Projections of the South Florida/Florida Keys Hogfish Stock under Various Rebuilding Scenarios

A report to the SAFMC SSC

April 2015

Dustin Addis and Mike Murphy
Florida Fish and Wildlife Research Institute
100 8th Ave. S.E., Saint Petersburg, FL 33701
(727) 502-4935
Dustin.Addis@myfwc.com

Introduction

Projections of Hogfish biomass were approved by the SAFMC at its March 2015 meeting to develop alternatives for rebuilding the Florida Keys including the Dry Tortugas and Eastern Florida (FLK/EFL) hogfish stock. Preliminary projections indicated the stock can be rebuilt within 10 years under an F=0 scenario, so the maximum rebuilding time for projections is 10 years.

Methods

Interim Landings

The last year of data in the Hogfish assessment report (SEDAR 37, 2014) was 2012 and changes in regulations will impact 2016 landings for the FLK/EFL stock. Therefore, recent catch data were generated for commercial (2013, 2014, and the 2013-2014 average for 2015) and recreational fleets (2013, a 2012-2013 average for 2014, and a 2013-2014 average for 2015). The construction of landings and discard data follow methods within SEDAR 37 unless otherwise specified. Recent commercial catch data were based on landings from the FWC-FWRI Marine Fisheries Information System (Trip ticket) and discard logbook program discards (2013, a 2012-2013 average for 2014, and a 2013-2014 average for 2015). Recent recreational catch data were based on landings and discards from the Marine Recreational Information Program (MRIP) and Southeast Region Headboat Survey (SRHS) (2013, a 2012-2013 average for 2014, and a 2013-2014 average for 2015). In order to generate these landings within the assessment model, the level of fishing mortality rate (F) needed to project the annual total dead biomass (landings and dead discards) for 2013-2015 was estimated and used for all considered projection scenarios.

Projections

Projections for various F scenarios were completed using Stock Synthesis (SS3) base model configurations for the FLK/EFL hogfish stock (SEDAR 37, 2014):

- F=0: no directed fishing scenario (constant discard mortality)
- $F=F_{Current}$: total fishing rate was held constant during 2016-2026 at the geometric mean rate for 2010-2012

- Constant F at F=75% F_{MSY}: a constant fishing mortality rate at 75% of F_{MSY}
- Constant F at F=F_{MSY}: a constant fishing mortality rate at MSY
- Constant F that rebuilds to the spawning stock biomass at MSY level in 10 years and F's associated with 72.5% probability of rebuilding in 10 years
- Constant F that rebuilds to the spawning stock biomass at MSY level in 7 years and F's associated with 72.5% probability of rebuilding in 7 years

Projection results are based on year 1 = 2016 and extending through 2026, or to the point of stock rebuilding if a scenario did not result in rebuilding within 10 years.

Within SS3 forecasting, projections were run assuming that biology, recruitment, selectivity, and relative apical F's among fleets are the same as the last three years of the assessment (2010-2012). The predicted fleet (commercial: spear, hook-and-line, trap; recreational spear and hook-and-line) catch allocations reflected the average distribution of apical F's among fleets during 2010-2012. These allocations were also applied to 2013-2015 interim catch totals. Forecast catches within the projections were total dead fish (biomass or numbers) because hogfish discards were included in the landings in the assessment model. The predicted discarded portions of the forecasted total dead catches were estimated using observed landings and discards during 2010-2012. The base model estimates of 2010-2012 fleet-specific exploitation rates were partitioned into landed and discarded components by dividing observed discards by the total biomass or numbers to estimate fleet-specific discard exploitation rates. These discard rates were subtracted from the corresponding fleet-specific total exploitation rates estimated within all projections and applied to the stock biomass or abundance to calculate discards. Retained catch was then calculated by subtracting these predicted discards from the total dead biomass or numbers.

All projection analyses involved iterative searches used to solve for annual scalars applied to fleet-specific exploitations to match the target exploitation rate for each projection scenario. Similar iterative searches were run for rebuild projections but the F was found by matching to the target spawning biomass at MSY. These scalars changed through time to keep the overall force of fishing constant despite the changing age structure of the stock encountered by fisheries with different selectivity patterns.

Results

The total interim landings (2013-2015) including dead discards by fishery, year, and fishing gear are presented in thousands of pounds and numbers in Table 1. Projection results under scenarios: F_0, $F_{Current}$, 75% F_{MSY}, and F_{MSY} for 2016-2026 are presented in Tables 2,3,4, and 5, respectively in terms of fishing mortality rate applied, spawning stock biomass, annual stock biomass, and yield expressed in pounds (thousands) and numbers (thousands) for landings and discards. Projection results under rebuilding scenarios for constant F projections that rebuild in 10 years are presented for Prebuild=50% (Table 6) and Prebuild=72.5% (Table 7). Projection results under Prebuild scenarios for constant F projections that rebuild in 7 years are presented for Prebuild=50% (Table 8) and Prebuild=72.5% (Table 9).

References

SEDAR 37. 2014. The 2013 Stock Assessment Report for Hogfish in the South Atlantic and Gulf of Mexico. SEDAR, North Charleston, SC. 295 p.

Tables

Table 1. FLK/EFL Hogfish combined landings and dead discards for commercial and recreational fisheries by gear for 2013-2015.

Pounds in 1000's

Year	Commercial Spear	Commercial Hook/Line	Commercial Traps	Recreational Spear	Recreational Hook/Line	Total
2013	9.133	9.357	2.876	103.519	24.261	149.158
2014	17.064	18.042	5.590	192.288	44.278	277.264
2015	12.926	13.454	4.104	141.746	33.503	205.732

Numbers in 1000's

Year	Commercial Spear	Commercial Hook/Line	Commercial Traps	Recreational Spear	Recreational Hook/Line	Total
2013	3.339	2.943	0.808	40.549	11.484	59.123
2014	5.855	5.337	1.477	71.924	20.596	105.190
2015	4.658	4.165	1.109	55.873	16.652	82.456

Table 2. Projection results from the FLK/EFL stock for the F_0 rebuilding scenario. Pounds and numbers are in thousands. The calculated SSB_{MSY} = 2300.39

Year	F	SSB (pounds)	Annual Stock Biomass (pounds)	Yield (pounds)	Yield (numbers)	Discards (pounds)	Discards (numbers)
2016	0.001	806.96	928.37	0	0	0.93	0.39
2017	0.001	1054.40	1198.03	0	0	1.20	0.48
2018	0.001	1343.87	1508.43	0	0	1.51	0.58
2019	0.001	1671.36	1855.59	0	0	1.86	0.68
2020	0.001	2032.80	2234.93	0	0	2.24	0.78
2021	0.001	2423.16	2641.00	0	0	2.65	0.89
2022	0.001	2836.29	3067.75	0	0	3.08	0.99
2023	0.001	3265.90	3509.14	0	0	3.52	1.09
2024	0.001	3705.83	3959.19	0	0	3.97	1.19
2025	0.001	4150.59	4412.48	0	0	4.43	1.28
2026	0.001	4594.69	4863.63	0	0	4.88	1.36

Table 3. Projection results from the FLK/EFL stock for the $F_{Current}$ rebuilding scenario, where $F_{Current}$ is the geometric mean of the terminal three years (2010-2012). Pounds and numbers are in thousands. The calculated SSB_{MSY} = 2300.39

Year	F	SSB (pounds)	Annual Stock Biomass (pounds)	Yield (pounds)	Yield (numbers)	Discards (pounds)	Discards (numbers)
2016	0.220	806.96	928.37	203.59	85.08	0.93	0.39
2017	0.220	864.69	993.13	217.80	90.35	1.00	0.44
2018	0.220	921.64	1055.61	231.50	94.77	1.06	0.47
2019	0.220	974.37	1113.01	244.09	98.90	1.12	0.51
2020	0.220	1022.31	1164.91	255.47	102.74	1.17	0.54
2021	0.220	1065.37	1211.28	265.64	106.22	1.22	0.58
2022	0.220	1103.55	1252.23	274.62	109.31	1.26	0.61
2023	0.220	1136.97	1287.96	282.45	112.02	1.29	0.64
2024	0.220	1165.96	1318.88	289.24	114.37	1.32	0.66
2025	0.220	1190.93	1345.45	295.06	116.40	1.35	0.69
2026	0.220	1212.15	1367.97	300.00	118.13	1.37	0.71

Table 4. Projection results from the FLK/EFL stock for the 75% F_{MSY} rebuilding scenario. Pounds and numbers are in thousands. The calculated SSB_{MSY} = 2300.39

Year	F	SSB (pounds)	Annual Stock Biomass (pounds)	Yield (pounds)	Yield (numbers)	Discards (pounds)	Discards (numbers)
2016	0.104	806.96	928.37	95.38	39.71	0.93	0.39
2017	0.104	965.14	1101.65	113.18	45.90	1.11	0.46
2018	0.104	1133.82	1283.52	131.87	51.66	1.29	0.53
2019	0.104	1306.58	1468.17	150.84	57.52	1.47	0.59
2020	0.104	1479.65	1651.76	169.70	63.43	1.66	0.66
2021	0.104	1649.81	1830.97	188.11	69.19	1.84	0.72
2022	0.104	1813.95	2002.78	205.76	74.66	2.01	0.79
2023	0.104	1969.51	2164.80	222.41	79.75	2.17	0.84
2024	0.104	2114.57	2315.27	237.87	84.43	2.32	0.90
2025	0.104	2247.96	2453.08	252.03	88.67	2.46	0.94
2026	0.104	2368.78	2577.44	264.80	92.47	2.59	0.99

Table 5. Projection results from the FLK/EFL stock for the F_{MSY} rebuilding scenario. Pounds and numbers are in thousands. The calculated SSB_{MSY} = 2300.39

Year	F	SSB (pounds)	Annual Stock Biomass (pounds)	Yield (pounds)	Yield (numbers)	Discards (pounds)	Discards (numbers)
2016	0.138	806.96	928.37	127.49	53.14	0.93	0.39
2017	0.138	935.24	1069.36	146.85	59.93	1.07	0.45
2018	0.138	1067.98	1212.89	166.56	66.06	1.22	0.51
2019	0.138	1199.45	1353.95	185.93	72.14	1.36	0.57
2020	0.138	1327.04	1489.94	204.61	78.13	1.50	0.62
2021	0.138	1448.81	1618.89	222.31	83.83	1.62	0.68
2022	0.138	1563.00	1739.13	238.83	89.13	1.75	0.73
2023	0.138	1668.30	1849.51	253.99	93.95	1.86	0.78
2024	0.138	1763.94	1949.39	267.70	98.28	1.96	0.82
2025	0.138	1849.70	2038.61	279.93	102.12	2.05	0.86
2026	0.138	1925.46	2117.17	290.72	105.50	2.12	0.89

Table 6. Projection results from the FLK/EFL stock for the Rebuild 10 scenario, referring to a constant fishing rate that will rebuild the stock in 10 years associated with a probability of rebuilding (Prebuild) of 50%. Pounds and numbers are in thousands. The calculated SSB_{MSY} = 2300.39

Year	F	SSB (pounds)	Annual Stock Biomass (pounds)	Yield (pounds)	Yield (numbers)	Discards (pounds)	Discards (numbers)
2016	0.109	806.96	928.37	100.77	41.97	0.93	0.39
2017	0.109	960.98	1097.16	119.09	48.36	1.10	0.46
2018	0.109	1124.52	1273.55	138.24	54.27	1.28	0.52
2019	0.109	1291.24	1451.83	157.59	60.27	1.46	0.59
2020	0.109	1457.51	1628.31	176.75	66.30	1.63	0.65
2021	0.109	1620.29	1799.87	195.37	72.16	1.81	0.72
2022	0.109	1776.69	1963.71	213.16	77.71	1.97	0.78
2023	0.109	1924.32	2117.60	229.86	82.86	2.13	0.83
2024	0.109	2061.46	2259.96	245.32	87.56	2.27	0.89
2025	0.109	2187.10	2389.87	259.42	91.82	2.40	0.93
2026	0.109	2300.45	2506.67	272.10	95.63	2.52	0.97

Table 7. Projection results from the FLK/EFL stock for the Rebuild 10 scenario, referring to a constant fishing rate that will rebuild the stock in 10 years associated with a probability of rebuilding (Prebuild) of 72.5%. Pounds and numbers are in thousands. The calculated SSB_{MSY} = 2300.39

Year	F	SSB (pounds)	Annual Stock Biomass (pounds)	Yield (pounds)	Yield (numbers)	Discards (pounds)	Discards (numbers)
2016	0.097	806.96	928.37	89.83	37.40	0.93	0.39
2017	0.095	971.19	1108.18	105.17	42.61	1.11	0.46
2018	0.093	1149.35	1300.17	121.39	47.45	1.30	0.53
2019	0.092	1335.40	1498.88	138.02	52.43	1.50	0.60
2020	0.091	1525.60	1700.43	154.76	57.53	1.71	0.67
2021	0.090	1716.55	1901.28	171.32	62.57	1.91	0.74
2022	0.089	1904.79	2098.04	187.39	67.41	2.11	0.81
2023	0.089	2087.28	2287.82	202.76	71.96	2.30	0.87
2024	0.088	2261.57	2468.27	217.23	76.18	2.48	0.93
2025	0.087	2425.90	2637.76	230.68	80.05	2.65	0.98
2026	0.087	2578.74	2794.86	243.01	83.55	2.81	1.03

Table 8. Projection results from the FLK/EFL stock for the Rebuild 7 scenario, referring to a constant fishing rate that will rebuild the stock in 7 years associated with a probability of rebuilding (Prebuild) of 50%. Pounds and numbers are in thousands. The calculated SSB_{MSY} = 2300.39

Year	F	SSB (pounds)	Annual Stock Biomass (pounds)	Yield (pounds)	Yield (numbers)	Discards (pounds)	Discards (numbers)
2016	0.072	806.96	928.37	66.65	27.73	0.93	0.39
2017	0.072	992.83	1131.55	81.24	32.78	1.14	0.47
2018	0.072	1196.82	1351.03	96.99	37.61	1.36	0.54
2019	0.072	1412.36	1580.73	113.48	42.63	1.59	0.62
2020	0.072	1634.86	1815.86	130.36	47.81	1.82	0.70
2021	0.072	1859.95	2051.88	147.31	52.99	2.06	0.77
2022	0.072	2083.19	2284.43	164.00	58.01	2.29	0.84
2023	0.072	2300.61	2509.74	180.18	62.79	2.52	0.91

Table 9. Projection results from the FLK/EFL stock for the Rebuild 7 scenario, referring to a constant fishing rate that will rebuild the stock in 7 years associated with a probability of rebuilding (Prebuild) of 72.5%. Pounds and numbers are in thousands. The calculated SSB_{MSY} = 2300.39

Year	F	SSB (pounds)	Annual Stock Biomass (pounds)	Yield (pounds)	Yield (numbers)	Discards (pounds)	Discards (numbers)
2016	0.064	806.96	928.37	59.48	24.74	0.93	0.39
2017	0.063	999.53	1138.79	71.81	28.94	1.14	0.47
2018	0.062	1213.45	1368.86	85.23	32.95	1.37	0.55
2019	0.062	1442.51	1612.79	99.43	37.20	1.62	0.63
2020	0.061	1682.14	1865.80	114.17	41.64	1.87	0.71
2021	0.061	1927.80	2123.11	129.15	46.14	2.13	0.79
2022	0.061	2174.69	2379.98	144.11	50.56	2.39	0.86
2023	0.060	2418.36	2632.18	158.79	54.81	2.64	0.94