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.

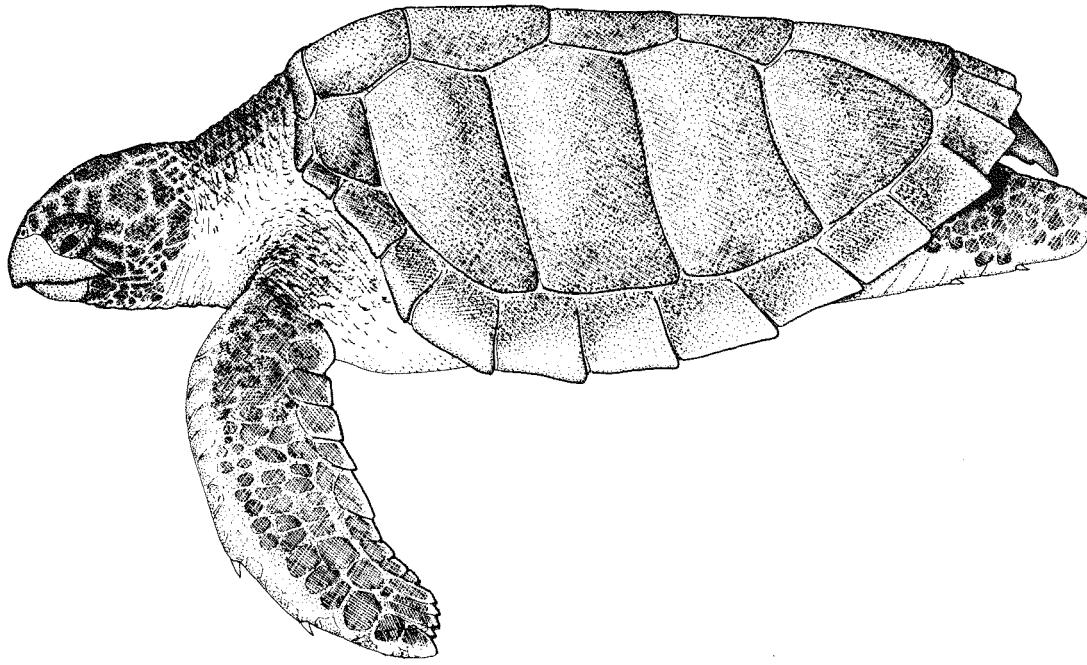

Fig. 22

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.

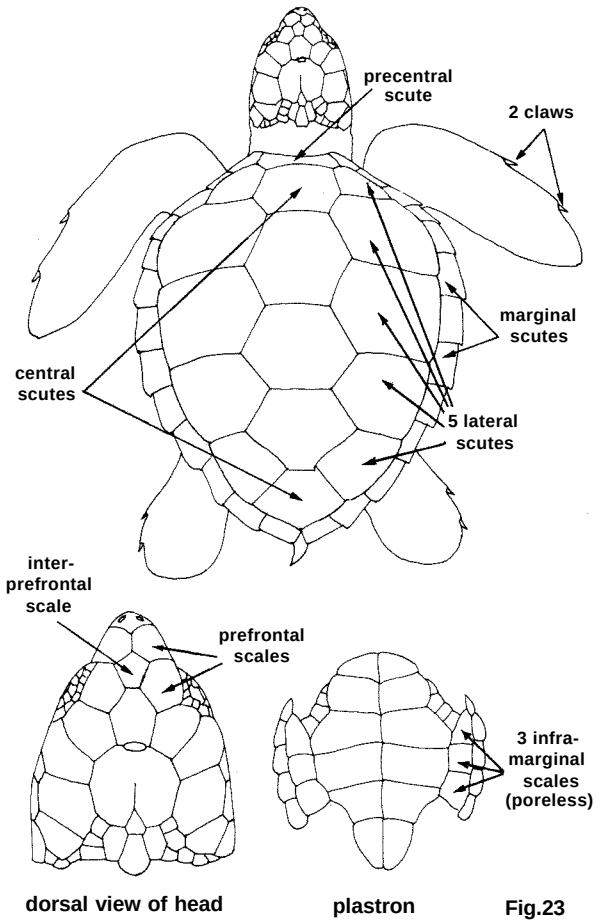

Fig.23

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

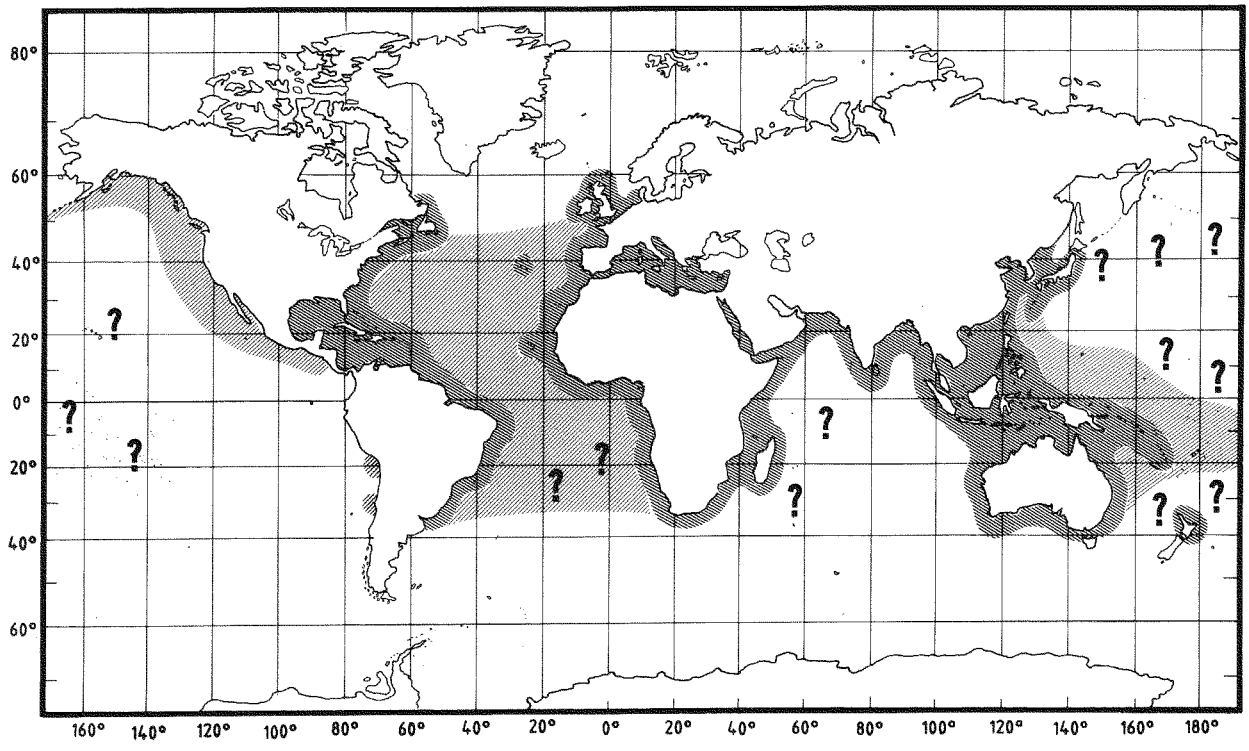

Fig.24

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 20ºC.

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

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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 (52º 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.

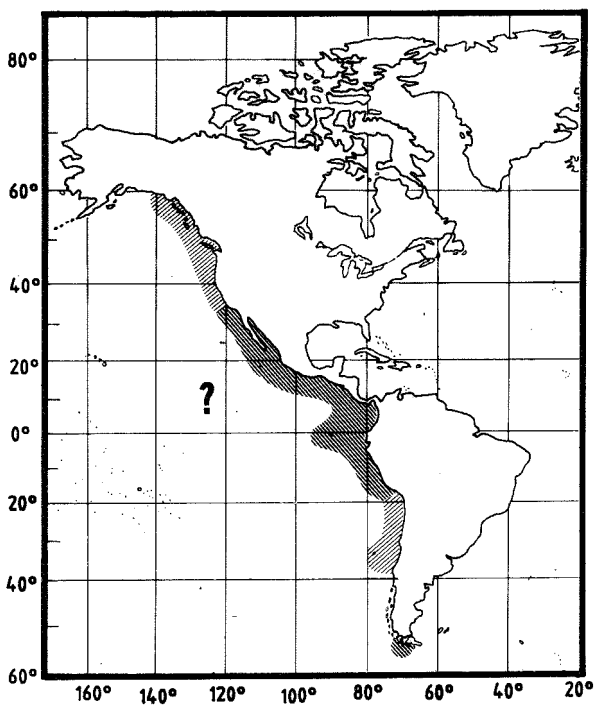

Fig.25

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: ***Gracillaria*** (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.

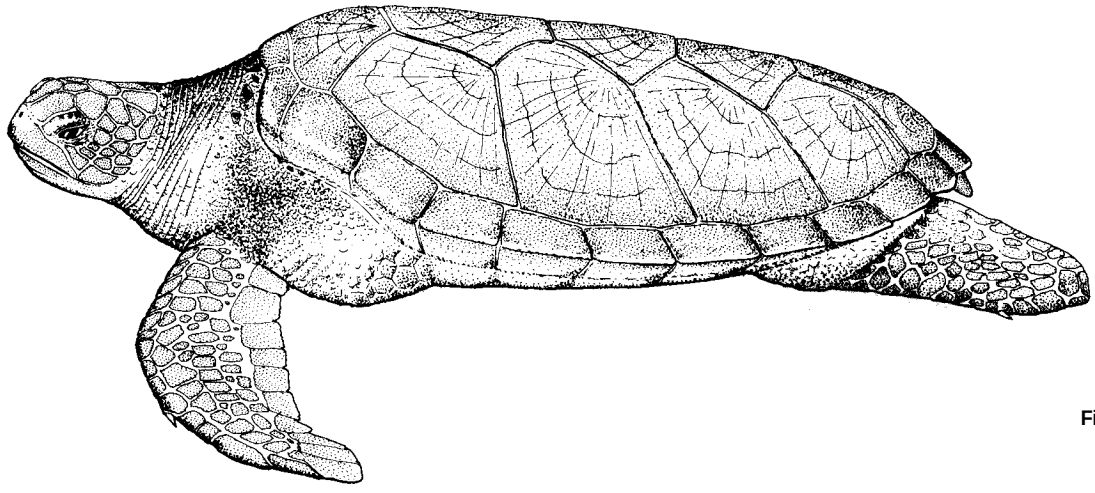

Fig. 26

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*)**,

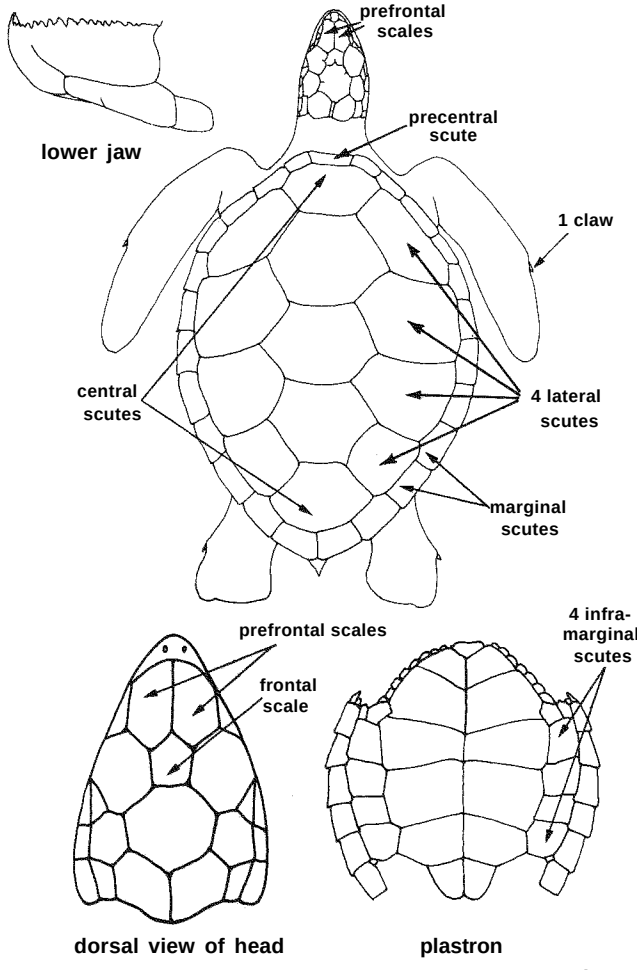

Fig. 27

the green turtle is the most tropical of the marine turtles. Its normal latitudinal range remains within the northern and southern limits of the 20ºC isotherms, and follows the seasonal latitudinal changes of these limits. In summer, the limits are about 40ºN and 35ºS on the western sides of the oceans, and somewhat more contracted (to 30ºN and 25ºS) on the eastern sides. During winter, they descend to 30ºN and 25ºS or less in the western sides, and to 20ºN and 15ºS 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 25ºC. 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.

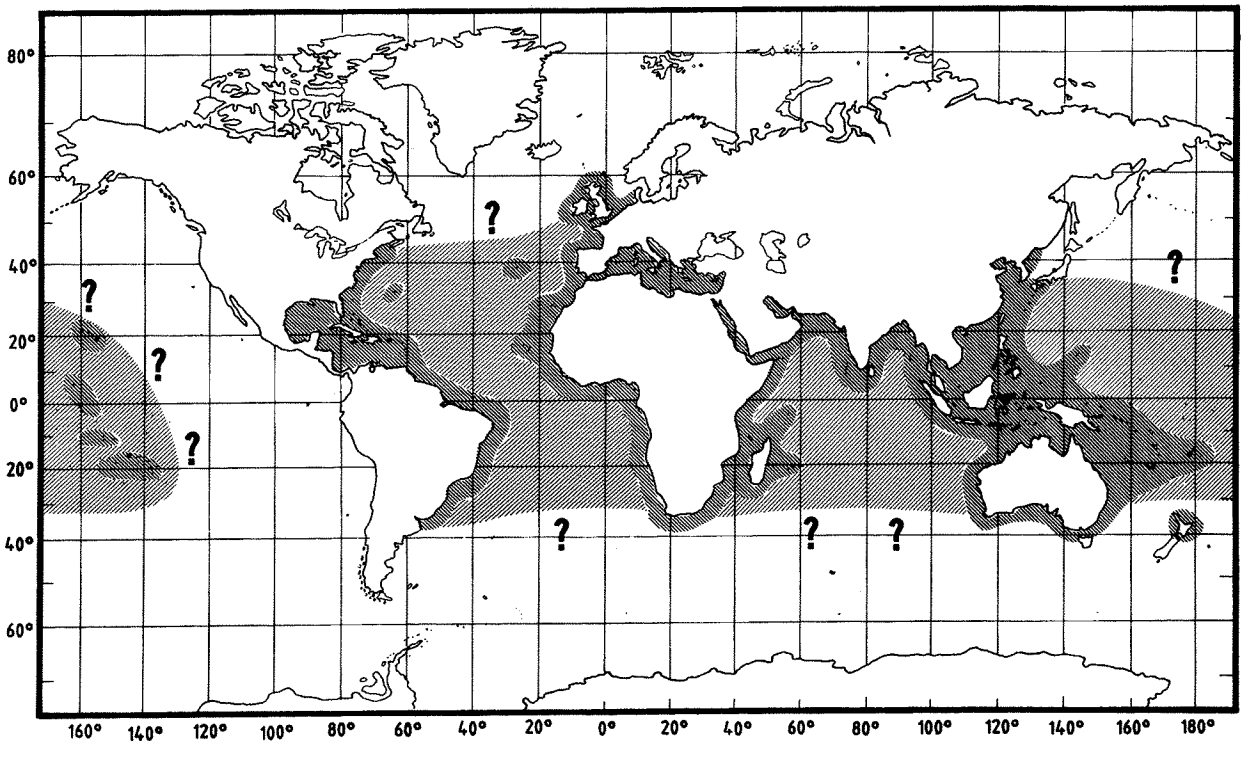

Fig. 28

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