

DALILA ALDANA ARANDA<sup>1</sup>, LILIANE FRENKIEL<sup>2</sup>,  
 SAITRA PÉREZ CABRERA<sup>3</sup>, and MIGUEL TAPIA<sup>1</sup>  
<sup>1</sup>*CINVESTAV, IPN, Unidad Merida*  
*Antigua carretera a Progreso*  
*Merida, Yucatán, Mexico*  
<sup>2</sup>*Archipel des Sciences*  
*Centre d'éducation scientifique et technique de Guadeloupe*  
*Route de Grosse*  
*Montagne, Lamentin Guadeloupe (FWI)*  
<sup>3</sup>*Xel-Ha*  
*Tulum, Quintana Roo, Mexico*

#### ABSTRACT

The queen conch, *Strombus gigas*, is a large Caribbean gastropod mollusc which has been exploited for food and many other purposes since pre-Columbian times. It has also been used during slavery for remote communication. It is still being used as traditional food, and as a tourist attraction delicatessen. Its shell is used as music instrument, tourist curios and much more. Mainly because of over-fishing, but probably also because of destruction and pollution of its natural habitat, it is today an endangered marine resource. It is included in annex II of CITES (Convention for International Trade of Endangered Species). However CITES is in charge only of international trade and is not concerned with local trade and fisheries. Each country is responsible for its protection and enforcement of regulation. However in most countries, lack of respect of the main regulations is the rule.

Research workers at academic level, in Guadeloupe (French Caribbean) and in Yucatan (Mexico), cooperating with the education group of the private marine park of Xel-Há in Quintana Roo (Mexico), with the support of Puerto Rico's Caribbean Fisheries Management Council (CFMC), have joined their efforts to produce a whole set of documents at school and general public level. These documents, published in English, French and Spanish, comprise a booklet, a slide presentation and a large set of games, all accessible on four internet sites and in CD edition, distributed for free at the Gulf and Caribbean Fisheries Institute (GCFI) meetings and through the *Strombus* net site. They may be reproduced, used to print paper booklets and cardboard games for school and public information. They are designed to be adapted in each country to popularize the idea that *Strombus gigas* is a common natural resource and a cultural and economic heritage for all the Caribbean people. Children have to be involved in protecting it.

**KEY WORDS:** Caribbean, education, endangered species, Queen conch, *Strombus gigas*

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## Programa Educativo de Manejo Sustentable del Caracol, *Strombus gigas*

El caracol rosa *Strombus gigas* es un molusco gasterópodo, inofensivo, habitante de aguas someras del Caribe. Su impacto económico en esta región ha sido estimado en 60 millones de dólares americanos. Su carne es suave, rica en proteínas y ácidos grasos no saturados, atributos que lo sitúan en uno de los platillos favoritos del Caribe. Estas características han derivado en una extracción desmedida del recurso, al grado de ser considerado por la Convención para el Comercio de Flora y Fauna Silvestre en Peligro de Extinción (CITES), como una especie vulnerable a la sobre explotación, que se encuentra amenazada (apéndice II). En respuesta a esta situación se han implementado programas de manejo con regulaciones; tales como, tallas mínimas de captura, vedas, cuotas de captura, restricción en los artes de pesca y el cierre total de la pesquería. Pese a estas medidas, las poblaciones naturales no se han recuperado, ya que también ha surgido un mercado negro de caracol, proveniente de la pesca ilegal.

A fin de sensibilizar a la sociedad de la necesidad de proteger y conservar esta especie marina amenazada y su hábitat, se presenta un programa de educación ambiental sobre la vida, usos, importancia económica, ecológica y cultural del caracol rosa en el Caribe. Este programa que educa a través de juegos, está dirigido principalmente a los niños; sin embargo, también ha resultado interesante para consumidores, pescadores, dueños de restaurantes, funcionarios y empresarios, que de alguna manera están ligados al recurso.

**PALABRAS CLAVES:** Caracol, *Strombus gigas*, programa educativo, manejo sustentable

### INTRODUCTION

The queen conch, *Strombus gigas*, is a large gastropod mollusk distributed along the Caribbean Sea from Brazil and Venezuela in the south, to Florida and to the Bahamas in the north, including all the minor and large Caribbean islands, representing overall 30 different countries. The fishery for this species has been an important source of food for the inhabitants of Caribbean coasts and islands, since pre-Colombian times. Today, queen conch represents one of the most valuable benthic resources in the region, exceeded only by the spiny lobster. Landings were recently estimated at 6,000 metric tons, with a value of 6,000,000 US \$ (Chakalall 1997). The volume catch reached 6,520 tons in 1992 but collapsed to 3,132 tons in 2002 (CITES 2002). Therefore, *S. gigas* is now an over-exploited resource.

International management measures were taken to slow down over-exploitation. Queen conch was included in Appendix II under CITES (Convention on International Trade of Endangered Species) in 1992. Since 1994, it has also been included in the red list of the International Convention for Nature Conservation. In 2002, it was included in Annex II of SPAW (Specially Protected Areas and Wildlife in the Wider Caribbean region).

The landings of queen conch in various Caribbean countries (Bahamas, Belize, Colombia, Cuba, Dominican Republic, Honduras, Jamaica, Turks and Caicos...) are mainly exported to USA and to France. Seventy-eight percent of these landings are exported to Puerto Rico, Florida, and the US Virgin Islands, and 18% to the French West Indies (Guadeloupe and Martinique). Only 3% of the registered catch volume is consumed in the countries where queen conchs are captured. However, if CITES regulates the international market, it remains up to each country to take up adequate protection measures. For example, in Florida, *S. gigas* fishery has been closed for over 10 years, but the queen conch population still has failed to recover; in Guadeloupe, queen conch fishery is closed eight months each year. In most Caribbean countries where queen conch meat is an appreciated staple food, illegal catches and poaching are widely practiced to meet the local market. Protection measures cannot be efficient unless both fishermen and consumers feel involved. In order to control over-fishing due to these illegal practices, it is therefore urgent to promote a dedicated education program as well as to enforce management regulations.

#### LANDINGS AND IMPORTS OF *S. GIGAS* IN THE CARIBBEAN

Queen conch resources occur throughout the Caribbean Sea and in the Atlantic Ocean northward up to Bermuda, but populations in several areas are decidedly over-fished and need management measures. Queen conch is extremely vulnerable to harvest especially during the spawning season. Estimates covering a range of three years (from 1988 through 1991), represent annual landings for most of the major conch producing nations in the area. The resulting total was 4,168 metric tons. The information indicated:

- i) That over one-third of the catch was used solely in the Cuban bait fishery, and
- ii) That landings from Colombia, Mexico, and Puerto Rico all declined considerably (47 - 140%) in recent years. Cuba led the area in production and was followed in order of decreasing landings by Jamaica, Turks and Caicos Islands, Bahamas, Venezuela (all illegal), Colombia, and Belize; landings of other nations were substantially lower than 100 tons each.

To curb over-fishing (defined as a population level that is below 20% of the unfished spawning stock biomass per recruit) of queen conch, the Caribbean Fisheries Management Council has proposed a management program designed to reduce the mortality on spawning adults and prevent the harvest of immature individuals. The management program contains provisions for total or temporal closures, but favors effort reduction as the socio-economic impacts are less severe. The program would:

- i) Impose a 24cm overall minimum size limit or 10mm shell-lip thickness limitation on the possession of queen conch;
- ii) Require that all species in the management unit be landed in the shell and prohibit the sale of undersized queen conch and queen conch shells;

- iii) Establish a bag limit of 3 queen conch/day for recreational fishers, not to exceed 12 per boat, and 150 queen conch/day for licensed commercial fishers;
- iv) Close the harvest season from July 1 through September 30 of each year coincident with the peak spawning period (Aldana Aranda, 2005); and
- v) Prohibit harvest of queen conch by scuba diving and hookah gear to protect deep-water spawning stocks. These measures should resolve over-fishing problems in the queen conch fishery and optimize production in the management area. However, if recruitment is dependent on nations in the eastern arc of the Caribbean basin, cooperative efforts by other communities will be required to effectively manage queen conch resources throughout their range. Landing queen conchs and other mollusk species in the shell in the management unit is an enforcement tactic designed to protect immature or juvenile conchs. Other problems in the fishery, such as insufficient data, insufficient knowledge about life history life, information dissemination to educate the public, and habitat degradation will require additional efforts by both local and federal entities.

A difference does exist between landings and imports (CITES 2002). Two hypotheses can be explaining this situation: a re-expedition of queen conch meat between countries or illegal catches of queen conch incoming to quotes established by CITES. To regulate catch of *S. gigas*, different management measures are applied; however the heterogeneity of management regulations for this fishery promoted illegal catch and poaching. To avoid these illegal catches, it is necessary to enforce management regulations and to promote an educative program directed at the communities involved in the conch fisheries, to emphasize the importance of the resource and the severe damage of over-harvesting that could result in stock collapse.

#### CARIBBEAN EDUCATION PROGRAM OF QUEEN CONCH

This education program was initiated by the Marine park Xel-Há, the CINVESTAV-IPN research center in Mexico and the association Archipel des Sciences in the French West Indies with the grant and support of governmental agencies such as: Caribbean Fisheries Management Council, Mexican Academy of Science, the French embassy and No Governmental Organizations.

In this Caribbean education program, research teams and teachers produced a wealth of documents and elaborated a "teaching package" in the form of compact disk entitled "*Education for the conservation and safeguard of the queen conch, *Strombus gigas*, in the Caribbean Area*". The aim is to involve Caribbean people and especially children in the protection and recovery of queen conch populations and to keep queen conch alive in its natural habitat, as a cultural, ecological and economic common heritage, through research and education, to make the citizens aware of the urgent need for insuring the protection and rescue of an endangered species and its habitats.

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The project is designed to transmit to the general public and particularly to the children, information about the biology and ecology of *S. gigas*, the state of current over-fishing and possible solutions for protection, conservation, and sustainable exploitation of the queen conch.

The education package for the conservation and safeguard of the queen conch, *Strombus gigas*, in the Caribbean region is published as a CD which comprises five sections. The first section entitled “*The Queen Conch Life Story*” is an illustrated life cycle description of *S. gigas*, and of its ecological importance, followed by a description of its state of current over-fishing and of the various strategies for its protection, conservation and sustainable exploitation. The second section comprises a slide show entitled “*The Life of Conchita and Caracolito*”, which constitutes a direct usable material for a lively power point presentation. In the third part “*Learn by Playing with Conchita and Caracolito*”, eleven activities allow to reinforce the knowledge issued from the first and second part. Each activity contains an introduction, its objectives, the age of the children concerned, the material included and the instructions to carry out the game. In the fourth part, “*Materials Allowing to Prepare the Activities*”, all the illustrations which make it possible to carry out the games that form the “teaching package” are gathered. They are readily printable on cardboard to be used with pupils. In the fifth part “*Annex*”, the teachers will find forms that allow evaluation of the educational package by the pupils and teachers to give hints for further improvement. A special postcard and a poster of this education program are included in this section. The authors shared the “know-how knowledge to do” scientific studies, education and games.

The aim of this package is to transmit the necessary knowledge to the children who are the future of the Caribbean countries, and to their parents, allowing them to understand the importance of rules and precautions for a reasonable and sustainable use of the queen conch. We hope everybody will help to preserve this valuable species as a common cultural and economical heritage for the Caribbean people.

Since March 2004, 200 primary school teachers and 9,000 pupils from public schools of Quintana Roo (Mexico) received the training in Xel-Há park with the education program for the conservation of the queen conch. In order to promote the scientific education, this program collaborates with the Mexican Academy of Science and Ministry of Education in different programs: *Hands on, Sciences in the school, Sciences at the beach, week-end of science, and scientific summer*.

The education CD is offered for free with all rights for reproduction for educational purposes. It is now used in various countries: Colombia, French Caribbean, Honduras, Mexico, Nicaragua, Puerto Rico and Venezuela.

#### LIFE STORY OF THE QUEEN CONCH, *STROMBUS GIGAS*, A CARIBBEAN EDUCATIONAL PROGRAM

This education program has two mascots: the veliger larva named “*Conchita*” and its brother named “*Caracolito*” which is a young metamorphosed queen conch. They explain their life cycle story with a series of questions and answers: Where queen conch lives? How are little queen conch

born? Why queen conch has a planktonic and benthic life cycle. How do I grow up? How do I reach sexual maturity? Why parents produce a large number of eggs but few of these reach the adult reproductive stage? Why am I an important species in the Caribbean? Am I an important fishing resource? How I am inserted in the marine food web? Why, people take out of the sea more and more queen conchs without taking in account the necessary renewal of populations? Which other ways for conservation and sustainable exploitation of queen conch have been found by biologists ?

The mascots explain that the queen conch is a very important fishery but also an important part of the marine food web in the plankton as well as in sea-grass beds and sandy grounds. When *S. gigas* was a planktonic larva, it was food for some fishes and crustacean larvae; it is inserted in the marine food web when juvenile or adult. Moreover, humans collect us as staple food and to sell us and make big money. Mascots explain that queen conch is an endangered over-exploited species, in danger to disappear from Caribbean fishing grounds; but it is a renewable resource as long as it has the opportunity to reproduce and carry out its life cycle, and as long as fishermen practice a limited fishing under control. The powerpoint presentation explains also that biologists have found other ways for the conservation of queen conch in Marine Parks. These parks are sanctuaries for the reproduction of the queen conch and the other marine animals and serve to educate the society and especially children to respect the protected areas and the endangered species. We ask all children to make the adult society conscious of the importance to protect the queen conch in the Caribbean and its habitat because of the biological, ecological, economic, and cultural status of this species for all the Caribbean countries.

#### HANDS ON

Eleven activities allow in a simple and creative way to reinforce the knowledge acquired from the queen conch story and from Conchita and Caracolito slide show.

*The queen conch life cycle* — the objective of this activity is identifying the life cycle of the queen conch and its main predators at each stage with twelve card set. It is recommended for children eight years and older.

*Pyramid of survival of the queen conch* — represents the queen conch survival rate at each stage of its life cycle. Children will build a pyramid with the number of individuals that pass from a stage to the next one. On one face, it features the stage of life, on another face, the number of individuals at this stage, on the third face, the size of queen conchs and on the fourth one, the duration of each stage. The objective is to understand the stages of the life cycle of *S. gigas* and establish the relationship between the number of individuals alive at each stage and those which survive at the next one and thus until the adult size. The recommended age is nine years and older.

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*Who eats who* — by using cards with a short description of the species which forms part of the marine food web in which queen conch is implied; players build some possible food chains and identify main predators. Queen conch is an herbivorous animal which feeds on algae living on sea grass leaves. They have many predators, from larval to adult stage. The objective is to identify participants of the food web involving queen conch and marine turtles. The recommended age is nine years and older.

*Hand in hand* — in this game, children have to match pairs of cards on the topics of biology and ecology, on fishing and on the solutions for protection, conservation and sustainable exploitation of *S. gigas*. The purpose is to associate cards as identical pairs and to learn essential topics about the life of queen conchs such as life cycle, distribution, taxonomy, common and scientific names, predators, uses, over-fishing, non-respect of rules and bans, destruction of the habitats, restoration, education and research. The recommended age is seven years and older.

*You will not catch me!* — it is a dynamic game in which participants represent the main predators of the queen conch, at various stages of its life cycle as well as various adverse environmental conditions. A group of children featuring predators and adverse conditions try to catch the opposing team representing the queen conch population. Out of millions larvae which hatch each year, few of them reach adulthood. This situation is due partly to the environmental conditions which can be unfavourable. Objective is to identify the main predators and adverse conditions and their impact on the populations of this species, responsible for the poor survival of queen conchs. The recommended age is nine years and older.

*Timetable of queen conchs* — in this game, children compare the activities which they carry out during the year with the activities along the year and various stages of life cycle of queen conchs, in order to know how they grow, how they reproduce and relate this knowledge with main fishing regulations. The purpose is to establish a comparison between the stages of life of queen conchs and the seasonal activities of a pupil along the year. Age recommended from 9 years on.

## CONCLUSION

The Holistic program of queen conch *Strombus gigas* for sustainable management has developed an education program in the Caribbean region for teaching the communities involve with the conch, the importance of this endangered resource. This education program was initiated by the Marine park Xel-Há, the CINVESTAV-IPN research center in Mexico and the association Archipel des Sciences in the French West Indies with the grant and support of Caribbean Fisheries Management Council, Mexican Academy of Science, the French embassy and No Governmental Organizations. Research teams and teachers produced this Caribbean education program, and elaborated a “teaching package” in three languages: French, English and Spanish in a

compact disk entitled “*Education for the conservation and safeguard of the queen conch, *Strombus gigas*, in the Caribbean Area*”. Since 2004, this program is applied and distributed in West French Antillean Indies, Mexico, Honduras, Nicaragua, Puerto Rico, Colombia. The education CD is offered for free with all rights for reproduction for educational purpose. In order to promote the scientific education this program collaborates with the Mexican Academy of Science and Ministry of Education in different programs: *Hands on, Sciences in the school, Sciences at the beach, week-end of science and scientific summer*. Besides it is possible to access a this program in various web sites:

<http://www.mda.cinvestav.mx/biblioteca.htm>

<http://bellsouthpwp.net/c/u/culpsb/conchnews/welcome.html>

<http://www.strombusgigas.com/cfmc.htm>

<http://perso.wanadoo.fr/a.d.s/index.html>

<http://www.xelha.com.mx>

<http://www.savetheconch.org/>

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