DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES

Partial Report

to

National Marine Fisheries Service
NOAA

Entitled

Caribbean/NMFS Cooperative SEAMAP Program- Queen conch, *Strombus gigas*, Assessment 2006

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INTRODUCTION

The Queen conch, *Strombus gigas*, is one of the target species in the fisheries industry. The fishing pressure over the resource had as result that most of its stock was at one point thought fully or overexploited throughout most of its range (Appeldoorn, 1994). In 1992 it was included, by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), in the Appendix II, which are species that, although currently not threatened with extinction, may become threatened without trade controls. It is also protected federally and locally with size limits and fishing closures (Caribbean Fishery Management Council, 1996; Caribbean Fishery Management Council and National Marine Fisheries Service, 2005). Concerned and responsible for the status of the resource, the Department of Natural and Environmental Resources (DNER) has been conducting periodical surveys of the Queen conch population around Puerto Rico. Following are the results and findings of the last surveyed, conducted in 2006.

OBJECTIVES

- To collect, manage, and disseminate fishery-independent data on the Queen conch, *Strombus gigas*, resources and their environment, encompassed in marine waters within the territorial sea and the Exclusive Economic Zone (EEZ) contiguous to Puerto Rico.
- To identify areas where Queen conch is fished and areas where it used to be fished in the past, and compare these with a previous survey.
- To conduct a Queen conch survey to determine its spatial and temporal variations in stock abundance within the territorial sea of Puerto Rico and the EEZ.
- To estimate the Queen conch abundance, size/age structure, and density variations due to locality, habitat type and depth.

METHODOLOGY

1. Information about fishermen that were actively fishing Queen conch on the west, south and east coast of Puerto Rico was obtained from the Fisheries Statistics Division in the DNER-Fisheries Research Laboratory.

2. The identified fishermen were interviewed, using the same questionnaire as in the Queen conch stratification survey done in 1995. Information collected during the interview included fishing history of the area, areas where the fishermen have observe Queen conch juveniles, possible fishing grounds and fishing effort data. The information was compared with the data collected for the Queen conch stratification survey done on 1995 (Rosario, 1995). The same questionnaire was used.

3. One hundred stations were selected randomly, within a depth limit of 90 feet, in the areas identified by the fishermen as present or past fishing grounds. Forty-six stations were selected from the west, forty from the east and fourteen from the south. Amount of stations per coast was determined keeping the same ratio as the fishing areas.

4. Divers were trained on scooter operation, maintaining constant speed, direction and transect width and live conch maturity stage identification and measurement. They were also briefed on safety rules.

5. Transects were mostly conducted during the state close season for the Queen conch, from 1 July 2006 to 30 September 2006, to avoid doing transects in places recently fished out

6. Abundance and density of Queen conch was estimated from visual surveys conducted by Scuba divers using underwater scooters along a line transect. Maximum survey time was 45 minutes and did not exceed the no-decompression limits. Differential Global Position Systems was used to locate the beginning and end of each transect. One of the divers carried the Scuba safety buoy. The other diver carried the compass to follow a fixed direction for a set period of time. Data on depth, habitat type, start time, time at each habitat change and end time was recorded. While doing the transect, the scooter was kept approximately one meter above the substrate so that path width remained constant at 4 meters within the transect. All conchs within a transect were counted.

7. The length of each individual conch was measured to the nearest cm; and age was estimated to one of the five relative age classes (juvenile, newly mature, adult, old adult, and very old adult). Amount of individuals, size and age class was estimated when the group of individuals observed was too large. Record was kept of time when each individual was found and time when the survey was resumed. Record of habitat types changes encounter during the transect run was kept. Habitat types were classified as: rubble, sand, reef, hard ground, gorgonians, seagrass and algal plains.

8. Length of transect was obtained by calculating the distance between the beginning and end points of each transect. Total area was calculated by multiplying the distance of each transect by the transect width (4 meters). Densities were calculated by summing the number of conchs observed per transect divided by the total area of each transect. Densities for each habitat were derived by dividing the numbers of conch per habitat type by the total area of that habitat type per transect. Densities based on depth were calculated by determining the number of conch in each depth range divided by the area covered over that depth range.

RESULTS

Interviews

A total of 42 fishers were interviewed. Twenty interviews were obtained from the west coast, 4 from the south and 16 from the east coast, including Vieques Island. Various fishermen on the east coast were reluctant to give the interview. It seems that many are using HOOKAH in this area for collecting queen conch, which is a practice forbidden by state and federal fisheries regulations, reason for which they probably had trepidations about the interview.

All interviewed fishers were queen conch fishers who target other species (Figure 1). All conch fishers reported lobster as another target species. Other main target species were the grouper, the hogfish and the trunkfish. Four fishers (9.5%) mentioned to collect queen conch by skin diving and scuba, three (7%) mentioned to use only skin diving and the others (83.5%) only use scuba. Other fishing gears that conch fishers use for other target species were fish traps, hook and line and seine net.

The mean number of divers per boat was 1.8, the mean number of trips per week was 4.9 and the mean number of tanks per trips was 4.9. Diving depth range was from 1 to 18 fathoms. There were areas of 21-25 fathoms that were marked on the nautical charts as fishing areas, which were assumed to be a mistake while reading the nautical charts during the interviewed.

Table 1 summarizes the results of the interviews and compares them with the results of 1995 (Rosario, 1995). Appendix I shows the areas identified by fishers during the interview as fishing grounds, old fishing grounds and juvenile conchs areas.

Surveys

A total of 99 stations were sampled covering 46.57 ha. Table 2 summarizes the time, locality and transect length for the stations. For better comprehension of the area covered a nautical chart with plots of the starting point of the transects is included (Figure 2). Conch was found in 81 of the 99 stations. Table 3 summarizes de number of conch observed per station and gives information on depth and area covered for each transect. Densities per transect ranged from 0.0 to 833 ind/ha (Table 3).

Most of the habitat covered during the surveys was seagrass or hard ground. Figure 3 shows the habitat distribution, in percentages, of the total area sampled, and per coastline. There was a particular habitat found on the Vieques Passage that was classified as rubble, but it was mostly composed of rounded pebbles. Island-wide densities per habitat type ranged from 5.5 to 73.8 conch/ha. Table 4 summarizes the densities found per habitat type for each coastline and compares it with available data from previous surveys. A Kruskal-Wallis analysis of the data indicated that there were no significant differences for conch densities found in algal mats and sand at the different coastlines. There were significant differences for conch densities found in hard ground, seagrass and reef. For densities in seagrasses there were significant differences with the densities reported for the south but not between the west and east.

Most of the individuals observed were juveniles. Figure 4 summarizes the age class distribution of the conchs observed island wide. Adult distribution was even from the newly mature to the very old stage. Figure 5 and 6 gives the length frequency distribution for adults and juveniles respectively. Juvenile length frequency distribution was analyzed using the Bhattacharhya's method of the FISATII program. This analysis was not done per coastline (east, south and west) because the small sample size created too much noise. Table 5 summarizes density and population data from all surveys conducted in the area from 1996 to 2006. Adult size ranged from 15 to 31 cm. The smaller juvenile observed was 3 cm. The east coast had the greatest percentage of adult conchs that were very old. The ratio of adult to very old conch in the south and west coast was similar, 1:1, while in the east coast it was 1:0.3. Age class distribution within habitats is shown in Figure 7. The majority of conch was found over seagrasses (40%), followed by hardground (27%) and algal mats (21%).

Depth range sampled was 6 to 95 feet. Density distribution with depth is given in Figure 8. The east coast shows a greater density of conch at greater depths. There were no significant differences between conch densities found, for the different coastlines, in the following depth ranges: less than 21 feet, 41-60 feet and 61-80 feet. There was significant difference between conch densities found at 21-40 feet for the east and west coast. No statistical analysis could be done to establish differences for depth range greater than 80 feet due to insufficient data.

Table 1. Interview information summary comparing data from 1995 to data from 2006.

	1995	2006
Total interviews	166	42
-north	9	0
-east	44	16
-south	46	4
-west	67	20
Fishing gear:		
- Scuba	66%	83.5%
-Skindiving	21%	7%
-Skin and Scuba	11%	9.5%
Other species collected		
-Spiny lobster	75%	100%
-Octopus	33%	4.9%
Other fish species collected		
-hogfish	37%	78%
-grouper	32%	30.2%
-snapper	11%	68%

Figure 1. Other target species reported by queen conch fishers

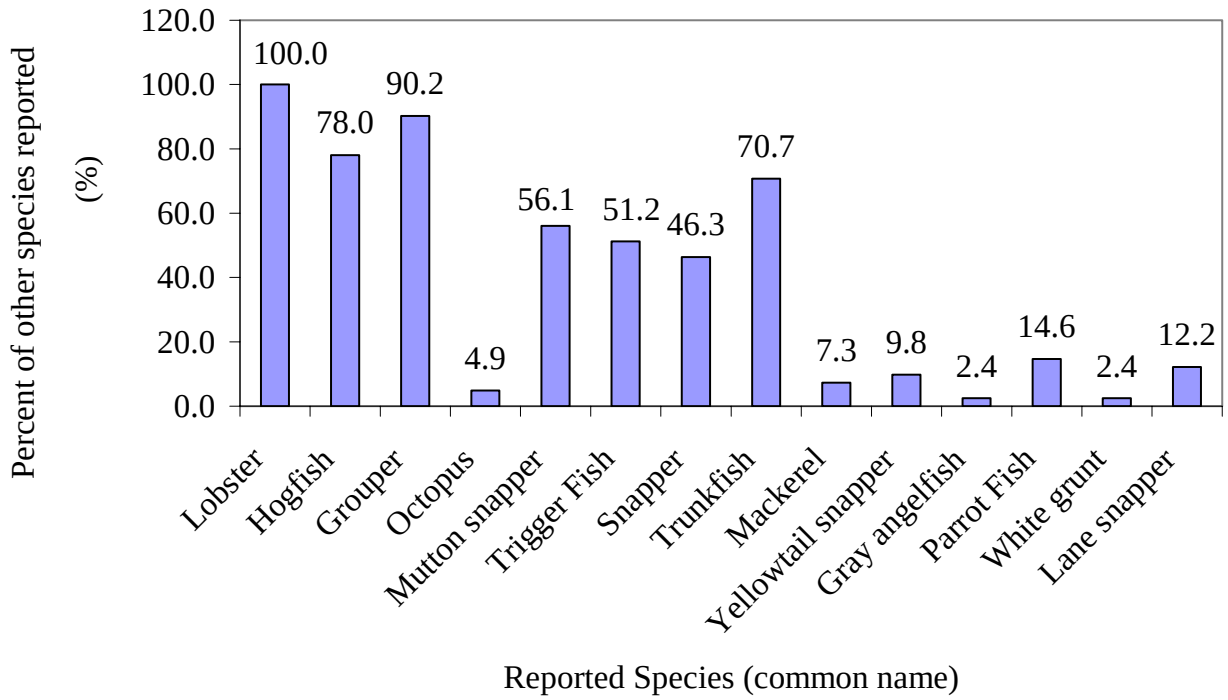


Table 2. Locality, time and distance information of the stations used for the Queen conch surveys

Station	Date	Starting coordinate		Ending coordinate		Distance
		North	West	North	West	km
W1	12-Jul-06	18°09.188	67°15.720	18°09.083	67°15.920	0.41
W2	12-Jul-06	18°09.278	67°13.856	18°08.522	67°13.702	1.43
W3	13-Jul-06	18°04.419	67°17.017	18°04.175	67°17.204	0.56
W4	13-Jul-06	18°06.597	67°16.754	18°06.273	67°16.679	0.61
W5	18-Jul-06	17°54.047	67°15.809	17°54.359	67°16.156	0.84
W6	18-Jul-06	17°54.333	67°18.569	17°53.900	67°18.663	0.81
W7	19-Jul-06	17°59.551	67°15.175	17°59.171	67°15.592	1.02
W8	19-Jul-06	17°57.859	67°14.219	17°58.246	67°14.488	0.86
W9	21-Jul-06	17°55.704	67°18.478	17°55.634	67°18.125	0.64
W10	21-Jul-06	17°55.937	67°16.131	17°55.732	67°15.914	.54
W11	1-Aug-06	17°56.930	67°18.084	17°56.830	67°17.918	0.35
W12	1-Aug-06	17°55.647	67°13.890	17°55.895	67°14.135	0.69
W13	2-Aug-06	17°55.420	67°16.002	17°55.263	67°17.108	1.97
W14	2-Aug-06	17°54.250	67°14.695	17°54.629	67°14.799	0.73
W15	4-Aug-06	17°57.851	67°16.755	17°58.107	67°17.075	0.74
W16	4-Aug-06	17°58.201	67°15.578	17°58.215	67°15.590	0.03
W17	10-Aug-06	17°59.042	67°17.419	17°58.755	67°17.329	0.56
W18	10-Aug-06	17°58.620	67°16.750	17°58.348	67°16.721	0.51
W19	10-Aug-06	17°56.379	67°14.546	17°56.062	67°14.174	0.88
W20	14-Aug-06	18°03.480	67°24.236	18°04.117	67°24.145	1.19
W21	14-Aug-06	18°06.466	67°25.235	18°06.309	67°25.366	0.37
W22	15-Aug-06	17°53.393	67°10.942	17°53.574	67°11.323	0.75
W23	15-Aug-06	17°54.607	67°10.996	17°54.622	67°11.408	0.73
W24	15-Aug-06	17°54.855	67°15.906	17°54.859	67°16.241	0.59
W25	17-Aug-06	17°57.957	67°17.570	17°57.827	67°17.385	0.4
W26	17-Aug-06	17°58.133	67°13.593	17°58.131	67°13.715	0.21
W27	22-Aug-06	17°56.070	67°19.437	17°55.849	67°19.431	0.41
W28	22-Aug-06	17°57.917	67°19.634	17°57.986	67°19.967	0.6
W29	22-Aug-06	17°58.954	67°20.470	17°58.867	67°20.174	0.55
W30	23-Aug-06	18°01.807	67°20.714	18°01.806	67°20.503	0.37
W31	23-Aug-06	18°00.640	67°19.055	18°00.660	67°18.900	0.29
W32	30-Aug-06	18°03.493	67°51.732	18°02.938	67°52.334	1.48
W33	30-Aug-06	18°04.193	67°55.835	18°04.432	67°56.052	0.58
W34	31-Aug-06	18°04.369	67°56.504	18°04.600	67°56.553	0.44
W35	31-Aug-06	18°03.463	67°54.755	18°03.665	67°55.154	0.8
W36	31-Aug-06	18°05.555	67°56.410	18°05.708	67°56.456	0.29
W37	12-Sep-06	18°08.347	67°19.576	18°08.838	67°19.722	0.94
W38	12-Sep-06	18°08.080	67°17.082	18°07.888	67°16.770	0.65
W39	12-Sep-06	18°05.927	67°21.676	18°06.416	67°21.725	0.91
W40	12-Sep-06	18°09.035	67°22.134	18°09.419	67°22.127	0.71

Station	Date	Starting coordinate		Ending coordinate		Distance
		North	West	North	West	km
W41	14-Sep-06	18°06.130	67°15.572	18°06.480	67°15.460	0.68
W42	14-Sep-06	18°09.224	67°12.560	18°08.984	67°12.605	0.45
W43	15-Sep-06	18°09.525	67°16.825	18°09.798	67°17.259	0.92
W44	15-Sep-06	18°08.643	67°14.488	18°08.445	67°14.371	0.42
W45	15-Sep-06	18°09.476	67°20.177	18°09.040	67°20.088	0.82
W46	15-Sep-06	18°08.957	67°18.667	18°09.427	67°18.716	0.87
S1	20-Sep-06	17°52.378	66°30.858	17°52.308	66°31.190	0.6
S2	20-Sep-06	17°57.309	66°41.514	17°57.660	66°41.240	0.81
S3	20-Sep-06	17°55.655	66°28.323	17°55.828	66°28.758	0.83
E1	25-Sep-06	18°10.111	65°28.413	18°10.035	65°28.506	0.22
E2	26-Sep-06	18°07.377	65°17.168	18°07.135	65°17.025	0.51
E3	26-Sep-06	18°05.834	65°22.385	18°05.960	65°22.322	0.26
E4	26-Sep-06	18°05.622	65°24.610	18°05.655	65°24.678	0.13
E5	26-Sep-06	18°07.596	65°35.203	18°07.857	65°35.043	0.56
E6	26-Sep-06	18°05.030	65°28.783	18°05.118	65°29.242	0.83
E7	27-Sep-06	18°11.350	65°25.772	18°11.404	65°25.750	0.11
E8	27-Sep-06	18°09.555	65°17.867	18°09.638	65°17.971	0.24
E9	27-Sep-06	18°09.193	65°19.826	18°08.991	65°19.783	0.38
E10	27-Sep-06	18°10.519	65°22.332	18°10.561	65°22.525	0.35
E11	27-Sep-06	18°10.064	65°24.132	18°10.072	65°24.625	0.87
E12	28-Sep-06	18°10.098	65°28.409	18°10.387	65°28.340	0.55
E13	28-Sep-06	18°13.743	65°30.724	18°13.742	65°31.001	0.49
S4	5-Oct-06	17°55.224	66°56.215	17°55.353	66°56.554	0.64
S5	5-Oct-06	17°55.762	66°57.019	17°55.646	66°57.428	0.75
S6	5-Oct-06	17°56.855	66°53.297	17°56.806	66°53.635	0.6
S7	6-Oct-06	17°55.343	66°13.063	17°55.122	66°13.101	0.42
S8	6-Oct-06	17°54.655	66°13.182	17°54.427	66°13.604	0.86
S9	6-Oct-06	17°55.058	66°13.400	17°55.109	66°13.890	0.87
S10	6-Oct-06	17°56.195	66°17.653	17°56.385	66°18.123	0.9
E14	10-Oct-06	18°20.924	65°32.405	18°20.937	65°32.606	0.35
E15	10-Oct-06	18°19.827	65°34.119	18°19.761	65°34.326	0.38
E16	10-Oct-06	18°21.909	65°35.873	18°21.998	65°35.703	0.34
E17	10-Oct-06	18°21.370	65°35.887	18°21.164	65°34.688	2.14
E18	11-Oct-06	18°16.379	65°28.266	18°16.346	65°28.520	0.5
E19	11-Oct-06	18°15.127	65°29.949	18°14.927	65°30.097	0.45
E20	11-Oct-06	18°14.824	65°31.248	18°15.096	65°31.284	0.51
E21	11-Oct-06	18°15.609	65°32.884	18°15.641	65°33.255	0.66
E22	12-Oct-06	18°20.713	65°30.396	18°20.744	65°30.405	0.06
E23	30-Oct-06	18°17.730	65°20.567	18°17.947	65°20.708	0.47
E24	30-Oct-06	18°19.077	65°20.624	18°19.364	65°20.809	0.62
E25	30-Oct-06	18°18.185	65°18.826	18°18.314	65°18.928	0.3
E26	31-Oct-06	18°15.020	65°17.090	18°15.088	65°17.140	0.15
E27	31-Oct-06	18°12.987	65°24.072	18°13.151	65°24.097	0.31

Station	Date	Starting coordinate		Ending coordinate		Distance
		North	West	North	West	km
E28	31-Oct-06	18°16.949	65°17.953	18°17.142	65°17.973	0.36
E29	1-Nov-06	18°13.318	65°19.996	18°13.295	65°20.094	0.18
E30	1-Nov-06	18°17.315	65°17.751	18°17.561	65°17.939	0.56
E31	1-Nov-06	18°17.498	65°15.982	18°17.720	65°15.920	0.43
E32	2-Nov-06	18°15.428	65°18.976	18°15.381	65°19.009	0.1
E33	2-Nov-06	18°19.936	65°15.073	18°19.971	65°15.495	0.74
E34	2-Nov-06	18°19.167	65°13.665	18°19.443	65°13.922	0.68
E35	13-Nov-06	18°05.207	65°34.838	18°05.177	65°34.917	0.15
E36	13-Nov-06	18°10.862	65°40.619	18°10.642	65°40.903	0.65
E37	13-Nov-06	18°11.647	65°39.465	18°11.660	65°39.465	0.02
E38	14-Nov-06	18°06.170	65°35.716	18°06.324	65°35.380	0.66
E39	14-Nov-06	18°12.860	65°35.511	18°13.105	65°35.489	0.46
E40	14-Nov-06	18°14.773	65°34.598	18°14.579	65°34.727	0.43
S11	17-Nov-06	17°54.793	66°22.593	17°54.597	66°22.805	0.77
S12	17-Nov-06	17°57.303	66°48.856	17°57.152	66°49.116	0.54
S13	17-Nov-06	17°58.235	66°47.298	17°57.995	66°47.476	0.54

Figure 2. Nautical chart with plots of the starting point of the queen conch survey transects

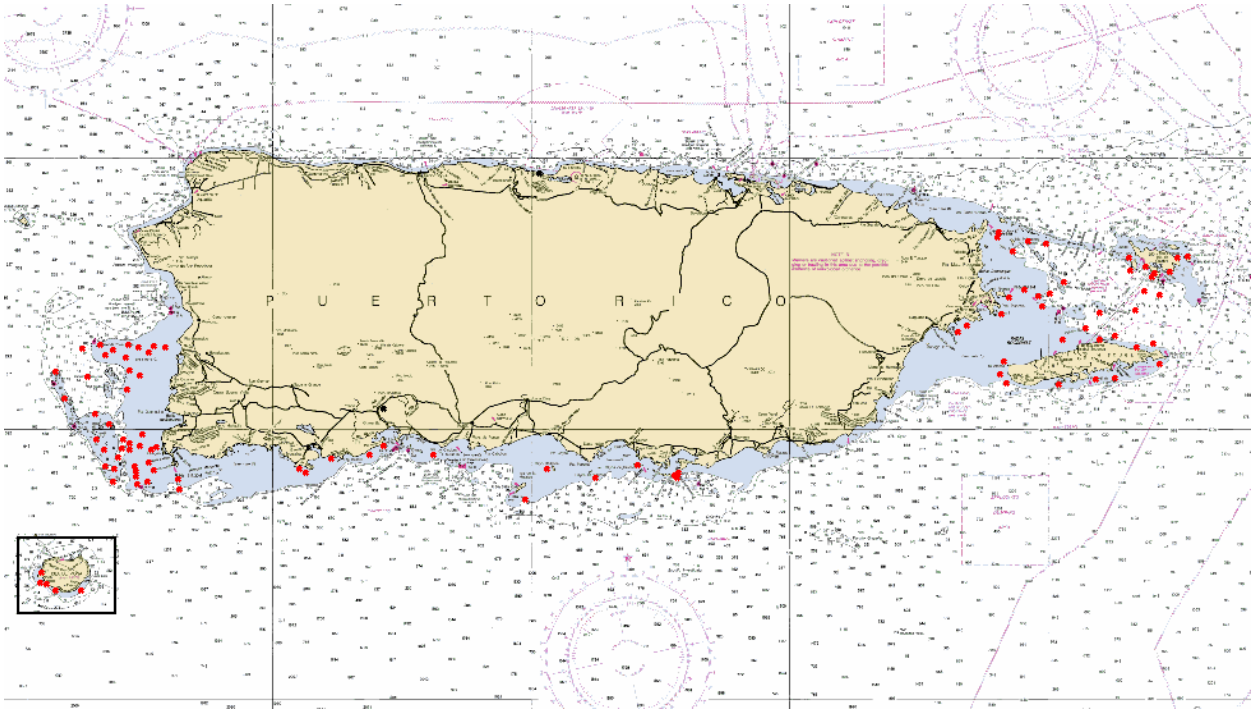


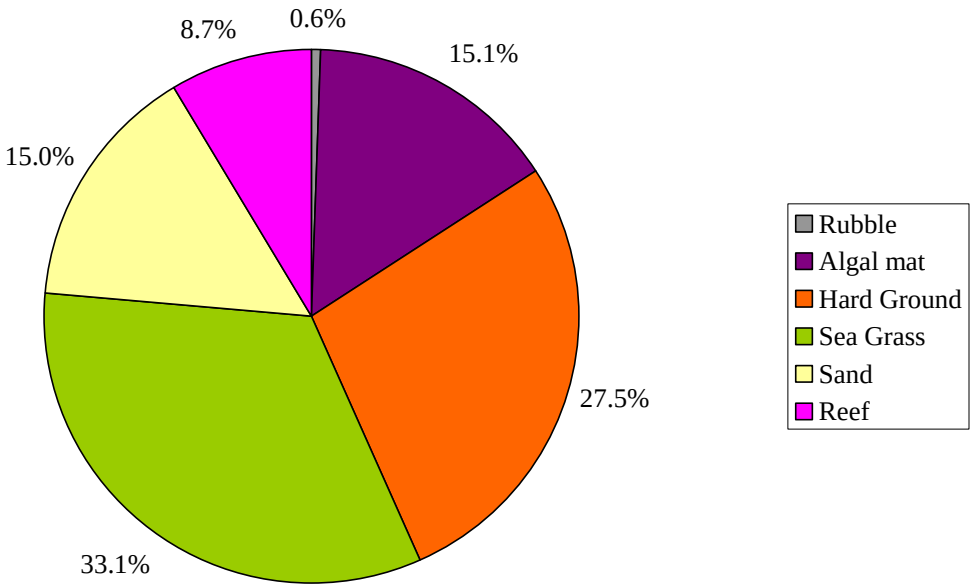
Table 3. Area, depth, number of conch observed and density for all stations. Station identification is related to the coastline (E- East, S- South, W- West). Conchs observed are classified according to sexual maturity (J- juvenile, NA- newly adult, A- Adult, O- Old, VO- very old)

Station	Area (m^2)	Depth (ft)	J	NA	A	O	VO	Density ind/ha	Station	Area (m^2)	Depth (ft)	J	NA	A	O	VO	Density ind/ha
E1	880	42	0	0	0	0	1	11.36	S10	3600	20	0	2	0	0	0	5.56
E1	880	40	1	1	1			34.09	S11	2080	60	0	0	0	0	0	0.00
E2	2040	25	3	0	0	0	7	49.02	S11	2080	61	0	0	0	0	0	0.00
E2	2040	27	0	0	0	0	5	24.51	S12	2160	20	0	0	0	0	0	0.00
E3	1040	70	2	0	2	0	0	38.46	S12	2160	20	0	0	0	0	0	0.00
E3	1040	73	0	0	0	0	0	0.00	S13	2160	8	0	0	0	0	0	0.00
E4	520	50	0	0	1	0	0	19.23	S13	2160	7	0	0	0	0	0	0.00
E4	520	48	0	1	0	0	0	19.23	W1	1640	27	0	0		1	1	12.20
E5	2240	21	2	1	5	2	0	44.64	W1	1640	27	0	0	0	0	0	0.00
E5	2240	20	4	8	2	2	0	71.43	W2	5720	25	2	0	1	0	0	5.24
E6	3320	35	3	3	4	0	0	30.12	W2	5720	25	0	0	0	0	0	0.00
E6	3320	35	3	0	2	5	0	30.12	W3	2240	82	0	0	0	0	0	0.00
E7	440	65	0	0	0	0	0	0.00	W3	2240	82	0	0	0	0	0	0.00
E7	440	68	0	0	0	0	0	0.00	W4	2440	55	22	0	0	0	0	90.16
E8	960	70	5	2	1	1	0	93.75	W4	2440	55	7	0	0	0	0	28.69
E8	960	70	1	0	0	0	0	10.42	W5	3360	45	3	0	1	1	1	17.86
E9	1520	40	0	0	0	0	0	0.00	W5	3360	45	3	0	1	0	0	11.90
E9	1520	42	0	0	0	0	0	0.00	W6	3220	60	7	1	1	1		31.06
E10	1400	72	4	0	0	1	1	42.86	W6	3220	60	6		5	1	1	40.37
E10	1400	75	1	0	1	0	0	14.29	W7	4080	40	0	0	0	1	0	2.45
E11	3480	48	1	0	0	0	0	2.87	W7	4080	41	0	0	0	1	0	2.45
E11	3480	50	0	0	0	0	0	0.00	W8	3440	25	1	0	0	1	1	8.72
E12	2200	40	15	13	3	0	1	145.45	W8	3440	24	1	0	0	1	0	5.81
E12	2200	40	9	0	16	0	1	118.18	W9	2560	60	1	0	0	0	0	3.91
E13	1960	50	0	2	1	0	1	20.41	W9	2560	60	0	0	0	0	0	0.00
E13	1960	50	0	0	0	0	2	10.20	W10	2160	48	1	0	2	2	2	32.41
E14	1400	70	21	0	0	3	0	171.43	W10	2160	48	1	0	0	2	0	13.89
E14	1400	70	20	0	0	2	0	157.14	W11	1400	55	0	0	0	0	0	0.00
E15	1520	67	0	0	0	0	0	0.00	W11	1400	55	0	0	0	0	0	0.00
E15	1520	68	0	0	0	0	0	0.00	W12	2760	42	2	0	2	2	1	25.36
E16	1360	50	0	0	2	0	0	14.71	W12	2760	42	2	0	0	1	0	10.87
E16	1360	51	0	0	4	0	0	29.41	W13	7880	60	0	0	2	1	0	3.81
E17	8560	42	0	0	0	0	0	0.00	W13	7880	58	0	0	1	0	0	1.27
E17	8560	42	0	0	0	0	0	0.00	W14	2920	37	4	0	0	0	0	13.70
E18	2000	80	0	0	1	0	0	5.00	W14	2920	40	13	1	0	3	0	58.22
E18	2000	80	0	0	0	0	0	0.00	W15	2960	45	1	0	0	1	0	6.76
E19	1800	83	0	0	0	0	0	0.00	W15	2960	49	1	0	0	1	0	6.76
E19	1800	84	0	0	0	0	0	0.00	W16	120	29	0	0	0	1	0	83.33
E20	2040	55	2	0	1	1	0	19.61	W16	120	27	2	0	0	0	0	166.67
E20	2040	55	3	0	1	2	0	29.41	W17	2240	70	0	1	0	1	1	13.39
E21	2640	50	2	0	1	0	0	11.36	W17	2240	71	0	0	0	1	0	4.46
E21	2640	50	2	0	0	0	0	7.58	W18	2040	45	4	7	1	2	2	78.43

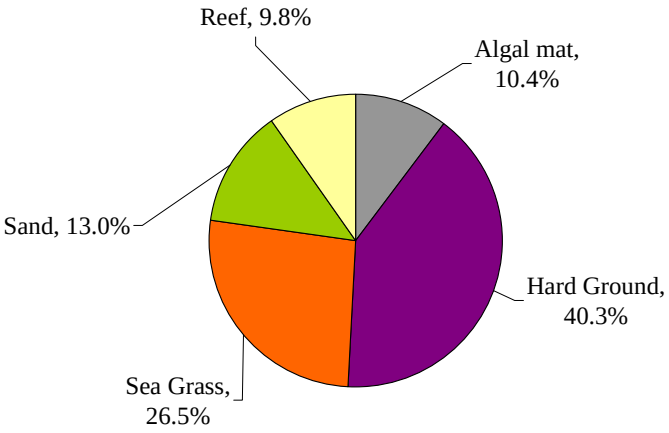
Station	Area (m^2)	Depth (ft)	J	NA	A	O	VO	Density ind/ha	Station	Area (m^2)	Depth (ft)	J	NA	A	O	VO	Density ind/ha
E22	240	89	0	0	0	0	15	625.00	W18	2040	45	3	7	3	0	0	63.73
E22	240	88	0	0	0	0	20	833.33	W19	3520	40	2	1	0	0	2	14.20
E23	1880	83	1	0	0	1	0	10.64	W19	3520	40	2	1	1	0	0	11.36
E23	1880	80	3	0	0	1	0	21.28	W20	4760	35	1	1	0	1		6.30
E24	2480	60	0	0	0	0	0	0.00	W20	4760	34	0	0	0	0	0	0.00
E24	2480	61	0	0	0	0	0	0.00	W21	1480	60	2	0	1	2	0	33.78
E25	1200	42	1	0	0	0	3	33.33	W21	1480	61	2	4	2	0	0	54.05
E25	1200	42	0	0	0	1	6	58.33	W22	3000	61	4	0	0	0	0	13.33
E26	600	81	2	0	0	0	6	133.33	W22	3000	65	68	1	0	0	0	230.00
E26	600	83	0	0	0	0	5	83.33	W23	2920	55	0	2	2	4	0	27.40
E27	1240	74	0	0	0	0	2	16.13	W23	2920	58	3	0	0	2	0	17.12
E27	1240	74	0	0	0	0	2	16.13	W24	2360	50	2	3	0	0	0	21.19
E28	1440	68	1	0	0	0	0	6.94	W24	2360	50	1	1	0	0	2	16.95
E28	1440	70	3	0	0	0	0	20.83	W25	1600	78	0	0	0	0	0	0.00
E29	720	83	1	0	0	0	3	55.56	W25	1600	73	1	0	0	1	0	12.50
E29	720	82	0	1	0	2	2	69.44	W26	840	8	0	0	0	0	0	0.00
E30	2240	20	0	0	0	0	0	0.00	W26	840	10	1	0	2	1	0	47.62
E30	2240	14	0	2	0	0	0	8.93	W27	1640	57	0	0	0	0	6	36.59
E31	1720	42	4	0	0	0	0	23.26	W27	1640	57	0	0	0	0	3	18.29
E31	1720	41	2	0	0	0	0	11.63	W28	2400	51	0	0	1	0	0	4.17
E32	400	95	0	0	0	0	0	0.00	W28	2400	50	0	0	0	1	3	16.67
E32	400	94	0	0	0	0	1	25.00	W29	2200	50	0	0	1	1	1	13.64
E33	2960	23	3	0	0	0	0	10.14	W29	2200	50	0	0	0	1	0	4.55
E33	2960	23	2	0	0	0	2	13.51	W30	1480	60	0	0	0	1	2	20.27
E34	2720	15	0	0	0	0	0	0.00	W30	1480	60	0	0	0	0	0	0.00
E34	2720	12	0	0	2	0	0	7.35	W31	1160	55	0	0	0	0	1	8.62
E35	600	62	0	0	0	0	0	0.00	W31	1160	55	0	0	0	0	2	17.24
E35	600	60	0	0	0	0	0	0.00	W32	5920	40	1	1	0	0	0	3.38
E36	2600	20	5	0	2	0	0	26.92	W32	5920	41	0	0	0	0	0	0.00
E36	2600	25	5	1	1	0	0	26.92	W33	2320	17	1	0	3	0	0	17.24
E37	80	16	1	0	0	0	0	125.00	W33	2320	17	1	0	0	1	0	8.62
E37	80	16	0	1	0	0	0	125.00	W34	1760	55	0	0	0	3	3	34.09
E38	2640	42	0	0	0	0	0	0.00	W34	1760	55	0	0	0	1	10	62.50
E38	2640	42	0	0	0	0	0	0.00	W35	3200	26	1	0	1	1	0	9.38
E39	1840	50	2	0	0	0	1	16.30	W35	3200	27	4	3	4	1	0	37.50
E39	1840	50	0	0	0	0	0	0.00	W36	1160	20	0	0	0	0	0	0.00
E40	1720	23	2	2	1	0	0	29.07	W36	1160	20	0	0	0	0	0	0.00
E40	1720	25	1	0	2	0	0	17.44	W37	3760	35	0	0	0	0	0	0.00
S1	2400	50	32	0	3	1	0	150.00	W37	3760	35	0	1	0	0	0	2.66
S1	2400	48	20	12	0	1	2	145.83	W38	2600	35	1	1	0	1	0	11.54
S2	2400	40	0	0	0	0	0	0.00	W38	2600	35	0	2	0	1	0	11.54
S2	2400	40	0	0	0	0	0	0.00	W39	3640	78	1	1	0	0	0	5.49
S3	3240	15	5	5	0	0	0	30.86	W39	3640	80	0	1	1	0	0	5.49
S3	3240	17	6	8	1	0	0	46.30	W40	2840	65	0	0	0	0	0	0.00
S4	2560	50	1	0	0	1	0	7.81	W40	2840	70	3	1	0	0	0	14.08
S4	2560	45	0	1	0	0	0	3.91	W41	2720	10	14	0	1	0	0	55.15
S5	3000	11	0	0	0	0	0	0.00	W41	2720	10	27	7	2	0	0	132.35

Station	Area (m^2)	Depth (ft)	J	NA	A	O	VO	Density ind/ha	Station	Area (m^2)	Depth (ft)	J	NA	A	O	VO	Density ind/ha
S5	3000	12	0	1	0	1	0	6.67	W42	1800	27	2	2	5	1	0	55.56
S6	2400	12	1	2	2	1	0	25.00	W42	1800	27	5	0	0	0	0	27.78
S6	2400	15	1	2	3	0	0	25.00	W43	3320	25	0	0	0	0	0	0.00
S7	1680	6	1	0	0	0	0	5.95	W43	3320	25	0	0	0	0	0	0.00
S7	1680	6	0	0	0	0	0	0.00	W44	1680	8	0	1	4	0	0	29.76
S8	3440	55	0	0	0	0	1	2.91	W44	1680	10	2	4	1	0	0	41.67
S8	3440	55	0	0	0	0	0	0.00	W45	3280	37	0	0	0	0	0	0.00
S9	3480	18	0	0	0	0	0	0.00	W45	3280	37	0	0	0	0	0	0.00
S9	3480	20	0	0	0	0	0	0.00	W46	3480	30	1	0	0	1	0	5.75
S10	3600	20	1	1	0	0	0	5.56	W46	3480	30	0	0	0	0	0	0.00
									Total	465720		451	128	118	81	135	

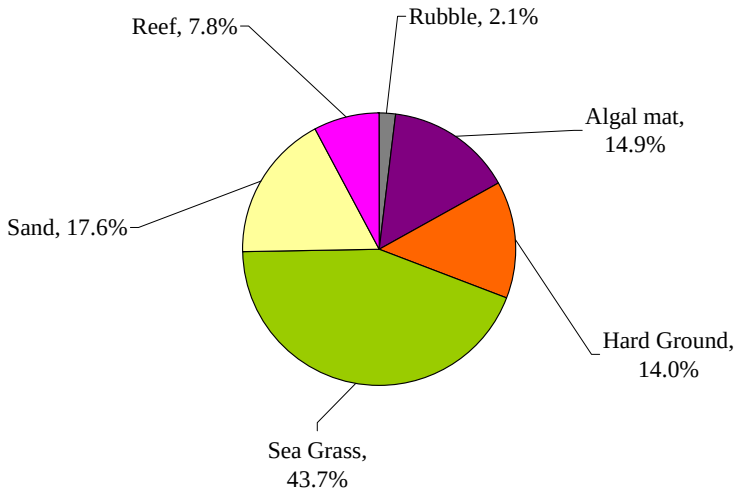
Figure 3. Percent habitat distribution of all sampled area during this survey



Habitat distribution on the West coast



Habitat distribution on the East coast



Habitat distribution on the South coast

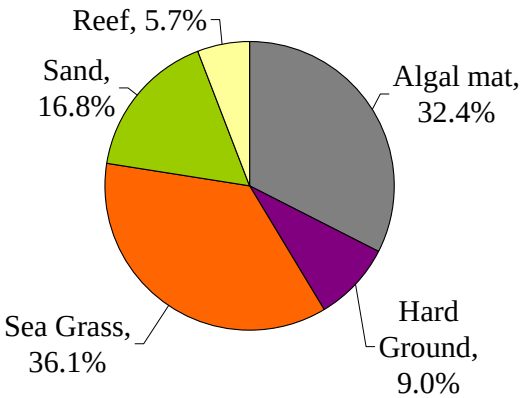


Table 4. Queen conch density (individuals/ha) per habitat type

Habitat type	Ind/ha						
	East		South	West			Island-wide
	2006	1996*	2006	2006	2001**	1996*	2006
Algae	29.66	1.09	34.27	18.68	2.05	6.07	27.00
Hard ground	23.09	n/a	1.63	19.09	3.16	n/a	19.00
Sea Grass	28.95	14.78	15.38	21.12	23.30	12.96	23.00
Sand	12.14	4.49	1.75	12.84	3.20	2.36	11.00
Reef	0.89	5.01	5.11	7.69	0.33	1.50	5.50
Rubble	73.83	0.00	n/a	n/a	n/a	11.16	73.80

* Appeldoorn, 1996.
** Appeldoorn, 2002.

Figure 4. Age class distribution found during 2006 survey

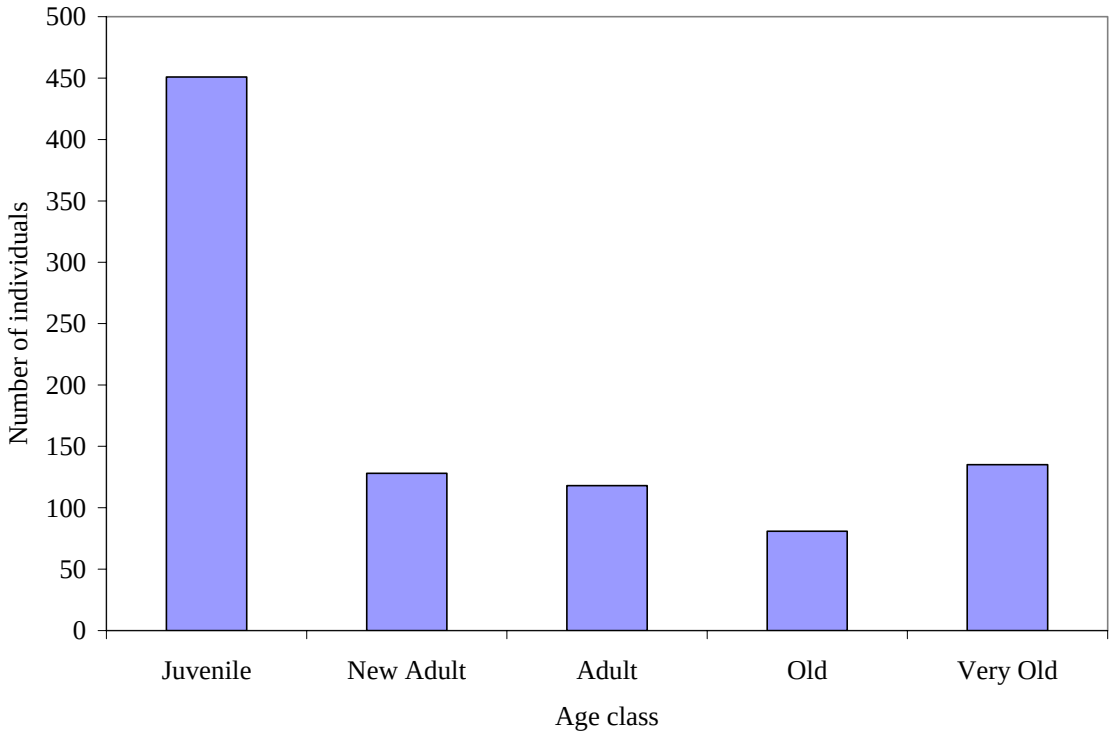


Figure 5. Adult size frequency distribution

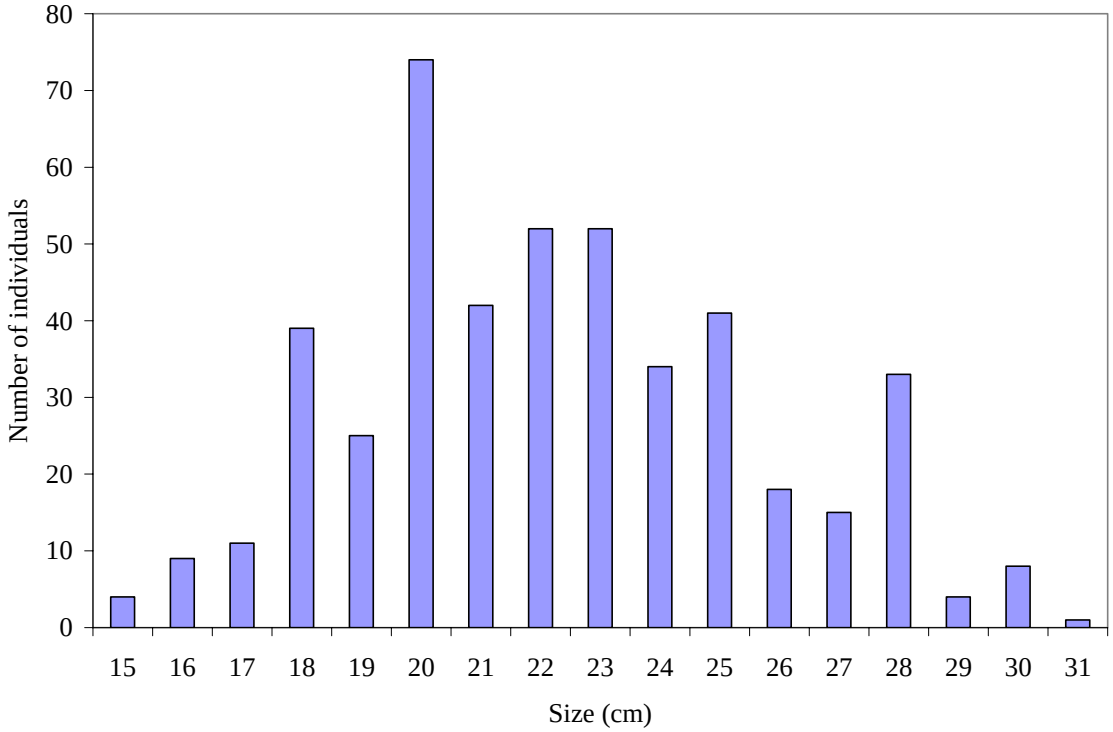
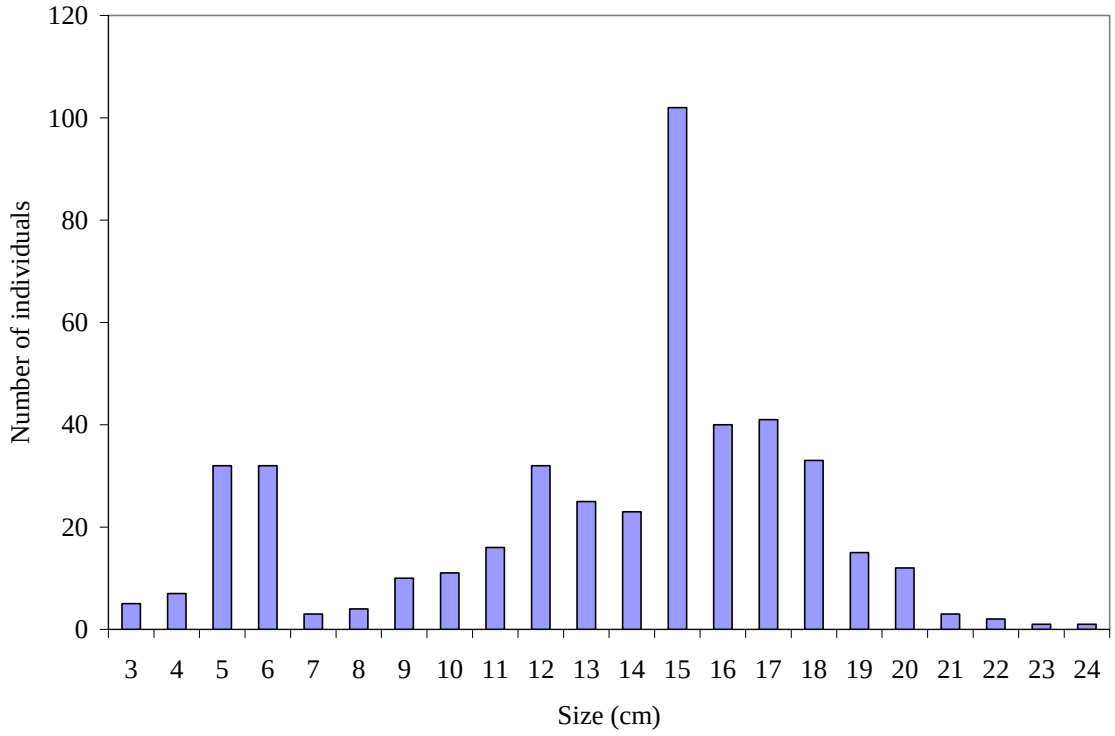
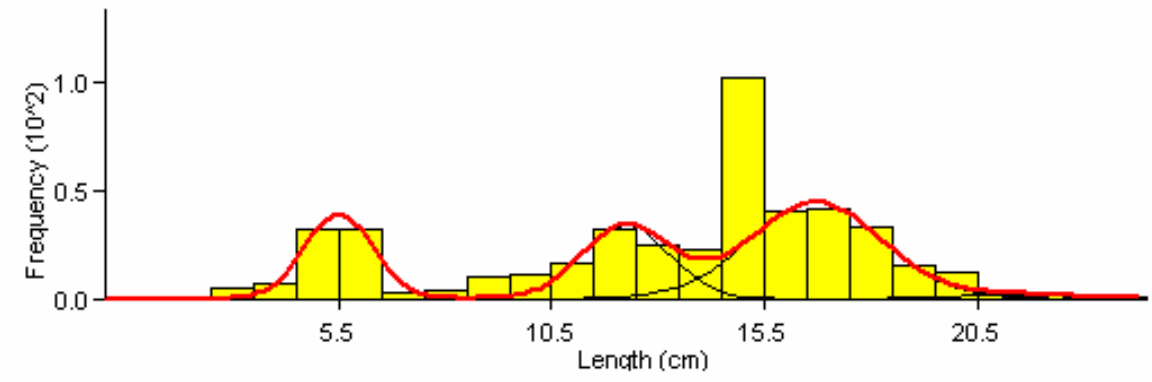


Figure 6. Juvenile size frequency distribution



Overall Age class analysis using Bhattacharya's method of the FISAT II program



Average	Standard deviation	Population
5.50	0.810	79.00
12.24	1.030	87.00
16.70	1.570	175.00
21.48	1.280	6.00

Table 5. Queen conch data summary of surveys undertaken during 1996, 2001 and 2006
W= West E= East S=South

	1996W	1996E	2001	2006	2006W	2006E	2006S
Area Surveyed (ha)	47.48	17.95	23.58	46.57	25.2	14.53	6.84
Densities							
juvenile density	6.24	7.10	10.14	9.7	9.52	9.84	9.94
adult density	2.24	4.62	4.29	9.92	8.13	14.18	7.46
lower density range	1.2	1.6	1.69	1.3	1.3	2.9	2.9
highest density range	37.5	60.35	509.27	833.3	230	833.3	150
overall mean density	5.68	11.72	14.42	31.6	24	17.7	17.4
median density of all stations			2.15	11.4	11.5	16.1	1.5
median density of stations with conch			5.68	19.2	25	14.2	7.8
Population							
Juveniles found overall	68.40%	60.61%	59.70%	49.40%	53.93%	40.97%	57.14%
Queen conch found in *Thalassia*	47%	60%	67.80%	40%	31.69%	52.72%	31.93%
smaller juvenile	10 cm	10 cm	7cm	3 cm	3 cm	5 cm	9 cm
largest juvenile	22 cm	23 cm	22cm	24 cm	22 cm	24 cm	23 cm
Portion of adults that were old	36.99%	7.69%	16.70%	17.53%	25.37%	11.65%	4.20%
very old	0.00%	0.00%	3.30%	29.22%	21.95%	42.23%	5.88%

Figure 7. Age class distribution according to habitat

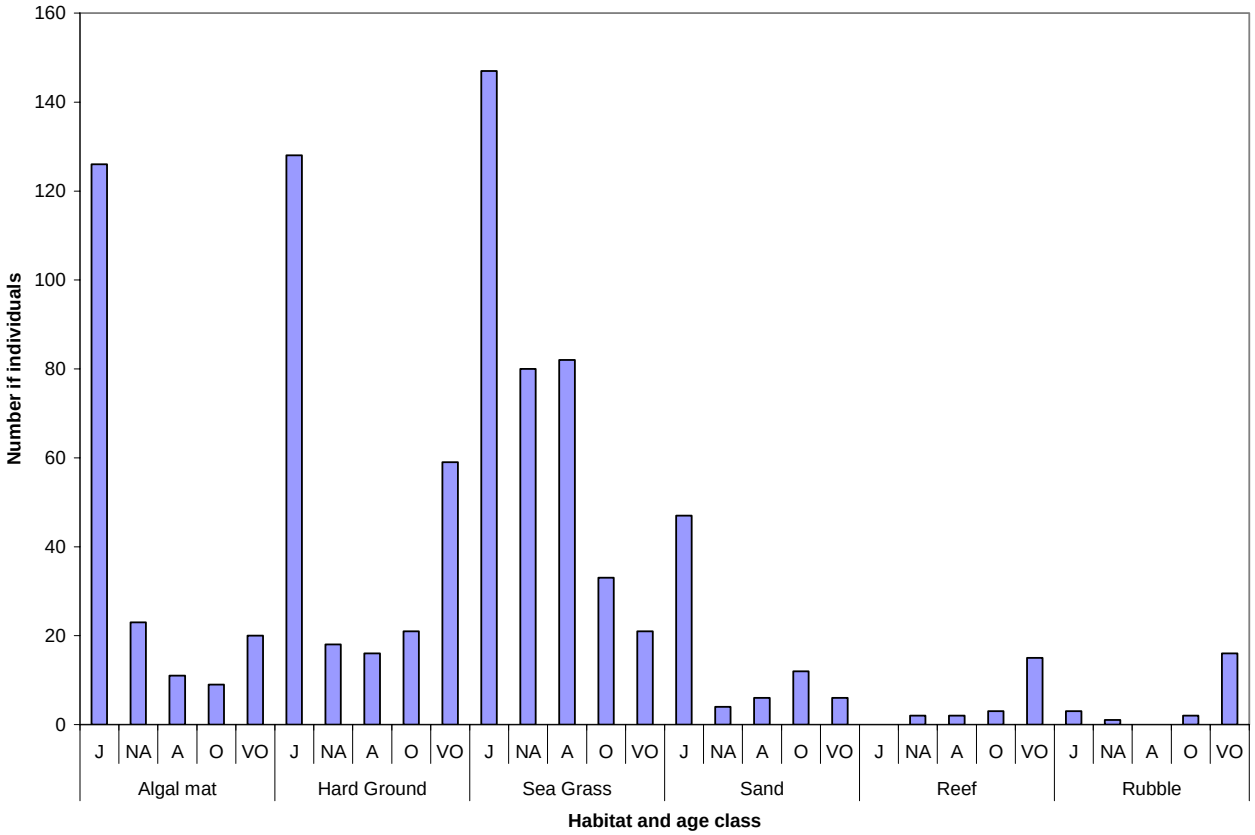
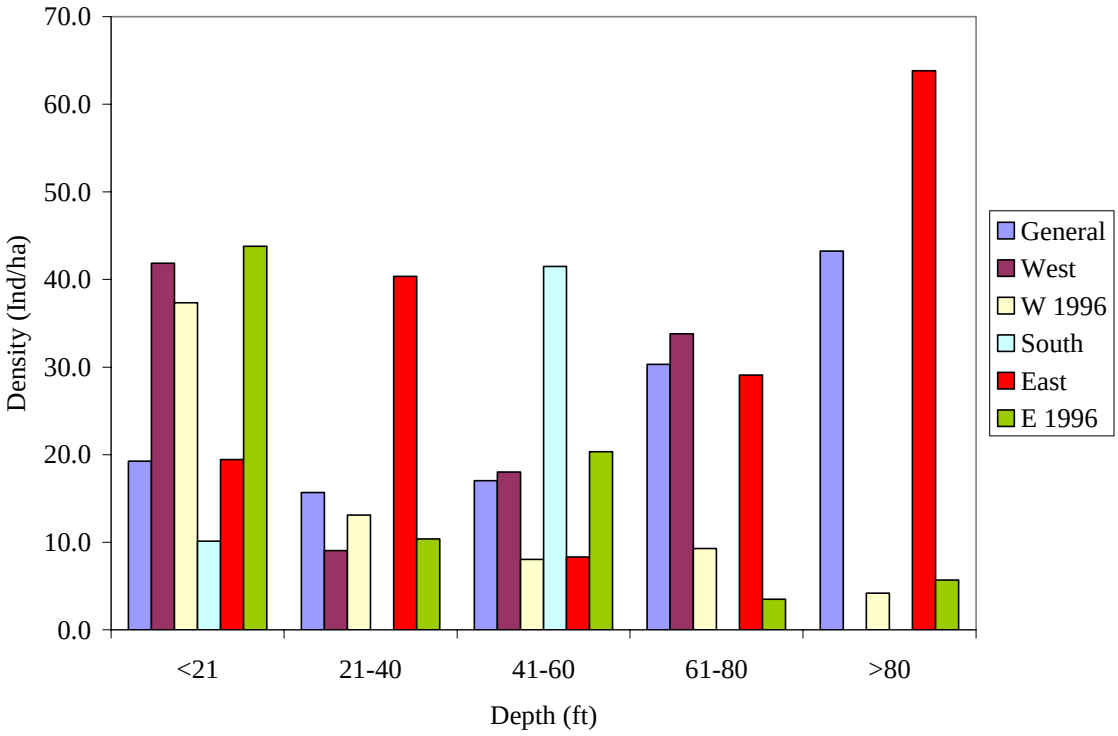

160
140
120
100
80
60
40
20
0
Number if individuals
J NA A O VO J NA A O VO J NA A O VO J NA A O VO J NA A O VO J NA A O VO
Algal mat
Hard Ground
Sea Grass
Sand
Reef
Rubble
Habitat and age class

Figure 8. Density of conch per depth range



	General	West		South	East	
Depth	2006	2006	1996	2006	2006	1996**
<21	19.3	41.9	37.3	10.1	19.4	43.8
21-40	15.7	9.1	13.1	0	40.4	10.4
41-60	17	18	8.1	41.5	8.3	20.3
61-80	30.3	33.8	9.3	0	29.1	3.5
>80	43.2	0	4.2	n/a	63.8	5.7

**The calculations of density correspond to a different depth range. Range is off from the one used by 10 feet.

Figure 9. Total Queen conch landing reports from 1983 to 2005 including the correction factor

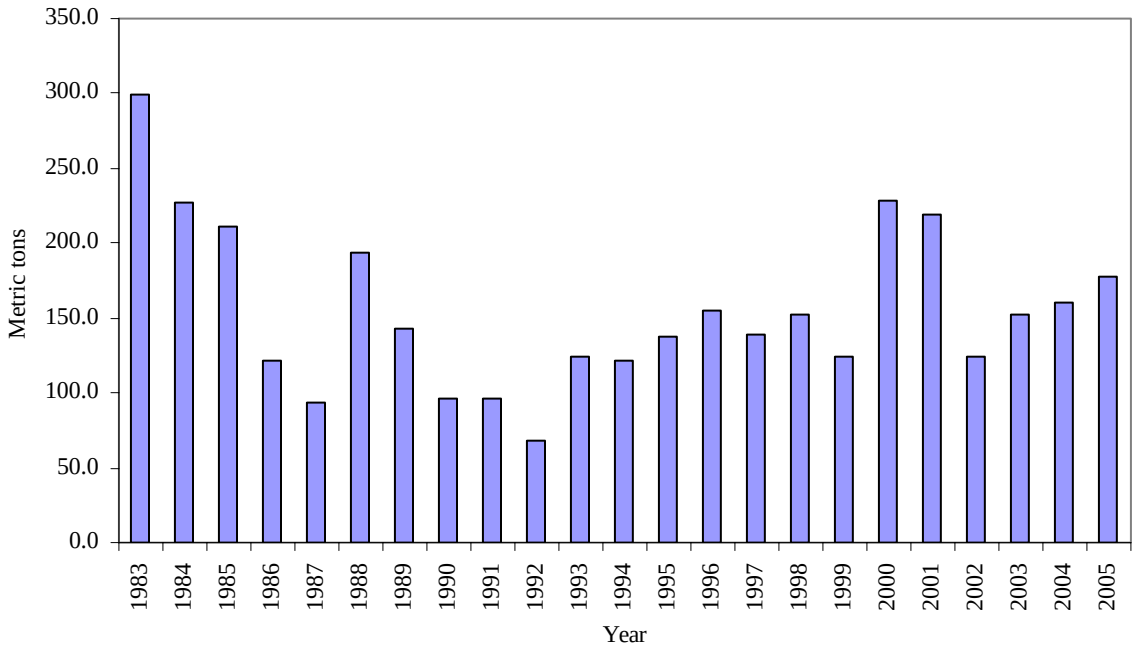
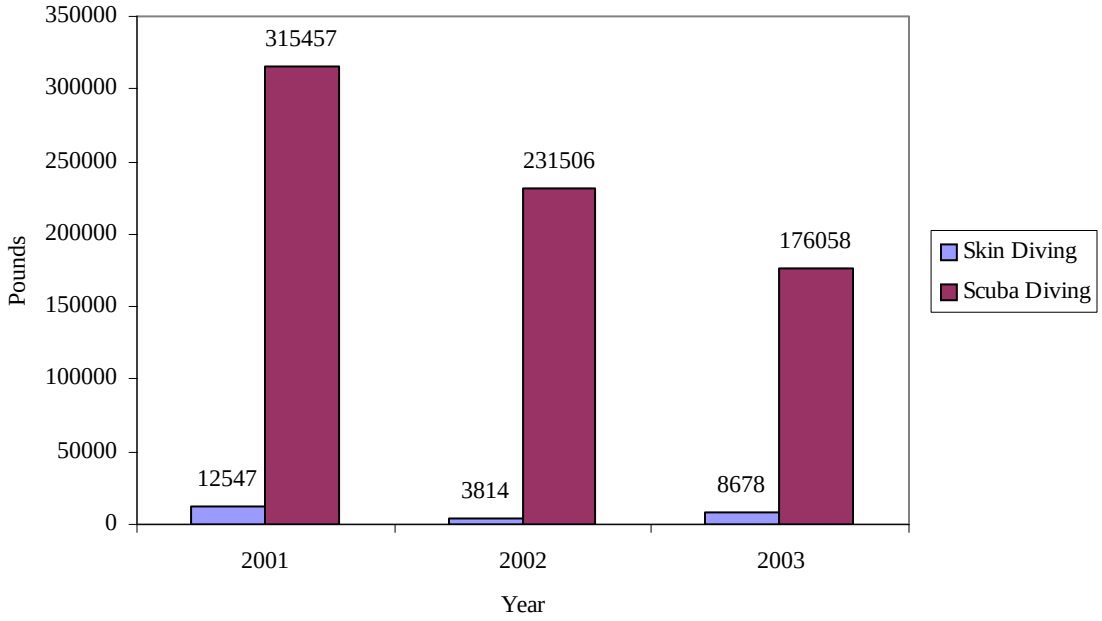


Figure 10. Queen conch landing reports from 2001-2003



Discussion

We are confident that most Queen conch fishers were interviewed for which the data obtained was considered representative for the Puerto Rico Queen conch fisheries. There has been a decrease in number of conch fishers from 1995, when there were at least 166 conch fishers (number of interviews in Rosario, 1995), to 2006. A possible explanation for the decrease is the resource status, since all of them are now more generalists. In 1995 there were 18 (11%) fishers that fished exclusively Queen conch whereas now there are none. The data also shows that they are using a greater variety of fishing gear. In 1995 they only report speargun whereas now they use fish traps, seine net and hook and line. In addition to that the number of trips per week has increase from 3.7 to 4.9 as well as the number of tank per trip from 3.4 to 4.9.

The lobster as main target species of the conch fishers is a similar result with what was found in 1995. Notwithstanding, there are some variations on target species from 1995 to 2006. The trunkfish has more fishing pressure than the snapper, and the octopus was only reported by two of the fishers. The hogfish and the groupers are still among the main targets, although maybe now they are under higher fishing pressure, as they are reported by a higher percentage of the interviewed fishers.

It was interesting that 14 (33%) of the fishers mentioned that they select possible fishing areas by depth. When compare the past fishing grounds with present ones, there has been a general shift towards the deeper areas island-wide. This is a classic result of overexploitation of the resource, where adults are found in deeper waters.

Overall landing data (Figure 9) seem to be stable, if the correction factor for fish landings is included. This correction factor is performed for fish, not queen conch, for which its used on this kind of analysis might not be appropriate. Raw data for landings from 2001-2003 indicates a decline (Figure 10), but there are many factors that could influence this. Unfortunately data on effort for the landings is not been collected. This information is critical in order to conduct a more thorough analysis of the fisheries status.

The density of queen conch increased in most of the habitat types. Rubble, a particular habitat found mainly on the east coast, had the highest density. This habitat was found at depth greater than 70 feet and in the survey composes only 0.6% of the habitat surveyed. Although seagrass was in general the area were most of the queen conchs were observed, densities were higher in algal mats.

As in other surveys, most of the individuals found were juveniles. Contrary to other surveys, the amount of very old conchs was similar to the amount of other adult stages found. The east coast had the greater percentage of adult conchs that were very old, but the ratio with adult conchs was less than in the other coastlines. Since the rubble habitat was found only in the Vieques Passage in deep areas, the data could be reflecting the presence of an old conch population hard to reach by fishermen because of the depth and water conditions in this area.

Juveniles were observed mainly at algal mats, hard ground and segrasses. Seagrasses have a greater diversity of age classes. Algal mats and hard ground showed a greater number of juveniles than in previous studies. This might be a result of an improvement in population status, and the resource extending the habitat range.

In terms of depth, previous studies found a greater density in shallow waters. On the contrary, this study found a greater density at deep depth. This might be the reason for which the fishermen are looking for the resource at greater depth.

In conclusion, the population seems to be improving, which might be a result of the management measurements taken. Notwithstanding, there is needed information that is crucial to analyze more thoroughly the fisheries status. I urge to the inclusion of this data when collecting the fisheries statistics.

References:

Appeldoorn, R.S. 1996. Underwater survey of the queen conch resources in Puerto Rico. Final Report: NMFS\SEAMAP Program. 1-30 pp.

Appeldoorn, R.S. 2002. Underwater survey of the queen conch resources in Puerto Rico. Final Report: NMFS\SEAMAP Program, Reg. No. 4-9-01. 21 pp.

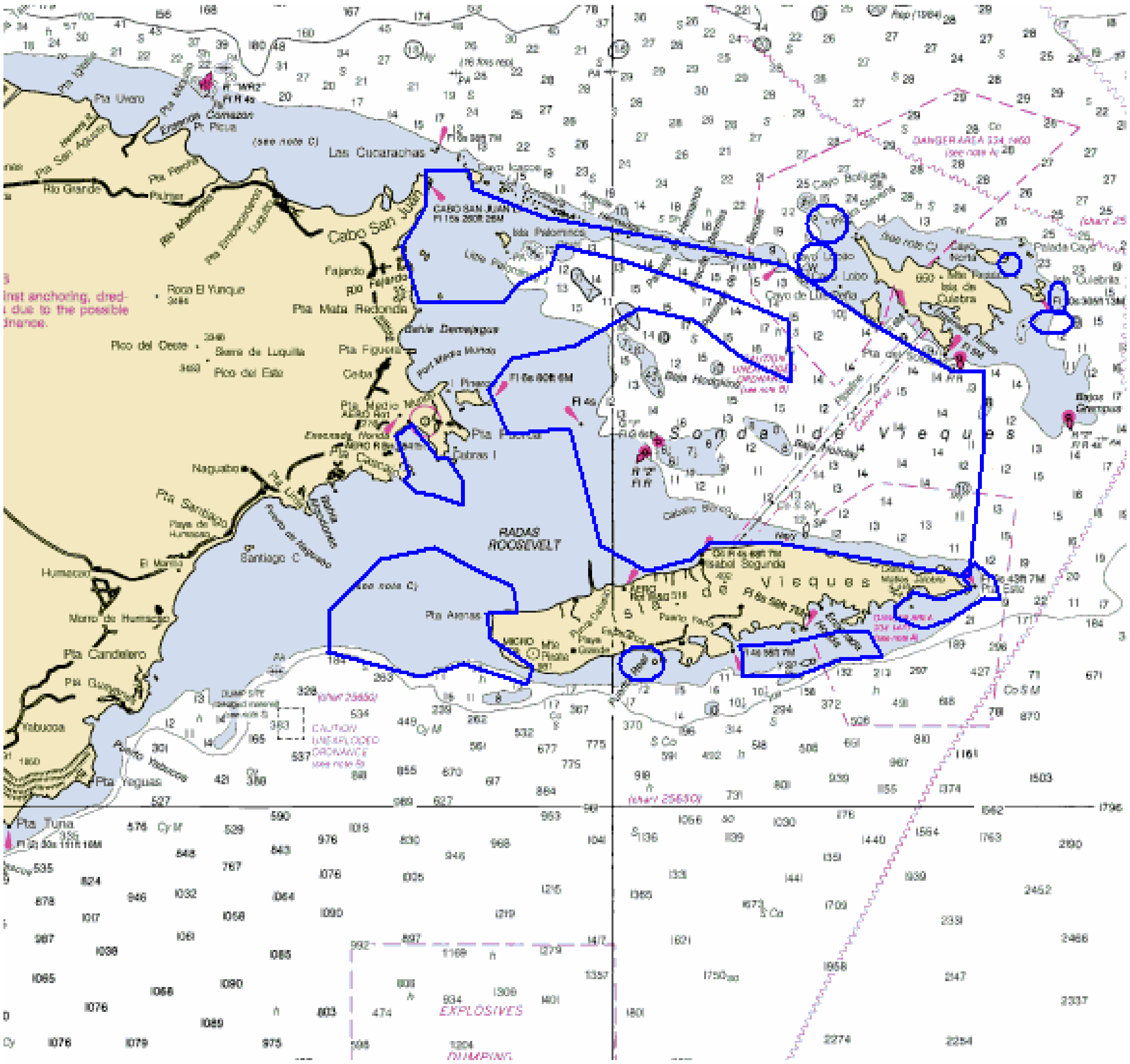
Appeldoorn, R.S. 1994. Queen conch management and research: Status, needs and priorities. In Queen Conch Biology, Fisheries and Mariculture. 301-320 p.

Caribbean Fishery Management Council. 1996. Fishery Management Plan, Regulatory Impact Review, and Final Environmental Impact Statement for the Queen Conch Resources of Puerto Rico and the United States Virgin Islands. 78 pp.

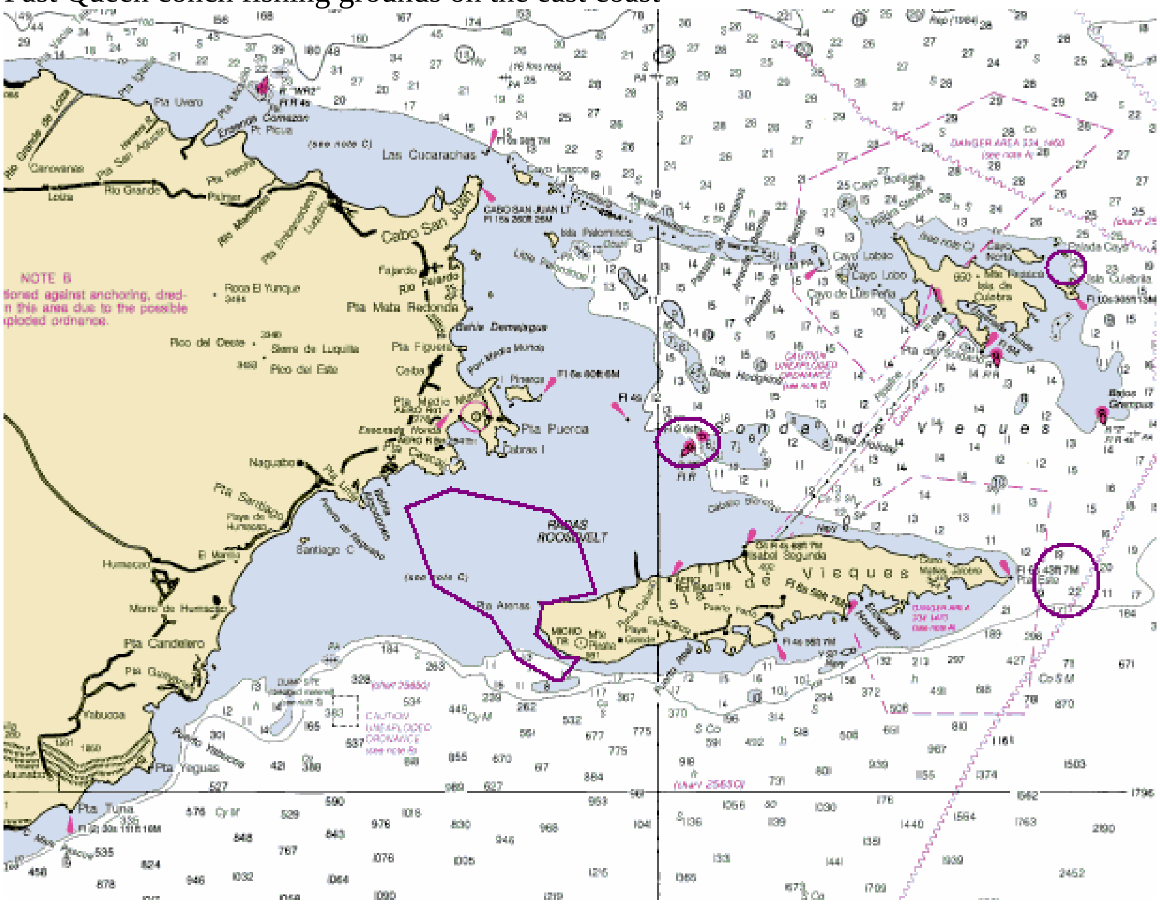
Caribbean Fishery Management Council and National Marine Fisheries Service. 2005. Comprehensive Amendment to the Fishery Management Plans (FMPs) of the U.S. Caribbean to Address Required Provisions of the Magnuson-Stevens Fishery Conservation and Management Act: Amendment 2 to the FMP for the Spiny Lobster Fishery of Puerto Rico and the U.S. Virgin Islands • Amendment 1 to FMP for the Queen Conch Resources of Puerto Rico and the U.S. Virgin Islands • Amendment 3 to the FMP for the Reef Fish Fishery of Puerto Rico and the U.S. Virgin Islands • Amendment 2 to the FMP for the Corals and Reef Associated Invertebrates of Puerto Rico and the U.S. Virgin Islands Including Supplemental Environmental Impact Statement, Regulatory Impact Review , and Regulatory Flexibility Act Analysis. 500 pp.

Rosario, A. 1995. Queen conch stratification survey. Report to Caribbean Fishery Management Council NOAA/ NMFS- SEAMAP- Caribbean Program. 1-45pp.

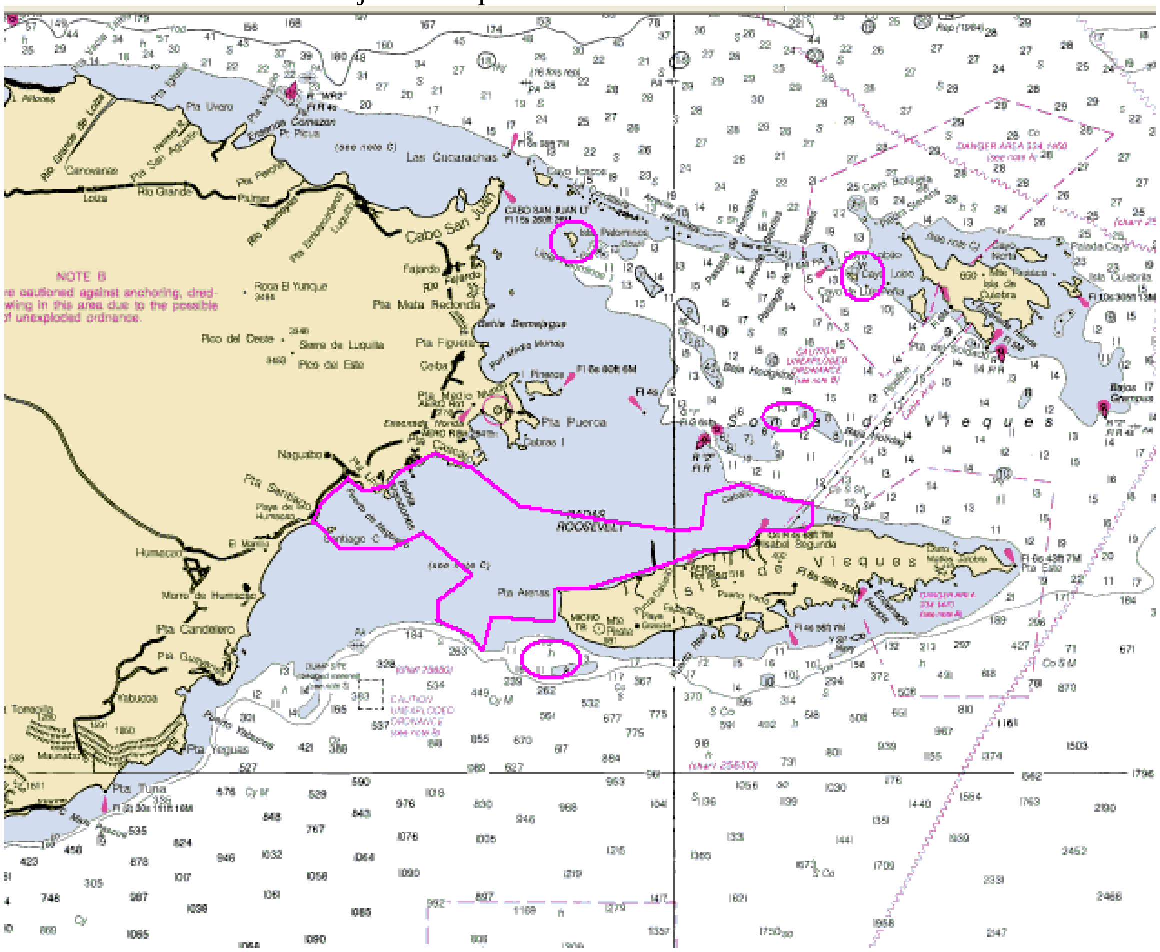
Appendix I
Queen conch fishing areas on the east coast



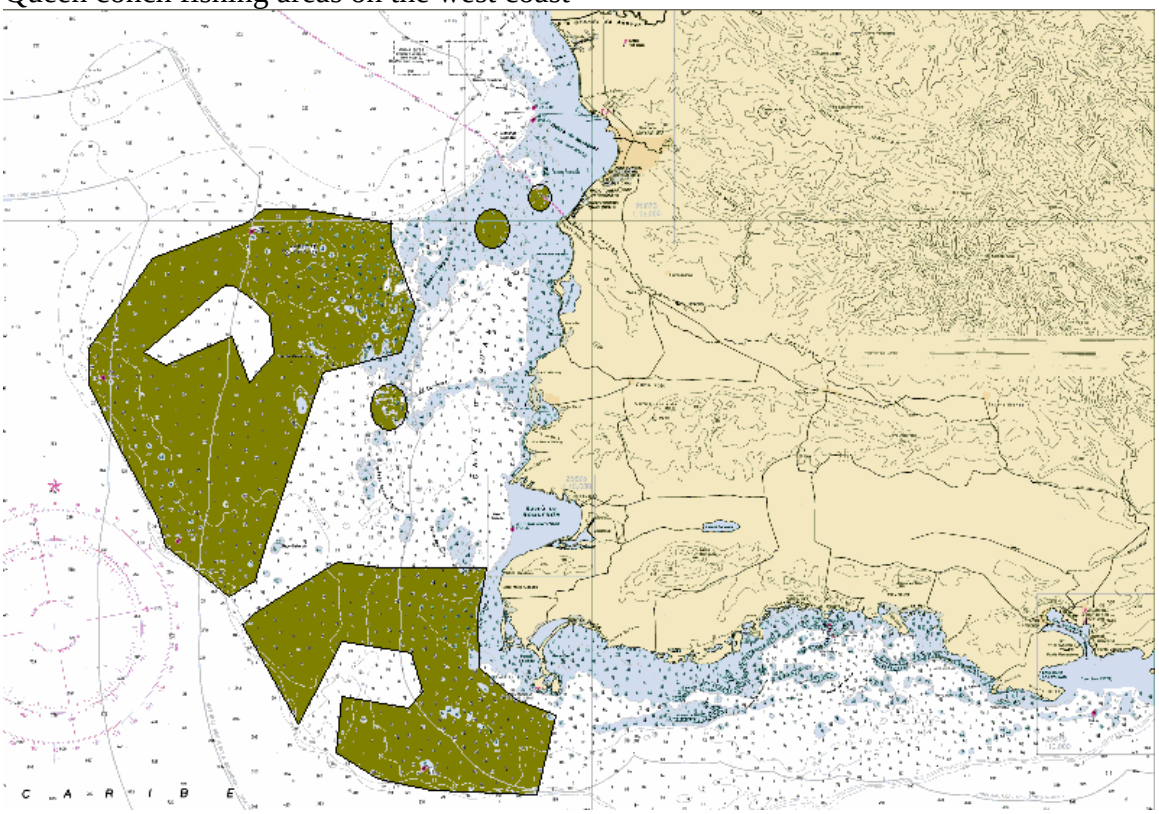
Past Queen conch fishing grounds on the east coast



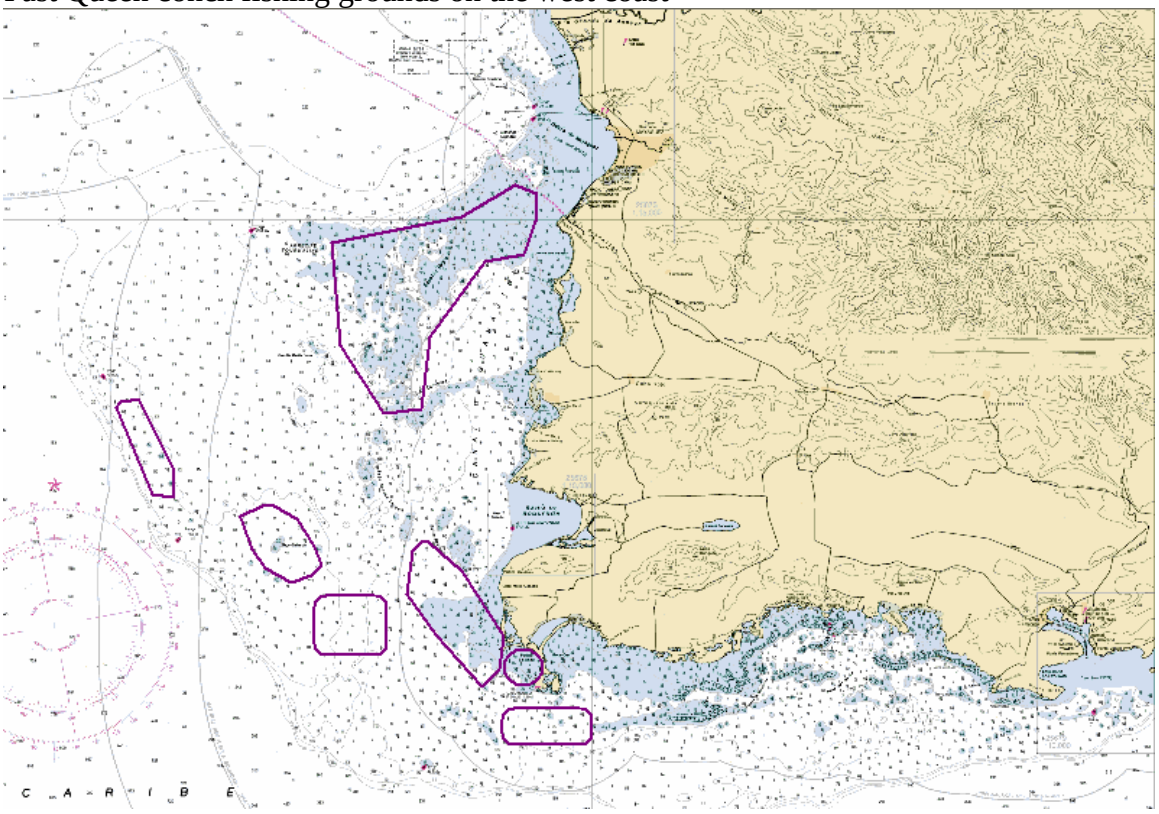
Areas were fishers observe juvenile queen conch on the east



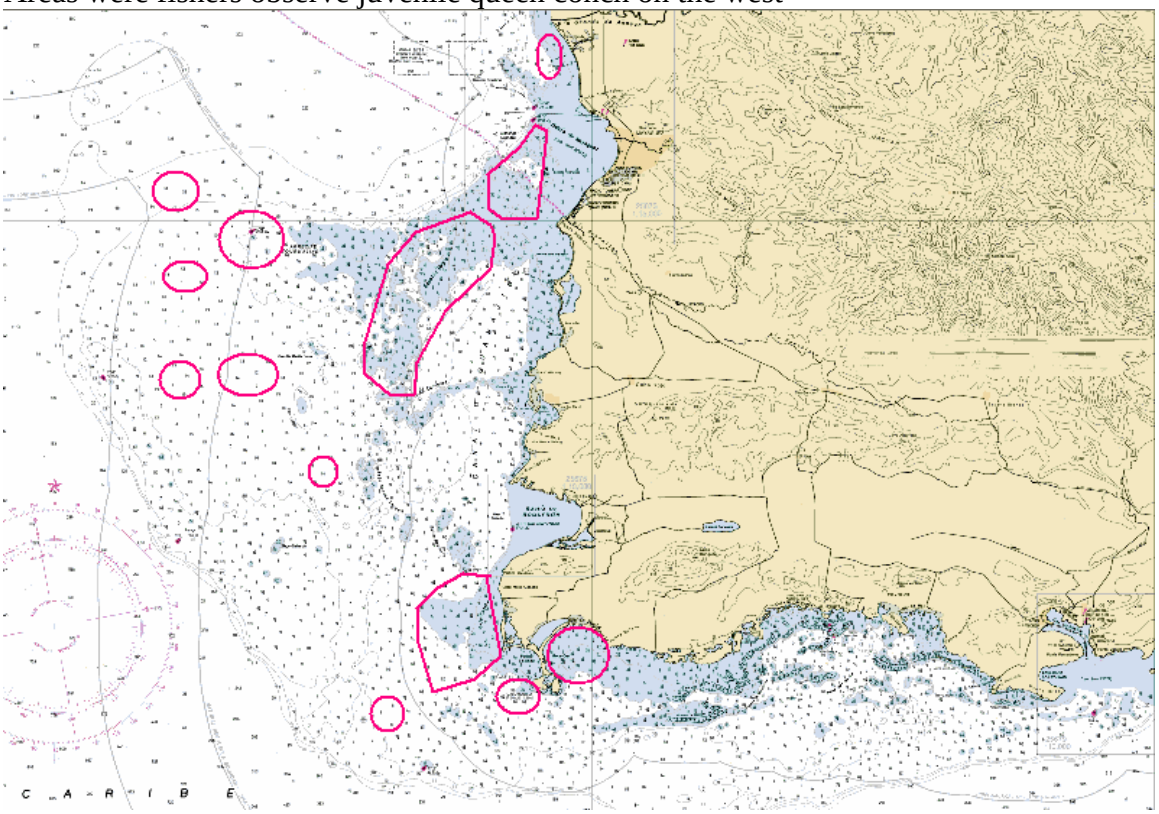
Queen conch fishing areas on the west coast



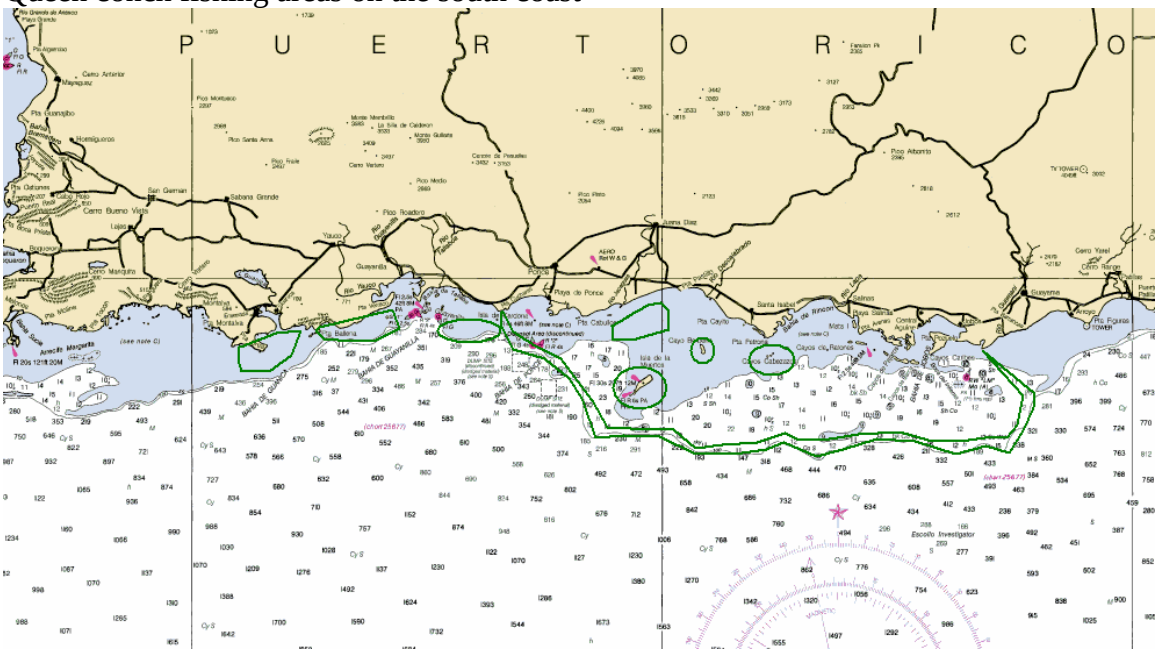
Past Queen conch fishing grounds on the west coast



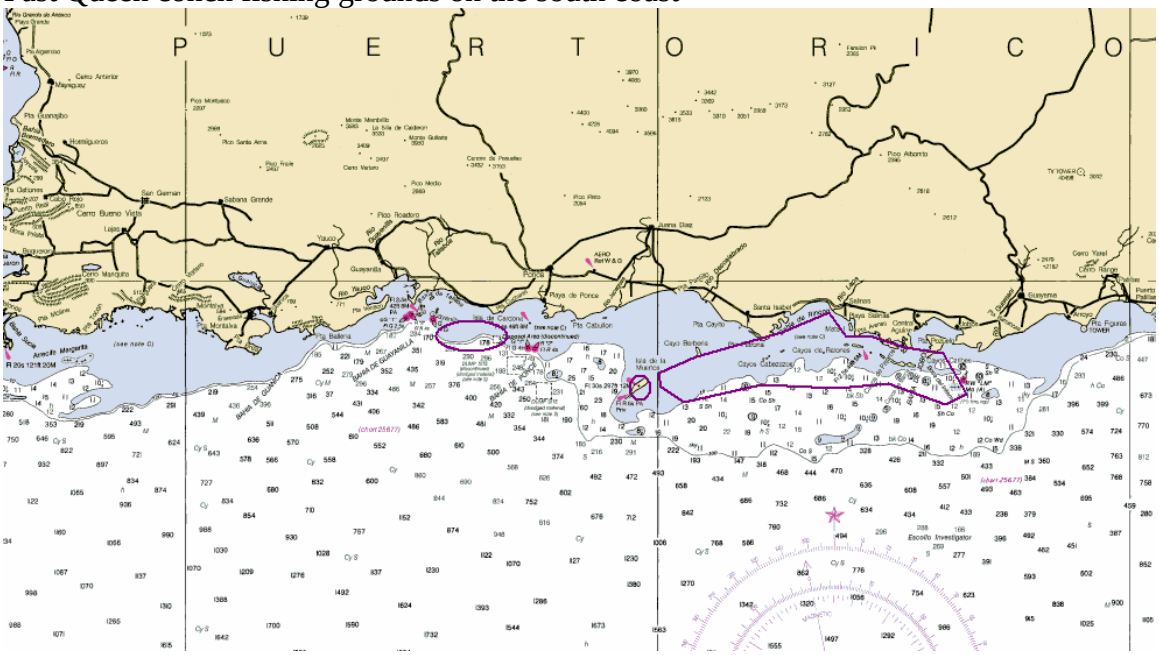
Areas were fishers observe juvenile queen conch on the west



Queen conch fishing areas on the south coast



Past Queen conch fishing grounds on the south coast



Areas were fishers observe juvenile queen conch on the south