APPENDIX A

THE HABITATS, DISTRIBUTION, AND INCIDENTAL CAPTURE OF SEATURTLES IN THE GULF OF MEXICO

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THE HABITS, DISTRIBUTION AND INCIDENTAL CAPTURE OF SEA TURTLES IN THE GULF OF MEXICO

Sea turtles are large, marine reptiles. They are found circumglobally in tropical and sub-tropical marine waters. Nesting may occur throughout the range but most nesting occurs on restricted areas of beach that the turtles return to each nesting season. Foraging areas are often very far from nesting beaches and in order to nest, turtles maym igrate long distances. Mating generally takes place in offshore waters near the nesting beach. Males rarely come ashore. Mature females usually emerge at night and excavate a nest near the upper limits of the beach. There they lay a clutch of approximately 100 eggs. Females may nest several times in one season, but with the exception of the ridleys, (Lepidochelys kempi, L. olivacea), do not usually nest every year. Incubation takes about two months. The hatchlings dig out of the nest and make their way to the sea. They suffer high losses to predators both on the beaches and in the water. Juveniles are rarely seen in the oceans. Little is known about the first year of life, but mortality is thought to be great. It may be that due to high juvenile mortality, rapid growth, and adult longevity, most turtle populations could consist mainly of larger turtles (Caldwell, 1960).

Six of the seven species of sea turtles can be found in the Gulf of Mexico and Caribbean Sea. At one time three species, the green turtle (Chelonia mydas), hawksbill (Eretmochelys imbricata), and loggerhead (Caretta caretta), were very plentiful and had great commercial value. The other three species, the olive ridley, Kemp's ridley and the leatherback (Dermochelys coriacea), have been of limited economic importance (Rebel, 1974). Over the past few decades sea turtle populations have suffered a serious decline in numbers. Three species of sea turtles have been listed as endangered[1] under the Endangered Species Act of 1973. They are Kemp's ridley (35 Federal Register F.R. 18319-18322), Hawksbill (35 F.R. 8495-8497), and Leatherback (35 F.R. 8495-8497). These three are also listed in Appendix I[2] of the Convention on International Trade in Endangered Species of Wild Flora and Fauna. The three remaining species have recently been listed as threatened under the Endangered Species Act (43 F.R. 32800-32811). In addition to an overall threatened status, the green turtle breeding populations in Florida and the Pacific coast of Mexico and the Pacific coast breeding populations of olive ridleys are determined to be endangered. The green, olive ridley, and loggerhead are listed in Appendix I of the International Convention. Commercial exploitation and nesting habitat destruction are primary causes for the population decline. Many turtles are also takenincidental to commercial

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[1] An endangered status refers to a species in danger of extinction throughout all or significant portions of its range. A threatened species is one whose prospects for survival and reproduction are in immediate jeopardy or is of such small numbers throughout its range that it may become endangered if its environment worsens.

[2] Appendix I includes species that are threatened with extinction and are (or may be) affected by trade.

or sport fishing activities (Caldwell, 1960). Shrimp trawls are the gear most frequently responsible for incidental capture of turtles (Ogren, et al. 1977). Trawling activities have been cited as another factor responsible for the decline of turtle populations (Carr, 1972). This section was compiled for inclusion in the draft shrimp management plan because of the reported impact of shrimp trawling on sea turtles. It is in the national interest to evaluate methods of minimizing this impact if we are to preserve and utilize both the sea turtle and shrimp resources of the U.S. Gulf of Mexico.

GREEN TURTLE

Description

This turtle can be recognized by the single pair of prefrontal scales, Figure 1, and the four pairs of scutes (Caldwell, 1960). The first pair of scutes is not in contact with the precentral. The scutes are non-overlapping except in juveniles. The carapace ranges in coloration from light to dark brown with darker mottled markings. The plastron is white or yellowish. The skin may be brown or gray and many scales of the head have yellow margins.

Distribution

The green turtle has a worldwide distribution primarily concentrated between 35° north and 35° south latitudes, Figure 2. Along the western Atlantic, its occurrence has been recorded from as far north as Massachusetts to a southernmost record of Necochea, Argentina (Carr, 1952). It is still occasionally seen along the Long Island and New Jersey coasts (Rebel, 1974). These are the most common sea turtles found in Bermuda (Mowbray and Caldwell, 1958). In the Caribbean, green turtles can still be found throughout the Windward and Leeward Islands and are abundant off the coasts of Nicaragua and Costa Rica (Rebel, 1974). Immature green turtles are found along the Florida west coast (Carr and Caldwell, 1956).

Along the Pacific coast of North America it has been recorded as far north as southern British Columbia and as far south as Chiloe Island, Chile (Anon. 1975; Carr, 1952).

Breeding Habits

Reproduction generally takes place between 30° south and 30° north latitude, Figure 2. The commencement and duration of the nesting season varies from one locale to another. Only two green turtle rookeries of major importance remain in the Caribbean. At the first, Tortuguero, Costa Rica, nesting occurs from July to September (Carr, 1967). This area is believed to supply green turtles to the western Caribbean (Rebel, 1974). The second rookery, on Aves Island, is active from mid-July to mid-October (Roze, 1955 cited by Rebel, 1974), and is believed to be a source of green turtles in the eastern Caribbean (Rebel, 1974). Substantial nesting occurs around the Yucatan Peninsula. Most of the nesting occurs on the islands off the northeast peninsula, southeastern Quintana Roo and in the Gulf around the Triangulos Reef

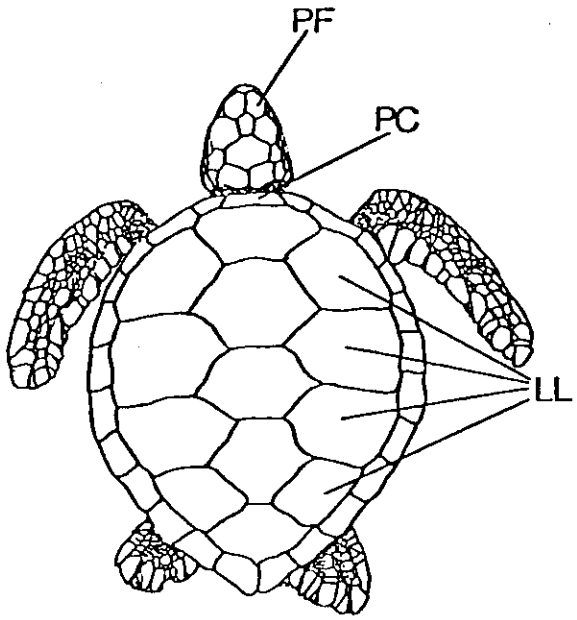

Fig. 1. Green turtle (Chelonia mydas), showing prefrontal scales (PF), lateral laminae (LL) and precentral (PC).

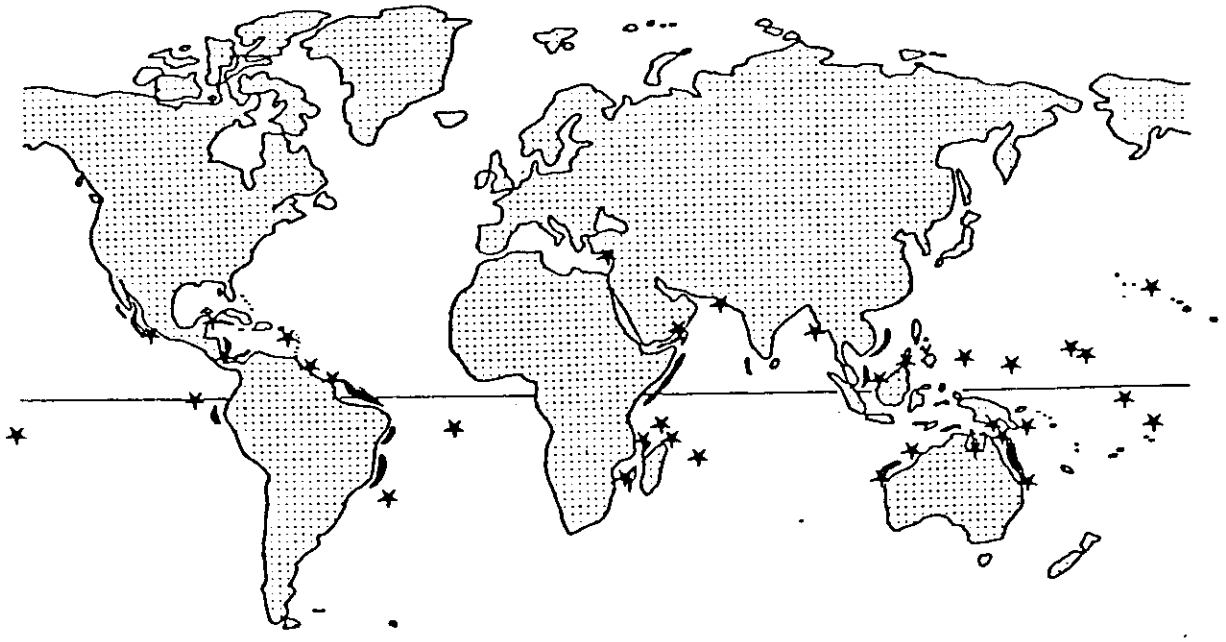

Fig. 2. Breeding (*) and foraging (~) distribution of the green sea turtle.

(Rebel, 1974). Some green turtle nestings occur in Florida. Carr and Ingle, (1959, cited by Rebel, 1974), recorded two nestings on Hutchinson Island in 1957 and 1958. Gallagher, et al. (1972) reported 25 nests in 1971. It is now believed that about 50 females nest in southeastern Florida each year (43 F.R. 32603). Nesting takes place here from May through August (Routa, 1967).

Green turtles seem to prefer a nesting beach that has a steep slope, a beach platform high above flood tide, and is composed of lightweight, medium coarse, sand (Rebel, 1974).

Nesting can occur in cycles of two, three or four years. Carr and Carr, (1970) believed cycle lengths may depend on various ecological conditions on the feeding grounds. In Costa Rica a three year cycle is the most common (Rebel, 1974).

Copulation occurs in nearshore waters before and during the nesting season. Carr (1965) believes that mating takes place only at the nesting ground and that this act fertilizes the female for the next mating season. It takes approximately two hours for the female to come ashore, excavate a nest, deposit her eggs, cover the nest and return to the sea. The average number of eggs per clutch varies for different areas. At Tortuguero it is 110 (Carr and Hirth, 1962) while it is 142.8 and 141.9 for two areas in Surinam (Pritchard, 1969a). Females may nest from two to four times a season. Renesting intervals range from ten to fourteen days (Carr and Ogren, 1960). The turtles usually remain along or near the coast between nestings (Carr, et al. 1974). This was not found at Tortuguero and it was suggested turtles left the beach for river mouths where there was more protection (Carr and Giovannoli, 1957).

Growth and Mortality

The time it takes for a green turtle to reach maturity (about 89 cm carapace length), may vary from temperate to tropical regions. Caldwell, (1962b cited by Rebel, 1974) estimated that in temperate waters maturity was reached at thirteen years or earlier. Rebel (1974) believed it took eight years to reach maturity in tropical waters.

Predators of the eggs and young probably include most of the carnivores and omnivores that live near a turtle nesting beach (Rebel, 1974). Hatchlings are preyed upon by birds, crabs and fish. Fish predation is usually the highest when hatchlings first cross reef areas on their way to sea (Frick, 1976). Mortality rates of this age group are very high.

Recorded predation upon adults has been by sharks and whales (Brongersma, 1972, cited by Rebel, 1974).

Adults have survived in captivity for more than 20 years (Ernst and Barbour, 1972). Bustard and Tognette (1969) used a stochastic model which illustrated nest destruction by females was density dependent and therefore was an important natural population control. Hirth and Schaffer (1974) found that in a constant environment no less than 2.2 and perhaps as many as ten hatchlings per 1,000 must reach reproductive maturity to maintain a stable population.

Foraging Habitat and Foods

Green turtles usually frequent shallow water inside reefs, Figure 2. They can also be found where marine grasses and algae are plentiful in shoals, lagoons and bays (Rebel, 1974). Carr (1967) observed mature turtles to sleep on the bottom with their shells lodged under a ledge or rock.

Green turtles are mainly herbivores feeding upon marine grasses and algae (Rebel, 1974). Small mollusks and crustaceans are also part of the diet. The young are apparently more carnivorous than adults and for the first year of life feed primarily on weak marine invertebrates (Carr, 1965).

Migration

The green turtle appears to be the most regular long distance migrant of all the sea turtles. Its nesting beaches and feeding grounds may be as much as 2,253 km apart. Green turtles exhibit a high degree of site tenacity (Carr and Carr, 1972). There is some evidence that migration may be made by groups of turtles rather than solitary individuals (Carr and Ogren, 1960).

Population Status

The green turtle is currently classified as an endangered species in Florida state waters and is threatened throughout the rest of its range. One estimate of sixteenth to eighteenth century world populations was 50 million turtles (Lund, 1973). More recent population estimates are 62,500 sexually mature turtles in the west Caribbean and 100,000 to 400,000 sexually mature turtles of both sexes worldwide (Anon., 1978).

Historically, green turtles have been sought after as a food source in certain coastal areas. Commercial activity decreased in the 1940's but has recently begun to rise (Anon., 1975). Commercial turtling is now thought to pose a serious threat to green turtle populations (Carr, 1972).

The loss of coastal nesting areas to tourism and industry and the incidental capture of green turtles by shrimp trawls are two other major factors adversely affecting populations (Anon., 1975).

HAWKSBILL TURTLE

Description

The distinguishing features of this turtle are its two pairs of prefrontal scales and the four pairs of scutes on the carapace, Figure 3. The scutes of this turtle overlap except in the very youngest and oldest individuals (Caldwell, 1960). The margins of the overlapping edges are markedly serrate as is the margin of the carapace. The coloration of the adult carapace is amber with streaks of reddish brown, blackish brown and yellow (Rebel, 1974).

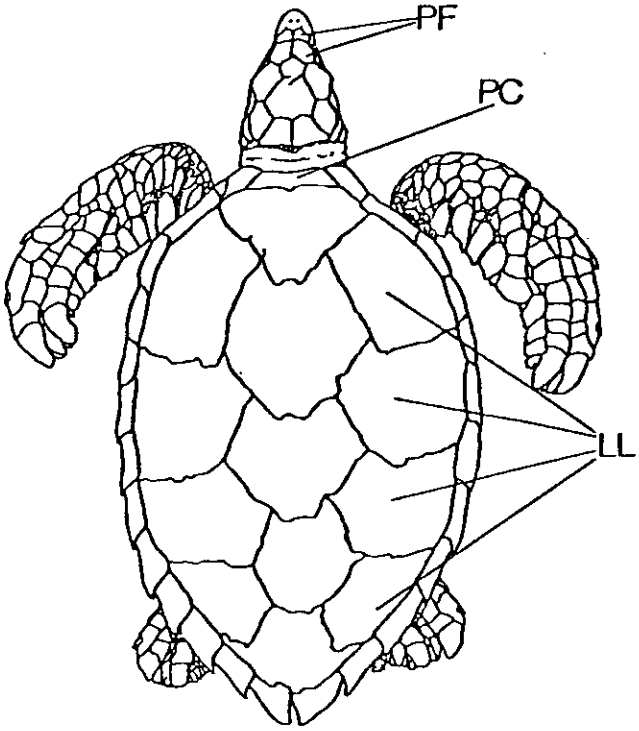

Fig. 3. Hawksbill turtle (Eretmochelys imbricata), showing prefrontal scales (PF), lateral laminae (LL), and precentral (PC).

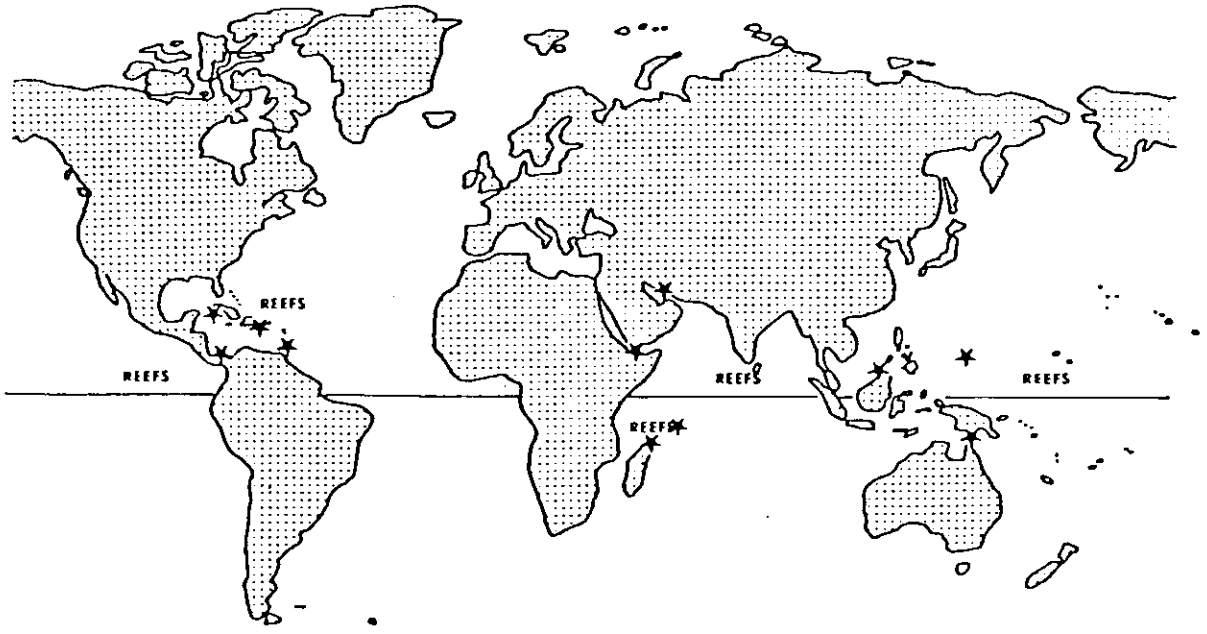

Fig. 4. Breeding (*) and foraging (reefs) distribution of the hawksbill sea turtle.

Distribution

The hawksbill's distribution, Figure 4, is primarily confined to tropical waters such as the warmer parts of the Atlantic Ocean, Gulf of Mexico shores and the Caribbean Sea (Carr, 1952). In the Americas, the hawksbill has been recorded from Woods Hole, Massachusetts, to southern Brazil, but is rarely found north of Florida. It is known from all the Caribbean Islands including the U.S. Virgin Islands, Cayman Islands, Jamaica Keys (Rebel, 1974) and the Bermudas (Carr, 1952). In the Pacific, it has been recorded from Baja, California to Peru and Hawaii.

Reproduction

Hawksbill turtles have diffuse breeding and nesting areas within warm waters between 25° north and 25° south latitude (Rebel, 1974). No other sea turtle is such a solitary nester (Carr, 1972). In Atlantic waters, the nesting range extends from southern Florida and Bermuda to Brazil (Carr, et al. 1966). Some nesting sites recorded by Caldwell, Rathjen and Hsu (1969) are: Florida, Jamaica, Cayman Islands, U.S. Virgin Islands, Guyana, Surinam, French Guiana, Panama, Costa Rica, Mexico, Aves Islands and the islands off the Central American coast. Carr, et al. (1966) believed that nesting takes place "on all undisturbed Caribbean shores, both insular and mainland, wherever there is suitable sand beach." Rebel (1974) mentioned that hawksbills prefer cleaner beaches with more oceanic exposure than do green turtles, although both are often found nesting on the same beach. Copulation takes place in nearshore waters. Nests are usually made in beaches with fine, gravelly textures (Rebel, 1974). Early records report the breeding season in Bermuda from April to June. In Costa Rica, nesting occurs from May through November (Carr, et al. 1966) and in Venezuela from May to August (Roze, 1955). Pritchard (1969a) reported August nesting in Guyana and limited nesting in Surinam during June and July.

Carr, et al. (1966) believed that reproduction probably did not occur annually. Hawksbills may lay in two or even three year cycles (Rebel, 1974). They may nest at least twice a season at about three-week intervals (Carr and Stancyk, 1975). Average clutch size is 160 eggs with an average incubation time of 58.6 days (Carr, et al. 1966).

Growth and Mortality

Hawksbills rarely exceed 91 cm in carapace length or 68 kg in weight (Rebel, 1974). Young turtles appear to have a growth rate of about four inches per year (Rebel, 1974). Adults are believed to be mature at approximately 36 kg (Carr, et al. 1966) or three years (Carr, 1952). Both young and adult hawksbills are subject to predation by the same predators as green turtles (Rebel, 1974). One species of barnacle is known to bore into the carapace, plastron, and flippers (Hornell, 1927 cited by Rebel, 1974).

Foraging Habitat and Foods

Hawksbill turtles are usually found in waters less than 15 m deep. They are typically found near coral reefs, shoals, lagoons and lagoon channels and

bays where marine vegetation provides both plant and animal food (Rebel, 1974), and protection (Carr, et al. 1966). Carr (1952) believed hawksbills have a greater tolerance for muddy bottoms and areas with less extensive vegetation than do green turtles.

The common occurrence of barnacles on the carapace suggests that hawksbills may generally lead a sedentary life (Carr, et al. 1966).

Hawksbills are omnivorous. They feed primarily on invertebrates such as sponges, sea urchins, barnacles, Portuguese men-of-war and smaller invertebrates. They also consume grasses and algae (Rebel, 1974).

Migration

Hawksbills have a tendency to wander while foraging (Carr, et al. 1966). Migration of sorts is believed to occur during the nesting season (Carr, et al. 1966).

Population Status

Little is known about population numbers for hawksbill turtles. Their large range and diffuse nesting habits make them hard to census. It is known, however, that hawksbill stocks have declined drastically. They are considered one of the sea turtles most in danger of extinction (Carr, 1972).

These turtles are highly sought after for their shells and this hunting is primarily responsible for declining stocks (Anon., 1978). Carr (1972) felt that if the tortoiseshell trade was eliminated the hawksbill would survive. Populations in the Virgin Islands have seemed to increase due to less taking of turtles (Rainey, 1976).

LOGGERHEAD

Description

The loggerhead turtle can be recognized by its two pairs of prefrontal scales, five or more pairs of scutes (the first pair in contact with the precentral, Figure 5, and three poreless inframarginal scutes, Figure 6. The carapace is oval and may range in color from reddish-brown to brown. The plastron may be yellow or cream colored. The large head is reddish or brown and the scale often has a yellow border.

Distribution

In the Atlantic Ocean the loggerhead is commonly found from Argentina, throughout the Caribbean north to Virginia, Figure 7. It has been recorded as far north as Nova Scotia and England (Carr, 1952). On the Pacific coast it can be found from Chile to southern California and Hawaii.

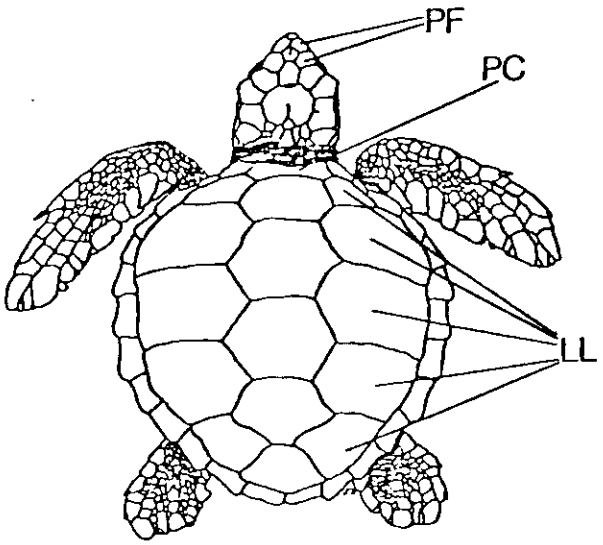

Fig. 5. Loggerhead sea turtle (Caretta caretta) showing prefrontal scales (PF), lateral laminae (LL), and (PC).

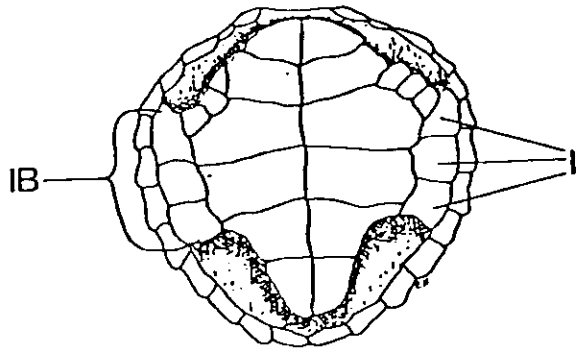

Fig. 6. Ventral view of loggerhead turtle shell showing inframarginal bridge (IM) and inframarginals (I).

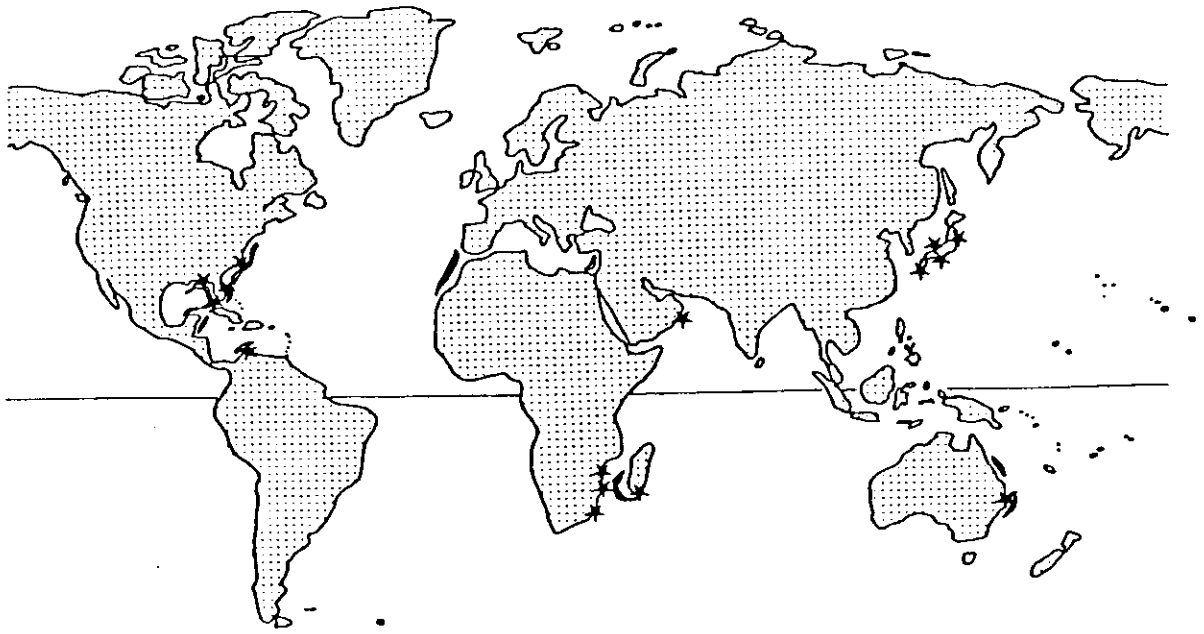

Fig. 7. Breeding (*) and foraging (~) distribution of the loggerhead sea turtle

Breeding Habits

The most important breeding areas for the loggerhead turtle are the Atlantic coasts of Florida, Georgia, and South Carolina (Carr and Carr, 1977). Concentrated rookeries are located at Hutchinson Island, Florida; Jekyll Island and Little Cumberland Island, Georgia; and Cape Romain, South Carolina, (Caldwell, et al. 1959b), Figure 7. Loggerheads have been recorded nesting on the coastal states of the Atlantic and Gulf from North Carolina to Texas (Caldwell, et al. 1959b). Loggerhead nesting has also been recorded in Africa, Australia, and the eastern Pacific (Ernst and Barbour, 1972). In South Carolina nesting begins in mid-May and continues to August (Caldwell, 1959). Nesting occurs from May to August at Hutchinson Island, (Routa, 1967), Sanibel and Captiva Islands, (Gallagher, et al. 1972), and Cape Sable in Florida (Davis and Whiting, 1977).

Loggerheads along the eastern coast of the United States show a preference for beaches with dunes or vegetation that present a dark, broken horizon (Caldwell, 1959). Wide sloping beaches are preferred (Caldwell, 1959) and nests are usually dug above the high tide line on the seaward side of the dunes (Ernst and Barbour, 1972). Nesting takes place at night and usually during a high tide (Ernst and Barbour, 1972).

Breeding and nesting occurs primarily in two or three year cycles (Caldwell, 1962a). Annual remigration, however, is known to occur along the Atlantic coast (Richardson, et al. 1976). Mating takes place in the waters off the nesting beaches. Females may nest more than once during a season at twelve to fifteen day intervals (Caldwell, et al. 1959b). Tagging results show that groups of turtles may nest together several times and may stay together during internesting (Caldwell, et al. 1959a). The entire nesting process takes about two hours (Kaufman, 1968 cited by Rebel, 1974).

Incubation averages 55 (49 to 62) days (Caldwell, 1959). The average clutch size at Cape Romain is 126 (64 to 198) eggs (Caldwell, 1959). In southwest Florida there is a seasonal decline in the number of eggs per clutch (LeBuff and Beatty, 1971).

Growth and Mortality

Loggerheads may gain as much as 7 kg in weight and 17.8 cm carapace length during their first few years (Rebel, 1974). One yearling grew from 136 mm to 538 mm in carapace length in 3.5 years (Hildebrand and Hatsel, 1927). At six years it weighed 27.7 kg. Loggerheads probably mature at less than 91 ka or a carapace length of about 31 inches (Caldwell, 1959). One of the oldest known captive loggerheads lived for 35 years (Rebel, 1974).

Land crabs and raccoons are the main nest predators. An estimated 5.6 percent of the nests at Cape Romain were destroyed by raccoons (Caldwell, 1959). At Hutchinson Island 7.8 percent of the nests were lost to raccoons (Routa, 1967). Ants are frequently found in nests (Rebel, 1974). Excessive rainfall can also cause egg mortality (Ragotzkie, 1959). Hatchlings are eaten by sand crabs, raccoons, gulls, crows and other birds and mammals on the beach

and also by various fish in the water (Ernst and Barbour, 1972). Other than man, sharks (Ernst and Barbour, 1972) and dolphins (Witham, 1974), adult loggerheads have few predators.

Foraging Habitat and Foods

Loggerheads are found in warm waters of the continental shelf (Rebel, 1974). They frequently forage around coral reefs, rocky places and old boat wrecks (Ernst and Barbour, 1972). They often enter bays, lagoons and estuaries (Ernst and Barbour, 1972). Carr (1952) reported that loggerheads sometimes enter streams and ascend them until the water is no longer brackish or the turtle dies in the marsh. Loggerheads are also found in the deeper waters of the oceans and have been recorded as far as 804 km out in the open sea (Ernst and Barbour, 1972). They have been caught on the red snapper banks of the Gulf of Mexico (Rebel, 1974). Baby loggerheads have been observed to associate with drifting sargassum which provides food and shelter (Caldwell, 1968; Fletemeyer, 1978; Smith, 1968).

Loggerheads are omnivores. They eat some marine grasses and seaweeds (Ernst and Barbour, 1972; Rebel, 1974). Sponges, jellyfish, mussels, clams, oysters, conchs, borers, squid, shrimp, amphipods, crabs, barnacles, sea urchins and various fish are also eaten (Ernst and Barbour, 1972).

Movements

Loggerheads are known to travel long distances (Bustard and Limpus, 1971). So far there is nothing to indicate these movements are migratory (Rebel, 1974). Nonbreeding adults are believed to range widely as solitary individuals (Caldwell, et al. 1956a). One female tagged at Hutchinson Island was found 302 days later some 1,609 shoreline kilometers away at the mouth of the Mississippi River (Caldwell, et al. 1959b). Another female tagged at Fort Pierce, Florida, was recovered 209 km north three weeks later (Caldwell, et al. 1956).

Population Status

The loggerhead turtle has been designated a threatened species. There are no estimates for early numbers of loggerheads. It is obvious, however, from the disappearance of this turtle from some parts of its original range, and decreased nesting numbers at certain areas, that the population is declining. In the southeastern United States, populations are estimated at 25,000 to 50,000 sexually mature turtles (Anon., 1978).

The flesh of this turtle is eaten and has some commercial value. Loss of nesting grounds, increased predation by raccoons and incidental catch are all factors responsible for the decline of this species.

KEMP'S RIDLEY

Description

Kemp's, or the Atlantic ridley, is one of the smallest sea turtles. Its size generally ranges from 50-70 cm (Ernst and Barbour, 1972). It can be recognized by two pairs of prefrontal scales on the head, five pairs of scutes (the first pair in contact with precentral), Figure 8, and four inframarginal scutes with pores, Figure 9. The carapace is heart-shaped ornearly round and is often wider than it is long. It ranges in color from gray or grayish brown to olive green (Rebel, 1974). The plastron is white.

Distribution

Kemp's ridley has a very restricted distribution compared to other sea turtles. Its primary range is in the Gulf of Mexico from Florida to Mexico (Rebel, 1974), Figure 10. It has been recorded along the western Atlantic from Massachusetts to Campeche Bay, Mexico, (Caldwell, 1960), but is rarely found north of Florida (Rebel, 1974). It is absent from the Caribbean.

Breeding Habits

Most of the Kemp's ridley nesting occurs along a stretch of beach from Boca San Vincente to Baha Coma near Rancho Nuevo, Tamaulipas, Mexico, Figure 10, (Rebel, 1974). Some nesting does occur along the Gulf coast between Corpus Christi, Texas, and southern Veracruz, Mexico (Ernst and Barbour 1972). Nesting has been recorded on Padre Island, Texas (Werler, 1951). Nesting occurs from April through mid-August (Ernst and Barbour, 1972).

Courtship and mating occur in the offshore waters of the nesting beaches (Ernst and Barbour, 1972). Kemp's ridley nests almost exclusively in large group nesting emergences or arribadas. Up to 40,000 females have been recorded on the beach at one time (Carr, 1963). These turtles are unique in that they are the only sea turtles which nest during the day (Caldwell, 1966).

Nests are usually dug in fine sand on the beach or dunes ranging from 13-45 m from the water (Chavez, et al. 1968). Females may nest up to three times a season (Ernst and Barbour, 1972) at intervals of 20 to 28 days (Rebel, 1974). Unlike other sea turtles, Kemp's ridley may nest in successive years (Ernst and Barbour, 1972). The average clutch size is 110 eggs with a range of 54 to 185 (Chavez, et al. 1967). Incubation takes from 50 to 70 days (Chavez, et al. 1967).

Growth and Mortality

Ridleys mature at about 64 cm carapace length (Carr and Caldwell, 1958). Hatching length ranges from 38 to 46 mm (Chavez, et al. 1967). The growth rate of intermediate sized turtles seems to be about five cm per year (Rebel, 1974). Kemp's ridleys have survived for over twenty years in captivity (Ernst and Barbour, 1972).

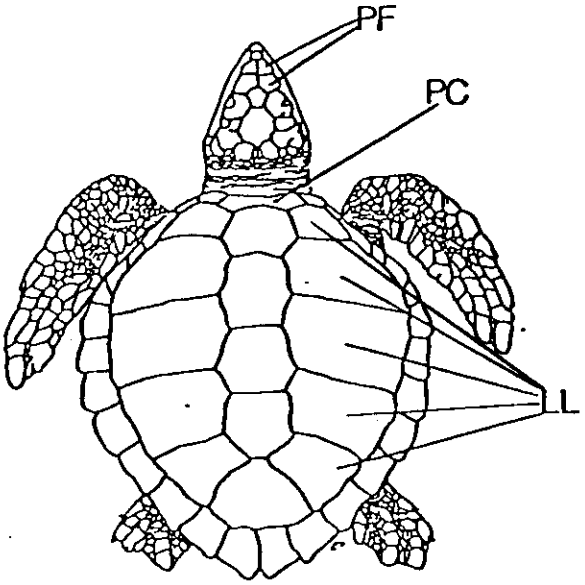

Fig. 8. Kemp's ridley sea turtle (Lepidochelys kempi) showing prefrontal scales (PF), lateral laminae (LL) and precentral (PC).

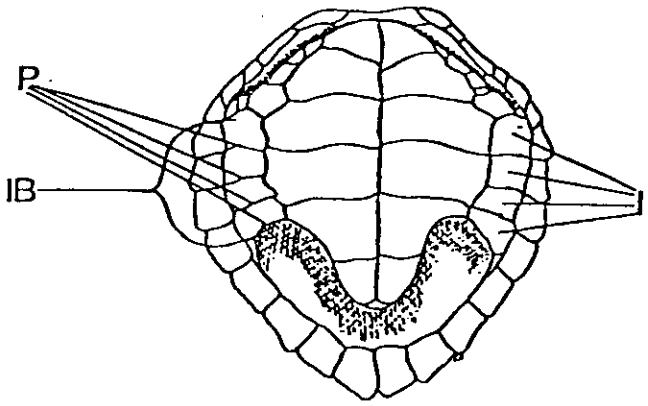

Fig. 9. Ventral view of Kemp's ridley turtle shell showing inframarginal bridge (IB) inframarginals (I) and pores (P).

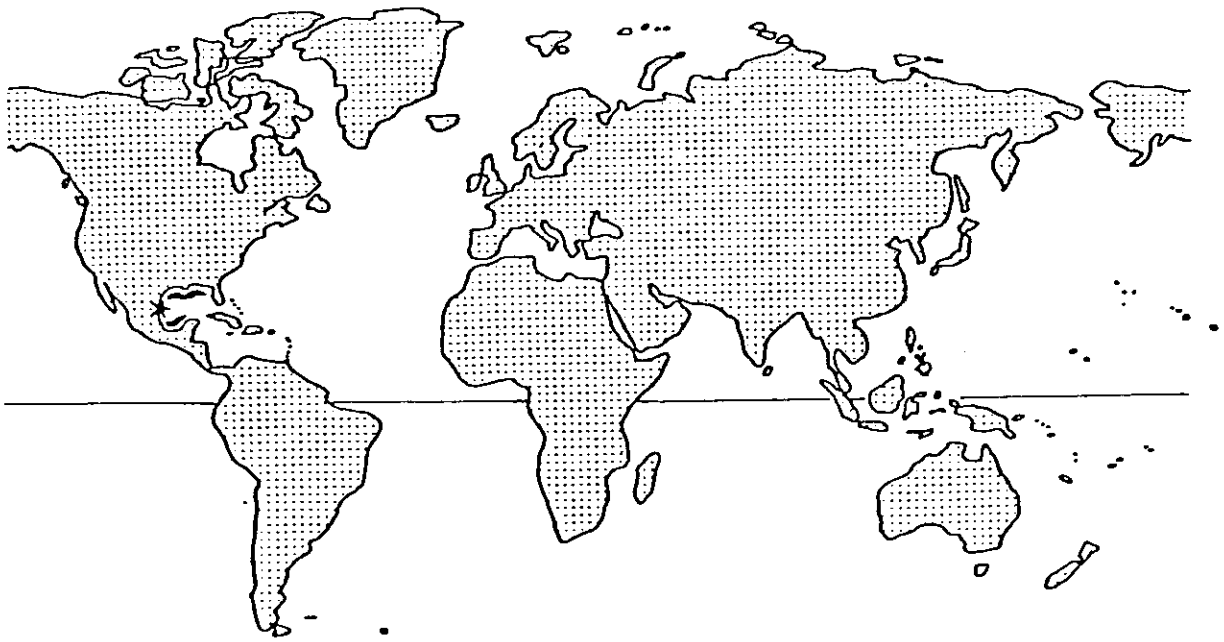

Fig. 10. Breeding (*) and foraging (≈) distribution of Kemp's ridley sea turtle.

Because of the aggregated nesting emergences, ridley nests are "easy prey" for dog packs (Rebel, 1974), other mammals and crabs. Hatchlings are also preyed upon by crabs as well as birds, fish and turtles.

Foraging Habitat and Foods

Kemp's ridley is a turtle of coastal areas. It seems to prefer shallow waters. It is found in close association with the shoreline of red mangrove in the Florida Keys (Carr, 1952). Carr and Caldwell (1956) found Kemp's ridley to be commonly found in associated grass flats in the Cedar Key-Crystal River area of Florida. Capture records seem to indicate the feeding grounds extended along the Gulf coast from southern Florida to the Yucatan, Figure 10 (Carr, 1961).

This turtle is primarily a carnivore and seems to be a bottom feeder (Ernst and Barbour, 1972). Recorded food items are crabs (Smith and List, 1950), barnacles (Liner, 1954), as well as gastropods and clams (Dobie, et al. 1961).

Movements

Carr (1961) assumed Kemp's ridley migrated along the Gulf coast. Turtles tagged at nesting grounds in Mexico have been recorded from Ciudad Carmen, Mexico, along the Gulf coast to Louisiana and also in the Dry Tortugas, Florida (Chavez, 1969).

Population Status

Kemp's ridley is listed as an endangered species. This species, of all the sea turtles, is probably the most in danger of extinction, due to its localized nesting (Pritchard, 1969c). Numbers have been reduced drastically by egg stealing, slaughter of nesting females, and fishing (Ernst and Barbour 1972). Pritchard and Marquez (1973) believed that the accidental capture and drowning in shrimp trawls is the most serious problem facing Kemp's ridley.

The location of Kemp's ridley's major nesting beach was not known until about two decades ago. In one 1947 filming of an arribada, 40,000 turtles were estimated to be present (Carr, 1963). The most recent estimate for the total Kemp's ridley population is less than 1,000 (600-800) sexually mature females (Anon., 1978). There may be as few as 400-500 based on 1978 nesting data.

Kemp's ridley has been of limited economic importance in Mexico and southwestern Florida (Rebel, 1974).

OLIVE RIDLEY

Description

The olive (Pacific) ridley is one of the smaller sea turtles. It has two pairs of prefrontal scales and four inframarginals on the bridge. It almost always has six to eight (occasionally five to nine) scutes, with the

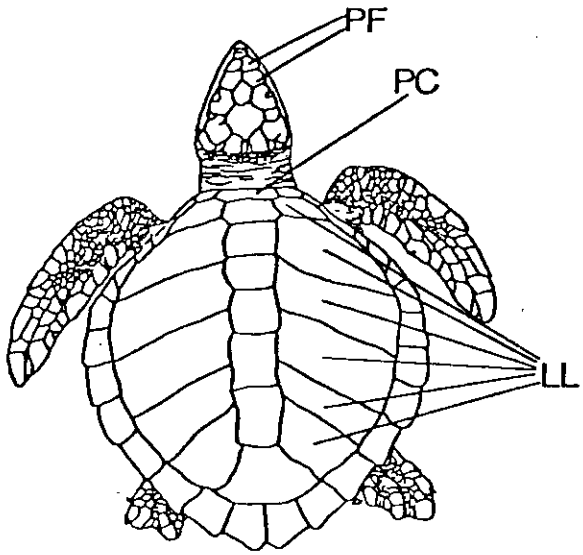

Fig. 11. Pacific ridley (Lepidochelys olivacea) sea turtle showing prefrontal scales (PF), lateral laminae (LL) and precentral (PC).

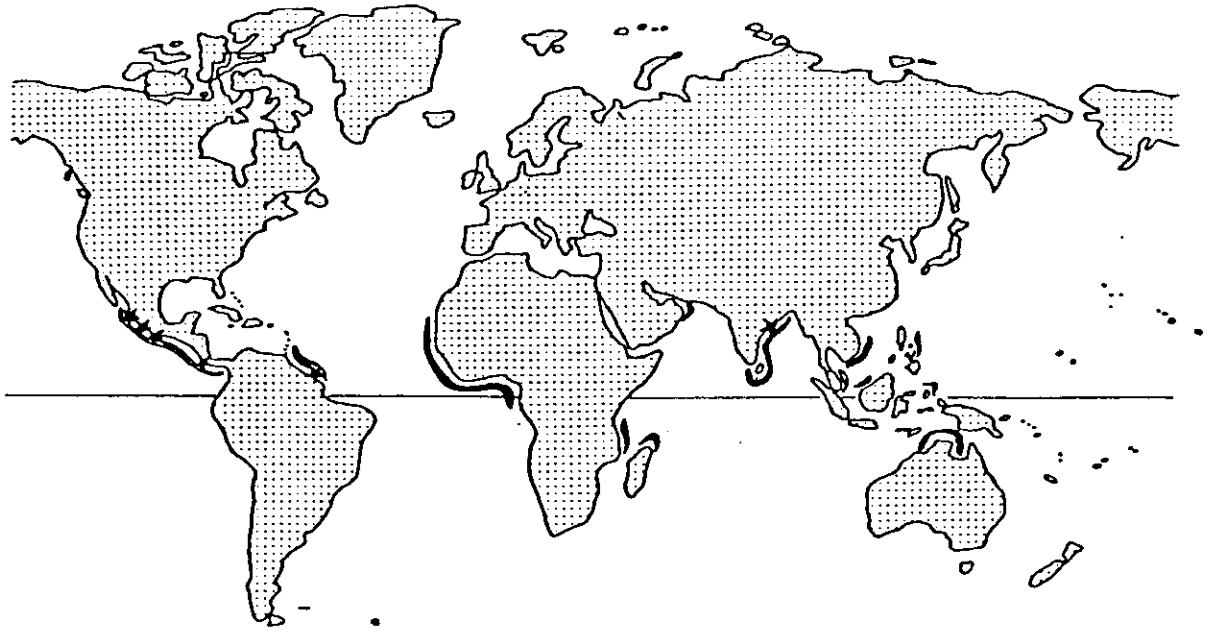

Fig. 12. Breeding (*) and foraging (~) distribution of the olive ridley sea turtle.

first pair in contact with the precentral, Figure 11. There may be more scutes on one side of the carapace than the other (Ernst and Barbour, 1972). The heart-shaped carapace is flattened dorsally and is colored olive or greenish-white. The plastron is greenish-white to greenis- yellow.

Distribution

This ridley is found in the Indian and Pacific oceans, Figure 12, southeast Caribbean (Rebel, 1974), off the coasts of Surinam and Guiana in South America and the western coast of Africa (Ernst and Barbour, 1972). It has also been recorded off the California coast.

Breeding Habits

Olive ridleys nest along the western coast of Africa, the Guianas and in the Pacific and Indo-Pacific oceans, Figure 12. The breeding season varies with locality. In the eastern Pacific, nesting occurs from mid-August through January, in India and Ceylon from September to March and from April through July in Surinam (Ernst and Barbour, 1972). On the Pacific coast of Costa Rica nesting occurs from July through November (Richard and Hughes, 1972). Pritchard (1969a) reported fair numbers of turtles nesting on Shell Beach, Guyana.

Olive ridleys may be found nesting on the same beaches as green, hawksbill, loggerhead and leatherback turtles (Ernst and Barbour, 1972). Little is known about courtship and mating but observations by Carr (1952) seem to indicate that the mating season coincides with the nesting season.

Females usually emerge to nest with a rising tide in late afternoon (Ernst and Barbour, 1972). Nesting occurs annually (Pritchard, 1969c). Females usually nest two and occasionally three times a season (Ernst and Barbour, 1972). In Surinam internesting periods ranged from 17 days, 30 days, 44 days to even as many as 60 days (Pritchard, 1969b). In Surinam the average clutch size of 928 nests ranged from 30 to 168 eggs (Pritchard, 1969a). Two nests observed by Pritchard (1969b) had a very high percentage of viable eggs. Incubation time in Surinam varied from 49 to 62 days (Pritchard, 1969b).

Growth and Mortality

Little is known about the growth rate of the olive ridley. Ernst and Barbour (1972) cite Deraniyagala's (1939) measurements: at 30 days carapace length was 85 mm; at 210 days, 170 mm; and 307 days, 185 mm. From 1 February to 3 August 1929 one turtle grew from 43 mm to 74 mm. Another grew from 45 mm to 490 mm from 18 January 1934 to 30 May 1936. In Surinam the majority of nesting females had a carapace length of 66-71 cm (Pritchard, 1969a).

The eggs and young are preyed upon by mammals, birds, crabs, and fish. Adults are preyed upon by man and sharks. Man appears to be the major predator through nest robbing and fishing efforts (Anon., 1978).

Foraging Habitat and Foods

Rebel (1974) cites Deraniyagala's (1939) belief that the olive ridley is the most bottom dwelling of all the sea turtles. He described their habitat as the shallow water between reefs and shore, large bays and lagoons.

Carr (1952) thought the olive ridley to be primarily a vegetarian but Ernst and Barbour (1972) describe it as mainly carnivorous. Fish, crabs, snails, oysters, sea urchins, and jellyfish are eaten. Sea weed is taken occasionally.

Movements

Records for movements of tagged turtles showed that one traveled 483 km in approximately four months and another 121 km in one day. What might have been a migratory aggregation was observed in late November off the coast of Guerro, Mexico (Oliver, 1946).

Population Status

The olive ridley has been designated as endangered on the Mexican Pacific coast and threatened throughout the rest of its range under the U.S. Endangered Species Act. No estimate has been made of the world population. In 1970-71 it was estimated 450,000 olive ridleys were nesting annually in Costa Rica (Richard and Hughes, 1972). In 1971, 120,000 were reported nesting in Mexico (Anon., 1975). During 1975 an estimated 1,000 were nesting in Surinam (Anon., 1975).

This species has been undergoing a high degree of exploitation. Both the turtles' flesh and eggs are consumed. In 1968, the Mexican catch of Pacific ridleys was more than one million (Carr, 1972).

LEATHERBACK

Description

The adult leatherback is the largest of all the sea turtles. The carapace does not have the horny shields as do other sea turtles. Instead the carapace is covered with a leathery black skin, flecked with small white irregularly shaped bones imbedded in the skin. This forms a mosaic-type pattern. There are two to seven prominent longitudinal ridges on the carapace, Figure 13. The whitish plastron has five longitudinal ridges. The head and neck are black or dark brown with yellow or white patches.

Distribution

The leatherback can be found throughout the tropical waters of the Atlantic, Pacific and Indian Oceans (Ernst and Barbour, 1972), Gulf of Mexico and the Caribbean (Carr, 1952), Figure 14. In the Americas it has been recorded from Nova Scotia south to Argentina and from British Columbia to Chile and Hawaii in the Pacific. While they are widely distributed in tropical and subtropical waters they are not plentiful in the Atlantic (Rebel, 1974).

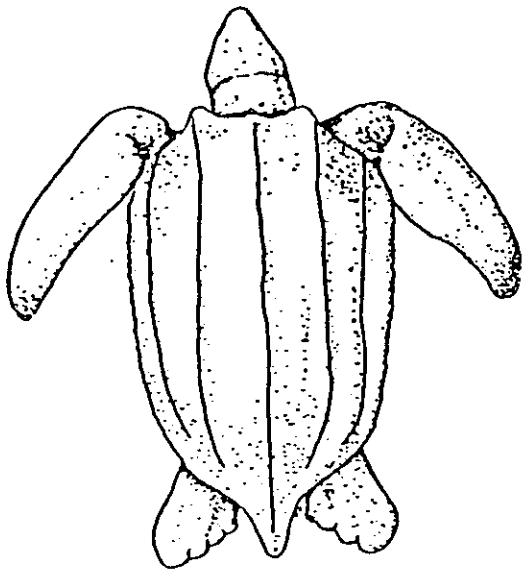

Fig. 13. Leatherback sea turtle (Dermochelys coriacea) showing leathery carapace with longitudinal ridges.

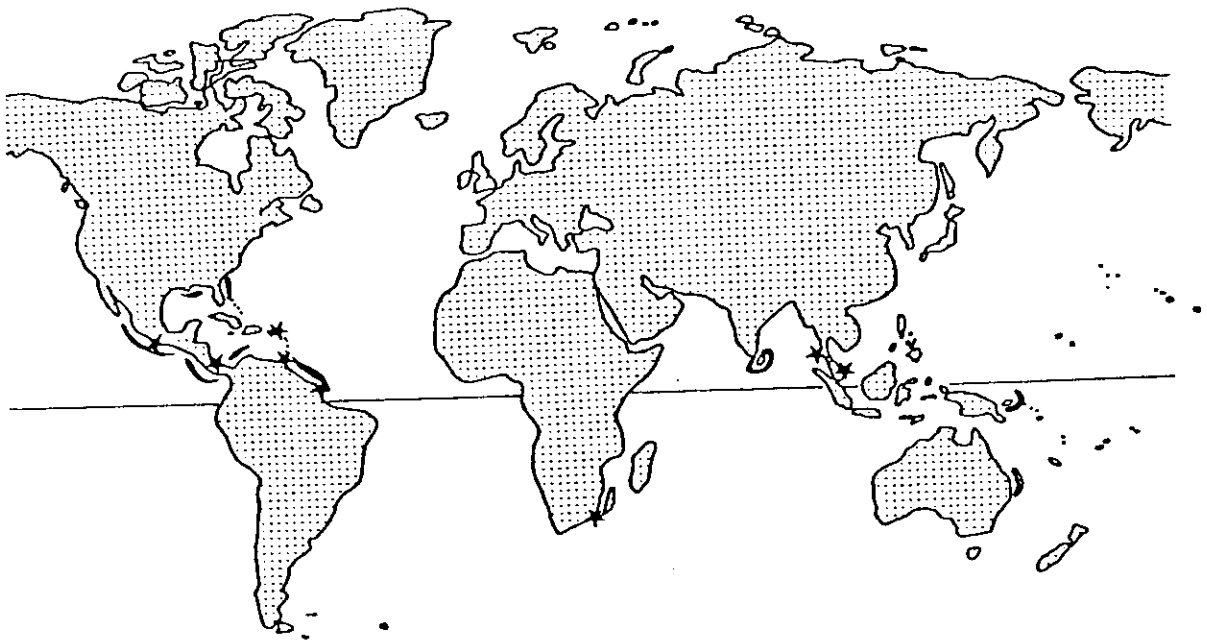

Fig. 14. Breeding (*) and foraging (~) distribution of the leatherback sea turtles.

Breeding Habits

Leatherbacks have been recorded nesting regularly in Florida (Allen and Neill, 1957; Caldwell, 1958). Jamaica, Costa Rica, Trinidad, Tobago, St. Croix and Tortola, Honduras, Nicaragua, the Bahamas and Brazil (Caldwell, et al. 1956a) have leatherbacks nesting, as well as Columbia, Cayman Islands (Caldwell and Rathjen, 1969), Venezuela, St. Thomas, Puerto Rico, Grenada and Brazil (Pritchard, 1971). Deraniyagala (1957) thought that two of the most prolific leatherback breeding grounds were Sri Lanka and the east coast of Malaya. Silebache Beach in French Guiana has one of the largest breeding populations in its hemisphere (Pritchard, 1969b). In Costa Rica nesting occurs from April to mid-July (Carr and Ogren, 1959). In Florida, it extends from April to late July (Pritchard, 1971).

Leatherbacks appear to prefer to nest on mainland beaches (Pritchard, 1971), of coarse sand (McAllister, et al. 1965, cited by Rebel, 1974). They usually come ashore in areas free of rocks (McAllister, et al. 1965). Pritchard (1971) noted that in Malaya and Surinam beaches were selected where slopes made the distance from waters' edge to dry sand relatively short.

Courtship and mating are thought to occur in offshore waters during the nesting season (Ernst and Barbour, 1972).

Usually the clutch size is 50 to 170 eggs (Ernst and Barbour, 1972). Leatherbacks may nest several times a season, usually in nine to ten day intervals (Pritchard, 1969a). They probably nest in two or three year cycles (Rebel, 1974). Incubation varies from 53 to 57 days (Ernst and Barbour, 1972). An unusual note about nesting is that clutches often include a number of misshapen, yolkless eggs (Carr and Ogren, 1959).

Growth and Mortality

Little information is available on growth rates for leatherbacks. Nine-day old hatchlings from Costa Rica were recorded to have a mean carapace length of 67.2 mm and a mean carapace width to 47.9 mm (Carr and Ogren, 1959). The average weight of an adult leatherback is probably around 318 kg (Rebel, 1974), but specimens weighing over 454 kg have been recorded. The smallest nesting leatherback observed by Pritchard (1969a) was 295.6 kg and had a carapace length of 148.6 cm.

Leatherback hatchlings are subject to predation from the same organisms as other sea turtles such as crabs, gulls, and fish. Adults can suffer from infestations of trematodes, intestinal amoeba, flat parasitic worms and nematodes (Rebel, 1974). There are few predators on adults other than sharks, killer whales (Orcinus orca, Caldwell and Caldwell, 1969) and man (Ernst and Barbour, 1972).

Foraging Habitat and Foods

The leatherback is probably the most oceanic of all the sea turtles. It is decidedly pelagic and appears to prefer deep waters (Rebel, 1974). It occasionally enters shallow waters and estuaries (Carr, 1952; Ernst and

Barbour, 1972) usually in more northern waters. It is commonly found in water greater than 46 m deep throughout most of its range (Rebel, 1974).

Leatherbacks are probably omnivorous (Ernst and Barbour, 1972; Carr 1952). They feed primarily on jellyfish (Rebel, 1974) and also consume tunicates, sea urchins, squid, crustaceans, fish, some algae and seaweeds (Ernst and Barbour, 1972).

Movements

The leatherback travels great distances. It is found in higher latitudes more frequently than any other sea turtle (Rebel, 1974). It is not known if regular migrations occur (Ernst and Barbour, 1972). They have been observed traveling in groups (Leary, 1957).

Population Status

The leatherback is currently listed as an endangered species. One decade ago the world population of leatherbacks was estimated to be approximately 1,000 nesting females (Fitter, 1961). A more recent estimate conservatively places population numbers at 29,000 to 40,000 sexually mature females (Anon., 1978). The leatherback is not usually considered to be of commercial value but its oil is occasionally used and eggs are still collected in certain areas (Rebel, 1974).

DISTRIBUTION AND ABUNDANCE OF SEA TURTLES IN THE NORTHERN GULF OF MEXICO

All six species of sea turtles discussed above can occur in the Gulf of Mexico. Only two, however, Kemp's ridley and the loggerhead, have been recorded nesting in any abundance, Figure 15.

Kemp's Ridley Sea Turtles

Almost all of Kemp's ridley's nesting is restricted to a small stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Rebel, 1974). There have been two early records of nesting, one in 1948 and one in 1950, on Padre Island (Werler, 1951; Carr, 1961). More recently, four more nestings have been reported, one each in 1968 and 1974 and two in 1976 on South Padre Island (Mr. D. Adams, personal communication cited by Ogren, 1977). During an overflight of Timbalier, and Wine Island and Isle Dernieres a small sea turtle was observed crawling up the beach. It may have been a ridley since it was emerging during the day (Ogren, 1977). Carr (1961) believed Kemp's ridley feeding grounds extend along Gulf shores from the Yucatan to southern Florida. Seventeen recaptures of 285 tagged nesting females by Chavez (1969) showed that these ridleys were distributed throughout most of the Gulf. Eight of these recaptures (all by shrimp trawlers), occurred between Brownsville, Texas, and the mouth of the Mississippi River. Such data may indicate a concentration of ridleys in this area or a more intensive shrimping effort or both. Another such concentration of recaptures occurred off the southern Gulf

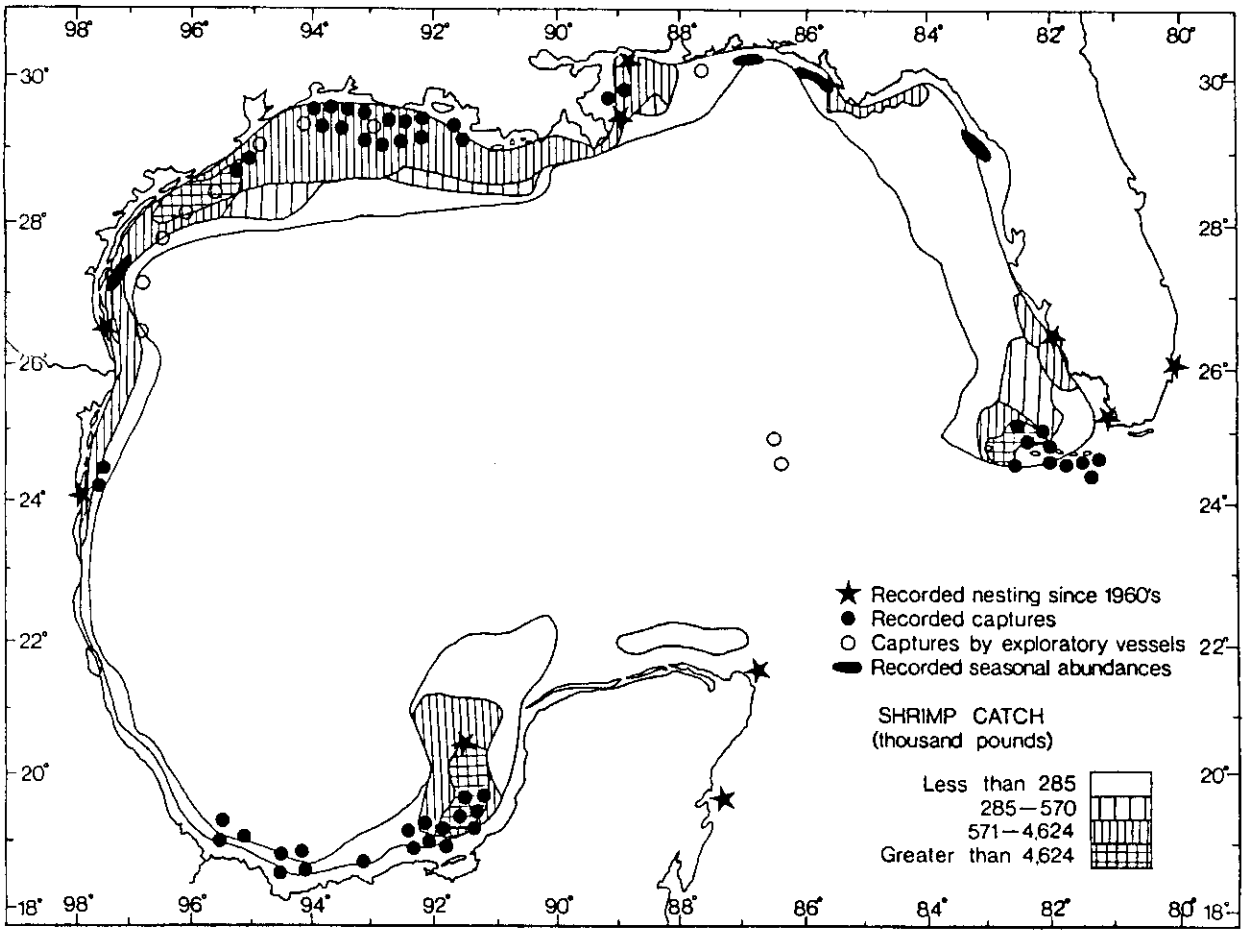

Fig. 15. Reported sea turtle nesting (Lebuff and Hagen 1976, Ogren 1977), abundances (Leary 1957, Pritchard 1976, Yerger 1965), and recaptures (Bullis and Drummond 1976, Chavez 1969, Liner 1954, Smith and List 1950) in relation to shrimping effort (Osborn et al. 1969) for the Gulf of Mexico.

coast of Mexico. Several other captures of Kemp's ridley by shrimp trawlers have been made in the same general area; one in Chandeleur Sound (Smith and List, 1950) and eleven off of Terrebonne Parish, Louisiana (Liner, 1954). Carr (1955) reported two centers of abundance along the Florida coast. One was on the Atlantic shores and the other was in the Gulf from the Suwanee River to Florida Bay. The ridleys in this area are immatures (Carr and Caldwell, 1956). At one time they were commonly found in red mangrove areas of the Florida Keys (Carr, 1952). Kemp's ridleys have also been captured by shrimp trawlers in the Dry Tortugas (Sweat, 1968). The seasonal abundance of ridleys in Florida was once an important source for the turtle industry. By 1957 numbers had decreased enough that few were being landed (Caldwell and Carr, 1957). Along the Florida Gulf Coast where Kemp's ridleys were once commonly known by shrimp trawlers, few young shrimpers now would recognize this species (Carr and Carr, 1977). These Florida waters were once important foraging and developmental habitat (Carr and Carr, 1977). In general, however, Kemp's ridleys can be found throughout the Gulf and are believed to migrate along the shores back to Mexico for nesting (Chavez, 1969).

Loggerhead Sea Turtles

Only a small portion of loggerhead nesting occurs in the Gulf. About 90 percent of the total nesting effort in the United States occurs on the south Atlantic coast of Florida (Carr and Carr, 1977). Loggerhead rookeries have been recorded at Cape Sable, in the Everglades and Keewaydin Island on the Gulf Coast of Florida (LeBuff and Hagen, 1976). In 1962 eggs removed from a nest in the Chandeleur Islands, Louisiana, were incubated, hatched and identified as loggerheads (Ogren, 1977). In 1960, 32 crawls of unknown species were observed on the Chandeleur Chain. The crawls occurred at the same time loggerhead nesting activity was happening in Florida and Georgia (Ogren, 1977).

Outside of the nesting occurring in Florida, most of the nesting activity recorded in the Gulf has been from Louisiana (east of the Mississippi River), to the panhandle of Florida (Ogren, 1977). Within this region most of the nesting has occurred on the Chandeleur Islands in Louisiana, Ship, Horn, and Petit Bois Islands in Mississippi, and Alabama (Ogren, 1977). While no estimate of the 1960-62 nesting population west of Florida has been made, it was thought that approximately 100 loggerheads "existed and nested" more or less regularly on the beaches of Bird, Breton, Chandeleur Islands in Louisiana, Cat, Ship, Horn, and Petit Bois Islands in Mississippi and Petit Bois and Dauphin Islands in Alabama (Ogren, 1977). In 1977 one loggerhead nest was recorded near Port Isabel, Texas (Personal communication, Dr. Henry Hildebrand, Texas A&I Univ., Kingsville, Texas, August 16, 1978). A 1977 nesting survey of the northern Gulf by Ogren (1977) revealed one nest on Horn Island and four crawls and nests in the Chandeleurs. Erosion of the Chandeleurs may be partially responsible for the decrease in nesting over the years, but egg robbing, predation and incidental capture are also factors to be considered (Ogren, 1977).

Leatherback Sea Turtles

Leatherback sea turtles are frequently seen in the Gulf of Mexico. There is at least one record of a nest near Destin, Florida, in 1962 (Yerger, 1965). Leatherbacks are seasonally abundant off the Florida coast near Panama City

(Pritchard, 1976). Leary (1957) reported a concentration of approximately 100 leatherbacks in the surf along a 30 mile line extending north from Port Aransas, Texas. Two nesting females tagged in French Guiana were recovered in the Gulf of Mexico. This along with the above records may suggest that Gulf waters are a "preferred destination" for leatherbacks (Pritchard, 1976).

Green Sea Turtles

Green turtles were once relatively abundant from North Carolina throughout the Gulf of Mexico (Rebel, 1974). The Dry Tortugas at one time were important breeding grounds (Parson, 1962), but now most nesting is restricted to Florida's southeast coast (Lund, 1974). An important nesting area in the Gulf is on the eastern shores of the Yucatan Peninsula (Parsons, 1962) and the Triangulos Reef area (Carranza, 1967 cited by Rebel, 1974). Important developmental habitats that until recently were well populated by sea turtles are: the Florida Bay and Keys and the Gulf coast of mid-peninsula Florida especially from the mouth of the Suwanee River south to the mouth of the Waccasassa (Carr and Carr, 1977). Immature green turtles are very common during early spring and summer in the Cedar Keys-Crystal River area (Carr and Caldwell, 1956), but numbers have decreased drastically since the 1950's (Carr and Carr, 1977). Tagged green turtles have been recovered in Marquesas and the Gulf of Mexico off the Yucatan (Carr, 1965).

Hawksbill Sea Turtles

The hawksbill is seen along the Gulf coast shores (Carr, 1952). Carr and Caldwell (1956) reported occasional sightings of hawksbills in the deeper offshore waters of the Cedar Key-Crystal River area, Florida.

Olive Ridley Sea Turtles

The olive ridley nests on the Pacific Coast of Mexico, Central America and the Atlantic coasts of Surinam and the Guianas. It is rarely seen as far north as Cuba (Lund, 1973). It is possible that this species may infrequently occur in Gulf waters.

DECIMATING FACTORS AND PRESERVATION MEASURES

Exploitation and habitat loss are two major causes of the drastic decline in sea turtle population. Incidental capture by shrimp and ground fishing operations is another factor that is becoming increasingly important as population numbers decrease. These factors affect each species to a varying degree depending on the turtle's range and socioeconomic importance. Preservation measures are aimed at reducing adult and subadult mortality and also increasing juvenile recruitment.

Exploitation and Protection

Exploitation of sea turtle populations in the Gulf of Mexico is best documented for southeastern Florida and Mexico. Large green turtle populations in Florida were exploited almost to the point of nonexistence (Parsons, 1962). Since 1947 the majority of turtle landings in Florida were turtles

caught in western Caribbean waters (Rebel, 1974). Kemp's ridleys and loggerheads were also taken commercially in Florida (Rebel, 1974). Loggerhead eggs are still taken in numbers in many areas (Carr, 1972). The latest figures available for U.S. commercial turtle harvest were collected in 1972. At this time 59,474 kg of green turtle meat at a value of $33,000 and 908 kg of loggerhead meat at a value of $230 were taken in the Gulf of Mexico (Anon., 1975). All the Gulf coast states now have laws protecting sea turtles and/or their eggs (Table 1). Strict law enforcement should reduce this mortality to a minimal level. The addition of the loggerhead and green turtles to the threatened species list will prohibit almost all commercial take and strictly control noncommercial take in areas under U.S. jurisdiction. In addition, all take of green turtles is prohibited in Florida waters where this species is now considered endangered.

Outside of U.S. jurisdiction, Kemp's ridley has been subject to an extremely heavy harvest of eggs and nesting females. In 1966 the Mexican government began to patrol the nesting beach during breeding season (Chavez, 1969). Kemp's ridley is now protected by law in Mexico (Marquez, 1976). Poaching of green turtle eggs is a problem on the Yucatan Peninsula. After a serious decline in the number of nesting turtles, the Mexican government declared a closed season for 1971 and 1972 (Anon., 1975). Sea turtles can be legally protected only when in U.S. waters or through importation controls.

Habitat Loss

Little is known about adult and juvenile foraging habitat requirements. Carr and Carr (1977) suggested that reefs and craggy bottom areas in the Florida Keys and major grass-flat bottoms (especially in the Cedar Key-Waccasassa area and the vegetated bottom of Florida Bay), be designated critical habitat. The Cape Canaveral ship channel is another area being considered for critical habitat designation. The U.S. Fish and Wildlife Service and National Marine Fisheries Service are collecting information in order to designate other areas as restricted fishing zones and/or critical habitats. The magnitude of nesting habitat deterioration in the Gulf of Mexico is not well known. Historical records seem to indicate that the Gulf has been an area of sparse nesting (Ogren, 1977). In southwestern Florida, where there are several loggerhead rookeries, coastal development has adversely affected nesting populations (LeBuff and Hagen, 1978). Construction of buildings, roads, artificial lights and bulkheading has reduced natural nesting habitat (Anon., 1978). Sand compaction, due to recreational uses, causes hatchling mortality (Carr and Carr, 1977). Increased predation by raccoons is also an important factor in the reduction of nesting habitat (Carr and Carr, 1977). Ogren (1977) suggested that decreased nesting on the Chandeleur Islands may be due to the gradual erosion of the beaches and islands themselves. The two other major nesting areas in the Gulf are in Rancho Nuevo and Yucatan Peninsula, Mexico. Coastal development is always a threat but the protection of these beaches is under Mexican jurisdiction. How great an effect loss of nesting habitat has on a population is not known but it surely decreases recruitment into that population.

Table 1. Sea turtle conservation laws in effect in Gulf states.

Florida:	a) Unlawful to take, kill or harass any marine turtles from Florida territory.
	b) Unlawful to take, disturb or possess any marine turtle nest or eggs.
Alabama:	Prohibits taking or possession of marine turtles and their eggs.
Mississippi:	Prohibits taking of any turtles or eggs of species listed by U.S.F.W.S. as endangered or threatened.
Texas:	Unlawful to take, kill or disturb any sea turtles and eggs in or from waters of the State.
Louisiana:	No person shall take the eggs of any species of turtle except the mobilian turtle (Pseudemys spp.) wherever found.

Recruitment Enhancement

There are several ways to enhance recruitment into sea turtle populations: (1) artificial propagation, (2) headstarting, (3) transplanting and (4) predator control. Artificial propagation is a highly controversial technique. While proponents claimed that release of farm-reared hatchlings could increase recruitment, opponents believed the technique was not perfected and caused additional mortality to already low populations (Anon., 1975). In a final ruling (43 F.R. 3200-32811) the FWS and NMFS decided not to provide an exemption to the Endangered Species Act for mariculture.

Headstarting is still in experimental stages. Soon after being laid, the eggs are removed from the nest and kept in a protected area to incubate and hatch. The young turtles are reared in captivity for one year and then released. In this way a naturally high first year mortality is reduced. Preliminary experiments with headstarting in Florida may indicate hatchery-reared green turtles can survive in their natural environment (Futch and Witham, 1977). Since 1971 the program has had a one percent return of tagged turtles over a three to five year period (Sylvester, 1978). The U.S. and Mexican governments are cooperating on a headstarting-transplanting program for Kemp's ridley. In June 1978, 2,000 eggs were collected from Rancho Nuevo nests, packed in Padre Island sand and transported to Padre Island, Texas, for incubation and hatching. Another 2,000 eggs were collected which will be incubated and hatched in Rancho Nuevo, Mexico. The young turtles will be allowed to enter the water after hatching and will then be collected and transported to Galveston, Texas, where they will be headstarted for a year (Ridley Action Plan Team, 1978). At the end of one year the juveniles will be released at grass flats off the Florida west coast, lower Gulf of Mexico and other areas where juveniles have been observed. On Little Cumberland Island, Georgia, eggs are removed from the nests for incubation and then hatchlings are released into the sea (Richardson, 1976). All of these methods reduce juvenile mortality but it is not yet known if populations increase as a result.

Predator control, primarily for raccoons, protects nests from destruction. Two years of predator control at Cape Sable, Florida, reduced nest destruction from 70 percent in 1964 to less than 25 percent in 1966 (Carr and Carr, 1977).

INCIDENTAL CAPTURE

Sea turtles are often accidentally caught during shrimp and groundfishing activities. This is a major problem along the U.S. coasts of the southern Atlantic and Gulf of Mexico (Ogren, et al. 1977). An estimated 800 to 1,000 sea turtles are caught each year off the south Atlantic coast of the United States (based on Hillestad, et al. 1977; Ulrich, 1978). No estimates are available for total incidental captures in the Gulf of Mexico.

Carr (1972) believed incidental capture to be responsible for significant turtle mortality. Virtually all mortality is a result of drowning (Hillestad, et al. 1977). Ogren, et al. (1977) observed that the reactions of sea turtles when encountering a trawl increase the probability of their capture.

The observed turtles did not make any sudden turns to avoid the trawl, but instead tried to outswim it. This action was often unsuccessful because the turtles could not swim at high speeds long enough to escape. The increase in oxygen consumption caused by escape attempts made drowning likely.

Species, sex and age composition of captures

Because little is known about the distribution of sea turtles and their accidental capture in the Gulf, it would be difficult to say which species, age or sex might be captured most frequently. Kemp's ridleys, loggerheads and leatherbacks are probably the most commonly captured sea turtles in the Gulf. Green turtles and hawksbills may also be taken but the majority of their captures would most likely be restricted to the more tropical Gulf areas such as southern Florida and the Yucatan. Published sea turtle captures (Bullis and Drummond, 1976; Chavez, 1969; Liner, 1954; Smith and List, 1950) in the Gulf are illustrated in Figure 15. Most recorded accidental captures in the Gulf are for Kemp's ridleys. Marquez (1976) estimated the annual incidental catch of ridleys by United States, Cuban and Mexican shrimp trawlers at 500 turtles. Five loggerheads, two hawksbills and two green turtles were captured in Gulf waters during 26 years of offshore trawling by NMFS exploratory fishing vessels (Bullis and Drummond, 1976), Figure 15. No leatherback captures in the Gulf have been published, but in Georgia, most leatherbacks were captured three to eight km offshore (Hillestad, et al. 1977).

In Port Isabel, Texas, Carr (1961) recorded that Kemp's ridley females with eggs were often captured in the spring and early summer during inshore trawling. Recaptures of adult, female Kemp's ridleys that were tagged while nesting, were made at distances of 200 m to 30 km offshore. Pritchard (1973) suggested that green turtles were more likely to be captured when leaving nesting grounds because they would be physically exhausted from months of breeding activity. Incidental capture studies of loggerheads along nesting beaches in South Carolina and Georgia showed that few adult females were captured. The majority of turtles captured were juveniles (Hillestad, et al. 1977; Ulrich, 1978). Eight of the eleven trawl captures in the Gulf reported by Liner (1954) were immature females.

Shrimping effort and incidental captures

The 1959-1963 average commercial shrimping efforts for the Gulf of Mexico (Osborn, et al. 1969) are shown in Figure 15. Regional shrimping efforts vary seasonally. Off the Texas and northern Mexico coast, brown shrimp are heavily fished from June to October. The heaviest shrimping effort off the Louisiana coast, for white shrimp, is from September to December. Pink shrimp are fished year-round off the southeastern Florida coast and the western Yucatan (Osborn, et al. 1969). As might be expected, the majority of reported sea turtle captures occurred in heavily shrimped areas. Management procedures aimed at reducing and/or eliminating incidental captures will most likely be focused on high interaction areas until more is known about sea turtle distribution in the Gulf of Mexico.

Interviews of shrimp fishermen in western Florida, Alabama, Louisiana Tables 2, 3, 4, and Texas (Cox and Mauerman, 1976) were recently made. The catch per vessel in one year, fishing days for one turtle and estimated

percent mortality were calculated and are presented in Table 5. Caution should be used in the interpretation of interview data. Shrimpers who do not understand why such data are being collected may be unwilling to fully cooperate and may intentionally or unintentionally bias their answers. Based on these interview data, western Florida shrimping vessels averaged a catch of approximately six turtles during one season or one turtle every 27 fishing days. This was the highest estimated capture rate of all the states in the interview. This fact is not evident from the distribution of recorded turtle captures, Figure 15. However, recorded abundances of sea turtles off the Florida panhandle make a high capture rate plausible. Louisiana had the next highest average capture rate of 3.92 turtles per vessel in one season. At that rate a Louisiana shrimper could be expected to catch one turtle every 52.55 fishing days. The estimated overall average catch for Texas was 3.48 turtles, slightly lower than Louisiana's catch. Cox and Mauerman (1976) divided the shrimpers into those who shrimped north of Port Isabel, Texas, and those who shrimped south of Port Isabel in the offshore waters of Mexico. The seasonal catch per boat in northern waters was 5.03 turtles, slightly higher than Louisiana's average catch. Alabama shrimpers estimated the lowest annual capture rate per vessel of 1.62 turtles or one turtle every 72 days. Bullis and Drummond (1976) examined records of National Marine Fisheries Service exploratory offshore trawling activities along the south Atlantic, Gulf of Mexico, Caribbean and northeast coasts of South America from 1950 to 1976. They calculated a capture rate of 0.004 turtles/hour for shrimp trawls (4,670 hours total shrimp trawl effort). A slightly higher capture rate of 0.009 turtles/hour was calculated for bottomfish trawling (2,955 hours total bottomfish trawl effort). A total of nine turtle captures were made by these vessels in the U.S. Gulf of Mexico. The catch of sea turtles per fishing day is much lower than those estimated by Gulf shrimpers or determined during south Atlantic studies. The apparent discrepancy is probably due to the fact that most turtle captures occur in inshore waters and this trawling was conducted offshore. Unfortunately a catch per day fished for Gulf waters cannot be estimated from Bullis and Drummond's (1976) paper.

The estimated mortality for Florida, Alabama, and Louisiana ranged from 21 to 25 percent. Texas shrimpers estimated their turtle mortality to be 16 percent. These probably represent a minimum mortality estimate. A South Carolina study found that mortality estimates calculated from interview data were much lower than observed mortalities (Ulrich, 1978). However, dead turtles that are recaptured by trawls could bias mortality estimates upwards (Ulrich, 1978).

Shrimp fishermen from Georgia estimated they caught an average of 30.7 turtles per boat in one season (Hillestad, et al. 1977). Minimum mortality was estimated to be 7.3 percent. On board observations showed a 15 percent minimum mortality after resuscitation efforts (Hillestad, et al. 1977). South Carolina shrimpers who were interviewed estimated they caught one to three turtles per vessel per week (Ulrich, 1978). Mortality rates for South Carolina shrimpers in 1976 and 1977 were 18.2 and 43.3 percent respectively (Ulrich, 1978). According to interview data, Gulf of Mexico shrimpers catch fewer turtles during one season than south Atlantic shrimpers but a greater percentage of these turtles die in the trawls. This could be due to differences in: (1) concentrations of sea turtles along nesting beaches in the south

Table 2. West Florida shrimp fishermen interviews for 1976. (Unpublished data. Marine Adisory Program, University of Florida, Gainesville, Florida).

Interview number	No. of turtles trawled up in one year	Number alive	Number dead	Average No. days fished per year	Vessel[1] length (feet)	Feet of[1] net pulled	Months of most capture	Area where most turtles caught
1	8-10	5-6	3-4	200			June-July	Cape San Blas
2	2	0	2	150			June-July	Choctawhatchee Bay
3	20	20	0	200			June-July	Cape San Blas
4	1	1	0	125			May-June	Choctawhatchee Bay
5	4	3	1	100			May-July	Choctawhatchee Bay
6	25	22-24	2-3	225			Summer	Gulf of Apalachicola
7	15	10-12	3-5	225-250			Summer	Cape San Blas to St. Joe Bay
8	2	2	0	100			Spring and Summer	Choctawhatchee Bay
9	15	12-14	2-3	250-300			Spring	Apalachicola to Cape San Blas near wrecks or "hangs"
10	25	12-13	12-13	250			Summer	Gulf to Cape San Blas
11	8	6	2	160			April-May	Gulf off Bay Co.
12	3	2	1	200			Summer	Gulf off Cape San Blas
13	10	8	2	175-200			Spring and Summer	Bay Co, Eastward (Gulf)
14	6	5	1	225			April-May, Oct.-Nov.	St. Joe Bay
15	7	6	1	200			April-May Oct.-Nov.	St. Joe Bay
16	6	4	2	150			Spring	Bay Co. and Gulf Coast
17	2	2	0	150			Summer	Apalachicola Bay
18	1	1	0	150			Summer	Apalachicola Bay
19	1	0	1	200			Summer	Gulf of Franklin Co.
20	1	1	0	125			April	St. Joe Bay
21	1	1	0	200			Summer	Cape San Blas
22	0	N.R.[2]	N.R.	100			Spring	Escambia Bay
23	0	N.R.	N.R.	100			Summer	Apalachicola Bay
24	0	N.R.	N.R.	175			N.R.	N.R.
25	0	N.R.	N.R.	125			N.R.	N.R.
26	3	3	0	180			N.R.	>120 feet off Cortez
27	40 (2 years)	40	0	190			February	Deep water off Boca
Totals	206-208	168-174	35-41	4630-4730				

[1]Data not collected for these interviews.

[2]N.R. = no response.

Table 3. Alabama shrimp fishermen interviews for 1977-78.[1] (Unpublished data. Marine Resource Office, Alabama Cooperative Extension Service., Mobile, Alabama).

Interview number	No. of turtles trawled up in one year	Number alive	Number dead	Average No. days fished per year	Vessel length (feet)	Feet of net pulled	Months of most capture	Area where most turtles caught
1	N.R.[3]	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
2	N.R.	N.R.	N.R.	N.R.	14	16	N.R.	N.R.
3	0	0	0	100	40	50	N.R.	N.R.
4	0	0	0	150-160	50	50	Summer	N.R.
5	4	3	1	150	80	110 (2 x 55)	June-July	Northern Chandeleur Island
6	3	3	0	35	30	N.R.	September	Mouth of Dog River
7	N.R.	N.R.	N.R.	200	N.R.	N.R.[4]	July and August[4]	Between Pensacola and Mobile
8	0	0	0	30	19	16	N.R.	N.R.
9	0	0	0	90	35	48	N.R.	N.R.
10	0	0	0	160	40	50	N.R.	Dauphin Island
11	N.R.	N.R.	N.R.	30	17	16	N.R.	N.R.
12	12	8	4	225	75, 75, 55[5]	140 (4 x 35)	N.R.	N.R.
13	0	0	0	200	59	50	All year	N.R.
14	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
15	0	0	0	8	18	20	N.R.	N.R.
16	0	0	0	N.R.	N.R.	N.R.	N.R.	N.R.
17	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
18	0	0	0	0	50	50 (2 x 25)	May and June	N.R.
19	0	0	0	60	25	30	N.R.	N.R.
20[6]	10	9	1	250	71	160 (4 x 40)	April to Oct.	Florida Area and Morgan City, La. to Texas
21	3	2	1	300	50	50	May and June	Duphin Island
22	0	0	0	N.R.	N.R.	N.R	N.R.	N.R.
23	0	0	0	Few	16	16	N.R.	N.R.
24	0	0	0	30	18	16 and 20	N.R.	N.R.
25	0	0	0	130	38	40	N.R.	N.R.
26	0	0	0	N.R.	16	16	N.R.	N.R.
27	2	2	0	70	40	50	June-Oct.	Mississippi Sound
Totals	34	27	7	2218-2228				

[1]This interview asked questions about sea turtles and shrimping regulations. Many respondents answered the shrimp questions but did not answer questions pertaining to sea turtles.

[2]Number of turtles captured alive was calculated from estimated percent alive. Values with decimals of 0.50 or greater were rounded up to the next whole number.

[3]N.R. = no response.

[4]This respondent was a snapper fisherman and did not use nets. Responses for months and area of capture based on observations of turtles.

[5]Respondent owned three boats.

[6]Respondent added that resuscitation efforts were made on captured turtles.

Table 4. Louisiana shrimp fishermen interviews for 1977. (Unpublished data. Louisiana Cooperative Extension Service, Houma, Louisiana and Franklin, Louisiana).

Interview number	No. of turtles trawled up in one year	Number[1] alive	Number dead	Average No. days fished per year	Vessel length (feet)	Feet of net pulled	Months of most capture	Area where most turtles caught
1	1	1	0	200	65	100 (2 x 50)	July	Ship Shoal - 24 feet
2	0	0	0	100	70	55	N.R.[2]	N.R.
3	12	8	4	220	68	65	Jan.-Feb.	Louisiana Coast
4	1	1	0	195	68	60	All year	Louisiana Coast
5	2	2	0	180	67	55	All year	Louisiana Coast
6	0	0	0	150	50	50	N.R.	N.R.
7	5	5	0	200	73	65	All year	Gulf Coast
8	2	0	2	200	68	100	All year	Louisiana Coast, inshore and offshore
9	2	2	0	200	68	60	All year	Louisiana Coast
10	3	3	0	175	55	95	May and August	Mississippi River
11	5	4	1	225	85	144	No special time	Cameron, Delcambre
12	6	4	2	200	80	140	Fall	Marsh Island
13	5	4	1	225	80	144	Spring and Fall	Delecambre
14	5	4	1	250	90	180	Spring	No special area
15	4	3	1	230	85	180	Early spring	Morgan City, Louisiana
16	5	4	1	230	72	120	Spring	Eugene Island Beacon
17	3	2	1	225	80	144	No special time	Delcambre
18	3	2	1	220	65	120	Spring and fall	Grand Isle, Louisiana
19	2	1	1	200	80	144	Spring and fall	West Delta
20	4	3	1	220	80	144	No special season	Delcambre
21	2	2	0	225	85	144	No special season	Ship Shoal
22	1	1	0	225	80	144	Fall	Eugene Island Area
23	2	2	0	200	60	108	May and August	Mississippi River
24	10	8	2	200	80	120	April, May and September	Ship Shoal and West
25	10	8	2	250	85	180	May and October	High Island
26	7	4	3	200	85	144	April and May	Ship Shoal
Totals	102	78	24	5345				

[1]Number of turtles captured alive was calculated from estimated percent alive. Values with a decimal of 0.50 or greater were rounded up to the next whole number.

[2]N.R. = No response.

'able 5. Estimated total effort, catch, and mortality of sea turtles captured incidentally in shrimp trawls in Florida and Texas for 1976 and Alabama and Louisiana for 1977.

State	Number of vessels	Total no. of fishing days	Average no. of fishing days	Total no. turtles caught	Number dead	Percent dead	Turtles caught per boat in one season	No. fishing days for each turtle caught
'lorida	26	4,440-4,540	170-175	166-168	35-41	21-25	6.38-6.46	26.32-27.09
.labama	21	2,218-2,228	116-117	34	7	21	1.62	71.60-72.41
.ouisiana	26	5,345	206	102	24	24	3.92	52.55
'exas[1]	66	14,200	215	230	38	16	3.48	62.5

Atlantic compared to general foraging in the Gulf, (2) species abundance, age, and distribution of sea turtles, (3) duration of trawling time and gear employed.

Hillestad, et al. (1977) found that the number of turtles caught per vessel in one year seemed to be related directly to net width. Nets less than 41 ft (12.4 m) wide caught significantly fewer turtles than larger nets. A Spearman-Rank Correlation was performed on net widths and turtle captures reported by Alabama and Louisiana shrimpers. A positive correlation was found to exist (0.01) between the number of sea turtles caught and net width.

Hillestad, et al. (1977) believed that because of their limited activities, gear used and capture rates, noncommercial and live bait shrimpers accounted for an insignificant portion of sea turtle mortality. This is probably true for the Gulf coast, but there is no information to support or refute this.

Regulations

The leatherback, hawksbill, Kemp's ridley and Florida waters populations of green turtles have been designated as endangered species under the U.S. Endangered Species Act. The incidental capture of endangered sea turtles by commercial fishermen is prohibited. With present technology, incidental capture of sea turtles is unavoidable short of closing down the shrimp trawling industry. Pending the development and deployment of excluder devices and designation of restricted fishing areas, the Environmental Defense Fund (EDF) suggested in a comment letter to the director of the U.S. Fish and Wildlife Service that an official statement be made with regards to enforcement policies and encouraged the use of prosecutorial discretion. Similar recommendations were made by panel members of the turtle excluder workshop at a Southeast Regional Turtle Program Meeting (Sylvester, 1978). Such recommendations mean that the incidental capture of sea turtles would not be prosecuted where the fishing effort is not directed at the turtle and where turtles are returned to the sea after resuscitation efforts have been made.

The loggerhead, Pacific ridley (outside of Mexican Pacific coast waters) and the green turtle (outside of Florida and Mexican Pacific coast waters) have been designated as threatened species. The incidental capture of threatened species will be allowed provided that: (a) fishing effort was not directed at the turtle, (b) any sea turtle incidentally taken must be handled so as to avoid injury and must be returned to the sea whether alive or dead; if the turtle is alive and unconscious, resuscitation must be attempted, and (c) any incidentally taken sea turtle cannot be consumed, landed, offloaded, transshipped, or kept below deck. The eventual goal of the U.S. Fish and Wildlife Service and U.S. National Marine Fisheries Service is to develop regulations based on the use of excluder panels and designation of critical habitat and/or restricted fishing areas. In restricted fishing areas incidental catch may be prohibited or controlled. Controls may include such things as proper gear usage, fishing methods and procedures and any other regulatory controls to reduce the incidental capture of sea turtles.

Reduction and/or elimination of incidental capture

Currently there are three methods being used or developed to help alleviate the incidental catch problem. They are: (1) excluder panels, (2) regulation of fishing effort, and (3) resuscitation efforts. Excluder panels for shrimp trawls are being developed and tested by U.S. National Marine Fisheries Service. The panel would be fitted across the mouth of a standard shrimp trawl. The U.S. National Marine Fisheries Service is attempting to develop a gear that would reduce turtle captures by 79 percent and not significantly reduce the shrimp catch. This gear will hopefully be relatively inexpensive. At the present time several excluder shrimp trawl designs are being tested along the Atlantic and Gulf coast states. No definitive results are yet available but preliminary trials along the Atlantic coast showed turtle capture to be reduced by 75 percent (Sylvester, 1978).

The regulation of fishing effort has been discussed under the critical habitat and restricted fishing areas portion of the regulations section. In addition to excluder panel studies, the U.S. National Marine Fisheries Service is attempting to design new trawling methods to reduce the mortality of captured turtles.

Resuscitation of unconscious sea turtles is a method currently in use. While there has been some controversy over the effectiveness of this method Ulrich (1978) found that resuscitation and recovery periods do have merit. At any rate, this procedure is now required to be performed on all unconscious threatened turtle species.

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Appendix A-1

Reported Strandings of Sea Turtles in Texas
(manuscript in preparation)
provided by: Steven C. Rabalais
Port Aransas Marine Laboratory
Port Aransas, Texas

Month	Year	Loggerhead	Green	Ridley	Unknown
September	1976		1		
October	1976	1			
November	1976	18			2
March	1977	1			
April	1977	9	1		
May	1977	6			
July	1977	2			
October	1977	1			
November	1977	5			
April	1978	39		3	2
May	1978	17		1	