Scientific Cooperation in the Caribbean: Queen conch a good indicator of Climatic Change and of stories from the field
Cooperación científica en el Caribe: El caracol rosa un buen indicador de cambio climático e historias de campo
Cooperation scientific in the Caribbean: Le lambi comment indicateur de changement climatic avec histoire de travail sur le terrain

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ABSTRACT

For the Caribbean people, this region is much more than a place for leisure and relaxation. It is literally the lifeblood of their economies, supporting the transportation of goods and people through shipping, providing food from fisheries, and sustaining the most important economic activity in the region: tourism. The Caribbean Sea covers an area of 2.75 million Km2. Nevertheless, this sea is important for 40 million people who inhabit its many small islands, talking about "Blue Economy". Its activities generated revenues of US$407 billion that represents 14-27% of the global ocean economy, in an area that represents less than 1% of the world's ocean area. The queen conch, *Strombus (Lobatus) gigas* is a marine gastropod mollusk. This is an endemic species from the Caribbean Sea, it is present in the water of 37 countries of the Caribbean Sea. It is a valuable marine invertebrate of significant commercial importance, which permit to use as indicator of climatic change. The aim of this work was to display results of a scientific collaboration in the Caribbean, showing how we have organized our scientific work in this region using our friendly relations, starting from simple protocols. Success stories of cooperation effect of climatic change on reproduction, abundance of larvae and contamination by micro plastics are shown.

KEYWORDS: cooperation, climate change, scientific

INTRODUCTION

The queen conch, *Strombus (Lobatus) gigas* (Linne 1758) is an endemic gastropod widely distributed in the Caribbean. Queen conch stocks have declined significantly throughout the region over the past few decades. It has been listed in the Convention on International Trade in Endangered Species and various fishery regulations have now been implemented in most Caribbean countries for its sustainable catch (FAO-WECAFC 2013). Larval abundance studies and their distribution throughout the Caribbean are needed, particularly by examining larval density during their spawning period. In addtition, the increase in CO_2 emissions and temperature affect the Caribbean region. Temperature in this region could rise to 31 °C and acidification could drop at 7.6 by the year 2100 (Caldeira and Wickett 2003). These changes affect abundance, distribution and reproduction of species and their calcification, where the larval phases are more susceptible. In other hand, every day about one megaton of plastic is produced. As much as 12.7 million metric tons of it ends up in the oceans. Plastics represent more than 80% of the debris swirling through the oceans being the most prevalent type of marine debris. Plastics in the oceans break up into microplastics and these belong to emerging pollutants (Bosker et al. 2018). The most serious problem about microplastics is its ability to accumulate and bio-magnified of persistent organic pollutants such as insecticides and heavy metals. The goals of this work were to show results of a scientific collaboration in the Caribbean about effect of climatic change on abundance of queen conch larvae and its reproduction patter. Besides, to show the effect on shell calcification and the pollution by microplastics in queen conch in various sites from the Caribbean.

To study larvae abundance of *Strombus gigas*, samples of plankton were collected from various sites from the Caribbean. Banco Chinchorro and Puerto Morelos, Yucatan Peninsula of Mexico at western locations. Florida, for northern site. Puerto Rico and Dominican Republic for the middle Caribbean and French West Indies and Barbados from eastern locations. Sampling period was carried out from July to September with the same methodology in each site. Tows were diurnal and made for 15 minutes.

For analyze effect of temperature on queen reproduction patter, we analyzed historical data from the literature of the spawning periods reported and at what temperature it occurred. A correlation was created between temperatures and spawning period. On the other hand, a study of the reproductive cycle was carried out through an annual cycle. To assess variation in temperature and proportion of reproductive stages across sampling sites, we used a canonical-correspondence analysis (CCA) (Ter Braak 1986) using the computer program CANOCO 4.5 (Ter Baark and Šmilauer 2002).

The effect of temperature and acidification were analyzed in larvae from 28 to 31°C and pH from 8.1 to 7.6. For analysis of calcification, imaging and chemical mapping were performed on 30-day-old larvae using a high-resolution scanning electron microscopy.

Microplastics analyses were analyzed from conch feces in various sites of the Caribbean. Each conch was placed in a separate aquarium and their feces were collected. Plastics were analyzed by the Hidalgo-Ruz et al. (2013) method using a high-resolution scanning electron microscopy and Raman microscopy.

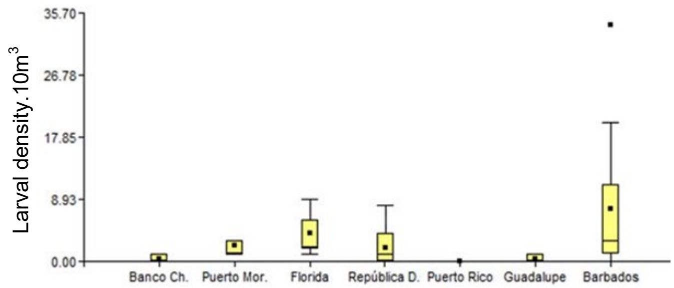

Figure 1. Larval abundance of queen conch *Strombus gigas*

RESULTS AND DISCUSSION

Queen conch veliger were presented from July to September in all sites sampled. Most larvae were collected in Barbados (60.13 % of larvae) and 21.52 % at the Dominican Republic. The highest abundance was observed in July. Larval densities also varied between months from 1.18 larvae.10m^3 to 0.45 larvae.10m^3 (Fig. 1). Size structure of larvae around the Caribbean was different. The largest larvae were observed in the Northern Caribbean (Fig. 2). The most frequent size range of the larvae was <400 µm of shell length (86 %). Probably due to the positive phototropism of the youngest larvae and the plankton town that was superficial (Chavez Villegas, et al. 2012, Sanchez Crespo, et al. 2015).

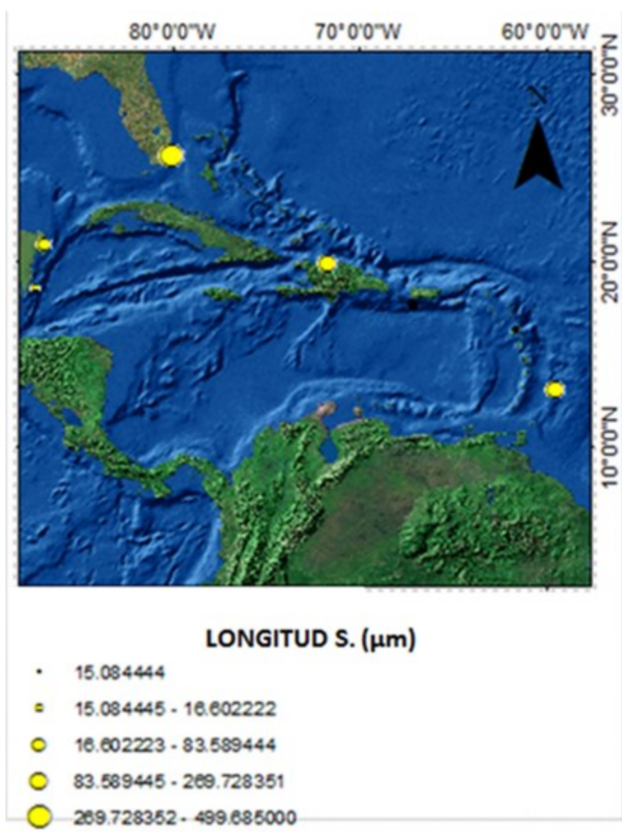

Figure 2. Shell length of queen conch larvae (*Strombus gigas)* in various sites from the Caribbean .

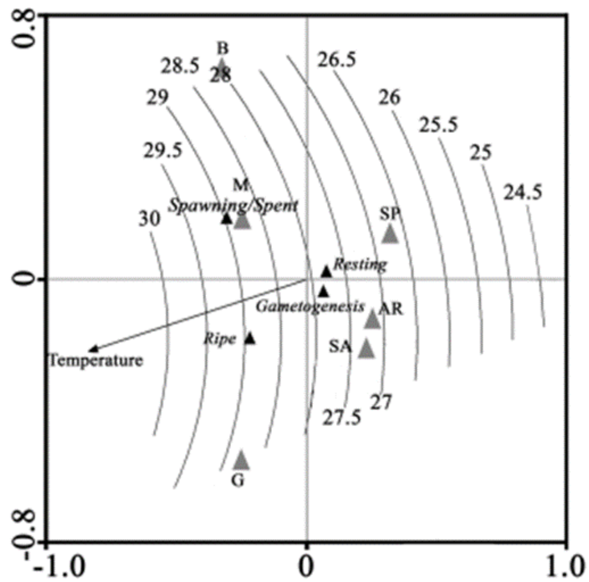

Figure 3. A canonical-correlation analysis (CCA) for proportion of reproductive stages of queen conch and average annual water temperatures at six localities examined in this study. Curved lines represent prediction of temperature values. Reproductive stages are shown as black triangles and localities as grey triangles

Aldana Aranda et al (2014) observed that Queen conch required a temperature of ≥27.7 °C to initiate gametogenesis; and were found in the resting stage below 27.5 °C. A canonical-correspondence analysis (CCA) examining annual mean temperature and proportion of each reproductive stage across localities studied is shown in Figure 3 and illustrates that ripe and spawning/spent stages were associated with water temperatures of 28–29 °C resulting in higher proportions of these stage conch in Guadeloupe, Martinique, and Barbados. The coldest mean annual temperatures were observed in Alacranes Reef, San Pedro, and San Andrés Archipelago. These results suggest that conch require a minimum temperature of 27.7 °C to initiate gametogenesis; and that below 27.5 °C organisms are in resting stage.

The proportion of Calcium (%wt) was higher in the control with 41.94 ± 11.31% wt at 28oC and pH 8.1 and lower at 31 °C and pH 7.6 with 38.17±3.97%. The highest intensity peak was presented at 28 ° C and pH 8.1 = 1039 ± 780 a.u. and the one with the lowest intensity at pH 7.6 and 31 ° C = 534 ± 180 a.u (Fig. 4). Acidification conditions produced a 50% decrease in Aragonite in the larval shell (Chávez et al. 2017).

Related with pollution by microplastics, all conch analyzed from the four sites across the wider Caribbean had microplastics. Conchs from the northwestern sites in the wider Caribbean had the highest overall abundance of microplastics compared with those from the eastern Caribbean (Fig. 5). The size of the fibers varied between 300 and 4500 µm (Aldana Aranda, et al, 2019).

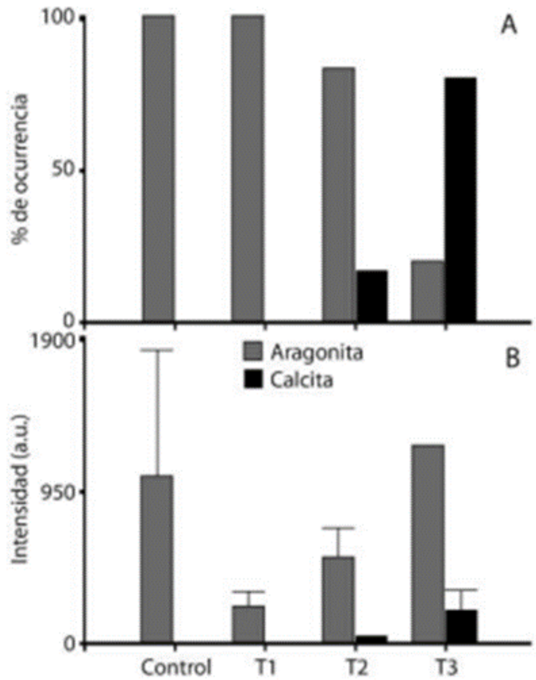

Figure 4. Proportions (A) and intensity (B) of the carbonates aragonite and calcite, measured by RAMAN Spectroscopy in the S. gigas larval shell of 30 days old. Larvae per treatment = 3-5. control = 28 °C - pH 8.1, T1 = 28 °C - pH 7.6, T2 = 31 °C - pH 8.1, T3 = 31 °C - pH 7.6; a.u.:arbitrary units (Chávez et al. 2017).

The present work showed several results that have been possible to obtain with the queen conch in the Caribbean screening the cooperative work with several institutions and researchers, allowing to have a global vision at a Caribbean scale on the reproduction of this queen conch, its contamination by microplastics and the effect of climate change on larval calcification and development processes of larvae of queen conch.

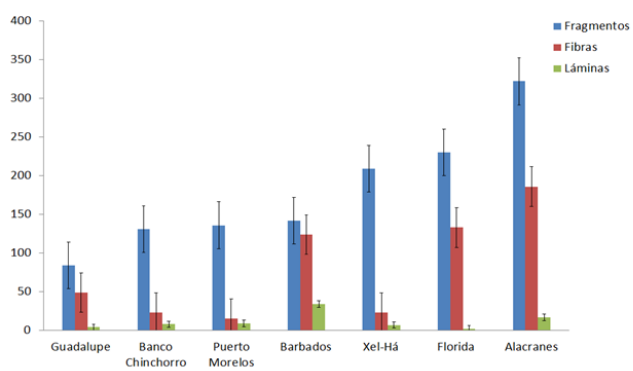

Figure 5. Abundance of microplastics within queen conch of various sites from the Caribbean. Microplastics were classified by their shape in fragments, fibers and sheets.

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