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Annual indices of abundance of Gulf of Mexico Spanish Mackerel from Florida commercial trip tickets, 1986-2021

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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 harvested by a U.S. vessel which are landed in a foreign country and purchased by a Florida wholesale dealer. 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 either electronically or on paper form (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. A push to more electronic reporting with the development of a new application in 2003 along with federal requirements for electronic reporting in 2013 lead to an increase in reporting of more specific 4-digit gear types.

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 gear 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 1993-2021), 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 Gulf coast Spanish Mackerel trips, those with landings greater than 1,223 pounds were excluded. This same methodology is also being applied to the SEDAR 81 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 or released catches is not required to be 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 Gulf Group Spanish Mackerel (Table 3) were taken from SEDAR 28 and updated through 2021 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. For Gulf of Mexico Group

Spanish Mackerel, all trips were in the unlimited portion of the quota management periods, so trip limits were not a factor in the analyses of the landings.

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 natural log-transformed ($\log_e$) 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 Florida Atlantic Coast or Gulf Coast, and separately by area fished (if present on the trip ticket) and county landed for SEDAR 78 and 81. 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 for SEDAR 81. 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 GMFMC 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)].

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), Monroe County (subregion 3), Collier-Levy (subregion 2), and Dixie-Escambia (subregion 1). 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 2021 were used for developing the indices. The hook and line indices were developed over the entire period by 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 by coast. The time period from July 1, 1995, to December 31, 1995, was not used for index generation because of low sample sizes for the cast net and gill net gears.

Indices:

There were four indices for Spanish Mackerel developed from Florida trip tickets: Gulf Coast (GULF) gill nets for 1986-June 30, 1995 (GULF_GN_before), Gulf gill nets for 1996 to 2021 (GULF_GN_after), GULF cast nets for 1996-2021 (GULF_CN), and GULF hook and line gears for 1986-2021 (GULF_HL). Each of the GN and CN 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 landings during these portions of the quota season landings may be more likely to reflect the availability of fish on those trips. Because all trips on the Gulf Coast were in the unlimited portion of the managed quotas, trip limits were not a factor in the analyses of Florida Gulf Coast landings of Spanish Mackerel.

Trips with Spanish Mackerel (pounds whole weight landed) were selected by coast, 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 (by area fished or county), and fishery codes were the eleven classification variables used to examine for trends in the amount (whole weight in 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 natural log-transformed and the model used a normal probability distribution with an identity link function. Variables in the analyses are the response variable (in these analyses, whole weight in pounds of Spanish mackerel landed) and explanatory variables (year, month, etc.) which are called covariates. SAS uses the convention that discrete variables (those that take on discrete values like "presence" or "absence", year, month, Florida sub-region, etc.) are called "class variables" and those which are continuous values are called "covariates." All explanatory variables in these analyses were, using the SAS terminology, "class variables."

The forward selection process analyzes the null model (no class variables or covariates chosen), and then each class variable or covariate added singly in the model. If the GLM successfully converges and a significant χ^2 (Chi-square) value is attained, the reduction in deviance from the null model is assessed for each of these candidate models, and the class variable with the largest percentage reduction in deviance than other class variables or covariates 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 and significance criteria (χ^2), and the largest percentage reduction in deviance from the null model as before. This process continues until, for all candidate variables, 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 or covariates. Alternatively, another series of model runs were conducted in a similar manner to that described above except that the variable with the greatest change in the Akaike Information Criterion (AIC) (a minimum change of at least 2 units for these analyses) is used to select variables for the models. An additional constraint for these candidate variables was that the variable selected achieves at least a 0.5% reduction in deviance at each step. Using the criteria of percentage reduction in deviance can be thought of as related to model fit with the candidate variables, whereas using AIC is also related to model fit but penalizes class variables for the number of levels that they have in the data set considered. Both methods of model variable selection usually result in a reduced set of variables for the "final" model and are useful ways to include only those variables that contribute more to model fit rather than overfitting with all the candidate 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 distribution, 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. After the final suite of model variables were identified, the model was re-run with the dispersion factor freed for the solution. Unfortunately, at the time of this report, the procedure to estimate the percentage reduction in deviance (a relative measure of fit of the model) is only approximate but this 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 be included in the model statement so that a year effect could be estimated. Annual values (and associated standard errors and coefficients of variation) were estimated using the least square means 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 shown in Table 4 a-d. Table 5 presents a brief summary of models selected by gear, showing candidate model distribution, selected class variables, numbers of trips selected, number of outliers by model, and the percentage reduction in deviance (a measure of fit to the data). The model results from the forward stepwise selection of variables for the linear models are in Tables 6 a-h, 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. 3-10. 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 7 a-b. 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 Figs. 3, 5, 7, and 9.

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. The negative binomial models all had low percentage reduction in deviance and showed relatively poor fits (q-q plots) to the negative binomial distribution and will not be discussed further. The models using the gamma and lognormal distributions were considered better candidates for indices in that they had reasonably few outliers (Table 5), reasonable reductions in deviance (Table 5), and better fitting to their underlying distributions (q-q plots; Figs. 4, 6, 8, and 10). Details of the stepwise selection of model variables for the gamma and lognormal models are shown in Table 6 a-h. Candidate index values (index scaled to mean, coefficient of variation, and sample size for the gamma and lognormal models are contained in Table 7. Overall, the lognormal models had better fits of the modeled data to the underlying distribution (q-q plots) and fewer outliers than the gamma distribution models, thus are better choices for indices (Table 7b) meriting recommendation. Indices produced from both the gamma and lognormal models, when the index is scaled to its mean value, produced reasonably similar trends (Figs. 3d, 5d, 7d, and 9d).

Potential advantages

The indices produced from the lognormal data had deviance residuals that produced reasonable fits to the lognormal distribution (Fig. 4b, 6b, 8b, and 10b), and fewer outliers (Table 5a) than those from models using the gamma distribution. The periods covered by the indices were relatively long (ten years for gill nets over 1986-1995, twenty-six years for gill nets for 1996-2021, twenty-six years for cast nets over 1996-2021, and thirty-six years for hook and line gears over 1986-2021).

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). The hook-and-line index also had relatively small annual coefficient of variation.

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 they may be deployed to drift with 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 GN indices in the FL Gulf 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 the 1995 data from the GN indices.

The most important limitation to the indices produced is that they are based solely upon "positive" trips (i.e., trips on which Spanish Mackerel were landed). Ideally, an index of abundance would include 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.

There may also be alternative ways of analyzing data from "positive only" trips such as restricting analyses to certain portions of the year when Spanish Mackerel are more abundant. Because this species is migratory, it may be difficult to select a time period since oceanic temperatures and circulation to which Spanish Mackerel respond vary spatially and temporally impacting availability to fishery participants.

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Table 1. List of data fields on Marine Fisheries Trip Tickets through time. Yellow indicates field was not mandatory. Green indicates field was mandatory. Blanks indicate field was not yet present on trip tickets during that time period. Form type was not designated until June of 1997.

Field Name	Initiated on Form Type***	Oct 1984-Jun 1986	Jul 1986-Feb 1990	Mar 1990-Dec 1994	Jan 1995-May 1997	Jun 1997 - Oct 2000 A2	Nov 2000 - Sep 2019 A3	Oct 2019 - present A6
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							
Reporting Units	A6**							
Market Size Code	A1*							
Market Grade Code	A3							
Amount of Catch (orig. units depend on species code used)	A1							
Unit Price ($US)	A1							
Catch Disposition	A3							
Form Number	A2							

* Form numbers were not designated until the A2 trip ticket was released in June 1997. No fields were added to the original trip ticket design (designated 'A1') until the addition of several fields in March of 1990.
** Reporting units (pounds, numbers, gallons, etc.) were originally embedded in the species code which included some size and grade codes for certain species. This resulted in multiple codes used for the same species. We now use a unique code for each species with all reporting units, size, and grade data reported seperately.
*** Form A4 was a change in the list of species codes and descriptions printed on the back of the hard copy paper trip ticket. Form A5 was a restart in the numbering sequence of the paper ticket to retain the same number of digits. There were no changes to the data field sections on these forms.

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 Eastern Gulf of Mexico migratory group (Spanish Mackerel)

Fishing Year	Time period	Trip limits (TL) in effect
86-87	19860401 – 19870331	TL unlimited
87-88	19870401 – 19870331	TL unlimited
88-89	19880401 – 19890331	TL unlimited
89-90	19890401 – 19900331	TL unlimited
90-91	19900401 – 19910331	TL unlimited
91-92	19910401 – 19920331	TL unlimited
92-93	19920401 – 19920331	TL=unlimited
93-94	19930401 – 19930331	TL=unlimited
94-95	19940401 – 19950331	TL unlimited
95-96	19950401 – 19960331	TL unlimited
96-97	19960401 – 19960331	TL unlimited
97-98	19970401 – 19970331	TL unlimited
98-99	19980401 – 19980331	TL unlimited
99-00	19990401 – 19990331	TL=unlimited
00-01	20000401 – 20000331	TL=unlimited
01-02	20010401 – 20010331	TL=unlimited
02-03	20020401 – 20020331	TL=unlimited
03-04	20030401 – 20030331	TL=unlimited
04-05	20040401 – 20040331	TL=unlimited
05-06	20050401 – 20060331	TL unlimited
06-07	20060401 – 20070331	TL unlimited
07-08	20070401 – 20080331	TL unlimited
08-09	20080401 – 20090331	TL unlimited
09-10	20090401 – 20100331	TL unlimited
10-11	20100401 – 20110331	TL unlimited
11-12	20110401 – 20120331	TL unlimited
12-13	20120401 – 20130331	TL unlimited
13-14	20130401 – 20140331	TL unlimited
14-15	20140401 – 20150331	TL unlimited
15-16	20150401 – 20160331	TL= unlimited
16-17	20160401 – 20170331	TL= unlimited
17-18	20170401 – 20180331	TL= unlimited
18-19	20180401 – 20180331	TL= unlimited
19-20	20190401 – 20200331	TL= unlimited
20-21	20200401 – 20210331	TL= unlimited

Table 4a-d. Florida Gulf of Mexico commercial fishing trips with reported landings of Spanish Mackerel by gear.

4a. FL Gulf Coast Hook and Line commercial landings of Spanish Mackerel, 1986-2021

Year	Variable	N (trips)	Mean weight (pounds/trip)	SE (pounds/trip)	LowerCL (pounds/trip)	UpperCL (pounds/trip)	Weighted Average Relative to Mean	$e^{(\log_e \text{ means})}$*	Wtd. avg. of $e^{(\log_e \text{ means})}$
1986	Whole wt.	1850	23.8	1.9	20.0	27.5	0.50	6.58	0.55
1987	Whole wt.	2487	17.8	1.3	15.2	20.4	0.38	5.02	0.42
1988	Whole wt.	1284	29.6	2.9	23.9	35.4	0.63	6.06	0.51
1989	Whole wt.	931	57.5	5.0	47.8	67.3	1.21	11.56	0.97
1990	Whole wt.	1262	42.1	3.2	36.0	48.3	0.89	9.10	0.76
1991	Whole wt.	1198	49.7	3.5	42.9	56.6	1.05	10.26	0.86
1992	Whole wt.	781	40.6	4.3	32.1	49.0	0.86	8.85	0.74
1993	Whole wt.	668	21.9	2.7	16.6	27.2	0.46	6.38	0.54
1994	Whole wt.	746	44.8	5.5	34.1	55.5	0.95	7.49	0.63
1995	Whole wt.	464	38.4	4.4	29.9	47.0	0.81	9.93	0.83
1996	Whole wt.	552	24.7	2.1	20.5	28.8	0.52	7.80	0.65
1997	Whole wt.	538	27.5	2.9	21.8	33.1	0.58	9.62	0.81
1998	Whole wt.	472	34.1	3.3	27.7	40.6	0.72	12.32	1.03
1999	Whole wt.	492	35.6	3.3	29.1	42.1	0.75	12.31	1.03
2000	Whole wt.	522	27.6	3.5	20.7	34.5	0.58	8.66	0.73
2001	Whole wt.	576	56.6	4.6	47.6	65.6	1.20	14.87	1.25
2002	Whole wt.	492	36.0	3.7	28.7	43.3	0.76	10.99	0.92
2003	Whole wt.	645	50.8	3.5	43.9	57.6	1.07	18.87	1.58
2004	Whole wt.	432	67.5	5.2	57.3	77.7	1.43	22.34	1.87
2005	Whole wt.	363	42.8	5.1	32.8	52.8	0.90	13.96	1.17
2006	Whole wt.	497	61.8	5.0	52.1	71.5	1.31	19.40	1.63
2007	Whole wt.	532	43.2	3.9	35.6	50.8	0.91	14.61	1.23
2008	Whole wt.	436	48.5	5.3	38.1	58.8	1.02	12.86	1.08
2009	Whole wt.	710	51.2	4.0	43.2	59.1	1.08	12.86	1.08
2010	Whole wt.	785	56.3	3.5	49.4	63.2	1.19	16.68	1.40
2011	Whole wt.	562	52.7	4.2	44.5	60.9	1.11	16.68	1.40
2012	Whole wt.	812	58.3	4.1	50.2	66.4	1.23	16.39	1.37
2013	Whole wt.	1176	45.1	2.8	39.5	50.6	0.95	14.47	1.21
2014	Whole wt.	873	60.8	3.8	53.3	68.4	1.29	17.52	1.47
2015	Whole wt.	1122	79.9	3.5	73.1	86.6	1.69	26.92	2.26
2016	Whole wt.	1076	91.8	4.8	82.3	101.3	1.94	22.98	1.93
2017	Whole wt.	1279	65.3	3.6	58.3	72.3	1.38	18.33	1.54
2018	Whole wt.	762	60.8	4.0	52.9	68.6	1.28	18.27	1.53
2019	Whole wt.	1001	70.8	3.7	63.6	78.1	1.50	23.50	1.97
2020	Whole wt.	805	73.2	4.8	63.8	82.5	1.54	21.95	1.84
2021	Whole wt.	618	48.7	4.0	40.8	56.6	1.03	15.17	1.27
1986-2021	Total Trips	29801							
Wtd. Avg.	Whole wt.		47.3	0.6	46.1	48.6		11.92	

* $e^{(\log \text{ means})}$: means of $\log_e$ transformed whole wt. (lbs/trip) were back-transformed to arithmetic scale for plotting purposes.

Table 4a-d. (cont.) Florida Gulf of Mexico commercial fishing trips with reported landings of Spanish Mackerel by gear.

4b. FL Gulf Coast commercial cast net landings of Spanish Mackerel, 1986-2021

Year	Variable	N (trips)	Mean weight (pounds/trip)	SE (pounds/trip)	LowerCL (pounds/trip)	UpperCL (pounds/trip)	Weighted Average Relative to Mean	$e^{(\log_e \text{means})}$*	Wtd. avg. of $e^{(\log_e \text{means})}$
1996	Whole wt.	178	38.9	6.9	25.4	52.4	0.45	8.30	0.30
1997	Whole wt.	241	17.5	3.0	11.7	23.3	0.20	4.98	0.78
1998	Whole wt.	383	64.8	14.3	36.8	92.7	0.75	8.12	0.46
1999	Whole wt.	232	114.9	38.1	40.3	189.6	1.33	8.18	0.76
2000	Whole wt.	411	117.8	25.6	67.7	168.0	1.36	11.65	0.76
2001	Whole wt.	302	154.3	29.0	97.6	211.1	1.79	14.66	1.09
2002	Whole wt.	398	94.6	24.9	45.7	143.5	1.10	14.76	1.37
2003	Whole wt.	218	112.1	22.0	69.0	155.2	1.30	18.92	1.38
2004	Whole wt.	158	132.5	33.8	66.4	198.7	1.53	12.76	1.77
2005	Whole wt.	179	52.5	12.2	28.5	76.5	0.61	8.86	1.19
2006	Whole wt.	156	111.8	27.0	58.9	164.8	1.29	18.92	0.83
2007	Whole wt.	153	59.8	38.8	-16.4	135.9	0.69	6.46	1.77
2008	Whole wt.	220	33.5	4.2	25.3	41.8	0.39	9.85	0.60
2009	Whole wt.	245	36.8	7.8	21.5	52.1	0.43	6.19	0.92
2010	Whole wt.	204	92.5	17.4	58.4	126.6	1.07	15.53	0.58
2011	Whole wt.	168	161.9	32.3	98.5	225.3	1.87	14.50	1.45
2012	Whole wt.	264	71.6	12.8	46.4	96.8	0.83	9.06	1.35
2013	Whole wt.	259	50.5	10.6	29.7	71.3	0.58	7.10	0.85
2014	Whole wt.	206	71.0	17.0	37.6	104.4	0.82	8.57	0.66
2015	Whole wt.	184	69.5	10.4	49.1	89.9	0.80	16.36	0.80
2016	Whole wt.	114	159.0	42.8	75.1	242.9	1.84	9.98	1.53
2017	Whole wt.	134	97.6	23.0	52.5	142.8	1.13	17.03	0.93
2018	Whole wt.	100	89.9	24.4	42.0	137.8	1.04	14.68	1.59
2019	Whole wt.	68	120.3	35.3	51.2	189.5	1.39	22.17	1.37
2020	Whole wt.	70	64.5	13.3	38.4	90.6	0.75	14.06	2.07
2021	Whole wt.	58	115.1	34.4	47.6	182.7	1.33	14.33	1.31
1996-2021	Total Trips	5316							
Wtd. Avg	Whole wt		86.2	4.8	76.8	95.6		10.71	

* $e^{(\log \text{means})}$: means of $\log_e$ transformed whole wt. (lbs/trip) were back-transformed to arithmetic scale for plotting purposes.

Table 4a-d. (cont.) Florida Gulf of Mexico commercial fishing trips with reported landings of Spanish Mackerel by gear.

4c. FL Gulf Coast commercial gill net landings, 1986-June 30, 1995.

Year	Variable	N (trips)	Mean weight (pounds)	SE (pounds)	LowerCL (pounds)	UpperCL (pounds)	Weighted Average Relative to Mean	$e^{(\log_e \text{means})}$*	Wtd. avg. of $e^{(\log_e \text{means})}$
1986	Whole wt.	3914	402.9	37.8	328.8	477.0	1.16	17.9	0.82
1987	Whole wt.	5125	328.9	26.1	277.8	380.1	0.95	13.2	0.60
1988	Whole wt.	3835	303.8	25.2	254.5	353.2	0.88	16.3	0.75
1989	Whole wt.	4069	529.0	44.2	442.5	615.6	1.53	21.7	1.00
1990	Whole wt.	6418	306.4	20.5	266.2	346.6	0.88	19.0	0.87
1991	Whole wt.	7765	338.7	21.7	296.1	381.3	0.98	20.2	0.93
1992	Whole wt.	7985	370.4	20.6	330.0	410.9	1.07	27.7	1.27
1993	Whole wt.	5710	369.6	22.0	326.6	412.7	1.07	24.3	1.11
1994	Whole wt.	7063	285.3	11.1	263.6	307.0	0.82	30.1	1.38
1995	Whole wt.	3096	251.0	14.3	223.1	279.0	0.72	32.2	1.47
1986-1995	Total Trips	54980							
Wtd. Avg.	Whole wt.		346.26	7.68	331.21	361.32		21.84	

* $e^{(\log \text{means})}$: means of $\log_e$ transformed whole wt. (lbs/trip) were back-transformed to arithmetic scale for plotting purposes.

4d. FL Gulf Coast commercial gill net landings, 1996-2021

Year	Variable	N (trips)	Mean weight (pounds)	SE (pounds)	LowerCL (pounds)	UpperCL (pounds)	Weighted Average Relative to Mean	$e^{(\log_e \text{means})}$*	Wtd. avg. of $e^{(\log_e \text{means})}$
1995									
1996	Whole wt.	254	836.8	200.9	442.8	1230.8	0.41	49.5	0.36
1997	Whole wt.	229	608.8	286.1	47.9	1169.6	0.30	18.9	0.14
1998	Whole wt.	397	305.2	57.0	193.5	416.9	0.15	16.4	0.12
1999	Whole wt.	295	1764.0	362.4	1053.6	2474.5	0.86	51.1	0.37
2000	Whole wt.	311	1592.6	321.7	961.9	2223.3	0.78	48.0	0.34
2001	Whole wt.	222	2626.1	449.9	1744.1	3508.1	1.28	166.6	1.19
2002	Whole wt.	109	1001.9	172.8	663.2	1340.6	0.49	138.4	0.99
2003	Whole wt.	128	4195.3	727.1	2769.8	5620.8	2.04	409.5	2.93
2004	Whole wt.	58	2603.9	818.4	999.3	4208.5	1.27	378.6	2.71
2005	Whole wt.	76	9765.0	1928.3	5984.3	13545.6	4.76	588.4	4.22
2006	Whole wt.	63	4812.6	1322.4	2220.0	7405.2	2.34	131.5	0.94
2007	Whole wt.	98	3247.7	573.8	2122.7	4372.8	1.58	146.7	1.05
2008	Whole wt.	145	1968.4	415.3	1154.1	2782.7	0.96	53.7	0.39
2009	Whole wt.	157	8248.1	825.6	6629.4	9866.7	4.02	920.4	6.60
2010	Whole wt.	78	4130.8	979.7	2209.9	6051.7	2.01	189.2	1.36
2011	Whole wt.	85	3790.2	1172.6	1491.2	6089.2	1.85	1007.3	7.22
2012	Whole wt.	51	3205.6	869.7	1500.5	4910.7	1.56	1260.7	9.03
2013	Whole wt.	178	975.0	81.8	814.7	1135.4	0.47	646.0	4.63
2014	Whole wt.	238	1078.6	140.0	804.2	1353.0	0.53	545.8	3.91
2015	Whole wt.	217	1382.4	171.7	1045.8	1719.0	0.67	628.1	4.50
2016	Whole wt.	149	1348.6	153.3	1048.1	1649.1	0.66	711.6	5.10
2017	Whole wt.	60	893.1	153.7	591.8	1194.4	0.44	374.3	2.68
2018	Whole wt.	38	670.1	106.4	461.4	878.8	0.33	348.2	2.50
2019	Whole wt.	43	492.6	125.6	246.3	738.8	0.24	173.6	1.24
2020	Whole wt.	69	1356.8	203.7	957.5	1756.2	0.66	603.2	4.32
2021	Whole wt.	68	1298.0	134.9	1033.6	1562.4	0.63	816.2	5.85
1996-2021	Total Trips	3873							
Wtd. Avg.	Whole wt.		2024.0	96.4	1835.0	2213.1		139.5	

* $e^{(\log \text{means})}$: means of $\log_e$ transformed whole wt. (lbs/trip) were back-transformed to arithmetic scale for plotting purposes.

Table 5. Summary of model runs by 5a.) percentage reduction in deviance and 5b.) by AIC.

5a.) Covariates (class variables) selected based on %reduction in deviance of at least 0.5%.

Gears	Model Distribution	Selected covariates (class variables)	No. of Trips	No. of Trips used [a]	Outliers (|z|>=4)	deviance reduction (%)
Hook and Line 1986-2021	Poisson	year rf month FL_reg_area_co op ib	29801	29783	20552	15.4
	gamma	year rf month FL_reg_area_co	29801	29786	87	12.9
	Lognormal	year ib FL_reg_area_co rf month	29801	29783	1	16.6
	negative binomial	rf year [b]	29801	29786	83	~ 1.5
Cast net 1996-2021	Poisson	month ip ib year FL_reg_area_co	5316	5316	3918	28.0
	gamma	month ib year ip FL_reg_area_co	5316	5316	20	23.6
	Lognormal	ib ip month year FL_reg_area_co	5316	5316	0	17.5
	negative binomial	month ib year	5316	5316	18	~ 3.1
Gill net (before) 1986-June 30, 1995	Poisson	FL_reg_area_co ip ib month year	54980	54950	45342	57.7
	gamma	month ib FL_reg_area_co ip year ob op	54980	54949	131	36.7
	Lognormal	FL_reg_area_co ib month year op ob ip	54980	54949	0	27.8
	negative binomial	month ib FL_reg_area_co year [b]	54980	54952	117	~ 6.3
Gill net (after) 1996-2021	Poisson	ip month year FL_reg_area_co	3873	3873	3579	59.4
	gamma	month ip year FL_reg_area_co	3873	3873	7	44.5
	Lognormal	year ip month FL_reg_area_co	3873	3873	0	52.8
	negative binomial	ip month year	3873	3873	8	~ 7.3

5b.) Covariates (class variables) selected based on greatest AIC and %reduction in deviance of at least 0.5%

Hook and Line 1986-2021	Poisson	year rf month FL_reg_area_co ib op	29801	29783	20552	15.4
	gamma	year rf month FL_reg_area_co	29801	29786	87	12.9
	Lognormal	year ib FL_reg_area_co rf month	29801	29783	1	16.6
	negative binomial	year	29801	29801	81	~ 1.5
Cast net 1996-2021	Poisson	month ip ib year FL_reg_area_co	5316	5316	3918	28.0
	gamma	month ib year ip FL_reg_area_co	5316	5316	20	23.6
	Lognormal	ib ip month year FL_reg_area_co	5316	5316	0	17.5
	negative binomial	month ib year	5316	5316	18	~ 3.1
Gill net (before) 1986-June 30, 1995	Poisson	FL_reg_area_co ip ib month year	54980	54950	45342	57.7
	gamma	month ib FL_reg_area_co ip year ob op	54980	54949	131	36.7
	Lognormal	FL_reg_area_co ib month year op ob ip	54980	54949	0	27.8
	negative binomial	month ib FL_reg_area_co year [b]	54980	54952	117	~ 6.3
Gill net (after) 1996-2021	Poisson	ip month year FL_reg_area_co	3873	3873	3579	59.4
	gamma	ip month year FL_reg_area_co	3873	3873	7	44.5
	Lognormal	ip year month FL_reg_area_co	3873	3873	0	52.8
	negative binomial	ip month year	3873	3873	8	~ 7.3

[a] No. of Trips used: no. of observations used. Missing or invalid values for some combinations of selected covariates cause this difference. For example, landings reported from inland counties could not always be assigned to the proper coast.

[b] The variable "year" did not meet the selection criteria but was added last in the model variables to produce annual estimates.

Table 6 a-h. Florida Gulf Coast commercial landings of Spanish Mackerel by gear: Stepwise selection of variables to include in estimating the catch per trip of Spanish Mackerel using a GLM based on highest percentage reduction (minimum of 0.5%)in model deviance. 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)

6a.) FL Gulf Coast commercial landings of Spanish Mackerel from hook-and-line trips, 1986-2021, gamma distribution model.

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq
Null	Intercept (null model)	29800	82201.12	2.758	.	.	-136638	157084.63	.	.
1	year	29765	76718.55	2.577	6.56	6.56	-135323	2630.03	35	<.0001
2	year rf	29749	74253.58	2.496	2.95	9.51	-134671	1216.95	1	<.0001
3	year rf month	29738	72236.56	2.429	2.43	11.94	-134152	1037.52	11	<.0001
4	year rf month FL_reg_area_co	29736	71443.24	2.403	0.96	12.90	-133944	414.96	2	<.0001

6b.) FL Gulf Coast commercial landings of Spanish Mackerel from hook-and-line trips, 1986-2021, lognormal distribution model.

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq
Null	Intercept (null model)	29800	79889.6	2.681	.	.	-56979.2	79889.6	.	.
1	year	29765	72699.3	2.442	8.89	8.89	-55573.9	2810.7	35	<.0001
2	year ib	29761	70018.2	2.353	3.35	12.24	-55010.0	1111.9	1	<.0001
3	year ib FL_reg_area_co	29759	68583.2	2.305	1.79	14.03	-54701.4	617.0	2	<.0001
4	year ib FL_reg_area_co rf	29743	67459.2	2.268	1.36	15.40	-54435.3	486.8	1	<.0001
5	year ib FL_reg_area_co rf month	29732	66464.3	2.235	1.22	16.62	-54214.1	442.5	11	<.0001

Table 6 (cont.) Florida Gulf Coast commercial landings of Spanish Mackerel by gear: Stepwise selection of variables to include in estimating the catch per trip of Spanish Mackerel using a GLM based on highest percentage reduction (minimum of 0.5%)in model deviance. 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)

6c.) FL Gulf Coast commercial landings of Spanish Mackerel from cast net trips, 1986-2021, gamma distribution model.

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq
Null	Intercept (null model)	5315	22174.50	4.172	.	.	-25255.6	86755.0	.	.
1	month	5304	19799.4	3.733	10.53	10.53	-24849.2	812.9	11	<.0001
2	month ib	5303	18678.2	3.522	5.05	15.58	-24642.6	413.3	1	<.0001
3	month ib year	5277	17569.0	3.329	4.62	20.20	-24427.4	430.4	26	<.0001
4	month ib year ip	5276	16999.9	3.222	2.57	22.77	-24312.4	230.0	1	<.0001
5	month ib year ip FL_reg_area_co	5274	16806.1	3.187	0.85	23.62	-24272.5	79.8	2	<.0001

6d.) FL Gulf Coast commercial landings of Spanish Mackerel from cast net trips, 1986-2021, lognormal distribution model.

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq
Null	Intercept (null model)	5315	18687.7	3.516	.	.	-10884.6	18687.7	.	.
1	ib	5314	17395.7	3.274	6.90	6.90	-10694.1	380.8	1	<.0001
2	ib ip	5313	16701.4	3.144	3.70	10.60	-10585.9	216.5	1	<.0001
3	ib ip month	5302	15995.0	3.017	3.60	14.20	-10471.0	229.8	11	<.0001
4	ib ip month year	5276	15433.6	2.925	2.60	16.80	-10376.0	189.9	26	<.0001
5	ib ip month year FL_reg_area_co	5274	15302.9	2.902	0.67	17.48	-10353.4	45.2	2	<.0001

Table 6 (cont.) Florida Gulf Coast commercial landings of Spanish Mackerel by gear: Stepwise selection of variables to include in estimating the catch per trip of Spanish Mackerel using a GLM based on highest percentage reduction (minimum of 0.5%)in model deviance. 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)

6e.) FL Gulf Coast commercial landings of Spanish Mackerel from gill net trips, 1986-June 30, 1995, gamma distribution model.

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq
Null	Intercept (null model)	54979	303866.1	5.527	.	.	-311131.8	1487614.4	.	.
1	month	54968	246664.9	4.487	18.81	18.81	-303135.7	15992.2	11	<.0001
2	month ib	54939	218000.2	3.968	9.40	28.21	-298327.0	9221.5	1	<.0001
3	month ib FL_reg_area_co	54937	204040.9	3.714	4.60	32.80	-295882.1	4889.8	2	<.0001
4	month ib FL_reg_area_co ip	54934	200265.8	3.646	1.24	34.04	-295183.7	1371.2	1	<.0001
5	month ib FL_reg_area_co ip year	54925	197003.5	3.587	1.06	35.10	-294582.0	1203.4	9	<.0001
6	month ib FL_reg_area_co ip year ob	54923	194328.3	3.538	0.88	35.98	-294076.2	999.6	1	<.0001
7	month ib FL_reg_area_co ip year ob op	54922	192235.1	3.500	0.69	36.67	-293681.0	790.5	1	<.0001

6f.) FL Gulf Coast commercial landings of Spanish Mackerel from gill net trips, 1986-June 30, 1995, lognormal distribution model.

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq
Null	Intercept (null model)	54979	273423.0	4.973	.	.	-122108.6	273423.0	.	.
1	FL_reg_area_co	54977	248523.8	4.521	9.10	9.10	-119483.8	5249.6	2	<.0001
2	FL_reg_area_co ib	54948	227326.4	4.137	7.71	16.81	-116987.4	4848.5	1	<.0001
3	FL_reg_area_co ib month	54937	208883.6	3.802	6.73	23.55	-114662.7	4649.5	11	<.0001
4	FL_reg_area_co ib month year	54928	204402.4	3.721	1.63	25.17	-114066.8	1191.7	9	<.0001
5	FL_reg_area_co ib month year op	54927	201615.0	3.671	1.02	26.19	-113689.6	754.5	1	<.0001
6	FL_reg_area_co ib month year op ob	54925	199054.1	3.624	0.94	27.13	-113336.8	702.3	1	<.0001
7	FL_reg_area_co ib month year op ob ip	54922	197341.4	3.593	0.62	27.75	-113096.2	471.0	1	<.0001

Table 6 (cont.) Florida Gulf Coast commercial landings of Spanish Mackerel by gear: Stepwise selection of variables to include in estimating the catch per trip of Spanish Mackerel using a GLM based on highest percentage reduction (minimum of 0.5%)in model deviance. 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)

6g.) FL Gulf Coast commercial landings of Spanish Mackerel from gill net trips, 1996-2021, gamma distribution model.

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq
Null	Intercept (null model)	3872	20716.6	5.350	.	.	-29010.7	34023.0	.	.
1	month	3861	15398.9	3.988	25.46	25.46	-28218.0	1585.3	11	<.0001
2	month ip	3860	12909.8	3.345	12.03	37.49	-27762.3	911.4	1	<.0001
3	month ip year	3834	11608.9	3.028	5.92	43.41	-27493.1	538.4	26	<.0001
4	month ip year FL_reg_area_co	3832	11376.1	2.969	1.11	44.51	-27442.2	101.8	2	<.0001

6h.) FL Gulf Coast commercial landings of Spanish Mackerel from gill net trips, 1996-2021, lognormal distribution model.

Level	Source	DF	Deviance	Mean Dev	%Change Mean Dev	Cum. %	Full Like	Chi-Sq	Chi-DF	PrChiSq
Null	Intercept (null model)	3872	28107.4	7.259	.	.	-9333.7	28107.4	.	.
1	year	3846	20429.2	5.312	26.83	26.83	-8715.8	1235.7	26	<.0001
2	year ip	3845	14738.5	3.833	20.37	47.20	-8083.6	1264.5	1	<.0001
3	year ip month	3834	13467.2	3.513	4.42	51.61	-7908.9	349.4	11	<.0001
4	year ip month FL_reg_area_co	3832	13136.3	3.428	1.16	52.78	-7860.7	96.3	2	<.0001

Table 7a-b. FL Gulf Coast Spanish Mackerel indices relative to their means for various gears, the coefficient of variation (cv), and number of trips. Commercial fishery data reported on Florida trip tickets.

7a.) Florida Gulf Coast Commercial Trip Ticket Indices, gamma distribution models

	Hook and Line Gears			Cast Nets, 1996-2021			Gill Nets, 1986-June 30, 1995			Gill Nets, 1996-2021		
Year	Index scaled to mean	cv	N (trips)	Index scaled to mean	cv	N (trips)	Index scaled to mean	cv	N (trips)	Index scaled to mean	cv	N (trips)
1986	0.632	0.033	1850				0.593	0.029	3914			
1987	0.498	0.029	2487				0.644	0.027	5125			
1988	0.769	0.040	1284				0.794	0.031	3835			
1989	1.516	0.046	931				0.774	0.029	4069			
1990	0.944	0.040	1262				0.792	0.025	6418			
1991	1.072	0.041	1198				1.088	0.023	7765			
1992	1.065	0.049	781				1.198	0.023	7985			
1993	0.537	0.054	668				1.265	0.026	5710			
1994	0.965	0.052	746				1.371	0.025	7063			
1995	0.839	0.065	464				1.020	0.035	3096			
1996	0.613	0.059	552	0.746	0.333	178				0.559	0.132	254
1997	0.639	0.061	538	0.333	0.336	241				0.205	0.138	229
1998	0.886	0.065	472	0.837	0.319	383				0.280	0.126	397
1999	0.885	0.063	492	0.990	0.329	232				0.482	0.128	295
2000	0.637	0.061	522	1.190	0.319	411				0.637	0.144	311
2001	1.303	0.057	576	1.925	0.314	302				0.915	0.142	222
2002	0.985	0.062	492	1.422	0.320	398				1.098	0.181	109
2003	1.162	0.055	645	0.831	0.331	218				0.866	0.173	128
2004	1.429	0.067	432	0.571	0.337	158				1.261	0.230	58
2005	1.121	0.073	363	0.573	0.320	179				1.982	0.203	76
2006	1.331	0.064	497	1.433	0.344	156				0.645	0.219	63
2007	0.964	0.061	532	0.440	0.342	153				0.677	0.191	98
2008	0.942	0.068	436	0.590	0.328	220				0.885	0.172	145
2009	1.215	0.052	710	0.579	0.328	245				1.668	0.162	157
2010	1.227	0.051	785	2.299	0.325	204				1.187	0.202	78
2011	1.167	0.059	562	1.097	0.337	168				2.652	0.200	85
2012	1.128	0.050	812	0.704	0.323	264				2.917	0.247	51
2013	0.918	0.042	1176	0.747	0.321	259				1.491	0.155	178
2014	1.104	0.048	873	0.721	0.336	206				1.355	0.145	238
2015	1.308	0.043	1122	0.809	0.342	184				1.614	0.149	217
2016	1.551	0.045	1076	2.096	0.351	114				1.767	0.164	149
2017	1.094	0.041	1279	0.818	0.344	134				0.982	0.228	60
2018	1.082	0.052	762	1.191	0.353	100				1.179	0.282	38
2019	1.310	0.045	1001	0.953	0.380	68				0.591	0.263	43
2020	1.355	0.051	805	0.725	0.379	70				1.644	0.220	69
2021	0.896	0.056	618	0.934	0.391	58				1.626	0.220	68
Distri-bution:	gamma			gamma			gamma			gamma		

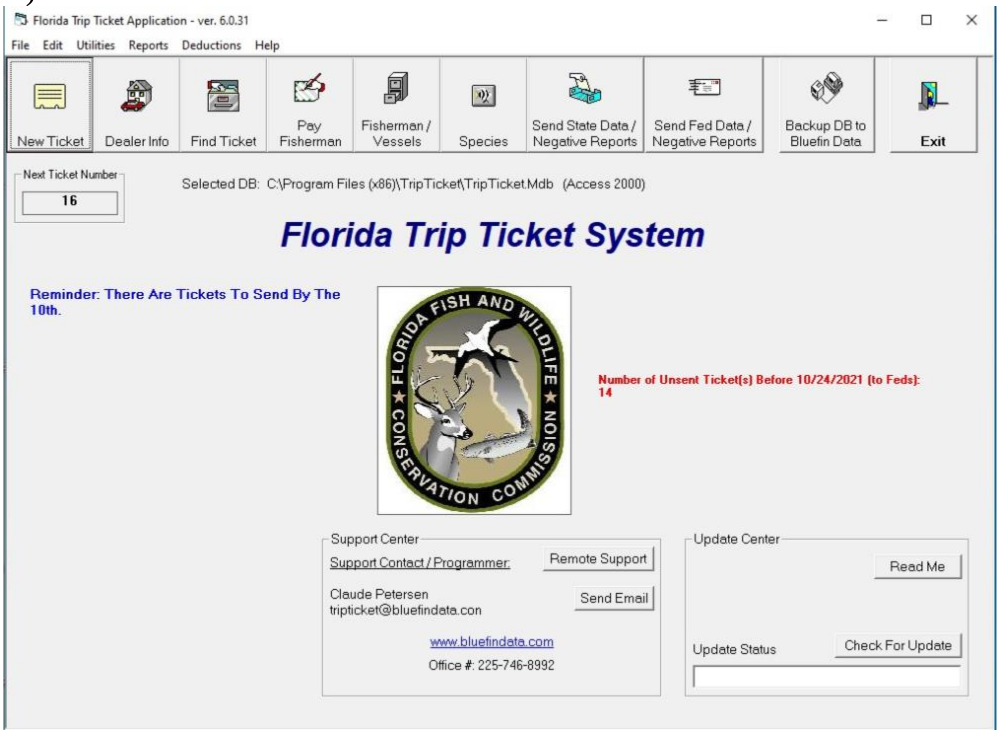
Table 7a-b. FL Gulf Coast Spanish Mackerel indices relative to their means for various gears, the coefficient of variation (cv), and number of trips. Commercial fishery data reported on Florida trip tickets.

7b.) Florida Gulf Coast Commercial Trip Ticket Indices, lognormal distribution models ***Recommended Indices***

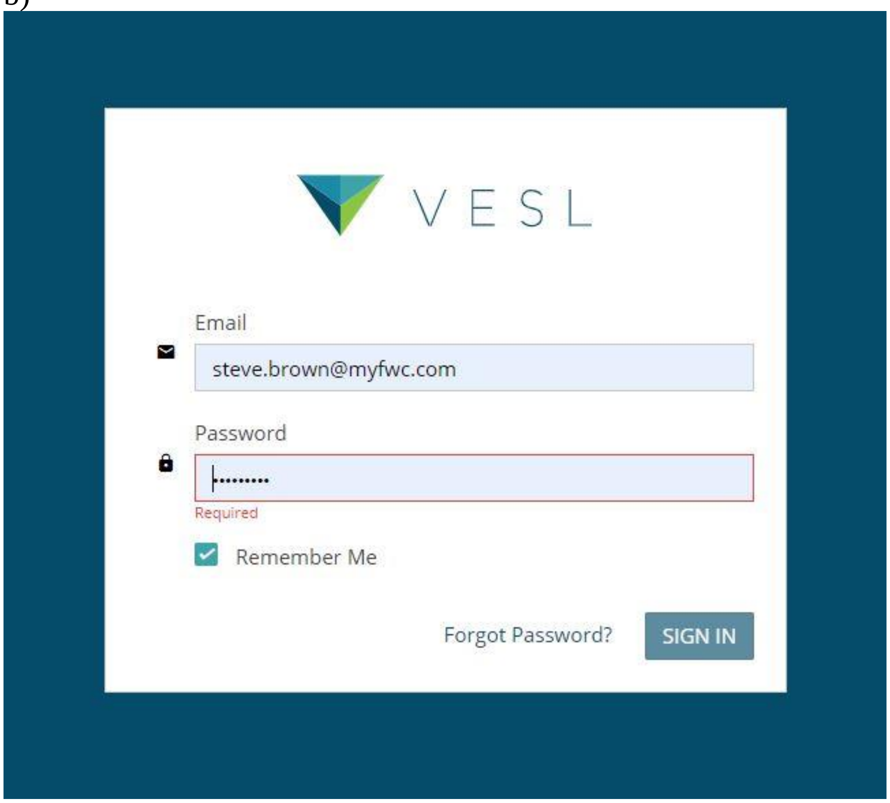
	Hook and Line Gears			Cast Nets, 1996-2021			Gill Nets, 1986-June 30, 1995			Gill Nets, 1996-2021		
Year	Index scaled to mean	cv	N (trips)	Index scaled to mean	cv	N (trips)	Index scaled to mean	cv	N (trips)	Index scaled to mean	cv	N (trips)
1986	0.625	0.036	1850				0.515	0.034	3914			
1987	0.502	0.032	2487				0.574	0.030	5125			
1988	0.628	0.043	1284				0.650	0.035	3835			
1989	1.149	0.049	931				0.786	0.033	4069			
1990	0.833	0.043	1262				0.838	0.028	6418			
1991	0.937	0.044	1198				1.049	0.027	7765			
1992	0.807	0.053	781				1.227	0.026	7985			
1993	0.564	0.058	668				1.275	0.030	5710			
1994	0.654	0.055	746				1.415	0.029	7063			
1995	0.811	0.070	464				1.206	0.040	3096			
1996	0.675	0.064	552	0.770	0.363	178				0.232	0.157	254
1997	0.798	0.066	538	0.474	0.366	241				0.119	0.165	229
1998	1.138	0.070	472	0.714	0.348	383				0.105	0.142	397
1999	1.119	0.068	492	0.777	0.357	232				0.237	0.146	295
2000	0.807	0.066	522	1.080	0.348	411				0.196	0.156	311
2001	1.257	0.062	576	1.388	0.341	302				0.511	0.165	222
2002	1.019	0.067	492	1.263	0.350	398				0.631	0.213	109
2003	1.474	0.059	645	1.241	0.363	218				0.654	0.204	128
2004	1.747	0.072	432	0.810	0.369	158				1.096	0.277	58
2005	1.182	0.079	363	0.808	0.355	179				0.912	0.239	76
2006	1.450	0.069	497	1.494	0.377	156				0.354	0.259	63
2007	1.103	0.066	532	0.544	0.373	153				0.528	0.225	98
2008	1.003	0.073	436	0.849	0.359	220				0.280	0.192	145
2009	1.116	0.056	710	0.714	0.359	245				1.288	0.184	157
2010	1.298	0.055	785	1.822	0.354	204				0.712	0.241	78
2011	1.290	0.065	562	1.133	0.367	168				2.833	0.235	85
2012	1.182	0.054	812	0.904	0.352	264				3.809	0.299	51
2013	0.905	0.046	1176	0.664	0.349	259				2.278	0.182	178
2014	1.063	0.053	873	0.799	0.366	206				2.435	0.170	238
2015	1.508	0.047	1122	1.177	0.372	184				2.058	0.174	217
2016	1.367	0.048	1076	1.075	0.378	114				2.856	0.193	149
2017	1.101	0.045	1279	1.313	0.376	134				0.954	0.273	60
2018	1.138	0.056	762	1.218	0.383	100				1.559	0.341	38
2019	1.422	0.049	1001	1.460	0.414	68				0.596	0.318	43
2020	1.375	0.056	805	1.079	0.416	70				1.666	0.260	69
2021	0.975	0.061	618	1.083	0.428	58				3.478	0.263	68
Distri-bution:	lognormal			lognormal			lognormal			lognormal		

Figures.

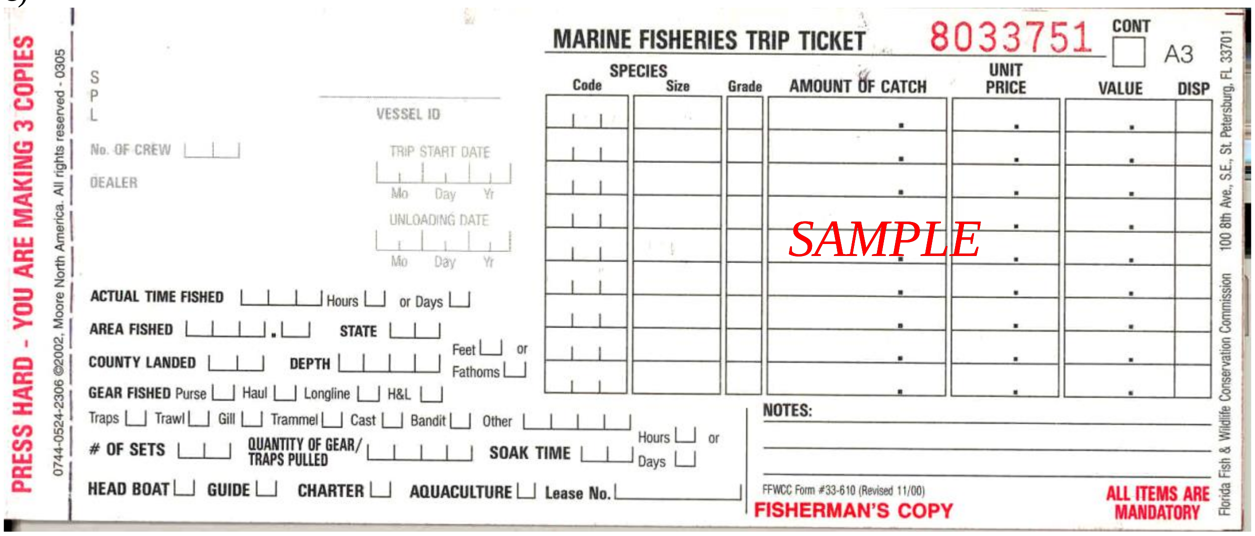
a.)


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)



PRESS HARD - YOU ARE MAKING 3 COPIES

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MARINE FISHERIES TRIP TICKET 8033751 CONT A3

S P L

VESSEL ID

No. OF CREW

TRIP START DATE Mo Day Yr

DEALER

UNLOADING DATE Mo Day Yr

ACTUAL TIME FISHED Hours or Days

AREA FISHED . STATE

COUNTY LANDED DEPTH Feet or Fathoms

GEAR FISHED Purse Haul Longline H&L

Traps Trawl Gill Trammel Cast Bandit Other

OF SETS QUANTITY OF GEAR/ TRAPS PULLED SOAK TIME Hours or Days

HEAD BOAT GUIDE CHARTER AQUACULTURE Lease No.

SPECIES Code	Size	Grade	AMOUNT OF CATCH	UNIT PRICE	VALUE	DISP

SAMPLE

NOTES:

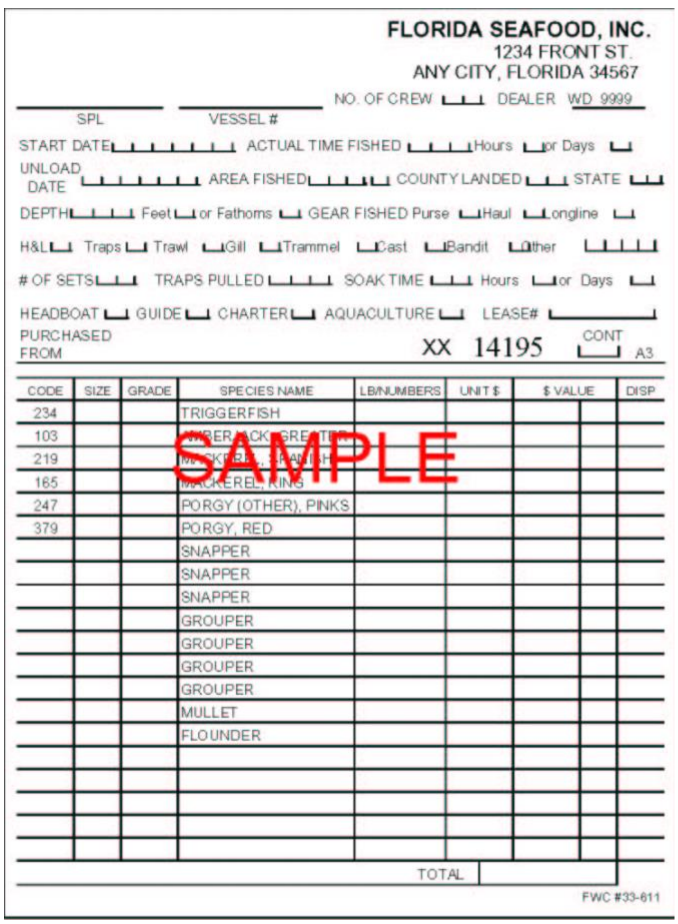
FFWCC Form #33-610 (Revised 11/00)

FISHERMAN'S COPY

ALL ITEMS ARE MANDATORY

Florida Fish & Wildlife Conservation Commission 100 8th Ave., S.E., St. Petersburg, FL 33701

d)



FLORIDA SEAFOOD, INC.
1234 FRONT ST.
ANY CITY, FLORIDA 34567

SPL VESSEL # NO. OF CREW DEALER WD 9999

START DATE ACTUAL TIME FISHED Hours or Days

UNLOAD DATE AREA FISHED COUNTY LANDED STATE

DEPTH Feet or Fathoms GEAR FISHED Purse Haul Longline

H&L Traps Trawl Gill Trammel Cast Bandit Other

OF SETS TRAPS PULLED SOAK TIME Hours or Days

HEADBOAT GUIDE CHARTER AQUACULTURE LEASE#

PURCHASED FROM XX 14195 CONT A3

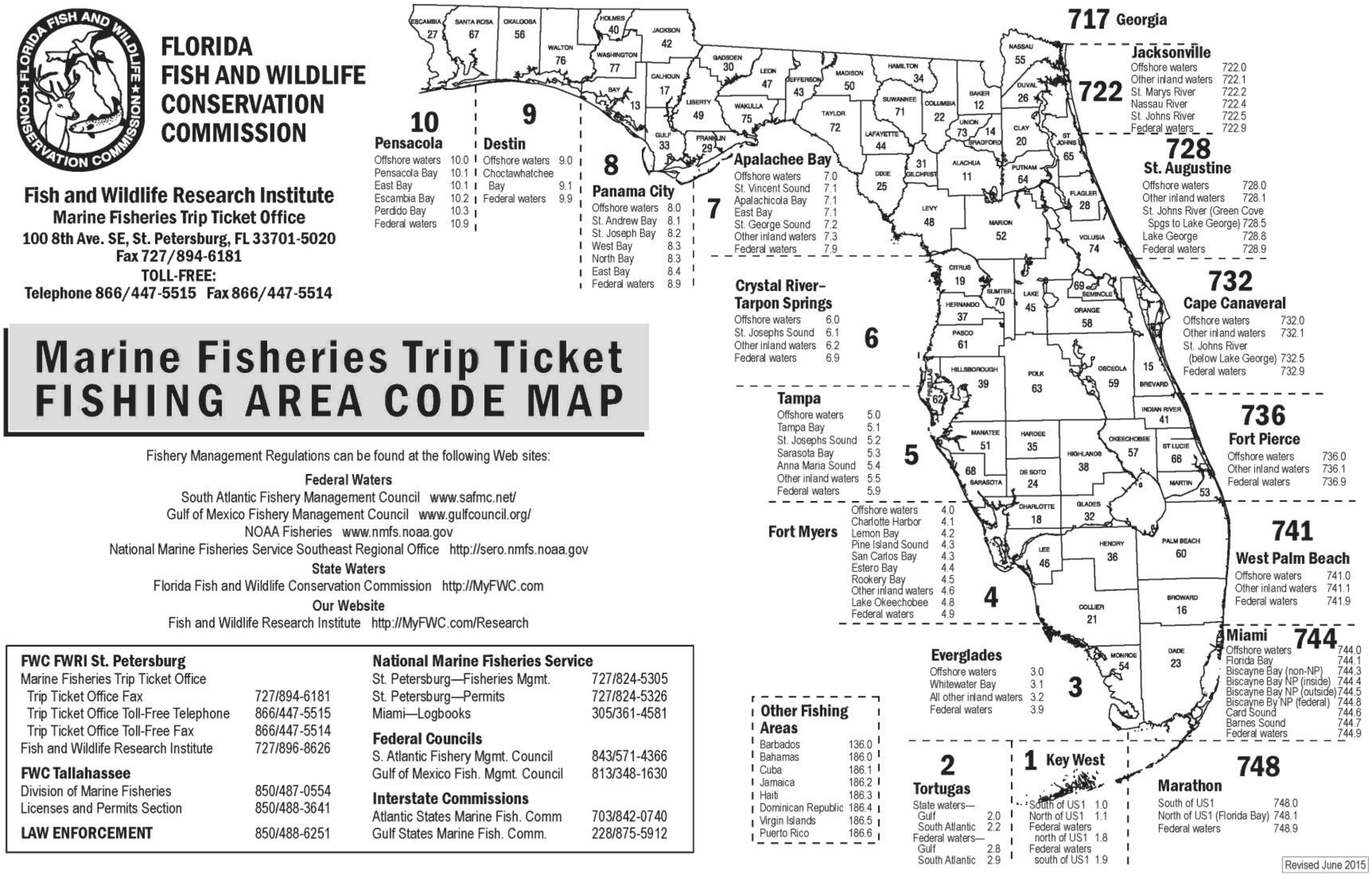
CODE	SIZE	GRADE	SPECIES NAME	LB/NUMBERS	UNIT $	$ VALUE	DISP
234			TRIGGERFISH				
103			AMBERJACK, GREATER				
219			MACKEREL, SPANISH				
165			MACKEREL, KING				
247			PORGY (OTHER), PINKS				
379			PORGY, RED				
			SNAPPER				
			SNAPPER				
			SNAPPER				
			GROUPER				
			GROUPER				
			GROUPER				
			GROUPER				
			MULLET				
			FLOUNDER				
			TOTAL				

SAMPLE

FWC #33-611

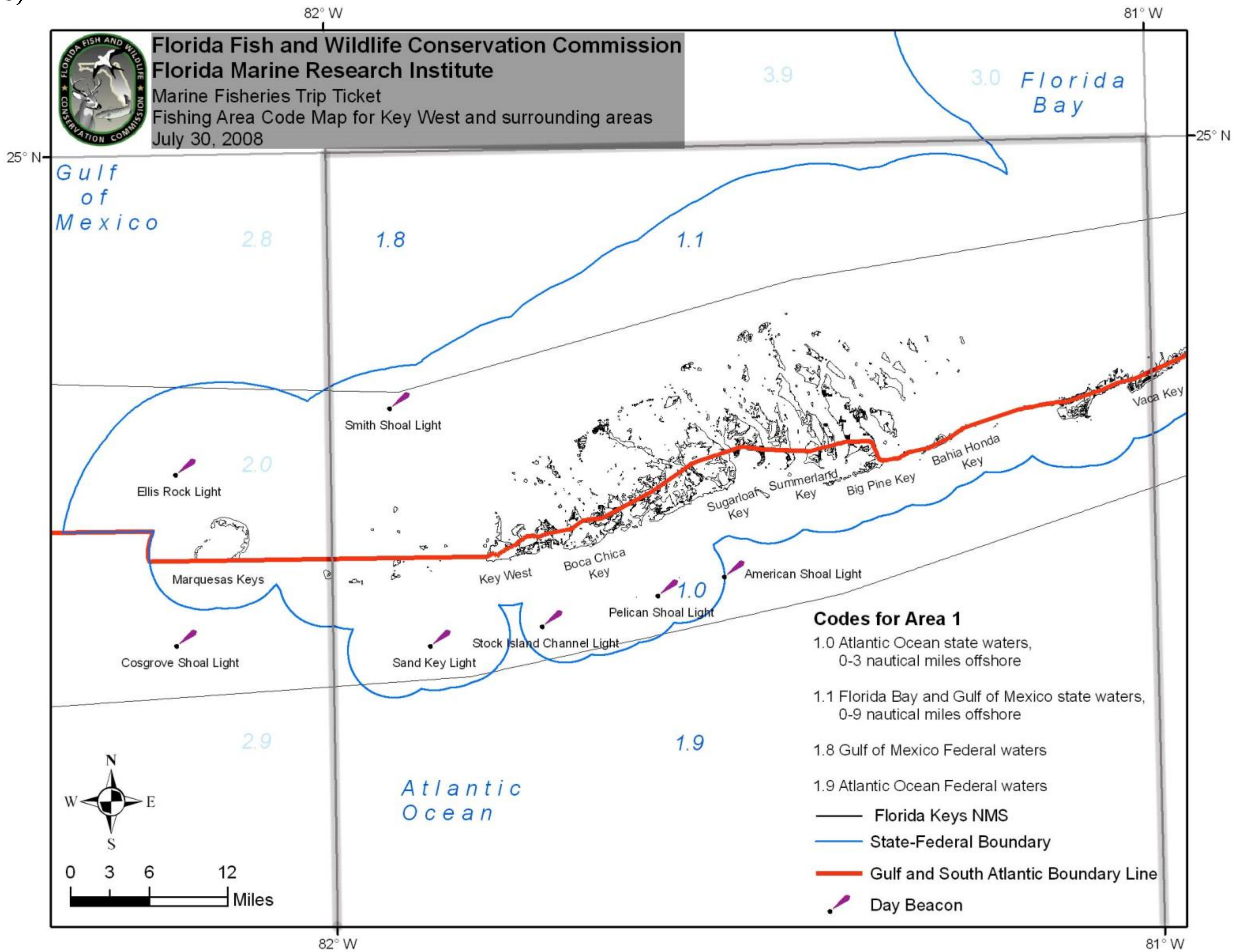
Figure 1. a) VESL web-based electronic reporting application, b) Florida Trip Ticket electronic reporting application, c) Florida trip ticket, form 'A3'; b) a "dealer-customized" Florida trip ticket form.

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
Atlantic Ocean
3.9
3.0
2.8
1.8
1.1
2.0
1.0
2.9
1.9
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
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
N
S
E
W
0 3 6 12
Miles

c)

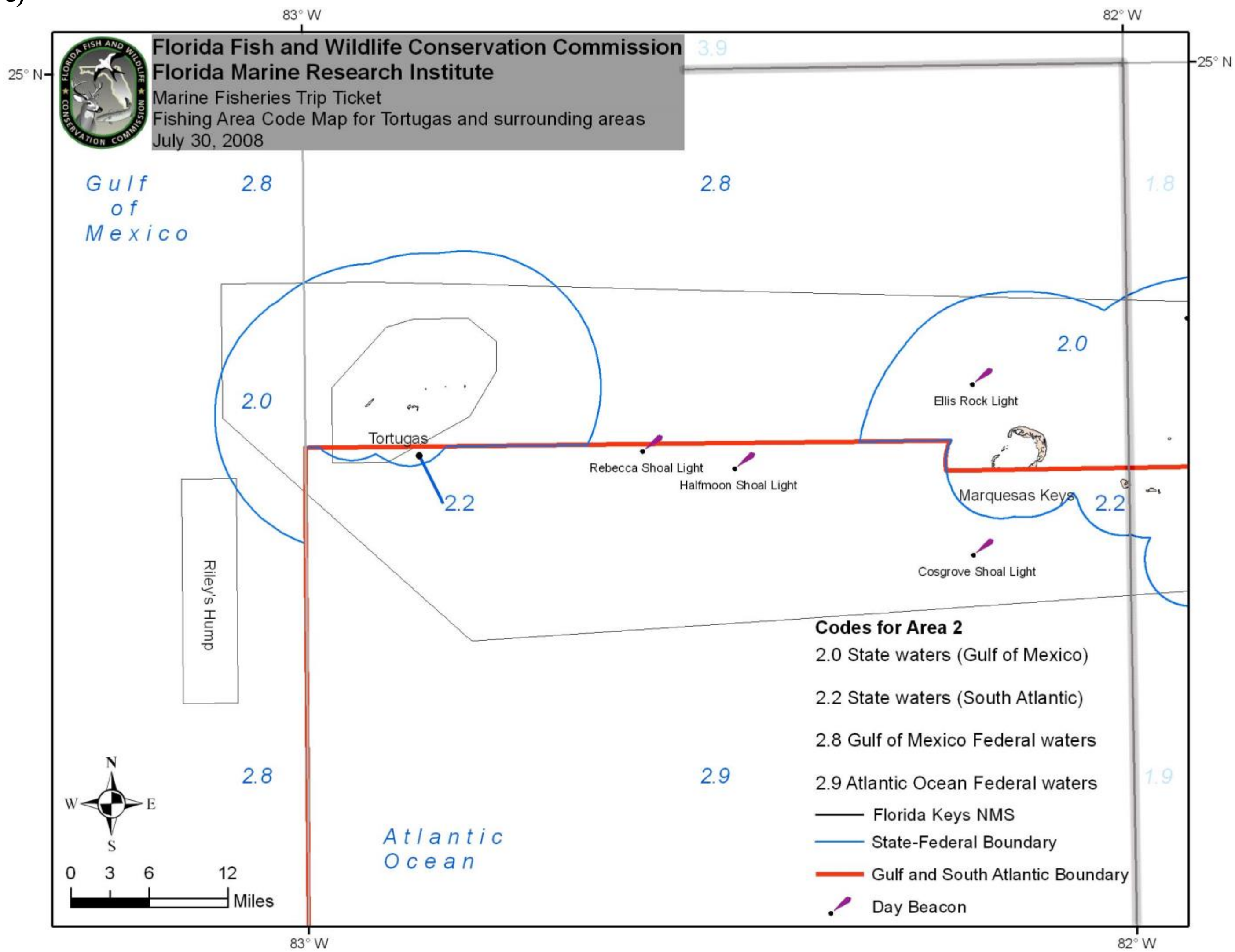


Figure 2. Area fished maps: a) statewide areas, b) Florida Keys areas, c) Tortugas areas. Red line in the Keys and Tortugas maps is the council boundary.

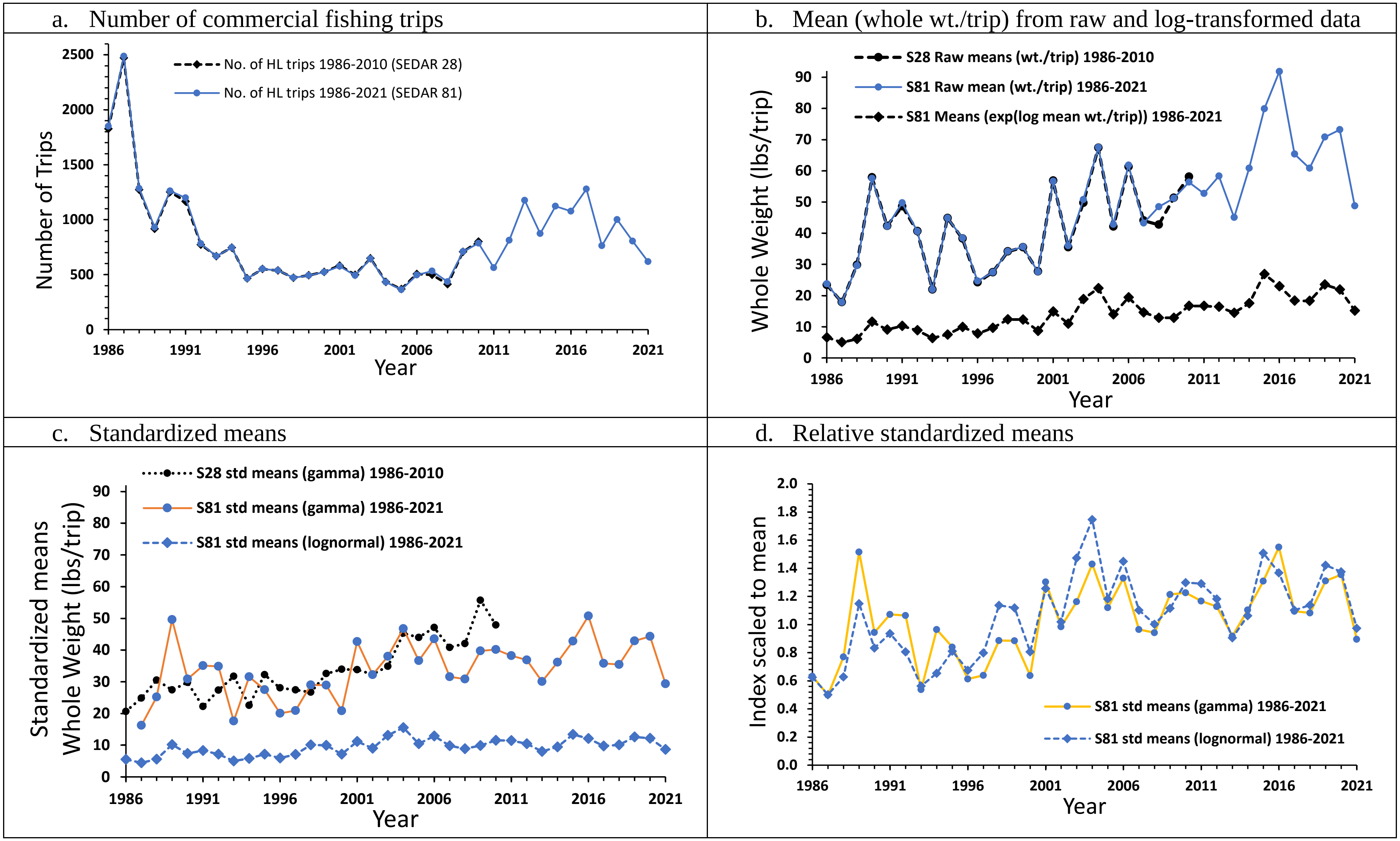
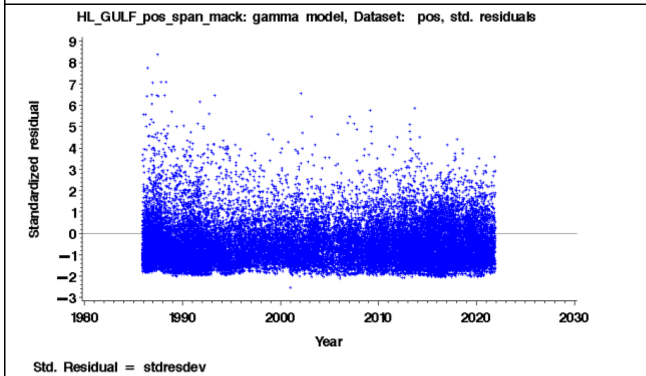


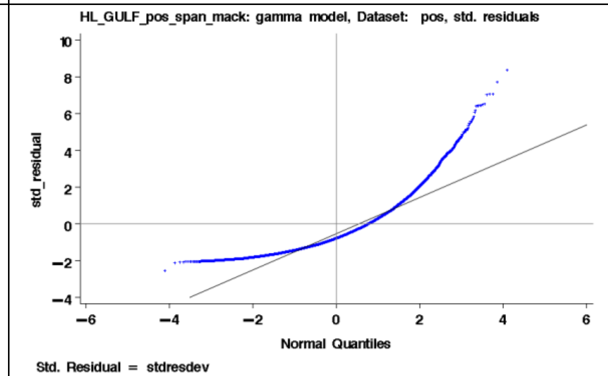
Figure 3. Hook-and-line gear trips with landings (whole wt. lbs/trip) of Florida Gulf Coast Spanish Mackerel, 1986-2021.

Figure 4a. Commercial landings (whole wt. lbs/trip) for hook-and-line gears 1986-2021. Diagnostics and scaled index for Florida Gulf Coast Spanish Mackerel using a gamma distribution.

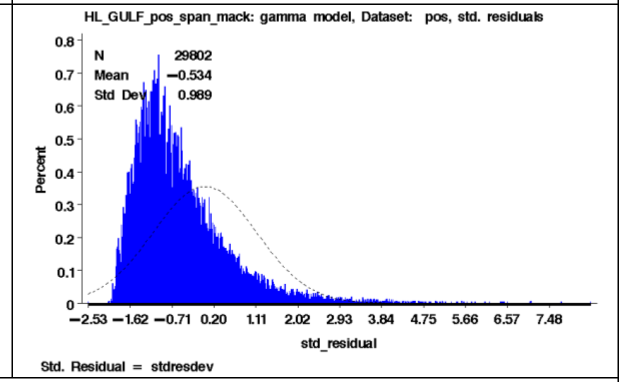
a.) Standardized residuals by year.



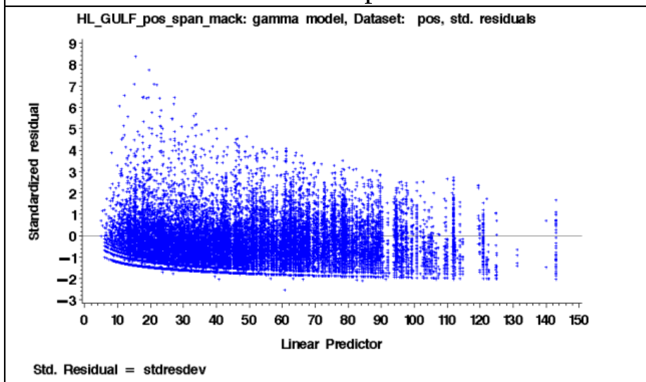
b.) Q-Q plot



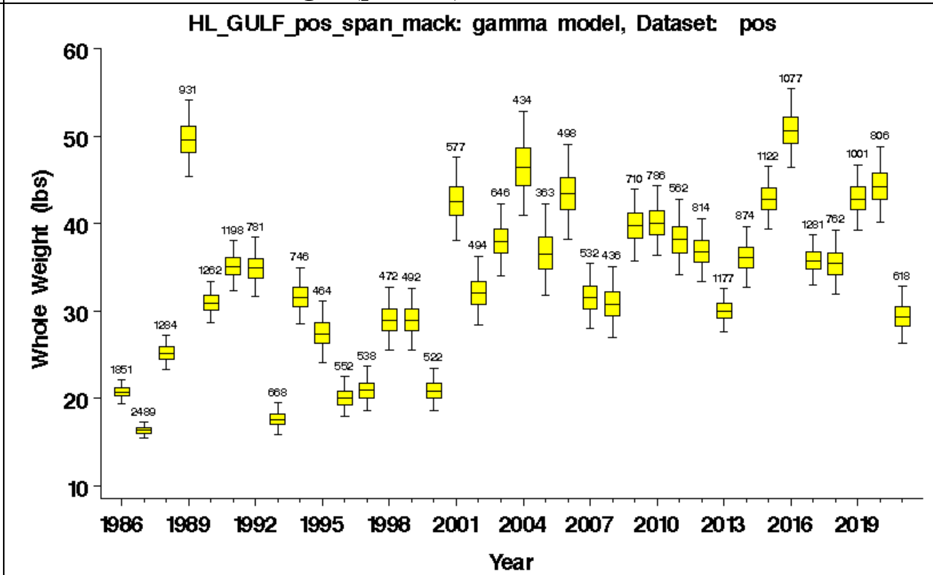
c.) Histogram of standardized residuals and fitted distribution.



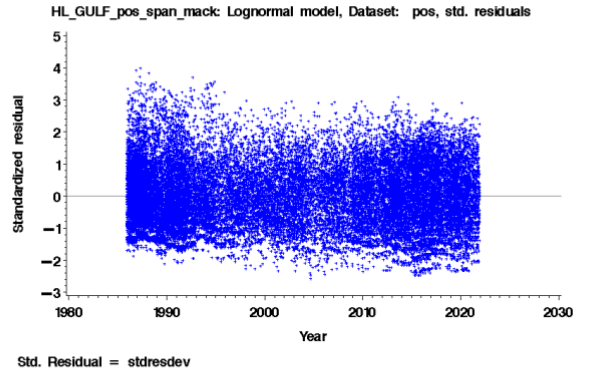
d. Std. residuals vs. linear predictor.



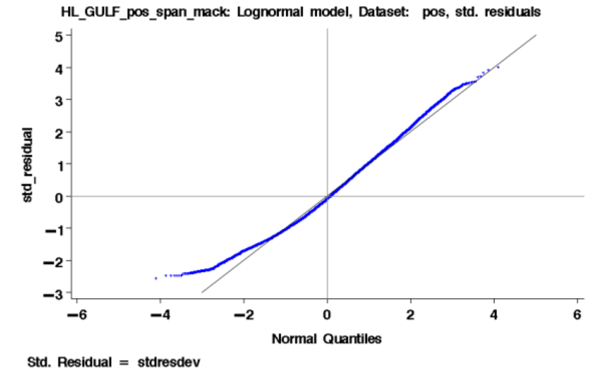
e. Index in whole weight (pounds).



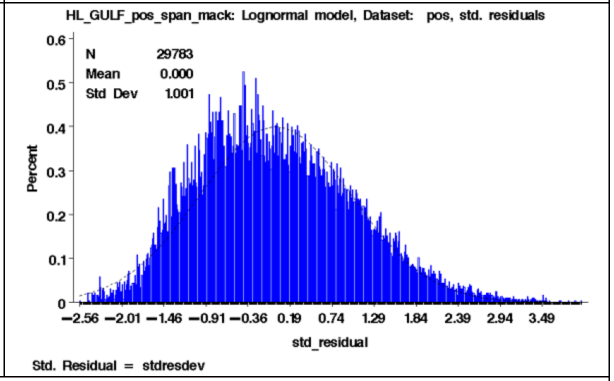
a.) Standardized residuals by year.



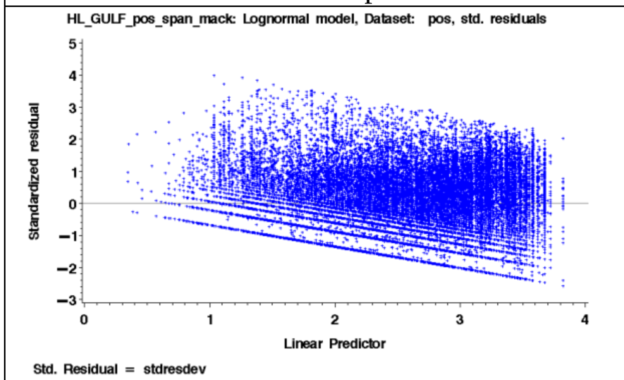
b.) Q-Q plot



c.) Histogram of standardized residuals and fitted distribution.



d. Std. residuals vs. linear predictor.



e. Index in whole weight (pounds).

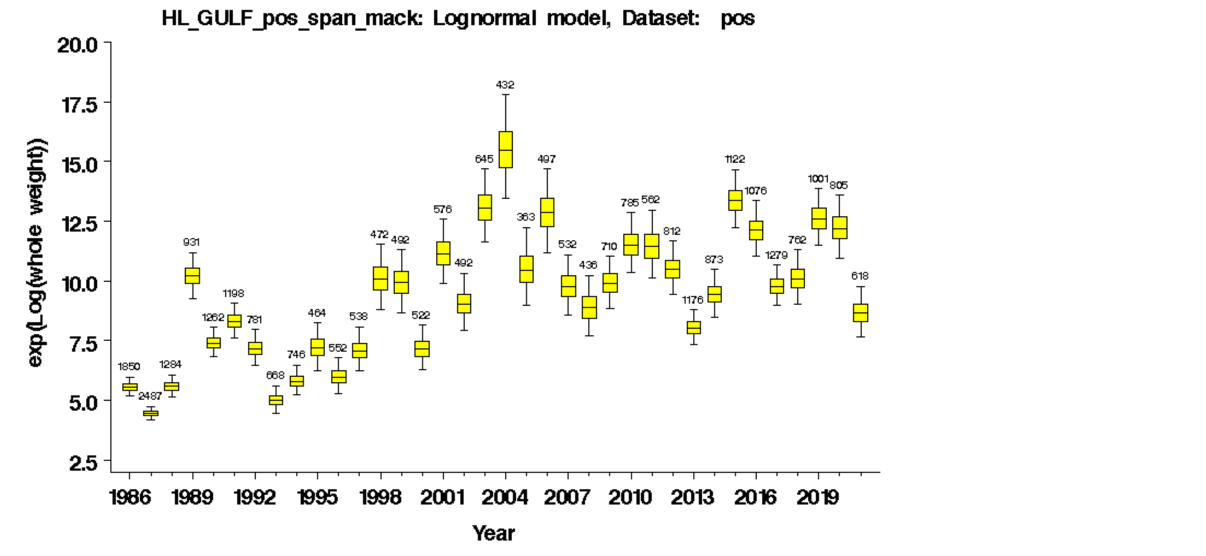


Figure 4b. Commercial landings (whole wt. lbs/trip) for hook-and-line gears 1986-2021. Diagnostics and scaled index for Florida Gulf Coast Spanish Mackerel using a lognormal distribution.

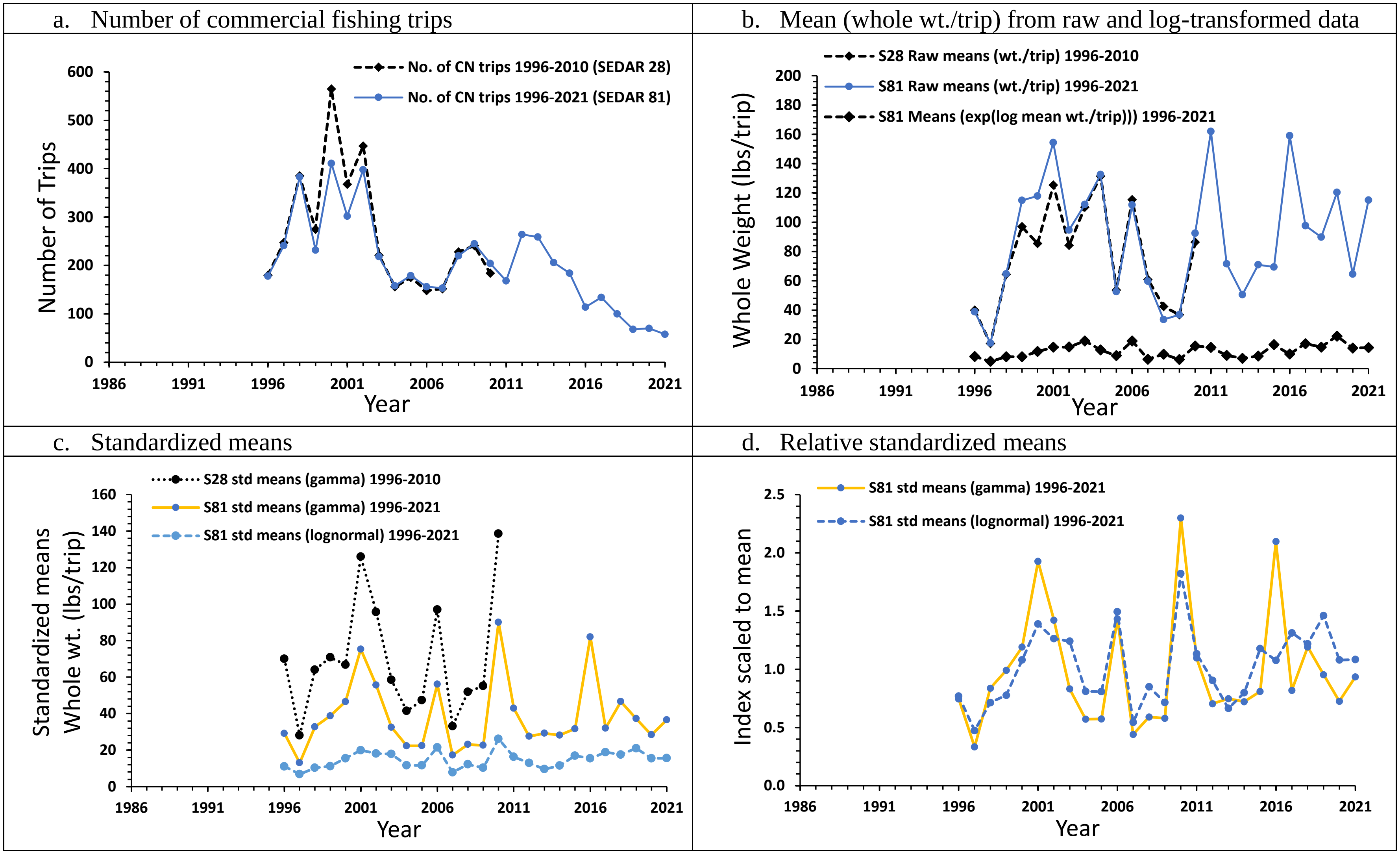
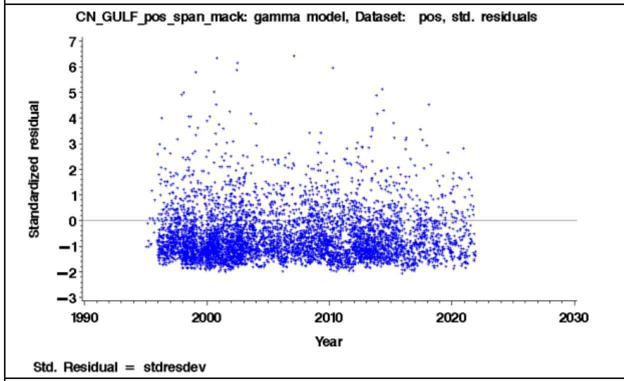
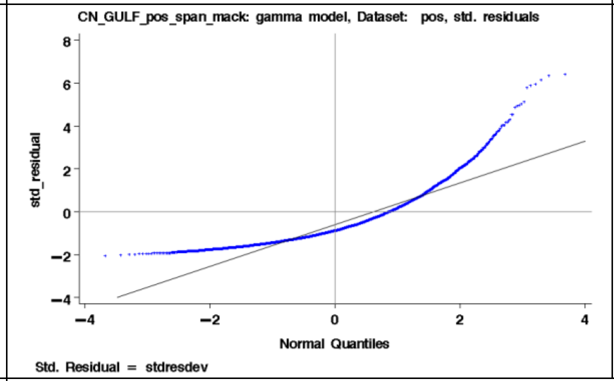


Figure 5. Cast net gear trips with landings (whole wt. lbs/trip) of Florida Gulf Coast Spanish Mackerel, 1986-2021.

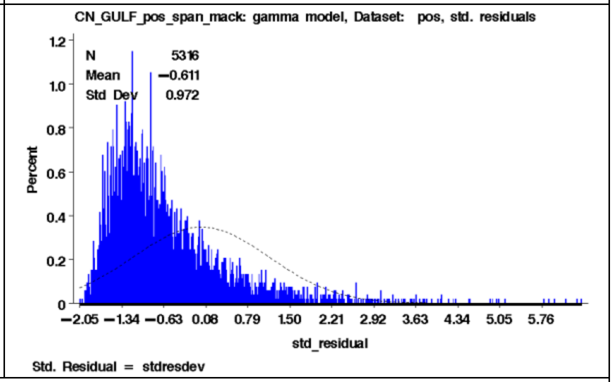
a.) Standardized residuals by year.



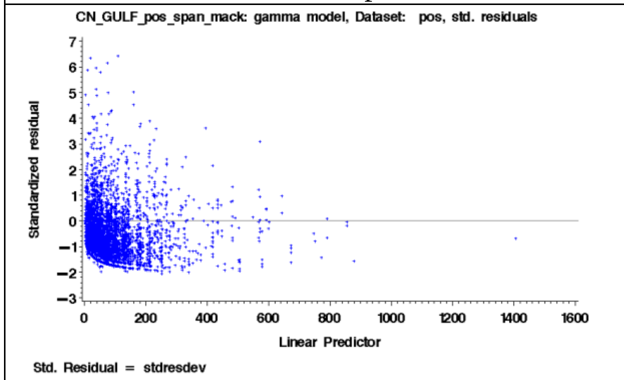
b.) Q-Q plot



c.) Histogram of standardized residuals and fitted distribution.



d. Std. residuals vs. linear predictor.



e. Index in whole weight (pounds).

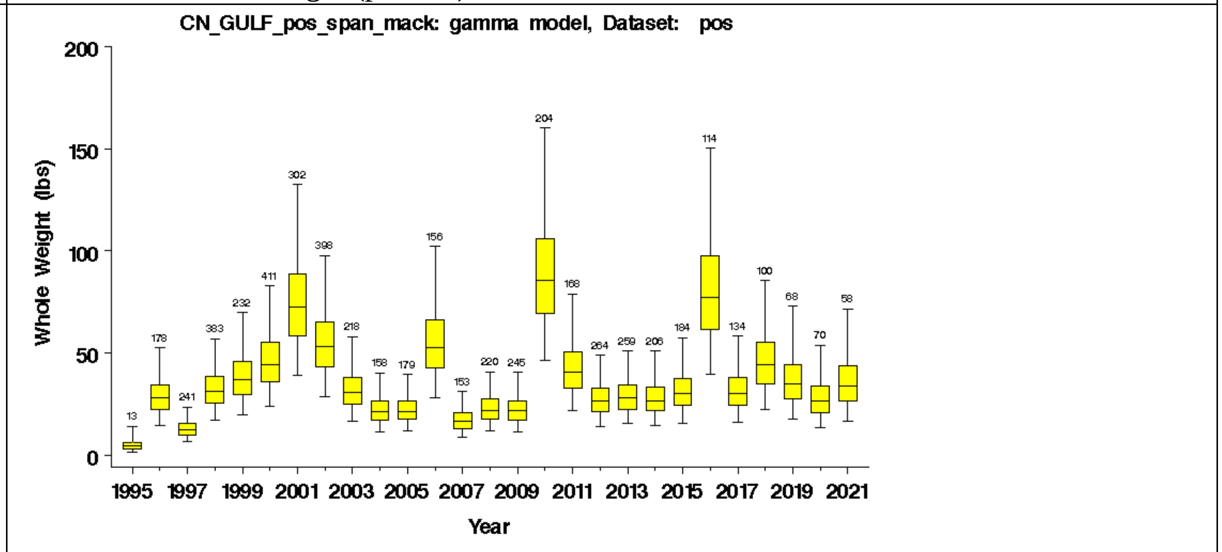
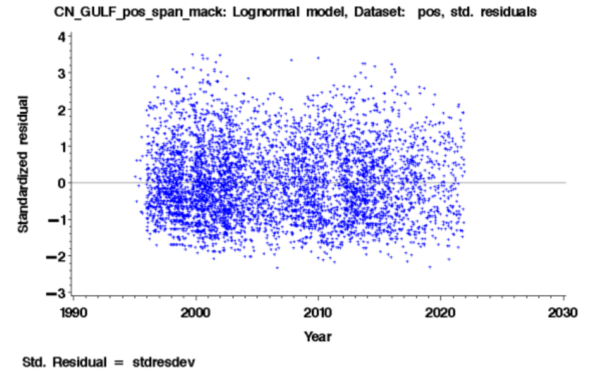
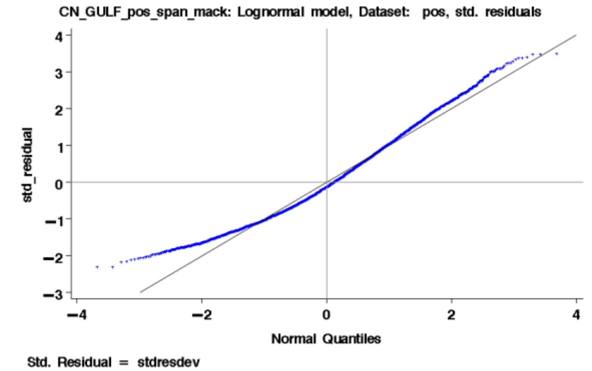


Figure 6a. Commercial landings (whole wt. lbs/trip) for cast net gears 1986-2021. Diagnostics and scaled index for Florida Gulf Coast Spanish Mackerel using a gamma distribution.

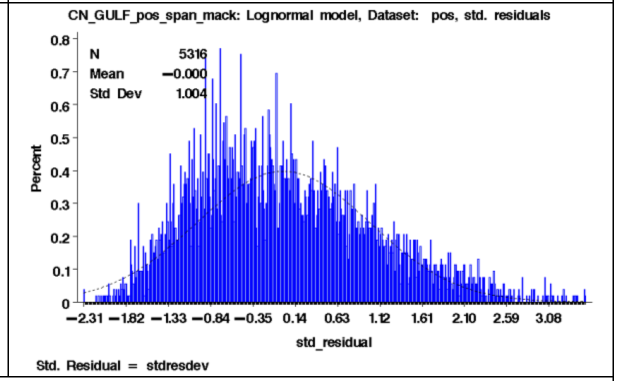
a.) Standardized residuals by year.



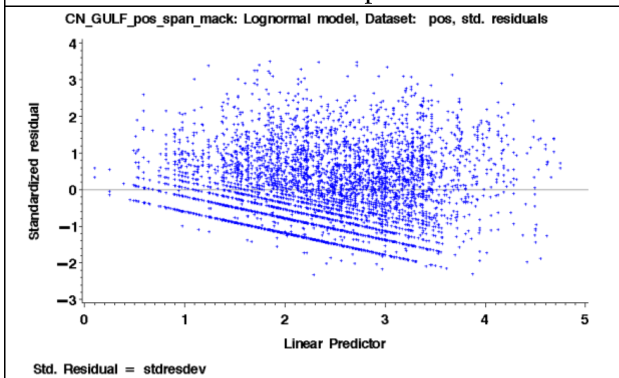
b.) Q-Q plot



c.) Histogram of standardized residuals and fitted distribution.



d. Std. residuals vs. linear predictor.



e. Index in whole weight (pounds).

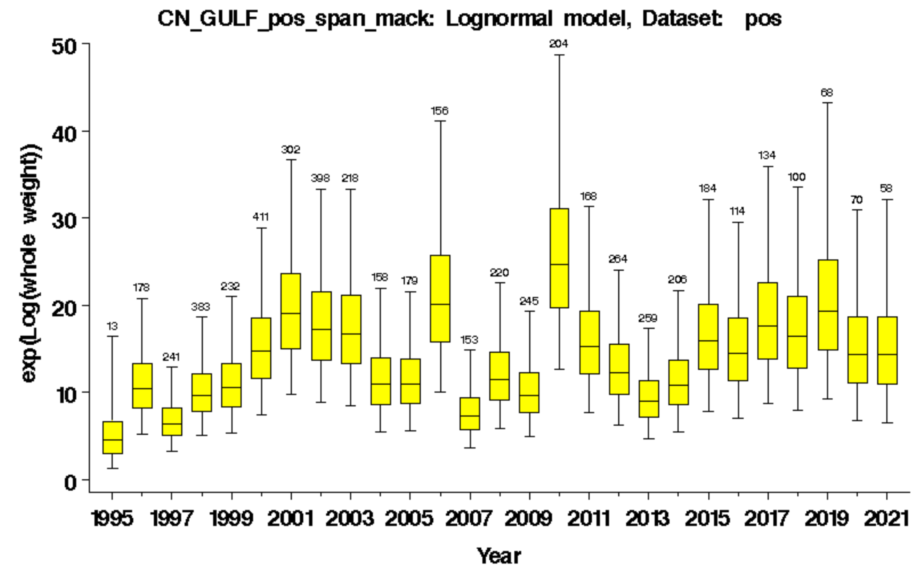


Figure 6b. Commercial landings (whole wt. lbs/trip) for cast net gears 1986-2021. Diagnostics and scaled index for Florida Gulf Coast Spanish Mackerel using a lognormal distribution.

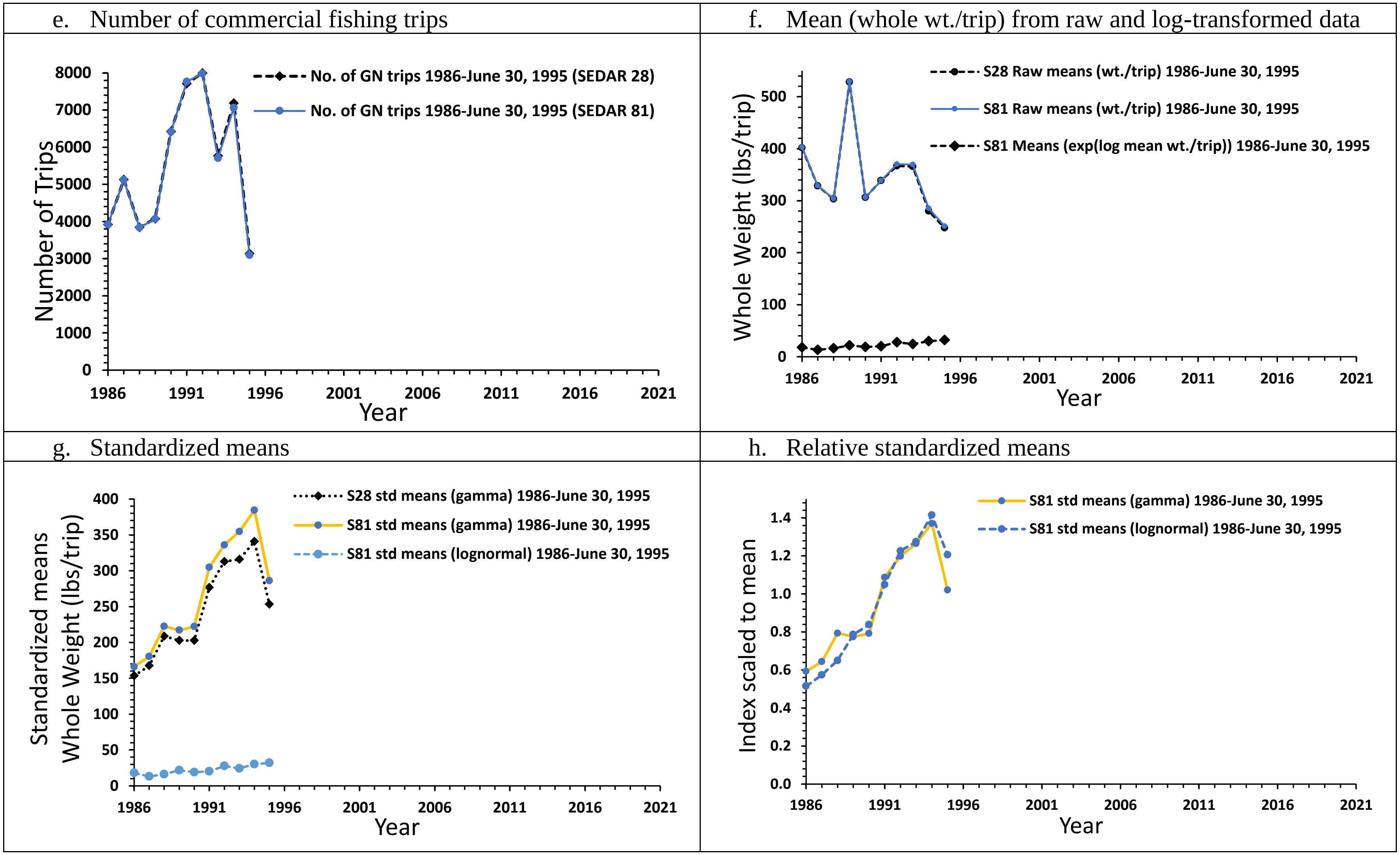
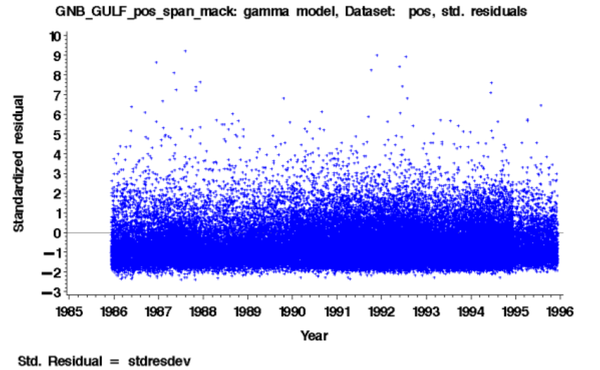
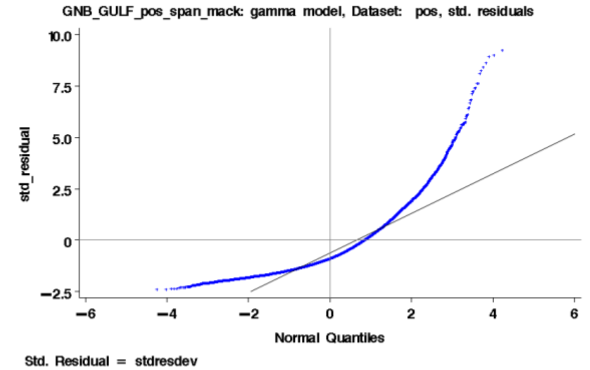


Figure 7. Gill net gear trips with landings (whole wt. lbs/trip) of Florida Gulf Coast Spanish Mackerel, 1986-June 30, 1995 (prior to implementation of Florida's State Constitution Amendment X limits on marine net fishing in state waters).

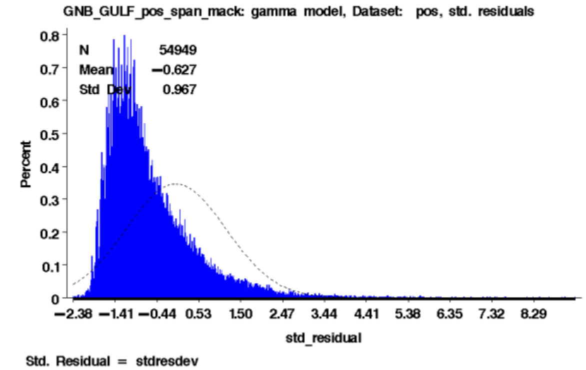
a.) Standardized residuals by year.



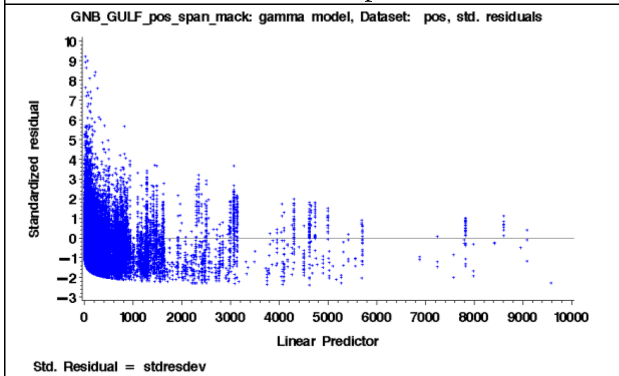
b.) Q-Q plot



c.) Histogram of standardized residuals and fitted distribution.



d. Std. residuals vs. linear predictor.



e. Index in whole weight (pounds).

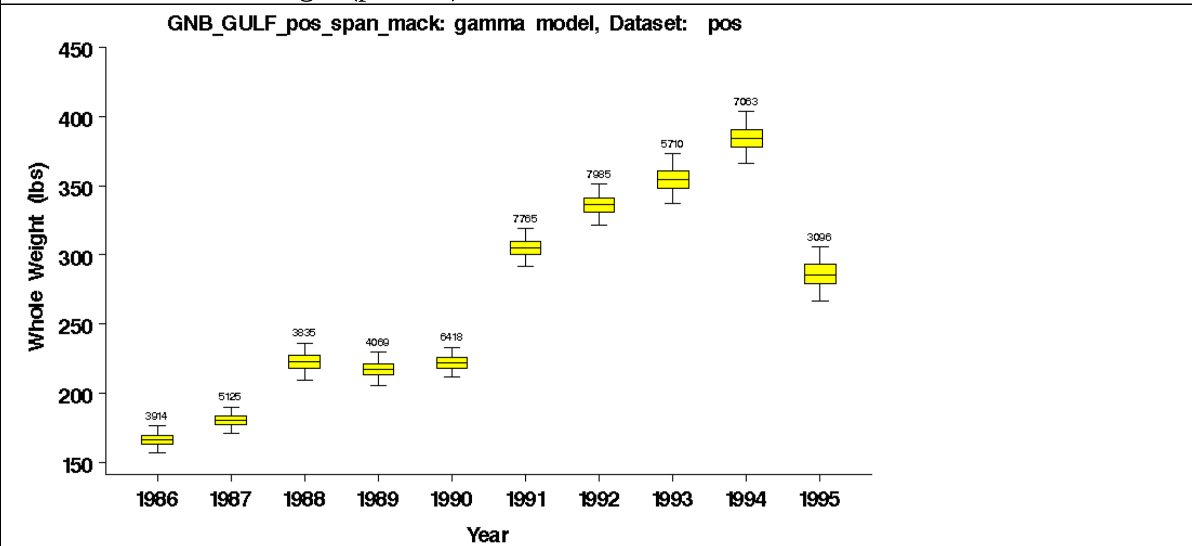
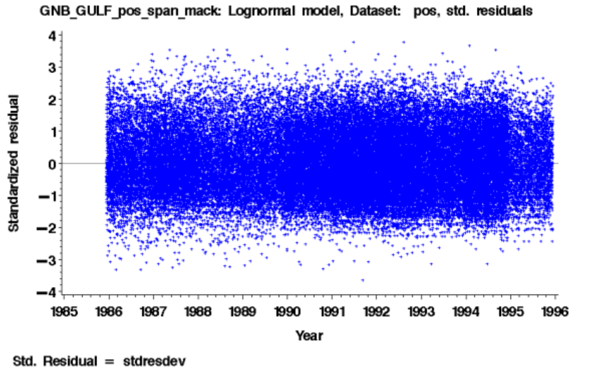
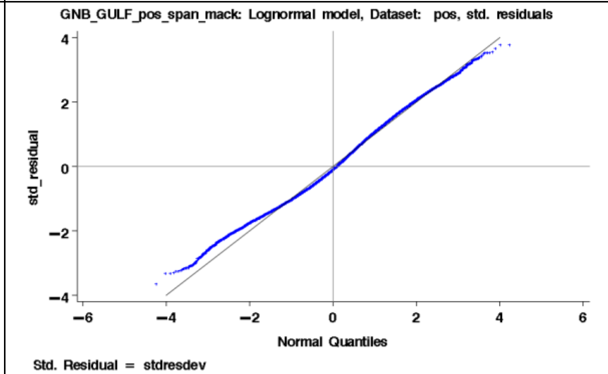


Figure 8a. Commercial landings (whole wt. lbs/trip) for gill net gears 1986-June 30, 1995. Diagnostics and scaled index for Florida Gulf Coast Spanish Mackerel using a gamma distribution.

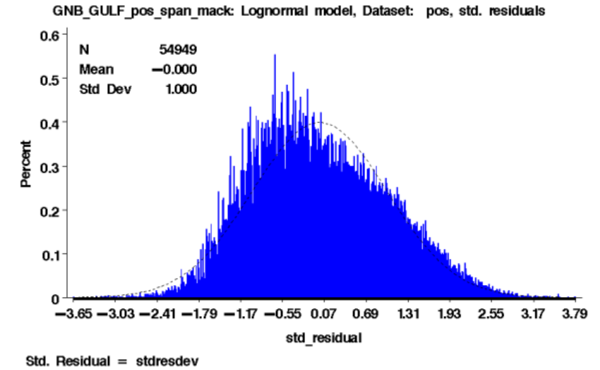
a.) Standardized residuals by year.



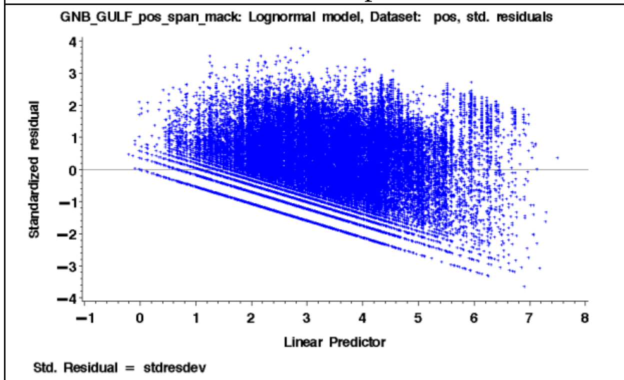
b.) Q-Q plot



c.) Histogram of standardized residuals and fitted distribution.



d. Std. residuals vs. linear predictor.



e. Index in whole weight (pounds).

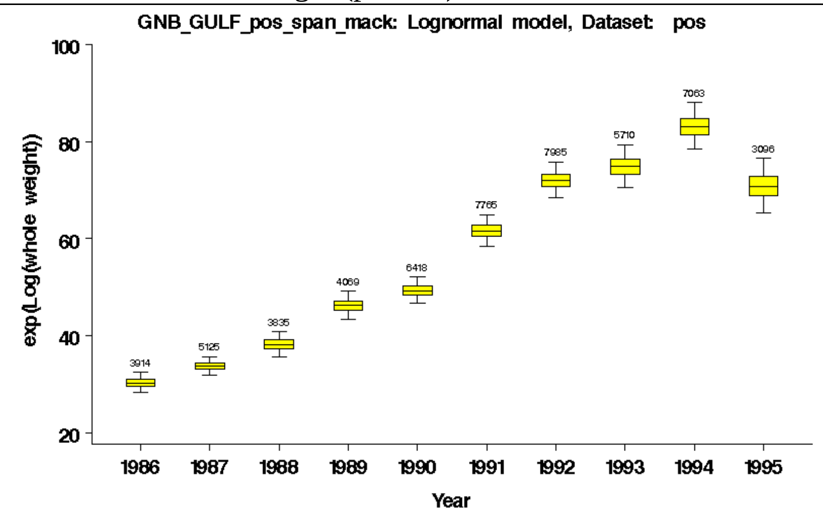


Figure 8b. Commercial landings (whole wt. lbs/trip) for gill net gears 1986-June 30, 1995. Diagnostics and scaled index for Florida Gulf Coast Spanish Mackerel using a lognormal distribution.

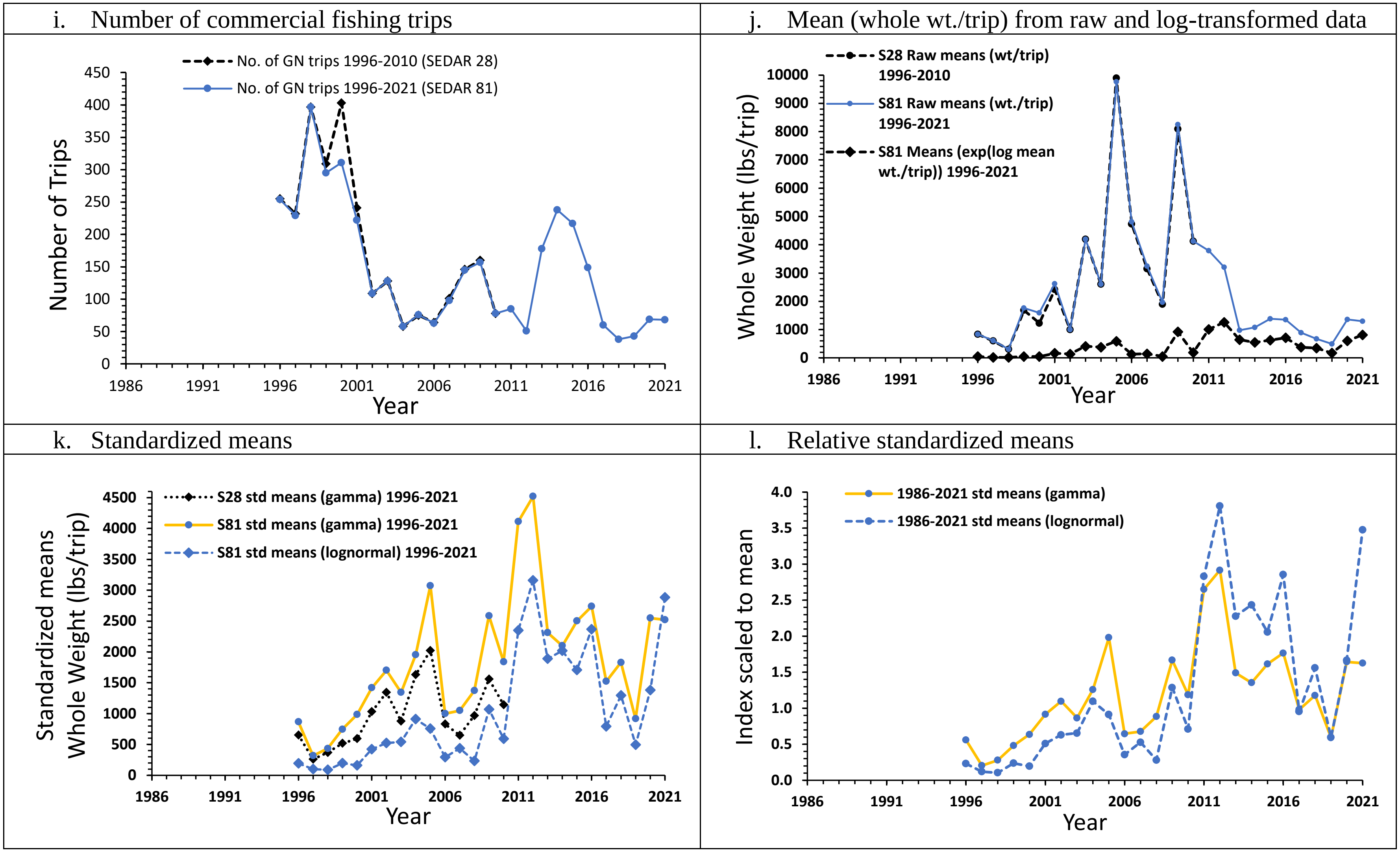
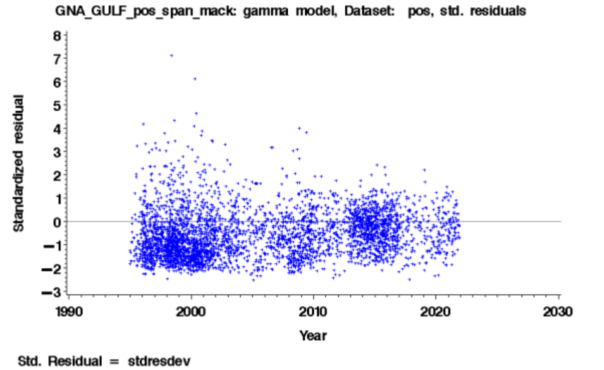
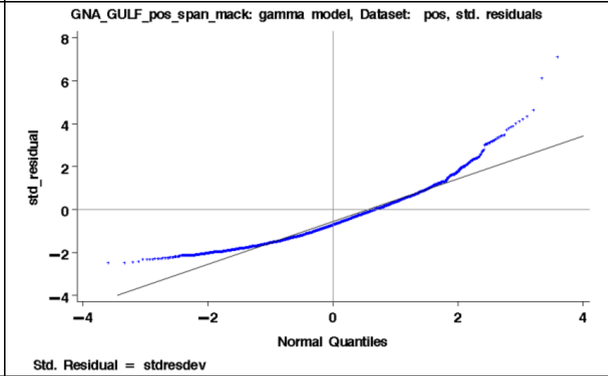


Figure 9. Gill net gear trips with landings (whole wt. lbs/trip) of Florida Gulf Coast Spanish Mackerel, 1996-2021 (after implementation of Florida's State Constitution Amendment X limits on marine net fishing in state waters).

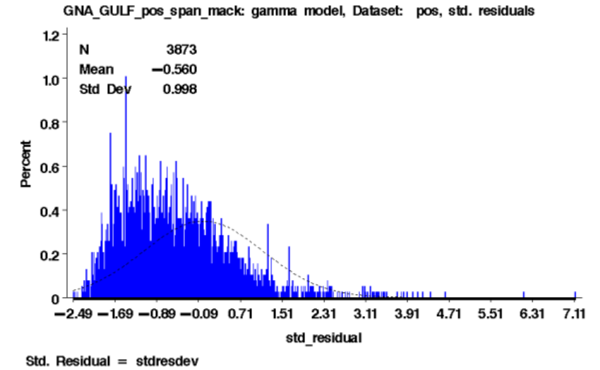
a.) Standardized residuals by year.



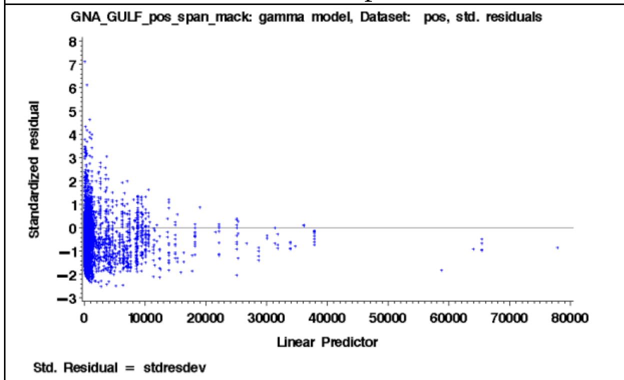
b.) Q-Q plot



c.) Histogram of standardized residuals and fitted distribution.



d. Std. residuals vs. linear predictor.



e. Index in whole weight (pounds/trip).

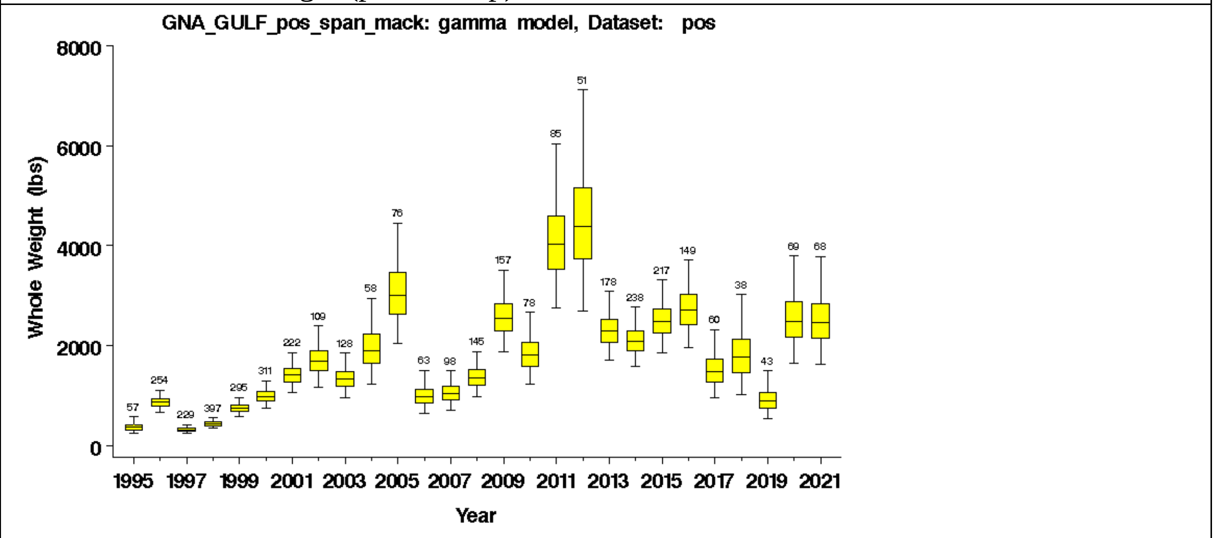
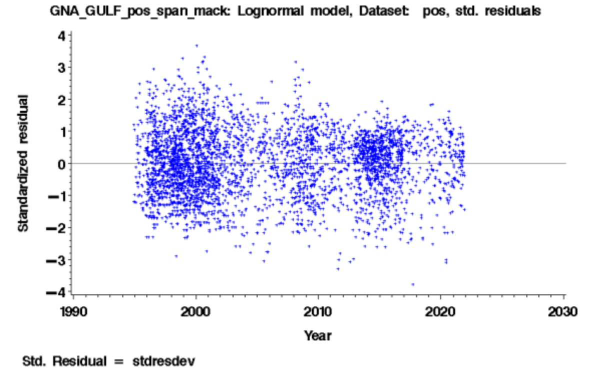
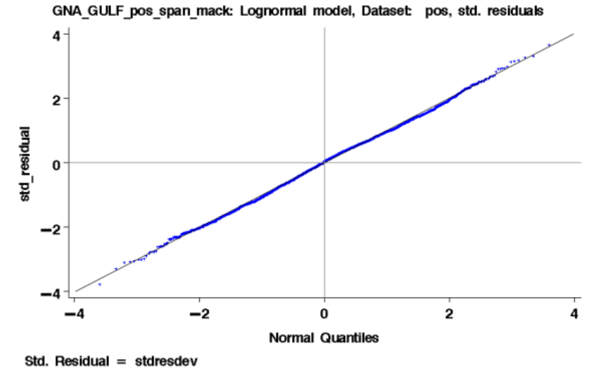


Figure 10a. Commercial landings (whole wt. lbs/trip) for gill net gears 1996-2021. Diagnostics and scaled index for Florida Gulf Coast Spanish Mackerel using a gamma distribution.

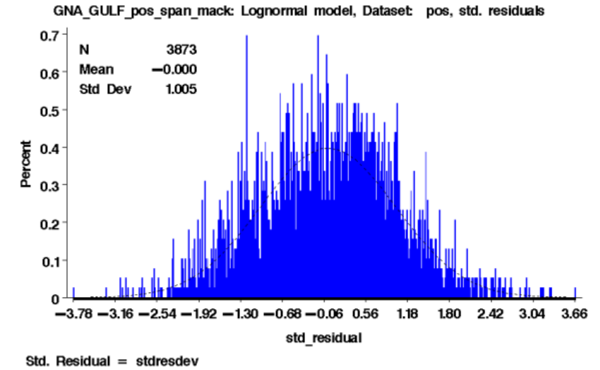
a.) Standardized residuals by year.



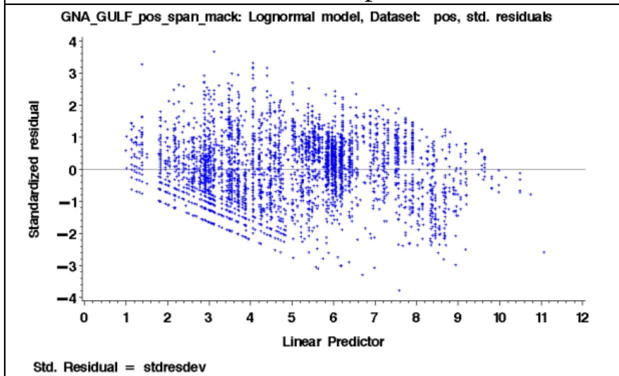
b.) Q-Q plot



c.) Histogram of standardized residuals and fitted distribution.



d. Std. residuals vs. linear predictor.



e. Index in whole weight (pounds/trip).

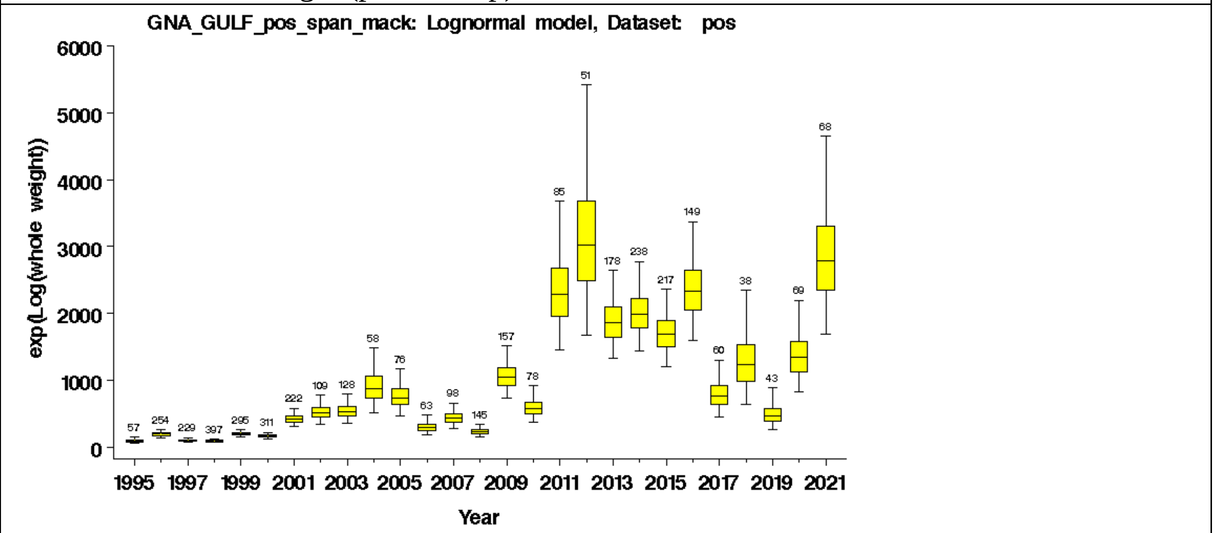


Figure 10b. Commercial landings (whole wt. lbs/trip) for gill net gears 1996-2021. Diagnostics and scaled index for Florida Gulf Coast Spanish Mackerel using a lognormal distribution.