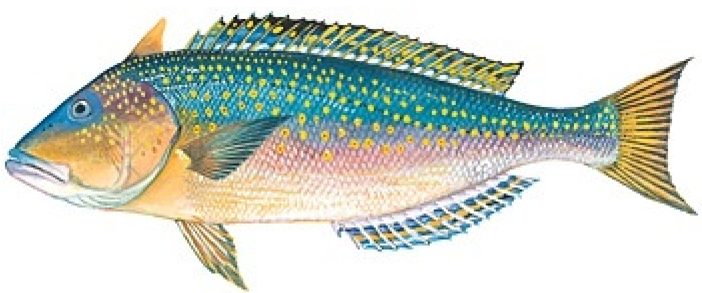
NOAA FISHERIES

- Southeast Fisheries Science Center

Revision to the 2016 Golden Tilefish Update Assessment



25 October 2017

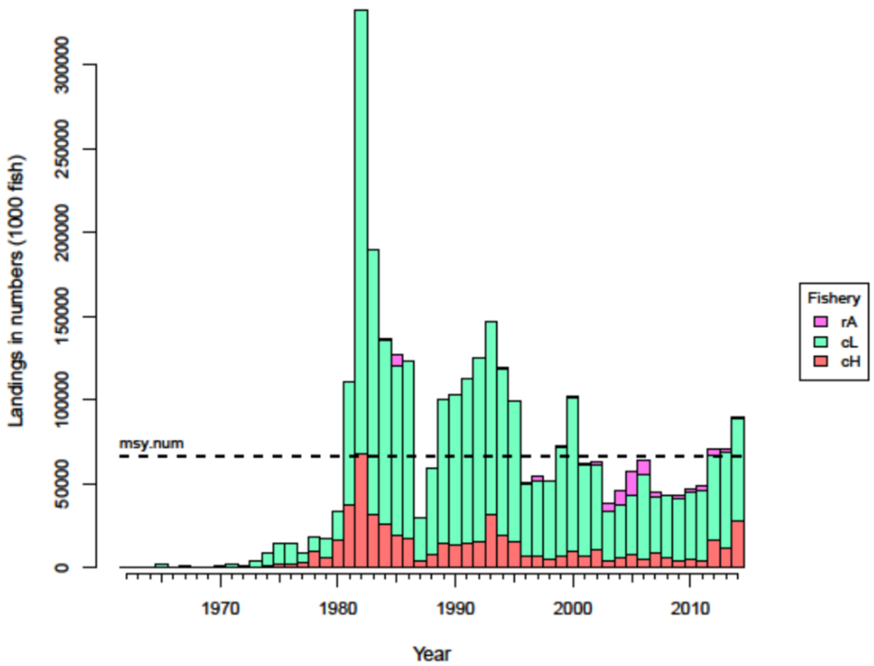
The Council's request

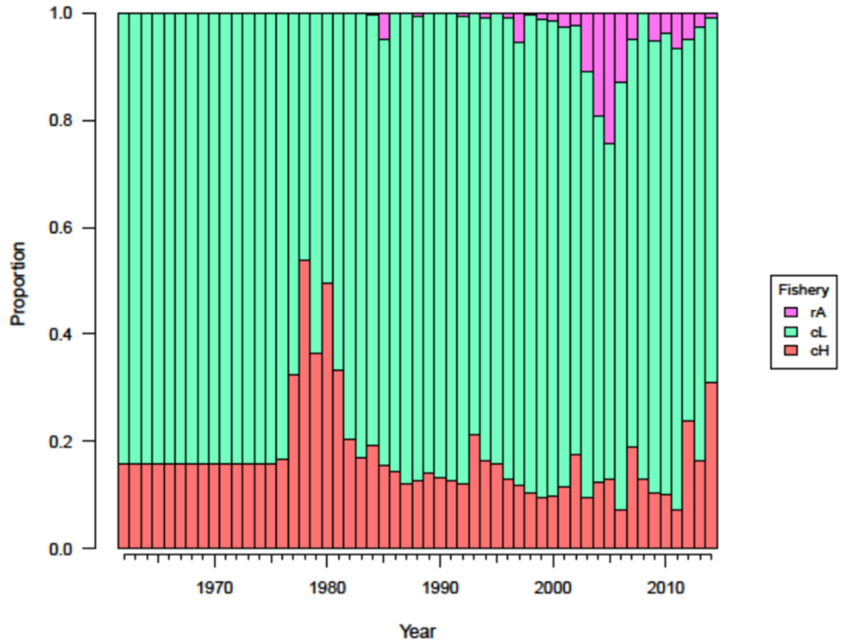
- Redo the 2016 golden tilefish update assessment
  - Replace the robust multinomial likelihood with the Dirichlet-multinomial likelihood
  - Everything else stays the same
- Do a bunch of projections

Summary of data

- Landings: commercial handline (1962-2014), commercial longline (1962-2014), recreational (1981-2014)
- Indices: commercial longline (1993-2014), MARMAP longline (5 years pooled, CV>100%)
- Length comps: commercial handline (muN=4.1), commercial longline (muN=30), recreational (muN=6.25)
- Age comps: commercial handline (muN=10.2), commercial longline (muN=34.2), MARMAP longline (muN=86.6)

Landings in numbers





Life history inputs

- Von Bert growth: k=0.19, Linf=825 mm, t0=-0.47
- Maturity: Age 1=0.1, Age 2=0.25, Age 3=0.5, Age4+=1.0
- Max age = 40
  - Implies constant M=0.11
- Lorenzen age dependent M, decreases from about 0.3 (age 1) to about 0.1 (age 25)

BAM: same basic model as in SEDAR25-Update (1 of 2)

- Assessment period: 1962-2014
- Catch-age formulation, fit to data using maximum likelihood
- Beverton-Holt spawner recruit model, with lognormal error
- Age-based natural mortality (Lorenzen)
- Age-based, logistic selectivities for the 3 fleets and for MARMAP longline
- Baranov catch equation
- Spawning stock based on mature female gonad weight
- Steepness h=0.84

BAM: same basic model as in SEDAR25-Update (2 of 2)

- Initial age structure in 1962 was computed as the stable age structure given initial F=0.01
- Recruitment deviations estimated1976-2007
- Ages modeled: 1-25+
- Constant (estimated) CV of size at age
- Uncertainty estimated through Monte/Carlo Bootstrap (MCB) approach

The difference between this assessment and the SEDAR25-Update

- This revised assessment replaced the robust multinomial likelihood with the Dirichlet-multinomial (DM) likelihood for fitting composition

- Unfortunately, this exercise didn't work right out of the box…

Issues

- The DM parameters were not identifiable
- Degraded fit to the primary index of abundance (commercial longline)
- Model convergence

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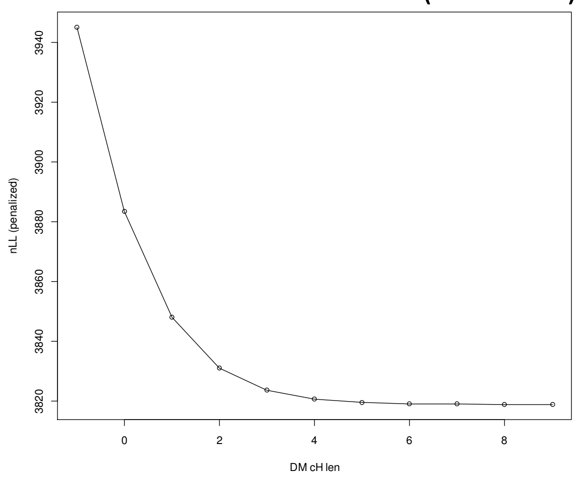
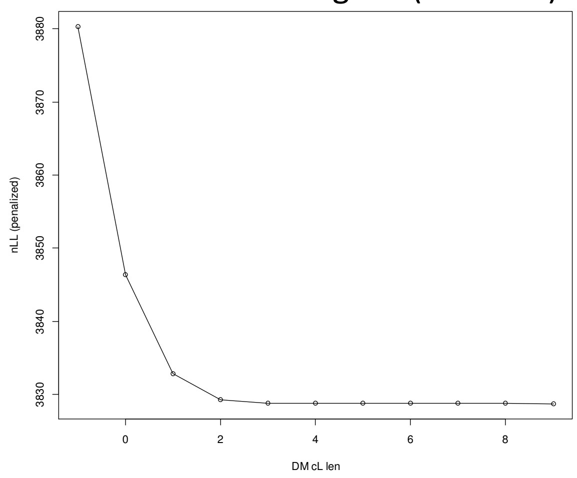
Likelihood profiles on DM parameters (log space): length comps

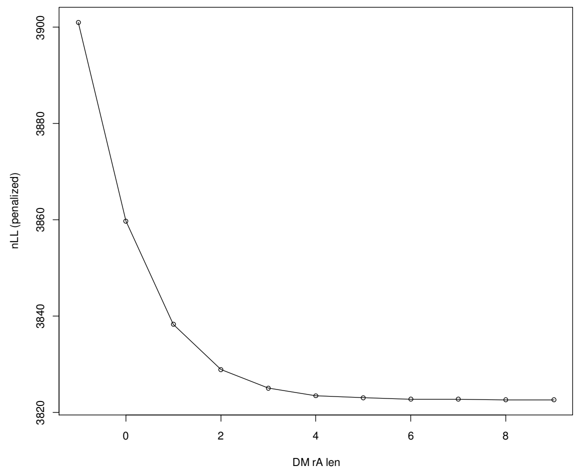
Commercial handline (muN=4.1)



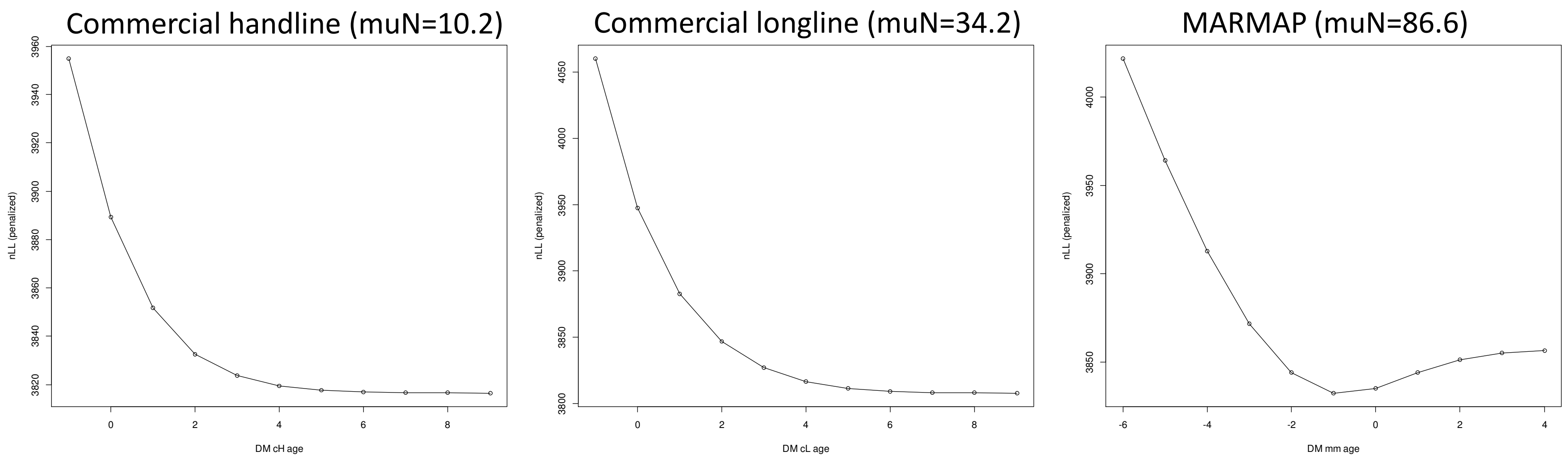
Commercial longline (muN=30)



Recreational (muN=6.25)

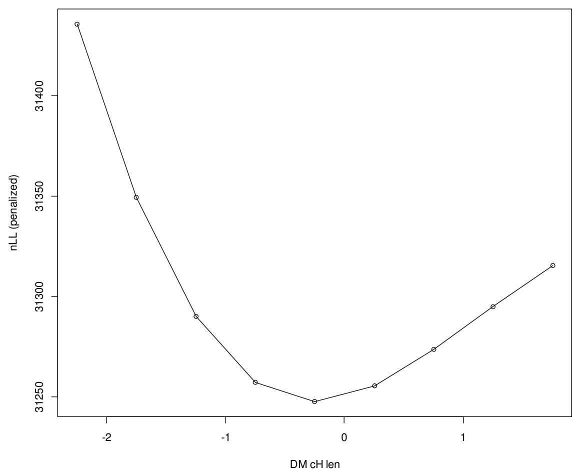


Likelihood profiles on DM parameters (log space): age comps

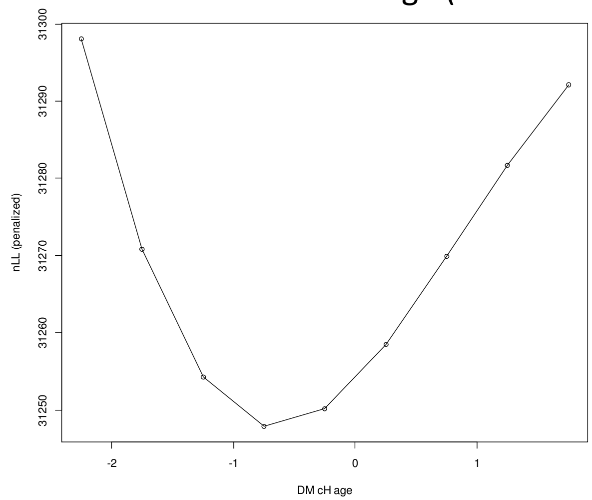


For comparison, here are a few from red grouper

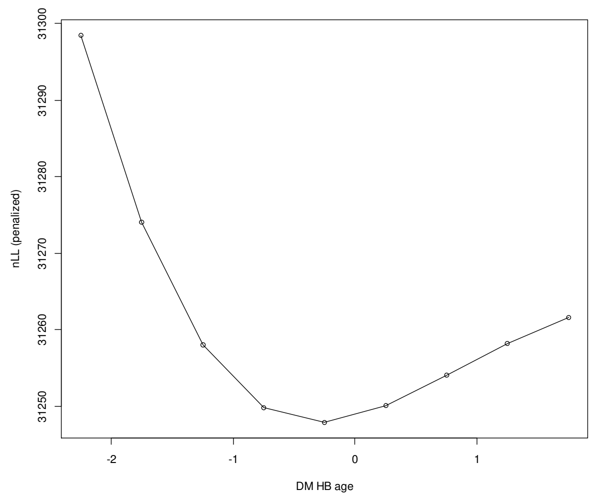
Commercial handline len (muN=136)



Commercial handline age (muN=152)



Commercial handline age (muN=48)



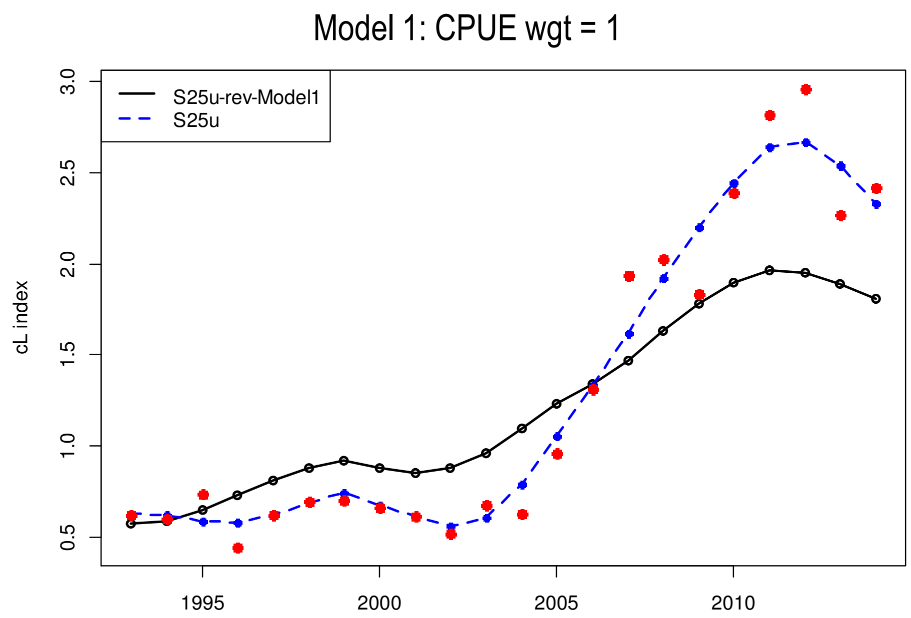
Conclusion and way forward

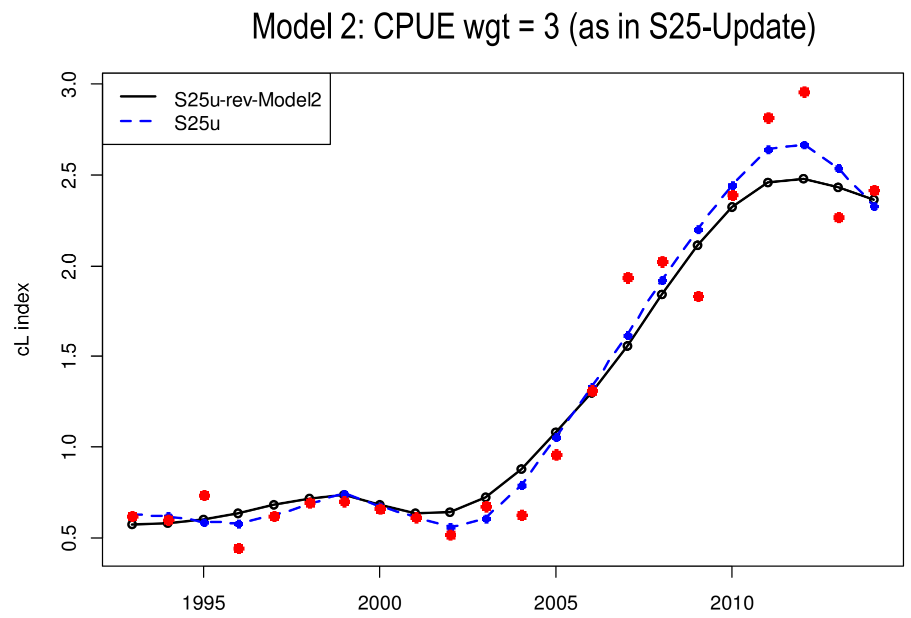
- For tilefish, estimation of the DM parameter is poorly informed by the data
- For each composition, applied a normal prior distribution, with CV=0.2 and mean equal to either:
  - The minimum from likelihood profiling (MM age comps)
  - The elbow in the profile, defined as the minimum inflation factor after which delta NLL < 2

Issues

- The DM parameters were not identifiable
- Degraded fit to the primary index of abundance (commercial longline)
- Model convergence

Fits to the commercial longline index





Issues

- The DM parameters were not identifiable
- Degraded fit to the primary index of abundance (commercial longline)
- Model convergence
  - Max gradient was not within the specified tolerance

Summary of models attempted

Mean square error of fit to comm index

Model	Description	Converge?	MSE
0.	2016 SEDAR25-Update	Y	0.024
1.	No priors on DM parameters, CPUE weights = 1	N	0.168
2.	No priors on DM parameters	N	0.037
3.	Priors from likelihood profiling	N	0.037
4.	Commercial index weight increased twofold	N	0.027
5.	Commercial index weight increased fourfold	N	0.020
6.	Commercial index weight increased sixfold	N	0.009
7.	DM parameters fixed to mimic N_{eff} in 2016 Update	N	0.060
8.	Composition likelihoods scaled by 2016 Update weights	N	0.027
9.	Composition likelihoods scaled by one tenth of 2016 Update weights	Y	0.013
10.	Composition likelihoods all scaled by 0.01	Y	0.014

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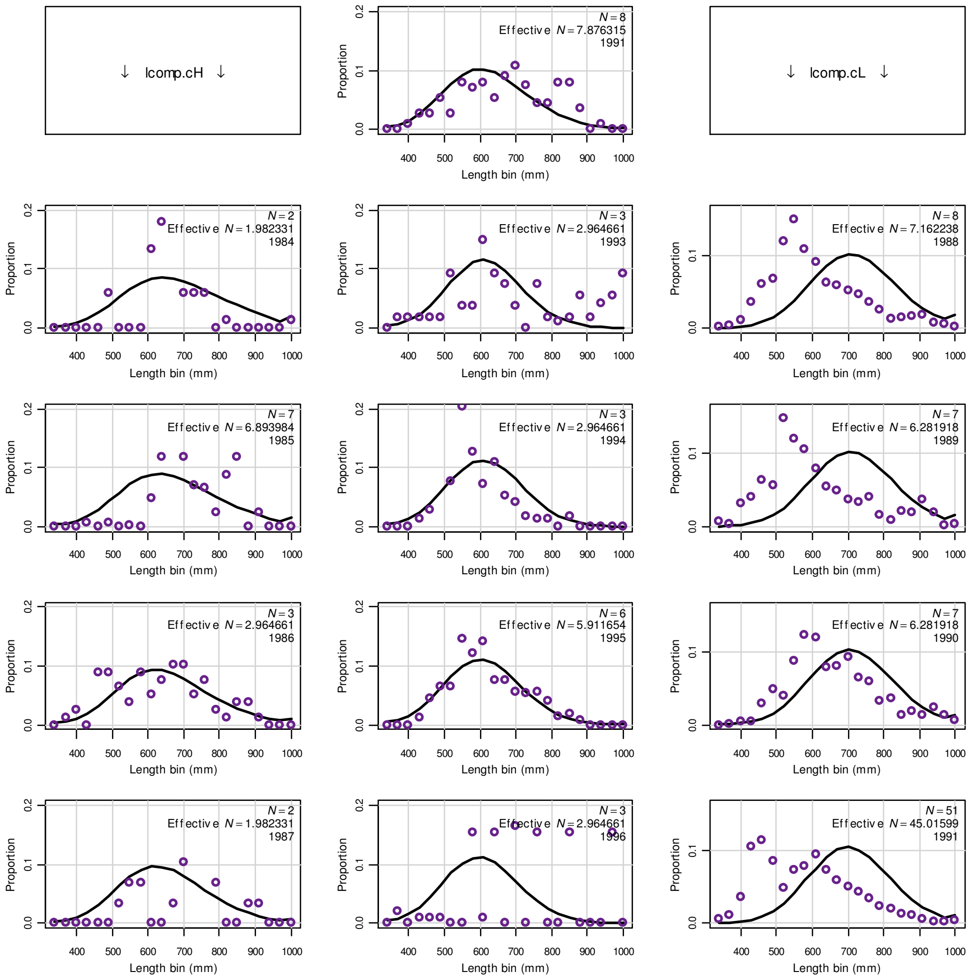
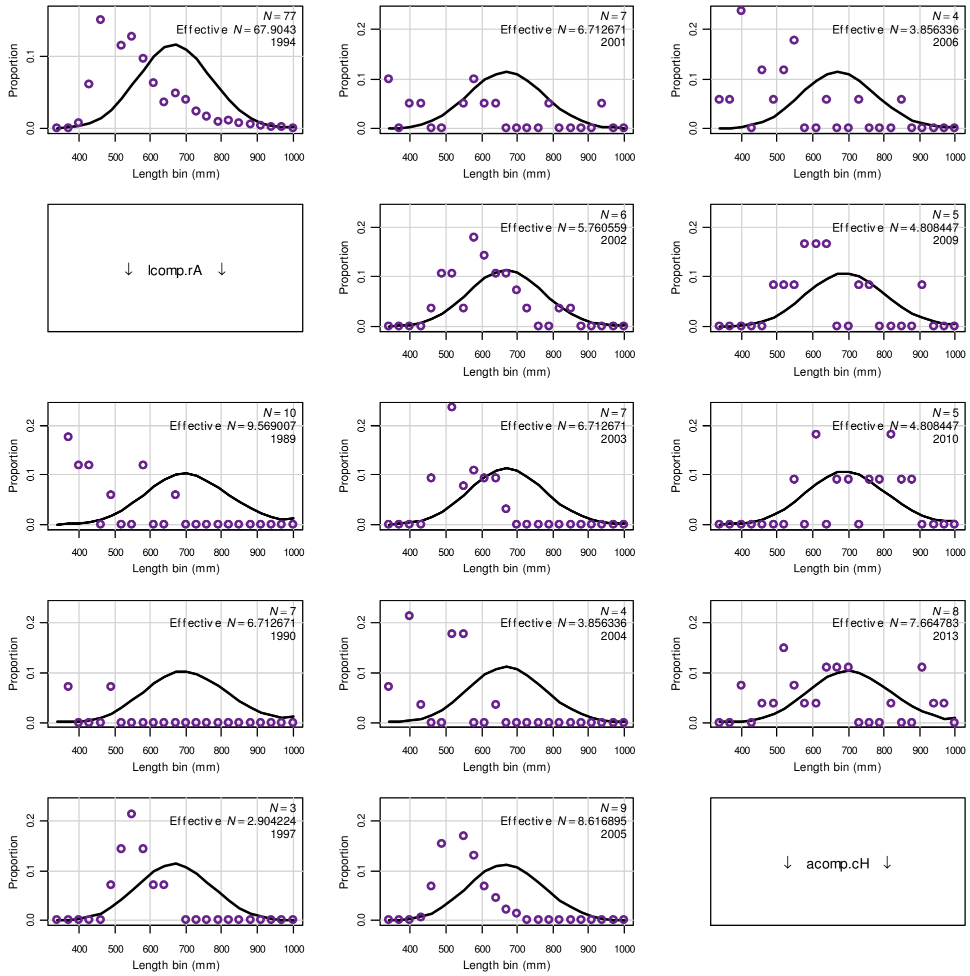
Base run = Model 10

BAM base run – fits to data



BAM base run – fits to data



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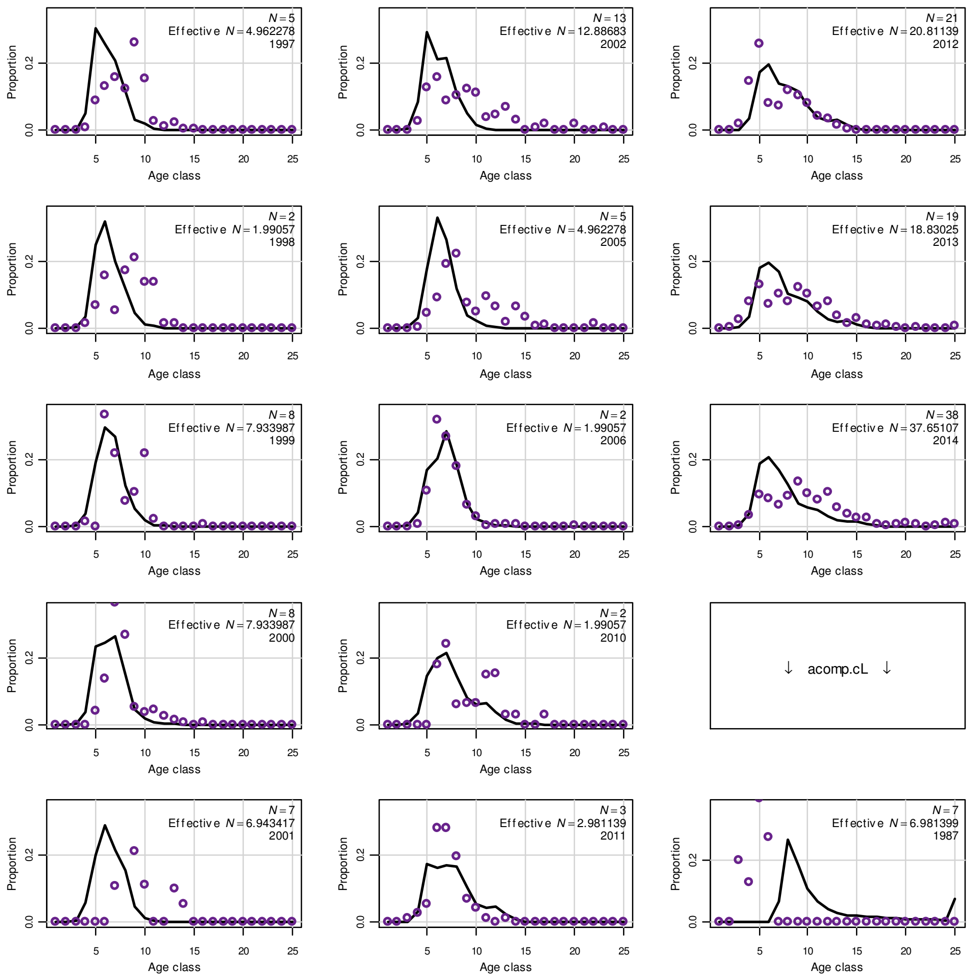

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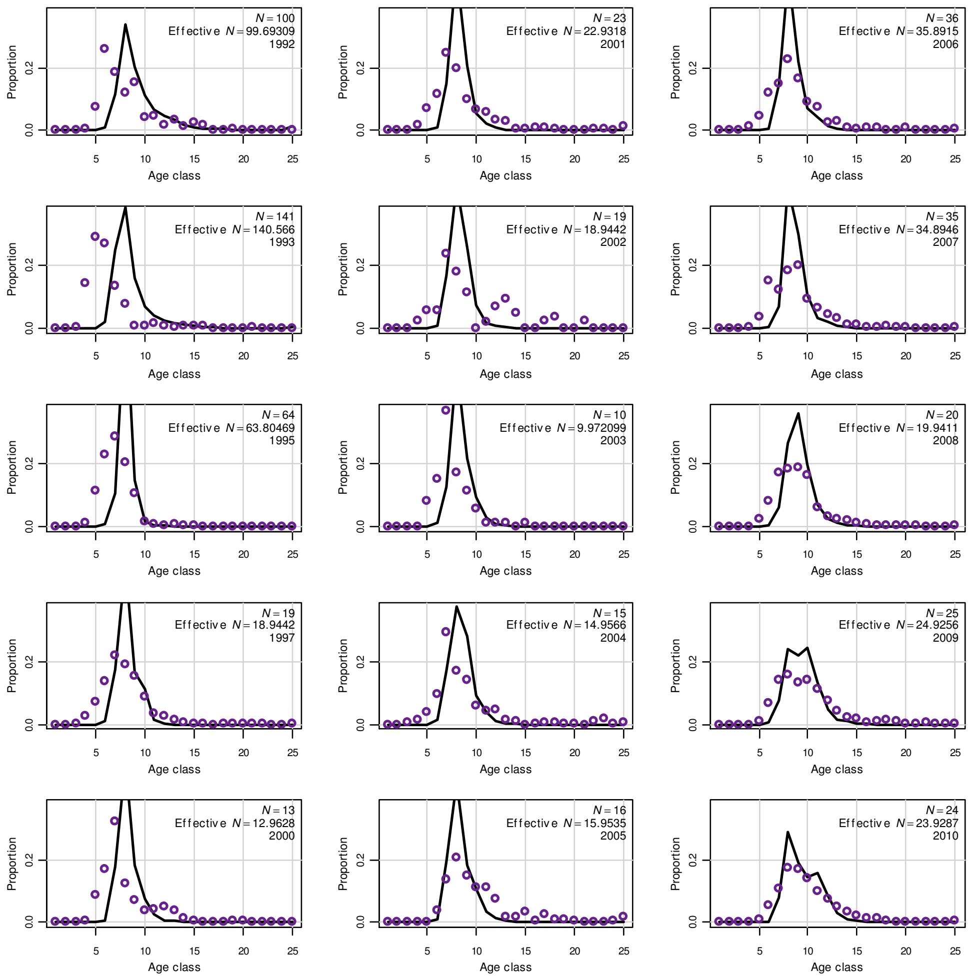

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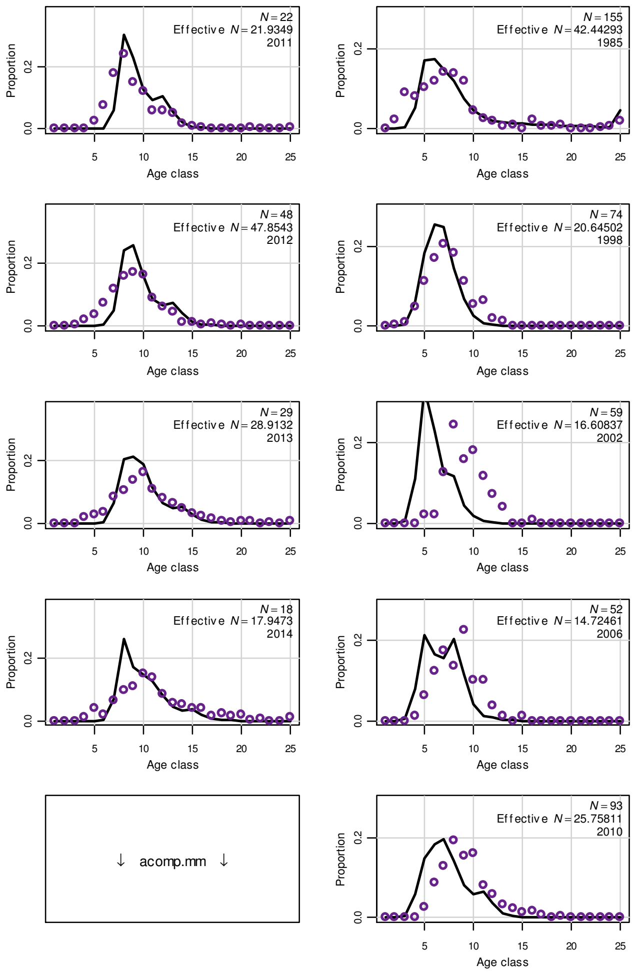
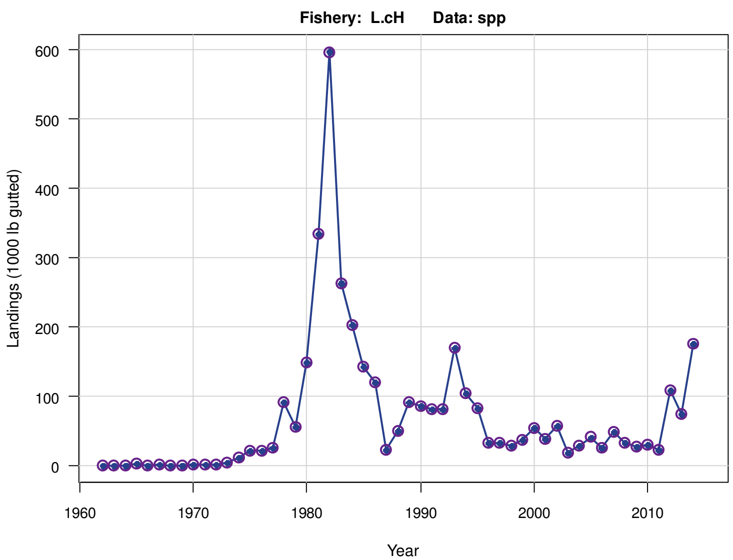
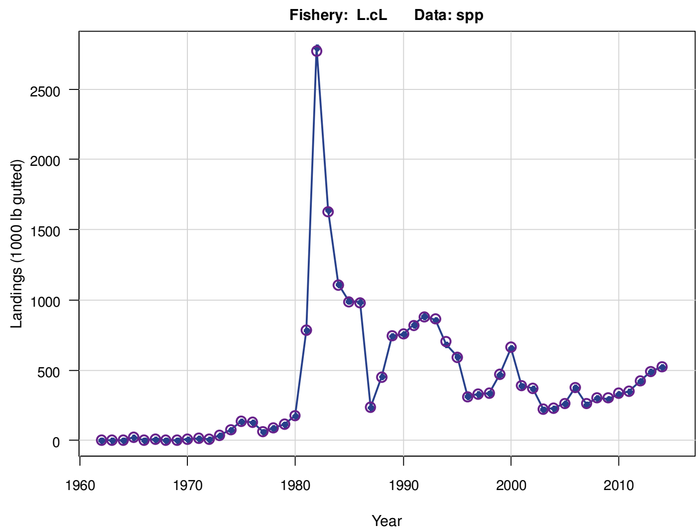
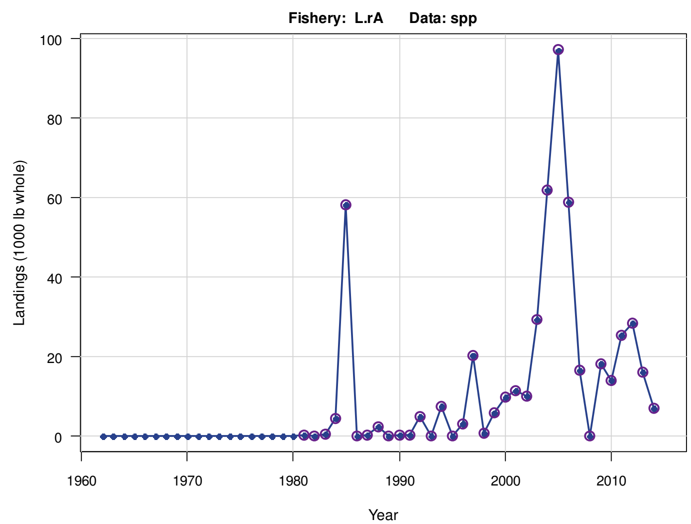


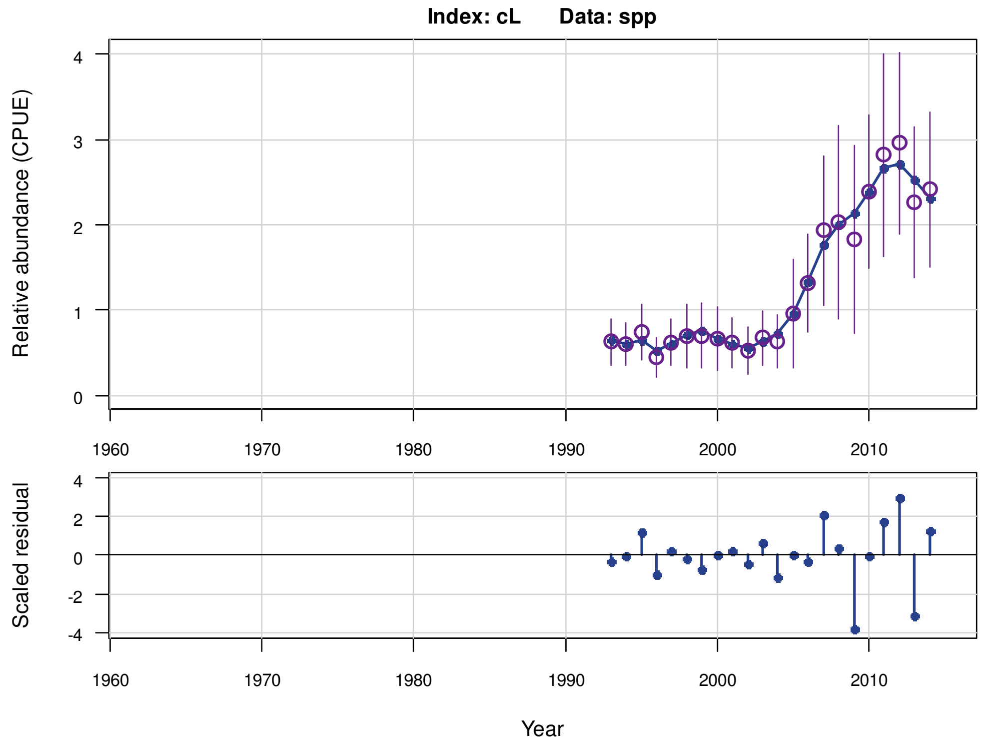
BAM base run – fits to data







BAM base run – fits to data



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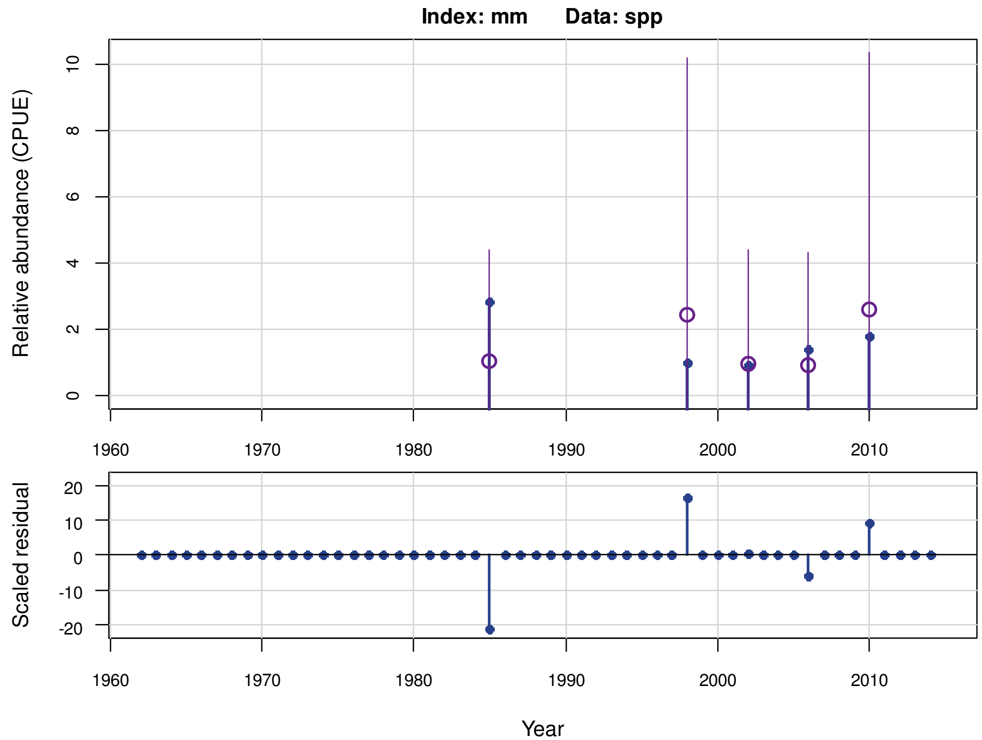
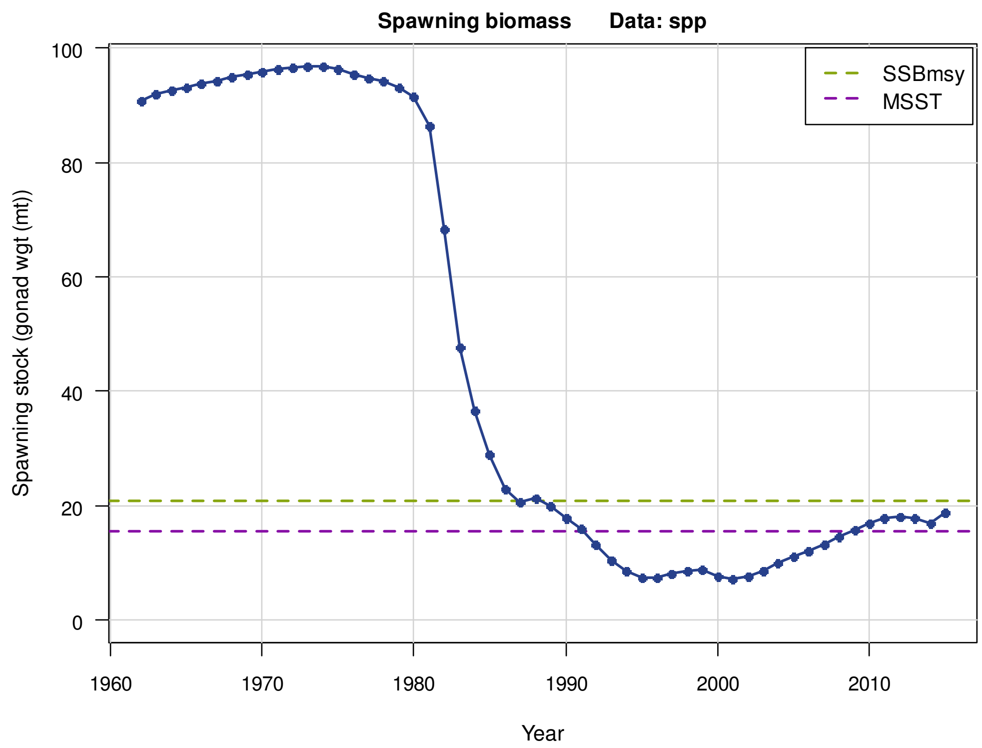
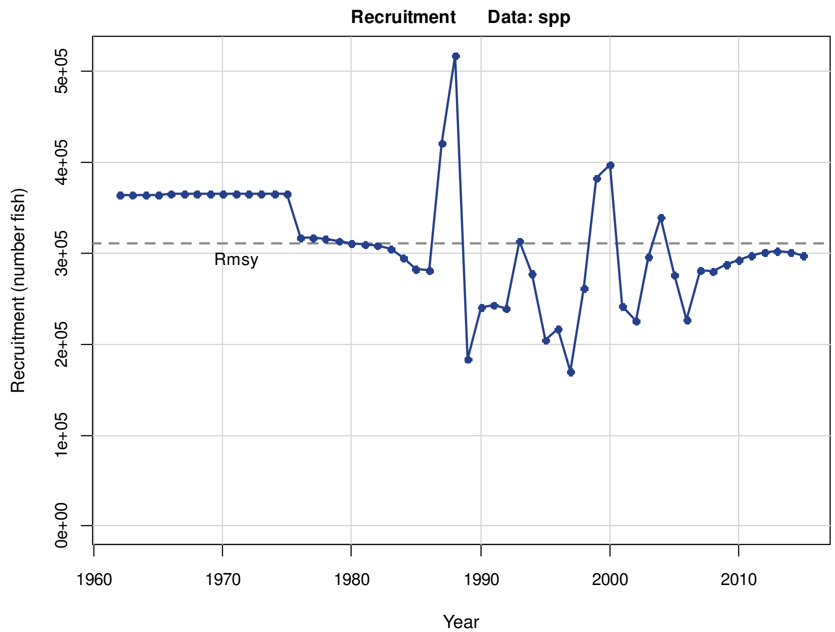
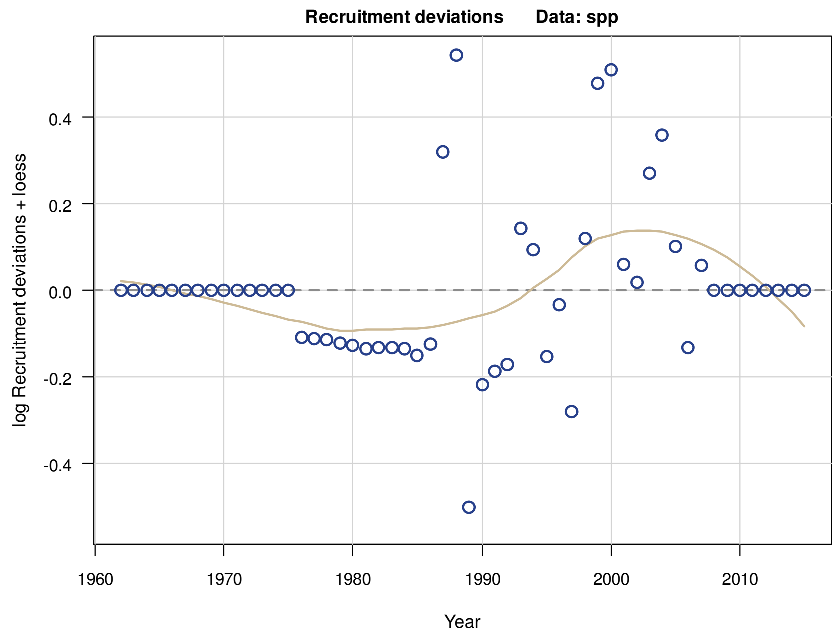


BAM base run – SSB

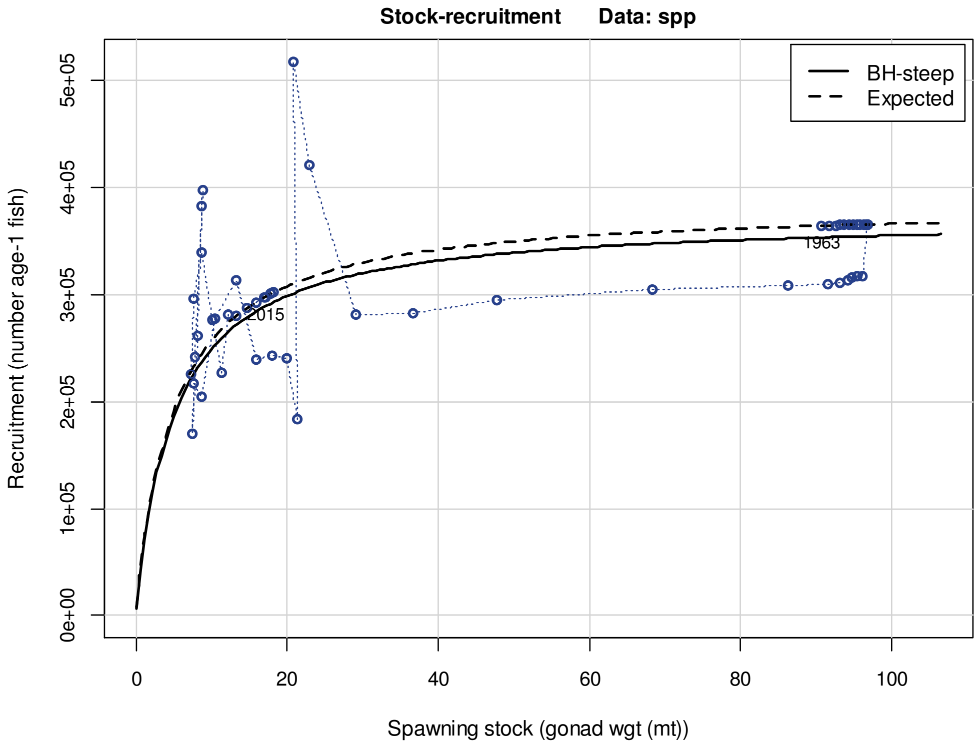


BAM base run – Recruitment

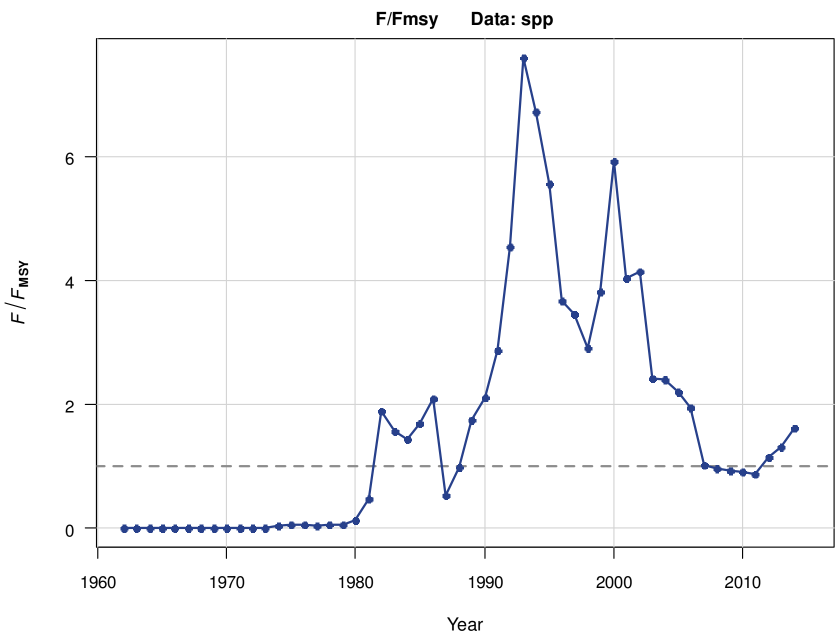


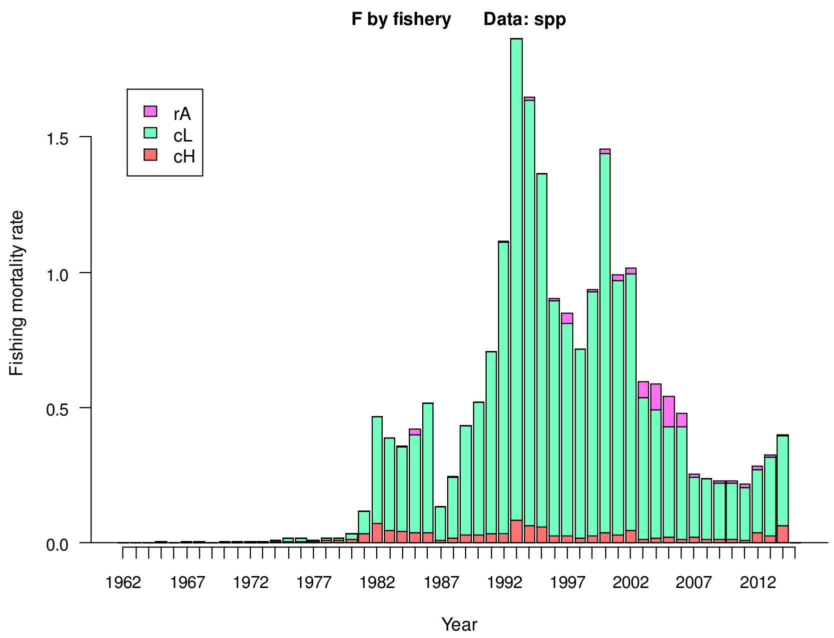


BAM base run – spawner-recruit curve



BAM base run – fishing mortality

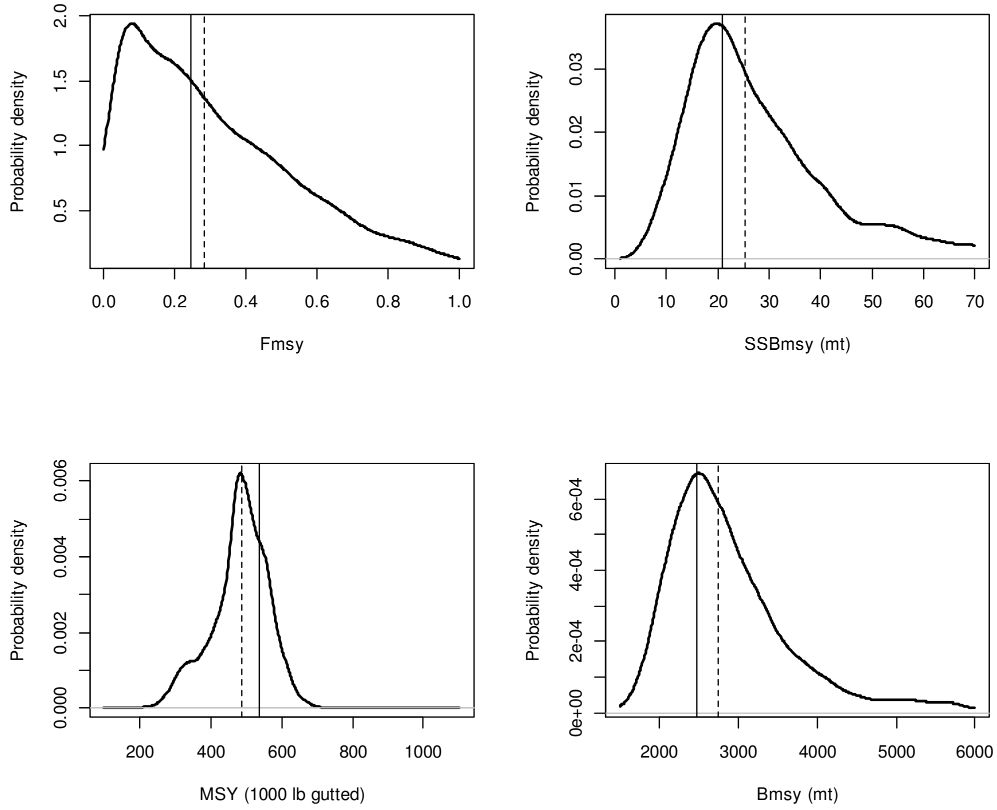




Uncertainty – Combined Monte Carlo and Bootstrap (MCB) approach

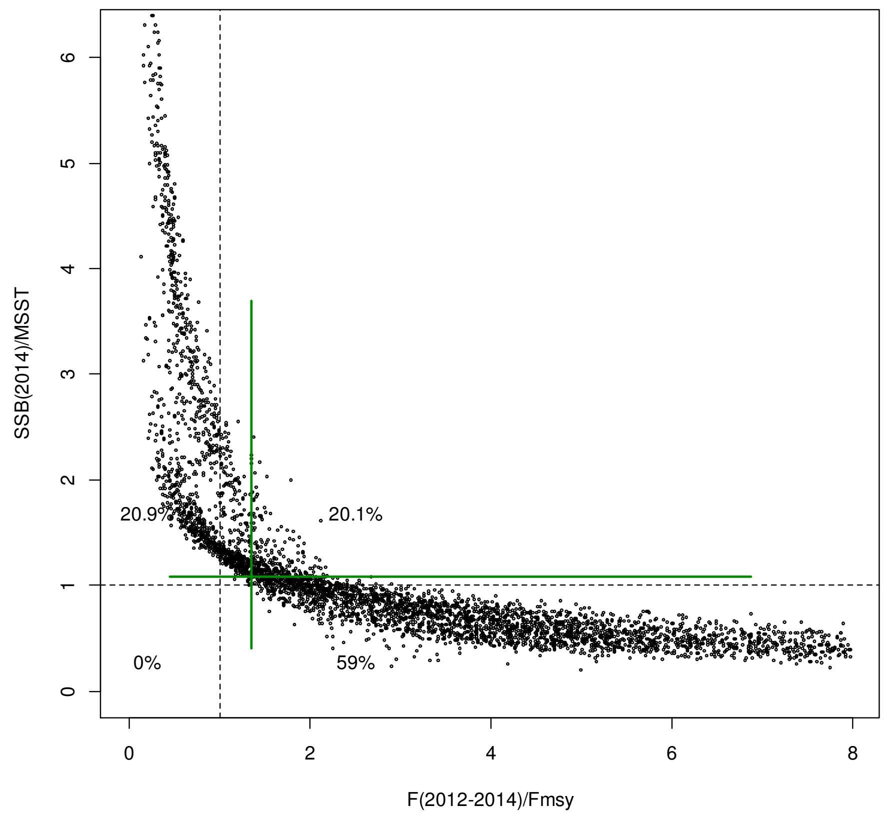
- n=5000 MCB trials attempted; n=4006 retained
- Bootstrap components:
  - Landings and indices: parametric bootstrap of original data, with CVs as applied in the fitting procedure
  - Length and age comps: resample Nfish and assign them to bins with probabilities equal to those from original data
- Monte Carlo components:
  - M: drawn from a uniform distribution, M~U(0.03,0.21). Chosen value scales age-based Lorenzen M.
  - Steepness: drawn from a beta distribution, h~B(5.94,1.97), truncated to the range [0.32, 0.99]
  - Commercial index weight: drawn from a uniform distribution, 3±25%

MCB – uncertainty in benchmarks



Solid=MLE (base)
Dash=Median

MCB – stock and fishery status



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Solid=MLE (base)
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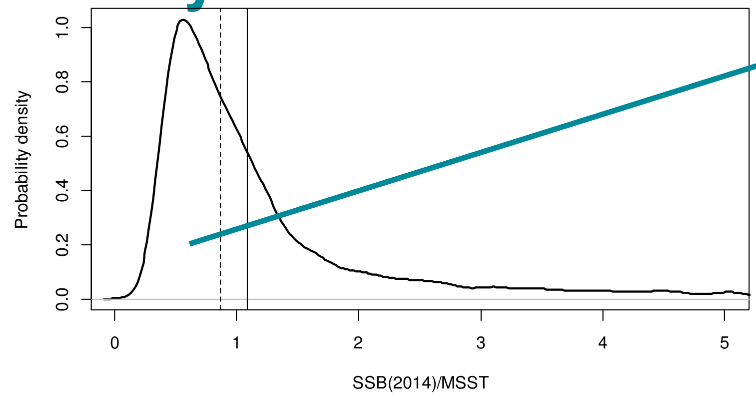
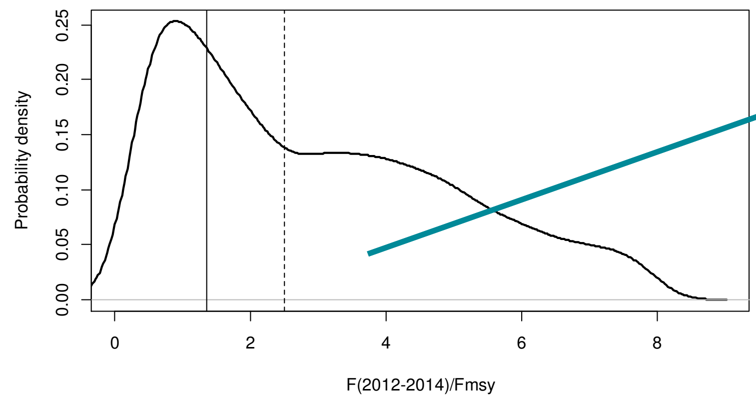


~59% of distribution below 1.0 (i.e., overfished)

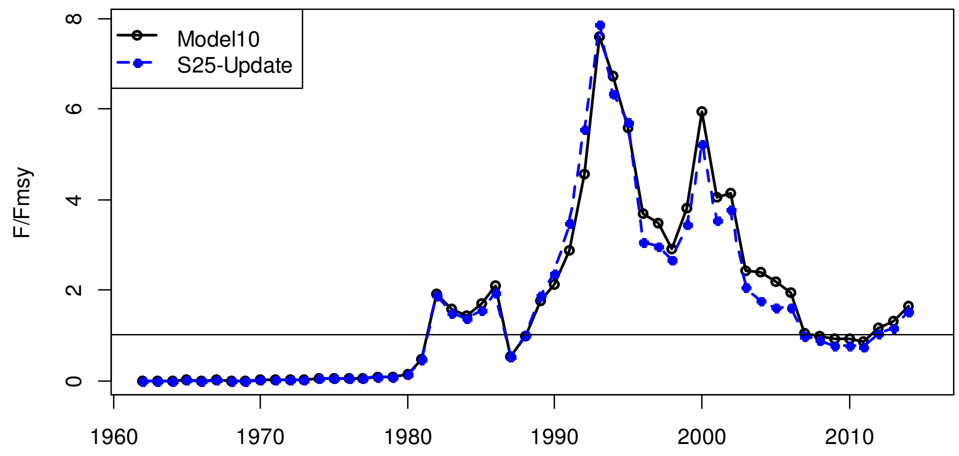


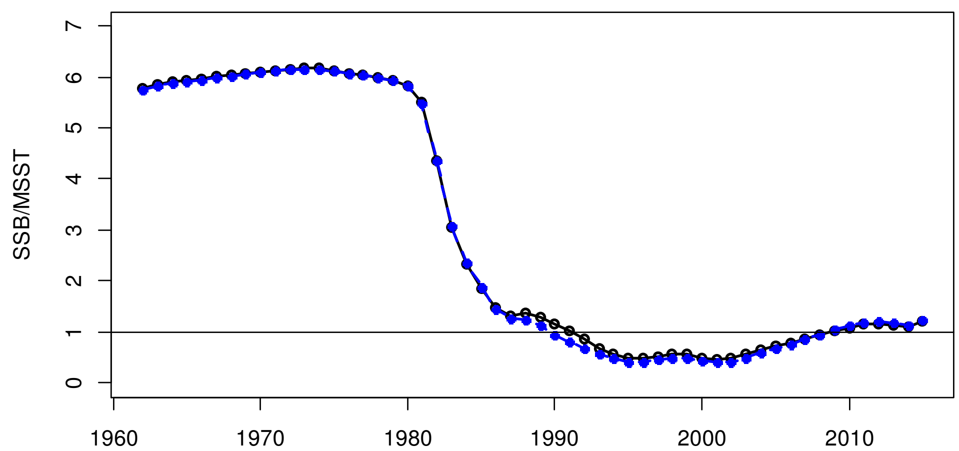
~79.1% of distribution exceeds 1.0 (i.e., overfishing)

BAM results – Management quantities

Quantity	Units	Estimate	Median	SE
F_{MSY}	y^{-1}	0.25	0.28	0.38
$85\%F_{\mathrm{MSY}}$	y^{-1}	0.21	0.24	0.33
$75\%F_{\mathrm{MSY}}$	y^{-1}	0.18	0.21	0.29
$65\%F_{\mathrm{MSY}}$	y^{-1}	0.16	0.18	0.25
$F_{30\%}$	y^{-1}	0.18	0.24	0.37
$F_{40\%}$	y^{-1}	0.11	0.14	0.12
$F_{50\%}$	y^{-1}	0.07	0.09	0.06
B_{MSY}	mt	2468.3	2736.1	1170.9
$\mathrm{SSB}_{\mathrm{MSY}}$	mt	20.9	25.2	22.5
MSST	mt	15.7	18.9	16.9
MSY	1000 lb	537.4	488.9	80.0
R_{MSY}	1000 age-1 fish	355.0	333.9	271.2
Y at $85\%F_{\mathrm{MSY}}$	1000 lb	534.8	486.9	80.5
Y at $75\%F_{\mathrm{MSY}}$	1000 lb	529.3	482.6	81.5
Y at $65\%F_{\mathrm{MSY}}$	1000 lb	519.1	474.9	83.2
$F_{2012-2014}/F_{\mathrm{MSY}}$	—	1.35	2.49	2.04
$\mathrm{SSB}_{2014}/\mathrm{MSST}$	—	1.09	0.86	1.06
$\mathrm{SSB}_{2014}/\mathrm{SSB}_{\mathrm{MSY}}$	—	0.81	0.65	0.80

Comparison to S25-Update





Projections

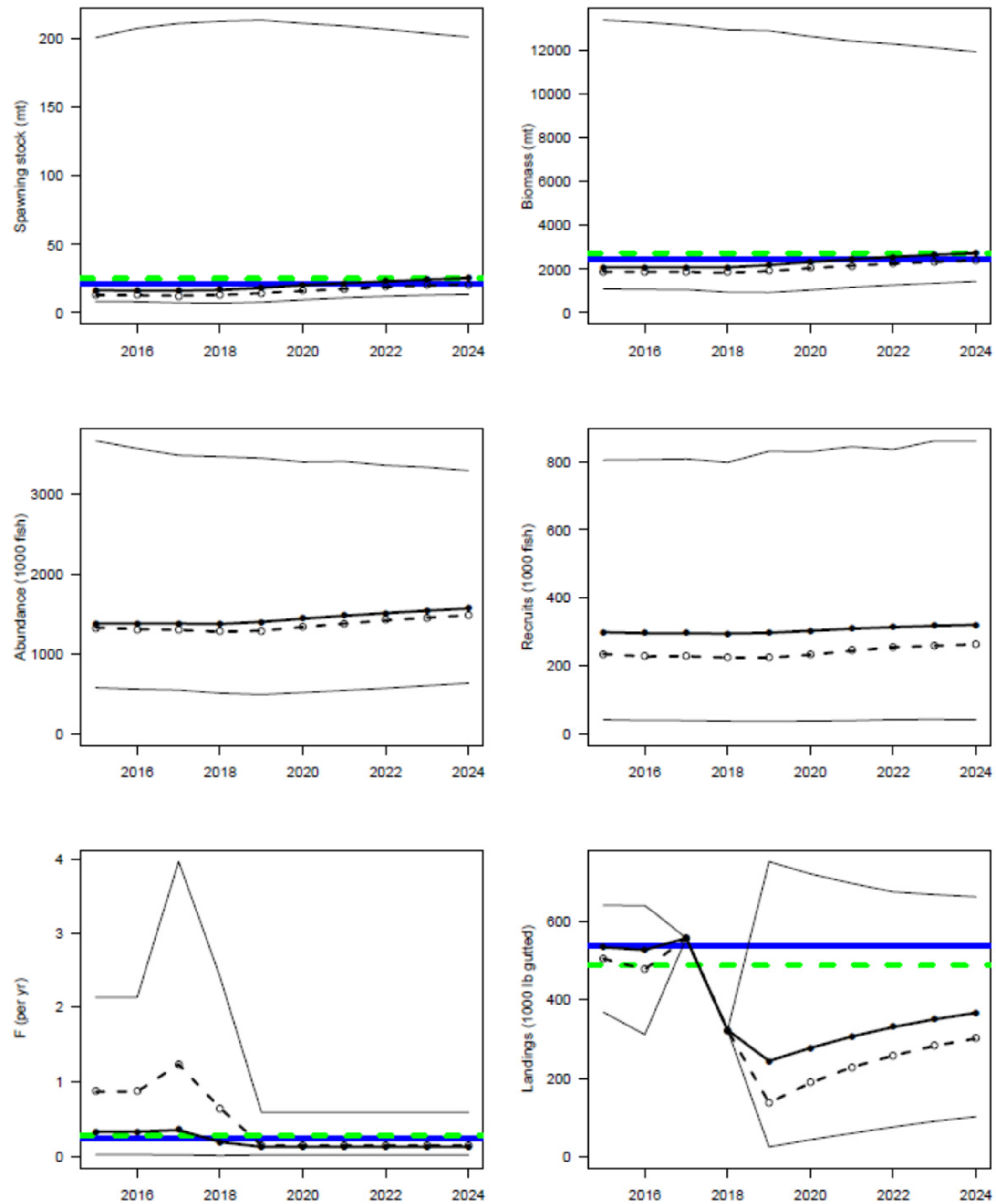
- Carry forward uncertainties from MCB runs, 2015-2024
  - Uncertainties in initial (2015) abundance at age, spawner-recruit function, natural mortality, selectivities, recruitment deviations, growth CV
- Uncertainty in Fmsy uses distribution from MCB runs
- Interim period
  - In 2015 and 2016, F=Fcurrent
  - In 2017, L=ACL (558K lb GW)
  - In 2018, L=status quo ACL or a reduced ACL of 323K lb GW, depending on the scenario

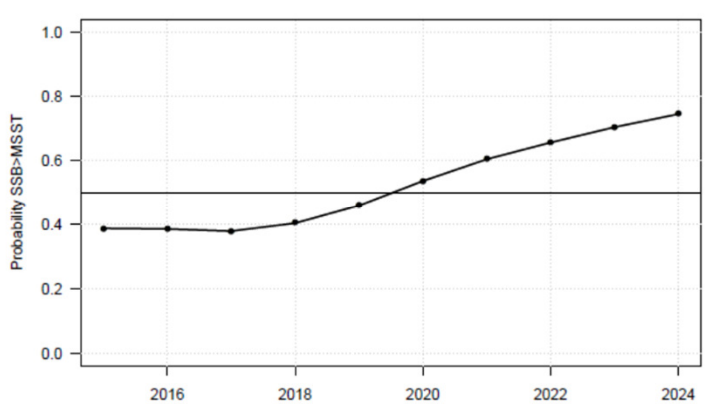
Projection scenarios

Scenario	ACL 2018	2019-2024
1	Status quo	P*=0.30
2	Reduced	P*=0.30
3	Status quo	P*=0.35
4	Reduced	P*=0.35
5	Status quo	P*=0.40
6	Reduced	P*=0.40
7	Status quo	75%Fmsy
8	Reduced	75%Fmsy

Example projection Scenario 2: P*=0.3, Reduced 2018 ACL

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





Scenario 1: P*=0.3, Status quo 2018 ACL

Year	R	N	F	S(mt)	B(mt)	L(n)	L(w)	pr.msst
2015	234	1324	0.871	13	1883	62	505	0.388
2016	227	1306	0.871	13	1872	59	478	0.386
2017	228	1296	1.236	12	1876	70	558	0.379
2018	223	1272	1.378	12	1838	73	558	0.374
2019	217	1247	0.148	13	1797	14	108	0.412
2020	223	1294	0.148	15	1958	19	162	0.489
2021	236	1336	0.148	16	2083	24	207	0.562
2022	248	1384	0.148	18	2187	27	239	0.621
2023	253	1419	0.148	19	2274	29	266	0.670
2024	258	1452	0.148	20	2349	31	288	0.714

Scenario 2: P*=0.3, Reduced 2018 ACL

Year	R	N	F	S(mt)	B(mt)	L(n)	L(w)	pr.msst
2015	234	1324	0.871	13	1883	62	505	0.388
2016	227	1306	0.871	13	1872	59	478	0.386
2017	228	1296	1.236	12	1876	70	558	0.379
2018	223	1272	0.649	13	1838	41	323	0.404
2019	223	1286	0.148	14	1915	17	137	0.459
2020	232	1332	0.148	16	2056	22	188	0.536
2021	243	1374	0.148	17	2166	26	228	0.604
2022	253	1416	0.148	19	2258	29	258	0.657
2023	258	1448	0.148	20	2340	31	283	0.705
2024	262	1479	0.148	21	2407	33	302	0.746

Scenario 3: P*=0.4, Status quo 2018 ACL

Year	R	N	F	S(mt)	B(mt)	L(n)	L(w)	pr.msst
2015	234	1324	0.871	13	1883	62	505	0.388
2016	227	1306	0.871	13	1872	59	478	0.386
2017	228	1296	1.236	12	1876	70	558	0.379
2018	223	1272	1.378	12	1838	73	558	0.374
2019	217	1247	0.215	13	1797	20	153	0.405
2020	222	1287	0.215	14	1928	26	219	0.468
2021	234	1319	0.215	16	2022	32	271	0.530
2022	245	1358	0.215	17	2097	35	305	0.581
2023	249	1384	0.215	17	2158	37	332	0.620
2024	253	1408	0.215	18	2208	39	353	0.655

Scenario 4: P*=0.4, Reduced 2018 ACL

Year	R	N	F	S(mt)	B(mt)	L(n)	L(w)	pr.msst
2015	234	1324	0.871	13	1883	62	505	0.388
2016	227	1306	0.871	13	1872	59	478	0.386
2017	228	1296	1.236	12	1876	70	558	0.379
2018	223	1272	0.649	13	1838	41	323	0.404
2019	223	1286	0.215	14	1915	24	194	0.451
2020	231	1322	0.215	15	2020	30	252	0.514
2021	241	1355	0.215	16	2098	34	296	0.572
2022	250	1387	0.215	17	2160	37	328	0.615
2023	253	1410	0.215	18	2212	39	350	0.652
2024	257	1431	0.215	19	2258	40	367	0.687

Scenario 5: P*=0.45, Status quo 2018 ACL

Year	R	N	F	S(mt)	B(mt)	L(n)	L(w)	pr.msst
2015	234	1324	0.871	13	1883	62	505	0.388
2016	227	1306	0.871	13	1872	59	478	0.386
2017	228	1296	1.236	12	1876	70	558	0.379
2018	223	1272	1.378	12	1838	73	558	0.374
2019	217	1247	0.257	13	1797	23	179	0.401
2020	222	1282	0.257	14	1910	30	250	0.455
2021	233	1310	0.257	15	1990	36	303	0.506
2022	243	1344	0.257	16	2049	39	337	0.551
2023	247	1364	0.257	17	2098	41	362	0.586
2024	250	1383	0.257	17	2138	43	380	0.616

Scenario 6: P*=0.45, Reduced 2018 ACL

Year	R	N	F	S(mt)	B(mt)	L(n)	L(w)	pr.msst
2015	234	1324	0.871	13	1883	62	505	0.388
2016	227	1306	0.871	13	1872	59	478	0.386
2017	228	1296	1.236	12	1876	70	558	0.379
2018	223	1272	0.649	13	1838	41	323	0.404
2019	223	1286	0.257	14	1915	28	228	0.448
2020	231	1318	0.257	15	1999	34	286	0.500
2021	240	1344	0.257	16	2061	38	331	0.549
2022	248	1372	0.257	17	2107	41	360	0.587
2023	251	1390	0.257	17	2148	43	380	0.617
2024	254	1406	0.257	18	2182	44	393	0.645

Scenario 7: F=75%Fmsy, Status quo 2018 ACL

Year	R	N	F	S(mt)	B(mt)	L(n)	L(w)	pr.msst
2015	234	1324	0.871	13	1883	62	505	0.388
2016	227	1306	0.871	13	1872	59	478	0.386
2017	228	1296	1.236	12	1876	70	558	0.379
2018	223	1272	1.378	12	1838	73	558	0.374
2019	217	1247	0.210	13	1797	19	150	0.406
2020	223	1288	0.210	14	1931	26	215	0.469
2021	234	1320	0.210	16	2026	31	266	0.532
2022	245	1360	0.210	17	2103	34	301	0.584
2023	249	1386	0.210	18	2166	37	327	0.625
2024	254	1411	0.210	18	2217	39	349	0.660

Scenario 8: F=75%Fmsy, Reduced 2018 ACL

Year	R	N	F	S(mt)	B(mt)	L(n)	L(w)	pr.msst
2015	234	1324	0.871	13	1883	62	505	0.388
2016	227	1306	0.871	13	1872	59	478	0.386
2017	228	1296	1.236	12	1876	70	558	0.379
2018	223	1272	0.649	13	1838	41	323	0.404
2019	223	1286	0.210	14	1915	23	190	0.452
2020	231	1323	0.210	15	2022	29	248	0.515
2021	241	1356	0.210	17	2102	33	292	0.575
2022	250	1389	0.210	17	2167	36	323	0.619
2023	254	1412	0.210	18	2221	38	346	0.657
2024	257	1434	0.210	19	2267	40	363	0.692

Assessment summary and conclusions

- This assessment indicates that tilefish are experiencing overfishing. The status of overfished is uncertain (base run indicates *no*, 59% of MCBs and median indicate *yes*)
- This assessment was not as straightforward as the Council's request implied
  - A simple substitution of the Dirichlet-multinomial for the robust multinomial resulted in a model that did not converge, lost fidelity to the commercial index, and DM parameters were not identifiable
  - Only two of the ten models explored converged
- Although several studies have described advantages of the DM distribution, more research is needed to better understand its limitations
- Model 10 was presented as the base model, but we urge careful consideration before adopting results of this assessment for management

Questions?