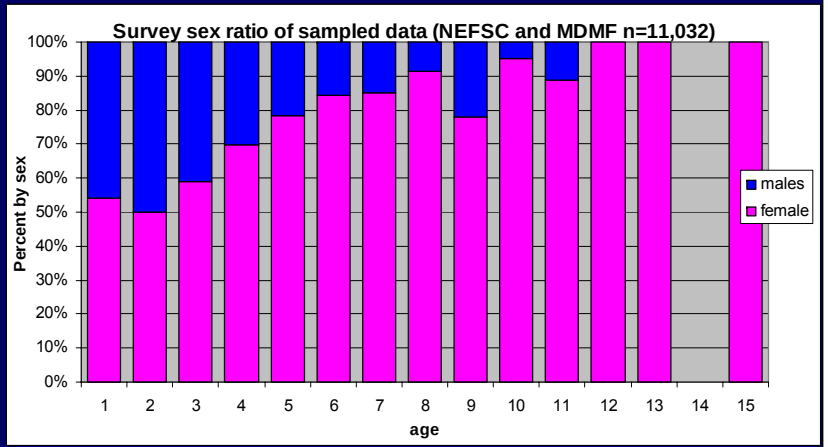
SCALE Split Population and Catch Numbers at age

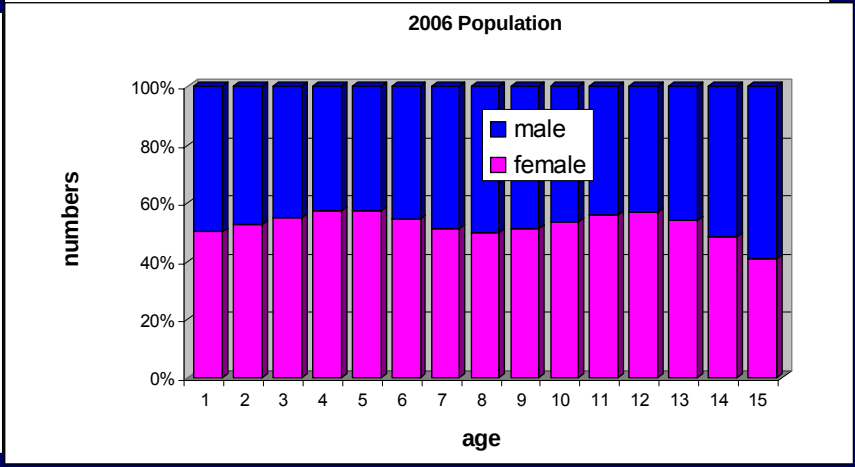
Survey sample data

SCALE 2006 Population estimates



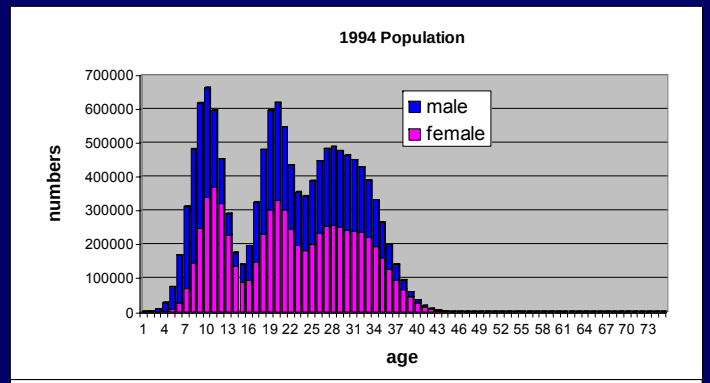


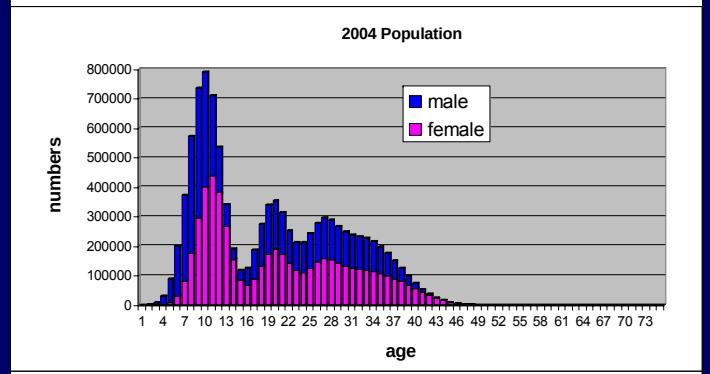


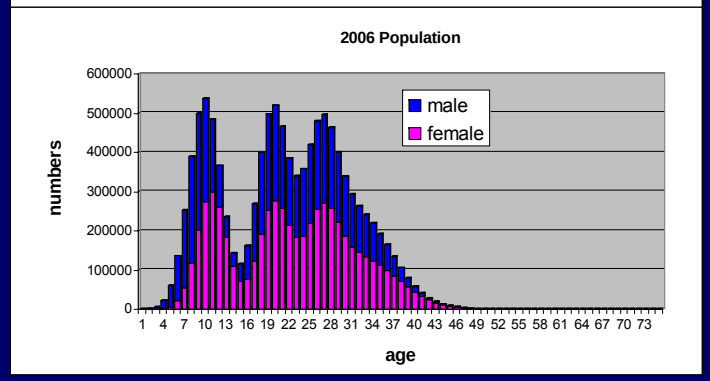


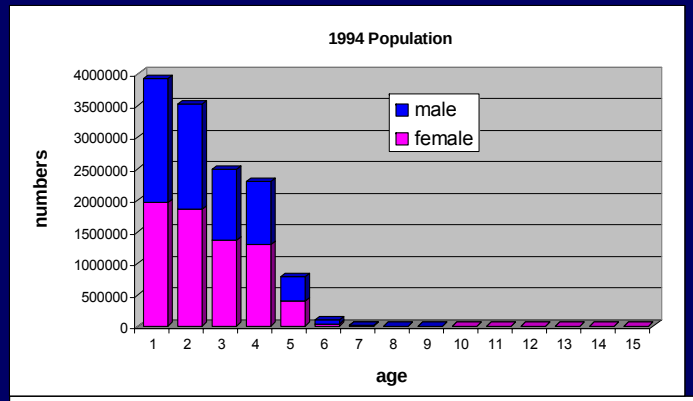
Survey sample data
4+ or 30+ cm fish are 76% female

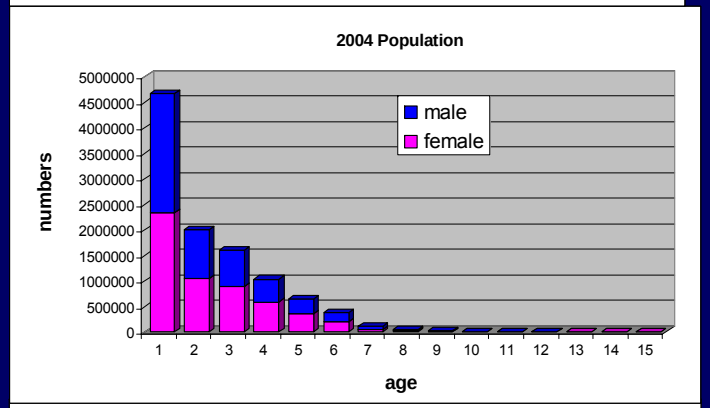
SCALE prediction
4+ = 57% female
30+ cm = 60% female

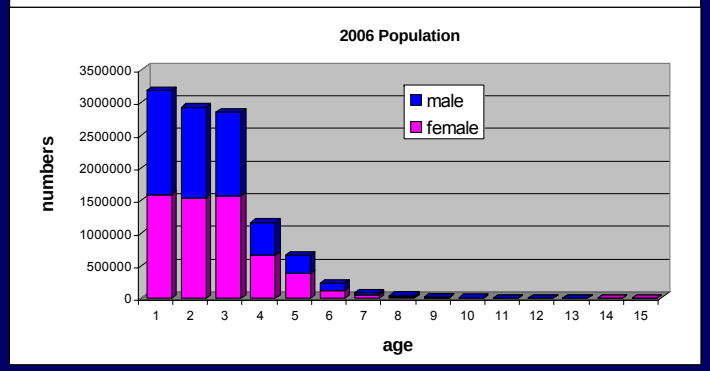




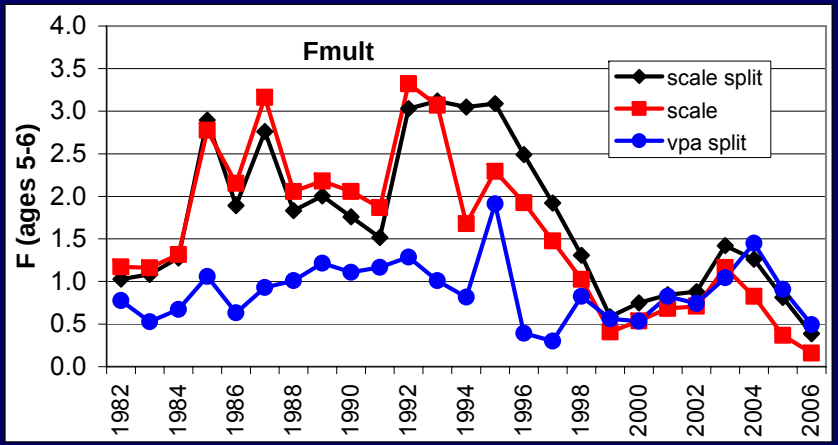


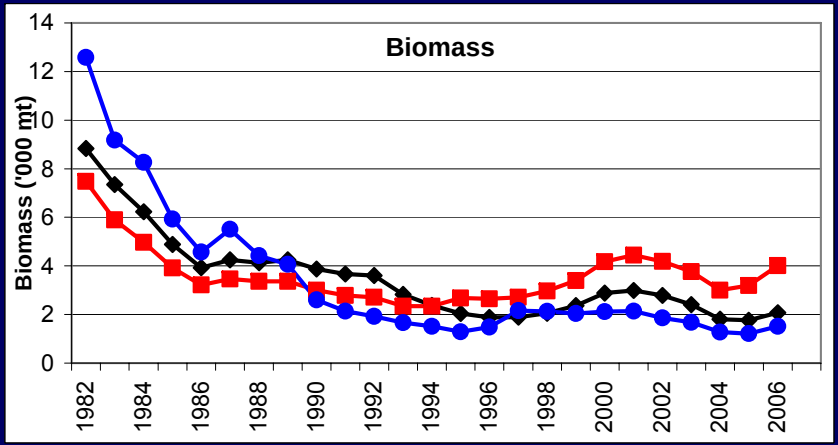


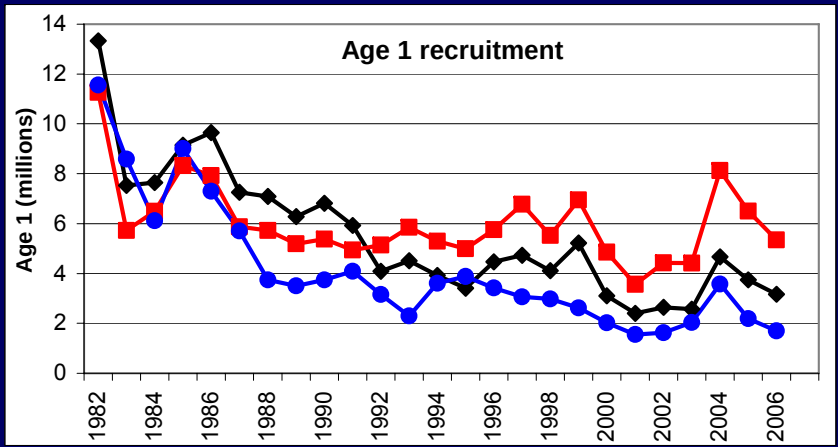


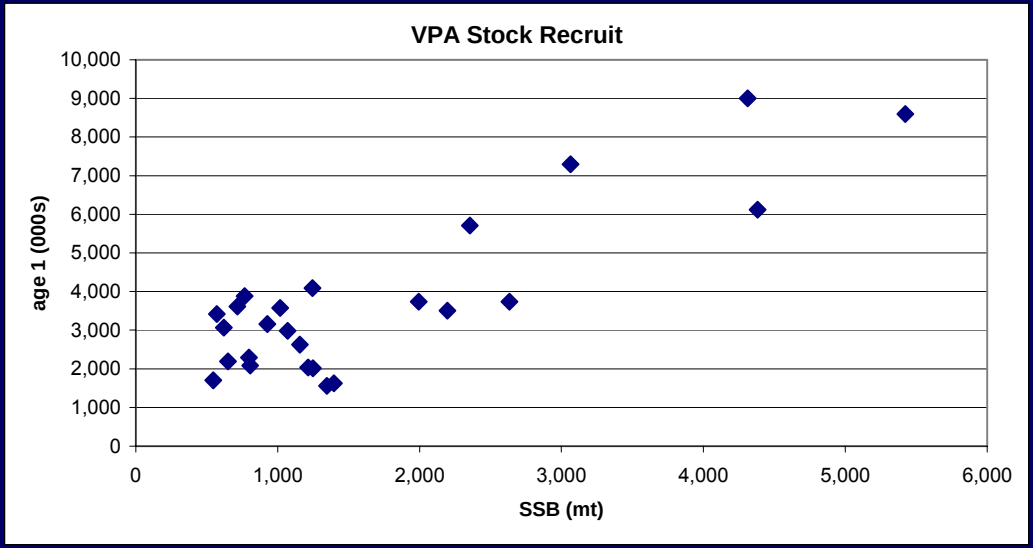


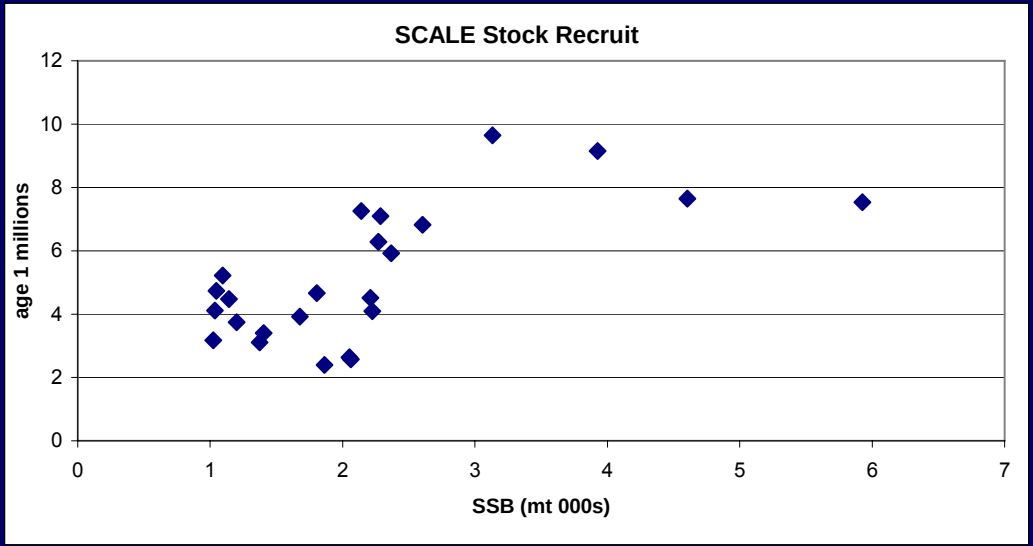
1994, 2004, & 2006 SCALE Split Population numbers at length


Fmult
F (ages 5-6)
scale split
scale
vpa split
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

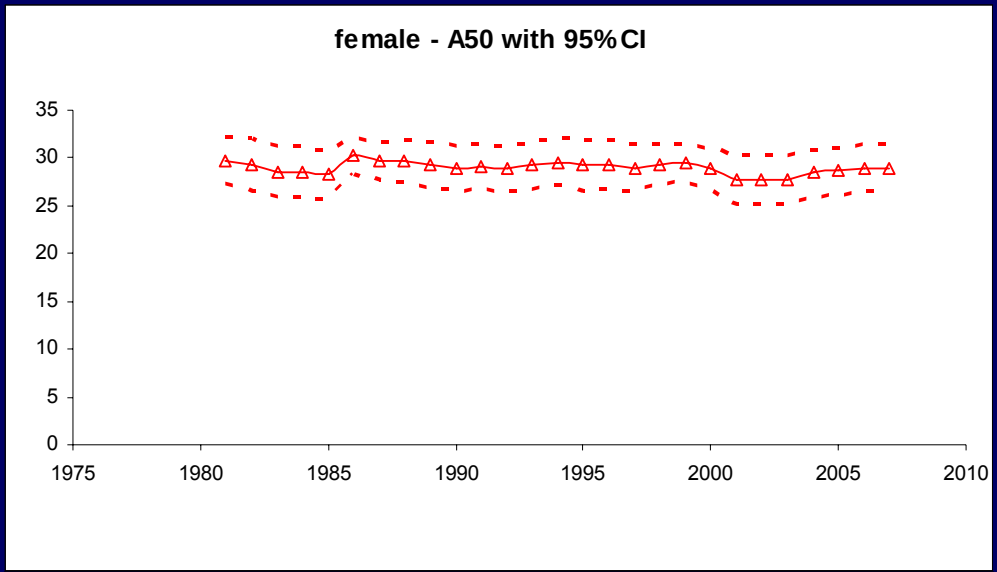

Biomass
Biomass ('000 mt)
14
12
10
8
6
4
2
0
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

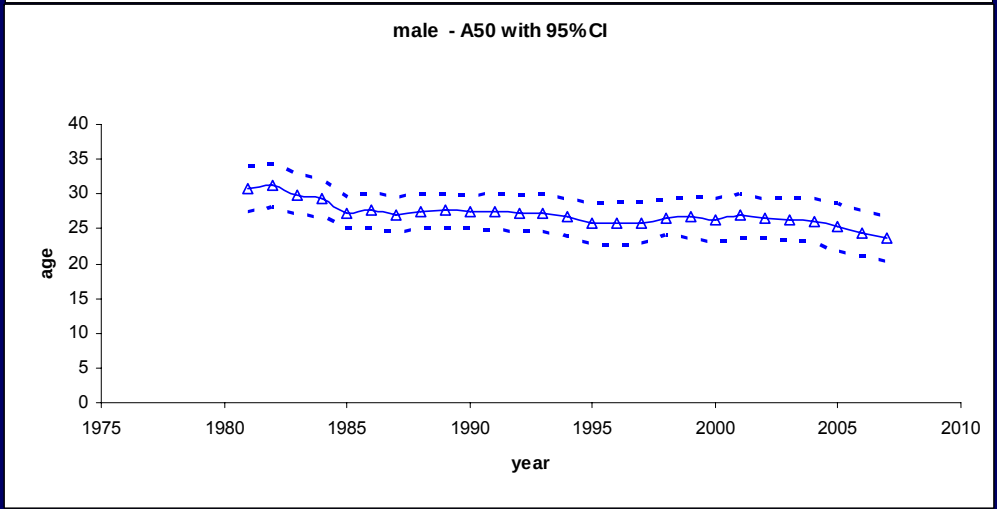

Age 1 recruitment
Age 1 (millions)
14
12
10
8
6
4
2
0
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

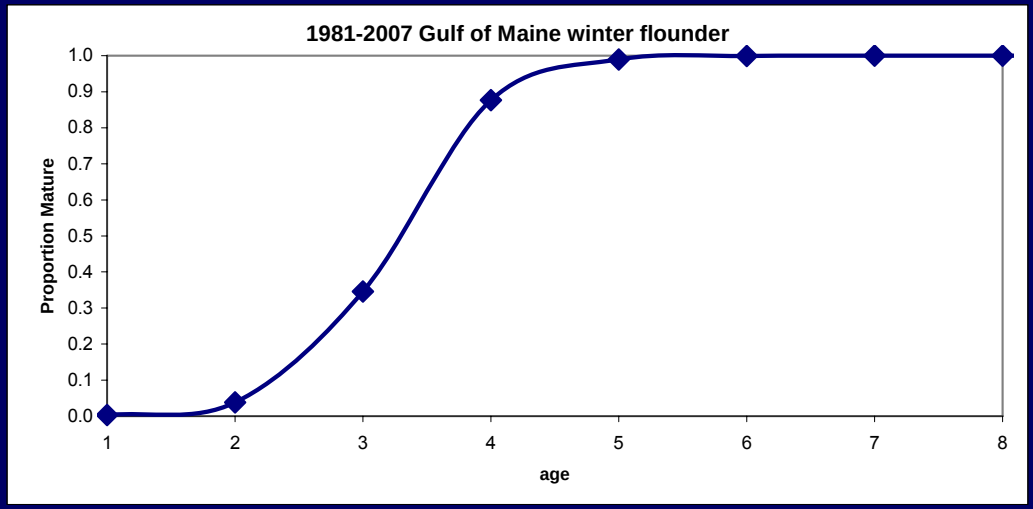

VPA Stock Recruit
age 1 (000s)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0
1,000
2,000
3,000
4,000
5,000
6,000
SSB (mt)

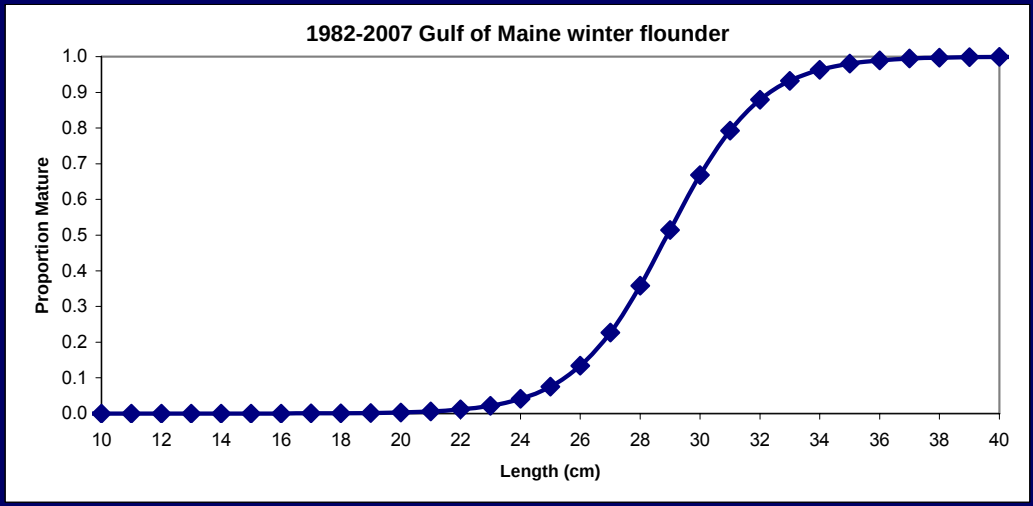

SCALE Stock Recruit
age 1 millions
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
SSB (mt 000s)

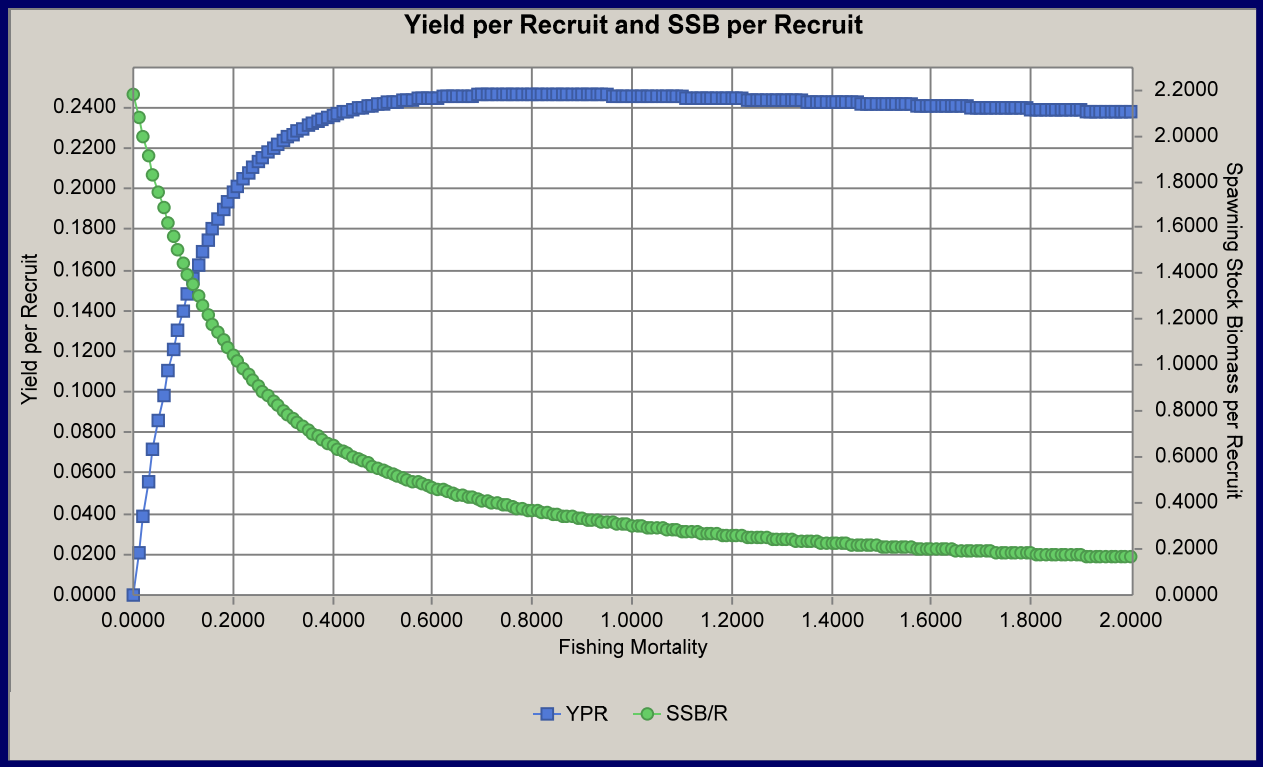
DMF Spring Survey



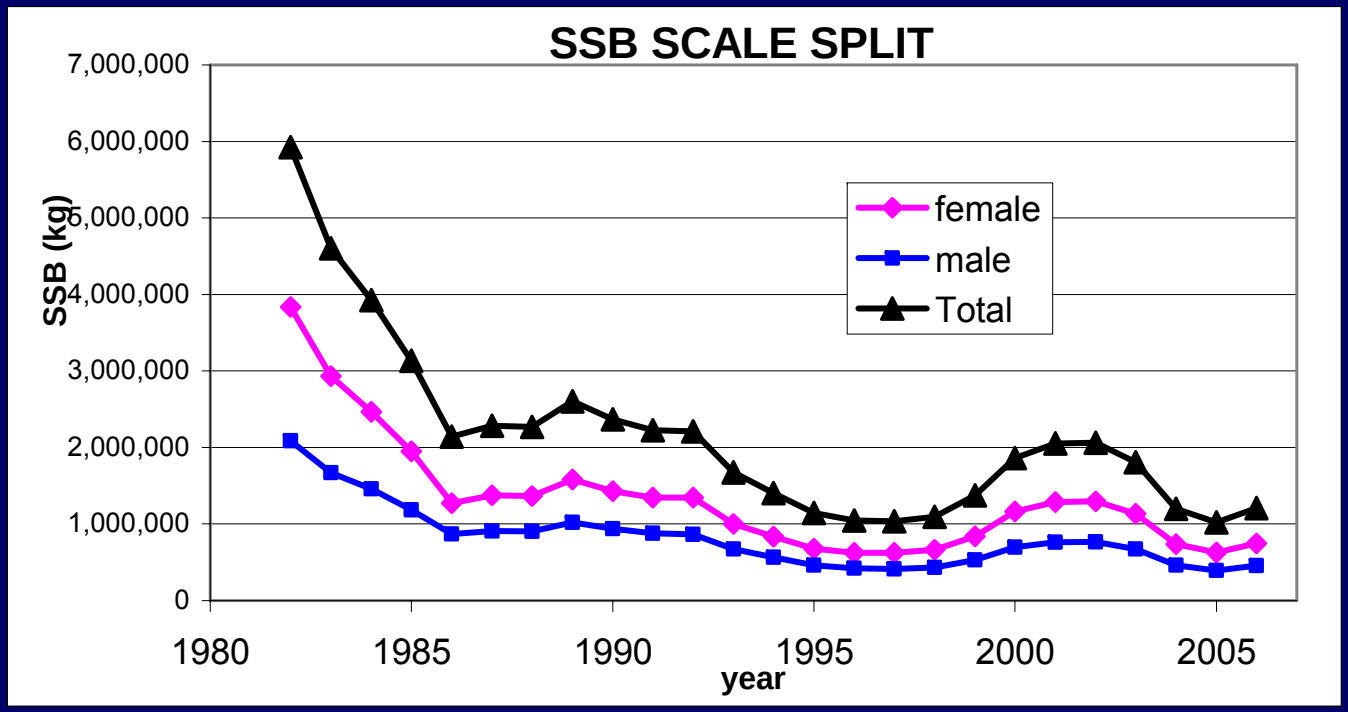


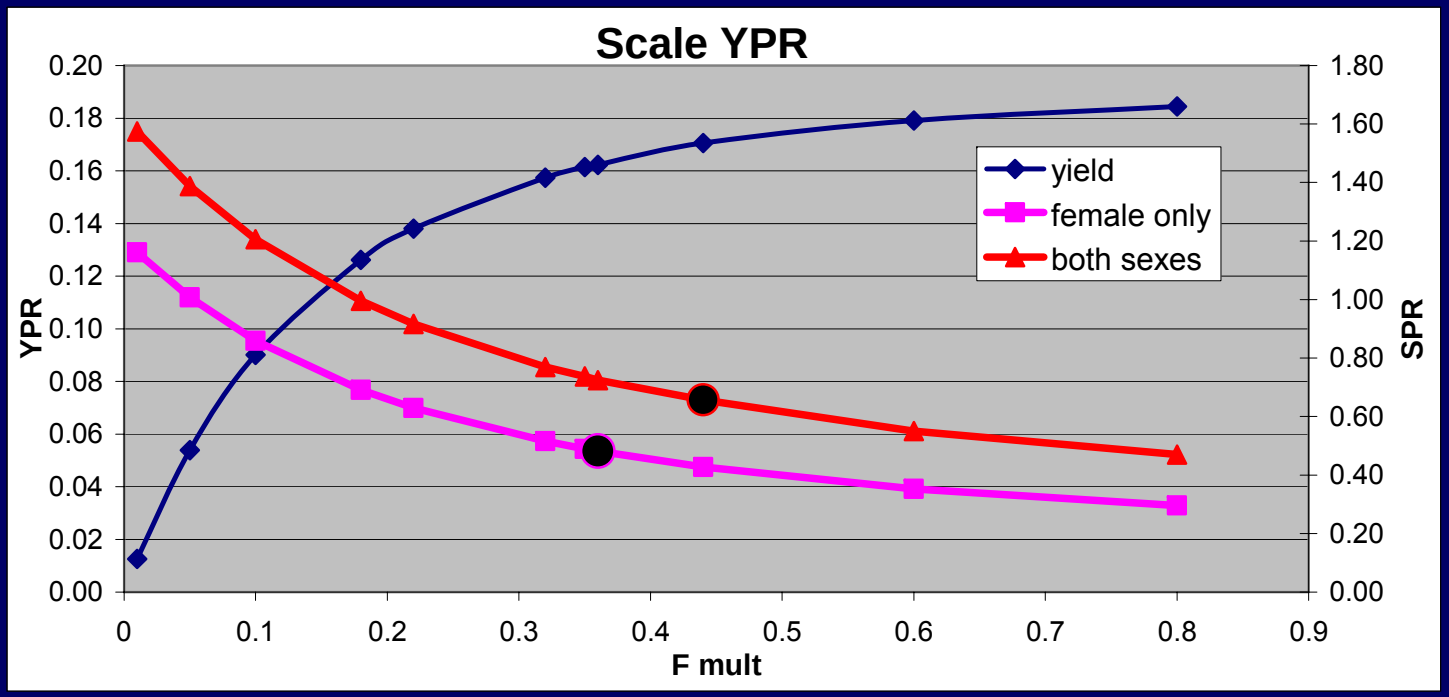

1981-2007 Gulf of Maine winter flounder
Proportion Mature
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
8
age


1982-2007 Gulf of Maine winter flounder
Proportion Mature
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Length (cm)



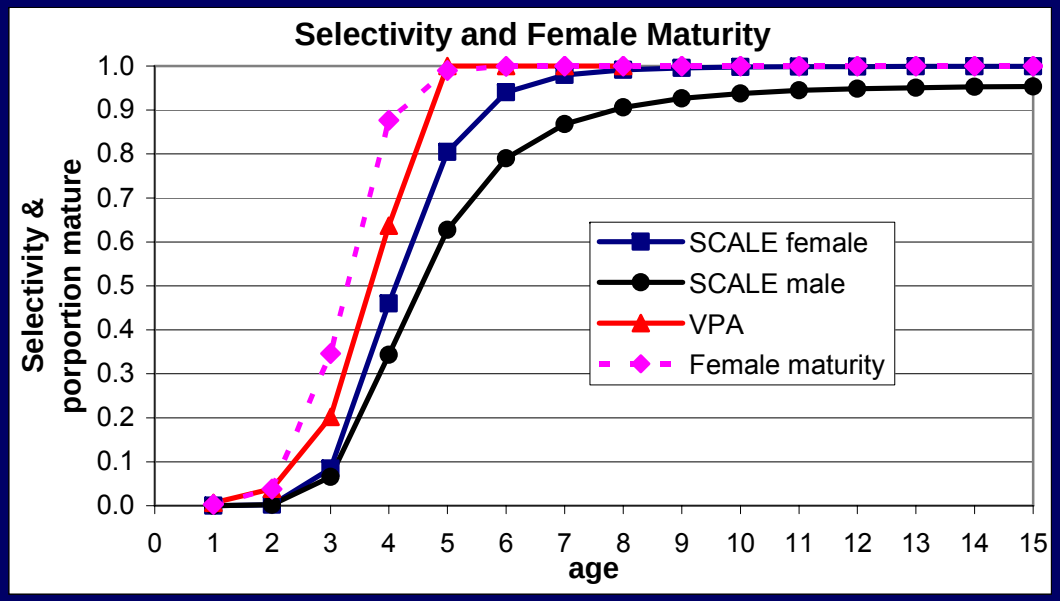
Age based F_{40} = 0.27

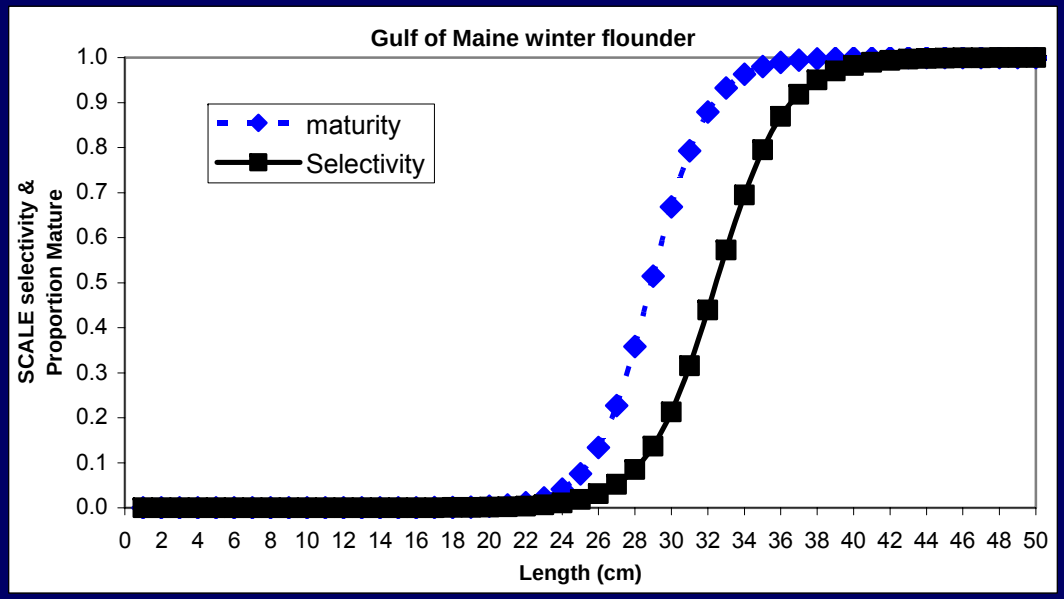

SSB SCALE SPLIT
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
SSB (kg)
1980
1985
1990
1995
2000
2005
year
female
male
Total

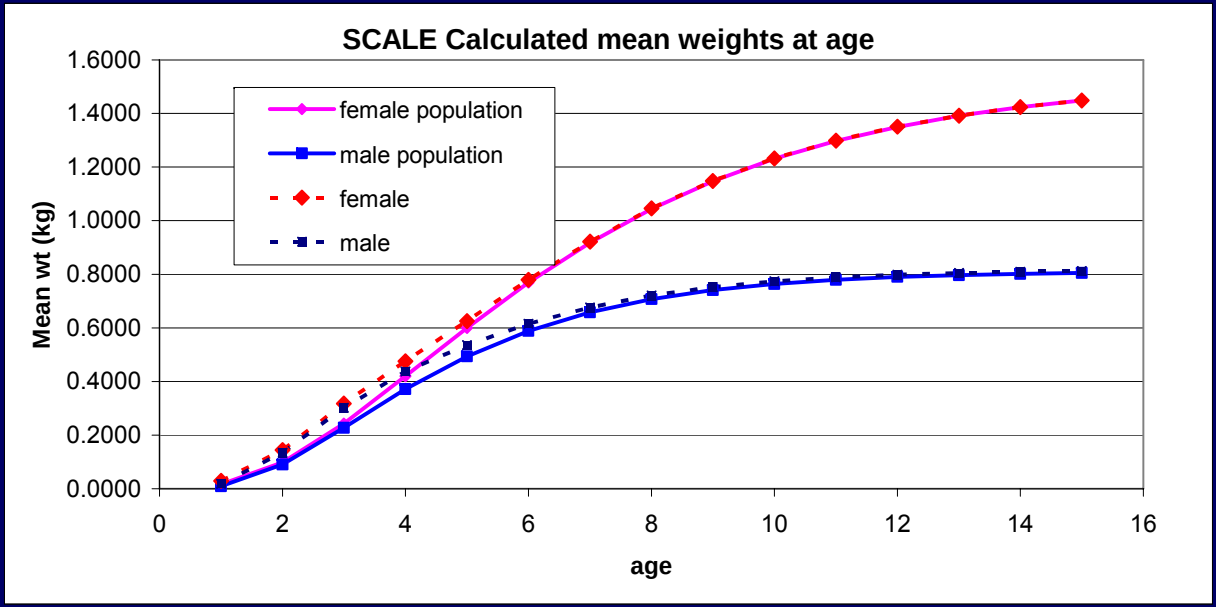


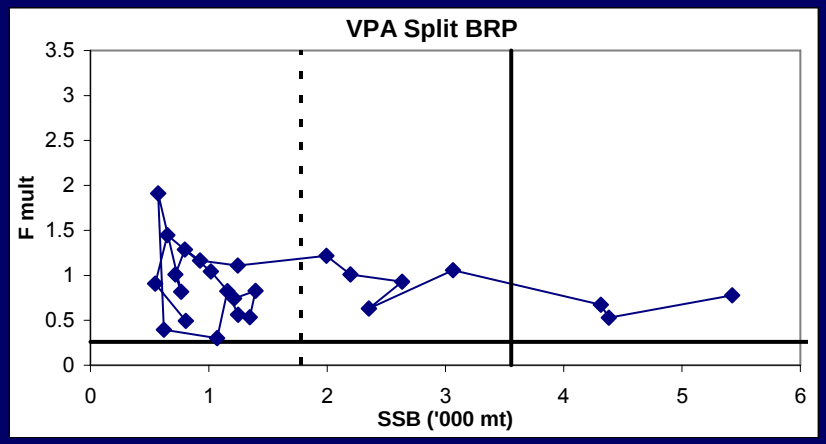
SCALE F40 = 0.44

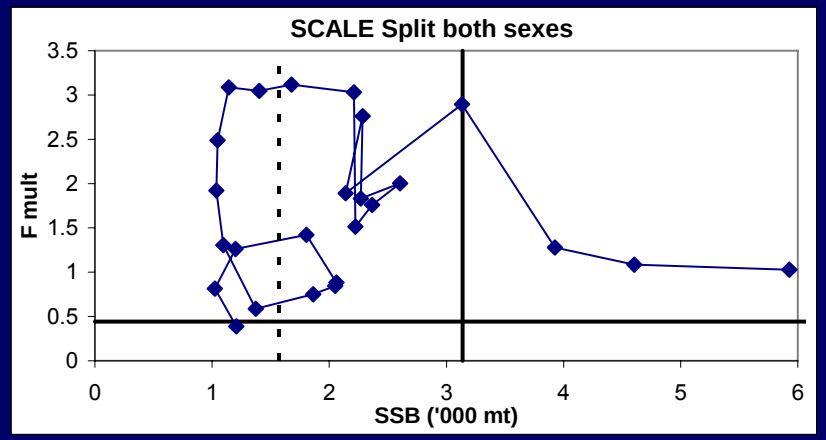
Female only SCALE F40 = 0.36

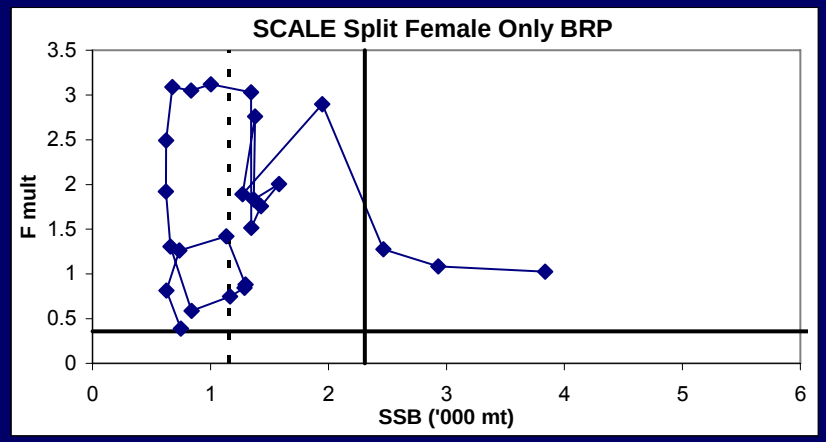

Selectivity and Female Maturity
Selectivity & porportion mature
age
SCALE female
SCALE male
VPA
Female maturity


Gulf of Maine winter flounder
SCALE selectivity & Proportion Mature
Length (cm)
maturity
Selectivity


SCALE Calculated mean weights at age
Mean wt (kg)
1.6000
1.4000
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
0
2
4
6
8
10
12
14
16
age
female population
male population
female
male


VPA Split BRP
F mult
SSB ('000 mt)
0
0.5
1
1.5
2
2.5
3
3.5
0
1
2
3
4
5
6


SCALE Split both sexes
F mult
SSB ('000 mt)
0
0.5
1
1.5
2
2.5
3
3.5
0
1
2
3
4
5
6


SCALE Split Female Only BRP
F mult
SSB ('000 mt)
0
0.5
1
1.5
2
2.5
3
3.5
0
1
2
3
4
5
6

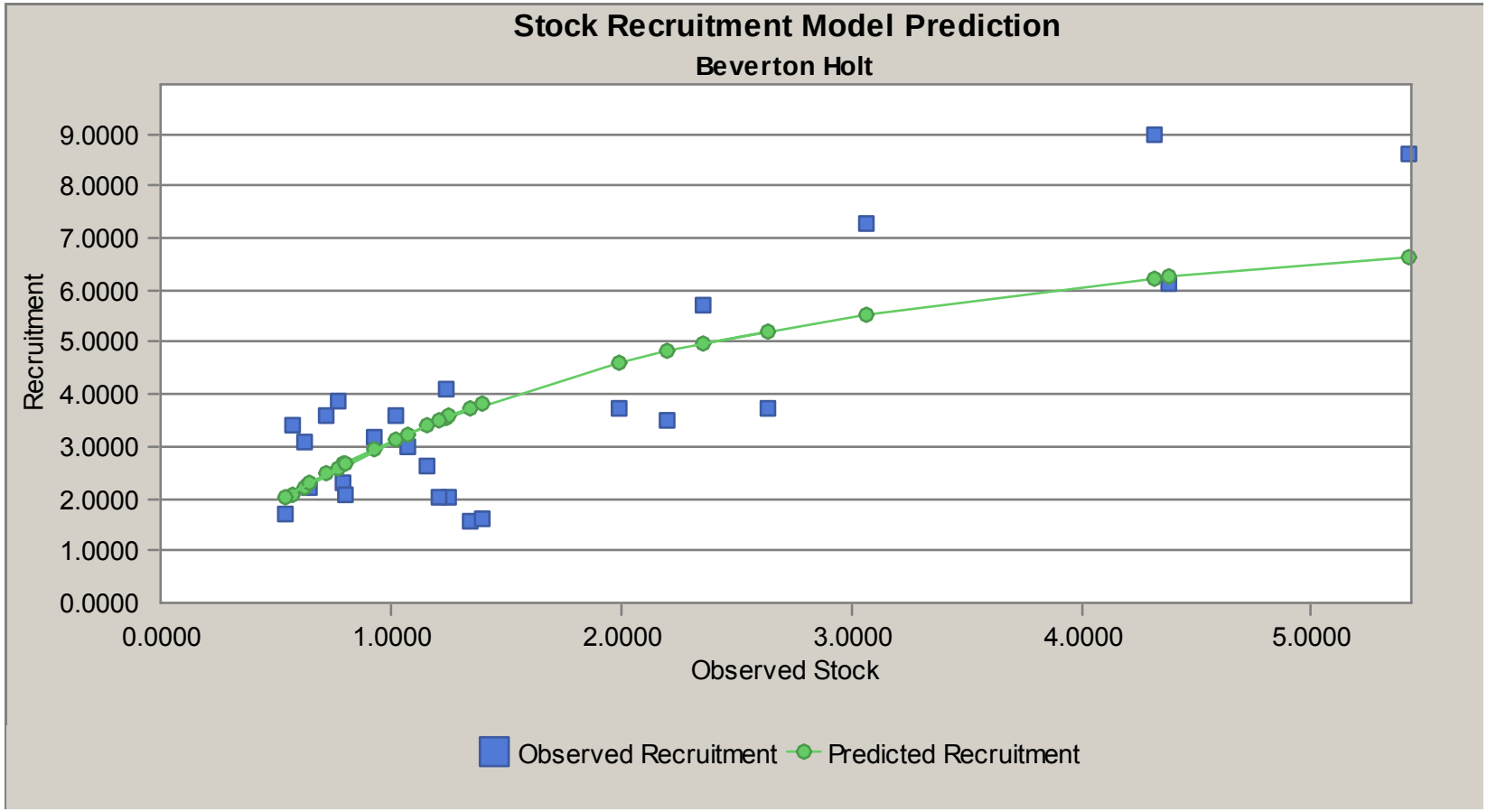
AGEPRO BRPS

	GARM II VPA	Revised VPA Split	Revised Scale Split	Revised female only Scale Split
Bmsy	4,100 mt	3,557 mt	3,138 mt	2,310 mt
Fmsy	0.43	0.27	0.44	0.36

Deterministic Bmsy BRPS

VPA split	scale split	female only scale
3,020 mt	3,043 mt	2,249 mt

VPA Split



msy = 1,486 mt
Fmsy = 0.29
Bmsy = 5,586 mt

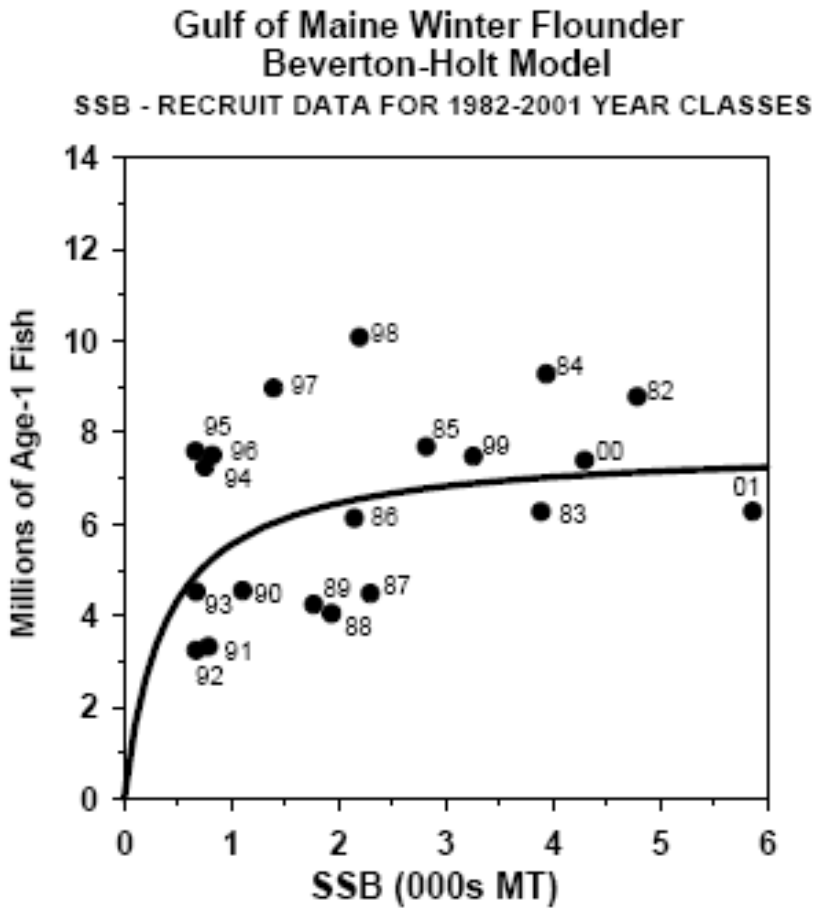
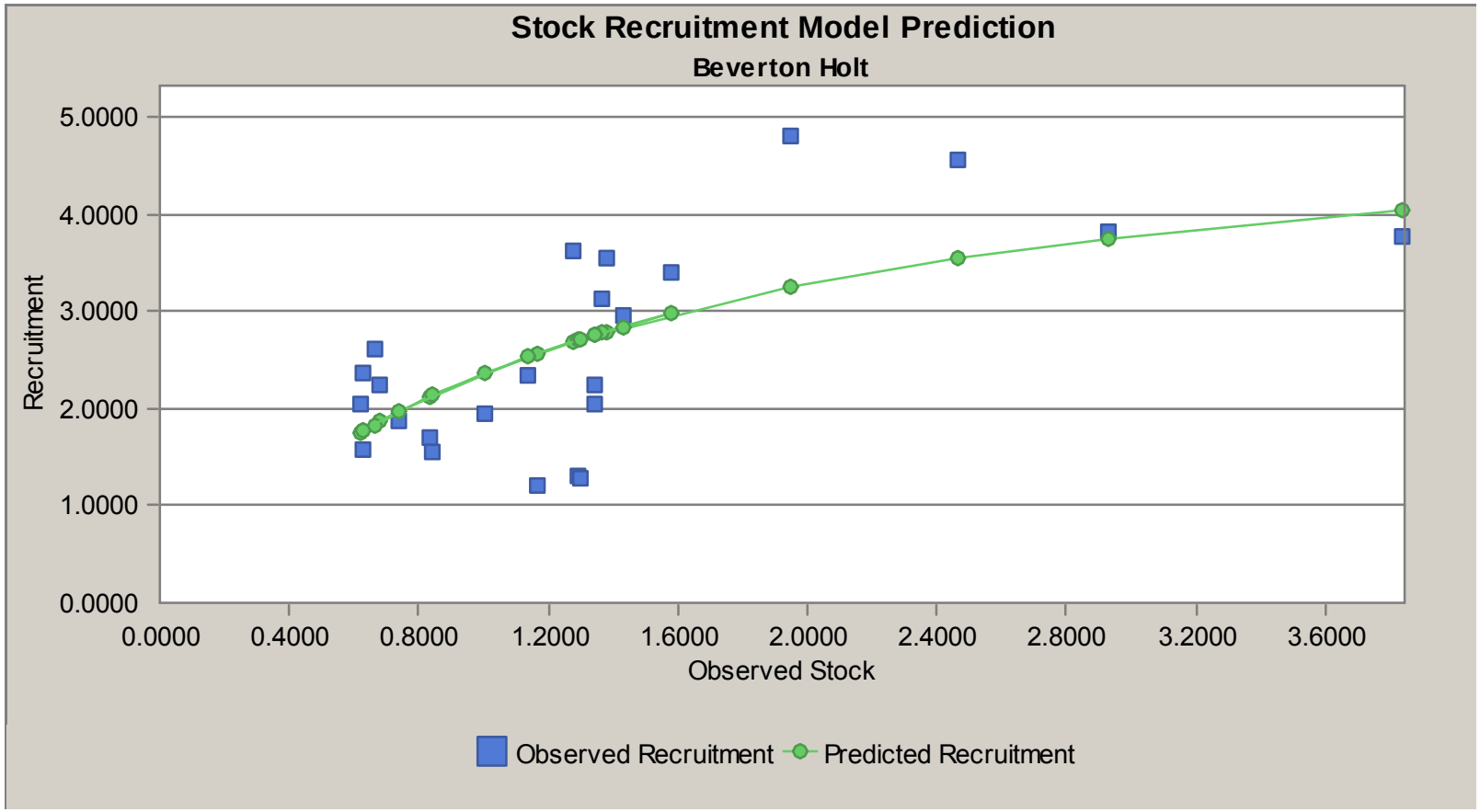
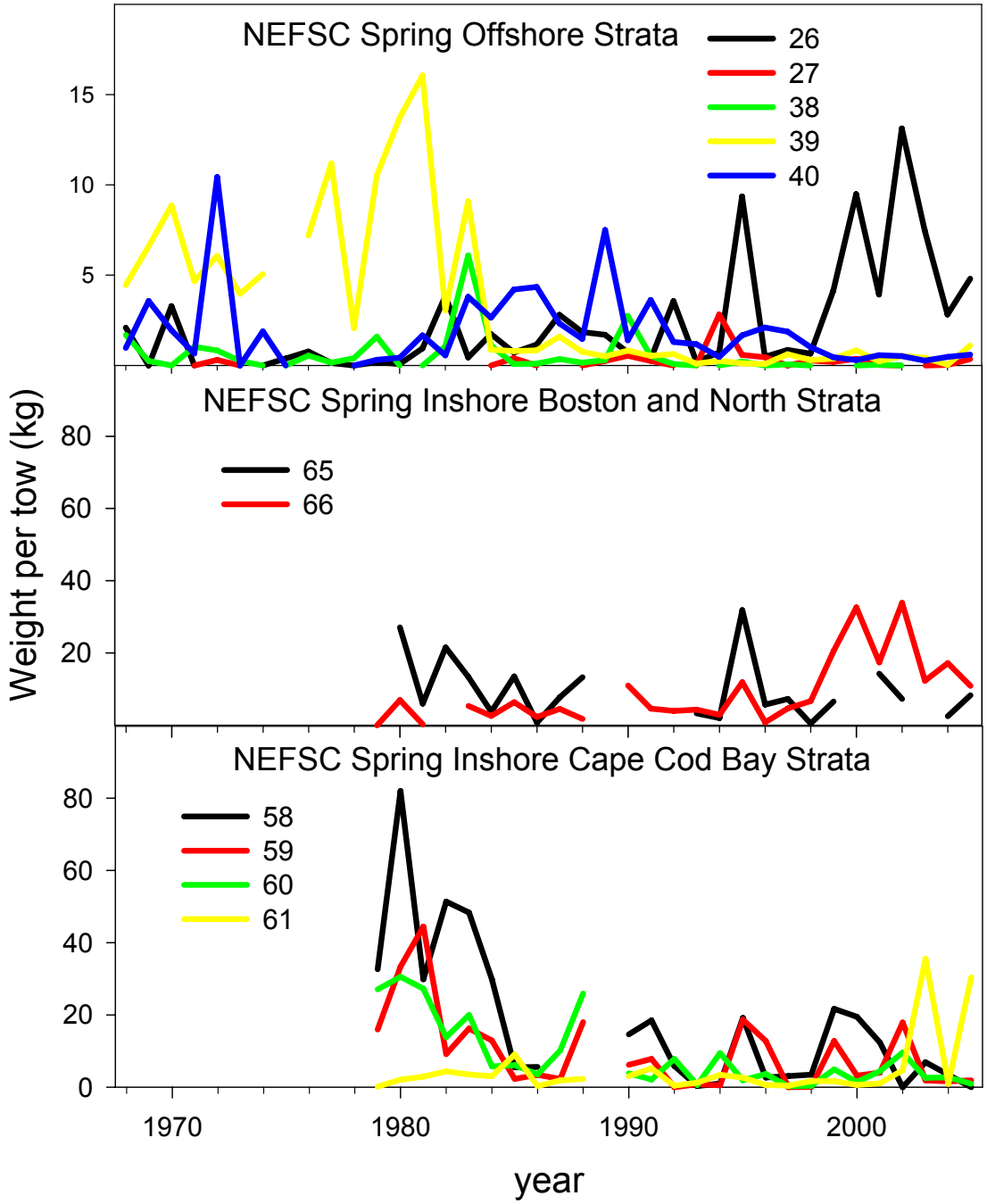


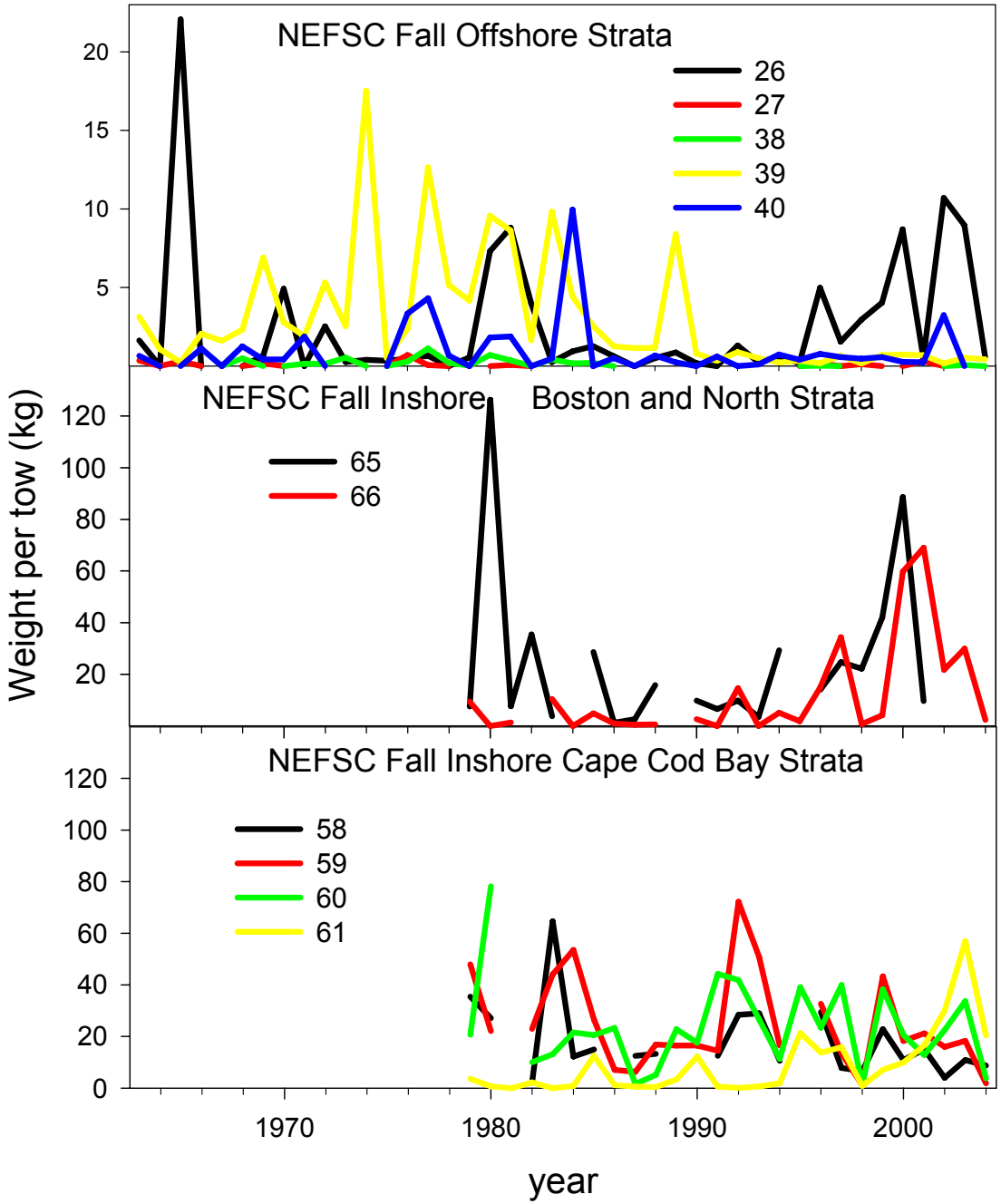
Figure B2.29. Beverton-Holt stock-recruitment model for Gulf of Maine winter flounder.

SCALE Split female only



Fmsy = 0.32
Female Bmsy = 3,800 mt
(Female selectivity, female population and catch mean wts, female maturity?)


NEFSC Spring Offshore Strata
26
27
38
39
40
15
10
5
NEFSC Spring Inshore Boston and North Strata
65
66
80
60
40
20
NEFSC Spring Inshore Cape Cod Bay Strata
58
59
60
61
80
60
40
20
0
Weight per tow (kg)
1970
1980
1990
2000
year


NEFSC Fall Offshore Strata
26
27
38
39
40
NEFSC Fall Inshore Boston and North Strata
65
66
NEFSC Fall Inshore Cape Cod Bay Strata
58
59
60
61
Weight per tow (kg)
year
1970
1980
1990
2000