Texas Parks and Wildlife Catch Per unit of Effort Abundance Information for cobia

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SEDAR28-DW10

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Introduction

Information on catch per unit of effort for recreational sport-boat fisheries in Texas was summarized. These data were evaluated for the use of calculating catch per unit of effort (CPUE) abundance trends for cobia (*Rachycentrum cendrum*) in the Gulf of Mexico for use in SEDAR 28 stock evaluations.

Data Sources

Observations of recreational catch and effort were available for sport-boat fisheries in Texas since 1983. The Texas Parks and Wildlife Departments Sport-boat Angling Survey samples fishing trips made by sport-boat anglers fishing in Texas marine waters; these include private and charterboat fisheries. All sampling takes place at recreational boat access sites. The primary focus of the TPWD survey is on private boats fishing in bays and passes because this accounts for most of the coastwide fishing pressure and landings in TX (78% of fishing effort and 67% of landings during May15, 2002 to May 14, 2003). Private boats in gulf waters (7% of effort), charterboats in bays and passes (14% of effort), and charterboats in gulf waters (<2% of effort) are also included in the TPWD survey, but special surveys are added to increase the precision of trips fishing in gulf areas since they are not encountered frequently in the normal survey. In addition, the survey is designed to estimate landings and effort by high-use seasons (May15-November 20) and low-use seasons (November 21-May 14). More details regarding the TPWD sport-boat fishing surveys are provided in Appendices I and II.

For all analyses CPUE was calculated as catch (number fish caught) divided by effort (number anglers x triplength).

Analysis Approach

Data Sub setting

First the Stephens and MaCall (2004) method was explored in an attempt to identify directed Cobia trips in the complete TPWD recreational data CPUE data set. This method uses the species composition information on a trip to subset the complete data or to help identify trips or set to only those trips on which the species of interest (the target species, Spanish mackerel in this case) would occur. The analysis involves fitting a logistic regression to the presence-absence of each trip's species catch. Routinely, the species composition included in the regression includes only those species occurring in at least 1% of all the trips combined. The analysis results include a critical probability value that predicts the target species presence and/or absence in the study data set which is used to select trips on an objective basis. In the Stephens and MaCall analysis of the TPWD data 329,616 unique trips were evaluated for Spanish mackerel targeting preference. The species that occurred in at least 1% of all the trips were TPWD species codes: 614, 629, 616, 625, 613, 602, 621, 772, 758, 818, 611, and 681. Cobia did not occur on at least 1% of all the trips but was included in the list. These species were then included in the logistic regression with cobia included as the target species.

The results of the Stephens MaCall analyses of the TPWD recreational CPUE data were not successful in identifying a suite of trips targeting Spanish mackerel. We found that on the majority of the 329, 616 fishing trips only one or two species were caught making it difficult to identify a group of species that

might associate with the target species (Cobia). In total, across all the time series, 1983-2010, Cobia occurred on only 0.24% (n=804) of all trips. Thus, we considered two datasets for the CPUE standardization analyses. The first set of observations included all the data, as in the previous MSAP 2003 analyses of TPWD CPUE for Cobia. The second data set that was evaluated for CPUE was formed by excluding inshore fishing trips from the CPUE standardizations. We found that the majority of the recreational fishing effort for Cobia did not occur inshore but rather in waters <10 miles (TTS, NEWAREA 3) or in waters >10 miles (EEZ, NEWAREA area 4) thus inshore effort in the bays and passes (NEWAREA 5) was excluded from subsequent analyses. The total number of trips in these two areas was 25, 337 of which Cobia occurred in 798 or 3.2% across all years.

For each analysis data set (Set 1: all observations (n=329, 616 trips) and Set 2: areas 3 and 4 only (n=25,337 trips) we then attempted to construct standardized CPUE indices were explored using the delta-lognormal modeling approach (Lo et al. 1992). This method applies two separate models, fitting a lognormal model to the positive CPUE observations and a separate binomial (logistic) model to the proportion of successful (positive) observations and combines results from the two models to obtain a single index. Parameter estimates were obtained using a general linear modeling (GLM) procedure (SAS GLIMMIX and MIXED procedures; SAS v.9.2 2004 of the SAS System, SAS Institute Inc.; Cary, NC, USA) to develop the binomial and lognormal sub models. Factor (covariate) significance was evaluated using Type 3 residual analysis and overall performance was assessed from residual analysis graphics. Residuals by year were plotted and reviewed and QQ plots of the residuals against a normal distribution were plotted. In applying the GLM procedure we assumed the proportion of successful trips per stratum approximated a binomial distribution, where the estimated probability was a linearized function of the fixed factors. We used a second generalized linear model to examine the influence the fixed factors on log(CPUE) of successful trips assuming a normal error distribution for the positive catch rates. As defined earlier, catch rate was calculated as number fish caught divided by (number anglers x triplength).

Model Construction

A forward stepwise procedure was used to quantify the relative importance of the factors that influenced catch rates. Factors evaluated were: YEAR, MONTH, NEWAREA (3 = <10 miles (TTS), 4 = >10 miles (EEZ), 5 = inshore (bays and passes), major bay (1 = Sabine Lake, 2 = Galveston, 3 = Matagorda, 4 = San Antonio, 5 = Aransas, 6 = Corpus Christi, 7 = Upper Laguna Madre, 8 = lower Laguna Madre), mode (3 = charterboat, 4 = private boat). First the null model was run. These results reflect the distribution of the nominal data. Next we added each potential factor to the null model one at a time, and examined the resulting reduction in deviance per degree of freedom. The factor that caused the greatest reduction in deviance per degree of freedom was added to the base model if the factor was significant ($p<0.05$) based upon a Chi-Square test, and the reduction in deviance per degree of freedom was >1%. This model then became the base model, and the process was repeated, adding factors and interactions individually until no factor or interaction met the criteria for incorporation into the final model. Year was always included in the model, regardless of its importance because it is required to calculate the standardized catch index for each year. After the models were identified, they were fit to the proper response variables using the SAS macro GLIMMIX (c/o Russ Wolfinger, SAS Institute Inc.). All factors and interactions were treated as fixed effects except year*factor interactions, which were treated as random effects. Interaction effects at the first level were considered for all the fixed factors. The final models identified by GENMOD, and used in the GLMMIX procedure were as follows:

All areas:

Lognormal: YEAR NEWAREA

Binomial: YEAR NEWAREA MONTH MAJOR

Areas 3 and 4
Lognormal: YEAR NEWAREA
Binomial: YEAR NEWAREA MONTH

Results
As summarized above, cobia were mainly captured on fishing trips that took place in waters <10 miles (TTS, NEWAREA 3) or in waters >10 miles (EEZ, NEWAREA=4). Over the time series, 1983-2010, Cobia was recorded on 798 trips of the total 25,337 trips in areas 3 and 4 or 3.1% across all trips. Only the standardization results for this analysis set are presented here as we feel this effort was more representative of fishing trips that could have targeted Cobia. In addition, convergence was not achieved for the binomial model fit to all the trips.

Figures 1-8 present results of the CPUE standardization for the standardization analysis. The lognormal CPUE model converged without problems however convergence for the GLIMMIX fit to the proportion of positives was not successful. Figures 1 and 2 present residual distribution of the lognormal CPUE observations and QQ plots fit to the lognormal CPUE observations. Figure 3 presents the proportion of positives by year plot. Figures 4 and 5 present the observed vs. predicted lognormal CPUE by year and the nominal CPUE. Figures 6 and 7 present plots of the distribution of the proportion of positives and by year and the frequency distribution of lognormal CPUE. Figure 8 presents the distribution of residuals for the lognormal CPUE.

Throughout the time period, 183-2010, the proportion of trips on which Cobia was recorded caught was variable and low, ranging from 0.01 – 0.07 over the entire time series. This alone suggests that of the total fishing pressure expended in waters <10 miles (TTS, NEWAREA 3) or in waters >10 miles (EEZ, NEWAREA=4) that few probably were targeting the study species, Cobia. There was some hint of two periods of targeting behavior over the time series, first a very low period averaging about 0.02 and then an increase in the mid to late 1990s increasing to 0.07, followed by another low period that continues to the present. Nominal Cobia CPUE suggested an early low level, with some hint of an increasing CPUE around the mid 1990's followed by a decline. The standardized trend for Cobia lognormal CPUE was relatively flat over the time series.

Due to apparent low targeting preference for Cobia by recreational anglers surveyed by the TPWD, the utility of this dataset for use in CPUE standardizations is in question. Of the 329,616 trips surveyed, most Cobia catches were recorded taken in waters <10 miles (TTS, NEWAREA 3) or in waters >10 miles (EEZ, NEWAREA=4) and of these trips (n=798), 75% were caught in waters >10 miles off shore. The primary areas surveyed by this survey were bays and passes (NEWAREA 5) therefore one should proceed with caution when using the TPWD data series to track abundance of Cobia from private and charterboat anglers.

References

Ortiz, M. 2003. Standardized catch rates of king and Spanish mackerel from the US Gulf of Mexico and South Atlantic Recreational Fisheries. SFD-02/02-006-(1).

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

Table 1. Nominal CPUE, lognormal fit, sample sizes, proportion of positives by year from NEWAREA 3 (<10 miles (TTS) and NEWAREA 4 >10 miles (EEZ).

YEAR	Proportion of Positves	N	Nominal CPUE
1983	0.024	663	0.745
1984	0.012	1053	0.417
1985	0.017	1138	0.479
1986	0.015	726	0.814
1987	0.021	729	0.605
1988	0.009	660	0.250
1989	0.019	529	0.614
1990	0.011	727	0.363
1991	0.025	691	0.729
1992	0.024	823	0.881
1993	0.019	697	0.613
1994	0.029	902	0.847
1995	0.031	1166	0.902
1996	0.070	1025	2.394
1997	0.044	1247	1.304
1998	0.045	1056	1.264
1999	0.024	1233	0.679
2000	0.028	975	0.870
2001	0.034	904	1.005
2002	0.023	877	0.737
2003	0.049	987	1.522
2004	0.035	950	1.442
2005	0.027	952	1.089
2006	0.034	1314	1.130
2007	0.042	935	1.360
2008	0.058	812	1.871
2009	0.046	932	1.759
2010	0.038	634	1.313

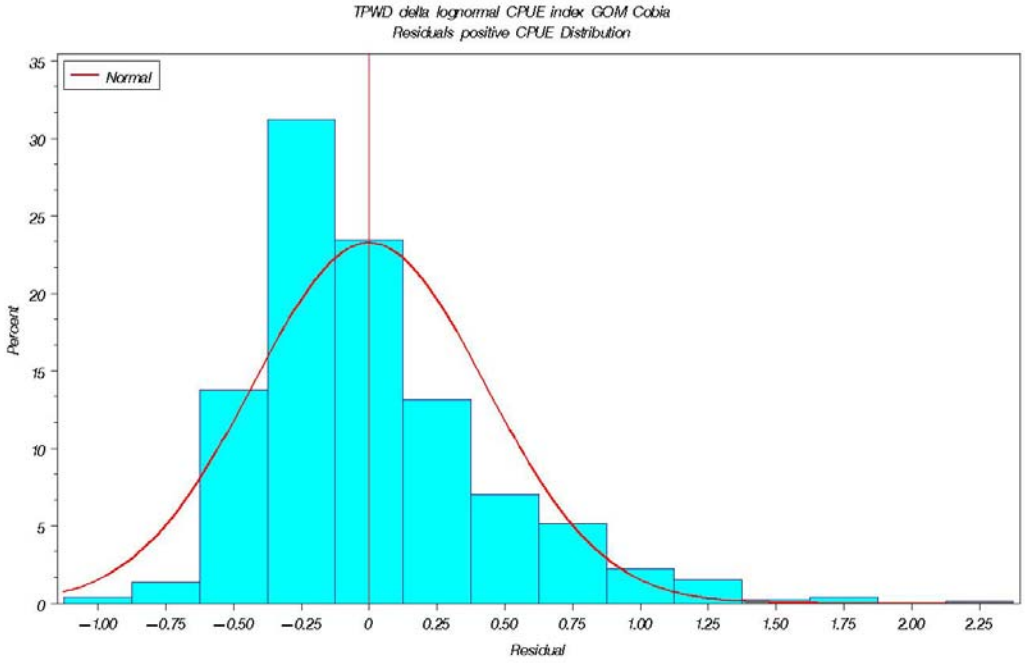

Figure 1. Distribution of residuals for lognormal CPUE positives model.

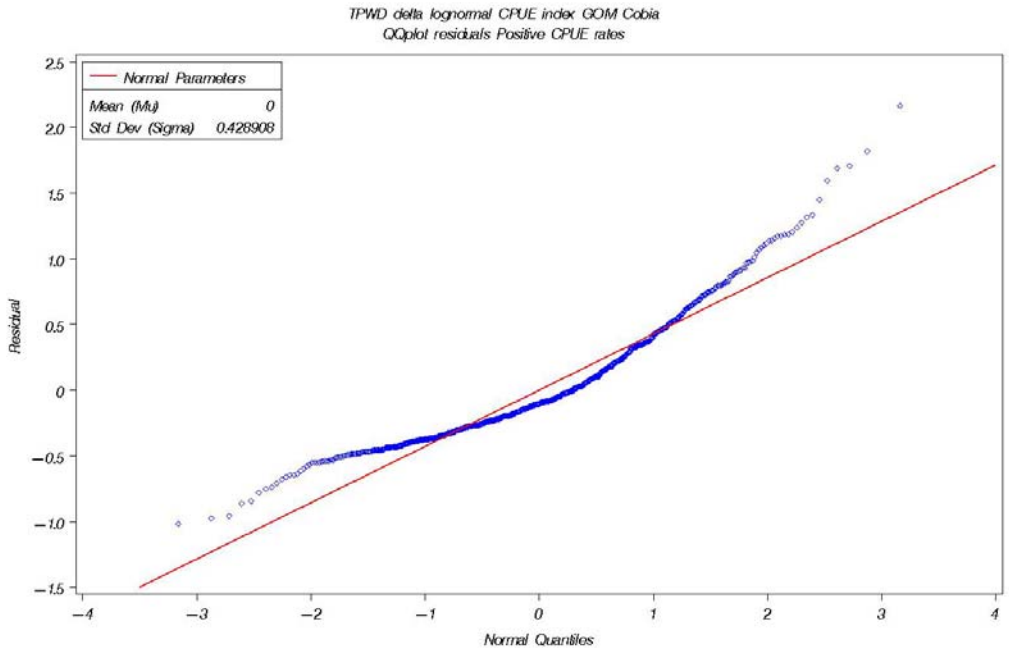

Figure 2. QQ Plot of residuals for positive lognormal CPUE observations.

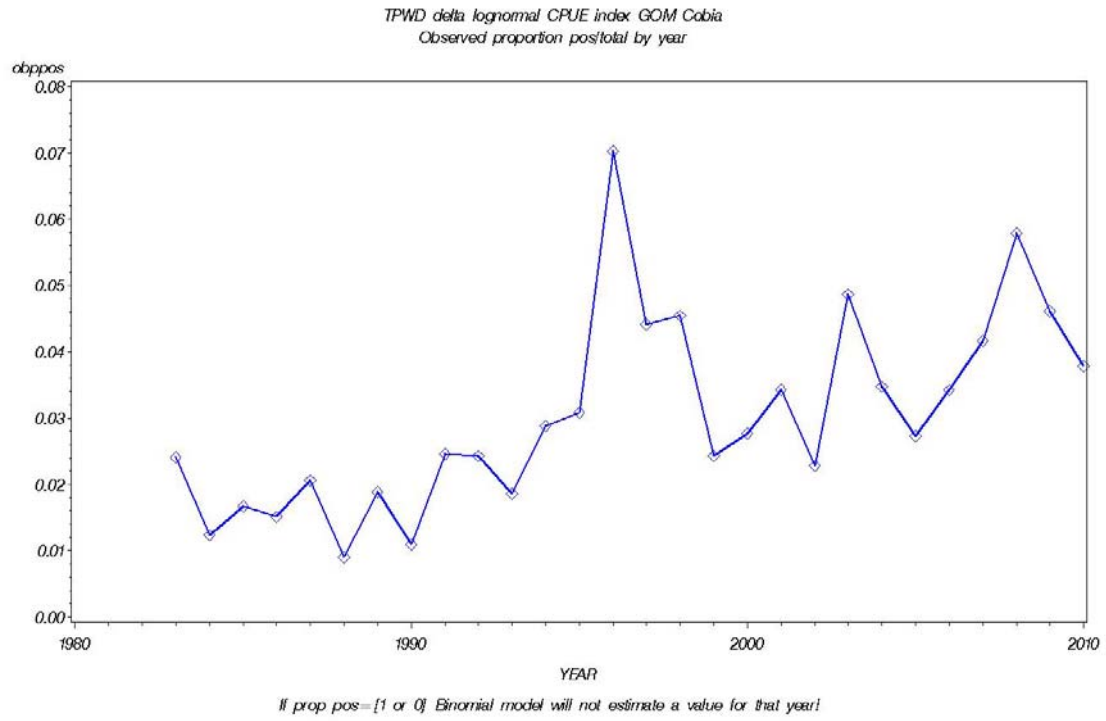

Figure 3. Observed proportion of positives by year.

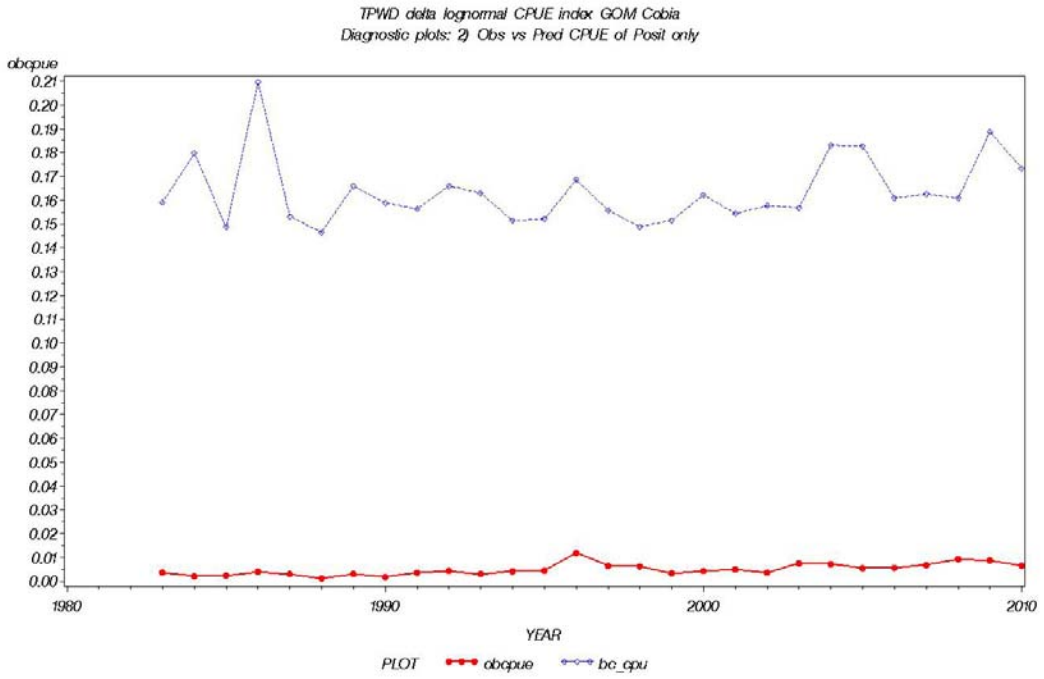

Figure 4. Observed CPUE vs Predicted CPUE for lognormal CPUE model.

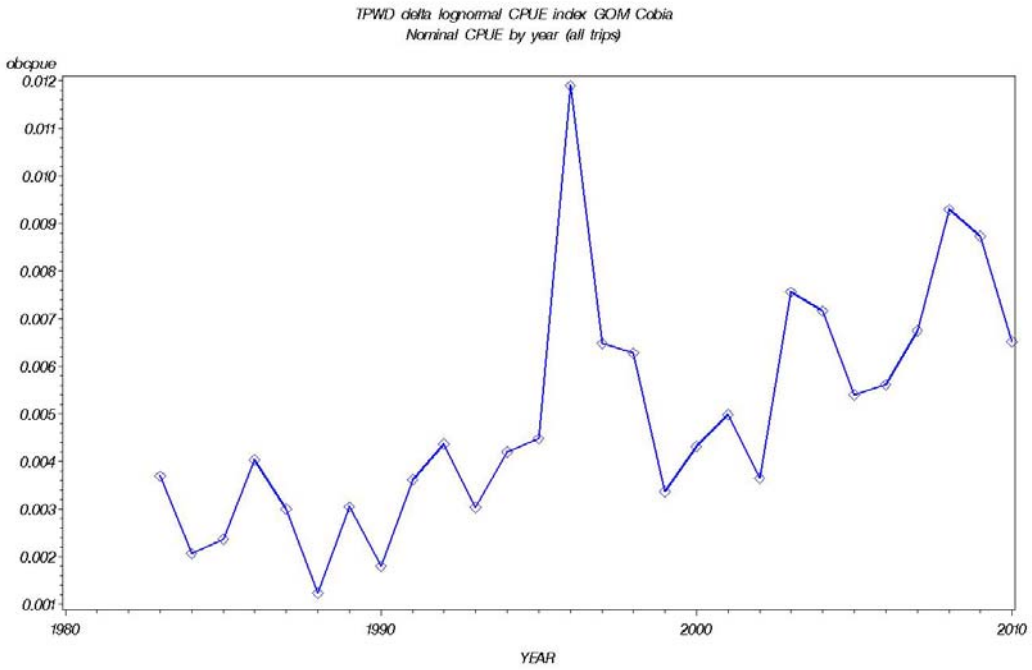

Figure 5. Plot of nominal CPUE by year.

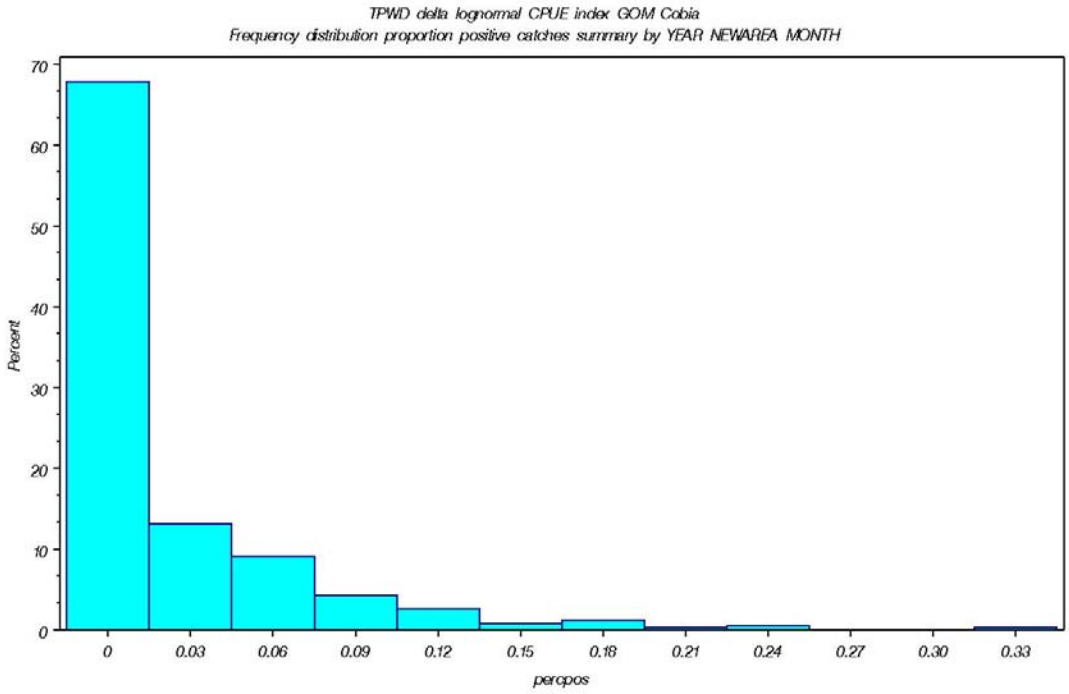

Figure 6. Distribution of proportion positives lognormal (CPUE).

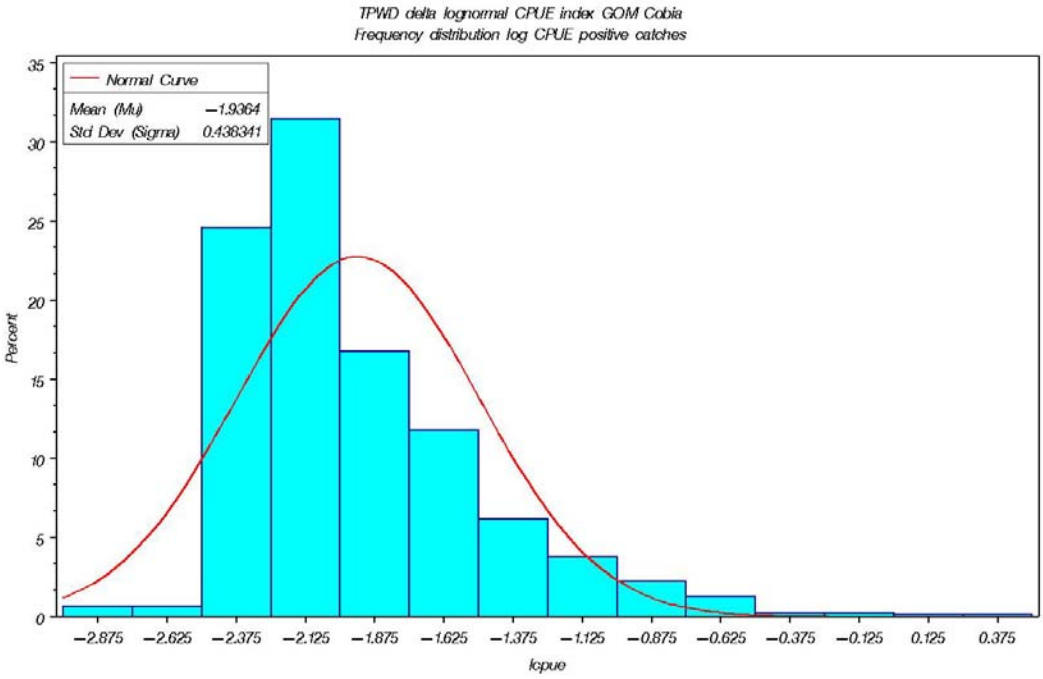

Figure 7. Frequency distribution of positive lognormal CPUE.

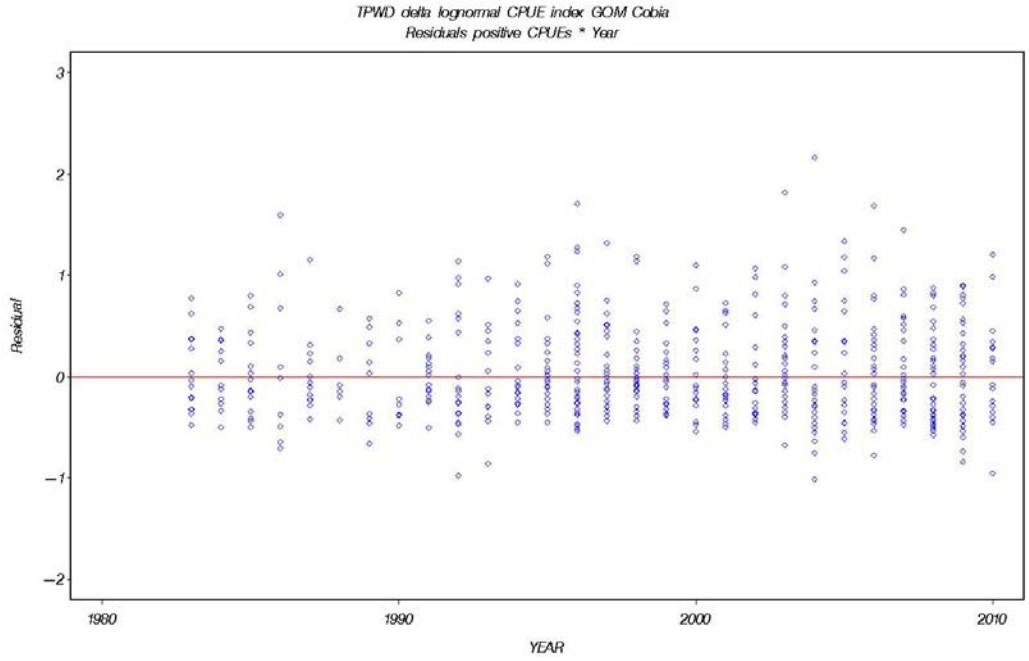

Figure 8. Distribution of residuals for positive lognormal CPUE observations by year.

Appendix 1. Information on TPWD catch and effort surveys

Source: "R:\RecrSurveys\Texas\documentationTrends\ Report_Summary_MDS234draft2 "

Summary of TPWD Management Data Series No. 234 (2005)

by Patty Phares, SEFSC, September 2006

Summary by SEFSC

File: **" Trends_Report_Summary_MSD234"**

SEFSC directory: **"SustainableFisheries\RecrSurveys\Texas\documentation"**

Original TPWD document

File: **"TX Harvest Report 1974-2003"**

SEFSC directory: **"SustainableFisheries\RecrSurveys\Texas\TX recr Trends reports\2005"**

Documentation of the TPWD survey is available in a separate document *Trends in Finfish Landings of Sport-Boat Anglers in Texas Marine Waters, May 1974 - May 2003* by Lee M. Green and R. Page Campbell [Texas Parks and Wildlife, Coastal Fisheries Division, Management Data Series No. 234 (2005). The following discussion contains a brief description of the survey based on the above report, a description of the special adjustments for data used by the National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center, and description of the raw data.

Survey description

The primary focus of the TPWD survey is private boats fishing in bays and passes because this accounts for most of the coastwide fishing pressure and landings in TX (78% of fishing effort and 67% of landings during May15, 2002 to May 14, 2003). Private boats in gulf waters (7% of effort), charterboats in bays and passes (14% of effort), and charterboats in gulf waters (<2% of effort) are also included in the TPWD survey, but special surveys are added to increase the precision of trips fishing in gulf areas since they are not encountered frequently in the normal survey. The primary objectives of the survey are to estimate daytime annual fishing pressure (trip man-hours) and landings (number of fish caught and kept), size composition, species composition and catch rates for sport-boat anglers on trips lasting 12 hours or less in Texas marine waters.

The survey consists of roving counts of boat-access sites to determine effort (relative fishing pressure) and interviews with boating parties to collect trip information and enumerate the catch.

The strata used in the sampling and estimation are:

• Fishing mode (using the MRFSS terminology) -- private boat (including rental) and charterboat (called "party-boat" by TPWD).

• Season and day type -- high-use (May 15 - Nov. 20), low-use (Nov.21 - May 14), and day types weekday or weekend.

• Area -- bay and pass, Texas Territorial Sea (TTS), US Exclusive Economic Zone (EEZ). (Note: These are comparable to the MRFSS areas inshore, ocean<=10 miles, and ocean>10 miles).

• Bay system or gulf waters off these bay systems (e.g., Sabine Lake, Galveston Bay, Matagorda Bay, etc.).

Texas boat-access sites are inventoried twice a year, and "roving counts" of these sites are conducted throughout the year to determine the number of boating parties using each site by counting empty boat trailers and empty wet slips. A set number of roving counts are assigned to each bay system, periods within each season, and weekday or weekend. The counts are later used to estimate relative fishing pressure at each site. The relative fishing pressure is the proportion of the total bay system fishing pressure occurring at that site. Bay and pass fishing pressure is calculated separately from gulf fishing pressure for each bay system.

"Pressure files" for weekends and weekdays are determined in advance of each season (high-use or low-use) based on the roving counts and boating party interviews of previous years. Sites are then selected for sampling (to conduct interviews) in proportion to their relative fishing pressure within bay system. For each sampled site, all parties with trips ending between 10 a.m. and 6 p.m. are interviewed. For angling parties, data recorded include trip length; number of anglers; area where *most harvested fish were caught* (bay/pass, TTS, EEZ) if fish were harvested or where most fishing took place if no fish were harvested; fishing mode (private or charter boat); number of each species landed (excluding released fish); and other data. (Note that in the MRFSS, the area where most fishing took place is recorded.) Up to 6 randomly selected individuals of each species landed are measured for length.

As with MRFSS, the TPWD survey includes tournament fishing if boats are using the inventoried boat-access sites but does not sample at tournament sites. Non-guided tournament-boat fishing interviews are coded separately by TPWD but are combined with private boat fishing interviews for pressure and landings estimates. Guided tournament-boat fishing interviews are coded as charterboat interviews and can not be distinguished from other charterboat interviews.

Since 1992, supplemental "gulf-only" surveys have been added during the high-use season at sites known to have gulf fishing activity using separate pressure files. Only gulf fishing parties are interviewed in full during the gulf-only surveys.

Fishing effort (trip man-hours) is estimated for each combination of strata (fishing mode, area and bay system of fishing, daytype) as the number of fishable days times the mean daily estimate of fishing effort. The mean daily fishing effort is the mean of observed fishing effort (from interviewed trips) which has been adjusted for daylight hours not surveyed and missed interviews during survey hours and then expanded using relative fishing pressures of surveyed sites. The mean daily fishing effort is then expanded to estimates for daytypes, seasons and annual period (May15-May14). Tables of annual estimates (May 15-May 14) by fishing mode, bay system and area (bay/pass, TTS, EEZ) are published in the *Trends in Finfish Landings* Management Data Series.

Estimates of landings (numbers of fish) are made the same way as for effort, substituting landings for effort in the above discussion. Landings estimates are made for a limited number of important or frequently-caught species ("target species"), and all other species are combined into "other". The list of target species is different for bay/pass estimates and gulf estimates.

The details of these calculations are in "Calculation of fishing effort, landings, catch rates, and associated standard errors" in *Trends in Finfish Landings*.

[*Note: TPWD landings estimates are comparable to MRFSS Type A catch because self-reported catch, including fish that are dead but not identified by the interviewer (MRFSS Type B1) and fish released alive (MRFSS Type B2), are not counted. However, because of survey methods, the catch estimate also corresponds closely to A+B1 in MRFSS because the B1 portion would be approximately zero. See discussion in SEFSC documentation of TPWD data files.*]

Special version of TPWD estimates used by NMFS ("wave estimates")

The above discussion describes the TPWD survey and estimates for which the survey was designed. However, since the recreational estimates for private and charterboats provided by TPWD are in lieu of MRFSS estimates, at the request of NMFS, TPWD recalculates the estimates (using the same raw data) to mesh as closely as possible with MRFSS strata. Thus "wave estimates" of landings and effort are provided by wave (2-month periods), area and fishing mode. There are other differences as noted elsewhere.

The stratification by season, daytype and bay system is still used in the estimation process but the estimates are summed over these strata before they are sent to NMFS. Also, a much larger list of target species is used than in the standard TPWD estimates, and the target species are the same for both bay/pass and gulf areas.

In November 2005 the NMFS estimates and raw data for all years were replaced. The new files incorporate changes made to the TPWD survey in the early 1990s discussed in *Trends in Finfish Landings,* "Calculation of Fishing Pressure and Harvest Estimates", p.9. These changes previously applied only to the NMFS estimates for 1998 and later because the files for 1983-1997 had not been replaced since their initial receipt by SEFSC. The replacement files also reflect many corrections to the raw data, and the standardize methods of calculating the NMFS estimates for all years (as described above).

Additionally, the replacement files do not include data for headboats which were surveyed only a few years (gulf headboats in 1983-1984 and bay headboats in 1983-1991). These data were previously included in the files sent for NMFS.

NMFS occasionally needs estimates for the species which are not included as target species by TPWD but are in the combined "other" estimate. Thus the "other" estimates are divided (by SEFSC) into individual species-specific "substitute estimates" in proportion to the observed counts of species in the survey in each wave, area and fishing mode.

While variances of the estimates are not provided with the wave estimates, it is known that estimates for charterboats, especially in gulf areas, are imprecise because of the low incidence of these trips in the sport-boat fishery and thus in the survey. TPWD would like to improve these estimates (*Trends in Finfish Landings*, "Discussion", p.18).

Data included in the wave estimates of catch for each year, wave, area and fishing mode are: TPWD species code and name, estimate of number landed, estimate of mean length (if available). Data included in the wave estimates of effort for each year, wave, area and fishing mode are: estimate of total manhours (trip hours), total anglers interviewed, estimate of average party size, estimate of average trip length in hours.

Raw data

The raw data (observations from the interviews) are also available to NMFS, including catch by species for the party, effort (trip length and number of anglers) and length measurements by fishing party. The catch and effort data for individual fishing parties can be used in catch/effort analyses. The length measurements can be used to estimate catch at length for a species, if enough were measured, or to estimate average weight, if length-weight conversions are available.

Appendix II. Variables recorded for TPWD CPUE data.

Source: R:\RecrSurveys\Texas\documentation\TPWD data_doc_May24_07draft5

Section 4. CPUE FILES: Party and Fish merged by trip (by SEFSC) for use in CPUE analyses.

Directory: "SustainableFisheries\RecrSurveys\Texas\catch-effort"

SAS datasets: TXCPUE_yyyy

See Section 3 (Raw Data) for explanation of the fields.

Trip Trip number assigned by TPWD.

year, wave, month, day, wave Date of interview (wave = 2-month sampling period, as in MRFSS).

inttime Interview time

major Bay system of fishing (within the bay system for bay and pass fishing or the waters off this bay system for gulf fishing).

site Location of interview

id Boat ID (or interview time)

newarea Recoded fishing area

state Recoded state

mode Recoded fishing mode

anglers Number of anglers [named **ttlanglrs** in the Party files]

triplen Trip length (hours)

mspec MRFSS species code

number Number of fish caught and kept for this trip and species. [named **ttlcot** in the Fish files] (See discussion in 6.4)

count_err Error flag for comparing counts of fish (on Length and Fish records).

area_err Error flag for comparing areas for this trip between Party, Fish and Length files.

speccode Original TPWD species code

All data fields in TXCPUE:

trip year month day wave inttime major site id newarea state mode anglers triplen mspec number count_err area_err speccode

Notes:

(1) There is one record per species per trip.

(2) Party records with no matching Fish records are assumed to be trips with no catch. The effort is retained, and catch is added with species codes equal to 0 and catch equal to 0.

In TPWD interviewed trips, 10% of charterboat parties and 39% of private boat parties have no catch in 1991-2005 combined. In MRFSS intercepts, charterboat parties with zero-catch trips are 13% gulf-wide, 3% in LA, 17% in FLW for 1991-2005 combined. Private boat zero-catch trips are 53% gulf-wide, 30% in LA, 64% in FLW for 1991-2005 combined. (MRFSS trips selected for comparison have B1=0 and have complete type A catch for the whole party in order to compare to TPWD.) Thus the TPWD and MRFSS results are similar.

(3) A few Fish records with no matching Party record have been deleted (by SEFSC).

(4) Effort information consists of the number of anglers ("anglers") and the trip length in hours ("triplen"). There are a few trips with missing effort information (anglers, triplen or both), 37 occurrences in 1983-1999. Depending on the unit of effort needed (per angler, per hour or per boat trip), the data may be useable but probably should be deleted (incomplete interview).

(5) Deleting records with detected errors (see area_err and count_err) might not eliminate all of the problem – e.g., if a record is mis-assigned to a trip and this shows up as inconsistent values for the area or number caught, the trip to which it should have been assigned (which is missing records) is not known. The number of errors detected is small compared to the overall size of the files.