Backcalculation of recreational catch of red grouper from 1945 to 1985

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Summary

- Private recreational effort (A, B1 and B2) for the years 1945-1985 were back calculated from a regression of total MRFSS effort against total estimated U. S. vessel registrations.

- Private recreational effort was multiplied by an estimated MRFSS CPUE for the years 1981-1986 prior to regulations to obtain total catch

- Charter boat landings were obtained from point estimates of total numbers of vessels, average number of trips, duration of trip, number of passengers and catch rates from historical surveys.

- Headboat catch rates were obtained in a similar manner from historical surveys and interpolated for the intervening years.

- Total recreational landings were obtained as the sum of the three modes and appear to be between ¼ and 1 million fish between 1947-1985,

- The most questionable assumptions of this method are which historical catch rates to use.

Introduction

An emerging trend in stock assessments is to push the starting point for population modeling further and further back in time. This is necessary in the case of long-lived species for which the entire time series of assessment data may not encompass the lifespan of older individuals (Coleman et al. 2000). It also protects against the shifting baseline syndrome in fisheries (Pauly 1995) where major population changes may have occurred prior to the inception of conventional fisheries data collection programs.

Time series of commercial landings for many marine species extend back to the late 1800's (Schirripa and Legault 1999, Porch et al. 2006) however collection of formal time

series of recreational landings began only in 1981 with the initiation of the Marine Recreational Fisheries Statistics Survey (MFRSS). With recreational landings constituting a substantial source of current fishing mortality estimates (Coleman et al. 2004) and the potential that recreational fishing has been an historically important source of mortality, it is important to extend time series backwards from the start of the formalized MFRSS survey (1981) to the inception of the recreational fishery, likely sometime in the early 1900's though, at present, this date is unknown. Scott (2004) began the recreational fishery for red snapper at 1945, post-World War II and this date is a sensible start date given the increase in US population, recreational spending and leisure time that occurred in the years following the WWII. In the 1999 stock assessment of red grouper Schirripa et al. (1999) back-calculate recreational red grouper catches to a date of 1940 using population census data as a proxy for recreational catch and effort.

This paper back calculates recreational catches of red grouper for the time period from 1945 to 1985 or the initiation reliable MRFSS data collection. We utilize several proxies to obtain recreational effort and from that and assumed CPUE's, total catch: human census numbers in the Gulf of Mexico Coastal counties, nationwide marine and boating expenditures in dollars and total numbers of vessels owned in the United States. To obtain charterboat and headboat landings we use data found in several published accounts of headboat and charterboat catch and effort. We also provide a brief history and description of the recreational fishery.

Beginnings of a recreational fishery for red grouper

One of the first accounts of sportfishing for groupers is given by Holder (1908) under a description of sportfishing in Florida and published alongside accounts of fishing at famous locations as the Catalina Tuna club. From these historical accounts and the obvious largesse with which the pioneers of saltwater sportfishing pursued gamefish (http://www.tunaclub.com/publichome.htm), it appears that the fraternity of ocean sportfishers was small and rather exclusively confined to those with the time and money to pursue fish in the ocean for sport. Moreover, the tackle, vessels and technology to fish in the ocean was very limited and the period prior to and immediately after World War II has been termed the "bamboo age" of saltwater fishing (Moss 1976), defined its primary rod building material. Bottom fishing for groupers and snappers was conducted with handlines and tarred cotton line (Jarvis 1935) and there was likely little distinction between whether this fishing was recreational or commercial. It is likely that most substantive fishing for snappers and groupers prior to World War II was of a commercial rather than a sport or recreational nature.

Immediately after World War II the nature of saltwater sportfishing nationwide and in the Gulf Coast began to change in two ways. First, increased leisure time and disposable income allowed more people to participate in fishing and to vacation in what would become the resort towns of the Gulf Coast. The increased numbers of visitors spawned a large party boat fishery in the Gulf coast of Florida which primarily targeted red snapper but also groupers (Ellis 1958). These offshore party or headboats charged anglers by the head and allowed the average fisherman a low-cost means of accessing the abundant

snapper-grouper fishing grounds that otherwise were fished only commercially. It is likely that a substantial fraction of the catch of these headboats was sold by the fee-paying passengers to offset the cost of the trip but these landings would likely never have been recorded as commercial landings. It appears that headboat effort was the primary source of recreational red grouper landings in the 1950's and 1960's.

The second way saltwater sportfishing changed was through what has been termed the "the Great Boating Boom of the 1950's" (Moss, 1976) where improvements in vessel motor technology and the mass production of fiberglass boats greatly increased the availability of vessels that could take fisherman into ocean waters. Major improvements in fishing tackle, navigational and fish and depth-finding electronics also greatly increased the efficiency of the average fishermen to get to and from ocean fishing grounds and to find, hook and capture reef and structure-associated fish such as grouper. The combination of these the three factors of increased boating accessibility, technological improvements and greater recreational fishing demand have conspired to make recreational fishing a substantial source of mortality for reef complex species (Coleman et al. 2004) and, in particular, red grouper.

Description of the recreational fisheries

Recreational red grouper landings in the Gulf of Mexico have traditionally come from the West Coast and Pan handle region of Florida. Only limited landings exist in the MRFSS data base from Alabama, Mississippi and Lousiana and the majority of these landings have occurred in recent years (2000 and later) and no landings have been reported in the MRFSS database from Texas.

The major ports of for red grouper are Key West, Naples, Ft. Myers Beach, Boca Grande, Clearwater, Panama City, Destin and Pensacola. Pinellas county was historically the epicenter of West Florida offshore fishing possessing an extensive party and charter boat fleet as far back as at least 1954 (Moe 1966, http://www.hubbardsmarina.com/history.html). Groupers and specifically red grouper were the target species. For party boats the red grouper was the most abundant grouper in catches with the exception of the counties of Citrus, Levy, Taylor and Wakulla where the black (or gag, author's emphasis) grouper was the most abundant (Moe, 1966). The dominance of red grouper in party boat catches is a dramatic change from current boat catches where grunts (Haemulidae) far exceed groupers in numbers and gag (*Myctoperca microlepis*) exceed red grouper.

Party boats usually made 8-hour trips 15-18 miles offshore to depths of around 10-15 fathoms with an average travel time of about 1.5 hours each way giving an average fishing time of 4-5 hours per 8 hour trip (see http://www.hubbardsmarina.com/charts.html for a chart of the fishing grounds from Madeira beach, a major Pinellas county port). A few boats made either shorter four-hour trips to near-shore ground to fish for grunts or longer 16-18 hour runs to the Florida Middlegrounds. The first party boat to regularly fish the Florida Middlegrounds appears to have started in 1956.

Based on the Moe's (1963) characterization of the Florida Panhandle fisheries almost all of the party boat fishing was for red snapper in offshore waters in 10-35 fathoms. Red grouper constituted a portion of the catch but was much less important in the fishery than on the West and Southwest coast of Florida. The major ports were and still are Pensacola, Destin, Panama City and Carrabelle. Very few red groupers were historically landed from west of Alabama and this trend continues in the rare occurrence of red groupers in MFRSS estimates from Texas, Louisiana and Mississippi.

Predicting catches

1. Private recreational

We obtained private vessel catch data from predictions of total trips from MRFSS and estimates of the catch of groupers per trip obtained from MRFFS CPUE data (http://www.st.nmfs.gov/st1/recreational/overview/overview.html). We predicted total private recreational and total private and charter trips from the total number of boats owned nationwide. Estimates of the total number of boats owned nationwide were obtained from the National Marine Manufacturers Association (http://www.nmma.org/facts/boatingstats/2001/files/boatsowned.asp) and consist of the total numbers of all types of boats owned across the country. These estimates exist back to 1913. We used several other proxies for recreational effort (Table 1). We obtained data on total NMMA nationwide retail boating expenditures accessed at the following website: http://www.nmma.org/facts/boatingstats/2002/files/retailexpenditures.asp. and all values were converted to 2006 dollars using the consumer price index (2005/files/ Abstract.pdf , http://data.bls.gov/cgi-bin/cpicalc.pl). We also obtained data on Gulf Coast county population census numbers and on the total numbers of fishing licenses nationwide (USFWS, http:// federalaid.fws.gov/).

We obtained regressions of the natural log of the total number of MRFSS private and private and charter trips (Table 3) against the total number of vessels, retail expenditures, census numbers and license numbers. The numbers of boats owned provided the best fit to the data (Figure 1, Table 2). We then obtained an average catch of red grouper per trip from the private recreational fishery for the years 1981-1986 prior to the imposition of any size or bag limits from MRFSS catch and effort statistics (Table 4). This value (0.09 grouper per trip) was then multiplied by the predicted number of private vessel trips to obtain predicted catch of red grouper by number (Table 7, Figure 2). We also predicted the number of private plus charter trips and obtained a total catch based on the same CPUE (blue line in Figure 2) but these values are used only for comparison and not to obtain the total recreational catch.

Note that we use total numbers of grouper caught under the assumption that few groupers were released in the days prior to size or bag limits. Also historical catch rate data made no mention of released grouper, and provide only numbers of red grouper caught per hour of actual fishing (not travel) time (Brusher and Palko 1985). Assuming that the same percentage of red grouper was released prior to 1981 as for the time period from 1981 to 1986, prior to the imposition of size or bag limits, MRFSS estimates of B2 (live releases)

can be divided by the total catch (A+B1+B2) to get the fraction of the total catch that is landed. Assuming a release mortality rate of 10% similar to Schirripa et al. (1999) using data from Wilson and Burns (1996), the total recreational kill can be estimated by multiplying the percentage of live releases by 10% and adding this to the A and B1 component (Table 3).

2. Obtaining historical headboat and charter catch

Neither of the proxies for private recreational or private plus charter effort were positively correlated with headboat effort (Table 3). This is likely due to the fact that headboat effort is inversely correlated with the rise in private vessel usage. Once people own their own boat, their patronage of headboats is likely to decrease. Use of one of these proxies is likely to underestimate historical headboat catch and effort.

Given the difficulty of finding a suitable proxy for party boat landings and the availability of several detailed surveys of the party boat fishery for the years 1955, 1960, 1977 and 1985 (Ellis, et al, 1958, Moe 1963. Browder et al 1981, Brusher, & Palko 1985, Brusher & Palko 1987, Ditton et al. 1992) we obtained point estimates of party boat landings for these years and interpolated between them. We have separated the headboat fishery into two areas activity: a) Southwest and West central Florida and b) Northwest and Panhandle Florida (Table 5). Based on fairly detailed information on the number of party boats we can obtain a total number of angler hours as the product of the average numbers of fishers per boat, the average number of trips per year and the average hours fished. When data was unavailable for a given year we used values from similar locations or years. Ellis provides the most detailed information on the average duration of a fishing trip. Since the effort data is in fish per hour fishing (Brusher and Palko 1985) we divide the trip duration in half as we assume that one-half of the trip is spent traveling, searching for fish, etc and the other half is spent with lines in the water. To obtain catch we multiply this effort by the average catch rates.

We apply catch rates from charter boats (Brusher and Palko 1985) for years 1955, 1950 and 1977 and catch rates (0.58 grouper per hour in Southwest Florida and 0.17/ hr in Northwest Florida) to obtain headboat catches. For 1985 we use catch rates from MRFSS estimates from “targeted” grouper trips from 1981-1986 (0.128 in SW and 0.007 in NW). These estimates are also in groupers per hour assuming that one-half of the total duration of a fishing trip is actually spent fishing. These catch rates are far lower than those in Brusher and Palko (1985) and it may be a tenuous assumption catch rate data borrowed from the charter boat fishery in 1984-85 applies to headboats in the 50’s – 70’s however no other headboat catch rates could be found. It is highly unlikely, however, that catch rates from MRFSS estimates from 1981-1986 should be applied for the entire headboat time series as a catch rate of 0.17 groupers per hour per man translate to an average of less than one grouper per trip (0.969) for a fishery (Central West Florida) in which red grouper were the primary species (Moe 1966).

It may be likely that headboat catch rates are not as high as charterboat catch rates and if this is the case then we are overestimating headboat catch of grouper. This issue can

likely be dealt with by framing the question of historical catch rates in the form of “how many red grouper did an average headboat angler catch? Figure 3 shows predicted headboat landings if fisherman caught (or caught and released 2 or 4 red grouper). Similarly, decreases in catch rate can be explored.

As similar data from also exists for charterboats from the same data sources for the years 1955, 1960, 1977 and 1985 we obtained point estimates and interpolated charter boat catches to provide a comparison with charter boat catches obtained from predicted effort in (1). Not that we obtained an estimate for 1987 (476.61 million fish) that was far higher than the MRFFS estimate of 132.99 million fish. We used 476.61 million fish and linearly interpolated from the 1977 estimate.

Constructing the continuous time series

To construct a continuous time series we summed predictions from the three modes of recreational fishing for the years 1945 to 1986. We used predictions or literature estimates up to 1986 due to the low precision of the MRFSS survey estimates in early years and due to the fact that charter and headboats were not separated until after 1986. Alternatively predictions could be truncated at 1981 (the beginning of MRFSS).

References

Browder, J. A., J. Connor Davis, E. Sullivan. 1981. Paying-passenger recreational fisheries of the Florida Gulf Coast and Keys. Marine Fisheries Review 43(8):12-20.

Brusher, H. A. and B. J. Palko. 1985. 1983 charterboat catch and effort from a sample survey of charterboat captains in the Southeastern United States, 1985. U. S. Dept of Commerce NOAA Technical Memo. NMFS-SEFC-170, 138 p.

Brusher, H. A., B. J. Palko, 1987. Results from the 1984 and 1985 surveys in Southeastern U. S. waters and the U.S. Caribbean Sea. Marine Fisheries Review. 49(2) 109-117.

Coleman, F. C., W. F. Figueira, J. S. Ueland, L. B. Crowder. 2004. The impact of recreational fisheries on marine fish populations. Science. Vol. 305, no. 5692, pp. 1958-1960.

Ditton, R. B., S. M. Holland, D. A. Gill. 1992. The U.S. Gulf of Mexico Party Boat Industry: Activity centers, species targeted and fisheries management options. Marine Fisheries Review. 54(2): 15-27.

Ellis, R. W., A. Rosen and A. W. Moffett. 1958. A survey of the number of anglers and their fishing effort and expenditures in the coastal recreational fishery of Florida. Florida State Board of Conservation Marine Laboratory. Technical Series 24.

Holder, C. H. 1908. Sportfishing in California and Florida. Proceedings of the fourth international fisheries congress. Washington, D. C.

Moe, M. A. 1963. A survey of offshore fishing in Florida. Florida State Board of Conservation Marine Laboratory. Professional Paper Series No. 4.117 p.

Moss, F. T. 1976. Modern Saltwater Fishing Tackle. International Marine Publishing Company, Camden ME.

Schirripa, M.J., C.M. Legault and M. Ortiz. 1999. The red grouper fishery of the Gulf of Mexico: Assessment 3.0. National Marine Fisheries Service, Sustainable Fisheries Division. Miami, SFD-98/99-56.

Scott, G. P. 2004. Estimates of historical red snapper recreational catch levels using US census data and recreational survey information. SEDAR7-AW16.

Wilson, R.R., Jr. and K.M. Burns. 1996. Potential survival of released groupers caught deeper than 40 M based on shipboard and in-situ observations, and tag-recapture data. Bul. Mar. Sci. 58(1): 234-247.

Table 1. Proxies used to predict fishing effort.

Year	NMMA retail expenditures on boating (billion $'s), adjusted for to 2006 dollars with consumer price index	NMMA Total registered and nonregistered water craft, outboard (48%), IB, I/O, sail, jetski, other (million)	Gulf states census numbers, interpolated between census estimates in bold (million)	USFWS Licenses, total US (million)
	http://www.nmma.org/facts/boatingstats/2002/files/ retailexpenditures.asp, http://www.nmma.org/facts/boatingstats/2005/files/ Abstract.pdf , http://data.bls.gov/cgi-bin/cpicalc.pl	http://www.nmma.org/facts/boatingstats/2001/files/boatsowned.asp, http://www.nmma.org/facts/boatingstats/2005/files/Abstract.pdf	1900-1990: http://www.census.gov/population/www/ce nsusdata/cencounts.html) 2000 census: http://www.factfinder.census.gov/. Gulf states are those that directly border Gulf of Mexico	http:// federalaid.fws.gov/
1900	NA	NA	0.8996	NA
1910	NA	NA	1.1804	NA
1913	NA	0.4000	1.2574	NA
1920	NA	NA	1.3345	NA
1930	NA	1.5000	1.6498	NA
1940	NA	1.6827	1.6135	NA
1941	NA	1.8655	1.6857	NA
1942	NA	2.0482	1.7579	NA
1943	NA	2.2309	1.8301	NA
1944	NA	2.4136	1.9023	NA
1945	NA	2.5964	1.9745	NA
1946	NA	2.7791	2.0467	NA
1947	NA	2.9618	2.1189	NA
1948	NA	3.1445	2.1911	NA
1949	NA	3.3273	2.2633	NA
1950	NA	3.5100	2.3355	NA
1951	NA	3.8432	2.4587	NA
1952	NA	4.1764	2.5818	NA
1953	NA	4.5095	2.7049	NA
1954	NA	4.8427	2.8280	NA
1955	8.9634	5.1759	2.9511	NA
1956	10.6912	5.5091	3.0742	NA
1957	12.1489	5.8423	3.1973	NA
1958	13.5629	6.1755	3.3204	1.3708
1959	15.2079	6.5086	3.4436	1.3735
1960	16.6599	6.8418	3.5667	1.4247
1961	17.0937	7.1750	3.6537	1.4458
1962	17.5123	7.3571	3.7407	1.4368
1963	17.8706	7.5392	3.8278	1.5054
1964	18.2133	7.7213	3.9148	1.7092
1965	18.4946	7.9034	4.0018	1.4122
1966	18.5294	8.0856	4.0889	1.6521
1967	18.5126	8.2677	4.1759	1.8919
1968	18.2785	8.4498	4.2630	1.9828

Table 1, continued

Year	NMMA expenditures	NMMA boats	Census	Licenses
1969	17.8218	8.6319	4.3500	2.0738
1970	17.3153	8.8140	4.4370	2.0906
1971	17.9387	9.1158	4.5870	2.1074
1972	18.6890	9.4176	4.7371	2.2133
1973	18.8262	9.7194	4.8871	2.3193
1974	18.0643	10.0212	5.0371	2.3261
1975	17.4245	10.3230	5.1871	2.2412
1976	18.3973	10.6248	5.3372	2.2665
1977	19.8213	10.9266	5.4872	2.2917
1978	20.8190	11.2284	5.6372	2.1604
1979	20.9607	11.5302	5.7872	2.1698
1980	18.1477	11.8320	5.9372	2.1793
1981	18.4150	12.2212	6.0535	2.3035
1982	18.0802	12.6104	6.1699	2.4277
1983	19.7118	12.9996	6.2862	2.4966
1984	24.0980	13.3888	6.4025	2.4868
1985	25.0495	13.7780	6.5188	2.4771
1986	26.8046	14.1465	6.6351	2.4399
1987	29.4705	14.5150	6.7514	2.4027
1988	30.7472	15.0930	6.8678	2.4399
1989	28.0509	15.6580	6.9841	2.5362
1990	21.3161	15.9870	7.1004	2.6813
1991	15.7374	16.2620	7.1466	2.5902
1992	14.9203	16.2620	7.1927	2.6150
1993	15.8023	16.2120	7.2389	2.6333
1994	19.2645	16.2390	7.2851	2.5569
1995	22.9341	15.3750	7.3312	2.4744
1996	22.9578	15.8300	7.3774	2.5792
1997	24.4542	16.2300	7.4236	2.7830
1998	23.8351	16.8240	7.4697	2.7811
1999	26.4720	16.7905	7.5159	2.6396
2000	32.8069	16.9911	7.5621	2.5748
2001	32.6760	16.9994	NA	NA
2002	34.1840	17.3400	NA	NA
2003	33.3109	17.4000	NA	NA
2004	35.3920	17.6100	NA	NA
2005	38.7723	17.9500	NA	NA

Table 2. Private charter and headboat fishing activity and catch rates from 1955-1985 for a) Southwest and West central Florida and b) Northwest and Panhandle Florida.

Year	Private recreational trips MRFSS, Vivian Matter, SEFSC	Private recreational and charter trips MRFSS, Vivian Matter, SEFSC	charter trips MRFSS, Vivian Matter, SEFSC	headboat trips (areas 18,20,21,22,23,24,25,26,27) Beaufort headboat survey, Patrica Phares
1981	7,764,455			
1982	5,438,965			
1983	6,841,641			
1984	7,506,796			
1985	8,314,889			
1986	8,136,242	8,138,229	513,342	302,536
1987	8,517,788	8,519,777	546,764	286,774
1988	10,698,532	10,700,522	559,513	274,035
1989	8,712,307	8,714,298	524,157	274,581
1990	7,216,506	7,218,498	426,134	278,948
1991	9,086,738	9,088,731	449,908	240,654
1992	9,373,254	9,375,248	469,662	270,931
1993	9,041,306	9,043,302	788,055	300,058
1994	9,384,801	9,386,797	860,370	317,991
1995	9,570,896	9,572,893	1,020,387	283,372
1996	9,351,017	9,353,015	990,457	257,753
1997	10,195,083	10,197,082	1,091,871	240,657
1998	8,938,905	8,940,906	760,667	270,835
1999	9,097,803	9,099,805	683,768	242,378
2000	11,728,464	11,730,467	811,634	222,678
2001	12,371,138	12,373,142	742,386	218,826
2002	11,635,095	11,637,100	764,222	215,004
2003	14,110,007	14,112,013	691,362	225,279
2004	14,232,316	14,234,325	782,409	223,420
2005	12,636,632	12,638,642	1,125,006	190,090

Table 3. Regressions of the natural log of all MRFSS or Headboat surveys estimates of total number of trips in the Gulf, excluding Texas for private recreational, recreational and charterboat combined, charterboat and headboat versus national expenditures on boating, number of national boats, Gulf counties population census and number of national fishing licenses. Models with asterisks were used to predict the values in table 7.

Model	Slope	intercept	R-squared
ln(recreational trips, millions) ~ expenditures	0.025	1.586	0.49
ln(recreational trips, millions) ~ boats	0.127	0.245	0.73*
ln(recreational trips, millions) ~ census	0.316	-0.065	0.67
ln(recreational trips, millions) ~ licenses	0.627	0.543	0.17
ln(recreational and charter trips, millions) ~ expenditures	0.023	1.779	0.49
ln(recreational and charter trips, millions) ~ boats	0.114	0.592	0.69*
ln(recreational and charter trips, millions) ~ census	0.291	0.266	0.65
ln(recreational and charter trips, millions) ~ licenses	0.571	0.839	0.17
ln(charterboat trips) ~ expenditures	0.013	13.116	0.09
ln(charterboat trips)~ boats	0.124	11.440	0.12
ln(charterboat trips) ~ census	0.722	8.219	0.72
ln(charterboat trips) ~ licenses	0.707	11.585	0.71
ln(headboat trips) ~ boats	-0.065	13.539	-0.07
ln(headboat trips) ~ census	-0.191	13.876	-0.19
ln(headboat trips) ~ exp	-0.013	12.799	-0.01
ln(headboat trips) ~ licenses	-0.318	13.327	-0.32

Table 4. MRFSS estimates of total catch and total effort for all red groupers for all areas (ocean <=,>=3mi, ocean >10, ocean <= 10 mi) from West Florida, Alabama, Mississippi and Louisiana for the years 1981-1986 prior to any regulations. This is used to obtain an overall CPUE. The percent discards could be used to obtain numbers discarded from the predictions in Table 7.

Year	Catch (numbers)	Effort (trips)	CPUE (#/trip)	Percent Discards (B2/sum(A+B1+B2))
1981	146,887.00	6,801,904	0.0216	0.3337
1982	315,109.57	5,438,965	0.0579	0.1761
1983	730,632.28	6,608,030	0.1106	0.2608
1984	1,496,931.36	7,506,796	0.1994	0.2634
1985	472,218.05	6,927,563	0.0682	0.0831
average			0.0915	0.2234

Table 5. Headboat fishing activity and catch rates from 1955-1985 for a) Southwest and West central Florida and b) Northwest and Panhandle Florida.

a. Southwest and West central Florida

Major ports: Johns Pass, Clearwater, Sarasota, Tarpon Springs, Ft Myers

year	# party boats	Avg # fishers	average number of trips	Total Trips	Average hours fished (Based on Ellis 1958, 6.7 hours, I assumed that 1/2 time is fishing	Grouper / hr, years 55-77- Brusher and Palko for charter boats, 1985- MRFSS estimates for targeted grouper trips	Grouper per man per trip	Source
1955	24	18	201	87,141	3.4	0.58	1.94	Ellis et al (1958)
1960	28	18	201	101,664	3.4	0.58	1.94	Moe (1963)
1977	22	18	201	79,879	3.4	0.58	1.94	Browder et al (1981)
1985	62	18	280	294,940	3.4	0.12	0.429	Ditton et al (1992)

b. Northwest and Panhandle Florida

Major ports: Carrabelle, Destin, Panama City, Pensacola

year	# party boats	Avg # fishers	average number of trips	Total Trips	Average hours fished (Based on Ellis 1958, 6.7 hours, I assumed that 1/2 time is fishing	Grouper / hr, years 55-77- Brusher and Palko for charter boats, 1985- MRFSS estimates for targeted grouper trips	Grouper per man per trip	Source
1955	57	17	1955	111,550	5.7	0.17	0.969	Ellis et al (1958)
1960	48	17	1960	93,937	5.7	0.17	0.969	Moe (1963)
1977	23	17	1977	45,011	5.7	0.17	0.969	Browder et al (1981)
1985	14	17	1985	66,599	5.7	0.007	0.041738	Ditton et al (1992)

Table 6. Charterboat fishing activity and catch rates from 1955-1985 for a) Southwest and West central Florida and b) Northwest and Panhandle Florida.

a. Southwest and West central Florida

Major ports: Johns Pass, Clearwater, Sarasota, Tarpon Springs, Ft Myers

year	Number of charter boats	Avg # fishers	average number of trips	Total Trips	Average hours fished (Based on Ellis 1958, 6.7 hours, I assumed that 1/2 time is fishing	Grouper / hr, years 55-77- Brusher and Palko for charter boats, 1985- MRFSS estimates for targeted grouper trips	Grouper per man per trip	Source
1955	165	4	113	74,844	3.8	0.58	2.204	Ellis
1960	157	4	113	71,215	3.8	1.46	5.548	Moe
1977	138	4	113	62,597	3.8	0.58	2.204	Browder et al.
1985	530	4	113	472,897	3.4	0.170	0.5695	Ditton et al 1992

b. Northwest and Panhandle Florida

B. Major ports: Carrabelle, Destin, Panama City, Pensacola

year	Number of charter boats	Avg # fishers	average number of trips	Total Trips	Average hours fished (Based on Ellis 1958, 6.7 hours, I assumed that 1/2 time is fishing	Grouper / hr, years 55-77- Brusher and Palko for charter boats, 1985- MRFSS estimates for targeted grouper trips	Grouper per man per trip	Source
1955	76	4	109	30,595	3.0	0.04	0.1193	Ellis
1960	126	4	109	50,723	0.0	0.04	0	Moe
1977	108	4	109	43,476	3.4	0.67	2.30815	Browder et al.
1985	107	4	109	43,640	3.4	0.040	0.1378	Ditton et al 1992

Table 7. Predictions of total catch from literature surveys and from the regression of total trips versus numbers of boats. Estimates from the literature are in bold, interpolations of these estimates are in italics. Predictions from the regressions are underlined. Values that are used to construct figure are shaded in the color on the figure

year	from survey, in thousands		predicted from boats			MRFSS, in thousands				
	1. charter	2. headboat	3. private	4. private, charter	5. total from (1, 2 and 4)	1. charter	2. charter/ head	3. Private recreational and shore	5. Beaufort Head boat	6. MRFSS Total
1945	0.00	0.00	162.40	222.35	222.35	NA	NA	NA	NA	NA
1946	*17.38*	*27.74*	166.20	227.02	272.14	NA	NA	NA	NA	NA
1947	*34.75*	*55.48*	170.09	231.79	322.03	NA	NA	NA	NA	NA
1948	*52.13*	*83.22*	174.07	236.66	372.01	NA	NA	NA	NA	NA
1949	*69.50*	*110.96*	178.14	241.64	422.10	NA	NA	NA	NA	NA
1950	*86.88*	*138.70*	182.31	246.71	472.29	NA	NA	NA	NA	NA
1951	*104.25*	*166.44*	190.16	256.24	526.94	NA	NA	NA	NA	NA
1952	*121.63*	*194.18*	198.35	266.14	581.96	NA	NA	NA	NA	NA
1953	*139.00*	*221.93*	206.90	276.43	637.36	NA	NA	NA	NA	NA
1954	*156.38*	*249.67*	215.81	287.11	693.15	NA	NA	NA	NA	NA
1955	**173.75**	**277.41**	225.10	298.20	749.36	NA	NA	NA	NA	NA
1956	*171.58*	*279.64*	234.80	309.72	760.94	NA	NA	NA	NA	NA
1957	*169.40*	*281.87*	244.91	321.69	772.96	NA	NA	NA	NA	NA
1958	*167.22*	*284.10*	255.46	334.12	785.44	NA	NA	NA	NA	NA
1959	*165.05*	*286.33*	266.47	347.03	798.40	NA	NA	NA	NA	NA
1960	**162.87**	**288.56**	277.94	360.44	811.86	NA	NA	NA	NA	NA
1961	*159.13*	*283.28*	289.91	374.36	816.77	NA	NA	NA	NA	NA
1962	*155.40*	*278.00*	296.67	382.20	815.60	NA	NA	NA	NA	NA
1963	*151.66*	*272.72*	303.59	390.20	814.58	NA	NA	NA	NA	NA
1964	*147.92*	*267.44*	310.67	398.37	813.74	NA	NA	NA	NA	NA
1965	*144.18*	*262.17*	317.92	406.71	813.06	NA	NA	NA	NA	NA
1966	*140.45*	*256.89*	325.33	415.23	812.56	NA	NA	NA	NA	NA
1967	*136.71*	*251.61*	332.91	423.92	812.24	NA	NA	NA	NA	NA
1968	*132.97*	*246.33*	340.68	432.80	812.10	NA	NA	NA	NA	NA
1969	*129.24*	*241.05*	348.62	441.86	812.14	NA	NA	NA	NA	NA
1970	*125.50*	*235.77*	356.75	451.11	812.38	NA	NA	NA	NA	NA
1971	*121.76*	*230.49*	370.64	466.87	819.12	NA	NA	NA	NA	NA
1972	*118.02*	*225.21*	385.07	483.18	826.42	NA	NA	NA	NA	NA
1973	*114.29*	*219.94*	400.07	500.06	834.28	NA	NA	NA	NA	NA
1974	*110.55*	*214.66*	415.64	517.53	842.73	NA	NA	NA	NA	NA
1975	*106.81*	*209.38*	431.83	535.61	851.80	NA	NA	NA	NA	NA
1976	*103.08*	*204.10*	448.64	554.32	861.49	NA	NA	NA	NA	NA
1977	**99.34**	**198.82**	466.11	573.68	871.84	NA	NA	NA	NA	NA
1978	*137.07*	*189.81*	484.26	593.72	920.60	NA	NA	NA	NA	NA
1979	*174.79*	*180.79*	503.12	614.47	970.05	NA	NA	NA	NA	NA
1980	*212.52*	*171.78*	522.71	635.93	1,020.23	NA	NA	NA	NA	NA
1981	*250.25*	*162.76*	549.10	664.73	1,077.74	NA	177.62	165.76	NA	343.38
1982	*287.98*	*153.75*	576.83	694.82	1,136.55	NA	46.78	319.18	NA	365.96
1983	*325.70*	*144.74*	605.95	726.28	1,196.72	NA	102.15	755.32	NA	857.47

Table 7. Continued.

	1. charter	2. headboat	3. private	4. private, charter	5. total from (1, 2 and 4)	1. charter	2. charter/ head	3. Private recreational and shore	5. Beaufort Head boat	6. MRFSS Total
1984	*363.43*	*135.72*	636.55	759.17	1,258.32	NA	288.04	1,593.02	NA	1,881.05
1985	*401.16*	**126.71**	668.69	793.54	1,321.41	NA	408.85	477.34	NA	886.19
1986	*438.89*	*NA*	700.62	827.52	NA	132.99	NA	1,126.97	57.36	1,317.32
1987	**476.61**	*NA*	734.07	862.95	NA	119.35	NA	751.10	60.76	931.22
1988	*NA*	*NA*	789.79	921.61	NA	81.56	NA	1,468.38	64.99	1,614.92
1989	*NA*	*NA*	848.34	982.81	NA	130.08	NA	2,592.17	185.35	2,907.60
1990	*NA*	*NA*	884.41	1,020.29	NA	228.25	NA	1,509.55	235.68	1,973.48
1991	*NA*	*NA*	915.73	1,052.72	NA	61.24	NA	3,229.91	122.30	3,413.45
1992	*NA*	*NA*	915.73	1,052.72	NA	172.47	NA	2,939.49	71.50	3,183.45
1993	*NA*	*NA*	909.96	1,046.75	NA	139.29	NA	1,961.08	60.08	2,160.45
1994	*NA*	*NA*	913.07	1,049.97	NA	128.36	NA	1,836.10	69.51	2,033.97
1995	*NA*	*NA*	818.49	951.66	NA	190.17	NA	1,713.90	113.87	2,017.94
1996	*NA*	*NA*	867.01	1,002.23	NA	86.66	NA	1,114.71	168.30	1,369.66
1997	*NA*	*NA*	912.03	1,048.90	NA	124.22	NA	1,043.47	90.85	1,258.54
1998	*NA*	*NA*	983.24	1,122.24	NA	245.66	NA	1,385.78	110.03	1,741.47
1999	*NA*	*NA*	979.08	1,117.97	NA	357.28	NA	1,907.77	99.82	2,364.87
2000	*NA*	*NA*	1,004.27	1,143.78	NA	642.63	NA	1,913.96	89.48	2,646.07
2001	*NA*	*NA*	1,005.32	1,144.86	NA	288.39	NA	1,592.18	103.72	1,984.28
2002	*NA*	*NA*	1,049.60	1,190.10	NA	271.12	NA	1,926.18	NA	2,197.30
2003	*NA*	*NA*	1,057.60	1,198.25	NA	338.41	NA	1,959.88	NA	2,298.29
2004	*NA*	*NA*	1,086.09	1,227.22	NA	431.24	NA	3,186.51	NA	3,617.75
2005	*NA*	*NA*	1,133.85	1,275.63	NA	398.69	NA	1,516.44	NA	1,915.13

Table 7. Continuous time series of recreational landings. Estimates in bold are predicted, estimated from literature or linearly interpolate

year	1. charter	2. headboat	3. private	total
1945	**0**	**0**	**162,400**	**162,400**
1946	**17,380**	**27,740**	**166,200**	**211,320**
1947	**34,750**	**55,480**	**170,090**	**260,320**
1948	**52,130**	**83,220**	**174,070**	**309,420**
1949	**69,500**	**110,960**	**178,140**	**358,600**
1950	**86,880**	**138,700**	**182,310**	**407,890**
1951	**104,250**	**166,440**	**190,160**	**460,850**
1952	**121,630**	**194,180**	**198,350**	**514,160**
1953	**139,000**	**221,930**	**206,900**	**567,830**
1954	**156,380**	**249,670**	**215,810**	**621,860**
1955	**173,750**	**277,410**	**225,100**	**676,260**
1956	**171,580**	**279,640**	**234,800**	**686,020**
1957	**169,400**	**281,870**	**244,910**	**696,180**
1958	**167,220**	**284,100**	**255,460**	**706,780**
1959	**165,050**	**286,330**	**266,470**	**717,850**
1960	**162,870**	**288,560**	**277,940**	**729,370**
1961	**159,130**	**283,280**	**289,910**	**732,320**
1962	**155,400**	**278,000**	**296,670**	**730,070**
1963	**151,660**	**272,720**	**303,590**	**727,970**
1964	**147,920**	**267,440**	**310,670**	**726,030**
1965	**144,180**	**262,170**	**317,920**	**724,270**
1966	**140,450**	**256,890**	**325,330**	**722,670**
1967	**136,710**	**251,610**	**332,910**	**721,230**
1968	**132,970**	**246,330**	**340,680**	**719,980**
1969	**129,240**	**241,050**	**348,620**	**718,910**
1970	**125,500**	**235,770**	**356,750**	**718,020**
1971	**121,760**	**230,490**	**370,640**	**722,890**
1972	**118,020**	**225,210**	**385,070**	**728,300**
1973	**114,290**	**219,940**	**400,070**	**734,300**
1974	**110,550**	**214,660**	**415,640**	**740,850**
1975	**106,810**	**209,380**	**431,830**	**748,020**
1976	**103,080**	**204,100**	**448,640**	**755,820**
1977	**99,340**	**198,820**	**466,110**	**764,270**
1978	**137,070**	**189,810**	**484,260**	**811,140**
1979	**174,790**	**180,790**	**503,120**	**858,700**
1980	**212,520**	**171,780**	**522,710**	**907,010**
1981	**250,250**	**162,760**	**549,100**	**962,110**
1982	**287,980**	**153,750**	**576,830**	**1,018,560**
1983	**325,700**	**144,740**	**605,950**	**1,076,390**
1984	**363,430**	**135,720**	**636,550**	**1,135,700**
1985	**401,160**	**126,710**	**668,690**	**1,196,560**
1986	132,990	57,360	1,126,970	1,317,320
1987	119,350	60,760	751,100	931,220

Table 7. Continuous time series of recreational landings, continued

year	1. charter	2. headboat	3. private	total
1987	119,350	60,760	751,100	931,220
1988	81,560	64,990	1,468,380	1,614,920
1989	130,080	185,350	2,592,170	2,907,600
1990	228,250	235,680	1,509,550	1,973,480
1991	61,240	122,300	3,229,910	3,413,450
1992	172,470	71,500	2,939,490	3,183,450
1993	139,290	60,080	1,961,080	2,160,450
1994	128,360	69,510	1,836,100	2,033,970
1995	190,170	113,870	1,713,900	2,017,940
1996	86,660	168,300	1,114,710	1,369,660
1997	124,220	90,850	1,043,470	1,258,540
1998	245,660	110,030	1,385,780	1,741,470
1999	357,280	99,820	1,907,770	2,364,870
2000	642,630	89,480	1,913,960	2,646,070
2001	288,390	103,720	1,592,180	1,984,280
2002	271,120	NA	1,926,180	2,197,300
2003	338,410	NA	1,959,880	2,298,290
2004	431,240	NA	3,186,510	3,617,750
2005	398,690	NA	1,516,440	1,915,130

Figure 1. Regressions of the natural log of all MRFSS or Headboat surveys estimates of total number of trips in the Gulf, excluding Texas for private recreational versus national retail expenditures on boating, number of national boats, Gulf counties population census and number of national fishing licenses.

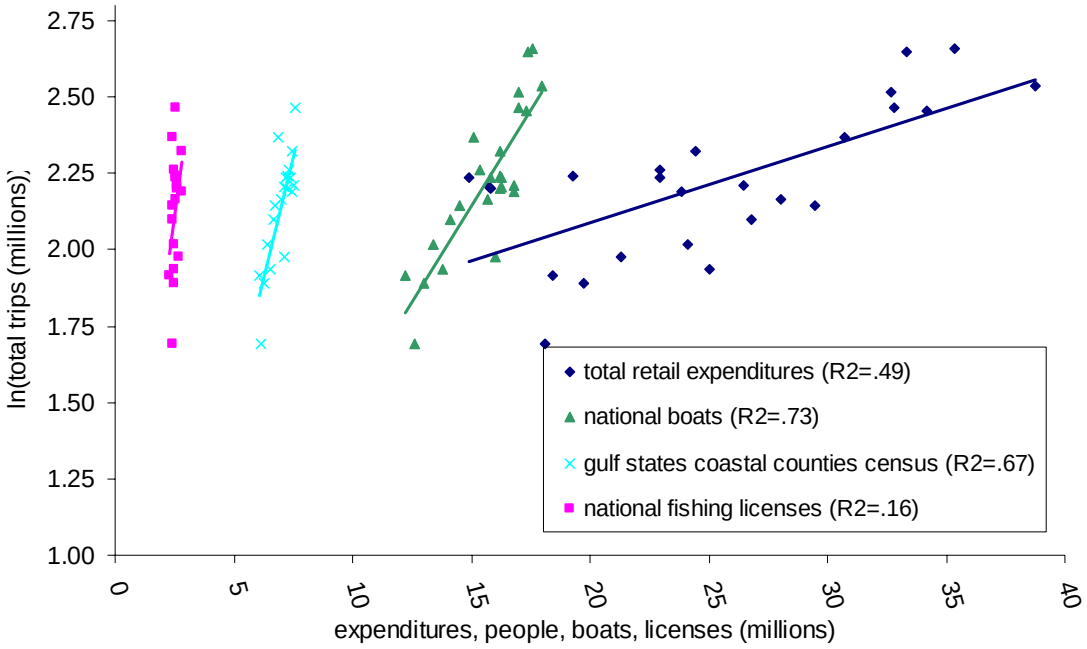

Figure.2. Total catch (A, B1 and B2) of red grouper in all recreational fisheries (thousands of fish). For years 1945-1985 catches are based upon regressions and literature estimates. For 1986 to 2005 catches are from MRFFS and the Beaufort Headboat survey. The blue line is the predicted private recreational and charter catches based upon the total number of nationally owned boats.

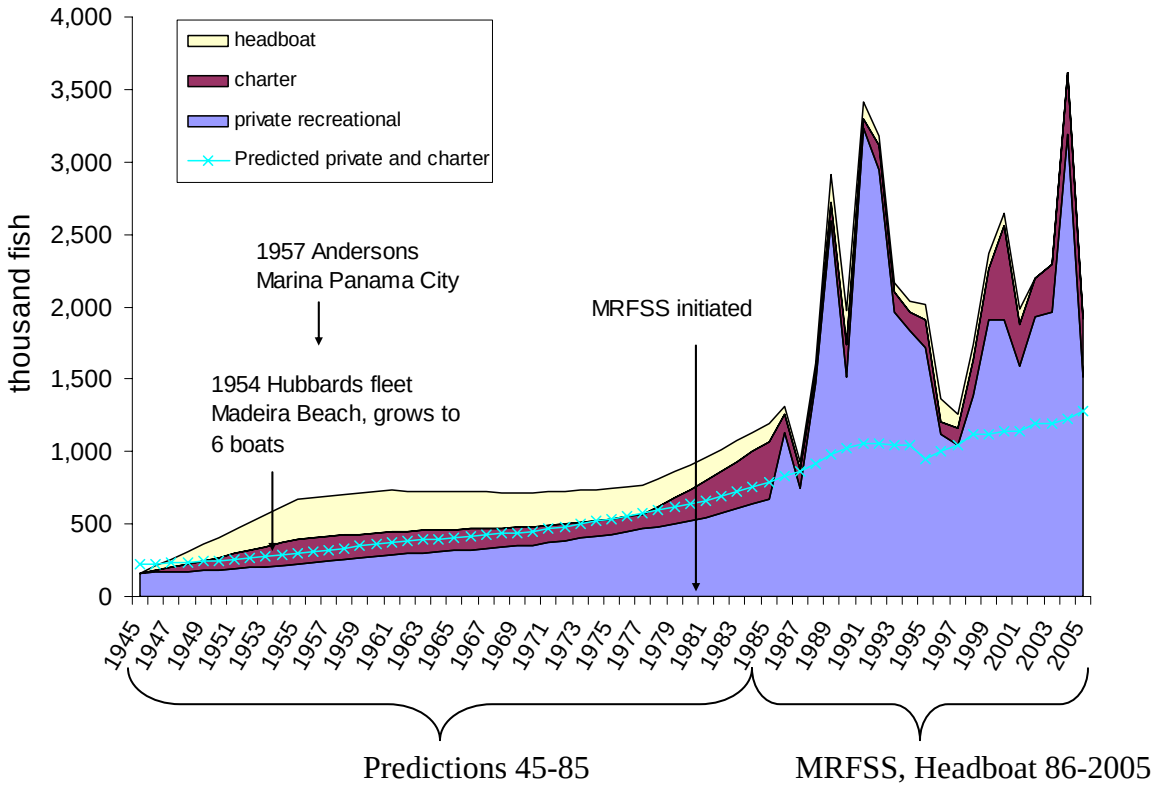

Figure 3. Predictions of headboat catch with either 2 (the assumed number) groupers per man per trip or 4 groupers. The shaded areas is only the additional number that are landed.