



**NOAA**  
**FISHERIES**

SEFSC

# SEDAR 72: US Gulf of Mexico Gag Grouper Operational Assessment

## Updated Projections



GMFMC SSC Presentation

November 2021

NOAA Fisheries, Southeast Fisheries Science Center,  
Sustainable Fisheries Division (SFD)



**NOAA FISHERIES**

# Projection Settings

## SEDAR 72 – SSB combined

Parameter	Value	Comment
Relative F	Average from 2017 - 2019	Average relative fishing mortality (apical F) over terminal three years of model (Red Tide F excluded)
Selectivity	2019	Fleet specific selectivity estimated in the terminal year of the model
Retention	2019	Fleet specific retention estimated in the terminal year of the model
Recruitment	Beverton-Holt stock-recruitment relationship	Derived from the model estimated Beverton-Holt stock-recruitment relationship
Interim Landings (2020-2022)	73.79/126.72/126.72 mt (Comm. Vertical Line)	Landings provided for 2020; For 2021-2022, used 3-year average of landings (2018-2020)
	133.69/97.41/97.41 mt (Comm. Longline)	
	2.61/2.54/2.54 thousands of fish (Headboat)	
	37.61/28.66/28.66 thousands of fish (Charter)	
	305.4/271.68/271.68 thousands of fish (Private)	
Allocation Ratio	39:61	Commercial:Recreational

# Projection Scenarios – 2021 Red Tide

- Ecosystem model (updated with data up to the end of October) :  
 $\hat{M}_{2021\_redtide} = 0.103$ ; 95% CI (0.027, 0.290)
- We take the mean estimate as the “Medium Red Tide” scenario and the lower and upper limits of the 95% confidence intervals as the “Low” and “High” scenarios, respectively
- For SS, this translates into a red tide that is  
**Low = 6%** the strength of the 2005 red tide,  
**Med = 24%** the strength of the 2005 red tide,  
**High = 68%** the strength of the 2005 red tide

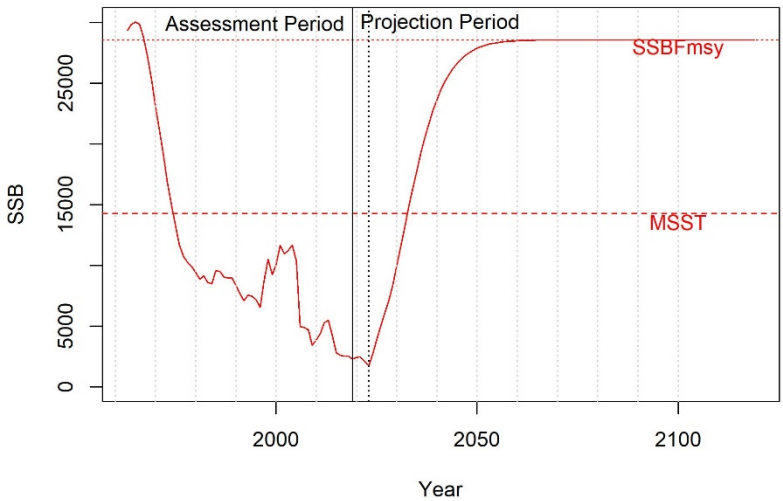
# Projection Scenarios

	Fspr30			Fmax		
	LOW	HIGH	MED	LOW	HIGH	MED
Base M	0.159	0.159	0.159	0.159	0.159	0.159
Steepness	0.855	0.855	0.855	0.855	0.855	0.855
R0	14319.2	14319.2	14319.2	14319.2	14319.2	14319.2
Generation Time	7.88	7.88	7.88	7.88	7.88	7.88
SSB0	106178	106178	106178	106178	106178	106178
Proxy	Fspr30	Fspr30	Fspr30	Fmax	Fmax	Fmax
Fmsy proxy	0.148	0.148	0.148	0.328	0.328	0.328
MFMT	0.148	0.148	0.148	0.328	0.328	0.328
%SPR equivalent of Fmsy proxy	30	30	30	13	13	13
Fcurrent	0.412	0.412	0.412	0.412	0.412	0.412
Fcurrent/MFMT	2.784	2.784	2.784	1.256	1.256	1.256
SSBmsy proxy	28559.6	28559.8	28559.4	9956.4	9956.53	9957.26
MSST	14279.8	14279.9	14279.7	4978.2	4978.265	4978.63
SSBcurrent	2296.24	2296.24	2296.24	2296.24	2296.24	2296.24
SSBcurrent/SSBFmsy_proxy	0.08	0.08	0.08	0.231	0.231	0.231
SSBcurrent/MSST	0.161	0.161	0.161	0.461	0.461	0.461
First year mgmt	2023	2023	2023	2023	2023	2023
Yr rebuilt at F=0	<b>2033</b>	<b>2035</b>	<b>2034</b>	<b>2028</b>	<b>2030</b>	<b>2029</b>
SSBcurrent/SSB0	0.022	0.022	0.022	0.022	0.022	0.022
SSByrrebuilt/SSB0	0.139	0.128	0.143	0.038	0.028	0.036

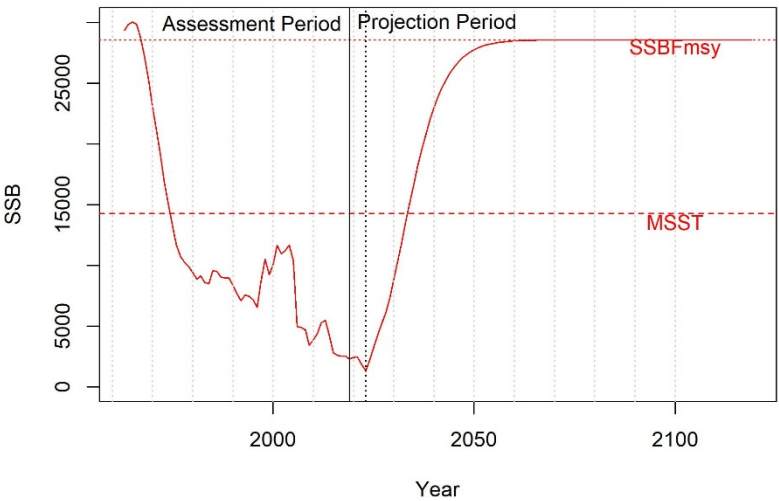


# Fspr30%

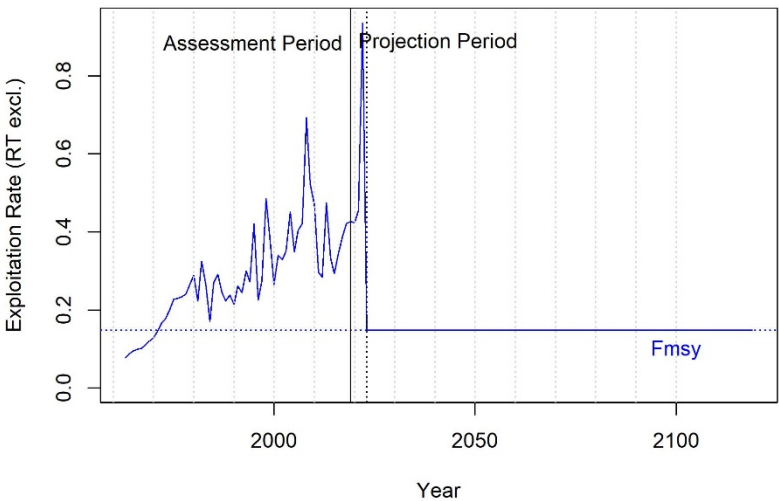
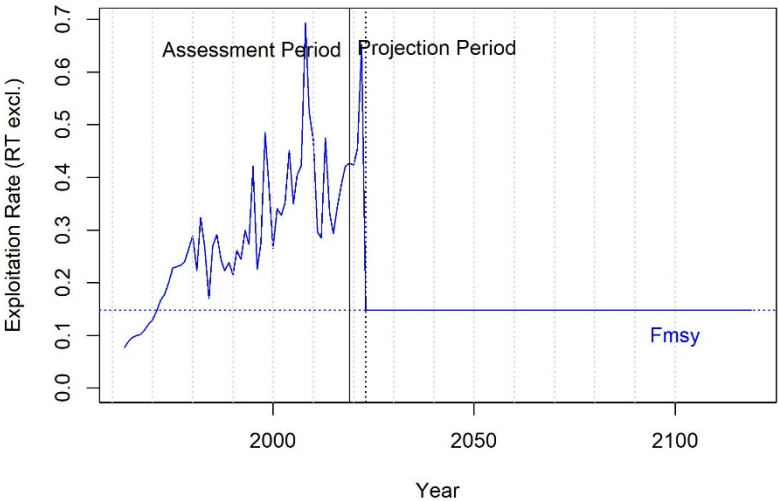
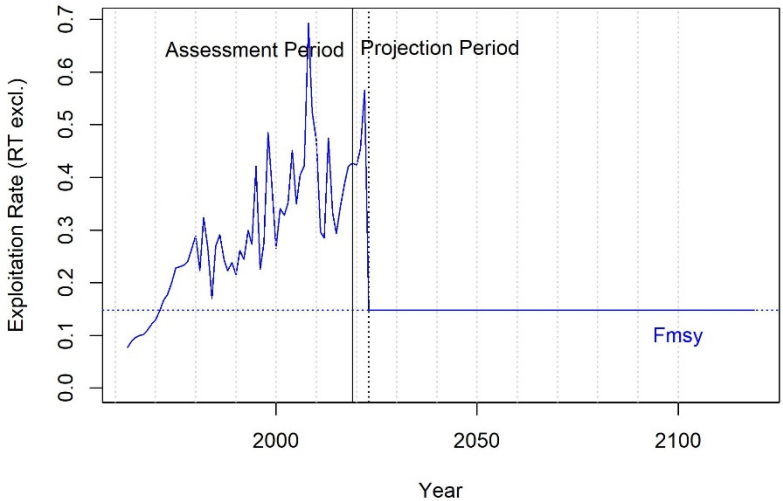
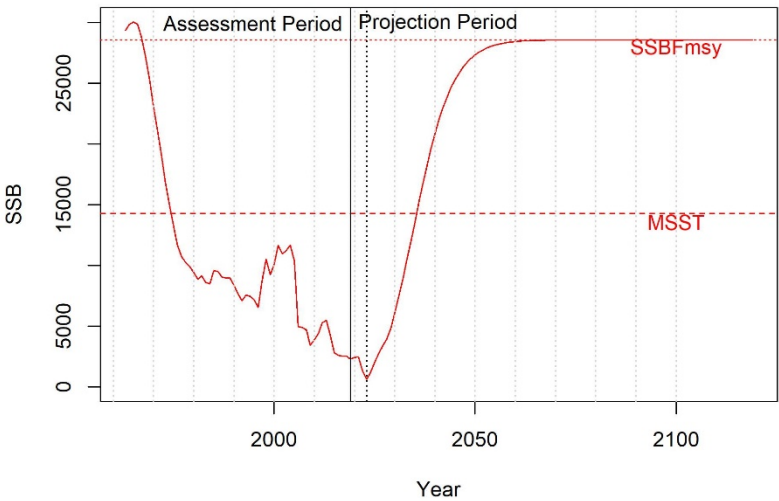
Fmsy\_proxy = Fspr30% ; Lo 2021 Red Tide



Fmsy\_proxy = Fspr30% ; Med 2021 Red Tide

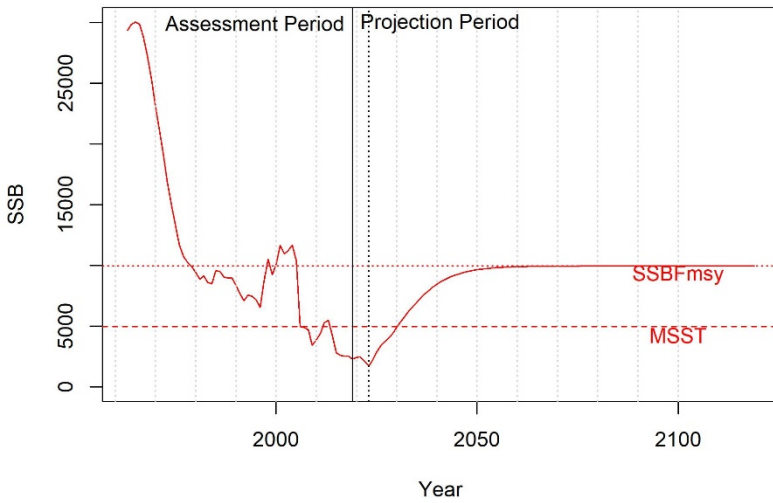


Fmsy\_proxy = Fspr30% ; Hi 2021 Red Tide

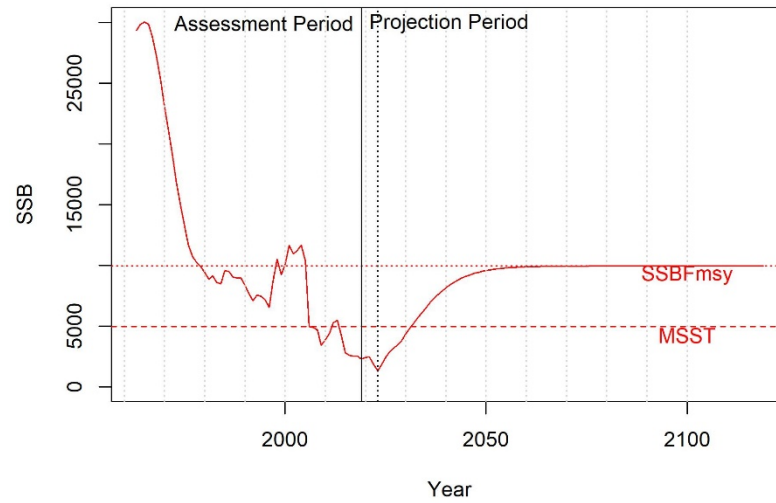


# Fmax

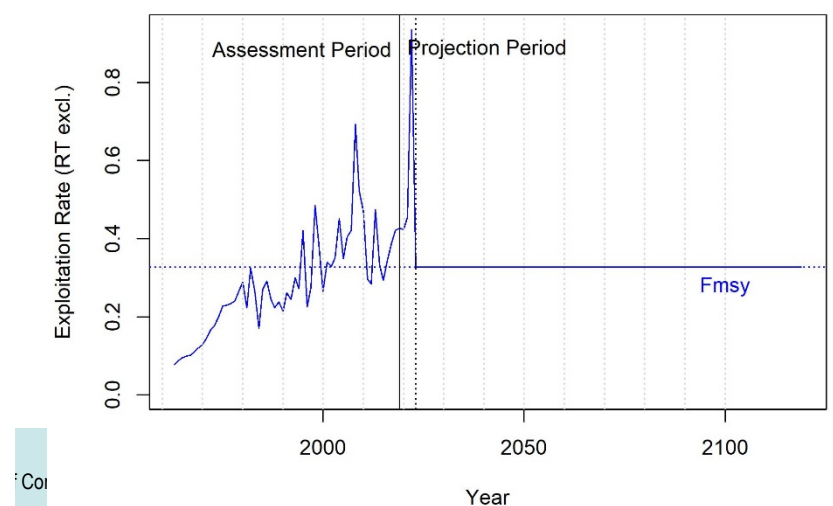
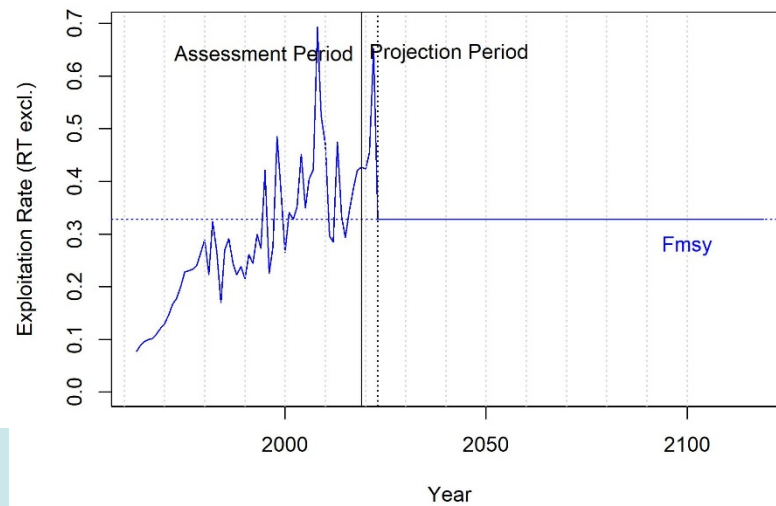
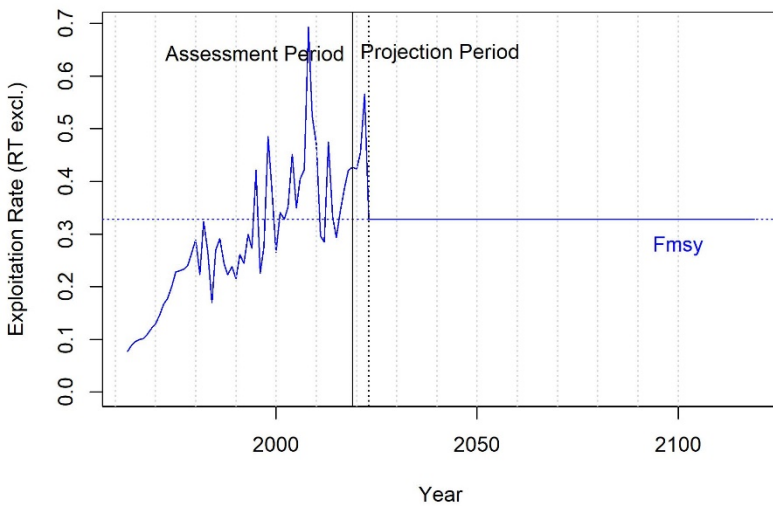
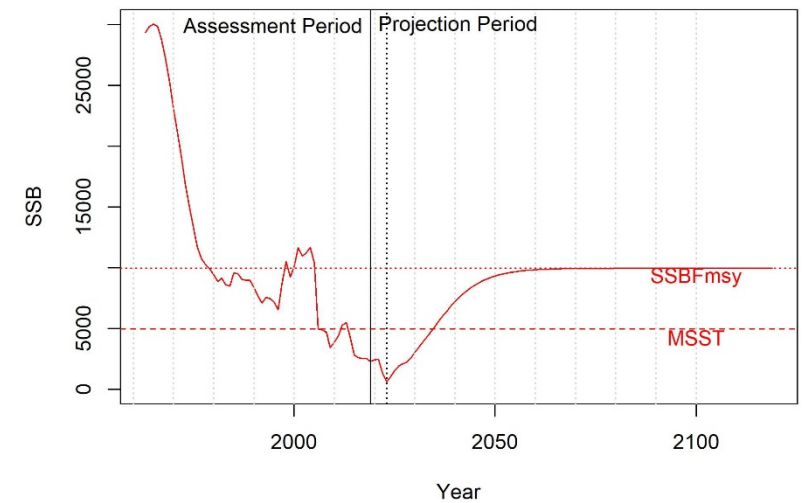
Fmsy\_proxy = Fmax ; Lo 2021 Red Tide



Fmsy\_proxy = Fmax ; Med 2021 Red Tide



Fmsy\_proxy = Fmax ; Hi 2021 Red Tide





# Frebuild

- $T_{min}$  = the amount of time the stock or stock complex is expected to take to rebuild to its MSY biomass level in the absence of any fishing mortality ( $F=0$ ).
- If  $T_{min} = 10$  years → No fishing
- If  $T_{min} < 10$  years, the choices are rebuild by
  - $T_{min}$  → No fishing
  - Halfway between  $T_{min}$  and 10 years, rounded to the nearest year
  - 10 years
- If  $T_{min} > 10$  years, the choices are rebuild by
  - $T_{min}$  + length of time associated with one generation time
  - Amount of time stock expected to take to rebuild to  $B_{msy}$  proxy if fished at 75% MFMT
  - $T_{min} * 2$

# Fspr30\_IoRT

## F=0

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBF <sub>msy</sub>	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.09	0.17	2.86	0.02
2021	5,170	0.454	3.10	2,484	0.09	0.17	3.07	0.02
2022	4,664	0.566	3.17	2,131	0.07	0.15	3.82	0.02
<b>2023</b>	3,992	0.000	0.00	1,712	0.06	0.12	0.00	0.02
2024	5,836	0.000	0.00	3,009	0.11	0.21	0.00	0.03
2025	7,583	0.000	0.00	4,837	0.17	0.34	0.00	0.05
2026	8,862	0.000	0.00	6,840	0.24	0.48	0.00	0.06
2027	9,766	0.000	0.00	8,851	0.31	0.62	0.00	0.08
2028	10,523	0.000	0.00	11,165	0.39	0.78	0.00	0.11
2029	11,218	0.000	0.00	14,120	0.49	0.99	0.00	0.13
2030	11,812	0.000	0.00	17,676	0.62	1.24	0.00	0.17
2031	12,288	0.000	0.00	21,676	0.76	1.52	0.00	0.20
2032	12,662	0.000	0.00	25,982	0.91	1.82	0.00	0.24
2033	12,956	0.000	0.00	30,503	1.07	2.14	0.00	0.29





# Fspr30\_hiRT

## F=0

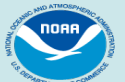
Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.09	0.17	2.86	0.02
2021	5,170	0.455	3.09	2,484	0.09	0.17	3.07	0.02
2022	3,239	0.936	3.10	1,300	0.05	0.09	6.32	0.01
<b>2023</b>	1,751	0.000	0.00	623	0.02	0.04	0.00	0.01
2024	3,374	0.000	0.00	1,370	0.05	0.10	0.00	0.01
2025	5,166	0.000	0.00	2,481	0.09	0.17	0.00	0.02
2026	6,613	0.000	0.00	3,727	0.13	0.26	0.00	0.04
2027	7,608	0.000	0.00	4,870	0.17	0.34	0.00	0.05
2028	8,484	0.000	0.00	6,164	0.22	0.43	0.00	0.06
2029	9,449	0.000	0.00	8,070	0.28	0.57	0.00	0.08
2030	10,371	0.000	0.00	10,641	0.37	0.75	0.00	0.10
2031	11,144	0.000	0.00	13,751	0.48	0.96	0.00	0.13
2032	11,755	0.000	0.00	17,278	0.60	1.21	0.00	0.16
2033	12,236	0.000	0.00	21,171	0.74	1.48	0.00	0.20
2034	12,618	0.000	0.00	25,395	0.89	1.78	0.00	0.24
2035	12,920	0.000	0.00	29,878	1.05	2.09	0.00	0.28



# Fspr30\_hiRT

## Frebuild Tmin\*2

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.09	0.17	2.86	0.02
2021	5,170	0.455	3.09	2,484	0.09	0.17	3.07	0.02
2022	3,239	0.936	3.10	1,300	0.05	0.09	6.32	0.01
2023	1,751	0.135	0.35	623	0.02	0.04	0.91	0.01
2024	3,101	0.135	0.63	1,230	0.04	0.09	0.91	0.01
2025	4,551	0.135	0.91	2,056	0.07	0.14	0.91	0.02
2026	5,665	0.135	1.05	2,867	0.10	0.20	0.91	0.03
2027	6,364	0.135	1.26	3,483	0.12	0.24	0.91	0.03
2028	6,969	0.135	1.58	4,103	0.14	0.29	0.91	0.04
2029	7,760	0.135	2.00	5,072	0.18	0.36	0.91	0.05
2030	8,606	0.135	2.48	6,374	0.22	0.45	0.91	0.06
2031	9,360	0.135	2.98	7,866	0.28	0.55	0.91	0.07
2032	9,981	0.135	3.52	9,437	0.33	0.66	0.91	0.09
2033	10,496	0.135	4.08	11,069	0.39	0.78	0.91	0.10
2034	10,930	0.135	4.66	12,773	0.45	0.89	0.91	0.12
2035	11,297	0.135	5.25	14,527	0.51	1.02	0.91	0.14
2036	11,603	0.135	5.82	16,280	0.57	1.14	0.91	0.15
2037	11,854	0.135	6.36	17,983	0.63	1.26	0.91	0.17
2038	12,060	0.135	6.87	19,599	0.69	1.37	0.91	0.18
2039	12,229	0.135	7.34	21,104	0.74	1.48	0.91	0.20
2040	12,367	0.135	7.77	22,484	0.79	1.57	0.91	0.21
2041	12,481	0.135	8.15	23,729	0.83	1.66	0.91	0.22
2042	12,574	0.135	8.49	24,838	0.87	1.74	0.91	0.23
2043	12,650	0.135	8.78	25,815	0.90	1.81	0.91	0.24
2044	12,712	0.135	9.04	26,666	0.93	1.87	0.91	0.25
2045	12,763	0.135	9.26	27,400	0.96	1.92	0.91	0.26
2046	12,805	0.135	9.44	28,027	0.98	1.96	0.91	0.26
2047	12,840	0.135	9.60	28,560	1.00	2.00	0.91	0.27



# Fspr30\_hiRT

## F fixed at 75%MFMT

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.09	0.17	2.86	0.02
2021	5,170	0.455	3.09	2,484	0.09	0.17	3.07	0.02
2022	3,239	0.936	3.10	1,300	0.05	0.09	6.32	0.01
2023	1,751	0.111	0.29	623	0.02	0.04	0.75	0.01
2024	3,150	0.111	0.52	1,254	0.04	0.09	0.75	0.01
2025	4,660	0.111	0.76	2,128	0.07	0.15	0.75	0.02
2026	5,835	0.111	0.90	3,008	0.11	0.21	0.75	0.03
2027	6,588	0.111	1.10	3,703	0.13	0.26	0.75	0.03
2028	7,244	0.111	1.38	4,417	0.15	0.31	0.75	0.04
2029	8,072	0.111	1.76	5,515	0.19	0.39	0.75	0.05
2030	8,940	0.111	2.20	6,989	0.24	0.49	0.75	0.07
2031	9,706	0.111	2.68	8,695	0.30	0.61	0.75	0.08
2032	10,334	0.111	3.18	10,517	0.37	0.74	0.75	0.10
2033	10,850	0.111	3.71	12,430	0.44	0.87	0.75	0.12
2034	11,280	0.111	4.27	14,436	0.51	1.01	0.75	0.14
2035	11,638	0.111	4.82	16,505	0.58	1.16	0.75	0.16
2036	11,934	0.111	5.37	18,579	0.65	1.30	0.75	0.17
2037	12,175	0.111	5.89	20,603	0.72	1.44	0.75	0.19
2038	12,372	0.111	6.38	22,533	0.79	1.58	0.75	0.21
2039	12,533	0.111	6.84	24,339	0.85	1.70	0.75	0.23
2040	12,664	0.111	7.26	26,003	0.91	1.82	0.75	0.24
2041	12,771	0.111	7.63	27,514	0.96	1.93	0.75	0.26
2042	12,859	0.111	7.97	28,867	1.01	2.02	0.75	0.27



# Fspr30\_hiRT

## Frebuild Tmin + 1 generation

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBF <sub>msy</sub>	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.09	0.17	2.86	0.02
2021	5,170	0.455	3.09	2,484	0.09	0.17	3.07	0.02
2022	3,239	0.936	3.10	1,300	0.05	0.09	6.32	0.01
2023	1,751	0.119	0.31	623	0.02	0.04	0.80	0.01
2024	3,134	0.119	0.56	1,246	0.04	0.09	0.80	0.01
2025	4,624	0.119	0.81	2,104	0.07	0.15	0.80	0.02
2026	5,778	0.119	0.96	2,960	0.10	0.21	0.80	0.03
2027	6,513	0.119	1.16	3,628	0.13	0.25	0.80	0.03
2028	7,151	0.119	1.45	4,309	0.15	0.30	0.80	0.04
2029	7,968	0.119	1.85	5,362	0.19	0.38	0.80	0.05
2030	8,829	0.119	2.30	6,776	0.24	0.47	0.80	0.06
2031	9,591	0.119	2.79	8,408	0.29	0.59	0.80	0.08
2032	10,217	0.119	3.30	10,142	0.36	0.71	0.80	0.10
2033	10,733	0.119	3.85	11,955	0.42	0.84	0.80	0.11
2034	11,165	0.119	4.41	13,855	0.49	0.97	0.80	0.13
2035	11,526	0.119	4.98	15,812	0.55	1.11	0.80	0.15
2036	11,825	0.119	5.54	17,772	0.62	1.24	0.80	0.17
2037	12,070	0.119	6.07	19,681	0.69	1.38	0.80	0.19
2038	12,270	0.119	6.57	21,498	0.75	1.51	0.80	0.20
2039	12,433	0.119	7.03	23,196	0.81	1.62	0.80	0.22
2040	12,567	0.119	7.46	24,757	0.87	1.73	0.80	0.23
2041	12,676	0.119	7.83	26,171	0.92	1.83	0.80	0.25
2042	12,766	0.119	8.17	27,435	0.96	1.92	0.80	0.26
2043	12,839	0.119	8.46	28,552	1.00	2.00	0.80	0.27
2044	12,900	0.148	10.83	29,528	1.03	2.07	1.00	0.28



# Fspr30\_medRT

## F=0

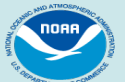
Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.09	0.17	2.86	0.02
2021	5,170	0.454	3.10	2,484	0.09	0.17	3.07	0.02
2022	4,221	0.652	3.15	1,849	0.06	0.13	4.40	0.02
<b>2023</b>	3,312	0.000	0.00	1,337	0.05	0.09	0.00	0.01
2024	5,134	0.000	0.00	2,458	0.09	0.17	0.00	0.02
2025	6,927	0.000	0.00	4,057	0.14	0.28	0.00	0.04
2026	8,274	0.000	0.00	5,824	0.20	0.41	0.00	0.05
2027	9,226	0.000	0.00	7,573	0.27	0.53	0.00	0.07
2028	10,035	0.000	0.00	9,591	0.34	0.67	0.00	0.09
2029	10,808	0.000	0.00	12,257	0.43	0.86	0.00	0.12
2030	11,483	0.000	0.00	15,557	0.54	1.09	0.00	0.15
2031	12,029	0.000	0.00	19,340	0.68	1.35	0.00	0.18
2032	12,458	0.000	0.00	23,471	0.82	1.64	0.00	0.22
2033	12,795	0.000	0.00	27,865	0.98	1.95	0.00	0.26
2034	13,061	0.000	0.00	32,449	1.14	2.27	0.00	0.31



# Fspr30\_medRT

## Frebuild Tmin\*2

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBF <sub>msy</sub>	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.09	0.17	2.86	0.02
2021	5,170	0.454	3.10	2,484	0.09	0.17	3.07	0.02
2022	4,221	0.652	3.15	1,849	0.06	0.13	4.40	0.02
2023	3,312	0.135	0.66	1,337	0.05	0.09	0.91	0.01
2024	4,753	0.135	1.02	2,190	0.08	0.15	0.91	0.02
2025	6,195	0.135	1.39	3,325	0.12	0.23	0.91	0.03
2026	7,255	0.135	1.65	4,430	0.16	0.31	0.91	0.04
2027	7,974	0.135	1.98	5,370	0.19	0.38	0.91	0.05
2028	8,595	0.135	2.41	6,354	0.22	0.44	0.91	0.06
2029	9,267	0.135	2.92	7,660	0.27	0.54	0.91	0.07
2030	9,912	0.135	3.48	9,244	0.32	0.65	0.91	0.09
2031	10,466	0.135	4.05	10,965	0.38	0.77	0.91	0.10
2032	10,918	0.135	4.64	12,721	0.45	0.89	0.91	0.12
2033	11,288	0.135	5.22	14,477	0.51	1.01	0.91	0.14
2034	11,593	0.135	5.79	16,217	0.57	1.14	0.91	0.15
2035	11,845	0.135	6.33	17,915	0.63	1.25	0.91	0.17
2036	12,053	0.135	6.84	19,536	0.68	1.37	0.91	0.18
2037	12,223	0.135	7.32	21,049	0.74	1.47	0.91	0.20
2038	12,363	0.135	7.75	22,437	0.79	1.57	0.91	0.21
2039	12,477	0.135	8.13	23,691	0.83	1.66	0.91	0.22
2040	12,571	0.135	8.47	24,808	0.87	1.74	0.91	0.23
2041	12,648	0.135	8.77	25,792	0.90	1.81	0.91	0.24
2042	12,711	0.135	9.02	26,649	0.93	1.87	0.91	0.25
2043	12,763	0.135	9.25	27,389	0.96	1.92	0.91	0.26
2044	12,805	0.135	9.43	28,022	0.98	1.96	0.91	0.26
2045	12,840	0.135	9.59	28,560	1.00	2.00	0.91	0.27



# Fspr30\_medRT

## F fixed at 75%MFMT

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.09	0.17	2.86	0.02
2021	5,170	0.454	3.10	2,484	0.09	0.17	3.07	0.02
2022	4,221	0.652	3.15	1,849	0.06	0.13	4.40	0.02
2023	3,312	0.111	0.54	1,337	0.05	0.09	0.75	0.01
2024	4,822	0.111	0.85	2,237	0.08	0.16	0.75	0.02
2025	6,327	0.111	1.17	3,448	0.12	0.24	0.75	0.03
2026	7,441	0.111	1.42	4,656	0.16	0.33	0.75	0.04
2027	8,204	0.111	1.72	5,715	0.20	0.40	0.75	0.05
2028	8,864	0.111	2.11	6,842	0.24	0.48	0.75	0.06
2029	9,560	0.111	2.58	8,333	0.29	0.58	0.75	0.08
2030	10,218	0.111	3.10	10,143	0.36	0.71	0.75	0.10
2031	10,776	0.111	3.64	12,127	0.42	0.85	0.75	0.11
2032	11,230	0.111	4.19	14,177	0.50	0.99	0.75	0.13
2033	11,598	0.111	4.75	16,247	0.57	1.14	0.75	0.15
2034	11,899	0.111	5.30	18,312	0.64	1.28	0.75	0.17
2035	12,146	0.111	5.82	20,336	0.71	1.42	0.75	0.19
2036	12,348	0.111	6.32	22,279	0.78	1.56	0.75	0.21
2037	12,513	0.111	6.78	24,104	0.84	1.69	0.75	0.23
2038	12,648	0.111	7.20	25,788	0.90	1.81	0.75	0.24
2039	12,758	0.111	7.59	27,320	0.96	1.91	0.75	0.26
2040	12,848	0.111	7.92	28,694	1.00	2.01	0.75	0.27





# Fspr30\_medRT

## Frebuild Tmin + 1 generation

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.09	0.17	2.86	0.02
2021	5,170	0.454	3.10	2,484	0.09	0.17	3.07	0.02
2022	4,221	0.652	3.15	1,849	0.06	0.13	4.40	0.02
2023	3,312	0.124	0.60	1,337	0.05	0.09	0.84	0.01
2024	4,785	0.124	0.95	2,212	0.08	0.15	0.84	0.02
2025	6,256	0.124	1.29	3,381	0.12	0.24	0.84	0.03
2026	7,341	0.124	1.55	4,533	0.16	0.32	0.84	0.04
2027	8,080	0.124	1.87	5,527	0.19	0.39	0.84	0.05
2028	8,719	0.124	2.28	6,575	0.23	0.46	0.84	0.06
2029	9,403	0.124	2.77	7,964	0.28	0.56	0.84	0.08
2030	10,054	0.124	3.32	9,648	0.34	0.68	0.84	0.09
2031	10,611	0.124	3.88	11,486	0.40	0.80	0.84	0.11
2032	11,064	0.124	4.45	13,373	0.47	0.94	0.84	0.13
2033	11,433	0.124	5.02	15,267	0.53	1.07	0.84	0.14
2034	11,736	0.124	5.58	17,151	0.60	1.20	0.84	0.16
2035	11,986	0.124	6.12	18,992	0.67	1.33	0.84	0.18
2036	12,192	0.124	6.63	20,753	0.73	1.45	0.84	0.20
2037	12,360	0.124	7.10	22,402	0.78	1.57	0.84	0.21
2038	12,497	0.124	7.52	23,919	0.84	1.68	0.84	0.23
2039	12,610	0.124	7.91	25,292	0.89	1.77	0.84	0.24
2040	12,702	0.124	8.25	26,520	0.93	1.86	0.84	0.25
2041	12,777	0.124	8.55	27,604	0.97	1.93	0.84	0.26
2042	12,839	0.124	8.81	28,552	1.00	2.00	0.84	0.27
2043	12,890	0.148	10.78	29,372	1.03	2.06	1.00	0.28



# Fmax\_IoRT

F=0

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.24	0.49	1.29	0.02
2021	5,170	0.454	3.10	2,484	0.25	0.50	1.38	0.02
2022	4,664	0.566	3.17	2,131	0.21	0.43	1.73	0.02
<b>2023</b>	3,992	0.000	0.00	1,712	0.17	0.34	0.00	0.02
2024	5,836	0.000	0.00	3,009	0.30	0.60	0.00	0.03
2025	7,583	0.000	0.00	4,837	0.49	0.97	0.00	0.05
2026	8,862	0.000	0.00	6,840	0.69	1.37	0.00	0.06
2027	9,766	0.000	0.00	8,851	0.89	1.78	0.00	0.08
2028	10,523	0.000	0.00	11,165	1.12	2.24	0.00	0.11



# Fmax\_loRT

## Frebuild 10 years

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.24	0.49	1.29	0.02
2021	5,170	0.454	3.10	2,484	0.25	0.50	1.38	0.02
2022	4,664	0.566	3.17	2,131	0.21	0.43	1.73	0.02
2023	3,992	0.231	1.38	1,712	0.17	0.34	0.70	0.02
2024	5,118	0.231	1.94	2,446	0.25	0.49	0.70	0.02
2025	6,265	0.231	2.45	3,390	0.34	0.68	0.70	0.03
2026	7,069	0.231	2.79	4,215	0.42	0.85	0.70	0.04
2027	7,590	0.231	3.18	4,845	0.49	0.97	0.70	0.05
2028	8,035	0.231	3.67	5,460	0.55	1.10	0.70	0.05
2029	8,540	0.231	4.24	6,261	0.63	1.26	0.70	0.06
2030	9,046	0.231	4.82	7,198	0.72	1.45	0.70	0.07
2031	9,488	0.231	5.38	8,161	0.82	1.64	0.70	0.08
2032	9,854	0.231	5.93	9,085	0.91	1.82	0.70	0.09
2033	10,160	0.231	6.45	9,964	1.00	2.00	0.70	0.09



Fmax\_loRT

Halfway  
between  
Tmin and  
10 yrs

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.24	0.49	1.29	0.02
2021	5,170	0.454	3.10	2,484	0.25	0.50	1.38	0.02
2022	4,664	0.566	3.17	2,131	0.21	0.43	1.73	0.02
2023	3,992	0.149	0.89	1,712	0.17	0.34	0.45	0.02
2024	5,381	0.149	1.33	2,642	0.27	0.53	0.45	0.02
2025	6,747	0.149	1.76	3,865	0.39	0.78	0.45	0.04
2026	7,730	0.149	2.08	5,031	0.51	1.01	0.45	0.05
2027	8,401	0.149	2.47	6,027	0.61	1.21	0.45	0.06
2028	8,977	0.149	2.95	7,061	0.71	1.42	0.45	0.07
2029	9,576	0.149	3.51	8,372	0.84	1.68	0.45	0.08
2030	10,141	0.149	4.10	9,906	0.99	1.99	0.45	0.09
2031	10,623	0.328	10.29	11,532	1.16	2.32	1.00	0.11



# Fmax\_hiRT

F=0

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBF <sub>msy</sub>	SSB/ MSST	F/ MFMT	SSB/ SSB <sub>0</sub>
2020	5,098	0.424	3.31	2,432	0.24	0.49	1.29	0.02
2021	5,170	0.455	3.09	2,484	0.25	0.50	1.39	0.02
2022	3,239	0.936	3.10	1,300	0.13	0.26	2.85	0.01
<b>2023</b>	1,751	0.000	0.00	623	0.06	0.13	0.00	0.01
2024	3,374	0.000	0.00	1,370	0.14	0.28	0.00	0.01
2025	5,166	0.000	0.00	2,481	0.25	0.50	0.00	0.02
2026	6,613	0.000	0.00	3,727	0.37	0.75	0.00	0.04
2027	7,608	0.000	0.00	4,870	0.49	0.98	0.00	0.05
2028	8,484	0.000	0.00	6,164	0.62	1.24	0.00	0.06
2029	9,449	0.000	0.00	8,070	0.81	1.62	0.00	0.08
2030	10,371	0.000	0.00	10,641	1.07	2.14	0.00	0.10

# Fmax\_hiRT

## Frebuild 10 years

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.24	0.49	1.29	0.02
2021	5,170	0.455	3.09	2,484	0.25	0.50	1.39	0.02
2022	3,239	0.936	3.10	1,300	0.13	0.26	2.85	0.01
<b>2023</b>	1,751	0.158	0.41	623	0.06	0.13	0.48	0.01
2024	3,054	0.158	0.72	1,207	0.12	0.24	0.48	0.01
2025	4,446	0.158	1.03	1,989	0.20	0.40	0.48	0.02
2026	5,503	0.158	1.19	2,737	0.27	0.55	0.48	0.03
2027	6,151	0.158	1.41	3,285	0.33	0.66	0.48	0.03
2028	6,706	0.158	1.74	3,823	0.38	0.77	0.48	0.04
2029	7,461	0.158	2.18	4,681	0.47	0.94	0.48	0.04
2030	8,283	0.158	2.68	5,837	0.59	1.17	0.48	0.05
2031	9,021	0.158	3.21	7,148	0.72	1.44	0.48	0.07
2032	9,632	0.158	3.75	8,508	0.85	1.71	0.48	0.08
2033	10,142	0.158	4.33	9,908	1.00	1.99	0.48	0.09
2034	10,578	0.328	10.15	11,365	1.14	2.28	1.00	0.11



# Fmax\_hiRT

## Halfway between Tmin and 10 yrs

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.24	0.49	1.29	0.02
2021	5,170	0.455	3.09	2,484	0.25	0.50	1.39	0.02
2022	3,239	0.936	3.10	1,300	0.13	0.26	2.85	0.01
<b>2023</b>	1,751	0.124	0.33	623	0.06	0.13	0.38	0.01
2024	3,123	0.124	0.58	1,241	0.12	0.25	0.38	0.01
2025	4,600	0.124	0.84	2,089	0.21	0.42	0.38	0.02
2026	5,741	0.124	0.99	2,930	0.29	0.59	0.38	0.03
2027	6,466	0.124	1.19	3,581	0.36	0.72	0.38	0.03
2028	7,093	0.124	1.49	4,242	0.43	0.85	0.38	0.04
2029	7,901	0.124	1.90	5,267	0.53	1.06	0.38	0.05
2030	8,758	0.124	2.36	6,645	0.67	1.33	0.38	0.06
2031	9,517	0.124	2.85	8,230	0.83	1.65	0.38	0.08
2032	10,142	0.124	3.38	9,911	1.00	1.99	0.38	0.09
2033	10,658	0.328	10.31	11,664	1.17	2.34	1.00	0.11





# Fmax\_medRT

F=0

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.24	0.49	1.29	0.02
2021	5,170	0.454	3.10	2,484	0.25	0.50	1.39	0.02
2022	4,221	0.652	3.15	1,849	0.19	0.37	1.99	0.02
<b>2023</b>	3,312	0.000	0.00	1,337	0.13	0.27	0.00	0.01
2024	5,134	0.000	0.00	2,458	0.25	0.49	0.00	0.02
2025	6,927	0.000	0.00	4,057	0.41	0.81	0.00	0.04
2026	8,274	0.000	0.00	5,824	0.58	1.17	0.00	0.05
2027	9,226	0.000	0.00	7,573	0.76	1.52	0.00	0.07
2028	10,035	0.000	0.00	9,591	0.96	1.93	0.00	0.09
2029	10,808	0.000	0.00	12,257	1.23	2.46	0.00	0.12



# Fmax\_medRT

## Frebuild 10 years

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.24	0.49	1.29	0.02
2021	5,170	0.454	3.10	2,484	0.25	0.50	1.39	0.02
2022	4,221	0.652	3.15	1,849	0.19	0.37	1.99	0.02
<b>2023</b>	3,312	0.214	1.03	1,337	0.13	0.27	0.65	0.01
2024	4,523	0.214	1.53	2,039	0.20	0.41	0.65	0.02
2025	5,756	0.214	1.99	2,942	0.30	0.59	0.65	0.03
2026	6,637	0.214	2.28	3,752	0.38	0.75	0.65	0.04
2027	7,203	0.214	2.63	4,369	0.44	0.88	0.65	0.04
2028	7,689	0.214	3.09	4,976	0.50	1.00	0.65	0.05
2029	8,265	0.214	3.64	5,809	0.58	1.17	0.65	0.05
2030	8,851	0.214	4.23	6,818	0.68	1.37	0.65	0.06
2031	9,367	0.214	4.80	7,882	0.79	1.58	0.65	0.07
2032	9,794	0.214	5.37	8,925	0.90	1.79	0.65	0.08
2033	10,151	0.214	5.93	9,936	1.00	2.00	0.65	0.09
2034	10,455	0.328	9.91	10,926	1.10	2.19	1.00	0.10



# Fmax\_medRT

## Halfway between Tmin and 10 yrs

Year	R (1000s)	F	Yield (mp gwt)	SSB (mt)	SSB/ SSBFmsy	SSB/ MSST	F/ MFMT	SSB/ SSB0
2020	5,098	0.424	3.31	2,432	0.24	0.49	1.29	0.02
2021	5,170	0.454	3.10	2,484	0.25	0.50	1.39	0.02
2022	4,221	0.652	3.15	1,849	0.19	0.37	1.99	0.02
2023	3,312	0.159	0.77	1,337	0.13	0.27	0.48	0.01
2024	4,683	0.159	1.18	2,143	0.22	0.43	0.49	0.02
2025	6,061	0.159	1.59	3,204	0.32	0.64	0.49	0.03
2026	7,067	0.159	1.87	4,213	0.42	0.85	0.49	0.04
2027	7,740	0.159	2.21	5,044	0.51	1.01	0.49	0.05
2028	8,321	0.159	2.66	5,898	0.59	1.18	0.49	0.06
2029	8,966	0.159	3.20	7,040	0.71	1.41	0.49	0.07
2030	9,597	0.159	3.78	8,423	0.85	1.69	0.49	0.08
2031	10,143	0.159	4.37	9,911	1.00	1.99	0.49	0.09
2032	10,591	0.328	10.19	11,413	1.15	2.29	1.00	0.11