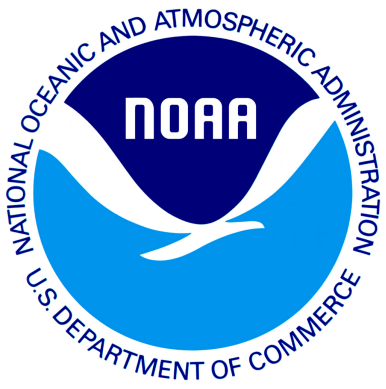

Northeast Fisheries Science Center Reference Document 15-XXXX

Stock Assessment Update of 20 Northeast Groundfish Stocks Through 2014

by Northeast Fisheries Science Center

October 2015

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by Northeast Fisheries Science Center

NOAA, National Marine Fisheries Service,

Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

October 2015

Northeast Fisheries Science Center Reference Documents

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Contents

1 Executive Summary

Update assessments were conducted for the twenty stocks in the Northeast Multispecies Fishery Management Plan in 2015 (**??**). The updates replicated the methods recommended in the most recent benchmark decisions, as modified by any subsequent operational assessments or updates (**??**), with the intention of simply adding years of data (**??**). However, minor flexibility was allowed to address emerging issues (**??**).

Stock status did not change for 15 of the 20 stocks, worsened for two stocks, improved for one stock, and became more uncertain for two stocks (**??**).

The number of stocks with retrospective adjustments applied increased from the last assessment from 2 to 7 (**??**). The previous Georges Bank cod assessment did apply a retrospective adjustment, however, the assessment model was not approved at the 2015 Updates so it has been excluded from these counts.

While the number of overfished stocks and stocks experiencing overfishing has generally decreased since 2007 (**??**), the magnitude of overfishing or depletion for several stocks has worsened considerably (**??** and **??**); Gulf of Maine cod, Southern New England/Mid-Atlantic yellowtail flounder, witch flounder and Cape Cod/Gulf of Maine yellowtail flounder). Of those Northeast groundfish stocks for which stock status can be determined, the majority remain below their biomass targets (69%; Figures **??** and **??**).

Recent NEFSC survey biomass indices for both the spring and fall surveys are below the long term means. For the majority of stocks the average of the most recent five years are below the time series means (**??** and **??**)

Estimates of overall (aggregate) groundfish minimum swept area biomass are at, or near, all-time highs (**??** and **??**). However, the current stock diversity of the overall groundfish biomass is less than that seen in the 1960s and 1970s. Current groundfish biomass is dominated by only a few stocks: For example the combined biomass of the Georges Bank haddock, Gulf of Maine haddock, and redfish stocks currently make up more than 80% of the overall groundfish biomass (**??**).

Table B1: List of stocks included in the groundfish update and the abbreviations used for each in this document.

Stock Abbrev	Stock Name
CODGM	Gulf of Maine Cod
CODGB	Georges Bank Cod
HADGM	Gulf of Maine Haddock
HADGB	Georges Bank Haddock
YELCCGM	Cape Cod/Gulf of Maine Yellowtail Flounder
YELSNEMA	Southern New England/Mid-AtlanticYellowtail Flounder
FLWGB	Georges Bank Winter Flounder
FLWSNEMA	Southern New England/Mid-Atlantic Winter Flounder
REDUNIT	Acadian Redfish
PLAUNIT	American Plaice
WITUNIT	Witch Flounder
HKWUNIT	White Hake
POLUNIT	Pollock
CATUNIT	Wolffish
HALUNIT	Atlantic Halibut
FLDGMGB	Gulf of Maine/Georges Bank Windowpane
FLDSNEMA	Southern New England/Mid-Atlantic Windowpane
OPTUNIT	Ocean Pout
FLWGM	Gulf of Maine Winter Flounder
YELGB	Georges Bank Yellowtail Flounder

Table B2: Lead scientist for each stock (current/previous if different), information about last assessment, including: the forum for review of the last assessment (Forum), the type of assessment done (Type), publication year (Pub.) the terminal year of the catch data included (Term. yr.), overfished/overfishing status, rebuilding status, and reference. *Note: Op. Update = Operational Update*

Stock	Lead	Forum	Type	Pub.	Term. yr.	Overfished?	Overfishing?	Rebuild status	Reference
CODGM	Michael Palmer	Op. Update	Update	2014	2013	Yes	Yes	By 2024	CRD14-14
CODGB	Loretta O'Brien	SARC 55	Benchmark	2012	2011	Yes	Yes	By 2026	CRD13-11
HADGM	Michael Palmer	SARC 59	Benchmark	2014	2013	No	No	Rebuilt	CRD14-09
HADGB	Liz Brooks	GARM2012	Update	2012	2010	No	No	Rebuilt	CRD12-06
YELCCGM	Larry Alade/Chris Legault	GARM2012	Update	2012	2010	Yes	Yes	By 2023	CRD12-06
YELSNEMA	Larry Alade	SARC 54	Benchmark	2012	2011	No	No	Rebuilt	CRD12-18
FLWGB	Lisa Hendrickson	Op. Update	Update	2015	2013	No	No	By 2017	CRD15-01
FLWSNEMA	Tony Wood/Mark Terciero	SARC 52	Benchmark	2011	2010	Yes	No	By 2023	SARC52
REDUNIT	Brian Linton/Tim Miller	GARM2012	Update	2012	2010	No	No	Rebuilt	CRD12-06
PLAUNIT	Loretta O'Brien	GARM2012	Update	2012	2010	No	No	By 2024	CRD12-06
WITUNIT	Susan Wigley	GARM2012	Update	2012	2010	Yes	Yes	By 2017	CRD12-06
HKWUNIT	Kathy Sosebee	SARC 56	Benchmark	2013	2011	No	No	By 2014	CRD13-10
POLUNIT	Brian Linton	Op. Update	Update	2015	2013	No	No	Rebuilt	CRD15-01
CATUNIT	Chuck Adams/Chad Keith	GARM2012	Update	2012	2010	Yes	No	Unknown	CRD12-06
HALUNIT	Dan Hennen/Jessica Blaylock	GARM2012	Update	2012	2010	Yes	No	By 2055	CRD12-06
FLDGMGB	Toni Chute/Lisa Hendrickson	GARM2012	Update	2012	2010	Yes	Yes	By 2017	CRD12-06
FLDSNEMA	Toni Chute/Lisa Hendrickson	GARM2012	Update	2012	2010	No	No	Rebuilt	CRD12-06
OPTUNIT	Susan Wigley	GARM2012	Update	2012	2010	Yes	No	By 2014	CRD12-06
FLWGM	Paul Nitschke	Op. Update	Update	2015	2013	Unknown	No	Unknown	CRD15-01
YELGB	Chris Legault	TRAC 2015	Update	2015	2014	Unknown	Unknown	By 2032	TRAC2015

Table B3: Data used in each assessment. The column heads are US commercial landings (US c-land), US commercial discards (US c-disc), US recreational landings (US r-land), US recreational discards (US r-disc), Canadian catch (CA catch), NEFSC spring, fall and winter surveys (NEFSC S, NEFSC F and NEFSC W), Massachusetts spring and fall surveys (MA S and MA F), Maine/New Hampshire spring and fall surveys (ME/NH S and ME/NH F) and Canadian Department of Fisheries and Oceans February survey (DFO S).

	Catch					**Surveys**							
Stock	US c-land	US c-disc	US r-land	US r-disc	CA Catch	NEFSC S	NEFSC F	NEFSC W	MA S	MA F	ME/NH S	ME/NH F	DFO S
CODGM	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	No	No	No
CODGB	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
HADGM	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	No	No
HADGB	Yes	Yes	No	No	Yes	Yes	Yes	No	No	No	No	No	Yes
YELCCGM	Yes	Yes	No	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No
YELSNEMA	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	No	No
FLWGB	Yes	Yes	No	No	Yes	Yes	Yes	No	No	No	No	No	Yes
FLWSNEMA	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No
REDUNIT	Yes	Yes	No	No	No	Yes	Yes	No	No	No	No	No	No
PLAUNIT	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	No	No	No
WITUNIT	Yes	Yes	No	No	No	Yes	Yes	No	No	No	No	No	No
HKWUNIT	Yes	Yes	No	No	Yes	Yes	Yes	No	No	No	No	No	No
POLUNIT	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	No	No
CATUNIT	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	No	No	No	No
HALUNIT	Yes	Yes	No	No	Yes	No	Yes	No	No	No	No	No	No
FLDGMGB	Yes	Yes	No	No	No	No	Yes	No	No	No	No	No	No
FLDSNEMA	Yes	Yes	No	No	No	No	Yes	No	No	No	No	No	No
OPTUNIT	Yes	Yes	No	No	No	Yes	No	No	No	No	No	No	No
FLDWGM	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No
YELGB	Yes	Yes	No	No	Yes	Yes	Yes	No	No	No	No	No	Yes

Table B4: Assessment type and reference points from previous assessment. *Note: sp=stochastic projection.*

Stock	Assess.	Type	F def.	B def.	F_{MSY} type	F_{MSY} value	B_{MSY} type	B_{MSY} value	MSY type	MSY value
CODGM	ASAP	age-based	F_{Full}	SSB	$F_{40\%SPR}$	0.18	sp	47,184 (M=0.2) or 69,621 (Mramp)	sp	7,753 (M=0.2) or 11,388 (Mramp)
CODGB	ASAP	age-based	F_{Full}	SSB	$F_{40\%SPR}$	0.18	sp	186,535	sp	30,622
HADGM	ASAP	age-based	F_{Full}	SSB	$F_{40\%SPR}$	0.46	sp	4,108	sp	955
HADGB	VPA	age-based	avg F ages 5-7	SSB	$F_{40\%SPR}$	0.39	sp	124,900	sp	28,000
YELCCGOM	VPA	age-based	avg F ages 4-6	SSB	$F_{40\%SPR}$	0.26	sp	7,080	sp	1,600
YELSNEMA	ASAP	age-based	avg F ages 4-5	SSB	$F_{40\%SPR}$	0.32	sp	2,995	sp	773
FLWGB	VPA	age-based	avg F ages 4-6	SSB	Fmsy	0.44	sp	8,100	sp	3,200
FLWSNEMA	ASAP	age-based	avg F ages 4-5	SSB	Fmsy	0.29	sp	43,661	sp	11,728
REDUNIT	ASAP	age-based	F_{Full}	SSB	$F_{50\%SPR}$	0.04	sp	238,000	sp	8,891
PLAUNIT	VPA	age-based	avg F ages 6-9	SSB	$F_{40\%SPR}$	0.18	sp	18,398	sp	3,385
WITUNIT	VPA	age-based	avg F ages 8-11	SSB	$F_{40\%SPR}$	0.27	sp	10,051	sp	2,075
HKWUNIT	ASAP	age-based	F_{Full}	SSB	$F_{40\%SPR}$	0.20	sp	32,400	sp	5,630
POLUNIT	ASAP	age-based	avg F ages 5-7	SSB	$F_{40\%SPR}$	0.27	sp	76,900	sp	14,800
CATUNIT	SCALE	length-based	F_{Full}	SSB	$F_{40\%SPR}$	0.33	sp	1,756	sp	261
HALUNIT	RYM	surplus production	biomass wted F	B	F0.1	0.07	deterministic	49,000	deterministic	3,500
FLDGMGB	AIM	index	relative F (catch/survey biomass)	surv. B	replacement ratio	0.44	MSY *proxy* / $F_{MSYproxy}$	1.60	median catch 1995-2001	700
FLDSNEMA	AIM	index	relative F (catch/survey biomass)	surv. B	replacement ratio	2.09	MSY *proxy* / $F_{MSYproxy}$	0.24	median catch 1995-2001	500
OPTUNIT	index	index	relative F (catch/survey biomass)	surv. B	median relative F 1977-1985	0.76	median surv. B 1977-1985	4.94	F_{MSY} * B_{MSY}	3,754
FLWGM	empirical	survey expansion	exploitation rate (catch/30+cm biomass)	surv. B	exploitation rate ($F_{40\%}$ from YPR)	0.23	NA	NA	NA	NA
YELGB	empirical	survey expansion	NA	surv. B	NA	NA	NA	NA	NA	NA

Table B5: The biomass (B) and exploitation rate (F) values used for status determination were adjusted to account for a retrospective pattern in some stocks. In general, when the B or F values adjusted for restrospective pattern (B_ρ and F_ρ) were outside of the approximate 90% confidence interval (Conf. limits), the ρ adjusted values were used to determine stock status (Adj. = Yes). There were exceptions however, such as YELSNEMA and CODGM(M=0.2) and details regarding each decision can be found in the report and reviewer comments sections for each stock. Only stocks that had both an estimable 7-year Mohn's ρ for B and F and estimable approximate 90% confidence limits on terminal year B and F values are included.

Stock	B_{2014}	B_ρ	Conf. limits	F_{2014}	F_ρ	Conf. limits	Adj?
CODGM(M=0.2)	2,225	1,443	1,942 - 2,892	0.956	1.39	0.654 - 1.387	No
CODGM(M ramp)	2,536	2,106	1,921 - 3,298	0.932	1.01	0.662 - 1.304	No
HADGB	225,080	150,053	171,911 - 301,282	0.159	0.241	0.13 - 0.203	Yes
HADGM	10,325	10,712	7,229 - 14,453	0.257	0.25	0.164 - 0.373	No
YELSNEMA	502	243	355 - 739	1.64	3.53	1.053 - 2.348	No
YELCCGM	1,695	857	1,375 - 2,111	0.355	0.64	0.25 - 0.52	Yes
FLWSNEMA	6,151	5,105	5,045 - 7,500	0.16	0.21	0.12 - 0.213	No
FLWGB	5,275	2,883	3,783 - 6,767	0.379	0.778	0.254 - 0.504	Yes
PLAUNIT	14,543	10,915	12,742 - 16,439	0.08	0.118	0.069 - 0.093	Yes
WITUNIT	3,129	2,077	2,643 - 3,864	0.428	0.687	0.321 - 0.603	Yes
HWKUNIT	28,553	24,197	24,351 - 33,480	0.076	0.086	0.063 - 0.092	No
POLUNIT	198,847	154,919	37,243 - 255,097	0.051	0.07	0.084 - 0.066	Yes
REDUNIT	414,544	330,004	368,906 - 465,828	0.012	0.015	0.011 - 0.014	Yes

Table B6: Comparison of biomass (B) and fishing mortality (F) rate Mohn's rho values (ρ) by stock between the previous assessment and the 2015 updates. The biomass and fishing mortality rate point estimates and ρ adjusted values (Adj.) are provided for the 2015 update assessments. The total number of stocks using ρ adjusted values in the last assessment and the 2015 assessments (ρ adj. vs. pt. est. for those stocks that did not use the ρ adjustment), along with the type of ρ adjustment used in the 2015 assessment (NAA=numbers at age, SSB=spawning stock biomass applied to all ages), are also provided. Only age-based and length-based stocks that could exhibit retrospective patterns are included in this table. *Note: Because the Georges Bank cod assessment was rejected at the 2015 OA Update it has been excluded from this table.*

		Biomass				**Fishing Mortality Rate**				**Used**		
Stock	Model	ρ_{last}	ρ_{2015}	B_{2015}	Adj.	ρ_{last}	ρ_{2015}	F_{2015}	Adj.	Last assess.	2015	Proj. adj.
CODGM	ASAP(M=0.2)	0.53	0.54	2225	1445	-0.33	-0.31	0.956	1.386	pt. est.	pt. est.	none
CODGM	ASAP(M-ramp)	0.17	0.2	2536	2113	-0.05	-0.08	0.932	1.013	pt. est.	pt. est.	none
HADGM	ASAP	-0.15	-0.04	10325	10755	0.3	0.03	0.257	0.25	pt. est.	pt. est.	none
HADGB	VPA	0.2	0.5	225080	150053	-0.15	-0.34	0.159	0.241	pt. est.	ρ adj.	SSB
YELCCGM	VPA	0.68	0.98	1695	857	-0.19	-0.45	0.35	0.64	ρ adj.	ρ adj.	NAA
YELSNEMA	ASAP	0.14	1.06	502	243	-0.16	-0.53	1.64	3.53	pt. est.	pt. est.	none
FLWGB	VPA	0.26	0.83	5275	2883	-0.16	-0.51	0.379	0.778	pt. est.	ρ adj.	SSB
FLWSNEMA	ASAP	0.35	0.21	6151	5105	-0.31	-0.25	0.16	0.214	pt. est.	pt. est.	none
REDUNIT	ASAP	0.04	0.26	414544	330004	-0.04	-0.19	0.012	0.015	pt. est.	ρ adj.	NAA
PLAUNIT	VPA	0.62	0.32	14439	10915	-0.35	-0.32	0.08	0.12	ρ adj.	ρ adj.	NAA
WITUNIT	VPA	0.61	0.51	3129	2077	-0.33	-0.38	0.428	0.687	pt. est.	ρ adj.	SSB
HKWUNIT	ASAP	0.15	0.18	28553	24197	-0.13	-0.12	0.076	0.086	pt. est.	pt. est.	none
POLUNIT	ASAP	0.29	0.28	198847	154865	-0.25	-0.28	0.051	0.07	pt. est.	ρ adj.	NAA
CATUNIT	SCALE	0.96	0.83	592	324	-0.55	-0.36	0.003	0.005	pt. est.	pt. est.	none

Table B7: Synopsis of status by stock.

Stock	Last Assessment	Status Change?	Overfishing?	Overfished?
CODGM	2014	Same	Yes	Yes
CODGB	2012	More uncertain	Unknown	Yes
HADGM	2012	Same	No	No
HADGB	2014	Same	No	No
YELCCGM	2012	Same	Yes	Yes
YELSNEMA	2012	Worse	Yes	Yes
FLWGB	2014	Worse	Yes	Yes
FLWSNEMA	2011	Same	No	Yes
REDUNIT	2012	Same	No	No
PLAUNIT	2012	Same	No	No
WITUNIT	2012	Same	Yes	Yes
HKWUNIT	2013	Same	No	No
POLUNIT	2014	Same	No	No
CATUNIT	2012	Same	No	Yes
HALUNIT	2012	More uncertain	Unknown	Yes
FLDGMGB	2012	Better	No	Yes
FLDSNEMA	2012	Same	No	No
OPTUNIT	2012	Same	No	Yes
FLWGM	2014	Same	No	Unknown
YELGB	2014	Same	Unknown	Unknown

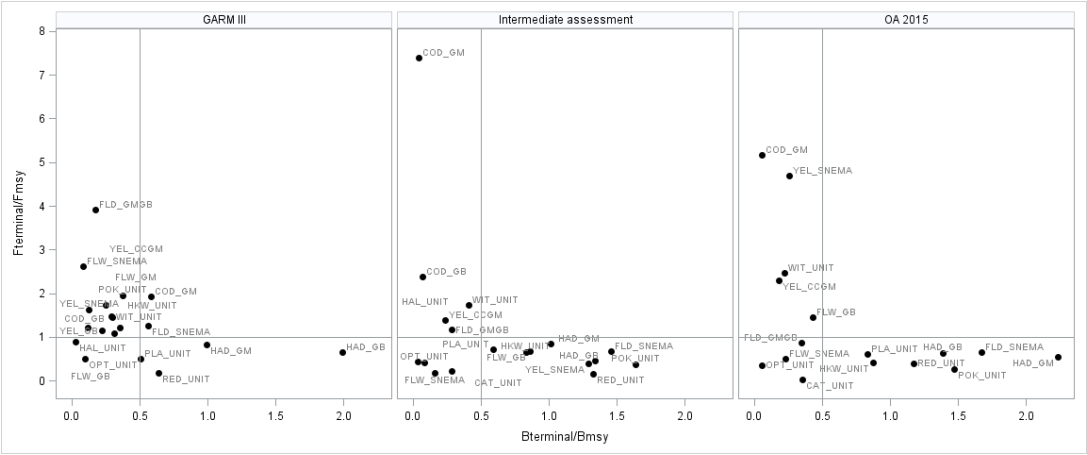

Figure B1: Status of the Northeast Multispecies Fishery Management Plan (groundfish) stocks in 2007 (GARM III) and 2014 (OA 2015) with respect to the F_{MSY} and B_{MSY} proxies. The 'Intermediate assessment' represents the last stock assessment conducted prior to the OA 2015 assessment (year varies by stock). Stocks on which overfishing is occurring are those where the $\frac{F_{terminal}}{F_{MSYproxy}}$ ratio is greater than 1 and overfished stocks are those where the $\frac{B_{terminal}}{B_{MSYproxy}}$ ratio is less than 0.5. *Notes: (1) the GARM III assessments did not include wolfish; (2) for the intermediate assessments stock status could not be determined for Gulf of Maine winter flounder (OA 2014) or Georges Bank yellowtail (TRAC 2015); and, (3) based on the OA 2015 assessments stock status could not be determined for Atlantic halibut, Gulf of Maine winter flounder and Georges Bank yellowtail flounder. In the OA 2015 assessment, the stock status for Georges Bank cod remained overfished and overfishing is occurring; however, since the assessment was rejected, ratios of terminal conditions to reference points cannot be determined. Species codes: COD-Atlantic cod, HAD-haddock, POL-pollock, RED-redfish, WHK-white hake, OPT-ocean pout, CAT-wolffish, PLA-American plaice, FLW-winter flounder, YEL-yellowtail flounder, WIT-witch flounder, FLD-windowpane flounder, HAL-Atlantic halibut.*

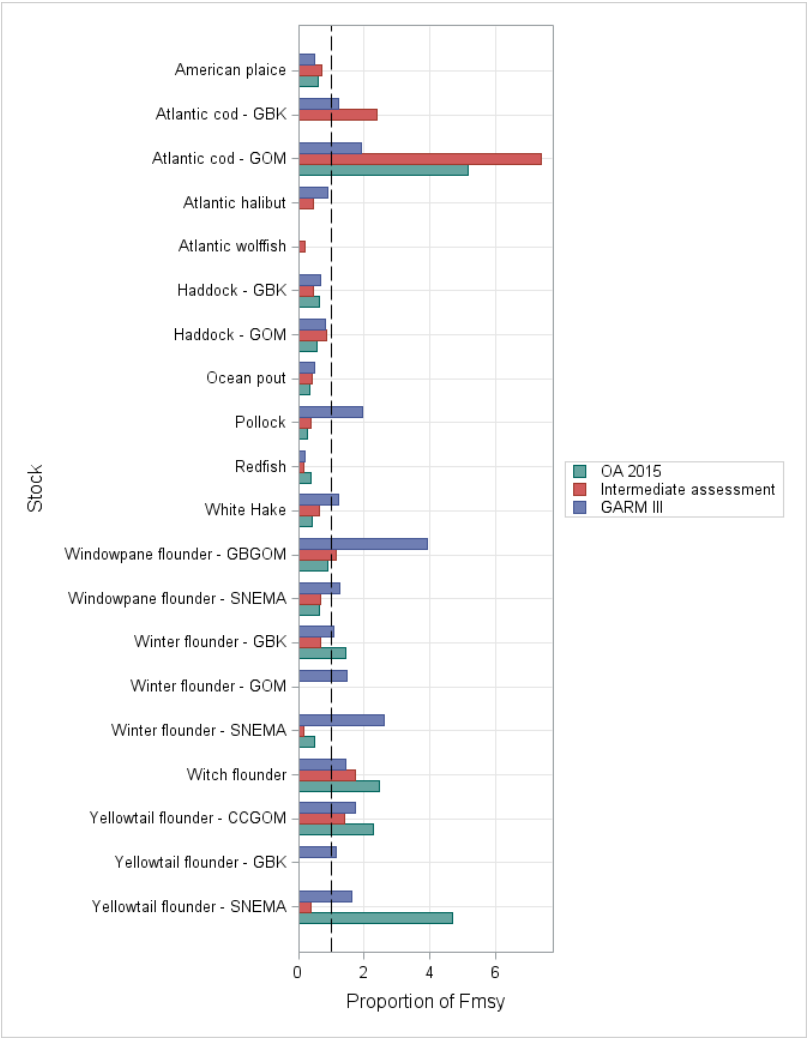

Figure B2: Changes in the ratio of fishing mortality to FMSY proxy from 2007 (GARM III) to 2014 (OA 2015) for the twenty Northeast Multispecies Fishery Management Plan (groundfish) stocks. The results from the assessment prior to the OA 2015 assessment are shown for each stock to provide an 'Intermediate' value. Stocks on which overfishing is occurring are those where the $\frac{F_{terminal}}{F_{MSYproxy}}$ ratio is greater than 1. *Notes: (1) the GARM III assessments did not include wolfish; (2) stock status in the 'Intermediate' assessment could not be determined for Gulf of Maine winter flounder or Georges Bank yellowtail flounder; and, (3) based on the OA 2015 assessments stock status could not be determined for Atlantic halibut, Gulf of Maine winter flounder and Georges Bank yellowtail flounder. In the OA 2015 assessment, the stock status for Georges Bank cod remained overfished and overfishing is occurring; however, since the assessment was rejected, ratios of terminal conditions to reference points cannot be determined.*

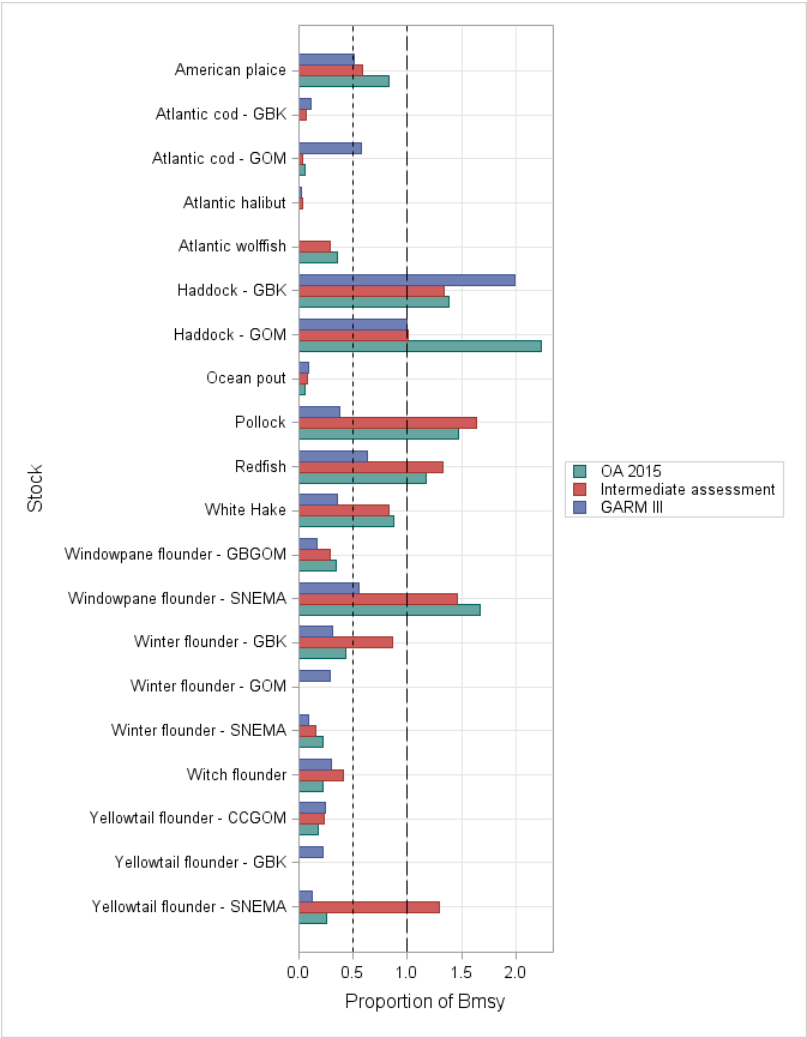

Figure B3: Changes in the ratio of stock biomass to BMSY proxy from 2007 (GARM III) to 2014 (OA 2015) for the twenty Northeast Multispecies Fishery Management Plan (groundfish) stocks. The results from the assessment prior to the OA 2015 assessment are shown for each stock to provide an 'Intermediate' value. Stocks that are overfished stocks are those where the $\frac{B_{terminal}}{B_{MSYproxy}}$ ratio is less than 0.5. *Notes: (1) the GARM III assessments did not include wolfish; (2) stock status in the 'Intermediate' assessment could not be determined for Gulf of Maine winter flounder or Georges Bank yellowtail flounder; and, (3) based on the OA 2015 assessments stock status could not be determined for Atlantic halibut, Gulf of Maine winter flounder and Georges Bank yellowtail flounder. In the OA 2015 assessment, the stock status for Georges Bank cod remained overfished and overfishing is occurring; however, since the assessment was rejected, ratios of terminal conditions to reference points cannot be determined.*

Figure B4: NEFSC spring bottom trawl survey index standardized anomalies (Z-score) for the Northeast Multispecies Fishery Management Plan (groundfish) stocks from 1968 to 2015. *Note that both the Georges Bank/Gulf of Maine and Southern New England/Mid-Atlantic windowpane flounder stocks are not included since the spring survey is uninformative as an index of abundance and not used in the stock assessment.*

Figure B5: NEFSC fall bottom trawl survey index standardized anomalies (Z-score) for the Northeast Multispecies Fishery Management Plan (groundfish) stocks from 1963 to 2014. *Note that ocean pout is not included since the fall survey is uninformative as an index of abundance and not used in the stock assessment.*

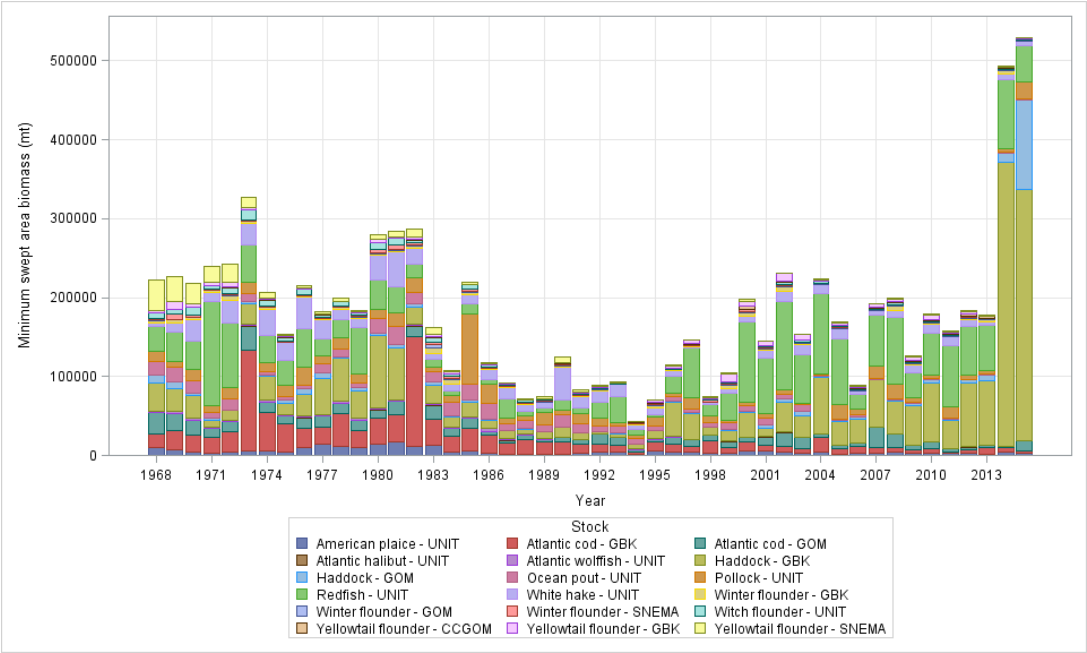

Figure B6: NEFSC spring bottom trawl survey minimum swept area biomass (mt) for the Northeast Multispecies Fishery Management Plan (groundfish) stocks from 1968 to 2015, by stock. Minimum swept area estimates assume a trawl swept area of 0.0112 nm^2) (0.0384 km^2) based on the wing spread of the trawl net. *Note that both the Georges Bank/Gulf of Maine and Southern New England/Mid-Atlantic windowpane flounder stocks are not included since the spring survey is uninformative as an index of abundance and not used in the stock assessment.*

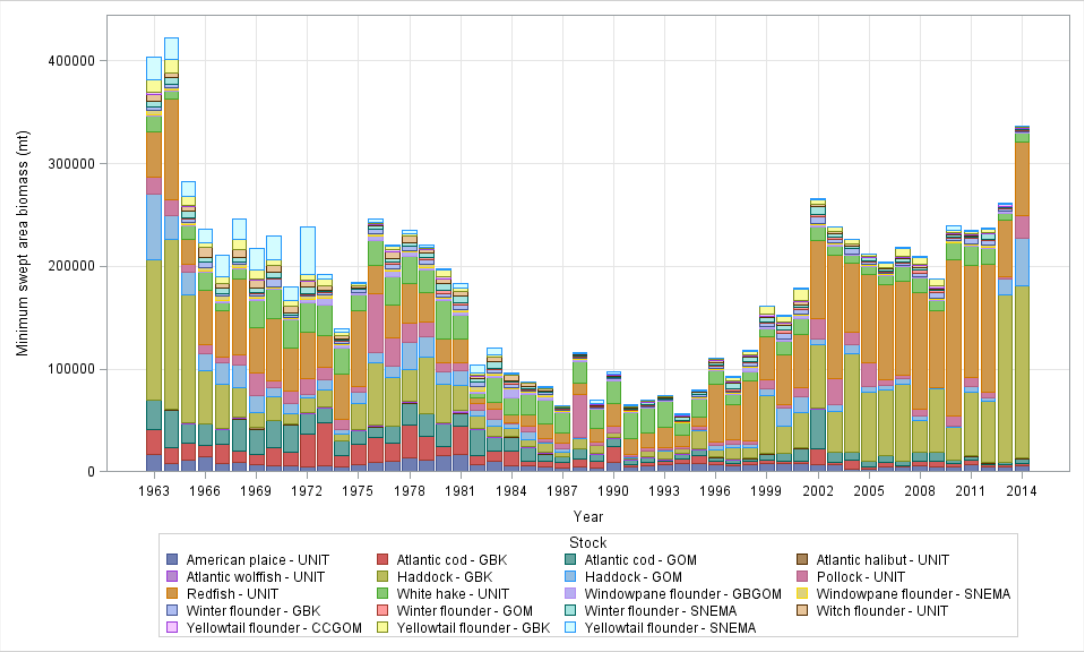

Figure B7: NEFSC fall bottom trawl survey minimum swept area biomass (mt) for for the Northeast Multispecies Fishery Management Plan (groundfish) stocks from 1963 to 2014, by stock. Minimum swept area estimates assume a trawl swept area of 0.0112 nm^2 (0.0384 km^2) based on the wing spread of the trawl net. *Note that ocean pout is not included since the fall survey is uninformative as an index of abundance and not used in the stock assessment.*

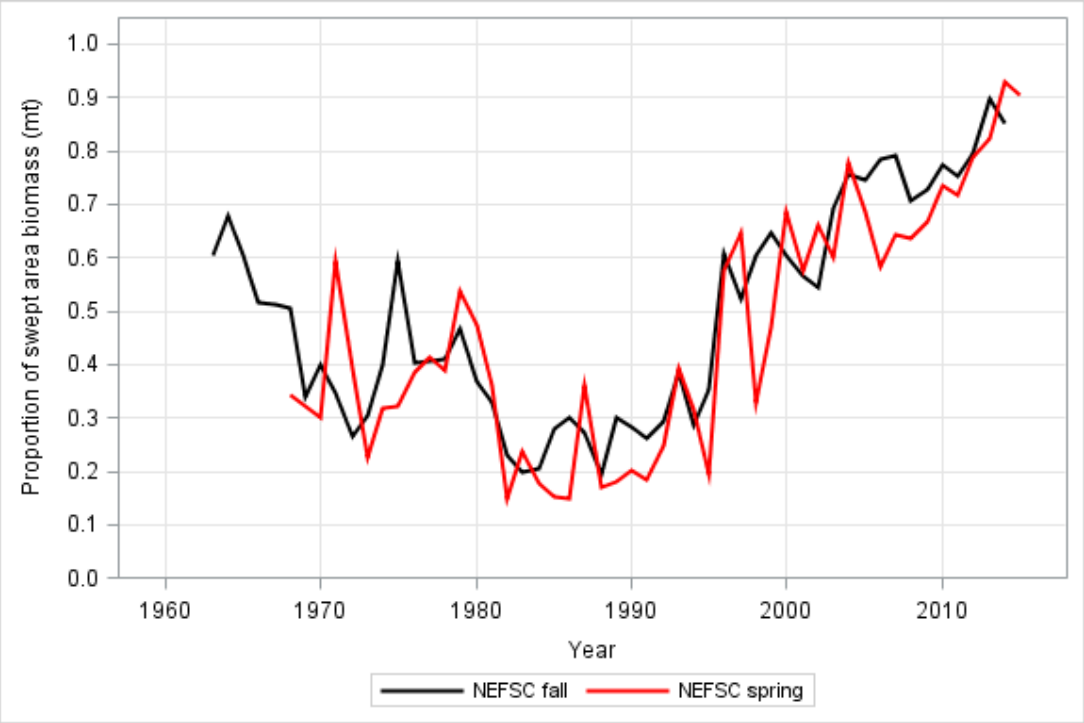

Figure B8: Proportion of the total groundfish swept minimum swept area biomass contributed by Georges Bank and Gulf of Maine haddock and Redfish based on the NEFSC spring and fall bottom trawl surveys.

2 Gulf of Maine Atlantic cod

Michael Palmer

This assessment of the Gulf of Maine Atlantic cod (Gadus morhua) stock is an update of the existing 2014 assessment (Palmer 2014). This assessment updates commercial and recreational fishery catch data, research survey indices of abundance, and the analytical ASAPassessment models through 2014. Additionally, stock projections have been updated through 2018. In what follows, there are two population assessment models brought forward from the most recent benchmark assessment (2012), the M=0.2 (natural mortality = 0.2) and the M-ramp (M ramps from 0.2 to 0.4) assessment models (see NEFSC 2013 for a full description of the model formulations).

State of Stock: Based on this updated assessment, the Gulf of Maine Atlantic cod (*Gadus morhua*) stock is overfished and overfishing is occurring (Figures **??**-**??**). Retrospective adjustments were not made to the model results (see Special Comments section of this report). Spawning stock biomass (SSB) in 2014 was estimated to be 2,225 (mt) under the M=0.2 model and 2,536 (mt) under the M-ramp model scenario (Table **??**) which is 6 and 4% (respectively) of the biomass target, SSB_{MSY} *proxy* (40,187 (mt) and 59,045 (mt); Figure **??**). The 2014 fully selected fishing mortality was estimated to be 0.956 and 0.932 which is 517 and 498% of the F_{MSY} *proxy*($F_{40\%}$; 0.185 and 0.187; Figure **??**).

Table B8: Catch and status table for Gulf of Maine Atlantic cod. All weights are in (mt) recruitment is in (000s) and F_{Full} is the fishing mortality on fully selected ages.

	2007	2008	2009	2010	2011	2012	2013	2014
Data								
Recreational discards	154	153	142	188	164	48	69	85
Recreational landings	1,162	1,240	1,399	1,803	1,813	571	705	528
Commercial discards	178	349	752	171	99	93	52	26
Commercial landings	3,990	5,444	5,953	5,356	4,598	2,759	951	832
Catch for Assessment	5,485	7,186	8,247	7,517	6,673	3,472	1,777	1,471
Model Results (M=0.2)								
Spawning Stock Biomass	8608	9716	10088	8638	5617	2954	2064	2225
F_{Full}	0.716	0.926	1.043	1.073	1.563	1.778	1.334	0.956
Recruits $age1$	4407	3087	2035	1281	1615	2269	1030	2042
Model Results (M-ramp)								
Spawning Stock Biomass	11583	12649	12871	10645	6727	3599	2526	2536
F_{Full}	0.564	0.751	0.859	0.908	1.347	1.528	1.185	0.932
Recruits $age1$	9368	6307	4024	2486	3066	4114	1738	3211

Table B9: Comparison of reference points estimated in an earlier assessment and from the current assessment update. The overfishing threshold is the F_{MSY} *proxy* ($F_{40\%}$). The biomass target, (SSB_{MSY} *proxy*) was based on long-term stochastic projections of fishing at the F_{MSY} *proxy*. Median recruitment reflects the median estimated age-1 recruitment from 1982 - 2012. Intervals shown reflect the 5^{th} and 95^{th} percentiles.

	2014 M=0.2	2014 M-ramp	M=0.2	M-ramp
F_{MSY}	0.18	0.18	0.185	0.187
SSB_{MSY} (mt)	47,184 (32,903 - 67,045)	69,621 (53,349 - 89,302)	40,187 (27,551 - 58,228)	59,045 (44,976 - 76,525)
MSY (mt)	7,753 (5,355 - 11,162)	11,388 (8,624 - 14,750)	6,797 (4,608 - 9,990)	10,043 (7,560 - 13,130)
Median recruits age-1) (000s)	4,665 (1,414 - 14,649)	9,173 (2,682 - 16,262)	4,406 (1,458 - 14,450)	8,965 (2,489 - 15,908)
Overfishing	Yes	Yes	Yes	Yes
Overfished	Yes	Yes	Yes	Yes

Projections: Short term projections of median total fishery yield and spawning stock biomass for Gulf of Maine Atlantic cod were conducted based on a harvest scenario of fishing at the FMSY proxy between 2016 and 2018. Catch in 2015 was estimated at 279 mt. Recruitment was sampled from a cumulative distribution function derived from ASAP estimated age-1 recruitment between 1982 and 2012. The projection recruitment model declines linearly to zero when SSB is below 6.3 kmt under the M=0.2 model and 7.9 kmt under the M-ramp model. The 2015 age-1 recruitment was estimated from the geometric mean of the 2010-2014 ASAP recruitment estimates. No retrospective adjustments were applied in the projections as the retrospective patterns are similar to the 2014 update for which no retrospective adjustments were made; however, the 2015 assessment review panel recommended that that M=0.2 projections with retrospective adjustments be brought forward to the SSC for consideration in the evaluation of uncertainty when setting catch advice (provided in the Supplemental Information Report, SASINF). Assumed weights are based on an average of the most recent three years. For the M-ramp model, projections are shown under two assumptions of short-term natural mortality: M=0.2 and M=0.4.

Table B10: Short term projections of total fishery catch and spawning stock biomass for Gulf of Maine Atlantic cod based on a harvest scenario of fishing at the F_{MSY} *proxy* ($F_{40\%}$) between 2016 and 2018. Catch in 2015 has been estimated at 279 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}	Catch (mt)	SSB (mt)	F_{Full}	Catch (mt)	SSB (mt)	F_{Full}
		M=0.2			*M-ramp(M=0.2)*			*M-ramp(M=0.4)*	
2015	279	3045	0.111	279	3219	0.112	279	3057	0.123
2016	697	4400	0.185	748	4950	0.187	555	3841	0.187
2017	939	5852	0.185	1085	7062	0.187	662	4536	0.187
2018	1211	7601	0.185	1507	9674	0.187	765	5220	0.187

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The largest source of uncertainty is the estimate of natural mortality. Past investigations into changes in natural mortality over time have been inconclusive (NEFSC 2013). Different assumptions about natural mortality affect the scale of the biomass, recruitment, and fishing mortality estimates. Other areas of uncertainty include the retrospective error in the M=0.2 model, residual patterns in the model fits to some of the survey series (e.g., aggregate MADMF spring survey) and stock structure.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lie outside of the approximate joint confidence region for SSB and F_{Full}).

  The M=0.2 model has a major retrospective pattern (7-year Mohn's rho SSB=0.54, F=-0.31) and the M-ramp model has a minor retrospective pattern (7-year Mohn's rho SSB=0.20, F=-0.08). The 7-year Mohn's rho values from the current assessment are similar to those from the 2014 assessment (M=0.2: SSB=0.53, F=-0.33; M-ramp: SSB=0.17, F=-0.05) where the M=0.2 model had a major retrospective pattern and the M-ramp model had a minor pattern. No retrospective adjustment have been to the terminal model results or in the base catch projections following the recommendations of the SARC 55 and 2014 assessment review panels. The 2015 assessment review panel supported this decision noting that the most recent retrospective 'peel' suggested that an adjustment using the 7-year average may not be appropriate. However, the 2015 review panel highlighted the retrospective error in the M=0.2 model as a source of uncertainty - it should be noted that the retrospective error of the most recent peel is larger for the M-ramp model. Should the retrospective patterns continue then the models may have overestimated spawning stock size and underestimated fishing mortality.

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for Gulf of Maine Atlantic cod are reasonably well determined and projected boimass from the last assessment was within the confidence bounds of the biomass estimated in the current assessment.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  This update included several minor changes to model input data including: (1) re-estimation of recreational catch from 2004-2014 to account for recent updates to the MRIP data; (2) a revised assumption on recreational discard mortality from 30% to 15% following a Capizzano et al. 2015 study (unpublished); and (3) re-estimation of 2009-2014 NEFSC spring and fall survey time series using the TOGA station acceptance criterion. Additionally, the ASAP assessment model was run with the likelihood constants option turned off. All of these changes had minimal impacts on model results - summaries of the impacts of these changes are provided in the Supplemental Information Report (SASINF).

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  There has been no change in stock status since the 2014 udpate assessment.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  The Gulf of Maine Atlantic cod assessment could be improved with additional studies on natural mortality and stock structure. Additionally, future assessments should consider possible changes in recent fishery selectivity patterns and exlore alternative methods for estimating recruitment. Potential causes of low stock productivity (i.e., low recruitment) should also be investigated.

- Are there other important issues?

  When setting catch advice careful attention should be given to the retrospective error present in both models, particularly given the poor performance of previous stock projections. Additionally, it is unclear as to which level of natural mortality (M=0.2 or 0.4) to assume for the short-term projections under the M-ramp model.

2.1 Reviewer Comments: Gulf of Maine Atlantic cod

The GOM Cod assessment was awesome.
Reviewer 1

The GOM Cod assessment was amazing.
Reviewer 2

The GOM Cod assessment was pretty good.
Reviewer 3

References:

Northeast Fisheries Science Center. 2013. 55^{th} Northeast Regional Stock Assessment Workshop (55^{th} SAW) Assessment Summary Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 13-01; 41 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026

Palmer MC. 2014. 2014 Assessment update report of the Gulf of Maine Atlantic cod stock. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 14-14; 119 p. Available from: National Marine Fisheries Service,166 Water Street, Woods Hole, MA 02543-1026

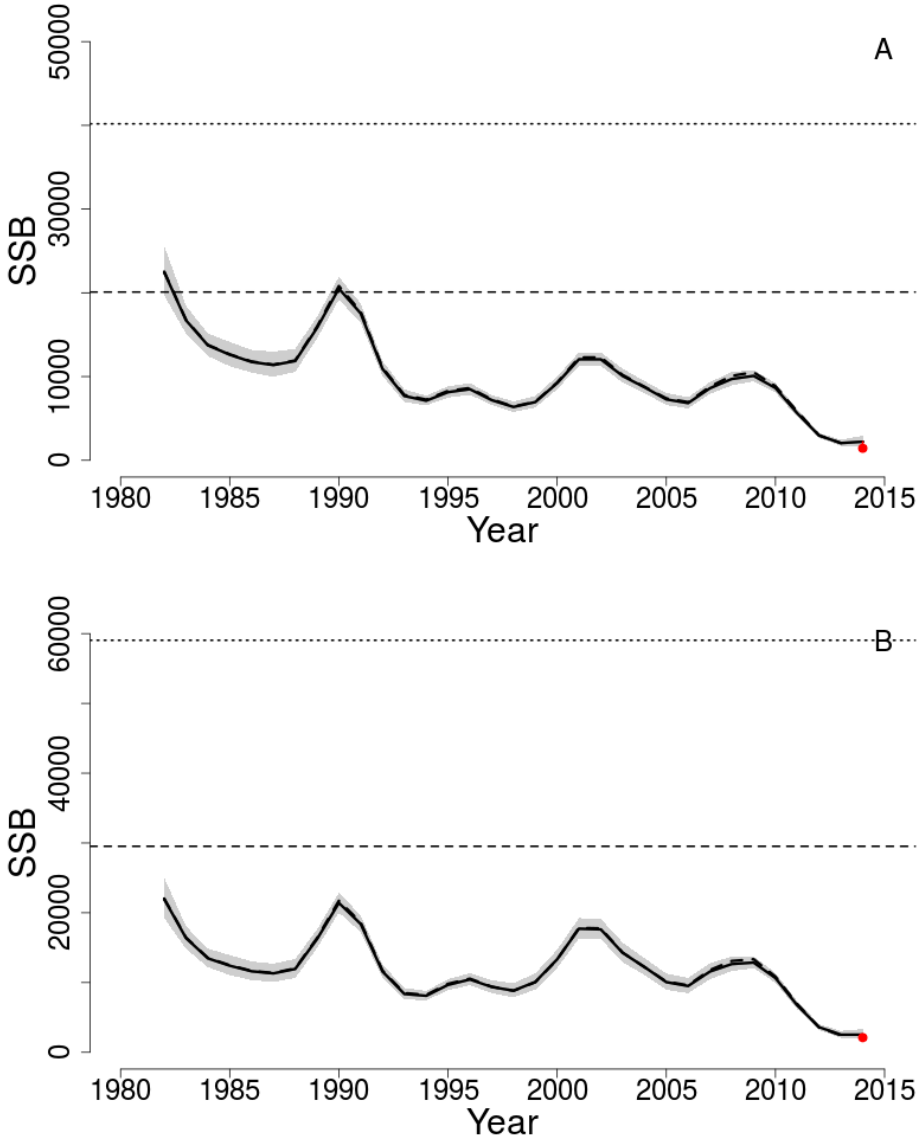

Figure B9: Estimated trends in the spawning stock biomass (SSB) of Gulf of Maine Atlantic cod between 1982 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY}; horizontal dashed line) as well as SSB_{Target} SSB_{MSY}; horizontal dotted line) based on the 2015 M=0.2 (A) and M-ramp (B) assessment models. The 90% lognormal confidence intervals are shown. The red dot indicates the rho-adjusted SSB values that would have resulted had a retrospective adjusment been made to either model (see Special Comments section).

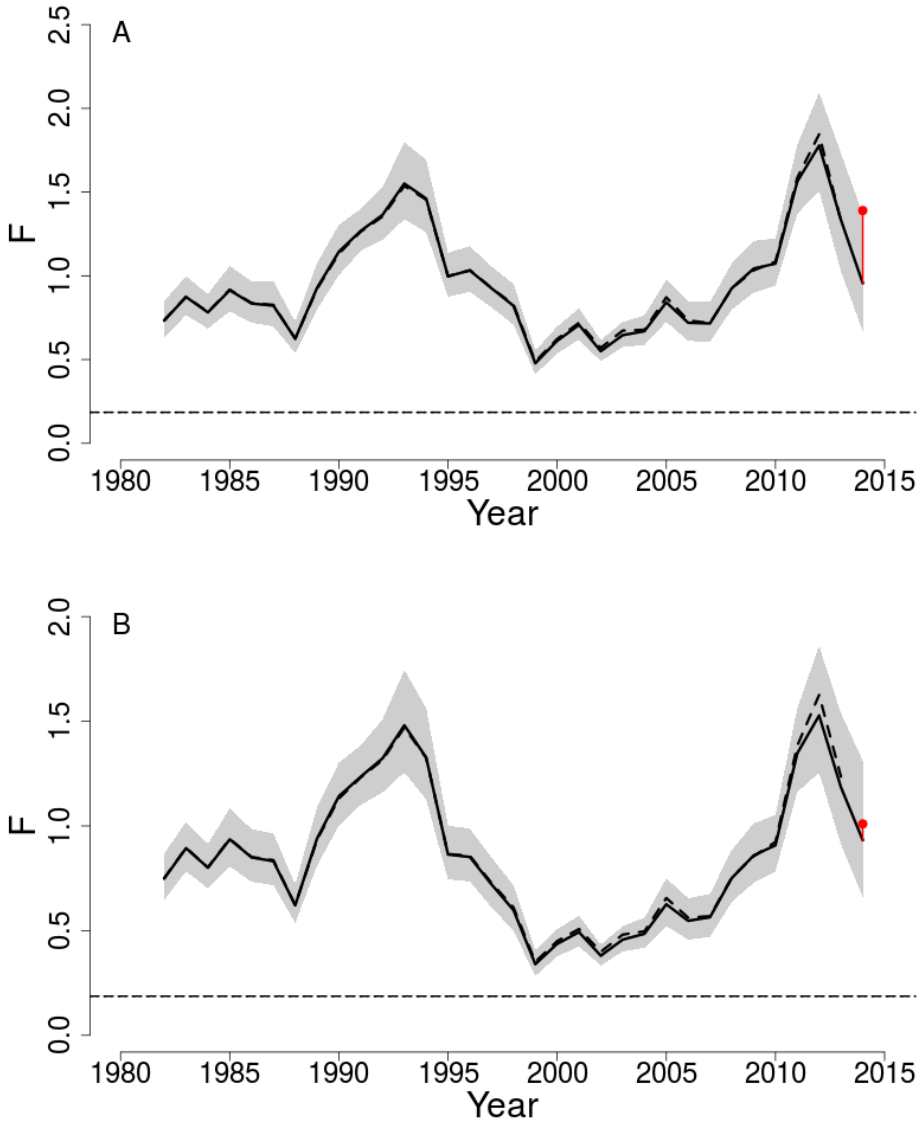

Figure B10: Estimated trends in the fully selected fishing mortality (F) of Gulf of Maine Atlantic cod between 1982 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (0.185 (M=0.2), 0.187 (M-ramp); dashed line) based on the 2015 M=0.2 (A) and M-ramp (B) assessment models. The 90% lognormal confidence intervals are shown. The red dot indicates the rho-adjusted F values that would have resulted had a retrospective adjusment been made to either model (see Special Comments section).

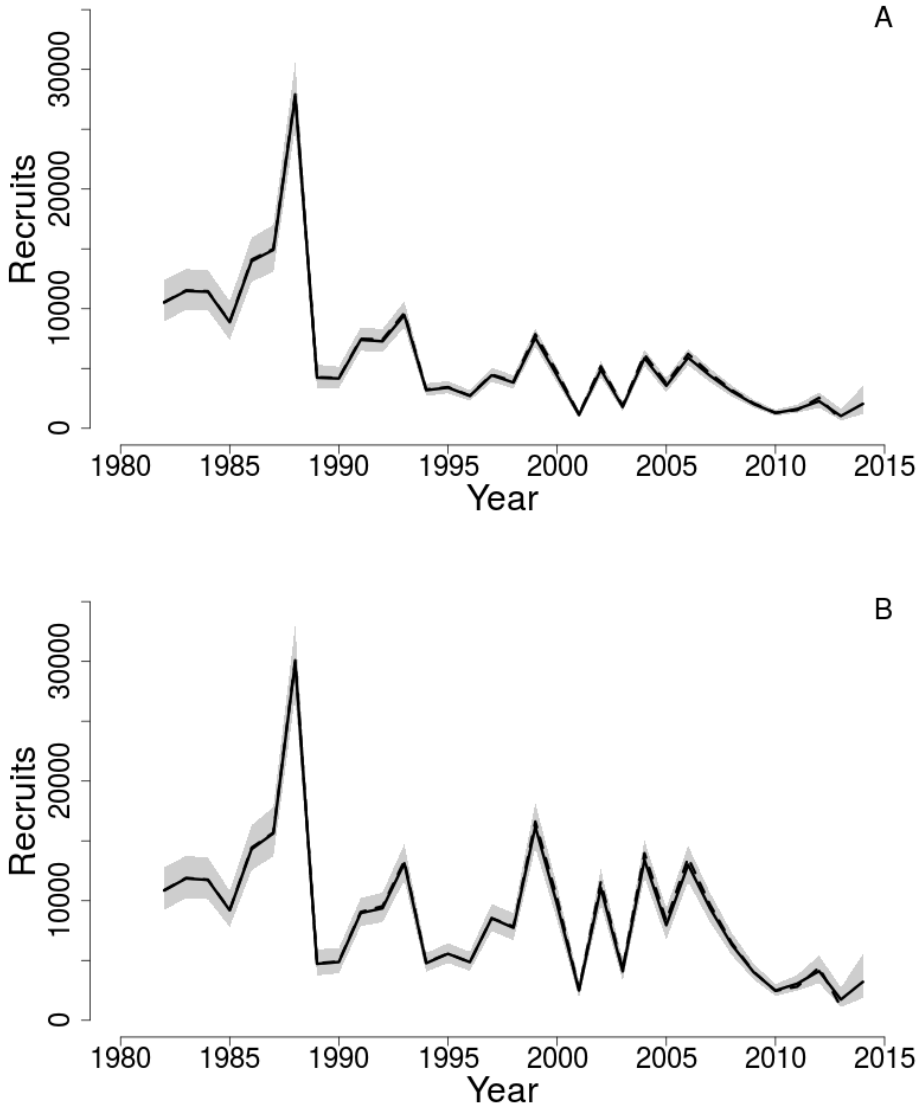

Figure B11: Estimated trends in age-1 recruitment (000s) of Gulf of Maine Atlantic cod between 1982 and 2014 from the current (solid line) and previous (dashed line) M=0.2 (A) and M-ramp (B) assessment models. The 90% lognormal confidence intervals are shown.

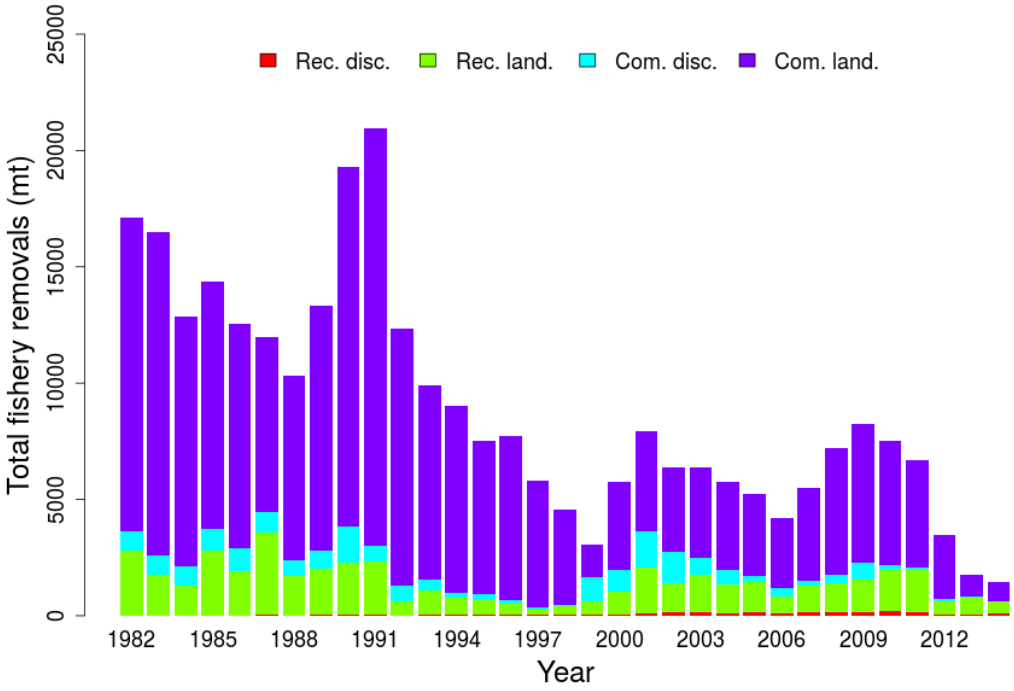

Figure B12: Total catch of Gulf of Maine Atlantic cod between 1982 and 2014 by fleet (commercial and recreational) and disposition (landings and discards).

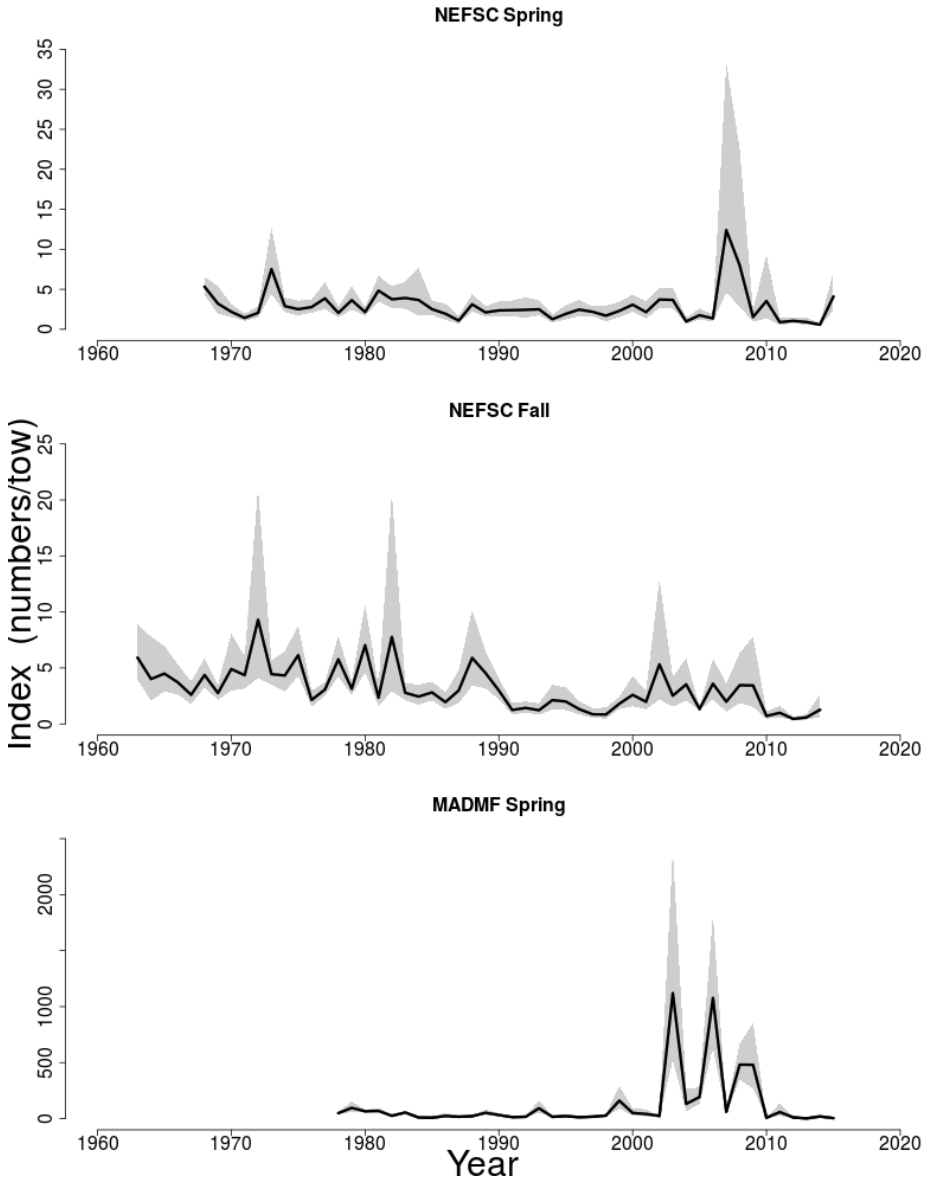

Figure B13: Indices of biomass for the Gulf of Maine Atlantic cod between 1963 and 2015 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys and Massachusetts Division of Marine Fisheries (MADMF) spring bottom trawl survey. The 90% lognormal confidence intervals are shown.

3 Georges Bank Atlantic Cod

Loretta O'Brien

This assessment of the Georges Bank Atlantic Cod (Gadus morhua) stock is an operational update of the existing 2012 benchmark assessment (NEFSC 2013). Based on the previous assessment the stock was overfished, and overfishing was ocurring. This 2015 assessment updates commercial fishery catch data, research survey indices of abundance, the analytical ASAP assessment model, and reference points through 2014. Additionally, stock projections have been updated through 2018.

State of Stock: Based on this updated assessment, the Georges Bank Atlantic Cod (*Gadus morhua*) stock is overfished and overfishing is occurring (Figures **??**-**??**). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2014 was estimated to be 1,804 (mt) which is 1% of the biomass target for this stock (SSB_{MSY} *proxy* = 201,152; Figure **??**). The 2014 fully selected fishing mortality was estimated to be 1.68 which is 994% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.169; Figure **??**).

Table B11: Catch and model results for Georges Bank Atlantic Cod. All weights are in (mt), recruitment is in (000s), and F_{Full} is the fishing mortality on fully selected ages (ages 5-8). Model results are from the current updated ASAP assessment.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
					Data					
Commercial landings	2,754	2,700	3,699	3,255	2,999	2,688	3,387	2,007	1,312	1,514
Commercial discards	394	232	728	309	385	253	122	120	83	19
Recreational landings	966	59	11	69	48	153	177	56	6	88
Recreational discards	101	4	3	1	5	23	17	1	1	2
CA landings	630	1,097	1,107	1,390	1,003	748	702	395	384	430
CA discards	226	350	117	140	206	94	43	75	39	28
Catch for Assessment	5,072	4,441	5,665	5,164	4,646	3,959	4,449	2,653	1,824	2,081
					Model Results					
Spawning Stock Biomass	9,438	9,362	9,202	7,978	7,672	6,108	5,231	4,066	5,202	6,180
F_{Full}	0.703	0.583	0.825	0.903	0.898	0.916	1.33	1	0.483	0.463
Recruits $age1$	1,298	2,935	3,412	2,214	2,405	1,908	3,248	2,107	929	1,151

Table B12: Comparison of reference points estimated in the previous assessment and from the current assessment update. An $F_{40\%}$ proxy was used for the overfishing threshold and was based on long-term stochastic projections.

	2012	Current
F_{MSY} *proxy*	0.177	0.169
SSB_{MSY} (mt)	186,535	201,152 (157,963 - 247,517)
MSY (mt)	30,622	30,569 (23,910 - 37,712)
Median recruits (age 1) (000s)	8,765	7,118
Overfishing	Yes	Yes
Overfished	Yes	Yes

Projections: Short term projections of biomass were derived by sampling from a two-stage cumulative distribution function of recruitment estimates from ASAP model results, using a 50,000 mt cutpoint. The annual fishery selectivity, maturity ogive, and mean weights at age used in projections are the most recent 5 year averages; retrospective adjustments were applied in the projections.

Table B13: Short term projections of total fishery catch and spawning stock biomass for Georges Bank Atlantic Cod based on a harvest scenario of fishing at F_{MSY} *proxy* between 2016 and 2018. Catch in 2015 was assumed to be 1,784 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	1,784	1,552 (539 - 3,192)	1.510
2016	135	932 (152 - 2,508)	0.169
2017	263	2,134 (787 - 6,250)	0.169
2018	799	7,001 (3,054 - 24,931)	0.169

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The major source of uncertainty is presumbaly the estimate of catch or of natural mortality, considering the magnitude of the retrospective bias. These both affect the scale of the biomass, fishing mortality estimates, and the reference point estimates. The catch estimates do not include all discards (e.g.,lobster gear) and includes uncertain estimates of recreational landings and discards, and of some commercial discards (e.g., small mesh). Natural mortality (M) of Georges Bank Atlantic Cod is not well understood and is assumed constant over time in the model. Other sources of uncertainty include possible changes in growth parameters in recent years and how this affects fecundity, the viability of eggs/sperm, and the success rate of hatching - all influencing recruitment survival and year class strength.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Figure **??**).

  The 7-year Mohn's ρ, relative to SSB, was 0.68 in the 2012 assessment and was 2.43 in 2014. The 7-year Mohn's ρ, relative to F, was -0.46 in the 2012 assessment and was -0.72 in 2014. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2014 SSB (SSB_{ρ}=1,804) and 2014 F (F_{ρ}=1.68) were outside the approximate 90% confidence regions around SSB (3,922 - 10,596) and F (0.251 - 0.815). A retrospective adjustment was made for both the determination of stock status and for projections of catch in 2016. The retrospective adjustment changed the 2014 SSB from 6,180 to 1,804 and the 2014 F_{Full} from 0.463 to 1.68.

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for Georges Bank Atlantic Cod are uncertain and likely optimistic. The projections are based on a biomass cutpoint of 50,000 mt, which has not been produced since 1992. The average recruitment since 1992 has been 4.9 million age 1 fish, whereas during the last 10 years, average recruitment has been about 2.7 million age 1 fish. A sensistivity projection using the most recent 10 years of recruitment was conducted and results presented in the SASINF database.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the effect these changes had on the assessment and stock status.

  No major changes, other than the addition of recent years of data, were made to the Georges Bank Atlantic Cod assessment for this update. However, recreational catch and commercial discard estimates were revised slightly due to minor changes in the databases, and the application of length frequencies (annual instead of half year) in one instance.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  As in recent assessments for Georges Bank Atlantic Cod the stock remains in an overfishing and overfished status.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  The Georges Bank Atlantic Cod assessment could be improved with additional studies on natural mortality, growth, and fecundity. Additionally, more precise estimates of recreational landings and discards, sampling of fish caught by individual recreational anglers, and incorporation of discards in the lobster fishery would decrease uncertainty in the discard esimates.

- Are there other important issues?

  The differences in model assumptions of natural mortality between the SARC GB cod and the TRAC eGB cod assessment is problematic for the recovery of the entire GB cod stock. Model results of the TRAC VPA M=0.8 model are used to determine quota for the eGB management unit, so by default, proportionally more cod are being removed from eastern GB than what the GB cod ASAP model would predict.

3.1 Reviewer Comments: Georges Bank Atlantic Cod

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Northeast Fisheries Science Center. 2013. 55^{th} Northeast Regional Stock AssessmentWorkshop (55^{th} SAW) Assessment Summary Report. Northeast Fisheries Science CenterReference Document 13-01:43.

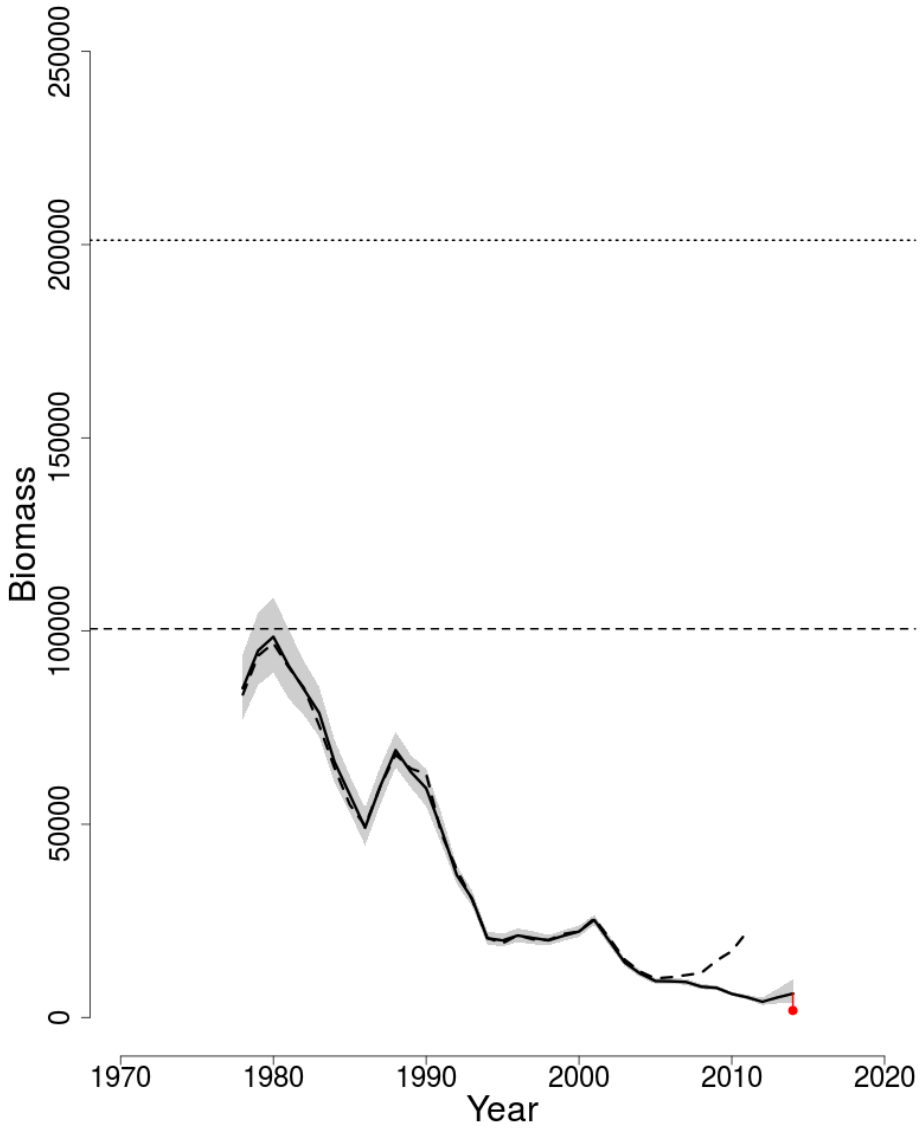

Figure B14: Trends in spawning stock biomass of Georges Bank Atlantic Cod between 1978 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2015 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% lognormal confidence intervals are shown.

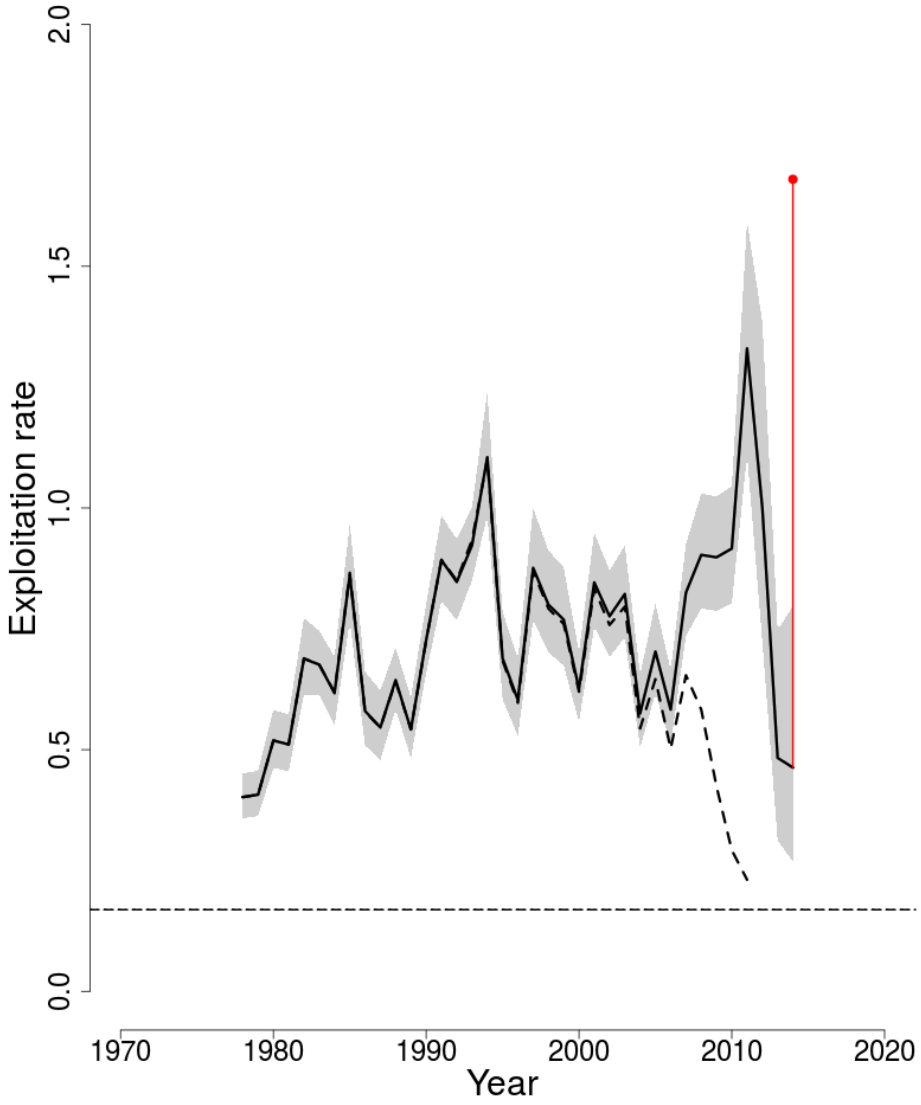

Figure B15: Trends in the fully selected fishing mortality (F_{Full}) of Georges Bank Atlantic Cod between 1978 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.169; horizontal dashed line). F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red, based on the 2015 assessment. The approximate 90% lognormal confidence intervals are shown.

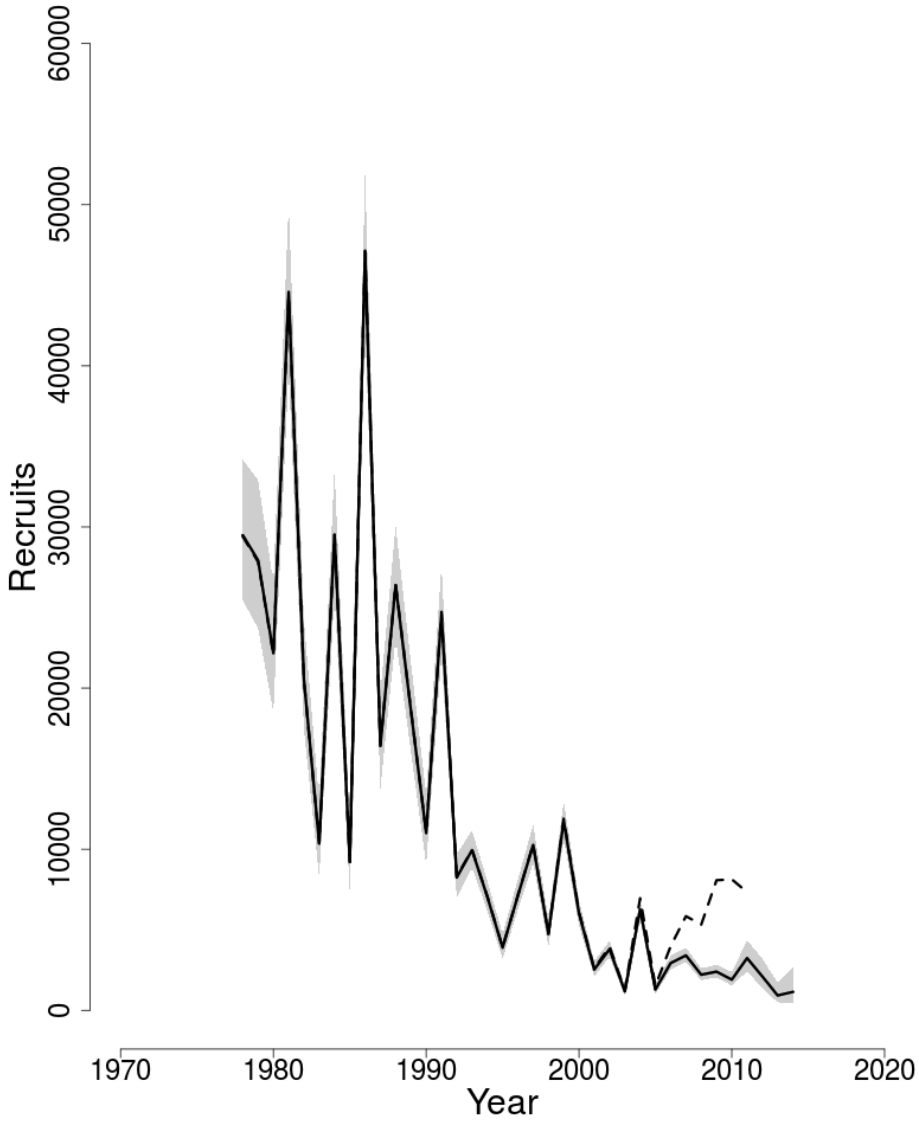

Figure B16: Trends in Recruits (age 1) (000s) of Georges Bank Atlantic Cod between 1978 and 2014 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

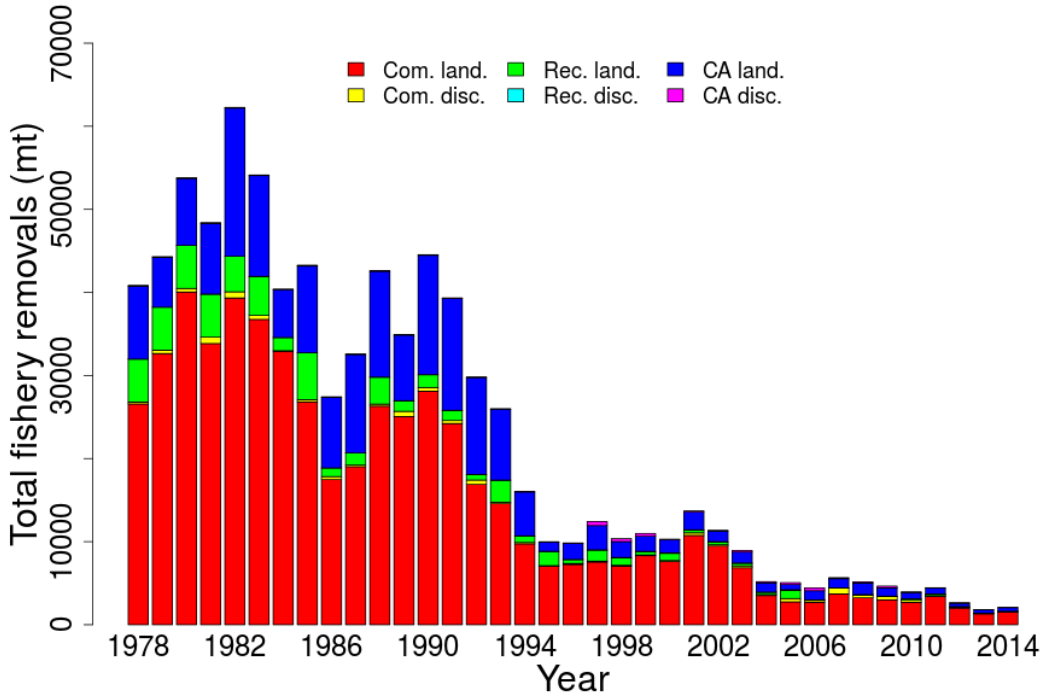

Figure B17: Total catch of Georges Bank Atlantic Cod between 1978 and 2014 by fleet (US commercial, US recreational, or Canadian) and disposition (landings and discards).

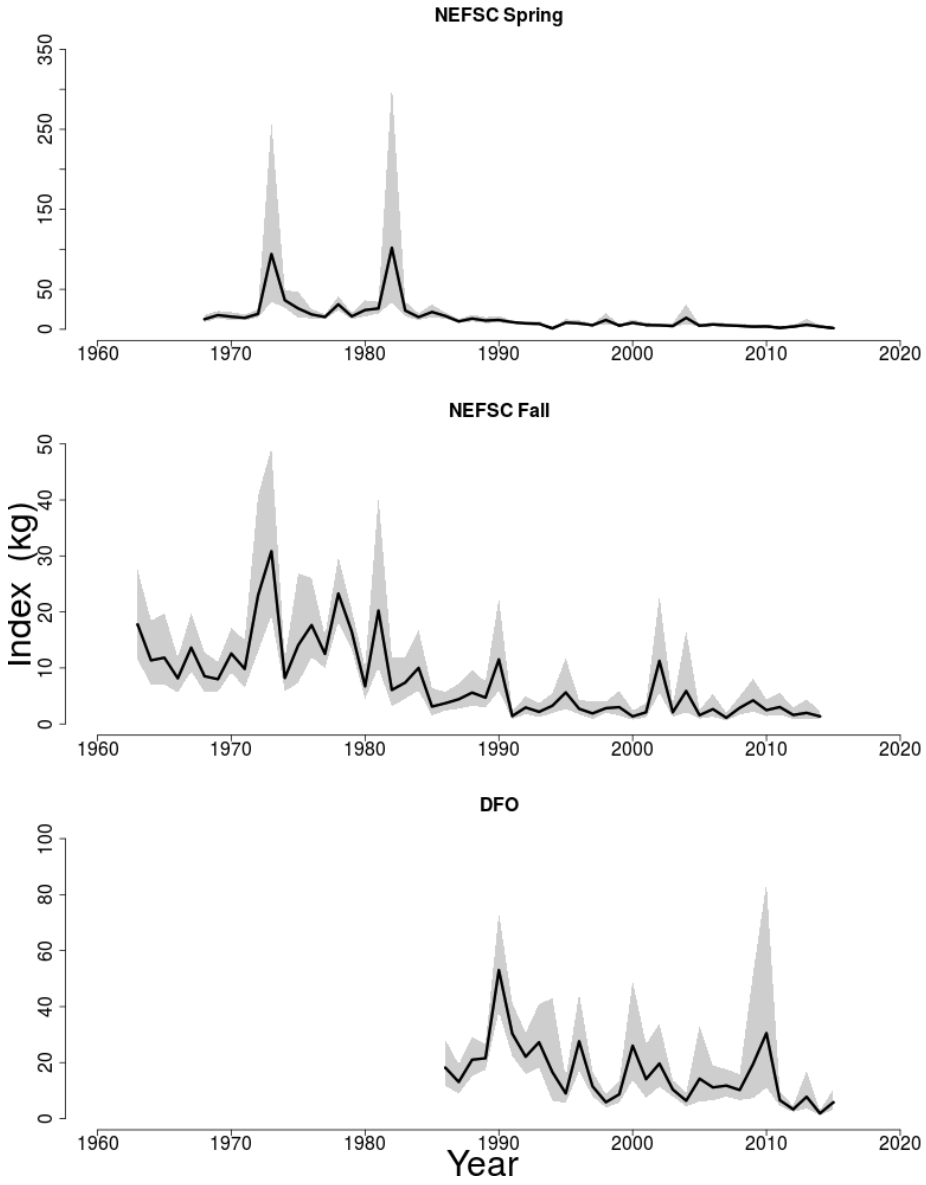

Figure B18: Indices of biomass for the Georges Bank Atlantic Cod between 1963 and 2015 for the Northeast Fisheries Science Center (NEFSC) spring and fall, and the DFO research bottom trawl surveys. The approximate 90% lognormal confidence intervals are shown.

4 Georges Bank haddock

Liz Brooks

This assessment of the Georges Bank haddock (Melanogrammus aeglefinus) stock is an operational update of the existing 2012 update VPA assessment (Brooks et al., 2012). The last benchmark for this stock was in 2008 (Brooks et al., 2008). Based on the previous assessment in 2012, the stock was not overfished, and overfishing was not ocurring. This assessment updates commercial fishery catch data, research survey indices of abundance, weights and maturity at age, and the analytical VPA assessment model and reference points through 2014. Additionally, stock projections have been updated through 2018.

State of Stock: Based on this updated assessment, the Georges Bank haddock (*Melanogrammus aeglefinus*) stock is not overfished and overfishing is not occurring (Figures **??**-**??**). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2014 was estimated to be 150,053 (mt) which is 139% of the biomass target (SSB_{MSY} *proxy* = 108,300; Figure **??**). The 2014 fully selected fishing mortality was estimated to be 0.241 which is 62% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.39; Figure **??**).

Table B14: Catch and status table for Georges Bank haddock. All weights are in (mt), recruitment is in (000s), and F_{Full} is the average fishing mortality on ages 5 to 7. Model results are from the current updated VPA assessment. A rho adjustment was not applied to values in this Table.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
					Data					
US Commercial discards	727	1,360	1,968	389	196	144	212	321	538	1,409
US Commercial landings	21,087	14,629	14,837	20,632	22,930	25,759	5,210	1,550	1,659	4,240
Canadian Catch	12,051	11,951	10	0	0	0	11,248	5,064	4,631	12,953
Catch for Assessment	21,814	15,989	16,815	21,021	23,126	25,903	16,670	6,935	6,828	18,601
					Model Results					
Spawning Stock Biomass	102,539	168,119	182,528	166,726	140,278	103,889	71,076	65,848	162,078	225,080
F_{Full}	0.384	0.322	0.241	0.183	0.195	0.308	0.266	0.258	0.16	0.159
Recruits $age1$	6,634	15,437	5,826	6,488	3,574	7,696	399,497	70,916	29,655	3,406,466

Table B15: Comparison of reference points estimated in an earlier assessment and from the current assessment update. An $F_{40\%}$ proxy was used for the overfishing threshold. The medians and 90% probability intervals are reported for MSY, SSBMSY, and RMSY, based on long-term stochastic projections with fishing mortality fixed at $F_{40\%}$.

	2012	Current
F_{MSY} *proxy*	0.39	0.39
SSB_{MSY} (mt)	124,900	108,300 (58,200 - 167,900)
MSY (mt)	28,000	24,900 (13,600 - 38,400)
Median recruits (age 1) (000s)	54,200	53,400 (3,500 - 130,000
Overfishing	No	No
Overfished	No	No

Projections: Short term projections of biomass were derived by sampling from a cumulative distribution function of recruitment estimates from ADAPT VPA (corresponding to SSB>75,000 mt and dropping the extremely large 1963, 2003, and 2010 year classes, as well as the two final year class estimates for 2013 and 2014). The annual fishery selectivity, maturity ogive, and mean weights at age used in this projection are the most recent 5 year averages; retrospective adjustments were applied to the starting numbers at age (2015) in the projections.

Table B16: Short term projections of total fishery catch and spawning stock biomass for Georges Bank haddock based on a harvest scenario of fishing at F_{MSY} *proxy* between 2016 and 2018. Catch in 2015 was assumed to be 20,686 mt.

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	20,686	450,644 (295,863 - 677,103)	0.100 (0.073 - 0.139)
2016	160,385 (98,994 - 255,087)	1,171,481 (636,247 - 1,997,691)	0.390
2017	242,187 (132,381 - 414,260)	1,226,513 (655,530 - 2,109,738)	0.390
2018	293,033 (155,255 - 506,597)	962,959 (525,327 - 1,647,905)	0.390

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The largest source of uncertainty is the estimate of 2013 recruitment, which accounts for a substantial portion of catch and SSB in projections. The rho adjusted projections reduce all starting numbers at age to 67% of unadjusted values (i.e., all 2015 numbers at age are multiplied by 0.667). Two other exceptionally large year classes were observed in 2003 and 2010. The 2003 year class is now estimated to be only 28% of its initial model estimate, while the 2010 year class is now estimated to be 63% of it's initial estimate. Given that only 5 years of data are available to estimate the 2010 year class, it is possible that there may be further revisions to the magnitude of this year class estimate with more years of data. Therefore, it remains uncertain if the scalar applied to all age classes in these projections (0.667, based on Mohn's rho for SSB) is sufficient to account for future revisions to the 2013

year class estimate. In addition, the median recruitment in the projections (the proxy for recruitment at MSY) is 53.4 million, which is greater than 7 of the last 10 recruitments even though SSB is above the SSBMSY proxy (Table 1). While projections of catch and SSB in the near-term are mostly driven by the 2013 year class, it is worth noting the magnitude of median projected recruitment relative to recent recruitment observations.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}).

  The 7-year Mohn's ρ, relative to SSB, was 0.20 in the 2012 assessment and was 0.50 in 2014. The 7-year Mohn's ρ, relative to F, was -0.15 in the 2012 assessment and was -0.34 in 2014. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2014 SSB (SSB_{ρ}=150,053) and 2014 F (F_{ρ}=0.241) were outside the approximate 90% confidence regions around SSB (171,911 - 301,282) and F (0.13 - 0.203). A retrospective adjustment was made for both the determination of stock status and for projections of catch in 2016. The retrospective adjustment changed the 2014 SSB from 225,080 to 150,053 and the 2014 F_{Full} from 0.159 to 0.241.

- Based on this stock assessment, are population projections well determined or uncertain?

  As noted in (1) above, population projections for Georges Bank haddock are uncertain due to uncertainty about the size of the 2013 year class. Two sensitivity projections were conducted. The first sensitivity used biological parameters and fishery selectivity values from the 2010 year class for the 2013 year class. A second sensitivity projection was made that used the same biological and selectivity parameters as the first sensitivity, and in addition it doubled the rho-adjustment on the 2013 year class (age 2 at the start of 2015) by multiplying it by 0.33. These sensitivity runs are available on the Stock Assessment Supplementary Information website (SASINF), in the sensitivity slides appended to the end of the background presentation.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  No changes, other than the incorporation of new data were made to the Georges Bank haddock assessment for this update. However, the criterion for determining acceptable tows on NEFSC surveys used the TOGA protocol rather than the SHG protocol (TOGA=132x).

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The stock status of Georges Bank haddock has not changed.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  Projection advice and reference points for Georges Bank haddock are strongly dependent on recruitment. A decade ago, extremely large year classes were considered anomalies (e.g., 1963 and 2003). However, since 2003, there have been two more extremely large (2010 and 2013) and one very large (2012) year classes. Future work could focus on recruitment forecasting and providing robust catch advice.

- Are there other important issues?

  The Georges Bank haddock assessment has recently developed a major retrospective

pattern. This stock assessment has historically performed very consistently. This should continue to be monitored. Density-dependent responses in growth should also continue to be monitored. The switch from SHG to TOGA was ruled out as the cause of the retrospective pattern.

4.1 Reviewer Comments: Georges Bank haddock

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Brooks, E.N, M.L. Traver, S.J. Sutherland, L. Van Eeckhaute, and L. Col. 2008. In. Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3^{rd} Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii. http://www.nefsc.noaa.gov/publications/crd/crd0815/

Brooks, E.N, S.J. Sutherland, L. Van Eeckhaute, and M. Palmer. 2012. In. Northeast Fisheries Science Center. 2012. Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dept Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 12-06.; 789 p. http://nefsc.noaa.gov/publications/crd/crd1206/

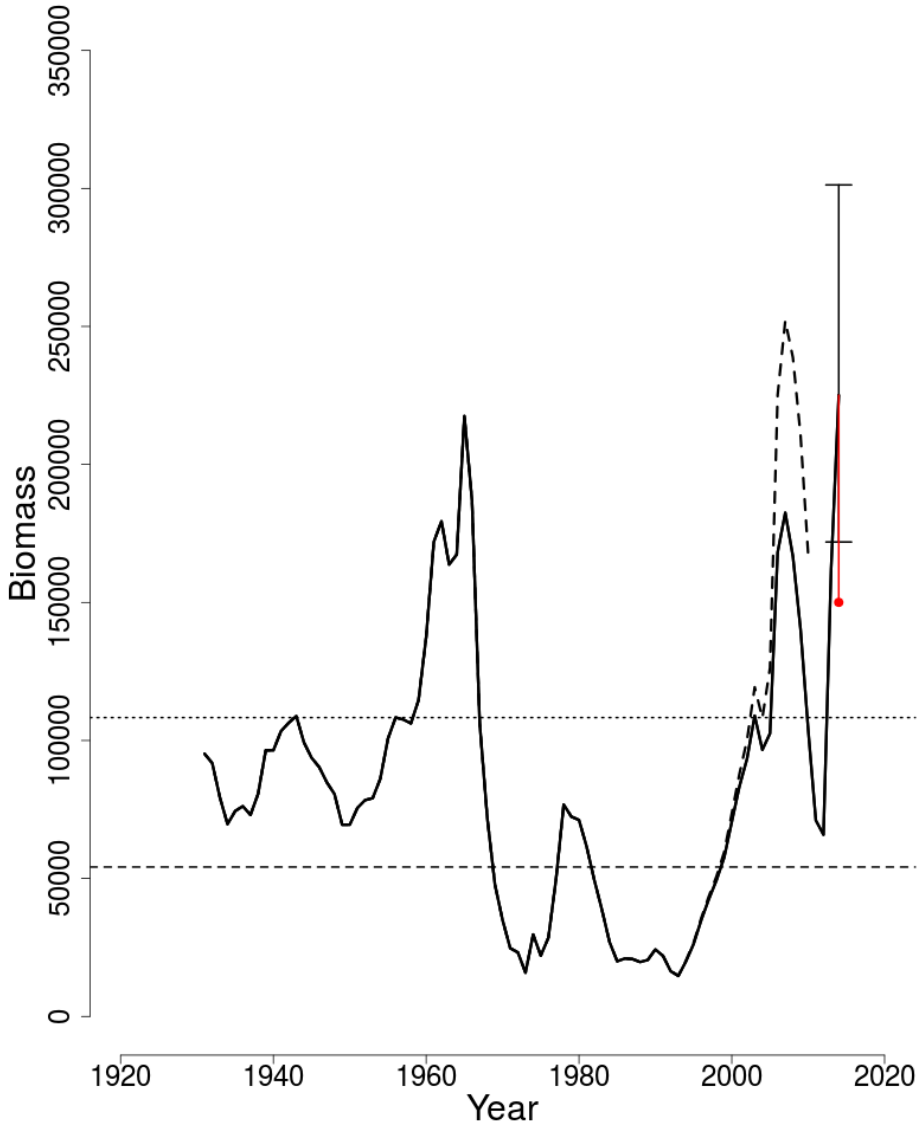

Figure B19: Trends in spawning stock biomass of Georges Bank haddock between 1931 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2015 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The 90% bootstrap probability intervals are shown.

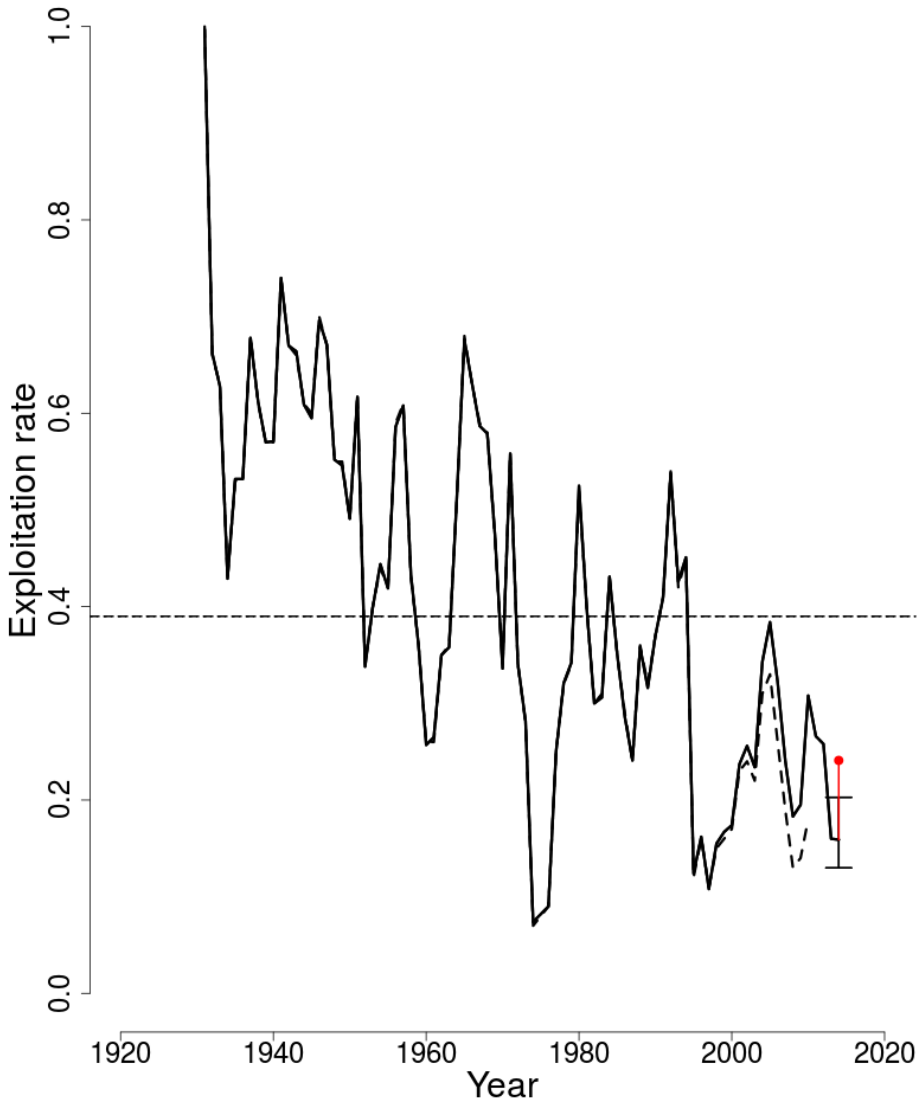

Figure B20: Trends in the fully selected fishing mortality (F_{Full}) of Georges Bank haddock between 1931 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.39; horizontal dashed line) based on the 2015 assessment. F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red. The 90% bootstrap probability intervals are shown.

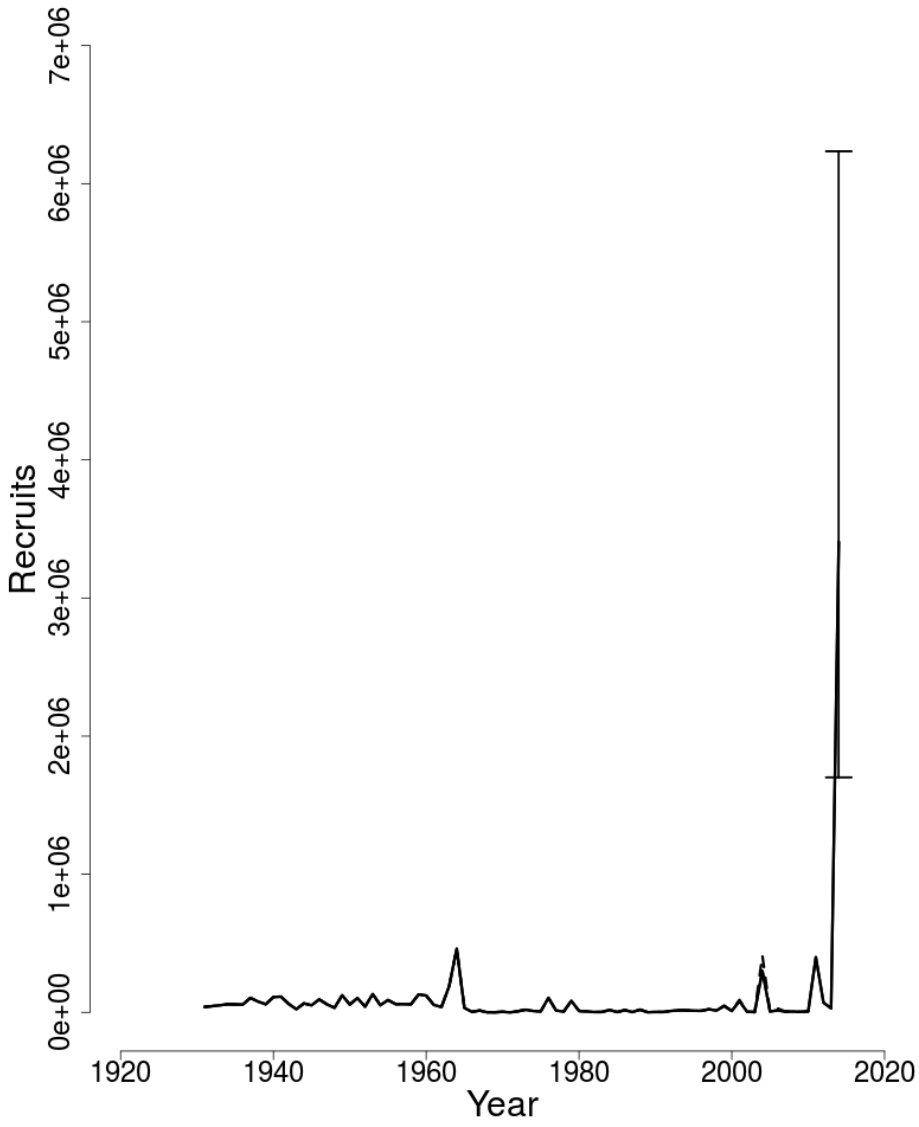

Figure B21: Trends in Recruits (age 1) (000s) of Georges Bank haddock between 1931 and 2014 from the current (solid line) and previous (dashed line) assessment. The 90% bootstrap probability intervals are shown.

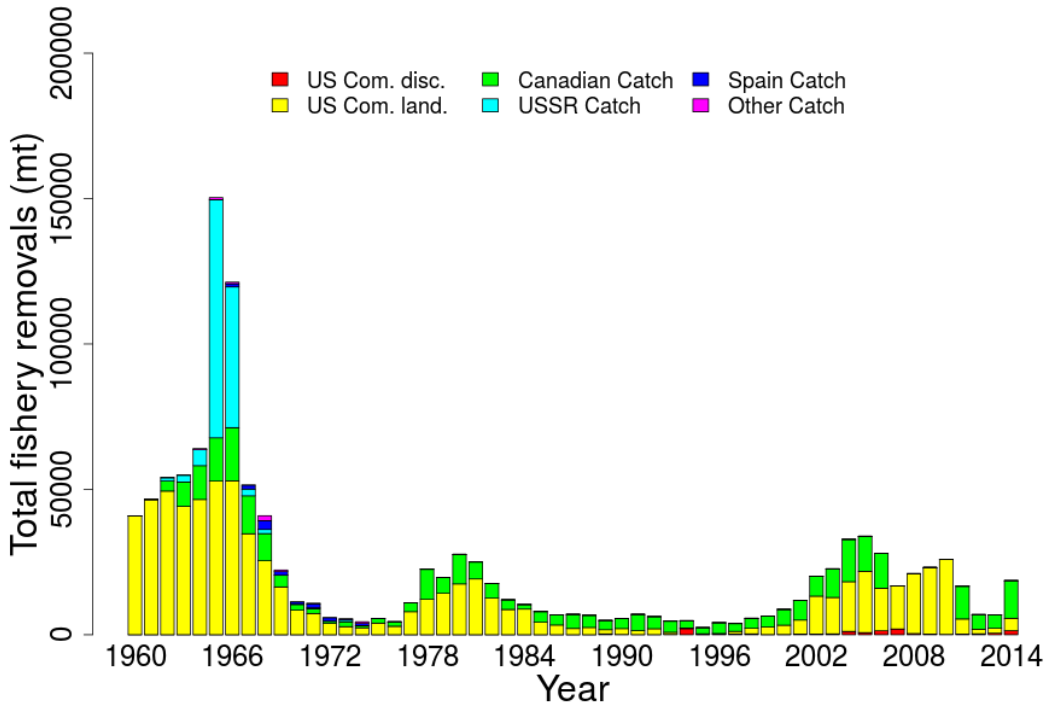

Figure B22: Total catch of Georges Bank haddock between 1931 and 2014 by fleet (US Commercial, Canadian, or foreign fleet) and disposition (landings and discards).

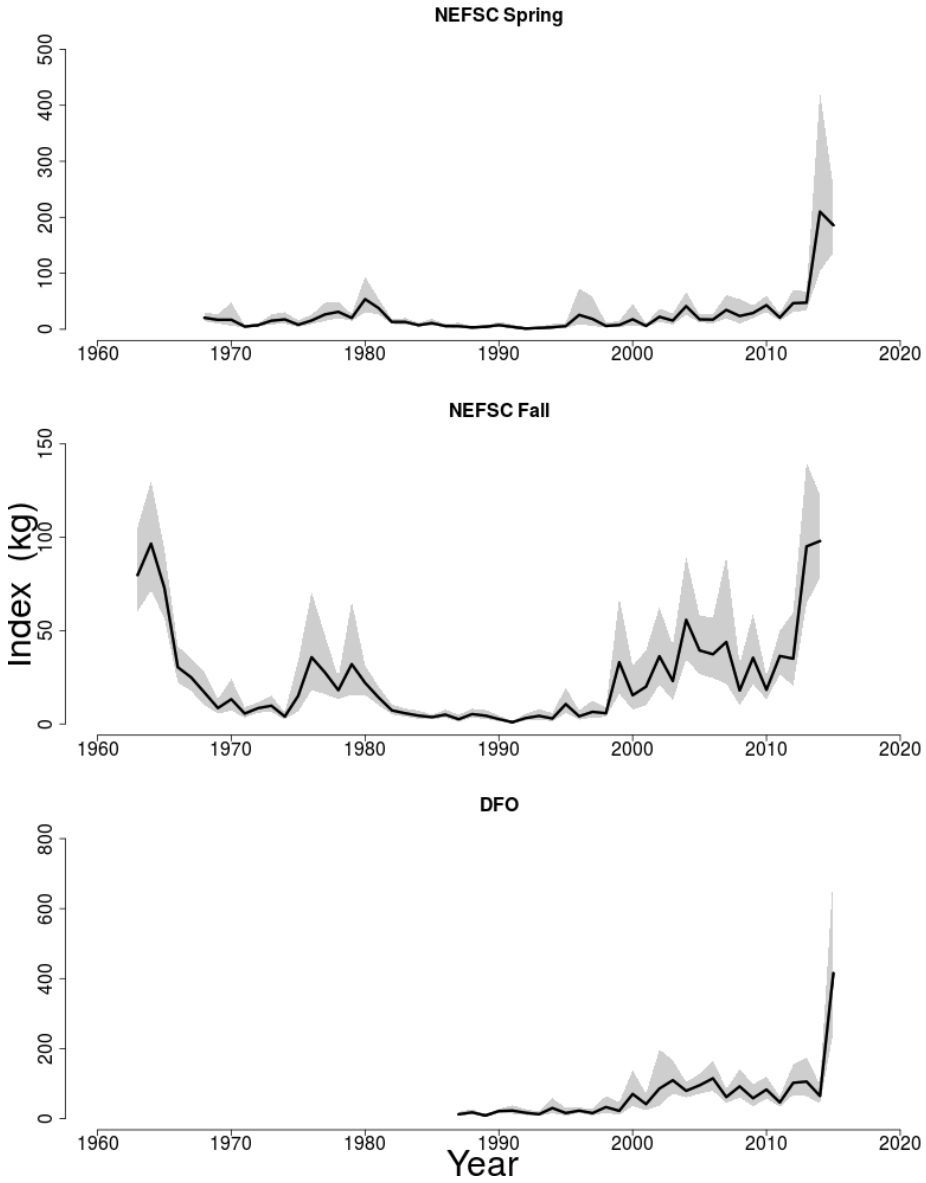

Figure B23: Indices of biomass (Mean kg/tow) for the Georges Bank haddock stock between 1963 and 2015 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys and the DFO winter bottom trawl survey. The approximate 90% lognormal confidence intervals are shown.

5 Gulf of Maine haddock

Michael Palmer

This assessment of the Gulf of Maine haddock (Melanogrammus aeglefinus) stock is an operational update of the existing 2014 benchmark assessment (NEFSC 2014). Based on the previous assessment, the stock was not overfished, and overfishing was not ocurring. This assessment updates commercial and recreational fishery catch data, research survey indices of abundance, and the analytical ASAP assessment model and reference points through 2014. Additionally, stock projections have been updated through 2018

State of Stock: Based on this updated assessment, the Gulf of Maine haddock (*Melanogrammus aeglefinus*) stock is not overfished and overfishing is not occurring (Figures **??**-**??**). Retrospective adjustments were not made to the model results (see Special Comments section of this report). Spawning stock biomass (SSB) in 2014 was estimated to be 10,325 (mt) which is 223% of the biomass target (SSB_{MSY} *proxy* = 4,623; Figure **??**). The 2014 fully selected fishing mortality was estimated to be 0.257 which is 55% of the overfishing threshold proxy (F_{MSY} *proxy* = $F_{40\%}$ = 0.468; Figure **??**).

Table B17: Catch and status table for Gulf of Maine haddock. All weights are in (mt) recruitment is in (000s) and F_{Full} is the fully selected fishing mortality. Model results are from the current updated ASAP assessment.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
					Data					
Recreational discards	36	66	46	72	24	19	11	54	250	371
Recreational landings	538	447	573	537	409	314	229	251	299	314
Commercial discards	25	32	47	10	12	3	6	18	32	22
Commercial landings	978	622	678	543	500	623	499	417	212	314
Foreign landings	0	0	0	0	0	0	0	0	0	0
Catch for Assessment	1,577	1,167	1,343	1,162	946	958	744	739	793	1,021
					Model Results					
Spawning Stock Biomass	8,848	8,219	7,271	6,369	5,735	4,877	4,086	4,551	6,907	10,325
F_{Full}	0.264	0.226	0.322	0.298	0.247	0.287	0.26	0.337	0.296	0.257
Recruits $age1$	451	1,325	1,541	279	438	1,345	11,547	3,930	18,186	26,457

Table B18: Comparison of reference points estimated in an earlier assessment and from the current assessment update. The overfishing threshold is the F_{MSY} *proxy* ($F_{40\%}$). The biomass target, (SSB_{MSY} *proxy*) was based on long-term stochastic projections of fishing at the F_{MSY} *proxy*. Median recruitment reflects the median estimated age-1 recruitment from 1977 - 2012. Intervals shown reflect the 5^{th} and 95^{th} percentiles.

	2014	Current
F_{MSY} *proxy*	0.46 (0.36 - 0.54)	0.468 (0.391 - 0.547)
SSB_{MSY} (mt)	4,108 (1,774 - 7,861)	4,623 (2,036 - 9,283)
MSY (mt)	955 (421 - 1,807)	1,083 (489 - 2,148)
Median recruits (age 1) (000s)	1,121 (205 - 6,500)	1,335 (253 - 8,198)
Overfishing	No	No
Overfished	No	No

Projections: Short term projections of median total fishery yield and spawning stock biomass for Gulf of Maine haddock were conducted based on a harvest scenario of fishing at the F_{MSY} *proxy* between 2016 and 2018. Catch in 2015 has been estimated at 885 mt. Recruitment was sampled from a cumulative distribution function of model estimated age-1 recruitment from 1977-2012. The age-1 estimate in 2015 was generated from the geometric mean of the 1977-2014 recruitment series. The annual fishery selectivity, maturity ogive, and mean weights at age used in the projections were estimated from the most recent 5 year averages; retrospective adjustments were not applied in the projections. Given the uncertainty in the size of the 2012 and 2013 year classes and the model's tendency to overestimate large terminal year classes, the 2015 assessment review panel recommended that a sensitivity projection scenario which constrains terminal recruitment ('Constrain terminal R') be brought forward to the New England Fishery Management Council's Scientific and Statistical Committee (NEFMC SSC) for consideration when setting catch advice; these sensitivity projections are provided in the Supplemental Information Report (SASINF).

Table B19: Short term projections of total fishery catch and spawning stock biomass for Gulf of Maine haddock based on a harvest scenario of fishing at F_{MSY} *proxy* ($F_{40\%}$) between 2016 and 2018. Catch in 2015 was assumed to be 885 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	885	18,026	0.131
2016	4,717	25,352	0.468
2017	5,614	24,623	0.468
2018	5,642	20,371	0.468

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The largest source of uncertainty in the assessment is the estimated size of the 2012 and 2013 year classes. Based on the estimated selectivity patterns, these year classes are projected to be 30% selected to the fishery in 2016 and 2017 respectively. However, recent changes to the commercial and recreational minimum retention size may result in these year classes recruiting to the fishery sooner than projected. The abundance and growth of the 2012 and 2013 year classes should be monitored and frequent model updates would be expected to improve the estimates of year class size and validate projection assumptions.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lie outside of the approximate joint confidence region for SSB and F_{Full}).

  This assessment does not exhibit a retrospective pattern and therefore no retrospective adjustments were made to the terminal model results or the short-term catch projections. The 7-year Mohn's rho values on SSB (-0.04) and F (0.03) are small and there were no consistent patterns in the directionality of the retrospective 'peels' (see the Supplemental Information Report, SASINF).

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for Gulf of Maine haddock, are reasonably well determined. The projected boimass from the last assessment is below the confidence bounds of the biomass estimated in the current assessment; however, this is primarily due to the positive rescaling of the population size that occured from turning the ASAP model likelihood constants option off (see next Special Comment).

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  Recreational catch estimates from 2004-2014 were re-estimated as part of this update to account for updates to the MRIP data. Additionally, the ASAP model was revised by turning the likelihood constants off; sensitivity runs on SAW/SARC 59 model suggest minor positive rescaling of recruitment and SSB, negative rescaling of F (sensitivity results are provided in the Supplemental Information Report, SASINF).

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  There has been no change in stock status since the previous SAW/SARC 59 assessment (2014).

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  Currently the assessment assumes 50% survival of haddock discarded in the recreational fishery - directed field research would improve this estimate. Additionally, a better understanding of recruitment processes may help to improve recruitment forecasting.

- Are there other important issues?

  None.

5.1 Reviewer Comments: Gulf of Maine haddock

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Northeast Fisheries Science Center. 2014. 59^{th} Northeast Regional Stock Assessment Workshop (59^{th} SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 14-09; 782 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026

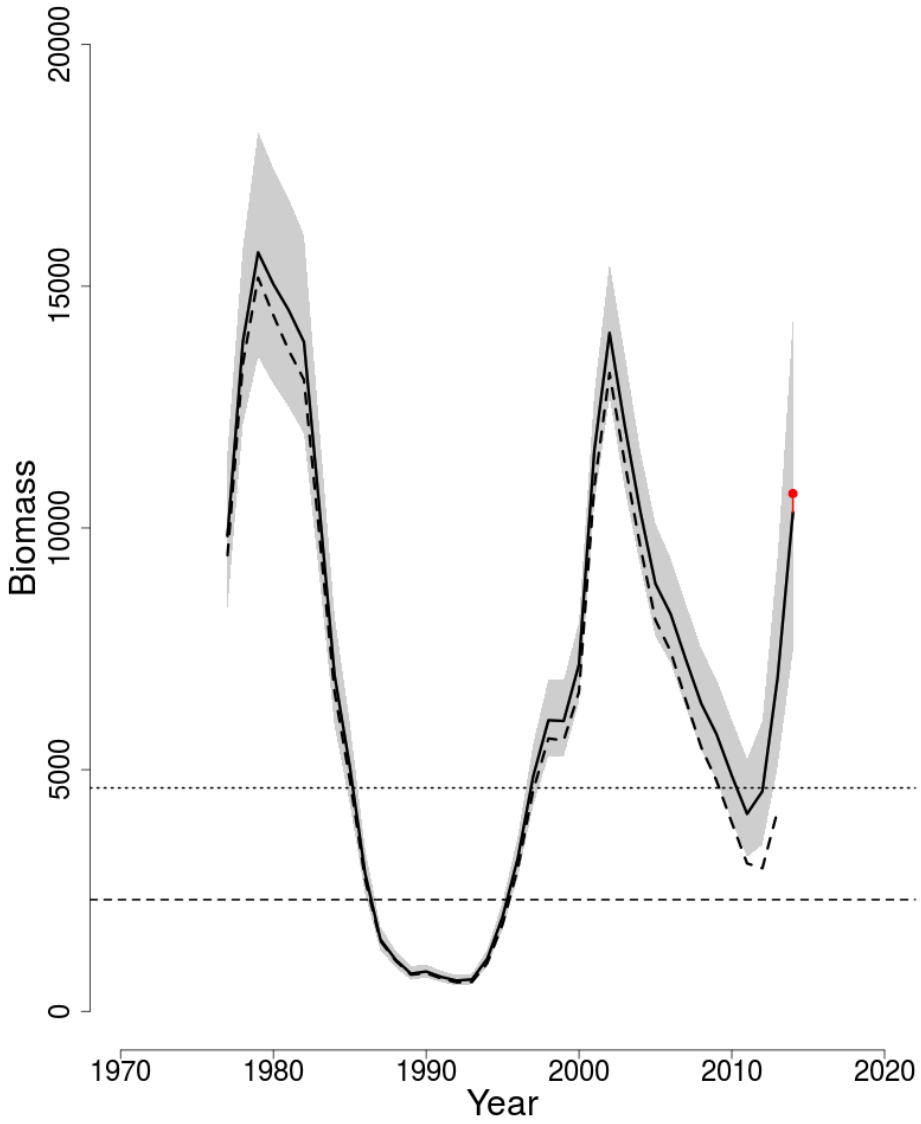

Figure B24: Trends in spawning stock biomass (SSB) of Gulf of Maine haddock between 1977 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2015 assessment. The approximate 90% lognormal confidence intervals are shown. The red dot indicates the rho-adjusted SSB values that would have resulted had a retrospective adjusment been made to either model (see Special Comments section).

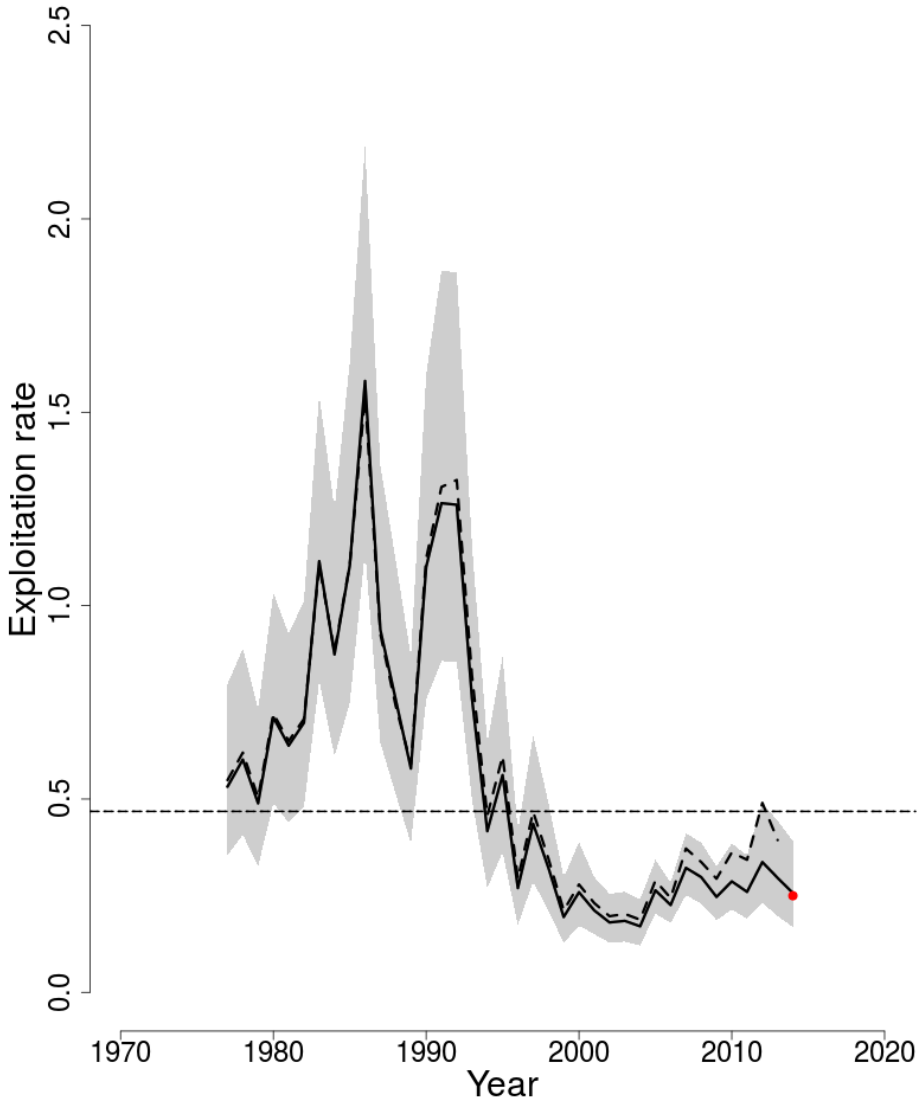

Figure B25: Trends in the fully selected fishing mortality (F) of Gulf of Maine haddock between 1977 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.468; horizontal dashed line) from the 2015 assessment model. The approximate 90% lognormal confidence intervals are shown. The red dot indicates the rho-adjusted F values that would have resulted had a retrospective adjusment been made to either model (see Special Comments section).

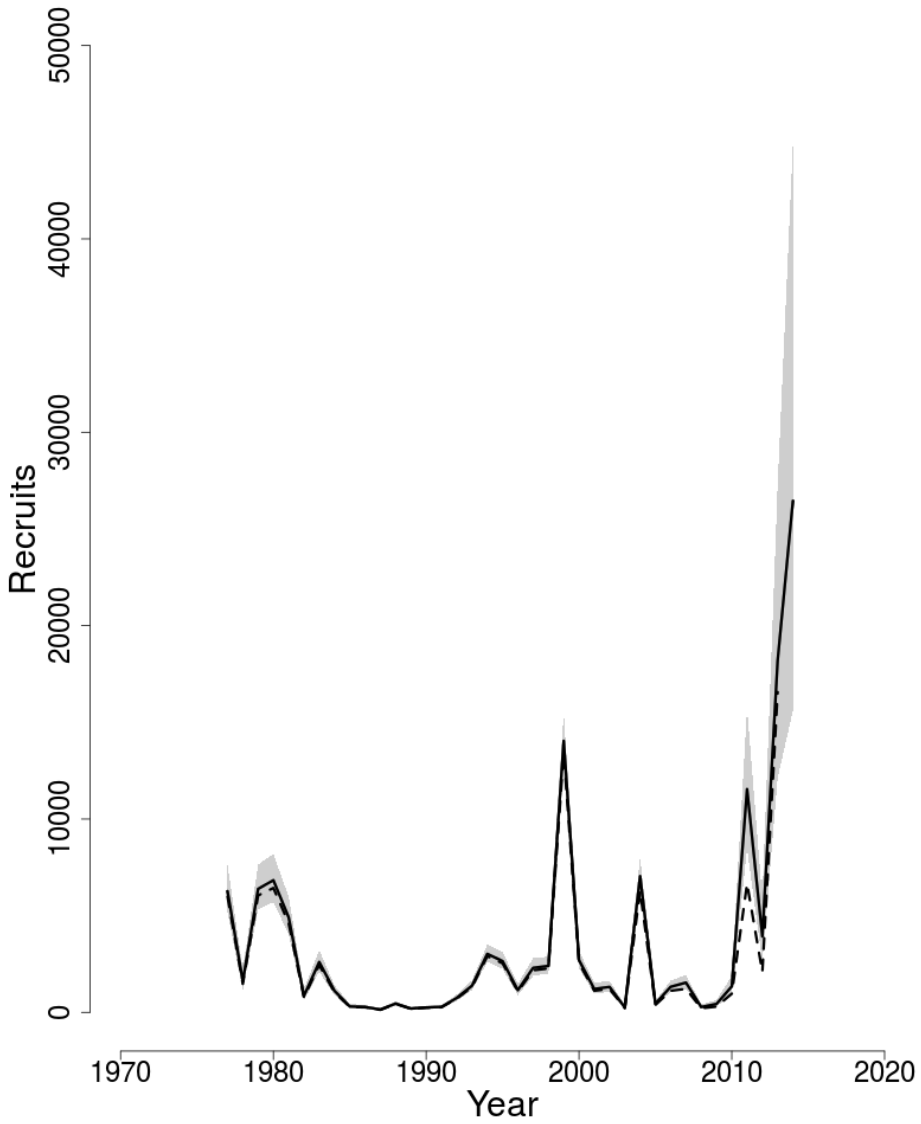

Figure B26: Trends in Recruits (age 1) (000s) of Gulf of Maine haddock between 1977 and 2014 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

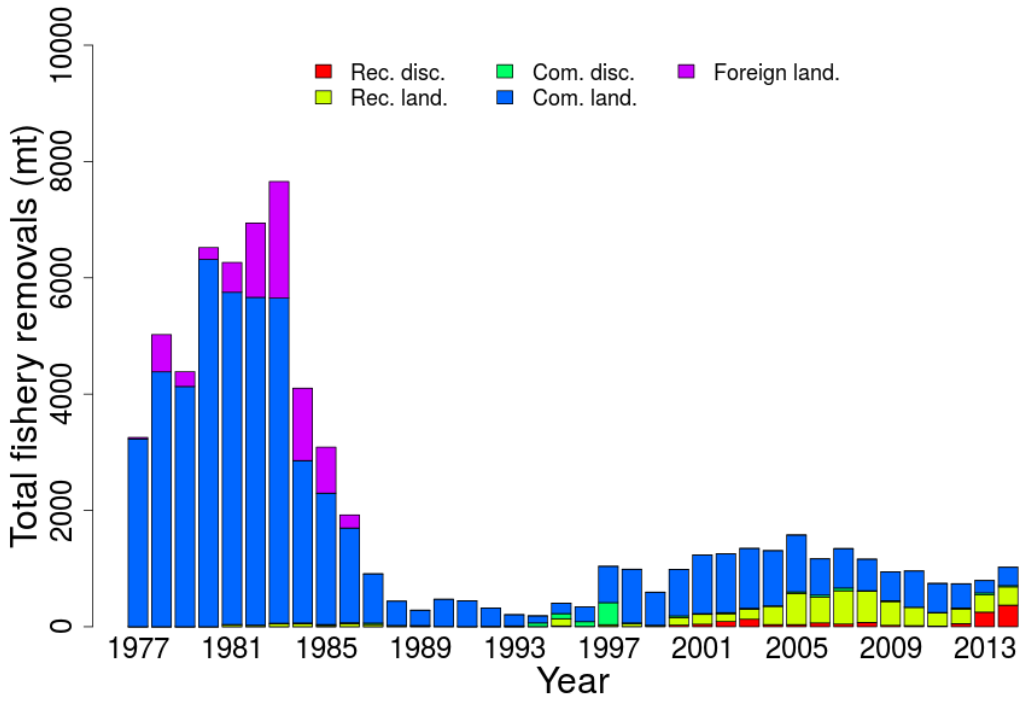

Figure B27: Total catch of Gulf of Maine haddock between 1977 and 2014 by fleet (commercial, recreational, or foreign) and disposition (landings and discards).

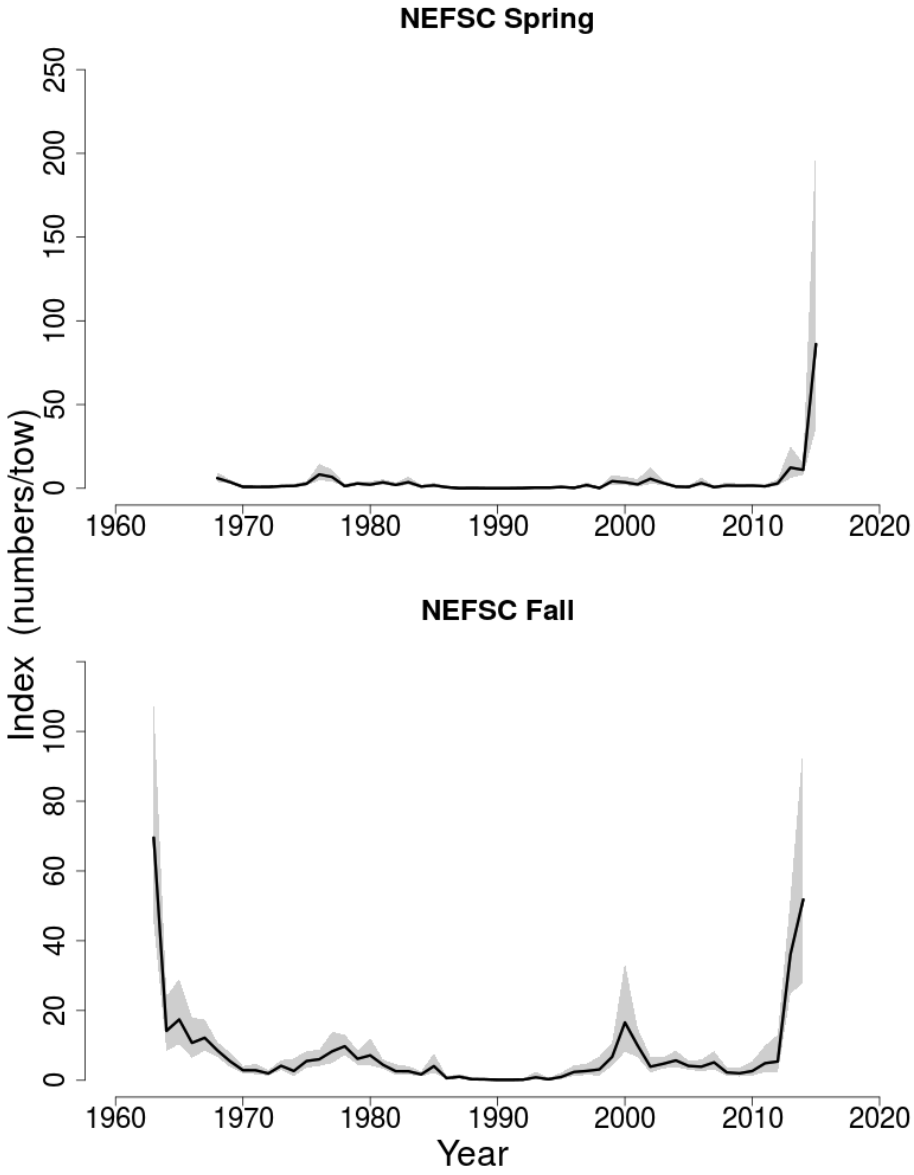

Figure B28: Indices of biomass for the Gulf of Maine haddock between 1963 and 2015 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys. The approximate 90% lognormal confidence intervals are shown.

6 Cape Cod-Gulf of Maine Yellowtail flounder

Larry Alade

This assessment of the Cape Cod-Gulf of Maine Yellowtail flounder (Limanda ferruginea) stock is an operational update of the existing 2012 VPA assessment (Legault et al., 2012). The last benchmark for this stock was in 2008 (Legault et al., 2008). Based on the previous assessment the stock was overfished, and overfishing was ocurring. This assessment updates commercial fishery catch data, research survey indices of abundance, weights at age, and the analytical VPA assessment model and reference points through 2014. Additionally, stock projections have been updated through 2018

State of Stock: Based on this updated assessment, Cape Cod-Gulf of Maine Yellowtail flounder (*Limanda ferruginea*) stock is overfished and overfishing is occurring (Figures **??**-**??**). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2014 was estimated to be 857 (mt) which is 16% of the biomass target (SSB_{MSY} *proxy* = 5,259; Figure **??**). The 2014 fully selected fishing mortality was estimated to be 0.64 which is 229% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.279; Figure **??**).

Table B20: Catch and model results for Cape Cod-Gulf of Maine Yellowtail flounder. All weights are in (mt), recruitment is in (000s) and F_{Full} is the average fishing mortality on ages (ages 4 and 5). Model results are from the current updated VPA assessment without any retrospective adjustment.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
					Data					
Commercial discards	282	85	141	156	175	87	74	146	86	54
Commercial landings	715	534	492	543	464	546	684	946	590	421
Total Catch for Assessment	997	620	633	699	639	633	758	1,092	676	475
					Model Results					
Spawning Stock Biomass	687	668	789	944	1,120	1,474	1,659	1,285	1,179	1,695
F_{Full}	1.685	1.48	1.056	1.163	0.745	0.491	0.645	0.977	0.818	0.355
Recruits $age1$	2,927	3,593	3,458	3,816	4,151	3,542	3,332	4,666	8,013	10,268

Table B21: Comparison of reference points estimated in an earlier assessment and from the current assessment update. An $F_{40\%}$ proxy was used for the overfishing threshold and was based on long-term stochastic projections. The medians and 90% probability intervals are reported for MSY and SSBMSY. The median recruits is descriptive and does not reflect the RMSY proxy.

	2012	Current

F_{MSY} *proxy*	0.259	0.279
SSB_{MSY} (mt)	7,080	5,259 (3,950 - 7,412)
MSY (mt)	1,720	1,285 (968 - 1,806)
Median recruits (age 1) (000s)	7,279	6,562
Overfishing	Yes	Yes
Overfished	Yes	Yes

Projections: Short term projections of biomass were derived by sampling from a cumulative distribution function of recruitment estimates from ADAPT VPA. Recruitment estimates were hindcasted based on a simple linear regression between the NEFSC Fall survey abundance at age 1 and the VPA estimate at age 1. The most recent two years (2013 and 2014) were not included in the series of values due to high uncertainty in these estimates. This resulted in a total of 36 recruitment values: 8 from the hindcast predictions (years 1977-1984) and 28 from the VPA (years 1985-2012). The annual fishery selectivity, maturity ogive, and mean weights at age used in projection are the most recent 5 year averages; retrospective adjustments were applied in the projections.

Table B22: Short term projections of total fishery catch and spawning stock biomass for Cape Cod-Gulf of Maine Yellowtail flounder based on a harvest scenario of fishing at F_{MSY} *proxy* between 2017 and 2018. Catch in 2015 was assumed to be 376 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	376	1,762 (1,364 - 2,300)	0.276
2016	555 (426 - 750)	2,429 (1,846 - 3,341)	0.279
2017	680 (542 - 892)	2,847 (2,313 - 3,656)	0.279
2018	814 (645 - 1,075)	3,518 (2,706 - 4,832)	0.279

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The largest source of uncertainty is the source of the retrospective pattern.This pattern has persisted for a number of years causing SSB estimates to decrease and F estimates to increaseas more years of data are added.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see RhoDecisionTab.ref).

  The 7-year Mohn's ρ, relative to SSB, was 0.68 in the 2012 assessment and was 0.98 in

2014. The 7-year Mohn's ρ, relative to F, was -0.19 in the 2012 assessment and was -0.45 in 2014. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2014 SSB (SSB_ρ=857) and 2014 F (F_ρ=0.64) were outside the approximate 90% confidence regions around SSB (1,375 - 2,111) and F (0.25 - 0.52). A retrospective adjustment was made for both the determination of stock status and for projections of catch in 2016. The retrospective adjustment changed the 2014 SSB from 1,695 to 857 and the 2014 F_{Full} from 0.355 to 0.64.

- Based on this stock assessment, are population projections well determined or uncertain?
  Population projections for Cape Cod-Gulf of Maine Yellowtail flounder, are uncertain with projected biomass from the last assessmentabove the confidence bounds of the biomass estimated in the current assessment.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.
  No changes, other than the incorporation of new data were made to the Cape Cod-Gulf of Maine Yellowtail flounder assessment for this update.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.
  The stock status has not changed since the previous assessment.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.
  Extensive studies have examined the causes of the retrospective patterns with no definitive conclusions other than a change in model does not resolve the issue.

- Are there other important issues?
  No.

6.1 Reviewer Comments: Cape Cod-Gulf of Maine Yellowtail flounder

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Legault, C, L. Alade, S.Cadrin, J. King, and S. Sherman. 2008. In. Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3^{rd} Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii. http://www.nefsc.noaa.gov/publications/crd/crd0815/

Legault, C, L. Alade, S.Emery, J. King, and S. Sherman. 2012. In. Northeast Fisheries Science Center. 2012. Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dept Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 12-06.; 789 p. http://nefsc.noaa.gov/publications/crd/crd1206/

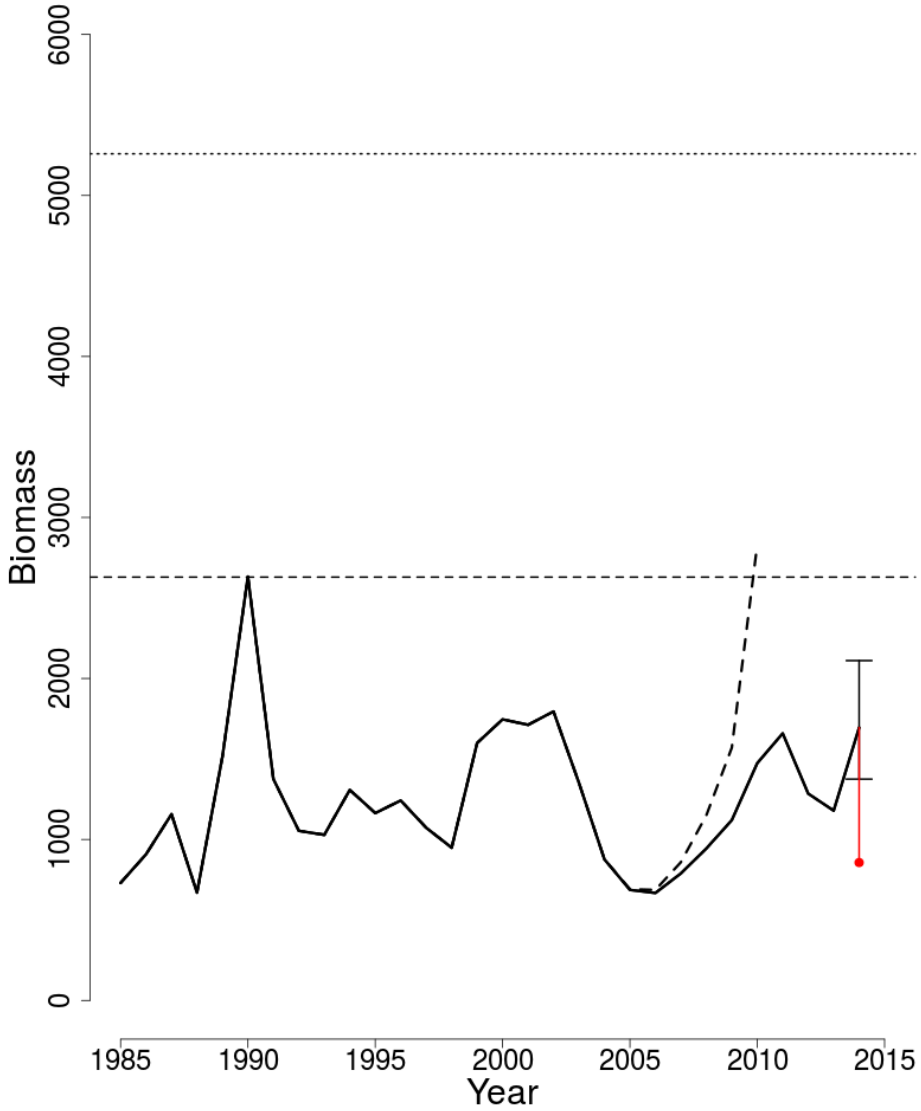

Figure B29: Trends in spawning stock biomass of Cape Cod-Gulf of Maine Yellowtail flounder between 1985 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2015 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The 90% bootstrap probability intervals are shown.

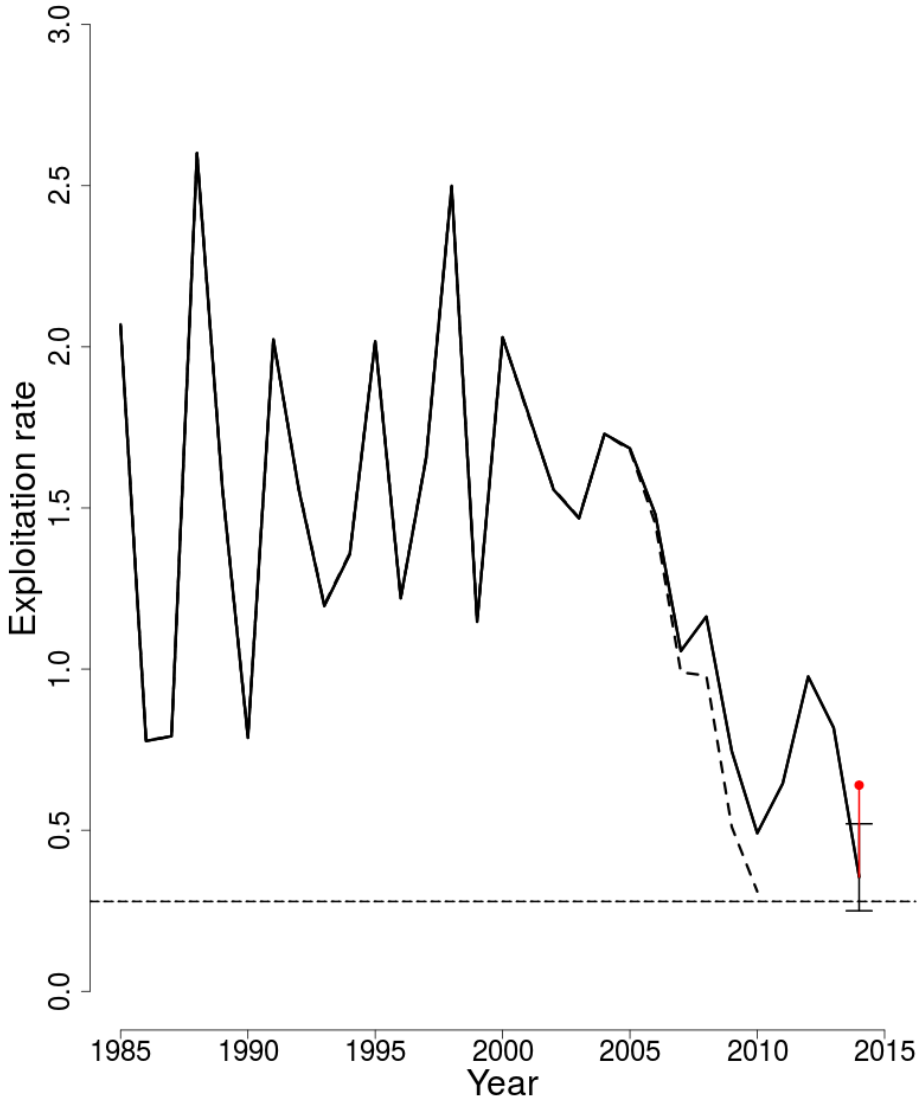

Figure B30: Trends in the fully selected fishing mortality (F_{Full}) of Cape Cod-Gulf of Maine Yellowtail flounder between 1985 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.279; horizontal dashed line). F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red based on the 2015 assessment. The 90% bootstrap probability intervals are shown.

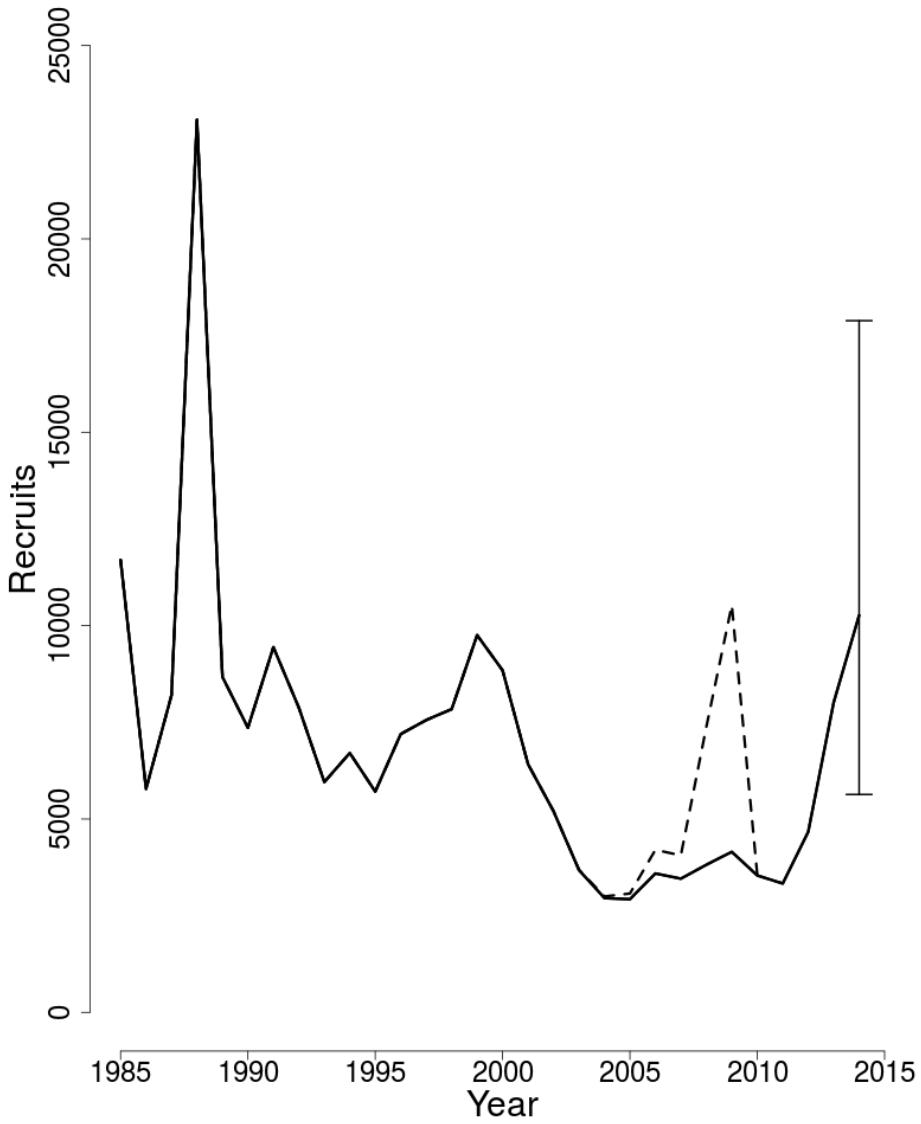

Figure B31: Trends in Recruits (age 1) (000s) of Cape Cod-Gulf of Maine Yellowtail flounder between 1985 and 2014 from the current (solid line) and previous (dashed line) assessment. The 90% bootstrap probability intervals are shown.

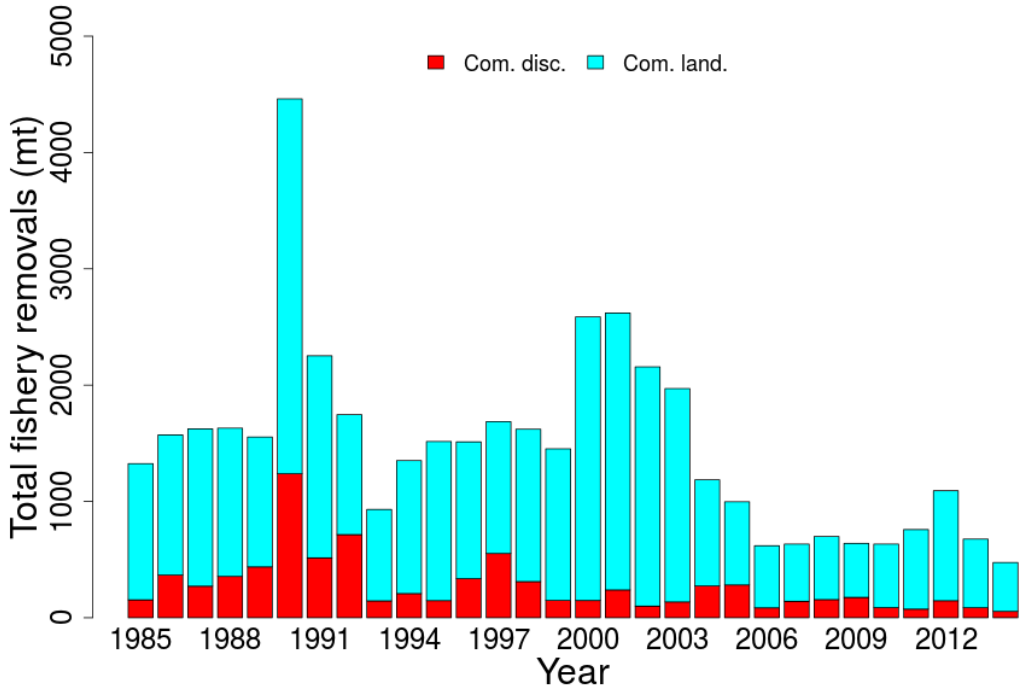

Figure B32: Total catch of Cape Cod-Gulf of Maine Yellowtail flounder between 1985 and 2014 by disposition (landings and discards).

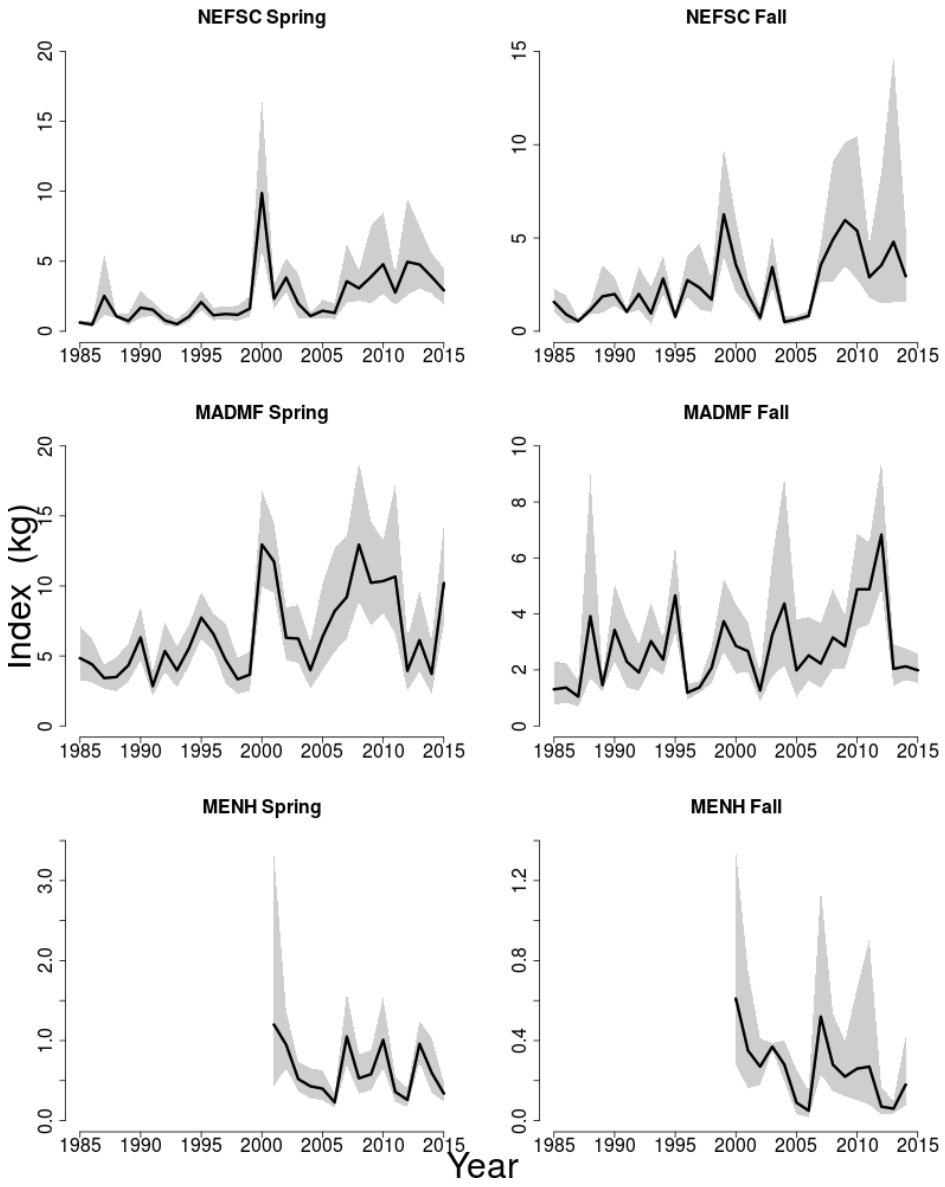

Figure B33: Indices of biomass for the Cape Cod-Gulf of Maine Yellowtail flounder between 1985 and 2015 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys, Massachusetts Department of Marine Fisheries (MADMF) inshore state spring and fall bottom trawl surveys,and the Maine New Hampshire inshore state spring and fall state surveys The 90% bootstrap probability intervals are shown.

7 Southern New England-Mid Atlantic Yellowtail flounder

Larry Alade

This assessment of the Southern New England-Mid Atlantic Yellowtail flounder (Limanda ferruginea) stock is an operational update of the existing 2012 benchmark ASAP assessment (NEFSC 2012). Based on the previous assessment the stock was not overfished, and overfishing was not ocurring. This assessment updates commercial fishery catch data, research survey indices of abundance, weights at age and the analytical ASAP assessment model and reference points through 2014. Additionally, stock projections have been updated through 2018

State of Stock: Based on this updated assessment, Southern New England-Mid Atlantic Yellowtail flounder (*Limanda ferruginea*) stock is overfished and overfishing is occurring (Figures **??**-**??**). Retrospective adjustments were not made to the model results. Spawning stock biomass (SSB) in 2014 was estimated to be 502 (mt) which is 26% of the biomass target (SSB_{MSY} *proxy* = 1,959; Figure **??**). The 2014 fully selected fishing mortality was estimated to be 1.64 which is 469% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.35; Figure **??**).

Table B23: Catch and model results for Southern New England-Mid Atlantic Yellowtail flounder. All weights are in (mt) recruitment is in (000s) and F_{Full} is the average fishing mortality on ages (ages 4 and 5). Model results are from the current updated ASAP assessment.Note: Terminal year estimates of SSB and F reflect the unadjusted values for retrospective error.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
					Data					
Commercial discards	104	187	296	391	268	177	145	221	185	109
Commercial landings	242	209	205	192	185	113	243	342	461	516
Foreign Catch	0	0	0	0	0	0	0	0	0	0
Total Catch for Assessment	346	396	502	583	453	291	388	563	646	625
					Model Results					
Spawning Stock Biomass	603	896	1,350	1,390	1,277	1,342	1,367	1,204	893	502
F_{Full}	0.81	0.82	0.66	0.59	0.46	0.3	0.41	0.72	1.01	1.64
Recruits $age1$	7,463	5,363	2,315	3,450	3,009	2,695	4,467	1,221	1,925	435

Table B24: Comparison of reference points estimated in an earlier assessment and from the current assessment update. An $F_{40\%}$ proxy was used for the overfishing threshold and was based on long-term stochastic projections.

	2012	Current

F_{MSY} *proxy*	0.32	0.35
SSB_{MSY} (mt)	2,995	1,959 (1,298 - 2,840)
MSY (mt)	773	541 (361 - 776)
Median recruits (age 1) (000s)	9,652	7,634
Overfishing	No	Yes
Overfished	No	Yes

Projections: Short term projections of biomass were derived by sampling from a cumulative distribution function of recruitment estimates from ASAP. Following the previous and accepted benchmark formulation, recruitment was based on the more recent estimates of the model time series (i.e. corresponding to year classes 1990 through 2013) to reflect the low recent pattern in recruitment. The annual fishery selectivity, maturity ogive, and mean weights at age used in projection are the most recent 5 year averages; retrospective adjustments were not applied in the projections.

Table B25: Short term projections of total fishery catch and spawning stock biomass for Southern New England-Mid Atlantic Yellowtail flounder based on a harvest scenario of fishing at F_{MSY} *proxy* between 2017 and 2018. Catch in 2015 was assumed to be 478 (mt). Note: The numbers-at-age used in the short-term projections for Southern New England-Mid Atlantic yellowtail were not adjusted for retrospective error.

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	478	597 (444 - 798)	1.018
2016	130 (89 - 193)	477 (324 - 715)	0.349
2017	162 (111 - 233)	647 (408 - 1,020)	0.349
2018	234 (146 - 382)	1,062 (611 - 1,799)	0.349

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The largest source of uncertainty is the emergence of the retrospective in this updated assessment. This retrospective bias has resulted in the reduction SSB estimates and F estimates to increase with additional years of data Further, the basis for recruitment assumption for stock status determination and population forecast (i.e. the inclusion of historical recruitment values versus contemporary basis of recruitment) is another source of uncertainty. Although recent estmated recruitment likely reflect the realistic conditions for the stock, the basis for recruitment selection is not clearly understood.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see RhoDecisionTab.ref).

  The 7-year Mohn's ρ, relative to SSB, was 0.14 in the 2012 assessment and was 1.06 in 2014. The 7-year Mohn's ρ, relative to F, was -0.16 in the 2012 assessment and was -0.53 in 2014. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2014 SSB (SSB_ρ=502) and 2014 F (F_ρ=1.64) were outside the approximate 90% confidence regions around SSB (355 - 739) and F (1.053 - 2.348). However, a retrospective adjustment was not made for both the determination of stock status and for projections of catch because of the large proportion of unfeasible projections (assumed 2015 catch required a fishing mortality rate greater than 5). This implies the retrospective adjustment was too large or the assumed 2015 catch was too high. The review panel decided to use the unadjusted projections as an upper bound for OFL with the strong suggestion that the OFL estimates were too high (meaning the ABC buffer should be larger than normal).

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections are uncertain with projected biomass from the last assessment above the confidence bounds of the biomass estimate in the current assessment. Further, the short-term projections which accounted for retropective adjustment in the starting numbers-at-age were unrelaible due to the low percentage of feasible solutions (33%) encountered durring the simulation. The feasibility problem in the projections were due to the assumed 2015 projected cacth exceeding the population biomass in several of the iteration caused by the retrospective adjustment. Evaluation of the the estimated January-1 2015 biomass from the few feasbile projections indicated that the assumed 2015 catch was approximately 98% of the stock biomass. This suggests that the assumed 2015 catch is not sustainable given the low starting abundance in the forecast. Alternatively, the retro unadjusted projections performed well, but it is likely to result in an overly optimistic projection of the fishery yield and population biomass.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  There were no major changes to the current stock assessment formulation. However, the criterion for determining acceptable tows on the NEFSC surveys were revised for years the Bigelow year (i.e. 2009-2011) and carried foreward to ensure consistency between the assessment and deck operations. The influence of the revised protocol on the survey indices was inconsequential.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The overfishing and biomass stock status have changed since the previous assessment due to increased catches relative to the stock biomass and the very low recruitment of young fish, contributing very little to the adult biomass.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  The emergence of retrospective bias in this assessment is not clearly understood and may result from a variety of sources. Future studiesshould further investigate the source of this retrospective pattern to help improve the underlying diagnostics of the model for providing

catch advice for this stock. Recruitment for Southern New England-Mid Atlantic yellowtail flounder continues to be weak and it is likely that the stock is in a new productivity regime. Should this pattern of poor recruitment continue into the future, the ability of the stock to recover will be impeded. Therefore, future studies should build on current knowledge to further understand the underlying ecological mechanisms of poor recruitment in the stock as it may relate to the physical environment.

- Are there other important issues?
  None.

7.1 Reviewer Comments: Southern New England-Mid Atlantic Yellowtail flounder

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Alade, L, C. Legault, S.Cadrin. 2008. In. Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3^{rd} Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii. http://www.nefsc.noaa.gov/publications/crd/crd0815/

Northeast Fisheries Science Center. 2012. 54^{th} Northeast Regional Stock Assessment Workshop (54^{th} SAW) Assessment Report. US Dept Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 12-18.; 600 p. http://nefsc.noaa.gov/publications/crd/crd1218/

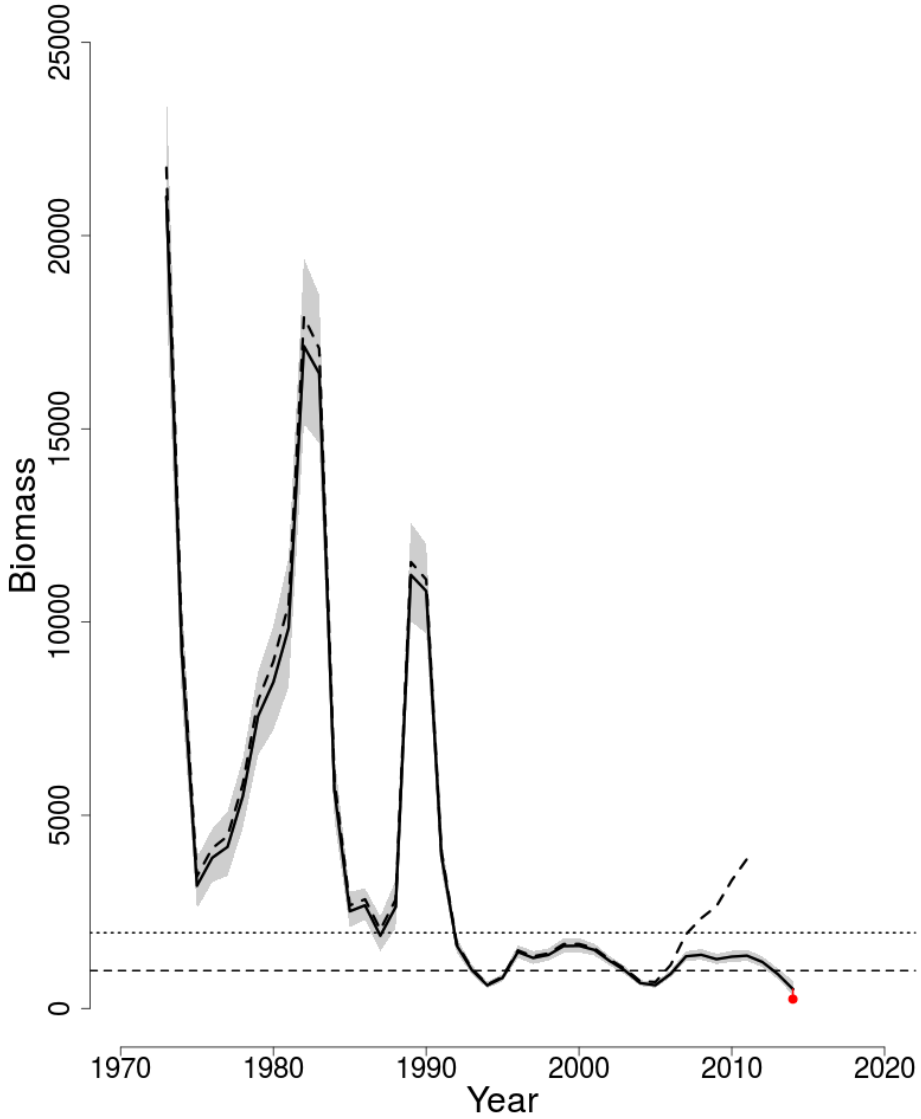

Figure B34: Trends in spawning stock biomass of Southern New England-Mid Atlantic Yellowtail flounder between 1973 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2015 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% lognormal confidence intervals are shown.

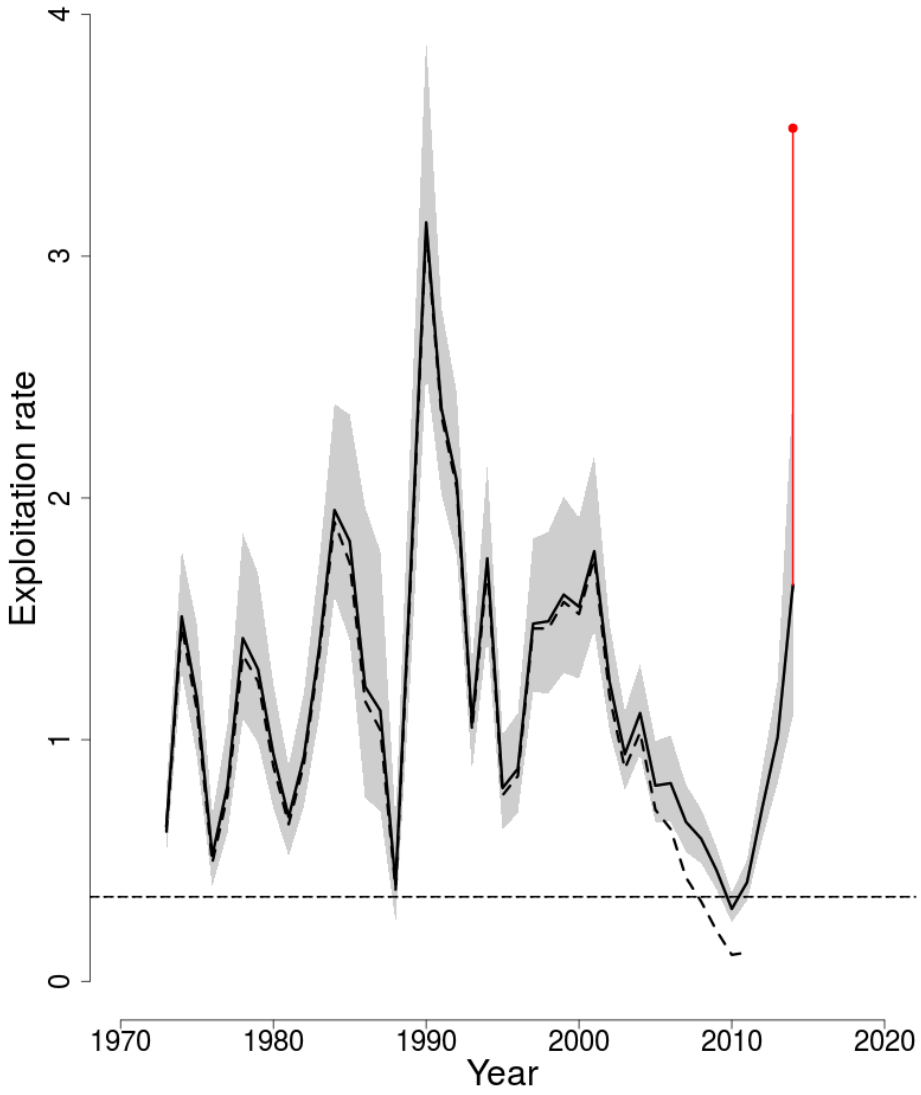

Figure B35: Trends in the fully selected fishing mortality (F_{Full}) of Southern New England-Mid Atlantic Yellowtail flounder between 1973 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.35; horizontal dashed line). F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red based on the 2015 assessment. The approximate 90% lognormal confidence intervals are shown.

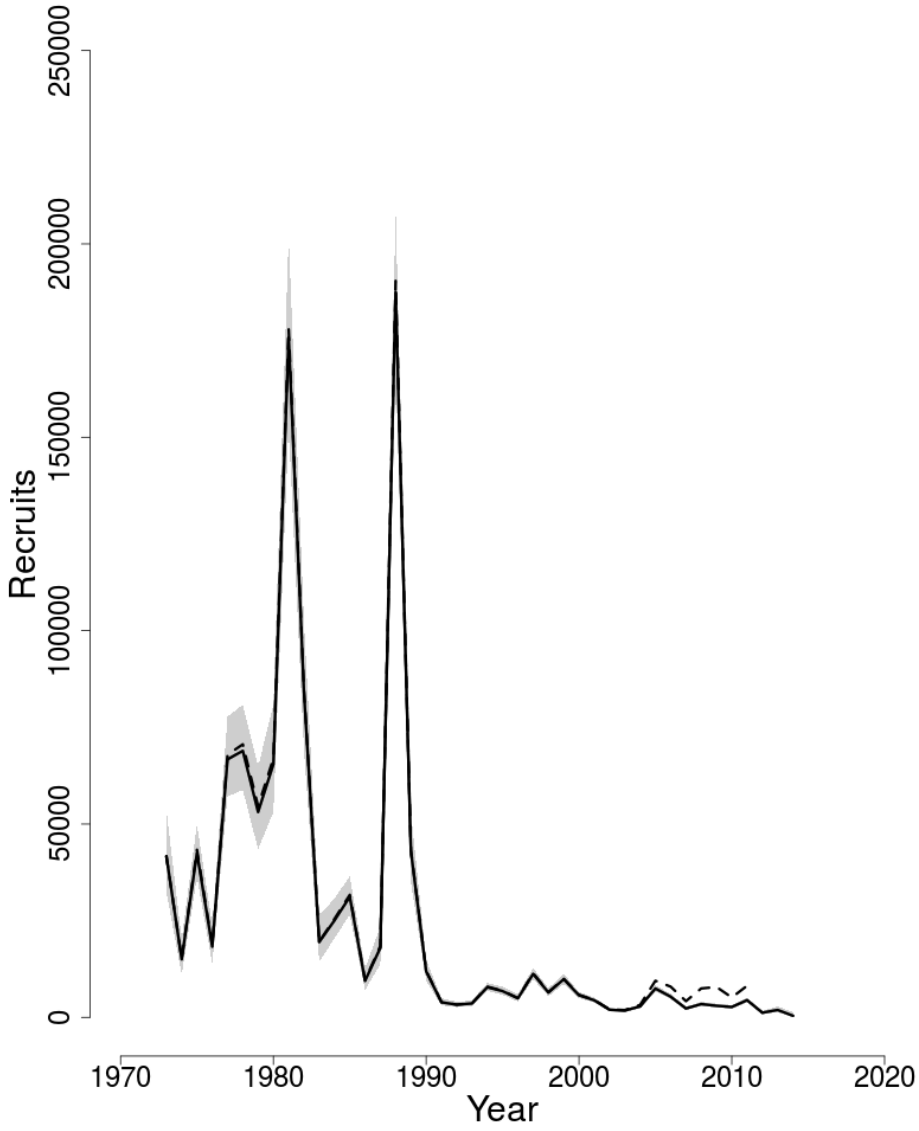

Figure B36: Trends in Recruits (age 1) (000s) of Southern New England-Mid Atlantic Yellowtail flounder between 1973 and 2014 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

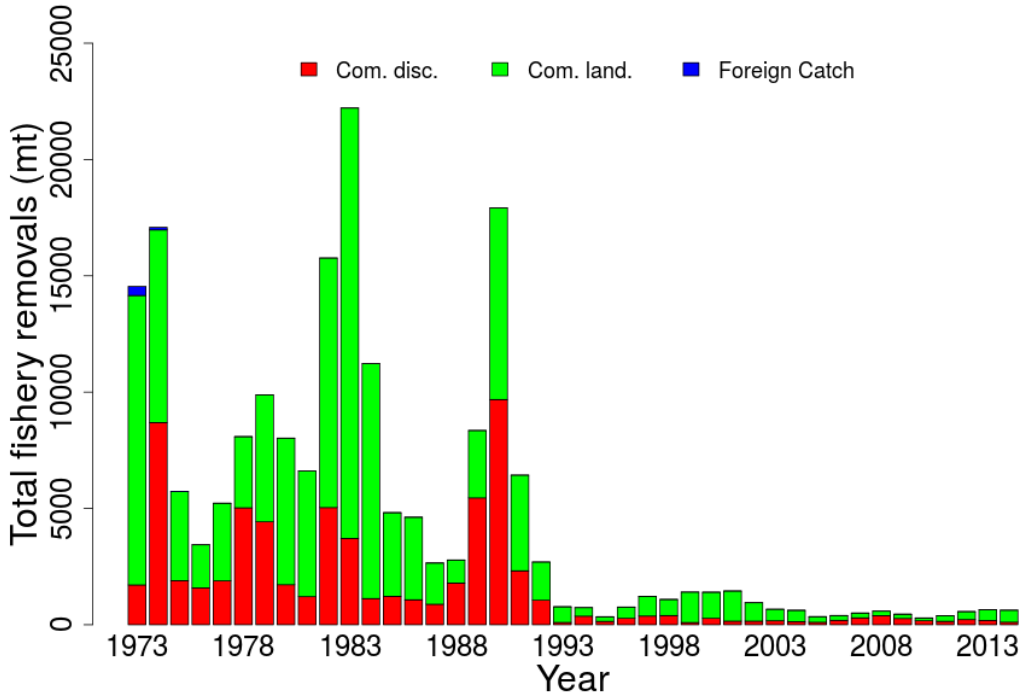

Figure B37: Total catch of Southern New England-Mid Atlantic Yellowtail flounder between 1973 and 2014 by fleet (US domestic and foreign catch) and disposition (landings and discards).

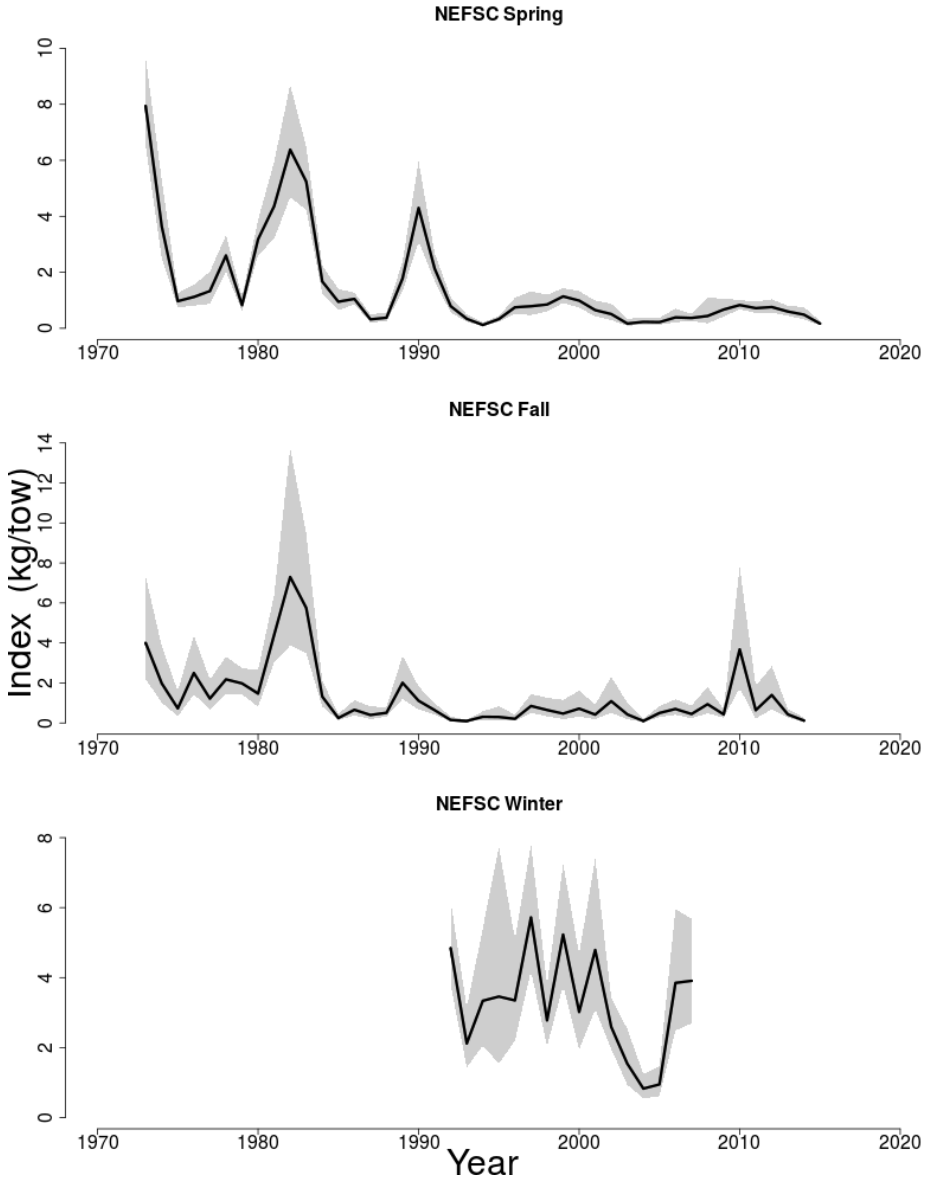

Figure B38: Indices of biomass for the Southern New England-Mid Atlantic Yellowtail flounder between 1973 and 2015 for the Northeast Fisheries Science Center (NEFSC) spring, fall and winter bottom trawl surveys. The approximate 90% log-normal confidence intervals are shown.Note: Larval index was also used in this assessment and is available in the supplemental documentation

8 Georges Bank Winter Flounder

Lisa Hendrickson

This assessment of the Georges Bank Winter Flounder (Pseudopleuronectes americanus) stock is an operational update of the existing 2014 operational VPA assessment which included data for 1982-2013 (Hendrickson et al. 2015). Based on the previous assessment the stock was not overfished and overfishing was not ocurring. This assessment updates commercial fishery catch data, research survey biomass indices, and the analytical VPA assessment model and reference points through 2014. Additionally, stock projections have been updated through 2018.

State of Stock: Based on this updated assessment, the Georges Bank Winter Flounder (*Pseudopleuronectes americanus*) stock is overfished and overfishing is occurring (Figures **??**-**??**). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2014 was estimated to be 2,883 (mt) which is 43% of the biomass target for an overfished stock (SSB_{MSY} = 6,700 with a threshold of 50% of SSBMSY; Figure **??**). The 2014 fully selected fishing mortality (F) was estimated to be 0.778 which is 145% of the overfishing threshold (F_{MSY} = 0.536; Figure **??**). However, the 2014 point estimate of SSB and F, when adjusted for retrospective error (83% for SSB and -51% for F), is outside the 90% confidence interval of the unadjusted 2014 point estimate. Therefore, the 2014 F and SSB values used in the stock status determination were the retrospective-adjusted values of 0.778 and 2,883 mt, respectively.

Table B26: Catch input data and VPA model results for Georges Bank Winter Flounder. All weights are in (mt), recruitment is in (000s) and F_{Full} is the fishing mortality on fully selected ages (ages 4-6). Catch and model results are only for the most recent years (2005-2014) of the current updated VPA assessment.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
					Data					
US landings	2,012	825	795	947	1,658	1,252	1,801	1,911	1,675	1,114
CA landings	73	55	12	20	12	45	52	83	12	12
US discards	118	110	188	143	91	138	129	113	47	46
CA scall dr discards	145	135	44	69	252	109	88	79	29	47
Catch for Assessment	2,348	1,125	1,039	1,179	2,013	1,544	2,070	2,186	1,763	1,219
					Model Results					
Spawning Stock Biomass	4,426	4,478	4,316	3,931	4,282	4,997	5,157	4,829	4,645	5,275
F_{Full}	0.679	0.265	0.309	0.371	0.459	0.365	0.507	0.5	0.533	0.379
Recruits $age1$	3,840	6,106	9,566	12,874	11,355	5,789	7,650	6,519	6,217	6,575

Table B27: Comparison of reference points estimated in the 2014 assessment and the current assessment update and stock status during 2013 and 2014, respectively. An estimate of F_{MSY} was used for the overfishing threshold and was based on long-term stochastic projections.

	2014	Current
F_{MSY}	0.44	0.536
SSB_{MSY} (mt)	8,100	6,700 (4,370 - 10,610)
MSY (mt)	3,200	2,840 (1,850 - 4,480)
Median recruits (age 1) (000s)	13,235	9,880
Overfishing	No	Yes
Overfished	No	Yes

Projections: Short-term projections of biomass were derived by sampling from a cumulative distribution function of recruitment estimates (1982-2013 YC) from the final run of the ADAPT VPA model. The annual fishery selectivity, maturity ogive, and mean weights-at-age used in the projection are the most recent 5 year averages (2010-2014). An SSB retrospective adjustment factor of 0.546 was applied in the projections.

Table B28: Short-term projections of catch (mt) and spawning stock biomass (mt) for Georges Bank Winter Flounder based on a harvest scenario of fishing at 75% of F_{MSY} between 2016 and 2018. Catch in 2015 was assumed to be 1,150 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	1,150	2,623 (1,802 - 3,813)	0.362
2016	755	2,295 (1,472 - 3,482)	0.402
2017	830	2,595 (1,894 - 3,594)	0.402
2018	1,110	3,581 (2,390 - 5,948)	0.402

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The largest source of uncertainty is the estimate of natural mortality based on longevity (max. age = 20 for this stock), which is not well studied in Georges Bank Winter Flounder, and assumed constant over time. Natural mortality affects the scale of the biomass and fishing mortality estimates. Other sources of uncertainty include the underestimation of catches. Discards from the Canadian bottom trawl fleet were not provided by the CA DFO and the precision of the Canadian scallop dredge discard estimates, with only 1-2 trips per

month, are uncertain.The lack of age data for the Canadian spring survey catches requires the use of the US spring survey A/L keys despite selectivity differences. In addition, there are no length or age composition data from the Canadian landings or discards GB winter flounder.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Figure **??**).

  The 7-year Mohn's ρ, relative to SSB, was 0.26 in the 2014 assessment and was 0.83 in 2014. The 7-year Mohn's ρ, relative to F, was -0.16 in the 2014 assessment and was -0.51 in 2014. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2014 SSB (SSB_{ρ}=2,883) and 2014 F (F_{ρ}=0.778) were outside the approximate 90% confidence region around SSB (3,783 - 6,767) and F (0.254 - 0.504). A retrospective adjustment was made for both the determination of stock status and for projections of catch in 2016. The retrospective adjustment changed the 2014 SSB from 5,275 to 2,883 and the 2014 F_{Full} from 0.379 to 0.778.

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for Georges Bank Winter Flounder are reasonably well determined.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  The only change made to the Georges Bank Winter Flounder assessment, other than the incorporation of an additional year of data, involved fishery selectivity. During the 2014 assessment update, stock size estimates of age 1 and age 2 fish were not estimable in the VPA during year t + 1 (CVs near 1.0). When age 2 stock size is not estimated in year t + 1, the VPA model calculates the stock size of age 1 fish (i.e., recruitment) in the terminal year by using the age 1 partial recruitment (PR) value to derive the F at age 1 in the terminal year. The age 1 PR value used in the 2014 assessment update was 0.001. However, when this same age 1 PR value was used in a VPA run for the current assessment update, the low PR value combined with the low age 1 catch in 2014 resulted in an unlikely high stock size estimate for age 1 recruitment in 2014 (i.e., 41,587,000 fish) when compared to survey observations of the same cohort (i.e., age 1 in 2014 and age 2 in 2015). In order to obtain a more realistic estimate of age 1 recruitment in 2014, I allowed the VPA model to estimate age 2 stock size in 2015 (i.e., and thereby avoided the use of an age 1 PR value in the age 1 stock size calculation for 2014) and used the back-calculated PR values from this VPA run to derive a new PR-at-age vector which was used in the final 2015 VPA run. Similar to the 2014 assessment update, the final 2015 VPA run did not include the estimation of age 2 stock size and the new PR-at-age vector was computed using the same methods as in the 2014 assessment. Full selectivity occurs at age 4. For the 2015 assessment update, fishery selectivity for ages 1-3 was changed from the 2014 assessment values of 0.001, 0.10 and 0.43, respectively, to 0.01, 0.08 and 0.55, respectively. Differences between estimates of F, SSB and R values from the final 2015 VPA run, with the new PR vector, and a 2015 VPA run that utilized the PR vector from the 2014 assessment are shown in Table G30.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

The overfished and overfishing status of Georges Bank Winter Flounder has changed in the current assessment update due to a worsening of the retrospective error associated with fishing mortality and SSB.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.
  The Georges Bank Winter Flounder assessment could be improved with discard estimates from the Canadian bottom trawl fleet and age data from the Canadian spring bottom trawl surveys.

- Are there other important issues?
  None.

8.1 Reviewer Comments: Georges Bank Winter Flounder

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Hendrickson L, Nitschke P, Linton B. 2015. 2014 Operational Stock Assessments for Georges Bank winter flounder, Gulf of Maine winter flounder, and pollock. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-01; 228 p.

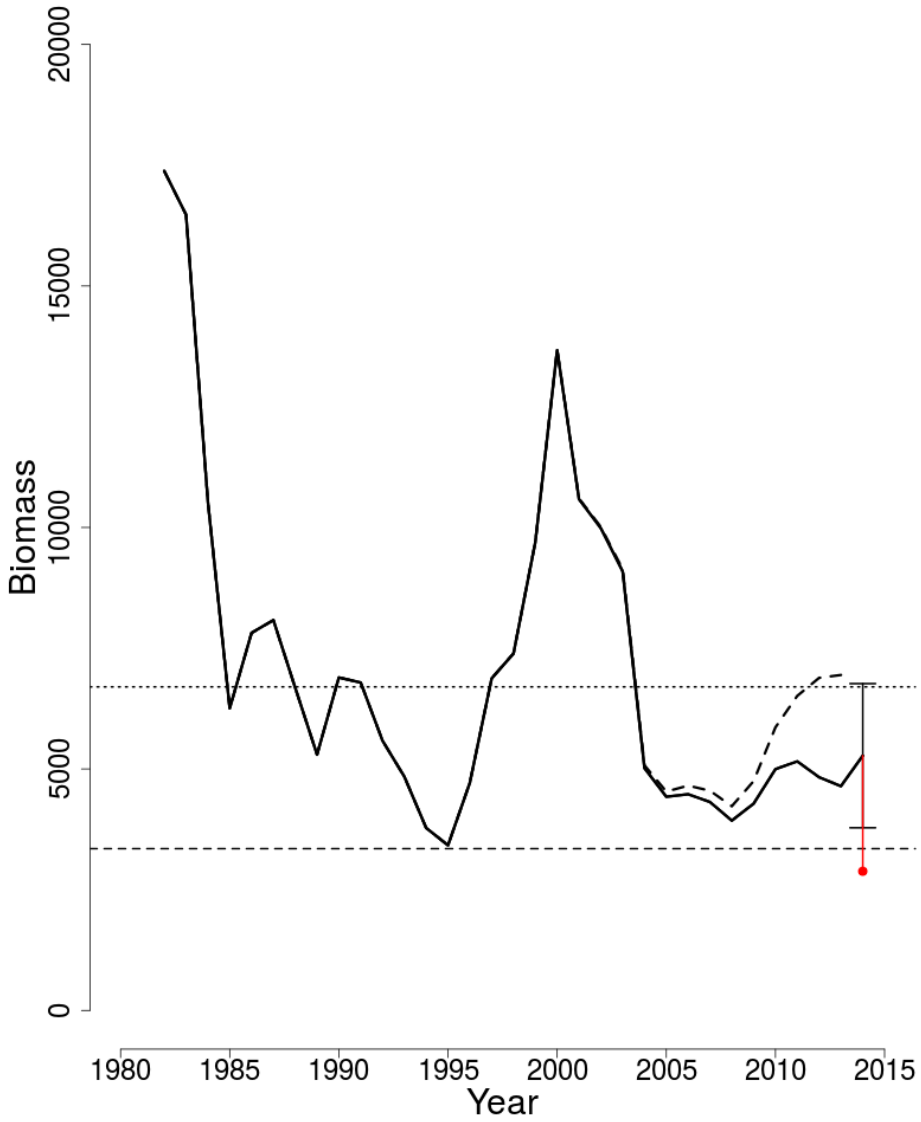

Figure B39: Trends in spawning stock biomass (mt) of Georges Bank Winter Flounder between 1982 and 2014 from the current (solid line) and previous (dashed line) assessments and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY}; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY}; horizontal dotted line) based on the 2015 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% normal confidence intervals are shown.

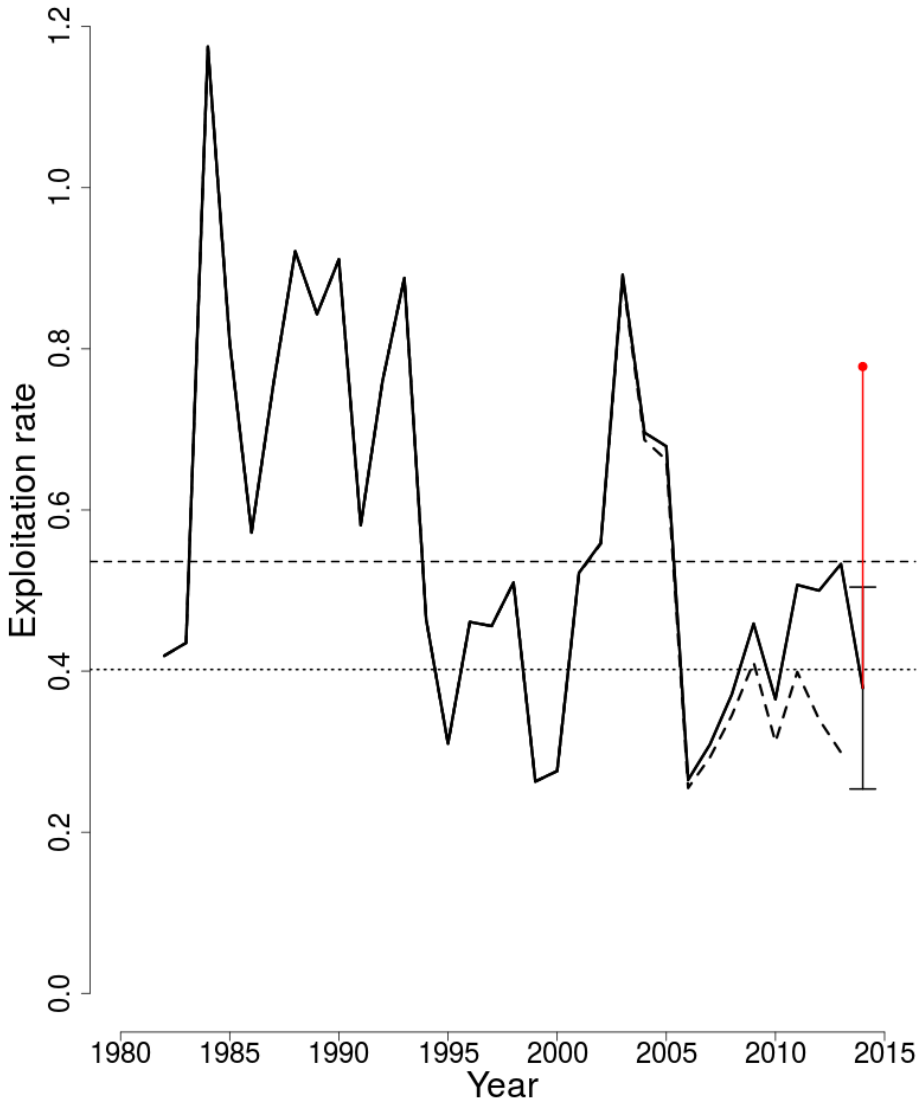

Figure B40: Trends in fully selected fishing mortality (F_{Full}) of Georges Bank Winter Flounder between 1982 and 2014 from the current (solid line) and previous (dashed line) assessments and the corresponding $F_{Threshold}$ (F_{MSY}=0.536; horizontal dashed line) as well as (F_{Target}= 75% of FMSY; horizontal dotted line). F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% normal confidence intervals are also shown.

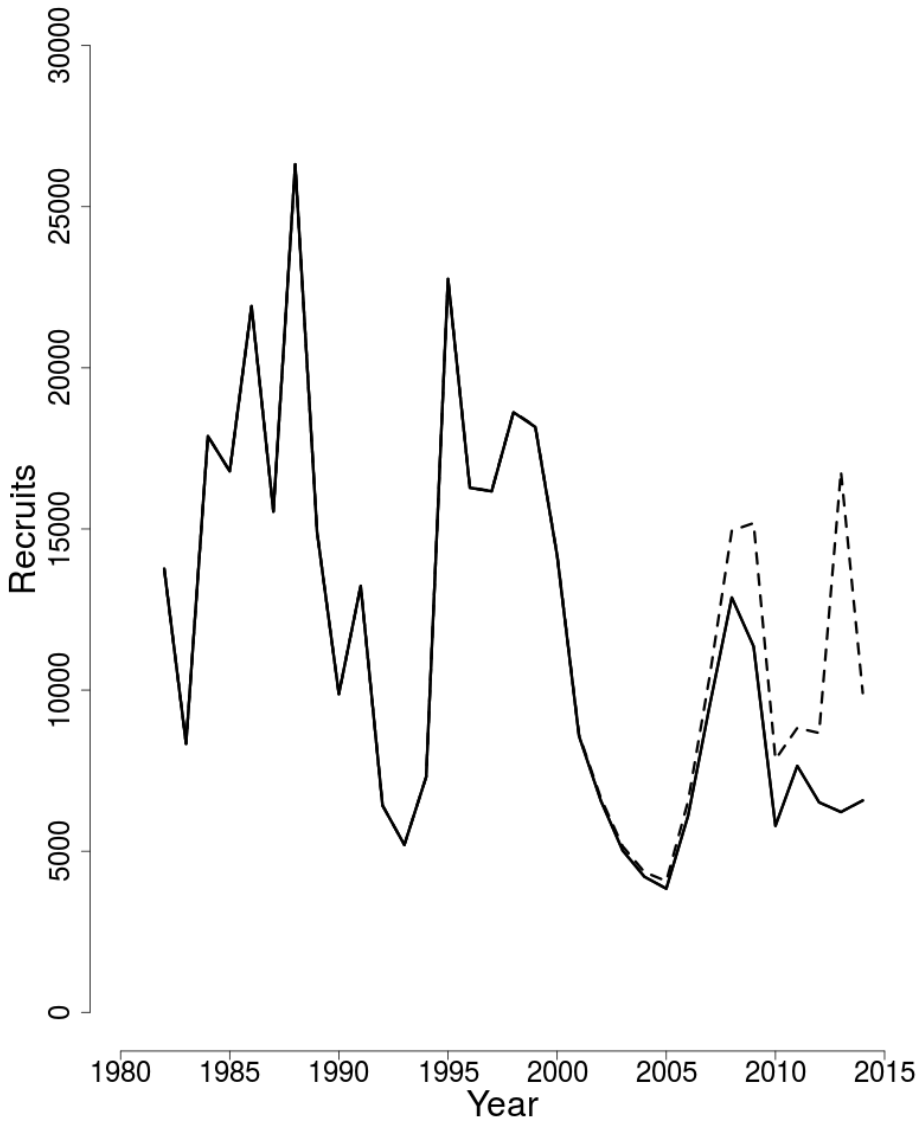

Figure B41: Trends in Recruits (age 1) (000s) of Georges Bank Winter Flounder between 1982 and 2014 from the current (solid line) and previous (dashed line) assessments. The approximate 90% normal confidence intervals are shown.

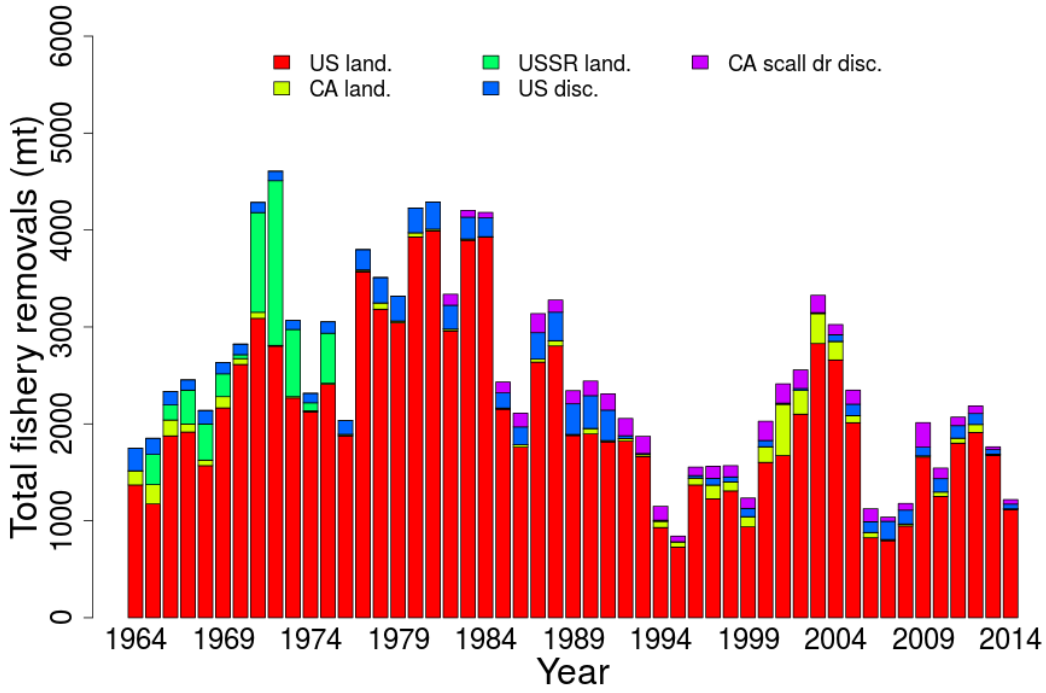

Figure B42: Total catches (mt) of Georges Bank Winter Flounder between 1982 and 2015 by country and disposition (landings and discards).

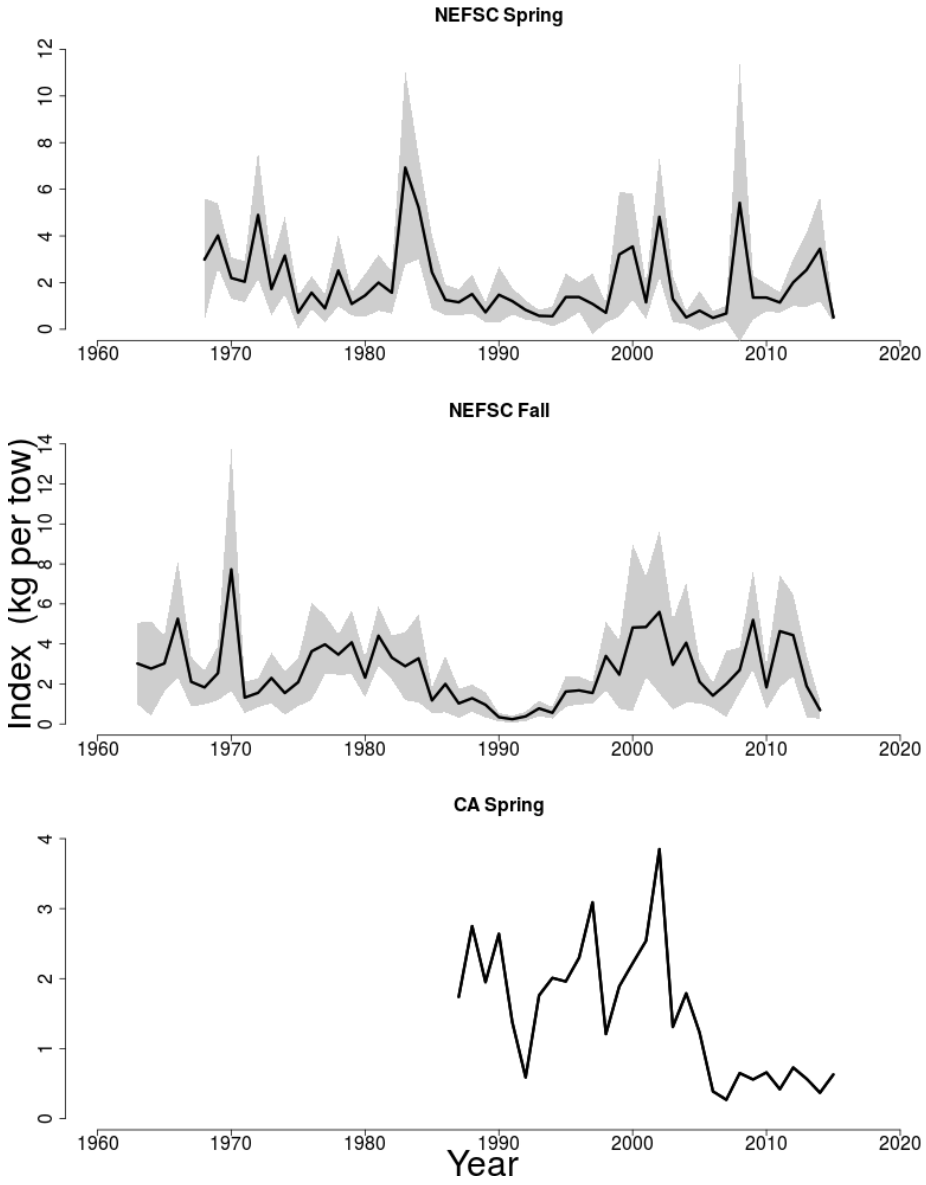

Figure B43: Indices of biomass for the Georges Bank Winter Flounder for the Northeast Fisheries Science Center (NEFSC) spring (1968-2015) and fall (1963-2014) bottom trawl surveys and the Canadian DFO spring survey (1987-2015). The approximate 90% normal confidence intervals are shown.

9 Southern New England Mid-Atlantic Winter Flounder

Anthony Wood

This assessment of the Southern New England Mid-Atlantic Winter Flounder (Pseudopleuronectes americanus) stock is an operational update of the existing 2011 benchmark ASAP assessment (NEFSC 2011). Based on the previous assessment the stock was overfished, but overfishing was not ocurring. This assessment updates commercial fishery catch data, recreational fishery catch data, and research survey indices of abundance, and the analytical ASAP assessment models and reference points through 2014. Additionally, stock projections have been updated through 2018

State of Stock: Based on this updated assessment, the Southern New England Mid-Atlantic Winter Flounder (*Pseudopleuronectes americanus*) stock is overfished but overfishing is not occurring (Figures **??**-**??**). Spawning stock biomass (SSB) in 2014 was estimated to be 6,151 (mt) which is 23% of the biomass target (26,928 mt), and 23% of the biomass threshold for an overfished stock ($SSB_{Threshold}$ = 13464 (mt); Figure **??**). The 2014 fully selected fishing mortality was estimated to be 0.16 which is 49% of the overfishing threshold (F_{MSY} = 0.325; Figure **??**). Retrospective adjustments were not made to the model results.

Table B29: Catch and status table for Southern New England Mid-Atlantic Winter Flounder. All weights are in (mt) recruitment is in (000s) and F_{Full} is the fishing mortality on fully selected ages (ages 4 and 5). Model results are from the current updated ASAP assessment.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
					Data					
Recreational discards	14	16	5	3	9	8	18	2	4	1
Recreational landings	124	136	116	73	87	28	65	31	7	30
Commercial discards	105	151	118	109	165	153	298	483	206	64
Commercial landings	1,320	1,720	1,628	1,113	271	174	150	134	857	658
Catch for Assessment	1,563	2,023	1,867	1,298	532	363	531	650	1,074	753
					Model Results					
Spawning Stock Biomass	5,021	5,517	6,338	5,552	5,038	5,806	6,946	7,116	7,077	6,151
F_{Full}	0.35	0.41	0.36	0.28	0.11	0.07	0.09	0.11	0.19	0.16
Recruits $age1$	13,244	7,368	6,212	9,422	7,416	7,070	5,365	5,281	2,633	4,906

Table B30: Comparison of reference points estimated in an earlier assessment and from the current assessment update. F_{MSY} was generated assuming a Beverton-Holt S-R relationship and an SSB_{MSY} proxy was used for the overfished threshold and was based on long-term stochastic projections. Recruitment estimates are median values of the time-series. 90% CI are shown in parentheses.

	2011	Current
F_{MSY}	0.290	0.325
SSB_{MSY} (mt)	43,661	26,928 (18,488 - 39,847)
MSY (mt)	11,728	7,831 (5,237 - 11,930)
Median recruits (age 1) (000s)	19,256	16,448
Overfishing	No	No
Overfished	Yes	Yes

Projections: Short term projections of biomass were derived by sampling from a cumulative distribution function of recruitment estimates assuming a Beverton-Holt stock recruitment relationship. The annual fishery selectivity, maturity ogive, and mean weights at age used in projection are the most recent 5 year averages; The model exhibited minor retrospective pattern in F and SSB so no retrospective adjustments were applied in the projections.

Table B31: Short term projections of total fishery catch and spawning stock biomass for Southern New England Mid-Atlantic Winter Flounder based on a harvest scenario of fishing at F_{MSY} between 2016 and 2018. Catch in 2015 was assumed to be 717 (mt), a value provided by GARFO (Dan Caless pers. comm.). 90% CI are shown next to SSB estimates.

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	717	5,439 (4,423 - 6,607)	0.183
2016	1,041	4,732 (3,827 - 5,774)	0.325
2017	973	3,782 (3,057 - 4,645)	0.325
2018	1,515	4,612 (3,267 - 7,339)	0.325

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  A large source of uncertainty is the estimate of natural mortality based on longevity, which is not well studied in Southern New England Mid-Atlantic Winter Flounder, and assumed constant over time. Natural mortality affects the scale of the biomass and fishing

mortality estimates. Natural mortality was adjusted upwards from 0.2 to 0.3 during the last benchmark assessment assuming a max age of 16. However, there is still uncertainty in the true max age of the population and the resulting natural mortality estimate. Other sources of uncertainty include length distribution of the recreational discards. The recreational discards, are a small component of the total catch, but the assessment suffers from very little length information used to characterize the recreational discards (1 to 2 lengths in recent years).

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Figure **??**).

  No retrospective adjustment of spawning stock biomass or fishing mortality in 2014 was required.

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for Southern New England Mid-Atlantic Winter Flounder are reasonably well determined. There is uncertainty in the estimates of M. In addition, while the retrospective pattern is considered minor (within the 90% CI of both F and SSB) the rho adjusted terminal value is very close to falling out of the bounds, becoming a major retrospective pattern. This would lead to retrospective adjustments being needed for the projections.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  No changes, other than the incorporation of new data were made to the Southern New England Mid-Atlantic Winter Flounder assessment for this update.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The stock status of Southern New England Mid-Atlantic Winter Flounder has not changed since the previous benchmark in 2011.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  The Southern New England Mid-Atlantic Winter Flounder assessment could be improved with additional studies on maximum age, as well additional information of recreational discard lengths. In addition, further investigation into the localized struture/genetics of the stock is warranted. Also, a future shift to ASAP version 4 will provide the ability to model envirionmental factors that may influence both survey catchability and the modeled S-R relationship

- Are there other important issues?

  None.

9.1 Reviewer Comments: Southern New England Mid-Atlantic Winter Flounder

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Smith, A. and S. Jones. 2008. In. Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3^{rd} Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii. http://www.nefsc.noaa.gov/publications/crd/crd0815/

Northeast Fisheries Science Center. 2011. 52^{nd} Northeast Regional Stock AssessmentWorkshop (52^{nd} SAW) Assessment Report. US Dept Commer, Northeast Fish SciCent Ref Doc. 11-17; 962 p. Available from: National Marine Fisheries Service, 166Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

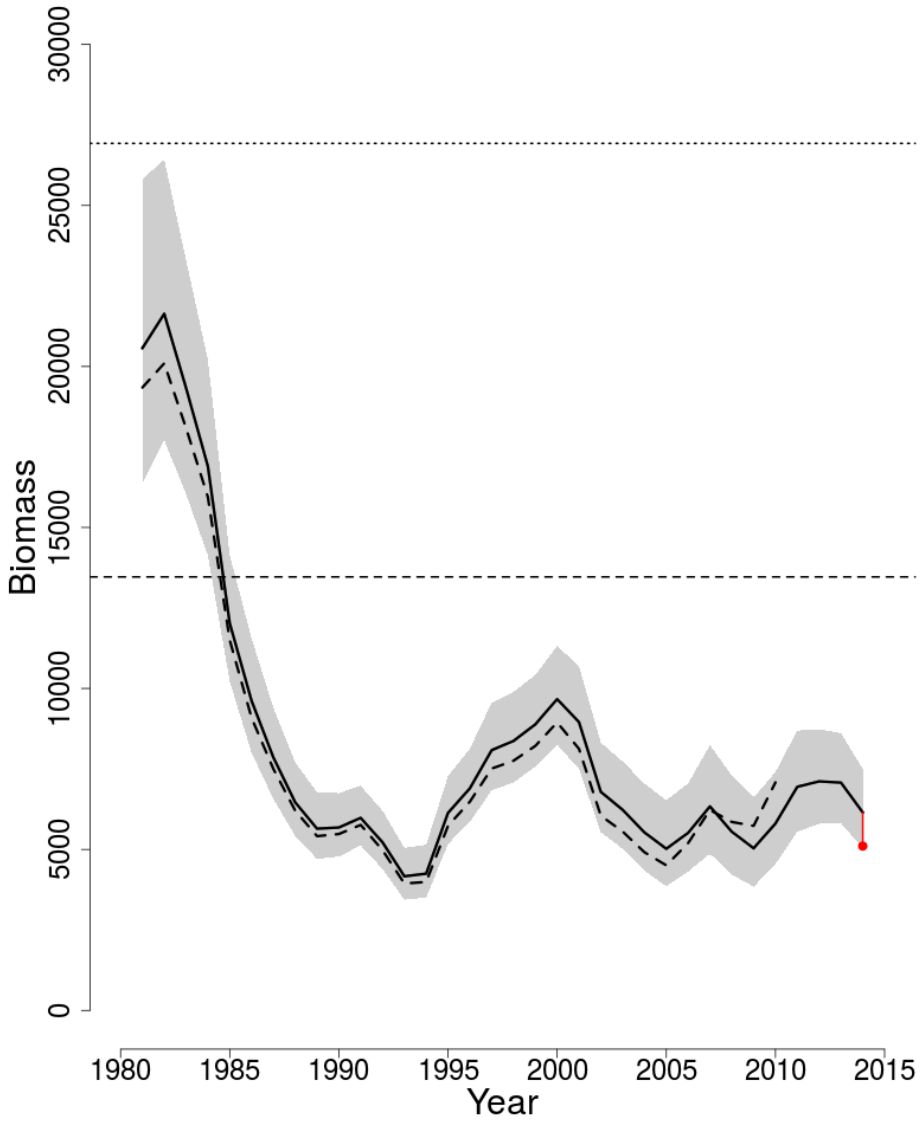

Figure B44: Trends in spawning stock biomass of Southern New England Mid-Atlantic Winter Flounder between 1981 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2015 assessment. The approximate 90% log-normal confidence intervals are shown.

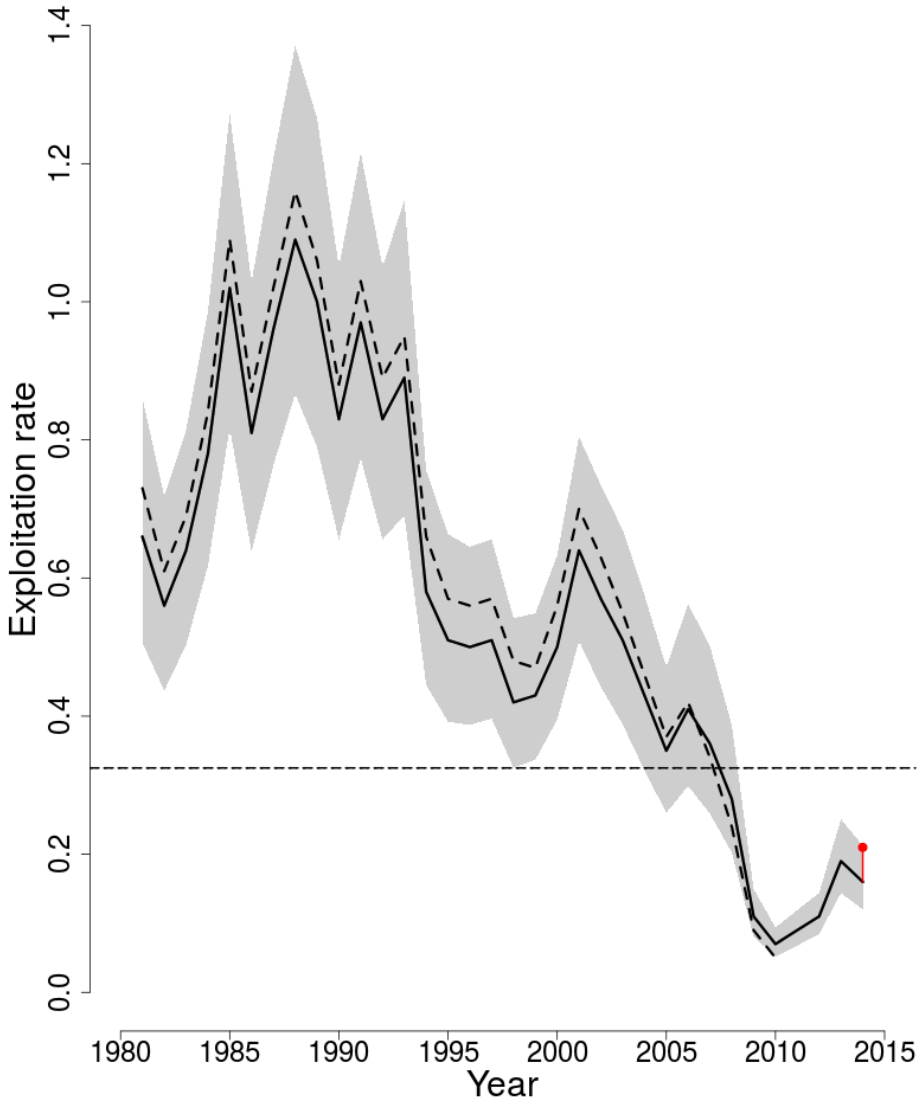

Figure B45: Trends in the fully selected fishing mortality (F_{Full}) of Southern New England Mid-Atlantic Winter Flounder between 1981 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY}=0.325; horizontal dashed line) based on the 2015 assessment. The approximate 90% lognormal confidence intervals are shown.

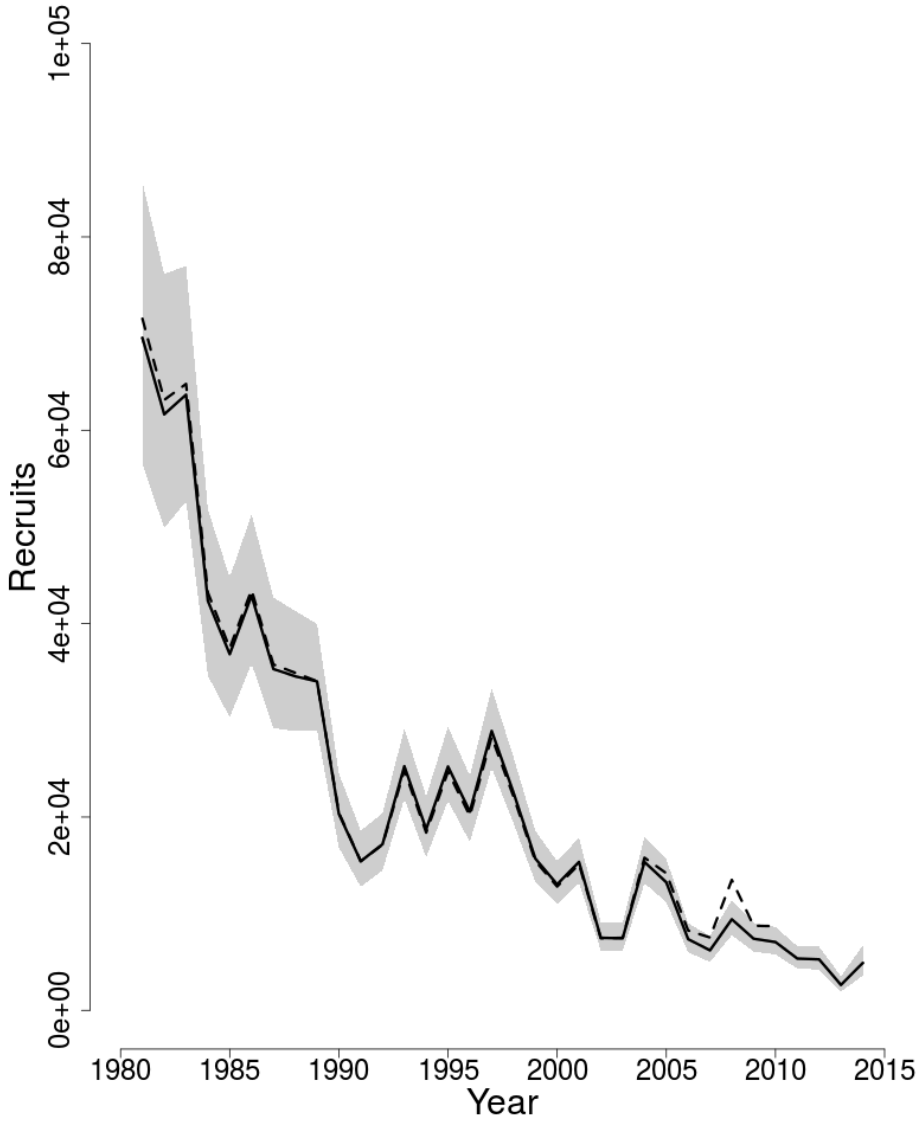

Figure B46: Trends in Recruits (age 1) (000s) of Southern New England Mid-Atlantic Winter Flounder between 1981 and 2014 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

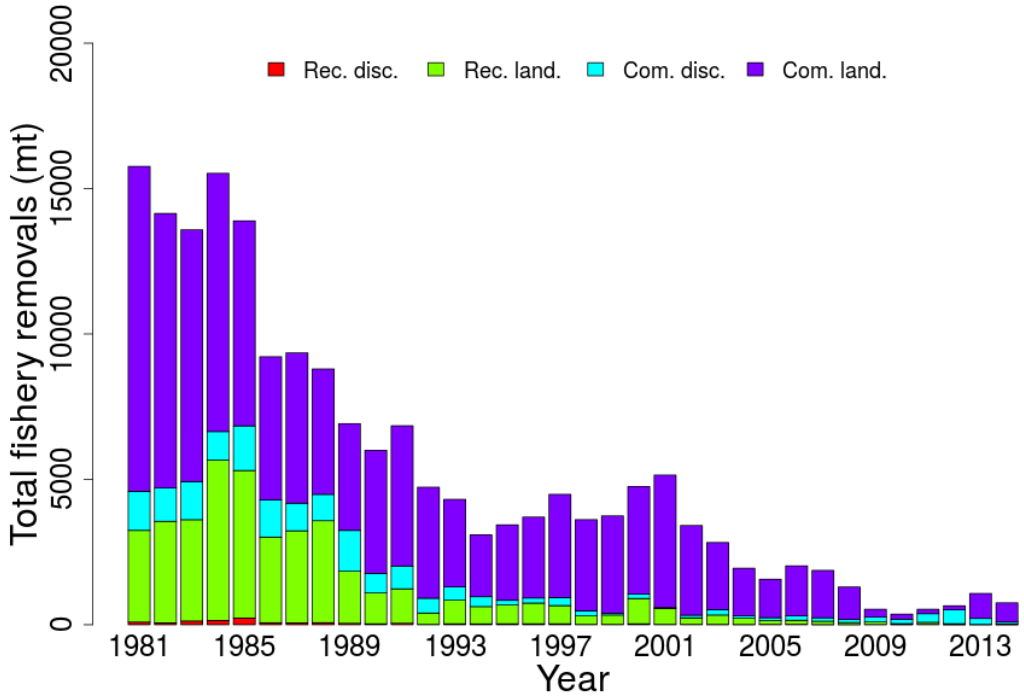

Figure B47: Total catch of Southern New England Mid-Atlantic Winter Flounder between 1981 and 2014 by fleet (commercial, recreational) and disposition (landings and discards).

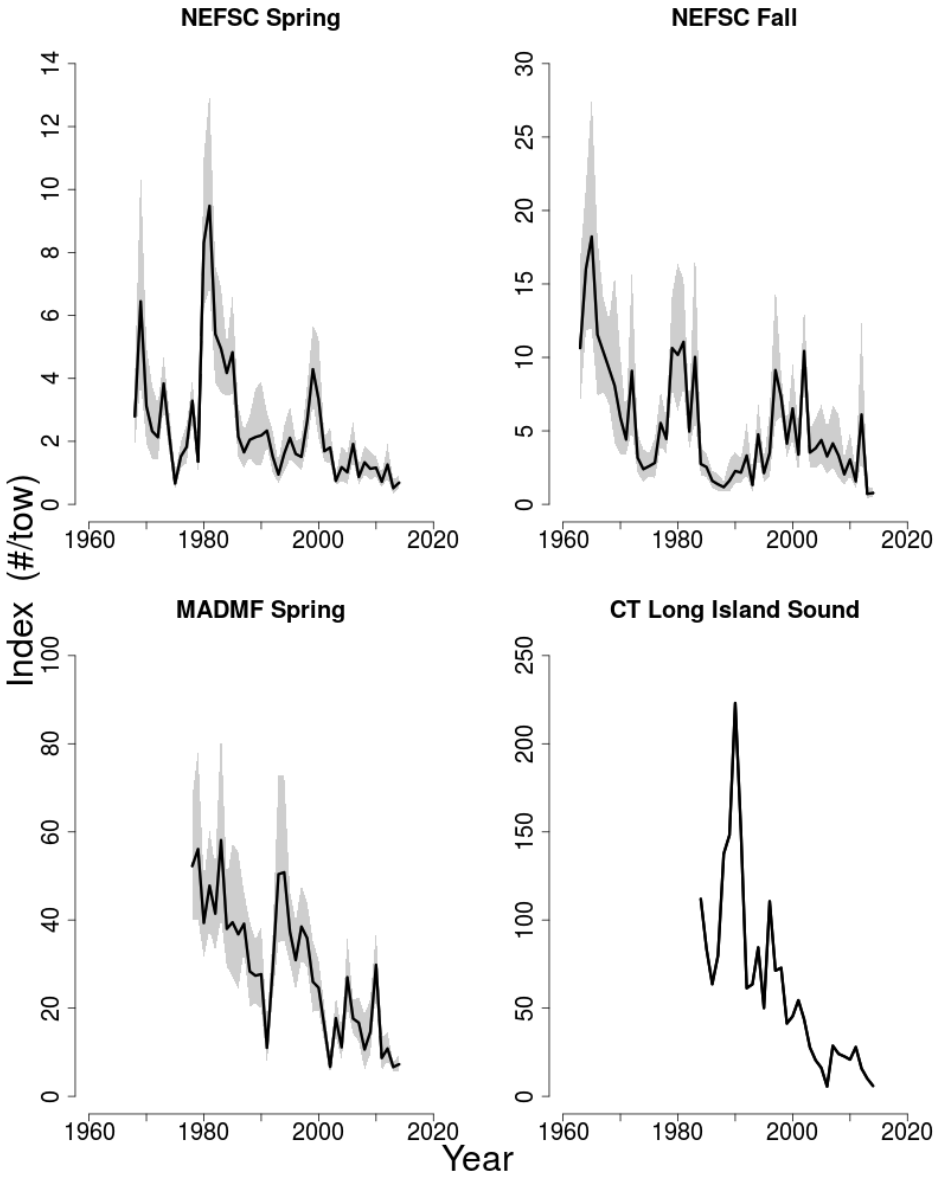

Figure B48: Indices of biomass for the Southern New England Mid-Atlantic Winter Flounder between 1963 and 2014 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys, the MADMF spring survey, and the CT LISTS survey The approximate 90% lognormal confidence intervals are shown.

10 Gulf of Maine-Georges Bank American Plaice

Loretta O'Brien

This assessment of the Gulf of Maine-Georges Bank American Plaice (Hippoglossoides platessoides) stock is an operational update of the existing 2012 benchmark assessment (O'Brien et al. 2012). Based on the previous assessment the stock was not overfished, and overfishing was not ocurring. This 2015 assessment updates commercial fishery catch data, research survey indices of abundance, the analytical VPA assessment model, and reference points through 2014. Additionally, stock projections have been updated through 2018.

State of Stock: Based on this updated assessment, the Gulf of Maine-Georges Bank American Plaice (*Hippoglossoides platessoides*) stock is not overfished and overfishing is not occurring (Figures **??**-**??**). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2014 was estimated to be 10,915 mt which is 83% of the biomass target for this stock (SSB_{MSY} *proxy* = 13,107; Figure **??**). The 2014 fully selected fishing mortality was estimated to be 0.118 which is 60% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.196; Figure **??**).

Table B32: Catch and model results for Gulf of Maine-Georges Bank American Plaice. All weights are in (mt), recruitment is in (000s), and F_{Full} is the fishing mortality on fully selected ages (ages 6-9). Model results are from the current updated VPA assessment.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
					Data					
GM Commercial landings	752	583	601	703	866	901	771	762	764	738
GM Commercial discards	213	142	82	113	115	239	96	161	88	36
GB Commercial landings	574	504	377	388	501	492	595	699	528	498
GB Commercial discards	76	144	164	144	274	154	0	0	0	0
SNE landings	16	18	12	9	13	11	3	1	5	3
CA landings	5	11	2	0	0	0	1	0	0	0
Catch for Assessment	1,636	1,402	1,239	1,357	1,770	1,797	1,467	1,624	1,385	1,275
					Model Results					
Spawning Stock Biomass	5,145	6,118	8,079	11,193	12,988	13,990	14,937	14,811	14,427	14,543
F_{Full}	0.33	0.28	0.13	0.17	0.2	0.14	0.11	0.13	0.1	0.08
Recruits $age1$	29,643	40,420	16,684	23,538	14,199	8,655	12,495	9,184	11,302	30,333

Table B33: Comparison of reference points estimated in the previous assessment and from the current assessment update. An $F_{40\%}$ proxy was used for the overfishing threshold and was based on long-term stochastic projections.

	2012	Current
F_{MSY} *proxy*	0.179	0.196
SSB_{MSY} (mt)	18,398	13,107 (10,142-16,951)
MSY (mt)	3,385	2,675 (2,071 - 3,456)
Median recruits (age 1) (000s)	24,504	22,514
Overfishing	No	No
Overfished	No	No

Projections: Short term projections of biomass were derived by sampling from an empirical cumulative distribution function of 34 recruitment estimates from VPA model results. The annual fishery selectivity, maturity ogive, and mean weights at age used in projections are the most recent 5 year averages; retrospective adjustments were applied in the projections.

Table B34: Short term projections of total fishery catch and spawning stock biomass for Gulf of Maine-Georges Bank American Plaice based on a harvest scenario of fishing at F_{MSY} *proxy* between 2016 and 2018. Catch in 2015 was assumed to be 1,395 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	1,395	8,948 (7,858 - 10,160)	0.156
2016	1,695	8,645 (7,506 - 9,863)	0.196
2017	1,686	8,325 (7,163 - 9,697)	0.196
2018	1,722	8,710 (7,136 - 11,184)	0.196

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  A source of uncertainty in this assessment are the estimates of historical landings at age, prior to 1984, and the magnitude of historical discards, prior to 1989. Both of these affect the scale of the biomass and fishing mortality estimates, and influence reference point estimations.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Figure **??**).

  The 7-year Mohn's ρ, relative to SSB, was 0.63 in the 2012 assessment and was 0.32 in 2014. The 7-year Mohn's ρ, relative to F, was -0.35 in the 2012 assessment and was 0.32 in 2014. There was a major retrospective pattern for this assessment because the ρ adjusted

estimates of 2014 SSB (SSB_ρ=10,915) and 2014 F (F_ρ=0.118) were outside the approximate 90% confidence regions around SSB (12,742 - 16,439) and F (0.069 - 0.093). A retrospective adjustment was made for both the determination of stock status and for projections of catch in 2016. The retrospective adjustment changed the 2014 SSB from 14,543 to 10,915 and the 2014 F_{Full} from 0.08 to 0.118.

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for Gulf of Maine-Georges Bank American Plaice are reasonably well determined.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the effect these changes had on the assessment and stock status.

  No major changes, other than the addition of recent years of data, were made to the Gulf of Maine-Georges Bank American Plaice assessment for this update. A new version of VPA was used (V3.3.0) which gave very similar results to the 2012 VPA 3.1.0 run, with the same F and slightly lower SSB. The MADMF spring and autumn survey indices were re-estimated for the time series, accounting for revised stratum areas. The revision occurred in 2007, but was overlooked in the 2012 assessment. A comparison of 2010 terminal year VPAs indicated minimal differences in 2010 SSB (now slightly lower) and no change in F.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  As in recent assessments for Gulf of Maine-Georges Bank American Plaice the stock status remains as not overfished and overfishing not occurring.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  The Gulf of Maine-Georges Bank American Plaice assessment could be improved with updated studies on growth of Georges Bank and Gulf of Maine fish.

- Are there other important issues?

  A difference in growth between GM and GB fish has been documented, however, historical catch data information for GB may not be sufficient to conduct a separate assessment. Also, the growth difference may not persist in the most recent years. This could all be explored further in an benchmark review.

10.1 Reviewer Comments: Gulf of Maine-Georges Bank American Plaice

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

O'Brien, L. and J. Dayton (2012). E. Gulf of Maine - Georges Bank American plaice Assessment for 2012 in Northeast Fisheries Science Center, 2012, Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-06; 789 p. http://www.nefsc.noaa.gov/publications/crd/crd1206/.

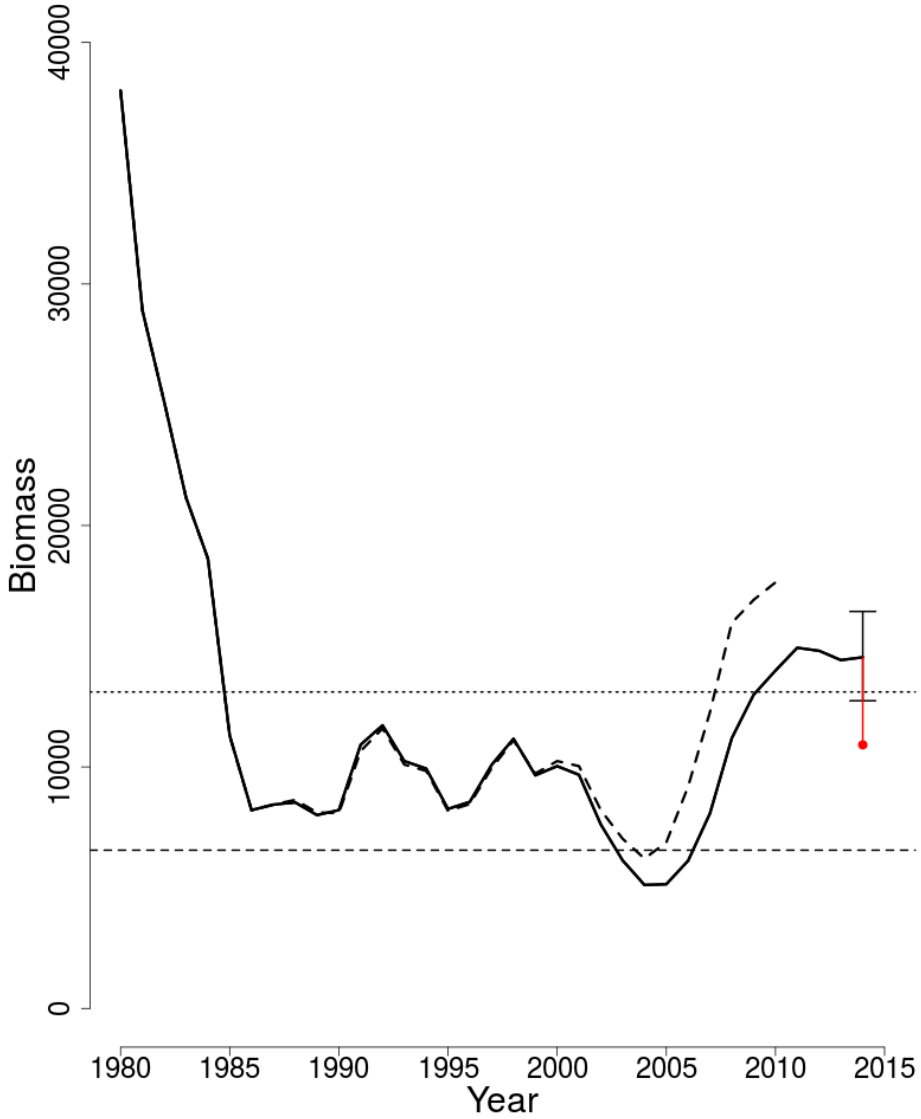

Figure B49: Trends in spawning stock biomass of Gulf of Maine-Georges Bank American Plaice between 1980 and 2015 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY} *proxy*; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} *proxy*; horizontal dotted line) based on the 2015 assessment. Biomass was adjusted for a retrospective pattern and the adjustment is shown in red. The approximate 90% normal confidence intervals are shown.

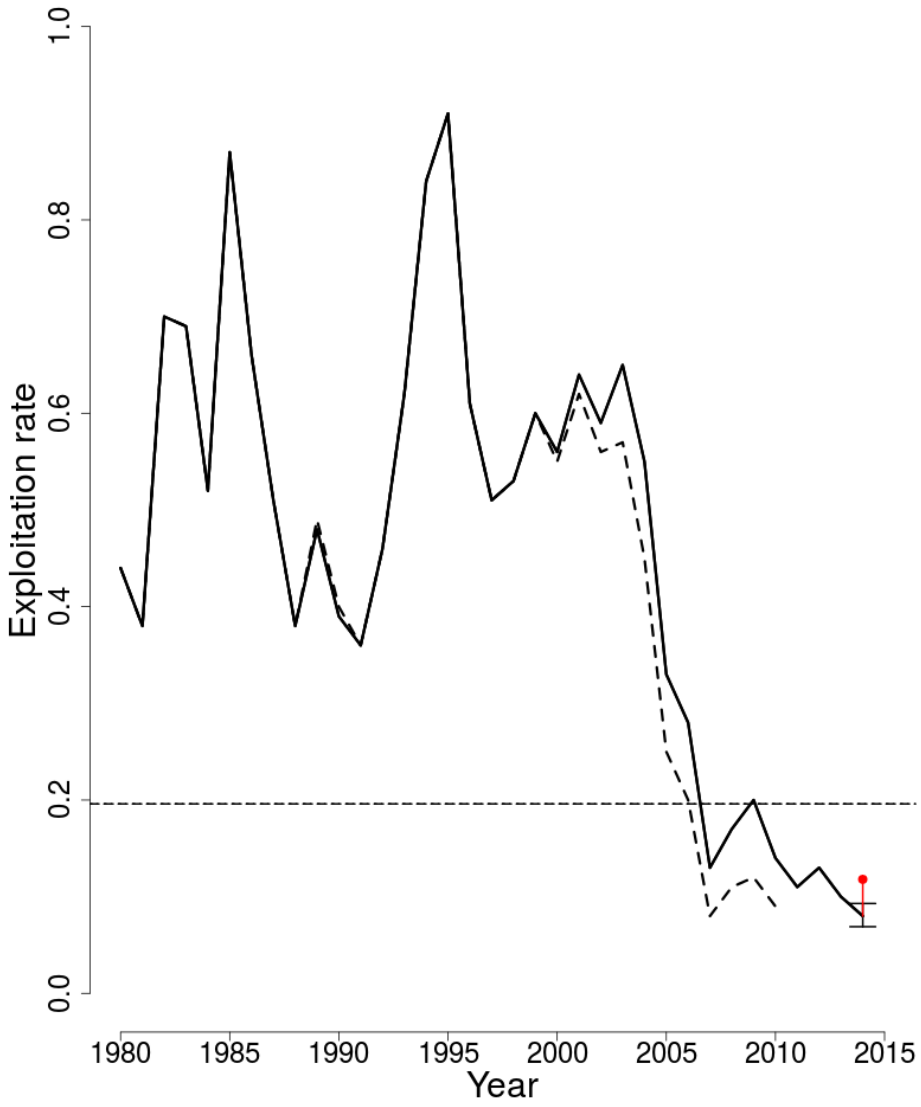

Figure B50: Trends in the fully selected fishing mortality (F_{Full}) of Gulf of Maine-Georges Bank American Plaice between 1980 and 2015 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} *proxy*=0.196; horizontal dashed line). F_{Full} was adjusted for a retrospective pattern and the adjustment is shown in red, based on the 2015 assessment. The approximate 90% normal confidence intervals are shown.

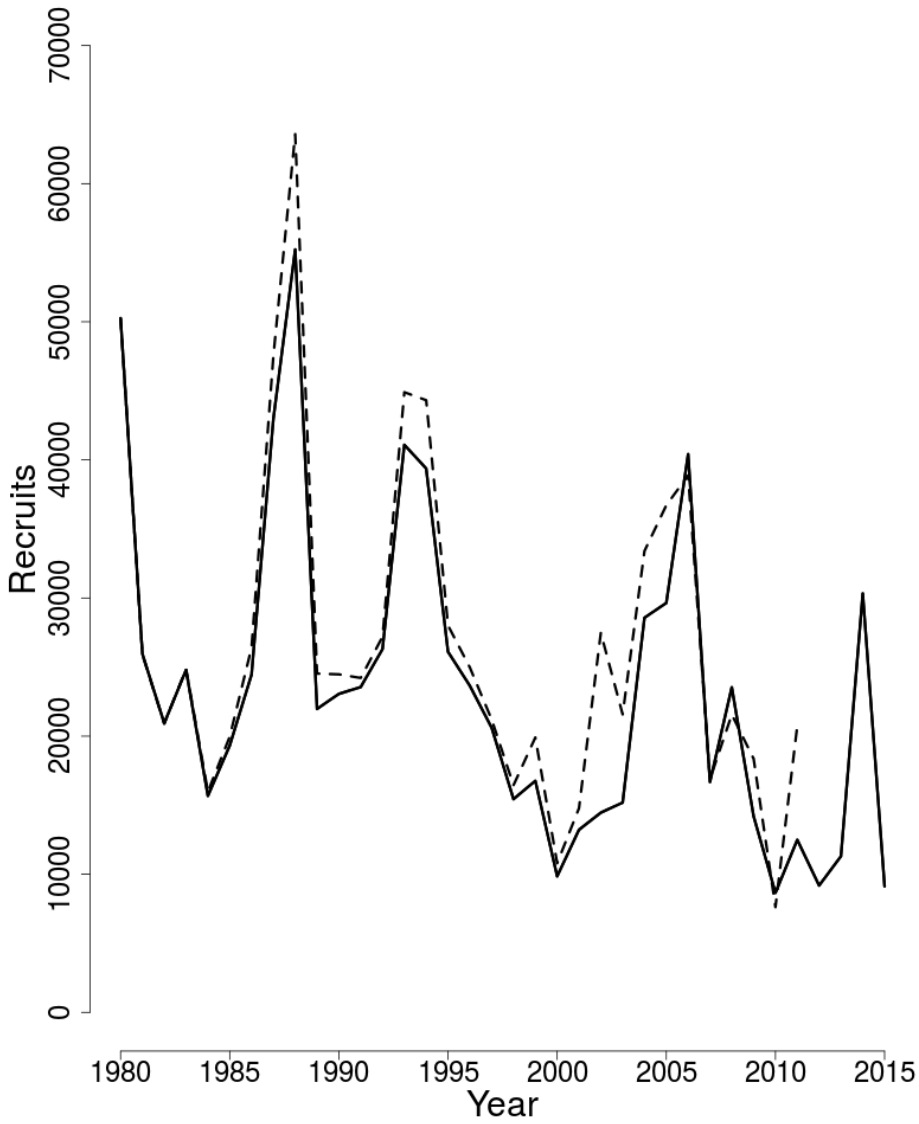

Figure B51: Trends in Recruits (age 1) (000s) of Gulf of Maine-Georges Bank American Plaice between 1980 and 2015 from the current (solid line) and previous (dashed line) assessment.

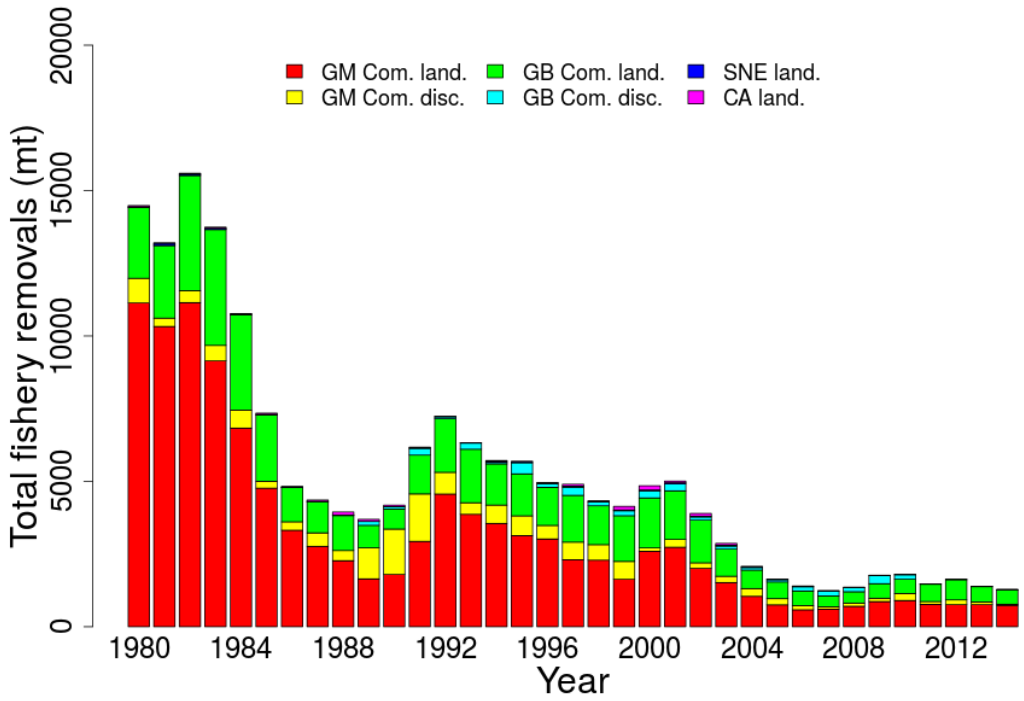

Figure B52: Total catch of Gulf of Maine-Georges Bank American Plaice between 1980 and 2015 by fleet (Gulf of Maine, Georges Bank, Southern New England, and Canadian) and disposition (landings and discards).

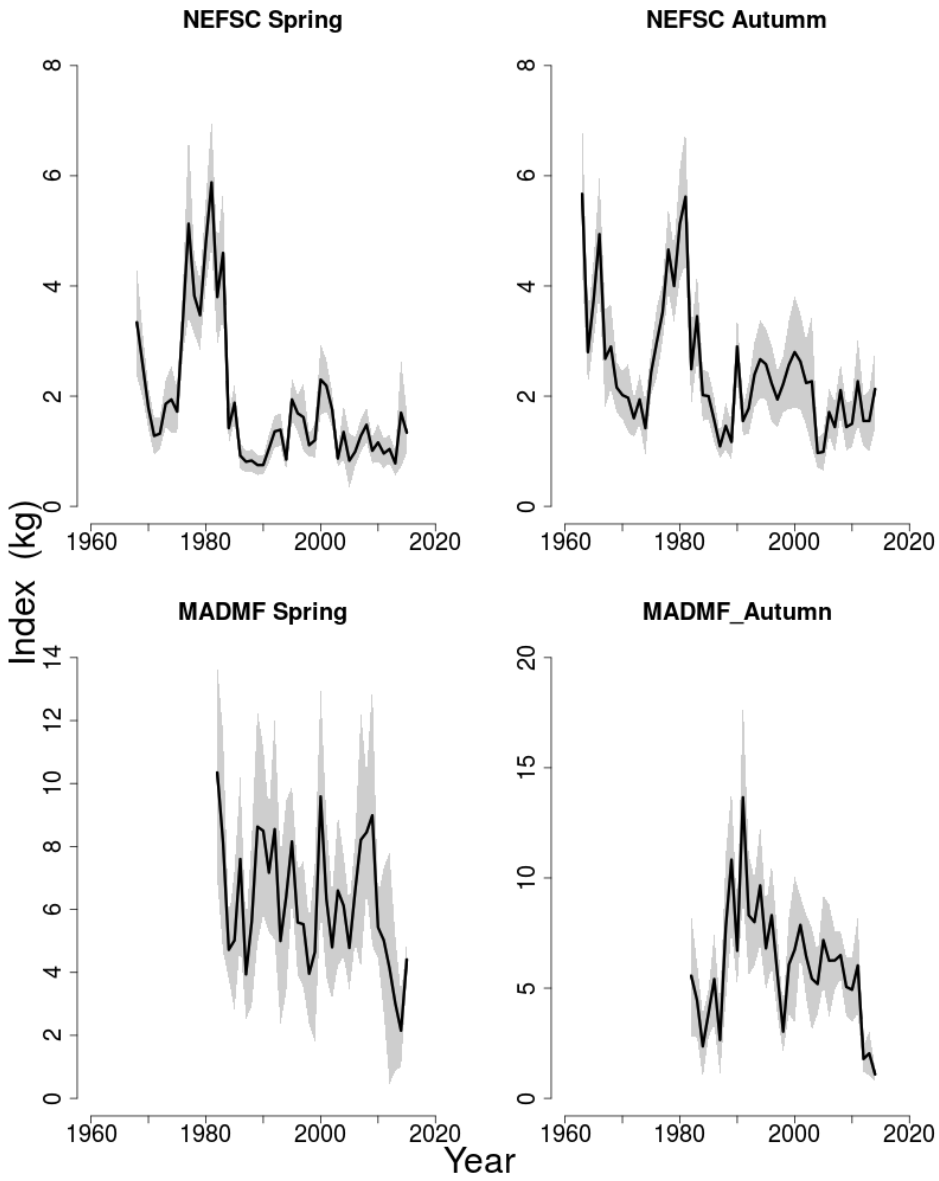

Figure B53: Indices of biomass for the Gulf of Maine-Georges Bank American Plaice between 1963 and 2015 for the Northeast Fisheries Science Center (NEFSC) and Massachusetts Division of Marine Fisheries (MADMF) spring and autumn research bottom trawl surveys. The approximate 90% normal confidence intervals are shown.

11 Witch flounder

Susan Wigley

This assessment of the witch flounder (Glyptocephalus cynoglossus) stock is an operational update of the 2012 assessment (NEFSC 2012) and the 2008 benchmark assessment (NEFSC 2008). This assessment updates commercial fishery catch data, research survey indices, and the analytical assessment model through 2014. Additionally, stock projections have been updated through 2018. Reference points have been updated.

State of Stock: witch flounder (*Glyptocephalus cynoglossus*) stock is overfished and overfishing is occurring (Figures **??**-**??**). Retrospective adjustments were made to the model results. Spawning stock biomass (SSB) in 2014 was estimated to be 2,077 (mt) which is 22% of the SSB_{MSY} proxy (9,473; Figure **??**). The 2014 fully selected fishing mortality was estimated to be 0.687 which is 246% of the F_{MSY} proxy (0.279; Figure **??**). A retrospective adjustment to F_{Full} and SSB in 2014 was required but did not lead to a change in status.

Table B35: Catch and model results table for witch flounder. All weights are in (mt), recruitment is in (000s). In this report, F_{Full} is defined as the average fishing mortality on ages 8 and 9 (unweighted). The 2014 retrospective adjusted values for F_{Full} and SSB are 0.687 and 2,077, respectively.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
						Data					
Commercial Landings	2,917	2,652	1,863	1,076	1,009	954	759	870	1,038	686	570
Commercial Discards	312	148	86	89	63	105	90	74	70	50	35
Catch for Assessment	3,229	2,800	1,949	1,165	1,072	1,059	850	944	1,108	737	604
						Model Results					
Spawning Stock Biomass	4,167	3,642	2,592	2,395	2,571	2,653	2,363	2,309	2,477	2,494	3,129
F_{Full}	0.936	0.859	0.899	0.568	0.658	0.583	0.671	0.633	0.78	0.637	0.428
Recruits $Age3$	4,268	3,546	3,619	4,992	4,713	3,730	3,229	5,388	7,740	3,876	10,160

Table B36: Biological references points for witch flounder from the previous and current assessments are given. An $F_{40\%}$ proxy was used for the overfishing threshold and biomass and catch proxies were based on long-term stochastic projections.

	2012	Current
F_{MSY}	0.27	0.279
SSB_{MSY} (mt)	10,051	9,473
MSY (mt)	2,075	1,957
Median Recruits Age 3 (000s)	9,301	8,517

Overfishing	Yes	Yes
Overfished	Yes	Yes

Projections: Short term projection recruitment was sampled from a cumulative distribution function derived from ADAPT VPA (with split time series between 1994 and 1995) estimated age 3 recruitment between 1982 and 2013. Average 2010-2014 partial recruitment, average 2010-2014 mean weights, and maturation ogive representing 2011-2015 maturity data were used.

Table B37: Short term projections of median total fishery yield and spawning stock biomass for witch flounder based a harvest scenario of fishing at F_{MSY} between 2016 and 2018. Catch in 2015 has been estimated at 637 mt; initial 2015 stock sizes for ages 3 to 11+. The SSB retrospective adjustment factor (0.6638) was applied to all ages.

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	637	2556	0.437
2016	513	3201	0.279
2017	712	4143	0.279
2018	879	5163	0.279

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  An important source of uncertainty is the retrospective pattern where fishing mortality is underestimated and spawning stock biomass and recruitment are overestimated.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}).

  The 7-year Mohn's ρ, relative to SSB, was 0.61 in the 2012 assessment and was 0.51 in 2014. The 7-year Mohn's ρ, relative to F, was -0.33 in the 2012 assessment and was -0.38 in 2014. There was a major retrospective pattern for this assessment because the ρ adjusted estimates of 2014 SSB (SSB_{ρ}=2,077) and 2014 F (F_{ρ}=0.687) were outside the approximate 90% confidence regions around SSB (2,643 - 3,864) and F (0.321 - 0.603). A retrospective adjustment was made for both the determination of stock status and for projections of catch in 2016. The retrospective adjustment changed the 2014 SSB from 3,129 to 2,077 and the 2014 F_{Full} from 0.428 to 0.687.

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for witch flounder appear to be optimistic; the projected rho adjusted biomass from the last assessment was above the upper confidence bounds of the projected rho adjusted biomass estimated in the current assessment.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the effect these changes had on the assessment and stock status.

  TOGA (Type, Operation, Gear, Acquisition) values were used for haul criteria for NEFSC surveys for 2009 onward and minor changes in the use of observer data for discard estimates were made to the current witch flounder assessment. These changes had negligible effect on the assessment and stock status.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  No change in stock status has occurred for witch flounder since the previous assessment.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  Extensive studies have examined the causes of retrospective patterns with no definitive conclusions other than a change in model does not resolve the issue.

- Are there other important comments?

  The VPA analysis was performed with survey time series split between 1994 and 1995. This time split corresponds to changes in the commercial reporting methods as well as other regulatory management changes.

11.1 Reviewer Comments: Witch flounder

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3^{rd} Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii. http://www.nefsc.noaa.gov/publications/crd/crd0815/

Northeast Fisheries Science Center. 2012. Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 12-06; 789 p. http://www.nefsc.noaa.gov/publications/crd/crd1206/

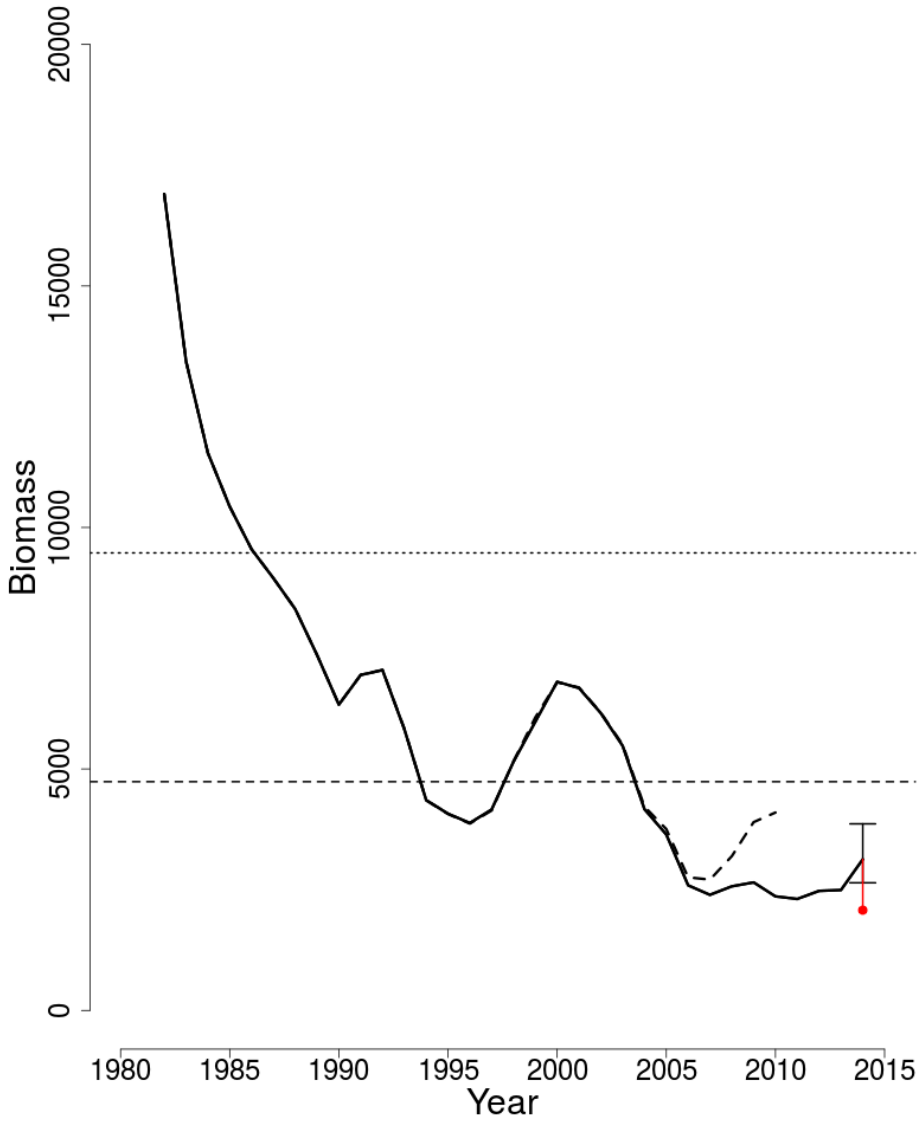

Figure B54: Trends in spawning stock biomass (mt) of witch flounder between 1982 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2}$ SSB_{MSY}; horizontal dashed line) as well as SSB_{Target} SSB_{MSY}; horizontal dotted line) based on the current assessment. Red solid vertical line indicates rho adjusted SSB. Black solid vertical line indicates 90% confidence interval for 2014.

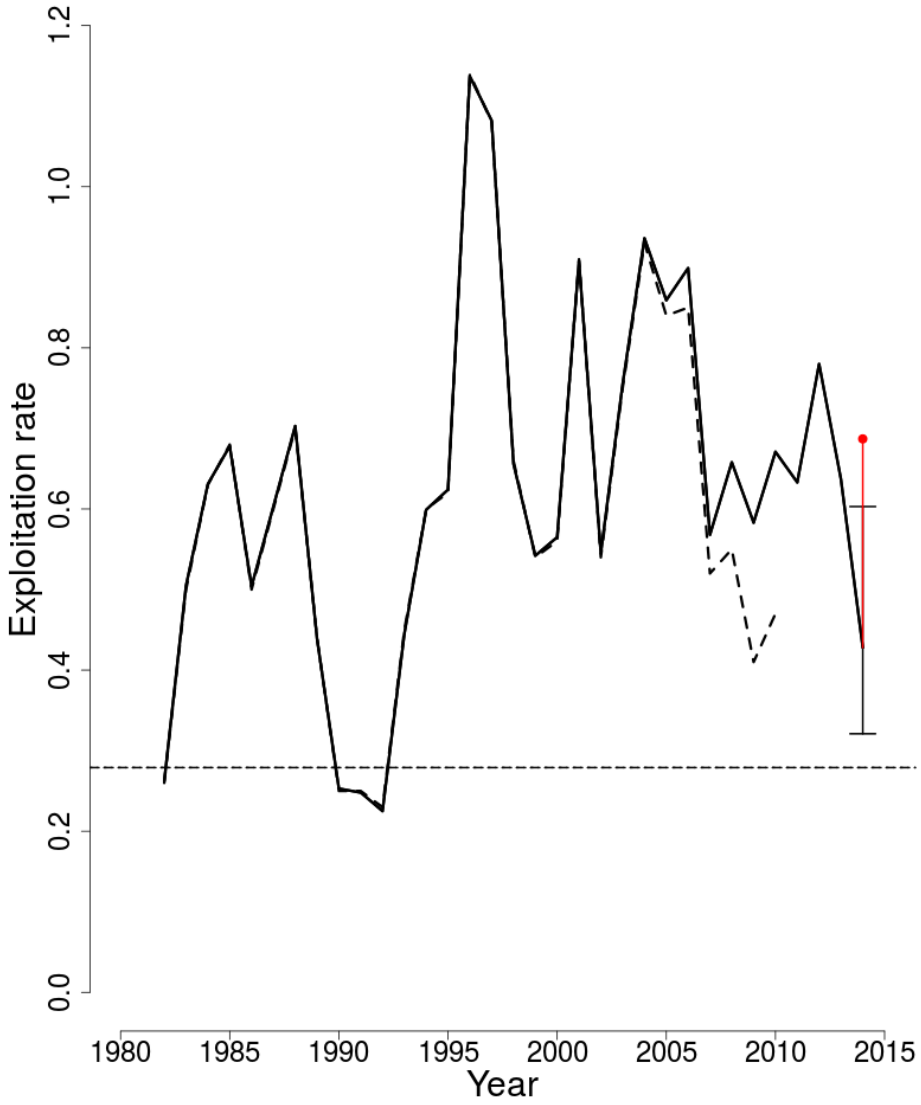

Figure B55: Trends in the fully selected fishing mortality (F_{Full}) of witch flounder between 1982 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY}=0.279; horizontal dashed line) based on the current assessment. Red solid vertical line indicates rho adjusted F_{Full}. Black solid vertical line indicates 90% confidence interval for 2014.

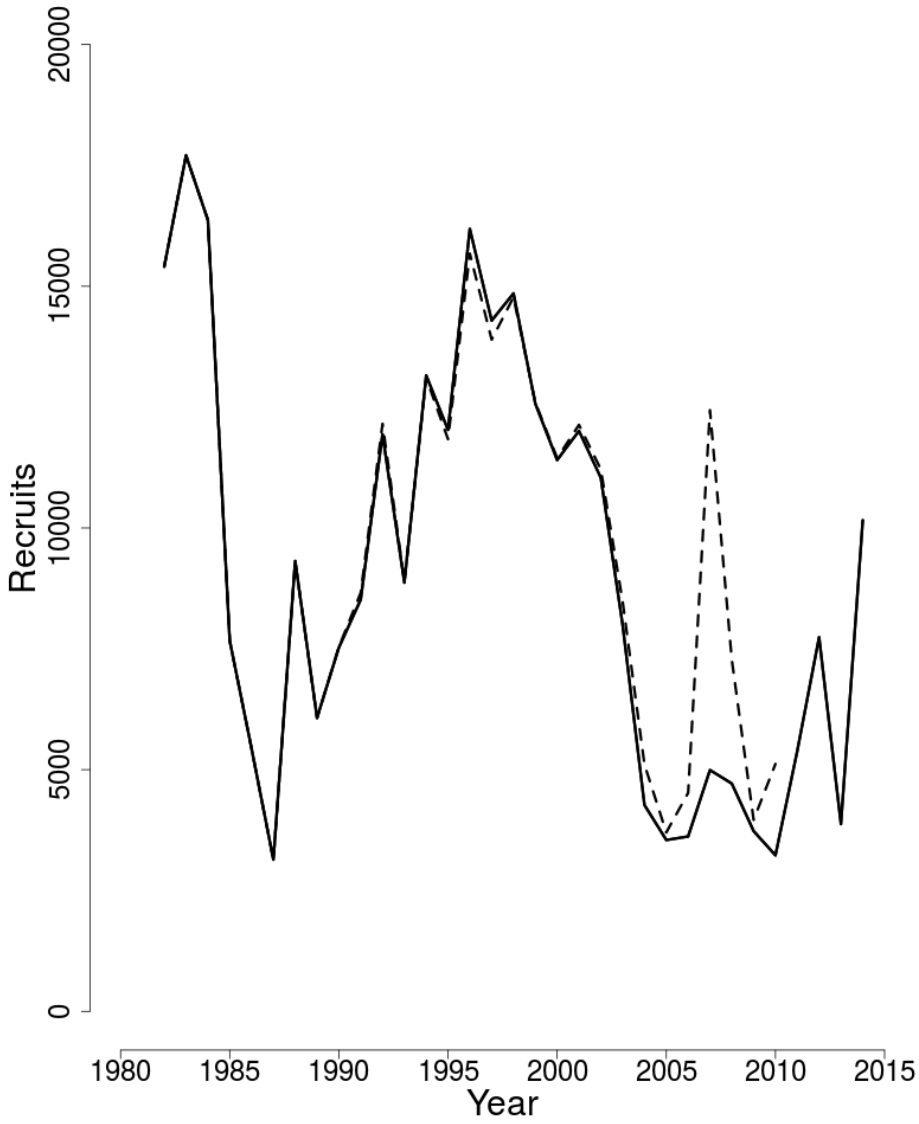

Figure B56: Trends in Age 3 (000s) of witch flounder between 1982 and 2014 from the current (solid line) and previous (dashed line) assessment.

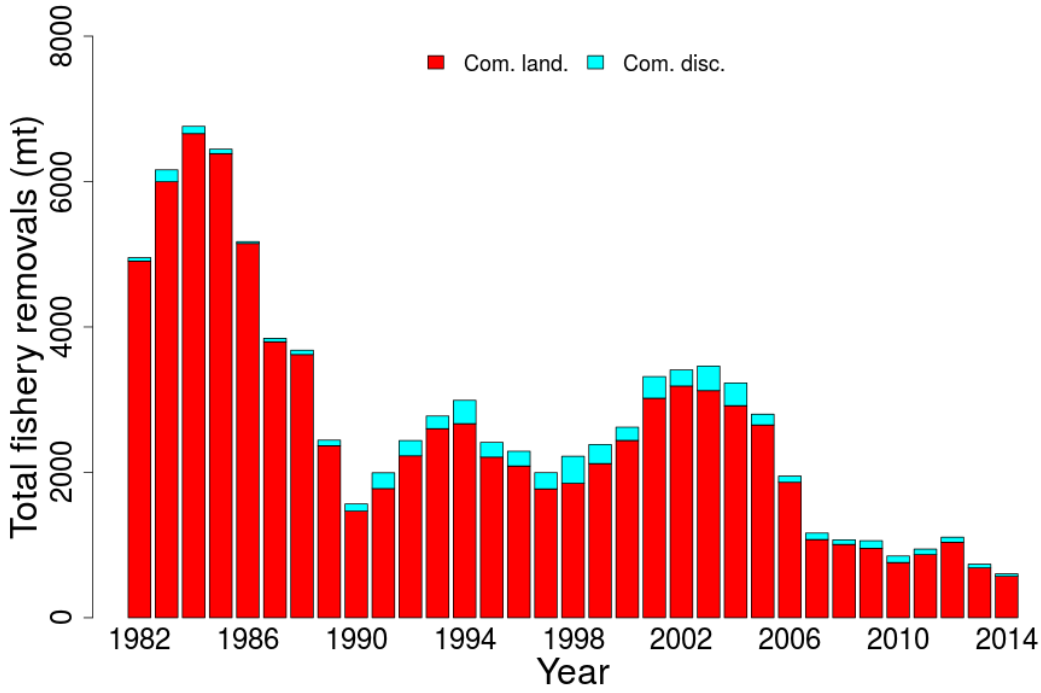

Figure B57: Total catch of witch flounder between 1982 and 2014 by fleet (commercial) and disposition (landings and discards).

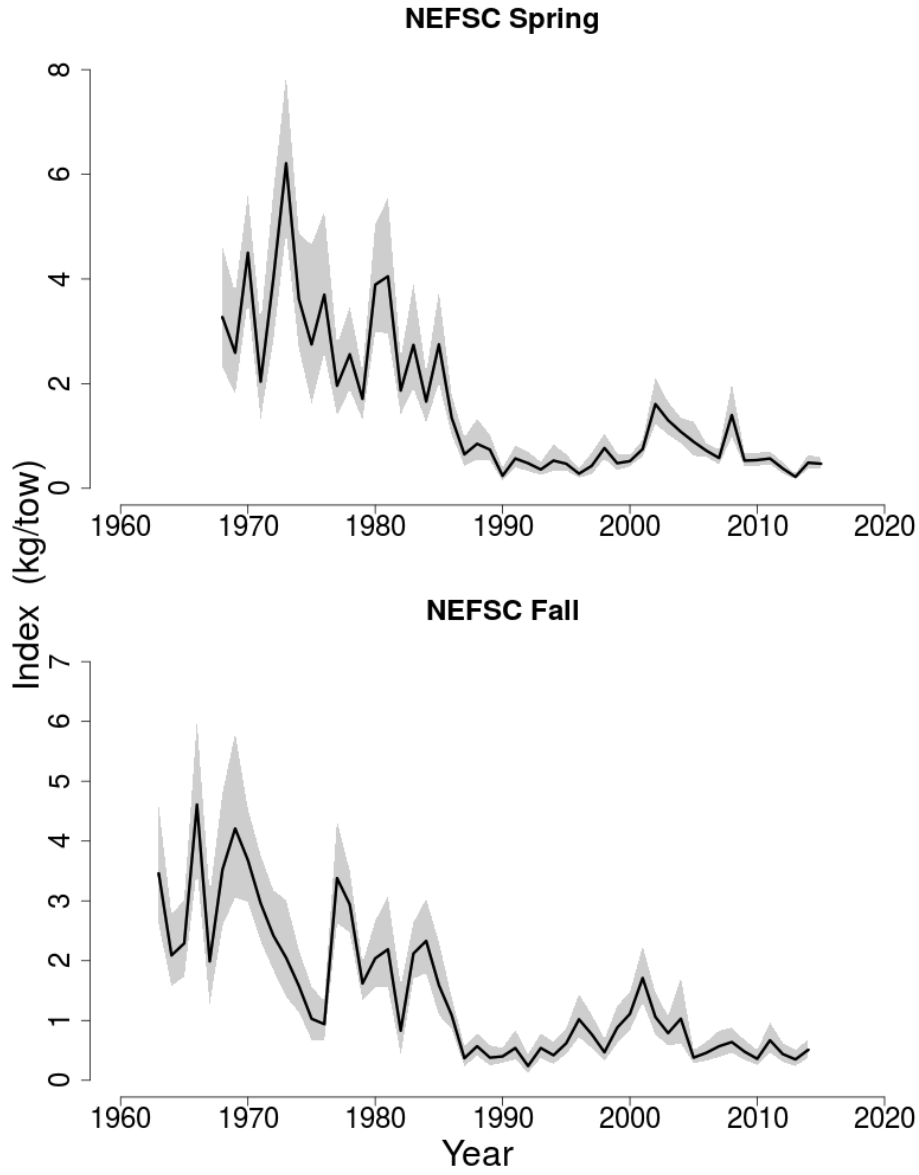

Figure B58: Indices of biomass (kg/tow) for the witch flounder between 1963 and 2015 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys. The 90% lognormal confidence intervals are shown.

12 Atlantic halibut

Daniel Hennen

This assessment of the Atlantic halibut (Hippoglossus hippoglossus) stock is an update of the existing 2012 benchmark assessment (NEFSC 2010) and the last update assessment (NEFSC 2012). This assessment updates commercial fishery catch data, research survey indices of abundance, and the replacement yield assessment model through 2014. Additionally, stock projections have been updated through 2018. Reference points have not been updated.

State of Stock: Based on this updated assessment, Atlantic halibut (*Hippoglossus hippoglossus*) stock is unknown and unknown (Figures **??-??**). Retrospective adjustments were not made to the model results. Biomass (SSB) in 2014 was estimated to be 96,464 (mt) which is 199% of the biomass target (SSB_{MSY} *proxy* = 48,509; Figure **??**). The 2014 fully selected fishing mortality was estimated to be 0.001 which is 1% of the overfishing threshold proxy (F_{MSY} *proxy* = 0.073; Figure **??**).

Table B38: Catch and status table for Atlantic halibut. All weights are in (mt) and F_{Full} is the fishing mortality on fully selected ages.

	2007	2008	2009	2010	2011	2012	2013	2014
				Data				
Commercial landings	25	29	45	20	26	35	35	45
Commercial discards	30	34	54	24	31	42	42	54
CA landings	40	32	22	23	29	32	38	33
Catch for Assessment	95	96	121	67	86	109	115	132
				Model Results				
Biomass	96,641	96,607	96,578	96,527	96,538	96,528	96,497	96,464
F_{Full}	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Table B39: An F_{MSY} *proxy* ($F_{0.1}$) was used for the overfishing threshold. The biomass target and threshold were based on the B_{MSY} *proxy* (estimated carrying capacity), B_{Target}= B_{MSY} *proxy* and $B_{Threshold}$= $\frac{1}{2}$ B_{MSY} *proxy*.

	2012	Current
F_{MSY} *proxy*	0.073	0.073
SSB_{MSY} (mt)	48,509	48,509
MSY (mt)	3,546	3,546
Overfishing	No	Unknown
Overfished	Yes	Unknown

Projections: Short term projections were based on a constant F = F_{MSY} *proxy* = 0.073. Projections use the assessment model (replacement yield) and maintain all other model assumptions.

Table B40: Short term projections of catch and biomass for Atlantic halibut based on a harvest scenario of fishing at F_{MSY} *proxy*=0.073 between 2016 and 2018.

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	124	96147	0.001
2016	7025	96156	0.073
2017	6521	89262	0.073
2018	6121	83788	0.073

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The assessment model used for Atlantic halibut is highly uncertain. It estimates one parameter, the initial biomass, and proceeds deterministically from 1800 to 2014. The model is highly sensitive to the initial biomass. The model is tuned to the survey index, which is inefficient for Atlantic halibut, catches very few animals and is therefore noisy. The RYM model assumes no immigration or emmigration and that the population both began, and tends to, equilibrium. These assumptions are unlikely to be true for Atlantic halibut. The model estimates a biomass that is approximately equal to unfished biomass, which is not credible. Catch has been very low for at least 100 years relative to the landings reported early in the time series, despite a strong market and high value relative to other groundfish. The low catch throughout the century implies that the Atlantic halibut stock is very likely depleted relative to it's unfished condition and is therefore likely to be overfished, even if its current biomass is unknown.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Figure **??**).

  The model used to determine the status of this stock does not allow estimation of a retrospective pattern.

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for Atlantic halibut are uncertain because biomass cannot be reasonably determined using the current assessment model.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  The catch data were slightly altered due to the exclusion of catch made in international waters and the re-estiamtion of average discard ratio after 1998 (due to the incorporation of more years of data).

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The overfishing and overfished status of Atlantic halibut cannot be determined using the current assessment. This occurred because diagnostics showed the model was unreliable.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  The Atlantic halibut assessment could be improved with additional studies on stock structure, additional age and length data, a more precise and accurrate survey, and an investigation of alternate assessment models.

- Are there other important issues?

  Atlantic halibut are clearly depleted relative to their unfished state. Catches have been far below historical landings for more than 100 years, despite a lack of regulation before 1999 and a strong commercial market. The current assessment model implies that Atlantic halibut is near or above its unfished biomass and could support removals commensurate with MSY. The current assessment should probably not be used to inform management decisions.

12.1 Reviewer Comments: Atlantic halibut

The halibut assessment was truly awful
Reviewer 1

The halibut assessment should be used as toilet paper because it has no other purpose I can find.
Reviewer 2

At least the GOM Cod assessment was pretty good.
Reviewer 3

References:

Northeast Fisheries Science Center. 2012. Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-06; 789 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

Col, L.A., Legault, C.M. 2009. The 2008 Assessment of Atlantic halibut in the Gulf of Maine Georges Bank region. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 09-08; 39 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

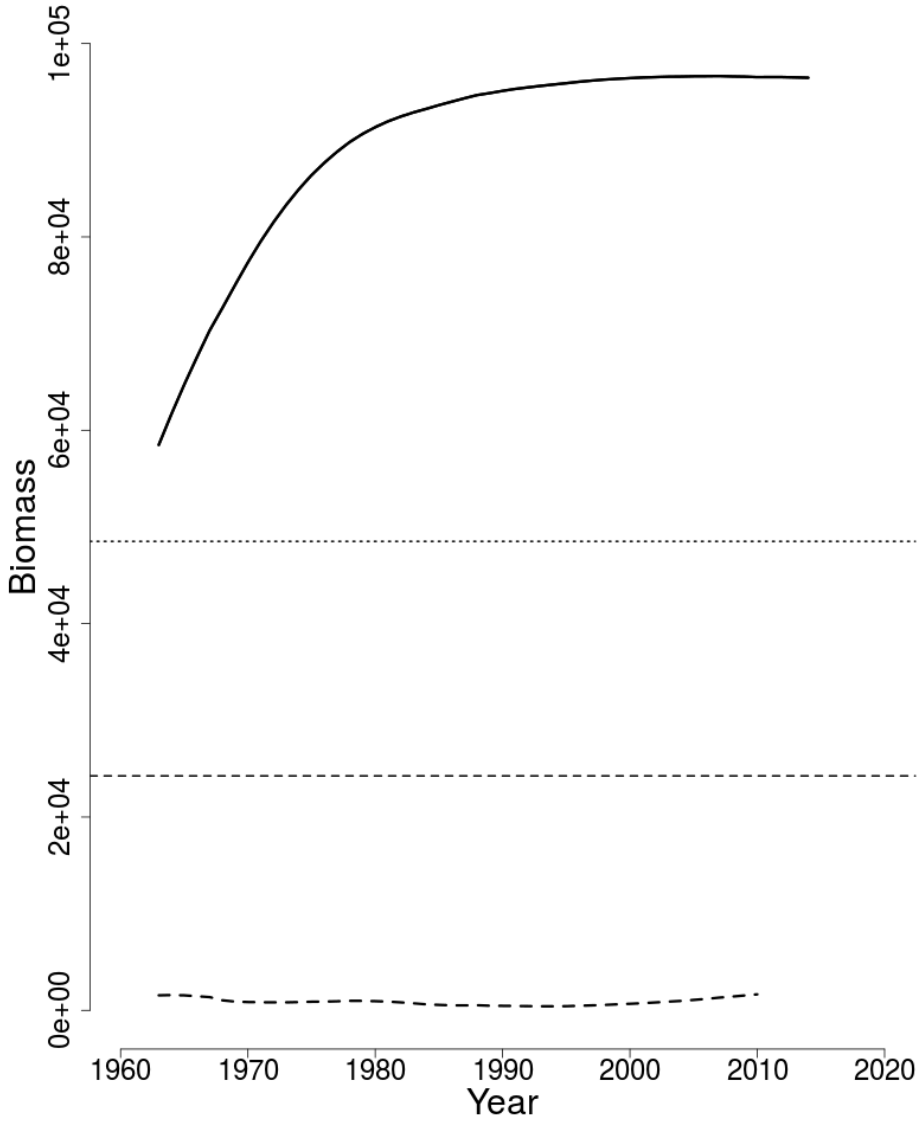

Figure B59: Estimated trends in the biomass of Atlantic halibut between 1963 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $B_{Threshold}$= $\frac{1}{2}$ B_{MSY} *proxy*(horizontal dashed line) as well as B_{Target} (B_{MSY} *proxy*; horizontal dotted line) based on the 2015 assessment.

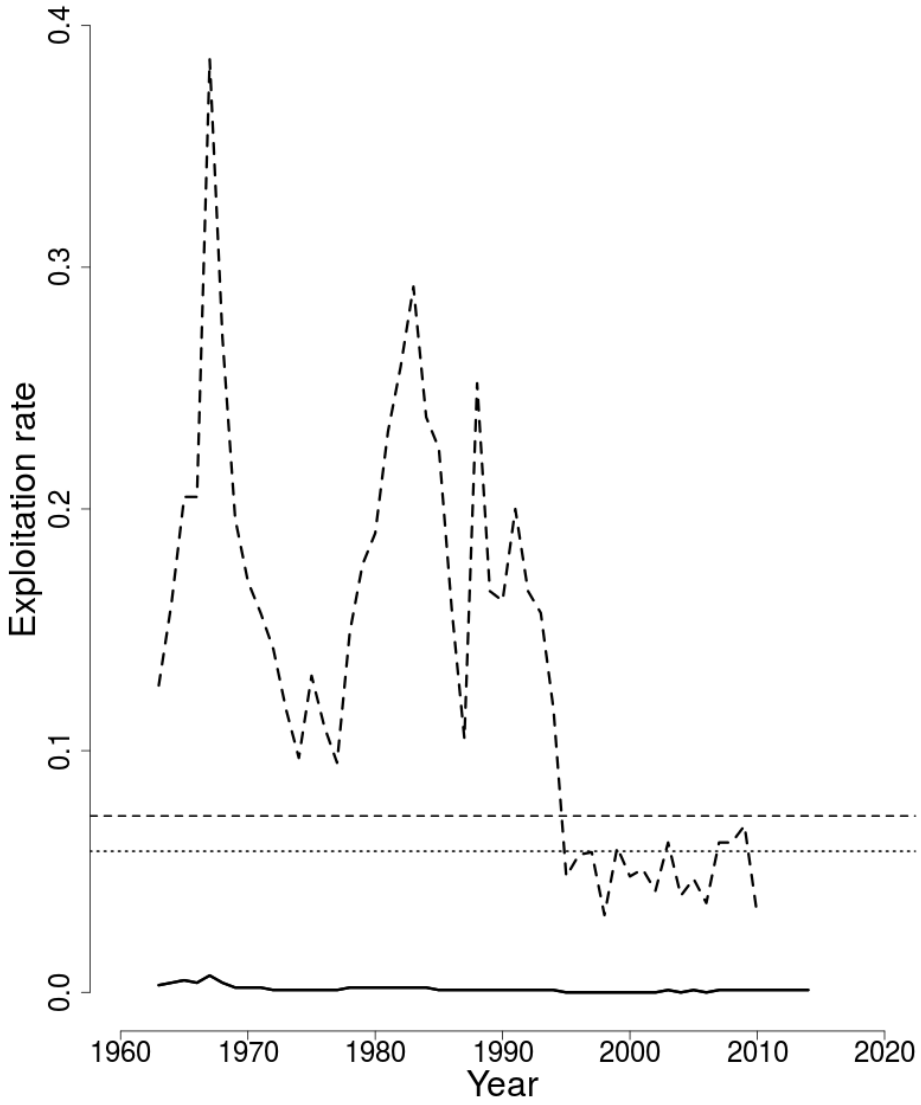

Figure B60: Estimated trends in the fully selected fishing mortality (F_{Full}) of Atlantic halibut between 1963 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (0.073; horizontal dashed line) as well as F_{Target} (0.8 * F_{MSY} *proxy*; dotted line) based on the 2015 assessment.

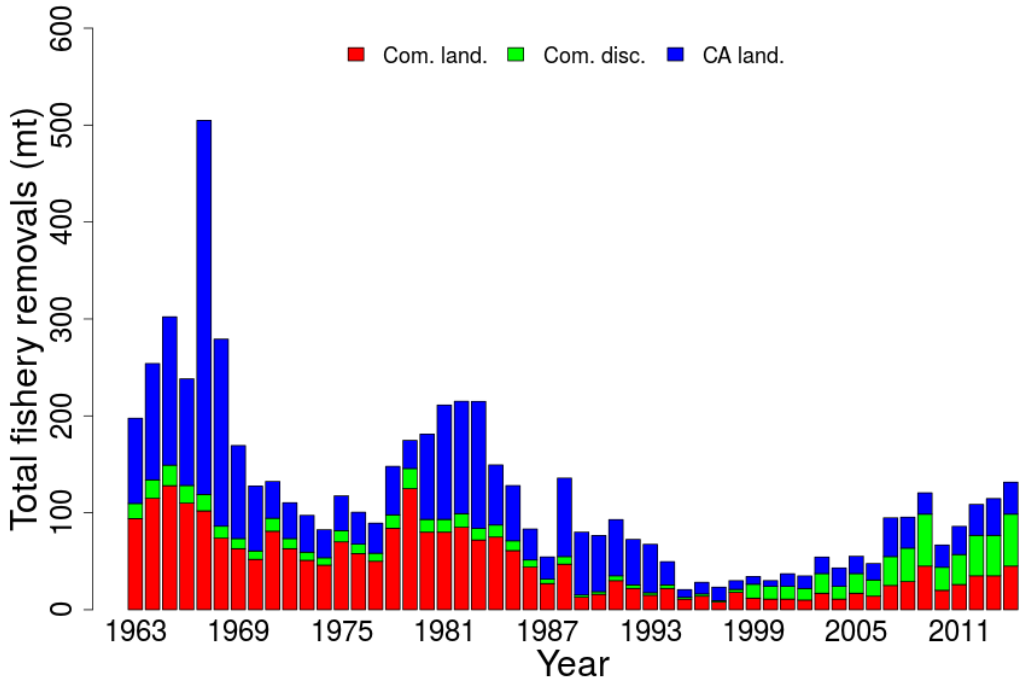

Figure B61: Total catch of Atlantic halibut between 1963 and 2014 by disposition (landings and discards).

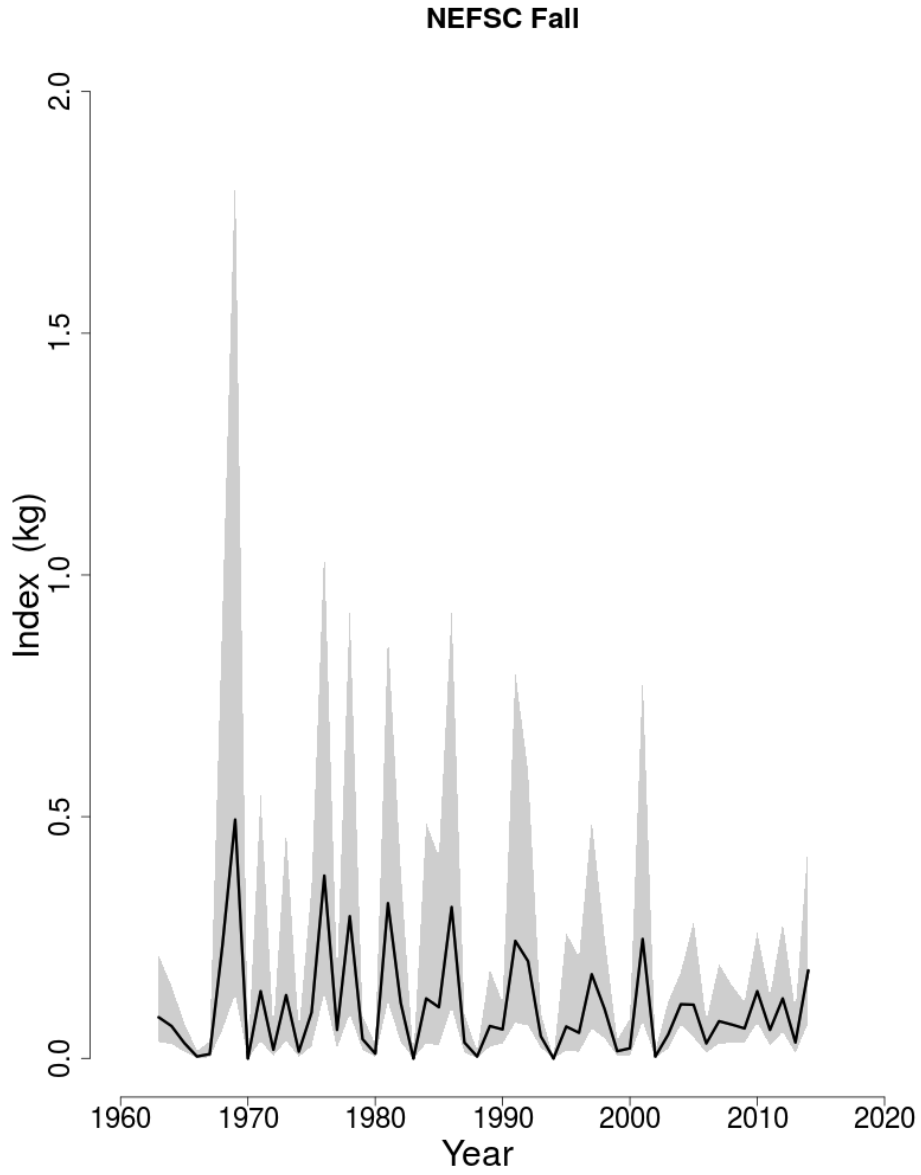

Figure B62: Indices of biomass for the Atlantic halibut between 1963 and 2014 for the Northeast Fisheries Science Center (NEFSC) fall bottom trawl survey. The 90% lognormal confidence intervals are shown.

13 Northern windowpane flounder

Toni Chute

This assessment of the northern windowpane flounder (Scophthalmus aquosus) stock is an operational update of the 2012 assessment which included updates through 2010 (NEFSC 2012). Based on the 2012 assessment the stock was overfished, and overfishing was ocurring. This assessment updates commercial fishery catch data, survey indices of abundance, AIM model results, and reference points through 2014.

State of Stock: Based on this updated assessment, the northern windowpane flounder (*Scophthalmus aquosus*) stock is overfished but overfishing is not occurring (Figures **??-??**). Retrospective adjustments were not made to the model results. The mean NEFSC fall bottom trawl survey index from years 2012, 2013 and 2014 (a 3-year moving average is used as a biomass index) was 0.535 kg/tow which is lower than the $B_{Threshold}$ of 0.777 kg/tow. The 2014 relative fishing mortality was estimated to be 0.393 kt per kg/tow which is lower than the F_{MSY} *proxy* of 0.450 kt per kg/tow.

Table B41: Catch and model results table for northern windowpane flounder. All landings and discard weights are rounded to the nearest metric ton. Biomass index is in units of kg/tow, and relative F is in units of kt per kg/tow.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Data										
Commercial landings	51	46	117	46	28	0	0	1	0	0
Commercial discards	917	637	974	329	412	235	180	198	355	215
Total catch	967	683	1,092	376	440	236	180	199	355	215
Model Results										
Biomass index	0.7	0.67	0.52	0.45	0.44	0.47	0.43	0.34	0.52	0.54
Relative F	1.39	1.02	2.08	0.85	1	0.51	0.42	0.58	0.68	0.393

Table B42: Reference points estimated in the 2012 assessment and in the current assessment update. F_{MSY} *proxy* is in units of kt per kg/tow.

	2012	Current
F_{MSY} *proxy*	0.44	0.450 (0.020 - 0.765)
B_{MSY} *proxy* (kg/tow)	1.60	1.554
MSY proxy (mt)	700	700
Overfishing	Yes	No
Overfished	Yes	Yes

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The main source of uncertainty in this assessment is the lack of windowpane discard estimates from Canadian fisheries to add to the catch component of model input. Discard estimates were from the U.S. only. There is overlap between the survey area and Canadian fishing grounds (Van Eeckhaute et al. 2010), which means catch from within the stock area was likely underestimated.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Figure **??**).

  The model used to estimate status of this stock does not allow estimation of a retrospective pattern.

- Based on this stock assessment, are population projections well determined or uncertain?

  N/A

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  No changes were made to the northern windowpane flounder assessment for this update other than the incorporation of four years of new NEFSC fall bottom trawl survey data and four years of new U.S. commercial landings and discard data (2011 - 2014).

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The stock status of northern windowpane flounder changed from 'overfished and overfishing is occurring' to 'overfished and overfishing is not occurring' due to stable-to-decreasing catch since 2008, and an increasing trend in the survey index since 2010.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  The northern windowpane flounder assessment could be improved by estimating the Canadian windowpane removals and, although to a lesser degree, the 'general category' scallop dredge fleet discards from within the stock area and using them as additional catch input to the AIM model. While the model fit now is reasonable (the relationship between ln(relative F) and ln(replacement ratio), a measure of the relationship between catch and survey index values, has a p-value of 0.079) there are probably removals unaccounted for in the model and the fit can likely be improved.

- Are there other important issues?

  None.

13.1 Reviewer Comments: Northern windowpane flounder

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Most recent assessment update:
Northeast Fisheries Science Center. 2012. Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-06; 789 p. Available online at http://nefsc.noaa.gov/publications/

Most recent benchmark assessment:
Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3^{rd} Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. US Dep Commer, NOAA FIsheries, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii.

Van Eeckhaute, L., Sameoto, J., and A. Glass. 2010. Discards of Atlantic cod, haddock and yellowtail flounder from the 2009 Canadian scallop fishery on Georges Bank. TRAC Ref. Doc. 2010/10. 7p.

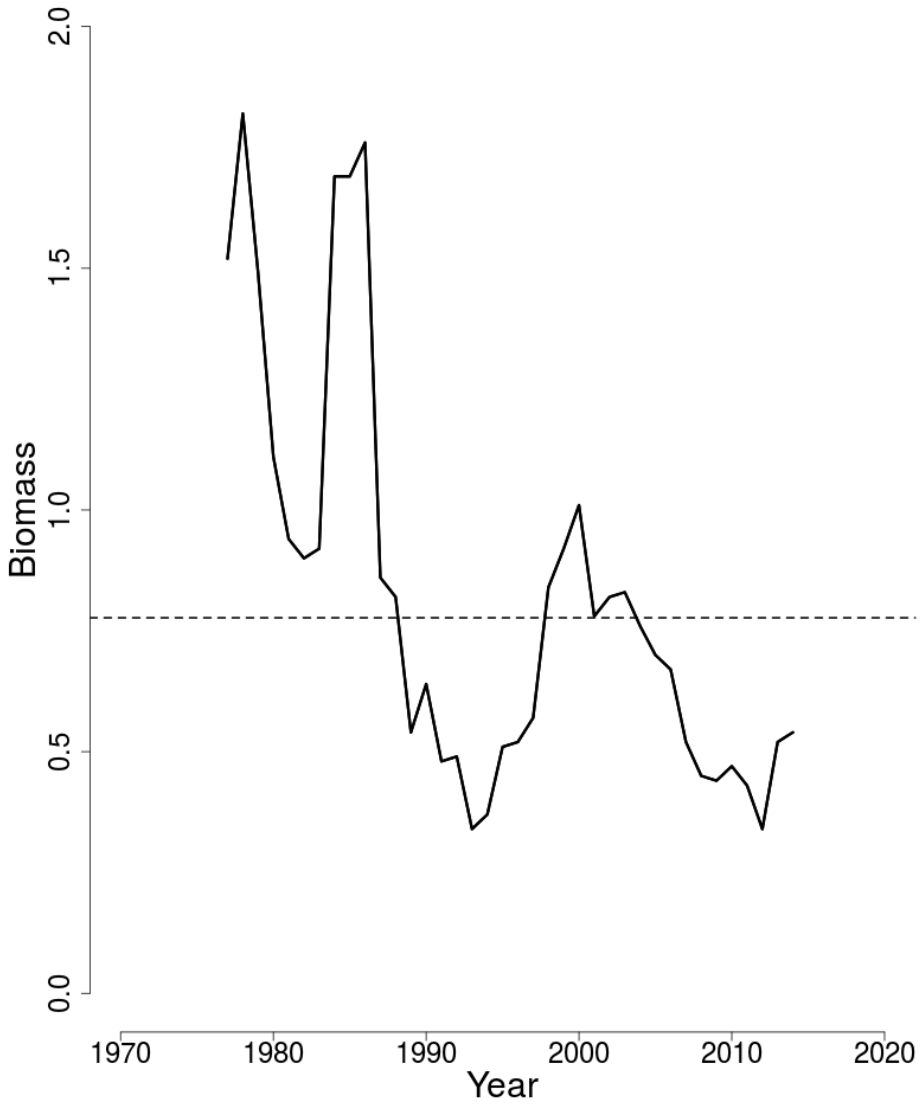

Figure B63: Trends in the biomass index (a 3-year moving average of the NEFSC fall bottom trawl survey index) of northern windowpane flounder between 1975 and 2014 from the current assessment, and the corresponding $B_{Threshold} = \frac{1}{2} B_{MSY}$ *proxy* = 0.777 kg/tow (horizontal dashed line).

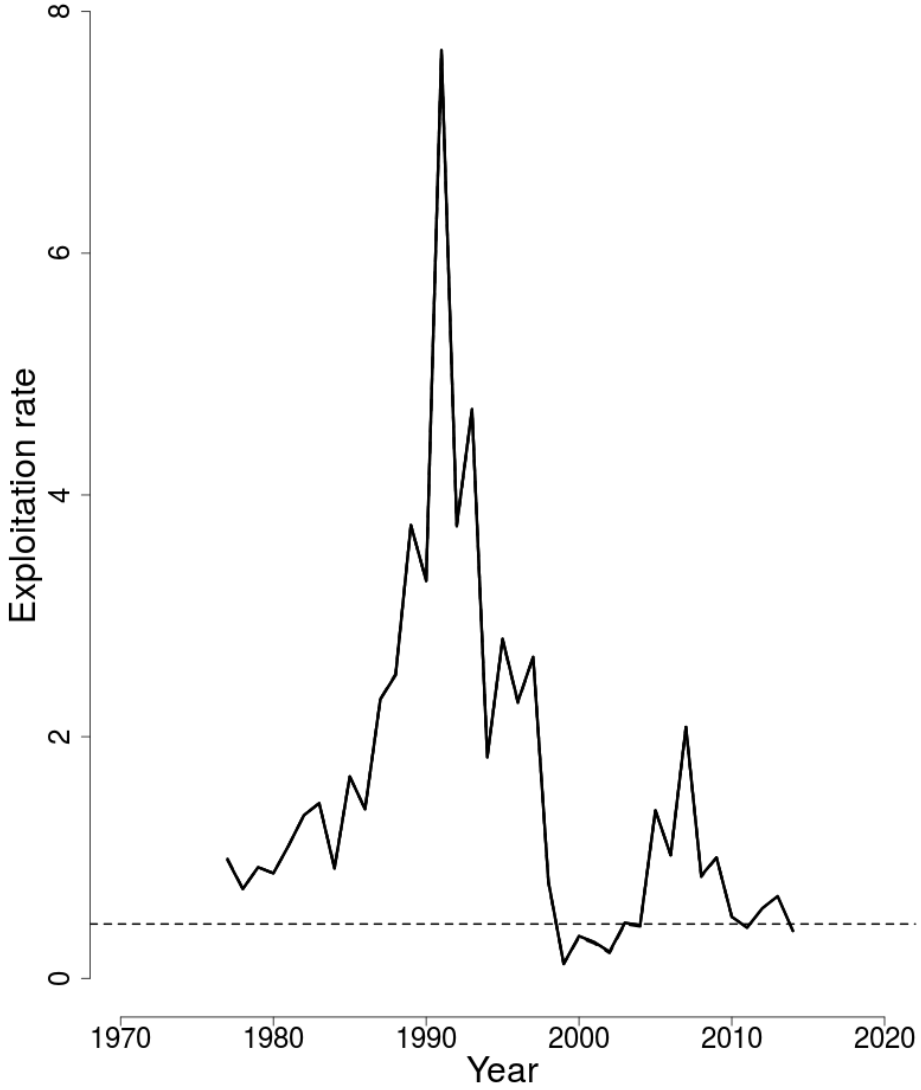

Figure B64: Trends in relative fishing mortality of northern windowpane flounder between 1975 and 2014 from the current assessment, and the corresponding F_{MSY} *proxy*=0.45 (horizontal dashed line).

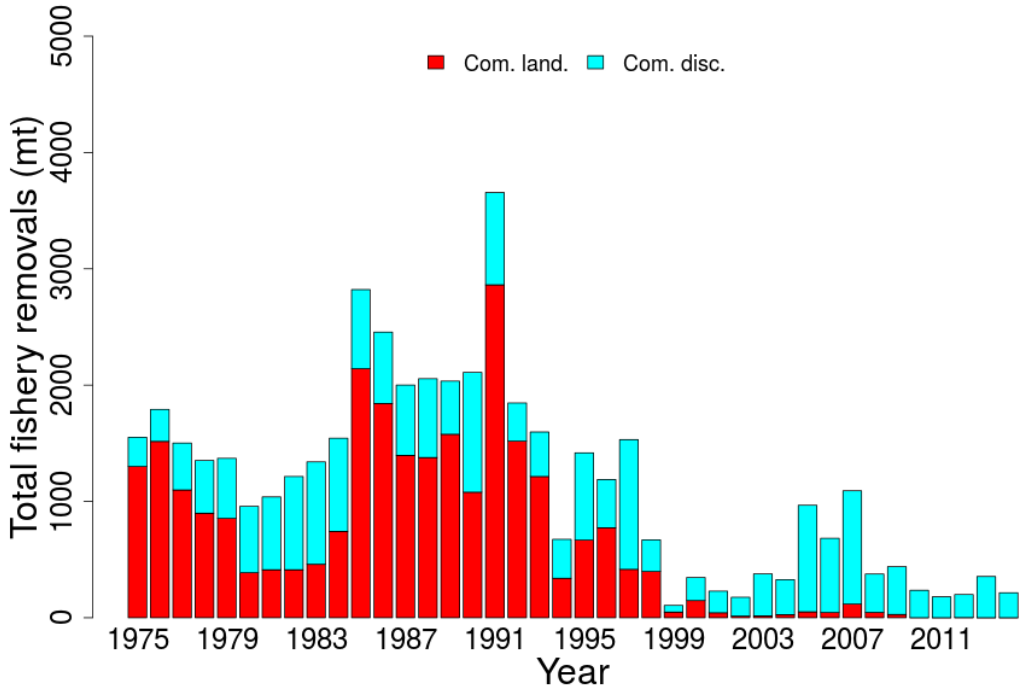

Figure B65: Total catch of northern windowpane flounder between 1975 and 2014 by disposition (landings and discards).

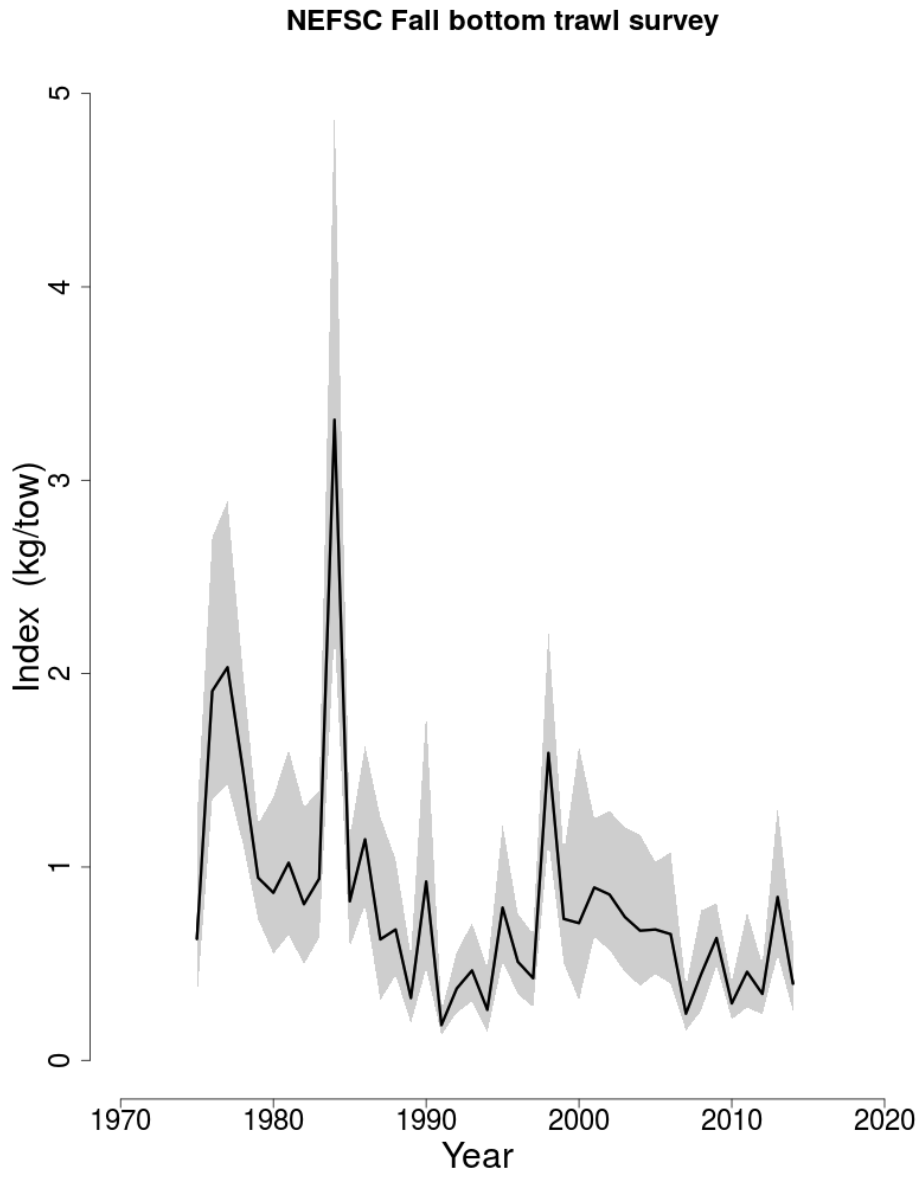

Figure B66: NEFSC fall bottom trawl survey indices in kg/tow for northern windowpane flounder between 1975 and 2014 The approximate 90% lognormal confidence intervals are shown.

14 Southern windowpane flounder

Toni Chute

This assessment of the southern windowpane flounder (Scophthalmus aquosus) stock is an operational update of the 2012 assessment which included updates through 2010 (NEFSC 2012). Based on the 2012 assessment the stock was not overfished, and overfishing was not ocurring. This assessment updates commercial fishery catch data, survey indices of abundance, AIM model results, and reference points through 2014.

State of Stock: Based on this updated assessment, the southern windowpane flounder (*Scophthalmus aquosus*) stock is not overfished and overfishing is not occurring (Figures **??-??**). Retrospective adjustments were not made to the model results. The mean NEFSC fall bottom trawl survey index from years 2012, 2013, and 2014 (a 3-year moving average is used as a biomass index) was 0.413 (kg/tow) which is higher than the $B_{Threshold}$of 0.123 (kg/tow). The 2014 relative fishing mortality was estimated to be 1.308 (kt per kg/tow) which is lower than the F_{MSY} *proxy* of 2.027 (kt per kg/tow).

Table B43: Catch and model results table for southern windowpane flounder. All landings and discard weights are rounded to the nearest metric ton. Biomass index is in units of kg/tow, and relative F is in units of kt per kg/tow.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
					Data					
Commercial landings	38	57	83	74	53	53	32	29	22	14
Commercial discards	293	374	266	246	405	435	445	701	681	525
Total catch	330	431	349	321	458	489	477	730	703	539
					Model Results					
Biomass index	0.21	0.17	0.19	0.2	0.24	0.35	0.44	0.52	0.46	0.41
Relative F	1.6	2.53	1.83	1.57	1.88	1.42	1.1	1.41	1.51	1.31

Table B44: Reference points estimated in the 2012 assessment and in the current assessment update. F_{MSY} *proxy* is in units of kt per kg/tow.

	2012	Current
F_{MSY} *proxy*	2.088	2.027 (1.131 - 2.576)
B_{MSY} *proxy* (kg/tow)	0.240	0.247
MSY proxy (mt)	500	500
Overfishing	No	No
Overfished	No	No

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  A source of uncertainty for this assessment is missing commercial discard estimates from the general category scallop dredge fleet that should be added to the catch time series for model input.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Figure **??**).

  The model used to estimate status of this stock does not allow estimation of a retrospective pattern.

- Based on this stock assessment, are population projections well determined or uncertain?

  N/A

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  No changes were made to the southern windowpane flounder assessment for this update other than the incorporation of four years of new NEFSC fall bottom trawl survey data and four years of new U.S. commercial landings and discard data (2011 - 2014).

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The stock status of southern windowpane flounder has not changed since the previous assessment.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  Estimates of discards from the general category scallop dredge fleet should be added to the catch time series for model input. However, the model fit is presently good with a randomization test indicating the correlation between ln(relative F) and ln(replacement ratio), a measure of the relationship between catch and survey index values, is significant (p = 0.002.)

- Are there other important issues?

  None.

14.1 Reviewer Comments: Southern windowpane flounder

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Most recent assessment update:
Northeast Fisheries Science Center. 2012. Assessment or Data Updates of 13 Northeast Groundfish Stocks through 2010. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-06; 789 p. Available online at http://nefsc.noaa.gov/publications/

Most recent benchmark assessment:
Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3^{rd} Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, MA, August
4-8, 2008. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii.

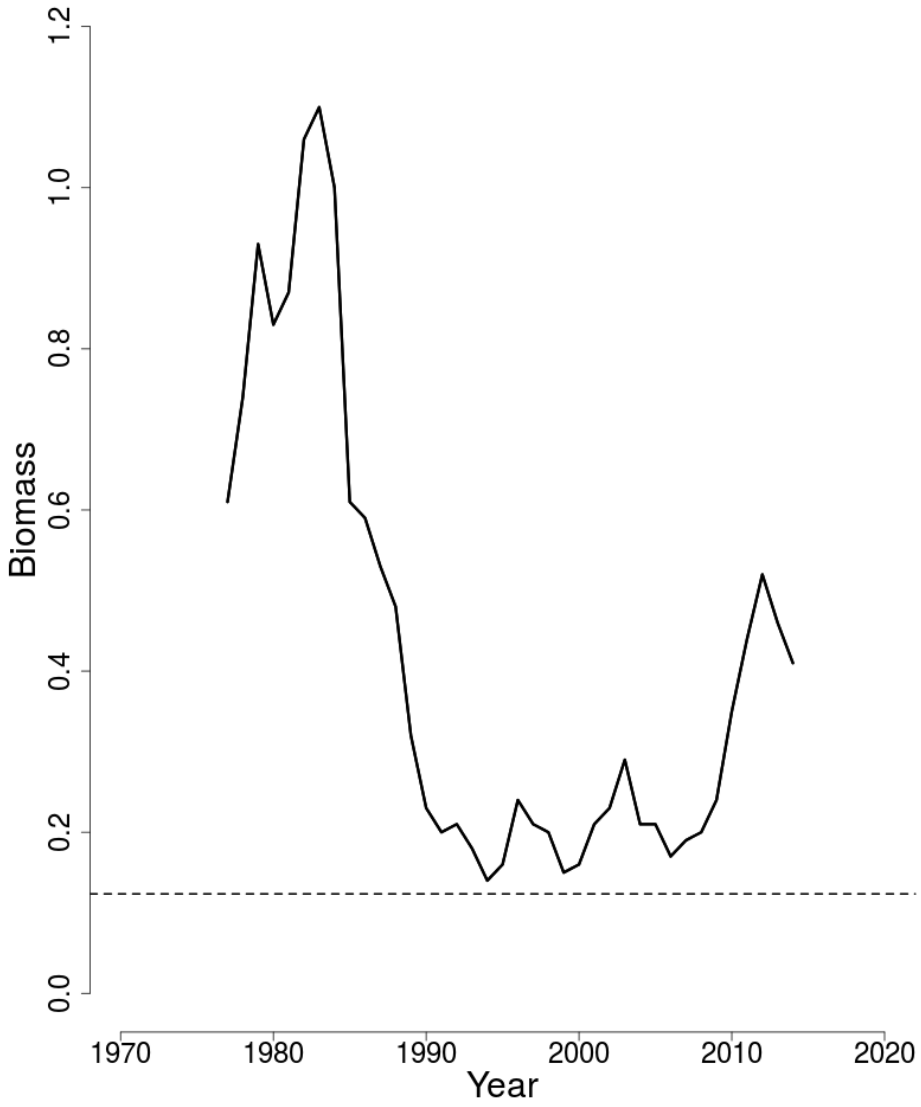

Figure B67: Trends in the biomass index (a 3-year moving average of the NEFSC fall bottom trawl survey index) of southern windowpane flounder between 1975 and 2014 from the current assessment, and the corresponding $B_{Threshold} = \frac{1}{2} B_{MSY}$ *proxy* = 0.123 kg/tow(horizontal dashed line).

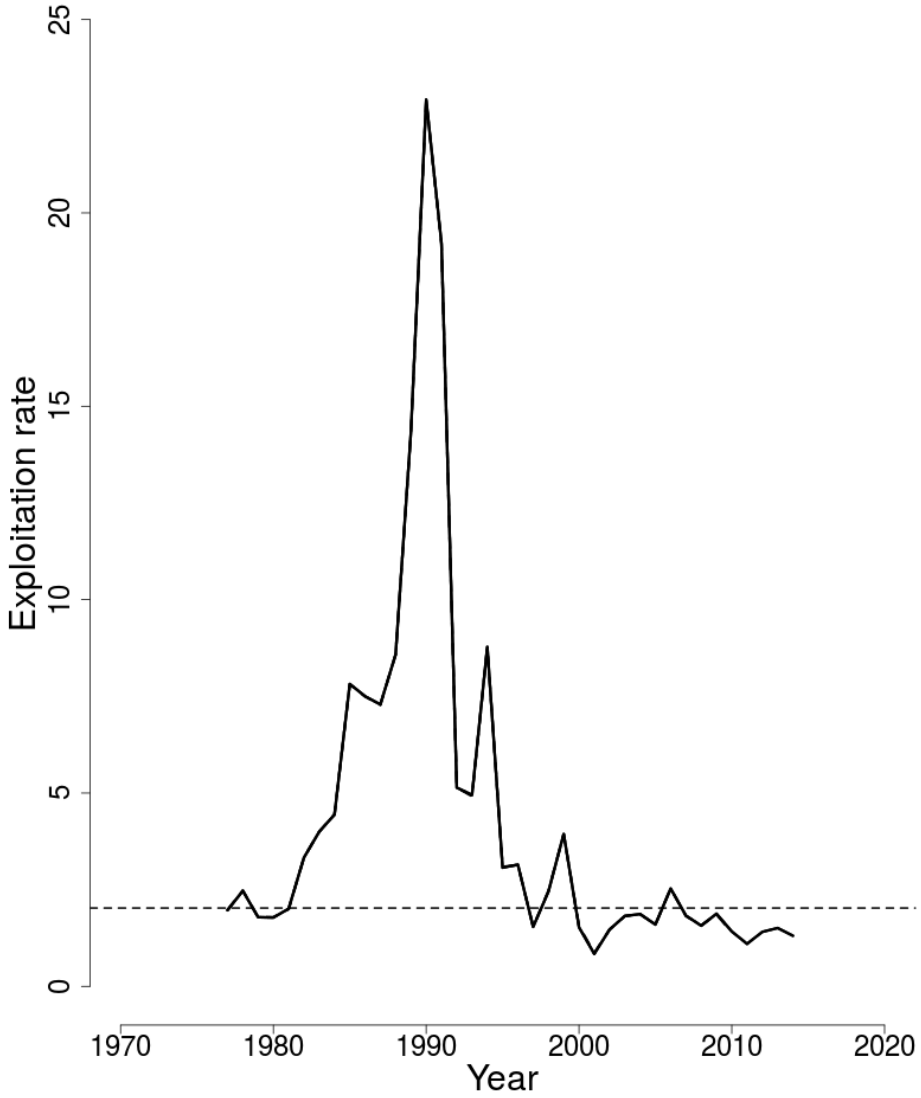

Figure B68: Trends in relative fishing mortality of southern windowpane flounder between 1975 and 2014 from the current assessment, and the corresponding F_{MSY} *proxy*=2.027 (horizontal dashed line).

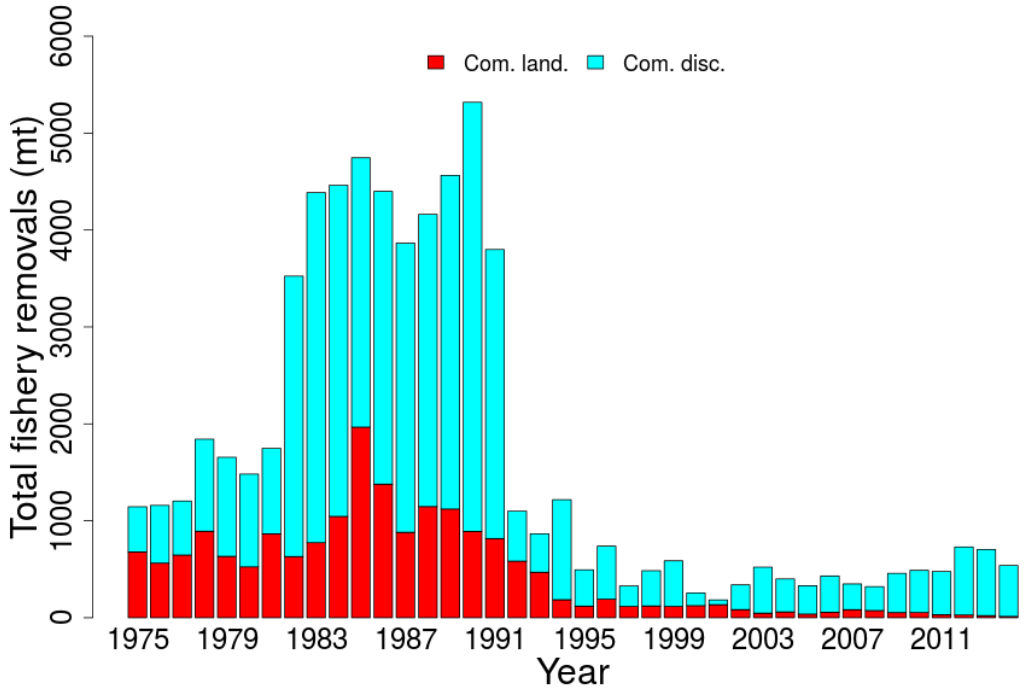

Figure B69: Total catch of southern windowpane flounder between 1975 and 2014 by disposition (landings and discards).

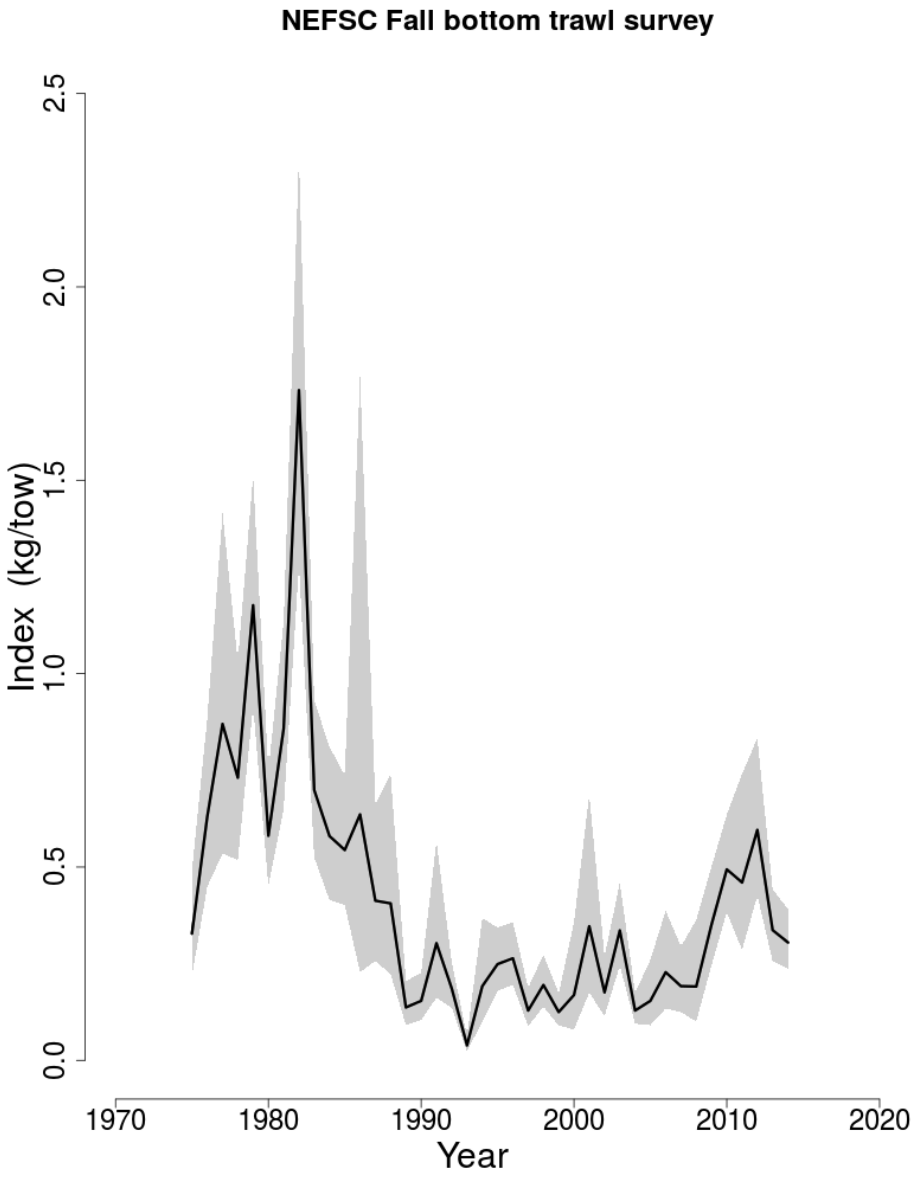

Figure B70: NEFSC fall bottom trawl survey indices in kg/tow for southern windowpane flounder between 1975 and 2014. The approximate 90% lognormal confidence intervals are shown.

15 Gulf of Maine Winter Flounder

Paul Nitschke

This assessment of the Gulf of Maine Winter Flounder (Pseudopleuronectes americanus) stock is an operational update of the existing 2014 operational update area-swept assessment (NEFSC 2014). Based on the previous assessment the biomass status is unknown but overfishing was not occurring. This assessment updates commercial and recreational fishery catch data, research survey indices of abundance, and the area-swept estimates of 30+ cm biomass based on the fall NEFSC, MDMF, and MENH surveys.

State of Stock: Based on this updated assessment, the Gulf of Maine Winter Flounder (*Pseudopleuronectes americanus*) stock biomass status is unknown and overfishing is not occurring (Figures **??**-**??**). Retrospective adjustments were not made to the model results. Biomass (30+ cm mt) in 2014 was estimated to be 4,655 mt (Figure **??**). The 2014 30+ cm exploitation rate was estimated to be 0.06 which is 26% of the overfishing exploitation threshold proxy (E_{MSY} *proxy* = 0.23; Figure **??**).

Table B45: Catch and status table for Gulf of Maine Winter Flounder. All weights are in (mt) and E_{Full} is the exploitation rate on 30+ cm fish. Biomass is estimated from survey area-swept for non-overlaping strata from three different fall surveys (MENH, MDMF, NEFSC) using a q=0.6 assumption on the wing spread.

	2009	2010	2011	2012	2013	2014
	Data					
Recreational discards	4	3	4	1	1	2
Recreational landings	60	40	38	22	29	55
Commercial discards	12	6	4	10	6	5
Commercial landings	283	139	173	348	218	213
Catch for Assessment	359	187	219	381	254	275
	Model Results					
30+ cm Biomass	7,612	6,341	6,666	3,337	2,932	4,655
E_{Full}	0.05	0.03	0.03	0.11	0.09	0.06

Table B46: Comparison of reference points estimated in an earlier assessment and from the current assessment update. An $E_{40\%}$ exploitation rate proxy was used for the overfishing threshold and was based on a length based yield per recruit model from the 2011 SARC 52 benchmark assessment.

	2014	Current

E_{MSY} *proxy*	0.23	0.23
B_{MSY}	Unkown	Unkown
MSY (mt)	Unkown	Unkown
Overfishing	No	No
Overfished	Unknown	Unknown

Projections: Projections are not possible with area-swept based assessments. Catch advice was based on 75% of $E_{40\%}$(75% E_{MSY} *proxy*) using the fall area-swept estimate assuming q=0.6 on the wing spread. Updated 2014 fall 30+ cm area-swept biomass (4,655 mt) implies an OFL of 1,080 mt based on the E_{MSY} *proxy* and a catch of 810 mt for 75% of the E_{MSY} *proxy*.

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The largest source of uncertainty with the direct estimates of stock biomass from survey area-swept estimates originate from the assumption of survey gear catchability (q). Biomass and exploitation rate estimates are sensitive to the survey q assumption (0.6 on wing spread). The 2014 empirical benchmark assessement of Georges bank yellowtail flounder based the area-swept q assumption on an average value taken from the literature for west coast flatfish (0.37 on door spread). The yellowtail q assumption corresponds to a value close to 1 on the wing spread which would result in a lower estimate of biomass (2,995 mt). Another major source of uncertainty with this method is that biomass based reference points cannot be determined and overfished status is unknown.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see Figure **??**).

  The model used to determine status of this stock does not allow estimation of a retrospective pattern. An analytical stock assessment model does not exist for Gulf of Maine Winter Flounder. An analytical model was no longer used for stock status determination at SARC 52 (2011) due to concerns with a strong retrospective pattern. Models have difficulty with the apparent lack of a relationship between a large decrease in the catch with little change in the indices and age and/or size structure over time.

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for Gulf of Maine Winter Flounder, do not exist for area-swept assessments. Catch advice from area-swept estimates tend to vary with interannual variability in the surveys.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  No changes, other than the incorporation of new data were made to the Gulf of Maine Winter Flounder assessment for this update. However, stabilizing the catch advice may be desired and could be obtained through the averaging of the area-swept fall and spring survey estimates.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The overfishing status of Gulf of Maine Winter Flounder has not changed.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  Direct area-swept assessment could be improved with additional studies on survey gear efficiency. Quantifying the degree of herding between the doors and escapement under the footrope and/or above the headrope for each survey is needed since area-swept biomass estimates and catch advice are sensitive to the assumed catchability.

- Are there other important issues?

  The general lack of a response in survey indices and age/size structure is the primary source of concern with catches remaining far below the overfishing level.

15.1 Reviewer Comments: Gulf of Maine Winter Flounder

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Hendrickson L, Nitschke P, Linton B. 2015. 2014 Operational Stock Assessments for Georges Bank winter flounder, Gulf of Maine winter flounder, and pollock. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-01; 228 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

Northeast Fisheries Science Center. 2011. 52^{nd} Northeast Regional Stock AssessmentWorkshop (52^{nd} SAW) Assessment Report. US Dept Commer, Northeast Fish SciCent Ref Doc. 11-17; 962 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

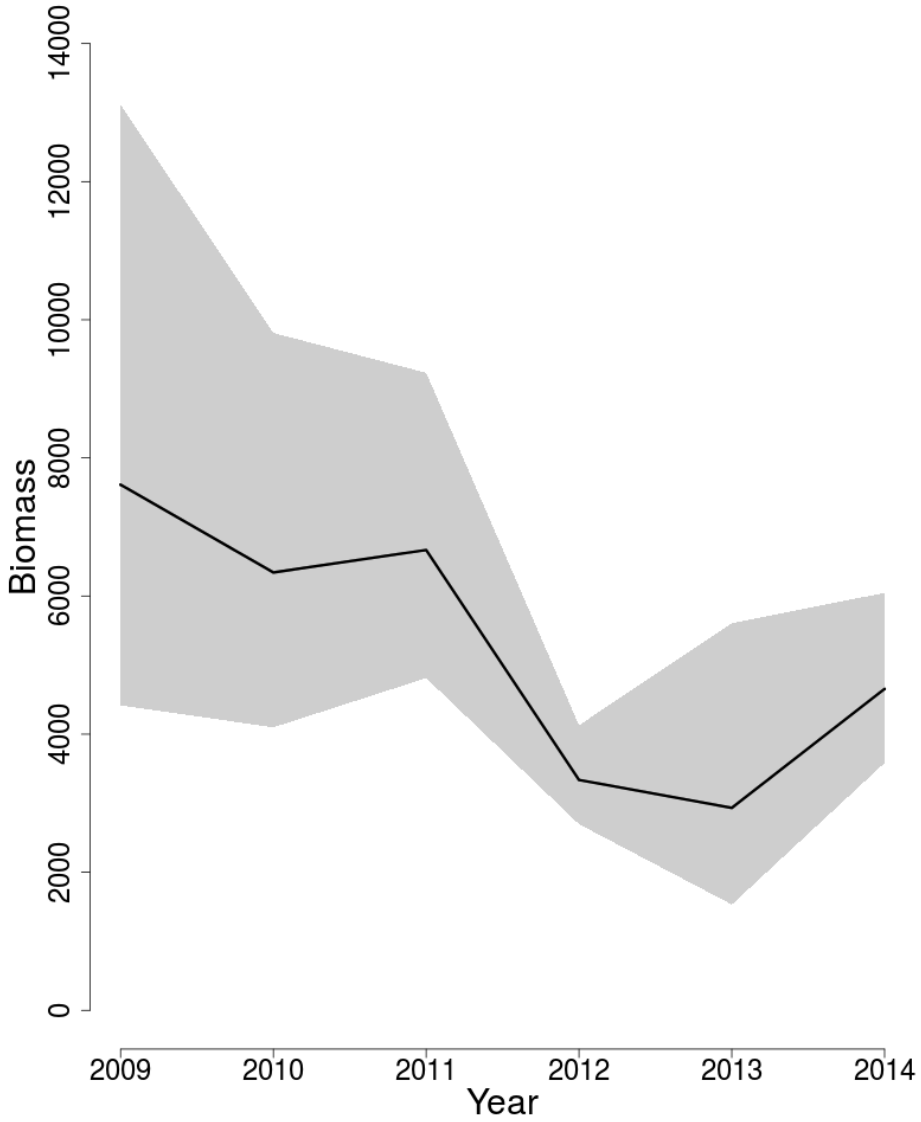

Figure B71: Trends in 30+ cm area-swept biomass of Gulf of Maine Winter Flounder between 2009 and 2014 from the current assessment based on the fall (MENH, MDMF, NEFSC) surveys. The approximate 90% lognormal confidence intervals are shown.

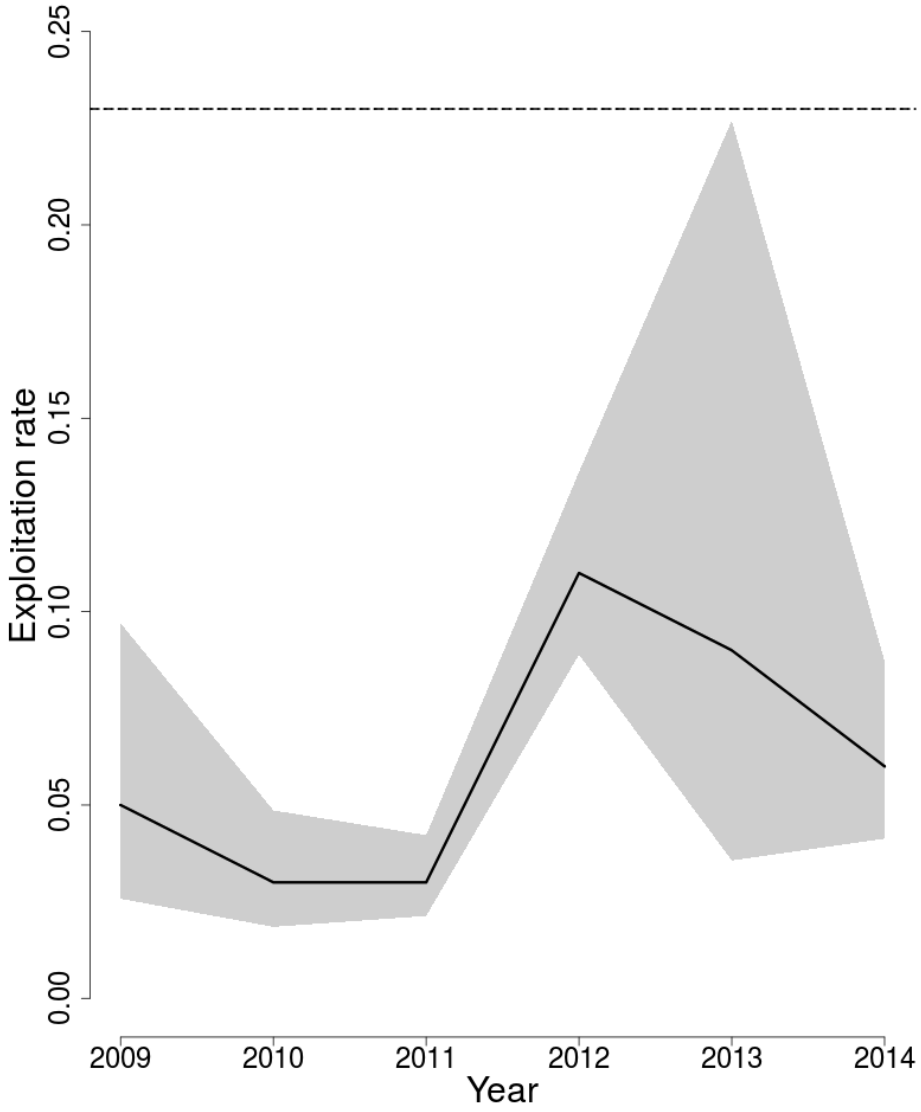

Figure B72: Trends in the exploitation rates (E_{Full}) of Gulf of Maine Winter Flounder between 2009 and 2014 from the current assessment and the corresponding $F_{Threshold}$ (E_{MSY} *proxy*=0.23; horizontal dashed line). The approximate 90% lognormal confidence intervals are shown.

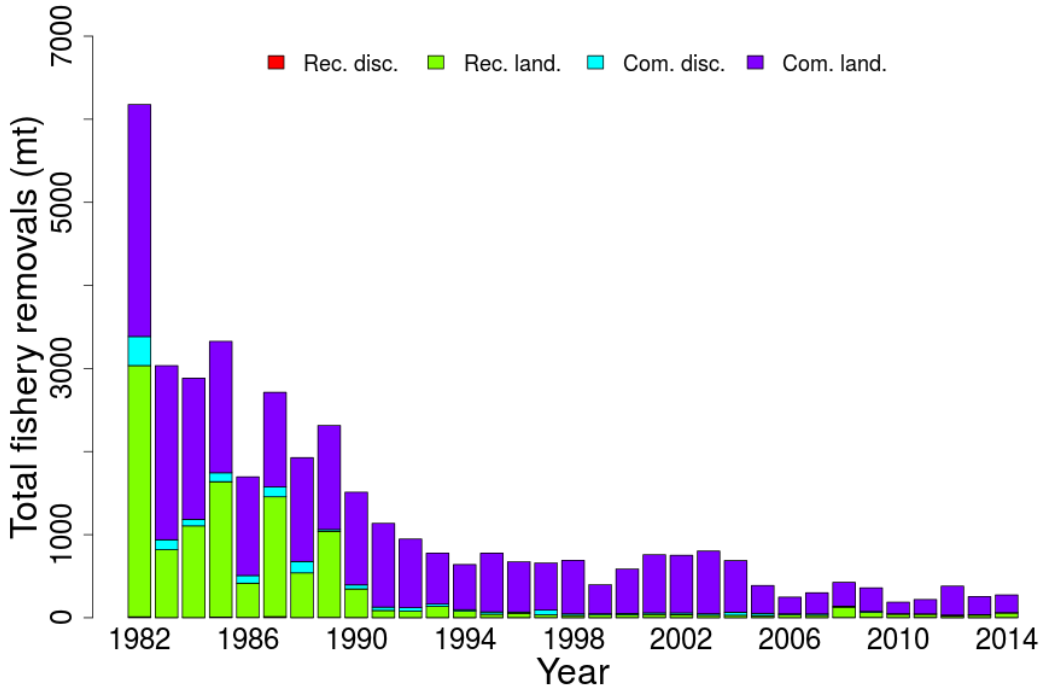

Figure B73: Total catch of Gulf of Maine Winter Flounder between 2009 and 2014 by fleet (commercial and recreational) and disposition (landings and discards). A 15% mortality rate is assumed on recreational discards and a 50% mortality rate on commercial discards.

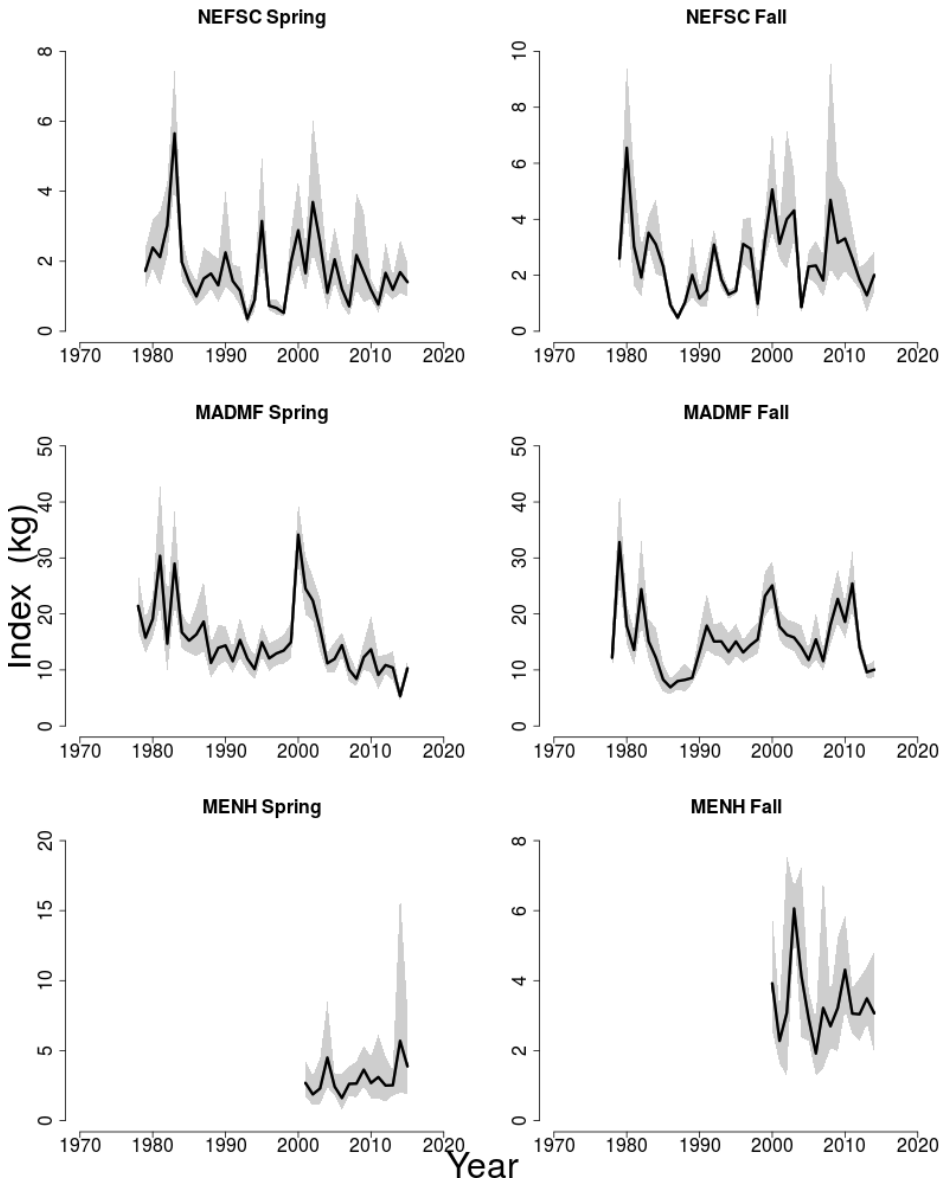

Figure B74: Indices of biomass for the Gulf of Maine Winter Flounder between 1978 and 2015 for the Northeast Fisheries Science Center (NEFSC), Massachusetts Division of Marine Fisheries (MDMF), and the Maine New Hampshire (MENH) spring and fall bottom trawl surveys. NEFSC indices are calculated with gear and vessel conversion factors where appropriate. The approximate 90% lognormal confidence intervals are shown.

16 Georges Bank Yellowtail Flounder

Chris Legault

This assessment of the Georges Bank Yellowtail Flounder (Limanda ferruginea) stock was reviewed during the July 2015 TRAC meeting (Legault et al. 2015). It is an operational update of the existing 2014 update assessment (Legault et al. 2014). Based on the previous assessment the stock status was unknown, but stock condition was poor. This assessment updates commercial fishery catch data through 2014 (Table **??**, *Figure* **??**), *and updates research survey indices of abundance and the empirical approach assessment through 2015 (Figure* **??**). *No stock projections can be computed using the empirical approach.*

State of Stock: Based on this updated assessment, Georges Bank Yellowtail Flounder (*Limanda ferruginea*) stock status is unknown due to a lack of biological reference points associated with the empirical approach, but stock condition is poor. Retrospective adjustments were not made to the model results. The average survey biomass in 2015 (the arithmetic average of the 2015 DFO, 2015 NEFSC spring, and 2014 NEFSC fall surveys) was estimated to be 2,240 (mt) (Figure **??**). The 2014 exploitation rate (2014 catch divided by 2014 average survey biomass) was estimated to be 0.071 (Figure **??**).

Table B47: Catch and model results table for Georges Bank Yellowtail Flounder. All weights are in (mt). The average survey biomass in year y is the arithmetic average of the year y DFO, year y NEFSC spring, and year y-1 NEFSC fall surveys. The exploitation rate is the catch divided by the average survey biomass. Model results are from the current updated empirical approach assessment.

	2010	2011	2012	2013	2014
	Data				
US landings	654	904	443	130	70
US discards	289	192	188	49	74
Canadian landings	17	22	46	1	1
Canadian discards	210	53	48	39	14
Other catch	0	0	0	0	0
Catch for Assessment	1,170	1,171	725	218	159
	Model Results				
Average Survey Biomass	19,117	7,328	9,921	4,938	2,240
Exploitation Rate	0.061	0.16	0.073	0.044	0.071

Table B48: Comparison of reference points estimated in an earlier assessment and from the current assessment update.

	2014	Current
F_{MSY} *proxy*	NA	NA
SSB_{MSY} (mt)	NA	NA
MSY (mt)	NA	NA
Overfishing	Unknown	Unknown
Overfished	Unknown	Unknown

Projections: Short term projections cannot be computed using the empirical approach. Application of an exploitation rate of 2% to 16% to the 2015 average survey biomass (2,240 mt) results in catch advice for 2016 of 45 mt to 359 mt.

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).

  The largest source of uncertainty is the estimate of survey catchability, which currently relies on literature values for other species in other regions of the world using different gear. The survey catchability affects the expansion of the stratified mean catch per tow for each survey and is inversely related to the catch advice. Other sources of uncertainty include the appropriate exploitation rate to apply to this stock, which has seen continued decrease in survey biomass despite low exploitation rates.

- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}; see RhoDecisionTab.ref).

  The model used to estimate status of this stock does not allow estimation of a retrospective pattern.

- Based on this stock assessment, are population projections well determined or uncertain?

  Population projections for Georges Bank Yellowtail Flounder are not computed. Catch advice is derived from applying an exploitation rate to the current estimate of survey biomass.

- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the affect these changes had on the assessment and stock status.

  The 2014 NMFS spring survey value was changed from 2,684 mt to 2,763 mt due to using preliminary data during the 2014 TRAC meeting. However, this has no impact on the 2015 stock status or 2016 catch advice in this update assessment.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

  The stock status of Georges Bank Yellowtail Flounder remains unknown and stock condition continues to be poor.

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

  The Georges Bank Yellowtail Flounder assessment could be improved with studies on NMFS and DFO survey catchability for flatfish.

- Are there other important issues?

  None.

16.1 Reviewer Comments: Georges Bank Yellowtail Flounder

Generic reviewer comments.
Reviewer 1

Things and stuff.
Reviewer 2

Blah blah
Reviewer 3

References:

Legault, C.M., L. Alade, W.E. Gross, and H.H. Stone. 2014. Stock Assessment of Georges Bank Yellowtail Flounder for 2014. TRAC Ref. Doc. 2014/01. 214 p.

Legault, C.M., L. Alade, D. Busawon, and H.H. Stone. 2015. Stock Assessment of Georges Bank Yellowtail Flounder for 2015. TRAC Ref. Doc. 2015/01. 66 p.

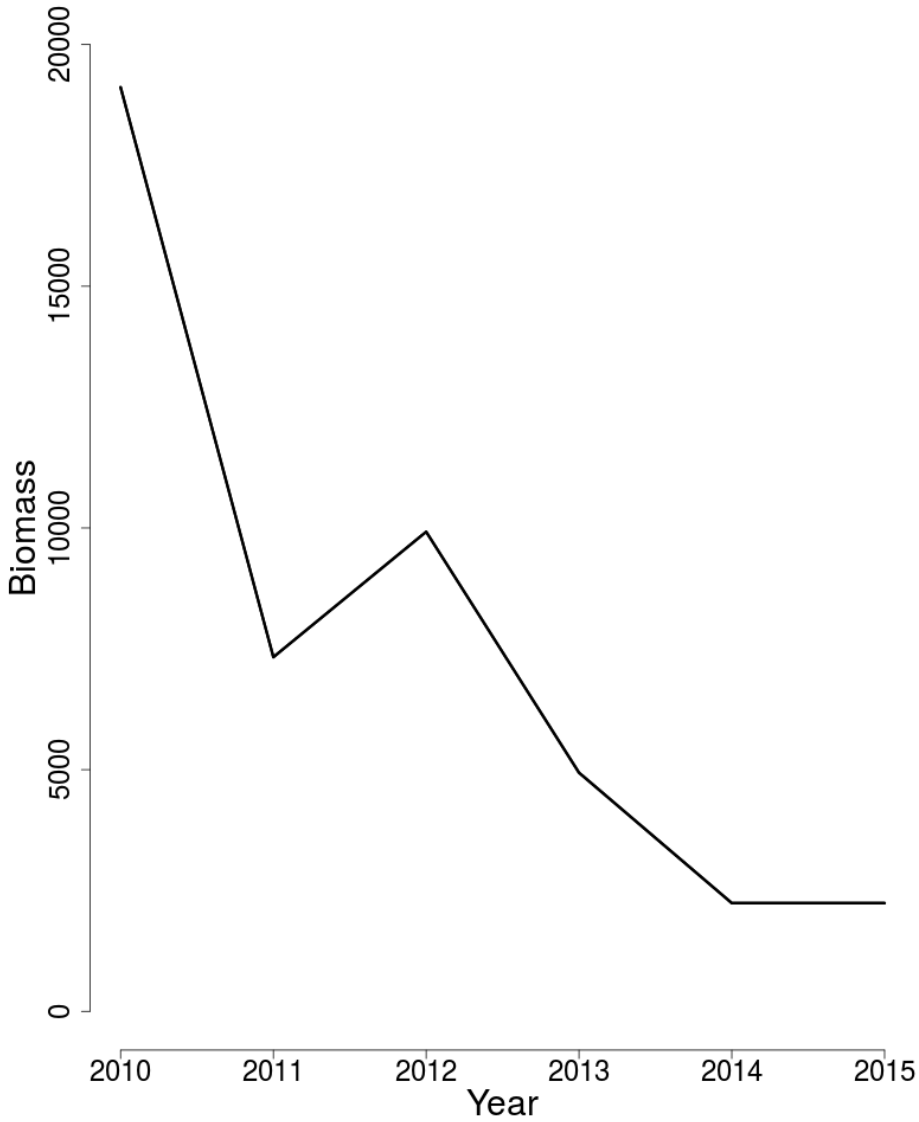

Figure B75: Trends in average survey biomass (mt) of Georges Bank Yellowtail Flounder between 2010 and 2015 from the current assessment.

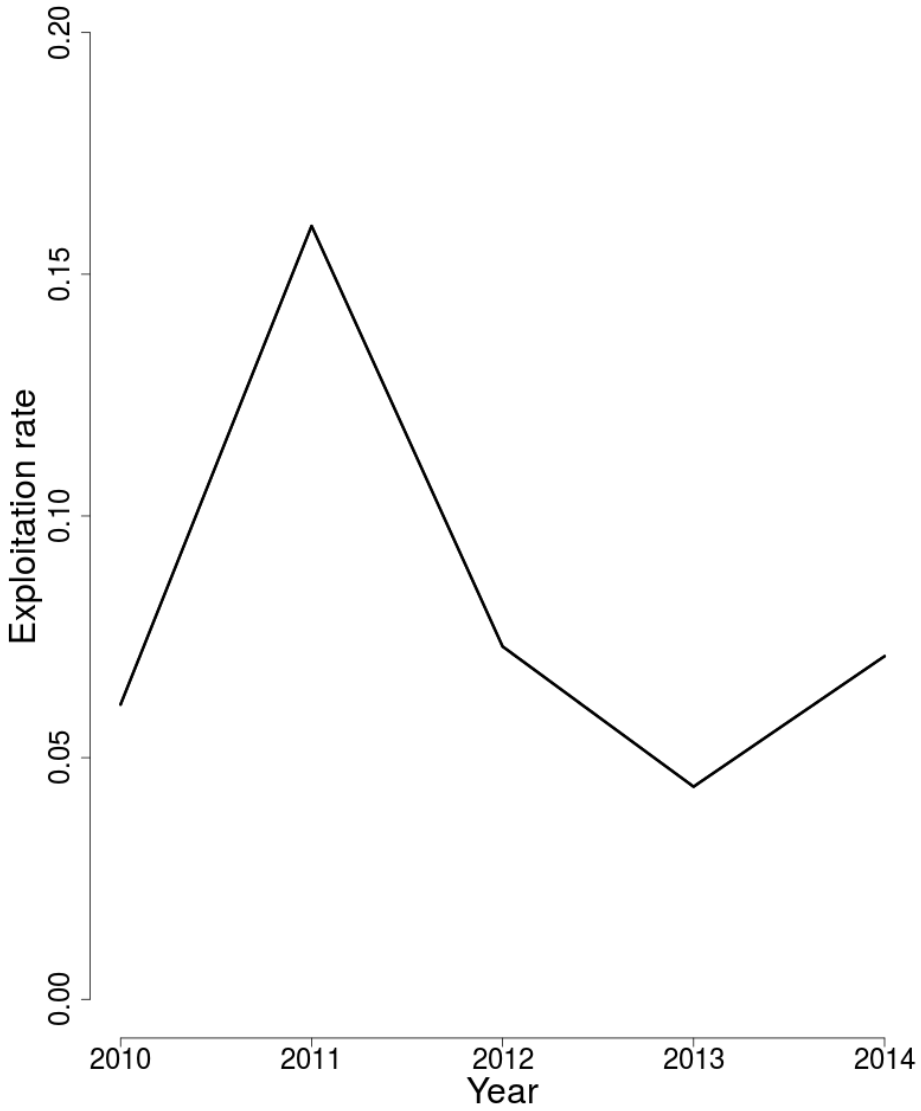

Figure B76: Trends in the exploitation rate (catch/average survey biomass) of Georges Bank Yellowtail Flounder between 2010 and 2014 from the current assessment.

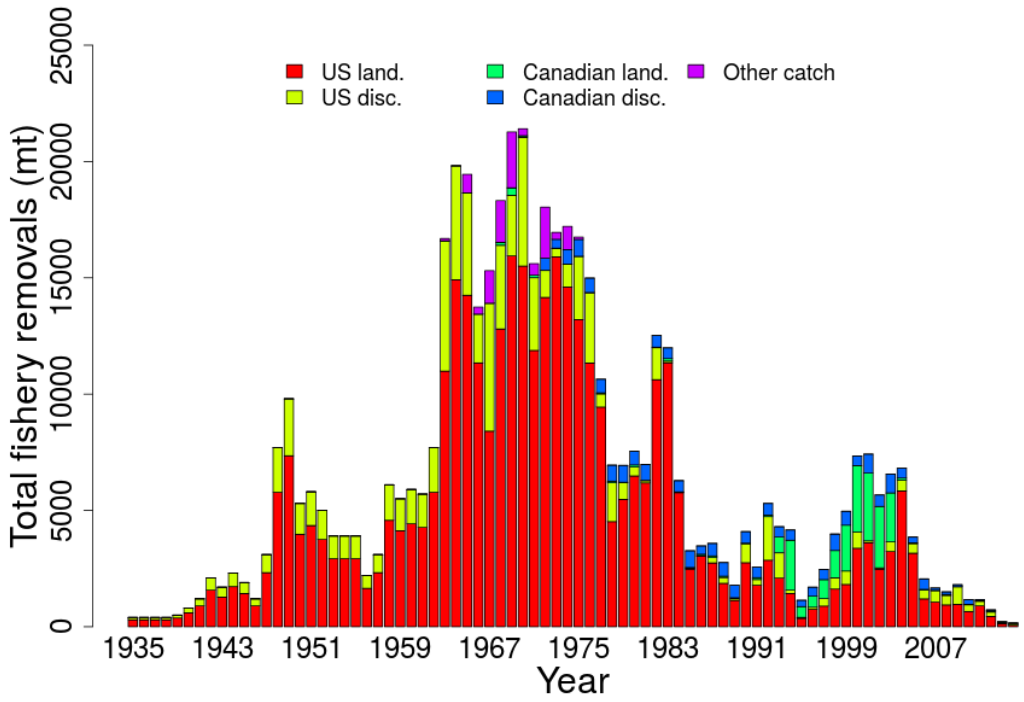

Figure B77: Total catch of Georges Bank Yellowtail Flounder between 1935 and 2014 by fleet (US, Canadian, or Other) and disposition (landings or discards).

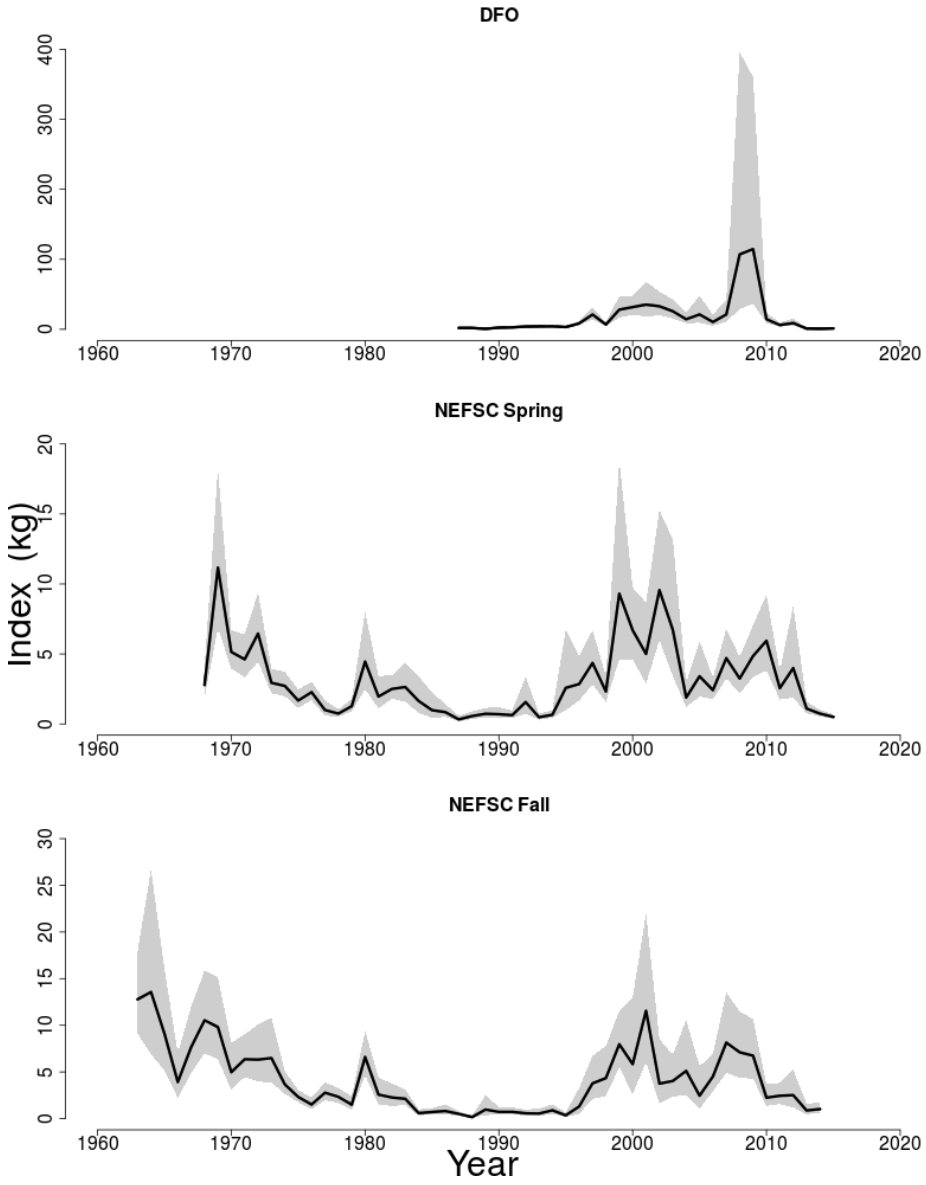

Figure B78: Indices of biomass for the Georges Bank Yellowtail Flounder between 1963 and 2015 for the Canadian DFO and Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys. The approximate 90% lognormal confidence intervals are shown.