

Economic Considerations to the Management of Queen Conch Resources in Puerto Rico

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ABSTRACT

The economic value of the queen conch (*Strombus gigas*) resource in Puerto Rico has declined in recent years. It is assumed that the lower harvest rates and resulting decrease in harvested value are caused by excessive fishing mortality and habitat degradation. Several management measures currently being considered by the Caribbean Fishery Management Council have the potential to lessen mortality and to restore the resource to previous levels, and thus generate increased economic returns for fishermen.

The data needed to efficiently monitor the recovery of the queen conch resource are reviewed and the need for strict enforcement of management measures is stressed.

INTRODUCTION

Queen conch (*Strombus gigas*) have long been considered an easily harvested resource, with many older fishermen recollecting that they could once harvest conch in the U. S. Caribbean directly from the shoreline (Joe LaPlace, personal communication). The situation has changed greatly in recent times. Queen conch landings from Puerto Rico have dropped profoundly, and this fishery is now considered to be overfished (CFMC 1989). Whether this situation is due to excessive fishing mortality, habitat loss, poor recruitment, or a combination of these conditions is not certain. However, the resulting losses have led to increasing imports of queen conch meat and declining trade balances to compensate for the imports.

This paper examines the economic trends in the fishery, reviews currently proposed management measures and assesses economic benefits of different management plans. The paper also makes recommendations for both improved data collection methods to yield more precise estimates of the condition of the fishery and the need for strict enforcement of management measures.

METHODS

The National Marine Fisheries Service (NMFS) funds two data collection programs for commercial fisheries in Puerto Rico. In the Trip Interview Program, port agents intercept fishermen and collect biostatistical information specific to the trip from which the fish were harvested. This information includes species composition, lengths, weights, effort, gear, etc.; however, biostatistical information is not collected for queen conch. The preferred method of harvest is for divers to sever the queen conch's abductor muscle and leave the shell on the ocean bottom, returning to their boats with only the meat. Meat weight provides imprecise estimates of shell length and lip flair, both of which are used to estimate sexual maturity and are the primary biostatistical data collected (Appeldoorn, 1991).

The second data collection program is referred to as the General Canvas Survey, in which Puerto Rican fishermen prepare voluntary trip tickets with species harvested, weight, expected price per pound, gear, and other information. In ideal circumstances, only one trip would be summarized by each individual trip ticket, thus giving an index of harvest on a per trip basis. The voluntary trip tickets are collected at various fishing centers and establishments by port agents for entry into a computerized data base. As the data collection system is voluntary, the percentage of actual harvest reflected in trip tickets is unknown.

Although the recreational harvest of queen conch is thought to be substantial and involves a growing segment of recreational scuba divers, there is no current collection of marine recreational fishing data in Puerto Rico (Appeldoorn, personal communication), nor are there historical data for recreational queen conch harvest.

For this study, annual landings data from 1977 through 1991 were examined from the general canvas data base. Detailed queen conch trip ticket information was available only from 1983 through 1991. Examination of the queen conch data showed that the majority of trip tickets summarized many trips in all years except for 1987, and thus reduced the possibility of the ticket to provide information for a specific trip. All trip tickets for 1987 equaled zero trips and dropping all the trips not equal to one in other years would eliminate all 1987 data. As Kruskal Wallis tests indicated significant differences ($p > 0.05$) for harvest weights for different numbers of trips per trip ticket in a given year, the data were not pooled as a single trip. It was thus decided to evaluate the data on a per trip ticket basis, rather than on a per trip basis, and to use this as an index of the catch per unit of effort and the value generated. Table 1 shows the mean, minimum, and maximum number of trips per ticket for each year considered in this paper.

Value was calculated by multiplying the reported weight of queen conch per trip ticket by the price per pound reported by the fishermen on the trip ticket.

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Table 1. The number of reported voluntary trip tickets with respective mean, minimum, and maximum numbers of trips for queen conch (*Strombus gigas*) for Puerto Rico. Source: Fisheries Research Laboratory, Puerto Rico.

Year	Number of Trips per Trip Ticket	Mean Number Number of Trips per	Minimum Number of Trips per	Maximum Number of Trips per Trip Ticket	Reported of Trip Tickets Trip Ticket
1983	1583	3.7	0	68	
1984	1439	5.4	0	25	
1985	1149	5.2	0	29	
1986	1524	1.0	0	24	
1987	1561	0.0	0	0	
1988	2680	1.3	0	99	
1989	1711	1.6	0	92	
1990	1250	1.2	0	24	
1991	1504	1.5	0	26	
Average	1543.5				
Standard Deviation	55.9				

Adjusted value is the value after inflation, using 1982 as the base year from the Producers Price Index.

ANALYSIS OF AVAILABLE DATA

Given the lack of precision found in the 1983 through 1985 trip tickets, the data must be inspected with care, so as not to infer changes in the condition of the fishery based only on data artifacts rather than on actual changes in biomass harvested, fishing effort, and value. Although examination of the data from 1983 through 1986 shows higher levels of harvest per trip ticket than in subsequent years, the number of trip tickets submitted each year remain fairly constant (mean = 1,543.5; standard deviation = 55.9), and are thought to represent a usable baseline for comparison of trends in the fishery.

Table 2 shows reported landings, adjusted value, pounds per trip ticket and other trends. Pounds harvested decreased from a high of 615,000 pounds in 1982 to a low of 84,303 pounds in 1991, a decrease of 86.3%. The adjusted value, which is the value adjusted for inflation, decreased from a high of \$512,615 in 1982 to a low of \$143,636 in 1991, a decrease of 71.9%. Pounds per trip ticket declined from 284.3 pounds in 1985 to 56.1 pounds in 1991, a decrease of 80.3%.

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Table 2. Annual reported landings in pounds, value (\$ US), adjusted value (1982 = \$100 US), Number of returned voluntary trip tickets, and pounds harvested per trip ticket for queen conch (*Strombus gigas*) in Puerto Rico. n/a = not available. Source: Fisheries Research Laboratory, Puerto Rico.

Year	Pounds Harvested	Value	Adjusted Value	Number of Trip Tickets	Pounds per Trip ticket
1977	251,000	194,000	298,760	n/a	n/a
1978	356,000	309,000	441,870	n/a	n/a
1979	431,000	n/a	n/a	n/a	n/a
1980	469,000	n/a	n/a	n/a	n/a
1981	491,000	n/a	n/a	n/a	n/a
1982	615,000	n/a	n/a	n/a	n/a
1983	402,510	519,279	512,615	1583	254.3
1984	357,790	475,522	458,555	1439	248.6
1985	324,005	463,753	449,373	1149	282.0
1986	184,850	284,000	283,433	1524	121.3
1987	141,958	234,181	227,802	1561	90.9
1988	238,676	424,371	396,980	2680	89.9
1989	160,587	299,573	266,999	1711	93.9
1990	108,075	206,298	177,384	1250	86.4
1991	84,303	167,336	143,636	1504	56.1

Trends in pounds landed and adjusted value by gear are shown in Table 3. Scuba, skin diving, spear, and "other gear" are the primary methods recorded on the trip tickets. The occurrence of certain gear types has changed over time, with spear fishing being refined as either scuba, skin diving or other gear. The level of distinction between these gear types by the fishermen is unknown. The harvest with the secondary gear types (fish pots, nets, trolling) is not considered likely, as the probability of catching and retaining queen conch with these types of gear is very small. Data records using these secondary gear are either artifacts of improper recording by the fishermen or errors in data entry. There is no category for unknown gear. It should be noted that the voluntary trip ticket has queen conch information recorded on the same line as lobster and octopus. Mistakes made in recording the correct species and expected value on this line could skew landings and value data, as lobster is sold at a higher price than conch. The predominate use of spear and scuba gear reflects the need for divers to go increasingly deeper to find queen conch. This increased depth has led to an increase in diving related accidents, often requiring the use of recompression treatments (C. Farnsworth, personal communication).

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Table 3. Annual landings and adjusted value (1982 = \$100) of queen conch (*Strombus gigas*) by gear types, as reported by Puerto Rico voluntary trip tickets. Source: Fisheries Research Laboratory, Puerto Rico.

Year	Gear Landed	Pounds Value	Adjusted
1983	Bottom Line	12	23.70
	Fish Pot	16	15.80
	Gill Net	187	
		230.80	
1984	Scuba	402, 295	512, 344.90
	Beach Seine	790	952.30
	Bottom Line	270	319.40
	Fish Pot	2329	4,052.00
	Gill Net	1062	1,947.00
	Other Gear	825, 321	117, 046.20
	Spear	270, 807	334, 238.20
1985	Bottom Line	10	12.10
	Fish Pot	1,188	1,489.10
	Gill Net	770	341.40
	Other Gear	160, 246	238, 167.20
	Spear	160, 869	208, 353.10
	Troll Line	922	1,009.90
1986	Beach Seine	50	74.90
	Bottom Line	579	972.60
	Fish Pot	2,105	3,831.80
	Gill Net	256	396.20
	Lobster Pot	268	1,069.90
	Other Gear	146	781 223,578.40
	Spear	34, 446	53, 026.60
	Troll Line	347	482.50
	1987	Beach Seine	82
Bottom Line		77	115.80
Cast Net		310	301.60
Fish Pot		5, 139	8, 121.30
Gill Net		259	573.80
Other Gear		86, 492	142, 782.70
Spear		49, 599	75, 747.30
1988		Bottom Line	1, 531
	By Hand	2, 725	4, 314.40
	Fish Pot	6, 923	12, 738.20
	Gill Net	869	1,632.90
	Lobster Pot	179	321.80
	Other Gear	8, 541	14, 341.40
	Scuba	14, 867	27, 230.00
	Skin Diving	5, 743	9, 919.60
	Spear	197, 293	324, 078.30

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Table 3. (Cont.).

Year	Gear Landed	Pounds Value	Adjusted
1989	Beach Seine	190	211.70
	Bottom Line	755	1,422.50
	By Hand	5	10.00
	Cast Net	219	351.30
	Fish Pot	5,300	9,287.20
	Gill Net	26	44.80
	Lobster Pot	219	442.10
	Other Gear	5,080	8,737.50
	Rod And Reel	45	80.20
	Scuba	56,255	96,069.90
	Skin Diving	9,258	16,326.80
	Spear	82,88	133,466.20
	Trammel	47	83.80
	Troll Line	61	57.70
Trot Line	244	407.50	
1990	Beach Seine	35	75.20
	Bottom Line	317	465.20
	By Hand	10	17.20
	Fish Pot	2,999	5,421.70
	Gill Net	35	58.00
	Lobster Pot	47	96.30
	Scuba	97,730	160,149.20
	Skin Diving	6,526	10,444.10
	Spear	71	106.80
	Trammel	236	427.30
1991	Bottom Line	154	247.70
	Fish Pot	1,009	2,593.60
	Gaff	2	4.30
	Gill Net	202	347.60
	Lobster Pot	214	495.20
	Scuba	77,441	130,666.70
	Skin Diving	5,242	9,243.60
	Trammel	16	32.30

The declining trends in pounds landed and harvest per trip ticket from 1983 through 1991 shows that the fishery is capable of producing both greater yield and profit. Implementation and enforcement of management regulations have the potential of increasing the harvest and economic return of the fishery.

ECONOMIC CONSIDERATIONS OF PROPOSED MANAGEMENT MEASURES

The Caribbean Fishery Management Council (CFMC) is one of eight U. S. regional fishery management councils charged with developing fishery management recommendations for the federal government. The Council's jurisdiction is limited to the federal waters around Puerto Rico. These waters comprise the exclusive economic zone (EEZ) and begin nine nautical miles from the shoreline and extend to 200 nautical miles, unless the boundary intersects the EEZ of another country. For any of the following management measures to be beneficial, it is critical for the government of Puerto Rico to establish and enforce regulations that are compatible, if not identical, with those established for the EEZ. The following are management measures currently being considered along with comments on the possible economic benefits of their implementation.

1. Establish a size limit for queen conch of nine (9) inches total length. The central management problem stated in the draft FMP is that queen conch reach harvestable size before they are sexually mature. This implies that most are caught before they spawn, leading to possible recruitment overfishing, as well as growth overfishing. Hence, a size limit of at least nine (9) inches is necessary, as this size should ensure spawning at least once in most queen conch and eliminate juveniles from the fishery (CFMC, 1989). While more information on length at capture is required for a refined analysis, it appears that this measure would eliminate approximately 20 to 30% of the catch from areas containing larger conch and virtually all of the catch from areas containing small conch (Raulerson, 1992). A nine inch minimum size would practically close fishing in those areas such as the shelf around Isla Caja de Muertos island in Puerto Rico, where the majority of conch mature at less than nine inches total length. Although this would result in an unnecessary loss of yield and an additional economic burden for the fishermen in these areas, fishermen have access to other areas where conch mature at nine inches. Although a seven or eight inch total length would not impose less economic hardship for the fishermen than a nine inch limit, the smaller size limits do not ensure spawning.

By the end of the second year with the nine inch limit, conch would be recruited to the fishery and gain 30 to 40% inweight on an individual basis. By the end of the third year, the additional recruit should bring the harvested yield back to the former level. From this point on there will be a positive biological yield compared to the starting point. Yield would thus be enhanced if there is a significant relationship between local spawning stock biomass and recruitment. This increased catch would have a positive economic effect through increases in producer and consumer surplus (Raulerson, 1992).

2. Require all conch, including queen conch, fighting conch, milk conch and other conch to be landed in the shell.

This measure is for enforcement purposes and to resolve problems associated with other measures such as a specified number of meats per pound and with difficulty in identifying conch meats by species. This measure would undoubtedly increase the costs of fishing by reducing the amount of conch taken on some trips, and the cargo capacity of the vessel would be reached sooner with both the shell and meat than with only the meat. However, the benefits from increased compliance would not need to be very large to offset the catches of both shell and meat because of excess fishing effort within the fishery. This measure is fully expected to have a positive benefit if the compliance rates for the size limit are acceptable. Efficient methods to dispose of the shell will need to be developed; however, it is judged that insuring a higher probability of spawning success for this stressed fishery is the most important factor to be considered.

3. Prohibit the sale of undersized queen conch and conch shells.

The outcome of the prohibition on the sale of undersized conch shells should have a positive effect on compliance, but it may not be large. If it is assumed that the tourist and local use market for small conch shells is sufficiently small, then the overall outcome of the measure as applied to conch shells is positive. Information on the market for shells is necessary to validate the outcome.

4. Establish a bag limit for personal use fishermen of six (6) queen conch per day per person. A personal use fisherman is anyone who does not have a commercial fishing license or permit. There is an underlying assumption that the recreational or personal use fishery is large enough to have an overall impact on the resource. However, while the draft FMP says that no information is available, the measure was nonetheless proposed and anecdotal information indicates that this is an increasingly important class of user. If the personal use sector of the fishery is not currently important from a biological standpoint, then the measure has a neutral outcome. The economic outcome of implementing this measure would depend on whether or not the bag limit significantly affects the current level of take. From this aspect, the regulation would be negative if the personal use fishermen suffer economic losses and there are no offsetting biological gains which would result in future increases in commercial and personal use value. However, it may have a positive outcome if the personal use sector is expected to grow significantly and the bag limit forestalls a biological and hence economic problem. In addition, there may be a positive outcome associated with the ability to conduct at-sea enforcement of the proposal that commercial fishermen must be permitted. New information on the potential size of the personal use fishery is needed before the outcome of this measure can be fully ascertained.

5. Establish an annual closed season from July 1 to September 30. The measure is proposed as a spawning closure and anecdotal information in the

draft FMP indicates that very little fishing occurs during this period. The benefits accruing from increased spawning ability should offset most of the losses of income from fishing queen conch during these months.

6. Require that all commercial fishermen have a permit or license. This measure will be necessary for identification of legitimate commercial fishermen as opposed to personal use fishermen and will have obvious benefits via increased compliance. Puerto Rico fishermen are now issued a license that is valid for four years, and does not have a reporting requirement. Given the length of the license period and the need for accurate data in a timely manner, it is important for the NMFS to establish a permit system for individuals fishing for queen conch in the EEZ. If the license system in Puerto Rico could be modified for annual issuance and effectively administrated, then that license could be used in place of a federal permit.

FUTURE DATA NEEDS

Examination of data from voluntary trip tickets clearly indicate that this information is not adequate for reliably assessing or monitoring the queen conch fishery in Puerto Rico. A thorough review of all data collection methods in Puerto Rico is needed to ascertain the effectiveness of the information currently being collected.

One approach would be to establish a probability based sampling program to estimate total landings and to provide specific and detailed information on a per trip basis. Simultaneously it would be important to identify interested fishermen and their organizations and to involve them in a detailed economic study. The establishment of a recreational data collection program for all of Puerto Rico fisheries is also critical for effective management of the queen conch resources.

As protection of nursery habitat for the queen conch is comparable to the prevention of harvesting the animals before sexual maturity, it will be vital to establish a data base on the location and condition of these areas. A geographical information system identifying all coastal fisheries habitats would greatly aid this endeavor.

CONCLUSIONS

Although only imprecise general canvas landings data were available, several trends in the queen conch fishery in Puerto Rico are apparent. A pronounced decline in pounds harvested and in adjusted value has occurred. A pronounced decline in pounds harvested per trip ticket was also noted, even though the number of reported trip tickets stayed fairly constant.

All six management measures contained in the draft queen conch FMP have positive economic benefits. The most effective management measure would

require that all conch be landed in the shell, and that the minimum shell length be nine inches.

The current data collection system clearly does not meet the need for monitoring and assessing the condition of the queen conch resource. The voluntary trip ticket system requires extensive modification, if not elimination. A probability based sampling system, organized in coordination with intensive dialogue with the fishermen will give better estimates of harvest, catch per unit of effort, and economic returns for the fishery.

Although the draft FMP has a section devoted to habitat concerns, it is not possible at this time to assess the economic effects of habitat destruction and the loss of queen conch production. This topic should be seriously considered for future emphasis, as benefits arising from reduction of fishing mortality could be negated by the destruction of nursery habitats.

Any successful implementation of these management measures will require strong enforcement action by the local government. Without these enforcement actions, the management measures will not contribute to the re-establishment of the queen conch fishery to optimum levels.

It should be noted that this FMP has been under development in one form or another for over ten years, and still has not been finished or implemented. Although there has been recent movement to finish and submit this document, the Puerto Rico government has requested that additional public hearings be scheduled to receive additional input. It is hoped that this will not be used as a tactic to further delay the implementation of badly needed management measures to halt the decline in the abundance of queen conch resources.

LITERATURE CITED

- Appeldoorn, R. Personal Communication. Department of Marine Sciences. University of Puerto Rico.
- Appeldoorn, R. 1991. Variations in queen conch morphology around Vieques Island, Puerto Rico. Final report to the Caribbean Fishery Management Council. 25 p.
- Caribbean Fishery Management Council. 1989. Third preliminary draft. Queen conch fishery management plan. 59 p.
- Farnsworth, C. Personal communication. Greater Antilles Section. United States Coast Guard.
- LaPlace, J. Personnel Communication. Division of Fish and Wildlife. St. Thomas, United States Virgin Islands.
- Raulerson, R. 1992. Draft Regulatory Impact Review for the queen conch fishery management plan. Caribbean Fishery Management Council.