Estimates of Historic Recreational Landings of Spanish Mackerel in the South Atlantic Using the FHWAR Census Method

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Introduction

During previous SEDAR data workshops considerable time and effort was devoted to developing methods of back-calculating recreational landings for years prior to the start of modern data collection programs and landings estimates. Methods used in past stock assessments included: ratios of commercial landings to recreational landings; estimates from the U.S. Fish and Wildlife Saltwater Angling Survey (SWAS); and U.S. Census data as a proxy for recreational fishing effort to produce regression estimates of catch. These approaches resulted in estimates that, in some cases, have generated a great deal of controversy.

In the Terms of Reference (TOR) for the SEDAR 28 Data Workshop (DW) for South Atlantic Spanish Mackerel, the Recreational Working Group (RWG) was tasked to "evaluate historic recreational catch information and modify, as necessary, pre-MRFSS estimates provided in SEDAR 17." In order to address this task, the RWG reviewed the SWAS used in SEDAR 17 and evaluated other potential historical sources and methods to compile landings of Spanish mackerel prior to the available time series of MRFSS and headboat estimated landings (1981).

Historical Angling Sources

Salt Water Angler Surveys (SWAS)

The historic recreational landings of Spanish mackerel are defined as pre-1981 for the charter boat, headboat, private boat, and shore fishing modes; pre-1981 represents the start of the Marine Recreational Fisheries Statistics Survey (MRFSS) and the beginning of landings estimates for Spanish mackerel in the South Atlantic from the Southeast Region Headboat Survey (SRHS). SEDAR 17 included historical recreational landings estimates for 1950 – 1980, based on linear interpolation using the SWAS landings estimates from 1960, 1965, and 1970. The work group noted that the SWAS landings estimates for Spanish mackerel were six times those of recent years. These high estimates were attributed to recall bias and possible exaggeration of catches by anglers (SWAS 1960). The small sample size of SWAS angler interviews may have further inflated these estimates. The mean interview sample size for the three SWAS was 0.02% of total estimated saltwater anglers in the US. The changes in the SWAS methodology over the years were also discussed by the RWG as part of the overall discussion regarding the potential uncertainty and bias for this method.

Anderson, 1965

The RWG discussed the study by Anderson (1965 [SEDAR28-RD04]) as a possible source of information for historical landings of Spanish mackerel. Anderson's study area focused on Cape Canaveral, FL, including Brevard and Volusia counties. Field surveys were conducted from

February to October 1963. The RWG considered the Anderson study spatially and temporally limited, thus not useful for expanding coastwide estimated landings prior to 1981.

National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Survey (FHWAR), U.S Fish and Wildlife Service (USFWS).

The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Survey has been conducted every 5 years since 1955 and is one of the oldest and most comprehensive recreational surveys. Among other things, its purpose is to gather information on the number of anglers in the United States, including frequency and time spent fishing (FHWAR 1991).

The FHWAR Surveys published in 1991, 1996, 2001 and 2006 provide summary tables (Comparison of Major Findings of the National Surveys: 1955 to 1985) of U.S. population estimates, along with estimates of fishing participation and effort from surveys conducted by the USFWS every five years from 1955 to 1985 (Tables 1 and 2). This information was used to develop an alternative method for estimating coastwide recreational landings prior to 1981.

FHWAR Method

The two key components from the FHWAR surveys used in this census method were the estimates of U.S. saltwater anglers and the estimates of U.S. saltwater days. The first objective was to determine the total saltwater anglers and saltwater days from New England to the South Atlantic (NE-SA) by using the summary information of U.S. anglers and U.S. saltwater anglers from the FHWAR surveys. The ratio of U.S saltwater anglers to the total U.S anglers was applied to the total number of anglers for the NE-SA to yield the total saltwater anglers for NE-SA. The same method was used to calculate the total saltwater days for the NE-SA from the FHWAR surveys from 1955-1985.

The FHWAR surveys for the South Atlantic included the entire state of Florida - east and west coasts. In order to address the management boundaries for Spanish mackerel, the saltwater angler days for Florida's west coast (FLW) were separated from the NE-SA saltwater angler days using the ratio of the MRFSS total angler trips for FLW to the MRFSS total angler trips for Maine to FLW. The mean ratio from 1984-1986 was applied to the total saltwater days for the NE-SA from 1955-1985 to remove FLW effort.

Similar to the SWAS, there was a 12-month recall period for respondents participating in the FHWAR surveys from 1955 – 1985. As part of the 1991 FWHAR, a study was conducted to compare the 12- month recall period to a four-month period. This study revealed that the level of recall bias varies for different types of fishing participation and expenditure (FHWAR, 1991). Consequently, it was necessary to account for possible reporting bias and adjust the angling effort

(saltwater days) in the FHWAR Surveys 1955-1985. In the case of Spanish mackerel in the South Atlantic, the total saltwater days for the NE-SA 1955-1985 were adjusted for recall bias in the FHWAR surveys by using the mean MRFSS total angler trips for the US East Coast (ME-FLE) 1984 to 1986, divided by the total saltwater days from the 1985 FHWAR Survey. This multiplier was then applied to the total NE-SA saltwater days from 1955-1985 to adjust for recall bias.

Using the adjusted saltwater days for NE-SA from 1955 – 1985, the next step in this process was estimating landings of Spanish mackerel. This was accomplished by calculating the mean CPUE for Spanish mackerel in the South Atlantic from the MRFSS landings estimates for 1981 to 1985. This mean CPUE was then applied to the adjusted saltwater days for the NE-SA from 1955-1985 to estimate the historical landings of Spanish mackerel for those years (Table 3). Linear interpolation was used to estimate landings for years that the FHWAR surveys were not conducted during 1955-1980. Since historical recreational landings for Spanish mackerel were only lacking prior to 1981, the 1985 estimated landings using the FHWAR census method were excluded (Table 4).

A bootstrap analysis was used to capture the range of uncertainty in the historic recreational catch estimates. More specifically, the historic catch estimates were based on the mean CPUE and the ratio of MRFSS effort to historic estimates of effort. These two quantities were bootstrapped 200 times using the empirical estimates that went into each. The 5th and 95th percentiles were then computed from the distribution of bootstrap estimates to characterize the uncertainty (Figure 2).

Conclusions

The FHWAR method utilizes a combination of information including U.S. angler population estimates and angling effort estimates from 1955 – 1985 FHWAR, along with estimates of recreational effort and landings from the MRFSS 1981 – 1985. The FWHAR method also used both sources of information to adjust for recall bias, an issue that must be addressed when considering using either the SWAS or the FHWAR Surveys for historical recreational landings. By using data from FHWAR and the MRFSS to calibrate this adjustment, the effect of the 12-month angler recall period is reduced. The historical landings of Spanish mackerel that were calculated using this method show a gradual increase from 1955 to 1980, as opposed to the significant landings represented in SEDAR 17 using the SWAS estimates for the same time period (Figure 3). The FHWAR method could be used for other species by adjusting the geographic range of the FHWAR surveys to match management boundaries and the associated MRFSS catch and effort data for a particular species.

Literature Cited:

Anderson, W.W. 1965 and J.W. Gehringer. Biological Statistical Census of the Species Entering Fisheries in the Cape Canaveral Area. U.S. Fish and Wildlife Service Special Scientific Report. Fisheries No. 514

Clark, J.R. 1962. The 1960 Salt-Water Angling Survey. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife.

Deuel, D.G. and J.R. Clark. 1968. The 1965 Salt-Water Angling Survey. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Resource Publication.

Deuel, D.G. 1973. The 1970 Salt-Water Angling Survey. U.S. Department of Commerce, National Marine Fisheries Service, Current Fishery Statistics No. 6200.

U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau. 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

Table 1. Anglers and Hunters, by Census Division: 1955 to 1985

(U.S. population 12 years old and older. Numbers in thousands)

Year	Population		Sportsmen (fished or hunted)		Anglers		Hunters	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total, United States								
1955	118,366	100	24,917	21.1	20,813	17.6	11,784	10.0
1960	131,226	100	30,435	23.2	25,323	19.3	14,637	11.2
1965	141,928	100	32,881	23.2	28,348	20.0	13,585	9.6
1970	155,230	100	36,277	23.4	33,158	21.4	14,336	9.2
1975	171,860	100	45,773	26.6	41,299	24.0	17,094	9.9
1980	184,691	100	46,966	25.4	41,873	22.7	16,758	9.1
1985	195,659	100	49,827	25.5	45,345	23.2	16,340	8.4
New England								
1955	7,919	100	1,224	15.4	1,002	12.7	589	7.4
1960	8,349	100	1,368	16.4	1,205	14.4	517	6.2
1965	9,256	100	1,650	17.8	1,488	16.0	583	6.3
1970	8,652	100	1,579	18.3	1,430	16.5	582	6.7
1975	9,910	100	2,004	20.2	1,861	18.8	566	5.7
1980	10,205	100	1,974	19.3	1,788	17.5	572	5.6
1985	10,554	100	2,058	19.5	1,914	18.1	552	5.2
Middle Atlantic								
1955	24,869	100	3,539	14.2	2,811	11.3	1,608	6.5
1960	26,493	100	3,432	13.0	2,569	9.7	1,723	6.5
1965	27,346	100	3,602	13.2	2,760	10.1	1,631	6.0
1970	28,244	100	4,539	16.1	4,504	14.4	1,731	6.1
1975	30,449	100	5,919	19.4	5,097	16.7	2,096	6.9
1980	30,256	100	5,181	17.1	4,332	14.3	2,001	6.6
1985	31,099	100	5,565	17.9	4,820	15.5	1,972	6.3
East North Central								
1955	25,733	100	5,489	21.3	4,583	17.8	2,538	9.9
1960	26,833	100	6,316	32.5	5,317	19.8	2,985	11.1
1965	28,124	100	6,214	22.1	5,336	19.0	2,563	9.1
1970	31,550	100	7,284	23.1	6,699	21.2	2,812	8.9
1975	32,796	100	9,049	27.6	8,181	24.9	3,392	10.3
1980	33,526	100	8,725	26.0	7,891	23.5	2,955	8.8
1985	33,747	100	8,973	26.6	8,270	24.5	2,814	8.3
West North Central								
1955	9,201	100	2,913	31.7	2,346	25.5	1,534	16.7
1960	10,149	100	3,383	33.3	2,855	28.1	1,709	16.8
1965	11,681	100	3,678	31.5	3,226	27.6	1,620	13.9
1970	12,904	100	4,000	31.0	3,579	27.7	1,783	13.8
1975	13,564	100	4,524	33.3	4,089	30.1	1,863	13.7
1980	13,826	100	4,770	34.5	4,220	30.5	1,965	14.2
1985	14,137	100	5,140	36.4	4,681	33.1	1,971	13.9
South Atlantic								
1955	14,336	100	3,223	22.5	2,805	19.6	1,449	10.1
1960	17,798	100	4,423	24.9	3,695	20.8	2,045	11.5
1965	20,593	100	5,626	27.3	5,054	24.5	1,900	9.2
1970	23,539	100	5,461	23.2	5,129	21.8	1,904	8.1
1975	27,127	100	7,110	26.2	6,479	23.9	2,494	9.2
1980	30,512	100	7,769	25.5	7,086	23.2	2,444	8.0
1985	33,636	100	8,721	25.9	8,056	24.0	2,467	7.3
East South Central								
1955	7,959	100	1,963	24.7	1,665	20.9	989	12.4
1960	9,277	100	2,778	29.9	2,207	23.8	1,510	16.3
1965	9,652	100	2,587	26.8	2,201	22.8	1,294	13.4
1970	9,862	100	2,660	27.0	2,464	25.0	1,162	11.8
1975	10,798	100	3,007	27.8	2,689	24.9	1,355	12.5
1980	11,771	100	3,614	30.7	3,173	27.0	1,567	13.3
1985	12,364	100	3,671	29.7	3,308	26.8	1,441	11.7

Table 2. Comparison of Major Findings of the National Surveys: 1955 to 1985

(U.S. population 12 years old and older. Numbers in thousands)

Sportsmen, expenditures, and days	1955	1960	1965	1970	1975	1980	1985
Total sportsmen	24,917	30,435	32,881	36,277	45,773	46,966	49,827
Anglers	20,813	25,323	28,348	33,158	41,299	41,873	45,345
Freshwater	18,420	21,677	23,962	29,363	36,599	35,782	39,122
Saltwater	4,557	6,292	8,305	9,460	13,738	11,972	12,893
Hunters	11,784	14,637	13,583	14,336	17,094	16,758	16,340
Small game	9,822	12,105	10,576	11,671	14,182	12,496	11,130
Big game	4,414	6,277	6,566	7,774	11,037	11,047	12,576
Waterfowl	1,986	1,955	1,650	2,894	4,284	3,177	3,201
Expenditures[1]	13,904,225	17,010,944	18,282,320	23,925,058	40,730,094	42,094,416	51,101,515
Anglers	9,336,002	11,882,891	12,137,086	16,706,477	28,656,715	28,521,304	34,731,608
Freshwater	6,951,447	9,117,627	8,819,330	12,580,446	21,138,064	20,321,023	23,014,603
Saltwater	2,384,556	2,765,259	3,317,773	4,126,031	7,518,651	6,807,288	8,737,535
Hunters	4,568,222	5,128,045	4,651,589	7,218,581	12,073,379	13,185,436	12,461,852
Small game	2,409,399	3,206,537	2,552,606	3,185,841	5,519,441	4,068,112	2,846,575
Big game	1,579,704	1,526,585	1,737,452	3,209,185	5,168,708	6,876,092	6,494,911
Waterfowl	579,119	394,927	361,527	823,555	1,385,230	934,186	951,728
Days	566,870	658,308	708,578	909,876	1,459,551	1,300,983	1,415,379
Fishing	397,447	465,769	522,759	706,187	1,058,075	952,420	1,064,986
Freshwater	338,826	385,167	426,922	592,494	890,576	788,392	895,027
Saltwater	58,621	80,602	95,837	113,694	167,499	164,040	171,055
Hunting	169,423	192,539	185,819	203,689	401,476	348,543	350,393
Small game	118,630	138,192	128,448	124,041	269,653	225,793	214,544
Big game	30,834	39,190	43,845	54,536	100,600	117,406	135,447
Waterfowl	19,959	15,158	13,526	25,113	31,223	26,179	25,933

Table 3.	FWHAR census method adjusted saltwater days and adjusted Spanish mackerel estimated landings.						
	Total U.S.	Percent Saltwater	Saltwater Days	MRFSS SM Avg	MRFSS Angler Trips Avg84-86	Adjusted Saltwater	Adjusted SM
Year	Saltwater Days	Anglers NE-SA	NE-FLE	CPUE 81-85	: 85 Saltwater Days (recall bias)	Days NE-FLE	Estimated Landings
1955	58621000	0.318	13737542	0.02	0.96	13189903	252837
1960	80602000	0.295	17520918	0.02	0.96	16822457	322469
1965	95837000	0.328	23176661	0.02	0.96	22252737	426562
1970	113694000	0.334	27956698	0.02	0.96	26842220	514538
1975	167499000	0.325	40164165	0.02	0.96	38563044	739214
1980	164040000	0.315	38128587	0.02	0.96	36608614	701750
1985	171055000	0.326	41118596	0.02	0.96	39479427	756780

Table 4. Estimated Spanish mackerel landings (number) using FHWAR census method (1955-1980 MRFSS (1981-2003), MRIP (2004-2011), and SRHS (81-11) estimation methods.

Year	Estimatedlandings(n)	Year	Estimatedlandings(n)
1955	252,837	1984	938,061
1956	266,763	1985	495,354
1957	280,690	1986	937,429
1958	294,616	1987	1,198,109
1959	308,543	1988	1,884,597
1960	322,469	1989	1,232,315
1961	343,288	1990	1,391,631
1962	364,106	1991	1,638,608
1963	384,925	1992	1,346,942
1964	405,744	1993	980,356
1965	426,562	1994	1,252,470
1966	444,157	1995	753,008
1967	461,752	1996	969,077
1968	479,348	1997	1,155,037
1969	496,943	1998	690,496
1970	514,538	1999	1,116,645
1971	559,473	2000	1,437,330
1972	604,408	2001	1,307,163
1973	649,344	2002	1,439,449
1974	694,279	2003	1,243,097
1975	739,214	2004	800,943
1976	731,721	2005	962,090
1977	724,228	2006	663,235
1978	716,735	2007	1,087,412
1979	709,243	2008	1,415,570
1980	701,750	2009	1,170,894
1981	867,492	2010	1,103,948
1982	965,918	2011	879,230
1983	130,237		

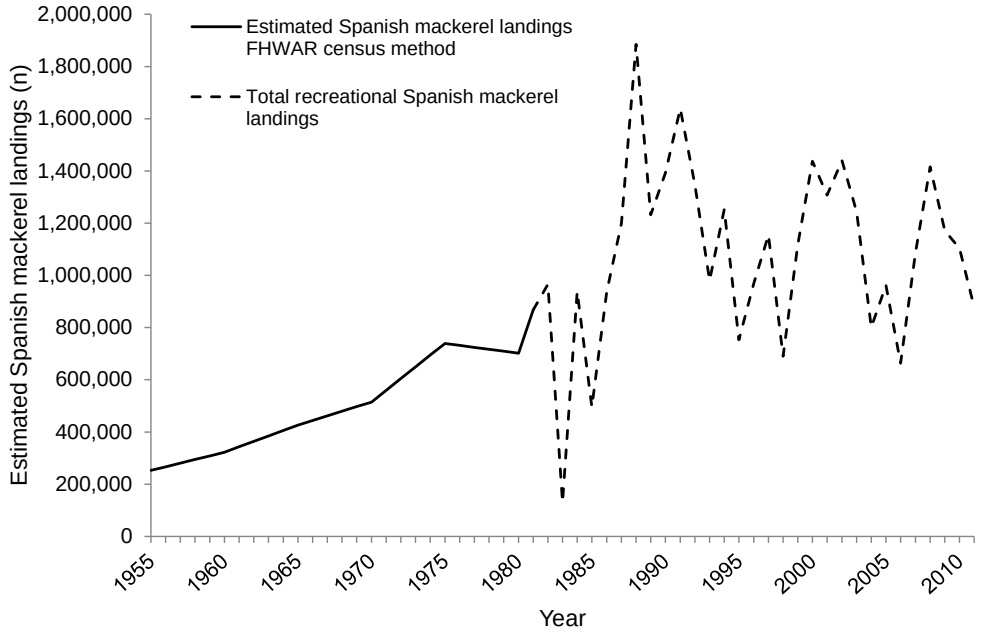

Figure 1. Estimated Spanish mackerel landings (number) using FHWAR census method (1955 - 1980 MRFSS (1981-2003), MRIP (2004-2011), and SRHS (81-11) estimation methods.

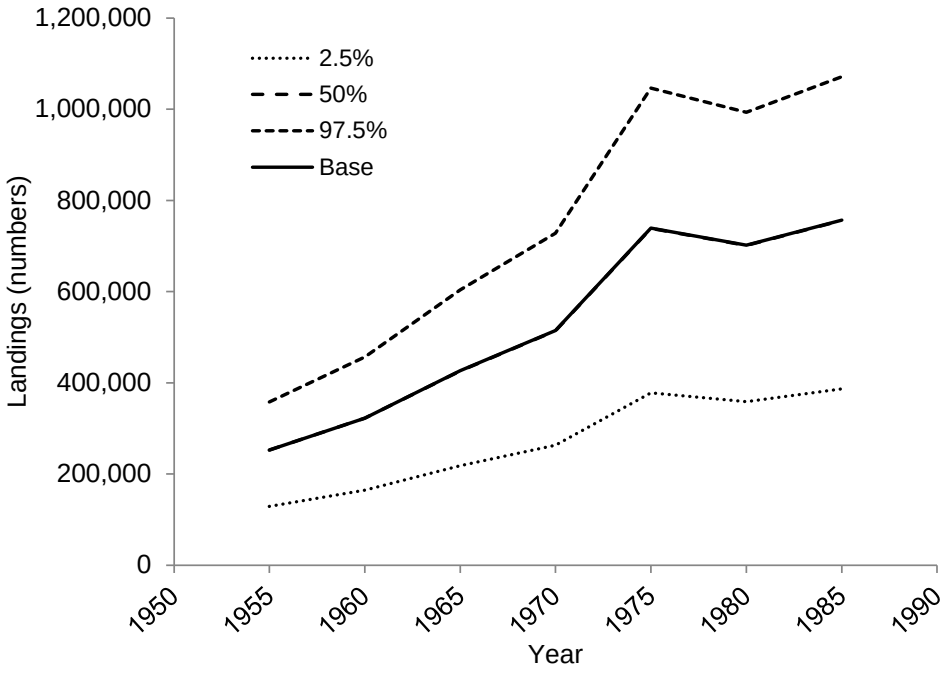

Figure 2. Bootstrap analysis of FHWAR census method (1955-1985) Spanish mackerel landings estimates.

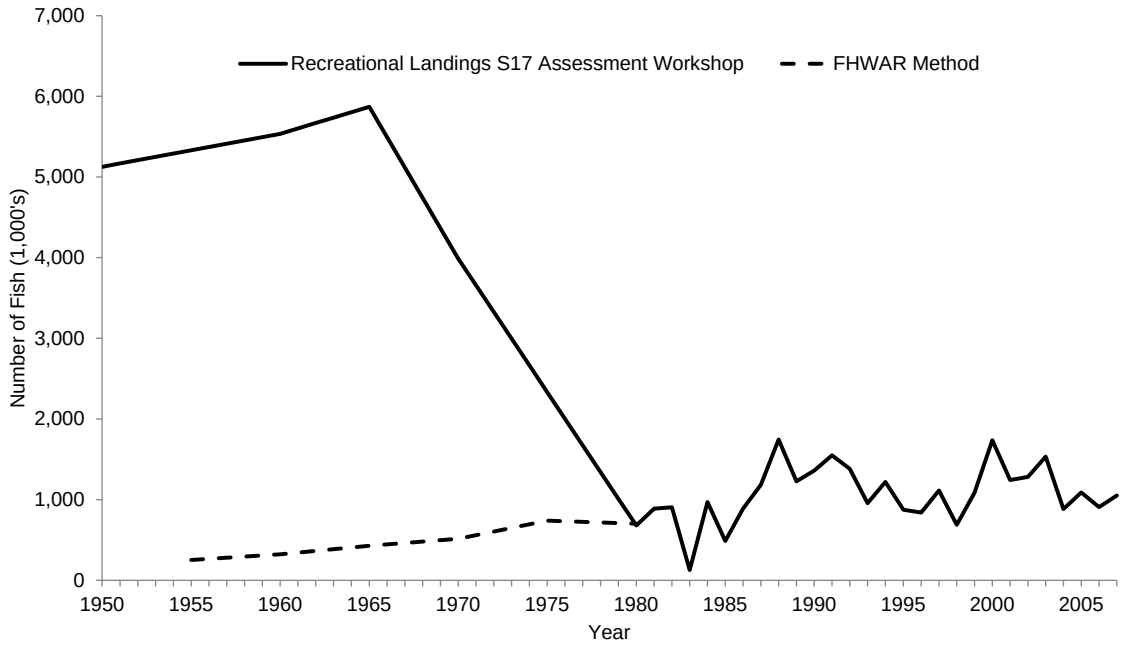

Figure 3. Historic recreational Spanish mackerel landings using the SWAS method (SEDAR 17) and the FHWAR method (SEDAR 28).