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 & IePolain (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, IeGall & 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.

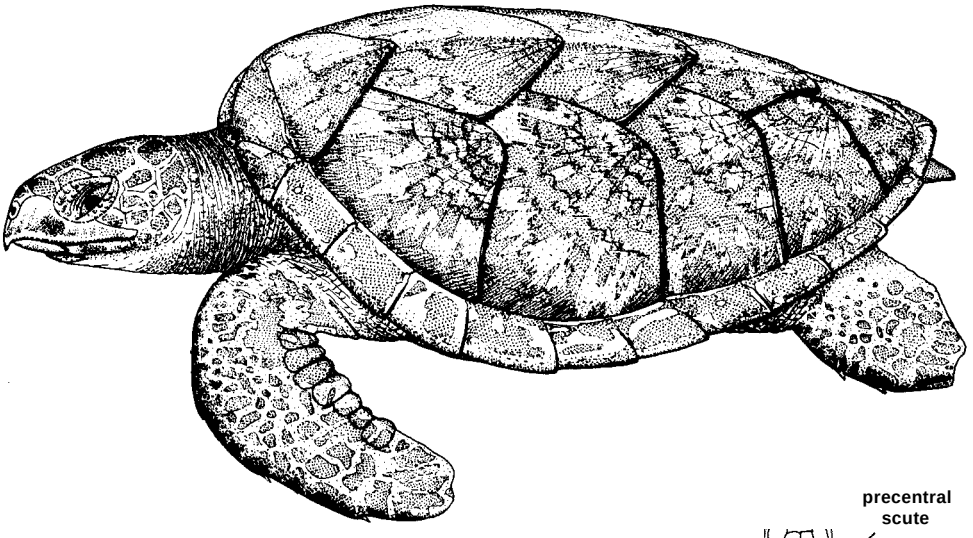
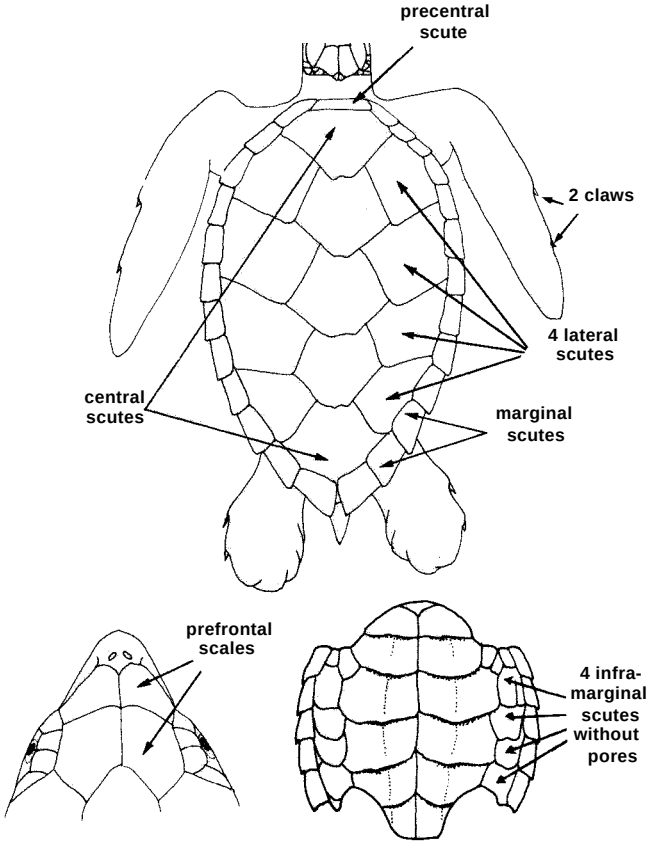


Fig. 29

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.

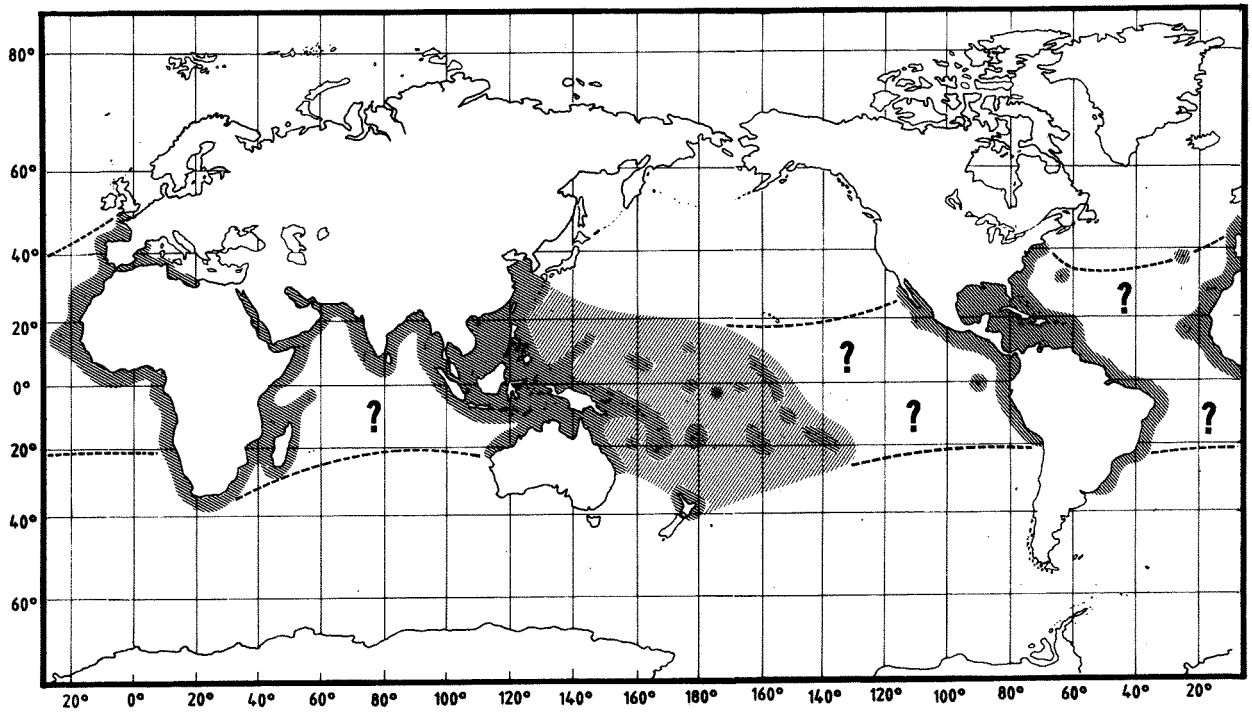


Fig. 31

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 measure-

ments 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 lsla 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 lsla 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 comprehenslve 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, PhIlppines, 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.

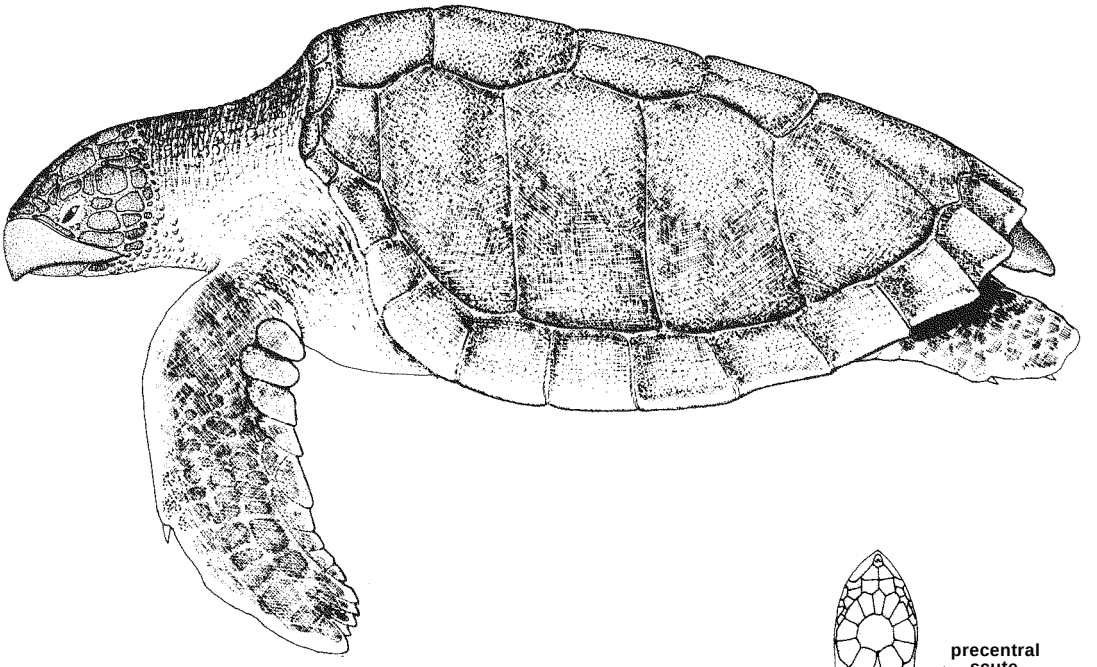


Fig. 32

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.

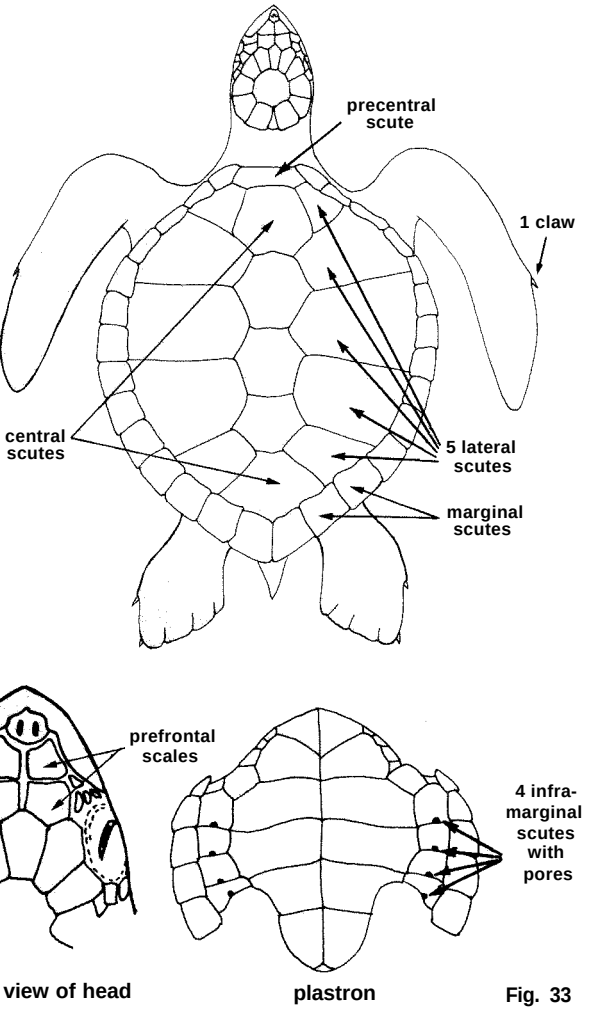


Fig. 33

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***.

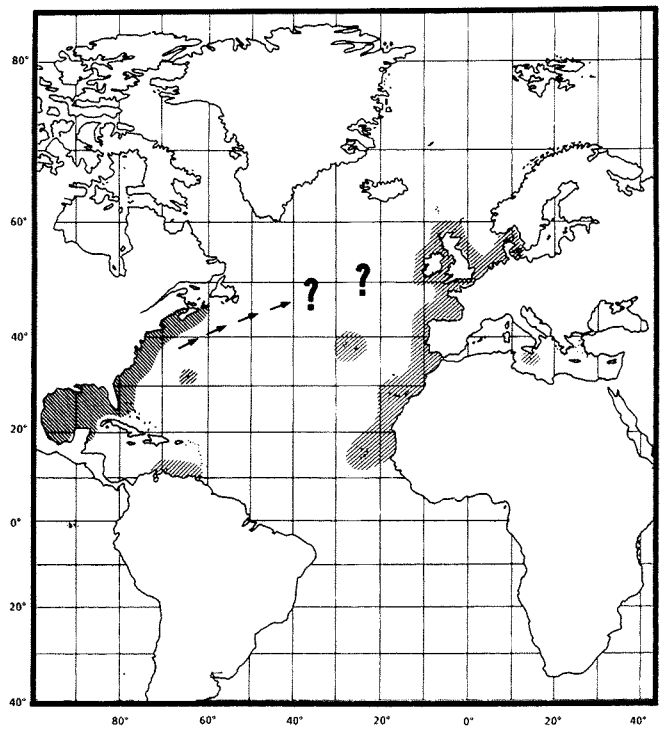


Fig. 34

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.

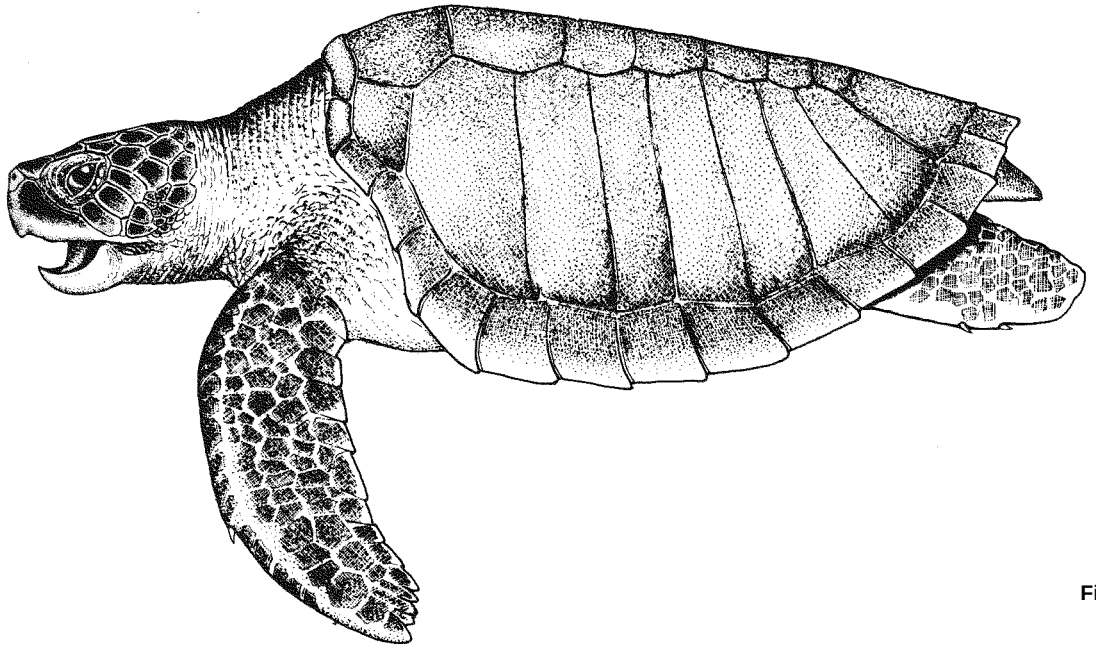


Fig. 35

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.

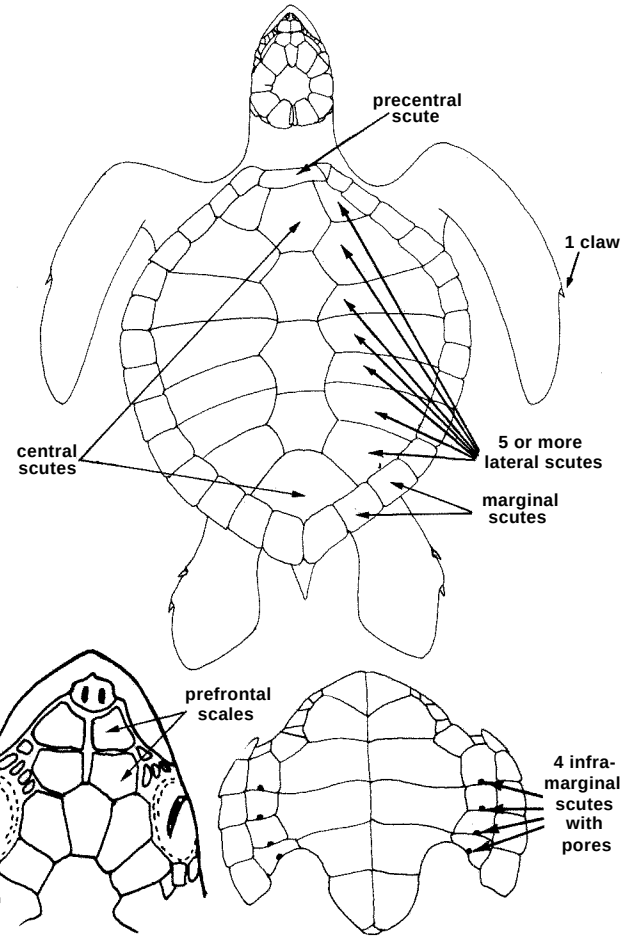


Fig. 36

Geographic Distribution : This is a pantropical species, living principally in the northern hemisphere, with the 20ºC 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,

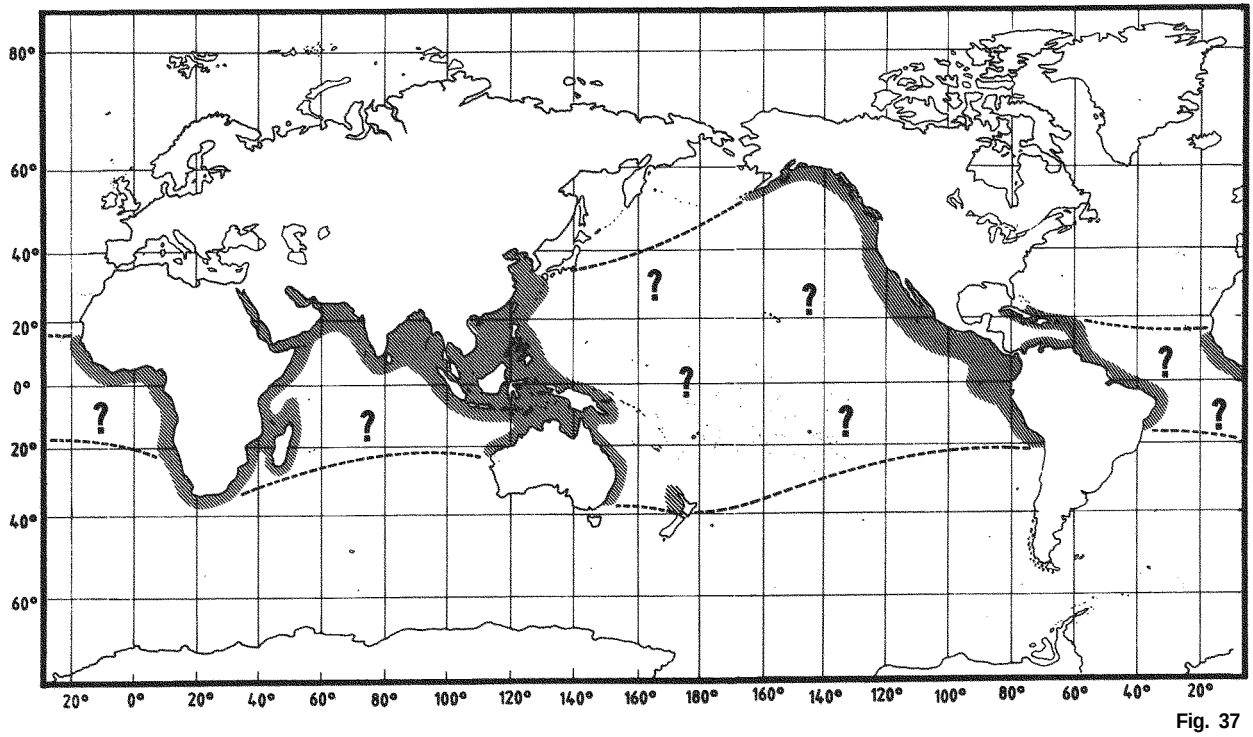


Fig. 37

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 3OºC 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

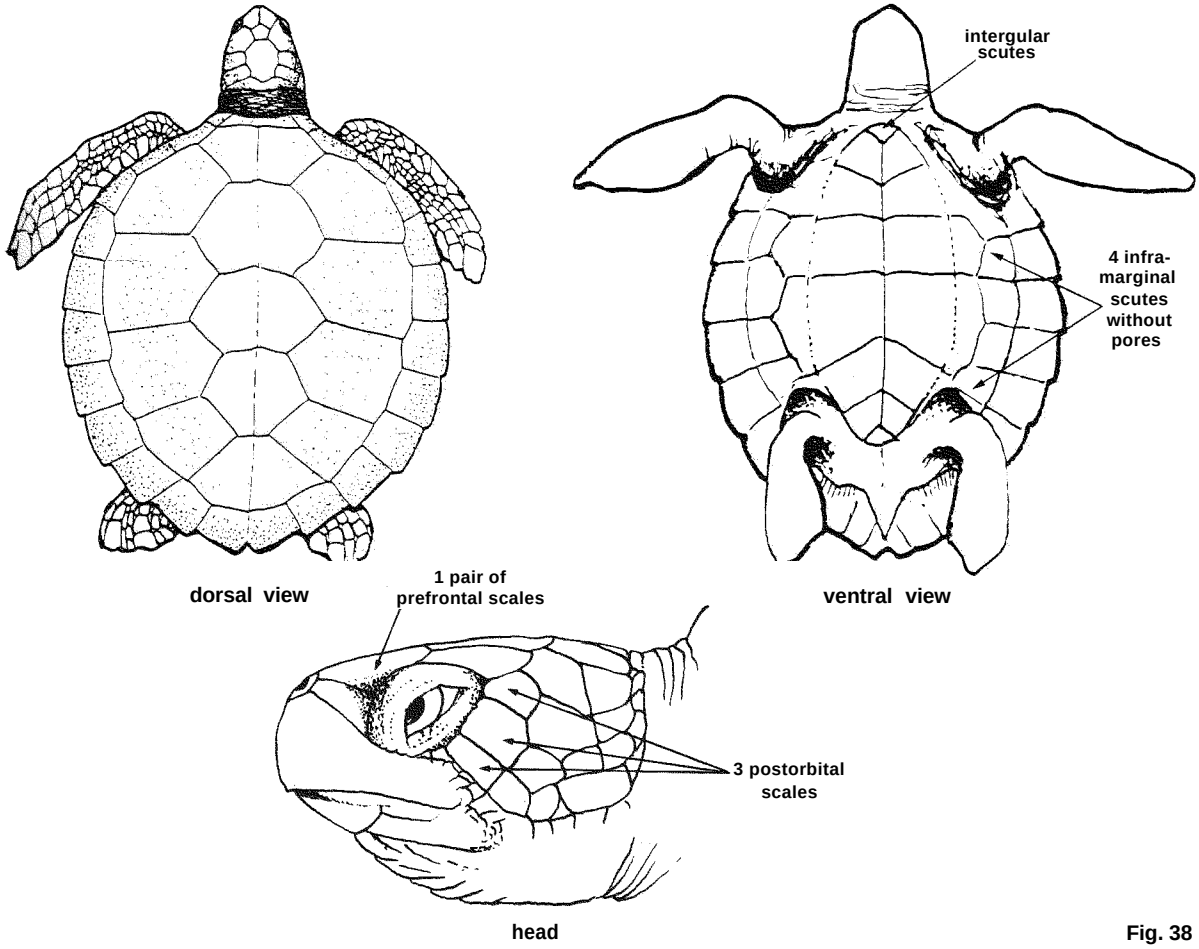
CHE Nat 1

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.



dorsal view — ventral view — head

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 21ºS 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 misidenti-fication, 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.

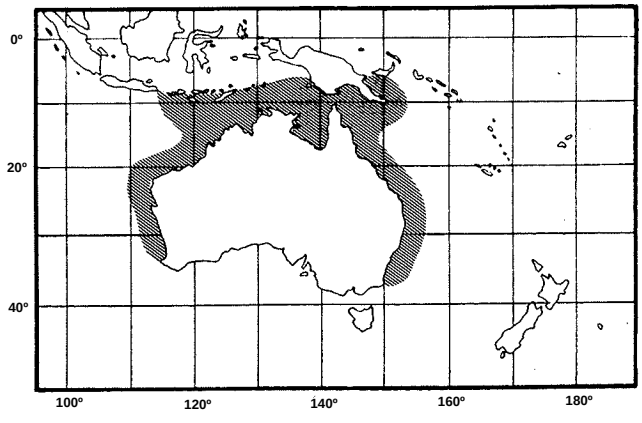


Fig. 39

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 (20ºS) in the west to Mon Repos (25ºS) 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 (11ºS) and Townsville (19ºS) nesting is negligible or absent; there are several nesting points on the continent, from Townsville to Mon Repos (25ºS) such as: Langham (22ºS), Rocky Point (24.5ºS) and Mon Repos; and on the nearby islands, such as: Wild duck and Avoid Island (22ºS), Peak Island (23ºS), Curtis and Facing Island (24ºS); 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).

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