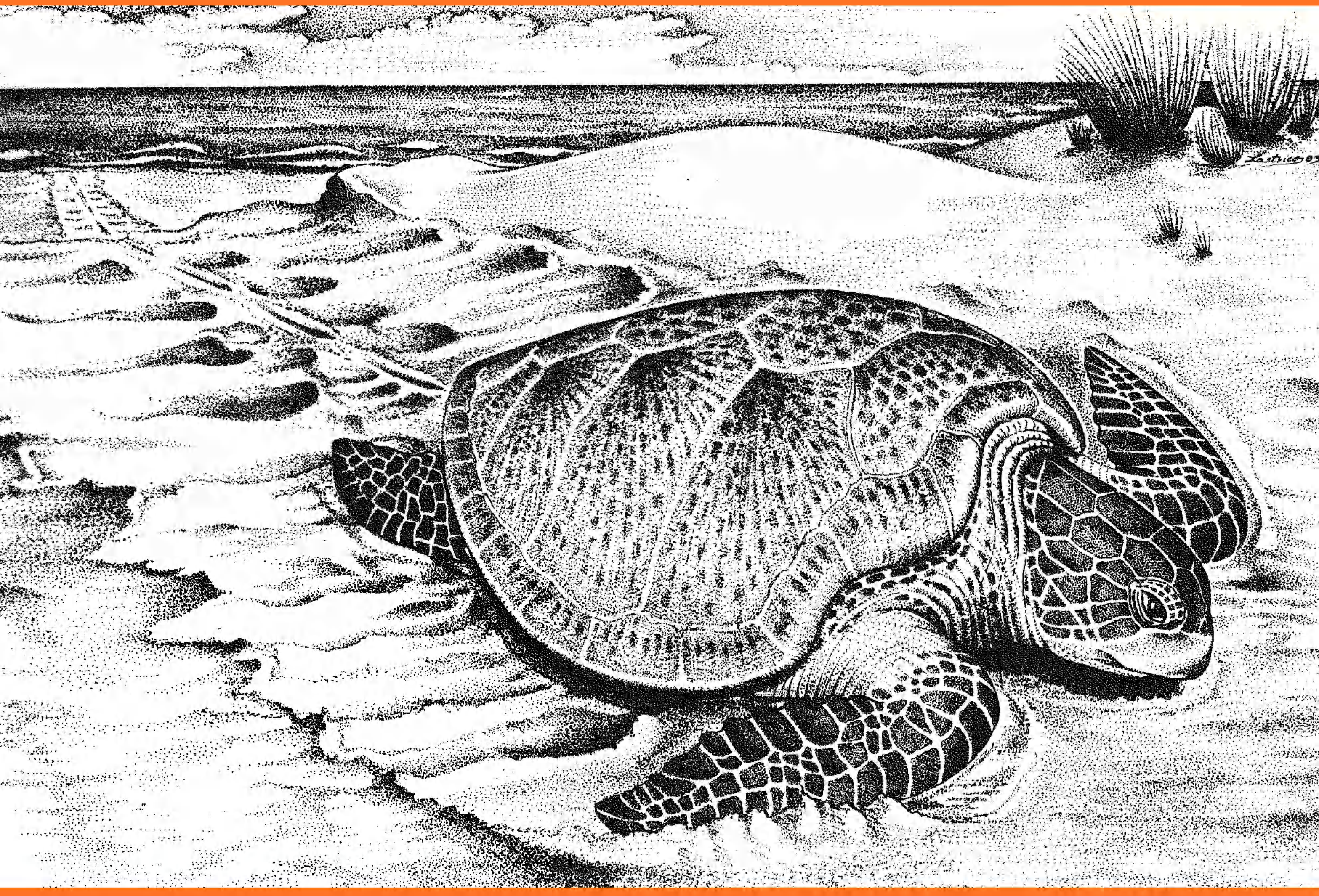
FAO Fisheries Synopsis No. 125, Volume 11

FIR/S125 Vol. 11

FAO SPECIES CATALOGUE

VOL. 11. SEA TURTLES OF THE WORLD

AN ANNOTATED AND ILLUSTRATED CATALOGUE OF SEA TURTLE SPECIES KNOWN TO DATE



FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

FAO SPECIES CATALOGUE

VOL. 11 SEA TURTLES OF THE WORLD

An Annotated and Illustrated Catalogue

of Sea Turtle Species Known to Date

prepared by

René Márquez M.
Instituto Nacional de la Pesca
Centro de Investigación Pesquera
Apartado Postal 591
Manzanillo, Col. México 28200

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 1990

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

PREPARATION OF THIS DOCUMENT

Their high commercial value and traditional role as a basic protein source for many riparian peoples in tropical and subtropical areas place sea turtles among the marine resources groups of major interest to fisheries. On the other hand, they also have become part of the rapidly increasing group of marine animals that are seriously threatened by over-exploitation and other man-related disturbances.

The present catalogue is an attempt to present a global synthesis of the information on sea turtle species scattered in many specialized publication series and thus facilitate the work of fishery officers and environmentalists towards management, farming and protection of these fascinating and delicate animals.

The author has collaborated with FAO for many years in the preparation of species identification sheets for sea turtles from various marine fishing areas, e.g. the Western Central Atlantic, the Eastern Central Atlantic, the Western Indian Ocean and the Mediterranean/Black Seas. For the past 20 years, he has been actively engaged in research programmes, as well a s in management, protection and farming activities, both in the framework of th IUCNeand of the Instituto National de la Pesca of Mexico. He is currently the Coordinator of the Mexican National Research Programme on Sea Turtles of the Secretaria de Pesca of México, member of the Marine Turtle Specialist Group of the IUCN and President of the Ad Hoc Commission for the Investigation of the Sea Turtles of the American Pacific.

Technical Editors: W. Fischer, W. Schneider and Nadia Scialabba, Fishery Resources and Environment Division, FAO

Illustrators: P. Lastrico, FAO, Rome and R. Márquez M., INP, Mexico

Page composition: M. Kautenberger-Longo, FAO, Rome

Márquez M., R.
FAO species catalogue. Vol.11: Sea turtles of the world. An annotated and illustrated catalogue of sea turtle species known to date. FAO Fisheries Synopsis No. 125, Vol. 11. Rome, FAO. 1990. 81 p.

ABSTRACT

This is the eleventh issue in the FAO series of worldwide annotated and illustrated catalogues of major groups of organisms that enter marine fisheries. The present volume includes 8 sea turtle species belonging to 2 families and 6 genera. It comprises an introductory section with general remarks on habitat and fisheries of the families, a glossary of technical terms used, an illustrated key to genera, and detailed accounts on all species. Species accounts include drawings, scientific and vernacular names, information on habitat, biology and fisheries, and a distribution map. Lists of nominal species in the families, a table of species by major marine fishing areas and colour plates follow the species accounts. The work is fully indexed and there is ample reference to pertinent literature.

Distribution

Author
FAO Fisheries Department
FAO Regional Fisheries Officers
Regional Fisheries Councils
and Commissions
Selector Global Species Catalogues

TABLE OF CONTENTS

click for previous page

1. INTRODUCTION

Although sea turtle conservation programmes have been encouraged by the recent discovery of important new nesting beaches, the future of sea turtles is still threatened by the decline of their natural populations, especially in nesting areas. Research and conservation activities on sea turtles are increasing, but there are still many gaps in our knowledge of the life history of these animals.

This catalogue provides a brief description of the world's eight sea turtle species, as well as up-to-date information on the state of the various populations presently or historically exploited by man. It also includes guidelines for species identification, diagnoses of families, genera and species, and notes on geographical distribution, habitat, and biology of each species. A good understanding of the biology of sea turtles is essential for their management and protection.

Since the present document is not intended as a primarily taxonomic work on the group, the complex problem of subspecies has not been treated in detail. Furthermore, the compilation of information for each species is far from complete and hence, it is advisable to consult other recent publications on this group, such as, for example, **Björndal, K.E. (ed.), 1981**: Biology and Conservation of Sea Turtles. Proceedings of the World Conference on Sea Turtle Conservation. Washington, D.C., 20-26 November 1979, and **Bacon, P. *et al.* 1984**: The Proceedings of the Western Atlantic Turtle Symposium, WAYS-I, San Jose, C.R., 17-22 July 1983 (Spanish edition 1987). and WATS-II, Mayaquez, Puerto Rica, 12-16 October, 1987.

Finally, it is obvious that not all existing information on sea turtles was available to the author. Catch statistics by species were usually difficult to evaluate or were available only in local records; no statistics are recorded on the bycatch of sea turtles in shrimp fisheries, and in many places, catch figures are concealed or mislabelled. The reader is hereby kindly requested to notify the editors and the author of possible errors and omissions that should be corrected in eventual future editions of the catalogue.

1.1 Plan of the Catalogue

Following the general introductory section and the illustrated keys, the information on families, genera and species is presented in alphabetical order. The species accounts are arranged as follows:

(1) **Scientific name** : Reference is given to the original description of the species.

(2) **Synonymy** : Synonyms and different name combinations are listed (misidentifications and other nomenclatorial problems are discussed under "Remarks" (see paragraph 11).

(3) **FAO Species Names** : English, French and Spanish names for each species were selected on the basis of the following criteria: (i) each name must apply to one species only, in a worldwide context; (ii) the name should not lead to confusion with other species. Wherever possible, the denominations selected were based on vernacular names (or parts of names) already in existence within the areas where the species occur. FAO species names are not intended to replace local names, but they are considered necessary to overcome the considerable confusion caused by the use of a single name for many different species, or several names for the same species.

(4) **Diagnostic Features** : Distinctive characters of the species as an aid for identification. Species identifications should be attempted only after consultation of the illustrated key to families and genera.

(5) **Geographical Distribution** : The entire geographic range of the species, including areas of seasonal occurrence, is given in the text and shown on a small map. In cases where only scattered records of occurrence are available, interrogation marks are used to indicate areas of suspected distribution.

(6) **Habitat and Biology** : The typical habitat and biological information, such as details of migrations, breeding, egg-laying behaviour, season and areas, and food and feeding grounds.

(7) **Size** : The maximum total carapace straight-line length and weight. Also, average size and weight of eggs and hatchlings. Size at first maturity, and average size recorded during the nesting period.

(8) **Interest to Fisheries** : An account of the areas where the species is captured and of its fishery. Its importance is either qualitatively estimated or figures of annual landings are provided. Data on utilization are also given where available. Here too, the quality and quantity of the information available vary considerably with species and countries. If species are considered threatened or endangered, and if they are the object of an enhancement programme, or protection laws, this is mentioned under "Remarks" (see paragraph 11).

(9) **Local Species Names** : These are the names used locally for the various species. The present compilation is necessarily incomplete, since only a fraction of the local names used throughout the world is actually published Usually, local names are available only for species supporting traditional fisheries. Apart from

possible omissions due to limitations of available literature, some of the denominations included may be somewhat artificial (i.e. through transliterations of indigenous words into English or *vice versa*). Each local species denomination is preceded by the name of the country concerned (in capital letters) and, where necessary, by the geographical specification (in lower case). Whenever possible, the language of the transcribed vernacular name is added in parenthesis. When more than one name is used within a country, the official name, if available, is underlined.

(10) **Literature** : This includes references to important publications relevant to the species, the emphasis being on biology, conservation, and fisheries. These references are included in the bibliography at the end of the catalogue.

(11) **Remarks** : Important information concerning the species not fitting in any of the previous paragraphs is given here.

1.2 General Remarks on Sea Turtles

Sea turtles were common in the Cretaceous, 130 million years ago, and their fossil record extends back at least 200 million years. They lived together with dinosaurs, and have survived the giant *Plesiosaurus* and the *Ichthyosaurus.* All present-day genera and species originated in the period from the early Eocene to the Pleistocene, between 60 and 10 million years ago. Together with the marine snakes and iguanas, they are the only surviving sea-water-adapted reptiles. Their distribution is mostly tropical and subtropical and they depend on the land only during the reproduction period (except some viviparous sea snakes).

In spite of their circumtropical distribution, sea turtles are represented by species that differ widely in their seasonal cycles, geographical ranges and behaviour. There are also considerable differences among populations of the same species.

All sea turtles have a high commercial value. Their importance varies among countries and also, locally within countries. In some areas, they constitute a valuable protein source, in others they are only used as a delicacy. In certain countries, sea turtles have been the object of ancient ritual practices, or they are venerated as sacred animals. Since the Second World War, commercialization of sea turtles has increased considerably. As a result of this, the formerly numerous colonies have been very rapidly depleted and some of them nearly extinguished. Nowadays, additional problems such as pollution, beach invasion, poaching, entanglement of turtles in set-nets, or their drowning in trawl-fishing, are further endangering these species, and it has become evident that the remaining sea turtle populations are seriously threatened if these dangers cannot be reduced.

The sea turtle catch is primarily directed to the sale of fresh meat for human consumption. However, egg-harvesting is also important to riparian people of many countries. Leather made from turtle skin is a relatively new product introduced in the international market about 20 years ago. Tortoise-shell or “Carey” was common for ornamental use in Europe during the Middle Ages, and even earlier in Oriental countries (e.g. Japan), where it had and still has a deeper cultural value, being used during wedding ceremonies in the bride’s costume, and as carved pins in the hair. Turtle oil has multiple uses, principally as a basic ingredient of certain cosmetic creams, or as medicine for pulmonary diseases. The commercial value of sea turtles varies strongly from one species to another. The green sea turtles (***Chelonia***) are pursued for their meat; the hawksbill (***Eretmochelys***) for its shiny tortoise-shell; the Ridley (***Lepidochelys***) for its excellent leather; the leatherback (***Dermochelys***) for its large yield of oil; the loggerhead (***Caretta***) is the least profitable of these species. The eggs of most species are harvested wherever found, usually irrespective of official permits. All species, except the leatherback, are used for the production of “calipee” and “calipash” which are strips of cartilaginous tissue taken from the rims of the carapace and plastron and between the bone plates of the plastron. This product is used for the preparation of “turtle soup”, an expensive item in many top quality restaurants.

Nowadays, almost all sea turtles are considered threatened or endangered by the International Union for the Conservation of Nature and Natural Resources (IUCN), quoted in the Red Data Book, and their commerce is prohibited in those countries that have signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Programmes for the recovery and enhancement of depleted populations are undertaken in the framework of a worldwide action, supported by local or international wildlife foundations in conjunction with various governmental organizations. Those campaigns include principally law enforcement, adoption of fishing regulations, gear restrictions (e g ., TED or “Trawl Efficiency Device” or “‘Turtle Excluder Device”), protection of nesting areas through turtle camps, nurseries for hatchling release, and “imprinting-headstarting” aimed at the development of new nesting places and of the avoidance of the strong predation to which small turtles are subjected during the first year of their lives. Some of these activities are still in the experimental phase but may become important tools for avoiding the extinction of these valuable animals.

Because of the depletion of natural populations, two additional methods of augmenting sea turtle populations (especially of the green turtle ***Chelonia mydas***) have been introduced. The first method, called “**Ranching**”- involves raising sea turtles from eggs or hatchlings taken from wild stocks to a marketable size. This is not a closed-cycle system as it continually relies on wild populations as a source for eggs or hatchlings. The second method, known as **"Farming"** - relies only initially on wild populations for eggs or hatchlings (and occasionally, later, in order to maintain a genetic diversity, to avoid problems with inbreeding); it attempts to raise these hatchlings to maturity for breeding and development of a self-sustaining captive population. Both practices appear to be harmless and could be of aid to the survival of natural populations by reducing the trade pressure on wild stocks, but they have raised more controversy than had been suspected at their inception. The commercialization of sea turtles is now under review by CITES, and trade with animals bred in captivity is allowed only if the breeding stock is not replenished from the wild popuation and if the farm can reliably produce a second generation offspring under captive conditions. A second generation is defined as that conceived in captivity from parents that were also born in the farm.

Official catch statistics for sea turtles are rather scanty and doubtless represent only a small fraction of the actual capture. The world catch of adults reported for 1987 in the FAO Yearbook on Fishery Statistics totalled 3 100 metric tons, of which ca. 1 200 metric tons came from the Western Central Atlantic (Fishing Area 31), 864 metric tons from the Eastern Central Pacific (Fishing Area 77), 305 metric tons from the South East Pacific (Fishing Area 81), 258 metric tons from the Western Central Pacific (Fishing Area 71), 190 metric tons from North West Pacific (Fishing Area 61), 153 metric tons from the Eastern Central Atlantic (Fishing Area 34), 50 metric tons from the Eastern Indian Ocean (Fishing Area 57), 37 metric tons from the Western Indian Ocean (Fishing Area 51), 20 metric tons from the Mediterranean (Fishing Area 37) and 10 metric tons from the South East Atlantic (Fishing Area 41). No statistics are reported for turtle eggs.

Acknowledgements

I wish to extend my special thanks to the following colleagues for their suggestions and technical revisions of the text: Anne Meylan (Florida Marine Research Institute, San Petersburg, Florida), genus ***Ertmochelys***; Karen Eckert (Southwest Fisheries Center, La Jolla, California) and Peter Dutton (Sea World Research Institute, San Diego, California), genus ***Dermochelys***; Henry Hildebrand (Corpus Christi, Texas), genus ***Lepidochelys***; John Hendrickson (Corpus Christi, Texas), genus ***Chelonia***; and Colin Limpus (National Parks and Wildlife Service, Townsville, Australia), genus ***Natator***.

I am most grateful to W. Fischer and W. Schneider (FAO) for their encouragement and final revision and editing of the manuscript. Thanks are also due to P. Lastrico (FAO) for his illustrative work and to M. Kautenberger-Longo (FAO) for page composition.

Thanks are extended to the staff of the "Programa Nacional de Investigación de Tortugas Marinas" (Instituto Nacional de la Pesca, Secretaria de Pesca, Mexico) who provided most of the information on the sea turtles of Mexico and to Mirna Cruz R., without whose help this work could not have been completed.

Special thanks are due to my friend, the late Carlos Maya U., who passed away this year while conducting research on the sea turtles of Escobilla in Oaxaca, Mexico.

1.3 Illustrated Glossary of Technical Terms and Measurements

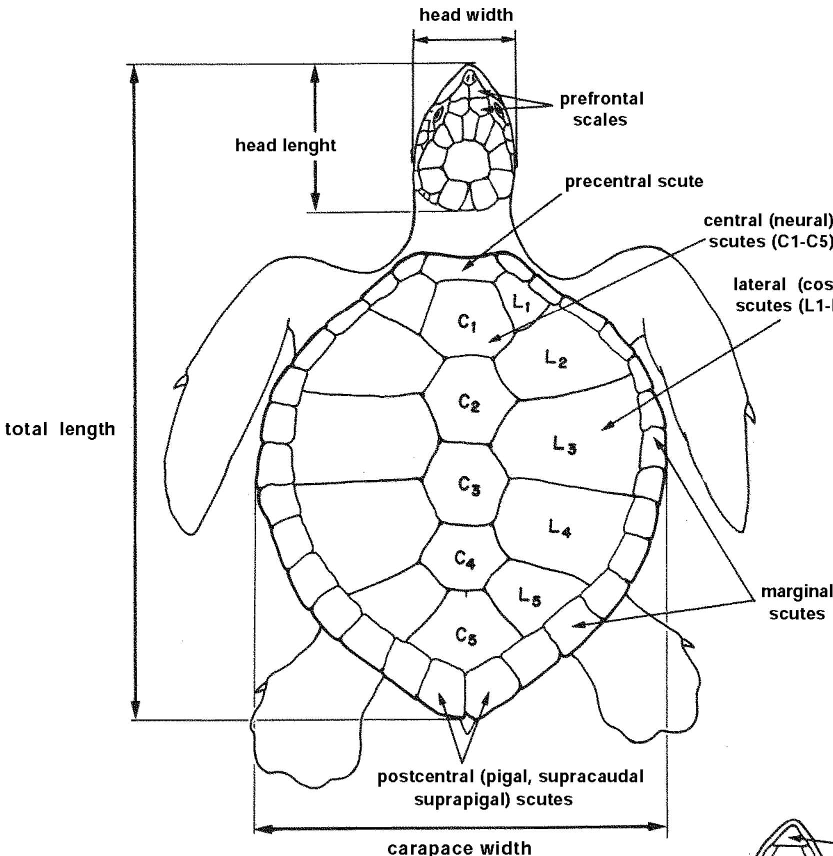


Fig. 1 Schematic dorsal view of a sea turtle

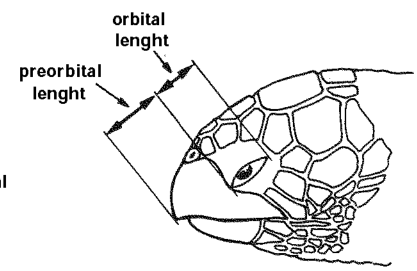


Fig. 2 Lateral view of head

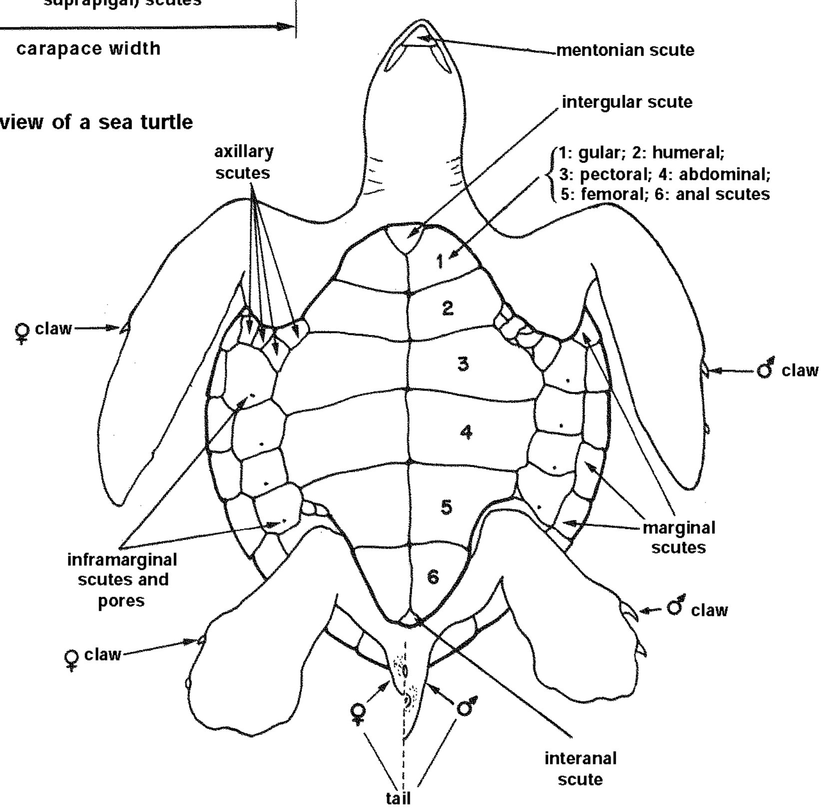


Fig. 3 Schematic ventral view of a sea turtle (right side: male, left side: female)

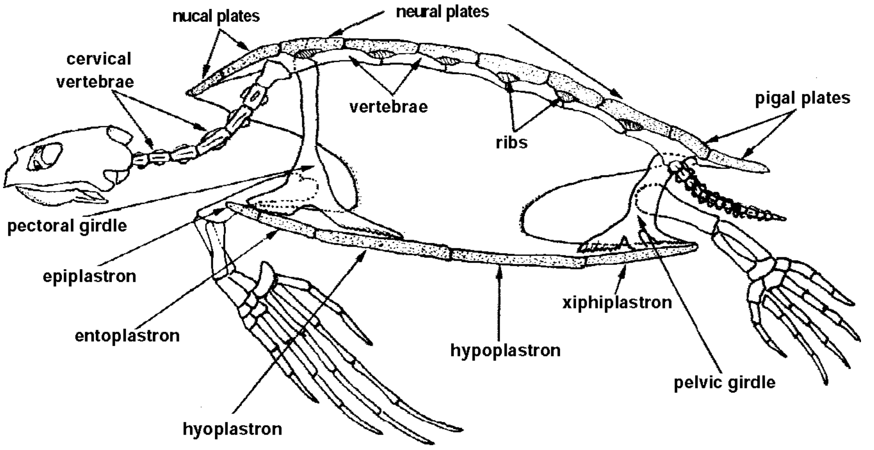


Fig. 4 Schematic generalized sea turtle skeleton

Abdominal scutes - The pair of plastral scutes in nearly central position. They are in contact with the pectoral, femoral and inframarginal scutes (Fig. 3).

Alveolar - The ridges and inner grooves of the mandibles where the horny beak or tomium is implanted (Fig. 5).

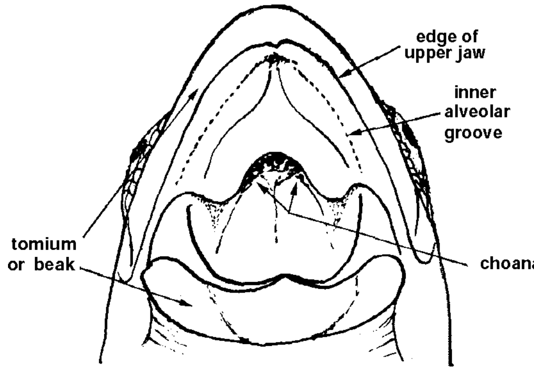


Fig. 5 Diagrammatic ventral view of head of an adult Kemp's ridley

Anal scutes - The rearmost pair of scutes of the plastron (Fig. 3).

Angular bone - Postventral element forming the lateral surface in each ramus of the lower mandible (Fig. 6).

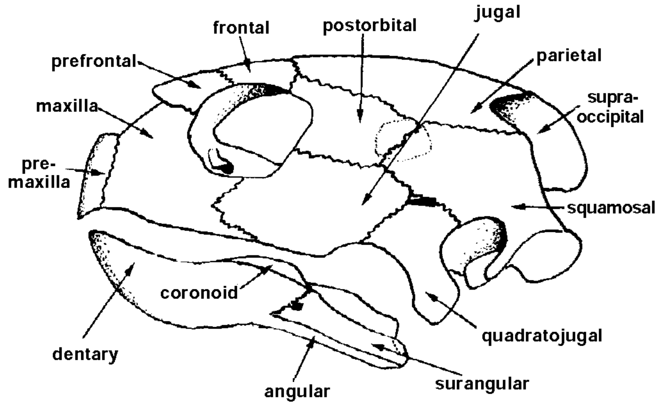


Fig. 6 Schematic skull of an adult Kemp's ridley, showing basic structures (adapted from Romer, 1956)

Arribazon (Arrival) - Spanish word used to describe the simultaneous emergence of nesting females on a small stretch of sandy beach. It extends from several hours to several days. Also "Arribada" is used.

Axillary notch - Frontal cavities on each side of the body between the carapace and plastron, from which the fore flippers project (Fig. 7).

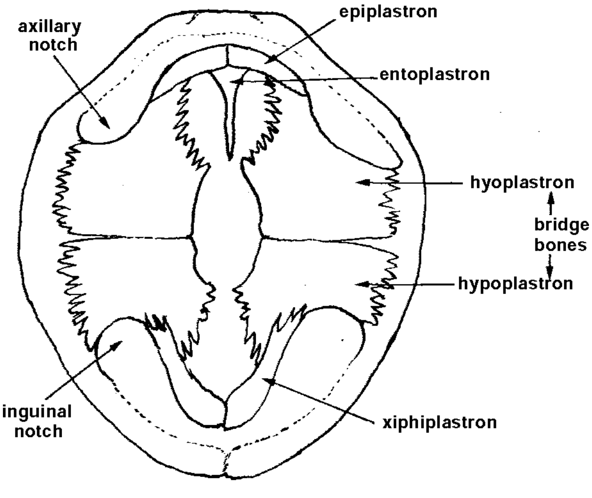


Fig. 7 Schematic ventral view of the plastron bones

Axillary scutes - The variable number of scutes between the marginal, humeral and pectoral scutes, on the rear margin of the axillary notches (Fig. 3).

Body pit - A depression made by the female turtle on the sandy beach, during nesting. Shape and depth of the pit are generic characteristics. The pits made by the ridley, hawksbill and flatback are shallow (Fig. 8a), while those of the loggerhead, green and leatherback are medium to deep (Fig. 8b). Some turtles (e.g., green turtle) construct several body pits before they lay the eggs.

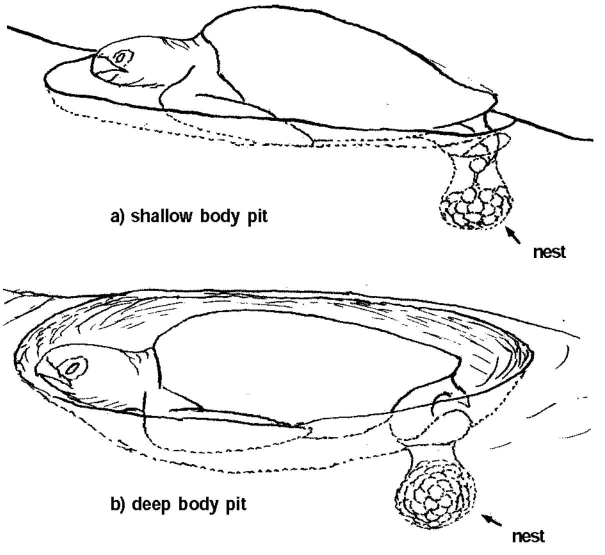


Fig. 8 Female sea turtle in nesting attitude

Bridge bones - Ventral parts of the shell that connect the peripheral bones of the carapace with the plastral bones. The contact area may be calcified or cartilaginous material (Fig. 7).

Calipash - Cartilaginous strips obtained from the edge of the carapace or extracted as jelly from the dried flippers. Generally of green colour when fresh.

Calipee - Cartilage extracted from the border of the plastron, along the axillary and inguinal notches, the bridge and between the bones of the plastron. Calipee and calipash are used for the preparation of turtle soup.

Carapace - Dorsal osseous shell of the turtle covered by horny scutes or soft skin (Figs. 1,4).

Carapace length - Distance either in straight-line (SCL) or over the curve (CCL), between the anteriormost edge to the rearmost edge of the carapace (Fig. 9).

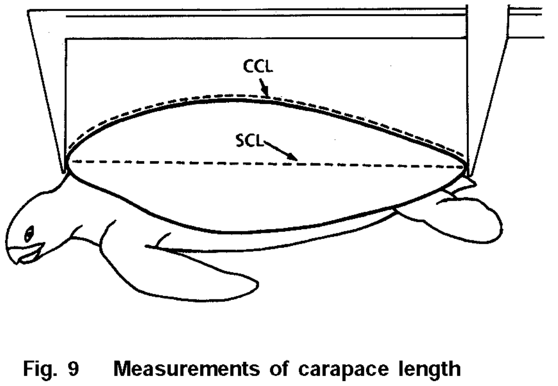


Fig. 9 Measurements of carapace length

Carapace width - Distance in straight-line or over the curve across the widest part of the carapace, measured on its dorsal side (Fig. 1).

Carey - See tortoise shell.

Caruncle - Sharp horny tubercle on the tip of the upper tomium of newborn hatchlings; used to pierce the egg-shell (Fig. 10). Usually disappears two weeks after hatching.

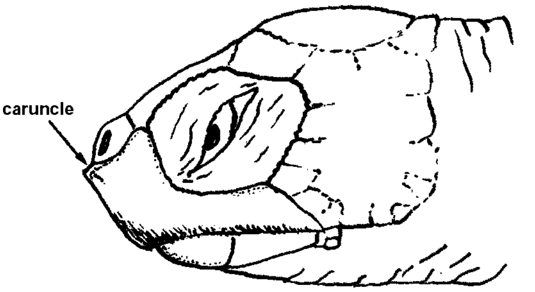


Fig. 10 Head of a newborn Kemp's ridley hatchling

Central scutes - The middle scutes covering the neural plates of the carapace, in between the lateral scutes. Also named neural or vertebral scutes (Fig. 1).

Cervical vertebrae - Anterior (8) bony elements of the vertebral column. In turtles, the neck is typically retractile. The shortening of the neck in sea turtles is an adaptation to marine life (Fig. 4)

Choanae - The internal openings of the nasal funnels through the vomerian bones on the palate (Figs 5, 13).

CITES - An acronym for "Convention on International Trade in Endangered Species of Wildlife and Flora". The IUCN determines the criteria for addition of species and other taxa to Appendix I (Endangered) and Appendix II (Threatened) of CITES, and for the transfer of species and other taxa from Appendix II to Appendix I. All the sea turtles are included in Appendix I, because their survival is affected by international trade.

Claw - Sharp, horny nail on the anterior margin of the flippers. The claws (usually one or two on each flipper) are more strongly developed in males than in females, and they are used to hold the female during copulation (Figs 1, 3).

Clutch size - Total number of eggs laid simultaneously to form a nest (Fig. 8).

Coronoid bones - Flat, paired, bony elements of the lower mandible (Fig. 6).

Costal plates - Expanded, ossified dermal plates fused to the axial skeleton (vertebrae and ribs), between the peripheral and neural plates of the carapace (Fig. 11).

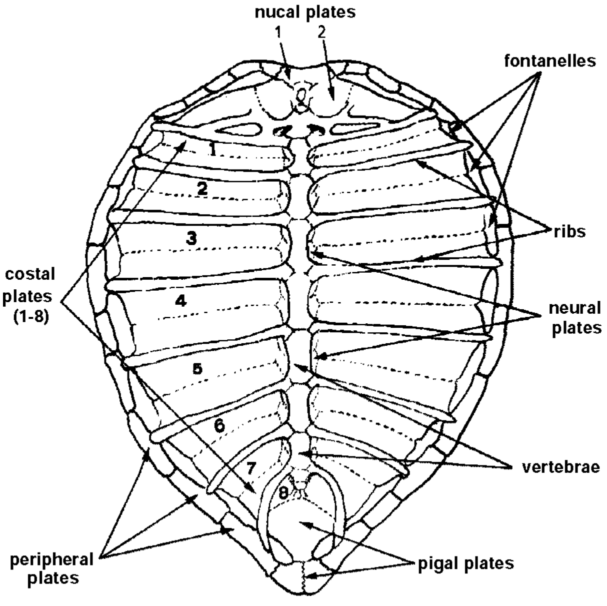


Fig. 11 Carapace bones in schematic ventral view of a juvenile green sea turtle, showing the characteristic fontanelles of premature ages

Crawl - Symmetrical tract left by the fore and rear flippers of turtles on the sandy beach. Sizes and shapes of the crawl are considered characteristic for the species.

Cusp - Sharp projection, usually on the tip of the jaws (Fig. 12).

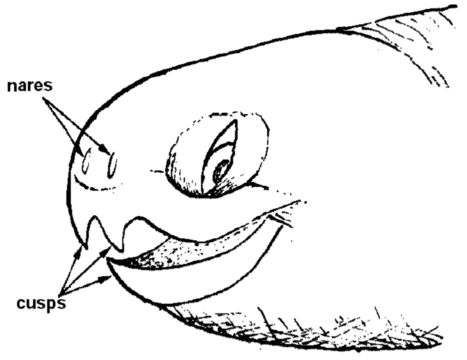


Fig. 12 Beak cusps on jaws of adult leatherback sea turtle

Dentary bone - Largest element of the lower jaw, the principal support of the lower tomium (Fig. 6).

Endemic - Found only in a limited region.

Entoplastron plate - Median bony plate lying between epiplastra and hyoplastra (Figs. 4, 7).

Epifauna - Those animals living on the body of a turtle.

Epiplastron plate - The foremost paired bony plates of the plastron (Figs. 4, 7).

Farming - The culturing of sea turtles in tracts of sea water for commercial purposes. It must not rely on wild populations except initially or later occasionally, to avoid inbreeding problems and genetic degeneration.

Femoral scutes - The pair of posterior plastral scutes in contact with the abdominal, inframarginal and anal scutes (Fig. 3).

"Flotilla" - Spanish name for a large number of migrant turtles drifting or swimming together in the open ocean.

Fontanelles - Carapacial unossified areas between the peripheral and costal bones, usually disappearing with age (Fig. 11).

Frontal bone - The long bone above the orbit on each side of the skull (Fig. 6).

Gular scutes - The foremost paired scutes of the plastron (Fig. 3).

Habitat - The environment in which a species usually occurs.

Hatchery - Construction for the incubation of eggs and releasing or rearing the produced hatchligs. The incubation of eggs can be done in fenced areas of the beach or indoors, under semi-controlled conditions, using styrofoam boxes.

Head length - The distance between the tip of the beak and the posterior margin of the head (Fig. 1).

Head-starting - The practice of raising hatchling turtles in captivity for a few months to give them a better chance of survival when they are later released into the wild.

Head width - The distance across the widest part of the head (Fig. 1).

Humeral scutes - The anterior paired scutes of the plastron, between the gular, pectoral and axillary scutes (Fig. 3).

Hyoplastron plates - The median-front paired bony plates of the plastron (Figs. 4, 7).

Hypoplastron plates - The median-rear paired bony plates of the plastron (Figs. 4, 7).

Imbricate - Overlapping condition (like shingles on a roof) of the scutes of the carapace and plastron in the hawksbill sea turtle. Hatchlings and juveniles of other species commonly also have this condition.

Imprinting - Theoretical procedure by which a sea turtle hatchling unconsciously "memorizes" environmental cues of its natal beach, that enable it to relocate the same beach when mature.

Incidental catch - The unintentional catch of non-targetted species, such as turtles and bottom fishes during shrimp trawling.

Incubation period - The time elapsed between egg laying and hatching. In sea turtles, it ranges from 45 to about 70 days, depending on species, temperature, humidity and latitude.

Indigenous - An organism that originated and is living in a specified region (see endemic).

Inframarginal pore - A single, small orifice through each inframarginal scute, serving as the outlet for the Rathke's gland secretions; their function is unknown. These pores are present principally in turtles of the genus ***Lepidochelys*** (Fig. 3).

Inframarginal scutes - The scutes covering the bridge bones, between the ventral side of the marginal scutes and the central scutes of the plastron (Fig. 3).

Inguinal notch - The cavities on each side of the plastron from which the rear flippers project (Fig. 7).

Interanal scute - The middle, rearmost plastron scute or scutes between the pair of anal scutes (sometimes absent) (Fig. 3)

Intergular scute - The middle, foremost plastron scute or scutes between the pair of gular scutes (sometimes absent) (Fig. 3).

Isotherm - A theoretical warped plane or line in the water connecting points of equal temperature.

I.U.C.N. - An acronym for the International Union for the Conservation of Nature and Natural Resources.

Jugal bone - The long bone under the orbit, forming part of the cheek region on each side of the skull (Fig. 6).

Kraal - A pen used for holding turtles before slaughter; also an artificial beach for nesting purposes, an installation used to protect nests on a beach, or a fenced area against predation. Also called "corral".

Lateral scutes - The lateralmost scutes covering the carapace on both sides, between the central and marginal scutes. Also named pleural or costal scutes (Fig. 1).

Lepidosis - Configuration of the scales and scutes covering the body; of taxonomic value at genus level (Figs. 1, 3).

Lost year - The elapsed time between newborn hatchlings and growth to small-plate-size juveniles, during which the turtle is rarely encountered and its habits are largely unknown.

Marginal scutes - The scutes covering the peripheral bones of the carapace, forming a hard edge all around it (Fig. 1).

Maxilla - The large bone extending up to the orbit and forming, with the premaxilla, the upper jaw margin (Fig. 6).

Melanism - The propensity of an organism to develop dark pigment throughout the skin.

Mentonian scute - The scute under the tip of the lower tomium (Fig. 3).

Nares - Pair of openings into the nose, the nostrils (Figs 12,14).

Nekton - Free-swimming organisms whose activity largely determines direction and speed of their movements, independent of water currents.

Neritic - Relating to the waters over the continental shelves.

Nest - The cavity where the eggs are laid by the turtles. Shape and depth differ by genus (Fig. 8). It is also related to the clutch of eggs.

Neural plates - Carapacial osseous plates fused to the vertebrae (Figs 4, 11).

Niche - The habits or role of an organism in a particular community. Mainly concerned with the food chain, competitors and enemies.

Nucal bones (or plates) - The bones (usually two) forming the foremost central part of the carapace (Figs 4, 11).

Orbital length - Longitudinal diameter of the eye socket (Fig. 2).

Papillary projections - Spine-like growths present in the throat of the sea turtles; they are more conspicuous in the leatherbacks (Fig. 13).

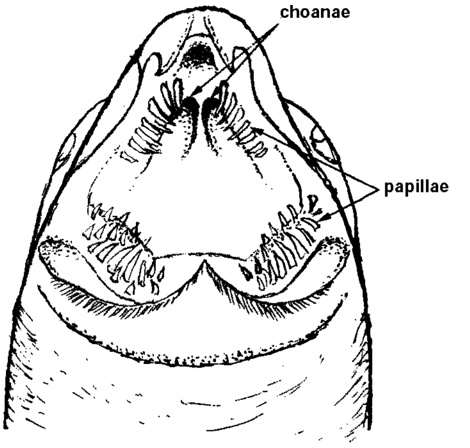


Fig. 13 Buccal cavity of a leatherback sea turtle

Parietal bones - The major elements of the skull roof between and behind the orbits (Fig. 6).

Pectoral girdle - Bones forming the support for the fore-limbs or anterior flippers (Fig. 4).

Pectoral scutes - The median pair of scutes in contact with the humeral, inframarginal and abdominal scutes of the plastron (Fig. 3).

Pelvic girdle - Bones forming the support for the hind-limbs or posterior flippers (Fig. 4).

Peripheral bones (or plates) - Osseous elements forming the edge of the carapace (Fig. 11).

Philopatry - Tendency of sea turtles to nest in, or very near to, the previous nesting place, during the same or in successive breeding seasons. Also called "nesting site fixity or fidelity".

Pigal bones (or plates) - The rearmost marginal osseous plates that form the carapace (Figs 4, 11).

Pigal scutes - The rearmost pair of marginal scutes of the carapace. Also named postcentral, suprapigal, or supracaudal scutes (Fig. 1).

Pivotal temperature - Theoretical temperature at which incubation produces a sex ratio of 1:1.

Plastron - Ventral osseous shell of the turtles, covered by horny scutes or soft skin (Fig. 3,4,7).

Postcentral scutes - The rearmost pair of marginal scutes of the carapace. Also named suprapigal, supracaudal or pigal scutes (Fig. 1).

Postorbital bone - The bone behind the orbit that forms part of each cheek of (Fig. 6).

Postorbital scales - The horny scales (usually 3 or 4) covering the sides of the head behind the orbits (Fig. 14).

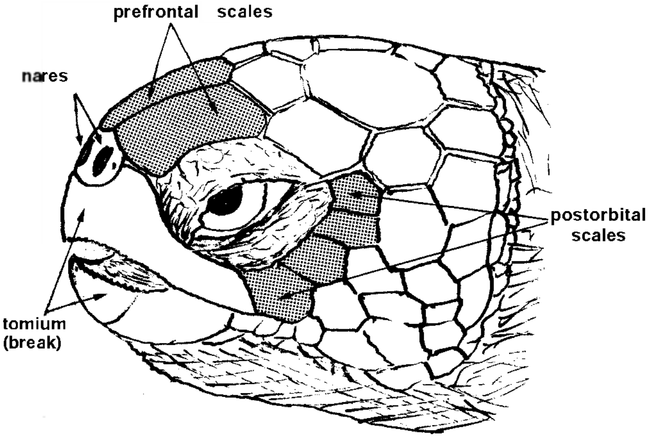


Fig. 14 Head showing disposition of scales in a green turtle (schematic)

Precentral scute - The foremost central scute of the carapace (Fig. 1). Also named prevertebral, nucal or cervical scute.

Prefrontal bones - A pair of circumorbital bones, extending anteriorly and also bordering the external nares (Fig. 6).

Prefrontal scales - Usually 1 or 2 pairs of horny scales covering the anterior interorbital area (characteristic at generic level) (Fig. 14).

Premaxilla bones - The paired bones forming the front margin of the snout, supporting, together with the maxilla, the upper tomium (Fig. 6).

Preorbital length - The shortest distance between the anterior margin of the orbit and the tip of the snout. Also called preocular length (Fig. 2).

Quadrate bone - Thick bone close to the jaw articulation. Laterally, it is bound to the quadratojugal bone (Fig. 6).

Ranching - The raising of turtles from wild stock eggs or hatchlings to marketable size.

Remigrant - Turtles that return to nest in a subsequent season.

Renesting - Successive visits of a turtle to a nesting area, laying eggs each time.

Ribs - Beneath the carapace of chelonians there are eight pairs of dorsal ribs fused to the costal or pleural and to the neural plates. The tips of the ribs are inserted in ventral pits of the peripheral bones (Figs 4, 11).

Scales - Thin, leathery or horny shields covering the head and flippers and forming callosities in some parts of the flippers (Fig. 14).

Scutes - Horny shields covering the carapace and plastron. The shape and size do not correspond with the underlying bony plates. The thickest and most valuable scutes are those of the hawksbill turtle (Figs 1,3).

Sexual dimorphism - Morphological differences between males and females that appear at sexual maturity. Males develop stronger claws and thicker and longer tails (Fig. 3). Females become heavier and have a deeper body shape.

Squamosal bones - The principal component of the cheek region of the skull (Fig. 6).

Supracaudal scutes - The rearmost pair of marginal scutes of the carapace. Also named postcentral, pigal or suprapigal scutes (Fig. 1).

Supraoccipital bones - Paired bones of the upper part of the occiput at the back of the skull (Fig. 6).

Suprapigal scutes - The rearmost pair of marginal scutes of the carapace. Also named postcentral, pigal or supracaudal scutes (Fig. 1).

Surangular bones - The upper posterior bones of each ramus of the lower jaw (Fig. 6).

T.E.D. - An acronym for “trawl efficiency device” or “turtle excluder device”. Originally, a collapsible structure fitted to a shrimp trawl net, designed to reduce incidental catch, especially of sea turtles. Today there are several kinds of T.E.D.'s tested and approved by the US National Marine Fisheries Service.

Tomium - The horny beak that covers the alveolar surface of the mandibles of birds and turtles. In sea turtles, the cutting edges can be smooth or serrated (Figs. 5, 14). Also known as ramphoteca.

Tortoise shell, or "carey" - The generic name for the scutes of the plastron and carapace of the hawksbill, used in jewellery and handycraft work.

Total length - The straight-line distance between the snout and the rearmost part of the carapace (Fig. 1).

Vertebrae - The elements of the vertebral column or axial skeleton. In turtles, the dorsal and sacral vertebrae are deeply modified and dorsally fused to the neural plates of the carapace (Figs. 4, 11).

Vomerine bone - One of the pairs of osseous elements centrally placed behind the premaxillae and forming a bar between the internal nostrils or choanae.

Xiphiplastron bones - The rearmost pair of bones forming the plastron (Figs 4,7).

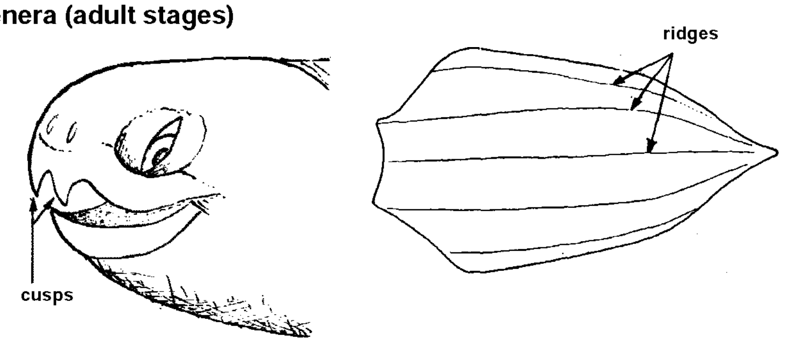
click for next page

click for previous page

2. SYSTEMATIC CATALOGUE

2.1 Illustrated key to Families and Genera (adult stages)

1a. Body without horny scutes. covered by leathery skin, small scales present only in hatchlings; carapace with 5 dorsal longitudinal ridges (Fig. 15b); upper tomium with a pair of frontal cusps (Fig. 15a). Choanae open in two separate apertures on anterior half of palate. Patches of papillary projections arranged in rows on palate and floor of mouth and in throat (Fig. 16a). Flippers without visible claws ..... FAMILY **DERMOCHELYDAE** ***(Dermochelys)***



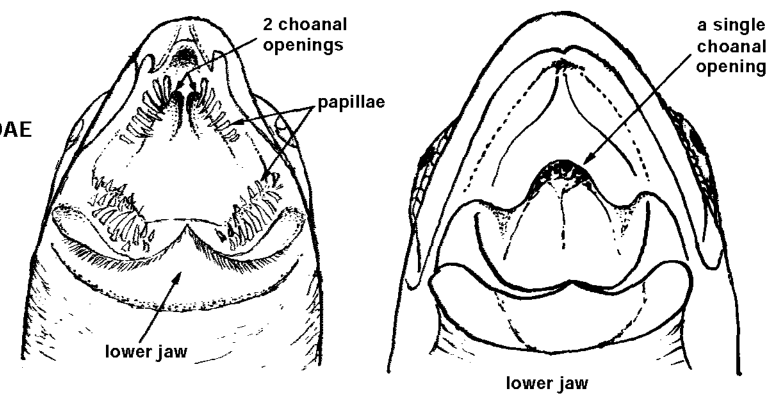
a) head **b) carapace**

Dermochelys **Fig.15**

1b. Scutes covering carapace and plastron; scales present on head and flippers. Choanae open in a single aperature on the rear half of palate (Fig.16b). Papillary projections absent in mouth, but present in the throat. Flippers with one or two developed claws .... FAMILY **CHELONIIDAE**

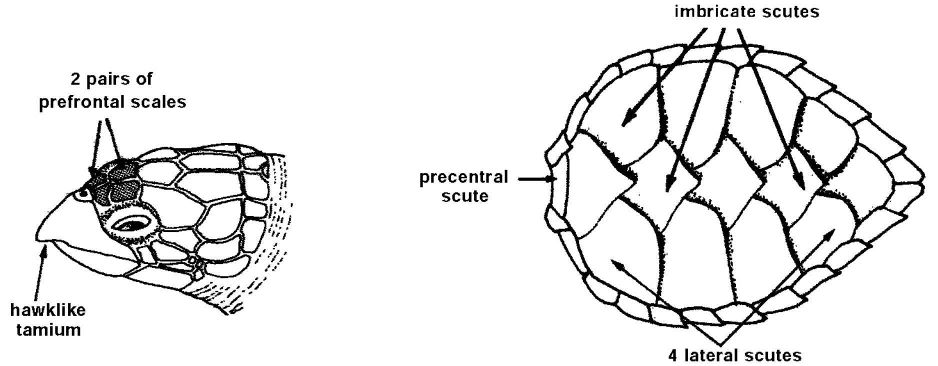
2a. Carapace with 4 lateral scutes on each side. the first pair not in contact with the precentral scute (Figs 17, 18, 19)

3a. Carapace elliptical, covered by imbricate scutes (Fig. 15b) except in very old individuals. Head narrow, with two pairs of prefrontal scales; tomium hawklike, not serrated (Fig. 17a). Flippers usually with two evident claws ...... ***Eretmochelys***



a) Dermochelyidae **b) Cheloniidae**

ventral view of head (mouth open) **Fig.16**



a) head **b) carapace**

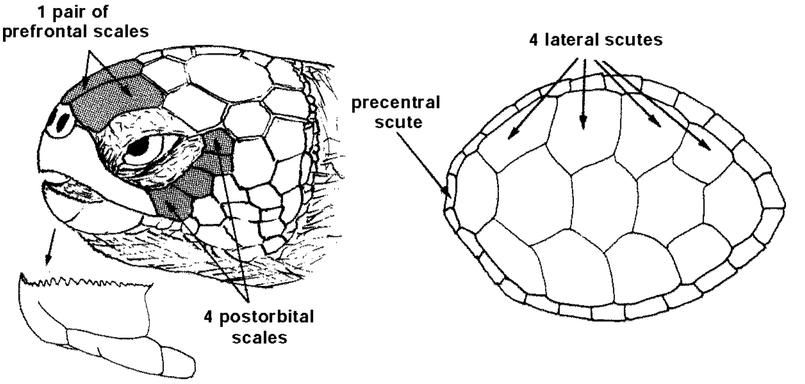
Eretmochelys **Fig.17**

3b. Carapace nearly oval, with no imbricate scutes (18b). Head blunt (short snout), the preorbital distance clearly smaller than orbital length; a single pair of prefrontal scales, usually 4 postorbital scales; tomium serrated (Fig. 18a). Flippers usually with only one evident claw .... ***Chelonia***

3c. Carapace nearly round and flattened, with slightly upward-folded margins, covered by rather thin, non-imbricate scutes, waxy to touch (Fig 19b); preorbital distance nearly equal to orbital length; a single pair of prefrontal scales, usually 3 postorbital scales; tomium not serrated (Fig. 19a). Flippers with one evident claw .... ***Natator***

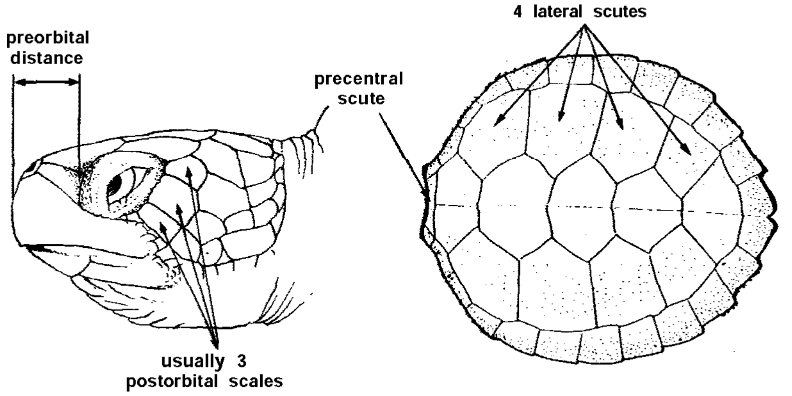
2b. Carapace with 5 lateral scutes on each side, the first pair in contact with the precentral scute (Figs 20,21)

4a. Carapace cardiform, its length always greater than the width (Fig.20b). Plastron usually with 3 pairs of inframarginal scutes, generally without pores (fig. 20c). Carapace scutes thick and rough to touch. Head relatively large, with a heavy and strong tomium lacking an internal alveolar rim (Fig. 20a). Body colour usually reddish-brown or yellowish-brown .... ***Caretta***



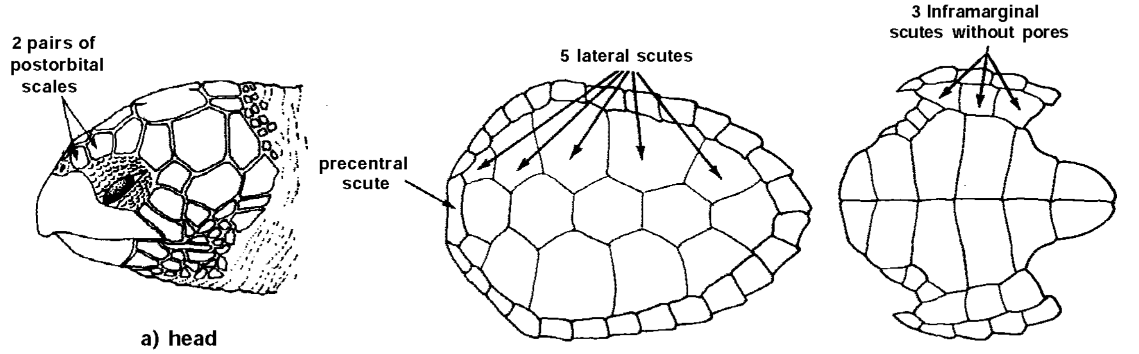
a) head **b) carapace**

Chelonia **Fig.18**



a) head **b) carapace**

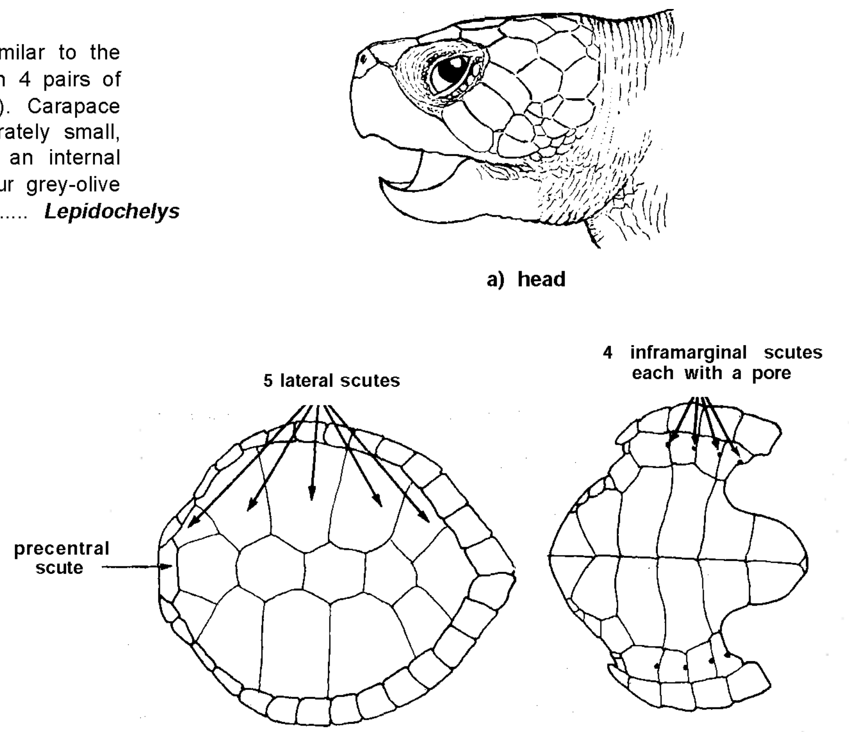
Natator **Fig.19**



a) head **b) carapace** **c) plastron**

Caretta **Fig.20**

4b. Carapace nearly round, its length similar to the width (Fig. 21b). Plastron usually with 4 pairs of pored inframarginal scutes (Fig. 21c). Carapace scutes smooth to touch. Head moderately small, with a cutting tomium provided with an internal alveolar rim (Figs 5, 21a). Body colour grey-olive or olive-yellowish .... ***Lepidochelys***



a) head

b) carapace

c) plastron

Lepidochelys **Fig.21**

click for previous page

2.2 FAMILY CHELONIIDAE

CHEL

Synonyms : Cheloniadae; Chelonioidae; Chelonidae; Chelonydae.

Diagnostic Features : Hard-shelled turtles with paddle-like limbs. Body depressed, but streamlined. Shell covered with horny scutes, limbs and head partially covered with rather thin scales. Vertebrae and ribs fused with the osseous carapace plates. Neck incompletely rectractile; a well-developed horny beak or tomium covering both mandibles; a valvular glottis occludes the throat during immersions; no papillary projections in mouth. Paddle-like fore flippers with 5 very elongated, nearly immobile fingers, one or two claws visible on the anterior border of each flipper. Rear flippers with partially mobile digits, with the same number of claws as the fore flippers. Males are distinguished from females by their longer tails and stronger claws. Eggs with a white, soft, papery shell.

Geographical Distribution, Habitat and Biology : The representatives of this family have a pantropical distribution, with periodical or occasional migrations into temperate waters for feeding, during warm weather. After the nesting season, some chelonirds overwinter buried in muddy bottoms of shallow coastal waters or migrate to warmer areas to avoid freezing temperatures. Nesting is performed on sandy beaches, just above the high tide mark; the clutch, of around one hundred eggs, is buried in the sand and left unattended. Depending on the species and weather, hatching occurs between 45 and 70 days after the eggs are laid; this incubation time is also influenced by the temperature and the humidity in the nest. Hatchlings apparently lead a pelagic-nectonic existence until they reach juvenile size; this period is known as the “lost years” because so little is known of this part of their life history. There is also very little information on the habitat and behaviour in the juvenile and subadult stages. Most cheloniids are carnivorous up to adult age, although the green sea turtle changes to a vegetarian diet about the end of the juvenile stage. Migrations in large groups or “flotillas”, with simultaneous arrival at rookeries or nesting beaches (“arribazones”) are commonly observed in these animals. Usually, these arrivals have fortnighthly or almost monthly periodicity and each female may come to nest in the same season from 2 to 5 times. It is assumed that these synchronised nest-building arrivals are an adaptative response to predation on adults and eggs and are also favourable for survival of the hatchlings which will emerge from several nests at the same time and thus make it easier for at least some of the young to avoid birds and terrestrial predators in their race to the sea.

Turtles are highly vulnerable to predation, the kind of predator depending on their developmental stage. The eggs are eaten principally by skunks, raccoons, opossums, coaties, coyotes, badgers, dogs, jaguars, pigs, monkeys, varanid lizards, ghost crabs, dipterous maggots, ants, and beetles; also fungal and bacterial infections are common. The hatchlings, just before erupting from the nest, can be attacked by ants, mites and fly-maggots, and the nest may be opened by mammals. When the hatchlings emerge from the nest, they race to the sea, and, on the way, they are attacked by mammals, birds and ghost crabs. In the water, predation continues, by birds at the surface and by fishes in the water column. Sharks and other fishes feed on juvenile sea turtles, but this predation diminishes with growth. Except for man, the worst enemy of the adult sea turtles are sharks.

Interest to Fisheries : All species of Cheloniidae are of interest to fisheries. Their products are highly valuable and include meat, leather, eggs, scutes (Carey), oil and meal or fertilizer. Egg-harvesting is now forbidden in nearly all countries with nesting beaches. Because of the severe depletion of the majority of wild sea turtle populations, nowadays all species are considered as endangered and all of them are listed in the Red Data Book of the IUCN and included in Appendix I of CITES. The commerce of turtle products is restricted by international regulations, and all signatory countries to CITES are committed to implement measures to conserve these species and avoid illegal trade. The farming and ranching for commercial purposes of some of the species, are now under review and future activities and regulations will be decided at the next meeting of the IUCN.

Remarks : This family comprises 5 genera with 7 species. ***Natator depressus*** was recently removed from ***Chelonia.*** Subspecies are recognized by several authors, but the separation of these populations is unclear and mainly substantiated through their geographical distribution patterns (Carr, 1952; Loveridge and Williams, 1957; Wermuth and Mertens, 1961; Smith and Smith, 1979).

Caretta Rafinesque, 1814

CHEL Car

Genus : ***Caretta*** Rafinesque, 1814. Specchio Sci. Palermo, 2(9):66

Type Species : ***Testudo caretta*** Linnaeus 1758, Syst. Nat., Ed. 10, T. 1 : 197

Synonyms : ***Thalassochelys*** Fitzinger, 1835; ***Caouana*** Cocteau, 1838; ***Halichelys*** Fitzinger, 1843; ***Cephalochelys*** Gray, 1873; ***Eremonia*** Gray, 1873.

Diagnostic Features : See species.

Remarks : This genus includes a single species: ***Ca. caretta,*** which was subdivided on the basis of its morphology and geographical distribution in two subspecies, ***Ca. c. caretta*** and ***Ca. c. gigas***, some authors consider these taxa as separate species.

Caretta caretta (Linnaeus, 1758) **Fig. 22,23** **CHEL Car 1**

Testudo caretta Linnaeus, 1758, Systema Naturae, Ed. 10, T. 1: 197 (Islands of America)

Synonyms : ***Testudo Cephalo*** Schneider, 1783; ***Testudo nasicornis*** Lacepède, 1788; ***Testudo Caouana*** Lacepède, 1788; ***Chelone caretta:*** Brongniart, 1805; ***Chelonia Caouanna:*** Schweigger, 1812; ***Caretta nasuta*** Rafinesque, 1814; ***Chelonia cavanna*** Oken, 1816; ***Caretta atra*** Merrem, 1820; ***Caretta Cephalo*** Merrem, 1820; ***Caretta nasicornis***: Merrem, 1820; ***Chelonia caretta***: Bory de Saint Vincent, 1828; ***Testudo Corianna*** Gray, 1831; ***Chelonia pelasgorum*** Valenciennes, 1833; ***Chelonia cephalo***: Temminck and Schlegel, 1834; ***Chelonia (Caretta) cephalo***: Lesson, 1834; ***Chelonia caouana***: Duméril and Bibron, 1835; ***Chelonia (Thallassochelys) Caouana***: Fitzinger, 1836; ***Chelonia (Thalassochelys) atra***: Fitzinger, 1836; ***Thalassochelys caretta***: Bonaparte, 1838; ***Chelonia (Caouana) cephalo***: Cocteau, 1838; ***Halichelys atra***: Fitzinger, 1843; ***Caouana Caretta***: Gray, 1844; ***Caouana elongata*** Gray, 1844; ***Thalassochelys Caouana***: Agassiz, 1857; ***Thalassochelys corticata*** Girard, 1858; ***Chelonia corticata***: Strauch, 1862; ***Thalassochelys elongata*** Strauch, 1862; ***Thalassiochelis caouana***: Nardo, 1864; ***Eremonia elongata***: Gray, 1873; ***Caretta caretta***: Stejneger, 1904; Frazier, 1985; ***Thallasochelys cephalo***: Barbour and Cole, 1906; ***Caretta caretta caretta***: Mertens and Müller, 1928; ***Caretta gigas*** Deraniyagala, 1933; ***Caretta caretta gigas***: Deraniyagala, 1939; ***Caretta caretta tarapacana*** Caldwell, 1962.

Subspecies : The subspecific status should be re-assessed because the two described subspecies, one for the Pacific, ***Caretta caretta gigas*** and the other for the Atlantic, ***Caretta caretta caretta***, are not valid in the light of available information, since they were based on characters showing considerable variation, principally colour, body size, number of neural and peripheral bones and number of marginal scutes (***caretta*** 12-12, ***gigas*** 13-13). Most authors now recognize ***caretta*** as a single polymorphic species.

FAO Species Names : **En** - Loggerhead turtle; **Fr** - Tortue caouanne; **Sp** - Caguama.

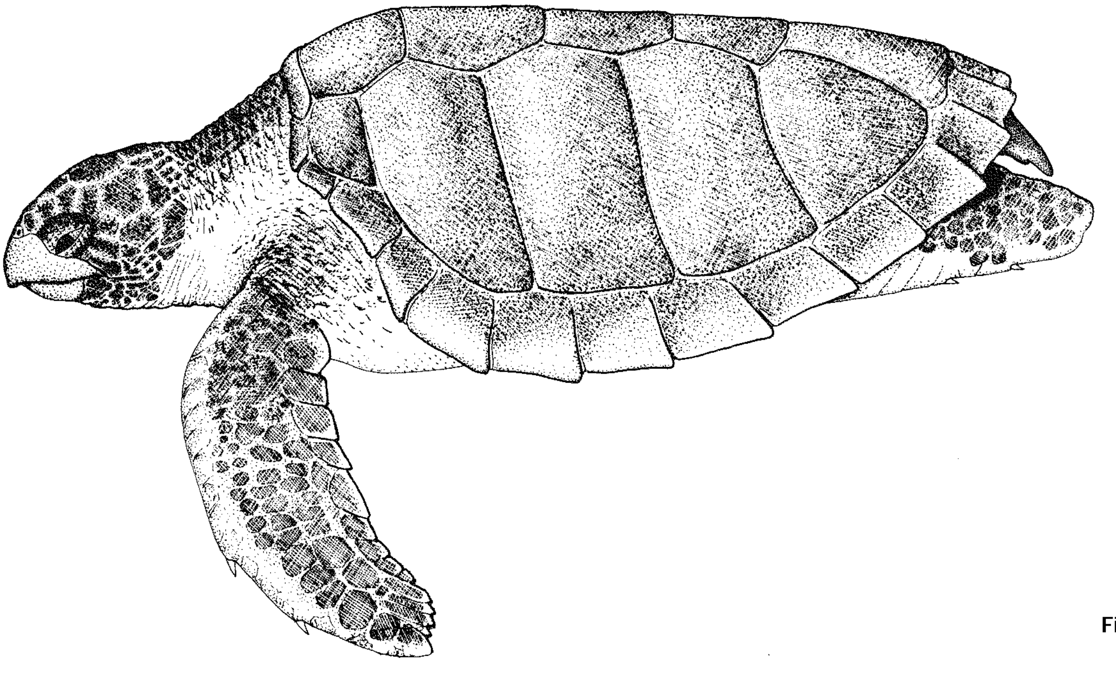


Fig. 22

Diagnostic Features : In adults, the carapace in dorsal view is heart-shaped, its width about 76 to 86% of its length. Head large, broad and subtriangular, 23 to 28% of carapace length, with 2 pairs of prefrontal scales, and commonly one inter-prefrontal; horny beak very strong, comparatively thicker than in other sea turtles. Carapacial scutes thin, but hard and very rough, commonly covered with barnacles. They include 5 pairs of laterals, the anterior touching the precentral scute, 5 centrals (neurals), and commonly 12 or 13 pairs of marginals, including the postcentral or pygal scute. Underneath the bridge of the plastron, there are 3 pairs of inframarginal scutes which rarely have pores. Fore flippers relatively short and thick, each with 2 visible claws on anterior margin; rear flippers with 2 or 3 claws. Hatchlings and juvenile turtles have blunt spines on the carapace scutes, forming 3 longitudinal keels that disappear during the juvenile stage. **Colour**: The adults of ***Caretta*** generally have a constant dorsal pattern, easily recognisable by the reddish-brown coloration, sometimes with dark streaks (South African turtles), that become orange-creamy on the flanks and yellow-creamy underneath. The hatchlings are dark-brown dorsally, with the flippers pale brown marginally and underneath, and the plastron usually is much paler.

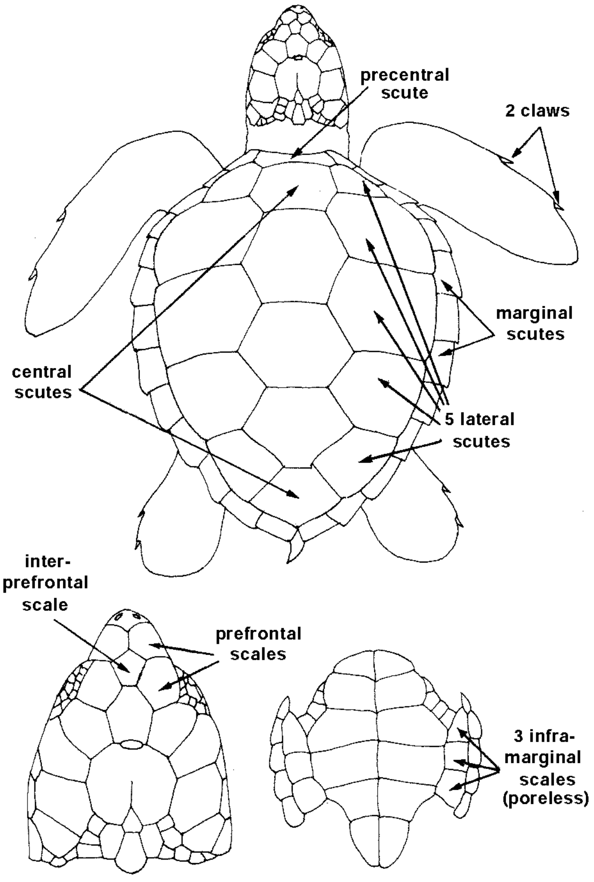


Fig.23

Geographical Distribution : ***Caretta caretta*** is widely distributed in coastal tropical and subtropical waters (16-20ºC) around the world (Fig. 24). Commonly this species wanders into temperate waters and to the boundaries of warm currents. It is suspected that some loggerhead turtles undertake long migrations using warm currents (e. g., the Gulf Stream in the North Atlantic; the North Equatorial and Kuroshio Currents and the California Current (12-20ºC) in the North Pacific and other currents in the southern hemisphere), that bring them far from the nesting and feeding grounds. An example of such deplacements is the recapture of a juvenile released at Okinawa Island on 22 July 1985, and recaptured off San Diego, California two years and

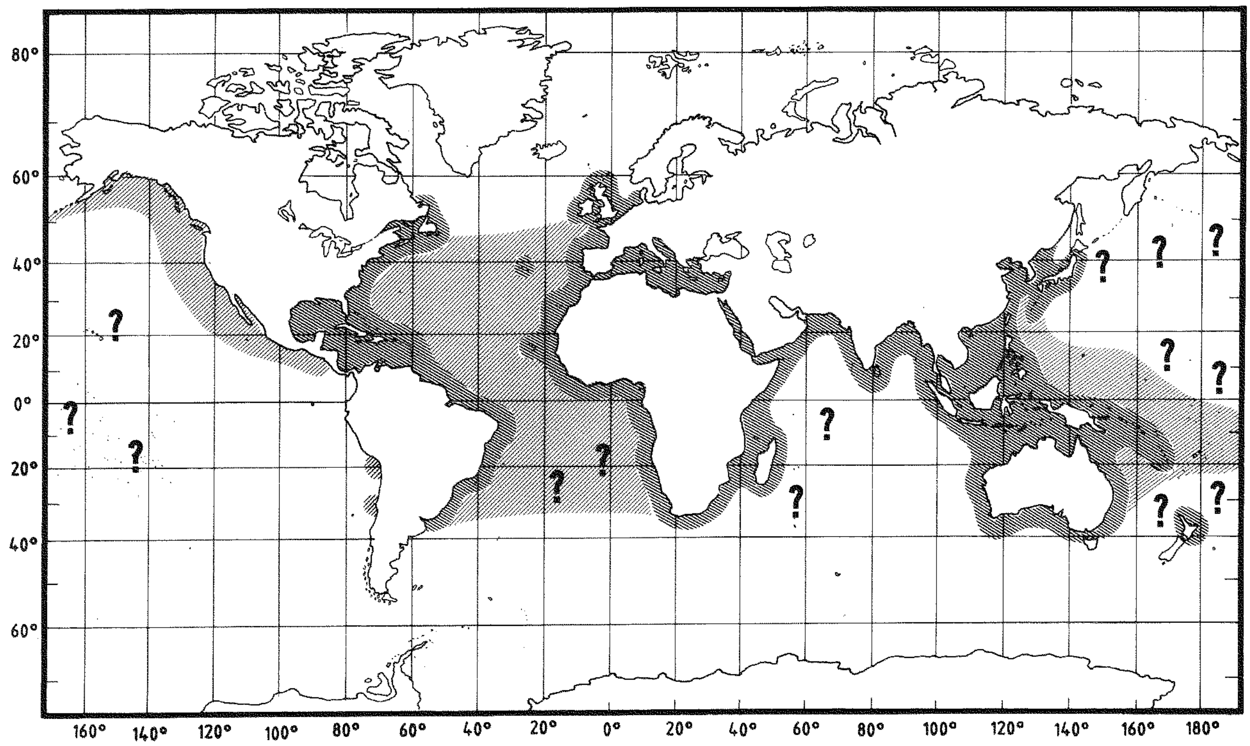


Fig.24

four months later (Uchida and Teruya, 1988 ms). There are groups of turtles reported from open seas, e.g., the encounter of thousands of juvenile loggerheads swimming westward off Gibraltar (33ºN. 14' W), or in the Western Atlantic, 700 to 900 km off the coast of Uruguay, or 50 to 60 km west of Bahia Tortugas and Todos Santos Bay, along southern Baja California, Mexico. This latter locality seems to be a spring-summer feeding ground for thousands of juvenile, subadult, and a few adult loggerheads. This species is capable of living in a variety of environments for a relatively long time, such as in brackish waters of coastal lagoons and river mouths. It may remain dormant during the winter, buried in muddy bottoms located in moderately deep waters such as sounds, bays and estuaries, e.g., Cape Canaveral in Florida. Apparently, the limit of distribution is waters of about 10°C; if they encounter colder waters, they may become stunned, drift helplessly and strand on nearby shores. Records are quoted from New England and eastern Canada, Labrador and Nova Scotia, especially between July and October of warm years. The northern limit of distribution is a summer capture of a live young turtle entangled in a fishing line off Murmansk, Barents Sea (68º 55'N). Brongersma (1972) quotes this and many other records for European waters. Occasionally, the species is sighted in southern Australia and New Zealand. In South America it is absent from west Colombia, Ecuador and Peru, but there are some records from Arica and Coquimbo, in Chile; on the eastern coast, the southernmost record is Rio de la Plata, Argentina.

Habitat and Biology : This turtle primarily is an inhabitant of continental shores of warm seas, common in shallow waters, but it also lives around some islands as: Masirah in Oman, Zakinthos in Greece, and the Ryukyu and Japan Archipelago. The most important aggregations are temporarily formed just off the nesting beaches at the end of the spring, in summer and at the beginning of autumn. In some places, the nesting grounds are associated with underwater "refuges", such as crevices in rocky or reef points, near to the nesting beaches where the turtles remain throughout the reproductive period, e. g., Gamoda Beach in Japan (Uchida, pers. corn., 1977). It is possible that these places could be associated with nesting site fixity. This is the only sea turtle that can nest successfully outside of the tropics, but the summer surface temperature must be over 20°C.

During, or soon after the breeding season ends, some females disperse to distant feeding grounds. Migratory routes are not clearly delineated, but hatchlings theoretically follow warm currents such as the Gulf Stream, or may enter the big gyre of the North Pacific Ocean, along the Kuroshio, the California and the North Equatorial currents. It is possible that if they are "trapped" by these enormous warm currents and complete the intercontinental circuit (gyre) they may be near maturity when they are carried back to their natal beaches.

Loggerhead hatchlings and juveniles are frequently associated with sea fronts (oceanic current convergences), downwellings and eddies, where floating epipelagic animals and floatsam are gathered. The elapsed time, usually more than a year - during which the small turtles remain in those places feeding and growing - is called the "lost year". During this first period of life there is evidence that these turtles lead a pelagic-nectonic existence, feeding on organisms usually associated with sargassum mats.

There are several major nesting grounds, and some of them are located in northern latitudes. In general, the loggerhead does not form "arribazones" but nests on large beaches. The major nesting grounds are located in the southeastern USA, principally in Florida and South Carolina with a mean annual production (in 1986) of about 24 000 and 4 000 nests respectively; in Florida, the nesting is much more important on the Atlantic than on the Gulf coast: Georgia with 1 250, and North Carolina with 280 nests per year. In the eastern USA, minor and solitary nesting occurs as far north as New Jersey.

Along the Gulf of Mexico coasts, only minor and solitary nesting is recorded. In Mexico, on the northeastern coasts of the Yucatan peninsula and in Quintana Roo State, small groups of turtles occur from Cape Catoche and Contoy Island to Ascencion Bay, with a relatively greater abundance between Carmen Port and Ascencion Bay, including Cozumel Island and Boca Paila Beach as the more important nesting places in this region. Minor nesting beaches are located on some islands of the Caribbean region, principally on the south-central coasts, islands and cays of Cuba.

Going south in this region, other nesting is negligible, except for Colombia, where the remains of an important nesting aggregation is reported, especially to the east side of Santa Marta, between the rivers Piedras and Riohacha (which includes the Buritaca Reserve). It was calculated that about 2 000 nests were laid every season in this area, but they have recently declined to a few hundred. East of Colombia, the presence and nesting of loggerheads are negligible. In Brazil, e.g., Maranhao and Ceara. an annual production of over a thousand nests is reported; nesting is consistently reported from Sergipe and also occurs in the states of Bahia, Espirito Santo and Rio de Janeiro. Subadult and few adult loggerhead turtles have been reported as far south as Uruguay, especially between Rocha and Maldonado, including the area of Rio de la Plata. Nesting does not occur this far south.

In the Mediterranean Sea, ***Caretta*** is the most common turtle, and it is regularly captured either directly or incidentally. Nesting is reported principally from the coasts of Greece, Turkey to Israel, Tunisia, both coasts of Italy, Sicily and historically from Sardinia and Corsica; in Cyprus and Algeria, nesting was formerly more widely and consistently observed, but nowadays occurs only from time-to-time. The annual production of nests, in all of the Mediterranean continental rookeries was believed not to exceed 1 000 nests, but recently the Zakinthos Island, in Greece, was indicated as an important nesting place, with over 2 000 nests per year. In the southern Mediterranean, the northeast coast of Libya is known as a minor nesting beach. ***Caretta*** is also reported from the Iberian peninsula, but no nesting has been observed there up to now. The western and the southwestern coasts of the Black Sea probably also have sporadic nesting.

On the Bahamas, Bermuda and the oceanic North Atlantic Islands nesting does not occur, but juvenile loggerheads are commonly observed (reported from around Madeira, the Canary Islands and especially the Azores). These turtles apparently originate in the Western Atlantic rookeries, from which hatchlings enter the Gulf Stream and are carried to these islands. These oceanic gyres and eddies are considered as feeding grounds and developing habitats, where the loggerheads reach the last juvenile stages.

In the Eastern Atlantic, minor nesting takes place in Morocco, the Cape Verde Archipelago and on the coast of Senegal (Dakar). In the Gulf of Guinea, loggerheads may nest, but no reports are as yet available from this area. Minor nesting is reported for southern Angola and northern Namibia, known in the region as the “Skeleton coast”.

Major Indian Ocean nesting grounds occur in South Africa, especially in the northeastern part of Tongaland on the Natal coast, where the nesting population comprises several hundred females. Other important nesting grounds are those in southern Madagascar, but no mention is made of the Comores Archipelago in the compilation prepared by Frazier (1985). Further north, the largest known breeding aggregation occurs on the Arabian peninsula, described in 1979 as the most important rookery for loggerheads in the world, with an annual rough estimate of 30 000 nesting females on Masirah Island, Sultanate of Oman alone; other nesting may occur in the area but it is negligible and there is apparently no nesting in the Red Sea or the Persian (Arabian) Gulf.

Around the islands of the Indian Ocean, this species is nearly unknown. There is minor turtle nesting in Kosgoda, southwestern Sri Lanka, where ridleys and green turtles are common, but loggerheads are rare.

In China, nesting occurs along the coasts of the South China Sea, principally in Hainan Island. ***Caretta*** is frequently observed from Kuangsi (south) to Hopei (north) in Taiwanese waters, but without nesting records. Going northeast, nesting occurs just up to Japanese waters, especially on the southern islands, from the Ryukyu Archipelago to Kyushu and Shikoku Islands. The northernmost point of nesting in the Western Pacific is about 37ºN, on the east coast of Honshu Island, where ***Caretta*** is the most abundant of all sea turtles. In the western Pacific, nesting is mentioned, but not quantified for waters of Sumatra, Borneo, Sabah, Philippines, Indochina, Malaysia and Thailand; from the Arafura Sea to Australia, the loggerhead not only nests, but is recognized as being very common. For the coasts of western Australia (Shark Bay and Barrow Island) and Queensland, south of the Great Barrier Reef (Mon Repos-Bundaberg, Crab Islands and Swain Reefs Islands) there are estimates of annual numbers of over 3 000 females. Records are also available from around Papua New Guinea and New Caledonia, but they become less frequent in New Zealand waters and nearly absent in the western and central Pacific Oceanic Islands, except Tokelau, Fiji, New Caledonia and Solomon, where they are reported as rare. Those records have been apparently confused with the olive ridley ***(L. olivacea)***. In the Hawaiian Archipelago, ***Caretta*** is not common, and nesting does not occur.

In the Eastern Pacific Ocean, nesting of ***Caretta*** was reported from the Gulf of Panama and El Salvador, but it is unclear whether the identification of the species was accurate. It was very probably confused with the olive ridley ***(L. olivacea).*** Loggerheads are absent on the coasts of Colombia, Ecuador and Peru. There are also several non-nesting reports from Chile.

Thousands of loggerheads appear during spring and summer in Baja California and the Gulf of California waters, but apparently all these turtles are non-reproductive, measuring between 25 and 92 cm of CCL. Until now, no turtle in this area has been reported bearing mature eggs.

Nesting of ***Caretta*** usually occurs in spring and summer, with variations according to the latitude and geographical characteristics of the coast. Data available in the literature show that the nesting season also varies in extent: In the Caribbean area it extends from April to July or the first week of August, with the peak in May or June (principally southern Cuba and Quintana Roo, Mexico). In the northwest Atlantic Ocean, from April to September, with the peak in June-July (Florida). In the southwestern Atlantic, from April to August, with the peak in June (Colombia). In the Eastern Atlantic, from June to September (eastern Mediterranean, Turkey, Libya, and Zakinthos Island, Greece), and from July to October (Senegal). In the southwestern Indian Ocean from October to February, with the peak in November-December (South Africa: Natal-Tongaland). In the northwestern Indian Ocean, from May to June, but there are also reports for the winter from November to March, with the peak in December-January (Masirah Island, Oman). In the east up to Sri Lanka, questionable reports that may correspond to ***Lepidochelys olivacea,*** state that the season runs in the winter, starting from September and lasting seven months up to the next year. In the Northwest Pacific Ocean there are no big nesting grounds; in China, the season goes from April to August with a peak in June or July; in Japan (Honshu, Kiushu and the Ryukyu Archipelago), the situation is similar, but the season starts earlier in the southern beaches and also has the peak in June or July. In Australia, the season runs from October to April, with the peak between November to January. No nesting is reported from New Zealand.

Caretta shows renesting frequency intervals of nearly two weeks; females usually lay between two and five times per season, depositing on each occasion from 40 to 190 eggs (mean: 110 eggs). Hence, a single female could lay a maximum of 560 eggs per season. The major pattern of the reproductive cycle is two or three years, but some parts of the population may shift from one cycle to another, including to a yearly cycle.

The size of the egg clutch varies from place to place, from a minimum of 23 to a maximum of 190 eggs per clutch.

Some examples are the following: **USA** - North Carolina from 86 to 159 eggs, with a mean of 123 (n = 26 nests); -South Carolina from 64 to 198 eggs, with a mean of 126 (n = 71 nests); -Georgia, Cumberland Island with a mean of 120 eggs (n = 2827 nests); Florida, Broward County from 53 to 174 eggs, with a mean of 107 (n = 1928); Merrit Island, from 82 to 173 eggs, with a mean of 123 (n = 64); **Mexico**-Quintana Roo, Mujeres Island from 68 to 188 eggs, with a mean of 97 (n =66); -continental beaches of the same state, from 45 to 183 eggs, with a mean of 103.5 (n=795); **Colombia** - Buritaca River, from 58 to 163 eggs, with a mean of 106.5 (n = 254); **Greece** - Zakinthos Island, from 52 to 114 eggs; **Turkey**-Mediterranean coast, from 23 to 134 eggs, with a mean of 93 (n = 50); **Oman** - Masirah Island from 72 to 130 eggs, with a mean of 101 (n = 29); **South Africa** - Tongaland, from 55 to 160 eggs (n=98), and a mean of 114 (n=112), other two measurements give means of 113 and 105.3 eggs (n=41 and 72 nests respectively); **Australia** - Mon Repos Bundaberg from 48 to 190 eggs, with a mean of 127 (n = 1 056 nests). The general minimum and maximum averages for the species in Turkey and Australia are 93 and 127 eggs, respectively.

In general, the egg size in diameter and mass usually varies proportionally to the size of the turtle, hence small turtles lay smaller eggs. The egg diameter ranges from 34.7 to 55.2 mm.

Variations in diameter size have been quoted by several authors, e.g , in **USA**, South Carolina, it varies from 35 to 49, hence, with a mean of 41.5 mm (n =44 clutches with 827 eggs); in Florida, Merritt Islands, mean measurements range from 39.2 to 44.6 mm, with a general mean of 42.1 mm (n = 5 666 eggs); in Cape Canaveral, the minimum and maximum sizes of the eggs were 37 and 55.2 mm respectively, with a mean of 42.2 mm (n = 44 clutches with 4 804 eggs); in **Mexico**, Quintana Roo, a mean of 43 mm was obtained (n= 10 100 eggs); in **Colombia**, Buritaca River, egg diameters ranged from 39.7 to 47.5 mm, with a mean of 43.3 mm (n = 3 370 egg); on the Mediterranean coast, in southwest **Turkey**, from 37 to 42 mm, with a mean of 39 mm (n = 50,500 eggs); in **South Africa**, Tongaland, from 36 to 44 mm, with a mean of about 42.1 mm (n = 26 clutches, 260 eggs); in **Oman**, Masirah Island, from 38 to 46 mm, with a mean of 42.1 mm (n = 29 clutches); in **Australia**, Queensland, from 34.7 to 49.8 mm, with a mean of 40.4 mm (n = 399 clutches, 3 990 eggs).

The nests of these turtles sometimes contain undersized eggs, laid together with the normal ones, but never in such large quantities as in the leatherback turtle; oversized and abnormal-shaped eggs are also present, but not frequent.

Egg weight measurements are less frequent than those of diameter size, and available data range from 26.2 to 46.8 g.

Some examples are the following: **USA**, Florida, Merritt Islands, from 33.7 to 49.1 g, with a mean of 41.2 g (n =46 clutches, 5 666 eggs); **Mexico**, Quintana Roo, Mujeres Island, from 35.2 to 48.7 g, with a mean of 40.7 g (n = 23 clutches, 10 eggs per clutch); continental beaches of the same state the mean was 36 g (n = 10 100 eggs); **Colombia**, Buritaca River, from 29.7 to 46.8 g, with a mean of 38.4 g (n = 3 clutches, 370 eggs); **Australia**, Queensland, from 26.2 to 43.1 g, with a mean of 36.5 g (n = 24 clutches, 240 eggs); **Japan**, Hiwasa, from 30.5 to 32.8 g, with a mean of 31.8 g (n = 9 eggs with 9 days of incubation). In general, the mean egg mass varies from 36.5 to 41.2 g; the small eggs from Hiwasa were not used because of the nine days already elapsed after deposition and the reduced number of eggs in the sample.

The incubation period varies among populations and with beach latitude; e.g. USA, South Carolina, 55 to 62 days; Hutchinson Island, Florida, mean duration 68 days; Mexico, Quintana Roo, mean duration 56 days; Turkey, 50 to 64 days, mean duration 57 days; Greece, Zakinthos Islands 49 to 69 days, mean duration 57 days; South Africa, Tongaland, 55 to 65 days, mean duration 68 days; Japan, Hiwasa, usually 58 days. In general, the warmest places and times result in the shortest periods of incubation, so there are differences on the same beaches depending on location of the nest and time of oviposition; even in the same localities, the incubation length changes from season to season.

Size and weight of hatchlings are considered to be correlated directly with the size of the eggs; the more frequent measurements are straight carapace length (SCL) which ranges from 33.5 to 55 mm, and total weight (range of mean values from 18.8 to 21.1 g).

In **USA**, these measurements vary from 33.5 to 50 mm in several samples from South Carolina, Georgia, Florida and Texas (n = 722), with an approximate mean of 45.3 mm and a mean weight of 20.2 g (n=438); in **Mexico**, from 38 to 50.5 mm, in several samples from Quintana Roo (n = 185), with an approximate mean of 45.3 mm and a mean weight of 24.2 g (n= 100); in **Colombia**, from 42.5 to 48 mm in two samples from Buritaca River, with a mean of 45 mm and a mean weight of 18.8 g (n = 46); in **Greece**, Zakinthos, a mean of 40 mm was obtained (n = 221); in **Turkey**, from 37 to 42 mm. with a mean of 39.9 mm (n = 50); in **South Africa**, from 37 to 48.8 mm in several samples from Tongaland, with a mean of 43.7 mm (n = 1824) and a mean of 21.2 g (n =88); in **Australia**, from 39 to 49.6 mm in several samples from Mon Repos-Bundaberg with a mean of 43.4 mm (n = 837) and 20.7 g of mean weight (n = 817); in the **Solomon Islands**, from 43 to 46 mm with a mean of 44.9 mm (n = 10); in **Japan**, from 43 to 55 mm, with a mean of 45.8 mm (n = 60) and a total weight of 24.2 g (n = no data).

Age at first maturity has not been clearly determined yet. Data derivated from research in captivity indicate ages from 6 to 20 years; the back calculation from capture - recapture data of tagged nesting females, analyzed through logistic and von Bertalanffy growth curves, produce ranges from 12 to 30 or more years, for minimum (74 cm) and maximum (92 cm) straight carapace lengths; these data apply to the southeastern coast of the United States, but differences must be expected for nesting beaches located on different latitudes, as Colombia, Oman, Australia or Japan.

Unlike other sea turtles, courtship and mating are usually not performed near or in front of the nesting beaches, but along the migration routes between feeding and breeding grounds. Courtship and mating are not commonly observed, but some photographs have been taken, e.g. the photograph by Mr Larry Bearse (Anon., 1985) south of Cape Hatteras in North Carolina, USA, on 28 March 1985, in waters of the western side of the Gulf Stream. Mating apparently is accomplished while floating on the water surface, but in Australia near Sandy Cape, Limpus (1985) has reported underwater copulation. In captivity, it is common for one female to be covered several times by different males before the nesting time, but other females are covered by only one male before nesting, apparently without any effect on the fertility of the eggs. It is also possible that through storage of the sperm of one or several males in the reproductive tract (oviducts) of the female, all clutches of the current nesting season can be fertilized without repeated matings. Mating usually is performed several weeks before the nesting season.

Optimal incubation occurs within a limited range of temperatures, usually between a minimum of 26ºC and a maximum of 32ºC; there is evidence that sex determination is male-biased in cool temperatures and that survival rate decreases at the extreme temperatures of this range. The "pivotal temperature", defined as the temperature where a 1: 1 sex ratio occurs, seems to be about 30ºC for this species, but it may show small variations among populations and with geographical latitude. As in all the other sea turtles, hatching occurs in the course of several days (2 to 3); it takes several hours for the hatchlings to reach the surface of the sand and only a few minutes to emerge from the nests. Emergence occurs mostly at night; the peak time usually lies between 21:00 and 02:00 hours, but during cloudy days it may continue late in the morning. After the majority of hatchlings appear at the surface of the nest, they start a frenzied race to the surf and disappear in the waves. Highest predation occurs in the incubation period and during the race of the hatchlings to the sea. Small turtles swim straight out from the coastal shallow waters, since fish predation decreases strongly in deep waters. Massive destruction of eggs and embryos is also caused by natural phenomena such as erosion or sea overwash. Eggs, embryos and hatchlings are devoured by a great variety of predators and primarily or secondarily affected by bacterial and fungal diseases. It is common that clutches of eggs or hatchlings, while remaining in the nests, are eaten by ghost crabs, ants and fly larvae; predation by monitor lizards (***Varanus***) in South Africa and Northern Australia, and by raccoons in some beaches of Florida and South Carolina is responsible for over 40 and 56% of egg losses respectively; skunks, feral dogs, genets, pigs, foxes, jackals (in Cape Verde and Libya) also destroy nests. During the synchronous nocturnal travel from the nest to the surf, hatchlings are devoured by many of the above-mentioned predators. Land and shore birds also take their quota if hatchlings emerge in day time. After reaching the waves, predation continues by marine birds and neritic and pelagic fishes (e.g., ***Centropristes, Coryphaena***).

Little is known about predation on juveniles and adults, but they are usually too large for many predators except the big carnivorous fishes such as groupers, snappers and jacks. Sharks are the principal enemies for all size classes of turtles. Turtles above medium size are able to avoid shark attacks, by presenting the flat side of the plastron or carapace to prevent biting. The worst predator of loggerhead turtles is man who is able to take the entire egg production of any beach or capture any size and quantity of turtles. The loggerhead turtle is the most prone to bear epibiontic organisms, including leeches, crabs, green filamentous algae, etc. Leeches could be the cause of skin damage and secondary infection and also propitiate the tissue degeneration known as papillomae.

Feeding behaviour may change somewhat with age, but this species is carnivorous throughout its life. There is evidence that hatchlings obtain their food from the fauna living in seagrass mats, frequently distributed along the drift lines and eddies. Hatchling gut contents have shown jellyfishes, pieces of ***Sargassum,*** gastropods (***Diacria, Litiopa***), crustacean appendages and materials as grit, feathers, bark and plastic pieces. Juveniles, subadults and adults have been more extensively studied and show a very wide variety of prey, principally benthic fauna like, conchs (***Strombus, Cypraea, Conus, Kelletia, Cassis, Janthina, Harpa,*** etc), clams (***Cardium, Pecten, Mactra, Pinna, Venus,*** etc.), horse shoe crab (***Limulus***), crabs (***Calappa, Callinectes, Portunus, Cancer, Hepatus,*** etc.), occasionally shrimps (***Pennaeus, Sicyonia***), sea urchins, sponges, fishes (***Brevoortia, Sardinops, Scomber, Diodon,*** etc.), squids, octopuses, and also man-caught fauna (shrimp-trawl bycatch). Because of their carnivorous diet (molluscs-crustaceans), loggerheads compete for food with ridley sea turtles (***Lepidochelys***). During their migration through the open sea they eat jellyfishes, pteropods, floating molluscs (***Janthina***), floating egg clusters, flying fishes, squids, lobsterets (***Galatheids***). In western Baja California, many of the dissected loggerheads had full stomachs containing only ***Pleuroncodes planipes*** (the pelagic small red lobsteret). Sometimes the diet includes sea turtle hatchlings, floating algae (***Sargassum***) and other plants, but it is suspected that plant ingestion is involuntary during feeding activities. In a loggerhead from Trinidad and Tobago, the only species found in the stomach was ***Conus ermius***. Experiments show that although this species has food preferences, it clearly is a facultative feeder over a wide range of food items.

Size : In general, the mean straight carapace length (SCL) of the mature females is between 81.5 and 105.3 cm (n = 3502), with a mean weight near to 75 kg (65.7 to 101.4 kg, n = 153). The carapace length (SCL) in nesting females varies within a limited size range, but is always over 70 cm.

For example, in the **USA,** South Carolina, 84.4 to 103 cm, with a mean of 92.7 cm (n = 18); Georgia, a mean of 95.9 cm (n = 110); Florida, 74.9 to 109.2 cm with a mean of 92 cm (n = 661), and Broward county, a mean of 99.6 cm (n = 1203). In **Mexico**, Quintana Roo. 73 to 109 cm, with a mean of 90.5 cm (n = 423) for females, and 75.3 to 99.5 cm, with a mean of 86.5 cm (n = 39) for males. In **Colombia,** Buritaca, 70 to 102 cm, with a mean of 87.9 cm (n = 77). In **Argentina-Uruguay,** Mar del Plata, a non-breeding population ranges from 50 to 115 cm (n = 61, both sexes). In **Greece,** Zakinthos Islands, a mean of 81.5 cm (n =95). In **Senegal,** a mean of 105.3 cm (n = 3). In **South Africa,** Tongaland, from 72.8 to 98.5 cm, with a mean of 86.4 cm (n = 1 182); Natal, from 75.2 to 90.5 cm, with a mean o f 81.6 cm (n = 13). In **Oman,** Masirah islands, a mean of 91.2 cm (n = 1 378). In **Australia.** Heron Islands, from 86 to 102 cm. In **Japan,** Shikoku, from 72 to 107.5 cm, with a mean of 89 cm (n = 118). Data on body mass are less available. In **Mexico,** Quintana Roo, mean weights of females are 65.7 kg (n= 115) and of males, 101.4 kg (n =38); in the Mediterranean region a mean of 105 kg is common; in **South Africa**, Tongaland, the mean is 106.9 kg (n = 31) in females and 68 kg (n = 13) in males.

Interest to Fisheries : Up to several years ago (the seventies), ***Caretta*** was commonly captured in commercial operations and the meat, eggs, leather and fat were used. However, its flesh and leather is less valuable than that of the green turtle ***(Chelonia),*** and the carapace brings a lower price than that of the hawksbill turtle ***(Eretmochelys)***, which produces tortoise-shell. With few exceptions, in many countries this species has not been the major target in the sea turtle catch; but in the northern and northeastern Gulf of Mexico, Texas and Florida, it was captured as bycatch and canned together with the green sea turtle up to the early fifties. On the eastern coast of Mexico it was captured jointly with the green turtle, but while the loggerhead was consumed fresh, the green turtle was exported, principally to Tampa, Florida, up to late seventies. In Cuba, the exploitation continues, but at a restricted annual level of between 250 and 300 metric tons. It is very common that in places where regulations are not strictly enforced, the eggs are consumed whenever found and also widely commercialized in unknown quantities, generally through illegal markets. The most common way of ***Caretta*** harvesting has been the "turtle turning" on the beaches and the setting of entangling nets, the majority in front of nesting beaches. In Caribbean shallow waters, the nets used are made of cotton yarn with light weights on the bottom line, to avoid drowning the turtles, and similar nets are used in the Gulf of Mannar. The capture with nets is increased during the night time. Several kinds of harpoons with detachable iron points have been widely used. Harpooning generally was performed by two fishermen on small wooden boats, one of them paddling and the other "hunting" at the bow of the boat. In the transparent Caribbean waters it is possible to observe the turtles on the bottom, so the turtlers can follow the prey until it comes up to breathe. This moment is used for harpooning it; this method is called "correteada", - rove or boat-chase - on the Western Caribbean coast of Mexico.

The FAO Yearbook of Fishery Statistics reports loggerhead catches only from Fishing Area 31 (Western Central Atlantic, Cuba only). The registered world catch was 273 metric tons in 1983, 277 metric tons in 1984. 322 metric tons in 1985, 309 metric tons in 1986 and 238 metric tons in 1987.

Because of their feeding behaviour and their habit of overwintering in shallow waters, this species, together with ***Lepidochelys***, is more prone to capture by shrimp trawlers and gill-nets (mainly shark-nets). In recent years, in Atlantic waters of the USA, around 32 000 loggerheads were caught annually and nearly 21% of them died by drowning; in addition, more than 10 500 turtles were trapped annually in the Gulf of Mexico by the same types of gear, and approximately 29.8% of them were killed during trawling. The majority were late juveniles and subadults, while adults were relatively few. Also the records of the "Sea Turtle Stranding and Salvage Network" from the east coast of the USA show that loggerhead turtles were the most frequently stranded (73%) of the five Atlantic species, with a total of 2 373 individuals registered during 1987. The blasting of old petroleum platforms is another cause of high sea-turtle mortality, especially of loggerheads. This kind of mortality is also reported for Mexico, Australia, South Africa, Japan, China, and wherever the loggerhead lives. The extent of the mortality needs to be evaluated in all these and other areas such as the Mediterranean Sea and the southern coast of the Arabian Peninsula.

Local Species Names : ARABIAN PENINSULA, EGYPT, OMAN (Red Sea): Remani; AUSTRALIA (Torres Strait): Maiwa; BRAZIL: Avo de aruana, Tartaruga caret, Tartaruga mesticona, Vovo de tartaruga; CARIBBEAN REGION, COLOMBIA, CUBA, GUATEMALA, MEXICO, PANAMA, PERU, VENEZUELA: Caguama, Cahuama; CHILE, SPAIN: Boba; CHINA: Tsu-tsi; COLOMBIA: Coco, Tortuga gogo; FRANCE: Grosse tête, Tortue caouanne; GERMANY: Unechte Karettschildkröte; ISRAEL: Taras al asfar (Arabic); ITALY: Tartaruga caretta, Tartaruga comune; INDIA (Tamil): Perunthalai amai; INDOCHINA: Lemech; INDONESIA: Penyu mangong; IRIAN JAYA: Marab, Penyu waukaku; JAPAN: Aka umi game; MEXICO (Pacific)- Javalina, Perica; MOZAMBIQUE: Lindi, N'duvi; PAPUA NEW GUINEA: Babamukara, Guiguina, Lantuc, Maiwa-gamo, Mogobul, Nukali, Ponowan; PHILIPPINES: Pawikan; PORTUGAL: Tartaruga; SENEGAL: Tortue caouanne, Tortue jaune; SEYCHELLES: Nam koyo. Torti batar; SOUTH AFRICA: Eluvi, Ilongosi; (Afrikaans: Kertseeskilpad); SRI LANDK: Nai mai, Olu geddi kasdava; THAILAND: Tao-ya; TUNISIA: Fahroun el bahr; UK, USA: Loggerhead; VENEZUELA: Cardon.

Literature : Pope (1935); Deraniyagala (1939); Kuriyan (1950); Carr (1952, 1986a.b. 1987); Caldwell, Carr & Hellier (1955); Carranza (1956); Caldwell & Carr (1957); Loveridge & Williams (1957); Caldwell (1959, 1962, 1969); Schaefer (1962); Achaval (1965); Bleakney (1965); Mc Allister, Bass & van Schoor (1965); Capocaccia (1966); Kauffman (1966, 1971, 1972. 1975); Mc Cann (1966); Hughes, Bass & Mentis (1967); Hughes & Mentis (1967); Nishimura (1967); Kondo (1968); Routa (1968); de Silva (1969); Marquez (1970, 1977); Bustard & Limpus (1971); Brongersma (1972, 1981); Ross (1972, 1981); Bruno(1973); Hughes (1974, 1975, 1977, 1981); MC Gehee (1974); Rebel (1974); Schwartz (1974); Witham (1974); Ogren, Watson Jr. & Wickman (1977); Uchida (1977); Frazier (1979, 1984, 1985a,b); Hopkins, Murphy, Stansell & Wilkinson (1979); Lazell (1979); Carr, Ogren & Mc Vea (1980); Rodin, Springer & Pritchard (1980); Balazs (1981); de Silva

(1981); Geldiay, Koray & Balik (1981); Chu-Chien (1981); Orgen & Mc Vea (1981); Polunin & Sumertha (1981); Pritchard (1981); Ross & Barwani (1981); Sella (1981); Spring (1981); Suwelo, Sumertha & Soetrisno (1981); Uchida & Nishiwaki (1981); Grassmari & Owens (1982); Hoffman & Fritts (1982); Mendonca & Erhart (1982); Shoop & Ruckdeschel (1982); Wickramsinge (1982); Argano & Baldani (1983); Berry *et al.* (1983); Bjorndal & Meylan (1983); Frazier & Salas (1983, 1984); Maigret (1983, 1986); Margaritoulis (1983, 1985); Musick *et al.* (1983); Ogren (1983); Fletemeyer (1984); Martinez (1984); Pritchard & Trebbau (1984); Frazer & Erhart (1985); Limpus & Reed (1985); Pascual (1985); Sutherland (1985); Dupuy (1986); Ehrhart & Witherington (1986); Kamezaki (1986); Kushlan (1986); Moreira & Benitez (1986); Veniselos (1986); Zug, Hynn & Ruckdeschel (1986); Alfaro, Blain & Munoz (1987); Discovery Center (1987); Fretey (1987); Hoffman & Conley (1987); Marquez & Bauchot (1987); Schleich (1987a,b); Dood (1988, pers com.); Gil-Hernandez (1988); Gramentz (1988); Marquez & Fritts (1988); Senaris (1988); Schroeder & Warner (1988); Uchida & Teruya (1988).

Chelonia Brongniart, 1800

CHEL Chel

Genus : ***Chelonia*** Brongniart, 1800, Bull. Soc. Philom., Paris, 2:89.

Type Species : ***Testudo mydas*** Linnaeus, 1758, Syst. Nat., Ed. 10, T. 1: 197

Synonyms : ***Chelonia*** Latreille, 1801; ***Chelone*** Brongniart, 1806; ***Chelonias*** Rafinesque, 1814; ***Caretta*** (in part): Merrem. 1820; ***Chelona*** Burmeister, 1837; ***Mydas*** Cocteau, 1938; ***Euchelonia*** Tschudi, 1845; ***Megemys*** Gistel, 1848; ***Euchelys*** Girard, 1858; ***Chelone*** Strauch, 1862; ***Chelone*** Boulenger, 1889.

Diagnostic Features : Medium- to large-sized sea turtles; adults usually have a body mass between 50 and 200 kg and a carapace length (SCL) between 70 and 140 cm. Carapace profile generally oval in dorsal view, with 4 pairs of lateral scutes. Head comparatively small and blunt (preorbital distance smaller than orbital length), with two prefrontal scales. Mandibles covered by a horny tomium, with sharp cutting ridges, the lower jaw more strongly serrated; the serration engages with the vertical ribbing on the inner surface of the upper tomium and becomes smooth with age. Flippers with only one visible claw.

Remarks : This genus formerly included 3 species, but one of them was recently reviewed and renamed as ***Natator depressus***. Some authors recognize only one species, ***Ch. mydas***, with two or three subspecies. The present author recognizes two valid species, ***Ch. mydas*** and ***Ch. agassizii***, which are distinguished mainly by the shape of the carapace which is subcardiform, narrower and usually more strongly vaulted in ***Ch. agassizii***, and by their well-delimited distribution areas (Eastern Pacific for ***Ch. agassizii*** and Atlantic, and Indo-Pacific for ***Ch. mydas***).

Chelonia agassizii Bocourt, 1868 *

CHEL Chel 2

Chelonia agassizii Bocourt, 1868, Ann. Sci. Natur., Ser., 5, Zool., 10:121-122, 3 pl. (Guatemala, Nagualate river mouth).

Synonyms : ***Chelonia (Euchelonia) midas*** Tsuchudi, 1845; ***Chelonia virgata*** Agassiz, 1857; ***Chelonia Agassizii:*** Duméril & Bocourt, 1870; ***Chelonia lata*** Philippi, 1887; ***Chelonia virgata:*** Velasco, 1892; ***Chelonia agassizi:*** van Denburg, 1886; ***Chelonia viridis*** Gadow, 1905; ***Chelonia japonica*** Stephens, 1921; ***Chelonia mydas japonica:*** Mertens & Müller, 1928; ***Chelonia mydas agassizii:*** Carr, 1952; ***Chelonia mydas carrinegra*** Caldwell, 1962; ***Chelonia agassizi:*** Carr, 1967.

Subspecies : None.

FAO Species Names : **En** - Eastern Pacific green turtle; **Fr** - Tortue verte du Pacifique est; **Sp** - Tortuga prieta.

Diagnostic Features : This is the smaller species of the genus ***Chelonia***. The carapace in adults is often strongly elevated or vaulted, especially in large females, but with a less round profile in frontal view than in ***Chelonia mydas***; in dorsal view the carapace is subcardiform and slightly emarginate over the neck and fore flippers, and deeply emarginate over the rear flippers. In subadults and young turtles, the last third of the carapace usually has indentations between each marginal scute. The carapace width attains from 76 to 82% of its straight-line length (SCL) and it becomes relatively narrower with age. The head is small and blunt, about 21.5% SCL. Carapacial scutes rather thin and smooth, usually 5 centrals, 4 pairs of laterals, and 11 pairs of marginals. Ventrally, on the plastron, the scutes are less thick than those of the carapace. Scute counts are the same as in ***Ch. mydas***, a total of 6 pairs plus 4 inframarginals at each side; there may also be one intergular and one interanal scute. Head with usually one pair of elongated prefrontal scales and 4 postorbital scales at each side (variable from 2 to 5). Tomium of lower jaw serrated, the serrations corresponding with strong ridges on the inner surface of the upper tomium. Each flipper with a single visible claw at the outer border.

---

* No illustration available. See Figs 26 and 27 for ***Ch. mydas*** which is very similar to ***Ch. agassizii***

Colour : In dorsal, view, adults are characteristically dark. Carapace slate grey to black, with a blotched or radiating brown and olive pattern, with or without yellow radiating stripes; upper surfaces of the head and flippers plain dark. Plastron varying from whitish grey to bluish or olive-grey. Young individuals are usually brighter and more colourful, very similar to those of the Atlantic species. Some adult turtles have the carapace covered by a coat of microscopic green algae that give them a lustreless greenish colour; these turtles are considered non-migratory forms that overwinter in the Gulf of California, in a dormant status, over meadow sites and are called locally "la tortuga echada" (the flattened turtle). Several authors have described brightly coloured individuals from the Galapagos Islands, which they suggest are non-reproductive phases, because they have failed to find females with ripe ovaries and enlarged eggs. They call this variety "the yellow" and describe it as more fatty than the black one. Hatchlings, in general, have colour patterns similar to ***Ch. mydas***: carapace and flippers dorsally very dark brown or black with a narrow white border; ventrally white.

Geographical Distribution : The Eastern Pacific green turtle is common along the west coast of America, from central Baja California (Cedros Island Scammon Lagoon) and the Gulf of California, to southern Peru (Paracas Peninsula, Ilo); also on islands like Revillagigedo and Galapagos (Fig. 25) Records from outside these major dwelling areas include British Columbia, Canada to Coquimbo, Chile, and there is even a report from Desolacion Island (52° 51'S), the southernmost record for the species. The western range is uncertain; there are reports of melanistic green sea turtles from Easter Island and Hawaii. A possible intergradation with ***Chelonia mydas*** (***japonica*** variety ?), in these places and in the easternmost Polynesian Islands, needs to be clarified and even the geographical limits for both these species must yet be studied.

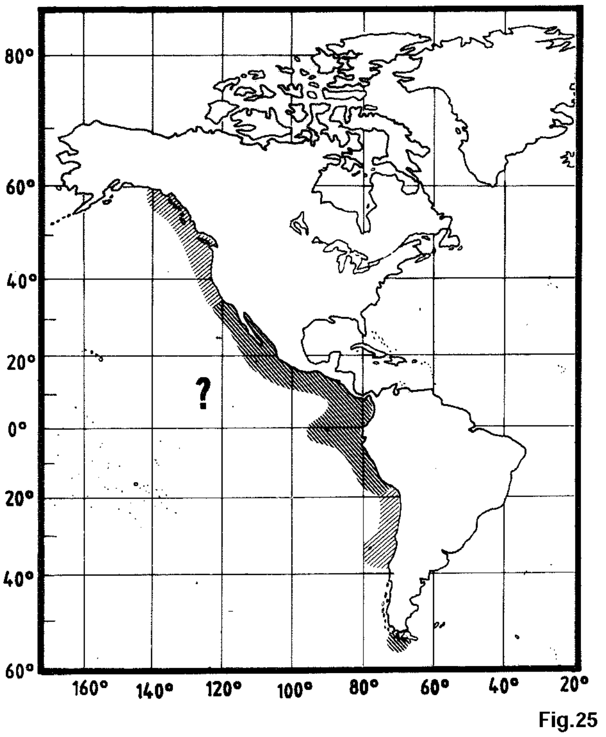


Fig.25

Habitat and Biology : ***Chelonia agassizii*** inhabits coastal waters of the eastern tropical Pacific Ocean, and is not commonly observed in the open ocean.

Migrations (shown by tag-recovery studies) occur between the northern and southern extremes of the distribution range as well as in regional patterns. Turtles tagged at nesting beaches of Michoacan, Mexico, were recovered northward and southward of this point, as far as: Colombia, Panama, Costa Rica, El Salvador, Guatemala and principally Mexico, from the Gulf of California and Bahia Magdalena on the western side of the Peninsula to the southern border with Guatemala. Turtles tagged on the Galapagos Islands were found principally eastward to the mainland and from Costa Rica to Peru. The dispersion starts from the breeding areas, just after the nesting season, and the destinations are the feeding grounds, but the exact routes followed are unknown. The longest distance covered by ***Ch. agassizii*** was 3 500 km (measured along the coast and as straight as possible), for a turtle tagged in Michoacan, Mexico, on 1 November 1976 and recovered near Buena Ventura, Colombia, after 266 days. The feeding grounds are not clearly delimited, but some of them are located on the west coast of Baja California (Scammon Lagoon, Tortugas Bay and Magdalena Bay), the Gulf of California and the lagoons of Oaxaca, in Mexico, the Gulf of Fonseca (El Salvador) and the area between the Gulf of Panama and southwest of Colombia, around the Galapagos Islands (Punta Espinosa, Elizabeth Bay, Turtle Cove, Puerto Nuñez, etc.),and off to Paracas Peninsula in Peru.

Some of the principal nesting grounds are located on the mainland coast of Michoacan, Mexico, on a dozen sandy beaches such as: Colola, Maruata, Llorona, Kachan, Motin, Cuilala, La Tikla, Xicuasha, etc., all of them covering more than 25 km and separated by rocky cliffs. In Central America there are several nesting points such as Jiquilisco in El Salvador and several beaches in Guatemala, where also tag-recoveries of Mexican-tagged "black turtles" come from. Other less important nesting sites are on islands, such as the Revillagigedo Archipelago, in Academy Bay and Playas Blancas on Clarion Island and in Sulfur Bay on Socorro Island. In the southern part of the range, nesting occurs in the Galapagos Archipelago: Quinta Playa and Barahona Bay on Isabel Island, Las Bachas on Santa Cruz Island, Las Salinas on Baltra Island, Bartolome on Bartolome Island, Espumilla on Santiago Island and Playa Sardina on San Cristobal Island. In addition to these breeding grounds, solitary nesting occurs throughout the range of distribution, wherever a nesting beach seems suitable. This solitary nesting is reported from Jalisco, Mexico to Manta, Ecuador. The existence of a historical nesting ground was reported about 25 years ago, between the Paracas Peninsula and Ilo Port, in Peru (Estremadoyro, pers. corn.).

The nesting season shifts in time, with the latitudinal position of the rookery; thus in Michoacan, it extends from August to January, with the peak in October-November; on the Revillagigedo Islands it is between March and July, and in the Galapagos Islands, from December to June, with the peak in February-March. On beaches shared with other turtle species, the breeding of ***Ch. agassizii*** usually occurs after the peak of the olive ridley, ***L. olivacea***, and before that of the leatherback, ***D. coriacea***, a behaviour which shows a clear adaptation in time and also in space; the Pacific green is the species that nests at a greater distance from the high tide line than the other two, while the leatherback is the one with the shortest distance. Such differences in time and space allow the use of the same nesting beaches by various species without disturbing their life-cycles.

The nesting cycle shows differences between northern and southern populations. In Michoacan each female may produce from 1 to 8 nests each season, with an average of about 2.8 nests per female, and a periodicity of nearly 14 days between successive nestings; this turtle nests every 1,2 or 3 years, with a mean pattern of 2.2 years for the overall population; the mean size per clutch is about 70 eggs, with 38 to 139 eggs as a minimum and maximum for viable clutches. In the south, on the Galapagos Islands, each female produces 1 to 5 clutches per season, with an average per female of about 1.4 nests, between periods of nearly the same duration (14.3 days). The females return to nest in cycles of 2 to 5 years (average 3.5 years) and the mean size of clutches is around 81 eggs, with a minimum of 56 and a maximum of 152 units per clutch.

In Mexico, the size of the eggs is sligthly correlated with age and size of the turtle, as is also the case with fecundity. Consequently, young and small turtles lay fewer and smaller eggs. The minimum and maximum diameters of 70 eggs measured were 36.9 and 48 mm, with an average of 41.6 mm; egg masses of 67 eggs weighed from 35 to 46 g, with a mean of 39.6 g. The average size and weight of 101 hatchlings were very similar to those of ***Ch. mydas***, 46.6 mm of carapace length ano 21.8 g of total weight.

The incubation period varies with latitude and time of the season, from a minimum of 46 to a maximum of 62 days, in warm and cool weather respectively, commonly it is 50 to 55 days. After pipping the egg shell, the hatchlings remain in the nest until the entire clutch is ready; during the night, suddenly all of them emerge to the surface. If the weather is cloudy or cool, emergence of the hatchlings may be prolonged into the morning. This behaviour is common to all sea turtles, as is also the hatchling's way of approaching the surf zone, as described for ***Chelonia mydas***.

The mean size at first maturity changes every season, within a limited range; generalized data put it at about 68 cm of straight line carapace length. The age at first maturity is uncertain; some authors assume it to be 8 to 9 years, but it is necessary to clarify this parameter on the basis of more reliable data.

Nest site fixity is strong, and studies carried out on the Galapagos Islands show that 88% of the turtles nesting at a particular beach had also nested at the same beach in the previous season. Of 12 turtles tagged at Michoacan (1985) 11 had nested at the same beach in the previous season, and the twelfth nested on another beach (7 km away). In this species, subsequent nesting in the same season also shows high site fidelity.

Courtship is more remarkable in this species than in other sea turtles; unpublished observations made by Cliffton, Villanueva and the present author in the years 1976-79, off Colola and Maruata nesting beaches, showed that mating pairs usually were escorted by up to a dozen additional male suitors, who sometimes nibbled the maiting pair. Mating pairs were more common in the neighbourhood of the nesting beaches, especially during the first hours of the day; and it was not uncommon that a mating pair came stranding just to the breakers. As a result of recent male-biassed commercial capture, the observation of male suitors is now rare. Aerial surveys by Cliffton (1983) observed an average of only 1.04 male suitors per mating pair. In Michoacan, the breeding season begins with the approach of the pairs to the nesting beaches, around July or August and mating is observed nearly throughout the season (August to December) with a peak at its beginning; the peak of the nesting activity is in September and October.

Predation is similar to that of ***Ch. mydas***. Eggs are eaten by skunks (in Michoacan) or boars (in Galapagos) or domestic and feral dogs, pigs, ghost crabs, ants, a kind of burrowing beetle, ***Trox suberosus*** (in Galapagos) and other predators. A scavenger fly (Sarcophagidae), that usually infests the entire clutch at any time of the incubation, causes a high mortality to the hatchlings in Michaocan, just before they leave the nest. A high predation rate occurs at the pipping time, when the nests release an odour easily detected by pigs and dogs, or any other predators. The crabs invade the nests through holes or capture the hatchlings when they cross over the beach to the water, a moment in which these are also predated upon by shore birds. In the Revillagigedo Islands (Mexico), a racer snake ***(Masticophis anthonyi)*** eats hatchlings of sea turtles. In the water, sea birds continue the predation, together with pelagic fishes of the families Carangidae and Scombridae, and a needlefish ***(Thylosurus)*** has been seen in the moment of capturing new hatchlings in front of the Michoacan's nesting beach; at this time, also sharks maraud the beaches. Predation continues all along the life-cycle, specially by carnivore bony fishes and sharks. In Michoacan it was common to observe, during the seventies, carcasses of females on the beaches that had been attacked by dogs while they were laying; the attack usually was performed at first by the bitch that was followed by a pack of hounds. This kind of predation is less common today because of protection measures implemented in turtle camps.

The food of adults of ***Chelonia agassizii*** includes a number of species of algae; the diet varies between the feeding grounds, for example: ***Macrocystis*** in Peru, ***Zostera*** and ***Gigartina*** in Chile, ***Caulerpa*** in Galapagos, ***Sargassum, Gracillaria, Rhodimenia*** and ***Gelidium*** in the Gulf of California. Besides these food items, other species are consumed in variable quantities and occasionally the stomach is full of only one of them, e.g.: ***Grateloupia, Laurentia, Griffitsia, Liagora, Ulva***, etc. In addition to mangrove shoots and algae, many species of animals, including molluscs (***Mytilus, Nassarius, Janthina***), sponges, jellyfishes, annelids, and several kinds of fishes and their eggs are eaten by the turtles, possibly during their travel to and between feeding and breeding grounds. In a sample of 19 turtles from Bahia de los Angeles, Gulf of California, an average of 1 230 cm^3 of food per individual was obtained, composed of 90% of algae, 1% of animal food, and 9% of unidentified material; some of the plant species found were: ***Graciiiaria*** (19.5%), ***Rhodimenia*** (13%), ***Gelidium*** (12.2%), ***Grateloupia*** (1.6%). ***Gigartina*** and ***Griffitsia*** (1.1%) (Rhodophyceae); ***Sargassum*** (21%) and ***Padina*** (I .3%) (Phaeophyceae); ***Ulva*** (3.4%) and ***Cladophora*** (1.3%) (Chlorophyceae); animal food included minor quantities of small molluscs, crustaceans, bryozoans, sponges, jellyfishes and echinoderms. Another study made with 9 adults on the central western coast of Mexico, showed similar results, but the most abundant alga was ***Ulva***, and there was also a larger variety of animal food. One turtle from that sample with a stomach content of 200 cm^3 had consumed exclusively the pelagic tunicate ***Pyrosoma*** (Urochordata). The feeding behaviour of hatchlings and juveniles is unknown.

Size : In the rookeries of Mexico, the adult mean size for nesting females is over 72 cm (CCL - over the carapace curve), while the minimum and maximum values are 65 and 117 cm (CCL) respectively. On the Galapagos Islands, the CCL is 74 to 100 cm, with a mean of 80 cm; the males are hence smaller than the females. On the feeding grounds, the individual size shows greater variations. In the Gulf of California, the CCL in females ranges from 59 to 107 cm, with a mean of 74.6 cm (n = 171) and in males, from 60 to 99 cm, with a mean of 80.9 cm (n = 49). Hence, unlike in the rookeries, the mean size of males on the feeding grounds appears to be greater than that of females. The body mass per individual (including juveniles, subadults and adults) in the Gulf of California ranges from 3.5 to 126 kg with a mean of 39 kg (n = 335). In general, males are lighter than females, but on the feeding grounds, the weight averages are inverted, so that, at the same size, males are heavier than females (55.8 and 41.6 kg respectively); possibly this is due to the fact that the females, while in the Gulf of California, never have ripe gonads; it may also be a result of a differential sex-related distribution.

Interest to Fisheries : This species is the object of important subsistence fisheries throughout its distribution, from Mexico to Peru. The eastern tropical Pacific Ocean corresponds to FAO Fishing Areas 77 and 87, for which only general statistics for marine turtles are reported, without a breakdown to species (total catch in 1987, 864 metric tons for Area 77, and 305 metric tons for Area 87). However, more than 90% of the total turtle catch in these areas corresponds to the olive ridley, ***Lepidochelys olivacea***. No official catch statistics for this species are available for any country of the area. International commerce is forbidden throughout its range of distribution by the signatory countries of the CITES regulations.

Together with its Atlantic congener ***Chelonia mydas***, the Eastern Pacific green turtle was the most valuable among marine reptiles. For a long time it provided an abundant and easily available source of food for the coastal inhabitants of Baja California. Historically, this species has supplied food for coastal Indian tribes, the Seris in the Gulf of California, the Pomaros in Michoacan and the Huaves in Oaxaca, Mexico. In Baja California, Sonora and Oaxaca, the turtles were captured for their meat, but in Michoacan only the eggs were harvested. In the 19th century, passing ships, particularly whalers, were supplied with fresh meat from this abundant resource. Early in this century, about 1 000 turtles per month were shipped from Baja California (Magdalena Bay, Scammon's Lagoon, Tortugas Bay, and Bahia de los Angeles) to San Diego and San Francisco, California, USA; turtle export declined during the 1940's and 1950's but continued up to the 1960's. In the middle of the seventies, a kind of "dormant or overwintering" green turtle was discovered resting over the seaweed meadows in shallow waters of the central part of the Gulf of California. Shorthly afterwards, this population was decimated by scuba divers. Another dwelling area for the species lies in the neighbourhood of the Tehuantepec Isthmus and in the coastal lagoons of this zone; here juveniles and subadults are commonly found in the turtle fishery practised by the Huave Indians.

In Michoacan, Mexico, poaching of eggs was very common up to the seventies. In the 1960's, hatchlings from the Revillagigedo Islands were sold to pet shops in California, USA. Hatchlings are often collected by people as souvenirs wherever they see them, and they are sold to tourists on several beaches of the Galapagos Islands and on the mainland in Mexico.

This species appears to be common but transient in Central America, and its capture usually is a bycatch of the olive ridley fishery as it also occurs on the feeding grounds off Colombia and southern Panama; but on the mainland of Ecuador and futher south it forms small fisheries, specially near the Paracas Peninsula, in Peru. Throughout its range of distribution, the Eastern Pacific green turtle is accidentally captured during shrimp trawling or entangled in shark nets. Nowadays, commercial exploitation is prohibited, but ten years ago the species was captured principally with harpoons, spears, entangling nets, by "jumping" and also when they came to nest (actually this is the more common practice of poaching adults). For the fishery, motorized boats, averaging 20 feet long, were used. In Mexico, ***Ch. agassizii*** was captured as a "bycatch" of the ***L. olivacea*** fishery. But in Michoacan, during several years in the seventies, quotas of up to 200 male turtles per month were allowed between October and May or June, and used exclusively for Indian communities. Today unregistered capture and poaching are the more common practices of exploitation throughout its geographical range. The fishing grounds correspond with the nesting and feeding grounds mentioned above. Fishing is practised throughout the year, with peaks during the breeding season, which extends from the end of summer to the end of autumn.

Local Names : COLOMBIA, CHILE, EL SALVADOR, PANAMA and PERU: Tortuga Verde; COSTA RICA: Tortuga negra; ECUADOR: Tortuga prieta; GUATEMALA: Parlama, Tortuga negra, Tortuga Verde; HONDURAS: Guiltora; MEXICO: Caguama prieta, Parlama, Sacacillo, Tortuga negra and Tortuga prieta; NICARAGUA: Torita; PERU: Tortuga blanca, Tortuga comestible; USA: Black turtle, East Pacific green turtle.

Literature : Garman (1880); van Denburg (1922); Stejneger (1943); Yanez (1951); Peters (1954); Battstrom (1955); Caldwell (1962, 1962a. 1963, 1969); Donoso-Barros (1966); Nelson (1966); Marquez (1970); Pritchard (1971, 1971a); Marquez & Doi (1973); Casas-Andreu & Gomez-Aguirre (1980); Nat. Fish. & Wildlife Lab. (1980); Fritts (1981); Green & Ortiz-Crespo (1981); Hays-Brown (1981); Hurtado, Corrales & Fuentes (1981); Marquez *et al.* (1981); Mortimer (1981); Groombridge (1982); Frazier & Salas (1982); Cliffton & Cornejo (1983); Hurtado (1984); Alvarado, Figueroa & Gallardo (1985); Alvarado & Figueroa (1986); Hendrickson (pers.corn.).

Chelonia mydas (Linnaeus, 1758) — **Figs 26, 27** — CHEL Chel 1

Testudo mydas Linnaeus, 1758, Systema Naturae, Ed. 10, T. 1: 197 (Ascension Island).

Synonyms : ***Testudo macropus*** Walbaum, 1782; ***Testudo viridis*** Schneider, 1783; ***Testudo japonica*** Thunberg, 1787; ***Testudo Marina Vulgaris*** Lacepède, 1788; ***Testudo viridi-squamosa*** Lacepède, 1788; ***Testudo chloronotus*** Bechstein, 1800; ***Chelonia mydas:*** Brongniart, 1800; ***Testudo cepediana*** Daudin, 1802; ***Testudo rugosa*** Daudin, 1802; ***Chelonia midas*** (sic): Shaw, 1802; ***Chelone mydas***: Brongniart, 1805; ***Chelonia mydas***: Schweigger, 1812; ***Chelonia virgata*** Schweigger, 1812; ***Caretta Cepedii*** Merrem, 1820; ***Caretta esculenta*** Merrem, 1820; ***Caretta nasicornis*** Merrem, 1820; ***Caretta Thunbergii*** Merrem, 1820; ***Caretta Mydas***: Fitzinger, 1826; ***Chelonia maculosa*** Cuvier, 1829; ***Chelonia lachrymata*** Cuvier, 1829; ***Chelonia Midas*** (sic): Wagler, 1830; ***Chelonia mydas*** (var.) ***japonica***: Gray, 1831; ***Chelonia esculenta*** Weigmann & Ruthe, 1832; ***Chelonia bicarinata*** Lesson, 1834: ***Chelonia viridis***: Temminck & Schlegel, 1834; ***Chelonia Marmorata*** Duméril & Bibron, 1835; ***Chelonia (Chelonia) Mydas***: Fitzinger, 1836; ***Chelonia (Mydas) viridis***: Cocteau, 1838; ***Chelonia (Mydas) virgata***: Cocteau, 1838; ***Chelonia (Mydasea) mydas***: Gervais, 1843; ***Chelonia viridis***: Gray, 1844; ***Megemys mydas***: Gistel, 1848; ***Chelonia mydas***: Agassiz, 1857; ***Chelonia formosa*** Girard, 1858; ***Euchelys macropus*** Girard, 1858; ***Chelonia tenuis*** Girard. 1858; ***Chelone macropus***: Strauch, 1862; ***Chelone virgata***: Strauch, 1862; ***Chelone maculosa*** Strauch, 1862; ***Chelone marmorata***: Strauch, 1862; ***Chelone albiventer*** Nardo, 1864; ***Chelone viridis***: Strauch, 1865; ***Thalassiochelys albiventer***: Günther, 1865; ***Mydas viridis***: Gray, 1870; ***Chelone midas*** (sic): Cope, 1871; ***Chelone mydas***: Boulenger, 1889; ***Chelonia mydas mydas***: Mertens & Müller, 1928; ***Chelonia mydas japonica***: Mertens & Müller, 1928.

Subspecies : These are not clearly defined. Apparently, ***Chelonia mydas*** has at least two subspecies, separated mainly by their geographical distribution ranges and by some morphological and behavioural features, that need to be further elucidated. The Pacific subspecies complex is more difficult to define in the overlapping distribution areas off South Africa and Oceania, and possibly there is intergradation between the Central Pacific population of ***Chelonia mydas*** and the Eastern Pacific species, ***Chelonia agassizii***. The position adopted by the author is that ***Chelonia mydas*** comprises two subspecies: ***Ch. m. mydas*** (Linnaeus, 1758) for the tropical and subtropical Atlantic Ocean and ***Ch. m. japonica*** (Thunberg, 1787) for the tropical and subtropical Indian and the Western and Central Pacific oceans. The eastern Pacific boundary of the subspecies ***japonica*** is uncertain.

FAO Names : **En** - Green sea turtle; **Fr** - Tortue verte; **Sp** - Tortuga blanca.

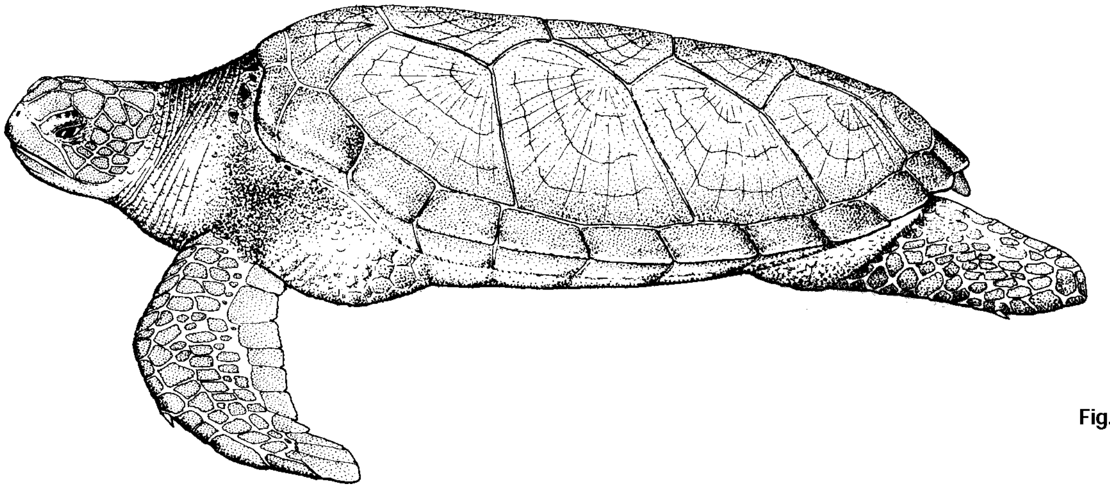


Fig. 26

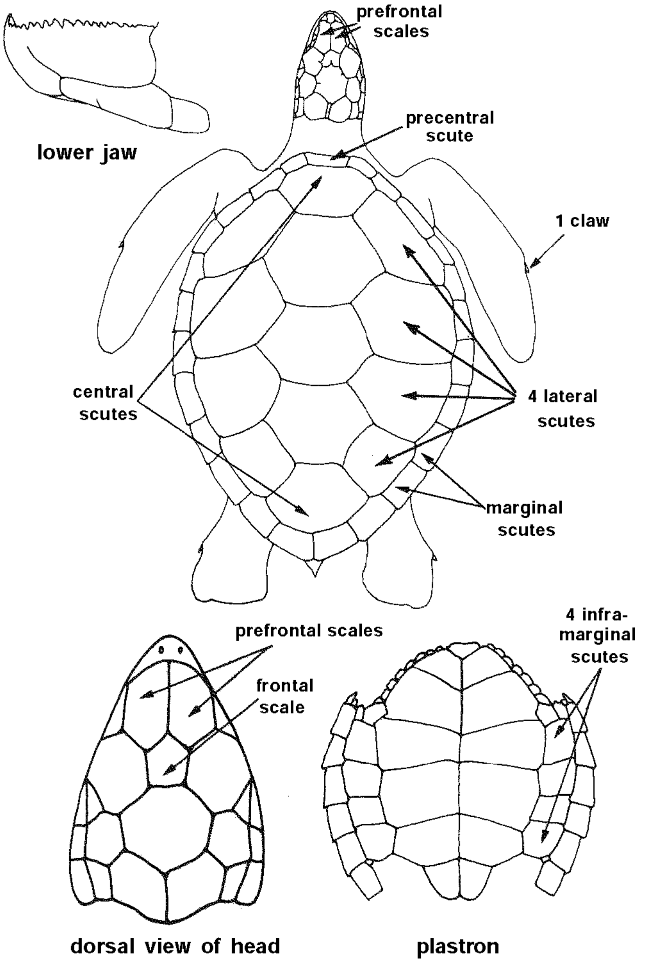


Fig. 27

Diagnostic Features : Body depressed in adults, carapace oval in dorsal view, its width about 88% of its length. Head relatively small and blunt, about 20% of the carapace length; one pair of elongated prefrontal scales between the orbits; tomium of lower jaw with a sharply serrated, cutting rim that corresponds with strong ridges on the inner surface of the upper tomium, which loses its tip cusp with age. The carapacial scutes are thin, smooth and flexible when removed. Those of the dorsal side include 4 pairs of lateral scutes, the foremost not touching the precentral scute; 5 central scutes, low-keeled in juveniles, but lacking a median keel in subadults and adults; and usually 12 pairs of marginal scutes. On the underside, the scutes are also smooth and rather thin and comprise 4 pairs of inframarginal, 12 pairs of central plastral, usually one intergular and sometimes one interanal scute. Each flipper has a single, visible claw. **Colour:** On the upper side, the general appearance varies from pale to very dark and from plain colour to brilliant combinations of yellow, brown and greenish tones, forming radiated stripes, or abundantly splattered with dark blotches. The Pacific populations are more melanistic than the Atlantic ones. In juveniles, the scales of the head and upper sides of the flippers are fringed by a narrow, clear, yellowish margin that is lost with age. Underneath, the Atlantic forms are plain white, dirty white or yellowish white; the Pacific forms are a dark grey-bluish-green, The newborn hatchlings are dark brown or nearly black on the upper side, the carapace and the rear edges of the flippers with a white margin. Underneath they are white.

Geographical Distribution : Widely distributed in tropical and subtropical waters, near continental coasts and around islands, rare in temperate waters (Fig. 28). Together with the hawksbill ***(Eretmochelys)***, the green turtle is the most tropical of the marine turtles. Its normal latitudinal range remains within the northern and southern limits of the 20°C isotherms, and follows the seasonal latitudinal changes of these limits. In summer, the limits are about 40°N and 35°S on the western sides of the oceans, and somewhat more contracted (to 30°N and 25°S) on the eastern sides. During winter, they descend to 30°N and 25°S or less in the western sides, and to 20°N and 15°S or less in the eastern sides. Occasionally, some turtles overwinter outside the above-mentioned latitudinal limits, as in Chesapeake Bay on the east coast of the USA. Also outside the normal range there are many records of solitary individuals, all of them in non-reproductive stages. These stragglers reach higher latitudes in the north than in the south.

Habitat and Biology : ***Ch. mydas*** is a typical solitary nektonic animal that occasionally forms feeding aggregations in shallow water areas with abundant seagrasses or algae. This species migrates from rookeries to feeding grounds, which are sometimes several thousand kilometers away. Nearly all migrations are performed along the coasts, but some populations, e.g. those at Ascension Island, carry out transoceanic migrations of more than 2 200 km from this island, where they nest, to the coast of Brazil where the feeding grounds are located (Carr, 1962, 1975). The major nesting grounds are always found in places with seawater temperatures mainly over 25°C. The most important nesting beaches for the Atlantic population are as follows: Tortuguero, Costa Rica and Aves Island, Venezuela; Bigisanti, Eilanti and Baboensanti, Suriname; several beaches from Para to Sergipe, in Brazil; Ascension Island and Cape Verde Islands. In the Mediterranean Sea, small colonies nest in several beaches off the southern coast of Turkey: Mersin, Side, Belek. and also on Cyprus Island, where single nestings occur on the eastern coast. In the Western Indian Ocean, nesting occurs at Europa Island, the Comoro Islands (Moheli), Seychelles, Tromelin and Mascarenes Islands; Democratic Republic of Yemen (Mukalla, Shihr); northeast of Oman and Masira Island. In the Western Pacific Ocean, nests have been recorded from the southeast coast of Malaysia and offshore islands; Sarawak, Satang and Talang Islands; Philippines ("Turtle Islands",the Sulu Sea, Pulau Boaan, Baguan, Taganak, Bakkungan, Palawan); Australia (Lacepéde Islands); Gulf of Carpentaria, Rayne Island, Pandora Cay, Capricorn Group, including Heron Islands and Bunker Group with Hoskyn Island. In the Central Pacific, nesting occurs on hundreds of islands, but there is no comprehensive study that could show their status and the specific boundaries of the populations.

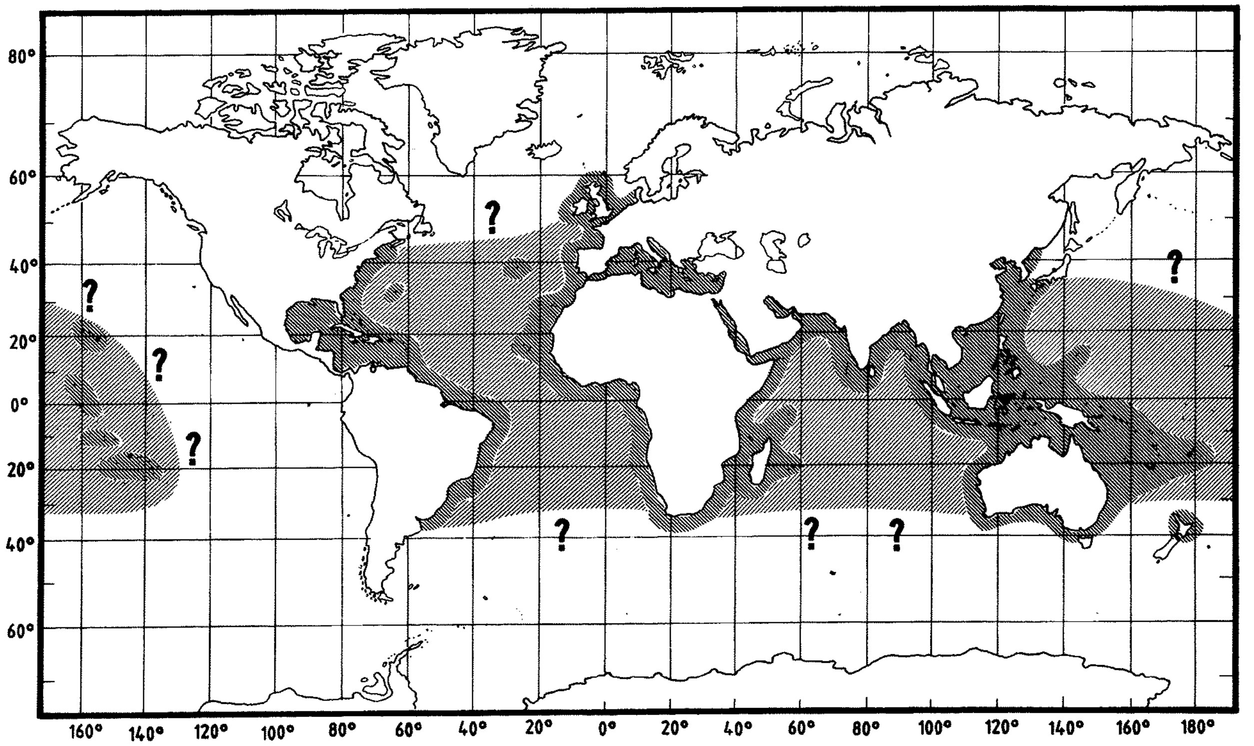


Fig. 28

Because of the wide distributional range of the species, the nesting season varies in time among distant and near localities. The available information on nesting seasons is very disperse, and two or more authors often quote different periods for the same localities. Such information makes it more difficult to prepare comprehensive nesting calendars by latitudes; hence, the available data are here compiled by geographical areas, e.g.: Caribbean Sea, from April to October, with the peak between June and September (Belize, Cayman Islands, Cuba, Tortuguero - Costa Rica). Northwestern Atlantic Ocean, from May to October, with the peak between June and August (eastern Florida). Gulf of Mexico, from May to September, with a peak between June and August (Tamaulipar, Campeche, Yucatan and

Quintana Roo). Southwestern Atlantic Ocean, throughout the year, with peaks from March to September (April - May in Surinam, July - August in French Guiana and September in Colombia). Southeastern Atlantic Ocean, from November to February (Gulf of Guinea) and February - April (Ascension Island). Western Indian Ocean, throughout the year, with peaks from February to April (Aldabra Islands), from May to August (Seychelles, Comoro Archipelago) and from November to February (Reunion and Eparses Islands). Northwestern Indian Ocean, from May to October beginning in Saudi Arabia, and onwards from August in Oman and Masira Island. Central Indian Ocean, from July to March, starting in southeast India and ending in the Maldive and Laccadive Islands. Eastern Indian Ocean, with a very long season, and several peaks, from May to August (Andaman - Nicobar Islands, Thailand and Western Malaysia), from June to November (Burma). Western Pacific Ocean, throughout the year, with peaks from November to April (Western Indonesia); from March to September (Southern Japan, in June to July; China, Philippines and Papua New Guinea, in July - August) and from September to April (Sabah, Palau, Bismark Archipelago, Turks Islands). Central Pacific Ocean, throughout the year, with peaks from September to February (New Caledonia, New Hebrides, Tonga, Samoa, Tokelau Islands), from June to August (Marshall Islands), from November to February (northern and northeastern Australia), from June to August (Hawaii - French Frigate Shoals) and from September to December (Society, Tuamotu and French Polynesia Islands).

Females usually show nesting site fixity, and they are able to return to lay eggs near the same spot where they left the last clutch or even on the same beach from which they emerged as hatchlings. The interval between successive seasonal nesting migrations depends on population, feeding ground quality and remoteness. Usually there is a two-year breeding interval, but the turtles may breed in cycles of one, 3 or 4 years, or switch from one to another cycle, as a result of ageing or external influences (food quality and quantity). The successive nestings within the same season are separated by intervals of about two weeks. The majority of green turtles lay between 2 and 5 clutches, others lay only once or more than 5 times, the average of the colony, during the season, being usually slightly over 2.5 times per female. The mean clutch size ranges from 84.6 eggs (in the Solomon Islands) to 144.4 eggs (in southeast Africa). This quantity also varies with age and size of the turtle, time of the season, distance of migration, etc.; the minimum and maximum records are 38 and 195 eggs per clutch, in South Yemen and Ascension Island respectively. Minimum and maximum egg sizes recorded are 38 and 58.7 mm, with averages of 42.3 and 54.6 mm (South Yemen and Ascension Island respectively); the minimum and maximum weight records for egg masses are 38.1 and 60.4 g (Southeast Africa and Australia respectively), with averages of 47.7 and 52.9 g (Southeast Africa and Comoro Island respectively). Hatchlings also show variations in size and weight among populations; the records for carapace length are between 44 and 59 mm, with mean lengths of 46.9 and 54 mm (South Yemen and Northeast Australia); the minimum and maximum body weight records are 18.4 and 35 g (Southeast Africa and Hawaii) and the averages are 21.6 to 31 g (Comoros, French Polynesia and Hawaii).

There are many speculations about the age at first maturity. It has been estimated as low as 6 years by some authors, and between 8 and 13 or more years, by others. New studies using the average instead of the smallest sizes of nesting turtles, have produced estimates ranging between 25 and 30 or more years (Florida, Hawaii and Australia). Of course, the size and age at which the sexual maturity is reached, show variations among individuals of the same population, and the differences are more remarkable when comparing isolated populations. In captivity, green turtles reach 35 kg in about 3 years (Cayman Turtle Farm, on Cayman Islands) and start to reproduce in less than 10 years.

Reproduction involves courtship, copulation and nesting. A single female, usually near shore, is courted by several males; copulation begins early in the breeding season and stops when nesting begins; usually the females avoid mating after they have laid the first clutch. It is hypothesized that fertilization of the eggs laid in any nesting season takes place several years before, and that the last "encounter" between males and females probably serves to fertilize eggs for the next season. New studies with turtles in captivity show that fertilization occurs early in the season and that excess sperm is probably stored and used in the fertilization of later clutches, and there may even be enough sperm for some clutches of the next season. Apparently there are no variations among hatch rates of successive clutches within a season, but certainly some females have higher or lower rates of fertility, and a few are infertile.

Egg incubation on the sand beach normally extends from 48 to 70 days; the duration of the incubation is related to temperature and humidity which change in the course of the season; hence it will be longer in cool weather conditions. Hatching and emergence occur mostly at night and stop when the sand becomes hot. The hatchlings emerge from the nest simultaneously, race quickly to the surf and swim frenziedly toward the open sea. The colour of the hatchlings, black above and white below, is probably an adaptation to nektonic life at the water surface and makes the turtle less conspicuous to fish and bird predators.

There is high predation throughout the life-cycle of green turtles, the eggs are consumed by mammals such as raccoons, skunks, opossums, mongooses, coatis, domestic pigs, dogs and also jaguars, and by other animals like the monitor lizards ***(Varanus)***, ghost crabs, ants, fly maggots, etc. Some hatchlings are invaded by ants, maggots and mites immediatly after. they pip the egg-shells, or by crabs, mammals and birds, when they reach the nest surface; in the water, the main predators are sea birds and carnivorous fishes,e.g., hatchlings were recovered from the stomachs of a dolphin fish ***(Coryphaena hippurus)***, and from groupers ***(Epinephelus (Promicrops) lanceolatus)*** which are capable of devouring entire juvenile green turtles in the South Pacific. This predation continues until the turtle reaches a size big enough to avoid being swallowed. Sharks are the most formidable enemy throughout the life-cycle of green turtles. In the sea, invertebrates such as leaches ***(Ozobranchius branchiatus*** and ***O. marggoi)***, invade the epithelial areas of the body, especially near to the cloacal opening, eyes, axils, etc. causing necrosis, and it is reported that heavy infestations can produce a kind of papillomatosis.

This species, and the black turtle (***Chelonia agassizii)***, in adulthood, are the only herbivorous sea turtles, but in captivity, both can be maintained on a carnivorous diet. Feeding behaviour in the young stages, from hatchlings until juvenile size, is nearly unknown, but it is assumed that they are carnivorous - which ensures them fast growth rates - and when they get enough weight and size to avoid most predators, they progressively shift to a herbivorous diet. The mechanisms and time required to become strictly herbivorous are unknown, but for example, in all of the 18 green turtles of 7.8 to 54.5 kg studied in Mosquito Lagoon, Florida, seagrasses ***(Syringodium, Diplantera*** and ***Halophila)*** made up 86.5% +/- 10.6 of the wet biomass of the stomach contents; also, the stomach contents of 94 green turtles between 31 and 120 cm of carapace length from the commercial catch off the coast of Ceara, Brazil (1965-67), included from 88.3% to 95.5% of bentic algae, and the remainder was made up of small quantities of phanerogams, sponges, bryozoans, crustaceans, sea urchins, molluscs and sea squirts.

Green turtles feed during day-time in the seagrass beds that grow in shallow waters. These feeding grounds are apparently not much used by other vertebrates, except for sirenians, but usually these mammals and the green turtles have minimal overlapping distribution. Some fishes, molluscs and other invertebrates also live on these seagrass beds, but their grazing is not significant compared to that of the green turtle. Among the major forage items of adult green turtles are the seagrasses ***Zoostera, Thallasia, Cymodocea, Syringodium, Diplantera, Halodule*** and ***Halophila,*** and the algae ***Gelidium, Gracillaria, Gracilliaropsis, Hypnea, Caulerpa, Vidalia, Bryothamnion, Cryptonemia, Agardiella,*** etc. Together with this vegetarian food, small quantities of animals living in these meadows are ingested indirectly but they usually represent less than 2% of the total dry weight of the stomach contents.

Size : The size of turtles is principally related to the carapace length, which is considered a reliable measure of overall size. Measurements over the carapace curve (CCL) in adults are 3 to 4 cm larger than straight carapace length (SCL). The available data sometimes do not indicate in which way the measurements were done, and in such cases the information must be used as a reference of relative value, bearing in mind that such records could be biassed by up to 4%. Because of their presence on the nesting beaches, size reports on females are more common than those on males.

The mean size of nesting females shows wide variations from place to place. The largest green turtles are those recorded from the Comoro Islands (111.6 cm CCL) and the smaller ones from Guyana (81.2 cm SCL); the heaviest turtles are those from Australia (186 kg) and the lightest ones from the Solomons (89.8 kg). The records of size and weight are respectively 139.5 cm (CCL), from Ascension Island, and 235 kg from Surinam. The minimum size and weight at maturity are 78 cm (SCL ?), from the Solomons and 68 kg, from Hawaii. Size data for males are very scarce; measurements at maturity size range from a minimum of 71 cm (CCL ?) to a maximum of 104 cm (CCL ?), both records from South Yemen, with a mean size of 90.4 cm Western Samoa males are a little bigger, 92.2 cm (SCL). Unconfirmed records of green turtles captured in the West Indies, probably during the early sixties, cite unsexed animals of 850 pounds (395 kg) with carapaces over 5 feet (150 cm) long. In recent times, the smaller adult males are those from Guyana, Solomons and Australia and the larger size records those from Comoros, Surinam, Ascension Island and Southeast Africa. In general, males are smaller than females.

Interest to Fisheries : The main commercial fishing gear used to catch green turtles are: entangling nets, drift-nets, harpoons, grapnels, hooks and also “turning nesting females onto their backs”. Green turtles are often taken as bycatch in shrimp trawls, set-nets, gill-nets and beach seines, and sometimes juveniles are captured with cast-nets. Other common methods are spear-gunning by scuba divers, and following turtles closely in shallow waters until they get tired and are hauled up to the boat. Finally, an interesting method of turtle hunting is the use of the “living fish hook”, the sucking fish or remora, that was common in the Caribbean Sea, in Chinese waters, Torres Straits and some other south Asian localities.

The major “Fishing Areas” for green turtles correspond to the sites of important rookeries and feeding grounds already mentioned in the former chapter, and capture may be increased during the breeding season. Meat is the principal product obtained from the green turtle, and the yield per animal ranges from 20 to 25% of its total live weight. Other products are calipee and calipash. Oil is obtained from the green or yellowish fat. Green turtle eggs are obtained either from the butchered turtle or directly from the nesting beaches.

The green turtle is considered the best species for commercial farming or ranching. International commerce of wild green sea turtles is forbidden, but capture for use as a food for local consumption persists in many central Pacific Islands, in Southeast Asia and Indonesia, Indian Ocean islands and mainland coasts, east coasts of Africa and Arabian

click for next page

click for previous page

peninsula, South America (northeastern countries, Caribbean islands), Mexico and Central America (Atlantic-side countries). All those places have had variable levels of green sea turtle exploitation and some of them were historically important fresh-meat exporters. The FAO Yearbook of Fishery Statistics reports only data for Fishing Area 31 (Western Central Atlantic, 359 metric tons in 1987 of which 291 correspond to Cuba), and Fishing Area 71 (Western Central Pacific, 46 metric tons, Fiji only). The total reported catch of ***Chelonia mydas*** in recent years was: in 1982: 411 metric tons, in 1983: 432 metric tons, in 1984: 282 metric tons, in 1985: 719 metric tons, and in 1986: 428 metric tons.

The United States imports of turtle meat and calipee were registered up to the 1970's. but since 1978-1979, they were mostly replaced by Cayman Turtle Farm products. European countries such as Switzerland, West Germany and the United Kingdom, also were importers up to the ban, proclaimed in the late 1970's. when they all signed the CITES resolutions prohibiting the commerce of wild sea turtle products. However, some of the countries that ratified the CITES, decided that trade with Cayman Turtle Farm products could continue (West Germany, United Kingdom, France, Italy, etc) but placed a reservation on green, ridley and hawksbill turtles. Finally, all these reservations became ineffective when the proposal to transfer sea turtles produced by farming or ranching from Appendix I to Appendix II was rejected at the last Conference of the Parties, held in Buenos Aires, Argentina on 3 May 1985.

Local Names : ANDAMAN - NICOBAR Islands: Duch-kacchua, Yadi-da; BELIZE: White turtle; BRAZIL: Arauana, Aruana, Suruana, Tartaruga, Uruana; CANADA: Green turtle; CARIBBEAN: Kadaloe; CAROLINE ISLANDS: (Palau) Melop, (Ponape) Calap, (Marshall) Won, (Truk) Winimon, (Yap) Wel mwon; COLOMBIA: Tortuga blanca or Verde; CUBA: Tortuga Verde; ETHIOPIA: (Eritrea) Nyamba; FIJI: Ika dame, Mako loa, Vonu damu, Vonu loa; FRANCE: Tortue franche, Tortue mangeable, Tortue verte; FRENCH GUIANA - Tortue verte; GERMANY: Suppenschildkröte; GHANA (Gold Coast): Apuhulu, Ga-hala, Nzima-anjua; HAWAII: Honu; GUATEMALA: Tortuga Verde; INDIA: T(amil) Peramai; INDOCHINA: Lemech, Vich; INDONESIA: Penyu daging, Penyu nijaul, Penyu sala; ITALY: Tartaruga franca or Verde; JAPAN: Ao umi-game; MALAYSIA: Penyu agar, Penyu pulau; MEXICO: Tortuga blanca, Jacona (juvenile); MOZAMBIQUE: Itaruca, Nrubi; (Swahili): Nyamba, Ewe-klo, Kassa; (Cabo Delgado) Assa; PHILIPPINES: Pawikan; PORTUGAL: Tartaruga; SABA: Penyu, Timbau; SENEGAL: Tortue verte or franche; SEYCHELLES: Torti; SOUTH AFRICA: Asa, Fano, Icaha, Ifudu; (Afrikaans) Groenseeskilpad ; SRI LANKA: Gal kasbava, Mali kasbava, Mas kasbava, Pal amai, Perr amai; SURINAM: Krap'e; THAILAND: Tao-ta-nu; TONGA (females): Tu'apolata, Tu'a'uli, Tongo tongo, Tufonu, (males): Ika-ta'one; UK: Green turtle; URUGUAY: Tortuga Verde; USA: Green turtle; VENEZUELA: Tortuga de sopa or Tortugas franca.

Literature : Boulenger (1889); Stejneger (1907); Babcock (1919); Bourret & lePolain (1941); Carr (1952, 1962, 1975); Carl (1955); Carranza (1956); Romer (1956); Loveridge & Williams (1957); Wemurth & Merterns (1961); Caldwell (1962, 1962a. 1963, 1969); Carr & Hirt (1962); Achaval (1965); Kauffman (1966); Ferreira (1968); Pritchard (1969, 1977, 1981); Hirt & Carr (1970); Marquez (1970, 1977); Hirt (1971); Moiseev (1971) Bustard (1972); Carr & Carr (1972); Menezes (1972); Hughes (1974); Schwartz (1974); Polunin (1975, 1981); Schultz (1975); Kowarski (1978); Kurata et al. (1978); Limpus (1978); Urlich & Parkes (1978); Smith & Smith (1979); Balazs (1980, 1981); Casas-Andreu & Gomez-Aguirre (1980); Rhodin, Spring & Pritchard (1980); de Silva (1969, 1981); Chu-Chien (1981); Frazier (1981, 1981a. 1985); Geliday, Koray & Balik (1981); Kar & Bhaskar (1981); Kuan-Tow & Moll (1981); Mendonca (1981, 1983); Spring (1981); Polunin & Sumertha (1981); Ross & Barwani (1981); Sella (1981); Sternberg (1981); Uchida & Nishiwaki (1981); Frazier & Salas (1984); Pritchard & Trebbau (1984); Bonnet, leGall & Lebrun (1985); Fletemeyer (1985); Frazer & Erhart (1985); Ross (1985); Depuy (1986); Lebeau (1986); Margaritoulis *et al*. (1986); Hendrickson (pers corn.).

Eretmochelys Fitzinger, 1843

CHEL Eret

Genus : ***Eretmochelys*** Fitzinger, 1843, Syst. Rep., (p.30), 106 p.

Type Species : ***Testudo imbricata*** Linnaeus, 1766, Syst. Nat., ed.12,Vol.I: 350 p,

Synonyms : ***Caretta*** Ritgen. 1828; ***Herpysmostes*** Girtel, 1868; ***Onychochelys*** Gray, 1873.

Remarks : The author considers this as a monotypic genus. Several authors have described two species, one for the Atlantic, ***E. imbricata***, and one for the Indo-Pacific region, ***E. squamata***, and a third species, ***E. bissa***, was described earlier for the Red Sea. All of these descriptions are based on highly variable morphological features as well as on geographical distribution. Other authors consider these taxa as having subspecific status. In fact, coloration and also, the shape of the carapace changes greatly with growth, from cardiform or oval in hatchlings and juveniles, to elliptic in adults. Hence, detailed statistical and genetic studies are required to ascertain the specific or subspecific validity of these morphological characters.

Eretmochelys imbricata (Linnaeus, 1766) **Figs 29, 30**

CHEL Eret 1

Testudo imbricata Linnaeus, 1766, Sys.Nat., Ed. 12, Vol.1:350 p. (Bermuda; restricted by Smith and Taylor, 1950).

Synonyms : ***Chelone imbricata:*** Brongniart 1805; Strauch, 1862; ***Chelonia imbricata:*** Schweiger, 1812; ***Caretta imbricata:*** Merrem, 1820; ***Chelonia pseudo-midas*** Lesson, 1834; ***Chelonia pseudo-caretta*** Lesson, 1834; ***Caretta bissa*** Rüppel, 1835; ***Eretmochelys imbricata:*** Fitzinger, 1843; ***Eretmochelys squamata*** Agassiz. 1857; ***Caretta squamosa*** Girard, 1858; ***Herpysmostes imbricata:*** Gistel, 1868; ***Onychochelys kraussi*** Gray, 1873.

Subspecies : See remarks under genus ***Eretmochelys***.

FAO Names : **En** - Hawksbill sea turtle; **Fr**- Tortue caret; **Sp** - Tortuga de Carey.

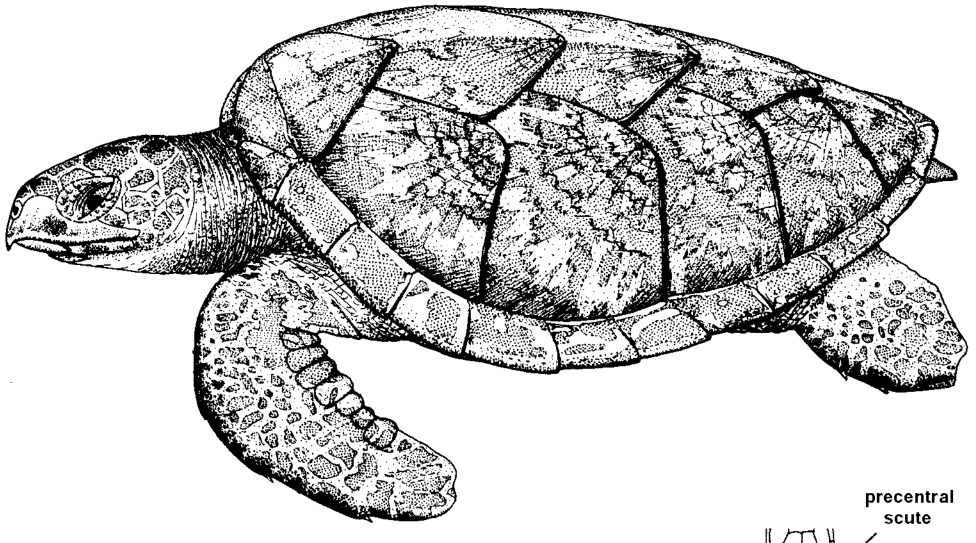
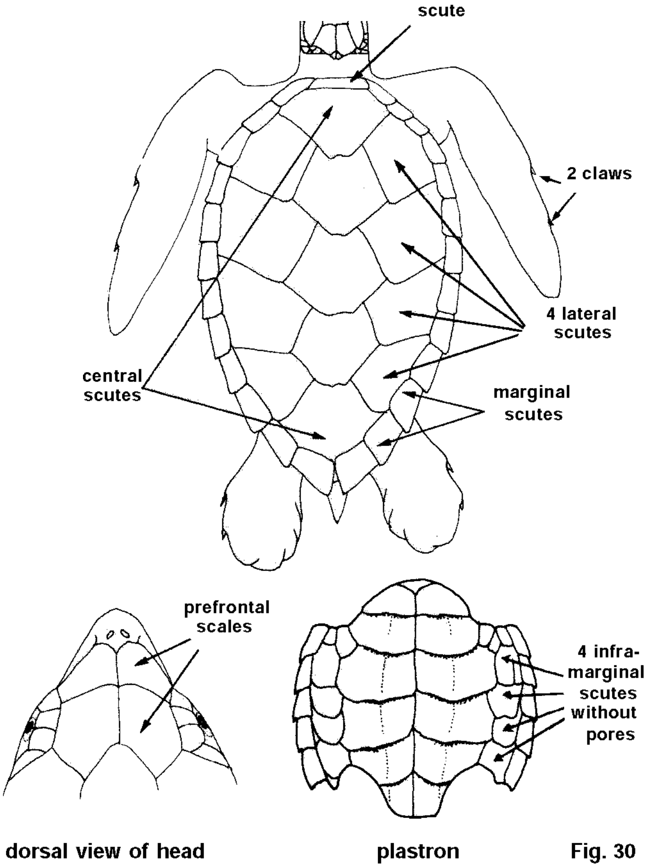


Fig. 29

Diagnostic Features : Carapace in adults cardiform or elliptical, with imbricated dorsal scutes, its width 70 to 79% of its total length (mean 74.1% SCL). Head medium-sized, narrow, with a pointed beak, its length 21 to 33% of the straight carapace length (mean 27.6% SCL); 2 pairs of prefrontal and 3 or 4 postorbital scales; tomium not serrated on the cutting edge, but hooked at the tip. The narrow and elongated snout and the thick scutes of the carapace are adaptations to cope with waves and to obtain food from between corals and rocky substrates.

The scutes are most strongly imbricated at maturity, but in older animals the overlapping character is frequently lost. The scutelation of the carapace is similar to that of ***Chelonia***, with 5 costal, 4 pairs of lateral (the first not touching the precentral scute), 11 pairs of marginal plus one pair of postcentral or pigal scutes. The plastron is covered by 5 pairs of scutes, plus one or two intergular and sometimes one small interanal. There are 4 poreless inframarginal scutes covering each bridge. Each rear and fore flipper bears 2 claws on its anterior border. As in other species of sea turtles, males have stronger and more curved claws and longer tails than females. Hatchlings and juveniles have a wider carapace than adults. the mean carapace width usually exceeding 76% of its length. They also have three keels of spines along the carapace which disappear with growth. Young adults sometimes have



dorsal view of head

plastron

Fig. 30

a remnant of the dorsal central keel, without spines. In juveniles and subadults, the scutes of the carapace are indented on the rear third of the carapace margin. **Colour:** this species is the most colourful among sea turtles. The pattern shows a large range of variation, from very bright colours to the heavy melanistic forms in the Eastern Pacific. The scales of the head have creamy or yellow margins, more apparent at the sides or cheeks than on the roof. The colour of the thick, horny scutes of the carapace is important in relation to the quality of the "carey" which is determined by its degree of transparency, the intensity of the amber ground colour and the quantity and arrangement, in spots or stripes, of the complementary colours: brown, red, black and yellow. The colour spots and stripes are usually arranged in a fan-like pattern. Underneath, the scutes are rather thin and amber-coloured, in juveniles there are brown spots in the rear part of each scute. The dorsal sides of head and flippers are darker and less variable; in the eastern Pacific population, the coloration is sometimes nearly black. Hatchlings are more homogeneous in colour, mostly brown, with paler blotches on the scutes of the rear part of the carapace, and also small pale spots on the "tip" of each scute along the 2 keels of the plastron

Geographical Distribution : ***Eretmochelys*** is the most tropical of all sea turtles. It is distributed throughout the central Atlantic and Indo-Pacific regions (Fig. 31). The population density is lower than that of ***Lepidochelys olivacea***; also nesting is performed in a more widespread pattern, with very few major nesting places. The hawksbill is more common where reef formations are present; it is also observed in shallow waters with seagrass or algal meadows, including coastal lagoons and bays. Nesting is confined between the 25ºN and 35ºS, mostly within the tropical region, with very few isolated records outside these latitudes. There are some records of non-nesting turtles outside the above-mentioned range, e.g. in the northern hemisphere: western Atlantic, up to Cape Cod, USA; eastern Atlantic, the English Channel; western Pacific, China, up to the Yellow Sea, Shangtung region, and southern Japan -Archipelago of Ryukyu; eastern Pacific to Cedros Island, Baja California, Mexico. In the southern hemisphere: western Atlantic, up to southern Brazil, but no data from Uruguay; eastern Atlantic, often observed in northern Namibia, but sporadically down to the west coast of South Africa; Western Indian Ocean, Red Sea as the northernmost record (nesting ground) and South Africa (Natal) as the southernmost record; south-central Pacific, up to New Zealand; eastern Pacific, up to southern Peru, no records available from Chile; islands of the Central Pacific, mainly reports of nesting grounds.

This is one of the sea turtles whose juvenile stages have most often been sighted, especially from intentional or incidental catches in commercial fishing gears used in coastal shallow waters, and from captures by scuba-divers. There are reports of multiple recapture of the same young individual at the same place. This would suggest that at least part of the population has residential or non-migratory behaviour.

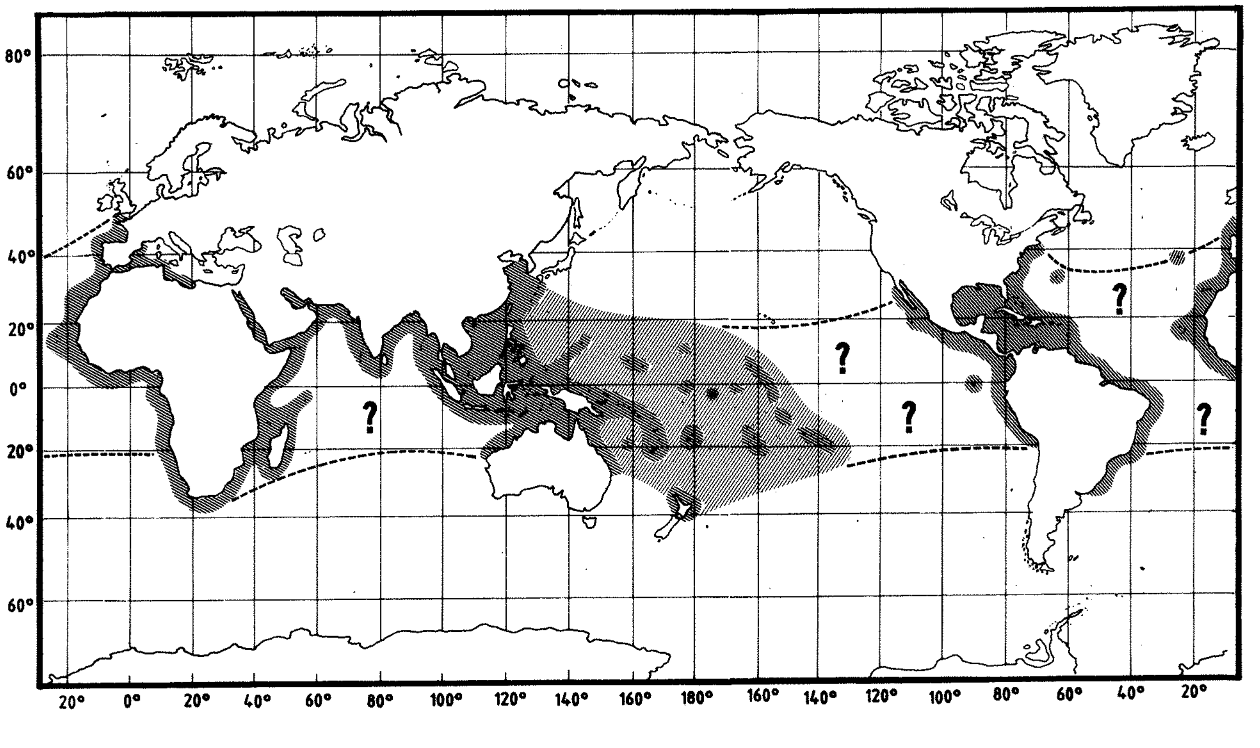


Fig. 31

Habitat and Biology : Hawksbill turtles live in clear, littoral waters of mainland and island shelves; they perform migratory movements that cause variations of population density in certain areas and seasons. Frequently, individuals of several year classes are found together on the same feeding grounds. Another feature of this species is that up to now, it has not been observed travelling in “flotillas”. Studies on migrations have revealed short as well as long-distance movements, at least for parts of the population; during the breeding period, the most common are short displacements between the nesting beach and the nearest offshore (feeding) bank, as in Tortuguero, Costa Rica, or slightly longer travels, i.e. from the same nesting beach to Miskito Cays in Nicaragua, from the nesting place on Isla Mujeres, Mexico, to Bani in the Dominican Republic (presumably the feeding ground), from Yucatan, Mexico to southern Cuba, from Nicaragua to Jamaica, and from northern Australia to Papua/New Guinea. Migrations among the islands in Philippines, Indonesia, Java, or along Malaysia and Sarawak are probably performed by solitary turtles or by small groups, but no data are available. It is suspected that migrations also occur among the groups of islands of Oceania.

The hawksbill turtle repeatedly has been considered a solitary nester; although it does not form real “arribazones”, there are few nesting beaches where females arrive in larger groups. As in other sea turtles, the hawksbill shows nesting site fixity, which is more frequently observed among older individuals. However, subsequent nesting on beaches other than the original one also seems to be possible. Nesting occurs during the warm and rainy season, principally in summer, but it generally starts at the end of spring. This turtle has a nesting cycle of 2 or 3 years, with a mean around 2.6 years.

Most hawksbills nest at night, but there are reports of day-time nesting, as well as basking behaviour, principally on uninhabited or low-inhabited beaches, such as those on Western Indian Ocean islands.

In the Atlantic, there are several major nesting grounds, often located in the proximity of coral reefs, e.g. on the Yucatan Peninsula: Isla Aguada and Rio Lagartos, with at least 500 nests per year in each site. Other nesting areas are in southern Cuba, with several hundred nests; some islands of the Caribbean, such as: Jamaica, Dominican Republic, Turks and Caicos, and Grenada, each one with about 100 females nesting per year. The nesting grounds in northeastern Brazil are visited by about the same number of females each year. Some islands of the Indian Ocean, e.g., Seychelles, with over 600 nests or 300 turtles each year, British Indian Ocean Territory, with over 200 turtles, Comoro islands, with less than 100 turtles; Aldabra, with about 25 turtles, Amirantes, with about 150 turtles, Providence, with about 40 turtles, La Reunion, with about 50 turtles, Sri Lanka, with a few dozen turtles, southeast India (Tamil Nadu) with a few dozen turtles, and also the Maldives/Laccadives. In certain places, the presence of hawksbills is reported as “common”,e.g., Iran, Somalia, Kenya, Tanzania, Madagascar and northern Mozambique. In the Eastern Indian Ocean, nesting occurs on the Andaman and Nicobar Islands and eastern Malaysia. Nesting apparently is more dispersed elsewhere, e.g. in the Indonesian Archipelago, with small concentrations quoted for southern Sumatra, Java,Bali, Sumbawa, and Celebes; in the Philippines (southern part of the Sulu Sea, on the “Philippine Turtle Islands”, etc.); along Irian Jaya, Papua New Guinea, Solomon islands, Fiji Islands, northern Australia and on the Leeward islands in the north of the Great Barrier Reef. Nesting has also been reported from the Pacific islands of Micronesia and Polynesia, but rarely from Hawaii. In the eastern Pacific, from Mexico to Panama, nesting is spread thinly, or rarely with small concentrations in the latter country and on the Mexican Pacific Islands.

The nesting season occurs mostly toward the end of spring and throughout summer, usually before the peak of the green turtle season, sometimes another peak for the hawksbill appears after that of green turtle, e.g. in Tortuguero, Costa Rica. Some examples of timing of the nesting season are the following: **Western Atlantic**: coast of Mexico, from April to August, with a peak in May-June; Belize and Cuba same season as in Mexico, with a peak in June-August; Puerto Rico, from March to November; Jamaica, from May to September; Guatemala, from May to November, with a peak in June-August; Honduras, from June to September; Nicaragua, from May to October; in Costa Rica, from May to November, with a peak in May-June; US Virgin Islands, from June to December, with a peak in August-September; Turks and Caicos from April to August; Dominica Islands, from April to October; Guyana, Surinam and French Guiana, from May to August, with a peak in June-July; Colombia, from April to August (very few turtles today); Brazil, from December to March. **Eastern Atlantic** - Cabo Verde, from May to August. **Western Indo-Pacific**: Oman, from February to April; South Africa, from April to July; Comoro Islands, from October to June, with a peak in January-March; Seychelles, from September to January; Laccadives Islands, in October; India (Tamil Nadu), from September to February; Andaman Islands, from October to December; Burma, from June to September; Philippines, from May to August; China, from March to April; Japan, from June to October; Palau, from July to August; New Hebrides, from September to January; New Caledonia, from November to March; Solomon Islands, from March to August; Irian Jaya, from May to September; Papua New Guinea, from March to September; Australia-Torres Strait, from December to February. **Central Pacific Islands**: Tokelau, from September-October; Micronesia, from May to September; Western Samoa, from September to February, with the peak in January to February; Fiji, from November to February. **Eastern Pacific**: Mexico, from May to October; El Salvador, from July to December; Honduras, from August to November; Panama, from May to December; Ecuador Mainland, from December to May.

Some reports quote renesting intervals of around two weeks, others of nearly three weeks. It is possible that both intervals are correct and that such periodicity depends of unknown internal and external factors. Also, in succeeding nesting periods, females may shift from one type of interval to another or show irregularities during the same nesting season. The interval most frequently quoted is the one extending for 2 weeks. For this species five or more subsequent nestings, with anaverage number of 2.3 clutches per season have been recorded.

Judging from the total number of eggs per clutch, the hawksbill has the highest mean individual fecundity among sea. turtles. When taking into account the number of times each female nests per season, together with the nesting cycle of 2-3 years, the fecundity of the hawksbill is comparable to that of the Kemp's ridley, which in average nests only 1.5 times per season but has a shorter nesting cycle of nearly every year. Pressure from predation probably has influenced the evolution of this feature; it is possible that mortality during incubation is higher in the hawksbill nests due to hazardous conditions of the nesting places, usually among bushes and farther from the surf zone, and hence, the increase in mortality must be compensated by higher fecundity. Also the leatherback lays fewer eggs, but the nesting place is very near to the surf zone. A comparative study is needed to clarify such parameters, but there is no doubt that higher fecundity is a biological compensation for high mortality. In hawksbills, the number of eggs per clutch is highly variable, and the data are also sometimes biassed by the presence of small and yolkless eggs, but never in substantial quantities as in the leatherback turtle.

Some examples of variation in clutch size are the following: **Mexico**, Isla Aguada, Campeche, from 71 to 202 eggs, with a mean of 135 (n = 163 clutches); in **Rio Lagartos,** Yucatan, from 93 to 223 eggs, with a mean of 150 (n = 114 clutches); **USA,** Virgin Islands, from 51 to 211 eggs, with a mean of 141 6 (n = 39 clutches); Puerto RICO, with a mean of 157 eggs; Costa Rica, Tortuguero, from 86 to 206 eggs, with a mean of 158 (n = no data); Guyana, from 139 to 176 eggs, with a mean of 157 (n = 7 clutches); **Surinam,** from 112 to 179 eggs, with a mean of 146 (n = 13 clutches); **Oman,** from 81 to 113 eggs, with a mean of 97 (n = 9 clutches), for the same area, also a mean of 108 is quoted; **South Yemen,** from 96 to 127 eggs, with a mean of 107.8 (n = 5 clutches); **Seychelles Islands,** from 125 to 197 eggs, with a mean of 161 (n = 64 clutches); **Andaman,** Nicobar Islands, with a mean of 130 eggs; **Australia**, Torres Strait, from 89 to 192 eggs, with a mean of 131.8 (n =47 clutches); **Fiji**, from 68-168 eggs a mean of 116.9 (n = 8 clutches); **Western Samoa,** from 59 to 213 eggs, with a mean of 145.7 (n = 23 clutches); **Truk Islands**, from 110 to 152 eggs (n = no data); **Solomon Islands**, from 75 to 250 eggs, with a mean of 137 5 (n = 164 clutches).

Egg diameters are often reported in the literature (range: 30 to 45 mm), but data on egg mass or weight of the clutch are relatively scarce (range: 20 to 31.6 g).

Some examples are the following: **Mexico**, Yucatan Peninsula: egg size from 34 to 42 mm, with a mean of 36.2 (n = 3 clutches, 216 eggs); egg mass from 28.6 to 32.5 g, with a mean of 30.8 (n = 122); **Costa Rica,** Tortuguero: egg diameter from 35.1 to 39.6 mm, with a mean of 37.7 (n = 13 clutches, 363 eggs); **USA,** Virgin islands: egg diameter from 39 to 40 mm (n = no data); **Guyana:** egg diameter from 36 to 40 mm (n = no data); **French Guiana:** egg diameter from 35 to 42 mm; egg mass from 20 to 30 g (n = no data); **Red Sea**, Sudan: egg diameter from 37 to 42 mm, with a mean of 40 (n = 2 clutches, 20 eggs); **South Yemen:** egg diameter from 38 to 45 mm, with a mean of 40 (n = 1 clutch); **Sri Lanka**: egg diameter from 35 to 38 mm, with a mean of 36 (n = 1 clutch, 19 eggs), egg mass from 26.2 to 27.6 g, with a mean of 26.7 (n = 1 clutch, 5 eggs); **India**, Tamil Nadu: egg diameter from 30 to 35 mm (n = 103 eggs); **Australia,** Campbell Islands: egg diameter from 32.3 to 40.7 mm, with a mean of 36.4 (n = 47 clutches,470 eggs), Great Barrier Reef. NW: egg diameter from 33 to 38.9 mm, with a mean of 36.4 (n = 7 clutches, 70 eggs), egg mass from 22.5 to 30.5 g, with a mean of 26.4 (n = 6, 60); **Philippines:** egg diameter from 31 to 35 mm (n = 1 clutch), egg mass from 20 to 22 g (n = 1); **Indonesia:** egg diameter from 33 to 39 mm, with a mean of 36, egg mass from 20 to 31.6 g. with a mean of 24.2 g (n = 20 eggs); **Western Samoa:** egg diameter from 34 to 36 mm, with a mean of 34.7 (n = 23 clutches, 194 eggs), egg mass from 23 to 25.9 g, with a mean of 24.4 (n = 3 clutches); **Micronesia:** egg diameter from 33 to 36 mm, mean egg mass 23 g (n = no data).

The duration of the incubation in days varies among separated nesting beaches and also along the season. It may last from 47 to 75 days, depending on the place and time.

In **Mexico** (Campeche), 1988, it extends from 44 to 54 days, with a mean of 49 days (n = 15) for undisturbed nests, and from 49 to 65 days, with a mean of 56.1 days (n = 145) for box-hatchmg; in Costa Rica, for transplanted nests, from 52 to 74 days, with a mean of 58 6 (n = 13); in **Barbados,** from 60 to 65 days (n = no data), in **Grenada**, for transplanted nests, from 65 to 82 days, with a mean of 75 (n = 34); in the **USA**, Virgin Islands, a mean of 62.4 days (n = 7) in 1980 and 66.5 days (n = 21) in 1981, in **Western Samoa**, for transplanted nests, from 59 to 70 days, with a mean of 62 days (n = 23); in **Fiji,** for transplanted nests. from 61 to 66 days, with a mean of 63 days (n = 4); in the **Solomon Islands**, for undisturbed nests, from 43 to 90 days, with a mean of 64.4 days (n = 174), in **Sri Lanka,** for transplanted nests, a mean of 62.5 days (n = 2); in **Seychelles** for undisturbed nests, from 56 to 79 days, with a mean of 62 days (n = 31); in north-eastern **Australia**, Campbell islands, for transplanted nests, from 52 to 57 days, with a mean of 55 days (n = 5).

Data on size and body mass of hatchlings range from 38 to 46 mm, and from 8 to 17.9 g; respectively.

Such data are available for the following places: **Mexico,** Yucatan Peninsula, carapace length from 38.1 to 43 mm, with a mean of 41 .1 (n = 36), body mass from 12.1 to 17.9 g, with a mean of 12.6 (n = 23); **Costa Rica,** La Uvita Islands, mean carapace length 40 mm, body mass 15.6 g (n = 137) and Tortuguero, carapace length from 39.1 to 45.9 mm, with a mean of 42.4 (n=41); **Colombia,** carapace length from 39.2 to 44.1 mm, with a mean of 42.3, body mass 17.1 to 19.2 g, with a mean of 18.1 (n = 25)**; Surinam,** carapace length 41.3 to 43.7 mm (n = 10); **French Guiana,** carapace length 38 to 46 mm, body mass, 15 g (n = no data); **Grenada,** carapace length from 42 to 45 mm, with a mean of 44, body mass from 16.3 to 18.5 g, with a mean of 17.5 (n = 319); **USA,** Virgin Islands, mean carapace length 43.7 mm (n = 47); **South Yemen,** carapace length 42 mm (n = 1); **Sri Lanka**, carapace length from 39 to 40 mm, body mass 14.6 g (n=3 and 2); **India,** Tamil Nadu, mean carapace length 35 mm, mean body mass 12 g (n=63); **Western Samoa,** carapace length from 38 to 41 mm, with a mean of 39.6 (n = 235). body mass 12.1 to 13.2 g (n = 3 clutches); **Australia,** Campbell Islands, carapace length from 38.2 to 43.8 mm. with a mean of 41.1 mm, body mass from 12.7 to 16.8 g, with a mean of 14.3 (n = 7 clutches, 70 hatchlings); **Philippines,** body mass from 8 to 11 g, with a mean of 9.4 (n = 14); Sabah, body mass from 10.7 to 12.4 g, with a mean of 11.4 ; **Fiji,** body mass from 12 g (n = 128); **Solomon Islands,** body mass 13.2 g (n = 120); **Micronesia,** body mass 13.0 g (n = no data).

Hatchlings emerge mainly during the first hours of the night, when sand temperature is below 28ºC, above this temperature their activity is inhibited. As in the other species, the small turtles run rapidly to the surf zone; after reaching the sea they disappear for an unknown period and are again observed when approaching coastal shallow waters at sizes usually over 20 cm of carapace length (SCL). Age at sexual maturity is uncertain; old reports quote ages from 3 to 4.5 years, but these figures were obtained from turtles reared in captivity, and it is assumed that for wild stocks they must be much higher. Furthermore, the figures for age at first maturity should be different if they are correlated to the mean carapace lengths observed on nesting beaches and if all size data are obtained from measurements of straight carapace lengths. Under such circumstances, the first maturity of females should be reached at sizes between 68 and 80 cm (SCL) and at body weights from 40 to 56 kg depending on the locality. It is suggested that males reach maturity at similar sizes but no data are available to confirm this assumption.

There are few reports on courtship and mating; both have been observed in shallow waters. During mating, the male holds the female by using its claws and tail, and this operation may last several hours. It has been observed that females are more receptive after nesting and that they commonly receive attention from several males without having preference for any special partner. Hence, polygamy is the normal pattern.

The optimal incubation temperatures recorded on Campbell Island, Australia range from 27.3º-31.8ºC (at 50 cm depth, at the bottom of the nest) and from 28.9º-32.4ºC (at 30 cm depth, at the side of the egg mass). Figures from Eastern Samoa showed an increase of 3.6° (range 2.7-5ºC) above the sand temperature at equal depth. On Isla Aguada, Mexico, ambient temperature and sand egg mass temperature were closely correlated, the changes in temperature of the egg mass normally dephasing by several hours; however, abrupt temperature decreases were observed during rainfall. The incubation temperature in translocated nests ranged from 27.2° to 33.5ºC (n = 54 clutches) throughout the 1985 season, and from 28.5° to 30.5ºC (n = 32 clutches) for the second third of the incubation period in 1986.

Studies on sex determination related to incubation temperature are currently in progress on the Isla Aguada nesting beach (Mexico); no data are available for other nesting beaches. The critical, pivotal or threshold temperature and time at which the sex of the hatchling is determined apparently is one or two degrees lower than for other sea turtles (29º or 30ºC), because the hawksbill is prone to nest in shadowy places; to balance the sex-ratio, mechanisms other than temperature must be brought into play.

As the other sea turtles, this species is subjected to predation throughout its life-cycle. The eggs and embryos are consumed by several species of ghost crabs (***Ocypode*** sp.), nearly throughout the nesting range, on the mainland as well as on insular beaches; predation also affects the hatchlings in and outside the nest. Mammals like genets and mongooses are reported as predators of eggs in the Indian Pacific Islands, South Africa and also in the US Virgin Islands, Barbados and Guadaloupe, where the introduced mongoose (***Herpestes*** sp.) is one of the main causes of predation; skunks and raccoons are common on beaches of Mexico and are quoted as predators of nests and hatchlings. Iguanas are reported on beaches of Cuba, and although direct predation has not been observed, it is possible that these reptiles eat the rest of the nest following the predation by other animals such as raccoons. In some areas, rats are reported as potential predators (the Polynesian rat - ***Rattus exulans***). Jackals, pigs and feral dogs also dig out nests, the latter two in connection with the presence of human dwellings in the neighbourhood of the nesting beaches. Monitor lizards (***Varanus*** sp.) are important nest predators on mainland Africa, India, Cambodia, northern Australia, the Philippines, and Andaman/Nicobar Islands. Birds such as frigates, herons, vultures, kites, crows, etc., eat hatchlings when they emerge in day-time. The barn owl (***Tyto alba***) is quoted as a crepuscular predator of hatchlings in the Comoro Archipelago. In the water, hatchlings are captured by sea birds (frigates, gulls, etc.), and carnivore fishes, e.g., tunas, dolphin-fish and jacks, or sharks as was documented for Sarawak and Samoa. Because of its occurrence around coral reefs, where big carnivore fishes remain in ambush, this turtle is continuously exposed to heavy predation, and not only hatchlings, but also juveniles and adults are attacked by those big carnivores, principally sharks (e.g. the tiger shark - ***Galeocerdo cuvier***). Apart from predation, no other kinds of natural mortality have been documented, and there are no reports on dermic papillomae. Commonly these turtles are covered by epibiotic organisms, e.g., green algae sometimes form a rug over the carapace in old individuals; also leeches, barnacles, small pelagic crabs, other crustacea and nudibranchs are often observed.

This is a carnivorous turtle, commonly poking in crevices between rocks and corals, so the diet often is highly variable. Up to around 10 cm of SCL the hawksbill apparently is a nectonic animal, and when it approaches coastal areas, it changes over to benthic feeding, and becomes a regular inhabitant of hard substrata where its diet consists principally of corals, tunicates, algae, and sponges. Some data on stomach contents from several studies are the following: a) Juveniles: for Salvage Island (Canary Archipelago), coelenterates (Anemonia, hydroids, siphonophora, especially ***Velella,*** hydromedusae), algae (***Stypodium, Sargassum, Dyctiota,*** cyanophytes), gastropods (***Littorina, Amyclina, Janthina***), cephalopods (***Taonius, Histioteuthis,*** Oegopsida), sponges (2 species), spider crabs (***Inachus***), sea urchins, stones, and plastic materials; for Taiwan Island, algae, shells, and bark. b) Subadults: for Magdalena Bay, Mexico, crustaceans and red lobsterets (***Pleuroncodes***); for Australia (subadults and adults), ascidians, encrusting animals and algae; for French Guiana, sponges, tunicates, coelenterates, molluscs, algae, and angiospermes; for Ascension Islands, Costa Rica (Tortuguero), Hawaii (3 samples), Seychelles, Aldabra, Oman, Cousin Islands, mainly sponges (***Demospongia***-group); for Honduras: mangrove leaves and fruits, bark and wood; for New Zealand, barnacles, cephalopods, siphonophores (***Velella***), and tunicates (***Salpa***); for the Philippines, seagrass and sponges, (***Echeuma, Codium***); for Sri Lanka, algae, corals, gastropods, and ascidians; for the Seychelles, sargassum weeds, sponges and algae; for South Yemen, green algae. Comprehensive studies of the diet were made by Carr and Stancyk (1975). and their conclusion for the Tortuguero hawksbill's population was that it consists mainly of sponges of the group ***Demospongia,*** and that competition with other species within this niche is rare; in fact, ***Eretmochelys*** is the only known spongivore marine reptile (Meylan, 1988); and strictly spongivore vertebrates include only a small number of teleostean fishes.

Size : The mean straight carapace length (SCL) in adult females of this species ranges from 53 to 114 cm, but has been reported to be highly variable.

The nesting population with the smallest carapace size is found in Sudan, with a range from 53.3 to 73.7 cm and a mean of 66.0 cm (n = 42); larger sizes have been reported for Yucatan, Mexico, with a range from 76 to 114 cm, and a mean of 94.4 cm (n = 57). Some other measurements of nesting females differing from those referred to above are quoted in the literature. It is assumed that there must be an ecologlcal explanation for the size differences at average maturity, and also, for age differences at first maturity, but more comprehensive studies are needed to clarify this varlability. Other size data on nesting females are reported for the following localities: **Mexico,** Campeche, from 86 to 99 cm (CCL), with a mean of 92.9 cm (n = 9), Yucatan, from 76 to 114 cm (CCL), with a mean of 94.4 cm (n = 57), Quintana Roo, from 74 to 101 cm (CCL), with a mean of 86.5 cm (n = 30); **Nicaragua,** from 62.5 to 87 cm, with a mean of 76.5 cm (n = 32); **Costa Rica,** Tortuguero, from 72.4 to 94.0 cm with a mean of 82.0 cm (n = 180); **Colombia**, from 80 to 95 cm (CCL), with mean of 90.7 cm (n =4); **Guyana**, from 80.0 to 88.9 cm, with a mean of 83.8 cm (n = 23); **Puerto Rico,** from 67.5 to 85.6 cm. with a mean of 77.6 cm (n = 4); **South Yemen**, from 63.5 to 72.4 cm, with a mean of 69.4 cm (n = 15); **Oman,** from 60 to 83 cm, with a mean of 73.3 cm (n = 48); **Sudan,** from 53.3 to 73.7 cm, with a mean of 66.0 cm (n = 42); **Western Samoa**, from 60 to 73.5 cm, with a mean of 68.6 cm (n = 7); **Solomon Islands,** from 68 to 93 cm, with a mean of 80.5 cm (n = 85); **Seychelles,** from 83 to 91.5 cm (CCL), with a mean of 89.5 cm (n = 9); **Australia,** Torres Strait, from 70.7 to 83.3 cm, with a mean of 76 3 cm (n = 22).

Data for carapace length of males, range from 16 to 85 cm (juveniles, adults).

Such data are available for the following localities: **Nicaragua**: from, 71.4 to 85.1 cm, with a mean of 77.8 cm (n = 17). Also the Information on size of juveniles and immatures is not very common: **Mexico**, Yucatan, from 16 to 62 cm (CCL),with a mean of 34.8 cm (n = 330); **Nicaragua,** from 21.5 to 49.5 cm, with a mean of 35.5 cm (n = 10); **Comoro Islands,** from 34 to 67 cm (SCL), with a mean of 44 cm (n = 13); **South Africa,** from 18.4 to 58.5 cm (CCL), with a mean of 38.3 cm (n = 11); **Japan,** Okinawa, from 36.7 to 42.3 cm (SCL), with a mean of 40.2 cm (n = 4); **New Zealand,** 39.7 cm and 6.5 kg (n = 1).

The body mass of turtles on nesting beaches, feeding grounds or in markets is difficult to obtain.

Some of the available figures are the followlng: **Mexico**, females, from 39 to 62 kg, with a mean of 54 kg (n= 5); **Nicaragua**, females from 27.2 to 86.2 kg, with a mean of 54.2 kg (n = 32), males from 50 to 65.7 kg, with a mean of 53.4 kg (n= 17), and immatures from 1.36 to 13.6 kg, with a mean of 6.25 kg (n = 10); **Costa Rica**, females from 46 to 69 kg, with a mean of 59 kg (n = 16); **Puerto Rico,** females, from 60.5 and 76.3 kg (n = 2); **Solomon Islands**, females from 36 to 77.3 kg, with a mean of 61.9 kg (n = 83); **Yemen**, females from 35.3 to 50.0, with a mean of 43.2 kg (n = 15); **Australia,** females from 38.5 to 68 kg, with a mean of 51.5 kg (n = 38)

Interest to Fisheries : The hawksbill is a unique species, because in addition to all the products commonly obtained from other sea turtles, it also yields the brightly-coloured, thick scutes covering the carapace, which are of high value in the international market. These flexible scutes, the so-called "Carey" or "tortoise-shell" are mainly used in jewellery. The term "tortoise-shell" applies to the raw material of scutes, while "Carey" refers to the worked tortoise-shell. In the old world, this species has been exploited since the pharaonic period, and in China its exploitation dates back to still more ancient times. From China it was introduced to Japan in the Nara Period (A.D. 745-784) in the form of ornamental articles reserved exclusively for the aristocracy to symbolize a high status of nobility. Handicrafts made of tortoise-shell appear to have florished in many ancient cultures, in places like Ceylon, India, Rome, Oceania, etc.

In many other cultures, the hawksbill and other sea turtles, were exploited only for their meat and eggs. Up to the sixties and seventies of this century, the commerce of the tortoise-shell, raw and worked, showed an extraordinary increase, and many countries were engaged in the export-market to Hong Kong, Japan, Singapore, China and Korea, in Asia, and to Italy, West Germany, France, the UK and Spain, in Europe. Also the market for stuffed turtles had increased to incredible numbers up to recent years. In the presence of such a global market it is actually surprising that there are still hawksbill turtles left in the tropical seas of the world. No precise figures are available for the huge quantities of raw and worked tortoise-shell and of stuffed hawksbill turtles commercialized in the past two decades (60's and 70's), but it is known that about 90% of the products were imported by Japan; part of this is documented by the Japanese Custom Statistics. The internal market in each country is difficult to evaluate because of the dispersed nature of the handicraft industry.

Tortoise-shell and Carey are processed in small-scale indigenous industries of Southeast Asia, the Caribbean, the Seychelles, Micronesia (Oceania), and elsewhere; they produce low-quality souvenir trinkets, carved directly on the backshell scutes. But the bekko Japanese craftsmen elaborately shape the scutes, hooves and plastron pieces and blend the natural colours, using a technique combining water, steam, heat and pressure. Only the French and Italian artisans are known to employ similar techniques to produce high-quality products. Historically, the bekko jewellery was dedicated to the hair ornament of Japanese brides. Today, a huge variety of designs of jewellery, eyeglass frames, inlay boxes, combs, pins, etc., are produced and used nearly exclusively for domestic consumption in Japan.

Because of the peculiarity of the hawksbill market, any size of turtles are captured, the smaller ones for stuffing and the big ones for the scutes, and in many places also for the meat and the eggs. Today, the commerce with eggs is prohibited in many of the countries. With the CITES restrictions, the exports of carey scutes, particularly since 1979, have decreased substantially, and only few countries retain a reservation effective for the hawksbill, and hence continue importing its products. In the majority of the former exporter countries, the commerce today is reduced to the internal demand mainly for meat and tortoise-shell. Complete and up-to-date statistics for each country are not available, but the importation of hawksbill scutes by Japan in 1987 and 1988 was published in the newsletter of Traffic (USA) in January 1989, and according to that the most important exporter was Cuba with 13 905 kg for both years, followed by Haiti, with 7 641 kg, the Maldives, with 7 436 kg, the Solomon Islands, with 7 369 kg, Jamaica, with 6 827 kg, the Comoro Islands, with 4 566 kg, Fiji, with 2 837 kg, Singapore, with 1 009 kg. All the other countries trading in hawksbill scutes were exporting less than one metric ton per year, e.g. St. Vincent, Ethiopia, Dominican Republic, Grenada, Antigua - Barbuda and Brunei. In 1987, other very important former exporters became parties of CITES: Indonesia, PhIlIppines, Singapore the Dominican Republic. The total imports by Japan, of Carey scutes, for these two years were: 29 808 kg in 1987 and 25 043 kg in 1988 (up to November only).

A very important market for stuffed hawksbills was developed during the seventies. The importation of stuffed turtles by Japan was increasing from 9 329 kg in 1970 to a maximum of 85 843 kg in 1983; after that year, the imports steadily decreased, down to 8 855 in 1986, and a total ban is expected during 1989. The principal exporters between 1970 and 1986 were: Indonesia, Singapore (until 1984). China (Taiwan island), Philippines (until 1980) and Hong Kong.

The size of stuffed turtles is highly variable, usually juveniles are used for this purpose, but often also big adults appear on the market. Since the ratio for converting dry weights (stuffed turtles) to live weights is not yet available, the total number of turtles used for this market is still unknown. For statistical purposes, the stuffed hawksbill is called in Japan "worked bekko" to distinguish it from the "worked tortoise-shell", which includes all the stuffed species except the hawksbill.

In the FAO Yearbook of Fishery Statistics, catches of ***Eretmochelys imbricata*** are reported only for the Western Central Atlantic (Fishing Area 31), totalling 318 metric tons in 1987 mostly by Cuba (277 metric tons) and the Dominican Republic, 41 metric tons. These data refer to entire animals. If we compare the statistics of hawksbill imports reported by Japan, with the data reported by FAO, the latter appear to be very incomplete. It is possible that hawksbill catches are included under the item "Marine turtles n.e.i." (unidentified species) but it is not possible, at present, to calculate the proportion of hawksbills in the catches.

As with other species of sea turtles, the hawksbill is usually captured by turning over the females when they crawl onto the beach to nest. This method is widely used by riparian people nearly everywhere the hawksblll nests. The harpoon is another common method to capture turtles, but nowadays, entangling nets of different mesh-sizes, made of natural fibres or monofilament-nylon, are becoming a more effective and less time-consuming fishing gear. Not withstanding their great diversity, these nets have some common features, especially the large mesh-size and the light bottom-lines that allow the captured turtles to reach the water surface and breathe. Length and depth are variable and usually several nets are joined to enlarge the area covered; also floating decoys are used in the head line to attract males. Seines with finer mesh are set to surround the turtles in forageing areas. Scuba-diving is of special importance in the capture of this species, but the use of spear-guns is more popular and productive around reefs; harpoons, hooks and ropes are used also by divers. Remoras were used by Caribbean people even before the discovery of America, and this fish, known as "pega-pega" on the Spanish-speaking islands of the Caribbean, was or still is, used in other places such as Sri Lanka, Kenya, Yemen, Somalia, Madagascar and northern Australia.

Eggs are collected directly on the nesting beaches, while the meat comes from overturned females or turtles captured at sea. The skin is of lower quality than that of the olive ridley.

Among coral-reef organisms consumed by man, a small number is considered to be toxic, and one of these is the hawksbill turtle. In some places, these turtles are avoided as food because of the high risk of intoxication. Apparently, a high percentage of fatalities resulting from the consumption of hawksbill meat has occurred in the Indo-Pacific region, Oceania; two fatal cases were quoted for the Caribbean in 1967, but the species of turtle that caused them was not identified. In some of the reported cases, the other species implicated is ***Chelonia mydas***.

Poisoning by hawksbills has been quoted by several authors and in some cases, a great number of deaths were reported, mainly in India, Sri Lanka, China (Taiwan Island), Philippines, Indonesia, Papua/New Guinea, northern Australia (Torres Strait), Central Pacific (Arorue, Gilbert Islands), and Caribbean (Windward Islands). Intoxications were also produced by the green turtle ***Chelonia mydas***, and some other cases were caused by unidentified species. In a short paper produced in Australia by Limpus (1987), general information is offered on the toxine, the medical aspects of the intoxication, treatment and prevention, and it is recommended not to eat hawksbill turtle meat in areas where toxicity has been reported.

Local names : ALDABRA ISLANDS: Caret; AUSTRALIA: (Queensland) Gounam, Unawa, (Torres Strait) Unuwa; BANGLADESH: Samudrik kasim; BRAZIL: Tartaruga de pente, Tartaruga imbricada, Tartaruga verdadeira; CARIBBEAN REGION: Krayoea. Kulalashli; CAYMAN ISLANDS: Hawksbill turtle, (Hybrids), McQuankie, McQueggie; COLOMBIA: Carey, Tortuga fina; COMORO ISLANDS: Nayamba (male), Nyamba; COSTA RICA, CUBA, ECUADOR (Peinilla), EL SALVADOR, ESPAÑA, GUATEMALA, MEXICO, PANAMA, PERU, PUERTO RICO, VENEZUELA: Carey; CHINA: Kou pi, Tai mei; EGYPT: Sagl, Sugr; ETIOPIA (Eritrea) Red Sea: Bissa (males), Baga (females); FRANCE: Caret, Tortue d'écaille, Tortue imbriquée; FIJI: Taku; FRENCH GUIANA: Kala-luwa; GOLD COAST: (Ga) Ayikploto, Halapatadzi, (Nzima) Apuhuru; GERMANY: Echte Karettschildkrote; HAWAII: Ea; INDIA (Tamil Nadu): Alungamai, (Andaman Islands)

Kangha kac-chua; Tau-da; INDOCHINA (BURMA, THAILAND, MALAYSIA, VIET NAM, etc): Doi-moi, Sat kras; INDONESIA: Penyu sisik, Sisila pagal; IRIAN-JAYA: Wau mis; ITALY: Tartaruga, Imbricata; JAPAN: Tai-mai; LEEWARD ISLAND: Caret; MALAYSIA: Penyu karah, Penyu sisek; MEXICO (hybrids): Morrocoy; MICRONESIA: Mu winichen, (Truk Dist.) Wounlele, (Palau) Ngasech, (Panape) Sapake, (Marshall Islands) Jebake, (Yap Dist.) Darau; MOZAMBIQUE: Ingappa; NAMIBIA: Fanohara, Inhama, Taha; PHILIPPINES: Pawikan, Sisikan; POLYNESIA, PAPUA NEW GUINEA: Era, Fung, Gela, Hara, Lappi, Mahana, Maia, Musana, Purai, Ololo, Opapei, Unawa, Veu, etc.; PORTUGAL: Tartaruga de pente; SABAH: Tottongan, Sisipangal; SENEGAL: Tortue a ecailles, Tortue tuille; SOUTH AFRICA: (Africaans) Valkbekseeskilpad; SRI LANKA: Potu kasvaba, Alunk amai; SUDAN: Abu gudr, Shukert; SURINAM: Kar'et; THAILAND: Tao-kra, (Siam Gulf) Con doi-moi; TONGA: Fonu koloa; UK, USA: Hawkbill, Hawksbill, Hawk's bill, Tortoise-shell; VENEZUELA: Parape; YEMEN: Sugr.

Literature : True (1893); Seale (1911); Lewis (1940); Kuriyan (1950); Smith & Taylor (1950); Yañes-A. (1951); Domantay (1952-3); Hendrickson (1958); Zweifel (1960); Schafer (1962); Donoso-Barros (1964); Carr, Hirt & Ogren (1966); McCann (1966); Flores (1969); Pritchard (1969, 1977, 1981); Frazier (1971, 1975, 1976, 1979, 1980, 1981, 1984); Bustard (1972); Ferreira de M. (1972); Kaufmann (1972); Hughes (1974); McCoy (1974, 1981); Rebel (1974); Carr & Stancyk (1975); Polunin (1975); Schulz (1975); McKeown (1977); Garnett & Frazier (1979); Smith & Smith (1980); Witzell (1980, 1983); Witzell & Banner (1980); Chu-Chien (1981); Hughes (1981); Mack, Duplaix & Wells (1981); Nietschmann (1981); Polunin & Sumertha-N. (1981); Ross & Barwani (1981); Sternberg (1981, 1982); Groombridge (1982); Khan (1982); Potter (1982); Vonnie (1982); Wood, Wood & Critchley (1982); Bastian-Fernando (1983); Brooke & Garnett (1983); Frazier & Salas (1983, 1984); Garduño (1983); Limpus *et al.* (1983); Meylan (1983, 1985, 1988, 1989, pers.com.); Mrosovski (1983); Parmenter (1983); Mot-timer (1984); Pritchard & Trebbau (1984); Bjorndall *et al.* (1985); Fretey (1986, 1987); Kamezaki & Yokuch (1986); Castañeda-A. (1987); Kamezaki (1986, 1987); Limpus (1987a,b); Milliken & Tokunaga (1987); Schroeder (1987); Schroeder & Warner (1988); Anonym (1989); Duran-N. (1989); Meza-Ch. (1989).

Lepidochelys Fitzinger, 1843 — **CHEL Lep**

Genus : ***Lepidochelys*** Fitzinger, 1843, Syst. Rept., Fast. 1, p. 30.

Type Species : ***Chelonia olivacea*** Eschscholtz, 1829, Zool. Atlas, 1: 3; by original designation

Synonyms : ***Caouana*** Gray, 1844; ***Colpochelys*** Garman, 1880.

Diagnostic Features : The ridleys are the smallest of the sea turtles. Adults usually have a body mass of 30 to 50 kg and measure between 55 and 75 cm in straight line carapace length (SCL). In dorsal view, the carapace has a nearly circular shape, with five or more pairs of lateral scutes, the first one in contact with the precentral scute. In the bridge of the plastron, each scute bears a pore that is the opening of the Rathke's gland; carapace usually clean and smooth. Head medium-sized and subtriangular; mandibles forming a parrot-like strong, horny beak. Front flippers medium-sized, usually with one or two (sometimes three) claws on the anterior border. In males, the claws are stronger and more curved, and the tail is longer; these features are used to grasp the female during mating. Hatchlings have a relatively longer carapace, and bigger head and flippers than adults. **Colour:** There is comparatively little variability of colour among adults of the same species. Dorsally, ***L. kempii*** is plain olive or yellowish-grey; ***L. olivacea*** is slightly darker. Underneath, both species are creamy-yellow with the flipper margins darker.

Remarks : Many authors accept that ***Lepidochelys*** comprises two species, well characterized by their geographical distribution, morphology and behaviour. ***L. olivacea*** lives in all tropical and subtropical waters of the Pacific and Central Atlantic Oceans, while ***L. kempii*** is indigenous to the Gulf of Mexico, with seasonally extended incursions to temperate waters of the northwestern Atlantic Ocean; occasionally expatriated individuals appear also in the northwestern European waters.

Morphological differences in the cranial skeleton of the two species are easily recognized; furthermore, the scutelation is more constant (5 lateral scutes in ***L. kempii*** and 5 to 9 - usually 6 to 8, in ***L. olivacea***) and the carapace is more flat and rounded in ***L. kempii*** than in ***L. olivacea***. There are also divergences in diet, and an obvious behavioural difference is that ***kempii*** nests during the day and olivacea mostly at night.

Lepidochelys kempii (Garman, 1880) — Figs 32, 33 — **CHEL Lep 1**

Thalassochelys kempii Garman, 1880, Bull. Mus. Comp. Zool., 6(6): 123-124 (Gulf of Mexico).

Synonyms : ***Colpochelys Kempii***: Garman, 1880; ***Thalassochelys (Colpochelys) kempii***: Garman, 1884; ***Thalassochelys kempii***: Boulenger, 1889; ***Lepidochelys kempii***: Baur, 1890; ***Lepidochelys kempi***: Hay, 1908a; ***Colpochelys kempi***: Hay, 1908b; ***Caretta kempi***: Siebenrock, 1909; ***Colpochelys kempi***: Deraniyagala, 1939; ***Lepidochelys* olivacea *kempii***: Deraniyagala, 1939; ***Lepidochelys kempii***: Carr, 1942

Subspecies : None.

FAO Names : **En** - Kemp's ridley turtle; **Fr** - Tortue de Kemp; **Sp** - Tortuga lora.

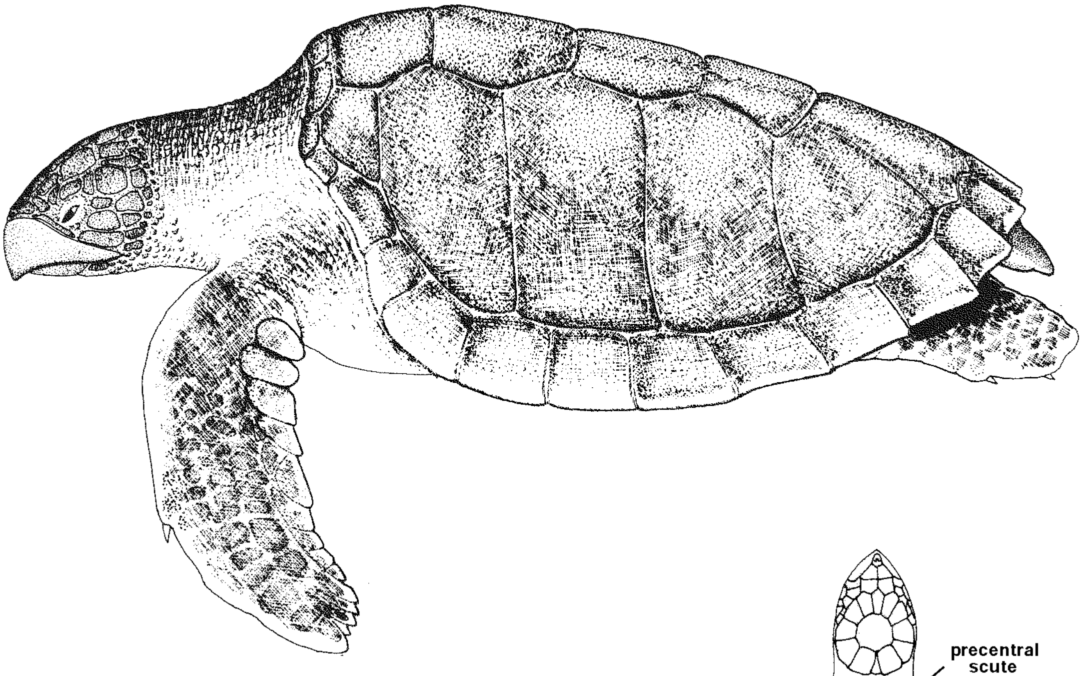


Fig. 32

Diagnostic Features : Together with its congener, ***L. olivacea***, Kemp's ridley is the smallest of all marine turtles, with a body mass lower than 50 kg. Viewed from above, the carapace of adults is nearly round (width of carapace about 95% of its length). The head is moderate-sized, sub-triangular (head length about 20% of total carapace length). Hatchlings have a longer carapace, width about 84% of total length (SCL), and a larger head, about 41% of carapace length (SCL). During growth, the proportions of the carapace change, and after one year it becomes a little wider, (87% SCL), and the head length diminishes to 37% of the SCL. Head with 2 pairs of prefrontal scales. Carapace with 5 central, 5 pairs of lateral and 12 pairs of marginal scutes; bridge areas with 4 scutes, each with a pore, which is the opening of the Rathke's gland. This gland releases an odoriferous substance which possibly plays a pheromonal role in maintaining the integrity of the massed nesting assemblage of females just off the beaches, before and during their arrival. Usually only one visible claw on foreflippers, hatchlings show two; in rear flippers 1 or 2 claws. **Colour**: body of adults plain olive-grey dorsally, white or yellowish underneath. Hatchlings are entirely jet black when wet, but this changes significantly with age, and after ten months the plastron is nearly white.

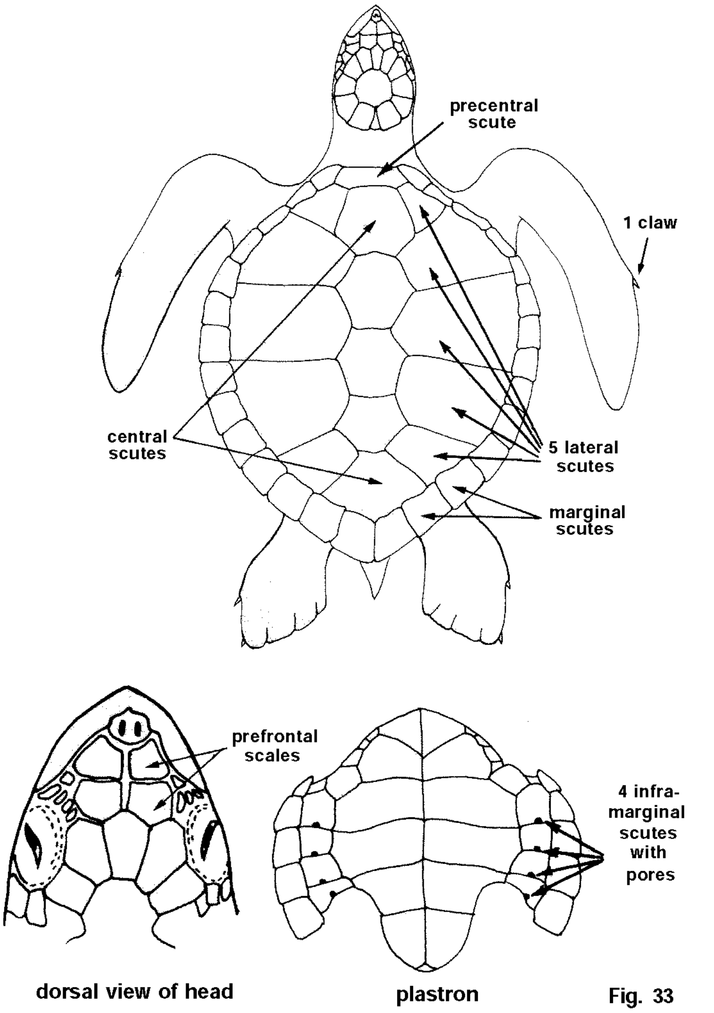


Fig. 33

Geographical Distribution : Kemp's ridley turtle is one of the two turtle species with a rather restricted geographical distribution. The other one is the flatback turtle ***(Natator depressus)***, confined to northern Australian waters. Both turtles are living in warm waters, within the limits of the northern and southern 20ºC isotherms.

The adults of Kemp's ridley turtle usually occur only in the Gulf of Mexico, but juveniles and immature individuals range between tropical and temperate coastal areas of the northwestern Atlantic ocean (Fig. 34). Occasionally, "waif" juvenile and immature turtles reach northern European waters; there are also several records from further south, i.e. one from Malta and a few from the Madeira Islands and the Moroccan coast Reports from outside of the normal geographical distribution area include an adult female tagged in Rancho Nuevo, Mexico, and encountered "nesting" at Santa Marta, Magdalena, Colombia; this seems to be the first record for nesting of the species out of its primary rookery, but there are some doubts about this record. A second record for nesting of this species out of its normal range refers to a turtle that laid 116 eggs the morning of 30 May 1989, on Madeira beach - St. Petersburg, Florida, as reported by biologists of the Florida Marine Research Institute. Nesting has also been observed on Aguada Island, Campeche, on the southwestern side of the Gulf of Mexico. All records reported for the Greater Antilles are probably misidentifications of the olive ridley turtle, ***Lepidochelys olivacea***.

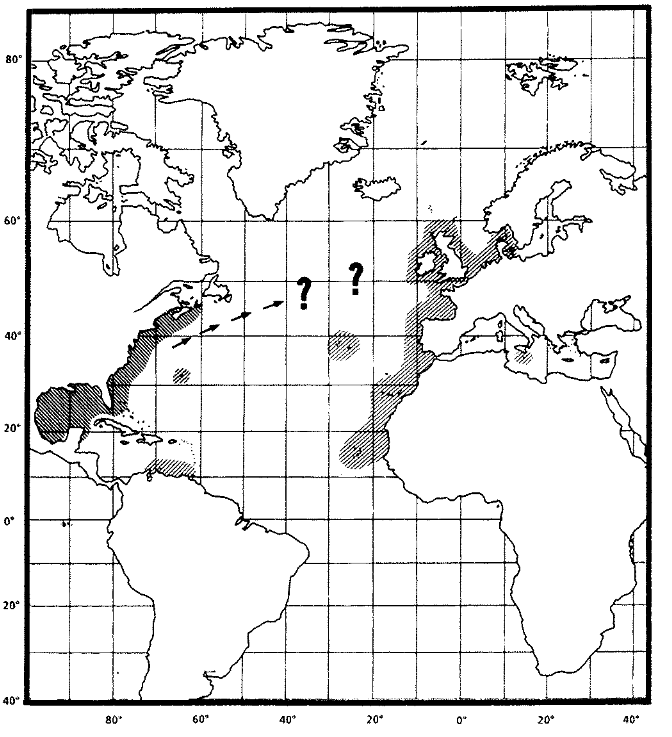


Fig. 34

As in other sea turtles, the hatchlings, after entering the ocean, are rarely seen until they reach juvenile size, i.e. over 20 cm of SCL. Juveniles usually are more common outside the Gulf of Mexico, along the east coasts of the USA, from Florida to New England, especially off Florida and Georgia; other spots of occurrence of juvenile and immature ridleys, quoted in stranding reports, are the west coast of Florida and the mouth of the Mississippi River. Kemp's ridleys found in New York and Massachusetts (Cape Cod) were carried northward by the Gulf Stream. Occasionally, some yearlings and immature turtles reach New Foundland waters; such individuals, and also those that have drifted into European seas may be considered expatriates with little probability of returning to the western Gulf of Mexico and joining the reproductive population.

Less than fifty years ago, ***L. kempii*** was the most abundant turtle in the Gulf of Mexico, with populations that were able to generate "arribazones" estimated at around 40 000 females on the single nesting beach of Rancho Nuevo, to the north of Tampico, Tamaulipas, in the western central Gulf of Mexico (Carr, 1963 and Hildebrand 1963). The majority of females still come to this beach to lay their eggs on fresh and windy days, mostly between April and June. That big historical aggregation could only have been maintained by a very large adult population, at least three times larger than the one shown in the film analysed by Carr and by Hildebrand op. cit. It is possible that similar large nesting aggregations existed in places where relevant nesting still occurs today, such as: Playa Washington and Tepehuaje in Tamaulipas, Playa Estero Grande and Cabo Rojo (Tamiahua Lagoon) and Tecolutla, in Veracruz; Isla Aguada, in Campeche; Padre Island, in Texas, but this is undocumented. The original range of the adult population of ***L. kempii*** included the entire Gulf of Mexico as a forageing area; nowadays it is still essentially the same, in spite of the species' great decline in abundance. Also, today juvenile and immature individuals are more commonly found along the southeastern coasts of the United States.

Habitat and Biology : In the Gulf of Mexico**,** ***L. kempii*** usually inhabits sandy and muddy bottoms, rich in crustaceans, which are the most common items in the stomach contents of subadults and adults. Juveniles frequently are observed in bays, coastal lagoons and river mouths; adults are present seasonally in places like the Louisiana coasts and Campeche Bank, and converge on the Rancho Nuevo nesting ground each spring. Partial migratory routes for adult females may be reconstructed from tag-recapture records, on the basis of the following facts: the turtles remain as a breeding group at least from April to the end of July; however, individuals may stay near the nesting beach no longer than a couple of months and are replaced by new individuals; after nesting one or more times per season, the females disappear from the area and do not come back before one or two years; males are not common around the nesting beach, but can occasionally be seen escorting females or mating with them near the surf area, from March to May, but not throughout the nesting period. It is assumed that the Kemp's ridleys follow two major routes: one northward to the Mississippi area, spread between Texas and Alabama; and the other southward to the Campeche Bank. Some individuals may migrate beyond these areas, up to west Florida or to the northeastern side of the Yucatan Peninsula around Holbox Islands, where they remain for the rest of the year, including winter. Winter dormancy (brumation) has been observed in parts of the range subjected seasonally to low temperatures, principally Chesapeake Bay, Cape Canaveral Channel and Florida Bay. The turtles travel near the coast.

At Rancho Nuevo, hatchlings swim directly to offshore currents, water fronts and eddies, searching for concealment, support and food. During this pelagic period, some of them may be trapped in currents that carry them out of the Gulf of Mexico. Juveniles and immature individuals are commonly encountered feeding in shallow water, bays and lagoons of the eastern coast of the USA. It is hypothesized that "when they reach around 30 cm of carapace length, they are strong enough to migrate back to the nesting beach". The place, time and size at which the turtles undertake the return travel to the Gulf of Mexico is uncertain. It has been stated that "individuals reaching the farthermost points, like European waters, will not be able to migrate back and consequently will be lost to the breeding population". It is also said that,"when some of these turtles attain juvenile sizes, they were reaching the northernmost point of their migration, and started to make their return southward to the rookery in the Gulf of Mexico". Hence, size, age and sex may be determinants of the geographical distribution of the population.

The minimum size at maturity in females of ***L. kempii*** could be 52.4 cm of straight carapace length (recorded on the nesting beach). The mean for this parameter undergoes annual variations, which have been quoted to lie between 61.4 and 65.7 cm (1966-1987). At these sizes, and after nesting, the body weight averages from 32 to 48 kg; for 1988 the mean body weight was 36.7 kg, for a range between 30 and 47 kg (n = 45); the egg clutch usually weighs around 3.2 kg. Because of the Kemp's ridley's small size and carnivorous behaviour, the age at first maturity in the wild may be reached earlier than in other sea turtle species, around 10 to 12 years, but in captivity such age could be reduced to nearly five years, as was shown in the Cayman Turtle Farm, Ltd., when in April of 1984 two individuals of the 1979 year class laid eggs, while in 1989 there were eight mature females laying viable eggs. As a result of stock ageing, every year the fertility of these individuals was improved and the survival rate of the eggs during incubation increased, e.g., by 4.8% in 1984, 14.2% in 1986,30 3% in 1987 (Wood, pers. corn.).

Among marine turtles, ***L. kempii*** is the most conspicuous day-time nester, and usually mass-nesting takes place on windy days. As nearly the entire adult population nests on a single beach (about 40 km in length, on the west coast of the Gulf of Mexico), the reproductive population could be evaluated very accurately by using tag-recapture data on the beach, counting all buried nests and number of ovipositions per female and season (1.4 - 1.55 times) and the frequency of individual interseasonal returns. By using the annual average number of nests laid in Rancho Nuevo during the last eleven years (1978 to 1988), i.e. 862 nests, together with the above-mentioned parameters, it is possible to calculate the annual female nesting population at between 556 and 615 individuals. The trend of the total number of nests, calculated with a linear regression corresponds to an annual average declination of 1.95% (in 1989). Considering that about 58% of the turtles nest every year, the total annual female population could comprise between 790 and 875 individuals, and if the female-male ratio is 1: 1, the total adult population in 1988 should have amounted to between 1 580 and 1 750 individuals. This figure excludes immature turtles and small breeding groups dispersed between Padre Island. Texas and Isla Aguada, Campeche, e.g., the turtles that every year lay around 50 nests in the area between Cabo Rojo and Tecolutla, in Veracruz State. The data on these groups need to be evaluated quantitatively in order to obtain a more accurate assessment of the total adult population in the Gulf of Mexico.

Kemp's ridley turtle is a carnivore throughout its life cycle. In the wild, the feeding behaviour of hatchlings is poorly known, and very little is known for juveniles. For adults, several reports are available and the principal items in the diet are crabs (***Callinectes, Ovalipes, Hepatus, Areneus, Portunus, Panopeus, Mennipe,*** and ***Calappa***); shrimps (***Sicyonia*** and ***Penaeus***), gastropods, clams, sea urchins, jellyfishes, squid eggs, fishes, vegetable fragments, etc. In captivity, these turtles readily accept chopped fish, squid, and vegetables or pelletized food. They eat mainly in day time.

Predation occurs throughout the ridley's life-cycle; eggs are predated principally by coyotes, skunks and coaties, ghost crabs and ants, but when the nest has been opened and abandoned, the remaining eggs are eaten by vultures and boat-tailed grackles. On land, the hatchlings are attacked by the same predators and sea birds; in shallow waters, by sea birds and bottom fishes such as red snappers, groupers, etc; and in open waters, by birds and carnivore pelagic fishes like tunas, mackerels, jacks, yellow tail, wahoo, barracudas, dolphin fish, sharks, etc. Adult turtles are not eaten by birds and small fishes, but are attacked by large sharks, throughout their lives. Hence, it is common to see on the beaches mutilated turtles, usually without one rear flipper or with big wounds on the rear margins of the carapace.

Parasitic problems and other diseases have not yet been studied in the wild, but it is common to observe different kinds of flat worms in the anterior part of the intestine. Fibropapillomae have been detected only once or twice a year in the course of the last 23 years of work on the nesting beaches, and only one time this year (1989). Epibionts are not so common; small quantities of barnacles are observed from time to time, but never a massive invasion, as in loggerheads or leatherback turtles. In fact, the scutes and scales of the carapace and head of Kemp's ridleys are usually clean of epibionts of any kind.

Size : All available data for adults were obtained from the nesting beach of Rancho Nuevo and its neighbourhood. Minimum and maximum carapace lengths (SCL) are 52.4 and 74.8 cm respectively (between 1966 and 1987, n = 4 924). The annual average length (SCL) of the carapace between 1972 and 1987 showed a decrease from 67.4 to 65.7 cm; this may indicate that the mean age in this breeding population has been diminishing, probably as a result of the enhancement work done for the last 23 years in the nesting beach and of a higher mortality of adults on the feeding grounds. Very few data are available for adult males; up to now only 9 have been measured in the above-mentioned period, and the minimum and maximum SCL values were 58.5 and 72 cm respectively, with a mean of 65.6 cm, hence, very similar to the data for females. There are also only a few measurements of total body mass for both sexes, covering the period from 1966 to 1978: females after oviposition weighed between 32 and 48 kg, with a mean of 38.9 kg (n = 281); the mean weight for 1988 was 36.7 kg (n = 45), and the weight of the egg clutch around 2.45 to 4.08 kg. The mean weight of males (n = 8) was 34.6 kg. In 1966, the body mass in 17 females ranged from 39 to 49.3 kg, also after having laid the clutch.

The eggs have the appearance of ping-pong balls, between 34 and 45 mm in diameter and from 24 to 40 g in weight. The female lays about 102 eggs per clutch, 1.4 to 1.55 times each season. The Kemp's ridley hatchlings emerge from the nests after 45 to 58 days, depending on the weather (temperature and humidity). The body mass in neonates is around 17.2 g, corresponding to an average of 43.9 mm of total carapace length.

Interest to Fisheries : Commercial exploitation of the Kemp's ridley sea turtle, is nowadays not officially allowed at any place of its geographical distribution range, and consequently no catch is reported in the FAO Yearbook of Fisheries Statistics. The Kemp's ridley is restricted to the coastal waters of FAO Fishing Areas 31 (west), 21 (southwest), 27 (southeast) and 34 (east), and there is a single record from Area 37 (Malta Island). In the northern and the northeastern Gulf of Mexico, this turtle was commercially captured jointly with green and loggerhead turtles up to nearly 15 years ago. The Kemp's ridley was the least desirable, because of its "poor" flavour. The eggs on the nesting beach were massively exploited up to 1965. From 1966 onwards, a total ban was laid on egg exploitation and in 1977, a decree declared the Rancho Nuevo nesting beach as a natural reserve. Nowadays, this turtle is fully protected all along its range, and it is also included in the Red Databook and considered as an endangered species in Appendix I of the CITES.

In the Natural Reserve of Rancho Nuevo, full protection was started in 1966. From this time up to 1977, an average of 23 000 hatchlings were released each year. From 1978 up to now, as a result of joint efforts of the US Fish & Wildlife Service, the US National Marine Fisheries Service and the Fisheries Secretariat of Mexico, the number of annually released hatchlings has been increased to an average of 53 000 individuals. In spite of the tremendous effort made to achieve total protection of the nesting females and their eggs and hatchlings, and to release increased numbers of hatchlings every year, a negative trend of the population density continues to be observed. Nevertheless, and possibly as a result of the above-mentioned programme, the decreasing annual trend for the number of nests (mortality) showed an upturn from 4.5% (in 1986) to 3.2% (in 1988) and 1.95 % (in 1989).

The fluctuation in the total number of populations and the steady decline of the adult population may be caused by the cumulative effect of several factors; some of them may be natural physical phenomena like hurricanes, storms, floods or dry weather on the nesting beaches, cold stunning in northern grounds and perhaps strong currents that carry small turtles out of their normal range of dispersion; and biological factors such as natural predation, food scarcity, competition, disease, etc., all of them known to be the causes of natural mortality. In a natural (undisturbed) population, such mortality is compensated through the natural survival mechanisms of the species. But if it is not possible to stop the additional, wide-spread man-induced mortality, due to incidental catch by commercial and recreational fishing vessels, blasting of obsolete oil platforms, ingestion of debris (plastics), oil pollution, impacts by speed boats, deliberate mutilation, entanglement by gill-nets, drift-nets and abandoned fishing gears, disturbance of nests and nesting activities, construction of barriers, etc., it will never be possible to achieve any significant enhancement of the Kemp's ridley population.

With regard to incidental captures - one of the important negative man-induced factors - Marquez *et al*., (1987) and Manzella *et al*., (1988 ms) have estimated the relative impact of various types of fishing activities upon both adult and juvenile Kemp's ridleys. They concluded that of the juveniles, 28% are caught in shrimp trawls, 4% in gill-nets, 6% on hook-and-line, 1% by dip-nets, 0.8% by swimmers, 0.2% by beach seines, 0.4% by cast-nets, 0.4% by butterfly nets, and 0.2% by crab pots; another 34% appear as beach strandings, dead or alive, presumably as a result of unidentified fishing activities, and 26% died of unknown causes. For adults, the figures were 75% in shrimp trawls, 7% in gill-nets, 4% in fish trawls, 1% on hook-and-line, 0.7% in purse seines, 0.7% in beach seines, and 0.7% died of unknown causes. However, the data for adults are based exclusively upon tag returns and there is probably additional man-induced mortality of which we are unaware.

Local Names : CANADA: Kemp's ridley turtle; FRANCE: Tortue bâtarde, Tortue de Kemp, Tortue de Ridley; ITALY: Tartaruga bastarda; MEXICO: Tortuga cotorra, Tortuga lora; SPAIN: Tortuga bastarda; UK: Bastard turtle, Kemp's ridley turtle; USA: Atlantic ridley turtle, Bastard turtle, Kemp's ridley turtle.

Literature : Deraniyagala (1938a.b); Carr (1952, 1957, 1963a); Aguayo (1953); Squires (1954); Bleakney (1955); Carr & Caldwell (1958); Mowbray & Caldwell (1958); Wermuth & Mertens (1961); Hildebrand (1963, 1980, 1981, 1983, pers.com.); Donoso-Barros (1964a); Chavez, Contreras & Hernandez (1967, 1968 a,b); Caldwell & Erdman (1969); Pritchard (1969a,b); Brongersma (1972, 1981); IUCN (1973, 1976); Pritchard & Marquez (1973); Revel (1974); Marquez (1976a,b, 1977, 1978, 1981, 1983a, 1984b,c, 1989); Hillestad *et al.* (1978); Smith & Smith (1979); Carr, Ogren & McVea (1980); Hendrickson (1980); Lazell (1980); Rabalais & Rabalais (1980); Klima & McVey (1981); Marquez *et al.* (1981, 1985a,b, 1987); Seidel & McVea (1981); Groombridge (1982); Brongersma & Carr (1983); Mrosovsky (1983); Wibbels (1983); Bacon *et al.* (1984); Caillouet (1984); McVey & Wibbels (1984); Pritchard & Trebbau (1984); Amos (1985); Berry (1985); Byles (1985); Fontaine *et a/.* (1985 b); Ogren (1985); Oravetz (1985); Seidel & Oravetz (1985); Marquez & Bauchot (1987); Schroeder (1987); Manzella *et al.* (1988); Schroeder & Warner (1988); Wood & Wood (in press).

Lepidochelys olivacea (Eschscholtz,1829)

Fig. 35, 36

CHEL Lep 2

Chelonia olivacea Eschscholtz, 1829, Zool. Atlas, 1:3. Type localities: China Sea, Manila Bay and Sumatra.

Synonyms : ***Testudo mydas minor*** Suchow, 1798; ***Chelonia multicustata*** Kuhl, 1820; ***Chelonia Caretta*** var. ***Olivacea***: Gray, 1831; ***Caretta olivacea***: Rüppell, 1835; ***Chelonia (Thalassochelys) olivacea***: Fitzinger, 1836; ***Lepidochelys olivacea***: Fitzinger, 1843; ***Caouana Rüppellii*** Gray, 1844; ***Chelonia subcarinata*** Rüppell in Gray, 1844; ***Caouana olivacea***: Gray, 1844; ***Chelonia polyaspis*** Bleeker, 1857; ***Lepidochelys dussumieri*** Girard, 1858; ***Lepidochelys olivacea:*** Girard, 1858; ***Thalassochelys olivacea***: Strauch, 1862; ***Chelonia dubia*** Bleeker,1864; ***Cephalochelys oceanica*** Gray, 1873; ***Thalassiochelys tarapacona*** Philippi, 1887; ***Chelonia olivacea***: Velasco, 1892; ***Thalassochelys tarapacana*** Philippi, 1899; ***Thalassochelys controversa*** Philippi, 1899; ***Thalassochelys caretta*** (part), Gadow, 1899; ***Caretta remivaga*** Hay, 1908; ***Caretta caretta*** var. ***olivacea:*** Deraniyagala, 1930; ***Caretta caretta olivacea***: M. Smith 1931; ***Lepidochelys olivacea olivacea:*** Deraniyagala, 1943; ***Caretta olivacea olivacea:*** Mertens, 1952; ***Lepidochelys olivacea remivaga***: Schmidt, 1953.

Subspecies : None.

FAO Names : **En -** Olive ridley turtle**; Fr -** Tot-tue olivâtre**; Sp -** Tortuga golfina.

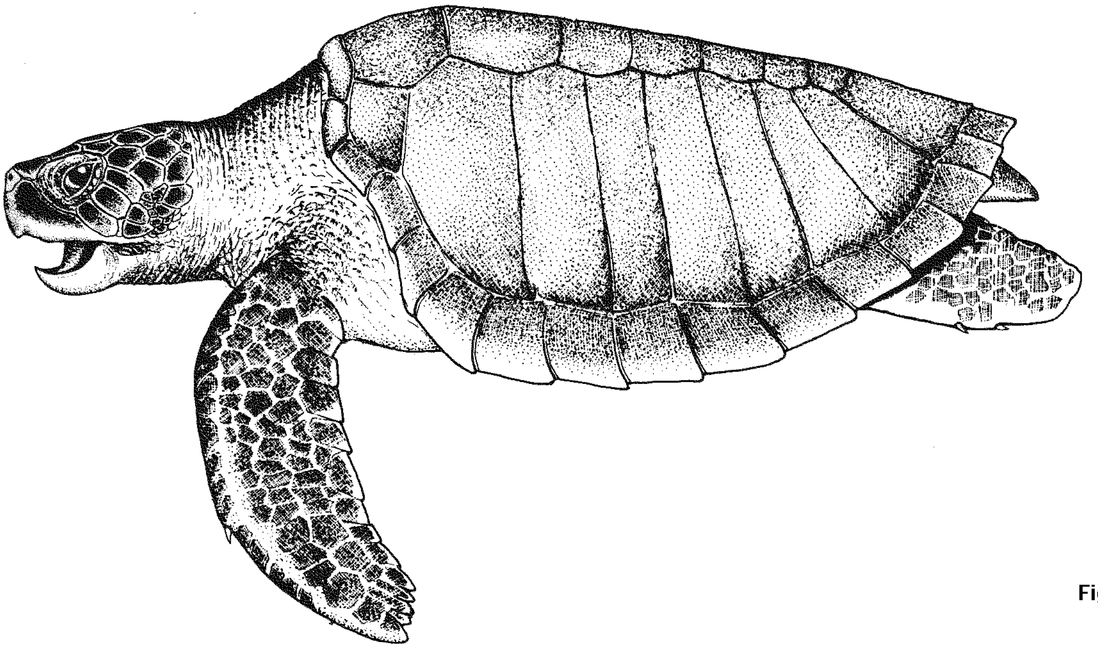


Fig. 35

Diagnostic Features : The olive ridley turtle has a slightly deeper body than the Kemp's ridley. In adults, carapace nearly round, upturned on the lateral margins and flat on top, its width 90% of its length (SCL). Head subtriangular, moderate-sized, averaging 22.4% of straight carapace length (SCL). Hatchlings have relatively bigger heads (39% SCL) and longer carapaces (width 78% SCL), and also the flippers are comparatively bigger than in adults. In 3-year old juveniles, the carapace width is 93% of SCL and the head length, 26% of SCL. Scales and scutes have the same configuration as in the Kemp's ridley, but the lateral scutes are often more than five pairs, the first pair is always in touch with the precentral scute. This species also has openings of the Rathke's glands on the plastral bridges, through a pore on the rear part of each inframarginal scute Fore flippers with one or two visible claws on the anterior border, and sometimes another small claw in the distal part; rear flippers also with two claws. As in other turtle species, males have larger and more strongly curved claws, as well as a longer tail. **Colour:** adults are plain olive-grey above and creamy or whitish, with pale grey margins underneath. Newborn hatchlings, when wet, are almost completely black, sometimes with greenish sides, and in general become dark grey after drying. With growth, they change to grey dorsally and white underneath.

Geographic Distribution : This is a pantropical species, living principally in the northern hemisphere, with the 20°C isotherms as its distributional boundaries (Fig. 37). In continental coastal waters, where the major reproductive colonies are found, these turtles are usually seen in large flotillas travelling between breeding and feeding grounds, principally in the Eastern Pacific and the Indian Ocean. In spite of its wide range of distribution, this species is nearly unknown around oceanic islands,

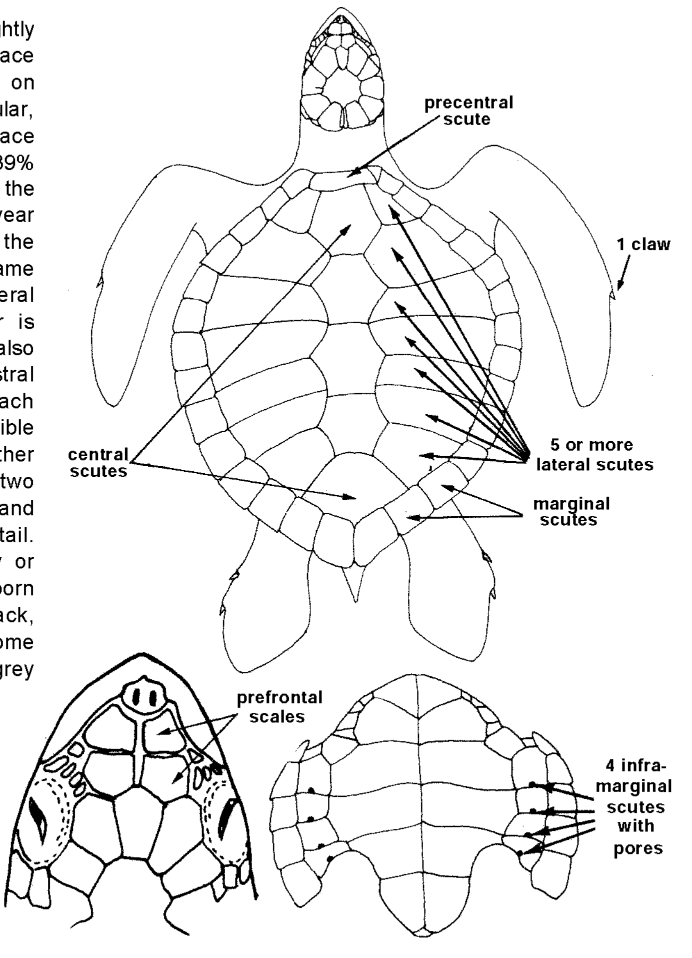


Fig. 36

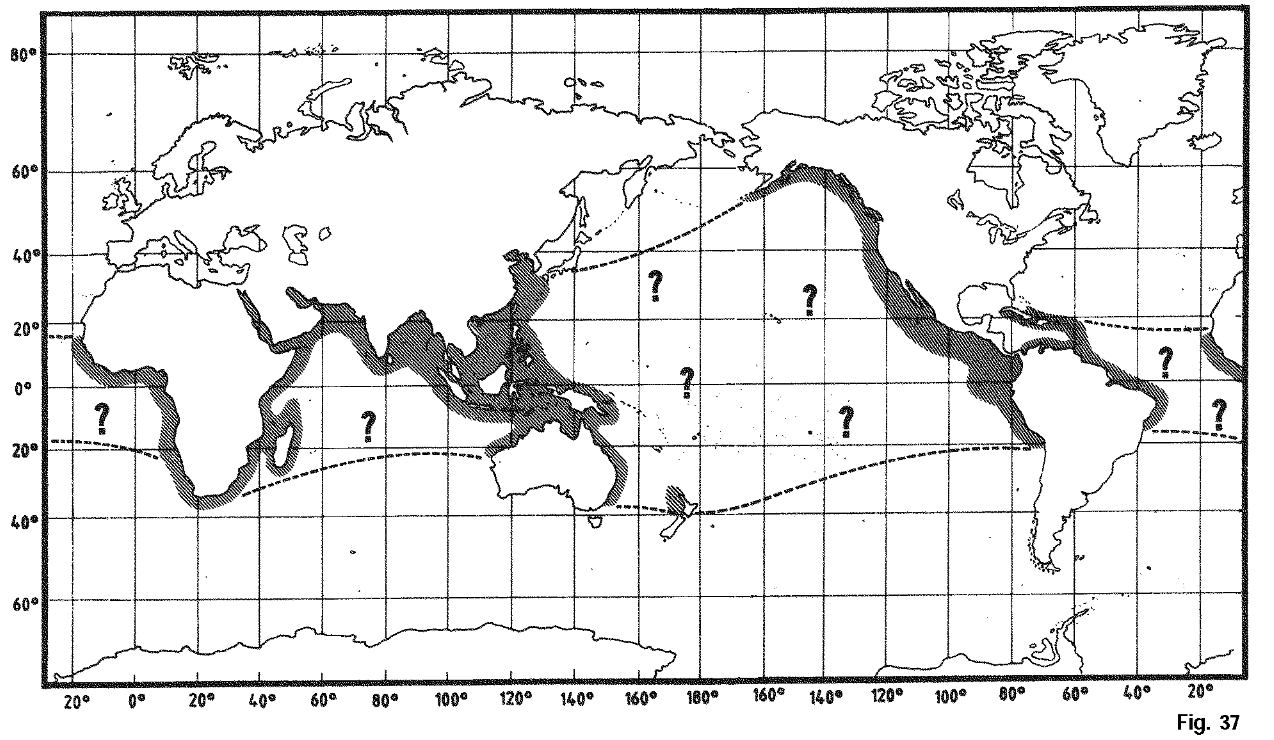


Fig. 37

except for a recent single record from Hawaii. As in the other species of sea turtles, there are very few observations on juvenile and immature olive ridley turtles.

It is suspected that oceanic currents are used by adults to travel between their different grounds, but the hatchlings are dispersed passively by strong currents and transported far from the breeding grounds. Juveniles remain hidden until nearly maturity; then they are observed approaching the inshore feeding and breeding grounds.

The olive ridley turtle probably was (and still is) the most abundant of the world's sea turtles. Nowadays, there are still several spots of high concentration where these turtles arrive seasonally to nest (principally in the Eastern Pacific Ocean, from Mexico to Costa Rica, on the northeast coast of India and also in the Atlantic, in Suriname), or to feed (as in the region between Panama and Ecuador).

Records of non-breeding olive ridleys, outside the common'range of the 20ºC isotherms, have occurred during warm weather; e.g. in the course of the El Niño phenomena in the eastern Pacific, when ***L. olivacea*** has been observed as far north as the Gulf of Alaska. Other such records quoted in the literature are from Chile (Arica, Iquique, and the southernmost, from Quintero), from the Japan Sea and its southern islands, from the northwest coast of New Zealand, and from south of Queensland, Australia, when the water is not cooler than 15ºC. These records are most common during summer. Other extra-territorial, but warm-water records are known from Cuba, Puerto Rico and the eastern Caribbean islands, and sporadic occurrences have been reported from Bahia and Sergipe in Brazil, where this species usually is absent.

Habitat and Biology : Outside their nesting areas, the adults of these turtles are most frequently neritic, travelling or resting in surface waters, but also observations of turtles diving and feeding in 200 m deep have been reported. Basking behaviour on sand beaches is not common, but it is not unusual to observe thousands of olive ridleys floating just in front of their nesting beaches at about noon time. During this kind of "basking", the upper part of the carapace dries and the turtle has difficulty to dive rapidly, a situation which is used during the capture and is advantageous for any predator. It is also common to observe birds resting on floating turtles.

This turtle usually migrates along the continental shelves, and feeds in shallow waters, converging in summer and autumn for nesting on the beaches of slight slope with fine and medium- to coarse-grained sand. The nesting beaches are usually located in isolated areas, some of them also separated from the mainland by coastal lagoons. This search for isolated places and the constitution of large "arribazones" may have high adaptative significance against predation and maybe they are the reasons for the generation, within short periods, of locally restricted populations of hundreds or thousands of females and hence, its success as a biological species.

In the nesting season, the turtles approach special spots on the shore at the beginning of summer; soon afterward, during the next quarter moon, thousands of females arrive along a stretch of several kilometres of flat beach (always less than 10 km). During the "arribazon", the olive ridley shows a cyclic response to temperature, so usually there are no turtles on the beach at noon. In the afternoon, when the sand becomes fresh, the turtles come onto the beach, increase their numbers up to a maximum toward midnight, and then start leaving the beach until the next morning. Nesting may extend for two or three nights, and usually is repeated every last quarter-moon until the end of autumn.

If the "arribazon" is an anti-predation strategy, its selective advantage remains doubtful when it occurs on beaches of restricted length, like Nancite and Ostional in Costa Rica, where high mortality of eggs, embryos and hatchlings occurs when the females excavate and bury new clutches of eggs in the same spot as the nests of earlier arrivals. Such mortality is also common on longer beaches because the arrivals occur in monthly periods and the incubation period of the eggs exceeds 50 days.

Because the success of the hatching of the eggs laid in subsequent arrivals is low (less than 10%) on small beaches, it is postulated that the colony is supported by inter-arrival solitary nestings that lay clutches with higher survival rates. On longer beaches, as in Mexico or India, the survival rate of eggs is usually over 30%, which means that several million hatchlings enter the sea annually. Hence, in the same species, quite different results are obtained with the same strategy.

The location of the most important breeding grounds is as follows: **Eastern Pacific Ocean**: western central coast of Mexico, with over 200 000 nests per year (La Escobilla, Morro Ayuta, Chacahua, Piedra de Tlacoyunque and Mismaloya-La Gloria nesting beaches); west coast of Costa Rica (Nancite and Ostional), with over 200 000 nests, Nicaragua, with more than 20 000 nests; Guatemala, with 3 000 nests, Honduras, with 3 000 nests; and Panama, with slightly more than 1 000 nests. **Western Atlantic Ocean**: Surinam (Eilanti), with around 2 000 nests; and French Guiana, with less than 500 nests. **Eastern Atlantic Ocean**: minor nesting in Angola (Ambris), Skeleton Coast, and northern part of Namibia, with around 500 nests. **Indo-Pacific region**: Mozambique, several spots, with a total of no more than 500 nests; India (Madras and Orissa States - Gahimartha) with the biggest nesting aggregation still present today, annually over 300 000 nests. **Eastern Indian Ocean**: negligible nesting throughout, but with no more than 1 000 nests per year, especially on Andaman island and in the southeastern Malaysia peninsula (Kelantan). The species is known up to Japan and eastern

Papua New Guinea. Other seasonal, but not reproductive concentrations, occur in feeding localities, like the eastern part of Venezuela or the area between Colombia and Ecuador.

In general, the nesting season is in summer and autumn, with variations from place to place: in Mexico and Central America, it extends from June or July to November or December, in French Guiana and Guyana, from June to July; in Surinam, from April to September, in Cabo Verde and Senegal, from May to August, in northeastern India, from February to June, in Sri Lanka, from September to January, in Malaysia, from August to November, in Burma, from August to January, etc.

As in other species, the olive ridley shows nest-site fidelity, and it is common to observe the same turtle nesting several times on the same spot of the beach, also during subsequent nesting seasons; hence, the reproductive activity of a turtle can be followed through several years. But there are also records of turtles nesting in different beaches, near or far away from the "original one". When the nesting occurs on long beaches, it is common to observe turtles shifting their nesting sites from one section of the beach to another during the nesting season.

Massive arrivals occur mostly around each quarter of the moon (every 14 or 28 days) and are repeated two to seven or eight times each season, but the mean number of nests laid by each turtle usually is no more than 1.5 per season. The reproductive cycle is nearly annual; over 60% of the turtles nest every year, 29% every two years and 11% every three years. In fact, the majority of the female population have an annual schedule but many individuals shift from one to another pattern, maybe as a result of the quality of the preceding feeding season and of the distance covered during migrations, so turtles with long migration routes will nest every two or more years, and non-migratory individuals (residents), will be able to nest each year. The number of eggs laid by each turtle ranges from a couple of dozen to more than 155; small clutches may be the result of interrupted nesting or may be the last nest made by this turtle in the season. The mean number in a clutch usually is around 109 eggs, but there are significative variations among localities, e.g., in Mexico, 105.3 eggs (n = 1 120 nests); Honduras, 108.3 eggs (n = 50 nests); Costa Rica (Nancite), 105 eggs (n = 20 nests); Surinam, 116 eggs (n = 1 154 nests); British Guiana, 167 eggs (n = 50 nests); Oman, 118 eggs (n = no data); India, 113 eggs (n=9).

The mean diameter of the egg is rather similar among different populations, usually ranging from 32.1 to 44.7 mm and from 30 to 38 g in weight. Hatchlings are between 34.7 and 44.6 mm of SCL and from 12 to 22.3 g in body weight.

For example, in **Mexico,** the mean egg size ranges from 39.1 to 40.6 mm (n = 7 clutches, 757 eggs), in **Honduras,** 37.5 mm (n = 50 eggs), in **Surinam,** 42 mm (n = 116 eggs), in **British Guiana,** 39.5 mm (n = 50 eggs); in **Andaman Islands,** 39 mm (n = 51 eggs), and in **India**, Gahimartha, 37.5 mm (n =90 eggs). The mean egg mass or weight also shows variations, but is usually around 30.1 to 38.2 g. The carapace size (SCL) of the hatchling also varies, but in general the mean value lies between 39 and 42 mm; in **Mexico**, the mean is around 39 mm, with a range usually between 37 and 42 mm (n = 329); in **SouthAfrica**, 43.9 mm, with a range between 42.9 and 44.6 mm (n = 5); in **British Guiana**, 41 mm (n =4); in **India,** 39.4.mm with a range from 34.7 to 42.9. The mean body mass of the hatchling varies between 15 to 19 g, in **Mexico** it is nearly to 14 g, with a range from 12 to 21.5 g for viable turtles (n = 329); In **South Africa,** 19.5 g with a range from 16.8 to 22.3 g (n = 5); in **India,** 16.72 g, with a ranges from 12 to 19.5 g (n = 200).

The incubation period of the egg clutch usually extends from 45 to 65 days, and is strongly correlated with temperature and humidity; in dry and cold weather, it lasts longer than under optimal temperature and humidity conditions, around 3O°C and 14% respectively. Other parameters that influence the length of the incubation period are: sand grain size, organic matter content, clutch size, date of oviposition, and possibly, the proximity to other nests (arrival conditions). A shorter incubation period reduces the possibilities for predation and the detrimental effects of bad weather. It is difficult to indicate precisely the duration of the incubation period for each nesting beach, but it generally runs within the above-quoted range. In Escobilla, Mexico, it changes along with the season, with a minimum duration for nests laid between August and September (around 47 to 58 days); in northern beaches like Sinaloa, it lasts between 49 and 62 days, in Surinam, 49 to 62 days (n = 22); in Australia, 48 to 51 days, and in India, 50 to 62 days. In captivity, the incubation usually lasts longer, and the sex ratio obtained may be biassed to males.

The age at maturity for the olive ridley is, as in the majority of other sea turtles, uncertain; since it is one of the smallest species, it must mature earlier, possibly at average sizes of 62 cm of SCL. Variations should occur with latitudinal range of distribution, quality of the food, size of the population (competition) and genetic factors. The smallest mature size observed in La Escobilla, Mexico, was a female of 49 cm (SCL).

Courtship in this species is not often observed. Mating is performed near the nesting beaches or along the migratory routes, and occurs principally at the sea surface; the coupling pair may dive if disturbed, and soon afterward the partners usually swim separately. As in other species, the male holds the carapace of the female with the claws of his four flippers, and mating may last for a few minutes to several hours. It occurs before and during the nesting season. Multiple mating of a female, by several males, may occur but has not yet been reported.

Because nesting usually is performed through arrivals of very large aggregations of females, the incubation and hatchout also occur massively and within well-defined periods. Depending on the weather conditions at the time of the arrival, the incubation period and hatchout will show different characteristics. If at these times the weather is dry and cold, the sex rate of hatchlings may be biassed to males or to females and the success of the incubation substantially reduced. The incubation conditions change abruptly from arrival to arrival, and they are mainly dependant on temperature and humidity. It has been found that a normal sex rate of 1:1 is obtained under incubation temperatures of around 30ºC, with very small variations between populations. In olive ridleys, males are predominant at 28ºC and females at 32ºC. Temperatures outside this range not only affect the sex-ratio, but also lead to a decrease of the survival rate.

Hatching success is affected by direct and indirect disturbance of the beach by man, storms, floods, erosion, dryness, sand compactation, fungus and bacterial invasion and predation. The time of day at which hatchlings emerge may affect their survival rate; usually they leave the nest between afternoon and early morning; outside of this time-span they are more easily predated, or dried by the sun and hot sand before reaching the surf zone. Predation occurs in day-time and at night; during the day by many kinds of birds and mammals that are visually attracted to the contrasting colours of the turtles (black bodies against whitish sand), and all hatchlings of a clutch may easily be devoured before they reach the sea. At night, predation diminishes, but is accomplished by nocturnal mammals, like jaguars, jaguaroundis, raccoons, opossums, jackals, hyaenas. feral dogs and pigs. Other predators of eggs and hatchlings are monitor lizards (***Varanus***) in Asia, and caimans (***Paleosuchus palpebrosus*** and ***Cayman crocodilus***) and even racer snakes in the Guianas. One predator always present is the ghost crab, and there usually are thousands of these crabs roaming permanently on such beaches. In the sea, the hatchlings are eaten by sea birds and carnivorous fishes. On beaches of western Mexico, individual frigate birds (***Fregata magnificens***), are capable of swallowing up to six ridley hatchlings every morning, an activity that was photographed by S. Cornelius on the beach of Nancite, Costa Rica.

Predation at stages other than eggs, hatchlings or adults has been the object of much speculation. Large fishes and small sharks are capable of eating juveniles, but subadult and adult turtles are eaten in the sea only by sharks. Adults on the nesting beaches can be killed by dogs and in some areas also by hyaenas, jackals, jaguars and tigers. However, predation by felines is diminishing rapidly nowadays.

The olive ridley is a facultative carnivore, which for long periods is capable of eating a single kind of food, such as red lobsterets (***Pleuroncodes planipes***), e.g. on the west coast of Baja California.In other places, it may take a variety of food, e.g. off Oaxaca, southern Mexico, where a study, carried out from July to December (1982) showed that adult males (n=24) fed mainly on fishes (57%). salps (38%), crustaceans (2%) and molluscs (2%). and the diet of adult females (n = 115) included salps (58%), fishes (13%), molluscs (1 1%), algae (6%), crustaceans (6%), bryozoans (0.6%). sea squirts (0.1%), sipunculid worms (0.05%), and fish eggs (0.04%).

The large variety of food items in the olive ridley's diet is well documented in data gathered from the analysis of stomach contents of turtles in Mexico: gastropods, 9 species, (e.g., ***Polinices, Turritella***); neogastropods, 26 species (e.g., ***Persicula, Strombina, Conus, Terebra, Polystira***), pelecypods, Veneroidea, 17 species (e.g., ***Pitar, Tivela, Chione, Nemocardium, Nuculana***); scaphopods, (***Dentalium***); crustaceans: amphipods, isopods, stomatopods (***Squilla***), decapods (fragments); bryozoans; chordates: ascidans (sea squirts), Thaliacea (salps); vertebrates: fishes (***Sphoeroides*** and undetermined fragments of fish bones) and egg masses of fishes (probably eels and sardines), and unidentified algae. In another report (6 turtles) food items include bentonic fauna, such as: crustaceans (isopods and decapods: Portunidae, Paguridae); molluscs (bivalves and gastropods), and nectonic fauna i.e.: jellyfishes and chaetognaths. During migration in the open sea, olive ridleys have been sighted feeding on red lobsterets (galateids) on the western side of Baja California, and on floating egg clusters, probably of flying fishes, off Colombia.

Size : The mean straight carapace length (SCL) of mature olive ridleys, mostly collected from commercial catches, ranges between 51 and 75 cm, with an average of 67.6 cm (n = 844) for both sexes. In general, adult males have around 3 cm more of carapace length and nearly 2 kg less weight than females; this difference is because the female has a deeper body than the male, even though the latter has a longer carapace. The mean carapace length (SCL) changes from year to year, but always within the observed limits.

For example: in **Mexico** (Escobilla), from 49 to 71 cm, with a mean of 60.6 cm (n = 1 563); in **Costa Rica** (Nancite), from 57 to 72.5 cm with a mean of 65.2 cm (n = 53), in **Honduras**, from 58.5 to 75 cm; in **Guyana,** a mean of 68.1 (n = 14); **Surinam**, from 63 to 75 cm, with a mean of 68.5 cm (n = 500); South East Africa, from 63.3 and 67.5 cm (n = 2); **Mozambique,** from 58.1 to 69.5 cm, with a mean of 65.4 cm (n = 5); **Madagascar,** from 52.8 to 66.5 cm, with a mean of 60.6 cm (n=21); **Sultanate of Oman**, from 69.9 to 72.1 cm, with a mean of 71.5 (n = 100); **India** (Gahimartha), from 57 to 71 cm, with a mean of 64.3 cm (n = 55), other measurements in females give 65 to 75 cm with a mean of 72.9 (n = 108) and possibly the last measurements were made over the curve of the carapace (CCL); **Sri Lanka**, from 68 to 79 cm (n = no data) possibly made over the curve of the carapace (CCL). In **Colombia**, a sample obtained from incidental bycatch of shrimp trawling (Duque-Goodman, pers. com.) ranged from 52 to 75 cm, with a mean of 63.1 cm (n = 50) for both sexes.

Commonly the body mass varies from 33 to 43.4 kg, with a mean of 38.1 kg (n = 193).

Some data on body mass are available from the literature, e.g., **Mexico** (Oaxaca-Escobilla), mean weight for females: 39.25 kg (n = 136) and for males: 36.8 kg (n = 51); in **Surinam,** mean weight for both sexes: 35.7 kg (n = 14); in **India** (Gahimartha), mean weight for both sexes: 43.4 kg (n = 55). and for females, (1985): from 32 to48 kg, with a mean of 49.5 kg (n = 108).

Interest to Fisheries : The olive ridley is still today the most abundant sea turtle of the world and is captured legally or illegally throughout its distribution range. Up to the end of the seventies, the leather market was abundantly supplied with the hides of this species, and today the leather traffic continues, but on a smaller scale. Besides of the hides, this turtle yields 25% of its total body weight in meat, in addition to oil, and if industrialized, it provides a high-quality protein and residual fertilizer.

These are the reasons for the high value of this species and for its rapid depletion on the majority of breeding and feeding grounds. Egg exploitation was developed in pre-historical times, but has been increased in the last century to dangerous levels that are threatening several populations with extinction.

Harvesting of eggs continues in the majority of the nesting grounds: in some parts it is legalized and subjected to quotas, e.g., in Malaysia, Surinam, Honduras; in others it is illegal, e.g., in Mexico, Costa Rica, India and other nesting areas. Hence, the worldwide annual harvest must amount to several millions of eggs. Nowadays, campaigns against egg harvesting are in vogue, and the turtle camps for nesting protection also are increasing in all of the above-mentioned countries.

The capture of adults today may be directed or incidental, legal or illegal. In the case of developed fisheries, olive ridleys are usually captured on the breeding or feeding grounds, using small fiberglass or wooden boats with 40 HP outboard gasoline motors. The crew in general is formed by two fishermen, one of whom throws over the turtle and carries it up to the boat, while the other directs the boat and assists in hauling the animal on deck. This fishery is performed in the early morning, when the turtles are lazily floating in the sunshine, solitarily or in couples; under these conditions, they are unable to dive rapidly. At the height of the season each crew may capture over 40 individuals in a morning. Olive ridley turtles are also captured with monofilament nylon nets of 25-35 cm stretched mesh, usually over 500 m length and 4 m deep, with few leads, to avoid drowning the turtles. Such nets are similar to those used for sharks, and often they are actually registered for shark fishing, but used to catch turtles.

No separate official catch data are recorded for this species in the FAO Yearbook of Fishery Statistics. General catch statistics for unidentified marine turtles (doubtless including this species) are provided for Fishing Areas 77 - Eastern Central Pacific (305 metric tons in 1987) and 87 - South East Pacific (864 metric tons in 1987). In Area 77, Mexico is the main exploiting country (859 metric tons in 1987), while Ecuador and Panama take only insignificant quantities. In Area 87, the entire reported catch corresponds to Peru, but includes leatherbacks, olive ridleys and green turtles. By converting the mean total weight data, it was possible to estimate the total number of individuals captured in 1985 at more than 25 000 in Mexico and at about 1 000 in Peru. The worldwide annual catch is doubtless much higher, since no information is available from a large part of the Pacific coast of Central America and Colombia. National statistics from Ecuador, Instituto Nacional de la Pesca, indicate that between 1978 and 1981, an average number of 80 000 turtles were captured annually; after 1981, the capture was reduced substantially everywhere because of the signature of CITES by many countries. Until that year, the principal importers of skin and leather were Italy, Japan, Switzerland, France and Mexico.

The species is also caught on the northeasterncoast of South America and in the eastern Indo-Pacific region. The incidental capture of olive ridleys by shrimp trawlers, long-liners and purse-seiners is generally not reported and may amount to several thousand turtles each year.

Local Names : ANDAMAN ISLANDS: Gadha kacchua; ARABIAN RED SEA: Bage; BANGLADESH: Samudrick-kasim; BRAZIL: Sibirro; CARIBBEAN: Kulalashi; COLOMBIA: Golfina, Lora; COSTA RICA: Carpintera, Lora; EL SALVADOR: Golfina, Lora; ETHIOPIA (ERITREA): Bage; FRANCE: Tortue bâtarde, Tortue de Kemp, Tortue de Ridley, Tortue olivâtre; FRENCH GUIANA: Kula-lasi; GUATEMALA: Parlama; GULF OF SIAM: Condit; GUYANA: Tera-kui; INDIA (Tamil): Shitamai; INDOCHINA: Quan dong; INDONESIA: Penyu algu-abu; ITALY: Tartaruga bastarda; JAPAN: Hime-umigane; MALAYSIA: Penyu lipas; MEXICO: Cahuama, Golfina; NEW GUINEA: Ahulam, Bung, Mabua, Makabni; NICARAGUA: Paslama; PANAMA: Tortuga mulato; PERU: Pica de loro; PHILIPPINES: Powikan; POLYNESIA: Aonana, Mokabu, Pimbat; PORTUGAL: Tartaruga; SENEGAL: Tortue de roches, Tortue olive; SOUTH AFRICA: Oulo, Ouzo, Xicove (AFRICAANS): Olifkeurige Ridley, Seeskilpad; SPAIN: Tortuga bastarda, Tortuga de Kemp; SRI-LANKA: Batu casbaw, Mada casbaw; SURINAM: Warana; THAILAND: Tao-ya; TONGA: Tuangange; VENEZUELA: Bestia, Loba, Tortuga manila; VIETNAM: Guan dong, Lemech; UK, USA: Olive ridley, Pacific ridley.

Literature : Poulain (1941); Oliver (1946); Yañez, A. (1951); Aguayo (1953); Schaefer (1962); Pritchard (1966, 1969); Hughes & Mentis (1967a. b); Caldwell (1969); Flares (1969); Marquez (1970, 1977, 1978, 1981, 1984); Ferreira de Menezes (1972); Hughes (1974); Varona (1974); Phasuk & Rongmuangsart (1973); Honma & Yoshie (1975); Schulz (1969, 1975); Cornelius (1976); Marquez *et al.* (1976, 1981), Zwinenberg (1976); Hubbs (1977); Smith & Smith (1979); Casas-Andreu & Gomez-Aguirre (1980); Frazier (1980, 1983); Limpus, Miller & Fleay (1981); Stenberg (1981); Khan (1892); Marquez & van Dissel (1982); Rajagopalan & Bastian-Fernando (1983, 1985); Frazier & Salas (1982, 1983, 1984); Mohanty-Hejmandy & Dimond (1985, 1986); Resales-Loessener (1985); Fretey (1986); Montenegro *et al.* (1986); Acuña-Mesen (1988); Stinson (1989); Hildebrand (pers.com.).

Natator McCulloch, 1908

CHE Nat

Genus : ***Natator*** McCulloch, 1908, Rec. Aust. Mus. 7(2): 126-128

Type Species : ***Natator tessellatus*** McCulloch, 1908 [= ***Chelonia depressa*** Garman, 1880], Bull. Mus. Comp. Zool. 6: 123-126; by monotypy.

Synonyms : ***Chelonia*** Linnaeus, 1758; ***Chelone*** Boulenger, 1889.

Diagnostic Features : See species.

Remarks : This is a monotypic genus. The only species, ***Natator depressus***, was previously included in the genus ***Chelonia***, but several authors had questioned this taxonomic status.

Following a review of the original descriptions of ***Chelonia depressa*** and ***Natator tesselatus***, the species was redescribed as ***Natator depressus*** (Garman, 1880) by Limpus *et al.*, 1988 and Zangerl *et al.*, 1988.

Natator depressus (Garman, 1880)

Fig. 38

CHE Nat 1

Chelonia depressa Garman, 1880, Bull. Mus. Comp. Zool. 6: 123-6, (East Indian Ocean and North Australian waters)

Synonyms : ***Chelonia japonica*** Thunberg, 1787; ***Chelone mydas:*** Boulenger, 1889 (in part); ***Chelonia depressa:*** Baur, 1890; ***Natator tessellatus*** McCulloch, 1908; ***Chelonia mydas japonica:*** Wermuth & Mertens, 1961.

Subspecies : None.

FAO Names : **En** - Flatback turtle; **Fr** - Tortue Platte; **Sp** - Tortuga plana de Australia.

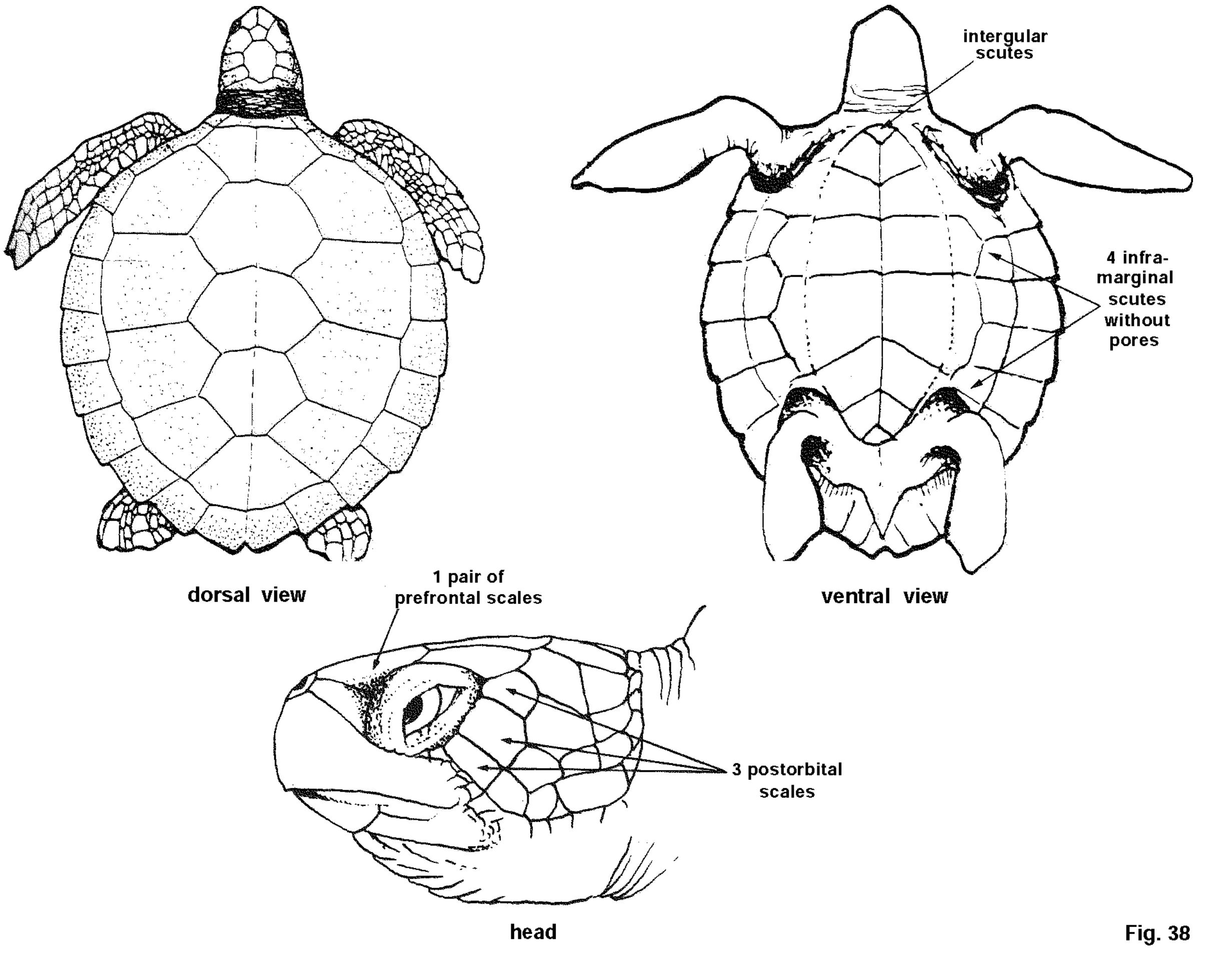


Fig. 38

Diagnostic Features : A medium-sized species, with very special morphological features. In the adult, the body is flat and the carapace smooth, nearly elliptical, with upturned margins; in subadults, the carapace rim is usually indented from the middle part backward. Carapace width (n = 14) from 82 to 84% of carapace length (CCL). Head medium-sized, subtriangular, flat on top, similar to that of ***Lepidochelys***, with a moderately serrated lower tomium. Overall scutellation similar to that of the ***Chelonia*** group (5 central, 4 pairs of lateral and 12 pairs of marginal scutes), but the carapace feels soft. waxy and smooth and is usually free of barnacles. Head scales also generally similar to those of the ***Chelonia*** group, but consistently 3 post-orbitals at each side (4-4 in ***Ch. mydas***), and prefrontals without (or with very limited) contact with the sheath of the upper tomium; sometimes, an extra-preorbital (preocular) scale on each side. Snout longer than in ***Ch. mydas*** and nearly equal to length of orbit. Ventrally, the scutes have the same counts as in ***Ch. mydas*** (6 pairs of main scutes, one intergular scute, often a pair of postanal scutes, and 4 poreless inframarginal scutes in each bridge); there is only one axillary scale in each bridge. Each flipper has a single visible claw (in young individuals, an extra distal claw is present, more apparent in the fore flippers) and the scales of the fore and rear flippers are interrupted by wrinkled skin overlying the phalanges. **Colour**: adults dorsally dull olive-grey, with pale brownish-yellow tones marginally; neck and head with the same pale tonality. Ventrally the plastron, side of neck and proximal part of the flippers are creamy white. Young individuals are more brightly coloured. The colour of hatchlings is quite distinct from any other sea turtle hatchlings; the carapace scutes form a dark grey reticulate pattern, each scute with a pale olive grey centre and the entire rim of the carapace and flippers is contoured by a cream-coloured band. Ventrally, the hatchlings are cream-white, except along the central part of each flipper, which is stained by a bluish-grey diffuse spot.

Geographical Distribution : The flatback turtle is indigenous to the northwestern, northern and northeastern regions of Australia (Fig. 39). It occurs commonly in shallow waters, especially in coastal areas along the main coral reefs (Great Barrier Reef) and in the vicinity of continental islands, from 21°S in the west to 254 in the sourthern part of Queensland, which includes the southern coastal waters of the Timor and Arafura seas. Single individuals have been reported from the southeastern coasts of Papua/New Guinea through incidental capture by prawn trawlers, but no nesting or mature females (with white-shelled eggs) have been reported from these coasts. There are several reports from outside the Australian region, but these records represent misidentification, e.g.: Deraniyagala (1939) suspects that the flatback strays into Sri Lankan waters; Garman (1908) quotes its incidence on Easter Island in his "check list of reptiles" for that locality.

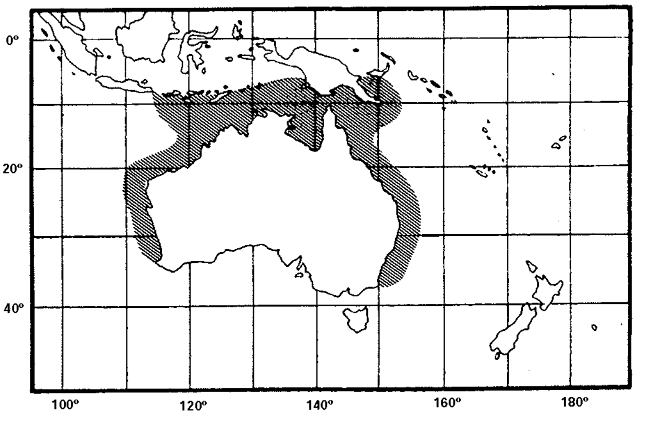


Fig. 39

Habitat and Biology : ***Natator depressus*** is the sea turtle with the most restricted distributional range. It seems to be completely neritic and endemic to shallow waters of Australia. This species apparently has a very low emigration rate out from its major distribution area and does not go beyond the continental shelf. It moves between the nesting grounds on the mainland and on islands, and the feeding grounds in shallow waters of north-eastern Australia and in the Gulf of Carpentaria. Distances covered by tagged turtles are between 215 and 1 300 km.

Nesting of the flatback turtle occurs along the northern coast of Australia, from Port Hedland (20°S) in the west to Mon Repos (25°S) in the east. In Western Australia, Delambre Island (located on the northwestern shelf) has been reported as an important nesting ground. In the Northern Territory, Greenhill Island appears to be the most significant rookery for the northwestern coast, while low-density nesting occurs throughout the state; on the western side of the Gulf of Carpentaria, which is part of the Northern Territory, the Sir Edward Pellew Island was reported as an important nesting area; and in the northeastern part of the Gulf, Crab Island appears to be the most important rookery for the species throughout Queensland and possibly for the entire range of distribution, with several thousand nesting females per season. On the eastern coast of Queensland, between Cape York (11°S) and Townsville (19°S) nesting is negligible or absent; there are several nesting points on the continent, from Townsville to Mon Repos (25°S) such as: Langham (22°S), Rocky Point (24.5°S) and Mon Repos; and on the nearby islands, such as: Wild duck and Avoid Island (22°S), Peak Island (23°S), Curtis and Facing Island (24°S); each of these nesting places supports an annual population of up to several hundred turtles.

The peak of the nesting season varies from one place to another; in southeastern Queensland, the flatback nests only in the summer months, from November to January, while on the northern beaches nesting occurs throughout the year, with a peak between March and April. On Crab Island, the main nesting period goes from August to October. In these rookeries, the nesting of other species besides ***Natator depressus*** is apparently rare, but even if it occurs, interference with the flatback seems to be minimized by the natural shift in time of the respective seasons and location of the nesting sites. No other place outside northern Australia has been reported as nesting ground for the flatback.

Adult flatback females show strong philopatric capabilities in successive nestings within the same and in different seasons. False crawls for nesting attempts are uncommon for this turtle.

At Mon Repos, the renesting interval for subsequent reproductive seasons ranges from 1 to 5 years, with a mean of 2.65 years (n = 40). Within a breeding season, the renesting interval observed for flatbacks ranges from 12 to 23 days, with a mean of 16 days, they lay from 1 to 4 successive times, producing a mean of 2.8 clutches per season. The number of eggs per clutch is less than half of that recorded for the other species of Cheloniidae, but the size of the eggs is quite large, comparable to that in ***Dermochelys***. The mean number of eggs per clutch is about the same in the northern part of the range, e.g. Crab Island: 56.2 eggs (range, 22 - 76, for n = 76 nests) and in the eastern part, e.g. Mon Repos: 50.2 eggs (range, 7 to 73, for n = 87 nests). The mean size of the eggs is 50.6 mm for Crab Island and 52 mm for Mon Repos (range, 46.6 to 54 mm, for n = 310 and 47.5 to 56 mm, for n = 250, respectively). The mean egg mass in the above-mentioned places is 72.7 and 77.8 g (50 to 83.5 g, for n = 238 and 63.5 to 86.7 g, for n = 220, respectively).

The hatchlings of ***Natator depressus*** are bigger than those of ***Chelonia***, but smaller than those of ***Dermochelys***. For Crab Island and Mon Repos, the measurements are respectively: 59.7 mm of SCL (range, 53.9 to 66.5 mm for n = 211). and 61.2 mm of SCL (range, 56.6 to 65.5 mm, for n = 190); the weights are 45.1 g (range, 40.5 to 51.5 g, for n = 40) and 43.6 g (range, 33.3 to 49.1 g, for n = 190). respectively. All these measurements were obtained from random sampling of several clutches gathered on both of the studied beaches.

Age at first maturity has not been determined for the flatback but, possibly because of its protein-rich diet, this species may reach maturity at a younger age than the vegetarian green turtles ***Chelonia mydas*** and ***Chelonia agassizii.***

Predation occurs throughout the life-cycle, but reaches its highest values during incubation, which lasts from 47 to 58 days (mean of 53.4 days for Mon Repos beach). In South Queensland, the eggs are eaten by introduced foxes (***Vulpes vulpes***), dingos, rats and goannas or monitor lizards (***Varanus***), the latter being the most pernicious predators on mainland beaches, but this reptile is also present on several islands of the region. Commonly, ghost crabs (***Ocypode***) invade the nests and destroy between 1 and 6% of each clutch. When storms and typhoons coincide with the peak of the nesting period, floods and erosion produce massive mortalities. Eggs are also eaten by man, as on Crab Islands (see section "Interest to fisheries"). The hatchlings are vulnerable to terrestial predators, especially when they emerge from the nest and cross over the beach to the surf. The flatback, because of its size, apparently is big enough to avoid most ghost-crab attacks. During the night, hatchlings are assaulted by rufous night herons (***Nycticorax***), which are capable of killing up to 100% of the clutch. The few hatchlings that escape from the nest during daylight are predated by diurnal birds such as the black-necked stork (***Xenorhynchus***), the white-belly sea eagle (***Haliaetus***), the brahminy and the whistling kite (***Halliastur***) and the osprey (***Pandion***). Offshore hatchling predation has not yet been quantified, but Australian pelicans (***Pelecanus***) were observed after some daylight emergences of hatchlings, and when disturbed at roost, they regurgitated as many as eight freshly ingested baby flatbacks. Once in the sea, hatchlings are easy prey of any carnivore animals large enough to swallow them, such as fishes, especially sharks, which threaten them throughout their lives. The adults, principally females when landing to nest, are easy prey, e.g. of crocodiles (***Crocodilus porosus***), as was recorded from Crab island beach.

Feeding grounds and food are nearly unknown for the hatchling and juvenile stages of the species. The carnivorous adults inhabit inshore turbid waters of the entire Australian continental shelf, except the southern coasts. The flatback is described as a carnivorous forager like ***Caretta*** and ***Lepidochelys***, because of its short flippers and broad skull. There are several reports of stomachs containing brown algae and squids, or filled with "trepang", sea cucumbers of the genera ***Actinopyga*** and ***Holothuria***; other benthic animals included in the diet are hydroids, soft corals (alcyonarians), and molluscs. A report on stomach contents of two immature (14 and 22 cm of SCL) flatbacks includes jellyfish, gastropods, bivalves and cephalopods (sepiids).

Size : The available measurements are confined to nesting females from the southeast Queensland and Crab Island nesting beaches. The southeastern Queensland turtles (n = 14) measured in curved carapace length (CCL), from 88 to 96 cm, (mean 92.3 cm), and the mean width was 77.8 cm, with a range of 72 to 81 cm. The nesting turtles (n = 326) from Crab Island measured from 80.5 to 97 cm (CCL) (mean 89.5 cm). The mean body weight for Queensland (n = 10) was 74.4 kg; the variation for the individuals (n = 28) from Crab Island was 59.5 to 84 kg, (mean of 71 kg).

Interest to Fisheries : Very little information exists on this subject. Because the catch is negligible for world statistical purposes, this species is not recorded in the FAO Yearbook of Fisheries Statistics. The flatback is restricted to the coastal waters of the northeastern part of Fishing Area 57, the central-southern part of Fishing Area 71 and the northwestern part of Area 81. This turtle has never been favoured as food by the aborigines or Europeans. Limpus (1978) and others report that, because of its "carnivorous" diet, the meat of the flatback turtle is disagreeable in taste. Annually, only a few turtles, principally females from the Crab Island rookery, are collected and sold to residents of Thursday Islands. The eggs are more appreciated by the residents of Bamaga and Thursday Islands, who regularly visit Crab Island to harvest them, principally for private consumption.

The species is recognized of value for subsistence use, but in the Gulf of Papua, during prawn trawling, several turtles per year are captured incidentally; also in the Gulf of Carpentaria and Shark Bay, flatbacks are quite often caught by the same type of fishing gear and by large-meshed set-nets, but again no statistical figures are available on these catches.

There is no information about the use of specialized fishing gear to catch flatbacks; the capture is mainly incidental, except for those caught on Crab Island by the Bamaga residents and the indigenous communities of northern and northeastern Queensland. Local consumption is low because some people consider the flatback meat as poisonous. In Torres Straits and North Queensland, there is a harpoon fishery for the green turtle and it is possible that some flatbacks are captured as bycatch in the former area, but no statistical data are available. Historically, the remora or sucking fish ***(Echeneis naucrates***) was used as a method to capture smaller turtles (principally greens); following the attachment of a tethered fish to the turtle's carapace, it can be hauled to the canoe. If the turtle is large, the fish is used only as a detector for the purpose of reaching the turtle by diving, by following the line. Sometimes, the struggle of the animal protracts itself for several hours before it can be hauled to the canoe.

Local Names : AUSTRALIA, NEW ZEALAND: Flatback turtle; PAPUA NEW GUINEA - Central Province (Fishermen's/ Daugo Islands): Kikila, (Paredaba village): Usi vidi.

Literature : Boulenger (1889); Baur (1890); Garman (1908); Gudger (1919); Wermuth & Mertens (1961); Williams, Grandison & Carr (1967); Bustard & Limpus (1969); Limpus (1971, 1978, 1980, 1981, 1986, pers.com.); Bustard (1969, 1972); Pritchard (1979); Rhodin, Spring & Pritchard (1980); Spring (1981); Limpus, Parmenter, Baker & Fleay (1983, 1983a); Mrosovsky (1983); Pritchard *et al*. (1983); Limpus, Fleay & Baker (1984); Salm (1984); Limpus, Gyuris & Miller (1988); Zangerl, Hendrickson & Hendrickson (1988); Limpus *et al*. (in press).

Remarks : Because of its restricted geographical distribution, the flatback is the most vulnerable of all sea turtles to any change of habitat or to over-exploitation (see section on "Interest to Fisheries" for Kemp's ridley), so it was necessary to develop a strict monitoring scheme to continually trace the population levelIt is strongly recommended to keep captures to a minimum.

The flatback turtle nesting grounds and habitats in northern Australia need to be preserved from the degradation that threatens the survival of wildlife. "Positive conservation management by Australia and her neighbours is required to ensure the survival of these turtles, which by their intrinsic biology, cannot adapt to long-term intensive harvests or to rapid alteration of their environment" (Limpus, 1986).

National parks protecting turtle habitats have been established by the Australian government as early as October of 1948; they include the southern coral cays in the Great Barrier Reef, some of them supporting turtle breeding populations. An interesting example is the National Park of Peak Islands that had been protected for decades before its flatback rookery was discovered. In February 1982, the Wild Duck Island, a very important breeding area for flatback turtles, was declared a National Park, and this is the first legislation specifically designed for the conservation of the endemic ***Natator depressus*** (Limpus, 1980).

click for next page

2.3 FAMILY DERMOCHELYIDAE

DERMO

Synonyms : Sphargidae; Dermatochelydae, Dermochelidae, Dermochelydidae.

Dermochelys Blainville, 1816

DERMO Dermo

Genus : ***Dermochelys*** Blainville, 1816, Bull.Soc.Philom.Paris, p.119.

Type Species : ***Testudo coriacea*** Vandelli, 1761.

Synonyms : ***Sphargis*** Merrem, 1820; ***Coriudo*** Fleming, 1822; ***Siphargis*** Risso, 1822; ***Scytina*** Wagler, 1828; ***Chelonia*** Bory de St. Vincent, 1828; ***Dermochelis*** LeSueur in Cuvier, 1829; ***Dermatochelys*** Wagler, 1830; ***Chelyra*** Rafinesque, 1832; ***Testudo*** Ranzani, 1834; ***Scytena*** Gray, 1844; ***Sphragis*** Agassiz, 1846; ***Seytinia*** Naeve, 1940; ***Dermatochelis*** Romer, 1950; ***Scytine*** Romer, 1956; ***Seytina*** Romer, 1956.

Diagnostic Features : See species.

Dermochelys coriacea (Vandelli, 1761)

figs 40, 41

DERMO Dermo 1

Testudo coriacea Vandelli, 1761, "Epistola de Holoturio et Testudine coriacea ad Celeberrimum Carolum Linnaeaum, Padua:2 (Maris Tyrrheni oram in agro Laurentiano).

Synonyms : ***Testudo coriacea:*** Linnaeus, 1766; ***Testudo coriaceous*** Pennant, 1769; ***Testudo arcuata*** Catesby, 1771; ***Testudo lyra*** Lacépède, 1788; ***Testudo marina*** Wilhelm, 1794; ***Testudo tuberculata*** Pennant in Schoepf, 1801 ; ***Chelone coriacea:*** Brongniart, 1805; ***Chelonia coriacea:*** Schweigger, 1812; ***Chelonia lutaria*** Rafinesque, 1814; ***Dermochelys coriacea:*** Blainville, 1816; ***Sphargis mercurialis*** Merrem, 1820; ***Coriudo coriacea***: Flemming, 1822; ***Chelonia Lyra*** Bory de St. Vincent, 1828; ***Scytina coriacea:*** Wagler, 1828; ***Sphargis tuberculata:*** Gravenhorst, 1829; ***Dermochelis atlantica*** LeSueur in Cuvier, 1829; ***Dermatochelys coriacea:*** Wagler, 1830; Gadow, 1901; ***Dermatochelys porcata*** Wagler, 1830; ***Sphargis coriacea:*** Gray, 1831; ***Chelyra coriacea:*** Rafinesque, 1832; ***Testudo coriacea marina:*** Ranzani, 1834; ***Dermatochelys atlantica:*** Fitzinger, 1836 (1835); ***Testudo (Sphargis) coriacea:*** Voigt, 1837; ***Dermochelydis tuberculata:*** Alessandrini, 1838; ***Chelonia (Dermochelys) coriacea:*** van der Hoeven, 1855; ***Testudo midas*** Hartwig, 1861; ***Sphargis coriacea*** var. ***Schlegelii*** Garman, 1884; ***Dermochely coriacea:*** Boulenger, 1889; ***Sphargis angusta*** Philippi, 1889; ***Dermatochaelis coriacea:*** Oliveira,1896; ***Dermochelys schlegelii:*** Stejneger, 1907; ***Dermatochelys angusta:*** Quijada, 1916; ***Dermochelys coriacea coriacea:*** Gruvel, 1926; ***Dermochelys coriacea schlegeli:*** Mertens and Müller, 1934.

Subspecies : There are two subspecies (Atlantic: ***D.c. coriacea;*** Indo-Pacific: ***D.c. schlegelii***) proposed by several authors, mainly on the basis of different geographical distribution patterns, but also differences in coloration and morphological characters (head and body measurements). It is said, for example, that the number of white blotches covering the body may be significantly different in the 2 populations, although this is a feature subjected to a considerable degree of variability; also, statistical differences have been observed in the mean carapace lengths of Atlantic and Indo-Pacific turtles. However, a detailed statistical and comparative analysis to validate the subspecific status of these populations has not yet been undertaken, and no comparative descriptions of the two subspecies have been published.

FAO Names : **En -** Leatherback turtle; **Fr -** Tortue luth; **Sp -** Tortuga laúd.

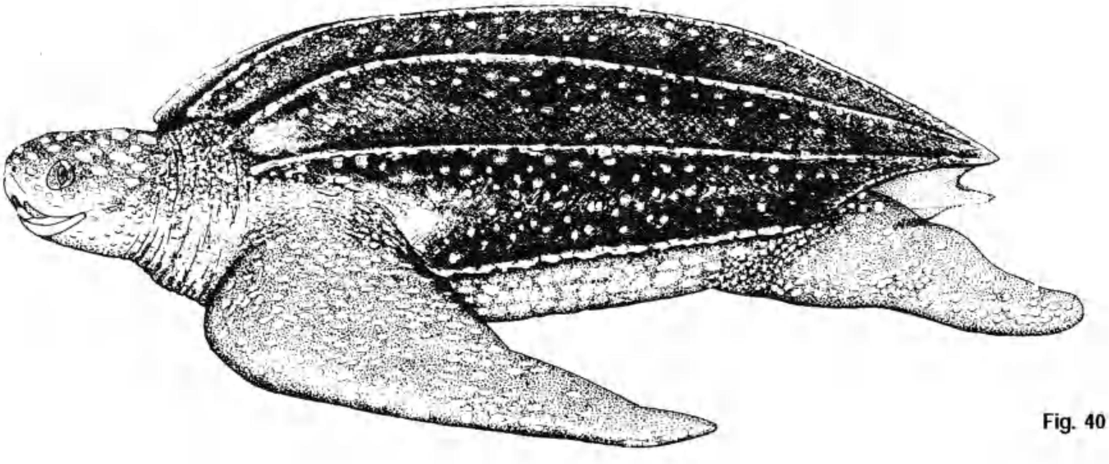
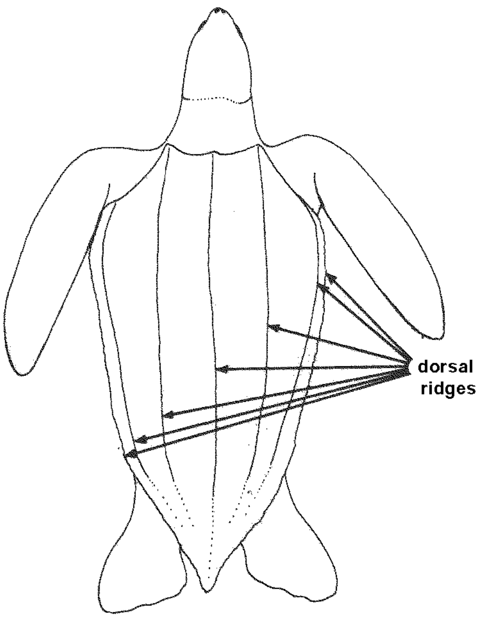


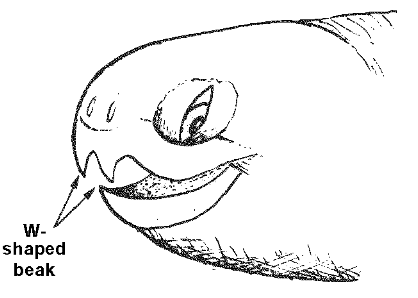
Fig. 40

Diagnostic Features : This is one of the largest living reptiles, surpassed in size only by some species of crocodiles. Adults are easily distinguished from all other species of sea turtles by their spindle-shaped huge bodies and their leathery, unscaled keeled carapaces. Furthermore, their anatomical and physiological features are different from those of other sea turtles, especially the presence of vascularized growth cartilages (chondro-osseus skeleton) and the development of an endothermy similar to that of marine mammals.

The head of the adult leatherback is small, round and scaleless, and equals 17 to 22.3% of the carapace length; beak feeble, but sharp-edged, lacking crushing surfaces, well adapted to grab sluggish pelagic food; upper jaw with two pointed cusps in front; lower jaw with a single, pointed central hook that fits between the upper cusps, when the mouth is closed, giving the appearance of a W in front view; part of mouth cavity and throat covered with rows of posteriorly-directed spine-like horny papillae that prevent the prey from moving outward. Carapace reduced and formed by a mosaic of small, polygonal osteodermic pieces, supported by a thick matrix of cartilaginous, oily dermal tissue, with 7 dorsal and 5 ventral longitudinal keels; dorsal keels (already present in hatchlings) converging posteriorly in a blunt end, much above the tail. The scales that cover the body in juveniles are lost in subadults and adults, which are covered by a rubber-like, leathery skin. Shell bones (such as neural, pleural, and peripheral bones) reduced in number or entirely absent; the preneural bone is well attached to the 8th vertebra and supports the neck elevator muscles; plastral bones reduced to a ring. Ribs apparently free, but embedded in the carapace cartilage. Flippers large and paddle-shaped; in adults, the fore flippers usually equal or exceed half the carapace length and thus are relatively longer than in other sea turtles; in hatchlings, they look enormous and are clearly as long as the carapace; rear flippers connected by a membrane with the tail; claws may be visible in hatchlings, but disappear in subadults and adults. **Colour**: adults show a certain variability in colour pattern. Dorsal side essentially black, with scattered white blotches that are usually arranged along the keels, becoming more numerous laterally and very dense beneath the body and flippers, so that the ventral side is predominantly whitish. Pinkish blotches on neck, shoulders and groin, becoming more intense when the turtle is out of the water, possibly by blood congestion in the skin vessels. Hatchlings and juveniles have more distinct white blotches which are clearly arranged along the keels. The density of the spots and also their size are highly variable among populations, but apparently show a certain constancy within each population.



dorsal view



head

Fig. 41

Males are distinguished from females mainly by their longer tail; they also seem to have a more narrow and less deep body. Apart from their short tail, females have a pink area on the crown of their head.

The eggs are covered by a soft white shell.

Geographical Distribution : Adult leatherbacks are adapted to colder water than other sea turtles, a capability that is due to their protective thick and oily dermis. As a result of this, the leatherback is the most widely distributed of all sea turtles; there are numerous records from higher latitudes, very far from the tropical and subtropical nesting grounds, where the water temperatures are between 10º and 20ºC. The species thus easily reaches the North Sea, Barents Sea, New Foundland and Labrador in the North Atlantic, and Mar del Plata, Argentina, and South Africa, in the South Atlantic; it also occurs throughout the Indian Ocean, in the northern Pacific, to the Gulf of Alaska and south of the Bering Sea, in the southwestern Pacific to Tasmania and New Zealand, and in the southeastern Pacific to Chiloé (Chile) (Fig. 42). In many of the central and south Pacific islands this species is well known, and also nests on some of them. Very little is known about the distribution of the hatchlings after they abandon the nests; juveniles and immatures are also difficult to observe.

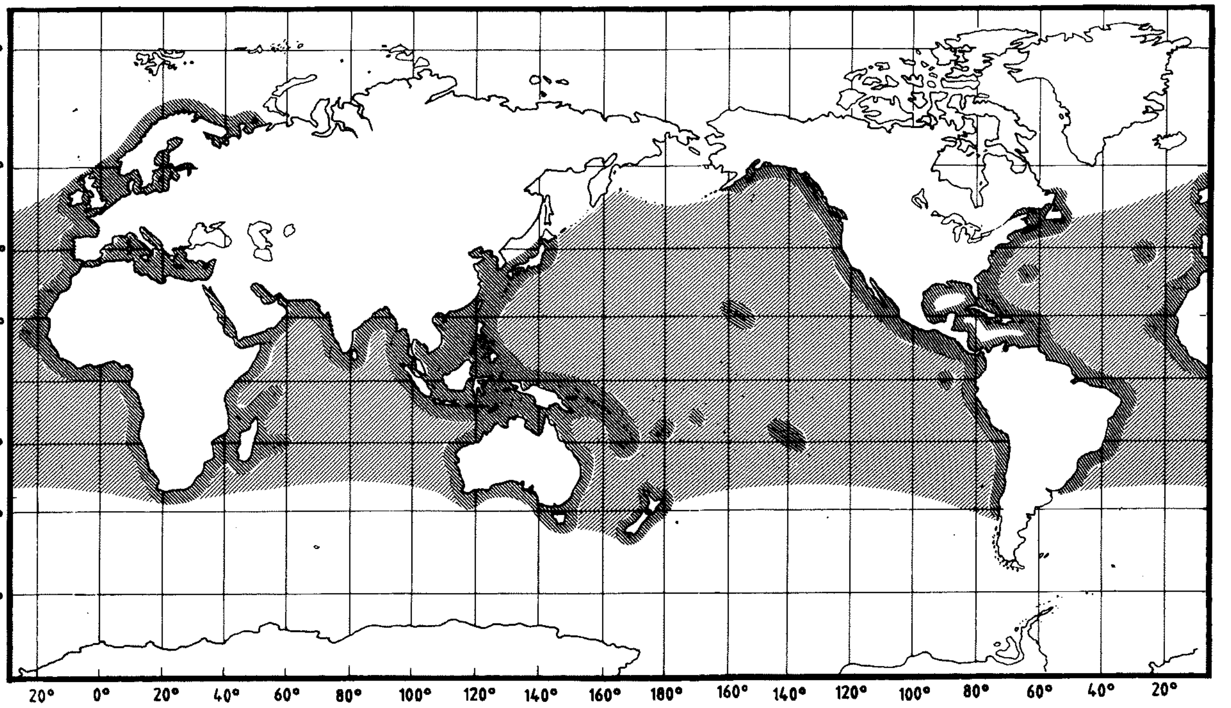


Fig. 42

Habitat and Biology : The leatherback turtle is a highly pelagic species that approaches coastal waters only during the reproduction season; although small groups of individuals have been reported moving in coastal waters in the middle of concentrations of jellyfish and tunicates, it seldom forms large aggregations (flotillas). When travelling, it apparently wanders erratically in search of food, but its migration routes are only recently being traced on the basis of tag-recovery reports. Until recently, this turtle was considered to be strictly epipelagic, but new observations have shown that it frequently descends into deep waters and that it is physiologically well adapted to deep-diving. Feeding behaviour is known for adults and subadults, but not for hatchlings and juveniles. It is assumed that this species is carnivorous throughout its life cycle; the adults feed mainly on jellyfish (Scyphomedusae), tunicates and other epipelagic soft-bodied invertebrates, that are abundant in the epipelagic region, with highest concentrations in upwelling areas and convergence currents.

Unlike most other sea turtles which nest during spring and summer, the leatherback usually nests in autumn and winter when it arrives in large groups at the nesting sites and forms “arribazones”. The rookeries are characterized by approaches of deep water, absence of fringing reefs, and high-sloped beaches that facilitate the landing of these corpulent animals. The nest is usually constructed just across the high tide mark and very often below it; in the latter case, the entire clutch is lost when water invades the nest during spring tides.

The location of the most important breeding grounds is as follows: **Eastern Pacific Ocean**: western coast of Mexico, with over 80 000 nests per year (biggest nesting aggregations in Mexiquillo, Tierra Colorada and Chacahua); scattered nesting occurs from Mexico to Panama, with only several thousand nests per year, most of them in Costa Rica (Playa Naranjo) and Panama; west coast of Colombia, Ecuador and Peru, but with no more than 500 nests per year. **Western Atlantic Ocean**: Caribbean: Trinidad and Tobago, 1 000 nests per year; Windward Islands, Leeward Islands and Virgin Islands (Mona, Culebra, Vieques); east coast of Puerto Rico; Dominican Republic, 500 nests per year; Costa Rica, between Tortuguero and Puerto Limon, with 5 000 nests per year; Panama and Colombia (Gulf of Urabd); between Surinam and French Guiana, 10 000 to 15 000 females are reported every year; other breeding grounds along the Atlantic coast of South America are located in Guyana, with 500 nests per year, and in Brazil (Espiritu Santo, Natal; between Sergipe and Para). **Eastern Atlantic Ocean**: only minor and solitary nesting is recorded from Mauritania, Senegal, Liberia, Ghana, Togo, Zaire and Angola; no nesting has been reported from the Mediterranean Sea in recent times. **Indo-Pacific region**: in the Western Indian Ocean, minor nesting takes place in Tongaland, Natal (100 nests per year) and Mozambique; occasional nesting occurs in Tanzania, Zanzibar, Kenya, the Seychelles, Somalia, South Yemen, Oman and on the Laccadive Islands; along the western coast of India, nesting occurs around Goa and in Kerala; for Sri Lanka, there was an important breeding ground in the past; today, only a few dozen nestings per year are recorded; major breeding sites are known in Malaysia, Terengganu, but with an alarming decline in number of nesting females (1950: 1 800 females; 1987: 100 females); exact figures are available for Irian Jaya, with up to 5 000 nesting females and about 20 000 nests per year; 50 nesting turtles were counted in southeastern Java, and 200 in Western Sumatra, with approximately 1 000 nests each year; negligible breeding occurs in eastern and northeastern

Australia; no nesting activities are known from the Central Pacific islands, but from the South Pacific islands: Papua New Guinea, the Solomon Islands, Vanuatu and Fiji; in China, nesting occurs in the provinces of Kuangtung, Fukien, Chekiang, Kiangsu, Shangtung and Liaoning.

The nesting season varies in extent, according to the latitude and geographical characteristics of the coast: **Eastern Pacific Ocean**: in Mexico, nesting occurs in autumn and winter, from October to February or March of the following year. **Western Atlantic Ocean**: in Colombia, French Guiana and Surinam, the season starts in March and ends in July, in Guyana it goes from January to March; in the Caribbean from spring to autumn (April to October), with a variation in Panama (Isla Cañas), where it lasts from March to June. **Eastern Atlantic Ocean**: for Senegal, nesting is reported from June to August; in South Africa it goes from October to February. **Indian Ocean**: nesting occurs from winter to spring as in the Seychelles (November to February) and the Andaman and Nicobar Islands (December to April), or from spring to summer, as in Sri Lanka (April to June) and India, Tamil Nadu (April to July); in West Malaysia it goes from May to September. **Western Pacific Region**: in China, the season runs from May to June, in Irian Jaya from May to September, in Australia from December to February, and on the Solomon Islands, nesting occurs from November to January.

Dermochelys coriacea has a nesting cycle of 2 or 3 years. Females usually lay 4 or 5 times per season (6 or 7 times on Culebra Island, Puerto Rico), depositing on each occasion from 61 to 126 eggs. Usually, about half of the clutch consists of smaller and yolkless eggs.

The size of the egg clutch varies from place to place, from a minimum of 46 to a maximum of 160 eggs per clutch.

Some examples are the following: **Mexico** - Michoacan, mean values of eggs per clutch are: 59.1 (1982-83, n = 86), 58.4 (1983-84, n=355), 61.5 (1984-85, n = 1 203), 60.6 (1985-86, n =987), 62.4 (1986-87, n =42), 52.9 (1987-88, n =35); in the period 1988-89, a mean of 66.1 normal sized eggs and a mean of 43.4 yolkless eggs per clutch (n = 758) were recorded; **Puerto Rico** - from 60 to 93 normal eggs, with a mean of 78.5 (n = 9), and 6 to 61 yolkless eggs, with a mean of 30.8 (n = 9); **Costa Rica** - Atlantic coast, from 46 to 128 normal eggs, with a mean of 81.6 (n = 47), and 9 to 77 yolkless eggs, with a mean of 29.8 (n = 46); Pacific coast, from 53 to 79 normal eggs per clutch, with a mean of 65.5 (n= 6), and 15 to 66 yolkless eggs, with a mean of 31.5 (n = 6); **Trinidad** - the clutch size ranges from 65 to 130 eggs (no detailed data available); **Surinam** - from 52 to 128 eggs, with a mean of 85.0 (n = 385); yolkless eggs from 1 to 60, with a mean of 23.0 (n = 195); **French Guiana** - in one count, eggs per clutch ranged from 50 to 148 (mean 84.3), in another 51 to 112 (mean 88.1, n = 19); yolkless eggs ranged from 9 to 57, with a mean of 29.1 (n = 19); **South Africa** - in Natal the mean values are 106 normal and 30 yolkless eggs per clutch; Tongaland from 58 to 160 eggs, with a mean of 103.9 (n = 252), and 3 to 57 yolkless eggs, with a mean of 30.0; **Andaman** and **Nicobar Islands** - mean values of 79 normal eggs and 23 yolkless eggs per clutch; **Australia** Queensland from 64 to 100 eggs, with a mean of 82.8 (n = 14) and 18 to 79 yolkless eggs per clutch, with a mean of 46.5 (n = 13); **Malaysia** - Terengganu from 58 to 160 eggs, with a mean of 82.3 eggs (n = 627); Sri Lanka - number of eggs per clutch range from 90 to 130, no other data available; **China** - 90 to 150 eggs per clutch, no other data available.

Together with the flatback of Australia, this species has the largest eggs and hatchlings among sea turtles. Data on egg diameter (range: 51.0 to 54.4 mm) and egg weight (range: 70.0 to 103.6 g) are relatively scarce. Variation in diameter is more marked in yolkless eggs.

Some examples are the following: **Mexico** - Mexiquillo: egg size from 45.6 to 59.2 mm, with a mean of 51.2 (n =420); egg weight from 54.5 to 93.4 g, with a mean of 76.7 g (n = 420); **Costa Rica** - Atlantic coast: egg size from 49.2 to 54.9 mm (20 eggs of 26 different clutches measured); egg weight from 72.6 to 103.6 g (20 eggs of 26 different clutches measured); size of yolkless eggs from 1 to 47 mm (n = 19 clutches); yolkless eggs made up 3 to 23% of the total weight of a clutch; clutch weights range from 4.02 to 13.39 kg, with a mean of 7.4 kg; Pacific coast: mean size of eggs 51.0 mm (n = 6 clutches), with yolkless eggs ranging from 15 to 45 mm; **Colombia** - egg size from 53.5 to 59 mm, with a mean of 56.1 mm (n =9 eggs); egg weight from 80 to 98.9 g, with a mean of 89.4 g (n =9 eggs); **Puerto Rico** - mean size of eggs 54.5 mm (n = 90 eggs); **Trinidad** - egg size range from 52 to 65 mm; **Surinam** - egg size from 50 to 57 mm, with a mean of 53.0 mm; **French Guiana** - mean egg diameter 65 mm; **South Africa** - Tongaland: egg size from 50 to 56 mm, with a mean of 53.1 mm (n = 165); **Andaman** and **Nicobar Islands** - egg size from 48.8 to 51 mm; **India** - egg size from 50 to 55 mm; egg weight from 70 to 80 g; **Sri Lanka** - egg size from 50 to 54 mm; egg weight from 61 to 85 g; **Australia** - Queensland: egg size from 51.1 to 56.2 mm, with a mean of 53.2 mm (n = 120 eggs; 12 clutches); egg weight from 74 to 90.8 g, with a mean of 81.9 g (n = 70 eggs; 7 clutches).

The incubation period varies from a minimum of 50 to a maximum of 78 days, and is correlated with temperature and humidity. In dry and warm weather, the incubation period is shorter, with a lower survival rate.

Mexico-Mexiquillo, 58 to 78 days (1980-81), with a mean of 65.2 days (n = 12 clutches, transfered nests); **Costa Rica** - Atlantic coast, 58 to 66 days for transfered nests, with a mean of 61.5 days; in Saint Croix, the incubation period varied from 60.3 to 63.9 days for undisturbed nests; **Puerto Rico** - 55 to 59 days, with a mean of 57.6 days (n = 9 clutches, transfered nests); **Surinam** - 60 to 70 days, with a mean of 64.1 days (n = 56 clutches); French **Guiana** - 1981: 59 to 74 days; 1982: 69 to 78 days: 1983: 67 to 76 days; 1984: 62 to 72 days; **South Africa** - Tongaland, 56 to 72 days; **Sri Lanka** - 58 to 65 days, with a mean of 60 days; **Malaysia** - 53 to 60 days for transfered nests; **Australia** - 60 to 61 days.

Size and weight of hatchlings vary between nesting sites, seasons and years. The straight carapace length (SCL) ranges from 51 to 68 mm, the mean weight from 37.6 to 48.6 g.

Data on size (SCL) and weight of hatchlings are available for the following places: **Mexico** - Mexiquillo, from 51.0 to 60.0 mm, with a mean of 56.1 mm and a mean weight of 39.4 g (n = 8 clutches, 78 hatchlings); Guerrero, from 57.7 to 65.3 mm, with a mean of 62.1 mm (n = 13); **Costa Rica** - Atlantic coast, from 54 to 63 mm, with a mean of 59.8 mm (n =6 clutches, 120 hatchlings) and a mean weight of 44.6 g (range: 40 to 50 g, n =6 clutches, 120 hatchlings); Saint Crow (Sandy Point), mean size 61 5 mm and body weight from 42.5 to 45.8 g; **Colombia** - from 58.6 to 62 mm, with a mean of 60.4 mm and a mean weight of 48.6 g (range 43.2 to 51.9 g, n = 7); **Trinidad** - 66 and 68 mm (n = 2 hatchlings); **Surinam** - from 57 to 61.3 mm, with a mean of 59.2 mm (n =27 hatchlmgs), **French Guiana** - one hatchling with 67 mm SCL and a weight of 46 g; **South Africa** - Tongaland, from 54.8 to 63.4 mm, with a mean of 58.7 mm (n = 131 turtles) and a mean weight of 37.3 g (range: 27.5 to 41 g, n =47 turtles), **Australia** - Queensland, from 51.4 to 65.2 mm, with a mean of 58.8 mm (n =4 clutches, 29 turtles) and a mean weight of 46.9 g (range: 38.3 to 54.2 g, n =4 clutches, 39 turtles)

There is only one published observation on courtship and mating. According to this report, courtship lasted for 20 minutes. When finally accepted by the female, the male mounted her carapace, embraced her with his flippers, and mating began.

Incubation time ranges from 50 to 70 or more days, in accordance with the weather. The optimal incubation temperature for eggs of this species is around 29ºC. There is evidence that sex determination is male-biased in cool temperatures and vice versa. The "pivotal temperature", defined as the temperature where a 1: 1 sex ratio occurs, ranges between 29.0ºC and 29.95ºC. Incubation experiments on 72 hatchlings and 11 embryos, carried out by the J. Monod Institute, Paris, indicate that an incubation below 28.75ºC results in phenotypic males, while incubation temperatures above 29.75ºC produce females.

Emergence of the hatchlings occurs mostly at night; after having reached the surface of the nest, they remain for some time half exposed, before they run rapidly to the surf zone. Predation occurs throughout the life-cycle, but is highest during incubation and emergence. Predators are the same as for other sea turtles, but the hatchlings of ***Dermochelys coriacea*** are too large for smaller predators. The eggs and embryos are consumed by ghost crabs (***Ocypode*** sp.), throughout the nesting range. in some cases, clutches are destroyed by ants or fungal and bacterial infections. Other predators are vultures (***Coragyps*** sp.), domestic and feral dogs, jackals, pigs and wild boars. Monitor lizards (***Varanus*** sp.) are important nest predators in South Africa (Tongaland), Australia (Queensland) and Sri Lanka. After emergence and while they are running to the surf zone, hatchlings are attacked by birds (vultures, kites, crows, grackles and owls) and mammals (genet cats, mongoose, skunks, racoons, coatis, opossums and jaguars). In the water, hatchlingsare captured by sea birds (frigates, gulls, etc.), carnivor fishes and squids.

Juveniles and adults are attacked by sharks. Bones of the leatherback turtle were recovered from the stomachs of killer whales (Orcinus orca). Plastic wastes are another cause of mortality, since the turtles confuse these materials with jellyfish and swallow them, thus clogging their throat, esophagus and intestines. In some areas, e.g. in French Guiana, high mortality of females is caused by roots and logs of dead mangroves that choke the turtles when they ascend the beach to nest.

Parasites, as trematodes (***Astrorchis renicapite***) and amoebae (***Entamoeba*** sp.), are found in the intestines. Commonly these turtles are covered by epibiontic organisms, e.g. barnacles (***Chelonibia*** sp., ***Conchoderma*** sp., ***Lepas*** sp., ***Stomatolepas*** sp., ***Platylepas*** sp., ***Balanus*** sp.) and parasitic isopods (e.g. ***Excollarana*** sp.). so far, no papillomatosis has been reported.

Dermochelys coriacea feeds mainly on pelagic invertebrates, such as jellyfishes and tunicates, pelagic crustaceans (***Libina*** sp., ***Hyperia*** sp.), juvenile fishes (***Trachurus*** sp., ***Urophycis*** sp.) and marine plants are ingested accidentally.

The feeding behaviour of hatchlings and juveniles is unknown, but is believed to be similar to that of adults. They are assumed to be pelagic, migrating along the borders of warm currents and eddies, in search of food.

Size : This species is not only the largest living sea turtle, but also one of the largest extant reptiles. The largest specimen ever recorded, was a male of 256.5 cm carapace length (CCL) and a body weight of 916 kg, found dead on Harlech Beach in Gwyneed, Wales, in September 1988. Although the exact age at first maturity is unknown, this species is believed to reach sexual maturity after 3 or 4 years, at a size of 1.25 m of straight carapace length. Data obtained from animals in captivity indicate that ***Dermochelys coriacea*** grows faster than any other marine turtle.

If not stated otherwise, the following data on size (SCL and CCL) and body weight refer to nesting females: **Mexico**: Mexiquillo, 1983-84: 129 to 163 cm SCL with a mean of 145.8 cm (n = 85); 1987-88: 124 to 162 cm SCL, with a mean of 144.4 cm (n = 52); 1988-89: 126.5 to 187.5 cm SCL, with a mean of 144.6 cm (n = 395); **Costa Rica:** Atlantic coast, Jalova Beach, 134.6 to 172.7 cm SCL, with a mean of 152.1 cm (n = 76); Pacific coast, 128 to 151 cm SCL with a mean of 141.0 cm (n = 18); in Saint Croix, Sandy Point, the straight carapace length of nesting females ranges from 137 to 176 cm and the body weight from 258 to 506 kg; **Puerto Rico:** 153 to 160 cm SCL (n = 2); **Trinidad:** 135 to 185 cm CCL, with a mean of 156.5 cm (n = 20); **Colombia:** 140 to 170 cm (CCL), with a mean of 155.6 cm (n = 7); **Guyana:** three females of 137.5, 152.5 and 162.5 cm SCL; **Surinam:** 143.3 to 164.5 cm SCL, with a mean of 153.8 cm (n= 16); the smallest female weighted 302 kg; **French Guiana:** 135 to 189 cm CCL, with a mean of 158.5 cm (n = 834); **Senegal:** one female measured 183 cm (SCL ?), the weight of another was calculated between 200 and 250 kg; for **India:** southeastern coast, only three length measurements (SCL ?) of non- nesting females are recorded, 213 cm (body weight 272 kg), 195 cm and 190 cm; **Sri Lanka:** 147.5 to 165 cm CCL, with a mean of 155.9 cm (n =4); the body weight of the smallest specimen was 301 kg, that of the largest 448 kg; **Australia:** Queensland, 150 5 to 174.5 cm CCL, with a mean of 162.4 cm (n = 9).

Data on size and weight of males and non-nesting females are rare.

Some examples are the following: **Canada:** Labrador Peninsula, one male with a carapace length of 165 cm and about 500 kg of body weight, and one female of 147 cm carapace length and 379 kg of body weight, both captured in September 1973; Nova Scotia, 106 to 177 cm carapace length (SCL ?), with a mean of 149 cm (n =9, 1889 to 1966), **USA:** Massachusetts, Cape Cod Bay, 124.5 to 170 cm CCL, with a mean of 144.8 cm (n =25); New Jersey, one stranded female that measured 145 cm (SCL); **Bardados Island;** Cattlewash Beach, one juvenile of 19 cm SCL; **Chile:** two specimens with 137 and 148 cm CCL; the holotype of ***Sphargis angusta*** Philippi, 1899, deposited in the Natural History Museum of Valparaiso, has a carapace length of 186 cm; **Madeira:** one female with a carapace length (CCL) of 166 cm; **Europe** Brongersma (1972) lists 188 records of the leatherback turtle (period: 1901-1970). but only for 11 specimens, all of them caught between June and September, information on size and weight is available, the carapace length ranged from 135 to 162 cm, and body weight from 494 to 1 069 kg, new data are available for **Greece,** where 11 subadults and adults were caught, their carapace length ranging from 123 to 180 cm; **Mauritania:** one female with 150 cm and two males with 143 and 155 cm of carapace length; another male weighed 600 kg; **Egypt,** Red Sea: two males with 168 and 143 cm of carapace length (CCL); **South Africa:**

nine records between 1969 and 1973; a juvenile of 76 cm SCL (body weight 27.3 kg), one male of 162 cm CCL (body weight 320 kg), and seven females with a carapace length (CCL) from 119 to 170 cm (body weight from 150 to 646 kg).

Interest to Fisheries : Adults are caught incidentally by set or drift nets used for pelagic fishing and by longlines used for tuna, sailfish, swordfish, and sharks. Generally speaking, there are no commercial fisheries for this species, although in some places it is used as bait in longline shark fisheries. In many countries, the leatherback population has been threatened by egg-harvesting, i.e. Malaysia and Sarawak, Surinam, the Guianas, Mexico (west coast) and Costa Rica; also in several of the Caribbean islands, where the leatherback was abundant two decades ago. In Terrengganu, Malaysia, the number of nesting females decreased from 1 800 in the fifties to not more than 100 in 1988.

The lack of an organized fishery for the adults of this species is partly due to the fact that they have no valuable scutes as the hawksbill, nor can they be used as a source of leather as the-olive ridley; however, they yield many litres of oil which was used in the past for caulking wooden boats and for oil lamps. The FAO Yearbook of Fishery Statistics does not report leatherback catches, but it is possible that catches are included under the item "Marine turtles n.e.i." (unidentified species).

Remarks : It is now considered an "endangered species" throughout its distributional range. It is included in Appendix I of the CITES and in the Red Data Book of the IUCN. No official statistics are available on catches of this species. In the majority of countries, this species is fully protected, but in many of them, legal enforcement of these protective measures is difficult. Hence, indiscriminate poaching of eggs on beaches and capture of adults in the sea or in nesting areas is still widespread. Rearing of this turtle in captivity was attempted on several occasions, without success, possibly because of the animal damaging itself by swimming mainly in one direction and hitting its snout against the wall of the container. However, several individuals have been reared for up to four years, before they died or were released.

Local Names : ALDABRA: Carembol; ANDAMAN ISLANDS: Sher-cacchua; BANGLADESH: Samudrik kasim: BRASIL: Canastra, Carepa becerra, Tartaruga de courot, Tartaruga grande encourada; CARIBBEAN REGION: Kawana; CAYMAN ISLANDS: Trunk; COLOMBIA: Bufeadora, Canal, Gaula; CHILE, ECUADOR, PERU: Tartaruga laud, Tortuga siete filos; CHINA: Leng-Pi-Gui; COSTA RICA, EL SALVADOR: Baula, Laúd; CUBA: Tinglado; FRANCE: Tortue luth; FRENCH GUIANA: Kawa-na; GERMANY: Lederschildkrote; GOLD COAST: Bosange, (Swahili): Noa; GUATEMALA: Baule, Licotea; GUYANA: Mata-mata; INDIA (Tamil-Nadu): Eluvarai-amai, Dhoni-amai, Thoni-amai; INDOCHINA (Vietnam): Ba-Tam; INDONESIA: Penyu belimbing, Labi-labi; (Irian Jaya): Kopem; ITALY: Sfargide, Tartaruga de luth, Tartaruga liuto; JAPAN: Osa game; MALAYSIA: Penyu belimbing; MEXICO: Tortuga laúd, Tortuga de cuero, Chalupa siete filos, Tinglada, Machincuepo, Galapago; MICRONESIA (Truk District): Mirang, Wongera; (Yap District-Central Carolines): Wonera; NEW GUINEA: Tonesu, Foakona, Goli, Tinuk, Veu, Epapo, Mabua, Latuk, Pwiri, Kuaurai, Peleleu, Wedara, Manibu, Bolu; NICARAGUA (Pacific): Tora; PANAMA: Tortuga de canal; PHILIPPINES: Pawican; PORTUGAL: Tartaruga; PUERTO RICO: Tinglar; RED SEA, EGYPT (Arabic): Na'ama; SENEGAL: Tortue luth, Tortue de cuir; SEYCHELLES: Torti karambol; SPAIN: Tortuga laúd; SRI LANKA: Dhara kasloave, Dhoni amai; SOUTH AFRICA: Irundu, Inhasa, Ronto, Valozoro; (Afrikaans): Leerrugseeskilpad; (Dutch): Lederschilpad; SURINAM: Aitkanti, Siksikanti: THAILAND: Tao-Ma-Fueung; UK, USA: Leathery, Luth, Leatherback, Leather-trunk turtle; VENEZUELA: Tortuga laud, Tres quillas, Chalupa.

Literature : Deraniyagala (1939); Yañez (1951); Carr (1952); Leary (1957); Loveridge & Williams (1957); Hendrickson (1961, 1962); Wermuth & Mertens (1961); Bleakney (1965); McCann (1966); Balasingam (1967); Capocaccia (1967); Huges & Mentis (1967); Hughes, Bass & Mentis (1967); Brongersma (1968, 1969, 1972); Moiseev (1969); Cadwell & Erdman (1969); Pritchard (1969, 1971, 1976, 1982a,b); Márquez (1970); Bacon (1971); Ferreira de Menezes (1972); Kaufman (1973); Rebel (1974); Schulz (1975, 1984 ms); Frazier (1975, 1984, 1987); Cornelius (1976); McConnaughey (1978); Threlfall (1978); Limpus, Neville & McLachlan (1979); Smith & Smith (1980); Rhodin *et al.* (1980); Meylan (1981); Bacon (1981); Sternberg (1981); Limpus (1981); Spring (1981); Kuan Tow (1981, 1988); Balazs (1981, 1982); Ramboux (1982); Groombridge (1982); Rhodin & Smith (1982); Rhodin & Schoelkopf (1982); Frazier & Salas (1982, 1984); Benabib (1983); Maigret (1983); Rajagopalan (1983); Eisemberg & Frazier (1983); Fritts, Hoffman & McGehee (1983); Limpus *et al.* (1984); Pritchard & Trebbau (1984); Baskar (in litt., 1985); Meylan & Ruiz (1985); Whitmore & Dutton (1985); Fretey & Lebean (1985); Frazier, Meneghel & Achaval (1985); Carr & Carr (1986); Dupuy (1986); Eckert *et al.* (1986); FAO (1986); Margaritoulis (1986); Matos (1986); Fretey (1986, 1987); Horrocks (1987); Eckert (1987, pers com.); Hirt & Ogren (1987); Fretey & Girondot (1987); Chan (1988); Limpus *et al.* (1988); Lutz (1988); Prescott (1988); Zangerl (1988); Alvarado & Figueroa (1988); Eckert & Eckert, (1988); Stinson (1989); Diaz *et al.* (1989); Dutton (pers.com.).

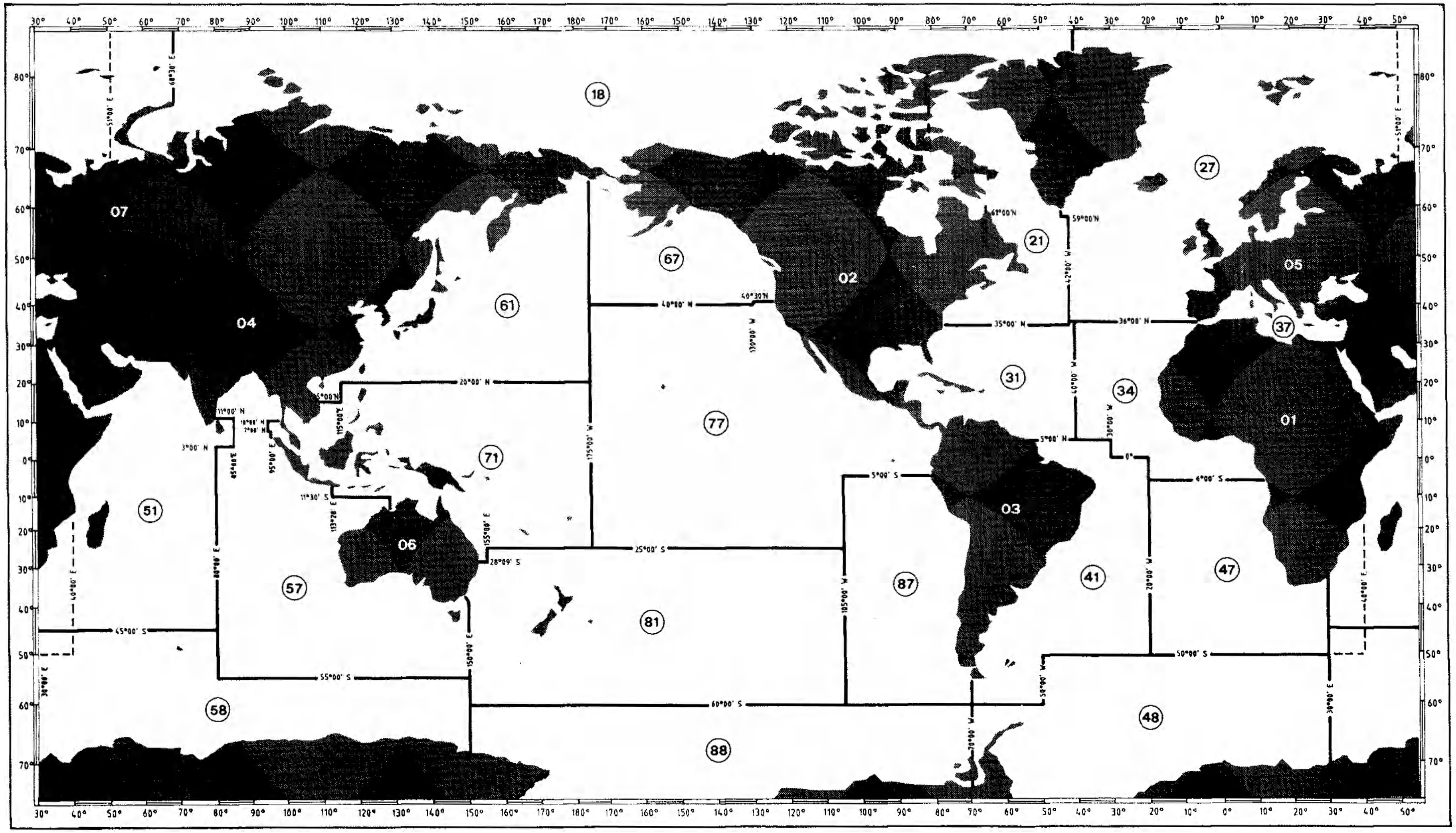
click for next page

click for previous page

3. LIST OF SPECIES BY MAJOR FISHING AREAS

SPECIES	PAGE	GEOGRAPHICAL DISTRIBUTION														
		MAJOR MARINE FISHING AREAS FOR STATISTICAL PURPOSES														
		21	27	31	34	37	41	47	51	57	61	67	71	77	81	87
Caretta caretta	14	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Chelonia agassizii	21											●		●		●
Chelonia mydas	25	●	●	●	●	●	●	●	●	●	●		●	●	●	
Eretmochelys imbricata	31	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Lepidochelys kempii	38	●	●	●	●	●										
Lepidochelys olivacea	43			●	●		●	●	●	●	●	●	●	●	●	●
Natator depressus	49									●			●		●	
Dermochelys coriacea	53	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

MAJOR MARINE FISHING AREAS FOR STATISTICAL PURPOSES



click for previous page

4. BIBLIOGRAPHY

Achaval, F., 1965. Hallazgo de ***Chelonia mydas*** (Linné) (Tortuga Verde) en el Uruguay. Rev.Oficial del Club Ancap., 108:27-28

Acuna, M.R. A., 1988. Influencia del cautiverio, peso y tamaño en la migración de los neonatos de ***Lepidochelys olivacea*** Eschscholtz (Testudines: Chelonidae). Rev.Biol.Trop., 36(1):97-106

Aguayo, C.G., 1953. La tortuga bastarda (***Lepidochelys olivacea kempii)*** en Cuba. Mem.Soc.Cubana Hist.Nat., 21(2):211-9, tabl.5

Alfaro, L.M., L.M. Blain & D.L. Munoz, 1987. "Evaluación de la población de tortugas marinas en el area de Buritaca a Don Diego (Magdalena) durante los meses de Mayo a Julio de 1987". Universidad de Colombia-Facultad de Biologia Marina. Informe de Trabajo (ms): 27 p.

Alvarado, J., & A. Figueroa, 1986. The ecological recovery of the sea turtles of Michoacan, Mexico. Special attention: The black turtle (***Chelonia agassizii***). Final Report to WWF US and US Fish and Wildlife Service, 1986, 69 p.

Alvarado, J.,A. Figueroa & H. Gallardo, 1985. Ecologia y coservacion de las tortugas marinas de Michoacán, de Mexico. Cuadernos de Investigación, UMSNH, Mexico, 4:44 p.

Argano, R. & F. Baldari, 1983. Status of Western Mediterranean Sea Turtles. Rapp. Comm. Int. Mer. Medit., 28(5):233-5

Babcock, H.L., 1919. Turtles of the Northeastern United States. Dover Pubs., Inc., NY, 105 p.

Bacon, P.R., 1971. Sea turtles in Trinidad and Tobago. Paper 13. Proc. 2nd Working Meeting of Marine Turtle Specialists Group. SS/IUCN. 8-10 March,1971. Morges, Switzerland. IUCN Pub. New. Ser., S.P.31:79-84

Balasingam, E., 1967. The ecology and conservation of the leathery turtle, ***Dermochelys coriacea*** (Linn.), in Malaya. Proc. 11th Pacific Sc. Congress, Tokyo:37-43

Balazs, G.H., 1980. Synopsis of Biological data on the green turtle in the Hawaiian Islands. NOAA Tech. Memorandum, NMFS., 141 p.

_______________, **1984.** Impact of ocean debris on marine turtles: entanglement and ingestion. In R.S. Shomura & H.O. Yoshida (eds): Proc. of the Workshop on the Fate and Impact of Marine Debris. 27-29 Nov. 1984, Hawaii: 1-38

_______________, **1981**. Status of sea turtles in the Central Pacific Ocean. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf.Sea Turtle Conserv.,Wash.,D.C.,26-30 Nov.1979, 243-52

Bastian, A.F., 1983. Nesting site and hatching of the hawksbill turtle along Tirunelveli Coast of Tamil Nadu. Mar.Fish.Infor.Serv. T. and E. Ser, 50:33-4

Battstrom, B.H., 1955. Notes on the herpetology of the Revillagigedo Island, Mexico. The American Midland Naturalist, 54(1):219-29

_______________, **1982.** Breeding of the green sea turtle, ***Chelonia mydas*** on the Islas Revillagigedo, Mexico. Herp. Review 13(3):71

Baur, G., 1890. The genera of the Chelonidae. Amer. Natur., 24:486-7

Benabib, N.M., 1983. Algunos aspectos de la biologia de ***Dermochelys coriacea*** en el Pacifico mexicano. UNAM-Facultad de Ciencias, (Tesis Prof.), 83 p.

Berry, F.H. *et al.*, 1983. The National Report for the country of United States of America. Western Atlantic Turtle Symposium, San Jose, C.R.,17-22 July, 1983 (eds: P. Bacon, F. Berry, K. Björndal, H. Hirt, L. Ogren and M. Weber), 3:423-88

Bhaskar, 5., 1979. Sea turtles survey in the Andaman and Nicobar. Hamadryad, 4 (3):26

Björndal, K. A. & A.B. Meylan, 1983. Sea turtles nesting at Melbourne Beach, Florida, 1. Size, growth and reproductive biology. Biol.Conserv., 26(1983):65-77

Björndal, K. A., *et al.*, 1985. Reproductive biology of the hawksbill ***Eretmochelys imbricata*** at Tortuguero, Costa Rica, with notes on the ecology of the species in the Caribbean. Biol.Conserv., 34:53-368

Bleakney, S., 1965. Reports of marine turtles from New England and Eastern Canada. Can. Field Nat., 792: 120-8

Bonnet.B.. J.Y. le Gall & G. Lebrun, 1980. Tortues Marines de la Réunion et des Iles Eparses. Conseil Régional de la Réunion, Université de la Réunion 25 p.

Boulenger, G.A., 1889. Catalogue of the chelonians, rhynchocephalians and crocodiles in the British Museum (Natural History). Brit.Mus. (Nat.Hist), London, 311 p.

Boulon (Jr.), R.,K Ecker & S. Ecker, 1988. ***Dermochelys coriacea*** (leatherback sea turtle). Migration. Herp.Review, 19(4):88

Bourret, R. & F. le Polain, 1941. Les tortues de l'Indochine. Avec une note sur la pêche et l'élevage des tortues de mer par F. Le Poulain. Notes Inst.Océanogr.Indochine Stn.Marit.Cauda, Nhatrang, (38):235 p.

Brongersma, L.D., 1968. Notes upon some turtles from the Canary Islands and from Madeira. Proc. Koninkl. Nederl. Akad. Wetensch., (C)71(2): 128-36

_______________, **1969.** Miscellaneous notes on turtles. IIA-B. Proc.Koninkl.Nederl.Akad.Wetensch., (C) 72(1):76-102

_______________, **1972.** European Atlantic turtles. Zool. Verhand. Leiden, 121:318 p.

_______________, **1981.** Marine turtles of the Eastern Atlantic Ocean. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtle Conserv., Wash., D.C., 26-30 Nov. 1979:407-16

Brooke, M. de L. & M. C. Garnet, 1983. Survival and reproductive performance of hawksbill ***Eretmochelys imbricata*** on Cousin island, Seychelles. Biol.Conserv., 25: 161-70

Bruno, S., 1973. Tartarughe marine nel Mediterraneo. In: III Simposio Nazionale sulla Conservazione della Natura, Bari, 2-6 Maggio 1973. II:11-2

Bustard, R., 1972. Sea turtles, their natural history and conservation. Taplinger Publ. Co., New York, 220 p., 16 figs, 24 pls

Bustard, R.H. & C. Limpus, 1969. Observations on the flatback turtle ***Chelonia depressa*** Garman. Herpetologica, 25(1):29-34

Bustard, R.H. & C. Limpus, 1971. Loggerhead turtle movements. Brit. J. Herpetol., 4(9):228-30

Caldwell, D. K., 1959. The Atlantic loggerhead sea turtle, ***Caretta caretta caretta*** (L.), in America. III. The loggerhead turtles of Cape Romain, South Carolina. Bull. Florida State Mus. Biol. Sci., 4(10):319-48

_______________, **1962.** Growth measurements of young captive Atlantic sea turtles in temperate waters. Los Angeles Co.Mus., Contrib.Sci., 50:1-8

_______________, **1962a.** Sea turtle in Baja California waters (with special reference to those of the Gulf of California), and the description of a new subspecies of northeastern Pacific green turtle. Los Angeles Co.Mus., Contrib.Sci., 61: 1-31

_______________, **1962b.** Carapace lenght - body weight relationship and size and sex ratio of the northeastern Pacific green sea trutle ***Chelonia mydas carrinegra.*** Los Angeles Co.Mus., Contrib.Sci., 62: 1-10

_______________, **1963.** The sea turtle fishery of Baja California, Mexico. Calif. Fish and Game, 49(3): 140-51

_______________, **1969.** Baby loggerhead turtles associated with Sargassum weed. Art. J Florida Acad.Sci., 31(4):271-2

_______________, **1969a.** Hatchling green turtles ***Chelonia mydas*** at sea in the northeastern Pacific Ocean. Bull. S. Calif. Acad. Sci., 68(2): 113-4

Caldwell, D.K. & A. Carr, 1957. Status of the sea turtle fishery in Florida. Transct. 22th North Am.Wildlife Conference, pp. 457-63

Caldwell, D.K. & D.S. Erdman, 1969. Pacific Ridley sea turtle ***Lepidochelys olivacea*** in Puerto Rico. Bull.So. Calif. Acad. Sci., 68(2): 112

Caldwell, D.K., A. Carr & T.R. Hellier, Jr., 1955. Natural history notes on the Atlantic loggerhead turtle ***Caretta caretta caretta.*** Quart.J.Acad.Florida Sci., 18(4):292-302

Capocaccia, L., 1966. Variabilità delta popolazione Mediterranea di ***Caretta caretta*** (L.). An. Museo Civico di Storia Naturale di Genova, 76:22 p.

________________, **1967.** La ***Dermochelys coriacea*** (L.) nel Mediterraneo (Reptilia, Testudinata). Atti dell' Academia Ligure di Scienze e Lettere, 24: 12 p.

Carl, G.C., 1955. The green turtle in British Columbia. Rep.Prov.Mus.Nat.Hist.Anthr., Victoria, B.C., 1954(8):77-8

Carr, A., 1952. Handbook of turtles of the United States, Canada and Baja California. Ithaca, Comstock Pub. Assoc., Cornell Univ. Press, 542 p.

________________, **1962.** Guidepost of animal navigation. BSCS Pamphlet no. 1:36 p.

________________, **1975.** The Ascencion Island Green Turtle colony. Copeia, 1975(3):547-55

________________, **1986.** New perspectives on the pelagic stage of sea turtle development. NOAA Tech.Mem.NMFS-SEFC, 190:36 p.

________________, **1986a.** Rips, fands and little loggerhead. Bio.Sci., 36(2):92-100

________________, **1987.** New perspectives on the pelagic stage of sea turtle development. Conservation Biology, 1(2):103-21

Carr, A. & M.H. Carr, 1972. Site fixity in the Caribbean green turtle. Ecology, 53(3):425-9

Carr, A. & H. Hirt, 1962. The ecology and migrations of sea turtles. 5. Comparative features of isolated green turtle colonies. Amer. Mus. Novitates, 2091:42 p.

Carr, A. & S. Stancyk, 1975. Observations on the ecology and survival outlook of the hawksbill turtle. Biol. Conserv., 8:161-172

Carr, A., H. Hirt & L. Ogren, 1966. The ecology and migrations of sea turtles. 6. The hawksbill turtle in the Caribbean Sea. Amer. Mus. Novitates, 2248: 1-29

Carr, A., L. Ogren & C. Mc Vea, 1980. Apparent hibernation by the Atlantic loggerhead turtle ***Caretta* caretta** off Cape Canaveral, Florida. Biol. Conserv., 19(1980-81):7-14

Carr, T. & N.Carr, 1986. ***Dermochelys coriacea*** (Leatherback sea turtle): Copulation. Herpetological Rev., 17(1):24-5

Carranza, J., 1956. Marine fisheries of the Yucatan Peninsula, Mexico. Proc. Gulf. and Carib. Fish. Inst., 9: 145-50

Casas, A. & S. Gomez-Aguirre, 1980. Contribución al conocimiento de los hábitos alimenticios de ***Lepidochelys olivacea*** y ***Chelonia mydas agassizi*** (Reptilia, Cheloniidae) en el Pacifico mexicano. Bolm. Inst. Oceanogr., S. Paulo, 29 (2):87-9

Chan, E.H., 1988. An update on the leatherback turtles of Rantau Abang, Terengganu, Malaysia. Mar.Turtle Newsletter, 42:4

Chu-Chien, H., 1981. Distribution of sea turtles in China Seas. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtles Conserv., Wash., D.C. 26-30 Nov. 1979

Cliffton, K. & D. Cornejo, 1983. The recovery of ***Chelonia mydas agassizii,*** the East Pacific green turtle of Mexico. Final Report to US Fish & Wildlife Service, 76 p.

Cornelius, S.E., 1976. Marine turtle nesting activity at Playa Naranjo, Costa Rica. Brenesia, 8:1-27

Deraniyagald, P.E.P., 1939. The tetrapod reptiles of Ceylon. Vol. I Testudinates and crocodilians. Ceylon Jour. Csi. Colombo Mus.Nat.Hist.Series, 412 p.

De Silva, G.S., **1969.** Turtle Conservation in Sabah. Sabah Soc.Jour., 5(1):6-26

_______________, **1981.** The status of sea turtles population in East Malaysia and the South China Sea. In K. Björdal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtle Conserv., Wash.,D.C., 26-30 Nov. 1979: 327-37

Diaz-M., L., *et al.*, 1989. Características biométricas de las tortugas ***Lepidochelys olivacea y Derrnochelys coriacea,*** anidadoras del Playón de Mexiquillo, Mich. VI Encuentro interuniversitario sobre tortugas marinas, Facultad de Ciencias, UNAM, Mexico. (Abstract)

Discovery Center Inc., 1987. Sea turtle conservation Project, Broward County, Florida, 1987 Report. Broward County Erosion Prevention District, Fort Lauderdale, Florida. 1987 Report:26 p.

Domantay, J.S., 1952-53. The turtle fisheries of the Turtle Islands. Bull.Fish.Soc.Philippines, Vol.3 & 4: 1-27

Donoso-Barros, R., 1964. Anotaciones sobre las tortugas marinas de Venezuela. Lagena, 3:26-31

_______________, **1966.** Reptiles de Chile. Santiago, University of Chile, 458 p.

Dood, Jr., C.K., 1988. Synopsis of the biological data on the loggerhead sea turtle ***Caretta caretta*** (Linnaeus 1758). US Fish.Wildl.Serv.Biol.Rep., 88(4): 110 p.

Dupuy, A.R.,1986. The status of marine turtles in Senegal. Mar.Turtle Newsletter, 39:4-7

Durán, N.J., 1989. Anidacion de la tortuga Carey ***Eretmochelys imbricata*** (Linnaeus 1766) en Isla Holbox, Q. Roo., Mexico. VI Encuentro interuniv. sobre tortugas marinas. Facultad de Ciencias, UNAM, Mexico, (Abstract)

Eckert, K.L., 1987. Environmental unpredictability and leatherback sea turtle ***Dermochelys coriacea*** nest loss. Herpetologica, 43(3):315-23

Eckert, K.L. & S.A. Eckert, 1988. Pre-reproductive movements of leatherback sea turtles ***(Dermochelys coriacea)*** nesting, in the Caribbean. Copeia, 1988(2):400-6

Eckert, K.L. & C. Luginbuhl, 1988. Death of a giant. Mar.Turtle Newsletter, 43:2-3

Ehrhart, L.M. & B.E. Witherington, 1986. Human and natural causes of marine turtle nest and hatchling mortality and their relationship to hatchling production on an important Florida nesting beach. Florida Game and Freshwater Fish Com. Nongame Wildlife Program. Tech-Rep., 1:141 p.

Eisenberg, J.F. & J. Frazier, 1983. A leatherback turtle ***(Dermochelys coriacea)*** feeding in the wild. Journal of Herpetology, 17(1):81-2

Ferreira de Menezes, M., 1968. Sôbre alimentaçâo da arauanâ, ***Chelonia mydas*** Linnaeus, ao longo da costa do Estado do Ceará. Arq.Est.Biol.Mar., Univ.Fed.Ceará, 8(1):83-6

_______________, **1972.** As tartarugas marinas do Brasil. Arq.Cien.Mar.Fortaleza, 12(1):17-20

Fletemeyer, J., 1984. Sea turtle monitoring report. Broward County Environmental Quality Control Board. 72 p.

_______________, **1985.** Sea turtle monitoring project report. Submitted to Broward County, Florida. Environmental Quality Control Board, Florida, 25 p.

Frazer, N.B. & L.M. Ehrhatt, 1985. Preliminary growth models for green, ***Chelonia mydas*** and loggerhead, ***Caretta caretta,*** turtles in the wild. Copeia, 1985(1):73-9

Frazier, J., 1971. Observations on sea turtles at Aldabra Atoll. Phil. Trans. R. Soc. Lond., (B) 260:373-410

_______________, **1975.** Marine turtles of the Western Indian Ocean. Rep. from Oryx, 13(2): 164-175

_______________, **1975a.** The status of knowledge on marine turtles in the Western Indian Ocean. East African Wildlife Society. Marine Turtle Survey. 10 p.

_______________, **1976.** Sea turtles in Tanzania. Tanzania Notes and Records, 77-78: 11-20

Frazier, J., 1979. Niche separation in Indian Ocean Turtles. American Zoologist, 19(3):955

———————, **1980.** Exploitation of marine turtle in the Indian Ocean. Human Ecology, 8(4):329-70

———————, **1981.** Status of sea turtles in Central Western Indian Ocean. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtle Conserv., Wash., D.C., 26-30 Nov. 1979: 385-90

———————, **1981a.** Sea turtle hunts throughout the world. Sea Turtle Rescue Fund-Center for Environmental Education. 16 p., 1 map.

———————, **1983.** Análisis estadistico de la tortuga golfina ***Lepidochelys olivacea*** (Eschscholtz) de Oaxaca, Mexico. Ciencia Pesquera, 4:49-75

———————, **1984.** Las tortugas marinas en el Atlåntico sur occidental. Asoc. Herpet. Arqetina, Ser. Div., 2:21 p.

———————, **1985.** Marine turtles in the Comoro Archipelago. North Holland Pub. Co., Amsterdam, Oxford, New York. 177 p. XVIII plt.

———————, **1985.** Misidentification of sea turtles in the East Pacific: ***Caretta caretta*** and ***Lepidochelys olivacea.*** Journal of Herpetology, 19(1):1-11

Frazier, J. & S. Salas, 1982. Tortugas marinas en Chile. Bol.Mus.Nac.Hist.Nat.Chile, 39:63-73

———————, **1983.** The marine turtle situation in the East Pacific. C.D.C. Newsleter, 2(1):7-10

———————, **1983a.** Tortugas marinas del Pacifico oriental: El recurso que nunca acabara? In: Simposio Conservación y Manejo Fauna Silvestre Neotropical. IX Cong.Lat. Am. de Zoologia. 9-15 Oct. Perú, 1983: 87-98

———————, **1984.** The status of marine turtles in the Egyptian Red Sea. Biol.Conserv., 30(1984):41-67

Frazier,J., M. Menechel & F. Achaval, 1985. A clarification on the feeding habits of ***Dermochelys* coriacea.** Journal of Herpetology, 19(1): 159-60

Fretey, J., 1986. Le statut des tortues marines en Guyane Française. Le Littoral Guyanais (Sepanguy Sepanrit): 179-90

———————, **1987.** Les tortues de Guyane Française: Données récentes sur leur systematique, leur biogéographie, leur ethologie et leur protection. Nature Guvanaise Sepanguy, 141 p.

———————, **1987a.** Nouvelle capture d'une tortue luth (***Dermochelys coriacea***) en Polynésie Française. Bull.Soc. Herp. Fr., 41:28-9

Fretey, J. & M. Girondot, 1987. Recensement des pontes de tortue luth, ***Dermochelys coriacea*** (Vandelli, 1761),sur les plages de Ya:Lima:Po - Les Hattes a Awara (Guyane Française) pendant la saison, 1986. Bull. Soc. Herp. Fr.,43:1-8

Fretey, J. & A. Lebeau, 1985. Capture d'une tortue luth ***Dermochelys coriacea*** (Vandelli,1761), en Polynésie Française. Bull. Soc. Herp.Fr., 33:37-42

Fretey, J. & L. Sanite, 1986. Fonctionnement de l'écloserie d'oeufs de tortues luths des hattes - Ya: Lima: Po (Guyane Française), Le Littoral Guyanais (Sepanguy Sepanrit): 191-6

Fritts, T.H., 1981. Marine turtles of the Galapagos Islands and adjacent areas of the Eastern Pacific on the basis of observations made by J. R. Slevin 1905-1906. Journal of Herpetology, 15(3):293-301

Fritis, T.H., 1982. Plastic bags in the intestinal tracts of leatherback marine turtles. Herpetological Rev., 13 (3), 72-3

Fritts, T.H., & W. Hoffman, 1982. Diurnal nesting of marine turtles in Southern Brevard County, Florida. Journal of Herpetology, 16(1):84-6

Garduno, A.M., 1983. Algunos aspectos de la protección de la tortuga de Carey, ***Eretmochelys imbricata*** (Linnaeus 1766) en las costas de Campeche. Mex.(Tesis Prof.), 76 p.

Garman, S., 1880. On certain species of Chelonioidae. Bull. Mus. Comp Zool., 6(6):123-6

Garman, S., 1908. Reports on the scientific results of the expedition to the Eastern Tropical Pacific. The reptiles of Easter Island. Bull. Mus. Comp. Zool., 52(1):14 p.

Garnet, M. & J. Frazier, 1979. ***Eretmochelys*** breeding biology in the Seychelles. American Zoologist, 19(3):517

Geldiay, R., T. Koray & S. Balik, 1981. Status of sea turtles populations ***(Caretta c. caretta*** and ***Chelonia m. mydas)*** in the northern Mediterranean Sea, Turkey. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc.World Conf.Sea Turtle Conserv., Wash., D.C.. 26-30 Nov. 1979:425-33

Gil-Hernández.R.A., 1988. Biologia y conservación de las tortugas marinas en el litoral central de Quintana Roo, México. Informe final 1987. CIQRO, 84 p.

Gramentz, D.,1988. Involvement of loggerhead turtle with the plastic, metal and hydrocarbon pollution in the Central Mediterranean. Reports Mar. Poll. Bull., 19(1):11-3

Grassman, M.A. & D.W. Owens, 1982. Development and extinction of food preferences in the loggerhead sea turtle, ***Caretta caretta.*** Copeia, 1982(4):965-9

Green, D., 1984. Long-distance movements of Galapagos green turtles. Journal of Herpetology, 18(2): 121-30

Green, D. & F. Ortiz-Crespo, 1981. Status of the sea turtle populations in the Central Eastern Pacific. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtle Conserv., Wash., D.C., 26-30 Nov. 1979:221-3

Groombridge, B., 1982. The IUCN Amphibia-Reptilia Red Data Book. Part. 1. Testudines, Crocodylia, Rhynchocephalia. IUCN. Gland, Switzerland, 426 p.

Gudger, E.W., 1919. On the use of the sucking fish for catching fish and turtles: Studies in ***Echeneis*** or rémora, II., Amer.Nat., 53(628):446-68

Hays-Brown, C., & W.M. Brown, 1981. Status of sea turtles in the southeastern Pacific: Emphasis on Peru. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc.World Conf.Sea Turtle Conserv., Wash., D-C., 26-30 Nov. 1979:235-40

Hendrickson, J.R., 1961. Conservation investigations on Malayan turtles. Malayan Nature Journal (Special Issue): 214-23

_______________, **1962.** The leathery turtle. Oryx , 6(6):335-7

Hirth, H.F., 1971. Synopsis of biological data on the green turtle ***Chelonia mydas*** (Linnaeus) 1758. FAO Fisheries Synopsis, FIRM/S85:75 p.

Hirth, H.F. & A.F. Carr, 1970. The green turtle in the Gulf of Aden and the Seychelles Islands. Verh. K. Ned. Akad. Wet. (Afd. Nat. Tweede Sect.), 58: 1-44

Hirth, H.F. & L.H. Ogren, 1987. Some aspects of the ecology of the leatherback turtle ***Dermochelys coriacea*** at Laguna Jalova, Costa Rica. NOAA Tech. Rep. NMFS, 56: 14 p.

Hoffman, B.A. & W.J. Conley, 1987. Update: Nesting Activity of Florida sea turtles. In VII Annual Workshop on Sea Turtle Biology and Conservation. 25-27 Feb. 1987, Wekiwa, Park, Florida. Posters Sessions, 1 plt.

Hoffman, W. & T.H. Fritts, 1982. Sea turtle distribution along the boundary of the Gulf Stream current off eastern Florida. Herpetologica, 39(3):405-9

Honna, Y. & S. Yoshie, 1975. A record of the Pacific ridley turtle ***Lepidochelys olivacea,*** from the coast of Niigata facing the Japan Sea, with description of some of the organs. Ann.Rep.Sado Mar.Biol.Stat.Niigata Univ., 5:1-g

Hopkins, S.R., et al., 1971. Biotic and abiotic factors affecting nest mortality in the Atlantic loggerhead turtles. In R.W. Dimmick (ed.): Proc. Thirty Second Annual Conf.Southeastern Assoc.Fish & Wildlife Agencies. SE. Assn.: 213-23

Horrocks, J.A., 1987. Leatherback in Barbados. Mar.Turtle Newsletter, 41:7

Hubbs, C.L., 1977. First record of mating ridley turtles in California, with notes on commensals, characters and systematics. Calif.Fish Game, 63(4):262-7

Hughes, G.R., 1974. The sea turtles of south-east Africa. I. Status, morphology and distribution. Oc.Res.Inst.South Afr.Invest.Rep., 35:144 p.

————————, **1975.** The marine turtles of Tongaland, VIII. The Lammergeyer, October. 22:9-18

————————, **1977.** Sea turtles - a simple guide to the Southern African species with notes of interest on their general biology, migrations and conservation status. Natal Parks Board, Pietermaritzburg, South Africa, 24 p.

————————, **1981.** Conservation of sea turtles in the Southern Africa region. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc World Conf.Sea Turtle Conserv., Wash.,DC. 26-30 Nov. 1979:397-404

Hughes, Gr. & M.T. Mentis, 1967. Further studies on marine turtles in Tongaland, II. The Lammergeyer, 3(7):55-72

Hughes,G.R., A.J. Bass & M.T. Mentis, 1967. Further studies on marine turtles in Tongaland, I. The Lammergeyer, 3(7): 1-54

Hurtado, M., 1984. Registros de anidación de la tortuga negra, ***Chelonia mydas*** en las Islas Galápagos. Bol.Cientifico y Tecnico, Guayaquil. Ecuador, 6(3):77-106

Hurtado, M., G. Corrales & K. Muentes, 1981. Participación de estudiantes universitarios en el programa de tortugas marinas. Instituto Nacional de pesca. Guayaquil, Ecuador.Bol.Inf., 2(5):24-9

Kamezaki, N.,1986. Notes on the nesting of the sea turtles in the Yaeyama Group, Ryukyu Archipelago. Japanese J. of Herpet., 11(3):152-5

————————, **1987.** Recapture of the hawksbill turtle ***Eretrnochelys imbricata*** (Linné), in the Yaeyama Islands, Ryukyu Archipelago. Galaxea, 6: 17-20

Kamezaki, N. & H. Yokochi, 1986. A record of casting juvenile hawksbill turtle ***Eretmochelys imbricata*** upon the Inomotejima Island. Akamata, 3:9-10

Kar, C.S. & S. Bhaskar, 1981. Status of sea turtles in the Eastern Indian Ocean. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc.World Conf.Sea Turtle Conserv., Wash., DC, 26-30 Nov. 1979: 365-72

Kaufman, R., 1966. Das Vorkommen von Meeresschildkröten in Kolumbien und Nutzung als Nahrungsquelle. Natur und Museum, 96(2):449

————————, **1971.** Report on status of sea turtles in Colombia. IUCN Publ. (ns.), Suppl.Pap., 31:75-8

————————, **1972.** Wachstumsraten in Gefangenschaft gehaltener Meeresschildkröten. I. Mitt.Inst. Colombo-Alemán Invest.Cient., 6: 105-12

————————, **1973.** Biologia de las tortugas marinas ***Caretta caretta*** y ***Dermochelys coriacea,*** de la costa Atlántica colombiana. Rev.Acad.Colombiana de Ciencias Exactas, Fisicas y Naturales, 16(54):67-80

————————,**1975.** Studies on the loggerhead sea turtle ***Caretta caretta caretta*** (Linné), in Colombia, South America, Herpetologica, 31(3):323-6

Khan, M.A.R.. 1982. Chelonians of Bangladesh and their conservation. Journal Bombay Nat.Hist.Soc., 79(1): 110-6

Kondo, Y ., 1968. Aka umi game ***Caretta caretta olivacea*** (Eschscholtz) preliminary survey of nesting loggerhead turtles in the beach of Hiwasa. Japan-Private Print, Japan. 96p (in Japanese)

Kowarski, J., 1978. Observations on green turtles ***(Chelonia mydas)*** in Northeastern Australia during the 1975/76 nesting season. Biol. Conserv., 13:51-62

Kuan-Tow, S., 1988. Proposed strategy for sea turtle conservation in Malaysia. Int. Symp. on Sea Turtles in Hiawasa 1988. Marine Turtle Specialist Group/IUCN, Hiwasa Community Center. (Abstract)

Kuan-Tow, S. & E.O. Moll, 1981. Status and conservation of estuarine and sea turtles in the West Malaysia waters. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtle Conserv., Wash., D.C., 26-30 Nov. 1979: 339-47

Kurata, Y., *et al.*, 1978. Experiments to increase numbers of green sea turtles through the release of the young (VII. Aoumigame Sosho-ku Horyu Shinken). Ogasawara Fish.Center, Tokyo Met. Gvn., Res. Rep., 3:58-80 (Japanese,Trad.: Tamio Otsu), Southwest Fish. Center, Honolulu Lab., NMFS, 1981,27 p.

Kuriyan, G.R., 1950. Turtle fishing in the sea around Krusadai Island. Journal Bombay Nat. Hist. Soc., 49:509-12

Kushlan, J.A., 1986. Atlantic loggerhead turtle nesting status in Southwest Florida. Herpetological Rev., 17(2):51-2

Lazell, L.D., 1979. Boreal and temperate migratory regimes of Atlantic marine turtles. American Zoologist, 19(3): 953 (Abstract)

Lebeau, A., 1986. Un essai de grossissement en captivité de la tortue verte ***Chelonia mydas*** réalisé a Tahiti (Polynésie Française). Rev. Trab. Inst. Peches Marit., 48(3-4):143-54

Le Poulain, F., 1941. Note on the sea of the Gulf of Siam. In Tortues de L'Indochine. Note by L. Bourret. Inst. Océanogr. Indochine Stn. Marit. Cauda, Nhatrang, 38:215-8

Lewis, C.8.,1940. The Cayman Islands and marine turtles. Bull.Inst. Jamaica. Science Series, 2:56-65

Limpus, C., 1971. The flatback turtle, ***Chelonia depressa*** Garman, in southeast Queensland, Australia. Herpetologica, 27(4):431-46

———————, **1978.** The reef: uncertain land of plenty. In H.J. Lavery (ed.): Exploration north, a natural history of Queensland. Richmond Hill Press, Richmond, Victoria, Australia, 249 p. (pages 187-222)

———————, **1980.** New national parks protecting turtle habitat in Queensland. Mar. Turtle Newsletter, 15:11-2

———————, **1981.** The status of Australian sea turtle populations. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtle Conserv., Wash., D. C., 26-30 Nov. 1979: 297-303

———————, **1984.** A benthic feeding record from neritic waters for leathery turtle ***(Dermochelys coriacea).*** Copeia, 1984(2):552-3

———————, **1986.** Sea Turtles. Oceans 29(2):98-9

———————, **1987.** Sea Turtles. In J. Covacevich *et al.* (eds): Toxic Plants and Animals. A guide for Australia. (pages 188-93)

Limpus, C. & P. Reed, 1985. The loggerhead turtle, ***Caretta caretta,*** in Queensland: observations on internesting behaviour. Aust. Wildl. Res., 12:535-40

Limpus, C., A. Fleay & V. Baker, 1984. The flatback turtle, ***Chelonia depressa***, in Queensland: reproductive periodicity, phylopatry and recruitment. Aust.Wildl.Res., 11:579-87

Limpus, C., E. Gyris & J. Miller, 1988. Reassessment of the taxonomic status of the sea turtle genus ***Natator*** McCulloch, 1908, with a redescription of the genus and species. Transactions of the Roval Society of South Australia, 112:1-9, plt.I

Limpus, C., J, Miller & A. Fleay, 1981. The olive ridley turtle ***Lepidochelys olivacea*** recorded from south Queensland. Herpetofauna, 12(2):2-3

Limpus, C., J. Miller, V. Baker & E. McLachlan, 1983. The hawksbill turtle ***Eretmochelys imbricata*** (L.), in north-eastern Australia: The Campbell Island Rookery. Aust.Wildl. Res., (10): 185-97

Limpus, C. *et al.*, 1983a. The Crab Island sea turtle rookery in the north-eastern Gulf of Carpentaria. Aust. Wild. Res., 1983(10) : 173-84

———————, **1983b.** The flatback turtle ***Chelonia depressa*** in Queensland; post-nesting migration and feeding ground distribution. Aust. Wildl.Res.,1983(10):557-61

———————, **(in press).** The sea turtle rookeries of north western Torres Strait. Austr.Wildl.Res.

Loveridge, A. & E. Williams, 1957. Revision of the African tortoises and turtles of the suborder Cryptodira. Bull. Mus. Comp. Zool., Harvard Univ., 115(6):161-557

Maigret, J., 1983. Repartition des tortues de mer sur les côtes ouest Africaines. Bull. Soc. Herp. Fr., 1983(28):22-34

———————, **1986.** Statut actuel des tortues de mer en Mediteranée. Rapp. Comm, int. Mer Médit., 30(2):243

Margaritoulis, D., 1983. The inter-nesting interval of Zakynthos loggerheads. In N.S. Margaris *et al.* (eds): Adaptation to terrestrial environments. Plenum Press, New York (pages 135-44)

———————, **1985.** Preliminary observations on the breeding behaviour and ecology of ***Caretta caretta*** in Zakynthos, Greece. In 2éme Cong. Int. sur la Zoogéographie et L'Ecologie de la Gréce et des Regions avoisinantes. Athènes, Sept. 1981. Biologia Gallo-Hellenica, 10:323-32

———————, **1986.** Captures and strandings of the leatherback sea turtle ***Dermochelys coriacea,*** in Greece (1982-1984). Journal of Herpetology, 20(3):471-74

Margaritoulis, D., T. Arapis, E. Kornaraki & C. Mytilineou, 1986. Three specimens of the green sea turtle ***Chelonia mydas*** (L.), recorded in Greece. Biologia Gallo-Hellenica, 12:237-43

Marquez M., R., 1970. Las tortugas marinas de Mexico. (Tesis pro ms), 184 p., 22 figs.

———————, **1978.** Sea turtles. In W. Fischer (ed.): FAO species identification sheets for fishery purposes. Western Central Atlantic (fishing area 31), Vol.6, FAO, Rome, Italy

———————, **1978a.** Natural reserves for the conservation of marine turtles of Mexico. Fla. Mar. Res. Pub., 33:56-60

———————, **1981.** Sea turtles. In W. Fischer, G. Bianchi & W.B. Scott (eds): FAO species identification sheets for fishery purposes. Eastern Central Atlantic (fishing area 34 and part of 47). Vol.6, FAO, Rome, Italy

———————, **1984.** Sea turtles. In W. Fischer & G. Bianchi (eds): FAO species identification sheets for fishery purposes. Western Indian Ocean (fishing area 51), Vol.5, FAO, Rome, Italy

Marquez M., R., & M.-L. Bauchot, 1987. Tortues. In W. Fischer, M.-L. Bauchot & M. Schneider (eds): Fiches FAO d'identification des especes pour les besoins de la pêche (révision 1). Mediterranee et Mer Noire. Zone de pêche 37. Vol.2. Vertébrés: 1422-38, FAO, Rome, Italy

Márquez M., R. & T. Doi, 1973. Ensayo teórico sobre el análisis de la población de tortuga prieta, ***Chelonia mydas carrinegra Caldwell,*** en aguas del Golfo de California, Mexico. Bull.Tokai Reg.Fish. Res.Lab., 73: 1-22

Marquez M., R., & T.H. Fritts, (in press). Prospección aerea para tortugas marinas en la costa mexicana del Golfo de Mexico y Caribe, 1982-1983, submitted to Ciencia Pesquera, INP-Mexico, 18 p.

Márquez M., R. & H. G. Van Dissel, 1982. A method for evaluating the number of massed nesting olive ridley sea turtles, ***Lepidochelys olivacea,*** during an arribazón, with comments on arribazón behaviour. Netherlands Journal of Zoology, 32(3):419-25

Marquez M., R., A. Villanueva & C. Penaflores, 1976. Sinopsis de datos biológicos sobre la tortuga golfina ***Lepidochelys olivacea*** (Eschscholtz. 1829). INP, Sinopsis sobre la Pesca (INP/S2,SAST), 2:61 p.

Marquez M., R. *et al.*, 1981. A model for diagnosis of the population of olive ridleys and green turtles of West Pacific Tropical coasts. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtle Conserv., Wash., D.C., 26-30 Nov. 1979: 159-64

Martinez, E.D., 1984. ***Caretta caretta caretta*** (L.) en la Bahia Blanca, Argentina, (Cheloniidae) (1). Historia Nat. Corrientes Argentina. 4(21):209-12

Matos. R., 1986. Sea turtle hatchery project with specific reference to the leatherback turtle ***(Dermochelys coriacea).*** Humacao, Puerto Rico, 1986 Natural Reserves Refuges Division, Department of Natural Resources, 24 p.(ms)

McAllister, H.J., A.J. Bass & H.J. van Schoor, 1965. The marine turtles on the coast of Tongaland, Natal. The Lammergever, 3(2): 10-40

McCann, C., 1966. The marine turtles and snakes occurring in New Zealand. Rec.Dom.Mus. (Wellington), 5(21):201-15

McConnaughey, B.H., 1978. Introduction to marine biology. The C.U. Mosby Co., 3rd ed., 624 p.

McCoy, M.A., 1974. Man and turtle in the Central Carolines. Reprinted from Micronesva, 10(2):207-21

McGeehe, M.A., 1979. Factors affecting the hatching success of loggerhead sea turtle eggs (***Caretta caretta caretta***). M.S. thesis, University of Central Florida, Orlando, 252 p.

Mendonça, M.T., 1981. Comparative growth rates of wild immature ***Chelonia mydas*** and ***Caretta caretta*** in Florida. Journal of Herpetology, 15:447-51

——————, **1983.** Movements and feeding ecology of immature green turtles ***(Chelonia mydas)*** in Florida Lagoon. Copeia, 1983(4): 1013-23

Mendonça, M.T. & L.M. Ehrhart, 1982. Activity, population size and structure of immature ***Chelonia mydas*** and ***Caretta caretta*** in Mosquito Lagoon, Florida. Copeia, 1982(1):161-7

Menezes, M.F., 1976. As tartarugas marinhas do Brasil. Arg. Cien. Mar., 12(1): 17-20

Meza, Ch.B.F., 1989. Presencia de tortuga Carey ***Eretmochelys imbricata.*** Playa Platanitos, Nay. Méx. VI Encuentro Interuniv. sobre Tortugas Marinas. Fac. Ccias. Marinas. (Abstract)

Meylan, A.B.. 1983. Marines turtles of the Leeward Islands, Lesser Antilles. Atoll Res. Bull., 278:43p

——————, **1985.** The role of sponge collagen: in the diet of the hawsksbill turtle ***Eretmochelys imbricata.*** (eds A. Bairati and R. Garrone) Plenum Publ. Corp., Gainesville, Fl., USA.: 191-6

——————, **1988.** Spongivory in hawksbill turtles: A diet of glass. Science, 239: 393-5

——————, **1989.** Hawksbill turtle ***(Eretmochelys imbricata).*** Status Report. In L. Ogren *et al.* (eds): Proceedings Second Western Atlantic Turtle Symposium. Mayaguez, P.R., 12-16 Oct. 1987. NOAA Tech.Mem., NMFS-SEFC-226;101-21

Milliken.T. & H. Tokunaga., 1987. A special report prepared by TRAFFIC (Japan). W.W.F. Center for Environmental Education. Washington, D.C., 171 p.

Mohanty-Hejmadi, P. & M. Dimond. 1986. Temperature dependent sex determination in the olive ridley turtle. Progress in Developmental Biology, part A: 159-62

Mohanty-Hejmadi, P., M. Behera & M. Dimond, 1985. Temperature dependent sex differentiation in the olive ridley ***Lepidochelys olivacea*** and its implications for conservation. Proc. Symp. Endanaered Marine Animals and Marine Parks. Cochin, India, 1:260-3

Moiseev, P.A.. 1971. The living resources of the world ocean. NMFS-NOAA, Israel Program for Scientifical Translation Ltd., 334 p.

Montenegro, S.B., N.G. Bernal & A. Martinez G., 1986. Estudio del contenido estomacal de la tortuga marina ***Lepidochelys olivacea,*** en la costa de Oaxaca, Méx. An. Inst. Cienc. del Mary Limnol. UNAM, Mexico., 13(2):121-32.

Moreira A.,& M. Benitez, 1986. Informe Nacional - El Salvador. In R, Márquez *et al.* (eds): I Simp. Tortugas Marinas Pac. Amer. San Jose, C.R., 2-6 Dic., 1985. (Abstract)

Mortimer, J. A., 1981. The feeding ecology of the West Caribbean green turtle ***(Chelonia mydas)*** in Nicaragua. Biotropica, 13(1):49-58

Mrosovsky, N., 1971. Black vultures attack live turtle hatchlings. The Auk, 88(3):672-3

——————, **1983.** Conserving sea turtles. The British Herpetological Soc. of London, 176 p.

Musick, J. *et al.*, 1983. Mortality and behaviour of sea turtles in the Chesapeake Bay. Summary Report for 1979 through 1983. Virginia Institute of Marine Science, Contract NA80FAC00004. Submitted to NMFS-Northeast Region, 102 p.

Nat.Fish. & Wildlife Lab., 1980. Selected vertebrate endangered species of the seacoast of the United States - green sea turtle. Biological Services Program, FWS/OBS-80/01. 13:9 p.

Nelson, E. W., 1966. Lower California and its Natural Resources. Reprod. of: E. W. Nelson's, 1922. National Acad. Sci., XVI. (First Memoir), 194p.

Nietschmann, B., 1981. Following the underwater trail of a vanishing species - the hawksbill turtle. Nat.Geogr. Soc. Res. Reports. 13:459-80

Nishimura, S., 1967. The loggerhead turtles in Japan and neighboring waters (Testudinata: Cheloniidae). Publ. Seto. Mar. Biol. Lab., 15(1): 19-35

Ogren, L., 1983. Draft national report for the country of Colombia. In P. Bacon *et al.* (eds): Western Atlantic Turtle Symposium, 17-22 July, 1983. Sn. Jose, Costa Rica, 3: 123-30

Ogren, L., & C. McVea (Jr), 1981. Apparent hibernation by sea turtles in North American water. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtles Conservation. Wash., D.C., 26-30 Nov. 1979: 127-32

Ogren, L.H.,J.W. Watson (Jr) & D.A. Wickham, 1977. Loggerhead sea turtles, ***Caretta caretta,*** encoutering shrimp trawls. Marine Fisheries Review, 1270: 15-7

Oliver, J.A., 1946. An aggregation of Pacific sea turtles. Copeia, 1946(2):103

Parmenter, C.J., 1983. Reproductive migration in the hawksbill turtle ***Eretmochelys imbricata.*** Copeia, 1983(1):271-3

Pascual, X., 1985. Contribución al estudio de las tortugas marinas en las costas españolas. I. Distribución. Misc. Zool., 9: 287-94

Peters, J.A., 1954. The amphibians and reptiles of the coast and coastal sierra of Michoacan, Mexico. Occ. Papers MUS. Zool. Univ. Mich., 554: 1-37

Phasuk, B., & S. Rongmuangsart, 1973. Growth studies on the olive ridley turtle, ***Lepidochelys olivacea olivacea*** Eschscholtz, in captivity and the effect of food preference on growth. Phuket Mar.Biol.Cent.Res.Bull., 1:14p.

Polunin, N.V.C., 1975. Sea turtles. Reports on Thailand, west Malaysia and Indonesia, with a synopsis of data on the conservation status of sea turtles in the Indo-West Pacific region. Dep.of Zoology, Cambridge, 113 p. (ms)

Polunin, N.V.C. & N. Sumertha-Nuitja, 1981. Sea turtles populations of Indonesia and Thailand. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf.Sea Turtle Conserv., Wash., D.C., 26-30 Nov. 1979: 353-62

Pope, C.H., 1935. The reptiles of China - turtles, crocodilians, snakes, lizards. Natural History of Central Asia. Vol.10. American Museum of Natural History, New York, 604 p.

Pritchard, P.C.H., 1966. Sea turtles of Shell Beach, British Guiana. Copeia, 1966(1):123-5

———————, **1969.** Sea turtles of the Guianas. Bull. Fla. State Mus., Biol.Sci., 13(2):85-140

———————, **1971.** Galapagos sea turtles: preliminary findings. Journal of Herpetology, 5: 1-9

———————, **1971a.** Sea turtles in the Galapagos. Paper 4. IUCN Publ.(n.s.), Suppl.Pap., 31:34-7

———————, **1977.** Marine turtles of Micronesia. Chelonia Press, San Francisco, 83 p.

———————, **1979.** Encyclopedia of turtles. T.F.H. Publ., Inc., Jersey City, 895 p.

Pritchard, P.C.H. & P. Trebbau, 1984. The turtles of Venezuela. Soc. Study Amph. and Rept., Contrib. Herpetol., 2:403 p., 47 plt., 16 maps

Raj, V., 1976. Incubation and hatching success in artificially incubated eggs of the hawksbill turtle ***Eretmochelys imbricata*** (L.). J. Exp. Mar. Biol. Ecol., 22:91-9

Rajagopalan, M., 1983. Leatherback turtle ***Dermochelys coriacea*** washed ashore at Kovalam, Madras. Marine information Service, Special Issue on Management and Conservation Sea Turtles. Central Mar. Res. Inst., Cochin, India. Tech. and Extension Series, 50:35-6

Ramboux, A.C., 1982. Programa de protección de las tortugas marinas en la costa sur-oriental del Pacifico. Resultados de la temporada de 1981. Acuicultura Experimental. Guatemala. Gua/81/004 Doc. de Campo, 1:42 p.

Rebel, T.P. (ed.), 1974. Sea turtles and the turtle industry of the West Indies, Florida and Gulf of Mexico. (Rev. ed. 1949 by R. M. Ingle and F.G.W.Smith) University of Miami Press, Coral Gables, Florida, 250 p.

Rhodin, A.J. & R.C. Schoelkopf, 1982. Reproduction data on a female leatherback turtle ***Dermochelys coriacea,*** stranded in New Jersey. Copeia, 1982(1):181-3

Rhodin, A.J. & H.M. Smith, 1982. The original authorship and type specimen of ***Dermochelys coriacea.*** Journal of Herpetology, 16(3):316-7

Rhodin, A.J., J.A. Ogden & G.J. Conlogue, 1980. Preliminary studies on skeleton morphology of the leatherback turtle. Mar.Turtle Newsletter, 16:7-9

Rhodin, A.J., S. Spring & P.C.H. Pritchard, 1980. Glossary of turtle vernacular names used in the New Guinea region. Jour.Polynesian Soc., 89(1):105-17

Rimblot, F. *et al.*, 1985. Sexual differentiation as a function of the incubation temperature of eggs in the sea turtle ***Dermochelys coriacea*** (Vandelli,1761). Amphibia-Reptilia, 6 (1985):83-92

Romer, A.S., 1956. Osteology of the Reptiles. Univ. Chicago Press, Chicago, 772 p.

Rosales-Loessener,F., 1985. Informe sobre la situacibn actual de las tortugas marinas de la costa del Pacifico de Guatemala. Min. de Agr. y Gan., Dir. Tec. de Pesca y Acuic., 9 p.

Ross, J.P., 1972. Sea turtles in the Sultanate of Oman. Rep. for World Wildlife Fund, (Project. 1320). 54 p.

______________, **1981.** Historical decline of loggerhead, ridley and leatherback sea turtles. In K. Björndal (ed.):Biology and conservation of sea turtles. Proc. World Conf. Sea Turtle Conserv., Wash., D.C., 26-30 Nov. 1979: 189-95

______________, **1985.** Biology of the green turtle ***Chelonia mydas*** on an Arabian feeding ground. Journal of Herpetology, 19(4): 459-68

Ross, J.P. & M. A.Barwani, 1981. Review of sea turtles in the Arabian Area. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtle Conserv., Wash., D.C., 26-30 Nov. 1979: 373-83

Routa, R.A.. 1968. Sea turtle nest survey of Hutchinson Island, Florida. Quart. J. Florida Acad. Sci., 30(4):287-94

Salas, F.S. *et al.* 1988. Sea Turtles in Fujian and Guangdong Provinces. Acta Herpetologica Sinica, 1983(3): 16-46

Schafer, E.F., 1962. Eating turtles in ancient China. J. Amer. Oriental Soc., 82(1):73-4

Schleich, H.H., 1987. Contributions to the herpetology of Kouf National Park (NE- Libya) and adjacent areas. Spixiana 10(1):37-80

______________, **1987a.** Herpetofauna Caboverdiana. Spixiana (supplement) 12: 1-75

Schroeder, B.A., 1987. Sea turtle stranding and salvage network Atlantic and Gulf Coasts of the United States. NMFS - Coastal Resources Div., Contr. No. CRD-87/88-12, 45 p.

Schroeder, B.A. & A. A. Warner, 1988. Annual report of the sea turtle stranding and salvage network Altantic and Gulf Coasts of United States, January-December 1987. NMFS-Coastal Resources Div., Contr. NO. CRD-87/88-28.45 p.

Schulz, J.P., 1975. Sea turtles nesting in Surinam. Nederl. Comm. Internatl. Natuurbesch. Meded., 23: 143 p.

————————, **1984.** Turtle conservation strategy in Indonesia. Report to Direktorat Pelestarian Alam of the Direktorat Jendral Perlindungan Hutan dan Pelestarian Alam. Departemen Kehutanan, Bogor. IUCN/WWF, 105 p. (ms)

Schwartzs, F.J., 1974. The marine leech ***Ozobranchus margoi*** (Hirudinea: Pisciocolidae), epizootic on ***Chelonia*** and ***Caretta*** sea turtles from North Carolina. The Journal of Parasitology, 60(5):889-90

Seale, A., 1911. The fishery resources of the Philippine Islands. Part IV. Miscellaneous marine products. Journal of Science, (D) 6(6):291-5

Sella, I., 1981. Sea turtles in the eastern Mediterranean and northern Red Sea. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtle Conserv., Wash., D.C., 26-30 Nov. 1979:417-23

Senaris, C., 1988. En peligro. Pro Vita Animalium, 2(4):10-2

Shoop, C.R., & C. Ruckdeschel, 1982. Increasing turtle strandings in the southeast United States: a complicating factor. Biol. Conserv., 23:213-5

Silas, E.G., M. Rajagopalan & A. Bastian-Fernando, 1983. Sea turtles of India. Need for a crash programme on conservation and effective management of the resource. Mar. Fish. Infor. Serv. Tech. and Extension Ser., 50:1-23

Silas, E.G. *et al.*, 1985. On the large and mini arribadas of the olive ridley ***Lepidochelys olivacea*** at Gahirmatha, Orissa during the 1985 season. Mar.Fish.Infor. Serv. Tech. and Extension Ser., 64: 1-16

Small, V., 1982. Sea turtle nesting at Virgin Islands National Park and Buck Island Reef National Monument 1980-81. U.S. Dep. of the Int. Nat. Park. Serv. Research Res. Management Rep.; SER-61, 54 pp.

Smith, H.M. & R. B. Smith, 1980. Synopsis of the herpetofauna of Mexico. VI. Guide to Mexican turtles. J. Johnson, North Bennington, Vermont., 1044 p.

Smith, H.M. & E.H. Taylor, 1950. An annotated checklist and key to the reptiles of Mexico exclusive of the snakes. Bull.U.S. Nat. Mus., 199:1-253

Spring, C.S., 1981. Status of marine turtle population in Papua New Guinea. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc.World Conf. Sea Turtle Conserv., Wash..D.C.. 26-30 Nov. 1979:281-9

Stejneger, L., 1907. Herpetology of Japan and adjacent territory. Bull. U.S. Nat. Mus., 58:577 p., 409 fig., 35 plt.

Stejneger, L. & T. Barbour, 1943. A checklist of North American amphibians and reptiles, (5th ed.). Bull. Mus. Comp. Zool., 98(1):260 p.

Sternberg, J., 1981. The worldwide distribution of sea turtle nesting beaches. Center for Environmental Education, Wash. DC, 5 p., 6 maps

————————, **1982.** Sea turtle hunts throughout the world. Center for Environmental Education, Sea Turtle Rescue Fund. Wash.DC, 16 p.

Sutanto-Suwelo. I., N. Sumertha-Nuitja & I. Soetrisno. 1981. Marine turtles in Indonesia. In K. Björnal (ed.): Biology and conservation of sea turtles. Proc. World Conf. Sea Turtles Conserv., Wash., D-C., 26-30 Nov. 1979: 349-51

Sutherland, J.M., 1985. Marine turtles in Greece and their conservation. Mar.Turtle Newsletter, 32:6-8

Uchida, I., 1977. Ocean navigation of sea turtle. Bunken Publish Co., Osaka, Japan, 80 p. (in Japanese)

Uchida. I. & M.Nishiwaki, 1981. Sea turtles in the waters adjacent to Japan. In K. Björndal (ed.): Biology and conservation of sea turtles. Proc.World Conf. Sea Turtle Conserv., Wash., D. C., 26-30 Nov. 1979: 317-9

Uchida, S. & H. Teruya, 1988. A) Transpacific migration of a tagged loggerhead, ***Caretta caretta.*** B) Tag-return result of loggerheads released from Okinawa Is., Japan. Okinawa Expo-Aquarium, 18 p. (ms)

Urlich, G.F. & A.S.Parkes, 1978. The green sea turtles ***(Chelonia mydas)***: further observations on breeding in captivity. J. Zool. London, 1978(185):237-51

Van Denburgh, J., 1922. The reptiles of western North America. Vol. II. Snakes and turtles. Occ.Papers Calif.Acad.Sci., 10:615-1028

Varona, S.L., 1974. Nuevo reporte de ***Lepidochelys olivacea*** (Testudinata: Cheloniidae) de Cuba. Poeyana. 137:4 p.

Veniselos, L. E., 1986. Guest editorial: Greek loggerheads face dangers. Mar.Turtle Newsletter, 39: 10-1

Wermuth, H. & R. Mertens, 1961. Schildkroten, Krokodile, Brückenechsen. VeB Gustav Fischer Verlag, Jena, 422 p.

Whitmore, C.P. & P.H. Dutton, 1985. Infertility, embryonic mortality and nest-site selection in leatherback and green sea turtles in Suriname. Biol.Conserv., 34(1985): 251-72

Wickramsinge, R.S.B., 1982. Turtle hatcheries in Sri Lanka. Mar.Turtle Newsletter, 22:3-4

Williams, E.E., A.C. Grandison & A. Carr, 1967. ***Chelonia depressa*** Garman re-investigated. Breviora, Mus.Comp.Zool., Harvard Univ., 271: 15 p.

Witham, R., 1974. Neonate sea turtles from the stomach of a pelagic fish. Copeia, 1974(2):548

Witzell, W.N., 1980. Growth of captive hawksbill turtles ***Eretmochelys imbricata,*** in western Samoa. Bull.Marine Science, 30(4):909-12

Witzell, W.N., & A.C. Banner, 1980. The hawksbill turtle ***Eretmochelys imbricata,*** in western Samoa. Bull.Marine Science, 30(3):571-579

Wood, J.R., F.E. Wodd, & K. Critchley, 1983. Hybridization of ***Chelonia mydas*** and ***Eretmochelys imbricata.*** Copeia. (3):839-42

Yañez, A.,P., 1951. Vertebrados marinos chilenos. Rev. Biol. Mar.(Valparaiso), 3(1,2):1-18

Zangerl, R., L.P. Hendrickson & J.R. Hendrickson, 1988. A redescription of the Australian flatback sea turtle ***Natator depressus.*** Bishop Mus.Bull.Zool.I., Honolulu. 69 p.

Zug, G.R., A.H. Wynn & C. Ruckdeschel, 1986. Age determination of loggerhead sea turtle, ***Caretta caretta,*** by incremental growth marks in the skeleton. Smithsonian Contr.Zoology, 427: 1-34

Zweifel, R.G., 1960. Results of the puritan-american museum of natural history expedition to western Mexico. American Museum of Natural History Bull., 119(2):94

Zwinenberg, A.J., 1976. The olive ridley, ***Lepidochelys olivacea*** (Eschscholtz, 1829): probably the most numerous marine turtle today. Bull.Maryland Herp.Soc., 12(3):75-95

click for previous page

5. INDEX OF SCIENTIFIC AND VERNACULAR NAMES

EXPLANATION OF THE SYSTEM

The index applies exclusively to family and species accounts (Sections 2.2 and 2.3)

Type faces used:

Italics : Valid scientific names (double entry by genera and species)

Italics : Primary synonyms (double entry by genera and species)

Roman : International (FAO) species names

Roman : Local species names

ROMAN : Families

A

B

C

D

E

F

G

H

I

J

O

P

Q

R

S

T

U

V

W

X

Y