



Strombus gigas

La vie du Lambi
La vida del Caracol
The Queen conch life story



Liliane Frenkiel
Dalia Aldana Aranda



To Kathy Orr

***Who taught to me the importance of
getting knowledge to the children, for we
can only protect that wich we have know
and loved from ourchildhood days.***

Liliane Frenkiel

***To Cosette, Emilie and to all the Children
of the Caribbean, because they are the
future***

Dalila Aldana Aranda

***Freedom to love is not less
sacred than the freedom to think***

Victor Hugo

***Who thinks little
is mistaken much***

Leonard de Vinci

Resurrection of mollusks



Strombus gigas La vie du Lambi, La vida del Caracol rosa, The Queen conch life story



*"Conch is a symbol of life.
The artist that created it
did not only create life through its form
but gathered shape and rhythm
and managed, with lines that softly flow
a constant movement
everlasting symbol of life"*

*In its infinite beauty
the conch reminds us
the water, the sea, the rain, fertility
in short, every thing that is part of life"*

Eduardo Matos Moctezuma

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November, 2003

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Presentation

The experience of the direction of Xel-Há natural park has been a privilege for me and for my team of coworkers in several ways. It has allowed me to fulfill as an entrepreneur creating wealth and employment, necessary for our country. It has also involved us in the knowledge and application of sustainable development, motivating us all in the adoption of a responsible enterprise with social responsibility. This has enriched our souls and no doubt has made of us responsible citizens, conscious and compromised Earth duelers and better human beings.

In this fortunate process we have been involved in several research projects and in the conservation of flora and fauna of the region which are fundamental for the sustainable development of the state of Quintana Roo.

No doubt a passionate project for us has been and will be “The Queen Conch *Strombus gigas*: Integral knowledge for a sustainable management”.

This project has such a social, cultural, ecological, political and economical importance, that means a challenge for the states, countries, institutions and scientists that working

on it, and before this reality, it is necessary and obliged for the private entrepreneurs to give support and resources.

For Xel-Há park it is an honor and real compromise to present this extraordinary book “The life of the Conch”, which is one more link of this project, which objectives are education and practical training with the purpose of preserving this important resource.

We are grateful to all those involved with the project, but our special acknowledgment to Dr. Dalila Aldana Aranda for her effort, leadership and compromise, and for allowing us to be part of this effort of conservation of prime importance to the beautiful and rich Caribbean region.

Francisco Córdova Lira
Director Ejecutivo
Grupo Xcaret

Prologue

The Queen conch, *Strombus gigas*, is a mollusk of commercial, nutritional and ecological importance in the whole Caribbean region. In 2002, the volume of capture has been estimated up to 3 131 metric tons with a value of 60 millions US\$.

Knowledge is the basis for a responsible management of natural resources, and education is the basis for conveying knowledge to the general public for the sustainable use of natural resources.

This work compiles information of biology, ecology and management regulations for the Queen conch, in order to establish a bridge between scientists and teachers or educators, and to spread this information among people and especially children.

The authors appreciate the help of all colleagues and friends who have participated at various levels to this work intended for the protection of the Queen conch *Strombus gigas* which is a common cultural, social and economic heritage of the inhabitants of all the Caribbean countries.

**Liliane Frenkiel
Dalila Aldana Aranda**

Preface

Present book had like origin the notebook “**La vie des Lambis**” by Liliane Frenkiel, which was an edition enriched of “La vie des Lambis” by Katherine Orr and Liliane Frenkiel published in 1986. The way this booklet was being used in the French Caribbean and the work done there was presented as a “Educación para rescatar el Caracol *Strombus gigas* en Guadalupe Antillas Francesas” at the special of *Strombus* session during of the 55^o congress of the Gulf and Caribbean Fisheries Institute (GCFI) in Xel-Há, November 2002.

The upshot of this communication was that Miguel Rolón from the Caribbean Fisheries Management Council (CFMC) proposed to Liliane the compilation of a compact disc, in the three official languages of the GCFI (French, Spanish, English) in view of distributing this pedagogical material throughout the Caribbean.

Liliane is a senior research scientist in mollusk reproduction, development and nutrition. Over the last few years, she has been working, within the Scientific and Technical Cultural Center of Guadeloupe, Archipel des

Sciences, in educational programs which target children in an awareness of environmental issues. Liliane invited me to participate in the initiative, which I regard as an enriching experience not only because of her professionalism, and her human sensibility but, in addition, she is an untiring and enthusiastic woman, passing energy and good humour to those who work with her.

We should therefore present to you on the occasion of the 56th congress of the GCFI, in the British Virgin Islands, the CD and book entitled **“*Strombus gigas*, La vie du lambi, La vida del Caracol rosa, The Queen conch life story”**.

This document consists of three sections: The first deals with the biology and ecology of the Queen conch, *Strombus gigas*; the second explains why Queen conchs are overfished; in the third and last, actions are proposed to reduce overfishing and retrieve a balance between production and harvest.

Throughout the text, words typed in bold face will be explained in a glossary.

The veliger larva of Queen conch, coined **“Conchita”** and mascot of the program *“El caracol *Strombus gigas*, Manejo*

Integral y Sustentable”, will guide the reader through the different sections.

We hope this document, which was designed for teachers and children, will constitute a valuable reference guide for all those working with the Queen conch, *Strombus gigas*, as well as to environmental investigators, fishery ministries, fishermen organizations, parks and reserve managers, nongovernmental organizations and any citizen involved in the conservation and sustainable use of the natural resources, which constitute the social, economic and cultural heritage of the Caribbean.

Dalila Aldana Aranda

Acknowledgments

This book derives its origin from a series of events that made possible a compilation of information about the *Strombus gigas* biology, ecology and fishing status as well as an account of fishing practices and consequences of not respecting existing fisheries' regulations concerning this Mollusc.

The series of events that culminated with this publication started in November 2002 on the occasion of the 55th congress of the Gulf and Caribbean Fisheries Institute (GCFI), which event took place in Xel-Há Nature Wonder Park. This congress was organized conjunctly by the Xel-Há Natural Park and CINVESTAV IPN. This was the third time that CINVESTAV had the honour of organizing the annual GCFI meeting. My gratitude goes to all the members of the Board of Directors and especially to Drs. Alejandro Acosta, LeRoy Creswell, and Robert Glazer for their confidence.

From November 2002, Liliane Frenkiel, the staff of Xel-Há Natural Park and the staff of the Laboratory of Molluscs Biology and Culture at CINVESTAV IPN united their human, logistical and financial efforts which enabled this work to

become a scientific, educative and cultural contribution for the conservation and revival of the Caribbean Queen conch *Strombus gigas*.

The tasks were multiple and many people worked behind the scenes; however, without the collaboration of the authorities and the colleagues from various divisions of CINVESTAV IPN, the CD and the book I am presenting on the occasion of the 56o GCFI in Tortola British Virgin Islands “*Strombus gigas*, La vie du Lambi, La vida del Caracol rosa, The Queen conch life story” would not have come into existence.

Special thanks to Miguel Tapia, Ph.D. student and CONACyT scholarship recipient for the preparation of a scale model of this work on a compact disk (CD) and in paper version.

As to the Xel-Há company, I wish to extend my gratitude to the General Director, Francisco Córdova Lira; the manager of Xel-Há Natural Park, Eduardo Briones and the manager of Environmental Education, Department, Manuel Sanchez Crespo, as well as to all the friends and especially the staff of the Environmental Education department.

Thanks to the CCSTI of Guadeloupe, Archipel des Sciences”, to Vonic Laubretton and Monique Barrillot who contributed to the book's illustrations and created the characters. Also to the French embassy in México, thanks for having offered a travel grant to Liliane Frenkiel, which enabled us to jointly work on the materials necessary to publish the book and CD.

My gratitude to Megan Davis, Gabriel Delgado, Bob Glazer, Silvia Manzanilla, Mari-Luz Nicaise, Miguel Rolón and Stephanie Theile for their help throughout this year for the editing.

Thanks to Clara Morán, of the Subdivision of Multilateral cooperation at CONACYT (the signatory organization of the CYTED - Science and Technology for Development), this initiative was integrated in the project II-7. However, the key person to be thanked in this initiative is Miguel Rolón of the Caribbean Fisheries Management Council (CFMC). Miguel is a man of vision who makes prompt and efficient action possible. I consider it an honor to work with him because he is a great person, very professional and totally committed to the conservation and reinstatement of marine species of the Caribbean which are fundamental in the balance

of these ecosystems. All of our gratitude goes to Miguel Rolón for the financial support of the CFMC that contributed greatly to the production of this CD.

I write these lines with great energy, passion and hope to say to all the participants, for their work, confidence and friendship, my gratitude.

Dalila Aldana Aranda

I join Dalila to thank all those people and friends that participated in the development, and editing of this book and CD. Thanks to all those that enriched our work. All my gratitude goes especially to Megan Davis who, several years ago, offered me to use her collection of slides of Queen conch larvae for the educational actions that I carry out in Guadalupe. These pictures have been used as models for the illustrations and will be used for more education tools.

I wish to add that although it was my aim to circulate to the greatest number, in the most accessible form, that information which would best promote the protection of our resources, this would not have been possible so, without the collaboration, enthusiasm and determination of Dalila Aldana Aranda. Working with Dalila has been an exciting experience,

not only because of her acute sense of humour, but also on account of her effervescent personality.

I hope that beyond this work we will stride towards new forms of collaboration and, so, continue to unite our efforts for the protection of the Queen conch which is one of the most valuable shared resources of the Caribbean Region.

Liliane Frenkie

Introduction



In the Caribbean area, since a very long time, long before the arrival of first human beings, lives a large and beautiful shellfish known to every Caribbean. This beautiful shellfish received different names in the different countries of the Caribbean area. In Mexico, it is called Caracol rosa, but in the prehispanic Mexico, it was named Teccizmama by the Aztec people. In other Spanish speaking countries, it has received various names. It is called Botuto in Venezuela, Cambombia in Panama, Cambute in Costa Rica, Caracol gigante en Honduras, Caracol pala in Colombia, Caracol in Nicaragua, Carrucho in Puerto Rico, Cobo in Cuba. In Florida, Bahamas, Jamaica and other English speaking islands, it is called Queen Conch. In French, it is called Strombe géant but

in Guadeloupe and Martinique, everyone knows it as Lambi, which comes from the remote period when most West Indians islands were inhabited by indian people coming from South America. In Santo Domingo and Haiti, it is also known as Lambí, probably for the same reason. All these traditional names, different in each country are popular names or vernacular names.

On the contrary, for biologists its unique name is *Strombus gigas*; it is its scientific name, which allows all the biologists in the world to identify it, no matter what language they speak. We may identify it by its scientific name but we will also call it Queen conch, Lambi, or Caracol rosa to write its history in English, in French and in Spanish.

Queen conch has been pretty much used for multiple purposes by Amerindian people settled in the different countries and islands of the Caribbean area. They used the conch shells to make tools, hooks and also art works; they ate the flesh probably cooked in the shell in charcoal fire on the beaches where one finds scraps of old burned shells.

Later, during the slavery, queen conchs made it possible to communicate from hill to hill to announce the great events of life; birth, marriage, death and rebellions too. It also

announced the return of the fishing boats and the start of yam crop season. It was at the same time radio, telephone and musical instrument. The most beautiful shells were used to decorate the fishermen graves. The ordinary ones were used to build dikes, and old lime-kilns give a proof of its ancient industrial use. It was part of every day life, joy and sorrow as well.

Today, their flesh is used for traditional cooking in most countries of the Caribbean area. The Queen conch shells, lined by a distinctive pink-mother-of-pearl, are sold to tourists as souvenirs. They are still used as musical instruments and take part in traditional ceremonies or festivities like carnivals.

If you seek cooking recipes throughout the Caribbean countries, you will find an even greater variety. You may eat it in Ceviche, macerated in lemon as in Mexico. But other people prefer it broiled or grilled. In the French islands, you may eat it in a spicy chili sauce with rice and red beans. Today, there are even rolls made of conch meat and chicken stuffed with conch meat. If you go further north, in the Bahamas, you may eat conch salad but especially conch fritters and a creamy soup which is called conch chowder.

Do you know that the Queen conch makes very pretty pink pearls and that the conch shell may be carved and is much used in jewelry in the Bahamas and in some other islands of the Caribbean? Unfortunately, when exposed to the sun, or with more time, even in the dark, the conch mother-of-pearl loses its pink color!

But for its bad luck, Queen conch was so much appreciated for its meat and its shell throughout the Caribbean area, that fishermen, consumers and managers of deep freeze industry forgot that the sea will not be able to provide us with more and more queen conchs for ever. Queen conchs are living animals which may be considered as a natural renewable resource only under sensible rate of exploitation. We will not find them as food for ever, unless we manage a sustainable rate of fishing.

In some countries, people eat much more conchs than the fishermen can collect in their fishing zone; in other countries, people do not eat much Queen conch and the conch production is mostly sold frozen in the international market. This commercial traffic may represent a good income for some Caribbean countries; but, with the actual rate of exploitation, it is a source of easy money leading to exhaustion

of an overexploited resource, which is not properly managed.

It is why queen conchs become scarce, around the Caribbean reefs and sea-grass beds. They even disappeared in certain places and to avoid an ecological disaster, a management plan taking into account the renewal capacity of the species according to its reproduction and growth rates, is necessary in each country. Everywhere, people started to wonder: "What should we do to keep the Queen conch resource going on?"

Then, people turned to the biologists and asked them:

"Could we raise queen conchs in farms as we raise chickens?" And biologists answered:

"It will be necessary to know them better, to know their way of life, what they eat, how they reproduce, who preys on them, how they grow, how long they live? And only when we find the answers to all these questions we will be able to say yes or no, and decide if it is possible to raise them and how it will be possible to organize aquaculture plants for queen conchs".

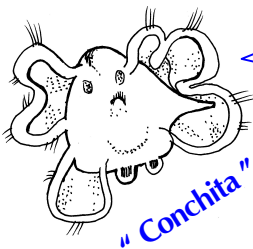
But Queen conch aquaculture is not so easy and it is not the only way to rescue the Queen conch populations.

The biologists proposed other reasonable ways to

sustain this natural resource and use it rationally, they are:

a) A program of protection within natural reserves such as Marine parks or larger Nature Protected Areas where capture of queen conchs would be banned.

b) An educational program designed for fishermen, restaurant and food industries managers, state managers as well as consumers, but also for children so that everybody may be aware of what is possible to do to protect the endangered resource and so that everybody may feel responsible for the success or failure of the management program.

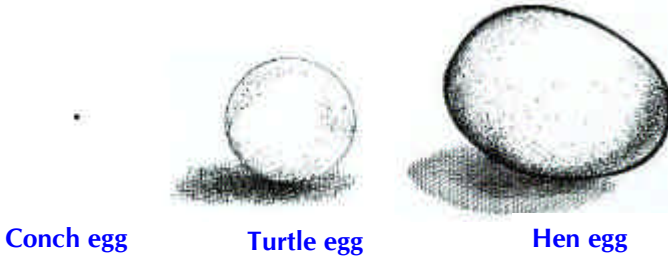


*Biologists have been working hard for more than 40 years. This book will explain to you what they know and what they do not know yet about **the life of the Queen conch, Strombus gigas***

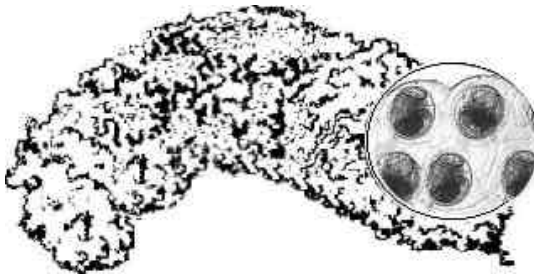
Some children who will read this book may become the biologists of the future and join the battle so that queen conchs will stay a living species, rather than an extinct species in a museum. The Queen conch will thrive again in the Caribbean

seas for the benefit of all Caribbean people, provided a sensible and sustainable use is achieved.

How Queen conchs are born?



Queen conch babies come from eggs like chicks or turtle babies. But the eggs of Queen conch are much smaller than the eggs of a hen or a turtle. They are even smaller than sand grains, so small that they are not visible to the naked eye.



They are in a strand of sticky jelly that the female Queen conch deposits with its **foot**. It rolls the jelly strand gently with its foot from the left to the right just like fishermen

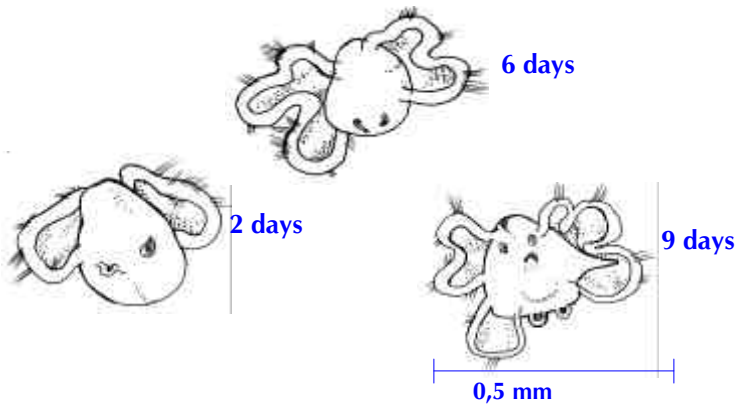
roll up their ropes neatly. Sand grains stick to the jelly strand, as it is spawned.

When the egg laying is finished, the jelly strand measures up to 30 meters when it is unrolled, but well formed into a crescent shaped egg mass, it is 10 to 15 cm long all coated with sand grains. This egg mass contains up to 400 000 eggs.

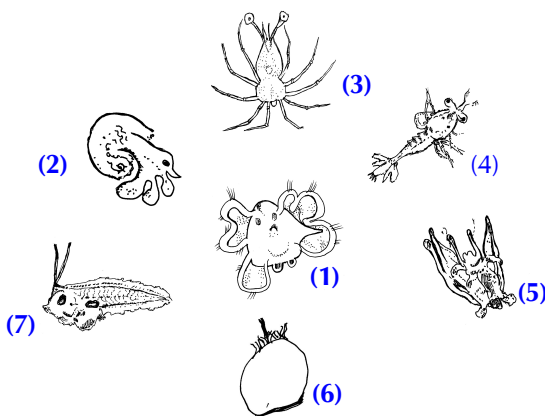
Once the eggs are laid, the Queen conch leaves the egg mass, well hidden in the sand and goes away. Inside the egg mass, each egg is a piece of life which develops into an embryo and will become a small baby Queen conch.

After 5 days, the baby queen conchs hatch from the eggs, but they do not yet look at all like their parents.

Where do Queen conch babies live?

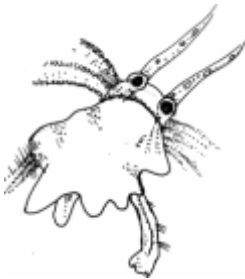


When the Queen conch babies hatch from their eggs, they are so small that they are still not visible to the naked eye. You can find at least 10 of them in a single drop of water and you need a microscope to see them. A Queen conch baby that has just hatched from an egg has two round lobes rimmed with fine hairs which move very fast. These transparent lobes form the **velum** which allows baby conchs to swim, to breathe and send microscopic algae towards their mouth to eat them! The velum is thus very important for the life of the Queen conch baby, which is called a **veliger larva**. The veliger larva has already a tiny transparent **shell**. Queen conch babies let themselves drift with the marine currents for about 1 month but it is difficult to say where they will arrive after this long journey. During this time, they eat microscopic algae that live in the sea water, and maybe some marine bacteria.



Queen conch babies are not the only microscopic animals which drift in the sea when they are little. The Queen conch veliger (1) is drifting with many other tiny gastropod larvae (2) lobsters (3), and many other crustaceans (4), sea urchins (5), clams (6) fishes (7) and a lot of other animals have babies that drift in the sea during the first days or weeks of their life.

All the small animals and all the microscopic algae which live free in the sea form the **plankton**. But in the plankton, everyone does not live in peace. There are larvae like all mollusk larvae that eat only microscopic algae (you can say that they are herbivorous) but others are carnivorous. For example, crab and lobster larvae eat other small animals like conch, oyster and clam larvae.

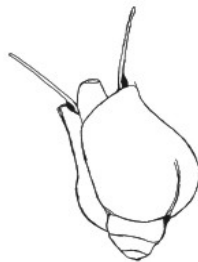


Pediveliger larvae
20 days

After 3 weeks spent in the plankton, the baby Queen conch is about 1 millimeter long; it becomes heavier because of its shell which has grown and eventually it goes down to the

ground to settle in sea-grass bed sand. At the same time, it **metamorphoses** (like a caterpillar, which becomes a butterfly or a tadpole that turns into a frog).

The velum, which enabled the small conch to swim, to breathe and to eat, disappears. Meanwhile, a small foot is growing and will enable the small conch to crawl on the bottom. In its **proboscis** a narrow rough tongue called **radula** is growing. It will allow the juvenile conch to scrap larger and tougher algae than those found in the plankton. It also acquires a gill which will enable it to breathe differently. On its foot, a horny pointed claw called **operculum** enables it to lock itself up in its shell. From that time, the **anatomy** it is begin to look like a small Queen conch... and it will never be able to swim again.



25 days
juvenile plantigrade

The small conch hides in the sand for one year to avoid the other animals that may eat it! Nevertheless, it goes out at night to eat tiny algae and bacteria stuck to the leaves of

seaweeds and it grows up. It can even swallow sand to select the eatable bacteria and algae stuck on to it. It is now a miniature Queen conch, which looks like its parents except for the flared lip, which is adult characteristic.

How does a Queen conch grow?

The Queen conch starts building its shell as soon as it hatches from the egg and even before. At hatching, the shell is transparent; it has only one and a half whorl. At metamorphosis, it has already 4 whorls and it is no more transparent. It is large enough so that the small conch can shelter inside. Its shell grows as its body grows bigger. Then it becomes hard and thick.



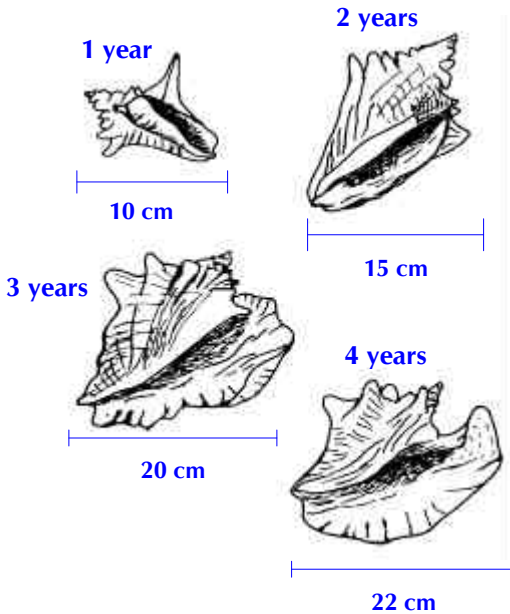
1 mm
1 month



1 cm
3 months

When the small conch is 2 or 3 months old, its shell is white; when it is 5 or 6 month old, it starts to show brown stripes. On its foot, a horny claw called operculum enables it

to leap, so it can escape or fight against predators and lock itself up within its shell.



When you encounter small queen conchs that are about 10 centimeter long, they are about one year old. Their shell forms pointed spines, a true fortress! When the Queen conch grows, its shell lengthens and continues to grow in a spiral. When it is about 3 years old, its shell stops growing and starts to form a broad flared **lip**. This shell lip shows that the Queen conch has reached its full growth and that it will come to maturity, which means that it will be able to reproduce. The Queen conch is now like a teenager; its shell lip is still fine

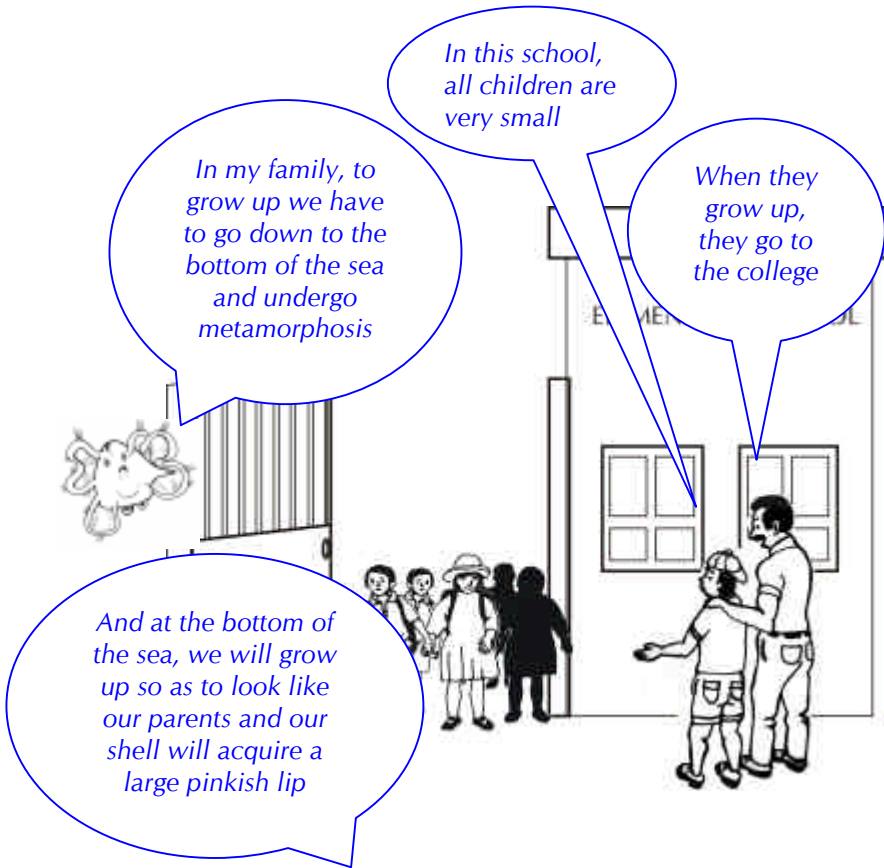
and fragile.

It thickens and reaches its adult size and thickness (about 5 mm) when it is about three and a half to four years old.

When the Queen conch is growing older, its shell becomes much thicker and heavier. The spines which were long and pointed become blunted and worn. The old conch shells are often covered with algae, and even small animals settle on them as if they were rocks. The thick shell of old conchs is often smaller than that of the young adult because the edge is worn. In many Caribbean islands, people call these old queen conchs "Samba conch". In Jamaica they are called "Stoned conch". They are also called "Conchudo" in Mexico.

Many people believe that each shell, big, small, with lip, without lip, with long spines or short spines, belongs to different species. But yet, these various forms are only the different age stages of the Queen conch, just like a baby is quite different from a child and even more different from its father or mother or from its grandfather.

Like in men, not all adult queen conchs have the same size, you can find bigger or smaller queen conchs, but all have a large shell lip.

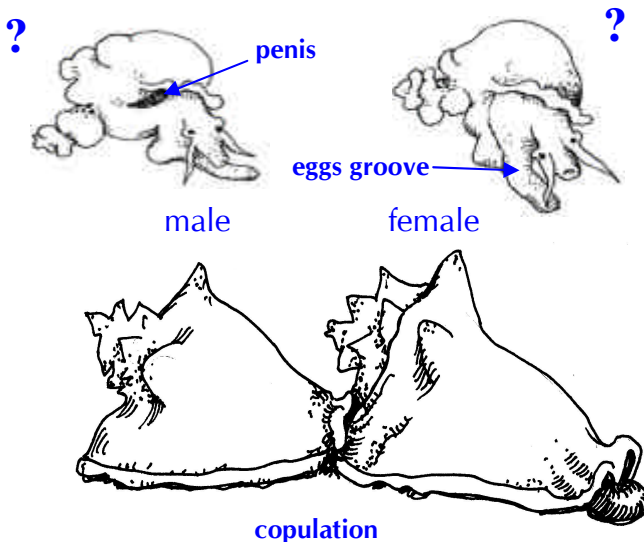


You can also find much smaller adult conchs with a thick shell and a thick white lip, but these belong to another species. It is the milk conch *Strombus costatus*, which may be exploited at small scale as a substitute for Queen conch.

There are also other *Strombus* species in the Caribbean area but they are much smaller species that may not be confused with Queen conch (**Systematics**). They are not exploited on a commercial basis except to sell some shells to collectors such as *Strombus gallus*.

Another small species, the fighting conch, *Strombus pugilis*, is really exploited in Mexico.

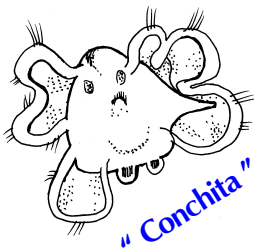
How does Queen conchs reproduce



As most animals, there are males and females *Strombus gigas*. But it is not possible to recognize them without taking them out of the shell, as their shells look much similar.

A spawning groove on the right part of the body is typical of adult females and is developed **the genital duct**. It allows the female to spawn but does not seem useful for copulation. **The male genital duct** is composed by a large black penis located on the right part of the body, up to the foot and back to the head. When the penis is well developed, the male is able to produce spermatozoa, which may fertilize the eggs produced by the female.

When queen conchs **copulate**, the male is behind the female so as to stretch the penis under its **mantle** to put sperm at the entrance of its genital duct. The sperm will fertilize the eggs later.



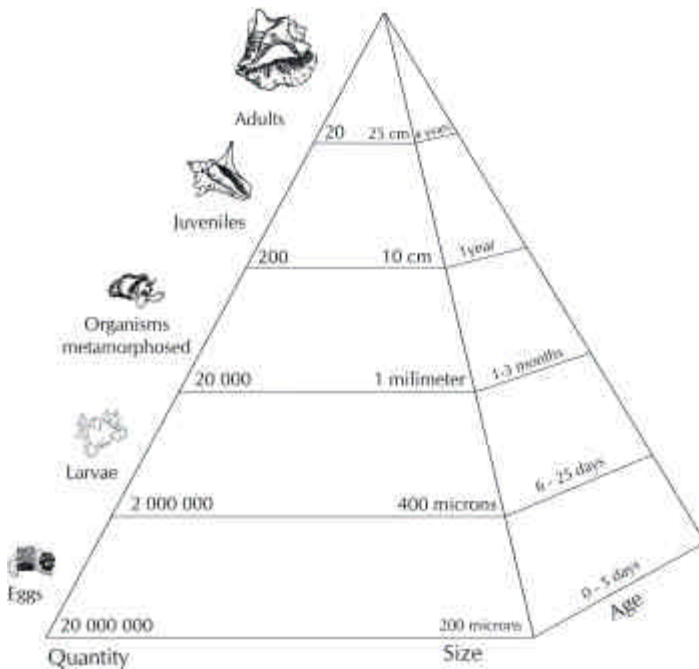
Each adult female may **spawn** 8 times each year and each spawn or **egg mass** may contain 400 000 eggs.

Therefore, we wonder, what happens with all these future conchs as everybody knows that there are not as much queen conchs in the sea as they used to be.

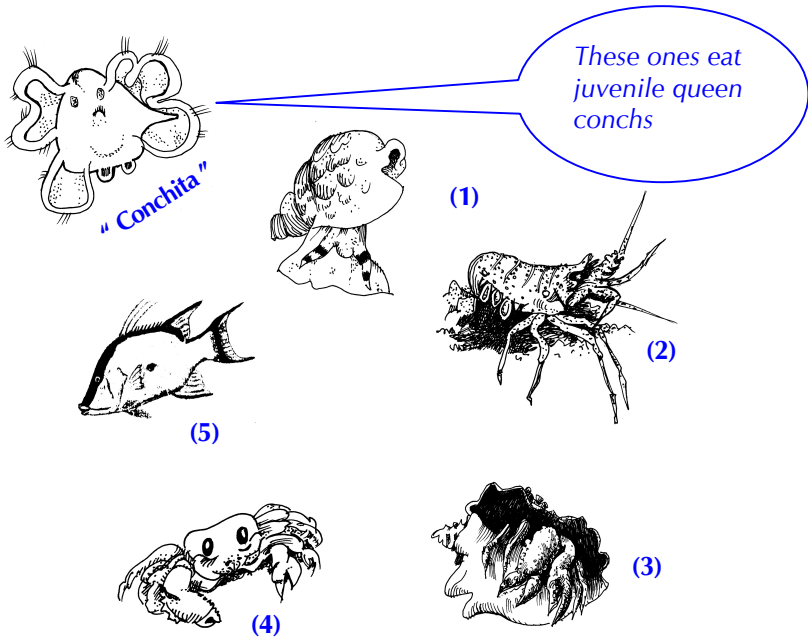
Who eats the Queen conchs?

Who eats the small queen conchs in the plankton? Who eats small queen conchs when they have undergone metamorphosis and who eats the larger queen conchs when they are grown up juveniles and adults?

And especially how many, among the millions Queen conch babies who are born each year, will survive and become adults that will be able to reproduce?



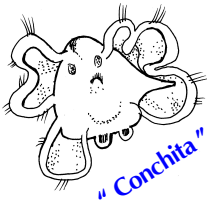
Many small carnivorous animals of the plankton eat the Queen conch babies who are not yet protected by a strong shell. After the metamorphosis and until they are one year old, they hide in the sand and go out to eat only at night. Nevertheless, many are eaten by fishes and other carnivorous animals.



When they are one year old and have a rather strong shell, they go out more often, but they still have to protect themselves against their carnivorous cousin the tulip conch (1), against lobsters (2), hermit crabs (3) and other carnivorous

crabs (4), against some carnivorous fishes (5) and all the animals which are their natural predators.

Those who survive up to two years are almost safe because their shell becomes hard enough to protect them from most predators.



These ones eat also grown up and adult queen conchs

(6)



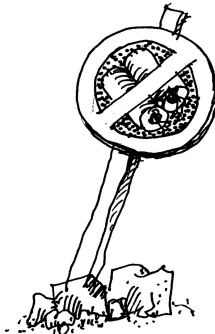
(7)



(8)



(9)



Loggerhead turtle (6), octopus (7), and stingray (8) still manage to eat Queen conch that are two to three years old and even adults. However, much more than all these animals, fishermen (9) are the most dangerous enemies of queen conchs, when they are large enough to protect themselves against their natural predators.

A Queen conch can fight for life by leaping and by giving a good kick with its foot claw to most predators. It can also hide in its shell and close it with the horny claw, which may act as a door.

But what to do against divers who take conchs to the beach and kill them by pulling them out of their shell? Their last protection is to go down in deep sea grass beds and algal plains, where the conch fishermen cannot go.

As everywhere in nature, animals eat and are eaten, but a balance is established between preys and predators, which ensure that from the millions of small queen conchs that are born each year, enough remain so that they can reproduce and replace their parents. Everything goes well as long as men do not bring this food chain out of balance.

Queen conch population collapse

Formerly, fishermen could catch as many queen conchs as they wanted to and each year, the remaining adult queen conchs could produce enough young ones to replace those, which had been collected. Now, it is increasingly difficult to find adult queen conchs and even small ones.

Why?

Just because a fast-profit-making market keeps developing, that asks for more and more queen conchs, so that an increasing number of fishermen are willing to catch the conchs.

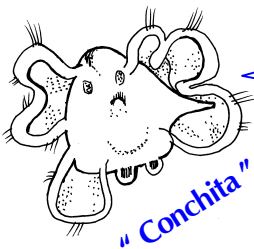
Every year, fishermen work more to catch more conchs either adult or young ones. The toll of fishing has been steadily increasing and as a result the queen conchs that remain in the sea are no longer numerous enough to replace those that have been fished. And the fishermen fish deeper and deeper, where the adults were still living quietly, using diving equipment for intensive fishing or even gill nets which kill also turtles.

Why are the Queen conchs so intensively fished?

It is in high demand because it is tasty; it provides work and high income because of its highly priced meat and shell; it is easily spotted because it is a large and conspicuous animal. Its protection against marine predators is its shell. On the contrary, when faced to man, this large shell hampers a fast escape and leaves the animal defenseless as it is easily spotted, and does not bite, nor pricks and is not venomous.

In the Natural History Museum of Paris, specimens of extinct species are labeled as follows: "I do not bite, I do not prick, I do not run, but don't handle me, I am the last".

However, if one does not leave enough adult queen conchs in the sea so that they can reproduce, they will disappear from the Caribbean sea.



Today, each fisherman may not fish as many queen conchs as he would like to anywhere and at any time

So what can be done?

For the question what can be done? Several alternatives exist:

- ✓ Fishermen may stop fishing the queen conchs for some years to allow the Queen conch populations to recover.
- ✓ Fishermen may fish all the queen conchs they want until there are none left, but then they will never be able to sell nor eat any.
- ✓ Fishermen may keep fishing queen conchs, but leave enough of them in the sea so that they can produce enough offspring, just as you must always keep several cows and at least one bull if you want calves the next year.

Each fisherman may not fish as many queen conchs as he would like to, but he will be able to continue fishing for many more years and after him, his sons, or other young fishermen will still be able to keep this trade as a provider of food and work for the Caribbean folks.

Many people think that this last solution is the best and therefore that enforcing regulations that apply to conch fisheries and trade will allow the queen conchs to reproduce

so that fishing may go on. Every fisherman must learn how to manage the conch fishery: he has to know how many conchs (according to fishing quotas) he is allowed to catch, with which fishing gear (according to authorized fishing techniques) and at what time (according to fishing ban).

And therefore fishermen may not take all the queen conchs they find, anywhere and at any time.

However an increasing number of scientists and fishermen think that the situation is so serious in the whole Caribbean sea, that we will soon have no alternative solution but to completely stop - at least for several years - fishing for this resource before it is too late.

Because nobody can decide on its own how to use a common resource, representatives of the users of the sea, politicians and scientists agreed to propose certain rules in each country that everyone will have to respect.

Once the life cycle of queen conchs is known, it will be easier to understand why and how certain regulation have been established; it will be easier to comply with them and to explain to anybody why it is in everyone's interest to try to save the resources of the sea, especially queen conchs. But as the Queen conch is a common resource shared between all

the countries in the Caribbean area, there are also international meetings to help all the countries to agree on regulations that can be applied in all the Caribbean countries.

Some countries have already set up a management plan and succeed to enforce it; but some others are not yet really aware of the urgency to protect their conch fishery for a sustainable exploitation. They allow an unrestricted access to this endangered resource.

Some others have set up regulations but cannot enforce them because the fishermen are not convinced that everybody has to respect the regulations to reach a sustainable yield. Finally, some countries have set up so permissive regulations, that they allow fishermen to catch the most important part of the conch population which is the youngster immature population (comprising 1 to 3 years conchs without a thick flaring lip), thus endangering the species.

There are several ways to protect the conch resources, but all of them have to combine monitoring of the Queen conch populations, consultation between all the users of the sea, well-advertised regulations, education and enforcement of the law.

In the following text, we propose some possible and important management tools keeping in mind that management have to adapt according to the conch fishery status, capacity of enforcement and on usage of each country of the Caribbean.

1. Protected areas

To protect various marine environments and marine resources, biosphere nature reserves and some regional reserves have been established: In these reserves, all the animals and all the plants are protected. Nobody is allowed to fish there or to collect anything including stones, algae, corals, gorgonia, molluscs, crustaceans and so on. They are sanctuaries for the reproduction of all marine plants and animals.

The reserves have to be supervised and they are good places to monitor the evolution of fauna without human predation so as to determine the real impact of exploitation. They may generate alternative activities and income such as sea life watching and several types of ecotourist development

that have also to be regulated to be non-destructive and sustainable.

2. Small Queen conch will grow up: Let them live!

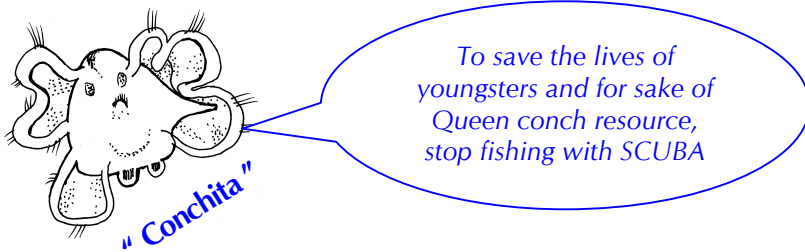
At any time and everywhere, it is forbidden to collect young queen conchs whose shell has not yet developed a flared lip. This rule is very important because these sub adult or teenager queen conchs are the survivors of the millions of Queen conch that were produced but that died at an earlier stage of their life. Their chances to reach adulthood are very good when they are 15 cm long because, at this stage, they have only few predators except humans. The first problem is that most of these small queen conchs live in shallow sea-grass beds and can be collected by anyone and even by children.

3. Let adult Queen conchs copulate and lay egg masses

In order to keep enough queen conchs for reproduction it is necessary to enforce a ban during the peak reproduction period to protect the spawning aggregations and to prevent that queen conchs of a whole area disappear precisely because

they have gathered to copulate. This period may last 4 to 8 months, depending upon local environmental condition and the size of the surviving conch population.

4. Skin diving or SCUBA diving



In some countries, it is forbidden to fish queen conchs (as well as lobster and fish) using SCUBA diving gear which makes it possible to dive to greater depths and to collect all the conchs of a whole area. It is important that the reproductive adults who live below 20m will not be collected.

SCUBA equipment has to be used to work under water. It may also be used to observe the animals in their natural habitat but should not be used to collect them.

SCUBA diving must comply with safety requirements that youngsters, who often fish queen conchs illegally for pirate boat owners, do not know. While poaching queen

conchs, they risk their lives or are likely to remain disabled because of the risk of dive accidents as their employers do not respect diving safety rules. Clearly neither natural resources nor human lives are taken into account in such trade.

An important goal for international conferences should be to have this rule adopted in all the Caribbean countries.

5. Limiting the fishing pressure to obtain a sustainable yield

When the population monitoring shows a decline in the number of adult conchs collected by a boat each day, from the opening of the fishing season up to a few months, it is a signal of over-fishing. It may be a day, a month or a year limitation for a whole area, or for each boat; it may be a limit in the number of boats allowed for the fishery; it may be also a seasonal limit to reduce the fishing pressure at a sustainable level.

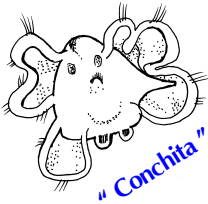
Then it is necessary to limit the fishing season to a few months per year, or even to stop fishing during a recovery period, which may be four years or more.

But to make the wealth of rules effective for the survival of queen conchs, all the Caribbean countries have to work

together and develop strong mutual agreements so that queen conchs fished in a country cannot be sold in another country.

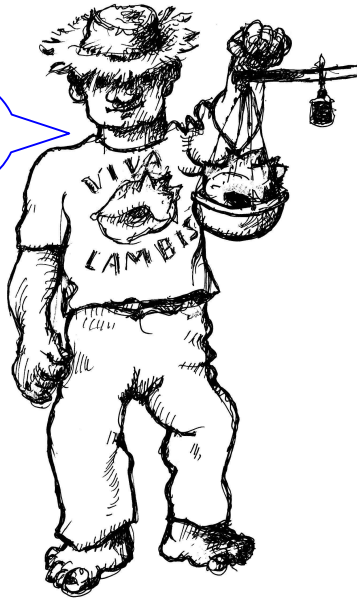
A first agreement should propose the following set of rules:

- ✓ All the countries have to create nature reserves and to enforce the ban on fishing in their nature reserves.



And when one sells the queen conchs without their shell, how do we know if they are adults who had a flaring lip?

But it is easy: you have to weigh them: there must not be more than 4 Conchs/kilo



- ✓ All the countries have to enforce:
 - a) the size limit and weigh limit at a realistic level to protect the juvenile queen conchs from being fished before reaching their reproductive size
 - b) the shell should be thick enough so that it cannot be broken with bare hands, and let them spawn at least once. The meat of a Queen Conch should be more than half a pound.

These two rules applied correctly are the measures that they protect to the young conch that they have still had not spawned.

- ✓ All the countries are urged to organize the conch fishery monitoring. But it is important to apply a principle of precaution that is to protect the resources at the best level meanwhile, without waiting for the monitoring conclusions. It is easier to protect than to reconstitute what it was destroyed.
- ✓ All the countries have to set a harvest limit at a sustainable level, but the harvest limit may be different according to the opportunity to really enforce it.

The illegal fishing may be reduced and eliminated by education programs so that everyone understands that it is the interest of fishermen, of consumers and of everybody in the country to promote a sustainable yield from the sea resources. It is not enough with establishing rules, it is also required that all the countries are organized in the monitoring of their resources in their natural reserves and to punish severely to transgressors

All the countries are urged to organize an educational program for children as well as for fishermen and for everybody.

This book is designed to help the countries of the Caribbean to implement their own programs of education.

Whitin a few years, we will know if these rules and mainly if the respect of them, helped to restore the stock of Queen conchs.

Millions of young conch are necessary to keep enough reproductive adult conchs to leave this resource to our daughters and sons and to the future generations.

Glossary

ANATOMY. All *Strombus* species share some typical anatomical characteristics. They have prominent **eye stalks (eyes)** and very small **tentacles**, a long **snout** called **proboscis**, a more or less large flared **lip** of the shell typical of adults. These features are well described most for *Strombus gigas* but are generally valid for other ***Strombus*** species.

CONCHITA. In spanish means little conch. Conchita is a veliger larva of Queen conch and it is the pet in this book and for the Queen conch Program.

COPULATION. Copulation is performed by the male which comes behind the female and inserts the penis under the female shell and mantle, up to the copulating pouch. It is possible to observe a male copulating with a spawning female. It does not mean that the eggs are immediately fertilized. The eggs have to be fertilized by sperm well before being coated by jelly coat and protecting envelopes. The male takes the opportunity of a female which does not move much as it is occupied during one day to lay eggs. And the sperm is put in the seminiferous pouch up to next spawning. Copulation is not very selective as it is possible to encounter males trying to copulate with females of a different species or even with another male. A female may be fertilized by two successive males.

CRYSTALLINE STYLE. Strombid Conchs as well as other Mollusks possess a gelatinous translucent rod, some 10 cms long, that may protrude from the visceral mass during cleaning procedure. In most Caribbean countries, this gelatinous rod is considered as aphrodisiac. In fact, it is the **crystalline style** which is an element of the digestive tract, secreted by the style sac which is an expansion of the stomach. It contains only digestive enzymes which are progressively dissolved in the stomach and takes part to the digestive process.

EYES. Strombid species as other Prosobranchs, (marine snails) possess a pair of eyes situated at the basis of cephalic tentacles. On the contrary, terrestrial snails possess eyes situated at the tip of the tentacles. But the **eyestalks** are much elongated to allow them to have a look outside from under the large flaring lip of their shell. The real **tentacles** are very small and look like a small expansion situated over the eye. So the more conspicuous eyestalks may be confused with tentacles. To be able to survey better for enemies, strombid species have a “stromboid notch” which is a special fold of the shell lip designed to accommodate the right eyestalk.

FOOT. The foot of ***Strombus gigas*** is large and powerful. It may slide as for other Gastropods but most often, it proceeds by jerky movements, typical of strombid species. It may use the pointed sickle-shaped operculum to anchor the foot in sediment and proceed by successive leaping movements which is not an easy task with such a heavy shell. But such disconcerting movements let *Strombus* species escape from natural predators.

Unfortunately such movements are of no use to escape from human predators. The muscular foot and columellar muscle which anchors the animal to its shell are the main parts to be consumed by human predators.

FEMALE GENITAL DUCT. comprises a genital glandular duct called **uterus** which will deposit the eggs mucous and proteinic protections. It comprises also a **copulating** and a **semiferous pouch** to keep the sperm to next spawning and cytological fertilization. The glandular uterus is composed of a modified part of the mantle. The ultimate part of the female genital duct is the **spawning groove** which goes from the distal end of uterus duct down to the right border of the foot.

MALE GENITAL DUCT. is composed of a long coiled **deferent duct** generally called vas deferens up to the male copulating organ which is a large black penis situated on the right part of the body up to the foot and back to the head. The penis may be seen without killing the Queen Conch when it tries to upright the shell. Young, immature male have a small yellow button which is the undeveloped penis.

LIP = SHELL LIP

MANTLE. The mantle is a very special molluscan tissue responsible for synthesis of the shell. In *Strombus gigas*, its edge appears as an orange thick fold lining the shell aperture. It is responsible for shell growth. All the outer surface of the mantle is responsible for mother-of-pearl deposit and shell

thickening. The mantle covers the pallial cavity which accommodates the gill filaments which allow for respiration.

METAMORPHOSIS. **Metamorphosis** is constituted by the wealth of anatomical and physiological modifications which allow to pass from an environment and a way of life to another during developmental stages. For *Strombus gigas*, the larva which hatches from egg is a **veliger larva** which is a swimming planctonic larva. During metamorphosis, the veliger larva loose its most important organ which is the **velum** and settles on the bottom in sea grass beds. It differentiates a **foot** which allows for moving, a **gill** which allows for breathing (that means use oxygen from the sea water) and a **radula** which allows for rasping algae to eat.

The veliger larva ready for metamorphosis has already differentiated a foot but not a gill. It is called **pediveliger**. As for many molluscan species, a successful metamorphosis may be triggered by environmental cues that allow for a rapid metamorphosis reducing the mortality that is a very common problem in molluscs aquaculture. Mortality at metamorphosis is generally due to the delay between velum destruction and gill differentiation. During this time, the larvae may be subject to bacterial diseases fatal in aquaculture. For *Strombus gigas*, the main identified metamorphosis cue is a red algal extract but some other chemicals may be efficient too.

OPERCULUM. The **operculum** is a horny proteinic hard structure stuck at the posterior dorsal face of the foot of most Prosobranchs. The operculum of *Strombus gigas* has a very special pointed, sickle shape which is similar

to some sort of claw. It is used to close up the shell aperture when the animal shelters within the shell. But its size is quite small when compared with the shell aperture to be really efficient unless the animal goes very far within its spiral shaped shell. Even like that, octopus may succeed to open the “door”. The very special function of the operculum in *Strombus* species is to allow for leaping movements.

PLANKTON. The **plankton** is composed of all small animals and small algae floating free in sea water. All the planctonic organisms drift with sea current and may travel on long distance. All the cells and organisms containing photosynthetic pigments are part of **phytoplankton**; all the small animals constitute the **zooplankton**. The zooplankton comprises as well small size animals living all their life in plankton as planctonic larval stages of benthic animals (living on the bottom) such as *Strombus* species and many other Molluscs. The planctonic larval stage allows for large dispersion of species before settlement. It is assumed that larvae of *Strombus gigas* may settle as far as 100 kms from their birth place. However, only genetic studies can discriminate the origin of settling juveniles.

The planctonic stage is subject to a very important natural mortality when compared with the rate of production of larvae from the egg masses.

Planctonic larvae undergo metamorphosis, which is a drastic anatomical change to become benthic juveniles.

PROBOSCIS. A prominent **proboscis**, tucked between the **eye stalks**, accommodate the mouth. It may be short as a calf muzzle at rest but is

much elongated when searching for food, as a miniature elephant trunk. It can protrude from the shell lip, through the siphonal canal of the shell, left to the eye notch.

RADULA. The **radula** is a narrow ribbon located in the mouth bearing small horny teeth which allow for grazing. It is a very useful organ for herbivorous snails such as all strombid species which feed on a variety of algae. They cannot eat the coarse leaves of sea grass but may scrap the surface for epiphytic algae.

SHELL. Early shell *Strombus gigas*, as most Molluscs elaborates its shell very early in its life history, from the first stages of embryonic development. *Strombus* shell is coiled as the shell of most Gasteropods.

At the moment of eclosion, the small shell is transparent as it is still constituted only of the proteinic non calcified part of the shell but it has already 1.5 whorl. At the moment of metamorphosis, it develops 4 whorls and becomes opaque because of calcification. It is still a larval shell that will remain at the apex of the adult shell which begins to grow at metamorphosis.

Shell growth. Strombid conchs grow up, coiling their shell, during approximately 3 years, then stop growing and elaborate a large flared lip which may grow during half a year. After that step, all the shell thickens, whereas the animal becomes sexually mature. It has been demonstrated that sexual maturity is not attained before the flared lip has reached a thickness of 4-5 mm.

Shell structure. The shell is composed of three parts; the outer one is the **periostracum** which is a thin brownish proteinic layer growing at the mantle edge. The periostracum dries and disappears in old dead shells.

The middle part which is also growing at the mantle border is the **prismatic layer** which is composed of a proteinic array enclosing aragonite crystalline calcium.

The inner part is the colorful **mother-of-pearl** glossy layer which is growing in thickness during most of life course. It is produced by all the outer surface of the mantle which may also produce pearls if there is some foreign particle included between mantle and shell.

Shell lip. When Queen Conch is 3 years old, the growing edge of its shell stops coiling and forms a large **flared lip**. At the beginning, the lip is thin and easy to break. Then it will not enlarge more and thickens during all adult life. Research work on reproduction has demonstrated that animals are not mature before they have a 4 mm thick shell lip. A 5 mm thick lip is considered as a cue for adulthood and is requested to allow for fishing. It is quite difficult to measure the lip thickness, while collecting the animals but it is easy to see that the lip thinner than 5 mm is easily broken on its border and that a lip thicker than 5 mm is not easily broken. Such a cue for adulthood has to be included in regulations of every Caribbean country.

SPAWN. It is the act of laying eggs and protecting structures and it is the **egg mass** as well. The egg mass is laid by the female during several hours and left in sand well covered by sand grains. The egg mass is a complex

structure which constitutes an efficient protection for the eggs during the first 5 days of development. Most larvae will hatch within 5 days.

SYSTEMATICS *Strombus gigas* is the most thoroughly studied species of *Strombus* to date. It occurs in the tropical and sub tropical waters of the wider Caribbean region north to Bermuda and south to Brazil.

It belongs to the phylum **Mollusca** (which comprises soft bodied animals generally protected by a hard shell) and to the **Gastropod** class (which means “animals with the stomach near the foot”). As most Gastropods, the strombid species have undergone a coiling of the shell, then a swinging round of the visceral mass with the covering mantle and shell (called **torsion**) very early during the larval development so that the mantle cavity comes to face forwards, opening above the head. It belongs to the Order **Prosobranchia** (which means that the gill is situated in anterior position).

The larval torsion has other important consequences such as the fact that there is only **one gill, one kidney, one gonad**. Anyway there is also only one foot but it is the same in other Molluscs which do not undergo the embryonic torsion such as the Bivalves. In the new phylogenetic classification, the Gastropods sub orders Mesogastropoda and Neogastropoda have been substituted for Caenogastropoda but the family Strombidae remains unchanged and for our purpose, it does not change much.

Other caribbean Strombus species. *Strombus gigas* is one of the 72 species of the family Strombidae, and one of 55 species of the genus Strombus

which all live in tropical and subtropical seas of the world. ***Strombus gigas*** is the largest species in the Caribbean region. Four other much smaller *Strombus* species live in the Caribbean region. The most common are the milk conch ***Strombus costatus***, which has a very thick milky white labium, the elegant rooster tail conch, ***Strombus gallus*** and the delicate bloody red shelled ***Strombus pugilis***. The hawk wing conch, ***Strombus raninus*** is less frequent and *Strombus alatus* is restricted to Florida. South to the Caribbean region, *Strombus goliath* is a Brazilian species, larger than *Strombus gigas*. For more details, it is necessary to refer to Abbott (1974) American sea shells.

TENTACLES. *Strombus* species have very small true **cephalic tentacles** located above the eye. They must not be confused with the very elongated **eyestalks** bearing the **eyes** which constitute a typical character of strombid species. Cephalic tentacles are sense organs bearing many sensory receptors that may detect chemicals which allow for identification of food or predators or mates.

They may also detect movements through mecanoreceptors. There is no particular study of sense organs in strombid species but behavioral studies show that ***Strombus gigas*** does not always identify properly the sexual partners as males have been observed to try to mate with other males or with females of other species.

VELIGER LARVA. The first free larval stage of ***Strombus gigas*** is a veliger larva which is a swimming planctonic larva which most important organ is the velum. At the moment of eclosion, the veliger larva has already a small

transparent shell, large enough to accommodate the larva for shelter. However, many plankton feeding animals engulf large quantities of planctonic organisms; therefore the natural mortality is very high during planctonic life which is about three to four weeks.

VELUM The velum is a larval organ which allows for respiration, swimming and feeding. Planctotrophic feeding of veliger larvae is constituted of microalgae and small other particles including bacteria.

Strombus larvae do not filtrate much water to eat but engulf the small particles orientated toward their mouth by the ciliated velar lobes. They are microfagic larvae.

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lambí devendrá grand • little queen conch is growing
petit • el caracolito crecerá •



laisse le vivre ! • let it live !
¡ déjalo vivir !



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