

By-Catch of Pelagic Sharks, Swordfish, and Other Large Pelagics
in the 1978 Distant-Water-Fleet Trawl Fishery in the
United States Fishery Conservation Zone in the Northwest Atlantic

by

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INTRODUCTION

In an attempt to determine the current level of pelagic shark catches in the Northwest Atlantic for use in preparation of a fishery management plan for sharks by the Mid-Atlantic Fishery Management Council, various sources of harvest have been considered including distant-water fleet commercial fisheries and domestic commercial and recreational fisheries. Reported catch statistics from distant-water fleets are available from regional fisheries commissions such as the International Commission for the Northwest Atlantic Fisheries (ICNAF) and the International Commission for the Conservation of Atlantic Tunas (ICCAT) or from the Food and Agriculture Organization (FAO) of the United Nations. However, very few countries have reported catches of pelagic sharks in ICNAF Subarea 5 and Statistical Areas 6, located primarily within the United States Fishery Conservation Zone (FCZ), except for Denmark and Norway which had small directed fisheries for porbeagle (Lamna nasus) in the 1960's and early 1970's.

Beginning in March 1977 following implementation of the Fishery Conservation and Management Act (FCMA) of 1976 (P.L. 94-265), United States (US) observers were placed aboard foreign vessels to monitor and quantify the catch of all species. This provided an opportunity to determine the catch of species (such as sharks, swordfish (Xiphias gladius) and other pelagics) which previously may have been unreported. Since the observer program did not begin until March 1977 and required several months to standardize reporting procedures, it was decided to analyze observer reports only for 1978 so as to obtain information for a complete calendar year of fishing.

The purpose of this paper is to summarize the observed catches of pelagic sharks, swordfish, and other large pelagics made by vessels of

distant-water fleets fishing in the US FCZ in the Northwest Atlantic in 1978, and to expand these observed catches to include the catches by vessels which were not monitored by observers.

METHODS AND MATERIALS

Observed by-catches of pelagic sharks, swordfish, and other large pelagics were obtained from the "Monthly Summary Reports on Foreign Fisheries Observer Program - Data on By-Catch and Catch Estimates" prepared by the National Marine Fisheries Service, Northeast Region, Fisheries Management Division, Law Enforcement Branch, Foreign Fisheries Observer Program, Otis Air Force Base, Massachusetts. These reports included summary logs prepared by observers for every trip made each month. Data extracted from each log included vessel nationality, fishing area, number of days fished while the observer was aboard, and the total by-catch (kg) of the species in question determined by the observer. Vessel days fished and the by-catch (by species) were summed for each month by country.

An estimate of each country's monthly total by-catch of pelagic sharks, swordfish, and other pelagics was calculated by assuming a direct proportion between the ratio of total by-catch and total vessel days on grounds and the ratio of by-catch and vessel days fished with observer coverage. The number of vessel days on grounds by country each month was obtained from the "Monthly Summary of Fishing Activity, United States Northeast Coast," NEREIS Report 008, generated by the NMFS, Northeast Regional Enforcement Information System (NEREIS).

RESULTS

A total of twelve separate species of sharks (excluding dogfish) was reported as by-catch. In addition, swordfish, four species of tuna, ocean

sunfish, and pilot whales were also observed. The common and scientific names of these species are given in Table 1.

United States foreign fisheries observers were present aboard vessels from seven nations for a total of 1,594 vessel days fished in 1978 in the Northwest Atlantic (Table 2). Coverage by country varied from 2 vessel days fished by Bulgaria to 620 days by Spanish vessels. Coverage by month varied from 19 vessel days in May to 228 vessel days in August and averaged 133 days per month. Principal coverage was of vessels from Spain, Japan, Italy, USSR, and Mexico. With the exception of the USSR vessels which fished primarily for silver hake (Merluccius bilinearis), the other vessels were involved in directed fisheries for long-finned (Loligo pealei) and short-finned (Illex illecebrosus) squid. Periods and areas of open fishing in 1978 are detailed in Table 3 and Figure 1. Gear used was primarily pelagic otter trawls capable of being fished to within several meters of the ocean floor and with opening heights of approximately 5-8 m.

By-catch of sharks was observed during all months of the year but was greatest during the second half of the year, particularly during July, August, and November (Table 4). A total of 29,716 kg of sharks was reported as by-catch by observers, followed by 15,669 kg of swordfish and 2,723 kg of tuna and other miscellaneous large pelagics. The shark by-catch consisted of 12,299 kg (41%) of species belonging to the Family Carcharhinidae (primarily blue and dusky sharks), 9,970 kg (34%) of hammerhead sharks (Family Sphyrnidae), 3,040 kg (10%) of species of the Family Lamnidae (primarily basking sharks), and 4,407 kg (15%) of angel sharks and non-specified sharks.

The total number of reported vessel days on ground by distant-water fleet vessels in the US FCZ in the Northwest Atlantic in 1978 was 8,520 (Table 5). Eight countries were represented, ranging from 5 days by

Bulgarian vessels to 3,327 vessel days by Spanish vessels, with Spanish, USSR, Japanese, Italian, and Mexican vessels contributing 8,445 vessel days or 99% of the total. Vessel days on grounds ranged from 135 in May to 1,808 in December, with fishing activity greatest during November-December and January-March.

Observer coverage of 1978 foreign fishing activity amounted to nearly 19%. For the five major countries which contributed 99% of the total vessel days on grounds, coverage ranged from 12.3% for USSR vessels to 25.4% for Italian vessels. Coverage by month varied from 8.5% during December to 41.3% during August.

The estimated amount of total by-catch determined by expanding the observed amount of by-catch using the country-monthly ratios between vessel days fished with observer coverage and total vessel days on grounds is presented in Table 6. The expanded results indicate a total by-catch of 128,168 kg of sharks, 71,129 kg of swordfish, and 9,856 kg of tuna, ocean sunfish, and pilot whales.

Carcharhinid sharks comprised 56,517 kg or 44% of the shark by-catch followed by hammerhead sharks (29,651 kg - 23%), angel sharks (24,922 kg - 19%), Lamnid sharks (9,225 kg - 7%), and non-specified sharks (7,853 kg - 6%). Within the Carcharhinid group, dusky sharks were most prevalent (31,237 kg) followed by sandbar (14,016 kg) and blue (10,650 kg) sharks; two other species caught were tiger (379 kg) and blacktip (235 kg) sharks.

The hammerhead group included non-specified hammerheads (21,951 kg) and scalloped hammerheads (7,700 kg). The Lamnids consisted primarily of basking sharks (8,066 kg), with lesser amounts of porbeagle (904 kg), great white shark (138 kg), and shortfin mako (117 kg).

Total estimated shark by-catch was greatest during November (66,565 kg - 52%) followed by July (27,398 kg - 21%) and August (10,855 kg - 8%). The swordfish by-catch was greatest during December, comprising 65% (46,384 kg) of the year's total.

Less than 10% of the shark by-catch was taken during January-June. The bulk of the fishing activity during this period occurred in areas 4 and 5, and to a much lesser extent in area 2 (Table 3, Figure 1). The shark catch during this period was predominantly Lamnids (mainly basking sharks). Fishing activity during July-September was conducted almost entirely in area 2. Vessels fished in all areas during October-December, but most of the shark by-catch occurred in area 1, particularly during November when 52% of the shark catch was taken. Over 80% of the total shark by-catch for the year was taken in areas 1 and 2, which were the southern-most areas with the warmest water temperatures where more sharks might be expected to be found compared to the northern, cooler areas.

The estimated shark by-catch was taken by vessels from six countries, with Spanish vessels accounting for 57% (73,225 kg) of the total and Mexican and Japanese vessels contributing 20% (26,169 kg) and 17% (22,225 kg), respectively (Table 7). The remaining 6% was taken by USSR, Italian, and Romanian vessels.

Japanese vessels were responsible for 68% (48,328 kg) of the total estimated swordfish by-catch, with Spanish (16%), Italian (11%), Mexican (3%), Romanian (2%), and USSR (1%) vessels contributing the remainder.

DISCUSSION

During 1978, an estimated 128 tons of sharks (excluding dogfish) were taken as by-catch by distant-water fleets fishing primarily for squid in

the US FCZ in the Northwest Atlantic. Assuming that in previous years a ratio existed between shark by-catch and squid catch equal to that for 1978, then estimates of shark by-catch for previous years would have ranged from about 1 ton in 1965 to 265 tons in 1973 (Table 8). Unfortunately, shark by-catch data are not available from previous years (except for part of 1977) to support these estimates. However, if fishing practices or shark abundance have not changed appreciably during the period, the estimates given in Table 8 may be approximately correct. Since the offshore squid fisheries have been somewhat seasonal (Loligo, winter-spring; Illex, summer-autumn) due to the distributional characteristics of the species, seasonal fishing patterns have not changed greatly throughout the period. Following extended jurisdiction, however, fishing has been restricted by month and area (Table 3, Figure 1), but previous patterns have not been altered significantly.

The by-catch of sharks in the international squid fishery is only one component of the unreported shark catch in the Northwest Atlantic. Sharks are also taken in the US and Canadian swordfish longline fisheries, the Japanese tuna longline fishery, and possibly in other directed fisheries. Estimates of by-catch from these sources must be considered in assessing the total level of shark harvest within the US FCZ.

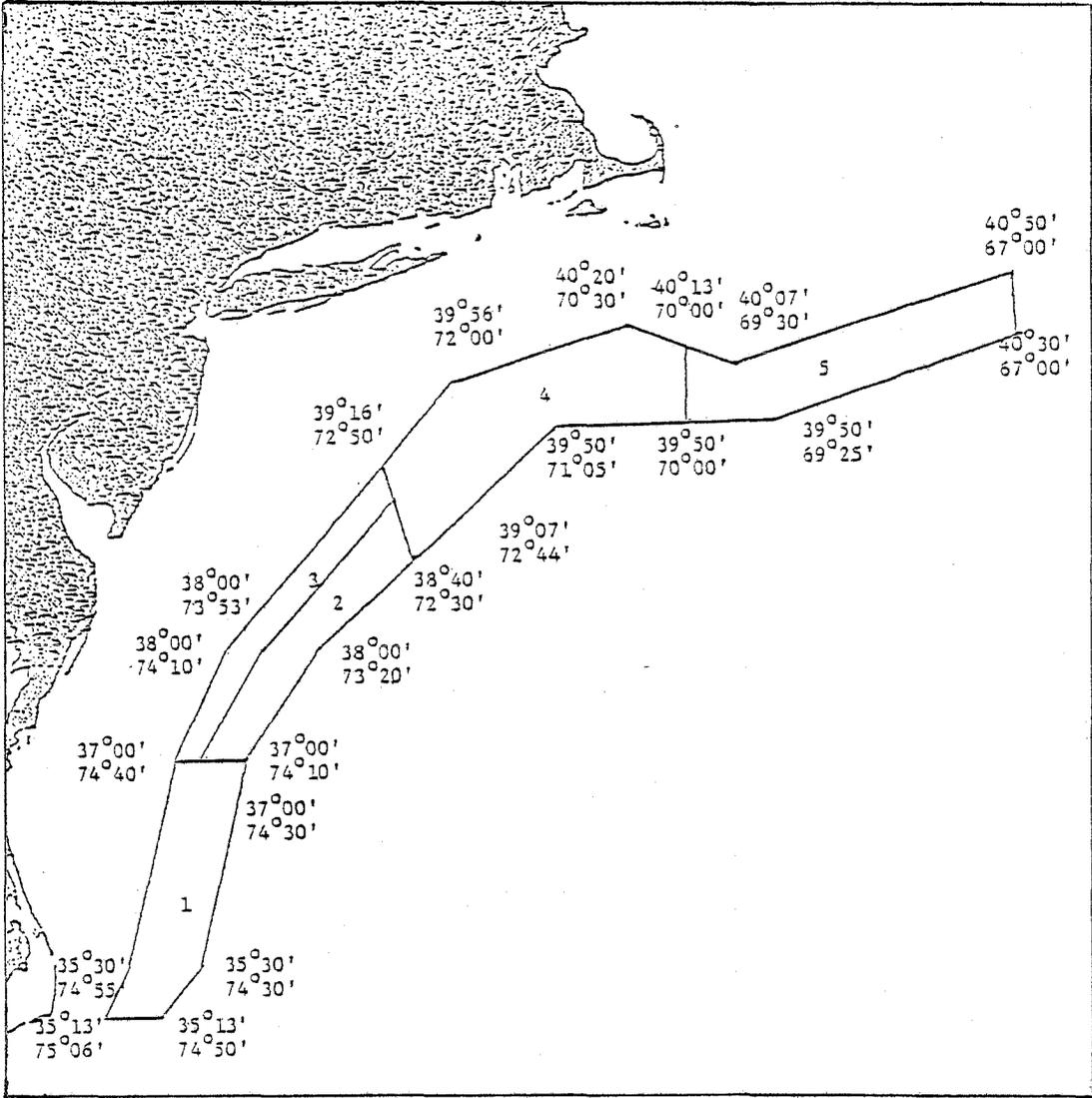


Figure 1. Foreign fishing areas in the US FCZ in the Northwest Atlantic for 1978.

Table 1. Common and scientific names of species considered in this report.

Common name	Scientific name
Great white shark	<u>Carcharodon carcharias</u>
Basking shark	<u>Cetorhinus maximus</u>
Shortfin mako	<u>Isurus oxyrinchus</u>
Porbeagle	<u>Lamna nasus</u>
Blacktip shark	<u>Carcharhinus limbatus</u>
Sandbar shark	<u>Carcharhinus milberti</u>
Dusky shark	<u>Carcharhinus obscurus</u>
Tiger shark	<u>Galeocerdo cuvieri</u>
Blue shark	<u>Prionace glauca</u>
Hammerhead (N.S.)	<u>Sphyrna spp.</u>
Scalloped hammerhead	<u>Sphyrna lewini</u>
Atlantic angel shark	<u>Squatina dumerili</u>
Swordfish	<u>Xiphias gladius</u>
Bigeye tuna	<u>Thunnus obesus</u>
Yellowfin tuna	<u>Thunnus albacares</u>
Atlantic bonito	<u>Sarda sarda</u>
Little tunny	<u>Euthynnus alletteratus</u>
Ocean sunfish	<u>Mola mola</u>
Pilot whale	<u>Globicephala melaena</u>

Table 2. Number of vessel days fished with United States foreign fisheries observer coverage by country and month in the United States Fishery Conservation Zone (FCZ) in the Northwest Atlantic in 1978.

Month	Country								Total
	Bulgaria	Cuba	Italy	Japan	Mexico	Romania	Spain	USSR	
Jan	-	-	57	22	2	-	65	-	146
Feb	-	-	21	52	13	-	39	49	174
Mar	-	-	-	11	-	-	88	100	199
Apr	-	-	-	-	4	-	33	61	98
May	2	-	-	-	-	-	-	17	19
Jun	-	-	-	-	37	-	-	-	37
Jul	-	-	-	30	30	-	116	-	176
Aug	-	-	-	72	24	-	132	-	228
Sep	-	-	53 ¹	-	8	-	26	-	87
Oct	-	-	22	-	52	-	46	-	120
Nov	-	-	74	29	13	-	40	-	156
Dec	-	-	35	51	12	13	35	8	154
Total	2	-	262	267	195	13	620	235	1,594

¹August and September.

Table 3. Foreign fishing gear restrictions by fishing area¹ in the US FCZ in the Northwest Atlantic for 1978. Hatching denotes open fishing periods.

Pelagic Gear Only

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1										hatched	hatched	hatched
2	hatched	hatched	hatched			hatched						
3	hatched	hatched	hatched							hatched	hatched	hatched
4						hatched	hatched		hatched	hatched	hatched	hatched
5			hatched							hatched	hatched	hatched

Bottom Gear and Pelagic Gear

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1												
2												
3												
4	hatched	hatched	hatched									
5				hatched	hatched	hatched						

¹Coordinates of the various areas are indicated in Figure 1.

²June 13 - September 15.

³June 1 - July 15.

Table 4. Observed by-catch (kg) of sharks, swordfish, and other large pelagics by the foreign trawl fishery in the US FCZ in the Northwest Atlantic in 1978 as reported by United States foreign fisheries observers.

Species	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
<u>Lamnidae</u>	700	400	225	50	-	1,640	-	-	-	-	25	-	3,040
Great white	-	-	-	-	-	-	-	-	-	-	15	-	15
Basking	700	400	150	-	-	1,400	-	-	-	-	-	-	2,650
Shortfin mako	-	-	-	-	-	-	-	-	-	-	10	-	10
Porbeagle	-	-	75	50	-	240	-	-	-	-	-	-	365
<u>Carcharhinidae</u>	-	-	-	-	-	150	1,425	4,268	1,210	435	4,635	176	12,299
Blacktip	-	-	-	-	-	-	-	-	-	-	3	12	15
Sandbar	-	-	-	-	-	-	-	-	-	-	1,418	-	1,418
Dusky	-	-	-	-	-	150	1,075	74	10	165	2,897	59	4,430
Tiger	-	-	-	-	-	-	-	-	-	-	47	-	47
Blue	-	-	-	-	-	-	350	4,194	1,200	270	270	105	6,389
<u>Sphyrnidae</u>	-	-	-	-	-	-	5,735	3,055	475	150	425	130	9,970
Hammerhead (N.S.)	-	-	-	-	-	-	4,430	2,260	380	-	260	130	7,460
Scalloped hammerhead	-	-	-	-	-	-	1,305	795	95	150	165	-	2,510
<u>Squatinidae</u>													
Atlantic angel	14	15	-	-	-	-	-	-	-	6	1,903	264	2,202
Sharks (N.S.)	-	-	350	100	2	-	1,066	535	150	-	2	-	2,205
Total sharks	714	415	575	150	2	1,790	8,226	7,858	1,835	591	6,990	570	29,716
Swordfish	-	-	-	-	-	210	1,832	4,006	1,983	988	1,390	5,260	15,669
<u>Tuna</u>	-	200	-	-	-	-	25	125	115	40	106	232	843
Bigeye	-	200	-	-	-	-	-	75	-	40	-	-	315
Yellowfin	-	-	-	-	-	-	25	50	115	-	-	-	190
Atlantic bonito	-	-	-	-	-	-	-	-	-	-	3	143	146
Little tunny	-	-	-	-	-	-	-	-	-	-	103	89	192
Ocean sunfish	-	-	-	-	-	-	-	405	75	-	-	-	480
Pilot whale	-	-	-	-	-	-	1,200	-	200	-	-	-	1,400

Table 5. Number of vessel days on grounds by country and month in the US FCZ in the Northwest Atlantic in 1978.

Month	Country								Total
	Bulgaria	Cuba	Italy	Japan	Mexico	Romania	Spain	USSR	
Jan	-	-	219	186	3	-	320	136	864
Feb	-	-	154	173	27	-	428	304	1,086
Mar	-	-	-	67	40	-	398	416	921
Apr	-	-	-	-	22	-	95	414	531
May	5	9	-	-	-	-	20	101	135
Jun	-	-	-	12	69	-	127	43	251
Jul	-	-	-	88	82	-	411	60	641
Aug	-	-	34	87	123	-	235	73	552
Sep	-	-	31	17	26	-	78	62	214
Oct	-	-	107	32	80	-	163	62	444
Nov	-	-	207	162	120	30	468	86	1,073
Dec	-	-	280	469	293	31	584	151	1,808
Total	5	9	1,032	1,293	885	61	3,327	1,908	8,520

Table 6. Estimated by-catch (kg) of sharks, swordfish, and other large pelagics by the foreign trawl fishery by month in the US FCZ in the Northwest Atlantic in 1978.

Species	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
<u>Lamnidae</u>	3,446	1,331	990	144	-	3,059	-	-	-	-	255	-	9,225
Great white	-	-	-	-	-	-	-	-	-	-	138	-	138
Basking	3,446	1,331	678	-	-	2,611	-	-	-	-	-	-	8,066
Shortfin mako	-	-	-	-	-	-	-	-	-	-	117	-	117
Porbeagle	-	-	312	144	-	448	-	-	-	-	-	-	904
<u>Carcharhinidae</u>	-	-	-	-	-	280	5,019	5,848	1,666	681	41,685	1,338	56,517
Blacktip	-	-	-	-	-	-	-	-	-	-	35	200	235
Sandbar	-	-	-	-	-	-	-	-	-	-	14,016	-	14,016
Dusky	-	-	-	-	-	280	3,809	123	12	266	25,859	888	31,237
Tiger	-	-	-	-	-	-	-	-	-	-	379	-	379
Blue	-	-	-	-	-	-	1,210	5,725	1,654	415	1,396	250	10,650
<u>Sphyrnidae</u>	-	-	-	-	-	-	18,602	4,055	583	231	3,726	2,454	29,651
Hammerhead (N.S.)	-	-	-	-	-	-	13,978	2,891	466	-	2,162	2,454	21,951
Scalloped hammerhead	-	-	-	-	-	-	4,624	1,164	117	231	1,564	-	7,700
<u>Squatinae</u>													
Atlantic angel	69	70	-	-	-	-	-	-	-	20	20,888	3,875	24,922
Sharks (N.S.)	-	-	2,132	679	12	-	3,777	952	290	-	11	-	7,853
Total sharks	3,515	1,401	3,122	823	12	3,339	27,398	10,855	2,539	932	66,565	7,667	128,168
Swordfish	-	-	-	-	-	392	5,848	5,932	2,794	3,627	6,152	46,384	71,129
<u>Tuna</u>	-	665	-	-	-	-	73	347	243	195	1,107	1,946	4,576
Bigeye	-	665	-	-	-	-	-	91	-	195	-	-	951
Yellowfin	-	-	-	-	-	-	73	256	243	-	-	-	572
Atlantic bonito	-	-	-	-	-	-	-	-	-	-	8	1,234	1,242
Little tunny	-	-	-	-	-	-	-	-	-	-	1,099	712	1,811
Ocean sunfish	-	-	-	-	-	-	-	558	225	-	-	-	783
Pilot whale	-	-	-	-	-	-	4,252	-	245	-	-	-	4,497

Table 7. Estimated by-catch (kg) of sharks, swordfish, and other large pelagics by the foreign trawl fishery by country in the US FCZ in the Northwest Atlantic in 1978.

Species	Country						Total
	Italy	Japan	Mexico	Romania	Spain	USSR	
<u>Lamnidae</u>	-	1,331	3,197	-	4,385	312	9,225
Great white	-	-	138	-	-	-	138
Basking	-	1,331	2,611	-	4,124	-	8,066
Shortfin mako	-	-	-	-	117	-	117
Porbeagle	-	-	448	-	144	312	904
<u>Carcharhinidae</u>	1,793	10,529	13,929	250	30,016	-	56,517
Blacktip	-	-	-	-	235	-	235
Sandbar	-	-	9,628	-	4,388	-	14,016
Dusky	12	6,903	2,888	-	21,434	-	31,237
Tiger	-	84	295	-	-	-	379
Blue	1,781	3,542	1,118	250	3,959	-	10,650
<u>Sphyrnidae</u>	751	7,631	4,256	-	14,559	2,454	29,651
Hammerhead (N.S.)	634	6,764	4,025	-	8,074	2,454	21,951
Scalloped hammerhead	117	867	231	-	6,485	-	7,700
<u>Squatinae</u>							
Atlantic angel	188	591	4,787	-	19,356	-	24,922
Sharks (N.S.)	110	2,143	-	-	4,909	691	7,853
Total sharks	2,842	22,225	26,169	250	73,225	3,457	128,168
Swordfish	7,655	48,328	2,012	1,335	11,233	566	71,129
<u>Tuna</u>	1,197	1,767	492	38	1,082	-	4,576
Bigeye	195	756	-	-	-	-	951
Yellowfin	80	73	419	-	-	-	572
Atlantic bonito	176	938	73	38	17	-	1,242
Little tunny	746	-	-	-	1,065	-	1,811
Ocean sunfish	-	344	-	-	439	-	783
Pilot whale	245	-	-	-	4,252	-	4,497

Table 8. Distant-water fleet catch (tons) of long-finned and short-finned squid in ICNAF Subarea 5 and Statistical Area 6 and estimated by-catch (tons) of sharks (excluding dogfish) during 1964-78. The 1964-77 estimates of by-catch are based on the 1978 ratio between squid catch and shark by-catch.

Year	Squid catch	Estimated shark by-catch
1964	4	-
1965	176	1
1966	389	2
1967	833	4
1968	4,917	24
1969	8,463	41
1970	18,824	90
1971	21,028	101
1972	47,500	228
1973	55,133	265
1974	53,106	255
1975	49,972	240
1976	46,389	223
1977	39,628	190
1978	26,666 ¹	128

¹Provisional