

Catch per Unit Effort

Discussion on catch per unit effort (CPUE) for conch revolved around two points. The first concerned what constituted a directed conch trip, given that conch fishers now routinely target multiple species, particularly spiny lobster, while fishing conch. The questions revolved around what zero-caught dives should not be counted toward CPUE, specifically putting spatial limits (e.g., excluding north coast dives) on these and excluding dives where lobster were caught but no conch were caught. Both of these assumptions were accepted based on both the knowledge of local scientists and fishers and the behavior of subsequent standardized CPUE.

The resulting CPUE trends showed a distinct flat trend despite evidence from resource surveys that densities have increased and in the face of an 8-fold increase in catch from St. Croix over the past decade (a trend that has accelerated over the last three years) and a significant catch reduction in Puerto Rico during 1992. The consensus interpretation is that CPUE was reflecting the daily catch quota (150 conch/commercial fisher/day), and despite any changes (up or down) in stock abundance, fishermen were still able to catch the daily quota. In support of this, a review of the data showed that the marked increase in St. Croix catch was due to a concomitant increase in the number of fishing trips.

In summary, while an acceptable measure of standardized CPUE was developed, it was uninformative of stock abundance.

Resource Surveys

Periodic transect surveys were available for Puerto Rico (west and east coasts), St. Thomas-St. Thomas, and St. Croix. PR surveys date back to 1986, while those in the USVI date to 1981. In Puerto Rico and the USVI, current surveys are conducted every 5 years as part of SEAMAP-Caribbean. Additional recent data are available from limited-area benthic surveys conducted by NOS-CCMA in the protected areas of St. John and St. Croix.

The consensus was that these surveys offer much promise for developing an index of conch abundance and that they could be coupled with landings data to get an indication of relative fishing pressure, and additionally compared to approximate target values developed or used elsewhere in the Caribbean (see below). Difficulties remain with respect to the data needed and best approach for expanding the limited survey results over some portion or the entire shelf.

Initial tentative expansions were made for Puerto Rico, St. John and St. Croix. Initial results for Puerto Rico (Table **XX**) were mixed, with Yield/Biomass values ranging from 0.26 to 1.17. A similar calculation for recent landings in St. Croix yielded a Yield/Biomass ratio of 0.195. Calculations for St. Croix were considered more reliable due to the greater proportion of the shelf mapped and area known. For Puerto Rico there was also considerable uncertainty in total yield, as reported landings are expanded by as much as a factor of two.

Table XX. Initial calculations of conch stock biomass for Puerto Rico (adult) based on spatial expansion of survey densities. These are compared to estimates of total yield.

Year	Number	Biomass(lb)	Yield(lb)	Y/B
1996	1,019,613	346,663	336,000	0.97
2001	2,270,528	686,589	358,000	0.52
2006	2,360,216	1,897,071	487,000	0.26

Status of the Resource

Resource surveys clearly show that densities were increasing in Puerto Rico and St. Croix (adults only), the two areas that support commercial fisheries. Both had current average densities of approximately 30 conch/ha. The most recent survey in Puerto Rico also showed an increase in both the proportion of adults and a shift in the age structure to older individuals, while still showing evidence of substantial juvenile recruitment. In Puerto Rico, this most recent survey may evidence a response to the application of the full extent of management measures in both local waters and the relatively small portion of the shelf within the EEZ. Size limits, daily quotas, and closed seasons in the EEZ went into effect in 1997. The closed season was extended into local waters in 1999, while the other measures were extended 2004. The closure of the EEZ occurred in 2005. In St. Croix these measures (except the EEZ closure) went into effect in 1994. However, newly protected areas have been initiated in St. Croix, which may contribute to the density increase. Data for St. John show a sustained decline in adults since 1981, while data for St. Thomas show mixed results.

The conch FMP currently has an estimated MSST of 1,404,000 lbs and an MSY of 452,000 lbs. Density-based estimates of total stock biomass (adults only) for Puerto Rico (1,897,000 lbs) and St. Croix (668,000 lbs) sum to the approximate value of the MSST. On the other hand, the yield for these areas (723,719) is 60% greater than the recommended MSY.

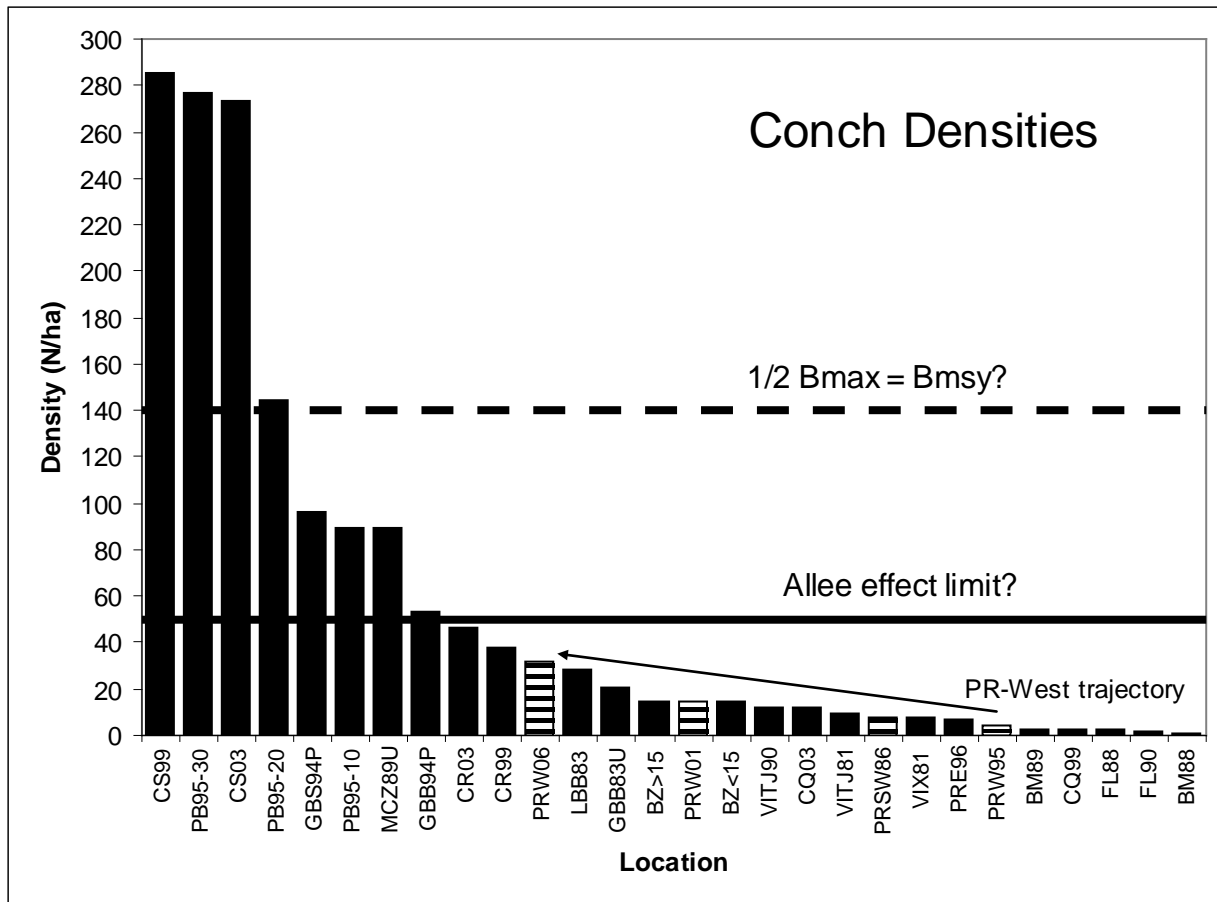
The density values can also be compared to approximate target values developed or used elsewhere in the Caribbean, as illustrated in Figure XX. Here, the density levels for Puerto Rico are plotted against values obtained elsewhere in the Caribbean for surveys that can be construed as being shelf wide. The increasing trend in conch density (juveniles and adults) for Puerto Rico over the last decade is shown by the arrow. Also shown is the observed limit (50 conch/ha) found by Stoner and Ray (1996) below which reproductive activity (copulation and egg deposition) was found to decline (in proportion to density decline). Also shown is the density level used to estimate stock size at MSY on Pedro Bank, based on one-half the observed density in the 20-30m stratum, which at the time was assumed to be unfished (Appeldoorn, 1995). Observed densities for both Puerto Rico and St. Croix are still substantially below both of these levels.

Lastly, catch rates per hectare can be compared to the predicted MSY for the Turks and Caicos. This was taken as the commercial catch (87 kg/km², Ninnes 1994) plus that for local

consumption (51 kg/km^2 , Olsen 1985), which totals 3.04 lbs/ha. In Puerto Rico, the most recent harvest was very similar, at 3.10 lbs/ha. For St. Croix, the value was more than double, at 7.39 lbs/ha.

For St. Croix, all calculations were made assuming the whole of the shelf to be exploited. However, most, if not all, of the recent survey stations were located within the Buck Island National Coral Reef Monument or the East End Marine Park, both of which are protected areas. Thus, it is possible that the increase in density observed in recent years may reflect a sharp reduction in exploitation rate, and expansion of density values over the whole of the shelf would be inappropriate. Under this scenario, expected biomass would be lower and exploitation rates would be much higher. Unfortunately, there was no representative from CCMA or the Virgin Islands present to address the question of exploitation/enforcement within the protected areas.

For Puerto Rico, observed densities were also expanded over the whole shelf, despite the fact that essentially no fishing occurs along the north coast and the western margin of the western shelf is within the EEZ and currently closed to fishing. Proportionally, however, the sum of these areas is still small relative to the whole shelf, so their impact on the conclusions would be low.



Conch densities for shelf wide surveys throughout the Caribbean. Densities are unadjusted for any potential differences, such as habitat distributions, proportion of juveniles, etc. Striped values are values for western Puerto Rico. Solid line represents the density below which reduced reproductive output may be expected based on studies in the Bahamas. Dashed line represents the level at which density is $\frac{1}{2}$ the maximum density observed in the deep stratum on Pedro Bank, assumed to reflect virgin stock density there. Arrow shows the general direction of density increase off western Puerto Rico over the past 10 years.

Remaining Issues

The Caribbean Fishery Management Council is charged with developing Annual Catch Limits for queen conch. At the moment it is unclear how density surveys can be used to set Annual Catch Limits. It is also unclear how density surveys can be used to assess (and hence open) the closed areas on the Puerto Rico and St. Thomas/St. John EEZ?

Recommendations

The efforts to analyze the available data were greatly enhanced by the presence of local fishers and agency representatives. However, there was no local representative from the USVI Division of Fish and Wildlife assigned to the meeting, while the Puerto Rico representative could not attend the full term of the meeting. There must be greater buy-in from the local agencies such that knowledgeable representatives are present for the full term of the meeting. Greater efforts should be made to attract the participation of local fishers.

Data from past density surveys should be re-analyzed so that values can be expanded on the basis of both habitat and depth, including confidence limits. Habitats should be matched to those available for existing/planned habitat maps. As a subportion of this, the data for the Puerto Rico 1986 survey should be entered into electronic and GIS formats. This could be done using NOAA's Data Rescue funds.

Expansion factors for both Puerto Rico and the USVI should be calculated for conch fishers only.

Assessment of the spatial and temporal variations and dynamics of the resource, fishery, habitat and species interactions would be greatly enhanced if traditional ecological knowledge were obtained from fishers. Efforts should be made to incorporate fishers into the process, particularly using NOAA's CRP funds.

The impact of the recreational fishery is unknown and must be quantified.

Considering the established and potential value of resource surveys, mechanisms should be identified to increase their aerial coverage.

More detailed spatial expansions of survey densities should be planned in preparation of the 2010 Conch Update. For this, significant improvements in available data and analyses are required, including but not limited to the following:

- Detailed bathymetry data for PR and USVI

- Analysis of the impact of closed areas

- Inclusion of more detailed habitat maps for the PR western platform currently in progress

- Quantified size/age structure of the exploitable stock.

The only estimate to date of fishing mortality came from a tagging study in the 1980's. New tagging studies should be initiated to quantify rates of exploitation. This would allow existing SPR models for conch to be used in assessments.

Another issue remaining is to investigate the potential impact of very old conch in deep refuges, especially with respect to reproduction, coupled with studies to age very old conch. Such refuges may be substation off St. Thomas/St. John, in patches in Puerto Rico and potentially in protected areas on all three platforms.

Intersessional data evaluation workshops for CFMC managed species or species-complexes should be conducted by the Council so that SEDAR level analyses are limited to those where data are sufficient to warrant such an analysis.

There needs to be a complete review of the potential data collection programs, including commercial and recreational catch, biostatistical sampling and fishery-independent surveys for Puerto Rico and US Virgin Islands with the purpose of identifying what relevant information could be obtained and modifying sampling procedures accordingly, including the identification of key economic and ecological indicator species.

Literature Cited

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