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ABSTRACT

Strombus gigas (Queen Conch) is an economically important fishery species managed by an export quota system in the Turks and Caicos Islands (TCI). The quota is based on the maximum sustainable yield (MSY) less an allowance for domestic consumption. A lack of data on domestic consumption however, raises the concern that if underestimated, stocks managed using MSY will diminish from over harvest. In 1999-2000, 5% of the MSY was allocated for domestic consumption, however, there is anecdotal evidence that domestic consumption of conch is much higher. In 2003, of the Total Landed Conch (1,657,876 lbs), 99% was exported, suggesting most domestic consumption does not pass through this system. To provide an accurate estimate of conch consumption by TCI residents, an intercept survey was administered to the adult population between July and September 2004. Information collected included individual consumption of conch and other seafood as well as limited demographic information (age, gender, island of residence, nationality). The majority of respondents ate conch (72%). The majority of conch consumed does not go through the market, with 15% claiming personal capture, while 36% receive the conch as a gift from fishermen. Median serving size differed by island (Kruskal-Wallis test: $H(3, n = 258) = 23.760, p = 0.0000$) and gender ($H(1, n = 339) = 6.651, p = 0.010$). The median serving size was 0.114 kg for all respondents. Frequency of consumption did not vary significantly by island or age, but differed by nationality (Kruskal-Wallis test: $H(3, n = 337) = 10.240, p = 0.017$), source ($H(3, n = 250) = 22.087, p = 0.0001$) and gender ($H(1, n = 339) = 7.781, p = 0.005$). The median frequency of consumption was 4.333 times/month. Concerns with potential biases in the results will be addressed through the use of a supplemental survey to be administered in conjunction with the larger survey to an additional sample of residents. With more conclusive figures, local consumption can be included in the calculations for MSY and utilized to determine the landings quota.

KEY WORDS: Conch, local Consumption, Turks and Caicos Islands

El Consumo de Caracola Local por Residentes del TCI

En las islas Turkos y Caicos (TCI) la especie *Strombus gigas* (Caracola de Reina) es económicamente importante en las pesquerías manejada por un

sistema de la cuota de la exportación. La cuota se basa en el rendimiento sostenible máximo (MSY) menos una concesión para el consumo doméstico. La falta de datos en el consumo doméstico levanta el peligro que la pesquería es subestimado, y el uso de MSY solamente, podría resultar en sobre cosecha. En 1999-2000 5% del MSY fue asignado para el consumo doméstico, sin embargo, evidencia anecdótica indica que el consumo doméstico de caracola es mucho más alto. En 2003, del total de Caracola pesquado (lbs de 1,657,876), 99% fue exportado, sugiriendo que la mayoría de los consumos domésticos no pasan por este sistema. Para proporcionar una estimación exacta del consumo de caracola por residentes de TCI, administramos un estudio de 201 adultos entre los meses de Junio y Agosto en 2004. La información incluyó tres temas: el consumo individual de caracola; el consumo individual de otros tipos de mariscos; información demográfica limitada (edad, género, isla de residencia, nacionalidad). La mayoría (72%) de participantes comen caracola. La gran proporción de caracola consumida no pasa por el mercado, sino 26% reclaman a través de la captura personal, mientras 37% adquieren caracola en forma de regalo de un pescador. El consumo medio de caracola era 42 lbs/persona/año (± 6 , el error uniforme). El análisis de ANOVA que no hay diferencias significativas en niveles de consumo entre las cuatro islas representadas ($df = 3$, $p = 0,90$), o las nacionalidades ($df = 3$, $p = 0,83$). Los datos resultados del censo de población 2001, indican que el consumo anual medio de caracola limpiada se estima ser más alto que el 5% asignado. Para mejorar la administración de Caracola de Reina en el TCI, un porcentaje exacto (basado en las inspecciones) debe ser incluido en los cálculos para MSY y utilizado para determinar la cuota.

PALABRAS CLAVES: Caracol de reina, *Strombus gigas*, consumo doméstico, las islas Turkos y Caicos

INTRODUCTION

People throughout the world, including the Caribbean region, have relied on marine resources as an important source of food. Marine resources such as fish stocks are not infinite and require a responsible management and development to contribute to the nutritional, economic, and social prosperity of the people in the Caribbean region (Haughton 1999).

The management of marine fisheries to ensure the best use of the resources of the ocean has become the major problem over the years facing fishery scientist and managers (Gulland 1974) in the region. Haughton (1999) argues that the traditional approaches to fisheries development and management will not transform Caribbean fisheries into sustainable dynamic systems capable of meeting future demands for food and employment. He proposes that a combination of traditional and new, innovative approaches are needed in the region for sustainable fisheries development. It is now widely accepted by many that the effective management of fisheries resources, requires a holistic approach, that is, the incorporation of interrelated disciplines taking into account all components which may impact on the fishery, including biological and socio-economic aspects. It is also important to consider all available

information concerning exploitation levels, such as commercial catch destined for export as well as for local consumption.

The Caribbean queen conch (*Strombus gigas*) is one of the most important marine fisheries in the region, being surpassed in economic value only by the spiny lobster (*Panulirus argus*) and by fin-fish as a dietary supplement (Brownell and Stevely 1981). Queen conch exploitation as a source of protein in the region has a long tradition dating back to pre-Columbian times (Sadler 1997, Clerveaux and Danylchuk 2001, Theile 2001).

With the introduction of freezing technology coupled with the growing demand and the expansion of export markets, queen conch stocks have been fished to such low levels in many countries that a viable fishery no longer exists in many of these locations (Clerveaux 2003). In an attempt to manage the queen conch resources, an assortment of mathematical models are being utilised by many range States to predict the productivity of the resource, the effect of fishing pressure, as well as the impact of management measures on the resource (Gulland 1983). On the other hand, Sparre and Venema (1992) pointed out that a model is only as good as its inherent assumptions and input parameters.

The importance of local consumption information is exemplified in the use of mathematical models such as surplus production models (e.g. Schaefer Model) which utilise catch and effort data to assess the status of the stock. Incomplete catch information may underestimate production and/or overestimate the stock size thereby masking gradual overexploitation of the resources.

Many countries in the region are faced with a similar challenge, that is, the lack of complete time series data sets. Most fisheries data in the region only represent catch which are destined for export, generally landed at centralized locations. In contrast, catch utilised for local consumptions is often more difficult to track because of the numerous possible landing sites which may exist in any one country.

Many countries, for example Belize, have reported that the catch obtained from the co-operatives or fish processing plants are not a true representation, as it does not include what is sold on the local market. Hence, the estimates based on the catch and effort data are considered unreliable. Similarly, the Bahamas have reported that the biomass dynamic (Schaefer) model, which is currently utilized to assess the status of the queen conch stock, did not produce a good fitted to the observed catch and effort data because of inadequate data (Anonymous 1999).

Likewise, in countries with a high tourist population, such as Grenada and the U.S. Virgin Islands, conch is used extensively by the local people. The fishery is artisanal in nature, and therefore, conch are marketed by fishermen along the roadside or sold directly to hotels and restaurants. The respective management authorities have reported that this arrangement has created a problem in determining total production (Anonymous 1999).

The challenges facing the Turks and Caicos Islands are similar to that of many countries in the region. Conch has been fished in the TCI for many years and used as a local food or for trade with Haiti. Catch and effort data are collected from the five processing facilities located on the islands of Providenciales and South Caicos. To date product diverted from the processing plants

is not documented. In 2003, of the Total Landed Conch (1,657,876 lbs), 99% was exported, with the remaining 1% sold locally to restaurants and individuals. Since 1992, the TCI has utilized a biomass dynamic (Schaefer) model to determine stock biomass which forms the basis of the yearly queen conch Total Allowable Catch (TAC).

Medley and Ninnes (1998) reported that the model did not fit the observed CPUE time series well. While overall the fit seems reasonable, the model has consistently underestimated the CPUE in recent years, forecasting a decline which has never materialized. It is proposed that the model is inherently faulty because not all catches are accounted for owing to fluctuations in local consumption and/or illegal catches (Anonymous 1999, Clerveaux and Danylchuk 2001).

Ninnes (1994) proposed that since local consumption is not taken into account in the catch data, then the data only represents a minimum estimation of total catch. Few previous estimates of local conch consumption have been made for the TCI. In 1984, Olsen estimated local seafood consumption index of 25.9 kgs/person/year for the Eastern Caribbean, including the Turks and Caicos Islands. He further estimated local consumption of queen conch at 312 mt (Olsen 1985). In 1985, Olsen estimated local consumption of queen conch for all residents and visitors in the Turks and Caicos Islands to be at 35.4 kgs/person/year, which Medley and Ninnes (1998) suggest is referring to unclean meat. In 2001, a social and economic impact census was conducted to validate the quantify the estimates from Olsen in (1985). Clerveaux (2003) estimated a conch consumption rate of 4.93 kgs/resident. However, unlike Olsen a separate tourist consumption rate of 0.28 kgs/person was determined. However, the estimation of consumption is assumed to be underestimated, because of the small number of surveyed respondents.

It was customary for the TCI to set the TAC at the MSY. However, from the 1999 - 2000 fishing season to the 2002 - 2003 fishing season, 5% of the MSY has been allocated for local consumption. In 2003 - 2004 fishing season, the allocation for local consumption was raised to 10% of the MSY, because of the increased concern of growing local consumption. The particular study reports the initial results of TCI residents' local conch consumption.

MATERIALS AND METHODS

Survey Design

Consumption surveys are generally conducted at the household level (Myrland et al. 200, Olsen 2001, 2003), with individual consumption calculated as the total prepared for the household divided by the number of individuals in the household (Anderson et al. 1994). In the TCI there are a large number of island commuters who live on multiple islands, which precludes household level data collection. By surveying random individuals, the potential for double counting was eliminated.

The survey was designed and pretest in March 2004. The six pre-tested individuals illustrated some of the difficulties with the standard format. Participants requested that they be allowed to determine their own time frame

for frequency of consumption on either a weekly, monthly or yearly basis. Some individuals had difficulty in determining quantity of conch contained in a meal. This led to the development of visual aids. Additionally, some respondents showed a preference for reporting consumption in terms of number of conch, rather than in weight. Conversion calculations were developed allowing for reporting in both formats. Finally, several participants indicated difficulties determining individual consumption as they prepared meals for the household. To assist these people, a section was added which allowed for reporting of household data, however respondents were still asked to determine his/her individual share of that consumption.

The intercept survey was administered by trained DECR conservation officers July – September 2004 on Grand Turk, Providenciales and South Caicos. The stratified design by island population and nationality was based on the adult resident population (> 15 years of age) as determined by 2001 Population Census for the Turks and Caicos Islands.

Weigh Calculations and Visual Aids

To allow for the conversion of alternate formats of a “serving of conch”, a variety of calculations were conducted and visual aids created. Conch cleaning tests determined that a conch fully cleaned of all skin, viscera (eyes, mouth, snout, anus, rectum, kidney and stomach) and operculum weighed an average of 0.11 kgs. Local restaurants indicated a serving size of conch was consistent with the 0.11 kgs. Additionally, tests determined that 20 conch fritters also utilized 0.11 kg of cleaned conch.

Alternatively, to weight calculations, a visual aid was created to allow respondents to visualize a one conch serving. A single serving of cracked conch (0.11 kg) was placed on a dinner plate with traditional side dishes and photographed. Respondents were able to base serving sizes relative to the pictured portion.

Data Analysis

The data were analyzed using a non-parametric Kruskal-Wallis ANOVA by Ranks test (StatSoft 1998), as the data failed tests for homogeneity and normality.

RESULTS

A total of 434 surveys were conducted with 359 useable for the conch component of this analysis. The demographic profile of respondents closely matched that of the general population (Table 1), except for an over-representation of South Caicos residents and an under-representation of the Haitian community. This was the result of logistical and linguistic difficulties in Providenciales, limiting the number of surveys that could be completed within the allocated time. This issue will be addressed under recommendations.

Table 1. Demographic comparison of survey respondents and Turks and Caicos Island 2001 Population Census.

	2001 Census		Respondents	
	#	%	#	%
Island population >15 yrs old				
Providenciales	9,247	65.2	151	42.1
Grand Turk	2,830	19.9	87	24.2
South Caicos	777	5.5	101	28.1
Other islands	1,338	9.4	20	5.6
Nationality by total population				
TCI Belonger	10,335	52.0	217	64.4
Haitian	5,027	25.3	53	15.7
Dominican	693	3.5	28	8.3
Other	3,883	19.3	39	11.6
Gender for those > 15 yrs old				
Female	7,033	49.6	170	50.2
Male	7,160	50.4	169	49.9
Age				
15-24 yrs	2,663	18.8	79	22.8
25-49 yrs	9,168	64.6	231	66.6
50-64 yrs	1,605	11.3	30	8.7
65+	775	5.3	7	2.0

Source of Conch Consumed

The source of conch for personal consumption appears to differ by island (Figure 1) and nationality (Figure 2). Approximately 51% of TCI conch consumers obtained their conch from non-market sources, including personal capture (15%) and as gifts from fishermen (36%). The proportions differ by island with South Caicos having the highest share obtained as gifts from fishermen (65%) and Grand Turk having the lowest (13%). Grand Turk however, has the highest proportion of conch obtained by personal capture (25%).

There appears to be differences between nationalities in the source for conch consumed (Figure 3), with TCI Belongers (native born residents) and Haitians obtaining a larger share from personal capture and gifts from fishermen compared to other nationalities. A higher proportion of individuals from the Dominican Republic and countries other than Haiti or the TCI obtain their conch by buying it or eating at restaurants.

Frequency of Consumption and Serving Size

Total consumption is a combination of the frequency with which people eat conch and the average serving size. Overall 28% of the population indicated they do not consume conch (Figure 4). The mean frequency of consumption for those that consumed conch was 6.723 times/month (± 0.427 SE), with a median value of 4.333 times/month. Frequency of consumption did not vary significantly by island (Kruskal-Wallis test: $H(3, n = 359) = 4.487, p = 0.216$), or age ($H(1, n = 339) = 7.781, p = 0.0741$), but did differ by nationality ($H(3, n = 337) = 10.240, p = 0.017$), source ($H(3, n = 250) = 22.087, p = 0.0001$) and gender ($H(1, n = 339) = 7.781, p = 0.005$). Median frequency of consumption values by nationality were: TCI Belonger 2.2 times/

month, Haitian 3.5 times/month, Dominican Republican 4.3 times/month and other nationalities 0.25 times/month. By source, the median values were personal capture 8.7 times/month and for all other sources 4.3 times/month. The median consumption frequency gender was 4.0 times/month for males and 1.0 times/month for females.

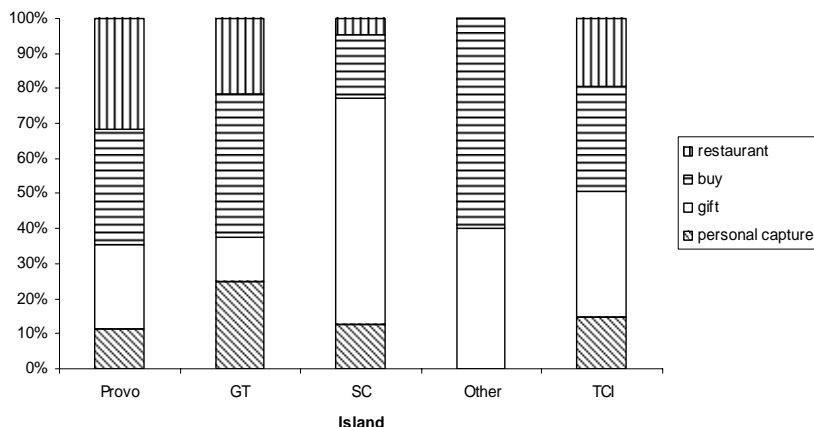


Figure 1. Distribution of conch for personal consumption by source for Provinciales (Provo, n = 104), Grand Turk (GT, n = 56), South Caicos (SC, n = 88), other islands (Other, n = 10) and the Turks and Cacios Islands overall (TCI, n = 258). Sources include personal capture, gift from fishermen (gift), (TCI, n = 169), Haitians (n = 43), Dominican Republican (Dominican, n = 21), purchases from fishermen (buy) and consumed at restaurants (restaurant).

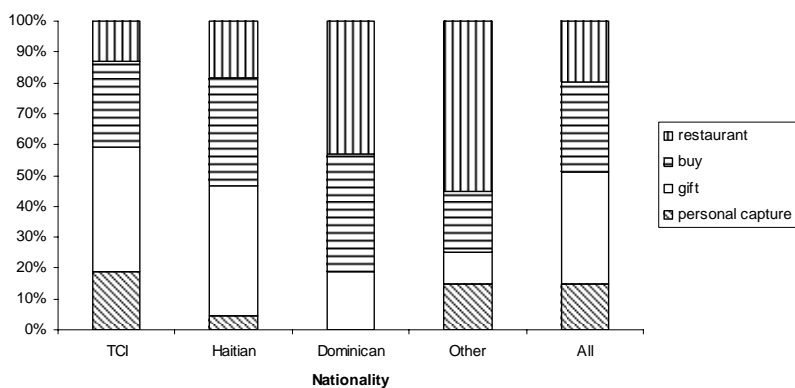


Figure 2. Distribution of conch for personal consumption by source for TCI Belongers other nationalities (Other, n = 20) and all nationalities (All, n = 253). Sources include personal capture, gift from fishermen (gift), purchases from fishermen (buy) and consumed at restaurants (restaurants).

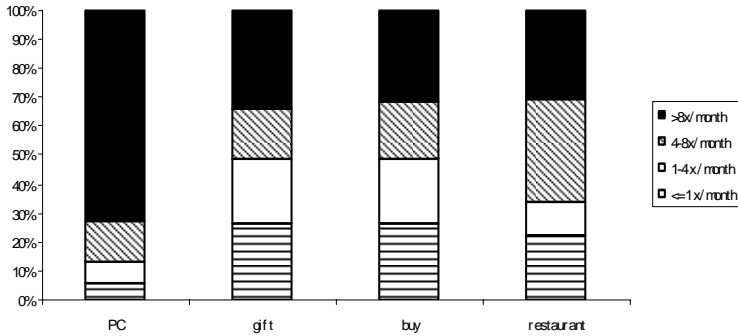


Figure 3. The distribution of the frequency of conch consumption by Sources (PC or Personal Capture, n = 37), (Gift from fishermen, n = 92), (Buy from fishermen or plants, n = 76). (Restaurants, n = 53).

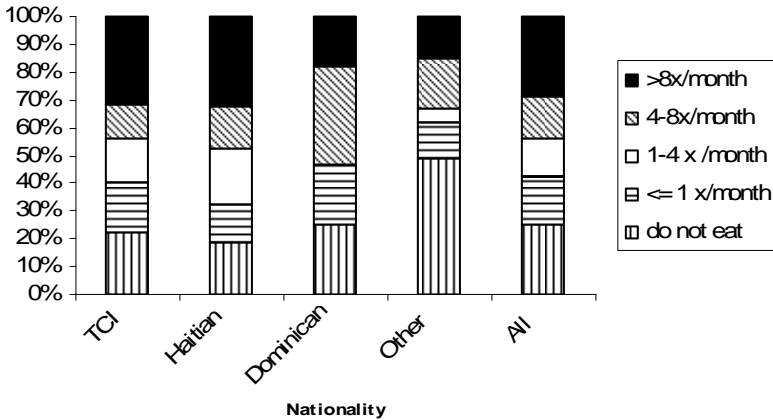


Figure 4. The distribution of the frequency of conch consumption by nationality (TCI) TCI residents, n = 217), (Haitian, n = 53), (Dominican, n = 28). (Other, n = 39) and the TCI (All, n = 337) overall.

Serving size differed between islands with the median value smaller for Grand Turk (0.113 kg/meal) than for Providenciales or South Caicos (both 0.227 kg/meal) and the other islands (0.454 kg/meal) ($H(3, n = 258) = 23.760, p = 0.000$). Additionally, serving size differed between male and female respondents ($H(1, n = 339) = 6.651, p = 0.010$) with females having a smaller median serving size (0.170 kg/meal) than males (0.227 kg/meal). Serving size

did not differ by nationality ($H(3, n = 253) = 2.333, p = 0.506$), source of the conch ($H(3, n = 258) = 1.465, p = 0.690$) or age ($H(5, n = 347) = 2.734, p = 0.741$).

DISCUSSION

The Turks and Caicos Islands has actively tried to protect its queen conch stocks. However, often when protecting the stocks we are only considering commercial catch for export in this management. It is time to also consider the local community and its own consumption. Often conch for local consumption does not even pass through landing sites for documentation. As we can see, a significant portion of conch is retrieved by personal capture and/or directly from local fishermen. Currently, local consumption is not utilized in the determination of the Maximum Sustainable Yield (MSY). Instead, the TCI sets a quota below MSY to accommodate for local consumption. The fact remains, that if the local consumption rate is higher than the "buffer" between the quota and MSY, the stocks will be overfished.

The initial results of the TCI local conch consumption survey suggested an annual consumption level well above the levels indicated in previous studies (Olsen 1985, Clerveaux 2003). The higher estimate could be due to a larger estimated serving size or higher frequency of consumption.

Clerveaux (2003) found 40% of survey participants in Grand Turk were frequent consumers, consuming conch at least once per week. Our results indicate that for the TCI as a whole, approximately 43% of survey respondents consume conch one or more times per week (4+ times per month). However, this group contains some very frequent consumers, including some individuals with daily consumption. This results in a highly skewed distribution with a mean value of almost seven times per month, while the median value is only four times per month. This suggests the use of the median value for national level calculations. However, there are significant differences in the frequency of consumption between some user groups, which suggests further analysis.

The frequency of consumption appears to be similar between islands, which suggests that any potential bias is most likely to reside with respondents. About half of the consumers appear to be heavy consumers, eating conch once a week or more. Such a heavy level of dependence on conch for protein may be reasonable for a location with a long history of utilization of conch, such as the TCI. However, such high utilization levels also call for further investigation to determine if it is indeed true or whether people are over estimating their frequency of consumption.

The serving size does show differences between genders, as might be expected, although other seafood consumption studies show no differences between men and women (Myrland et al. 2000). Explaining differences in the median serving size between islands is more difficult. One would expect that where an individual lives would not play a role in serving size. The most obvious sources of the difference are bias and leading questions by interviewers. Training was conducted with all officers, however it is possible that it was not sufficient or that interviewers may have ignored instructions. Each island was surveyed by a small number of officers, ranging from two (Grand Turk

and South Caicos) to four (Providenciales). While this might lead to consistent results for an individual location, it could introduce consistent bias for inter-island comparisons.

RECOMMENDATIONS

After reviewing the initial results of the survey, it has been determined that a supplemental survey will be administered to a smaller sample of TCI residents. The objective of the supplemental survey will be to further probe areas of potential respondent bias, such as frequency of consumption and quantity consumed. To address the potential problem of interview bias, a single officer will conduct all surveys on all three islands.

The survey, which explored local consumption by residents, is just the first step in further identifying consumption within the TCI. Currently, the DECR is collecting information on the volume of conch purchased by restaurants, including source information. Additionally, an airport survey of departing tourists will be used to estimate the visiting population's consumption. Together this information will provide a clearer picture of the amount of conch that is being harvested, but not recorded at the processing plants.

In order to manage marine fisheries in the Caribbean region, countries need to examine a holistic approach. Not only are basic catch and effort information necessary for stock assessment and management, but other parameters such as local consumption may play a larger role than first thought.

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