SMALL COASTAL SHARK 2007 SEDAR DATA WORKSHOP DOCUMENT

Trends in relative abundance for shark species caught during a UNC longline survey conducted between 1972 and 2005 in Onslow Bay, NC.

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Summary

Early information about shark abundances, species composition and life history characteristics in near-shore coastal areas along the Gulf and Atlantic coasts of the US was very limited. In the early 1960's, the Bureau of Sport Fish and Wildlife (BSFW) initiated a coastal shark survey (1961 and 1965) in response to shark attacks in New Jersey and concerns raised by resort owners. This early survey indicated high seasonal abundances and species diversity in near-shore waters from Cape Henry, VA to Long Island, NY. The BSFW survey was re-directed to deeper offshore strata in the mid 1960's, but questions about the importance of coastal habitats for shark life-history remained. In North Carolina waters information about sharks was limited prior to 1972. This led to the establishment of a bi-weekly longline survey (April- November, 1972-2005) to study the sharks found in Onslow Bay, North Carolina by the University of North Carolina Institute of Marine Sciences. Sampling was conducted at shallow east-west (13 m deep) and deeper north-south (22 m) stations, 1 to 3.5 km south of Shackleford Banks. The surveys objective was to define what sharks occurred in the area, their sizes, life stages, relative abundances and seasonal occurrences. While other surveys and sampling programs have been initiated, the 34 year UNC time series described here is particularly consistent in terms of fixed sampling stations and the gear that was used.

A total of 7,993 sharks were captured between 1972 and 2005 during 798 sets on 450 sampling days. Shark catch was dominated by six species, including Atlantic sharpnose *Rhizoprionodon terraenovae*, blacknose *Carcharhinus acronotus*, dusky *C. obscurus*, blacktip *C. limbatus*, smooth dogfish *Mustelus canis* and scalloped hammerhead *Sphyrna lewini* sharks (descending order), which accounted for 88% of the total shark catch. Sandbar *C. plumbeus*, spinner *C.* brevipinna, silky *C. falciformis* and finetooth *C. isodon* sharks were the next most abundant species, with 310, 228, 164 and 99 individuals, respectively. Blacknose, dusky, blacktip, smooth dogfish, scalloped hammerhead, and sandbar sharks all appear to have a decreasing trend of relative abundance during the survey years. The Atlantic sharpnose shark and the small coastal shark complex, which is driven by the Atlantic sharpnose shark, are the only ones that appear to have an increasing trend in relative abundance during the survey years from 1972-2005. Total shark relative abundance appears to be stable in Onslow Bay and is likely a balance between the increasing trend in the abundant Atlantic sharpnose shark and the decreasing trends in the majority of other species. The data from 2005 also indicate that the smooth dogfish may be beginning an upwards trend in relative abundance.

Methods

Sampling gear

An unanchored longline, approximately 4.8 km long of braided nylon (about 7.6 mm diameter) was suspended by orange 1.3 m diameter polyfoam plastic floats spaced every 10 hooks, spacing between hooks was 4.5 m. Gangions were 1.8 m long of No. 2 (95 kg) porch swing chain terminating in a No. 9 Mustad tuna hook. This gear was not altered throughout the 30 + years of sampling. The number of hooks varied more during early sample years and less during later years, rarely less than 100 hooks per set. The shallow (13 m) east-west (E-W) set was over sandy-silt and the deeper (22 m) north-south (N-S) set was over sandy areas. Bait was fresh fish trawled near Beaufort Inlet, North Carolina, usually consisting of spot *Leiostomus xanthus* and Atlantic croaker *Micropogonias undulatus*, occasionally pigfish *Orthopristis chrysptera* and pinfish *Lagodon rhombiodes*. Soak time was one hour, to avoid longer intervals that would often produce dead or dying sharks, usually from their fighting the line. Fork lengths were recorded for each species. Any specimen that was partially eaten, damaged or lost during line retrieval was counted but not measured. This report does not summarize other sharks caught during trawl tows for bait collection.

Survey effort

Bi-weekly sampling occurred between April and November. The daily sampling protocol generally included an early morning set at the E-W station, followed by a later set in the day at the N-S station. Weather occasionally prevented occupying both stations on a single day, affecting about 23% (103 sets) of 450 sampling days. A chi-square test was run on a 2x2 table comparing stations (E-W and N-S) and set numbers (set 1 vs set 2), as a proxy for time of day, to determine if time of day, depth, and station were independent of each other. An analysis of variance (ANOVA) with set number (set 1 vs set 2) as the independent variable was run for the top 10 species in numerical abundance, total sharks and the small coastal complex (Atlantic sharpnose, blacknose and finetooth sharks). Only days with multiple sets were selected and the catch per unit effort (CPUE) defined as shark catch per set divided by the number of hooks per set was compared between set numbers. A significant difference between set numbers would indicate higher catch rates either in the early morning hours (set 1) or mid-day (set 2). An

ANOVA with station (E-W vs N-S) as the independent variable was also run for the CPUE of total sharks, the small coastal complex and the top 10 species in numerical abundance.

Relative abundance trends

The CPUE was used to examine the trends in relative abundance for coastal shark species during UNC longline surveys conducted between 1972 and 2005 in Onslow Bay, NC. Box-plots were created for total sharks, the small coastal complex and the top ten species in numerical abundance. The yearly means for the nominal CPUE values for total sharks, the small coastal complex and each of the top ten species in numerical abundance were divided by the overall mean for comparison to other relative indices of abundance. This study also attempted to standardize the catch rates (number of sharks per set) for each of the 12 dependent variables using a two-step approach, which models the proportion of positive catch separately from the positive catch. This method was originally proposed by Lo et al. (1992) and is based on a delta-lognormal model. After initial exploratory analysis, factors considered as potential influences on the catch rates for the Lo et al. analyses were: year (1972-2005), month (April-November), and station (E-W and N-S). By standardizing the catch rates to include the effects of these variables a more accurate picture of the trends in shark relative abundance can be developed. The addition of year effects can also reduce the temporal variability due to a combination of environmental variables during those times.

The proportion of sets with positive catch values was modeled assuming a binomial distribution with a logit link function and the positive catch sets were modeled assuming a Poisson distribution with a log link function. For the positive catch sets an offset of the natural log of the number of hooks was used for the Poisson model. The models were fit in a stepwise forward manner adding one potential factor at a time after initially running a null model with no factors included (Gonzáles-Ania et al. 2001, Carlson 2002). Each potential factor was ranked from greatest to least reduction in deviance per degree of freedom when compared to the null model. The factor resulting in the greatest reduction in deviance was then incorporated into the model providing the effect was significant at $\alpha = 0.05$ based on a chi-square test, and the deviance per degree freedom was reduced by at least 1% from the less complex model. This process was continued until no additional factors met the criteria for incorporation into the final model. All models in the stepwise approach were fitted using the SAS GENMOD procedure (SAS Institute, Inc.). The final models were run through the SAS GLIMMIX macro to allow

fitting of the generalized linear mixed models using the SAS MIXED procedure (Wolfinger, SAS Institute, Inc). The factor "year" was kept in all final models, regardless of its significance, to allow for calculation of indices. The standardized indices of abundance were based on the year effect least square means determined from the combined binomial and Poisson components.

Results

Shark Catch

A total of 7,993 sharks were captured between 1972 and 2005 during 798 sets on 450 sampling days. Shark catch (Table 1, Figure 1) was dominated by six species, including Atlantic sharpnose *Rhizoprionodon terraenovae*, blacknose *Carcharhinus acronotus*, dusky *C. obscurus*, blacktip *C. limbatus*, smooth dogfish *Mustelus canis* and scalloped hammerhead *Sphyrna lewini* sharks (descending order), which accounted for 88% of the total shark catch. Sandbar *C. plumbeus*, spinner *C.* brevipinna, silky *C. falciformis* and finetooth *C. isodon* sharks were the next most abundant species, with 310, 228, 164 and 99 individuals, respectively. The top ten species accounted for 98% of the total shark catch. The remaining 12 species were represented by fewer than 50 individuals, with nine species represented by less than 15 records during the 30 + year sampling program. Seven of the top 10 species were represented by all life stages, neonate through adult, in the catch records: including Atlantic sharpnose, blacknose, dusky, smooth dogfish, scalloped hammerhead, sandbar, and spinner sharks (Figure 2). Atlantic sharpnose sharks, blacknose sharks, and smooth dogfish all occurred predominately as mature sharks (Figure 2). Both blacktip, silky and finetooth sharks were represented by juveniles (age 1+) through adults and occurred predominately as juveniles and especially older juveniles in the finetooth shark catch.

Examining the annual species counts during the UNC survey reveals that blacknose and blacktip sharks were caught in every year of the survey between 1972 and 2005 and Atlantic sharpnose sharks were only missing from the catch during the first year of the survey (Table 2). Spinner sharks ranked number eight in numerical abundance (n= 228) and were caught in all but four years of the survey, predominately in low numbers. Dusky sharks, which were also in the top four species in terms of numerical abundance, were not caught during four years of sampling between 1992 and 2005. Several species exhibited a more pronounced pattern than that of the dusky, with higher total numbers and consistent catches prior to 1990, but lower numbers and

infrequent and/or inconsistent annual catches subsequently, including: smooth dogfish, scalloped hammerhead, sandbar, tiger and bull sharks (Table 2).

Survey Effort

Inter-annual variability existed in numbers of sets and total and average number of hooks fished (Table 3, Figure 3). Effort appears to have peaked between 1975 and 1989, when between 24 and 32 sets were made each year, whereas between 1990 and 2005, there were only three years during which 25 sets were made and only one year with 27 sets. A chi-square test comparing stations and set numbers was statistically significant ($\chi^2 = 401.19$, df = 1, $p<.001$), indicating that time of day, depth, and station were confounded and that the sampling design was not randomized for the station number (proxy for time of day) versus station location (proxy for depth). Since the time of day and station – depth variables were not independent of one another; they can not be separated in terms of how either factor might affect a catch rate.

The ANOVAs comparing set number with the CPUE for total sharks, small coastal complex (Atlantic sharpnose, blacknose and finetooth sharks) and each of the top ten species in numerical abundance all indicated that the CPUE on the first set of the day was higher than on the second set of the day. This pattern was significant for total shark and small coastal complex CPUE and the CPUE of blacknose, blacktip, scalloped hammerhead, spinner, and finetooth sharks ($p<.05$) (Table 4). The CPUE between set numbers for the remaining species was not significant ($p>.05$) (Table 4). In the ANOVAs comparing station with the CPUE for total sharks, small coastal complex and each of the top ten species in numerical abundance, significant differences were found, with E-W station catches exceeding N-S catches for total sharks, small coastal complex, blacknose, blacktip, spinner and finetooth sharks ($p<.05$) (Table 5). The results for these species are expected given the previous ANOVA results on set number (set 1 vs set 2) and the results of the chi-square test.

Relative abundance trends

The box plots of nominal CPUE data (Appendix 1 and 2) mirror the catch results (Table 2), where several species exhibited a higher and more stable CPUE prior to 1990, but lower and less stable CPUE subsequently, including: smooth dogfish, scalloped hammerhead, sandbar, tiger and bull sharks. The final models chosen for total sharks, the small coastal complex and each of the top ten species for the proportion of positive catches (PP) and the positive catches (PC) in the

generalized linear mixed model are as follows: total sharks PP = month + year and PC = year + month + station; small coastal complex PP = month + year and PC = year + month; Atlantic sharpnose shark PP = month + year and PC = month + year; blacknose shark PP = month + year + station and PC = year + month; dusky shark PP = month + year and PC = year + month + station; blacktip shark PP = month + station + year and PC = year + month; smooth dogfish PP = month + year and PC = month + year; scalloped hammerhead shark PP = year + month + station and PC = year + month; sandbar shark PP = month + year and PC = year; spinner shark PP = station + year and PC = year; silky shark PP = year and PC = month + station + year; and finetooth shark PP = station + year and PC = year + month. The stepwise construction of these models and the resulting standardized indices of abundance can be viewed in Appendix 3 and 4. Even though the factor of year was significant in the proportion positive and positive catch generalized liner mixed models for five of the top ten species, month was significant for both generalized linear mixed models for six of the top ten species and the factor of station was significant in at least one of the generalized linear mixed models for six of the top ten species (Appendix 3), results from this study indicate that any bias associated with these factors did not significantly change the trends between the nominal and standardized data (Figures 4-15). Blacknose, dusky, blacktip, smooth dogfish, scalloped hammerhead, and sandbar sharks all appear to have a decreasing trend of relative abundance during the survey years (Figures 7-12). The Atlantic sharpnose shark and the small coastal shark complex, which is driven by the Atlantic sharpnose shark, are the only ones that appear to have an increasing trend in relative abundance during the survey years from 1972-2005 (Figures 5 and 6). Total shark relative abundance appears to be stable in Onslow Bay and is likely a balance between the increasing trend in the abundant Atlantic sharpnose shark and the decreasing trends in the majority of other species (Figure 4). The data from 2005 also indicate that the smooth dogfish may be beginning an upwards trend in relative abundance (Figure 6).

Literature Cited

Carlson J.K. 2002. A fishery-independent assessment of shark stock abundance for large coastal species in the northeast Gulf of Mexico. Panama City Laboratory Contribution Series 02-08. 26pp.

González-Ania, L.V., C.A. Brown, and E. Cortés. 2001. Standardized catch rates for yellowfin tuna (*Thunnus albacares*) in the 1992-1999 Gulf of Mexico longline fishery based upon observer programs from Mexico and the United States. Col. Vol. Sci. Pap. ICCAT 52:222-237.

Lo, N.C., 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. 49:2515-2526.

Table 1. Species totals recorded during the UNC shark survey for all years combined. Species are listed in descending order of abundance. Numbers of males and females measured are reported along with the number that were not measured or sexed for a variety of reasons, including predation and lost catch.

	measured		unmeasured/	
SHARKS	**males**	**females**	**not sexed**	**Total**
Atlantic Sharpnose	1148	1329	42	2519
Blacknose	480	742	95	1317
Dusky	441	573	30	1044
Blacktip	536	331	46	913
Smooth Dogfish	299	437	25	761
Scalloped Hammerhead	247	204	50	501
Sandbar	141	164	5	310
Spinner	88	131	9	228
Silky	71	92	1	164
Finetooth	76	23	0	99
Spiny Dogfish	16	24	0	40
Tiger	6	23	10	39
Bull	15	4	4	23
Unknown Dogfish	8	5	0	13
Smooth hammerhead	1	2	2	5
Great hammerhead	4	0	1	5
Lemon	1	0	2	3
Nurse	1	0	2	3
Night	0	1	2	3
Sand Tiger	1	0	0	1
Bigeye thresher	1	0	0	1
White	0	1	0	1
all sharks	3581	4086	326	7993

Table 2. Annual species counts recorded during the UNC shark survey.

YEAR	Atlantic Sharpnose	Blacknose	Dusky	Blacktip	Smooth Dogfish	Scalloped HH	Sandbar	Spinner	Silky	Finetooth	Spiny Dogfish	Tiger	Bull	Unknown Dogfish	Smooth HH	Great HH	Lemon	Nurse	Night	Sand Tiger	Bigeye thresher	Great White	All species
1972		8	8	5	5	1																	27
1973	8	44	6	37		31						2	3		1		2						134
1974	5	21	85	24	43	17		4				2	1						2			1	205
1975	17	60	121	48		34		7				2	3		1	2							295
1976	7	37	53	29	23	31	2	2															184
1977	20	134	78	34	42	38	35	12		1		1	1			1							397
1978	33	73	13	42	44	25	28	19		1	3	1								1			283
1979	30	77	33	22	62	27	36	30	1	3	5	9	5				1						341
1980	61	84	93	83	103	45	1	8	1			4											483
1981	28	29	76	12	70	33	3	2		2		1											256
1982	16	60	121	33	31	23	4	8	19	2		2	5		2								326
1983	71	34	51	61	45	34	43	7	31	2		1	2										382
1984	45	78	78	80	50	40	18	2	12			2	1										406
1985	77	43	18	23	6	10	19	1	3			2											202
1986	53	24	35	40	16	14	9	3			30	3											227
1987	80	48	56	80	30	19	43	13	16	2		3											390
1988	153	119	31	50	11	36	17	11	27	5													460
1989	71	38	35	25	25	4	15	10	19	16	1				1								260
1990	62	13	3	2	20	1			5			1											107
1991	110	31	13	24	40	1	2	8	3					1									233
1992	119	44		4	6			4	1	4													182
1993	113	44	4	12	4	3	2	4	1	3		1	1										192
1994	83	32	11	30	3	2	23	12	4	46													246
1995	136	42		20			1	7	1	1			1			1		1					211
1996	80	35	1	41	11	3	1	13	2														187
1997	93	15	3	10	5		3	8		5						1							143
1998	116	7		9	20	2	3	4	8			1									1		171
1999	84	3	2	6		12	1	8			1			12									129
2000	108	5	1	12		4	1	5	1														137
2001	95	10	1	2		1		2															111
2002	126	9	5	3		2			1			1						2	1				150
2003	139	3	1	2	3	2		6	6														162
2004	110	5	8	3	15	2		3															146
2005	170	8		5	28	4		5	2	6													228
all years	2519	1317	1044	913	761	501	310	228	164	99	40	39	23	13	5	5	3	3	3	1	1	1	7993

Table 3. The number of longline sets recorded during the UNC shark survey by year and month, along with the total number of sets per year, number of single set and double set sampling days, null sets, average number of hooks per set, total hooks set per year and the total shark catch (all species) by year. Null sets occurred when gear was set but no sharks were caught.

Year	April	May	June	July	Aug	Sept	Oct	Nov	Total Sets	Single Sets	Double Sets	Null Sets	Average Hooks/set	Total Hooks	Total Sharks
1972		1				1	1		3	3			95	284	27
1973			2	4	2	1	2		11	1	5		89	980	134
1974	2	4	3	3		2	2		16	2	7	1	97	1555	205
1975		3	4	4	2	4	4	3	24	6	9		99	2371	295
1976	4	2	3	4	3	4	3	2	25	5	10	1	86	2142	184
1977	4	3	3	4	6	4	4	2	30	2	14		96	2869	397
1978	4	4	3	3	4	5	3	2	28	4	12		92	2562	283
1979	3	6	2	4	4	5	4		28	2	13		110	3082	341
1980	5	4	4	4	4	6	2		29	1	14	2	171	4953	483
1981	4	4	6	4	4	6	3		31	1	15	3	139	4317	256
1982	2	4	4	4	6	3	4	4	31	3	14	3	168	5222	326
1983	1	6	4	4	4	4	4	4	31	1	15		167	5175	382
1984	2	8	4	4	5	4	5		32	2	15	1	158	5056	406
1985		6	8	2	4	4	6		30	2	14	2	160	4799	202
1986	4	3	4	4	4	4	4	2	29	1	14	3	155	4500	227
1987	2	4	4	4	4	3	4		25	1	12		177	4419	390
1988	1	5	9	4	4	5	4		32	4	14	2	180	5757	460
1989	4	5	6	3	3	4	2		27	7	10	3	173	4683	260
1990	2	4	4	2	2	3	4		21	5	8	2	166	3479	107
1991		3	4	4	1	5	1		18	4	7		158	2835	233
1992		5	2	3	2	1	2		15	7	4		134	2014	182
1993		2	6	4	3	2	2		19	1	9	3	150	2844	192
1994	1	2	8	4	4	2	6		27	3	12	5	139	3747	246
1995	1	3	3	7	1	2	2		19	9	5		149	2823	211
1996		4	3	4	2	5	2		20	4	8	1	132	2649	187
1997	1	4	3	4	5	5	3		25	5	10	4	122	3046	143
1998	2	4	4	7	2	3	1	2	25	3	11	1	130	3262	171
1999	2	5	4	2	3	4	4	1	25	3	11	3	122	3051	129
2000		4	3	2	4	4	5		22	2	10	2	121	2663	137
2001		4	3	3	3	1	1		15	5	5		118	1767	111
2002		4	3	6	4	2	4		23	1	11	3	118	2720	150
2003	2	4	4	4	4	2	2		22		11	3	101	2227	162
2004	2	4	3	2	2	2	4		19	2	9	1	100	1905	146
2005	2	3	2	4	4	2	4		21	1	10		101	2118	228
All years	57	130	132	125	109	114	108	22	797	103	347	48	132	107776	7993

Table 4. ANOVA results for set number comparisons (set 1 vs set 2) for total shark CPUE and the top 10 species' (by numerical abundance) CPUE

Total sharks

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.209605	0.209605	40.90	<.0001
error	694	3.556550	0.005125		
corrected total	695	3.766250			

Small coastal shark complex

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.037978	0.037978	19.83	<.0001
error	694	1.329050	0.001915		
corrected total	695	1.367030			

Atlantic sharpnose shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.001997	0.001997	1.39	0.2392
error	694	1.000610	0.001442		
corrected total	695	1.002600			

Blacknose shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.018698	0.018698	25.68	<.0001
error	694	0.505224	0.000728		
corrected total	695	0.523922			

Dusky shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.002641	0.002641	2.24	0.1347
error	694	0.819130	0.001180		
corrected total	695	0.821771			

Blacktip shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.007150	0.007150	20.09	<.0001
error	694	0.247053	0.000356		
corrected total	695	0.254203			

Table 4 continued

Smooth dogfish

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.002081	0.002081	1.93	0.1642
error	694	0.746387	0.001075		
corrected total	695	0.748467			

Scalloped hammerhead shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.001705	0.001705	9.32	0.0023
error	694	0.126988	0.000183		
corrected total	695	0.128693			

Sandbar shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000115	0.000115	0.94	0.3332
error	694	0.084905	0.000122		
corrected total	695	0.085019			

Spinner shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000418	0.000418	6.43	0.0112
error	694	0.045163	0.000065		
corrected total	695	0.045581			

Silky shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000060	0.000060	1.84	0.1754
error	694	0.022742	0.000033		
corrected total	695	0.022802			

Finetooth shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000181	0.000181	4.33	0.0374
error	694	0.028974	0.000042		
corrected total	695	0.029155			

Table 5. ANOVA results for station comparisons (E-W vs N-S) for total shark CPUE and the top 10 species' (by numerical abundance) CPUE

Total sharks

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.124308	0.124308	24.04	<.0001
error	796	4.116460	0.005171		
corrected total	797	4.240770			

Small coastal complex

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.017309	0.017309	8.06	0.0045
error	796	1.709460	0.002148		
corrected total	797	1.726770			

Atlantic sharpnose shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000001	0.000001	0.00	0.9810
error	796	1.302610	0.001636		
corrected total	797	1.302610			

Blacknose shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.014313	0.014313	19.29	<.0001
error	796	0.590774	0.000742		
corrected total	797	0.605088			

Dusky shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.003830	0.003830	2.93	0.0869
error	796	1.040480	0.001307		
corrected total	797	1.044310			

Blacktip shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.004297	0.004297	12.41	0.0004
error	796	0.275543	0.000346		
corrected total	797	0.279840			

Table 5 continued

Smooth dogfish

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000272	0.000272	0.29	0.5928
error	796	0.758205	0.000953		
corrected total	797	0.758478			

Scalloped hammerhead shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000493	0.000493	2.91	0.0880
error	796	0.134891	0.000169		
corrected total	797	0.135385			

Sandbar shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000350	0.000350	2.24	0.1346
error	796	0.124598	0.000157		
corrected total	797	0.124948			

Spinner shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000358	0.000358	5.905	0.0151
error	796	0.048321	0.000061		
corrected total	797	0.048698			

Silky shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000170	0.000170	3.72	0.0538
error	796	0.036458	0.000046		
corrected total	797	0.036629			

Finetooth shark

source	df	sum of squares	mean square	F-value	probability > F
model	1	0.000166	0.000166	4.13	0.0421
error	796	0.031987	0.000040		
corrected total	797	0.032153			

Figure 1. Percent species composition for UNC shark longline survey 1972-2005

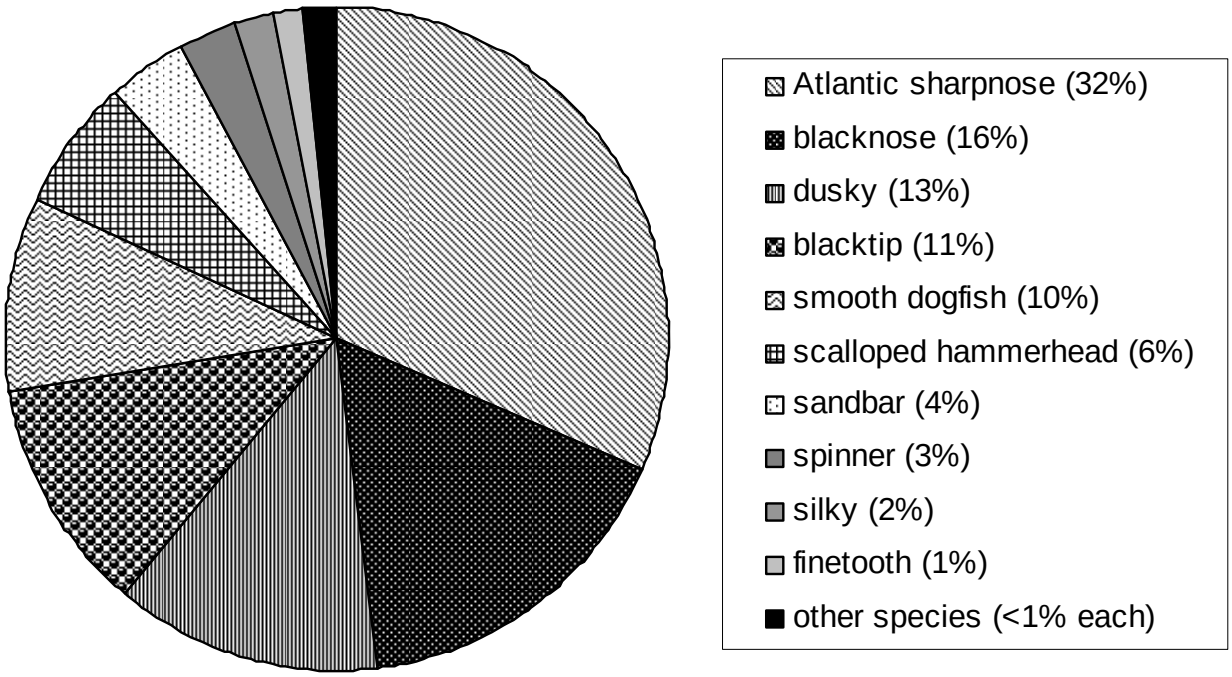
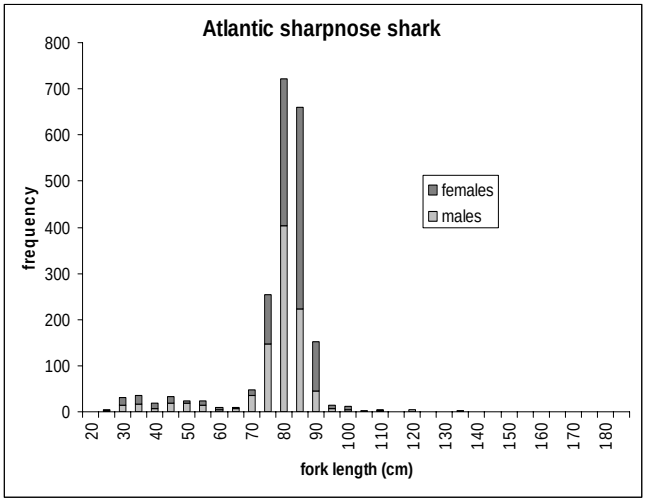
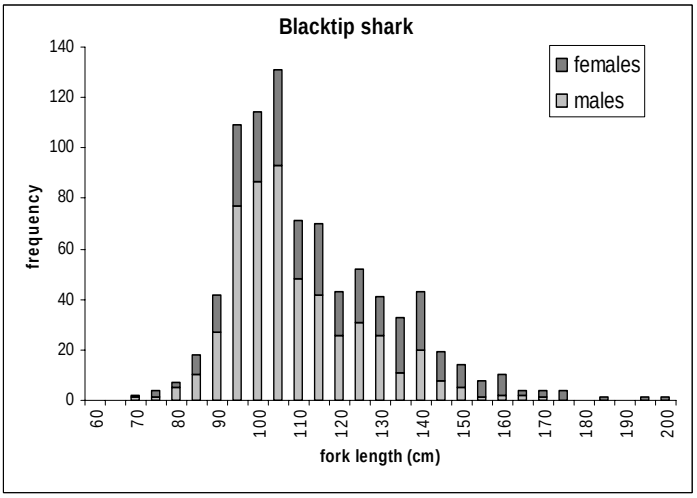
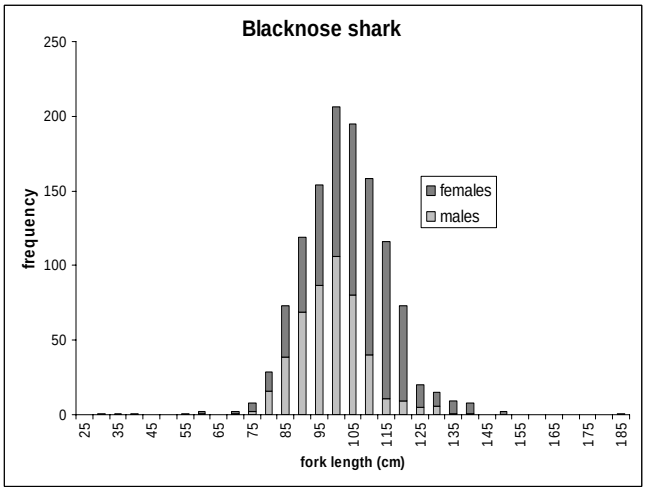
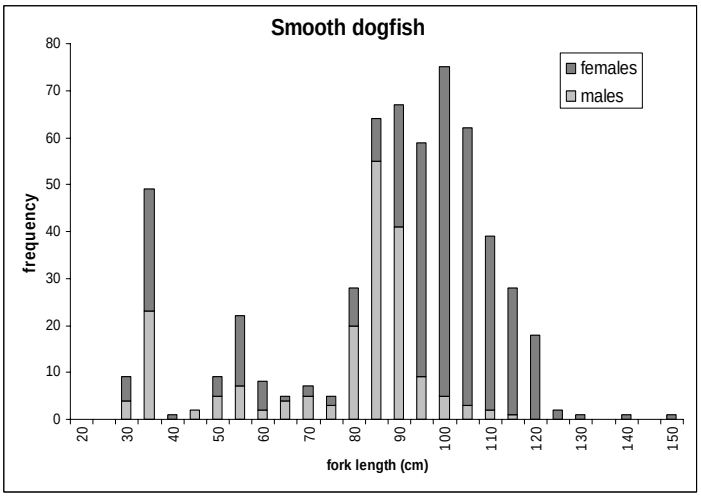


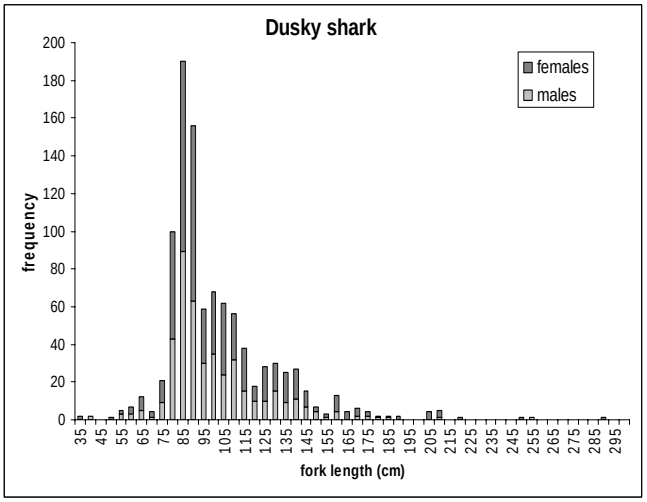
Figure 2. Length frequencies for the top 10 species in numerical abundance.











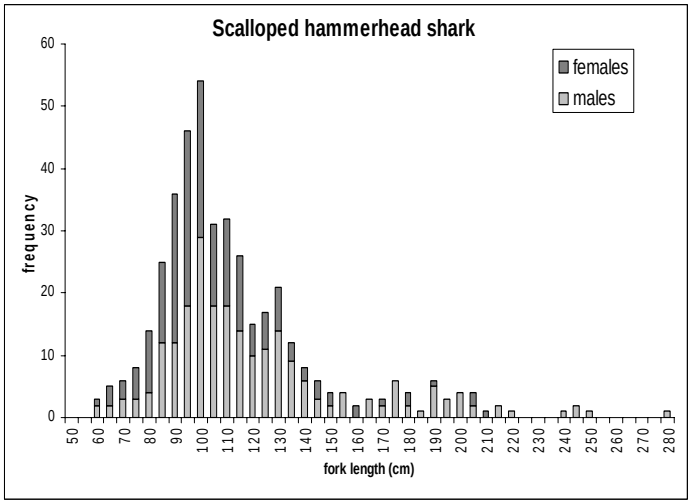
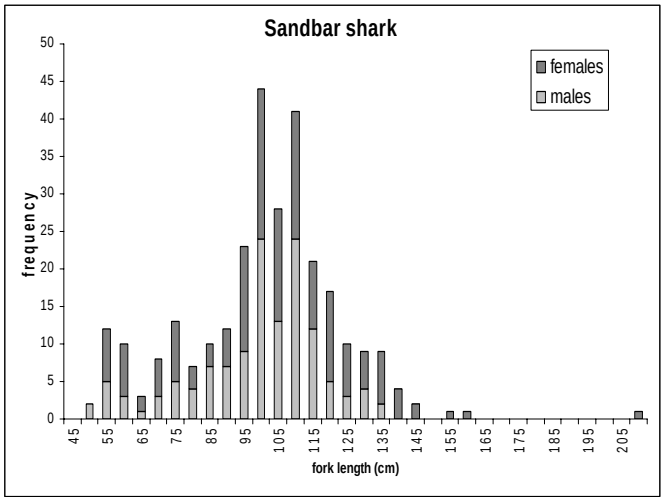
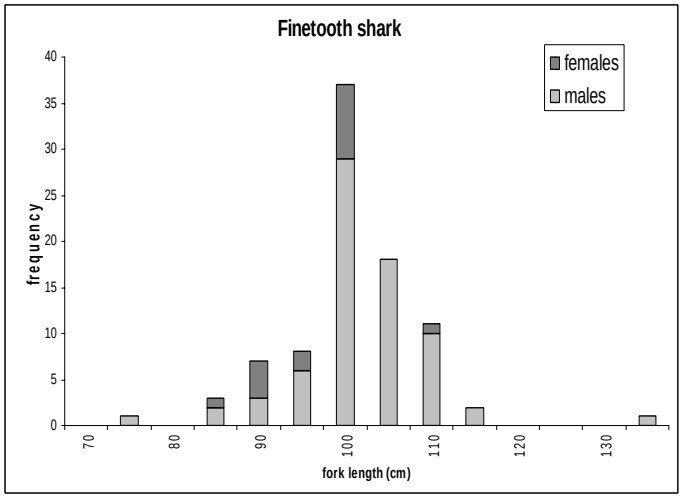
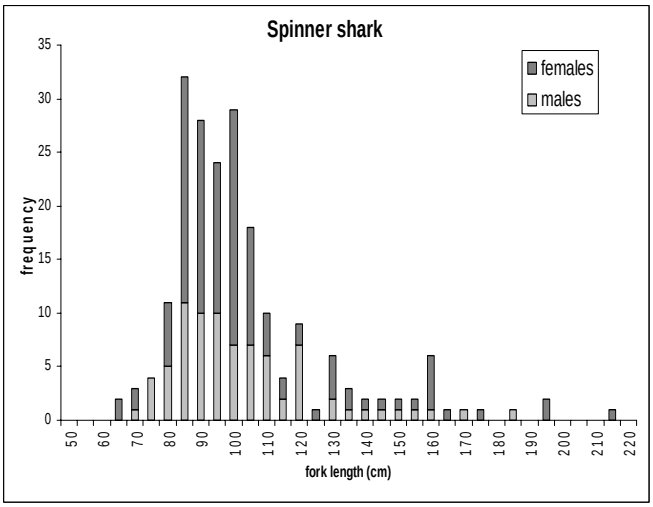


Figure 2 continued







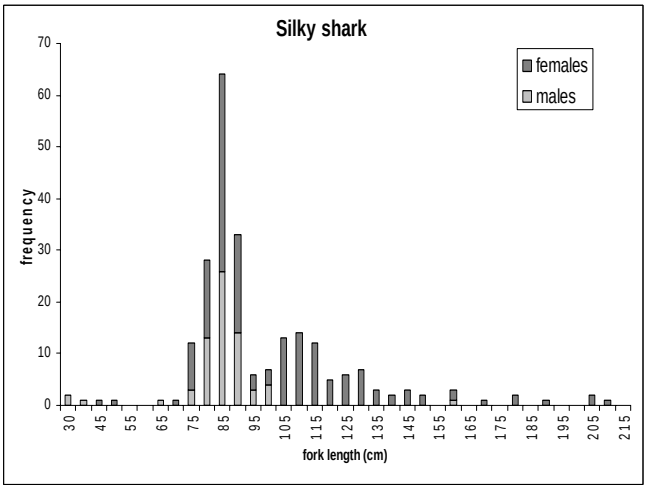


Figure 3. UNC shark longline survey effort from 1972-2005.

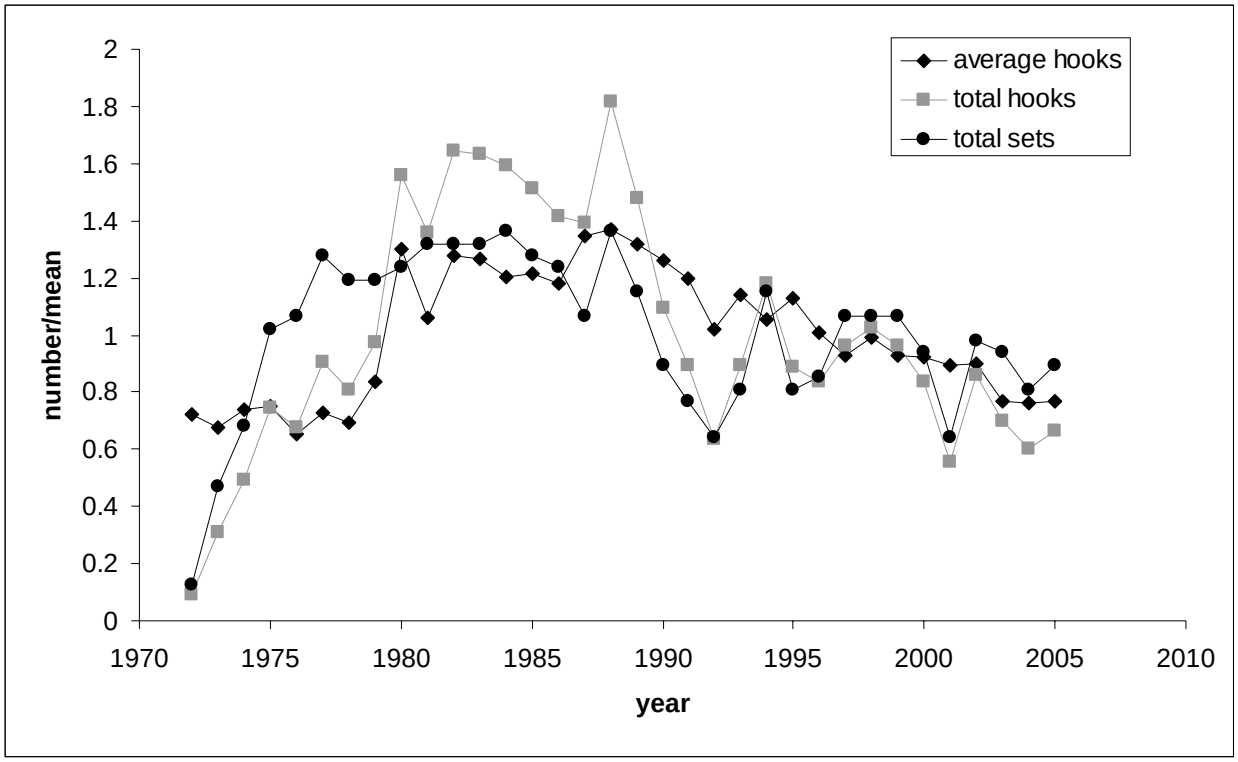


Figure 4. Relative indices of abundance by year for total sharks

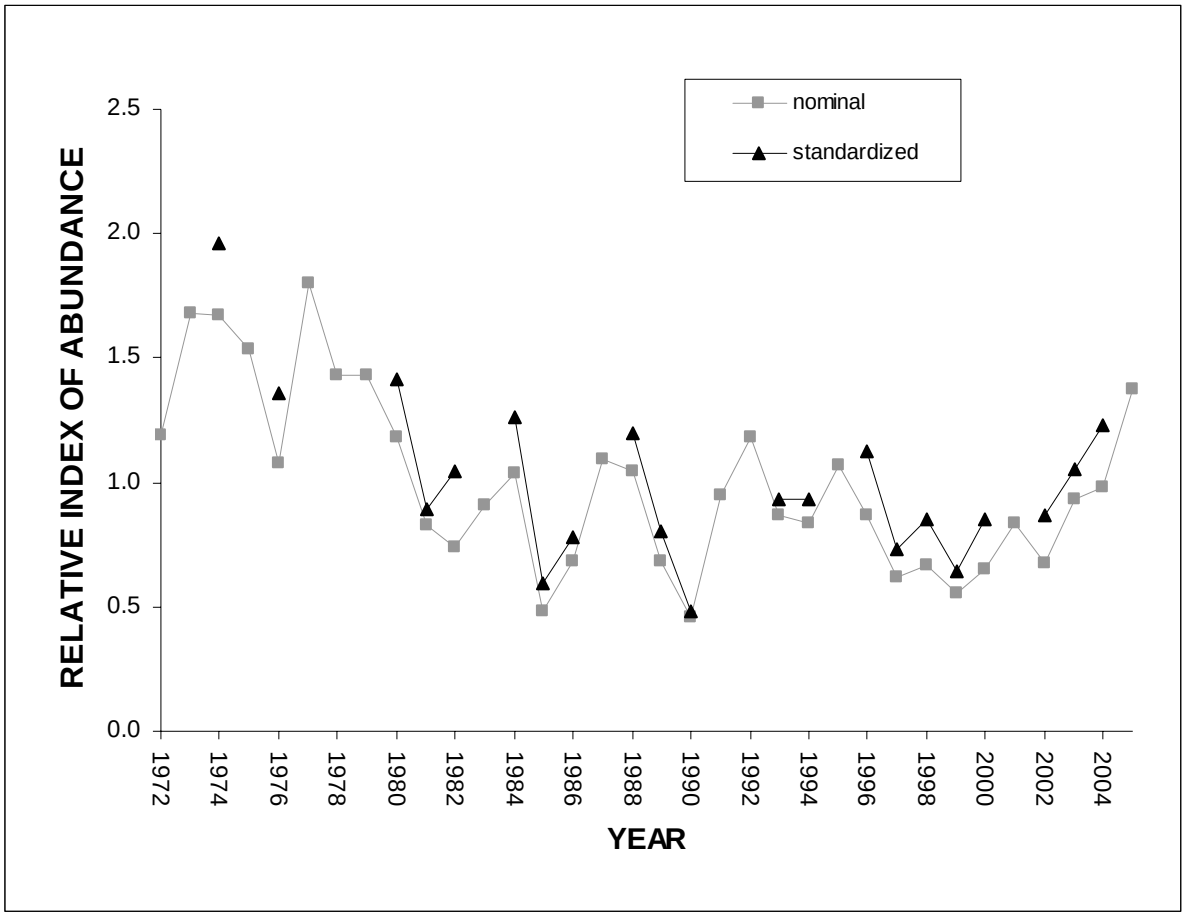


Figure 5. Relative indices of abundance by year for small coastal complex

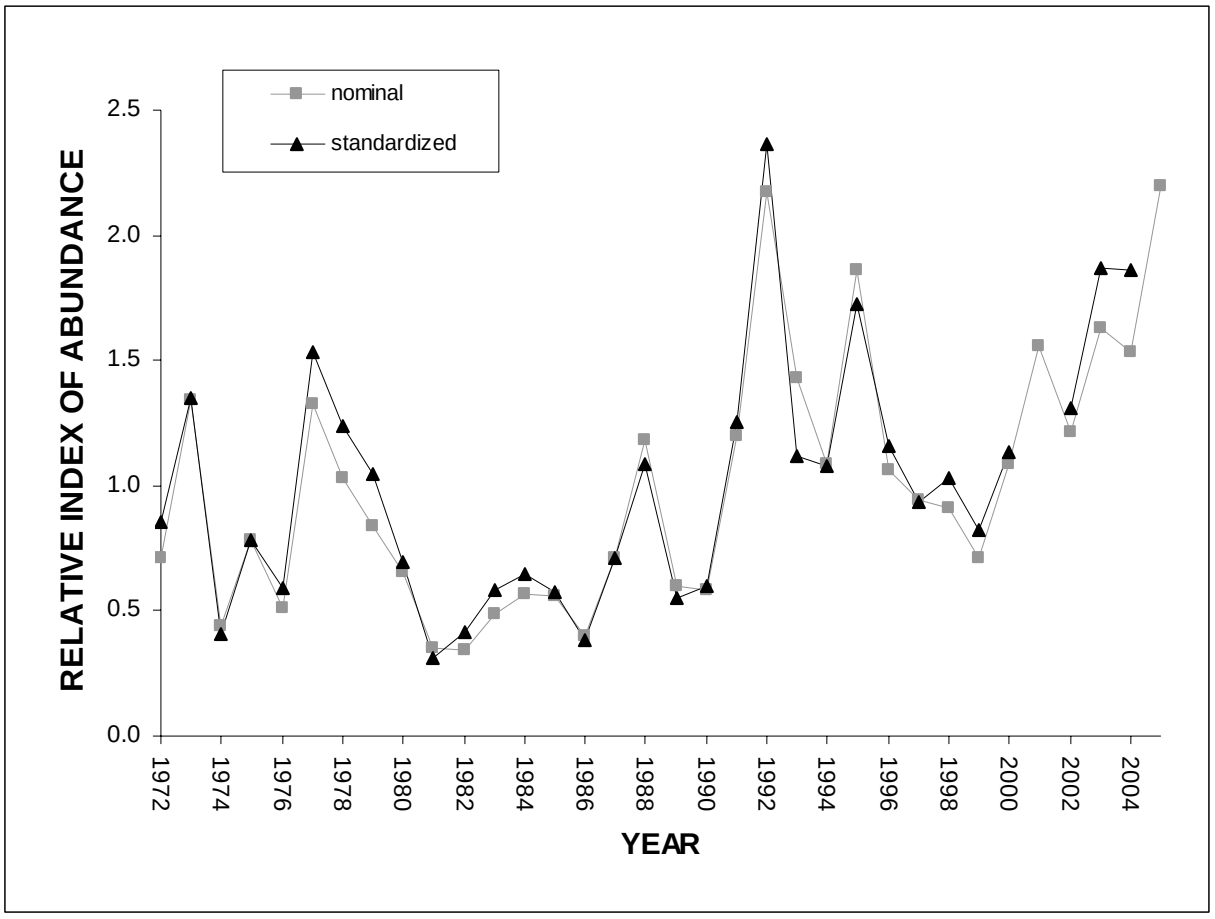


Figure 6. Relative indices of abundance by year for Atlantic sharpnose sharks

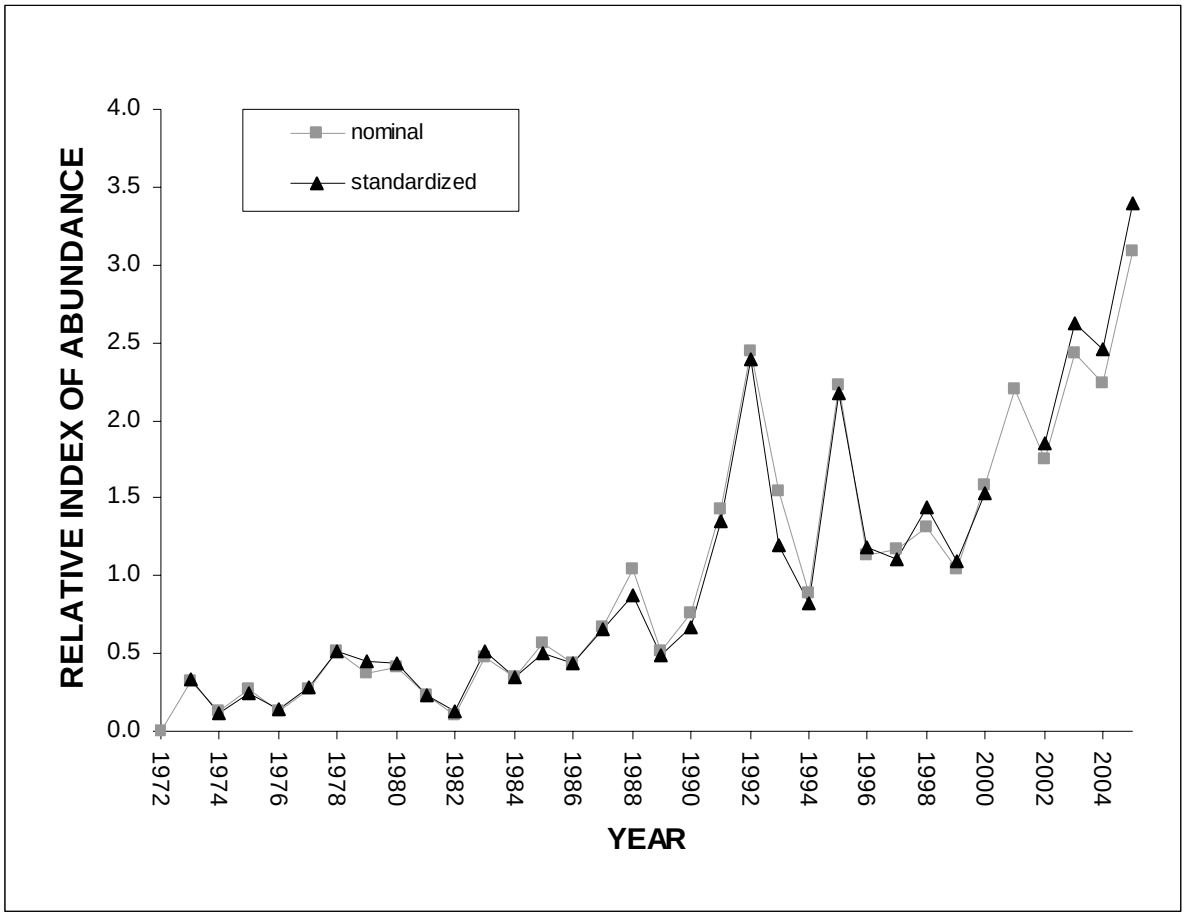


Figure 7. Relative indices of abundance by year for blacknose sharks

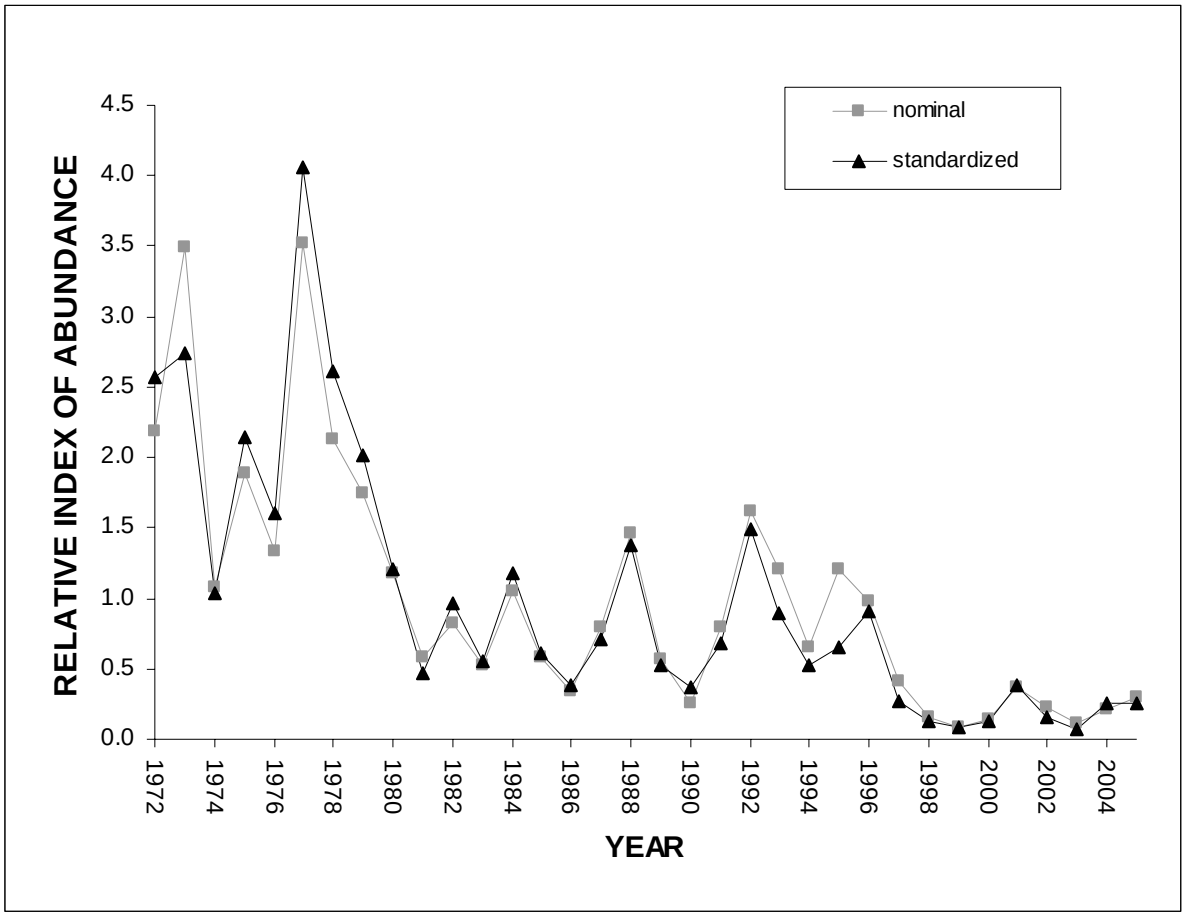


Figure 8. Relative indices of abundance by year for dusky sharks

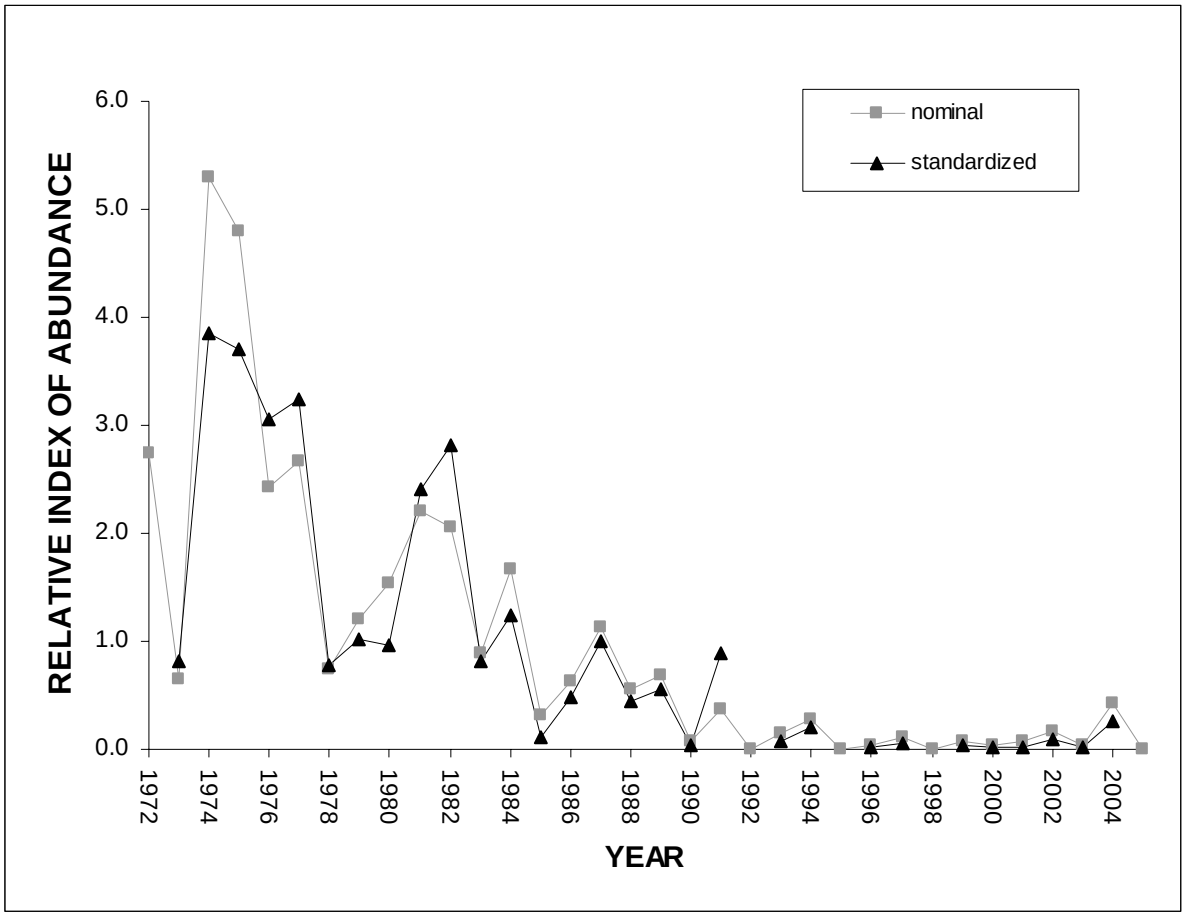


Figure 9. Relative indices of abundance by year for blacktip sharks

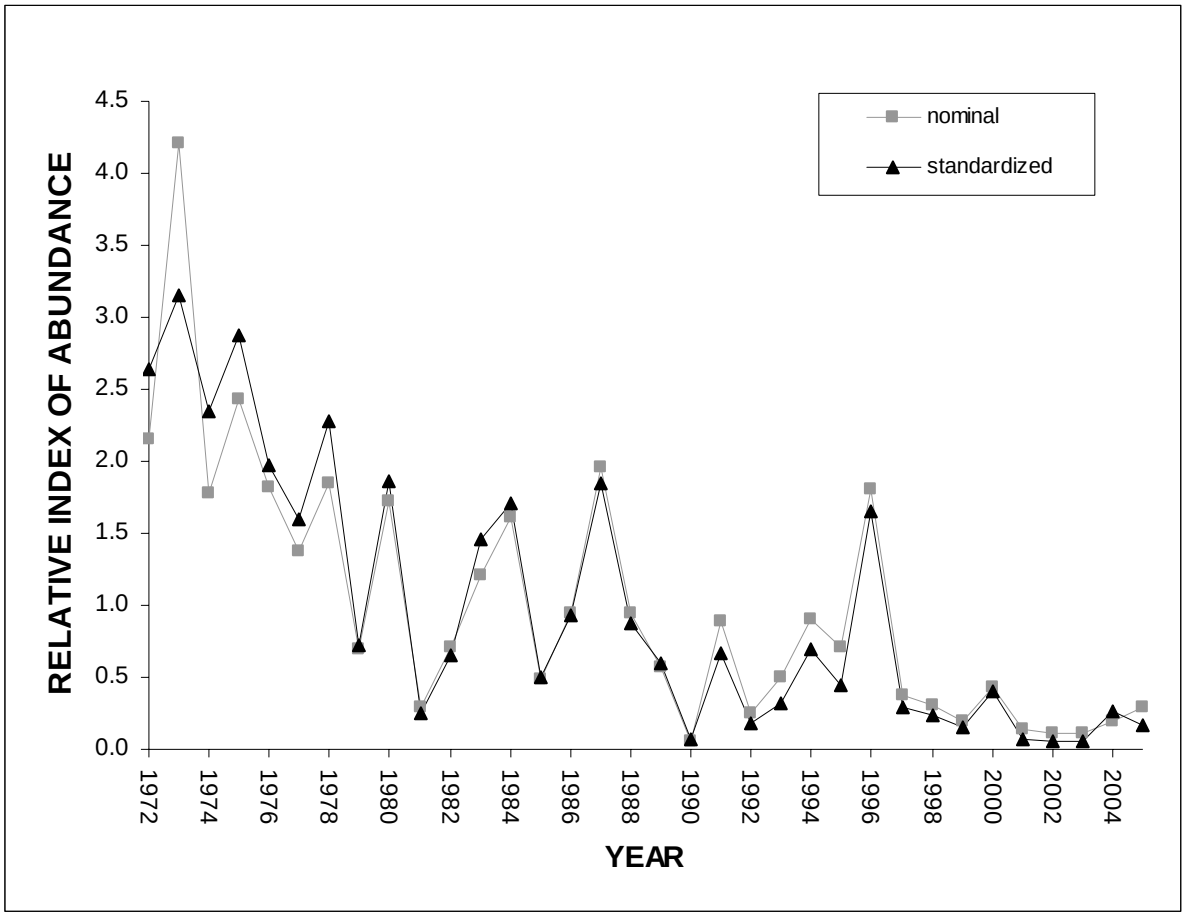


Figure 10. Relative indices of abundance by year for smooth dogfish

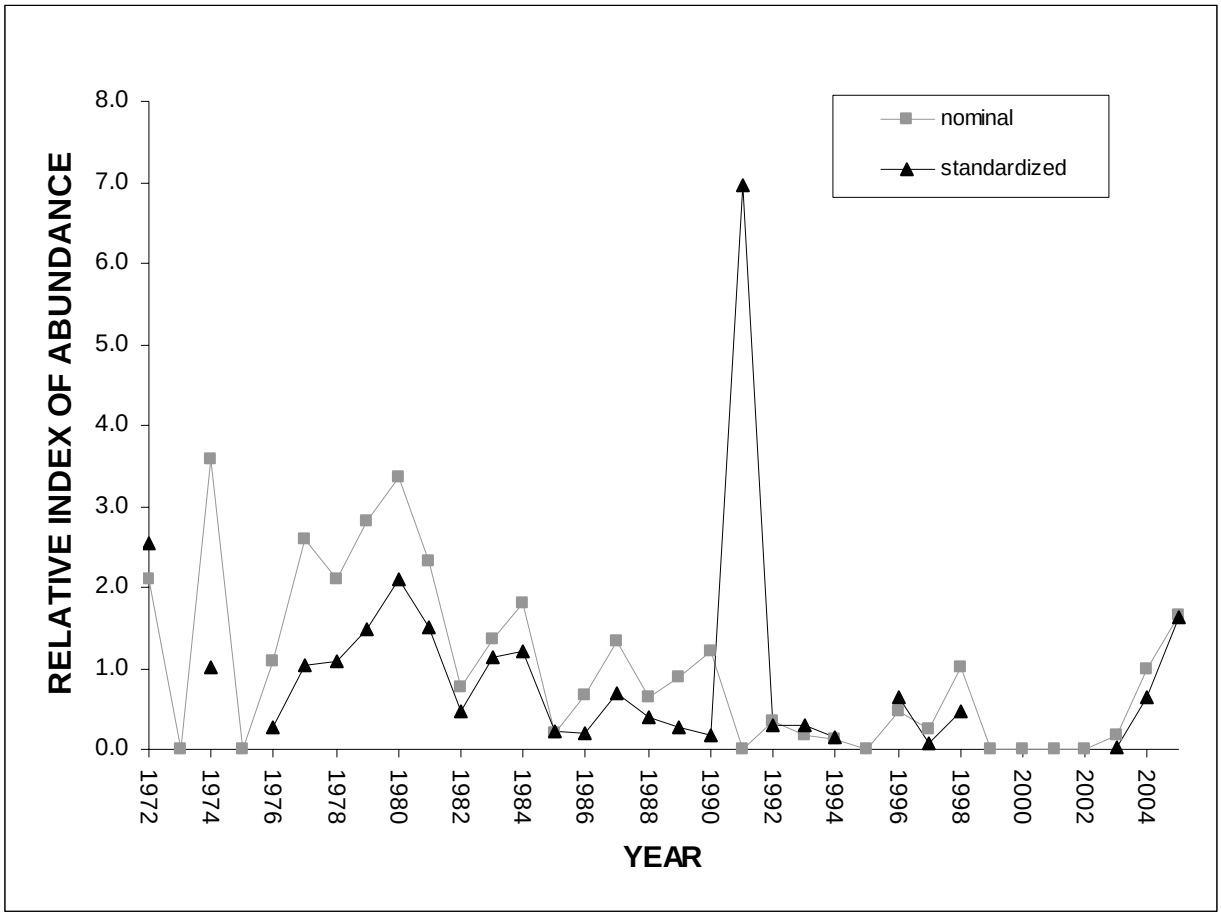


Figure 11. Relative indices of abundance by year for scalloped hammerhead sharks

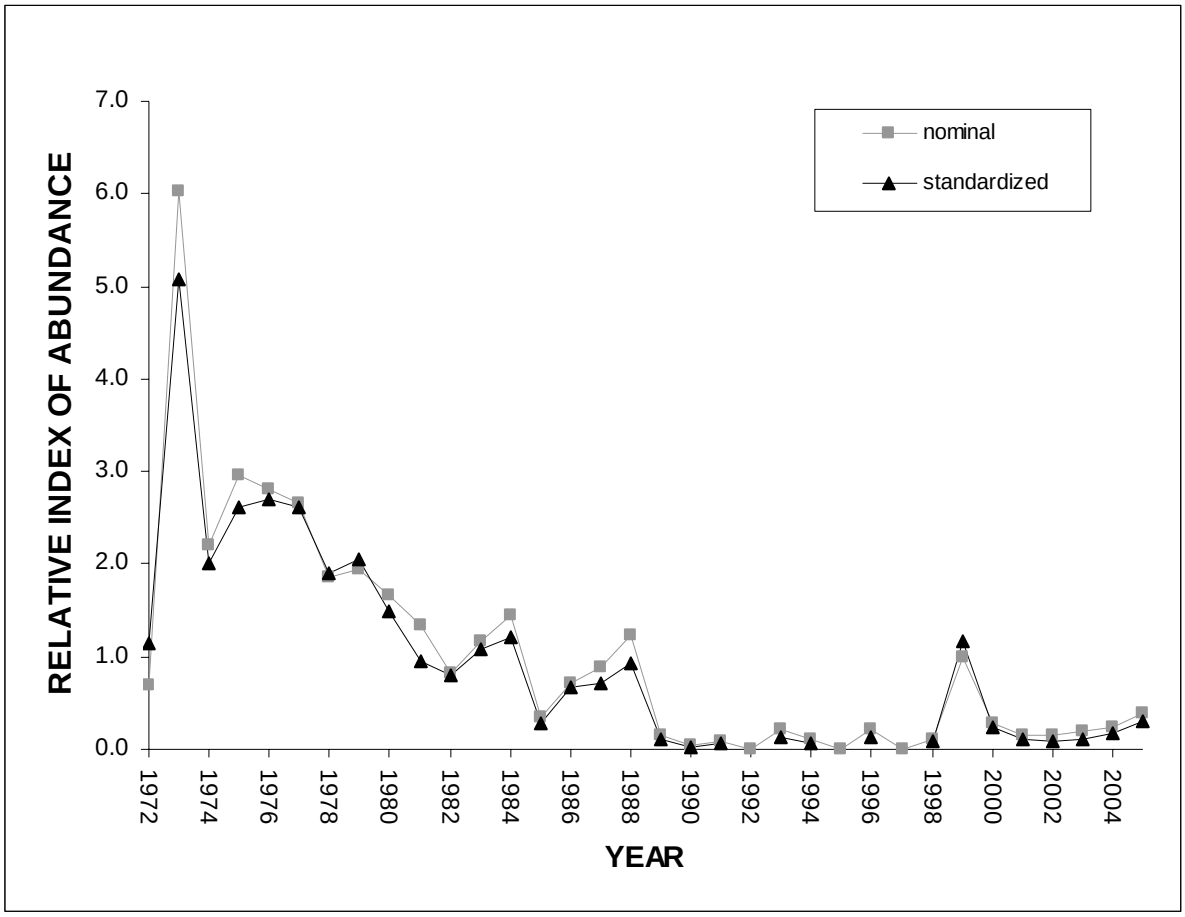


Figure 12. Relative indices of abundance by year for sandbar sharks

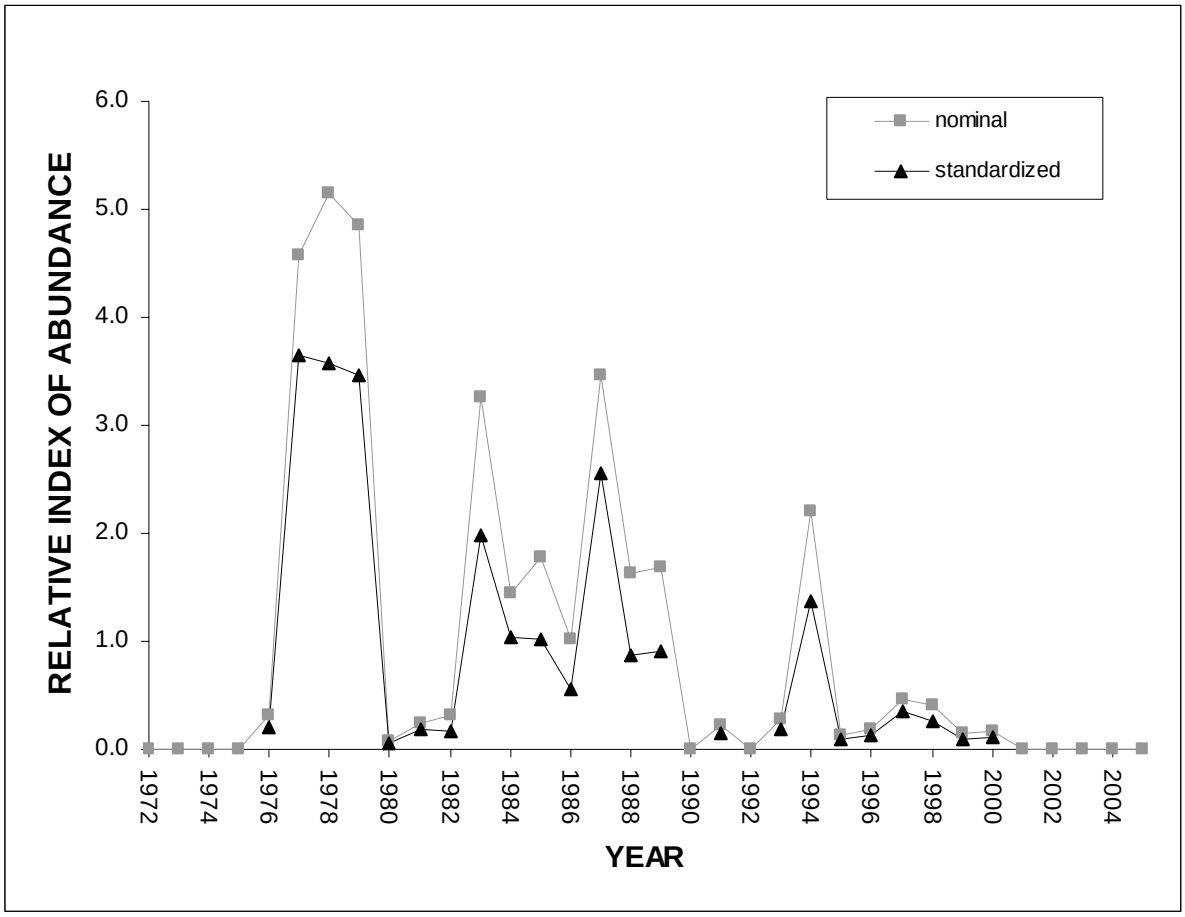


Figure 13. Relative indices of abundance by year for spinner sharks

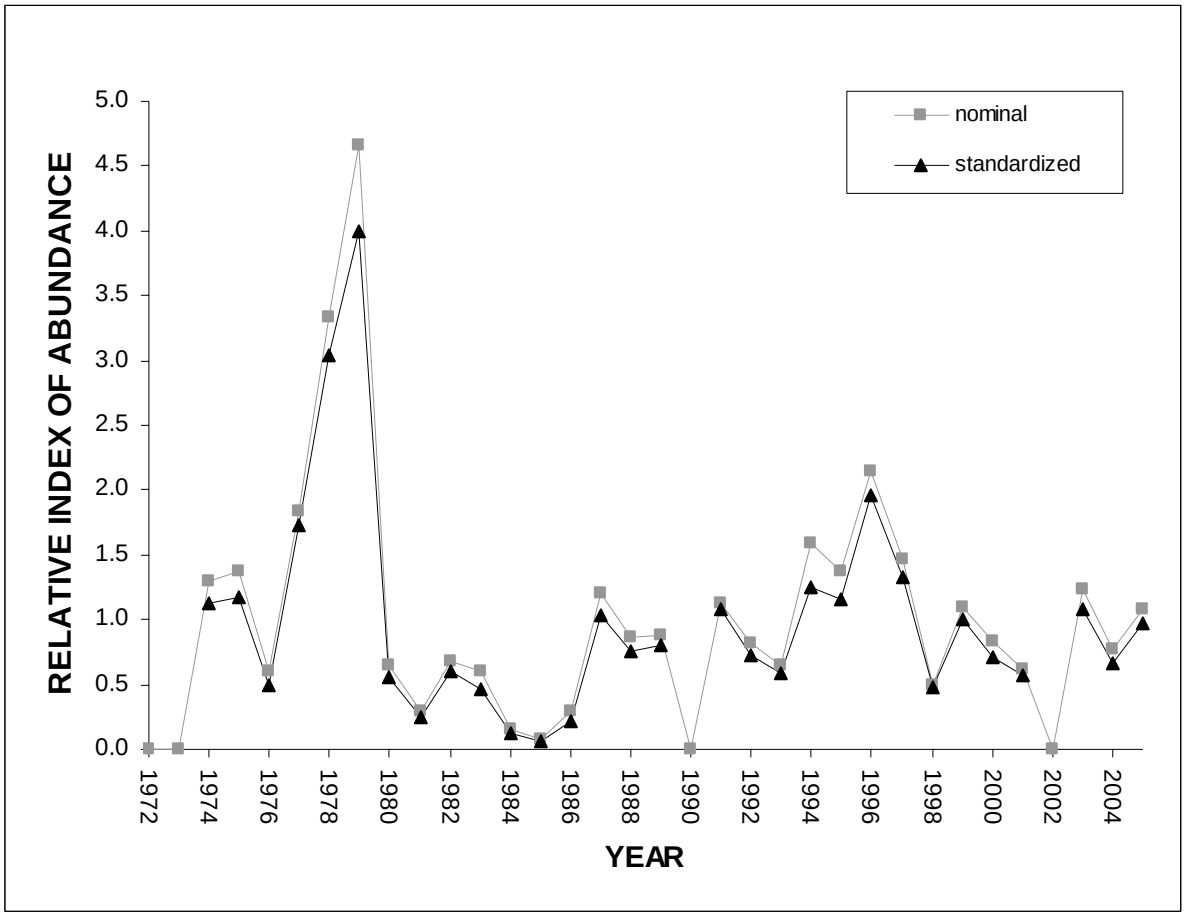


Figure 14. Relative indices of abundance by year for silky sharks

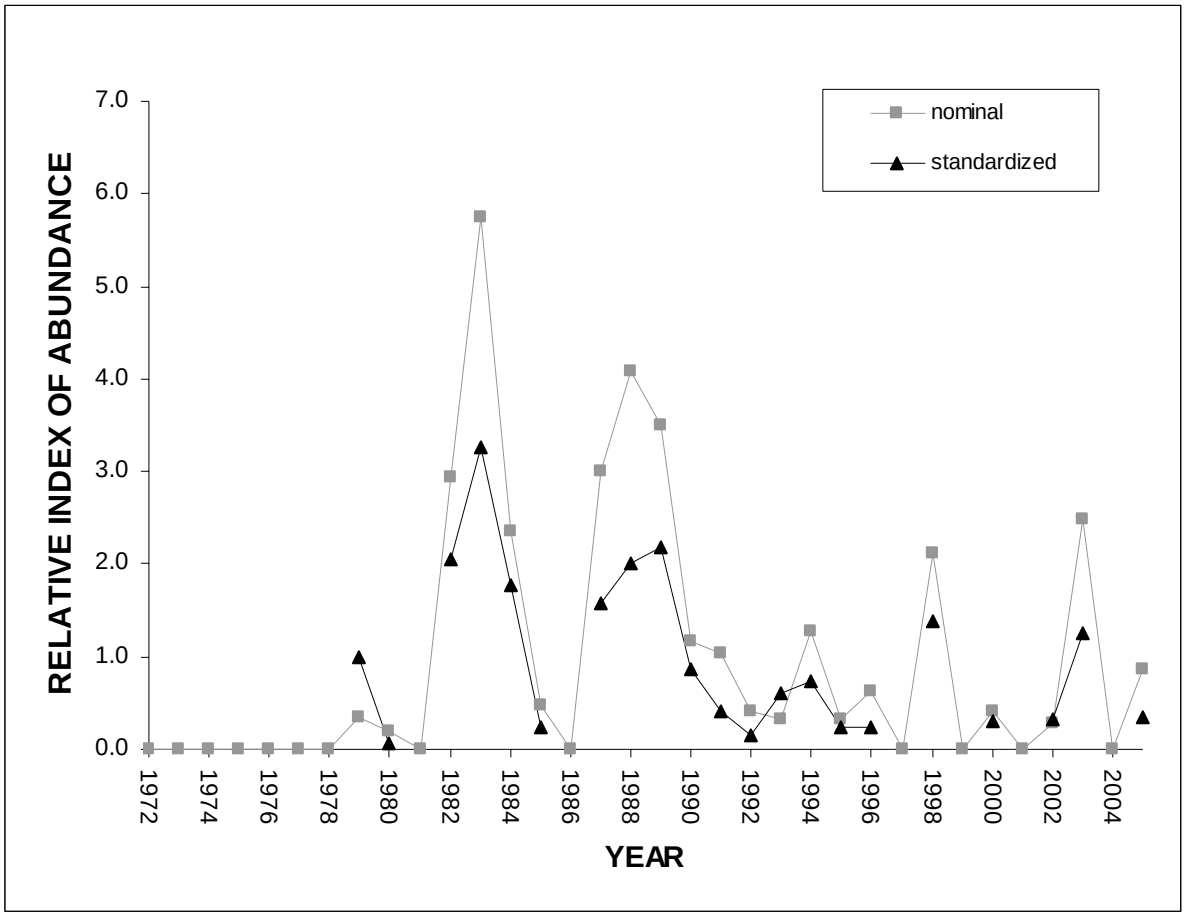
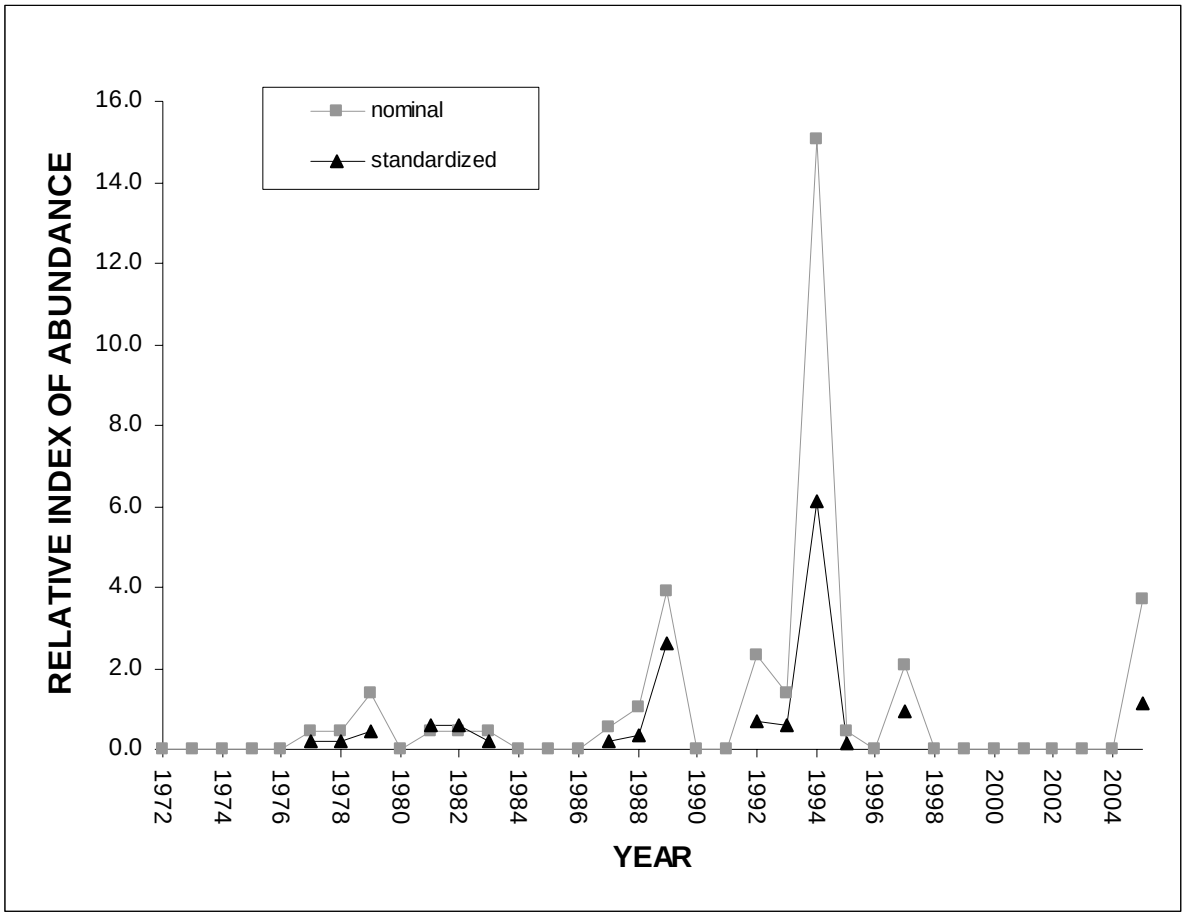
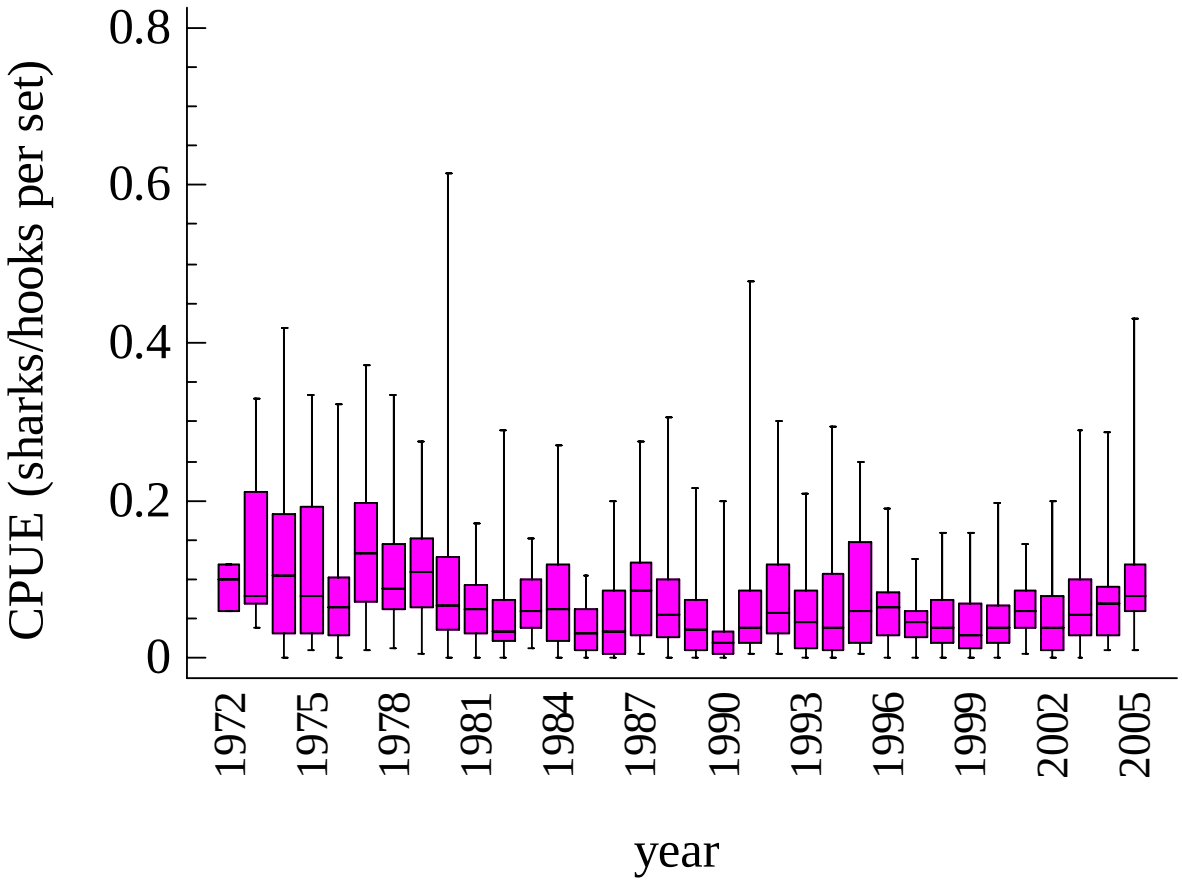


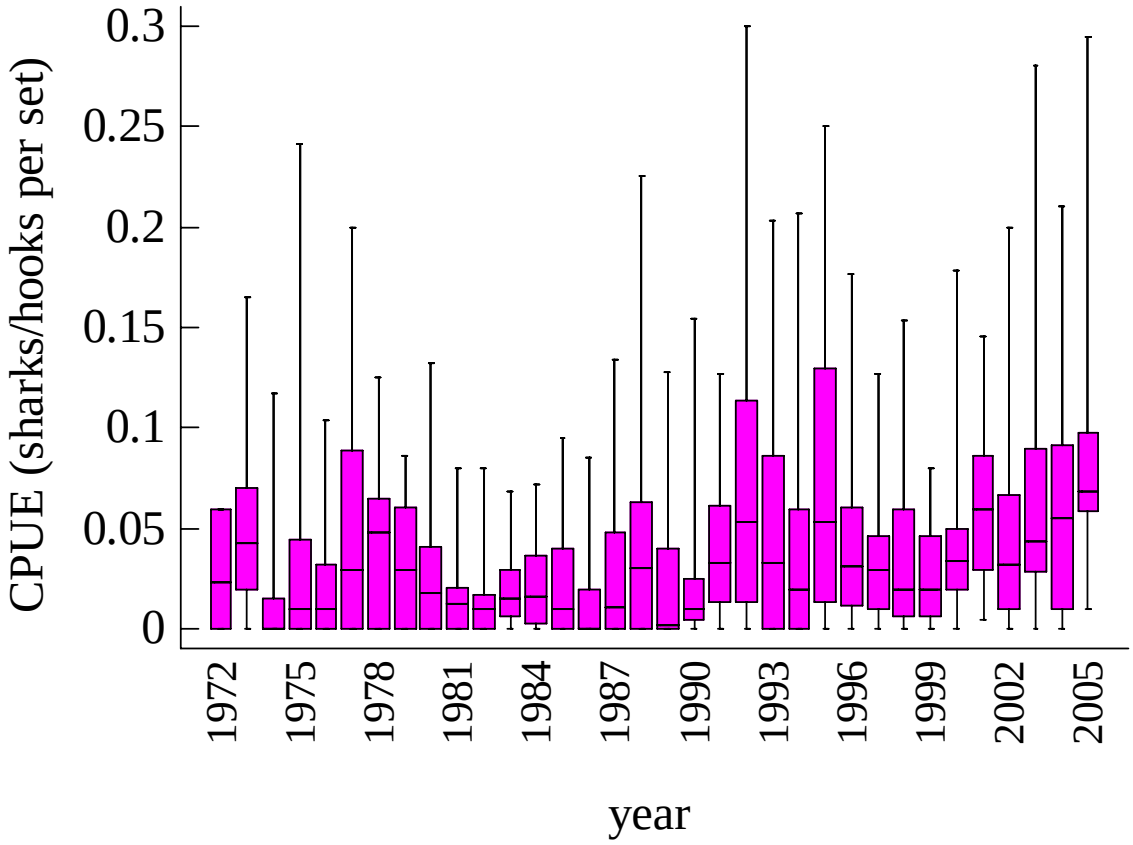
Figure 15. Relative indices of abundance by year for finetooth sharks



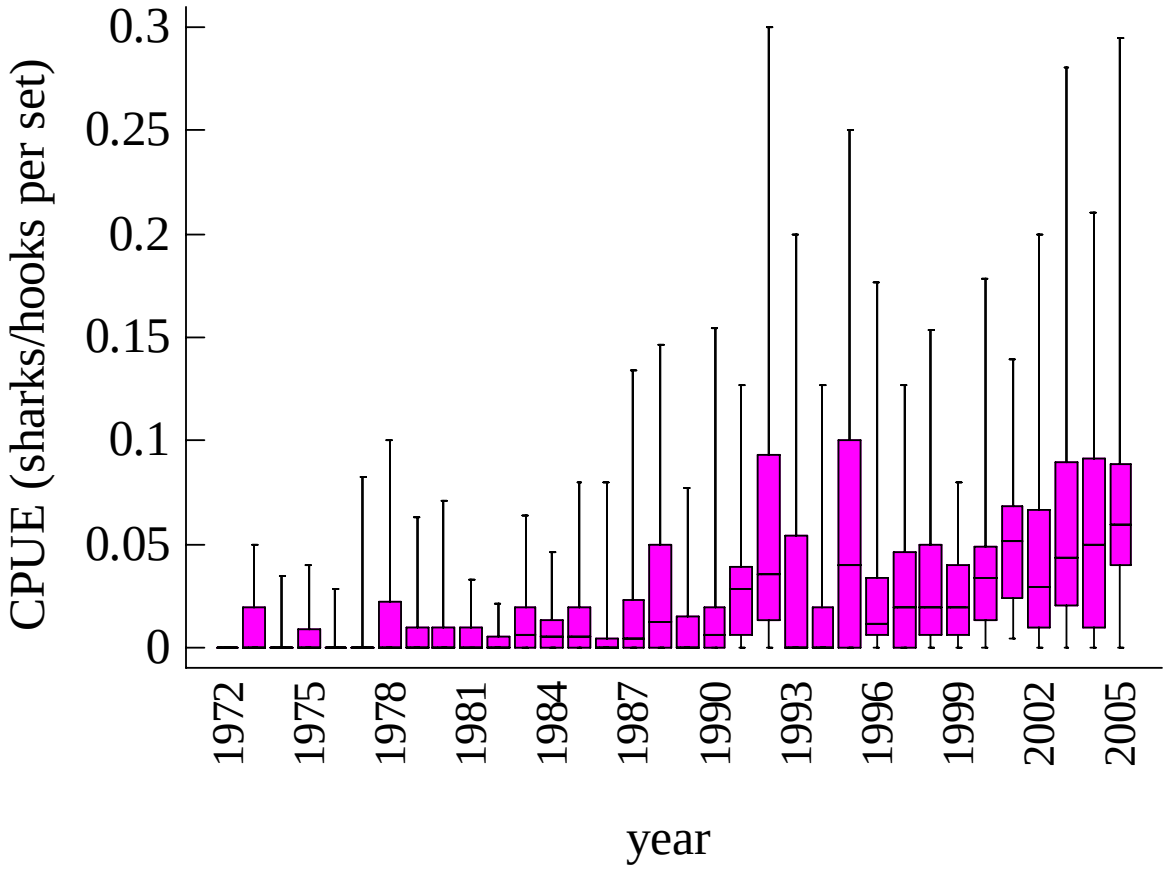
Appendix 1a. Box plot for total sharks nominal CPUE



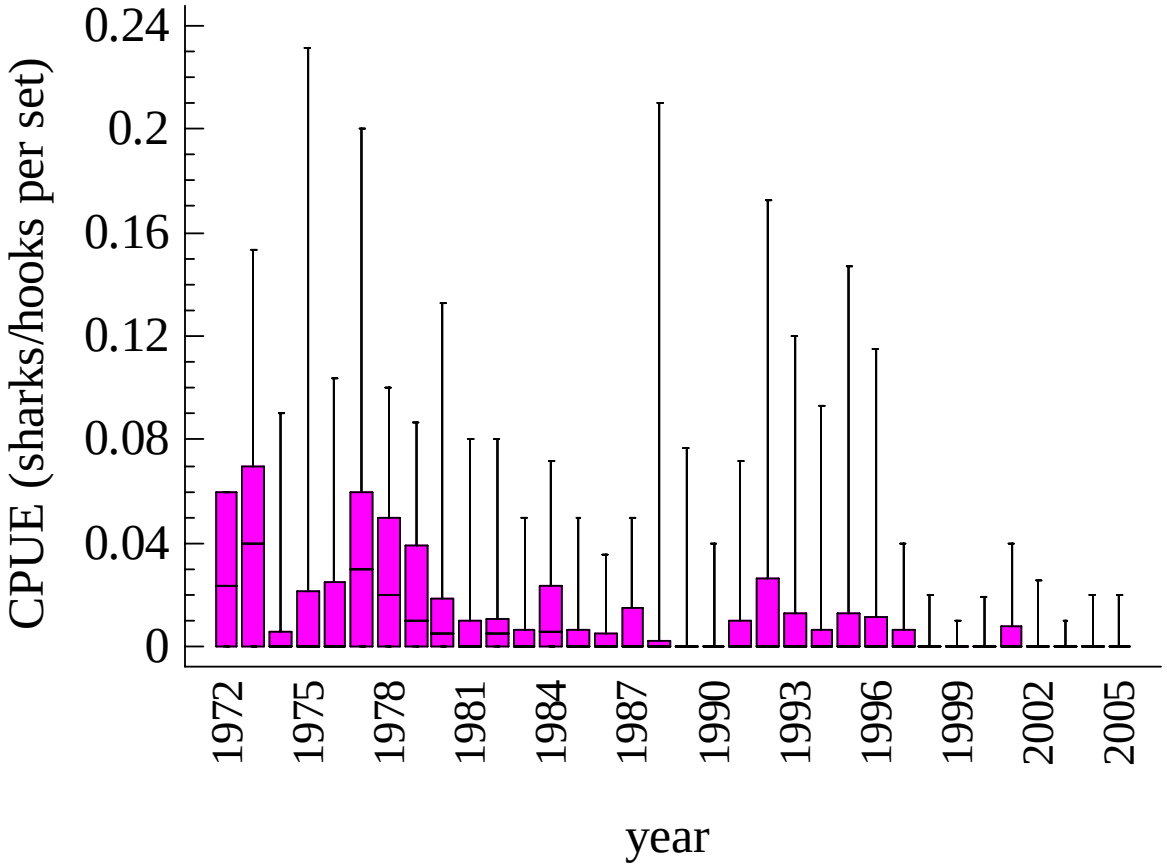
Appendix 1b. Box plot for the small coastal complex CPUE



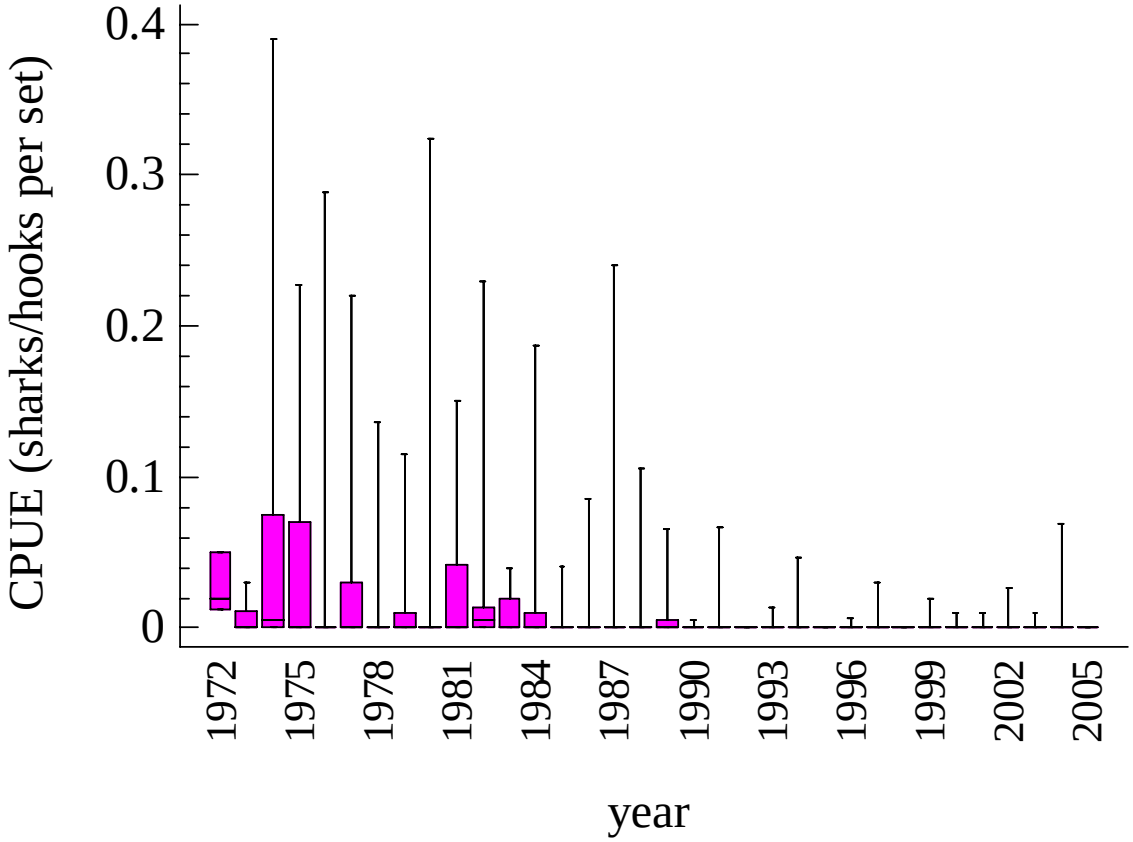
Appendix 1c. Box plot of Atlantic sharpnose shark nominal CPUE



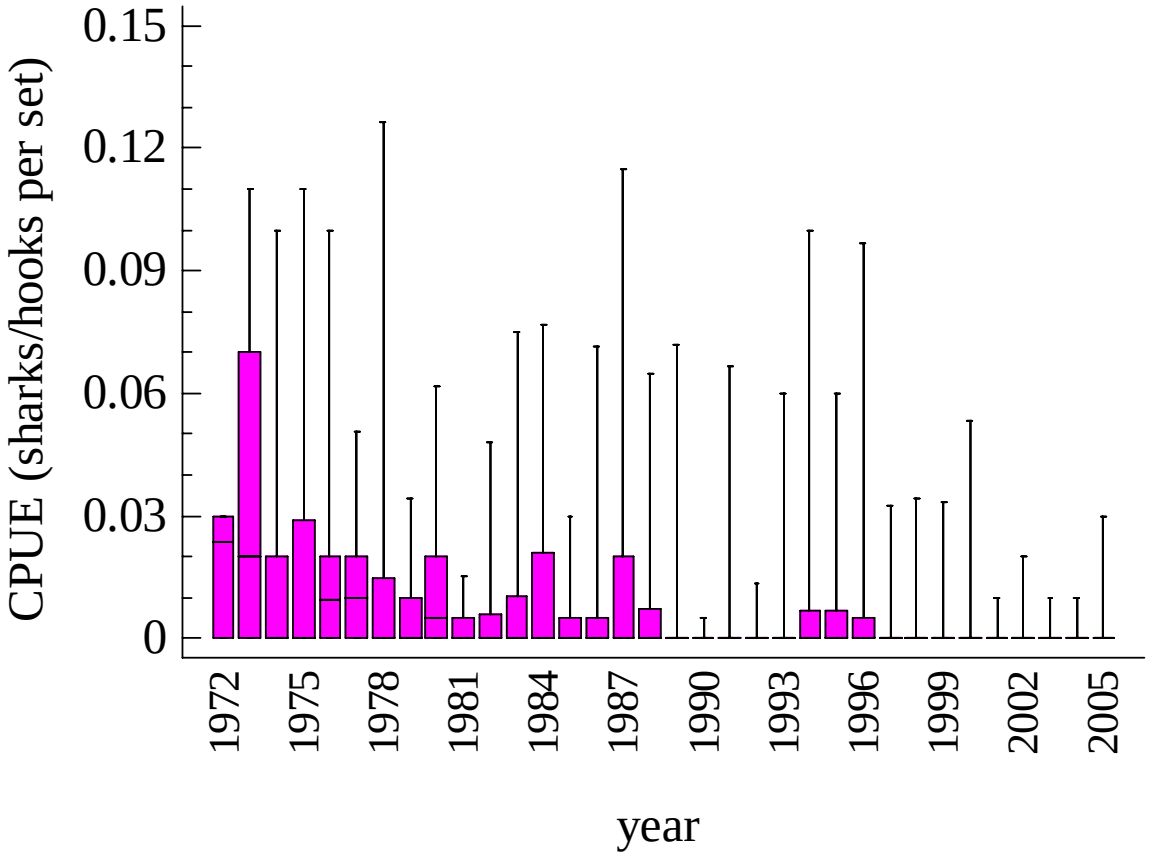
Appendix 1d. Box plot for blacknose shark nominal CPUE



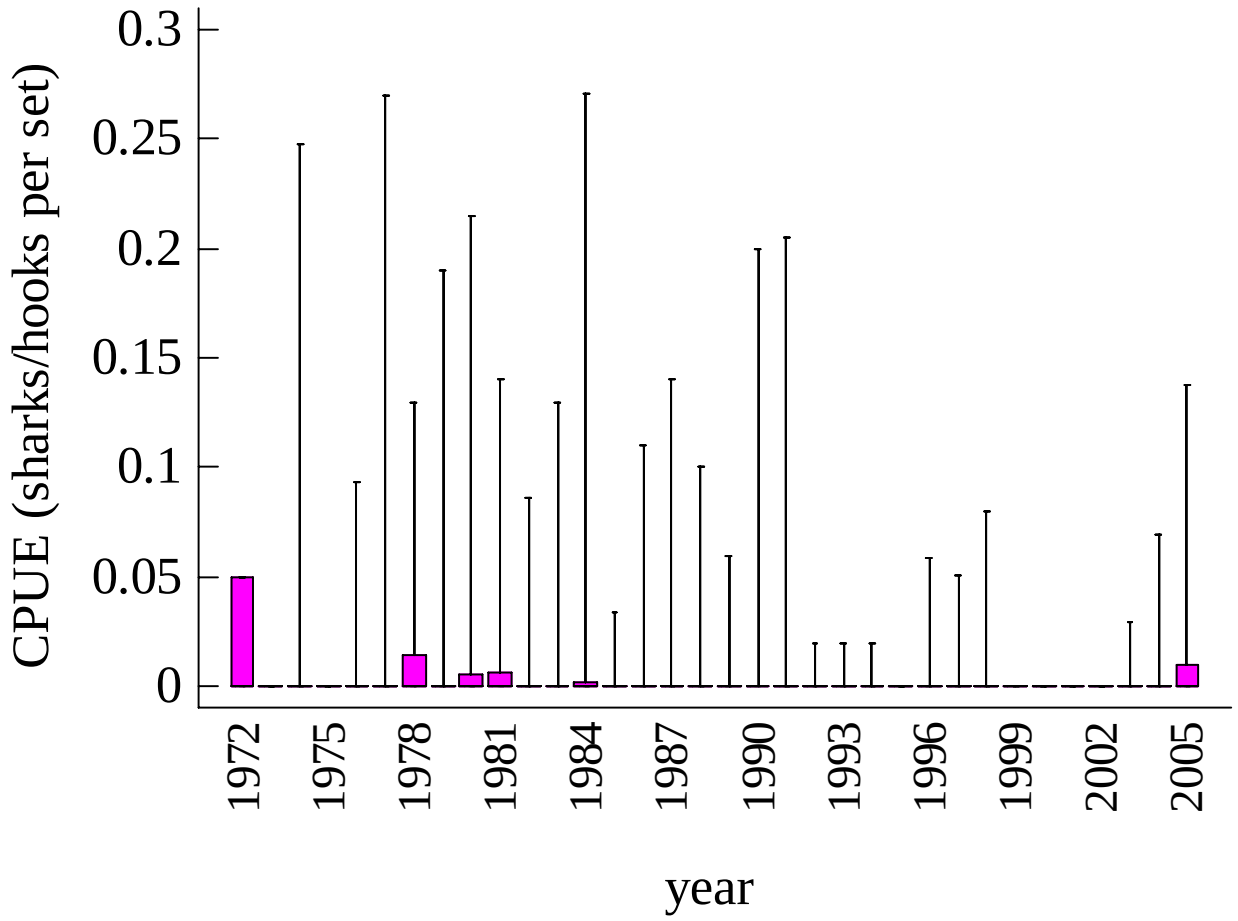
Appendix 1e. Box plot for dusky shark nominal CPUE



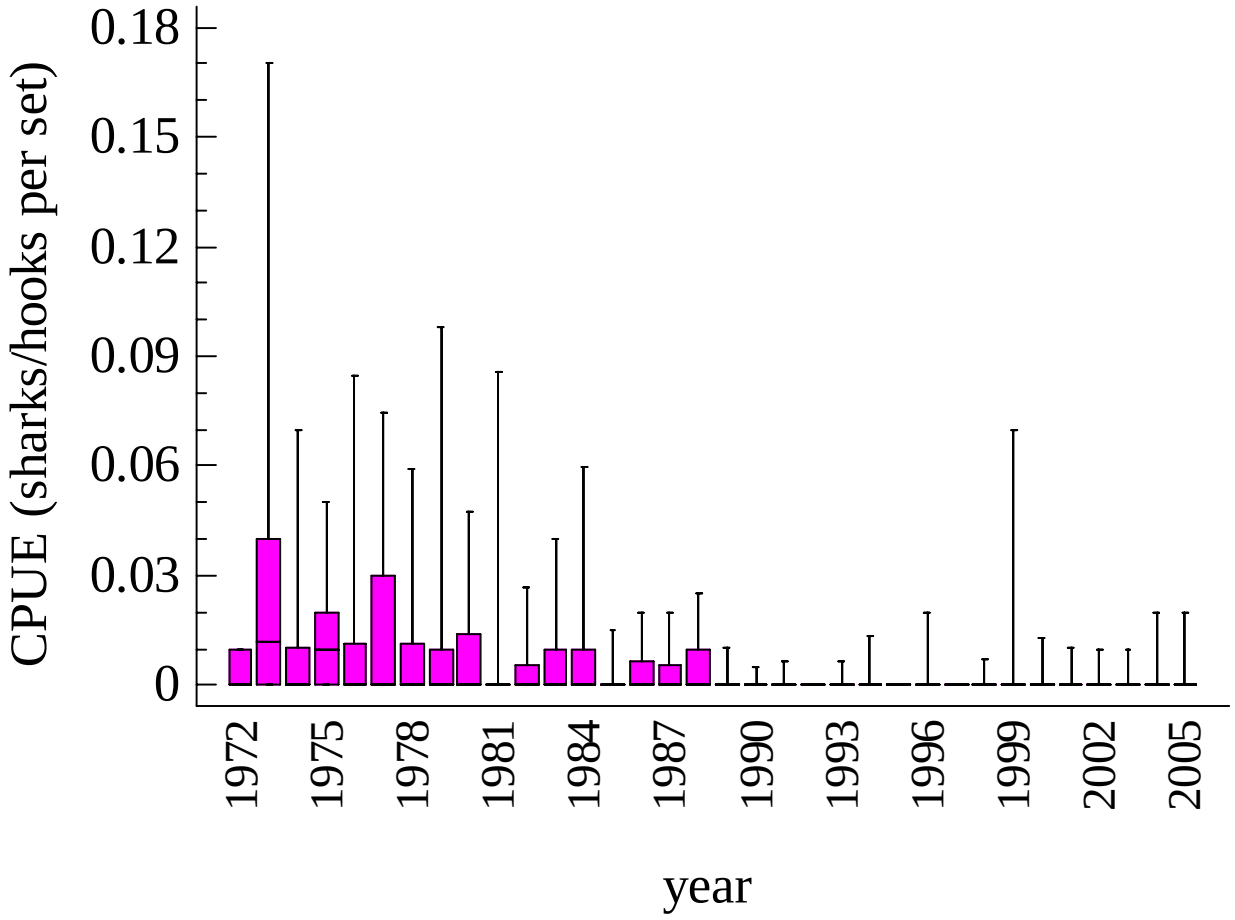
Appendix 1f. Box plot for blacktip shark nominal CPUE



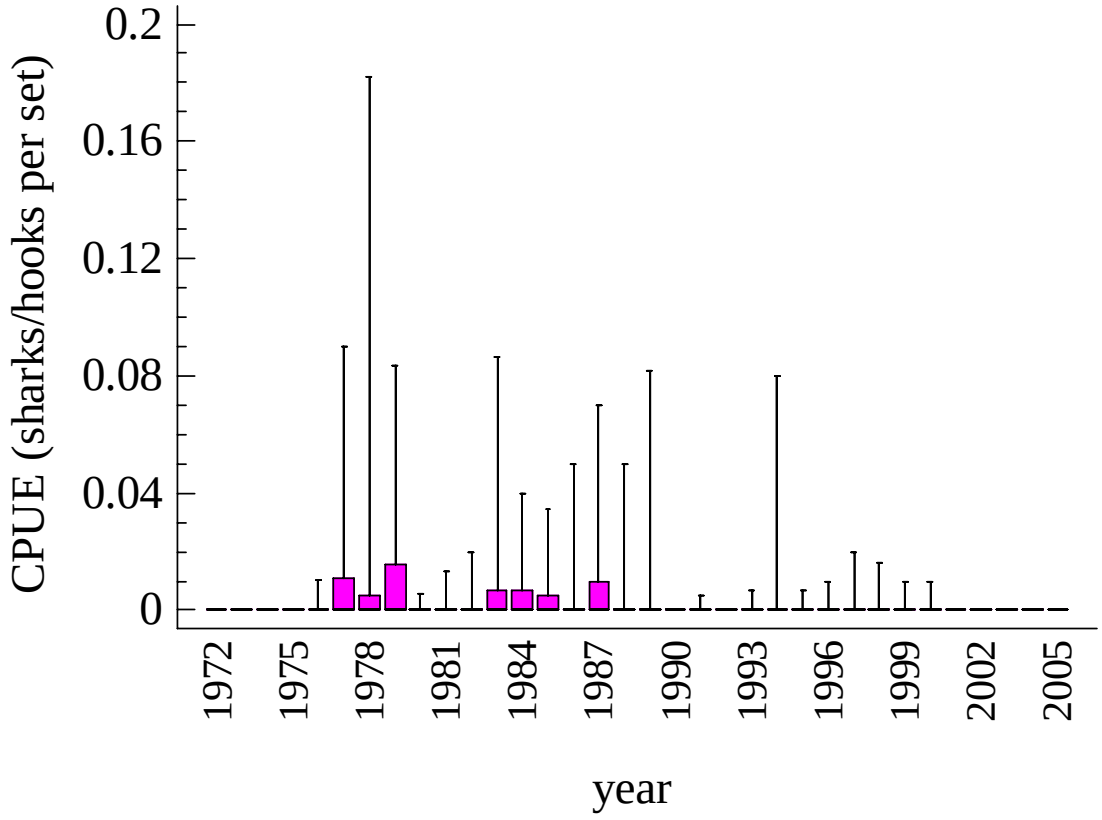
Appendix 1g. Box plot for smooth dogfish nominal CPUE



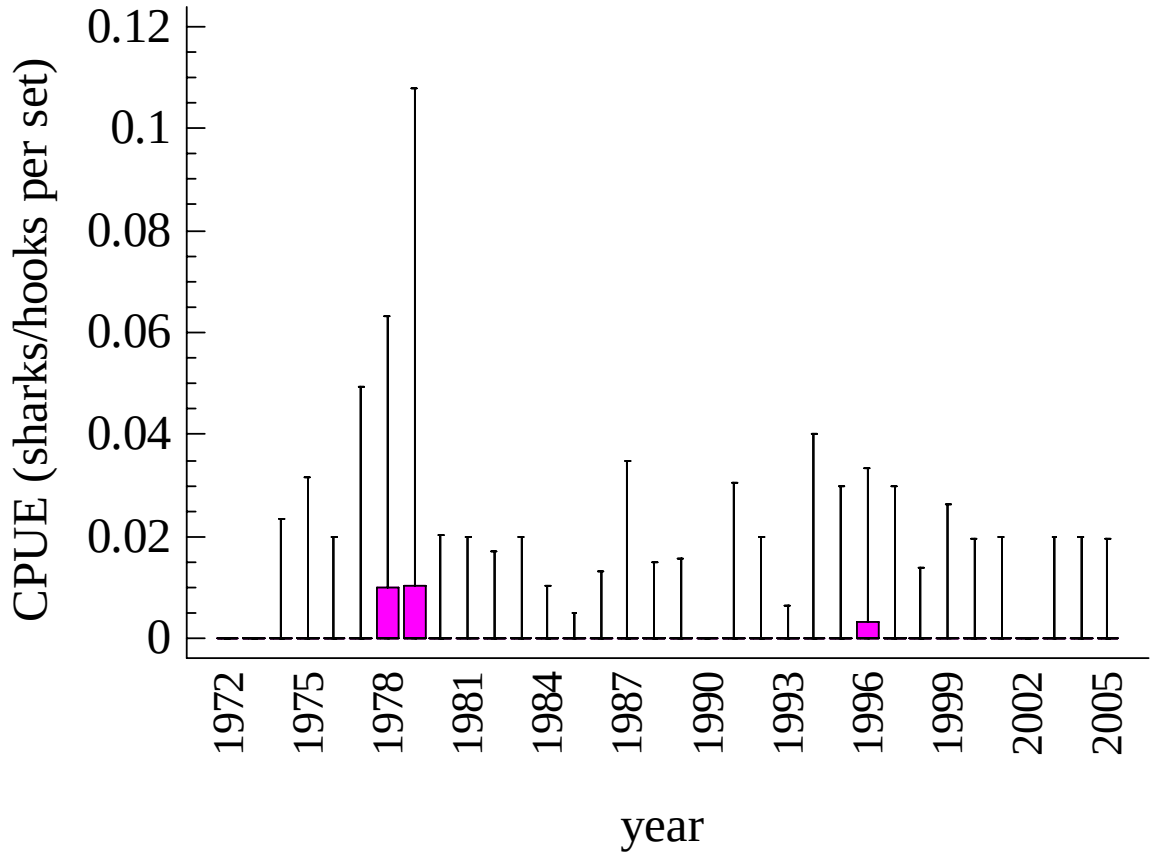
Appendix 1h. Box plot for scalloped hammerhead shark nominal CPUE



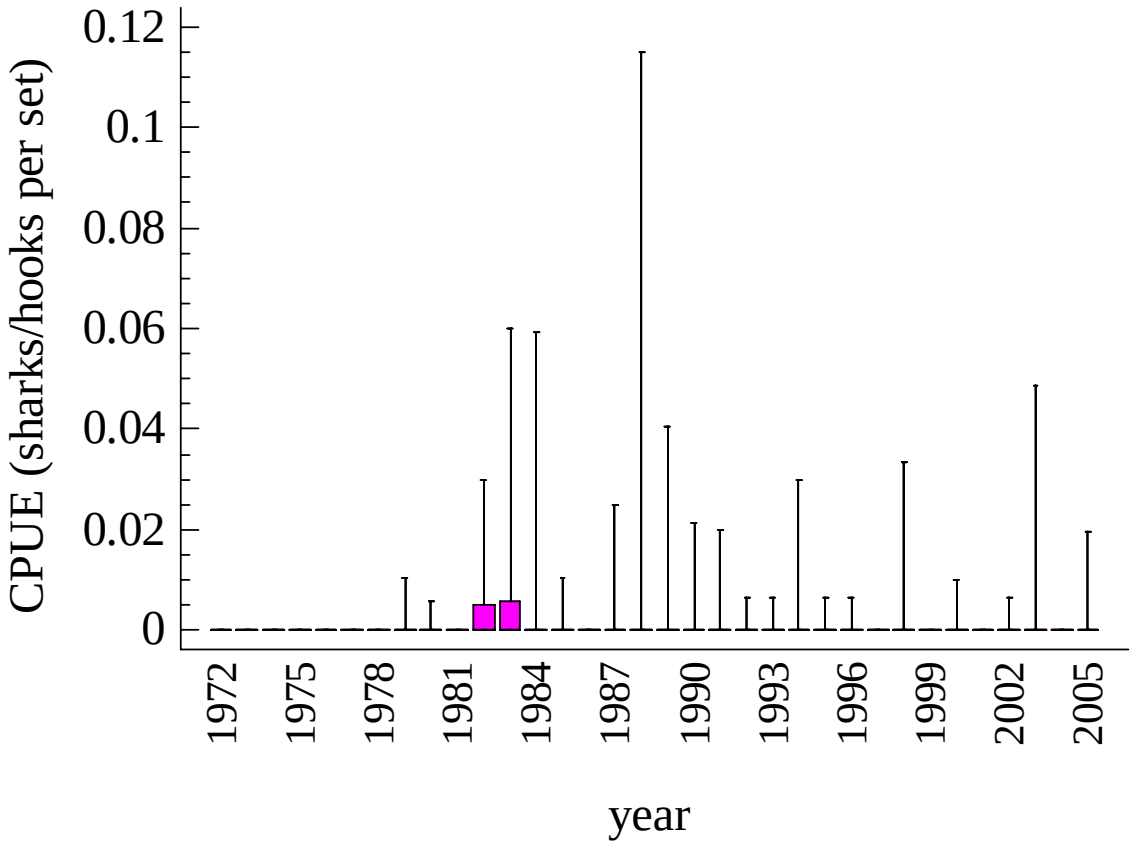
Appendix 1i. Box plot for sandbar shark nominal CPUE



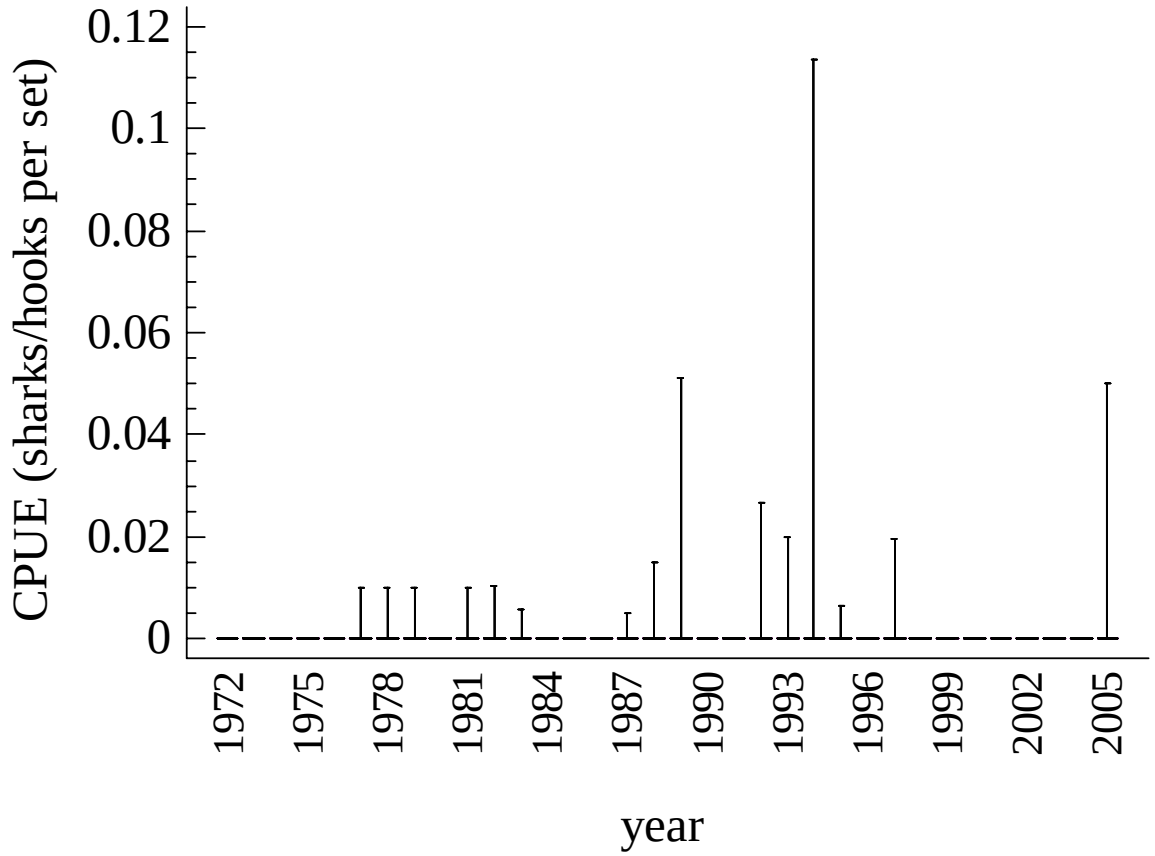
Appendix 1j. Box plot for spinner shark nominal CPUE



Appendix 1k. Box plot for silky shark nominal CPUE



Appendix 1l. Box plot for finetooth shark nominal CPUE



Appendix 2a. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for total sharks. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Total sharks

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0932	1.1927	0.7464	1.6390	0.3307	3
1973	0.1312	1.6794	0.8452	2.5137	0.8406	11
1974	0.1307	1.6735	0.9372	2.4099	0.8980	16
1975	0.1197	1.5322	1.0302	2.0341	0.8189	24
1976	0.0839	1.0743	0.6985	1.4501	0.8924	25
1977	0.1405	1.7985	1.3991	2.1979	0.6207	30
1978	0.1118	1.4311	1.0909	1.7714	0.6418	28
1979	0.1119	1.4324	1.1268	1.7379	0.5759	28
1980	0.0926	1.1854	0.6474	1.7234	1.2470	29
1981	0.0646	0.8275	0.6299	1.0251	0.6784	31
1982	0.0575	0.7359	0.4400	1.0318	1.1421	31
1983	0.0711	0.9096	0.7257	1.0935	0.5743	31
1984	0.0808	1.0340	0.7060	1.3619	0.9154	32
1985	0.0380	0.4860	0.3528	0.6193	0.7662	30
1986	0.0531	0.6794	0.4389	0.9198	0.9726	29
1987	0.0857	1.0970	0.7459	1.4482	0.8166	25
1988	0.0814	1.0415	0.6843	1.3986	0.9897	32
1989	0.0532	0.6807	0.3923	0.9690	1.1231	27
1990	0.0356	0.4552	0.1756	0.7348	1.4363	21
1991	0.0744	0.9519	0.5720	1.3319	0.8640	18
1992	0.0925	1.1835	0.6341	1.7329	0.9174	15
1993	0.0676	0.8648	0.4330	1.2966	1.1104	19
1994	0.0651	0.8331	0.4689	1.1973	1.1589	27
1995	0.0838	1.0727	0.6629	1.4826	0.8496	19
1996	0.0676	0.8655	0.5785	1.1524	0.7566	20
1997	0.0481	0.6156	0.4445	0.7867	0.7091	25
1998	0.0520	0.6651	0.4450	0.8852	0.8442	25
1999	0.0433	0.5546	0.3586	0.7506	0.9014	25
2000	0.0508	0.6500	0.4010	0.8990	0.9168	22
2001	0.0653	0.8363	0.5791	1.0935	0.6077	15
2002	0.0526	0.6731	0.4001	0.9461	0.9924	23
2003	0.0730	0.9350	0.5762	1.2938	0.9184	22
2004	0.0766	0.9805	0.5696	1.3913	0.9318	19
2005	0.1072	1.3720	0.8641	1.8799	0.8655	21

Appendix 2b. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for small coastal complex. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Small coastal complex

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0279	0.7092	-0.1587	1.5772	1.0815	3
1973	0.0530	1.3452	0.6524	2.0380	0.8715	11
1974	0.0173	0.4381	-0.0053	0.8815	2.0657	16
1975	0.0310	0.7861	0.2507	1.3216	1.7025	24
1976	0.0203	0.5150	0.2398	0.7903	1.3634	25
1977	0.0522	1.3255	0.7909	1.8601	1.1271	30
1978	0.0407	1.0335	0.6847	1.3822	0.9110	28
1979	0.0330	0.8385	0.5614	1.1157	0.8925	28
1980	0.0257	0.6535	0.3736	0.9335	1.1769	29
1981	0.0138	0.3509	0.1977	0.5040	1.2400	31
1982	0.0137	0.3467	0.1916	0.5019	1.2710	31
1983	0.0192	0.4882	0.3349	0.6416	0.8921	31
1984	0.0223	0.5659	0.3778	0.7540	0.9593	32
1985	0.0221	0.5600	0.3273	0.7927	1.1613	30
1986	0.0156	0.3970	0.1530	0.6410	1.6887	29
1987	0.0279	0.7072	0.3696	1.0447	1.2176	25
1988	0.0465	1.1807	0.6882	1.6733	1.2040	32
1989	0.0235	0.5967	0.2424	0.9509	1.5740	27
1990	0.0230	0.5844	0.2020	0.9669	1.5300	21
1991	0.0470	1.1945	0.7285	1.6605	0.8445	18
1992	0.0855	2.1708	1.0409	3.3007	1.0286	15
1993	0.0563	1.4298	0.6117	2.2479	1.2725	19
1994	0.0427	1.0849	0.5747	1.5950	1.2467	27
1995	0.0732	1.8577	1.0592	2.6562	0.9559	19
1996	0.0418	1.0606	0.5721	1.5491	1.0509	20
1997	0.0370	0.9401	0.6001	1.2801	0.9226	25
1998	0.0358	0.9081	0.4933	1.3229	1.1653	25
1999	0.0281	0.7140	0.4429	0.9851	0.9685	25
2000	0.0426	1.0828	0.6366	1.5289	0.9860	22
2001	0.0614	1.5599	1.0223	2.0974	0.6810	15
2002	0.0479	1.2173	0.6826	1.7519	1.0747	23
2003	0.0641	1.6262	0.9653	2.2872	0.9726	22
2004	0.0604	1.5340	0.8751	2.1929	0.9553	19
2005	0.0865	2.1969	1.4241	2.9697	0.8225	21

Appendix 2c. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for Atlantic sharpnose sharks. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Atlantic sharpnose shark

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0000	0.0000	.	.	.	3
1973	0.0083	0.3228	-0.0294	0.6751	1.8465	11
1974	0.0035	0.1337	-0.0530	0.3205	2.8495	16
1975	0.0069	0.2661	0.0610	0.4711	1.9263	24
1976	0.0032	0.1251	0.0036	0.2466	2.4772	25
1977	0.0068	0.2649	0.0063	0.5234	2.7277	30
1978	0.0132	0.5103	0.1777	0.8429	1.7598	28
1979	0.0096	0.3714	0.1391	0.6038	1.6890	28
1980	0.0106	0.4119	0.1391	0.6847	1.8199	29
1981	0.0060	0.2335	0.1139	0.3532	1.4556	31
1982	0.0028	0.1088	0.0410	0.1766	1.7714	31
1983	0.0123	0.4743	0.2614	0.6873	1.2755	31
1984	0.0089	0.3460	0.1831	0.5088	1.3583	32
1985	0.0146	0.5644	0.2560	0.8728	1.5268	30
1986	0.0113	0.4366	0.1178	0.7554	2.0063	29
1987	0.0172	0.6656	0.2132	1.1180	1.7339	25
1988	0.0271	1.0473	0.5849	1.5097	1.2743	32
1989	0.0133	0.5150	0.1699	0.8600	1.7764	27
1990	0.0197	0.7612	0.1749	1.3476	1.8010	21
1991	0.0369	1.4288	0.7175	2.1400	1.0776	18
1992	0.0631	2.4412	0.9179	3.9645	1.2331	15
1993	0.0398	1.5400	0.3735	2.7065	1.6845	19
1994	0.0228	0.8842	0.3433	1.4251	1.6218	27
1995	0.0575	2.2237	0.9962	3.4512	1.2277	19
1996	0.0292	1.1300	0.4417	1.8183	1.3899	20
1997	0.0301	1.1655	0.6157	1.7153	1.2035	25
1998	0.0338	1.3065	0.6941	1.9188	1.1958	25
1999	0.0271	1.0471	0.6430	1.4512	0.9846	25
2000	0.0409	1.5809	0.8846	2.2772	1.0541	22
2001	0.0567	2.1945	1.4111	2.9779	0.7054	15
2002	0.0451	1.7441	0.9252	2.5629	1.1488	23
2003	0.0627	2.4261	1.4217	3.4305	0.9908	22
2004	0.0578	2.2370	1.2269	3.2470	1.0042	19
2005	0.0799	3.0917	1.9017	4.2816	0.8999	21

Appendix 2d. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for blacknose sharks. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Blacknose shark

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0279	2.1865	-0.4892	4.8622	1.0815	3
1973	0.0446	3.4941	1.2497	5.7386	1.0870	11
1974	0.0138	1.0801	-0.0626	2.2229	2.1592	16
1975	0.0241	1.8854	0.2573	3.5135	2.1584	24
1976	0.0171	1.3347	0.4817	2.1876	1.6303	25
1977	0.0450	3.5246	1.9095	5.1396	1.2805	30
1978	0.0272	2.1261	1.2294	3.0227	1.1386	28
1979	0.0224	1.7497	0.9588	2.5407	1.2204	28
1980	0.0151	1.1817	0.3858	1.9777	1.8506	29
1981	0.0075	0.5839	0.1490	1.0188	2.1157	31
1982	0.0105	0.8230	0.3508	1.2951	1.6298	31
1983	0.0066	0.5184	0.2155	0.8213	1.6599	31
1984	0.0134	1.0450	0.5525	1.5375	1.3603	32
1985	0.0075	0.5848	0.2187	0.9510	1.7494	30
1986	0.0044	0.3409	0.0687	0.6131	2.1938	29
1987	0.0102	0.8009	0.3011	1.3007	1.5920	25
1988	0.0187	1.4607	0.1954	2.7260	2.5000	32
1989	0.0072	0.5619	0.0378	1.0859	2.4729	27
1990	0.0033	0.2621	-0.0411	0.5652	2.7043	21
1991	0.0101	0.7927	0.1144	1.4709	1.8521	18
1992	0.0206	1.6159	-0.1718	3.4035	2.1861	15
1993	0.0155	1.2109	0.0339	2.3879	2.1616	19
1994	0.0083	0.6479	0.0331	1.2627	2.5157	27
1995	0.0154	1.2022	-0.0800	2.4843	2.3719	19
1996	0.0126	0.9843	-0.0012	1.9699	2.2846	20
1997	0.0053	0.4170	0.0870	0.7470	2.0190	25
1998	0.0020	0.1573	0.0008	0.3137	2.5387	25
1999	0.0011	0.0835	-0.0086	0.1755	2.8125	25
2000	0.0018	0.1406	-0.0132	0.2944	2.6178	22
2001	0.0047	0.3704	-0.0507	0.7914	2.2467	15
2002	0.0029	0.2253	-0.0023	0.4530	2.4720	23
2003	0.0014	0.1067	-0.0081	0.2216	2.5758	22
2004	0.0026	0.2047	0.0084	0.4011	2.1324	19
2005	0.0038	0.2963	0.0502	0.5425	1.9422	21

Appendix 2e. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for dusky sharks. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Dusky shark

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0273	2.7343	0.4598	5.0087	0.7351	3
1973	0.0065	0.6474	0.0370	1.2578	1.5954	11
1974	0.0529	5.3029	0.2319	10.3739	1.9516	16
1975	0.0478	4.7920	1.6946	7.8893	1.6156	24
1976	0.0242	2.4197	-0.0888	4.9282	2.6447	25
1977	0.0266	2.6601	0.5288	4.7914	2.2390	30
1978	0.0074	0.7381	-0.2504	1.7267	3.6158	28
1979	0.0120	1.2057	0.1787	2.2327	2.2996	28
1980	0.0153	1.5310	-0.7548	3.8169	4.1022	29
1981	0.0221	2.2116	0.9501	3.4730	1.6204	31
1982	0.0206	2.0602	0.2795	3.8408	2.4553	31
1983	0.0089	0.8933	0.4423	1.3442	1.4341	31
1984	0.0167	1.6745	0.2000	3.1491	2.5416	32
1985	0.0031	0.3073	-0.0652	0.6798	3.3879	30
1986	0.0062	0.6220	-0.0254	1.2694	2.8598	29
1987	0.0112	1.1234	-0.7563	3.0031	4.2684	25
1988	0.0056	0.5619	-0.1206	1.2445	3.5057	32
1989	0.0068	0.6783	0.0403	1.3162	2.4935	27
1990	0.0007	0.0723	-0.0053	0.1499	2.5103	21
1991	0.0037	0.3709	-0.3561	1.0979	4.2426	18
1992	0.0000	0.0000	.	.	.	15
1993	0.0014	0.1406	-0.0201	0.3013	2.5427	19
1994	0.0028	0.2844	-0.0696	0.6383	3.2996	27
1995	0.0000	0.0000	.	.	.	19
1996	0.0003	0.0334	-0.0320	0.0988	4.4721	20
1997	0.0012	0.1202	-0.1154	0.3557	5.0000	25
1998	0.0000	0.0000	.	.	.	25
1999	0.0008	0.0801	-0.0769	0.2372	5.0000	25
2000	0.0004	0.0446	-0.0449	0.1342	4.8008	22
2001	0.0007	0.0668	-0.0641	0.1976	3.8730	15
2002	0.0016	0.1597	-0.0797	0.3991	3.6690	23
2003	0.0005	0.0455	-0.0437	0.1347	4.6904	22
2004	0.0042	0.4180	-0.2997	1.1358	3.8184	19
2005	0.0000	0.0000	.	.	.	21

Appendix 2f. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for blacktip sharks. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Blacktip shark

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0179	2.1559	0.0016	4.3102	0.8831	3
1973	0.0350	4.2034	0.4329	7.9738	1.5179	11
1974	0.0148	1.7745	0.1037	3.4453	1.9216	16
1975	0.0202	2.4250	0.9207	3.9293	1.5505	24
1976	0.0151	1.8138	0.6827	2.9448	1.5909	25
1977	0.0114	1.3722	0.7528	1.9916	1.2614	30
1978	0.0154	1.8489	0.5210	3.1767	1.9390	28
1979	0.0057	0.6910	0.2008	1.1811	1.9152	28
1980	0.0144	1.7278	0.8077	2.6478	1.4631	29
1981	0.0024	0.2879	0.1103	0.4655	1.7523	31
1982	0.0059	0.7065	0.1942	1.2189	2.0600	31
1983	0.0101	1.2107	0.4478	1.9736	1.7900	31
1984	0.0134	1.6075	0.6675	2.5474	1.6877	32
1985	0.0040	0.4865	0.1674	0.8056	1.8328	30
1986	0.0079	0.9497	0.2118	1.6877	2.1350	29
1987	0.0163	1.9646	0.6201	3.3092	1.7458	25
1988	0.0078	0.9400	0.2110	1.6690	2.2382	32
1989	0.0047	0.5654	-0.0901	1.2208	3.0736	27
1990	0.0005	0.0572	-0.0201	0.1346	3.1583	21
1991	0.0074	0.8835	-0.0955	1.8625	2.3987	18
1992	0.0021	0.2471	-0.0212	0.5154	2.1457	15
1993	0.0042	0.5067	-0.2358	1.2491	3.2590	19
1994	0.0075	0.9056	-0.0294	1.8406	2.7372	27
1995	0.0059	0.7081	-0.0640	1.4802	2.4251	19
1996	0.0150	1.8066	0.1931	3.4201	2.0379	20
1997	0.0032	0.3815	0.0139	0.7490	2.4579	25
1998	0.0026	0.3100	-0.0427	0.6627	2.9023	25
1999	0.0016	0.1923	-0.1254	0.5101	4.2150	25
2000	0.0036	0.4361	-0.1769	1.0492	3.3640	22
2001	0.0012	0.1442	-0.0498	0.3382	2.6577	15
2002	0.0009	0.1052	-0.1010	0.3114	4.7958	23
2003	0.0009	0.1093	-0.0385	0.2571	3.2367	22
2004	0.0016	0.1892	-0.0127	0.3910	2.3727	19
2005	0.0024	0.2862	-0.1088	0.6812	3.2274	21

Appendix 2g. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for smooth dogfish. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Smooth dogfish

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0167	2.1037	-2.0195	6.2270	1.7321	3
1973	0.0000	0.0000	.	.	.	11
1974	0.0284	3.5813	-0.9549	8.1175	2.5850	16
1975	0.0000	0.0000	.	.	.	24
1976	0.0086	1.0845	-0.0637	2.2326	2.7008	25
1977	0.0206	2.5996	0.0122	5.1871	2.7814	30
1978	0.0166	2.0932	0.4882	3.6981	2.0701	28
1979	0.0223	2.8139	0.2896	5.3382	2.4219	28
1980	0.0267	3.3659	0.5648	6.1670	2.2865	29
1981	0.0184	2.3264	0.5643	4.0884	2.1517	31
1982	0.0060	0.7573	-0.1063	1.6209	3.2395	31
1983	0.0108	1.3633	0.0997	2.6269	2.6331	31
1984	0.0143	1.8077	-0.3350	3.9505	3.4210	32
1985	0.0015	0.1907	-0.0932	0.4746	4.1605	30
1986	0.0054	0.6769	-0.2860	1.6399	3.9084	29
1987	0.0106	1.3380	-0.2753	2.9513	3.0761	25
1988	0.0050	0.6311	-0.2575	1.5198	4.0640	32
1989	0.0071	0.8965	0.0993	1.6937	2.3575	27
1990	0.0095	1.2021	-1.1540	3.5583	4.5826	21
1991	0.0000	0.0000	.	.	.	18
1992	0.0027	0.3366	-0.1129	0.7861	2.6390	15
1993	0.0014	0.1772	-0.0927	0.4470	3.3881	19
1994	0.0010	0.1247	-0.0663	0.3156	4.0602	27
1995	0.0000	0.0000	.	.	.	19
1996	0.0036	0.4578	-0.2844	1.2001	3.6991	20
1997	0.0020	0.2550	-0.2448	0.7548	5.0000	25
1998	0.0080	1.0098	-0.0686	2.0882	2.7243	25
1999	0.0000	0.0000	.	.	.	25
2000	0.0000	0.0000	.	.	.	22
2001	0.0000	0.0000	.	.	.	15
2002	0.0000	0.0000	.	.	.	23
2003	0.0014	0.1721	-0.1652	0.5095	4.6904	22
2004	0.0078	0.9834	-0.1602	2.1271	2.5863	19
2005	0.0131	1.6512	-0.0665	3.3689	2.4323	21

Appendix 2h. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for scalloped hammerhead sharks. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Scalloped hammerhead shark

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0033	0.6850	-0.6576	2.0277	1.7321	3
1973	0.0293	6.0293	0.5414	11.5173	1.5402	11
1974	0.0107	2.2053	0.1753	4.2353	1.8786	16
1975	0.0144	2.9516	1.7151	4.1881	1.0471	24
1976	0.0137	2.8148	0.9539	4.6757	1.6865	25
1977	0.0129	2.6540	1.2887	4.0194	1.4376	30
1978	0.0091	1.8673	0.6216	3.1129	1.8010	28
1979	0.0095	1.9477	0.1662	3.7291	2.4695	28
1980	0.0081	1.6551	0.7303	2.5799	1.5352	29
1981	0.0065	1.3294	0.0289	2.6299	2.7789	31
1982	0.0040	0.8164	0.2893	1.3436	1.8342	31
1983	0.0057	1.1737	0.5136	1.8337	1.5976	31
1984	0.0070	1.4382	0.4417	2.4346	1.9997	32
1985	0.0017	0.3443	0.0822	0.6064	2.1276	30
1986	0.0035	0.7187	0.3077	1.1297	1.5713	29
1987	0.0043	0.8861	0.3371	1.4352	1.5806	25
1988	0.0059	1.2227	0.6129	1.8325	1.4395	32
1989	0.0007	0.1538	-0.0552	0.3628	3.6029	27
1990	0.0002	0.0489	-0.0470	0.1448	4.5826	21
1991	0.0004	0.0761	-0.0731	0.2253	4.2426	18
1992	0.0000	0.0000	.	.	.	15
1993	0.0011	0.2163	-0.0145	0.4471	2.3727	19
1994	0.0005	0.1015	-0.0974	0.3004	5.1962	27
1995	0.0000	0.0000	.	.	.	19
1996	0.0010	0.2055	-0.1973	0.6083	4.4721	20
1997	0.0000	0.0000	.	.	.	25
1998	0.0005	0.1115	-0.0398	0.2628	3.4616	25
1999	0.0048	0.9865	-0.2898	2.2628	3.3006	25
2000	0.0013	0.2772	-0.0404	0.5947	2.7418	22
2001	0.0007	0.1412	-0.1356	0.4181	3.8730	15
2002	0.0007	0.1472	-0.0560	0.3504	3.3784	23
2003	0.0009	0.1868	-0.0659	0.4395	3.2367	22
2004	0.0011	0.2163	-0.2077	0.6403	4.3589	19
2005	0.0019	0.3915	-0.1373	0.9202	3.1583	21

Appendix 2i. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for sandbar sharks. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Sandbar shark

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0000	0.0000	.	.	.	3
1973	0.0000	0.0000	.	.	.	11
1974	0.0000	0.0000	.	.	.	16
1975	0.0000	0.0000	.	.	.	24
1976	0.0008	0.3085	-0.1103	0.7274	3.4634	25
1977	0.0118	4.5655	1.3570	7.7740	1.9639	30
1978	0.0133	5.1513	-0.1375	10.4402	2.7719	28
1979	0.0125	4.8521	1.8405	7.8637	1.6757	28
1980	0.0002	0.0763	-0.0732	0.2258	5.3852	29
1981	0.0006	0.2459	-0.1079	0.5998	4.0867	31
1982	0.0008	0.3211	-0.1835	0.8257	4.4639	31
1983	0.0084	3.2550	0.6241	5.8859	2.2961	31
1984	0.0037	1.4444	0.3225	2.5663	2.2418	32
1985	0.0046	1.7775	0.5246	3.0304	1.9697	30
1986	0.0026	1.0116	-0.3311	2.3544	3.6469	29
1987	0.0089	3.4631	0.7805	6.1457	1.9761	25
1988	0.0042	1.6332	-0.1298	3.3962	3.1155	32
1989	0.0043	1.6761	-0.6655	4.0176	3.7038	27
1990	0.0000	0.0000	.	.	.	21
1991	0.0006	0.2206	-0.0760	0.5172	2.9104	18
1992	0.0000	0.0000	.	.	.	15
1993	0.0007	0.2717	-0.0942	0.6376	2.9954	19
1994	0.0057	2.1985	-0.2864	4.6834	2.9965	27
1995	0.0004	0.1358	-0.1304	0.4021	4.3589	19
1996	0.0005	0.1936	-0.1858	0.5729	4.4721	20
1997	0.0012	0.4646	-0.2027	1.1318	3.6641	25
1998	0.0010	0.4046	-0.1605	0.9697	3.5631	25
1999	0.0004	0.1549	-0.1487	0.4584	5.0000	25
2000	0.0005	0.1742	-0.1753	0.5237	4.8008	22
2001	0.0000	0.0000	.	.	.	15
2002	0.0000	0.0000	.	.	.	23
2003	0.0000	0.0000	.	.	.	22
2004	0.0000	0.0000	.	.	.	19
2005	0.0000	0.0000	.	.	.	21

Appendix 2j. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for spinner sharks. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Spinner shark

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0000	0.0000	.	.	.	3
1973	0.0000	0.0000	.	.	.	11
1974	0.0028	1.2998	-0.1969	2.7965	2.3499	16
1975	0.0030	1.3694	-0.0554	2.7943	2.6007	24
1976	0.0013	0.5969	-0.2360	1.4299	3.5599	25
1977	0.0040	1.8383	0.0872	3.5895	2.6620	30
1978	0.0073	3.3324	0.5447	6.1200	2.2585	28
1979	0.0101	4.6586	0.7214	8.5957	2.2817	28
1980	0.0014	0.6494	-0.0321	1.3308	2.8833	29
1981	0.0006	0.2962	-0.2844	0.8768	5.5678	31
1982	0.0015	0.6762	0.0470	1.3053	2.6432	31
1983	0.0013	0.5959	-0.0658	1.2576	3.1542	31
1984	0.0003	0.1472	-0.1413	0.4356	5.6569	32
1985	0.0002	0.0785	-0.0753	0.2323	5.4772	30
1986	0.0006	0.2923	-0.1457	0.7303	4.1169	29
1987	0.0026	1.1997	-0.2269	2.6262	3.0335	25
1988	0.0019	0.8609	0.1985	1.5234	2.2208	32
1989	0.0019	0.8770	0.1238	1.6303	2.2770	27
1990	0.0000	0.0000	.	.	.	21
1991	0.0024	1.1217	-0.4443	2.6876	3.0220	18
1992	0.0018	0.8163	-0.4211	2.0537	2.9955	15
1993	0.0014	0.6444	0.0679	1.2209	1.9896	19
1994	0.0035	1.5872	-0.1185	3.2929	2.8490	27
1995	0.0030	1.3694	-0.4786	3.2174	3.0012	19
1996	0.0047	2.1469	0.2429	4.0509	2.0236	20
1997	0.0032	1.4693	0.0257	2.9129	2.5065	25
1998	0.0011	0.4982	-0.0823	1.0788	2.9727	25
1999	0.0024	1.1025	-0.0236	2.2286	2.6057	25
2000	0.0018	0.8289	-0.1652	1.8230	2.8702	22
2001	0.0013	0.6122	-0.5877	1.8121	3.8730	15
2002	0.0000	0.0000	.	.	.	23
2003	0.0027	1.2333	0.0315	2.4351	2.3320	22
2004	0.0016	0.7250	-0.3103	1.7603	3.1759	19
2005	0.0023	1.0761	-0.1294	2.2816	2.6192	21

Appendix 2k. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for silky sharks. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Silky shark

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0000	0.0000	.	.	.	3
1973	0.0000	0.0000	.	.	.	11
1974	0.0000	0.0000	.	.	.	16
1975	0.0000	0.0000	.	.	.	24
1976	0.0000	0.0000	.	.	.	25
1977	0.0000	0.0000	.	.	.	30
1978	0.0000	0.0000	.	.	.	28
1979	0.0004	0.3516	-0.3375	1.0408	5.2915	28
1980	0.0002	0.1854	-0.1779	0.5487	5.3852	29
1981	0.0000	0.0000	.	.	.	31
1982	0.0031	2.9423	0.5784	5.3063	2.2823	31
1983	0.0061	5.7386	0.8135	10.6636	2.4380	31
1984	0.0025	2.3654	-1.0638	5.7946	4.1842	32
1985	0.0005	0.4797	-0.2113	1.1706	4.0258	30
1986	0.0000	0.0000	.	.	.	29
1987	0.0032	2.9969	0.1526	5.8412	2.4212	25
1988	0.0044	4.0920	-2.5026	10.6867	4.6514	32
1989	0.0037	3.4914	0.2276	6.7553	2.4783	27
1990	0.0013	1.1772	-0.7119	3.0663	3.7519	21
1991	0.0011	1.0392	-0.9976	3.0761	4.2426	18
1992	0.0004	0.4157	-0.3991	1.2305	3.8730	15
1993	0.0004	0.3282	-0.3150	0.9714	4.3589	19
1994	0.0014	1.2702	-0.7993	3.3397	4.3195	27
1995	0.0004	0.3282	-0.3150	0.9714	4.3589	19
1996	0.0007	0.6235	-0.2176	1.4647	3.0779	20
1997	0.0000	0.0000	.	.	.	25
1998	0.0023	2.1201	-0.5370	4.7771	3.1972	25
1999	0.0000	0.0000	.	.	.	25
2000	0.0005	0.4209	-0.4235	1.2654	4.8008	22
2001	0.0000	0.0000	.	.	.	15
2002	0.0003	0.2711	-0.2603	0.8025	4.7958	23
2003	0.0027	2.4890	-1.6019	6.5799	3.9334	22
2004	0.0000	0.0000	.	.	.	19
2005	0.0009	0.8733	-0.8384	2.5850	4.5826	21

Appendix 2l. Nominal CPUE and the nominal relative (CPUE/mean) abundance indices for finetooth sharks. CPUE of a set = shark catch/#hooks. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed for the nominal relative abundance indices.

Finetooth shark

YEAR	CPUE	REL INDEX	LCL	UCL	CV	N
1972	0.0000	0.0000	.	.	.	3
1973	0.0000	0.0000	.	.	.	11
1974	0.0000	0.0000	.	.	.	16
1975	0.0000	0.0000	.	.	.	24
1976	0.0000	0.0000	.	.	.	25
1977	0.0003	0.4322	-0.4149	1.2793	5.4772	30
1978	0.0004	0.4631	-0.4445	1.3707	5.2915	28
1979	0.0011	1.3941	-0.1240	2.9123	2.9400	28
1980	0.0000	0.0000	.	.	.	29
1981	0.0003	0.4225	-0.4056	1.2506	5.5678	31
1982	0.0003	0.4290	-0.4118	1.2698	5.5678	31
1983	0.0004	0.4552	-0.1672	1.0776	3.8844	31
1984	0.0000	0.0000	.	.	.	32
1985	0.0000	0.0000	.	.	.	30
1986	0.0000	0.0000	.	.	.	29
1987	0.0004	0.5488	-0.1958	1.2935	3.4611	25
1988	0.0008	1.0130	-0.2767	2.3027	3.6745	32
1989	0.0030	3.9108	-1.2432	9.0648	3.4939	27
1990	0.0000	0.0000	.	.	.	21
1991	0.0000	0.0000	.	.	.	18
1992	0.0018	2.3051	-2.2128	6.8231	3.8730	15
1993	0.0011	1.3649	-1.3102	4.0400	4.3589	19
1994	0.0116	15.0474	1.3151	28.7797	2.4195	27
1995	0.0004	0.4550	-0.4367	1.3467	4.3589	19
1996	0.0000	0.0000	.	.	.	20
1997	0.0016	2.0543	-0.3155	4.4241	2.9429	25
1998	0.0000	0.0000	.	.	.	25
1999	0.0000	0.0000	.	.	.	25
2000	0.0000	0.0000	.	.	.	22
2001	0.0000	0.0000	.	.	.	15
2002	0.0000	0.0000	.	.	.	23
2003	0.0000	0.0000	.	.	.	22
2004	0.0000	0.0000	.	.	.	19
2005	0.0029	3.7047	-2.4064	9.8157	3.8568	21

Appendix 3a. Results of the stepwise procedure for development of the catch rate model for total sharks. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	368.3759	0.4622					
MONTH	790	352.0753	0.4457	3.5699	3.8402	-176.0377	16.30	0.0225
STATION	796	364.8099	0.4583	0.8438		-182.4049	3.57	0.0590
YEAR	764	315.4457	0.4129	10.6664		-157.7229	Negative of Hessian not positive definite	
MONTH +								
YEAR	757	293.1110	0.3872	16.2267	12.3865	-146.5555	Negative of Hessian not positive definite	

FINAL MODEL: MONTH + YEAR

Akaike's information criterion	2979.6
Schwartz's Bayesian criterion	2983.8
(-2) Res Log likelihood	2977.6

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	MONTH	YEAR
DF	7	20
CHI SQUARE	20.57	10.85

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	748	5662.3013	7.5699					
YEAR	715	4915.0275	6.8742	9.1903	9.1903	11458.1258	747.27	<.0001
MONTH	741	5359.9561	7.2334	4.4452		11235.6614	302.35	<.0001
STATION	747	5460.546	7.3100	3.4333		11185.3665	201.76	<.0001
YEAR +								
MONTH	708	4552.6699	6.4303	15.0544	5.8640	11639.3046	362.36	<.0001
STATION	714	4700.6058	6.5835	13.0306		11565.3366	214.42	<.0001
YEAR + MONTH +								
STATION	707	4362.8878	6.1710	18.4798	3.4254	11734.1956	189.78	<.0001

FINAL MODEL: YEAR + MONTH + STATION

Akaike's information criterion	1936.6
Schwartz's Bayesian criterion	1941.1
(-2) Res Log likelihood	1934.6

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	YEAR	MONTH	STATION
DF	<.0001	<.0001	<.0001
CHI SQUARE	33	7	1
	114.63	45.00	26.21

Appendix 3b. Results of the stepwise procedure for development of the catch rate model for the small coastal shark complex. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	933.9295	1.1718					
MONTH	790	800.7048	1.0136	13.5006	13.4957	-400.3524	133.22	<.0001
YEAR	764	829.5438	1.0858	7.3391		-414.7719	104.39	<.0001
STATION	796	931.7254	1.1705	0.1109		-465.8627	2.20	0.1376
MONTH + YEAR	757	699.3414	0.9238	21.1640	7.6683	-349.6707	101.36	<.0001

FINAL MODEL: MONTH + YEAR

Akaike's information criterion	3733.8
Schwartz's Bayesian criterion	3738.4
(-2) Res Log likelihood	3731.8

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	MONTH	YEAR
	<.0001	0.0015
DF	7	31
CHI SQUARE	96.50	59.71

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	580	2888.4064	4.9800					
YEAR	547	2317.7031	4.2371	14.9177	14.9177	3856.4232	570.70	<.0001
MONTH	573	2786.5818	4.8631	2.3474		3621.9838	101.82	<.0001
STATION	579	2858.8315	4.9375	0.8534		3585.8590	29.57	<.0001
YEAR + MONTH	540	2211.4190	4.0952	17.7671	2.8494	3909.5653	106.28	<.0001

FINAL MODEL: YEAR + MONTH

Akaike's information criterion	1485.9
Schwartz's Bayesian criterion	1490.2
(-2) Res Log likelihood	1483.9

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	YEAR	MONTH
	<.0001	0.0037
DF	33	7
CHI SQUARE	121.23	21.02

Appendix 3c. Results of the stepwise procedure for development of the catch rate model for Atlantic sharpnose sharks. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	1098.6267	1.3785					
MONTH	790	1044.6806	1.3224	4.0696	4.1141	-522.3403	53.95	<.0001
YEAR	764	911.7876	1.1934	13.4276		-455.8938	Negative of Hessian not positive definite	
STATION	796	1098.6258	1.3802	-0.1233		-549.3129	0.00	0.9768
MONTH + YEAR	757	867.7646	1.1463	16.8444	12.7303	-433.8823	Negative of Hessian not positive definite	

FINAL MODEL: MONTH + YEAR

Akaike's information criterion	3587.0
Schwartz's Bayesian criterion	3591.6
(-2) Res Log likelihood	3585.0

Type 3 Test of Fixed Effects

	MONTH	YEAR
Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	<.0001	<.0001
DF	7	31
CHI SQUARE	36.50	107.88

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	437	2157.2707	4.9365					
YEAR	405	1580.3018	3.9020	20.9561	20.9561	2109.7348	576.97	<.0001
MONTH	430	2049.8277	4.7670	3.4336		1874.9718	107.44	<.0001
STATION	436	2155.9354	4.9448	-0.1681		1821.9180	1.34	0.2479
YEAR + MONTH	398	1478.2483	3.7142	24.7605	3.8043	2160.7616	102.05	<.0001

FINAL MODEL: YEAR + MONTH

Akaike's information criterion	1170.8
Schwartz's Bayesian criterion	1174.7
(-2) Res Log likelihood	1168.8

Type 3 Test of Fixed Effects

	YEAR	MONTH
Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	<.0001	0.0021
DF	32	7
CHI SQUARE	124.78	22.51

Appendix 3d. Results of the stepwise procedure for development of the catch rate model for blacknose sharks. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	1044.8186	1.3109					
MONTH	790	888.3300	1.1245	14.2192	14.1975	-444.1650	156.49	<.0001
YEAR	764	961.2096	1.2581	4.0278		-480.6048	83.61	<.0001
STATION	796	1009.8234	1.2686	3.2268		-504.9117	35.00	<.0001
MONTH +								
YEAR	757	766.6747	1.0128	22.7401	8.5426	-383.3374	121.66	<.0001
STATION	789	853.1414	1.0813	17.5147		-426.5707	35.19	<.0001
MONTH + YEAR +								
STATION	756	731.4371	0.9675	26.1957	3.4556	-365.7185	35.24	<.0001

FINAL MODEL: MONTH + YEAR + STATION

Akaike's information criterion	3613.1
Schwartz's Bayesian criterion	3617.6
(-2) Res Log likelihood	3611.1

Type 3 Test of Fixed Effects

	MONTH	YEAR	STATION
Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	<.0001	<.0001	<.0001
DF	6	33	1
CHI SQUARE	79.70	85.41	29.01

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	288	1245.4470	4.3245					
YEAR	255	823.0679	3.2277	25.3625	25.3625	863.1923	422.38	<.0001
MONTH	282	1161.4567	4.1186	4.7612		693.9979	83.99	<.0001
STATION	287	1230.2131	4.2865	0.8787		659.6197	15.23	<.0001
YEAR +								
MONTH	249	744.9416	2.9917	30.8197	5.4573	902.2555	78.13	<.0001

FINAL MODEL: YEAR + MONTH

Akaike's information criterion	763.2
Schwartz's Bayesian criterion	766.7
(-2) Res Log likelihood	761.2

Type 3 Test of Fixed Effects

	YEAR	MONTH
Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	<.0001	0.0025
DF	33	6
CHI SQUARE	119.74	20.28

Appendix 3e. Results of the stepwise procedure for development of the catch rate model for dusky sharks. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	799.7501	1.0035					
MONTH	790	700.6544	0.8869	11.6193	11.7020	-350.3272	99.10	<.0001
STATION	796	799.3433	1.0042	-0.0698		-399.6716	0.41	0.5236
YEAR	764	662.9400	0.8677	13.5326		-331.4700	Negative of Hessian not positive definite	
MONTH +								
YEAR	757	538.8377	0.7118	29.0683	17.3662	-269.4188	Negative of Hessian not positive definite	

FINAL MODEL: MONTH + YEAR

Akaike's information criterion	3787.9
Schwartz's Bayesian criterion	3792.4
(-2) Res Log likelihood	3785.9

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	MONTH	YEAR
	<.0001	<.0001
DF	7	28
CHI SQUARE	91.02	87.83

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	159	1454.9535	9.1507					
YEAR	130	1029.2598	7.9174	13.4777	13.4777	1115.9375	425.69	<.0001
MONTH	152	1209.4506	7.9569	13.0460		1025.8420	245.50	<.0001
STATION	158	1421.3719	8.9960	1.6906		919.8814	33.58	<.0001
YEAR +								
MONTH	123	722.5495	5.8744	35.8038	22.3262	1269.2926	306.71	<.0001
STATION	129	970.8887	7.5263	17.7516		1145.1230	58.37	<.0001
YEAR + MONTH +								
STATION	122	695.7576	5.7029	37.6780	15.3518	1282.6886	26.79	<.0001

FINAL MODEL: YEAR + MONTH + STATION

Akaike's information criterion	434.2
Schwartz's Bayesian criterion	437.0
(-2) Res Log likelihood	432.2

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	YEAR	MONTH	STATION
	<.0001	<.0001	0.0319
DF	29	7	1
CHI SQUARE	71.74	36.09	4.60

Appendix 3f. Results of the stepwise procedure for development of the catch rate model for blacktip sharks. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	962.0707	1.2071					
MONTH	790	759.0755	0.9609	20.3960	20.3593	-379.5378	203.00	<.0001
YEAR	764	877.2547	1.1482	4.8795		-438.6274	84.82	<.0001
STATION	796	941.8766	1.1833	1.9717		-470.9383	20.19	<.0001
MONTH + STATION	789	738.9596	0.9366	22.4091	2.0497	-369.4798	20.12	<.0001
YEAR	757	627.8168	0.8293	31.2982		-313.9084	Negative of Hessian not positive definite	
MONTH + STATION + YEAR	756	607.7611	0.8039	33.4024	10.9933	-303.8805	Negative of Hessian not positive definite	

FINAL MODEL: MONTH + STATION + YEAR

Akaike's information criterion	3681.0
Schwartz's Bayesian criterion	3685.5
(-2) Res Log likelihood	3679.0

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	MONTH	STATION	YEAR
DF	5	1	33
CHI SQUARE	109.77	19.10	96.96

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	231	672.7347	2.9123					
YEAR	198	502.4085	2.5374	12.8730	12.8730	454.3721	170.33	<.0001
MONTH	226	633.7328	2.8041	3.7153		388.7100	39.00	<.0001
STATION	230	670.6210	2.9157	-0.1167		370.2659	2.11	0.1460
YEAR + MONTH	193	468.8910	2.4295	16.5780	3.7050	471.1308	33.52	<.0001

FINAL MODEL: YEAR + MONTH

Akaike's information criterion	570.5
Schwartz's Bayesian criterion	573.7
(-2) Res Log likelihood	568.5

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	YEAR	MONTH
DF	33	5
CHI SQUARE	57.37	11.65

Appendix 3g. Results of the stepwise procedure for development of the catch rate model for smooth dogfish. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	643.7023	0.8077					
MONTH	790	369.9288	0.4683	42.0206	42.1254	-184.9644	273.77	<.0001
STATION	796	643.6629	0.8086	-0.1114		-321.8315	0.04	0.8427
YEAR	764	562.4205	0.7362	8.8523		-281.2102	Negative of Hessian not positive definite	
MONTH + YEAR	757	286.4763	0.3784	53.1509	11.0255	-143.2382	Negative of Hessian not positive definite	

FINAL MODEL: MONTH + YEAR

Akaike's information criterion	2779.4
Schwartz's Bayesian criterion	2783.5
(-2) Res Log likelihood	2777.4

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	MONTH	YEAR
DF	5	26
CHI SQUARE	79.26	29.94

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	110	767.2628	6.9751					
MONTH	105	598.3199	5.6983	18.3051	18.3051	744.3980	168.94	<.0001
YEAR	84	523.7970	6.8742	1.4466		781.6595	243.47	<.0001
STATION	109	759.9000	6.9716	0.0502		663.6080	7.36	0.0067
MONTH + YEAR	79	413.3767	5.2326	24.9817	6.6766	836.8696	184.94	<.0001

FINAL MODEL: MONTH + YEAR

Akaike's information criterion	266.9
Schwartz's Bayesian criterion	269.2
(-2) Res Log likelihood	264.9

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	MONTH	YEAR
DF	5	26
CHI SQUARE	17.52	25.35

Appendix 3h. Results of the stepwise procedure for development of the catch rate model for scalloped hammerhead sharks. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	882.9205	1.1078					
YEAR	764	726.7899	0.9513	14.1271	14.0821	-363.3949	156.13	<.0001
MONTH	790	835.3387	1.0574	4.5496		-417.6694	47.58	<.0001
STATION	796	867.7628	1.0902	1.5887		-433.8814	15.16	0.0001
YEAR +								
MONTH	757	656.9511	0.8678	21.6646	7.5825	-328.4755	69.84	<.0001
STATION	763	711.6572	0.9327			-355.8286	15.13	0.0001
YEAR + MONTH +								
STATION	756	642.2765	0.8496	23.3075	1.6429	-321.1382	14.67	0.0001

FINAL MODEL: YEAR + MONTH + STATION

Akaike's information criterion	3693.7
Schwartz's Bayesian criterion	3698.3
(-2) Res Log likelihood	3691.7

Type 3 Test of Fixed Effects

	YEAR	MONTH	STATION
Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	<.0001	<.0001	0.0001
DF	30	7	1
CHI SQUARE	106.73	46.58	14.87

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	192	345.7954	1.8010					
YEAR	162	232.1754	1.4332	20.4220	9.1903	17.8700	113.62	<.0001
MONTH	185	323.3175	1.7477	2.9595		11235.6614	22.48	0.0021
STATION	191	343.8932	1.8005	0.0278		-37.9889	1.90	0.1678
YEAR +								
MONTH	155	207.2955	1.3374	25.7413	16.5509	30.3100	24.88	0.0008

FINAL MODEL: YEAR + MONTH

Akaike's information criterion	424.2
Schwartz's Bayesian criterion	427.2
(-2) Res Log likelihood	422.2

Type 3 Test of Fixed Effects

	YEAR	MONTH
Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	<.0001	0.0262
DF	30	7
CHI SQUARE	77.63	15.88

Appendix 3i. Results of the stepwise procedure for development of the catch rate model for sandbar sharks. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	617.6609	0.7750					
MONTH	790	561.5831	0.7109	8.2710	8.3032	-280.7915	56.08	<.0001
STATION	796	613.2054	0.7704	0.5935		-306.6027	4.46	0.0348
YEAR	764	486.8465	0.6372	17.7806		-243.4232	Negative of Hessian not positive definite	
MONTH + YEAR	757	422.6365	0.5583	27.9613	19.6580	-211.3183	Negative of Hessian not positive definite	

FINAL MODEL: MONTH + YEAR

Akaike's information criterion	3302.9
Schwartz's Bayesian criterion	3307.3
(-2) Res Log likelihood	3300.9

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	MONTH	YEAR
	<.0001	<.0001
DF	7	22
CHI SQUARE	36.64	66.93

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	103	269.3748	2.6153					
YEAR	81	199.5305	2.4633	5.8120	9.1903	50.1396	69.84	<.0001
MONTH	96	250.9993	2.6146	0.0268		24.4051	18.38	0.0104
STATION	102	268.9715	2.6370	-0.8297		15.4191	0.40	0.5254

FINAL MODEL: YEAR

Akaike's information criterion	261.1
Schwartz's Bayesian criterion	263.5
(-2) Res Log likelihood	259.1

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	YEAR
	0.4732
DF	22
CHI SQUARE	21.78

Appendix 3j. Results of the stepwise procedure for development of the catch rate model for spinner sharks. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	643.7023	0.8077					
STATION	796	629.4566	0.7908	2.0924	2.0784	-314.7283	14.25	0.0002
MONTH	790	595.407	0.7537	6.6857		-297.7035	Negative of Hessian not positive definite	
YEAR	764	595.2452	0.7791	3.5409		-297.6226	Negative of Hessian not positive definite	
STATION + YEAR	763	578.9081	0.7587	6.0666	3.9882	-289.4540	Negative of Hessian not positive definite	

FINAL MODEL: STATION + YEAR

Akaike's information criterion	3782.0
Schwartz's Bayesian criterion	3786.5
(-2) Res Log likelihood	3780.0

Type 3 Test of Fixed Effects

	STATION	YEAR
Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	0.0002	0.7664
DF	1	29
CHI SQUARE	14.23	23.22

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	110	127.5487	1.1595					
YEAR	81	78.3555	0.9674	16.5675	16.5675	-50.2387	49.19	0.0110
MONTH	105	117.7286	1.1212	3.3031		-69.9253	9.82	0.0805
STATION	109	127.5420	1.1701	-0.9142		-74.8320	0.01	0.9350
YEAR + MONTH	76	71.8243	0.9451	18.4907	1.9232	-46.9731	6.53	0.2579

FINAL MODEL: YEAR

Akaike's information criterion	217.2
Schwartz's Bayesian criterion	219.6
(-2) Res Log likelihood	215.2

Type 3 Test of Fixed Effects

	YEAR
Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	0.0223
DF	29
CHI SQUARE	46.23

Appendix 3k. Results of the stepwise procedure for development of the catch rate model for silky sharks. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	410.6806	0.5153					
STATION	796	409.3463	0.5143	0.1941	0.1939	-204.6732	1.33	0.2481
MONTH	790	305.1757	0.3863	25.0340		-152.5879	Negative of Hessian not positive definite	
YEAR	764	332.0485	0.4346	15.6608		-166.0243	Negative of Hessian not positive definite	

FINAL MODEL: YEAR

Akaike's information criterion	2755.1
Schwartz's Bayesian criterion	2759.4
(-2) Res Log likelihood	2753.1

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	YEAR
DF	20
CHI SQUARE	1.19

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	56	139.7750	2.4960					
MONTH	53	124.0916	2.3414	6.1939	6.1939	22.4010	15.68	0.0013
STATION	55	130.0688	2.3649	5.2524		19.4124	9.71	0.0018
YEAR	36	106.3637	2.9545	-18.3694		31.2650	33.41	0.0304
MONTH + STATION	52	111.5908	2.1460	14.0224	7.8285	28.6514	12.50	0.0004
YEAR	33	89.6492	2.7166	-8.8381		39.6222	34.44	0.0233
MONTH +STATION + YEAR	32	79.9813	2.4994	-0.1362	-7.9647	44.4562	31.61	0.0476

FINAL MODEL: MONTH + STATION + YEAR

Akaike's information criterion	111.2
Schwartz's Bayesian criterion	112.7
(-2) Res Log likelihood	109.2

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	MONTH	STATION	YEAR
DF	3	1	20
CHI SQUARE	5.40	3.49	9.89

Appendix 3l. Results of the stepwise procedure for development of the catch rate model for finetooth sharks. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model. L is the log likelihood.

PROPORTION POSITIVE-BINOMIAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	797	262.1634	0.3289					
STATION	796	257.5387	0.3235	1.6418	1.6398	-128.7694	4.62	0.0315
YEAR	764	204.8323	0.2681	18.4859		-102.4162	Negative of Hessian not positive definite	
MONTH	790	236.1064	0.2989	9.1213		-118.0532	Negative of Hessian not positive definite	
STATION + YEAR	763	199.7535	0.2618	20.4013	18.7615	-99.8767	Negative of Hessian not positive definite	

FINAL MODEL: STATION + YEAR

Akaike's information criterion	2250.0
Schwartz's Bayesian criterion	2254.0
(-2) Res Log likelihood	2248.0

Type 3 Test of Fixed Effects

	STATION	YEAR
Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	0.0498	0.8135
DF	1	14
CHI SQUARE	3.85	9.27

POSITIVE CATCHES-POISSON ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%	L	CHISQ	PR>CHI
NULL	30	94.1515	3.1384					
YEAR	16	33.9334	2.1208	32.4242	32.4242	46.9990	60.22	<.0001
MONTH	26	77.2847	2.9725	5.2861		25.3234	16.87	0.0021
STATION	29	89.0177	3.0696	2.1922		19.4568	5.13	0.0235
YEAR + MONTH	12	16.5930	1.3827	55.9425	23.5184	55.6692	17.34	0.0017
STATION	15	32.3450	2.1563	31.2930		47.7932	1.59	0.2076

FINAL MODEL: YEAR + MONTH

Akaike's information criterion	39.4
Schwartz's Bayesian criterion	39.9
(-2) Res Log likelihood	37.4

Type 3 Test of Fixed Effects

	YEAR	MONTH
Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	0.0005	0.0344
DF	14	4
CHI SQUARE	37.86	10.38

Appendix 4a. Standardized relative (index/mean) abundance indices for total sharks based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Total sharks

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	.	.	.	.	.	3
1973	.	.	.	.	.	11
1974	12.8558	1.9596	0.9953	2.9239	0.2511	16
1975	.	.	.	.	.	24
1976	8.9031	1.3571	0.7469	1.9673	0.2294	25
1977	.	.	.	.	.	30
1978	.	.	.	.	.	28
1979	.	.	.	.	.	28
1980	9.2979	1.4173	0.8804	1.9541	0.1933	29
1981	5.8293	0.8885	0.4089	1.3682	0.2754	31
1982	6.8759	1.0481	0.6298	1.4663	0.2036	31
1983	.	.	.	.	.	31
1984	8.2788	1.2619	0.8375	1.6864	0.1716	32
1985	3.9054	0.5953	0.2526	0.9380	0.2937	30
1986	5.1162	0.7799	0.3682	1.1915	0.2693	29
1987	.	.	.	.	.	25
1988	7.8369	1.1946	0.7490	1.6401	0.1903	32
1989	5.2859	0.8057	0.3256	1.2859	0.3040	27
1990	3.1592	0.4816	0.0673	0.8959	0.4389	21
1991	.	.	.	.	.	18
1992	.	.	.	.	.	15
1993	6.1218	0.9331	0.2696	1.5966	0.3628	19
1994	6.1188	0.9327	0.3669	1.4984	0.3095	27
1995	.	.	.	.	.	19
1996	7.3697	1.1233	0.5277	1.7190	0.2706	20
1997	4.7900	0.7301	0.1675	1.2927	0.3931	25
1998	5.5652	0.8483	0.4218	1.2747	0.2565	25
1999	4.2230	0.6437	0.1739	1.1135	0.3724	25
2000	5.6024	0.8540	0.2991	1.4088	0.3315	22
2001	.	.	.	.	.	15
2002	5.6736	0.8648	0.2794	1.4502	0.3454	23
2003	6.8838	1.0493	0.3379	1.7607	0.3459	22
2004	8.0770	1.2312	0.5443	1.9180	0.2846	19
2005	.	.	.	.	.	21

Appendix 4b. Standardized relative (index/mean) abundance indices for small coastal complex based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Small coastal complex

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	3.1631	0.8556	-1.7424	3.4536	1.5492	3
1973	4.9826	1.3478	-0.0531	2.7486	0.5303	11
1974	1.4969	0.4049	-0.8709	1.6807	1.6075	16
1975	2.8925	0.7824	-0.2717	1.8365	0.6874	24
1976	2.1828	0.5904	-0.4270	1.6079	0.8792	25
1977	5.6691	1.5335	0.4552	2.6118	0.3588	30
1978	4.5741	1.2373	0.3016	2.1729	0.3858	28
1979	3.8654	1.0456	0.1645	1.9267	0.4299	28
1980	2.5785	0.6975	0.0353	1.3597	0.4844	29
1981	1.1426	0.3091	-0.3203	0.9385	1.0389	31
1982	1.5378	0.4160	-0.1098	0.9418	0.6449	31
1983	2.1448	0.5802	0.0547	1.1056	0.4621	31
1984	2.3825	0.6445	0.0517	1.2372	0.4692	32
1985	2.1162	0.5724	-0.0677	1.2125	0.5705	30
1986	1.4264	0.3858	-0.3387	1.1104	0.9580	29
1987	2.6375	0.7134	-0.0777	1.5046	0.5658	25
1988	4.0120	1.0852	0.3162	1.8542	0.3615	32
1989	2.0502	0.5546	-0.2417	1.3509	0.7326	27
1990	2.2059	0.5967	-0.0764	1.2698	0.5755	21
1991	4.6289	1.2521	0.4691	2.0351	0.3191	18
1992	8.7516	2.3673	1.2257	3.5089	0.2460	15
1993	4.1378	1.1193	-0.0924	2.3309	0.5523	19
1994	3.9814	1.0770	0.2027	1.9512	0.4142	27
1995	6.3723	1.7237	0.9344	2.5130	0.2336	19
1996	4.2718	1.1555	0.3156	1.9955	0.3709	20
1997	3.4433	0.9314	0.0607	1.8021	0.4769	25
1998	3.7947	1.0265	0.2585	1.7945	0.3817	25
1999	3.0293	0.8194	0.0673	1.5715	0.4683	25
2000	4.1971	1.1353	0.3775	1.8931	0.3406	22
2001	.	.	.	.	.	15
2002	4.8314	1.3069	0.4184	2.1953	0.3469	23
2003	6.9172	1.8711	0.8136	2.9286	0.2884	22
2004	6.8830	1.8618	0.8633	2.8604	0.2736	19
2005	.	.	.	.	.	21

Appendix 4c. Standardized relative (index/mean) abundance indices for Atlantic sharpnose sharks based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Atlantic sharpnose shark

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	.	.	.	.	.	3
1973	0.8609	0.3282	-2.3316	2.9880	4.1345	11
1974	0.3127	0.1192	-2.1625	2.4009	9.7643	16
1975	0.6532	0.2490	-1.4522	1.9502	3.4856	24
1976	0.3720	0.1418	-1.7442	2.0278	6.7842	25
1977	0.7385	0.2815	-1.5551	2.1182	3.3283	30
1978	1.3662	0.5209	-1.2516	2.2934	1.7362	28
1979	1.1658	0.4445	-1.1779	2.0668	1.8623	28
1980	1.1392	0.4343	-0.8681	1.7368	1.5299	29
1981	0.5938	0.2264	-0.9464	1.3992	2.6432	31
1982	0.3397	0.1295	-0.9779	1.2369	4.3625	31
1983	1.3526	0.5157	-0.7078	1.7391	1.2104	31
1984	0.9224	0.3517	-0.8031	1.5065	1.6754	32
1985	1.3215	0.5038	-0.7918	1.7994	1.3121	30
1986	1.1497	0.4383	-1.2095	2.0862	1.9180	29
1987	1.7345	0.6613	-0.8284	2.1509	1.1494	25
1988	2.2989	0.8764	-0.4307	2.1836	0.7609	32
1989	1.2651	0.4823	-1.0344	1.9991	1.6044	27
1990	1.7495	0.6670	-0.6770	2.0110	1.0281	21
1991	3.5264	1.3445	-0.2193	2.9082	0.5934	18
1992	6.2862	2.3966	0.2982	4.4951	0.4467	15
1993	3.1414	1.1977	-1.0647	3.4600	0.9638	19
1994	2.1637	0.8249	-0.9472	2.5970	1.0960	27
1995	5.6978	2.1723	-0.0694	4.4140	0.5265	19
1996	3.1011	1.1823	-0.2872	2.6518	0.6341	20
1997	2.8980	1.1049	-0.5692	2.7789	0.7731	25
1998	3.7796	1.4410	-0.0799	2.9618	0.5385	25
1999	2.8649	1.0922	-0.3581	2.5426	0.6775	25
2000	4.0014	1.5256	-0.1002	3.1513	0.5437	22
2001	.	.	.	.	.	15
2002	4.8722	1.8575	0.1710	3.5440	0.4632	23
2003	6.8989	2.6302	0.7561	4.5042	0.3635	22
2004	6.4492	2.4588	0.2315	4.6860	0.4622	19
2005	8.9172	3.3997	1.7595	5.0398	0.2461	21

Appendix 4d. Standardized relative (index/mean) abundance indices for blacknose sharks based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Blacknose shark

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	3.9673	2.5638	-5.4437	10.5714	1.5935	3
1973	4.2333	2.7358	-2.2841	7.7557	0.9362	11
1974	1.6003	1.0342	-3.6144	5.6828	2.2933	16
1975	3.3256	2.1492	-2.0469	6.3452	0.9961	24
1976	2.4895	1.6088	-1.9009	5.1186	1.1130	25
1977	6.2761	4.0559	1.3247	6.7871	0.3436	30
1978	4.0479	2.6160	-0.4845	5.7164	0.6047	28
1979	3.1151	2.0131	-0.6143	4.6405	0.6659	28
1980	1.8658	1.2058	-0.8235	3.2350	0.8587	29
1981	0.7275	0.4702	-1.6839	2.6243	2.3375	31
1982	1.5026	0.9711	-0.6118	2.5539	0.8316	31
1983	0.8487	0.5485	-1.2464	2.3434	1.6697	31
1984	1.8139	1.1722	-0.7850	3.1295	0.8519	32
1985	0.9533	0.6161	-1.5414	2.7735	1.7867	30
1986	0.5945	0.3842	-1.8687	2.6371	2.9916	29
1987	1.0990	0.7102	-1.6366	3.0571	1.6859	25
1988	2.1347	1.3796	-1.6922	4.4514	1.1360	32
1989	0.8117	0.5246	-2.0530	3.1022	2.5069	27
1990	0.5648	0.3650	-2.5273	3.2572	4.0432	21
1991	1.0523	0.6801	-2.0692	3.4293	2.0626	18
1992	2.3154	1.4963	-2.5652	5.5579	1.3849	15
1993	1.3813	0.8927	-2.4371	4.2225	1.9031	19
1994	0.8185	0.5289	-2.1217	3.1796	2.5568	27
1995	1.0115	0.6537	-2.2754	3.5827	2.2862	19
1996	1.3957	0.9020	-2.5732	4.3772	1.9657	20
1997	0.4191	0.2709	-1.9880	2.5297	4.2547	25
1998	0.1894	0.1224	-2.0293	2.2741	8.9687	25
1999	0.1309	0.0846	-2.2715	2.4407	14.2076	25
2000	0.1936	0.1251	-2.1965	2.4468	9.4669	22
2001	0.5966	0.3856	-3.0941	3.8653	4.6044	15
2002	0.2429	0.1570	-2.1413	2.4553	7.4704	23
2003	0.1000	0.0646	-2.0171	2.1464	16.4335	22
2004	0.3869	0.2500	-2.9612	3.4613	6.5528	19
2005	0.4054	0.2620	-2.5651	3.0891	5.5059	21

Appendix 4e. Standardized relative (index/mean) abundance indices for dusky sharks based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Dusky shark

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	.	.	.	.	.	3
1973	1.2996	0.8104	-3.8082	5.4290	2.9077	11
1974	6.1749	3.8505	-1.6030	9.3040	0.7226	16
1975	5.9351	3.7009	-1.0349	8.4367	0.6529	24
1976	4.8927	3.0509	-3.0871	9.1889	1.0265	25
1977	5.1982	3.2414	-1.5953	8.0780	0.7613	30
1978	1.2592	0.7852	-3.9732	5.5435	3.0919	28
1979	1.6195	1.0099	-2.2343	4.2541	1.6390	28
1980	1.5455	0.9637	-2.3376	4.2650	1.7478	29
1981	3.8657	2.4105	-1.0218	5.8428	0.7265	31
1982	4.5041	2.8086	-0.1176	5.7347	0.5316	31
1983	1.3029	0.8124	-1.4321	3.0569	1.4096	31
1984	1.9889	1.2402	-1.5159	3.9963	1.1338	32
1985	0.1912	0.1192	-1.5548	1.7932	7.1636	30
1986	0.7745	0.4829	-1.9798	2.9456	2.6018	29
1987	1.5940	0.9940	-2.4918	4.4798	1.7893	25
1988	0.7057	0.4400	-2.1243	3.0044	2.9732	32
1989	0.8805	0.5490	-2.0802	3.1783	2.4433	27
1990	0.0559	0.0348	-1.4711	1.5408	22.0503	21
1991	1.4224	0.8870	-7.2429	9.0169	4.6765	18
1992	.	.	.	.	.	15
1993	0.1090	0.0680	-1.8741	2.0100	14.5780	19
1994	0.3172	0.1978	-2.2048	2.6004	6.1974	27
1995	.	.	.	.	.	19
1996	0.0333	0.0208	-1.9979	2.0394	49.5665	20
1997	0.0853	0.0532	-2.3989	2.5053	23.5262	25
1998	.	.	.	.	.	25
1999	0.0647	0.0404	-2.3239	2.4046	29.8929	25
2000	0.0406	0.0253	-2.2006	2.2513	44.8541	22
2001	0.0331	0.0206	-1.9964	2.0376	49.9013	15
2002	0.1599	0.0997	-2.3949	2.5943	12.7659	23
2003	0.0273	0.0170	-1.8065	1.8406	54.5902	22
2004	0.4260	0.2656	-3.3967	3.9280	7.0339	19
2005	.	.	.	.	.	21

Appendix 4f. Standardized relative (index/mean) abundance indices for blacktip sharks based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Blacktip shark

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	3.0648	2.6441	-3.9315	9.2197	1.2688	3
1973	3.6497	3.1488	-2.4311	8.7287	0.9041	11
1974	2.7269	2.3527	-3.5643	8.2696	1.2832	16
1975	3.3291	2.8722	-1.3704	7.1147	0.7536	24
1976	2.2850	1.9714	-1.1408	5.0836	0.8054	25
1977	1.8496	1.5958	-0.9374	4.1289	0.8099	30
1978	2.6348	2.2732	-1.3414	5.8877	0.8113	28
1979	0.8342	0.7197	-2.3886	3.8280	2.2034	28
1980	2.1525	1.8571	-0.5669	4.2810	0.6660	29
1981	0.2931	0.2529	-1.9005	2.4062	4.3445	31
1982	0.7561	0.6523	-2.0209	3.3255	2.0909	31
1983	1.6938	1.4613	-0.9451	3.8677	0.8402	31
1984	1.9875	1.7147	-1.3828	4.8123	0.9217	32
1985	0.5863	0.5058	-1.7587	2.7703	2.2841	30
1986	1.0808	0.9325	-2.1632	4.0281	1.6938	29
1987	2.1480	1.8532	-1.2590	4.9654	0.8568	25
1988	1.0217	0.8815	-1.9075	3.6704	1.6143	32
1989	0.6887	0.5942	-2.4193	3.6077	2.5876	27
1990	0.0780	0.0673	-2.5375	2.6721	19.7566	21
1991	0.7652	0.6602	-3.0102	4.3305	2.8365	18
1992	0.2067	0.1783	-3.0322	3.3889	9.1853	15
1993	0.3761	0.3245	-2.7478	3.3967	4.8310	19
1994	0.7988	0.6891	-2.3752	3.7535	2.2687	27
1995	0.5089	0.4391	-2.5808	3.4589	3.5093	19
1996	1.9228	1.6589	-3.2477	6.5656	1.5090	20
1997	0.3305	0.2851	-2.5619	3.1321	5.0949	25
1998	0.2780	0.2399	-2.6066	3.0864	6.0544	25
1999	0.1793	0.1547	-2.8347	3.1440	9.8621	25
2000	0.4745	0.4093	-3.3120	4.1307	4.6383	22
2001	0.0865	0.0746	-2.6962	2.8454	18.9477	15
2002	0.0571	0.0492	-2.3429	2.4413	24.7871	23
2003	0.0671	0.0579	-2.3710	2.4868	21.3929	22
2004	0.2976	0.2567	-3.8033	4.3168	8.0685	19
2005	0.1993	0.1720	-3.1618	3.5057	9.8915	21

Appendix 4g. Standardized relative (index/mean) abundance indices for smooth dogfish based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Smooth dogfish

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	5.8900	2.5326	-5.0941	10.1593	1.5364	3
1973	.	.	.	.	.	11
1974	2.3607	1.0150	-2.1950	4.2251	1.6135	16
1975	.	.	.	.	.	24
1976	0.6157	0.2647	-1.4636	1.9931	3.3310	25
1977	2.3858	1.0258	-1.6249	3.6766	1.3184	30
1978	2.5215	1.0842	-1.1225	3.2910	1.0384	28
1979	3.4397	1.4790	-1.4237	4.3818	1.0013	28
1980	4.9082	2.1105	-0.5401	4.7610	0.6408	29
1981	3.4864	1.4991	-0.8838	3.8820	0.8110	31
1982	1.0888	0.4682	-1.2630	2.1994	1.8867	31
1983	2.6691	1.1477	-1.0672	3.3625	0.9847	31
1984	2.8177	1.2116	-0.9478	3.3709	0.9093	32
1985	0.4968	0.2136	-1.5612	1.9884	4.2387	30
1986	0.4415	0.1898	-1.3623	1.7420	4.1712	29
1987	1.6239	0.6983	-1.6722	3.0687	1.7320	25
1988	0.8937	0.3843	-2.2004	2.9690	3.4315	32
1989	0.6389	0.2747	-1.1384	1.6878	2.6243	27
1990	0.3893	0.1674	-1.6388	1.9736	5.5056	21
1991	16.1970	6.9644	-24.8833	38.8122	2.3331	18
1992	0.7130	0.3066	-2.1141	2.7272	4.0285	15
1993	0.6872	0.2955	-2.1209	2.7120	4.1722	19
1994	0.3724	0.1601	-2.0647	2.3850	7.0893	27
1995	.	.	.	.	.	19
1996	1.4828	0.6376	-2.4361	3.7113	2.4596	20
1997	0.1989	0.0855	-1.6691	1.8401	10.4668	25
1998	1.1064	0.4757	-1.6338	2.5852	2.2624	25
1999	.	.	.	.	.	25
2000	.	.	.	.	.	22
2001	.	.	.	.	.	15
2002	.	.	.	.	.	23
2003	0.0582	0.0250	-1.0519	1.1020	21.9518	22
2004	1.5209	0.6540	-2.0248	3.3327	2.0899	19
2005	3.7885	1.6290	-0.6050	3.8630	0.6997	21

Appendix 4h. Standardized relative (index/mean) abundance indices for scalloped hammerhead sharks based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Scalloped hammerhead shark

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	0.7212	1.1374	-15.1780	17.4527	7.3187	3
1973	3.2183	5.0752	-3.9364	14.0867	0.9059	11
1974	1.2785	2.0163	-4.4073	8.4398	1.6254	16
1975	1.6576	2.6140	-1.7597	6.9877	0.8537	24
1976	1.7153	2.7050	-2.9663	8.3764	1.0697	25
1977	1.6643	2.6246	-2.2811	7.5303	0.9536	30
1978	1.2075	1.9043	-3.4429	7.2514	1.4327	28
1979	1.2960	2.0438	-3.8689	7.9564	1.4760	28
1980	0.9517	1.5008	-2.3610	5.3625	1.3128	29
1981	0.5972	0.9419	-3.3705	5.2542	2.3360	31
1982	0.5062	0.7982	-2.9095	4.5059	2.3698	31
1983	0.6811	1.0740	-2.2460	4.3941	1.5771	31
1984	0.7716	1.2168	-2.8432	5.2769	1.7023	32
1985	0.1724	0.2719	-2.7595	3.3033	5.6875	30
1986	0.4202	0.6627	-3.0468	4.3721	2.8559	29
1987	0.4566	0.7201	-2.9970	4.4371	2.6337	25
1988	0.5841	0.9211	-2.2087	4.0510	1.7336	32
1989	0.0640	0.1009	-3.1368	3.3386	16.3697	27
1990	0.0197	0.0310	-2.9867	3.0487	49.6610	21
1991	0.0378	0.0596	-4.1318	4.2511	35.8539	18
1992	.	.	.	.	.	15
1993	0.0833	0.1314	-3.4298	3.6927	13.8248	19
1994	0.0371	0.0585	-3.4450	3.5620	30.5381	27
1995	.	.	.	.	.	19
1996	0.0836	0.1319	-4.6171	4.8808	18.3761	20
1997	.	.	.	.	.	25
1998	0.0537	0.0847	-3.4347	3.6041	21.2078	25
1999	0.7443	1.1738	-6.8707	9.2183	3.4966	25
2000	0.1532	0.2416	-4.2090	4.6921	9.3997	22
2001	0.0645	0.1017	-5.3816	5.5851	27.5037	15
2002	0.0511	0.0805	-3.3587	3.5198	21.7885	23
2003	0.0721	0.1138	-3.9775	4.2051	18.3479	22
2004	0.1029	0.1623	-5.6450	5.9697	18.2508	19
2005	0.1904	0.3002	-5.2785	5.8789	9.4813	21

Appendix 4i. Standardized relative (index/mean) abundance indices for sandbar sharks based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Sandbar shark

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	.	.	.	.	.	3
1973	.	.	.	.	.	11
1974	.	.	.	.	.	16
1975	.	.	.	.	.	24
1976	0.0975	0.2104	-8.0836	8.5044	20.1098	25
1977	1.6932	3.6538	-7.0693	14.3769	1.4973	30
1978	1.6544	3.5702	-8.8783	16.0187	1.7790	28
1979	1.6055	3.4646	-4.8411	11.7704	1.2231	28
1980	0.0299	0.0645	-6.4025	6.5315	51.1430	29
1981	0.0860	0.1855	-6.7787	7.1498	19.1504	31
1982	0.0803	0.1733	-6.2530	6.5996	18.9180	31
1983	0.9163	1.9773	-4.7727	8.7272	1.7417	31
1984	0.4804	1.0368	-5.7319	7.8054	3.3310	32
1985	0.4742	1.0233	-5.7283	7.7748	3.3663	30
1986	0.2578	0.5564	-7.1209	8.2336	7.0400	29
1987	1.1866	2.5608	-5.5900	10.7116	1.6240	25
1988	0.4012	0.8657	-7.3017	9.0332	4.8134	32
1989	0.4226	0.9121	-7.5984	9.4226	4.7607	27
1990	.	.	.	.	.	21
1991	0.0674	0.1455	-6.5894	6.8805	23.6129	18
1992	.	.	.	.	.	15
1993	0.0838	0.1808	-7.3747	7.7364	21.3159	19
1994	0.6379	1.3766	-8.2123	10.9654	3.5540	27
1995	0.0450	0.0971	-7.8118	8.0059	41.5697	19
1996	0.0595	0.1284	-8.9894	9.2462	36.2298	20
1997	0.1633	0.3523	-9.2060	9.9107	13.8407	25
1998	0.1237	0.2668	-8.1704	8.7040	16.1320	25
1999	0.0419	0.0905	-7.6201	7.8011	43.4635	25
2000	0.0497	0.1072	-8.2601	8.4745	39.8267	22
2001	.	.	.	.	.	15
2002	.	.	.	.	.	23
2003	.	.	.	.	.	22
2004	.	.	.	.	.	19
2005	.	.	.	.	.	21

Appendix 4j. Standardized relative (index/mean) abundance indices for spinner sharks based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Spinner shark

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	.	.	.	.	.	3
1973	.	.	.	.	.	11
1974	0.2901	1.1199	-7.1716	9.4114	3.7775	16
1975	0.3034	1.1713	-5.7528	8.0953	3.0161	24
1976	0.1274	0.4917	-6.8853	7.8687	7.6549	25
1977	0.4493	1.7345	-4.8545	8.3234	1.9382	30
1978	0.7866	3.0363	-4.2020	10.2747	1.2163	28
1979	1.0344	3.9928	-3.6048	11.5903	0.9708	28
1980	0.1445	0.5579	-3.7586	4.8745	3.9473	29
1981	0.0637	0.2460	-6.0114	6.5034	12.9777	31
1982	0.1548	0.5977	-3.8775	5.0730	3.8200	31
1983	0.1213	0.4681	-3.9083	4.8445	4.7701	31
1984	0.0314	0.1211	-4.2602	4.5023	18.4607	32
1985	0.0158	0.0612	-3.6387	3.7610	30.8655	30
1986	0.0578	0.2229	-4.2678	4.7137	10.2772	29
1987	0.2678	1.0339	-4.5532	6.6209	2.7572	25
1988	0.1980	0.7641	-3.4568	4.9851	2.8184	32
1989	0.2100	0.8106	-4.0757	5.6970	3.0754	27
1990	.	.	.	.	.	21
1991	0.2805	1.0827	-5.8208	7.9861	3.2532	18
1992	0.1887	0.7284	-6.7363	8.1932	5.2283	15
1993	0.1505	0.5811	-4.8666	6.0287	4.7831	19
1994	0.3247	1.2534	-4.6508	7.1575	2.4034	27
1995	0.3016	1.1643	-7.2119	9.5405	3.6704	19
1996	0.5091	1.9651	-5.1502	9.0803	1.8474	20
1997	0.3437	1.3267	-5.8082	8.4616	2.7438	25
1998	0.1229	0.4743	-4.9379	5.8865	5.8219	25
1999	0.2603	1.0047	-5.1997	7.2091	3.1508	25
2000	0.1846	0.7126	-5.5758	7.0010	4.5025	22
2001	0.1484	0.5727	-8.9226	10.0679	8.4593	15
2002	.	.	.	.	.	23
2003	0.2811	1.0850	-5.7783	7.9483	3.2273	22
2004	0.1681	0.6488	-6.9684	8.2661	5.9899	19
2005	0.2514	0.9703	-6.3963	8.3369	3.8736	21

Appendix 4k. Standardized relative (index/mean) abundance indices for silky sharks based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Silky shark

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	.	.	.	.	.	3
1973	.	.	.	.	.	11
1974	.	.	.	.	.	16
1975	.	.	.	.	.	24
1976	.	.	.	.	.	25
1977	.	.	.	.	.	30
1978	.	.	.	.	.	28
1979	0.1974	0.9856	-29.0886	31.0598	15.5686	28
1980	0.0143	0.0713	-7.4773	7.6199	54.0244	29
1981	.	.	.	.	.	31
1982	0.4105	2.0495	-8.9320	13.0311	2.7337	31
1983	0.6536	3.2635	-9.2207	15.7477	1.9518	31
1984	0.3567	1.7811	-12.6455	16.2078	4.1326	32
1985	0.0484	0.2419	-8.5863	9.0700	18.6223	30
1986	.	.	.	.	.	29
1987	0.3169	1.5825	-9.9044	13.0694	3.7035	25
1988	0.4019	2.0065	-10.5247	14.5376	3.1864	32
1989	0.4368	2.1808	-10.6288	14.9904	2.9968	27
1990	0.1709	0.8535	-14.1532	15.8602	8.9710	21
1991	0.0801	0.3997	-13.1777	13.9771	17.3314	18
1992	0.0320	0.1599	-11.0579	11.3776	35.7983	15
1993	0.1197	0.5977	-23.6132	24.8086	20.6675	19
1994	0.1452	0.7249	-13.5091	14.9589	10.0182	27
1995	0.0481	0.2402	-13.6491	14.1296	29.4985	19
1996	0.0480	0.2398	-9.4073	9.8869	20.5240	20
1997	.	.	.	.	.	25
1998	0.2771	1.3837	-13.4658	16.2332	5.4754	25
1999	.	.	.	.	.	25
2000	0.0617	0.3081	-15.4609	16.0771	26.1109	22
2001	.	.	.	.	.	15
2002	0.0666	0.3325	-16.1795	16.8446	25.3337	23
2003	0.2527	1.2615	-15.7480	18.2709	6.8794	22
2004	.	.	.	.	.	19
2005	0.0673	0.3359	-13.4417	14.1135	20.9284	21

Appendix 4l. Standardized relative (index/mean) abundance indices for finetooth sharks based on the standardized year effects obtained from the GLM analyses. LCL = lower confidence limit, UCL = upper confidence limit, CV = coefficient of variation, and N = the number of sets observed.

Finetooth shark

YEAR	INDEX	REL INDEX	LCL	UCL	CV	N
1972	.	.	.	.	.	3
1973	.	.	.	.	.	11
1974	.	.	.	.	.	16
1975	.	.	.	.	.	24
1976	.	.	.	.	.	25
1977	0.0392	0.1895	-6.6839	7.0629	18.5016	30
1978	0.0385	0.1862	-6.6314	7.0039	18.6778	28
1979	0.0965	0.4665	-5.7283	6.6613	6.7755	28
1980	.	.	.	.	.	29
1981	0.1194	0.5770	-10.1495	11.3035	9.4850	31
1982	0.1275	0.6165	-10.4702	11.7033	9.1746	31
1983	0.0377	0.1821	-4.8491	5.2133	14.0995	31
1984	.	.	.	.	.	32
1985	.	.	.	.	.	30
1986	.	.	.	.	.	29
1987	0.0449	0.2169	-4.9983	5.4322	12.2649	25
1988	0.0698	0.3373	-4.2361	4.9108	6.9168	32
1989	0.5420	2.6201	-7.8587	13.0989	2.0405	27
1990	.	.	.	.	.	21
1991	.	.	.	.	.	18
1992	0.1437	0.6947	-8.6689	10.0584	6.8766	15
1993	0.1179	0.5701	-8.7417	9.8818	8.3341	19
1994	1.2711	6.1449	-4.3211	16.6108	0.8690	27
1995	0.0273	0.1321	-5.5288	5.7930	21.8657	19
1996	.	.	.	.	.	20
1997	0.1942	0.9387	-7.2774	9.1549	4.4655	25
1998	.	.	.	.	.	25
1999	.	.	.	.	.	25
2000	.	.	.	.	.	22
2001	.	.	.	.	.	15
2002	.	.	.	.	.	23
2003	.	.	.	.	.	22
2004	.	.	.	.	.	19
2005	0.2332	1.1273	-7.9950	10.2496	4.1288	21