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SEDAR 24 Data Workshop

Review and Analysis of Methods to Estimate Historic Recreational Red Snapper Landings in the South Atlantic

Working Paper prepared by the Historic Fisheries Working Group

For the SEDAR 24 Recreational Fisheries Workgroup

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During the Data Workshop for SEDAR 15, the Recreational Workgroup (RWG) was tasked with back-calculating recreational landings for years prior to the start of data collections extending backwards to 1962. Catch estimates from the MRFSS were not available from 1962 to 1980, and for headboat logbook estimates, red snapper landings estimates were not available from 1962 to 1971 from North Carolina to South Carolina, and from 1962 to 1980 for Georgia through Florida. The workgroup considered several historic data sets for comparison with available recreational data sets as a possible means for regressing recreational statistics back in time. Data sets considered during SEDAR 15 included historic U.S. Fish and Wildlife Service Saltwater Angling Surveys from 1960 to present and a database of the number of registered recreational vessels in Florida for the time series 1964 to 2005. Due to numerous methodology changes over several time periods, the U.S. Fish and Wildlife Service does not recommend use of their National Survey of Fishing and Hunting, which was expanded to estimate landings of saltwater species in 1960, as a continuous time series (http://wsfrprograms.fws.gov/Subpages/NationalSurvey/15_year_trend.htm). Therefore, the RWG chose not to use this time series for regressing recreational landings data back in time. The number of registered vessels in Florida steadily increased over time, and this trend did not correspond well with recreational red snapper harvest. Commercial landings data were not available to the Recreational Workgroup because they were still being constructed during the SEDAR 15 Data Workshop. In the absence of a good surrogate data set for recreational catch and harvest trends, the workgroup considered anecdotal accounts of the historic fishery and developments in technology in relation to fishing from recreational vessels.

To back-calculate recreational landings, the RWG averaged estimates from the first three years of available data (1981-1983 for MRFSS, 1972-1974 for headboats) and annual landings estimates were incrementally declined backwards to zero in 1946 (post WWII). Red snapper headboat landings were limited to North Carolina and South Carolina from 1972-1980 and landings for the non-coverage areas from 1972 -1980 were predicted by regressing landings of North Carolina and South Carolina catches combined against Georgia and Florida catches combined. The back-calculated recreational landings were made available to the SEDAR 15 Assessment Workshop for use in the Red Snapper stock assessment model. Preliminary model runs suggested significantly higher landings in the early period (1946-1980) than reflected in the recreational landings. Although the RWG dismissed estimates from the Salt-Water Angling reports (Clark 1962, Deuel and Clark 1968, Deuel 1973), the Assessment and Review Panels agreed that these estimates were at least as reasonable as the linear interpolation to zero in 1946 used by the RWG. Therefore, recreational landings were interpolated between zero in 1946 to 1981 with intermediate landings estimates used for 1960 (Clark 1962), 1965 (Deuel and Clark 1968), and 1970 (Deuel 1973).

SEDAR 24 Historic Fisheries Working Group

The Terms of Reference (TOR) for the SEDAR 24 Data Workshop (DW) list as a product to "Review the application of pre-MRFSS recreational catch records in the SEDAR 15 benchmark

assessment and recommend appropriate use of pre-MRFSS data for assessment of red snapper" (SEDAR24, DW TOR number 7). The Historic Fisheries Working Group (HFWG) was formed in advance of the SEDAR 24 Data Workshop to begin this task. Specifically, the charge given to the HFWG was to:

- Review the use of historical recreational catch surveys in the SEDAR 15 benchmark and discussions pertaining to the surveys in subsequent SEDAR assessments
- Consider other available sources of pre-MRIP and Headboat survey recreational catch estimates
- Recommend approaches for developing recreational catch estimates for the pre-MRIP and Headboat survey periods for consideration at the SEDAR 24 Data Workshop

The HFWG recognized that an important aspect of selecting an appropriate method for estimating historic catches is ground-truthing of the historic development and growth of the fishery through documentation. Much of this information is unpublished and historic fisheries participants are an invaluable resource. The members of the HFWG express their deep gratitude to Rusty Hudson, who pored through historic documents, family photos, and conducted personal interviews with fishermen and scientific researchers to generate an in-depth timeline of events and technology that document the onset and development of what is today one of the South Atlantic's most important recreational fisheries. The introduction of several new technologies, including the introduction of the first fiberglass boats in the 1940's; fiberglass rods and drag reels in the 1950's; LORAN A in the 1960's, which was later replaced in the 1970's by LORAN C; and the progressive development of electronic depth sounders and "fish finders"; all of which made transit to offshore areas, location of offshore reef fish habitats, and the sport of red snapper fishing a possibility for recreational saltwater anglers. During the same time that advances were being made in saltwater fishing technology, the human population in the South Atlantic region of the country was increasing exponentially, particularly in Florida. For-hire charter and party vessel fleets were small in the 1950's and began to steadily increase in the 1960's with improvements to major inlets along the coast. Sport fishing fleets also began to develop during the same time period.

The HFWG explored the following methods for generating estimates of historic recreational red snapper catches:

- Comparing ratios in commercial red snapper landings in the South Atlantic with recreational red snapper estimates for backwards calculations of recreational landings.
- Accounting for species mis-identifications and over-estimations (e.g. recall bias) in the U.S. Fish and Wildlife Saltwater Angling Survey estimates.
- Using U.S. Census data as a proxy for recreational fishing effort to produce regression estimates for red snapper catches.

The catch estimates are analyzed and presented in numbers which is the primary unit of data collection for most recreational data. Analyses presented in this report indicate catches for red snapper were high in the 1970's, dropped to lower levels in the 1980's, decreased through the 1990's, and moderately increased during the 2000's. The HFWG also reviewed a dataset

available online from a Florida sport fishing club, which indicates a similar trend in recreational catches based on club records. All of these trends track well with the timeline for early development and growth of red snapper recreational fisheries in the South Atlantic. Estimates produced from analyses in this report result in a significant reduction in historic recreational catches compared to the data used in SEDAR 15.

HFWG Recommendations

The SEDAR 24 Historic Fisheries Working Group (HFWG) recommends the methods which use (1) the ratios with the commercial red snapper landings and (2) the post-adjusted U.S. Fish and Wildlife Saltwater Angling Survey estimates, be considered by the data workshop for inclusion in the stock assessment. The HFWG believes both of these methods have merits, but could not come to any solid reasons why one method would be better than the other. Both methods have positive aspects and negative drawbacks. The two methods produce similar results in magnitude and historical pattern. Based on our preliminary analysis, we do not recommend use of U.S. Census data for back-calculation of historic recreational catches.

It should be noted that the ratio method should be re-computed at the data workshop, once the commercial landings have been finalized. The HFWG expectation is that these will not change significantly. The Recreational Workgroup will also need to discuss the uncertainty associated with those estimates and decide upon a method to bracket historic landings estimates for use in model runs.

Method 1: Evaluation of the US Fish and Wildlife Service (1960, 1965) and National Marine Fisheries Service (1970) Salt-water Angling Surveys for red snapper in the South Atlantic.

The Saltwater Angling Survey (SWAS) estimates of red snapper landings in weight were used to anchor the linear interpolation of the 1946-1980 time series of landings for SEDAR 15. The method of expanding the data was examined and discussed during the SEDAR 15 workshops. The data are explored here in greater detail addressing concerns raised since the SEDAR 15 assessment. The major concerns include landings reported from the "bridge/pier/jetty" category for 1965 and 1970 and consideration of the bias associated with a 1-year recall period compared to the 2-month recall period currently used to estimate recreational landings.

Historical recreational fishing data in the Southeast U.S. is very limited prior to 1981. Recreational landings were recognized as a major source of removals from stocks and the National Survey of Fishing and Hunting was expanded to estimate landings of saltwater species starting in 1960. The Marine Recreational Fisheries Statistics Survey (MRFSS) provides landings starting in 1981, well after initial exploitation of the snapper-grouper complex. Three separate documents exist that provide estimates of recreational red snapper landings from 1960 (all snapper), 1965, and 1970 (Clark 1962, Deuel and Clark 1968, and Deuel 1973).

The SWAS was conducted adjunct to the National Survey of Fishing and Hunting (NSFH) which consisted of household interviews of a subsample of the Current Population Survey (CPS)

conducted by the Bureau of the Census. The CPS identified individuals that participated in hunting and fishing and those households were subsampled by the NSHF. This subsample of substantial participants in saltwater angling was asked to provide the number and average weight for each species or species grouping. The survey also recorded area fished and the method of fishing. These catch estimates were then expanded by the estimated number of saltwater anglers for each sampling area and then pooled over regions to give landings estimates.

Table 1. Number Snapper Caught (x1,000) in South Atlantic Region.

year		Principal Area		Method of Fishing				
				Boat Still	Boat Motion	Shore Still	Shore Motion	Annual Total
1960	Snappers*			7111	1059	541	722	9433
1960	Yellowtail snapper			358	2200	653		3231
1960	Total			7469	3259	1194	722	12664
		Ocean	Sounds, Rivers, Bays	Private Rented	Party Charter	Bridge, Pier, Jetty	Beach, Bank	Annual Total
1965	Red snapper	500	98	150	213	235	0	598
1965	Yellowtail snapper*	15836	3850	13611	855	4887	333	19686
1965	Snappers	1002	114	419		673	24	1116
1965	Total	17338	4062	14180	1068	5795	357	21400
1970	Red snapper	1481	316	853	484	444	16	1797
1970	Yellowtail snapper	8505	2338	5802	505	3866	670	10843
1970	Snappers	112	501	402	54	132	25	613
1970	Total	10098	3155	6520	1412	4482	711	13125

(*) indicates categories listed on the SWAS interview form for 1960 and 1965. 1970 is unknown.

Table 2. The number of substantial saltwater anglers identified by the National Survey of Fishing and Hunting (NSFH) and the response rate of the saltwater anglers selected for interviews.

Year	NSFH Persons	NSFH Households	Saltwater Anglers	SW Anglers Response Rate
1960	45000	18000	1750	92%
1965	43500	16000	1566	95%
1970	60000	24000	1947	95%

Table 3. Estimated landings in weight, average weight and number of red snapper caught per angler for the years that provided estimates of red snapper.

Year	Weight (1000 lbs)	Average Weight (lbs)	Number/Angler
1965	1938	3.24	6.95
1970	5682	3.16	23.34

Issues:

1. Sources of overestimation bias were acknowledged in the 1965 and 1970 SWAS as prestige bias (e.g., exaggeration) and recall bias which includes rounding and not remembering correctly. The SWAS did not quantify the bias but generally stated that it could be substantial and higher than the true value. In general, a longer recall is likely to lead to overestimates of landings and effort (Roach et al. 1999, Tarrant et al. 1993). Landings reported in these salt-water angling surveys could be biased high by as much as 100% (Terceiro, 2002). Fisher et. al (1991) examined recall period and determined that in general longer recall periods are associated with larger estimates of effort.
2. The 1965 and 1970 estimates of red snapper include approximately 39 and 25% from the "bridge/pier/jetty" category which indicates misidentification or misreporting of species which overestimate red snapper. Other misidentification and misreporting are likely to have occurred but are not as easily detected and may over or under estimated catch.
3. Changes in the survey over time.
    a. The interview form and species or species groupings for which catch estimates were calculated changed from year to year in the South Atlantic region. Twenty categories were listed with 3 write-in rows for species not listed. In 1960 the snapper category reads "Snappers: Schoolmaster, Muttonfish." For 1960 estimates are given for Snappers and Yellowtail Snapper. In 1965 the snapper

category on the interview form reads "Yellowtail Snapper." The 1970 interview form was not provided in the document thus, the species groupings are unknown for the South Atlantic. For 1965 and 1970 estimates are given for "Snappers", "Red Snappers", and "Yellowtail Snapper." One example of the effect of the change in the interview form and the species estimated is shown in Figure 1.

b. The interview process changed among years.
    i. In 1960 and 1965 anglers 12 years old and older that were identified as a "substantial participant" were interviewed in January or February of the following year. In 1970 anglers 9 years old and older were interviewed but only the 12+ ages were used for estimates.
    ii. In 1960 one person from each household was interviewed. Each person in the household was interviewed in 1965. In 1970 each member of the household mailed in short questionnaire which was then subsampled for substantial participants.
c. The weight of fish in 1960 was calculated after the interview using regional advice from state agency staff, scientists, sportsmen, etc. Anglers estimated the average weight for each species or species grouping in 1965 and 1970.

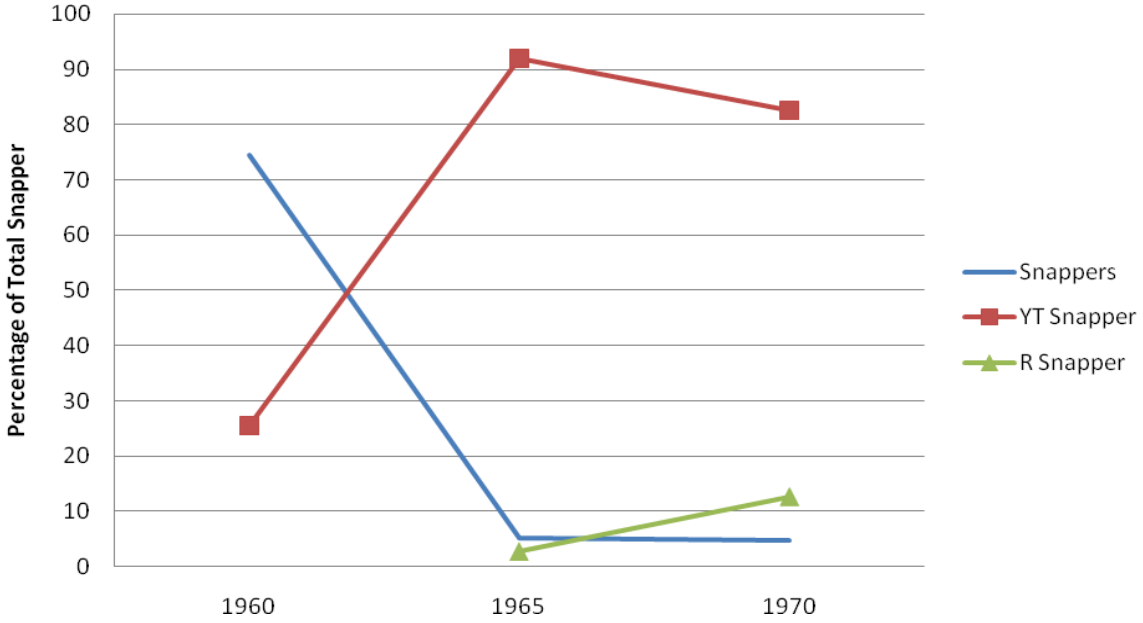


Figure 1. The percentage of red snapper, yellowtail snapper and general snapper to all snappers. The red snapper would need to be combined with snappers to compare with the 1960 snappers.

Recommendations:

The numbers reported are more likely to be estimated with less bias than weights in years where the anglers provided the weights. We recommend using numbers of fish instead of weights if the SWAS data are used. For 1965 and 1970 the estimated red snapper from the "bridge/pier/jetty" category should be removed from the total red snapper estimate. The red snapper estimate should be reduced by half to account for literature estimates of recall bias which can inflate

estimates by as much as 100%. The 1960 estimate of total snapper should be reduced by half to account for recall bias and the average proportion of red snapper to all snapper from 1965 and 1970 should be applied to derive the estimate of red snapper. The proportion of red snapper to all snapper changed dramatically from 1965 to 1970 (Table 4). Other methods for determining the proportion red snapper to all snapper should be discussed at the SEDAR 24 Data Workshop. Other possibilities include using the 1960 commercial proportion red snapper to all snapper or evaluating early MRFSS proportions.

The 1970 SWAS report includes a comparison with California Fish and Game Departments partyboat logbook program and suggests an overestimate of approximately 200-300% by the SWAS. Alternative time series of landings should be examined with greater reductions in landings. The SEDAR 15 estimates of red snapper numbers from 1981-2006 headboat and MRFSS combined were compared to the proposed SEDAR 24 estimates from the SWAS (Table 4, Figure 2). The uncertainty associated with the 1946-1980 recreational estimates is certainly large and difficult to quantify. The SEDAR 24 data workshop should discuss alternative time series of early recreational landings for consideration as sensitivity runs during the SEDAR 24 assessment workshop. There is some concern that interviewees may have lumped all snapper into the snapper category listed. A general snapper category was listed for 1960 and yellowtail snapper for 1965. The 1970 is unknown but is likely to have been the same as in 1965 given the description of how the categories were chosen.

Table 4. SWAS estimated red snapper (RS) and total snapper in thousands and SEDAR 24 estimates of red snapper adjusted by removing the bridge/pier/jetty estimates for 1965 and 1970. The average proportion of red snapper to all snapper from 1965 and 1970 was used to estimate red snapper for 1960.

	Estimated Number (thousands)				
	Saltwater Angling Survey			SEDAR 24	
Year	red snapper	total snapper	RS bridge/pier/jetty	RS-adjusted	RS proportion
1960		9433		283.10	
1965	598	21400	235	181.5	0.017
1970	1797	13125	444	676.5	0.103
				average	0.060

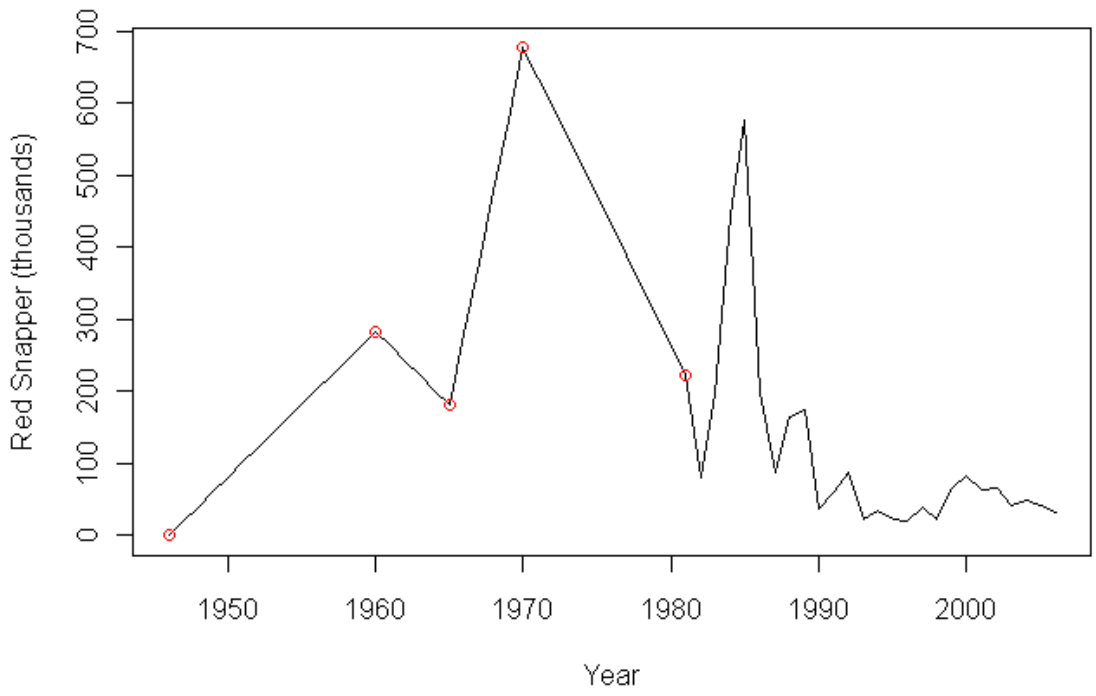


Figure 2. SEDAR 24 adjusted estimates (1946-1980) from the SWAS plotted with SEDAR 15 estimates of headboat and MRFSS combined (1981-2006). The anchor points (open circles) for the linearly interpolated estimates were the 1946 value of 0, the SWAS adjusted estimates (1960, 1965 and 1970), and the 1981 SEDAR15 estimate of headboat and MRFSS combined.

Table 5. Issues, bias direction and proposed corrections for SWAS estimates of red snapper.

Issue	Bias	Correction
Recall/Prestige Bias	Overestimate landings	General reduction of ½ the estimated landings(with larger reductions as alternatives)
Species Grouping	Unknown – likely to get higher estimates for the species listed on the interview form	none
Misidentification/Misreporting Mode of fishing (bridge/pier/jetty)	Overestimate	Remove "bridge/pier/jetty" estimates from total red snapper
Misidentification/Misreporting Oceanic species such as vermilion snapper reported as red snapper	Overestimate	None

Pros and Cons

Pros
The only attempt to understand recreational fishing specifically during the 1960's and 1970 across the entire Southeast US.
Cons
The limited number of species categories provided on the interview form raises concerns about the validity of estimates for species that were written in at the bottom of the form. Only three write-in rows were available for a year of fishing. It is unclear how this would effect the estimates.
Misidentification or misreporting species other than red snapper as red snapper can be detected in the method of fishing estimates. The misidentification or misreporting of species that occur in the same habitat as red snapper is unknown. It has been suggestion that vermilion snapper and other red colored species were referred to as red snapper by recreational fishermen during the 1960's and 1970's especially by inexperienced fishermen.
The proposed correction factors to account for the known biases are substantial and qualitatively reduce confidence in the data.

Method 2: Ratio methods for developing historical recreational catch time series for red snapper in the U.S. South Atlantic

For this analysis, the historic recreational catch time period was defined as pre-1981, which represents the start of the Marine Recreational Fisheries Statistics Survey (MRFSS). The MRFSS covers charter boats, private boats, and shoreside anglers. Another important sector for recreational fishing is the headboat sector. A separate survey for this fishery was started in 1972 in the Carolinas and then extended to Georgia and northeast Florida in 1976, and by 1978 was covering the whole U.S. South Atlantic. Therefore the recreational catch prior to 1981 is incomplete. This working paper explores some ratio methods that could be used for filling in this missing data based on the red snapper commercial catch time series which extends back into the early 1900s.

Data used in this analysis includes catch time series in numbers (1000s) and whole weight (ww lbs) for the years indicated in the table below:

Data Time Series	Years Used in Analysis
Headboat Landings (ww, 1000 lbs)	1981-2006
MRFSS Charter Boat Landings (ww, 1000 lbs)	1986-2009
MRFSS Private Boat Landings (ww, 1000 lbs)	1981-2009
Headboat Landings (1000s)	1981-2006
MRFSS Charter Boat Landings (1000s)	1986-2009
MRFSS Private Boat Landings (1000s)	1981-2009
MRFSS Discards (1000s)	1981-2009
Commercial Hook and Line Landings (ww, 1000 lbs)	1981-2006
Commercial Diving Landings (ww, 1000 lbs)	1981-2006
Commercial Hook and Line Landings (1000s)	1981-2006
Commercial Diving Landings (1000s)	1981-2006
Commercial Hook and Line Discards (1000s)	1981-1991*, 1992-2006
Headboat Trips reporting red snapper	1973-2006
Commercial Logbook Trips reporting red snapper	1992-2009
MRFSS Charter Boat Trips (total for SA)	1986-2009
MRFSS Private Boat Trips (total for SA)	1981-2009

**data from these years were filled in at the SEDAR 15 DW and are not based on recorded data.*

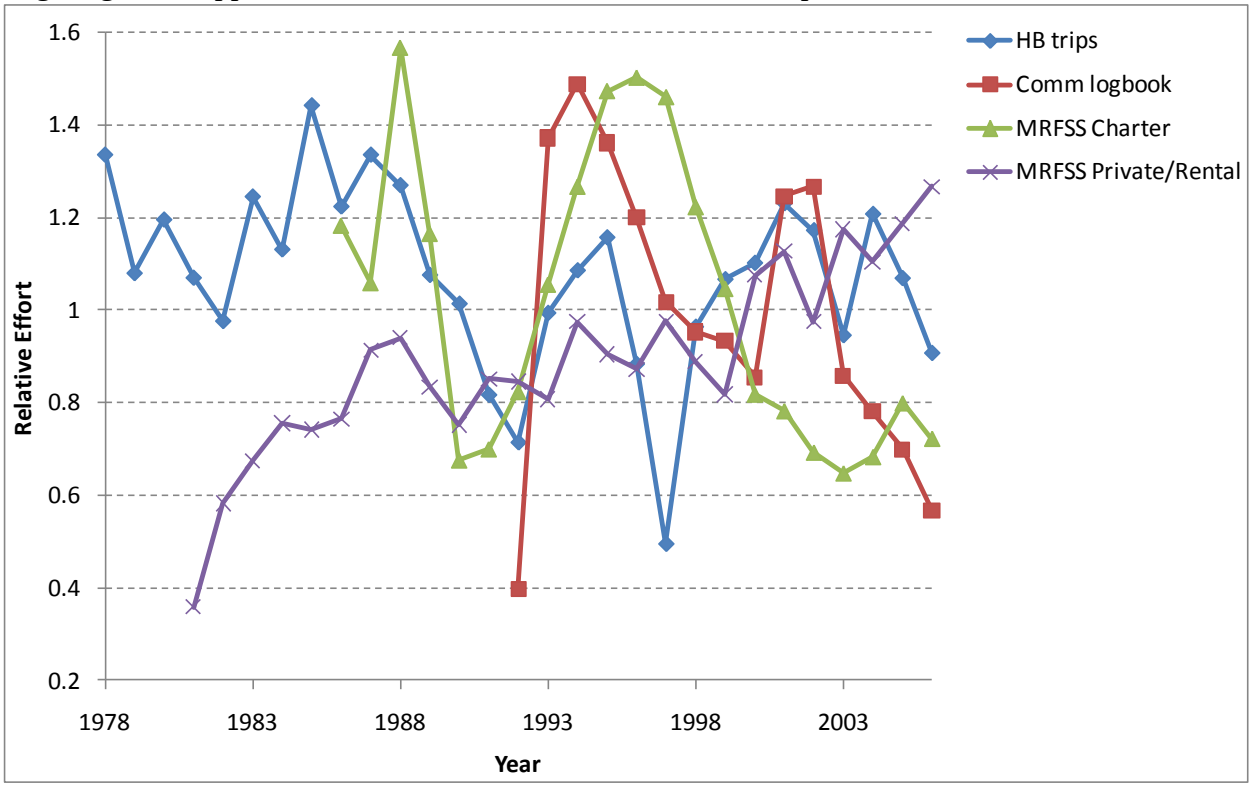
The landings and discard data from this table were extracted from the SEDAR 15 red snapper input spreadsheet, while the number of trips catching red snapper were pulled from Tables 5.4 and 5.8 of the SEDAR 15 red snapper SAR report. The MRFSS data was obtained from a query of the online database conducted on 4/27/10. The query used the Atlantic Coast region for red snapper. The MRFSS data indicated small landings from shore mode, because red snapper are very unlikely to occur near shore this data was ignored for this analysis.

Ratios and Their Applicability:

This working paper explores the use of the commercial catch time series in order to extend the recreational time series back in time. The simplest approach would apply the ratio of the commercial:recreational catch from the years of overlap to compute the recreational catch for the years in which we have commercial catch but no recreational catch. In order for this to work there is one key assumption that must be met. The ratio of effort between recreational and commercial fisheries during all years must be the same. Some things that would cause this to not be true include, (1) differing rates of development or decline in the amount of effort in each fishery, (2) regulations which disproportionately affect the effort in each sector (e.g. a minimum size limit in only one sector, limited entry in one sector), (3) other external factors that might disproportionately affect the effort in each sector (e.g. fuel prices, bad weather, travel distance from shore). At some level this important assumption of equal effort in both sectors is going to be violated. What is of concern here is whether that difference in effort is extreme enough to make the application of ratios useless.

Effort data is sometimes difficult to get a handle on. In this case we have data pulled from the SEDAR 15 report in the indices section (see Tables 5.4 and 5.8 in the SEDAR 15 SAR). This reports the number of trips reporting red snapper catches from the headboat and commercial logbooks. We obtained MRFSS effort data from a query of the online database. This database was queried for total effort in the South Atlantic region and does not account for effort just towards red snapper. The MRFSS data was split into charter and private/rental modes (shore mode was ignored). As mentioned above, the property we wish to see in these data is whether the change in effort in the sectors has remained the same or not. The time series of the ratio of commercial to recreational red snapper effort is shown in Figure 3.

Figure 3. Relative effort (based on 1992-2006 avg) from various sectors of recreational and commercial fishing. Note headboat (HB) and commercial (comm.) data are based on trips targeting red snapper, while MRFSS data are based on total trips in the South Atlantic.



The trends in Figure 3 suggest the needed assumption about relative effort between recreational and commercial fisheries is not being met. Unfortunately some of this data only goes back in time to 1992, which just happens to coincide with some big changes in the regulations affecting red snapper and snapper-grouper in general. This figure generally supports the notion that in the last couple of decades the private/rental recreational fishery has been growing, while the headboat and charter fisheries have remained relatively unchanged, and the commercial fishery appears to have been declining, especially in the most recent decade. In 1998 the two-for-one permit buyout rule went into effect for the commercial snapper-grouper permits, which may have contributed to the decrease in commercial fishing effort for snapper-grouper, including red snapper.

Further issues to note when trying to interpret Figure 3, include; (1) MRFSS effort data is not specific to red snapper, and (2) the 1992 commercial estimate is likely inaccurate because this was the first year of the logbook program and likely only represents partial coverage of the fishery.

Figure 3 suggests that data from 1992-2006 might not prove very useful for computing a reliable ratio of recreational to commercial catches for filling in missing years in the recreational time series. However, before 1992 there were minimal fishery regulations that went into effect, which suggests the ratio method may be useful with data from 1981-1991.

There are some suggestions that the charter and private boat modes of recreational fishing probably developed over separate time lines. Historical accounts suggest for-hire boats (headboats, party boats, charter boats) started becoming active soon after World War II (WWII) with the availability of war surplus ships. There is an isolated but still useful account of vessels being chartered out of Jacksonville, FL back in the early 1900s targeting red snapper (Goode 1903). One of these trips is described as catching 208 red snappers with an average weight of 25 lbs. It is very unlikely that private fishing boats were active before WWII. Based on anecdotal accounts from various fishermen, it seems likely that private fishing boats started showing up in the 1950s. The exact timing of when private boats started regularly targeting red snapper is unknown, as is any useful estimate of the total number of private vessels back in the 1950s and earlier. So an important, yet unanswered question is: When did private boats start becoming common place and start regularly catching red snapper? It appears by the 1970s there were likely a significant number of fiberglass boats being put in the water, and they were likely beginning to venture offshore for red snapper, particularly off the east coast of Florida. Based on the historical account above, it seems more likely that the for-hire sector effort, which includes headboat and charter boats, is more likely to follow the commercial effort back in time. The private boat sector should be treated differently, perhaps with a decline in the ratio of private:commercial back in time. The next set of figures attempts to explore many of the relationships within and between recreational and commercial sectors landings data.

Figure 4. Relationship between headboat and charter boat recreational landings (whole weight, 1000 lbs) for years 1986-2006.

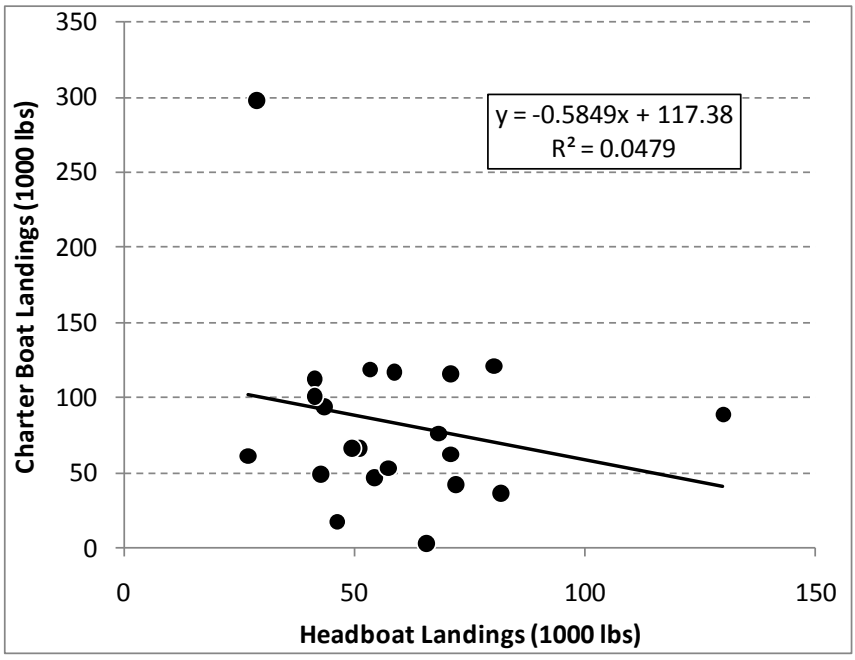


Figure 5. Relationship between headboat and charter boat recreational landings (numbers, 1000s) for years 1986-2006.

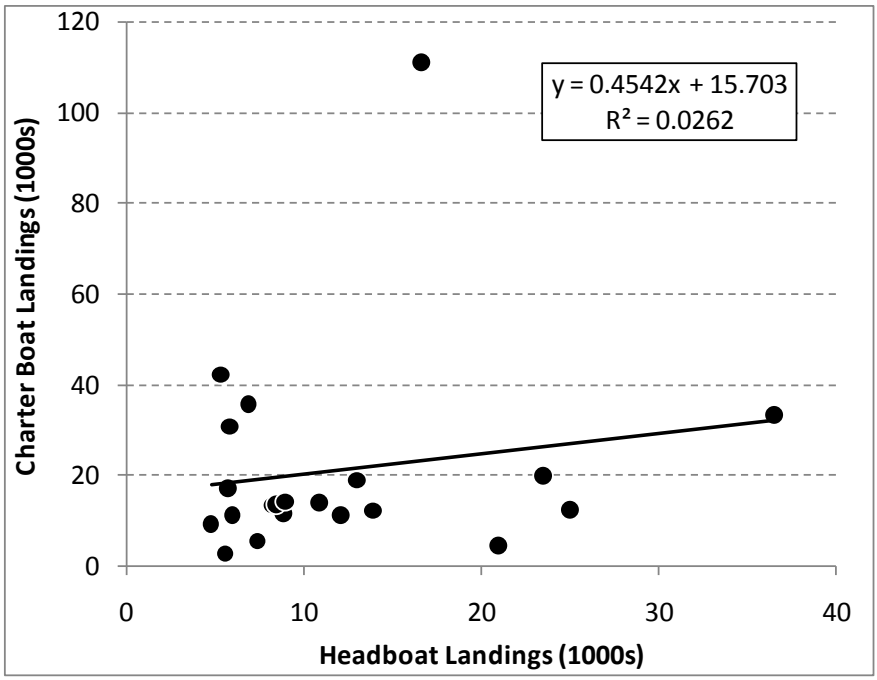


Figure 6. Relationship between headboat and smoothed charter boat recreational landings (whole weight, 1000 lbs) for years 1986-2006.

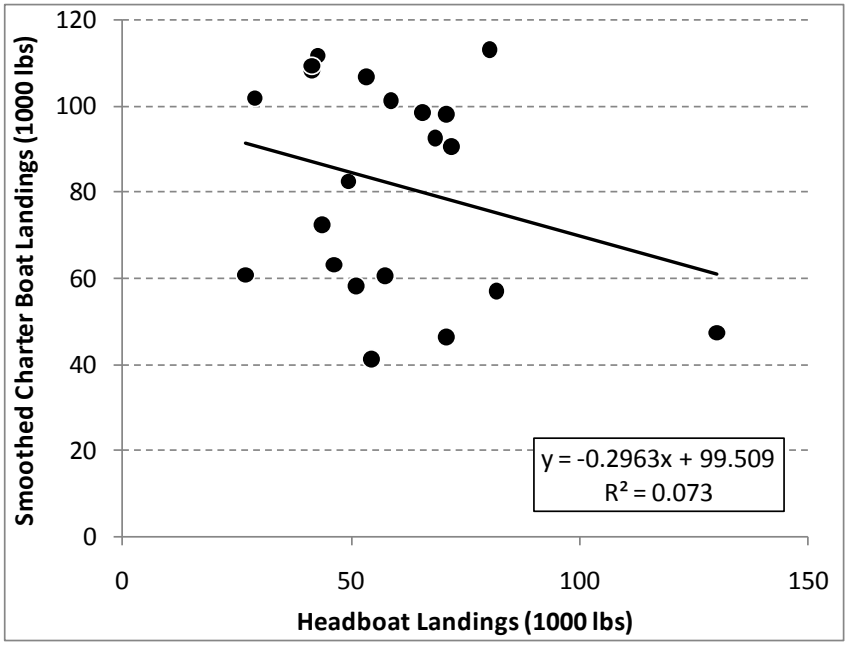


Figure 7. Relationship between headboat and smoothed charter boat recreational landings (numbers, 1000s) for years 1986-2006.

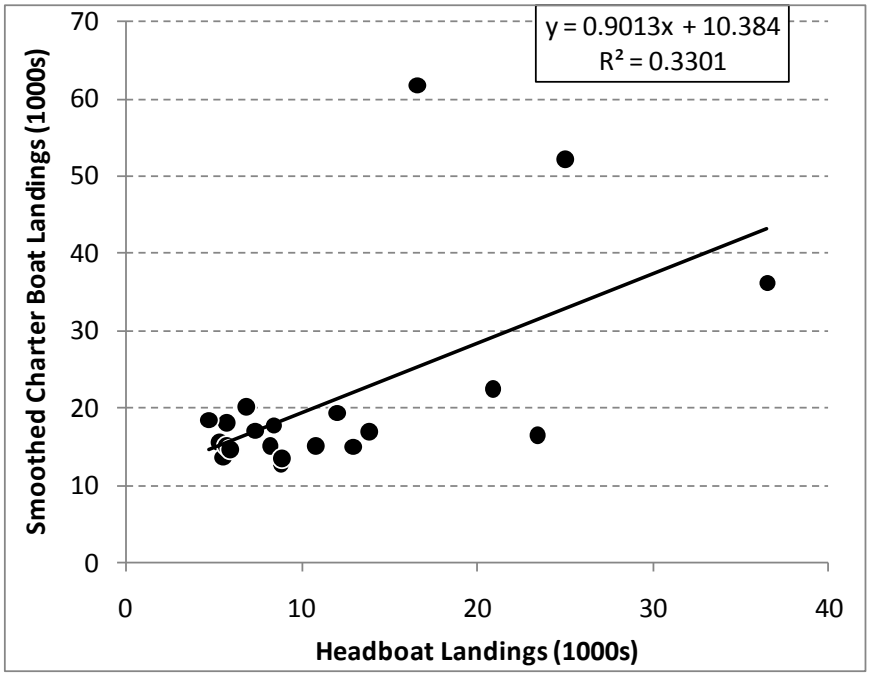


Figure 8. Relationship between commercial and for-hire (headboat and charter) recreational landings (whole weight, 1000 lbs.) for years 1986-2006.

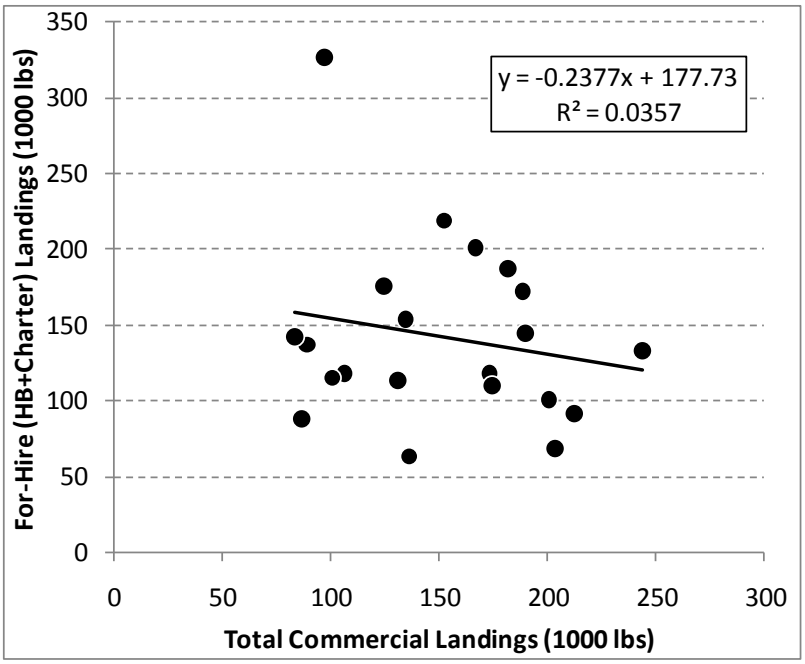


Figure 9. Relationship between commercial and for-hire (headboat and charter) recreational landings (whole weight, 1000 lbs.) for years 1986-1991.

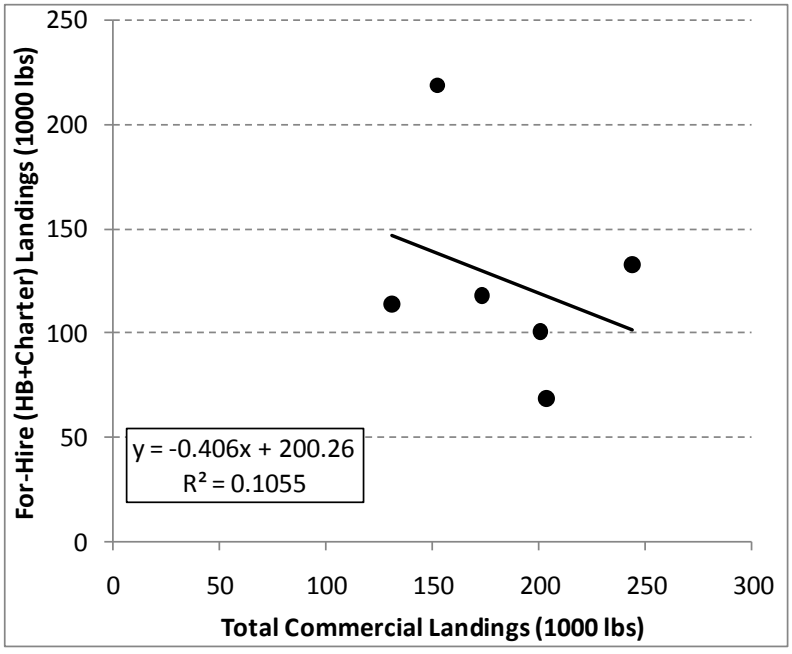


Figure 10. Relationship between commercial and for-hire (headboat and charter) recreational landings (numbers, 1000s) for years 1986-2006.

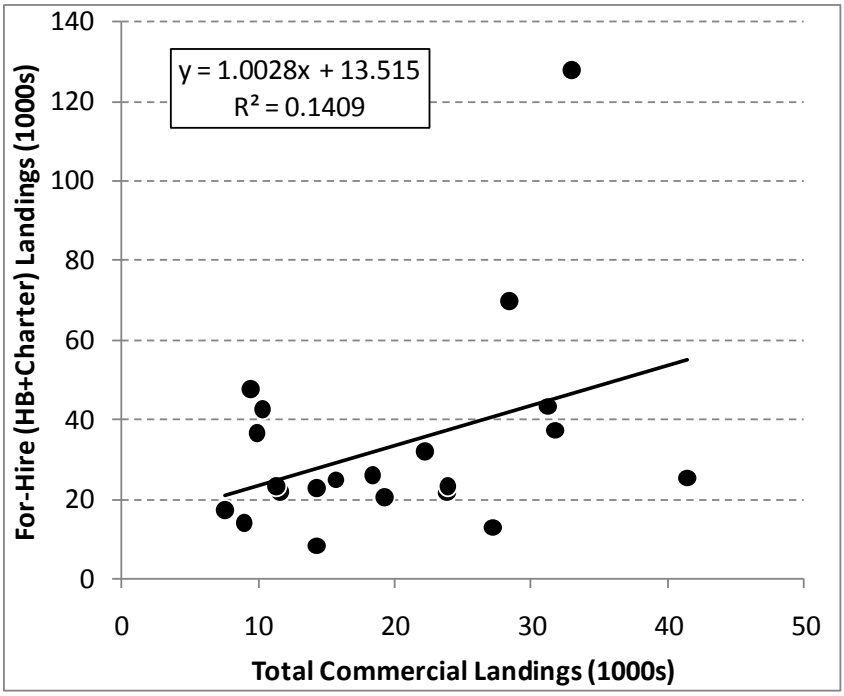


Figure 11. Relationship between commercial and for-hire (headboat and charter) recreational landings (numbers, 1000s) for years 1986-1991.

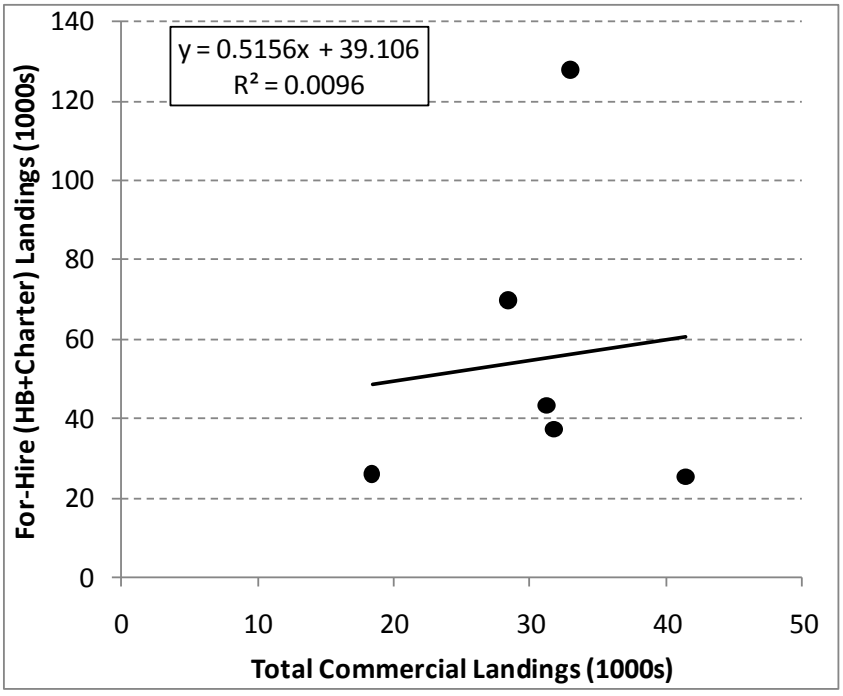


Figure 12. Time series of the ratio of the for-hire (headboat and charter) sector landings to total commercial sector landings by weight and numbers.

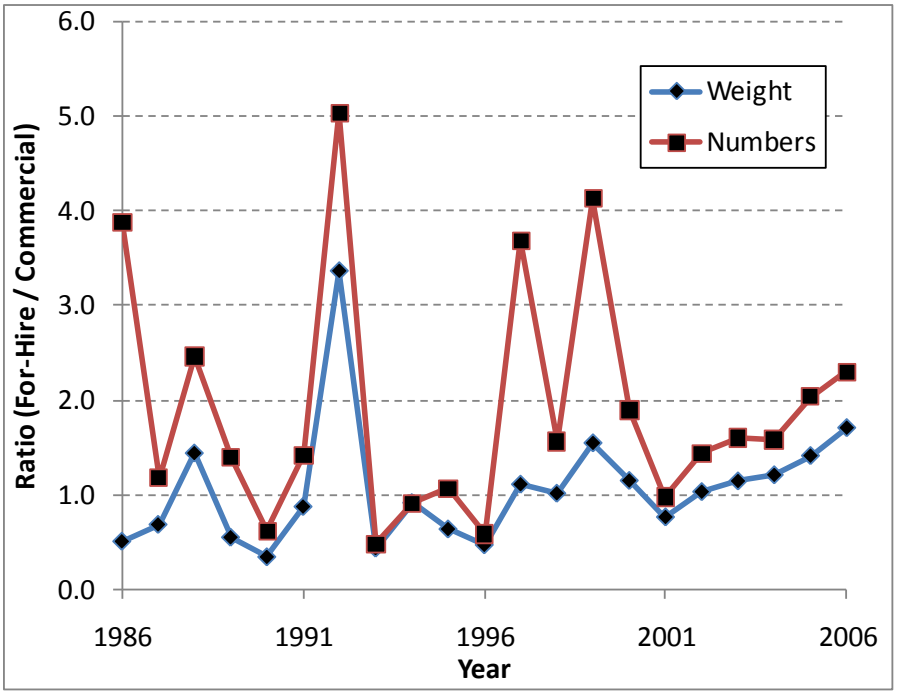
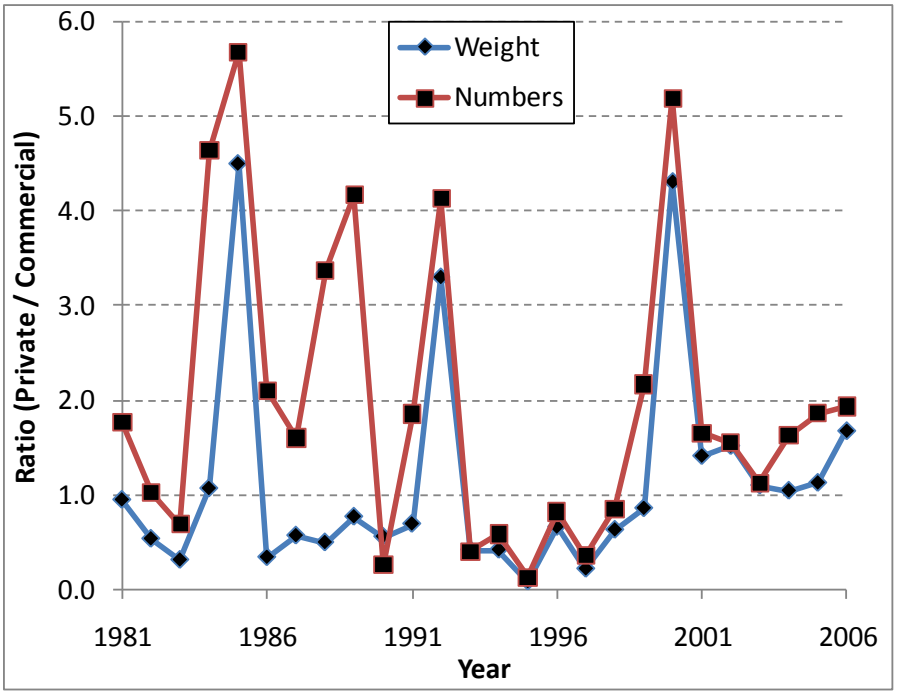


Figure 13. Time series of the ratio of the private boat sector landings to total commercial sector landings by weight and numbers.



Figures 4-11 suggest the relationships between and among recreational and commercial landings is weak and in some cases slightly negative. The headboat and charter boat recreational sectors do not show any strong positive relationships, even when the MRFSS charter data was smoothed (Figures 4-7). The direction of the relationships between the headboat and charter boat sectors differ depending on whether weights or numbers of landed fish are used (Figures 4-7). The relationship of the for-hire sector (headboat and charter combined) and the total commercial landings also does not show any strong positive relationships using weight or numbers of fish (Figures 8-11). The lack of relationship does not exclude the use of a ratio of commercial catch to recreational catch for filling in missing early year's recreational catch, but it does suggest there is at least a lot of uncertainty in this relationship. This uncertainty is important to consider when using this method for filling in the missing year's data.

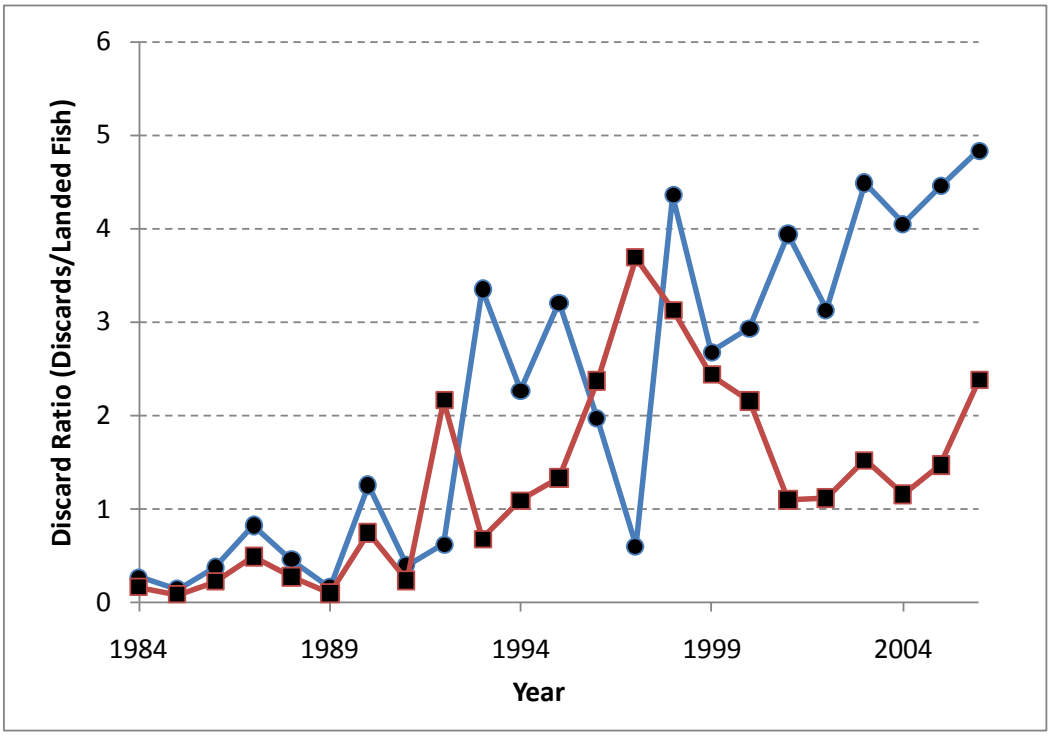
If the ratio of recreational to commercial catch is examined for each year it becomes clear that it can be quite variable (Figures 12 and 13). As was discussed above, the most appropriate time period for computing ratios between the recreational and commercial fisheries sectors is the pre-1992 period, before many regulations went into effect. This is also logical as the earliest time period of ratio data is the most applicable for earlier time periods. Based on the ratios shown in Figures 12 and 13, ratio statistics were computed (Table 7).

Table 7. Statistics for ratios of recreational to commercial landings data based on either the weight (wgt) of landings or the number (num) of fish landed.

Ratio	Mean	StDev	Min	Max
For-Hire:Commercial (wgt)	0.73	0.39	0.34	1.44
For-Hire:Commercial (num)	1.82	1.17	0.61	3.88
Private:Commercial (wgt)	0.98	1.19	0.30	4.51
Private:Commercial (num)	2.47	1.75	0.25	5.69

The relationship does not improve if discards are included in the total catch and the time series pattern of the ratios is slightly different from the patterns with just landed catch. However, there is good reason to not include discards in computing a ratio for filling in historic recreational catch. The main reason being that discards in this fishery show a very strong time trend and they likely play a small role in the pre-1981 time period (Figure 14). Also, the time trends for the discard ratios suggest different patterns for recreational and commercial sectors (Figure 14), and finally discards are very poorly estimated, particularly in the earlier years when almost no data was collected.

Figure 14. Ratio of discarded to landed catch for the total recreational (red with squares) and commercial (blue with circles) red snapper fishery (based on numbers of fish).



Despite some of the limitations mentioned in this report, a ratio of recreational to commercial catches could still be useful. As noted above, the pre-1981 time period is probably not going to be affected by any fishery regulations. This leaves just concerns about whether the effort time patterns for commercial and recreational fisheries were similar or not.

Recommendations:

Based on the data explorations in this working paper and the limited anecdotal and historical accounts, the following recommendations are put forward for consideration at the SEDAR 24 data workshop:

(1) Compute ratio (HB+MRFSS$_{charter}$) / Commercial for the years 1981-1991. Use the mean, min, and max from these years and apply to the commercial catch time series to represent the combined headboat (HB) and charter boat (MRFSS$_{charter}$) pre-1981 historic catches.
(2) Compute the MRFSS$_{private}$ / Commercial ratio for the years 1981-1991. Use the mean, min, and max from these years as the values to be applied to the 1980 commercial catch time series to represent that years private boat landings and its range. Next pick a year (e.g. 1950) for which it can be safely assumed that private boat activity toward red snapper is negligible and compute a linear decline in the MRFSS$_{private}$ / Commercial ratio from the 1980 mean value to zero in the chosen year above. Then use this linear declining ratio to apply to the commercial catch to fill in the historic recreational private boat catch.

Preliminary Results:

Based on the recommendations above, using the mean ratios from Table 7, and assuming the private boat ratio was zero in 1950, we computed the landings (in numbers and weight) for the early years of the recreational sectors (Figures 15-18).

Figure 15. Red snapper landings (1000s) from the South Atlantic for all sectors [recreational (For-Hire, Private Boat) and commercial (Hook and Line, Diving)], using the mean ratio of recreational:commercial (pre-1992) landings to fill in the early years of recreational landings. Note this is very preliminary and needs to be fully updated at the DW.

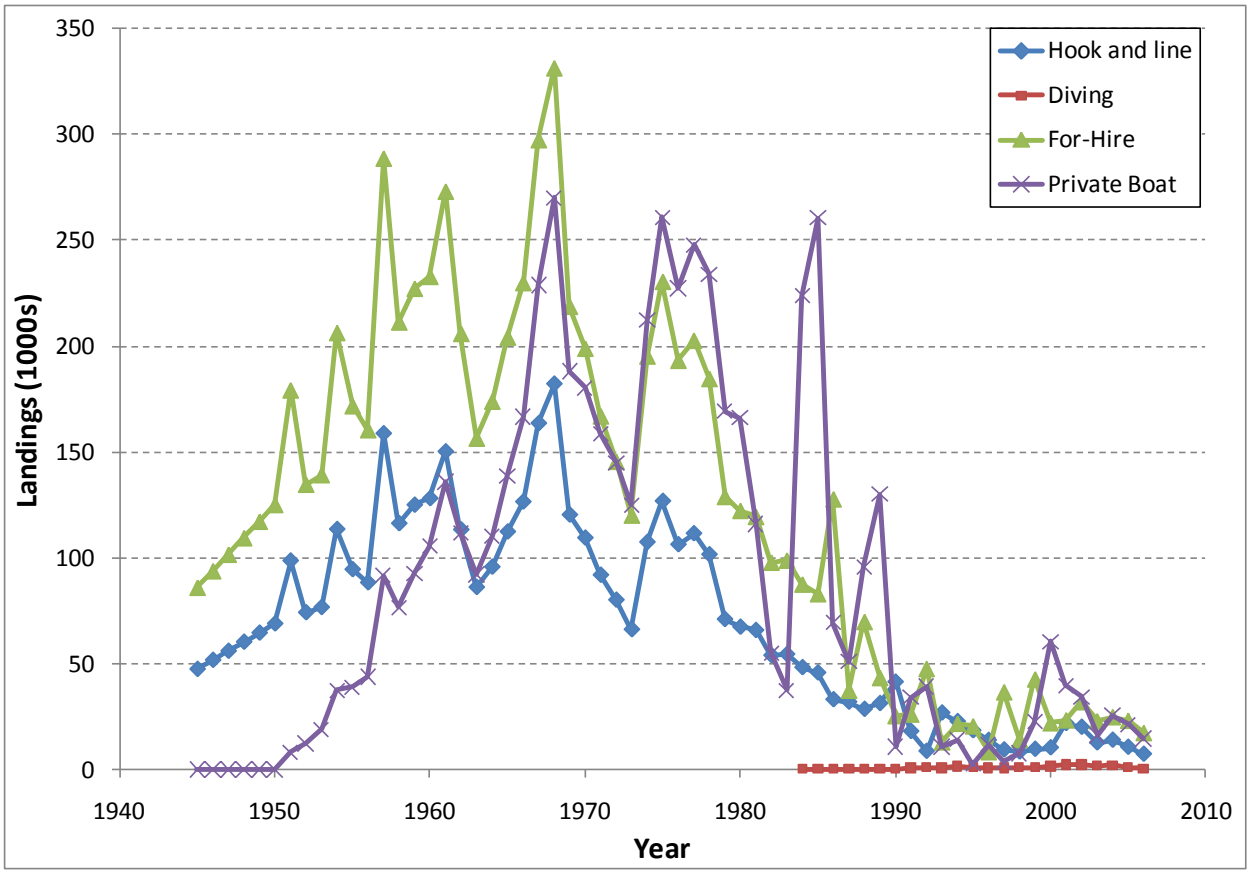


Figure 16. Red snapper landings (1000s) from the South Atlantic for all sectors [recreational (For-Hire, Private Boat) and commercial (Hook and Line, Diving)], using the mean ratio of recreational:commercial (pre-1992) landings to fill in the early years of recreational landings. Note this is very preliminary and needs to be fully updated at the DW.

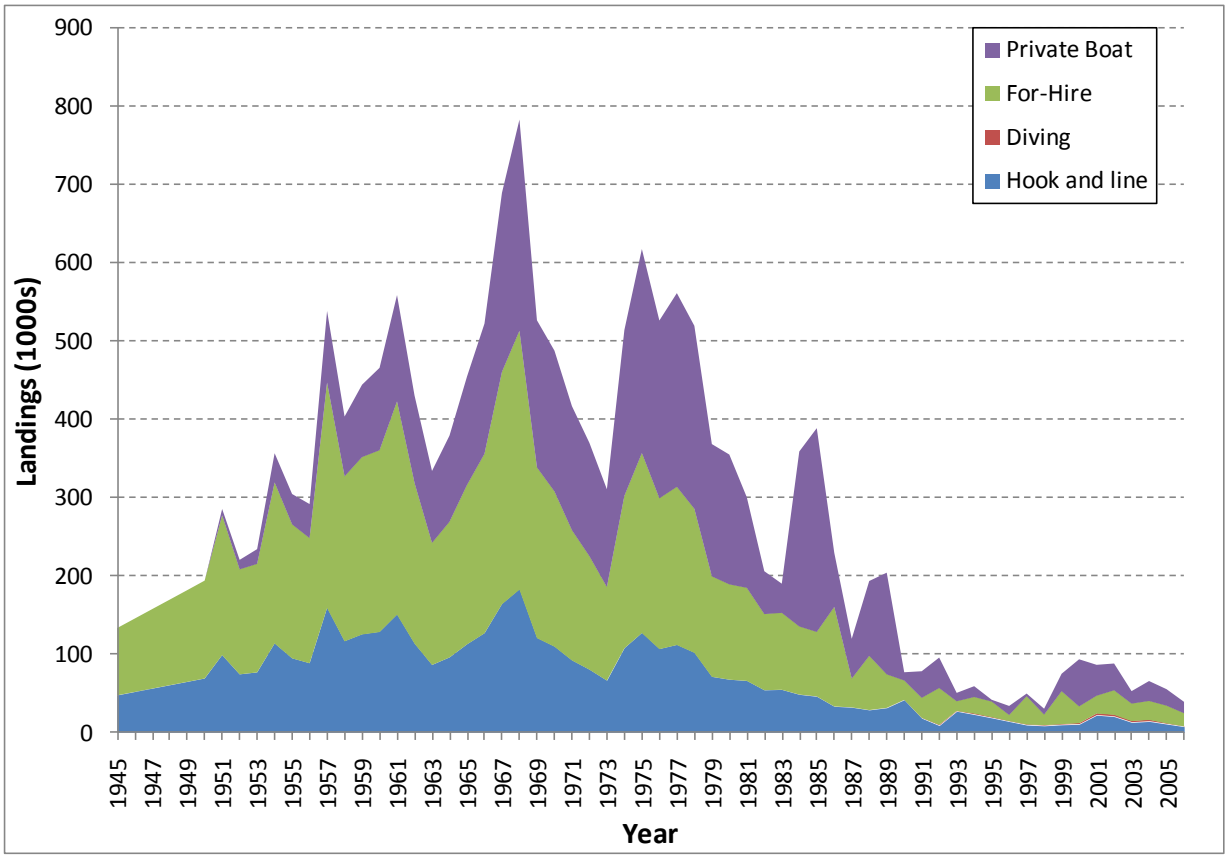


Figure 17. Red snapper landings (ww, 1000 lbs) from the South Atlantic for all sectors [recreational (For-Hire, Private Boat) and commercial (Hook and Line, Diving)], using the mean ratio of recreational:commercial (pre-1992) landings to fill in the early years of recreational landings. Note this is very preliminary and needs to be fully updated at the DW.

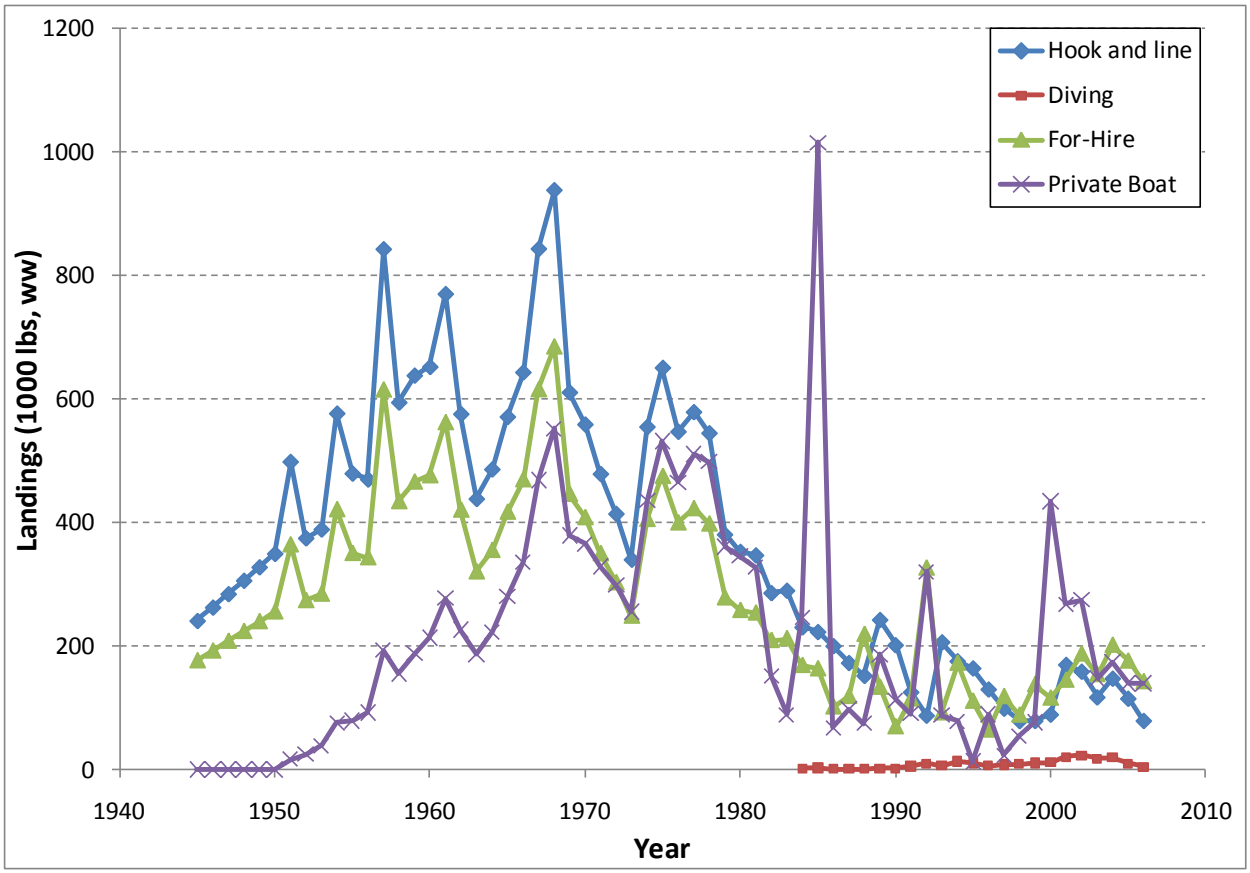
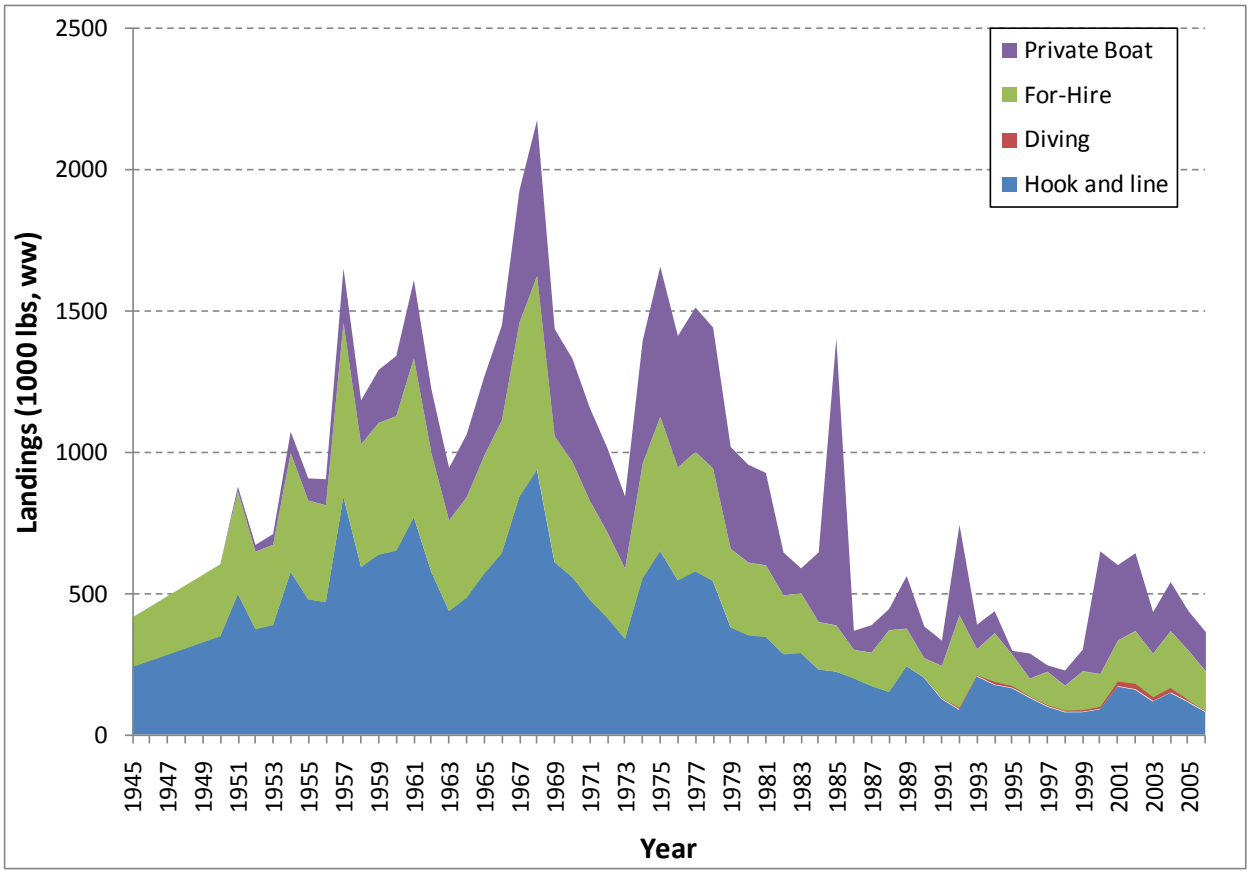


Figure 18. Red snapper landings (ww, 1000 lbs) from the South Atlantic for all sectors [recreational (For-Hire, Private Boat) and commercial (Hook and Line, Diving)], using the mean ratio of recreational:commercial (pre-1992) landings to fill in the early years of recreational landings. Note this is very preliminary and needs to be fully updated at the DW.



Method 3: Use of U.S. Census data as a proxy for recreational fishing effort to estimate historical red snapper recreational catches.

Historic red snapper recreational catches were estimated for the Gulf of Mexico during SEDAR 7 and described in the reference document by G.P. Scott (SEDAR24-DW-03). Scott downloaded human population data from U.S. Census Bureau from 1900-2000 and compared census numbers with estimated recreational fishing effort in Gulf of Mexico in more recent years. In the Gulf of Mexico, there was a general correlation between fishing effort and coastal human population levels, which was the basis for using coastal human population data as a proxy for fishing effort back in time. The author accounted for changes in red snapper management through time by including discards in recreational catch estimates. In a separate model, the author included a fishery-independent measure of red snapper abundance. Both models (with relative red snapper abundance signal and without) tracked well with observed recreational catch; however, predicted catch from the model with a relative abundance signal was higher than the predicted catch without the relative abundance signal.

The model predicted catch estimates for red snapper in the Gulf of Mexico are graphed in Figure 19. The time-series trend indicated very low catches in pounds for red snapper preceding WWII, and a pronounced increased catch after 1960 following human population growth in the region.

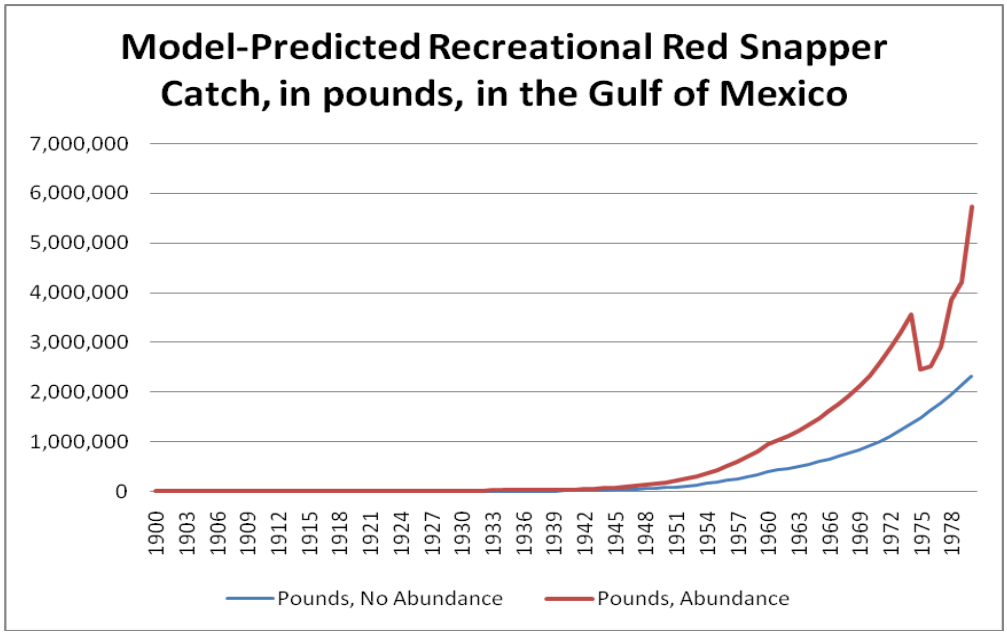


Figure 19. From Scott, 2004 (SEDAR24-DW-03).

We evaluated the potential use of this method in the South Atlantic for SEDAR 24, and identified the following pros and cons.

Pros

Model is simple

Data inputs require no adjustments for recall bias or species mis-identification

No concerns about differential rate of increase in commercial vs. recreational

Premise that human population is correlated with fishing is supported in the Gulf of Mexico model

Cons

Changes in management required use of recreational discards in catch estimates which must be separated out to get estimated landings

Not clear how pounds were generated given there are no estimates for weight of discards.

Author reports evidence for change in average weight of harvested fish over time, which could affect model-predicted estimates of weight.

South Atlantic is data-poor for fishery independent estimates of abundance, and abundance signal may not be possible for using this method in SEDAR 24.

Data and Methods for South Atlantic Analysis:

Census data from two internet sites (cited in Scott, 2004) were downloaded, including:

- Decadal state and county census numbers for Florida, Georgia, South Carolina, and North Carolina for the years 1900-2000. For east Florida, census data were summed from eastern counties for the years 1900-2000. Monroe County was included in East Florida census estimates.
- For years between decades, census values were interpolated by subtracting from a given census value the next census value 10 years later, and dividing by 10 to get an average annual increase in population during that decade.
- Annual estimated statewide census numbers for the years 2001-2009 were available from the U.S. Census website. To obtain annual estimates for east Florida, the proportion of east/west Florida from the most recent census (2000) was applied to annual estimated Florida census data from 2001-2009.

The full data set is provided in Appendix 1.

Recreational red snapper catch data were queried from the MRFSS website at http://www.st.nmfs.noaa.gov/st1/recreational/queries/index.html. Query parameters included annual estimates of total catch (A+B1+B2) in numbers of fish by mode for all south Atlantic states by state. MRFSS catch estimates for east Florida do not include Monroe County. MRFSS private boat effort data in state territorial seas and federal EEZ waters were also downloaded. Years 1981-2009 were selected for comparison of catch estimates with indices of effort from the same time period.

The SAS Proc Corr procedure was used to test for correlation between red snapper catch and indicators of red snapper fishing effort. The SAS Proc GLM procedure was used to model the dependent variable (log transformed red snapper catch) against several independent variables, including census data (log transformed), state (dummy variables), year, and all possible interaction terms.

Results:

Estimates of private boat effort from the MRFSS and statewide census data are not correlated with each other, invalidating that the assumption that statewide census data can serve as a proxy for fishing effort (Figure 20). An alternative would be to use only census data from coastal counties. MRFSS catch estimates, statewide census data, and fishing effort all generally increased over the time series; however, MRFSS catch estimates for the south Atlantic region are highly variable and dip to low levels in the middle of the time series during the 1990's. Census data exhibits an increasing trend over the entire time series (Figure 21).

Results of the GLM procedure are presented in Figure 22 and SAS output is provided below the figure. Results of the model indicate a good fit with a high r square and low p value. However, given that census data do not correlate with fishing effort and trends in catch data do not track well with trends in effort, it is likely that something other than human population is influencing red snapper catches in the South Atlantic.

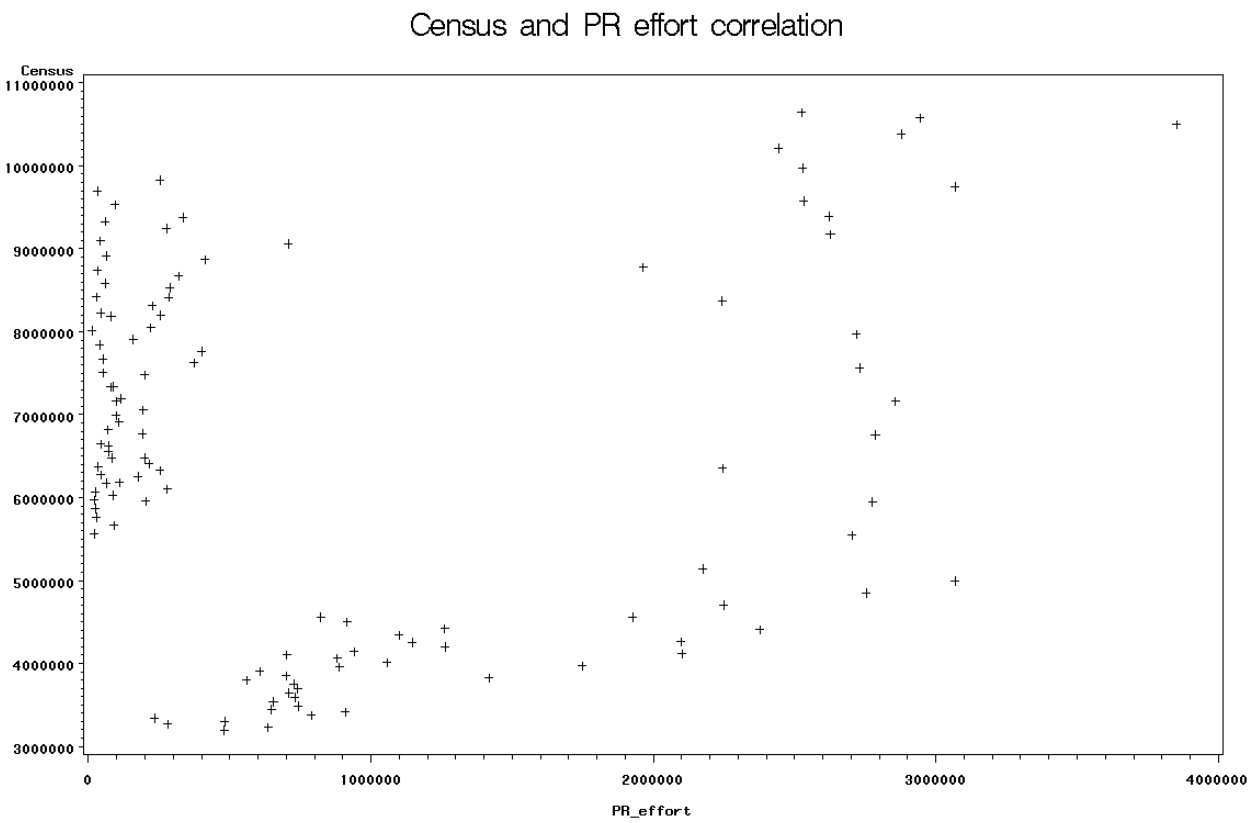


Figure 20. Scatter plot of census data plotted against private boat fishing effort. Results of SAS Proc Corr procedure were not significant (r=0.92, p=0.326).

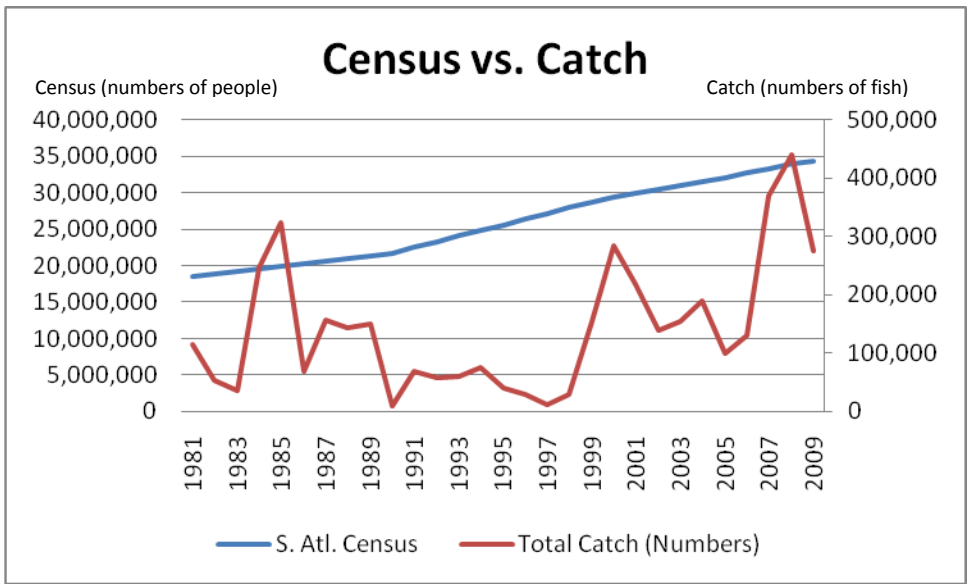


Figure 21. Patterns in growth of the South Atlantic human population versus recreational red snapper catch in the private boat fishery.

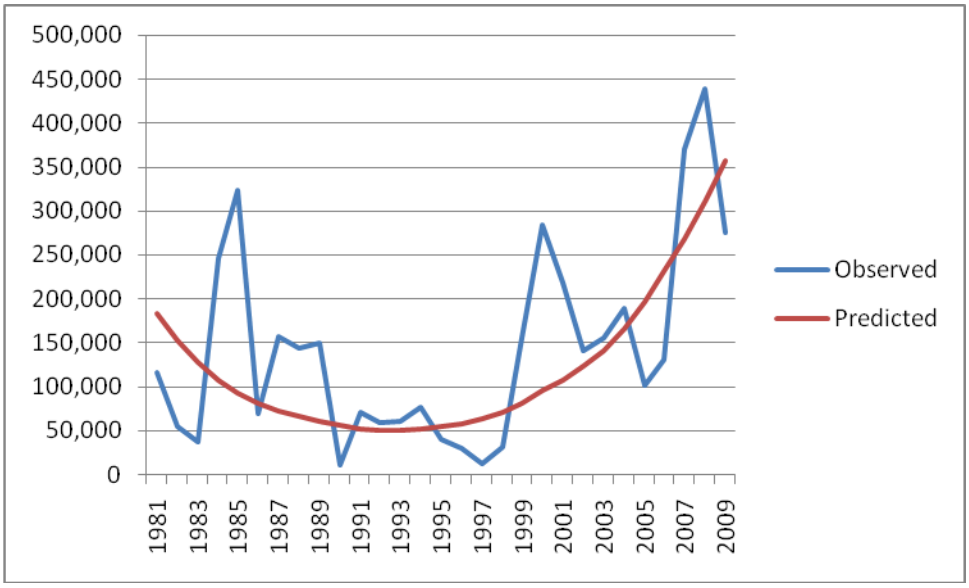


Figure 22. Fitted GLM model to observed catch (numbers of fish).

SAS OUTPUT: 03:25 Friday, April 30, 2010 21

The GLM Procedure
Number of Observations Read 116
Number of Observations Used 75

Dependent Variable: ln_prcatch

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	316.4532215	35.1614691	38.65	<.0001
Error	65	59.1348037	0.9097662		
Corrected Total	74	375.5880251			

R-Square	Coeff Var	Root MSE	ln_prcatch Mean
0.842554	10.60362	0.953817	8.995201

Source	DF	Type III SS	Mean Square	F Value	Pr > F
ln_census	1	8.22009775	8.22009775	9.04	0.0038
Year	1	7.63816022	7.63816022	8.40	0.0051
EFL	1	0.05869618	0.05869618	0.06	0.8003
GA	1	1.33820614	1.33820614	1.47	0.2296
SC	1	0.88451414	0.88451414	0.97	0.3278
ln_census*Year	1	8.08535491	8.08535491	8.89	0.0040
Year*EFL	1	0.06878292	0.06878292	0.08	0.7842
Year*GA	1	1.33449579	1.33449579	1.47	0.2302

Year*SC	1	0.87434937	0.96	0.3306

Parameter	Estimate	Std. Error	t Value	Pr > |t|
Intercept	7344.022932	2509.704973	2.93	0.0047
ln_census	-465.027129	154.705124	-3.01	0.0038
Year	-3.682928	1.271053	-2.90	0.0051
EFL	-43.947843	173.020492	-0.25	0.8003

Parameter	Estimate	Std. Error	t Value	Pr > |t|
GA	-99.757029	82.252082	-1.21	0.2296
SC	-146.435786	148.511380	-0.99	0.3278
ln_census*Year	0.233436	0.078304	2.98	0.0040
Year*EFL	0.023815	0.086613	0.27	0.7842
Year*GA	0.049884	0.041188	1.21	0.2302
Year*SC	0.073524	0.074999	0.98	0.3306

Recommendations

Given that trends in the south Atlantic human population do not follow the variable trends in red snapper catches throughout time, we do not recommend use of this model for estimating catches backwards in time. An abundance index may better explain variability in red snapper catches; however, no fisheries-independent indices of abundance for red snapper in the South Atlantic are available. If this method were to be pursued further, we recommend the following:

- Remove inland counties from census data and re-test the correlation with MRFSS effort. If census data and effort still do not correlate significantly, it is not recommended that census data be used as a proxy for fishing effort.
- It is strongly recommended that this model only be used if an index of red snapper abundance can be made available from the Indices Workgroup at SEDAR 24 and included in the model.

Review of Florida Sport Fishing Association (FSFA) Catch Program

The HFWG reviewed historic fishing data from the Florida Sportfishing Association presented by Dave Werner, Club Webmaster, February 1, 2010 and available on FSFA website http://www.fsfaclub.org/Florida%20Sport%20Fishing%20Association1_files/Presentations/2009%20Snappers.pdf. In their point fishing program, club anglers submit data to earn either 10 or 20 points toward "quality catch results" for various species, size and tackle class combinations. The point program is driven by anglers with "quality size" fish. For red snapper, there are 6 tackle classes for each of 10- and 20-point values, with minimum weights ranging from 3-30 pounds (12 total possible tackle class x weight combinations). Data elements collected since 1968 include date, angler, species, weight, tackle class, location, and bait/lure. The 2-year time-periods

with highest number of red snapper entries were 2008-2009 and 1971-1972. Red snapper entries from 2005-2009 represent 35% (n=79) of total entries, an increase from previous time periods.

Pro's

- Continuous dataset (1968-2009) collecting same data elements from recreational anglers landing fish from Ponce to Sebastian Inlets, FL (~90 miles, central east FL coast); no change in entry rules during time series
- Data available in Access database
- Data entered throughout time series as catches occurred
- Relative measure of angler success with "quality fish;" can assess trend over time
- No "reward" or "high volume" incentive since those categories not accepted by this club; only one species/tackle class/angler/year allowed.

Con's

- "availability" data represent species occurrence at specific minimum weights but no measure of total catch, harvest or effort (total number of anglers or angler trips). Cannot calculate CPUE or HPUE
- No discard data
- Small spatial area of species range
- Small sample size – of the ~15,200 individual catch entries throughout the time series, red snapper entries = ~1.5% (n=224)
- Data self reported; no validation

Recommendation:

The HFWG concluded that these data could not be used to generate region-wide estimates of red snapper catch and harvest for historic years in the South Atlantic. However, the trends in this data may be used as a ground-truthing index when compared with other methods for estimating historic catches.

Timeline of Development and Growth of Red Snapper Recreational Fisheries in the South Atlantic, Prepared by Rusty Hudson

1840's

"Fishing for red snappers on the west coast of Florida probably began some fifteen to twenty years previous to the civil war. Capt. James Keeny, a Connecticut fishermen, who used to go to the Gulf each winter in a smack Mississippi, beginning these trips nearly thirty years before the war, often told the following story of the beginning of the red snapper fishery"

"On one occasion when I was on my way to New Orleans with a cargo of beach fish (pompano, sheepshead, red-fish &c.), I got becalmed when several miles off shore. We had just finished eating, and the cook came on deck and threw over some refuse from the table. The vessel lay motionless, and very soon some strange looking red fish were seen in the water alongside, eagerly feeding on the material

the cook had thrown overboard. We quickly baited some lines and threw them out, and the fish bit fast as we could haul them in. Nearly two hundred snappers were caught, which we took to New Orleans, where they sold like hot cakes."" (Collins 1886)1

1850's
During the late 1840's or early 1850's, a group of New London Cod fishing sloops came to the Gulf of Mexico and began catching Red Snapper for marketing in New Orleans at good prices. (Jordan & Evermann 1902)2

1860's
Red Snapper scientifically named Mesoprion campechanus by Felipe Poey in 1860. (FAO 1985 Vol. 6 Snappers of the World)3

1870's
"Hexagonal split bamboo rods had been introduced in the United States around 1870 (Marden, 1965), and rods made of plain bamboo (Calcutta type) were also available before the turn of the century, as were a variety of hardwood rods..." (Smith 1979)4

During the early 1870's the Pensacola Ice Company and Warren & Stearns of Pensacola began making an effort to extend the red snapper trade. Eugene Blackford was active in introducing red snapper into the New York trade. (Jordan & Evermann 1902)

Red Snapper synonym scientifically named Lutjanus campechianus by Poey in 1875. (FAO 1985)

Red Snapper synonym scientifically named Lutjanus Blackfordii by Goode and Bean in 1879. (FAO 1985) Eventually Lutjanus campechanus was chosen officially.

1880's
During the summer of 1880, several specimens of red snapper were caught off the Middle States, including New Jersey. Found on the same grounds as the Black Sea Bass. "Red Snappers are also known to be abundant on the Savannah Bank and on the Saint John's Bank, off Eastern Georgia and Florida." "[In the Gulf of Mexico] They attain to the size of forty pounds. In East Florida, however, the average is much less. "A trip to the Snapper banks is a favorite summer recreation for the gentlemen of Jacksonville." "To feel the bite of a twenty-five pound Snapper at a depth of twelve fathoms causes a sensation never to be forgotten." (Goode 1887)5

Commercial fishing vessels with sails commonly called "Smacks" were used as snapper/grouper fishing boats. These vessels had live wells to begin with where the sound of water would make smacking noises, but later were converted to use ice. Some of these vessels were still fishing into the 1940's. (Coon 2010)6

1890's
By 1898 there were over 40 vessels involved in the red snapper fishery in the Gulf of Mexico. (Jordan & Evermann 1902)

1900's:

Red snapper in the Atlantic were not considered to be within reach of recreational anglers. William H. Gregg was assisted by Captain John Gardner of Ponce Park, Mosquito Inlet in writing the highly acclaimed book titled "When, Where, and How to Catch Fish on the East Coast of Florida. (Gregg 1902)7

Gregg follows the United States National Museum's Bulletin No. 47 prepared by Jordan and Evermann and completed March 1900. Red Snapper has a scientific name of Neomaenis Aya in Gregg's book.

The author notes that red snapper are normally found on reefs ten miles or further offshore and that he had never found an authenticated case of catching red snapper within five miles of the shore. Most of his book illustrated that the largest amount of fishing was near shore or inland from the inlets, and made note of the ice factory and "the man with the net"[seine nets] causing declines with the number of fish from historic highs, but that there were still enough left for "average sport fishers". (Gregg, 1902)

Lutianus aya is the scientific name used for Red Snapper in "American Food and Game Fishes" by Jordan & Evermann published May 1902.

"Off the east coast of Florida and the coast of Georgia it [red snapper] is abundant." (Jordan 1902)

1920's:
Depth sounding was done manually with lines over the rail. Finding banks, reefs, or lumps where snapper were abundant required experience and skill (Bureau of Fisheries, 1924)8.

Some boats would fish on nearby reefs in the 1920's out of Ponce de Leon Inlet. (Stone 2010)9

Mosquito Inlet was the historic name for Ponce de Leon Inlet before 1928. (Hudson 2010)10

Prohibition caused an increase in rum running boats from the Bahamas visiting ports on the Florida east coast including Volusia County.

The Florida land boom ended a few years before the Great Depression which started slowing population growth in Florida for a while.

1930's
"The red snapper grows to quite a large size and is one of the most highly prized of food fishes. I have caught them on the bottom and also trolling and found them to be a game fish of the highest order" (Heilner 1937)11

"In 1939, DuPont began marketing nylon monofilament fishing lines: however, braided Dacron lines remained the most used and popular fishing line for the next two decades, as early monofilament line was very stiff or "wiry", and difficult to handle and cast." The early monofilament had "a small but loyal following." (Wikipedia 2010)

In 1932 Otto Henze left Ocean City Reels and started his own fishing reel company called Penn Fishing Tackle Manufacturing Company. In 1933, the US Patent Office issued Mr. Henze a patent for his reel design. Today's reels still use the same basic design. Penn's growth in the early thirties was dramatic, especially since America was at the height of the depression...since many people fished for their food. In

1936 Penn began producing the Senator model. "The PENN Senator quickly became a popular reel used for world record catches." (www.pennreels.com 2010)

"In general, bamboo was the most popular rod material, although in 1936, tubular metal rods made of beryllium copper came on the market. These beryllium rods resisted saltwater corrosion better than other metal rods already on the market for freshwater use (Moss 1976), although corrosion was still a problem." (Smith 1979)

"Braided nylon fishing line made its appearance around 1939 (samples were exhibited at the San Francisco World's Fair), and it later came into limited use during the war years (A. W. Agnew)" (Smith 1979)

1940's

Beginning in 1940 the St. Augustine Inlet was relocated 400 yards north of where it had been located. Between 1941-1957 further efforts were made to stabilize the inlet by adding jetties.

"When the United States entered World War II in December 1941, the U. S. Navy closed all ports to sportfishing. Later a few boats with special permits were allowed to operate from certain ports, but under strict regulations (Young, 1969)." (Smith 1979)

Some vessels were allowed to fish offshore, but only during daylight hours on the Florida east coast about 1943 until the end of WWII. (Stone 2010)

LORAN-A was implemented during 1943 for military purposes. Following the end of WW II, LORAN-A became a tool primarily for civilian navigators. (USCG 2010)12

Al Gross, the inventor of the "walkie-talkie", during 1945 invented the citizens band (CB) radio and pioneered the use of the CB for the public about 1948.

"...monofilament nylon line , was introduced in 1946." "Soft monofilament was finally introduced to the west coast in the early 1950's, but it did not begin to outsell braided linen line until the early 1960's when spin fishing became popular in salt water." (Smith 1979)

Florida Tackle and Gun Club Fishing Tournament tracked annually largest fish such as a 39 pound red snapper entered into the contest and described in a Daytona Beach Morning Journal dated July 16, 1946. [Google digitalized news]

"An important advance in rod building occurred in 1948, when fiberglass rods were introduced, and solid, hollow and wooden core models became available (Major, 1948). (Smith 1979)

"Also, in the late 1940's, the first fiberglass boats were made available to the public." "In the following years this material would become a standard in the pleasure boat field (Whittier, 1976)." (Smith 1979)

While trolling towards known fishing reefs sometimes a large red snapper would be caught. Usually that indicated that a school of snapper would be found on a piece of bottom that was nearby and they would attempt to locate it. Large red snappers caught on the handline would suddenly be grabbed by

something large, smashed and scaled. It was found that both Warsaw Groupers and Jewfish would be the cause, depending on the time of the year. (Stone 2010)

In 1949 an aggregation of large red snapper (Bonanza) were found on a reef called the Northeast Grounds, about 14 miles Northeast of Ponce de Leon Inlet. Hand lines were the fishing equipment used for most bottom fishing while big Penn Senator reels spooled with "cuttyhunk" [twisted Irish linen] mounted on Beryllium copper rods and later on fiberglass rods and were used for trolling. (Stone 2010)

1950's:
About 1950 a charter vessel named the Candy Kidd came to the Volusia County area from Pompano, Florida to fish out of Ponce de Leon Inlet for a few summers and return to Pompano for the winter tourist season. The captain introduced fiberglass rods with Penn-65 star drag reels for bottom fishing to the local fishermen in the Daytona area so that the boats provided them to paying customers instead of handlines for bottom fishing. That Penn 65 rod & reel is still popular today. (Stone 2010)

During the early 1950's Port Canaveral created a man-made inlet for that area. Shortly after it was completed than a party boat and some charter boats began to operate in that region.

Compass bearing, a watch and a sounding line (lead) were used to fish known reefs 10 to 20 miles from the Florida east coast until later in the 1950's when echo sounders/fathometers and navigation devices became affordable for boats.

The WWII LORAN-A surplus was sold to civilians but at first needed a bulky voltage inverter to fit it to the vessel's 12-volt system. Later when they were made into solid state they become easier to use. (Wikipedia) LORAN-A was accurate to about a quarter of a mile. (Amicks 2010)[13] Some LORAN-A units were accurate enough to get close to the fishing spot. (Stone 2010)

Charter boats began fishing out of the Savannah, Georgia area for black sea bass about 10 to 15 miles from shore. Very little private recreational effort existed in that area. (Amicks 2010)

The charter fleet in northeast Florida was small and consisted of approximately 50 vessels between Nassau and Martin Counties. In 1955, 17 charter vessels were located in Volusia County, Florida fishing from the Ponce de Leon Inlet area. (Ellis et al., 1958)14

The charter fleet was more developed in southeast Florida between Palm Beach and Monroe Counties and primarily targeted pelagic species (Ellis, 1957; Ellis et al., 1958).

During the summer months when business was slow in the Southeast, some of these charter boats would fish in the Northeast Florida region. (Stone 2010)

Party and charter boats accounted for less than 3% of total recreational catch and retained catch (Rosen and Ellis, 1961; Ellis et al. 1958).

The Daytona Beach Fishing Association during the 1950's began awarding certificates and prizes for largest fish species. The Chamber of Commerce helped promote deep sea fishing. (Stone 2010)

In 1957-1958, private boats accounted for over 65% of total catch and over 70% of total retained catch from recreational anglers. The majority of fish caught and retained by recreational anglers was comprised of inshore species and king mackerel. Red snapper is mentioned as “more frequent” in reported catches for offshore fish, but the percentage of trips that caught offshore fish is not given (Rosen and Ellis, 1961)[15].

1955 Florida statewide estimated effort (total days fishing; Ellis et al., 1958):
Private boat = 10,589,000
Rental boat = 1,532,000
Charter = 449,000
Party = 474,000

During the 1950's, Captain Jake Stone on the Mako was using WWII surplus Loran-A navigation equipment and a Raytheon Cadet fathometer that used 3 inch wide paper. They also developed stationary electric reels to commercial fish snapper and groupers after the tourist season ended around Labor Day each year.(Stone 2010)

"...then in 1959 DuPont introduced Stren, a thinner and much softer monofilament line that could be used in a large range of reels" "Stren's monofilament lines soon became a favorite with many fishermen because of its overall ease of use and it spawned a whole host of imitators." (Wikipedia)

"In the late 1950's, the Coast Guard enforced stringent regulations for passenger boat (Frey, 1971)." (Smith 1979)

1960’s:
During the early 1960's at Ponce Inlet, Florida the newly constructed 62-foot 48 passenger party boat named the Marianne and a 40-foot 18 passenger party boat named the Miss Juanita began using the

Raytheon DX Navigator Loran A, state of the art for its time. Newer fathometers began using larger paper to image the bottom and the fish. CB ship to shore radios began to replace the old AM radios. (Stone 2010)

Inlet Harbor located in Ponce Inlet, Volusia County, Florida provides 447 dated pictures from February to September 1962 of the fishing catch that are used to estimate species, size and landings in a Special Scientific Report-Fisheries 514. Estimates for recreational and commercial fishing catch are made with the years 1962-1963 for the Cape Canaveral Brevard County/Volusia County area in this analysis requested by the U. S. Atomic Energy Commission. (Anderson and Gehringer 1965)16

The Schlitz beer company held an annual Florida fishing contest in the early to mid-1960's with significant prizes. A lot of the fish were tagged and released, besides the species that were landed and entered into the contest. The Florida DNR Marine Research Laboratory cooperated on the tagging and Schlitz paid significant rewards upwards of hundreds to thousands of dollars in some cases for the return of the tag and all relevant information required to claim the prize.

During the mid-1960's commercial snapper/grouper vessels from NE Florida would fish the 30 fathom ledge offshore of Georgia and unload in Savannah. By the late 1960's some charter boats began fishing out of Hilton Head, SC. Some boats had paper fathometers. (Amicks 2010)

“An estimated 200 or more pleasure boats, from the Florida west coast to Texas, make occasional trips to inshore snapper banks.”, (quoted from Carpenter, 1965)[17]

“The large sport fishing interests in Florida also utilize this fish [red snapper], thereby making it one of our most valuable seafood resources.”, (quoted from Futch and Torpey, 1966)[18]

"Daytona Beach offers some of the best deep sea fishing to be had anywhere in Florida. More than a dozen different varieties of game fish are plentiful on the offshore reefs, together with red snapper, grouper and triggerfish. These reefs...are from nine to 30 miles out. On a typical deep sea trip the fishing begins shortly after the boat clears the inlet. Trolling lines are put out, usually four..." "It takes about two hours to reach the fishing grounds where the boat is anchored and every one can fish at the same time." "There are times when a school of snapper will be located and then the fishing gets really wild." The trip back is handled just like the trip out and often more fish are caught in the afternoon than in the morning." [trolling] (Allyn 1967)19

“The exploitation of the reef fishes on the offshore fishing grounds of Florida has increased tremendously since World War II.”, (Moe, 1963)[20]

A survey in Florida identified fishing grounds between 10 and 100 fathoms offshore from Nassau County south through St. Lucie County, and additionally off the Atlantic coast of Monroe County, where red snapper was a primary target species from recreational, for-hire, and commercial vessels. Development of offshore private boat sport fisheries in NE Florida were limited by the availability of favorable fishing grounds relatively close to shore and within range of major inlets. Ponce Inlet in Volusia County was the only area where an offshore sport fishery for red snapper was well established in NE Florida.

Red snapper was the most sought after and most caught fish on party boats in northeast Florida and there were 15 year-round and 11 seasonal party boats carrying 10 - 50 passengers operating in the region. Charter boats relied upon king mackerel to provide the greatest amount of fishing activity in northeast Florida, [although red snapper was targeted out of Ponce de Leon Inlet by charter boats, party boats and commercial boats, see Tables 1-3, Page 12-18 from Moe, 1963] (Hudson 2010)

Halifax Sport Fishing Club (HSFC) was founded in Volusia County, Florida during August 1967. Later this fishing club developed fishing charts that showed many of the popular reefs, wrecks, etc. offshore of Ponce Inlet. The club later put flags and other buoy markers on these fishing reefs and replaced them after storms effected their position. HSFC longtime member Donald Monico spoke of being a "weekend warrior" following charter and party boats to the fishing reefs during the early years of the club that later led to the fishing charts that the club sold to the growing private recreational fleet.

Florida Sport Fishing Association (FSFA) established during 1968. (www.fsfaclub.org)

The Florida Sportsman magazine began to be published during 1969. (http://www.floridasportsman.com/features/)

Commercial red snapper landings peaked in 1968 at 1.1 million pounds. (SAFMC 1983 Snapper / Grouper FMP)21

Beginning in 1968 and finished by 1972, the Ponce de Leon Inlet was stabilized by the US Army Corps of Engineers by installing jetties and weirs, plus dredging the channel. Before that occurred the Ponce de Leon Inlet was considered one of the most dangerous inlets on the Florida east coast.

"Fathometers came into general use [1960's]." (Smith 1979)

VHF ship to shore radios became popular and had better clarity than earlier radios.

1970's

The private recreational deep sea fishing fleet began to rapidly increase when fiberglass boats became a more affordable choice for the public. The construction of condominiums increased the coastal population beginning during the 1970's, while ocean-going vessels on a trailer or in dry storage began to increase.

"...a new type of rod made from graphite was introduced around 1973." (Smith 1979)
Some vessels in Georgia began using LORAN-A in the early 1970's, and by the mid-1970's began using LORAN-C due to its greater accuracy to within mere feet. LORAN-C units cost several thousand dollars at this time. (Amicks 2010)

For-hire and commercial boats began using LORAN-C on the Florida east coast about the mid to late 1970's. The LORAN-C towers were increased during the 1970's-the 1980's in the US.

The "roller-net" reef fish trawl fishery began targeting vermilion snapper, etc. as landed catch during the late 1970's and were eventually banned effective January 12, 1989. (SAFMC 1988 Amendment 1 Snapper Grouper FMP)22

Pelagic longlines for swordfish began to become popular and some commercial fishermen shifted to that fishery.

Some commercial bottom fishing fishermen began using Circle hooks of different sizes about the late 1970's. (Hudson 2010)

In 1979, a total of 1,071 commercial hook and line vessels fished along the Florida east coast, including Monroe County, however it was unknown how many boats fished in the snapper-grouper fishery. About 400,000 pounds of red snapper were landed commercially. (SAFMC 1983 FMP)

In 1979, approximately 428 charter boats were along the east Florida coast. Approximately 46 head boats operated between Cape Hatteras, NC and Cape Canaveral, FL. About 49 head boats were operated between Cape Canaveral and Key West, FL. Headboat landings of red snappers were 245,400 pounds. (SAFMC 1983 FMP)

An estimated 133,449 private recreational boats fish offshore in the South Atlantic Region which includes the Florida east and west coast. About 42.3 percent of recreational landings are from federal waters. Total red snapper landings were estimated to be 1 million pounds in 1979. (SAFMC 1983 FMP)

1980's

LORAN-A is turned off in the United States during 1980. (USCG 2010)

LORAN-C units cost fell to an affordable range of prices so that the private recreational boats began normally purchasing them. (Amicks 2010)

"Geographical Distribution: Gulf of Mexico and Atlantic coast of the USA extending northward to Massachusetts, but rare north of the Carolinas." (FAO 1985)

The NMFS promoted utilization of "underutilized species" like sharks, etc., during the early to mid-1980's. Many commercial shallow water snapper/grouper fishermen began targeting deep-water grouper/tilefish species during this period.

On September 28, 1983 the South Atlantic Fishery Management Council (SAFMC) implemented a FMP for snapper/grouper species and set a 12-inch minimum size for red snappers. [48 Federal Register 39463]

In spite of conflicts between hook and line snapper/grouper fishermen and some Carolina fish trawlers ranging down to Florida reefs during the late 1970's and early 1980's over damage to live bottom and reefs by roller nets and other types of fish trawling nets, the SAFMC failed to prohibit the destructive gear until Amendment 1 was implemented in 1989. The 1988 Amendment 1 to the Snapper/Grouper FMP prohibited use of trawl gear to harvest fish in the snapper grouper fishery south of Cape Hatteras, NC and north of Cape Canaveral, FL; and defined directed snapper grouper fishery.
Commercial bottom longlines began to be utilized in the early 1980's for the Florida east coast regions for traditional species like shallow water grouper and snappers, as well as snowy grouper, golden tilefish and later sharks. The directed shark fishery began in the Volusia County, Florida area about 1984 and peaked out by 1993 when an Atlantic Shark FMP was implemented.

The private recreational fleet was increasing in size and ranged out past the traditional fishing reefs by the 1980's. (Hudson 2010)

Colorscope depth recorders began to replace older paper fathometers in the for-hire and commercial vessels. Video plotters became available but were mostly used by commercial boats fishing deep water. The private recreational boats began to purchase higher tech equipment.

While Charter Fishing during late June 1989, I found an aggregation of large Red Snapper just over five miles from the Ormond Pier, near to the Volusia/Flagler County line on a "shrimp hang". We fished on that school of Red Snapper for nearly a month, mostly at night without being discovered. (Hudson 2010)

1990's
The SAFMC raises the Red Snapper commercial and recreational minimum size to 20-inches total length from the 12-inches total length minimum with SAFMC Snapper Grouper FMP Amendment 4 final rule published in the Federal Register 1991 October 31 and effective January 01, 1992. (SAFMC 1991)23

NOTES:
It is my feeling that weather patterns such as hurricanes and winter storms need to be considered in understanding annual fishing efforts through history. Gregg mentions the effect of extra cold winters, and some other information sources note the disruption caused by hurricanes historically. In my

experience after a serious Northeaster or a hurricane, it generally takes several days to a few weeks for the ocean to settle down to normal as per fishing and boat rides.

Events such as WW II bombing practices made over the ocean reefs in the East Florida Coast, sinking of certain US Navy vessels that released high levels of dangerous substances including caustic soda, and the 1986 Challenger accident over the Cape Canaveral fishing area have all had some consequences on fish populations and habitat. Pollution from the coastal human population growth and increase of the oily bilge water and sewage has affected the habitat on an increasing basis during the past century or more.

1 "Notes on the Red-Snapper Fishery" 1886 Joseph William Collins
2 "American Food and Game Fishes" 1902 David Starr Jordan and Barton Warren Evermann
3 "Volume 6: Snappers of the World" 1985 G. R. Allen prepared for the FAO
4 "Changes in Saltwater Angling Methods and Gear in California" 1979, Susan E. Smith
5 "American Fishes" 1887/reprint 1903, George Brown Goode
6 Captain Joseph Coon, 2010, personal communication, Pensacola, Florida
7 "Where, When, and How to Catch Fish on the East Coast of Florida", 1902, William H. Gregg, assisted by Capt. John Gardner
8 Bureau of Fisheries, 1924
9 Captain Robert Stone, 2010, personal communication, Ponce Inlet, Florida
10 Captain Russell Hudson, 2010, personal communication, Daytona Beach, Florida
11 "Salt Water Fishing", 1937/reprint 1953, Van Campen Heilner
12 http://dxinfo.ea3bhk.com/Miscellaneous/LORAN-End-of-an-era.html
13 Captain Steve Amicks, 2010, personal communication, Savannah, Georgia
14 "Technical Series No. 24, A Survey of the Number of Anglers and of Their Fishing Effort and Expenditures in the Coastal Recreational Fishery of Florida", 1958, Robert W. Ellis, Albert Rosen and Allen W. Moffett
15 Rosen and Ellis, 1961
16 "Biological-Statistical Census of the Species Entering Fisheries in the Cape Canaveral Area" 1965, by William W. Anderson and Jack W. Gehringer for the US Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries and known as Special Scientific Report-Fisheries No. 514
17 Carpenter, 1965
18 Futch and Torpey, 1966
19 "Good Fishing In Florida" 1967, Rube Allyn
20 "A Survey Of Offshore Fishing In Florida", 1963, Martin A. Moe Jr.
21 http://www.safmc.net/Portals/6/Library/FMP/SnapGroup/SnapGroupFMP.pdf
22 http://www.safmc.net/Portals/6/Library/FMP/SnapGroup/SnapGroupAmend1FinalRule.pdf
23 http://www.safmc.net/Portals/6/Library/FMP/SnapGroup/SnapGroupAmend4FinalRule.pdf

Conclusions

The use of U.S. Census data as a proxy for historic fishing effort was rejected by the HFWG. The HFWG also rejected the use of historic estimates from USFWS surveys without significant adjustments for recall bias and species mis-identifications. Two methods investigated by the HFWG show promise for use in estimating historic recreational landings. Those methods include the ratio method using commercial landings as a proxy for recreational landings, and the U.S. Fish and Wildlife Survey estimates adjusted for recall bias and species mis-identification. Figure 23 below shows a comparison of estimates generated using the two methods. Note that differences in landings estimates after 1980 are due to sources where post-1980 data were obtained from. The ratio method analysis used red snapper estimates downloaded from the MRFSS website by mode (private boat and charter), and the USFWS method used total recreational landings estimates from SEDAR 15. For SEDAR 24, the most up-to-date landings estimates generated during the data workshop should be used.

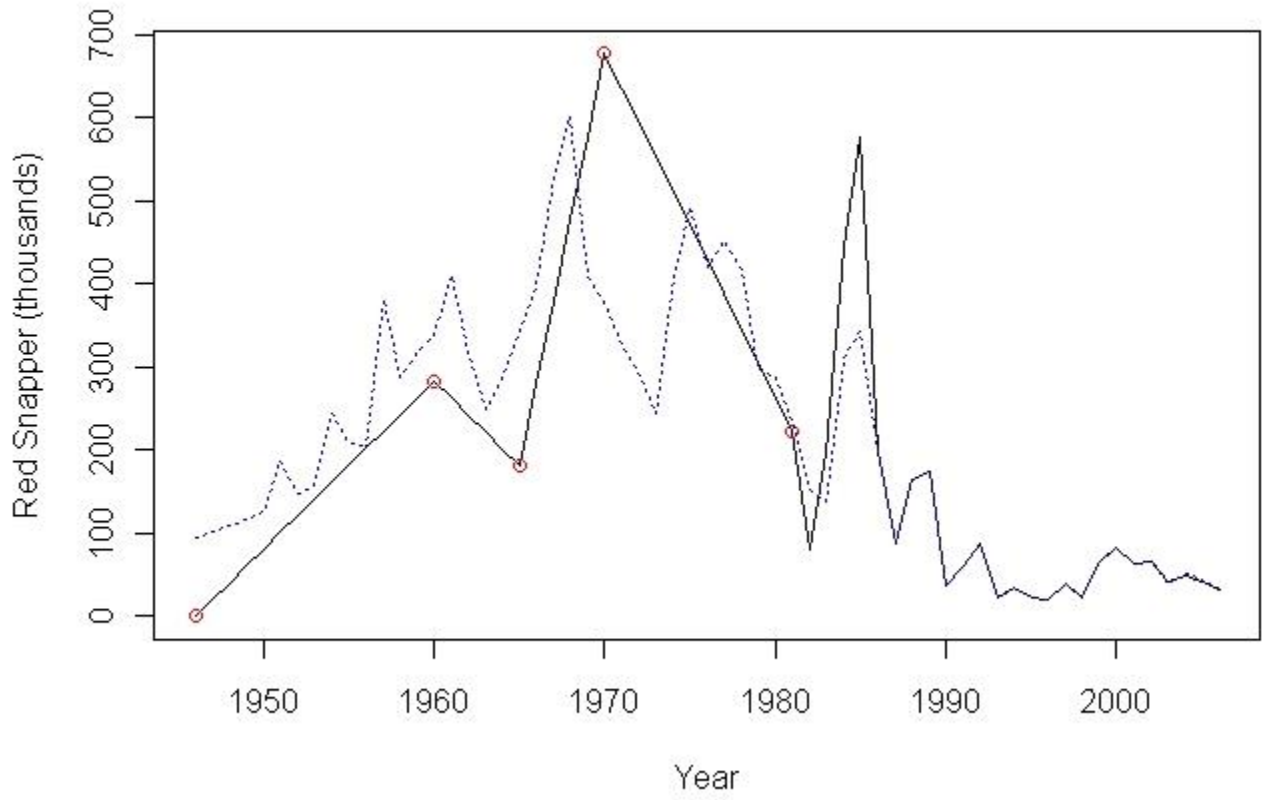


Figure 23: Estimated historic red snapper recreational landings (thousands of fish) using: 1) ratio method (dashed line), and 2) adjusted U.S. Fish and Wildlife Service estimates (red circles) with estimates interpolated between survey years (solid line).

Estimates generated by the two methods in Figure 23 are in agreement with each other, with the exception of 1970. Historic trends in recreational landings using the two methods presented here are also in agreement with trends in the Florida Sport Fishing Association Catch Program, which indicates red snapper catches were higher in the 1970's and lower in the 1980's and 1990's. Benchmark periods in the historic development and growth of the red snapper recreational fishery indicate landings should be low in the 1950's as the fishery was first being developed, increasing in the 1960's as the sport became more accessible to recreational anglers and human populations increased in the South Atlantic, and higher in the 1970's once the recreational fishery was well established in the region.

Recommendations

The SEDAR 24 Historic Fisheries Working Group (HFWG) recommends the methods which use (1) the ratios with the commercial red snapper landings and (2) the post-adjusted U.S. Fish and Wildlife Saltwater Angling Survey estimates, be considered by the data workshop for inclusion in the stock assessment. The HFWG believes both of these methods have merits, but could not come to any solid reasons why one method would be better than the other. Both methods have positive aspects and negative drawbacks. The two methods produce similar results in magnitude and historical pattern. Based on our preliminary analysis, we do not recommend use of U.S. Census data for back-calculation of historic recreational catches.

It should be noted that the ratio method should be re-computed at the data workshop, once the commercial landings have been finalized. The HFWG expectation is that these will not change significantly. The Recreational Workgroup will also need to discuss the uncertainty associated with those estimates and decide upon a method to bracket historic landings estimates for use in model runs.

Literature Cited

Clark, J. 1962. The 1960 Salt-Water Angling Survey. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, *Circular* 153, 36 pp.

Deuel, D. G. 1973. 1970 Salt-Water Angling Survey. U.S. Department of Commerce, NOAA, *Current Fishery Statistics* No. 6200, 54 p.

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* 67, 51 p.

Fisher, W.L., A.E. Grambsch, D.L. Eisenhower, and D.R. Morganstein. 1991. Length of recall period and accuracy of estimates from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. American Fisheries Society. 12: 367-374.2

Roach, B., J. Trial, and K. Boyle. 1999. Comparing 1994 angler catch and harvest rates from on-site and mail surveys on selected lakes. North American Journal of Fisheries Management 19:203-208.

Goode, G.B. 1903. American Fishes, A Popular Treatise Upon The Game and Food Fishes of North America with Special Reference to Habits and Methods of Capture. L.C. Page & Company, Boston. pp 73-82.

Tarrant, M. A., M. J. Manfredo, P. B. Bayley, and R. Hess. 1993. Effects of recall bias and nonresponse bias on self-report estimates of angling participation. North American Journal of Fisheries Management 13:217-222.

Teceiro, M. 2002. The summer flounder chronicles: Science, politics, and litigation, 1975-2000. Reviews in Fish Biology and Fisheries 11: 125-168.

Appendix 1. U.S. population data by state, including decadal U.S. Census values (highlighted) downloaded from the Internet, interpolated annual estimates between decades, and estimated values from the U.S. Census for recent years (2001-2009) downloaded from the Internet.

Year	NC	SC	GA	FL	EFL
1900	1,893,810	1,340,316	2,216,331	528,542	159,369
1901	1,925,058	1,357,824	2,255,610	550,950	164,974
1902	1,956,305	1,375,333	2,294,889	573,357	170,580
1903	1,987,553	1,392,841	2,334,168	595,765	176,185
1904	2,018,801	1,410,350	2,373,447	618,173	181,791
1905	2,050,049	1,427,858	2,412,726	640,581	187,396
1906	2,081,296	1,445,366	2,452,005	662,988	193,001
1907	2,112,544	1,462,875	2,491,284	685,396	198,607
1908	2,143,792	1,480,383	2,530,563	707,804	204,212
1909	2,175,039	1,497,892	2,569,842	730,211	209,818
1910	2,206,287	1,515,400	2,609,121	752,619	215,423
1911	2,241,571	1,532,232	2,637,792	774,204	221,103
1912	2,276,854	1,549,065	2,666,463	795,789	226,784
1913	2,312,138	1,565,897	2,695,134	817,374	232,464
1914	2,347,421	1,582,730	2,723,805	838,959	238,144
1915	2,382,705	1,599,562	2,752,477	860,545	243,825
1916	2,417,989	1,616,394	2,781,148	882,130	249,505
1917	2,453,272	1,633,227	2,809,819	903,715	255,185
1918	2,488,556	1,650,059	2,838,490	925,300	260,865
1919	2,523,839	1,666,892	2,867,161	946,885	266,546
1920	2,559,123	1,683,724	2,895,832	968,470	272,226
1921	2,620,238	1,689,228	2,897,099	1,018,444	285,824
1922	2,681,354	1,694,732	2,898,367	1,068,418	299,422
1923	2,742,469	1,700,236	2,899,634	1,118,392	313,020
1924	2,803,584	1,705,740	2,900,902	1,168,366	326,618
1925	2,864,700	1,711,245	2,902,169	1,218,341	340,216
1926	2,925,815	1,716,749	2,903,436	1,268,315	353,814
1927	2,986,930	1,722,253	2,904,704	1,318,289	367,412
1928	3,048,045	1,727,757	2,905,971	1,368,263	381,010
1929	3,109,161	1,733,261	2,907,239	1,418,237	394,608
1930	3,170,276	1,738,765	2,908,506	1,468,211	408,206
1931	3,210,411	1,754,869	2,930,028	1,511,131	420,084
1932	3,250,545	1,770,973	2,951,549	1,554,052	431,961
1933	3,290,680	1,787,077	2,973,071	1,596,972	443,839
1934	3,330,815	1,803,181	2,994,593	1,639,892	455,716
1935	3,370,950	1,819,285	3,016,115	1,682,813	467,594
1936	3,411,084	1,835,388	3,037,636	1,725,733	479,472

Year	NC	SC	GA	FL	EFL
1937	3,451,219	1,851,492	3,059,158	1,768,653	491,349
1938	3,491,354	1,867,596	3,080,680	1,811,573	503,227
1939	3,531,488	1,883,700	3,102,201	1,854,494	515,104
1940	3,571,623	1,899,804	3,123,723	1,897,414	526,982
1941	3,620,654	1,921,526	3,155,809	1,984,803	551,630
1942	3,669,684	1,943,249	3,187,894	2,072,192	576,279
1943	3,718,715	1,964,971	3,219,980	2,159,581	600,927
1944	3,767,745	1,986,693	3,252,065	2,246,970	625,576
1945	3,816,776	2,008,416	3,284,151	2,334,360	650,224
1946	3,865,807	2,030,138	3,316,236	2,421,749	674,872
1947	3,914,837	2,051,860	3,348,322	2,509,138	699,521
1948	3,963,868	2,073,582	3,380,407	2,596,527	724,169
1949	4,012,898	2,095,305	3,412,493	2,683,916	748,818
1950	4,061,929	2,117,027	3,444,578	2,771,305	773,466
1951	4,111,352	2,143,584	3,494,432	2,989,331	856,763
1952	4,160,774	2,170,140	3,544,286	3,207,356	940,061
1953	4,210,197	2,196,697	3,594,139	3,425,382	1,023,358
1954	4,259,619	2,223,254	3,643,993	3,643,407	1,106,656
1955	4,309,042	2,249,811	3,693,847	3,861,433	1,189,953
1956	4,358,465	2,276,367	3,743,701	4,079,458	1,273,250
1957	4,407,887	2,302,924	3,793,555	4,297,484	1,356,548
1958	4,457,310	2,329,481	3,843,408	4,515,509	1,439,845
1959	4,506,732	2,356,037	3,893,262	4,733,535	1,523,143
1960	4,556,155	2,382,594	3,943,116	4,951,560	1,606,440
1961	4,608,745	2,403,386	4,007,762	5,135,348	1,685,640
1962	4,661,336	2,424,178	4,072,408	5,319,137	1,764,840
1963	4,713,926	2,444,971	4,137,054	5,502,925	1,844,040
1964	4,766,517	2,465,763	4,201,700	5,686,713	1,923,240
1965	4,819,107	2,486,555	4,266,346	5,870,502	2,002,440
1966	4,871,697	2,507,347	4,330,991	6,054,290	2,081,639
1967	4,924,288	2,528,139	4,395,637	6,238,078	2,160,839
1968	4,976,878	2,548,932	4,460,283	6,421,866	2,240,039
1969	5,029,469	2,569,724	4,524,929	6,605,655	2,319,239
1970	5,082,059	2,590,516	4,589,575	6,789,443	2,398,439
1971	5,162,030	2,643,646	4,676,928	7,085,131	2,526,330
1972	5,242,000	2,696,777	4,764,281	7,380,819	2,654,222
1973	5,321,971	2,749,907	4,851,634	7,676,507	2,782,113
1974	5,401,942	2,803,038	4,938,987	7,972,195	2,910,005
1975	5,481,913	2,856,168	5,026,340	8,267,884	3,037,896
1976	5,561,883	2,909,298	5,113,693	8,563,572	3,165,787
1977	5,641,854	2,962,429	5,201,046	8,859,260	3,293,679

Year	NC	SC	GA	FL	EFL
1978	5,721,825	3,015,559	5,288,399	9,154,948	3,421,570
1979	5,801,795	3,068,690	5,375,752	9,450,636	3,549,462
1980	5,881,766	3,121,820	5,463,105	9,746,324	3,677,353
1981	5,956,453	3,158,308	5,564,616	10,065,484	3,824,016
1982	6,031,140	3,194,797	5,666,127	10,384,644	3,970,680
1983	6,105,827	3,231,285	5,767,638	10,703,805	4,117,343
1984	6,180,514	3,267,773	5,869,149	11,022,965	4,264,007
1985	6,255,202	3,304,262	5,970,661	11,342,125	4,410,670
1986	6,329,889	3,340,750	6,072,172	11,661,285	4,557,333
1987	6,404,576	3,377,238	6,173,683	11,980,445	4,703,997
1988	6,479,263	3,413,726	6,275,194	12,299,606	4,850,660
1989	6,553,950	3,450,215	6,376,705	12,618,766	4,997,324
1990	6,628,637	3,486,703	6,478,216	12,937,926	5,143,987
1991	6,770,705	3,539,234	6,649,040	13,242,371	5,547,402
1992	6,912,772	3,591,765	6,819,863	13,546,816	5,950,817
1993	7,054,840	3,644,296	6,990,687	13,851,262	6,354,231
1994	7,196,907	3,696,827	7,161,511	14,155,707	6,757,646
1995	7,338,975	3,749,358	7,332,335	14,460,152	7,161,061
1996	7,481,043	3,801,888	7,503,158	14,764,597	7,564,476
1997	7,623,110	3,854,419	7,673,982	15,069,042	7,967,891
1998	7,765,178	3,906,950	7,844,806	15,373,488	8,371,305
1999	7,907,245	3,959,481	8,015,629	15,677,933	8,774,720
2000	8,049,313	4,012,012	8,186,453	15,982,378	9,178,135
2001	8,203,451	4,062,701	8,230,161	16,353,869	9,391,470
2002	8,316,617	4,103,934	8,419,594	16,680,309	9,578,933
2003	8,416,451	4,146,474	8,585,535	16,981,183	9,751,715
2004	8,531,283	4,201,306	8,735,259	17,375,259	9,978,019
2005	8,669,452	4,256,199	8,913,676	17,783,868	10,212,669
2006	8,866,977	4,339,399	9,097,428	18,088,505	10,387,612
2007	9,064,074	4,424,232	9,330,086	18,277,888	10,496,368
2008	9,247,134	4,503,280	9,533,761	18,423,878	10,580,205
2009	9,380,884	4,561,242	9,697,838	18,537,969	10,645,724