Queen Conch (*Lobatus gigas*) in the Grenadines Islands: A Preliminary Assessment on its Abundance and Current Management Needs

Caracol Rosado (*Lobatus gigas*) en las Islas Granadinas: Una Evaluación Preliminar de su Abundancia y Necesidades de Gestión Actuales

Lambi (*Lobatus gigas*) dans les Îles Grenadines: Une Évaluation Préliminaire de son Abondance et des Besoins de Gestion Actuels

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EXTENDED ABSTRACT

Introduction

The queen conch, *Lobatus gigas*, is a very important fisheries resource among Caribbean countries due to its cultural and economic value (Appeldoorn et al. 2011). However, the increase in its consumption during the past decades has caused its overexploitation (Lawrence and Phillips 2013). The inclusion of this species under Appendix II of CITES in 1992 has allowed a more controlled trade and the establishment of specific fishing quotas to reduce threats in the local populations (Appeldoorn et al. 2011). Nevertheless, illegal and unregulated fishing and trade is still happening nowadays (Oxenford et al. 2007).

Saint Vincent and the Grenadines (SVG), located in the southeast Caribbean, also depend on the queen conch fishery. Currently, status information on SVG is limited. Management regulations for queen conch in this area include size limits and protected fishing areas (Tobago Cays Marine Park, TCMP) (FAO 2007). However, the TCMP has had many management problems since its designation in 1997, such as the lack of a management plan until 2007 (Hoggarth 2007). Thus, the effect that this Marine Protected Area (MPA) might be having in regards to queen conch conservation is not clear. In order to implement suitable and effective measures for the sustainable use of queen conch in this area, its status and the effect of current measures on this species' population should be analyzed. This assessment is essential, as lack of information on the current conch state could cause the failure of the fishery and generate negative impacts on the environment and all dependent livelihoods. It is key to also examine the effect that the TCMP is having on conch abundance. Therefore, the objectives of this study were to:

i) Assess the current status (density) *L. gigas* in the TCMP and Union Island,
ii) Determine the effect that the TCMP has on queen conch density, and analyze its effectiveness as an established management measure, and
iii) Analyze current and other existent management measures required in the area for the conservation and sustainable use of queen conch.

Methodology

The study area comprises Union Island and the TCMP, located at the southernmost edge of the SVG territory (Figure 1). In order to obtain conch density, shell length, and lip thickness data, underwater surveys were conducted. A stratified random sampling approach was used to design an effective survey plan (Prada and Glazer 2013). Three different criteria were considered to determine the survey area: conch distribution, bathymetry, and habitat type. Participatory mapping was conducted among the fishermen and local community members of Union Island to include local knowledge on conch distribution. In addition, only areas from 0 to 20 meters depth, with sandy, seagrass, or mixed bottom habitats were considered (Medley 2008, Appeldoorn et al. 2011). Once the final survey area was determined (Figure 1), due to time and capacity constraints, a grid was applied to randomly select 12 survey sites with an online number randomizer. Six surveys were conducted inside the park (three surveys in a depth range of 0-10 meters and other three surveys in a depth range of 10 -20 meters), and six surveys were conducted in the waters around Union Island (three surveys in a depth range of 0 - 10 meters and other three surveys in a depth range of 10 - 20 meters) (Figure 1).

The underwater survey protocol was based on 30 m x 4 m belt transects (also known as band transects) (Medley 2008). The data gathered during the 12 underwater surveys was analyzed to obtain the density of conch in the study area. In addition, statistical analyses were conducted to determine the effect of maturity level, depth, protection level, and time on conch abundance. In order to do a comparative analysis over time, data of the study conducted in 2013 by Prada and Glazer (which included 51 surveys) was obtained from their report (Prada and Glazer 2013). Only the closest and more similar 12 surveys sites' data from the Prada & Glazer study were considered to avoid differences in the sample size. Using this methodology, conch data obtained in 2013 and 2016 was comparable, as Prada and Glazer used the same sampling methodologies. Due to the reduced sample size and the distribution pattern of this species, the data did not follow a normal distribution. Therefore, the non-parametric Wilcoxon signed-rank test was used to conduct pairwise comparison among groups.

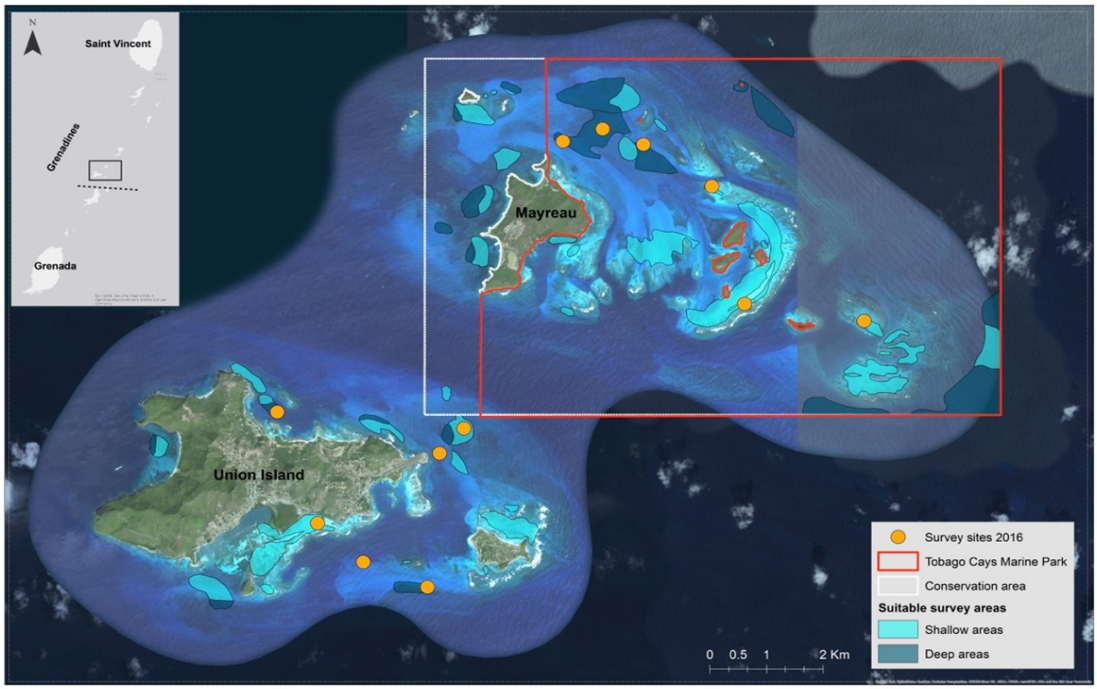

Figure 1. Survey sites map using a satellite map of the study area as the baseline. This map is the result of the combination of the habitats map, the bathymetric maps, and the participatory mapping map. Colored areas in the map show areas matching the three criteria (suitable conch habitat, depth from 0 to 20 meters, and current conch distribution according to participatory mapping). Light blue areas indicate shallow areas (from 0 to 10 meters), and dark blue areas indicate deeper areas (from 10 to 20 meters). Survey sites selected in 2016 are marked with an orange circle.

Results and Discussion

Results showed a reduced conch density in comparison to results from the 2013 study, mainly due to a decline in the juveniles' density (Table 1). Interestingly, in 2013, total conch abundance was higher outside the TCMP while this year total conch abundance was higher inside the TCMP. Total adult abundance inside the marine park did not changed between 2013 and 2016, while juvenile's abundance inside the park decreased in 2016. It is important to notice that no adults were found outside the park in 2016 (Table 1). Regarding to the depth as a factor influencing conch density, in both studies conch density was higher in deep areas; including juveniles. When conducting the statistical analyses, density differences over time, considering protection level, and depth were not significant with the exception of one test. Statistical analyses showed that juveniles' density inside the TCMP was significantly lower from in 2016 when compared to 2013. Multiple factors could have influenced the above-mentioned findings. A hypothesis considers fishing practices over time as an important driver for the reduced density found in the study area, but other hypotheses are also considered. These hypotheses include changes in water quality that could have severely impacted juveniles, the effect of rising sea surface temperatures and climate change, the introduction of invasive species, and others. It is possible that fishing pressures together with other factors could have forced juveniles to move to deeper areas. In addition, marine management at TCMP has improved from 2007 to date, but further improvements are required to meet conservation

Table 1. Abundance and density results for the 12 selected surveys of 2013 and all 2016 surveys, in total and also by maturity level, protection level, and depth.

		2013					2016				
		12 surveys	TCMP	Union Island	Shallow	Deep	12 surveys	TCMP	Union Island	Shallow	Deep
Density (Ind/ha)	Juveniles	114.58	55.56	173.61	38.19	190.97	20.83	24.31	17.36	10.42	31.25
	Adults	43.41	31.25	55.56	38.19	48.61	15.63	31.25	0	10.42	20.83
	Total	157.99	86.81	229.17	76.38	239.58	36.46	55.56	17.36	20.84	52.08

purposes. Illegal fishing is still happening within the TCMP, and there is a lack of capacity and enforcement. Furthermore, a brief exploration outside the study area showed what could be an extensive conch ground that has not previously been researched, which could be very promising for the overall density of this area's population.

Recommendations and Conclusion

In order to improve the current queen conch situation inside the study area several recommendations were made. The identified conch ground outside the study area should be included in future assessments to have a better understanding of current conch status. In addition, education and community engagement activities should be continuously conducted in Union Island to:

i) Raise awareness regarding conch conservation needs,
ii) Increase understanding and compliance of management measures, and
iii) Include local knowledge and local needs on the recommendations for the further management of this species.

Furthermore, management challenges at TCMP should be addressed by promoting better tourism practices inside the area, and increasing the monitoring capacity. Finally, a season for conch might be required in order to increase conch density within the study area. However, the establishment of such measure should be implemented if fishermen can conduct monitoring activities while they are not allowed to harvest this species. The feasibility of this last recommendation should be further explored to have a better understanding of its potential success. As a conclusion, conch density in the study area seemed to have decreased over time, and the closed area (TCMP) seems to be having no effect towards conch protection and conch density. However, this area has the potential to become a high-density conch area, as it was in the past, if effective measures are implemented. Queen conch is a very important resource in Saint Vincent and the Grenadines, and it is essential that its sustainable use is ensured.

KEYWORDS: Queen conch, fisheries management, MPA effectiveness, St. Vincent and the Grenadines, Tobago Cays Marine Park.

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