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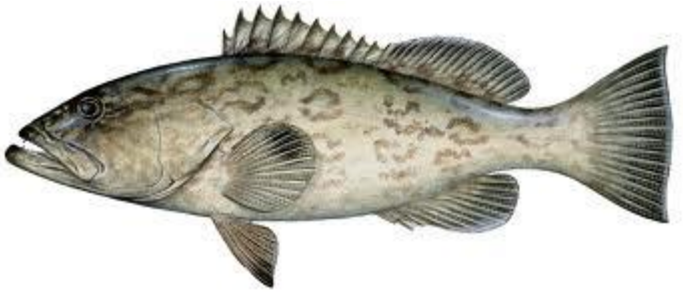
Southeast Fisheries Science Center

Gag



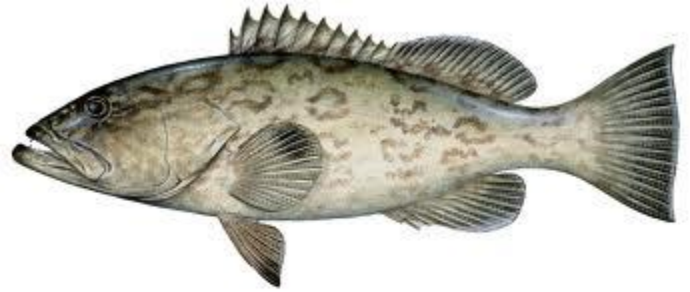
SEDAR-10 update assessment

April 30, 2014

Outline

- Background
- Data
  - Review of data sources from SEDAR10
  - Updates/modifications
- Assessment methods and results
  - Review of SEDAR10 model
  - Modifications in this update
  - Results
- Projections

Background



Background

- This is an “update assessment” under the current SEDAR definition
  - Modeling done by the SEFSC, with help from other data providers
  - SSC conducts the review

- Goals of this update
  - Update the model on which management was based (BAM)
  - Strike a balance between fidelity to SEDAR10 and modifications intended to improve the assessment

Background – summary of regulations

Year effective	Recreational	Commercial
1992	20in; 5-grouper aggregate bag	20in
1999	24in; 5-grouper aggregate bag	24in
2010	24in; 3-grouper aggregate bag	24in; Seasonal quota
2011	Same	24in; Seasonal quota; trip limit
2012	Same	24in; Fall closure due to quota

Size limits in TL; Quotas and trip limits in gutted weight; Spawning season (Jan-April) closure starting in 2010

Background – summary S10 results

- Two models of catchability (q) in S10: one constant and one increasing with time
  - Constant q model was used for management, and that is the model used for this update
- Overfishing: F2004/Fmsy=1.3
- Not overfished: SSB2005/MSST=1.1
- A new definition of MSST is currently under consideration in Reg Amendment 21: MSST=75%SSBmsy

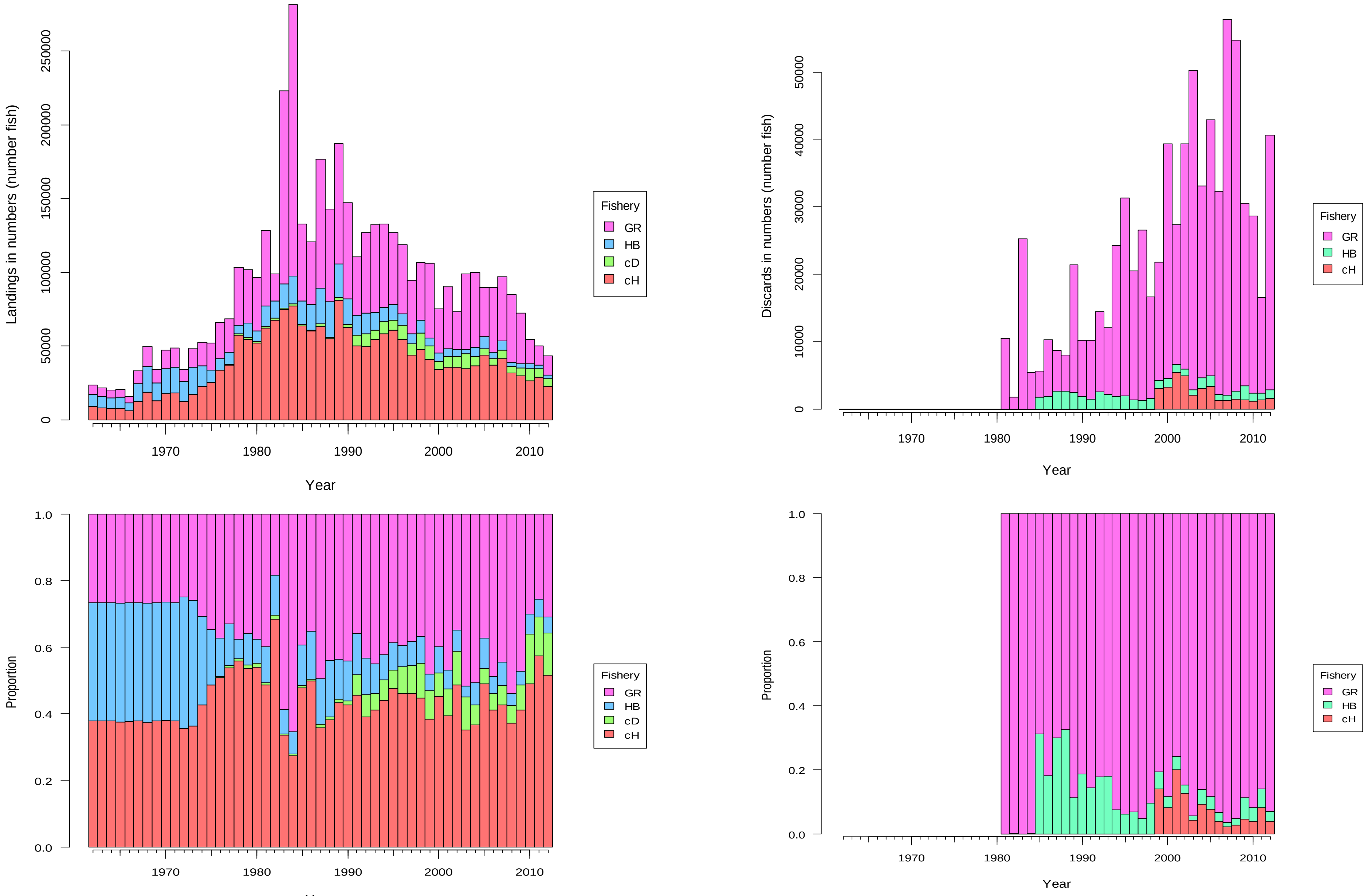
Data

Data fit by the assessment

Note: terminal yr of SEDAR10 was 2004

- Landings
  - Commercial handline (1962–2012, 1000 lb gutted weight)
  - Commercial diving (1976–2012, 1000 lb gutted weight)
  - Recreational headboat (1962–2012, 1000 fish)
  - General recreational (1962–2012, 1000 fish)
- Discards
  - Commercial handline (19992–2011 1000 fish)
  - Recreational headboat (1981–2012, 1000 fish)
  - General recreational (1981–2012, 1000 fish)

Landings and discard mortalities (in numbers)



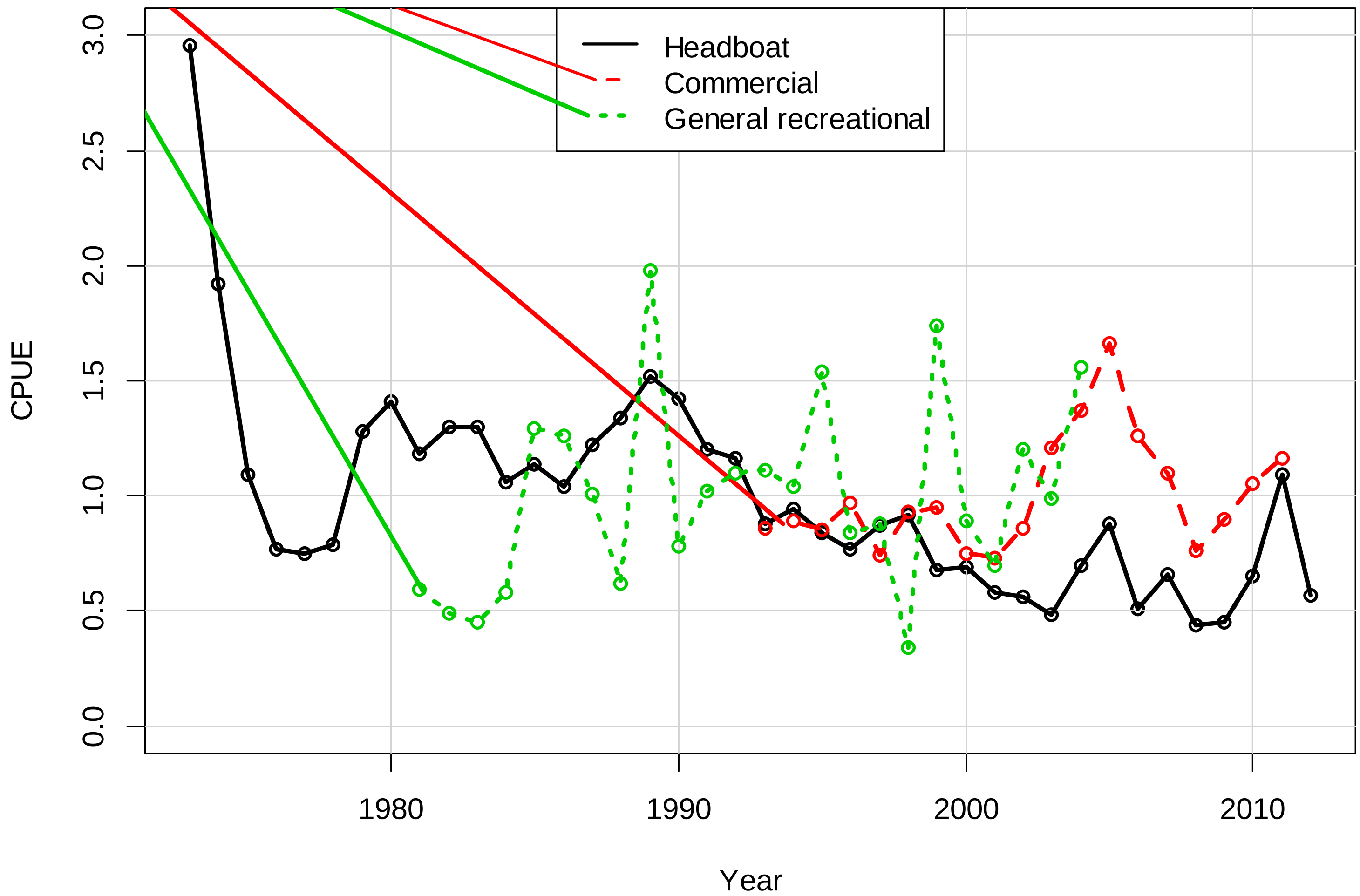
Age and length compositions

- Landings: Ages and lengths
  - Commercial handline
  - Commercial diving
  - Combined headboat and general recreational
- Discards: none

Indices of abundance

- Fishery dependent
  - General recreational (1981–2004)
  - Commercial handline (1993–2011)
  - Headboat (1973–2012)
- Fishery independent: none

Indices of abundance



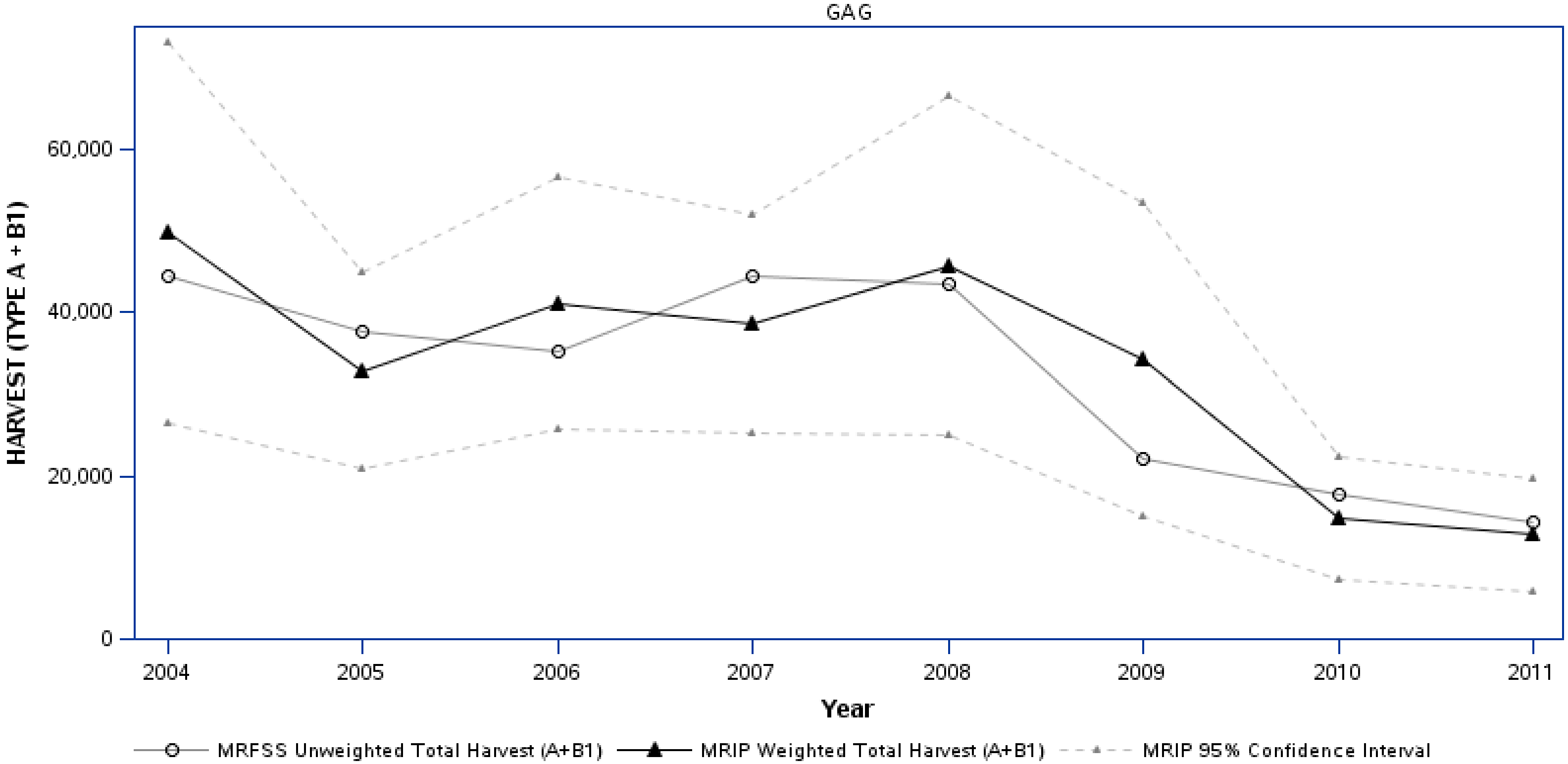
Other features, as in SEDAR10

- Life-history characteristics
  - Natural mortality: Lorenzen age-based curve, scaled to M=0.14
  - Somatic growth: length and weight at age; von Bert parameters estimated
  - Female maturity at age; all males assumed mature
  - Time-varying sex ratio at age
- Discard mortality
  - Headboat and general recreational: 0.25
  - Commercial handlines: 0.40

Modifications/updates to data

- In most cases, eight additional years were added to the end of the time series, using current or SEDAR10 methodology
- Exceptions:
  - GLMs (commercial discards) and Delta-GLMs (indices) were refitted using all relevant data, thus earlier years were subject to modification. Same methods as SEDAR10.
  - General recreational index not updated
  - Commercial index extended only to 2011, because recent management measures make its ability to track abundance questionable.
  - Data from the general recreational fleet were previously based on MRFSS methodology. Here, 2004–2012 estimates were based on MRIP methodology, and earlier MRFSS estimates were rescaled based on MRIP:MRFSS.
  - Age comps fitted to ages 1-12+, rather than 0-20+
  - Effective sample size of compositions based on number of trips rather than number of fish

Comparison of MRFSS and MRIP estimates



Plot generated by MRIP website

Assessment methods and results

BAM: same basic model as in SEDAR10

- Catch-age formulation, fit to data using maximum likelihood
- Beverton-Holt spawner recruit model, with lognormal error
- Age-based natural mortality
- Age-based selectivities, allowed to vary across regulation blocks
  - Logistic (flat-topped) for dominant fleets
  - Dome-shaped for commercial diving and all discards
- Baranov catch equation
- Spawning stock based on total mature biomass (males+females)

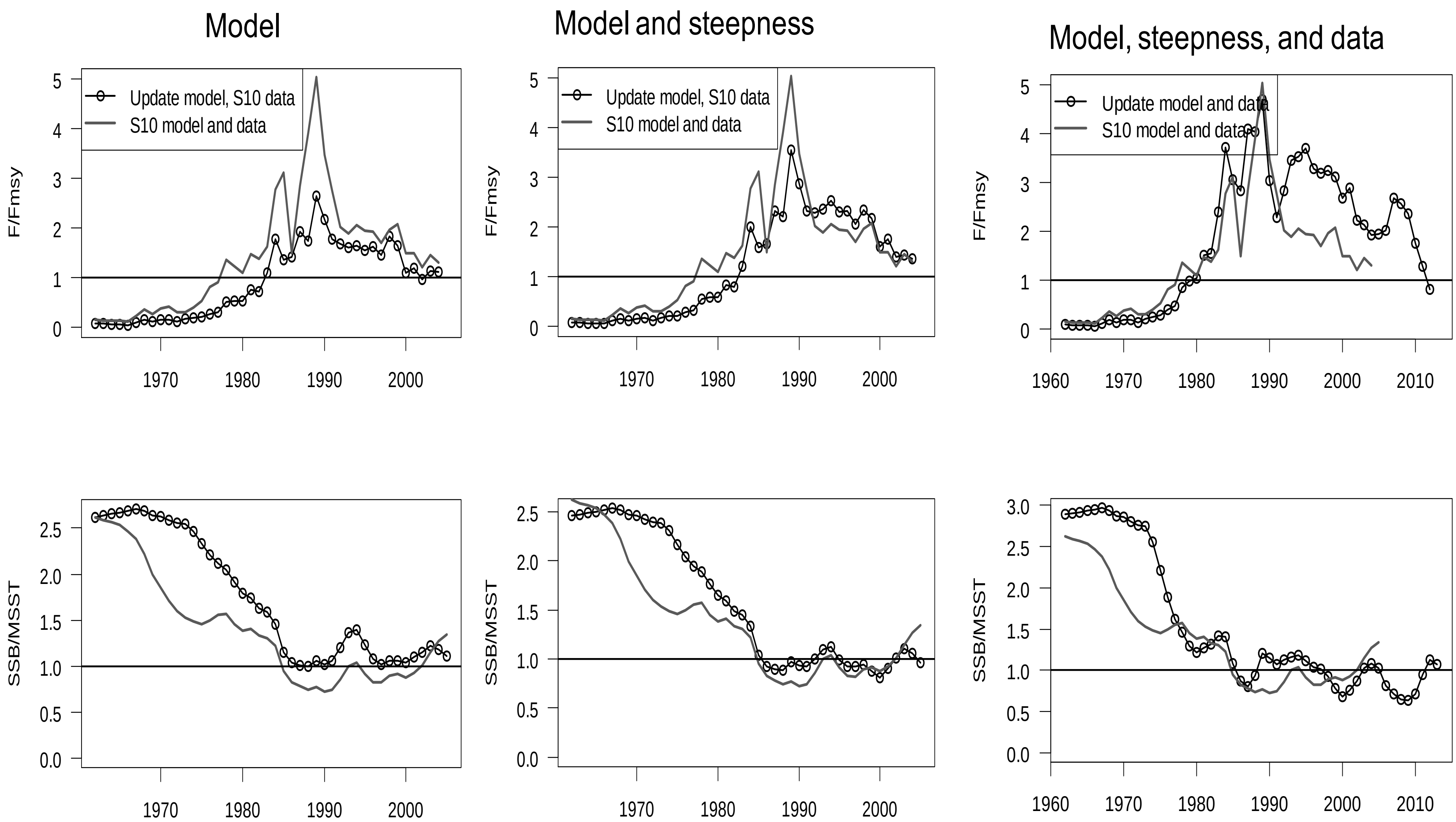
Modifications to the SEDAR10 model (1 of 2)

- **Initialization**
  - Equilibrium age structure in 1962, given Finit=0.03
  - Recruitment deviations start in 1972
- Ages modeled: 1-16+; S10 modeled 0-20+
- Normal priors on selectivity, von Bert, and σ_R parameters
  - S10 BAM did not have this capability
- Constant (estimated) CV of size at age, rather than age-dependent
- Different function to model dome-shaped selectivity
  - S10 applied double logistic
  - Update applied negative exponential on the descending limb

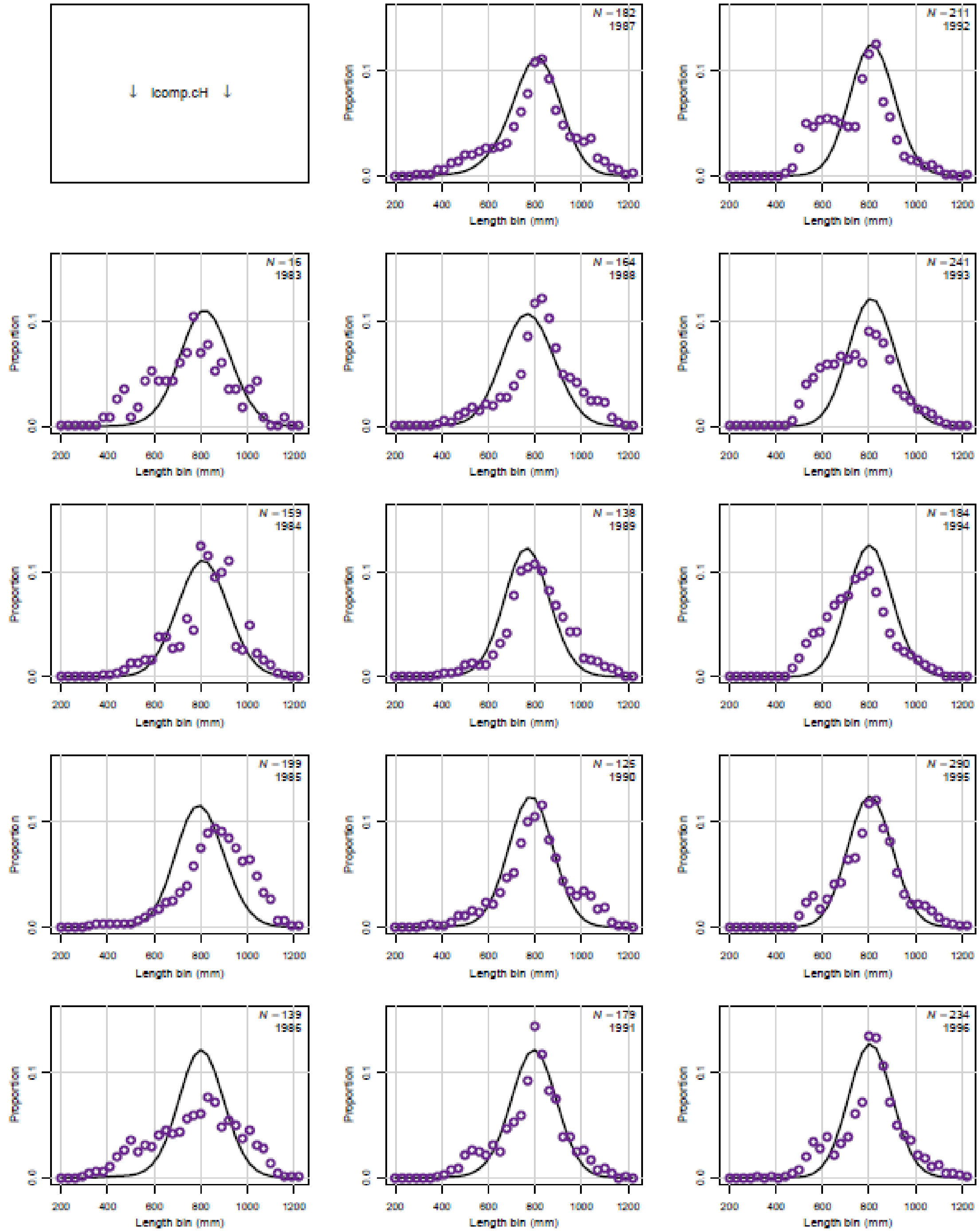
Modifications to the SEDAR10 model (2 of 2)

- **Data component weights**
  - S10 applied external weights to data components
  - The update applied iterative re-weighting to age and length comp data
- Negative log-likelihood applied to spawner-recruit deviations
  - Sum of squares penalty (in log space) used in S10
  - NLL used in the modern version of BAM
  - NLL approach requires additional parameter, σ_R (prior=0.6)
- Steepness fixed at 0.84
  - S10 attempted to estimate h, but it was at the upper bound
- Bias correction for estimating benchmarks
- Output: Total F's computed as apical F, rather than sum of full F's by fleet
- **Uncertainty estimated through Monte/Carlo Bootstrap (MCB) approach**
  - In S10, uncertainty in benchmarks was estimated through bootstrapping spawner-recruit residuals only
  - MCB approach recommended by SEDAR Uncertainty Workshop, and is now standard practice with the BAM

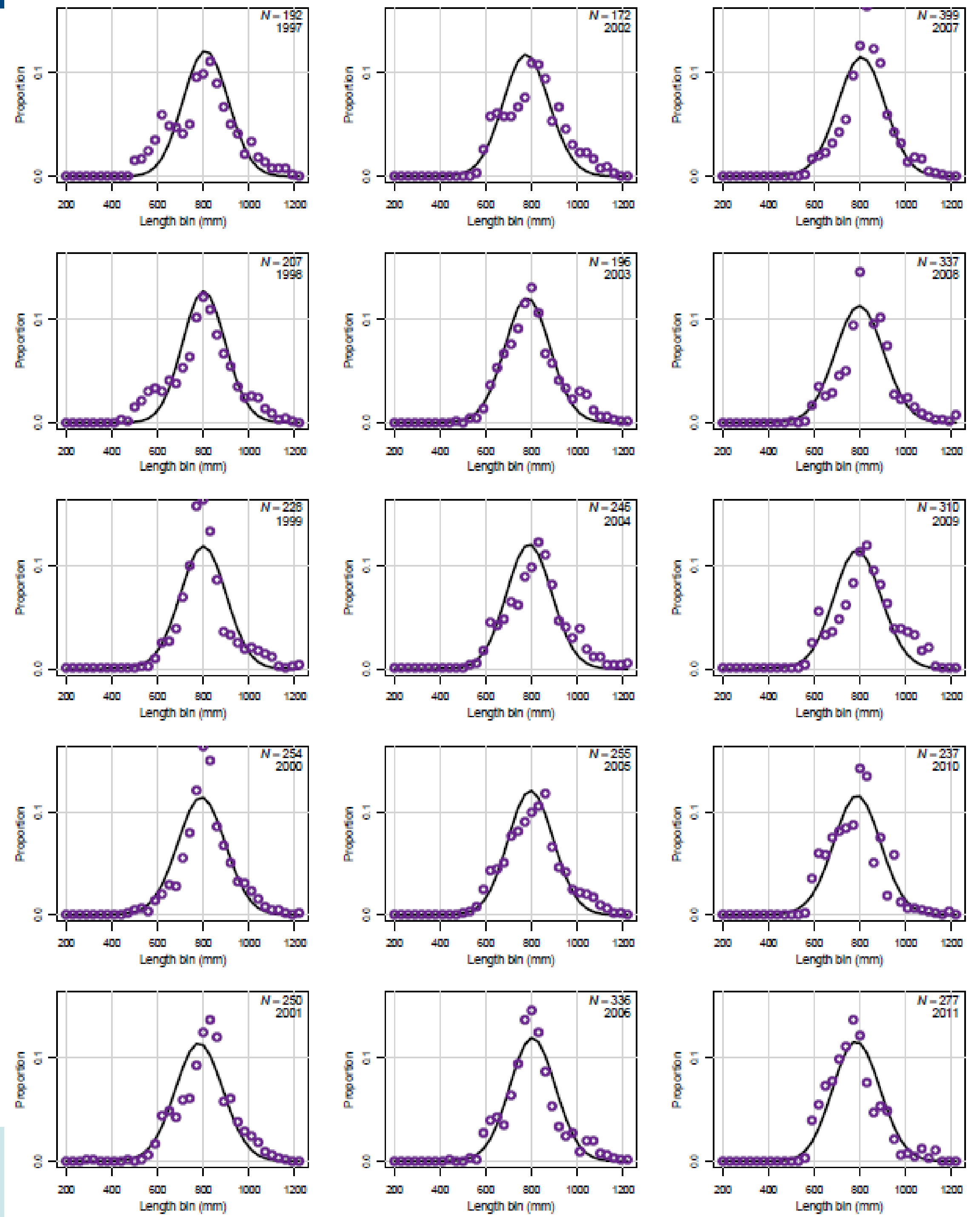
Effects of modifications



BAM base run – fits to data



BAM base run – fits to data



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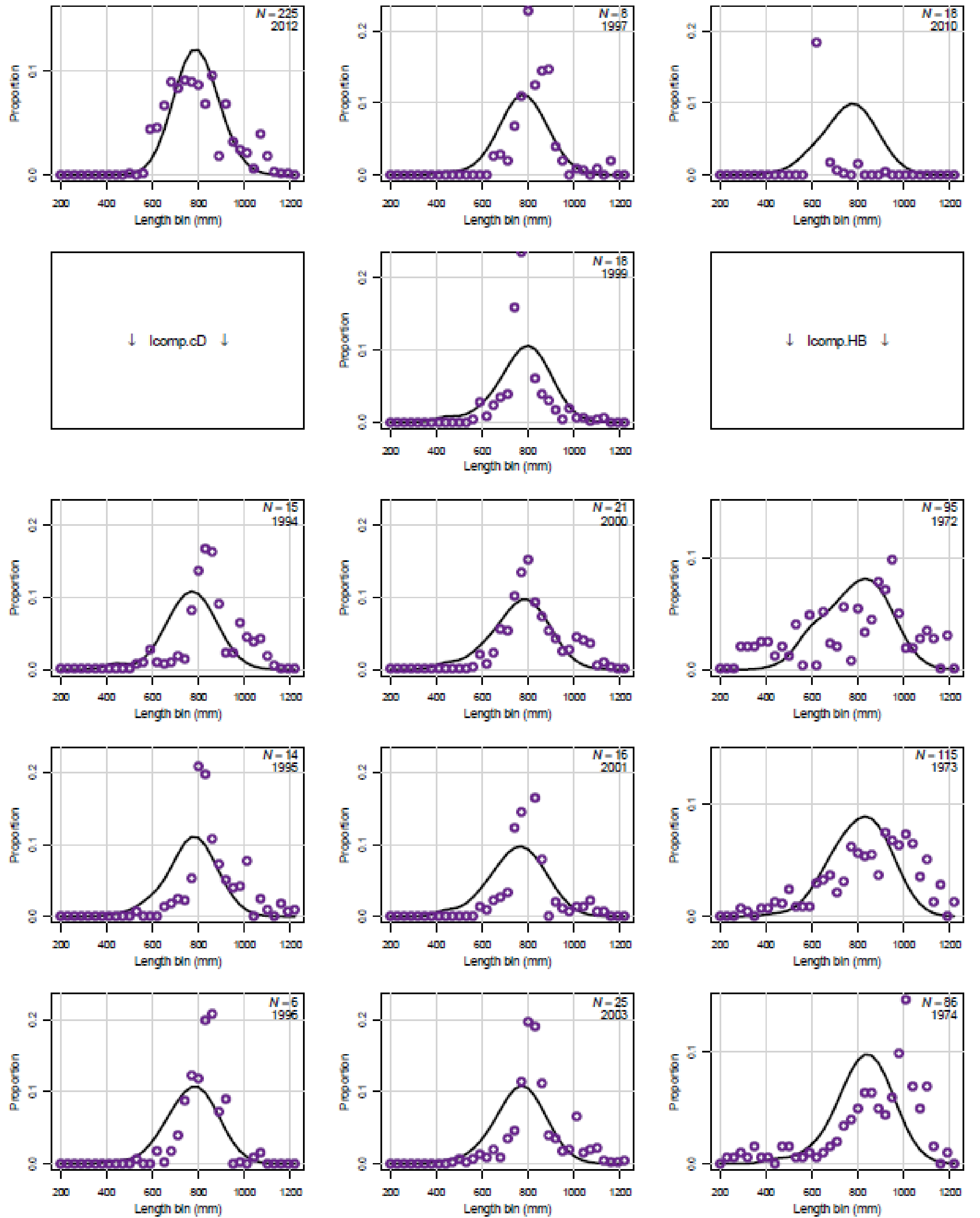

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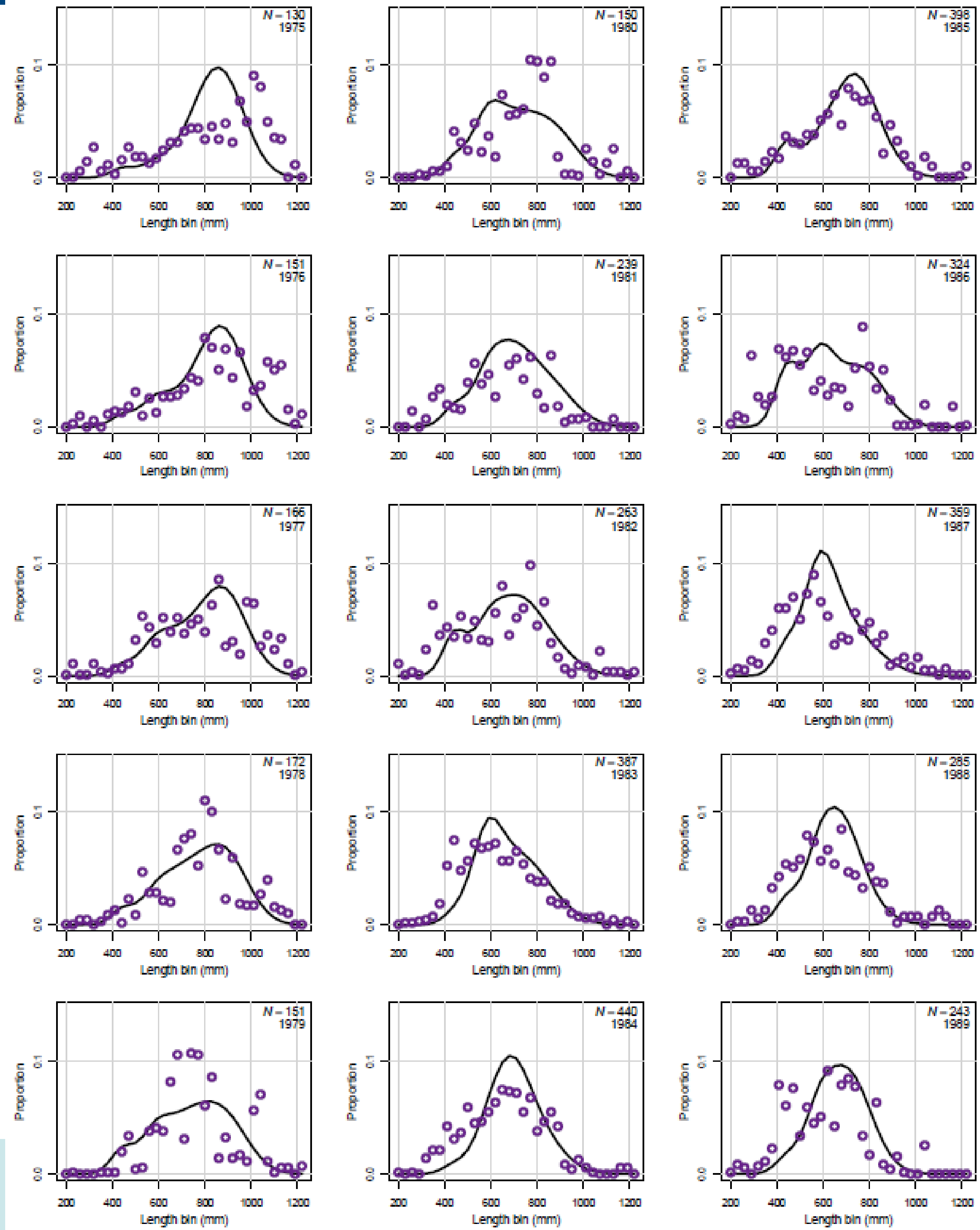

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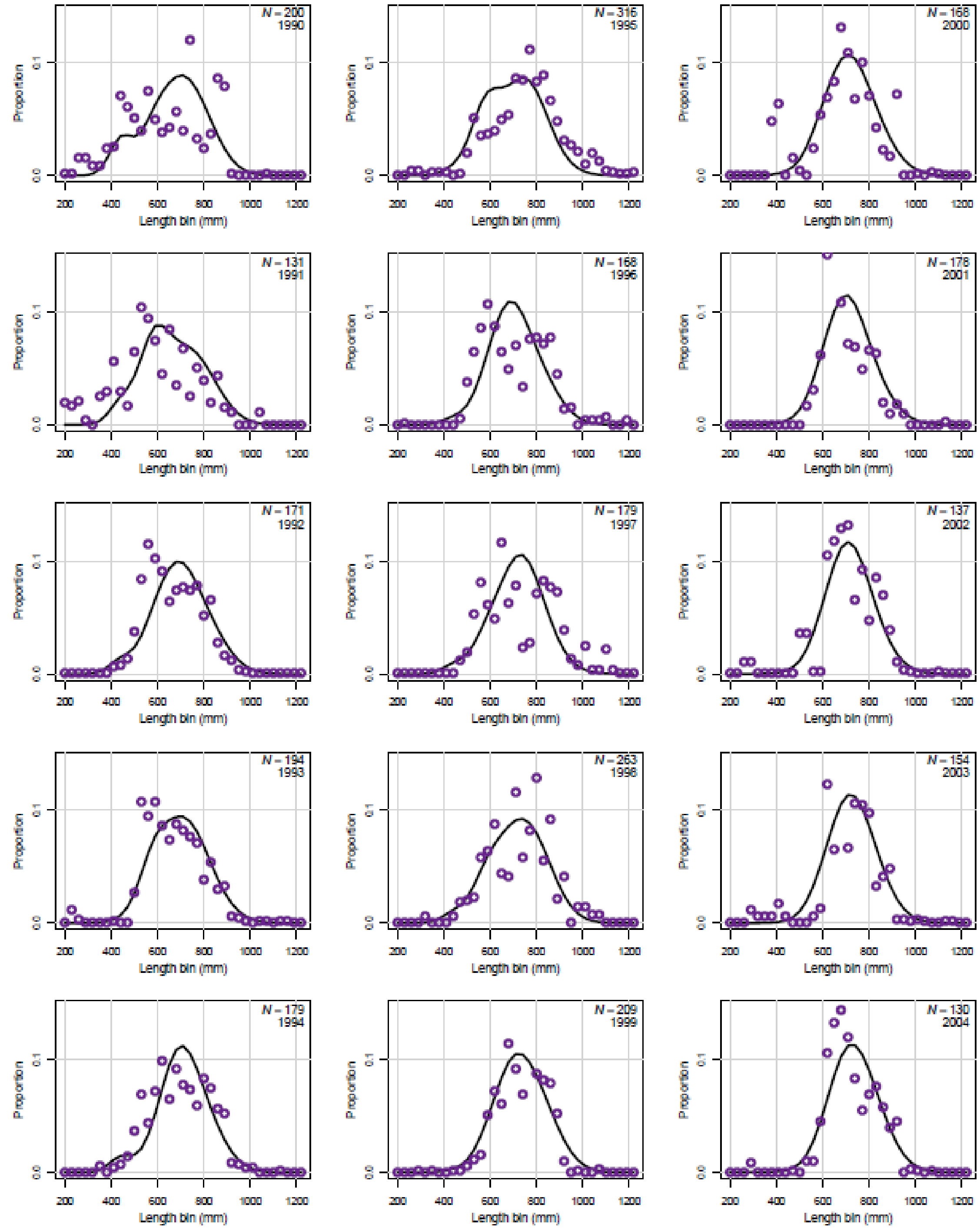

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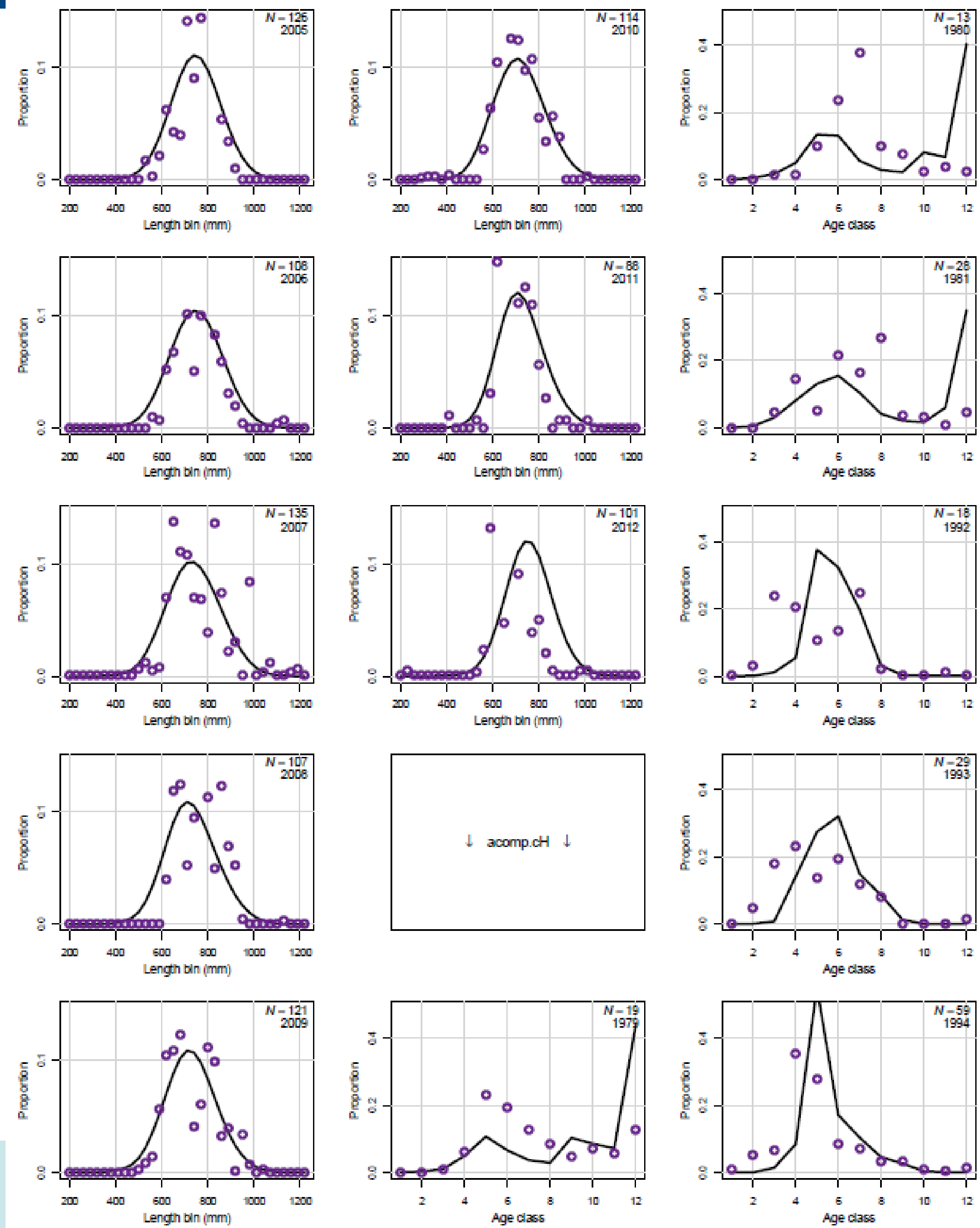

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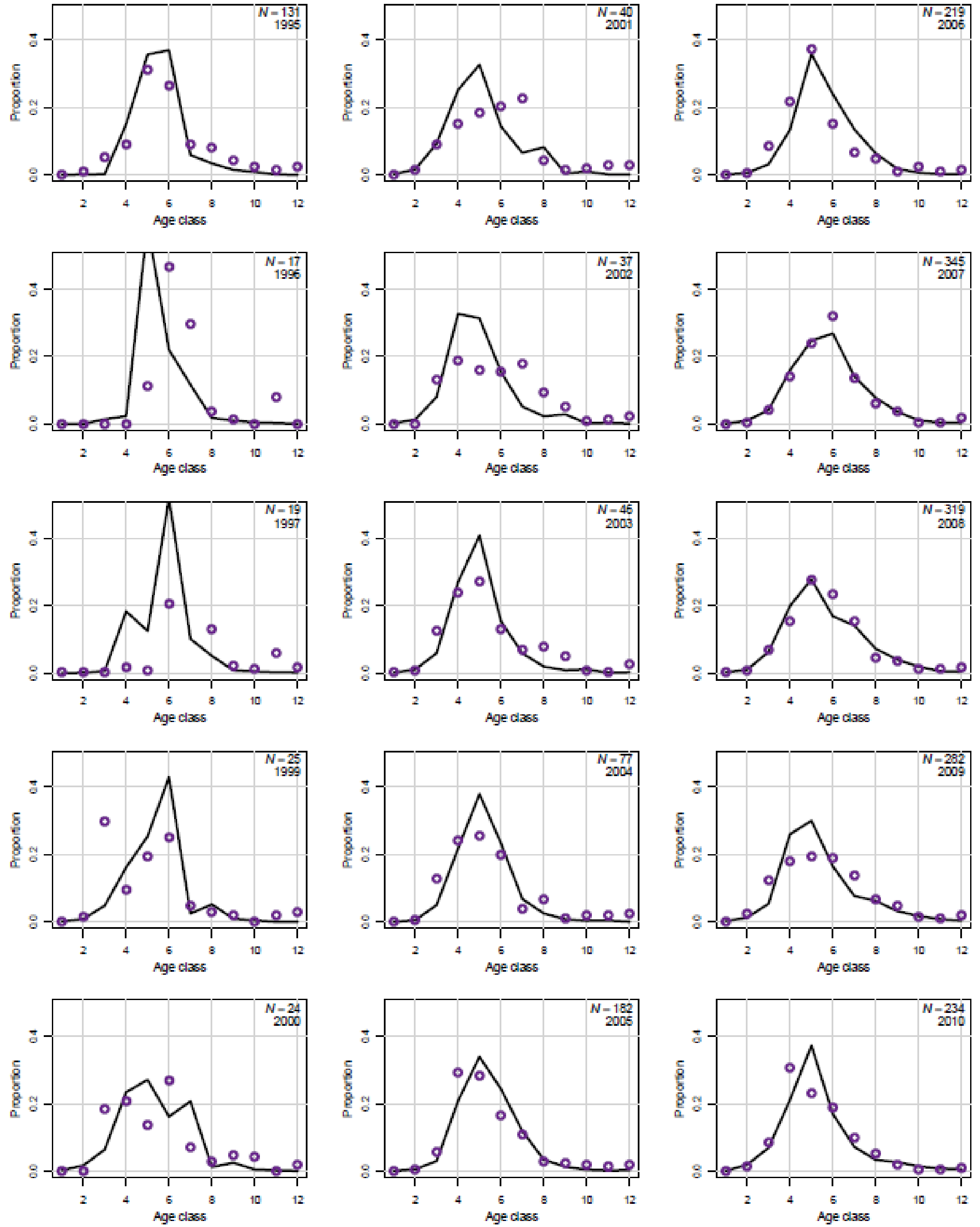
BAM base run – fits to data



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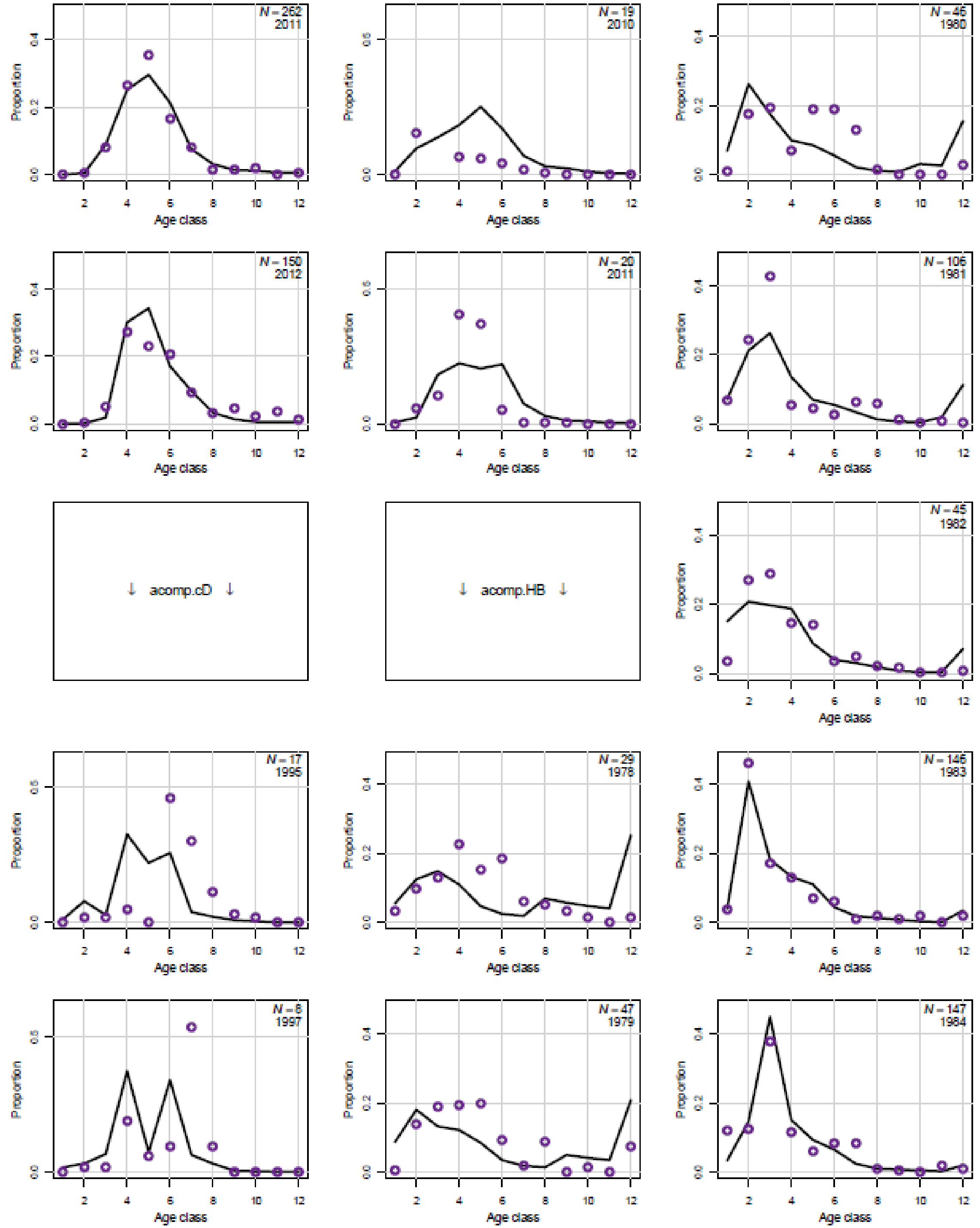
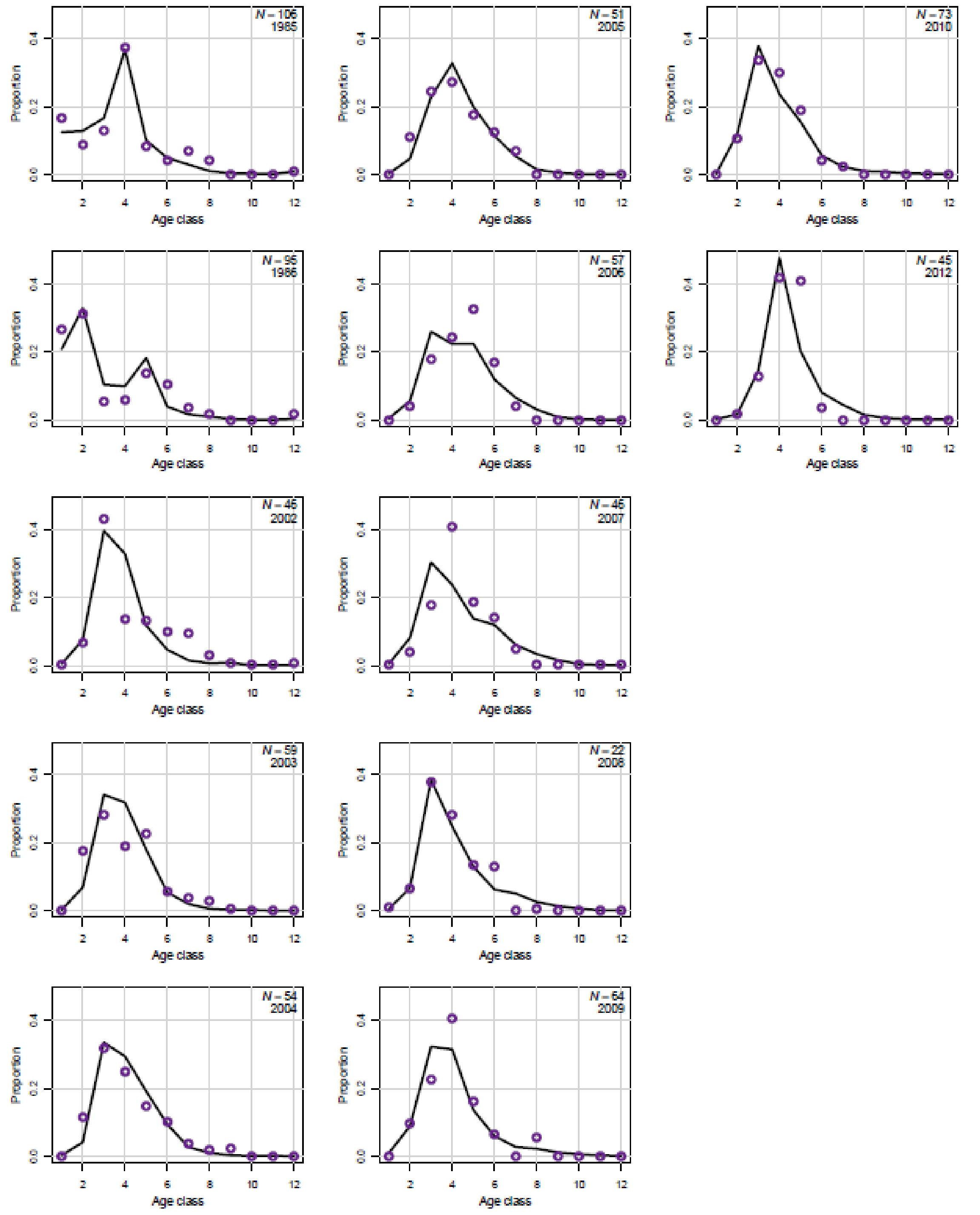


BAM base run – fits to data



BAM base run – fits to data

Figure 4. Observed (open circles) and estimated (solid line, circles) commercial handline landings (1000 lb gutted weight). Open and solid circles may be indistinguishable in years with very close fits.

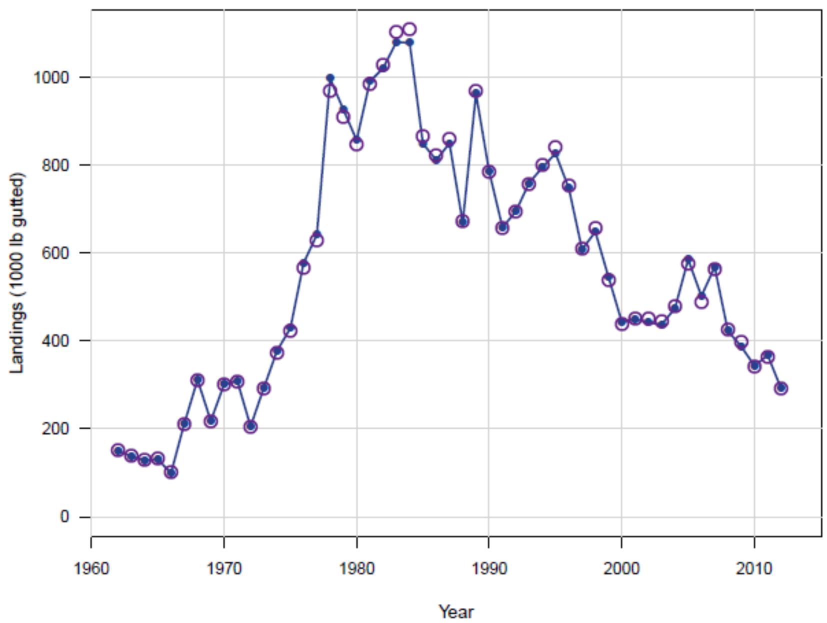
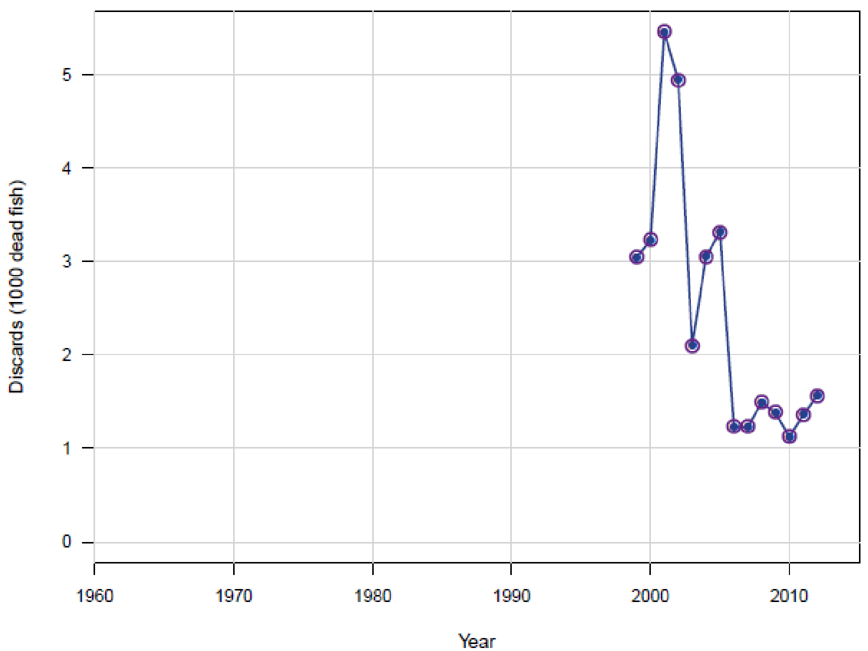
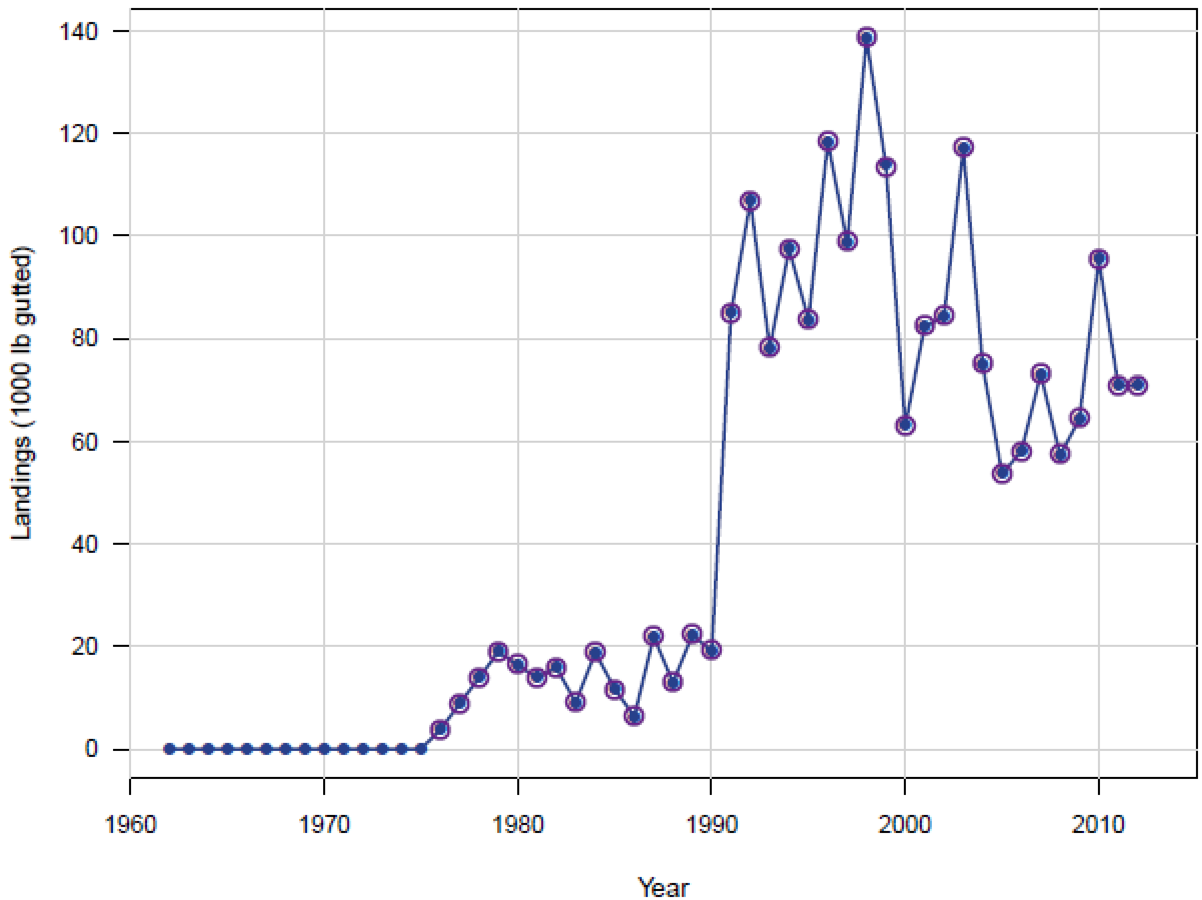


Figure 8. Observed (open circles) and estimated (solid line, circles) commercial handline discard mortalities (1000 dead fish). Open and solid circles may be indistinguishable in years with very close fits.



BAM base run – fits to data

Figure 5. Observed (open circles) and estimated (solid line, circles) commercial diving (1000 lb gutted weight). Open and solid circles may be indistinguishable in years with very close fits.



BAM base run – fits to data

Figure 6. Observed (open circles) and estimated (solid line, circles) headboat landings (1000 fish). Open and solid circles may be indistinguishable in years with very close fits.

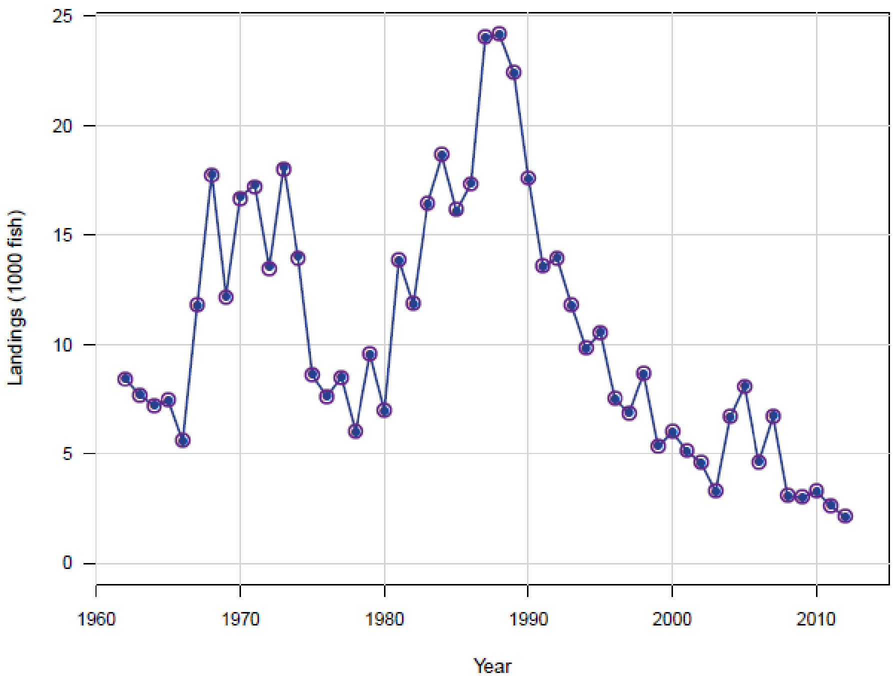
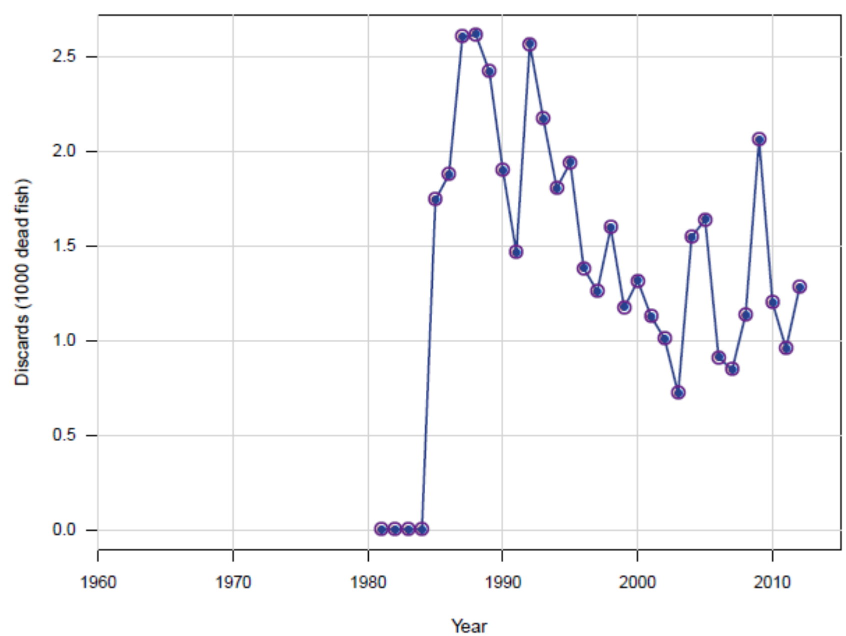


Figure 9. Observed (open circles) and estimated (solid line, circles) headboat discard mortalities (1000 dead fish). Open and solid circles may be indistinguishable in years with very close fits.



BAM base run – fits to data

Figure 7. Observed (open circles) and estimated (solid line, circles) general recreational landings (1000 fish). Open and solid circles may be indistinguishable in years with very close fits.

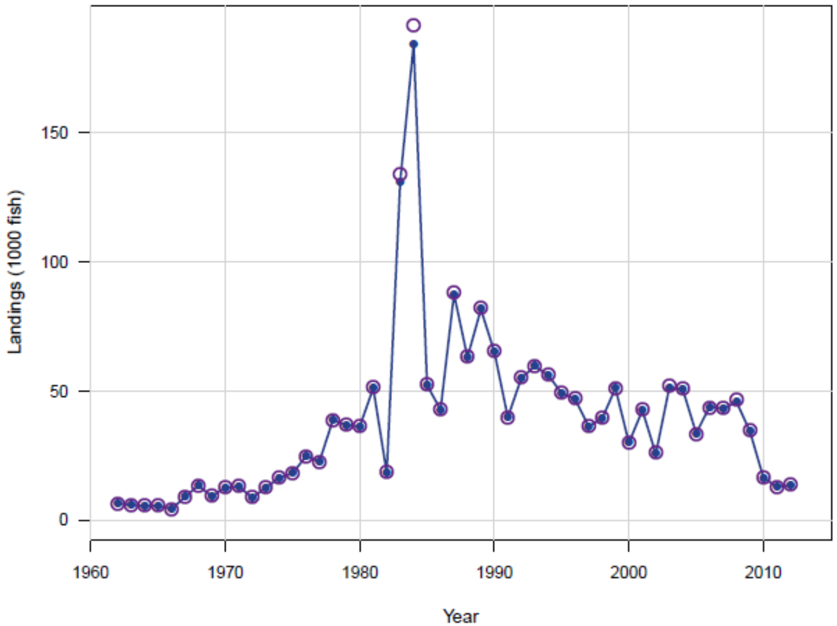
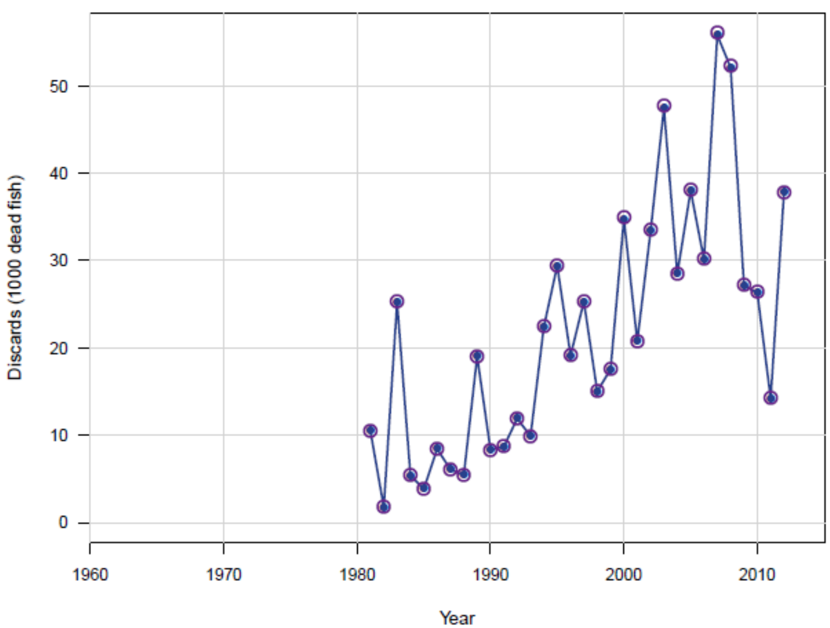
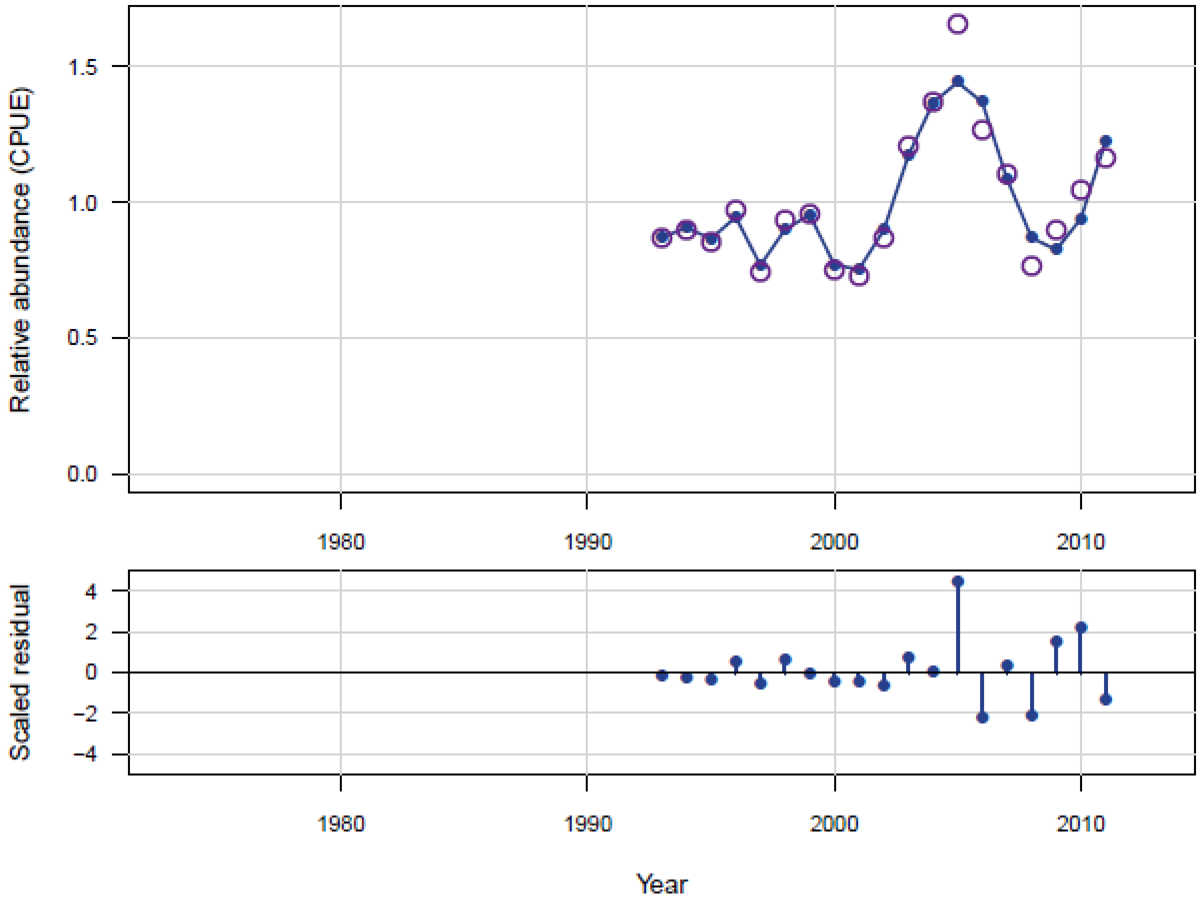


Figure 10. Observed (open circles) and estimated (solid line, circles) general recreational discard mortalities (1000 dead fish). Open and solid circles may be indistinguishable in years with very close fits.



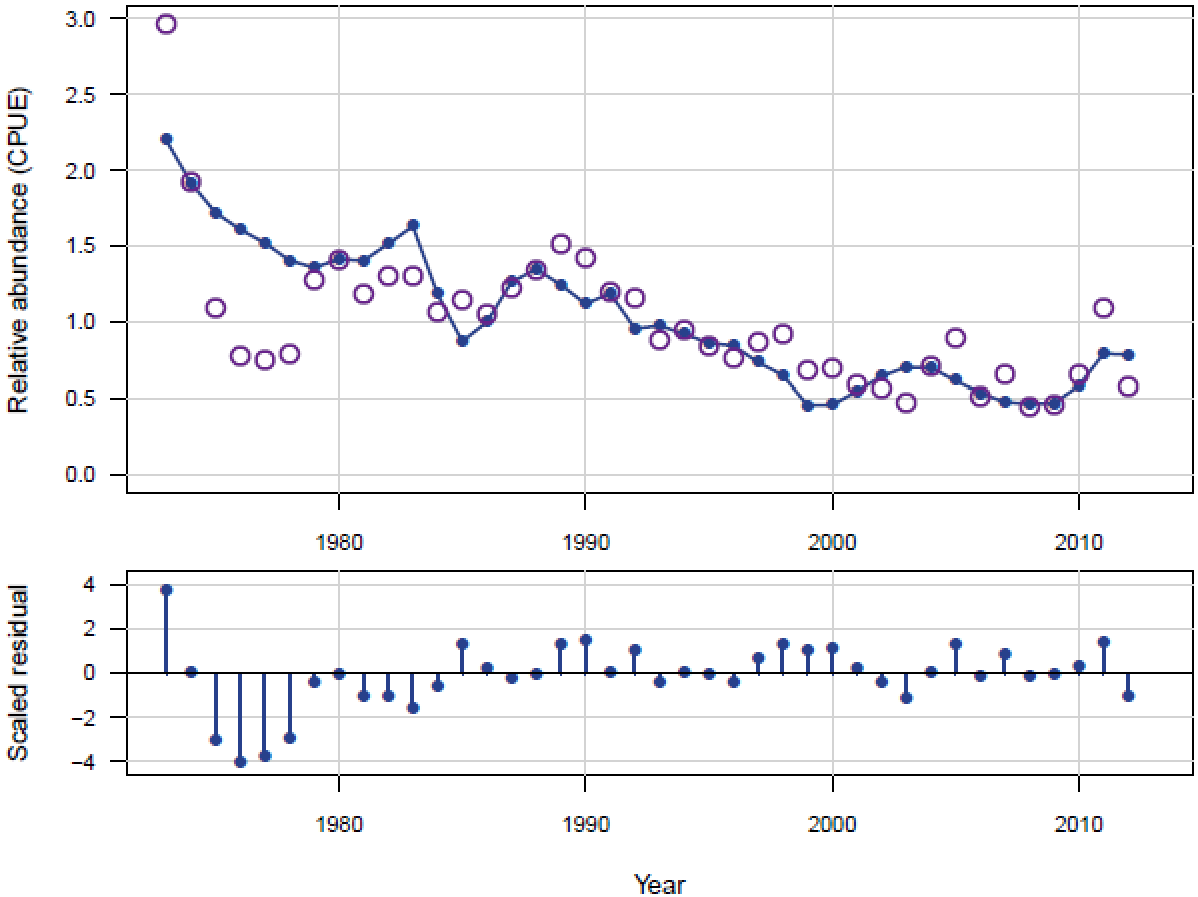
BAM base run – fits to data

Figure 11. Observed (open circles) and estimated (solid line, circles) index of abundance from commercial handline.



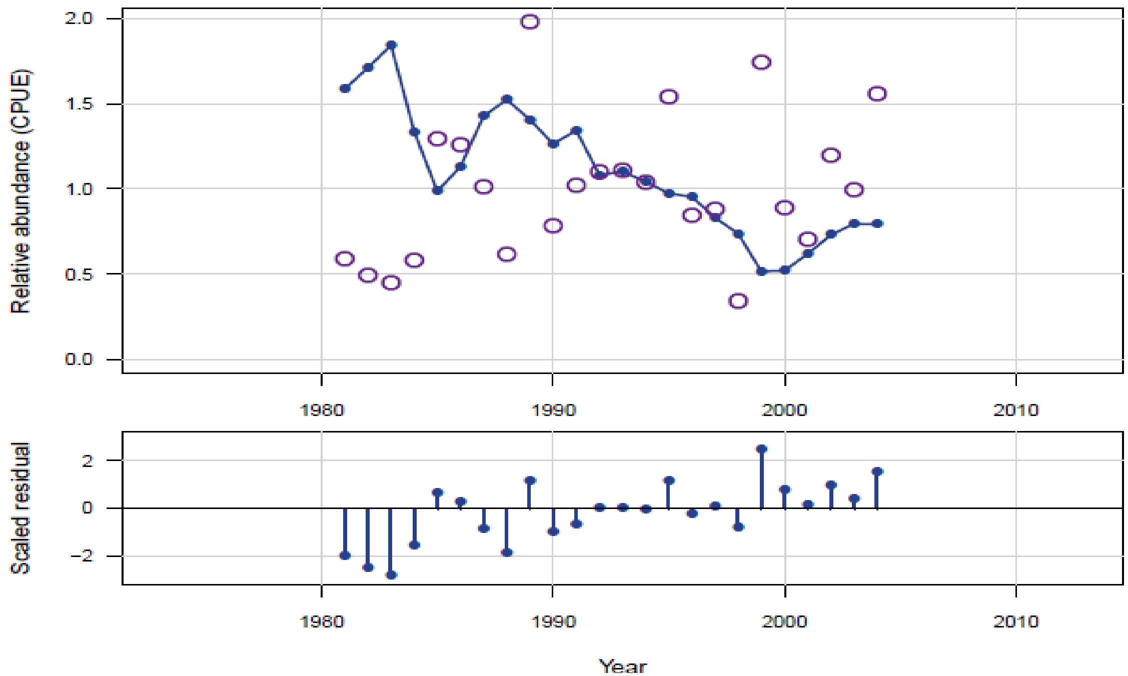
BAM base run – fits to data

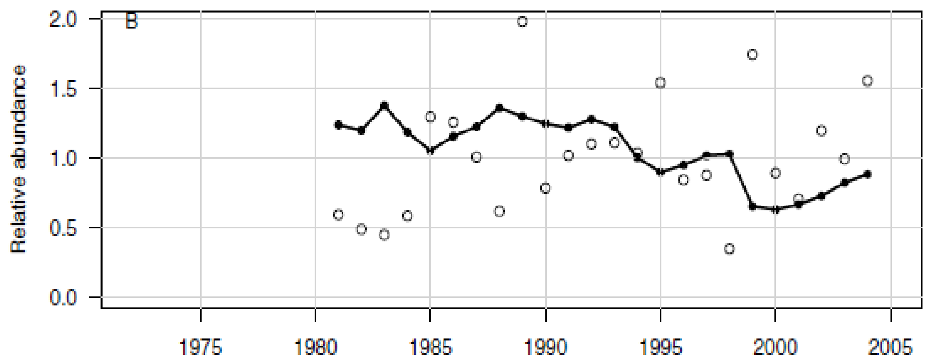
Figure 12. Observed (open circles) and estimated (solid line, circles) index of abundance from headboat.



BAM base run – fits to data

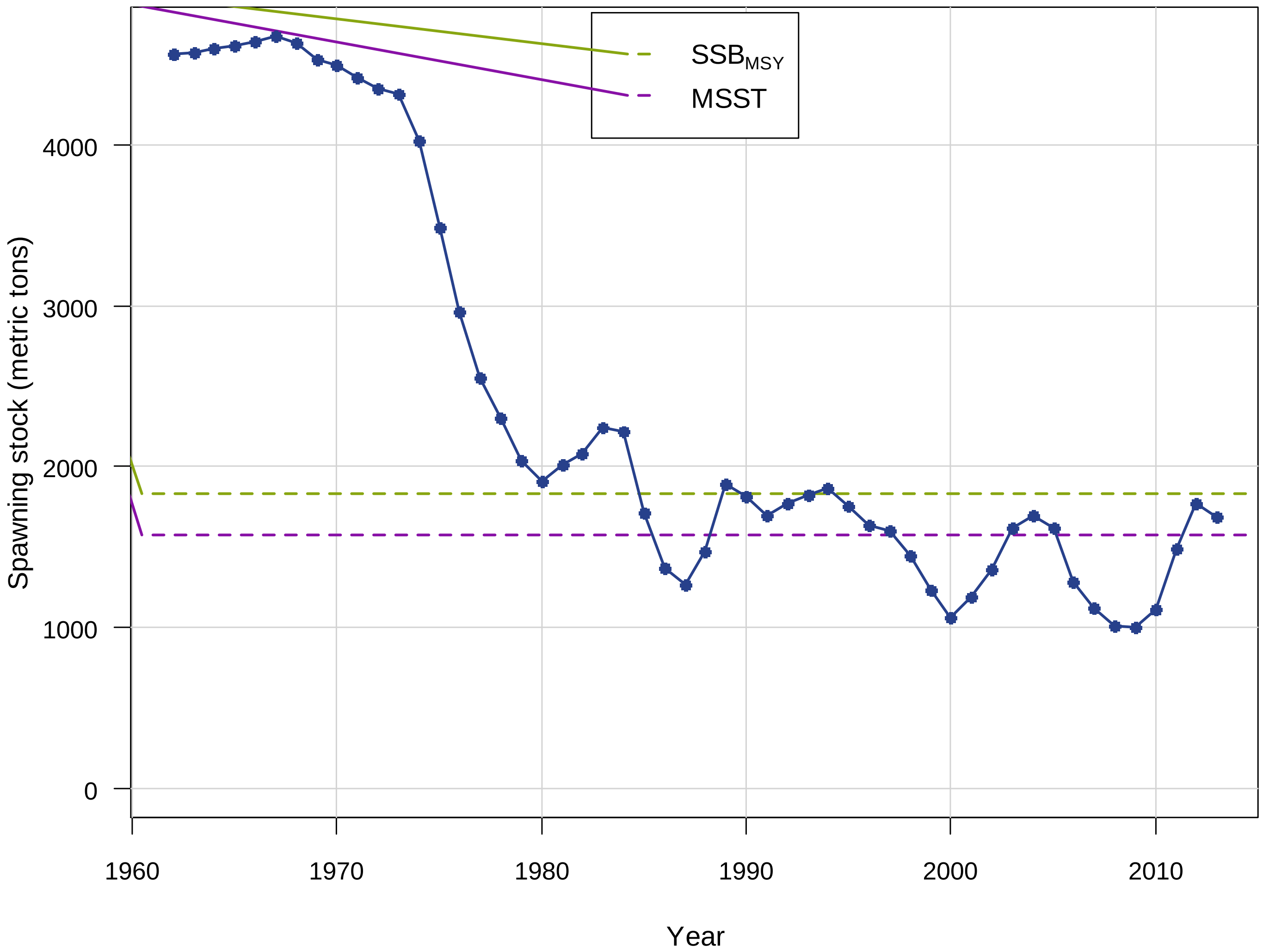
Figure 13. Observed (open circles) and estimated (solid line, circles) index of abundance from general recreational.



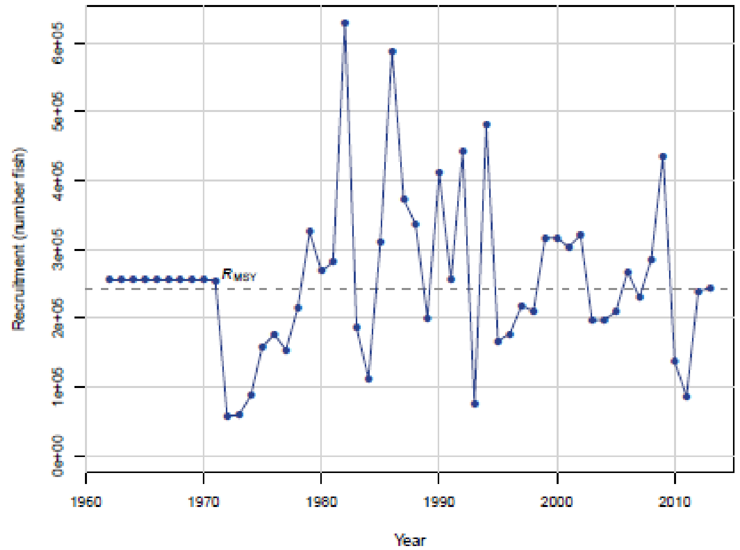


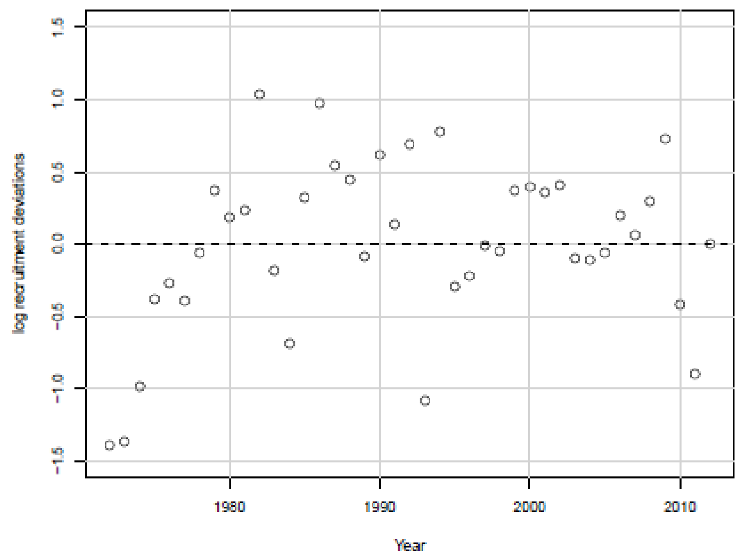
From SEDAR10

BAM base run – SSB

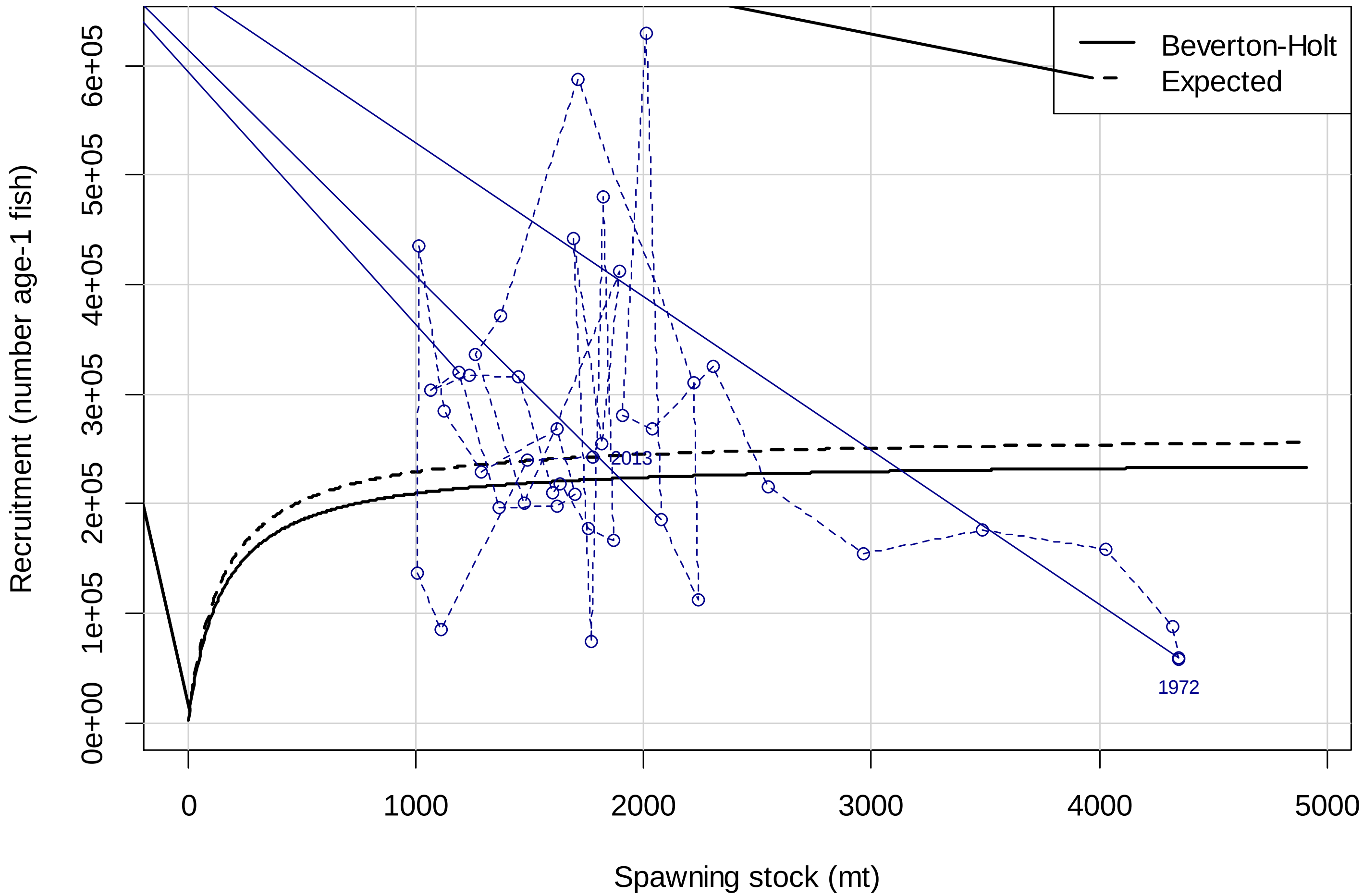


BAM base run – Recruitment

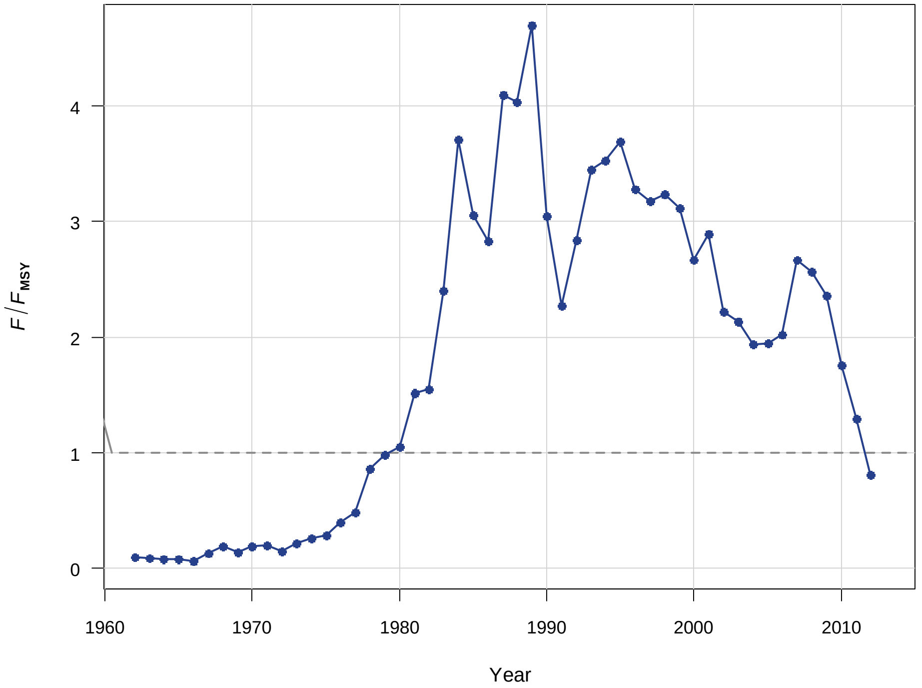


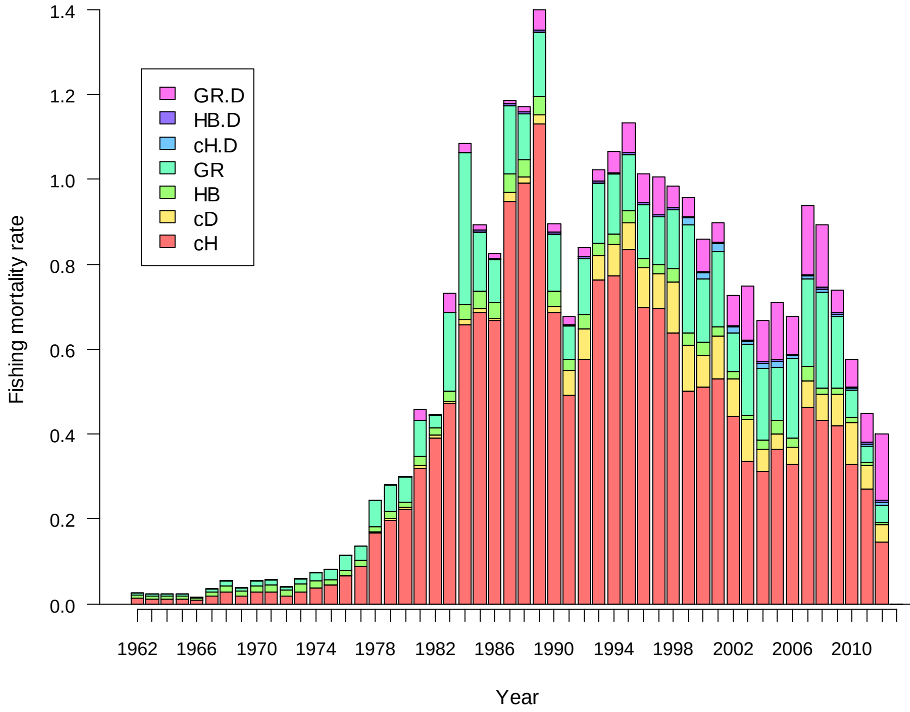


BAM base run – Spawner-recruit curve



BAM base run – Fishing mortality





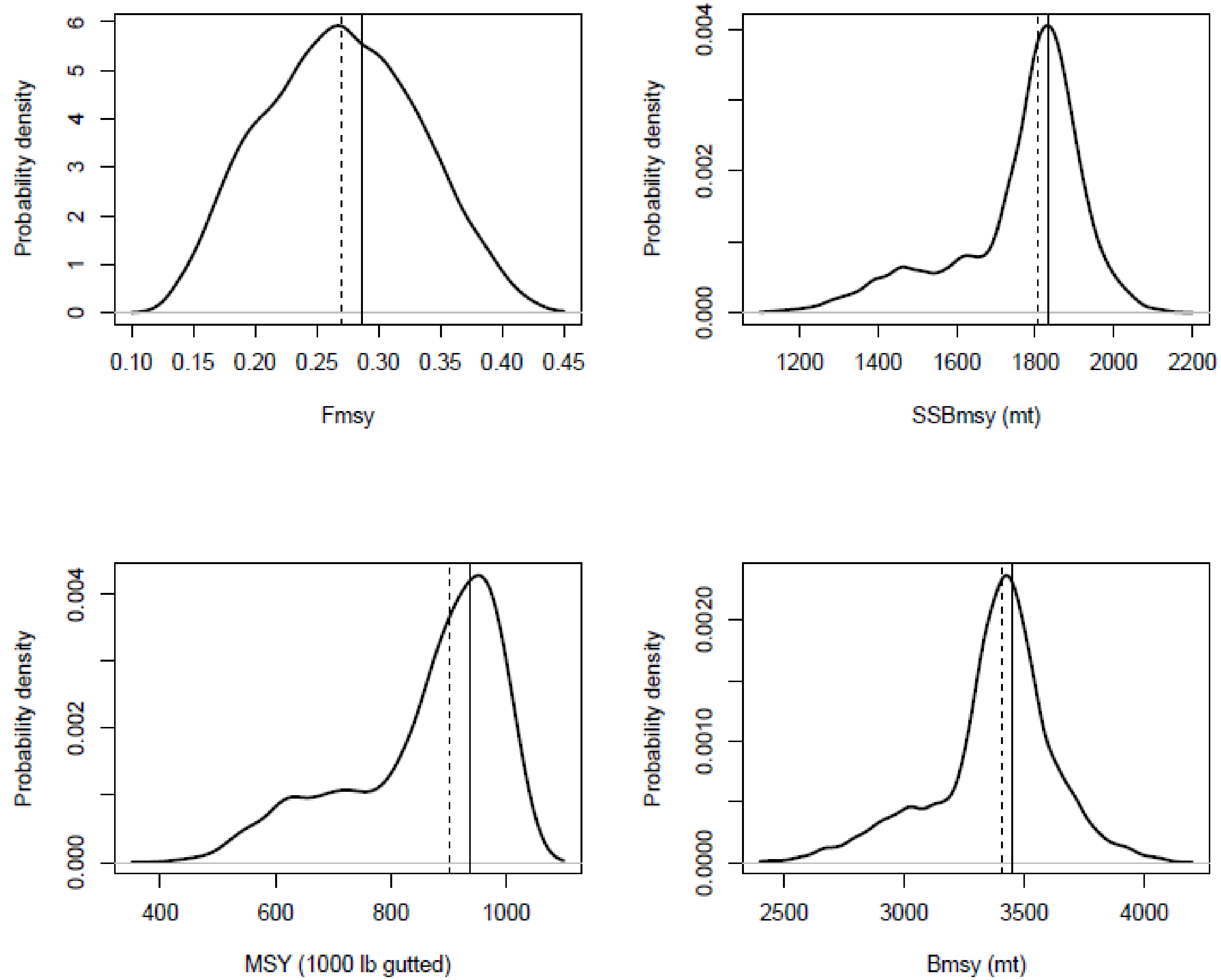
Uncertainty – Combined Monte Carlo and Bootstrap (MCB) approach

- n=4000 MCB trials attempted; n=3775 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

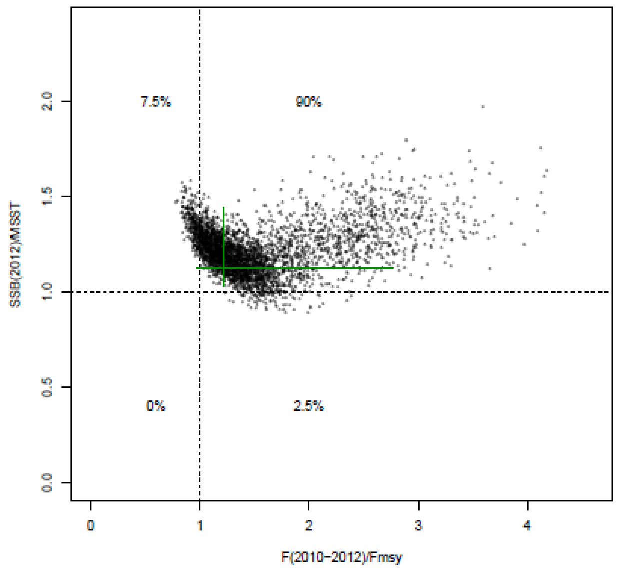
- Monte Carlo components:
  - M: drawn from a uniform distribution, with mean equal to base value (0.14), and bounds [0.10, 0.18]. Chosen value scales age-based Lorenzen M.
  - Steepness: drawn from a truncated beta distribution with expected value of 0.84 and bounds [0.32, 0.99]
  - Finit: drawn from a uniform distribution, with mean equal to Finit=0.03 and bounds at ±50% [0.015, 0.045]

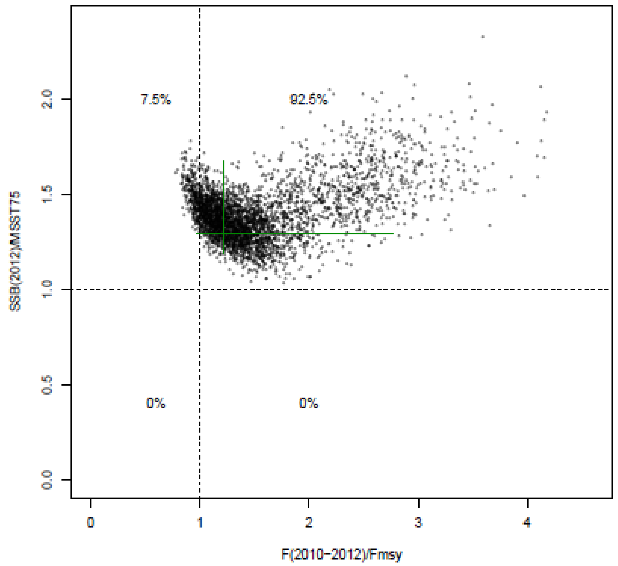
MCB – uncertainty in benchmarks



Solid=MLE (base)
Dash=Median

MCB – stock and fishery status

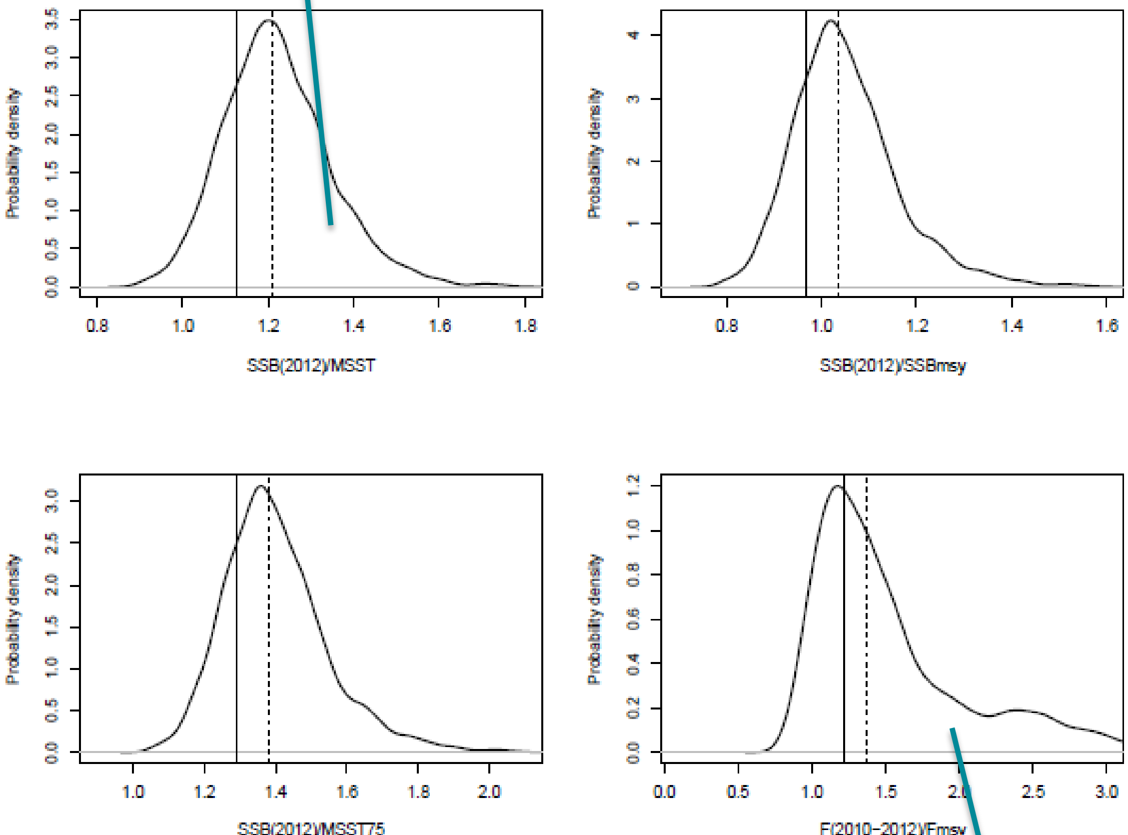




MCB – stock and fishery status

~97.5% of distribution
exceeds 1.0 (i.e., not overfished)

Solid=MLE (base)
Dash=Median



~92.5% of distribution
exceeds 1.0 (i.e., overfishing)

BAM results – Management quantities

Quantity	Units	Estimate	Median	SE
F_{MSY}	y^{-1}	0.29	0.27	0.06
$85\%F_{\mathrm{MSY}}$	y^{-1}	0.24	0.23	0.05
$75\%F_{\mathrm{MSY}}$	y^{-1}	0.21	0.20	0.05
$65\%F_{\mathrm{MSY}}$	y^{-1}	0.19	0.18	0.04
$F_{30\%}$	y^{-1}	0.78	0.79	0.13
$F_{40\%}$	y^{-1}	0.54	0.55	0.09
$F_{50\%}$	y^{-1}	0.38	0.38	0.06
B_{MSY}	mt whole	3449.3	3409.4	253.5
$\mathrm{SSB}_{\mathrm{MSY}}$	mt whole	1831.7	1806.8	165.9
MSST (M)	mt whole	1575.3	1546.3	120.9
MSST (75%)	mt whole	1373.8	1546.3	124.4
MSY	1000 lb gutted	938.2	900.4	131.8
D_{MSY}	1000 fish	28.6	26.4	4.2
R_{MSY}	1000 age-1 fish	243	232	53
Y at $85\%F_{\mathrm{MSY}}$	1000 lb gutted	932.7	894.9	131.5
Y at $75\%F_{\mathrm{MSY}}$	1000 lb gutted	921.1	883.6	130.7
Y at $65\%F_{\mathrm{MSY}}$	1000 lb gutted	900.8	863.8	129.3
$F_{2010-2012}/F_{\mathrm{MSY}}$	—	1.23	1.37	0.57
$\mathrm{SSB}_{2012}/\mathrm{MSST}$ (M)	—	1.13	1.21	0.13
$\mathrm{SSB}_{2012}/\mathrm{MSST}$ (75%)	—	1.29	1.38	0.15
$\mathrm{SSB}_{2012}/\mathrm{SSB}_{\mathrm{MSY}}$	—	0.97	1.04	0.11

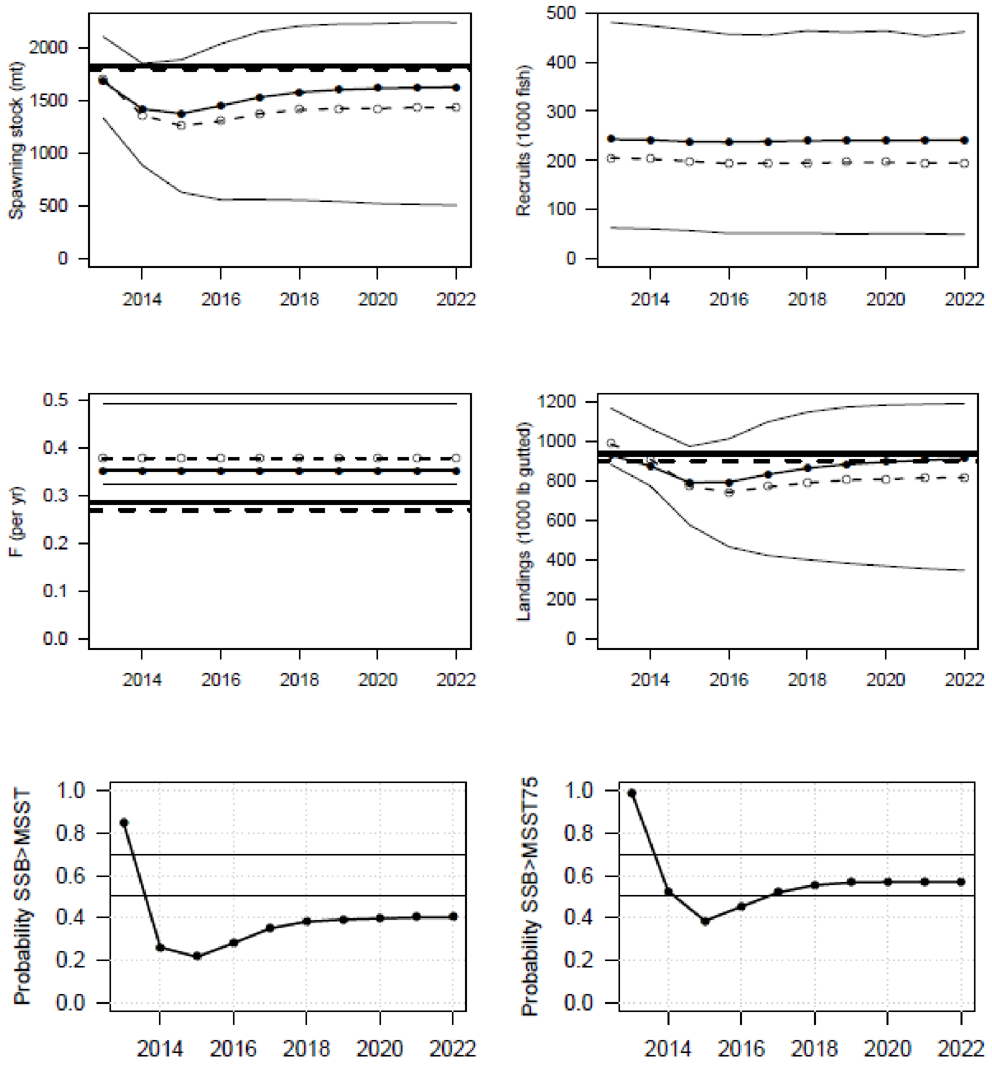
Projections

Projections

- Carry forward uncertainties from MCB runs
  - Uncertainties in initial (2013) abundance at age, spawner-recruit function, natural mortality, discard mortality, selectivities, recruitment deviations, growth parameters
- Uncertainty in Fmsy uses distribution from MCB runs
- 10-year projections: 2013-2022
- F in 2013-2014 equal to average from 2010-2012. New management assumed to start in 2015.
- Two types of projections
  - Constant F: F=Fcurrent, Fmsy, 75%Fmsy
  - P*: Probability of overfishing P*=0.3 and P*=0.5

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 19. Projection results with fishing mortality rate fixed at $F = F_{\text{current}}$ starting in 2013. R = number of age-1 recruits (in 1000s), F = fishing mortality rate (per year), S = spawning stock (mt), L = landings expressed in numbers (n, in 1000s) or gutted weight (w, in 1000 lb), and D = dead discards expressed in numbers (n, in 1000s) or gutted weight (w, in 1000 lb), pr.M = proportion of stochastic projection replicates with SSB $\geq$ MSST using the 1-M definition of MSST, and pr.75=proportion of stochastic projection replicates with SSB $\geq$ MSST using the 75% definition of MSST. The extension b indicates expected values (deterministic) from the base run; the extension med indicates median values from the stochastic projections.

Year	R.b	R.med	F.b	F.med	S.b(mt)	S.med(mt)	L.b(n)	L.med(n)	L.b(w)	L.med(w)	D.b(n)	D.med(n)	D.b(w)	D.med(w)	pr.M	pr.75
2013	243	205	0.35	0.38	1680	1700	69	73	930	985	31	29	119	111	0.845	0.990
2014	242	203	0.35	0.38	1419	1359	63	65	875	910	34	32	137	132	0.260	0.525
2015	238	198	0.35	0.38	1374	1258	58	56	791	773	34	32	141	136	0.214	0.385
2016	237	193	0.35	0.38	1450	1304	59	55	793	742	34	31	140	134	0.280	0.452
2017	238	194	0.35	0.38	1531	1373	63	57	833	769	34	31	140	131	0.350	0.519
2018	240	195	0.35	0.38	1578	1410	65	59	864	790	34	31	141	131	0.381	0.554
2019	240	196	0.35	0.38	1601	1422	66	60	883	803	34	31	141	132	0.391	0.566
2020	241	195	0.35	0.38	1613	1424	67	60	895	809	34	31	142	132	0.397	0.569
2021	241	195	0.35	0.38	1622	1432	67	60	904	814	34	31	142	131	0.402	0.570
2022	241	194	0.35	0.38	1628	1433	68	60	911	817	34	31	142	131	0.402	0.570

Projection results: F=Fmsy

Year	R.b	R.med	F.b	F.med	S.b(mt)	S.med(mt)	L.b(n)	L.med(n)	L.b(w)	L.med(w)	D.b(n)	D.med(n)	D.b(w)	D.med(w)	pr.M	pr.75
2013	243	205	0.35	0.38	1680	1700	69	73	930	985	31	29	119	111	0.845	0.990
2014	242	203	0.35	0.38	1419	1359	63	65	875	910	34	32	137	132	0.260	0.525
2015	238	198	0.29	0.27	1374	1258	48	42	661	582	28	24	116	101	0.214	0.385
2016	237	193	0.29	0.27	1496	1362	52	44	692	602	28	24	117	101	0.322	0.516
2017	239	196	0.29	0.27	1616	1482	56	48	750	658	28	24	117	101	0.444	0.644
2018	241	198	0.29	0.27	1698	1565	59	52	800	706	28	24	118	102	0.532	0.724
2019	242	200	0.29	0.27	1746	1608	62	54	837	743	28	24	118	103	0.580	0.764
2020	242	200	0.29	0.27	1774	1639	63	56	863	770	28	24	119	103	0.608	0.790
2021	243	200	0.29	0.27	1792	1657	64	57	883	790	28	24	119	104	0.626	0.805
2022	243	200	0.29	0.27	1805	1671	65	58	897	805	29	24	119	104	0.639	0.820

Projection results: F=75%Fmsy

Year	R.b	R.med	F.b	F.med	S.b(mt)	S.med(mt)	L.b(n)	L.med(n)	L.b(w)	L.med(w)	D.b(n)	D.med(n)	D.b(w)	D.med(w)	pr.M	pr.75
2013	243	205	0.35	0.38	1680	1700	69	73	930	985	31	29	119	111	0.845	0.990
2014	242	203	0.35	0.38	1419	1359	63	65	875	910	34	32	137	132	0.260	0.525
2015	238	198	0.21	0.20	1374	1258	37	32	510	448	21	18	88	76	0.214	0.385
2016	237	193	0.21	0.20	1548	1409	41	36	560	486	21	18	90	78	0.370	0.565
2017	240	197	0.21	0.20	1717	1570	46	40	630	551	21	18	90	78	0.527	0.718
2018	242	199	0.21	0.20	1843	1694	51	44	694	610	22	18	91	79	0.643	0.806
2019	243	202	0.21	0.20	1925	1767	54	47	746	659	22	18	92	80	0.712	0.852
2020	244	202	0.21	0.20	1977	1820	56	50	786	698	22	19	92	80	0.750	0.876
2021	245	203	0.21	0.20	2011	1854	58	52	818	730	22	19	93	81	0.776	0.893
2022	245	203	0.21	0.20	2034	1878	60	53	842	754	22	19	93	81	0.798	0.905

Projection results: P*=0.3

Year	R	F	S(mt)	L(n)	L(w)	D(n)	D(w)	ABC(n)	ABC(w)	pr.M	pr.75
2013	205	0.38	1700	73	985	29	111	102	1105	0.845	0.990
2014	203	0.38	1359	65	910	32	132	98	1054	0.260	0.525
2015	198	0.23	1258	36	494	20	85	57	587	0.214	0.385
2016	193	0.23	1392	39	528	20	86	60	621	0.354	0.549
2017	196	0.23	1539	43	591	20	86	64	682	0.501	0.694
2018	199	0.23	1649	47	647	20	87	69	740	0.607	0.781
2019	201	0.23	1710	50	692	20	88	72	788	0.672	0.826
2020	202	0.23	1754	52	728	21	88	74	824	0.705	0.849
2021	202	0.23	1784	54	756	21	89	76	851	0.730	0.868
2022	202	0.23	1803	55	777	21	89	77	873	0.749	0.882

Projection results: P*=0.5

Year	R	F	S(mt)	L(n)	L(w)	D(n)	D(w)	ABC(n)	ABC(w)	pr.M	pr.75
2013	205	0.38	1700	73	985	29	111	102	1105	0.845	0.990
2014	203	0.38	1359	65	910	32	132	98	1054	0.260	0.525
2015	198	0.27	1258	42	582	24	101	67	692	0.214	0.385
2016	193	0.27	1362	44	602	24	101	70	712	0.322	0.516
2017	196	0.27	1482	48	658	24	101	74	766	0.444	0.644
2018	198	0.27	1565	52	706	24	102	77	815	0.532	0.724
2019	200	0.27	1608	54	743	24	103	80	854	0.580	0.764
2020	200	0.27	1639	56	770	24	103	81	881	0.608	0.790
2021	200	0.27	1657	57	790	24	104	83	902	0.626	0.805
2022	200	0.27	1671	58	805	24	104	84	918	0.639	0.820

Questions