NOAA FISHERIES
Southeast
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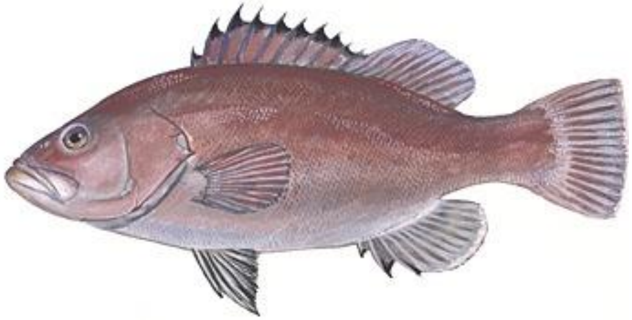
Snowy grouper



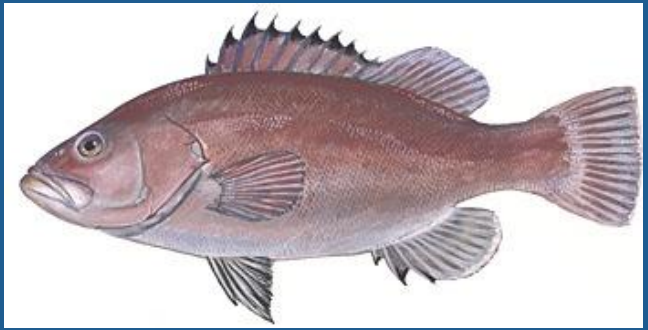
SEDAR36 Standard Assessment

April 30, 2014

Outline

- Background
- Data
  - Review of data sources from SEDAR4
  - Updates/modifications
- Assessment methods and results
  - Review of SEDAR4 model
  - Modifications in this update
  - Results
- Projections

Background



Background

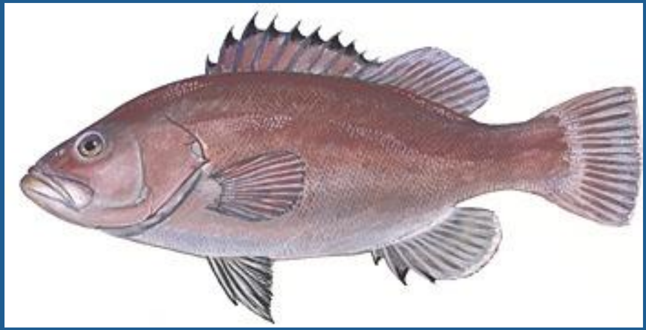
- This is a "standard assessment" under the current SEDAR definition
  - New data sources were considered
  - Assessment Panel met through a series of webinars
  - SEDAR32 was concurrent, so decisions on data and methodology followed SEDAR32 whenever that made sense
  - SSC conducts the review

- Goals of this standard assessment
  - Update and improve the data and primary model from SEDAR4
  - Guiding principle: Fidelity to SEDAR4 was the default, but was trumped where modification was considered an improvement

Background – summary SEDAR4 results

- Overfishing: F2002/Fmsy=3.04
- Overfished: SSB2003/MSST=0.21
- SEDAR4 used the definition of MSST=75%SSBmsy
- Based on SEDAR4, snowy grouper is under a rebuilding plan, with terminal year 2039
  - Thus, the relevant biomass benchmark for SEDAR36 is SSBmsy (the target for rebuilding) rather than MSST

Data



Data geography: Summary of fishery data north of NC

- Commercial
  - Almost no landings or discards (0 most yrs, max=0.6% of total)
  - No lengths or ages
  - Index: logbook includes trips in VA to 37 degrees latitude (few)

- Recreational
  - Landings - DE 2012: 6 fish, 35 lb
  - Discards – NY 2012: 24 fish
  - No Lengths; Ages = 7 fish from 1 trip from VA
  - Index: SHRS does not sample headboats VA-north

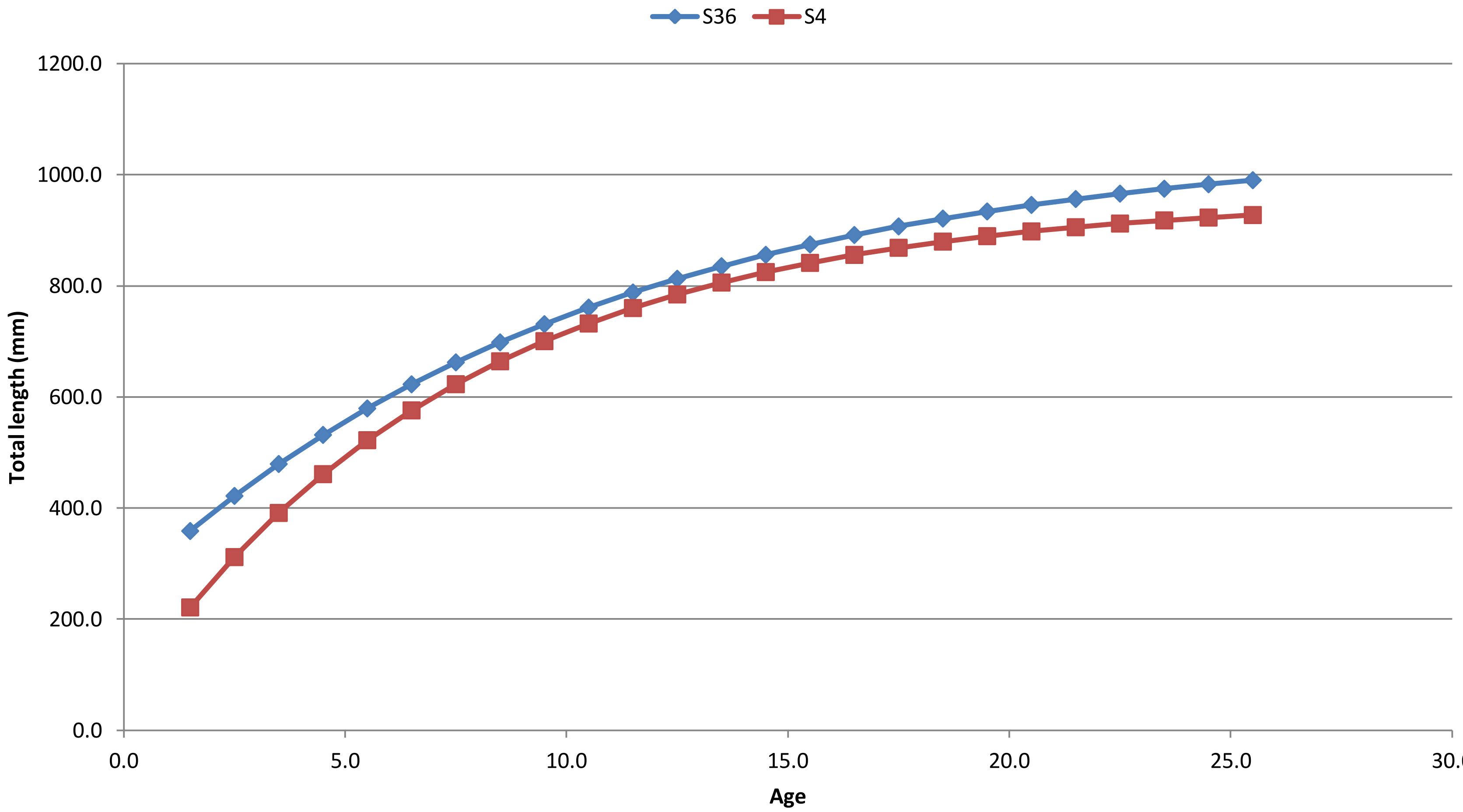
Data geography: Implications and considerations

- This assessment is essentially for the South Atlantic only (FL-NC)
- To make this clean, what little data were available from north of NC have been removed
- Although the fishery off VA has developed over the last decade, the proportion of the total stock north of the NC/VA line appears to be small relative to that in the south Atlantic
- Spawners in the north likely contribute little or nothing to South Atlantic stock productivity

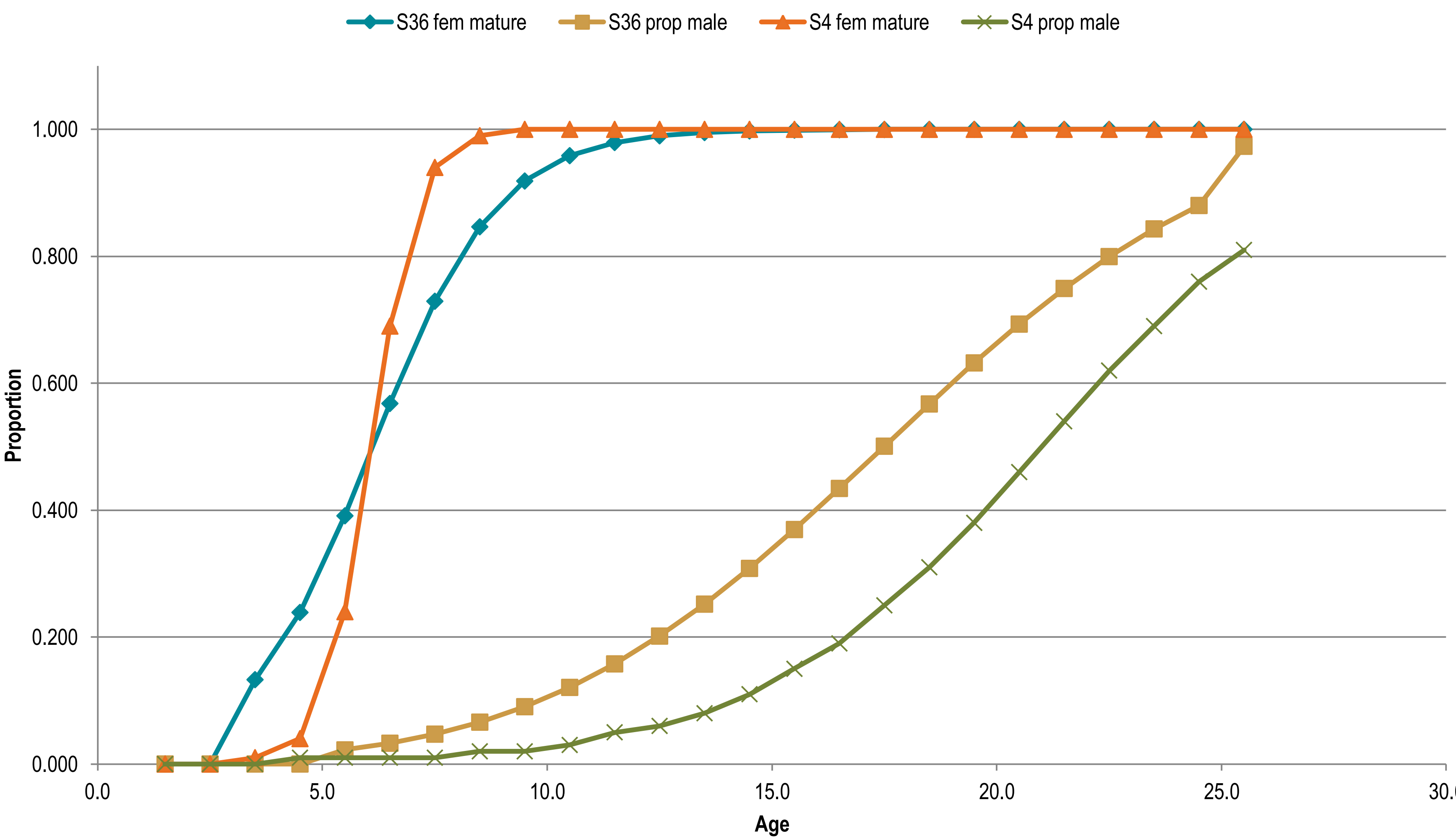
SEDAR 36 life-history update

- ~7700 additional ages since S4
- Re-estimated:
  - Growth curve
  - Female maturity at age
  - Sex transition at age
  - Whole wgt – gutted weight conversion

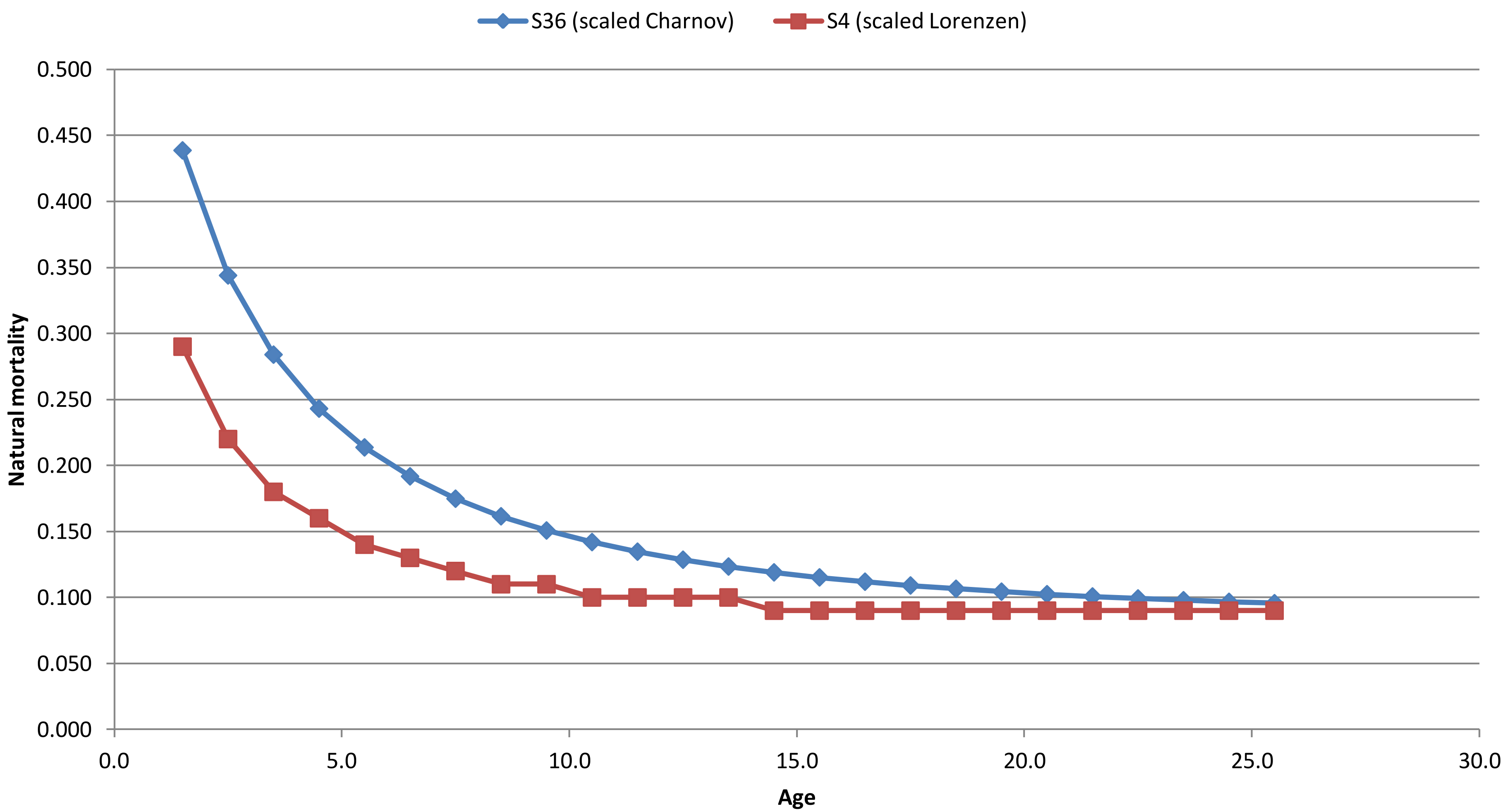
S4/S36 life-history comparison: growth



S4/S36 life-history comparison: reproduction



S4/S36 life-history comparison: M at age (scaled to M=0.12)

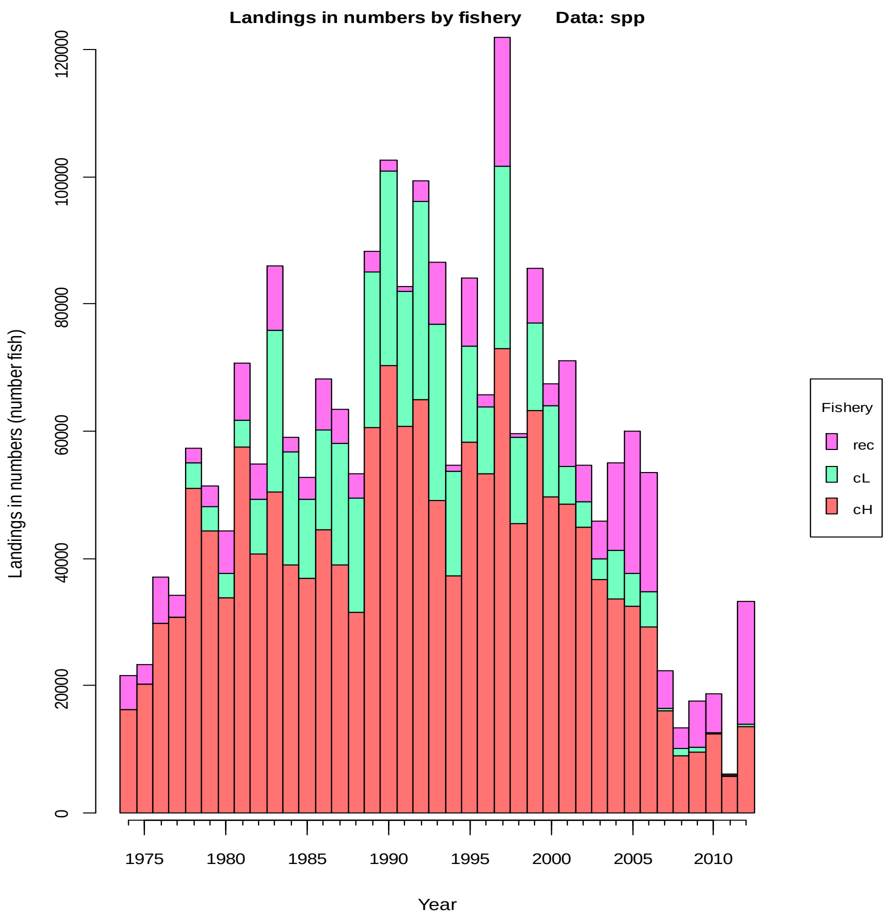


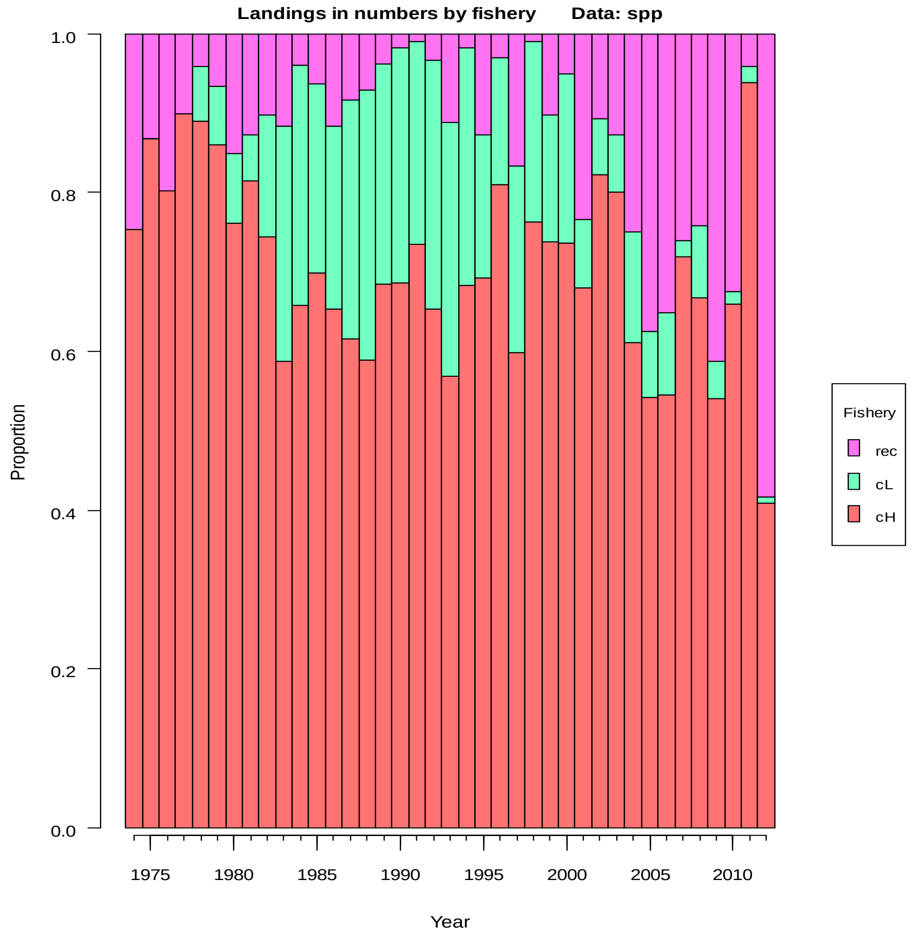
Summary of data fit by the assessment

Note: terminal yr of SEDAR4 was 2002

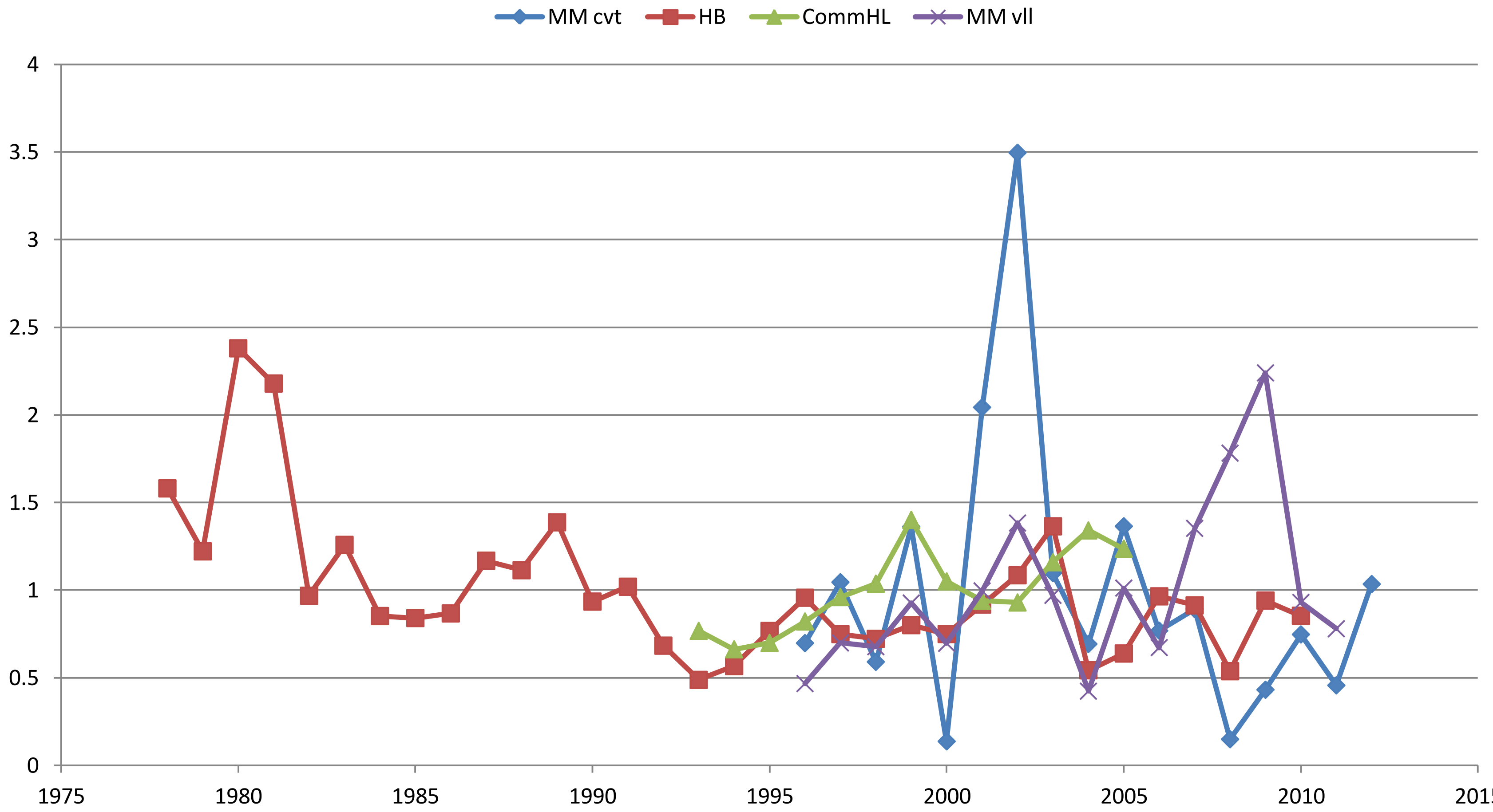
- Removals: Landings + Dead discards (discard M=100%)
  - Commercial handline (1974–2012, 1000 lb whole weight)
  - Commercial longline (1978–2012, 1000 lb whole weight)
  - Recreational (1974–2012, 1000 fish)
- Indices of abundance
  - MARMAP chevron trap (1996–2012)
  - MARMAP vertical longline (1996–2011)
  - Recreational headboat (1978–2010)
  - Commercial handline (1993–2010) [Sensitivity run only]
- Age and length comps
  - Available from each fleet and survey, but not in all years

Landings and discard mortalities (in numbers)





SEDAR 36 – indices



SEDAR 36 – age and length compositions

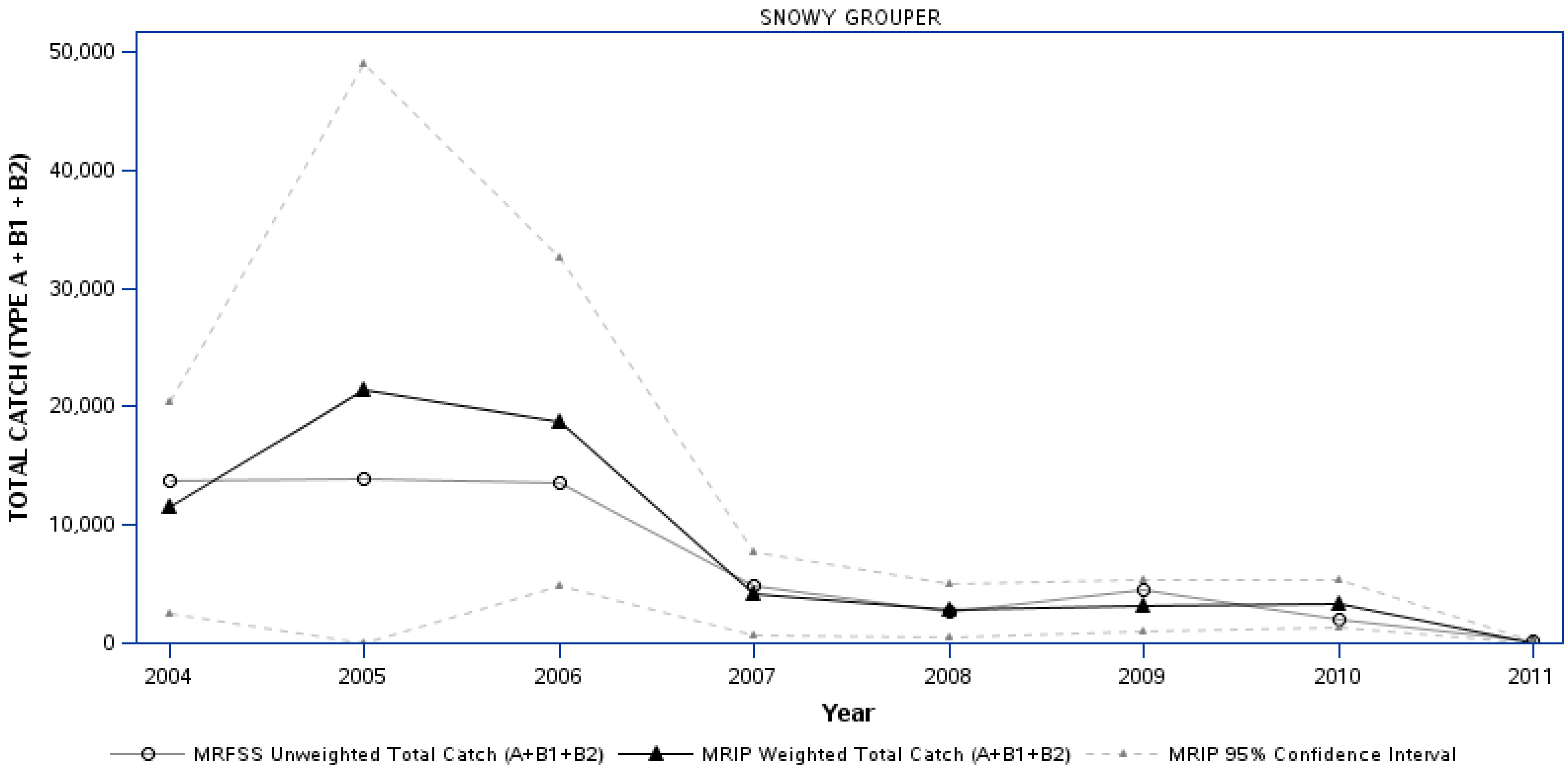
- Landings: Ages and lengths
  - Commercial handline
  - Commercial longline
  - Combined headboat and general recreational (S4 had only HB comp data)
- Discards: none

- Nfish>25 criterion used in S4 and retained here, however Ntrips used to represent sample size in S36
- Age comps given priority over length comps in years of overlap for a given fleet
- MARMAP age comps used instead of length comps (these age comps not available for S4)

S36 data summary

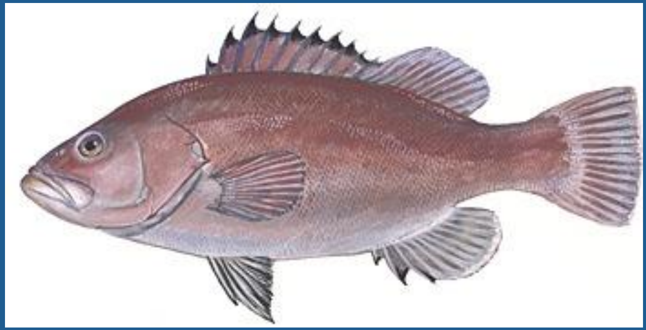
Removals	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**
C.hl (klb)	187	216	279	258	422	383	313	576	426	512	360	305	316	241	180	335	385	337	356	254	179	261	235	340	226	336	263	247	224	184	178	188	186	112	67	72	88	40	93
C.ll (klb)	**0**	**0**	**0**	**0**	46	42	43	47	104	323	225	149	171	184	153	192	228	154	227	197	110	98	64	174	85	92	101	43	27	23	54	36	43	4	11	8	3	1	3
Rec (1000s)	5	3	7	3	2	3	7	9	6	10	2	3	8	5	4	3	2	1	3	10	1	11	2	20	1	9	3	17	6	6	14	23	19	6	3	7	6	0	19
Indices																																							
HB					1.6	1.2	2.4	2.2	1.0	1.3	0.9	0.8	0.9	1.2	1.1	1.4	0.9	1.0	0.7	0.5	0.6	0.8	1.0	0.7	0.7	0.8	0.7	0.9	1.1	1.4	0.5	0.6	1.0	0.9	0.5	0.9	0.9		
MM vll																							0.5	0.7	0.7	0.9	0.7	1.0	1.4	1.0	0.4	1.0	0.7	1.4	1.8	2.2	0.9	0.8	
MM cvt																							0.7	1.0	0.6	1.4	0.1	2.0	3.5	1.1	0.7	1.4	0.8	0.9	0.1	0.4	0.7	0.5	1.0
C.HL																				0.8	0.7	0.7	0.8	1.0	1.0	1.4	1.0	0.9	0.9	1.2	1.3	1.2							
Age comps (N>25)																																							
C.hl																			38	3		1	5	105	72	64	87	70	60	83	215	381	189	963	538	455	735	599	834
C.ll																									62	64	109	104	117	69	86	41	161	33	53	51	35	1	44
Rec							21	45	1	17	11	6	18	1		15	4	2	1	4	3	1	7	2					4	185	62	5	19	7	13	8	8	2	2
MM vll																							13	38	25	33	36	42	27	52	10	36	30	15	61	21	98	127	
MM cvt																							56	61	20	7	5	38	28	19	22	4	10	11	2	6	13	18	44
Length comps (N>25, priority to ages)																																							
C.hl										95	2098	3645	1625	1395	795	1279	1677	1659	2997	2339	1922	4544	2143	1091	1722	2401	2261	1785	1280	1521	2131	1359	1726	1182	641	600	865	658	926
C.ll											1139	1065	1286	565	461	341	714	917	1700	4668	807	1755	757	1355	472	1277	862	904	957	372	450	106	234	40	61	105	63	9	52
Rec	242	196	233	122	51	48	54	85	24	75	43	72	77	36	47	51	7	6	2	10	17	21	108	144	69	34	15	49	24	30	53	30	43	56	35	53	86	3	20
~~MM vll~~																							~~13~~	~~38~~	~~27~~	~~33~~	~~36~~	~~43~~	~~27~~	~~52~~	~~10~~	~~36~~	~~34~~	~~15~~	~~61~~	~~21~~	~~101~~	~~170~~	
~~MM cvt~~																							~~60~~	~~61~~	~~22~~	~~7~~	~~5~~	~~39~~	~~29~~	~~19~~	~~22~~	~~4~~	~~10~~	~~11~~	~~2~~	~~6~~	~~14~~	~~23~~	~~43~~

Comparison of MRFSS and MRIP estimates



Plot generated by MRIP website

Assessment methods and results



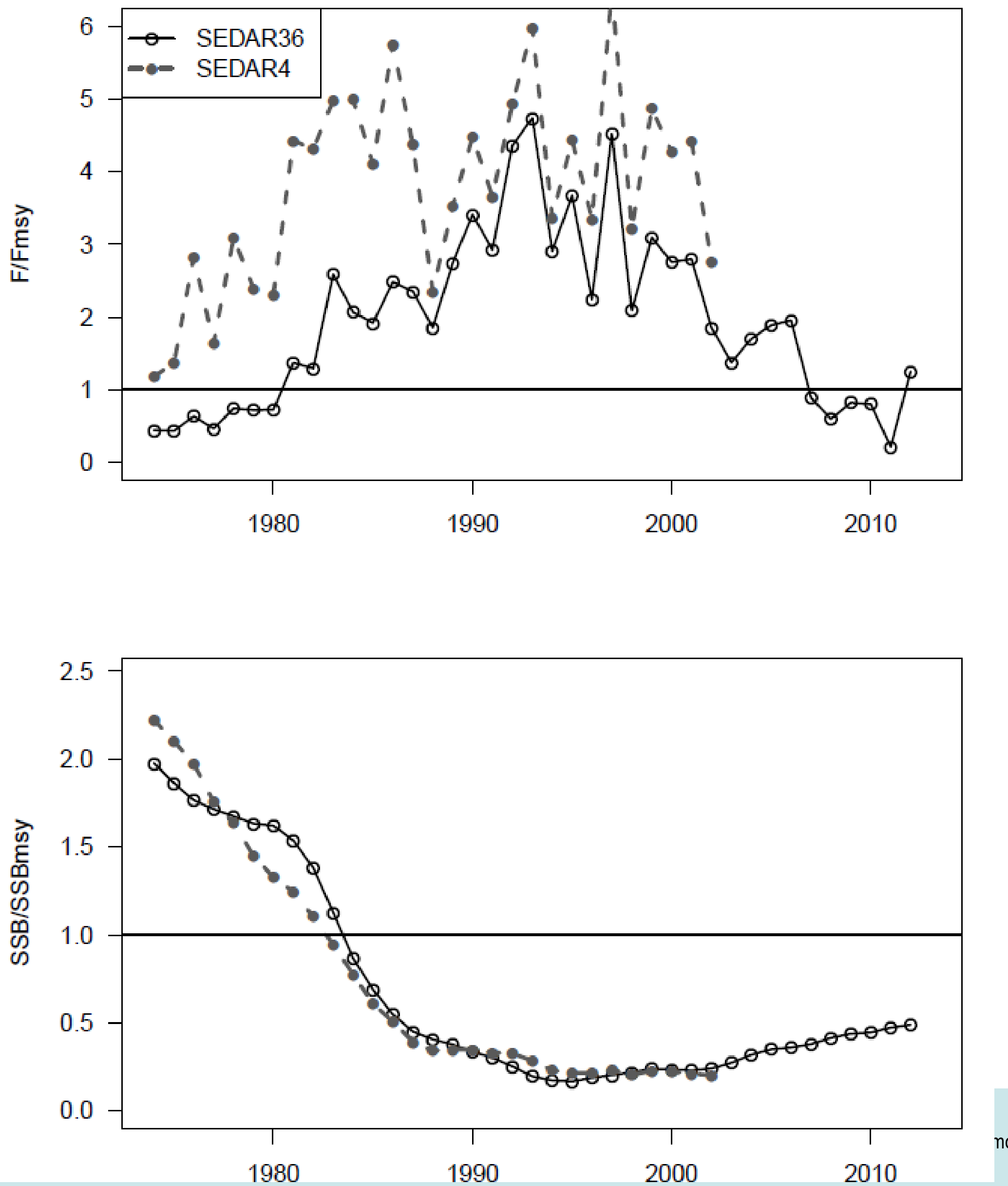
BAM: same basic model as in SEDAR4

- Catch-age formulation, fit to data using maximum likelihood
- Beverton-Holt spawner recruit model, with lognormal error
  - S4 used sum of squares error; S36 uses max likelihood
- Age-based natural mortality
- Age-based selectivities
  - Although there were no size limits, recreational selectivity varied across time periods (as in SEDAR4)
- Baranov catch equation
- Spawning stock based on total mature biomass (males+females)

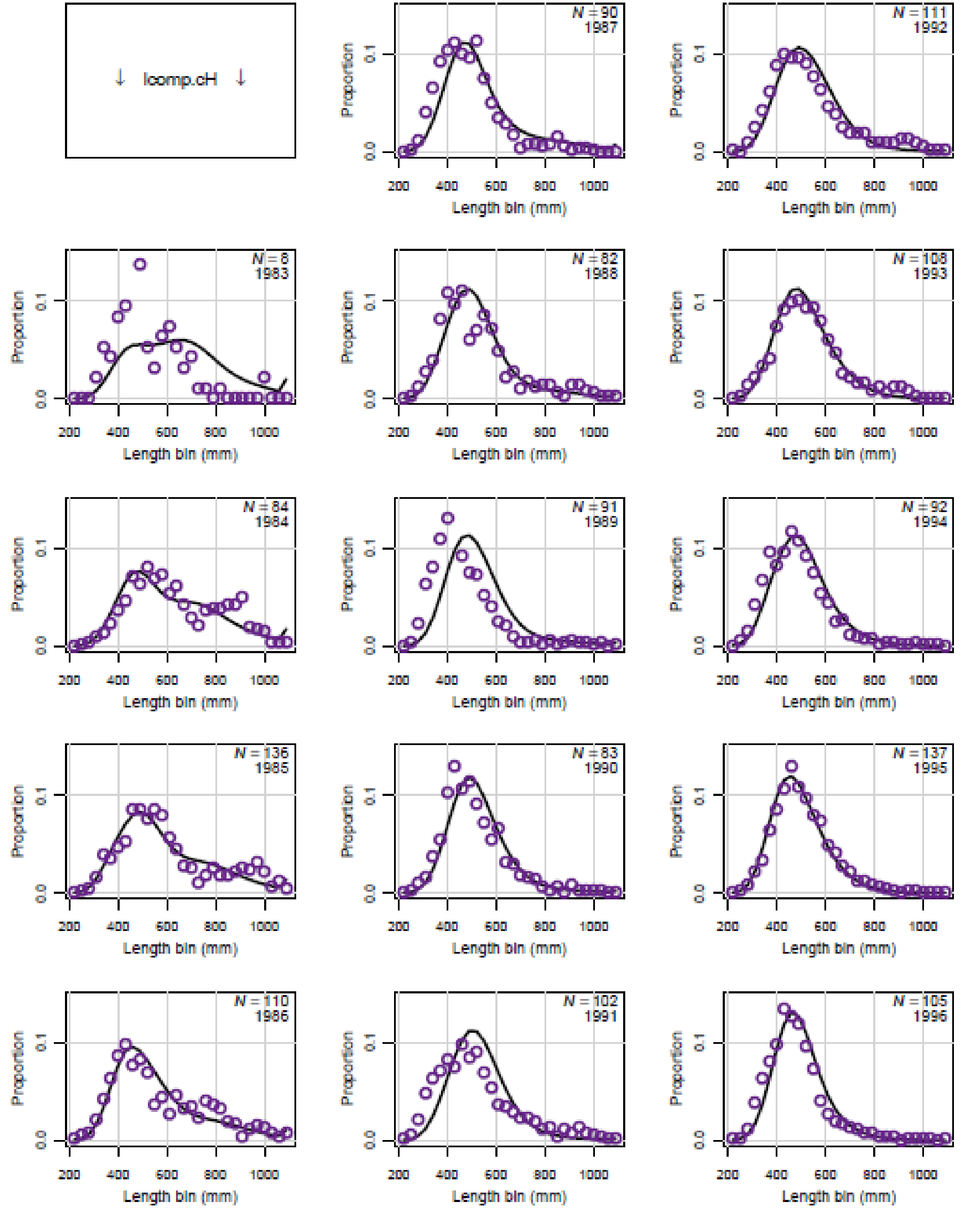
Assessment models: SEDARS 4 and 36 comparison

S4	S36
Stat. catch-age model – early version BAM	Stat. catch-age model – modern version BAM
Uncertainty through monte-carlo bootstrap	Uncertainty through monte-carlo bootstrap
Assessment period: 1962 – 2002	Assessment period: 1974 – 2012
Ages modeled: 0 – 35+	Ages modeled: 1 – 25+
Ages fitted in comp data: 0 – 35+	Ages fitted in comp data: 1 – 14+
Nfish>25 criterion for inclusion in comps	Nfish>25. Also, Ntrips≥5, as in SEDAR32
No bias correction in estimation of benchmarks	Bias correction in estimation of benchmarks
Steepness fix at h=0.7; lognormal distn	Steepness fixed at h=0.84; beta distn
Total F output: Sum of full F's by fleet	Total F output: Apical F
Initialization (1961): Equilibrium age structure at 90% unfished level	Initialization (1974): Age structure estimated
Selectivities: flat-topped for comm longline gear (comm LL); dome-shaped for others (MM vll, MM cvt, comm HL, recreational); descending limb of HB selex changed linearly 1977-1991	Selectivities same as S4, except: 1) MM vll and comm HL are flat-topped 2) Rec selex varies as time blocks 3) More stable function for dome-shaped selex

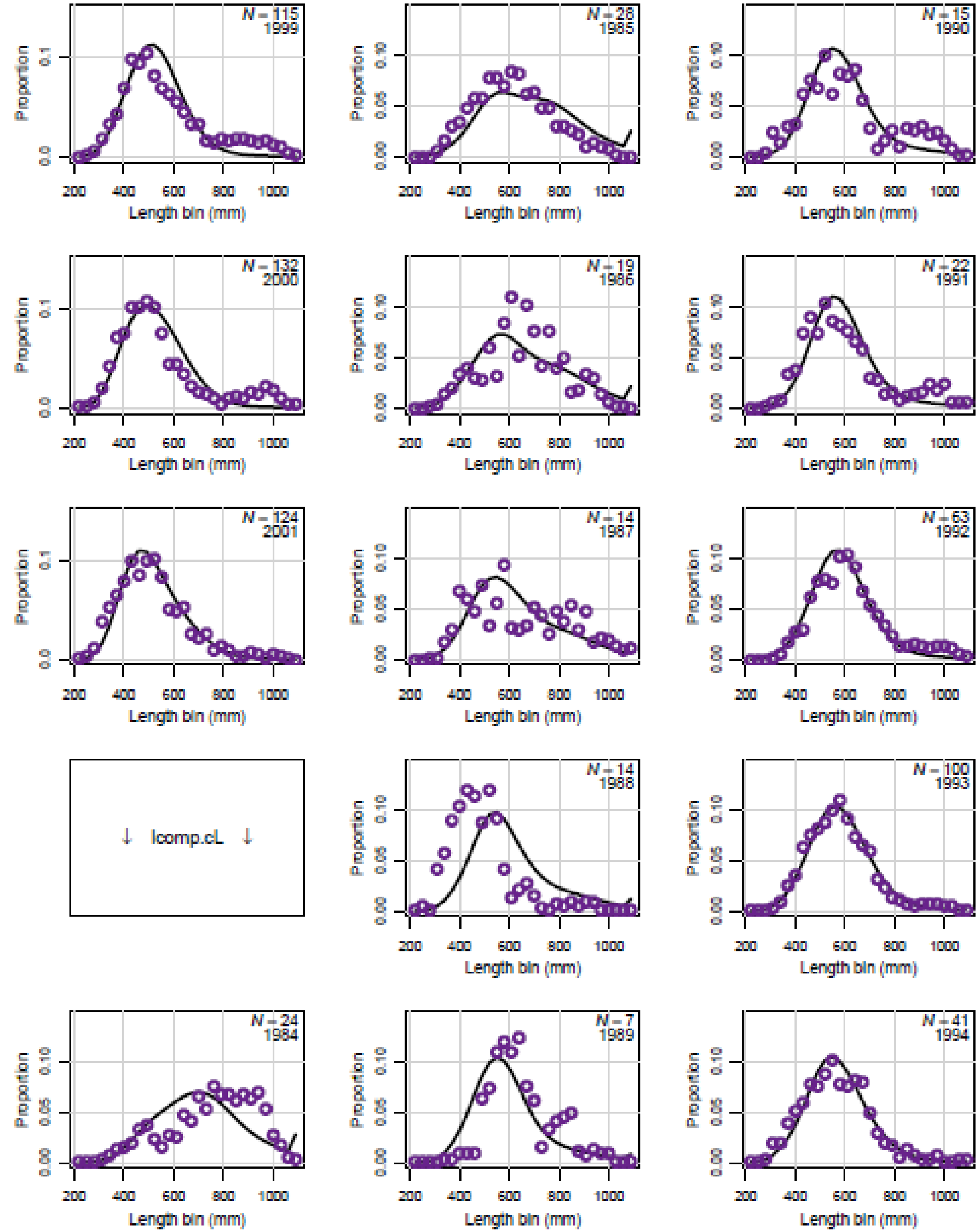
Effects of modifications



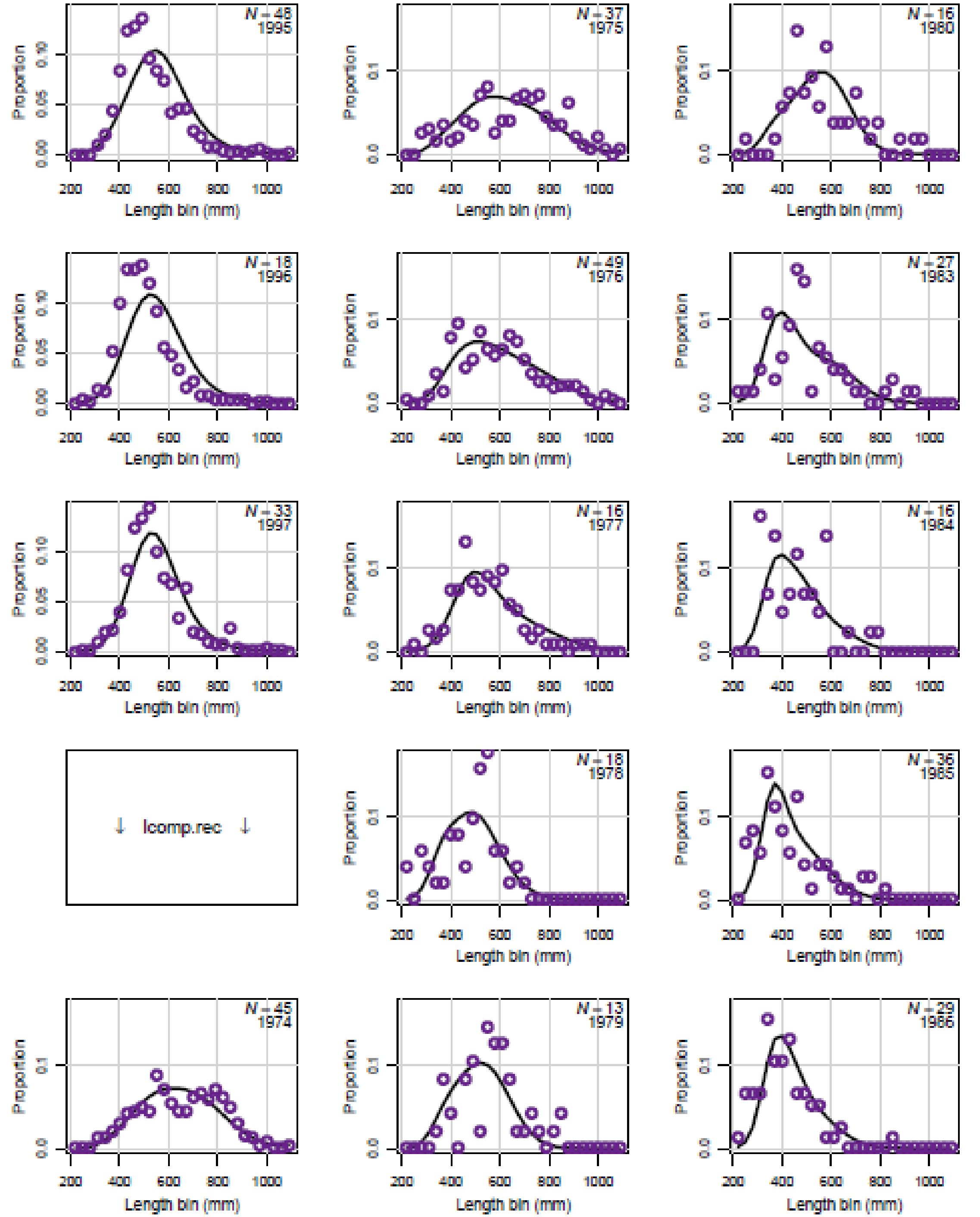
BAM base run – fits to data



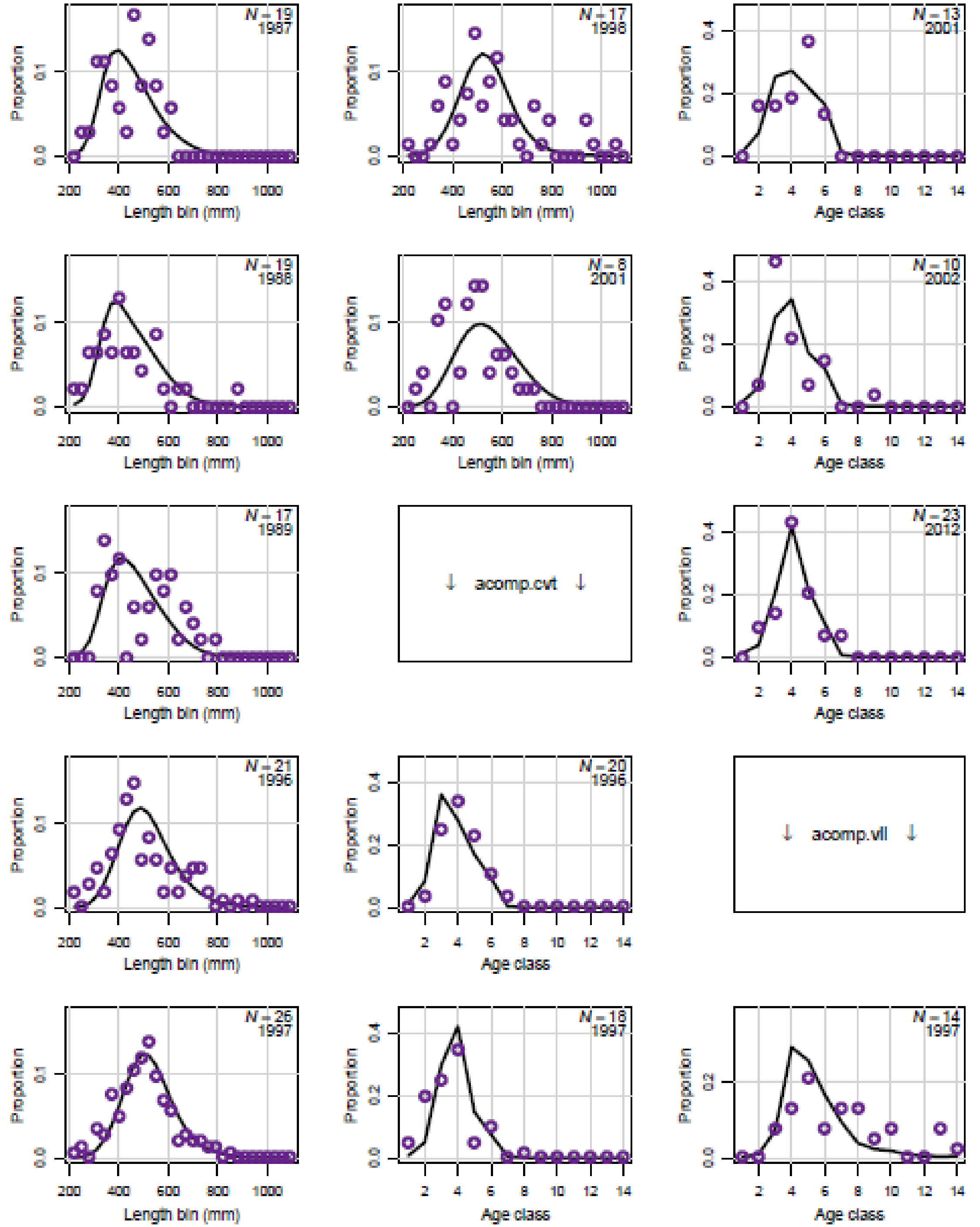
BAM base run – fits to data



BAM base run – fits to data



BAM base run – fits to data



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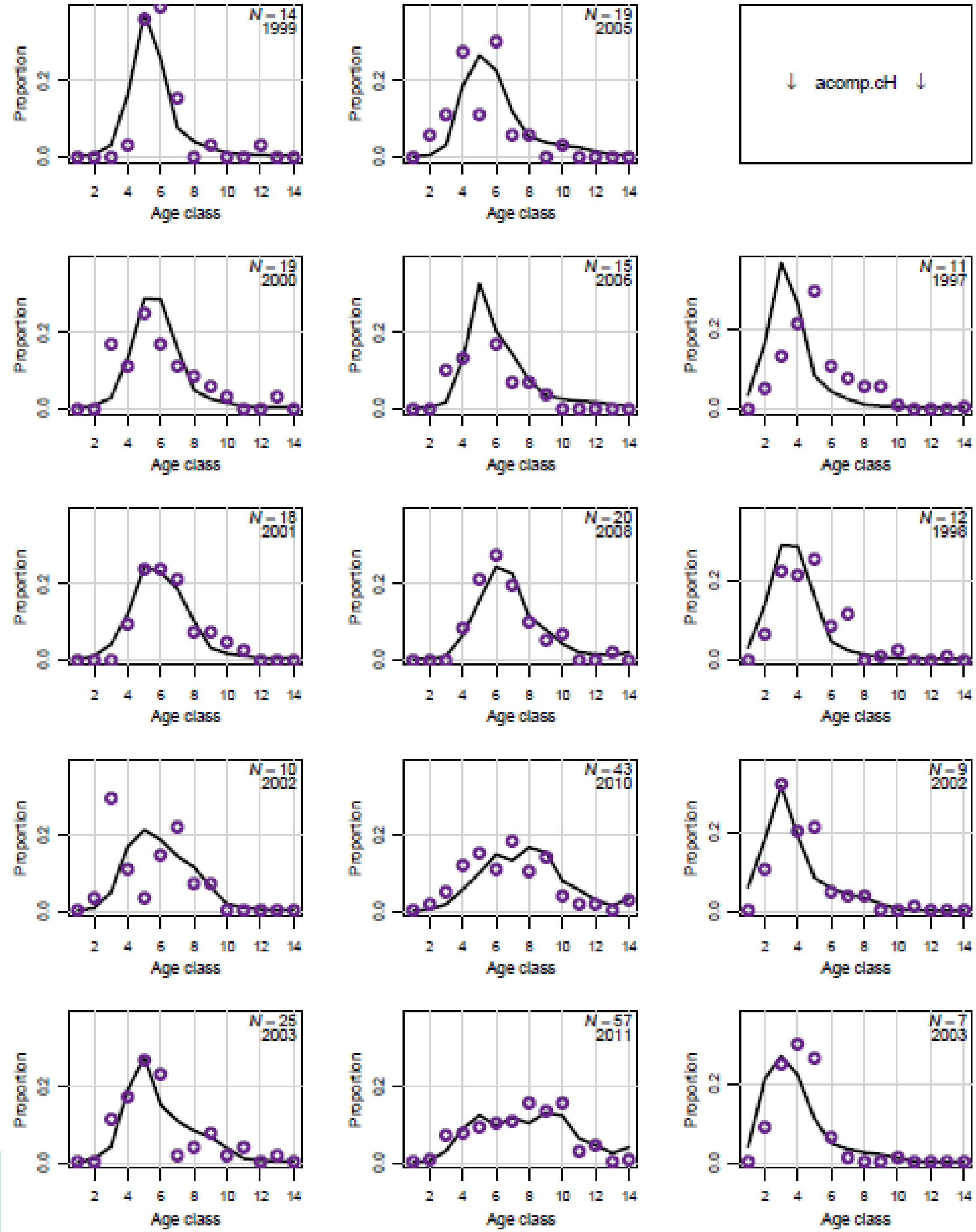
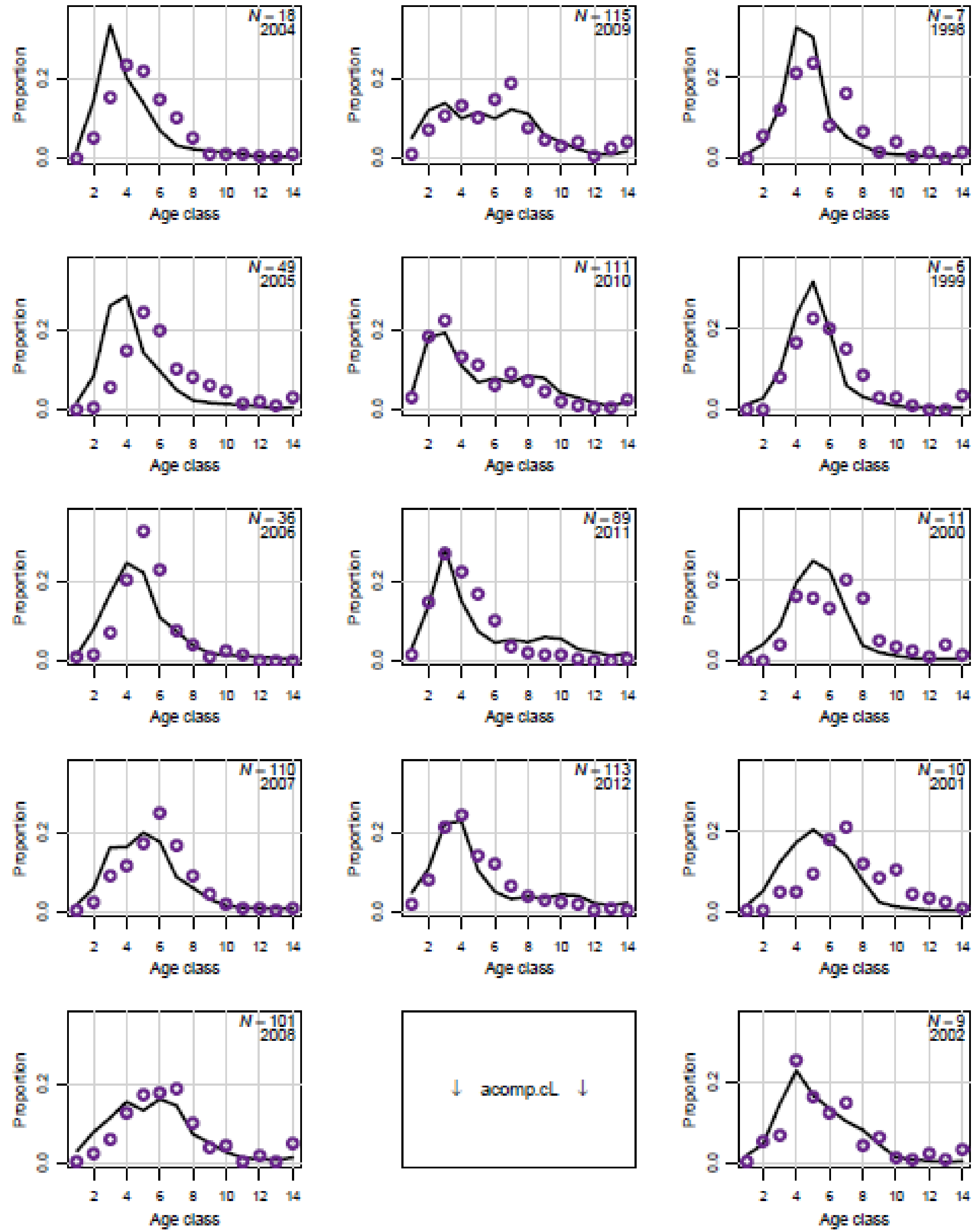
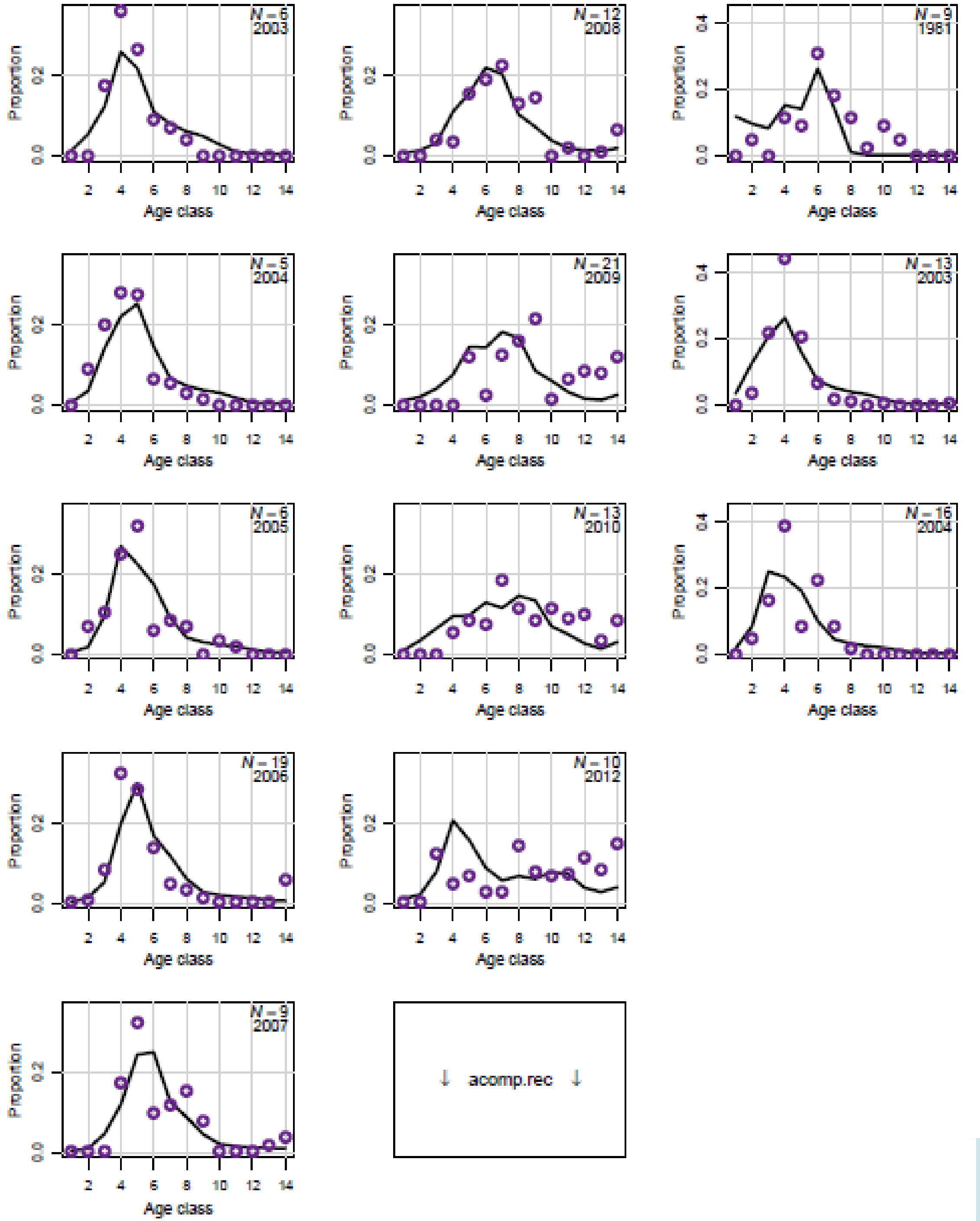
BAM base run – fits to data



BAM base run – fits to data



BAM base run – fits to data



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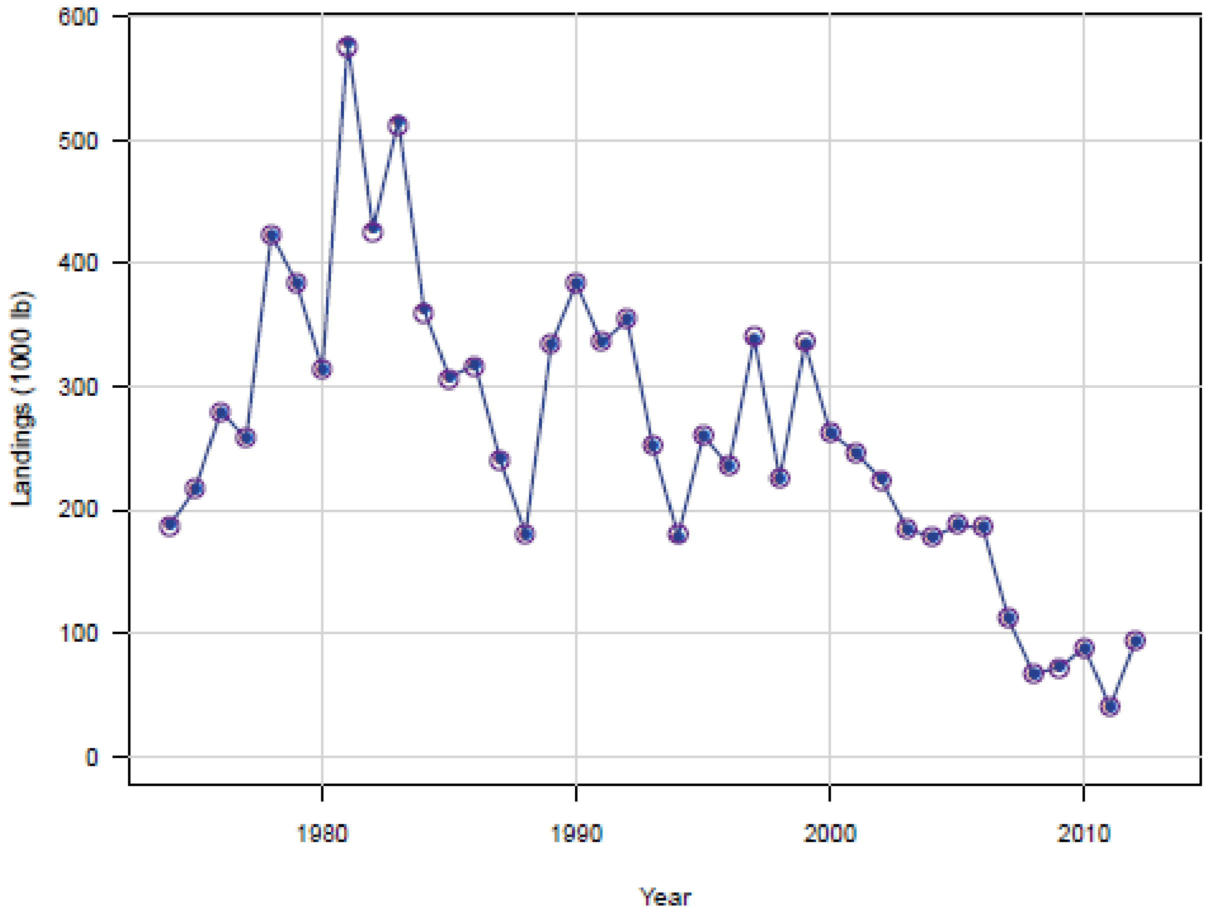
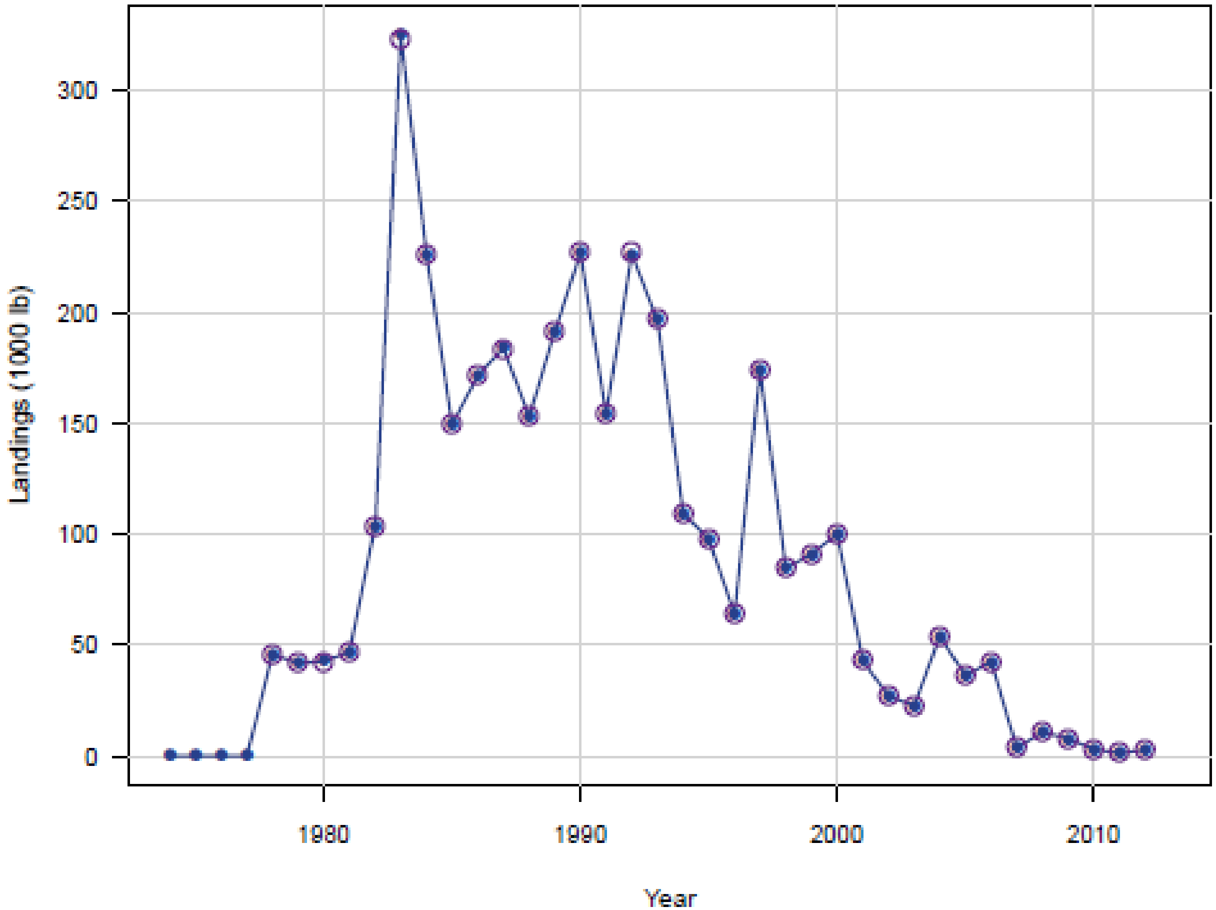
BAM base run – fits to data

Figure 4. Observed (open circles) and estimated (solid line, circles) commercial handline removals (landings and dead discards, 1000 lb whole weight). Open and solid circles are indistinguishable.



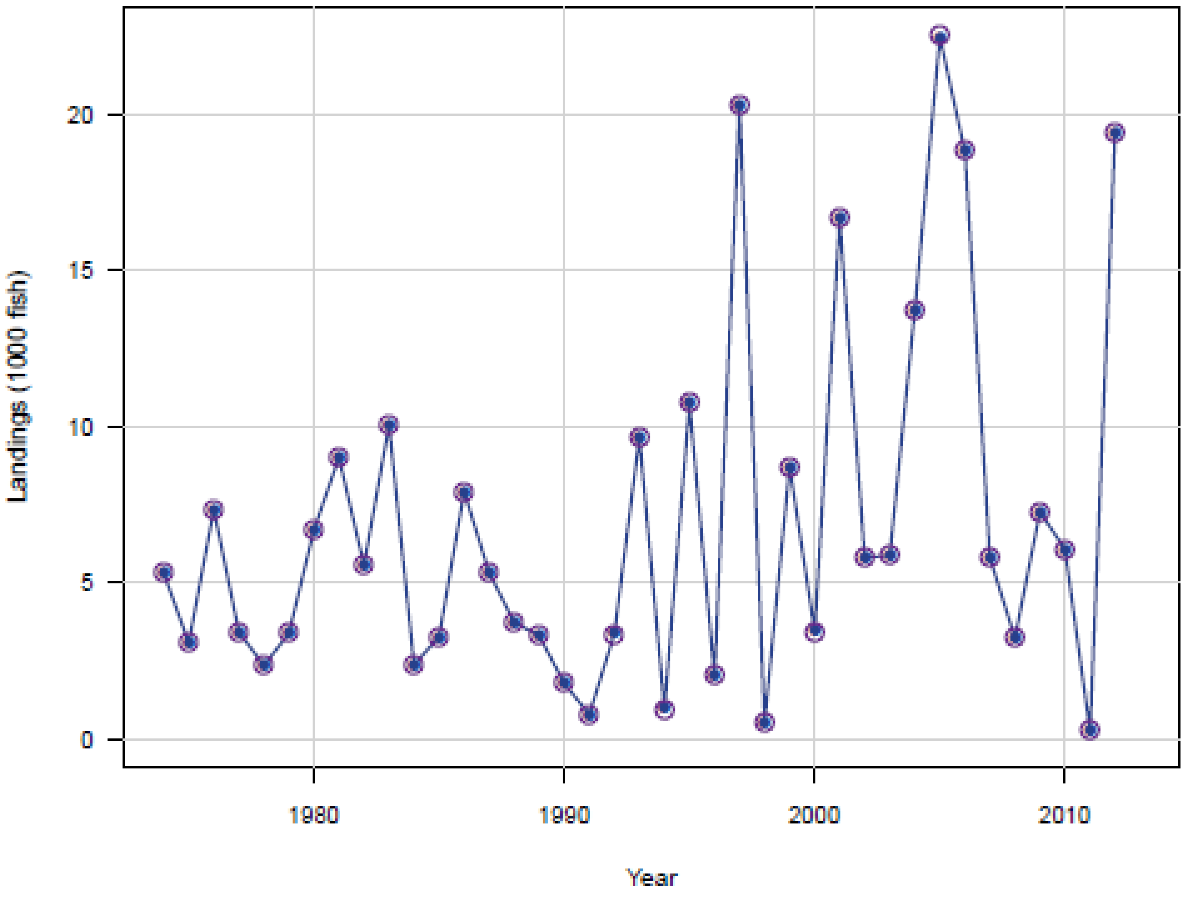
BAM base run – fits to data

Figure 5. Observed (open circles) and estimated (solid line, circles) commercial longline removals (landings and dead discards, 1000 lb whole weight). Open and solid circles are indistinguishable.



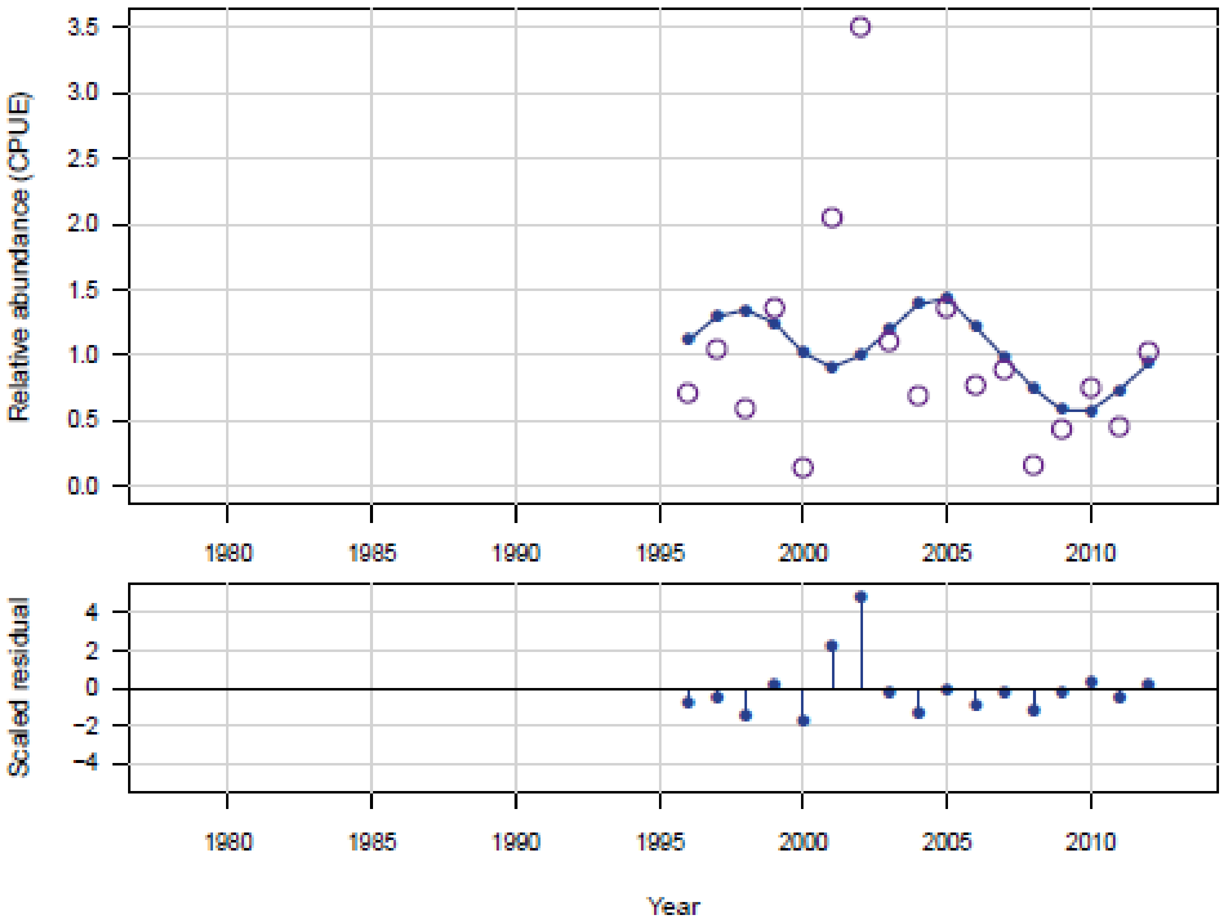
BAM base run – fits to data

Figure 6. Observed (open circles) and estimated (solid line, circles) recreational removals (landings and dead discards, 1000 fish). Open and solid circles are indistinguishable.



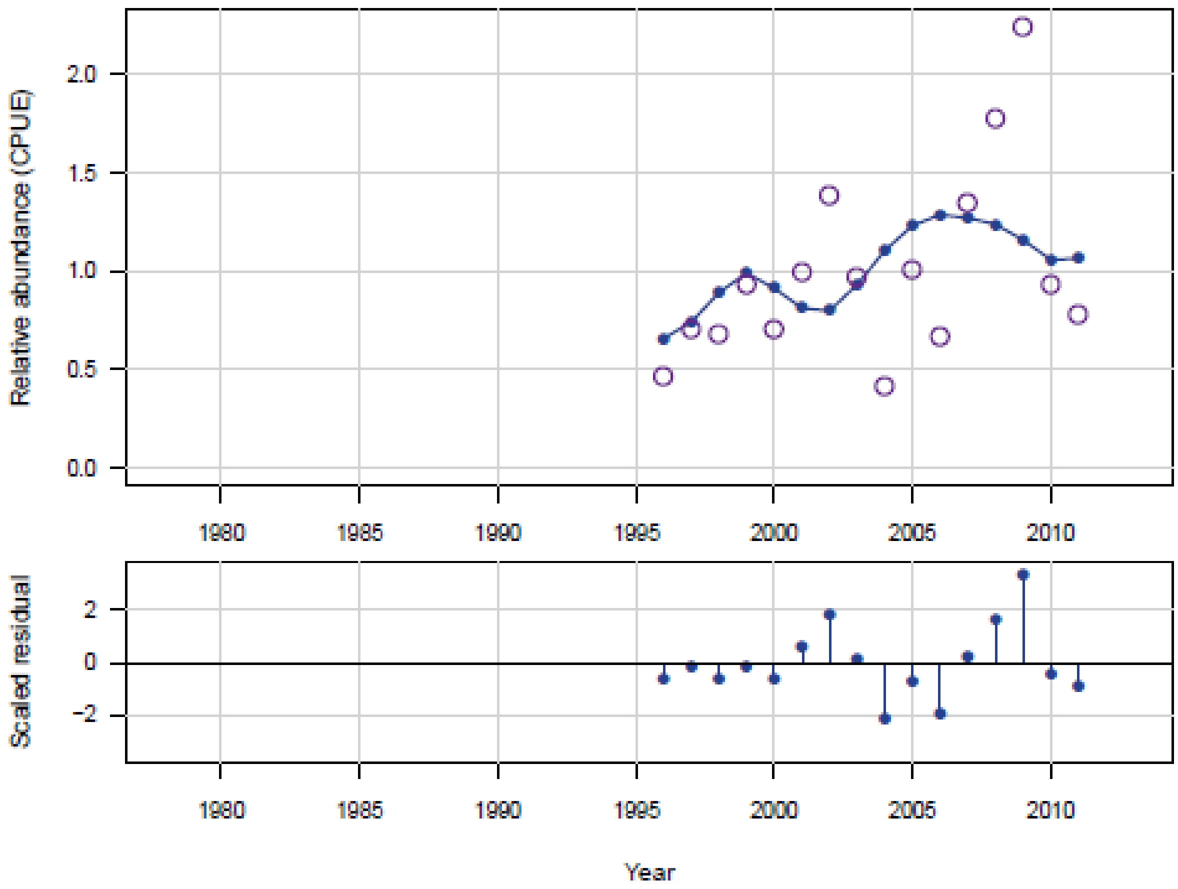
BAM base run – fits to data

Figure 7. Observed (open circles) and estimated (solid line, circles) index of abundance from the MARMAP chevron trap survey.



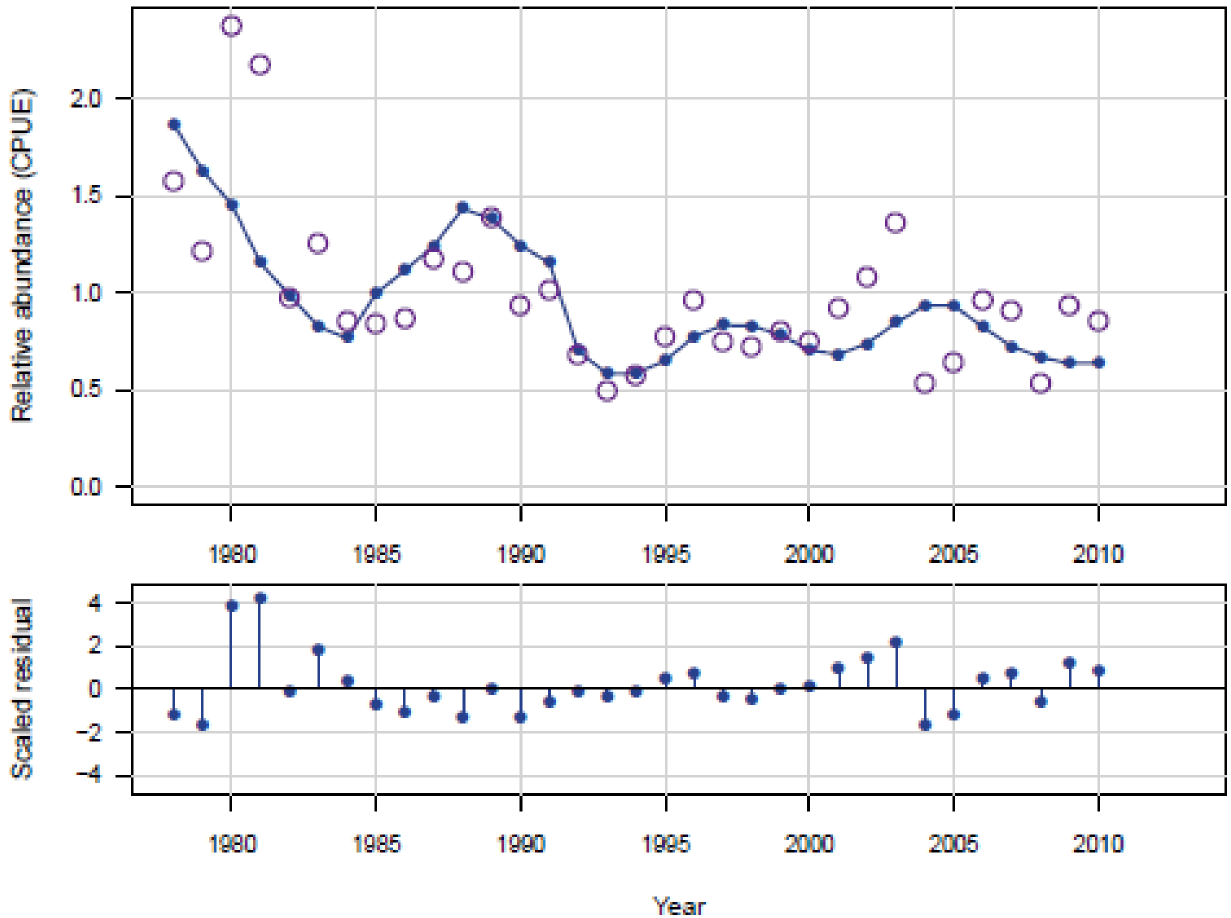
BAM base run – fits to data

Figure 8. Observed (open circles) and estimated (solid line, circles) index of abundance from the MARMAP vertical longline survey.

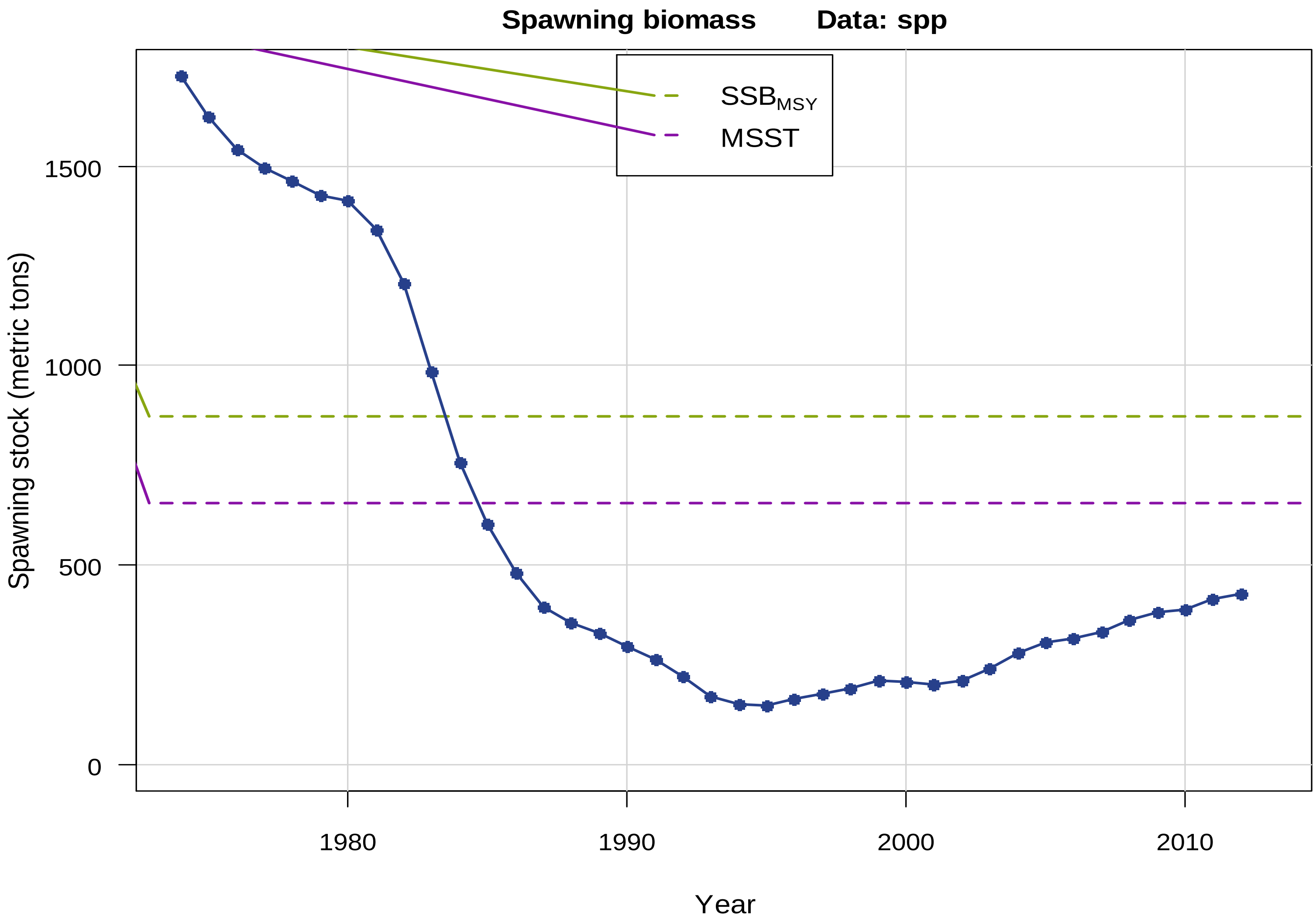


BAM base run – fits to data

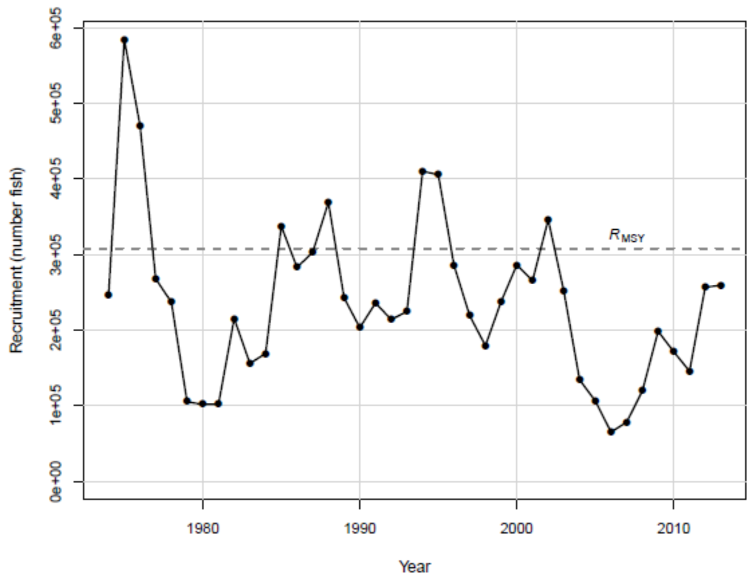
Figure 9. Observed (open circles) and estimated (solid line, circles) abundance from the recreational headboat fleet.

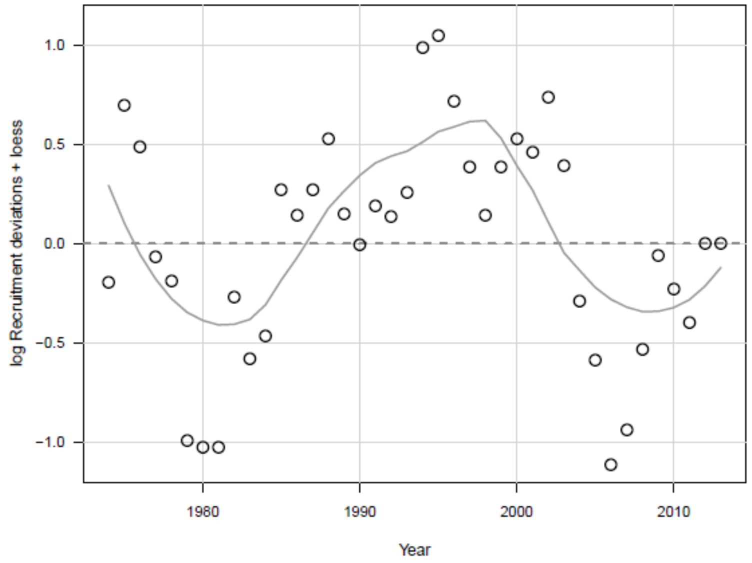


BAM base run – SSB

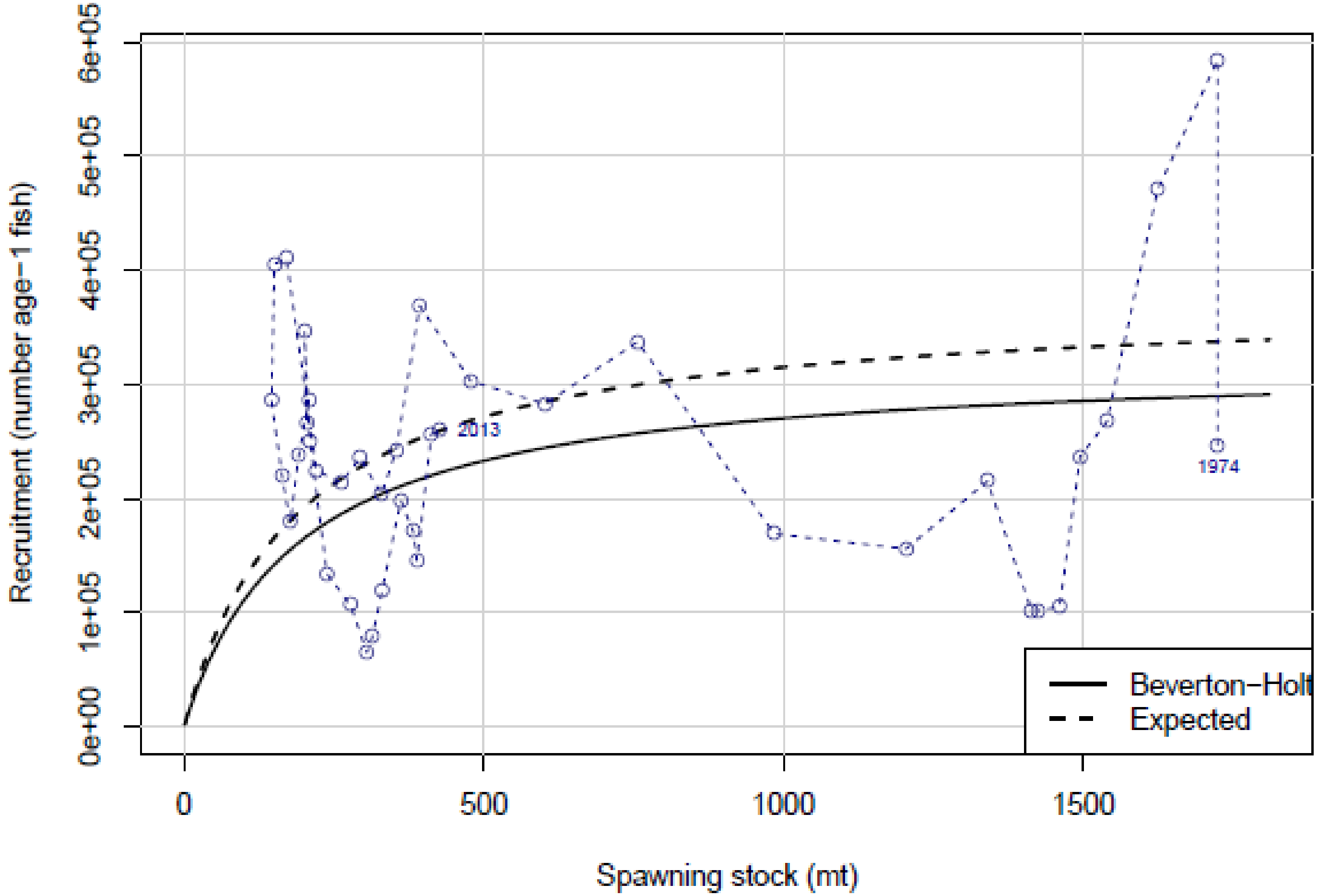


BAM base run – Recruitment

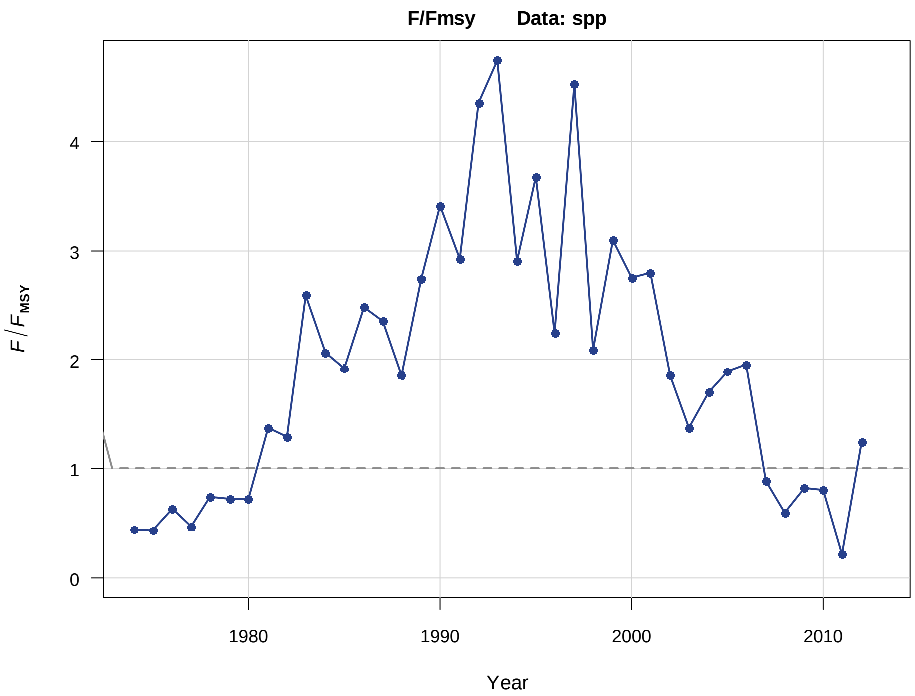


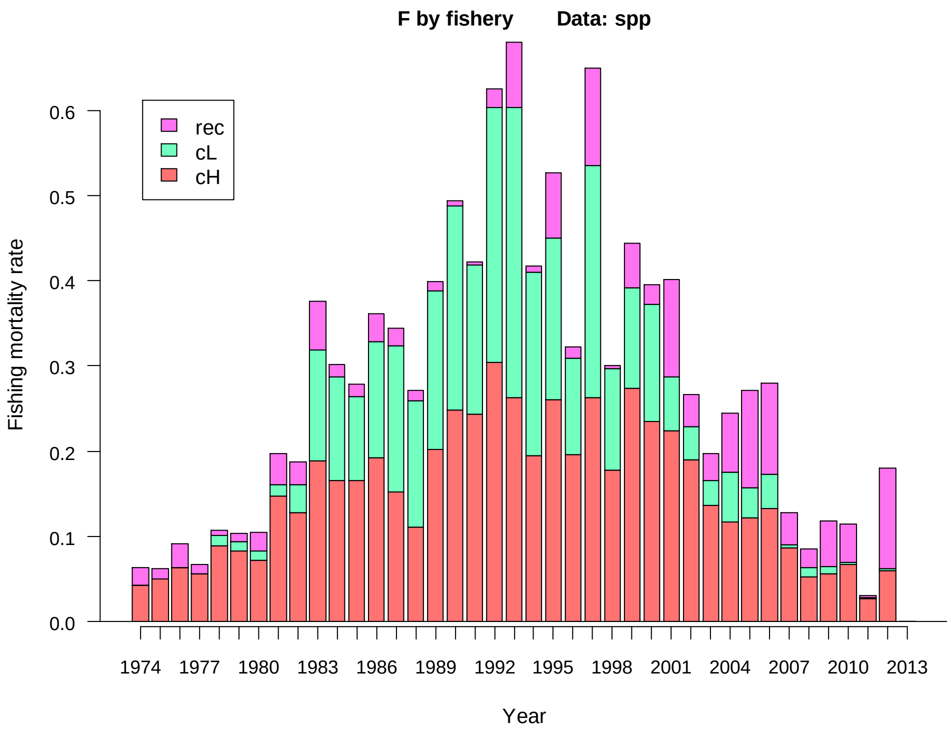


BAM base run – Spawner-recruit curve



BAM base run – Fishing mortality





Uncertainty – Combined Monte Carlo and Bootstrap (MCB) approach

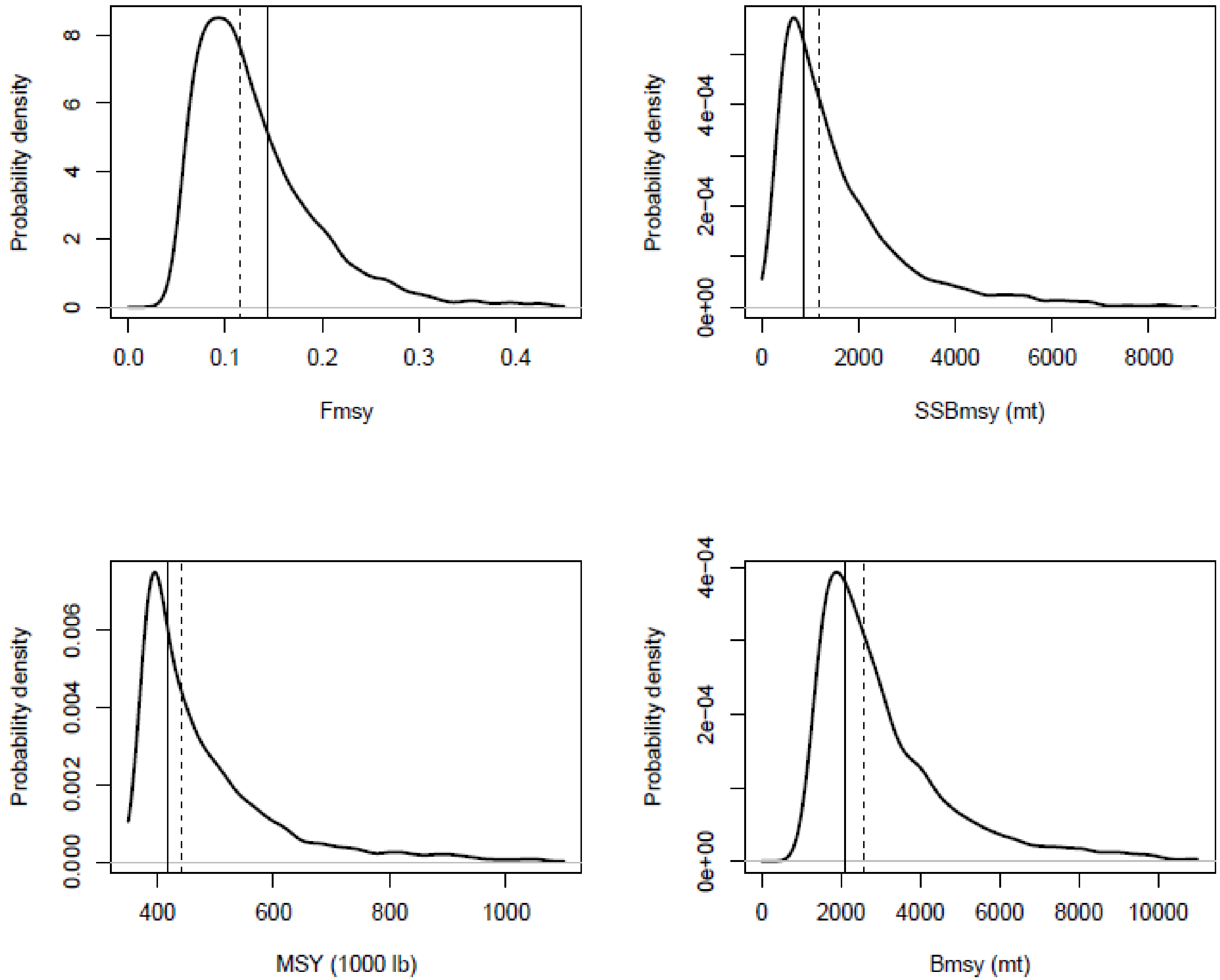
- n=4000 MCB trials attempted; n=3950 retained

- Bootstrap components:
  - Lognormal likelihood components (landings, discards, indices): a parametric bootstrap to original data, with CVs as applied in the fitting procedure
  - Multinomial likelihood components (length, age comps): resample Nfish and assign them to bins with probabilities equal to those from original data

MCB approach

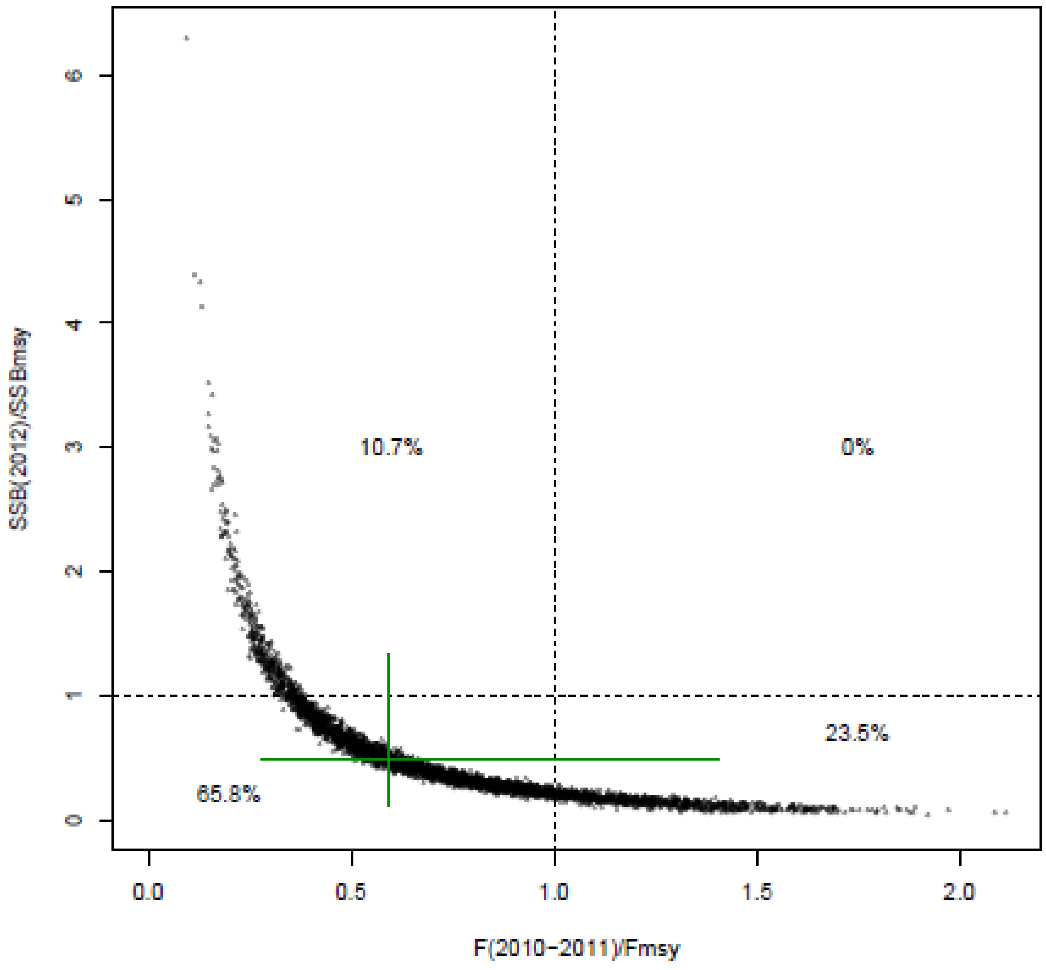
- Monte Carlo components:
  - M: drawn from a uniform distribution, with mean equal to base value (0.12), and bounds [0.08, 0.16]. Chosen value scales age-based Charnov M.
  - Steepness: drawn from a truncated beta distribution with expected value of 0.84 and bounds [0.32, 0.99]
  - Finit: drawn from a uniform distribution, with mean equal to Finit=0.03 and bounds at ±50% [0.015, 0.045]

MCB – uncertainty in benchmarks



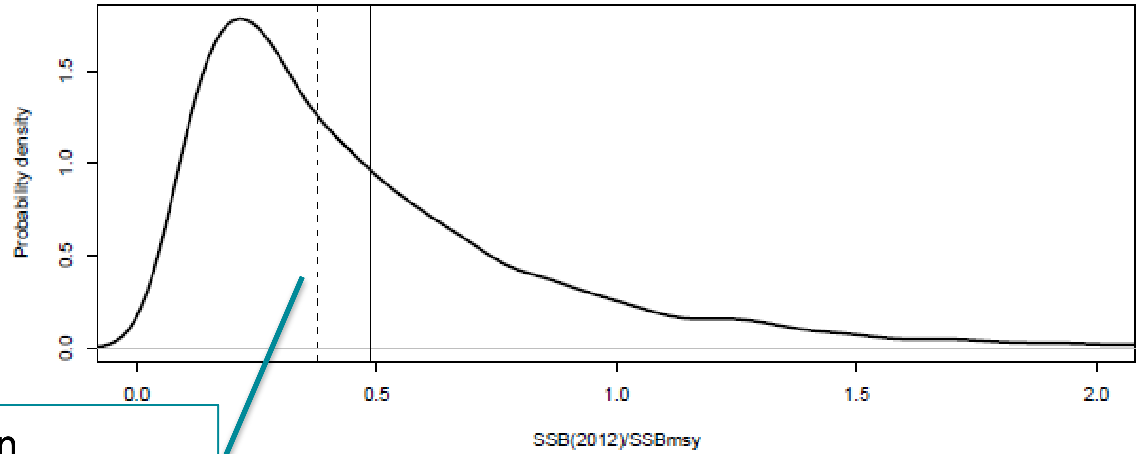
Solid=MLE (base)
Dash=Median

MCB – stock and fishery status

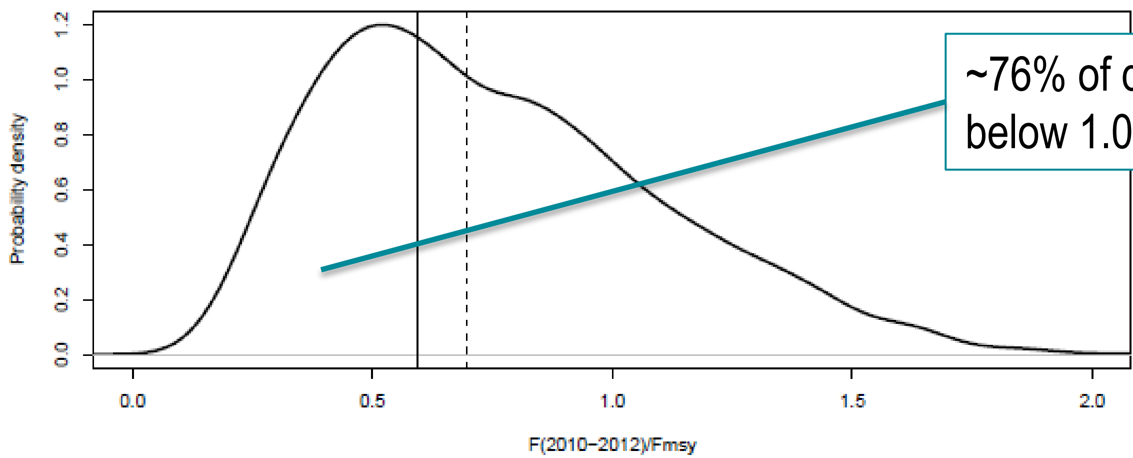


MCB – stock and fishery status

Solid=MLE (base)
Dash=Median



~89% of distribution
below 1.0 (i.e., not recovered)



~76% of distribution
below 1.0 (i.e., not overfishing)

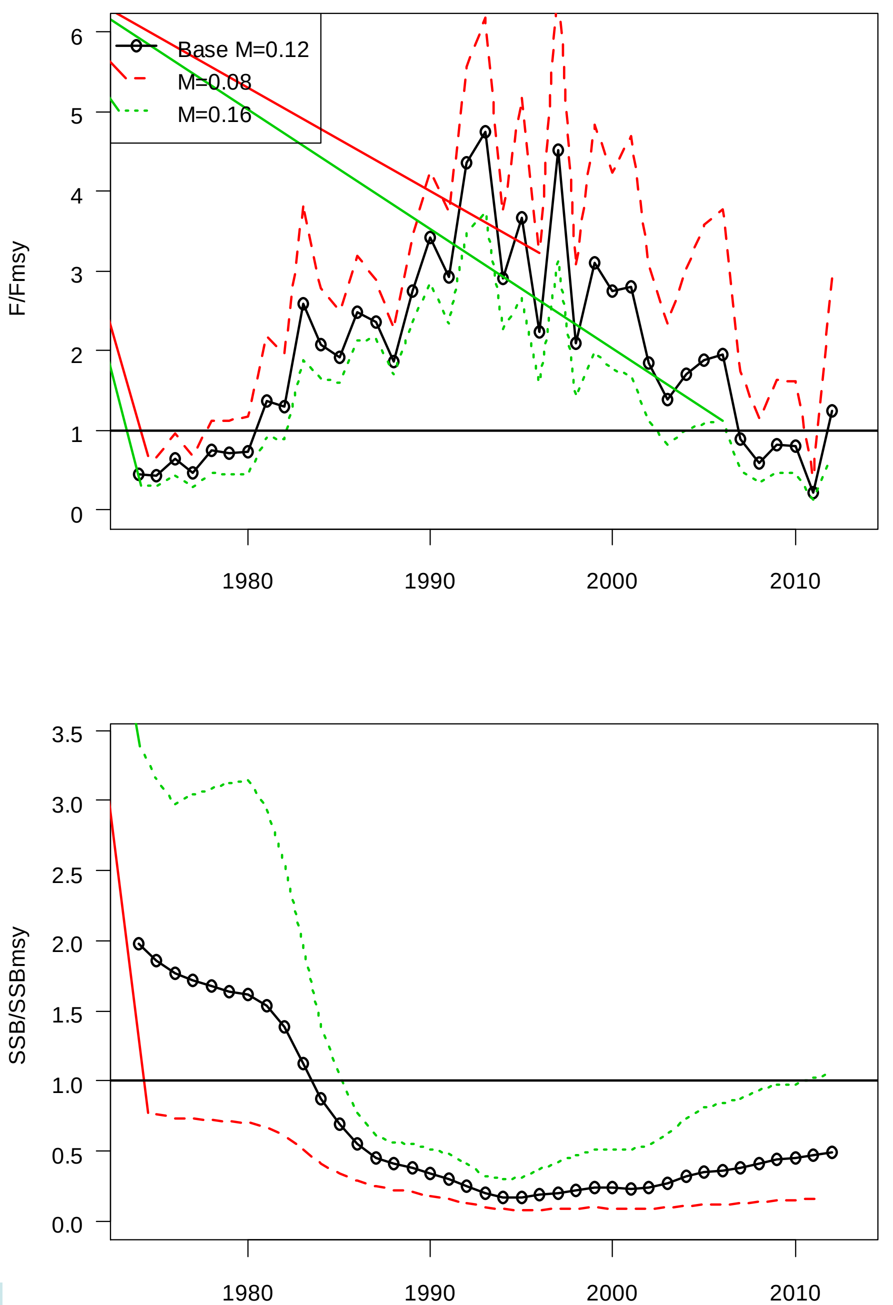
BAM results – Management quantities

Quantity	Units	Estimate	Median	SE
F_{MSY}	y^{-1}	0.14	0.12	0.07
$85\%F_{\text{MSY}}$	y^{-1}	0.12	0.10	0.06
$75\%F_{\text{MSY}}$	y^{-1}	0.11	0.09	0.05
$65\%F_{\text{MSY}}$	y^{-1}	0.09	0.08	0.04
$F_{30\%}$	y^{-1}	0.11	0.11	0.02
$F_{40\%}$	y^{-1}	0.08	0.08	0.01
$F_{50\%}$	y^{-1}	0.06	0.05	0.01
B_{MSY}	mt	2091.7	2590.2	1937
SSB_{MSY}	mt	872.3	1177.0	1384
MSST	mt	654.2	882.7	1038
MSY	1000 lb	418.6	441.4	134
R_{MSY}	1000 age-1 fish	308	361	149
Y at $85\%F_{\text{MSY}}$	1000 lb	414.8	436.6	131
Y at $75\%F_{\text{MSY}}$	1000 lb	407.3	427.6	127
Y at $65\%F_{\text{MSY}}$	1000 lb	394.8	412.5	120
$F_{2010-2012}/F_{\text{MSY}}$	—	0.59	0.70	0.35
$\text{SSB}_{2012}/\text{MSST}$	—	0.65	0.50	0.60
$\text{SSB}_{2012}/\text{SSB}_{\text{MSY}}$	—	0.49	0.38	0.45

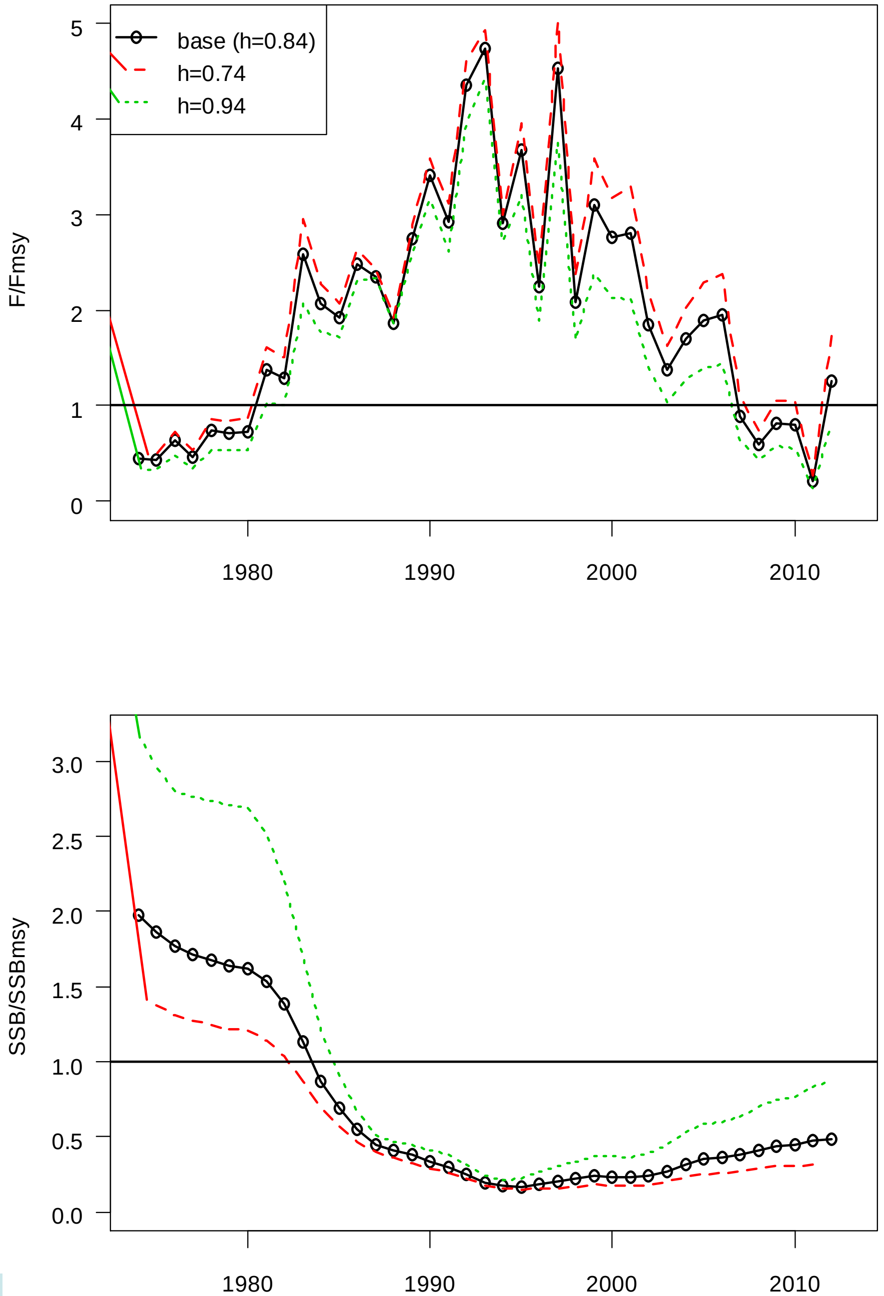
Sensitivity runs

- Age-dependent natural mortality scaled to high (M=0.16) or low (M=0.08) values
- Steepness at higher (0.94) or lower (0.74) values than base (0.84)
- Finit at upper (0.03+50%) and lower (0.03—50%) values of range
- Population initialized with equilibrium age structure
- Include commercial handline index
- Up-weight indices at 2X, 4X, and 8X the base weights
- Recreational selectivity constant through time (no time blocks)
- Two commercial selectivity blocks (1974-2006; 2007-2012)
- Drop commercial age comps prior to 2007
- S4 configuration (continuity run), with the following features:
  - Dome-shaped commercial handline selectivity
  - Scaled Lorenzen mortality vector
  - Old life-history information (growth, maturity, sex ratio)
  - Steepness=0.7
- Female-only SSB
- Male-only SSB
- Retrospective analysis

Natural mortality

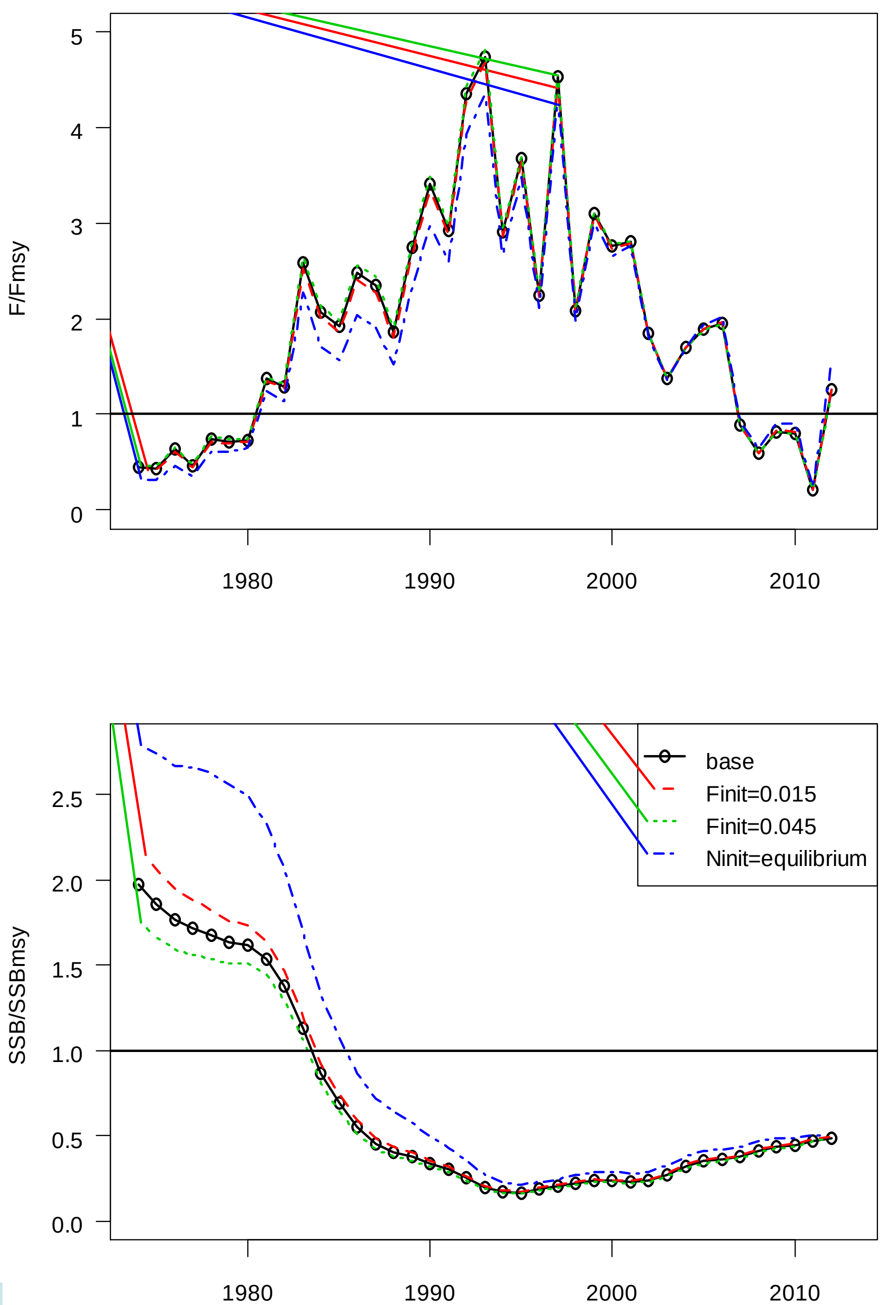


Steepness

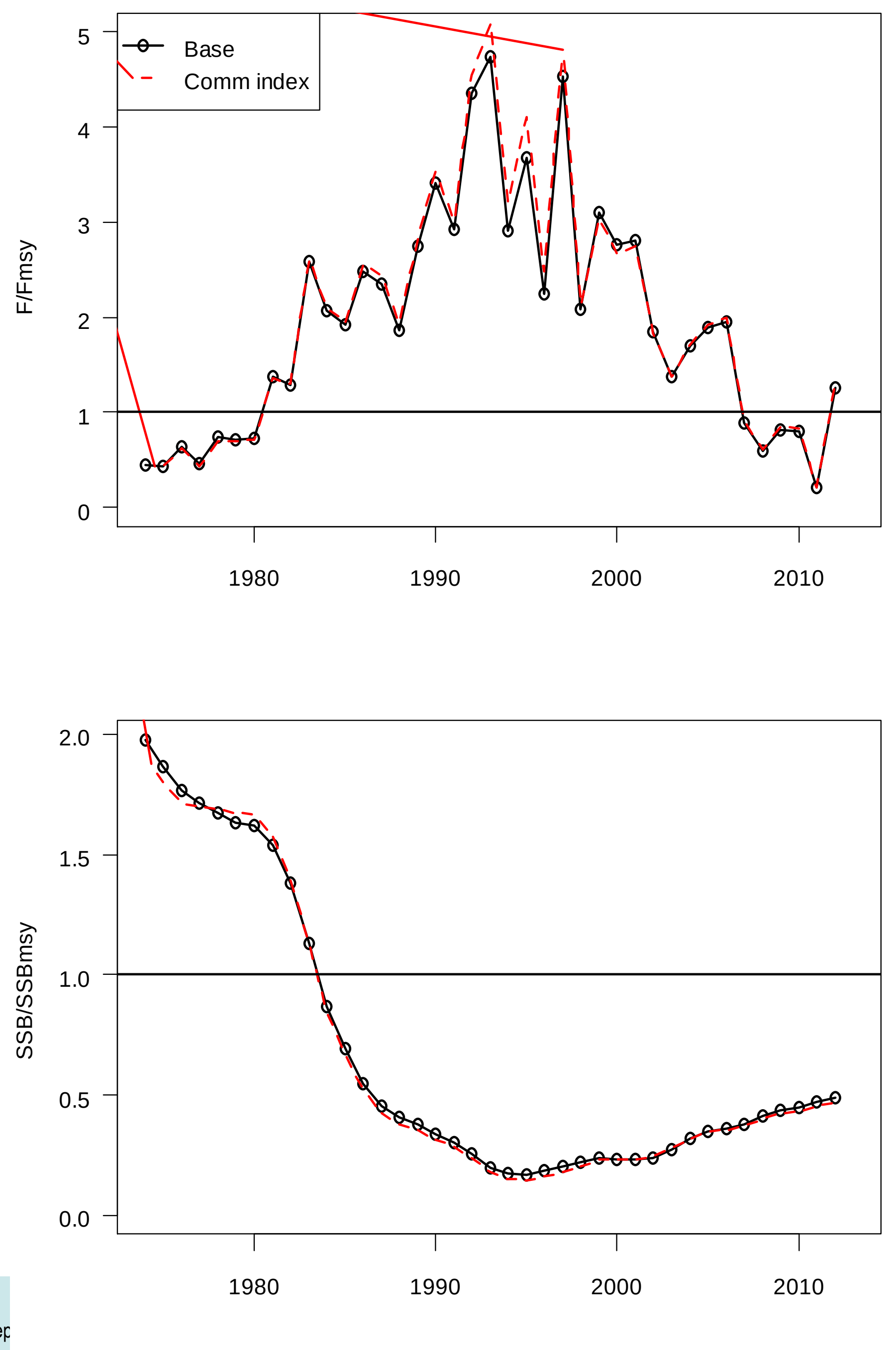


F/Fmsy
base (h=0.84)
h=0.74
h=0.94
0
1
2
3
4
5
1980
1990
2000
2010
SSB/SSBmsy
0.0
0.5
1.0
1.5
2.0
2.5
3.0

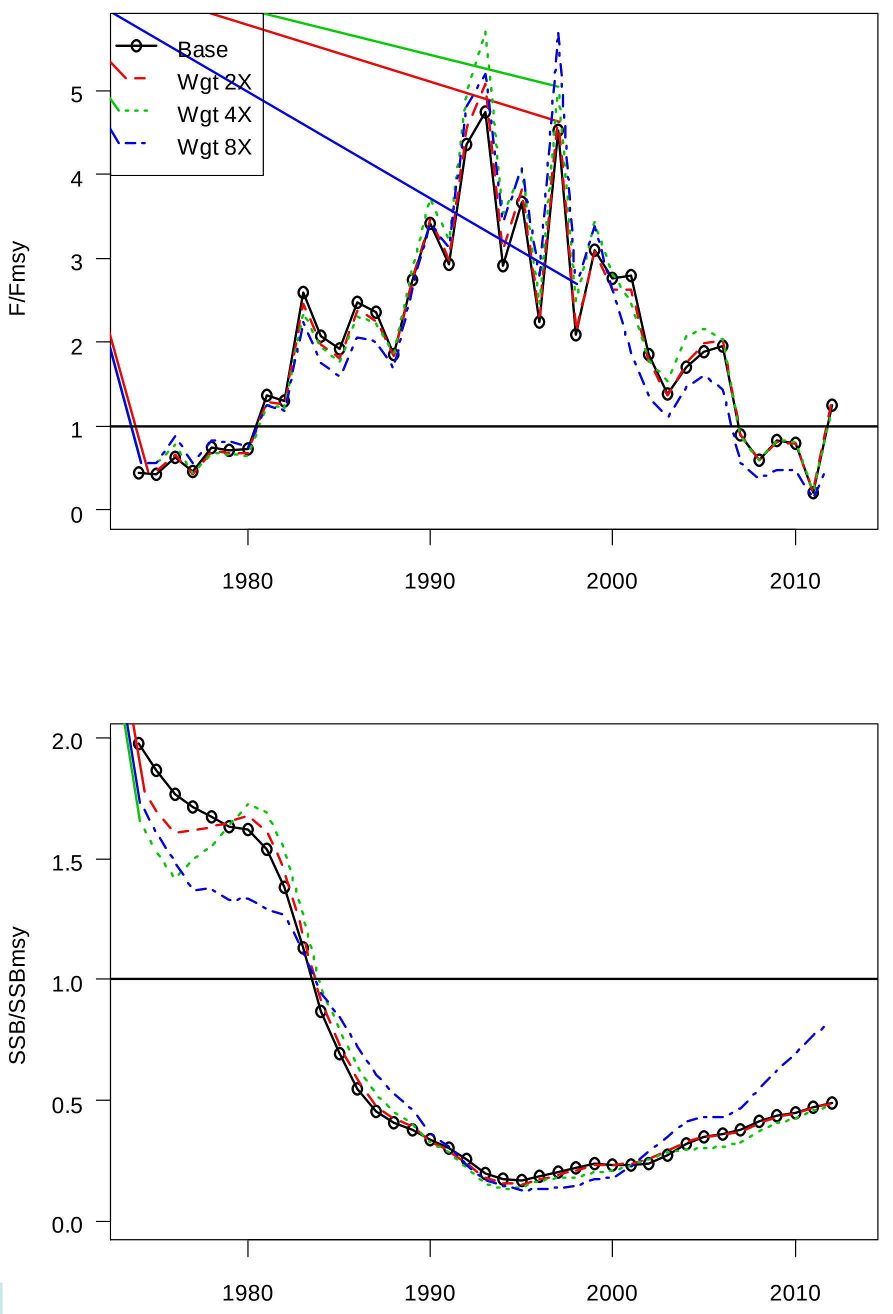
Initialization



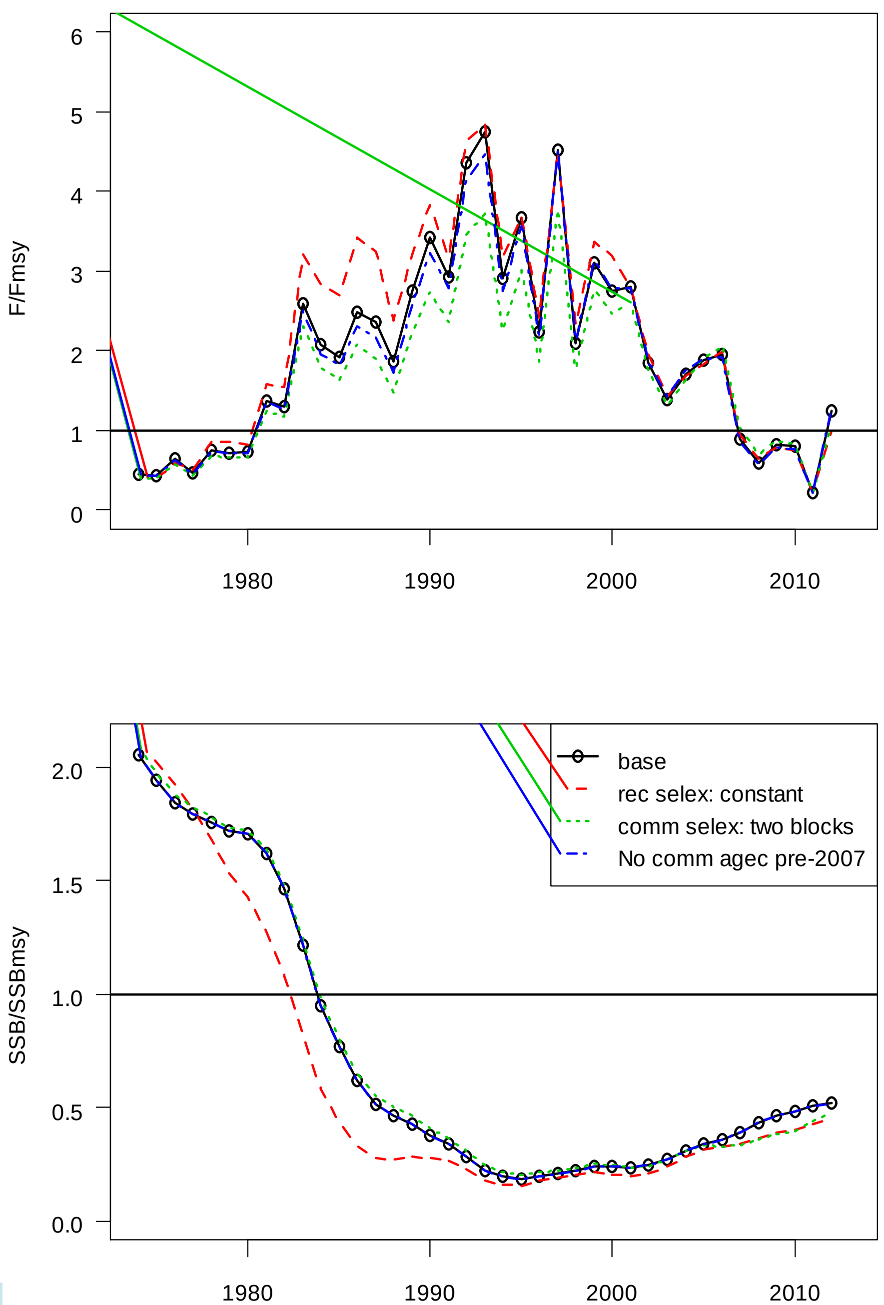
Commercial index



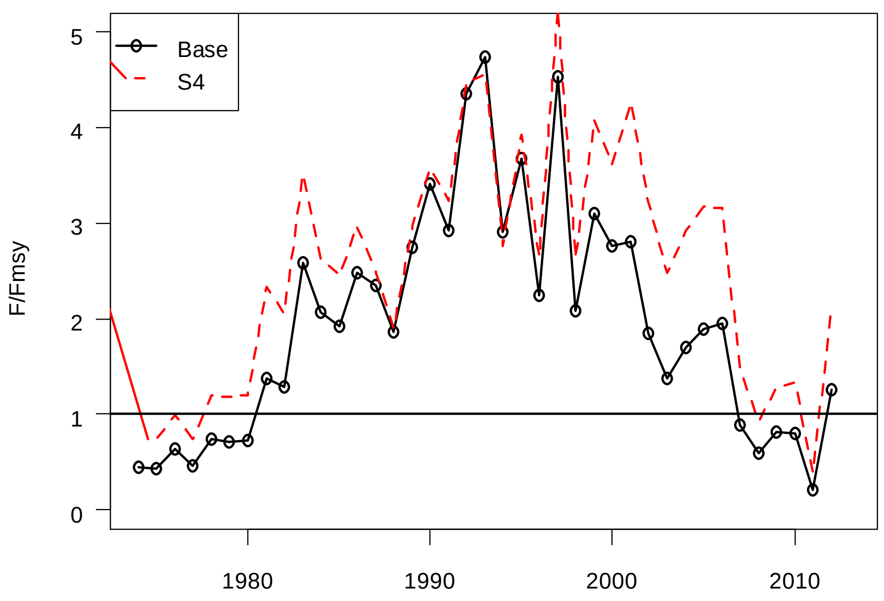
Index weights

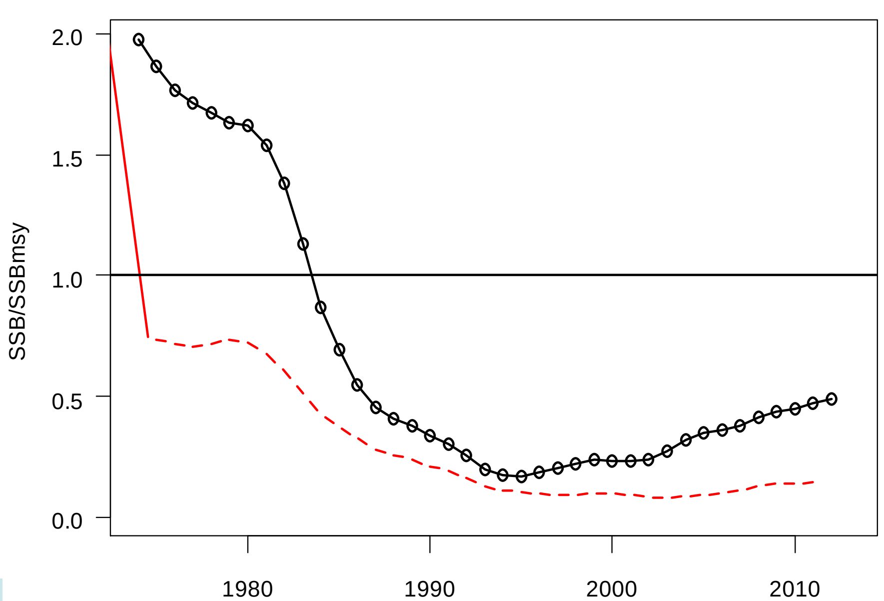


Selectivities and comp data

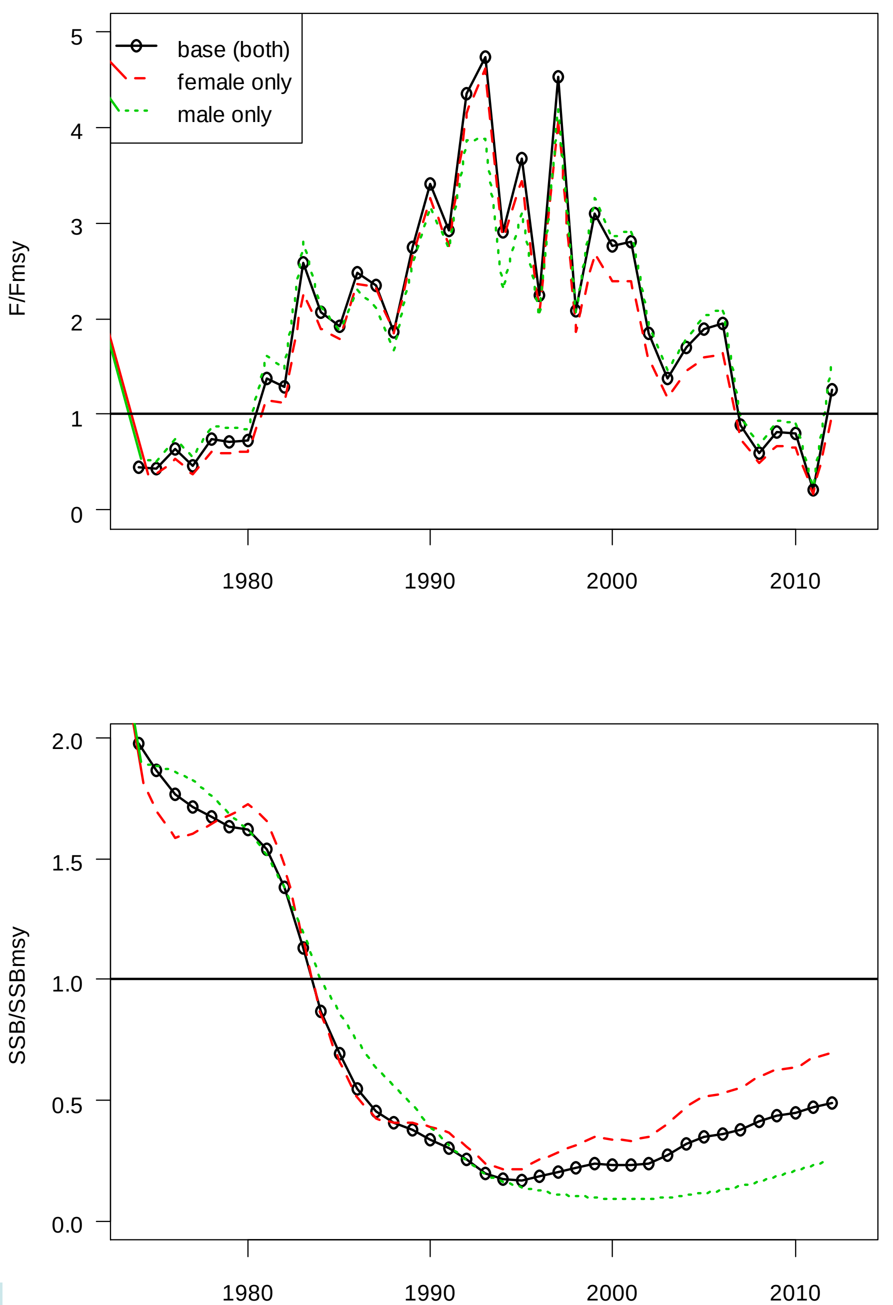


Continuity

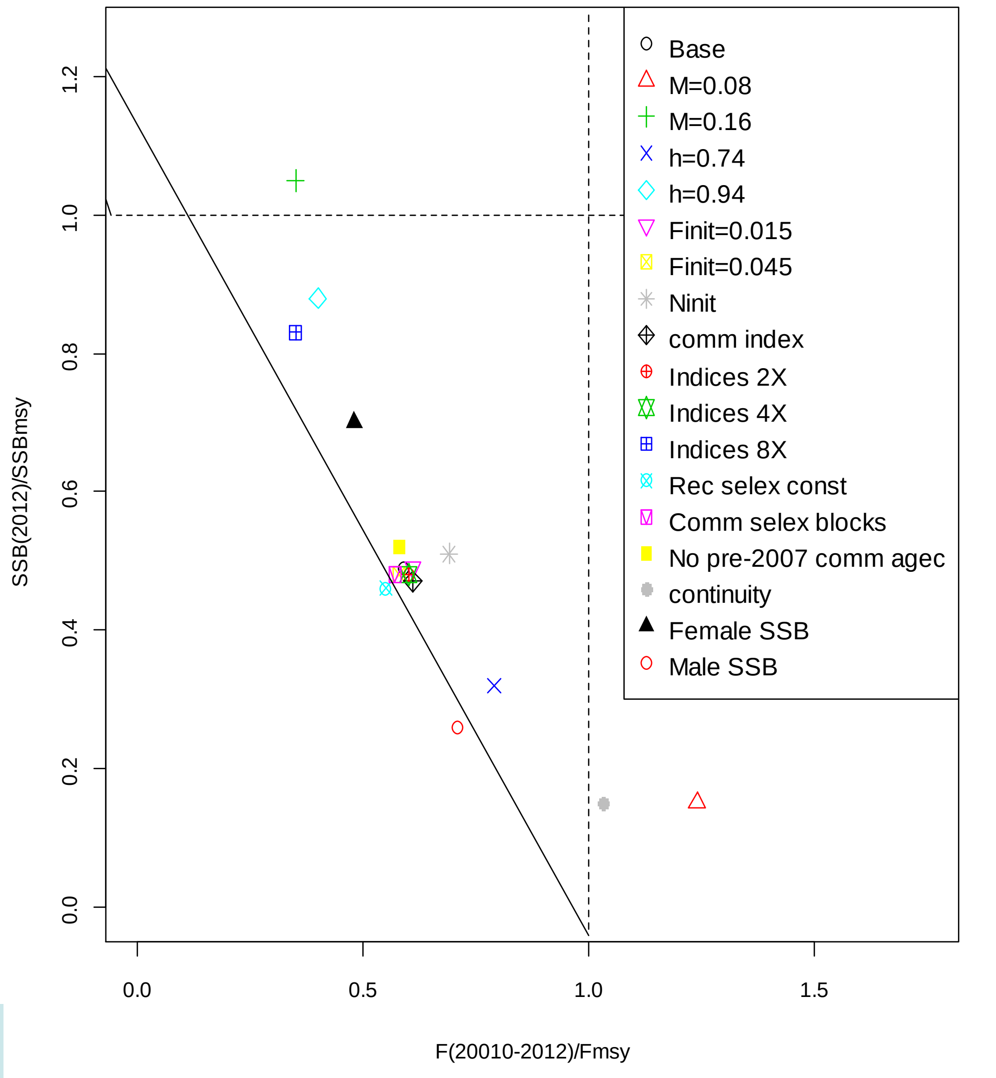

Base
S4
F/Fmsy
5
4
3
2
1
0
1980
1990
2000
2010


SSB/SSBmsy
2.0
1.5
1.0
0.5
0.0
1980
1990
2000
2010

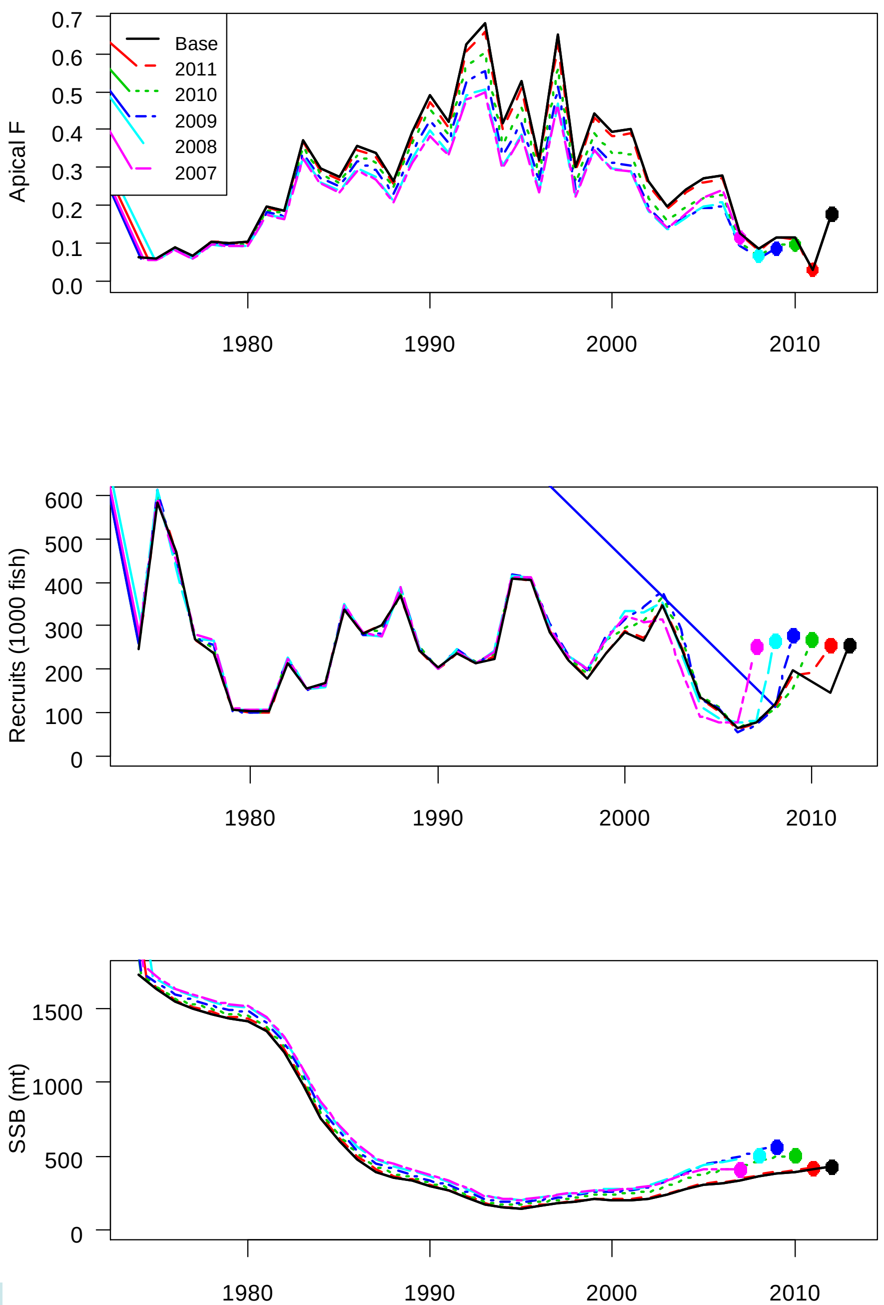
SSB measure


base (both)
female only
male only
F/Fmsy
SSB/SSBmsy
0
1
2
3
4
5
0.0
0.5
1.0
1.5
2.0
1980
1990
2000
2010

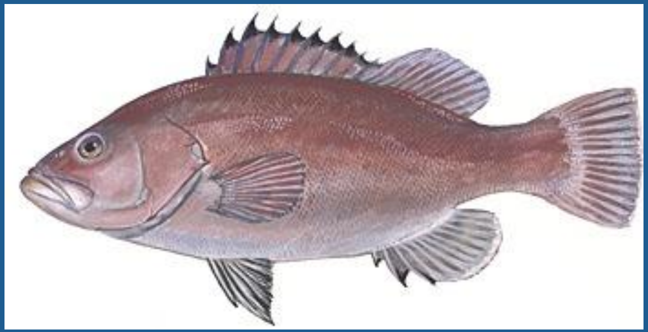
Summary of sensitivity runs



Retrospective analysis



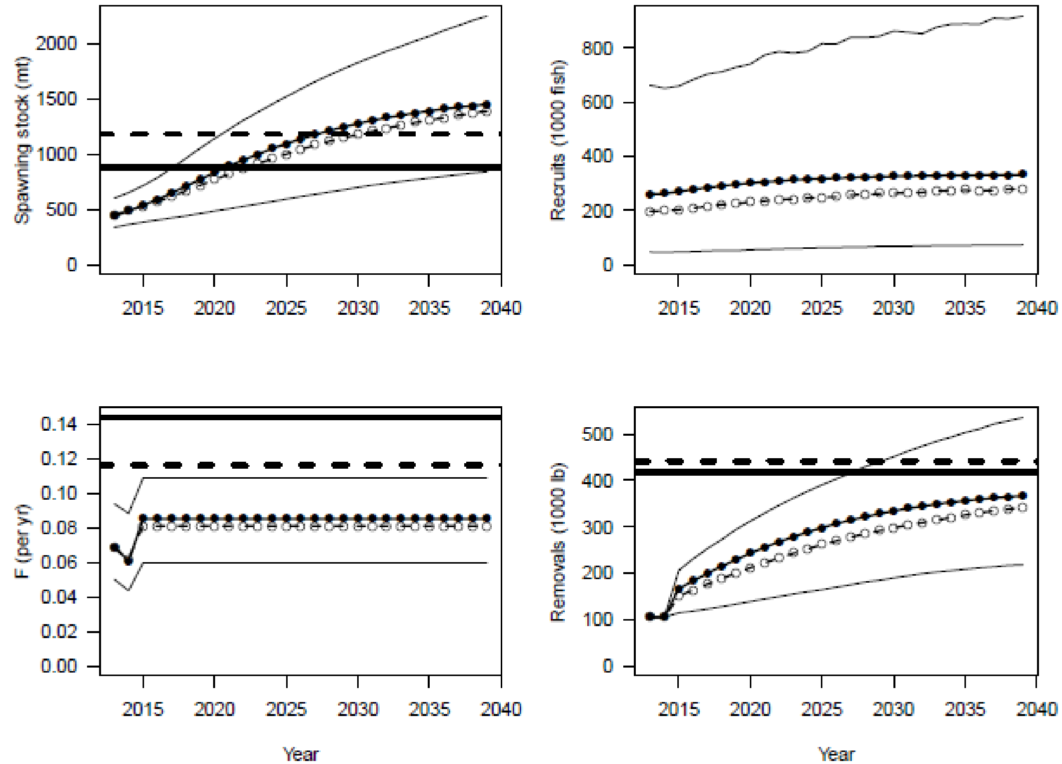
Projections



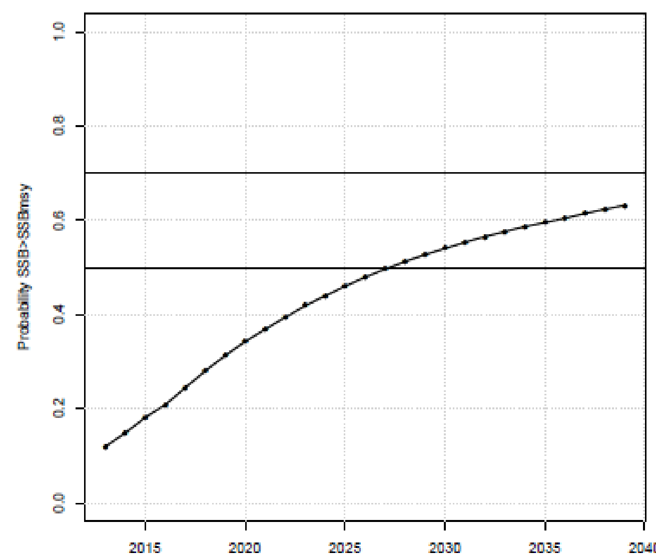
Projections

- Carry forward uncertainties from MCB runs
  - Uncertainties in initial (2013) abundance at age, spawner-recruit function, natural mortality, selectivities, recruitment deviations
- Uncertainty in Fmsy uses distribution from MCB runs
- Years 2013-2039
- Landings in 2013-2014 equal to current quota scaled up to include dead discards (102960/0.977=105,384 lb ww). New management assumed to start in 2015.
- Five constant-F projection scenarios
  - F=Fcurrent, Fmsy, 75%Fmsy, Frebuild (0.5), Frebuild (0.7)

Example projection (F=Fcurrent)



Thick solid=base benchmark
Thick dash=median benchmark
Thin solid, closed circles=deterministic
Thin dash, open circles=median
Thin solid=5th and 95th percentiles



Projection results: F=Fcurrent

Table 20. Projection results with fishing mortality rate fixed at $F = F_{\mathrm{current}}$ starting in 2015. F = fishing mortality rate (per year), pr.rebuild = proportion of stochastic projection replicates with $\mathrm{SSB} \geq \mathrm{SSB}_{\mathrm{MSY}}$, *S = spawning stock (mt) at peak spawning time, Rm = total removals (landings and dead discards) expressed in numbers (1000s) or whole weight (lb). Total removals presented here would need reduction if values are used to develop quotas based only on landings; recent data suggest that ~ 97.7% of total removals are landings (the remainder being dead discards). The extension* base *indicates expected values (deterministic) from the base run; the extension* med *indicates median values from the stochastic projections.*

Year	pr.rebuild	F.base	F.med	S.base(mt)	S.med(mt)	Rm.base(1000)	Rm.med(1000)	Rm.base(1000 lb)	Rm.med(1000 lb)
2013	0.120	0.07	0.07	437	450	15	15	105	105
2014	0.148	0.06	0.06	483	487	16	15	105	105
2015	0.182	0.09	0.08	534	527	25	22	167	151
2016	0.208	0.09	0.08	587	568	27	24	184	164
2017	0.244	0.09	0.08	646	614	29	25	200	176
2018	0.280	0.09	0.08	707	664	31	27	215	188
2019	0.313	0.09	0.08	770	716	32	28	230	200
2020	0.342	0.09	0.08	830	768	33	29	243	212
2021	0.369	0.09	0.08	889	816	35	30	256	222
2022	0.394	0.09	0.08	944	864	36	31	268	233
2023	0.418	0.09	0.08	996	910	37	32	279	243
2024	0.439	0.09	0.08	1045	954	38	33	289	252
2025	0.460	0.09	0.08	1091	996	38	34	298	262
2026	0.479	0.09	0.08	1133	1038	39	35	307	270
2027	0.496	0.09	0.08	1173	1076	40	35	315	278
2028	0.512	0.09	0.08	1209	1112	40	36	322	285
2029	0.527	0.09	0.08	1242	1144	41	37	328	292
2030	0.540	0.09	0.08	1273	1173	41	37	334	298
2031	0.553	0.09	0.08	1300	1202	42	38	340	304
2032	0.565	0.09	0.08	1326	1230	42	38	345	309
2033	0.576	0.09	0.08	1349	1257	42	39	349	315
2034	0.586	0.09	0.08	1369	1281	42	39	353	320
2035	0.595	0.09	0.08	1388	1304	43	40	356	326
2036	0.604	0.09	0.08	1405	1326	43	40	360	331
2037	0.614	0.09	0.08	1420	1347	43	40	362	334
2038	0.623	0.09	0.08	1433	1368	43	41	365	338
2039	0.631	0.09	0.08	1445	1386	43	41	367	342

Projection results: F=Fmsy

Year	pr.rebuild	F.base	F.med	S.base(mt)	S.med(mt)	Rm.base(1000)	Rm.med(1000)	Rm.base(1000 lb)	Rm.med(1000 lb)
2013	0.120	0.07	0.07	437	450	15	15	105	105
2014	0.148	0.06	0.06	483	487	16	15	105	105
2015	0.167	0.14	0.12	520	514	41	33	274	222
2016	0.163	0.14	0.12	542	529	43	35	288	235
2017	0.162	0.14	0.12	567	550	45	36	302	248
2018	0.161	0.14	0.12	594	573	46	38	314	259
2019	0.161	0.14	0.12	620	598	47	39	325	272
2020	0.160	0.14	0.12	644	623	49	41	335	282
2021	0.159	0.14	0.12	667	649	49	42	343	292
2022	0.159	0.14	0.12	688	676	50	43	351	301
2023	0.159	0.14	0.12	707	700	51	44	359	308
2024	0.164	0.14	0.12	724	726	52	45	365	316
2025	0.170	0.14	0.12	740	751	52	45	371	322
2026	0.176	0.14	0.12	754	774	53	46	376	329
2027	0.182	0.14	0.12	767	798	53	47	381	335
2028	0.186	0.14	0.12	779	819	54	47	385	341
2029	0.192	0.14	0.12	789	840	54	48	389	346
2030	0.199	0.14	0.12	798	861	54	48	392	350
2031	0.207	0.14	0.12	807	879	54	49	395	354
2032	0.214	0.14	0.12	814	897	55	49	398	359
2033	0.221	0.14	0.12	821	916	55	50	400	364
2034	0.228	0.14	0.12	827	933	55	50	403	368
2035	0.234	0.14	0.12	832	947	55	51	404	372
2036	0.244	0.14	0.12	837	963	55	51	406	376
2037	0.252	0.14	0.12	841	978	56	52	408	380
2038	0.258	0.14	0.12	845	992	56	52	409	384
2039	0.264	0.14	0.12	848	1005	56	52	410	387

Projection results: F=75%Fmsy

Year	pr.rebuild	F.base	F.med	S.base(mt)	S.med(mt)	Rm.base(1000)	Rm.med(1000)	Rm.base(1000 lb)	Rm.med(1000 lb)
2013	0.120	0.07	0.07	437	450	15	15	105	105
2014	0.148	0.06	0.06	483	487	16	15	105	105
2015	0.173	0.11	0.09	528	522	31	25	209	168
2016	0.185	0.11	0.09	569	553	34	27	226	183
2017	0.203	0.11	0.09	614	590	35	29	242	197
2018	0.224	0.11	0.09	661	629	37	30	257	210
2019	0.247	0.11	0.09	708	671	39	32	271	224
2020	0.272	0.11	0.09	753	712	40	33	284	237
2021	0.297	0.11	0.09	795	754	41	34	296	249
2022	0.323	0.11	0.09	835	794	42	36	307	261
2023	0.349	0.11	0.09	872	836	43	37	317	271
2024	0.374	0.11	0.09	906	878	44	38	326	281
2025	0.398	0.11	0.09	938	917	45	39	334	290
2026	0.424	0.11	0.09	967	956	45	39	342	298
2027	0.448	0.11	0.09	993	994	46	40	349	307
2028	0.472	0.11	0.09	1017	1032	46	41	355	314
2029	0.495	0.11	0.09	1040	1070	47	42	361	320
2030	0.518	0.11	0.09	1060	1104	47	42	366	326
2031	0.541	0.11	0.09	1078	1137	48	43	371	332
2032	0.563	0.11	0.09	1094	1169	48	43	375	338
2033	0.584	0.11	0.09	1109	1199	48	44	378	344
2034	0.602	0.11	0.09	1122	1229	48	44	382	349
2035	0.620	0.11	0.09	1134	1257	49	45	385	354
2036	0.636	0.11	0.09	1145	1282	49	45	387	359
2037	0.655	0.11	0.09	1154	1308	49	46	390	363
2038	0.672	0.11	0.09	1162	1332	49	46	392	367
2039	0.689	0.11	0.09	1170	1356	49	47	393	371

Projection results: F=Frebuild (prob 50%)

Year	pr.rebuild	F.base	F.med	S.base(mt)	S.med(mt)	Rm.base(1000)	Rm.med(1000)	Rm.base(1000 lb)	Rm.med(1000 lb)
2013	0.120	0.07	0.07	437	450	15	15	105	105
2014	0.148	0.06	0.06	483	487	16	15	105	105
2015	0.178	0.11	0.11	529	521	31	29	208	199
2016	0.197	0.11	0.11	570	547	33	31	225	213
2017	0.220	0.11	0.11	615	580	35	33	241	225
2018	0.246	0.11	0.11	662	615	37	34	256	237
2019	0.269	0.11	0.11	709	651	38	35	270	248
2020	0.291	0.11	0.11	755	685	40	36	283	259
2021	0.310	0.11	0.11	798	716	41	37	295	269
2022	0.328	0.11	0.11	838	747	42	38	306	278
2023	0.347	0.11	0.11	875	778	43	39	316	287
2024	0.362	0.11	0.11	909	805	44	40	325	295
2025	0.378	0.11	0.11	941	831	44	41	334	302
2026	0.391	0.11	0.11	971	857	45	41	341	309
2027	0.403	0.11	0.11	998	880	46	42	348	316
2028	0.415	0.11	0.11	1022	900	46	42	355	322
2029	0.425	0.11	0.11	1045	921	47	43	360	327
2030	0.437	0.11	0.11	1065	938	47	43	365	331
2031	0.446	0.11	0.11	1083	953	47	44	370	336
2032	0.454	0.11	0.11	1100	969	48	44	374	341
2033	0.462	0.11	0.11	1115	984	48	45	378	345
2034	0.470	0.11	0.11	1128	999	48	45	381	349
2035	0.477	0.11	0.11	1140	1012	48	46	384	353
2036	0.484	0.11	0.11	1151	1023	49	46	387	357
2037	0.491	0.11	0.11	1161	1036	49	46	389	360
2038	0.496	0.11	0.11	1169	1048	49	46	391	362
2039	0.502	0.11	0.11	1177	1057	49	47	393	366

Projection results: F=Frebuild (prob 70%)

Year	pr.rebuild	F.base	F.med	S.base(mt)	S.med(mt)	Rm.base(1000)	Rm.med(1000)	Rm.base(1000 lb)	Rm.med(1000 lb)
2013	0.120	0.07	0.07	437	450	15	15	105	105
2014	0.148	0.06	0.06	483	487	16	15	105	105
2015	0.183	0.07	0.07	538	530	21	20	140	134
2016	0.212	0.07	0.07	599	576	23	21	156	147
2017	0.252	0.07	0.07	666	629	25	23	171	160
2018	0.289	0.07	0.07	738	687	26	24	186	172
2019	0.324	0.07	0.07	812	746	28	26	200	184
2020	0.357	0.07	0.07	884	805	29	27	213	196
2021	0.388	0.07	0.07	954	861	30	28	226	207
2022	0.415	0.07	0.07	1021	917	31	29	238	218
2023	0.444	0.07	0.07	1085	971	32	30	249	228
2024	0.470	0.07	0.07	1145	1023	33	31	259	238
2025	0.494	0.07	0.07	1202	1073	34	31	269	247
2026	0.517	0.07	0.07	1256	1121	34	32	277	255
2027	0.539	0.07	0.07	1305	1168	35	33	285	264
2028	0.558	0.07	0.07	1351	1210	36	34	293	271
2029	0.577	0.07	0.07	1394	1251	36	34	300	278
2030	0.593	0.07	0.07	1433	1289	37	35	306	285
2031	0.609	0.07	0.07	1469	1326	37	35	312	291
2032	0.624	0.07	0.07	1502	1361	37	36	317	298
2033	0.636	0.07	0.07	1532	1392	38	36	322	303
2034	0.648	0.07	0.07	1560	1423	38	37	326	309
2035	0.660	0.07	0.07	1584	1452	38	37	330	315
2036	0.672	0.07	0.07	1607	1482	38	38	333	320
2037	0.683	0.07	0.07	1627	1510	38	38	336	324
2038	0.693	0.07	0.07	1645	1536	39	38	339	329
2039	0.702	0.07	0.07	1661	1560	39	39	341	333

Questions