Comparing Divers and Camera Sled Surveys: An Improvement for Fisheries Independent Data for Queen Conch in Puerto Rico?

Comparción de Censos de Buceo y Cámara en Trineo: ¿Será una Mejora para Datos Independientes de Pesquerías para el Caracol Rosado en Puerto Rico?

Comparaison entre les Plongeurs et les Enquêtes sur les Traîneaux Photographiques: Une Amélioration des Données Indépendantes de la Pêche pour le Lambi a Porto Rico?

WILMELIE CRUZ-MARRERO[1]*, BRADLEY G. STEVENS[1], CHELSEA TOUHY[2], and RICHARD S APPELDOORN[3]
[1]*University of Maryland — Eastern Shore*
3036 Nassawango Road, Pocomoke, Maryland 21851 USA.
**wcruz-marrero@umes.edu* bgstevens@umes.edu
[2]*Isla Mar Research Expeditions*
PO Box 828, Rincon, Puerto Rico 00677 USA.
islamarexp@gmail.com
[3]*University of Puerto Rico — Department of Marine Sciences, Mayaguez, Puerto Rico 00681 USA.*
richard.appeldoorn@upr.edu

EXTENDED ABSTRACT

Queen conch, *Lobatus (Strombus) gigas,* is one the most important fisheries species in the Caribbean. Currently, harvesting queen conch is prohibited in the Exclusive Economic Zone (EEZ) in Puerto Rico. Abundance estimates in Puerto Rico are conducted by scuba divers at intervals of 3 years, but limited availability of trained divers for conducting surveys has been an obstacle to complete coverage. Diver surveys are also limited by depth and time, whereas camera surveys are not, and provide a permanent photo record of observations. Preliminary results of a study in Puerto Rico showed that surveys conducted with a digital camera sled produced higher estimates of density (#/ha) than diver survey methods, and that measurements obtained using paired lasers were both more accurate and smaller than diver estimates. These results may lead to further applications or development of sled survey techniques, and improved data collection and analysis. Our research could improve the quality of information that can be used for management of queen conch in the Caribbean.

Introduction

Queen conch, *Lobatus (Strombus) gigas,* is one the most important fishery species in the Caribbean (Davis 2005), and its history can be traced back to pre-Columbian times. Fisheries have been declining since 1980s due to overfishing (Appeldoorn, 1991). Queen conch fisheries are currently closed in the US federal waters fisheries. In 1992, queen conch was included in Appendix II in CITES (Convention on International Trade of Endangered Species of Wild Fauna and Flora) (Boman et al. 2016). In order to determine the status of the queen conch fishery in Puerto Rico, the Department of Natural resources developed population density surveys conducted by scuba divers at intervals of 3 years. This survey requires trained divers and the cost and complexity impedes the frequency of the survey. Diver surveys are limited to shallow water, which may not encompass the extent of queen conch habitat in Puerto Rico. We tested the use of a camera sled that is towed on the bottom for population assessments of queen conch in Puerto Rico. The camera sled can operate at greater depths than divers, and stay underwater for longer periods of time, which should increase its efficiency and utility relative to diver surveys. In addition, it can provide a permanent record of observations that can be reviewed multiple times by different observers for comparison. In this research, we compare the precision and accuracy of divers to camera sled surveys for estimating density and length of queen conch in the south west coast of Puerto Rico.

Methods

A total of eight transects were completed using two techniques: divers with scuba, and camera sled. Transects were selected randomly in the previously surveyed southwest area in Puerto Rico. Transects were selected based on habitat type (eg. Sand, seagrass, and algae cover).

Scuba surveys

Prior to the start of the survey divers were required to complete and pass training on queen conch identification, aging, measuring, underwater propulsion vehicle operation, compass heading, and Nitrox certification. The survey was done by teams of two divers who countedand measured conchs along transect sections for 45 minutes. Each transect consisted of 3-4 sections depending on availability of divers, and habitat. Divers also recorded data on habitat, depth, and behavioral observations about conchs.

Sled Surveys

The camera sled consists of an aluminum frame (~ 2 m long × 1 m wide × 1.5 m high) (Figure 1), a downward facing camera, strobe lights and two lasers mounted 10 cm apart. The sled was deployed no later than a day preceding or following

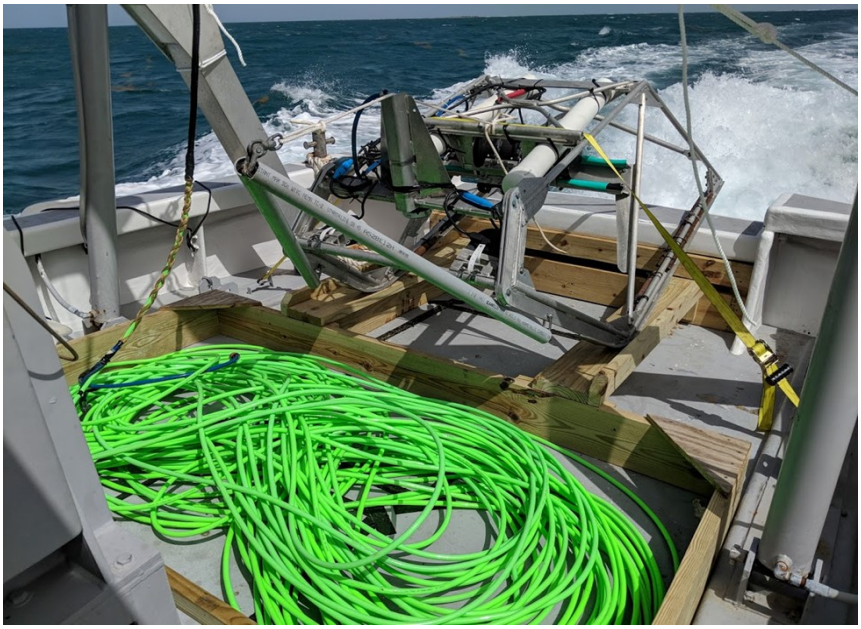

Figure 1. Image of the camera sled. The green cable is an Ethernet cable from which the sled is towed.

diver surveys. Since both techniques cover different areas, the camera sled was deployed in two parallel runs either north or south.

Laser Calibration

Nine conchs were arranged in different positions and photographed to corroborate the accuracy of the lasers for estimating length.

Image Annotation

Two viewers annotated 20,000 images taken by the camera sled as well as habitat and additional conch behavior information such as mating and egg capsules. All measurements of queen conch were accomplished using ImageJ software

Results

A total of 1193 and 773 conchs were counted by divers and the camera sled, respectively. Density estimated from camera sled images ranged from 122.57 to 343.89/ha and was significantly greater than density estimated by divers (62.30–113.57/ha) (paired t-test: t= -2.49, df= 21.98, p = 0.02; Figure 2). Length measurements of conchs made with laser calibration from test images were not significantly different from actual measurements made with calipers, indicating the accuracy of this method. However, laser-calibrated measurements made from transect images were significantly smaller (mean 12. 9 ± 4.7 sd) than those made by divers (mean 16.9 ± 5.2 sd).

Conclusions

Queen conch density estimates made during our survey were greater than those made during the 2013

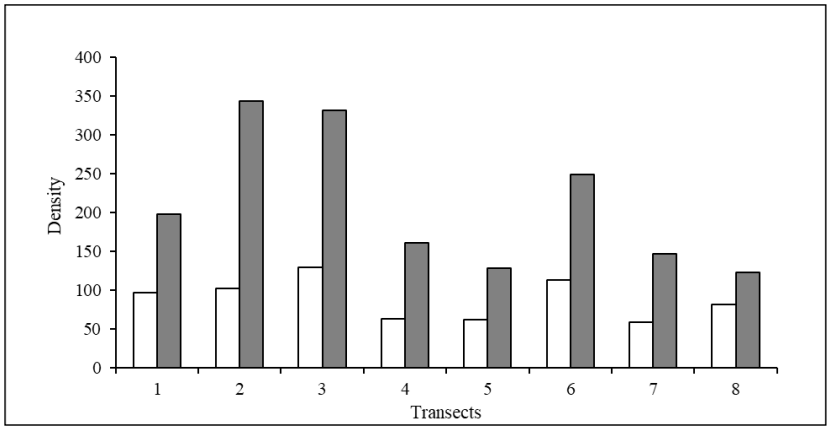

Figure 2. Density per transect by technique. White area represent the scuba transects meanwhile the grey represent the camera sled.

survey. Both techniques showed limitations and advantages during the survey. Some of the limitations include the inability to differentiate between dead and live conchs with the camera sled which can lead to overestimation of conch density. In addition, diver disturbances during the survey, distraction by the propulsion vehicles and requirements to monitor direction, depth, and dive gauges may inhibit divers from detecting all queen conchs along the transects. The camera sled appeared to be more advantageous for the queen conch surveys than the diver survey but further statistical analyses need to be completed to corroborate the data. Divers overestimated conch length, possibly due to air-water diffraction and inconsistent methods (not using calipers). Finally, use of image detection techniques for queen conch could improve density estimates. Improvements of the camera sled design could make this technique accessible for any environment and depth. The results of this research could improve the management of queen conch in Puerto Rico, especially the stocks in deeper zones.

KEYWORDS: Queen conch, camera surveys, sampling techniques

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