Diamond Back Squid (*Thysanoteuthis rhombus*) Catch Data in the Water of Commonwealth of Dominica from 2011 to 2014

Datos de capturas de Diamond Back Calamar (*Thysanoteuthis rhombus*) en el Agua de Mancomunidad de Dominica durante 2011 to 2014

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ABSTRACT

Since the inception of Diamond Back Squid (DBS), *Thysanoteuthis rhombus*, exploration in the Caribbean in April 1999 (Fujii et al. 2003) and collaborative operations with fisheries agencies across the region, the diamond back squid has been discovered in the offshore waters from Jamaica to Tobago (J. James et al. 2006).

As of May 2011 to August 2014, Dominica Fisheries Division and a select group of fishers continue working to advance their knowledge and skill to catch and collect biological data, for better understanding of the potential of developing a diamond back squid fishery. A total of 51 fishing trips recorded during the period has yielded 97 DBS individual data collected records. This work have aimed to reveal the potential of year round catch of DBS, which differ from recorded experiences in Japanese pacific ocean (Brown and Miyahara 2005), where it has a capture potential in Okinawa and the Sea of Japan from November to April and July to February, respectively. However, all executed fishing trips were concentrated during February to September due to fisher's preoccupation during other periods of the year. Catch statistics thus far reveal a sex ratio of 41% male 59% female for individuals caught in Dominica waters. Preliminary indications of spawning aggregations in September were observed for DBS caught in Dominica water. The average CPUE per trip range from 2.3 to 3.0, 1.3 to 1.5, and 2.3 individuals during February to April, May to July, and August to September, respectively. Its migration into the Caribbean is unknown and requires future studies.

KEY WORDS: Diamond Back Squid, mid water vertical long line, Commonwealth of Dominica, Diamond Back Calamar, linealarga vertical de agua mediana, Mancomunidad de Dominica

INTRODUCTION

Diamond Back Squid resource in the Caribbean was first confirmed during exploration activities conducted in the Caribbean Sea (12 nautical miles Southwest of Grenada) during the fishing operation by mid-water longline fishing for Tuna and Diamond Back Squid fishing in April 1999 by Caribbean Fisheries Training and Development Institute (CFTDI) and the Japan International Cooperation Agency (JICA) joint program "Project for the Promotion of Sustainable Marine Fisheries resource Utilization," (James 2006). The existence of DBS has since been confirmed in Dominica, Antigua and Barbuda (at Antigua), St. Kitts and Nevis (at Nevis), Dominican Republic (at Samana), St. Vincent and the Grenadians, St. Lucia, Trinidad and Tobago, and Jamaica (James et al. 2006).

All year round experimental operations for DBS were conducted in in Grenada during May 2000 to Nov 2001 by the JICA expert S. Arima (James et al. 2006), but the biological data is absent.

The exploration program for DBS was also introduced to Dominica in February 2000, with much success. However, the results of the exploration work did not progress beyond the experimental phase until the introduction of a follow-up JICA program in 2008 which resulted in the provision of a fishing vessel, winch and fishing gear. Further to this initiative was the commencement of *The Study on Formulating of Master Plan on Sustainable Use of Fisheries Resources for Coastal Community Development in the Caribbean*, under a CRFM/JICA agreement which rekindled activities on DBS fishery development during 2010 to 2012.

Dominica Fisheries Division and fisher working on diversification of the catch from near shore fisheries, such as fish pot, demersal and costal pelagic to offshore ocean migratory pelagic resources such as Dolphin fish (*Coryphaena hippurus*), Blackfin tuna (*Thunnus atlanticus*), Yellowfin tuna (*Thunnus albacares*), Skipjack tuna (*Katsuwonus pelamis*), and Blue marline (*Makaira nigricans*), sort to include DBS as a specie of social and economic importance in this diversification drive. Having successfully transferred the fishing effort during the past decade to ocean pelagic resources, a growth from 57% in 2003 to 74% in 2012 of the total fish production on Dominica has been realized (Fisheries Statistics Data in Dominica 2003 - 2012). Additionally, 45% of fisher responded that they use offshore Fish Aggregating Devices (FADs) on every fishing trip during the Fisheries Industry Census conducted in 2011. These efforts of growth and development are currently focused on researching the potential of DBS resource and its sustainable utilization as a viable fishery.

To date, DBS caught in Dominica is sold at 12XCD, Eastern Caribbean dollar (US$4.44) per pound to the landed market, and 26XCD(US$9.62) per pound after processing and packaging, to consumer. Trial exports of DBS to St. Lucia and Martinique for restaurant and hotel use have been conducted because of recent Sashimi and Sushi market demand. Locally, the product is available at the Roseau Fish Market in frozen vacuum pack product that purchased by restaurants, hotels, and the general consumer public. Freshly caught squid are not sold to the public due to the requirement of a consid-

erable freezing period to allow for the slow *rigor mortis* process to be completed, and at which stage its texture and flavor is best. This process also enhances its shelf life (as organoleptic sense) allowing the frozen product to be kept for periods as long as one year.

DBS is an un-utilized resource in the Caribbean, requiring continued work with regional fisheries organization to accumulate DBS catch data for better understanding of the resource and development of a resource utilization and management program. The understanding of its migration in the Caribbean Sea is essential for future planning of DBS fishery development as an alternative resource thus continuous research and development is necessary. The DBS in the Pacific has a life cycle of one year; the oldest squid was 306 days old (Miyahara et al. 2005). Its migration in Caribbean is unknown and requires future studies. The one-year life cycle indicates the potential of DBS resources.

MATERIALS AND METHODS

Open fiberglass pirogue and fiberglass launches were used. The number of units of fishing gear used were 5 to 8 sets of Drift Vertical Longline Fishing Gear (Figure 1) in association with a line holder to reel the main line. Each operation was conducted during early morning to noon or 3:00 pm. The gear was set with 500 m of main line during operation period 2011 to 2014 in water depth ranging from 1,000 - 2,000 m. The drifting vertical longlines were set perpendicular to the current direction at intervals of 300 m to 500 m apart. Immediately after the complete shooting of the first vertical longline, the second line was placed to be casted out. After the setting of all lines was completed, the vessel patrolled around the lines in observance for sing of the catch. On retrieval of a successful catch, the DBS or bycatch were removed and the gear were returned in the water. The retrieved DBS was immediately stored in ice after allowing sufficient time for the ejection of the ink. The location of the operation was 7.5 - 9.0 nautical miles west offshore of Roseau city in the Commonwealth of Dominica (Figure 2) (Caribbean Sea side of Dominica).

The catch was kept in ice on vessel and transferred to Processing Plant at Roseau Fish Market within the Roseau Fisheries Complex. Prior to processing, statistical data including, length and weight measurements, biological data and stomach content information are taken by Dominica Fisheries officer. The squid is then processed, vacuum packed and placed in frozen storage for sale by the plant operator.

Total data collected were date, position, depth of line set, number of line, length of line, start and end time, current and wind direction and strength, capture time, species, sex, body weight, mantle length, total length, maturity, and gonad weight. The determination of current and wind condition (strong, moderate, weak) has been done by fisher feeling. Wind gauges or GPS were not used for this purpose.

RESULTS

The length-weight relationship between mantle length (cm) and body weight (Lbs) for Female squid is $y = 0.0011X^{2.4015}$ $R^2 = 0.9468$; and for Male is $y = 8E\text{-}05X^{2.9981}$ $R^2 = 0.9723$ (Figure 3). One data point is deleted from

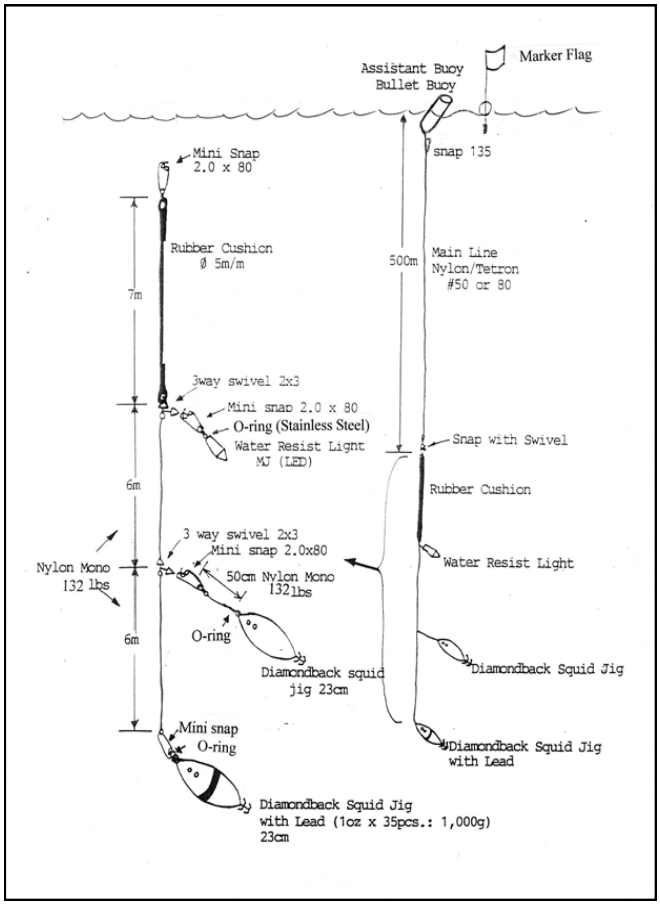

Figure 1. Diagram of Diamond Back Squid drift vertical longline fishing gear (James et al. 2006).

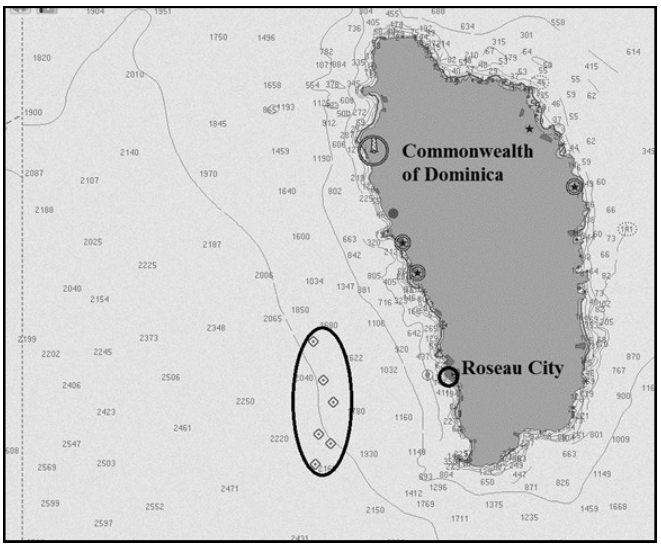

Figure 2. Diamond Back Squid fishing area. (Open CPN)

female and also another from *male*. However, body length was recorded instead of mantle length, therefore sample size of 19 females and 26 males are used for the analysis.

The possible mating and spawning period of DBS in Tobago waters could be presumed to be around January to March (Yanagawa et al. 2006). However, our sample size of gonad size of females is only 17, and there is no significant relationship on the spawning season.

Monthly average body weight of DBS was 31.1Lbs in April, 31.7 lbs in May and 27.5 in June, and dropped to 20.1 in June and 20.0 July (Figure 4). Peak season could be between February to March, and body size reduces after May (ANOVA, F 4.15 > F crit 2.121, $p < 0.001$). However sample size is small, the data should be accumulated for conformation. On the other hand, the average pieces per trip was between 2.3 to 3.0 during February to March and dropped to 1.3 to 1.5 during May to July (Figure 5), results of the ANOVA for the average pieces per trip has significant ($p < 0.01$) and there is high season during February to April compared to May to July. As a result of these two graphs, the size of DBS and CPUE during February to April is higher than during May to July. At same time, CPUE is 2.3 in September; further data collection after the month is strongly recommended due to the observation of increasing CPUE and also average size of catch.

The effect of moon phase on the average catch per day (lbs.) depicted in Figure 6 shows there is no significant relationship. However, further data collection is necessary, because the consideration of moon phase and current condition is a fisher concern. The relationship between wind condition and current conditions are analyzed, but there is no statistical significance due to the lack of sample numbers, only 24 trips have been recorded the both condition. However, there is no significance by ANOVA between average CPUE (pieces per trip) as 1.4 during strong current (n = 14), 2.4 moderate current (n = 0), and 0.8 weak current (n = 6), although the fishers' interest remained strong.

DISCUSSION

From the economical point of the view to increase DBS catch and return, it is recommended for fishers to work during high season. From February to April is the season identified by this survey. Also, the unit effort of fishing operations should be increased, similar to a commercial Japanese fisher – 20 lines per boat, by a typical Japanese fisher at Okinawa, south part of Japanese peninsula, instead of 5 to 8 lines per trip used by Dominica fishers. The estimation of return could be calculated as follow: If fishers use 20 lines during high season, the catch could be could be increased 7 pieces per trip from 2.3 pieces per trip (30 lbs per pieces) and equivalent of 2,580 XCD (US$955) in the landing price at Roseau Fish Market. After redacted operational cost e.g.500XCD (185USD): gasoline 300XCD, ice 50XCD and man power 150XCD, it is still satisfied figure by fisher.

For seeking best peak season, the research should be continued specially focused into:

i) Continues data collection during October to January,

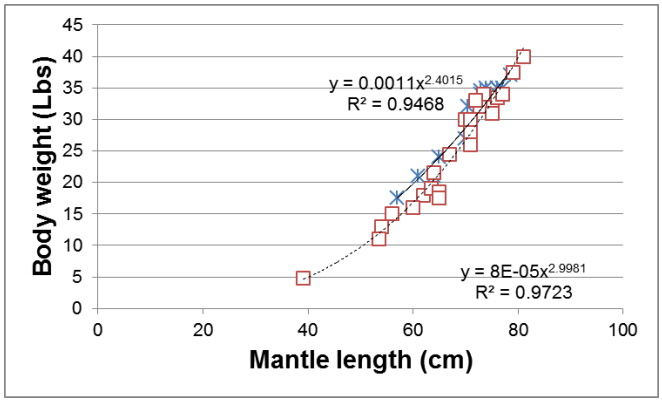

Figure 3. Length weight relationship for diamond back squid. Female (∗, ——— n=19), Male (□, - - - -, n=26).

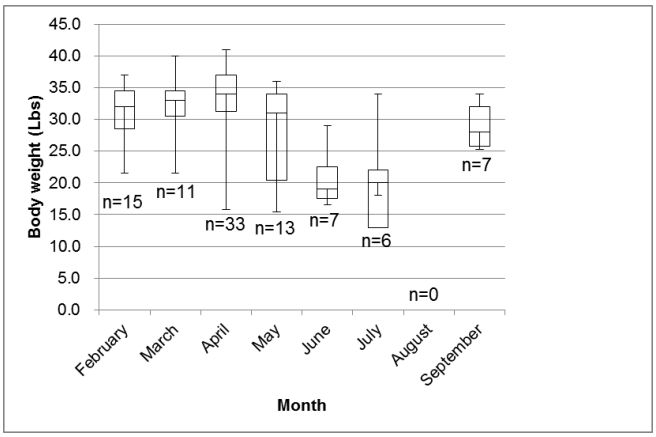

Figure 4. Monthly average body weight of diamond back squid, n = sample size.

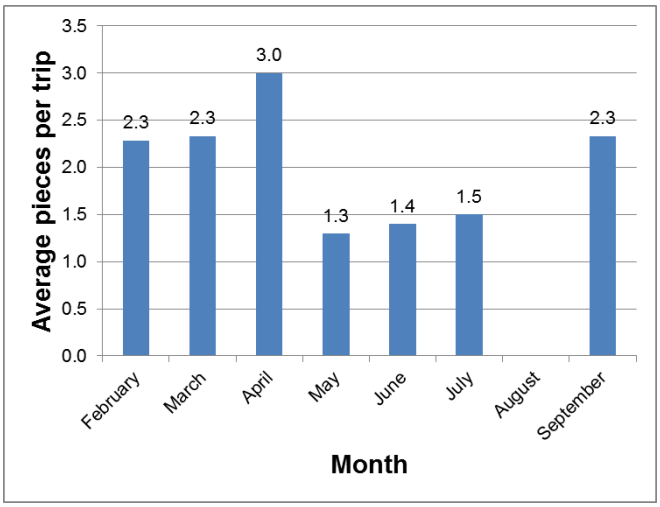

Figure 5. Monthly average pieces par trip, sample size n=7 in February, 6 in March, 11 in April, 10 in May, 5 in June, 4 in July and 3in September (total 96 pieces and 46 trips).

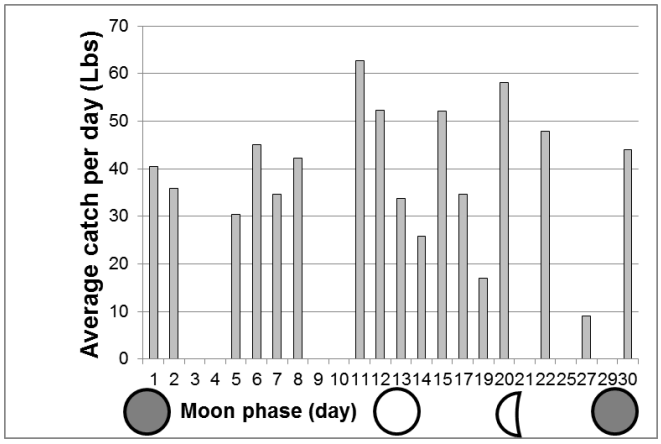

Figure 6. Fluctuation of average catch per day (Lbs.) and moon phase, (34 trips).

ii) Increasing basic data quality (no missing data) on "date, operation position (latitude/longitude), operation hour (fishing operation starting and ending time), current condition, number of line used, mantle length (cm), body weight (Lbs), sex, maturity, gonad weight (g)", and

iii) A further analysis is required for the conformation of findings in the result and discussion.

The sign of increasing the trend of CPUE from September, it is very important to observe the trend after August through January. If there is another peak or high peak, fishers will be able to operate efficiently. Also, increasing the number of data collections during February to September will be appreciated to support the theory. Gonad size and maturity (existence of the sperm spectacles at female) should be recorded for each catch. This allows the determination of migration patterns, spawning season, and/or cohort grouping.

DBS caught at 17 - 19ºC at 75 - 100 m in the Sea of Japan (bottom depth 100 - 500 m), at 5.8 - 16.7ºC at 500 - 550 m in Okinawa Prefecture (bottom depth 1,200 - 1,500 m) and 10.1-16.4ºC at 400 - 500 m in Bonin Islands (bottom depth 500 - 1,500m) (Bower and Miyahara 2005). Different line depth setting e.g. 400 m, 500 m, 600 m is one of the options to understand DBS migration patterns and its seasonal depth in Dominica waters. Understanding the depth of habitat of DBS in each season will allow efficient fishing operation for fishers. If possible, the temperature at the depth DBS caught should be observed. This information will help determine its migration pattern in Dominica waters. This knowledge of DBS migration patterns will be used to help fishers operate more efficiently in the future.

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