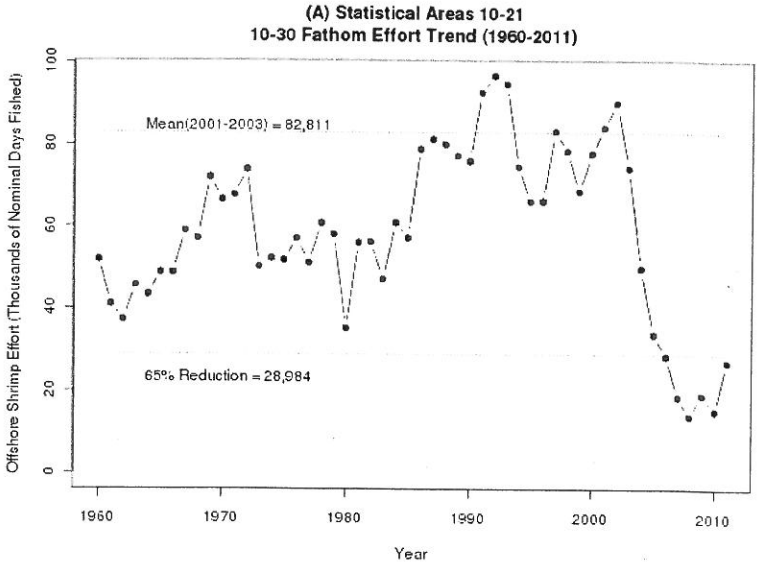
ESTIMATION OF SHRIMP FISHING EFFORT IN THE GULF OF MEXICO--2011



FINAL ANNUAL EFFORT REPORT FOR JANUARY-DECEMBER 2011

By

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To

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ESTIMATION OF SHRIMP FISHING EFFORT IN THE GULF OF MEXICO--2011

SUMMARY

The total offshore shrimp fishing effort for 2011 is estimated to have been 66,615 nominal days fished which yielded 88.4 million pounds of tails. The catch rates in 2011 were similar to those seen in most other years of this program. Effort was up about 10% from 2010, but was still 13% below the effort recorded in 2009. Landings were up 29% from 2010. The number of vessels recording an offshore landing in 2011 increased by 14% from 2010. Effort in the 10-30 fathom zone of the western Gulf in 2010 was down 67.3% from the 2001-2003 baseline. This reduction exceeds the GMFMC goal of a 65% reduction from the baseline.

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INTRODUCTION

The primary purpose of this report is to provide an estimate of shrimp fishing effort in the Gulf of Mexico (Gulf) for 2011 incorporating adjustments based upon Electronic Logbook (ELB) technology. Our analyses are restricted to offshore Gulf waters. Shrimp fishing effort estimates are important for, at least, 1) assessing whether the shrimp industry is either overcapitalized or, in contrast, fishing below the levels historically necessary to harvest Maximum Sustainable yield (MSY); and 2) estimating bycatch and bycatch mortality, especially juvenile red snapper bycatch mortality. For the latter, effort in the 10- to 30-fathom depth zone of the western Gulf has been shown to be directly related to juvenile red snapper bycatch mortality. The SEDAR7 Red Snapper Stock Assessment projects that, in order to end over fishing and rebuild the stock, juvenile mortality must be reduced on the order of 50% to 74%, depending upon what levels of adult harvest are selected.

ELB technology was developed in the mid- to late 1990s and continues to be refined (Gallaway et al. 2003a,b; Cole et al. 2006a). The technology has been adopted by the National Marine Fisheries Service (NMFS) that is funding a multi-year research program to refine and implement the technology, and to provide annual shrimp fishing effort estimates. This report provides the effort estimates for 2011.

METHODS

A description of the ELB being used to monitor shrimp fishing effort is provided in Gallaway et al. (2003a) and a description of how the data are used to calculate shrimp fishing effort is provided in Gallaway et al. (2003b) and Cole et al. (2006a,b). A recent description of Shrimp Data Files maintained by the Southeast Fisheries Science Center of NMFS is provided in Nance et al. (2008). The latter also describes the data and data collection procedures used by NMFS Port Agents to gather landings and fishery interview data. In summary, approximately 20 Port Agents scattered across the Gulf visit all the shrimp dealers in their assigned area (except for in Louisiana, Florida and Alabama where the states have fully implemented trip tickets) at least once per month and collect landings statistics for individual fishing trips for all the vessels fishing offshore that can be identified. From a sample of these trips, the Port Agents interview the Captain or a member of the crew to collect fishing effort and catch location information. In the non-trip ticket states, it is the Port Agents responsibility to assign the correct location for non-interview trip landings.

Data on landings and generalized location are obtained by dealer trip ticket programs in the states of Louisiana, Alabama, and Florida. ELB studies have demonstrated that it is virtually impossible for the Port Agents (or even the Captains) to accurately assign landings and effort to the specific 219 statistical cell arrays that were fished on a trip. Further, trip ticket forms do not include an entry for depth. ELB data, where available, are used to provide allocations of landings and effort data.

Sampling

Historically, the effort and landings data were assigned to the 219 statistical cell arrays on a monthly basis yielding a total of 2,628 spatial/temporal cells. Effort could be calculated for each cell, but in recent years, a pooling approach has been deemed more appropriate (Nance 2004). In the SEDAR7 Red Snapper Stock Assessment, a number of pooling strategies were examined and one, designated SN, was selected as the preferred approach. This pooling strategy included 3 trimesters (January to April; May to August; September to December); 4 subareas (Statistical Zones 1-9; 10-12; 13-17 and 18-21) and 2 depth zones (0 to 10 fathoms and >10 fathoms) for a total of 24 temporal/spatial cells (Nance 2004). In our program, we adopted this strategy in part but followed Nance et al. (2008) by using 3 depth zones (0 to 10, >10 to 30 and >30 fathoms). This array, therefore, has 12 spatial cells (Figure 1) and 3 temporal cells:

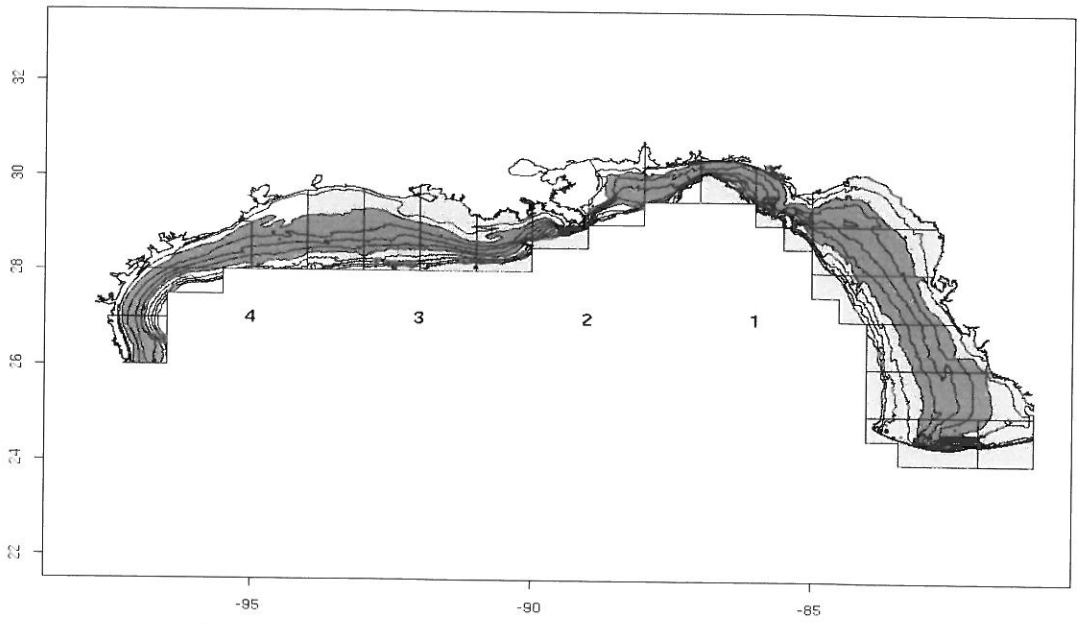


Figure 1. Spatial cells used for effort estimation. The Gulf is divided into four geographic regions 1) Florida west coast, Statistical Areas 1-9; 2) Alabama/Mississippi, east Louisiana, Statistical Areas 10-12; 3) west Louisiana, Statistical Areas 13-17; and 4) Texas, Statistical Areas 18-21. Each of the four regions is divided into three depth zones: 0-10 fathoms, >10 fathoms to 30 fathoms, and >30 fathoms.

During 2003, the Gulf of Mexico Fisheries Management Council (GMFMC) and NMFS instituted a permit system for vessels trawling for shrimp in the Exclusive Economic Zone (EEZ). Permits were issued to 2,666 vessels before the December 6, 2003 control date. Although other permits were issued after that time, the permits issued before the control date were the only ones that were valid when the moratorium went into

effect during 2007. The group of vessels that were permitted before the control date were used as the universe for the random selections of vessels to be monitored in this study.

The primary goal of the study is to estimate effort by the offshore shrimping fleet for the 36 temporal/spatial cells described above. In order to reduce the complexity of the characterization of the entire fleet, LGL scientists, in cooperation with Drs. James Nance and Mike Travis of the NMFS, separated the Gulf coast into 9 geographic regions (Figure 2). The goal is to characterize the fishing patterns of the vessels from each of these regions for each trimester, and sum them across the Gulf to calculate total effort. We assigned each NMFS landings port to one of the 9 geographic regions along the Gulf coast (Figure 2).

Stratification of the samples was completed using the following steps:

- NMFS landings records for offshore landings from 2004 and 2003 were summarized by vessel number for each year, then matched with the vessels in the permit database. One thousand eight hundred sixteen (1,816) of the permitted vessels recorded an offshore landing in 2004, 1,986 vessels recorded an offshore landing in 2003, and 2,104 vessels recorded an offshore landing in either 2004 or 2003. The permitted vessels accounted for 84.45% of the 103.0 million pounds of 2004 offshore landings (85.56% of 104.8 million pounds in 2003). A weighted average annual landings was calculated for each vessel with landings recorded in either year, assigning twice as much weight to 2004 landings as 2003 landings (all figures were calculated using the NMFS landings data as of 6/27/05).

- Each permitted vessel was assigned to a geographic region based on the location of the port where the vessel most often landed during its most recent year of fishing activity.

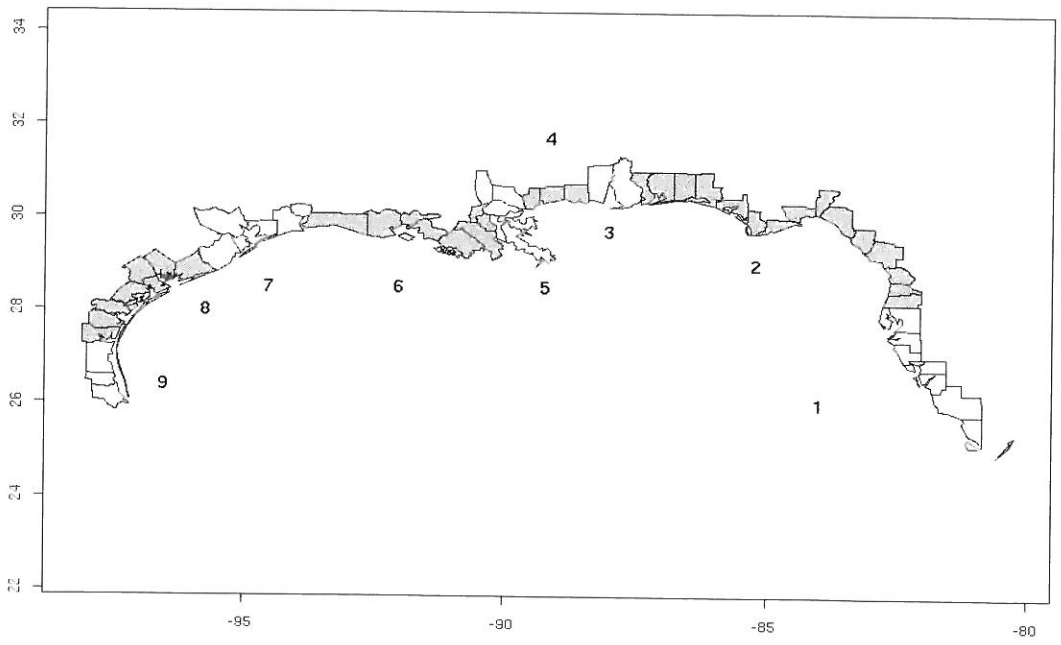
- The proportion of each region's accountable offshore landings to the total accountable landings was used to assign the number of samples to be drawn.

- Within the regions, for any region that had a significant (would create a sample size of 5 or more) split between iceboats and freezer boats, the region's samples were allocated based on percent landings by each type.

- These rules led to 14 geographical and refrigeration method strata.

- For each strata we randomly selected, without replacement, the vessels to be equipped with ELBs. We used the fraction of weighted landings for the vessel to total weighted landings for all vessels to influence the probability of a vessel's selection. The list of selected vessels is included in Appendix 1 of Cole et al. (2006b).

In September 2007, NMFS added a supplemental program milestone to select and install 100 additional units. The selection criteria for these additional samples were drawn similar to those described above, however, were based on 2006 landings, excluded



Region	Description	NMFS Port Codes	Number of Random Selections
1	Key West to Tampa FL	1-5, 12, 14, 15	24
2	Florida North of Tampa	6-11, 13, 16-19	3
3	Alabama	20-21	20
4	Mississippi	30-32	20
5	LA east of river	40-45	22
6	LA west of river	46-56	57
7	Upper Texas	70-73, 84-85	47
8	Central Texas	78-80, 83, 86-89	24
9	South Texas	75, 81, 82	33

Figure 2. The nine (9) geographic regions used to characterize the Gulf of Mexico offshore shrimp fishing fleet.

vessels previously drawn, and drew additional vessels for vessels on the previous draw that are no longer participating in the fishery.

Allocations of Landings and Effort

ELB location data are analyzed to calculate detected tows and summarized by trip as described by Gallaway et al. (2003a,b) and Cole et al. (2006a,b). Landings data, which are a combination of port agent-gathered trip and interview data, and state trip ticket data, are acquired from NMFS. The ELB and landings data are then merged using an algorithm that matches the trip ending dates with the landings unloading date (Cole et al. 2006b).

The resulting data are run through a set of algorithms described in Cole et al. (2006b) to assign catch to each Statistical Area/5-fathom depth zone fished during the trip. These records are used to calculate the percentage of total trimester landings assigned to each of the 12 area/depth strata cells for each geographical fleet for each trimester. Fleets that are judged to have representative ELB coverage for entire trimesters have their total fleet trimester landings allocated according to these ELB percentages with one exception. The exception is that landings from vessels that do not have a valid Federal Moratorium permit are assigned to state waters.

Catch and effort for this ELB-matched data set are used to calculate CPUE for each of the 36 cells described above using ELB data. These CPUE rates are used for calculating effort from landings allocated by the ELB method. For fleets not sufficiently covered by ELB data, landings are assigned to the area and depth cells based on the location data contained in the landings records, when it exists. Cell CPUE and error are calculated based on all interview data.

Nance et al. (2008) describe the methodology used for handling the problem of unknown depths in trip ticket records, and incorporation of ELB adjustments to landings locations and CPUE values. Offshore landings records from the NMFS landings Analyst File were summarized by trimester, geographic area and species. Records with unknown depth were assigned depth by drawing from a sample distribution of records from the same trimester, area and species having a known depth value. Landings records for vessels from geographic regions with sufficient ELB coverage were assigned area and depth location by sampling from the distribution of values representing the percentages described in the section above. Catch rates for those records were taken from ELB calculations. Landings and catch rates for fleets without sufficient ELB coverage were allocated and calculated based on trip ticket and port agent data.

Effort Estimates

Effort is calculated for each temporal/spatial cell using

$$CellEffort = \frac{\Sigma CellLandings}{CellCatchRate}$$

The landings data are obtained from commercial seafood dealers as described above and the catch rate or catch per unit effort (CPUE) is calculated for each cell using the ratio estimator Σ catch/Σ effort. This is accomplished by summing all the catches and efforts from all the trips in a given temporal/spatial cell. The more collapsed (i.e., larger) the cell, the more trip catches and landings that go into these summations. Nance (1992) and GMFMC (1994) determined that this estimator was the correct one based on plots of trip catch against trip effort (variability of trip catch increased as trip effort increased).

Effort and the associated CPUE error estimate are calculated for each of the 36 cells in which a landing was allocated by each of the methods. The standard error estimate of the CPUE is calculated following Krebs (1998). Total effort for any cell or group of cells is then calculated by summing all of the appropriate effort values. Standard error of any group of cell effort estimates is calculated using the following formula:

$$S_T = \sqrt{\sum_{i=1}^{n} \frac{L_i^2 * S_i^2}{R_i^4}}$$

where:

S_T is the estimated standard error of the total effort estimate
L_i is the cell landings
S_i is estimated standard error of the cell
R_i is the ratio estimator (CPUE) of the cell

RESULTS AND DISCUSSION

The original goal of the study was to install a total of 250 ELB units by mid-2007 and then add sufficient units to the sample to maintain 250 or more working units for the balance of the program. In April 2007 we reached and exceeded the 250 installation level. In September 2007, a supplemental milestone was added to the program to increase overall coverage by 100 additional units and to target the Vietnamese fishing community for program participation. The 350 installation goal was reached in October 2007, and by the end of 2011 a total of 669 ELB units had been installed, of which 544 were still outstanding and functioning (673 and 540 as of the report date). As of the end of 2011 planned levels of coverage for all regions had been reached (Table 1).

Data from 2,091 trips made by vessels carrying ELBs in 2011 were merged with the NMFS landings Analyst File to create ELB trip matches for 1,268 trips representing 18.2 million pounds of tails of shrimp and 13,117 nominal days fished from 30 port areas in the nine regions (Table 2). The data included tows in 188 of the 219 Statistical Area 5-fathom depth cells, and all 36 of the temporal/spatial cells used in our analyses. The ELB data were judged to be sufficient to be used in direct allocation of landings and calculation of catch per unit effort for all 9 of the previously identified geographic regions.

As of the date of this report, the program has recorded 494,190 tows covering over 2.7 million hours, and 47.0 million raw data points including over 16.6 million intra-tow points.

Table 1. ELB summary data for 2011.

	ELBs				Total		Matched		
Region	**Target**	**Targ350**	**Installed**	**Outstanding**	**Trips**	**Effort**	**Trips**	**Effort**	**Landings**
1	24	27	50	35	123	859	102	782	1,113,581
2	3	3	11	9	38	246	24	198	324,605
3	20	33	69	62	265	2,342	184	1,796	2,867,340
4	20	35	71	56	290	2,705	184	2,123	3,598,547
5	22	30	51	45	179	1,105	66	431	422,010
6	57	100	140	107	400	3,337	164	1,553	1,807,588
7	47	55	158	136	452	4,564	318	3,613	4,321,514
8	24	25	41	30	145	1,373	86	1,009	1,400,581
9	33	42	82	60	199	1,962	140	1,612	2,335,425
	250	**350**	**673**	**540**	**2,091**	**18,493**	**1,268**	**13,117**	**18,191,191**

Effort Distribution

Fishing patterns were much closer to traditional locations in 2011; in 2010 the closures of areas of Federal and State waters off the coasts of Florida, Alabama, Mississippi, and Louisiana due to the Deepwater Horizon oil spill, had great influence in the distribution of fleet fishing effort. As in prior years, in 2011, we see the effort extend from Alabama to the Texas Mexico border from the coast out to approximately 50 fathoms, and offshore the west coast of Florida, especially near the Tortugas. Figure 3 shows the pattern of fishing effort for 2011. The mid-shelf region from the mouth of the Mississippi River westward to about San Luis Pass at the west end of Galveston Bay was again characterized by relatively low fishing intensity as compared to nearshore (<10 fathoms) and offshore (>30 fathoms) areas in this region. Factors that may contribute to this pattern include the presence of the dead zone off western Louisiana, the proliferation of petroleum platforms in this region, and changes in fishing patterns (Nance et al. 2008).

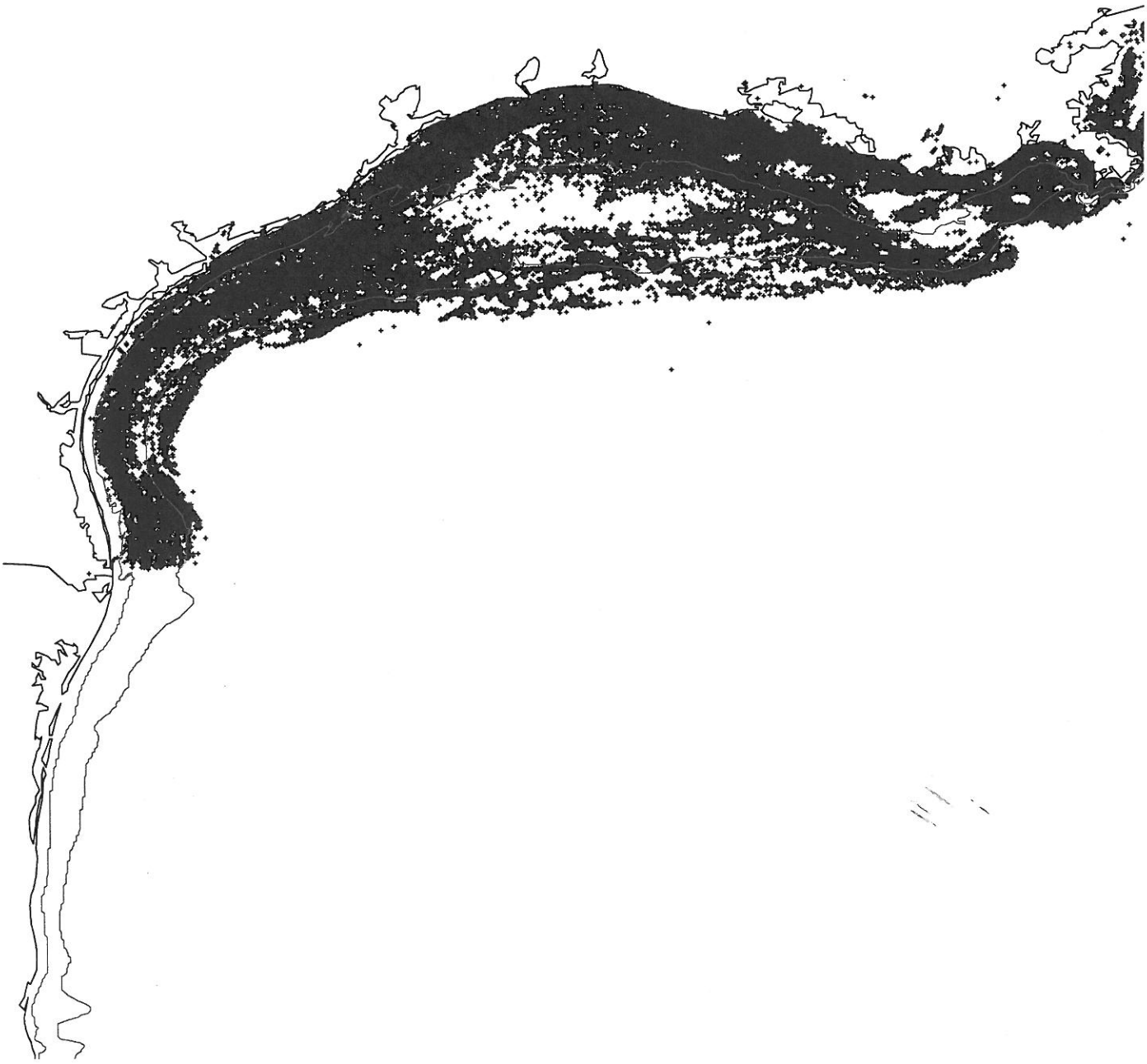
The offshore region extending from west Galveston Bay to the Texas-Mexico border is characterized by relatively high fishing estimates across all depths except for 1) the nearshore sea turtle conservation zone (no effort) and 2) a mid-shelf region characterized by the presence of banks and reefs (Figure 3).

Figure 3 can lead to erroneous conclusions about fishing intensity in areas where a large number of tows occur, especially in the western Gulf region. In Appendix 1, we

Table 2. ELB installation Port summary for 2011 trips.

Region	Port	ELBs		Total		Matched		Landings
		Installed	Outstanding	Trips	Effort	Trips	Effort	
1	Fort Myers	28	24	90	617	71	551	741,090
1	Tampa	12	7	25	182	23	171	246,854
1	Tarpon Springs	9	4	8	60	8	60	125,637
2	Apalachicola	3	2	0	0	0	0	0
2	Carabelle	2	1	0	0	0	0	0
2	Panama City	3	3	9	19	3	4	14,220
2	Pensacola	3	3	29	226	21	194	310,385
3	Bayou LaBatre	58	54	222	2,095	142	1,534	2,501,781
3	Bon Secour	11	8	52	308	45	288	427,045
4	Biloxi	63	51	249	2,374	161	1,883	3,177,393
4	Ocean Springs	1	0	1	4	0	0	0
4	Pascagoula	7	5	14	103	6	64	149,460
5	Empire	15	14	61	427	10	84	121,157
5	Lafitte	9	7	22	153	16	119	101,150
5	New Orleans	2	1	11	82	1	15	9,304
5	Venice	25	23	88	446	41	214	192,543
6	Chauvin	5	4	28	171	8	54	138,926
6	Cut Off	12	12	19	99	2	5	13,747
6	Dulac	23	18	46	278	18	104	141,758
6	Galliano	5	4	0	0	0	0	0
6	Golden Meadow	2	2	0	0	0	0	0
6	Grand Isle	4	4	20	62	8	24	57,054
6	Intracoastal City	66	46	224	2,208	99	1,120	1,216,942
6	Leeville	14	11	30	257	18	142	155,685
6	Morgan City	9	6	33	263	11	105	83,476
7	Bolivar	35	31	109	941	67	653	917,286
7	Crystal Beach	5	3	0	0	0	0	0
7	Freeport	15	12	14	138	9	92	135,341
7	Galveston	44	39	196	1,986	144	1,657	1,638,054
7	Houston	1	1	0	0	0	0	0
7	Port Acres	4	4	12	46	10	39	97,892
7	Port Arthur	38	31	81	916	55	695	884,473
7	Sabine Pass	16	15	46	596	38	535	706,548
8	Aransas Pass	6	3	2	0	0	0	0
8	Matagorda	2	0	0	0	0	0	0
8	Palacios	33	27	151	1,475	93	1,099	1,550,565
9	Brownsville	54	41	156	1,558	105	1,253	1,862,145
9	Port Isabel	28	18	43	405	35	359	473,280
	Total	**672**	**539**	**2,091**	**18,493**	**1,268**	**13,117**	**18,191,191**

ELB Tows from



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show monthly quantiles of fishing intensity for the western Gulf region. The south Texas region is not characterized by the highest fishing intensity as might be inferred by Figure 3. During the first six months of the year, the highest levels of fishing intensity in the western Gulf typically occur in nearshore areas less than 10 fathoms deep. Intensity remains high in nearshore areas in the last half of the year supplemented by high levels of effort in some offshore areas (Appendix 1). The impact of the dead zone also seems to be represented in the figures.

An indication of the increase of effort in the western Gulf from 2010 to 2011 can be seen in the values of the four ranges of cell density quantiles from the figures in Appendix 1 (in tow hours per 681 km^2 cell) between the years. Table 3 shows a comparison of the values between years.

Table 3. Effort Quantile Values in Tow Hours per 681 km^2 cell, 2011-2010.

Quantile Percentage	2011	2010
0%	0.66	0.65
33%	25.80	24.83
66%	139.00	113.42
100%	1,580.00	1,245.95

The maximum effort in the two highest quantile bins was increased by 23% and 27% between 2010 and 2011.

Offshore landings in 2011 totaled 88.4 million pounds of tails equivalent shrimp. This included 50.1 million pounds of brown shrimp, 31.3 million pounds of white shrimp, 5.0 million pounds of pink shrimp, and 195 thousand pounds of Royal red shrimp. The maps in Appendix 2 show the distribution of tows from trips by vessels carrying ELB units where over 90% of the catch was one species. We estimated the directed effort for each of the selected species based on data from the trips where the catch of that species represented over 90% of the total catch. Of the estimated 66.6 thousand nominal days fished in offshore waters of the Gulf in 2011, an estimated 24.5 thousand days were directed at brown shrimp, 20.2 thousand days were directed at white shrimp and 2.9 thousand days were directed at pink shrimp. The remaining 19 thousand days were from trips with mixed catches. The tables in Appendix 2 show the directed effort for each species allocated to each of the 36 spatial/temporal analysis cells, as appropriate.

Appendix 3 shows the fishing patterns of the 9 regional fleets. Distinct differences in fishing patterns were again evident in 2011. For example, vessels from Region 1 fish both the west coast of Florida as well as the central Gulf offshore Louisiana west of the Mississippi River and the upper Texas coast. In the latter region, Region 1 vessels fished mainly in the deeper versus shallower regions. In contrast, Region 9 vessels fished across the entire shelf of south Texas, but generally restricted their fishing to deep-water areas off the upper Texas coast and western Louisiana.

Effort in the 10- to 30-fathom depth zones in Statistical Areas 10-21 and Statistical Areas 13 to 21 has been reduced from the mean baseline effort by 67 and 65%, respectively (Table 3 C).

The increase in effort seen for the 10-30 fathom depth zone in the western Gulf, statistical zones 10-21, between 2010 and 2011 was considerable (11,829 nominal days fished), while the estimate of total offshore shrimp fishing effort in the Gulf of Mexico (66,500 nominal days fished) increased over 2010 by only 10%. It should be noted that the 2010 effort estimate is the lowest value recorded for the 50+ year period of record (Appendix 4), and that the 2011 estimate is also among the lower values. This value represents only 37.3% of the 178,765 nominal days fished that, based on landings and effort data for 1990-2005, have been historically required to harvest MSY (Nance et al. 2008). Offshore landings in 2011 totaled 88.4 million pounds, a level representing 87% of the estimate of the Gulf shrimp fishery MSY (101.2 million pounds, Nance et al. 2008).

Shrimp catch rates offshore in Texas in 2011 showed a much more traditional pattern, showing rates above 2500 pounds per nominal day fished immediately after the Texas opening, and steadily declining to below 1000 pounds by November (Figure 4). Western Louisiana showed an unusual bounce to 2000 pounds per nominal day fished around the first of the year, then fell back to the more common low rates in the spring of 2011 (below 1000 pounds), but experienced their annual run up before the Texas opening to around 2,500 pounds, declining steadily thereafter to around 1000 pounds by the end of December.

Catch rates in Florida showed a very high May-July peak (around 2500 pounds per nominal day fished), then fell to traditional rates in the fall (Figure 4).

Effort estimates by area, trimester and depth zone for 2011 are shown in Appendix 4. These data provide the basis for estimating red snapper and other bycatch.

Red Snapper Bycatch Mortality Reductions

The Red Snapper Stock Assessment model includes the assumption that juvenile mortality is directly related to shrimp fishing effort. Results of regression analyses of juvenile red snapper mortality on shrimp fishing effort in the western Gulf between 10 and 30 fathoms suggest that this is a reasonable assumption (e.g., GMFMC and NOAA 2007, LGL 2007). Technically, the western Gulf should be defined as Statistical Areas 13-21 to be consistent with the stock assessment definitions. However, the GMFMC has included an option defining the western Gulf to include Statistical Areas 10-21. The effort trend in 10- 30-fathoms for each of these regions is shown by Figure 5, which also includes the 2001-2003 reduction benchmark values. In 2011, effort in these zones increased but, overall, the effort levels still reflected 67% and 65% reductions from the benchmark values for Statistical Areas 10-21 and 13-21 (Figure 5, see also Table 4). Basically, these data suggest that the fleet is currently very close to the GMFMC's requirement of a 65% reduction. In 2012 the reduction goal will also be 65%. Given the

observed 67% effort reduction in the 10- to 30-fathom depth zone, shrimp trawl bycatch mortality is estimated to presently be on the order of F = 0.19 for age-1 red snapper in the western Gulf (Figure 6). At a 65% effort reduction, F would be on the order of 0.2.

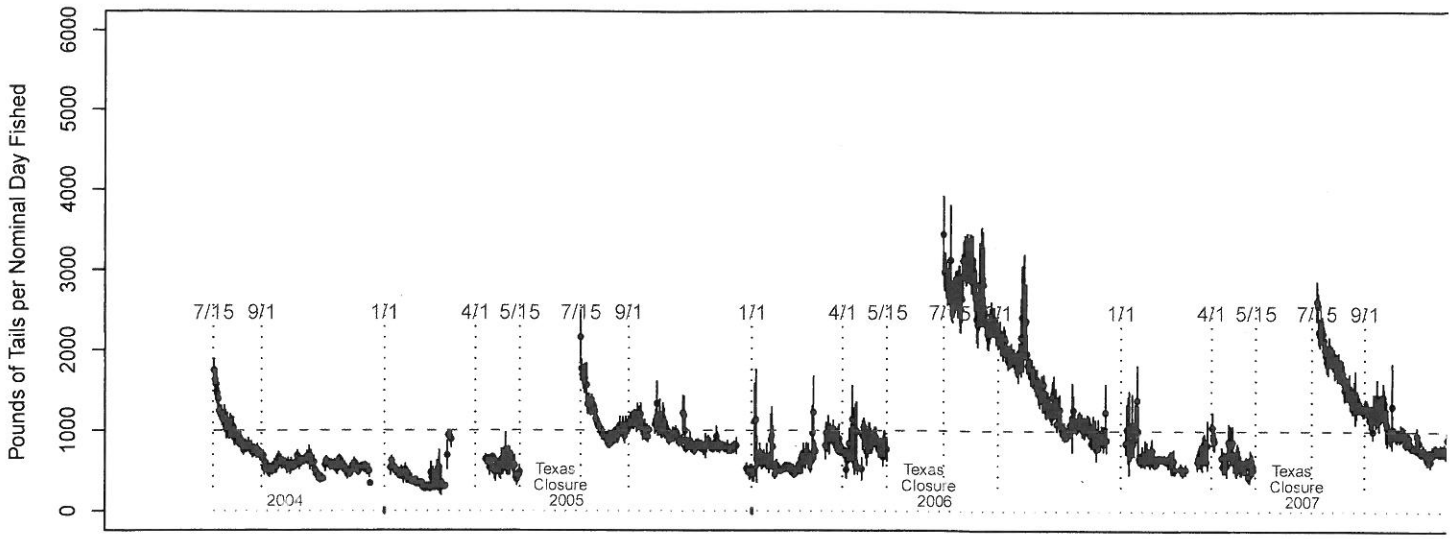
In contrast to effort levels observed in the 10-30 fathom depth zone of the western Gulf, total shrimp fishing effort decline began to slow in 2006 and effort continued to decline through 2008 effort increased in 2009, but fell again to historically low levels in 2010. Although effort increased again in 2011, it remains below the 2009 level. This long term decline in shrimp fishing effort may be possibly due to 1) increasing fuel costs, 2) continued low prices for shrimp to the vessels, and 3) the permit moratorium.

The monthly effort estimates for Statistical Areas 10-21 at depths 10 to 30 fathoms are shown in Table 5. Effort in that area increased from 2010 to 2011 by 78% overall. This compares to the overall increase of all offshore effort from 2010 to 2011 of 10%.

Table 5. Nominal days fished by month of 2011 for Statistical Areas 10-21 at depths of 10 to 30 fathoms in 2011 before, during, and after the Texas Closure.

Month	Pre-Closure	Closure	Post-Closure	Totals
January	1,326			1,326
February	893			893
March	1,030			1,030
April	1,279			1,279
May	451	868		1,319
June		2,269		2,269
July		1,954	1,887	3,841
August			4,237	4,237
September			3,789	3,789
October			3,335	3,335
November			1,965	1,965
December			1,827	1,827
Totals	**4,978**	**5,091**	**17,040**	**27,109**

As shown by Table 6, the 66,615 nominal days fished in the offshore Gulf of Mexico came from a total of 1,656 vessels. However, only 972 of the vessels had a moratorium permit that is currently required to fish in the EEZ (Table 6). The two Louisiana regions (5 and 6) were characterized by the lowest proportion of vessels with moratorium permits. Nearshore fishing dominates in these regions, although some vessels fish deep water (Appendix 3). In 2011 the total number of vessels with an offshore landing increased from 2010, by approximately 14%. However, the number of permitted vessels with an offshore landing only increased by 4%, from 939 to 972.



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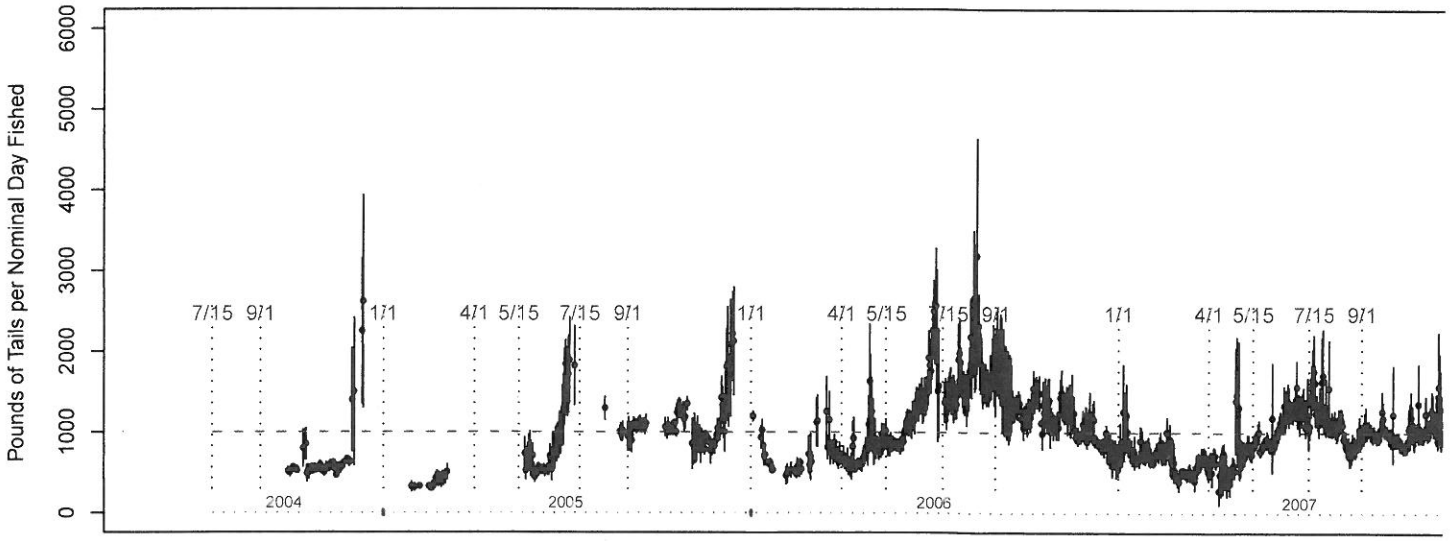

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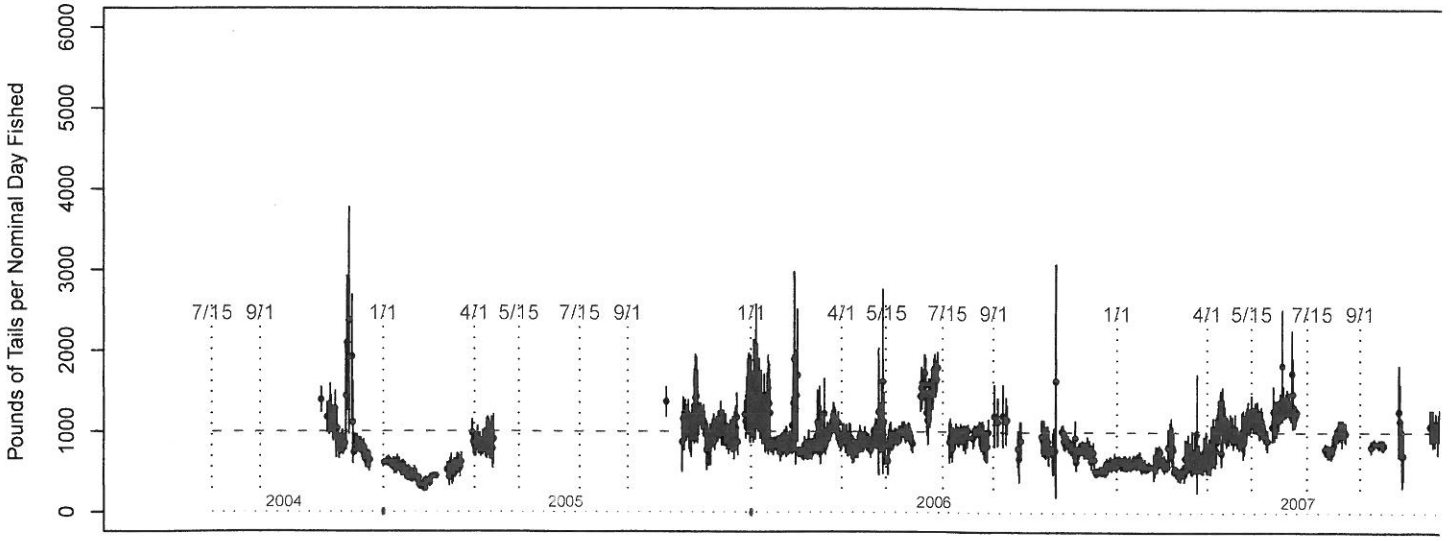

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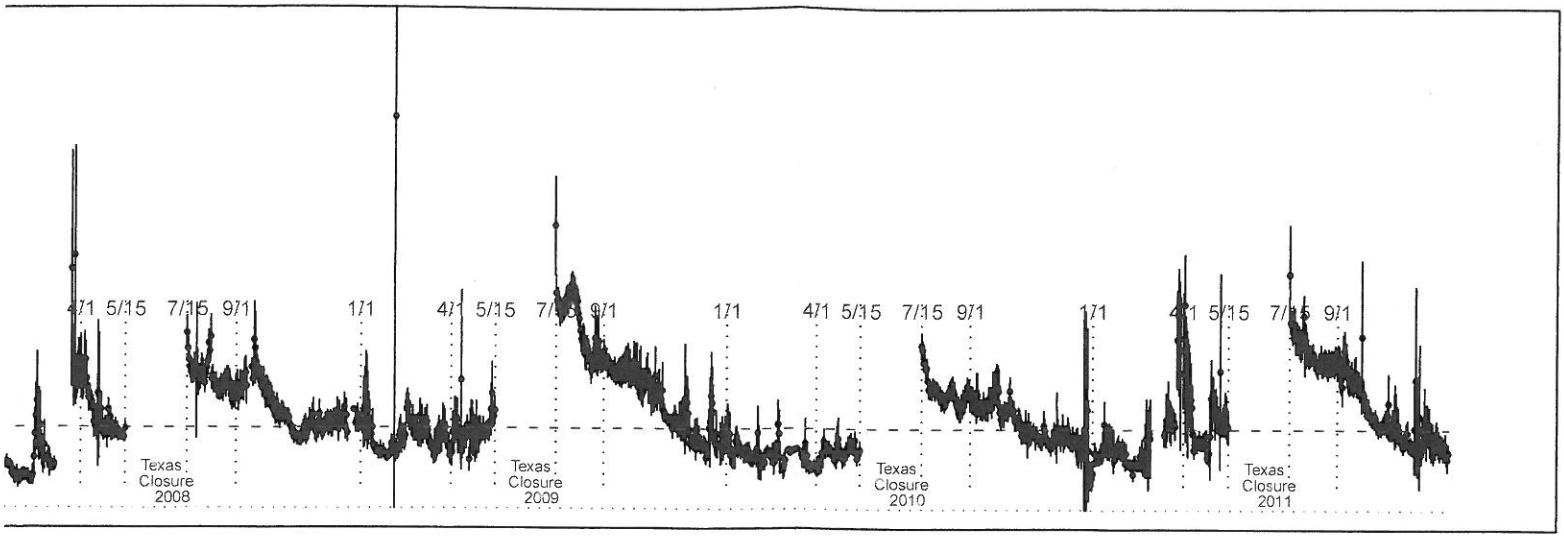
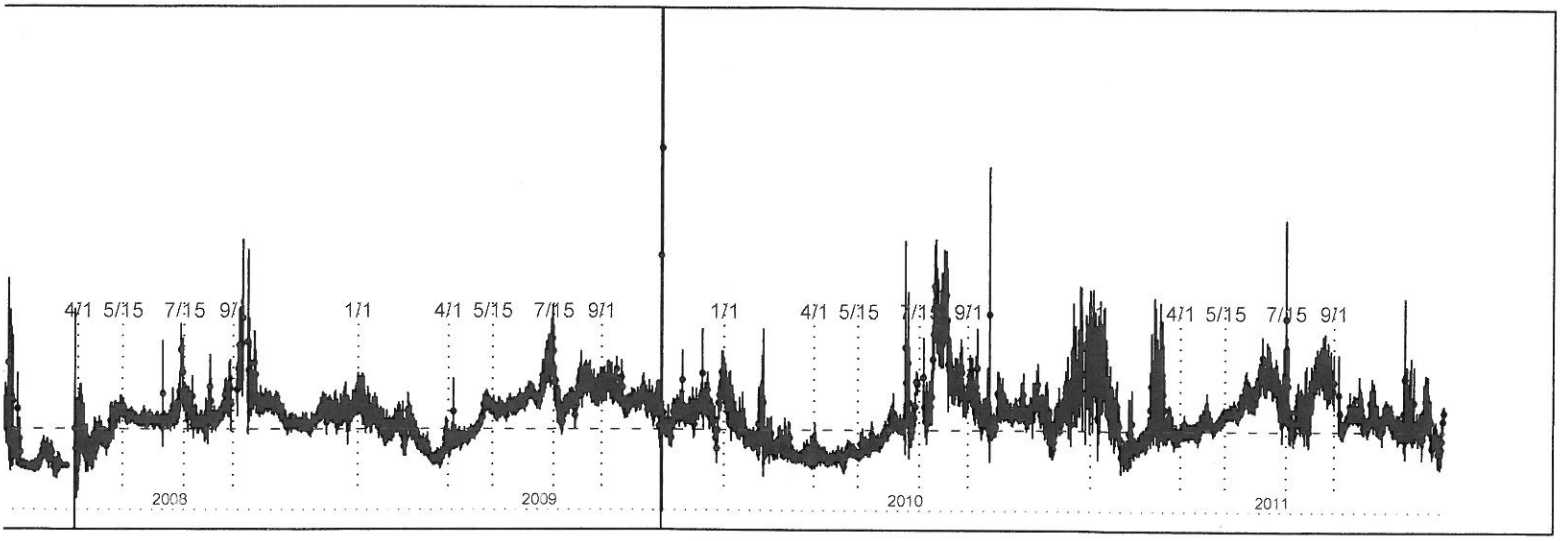
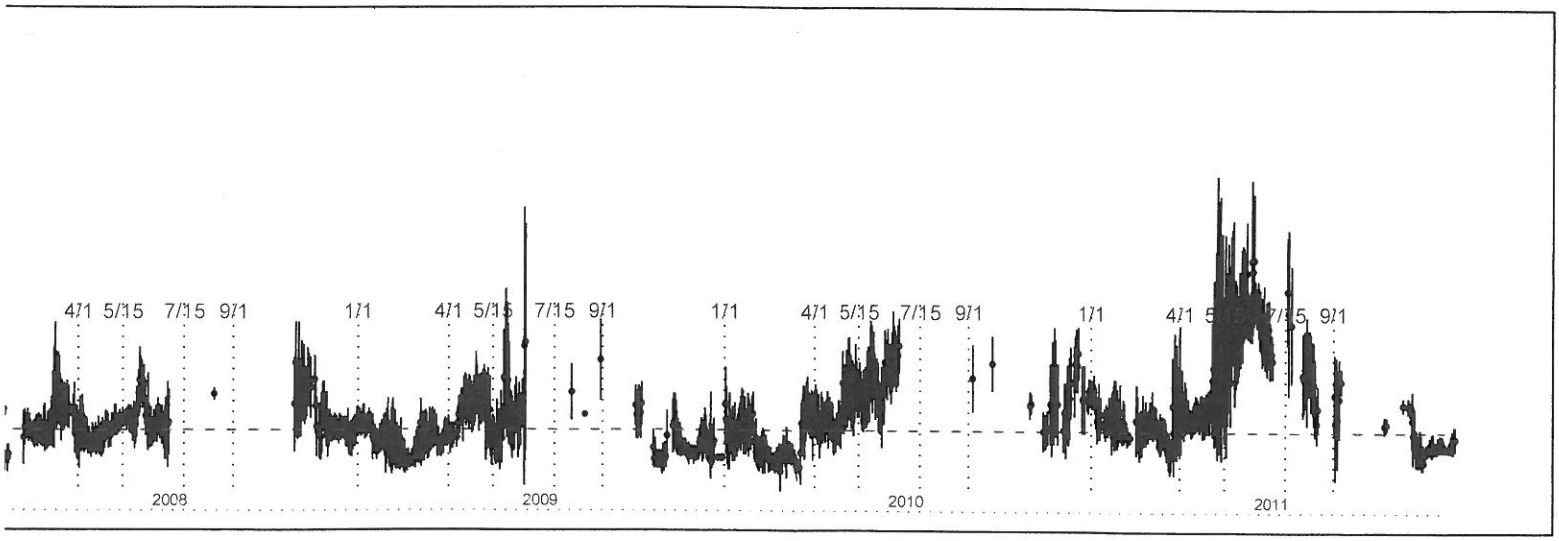


B–Landings (Western Louisiana)



m ELB–Landings (Florida)



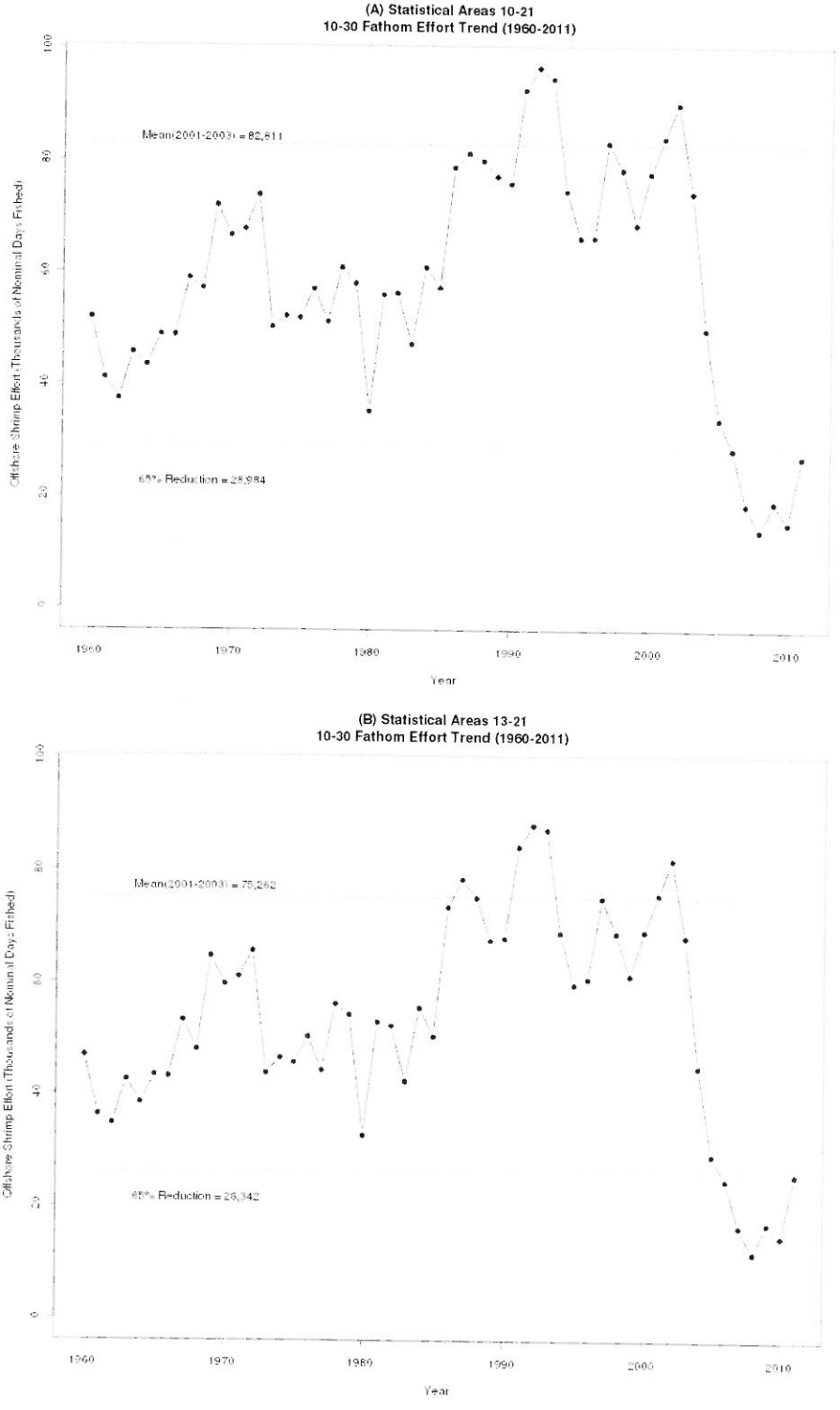


Figure 5. Shrimp fishing effort trends in the western Gulf of Mexico in the 10- to 30-fathom depth zone.

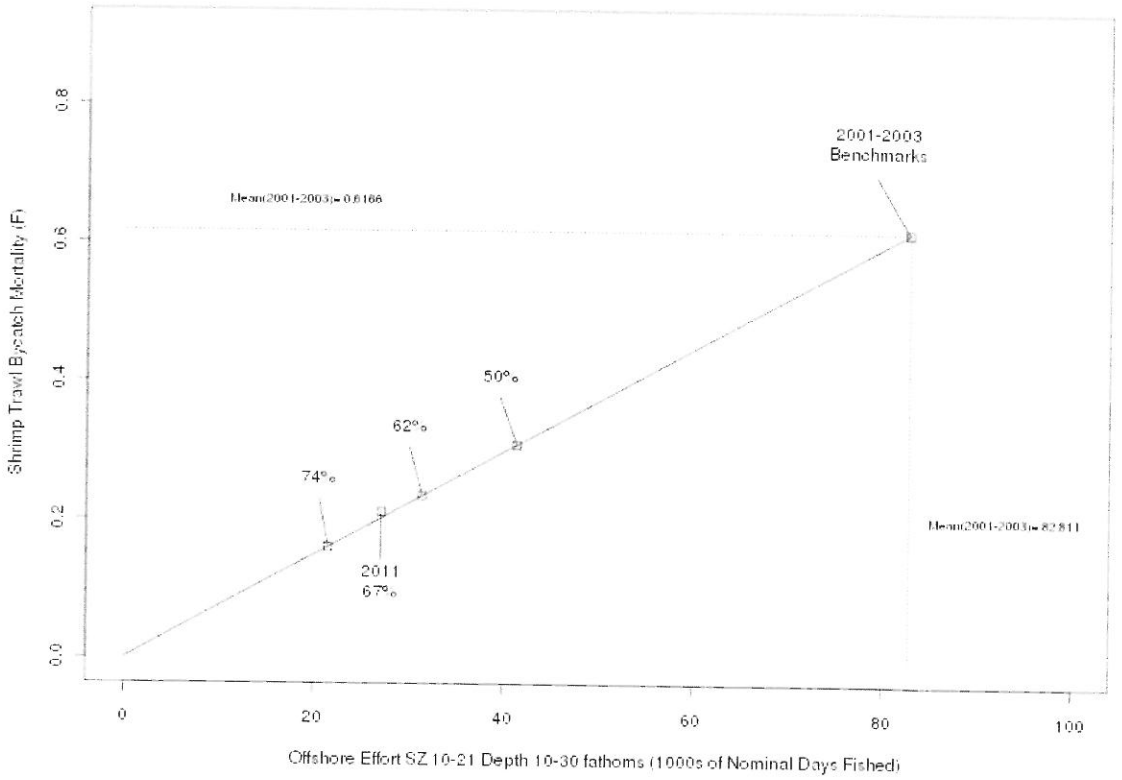


Figure 6. Shrimp fishing effort and associated juvenile red snapper bycatch mortality.

Table 6. Landings and effort by region and counts of vessels by permit type in 2011.

Regions	Total Landings	Total Effort	Effort 10-20	Total Vessels	Permit Vessels
1	6,515,575	4,608	277	90	76
2	1,034,612	809	11	72	36
3	9,410,167	6,309	1,881	124	101
4	6,005,638	4,438	1,455	140	77
5	825,658	1,110	136	115	10
6	12,578,026	10,355	2,246	496	171
7	23,271,394	18,254	6,444	337	236
8	11,643,707	9,233	7,189	109	104
9	17,162,964	11,499	7,470	173	161
Total	**88,447,741**	**66,615**	**27,109**	**1,656**	**972**

SUMMARY

The total offshore shrimp fishing effort for 2011 is estimated to have been 66,615 nominal days fished which yielded 88.4 million pounds of tails. This represents a 10% increase in effort and a 29% increase in landings from 2010. Shrimp fishing effort in the 10- to 30-fathom depth zone of the western Gulf was 67% below the 2001-2003 benchmark level. The GMFMC has stated that a 65% reduction is their required shrimp trawl bycatch mortality reduction target. Effort in the 10- to 30-fathom depth zone of the western Gulf could have increased by 1,875 nominal days fished (as compared to 2011) and still met this goal based on effort reductions alone.

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APPENDIX 1
Monthly Fishing Intensity in the Western Gulf 2011

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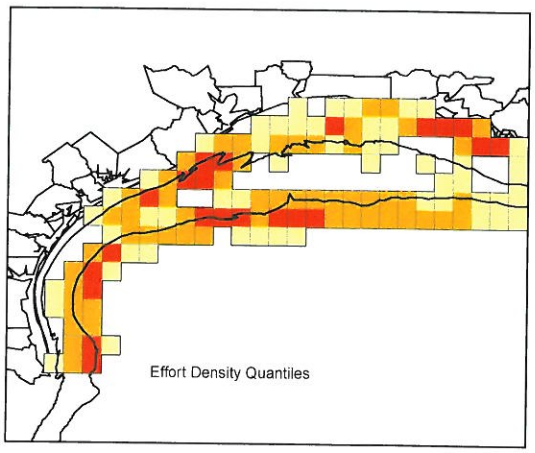

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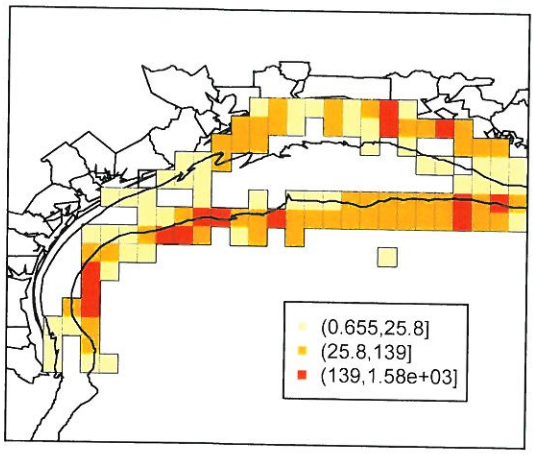

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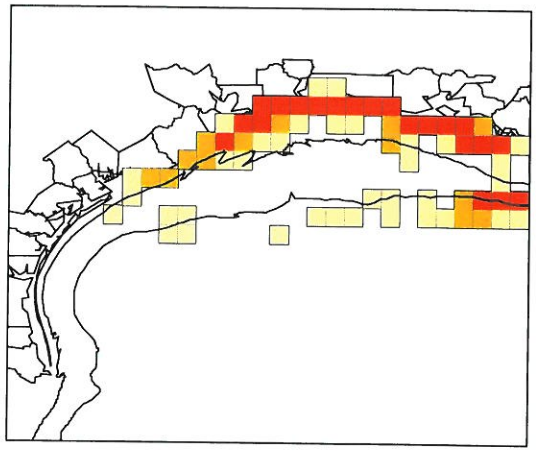

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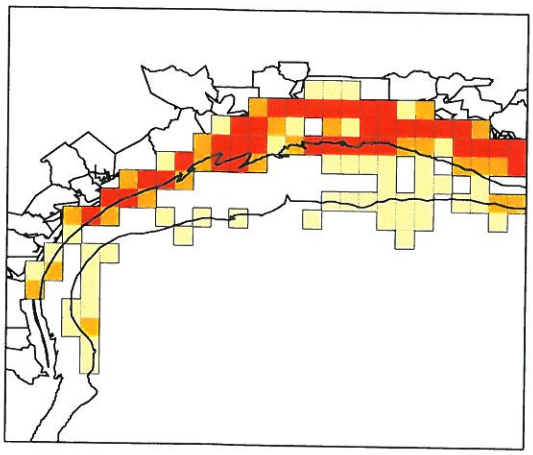

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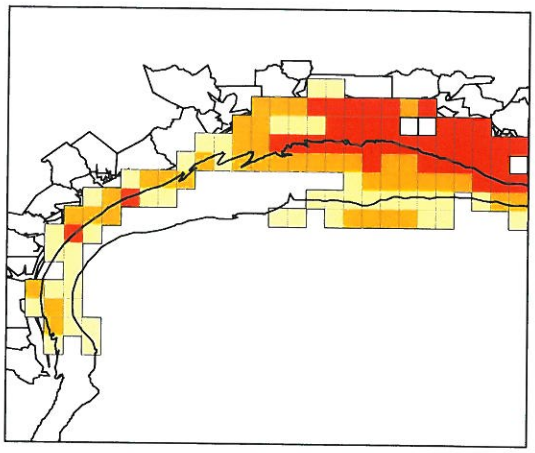

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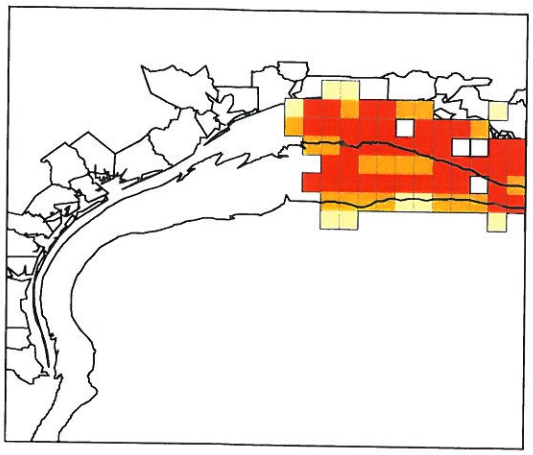

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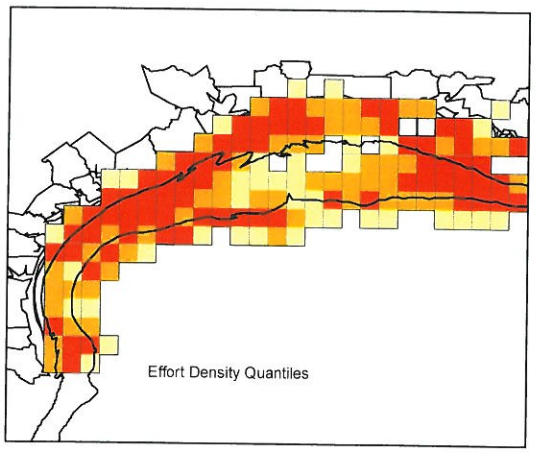

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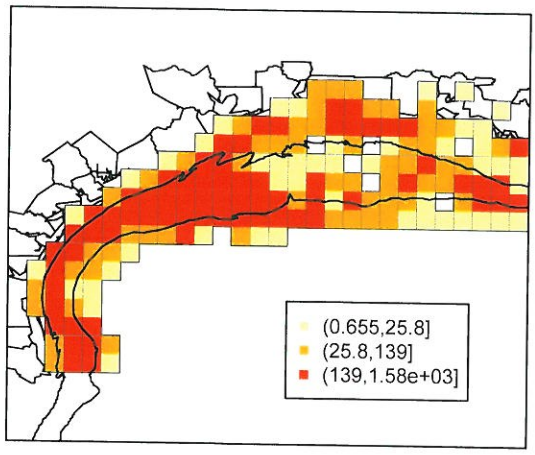

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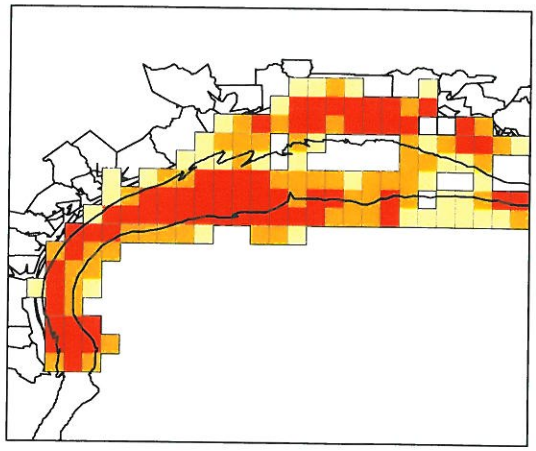

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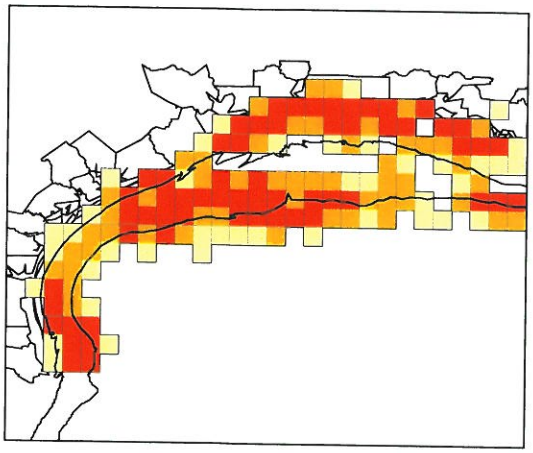

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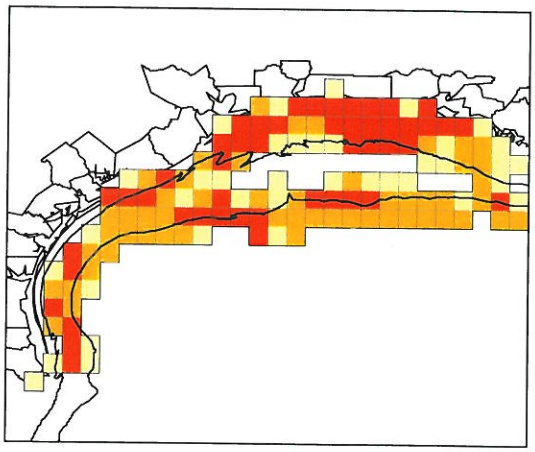

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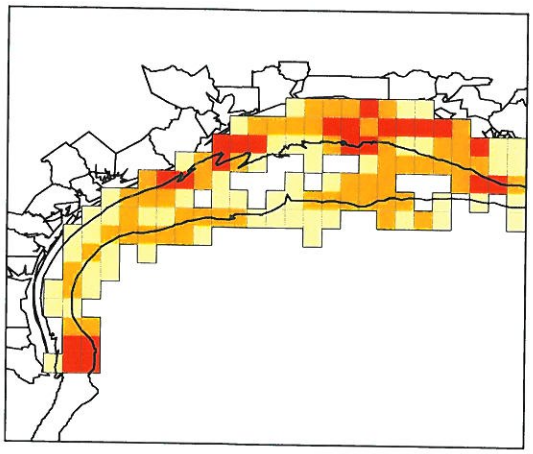


APPENDIX 2
Analysis of Trips Where One Species of Shrimp Represented Over 90% of the Catch

Tows from 367 ELB trips where over 90% of catch was White Shrimp

Prepared 19Jun2012 from 2011 landings file dated 2012-06-18

Table 1: Effort by SEDAR cell (Total 20174) Rows are Trimesters

	21	22	23	31	32	33	41	42
1	477.75	269.46	0.14	1946.64	725.90	0.25	606.79	361.20
2	477.95	45.91	6.90	5170.74	2036.11		988.92	559.94
3	735.59	55.14	12.57	3673.68	518.27	88.54	835.77	580.16

Total white shrimp pounds = 31318896; total pounds when white shrimp represented 90% of catch = 22309285 (71.23%); Total effort for trips when white shrimp represented 90% of catch = 20174; ELB matched pounds = 4288568 (19%)

Tows from 423 ELB trips where over 90% of catch was Brown Shrimp

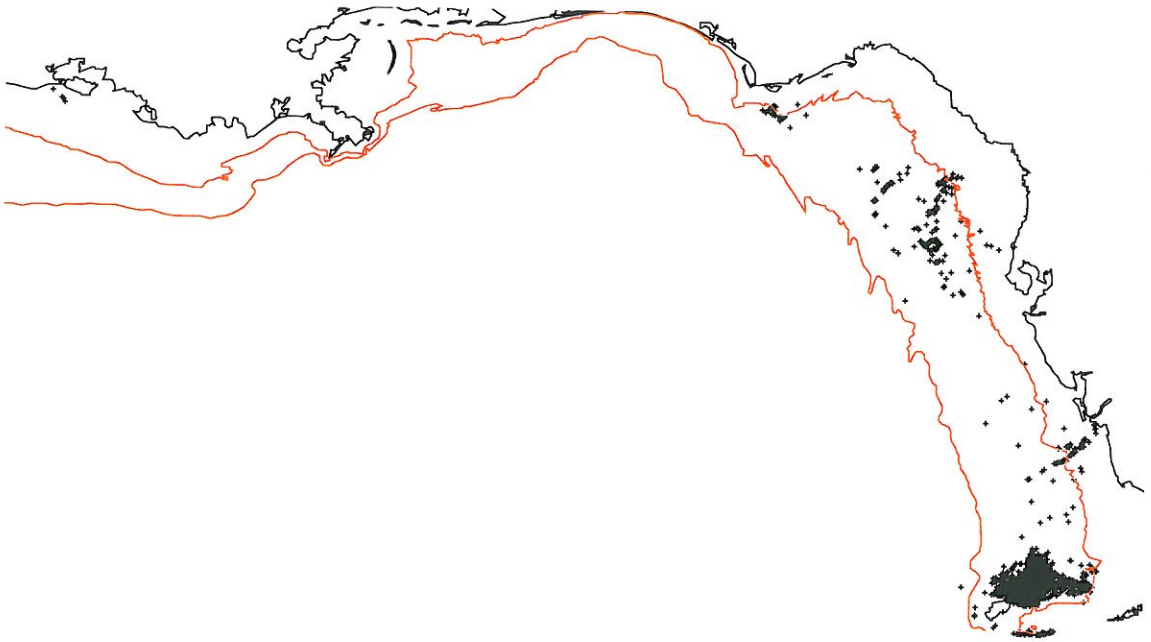
Prepared 19Jun2012 from 2011 landings file dated 2012−06−18

Table 1: Effort by SEDAR cell (Total 24501) Rows are Trimesters

	12	13	21	22	23	31	32	33	41	42	43
1	5.43		0.31	101.67	202.45	33.66	201.68	833.17	25.99	262.19	898.01
2	15.56	0.20	589.89	1298.99	1031.32	159.02	2300.82	801.93	56.76	2755.96	892.89
3			20.90	255.03	770.80	183.32	819.01	2425.32	115.08	6300.99	1142.29

Total brown shrimp pounds = 50120140; total pounds when brown shrimp represented 90% of catch = 40665921 (81.14%); Total effort for trips when brown shrimp represented 90% of catch = 24501; ELB matched pounds = 7224272 (18%)

Tows from 58 ELB trips where over 90% of catch was Pink Shrimp



Prepared 19Jun2012 from 2011 landings file dated 2012-06-18

Table 1: Effort by SEDAR cell; (Total 2932) Columns are Trimesters

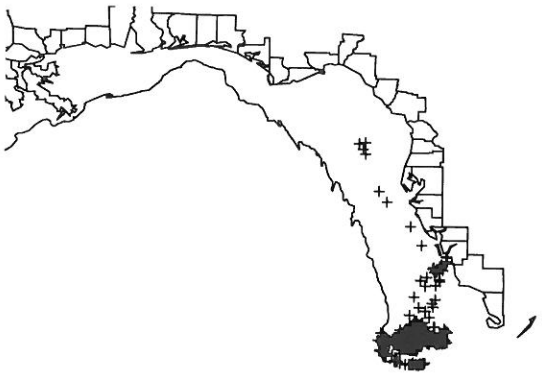
	1	2	3
11	2.04	19.84	2.08
12	1069.12	1190.71	640.96
13			1.67
31	5.84		

Total pink shrimp pounds = 4970036; total pounds when pink shrimp represented 90% of catch = 3609197 (72.62%); Total effort for trips when pink shrimp represented 90% of catch = 2932; ELB matched pounds = 566059 (16%)

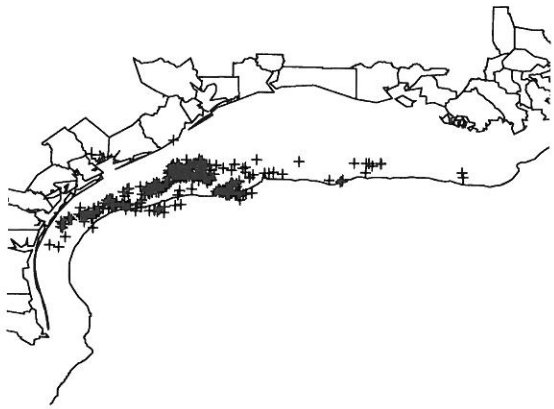
APPENDIX 3
Regional Fishing Patterns by Trimester, 2011

Region 1 ELB from 20 Boxes 2011−1

Region 1 ELB from 20 Boxes 2011−1



Region 1 ELB from 18 Boxes 2011−2



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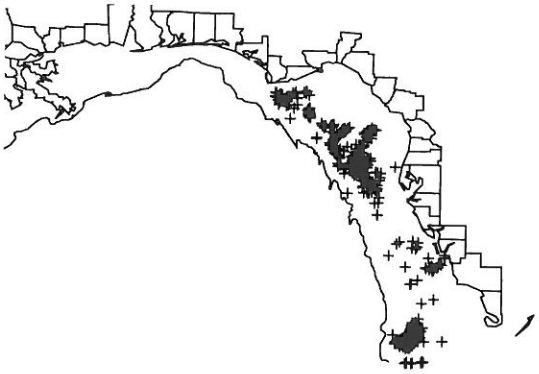
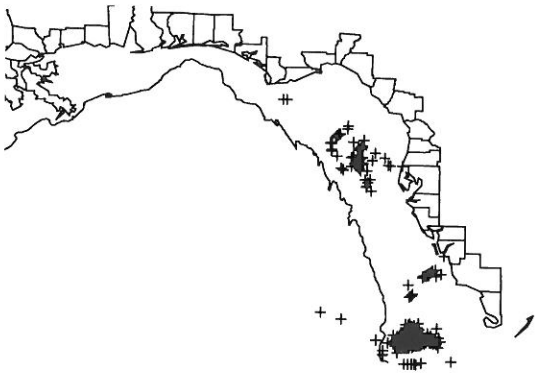
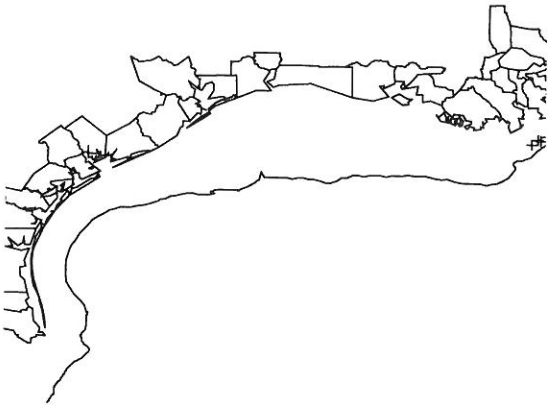


Region 1 ELB from 14 Boxes 2011−3

Region 1 ELB from 14 Boxes 2011−3



Region 2 ELB from 4 Boxes 2011−1



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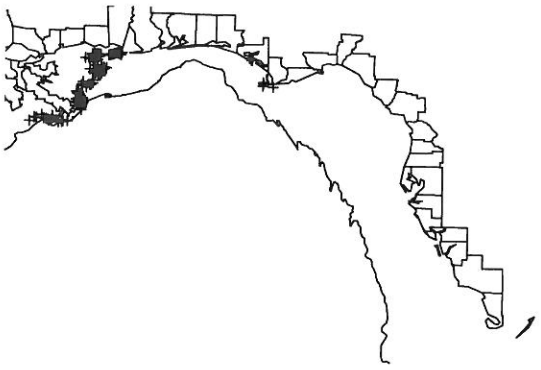
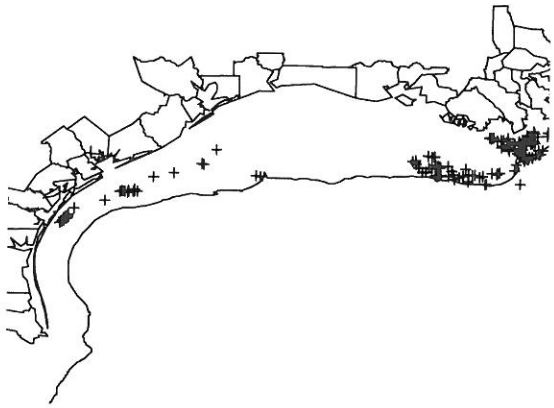


Region 2 ELB from 5 Boxes 2011−2



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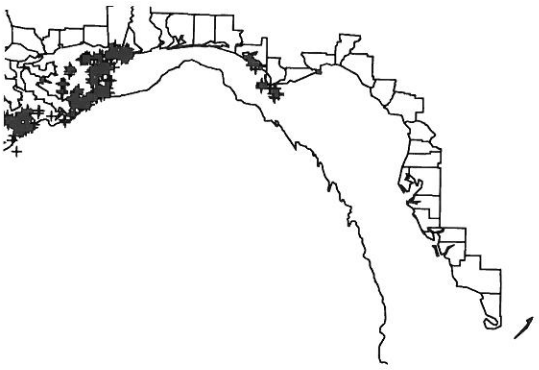

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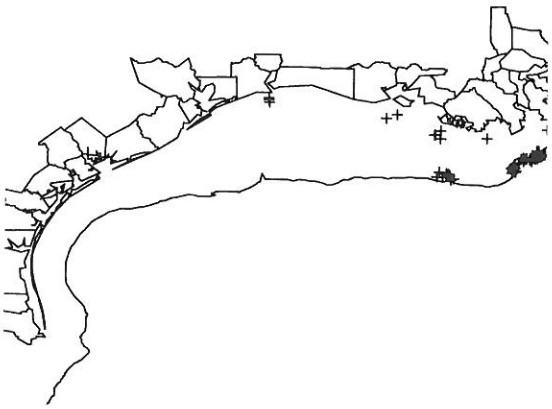

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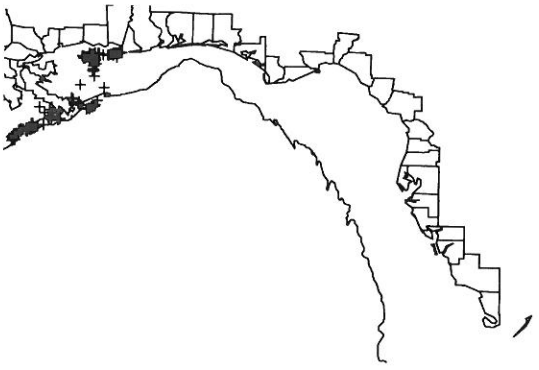
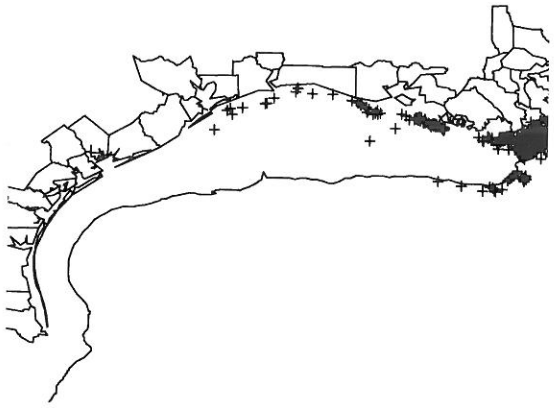


Region 3 ELB from 28 Boxes 2011-1



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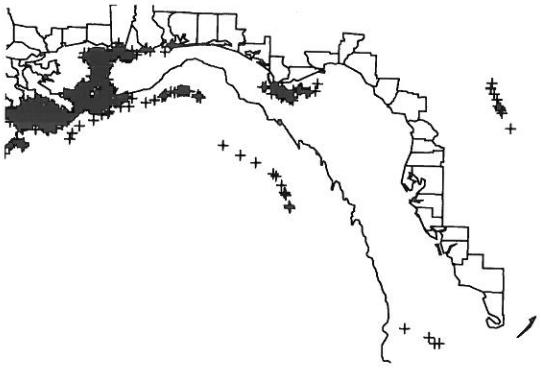
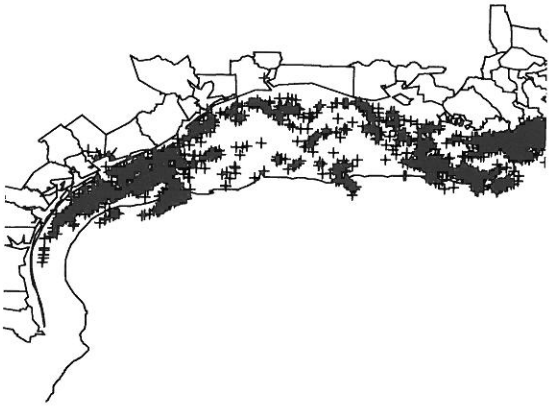


Region 3 ELB from 38 Boxes 2011-2



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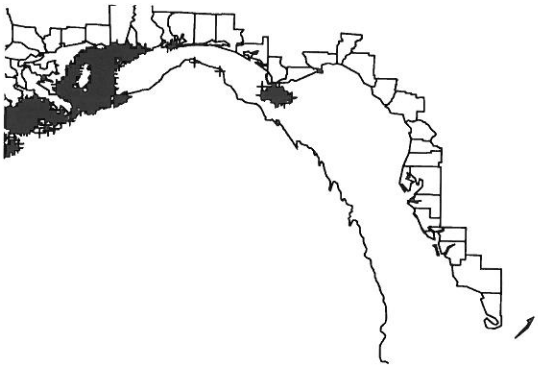

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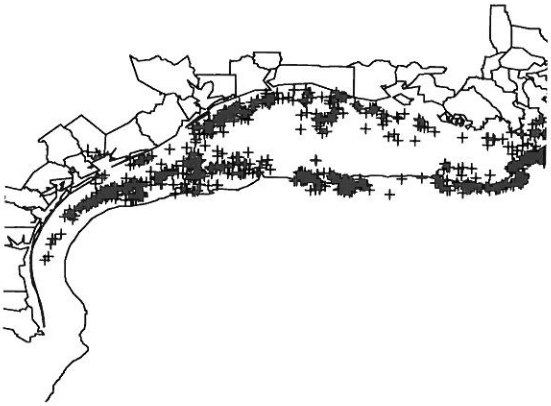

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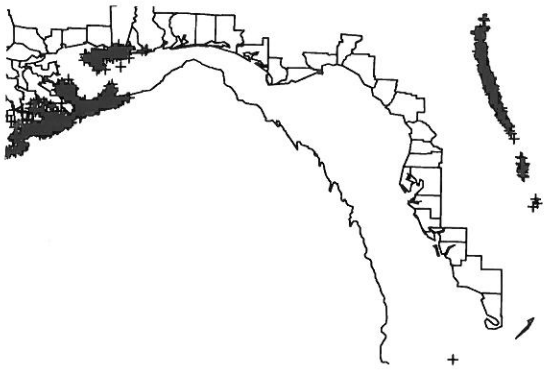
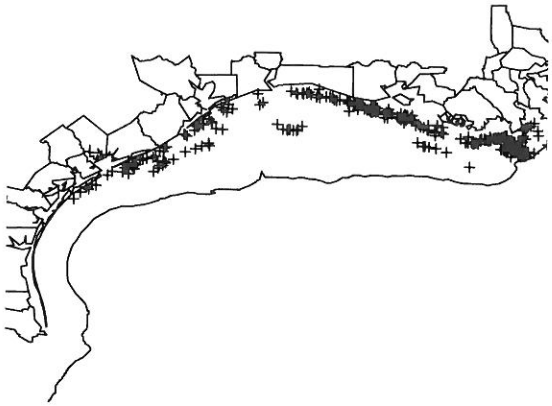
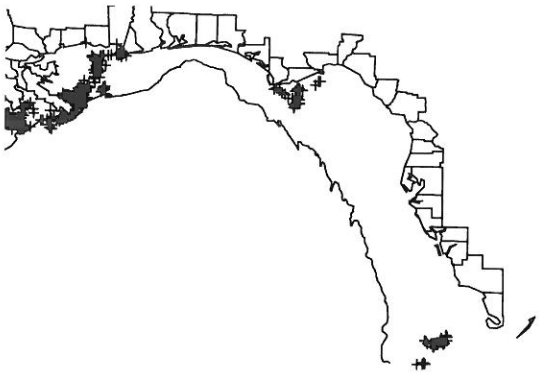


Region 4 ELB from 17 Boxes 2011-1



Region 4 ELB from 17 Boxes 2011-1



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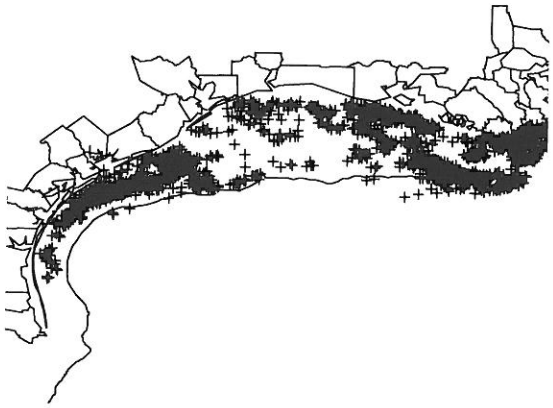

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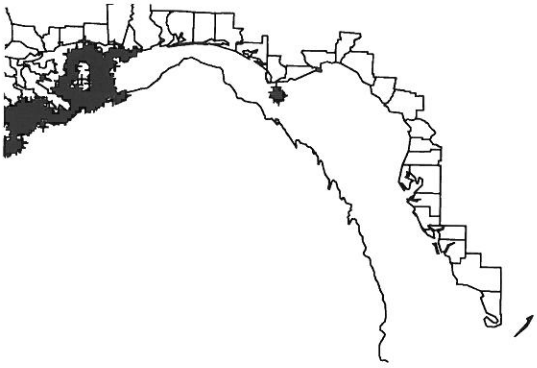
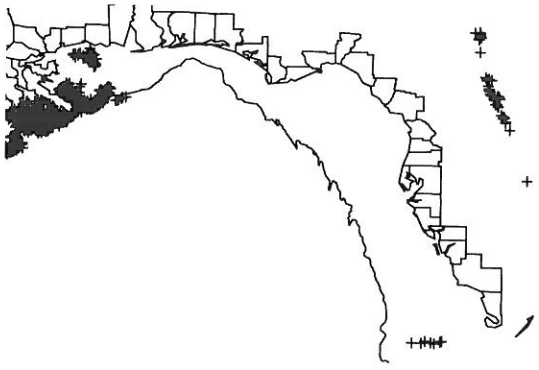
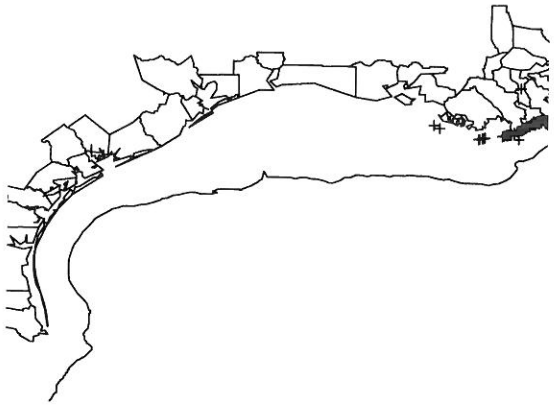


Region 4 ELB from 37 Boxes 2011-3

Region 4 ELB from 37 Boxes 2011-3



Region 5 ELB from 14 Boxes 2011-1



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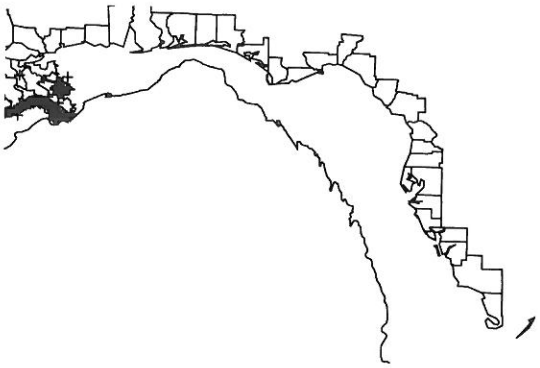

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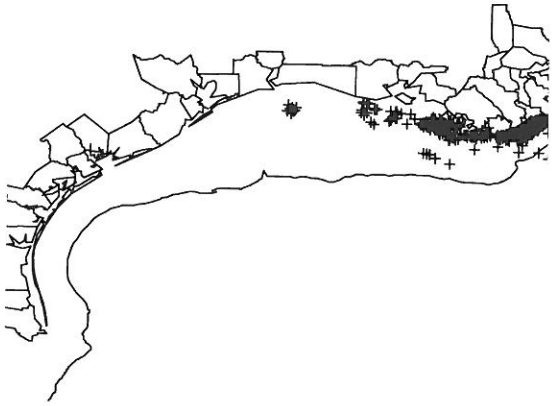
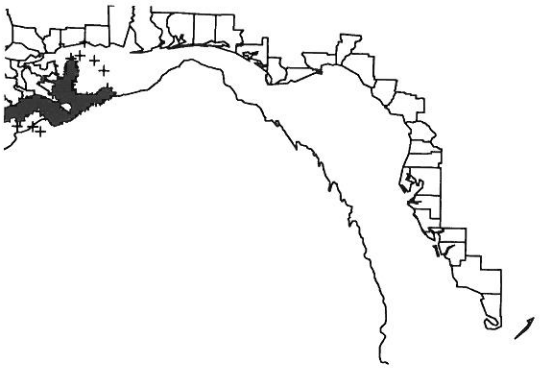
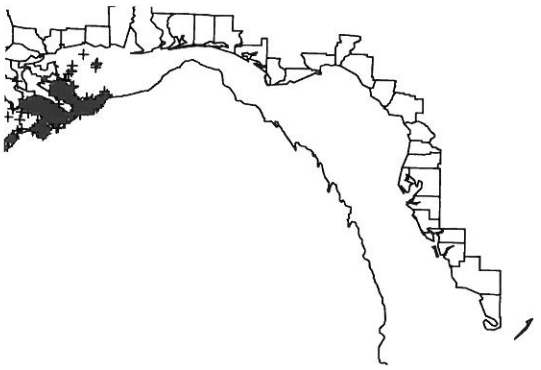


Region 5 ELB from 25 Boxes 2011-2

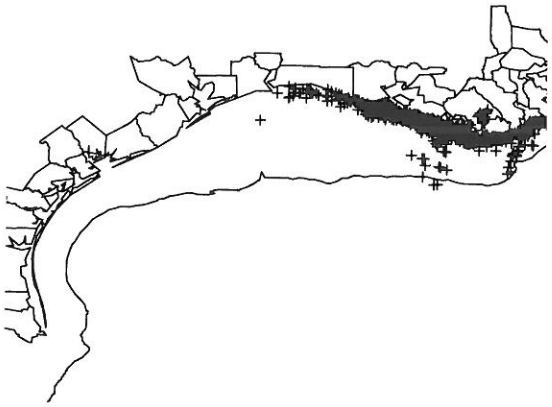


Region 5 ELB from 17 Boxes 2011-3

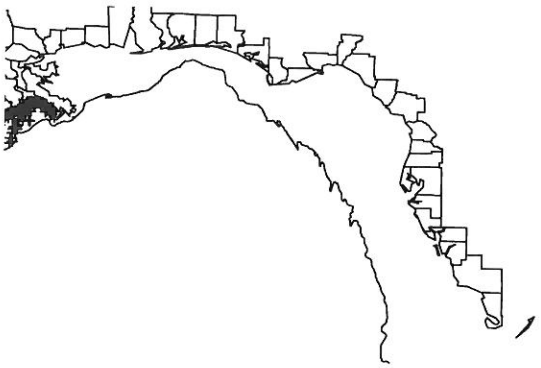
Region 5 ELB from 17 Boxes 2011-3



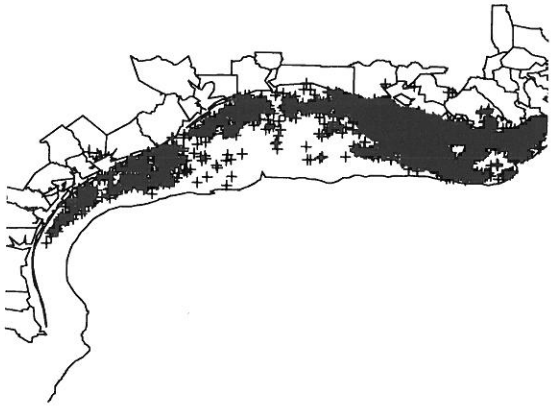
Region 6 ELB from 35 Boxes 2011-1



Region 6 ELB from 35 Boxes 2011-1



Region 6 ELB from 81 Boxes 2011-2



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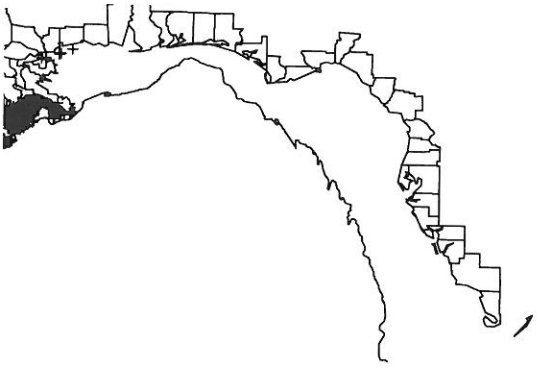
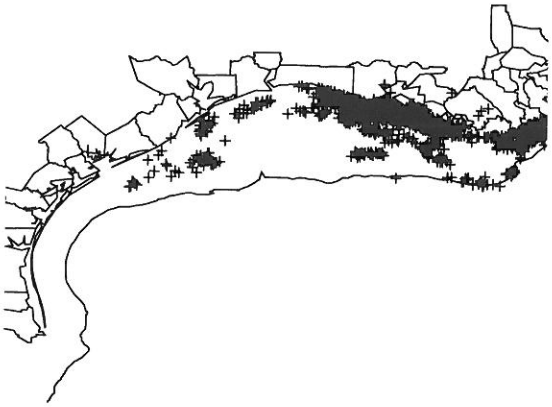


Region 6 ELB from 48 Boxes 2011-3



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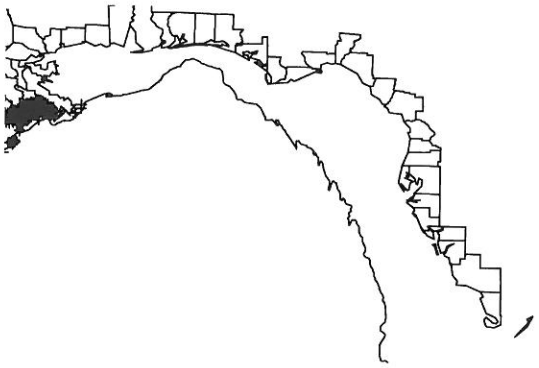
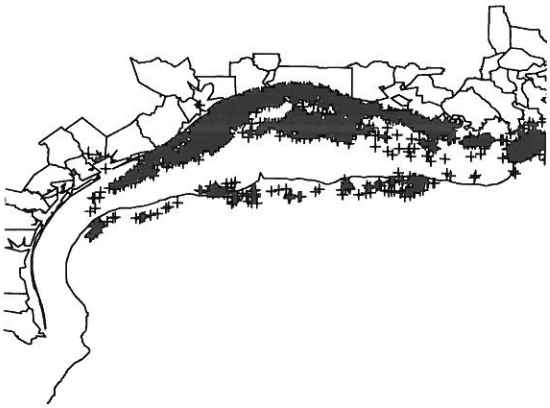


Region 7 ELB from 54 Boxes 2011–1



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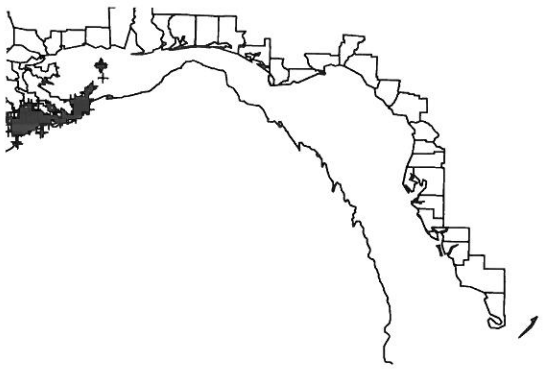
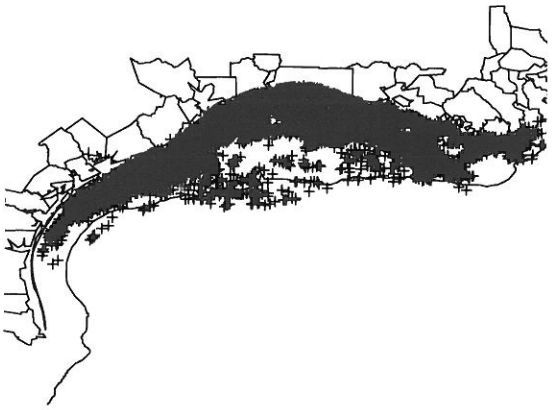


Region 7 ELB from 79 Boxes 2011–2



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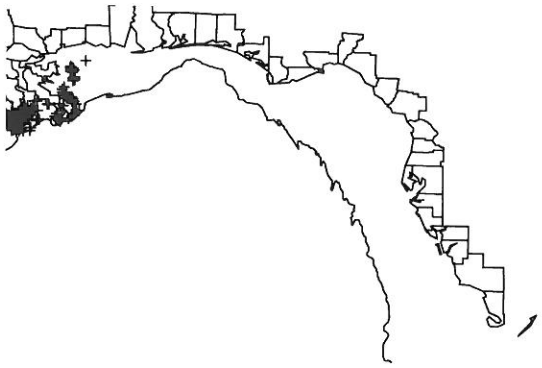

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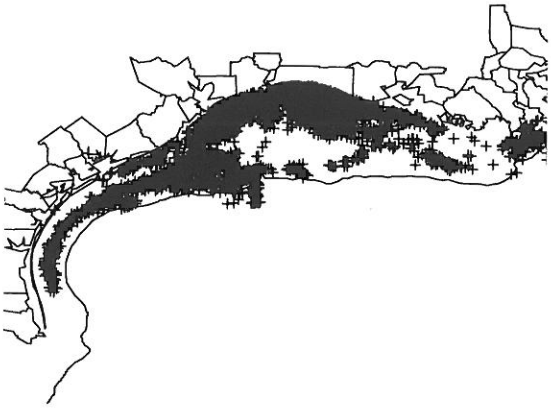
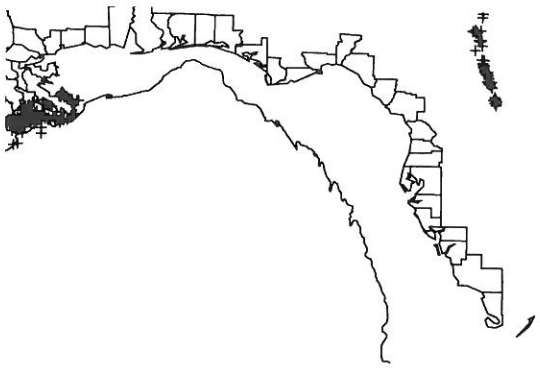
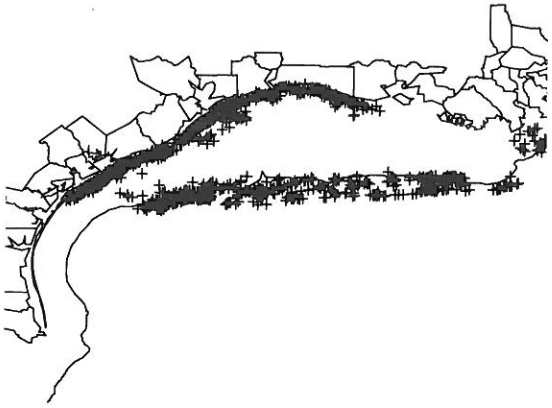


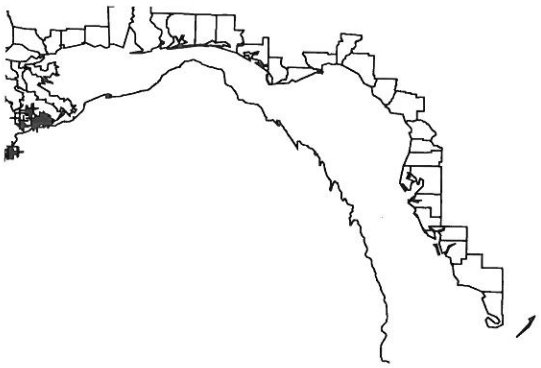
Region 7 ELB from 62 Boxes 2011–3



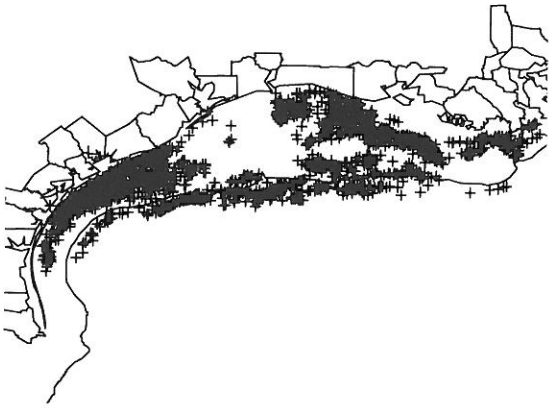
Region 8 ELB from 20 Boxes 2011-1



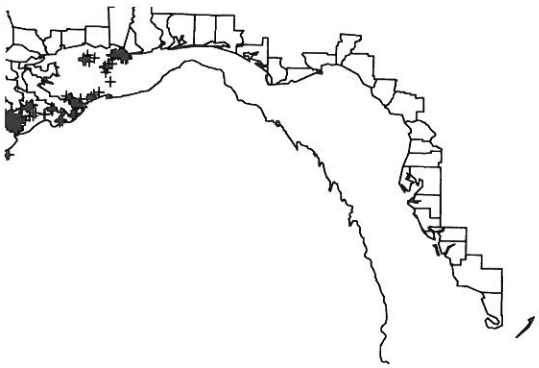
Region 8 ELB from 20 Boxes 2011-1



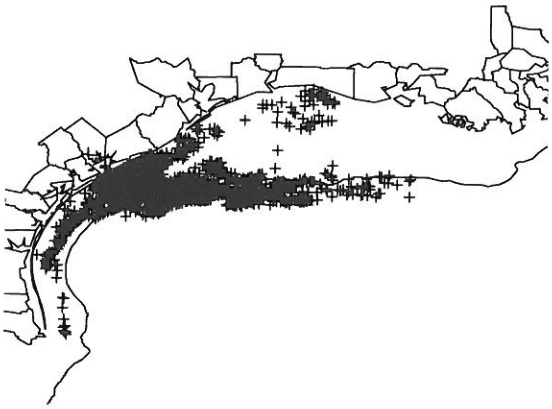
Region 8 ELB from 27 Boxes 2011-2



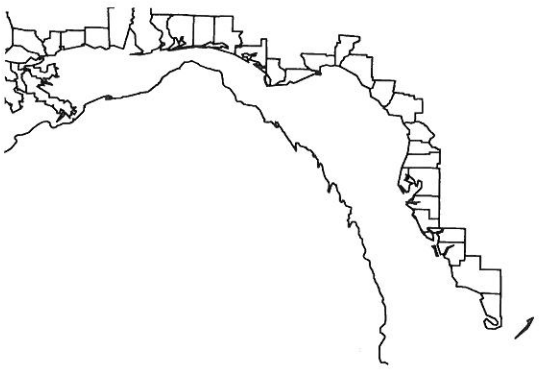
Region 8 ELB from 27 Boxes 2011-2



Region 8 ELB from 23 Boxes 2011-3

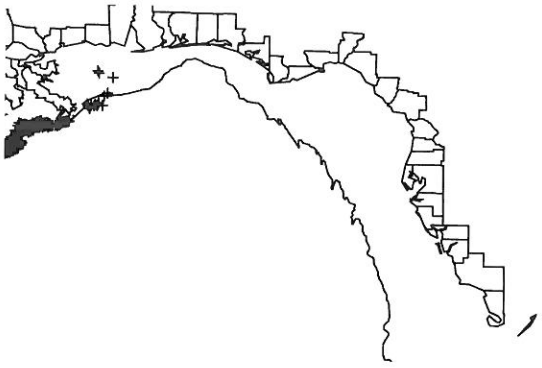


Region 8 ELB from 23 Boxes 2011-3



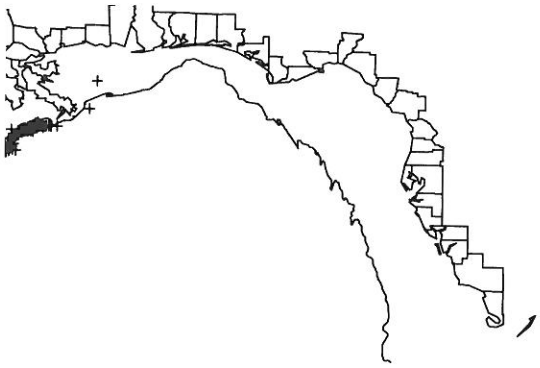
Region 9 ELB from 23 Boxes 2011-1

Region 9 ELB from 23 Boxes 2011-1



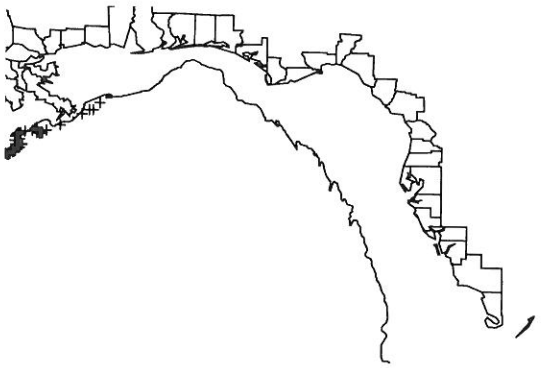
Region 9 ELB from 39 Boxes 2011-2

Region 9 ELB from 39 Boxes 2011-2



Region 9 ELB from 30 Boxes 2011-3

Region 9 ELB from 30 Boxes 2011-3



APPENDIX 4
Effort Estimates for 2011 by Area, Trimester, and Depth Zone

Year	Area	Tri	Dpz	EezEff	Steff	Toteff
2011	1	1	1	0	175	175
2011	1	1	2	1,701	0	1,701
2011	1	1	3	100	0	100
2011	2	1	1	0	461	461
2011	2	1	2	421	7	428
2011	2	1	3	226	7	233
2011	3	1	1	1,761	1,075	2,836
2011	3	1	2	1,918	10	1,928
2011	3	1	3	738	0	738
2011	4	1	1	0	631	631
2011	4	1	2	2,170	0	2,170
2011	4	1	3	1,080	0	1,080
2011	1	2	1	0	352	352
2011	1	2	2	2,104	4	2,108
2011	2	2	1	0	2,007	2,007
2011	2	2	2	606	21	628
2011	2	2	3	729	16	744
2011	3	2	1	6,511	3,720	10,231
2011	3	2	2	6,640	14	6,654
2011	3	2	3	930	0	930
2011	4	2	1	0	1,458	1,458
2011	4	2	2	4,371	13	4,384
2011	4	2	3	744	0	744
2011	1	3	1	0	138	138
2011	1	3	2	1,204	0	1,204
2011	1	3	3	12	0	12
2011	2	3	1	0	433	433
2011	2	3	2	242	27	269
2011	2	3	3	577	32	608
2011	3	3	1	4,102	2,061	6,163
2011	3	3	2	2,533	9	2,542
2011	3	3	3	1,547	45	1,592
2011	4	3	1	0	1,607	1,607
2011	4	3	2	8,103	2	8,106
2011	4	3	3	1,215	1	1,216

APPENDIX 5
Estimates of Total Offshore Shrimp Fishing Effort 1960-2011 in Nominal Days Fished

Yr	Totoff	s1021d1030	s1021eez	s1021off	s1321d1030	s1321eez	s1321off
1960	120,271	51,899	51,149	88,874	46,899	45,927	80,499
1961	85,881	41,049	41,062	68,687	36,394	36,200	61,196
1962	104,318	37,330	40,087	75,666	34,768	37,468	67,763
1963	118,940	45,632	46,255	91,361	42,572	43,015	81,957
1964	128,659	43,449	47,102	96,707	38,511	42,150	87,256
1965	113,778	48,815	48,666	89,669	43,442	42,778	79,141
1966	107,812	48,782	49,537	85,746	43,203	43,066	75,326
1967	126,084	58,941	64,402	106,767	53,293	57,933	96,663
1968	129,541	57,165	59,626	109,441	48,011	49,989	96,240
1969	151,224	71,938	72,632	130,831	64,682	64,279	116,357
1970	127,855	66,539	61,717	107,149	59,714	54,007	93,592
1971	132,102	67,686	67,290	114,590	61,078	59,890	101,145
1972	157,194	73,776	74,495	137,357	65,653	65,745	123,746
1973	146,089	50,188	61,472	120,486	43,818	54,442	109,861
1974	146,415	52,162	59,679	121,101	46,516	53,436	110,701
1975	128,520	51,830	58,218	101,856	45,704	51,961	93,212
1976	154,475	57,015	60,521	131,202	50,296	53,270	122,254
1977	166,307	51,159	55,849	137,833	44,357	48,928	125,020
1978	202,002	60,824	63,383	176,056	56,177	58,434	166,834
1979	211,497	58,046	70,736	186,209	54,230	66,204	177,769
1980	144,256	35,197	50,031	128,772	32,708	47,298	123,007
1981	176,727	55,998	81,330	149,664	52,957	78,301	140,659
1982	173,894	56,253	80,314	151,745	52,294	75,354	139,681
1983	171,311	47,174	69,810	146,522	42,361	64,477	131,012
1984	191,739	60,875	91,896	163,578	55,512	84,383	141,218
1985	196,628	57,255	86,383	170,428	50,390	79,926	152,612
1986	226,798	78,816	105,898	199,415	73,442	101,130	185,902
1987	241,902	81,248	113,484	217,552	78,410	110,470	206,181
1988	205,812	79,989	106,261	184,011	75,134	100,905	168,446
1989	221,165	77,153	103,738	200,496	67,562	94,030	178,010
1990	211,860	75,901	91,650	193,384	67,942	83,454	173,195
1991	223,388	92,575	122,709	206,395	84,263	114,604	189,578
1992	216,669	96,604	121,387	193,216	88,100	113,246	178,994
1993	204,482	94,660	117,589	185,463	87,293	109,830	173,121
1994	195,742	74,549	100,467	172,419	68,920	94,025	159,641
1995	176,589	66,166	93,747	147,528	59,611	86,336	133,787
1996	189,653	66,221	95,148	151,315	60,682	89,125	142,327
1997	207,912	83,146	105,231	173,024	75,090	96,862	160,366
1998	216,999	78,346	102,814	174,880	68,867	93,198	159,251
1999	200,475	68,534	95,307	177,499	61,271	87,614	162,073
2000	192,073	77,718	103,786	174,299	69,149	95,484	159,799
2001	197,644	84,034	110,156	177,277	75,688	102,692	163,659
2002	206,621	90,095	119,121	180,678	81,902	111,929	165,703
2003	168,135	74,304	97,362	145,992	68,196	91,887	134,967
2004	146,696	49,856	80,333	125,578	44,995	75,170	116,100
2005	102,840	33,799	59,542	86,910	29,229	54,211	78,207
2006	92,372	28,456	73,530	82,409	24,811	68,659	74,340
2007	80,733	18,542	57,398	74,628	16,562	52,205	65,153
2008	62,797	13,959	40,542	58,135	11,936	37,953	49,687
2009	76,508	19,012	44,016	68,137	17,076	41,345	58,981
2010	60,518	15,260	40,631	53,658	14,816	39,816	51,271
2011	66,615	27,109	47,166	60,824	25,784	44,364	55,012