Catch rates, distribution and size composition of small coastal sharks collected during NOAA Fisheries Bottom Longline Surveys from the U.S. Gulf of Mexico and U.S. Atlantic Ocean.

Walter Ingram, William Driggers, Mark Grace, Terry Henwood, Lisa Jones, and Karen Mitchell
NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center,
Mississippi Laboratories, Pascagoula, Mississippi 39567

Introduction and Survey Design

The Southeast Fisheries Science Center (SEFSC) Mississippi Laboratories has conducted standardized bottom longline surveys in the Gulf of Mexico, Caribbean Sea, and Western North Atlantic Ocean since 1995 (Figure 1). The objective of this longline survey is to provide fisheries independent data for stock assessment for as many species as possible. This survey, which is conducted annually in U.S. waters of the Gulf of Mexico (GOM) and/or the western north Atlantic Ocean (Atlantic) (Table 1), provides an important source of fisheries independent information on small coastal sharks in the GOM and Atlantic. Details concerning methodologies and evolution of this survey have been covered in previous documents (most recently LCS05/06-DW-27) and will not be repeated in this document.

Uses of Longline Data for the SCSC SEDAR 2007

For the small coastal shark SEDAR 2007, we used the entire time series of data to develop abundance indices for blacknose sharks, Atlantic sharpnose sharks (sharpnose) and the small coastal shark complex (SCSC) for both the GOM and Atlantic. The locations of all stations and stations where blacknose, sharpnose, bonnethead, and finetooth sharks, as well as where the SCSC were caught were plotted by year and all years combined (Figures 2 – 39). Survey coverage area varied during the time series due to weather, mechanical problems, and mission objectives (LCS05/06-DW-27).

Figure 40 shows percentage total catch of the SCSC species in our data set from the GOM and Atlantic. In both areas, the catch of small coastal sharks is dominated by sharpnose sharks. Catch in the GOM is comprised of approximately 85 % sharpnose sharks, 14 % blacknose sharks and less than 1 % of the other small coastal sharks, while in the Atlantic the catch is comprised of over 98 % sharpnose sharks and less than 2 % blacknose sharks. This could indicate a difference in the species composition of the small coastal shark complex in the each area.

To develop standardized indices of annual average CPUE for blacknose sharks, sharpnose sharks and SCSC for both the GOM and Atlantic, a delta-lognormal model, as described by Lo et al. (1992), was employed. This index is a mathematical combination of yearly CPUE estimates from two distinct generalized linear models: a binomial (logistic) model which describes proportion of positive CPUE values (i.e., presence/absence) and lognormal model which describes variability in only the nonzero CPUE data. A backward selection approach, while using the GLMMIX and MIXED procedures (Patetta, 2002) in SAS, was employed to provide yearly index values for both the binomial and lognormal sub-models, respectively. The parameters tested for inclusion in each sub-model were survey year, area, hook type, depth, bottom temperature, and bottom salinity; and separate covariance structures were developed for

each survey year. For this study there were two major area demarcations: Atlantic (south of 37^o north latitude) and the U.S. GOM; and three minor area demarcations in the GOM: Eastern Gulf (east of 88^o west longitude); Central Gulf (between 88^o and 93^o west longitude); and Western Gulf (west of 93^o west longitude). Also, as described in previous documents (most recently LCS05/06-DW-27), hook-type changed over time from J to circle-hooks (C-hooks). For the binomial models, a logistic-type mixed model was employed for all areas for SCSC. The fit of each model was evaluated using the fit statistics provided by the GLMMIX macro. Initially, several model types were used to describe the nonzero CPUE data. These included lognormal, Poisson and negative binomial. Based on analyses of residual scatter and QQ plots, the lognormal model was more fitting than the others in describing the variability in the nonzero data in most of the models. Due to the extremely low catches of finetooth sharks and bonnetheads, no abundance indices were developed for these species.

Figures 41 – 49 summarize annual abundance indices for blacknose sharks, sharpnose sharks and SCSC for the Atlantic, GOM and both areas combined. For the Atlantic, indices for both sharpnose sharks (Figure 42) and the SCSC (Figure 43) were found to be increasing over time. For blacknose sharks (Figure 41), the Atlantic indices are not recommended due to high variability and several years where no blacknose sharks were collected. For the GOM, indices for blacknose sharks (Figure 44), sharpnose sharks (Figure 45) and SCSC (Figure 46) were found to be increasing over time with a decrease in the later survey years. For both areas combined, indices for both sharpnose sharks (Figure 48) and the SCSC (Figure 49) were found to be increasing over time with a decrease in 2006. For blacknose sharks (Figure 47), the indices were found to be increasing over time with a decrease in the later survey years. The decreases seen in survey year 2005 may be a result of the lack of survey coverage for that year combined with the possible inability of the model to properly adjust for the lack of effort. This is due to the majority of the small coastal sharks collected during the survey being collected in the central and western GOM.

We next constructed fork length frequency histograms for blacknose, sharpnose, bonnethead, and finetooth sharks, as well as the SCSC for the Atlantic and GOM (Figures 50 – 57). These indicated possible differences in size distributions of blacknose sharks, sharpnose sharks, and the SCSC between the Atlantic and GOM.

Literature Cited

Walter Ingram, Terry Henwood, Mark Grace, Lisa Jones, William Driggers, and Karen Mitchell. 2005. Catch rates, distribution and size composition of large coastal sharks collected during NOAA Fisheries Bottom Longline Surveys from the U.S. Gulf of Mexico and U.S. Atlantic Ocean. LCS05/06-DW-27

Lo, N. C. H., L.D. Jacobson, and J.L. Squire. 1992. Indices of relative abundance from fish spotter data based on delta-lognormal models. Can. J. Fish. Aquat. Sci. 49: 2515-1526.

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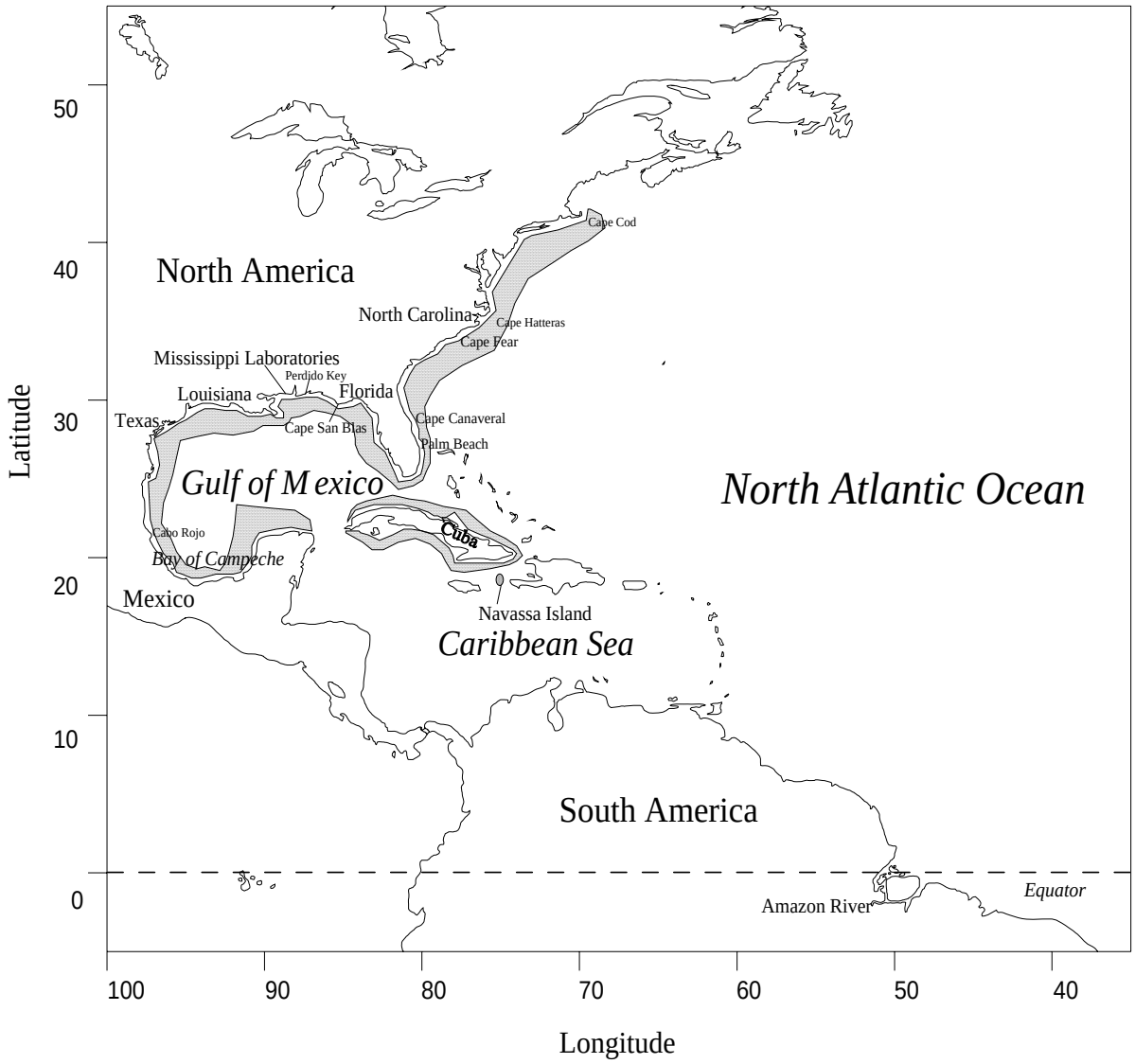


Figure 1. Survey areas for NMFS MS Laboratories longline projects (1995-2001) in the western North Atlantic Ocean. Stippled areas indicate where survey effort occurred.

Table 1. NMFS MS Laboratory longline projects, 1995 - 2003.

Survey	Date	Location	Depth range (m)	Effort (# sets)	Random station selection description.
OT-95-04 (218)	7/23 - 8/17/95	GOM[1]	18 m - 73 m	82	Stations depth stratified and equally allocated within statistical zones; depth strata 18 m - 37 m, 37 m - 55 m, 55 m - 73 m; J hooks.
RS-95-03 (2)	8/10 - 8/24/95	Atlantic[2]	18 m - 73 m	45	Stations depth stratified and equally allocated within statistical zones; depth strata 18 m - 37 m, 37 m - 55 m, 55 m - 73 m; J hooks.
OT-96-04 (222)	7/31 - 9/13/96	GOM and Atlantic	18 m - 73 m	151	Stations depth stratified and equally allocated within statistical zones; depth strata 18 m - 37 m, 37 m - 55 m, 55 m - 73 m; J hooks.
OT-97-04 (227)	7/25 - 9/24/97	Mexican GOM, GOM and Atlantic	9 m - 55 m	259	Stations not depth stratified but equally allocated within 60 linear n. mile zones or statistical zones; J hooks.
OT-98-02 (231)	7/24 - 9/22/98	Mexican GOM, Cuba [3], GOM	9 m - 413 m	216	Stations not depth stratified but equally allocated within 60 linear n. mile zones or statistical zones; J hooks.
OT-99-02 (233)	2/16 - 3/2/99	Atlantic	9 m - 55 m	29	Stations not depth stratified but equally allocated within statistical zones; J hooks.
FE-99-10 SEF	5/6 - 5/19/99	GOM	64 m - 146 m	60	Station coordinates by random longitude and random depth and equally allocated within 10 linear n. mile contiguous sampling blocks; circle hooks.
CARETTA 99-01	8/4 - 9/28/99	GOM	9 m - 55 m	161	Proportional allocation based on continental shelf width within statistical zones; sampling density experiment; hook comparison experiment with 75% J hooks, 25% circle hooks.
GU-00-03 (8)	6/6 - 6/19/00	GOM	64 m - 146 m	59	Station coordinates by random longitude and random depth and equally allocated within 20 linear n. mile contiguous sampling blocks; hook comparison experiment with 75% circle hooks, 25% J hooks.
OT-00-04 (241)	8/3 - 8/28/00	GOM	9 m - 183 m	137	Proportional allocation based on continental shelf width within statistical zones; sampling density experiment; hook comparison experiment with 75% J hooks, 25% circle hooks.
FE-00-12 (2)	9/6 - 10/16/00	Atlantic	9 m - 183 m	105	Proportional allocation based on continental shelf width within statistical zones; sampling density experiment; hook comparison experiment with 75% J hooks, 25% circle hooks.
OT-00-08 (244)	12/6 - 12/12/00	GOM	55 m - 366 m	41	Station coordinates by random longitude and random depth and equally allocated within 10 linear n. mile contiguous sampling blocks; stations depth stratified with 4 stations each block 55 m - 183 m, 2 stations each block 183 m - 366 m; hook comparison experiment with 75% circle hooks, 25% J hooks.
ONJUKU-01	6/1 - 6/20/01	Mexican GOM[4]	9 m - 50 m	38	Proportional allocation based on continental shelf width within 60 linear n. mile sampling zones; circle hooks, Atlantic bonito for bait.
OT-01-04 (247)	7/31 - 9/30/01	GOM	9 m - 366 m	277	Proportional allocation based on continental shelf width within statistical zones; depth stratified, 50% allocation 9 m - 55 m, 40% allocation 55 m - 183 m, 10% allocation 183 m - 366 m; circle hooks.
ONJUKU-01	6/28 - 7/5/02	Mexican GOM[4]	18 m - 217 m	30	Proportional allocation based on continental shelf width within 60 linear n. mile sampling zones; circle hooks, Atlantic bonito for bait
OT-02-04 (251)	7/31 - 9/21/02	GOM and Atlantic	9 m - 366 m	212	Proportional allocation based on continental shelf width within statistical zones; depth stratified, 50% allocation 9 m - 55 m, 40% allocation 55 m - 183 m, 10% allocation 183 m - 366 m; circle hooks.
OT-03-04 (255)	7/29 - 9/29/03	GOM	9 m - 366 m	280	Proportional allocation based on continental shelf width within statistical zones; depth stratified, 50% allocation 9 m - 55 m, 40% allocation 55 m - 183 m, 10% allocation 183 m - 366 m; circle hooks.
GANDY 72-043	07/25 - 08/28/04	Atlantic	8 m – 34 m	40	Proportional allocation based on continental shelf width within statistical zones; depth stratified, 50% allocation 9 m - 55 m, 40% allocation 55 m - 183 m, 10% allocation 183 m - 366 m; circle hooks.
OT-04-04 (260)	7/31 - 9/29/04	GOM	9 m - 366 m	232	Proportional allocation based on continental shelf width within statistical zones; depth stratified, 50% allocation 9 m - 55 m, 40% allocation 55 m - 183 m, 10% allocation 183 m - 366 m; circle hooks.
GANDY 72-044	10/06 - 10/23/04	GOM	7 m – 92 m	17	Proportional allocation based on continental shelf width within statistical zones; depth stratified, 50% allocation 9 m - 55 m, 40% allocation 55 m - 183 m, 10% allocation 183 m - 366 m; circle hooks.
OT-05-04 (266)	8/5 - 8/25/05	GOM and Atlantic	9 m - 366 m	74	Proportional allocation based on continental shelf width within statistical zones; depth stratified, 50% allocation 9 m - 55 m, 40% allocation 55 m - 183 m, 10% allocation 183 m - 366 m; circle hooks.
OT-06-04 (272)	7/29 - 9/22/06	GOM and Atlantic	9 m - 366 m	181	Proportional allocation based on continental shelf width within statistical zones; depth stratified, 50% allocation 9 m - 55 m, 40% allocation 55 m - 183 m, 10% allocation 183 m - 366 m; circle hooks.

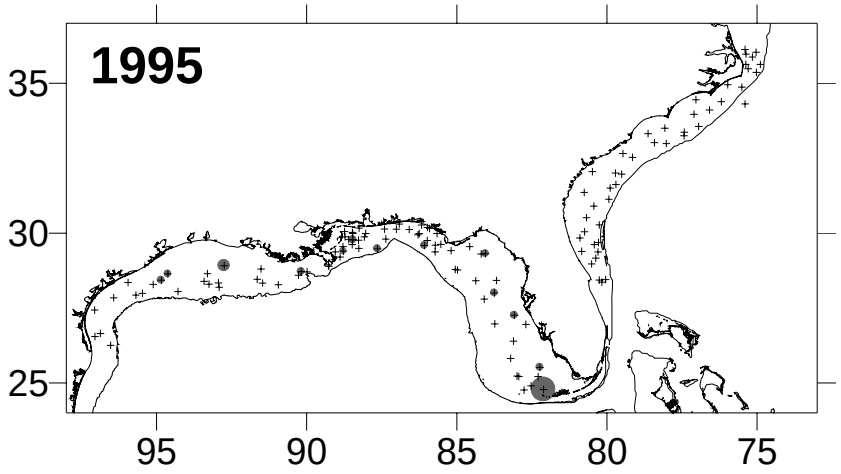


Figure 2. Survey effort (crosses) and positive CPUE (gray circles, range: 1 to 5 sharks per 100 hook hours) for blacknose sharks from 1995. X and Y axes represent degrees west longitude and degrees north latitude, respectively.

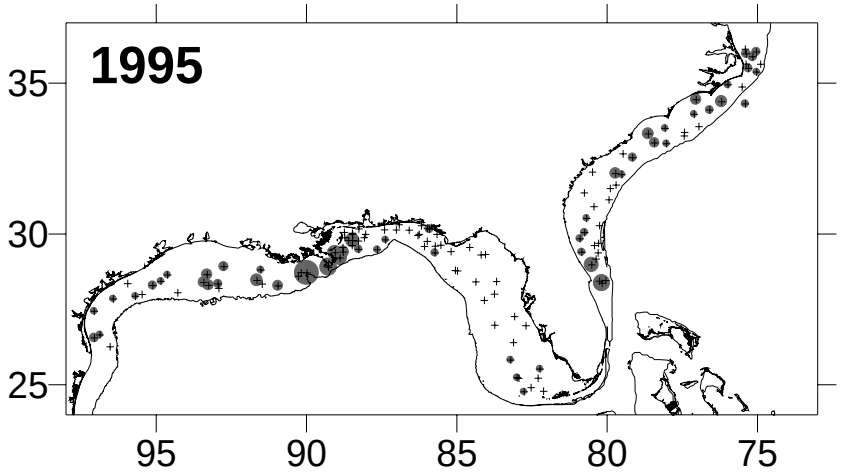


Figure 3. Survey effort and positive CPUE (range: 1 to 21 sharks per 100 hook hours) for Atlantic sharpnose sharks from 1995.

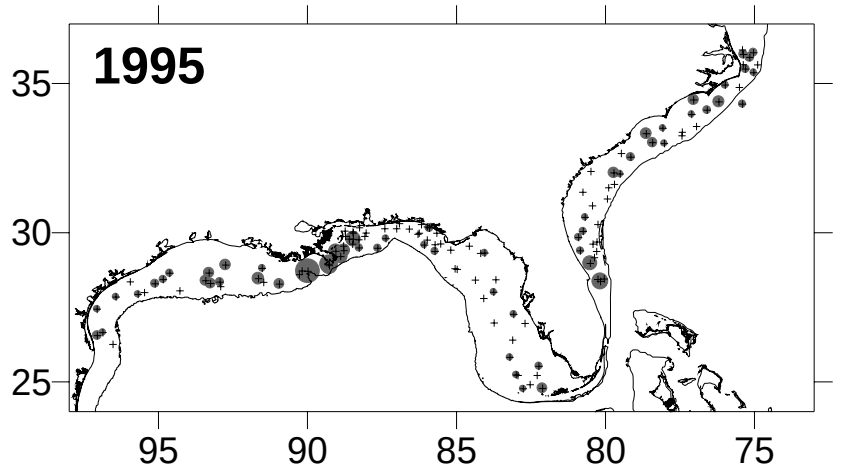


Figure 4. Survey effort and positive CPUE (range: 1 to 21 sharks per 100 hook hours) for small coastal sharks from 1995.

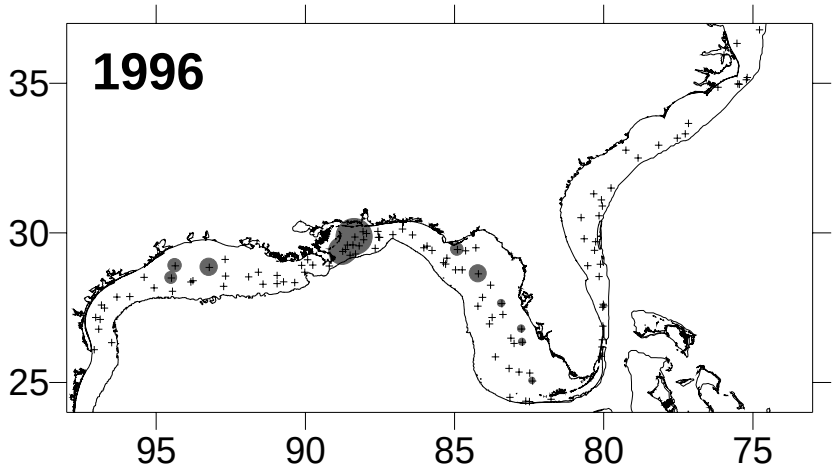


Figure 5. Survey effort and positive CPUE (range: 1 to 6 sharks per 100 hook hours) for blacknose sharks from 1996.

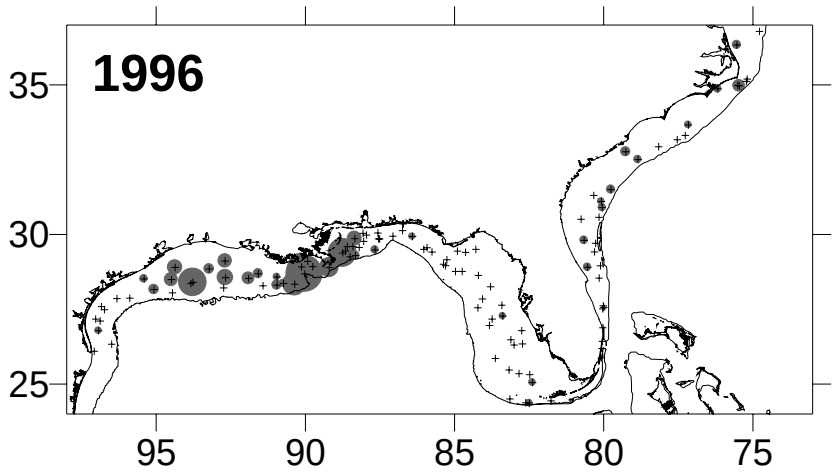


Figure 6. Survey effort and positive CPUE (range: 1 to 34 sharks per 100 hook hours) for Atlantic sharpnose sharks from 1996.

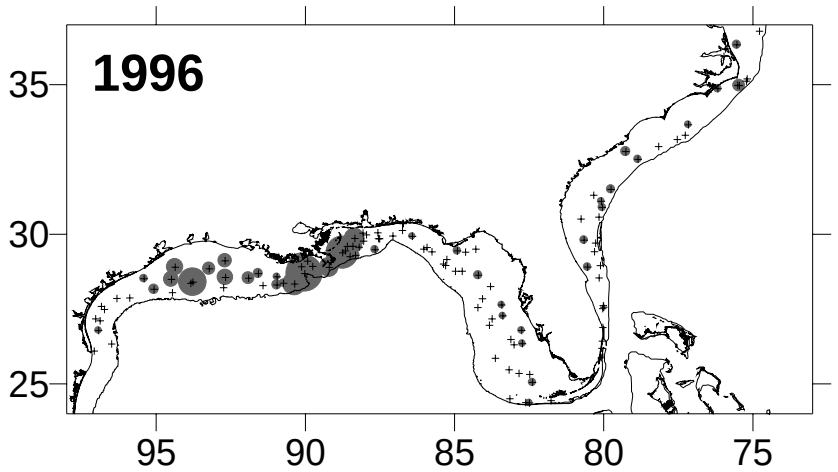


Figure 7. Survey effort and positive CPUE (range: 1 to 34 sharks per 100 hook hours) for small coastal sharks from 1996.

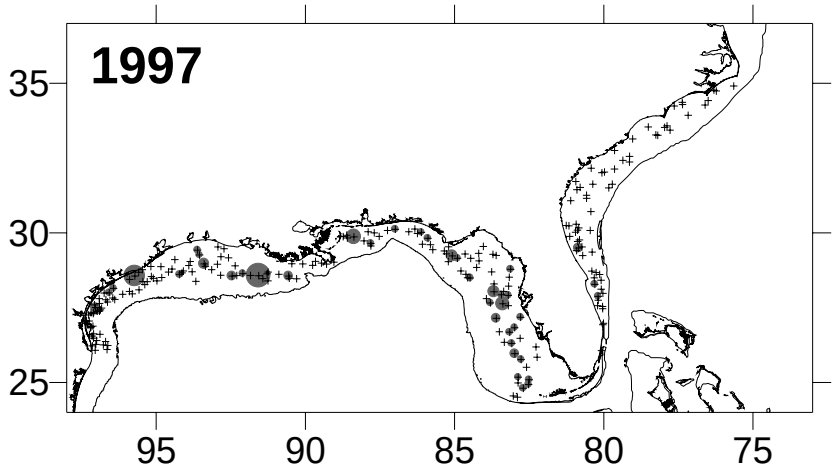


Figure 8. Survey effort and positive CPUE (range: 1 to 9 sharks per 100 hook hours) for blacknose sharks from 1997.

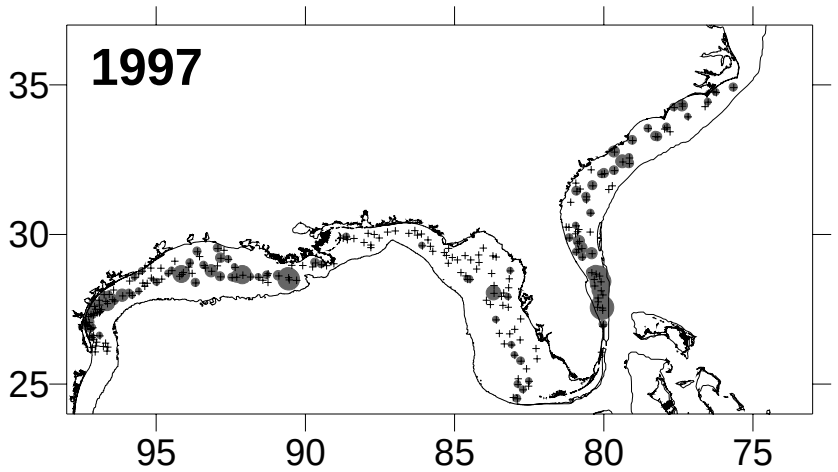


Figure 9. Survey effort and positive CPUE (range: 1 to 27 sharks per 100 hook hours) for Atlantic sharpnose sharks from 1997.

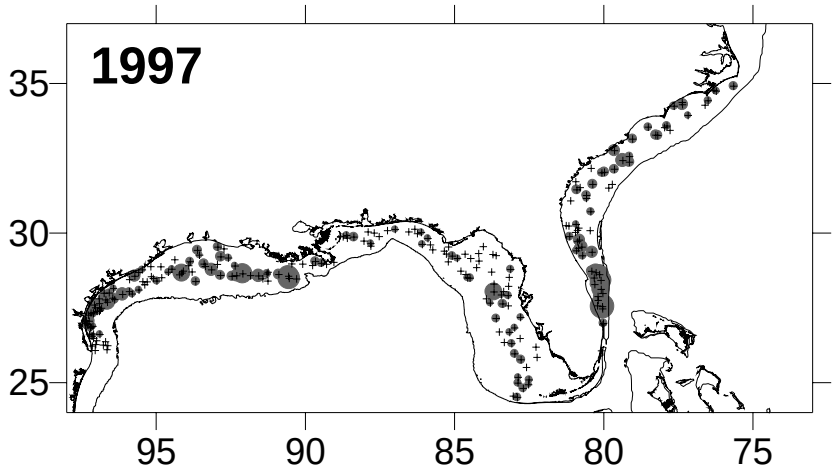


Figure 10. Survey effort and positive CPUE (range: 1 to 27 sharks per 100 hook hours) for small coastal sharks from 1997.

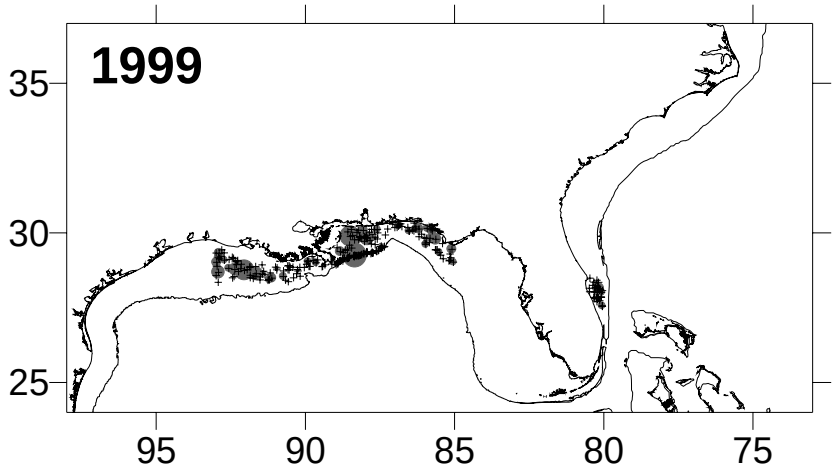


Figure 11. Survey effort and positive CPUE (range: 1 to 9 sharks per 100 hook hours) for blacknose sharks from 1999.

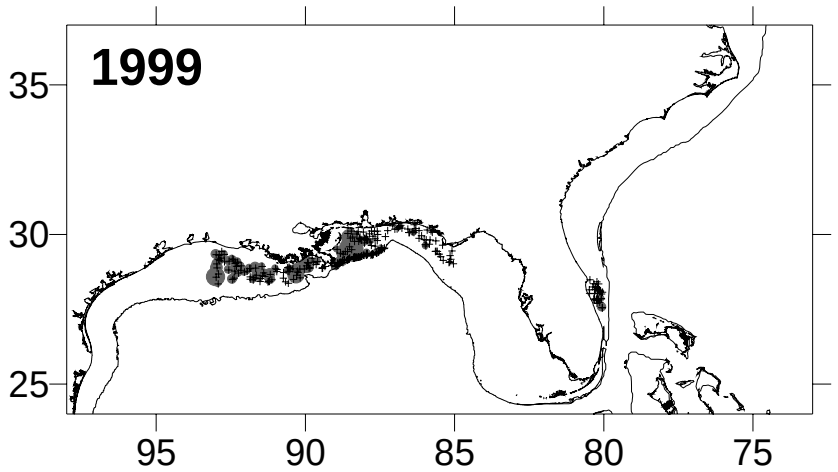


Figure 12. Survey effort and positive CPUE (range: 1 to 42 sharks per 100 hook hours) for Atlantic sharpnose sharks from 1999.

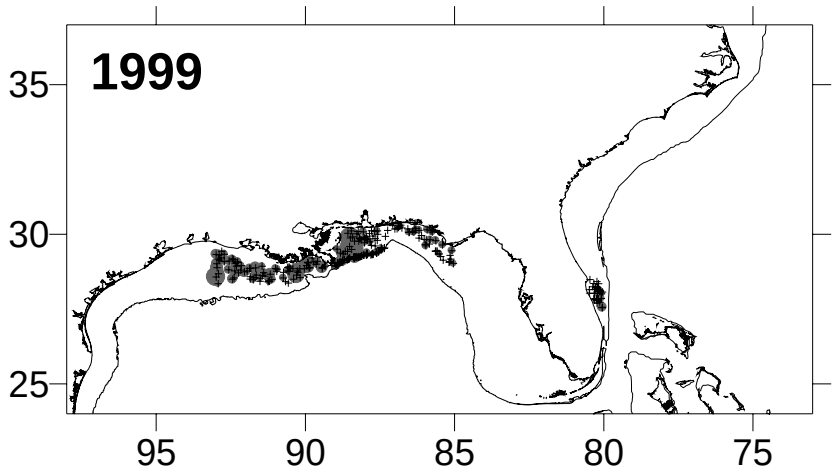


Figure 13. Survey effort and positive CPUE (range: 1 to 42 sharks per 100 hook hours) for small coastal sharks from 1999.

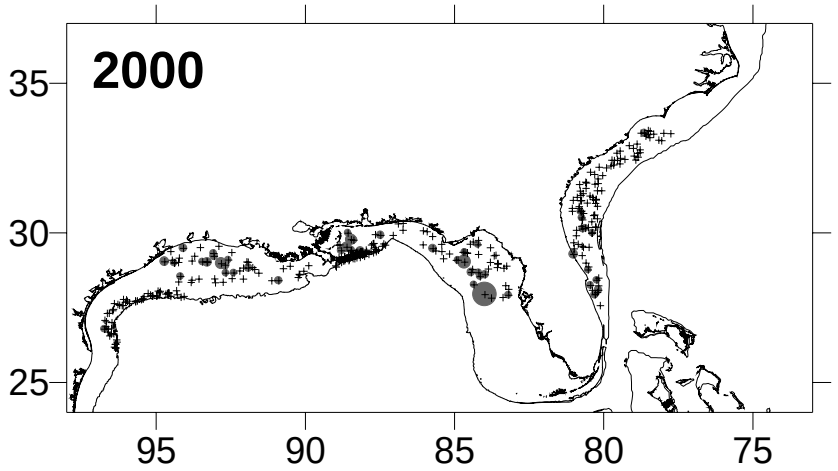


Figure 14. Survey effort and positive CPUE (range: 1 to 18 sharks per 100 hook hours) for blacknose sharks from 2000.

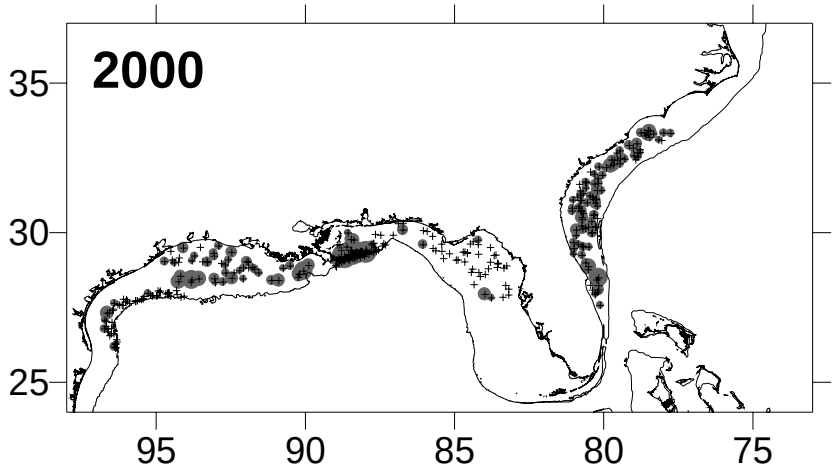


Figure 15. Survey effort and positive CPUE (range: 1 to 43 sharks per 100 hook hours) for Atlantic sharpnose sharks from 2000.

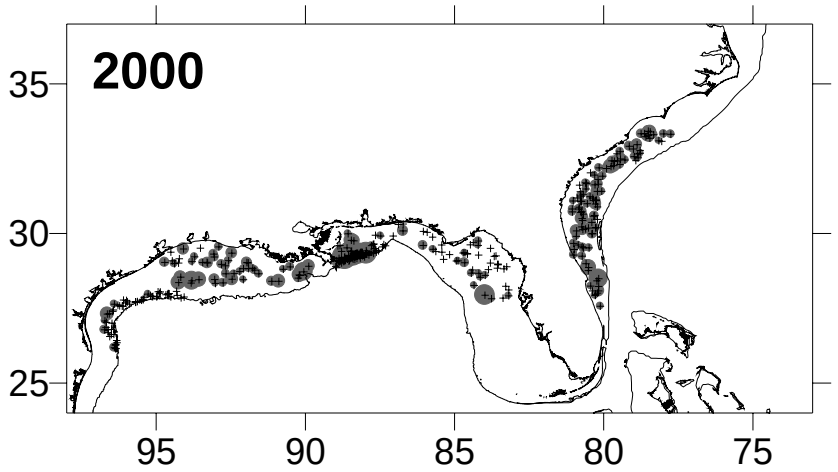


Figure 16. Survey effort and positive CPUE (range: 1 to 43 sharks per 100 hook hours) for small coastal sharks from 2000.

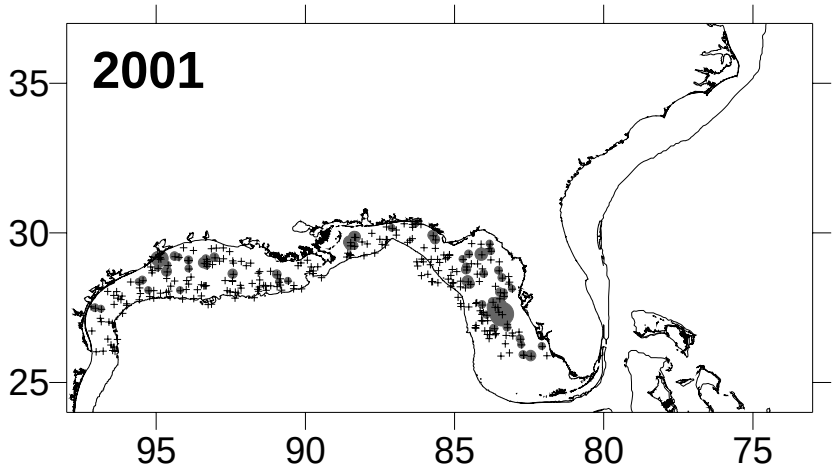


Figure 17. Survey effort and positive CPUE (range: 1 to 20 sharks per 100 hook hours) for blacknose sharks from 2001.

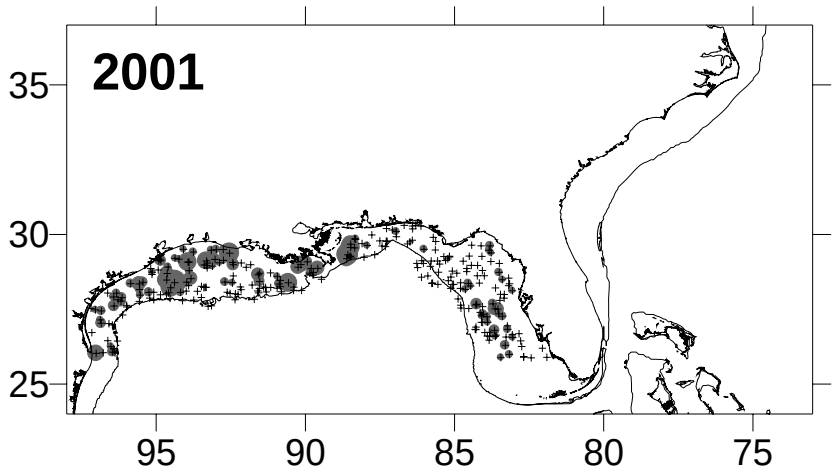


Figure 18. Survey effort and positive CPUE (range: 1 to 56 sharks per 100 hook hours) for Atlantic sharpnose sharks from 2001.

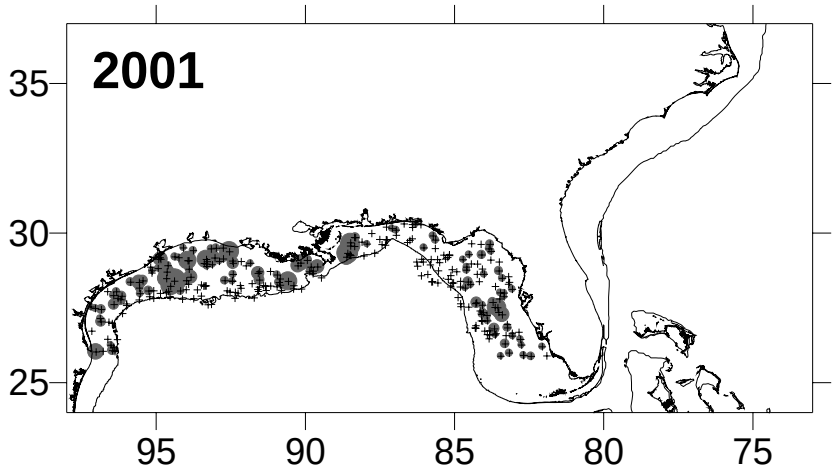


Figure 19. Survey effort and positive CPUE (range: 1 to 56 sharks per 100 hook hours) for small coastal sharks from 2001.

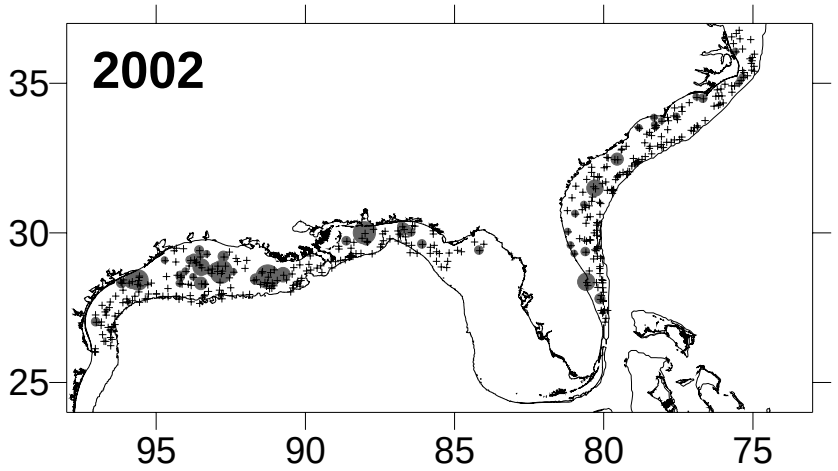


Figure 20. Survey effort and positive CPUE (range: 1 to 10 sharks per 100 hook hours) for blacknose sharks from 2002.

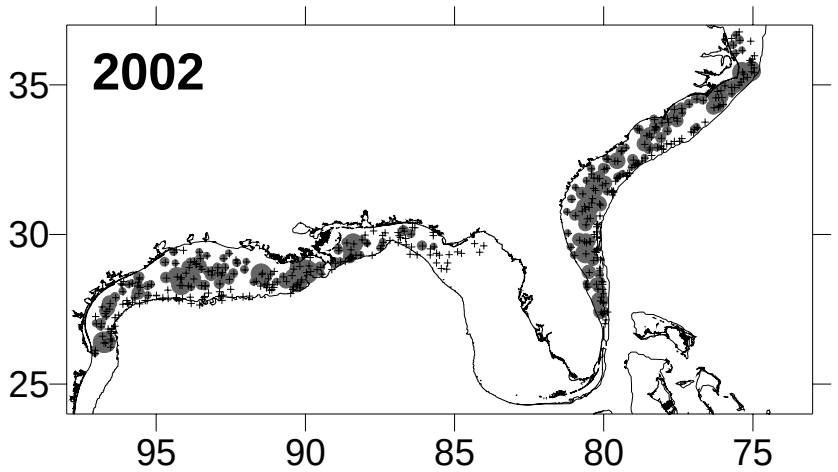


Figure 21. Survey effort and positive CPUE (range: 1 to 72 sharks per 100 hook hours) for Atlantic sharpnose sharks from 2002.

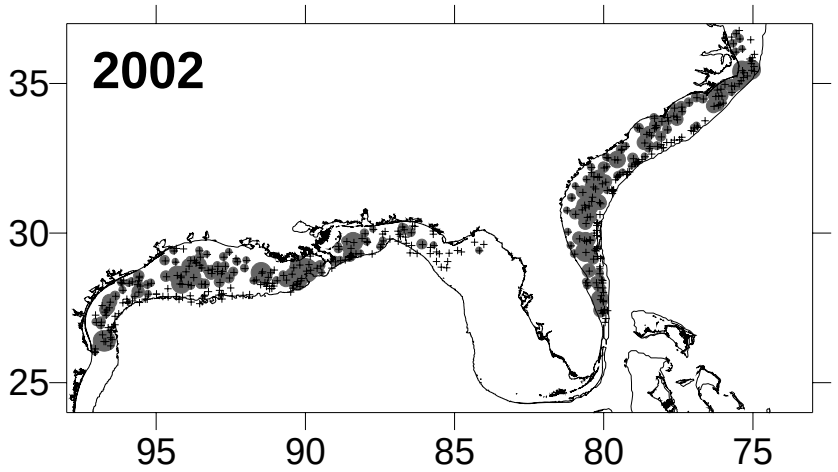


Figure 22. Survey effort and positive CPUE (range: 1 to 72 sharks per 100 hook hours) for small coastal sharks from 2002.

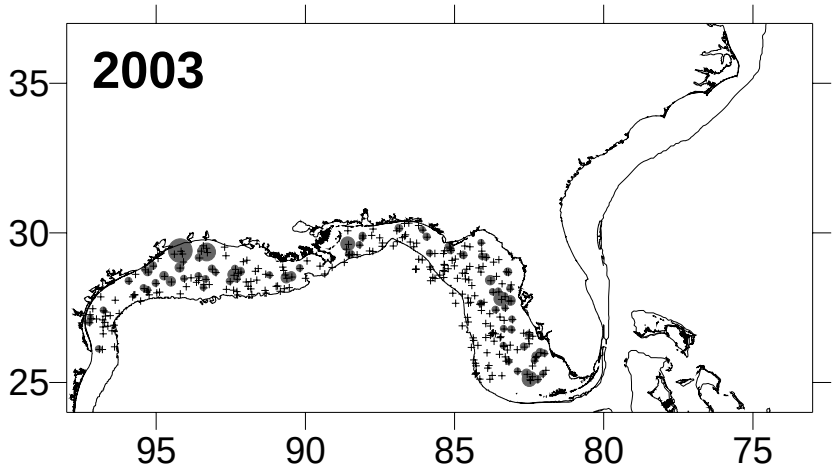


Figure 23. Survey effort and positive CPUE (range: 1 to 39 sharks per 100 hook hours) for blacknose sharks from 2003.

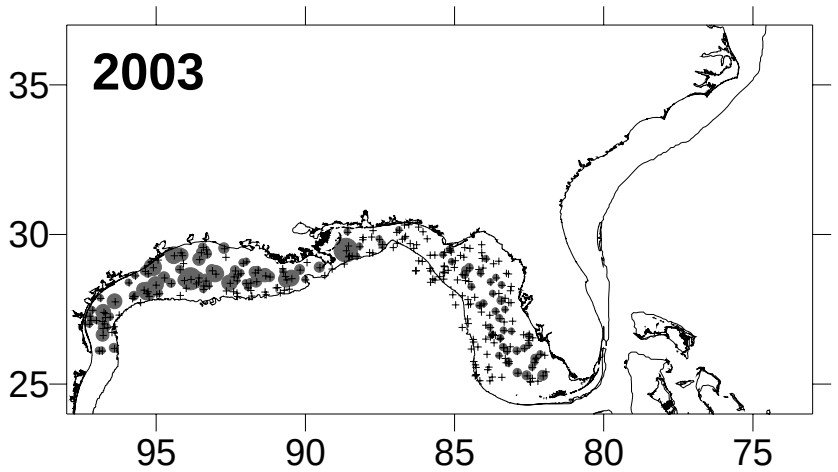


Figure 24. Survey effort and positive CPUE (range: 1 to 66 sharks per 100 hook hours) for Atlantic sharpnose sharks from 2003.

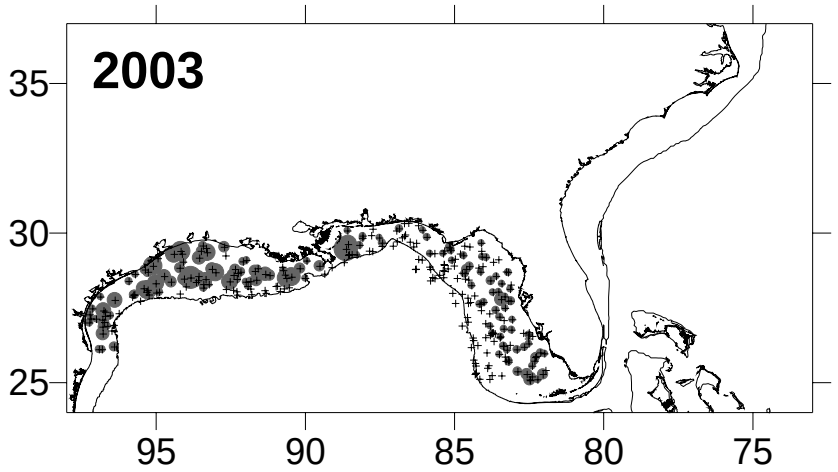


Figure 25. Survey effort and positive CPUE (range: 1 to 66 sharks per 100 hook hours) for small coastal sharks from 2003.

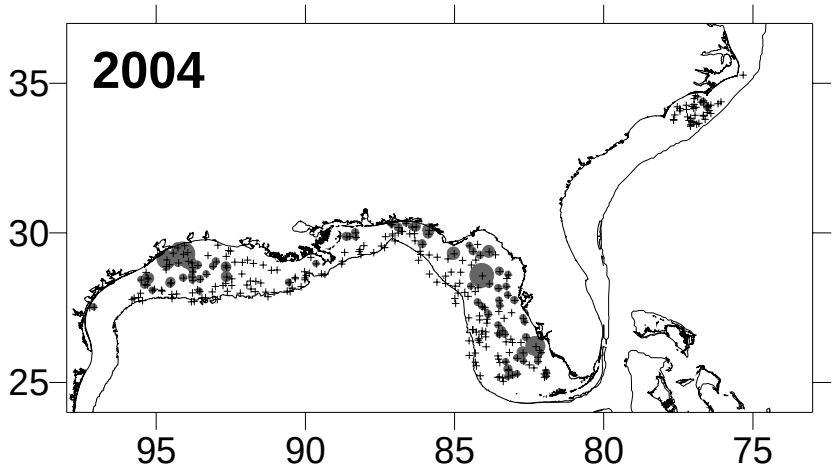


Figure 26. Survey effort and positive CPUE (range: 1 to 20 sharks per 100 hook hours) for blacknose sharks from 2004.

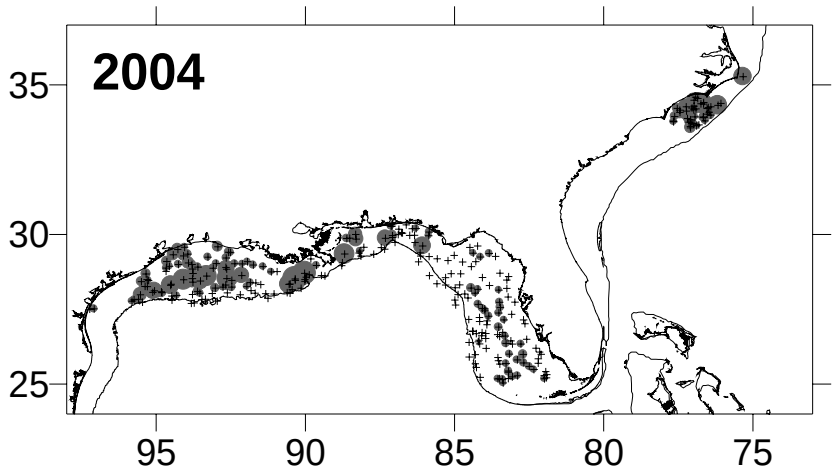


Figure 27. Survey effort and positive CPUE (range: 1 to 68 sharks per 100 hook hours) for Atlantic sharpnose sharks from 2004.

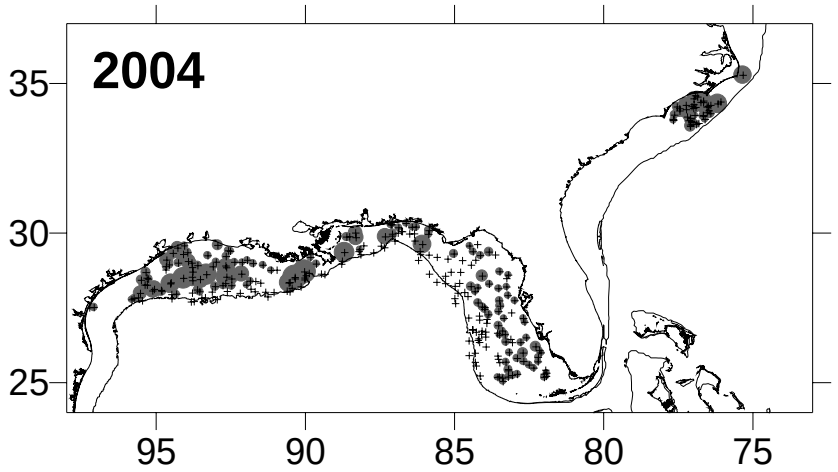


Figure 28. Survey effort and positive CPUE (range: 1 to 68 sharks per 100 hook hours) for small coastal sharks from 2004.

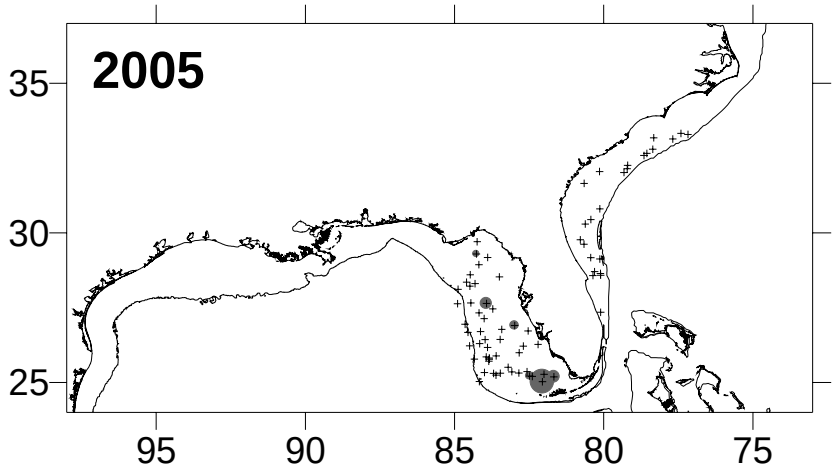


Figure 29. Survey effort and positive CPUE (range: 1 to 15 sharks per 100 hook hours) for blacknose sharks from 2005.

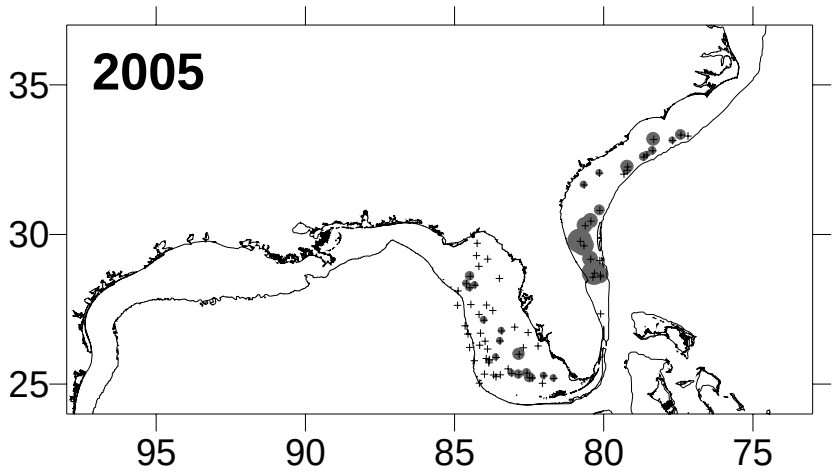


Figure 30. Survey effort and positive CPUE (range: 1 to 54 sharks per 100 hook hours) for Atlantic sharpnose sharks from 2005.

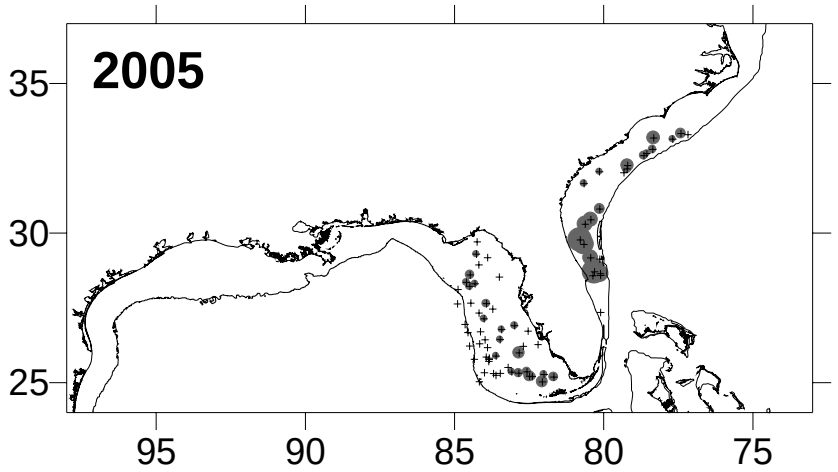


Figure 31. Survey effort and positive CPUE (range: 1 to 54 sharks per 100 hook hours) for small coastal sharks from 2005.

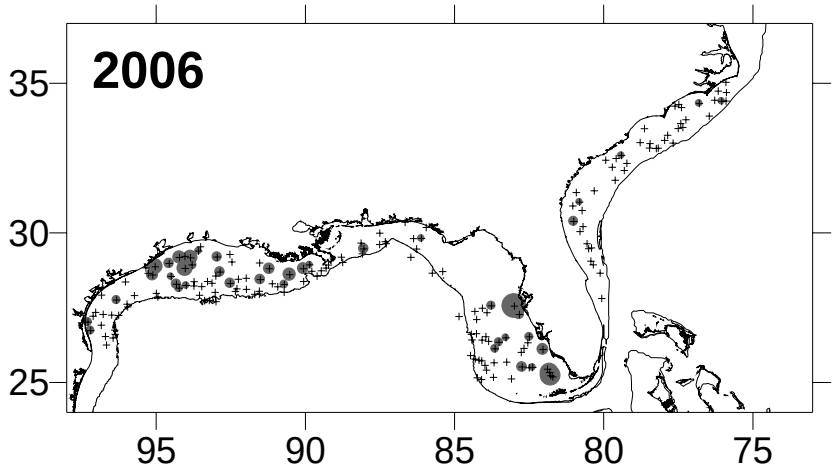


Figure 32. Survey effort and positive CPUE (range: 1 to 12 sharks per 100 hook hours) for blacknose sharks from 2006.

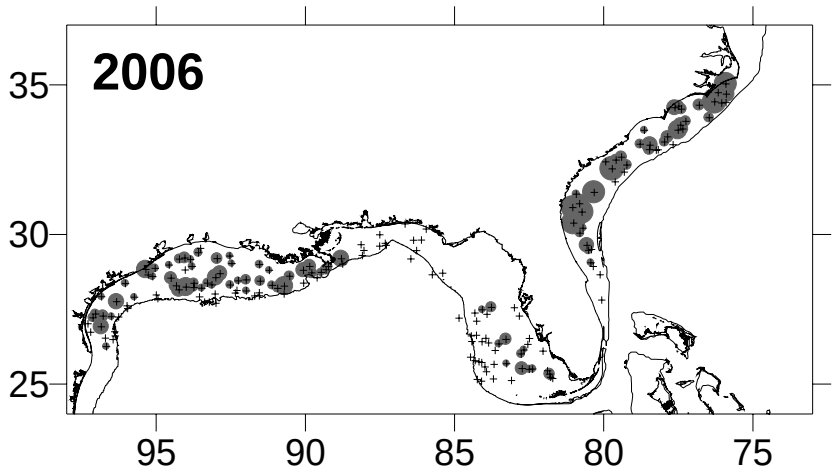


Figure 33. Survey effort and positive CPUE (range: 1 to 54 sharks per 100 hook hours) for Atlantic sharpnose sharks from 2006.

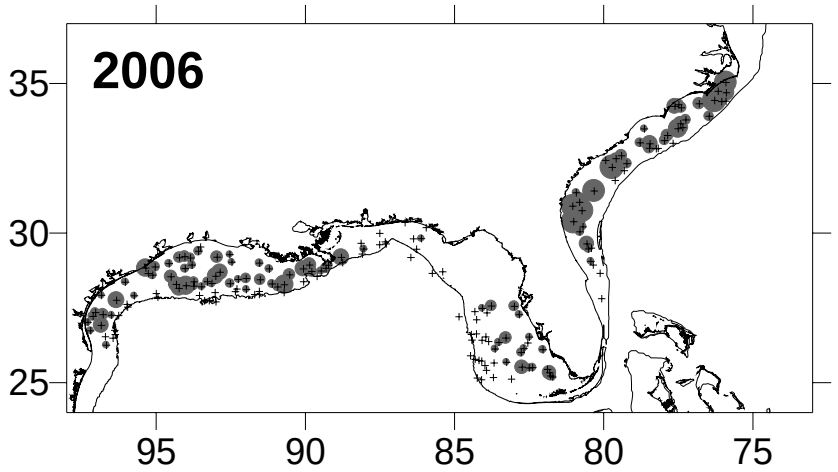


Figure 34. Survey effort and positive CPUE (range: 1 to 55 sharks per 100 hook hours) for small coastal sharks from 2006.

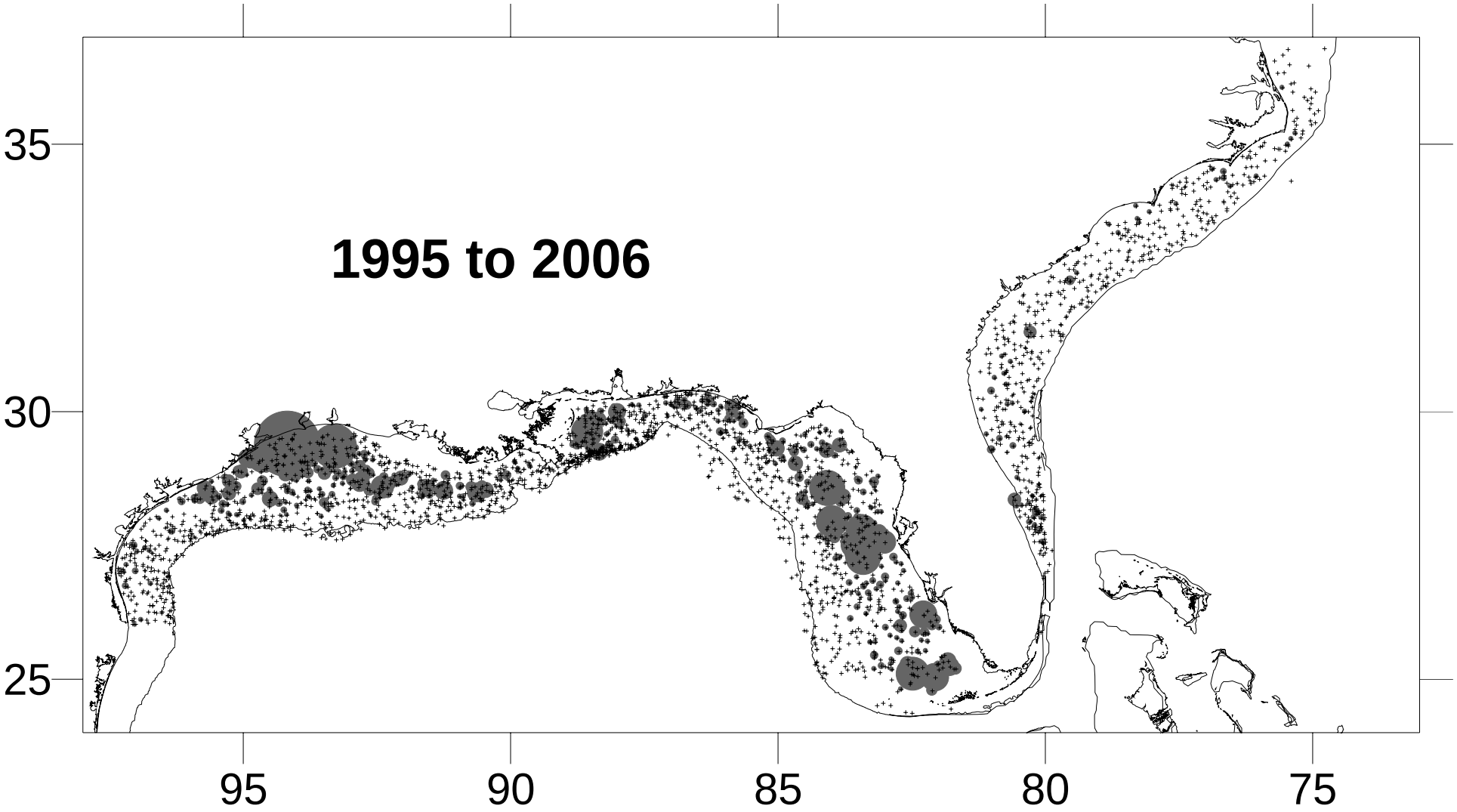


Figure 35. Survey effort and CPUE (range: 1 to 39 sharks per 100 hook hours) for blacknose sharks from 1995 through 2006.

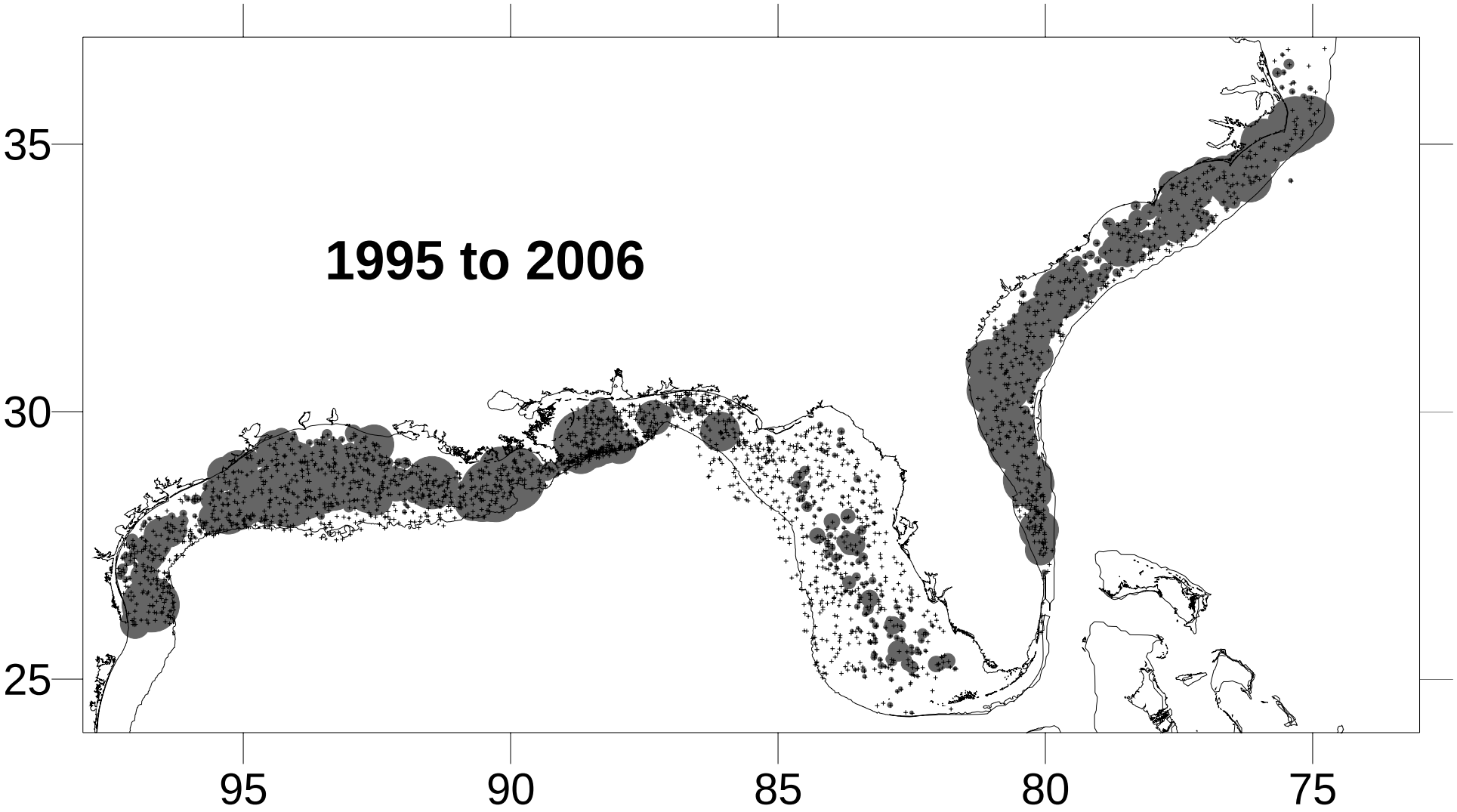


Figure 36. Survey effort and CPUE (range: 1 to 72 sharks per 100 hook hours) for Atlantic sharpnose sharks from 1995 through 2006.

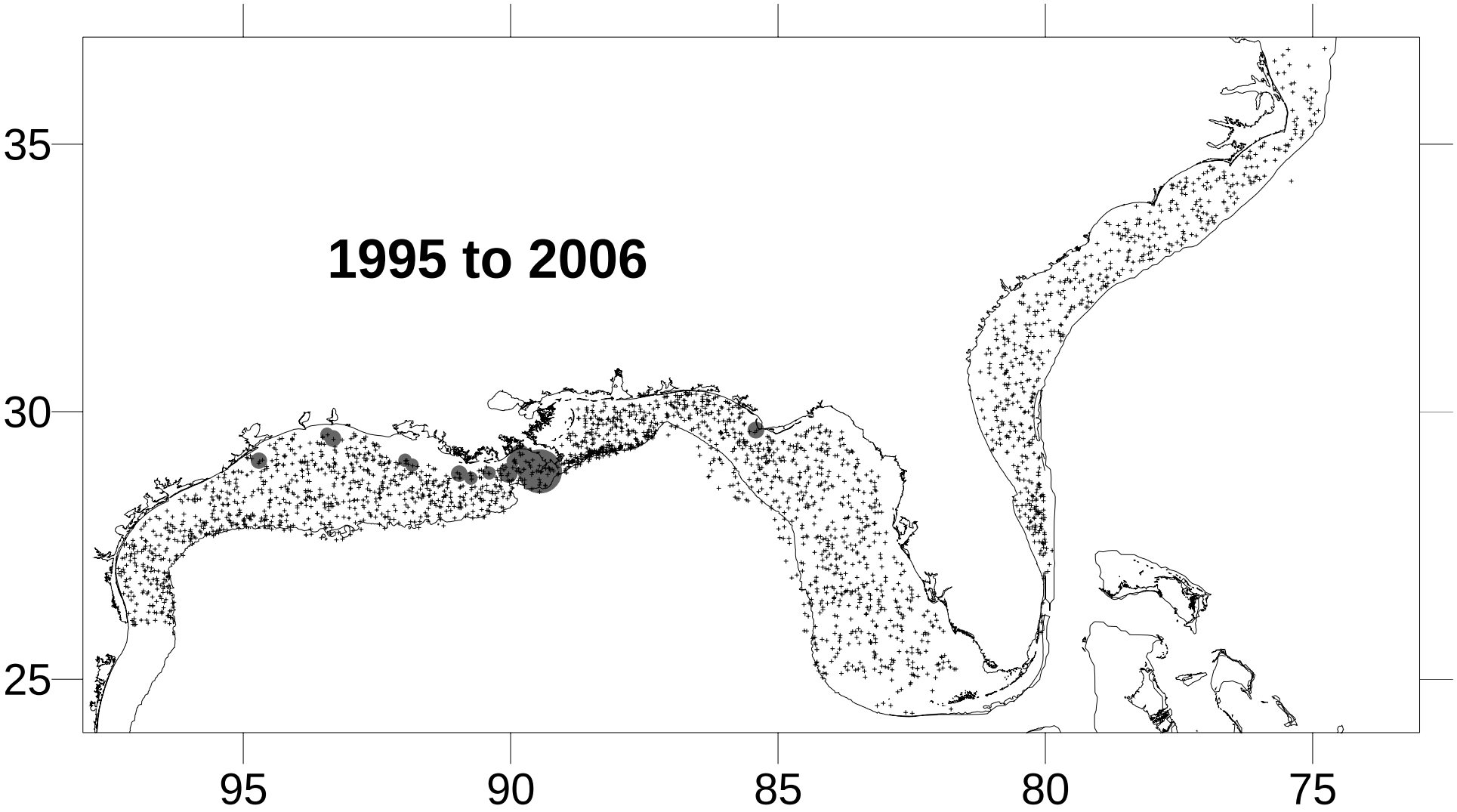


Figure 37. Survey effort and CPUE (range: 1 to 10 sharks per 100 hook hours) for finetooth sharks from 1995 through 2006.

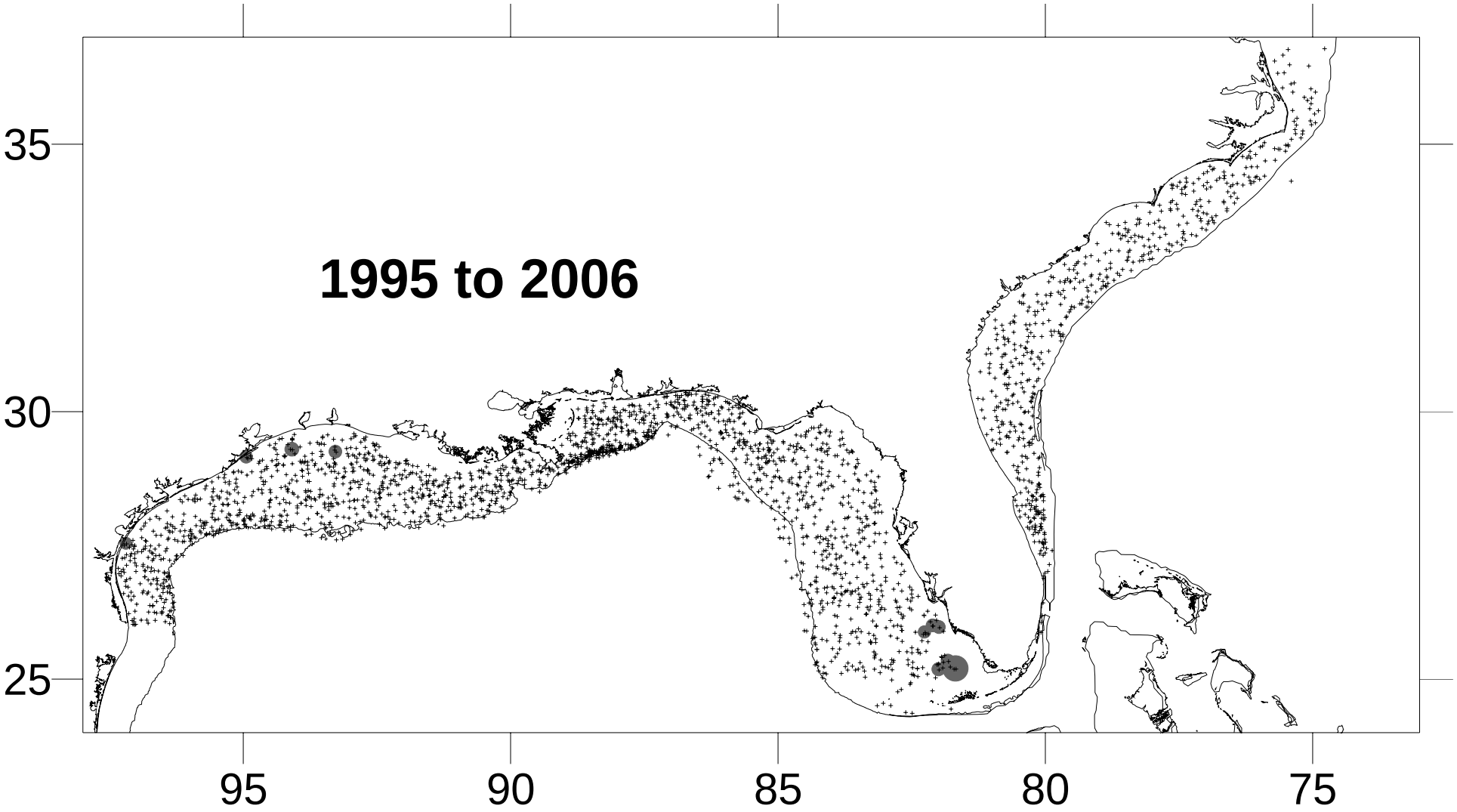


Figure 38. Survey effort and CPUE (range: 1 to 2 sharks per 100 hook hours) for bonnetheads from 1995 through 2006.

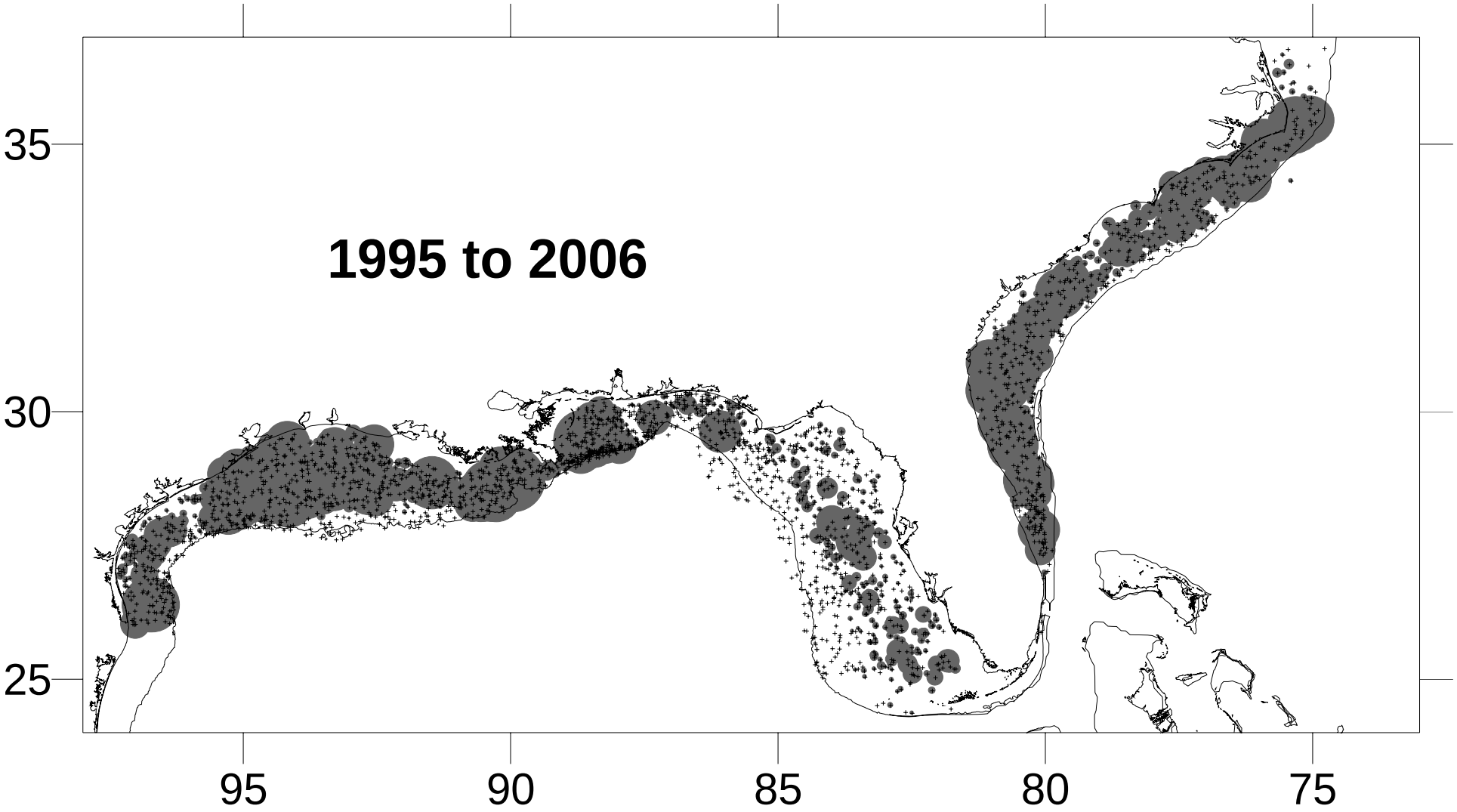


Figure 39. Survey effort and CPUE (range: 1 to 72 sharks per 100 hook hours) for small coastal shark complex from 1995 through 2006.

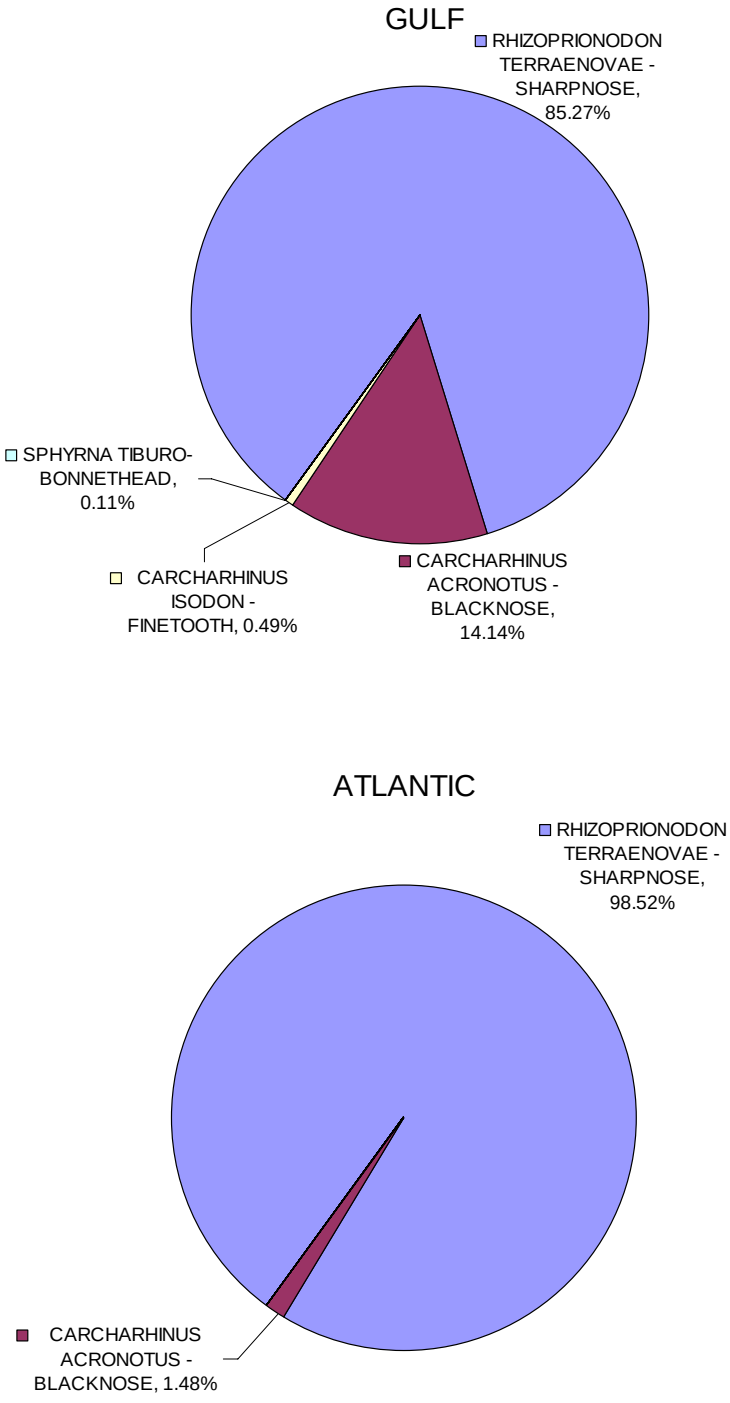
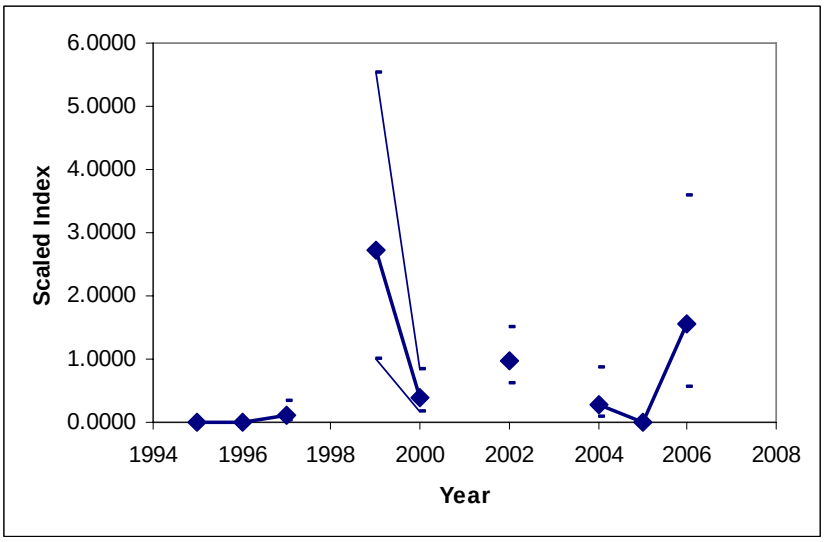


Figure 40. Percentage of species that the make up of the catch of small coastal sharks collected during NMFS bottom longline surveys in the U.S. Gulf of Mexico (top figure) and U.S. Atlantic Ocean (bottom figure).



Survey Year	N	Modeled Nonzero CPUE	Nominal Frequency of Occurrence	Modeled Frequency of Occurrence	Scaled Index	CV	LCL	UCL
1995	45		0.0000	0.0000	0.0000			
1996	34		0.0000	0.0000	0.0000			
1997	65	1.25506	0.0462	0.01101	0.1063	0.6193	0.0328	0.3388
1998	0							
1999	29	1.34115	0.1379	0.28056	2.7094	0.4216	0.9871	5.5228
2000	104	1.1675	0.1154	0.04009	0.3872	0.4472	0.1764	0.8276
2001	0							
2002	184	1.33974	0.1304	0.1006	0.9715	0.2601	0.6106	1.5101
2003	0							
2004	40	1.37497	0.0500	0.02776	0.2681	0.5788	0.0792	0.8671
2005	24		0.0000		0.0000			
2006	46	1.16648	0.1087	0.16128	1.5575	0.5788	0.5677	3.5910

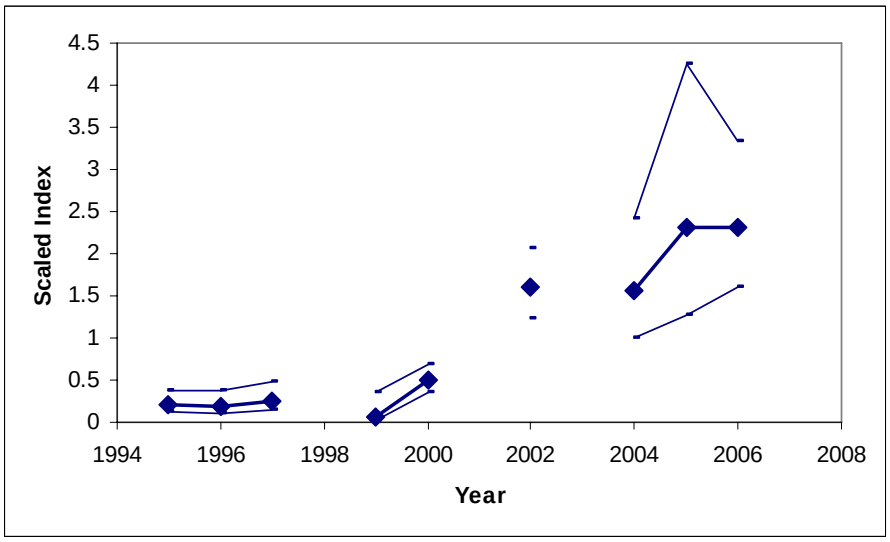
Type 3 Tests of Fixed Effects of Variables Retained in Binomial Sub-model

Effect	Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F
YEAR	5	141	27.04	5.31	<.0001	0.0002
TEMPMAX	1	319	25.51	25.51	<.0001	<.0001

Type 3 Tests of Fixed Effects of Variables Retained in Non-zero Sub-model

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	5	44	0.17	0.9727

Figure 41. Standardized annual abundance indices for blacknose sharks collected during bottom longline surveys from the U.S. Atlantic Ocean south of 37^{o} north latitude. Type 3 analyses results for those variables retained in sub-models. Legend for this and following figures: N = sample size; Scaled Index = index standardized to the time series mean of one; CV = coefficient of variation on the mean; and LCL and UCL = lower and upper 95% confidence intervals.



Survey Year	Nominal Frequency of Occurrence	N	Index (number per 100 hook-hours)	Scaled Index	CV	LCL	UCL
1995	0.55556	45	1.9817	0.21163	0.30414	0.11674	0.38365
1996	0.35294	34	1.82	0.19436	0.32603	0.10293	0.367
1997	0.69231	65	2.4256	0.25903	0.31991	0.13875	0.4836
1998		0					
1999	0.10345	29	0.6266	0.06692	1.01752	0.0124	0.36121
2000	0.83654	104	4.592	0.49039	0.16943	0.35028	0.68654
2001		0					
2002	0.67935	184	14.9491	1.59645	0.13043	1.23124	2.07001
2003		0					
2004	0.95	40	14.5995	1.55912	0.22323	1.00307	2.4234
2005	0.83333	24	21.6933	2.31668	0.30936	1.26555	4.24087
2006	0.76087	46	21.5878	2.30541	0.18576	1.59503	3.33218

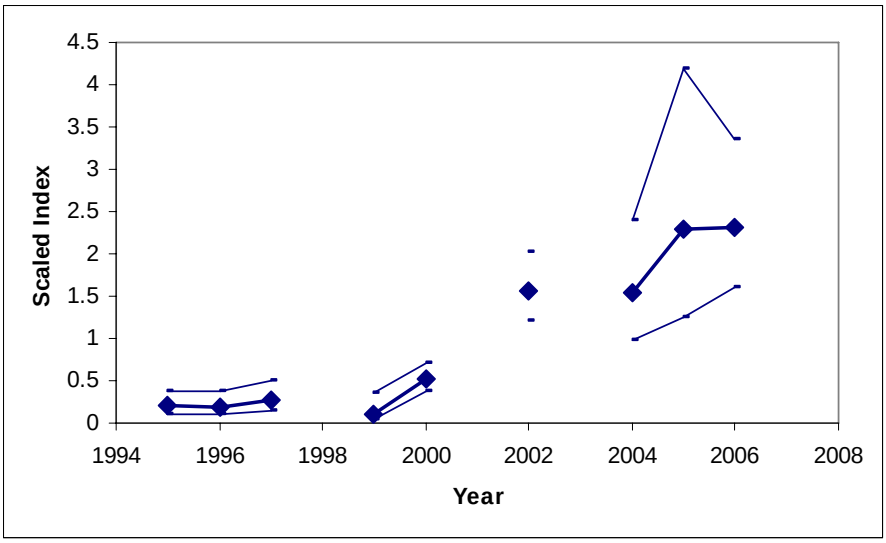
Type 3 Tests of Fixed Effects of Variables Retained in Binomial Sub-model

Effect	Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F
YEAR	8	147	65.95	8.00	<.0001	<.0001
DEPTH	1	323	18.56	18.56	<.0001	<.0001
TEMPMAX	1	365	40.48	40.48	<.0001	<.0001

Type 3 Tests of Fixed Effects of Variables Retained in Non-zero Sub-model

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	8	379	4.67	<.0001
HOOK TYPE	1	379	5.56	0.0189
TEMPMAX	1	379	7.46	0.0066

Figure 42. Standardized abundance indices for Atlantic sharpnose sharks collected during bottom longline surveys from the U.S. Atlantic Ocean south of 37^{o} north latitude. Type 3 analyses results for those variables retained in sub-models.



Survey Year	Nominal Frequency of Occurrence	N	Index (number per 100 hook-hours)	Scaled Index	CV	LCL	UCL
1995	0.55556	45	1.9768	0.20955	0.31049	0.11423	0.38442
1996	0.35294	34	1.8387	0.19491	0.33486	0.10155	0.3741
1997	0.70769	65	2.4809	0.26299	0.32089	0.14061	0.49188
1998		0					
1999	0.2069	29	1.039	0.11014	0.6244	0.03496	0.34698
2000	0.85577	104	4.8185	0.51078	0.16086	0.37102	0.70318
2001		0					
2002	0.67935	184	14.8217	1.57116	0.12763	1.21847	2.02595
2003		0					
2004	0.95	40	14.4947	1.5365	0.22429	0.98652	2.3931
2005	0.83333	24	21.566	2.28608	0.30957	1.24834	4.18651
2006	0.76087	46	21.866	2.31789	0.18547	1.60456	3.34833

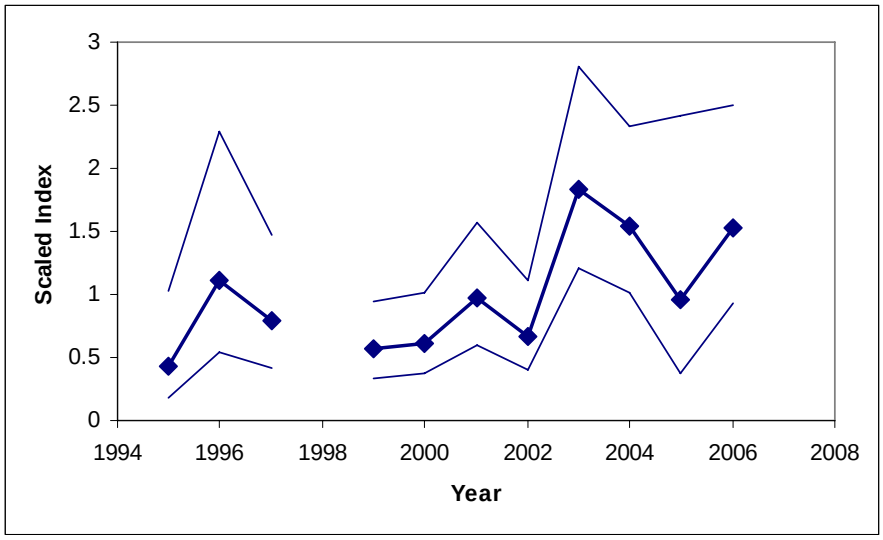
Type 3 Tests of Fixed Effects of Variables Retained in Binomial Sub-model

Effect	Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F
YEAR	8	149	63.67	7.73	<.0001	<.0001
DEPTH	1	328	17.63	17.63	<.0001	<.0001
TEMPMAX	1	374	41.78	41.78	<.0001	<.0001

Type 3 Tests of Fixed Effects of Variables Retained in Non-zero Sub-model

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	8	385	4.91	<.0001
HOOK TYPE	1	385	6.02	0.0146
TEMPMAX	1	385	8.90	0.0030

Figure 43. Standardized abundance indices for small coastal sharks collected during bottom longline surveys from the U.S. Atlantic Ocean south of 37^{o} north latitude. Type 3 analyses results for those variables retained in sub-models.



Survey Year	Nominal Frequency of Occurrence	N	Index (number per 100 hook-hours)	Scaled Index	CV	LCL	UCL
1995	0.15854	82	0.1226	0.43287	0.453	0.18243	1.0271
1996	0.16667	84	0.31467	1.11102	0.37398	0.53884	2.29078
1997	0.23669	169	0.22304	0.78749	0.31872	0.42275	1.46693
1998		0					
1999	0.19005	221	0.16074	0.56752	0.26258	0.3386	0.95118
2000	0.15612	237	0.17438	0.61568	0.25548	0.37235	1.01804
2001	0.22826	276	0.27406	0.96764	0.24752	0.59416	1.57587
2002	0.20362	221	0.18878	0.66651	0.2612	0.39872	1.11417
2003	0.3	280	0.52066	1.83828	0.21335	1.20546	2.80331
2004	0.3494	247	0.43483	1.53524	0.21256	1.0083	2.33758
2005	0.16	50	0.27016	0.95384	0.49203	0.37588	2.42051
2006	0.28889	135	0.43161	1.5239	0.25102	0.92949	2.49844

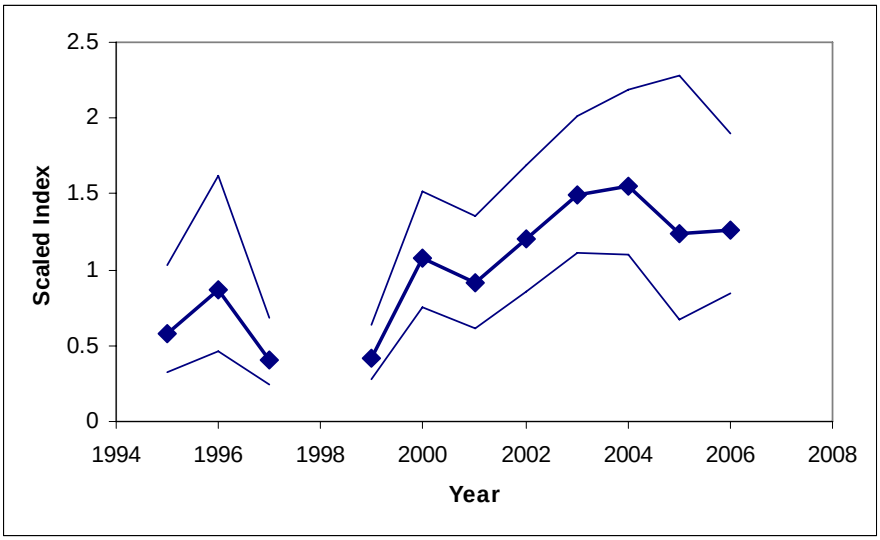
Type 3 Tests of Fixed Effects of Variables Retained in Binomial Sub-model

Effect	Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F
YEAR	10	601	41.17	4.08	<.0001	<.0001
HOOK TYPE	1	465	7.37	7.37	0.0066	0.0069
DEPTH	1	1822	54.07	54.07	<.0001	<.0001
TEMPMAX	1	1793	16.27	16.27	<.0001	<.0001
SALMAX	1	1170	37.52	37.52	<.0001	<.0001

Type 3 Tests of Fixed Effects of Variables Retained in Non-zero Sub-model

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	10	457	1.82	0.0557
AREA	2	457	3.43	0.0332
HOOK TYPE	1	457	4.13	0.0427
DEPTH	1	457	7.85	0.0053

Figure 44. Standardized abundance indices for blacknose sharks collected during bottom longline surveys from the U.S. Gulf of Mexico. Type 3 analyses results for those variables retained in sub-models.



Survey Year	Nominal Frequency of Occurrence	N	Index (number per 100 hook-hours)	Scaled Index	CV	LCL	UCL
1995	0.40244	82	1.89296	0.57714	0.2977	0.32224	1.03368
1996	0.34524	84	2.8467	0.86792	0.31962	0.46514	1.61948
1997	0.39645	169	1.32209	0.40309	0.26955	0.23734	0.6846
1998		0					
1999	0.40724	221	1.3764	0.41965	0.20734	0.27841	0.63253
2000	0.39662	237	3.51466	1.07157	0.17537	0.75657	1.51773
2001	0.37319	276	2.9823	0.90926	0.19993	0.61197	1.35098
2002	0.52489	221	3.93955	1.20111	0.17303	0.85192	1.69343
2003	0.46786	280	4.90172	1.49447	0.1509	1.10703	2.01751
2004	0.45783	247	5.08395	1.55003	0.1733	1.09882	2.18651
2005	0.32	50	4.06323	1.23882	0.31256	0.6727	2.28137
2006	0.46667	135	4.15544	1.26694	0.20542	0.84367	1.90256

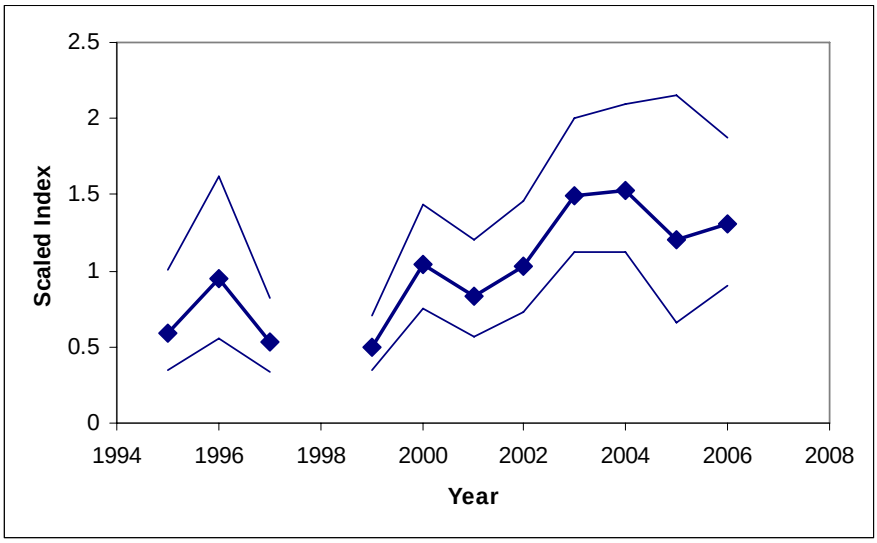
Type 3 Tests of Fixed Effects of Variables Retained in Binomial Sub-model

Effect	Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F
YEAR	10	627	28.11	2.79	0.0017	0.0022
AREA	2	1755	231.54	115.76	<.0001	<.0001
HOOK TYPE	1	477	5.31	5.31	0.0212	0.0217
DEPTH	1	1733	93.08	93.08	<.0001	<.0001
SALMAX	1	1798	3.88	3.88	0.0490	0.0491
TEMPMAX	1	1369	7.88	7.88	0.0050	0.0051

Type 3 Tests of Fixed Effects of Variables Retained in Non-zero Sub-model

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	10	841	2.47	0.0064
AREA	2	841	62.19	<.0001
HOOK TYPE	1	841	11.24	0.0008
SALMAX	1	841	13.60	0.0002

Figure 45. Standardized abundance indices for Atlantic sharpnose sharks collected during bottom longline surveys from the U.S. Gulf of Mexico. Type 3 analyses results for those variables retained in sub-models.



Survey Year	Nominal Frequency of Occurrence	N	Index (number per 100 hook-hours)	Scaled Index	CV	LCL	UCL
1995	0.46341	82	2.14066	0.59223	0.26822	0.34958	1.0033
1996	0.42857	84	3.42429	0.94736	0.27169	0.55554	1.61553
1997	0.50296	169	1.91529	0.52988	0.22485	0.33984	0.82618
1998		0					
1999	0.52036	221	1.79857	0.49759	0.17401	0.35225	0.70289
2000	0.46414	237	3.76485	1.04158	0.16174	0.75529	1.43639
2001	0.46739	276	2.99602	0.82887	0.18782	0.57117	1.20285
2002	0.56109	221	3.72291	1.02997	0.1746	0.72829	1.45662
2003	0.56071	280	5.41039	1.49683	0.14583	1.11987	2.00066
2004	0.5743	247	5.54174	1.53317	0.15709	1.12195	2.0951
2005	0.4	50	4.33027	1.19801	0.30087	0.66491	2.1585
2006	0.54815	135	4.71527	1.30452	0.18347	0.90658	1.87712

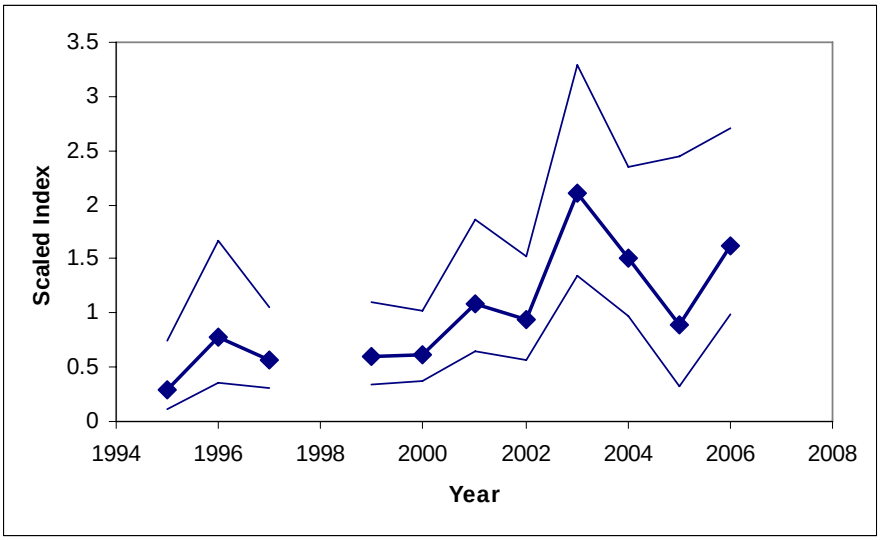
Type 3 Tests of Fixed Effects of Variables Retained in Binomial Sub-model

Effect	Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F
YEAR	10	617	24.40	2.42	0.0066	0.0080
AREA	2	1769	140.60	70.30	<.0001	<.0001
HOOK TYPE	1	501	13.54	13.54	0.0002	0.0003
DEPTH	1	1652	293.97	293.97	<.0001	<.0001
SALMAX	1	1385	9.47	9.47	0.0021	0.0021

Type 3 Tests of Fixed Effects of Variables Retained in Non-zero Sub-model

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	10	1016	2.92	0.0013
AREA	2	1016	91.90	<.0001
HOOK TYPE	1	1016	14.71	0.0001
SALMAX	1	1016	13.99	0.0002

Figure 46. Standardized abundance indices for small coastal sharks collected during bottom longline surveys from the U.S. Gulf of Mexico. Type 3 analyses results for those variables retained in sub-models.



Survey Year	Nominal Frequency of Occurrence	N	Index (number per 100 hook-hours)	Scaled Index	CV	LCL	UCL
1995	0.10236	127	0.06576	0.28645	0.51075	0.10936	0.75031
1996	0.11864	118	0.1774	0.77278	0.39865	0.35849	1.66585
1997	0.18376	234	0.12944	0.56386	0.3171	0.30361	1.04722
1998		0					
1999	0.184	250	0.13907	0.6058	0.30662	0.33263	1.1033
2000	0.1437	341	0.13997	0.60971	0.26039	0.3653	1.01764
2001	0.22826	276	0.25082	1.09262	0.27075	0.64187	1.85991
2002	0.17037	405	0.21501	0.9366	0.24806	0.57451	1.5269
2003	0.3	280	0.48306	2.10425	0.22698	1.34406	3.29439
2004	0.30796	287	0.34725	1.51265	0.22454	0.97073	2.35709
2005	0.10811	74	0.20378	0.88768	0.54048	0.32251	2.4433
2006	0.24309	181	0.37364	1.62759	0.25701	0.98146	2.69909

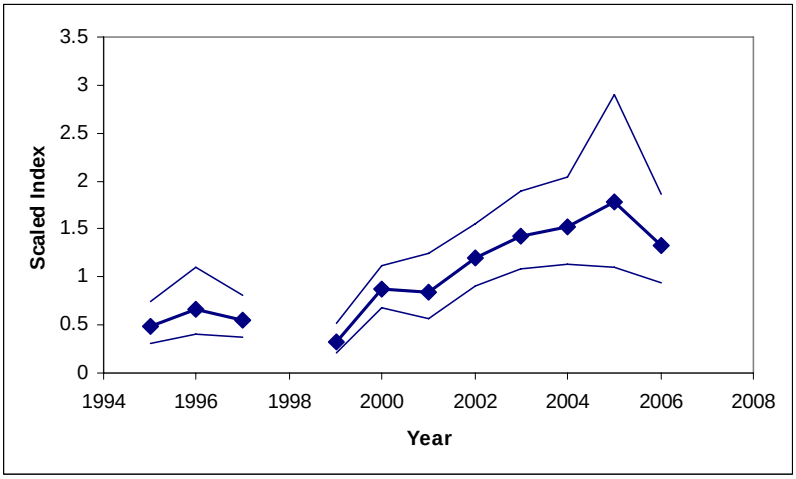
Type 3 Tests of Fixed Effects of Variables Retained in Binomial Sub-model

Effect	Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F
YEAR	10	866	32.03	3.18	0.0004	0.0005
AREA	3	2181	103.28	34.42	<.0001	<.0001
HOOK TYPE	1	594	4.98	4.98	0.0256	0.0260
DEPTH	1	2357	57.14	57.14	<.0001	<.0001
TEMPMAX	1	2208	23.04	23.04	<.0001	<.0001
SALMAX	1	1322	36.00	36.00	<.0001	<.0001

Type 3 Tests of Fixed Effects of Variables Retained in Non-zero Sub-model

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	10	507	5.58	<.0001
AREA	3	507	8.10	<.0001
DEPTH	1	507	5.83	0.0161

Figure 47. Standardized abundance indices for blacknose sharks collected during bottom longline surveys from the Gulf of Mexico and Atlantic combined. Type 3 analyses results for those variables retained in sub-models.



Survey Year	Nominal Frequency of Occurrence	N	Index (number per 100 hook-hours)	Scaled Index	CV	LCL	UCL
1995	0.45669	127	2.11993	0.4834	0.22057	0.3126	0.74752
1996	0.34746	118	2.90445	0.66229	0.2557	0.40037	1.09558
1997	0.47863	234	2.43006	0.55412	0.19156	0.37906	0.81001
1998		0					
1999	0.372	250	1.43786	0.32787	0.22815	0.20895	0.51447
2000	0.53079	341	3.83728	0.875	0.12285	0.68502	1.11767
2001	0.37319	276	3.69337	0.84219	0.19603	0.57114	1.24187
2002	0.59506	405	5.22895	1.19234	0.13587	0.90975	1.56271
2003	0.46786	280	6.2583	1.42706	0.14106	1.07776	1.88957
2004	0.52595	287	6.67867	1.52291	0.14741	1.13585	2.04187
2005	0.48649	74	7.83971	1.78766	0.24427	1.10454	2.89327
2006	0.54144	181	5.8114	1.32515	0.1713	0.94309	1.86199

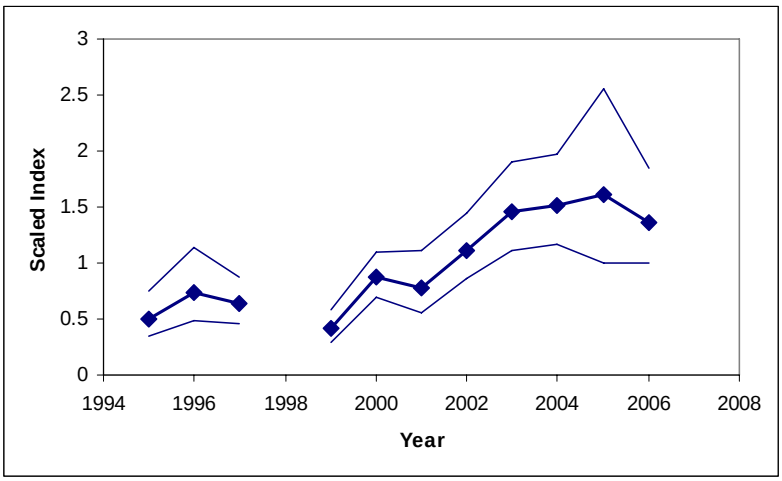
Type 3 Tests of Fixed Effects of Variables Retained in Binomial Sub-model

Effect	Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F
YEAR	10	862	36.16	3.59	<.0001	0.0001
AREA	3	2141	292.34	97.44	<.0001	<.0001
HOOK TYPE	1	581	10.18	10.18	0.0014	0.0015
DEPTH	1	1876	108.73	108.73	<.0001	<.0001
TEMPMAX	1	2031	7.79	7.79	0.0053	0.0053
SALMAX	1	1664	32.26	32.26	<.0001	<.0001

Type 3 Tests of Fixed Effects of Variables Retained in Non-zero Sub-model

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	10	1230	3.02	0.0009
AREA	3	1230	51.78	<.0001
HOOK TYPE	1	1230	19.40	<.0001
SALMAX	1	1230	18.11	<.0001

Figure 48. Standardized abundance indices for Atlantic sharpnose sharks collected during bottom longline surveys from the Gulf of Mexico and Atlantic combined. Type 3 analyses results for those variables retained in sub-models.



Survey Year	Nominal Frequency of Occurrence	N	Index (number per 100 hook-hours)	Scaled Index	CV	LCL	UCL
1995	0.49606	127	2.39438	0.5068	0.19725	0.34287	0.74909
1996	0.40678	118	3.50568	0.74202	0.2158	0.48428	1.13691
1997	0.55983	234	2.99567	0.63407	0.16564	0.45628	0.88113
1998		0					
1999	0.484	250	1.96151	0.41517	0.17084	0.29574	0.58285
2000	0.58358	341	4.13303	0.8748	0.11384	0.69719	1.09766
2001	0.46739	276	3.70708	0.78465	0.17609	0.55321	1.11291
2002	0.61481	405	5.25121	1.11148	0.13202	0.85452	1.4457
2003	0.56071	280	6.86797	1.45368	0.13341	1.11455	1.896
2004	0.6263	287	7.15695	1.51485	0.13171	1.16536	1.96915
2005	0.54054	74	7.58199	1.60481	0.23635	1.00675	2.55817
2006	0.60221	181	6.41439	1.35768	0.15434	0.99891	1.84531

Type 3 Tests of Fixed Effects of Variables Retained in Binomial Sub-model

Effect	Num DF	Den DF	Chi-Square	F Value	Pr > ChiSq	Pr > F
YEAR	10	863	32.92	3.27	0.0003	0.0004
AREA	3	2173	168.62	56.20	<.0001	<.0001
HOOK TYPE	1	645	18.14	18.14	<.0001	<.0001
DEPTH	1	2066	125.81	125.81	<.0001	<.0001
TEMPMAX	1	2067	26.60	26.60	<.0001	<.0001
SALMAX	1	1695	28.22	28.22	<.0001	<.0001

Type 3 Tests of Fixed Effects of Variables Retained in Non-zero Sub-model

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	10	1411	4.16	<.0001
AREA	3	1411	72.42	<.0001
HOOK TYPE	1	1411	24.22	<.0001
SALMAX	1	1411	18.00	<.0001

Figure 49. Standardized abundance indices for small coastal sharks collected during bottom longline surveys from the Gulf of Mexico and Atlantic combined. Type 3 analyses results for those variables retained in sub-models.

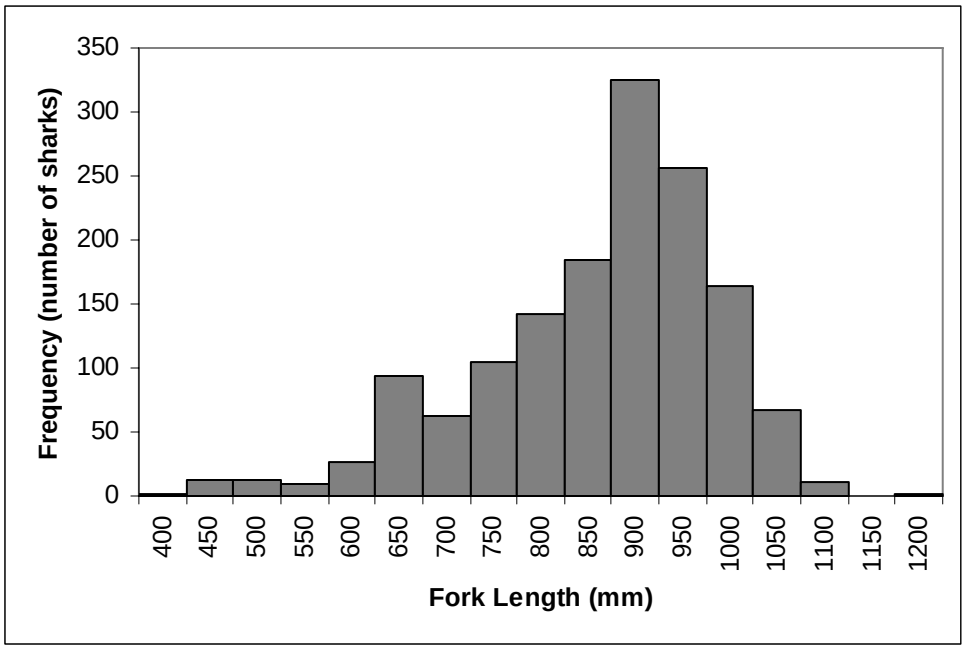


Figure 50. Length frequency histograms of blacknose shark fork lengths collected during bottom longline surveys (N =1473) for all areas combined.

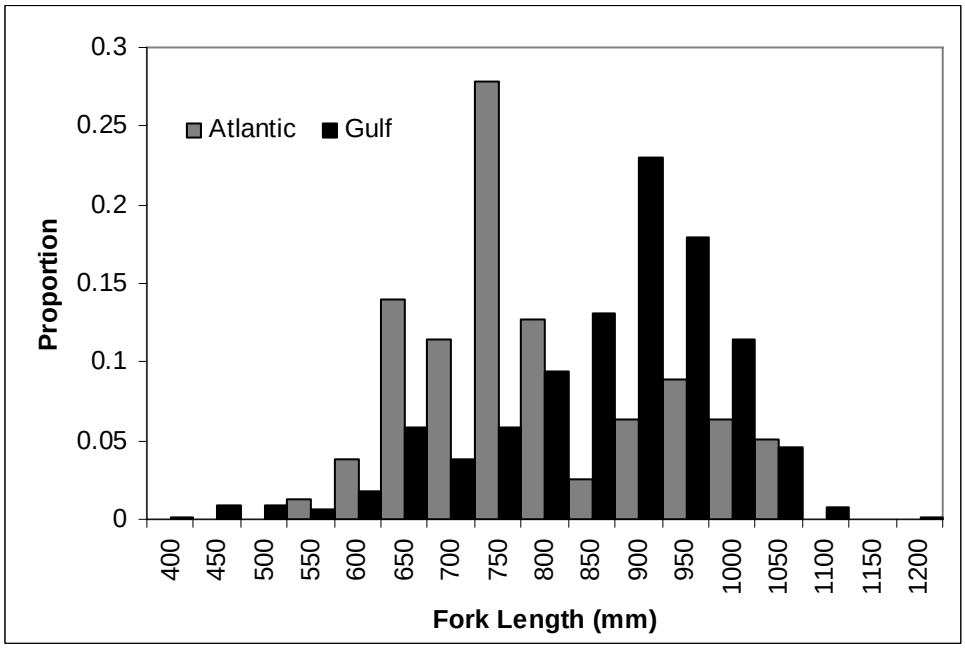


Figure 51. Length frequency histograms of blacknose shark fork lengths collected during bottom longline surveys in the Atlantic (N = 79) and the Gulf of Mexico (N = 1394).

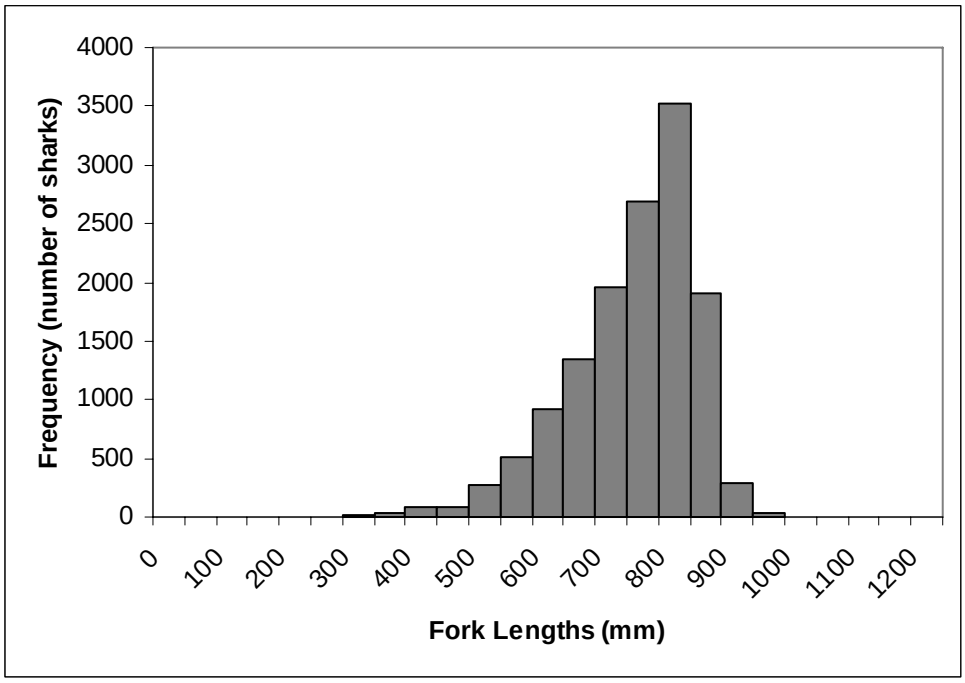


Figure 52. Length frequency histograms of Atlantic sharpnose shark fork lengths collected during bottom longline surveys (N = 13,710) for all areas combined.

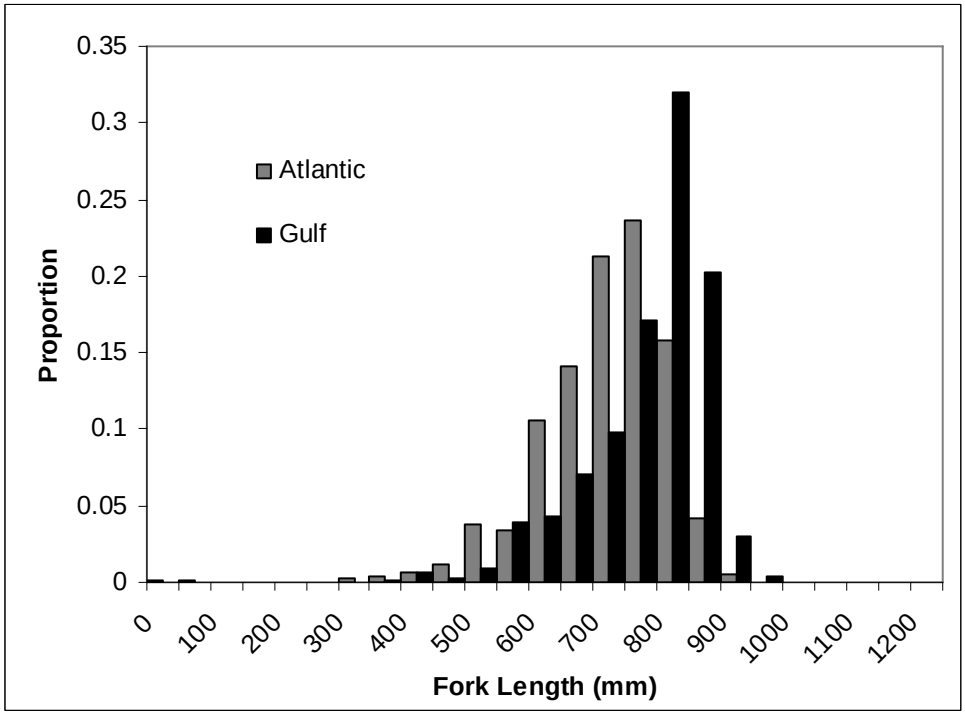


Figure 53. Length frequency histograms of Atlantic sharpnose shark fork lengths collected during bottom longline surveys in the Atlantic (N = 5345) and the Gulf of Mexico (N = 8365).

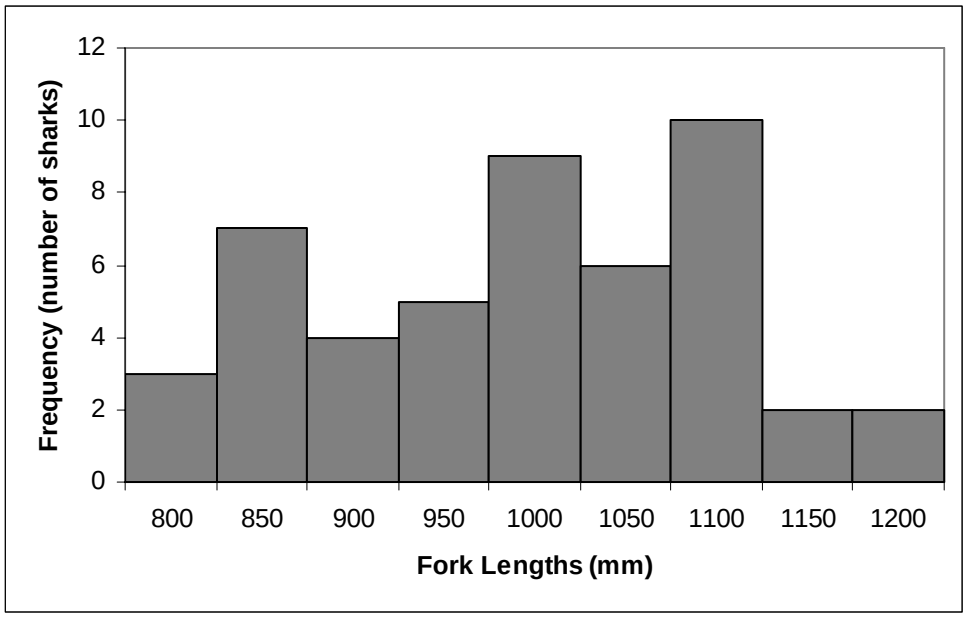


Figure 54. Length frequency histograms of finetooth shark fork lengths collected during bottom longline surveys (N = 48) for all areas combined.

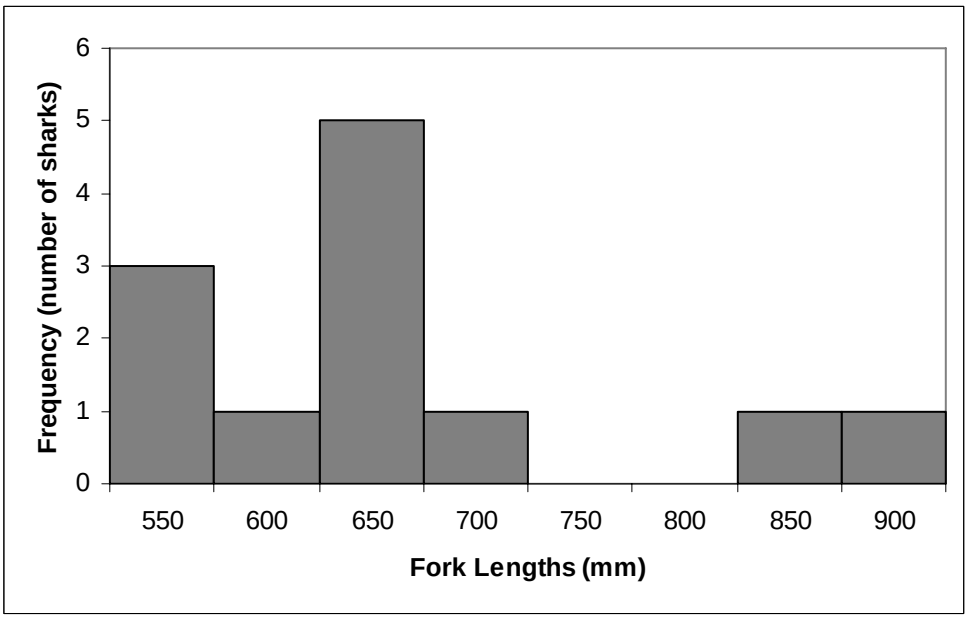


Figure 55. Length frequency histograms of bonnethead fork lengths collected during bottom longline surveys (N = 12) for all areas combined.

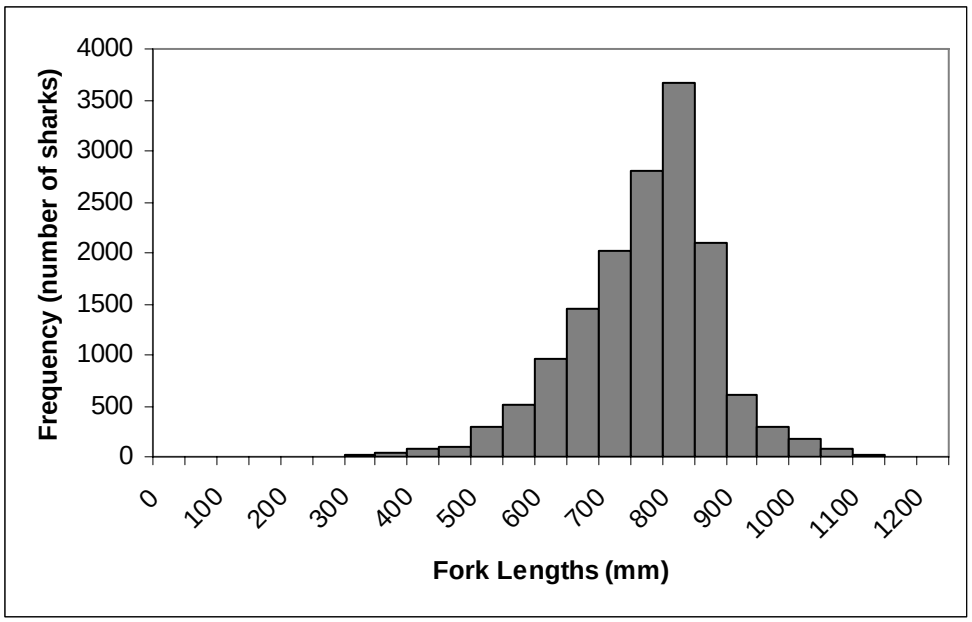


Figure 56. Length frequency histograms of fork lengths of sharks in the small coastal shark complex for all areas combined collected during bottom longline surveys (N = 15,243).

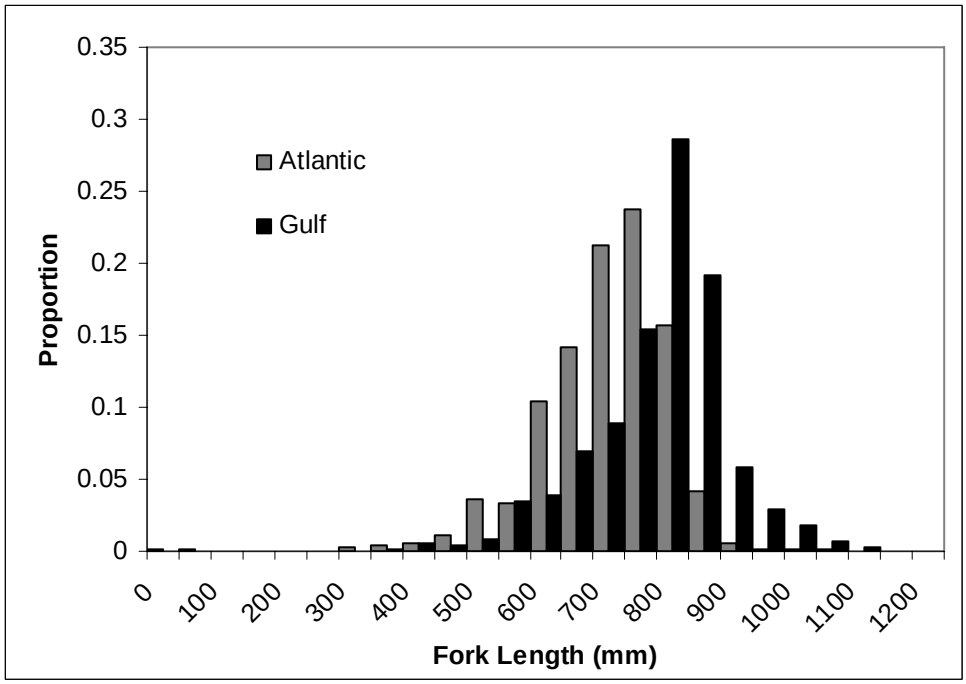


Figure 57. Length frequency histograms of fork lengths of sharks in the small coastal shark complex collected during bottom longline surveys in the Atlantic (N = 5424) and the Gulf of Mexico (N = 9819).