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Annual indices of abundance of Spanish Mackerel from Florida commercial trip tickets, 1986-2020

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Introduction

Established by the Florida Legislature in Florida Statute (F.S.) 370.026 during 1983, the Florida Marine Fisheries Commission in conjunction with the Department of Natural Resources (DNR)[2] was charged with conserving and managing Florida's marine fisheries. In late-1984, the DNR implemented the mandatory reporting of detailed trip-level commercial fishery landings data by wholesale and retail seafood dealers using marine fisheries trip tickets. Prior to this time, commercial fisheries data were collected from seafood dealers on a monthly basis by the National Marine Fisheries Service (NMFS). Data were collected by both the NMFS and the DNR trip ticket system during 1985 to enable a comparison of the new data collection system. After determinations that the monthly dealer summaries and the detailed trip ticket information were comparable, the trip ticket system became the official commercial fisheries landings data collection system in Florida.

Wholesale and retail dealers operating in Florida are required to purchase dealer licenses, and wholesale dealers that purchase saltwater products (marine fish, invertebrates, live marine specimens, etc.) from commercial fishermen or wholesale and retail dealers that catch saltwater products themselves for sale in Florida are required to report these amounts on marine fisheries trip tickets to the Florida Fish and Wildlife Conservation Commission. Exceptions to the reporting requirements are: 1) restaurants who harvest their own catch for consumption on their premises; 2) trans-shipments of saltwater products after landing in Florida for destinations outside of the state for which no purchase occurred (e.g., a corporate vessel landing saltwater products at a Florida port without receiving payment and shipping product to another state). Fishermen who harvest saltwater products commercially are required to purchase Saltwater Products Licenses and sell only to licensed wholesale seafood dealers or sell their catches directly to the public if they have a retail dealer license. Fishermen may also be required to have additional license endorsements and federal permits for the legal harvest and sale of some species (e.g., Spanish Mackerel).

Trip tickets have been used by wholesale and retail seafood dealers for the reporting of fish and invertebrates purchased in Florida from fishermen since the system's inception in 1984.

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[1] Retired.

[2] The Department of Natural Resources was established by the Florida Legislature in 1968 and incorporated the Florida Board of Conservation into its structure. Later, in 1993, Governor Lawton Chiles combined the Department of Natural Resources and the Department of Environmental Regulation into a single agency called the Department of Environmental Protection. During the 1998 general election, a majority of Florida voters approved an amendment to the Florida Constitution which combined the Florida Game and Freshwater Fish Commission, the Florida Marine Fisheries Commission, and portions (chiefly, most of the Division of Marine Resources and most of the Florida Marine Patrol) of the Department of Environmental Protection into a single commission. The Florida Legislature, on July 1, 1999, formed the new Florida Fish and Wildlife Conservation Commission in fulfillment of that amendment.

There have been revisions to the trip ticket fields and the mandatory nature of some fields over time (Table 1), as well as additions of new species codes, gear codes, and reporting units. Seafood dealers are required to report the preceding month's purchases from fishermen by the tenth day of the month following the transaction. In the case where a species is managed under federal quota like Spanish Mackerel, weekly electronic reporting is required. The time lag for data entry of submitted paper forms is approximately four weeks after forms are received. Once received from the vendor, electronic data are available immediately. Complete editing of computerized data typically takes two to three weeks. Computerized reporting of trip tickets, which eliminates the time lag for data entry, has occurred as early as 1987, and today, about 85% of all commercial trips in Florida are reported electronically.

Geographic range

All commercial harvests landed and sold in Florida are required to be reported on Florida marine fisheries trip tickets (Fig. 1). Reports are required to have all mandatory information submitted with the landings data. The area fished information required on trip tickets is based on the NMFS' shrimp grid zones (Fig. 2). Additional areas fished for locations outside of Florida are available and supplied to dealers upon request.

Assignment of fishing gears to trips:

At the time of applying for or renewing Saltwater Products License (SPL), fishermen were asked to indicate their use of fishing gears for the upcoming license year. Many license holders indicated more than one gear on their annual license application or renewal, and some did not indicate any gear at all. From the inception of the Florida trip ticket program until February of 1990, a "gear fished" field was not on the trip ticket (Table 1) so analysts inferred the gear used by a combination of the reported catch (species, amounts) and the gear fields on a fisherman's SPL license application. Beginning in 1990, the trip ticket was revised to include the gear fished field which consisted of rather generic "check boxes" for gears and a 4-digit gear code if the reporting of a more specific gear was desired (data reported electronically provide the specific 4-digit gear code). Old trip tickets were still in use for a couple of years, so not all records from 1990 to 1992 contained gear information. As the old stocks of trip tickets were used up by dealers, the reporting of gear used by trip increased.

Gear related to trip tickets was retrieved from the Saltwater Products (SPL) license record for the 1986 to 1992 license years during the editing of trip tickets, and this "gear" record was retained in the trip ticket data base. The SPL number was prohibited from being retained on the trip ticket by the Florida legislature when then trip ticket program was initially approved, but later was allowed to be retained in the trip ticket data base in late 1986.

For trip tickets from 1986-1992, gear was assigned from the commercial fishing license application database (which was retained on the edited trip ticket record) based on a species/gear hierarchy from later years where gear was reported by trip. Target species and species groups were identified on trips where gear was reported from 1991-1994. The species-gear associations from these data were ranked from most common to least common and applied to the trip ticket data from 1986-1992. The target species (defined as the species with the highest poundage) and species groups were identified on trips where gears was not reported by trip from 1986-1992. Gear was assigned to each trip based on matching the species-license gear association with the

species-ticket gear association from the 1991-1994 data. Gears by trip for these analyses were grouped into gill net, cast net, trawls, hook and line gears, and other. If gears were not determined for a trip (no license-gear information in the 1986-1992 period, or missing from the trip ticket from 1993-2020), the trip ticket was dropped from the analyses. The majority of Spanish Mackerel landings were categorized as one of these gear types, and analyses for gill nets, cast nets, and hook and line gears are provided in this report.

At the SEDAR 28 Data Workshop, the Indices workgroup examined the preliminary results and suggested that the hook-and-line gear assignments for the 1986-1992 period may have included some landings exceeding reasonable limits for trips using this gear. At that time, trips for this period were re-analyzed and landings in excess of the 99th percentile were excluded from the analyses. For the Florida Atlantic coast Spanish Mackerel trips, those with landings greater than 840 pounds were excluded. This same methodology is also being applied to the SEDAR 78 commercial indices.

Species and species groups

As in SEDAR 28, trip tickets with Spanish Mackerel ("positive" trips) were selected for analyses. A suitable method for selecting a universe of trips to evaluate (i.e., all trips which could have caught Spanish Mackerel – zeros as well as positives) has not been developed yet, but possibly could be done using clustering techniques (e.g., Shertzer and Williams 2008) or some other type of selection procedure (e.g., Stephens and MacCall 2004). However, the prospects for success in identifying fishing trips on which Spanish Mackerel could have been caught using only trip ticket information is doubtful because no habitat information is gathered on trip tickets and information on discarded/released catches is not reported on trip tickets.

Species were assigned to fishery groups (Table 2) based upon fishery characteristics. The pounds landed by fishery group were summed for a trip ticket. Spanish Mackerel was assigned to its own "group" because this was the species of interest for developing indices. For the purposes of developing the indices, a fishery group was classed as present or absent for the analyses.

Trip limits

Limits on harvest (pounds) of Spanish Mackerel per trip during specific periods of the year would potentially affect the observed catch per trip, so the trip limits that were in effect during these periods were added to the trip ticket records. The dates for these trip limits for Atlantic Group Spanish Mackerel (Table 3) were taken from SEDAR 28 and updated through 2020 with information provided by Christina Wiegand at the South Atlantic Fishery Management Council as well as NOAA Fisheries. Some of the trip limits were based on day of the week. Gill net and cast net trips with trip limits greater than 1,500 pounds and hook and line trips with trip limits greater than 500 pounds were selected for analyses as in SEDAR 28.

Unit measure of abundance:

Pounds (whole weight) of Spanish Mackerel landed on a trip was the response variable for most models (Poisson, gamma, and negative binomial models), and lognormal models used the log-transformed pounds of Spanish Mackerel.

Temporal and spatial resolution:

Quotas for Spanish Mackerel are managed by the NMFS for the South Atlantic Fishery Management Council (SAFMC) and the Gulf of Mexico Fishery Management Council (GMFMC). The boundary separating the SAFMC and GMFMC in Florida for Spanish Mackerel is the line dividing Monroe County (Florida Keys) and Miami-Dade County (Fig. 2). As in SEDAR 28, landings were divided by council jurisdictional boundaries rather than the boundaries used for managing Spanish Mackerel quotas.

The separation of Spanish Mackerel landings to coincide with the council jurisdictions rather than how they are currently managed was approximate. Landings were first assigned to a migratory group based upon the area fished (if present on the trip ticket) or county landed corresponding to the quota management regime (separated at the Monroe County and Miami-Dade County boundary) so that any trip limits in effect could be assigned to the records. Once the migratory group was determined, landings were categorized based on the quota management boundaries as either Atlantic Coast or Gulf Coast, and separately by area fished (if present on the trip ticket) and county landed for SEDAR 78. Gulf group Spanish Mackerel, if reported from areas 748 or 1 (Florida Keys) were classed as Atlantic Coast landings for SEDAR 78, while those in area 2 were considered Gulf Coast landings. If area fished was not reported on trip tickets from Monroe County (especially prior to 1992 when the reporting of this field was optional), the landings were considered to belong to the Gulf Coast. [There is a portion of area 2 that is in the SAFMC jurisdiction, but prior to 2008, dividing catches into each council jurisdiction for area 2 is difficult to accomplish unless there are gear restrictions (e.g., SAFMC long line regulations)]. Finally, only Atlantic coast landings were kept for the analyses.

Additionally, the county of landing for Spanish Mackerel was grouped into Florida subregions for these analyses. The subregion groupings were Nassau to Brevard (subregion 5), Indian River to Miami-Dade (subregion 4), and Monroe County (subregion 3). Landings may occur in a county in some years but not in others, and this situation can lead to missing cells in the general models that could result in model instability or inappropriate estimates for class variables. Two subregion groupings were devised. The first was based solely on county landed (corresponding to the usual subdivision of Florida landings in the NMFS commercial landings (Nassau County to Miami-Dade County landings are assigned to the Florida Atlantic Coast, and Monroe County to Escambia County are assigned to the Florida Gulf of Mexico Coast). A second subregion grouping modified the subregion based upon area fished (if reported on the trip ticket) as outlined in the preceding paragraph.

Series period:

Florida trip tickets reported for the time period of 1986 to 2020 were used for developing the indices. The hook and line indices were developed over the entire period for the Florida Atlantic coast. Because of the entangling net limitations implemented in Florida on July 1, 1995, trip tickets with the reported or assigned gear of gill nets or cast nets were split into groups before and after this date.

Indices:

There were four indices for Spanish Mackerel developed from Florida trip tickets for the Atlantic coast: gill nets for 1986-June 30, 1995, gill nets for July 1, 1995 to 2020, cast nets for 1996-2020, and hook and line gears for 1985-2020 (Table 9). Each of the gill net and cast net indices were analyzed during time periods when trip limits allowed more than 1,500 pounds of Spanish Mackerel to be landed, and each of the HL indices used data for time periods when trip limits allowed greater than 500 pounds of Spanish Mackerel to be landed. The logic behind these choices for trip limits was that during the unlimited portion of the quota season landings may be more likely to reflect the availability of fish on that trip.

Trips with Spanish Mackerel (pounds whole weight landed) were selected by gear, time period, and trip limit in effect (Table 3). The pounds of other species landed on the same trip ticket were grouped by fishery code (Table 2) and converted to '1' or '0' to indicate presence or absence from the landings for a trip. Year, month, Florida sub-region, and fishery codes were the classification variables used to examine for trends in the amount (pounds) of Spanish Mackerel landed.

A generalized linear model [McCullagh and Nelder 1989; GENMOD procedure (SAS Institute Inc. 2016)] using a forward stepwise selection technique was used to estimate trends in catch per trip by gear. Four types of model probability distributions were explored: gamma (with a log link function), lognormal, Poisson, and negative binomial. When the lognormal distribution was used, the pounds of Spanish Mackerel landed were log-transformed and the model used a normal probability distribution with an identity link function.

The forward selection process analyzes the null model (no class variables chosen), and then each class variable added singly in the model. If the GLM successfully converges, the reduction in deviance from the null model is assessed for each of these runs, and the class variable with the largest percentage reduction in deviance, a significant χ^2 (Chi-square) value, and a greater change in Akaike Information Criterion (AIC) (at least a $\Delta AIC >= 2$) than other class variables is selected for the model. The next series of model runs includes the variable selected in the previous series along with each of the remaining variables (one at a time), and each of the resulting two variable models are assessed for model convergence, the largest percentage reduction in deviance from the null model and significance criteria (χ^2, ΔAIC) as before. This process continues until, for all candidate variables, the AIC change is less than 2 or the percentage reduction in deviance becomes less than some desired level. For these model runs, a 0.5% reduction in deviance from the null model was the selected level of acceptance for a suite of class variables.

The selection process for models using the negative binomial distribution was similar, though it was modified following a suggestion in Millar (2011; Chapters 7.6-7.7). Because of the extra term in the negative binomial, the selection process was slightly altered by running the "saturated" model (all variables intended for the analyses). If the model converged, the dispersion factor was estimated for the saturated model. The forward selection process (described above) was begun with the dispersion factor fixed at the estimate for the saturated model and proceeded until all variables meeting the criteria were selected. Unfortunately, at the time of this report, the procedure to estimate the percentage reduction in deviance (a relative measure of fit of the model) has not been worked out but is not an impediment to variable selection, model selection, and evaluating residuals from fits.

If there were cases when the variable of interest (in this case, year was important) failed to be selected, it would have been included in the model statement so that a year effect could be estimated. Annual values (and associated coefficients of variation) were estimated using the least squares mean method (SAS Institute Inc. 2016) for the year effect.

Results

Summaries of the raw catch per trip from the selected data for each gear are in Table 4 a-d. Table 5 presents a brief summary of models selected by gear, showing numbers of trips selected, number of outliers by model, the percentage reduction in deviance (a measure of fit to the data), a decision on whether to accept or reject the model, and comments regarding each model fit and residual patterns observed. The model results from the forward stepwise selection of variables for the linear models are in Tables 6-8, and the diagnostic plots (standardized deviance residuals (McCullagh and Nelder 1989, SAS Institute, Inc. 2016) by year, standardized deviance residuals versus the linear predictor, q-q plot, and histograms of the standardized residuals from the fitted distribution) and scaled index values (index values scaled to their means) over time are in Figs. 3-5. The adjusted average catch rates (pounds per trip), coefficient of variation (as a percentage of the mean), and the scaled index values are in Table 9. Nominal average catch rates (simple averages) and adjusted averages by gear, and a comparison with SEDAR 28 of the annual scaled index values by gear are shown in Fig. 6. Figure 7 summarizes the relative means for each index with a comparison to relative means from SEDAR 28.

The Poisson models all had large numbers of outliers identified using the standardized residuals (Table 5) and were not considered suitable for use in index development and will not be discussed further.

Notably, none of the models fit well to the gill net trips for the 1986 to June 30, 1995 period, largely because of a large spike in catch per trip during the 1993-1995 years. The standardized index means showed some increases during those years (Figs. 6a, 7a) but very much less than the actual average catch per trip. For this reason, no model index was recommended and the relative means from the raw data ought to be considered for use (Table 5). In SEDAR 28, a lognormal model was recommended for developing the index based on the diagnostics in use at the time. That recommendation is no longer supported by these analyses.

The model recommended for the gill net trips for the July 1, 1995 to 2020 period was the negative binomial distribution (Table 5), which differs from the recommendation in SEDAR 28 of a gamma distribution model. This was a judgement call rather than a clear decision and was based on the relative standardized means fitting a little better to the early years of the time series to the relative means from the raw data (Fig. 7b) compared to the gamma model.

The model recommended for cast net trips was a gamma distribution (Table 5) as in SEDAR 28, and was based on somewhat better standardized residual patterns than other models as well as a reasonable fit to the patterns in the raw data (Fig. 7c).

The model recommended for hook and line trips was a gamma distribution model (Table 5) which was the same model distribution selected for SEDAR 28. Similar variables were selected for this model as in SEDAR 28. The standardized means do not show as considerable increase in catch per trip as seen for the raw data (Fig. 6d), but the relative standardized means do capture most of the peaks and valleys over the time series. The hook and line data should be examined more closely to see whether there are other potential variables that could be used in the modeling of these data that would better capture the increases seen in catch per trip. Additionally, an analysis of outliers and the use of the 500-pound limit as a cut-off should be re-examined to see whether a model could be constructed to better fit the early portion of the time series (Fig. 7d). The current index may be over-shooting the early portion of the time series and under-shooting the later portion of the time series, but it is probably the best available index at this time.

The recommended indices (Fig. 8; relative standardized means) show a slow but steady increasing trend in catch per trip over the time period with the exception of the spike in gill net landings during 1993- June 30, 1995. Reasons for this spike could be related to an increase in the availability of Spanish Mackerel during those years, dockside price and change in demand for this product, or perhaps fisherman behavior may have been altered with the anticipation of the possible limitations on gill net fishing that came into effect on July 1, 1995.

Potential advantages

The indices produced had reasonable fits to the distributions used and most had relatively modest coefficients of variation. The period of time covered by the indices were relatively long (ten years for gill nets over the 1986-1995 period, twenty-six years for gill nets for the 1995-2020 period, twenty-five years for cast nets over 1996-2020, and 35 years for hook and line gears over 1986-2020). The hook-and-line gears indices may be more reliable indicators of abundance because of selectivity issues that complicate the interpretation of data from trips using gill nets (e.g., deployment methods, mesh sizes, configuration of panels, target species, and changes in state/federal waters restrictions) and cast nets (e.g., configuration, depth, bottom types, target species).

Potential problems/limitations

Gill net and cast net trips, in general, were problematic. There are different methods to deploy gill nets (which may have different mesh sizes, lengths, and panels) and each method targets and catches fish differently which can affect the amounts of catch. The highest catches

on trips were from run-around gill nets, where a school or portion of a school of fish is surrounded by an actively fished gill net and the fish are "startled" into the net by noise (e.g., by jumping on the bottom of the boat or some other method). If the target species was Spanish Mackerel, landings could be in the thousands to tens of thousands of pounds. If the target species was not Spanish Mackerel, there may only be a few pounds (i.e., Spanish Mackerel may have been part of the retained bycatch). Gill nets may also be fished anchored to the bottom (stab nets, anchored gill nets) as a more passively fished gear or may drift on the current (drift gill nets). There have also been restrictions on the amount of soak time in some years (e.g., to reduce the potential encounter with marine turtles), and on transfers of catch at sea. The specific type of gill net deployment is not often provided on trip tickets. Prior to July 1, 1995, gill nets could be used in state as well as in federal waters. After Florida's net limitations (Article X of the Florida Constitution) went into effect on July 1, 1995, usage of entangling nets was limited to federal waters only, and other nets (seines, trawls, cast nets) usable in state waters were limited to 500 square feet or smaller in mesh area. Changes in the way gears are designed (mesh sizes, panels, depth, etc.), used (deployment method, soak time, etc.), and non-specific gear identification on trip tickets (e.g., "gill nets") make interpretation of patterns observed in the data more complex especially when trying to develop indices of abundance.

In retrospect, there were issues with the choice of the time period analyzed for the gill net indices. Because the two gill net indices in the Atlantic included only a partial year for 1995, the model may not give an appropriate "annual" value for 1995 since it would be based on only 6 months of the year. It may be more appropriate, if these indices are accepted for use, to drop all of the 1995 data from the gill net indices.

Catches of Spanish Mackerel were infrequent from cast nets until after Florida's net limitations went into effect. Several years after the passage of Article X, some fishermen on the southeastern coast of Florida developed a thrown net effective at catching Spanish Mackerel especially in an area of shallow offshore hard bottom [offshore of "Peck's Lake", about 3-5 miles southeast of St. Lucie Inlet, Martin County (Hartig, 2007)]. While called a cast net, it is not the typical cast net used for bait fish or mullet. It is of larger mesh, more heavily weighted to sink more quickly, and when retrieved the net does not "purse" in the usual way.

The more important limitation to all of the indices produced is that they are based upon only "positive" trips (i.e., trips when Spanish Mackerel were landed). Ideally, an index of abundance includes a component estimating the probability of encountering the target species on a trip ("zero" trips on which the target species might have been caught but was not, and "positive" trips on which the species was caught) as well as a component estimating the rate of capture on a trip (the number or weight of the target species caught on "positive" trips). Including "zero trips" (trips which could have but did not land Spanish Mackerel) would be a refinement that would enhance an index's potential value as an indicator of abundance.

Literature Cited

Hartig, B. 2007. Some observations on the Spanish Mackerel fishery. Letter to the South Atlantic Fishery Management Council. http://www.safmc.net/Portals/6/Meetings/Council/BriefingBook/June2007/MackComm/Ben%20Hartig.pdf

McCullagh, P. and J. A. Nelder. 1989. Generalized Linear Models. Second Edition. Chapman & Hall/CRC. Boca Raton, FL.

Millar, R. B. 2011. Maximum Likelihood Estimation and Inference: with examples in R, SAS, and ADMB. John Wiley & Sons, Ltd. West Sussex, UK.

SAS Institute, Inc. 2016. SAS/STAT 14.2 User's Guide: The GENMOD Procedure. Cary, NC: SAS Institute Inc.

Shertzer, K. W. and E. H. Williams. 2008. Fish assemblages and indicator species: reef fishes off the southeastern United States. Fish. Bull. 106: 257-269.

Stephens, A. and A. MacCall. 2004. A multispecies approach to subsetting logbook data for purposes of estimating CPUE. Fisheries Research 70: 299-310.

Table 1. Listing of reporting fields available on Florida trip tickets. A dotted line indicates that the field was available but not mandatory. Solid bars indicate that field was mandatory. Blanks indicate that field was not present. Form type was not designated until June of 1997.

Field Name	Initiated on Form Type	Oct 1984-Jun 1986	Jly 1986 - Feb 1990	Mar 1990-Aug 1993	Sep 1993-May 1997	Jun 1997-Oct 2000 A2	Nov 2000 - present A3
Saltwater Products License	A1	● ● ● ● ●	▬	▬	▬	▬	▬
Vessel Identification Number	A2					▬	▬
Dealer's License Number	A1	● ● ● ● ●	▬	▬	▬	▬	▬
Number of Crew (includes captain)	A3						▬
Trip Start Date	A3						▬
Unloading Date	A1	▬	▬	▬	▬	▬	▬
Actual Time Fished (hours assumed unless days indicated)	A1	▬	▬	▬	▬	▬	▬
Actual Time Fished Units (Hours or Days)	A2					▬	▬
Area Fished	A1	● ● ● ● ●	● ● ● ●	● ● ● ● ●	▬	▬	▬
State of Landing	A3						▬
County Landed (special coding for state landed other than Florida)	A1	▬	▬	▬	▬	▬	▬
Depth (Avg. depth fished, feet assumed unless fathoms indicated)	A1	● ● ● ● ●	● ● ● ●	● ● ● ● ●	● ● ● ●	▬	▬
Depth Units (Feet or Fathoms)	A2					▬	▬
Gears Fished: Purse Seine	A1*			▬	▬	▬	▬
Gears Fished: Beach or Haul Seine	A1*			▬	▬	▬	▬
Gears Fished: Long Line	A1*			▬	▬	▬	▬
Gears Fished: Hook & Line gears	A1*			▬	▬	▬	▬
Gears Fished: Traps	A1*			▬	▬	▬	▬
Gears Fished: Trawl	A1*			▬	▬	▬	▬
Gears Fished: Gill net	A1*			▬	▬	▬	▬
Gears Fished: Trammel net	A1*			▬	▬	▬	▬
Gears Fished: Cast net	A2					▬	▬
Gears Fished: Bandit rig	A2					▬	▬
Gears Fished: 4-digit gear code	A1*			▬	▬	▬	▬
Number of gear sets	A1	● ● ● ● ●	● ● ● ●	▬	▬	▬	▬
Quantity of traps pulled/gear set	A1	● ● ● ● ●	● ● ● ●	▬	▬	▬	▬
Soak Time (days assumed)	A1	● ● ● ● ●	● ● ● ●	▬	▬	▬	▬
Soak Time Units (Hours or Days)	A2					▬	▬
For-Hire Fishery: Head boat	A2					▬	▬
For-Hire Fishery: Charter boat	A2					▬	▬
For-Hire Fishery: Guide boat	A2					▬	▬
Aquaculture	A2					▬	▬
Aquaculture Lease Number	A2					▬	▬
Trip Ticket Invoice Prefix	A1	▬	▬	▬	▬	▬	▬
Trip Ticket Invoice Number	A1	▬	▬	▬	▬	▬	▬
Trip Ticket Invoice Continuation Field (split trips, etc.)	A1*			▬	▬	▬	▬
Species Code	A1	▬	▬	▬	▬	▬	▬
Market Size Code	A1*			▬	▬	▬	▬
Market Grade Code	A3						▬
Amount of Catch (units depend on species code used)	A1	▬	▬	▬	▬	▬	▬
Unit Price ($US)	A1	● ● ● ● ●	● ● ● ●	● ● ● ● ●	● ● ● ●	▬	▬
Catch Disposition	A3						▬
Form Number	A2					▬	▬

Table 2. Examples of species reported on trip tickets arranged into 'fishery groups' for these analyses.

Bait fish **BT**	Crustacea **CR**	Inshore Benthic **IB**	Inshore Pelagics* **IP**	Offshore Benthic **OB**	Offshore Pelagics **OP**	Reef Fish **RF**
anchovies	spiny lobster	catfish, hardhead	bluefish	flounders (gulf, southern, summer)	little tunny	greater amberjack
bait fish	Spanish lobster	catfish, gafftopsail	blue runner	tilefish (golden)	dolphin	squirrelfish
ballyhoo	blue crab	Atlantic croaker	cobia	tilefish, blueline	Mackerel, chub	grouper, black
scad, round	stone crab	black drum	crevalle jack	tilefish, anchor	Mackerel, king	gag
scad, bigeye	shrimp, pink	grunts	mixed jack	tilefish, blackline	marlin, blue	grouper, Nassau
herring, thread	shrimp, white	mullet, striped	other jack	tilefish, goldface	marlin, white	grouper, red
herring, round	shrimp, brown	mullet, white	ladyfish	shark, angel	sharks (mixed)	scamp
menhaden	shrimp, rock	tilapia	permit	shark, sand tiger	spearfish	grouper, snowy
sardines, Spanish	shrimp, royal red	rays and skates	Florida pompano	shark, sandbar	swordfish	warsaw
sardines, scaled	shrimp, other	red drum*	Atlantic bumper	brotula	tuna, bigeye	grouper, yellowedge
misc. industrial fish	shrimp, bait	sand perch	spadefish	cusk-eel	tuna, bluefin	grouper, yellowfin
pinfish		weakfish	cero	hake (southern, gulf, spotted)	tuna, albacore	grouper, goliath
flyingfish		seatrout, sand	Atlantic moonfish	longtail bass	tuna, skipjack	hogfish
needlefish		seatrout, silver	bar jack	wreckfish	tuna, yellowfin	sea bass
		seatrout, spotted	horse-eye jack		tuna, mixed	snapper, lane
		sheepshead	lookdown		wahoo	snapper, grey
		spot	yellow jack		oilfish	snapper, mutton
		kingfish ("whiting")	African pompano		escolar	snapper, red
		porgy, grass	shark, blacknose		opah	snapper, silk
		mojarra	Shark, bonnethead		cutlassfish	Snapper, vermilion
		goatfishes	shark, finetooth		banded rudderfish	snapper, yellowtail
		searobins			tripletail	triggerfish
					butterfish	surgeonfish
					harvestfish	bigeye
					barrelfish	porgy, jolthead
					shark, blacktip	porgy, littlehead
					shark, Atlantic sharpnose	porgy, knobbed
					shark, Bignose	porgy, longspine
					shark, bull	porgy, red
					shark, dusky	scorpionfish
					shark, hammerhead	blackbelly rosefish
					shark, lemon	margates
						lesser amberjack
						many others

*Spanish Mackerel is typically placed in "inshore pelagics", but in these analyses it is the target species.

Table 3. Trip limits in effect for the Atlantic migratory group (Spanish Mackerel)

Fishing Year	Time period	Trip limits (TL) in effect					
86-87	19860401 – 19870113	TL unlimited					
	19870114 – 19870331	TL=0	closed				
87-88	19870401 – 19871230	TL unlimited					
	19871231 – 19880401	TL=0	closed				
88-89	19880401 – 19890103	TL unlimited					
	19890104 – 19890331	TL=0	closed				
89-90	19890401 – 19900331	TL unlimited					
90-91	19900401 – 19910128	TL unlimited					
	19910129 – 19910401	TL=0	closed				
91-92	19910401 – 19920331	TL unlimited					
92-93	19920401 – 19921208	TL=1500					
	19921209 – 19921231	TL=500	Sa,Su	TL=1500	T,Th	TL unlimited	M,W,F
	19930101 – 19930111	TL=500	Sa,Su	TL=1500	T,Th	TL unlimited	M,W,F
	19930112 – 19930223	TL=1000					
	19930224 – 19930331	TL=500					
93-94	19930401 – 19931130	TL=1500					
	19931201 – 19931222	TL unlimited					
	19931223 – 19940223	TL=1000					
	19940224 – 19940331	TL=500					
94-95	19940401 – 19950124	TL unlimited					
	19940125 – 19950331	TL=1000					
95-96	19950401 – 19960331	TL unlimited					
96-97	19960401 – 19961031	TL unlimited					
	19971101 – 19980331	TL=1500	Sa,Su			TL unlimited	M-F
97-98	19970401 – 19971031	TL unlimited					
	19971101 – 19981217	TL=1500	Sa,Su			TL unlimited	M-F
	19971218 – 19980331	TL=1500					
98-99	19980401 – 19981031	TL unlimited					
	19981101 – 19990215	TL=1500	Sa,Su			TL unlimited	M-F
	19990216 – 19990331	TL=1500					
99-00	19990401 – 19991031	TL=1500					
	19991101 – 20000331	TL=1500	Sa,Su			TL unlimited	M-F
00-01	20000401 – 20001130	TL=3500					
	20001201 – 20010331	TL=1500	Sa,Su			TL unlimited	M-F
01-02	20010401 – 20011130	TL=3500					
	20011201 – 20020331	TL=1500	Sa,Su			TL unlimited	M-F
02-03	20020401 – 20021130	TL=3500					
	20021201 – 20030331	TL=1500	Sa,Su			TL unlimited	M-F
03-04	20030401 – 20031130	TL=3500					
	20031201 – 20040302	TL=1500	Sa,Su			TL unlimited	M-F
	20040303 – 20040331	TL=1500					
04-05	20040401 – 20041130	TL=3500					
	20041201 – 20050202	TL=1500	Sa,Su			TL unlimited	M-F
	20050203 – 20050228	TL=1500					
05-06	20050301 – 20050331	TL unlimited					
	20050401 – 20051130	TL=3500					
	20051201 – 20060228	TL=1500	Sa,Su			TL unlimited	M-F
06-07	20060301 – 20060331	TL unlimited					
	20060401 – 20061130	TL=3500					
	20061201 – 20070205	TL=1500	Sa,Su			TL unlimited	M-F
	20070206 – 20070228	TL=1500					
07-08	20070301 – 20070331	TL unlimited					
	20070401 – 20071130	TL=3500					
	20071201 – 20080229	TL=1500	Sa,Su			TL unlimited	M-F
08-09	20080301 – 20080331	TL unlimited					
	20080401 – 20081130	TL=3500					
	20081201 – 20090228	TL=1500	Sa,Su			TL unlimited	M-F
09-10	20090301 – 20090331	TL unlimited					

	20090401 – 20091130	TL=3500					
	20091201 – 20100228	TL=1500	Sa,Su			TL unlimited	M-F
10-11	20100301 – 20110331	TL unlimited					
	20100401 – 20101130	TL=3500					
	20101201 – 20110222	TL=1500	Sa,Su			TL unlimited	M-F
	20110206 – 20110228	TL=1500					
11-12	20110301 – 20110331	TL unlimited					
	20110401 – 20111130	TL=3500					
	20111201 – 20120126	TL=1500	Sa,Su			TL unlimited	M-F
	20120127 – 20120229	TL=1500					
12-13	20120301 – 20120331	TL unlimited					
	20120401 – 20121130	TL=3500					
	20121201 – 20130106	TL=1500	Sa,Su			TL unlimited	M-F
	20130107 – 20130228	TL=1500					
13-14	20130301 – 20130331	TL unlimited					
	20130401 – 20131130	TL=3500					
	20131201 – 20140116	TL=1500	Sa,Su			TL unlimited	M-F
	20130107 – 20130228	TL=1500					
14-15	20140301 – 20140331	TL unlimited					
	20140401 – 20141130	TL=3500					
	20141201 – 20150219	TL=1500	Sa,Su			TL unlimited	M-F
	20150220 – 20150228	TL=1500					
15-16	20150301 – 20160229	TL=3500					
16-17	20160301 – 20170205	TL=3500					
	20160206 – 20160228	TL=1500					
17-18	20170301 – 20180126	TL=3500					
	20180127 – 20180228	TL=1500					
18-19	20180301 – 20181225	TL=3500					
	20181226 – 20190126	TL=1500					
	20190127 – 20190205	TL=500					
	20190206 – 20190228	TL=0	closed				
19-20	20190301 – 20191223	TL=3500					
	20191224 – 20200128	TL=1500					
	20200129 – 20200229	TL=500					

Table 4a-d. Florida Atlantic trips by gear: Relative means from the raw CPUE data. Statistics were performed on variable whole weight and include number of trips (N), Mean weight per trip, SE (standard error), lower and upper confidence limits, and the weighted average of the relative mean.

4a. Atlantic Gillnet 1986- June 30, 1995

Year	Variable	N (trips)	Mean weight (pounds)	SE (pounds)	LowerCL (pounds)	UpperCL (pounds)	Weighted Average Relative to Mean
1986	whole	3658	860.769	61.095	741.021	980.516	1.284
1987	whole	3895	690.4144	63.586	565.782	815.046	1.030
1988	whole	3551	689.081	61.027	569.465	808.696	1.028
1989	whole	3708	590.606	51.855	488.969	692.244	0.881
1990	whole	5011	325.640	23.367	279.841	371.439	0.486
1991	whole	5213	517.761	45.775	428.041	607.481	0.773
1992	whole	5827	346.113	29.1011	289.074	403.152	0.516
1993	whole	556	4174.545	489.790	3214.539	5134.551	6.229
1994	whole	633	2513.468	252.227	2019.093	3007.842	3.750
1995	whole	722	1703.427	182.306	1346.101	2060.753	2.542
Wtd. Avg.	whole	32774	670.176	19.841	631.288	709.065	

4b. Atlantic Gillnet July 1, 1995-2020

Year	Variable	N (trips)	Mean weight (pounds)	SE (pounds)	LowerCL (pounds)	UpperCL (pounds)	Weighted Average Relative to Mean
1995	whole	73	3382.863	711.178	1988.887	4776.839	3.407
1996	whole	492	3695.996	340.107	3029.354	4362.638	3.722
1997	whole	428	2390.035	275.486	1850.057	2930.013	2.407
1998	whole	229	2968.576	397.769	2188.911	3748.241	2.990
1999	whole	548	1845.137	135.949	1578.665	2111.609	1.858
2000	whole	1129	968.971	63.284	844.9279	1093.015	0.976
2001	whole	904	984.461	70.6330	846.0134	1122.908	0.991
2002	whole	767	728.048	29.182	670.8481	785.248	0.733
2003	whole	446	1356.908	123.899	1114.055	1599.761	1.367
2004	whole	429	561.741	44.364	474.784	648.699	0.566
2005	whole	894	1083.037	130.188	827.856	1338.218	1.091
2006	whole	1021	1138.142	110.946	920.678	1355.606	1.146
2007	whole	1165	986.936	34.716	918.891	1054.982	0.994
2008	whole	899	771.396	31.321	710.004	832.787	0.777
2009	whole	1165	606.699	22.126	563.330	650.068	0.611
2010	whole	695	784.845	36.348	713.600	856.090	0.790
2011	whole	761	467.781	23.218	422.273	513.290	0.471
2012	whole	944	572.660	21.712	530.103	615.218	0.577
2013	whole	848	666.087	27.589	612.009	720.165	0.671
2014	whole	600	445.291	23.613	399.007	491.574	0.448
2015	whole	644	733.101	50.017	635.063	831.139	0.738
2016	whole	533	1032.716	93.628	849.197	1216.236	1.040
2017	whole	488	654.022	36.779	581.932	726.113	0.659
2018	whole	851	755.716	27.486	701.840	809.591	0.761
2019	whole	601	598.177	30.875	537.659	658.695	0.602
2020	whole	578	931.414	39.514	853.963	1008.864	0.938
Wtd. Avg.	whole	18132	992.988	18.775	956.186	1029.789	

Table 4a-d. (continued). Florida Atlantic trips by gear: Relative means from the raw CPUE data. Statistics were performed on variable whole weight and include number of trips (N), Mean weight per trip, SE (standard error), lower and upper confidence limits, and the weighted average of the relative mean.

4c. Atlantic Cast net 1996-2020

Year	Variable	N (trips)	Mean weight (pounds)	SE (pounds)	LowerCL (pounds)	UpperCL (pounds)	Weighted Average Relative to Mean
1996	whole	148	239.797	31.430	178.192	301.402	0.404
1997	whole	336	595.369	34.171	528.391	662.347	1.003
1998	whole	17	89.000	58.064	-24.810	202.810	0.150
1999	whole	96	251.521	83.255	88.336	414.706	0.424
2000	whole	617	489.828	21.388	447.906	531.751	0.825
2001	whole	992	684.290	22.048	641.074	727.506	1.152
2002	whole	1284	624.612	18.423	588.502	660.722	1.052
2003	whole	1977	838.707	16.957	805.470	871.944	1.413
2004	whole	1892	920.539	16.710	887.786	953.292	1.550
2005	whole	1271	653.548	15.921	622.342	684.755	1.101
2006	whole	1737	768.312	16.647	735.683	800.940	1.294
2007	whole	1180	517.772	18.232	482.037	553.508	0.872
2008	whole	1226	498.209	18.361	462.220	534.199	0.839
2009	whole	1386	521.521	16.726	488.737	554.306	0.878
2010	whole	1748	871.480	20.142	832.000	910.960	1.468
2011	whole	1641	794.838	18.122	759.318	830.359	1.339
2012	whole	1047	492.270	18.348	456.307	528.233	0.829
2013	whole	536	288.863	17.462	254.636	323.090	0.486
2014	whole	476	380.440	25.814	329.843	431.036	0.641
2015	whole	385	305.611	25.223	256.172	355.051	0.515
2016	whole	1022	676.013	20.280	636.263	715.764	1.139
2017	whole	810	976.847	29.714	918.606	1035.088	1.645
2018	whole	546	793.687	33.048	728.912	858.463	1.337
2019	whole	589	937.497	34.539	869.799	1005.196	1.579
2020	whole	450	633.486	36.736	561.481	705.491	1.067
Wtd. Avg	whole	23409	687.908	4.667	678.761	697.055	

Table 4a-d. (continued). Florida Atlantic trips by gear: Relative means from the raw CPUE data. Statistics were performed on variable whole weight and include number of trips (N), Mean weight per trip, SE (standard error), lower and upper confidence limits, and the weighted average of the relative mean.

4d. Atlantic Hook and Line 1986-2020

Year	Variable	N (trips)	Mean weight (pounds)	SE (pounds)	LowerCL (pounds)	UpperCL (pounds)	Weighted Average Relative to Mean
1986	whole	1147	30.495	1.984	26.606	34.384	0.139
1987	whole	1061	35.639	2.170	31.385	39.893	0.163
1988	whole	801	44.838	2.993	38.972	50.704	0.205
1989	whole	820	52.879	3.745	45.538	60.220	0.241
1990	whole	1208	53.594	3.238	47.247	59.941	0.245
1991	whole	1897	38.047	2.123	33.885	42.209	0.174
1992	whole	1086	39.297	2.642	34.119	44.474	0.179
1993	whole	1017	63.054	5.580	52.117	73.991	0.288
1994	whole	861	48.511	4.733	39.234	57.788	0.222
1995	whole	1188	142.114	8.042	126.351	157.878	0.649
1996	whole	1649	94.907	5.871	83.399	106.415	0.433
1997	whole	2126	68.635	3.623	61.534	75.736	0.313
1998	whole	2045	83.570	4.692	74.374	92.766	0.382
1999	whole	1940	102.246	4.532	93.363	111.129	0.467
2000	whole	2417	134.537	6.461	121.873	147.201	0.614
2001	whole	2489	143.756	5.643	132.695	154.816	0.656
2002	whole	2901	153.844	5.732	142.610	165.077	0.702
2003	whole	2216	179.938	7.744	164.759	195.116	0.822
2004	whole	2317	255.977	8.739	238.849	273.105	1.169
2005	whole	2993	284.970	8.003	269.285	300.655	1.301
2006	whole	2773	258.555	7.854	243.161	273.948	1.181
2007	whole	3419	224.361	6.297	212.019	236.702	1.024
2008	whole	3872	233.358	5.644	222.296	244.421	1.066
2009	whole	4666	215.635	4.376	207.059	224.211	0.985
2010	whole	4863	267.960	5.828	256.537	279.382	1.224
2011	whole	4951	281.337	5.434	270.686	291.988	1.285
2012	whole	5092	222.349	4.062	214.388	230.311	1.015
2013	whole	6050	225.544	3.744	218.206	232.883	1.030
2014	whole	6605	270.509	4.392	261.901	279.117	1.235
2015	whole	4762	259.254	4.833	249.781	268.727	1.184
2016	whole	4849	290.475	5.504	279.686	301.263	1.326
2017	whole	4069	337.901	6.742	324.686	351.116	1.543
2018	whole	4684	340.586	6.574	327.702	353.470	1.555
2019	whole	3692	300.013	7.407	285.496	314.530	1.370
2020	whole	3220	291.039	8.852	273.690	308.388	1.329
Wtd. Avg.	whole	101746	219.010	1.118	216.820	221.201	

Table 5. Summary of model runs and comments.

Atlantic Gillnet 1986-1995

Model	n	Outliers (|std_res.|>=4)	%deviance reduction	Index decision	comment
Poisson	32774	25402	64.5	Reject	Poor fit to 1993-1995, ~78% of data identified as outliers for this model, some trend in residuals versus linear predictor a concern.
Gamma	32774	75	43.6	Reject	Poor fit to 1993-1995, some trend in residuals versus linear predictor a concern.
lognormal	32774	0	31.4	Reject	Poor fit to 1993-1995, some trend in residuals versus linear predictor a concern.
Negative binomial	32774	76	*	Reject	Poor fit to 1993-1995, some trend in residuals versus linear predictor a concern.
*Not estimated					

Atlantic Gillnet 1995-2020

Model	n	Outliers (|std_res.|>=4)	%deviance reduction	Index decision	comment
Poisson	18132	16321	40.2	Reject	~90% of data identified as outliers for this model, poor fit to 1995-1999,
Gamma	18132	10	31.9	Reject	Fit a little poor to 1995-1999, some trend in residuals versus the linear predictor a concern.
Lognormal	18132	8	32.0	Reject	Fit a little poor to 1995-1999, some trend in residuals versus the linear predictor a concern.
Negative binomial	18132	19	*	Accept	Fit to 1995-1999 a little better for this model, some trend in residuals versus the linear predictor a concern.
*Not estimated					

Atlantic Cast net 1996-2020

Model	n	Outliers (|std_res.|>=4)	%deviance reduction	Index decision	comment
Poisson	23409	20004	34.9	Reject	~86% of data identified as outliers for this model, trends in residuals versus linear predictor a concern.
Gamma	23409	40	32.0	Accept	Probably best of the four models tested in terms of residuals, some trend in residuals versus linear predictor a concern
lognormal	23409	11	56.6	Reject	Best q-q plot, best %deviance reduction, fewest outliers, strong trend in residuals versus linear predictor a concern
Negative binomial	23409	41	*	Reject	Next best of the four models tested in terms of residuals, some trend in residuals versus the linear predictor.
*Not estimated					

Atlantic Hook and Line 1986-2020

Model	n	Outliers (|std_res.|>=4)	%deviance reduction	Index decision	comment
Poisson	101746	80945	35.6	Reject	~80% of data identified as outliers for this model
Gamma	101746	152	28.5	Accept	Probably best of the four models tested in terms of residuals, similar variables selected as in SEDAR 28
lognormal	101746	3	35.1	Reject	Trend in residuals versus linear predictor a concern, large predicted relative mean in 2020.
Negative binomial	101746	141	*	Reject	Next best of the four models tested (really a judgment call).
*Not estimated					

Table 6. Florida Atlantic Coast gill net gear trips during 1995-2020: Stepwise selection of variables to include in estimating the catch per trip of Spanish Mackerel from using a GLM (negative binomial distribution) based on highest percentage reduction in model deviance and lowest AIC values. The fields include the variables, the degrees of freedom for that variable (df), the deviance of the model with those variables, the mean deviance (deviance/df), percent reduction in mean deviance (% change in mean dev), full likelihood, chi-square value, the Chi-square degrees of freedom, the probability of the Chi-square (PrChiSq), the Akaike Information Criterion (AIC) and the change in AIC.

Atlantic Gillnet, 1995-2000

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq	AIC	Delta AIC
Null		18131	22923.655	1.264335			-139291.8976	58191.095			278587.8	
1	Month	18120	21984.924	1.213296	4.037	4.037	-135707.9347	7167.9257	11	<.0001	271441.87	7145.93
2	Month Year	18095	21887.819	1.209606	0.292		-135312.8423	790.1847	25	<.0001	270701.68	740.18

Table 7. Florida Atlantic Coast cast net gear trips during 1996-2020: Stepwise selection of variables to include in estimating the catch per trip of Spanish Mackerel from using a GLM (gamma distribution) based on highest percentage reduction in model deviance and lowest AIC values. The fields include the variables, the degrees of freedom for that variable (df), the deviance of the model with those variables, the mean deviance (deviance/df), percent reduction in mean deviance (% change in mean dev), full likelihood, chi-square value, the Chi-square degrees of freedom, the probability of the Chi-square (PrChiSq), the Akaike Information Criterion (AIC) and the change in AIC.

Atlantic Cast net, 1996-2020

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq	AIC	Delta_AIC
1		23408	63121.86	2.696593			-170358.5123	25216.377			340721.02	.
1	Month	23397	46962.222	2.00719	25.57	25.566	-166012.1685	8692.6877	11	<.0001	332050.34	8670.69
2	Month IB	23396	44699.205	1.910549	3.584	29.15	-165302.4637	1419.4096	1	<.0001	330632.93	1417.41
3	Month IB Year	23372	43221.164	1.849271	2.272	31.422	-164821.7908	961.3458	24	<.0001	329719.58	913.35
4	Month IB Year OP	23371	42884.613	1.83495	0.531	31.953	-164710.3341	222.9133	1	<.0001	329498.67	220.91

Table 8. Florida Atlantic Coast hook and line gear trips during 1986-2020: Stepwise selection of variables to include in estimating the catch per trip of Spanish Mackerel from using a GLM (gamma distribution) based on highest percentage reduction in model deviance and lowest AIC values. The fields include the variables, the degrees of freedom for that variable (df), the deviance of the model with those variables, the mean deviance (deviance/df), percent reduction in mean deviance (% change in mean dev), full likelihood, chi-square value, the Chi-square degrees of freedom, the probability of the Chi-square (PrChiSq), the Akaike Information Criterion (AIC) and the change in AIC.

Atlantic Hook and Line, 1986-2020

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq	AIC	Delta_AIC
Null		101745	332355.333	3.266552			-607661.9305	269646.54			1215327.9	
1	Month	101734	271002.332	2.663832	18.45	18.451	-594202.0992	26919.663	11	<.0001	1188430.2	26897.66
2	Month Year	101700	257614.596	2.533084	4.003	22.454	-590918.248	6567.7024	34	<.0001	1181930.5	6499.7
3	Month Year OP	101699	246979.69	2.428536	3.201	25.654	-588202.5978	5431.3005	1	<.0001	1176501.2	5429.3
4	Month Year OP RF	101698	240811.192	2.367905	1.856	27.511	-586580.6608	3243.8739	1	<.0001	1173259.3	3241.87
5	Month Year OP RF FL_reg_area_co	101696	237519.064	2.335579	0.99	28.5	-585700.2292	1760.8633	2	<.0001	1171502.5	1756.86

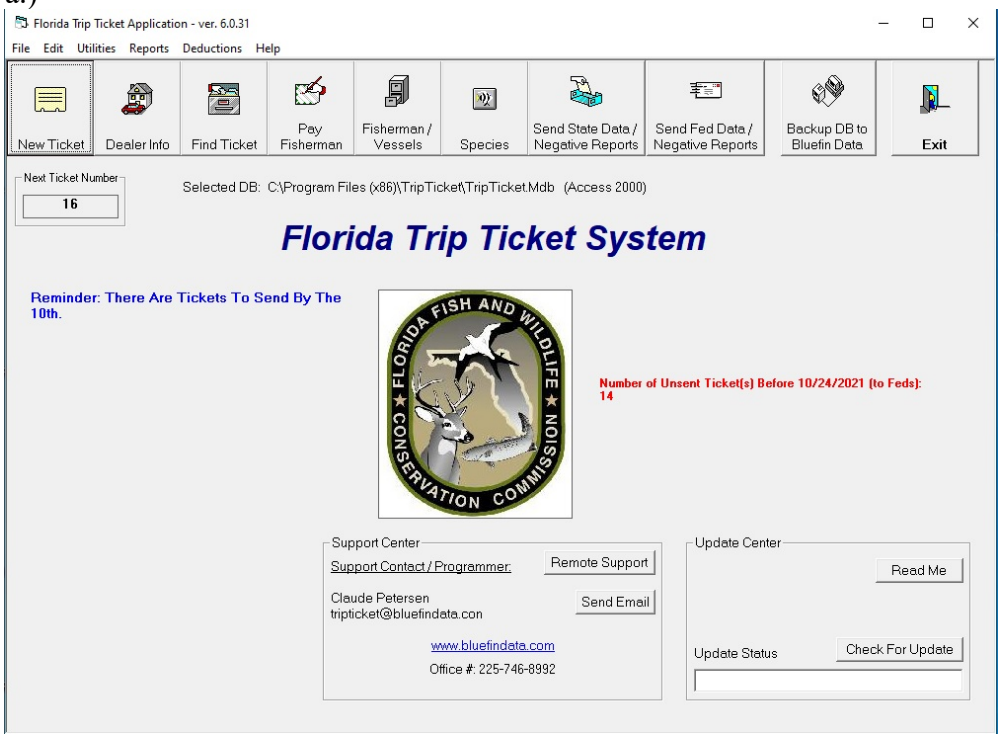
Table 9. Atlantic Coast Spanish Mackerel adjusted average pounds per trip for various gears, the coefficient of variation (cv), and index values scaled to mean. Commercial fishery data reported on Florida trip tickets.

Atlantic Coast, Florida Trip Ticket Indices

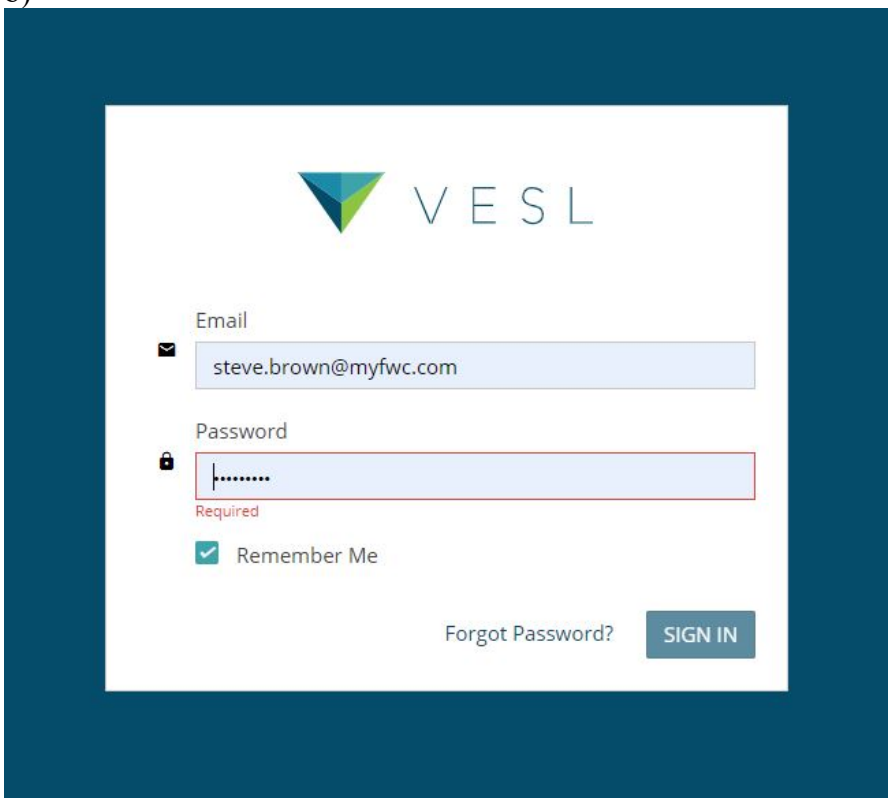
	Hook and Line Gears			Cast Nets, 1996-2020			Gill Nets, 1986-1995			Gill Nets, 1995-2020		
Year	Index (adjusted mean) pounds/ trip	cv (%)	Index scaled to mean	Index (adjusted mean) pounds/trip	cv (%)	Index scaled to mean	Index (mean) pounds/trip	cv (%)	Index scaled to mean	Index (adjusted mean) pounds/trip	cv (%)	Index scaled to mean
1986	18.883	4.09	0.415				860.769	7.10	1.284			
1987	24.237	4.23	0.533				690.414	9.21	1.030			
1988	28.061	4.95	0.617				689.081	8.86	1.028			
1989	26.200	4.73	0.576				590.606	8.78	0.881			
1990	29.577	4.02	0.650				325.640	7.18	0.486			
1991	21.418	3.18	0.471				517.761	8.84	0.773			
1992	26.151	4.16	0.575				346.113	8.41	0.516			
1993	40.292	4.33	0.886				4174.545	11.73	6.229			
1994	22.915	4.73	0.504				2513.468	10.04	3.750			
1995	33.162	4.03	0.729				1703.427	10.70	2.542	872.936	14.89	1.901
1996	29.732	3.38	0.654	34.058	10.64	0.268				966.130	5.92	2.104
1997	26.913	3.01	0.592	81.659	7.31	0.644				710.461	6.27	1.547
1998	27.674	3.07	0.609	28.342	34.89	0.223				760.163	8.53	1.655
1999	31.068	3.14	0.683	39.707	12.86	0.313				532.474	5.35	1.160
2000	32.363	2.82	0.712	81.584	5.76	0.643				508.910	3.62	1.108
2001	32.958	2.78	0.725	105.610	4.78	0.832				538.996	4.00	1.174
2002	32.643	2.60	0.718	106.068	4.43	0.836				417.791	4.43	0.910
2003	38.380	2.98	0.844	149.600	3.98	1.179				542.772	5.81	1.182
2004	53.306	2.91	1.172	148.327	4.02	1.169				313.363	5.91	0.682
2005	51.783	2.61	1.139	126.248	4.46	0.995				604.649	4.07	1.317
2006	51.946	2.75	1.142	128.681	4.08	1.014				527.421	3.91	1.149
2007	45.583	2.47	1.002	103.762	4.43	0.818				488.943	3.69	1.065
2008	46.873	2.33	1.031	127.2294	4.24	1.003				458.545	4.15	0.999
2009	57.550	2.17	1.266	114.044	4.08	0.899				441.362	3.61	0.961
2010	59.072	2.10	1.299	167.270	3.84	1.318				384.320	4.62	0.837
2011	53.368	2.12	1.174	156.212	3.97	1.231				283.473	4.47	0.617
2012	43.338	2.08	0.953	84.979	4.63	0.670				333.863	4.05	0.727
2013	44.577	2.00	0.980	68.815	5.80	0.542				357.021	4.26	0.777
2014	52.683	1.89	1.159	121.487	6.24	0.957				220.939	5.06	0.481
2015	47.257	2.16	1.039	56.513	6.82	0.445				325.6386	4.94	0.709
2016	55.616	2.18	1.223	128.322	4.75	1.011				567.311	5.35	1.235
2017	53.510	2.36	1.177	159.136	5.17	1.254				325.192	5.55	0.708
2018	57.454	2.20	1.264	132.158	5.93	1.042				419.948	4.19	0.915
2019	56.699	2.39	1.247	179.876	5.80	1.418				346.366	5.04	0.754
2020	49.088	2.60	1.080	117.990	6.60	0.930				433.876	5.13	0.945
Distri-bution:	gamma			gamma			raw data (no model)			negative binomial		

Figures.

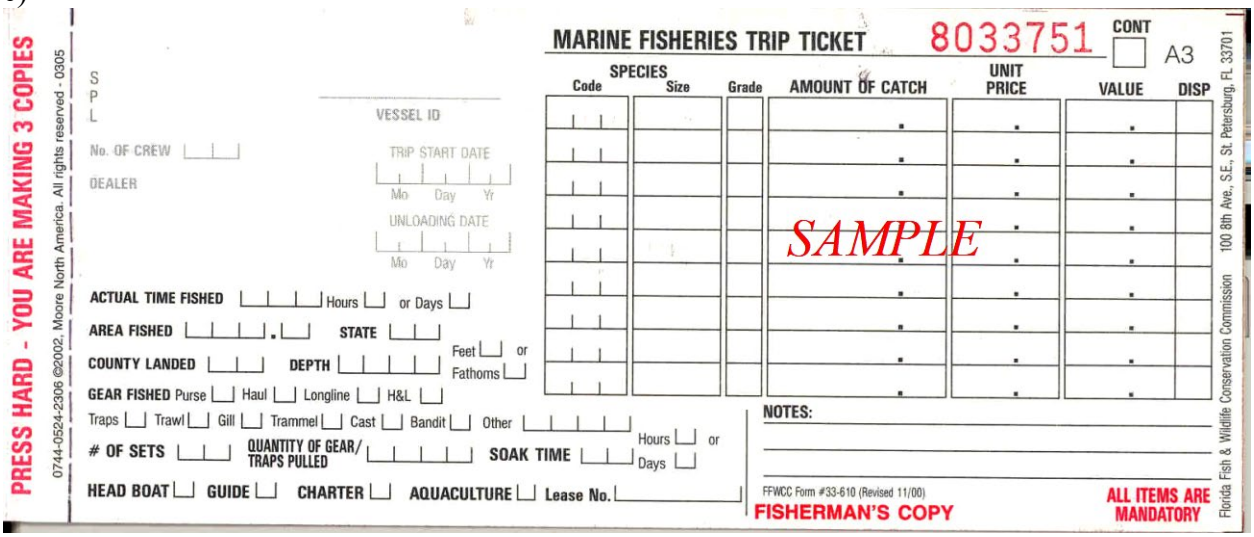
a.)


Florida Trip Ticket Application - ver. 6.0.31
File Edit Utilities Reports Deductions Help
New Ticket
Dealer Info
Find Ticket
Pay Fisherman
Fisherman / Vessels
Species
Send State Data / Negative Reports
Send Fed Data / Negative Reports
Backup DB to Bluefin Data
Exit
Next Ticket Number
16
Selected DB: C:\Program Files (x86)\TripTicket\TripTicket.Mdb (Access 2000)
Florida Trip Ticket System
Reminder: There Are Tickets To Send By The 10th.
FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
Number of Unsent Ticket(s) Before 10/24/2021 (to Feds): 14
Support Center
Support Contact / Programmer:
Remote Support
Claude Petersen
tripticket@bluefindata.con
Send Email
www.bluefindata.com
Office #: 225-746-8992
Update Center
Read Me
Update Status
Check For Update

b)


VESL
Email
steve.brown@myfwc.com
Password
Required
Remember Me
Forgot Password?
SIGN IN

c)



d)

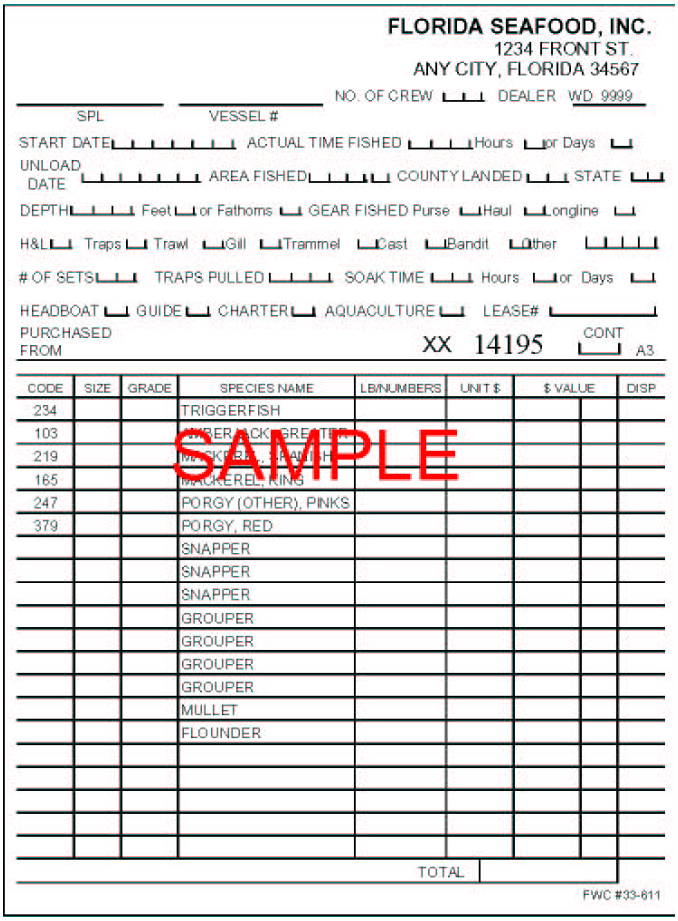
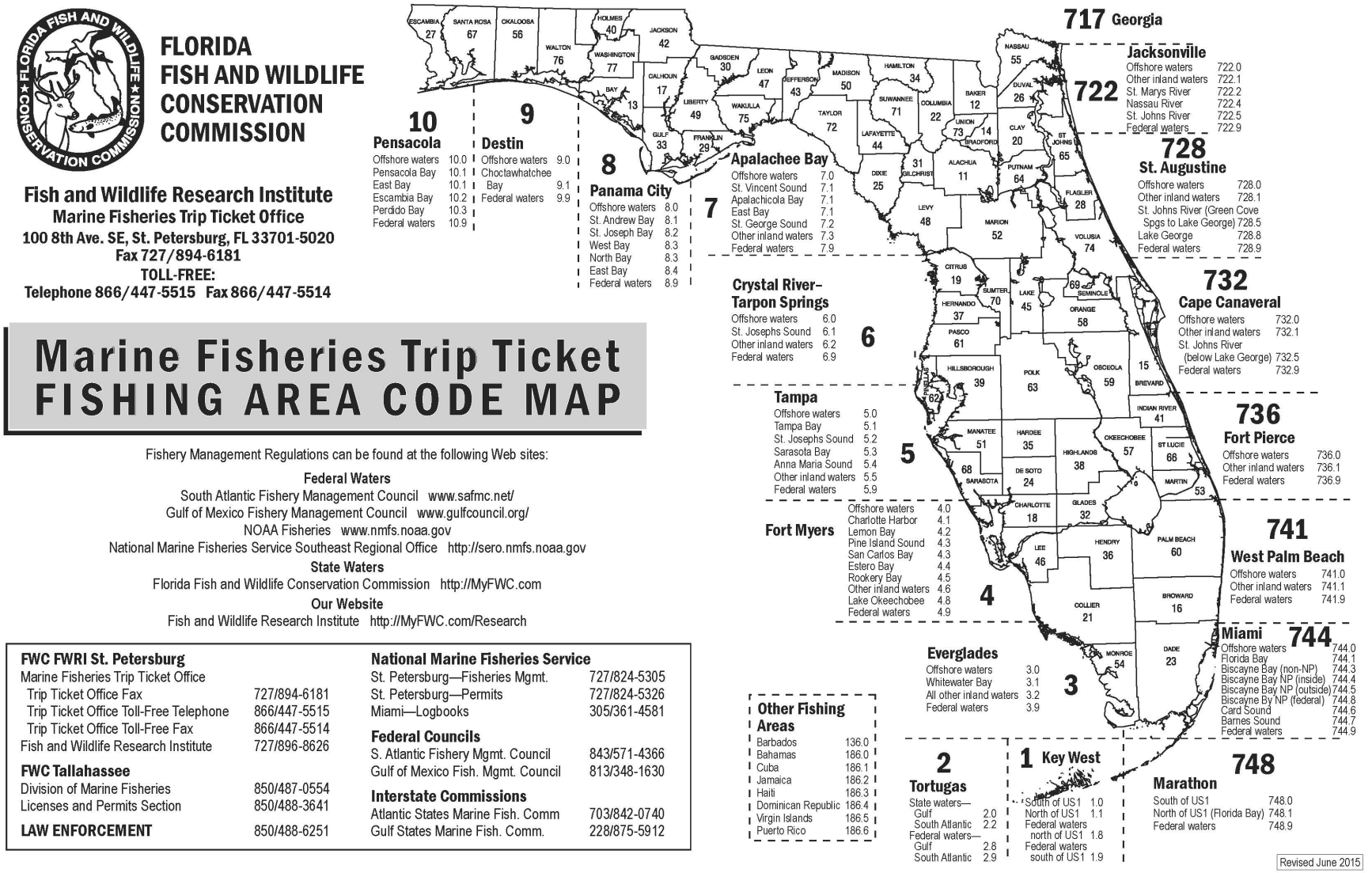
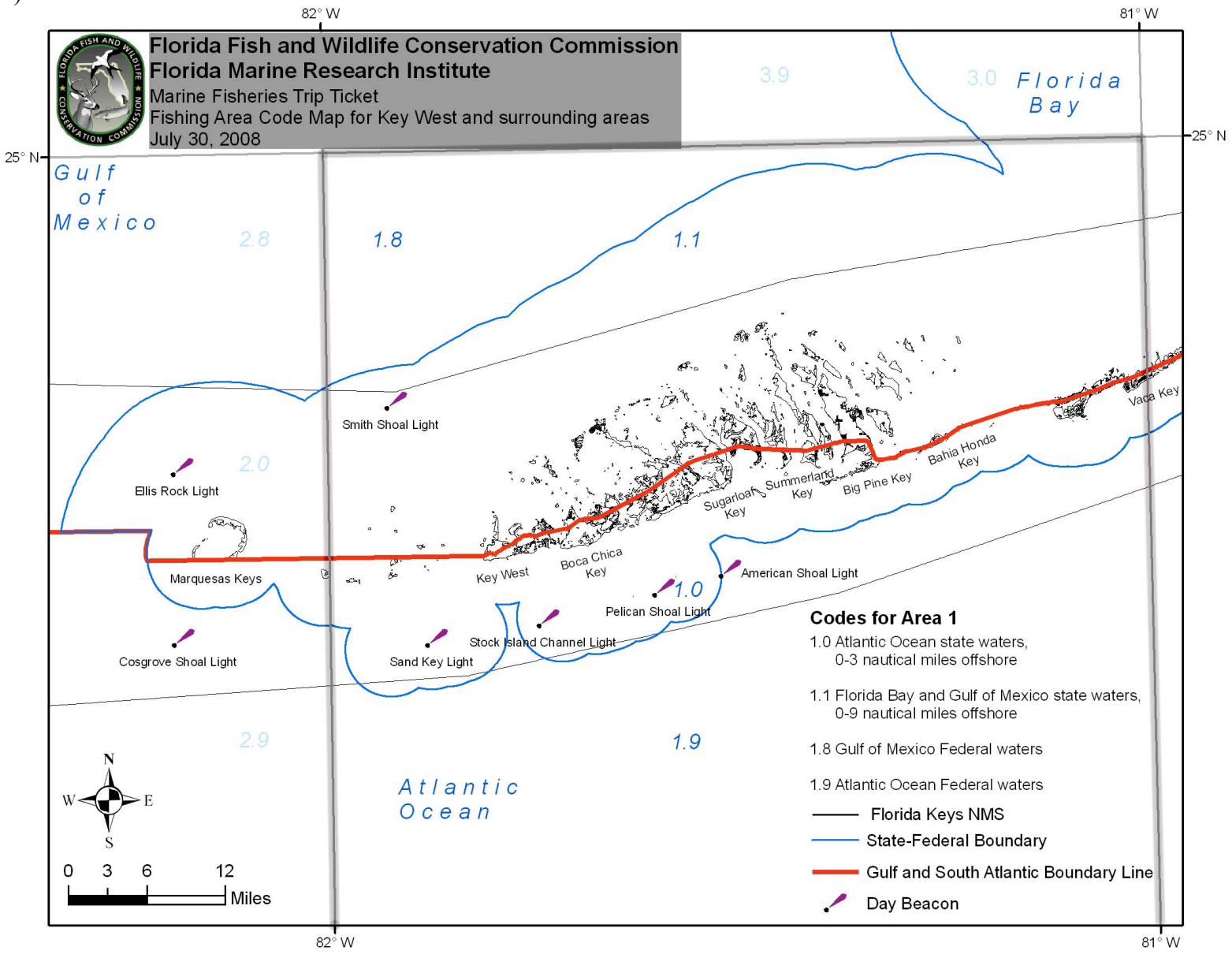


Figure 1. a) VESL web-based electronic reporting application, b) Florida Trip Ticket electronic reporting application, c) Florida trip ticket, form 'A3'; b) a "dealer-customized" Florida trip ticket form.

a)


FLORIDA
FISH AND WILDLIFE
CONSERVATION
COMMISSION
Fish and Wildlife Research Institute
Marine Fisheries Trip Ticket Office
100 8th Ave. SE, St. Petersburg, FL 33701-5020
Fax 727/894-6181
TOLL-FREE:
Telephone 866/447-5515 Fax 866/447-5514
Marine Fisheries Trip Ticket
FISHING AREA CODE MAP
Fishery Management Regulations can be found at the following Web sites:
Federal Waters
South Atlantic Fishery Management Council www.safmc.net/
Gulf of Mexico Fishery Management Council www.gulfcouncil.org/
NOAA Fisheries www.nmfs.noaa.gov
National Marine Fisheries Service Southeast Regional Office http://sero.nmfs.noaa.gov
State Waters
Florida Fish and Wildlife Conservation Commission http://MyFWC.com
Our Website
Fish and Wildlife Research Institute http://MyFWC.com/Research
FWC FWRI St. Petersburg
Marine Fisheries Trip Ticket Office
Trip Ticket Office Fax 727/894-6181
Trip Ticket Office Toll-Free Telephone 866/447-5515
Trip Ticket Office Toll-Free Fax 866/447-5514
Fish and Wildlife Research Institute 727/896-8626
FWC Tallahassee
Division of Marine Fisheries 850/487-0554
Licenses and Permits Section 850/488-3641
LAW ENFORCEMENT 850/488-6251
National Marine Fisheries Service
St. Petersburg—Fisheries Mgmt. 727/824-5305
St. Petersburg—Permits 727/824-5326
Miami—Logbooks 305/361-4581
Federal Councils
S. Atlantic Fishery Mgmt. Council 843/571-4366
Gulf of Mexico Fish. Mgmt. Council 813/348-1630
Interstate Commissions
Atlantic States Marine Fish. Comm 703/842-0740
Gulf States Marine Fish. Comm. 228/875-5912
10 Pensacola
Offshore waters 10.0
Pensacola Bay 10.1
East Bay 10.1
Escambia Bay 10.2
Perdido Bay 10.3
Federal waters 10.9
9 Destin
Offshore waters 9.0
Choctawhatchee Bay 9.1
Federal waters 9.9
8 Panama City
Offshore waters 8.0
St. Andrew Bay 8.1
St. Joseph Bay 8.2
West Bay 8.3
North Bay 8.3
East Bay 8.4
Federal waters 8.9
7 Apalachee Bay
Offshore waters 7.0
St. Vincent Sound 7.1
Apalachicola Bay 7.1
East Bay 7.1
St. George Sound 7.2
Other inland waters 7.3
Federal waters 7.9
6 Crystal River–Tarpon Springs
Offshore waters 6.0
St. Josephs Sound 6.1
Other inland waters 6.2
Federal waters 6.9
5 Tampa
Offshore waters 5.0
Tampa Bay 5.1
St. Josephs Sound 5.2
Sarasota Bay 5.3
Anna Maria Sound 5.4
Other inland waters 5.5
Federal waters 5.9
4 Fort Myers
Offshore waters 4.0
Charlotte Harbor 4.1
Lemon Bay 4.2
Pine Island Sound 4.3
San Carlos Bay 4.3
Estero Bay 4.4
Rookery Bay 4.5
Other inland waters 4.6
Lake Okeechobee 4.8
Federal waters 4.9
3 Everglades
Offshore waters 3.0
Whitewater Bay 3.1
All other inland waters 3.2
Federal waters 3.9
2 Tortugas
State waters—
Gulf 2.0
South Atlantic 2.2
Federal waters—
Gulf 2.8
South Atlantic 2.9
1 Key West
South of US1 1.0
North of US1 1.1
Federal waters north of US1 1.8
Federal waters south of US1 1.9
Other Fishing Areas
Barbados 136.0
Bahamas 186.0
Cuba 186.1
Jamaica 186.2
Haiti 186.3
Dominican Republic 186.4
Virgin Islands 186.5
Puerto Rico 186.6
717 Georgia
722 Jacksonville
Offshore waters 722.0
Other inland waters 722.1
St. Marys River 722.2
Nassau River 722.4
St. Johns River 722.5
Federal waters 722.9
728 St. Augustine
Offshore waters 728.0
Other inland waters 728.1
St. Johns River (Green Cove Spgs to Lake George) 728.5
Lake George 728.8
Federal waters 728.9
732 Cape Canaveral
Offshore waters 732.0
Other inland waters 732.1
St. Johns River (below Lake George) 732.5
Federal waters 732.9
736 Fort Pierce
Offshore waters 736.0
Other inland waters 736.1
Federal waters 736.9
741 West Palm Beach
Offshore waters 741.0
Other inland waters 741.1
Federal waters 741.9
744 Miami
Offshore waters 744.0
Florida Bay 744.1
Biscayne Bay (non-NP) 744.3
Biscayne Bay NP (inside) 744.4
Biscayne Bay NP (outside) 744.5
Biscayne By NP (federal) 744.8
Card Sound 744.6
Barnes Sound 744.7
Federal waters 744.9
748 Marathon
South of US1 748.0
North of US1 (Florida Bay) 748.1
Federal waters 748.9
Revised June 2015

b)


Florida Fish and Wildlife Conservation Commission
Florida Marine Research Institute
Marine Fisheries Trip Ticket
Fishing Area Code Map for Key West and surrounding areas
July 30, 2008
82° W
81° W
25° N
Gulf of Mexico
Florida Bay
3.9
3.0
2.8
1.8
1.1
2.0
1.5
1.0
2.9
1.9
Atlantic Ocean
Smith Shoal Light
Ellis Rock Light
Marquesas Keys
Key West
Boca Chica Key
Sugarloaf Key
Summerland Key
Big Pine Key
Bahia Honda Key
Vaca Key
American Shoal Light
Pelican Shoal Light
Stock Island Channel Light
Sand Key Light
Cosgrove Shoal Light
N
W
E
S
0 3 6 12
Miles
Codes for Area 1
1.0 Atlantic Ocean state waters, 0-3 nautical miles offshore
1.1 Florida Bay and Gulf of Mexico state waters, 0-9 nautical miles offshore
1.8 Gulf of Mexico Federal waters
1.9 Atlantic Ocean Federal waters
Florida Keys NMS
State-Federal Boundary
Gulf and South Atlantic Boundary Line
Day Beacon

c)

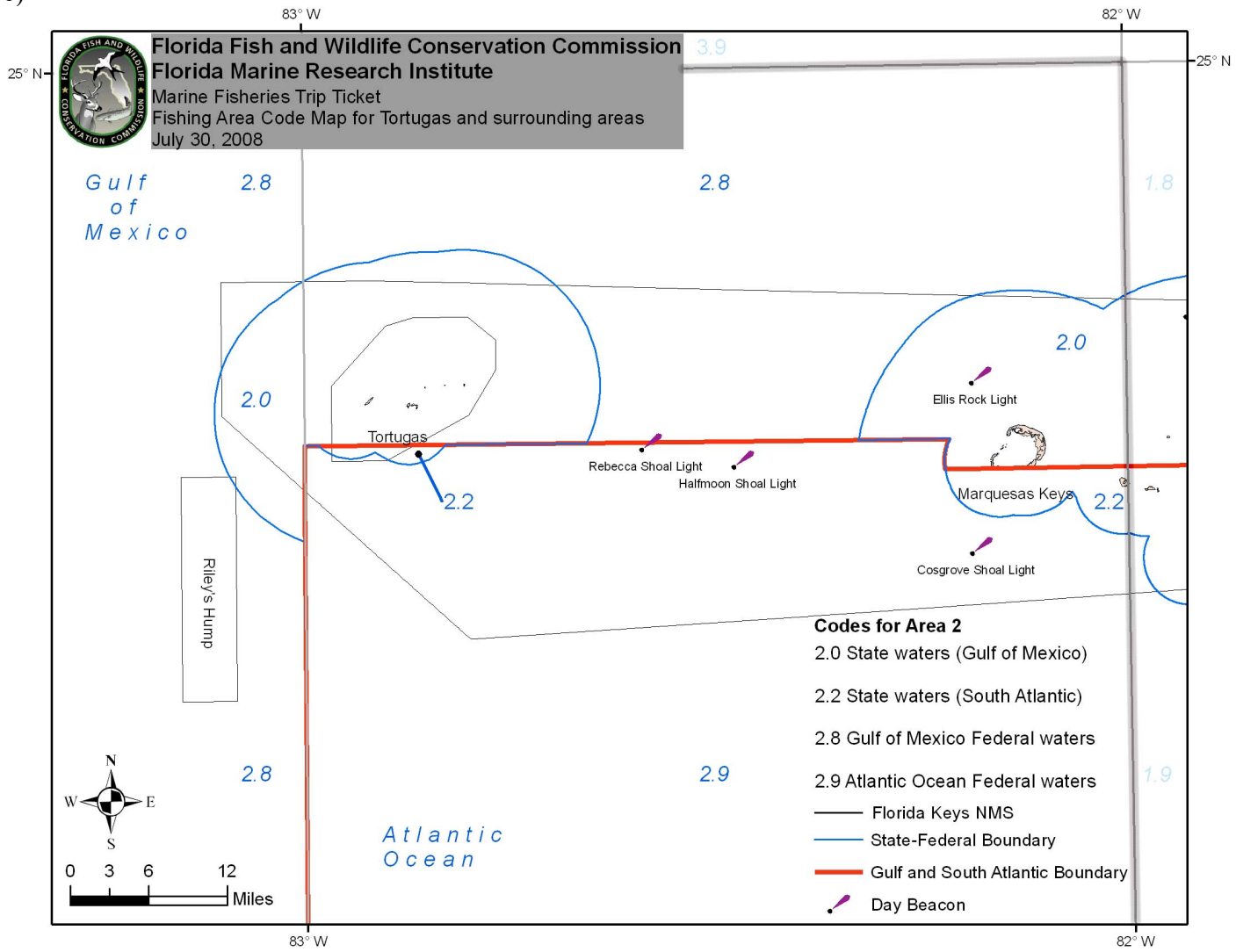
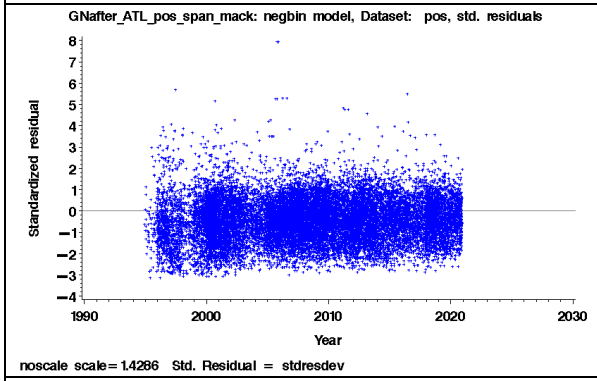


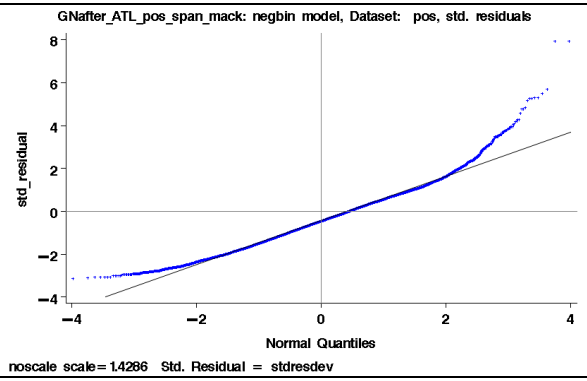
Figure 2. Area fished maps: a) statewide areas, b) Florida Keys areas, c) Tortugas areas. Red line in the Keys and Tortugas maps is the council boundary.

Figure 3. Diagnostics and scaled index for Florida Atlantic Coast Spanish Mackerel, gill net trip landings July 1, 1995-2020.

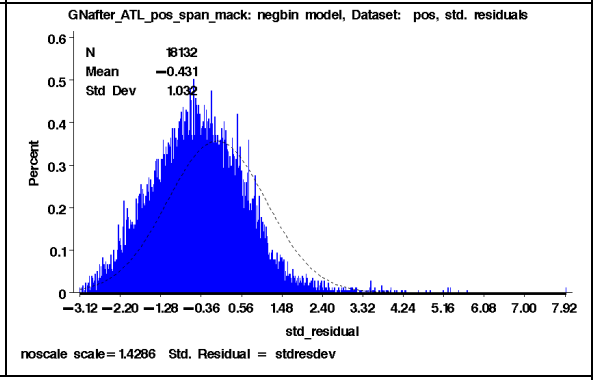
a.) Standardized residuals by year.



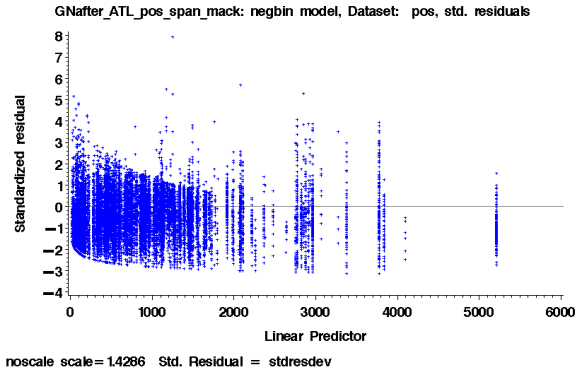
b.) Q-Q plot



c.) Histogram of standardized residuals and fitted distribution.



d.) Std. residuals vs. linear predictor



e.) Index in whole weight (pounds).

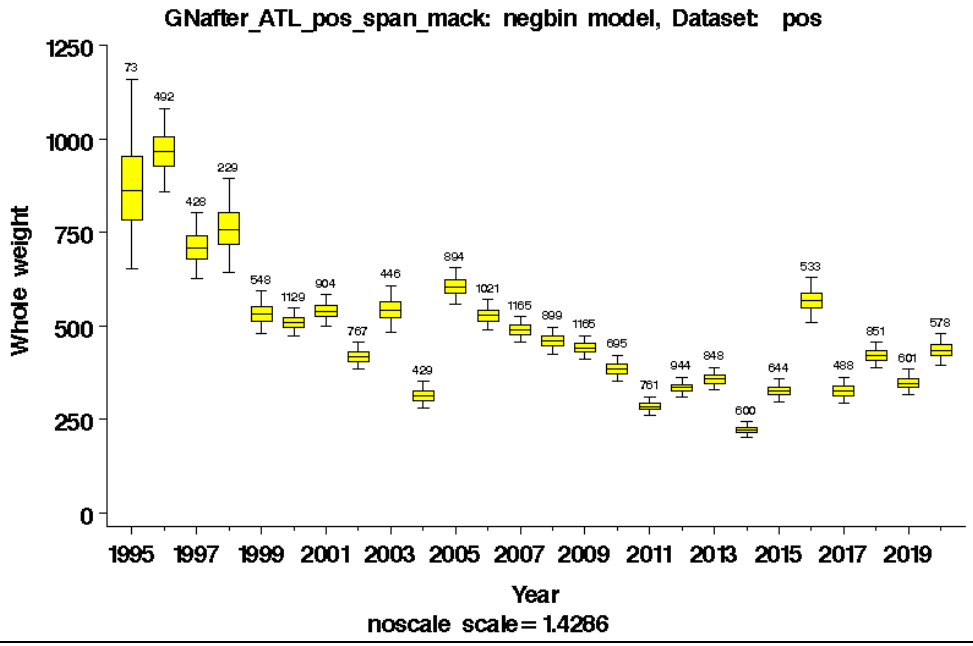
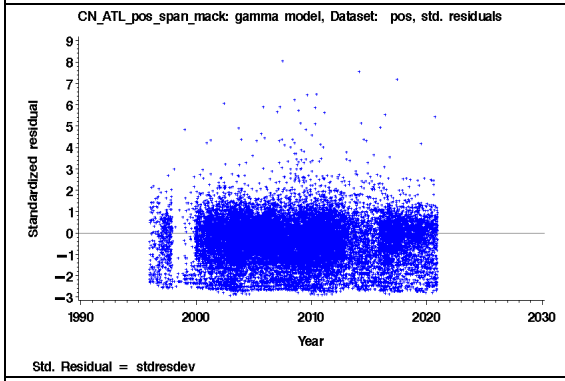
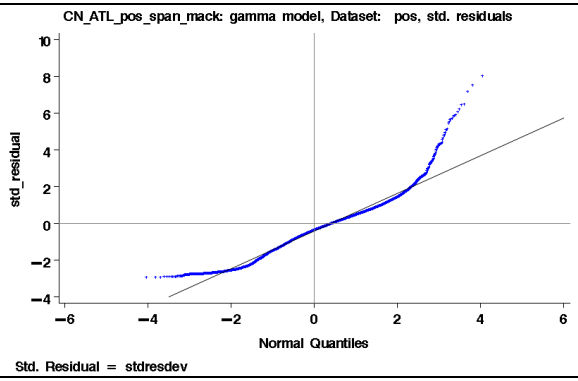


Figure 4. Diagnostics and scaled index for Florida Atlantic Coast Spanish Mackerel, cast net trip landings 1996-2020.

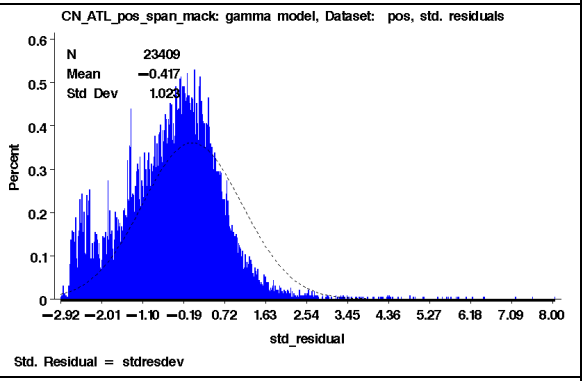
a.) Standardized residuals by year.



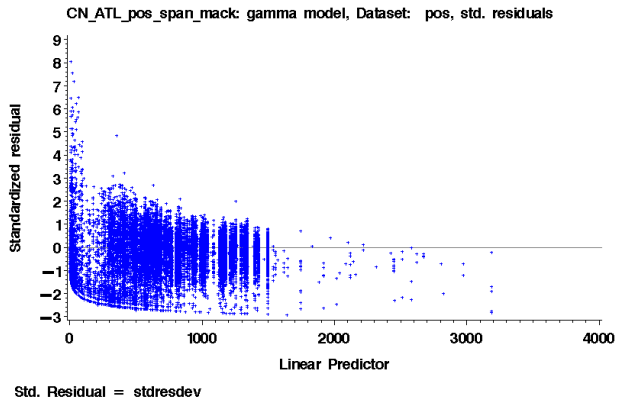
b.) Q-Q plot



c.) Histogram of standardized residuals and fitted distribution.



d. Std. residuals vs. linear predictor.



e. Index in whole weight (pounds).

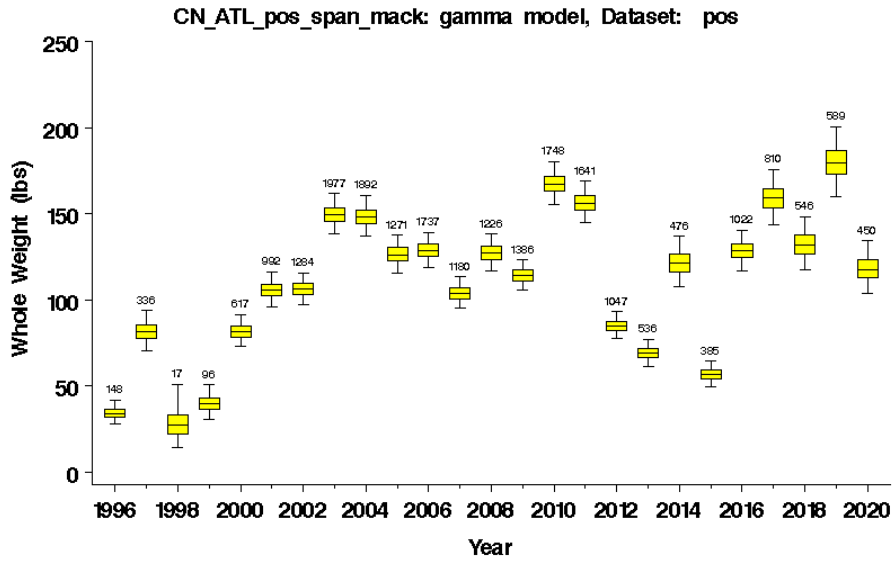
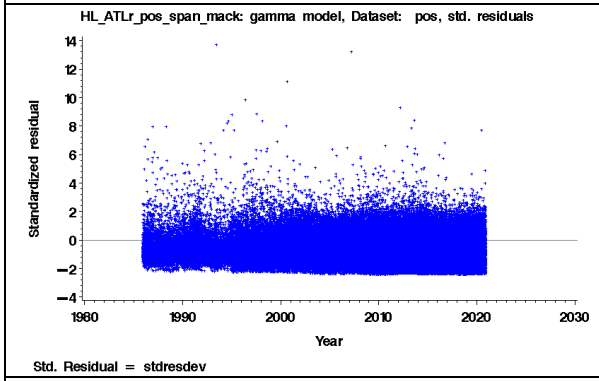
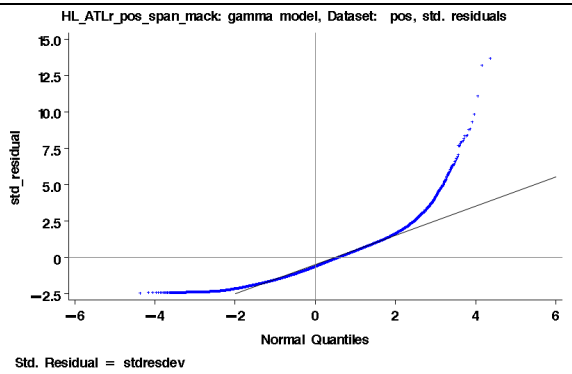


Figure 5. Diagnostics and scaled index for Florida Atlantic Coast Spanish Mackerel, hook and line gear trip landings 1986-2020.

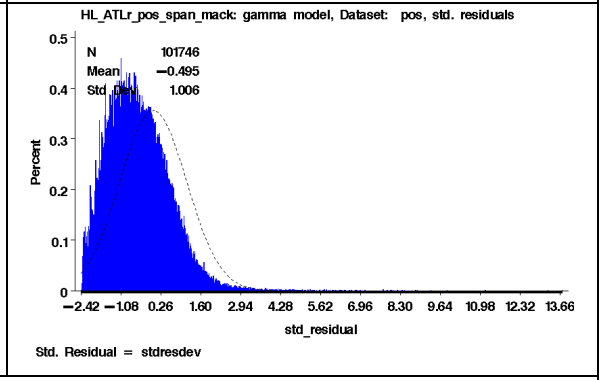
a.) Standardized residuals by year.



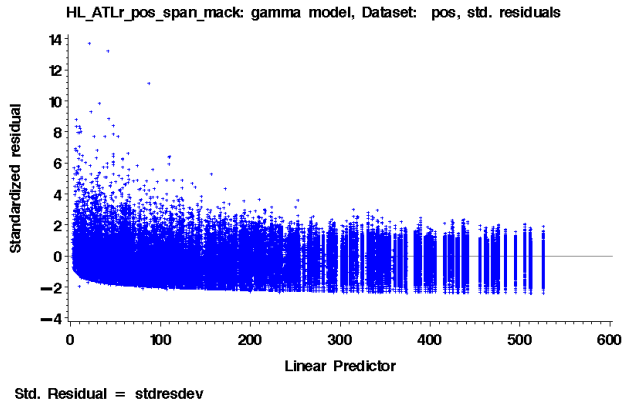
b.) Q-Q plot



c.) Histogram of standardized residuals and fitted distribution.



d. Std. residuals vs. linear predictor.



e. Index in whole weight (pounds).

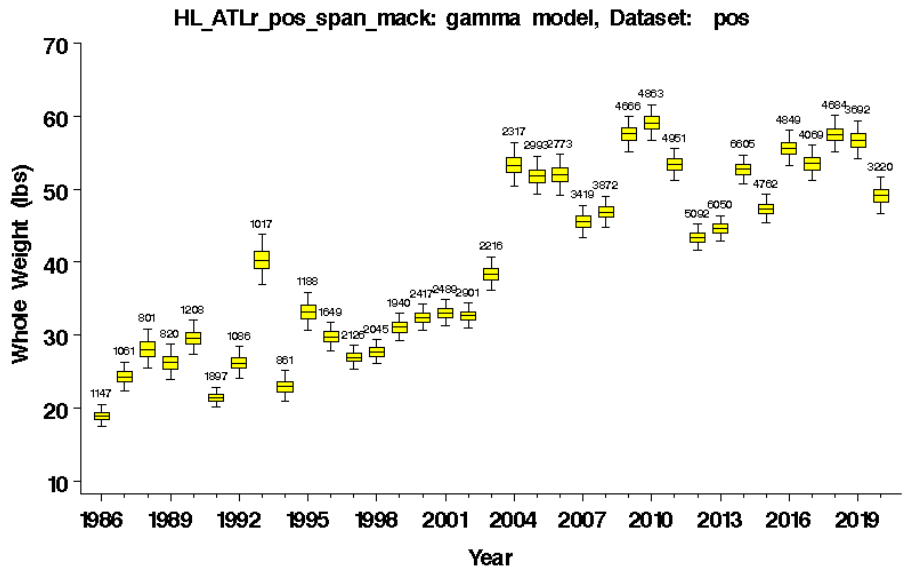
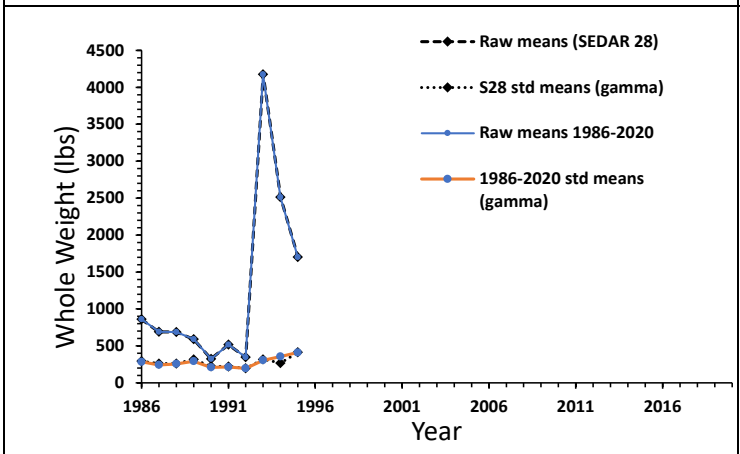
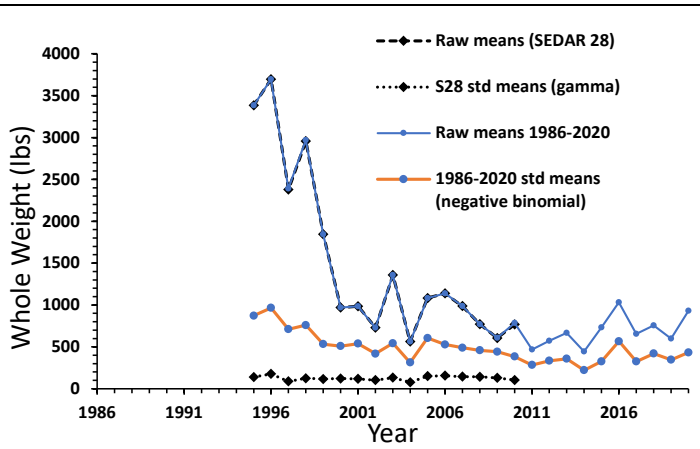


Figure 6. Atlantic Coast Spanish Mackerel reported on Florida commercial fishery trip tickets. Comparison of SEDAR 28 and current raw and standardized means for a) gill nets 1986-1995, b) gill nets 1995-2020, c) cast nets, and d) hook and line gear.

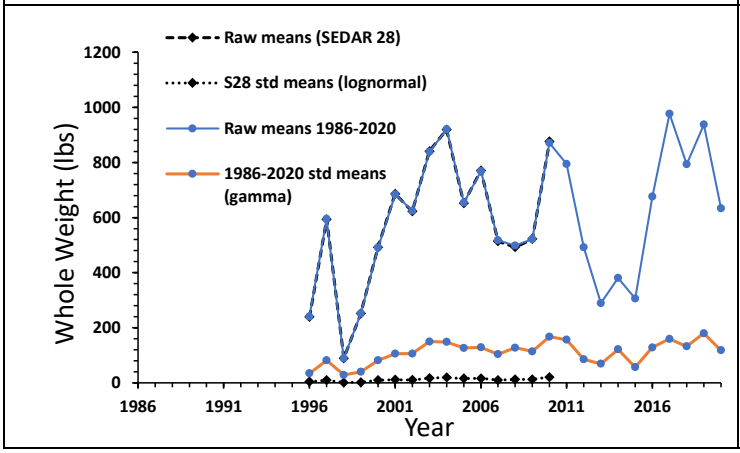
a) Raw and standardized means of gill net catch per trip, 1986-1995



b) Raw and standardized means of gill net catch per trip, 1996-2020



c) Raw and standardized means of cast net catch per trip, 1996-2020



d) Raw and standardized means of hook and line catch per trip, 1986-2020

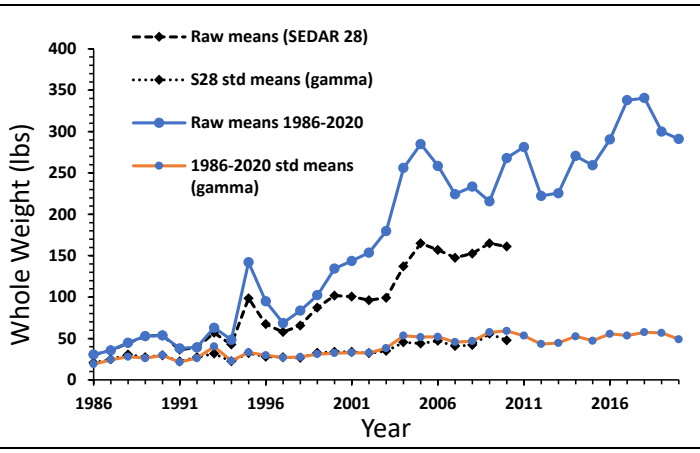
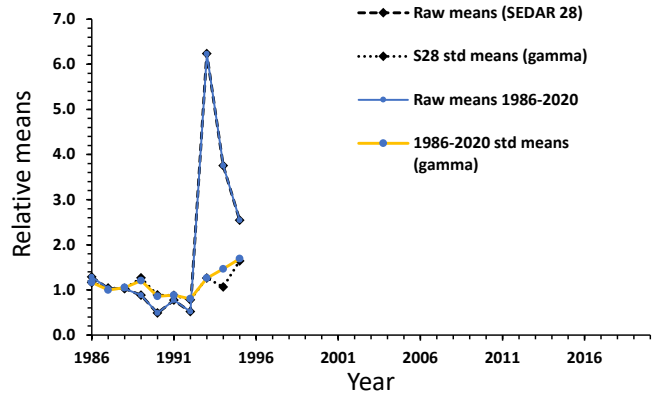
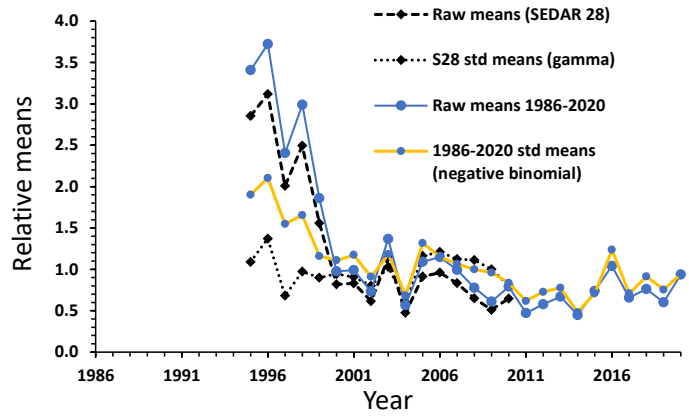


Figure 7. Atlantic Coast Spanish Mackerel reported on Florida commercial fishery trip tickets. Comparison of SEDAR 28 and current relative means for a) gill nets 1986-1995, b) gill nets 1995-2020, c) cast nets, and d) hook and line gear.

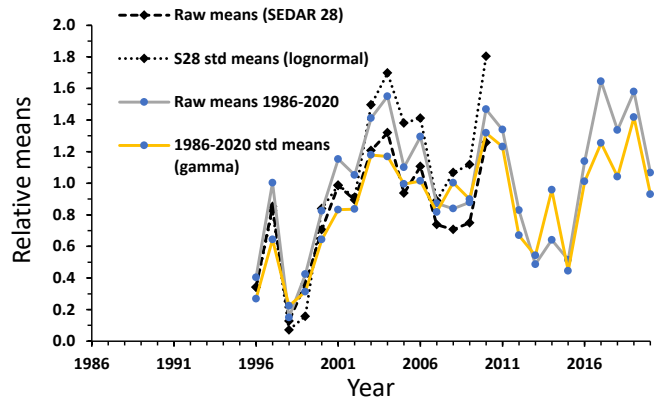
a) Relative means of gill net catch per trip, 1986-1995



b) Relative means of gill net catch per trip, 1996-2020



c) Relative means of cast net catch per trip, 1996-2020



d) Relative means of hook and line catch per trip, 1986-2020

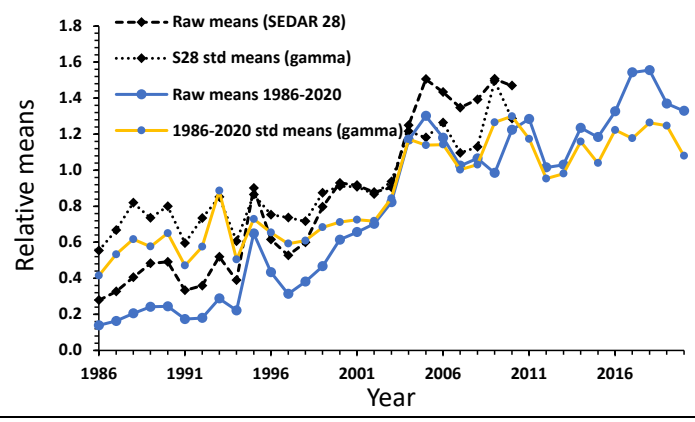


Figure 8. Atlantic coast Spanish Mackerel Florida trip ticket indices scaled to the mean for each gear type.