B. GEORGES BANK WINTER FLOUNDER ASSESSMENT SUMMARY FOR 2011

State of Stock: In 2010, the stock was not overfished and overfishing was not occurring, based on the new biological reference point (BRP) estimates of: F_{MSY} ($F_{THRESHOLD}$) = 0.42, SSB_{MSY} (B_{TARGET}) = 11,800 mt, and 1/2 SSB_{MSY} ($B_{THRESHOLD}$) = 5,900 mt, MSY = 4,400 mt. The 2010 estimate of spawning stock biomass (SSB) is 9,703 mt, which is well above the $B_{THRESHOLD}$ and at 82.2% of the B_{TARGET}. The 2010 estimate of fishing mortality (average F on ages 4-6) is 0.15 and is well below the $F_{THRESHOLD}$ of 0.42 (Figure B1). There was an 80% probability that the 2010 average F was between 0.12 and 0.21 and that the 2010 SSB estimate was between 7,304 mt and 12,578 mt.

Given the new model and assumptions in the current assessment, comparison of the 2010 estimates of SSB and F with the existing reference points is not appropriate. The BRPs derived from the 2008 assessment (NEFSC 2008) were: $F_{40\%}$ ($F_{THRESHOLD}$) = 0.26, $SSB_{40\%}$ (B_{TARGET}) = 16,000 mt, 1/2 $SSB_{40\%}$ ($B_{THRESHOLD}$) = 8,000 mt, and $MSY_{40\%}$ = 3,500 mt.

Projections: A projection of future stock status was made based on the VPA results using mean weights, maturity, and fishery selectivity patterns at age estimated for the most recent 5 years (2006-2010) to reflect current conditions in the stock and fishery. Stochastic projections were run for 2011-2017 because rebuilding of the stock, with at least 75% probability, is required by 2017. Recruitment was projected using the results from a Beverton-Holt stock-recruitment model, which fixed steepness (*h*) at 0.78, resulting in an F_{MSY} estimate of 0.42. The projections assumed the FMP Framework 44 fishing year (May 1) catch of 2,118 mt would be landed as a calendar year (Jan 1) catch in 2011.

The projection results indicate that rebuilding to SSB_{MSY} (= 11,800 mt) is expected to be achieved with 78% probability in 2012, assuming a 2011 catch of 2,118 mt.

Catch: Total landings during 1964-2010 were predominately from the U.S groundfish trawl fishery, with lesser amounts reported by the USSR (during 1965-1977), for the U.S scallop dredge fishery, and as bycatch in the Canadian bottom trawl fisheries for cod and haddock (1-24% of the total). Total landings reached a peak of 4,500 mt in 1972, and averaged 3,200 mt during 1973-1984, but then declined to their lowest level (780 mt) in 1995 (Figure B2). Following an increase to 3,100 mt in 2003, landings declined to 800 mt in 2007. Landings were 1,000 mt in 2008 and 1,300 mt in 2010. During 1995-2010, the proportional standard error (%) due to the allocation of Georges Bank winter flounder landings to Statistical Areas using Vessel Trip Reports, ranged between 0.7 and 1.3%.

U.S. discards during 1989-2010 were estimated using the Standardized Bycatch Reporting Methodology (Wigley et al. 2007) and were hindcast for 1964-1988. Discards for the Canadian scallop dredge fleet were estimated by the CA Division of Fisheries and Oceans for 2004-2010 and were hindcast for 1982-2003. Discards from the Canadian groundfish trawl fleet were not available. During the assessment period, 1982-2010, total discards of winter flounder averaged 15% of the total landings. Discards were higher during 1982-1991 than thereafter and were primarily from U.S. fisheries (i.e., primarily from the large mesh ($\geq$ 5.5 in. codend mesh size) fleet during 1964-1975 and the scallop dredge fleet during 1976-2010). However, after 1991,

discards were primarily from the Canadian scallop dredge fishery. Total discards have slowly increased since 1995. The precision (CVs) of U.S. discard estimates for 1992-2010 ranged between 0.09 and 0.49 (average = 0.26), but the precision of the Canadian estimates is unknown.

Catches during 1964-2010 and were dominated by landings from the U.S. groundfish bottom trawl fleet. Catches increased during 1964-1972, reaching a peak of 4,600 mt in 1972, but then declined to 2,000 mt in 1976 (Figure B3). During 1977-1984 catches ranged between 3,300 and 4,300 mt then gradually declined to a time series low of 800 mt in 1995. Catches increased again to 3,300 mt in 2003 then declined to 1,000 mt in 2007, followed by a slight increase to 2,000 mt in 2009. Total catch in 2010 was 1,500 mt. Catches prior to 1964 were likely higher because U.S. landings alone reached a peak of 4,100 mt in 1945, close to the 1964-2010 peak catch of 4,600 mt and without accounting for discards or landings from international fleets.

Catch and Status Table (weights in 000s mt, recruitment in millions, arithmetic means): Georges Bank Winter flounder

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		Max[1]	Min[1]	Mean[1]
U.S. landings	1.7	2.1	2.8	2.7	2.0	0.8	0.8	0.9	1.7	1.3		4.0	0.7	2.1
CA landings	0.5	0.2	0.3	0.2	0.1	0.1	<0.1	<0.1	<0.1	<0.1		0.5	<0.1	0.1
Total	2.2	2.3	3.1	2.9	2.1	0.9	0.8	0.9	1.7	1.3		4.5	0.8	2.3
U.S. discards	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1		0.3	<0.1	0.1
CA discards	0.2	0.2	0.2	0.1	0.1	0.1	<0.1	0.1	0.3	0.1		0.3	<0.1	0.1
Total	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.2		0.5	0.1	0.2
U.S. catch	1.7	2.1	2.8	2.8	2.1	0.9	1.0	1.0	1.8	1.4		4.3	0.7	2.2
CA catch	0.7	0.4	0.5	0.3	0.2	0.2	<0.1	0.1	0.3	0.1		0.7	0.0	0.2
Total	2.4	2.5	3.3	3.1	2.3	1.1	1.0	1.1	2.1	1.5		4.3	0.8	2.4
Spawning Stock Biomass[2]	10.7	10.2	9.5	5.5	5.3	5.9	6.2	6.5	7.9	9.7	17.4	26.3	1.2	10.7
Recruitment (age 1)	9.0	7.3	6.1	5.5	5.6	10.5	15.6	18.8	4.0	22.5	3.4	4.0	0.2	9.0
F (ages 4-6)	0.52	0.55	0.85	0.63	0.56	0.20	0.21	0.23	0.23	0.15	7.9	13.4	0.5	0.52

[1] During 1964-2010 for landings (includes pre-2001 USSR landings), discards (no CA discards available prior to 1982) and catches; during 1982-2010 for F, SSB and R
[2] On April 1 annually

Stock Distribution and Identification: Winter flounder (*Pseudopleuronectes americanus*) is a demersal flatfish species commonly found in North Atlantic estuaries and on the continental shelf. The species is distributed between the Gulf of St. Lawrence, Canada and North Carolina, U.S., although it is not abundant south of Delaware Bay. On Georges Bank, winter flounder are generally found at depths less than 82 m (Collette and Klein-MacPhee 2002). Tagging studies (e.g., Howe and Coates 1975) indicate that there is limited mixing of fish among the three current stock units, with about 1%-3% between the GOM and SNE/MA, about 1% between GBK and SNE/MA, and <1% between GOM and GBK. Meristics studies based mainly on fin ray counts also indicate a separate Georges Bank stock (Kendall 1912; Perlmutter 1947; Lux et al 1970). Growth and maturity studies also support the distinction of at least three stock areas (Lux 1973; Howe and Coates 1975; Witherell and Burnett 1993), with Georges Bank fish growing and maturing the fastest. The stock area extends from Georges Bank westward to about midway along the Great South Channel.

Data and Assessment: Similar to the 2008 assessment (NEFSC 2008), an ADAPT VPA model was run with catch-at-age data (ages 1-7+) for 1982-2010. Swept-area stock abundance from the

NEFSC spring and fall surveys (1982-2010) and the Canadian spring surveys (1987-2010), for ages 1-7+, were used in the VPA calibration. For the U.S. surveys, length-based, stock-specific calibration coefficients were used to convert catches by the SRV *H.B. Bigelow* to SRV *Albatross IV* catches. Major model changes included: the addition of discards from the Canadian scallop dredge fleet, a new maturity schedule, a new assumption for the instantaneous natural mortality rate (M = 0.3 instead of 0.2), and new MSY-based biological reference points (BRPs).

Biological Reference Points: F_{MSY}, SSB_{MSY}, and MSY were estimated from a stock-recruitment model using a range of fixed values (Table B1) for steepness (slope of the stock recruitment curve near the origin) which was consistent with the stock and recruitment data. Based on the assumption that steepness should be similar between the three winter flounder stocks, values of steepness were chosen which were constructed to be as similar as possible between stocks, but which also provided good fits to the stock-recruitment data for each stock. For the Georges Bank stock, steepness was set at 0.78 (further details in Appendix of the 2011 SAW-52 Stock Assessment Report). The new BRP estimates are direct MSY-based estimates. The recommended biological reference points are: F_{MSY} = $F_{THRESHOLD}$ = 0.42, SSB_{MSY} = B_{TARGET} = 11,800 mt, 1/2 SSB_{MSY} = $B_{THRESHOLD}$ = 5,900 mt, and MSY = 4,400 mt. For comparison, $F_{40\%}$, computed using the same biological and fishery characteristics, is 0.32, $SSB_{40\%}$ is 11,300 mt, and $MSY_{40\%}$ is 3,200 mt.

The existing biological reference points from the 2008 assessment (NEFSC 2008) are: $F_{40\%}$ ($F_{THRESHOLD}$) = 0.26, $SSB_{40\%}$ (B_{TARGET}) = 16,000 mt, 1/2 $SSB_{40\%}$ ($B_{THRESHOLD}$) = 8,000 mt, $MSY_{40\%}$ = 3,500 mt. However, given the new model assumptions in the current assessment (assumed M = 0.3 rather than 0.2), comparison of the 2010 estimates of SSB and F estimates with the existing reference points is not appropriate.

Fishing Mortality: Fishing mortality (fully recruited F, ages 4-6) increased from 0.42 in 1982 to a peak of 1.2 in 1984, and then ranged between 0.57 and 0.92 during 1985-1993 (Figure B4). Fishing mortality decreased to 0.26 in 1999, but then increased again to 0.85 in 2003. Following a decline to 0.20 in 2006, fishing mortality remained stable at low levels (0.21-0.23) during 2007-2009, and then declined to a record low of 0.15 in 2010. A retrospective analysis for the 2001-2009 terminal years indicated that the retrospective error in fishing mortality ranged from -48% in 2002 to +42% in 2009.

Spawning Stock Biomass: SSB decreased from a peak of 17,400 mt in 1982 to a record low of 3,400 mt in 1995, and then increased again to 13,800 mt in 2000. SSB varied between 5,300 and 10,700 mt during 2001-2009, and was 9,703 mt in 2010 (Figure B5). Retrospective error in SSB ranged from -13% in 2008 to +43% in 2002.

Recruitment: Recruitment at age 1 increased from 13.8 million fish in 1982 to a peak of 26.3 million fish in 1988, but then declined to 5.2 million fish in 1993 (Figure B6). Recruitment has averaged 10.5 million during 2003-2010. Retrospective error in recruitment at age 1 (R) ranged from +78% in 2005 (2004 year class) to -11% in 2009 (2008 year class).

Special Comments:
Stock-recruitment data showed no significant relationship with temperature or other environmental factors examined, unlike the SNE/MA winter flounder stock.

The stock-recruitment data for this stock are less informative than the SNE/MA data for predicting recruitment at low spawner levels making estimation of the spawner-recruit relationship difficult without external information (Table B1).

The revised assessment model alters the historical perception of stock status. Four changes from the previous assessment are: 1) a change of M from 0.2 to 0.3 and 2) a new maturity schedule, 3) the addition of Canadian discards, and 4) a change to MSY-based BRPs rather than proxies. The 2011 assessment indicates that the stock was overfished in 2004 and 2005, and stock size was below the biomass target from 2006-2010.
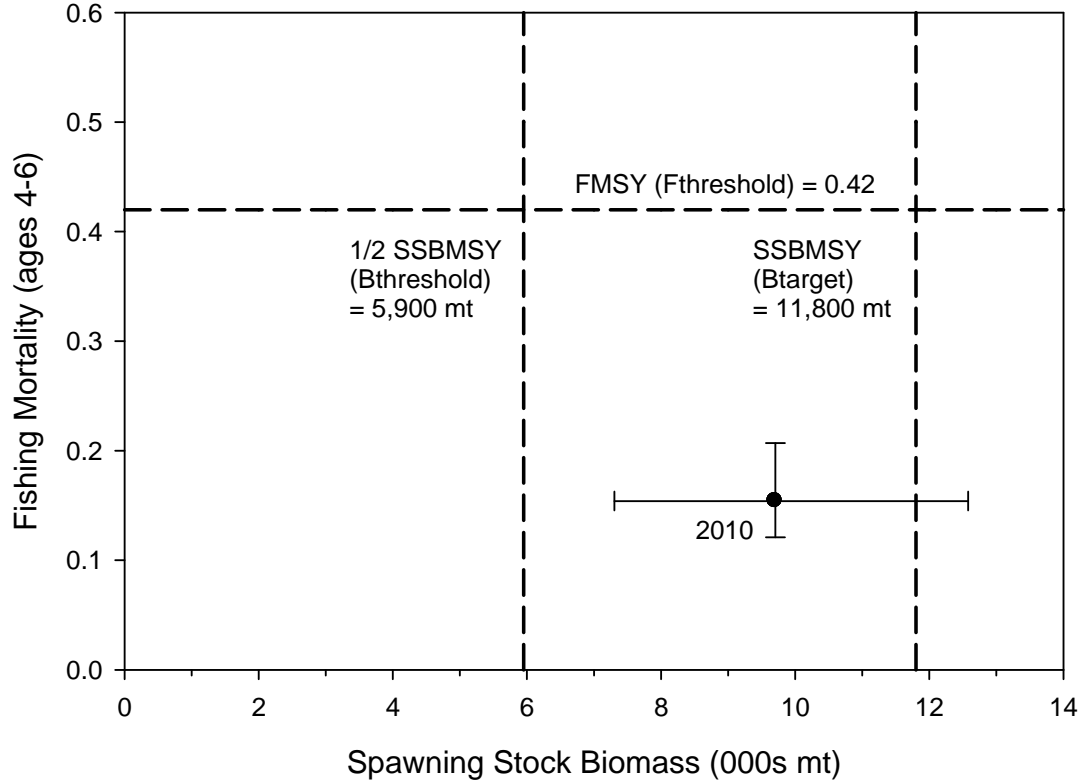
References:

Collette, B. and G. Klein-MacPhee. 2002. Bigelow and Schroeder's Fishes of the Gulf of Maine. 3rd Ed. Smithsonian Institution Press. Washington, D.C., USA. 748 p.

Howe, A.B. and P.G. Coates. 1975. Winter flounder movements, growth, and mortality off Massachusetts. Trans. Am. Fish. Soc. 104(1):13-29.

Kendall, W.C. 1912. Notes on a new species of flatfish from off the coast of New England. Bull. U.S. Bureau Comm. Fish. 30: 391-394.

Lux, F.E. 1973. Age and growth of the winter flounder, *Pseudopleuronectes americanus*, on Georges Bank. Fish. Bull. 71(2): 505-512.

Lux, F.E., A.E. Peterson, Jr., and R.F. Hutton. 1970. Geographical variation in fin ray number in winter flounder, *Pseudopleuronectes americanus* (Walbaum) off Massachusetts. Trans. Am. Fish. Soc. 99: 483-488.

NEFSC. 2008. Assessment of 19 Northeast groundfish stocks through 2007. Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts. August 4-8, 2008. NEFSC Ref Doc. 08-15. 884 p.

Perlmutter, A. 1947. The blackback flounder and its fishery in New England and New York.Bull. Bingham Oceanog. Collection, Yale University 11(2), 92 p.

Wigley, S.E., P.J. Rago, K.A. Sosebee, and D.L. Palka. 2007. The analytic component to the Standardized Bycatch Reporting Methodology Omnibus Amendment: sampling design and estimation of precision and accuracy (2nd ed.). Northeast Fish. Sci Cent. Rec. Doc. 07-09. 156 p.

Witherell DB, Burnett J. 1993. Growth and maturation of winter flounder, *Pseudopleuronectes americanus,* in Massachusetts. Fish. Bull. 91: 816-820.

Table B1. AIC profile for unfished steepness (h) values from Beverton-Holt stock-recruitment models for the 1982-2009 year classes of Georges Bank winter flounder.

| Fixed (h)	AIC	F_{MSY}	SSB_{MSY}	MSY
0.60	583.217	0.26	19,785	4,910
0.65	581.230	0.30	15,144	4,318
0.70	579.698	0.34	12,437	4,003
0.75	578.518	0.38	10,673	3,824
0.76	578.317	0.39	10,341	3,799
0.77	578.126	0.41	9,798	3,777
0.78	577.945	0.42	9,524	3,757
0.79	577.774	0.43	9,269	3,740
0.80	577.611	0.44	9,030	3,725
0.85	576.917	0.51	7,742	3,678
0.90	576.390	0.60	6,621	3,672
0.95	575.996	0.74	5,476	3,706

Georges Bank Winter Flounder

B1. Stock status for Georges Bank winter flounder, during 2010, based on F_{MSY} and SSB_{MSY} reference points. 80% confidence intervals are shown for the 2010 SSB and F estimates.
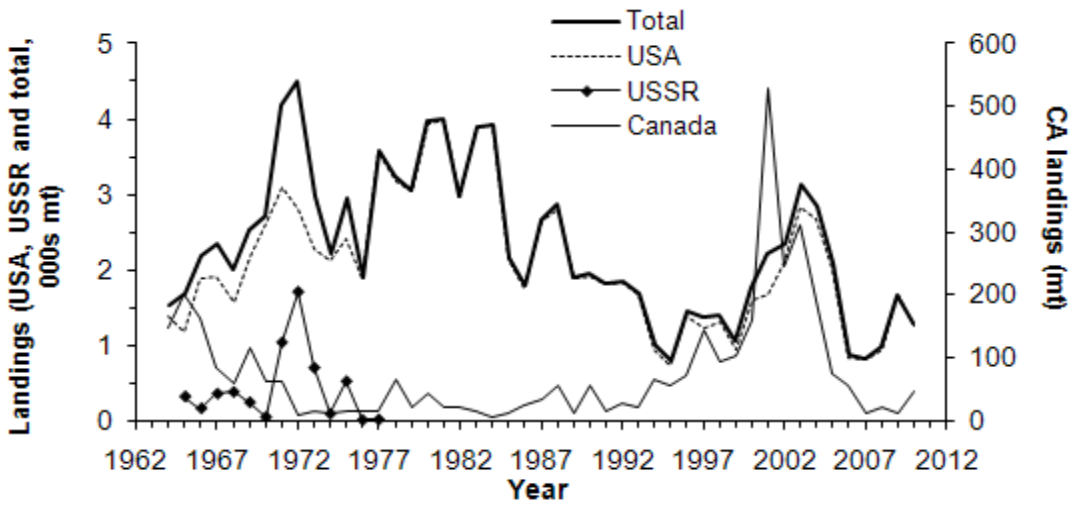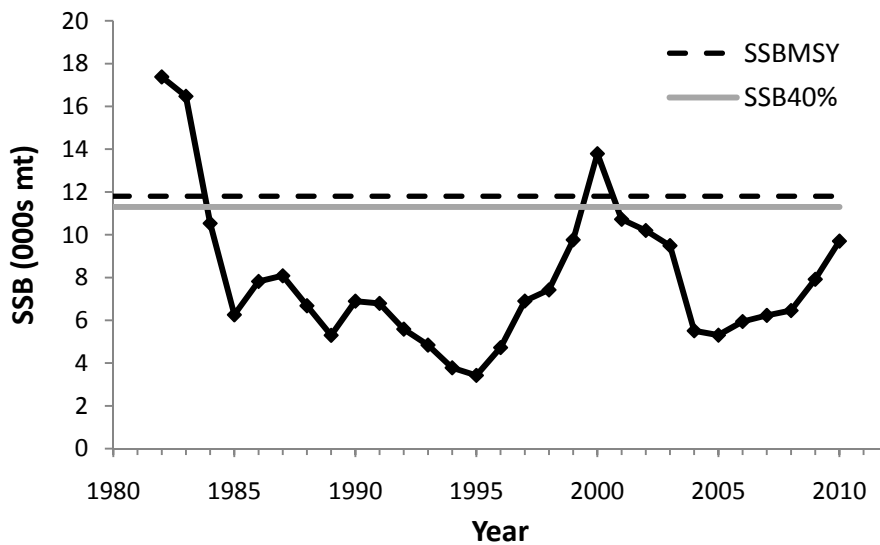
**B2.** Landings of Georges Bank winter flounder, by country, during 1964-2010.
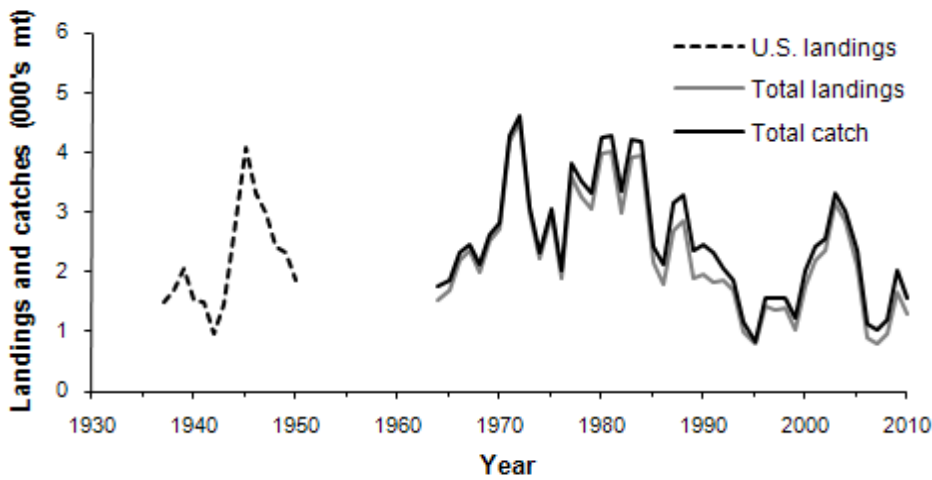
B3. U.S. landings of Georges Bank winter flounder during 1937-1950 and total landings and catches during 1964-2010.
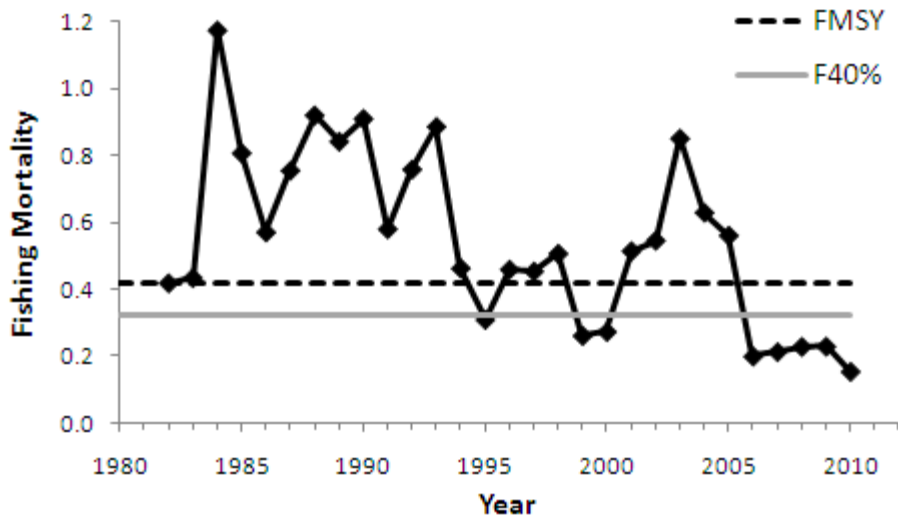
B4. Trends in average fishing mortality rates (ages 4-6) for Georges Bank winter flounder during 1982-2010. The MSY-based BRP is recommended for stock status determination.

B5. Trends in spawning stock biomass (SSB, 000s mt) for Georges Bank winter flounder during 1982-2010. The MSY-based BRP is recommended for stock status determination.
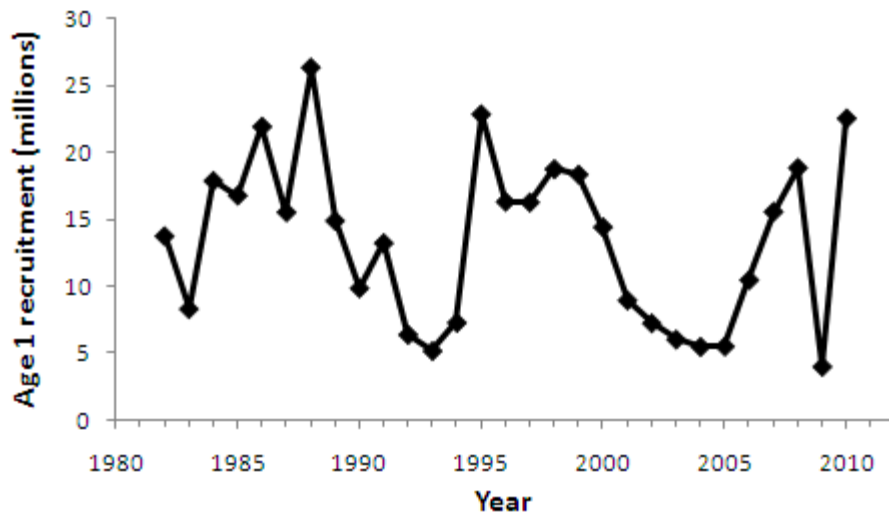
B6. Trends in age 1 recruitment (Jan. 1 stock numbers in millions) for Georges Bank winter flounder during 1982-2011.