Published by:

Marine Fishery Resources Development and Management Department
DEPARTMENT OF FISHERIES MALAYSIA
Taman Perikanan Chendering, 21080 Kuala Terengganu
Terengganu, MALAYSIA.
Tel: 609-6175940 Fax: 609-6175136
E-mail: mfrdmd@mfrdmd.org.my
Website: www.mfrdmd.org.my

ISBN 983-9114-30-1
9 789839 114300

ISBN-10 983-9114-30-1
ISBN-13 978-983-9114-30-0

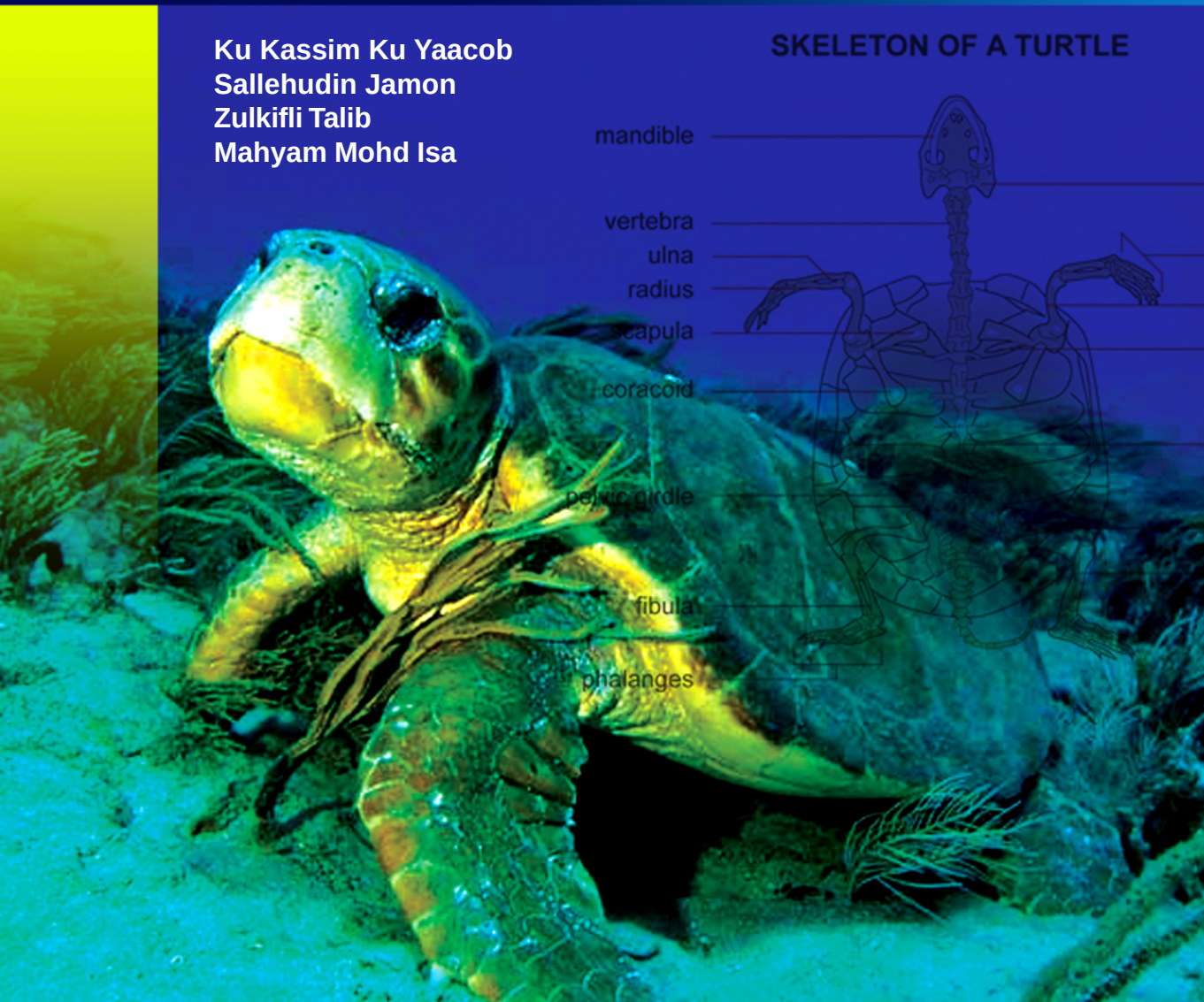
"Jabatan Perikanan" Malaysia

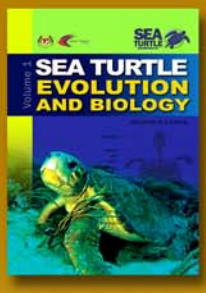
SEA TURTLE INFORMATION KIT

Volume 1

SEA TURTLE EVOLUTION AND BIOLOGY

Ku Kassim Ku Yaacob
Sallehudin Jamon
Zulkifli Talib
Mahyam Mohd Isa





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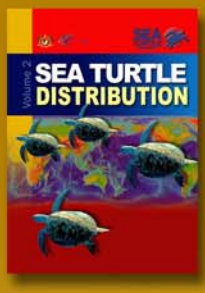

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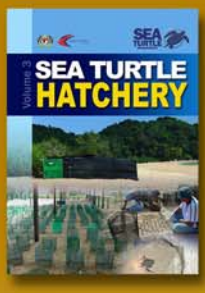

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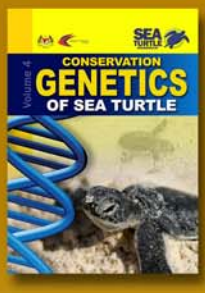

Volume 4

Volume 5

Sea Turtle Information Kit

Sea turtles are valued by people around the world. They are symbol of longevity, fertility, strength and protection from harm. However, sea turtles have also been exploited for their meat, eggs, shells and oil for years. This negatives impacts have accelerated the decline of the sea turtles population worldwide. The Sea Turtle Information Kit is specifically aimed at enhancing awareness, knowledge and understanding of the sea turtles among the public. It is hoped that the Sea Turtle Information Kit will help spread awareness among the public to protect and conserve the sea turtles and also the marine environment as a whole.

Message from the Honourable Dato' Junaidi bin Che Ayub, the Director-General of Fisheries Malaysia

The Southeast Asia holds a strong appeal to a myriad variety of sea creatures and one of these is the sea turtles. The region produces six of the seven living sea turtle species found worldwide and four of them are found nesting in Malaysia: green turtle (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and olive ridley (*Lepidochelys olivacea*).

Malaysia has, as early as in 1961, initiated and implemented conservation and management programs for the four species of sea turtles that occur in her waters. All the species which constitute a unique heritage in Malaysia have been accorded special attention through various conservation strategies to ensure their adequate conservation and protection.

In a world of diminishing natural heritage caused, in some cases by man-made pollution and overexploitation for commercial reasons, any effort to conserve the sea turtle from total annihilation is a virtuous idea that should be supported by all parties.

The Sea Turtle Information Kit is published to develop awareness, knowledge and understanding of sea turtles among the people. It is not easy to make people understand the serious and complex problems facing the sea turtles. However, with the publication of the Sea Turtle Information Kit it is hoped that it will drive home the message concerning the importance of sea turtles conservation.

I wish to congratulate the team for coming up with the Sea Turtle Information Kit. It is timely that such publication is produced to highlight the plight of the sea turtle. The sea turtles have been around since the dinosaurs' era. Let us protect these remarkable creatures and the habitats that they need to survive.

Dato' Junaidi bin Che Ayub
Putrajaya

1 December 2006

Foreword
Chief of
SEAFDEC-MFRDMD

The sea turtles have roamed Earth's oceans and sea for million of years. They were on Earth 150 millions years ago, and they have outlived almost all of the prehistoric animals with which they once shared the planet. Sea turtle survived the extinction of the dinosaurs and are still present in the world's ocean today.

Sea turtles once were found by the millions, but the demand for turtle meat, eggs, shell, leather and oil has greatly reduced their numbers. Their populations continue to decline because of the trade in sea turtle product and the loss of essential habitats.

Conservation is about reducing and removing the threat. But in reality, the work of conservation does not lie principally with the animals, plants and ecosystem but actually lies in dealing with humans. Although conservation programs are in existence, results in general have not been encouraging. The Sea Turtle Information Kit is produced with the intention of spreading awareness, knowledge and understanding to make people realize the importance of sea turtles conservation. It is our duty to make sure that the sea turtles still exist for our future generation to see.

I would like to take this opportunity to congratulate the team members headed by Ms Hjh. Mahyam bte Mohd Isa who have worked tirelessly to come up with this Sea Turtle Information Kit. Without their initiatives and sincere commitments, the Sea Turtle Information Kit would not have been realized.

Finally, I would like to express our thanks and gratitude to the Honorable Dato' Junaidi bin Che Ayub, the Director-General of Fisheries Malaysia, for the continuous support and confidence in the team members.

Raja Mohammad Noordin bin Raja Omar
Kuala Terengganu

1 December 2006

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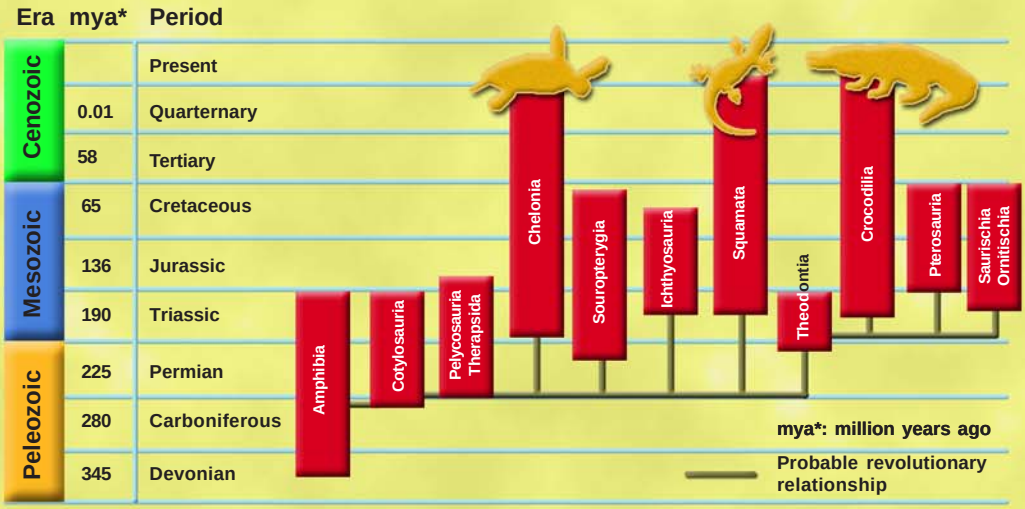
Sea Turtle Evolution

Where did the reptiles become separated from the amphibians? Actually we don't know. But we have to take our best guess and that's what we have done. The most primitive order of reptiles that we can agree on so far is that of the cotylosaurs which were lizard-like, insect eating, heavily limbed reptiles with solid roofed skulls and labyrinthine teeth and were very similar to amphibians of the time. Yet they were different enough that we have mostly agreed to start from this root-stock. Turtles are reptiles, a class of vertebrate animals that has survived for more than 200 million years, through stable periods and times of extreme environmental change. Reptiles evolved from amphibians, an even earlier class of vertebrates that lives on both land and in fresh water. From these roots came all the later families of reptiles. Some became todays turtles, snakes and lizards. Some of their other decendants turned back into the sea and became the plesiosaurs and ichthyosaurs which totally colonized the oceans as well as much of the fresh water. Interestingly, some of the earliest reptiles refused to leave the water at all. The Mesosaurs are perhaps the oldest group that we know of which decided not to colonize the land but instead stay in the waters untill they eventually died off. Over time, the reptiles came to dominate the Earth; on land, in fresh water and the seas, and in the air. But it was early in the history of reptiles that turtles, members of the order Chelonia split from the main line of the reptilian evolution.



The origin of chelonians is uncertain, but recognizable turtles are known as far back as the Triassic period, at least 180 million years ago when dinosaurs were becoming the dominant land animals. Although the Triassic turtles did not look very much different from some modern ones, closer examination would have revealed some characteristics absent from the turtles living today. For example, some of the earliest known turtles had teeth rather than sharp edged jaws. During Jurassic period, the main lineage of turtles had split into two branches: the side-neck turtles (pleurodires), which protect the head by folding the neck and head

over to one side, and the hidden-neck or arch-neck turtles (cryptodires), which pull the neck into a vertical S-curve and retract the head straight back between the shoulders. The side-necked turtles produced many sea-going species during the Cretaceous period, but all of these died out. Modern pleurodires live in fresh water. Jurassic sea turtles belonged to the hidden-neck group, the group to which more turtles belong today. Many families once made up the hidden-neck group, but most died out by the early part of the Cretaceous period. Towards the end of the Cretaceous period, turtles as large as the 3 meter (9 feet 10 inches), *Archelon ischyros,* lived in the shallow sea that covered much of what is now the western United States.

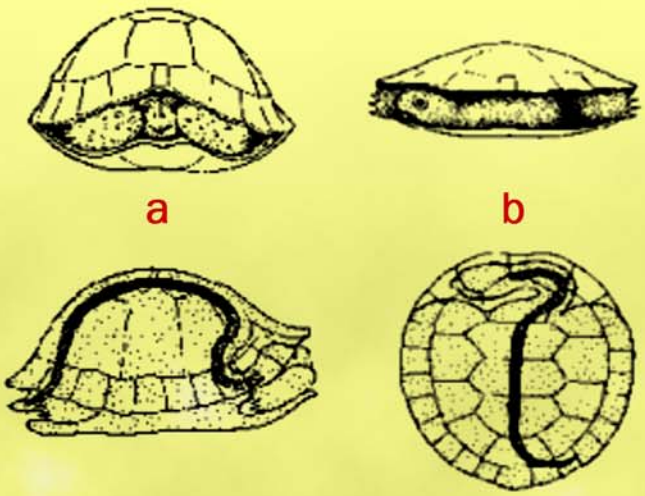


Figure a : Cryptodires
Figure b : Pleurodires
(http://www.tortue.ch/pages_html/les_tortues.htm)

Four important families of hidden-neck sea turtles did survive into the mid-Cretaceous period. Two of these families, the Dermochelyidae and the Cheloniidae, have modem descendants. The leatherback sea turtle is the only surviving member of the Dermochelyidae. All other modern sea turtles belong to the Cheloniidae.

Extinct Species

The extinct Toxochelyidae appear to be related to the Cheloniidae. They were small to medium-sized, round-shelled sea turtles. Some had upper shells of solid bone like modern sea turtles, while other members of the family had much lighter upper shells with large openings, most likely an adaptation for open ocean existence. In life these openings would have been covered with skin or horny plates. *Toxochelys*, the best known member of this family, had eye sockets that faced up, suggesting that the turtle may have been a bottom-dweller. The toxochelyids died out by the late Eocene (56 to 37 million years ago).

The extinct Protostegidae may be related to the Dermochelyidae. Like the toxochelyids, many of the protostegids had frame-type shells with gaps between the bones, and probably lived in open ocean. Although most later protostegids

were large to gigantic sea turtles with huge heads, the earliest known protostegid, *Santanachelys*, from 110 million ears ago, was only 8 inches (20 cm) long. Like modern fresh water turtles, *Santanachelys* had highly flexible flippers with movable digits, but, like marine-dwelling turtles, it also had large salt-excreting glands, indicating that it lived in the ocean. Later protostegids had semi-rigid flippers like modern sea turtles. This family includes the giants *Protostega* and *Archelon*, the latter being the largest sea turtle that ever lived.

Archelon inhabited the Western Interior Seaway, or Niobrara Sea, which covered the middle of the North American continent, separating the Rocky Mountains from the eastern half of the continent, and connecting the Arctic Ocean to the Gulf of Mexico. One *Archelon* fossil is 15 feet (4.5 m) long from beak to tail, with a span of 16.5 feet (5.25 m) between the extended tips of its massive flippers. Estimates of the creature's weight range from 4,500 to 11,000 pounds (2-5 metric tons). *Archelon*'s huge head alone could be 3.3 feet (1 m) long. The turtle may have used its formidable curved beak to crush ammonites, shelled molluscs related to the chambered nautilus.

Many types of ammonites occupied the seas during most of the Mesozoic era, but they began to disappear toward the end of the Cretaceous period. This may explain why the protostegid turtles disappeared at about the same time. Only one species of protostegid is known to have survived the mass extinction that eliminated the dinosaurs and the last of the giant fish-like reptiles at the end of the Cretaceous period. Eventually it too disappeared, leaving the leatherback and cheloniid lines (and a variety of terrestrial and freshwater turtles) to carry on to modern times.

The fossil record and chemical evidence in some rocks show that the Earth underwent some drastic changes about 65 million years ago which resulted in the extinction of many groups of organisms on land and sea, including the dinosaurs. But some groups of turtles survived these changes, and two suborders remain. One includes the side-necked turtles that retract their necks into their shells with a sideways motion. Turtles in the other more diverse suborder, which includes sea turtles, retract their necks straight in. The sea turtles of today belong to two families, the *Dermochelyidae*, which has a single species, the Leatherback turtle (*Dermochelys coriacea*); and the *Cheloniidae*, which has two subfamiles, each with two genera and three species. The subfamily *Chelonini* includes Green turtles (*Chelonia mydas*), flatback turtles (*Chelonia depressa*), and Hawksbill turtles (*Eretmochelys imbricata*). The subfamily *Carettini* includes Loggerhead turtles (*Carette caretta*), Olive Ridley turtles (*Lepidochelys olivacea*) and Kemp's Ridley turtles (*Lepidochelys kempii*).

Photo 5
Protostega, an ancient marine turtle's skeleton at the Carnegie Museum in Pittsburgh. Notice the long front flippers and pointed head – these are features shared with the modern leatherback turtles to aid in long-distance swimming.
(Photo provided by John Hutchinson)

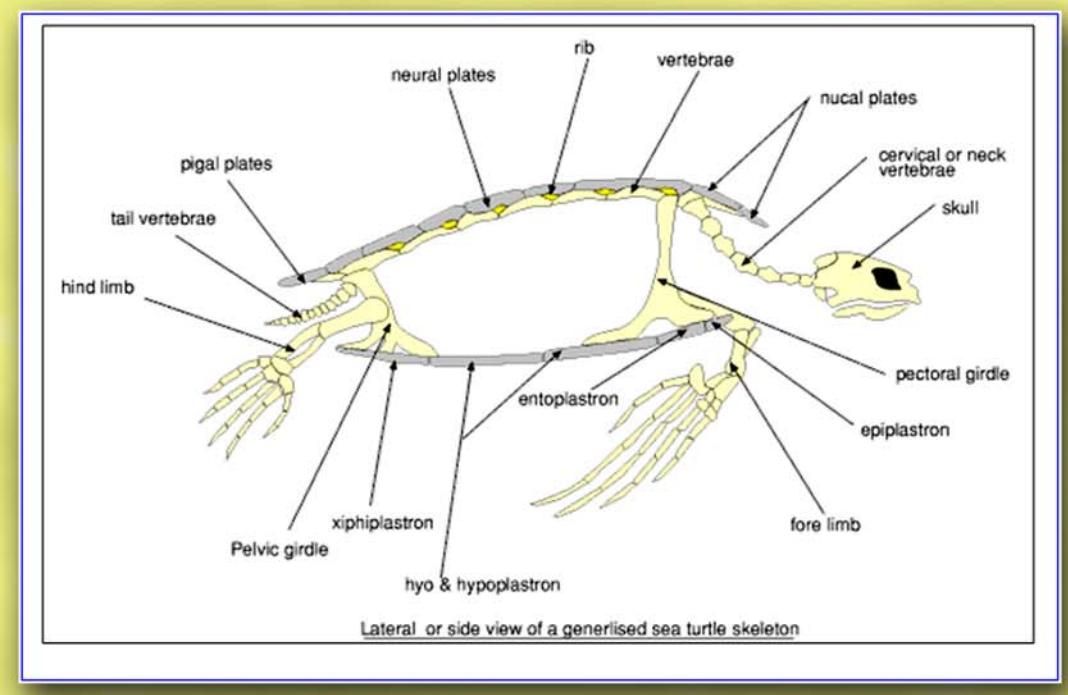
Photo 6
This photo is an artist's rendition of the ancient turtle species, *Protostega*. It is believed to be the ancestor of all modern sea turtle species.
(Photo provided by Eugene Gaffney of the AMNH)

Photos 7 and 8
Turtles evolved to two general categories: side-necked (pleurodires), top; and arch-necked (cryptodires), bottom. Leatherbacks are of the arch-necked variety.
(Photos from Eugene Gaffney of the AMNH)

Sea Turtle Biology

Introduction

- Sea Turtles are ancient reptiles that have roamed the world's oceans for 175 million years.
- Sea turtles are designed for life in the water. They have large streamlined shell and cannot retract their head or limbs like land turtles because this would prevent them from swimming or breathing.
- Their flippers are adapted for swimming with fore flippers long and paddle-like to provide most of the power in the water. The hind flippers are used as rudders to stabilize and direct motion. Leatherbacks have been recorded with speeds of up to 9.3 km/hr
- Seven species occur worldwide with only four species in Malaysia: Leatherback, green turtle, hawksbill and olive ridley.



Anatomy of sea turtle skeleton.
Source http://tofino.ex.ac.uk/euroturtle/bones/skel.htm

Species of Sea Turtles Found in Malaysian Waters

- The most common nester in Malaysia is the green turtle.

Green turtle (*Chelonia mydas*)

Hawksbill turtle
(*Eretmochelys imbricata*)

Olive/Pacific Ridley turtle
(*Lepidochelys olivacea)*

Leatherback turtle
(*Dermochelys coriacea)*

Another Species Found in the World

Kemp's ridley (*Lepidochelys kempii)*
http://www.cccturtle.org/kemps-ridley.htm

Loggerhead turtle (*Caretta caretta)*
http://www.johneasley.com/gallery/Underwater

Flat back turtle
(*Natator depressus)*
http://www.cccturtle.org/flatback.htm

Habitat

- Sea turtles live in marine environment where they mate, feed and migrate.
- Females return to land to dig nests and lay eggs but males will almost never return to land.
- In order to adapt spending 99% of their life in water, sea turtles have evolved:
  - Their jaws for crushing, biting and tearing;
  - Good underwater vision and good sense of smell and;
  - Hear low frequency sounds like ground vibrations and surf.

Sea turtle chose sandy beaches for nesting

What Group of Sea Turtle?

- Sea Turtles are reptiles that:
    - Cold-blooded and poikilotherm, which means that they use the heat of the environment to maintain body heat.
    - Have back bones.
    - Have white, leathery eggs.
    - Covered with scales or horn plates with exception of leatherback sea turtle (*Dermochelys coriacea*) which is covered with leathery skin shell.
    - Breath air and their heart is divided into two auricles and one ventricle, resulting in incomplete double circulation. This means that they can tolerate a fairly high level of carbon dioxide in their blood.
- The number of Reptiles in worldwide is just about 6,000 species, comprising 3,300 species of lizards, 2,200 species snakes and the remaining reptiles are turtles with fewer numbers.

Groups of Reptiles


Lizard


Snake

Why Sea Turtle “Crying”?

Sea turtles have adapted salt glands in their eyes that aid in the excretion of excess ions. These glands produce a highly concentrated fluid with sodium and chloride concentrations that can be twice as much as the concentration of seawater. This solution also washes the eyes free of sand.

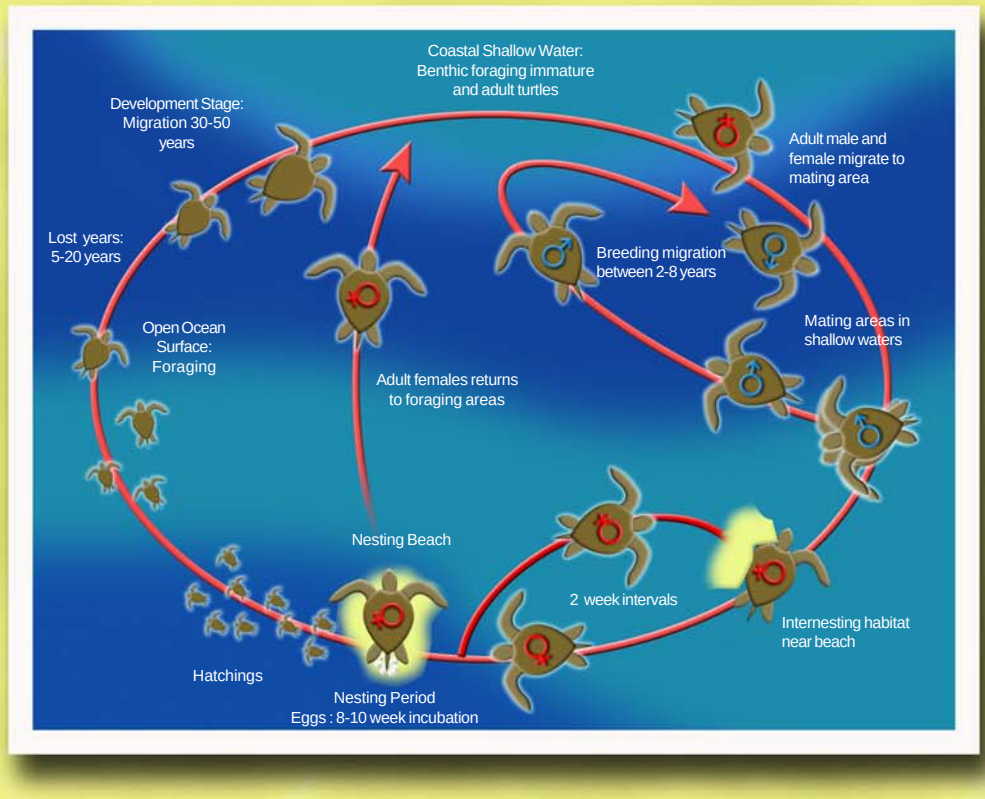
Feeding Behaviour

Sea turtles feed mostly on slow moving or sedentary animals such as jellyfish, mollusks, sea urchins, horseshoe crabs, sponges, and sea grasses. Little is known during their pelagic stages. They feed first on plankton and then on snails, truncates, gooseneck barnacles and other organisms at the high seas. After the pelagic state, sea turtles tend to live in coastal waters, except olive ridley (*Lepidochelys olivacea*) and leatherback that remain as pelagic animals through out their entire lives.

Green sea turtles are omnivores when young, eating both plant and animals. After reaching adulthood, they become vegetarians, eating only sea grasses and algae.

Food Types for Sea Turtle in the Sea

Life Cycle of Sea Turtle



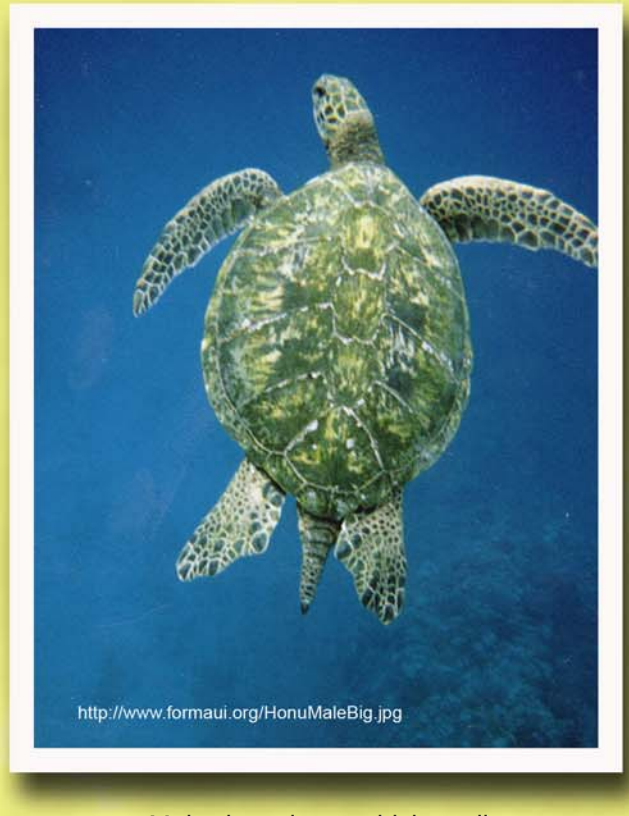
Reproduction

- It is very difficult to distinguish between sexes, except as mature adults. Males have longer thicker tail than females. Males develop single mating claw at the trailing edge of their fore flippers.
- A sea turtle reach sexual maturity between 15–30 years.

Mating Activity

- For most species, courtship activities occur several weeks before nesting season.
- Two or more males may court a single female.
- Males have enlarged claws on their front flippers and these aid males in grasping the shells of females during mating.
- Fertilization is internal with copulation takes place in the water, just offshore.

Sea turtle mating



Males have longer thicker tail
than females

Nesting

- Female digs a nest cavity using her hind flippers and lays approximately between 50 to 160 eggs.
- The female usually crawls above the high tide line, sometimes into the dunes to protect the nest from tides.
- Most species nest at night, with the exception of ridleys that nest during the day.
- Female sea turtles do not nest every year, but when they do, they will nest at least 2 to 3 times during the season. Some females have known to nest 5 or 6 times in one season.
- Nesting season in Malaysia is from March through October.

Sea turtle digging her nest cavity

Sea turtle laying the eggs in the nest

Sea turtle back to the sea after laying her eggs

Hatchlings

- When it's time for the hatchlings to emerge up to the surface of the nest, they do in a group. They usually hatch when the temperature drops after sun set and within a couple of hours before dawn.
- It usually takes about 60 days for the eggs in the clutch to hatch.

Green turtle hatch from the egg

Hatchling green turtle emerging from their nest

- The moonlight on the water or the light over the horizon may attract the hatchlings to the ocean.
- Once they hit the ocean, they cue for a magnetic bearing and head out to the sea.

Once the hatchlings enter the sea, they swim non-stop for 24 hours until reaching rafts of seaweed or vegetated drift lines. Here, the hatchlings are protected from predators because they blend into the vegetation.