SEDAR 41 Red Snapper: Projection Supplement 1
Prepared by NMFS Southeast Fisheries Science Center
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The SAFMC requested additional projections of the Red Snapper stock, based on the SEDAR 41 assessment model, for consideration by the SSC at its May meeting (Memorandum dated March 23rd, 2016, attached as Appendix).

Using the most recent estimates of actual landings and discard estimates for all fleets in 2015, rather than an average of prior years, this document describes the following four scenarios:

Scenario 1 – Yield based on fishing the stock at the Fmsy proxy (30% SPR) with management taking effect in 2016.
Scenario 2 – Yield based on fishing the stock at the Fmsy proxy (30% SPR) with management taking effect in 2017.
Scenario 3 – Yield based on fishing the stock at $F_{rebuild}$ with management taking effect in 2016.
Scenario 4 – Yield based on fishing the stock at $F_{rebuild}$ with management taking effect in 2017.

The most complete data available for 2015 landings and discards are shown in Table 1. These data were provided by the SEFSC for each fleet (commercial, headboat, and general recreational from MRIP). The commercial data are electronically reported and have not yet gone through the quality control process in each state.

In the Assessment Workshop projections, average selectivities were used to characterize the fish taken for landings and discards from all fleets throughout the projection time period. Here, fleet-specific selectivities were used for landings and discards to calculate fishing mortality by fleet during the interim period (i.e. the period before new management takes effect, either 2015 or 2015-2016). In Scenarios 2 and 4, where management takes effect in 2017, the 2015 values of landings and discards were assumed for 2016.

Projection results are shown in Figures 1–4, and tabulated in Tables 2–5.

Table 1. Estimates of landings and discards for Red Snapper in the South Atlantic by fleet in 2015.

	Commercial		Headboat		MRIP	
	Landings	Discards	Landings	Discards	Landings	Discards
2015	3,162 lb	30,397 fish	750 fish	54,405 fish	1,250 fish	499,161 fish

Table 2. Projection results with fishing mortality rate fixed at $F = F_{30\%}$ starting in 2016. R = number of age-1 recruits (in 1000s), F = fishing mortality rate (per year), B = biomass (mt), S = spawning stock (1E8 eggs), L = landings expressed in numbers (1000s) or whole weight (1000 lb), and D = dead discards expressed in numbers (1000s) or whole weight (1000 lb), pr.rebuild = proportion of stochastic projection replicates with SSB greater than or equal to $SSB_{F30\%}$. The extension .base indicates expected values (deterministic) from the base run; the extension .med indicates median values from the stochastic projections.

	R.base (1000)	R.med (1000)	F.base (/yr)	F.med (/yr)	B.base (mt)	B.med (mt)	S.base (1E8)	S.med (1E8)	L.base (1000)	L.med (1000)	L.base (1000 lb)	L.med (1000 lb)	D.base (1000)	D.med (1000)	D.base (1000 lb)	D.med (1000 lb)	pr.rebuild
2015	434	313	0.27	0.29	1849	1743	65721	59735	2	2	19	14	169	167	644	653	0.001
2016	437	313	0.15	0.15	2006	1839	91180	81316	17	16	151	144	42	38	206	187	0.003
2017	441	317	0.15	0.15	2322	2101	122217	107078	23	21	218	205	44	40	245	222	0.009
2018	443	317	0.15	0.15	2572	2317	152809	131890	25	23	262	241	45	41	269	242	0.021
2019	445	319	0.15	0.15	2773	2486	181102	154599	26	24	293	267	46	41	284	254	0.043
2020	445	318	0.15	0.15	2938	2628	205997	174400	27	25	318	287	46	41	293	262	0.069
2021	446	326	0.15	0.15	3073	2753	227666	191998	28	26	339	305	47	42	300	268	0.101
2022	446	321	0.15	0.15	3185	2859	246339	207299	29	26	356	321	47	42	305	274	0.135
2023	447	322	0.15	0.15	3276	2948	261827	220578	30	27	371	333	47	42	310	279	0.173
2024	447	320	0.15	0.15	3350	3017	274772	231439	30	27	382	345	47	43	315	284	0.208
2025	447	325	0.15	0.15	3410	3078	285256	241010	31	28	392	355	47	43	318	287	0.242
2026	447	323	0.15	0.15	3458	3130	293768	249092	31	28	400	362	48	43	321	290	0.271
2027	447	328	0.15	0.15	3496	3174	300779	255297	31	28	406	368	48	43	324	293	0.299
2028	447	322	0.15	0.15	3527	3201	306346	260192	31	29	411	373	48	43	326	295	0.324
2029	447	326	0.15	0.15	3551	3220	310811	265193	32	29	415	378	48	43	327	296	0.344
2030	447	323	0.15	0.15	3571	3245	314464	268843	32	29	418	381	48	43	328	298	0.363
2031	448	324	0.15	0.15	3586	3258	317377	271910	32	29	420	383	48	43	329	299	0.376
2032	448	322	0.15	0.15	3599	3278	319674	274276	32	29	422	385	48	43	330	299	0.39
2033	448	321	0.15	0.15	3609	3292	321502	275479	32	29	424	387	48	43	331	300	0.403
2034	448	322	0.15	0.15	3617	3296	322940	276691	32	29	425	388	48	43	331	300	0.409
2035	448	322	0.15	0.15	3623	3302	324089	276963	32	29	426	390	48	43	331	300	0.416
2036	448	324	0.15	0.15	3628	3317	325003	278123	32	29	427	391	48	43	332	300	0.422
2037	448	323	0.15	0.15	3632	3322	325731	279063	32	29	428	391	48	43	332	301	0.424
2038	448	322	0.15	0.15	3635	3321	326310	280450	32	29	428	392	48	43	332	302	0.427
2039	448	320	0.15	0.15	3637	3319	326770	281334	32	29	428	393	48	43	332	301	0.432
2040	448	324	0.15	0.15	3639	3326	327136	280981	32	29	429	393	48	43	332	302	0.432
2041	448	323	0.15	0.15	3641	3320	327427	281357	32	29	429	394	48	43	333	302	0.433
2042	448	324	0.15	0.15	3642	3329	327658	282160	32	29	429	394	48	44	333	302	0.436
2043	448	325	0.15	0.15	3643	3326	327842	282593	32	29	429	394	48	44	333	303	0.435
2044	448	324	0.15	0.15	3644	3332	327988	282187	32	30	430	394	48	44	333	303	0.44

Table 3. Projection results with fishing mortality rate fixed at F = $F_{30\%}$ starting in 2017. R = number of age-1 recruits (in 1000s), F = fishing mortality rate (per year), B = biomass (mt), S = spawning stock (1E8 eggs), L = landings expressed in numbers (1000s) or whole weight (1000 lb), and D = dead discards expressed in numbers (1000s) or whole weight (1000 lb), pr.rebuild = proportion of stochastic projection replicates with SSB greater than or equal to $SSB_{F30\%}$. The extension .base indicates expected values (deterministic) from the base run; the extension .med indicates median values from the stochastic projections.

	R.base (1000)	R.med (1000)	F.base (/yr)	F.med (/yr)	B.base (mt)	B.med (mt)	S.base (1E8)	S.med (1E8)	L.base (1000)	L.med (1000)	L.base (1000 lb)	L.med (1000 lb)	D.base (1000)	D.med (1000)	D.base (1000 lb)	D.med (1000 lb)	pr.rebuild
2015	434	313	0.27	0.29	1849	1743	65721	59735	2	2	19	14	169	167	644	653	0.001
2016	437	313	0.28	0.31	2006	1839	85574	74996	2	2	20	16	169	167	773	774	0.004
2017	440	315	0.15	0.15	2054	1820	109031	93099	20	18	191	174	40	35	214	189	0.01
2018	442	316	0.15	0.15	2310	2045	135314	113962	22	19	229	204	42	37	238	210	0.022
2019	444	317	0.15	0.15	2535	2247	160874	134085	23	21	258	230	43	39	257	227	0.039
2020	445	317	0.15	0.15	2731	2419	184830	153216	25	23	286	255	45	40	272	242	0.061
2021	446	325	0.15	0.15	2898	2577	206947	171313	27	24	312	278	46	41	284	253	0.085
2022	446	320	0.15	0.15	3038	2713	226973	187891	28	25	333	298	46	41	294	263	0.112
2023	446	321	0.15	0.15	3154	2825	244365	202964	29	26	352	314	47	42	302	271	0.144
2024	447	319	0.15	0.15	3250	2915	259410	216353	29	27	367	329	47	42	308	277	0.176
2025	447	325	0.15	0.15	3327	2993	272058	227315	30	27	379	341	47	43	313	282	0.207
2026	447	323	0.15	0.15	3390	3059	282619	237912	30	28	389	351	47	43	317	286	0.237
2027	447	328	0.15	0.15	3442	3114	291475	246168	31	28	397	358	48	43	320	290	0.265
2028	447	322	0.15	0.15	3483	3151	298672	252318	31	28	404	365	48	43	323	292	0.293
2029	447	326	0.15	0.15	3516	3183	304531	258501	31	29	409	372	48	43	325	294	0.317
2030	447	323	0.15	0.15	3542	3213	309355	263593	31	29	413	376	48	43	327	296	0.337
2031	447	324	0.15	0.15	3564	3235	313241	267665	32	29	417	379	48	43	328	298	0.355
2032	448	322	0.15	0.15	3581	3258	316339	270831	32	29	419	382	48	43	329	298	0.372
2033	448	321	0.15	0.15	3594	3274	318826	272743	32	29	422	385	48	43	330	299	0.388
2034	448	322	0.15	0.15	3605	3285	320805	274327	32	29	423	386	48	43	330	299	0.397
2035	448	322	0.15	0.15	3614	3290	322388	275183	32	29	425	388	48	43	331	299	0.406
2036	448	324	0.15	0.15	3621	3308	323652	276663	32	29	426	389	48	43	331	300	0.413
2037	448	323	0.15	0.15	3626	3315	324657	278023	32	29	427	390	48	43	332	301	0.417
2038	448	322	0.15	0.15	3630	3314	325456	279463	32	29	427	391	48	43	332	301	0.422
2039	448	320	0.15	0.15	3634	3314	326091	280433	32	29	428	392	48	43	332	301	0.428
2040	448	324	0.15	0.15	3636	3322	326597	280382	32	29	428	393	48	43	332	301	0.428
2041	448	323	0.15	0.15	3639	3316	326998	280827	32	29	429	393	48	43	332	301	0.431
2042	448	324	0.15	0.15	3640	3327	327317	281760	32	29	429	393	48	44	333	302	0.433
2043	448	325	0.15	0.15	3642	3324	327571	282287	32	29	429	394	48	44	333	302	0.433
2044	448	323	0.15	0.15	3643	3330	327773	281964	32	29	429	393	48	44	333	303	0.438

Table 4. Projection results with fishing mortality rate fixed at F = F$_{rebuild}$ starting in 2016. R = number of age-1 recruits (in 1000s), F = fishing mortality rate (per year), B = biomass (mt), S = spawning stock (1E8 eggs), L = landings expressed in numbers (1000s) or whole weight (1000 lb), and D = dead discards expressed in numbers (1000s) or whole weight (1000 lb), pr.rebuild = proportion of stochastic projection replicates with SSB greater than or equal to SSB$_{F30\%}$. The extension .base indicates expected values (deterministic) from the base run; the extension .med indicates median values from the stochastic projections.

	R.base (1000)	R.med (1000)	F.base (/yr)	F.med (/yr)	B.base (mt)	B.med (mt)	S.base (1E8)	S.med (1E8)	L.base (1000)	L.med (1000)	L.base (1000 lb)	L.med (1000 lb)	D.base (1000)	D.med (1000)	D.base (1000 lb)	D.med (1000 lb)	pr.rebuild
2015	434	313	0.27	0.29	1849	1743	65721	59735	2	2	19	14	169	167	644	653	0.001
2016	437	313	0.14	0.14	2006	1839	91334	81661	17	16	148	138	41	36	202	180	0.003
2017	441	317	0.14	0.14	2326	2110	122728	108294	22	20	214	196	43	38	241	213	0.011
2018	443	317	0.14	0.14	2581	2337	153818	133989	25	22	258	233	44	39	265	233	0.028
2019	445	319	0.14	0.14	2786	2516	182698	157710	26	23	289	258	45	39	279	246	0.057
2020	445	318	0.14	0.14	2956	2666	208209	179018	27	24	314	279	45	40	289	255	0.091
2021	446	326	0.14	0.14	3096	2799	230488	197522	28	25	335	298	46	41	295	261	0.133
2022	446	321	0.14	0.14	3211	2907	249743	213579	29	26	353	314	46	41	301	267	0.177
2023	447	322	0.14	0.14	3305	2999	265764	227338	29	26	367	327	46	41	306	272	0.224
2024	447	320	0.14	0.14	3382	3073	279191	239273	30	27	379	340	46	41	311	277	0.264
2025	447	325	0.14	0.14	3444	3131	290099	249092	30	27	389	350	47	41	314	281	0.304
2026	447	323	0.14	0.14	3494	3184	298980	257503	31	28	397	357	47	42	318	284	0.335
2027	447	328	0.14	0.14	3534	3228	306312	264572	31	28	403	363	47	42	320	287	0.365
2028	447	322	0.14	0.14	3566	3256	312149	270097	31	28	408	368	47	42	322	289	0.391
2029	448	326	0.14	0.14	3592	3282	316842	274273	31	28	412	373	47	42	323	290	0.411
2030	448	323	0.14	0.14	3612	3309	320691	278295	31	28	415	377	47	42	325	291	0.429
2031	448	324	0.14	0.14	3629	3327	323766	281322	31	29	418	379	47	42	326	292	0.444
2032	448	322	0.14	0.14	3642	3337	326197	283721	32	29	420	381	47	42	326	293	0.456
2033	448	321	0.14	0.14	3652	3352	328137	285494	32	29	422	384	47	42	327	293	0.468
2034	448	322	0.14	0.14	3661	3363	329666	286714	32	29	423	384	47	42	327	293	0.477
2035	448	322	0.14	0.14	3667	3365	330890	287446	32	29	424	385	47	42	328	294	0.484
2036	448	324	0.14	0.14	3672	3377	331867	288713	32	29	425	387	47	42	328	294	0.485
2037	448	323	0.14	0.14	3677	3384	332646	290120	32	29	426	387	47	42	328	296	0.489
2038	448	322	0.14	0.14	3680	3384	333266	290841	32	29	426	388	47	42	329	295	0.493
2039	448	320	0.14	0.14	3683	3383	333761	291413	32	29	426	388	47	42	329	295	0.494
2040	448	324	0.14	0.14	3685	3384	334155	291140	32	29	427	389	47	42	329	296	0.497
2041	448	323	0.14	0.14	3687	3383	334469	291547	32	29	427	390	47	42	329	295	0.498
2042	448	324	0.14	0.14	3688	3387	334719	292000	32	29	427	389	47	42	329	296	0.499
2043	448	325	0.14	0.14	3689	3386	334918	292442	32	29	427	390	47	42	329	297	0.5
2044	448	324	0.14	0.14	3690	3395	335077	292924	32	29	428	390	47	42	329	296	0.501

Table 5. Projection results with fishing mortality rate fixed at $F = F_{rebuild}$ starting in 2017. R = number of age-1 recruits (in 1000s), F = fishing mortality rate (per year), B = biomass (mt), S = spawning stock (1E8 eggs), L = landings expressed in numbers (1000s) or whole weight (1000 lb), and D = dead discards expressed in numbers (1000s) or whole weight (1000 lb), pr.rebuild = proportion of stochastic projection replicates with SSB greater than or equal to $SSB_{F30\%}$. The extension .base indicates expected values (deterministic) from the base run; the extension .med indicates median values from the stochastic projections.

|	R.base (1000)	R.med (1000)	F.base (/yr)	F.med (/yr)	B.base (mt)	B.med (mt)	S.base (1E8)	S.med (1E8)	L.base (1000)	L.med (1000)	L.base (1000 lb)	L.med (1000 lb)	D.base (1000)	D.med (1000)	D.base (1000 lb)	D.med (1000 lb)	pr.rebuild
2015	434	313	0.27	0.29	1849	1743	65721	59735	2	2	19	14	169	167	644	653	0.001
2016	437	313	0.28	0.31	2006	1839	85574	74996	2	2	20	16	169	167	773	774	0.004
2017	440	315	0.14	0.14	2054	1820	109291	93521	19	17	186	165	39	33	208	179	0.011
2018	442	316	0.14	0.14	2316	2057	136104	115389	21	18	223	195	41	35	233	200	0.026
2019	444	318	0.14	0.14	2547	2271	162324	136537	23	20	252	220	42	37	251	218	0.049
2020	445	317	0.14	0.14	2749	2453	187010	157061	25	22	281	245	44	38	267	232	0.077
2021	446	325	0.14	0.14	2921	2621	209889	176680	26	23	307	269	44	39	279	244	0.11
2022	446	320	0.14	0.14	3066	2764	230676	194241	27	24	329	290	45	40	288	254	0.146
2023	446	321	0.14	0.14	3187	2878	248796	209998	28	25	347	307	46	40	296	263	0.187
2024	447	319	0.14	0.14	3287	2974	264523	224460	29	26	362	323	46	41	303	270	0.227
2025	447	325	0.14	0.14	3368	3052	277791	236603	30	27	375	336	46	41	308	275	0.265
2026	447	323	0.14	0.14	3435	3120	288905	246977	30	27	385	345	46	41	312	278	0.3
2027	447	328	0.14	0.14	3488	3181	298252	255957	30	27	393	353	46	42	315	282	0.333
2028	447	322	0.14	0.14	3532	3218	305872	263805	31	28	400	360	47	41	318	285	0.363
2029	447	326	0.14	0.14	3567	3256	312095	269159	31	28	405	366	47	42	320	287	0.389
2030	448	323	0.14	0.14	3595	3290	317232	274514	31	28	410	371	47	42	322	288	0.413
2031	448	324	0.14	0.14	3618	3313	321383	278183	31	28	413	374	47	42	323	290	0.431
2032	448	322	0.14	0.14	3636	3329	324703	281876	31	28	416	377	47	42	324	291	0.448
2033	448	321	0.14	0.14	3651	3348	327375	284270	31	29	419	380	47	42	325	291	0.462
2034	448	322	0.14	0.14	3662	3361	329507	286248	31	29	420	381	47	42	326	292	0.474
2035	448	322	0.14	0.14	3671	3365	331218	287254	32	29	422	383	47	42	326	292	0.483
2036	448	324	0.14	0.14	3679	3383	332588	289024	32	29	423	385	47	42	327	293	0.488
2037	448	323	0.14	0.14	3685	3390	333680	290804	32	29	424	385	47	42	327	294	0.494
2038	448	322	0.14	0.14	3689	3392	334551	291720	32	29	425	386	47	42	327	294	0.498
2039	448	320	0.14	0.14	3693	3390	335246	292364	32	29	425	387	47	42	327	294	0.5
2040	448	324	0.14	0.14	3696	3394	335799	292355	32	29	426	388	47	42	328	294	0.505
2041	448	323	0.14	0.14	3698	3394	336241	292984	32	29	426	389	47	42	328	294	0.506
2042	448	324	0.14	0.14	3700	3397	336593	293493	32	29	426	388	47	42	328	295	0.508
2043	448	325	0.14	0.14	3702	3398	336873	294126	32	29	427	389	47	42	328	295	0.509
2044	448	323	0.14	0.14	3703	3407	337096	294594	32	29	427	389	47	42	328	295	0.51

Figure 1. Projection results under Scenario 1—fishing mortality rate at F = F$_{30\%}$ starting in 2016. In top four panels, expected values (base run) represented by solid lines with solid circles, medians represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to 5th and 95th percentiles of replicate projections. Solid horizontal lines mark F$_{30\%}$-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning. In bottom panel, the curve represents the proportion of projection replicates for which SSB has reached the replicate-specific SSB$_{F30\%}$.
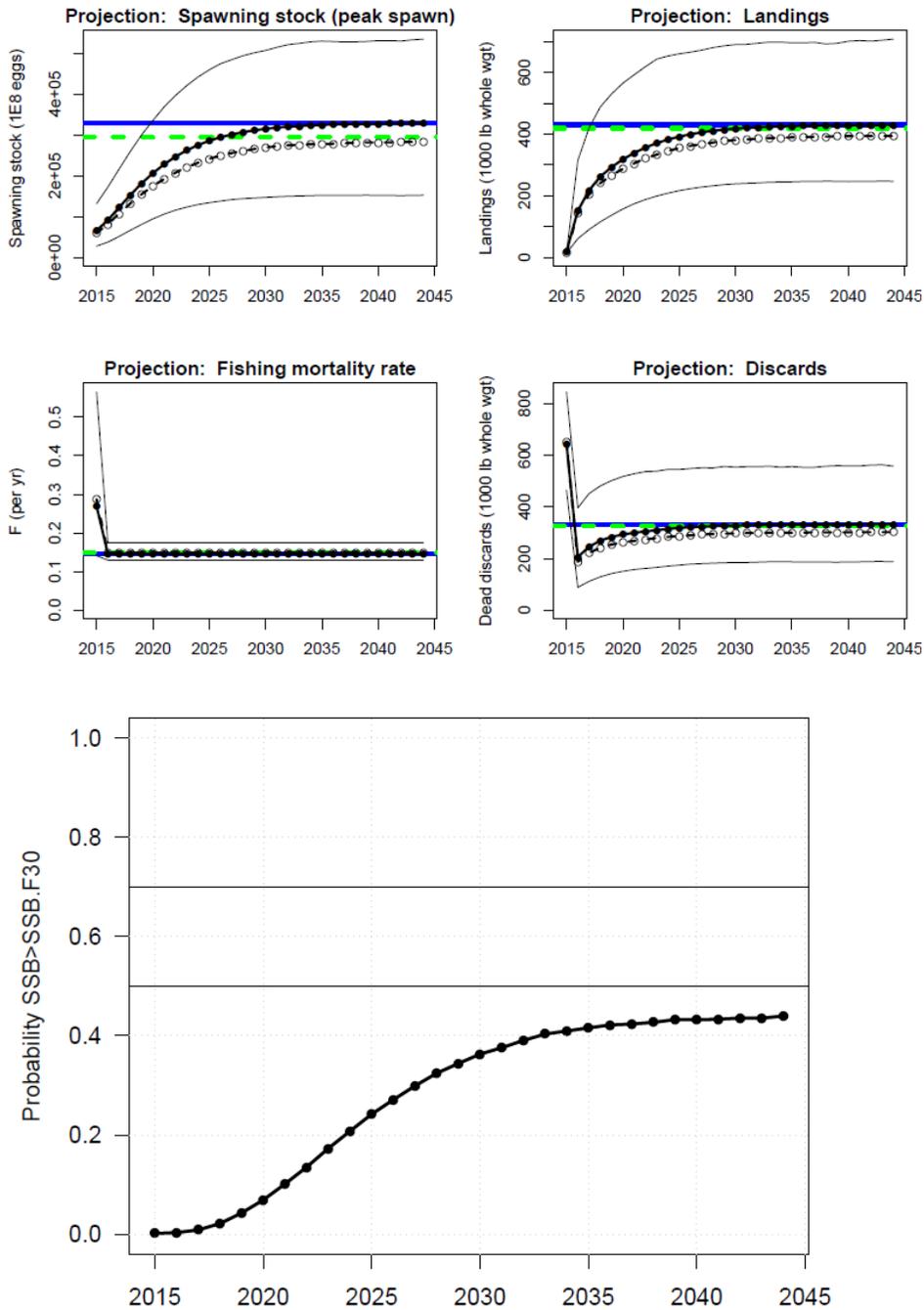
Figure 2. Projection results under scenario 2—fishing mortality rate at $F = F_{30\%}$ starting in 2017. In top four panels, expected values (base run) represented by solid lines with solid circles, medians represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to 5th and 95th percentiles of replicate projections. Solid horizontal lines mark $F_{30\%}$-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning. In bottom panel, the curve represents the proportion of projection replicates for which SSB has reached the replicate-specific $SSB_{F30\%}$.
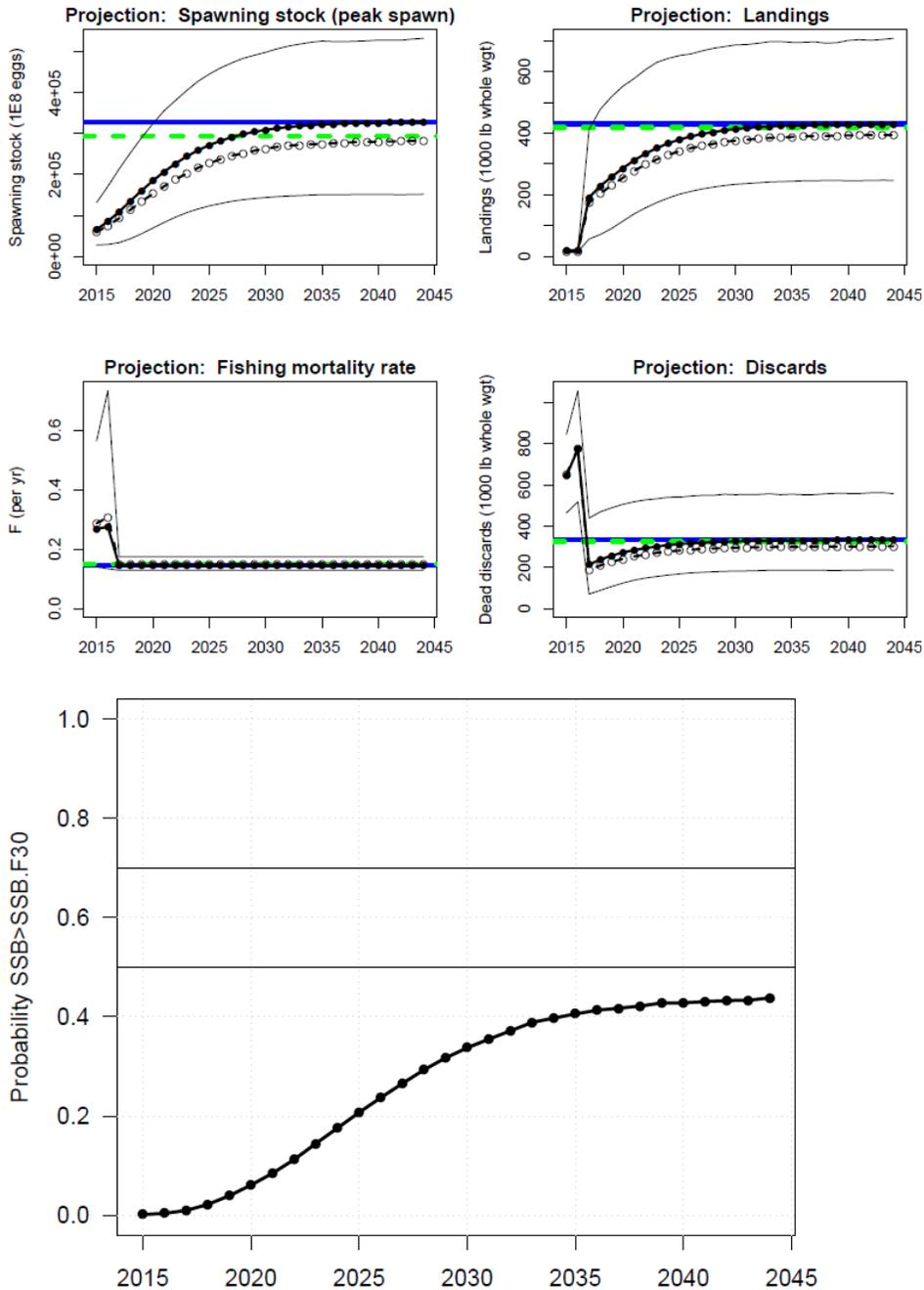
Figure 3. Projection results under scenario 3—fishing mortality rate at $F = F_{rebuild}$ starting in 2016, with rebuilding probability of 0.5 in 2044. In top four panels, expected values (base run) represented by solid lines with solid circles, medians represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to 5th and 95th percentiles of replicate projections. Solid horizontal lines mark $F_{30\%}$-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning. In bottom panel, the curve represents the proportion of projection replicates for which SSB has reached the replicate-specific $SSB_{F30\%}$.
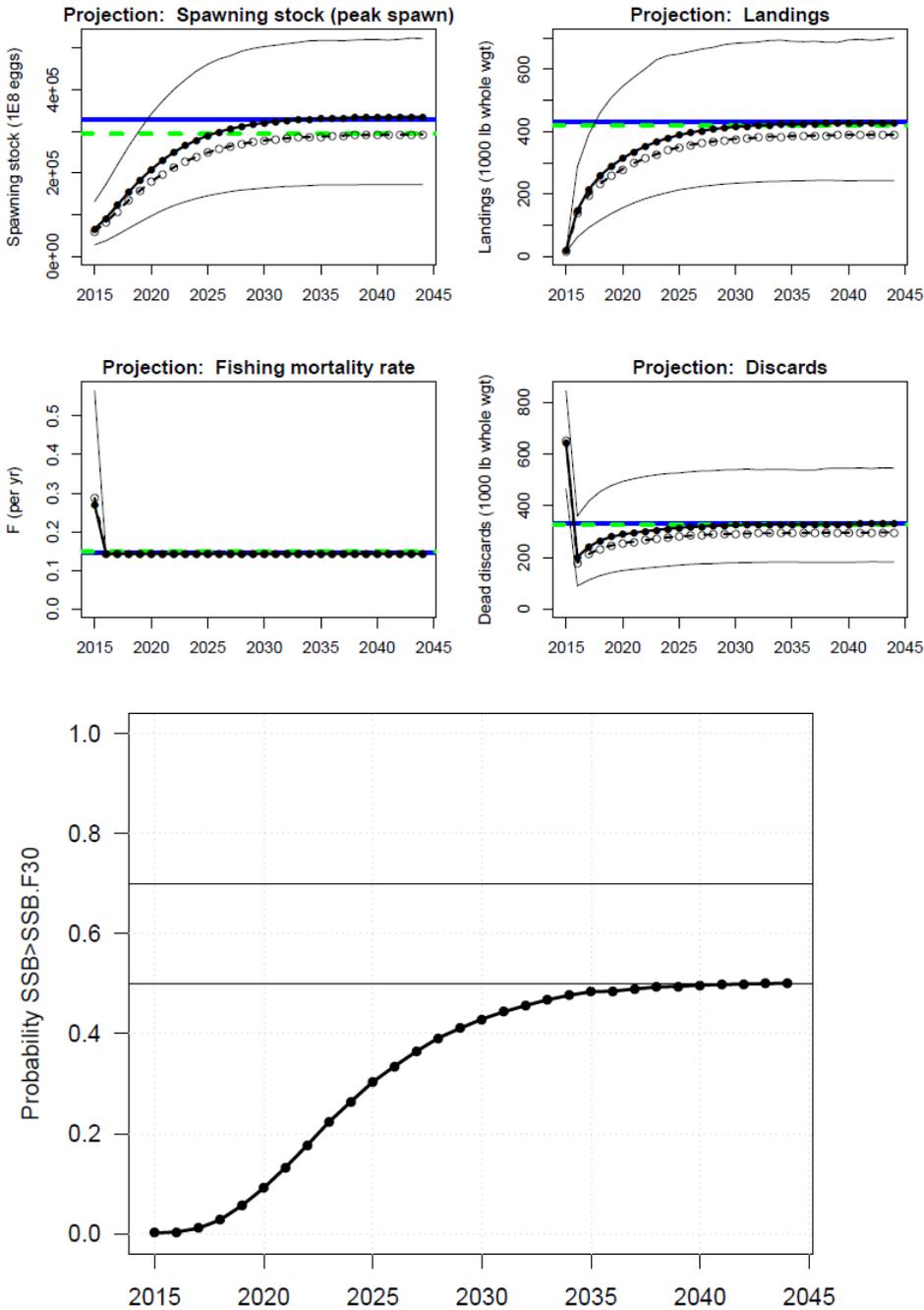
Figure 4. Projection results under scenario 4—fishing mortality rate at F = $F_{rebuild}$ starting in 2017, with rebuilding probability of 0.5 in 2044. In top four panels, expected values (base run) represented by solid lines with solid circles, medians represented by dashed lines with open circles, and uncertainty represented by thin lines corresponding to 5th and 95th percentiles of replicate projections. Solid horizontal lines mark $F_{30\%}$-related quantities; dashed horizontal lines represent corresponding medians. Spawning stock (SSB) is at time of peak spawning. In bottom panel, the curve represents the proportion of projection replicates for which SSB has reached the replicate-specific $SSB_{F30\%}$.
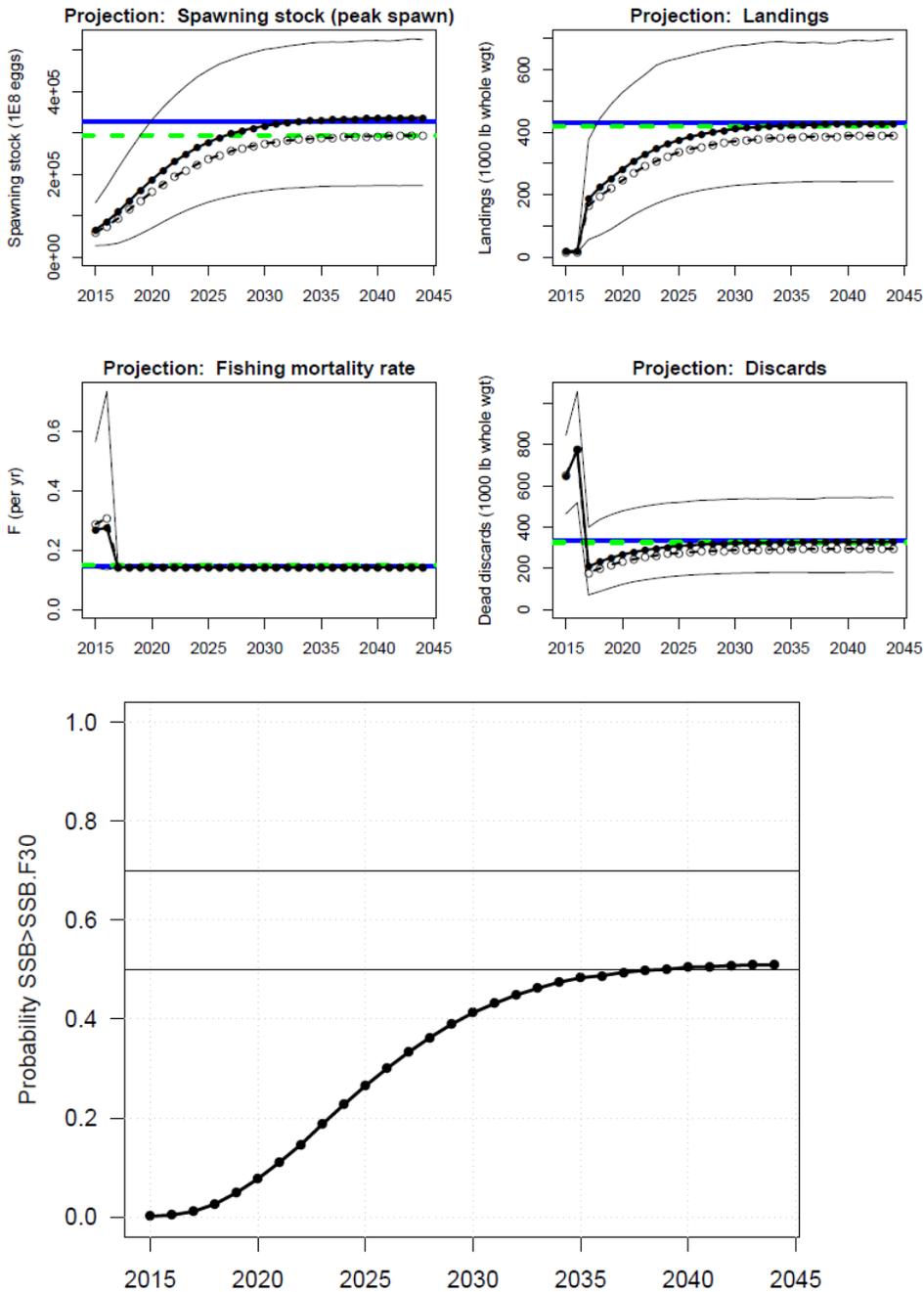
SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Dr. Michelle Duval, Chair | Charlie Phillips, Vice Chair
Gregg T. Waugh, Executive Director

MEMORANDUM

DATE: March 23, 2016

TO: Bonnie Ponwith

FROM: Gregg Waugh

SUBJECT: Red Snapper Projections

The Council requests additional projections of red snapper, based on the SEDAR 41 assessment model, for consideration by the SSC at its May meeting. The Council's intent is to ensure the SSC has the information necessary to provide fishing level recommendations for Council consideration in June, and that the projections include the most recent information available.

Because preliminary assessment results presented during the SEDAR 41 review workshop indicate the red snapper stock remains in an overfished condition, the additional projections requested here address the rebuilding plan. The rebuilding plan approved by SAFMC requires rebuilding at a fixed fishing mortality rate (Frebuild) that achieves at least a 50% probability of the spawning stock being rebuilt to the MSY level in 2044. In addition, we also request that the most recent estimates of actual landings and discard estimates be used in the projections for 2015, rather than an average of prior years. Specific projections requested are as follows:

1) Yield based on fishing the stock at Fmsy (30% SPR) with management taking effect in 2016, including actual 2015 removals.
2) Yield based on fishing the stock at Fmsy (30% SPR) with management taking effect in 2017, including actual 2015 removals.
3) Yield based on fishing the stock at Frebuild with management taking effect in 2016, including actual 2015 removals.
4) Yield based on fishing the stock at Frebuild with management taking effect in 2017, including actual 2015 removals.

For each projection scenario, please provide annual stock biomass, spawning stock biomass, probability that the spawning stock metric exceeds the spawning stock at MSY, the annual fishing mortality rate applied, and stock removals expressed in pounds and numbers for landings and discards.

We request projection results by April 15, 2016 for inclusion in the Briefing Book for the May 3-5, 2016, SSC meeting. Please let me know if this schedule cannot be met, and feel free to contact John Carmichael if there are any questions regarding this request.