APPENDIX II

# REGULATORY IMPACT REVIEW

# AND

# INITIAL REGULATORY FLEXIBILITY ANALYSIS

# FOR THE FISHERY MANAGEMENT PLAN

# FOR THE QUEEN CONCH RESOURCES OF PUERTO RICO

# AND THE UNITED STATES VIRGIN ISLANDS

Caribbean Fishery Management Council

and

National Marine Fisheries Service

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## 1.0 INTRODUCTION

Executive Order (E.O.) 12866 "Regulatory Planning and Review" was signed on September 30, 1993 and established guidelines for promulgating new regulations and reviewing existing regulations. While the E.O. covers a variety of regulatory policy considerations, the costs and benefits of regulatory actions are a prominent concern. Section 1 of the E.O. is repeated in its entirety:

**Section 1.** *Statement of Regulatory Philosophy and Principles*.

*(a) The Regulatory Philosophy.* Federal agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling public need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the well-being of the American people. In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts, and equity), unless a statute requires another regulatory approach.

*(b) The Principles of Regulation*. To ensure that the agencies' regulatory programs are consistent with the philosophy set forth above, agencies should adhere to the following principles, to the extent permitted by law and where applicable:

(1) Each agency shall identify the problem that it intends to address (including, where applicable, the failures of private markets or public institutions that warrant new agency action) as well as assess the significance of that problem.

(2) Each agency shall examine whether existing regulations (or other law) have created, or contributed to the problem that a new regulation is intended to correct and whether regulations (or other law) should be modified to achieve the intended goal of regulation more effectively.

(3) Each agency shall identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

(4) In setting regulatory priorities, each agency shall consider, to the extent reasonable, the degree and nature of the risks posed by various substances or activities within its jurisdiction.

(5) When an agency determines that a regulation is the best available method of achieving the

regulatory objective, it shall design its regulations in the most cost-effective manner to achieve the regulatory objective. In doing so, each agency shall consider incentives for innovation, consistency, predictability, the costs of enforcement and compliance (to the government, regulated entities, and the public), flexibility, distributive impacts, and equity.

(6) Each agency shall assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.

(7) Each agency shall base its decisions on the best reasonably obtainable scientific, technical, economic, and other information concerning the need for and consequences of the intended regulation.

(8) Each agency shall identify and assess alternative forms of regulation and shall, to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt.

(9) Wherever feasible, agencies shall seek views of appropriate State, local, and tribal officials before imposing regulatory requirements that might significantly or uniquely affect those governmental entities. Each agency shall assess the effects of Federal regulations on State, local and tribal governments, including specifically the availability of resources to carry out those mandates, and seek to minimize those burdens that uniquely or significantly affect such governmental entities, consistent with achieving regulatory objectives. In addition, as appropriate, agencies shall seek to harmonize Federal regulatory actions with related State, local and tribal regulatory and other governmental functions.

(10) Each agency shall avoid regulations that are inconsistent, incompatible, or duplicative with its other regulations or those of other Federal agencies.

(11) Each agency shall tailor its regulations to impose the least burden on society, including individuals, businesses of differing sizes, and other entities (including small communities and governmental entities), consistent with obtaining the regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations.

(12) Each agency shall draft its regulations to be simple and easy to understand, with the goal of minimizing the potential for uncertainty and litigation arising from such uncertainty.

In compliance with E.O. 12866, the Department of Commerce (DOC) and the National Oceanic and Atmospheric Administration (NOAA) require the preparation of a Regulatory Impact Review (RIR) for all regulatory actions which either implement a new Fishery Management Plan (FMP) or significantly amend an existing plan, or may be significant in that they reflect important DOC/NOAA policy concerns and are of public interest.

The RIR is part of the process of preparing and reviewing fishery management plans and provides a comprehensive review of the changes in net economic benefits to society associated with proposed regulatory actions. The analysis also provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to solve problems. The purpose of the analysis is to ensure that the regulatory agency systematically and comprehensively considers all available alternatives so that the public welfare can be enhanced in the most efficient and cost effective way.

The Regulatory Flexibility Act (P.L. 96-353) has the purpose of relieving small businesses, small organizations, and small governmental entities from burdensome regulations and record keeping requirements. The Small Business Administration (SBA) defines a small business in the commercial fishing activity, classified and found in the Standard Industrial Classification Code, Major Group, Hunting, Fishing and Trapping (SIC 09), as a firm with receipts up to $2.0 million annually. Additionally, the SBA defines a small business in the charter boat activity to be in the SIC 7999 code, Amusement and Recreational Services, not elsewhere classified, as a firm with receipts up to $3.5 million per year.

To meet the basic objective of the Regulatory Flexibility Act, federal agencies are required to determine if proposed regulations will have a significant economic impact on a substantial number of small business entities. The process of making such determinations requires the preparation of an Initial Regulatory Flexibility Analysis (IRFA) and the RIR serves as the source of most of the information for the IRFA. However, certain information required for IRFA determinations is not necessarily available in the RIR. For example, if the RIR does not contain an estimate of the number of small businesses affected, a description of the small businesses affected or a discussion of the nature and size of impacts, then the IRFA would be expanded to include such information.

Pursuant to E.O. 12866 a regulation is considered a "significant regulatory action" if it is likely to result in an annual effect on the economy of $100 million or more or has other major economic effects. Since the annual ex-vessel value of the fishery is estimated to be about $300 thousand, it is clear that there will not be annual effects on the economy of $100 million or more. Therefore, these proposed measures, if enacted, would not constitute a "significant regulatory action".

## 2.0 PROBLEM STATEMENT

A Draft Queen Conch Fishery Management Plan (FMP) is under preparation by the Caribbean Fishery Management Council to establish a management system for the queen conch resource within the Exclusive Economic Zone (EEZ). It is well established that the queen conch resource is vulnerable to overfishing throughout its range and landings from that portion of the commercial fishery which occurs around Puerto Rico and the U.S. Virgin Islands have been declining in recent years. Additionally, there is a recreational fishery of unknown size.

The specific problems in the fishery are:

2.1 Queen conch populations around St. Thomas and St. John are severely overfished. The queen conch resource is generally overfished in the U.S. Caribbean.

2.2 The total level of effort in the fishery, while not known with precision, is higher than necessary to harvest MSY.

2.3 The queen conch fishery tends to harvest juvenile animals before they are large enough to spawn. This depletes the spawning biomass to the degree that overfishing occurs.

2.4 The size of the commercial fishery and the amount of effort is not known to a great degree of confidence and the size of the recreational fishery is unknown.

2.5 It is not practical to distinguish queen conch meat from the meat of other conch species.

2.6 There is not enough current fishery dependent and fishery independent biological data on the fishery to conduct a stock assessment.

2.7 Fishery dependent data, such as cost and returns from fishing activities, which would be used to predict the reactions of fishery participants to regulations, is largely not available.

2.8 There are conflicts among the users of the resource, especially regarding the use of areas with habitat of importance for juvenile settlement and recruitment into the fishery.

## 3.0 OBJECTIVES

The objectives addressed by this Fishery Management Plan are:

Objective 1. To optimize the production of queen conch in waters surrounding Puerto Rico and the U.S. Virgin Islands through implementation of a management program, while ensuring the conservation of those resources throughout their range and in a manner consistent with other management programs currently in effect.

Objective 2. To reduce adverse impacts on queen conch through regulation of fishing effort and wasteful harvest practices, such as harvesting immature and reproducing individuals and exhausting deep water spawning reserves.

Objective 3. To promote the adoption of functional management measures that are practical and enforceable from the standpoint of conservation, in terms of education in general and the promotion of international cooperation in managing queen conch resources.

Objective 4. To generate a data base that will contribute to the knowledge and understanding of queen conch biology and other elements needed to improve management efforts, such as SAFE reports, monitoring of the resource, and determination of recruitment sources.

Objective 5. To recommend habitat improvements to federal and local governments and other entities responsible for curbing environmental degradation and loss.

Objective 6. To provide as much flexibility as possible within the management program to ensure that actions occur on a timely basis and in a manner consistent with the involved interests (See Section 5.2 of the Queen Conch FMP).

## 4.0 NATURE OF THE MANAGEMENT MEASURES

In the Queen Conch FMP the Council has proposed a management regime to resolve the problems in the fishery and to reach the objectives of the FMP. At this time the FMP contains five proposed actions which set a seasonal closure, establish size limits, provide for commercial and recreational bag limits, prohibit the use of HOOKAH gear for harvesting conch in the EEZ and prohibit the sale of undersized conch and conch shells. Rejected alternatives include area closures, measures to protect juveniles, quotas, limited entry, and import prohibitions. The specific measures are listed and discussed in Sections 6.0 and 7.0 (analysis of proposed and rejected measures).

## 5.0 APPROACH TO THE ANALYSIS

### 5.1 Intent of Management Measures

The five proposed measures which constitute the management regime for the fishery have a similar intent. All five are specifically designed to help meet the primary objective of the FMP regarding halting the declining trend of the resource and rebuilding the resource as necessary. In the case of the queen conch stocks the overfishing is well related to a combination of circumstances that have led to increased levels of fishing effort and may involve habitat degradation (refer to the FMP for a discussion). Since the five measures have a similar intent, it is clear that any changes in net economic benefits derived from the fishery depend heavily on the effect that the changed management strategy will have on the biological well being of the stocks. It is also clear that since all five proposed measures are designed to rebuild the stocks then the combined biological effect of the measures can be used as the major basis for the economic outcome. It is important to recognize that some biological effects may overlap so that the combined effect will not be the same as adding the separate effects from the five measures. Nonetheless, the measures will be looked at separately at the start to determine whether or not they contribute, in a positive manner, to the RIR condition of realizing a net positive economic benefit (benefits net of public and private costs), for the queen conch fishery. The combined economic effect of the alternate measures will also ultimately be contrasted with the results expected from the preferred set of measures.

### 5.2 Definition of Net Economic Benefit

Economic benefits include the sum of expected changes in producer surplus and consumer surplus for landings from the commercial fishery and potential changes in consumer surplus derived from recreational fishing trips. Net economic benefits are calculated by subtracting

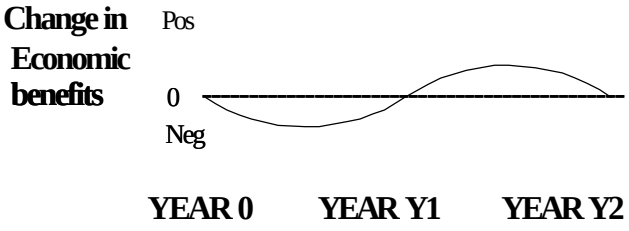
management costs (plan preparation, enforcement, additional data collection and/or reporting costs).

Since the data on the fishery and its participants are not sufficient to make the calculations implied by the last paragraph, much of the analysis used in this RIR will be qualitative instead of quantitative. In other words, the RIR analysis will attempt to discover whether or not the proposed management measures can contribute to economic improvements in the fisheries, but in some cases there will be no attempt to place estimated dollar values on any gains or losses which are discussed. An additional reason to conduct a qualitative analysis is that the general state of the fishery is known, but there is no current overall management structure in place. In this case it may be more important to see if there are plausible benefits at all versus trying to place exact dollar values on benefits. While the analysis will of necessity be qualitative, existing data will not be ignored because existing reliable information can be used along with theoretical considerations and anecdotal evidence to produce the best estimate as to the possible economic outcome of the measures.

### 5.3 Short and Long Term Effects and Period of Analysis

Since the proposed measures all involve more restrictive fishing practices, the analysis will entail a contrast of short term losses with long term gains as is usual with management schemes designed to rebuild overfished stocks. Further, as will be shown in the period of analysis discussion which follows, after an even longer period of time, the benefits will tend to be reduced or disappear altogether. Experience has shown that some of the original measures tend to be altered or discarded and some new measures introduced once an FMP has been implemented. This typical result occurs because the passage of time allows for the assembly of additional information about the fishery and because the actual biological and economic effects of the measures differ from the predicted biological and economic effects.

The period of analysis is critical and can change the direction of the outcome in certain cases. To the extent that measures are ultimately effective in increasing total biological yield and perhaps net revenue, this will occur after a period of time during which net revenues fall due to a decline in the catch of smaller conchs and a resulting decline in the overall landed weight of conch meat. Once the smaller conchs become legal-sized and enter the fishery in sufficient numbers, there should be a period of years during which yields and economic values are greater than before the management measures are introduced. Then for several years, there would be larger yields and further increases in net producer benefits. However, there is no question that at some point the increased yields and benefits will attract more fishers or more effort by existing fishers or both. The benefits will gradually disappear because increased effort means increased costs and even if there is a long term situation of greater catches (the effect of more conch and an increase in the yield per recruit) the net revenue of individual fishers and the industry will eventually decline to current levels (or lower). This makes the period of analysis very important as is shown in the following graph.




What the graph shows is a repeat of the discussion in the text. For years 0-Y1, there will be a decrease in economic benefits (small conchs excluded and a smaller number of conchs caught). Then at year Y1, increased catches result in the same level of benefits as at the start of the management program. For years Y1-Y2 the economic benefits will be positive relative to the starting point. As these benefits continue to accrue, more effort should be attracted into the fishery. Finally, at year Y2 the effort will have increased enough to erase the benefits and for all years following Y2 there will be a decrease in benefits because the costs of new effort in response to the increased profits will exceed the temporary benefits. This situation exists for all management measures that are designed to rebuild the resource and the management problem is that there are no provisions to control overall effort. This does not mean that such measures have no overall or lasting value. Indeed, if such measures can be viewed as having only a temporary life described as long enough to effect a biological recovery of the stocks and resulting in benefits from years Y1-Y2, then management will have been successful as long as some sort of limited entry program, such as Individual Transferrable Quotas (ITQ) comes into effect somewhere around year Y2.

The discussion of potential outcomes which follows contains an extremely important assumption. It was assumed that there must be a sufficient level of compliance with the regulations, either voluntary or resulting from enforcement. With those major caveats, the following sections examine the probable economic consequences of the proposed management structure for the queen conch fishery.

## 6.0 ANALYSIS OF PROPOSED MANAGEMENT MEASURES

Before consideration of the individual Management Measures, an analysis of consumer surplus emanating from commercial queen conch fishing activities is in order. This will facilitate the discussion of the individual measures.

Reported queen conch landings in Puerto Rico, along with relevant value and price information, are presented in Table 1. As indicated, pounds harvested varied from more than 400 thousand pounds in 1983 to less than 100 thousand pounds in 1992. Average annual landings during the 11-year period of analysis equalled just less than 200 thousand pounds.

Despite the large year-to-year fluctuations in queen conch landings during the 1983-93 period, the deflated price of the landed product illustrated only marginal year-to-year changes. When landings were in excess of 400 thousand pounds, for example, the deflated per pound price

Table 1. Conch Landings and Associated Value and Price for Puerto Rico, 1983-93.

| | | Value | | Price | |
|---|---|---|---|---|---|
| Year | Pounds | Current | Deflated[a] | Current | Deflated |
| 1983 | 402,510 | 522,061 | 685,119 | 1.29 | 1.70 |
| 1984 | 295,195 | 393,627 | 495,128 | 1.33 | 1.68 |
| 1985 | 261,105 | 386,862 | 469,493 | 1.48 | 1.80 |
| 1986 | 200,286 | 319,788 | 381,153 | 1.60 | 1.90 |
| 1987 | 155,313 | 261,677 | 301,124 | 1.68 | 1.94 |
| 1988 | 238,727 | 431,496 | 476,791 | 1.81 | 2.00 |
| 1989 | 160,588 | 303,084 | 319,372 | 1.89 | 1.99 |
| 1990 | 108,075 | 209,155 | 209,155 | 1.94 | 1.94 |
| 1991 | 108,157 | 218,596 | 209,785 | 2.02 | 1.94 |
| 1992 | 90,947 | 186,531 | 173,841 | 2.05 | 1.91 |
| 1993 | 165,080 | 337,122 | 306,196 | 2.04 | 1.85 |

[a] Deflated value and price is based on the U.S. Consumer Price Index (1990 base year).

Note: Prices reported in this table differ somewhat from those reported in the Management Plan (Table 2) due to the fact that the average yearly prices in the CODREMAR reports are not weighed by catch by area.

equalled $1.70. Though landings had fallen by more than 75% to less than 100 thousand pounds in 1992, the per pound price of the landed product equalled only $1.91, or about 12% above that reported in 1983. Even more telling, while the 1993 production of 165 thousand pounds was 80% above that reported in 1992, the 1993 price (deflated) was only three percentage points below that reported the previous year. In general, review of queen conch landings and price statistics for Puerto Rico for the 1983-93 period results in a tentative conclusion that price does not respond significantly to changes in landings.[1]

Because of the implications of this conclusion with respect to changes in consumer surplus emanating from imposed management measures to reduce harvest for biological considerations, it is worthwhile to explore possible explanations for this conclusion. The first reflects the fact that the product may be highly price inflexible with respect to quantity landed, indicating a low price elasticity of demand for the product (see Houck, 1965, for details). At the extreme, if price is totally invariant to quantity produced (implying a horizontal demand curve[2]), then changes in production will have no impact on consumer surplus. If this is the case in the queen conch fisheries for Puerto Rico and the U.S. Virgin Islands, management measures aimed at rebuilding the stocks to acceptable levels could be imposed with no resultant impact on consumer surplus. Producer surplus, however, may be impacted.

A second explanation for the stability in the dockside Puerto Rican queen conch price despite large observed fluctuations in annual landings reflects the fact that imported queen conch product, which currently represents more than 70% of the total supply in Puerto Rico, may constitute a perfect substitute for the domestically produced product and may respond directly to changes in domestic production. Given the assumption of perfect substitutability of imported product for domestic landings, demand for imports can be specified as follows (see Goldstein and Khan, 1985):

$$D = f(P, Y) \qquad f_1 < 0, f_2 > 0$$
$$S = g(P, F) \qquad g_1 > 0, g_2 < 0$$
$$I = D - S$$

Where D is the total quantity of queen conch demanded in Puerto Rico and the U.S. Virgin Islands, S is the supply of queen conch produced in Puerto Rico and the U.S. Virgin Islands, P is the domestic price of queen conch, Y and F are money income and factor costs, and I is equal to imports.

Two salient features of the perfect substitutes model are readily apparent. First, the demand for imported queen conch represents an "excess" demand for the domestically produced product. Second, assuming demand and supply conditions in Puerto Rico and the U.S. Virgin Islands are too small to affect the world price of the product, an increase (decrease) in the domestic supply of queen conch will reduce (increase) import demand directly with no corresponding change in

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[1] Examination of monthly dockside price data for Puerto Rico tends to support this conclusion. Overall, monthly prices appear to be invariant to quantity produced.

[2] As substitutes are considered, the relation between price flexibility and elasticity becomes somewhat more complicated.

price. Under the assumptions of a perfect substitutes model, therefore, management measures aimed at rebuilding stocks to acceptable levels could be imposed with no resultant impact on consumer surplus.

While the aforecited explanations provide a rationale for the stability in price in relation to some rather significant changes in production, they fall short of adequately explaining why the real price of the landed product has remained stable over an eleven year period of increasing income and tourism (see Appendix Table 1 for some general descriptive statistics on population, income, and tourism). These factors should, assuming a positive elasticity of demand with respect to income, exert a positive influence on demand and price over time, ceteris paribus. Absence of a real price increase over time suggests a third possible explanation for the lack of price responsiveness in relation to domestic output. This final explanation is based on the hypothesis that imports are an imperfect substitute for domestic production, a simplified model for which can be given as follows (see Goldstein and Khan, 1985, for a more detailed model):

$$I^d = f(Y, PI, P) \qquad f_1, f_3 > 0, f_2 < 0$$
$$I^s = g(PI, P^*) \qquad g_1 > 0, g_2 < 0$$
$$I^d = I^s = I$$

Where $I^d$ is the quantity of imported queen conch demanded in Puerto Rico and the U.S. Virgin Islands. $I^s$ the quantity of imports supplied to Puerto Rico and the U.S. Virgin Islands from the rest of the world, I is the equilibrium level of imports, PI is the price paid by Puerto Rico and the U.S. Virgin Islands for imported queen conch (abstracting from exchange rate differentials), P is the domestic price of queen conch in Puerto Rico and the U.S.V.I., P* is the price of queen conch in the rest of the world, and Y is money income in Puerto Rico and the U.S. Virgin Islands. A fourth equation, depicting the establishment of the queen conch dockside price in Puerto Rico and the U.S.V.I. can be given as follows:

$$P = h(L, I, Y) \quad h_1, h_2 < 0 \qquad h_3 > 0$$

where L is equal to domestic landings of queen conch.

The demand for imported queen conch, as identified in the first equation, responds positively to increases in income and the domestic (dockside) price and negatively to increases in the imported price, ceteris paribus. The supply of imports is positively related to the import price and negatively related to the "rest of the world" price. Finally, the domestic (dockside) price, as specified, is negatively related to domestic landings and imports and positively related to income.

As specified, the dockside price equation can be substituted into the import demand equation yielding

$$I^d = f(Y, PI, h(L, I, Y))$$

or, after respecification

$$I^d = i(Y, PI, L).$$

Demand for imported queen conch, as is now specified, is related directly to domestic landings. As landings increase, import demand decreases and vice versa.

Changes in consumer surplus from imposed management measures within the context of the imperfect substitutes model are primarily a function of two factors: (1) the degree of substitutability between the domestic and imported product, and (2) the degree to which import supply will respond to small changes in the import price. The closer the imported and domestic products are to being perfect substitutes, the less the loss in consumer surplus will be in response to management measures that would result in short run reductions in domestic production, ceteris paribus. Similarly, the more responsive import supply is to small changes in import price, the less consumer surplus will be reduced as a result of imposed management measures aimed at reducing current harvest levels to rebuild stocks.

Though data limitations preclude testing of the alternative models set forth in this section[3], some general observations can be made. First, the degree of substitutability between the domestic and imported products can to some extent be examined by evaluating prices for the two products. Given perfect substitutability between the two products, only marginal price differentials should be observed. In 1985-87, total conch imports into Puerto Rico equalled 69 thousand pounds with an associated value of $133 thousand. This indicates an average import price of $1.92 per pound[4], or about a 15%-25% price differential over the Puerto Rican dockside price. The average import price for the period of January 1992 through June of 1993 equalled $1.72 per pound, based on total imports in excess of 900 thousand pounds. This import price was about 15% below the domestic dockside price of just over $2.00 per pound.[5] Hence, while price differentials between the imported and domestic product are evident, they are within a range which would suggest that the two products are "relatively" well-defined substitutes.

Available statistics also indicate a substantial increase in queen conch being imported by Puerto Rico in recent years. Total imports during 1985-87, as noted, equalled 69 thousand pounds, or less than 25 thousand pounds per year. For the 18-month period ending in June of 1993, total

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[3] Specifically, a time series data base does not exist on imports or associated price.

[4] Though the import price averaged $1.92 per pound, there could still be considerable price variation in the import price by country of origin. As such, some of the imported product may be a perfect substitute while other imported products may be less than perfect substitute.

[5] Differences in import prices based on the country of origin are clearly evident in the 1992-93 import data. Specifically, Jamaican imported product received a considerably lower price than the U.S. product (given the prohibition on fishing in U.S. waters, this product must reflect one of reexports).

imports exceeded 900 thousand pounds, suggesting annual imports of about 600 thousand pounds. This poundage dwarfs domestic production which equalled 91 thousand pounds in 1992 and 165 thousand pounds in 1993. Hence, moderate changes in domestic production are not likely to significantly impact domestic prices.

In conclusion, available evidence leads to the conclusion that changes in domestic production exert little or no influence on domestic prices. This implies that consumer surplus will not be impacted by changes in domestic production emanating from proposed management measures. It is under this premise that the different management measures are considered.

**Management Measure 1: Prohibit the possession of undersized queen conch defined as less than nine (9) inches total length (22.9 cm) (as measured from the tip of the spire to the distal end of the shell) or with less than a 3/8-inch (9.5 mm) lip thickness measured at the thickest point of the lip. Queen conch less than nine (9) inches total length will be considered illegal if it does not have at least one area of the shell lip measuring 3/8-inch. All species in the fisheries management unit must be landed still attached to the shell.**

The crux of the FMP is that since queen conch reach marketable size and are harvested before they mature, spawning (and hence later recruitment) is severely limited and therefore the 9 inch legal size and more importantly the 3/8-inch lip thickness are necessary.

Regarding the requirement to land queen conch in the shell, public testimony was given that the landing of shells would reduce the ex-vessel value of a day's catch because the capacities of the fishing craft are not great enough to land a full day's catch of conchs in the shell. While the addition of quotas will partially negate the argument, there will still be instances when vessel capacity is exceeded, e.g., three licensed fishers operating from a 17-foot yola. Table 1 of the FMP shows the species included in the FMU, all of which would have to be landed in the shell as an additional enforcement measure.

The size limit, along with the requirement to land in the shell, would increase the cost of fishing and at the same time reduce the amount of conch taken on some trips. However, the benefits from increased compliance would not have to be very large to offset the increased costs. Further the reduction in catch for some trips will be accompanied by increases in some other, later catches because of the existence of excess effort as previously discussed.

This measure is fully expected to have a positive benefit if the compliance rates for the size limit are acceptable.

The following discussion is based largely on the work of Appeldoorn (1987) but includes information from other published works.

Assumption of 100% Compliance

Available data tend to indicate that virtually all juvenile conch would be eliminated from the fishery. While more information on length at capture (TIPS-type data) is required for a refined analysis, it appears that from 20 to 50% of the catch would be eliminated. This rough result assumes that conch are not harvested until they reach a marketable size of 7.5 inches. While this assumption may hold for the commercial fishery it may be less true for the personal use fishery. Thus it is reasonable that a total of 50% or more of the current yield would be eliminated the first year. By the end of the second year these conch, less some small amount of natural mortality, would be recruited to the fishery and would gain 30-45% in weight on an individual basis. By the end of the third year, the additional recruits 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 and this yield would 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 surplus.

Appeldoorn (1987) discusses the variability in size of the queen conch in different areas such as Caja de Muerto and Culebra where the conch reach maturity at a smaller size. Since it is known that once conch reach sexual maturity the growth in length stops and the shell begins to thicken, the 9.5 mm lip thickness rule will ensure that most of the conch which are harvested are sexually mature even though a large portion of them may be less than 9 inches long. Thus, in areas where the conch are smaller, the lip thickness measure should keep the fishery from closing in areas where smaller conch are commonly found.

From this time forward, the rebuilding of the fishery should attract more effort as the stock rebuilds and the benefits would begin to erode at some point in the future that cannot be estimated at this time.

Assumption of 50% Compliance

Under this scenario, it appears at first glance that the catch of juvenile conch (based on length or lip thickness, would be reduced by 50%. However, since the current amount of effort is more than sufficient to catch most of the harvestable yield, the catch of undersized conch will not be reduced by 50% and may go down only slightly. Under this scenario, there may be only a slight improvement from the status quo after three years, but the short-term losses are also obviously reduced.

Assumption of Other Compliance Rates

Without further elaboration, it is apparent that benefits are expected to accrue, but at a slow rate, for compliance rates of 50 to 100%. For rates less than 50%, it is doubtful that gains will be made because of the existence of excess effort and in this case the size limit measure will have a negative economic impact because there will be no benefits, but all the government and associated costs, along with somewhat reduced catches, will still exist.

Option 1A: **Establish a less restrictive minimum size limit of seven (7) or eight (8) inches total length for queen conch.**

Although this alternative would tend to minimize the short term losses to the commercial fishers, it is not practical for enforcement reasons. It is also not scientifically sound since as stated in the previous discussion the variability in size indicates that additional measures such as the lip thickness limit should be implemented. This measure will not be particularly effective in protecting the spawning stock, particularly in areas where queen conch tend to mature at larger sizes.

Given the above, this alternative is not expected to produce an increase in net benefits.

Option 1B: **Establish a minimum size limit for queen conch of eight (8) inches in Puerto Rico and nine (9) inches total length in the U.S. Virgin Islands.**

Differential size limits would open an enforcement loophole, the extent of which cannot be ascertained. Fishers could catch eight-inch conch in the U.S. Virgin Islands and land them in Puerto Rico. If this occurred extensively, spawning potential of the Virgin Islands stock could be reduced. See discussion above. The measure would not allow take of conch from populations which mature at less total length, and hence, some fishing areas would be virtually closed unnecessarily. The projected economic effect is for no major increase in benefits and definite losses for certain fishers dependent on selected stocks.

Option 1C: **Control the harvest size of queen conch through meat count size (2 uncleaned or 3 cleaned to the pound) rather than shell length.**

Variability in meat weight due to cleaning practices as well as variability of meat size as related to shell size, precluded adopting this alternative in lieu of shell length and lip thickness. Also, there may be an enforcement loophole since it may be possible to land immature queen conch under the guise of other species if meats were allowed to be removed from the shell. This possibility exists because it would not be particularly easy for law enforcement personnel to make the large number of species identifications necessary for each landing examined. From a practical standpoint, the fisher would have to remove the meat from landed conch to determine whether or not the total catch met the weight test (the presumption is that the conch would have to meet any weight test for the aggregate catch rather than for each conch).

Option 1D: **No Action**.

Given that the FMP does not consider the option of limited entry, it appears that some form of size limit to protect the stocks until the time they reach sexual maturity is one of the few short-term, and perhaps the most powerful actions available short of closing the fishery. From the standpoint of the RIR, a further depletion of spawners may mean that economic benefits would be foregone for a considerable period of time. This presumption is based on the observation that the Florida conch fishery has been closed for multiple generations and has not made a serious recovery. In any eventuality, the status quo would continue the current situation of depleted stocks and depressed net benefits.

**Management Measure 2: Prohibit the sale of undersized queen conch and queen conch shells as defined.**

For this measure to have any application it has to be assumed that the size limit measure is in effect. For application to conchs containing meat, the measure will have a positive benefit. 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 market for small conch shells is sufficiently small, then the overall outcome of the measure is positive. Information on the market for shells is necessary to validate the outcome.

Option 2A: **No Action**

There is a high probability that an illegal market will develop for undersized queen conch which can not be sold due to the size limit measure. There is a growing market for shells, and live invertebrates in the U.S. Caribbean and worldwide (See FMP for Coral and Reef associated resources). Hence, if undersized shells can continue to be sold, there will be a tendency to make the overfishing problem worsen. Clearly, the first two FMP objectives, i.e., conserve and optimize the stocks, will have a lesser chance of being reached if some form of size limit restrictions are not put into place.

**Management Measure 3: Establish a bag limit for personal-use fishers of three (3) queen conch per day, not to exceed twelve (12) per boat; licensed commercial fisheries may land one hundred and fifty (150) queen conch per day for the first year. The commercial fishers' quota will be lowered to one hundred (100) queen conch for the second year and to seventy-five (75) the third year. The quota reduction is subject to review upon receipt of empirical information on which to base the decisions for new limits. All conch harvested under these provisions must conform to minimum size specifications and be landed still attached to the shell.**

This particular management measure contains two very distinct proposals regarding daily limits on the number of queen conch that can be taken and the analysis has to be done separately for the two proposals.

**1. RECREATIONAL SECTOR:**

For the recreational fishery (personal use fishery) there is an underlying assumption that the recreational or personal use fishery is large enough to have an overall impact on the resource. While the FMP indicates that there is basically no information on the personal use fishery, the measure was nonetheless proposed and it follows that the anecdotal information available to the Council indicates that these users may have an important impact on the resource. If the information available to the Council is in error, and the personal use sector of the fishery is not important from a biological standpoint, then the measure has a neutral outcome with reference to the effect on queen conch stocks. Similarly, for the purposes of the RIR, the economic outcome would depend on whether or not the bag limit significantly affects the current level of take. From this aspect, if the proposed measure has a significant impact on the level of take, the regulation would create short-term losses to recreational fishers because the consumer surplus associated

with conch diving trips would be reduced. These losses would be recouped as the number of larger conchs became available, the catch per trip increased, the total meat weight increased and the consumer surplus from diving trips increased.

If the personal take limit curtails the recreational catch somewhat but does not have the expected biologically positive impact, then under some circumstances there would be an apparent negative short-term and long-term effect on the personal use fishery. This effect is termed apparent because the personal use fishery may be growing and in such a case, controlling overall take by the personal use fishery may forestall a biological and hence economic problem. More information on the potential size of the personal use fishery is needed before the outcome of this measure can be ascertained. There may be no need for the measure or a different bag limit may be indicated.

Under one probable scenario, there may be significant long-term gains in consumer surplus associated with diving trips directed at conch. The scenario is that the commercial limit has major biological benefits which expand the number of available conchs to the degree that a large portion of diving trips result in the taking of a limit of conch. This result would apply in the case where the commercial limit raises the cost of fishing to the degree that commercial effort is severely reduced.

## 2. COMMERCIAL SECTOR:

### A. Noneconomic Impact of Regulation

To evaluate the change in economic value, i.e., the change in producer surplus, resulting from enactment of bag limits on the commercial fishing sector, it is necessary to first consider the biological impact. The biological impact can be explored with the aid of the information contained in Tables 2 and 3. The first table contains information on the distribution of queen conch catch per trip in Puerto Rico during 1988-93 while the second table yields comparable information for the U.S. Virgin Islands for the 1991 (January) - 1994 (June) period (see Appendix A for a description of the data used in the analysis).

As indicated by the information contained in Table 2, an average of 55% of the total number of queen conch trips in Puerto Rico during 1988-93 yielded catches of less than 50 pounds whilemore than 80% yielded catches of less than 100 pounds.[6] Less than 4% of the total number of trips resulted in catches of 200 pounds or more.

Comparable analysis for the U.S. Virgin Islands suggests an overall similar pattern to that found for Puerto Rico. For example, almost 50% of the total number of queen conch trips in the U.S. Virgin Islands during 1991-94 yielded conch catches of less than 50 pounds or

[6] For purposes of analysis, a queen conch trip is identified as any trip wherein queen conch was reported harvested and landed.

Table 2. Distribution of Queen Conch Trips and Catch in Relation to Catch Per Trip, Puerto Rico, 1988-93.

| | Trips | | | Conch Catch | | |
|---|---|---|---|---|---|---|
| Conch Lbs/Trip | No. | % | Cumulative % | Lbs. | % | Cumulative % |
| < 10 lbs | 1,001 | 12.3 | 12.3 | 5,679 | 1.1 | 1.1 |
| 10 lbs-< 20 lbs | 1,345 | 16.6 | 28.9 | 18,927 | 3.8 | 4.9 |
| 20 lbs - < 30 lbs | 865 | 10.7 | 39.6 | 20,537 | 4.1 | 9.0 |
| 30 lbs - < 40 lbs | 681 | 8.4 | 48.0 | 22,906 | 4.6 | 13.6 |
| 40 lbs - < 50 lbs | 603 | 7.4 | 55.4 | 26,181 | 5.2 | 18.8 |
| 50 lbs - < 60 lbs | 494 | 6.1 | 61.5 | 26,149 | 5.2 | 24.0 |
| 60 lbs - < 70 lbs | 522 | 6.4 | 67.9 | 32,846 | 6.5 | 30.5 |
| 70 lbs - < 80 lbs | 403 | 5.0 | 72.9 | 29,482 | 5.9 | 36.4 |
| 80 lbs - < 90 lbs | 411 | 5.1 | 78.0 | 34,214 | 6.8 | 43.2 |
| 90 lbs - < 100 lbs | 348 | 4.3 | 82.3 | 32,288 | 6.4 | 49.6 |
| 100 lbs - < 110 lbs | 316 | 3.9 | 86.2 | 32,636 | 6.5 | 56.1 |
| 110 lbs - < 120 lbs | 229 | 2.8 | 89.0 | 25,976 | 5.1 | 61.2 |
| 120 lbs - < 130 lbs | 190 | 2.3 | 91.3 | 23,359 | 4.6 | 65.8 |
| 130 lbs - < 140 lbs | 91 | 1.1 | 92.5 | 12,080 | 2.4 | 68.2 |
| 140 lbs - < 150 lbs | 82 | 1.0 | 93.5 | 11,703 | 2.3 | 70.5 |
| 150 lbs - < 160 lbs | 64 | 0.8 | 94.3 | 9,730 | 1.9 | 72.4 |
| 160 lbs - < 170 lbs | 52 | 0.6 | 94.9 | 8,465 | 1.7 | 74.1 |
| 170 lbs - < 180 lbs | 39 | 0.5 | 95.4 | 6,766 | 1.3 | 75.4 |
| 180 lbs - < 190 lbs | 60 | 0.7 | 96.1 | 10,941 | 2.2 | 77.6 |
| 190 lbs - < 200 lbs | 31 | 0.4 | 96.5 | 5,999 | 1.2 | 78.8 |
| 200 lbs - < 250 lbs | 102 | 1.2 | 97.8 | 22,086 | 4.4 | 83.2 |
| $\geq$ 250 lbs | 182 | 2.2 | 100.0 | 84,964 | 16.9 | 100.0 |
| | | | | | | |
| Total | 8,111 | 100.0 | ----- | 503,913 | 100.0 | ----- |

Table 3. Distribution of Queen Conch Trips and Catch in Relation to Catch Per Trip, U.S. Virgin Islands, 1991 (January) - 1994 (June).

| | Trips | | | Conch Catch | | |
|---|---|---|---|---|---|---|
| Conch Lbs/Trip | No. | % | Cumulative % | Lbs. | % | Cumulative % |
| < 10 lbs | 23 | 1.3 | 1.3 | 166 | 0.2 | 0.2 |
| 10 lbs-< 20 lbs | 175 | 10.2 | 11.5 | 2,475 | 2.5 | 2.7 |
| 20 lbs - < 30 lbs | 189 | 11.0 | 22.5 | 4,243 | 4.3 | 7.0 |
| 30 lbs - < 40 lbs | 208 | 12.1 | 34.6 | 6,784 | 6.9 | 13.9 |
| 40 lbs - < 50 lbs | 233 | 13.6 | 48.2 | 9,885 | 10.1 | 24.0 |
| 50 lbs - < 60 lbs | 165 | 9.6 | 57.8 | 8,596 | 8.8 | 32.8 |
| 60 lbs - < 70 lbs | 181 | 10.6 | 68.4 | 11,164 | 11.4 | 44.2 |
| 70 lbs - < 80 lbs | 107 | 6.3 | 74.7 | 7,789 | 7.9 | 52.1 |
| 80 lbs - < 90 lbs | 100 | 5.8 | 80.5 | 8,186 | 8.4 | 60.5 |
| 90 lbs - < 100 lbs | 102 | 6.0 | 86.5 | 9,361 | 9.6 | 70.1 |
| 100 lbs - < 110 lbs | 105 | 6.1 | 92.6 | 10,574 | 10.8 | 80.9 |
| 110 lbs - < 120 lbs | 42 | 2.5 | 95.1 | 4,750 | 4.9 | 85.8 |
| 120 lbs - < 150 lbs | 33 | 2.0 | 97.1 | 4,210 | 4.3 | 90.1 |
| 150 lbs - < 200 lbs | 24 | 1.4 | 98.5 | 3,919 | 4.0 | 94.1 |
| 200 lbs - < 250 lbs | 16 | 1.0 | 99.5 | 3,283 | 3.3 | 97.4 |
| $\geq$ 250 lbs | 9 | 0.5 | 100.0 | 2,567 | 2.6 | 100.0 |
| | | | | | | |
| Total | 1,712 | 100.0 | ----- | 97,952 | 100.0 | ----- |

about a seven percentage point differential compared to that observed for Puerto Rico (i.e., 48.2% for the U.S.V.I. compared to 55.4% for Puerto Rico). About 86% of the total number of trips in the U.S.V.I. yielded queen conch catches of less than 100 pounds (for Puerto Rico, the comparable number was 82%). Finally, only 1.5% of the total U.S.V.I. trips resulted in catches of 200 pounds or more compared to 3.5% for Puerto Rico.

While less than 4% of the total number of queen conch trips in Puerto Rico during the 1988-93 period resulted in queen conch catches of 200 pounds or more, this small percentage of the trips yielded almost 21% of the catch during the period (conch catches of 200 pounds or more in the U.S.V.I., by comparison, accounted for about six percent of the total). Conversely, while catches of less than 50 pounds represented 61% of the total number of trips in Puerto Rico during 1988-93, this large portion of the trips accounted for less than 20% of the total queen conch catch (approx. 25% in the U.S. Virgin Islands).

To investigate catch impacts related to Management Measure 3, certain assumptions are employed for purposes of analysis. These assumptions are as follows. First, it is assumed that boats carry three licensed fishers. Second, it is assumed that three queen conch yield one pound of cleaned meat. Finally, it is assumed that there will be complete compliance. Based on these assumptions, an analysis of yearly impacts is presented below.

First Year Impacts: Based on the aforecited assumptions in conjunction with Management Measure 3, queen conch harvest per trip during the initial year of implementation (year 1) would be limited to 450 animals, or 150 pounds of meat. This harvest restriction suggests, based on the historical distribution of catches (Tables 2 and 3), an impact on approximately 7% of the trips for Puerto Rico compared to only 3% of the U.S.V.I. trips. These impacted trips, however, represent 30% of the total queen conch landings in Puerto Rico and 10% of the U.S.V.I. landings.

Historical (i.e., 1988-93) queen conch catch among the 7% of the Puerto Rican trips with queen conch catches in excess of 150 pounds averaged 281 pounds. For the U.S.V.I., catches in excess of 150 pounds during 1991-94 averaged about 200 pounds. Setting queen conch catch for these trips to 150 pounds results in a first year estimated reduction in catch of 14% in Puerto Rico compared to less than 3% for the U.S.V.I.

Second Year Impacts: In the second year of implementation of Management Measure 3, the quota would be reduced to 100 queen conch per licensed fisher per day. While at first glance this would suggest an impact on 18% of the historical number of trips in Puerto Rico and about 14% of the U.S.V.I. trips, this is not necessarily the case. Specifically, the impact (on trips) may be larger due to an increased harvestable population emanating from first year restrictions. Abstracting from the issues of natural mortality, escapement, etc., catch per trip in year 2 (before imposing a quota) could increase as much as 14% in Puerto and 3% in the U.S.V.I. Lack of basic information regarding escapement etc., however, precludes refining the model to a degree that a point estimate of increased harvestable stock and CPUE in year 2 could be derived.

Due to the inability to accurately predict the increase in CPUE in year 2 emanating from the first year restrictions, a range in estimates is derived. It will first be assumed that none of the increased stock from year 1 are available for harvest in year 2. Then, it will be assumed that all of the increased stock at the end of year 1 will be harvested in year 2.[7] While both of these assumed rates of harvest are likely to be outside the "actual" range, they will provide a lower and upper boundary within which to work. Also, these assumed rates will facilitate the third year analysis.

Within the context of the probability of year 1 remaining stock being harvested in year 2, estimated reductions in catch of queen conch in Puerto Rico and the U.S.V.I. resulting from the 100 conch per fisher quota in year 2 are summarized below.

Noneconomic Impact of Year 2 Regulation (i.e., 100 conch quota) Given Different Assumptions Regarding Year 2 Take of Increased Harvestable Stock.

| | Puerto Rico | | U.S.V.I. | |
|---|---|---|---|---|
| Probability of Capture[a] (%) | % of Trips Impacted | % Reduction in Catch | % of Trips Impacted | % Reduction in Catch |
| 0 | 17.7 | 22.0 | 13.5 | 6.5 |
| 100[b] | 22.0 | 15.3 | 13.5 | 4.4 |

[a] Reflects the probability that a conch surviving at the end of year 1 due to year 1 regulations will be harvested in year 2.

[b] The proportion of trips impacted under this scenario increases in Puerto Rico because CPUE increases. Given the discrete nature of the data in Table 2, the average CPUE of historical trips from 90 to 100 pounds now exceeds 100 pounds.

As indicated, the estimated reduction in catch in Puerto Rico in year 2 due to the 100 conch quota ranged from a low of 15.3% (assuming all increased population at the end of year 1 from year 1 regulations is harvested in year 2) to 22.0% (assuming none of the increased harvestable stock at the end of year 1 is taken in year 2). For the U.S.V.I., the range was from 4.4% to 6.5%.

Third Year Impacts. In the third year of implementation of Management Measure 3, the quota would be reduced to 75 conch per licensed fisher per day. Based on the same set of assumptions used in the analysis of year 2 restrictions, estimated reductions in catch of queen conch in Puerto Rico and the U.S.V.I. resulting from the 75 conch per fisher quota in year 3 are summarized below.

[7] While this assumption is, of course, somewhat unrealistic, there is reason to believe that a substantial proportion of the remaining harvestable stock will be taken in the second year. The basis for this conclusion is twofold. First, natural mortality for adult queen conch is low. Second, the fishery is heavily overfished. Hence, the probability of capture is high.

Noneconomic Impact of Year 3 Regulations (i.e., 75 conch quota). Given Different Assumptions Regarding Year 3 Take of Increased Harvestable Stock.

| | Puerto Rico | | U.S.V.I. | |
|---|---|---|---|---|
| Probability of Capture (%) | % of Trips Impacted | % Reduction in Catch | % of Trips Impacted | % Reduction in Catch |
| 0 | 29.6 | 31.0 | 28.3 | 14.7 |
| 100 | 32.1 | 26.1 | 28.3 | 12.6 |

Note: See footnotes on previous table.

As indicated, third year regulations (i.e., 75 conch quota) results in estimated catch reductions in excess of 25% in Puerto Rico and from about 13% to 15% in the U.S.V.I.

**B. Changes in Economic Value**

Economic value, as noted previously, consists of two components: producer surplus and consumer surplus. As per earlier discussion, changes in consumer surplus resulting from any management measure imposed on the commercial sector are assumed to be insignificant based on the premise that increased imports will compensate for any reduction in domestic supply. Hence, the component of interest is that of producer surplus.

To evaluate the change in producer surplus that would result to the commercial queen conch sector from the imposition of Management Measure 3, it is worthwhile to look at total catch and revenues generated from those trips wherein queen conch landings are reported. This information, characterized in relation to queen conch catch per trip, is reported for Puerto Rico in Table 4 and for the U.S. Virgin Islands in Table 5. As indicated, total catch per trip (i.e., queen conch and other species) among those trips in Puerto Rico reporting less than 20 pounds of queen conch averaged just under 30 pounds which sold for about $60 at dockside.[8] Among trips resulting in queen conch catches of 200 pounds or more, total catch averaged about 400 pounds with an associated dockside value of $763. For the U.S. Virgin Islands, total catch among those trips yielding less than 20 pounds of conch averaged 24 pounds valued at $115. Among trips wherein the queen conch catch per trip equalled or exceeded 200 pounds, total catch averaged 225 pounds and was valued at $967.[9]

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[8] When relevant price information was missing in the trip ticket data analyzed for Puerto Rico, an "average" price was used to reflect the actual price.

[9] Revenues for any level of catch in the U.S.V.I. will tend to be much larger than that for Puerto Rico. This is because the reported price in Puerto Rico is that received at dockside. Fishers in the U.S.V.I. tend to market their own product and, hence, the price received in the U.S.V.I. is more akin to a wholesale price.

Table 4. Catch of Different Species Associated With Different Levels of Queen Conch Catch for Puerto Rico, Expressed in Pounds and Value, 1988-93 avg.

| | Catch Per Trip | | | | | | |
|---|---|---|---|---|---|---|---|
| | Pounds | | | | Value ($) | | |
| Conch Lbs/Trip | Conch | Lobster | Other | Total | Conch | Other[b] | Total |
| < 20 lbs | 10.4 | 4.7(26)[a] | 14.1(42) | 29.2 | 19.8 | 39.8 | 59.6 |
| 20 lbs - < 40 lbs | 28.0 | 5.8(24) | 15.4(35) | 49.1 | 52.3 | 43.7 | 96.0 |
| 40 lbs - < 60 lbs | 47.9 | 4.4(25) | 15.5(26) | 67.9 | 89.1 | 38.7 | 127.8 |
| 60 lbs - < 80 lbs | 68.0 | 5.1(34) | 11.0(19) | 84.0 | 126.7 | 36.7 | 163.4 |
| 80 lbs - < 100 lbs | 87.4 | 9.8(36) | 15.2(16) | 112.4 | 160.2 | 61.7 | 221.9 |
| 100 lbs - < 120 lbs | 107.6 | 5.4(35) | 9.0(12) | 121.9 | 195.1 | 33.8 | 228.9 |
| 120 lbs - < 140 lbs | 126.4 | 8.4(31) | 49.3(12) | 184.1 | 225.1 | 92.0 | 317.1 |
| 140 lbs - < 160 lbs | 147.2 | 15.5(29) | 33.5(21) | 196.3 | 264.5 | 113.8 | 378.3 |
| 160 lbs - < 180 lbs | 167.5 | 12.0(29) | 30.8(21) | 210.3 | 296.8 | 62.9 | 359.8 |
| 180 lbs - < 200 lbs | 186.5 | 16.4(29) | 18.0(19) | 220.9 | 331.3 | 93.4 | 424.7 |
| ≥ 200 lbs | 332.9 | 26.5(39) | 43.5(29) | 402.9 | 591.4 | 171.6 | 763.1 |

[a] Numbers in parentheses refer to the percentage of trips wherein the identified species was harvested. For example, 26% of the trips yielding < 20 pounds of conch also reported lobster, while 42% reported the catch of other species (i.e., excluding conch and lobster) harvested.

[b] The value of lobster is included in the other category for value.

Table 5. Catch of Different Species Associated With Different Levels of Queen Conch Catch Per Trip for the U.S. Virgin Islands, Pounds and Value, 1991-94 avg.[a]

| | Catch Per Trip | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Pounds | | | | | Value[b] | | |
| Conch Lbs/Trip | Conch | Lobster | Reeffish | Other | Total | Conch | Other[c] | Total |
| < 20 lbs | 13.3 | 3.9(11)[d] | 5.6(12) | 1.2(9) | 24.1 | 49.9 | 65.4 | 115.3 |
| 20 lbs - < 40 lbs | 27.8 | 11.1(35) | 8.4(11) | 3.7(9) | 50.9 | 104.2 | 149.6 | 253.8 |
| 40 lbs - < 60 lbs | 46.4 | 12.3(41) | 11.4(15) | 5.6(12) | 75.7 | 174.0 | 120.0 | 294.2 |
| 60 lbs - < 80 lbs | 65.8 | 6.8(28) | 12.4(11) | 5.0(14) | 89.9 | 246.7 | 83.6 | 330.3 |
| 80 lbs - < 100 lbs | 86.9 | 4.8(13) | 14.8(18) | 3.1(5) | 109.6 | 325.9 | 73.7 | 399.6 |
| 100 lbs - < 120 lbs | 104.2 | 1.6(5) | 14.2(14) | 1.8(5) | 121.8 | 390.7 | 48.5 | 439.2 |
| 120 lbs - < 150 lbs | 127.6 | 3.2(2) | 17.3(21) | 0(0) | 148.1 | 478.5 | 65.6 | 544.1 |
| 150 lbs - < 200 lbs | 163.3 | 8.7(17) | 31.2(29) | 1.0(1) | 204.3 | 612.4 | 139.9 | 752.3 |
| ≥ 200 lbs | 234.0 | 8.1(16) | 13.2(16) | 0(0) | 255.3 | 877.5 | 89.7 | 967.2 |

[a] Data for 1994 covers the January through June period.

[b] Price data are not included on U.S. Virgin Islands trip ticket data. Prices used to compute value were therefore derived from those reported in the U.S. Virgin Islands 1991/92 State/Federal Commercial Fishery Statistics Project Report. These prices were: conch, $3.75/lb; lobster, $7.00/lb; and reeffish, $2.50/lb. A price of $1.00/lb was used for "other". Some of this "other" category is likely reeffish.

[c] Estimated value of catch for all species other than conch.

[d] Numbers in parentheses refer to the percentage of trips wherein the identified species was harvested. For example, 11% of the trips yielding < 20 pounds of conch also reported lobster.

In general, the total catch per trip increases in relation to the queen conch contribution (Table 6). In Puerto Rico, for example, queen conch represented only 36% of the total catch by weight for those trips yielding less than 20 pounds of queen conch (33% by value). The proportion rapidly advanced to about 80% (associated with queen conch landings of 60 pounds to 80 pounds per trip), and thereafter fluctuated in the 70% to 90% range. A similar pattern was found with respect to the U.S. Virgin Islands.

Average total catch per trip associated with queen conch trips in Puerto Rico during the 1988-93 period, estimated based on the distribution of queen conch trips in Table 2 in conjunction with the total catch per trip presented in Table 4, equalled 84.1 pounds valued at $160. Queen conch accounted for 72% of the total by poundage and 69% by value. For the U.S. Virgin Islands, total catch per queen conch trip averaged 80.2 pounds. The associated value per trip averaged $316. The relatively high average value per trip in the U.S. Virgin Islands vis-a-vis Puerto Rico reflects primarily the higher per pound price of the marketed product, given the fact that the average catch by weight in the two areas was nearly identical (i.e., 84.1 pounds in Puerto Rico versus 80.2 pounds in the U.S. Virgin Islands). The higher price received for the product in the U.S. Virgin Islands, in turn, reflects the direct marketing activities practiced in this region. Queen conch represented 71% of both poundage and value for the average trip in the U.S.V.I. during 1991-94.

Profits from queen conch fishing are, of course, a function of four components: (1) catch (queen conch and other species), (2) output prices (queen conch and other species), (3) quantities of inputs used in the production process, and (4) prices of inputs used in the production process. The first two of these components determine revenues while the second two determine costs. Changes in any of these four components will be reflected in a change in profits, ceteris paribus.

While the revenue side of the profit equation has been evaluated in some detail, considerably less information is available by which to evaluate the cost side. Costs will, in general, increase in relation to revenue though at a different rate. Hence, higher revenues indicate higher costs.

Public testimony suggests costs associated with the queen conch fishery in Puerto Rico and the U.S. Virgin Islands do vary widely from one fishing operation to the next. One fisher, for example, reported costs in the $25-$30 range. Another fisher, at a recent SSC meeting, reported variable costs in the $60-$92 range. The breakdown of these costs were as follows:

Table 6. Conch Catch Per Trip in Relation to Total Catch Per Trip, by Pounds and Value, Puerto Rico and the U.S. Virgin Islands.

| Puerto Rico | | | U.S. Virgin Islands | | |
|---|---|---|---|---|---|
| | Conch Catch as % of Total | | | Conch Catch as % of Total | |
| Conch Catch Per Trip | Weight | Value | Conch Catch Per Trip | Weight | Value |
| < 20 lbs | 35.6 | 33.2 | < 20 lbs | 55.2 | 43.3 |
| 20 lbs - < 40 lbs | 57.0 | 54.5 | 20 lbs - < 40 lbs | 54.6 | 41.1 |
| 40 lbs - < 60 lbs | 70.5 | 69.7 | 40 lbs - < 60 lbs | 61.3 | 59.1 |
| 60 lbs - < 80 lbs | 81.0 | 77.5 | 60 lbs - < 80 lbs | 73.2 | 74.7 |
| 80 lbs - < 100 lbs | 77.8 | 72.2 | 80 lbs - < 100 lbs | 79.3 | 81.6 |
| 100 lbs - < 120 lbs | 88.3 | 85.2 | 100 lbs - < 120 lbs | 85.6 | 89.0 |
| 120 lbs - < 140 lbs | 68.7 | 71.0 | 120 lbs - < 150 lbs | 86.2 | 87.9 |
| 140 lbs - < 160 lbs | 75.0 | 70.0 | 150 lbs - < 200 lbs | 80.0 | 81.4 |
| 160 lbs - < 180 lbs | 80.0 | 82.5 | ≥ 200 lbs | 91.7 | 90.7 |
| 180 lbs - < 200 lbs | 84.4 | 78.0 | | | |
| ≥ 200 lbs | 82.6 | 77.5 | | | |

Source: Compiled from information in Tables 4 and 5.

Estimated Costs per Trip Associated With the Queen Conch Fishery

| Item | Minimum | Maximum |
|---|---|---|
| Diving Tank | $ 24 | $ 24 |
| Fuel | $ 25 | $ 48 |
| Food | $ 10 | $ 10 |
| Total | $ 60 | $ 92 |

Note that these costs, which are based on a pilot and two divers, are exclusive of labor and fixed costs. With these costs estimates in mind, an economic analysis of the proposed management measure is presented below.

To examine the potential reduction in producer surplus emanating from Management Measure 3, it is first useful to estimate the change in revenues per trip. Based upon the information contained in Tables 4 and 5 in conjunction with previously discussed estimated reductions in queen conch catch, estimated reductions in revenues for Puerto Rico and the U.S.V.I. during each of the three years of analysis are summarized below.

Estimated Reductions in Revenues Per Trip Resulting from Implementation of Management Measure 3.[a]

| | Puerto Rico | | U.S.V.I. | |
|---|---|---|---|---|
| | Maximum[b] | Minimum | Maximum | Minimum |
| Year 1 | $ 12 | $ 12 | $ 5 | $ 5 |
| Year 2 | $ 21 | $ 14 | $ 14 | $ 9 |
| Year 3 | $ 31 | $ 25 | $ 33 | $ 27 |
| Avg. | $ 21 | $ 17 | $ 17 | $ 14 |

[a] Compiled from information contained in Tables 4 and 5 along with estimated reductions in queen conch landings.

[b] Maximum loss is that associated with the assumption that previous year's regulations will not impact future years' catch per trip. Minimum loss estimates are those associated with the assumption that all stock remaining at the end of a given year due to regulations in that year will be taken in the following time period.

As previously noted, estimated revenues per trip before restrictions (i.e., status quo) averaged $160 in Puerto Rico and $316 in the U.S.V.I. Assuming fishers do not compensate for the reduction in queen conch harvest through increased harvests of other species, estimated first year

reductions in revenues per trip in Puerto Rico associated with the 150 conch quota would equal $12, on average, resulting in average total revenues per trip of $148. This translates to a decline in total revenues per trip of about 7.5%. Average revenues per trip in the U.S.V.I. during the first year of Management Measure 3 would fall by just $5, from $316 to $311. This translates to less than a two percent decline in gross revenues per trip. Overall, the greater losses in revenues per trip from first year regulations in Puerto Rico vis-a-vis the U.S.V.I. reflects primarily a higher proportion of trips in Puerto Rico reporting conch catches of 150 pounds or more.[10]

As quotas become more restrictive in years 2 and 3, estimated losses in revenues would increase accordingly. In Puerto Rico, for example, third year losses in revenues would average from $25 to $31 per trip, depending upon the assumptions made regarding the third year harvest of stock not taken in year 2 due to second year restrictions. For the U.S.V.I., third year losses in revenues would average from $27 to $33, depending upon assumptions.

Under the status quo, returns to labor and capital can be calculated by subtracting variable costs (excluding labor) from revenues. Based on available information, these returns in Puerto Rico likely fall in the range of $68 per trip (i.e., $160-$92) to $100 per trip (i.e., $160-$60).[11] Due to significantly higher prices in the U.S.V.I., returns to capital and labor are estimated to fall in the range of $224 to $256. Labor costs in the U.S.V.I. are likely to be significantly higher than in Puerto Rico, however, due to added time involved in direct marketing practices.

While little information exists with which to develop the relationship between changes and revenues and changes in costs in the queen conch fishery, the cost components of a trip provided earlier can shed some light on the issue. Air for diving tanks and fuel, as indicated, represent the majority of "out of pocket" expenses for any given trip. These two components will likely decline to some unknown extent as quotas are placed on the fishery. Most of the fuel consumption, however, probably occurs in going and returning from the fishing grounds and will be reduced only marginally due to Management Measure 3. Most of the reduction in costs, therefore, would be associated with the need for less air, which is related more directly with take. For purposes of analysis, it will be assumed that costs decline by 30 cents for every dollar reduction in revenues. This assumption appears to be a valid working hypothesis given the nature of the fishery.

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[10] These estimated reductions in revenues are, of course, averages that do not fully portray the complete picture. For example, the first year implementation of Management Measure 3 will result in no reductions in revenues among the vast majority of trips reported for both Puerto Rico and the U.S.V.I. (i.e., those trips reporting less than 150 pounds of meats). Expected reductions in revenues for that portion exceeding the proposed quota can, however, be quite large. For the 3.4% of the Puerto Rico trips reporting queen conch catches in excess of 200 pounds, for example, expected reduction in revenues per trip would exceed $300.

[11] These figures are likely somewhat low for two reasons. First, the 1988-93 average prices were used for analysis. These average prices are somewhat lower than those reported in 1993. Second, the cost figures used in the analysis may be somewhat higher than the industry average.

Based on CODREMAR and other reports, total annual conch trips in Puerto Rico during 1988-93 averaged 1,851 per year. Average three year reductions in revenues per trip ranged from $17 to $21. This implies an average annual reduction in producer surplus over the three-year period of analysis in the range of $21 thousand to $26 thousand. The total reduction in producer surplus over the three-year period would be from about $63 thousand to more than $75 thousand. In the first year of regulation (i.e., 150 conch quota), estimated loss in producer surplus would be relatively small (about $15 thousand). As regulations become more restrictive, however, the estimated losses increase. By the third year, they would range from about $31 thousand to about $38 thousand. Due to a lack of data on the actual number of queen conch trips in the U.S.V.I., estimated loss in producer surplus cannot be determined.

**Discussion**. In conducting the analysis of Management Measure 3, certain assumptions were employed to facilitate the procedure. To complete the analysis, these assumptions should be critically reviewed. While a quantitative review of the assumptions is limited due to data constraints, a qualitative review, presented below, is possible.

One of the more important and uncertain assumptions made for purposes of analysis reflects that of constraining catch of other species to remain constant for those trips which would be impacted by the proposed bag limits. This assumption is, of course, overly simplistic in nature and is likely to be unrealistic under existing fishing practices. Alternative species that could be targeted are numerous in number and existing data for the U.S.V.I. suggests that fishers are able to redirect effort in response to management imposed harvesting restrictions on the queen conch fishery (see discussion of Management Measure 4). To the extent that fishers are able to redirect effort towards other species in response to enactment of Management Measure 3, reductions in profits per trip (and producer surplus), as previously assessed, will be overstated.

A second assumption imposed for analysis is that of a constant queen conch catch per trip (within a given year) among that segment of trips harvesting less than the proposed bag limit. This assumption is also likely to be somewhat unrealistic under actual fishing conditions. The fishable stock of queen conch in any given year is, for all intents and purposes, relatively fixed. There is competition for this relatively fixed resource among a large group of commercial and (possibly) recreational fishers. Imposing bag limits on only a certain segment of the trips (i.e., those where catch per commercial fishers exceed 150 conchs in year 1) results in a relative increase in fishable stock for the those trips where a bag limit is not attained. Hence, CPUE among that segment of trips that has traditionally harvested less than the proposed bag limit is likely to increase. For example, about 93% of the queen conch trips in Puerto Rico during the 1988-93 period were identified as having landed less than 150 pounds of meat. Queen conch catch per trip among this segment of the trips averaged 46 pounds. In all probability, this average will increase if bag limits on the upper end of catch per trip are imposed. This, in turn, will lead to the erosion of some of the desired biological benefits associated with the implementation of Management Measure 3. Such an occurrence, however, may also lower the estimated loss in

revenues and profits per trip to the extent that profits among that portion of trips not achieving the bag limit may be enhanced through an increased catch per unit effort. This, however, results in a potential redistribution of catch to the less efficient fishers.

A third assumption made for purposes of analysis reflects a constancy in the level of effort. While this assumption may be valid in the short run, an increasing stock of queen conch over an extended period of time should attract additional effort into the fishery. This increased effort, which could represent an increased number of fishers and/or number of trips by existing participants, is in response to increased CPUE and associated profits. As effort increases, the biological gains achieved through implementation of Management Measure 3 would be eroded.

A fourth assumption made for purposes of analysis reflects that of complete compliance. Empirical evidence suggests, however, that compliance will be less than complete unless there is a strong enforcement presence. If compliance is less than complete, estimated losses in producer surplus will be overstated. At the same time, biological gains may be unrealized.

A fifth assumption made for purposes of analysis is that boats carry three licensed fishers. Though this is apparently the "common" practice, public testimony suggests that there can be up to four fishers per boat, especially in Puerto Rico. And in other cases, there may be only two fishers per boat. Unfortunately, the data bases used in the analysis of Management Measure 3 do not include the number of fishers on a given trip. To the extent that four fishers are sometimes employed on a given trip, estimates in catch reductions will be somewhat overstated.

A final assumption employed in the analysis of Management Measure 3 is that three queen conch comprise one pound of meat. Though this assumption appears valid based on public testimony, it implies that trip limits are imposed in isolation to other management measures considered in the Management Plan. Management Measure 1 would prohibit the possession of undersized queen conch defined as less than nine (9) inches total length (22.9 cm) (as measured from the tip of the spire to the distal end of the shell) or with less than 3/8-inch (9.5 mm) lip thickness measured at the thickest point of the lip. This measure in and of itself would likely reduce catch per trip by a significant amount in the short run thus largely negating the need for Management Measure 3.

In conclusion, short run economic losses can be anticipated under Management Measure 3 due to an overall reduction in producer surplus (given the earlier discussion, consumer surplus is assumed to remain unchanged). The overall extent of loss in producer surplus depends on several unknown factors including the ability of fishers to substitute alternative species in their production process (in response to queen conch trip limits) and the relation between reduced revenues and reduced costs (currently an unknown). Furthermore, to the extent that it is the efficient fishers harvesting in excess of the proposed bag limits, this group of fishers will be disproportionately burdened by implementation of the Management Measure. To the extent that redistribution of catch occurs, more inefficient fishers will benefit. Thus, a given level of conch catch may not be taken at the lowest cost to society, resulting in a loss in net economic benefits.

While implementation of Management Measure 3 will likely result in short term losses of producer surplus, there exists the potential for it to help achieve the biological goal of rebuilding overfished stocks. The extent to which this goal can be achieved depends primarily on two factors: (1) the degree to which catch "freed up" under the trip limit is redistributed and (2) response and rate of response in effort as the stock is replenished.

With respect to the first factor, the vast majority of the trips in both Puerto Rico and the U.S.V.I. report queen conch catches below the proposed trip limit. Thus, there exists considerable potential for increased catch for a large segment of trips. If this redistribution is "significant", biological gains may be negated.

With respect to the second factor, overwhelming evidence in other fisheries throughout the world suggests that effort responds positively to increases in stock size, assuming price does not decline disproportionally with increases in catch (for the queen conch fishery, no price changes are anticipated due to the influence of imports). This effect will eventually dissipate any potential biological gains associated with Management Measure 3 and accentuates the need for a limited entry program in the long run for the Management Measure to achieve its desired biological goal.

If the redistribution of catch is not significant and if effort does not respond rapidly to larger stocks, there could be a period of time in which producer surplus is enhanced. At this time, however, it is impossible to weigh these potential future gains against the immediate losses in producer surplus. It is known, though, that these potential gains will be dissipated through time in the absence of some limited entry/effort program.

The analysis above did not consider the economic effects of the commercial bag (trip limit) under assumptions about the joint effect of other measures which are proposed. For example, the size limit/lip thickness measures will undoubtedly reduce catches in at least a portion of the trips, although the major effect may be only to postpone the time of capture and not in fact result in a greatly reduced catch in numbers. The closed season, assuming that compliance is adequate, may actually provide the basis for increased catch per trip because of the relatively higher presumed densities of conchs during the open season. Unfortunately, all of this is highly speculative and it is possible that the seasonal closure, particularly when combined with the size limit/lip thickness measure, may make free diving much more feasible than under current conditions.

The measure may have a positive outcome associated with the ability to conduct at-sea enforcement because of the provision that commercial fishers must be permitted. Although there is no way to calculate the increased compliance rate, acceptable enforcement and compliance rates are necessary if catch reduction goals are to be realized. Another possible reason for the proposed measure is that some persons are fishing illegally without being licensed but are posing as personal use fishers. If this is the reason for the measure, then the problem is enforcement and the measure would still be unnecessary or too costly.

The tentative conclusion of the RIR is that the commercial trip limit will result in a short run negative change in net benefits relative to the status quo. The basic reason is that catches can be controlled through other means that do not as severely impact the efficiency of individual trips. Stated another way, if the size limits and closed seasons are put into effect, the major effect of the bag limit may be only to double or perhaps treble the number of trips required to harvest the available conch. The resulting adverse impact on both the fishers and crew (pilots) as well as the implied overall increase in total fishing effort costs could be quite large, although they are not quantifiable at this time. For the personal use fishery the expected outcome is potential short-term minor losses but more than compensated by long-term gains associated with possible major reductions in commercial catches.

Option 3A: **Establish a bag limit for personal-use fishers of six (6) queen conch per day, not to exceed twenty four (24) per boat; licensed commercial fishers may land seventy-five (75) queen conch per day. All conch harvested under these provisions must conform to maximum size specifications and be landed still attached to shells.**

This measure, as previously identified, would have relatively large and immediate impacts on the commercial sector. In the first year of implementation, an estimated 30% of trips in Puerto Rico and 28% of the U.S.V.I. trips would be impacted. Estimated queen conch catch in Puerto Rico would be reduced by 31% and in the U.S.V.I., catch would be reduced by about 15%. This will result in a higher immediate loss in net economic benefits than the preferred option. However, any commercial bag limit quota may not be superior to the status quo of no commercial trip limits.

The personal use bag limit is more difficult to assess because the data to evaluate the measure are lacking (see the discussion on the Council's preferred measure of a bag limit of three). Nonetheless, anecdotal evidence appears to indicate that a bag limit of five or six may have essentially no effect. There is another problem in that it may be possible to enforce rules pertaining to the personal use fishery and voluntary compliance may not be great. If this is true, then any consideration of personal use limits may be moot.

Under one probable scenario, there may be long-term gains in consumer surplus associated with diving trips directed at conch. The scenario is that the commercial limit has some biological benefits which expand the number of available conchs to the degree that an increased portion of diving trips result in the taking of a limit of conch. This result would apply in the case where the commercial limit raises the cost of fishing to the degree that commercial effort is significantly reduced.

Option 3B: **No Action**

No action has tentatively been identified as superior to the commercial bag limit alternatives, but the outcome of a personal use limit is relatively unknown.

**Management Measure 4: Establish an annual closed harvest season from July 1 through September 30 for queen conch.**

The measure is proposed as a spawning closure and available data for Puerto Rico indicate that spawning may actually occur over a longer time period. From a biological perspective, therefore, a longer closed season may be preferable.

**1. Commercial Sector**

To examine potential changes in economic value resulting from the establishment of an annual closed harvest season, it is useful to first examine the distribution of trips per month and related queen conch catch per trip. This information is reported for Puerto Rico and the U.S. Virgin Islands in Table 7. As indicated, approximately 30% of the total number of queen conch trips reported in Puerto Rico during the 1988-93 period occurred during the proposed three month closed harvest season (i.e., July 1 to September 30). This is almost five percentage points above what one would expect to occur if trips were randomly distributed throughout the year. Queen conch catch per trip in Puerto Rico during the three month proposed closed season averaged 65.8 pounds, compared to the yearly catch per trip of 63.7 pounds. Overall, this suggests that the spawning aggregation and the reported increased availability for harvest during the three month proposed season may actually occur over a longer period of time.

Reported queen conch trips in the U.S. Virgin Islands averaged 109 per month during the 1991 (January)-1993 (December) period. Trips during the July - September period were insignificant (less than two percent of the total), reflecting the closure of the U.S. Virgin Islands fishery during these summer months.[12]

Overall, the information provided in Table 7 suggests that implementation of Management Measure 4 would potentially impact, at a maximum, 30% of the total queen conch trips in Puerto Rico. If state waters are not closed in conjunction with Federal waters during this three month period, the number of potentially impacted trips would be significantly less.

The imposed three month closure in the U.S. Virgin Islands queen conch fishery during the period of analysis can, under certain assumptions, be examined to help assess potential changes in economic value associated with a closed harvest season from July 1 to September 30 for queen conch in Puerto Rico. To do so, all queen conch fishers in the U.S. Virgin Islands were first identified during each fiscal year during the 1991-94 period.[13] Total

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[12] See Section 316-1 of the Amended Rules and Regulations "Conch and Whelk Harvesting" for the United States Virgin Islands.

[13] Analysis for this section of the report was conducted on a fiscal year basis (July through the following June) to be consistent with the unique identification number given to each fisher. Fishers in the U.S. Virgin Islands were characterized as queen conch fishermen if they reported any landings of queen conch during the fiscal year.

Table 7. Selected Statistics Pertaining to Monthly Number of Successful Queen Conch Trips and Average Monthly Catch Per Trip, Puerto Rico and U.S. Virgin Islands.

| | Puerto Rico[a] | | | Virgin Islands[b] | | |
|---|---|---|---|---|---|---|
| | Trips | | | Trips | | |
| Month | No. | % | Conch Catch Per Trip | No. | % | Conch Catch Per Trip |
| January | 475 | 5.9 | 81.1 | 127 | 9.7 | 61.6 |
| February | 579 | 7.1 | 60.2 | 124 | 9.5 | 63.8 |
| March | 677 | 8.4 | 72.5 | 181 | 13.9 | 61.4 |
| April | 740 | 9.1 | 52.9 | 158 | 12.1 | 52.9 |
| May | 930 | 11.5 | 53.2 | 153 | 11.7 | 68.3 |
| June | 744 | 9.2 | 70.0 | 97 | 7.4 | 52.7 |
| July | 760 | 9.4 | 68.5 | 13 | 1.0 | 68.2 |
| August | 811 | 10.0 | 66.5 | 7 | 0.5 | 33.7 |
| September | 844 | 10.4 | 62.6 | 2 | 0.1 | 40.0 |
| October | 710 | 8.7 | 56.9 | 179 | 13.7 | 55.5 |
| November | 477 | 5.9 | 70.4 | 121 | 9.3 | 51.8 |
| December | 364 | 4.5 | 58.0 | 145 | 11.1 | 56.5 |
| | | | | | | |
| Total/Avg. | 8,111 | 100.0 | 63.7 | 1,307 | 100.0 | 58.4 |

[a] Information for Puerto Rico reflects the 1988-93 period.

[b] Information for the Virgin Islands reflects the 1991 (January) - 1993 (December) period.

monthly trips and catch by this group of fishers were then identified by month, the results of which are presented in Table 8. As indicated, identified U.S. Virgin Islands queen conch fishers made 1,537 queen conch trips during 1991 (July) - 1994 (June) period. They also made 4,857 trips wherein no queen conch catch was reported, for a combined total number of trips equal to 6,394. Total catch for these 6,394 trips equalled 502.5 thousand pounds. Queen conch contributed 14.1% of this total.

When examined on a monthly basis, queen conch trips as a percentage of the total ranged from about one percent (in the summer months when the fishery was closed) to more than 30%. Similarly, queen conch catch as a percentage of total catch ranged from less than one percent in the summer months to about 20% during the December - March period.

Three features of the data presented in Table 8 are of significance in examining potential changes in economic value associated with implementation of Management Measure 4 in Puerto Rico. First, the total number of trips reported by U.S. Virgin Islands queen conch fishers in the three month summer period when the queen conch fishery is closed are not significantly different from those months when it is open (see Table 9 for a greater percentage breakdown by month). This suggests that this group of fishers redirects effort towards other species during the three month period when the harvesting of queen conch is prohibited. The second feature of significance reflects the fact that total catch by U.S. Virgin Islands queen conch fishers during the three month closed season is not significantly below the total monthly average (i.e., the monthly average across all twelve months). Specifically, total catch per month by identified queen conch fishers during the three month closed season for the 1991 (July) - 1994 (June) period averaged 40,056 pounds. This is within five percentage points of the overall monthly average of 41,870 pounds. The final feature of significance is that queen conch trips, after reopening of the fishery, do not expand for a significant and extended period. Specifically, while the reported number of queen conch trips in October is somewhat higher than that reported in most other months (i.e., 179 compared to an overall average of 151 for the nine month period when the fishery is open), the number of queen conch trips made in November and December are less than the overall monthly average. This suggests that short run gains from a seasonal closure may not be rapidly eroded upon the reopening of the fishery.

Of course, the fact that total catch among identified U.S.V.I. queen conch fishers does not significantly decline during the three month summer closed season does not necessarily imply that there is no change in revenues. Specifically, fishers may redirect effort towards lower valued species. To examine whether this is the case, revenues were estimated based upon the catch statistics reported in Table 8. Estimated revenues per trip, as indicated by the information contained in Table 9, fall within the relatively narrow range of $226 (June) to $286 (November) when examined on a monthly basis. Estimated revenues per trip during the three month closed season averaged $241 compared to an overall monthly average of $249. Hence it can tentatively be concluded that revenues to queen conch fishers in the

Table 8. Trips and Associated Catches[a] Among Identified Queen Conch Fishers U.S. Virgin Islands, 1991 (July) - 1994 (June) Totals.

| | Trips[c] | | | Catch (Lbs) | | | | |
|---|---|---|---|---|---|---|---|---|
| Month | Conch | Total | % Conch | Conch | Lobster | Other | Total | % Conch |
| January | 160 | 527 | 30.4 | 8,647 | 3,616 | 27,443 | 39,706 | 21.8 |
| February | 155 | 551 | 28.1 | 8,601 | 3,810 | 29,880 | 42,291 | 20.3 |
| March | 198 | 579 | 34.2 | 9,466 | 4,892 | 32,981 | 47,339 | 20.0 |
| April | 158 | 562 | 28.1 | 7,375 | 4,862 | 32,818 | 45,055 | 16.4 |
| May | 124 | 513 | 24.2 | 5,631 | 2,171 | 32,967 | 40,769 | 13.8 |
| June | 115 | 451 | 25.5 | 5,536 | 1,889 | 27,166 | 34,611 | 16.0 |
| July | 13 | 501 | 2.6 | 887 | 5,918 | 32,713 | 39,536 | 2.2 |
| August | 7 | 574 | 1.2 | 236 | 6,406 | 35,568 | 42,210 | 0.6 |
| September | 2 | 511 | 0.4 | 80 | 5,413 | 32,930 | 38,423 | 0.2 |
| October | 179 | 605 | 29.6 | 9,939 | 5,375 | 33,815 | 49,129 | 20.2 |
| November | 121 | 509 | 23.8 | 6,263 | 5,913 | 32,308 | 44,484 | 14.1 |
| December | 145 | 511 | 28.4 | 8,193 | 4,258 | 26,547 | 38,998 | 21.0 |
| | | | | | | | | |
| Total/Avg. | 1,537 | 6,394 | 24.0 | 70,854 | 54,523 | 377,154 | 502,551 | 14.1 |

[a] All trip and catch data represent three-year totals. For example, a total of 160 queen conch trips were identified in the month of January during the period of analysis, while identified queen conch fishers reported a total of 527 trips.

[b] Fishers were reported as queen conch producers in a given fiscal year if their record reported any production of queen conch.

[c] Data on trips were merged by date. Hence catch of conch and another species by an identified fishers on a given date is treated as one trip.

Table 9. Total Trips and Estimated Revenues Per Trip Among Identified Queen Conch Fishers U.S. Virgin Islands, 1991 (July) - 1994 (June).

| | Trips | | Estimated Value ($) | |
|---|---|---|---|---|
| Month | Total | % of Total | Total | Per Trip |
| January | 527 | 8.2 | 126,345 | 240 |
| February | 551 | 8.6 | 133,624 | 242 |
| March | 579 | 9.1 | 152,194 | 263 |
| April | 562 | 8.8 | 143,735 | 256 |
| May | 513 | 8.0 | 118,731 | 231 |
| June | 451 | 7.0 | 101,973 | 226 |
| July | 501 | 7.8 | 126,535 | 252 |
| August | 574 | 9.0 | 134,647 | 235 |
| September | 511 | 8.0 | 120,516 | 236 |
| October | 605 | 9.5 | 159,434 | 263 |
| November | 509 | 8.0 | 145,647 | 286 |
| December | 511 | 8.0 | 126,827 | 248 |

Note: See footnotes on previous table for a discussion of data.

U.S. Virgin Islands do not significantly decline in response to a seasonal closure of the queen conch fishery.[14]

While estimated revenues per trip among identified U.S. Virgin Islands queen conch fishers did not appear to decline appreciably during the three-month closed conch season, producer surplus could still be diminished via increased costs associated with harvesting non-preferred species. No data exist, however, to determine if, in fact, this is the case. To the extent that the data for the U.S. Virgin Islands indicates other species after being harvested with conch on a given trip (after merging the trip ticket data by date), however, would suggest that cost differentials are minimal.

The degree to which findings for the U.S. Virgin Islands lend themselves to Puerto Rico for the purpose of analyzing Management Measure 4 depends, of course, on the similarity between the fisheries in the two areas. Many similarities were developed in the context of the discussion of Management Measure 3. For example, the distribution of queen conch catch per trip in the U.S. Virgin Islands followed an overall similar pattern to that observed in Puerto Rico and total catch per trip in the two areas were nearly identical. Also, the catch of other species in relation to queen conch catch per trip was similar in the two areas. Finally, it should be noted that conch landings represent only a small fraction of total landings in both Puerto Rico and the U.S. Virgin Islands. In Puerto Rico, 1993 conch landings contributed only 7.6% to the total value of all fish and shellfish landings. By comparison, lobsters and snappers represented 18% and 28% of the total, respectively. These species can, in general, be targeted by that group of fishers who also target conch.

In conclusion, loss in producer surplus from implementation of Management Measure 4 (in Puerto Rico) appears to be relatively minor in the short run. Changes in consumer surplus, as previously discussed, are also likely to be insignificant.

One potential economic benefit of Management Measure 4 is that harvesting will occur over a shorter period of time. This suggests, assuming conch remain accessible to harvest throughout the year, higher per trip catches and fewer trips. This may potentially lead to a short-run increase in producer surplus.

Furthermore, it is difficult to construct a case where long run economic benefits from implementation of Management Measure 4 do not accrue. The idea behind closing the fishery during this period of time lies in the fact that a large number of mature conch would spawn during the closure and would contribute to overall conch numbers. Since the purpose of the measures and objectives of the FMP imply the allowance of some conch while the resource is recovering, then the longer term result should be a gradual increase in conch numbers and landed catch. Recall, however, the earlier discussion about the lack of measures to limit entry or

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[14] Identifying the relevant population of queen conch fishers as any one landing queen conch within a given fiscal year could be challenged as being too encompassing. Therefore, an alternative identification based on 500 pounds or more of queen conch was also examined (see Appendix Table 2). This alternative definition did not alter the overall conclusions.

otherwise control total effort. If the increased catches attract new effort or increased effort by existing fishers, then the benefits will be eroded over time.

**2. Recreational Sector**

Given the paucity of information on the recreational queen conch fishery, it is impossible to quantitatively assess the impact of Management Measure 4 on this component of the fishery. However, short-term losses are more likely than in the case of the commercial fishery for two interrelated reasons. First, consumer surplus is derived from trips and if no take is allowed, then diving trips for conch will not occur during the closed season and basically cannot be "made up" during the open season. Second, recreational divers may have fewer "close" substitute options than the commercial fishers, given the relatively few species generally harvested by recreational fishers on diving trips.

Option 4A: **No Action**

Not closing the fishery during this time will hinder the rebuilding of the overfished stocks, because increased vulnerability of the queen conch resource to overfishing occurs. The expected economic outcome of the status quo is negative relative to a class of proposals for a spawning closure.

**Management Measure 5: Prohibit the harvest of queen conch in the EEZ using HOOKAH gear. Any person with queen conch and HOOKAH gear aboard a vessel in the EEZ will be presumed in violation of this prohibition.**

SCUBA and similar gear (presumably HOOKAH) represent the overwhelming majority of commercial queen conch trips in Puerto Rico. Based on the data used in the analysis of the RIR (see Appendix), 89% of the identified queen conch trips in Puerto Rico during 1988-93 were SCUBA based with the figure approaching 95% in 1993. Skin diving, by comparison, represented only about 5% of the identified trips. When examined on a monthly basis over the 1988-93 period, SCUBA and similar gear represented more than 88% of the identified trips in all but two months. These months were July and August. All conch commercially harvested in St. Croix is by SCUBA.

As this introduction suggests, SCUBA/HOOKAH is by far the most preferred gear for harvest. Much of the cause for this is that the conch resource has been diminished to the extent that it is now principally harvested in deeper waters. This is in contrast to earlier years when free diving was the more popular mode of take.

While limited information on a number of factors (e.g., migration, maximum free diving depths, etc.) limits a complete economic analysis of Management Measure 5, some discussion can be presented based primarily on economic theory. This discussion is presented below.

In general, economic theory generally begins with the premise that, in equilibrium, costs[15] are equal to revenues in an open access system, such as the queen conch fisheries of Puerto Rico and the U.S. Virgin Islands. Hence, while revenues in an open access fishery may exceed costs in any given year (or vice versa), in the long run revenues should just equal costs (including the opportunity costs associated with one's own time). If revenues exceed costs, additional effort will be attracted into the fishery in the long run. Vice versa, if costs exceed revenues, effort will leave the fishery. An equilibrium amount of effort will be achieved only when revenues equal costs. At this point, producer surplus would equal zero.

An argument could be made that the use of SCUBA/HOOKAH in the queen conch fishery actually results in negative producer surplus in the fishery (and negative net economic benefits), due to the high health risks associated with its use. As noted in the Management Plan, decompression sickness is becoming increasingly more prevalent as divers are fishing in deeper waters and 10 of 37 diving accidents have resulted in the diver being paralyzed. Costs associated with these incidences (both hospital costs and costs associated with lost productivity and health care) represent components which, while not necessarily borne by the individual fishers are borne by society at large. These added costs, if included in the estimation of producer surplus (as they should be), would result in negative producer surplus and a net economic loss to society from queen conch fishing (based on the assumption that consumer surplus is insignificant). Taking the initial argument to its logical conclusion, losses in producer surplus could be reduced immediately by prohibiting SCUBA/HOOKAH for the take of queen conch in the EEZ.

On a more practical note, a total prohibition of SCUBA/HOOKAH gear in the EEZ, assuming no phase-in period, would create short term losses that can be expressed in terms of lost landings and ex-vessel value. The degree to which landings and value would be depressed as a result of a prohibition on SCUBA/HOOKAH gear would depend on the availability of conch in depths accessible to free diving. No data exist, however, to address this issue.

In the long run, economic benefits derived from the prohibition of SCUBA/HOOKAH are likely to be significant and varied. First, fewer injuries would represent one benefit to society. While estimated MSY for the Puerto Rican queen conch fishery differs depending on the method of analysis, it appears to be less than 300 thousand pounds (Appledoorn, 1987). This suggests maximum sustained revenues for the fishery in the six-hundred thousand to seven-hundred thousand dollar range, given the current dockside price. Assuming producer surplus exists from the fishery, which is debatable given its open access nature, it is certainly considerably less than any revenues that could potentially be derived. The costs to society from even a minimum number of cases of paralysis and/or death from SCUBA/HOOKAH would almost surely outweigh any producer surplus, or even revenues, that could potentially be derived from the fishery; even at MSY and/or under an effort limitation program.

A second likely economic benefit associated with the prohibition of SCUBA/HOOKAH in the EEZ is tied to the premise that, over time, conch could be found in shallower waters in increased abundance. Deeper waters, inaccessible to free diving, would act as a conservation zone where

[15] These costs include the opportunity costs of labor and capital.

the reproductive population would be protected. The Organization of Eastern Caribbean States has proposed such a regulation for this purpose (Berg and Olsen, 1989). Free diving entails significantly fewer costs than SCUBA diving. Based on the cost data previously provided, diving tanks alone (refilling) represent from about 25% to 40% of a trip's total costs. This cost component would immediately be eliminated. Since distance travelled would also decline, fuel costs, the other major component of a diving trip, would also fall. As stock recovers through time and abundance in shallower waters is enhanced, costs per unit of catch will decline. Long term benefits could be additionally enhanced if an effort limitation program is established.

A concern expressed by fishers at public hearings is that implementation of Management Measure 5 would require them to return to port to secure SCUBA equipment if they were to harvest other species by diving on the same day they were harvesting conch. Such actions would entail additional costs in time, fuel, etc. And at the extreme, the Management Measure may well limit the number of alternative species that could be harvested on a given conch trip. This would result in a reduction in revenues and profits per trip above and beyond the direct loss associated with the taking of lesser quantities of queen conch in the short run.

The discussion to this point has been general in that SCUBA and HOOKAH gear are considered together. The preferred measure would prohibit only the use of HOOKAH gear in the EEZ for the taking of queen conch. While no data exist which documents the extent of HOOKAH in the EEZ, it is thought to be insignificant relative to SCUBA. Hence, net economic benefits related to the prohibition of HOOKAH are likely to be very minor. Furthermore, biological benefits will also be minor.

Option 5A: **Prohibit the harvest of queen conch in the EEZ using SCUBA gear.**

For reasons cited above, significant long run economic benefits could likely be achieved by prohibiting the use of SCUBA in the EEZ if compliance is reasonable.

Option 5B: **Prohibit SCUBA gear in waters less than 35 feet deep.**

The federal waters do not have areas this shallow. In principle it would be very hard to enforce a measure of this type. That is, how is it really known if conch came from waters deeper than 35 ft while the fisher is in transit from the fishing ground to the landing dock.

The prohibition of SCUBA gear is not considered a viable option by the local governments; at least is not in the USVI regulations and it is not in the PRDNER draft for the management of queen conch.

This measure does not appear to be enforceable and would not provide benefits but would increase management costs.

Option 5C: **No Action**

Taking 'No Action' will result in the worsening of the decline trend observed in the fishery. SCUBA and HOOKAH gear allow for increased bottom time and increase in income as long as in the area fished the populations are not overfished. Increase in bottom time and deep water diving put the fisher at risk by increasing the chance of decompression sickness (bends). The increase in bottom time results in increased harvesting, most likely of the spawning population which returns to deeper water after spawning.

## 7.0 ANALYSIS OF REJECTED MEASURES

7.1 Closing half of the waters around Puerto Rico for two years, then alternating.

This measure has a likely negative outcome due to the disruption of the continuity of the fisheries. If the fisheries are interrupted, the implication is that fishers will migrate long distances every other year to fish in the open area and this would increase the costs of fishing, increase the fishing effort in localized areas, create conflicts among fishers, and reduce net benefits. Other approaches to restore the queen conch resource appear to be superior.

7.2 Close all waters around Puerto Rico out to the 35-foot contour line.

This measure does not appear to be enforceable and would not provide benefits but would increase management costs. The measure would protect juvenile queen conch and thus help in the rebuilding of the stock.

7.3 Establish a size limit by sex.

According to the FMP, it is difficult to distinguish between the sexes and the measure is unnecessary because both sexes mature at the same age. Enforcement agents would require additional training because the differences in size between the sexes are in most cases not significantly different.

7.4 Limited entry.

This measure cannot be evaluated because the methods to limit entry or effort have not been specified. In order to preserve the gains from other measures designed to rebuild stocks, some form of limited entry/effort will be necessary at some point in the future and should be formally addressed after the FMP has been implemented.

7.5 Prohibit imports during the closed season (July 1 to September 30).

The Council does not possess the legal authority to implement the measure.

Attempting to prohibit imports introduces legal problems. Import prohibitions must respond to the objectives of the FMP and meet the requirements of the Magnuson Act and other applicable law. In this case the CFMC determined with the advice of NOAA Regional Counsel, that neither criterion was met. This would not preclude local governments from taking independent action in this regard.

7.6 Institute a five (5) year moratorium on the harvest of queen conch in the EEZ off Puerto Rico and the U.S. Virgin Islands.

At one time, a moratorium on the harvest of queen conch in the U.S. Caribbean EEZ was considered. The approach was abandoned in lieu of an effort (mortality) reduction program because of the lack of a positive response of the resource in areas that have been closed. For example, the Florida fishery has been closed for nine (9) years and has shown little or no sign of recovery. This may be due to resource depletion in areas responsible for recruitment to Florida, to habitat degradation, or to Florida's location on the northern fringe of the range, or a combination of the three. At any rate if mortality can be reduced sufficiently by decreased effort (i.e., sufficient to maintain population levels above 20 percent SPR--the level designated as overfished), then the population should recover under the harvest reduction program with fewer economic impacts than a total closure.

The U.S. Virgin Islands closed their conch fishery off St. Thomas/St. John for a total of five years, but any gains were liquidated before they could be measured as the fishery was reopened without more restrictive measures in place.

## 8.0 MANAGEMENT COSTS

Statement of Estimated Cost as of September 30, 1995

I Costs associated with Council Meetings

| | |
|---|---|
| Estimated Cost of Council Members Compensation to one meeting 1* | $4,519 |
| Estimated Cost of Travel Expenses to one meeting 2* | 3,430 |
| Estimated Cost of Compensation and Travel Expenses to one meeting | $7,949 |

Council Meetings are estimated to last 16 hours. It has been estimated that the Council devoted 56 hours to the Draft Queen Conch FMP at meetings between meetings 50th and 81st.

| | |
|---|---|
| 56 hrs ÷ 16 hrs/meeting = 3.5 meetings | |
| $7,949.00 per meeting x 3.5 meetings = | $27,821 |

II Time Devoted by Staff

It is estimated that the Special Assistant to the Executive Director for FMP Development and the Executive Director had dedicated ten percent (10%) of their time during the last two years to the development of the Queen Conch FMP.

| | |
|---|---|
| Salary of the Special Assistant 2 years at 10% - | $18,449 |
| Salary of the Executive Director 2 years at 10% - | $26,498 |
| Estimated Cost of Staff | $44,947 |

III Public Hearings

| | |
|---|---|
| Estimated Council Member Compensation to one-day hearing (1) | $ 340 |
| Estimated Council Member Travel Expenses to one-day hearing (1) | 225 |
| Estimated Staff Members Travel Expenses to one-day hearing (3) | 675 |
| Estimated Cost of Conference Room (one hearing) | 200 |
| Estimated Cost of Announcements (one hearing) | 600 |
| Estimated Cost of One Public Hearing (one-day) | $ 2,040 |

It has been estimated that 17 public hearings were held on Queen Conch during the period 1989-1990

$2,040 per hearing x 17 hearings = $34,680

1* Based on average daily compensation for the years 1990, 1991 and 1992
2* Based on the average of Per Diem for the years 1990, 1991 and 1992

IV Contractors

| | | |
|---|---|---|
| Dr. Richard Appeldoorn | - determination of MSY for the fishery | $ 1,000 |
| Dr. Manuel Valdés Pizzini | - socio-economic study of the fishery | 1,000 |
| Sea Grant Program of UPR | - Study of Spawning Potential Ratio | 5,000 |
| Mr. William Turner | - to write the FMP document | 17,000 |
| Dr. Walter Keithly | - to finalize the Regulatory Impact Review | 9,000 |
| | Total Cost of Contractors | $33,000 |

V Summary of Estimated Costs

| | |
|---|---|
| Consideration at Council Meetings | $27,821 |
| Time Devoted by Staff | 44,947 |
| Public Hearings | 34,680 |
| Contractors | 33,000 |
| Total Estimated Cost of the Development of the Queen Conch FMP as of September 30, 1995 | $140,448 |

SUMMARY OF COSTS OF FMP

| | |
|---|---|
| Caribbean Council (Through September 30, 1995) | 140,448 |
| NMFS Administrative (One-time) | 25,000 |
| Enforcement (Annual) | 176,318 |
| Permits and Data Reporting (Annual)* | NA |
| **TOTAL FIRST YEAR COST (Exclusive of permits and data reporting)** | **$343,766** |

*** To be handled by states**

## 9.0 SUMMARY OF NET ECONOMIC BENEFIT OF PREFERRED AND ALTERNATIVE MANAGEMENT MEASURES

The following table constitutes the summary of economic outcomes.

QUEEN CONCH FMP
SUMMARY OF BENEFITS, LOSSES AND COSTS

| MEASURE | BENEFITS | LOSSES | NET BENEFITS |
|---|---|---|---|
| 1. Length of 9 inches or 9.5mm lip thickness | Short-term increase in producer surplus is possible but not assured. Longer-term benefits are more assured. Effects on personal use fishers is largely unknown due to lack of data. | Short-term losses for the first year may be incurred by commercial and personal use fishers. | Positive, with enforcement/ compliance being critically important. |
| 1a. Length of 7 or 8 inch | Negative expected. This is roughly the status quo. | Small or none because measure should not have much impact on take. | Essentially the same as status quo. |
| 1b. Puerto Rico - 8 inches USVI - 9 inches | Likely minor increases in long-term producer surplus. | Small short-term loss of producer surplus. | Essentially the same as status quo. |
| 1c. Two uncleaned or 3 cleaned meats/lb. | None projected because of enforce-ment problems. | NONE | NO CHANGE |
| 1d. No action | Inferior to pre-ferred measure (no change). | Inferior to pre-ferred measure (no change). | NO CHANGE |
| 2. Prohibit sale of undersized conch or conch shells | Positive because of increased compliance re size limit. | None projected. | Positive |
| 2a. No action | NONE | NONE | NO CHANGE |

(continued)

QUEEN CONCH FMP
SUMMARY OF BENEFITS, LOSSES AND COSTS

| MEASURE | BENEFITS | LOSSES | NET BENEFITS |
|---|---|---|---|
| 3. Bag limit of 3 for personal use and 150 for commercial in first year. Bag limit to decline to 75 by third year. | None commercial. Possible increased personal use benefits if stocks rebuild and commercial effort is curtailed. | Short and long-term commercial due to inefficiencies in harvesting. Possibly some short-term personal use benefits lost. | Negative for commercial. Positive for personal use fishery. |
| 3a. Bag limit of 3 for personal use and 75 for commercial | None or minor for personal use, none projected for commercial | Major short and long-term commercial losses. Perhaps positive long-term benefits for personal use. | Negative for commercial and overall positive for personal use. |
| 3b. No action | NO CHANGE | NO CHANGE | NO CHANGE |
| 4. Closed season July-September | Increased producer surplus from commercial fishery. Minor or no benefits for personal use fishery. | Small or none for commercial Relatively large losses in consumer surplus for personal use. | Overall increase. |
| 4a. No action | NO CHANGE | NO CHANGE | NO CHANGE |
| 5. Prohibit the use of HOOKAH in EEZ | Minimal | Minimal | Minimal |
| 5a. Prohibit use of SCUBA in EEZ | Relatively little short-run benefits but potential for significant increase in producer surplus in long-run. | Short-run commercial losses. | Significant positive net benefits. |
| 5b. Prohibit the use of SCUBA in waters under 35 feet | None because not enforceable. | None projected. | NO CHANGE |
| 5c. No action | NO CHANGE | NO CHANGE | NO CHANGE |

Other Possible Actions

This RIR serves to point out that the proposed set of preferred options do not provide for continuing long term benefits. The reason is that once any benefits from stock recovery become known (or perhaps even anticipated) the total amount of fishing effort will almost surely increase and the benefits will be dissipated. This outcome will not exist if these proposed management rules are considered to be in effect long enough to realize the stock recovery benefits but not long enough to allow the addition of a significant amount of new effort. In other words, if these measures can be considered as interim, then the identified benefits can be realized.

One problem with interim restrictions that provide benefits for some period of years is that the next set of rules has to be more restrictive if continuing benefits are to occur. This phenomenon, which at the same time is highly predictable and inevitable, is showing up in the mainland snapper/grouper and other finfish fisheries. Both of the mainland Councils have FMP's for all major finfish fisheries and both Councils are continually in the process of formulating more restrictive rules. For this reason, those Councils are now seriously considering management by individual transferable quota (ITQ) and the South Atlantic has implemented ITQ management for wreckfish.

Even though the class of alternatives involving limited entry, limited access or limited effort has been widely discussed for the Caribbean fisheries for a number of years, this discussion probably has to continue. There simply are no other long term types of alternatives which can be seen to resolve the joint biological and economic problems associated with overfishing of common property resources. The notion of some form of limited entry clearly has a host of stumbling blocks in the socio-political arena and is difficult to implement and that probably accounts for the reason limited entry discussions never result in formal alternatives to be rigorously addressed by fishery management bodies until all other management avenues have been fully exhausted. While recognizing that limited entry schemes are difficult to implement, there are some other potentially useful features of limited entry beyond resolving the problems associated with an ever-increasing level of total fishing effort. In general, the cost of management could be reduced if the limited entry scheme is less cumbersome than a host of individual restrictive measures on various gears, areas, individuals, etc. The potential of simpler, less costly and more effective enforcement may be one of the more attractive features. As has been noted several times in this RIR, the lack of enforcement or the cost of needed enforcement is a serious detriment to the realization of potential benefits from current management regimes.

## 10.0 INITIAL REGULATORY FLEXIBILITY ANALYSIS

The Regulatory Flexibility Act requires a determination as to whether or not a proposed rule has a significant impact on a substantial number of small entities. If the rule does have this impact then an Initial Regulatory Flexibility Analysis (IFRA) has to be completed for public comment. The IRFA becomes final after the public comments have been addressed. If the proposed rule does not meet the criteria for "substantial number" and "significant impact," then a certification to this effect must be prepared.

For this proposed rule the "substantial number" part of the determination will hold because virtually all the conch harvesting businesses in Puerto Rico and the U.S.V.I. will be affected by the proposed rules.

The outcome of "significant impact" is less clear but can be triggered by any of the following conditions.

- The regulations are likely to result in a reduction in annual gross revenues by more than 5 percent.

- Annual compliance costs (annualized capital, operating, reporting, etc.) increase total costs of production for small entities by more than 5 percent.

- Compliance costs as a percent of sales for small entities are at least 10 percent higher than compliance costs as a percent of sales for large entities.

- Capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow and external financing capabilities.

- The requirements of the regulation are likely to result in a number of the small entities affected being forced to cease business operations. This number is not precisely defined by SBA but a "rule of thumb" to trigger this criteria would be two percent of the small entities affected.

Although the RIR does not quantify the short term reduction in catches that are necessary to provide for stock recovery and subsequent economic gains, the first criteria of a 5 percent reduction in gross revenues will undoubtedly be met. Hence, an IFRA is required, and is based largely on the information contained in the FMP and the RIR. The IFRA follows.

Explanation of Why the Action is Being Considered

Refer to Chapter 4, "Problems in the Fishery", of the FMP document.

Objectives and Legal Basis for the Rule

Refer to Chapter 5, " Management Objectives", of the FMP document. The Magnuson Fishery Conservation and Management Act of 1976 provides the legal basis for the rule.

Demographic Analysis

Refer to Appendix I, "Social Impact Assessment", to the FMP document.

Cost Analysis

Refer to other subsections of this package. In particular see sections 6, 7, 8 and 9 ("Analysis of Proposed Management Measures", Analysis of Rejected Measures", "Management Costs" and "Summary of Net Economic Benefit").

Competitive Effects Analysis

The industry is composed entirely of small businesses. Hence, the impacts of the measures considered under this amendment will not involve disproportional effects on small versus large businesses.

Identification of Overlapping Regulations

The proposed action does not create overlapping regulations with any state regulations or other federal laws. For further discussion, refer to Chapter 8, "Related Management Jurisdictions, Laws and Policies" of the FMP document.

Conclusion

The proposed actions will clearly have significant effects on a substantial number of small businesses. The foregoing analysis, based largely on references to information in the RIR, SIA and FMP, are deemed to satisfy the analysis required under the RFA.

## REFERENCES


Appeldoorn, R.S. 1986. Size measurements from populations of queen conch (Strombus gigas) in Puerto Rico. Ms. Rept. to the Caribbean Fishery Management Council, San Juan, P.R. 25 p.

Appeldoorn, R.S. 1987. Assessment of mortality in an offshore population of queen conch, Strombus gigas L., in southwestern Puerto Rico. Fish. Bul. 85(4):797-804.

Appeldoorn, R.S. 1987. Considerations and preliminary calculations of maximum sustainable yield for the queen conch (Strombus gigas) resource of Puerto Rico and the U.S. Virgin Islands. Rep. Caribb. Fish. Manage. Counc., pp. 1-20.

Appeldoorn, R.S. 1988. Ontogenetic changes in natural mortality rate of queen conch, Strombus gigas (Mollusca: Mesogastropoda). Bull. Mar. Sci. 42(2):149-165.

Appeldoorn, R.S. 1991. Variations in queen conch morphology around Vieques Island, Puerto Rico. Ms. Rept. to the Caribbean Fishery Management Council, Hato Rey, P.R. 24 p.

Appeldoorn, R.S. and D.L. Ballantine. 1985. Assessment of fisheries of queen conch, Strombus gigas in Puerto Rico. Ms. Rept. to the U.S. Natl. Mar. Fish. Serv. under contract NA85-GA-C-00015. 62 p.

Berg, C.J., Jr. and D.A. Olsen. 1989. Conservation and management of queen conch (Strombus gigas) fisheries in the Caribbean. In: J.F. Caddy (ed.), Marine invertebrate fisheries: Their Assessment and Management. J. Wiley and Sons Inc., NY, pp. 421-442.

Goldstein, M. and M. S. Khan. 1985. Income and Price Effects in Foreign Trade. Chapter 20 In: R.W. Jones and P.B. Kenen (eds.), Handbook of International Economics, Vol. II. Elsevier Science Publishers B.V. pp. 1041-1105.

Houck, J.P. 1965. "The Relationship of Direct Price Flexibilities to Direct Price Elasticities." J. Farm Econ. 47:789-792.

Hughes, S. and C. Ninnes. Undated. Developing a Management Strategy for the Queen Conch (Strombus gigas) in the Turks and Caicos Islands. Ms. Rept. to Dept. of Fish. Turks and Caicos Islands.

Matos Caraballo, D. and Y. Sadovy. 1990. Overview of Puerto Rico's small-scale fisheries statistics 1988-1989. Informe Técnico, CODREMAR, 1(4):1-17.

Weiler, D. and J. A. Suarez-Caabro. 1980. Overview of Puerto Rico's Small-Scale Fisheries Statistics 1972-1978. Informe Técnico, CODREMAR, 1(1):1-27.

Wells, S.M. 1989. Impacts of the Precious Shell Harvest and Trade: Conservation of Rare or Fragile Resources. In: J.F. Caddy (ed.), Marine invertebrate fisheries: Their Assessment and Management. J. Wiley & Sons., Inc. New York.

Wells, S.M., R.M. Pyle, and N.M. Collins. 1983. "Commercially Threatened Queen or Pink Conch." The IUCN Invertebrate Red Data Book. Pub. IUCN, Gland, Switzerland. pp. 79-90.

Appendix to RIR

Data used to conduct an analysis of Management Measures 3 and 4 in the RIR were provided by the Puerto Rico Department of Natural and Environmental Resources and the U.S. Virgin Islands Division of Fish and Wildlife, Department of Planning and Natural Resources. The data, which represent trip tickets provided by the fishers to the responsible agencies, do not represent the total number of trips but should instead be considered as a sample. This is so in the U.S.V.I. because all licensed fishers have historically not returned the monthly trip tickets. The data used in the analysis for Puerto Rico included only that portion of the database which could clearly be identified as a single unique trip. Hence, trip tickets where the number of reported trips equalled zero or were greater than one were deleted prior to analysis.

Appendix Table 1.

Summary Population, Income, and Tourism Statistics for Puerto Rico, 1980-93.

| | Population | Disposable Personal Income | | Tourism | |
|---|---|---|---|---|---|
| | | Current | Deflated[a] | No. of Visitors | Visitor Expenditures |
| | (1,000s) | (---------- $ Mill ----------) | | (1,000s) | ($ Mill) |
| 1980 | 3,206 | 10,932 | 3,947 | 1,627.4 | 615.0 |
| 1981 | 3,247 | 12,100 | 3,965 | 1,573.4 | 649.7 |
| 1982 | 3,263 | 12,688 | 3,934 | 1,563.7 | 699.2 |
| 1983 | 3,265 | 12,695 | 3,827 | 1,529.8 | 690.9 |
| 1984 | 3,270 | 13,425 | 3,986 | 1,496.4 | 681.2 |
| | | | | | |
| 1985 | 3,276 | 13,760 | 4,032 | 1,642.3 | 757.7 |
| 1986 | 3,279 | 14,274 | 4,124 | 1,695.6 | 792.6 |
| 1987 | 3,285 | 15,289 | 4,377 | 2,034.9 | 955.4 |
| 1988 | 3,293 | 16,390 | 4,564 | 2,280.5 | 1,112.3 |
| 1989 | 3,497 | 18,170 | 4,921 | 3,221.2[b] | 1,254.0 |
| | | | | | |
| 1990 | 3,528 | 19,914 | 5,238 | 3,425.8 | 1,366.4 |
| 1991 | 3,549 | 20,632 | 5,198 | 3,504.3 | 1,435.7 |
| 1992 | 3,579 | 21,222 | 5,294 | 3,722.2 | 1,520.0 |
| 1993 | 3,621 | 22,664 | 5,596 | 3,871.1 | 1,629.1 |

[a] Expressed in 1954 dollars.

[b] Though not reported, some change in the definition of a tourist likely occurred in the late 1980s.

Source: U.S. Dept. of Commerce, Economics and Statistics Administration, Statistical Abstracts of the United States (various issues).

Appendix Table 2.

Trips and Associated Catches Among Identified Queen Conch Fishers Who Landed 500 Pounds or More of Queen Conch in a Fiscal Year, U.S. Virgin Islands, 1991 (July) - 1994 (June).

| | Trips | | | Catch (Lbs) | | | | |
|---|---|---|---|---|---|---|---|---|
| Month | Conch | Total | % Conch | Conch | Lobster | Other | Total | Estimated Revenues Per Trip ($) |
| January | 145 | 363 | 39.9 | 8,286 | 3,424 | 15,746 | 27,456 | 260 |
| February | 142 | 360 | 39.4 | 8,050 | 3,250 | 16,939 | 28,239 | 265 |
| March | 172 | 401 | 42.9 | 8,605 | 4,374 | 19,187 | 32,166 | 276 |
| April | 144 | 360 | 40.0 | 6,905 | 4,160 | 18,517 | 29,582 | 281 |
| May | 105 | 311 | 33.8 | 4,896 | 1,687 | 9,745 | 16,328 | 175 |
| June | 100 | 261 | 38.3 | 5,079 | 1,320 | 12,102 | 18,501 | 224 |
| July | 12 | 303 | 4.0 | 817 | 4,785 | 16,774 | 22,376 | 259 |
| August | 5 | 339 | 1.5 | 151 | 4,977 | 20,161 | 25,289 | 253 |
| September | 0 | 341 | 0.0 | 0 | 4,577 | 19,791 | 24,368 | 240 |
| October | 153 | 381 | 40.2 | 8,921 | 4,425 | 17,313 | 30,659 | 282 |
| November | 112 | 338 | 33.1 | 5,948 | 4,893 | 17,029 | 27,870 | 293 |
| December | 128 | 314 | 40.8 | 7,545 | 3,424 | 13,998 | 24,967 | 278 |

Note: Average total number of trips per month during the three month closed queen conch season equalled 328, or approximately 4% less than the average of 343 per month during the nine month period when conch harvesting is permitted. Estimated revenues per trip during the open season averaged $262 compared to $250 during the closed season.