

First Results of Reproductive Cycle of Deep-sea Queen Conch, *Strombus gigas*, from FWI, Martinique

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ABSTRACT

The queen conch *Strombus gigas* is a marine resource of commercial importance in the Caribbean countries supporting a high fishing pressure that reduced dramatically its populations as it represents one of the most valuable resources in the region. The North American market absorbed 80% of the conch production, 17% is exported to French islands, and 3% is consumed in the other Caribbean countries. The fishing pressure in most Caribbean countries has caused the reduction of the populations of *S. gigas*, forcing to the establishment of regulatory measures. FWI fishery had 2007 boats, which are essentially artisan fishery boats. Studies of the reproductive cycle of *S. gigas* are necessary to regulate this resource in the Caribbean region. An improvement of the abundance assessment should be realized. A better knowledge of factors inducing gonadic maturity process, and recruitment and their seasonality should be necessary to improve the management of fishing and bans periods and areas to ensure of recruitment. The management regulations for *S. gigas* in Martinique do not exist. This study shows the first results of reproductive cycle of *S. gigas* from 30 - 40 m landed at Vauclin, Martinique, FWI (14° 30'N and 60°45'W). All of the conchs could be old, as they have a very a lip thickness between 20 - 40 mm. Thirty to fifty samples were taken in March, June, September, and December. The group of conchs, exhibited a whole maturation cycle with gametogenesis in March, June, and September, a mature period in June, spawn period was observed in September and most of the conchs were undifferentiated in December. These observations showed that the old queen conchs also have the ability to have a normal reproductive cycle. Based on these observations, it would be possible to suggest a regulatory measure with a temporal ban from 1st May to 30 September. The level of protection will depend on an efficient survey of the populations and a high enforcement of regulations to control exploitation and reduce illegal fishing.

KEY WORDS: *Strombus gigas*, reproduction, deep-sea, queen conch

Primeros Resultados del Ciclo Reproductor del Caracol Rosa, *Strombus gigas*, en Aguas Profundas en Martinico, Antillas Francesas, Francia

El Caracol rosa *Strombus gigas* es un recurso marino de importancia comercial en el Caribe que esta sometido a una fuerte presión de pesca, la cual se ha traducido por un reducción severa de sus poblaciones. De la captura, el mercado norteamericano absorbe el 80% de la producción de caracol, 17% tiene como destino el mercado de las antillas francesas y el 3% restante es para consumo local por los diferentes países productores. La reducción de las poblaciones ha obligado a implementar medidas de regulación, por lo que los estudios del ciclo reproductivo de esta especie es necesario para regular este recurso en el contexto del mar Caribe. Este estudio mostró que los caracoles de aguas profundas en Vauclin y banco Dezi en Martinico, en las antillas francesas de profundidades entre 35 - 40 m presentan un ciclo reproductivo. Todas las muestras de caracol fueron animales viejos con un espesor de labio de 20 - 40 mm. Se tomaron de 30 a 50 organismos de manera cuatrimestral para los meses de Marzo, Junio, Septiembre y Diciembre. Este grupo de caracoles presento un ciclo de reproducción completo con un periodo de gametogenesis en Marzo, un periodo de madurez en Junio y un periodo de desove en septiembre. La mayoría de ellos presento una fase de indiferenciado en diciembre. Estas primeras observaciones muestran que los caracoles viejos de aguas profundas siguen teniendo una actividad de madurez sexual por lo que debería ser protegido con un periodo de veda temporal, que podría ir del 1° de Junio al 30 Septiembre. En el entendido que la eficiencia de medida de protección dependerá del respeto a la misma.

PALABRAS CLAVES: *Strombus gigas*, caracol rosa, reproducción, aguas profundas

Premières Données sur le Cycle de Reproduction du Lambi Profond, *Strombus gigas*, de Martinique, FWI

Le lambi *Strombus gigas* est une ressource marine de haute valeur commerciale dans les pays de la Caraïbe. De ce fait, il subit une forte pression de pêche. Le marché nord américain absorbe 80 % de la production de lambi, 17 % de celle-ci sont exportés vers les Antilles françaises et 3 % sont consommés dans les autres pays de la Caraïbe. La pression de pêche et la réduction des stocks de lambi dans la plus part des pays de la Caraïbe imposent la mise en place de mesures de régulation. Pour cela, des études du cycle de reproduction de *S. gigas* sont nécessaires. Cette étude présente les premiers résultats obtenus sur le cycle de reproduction du *S. gigas* des eaux profondes (35-40 m) du Vauclin en Martinique (FWI). Tous les lambis étaient de vieux individus, compte tenu de l'épaisseur importante du pavillon des coquilles qui se situait en moyenne entre 20 et 40 mm. Des échantillons de 30 à 50 lambis ont été récoltés en mars, juin, septembre et décembre. Ils ont montré un cycle complet de maturation avec gamétogenèse en mars, une période de maturité en juin, la ponte a été observée en septembre et la plupart des lambis était à un stade indifférencié en décembre. Ces observations ont montré que les vieux lambis ont la capacité à avoir un cycle normal de reproduction. Compte tenu de ces observations, une mesure visant à favoriser la reproduction des lambis profonds pourrait consister à en interdire la pêche du 1er juin au 30 septembre. L'efficacité d'une telle mesure dépendra de l'application réelle des règlements qui pourraient être adoptés, du contrôle qui sera mis en place pour réduire la pêche illégale ainsi que des suivis des populations de lambi qui seront effectués.

MOTS CLÉS: *Strombus gigas*, reproduction, profond, lambis

INTRODUCTION

Queen conch, *Strombus gigas* is distributed throughout the Caribbean, from Florida, US to the northern Venezuela, and the species is found at least on 36 countries. *S. gigas* has been harvested for food for centuries; however, a large commercial fishery has developed only in the last few decades, mainly in response to the increased international demand for the meat. Over the past few decades, intensive fishing pressure has led to population declines, stock collapses, and consequently the total or temporary closure of the fishery in a number of countries are implemented. Queen conch is traditionally fished in Martinique, but the high domestic consumption has depleted local populations and created a market for queen conch meat harvested from other parts of the Caribbean. Its price varies from 15-25 EUROS per kilogram. The management regulations for *S. gigas* in Martinique establish a minimum catch size, with 250g meat weight and a developed shell lip. This fishery is practiced mostly using a 300 to 400 m gill net on 30 to 40 m depth exploiting populations which constituted a reproductive stock protected by depth a few years ago in most queen conch fishing areas (Doray and Reynal 2001, Reynal and Guyader 2008).

A better knowledge of factors inducing gonadic maturity process, and recruitment and their seasonality is necessary to improve the management of fishing and bans periods to ensure the recruitment. Given the regional importance of *Strombus gigas* in the Caribbean, and the critical state of some of its populations, the dynamics and reproductive biology of this species have been studied in various countries (McCarthy et al. 2002, Aldana Aranda et al. 2003 a, b, c, Delgado et al. 2004, Castro et al. 2005; Aldana and Frenkiel 2007). This study shows the first results on the reproductive cycle of *S. gigas* in Martinique, FWI in order to promote a management measure for this species based in its reproductive patterns.

MATERIALS AND METHOD

The reproductive cycle of queen conch was established in Martinique from samples of a population from commercial fishery landed at the fishing harbor of Vauclin situated at 14° 30'N and 60°45'W. Samples of 30-50 individuals were collected each three months (March, June, September and December). All conchs sampled were adult with a shell length \geq of 22 cm and a shell lip over 10 mm thickness. Transverse sections of digestive gland and gonad tissues were processed for histology. The quantification to establish the occurrence of reproductive stages was done observing three fields per slide, at a magnification of X400. Sections were stained with a modified Goldner trichrome method (Gabe 1968). Gonad development stages for both sexes were limited to four stages: gametogenesis, mature, spawn and undifferentiated. Digital images were taken with a Sony CCD-IRIS video-camera mounted on the Carl Zeiss microscope.

RESULTS

The four stages of gonadic development were observed for queen conch organisms sampled in Martinique. Gametogenesis was characterized by active cell division and presence of various stages of gametes cells. In females, the mature stage was characterized by large eggs filled with vitelline platelets. In males, gonad showed follicles anastomosed and occupies the whole gonadic tissue. The spawning stage was characterized by follicles partially or totally emptied and broken. In males, the deferent duct is enlarged and filled with sperm. Undifferentiated stage was typified by no signs of follicles producing germinal cells. The gonad area was occupied almost in its totality by connective tissue. Numerous dispersed amoebocytes were observed.

Analysis of reproductive cycle throughout the year showed a gametogenesis (20%) and undifferentiated stages (60%) observed in March. The mature stage is characterized by a maximal development of gametes (70%) in June. In September, a peak of spawn organisms was observed; the other three stages were still observed. Queen conch displayed undifferentiated stage of 100% in December (Figure 1).

DISCUSSION

The gonadic cycle for any one species may vary in duration and intensity of gametogenesis, maturity and spawning periods. This preliminary study of reproduction of old queen conchs of deep-sea from Martinique showed that these stocks of adults undergo a normal reproductive cycle, with a high percentage of mature and spawn organism in June and September, respectively. The comparison with other queen conch populations indicates that *S. gigas* from Martinique could have a comparable reproductive cycle than conchs from Guadeloupe, but different from populations from other populations from West continental Caribbean. Rathier and Battaglia (1994) founded that fishery in Martinique in the nineties was practiced on shallow waters populations composed mostly of juveniles. For this preliminary study, mature stage started in March and it was observed until September. Frenkiel et al. (2008) from conch sampled monthly in Guadeloupe observed a mature stage starting in March and intensifying until September. Aldana Aranda, et al (2003a) from other localities reported a long maturity and spawning periods (March-November). Based on these partial observations it would be possible to suggest a regulatory measure for queen conchs, with a temporal ban from 1st Mai to 30 September. However, it is necessary to complete this study with a monthly sampling period and weekly in July in order to characterized correctly the reproductive cycle of conchs in the Caribbean eastern and to promote the adequate management regulation to protect the last stock of *S. gigas*. It is necessary also to know the impact of this fishery technique not only on conch but on other species. The level of protection will depend on an efficient

survey of the populations and a high enforcement of regulations to control exploitation and reduce illegal fishing.

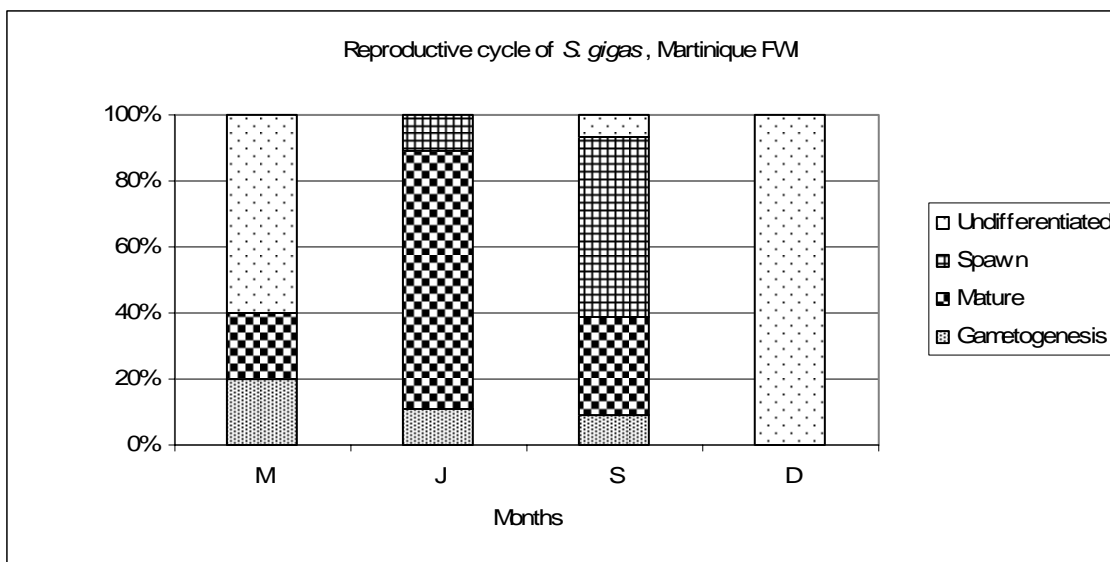


Figure 1. Reproductive cycle of *Strombus gigas* for both sexes from Martinique FWI.

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LITERATURE CITED

- Aldana Aranda, D., E. Baqueiro Cárdenas, I. Martínez Morales, R.I. Ochoa, and T. Brulé. 2003a. Reproductive Patterns of *Strombus gigas* from Alacranes Reef versus Chinchorro Bank of México. *Proceedings of the Gulf and Caribbean Fisheries Institute* 54:202-225.
- Aldana Aranda, D., E. Baqueiro Cardenas, I. Martínez Morales, R.I. Ochoa, and T. Brulé. 2003b. Gonad behavior during peak reproduction period of *Strombus gigas* from Banco Chinchorro. *Bulletin of Marine Science* 73:241-248.
- Aldana-Aranda, D., E.R. Baqueiro-Cárdenas, I. Martínez-Morales, A. Zetina-Zarate, and T. Brulé. 2003c. A review of the reproductive patterns of gastropods mollusks from Mexico. *Bulletin of Marine Science* 73:629-641.
- Aldana Aranda, D. and L. Frenkiel. 2007. Lip thickness of *Strombus gigas*, Mollusca Gastropoda versus maturity: a management measure. *Proceedings of the Gulf and Caribbean Fisheries Institute* 58:431-442.
- Castro, E., L. Frenkiel, E. Baqueiro, and D. Aldana Aranda. 2007. Atypical reproductive cycle of the queen conch *Strombus gigas* (Mollusca: Gastropoda). *Gulf and Caribbean Fisheries Institute* 58:445-450.
- Delgado, G.A., C.T. Bartels, R.A. Glazer, N.J. Brown-Peterson, and K.J. McCarthy. 2004. Translocation as a strategy to rehabilitate the queen conch (*Strombus gigas*) population in the Florida Keys. *Fishery Bulletin* 102:278-288.
- Doray, M. and L. Reynal. [Unpubl. Report]. The Conch fishery in Martinique. Unpublished report presented at the 2nd International Queen Conch Conference, Juan Dolio, Dominican Republic, 18-21. July 2001.
- Reynal, L. and O. Guyader, [In Press]. Fishery data collection optimization in tropical insular context: the case of the French West Indies. *Proceedings of the Gulf and Caribbean Fisheries Institute* 61.
- Frenkiel, L., L. Pruvost, A. Zetina Zarate, M. Enriquez, and D. Aldana Aranda. [In Press]. Reproductive cycle of the queen conch *Strombus gigas* L. 1758 in Guadeloupe FWI. *Gulf and Caribbean Fisheries Institute* 61.
- Gabe, M. 1968. *Technique Histologique*. Masson, Paris, France. 1168 pp
- Rathier, I. and A. Battaglia. 1994. Assessment of the Martinique Queen Conch fishery and management perspectives. In: R.S. McCarthy K.J., C.T. Bartels, M.C. Darcy, G.A. Delgado, and R.A. Glazer. 2002. Preliminary observation of reproductive failure in nearshore queen conch, *Strombus gigas* in the Florida Keys. *Proceedings of the Gulf and Caribbean Fisheries Institute* 53:674-680.